24. MEDNARODNA KONFERENCA O MATERIALIH IN TEHNOLOGIJAH

28.–30. september 2016, Portorož, Slovenija

24th INTERNATIONAL CONFERENCE ON MATERIALS AND TECHNOLOGY

28–30 September 2016, Portorož, Slovenia

PROGRAM IN KNJIGA POVZETKOV

PROGRAM AND BOOK OF ABSTRACTS

INŠTITUT ZA KOVINSKE MATERIALE IN TEHNOLOGIJE, LJUBLJANA

24. MEDNARODNA KONFERENCA O MATERIALIH IN TEHNOLOGIJAH /
24th INTERNATIONAL CONFERENCE ON MATERIALS AND TECHNOLOGY

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VSEBINA – CONTENTS

Legenda – Legend:
MM – Kovinski materiali/Metallic materials
CM – Kompozitni materiali/Composite materials
C – Keramika/Ceramic
P – Polimeri/Polymeric materials
MS – Modeliranje in simulacija procesov in tehnologij/Mathematical modeling and computer simulation of processes and technologies
HT – Toplotna obdelava in inženiring površin kovinskih materialov/Heat treatment and surface engineering of metals
CD – Korozija in degradacija materialov/Corrosion and degradation of materials
NN – Nanoznanost in nanotehnologije/Nanosciences and nanotechnologies

YR – Mladi raziskovalci/Young scientists

24. MEDNARODNA KONFERENCA O MATERIALIH IN TEHNOLOGIJAH,
28. – 30. SEPTEMBER 2016

24th INTERNATIONAL CONFERENCE ON MATERIALS AND TECHNOLOGY,
28–30 SEPTEMBER, 2016

Wednesday 28.9.2016 Hall B

9:00	Opening ceremony - director IMT
9:10	MIT Editor-in-Chief
9:20	PLENARY LECTURE Ludwig
10:00	INVITED LECTURE Šturm
10:30	INVITED LECTURE Savilov
11:00	**COFFEE BREAK**
11:30	Petrič
11:45	Major
12:00	Ozturk
12:15	Nazarenko
12:30	Pohanka
12:45	Terčelj
13:00	**LUNCH**
14:30	Kapun
14:45	Seitl
15:00	Žepič
15:15	Smola
15:30	K. Dvorak
15:45	Celebi Efe
16:00	**COFFEE BREAK**
16:30	**Poster Session Hall D**
19:30 21:00	**STANDING BUFFET HALL C AND D**

Thursday 29.9.2016 Hall B

8:30	PLENARY LECTURE Bals
9:10	PLENARY LECTURE Zaefferer
9:50	INVITED LECTURE Uhlenwinkel
10:20	**COFFEE BREAK**
10:35	**YR Introduction - Čeh**
10:40	Zelič - Kračun
10:54	Vidic - Kelhar
11:08	Stambolić - Malej
11:22	Nadrah - Šestan
11:36	Vorel - Borchert
11:50	Močnik - W. Choi
12:04	Temirov - Lazar
12:18	Robba - Khaydarov
12:30	**LUNCH**
13:30	Dolak - Hren
13:44	Kocen - Drvarič Talian
13:58	Viszlay - Gosar
14:12	Bradeško - Fulanović
14:26	Drozdz - Gabor
14:40	Tominc - Sever
14:54	Hatić - Mavrič
15:10	**COFFEE BREAK**
15:40	Bartuli - Berčič
15:54	S.-G. Choi - Jablonski
16:08	Kim - Ambrožič
16:22	Kubasov - Matus
16:36	Suhadolnik - Aničić
16:50	Gunji - Yudintseva
17:04	Parkelj - Rybarczyk
17:18	Matula - Brozova
18:30 22:00	**Social event at St. Bernardin**

Friday 30.9.2016 Hall D

9:00	PLENARY LECTURE Jokanović
9:40	PLENARY LECTURE Dianzhong
10:20	INVITED LECTURE Podgornik
10:50	Mori
11:05	Kosec
11:20	**COFFEE BREAK**
11:50	Šuštaršič
12:05	Aišman
12:20	Cao
12:35	Luan
12:50	Jimbert
13:05	**LUNCH**
14:00	Matocha
14:15	Ferčec
14:30	Kurka
14:45	Salihagić Hrenko
15:00	Kafexhiu
15:15	Bilyk
15:45	**CLOSING CEREMONY**

PROGRAM 24. MEDNARODNE KONFERENCE O MATERIALIH IN TEHNOLOGIJAH
24th INTERNATIONAL CONFERENCE ON MATERIALS AND TECHNOLOGY: PROGRAM

Sreda – Wednesday 28.9.2016 Hall B	
	Predsedujoči – Chair:
9:00	**ODPRTJE – OPENING CEREMONY – director IMT Matjaž Godec**
9:10	MIT Editor-in-Chief – Paul McGuiness
9:20	Simulation in Metallurgical Processing: Recent Developments and Future Perspectives A. Ludwig, M. Wu, A. Kharicha
10:00	INVITED LECTURE Transmission Electron Microscopy in Liquid Environments - a Powerful Tool for Dynamic Studies of Nucleation and Growth Phenomena of Nanomaterials Sašo Šturm[1], Bojan Ambrožič[1,2], Nina Kostevšek[1,2], Marjan Bele[3], Kristina-Žužek Rožman[1] 1 Jožef Stefan Institute, Department for Nanostructured Materials, Ljubljana, Slovenia, 2 Jožef Stefan International Postgraduate School, Ljubljana, Slovenia, 3 National Institute of Chemistry, Laboratory for Chemistry of Materials, Ljubljana, Slovenia
10:30	INVITED LECTURE Main Features of Experimental Techniques for Carbon Nanomaterials Characterization Serguei Savilov, Anton Ivanov, Natalia Kuznetsova, Valery Lunin M.V. Lomonosov Moscow State University, Chemistry Dept., 119991, Russia, Moscow, Leninskie gory, 1, b.3
11:00	**Coffee Break**
11:30	Calculation of thermal loadings of HPDC tools Mitja Petrič[1], Andrej Mikložič[2], Nejc Marčič[2], Sebastjan Kastelic[1], Primož Mrvar[1] [1]Naravoslovnotehniška fakulteta, Univerza v Ljubljani, Aškerčeva 12, Ljubljana, [2]Mariborska livarna Maribor, Oreško nabrežje 9, Maribor
11:45	The Fractographical Analysis and Numerical Model of Sub-surface Crack Formation Štěpán Major, Roman Dostál, Pavel Cyrus Department of Technical Education,University Hradec Králové, Rokitanského 62, Hradec Králové 500 03, Czech republic
12:00	Simulation of the Manufacturing Process of Mechanically Lined CRA Pipes Tianye Guo, Ana Bernal, Fahrettin Ozturk, Firas Jarrar, Jamal Y. Sheikh-Ahmad Department of Mechanical Engineering, The Petroleum Institute, Abu Dhabi, UAE
12:15	Improved Manufacturing Techniques and Use of Materials Based Cluster Systems Ivan Nazarenko, Igor Zalisko, Ivan Perehinets Kyiv National University of Construction and Architecture
12:30	Thermophysical properties measurement of scale layer on steel substrate using flash method Michal Pohanka, Martin Chabičovský, Tomáš Ondruch Brno University of Technology, Faculty of Mechanical Engineering, Technická 2, 616 69 Brno, Czech Republic
12:45	Dependence of Size of Eutectic Cells on Cooling Rates at Verified HTC during Solidification of M42 Super High Speed Steel Ingot M. Tercelj, M. Petric, T. Vecko Pirtovsek, P. Mrvar and G. Kugler Faculty of Natural Sciences and Engineering, University of Ljubljana, 1000 Ljubljana, SI-Slovenia
13:00	**LUNCH**

14:30	Three-Dimensional (3D) Characterization of Materials Using High-resolution FIB Tomography Gregor Kapun[1,3], Marjan Marinšek[2], Sara Drvarič Talian[1], Miran Gaberšček[1], Sašo Šturm[3,4] [1]Laboratory for Materials Chemistry, National Institute of Chemistry, Hajdrihova 19, Ljubljana, Slovenia, [2]Faculty for Chemistry and Chemical Technology, University of Ljubljana, Večna pot 113, Ljubljana, Slovenia, [3]Jožef Stefan International Postgraduate School, Jamova cesta 39, Ljubljana, Slovenia, [4]Department for Nanostructured Materials, Jožef Stefan Institute, Jamova cesta 39, Ljubljana, Slovenia
14:45	Method Covering Ageing for Evaluation of Fatigue Parameters of Cement Based Composites with Waste Aggregates Stanislav Seitl, Hana Šimonová, Zbyněk Keršner, Jacek Domski, Jacek, Katzer Institute of Physics of Materials, Academy of Science of the Czech Republic, Zizkova 22, 616 62 Brno, Czech Republic, Brno University of Technology, Faculty of Civil Engineering, Veveří 331/95, 60200 Brno, Czech Republic, Koszalin University of Technology, Faculty of Civil Engineering Environmental and Geodetic Sciences, ul. Śniadeckich 2, 75-453 Koszalin, Poland
15:00	Nanofibrillated Cellulose as a Reinforcing and Toughening Agent of the Poly(3-hydroxybutyrate) Vesna Žepič[1], Ida Poljanšek[2], Primož Oven[2] [1]TECOS – Slovenian Tool and Die Development Centre, Kidričeva 25, SI-3000 Celje, [2]University of Ljubljana, Biotechnical Faculty, Department of Wood Science and Technology, Jamnikarjeva 101, SI-1000 Ljubljana
15:15	Kinetics and Mechanism of High-Temperature Reduction of NiS and CoS Sulphides Grzegorz Smoła, Krzysztof Pasterak, Zbigniew Grzesik AGH University of Science and Technology, Faculty of Materials Science and Ceramics, Department of Physical Chemistry and Modelling, Al. Mickiewicza 30, 30-059 Krakow, Poland
15:30	The Effect of the Wear of Rotor Pins on Grinding Efficiency in a High-speed Disintegrator Karel Dvořák[1], Dušan Dolák[1], David Paloušek[2], Ladislav Čelko[3], David Jech[3] [1]Brno University of Technology, Faculty of Civil Engineering, Brno, Czech Republic, [2]Brno University of Technology, Faculty of Mechanical Engineering, Brno, Czech Republic, [3]Central European Institute of Technology, Brno University of Technology (CEITEC - BUT), Brno, Czech Republic
15:45	Surface Hardening of Ti6Al4V Alloy by Pack Siliconizing Gozde Celebi Efe[1,2], Mediha Ipek[1], Cuma Bindal[1,2], Sakin Zeytin[1] [1]Sakarya University, Engineering Faculty, Department of Metallurgy and Materials Engineering, Esentepe Campus, 54187 Sakarya-Turkey, [2]Sakarya University, Biomedical, magnetic and semi conductive materials research center, Esentepe Campus, 54187 Sakarya-Turkey
16:00	**Coffee Break**
16:30	**Poster Session Hall D**
19:30	**STANDING BUFFET HALL C AND D**
21:00	

Četrtek – Thursday 29.9.2016 Hall B	
	Predsedujoči – Chair:
9:30	PLENARY LECTURE Electron Tomography For Nanomaterials: Colouring Atoms in 3 Dimensions Sara Bals, Bart Goris, Annick De Backer, Sandra Van Aert and Gustaaf Van Tendeloo EMAT-University of Antwerp, Groenenborgerlaan 171, B-2020 Antwerp, Belgium
9:10	PLENARY LECTURE Investigations on the Relationship Between Crystallographic Character of Grain Boundaries and their Functional and Mechanical Properties in Various Engineering Materials Stefan Zaefferer Max Planck Institute for Iron Research, Max-Planck-Str. 1, Duesseldorf, Germany
9:50	INVITED LECTURE Fundamentals and Applications of Spray Forming Volker Uhlenwinkel Institut für Werkstofftechnik, Badgasteiner Str. 3, Bremen, Germany
10:20	**Coffee Break**
10:35	YR Introduction - Čeh
10:40	Primary Carbides Morphology Modification in AISI D2 Tool Steel, with Rare Earth Elements Zelič Klemen, Godec Matjaž, Burja Jaka, Tehovnik Franc Institute Of Metals And Technology, Department of Physics and Chemistry of Materials
	Distribution of Al_2O_3 Reinforcement Particles in Austenitic Stainless Steel Depending on Their Size and Concentration Ana Kračun[1,2], Franc Tehovnik [1], Fevzi Kafexhiu[1], Bojan Podgornik[1] [1]Institute of Metals and Technology, Ljubljana, [2]International postgraduate school Jožef Stefan, Ljubljana
10:54	Corrosion Behavior of Automotive Hot-End Components Under Combined Wet Corrosion and Molten Salt Attack K.J. Vidic[1], G. Mori[1], H. Wieser[2], D. Knoll[2], M. Karl[2], D. Saurat[2] [1]Chair of General and Analytical Chemistry, Montanuniversität Leoben, Franz Josef-Straße 18, A-8700 Leoben, Austria, [2]Faurecia Emissions Control Technologies, Biberbachstraße 9, D-86154 Augsburg, Germany
	Characterization of Structure and Magnetic Properties in Ce-based Bulk Amorphous Glass Luka Kelhar[1,3,4], Spomenka Kobe[1,3,4], Jean-Marie Dubois[1,2,3,4] [1]Department for Nanostructured Materials, Jožef Stefan Institute, Jamova cesta 39, Ljubljana 1000, Slovenia, [2]Institut Jean Lamour (UMR 7198 CNRS-Université de Lorraine), Parc de Saurupt, CS 50840, 54011 Nancy Cedex, France, [3]International Associated Laboratory PACS2, CNRS-Nancy, France and JSI-Ljubljana, Slovenia, [4]International Postgraduate School "Jožef Stefan", Jamova cesta 39, Ljubljana 1000, Slovenia
11:08	Analysis of coatings on the surface of nitinol formed by ALD process Aleš Stambolić[1,2], Monika Jenko[1,2], Aleksandra Kocijan[1], Črtomir Donik[1], Mladen Petravić[3], Ivna Kavre Piltaver[3], Iva Šarić[3], Veno Kononenko[4] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova 39, 1000 Ljubljana, Slovenia, [3]University of Rijeka, Department of Physics, Ulica Radmile Matejčić 2, 51000 Rijeka, Croatia, [4]University of Ljubljana, Biotechnical Faculty, Department of Biology, Večna pot 111, 1000 Ljubljana, Slovenia
	Microstructural Changes of Turbine in Turbocharger Simon Malej, Matjaž Godec, Barbara Šetina Batič, Franc Tehovnik, Jaka Burja Institute for Metals and Technology, Lepi Pot 11, 1000 Ljubljana

11:22	LIFE+ RusaLCA – An Advanced Water Purification Method with Utilization of Zero – Valent Iron Nanoparticles Ana Mladenovič[1], Primož Oprčkal[1], Peter Nadrah[1], Andrijana Sever Škapin[1], Janez Ščančar[2], Radmila Milačič[2], Janja Vidmar[2], Alenka Mauko Pranjič[1] [1]Slovenian National Building and Civil Engineering Institute, Dimičeva ulica 12, 1000 Ljubljana, [2]Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana
	Microstructure characterization of reinforce W-composite as plasma facing material A. Šestan[1,2], J. Zavašnik[1], P. Jenuš[3], S. Novak[2,3], M. Čeh[1,2,3] [1]Jožef Stefan Institute, Centre for electron microscopy and microanalysis, Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Ljubljana, Slovenia, [3]Jožef Stefan Institute, Department for nanostructured materials, Ljubljana, Slovenia
11:36	Influence of Bainite Fraction on Improving Mechanical Properties of Quenched and Tempered High Silicon Steel Ivan Vorel, Štěpán Jeníček, Josef Káňa University of West Bohemia, Regional Technological Institute, Univerzitní 22, Plzeň, Czech Republic
	Corrosion Behavior Influenced by Quenching Conditiones of HTGN Martensitic Stainless Steel M. Borchert[1], G. Mori[1], E. Kozeschnik[2],E. Povoden-Karadeniz[2] M. Bischof[3], A. Tomandl[3] [1]General and Analytical Chemistry, Montanuniversitaet Leoben, Franz-Josef-Strasse 18, 8700 Leoben, Austria, [2]Institute of Materials Science and Technology, Vienna University of Technology, Getreidemarkt 9, 1060 Wien, Austria, [3]Hilti Corporation, Feldkircherstrasse 100, 9494 Schaan, Liechtenstein
11:50	The Effect of Environmental Properties on Surface Condition of Dental Archwire during Tribocorrosion Petra Močnik[1], Tadeja Kosec[1], Milan Bizjak[2] [1]Slovenian National Building and Civil Engineering Institute, Dimičeva 12, 1000 Ljubljana, Slovenia [2]Faculty of Natural Sciences and Engineering, Aškerčeva c. 12, 1000 Ljubljana, Slovenia
	Surface Morphology Investigation of Invar Film Micro Hole Machining Using Wet Etching and Electrochemical Machining Method Woongkirl Choi, Seonghyun Kim, Seunggeon Choi, Eunsang Lee School of Mechanical Engineering, Inha University, 253 Yonghyun-Dong, Nam-Gu, Incheon, South Korea, 402-751,
12:04	Synthesis of Silicon-Carbon Films by High-Frequency Deposition Alexander Temirov, Nikita Timushkin, Roman Zhukov, Ilya Kubasov, Mikhail Malinkovich, Yurii Parkhomenko National University of Science and Technology “MISiS”, Moscow, Russia
	Synthesis-Related Properties of the Spark Plasma Sintered Electroconductive ZrO_2/TiN Ceramic Composites Ana Lazar, Kristoffer Krnel, Andraž Kocjan Josef Stefan Institute, Department for Nanostructured Materials, Jamova 39, 1000 Ljubljana
12:18	Investigation of Magnesium Intercalation into a Spinel Manganese Oxide Ana Robba, Elena Tchernychova, Robert Dominko National institute of Chemistry, Hajdrihova 19, 1000 Ljubljana, Slovenia
	Research Clinker-free Cementitious Materials Synthesized with the Use of Energy Efficient Technology for Composite Binder Materials Khaydarov B.B., Mazov I.N., Suvorov D.S., Kuznetsov D.V. National University of Science and Technology "MISIS", Leninsky pr. 4, Moscow, Russia
12:30	**LUNCH**

13:30	Alternative Evaluation of Grindability of Pozzolanic Materials fFor Cement Production Karel Dvořák, Dušan Dolák Brno University of Technology, Faculty of Civil Engineering, Veveří 331/95, 602 00 Brno, Czech Republic
	Characterization of Stainless Steel Corrosion Processes in Concrete by the Use of Various Monitoring Techniques Miha Hren, Tadeja Kosec, Andraž Legat Slovenian National Building and Civil Engineering Institute, Dimičeva 12, 1000 Ljubljana
13:44	Can Ultrasonic Wave Propagation Predict Mechanical Properties in Polymers? Rok Kocen [1,2], Saša Novak [1,2] [1]Jožef Stefan Institute, Department for Nanostructured Materials, Jamova c. 39, 1000 Ljubljana, Slovenia [2]Jožef Stefan International Postgraduate School, Jamova c. 39, 1000 Ljubljana, Slovenia
	Lithium-Sulfur Battery System Performance Evaluation Using Impedance Spectroscopy Measurements Sara Drvarič Talian[1], Jože Moškon[1], Robert Dominko[1] [1]Department of materials chemistry, National institute of chemistry, Hajdrihova 19, SI-1000 Ljubljana,Slovenia
13:58	Modified Compact Tension Test: Numerical Support for Processing of Experimentally Obtained Values Viliam Viszlay, Stanislav Seitl, Jose Rios, Hector Cifuentes Brno University of Technology, Faculty of Civil Engineering, Veveří 331/95, 60200 Brno, Czech Republic, Institute of Physics of Materials, Academy of Science of the Czech Republic, Zizkova 22, 616 62 Brno, Czech republic, Grupo de Estructuras, ETSI, Universidad de Sevilla, Camino de los Descubrimientos s/n, 41092 Sevilla, Spain
	Temperature Dependent Impact Resistance of Polymer Material Žiga Gosar ELVEZ d.o.o., Ulica Antona Tomšiča 35, 1294 Višnja Gora, Jožef Stefan International Postgraduate School, Jamova 39, 1000 Ljubljana
14:12	Passing the Heat Parcels with Multifunctional Cantilevers: A Novel Solid-State Cooler Andraž Bradeško[1,2], Lovro Fulanović[1,2], Marko Vrabelj[1,2], Barbara Malič[1,2], Zdravko Kutnjak[1,2], Tadej Rojac[1,2] [1]Jožef Stefan Institute, Jamova cesta 39, Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova cesta 39, Ljubljana, Slovenia
	Electrocaloric Properties of Multilayer $0.9Pb(Mg_{1/3}Nb_{2/3})O_3$-$0.1PbTiO_3$ Elements Lovro Fulanović[1,2], Marko Vrabelj[1,2], Silvo Drnovšek[1], Hana Uršič[1,2], Danjela Kuščer[1,2], Kostja Makarovič[1,3], Zdravko Kutnjak[1,2], Vid Bobnar[1,2], Barbara Malič[1,2] [1]Jožef Stefan Institute, Jamova cesta 39, Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova cesta 39, Ljubljana, Slovenia, [3]KEKO Equipment, Grajski trg 15, Žužemberk, Slovenia
14:26	The Influence of Aliovalent Addition on the Point Defect Structure In Nonstoichiometric Zinc Oxide Monika Drożdż, Zbigniew Grzesik AGH University of Science and Technology, Faculty of Materials Science and Technology, Department of Physical Chemistry and Modelling, Al. A. Mickiewicza 30, 30-059 Krakow, Poland
	Different Approaches to Avoiding Lead Deficiency in PMN-PT Thin Films Urška Gabor, Matjaž Spreitzer, Danilo Suvorov Jožef Stefan Institute, 39 Jamova cesta, 1000 Ljubljana, Slovenia
14:40	Microstructural and Electrical Properties in (Co,Nb)-doped SnO_2 Vvaristor Ceramics Sara Tominc[1], Matejka Podlogar[1], Slavko Bernik[1], Goran Dražić[2], Nina Daneu[1], Aleksander Rečnik[1] [1]Jožef Stefan Institute, Department for nanostructured material, Jamova 39, Ljubljana, Slovenia, [2]National Institute of Chemistry, Hajdrihova 19, Ljubljana, Slovenia

	Preparation of TiS_2-based thermoelectrics with high S/Ti ratio Tilen Sever[1,2], Boštjan Jančar[1], Danilo Suvorov[1] [1]Advanced Materials Department, Jožef Stefan Institute, Jamova 39, 1000, Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova 39, 1000 Ljubljana, Slovenia
14:54	Effect of Geometry and Electromagnetic Design on the Solidification of Direct Chill Aluminium Billets Under the Influence of Low Frequency Electromagnetic Field Hatić Vanja[1], Mavrič Boštjan[1], Košnik Nejc[3,4], Šarler Božidar[1,2] [1]Institute of Metals and Technology, Ljubljana, Slovenia, EU, [2]University of Nova Gorica, Nova Gorica, Slovenia, EU, [3]Jožef Stefan Institute, Ljubljana, Slovenia, EU, [4]University of Ljubljana, Department of Physics, Ljubljana, Slovenia, EU
	Modelling of Viscoplasticity during DC Casting of Aluminium Alloys by a Meshless Method Boštjan Mavrič[1], Božidar Šarler[1,2] [1]Institute of Metals and Technology, Lepi pot 11, SI-1000 Ljubljana, [2]University of Nova Gorica, Vipavska 13, SI-5000, Nova Gorica
15:10	**Coffee Break**
15:40	Numerical Investigation of Heat Transfer on the Outer Surface of Polymeric Hollow Fibers Erik Bartuli, Miroslav Raudensky Brno University of Technology, Faculty of Mechanical Engineering, Heat Transfer and Fluid Flow Laboratory, Technicka 2896/2, 616 69, Brno, Czech Republic, EU
	Microstructure Modelling with Phase Field Crystal Method Matjaž Berčič, Goran Kugler Faculty of Natural Sciences and Engineering, Aškerčeva Cesta 12, Ljubljana
15:54	Study on the Machining Trend Analysis of Invar Alloy According to the FEM Analysis by the Electrode Type in Electrochemical Machining Seung-Geon Choi[1], Seong-Hyun Kim[1], Woong-Kirl Choi[1], Eun-Sang Lee[2] [1]School of Mechanical Engineering, Inha Univ., 253 Yonghyun-Dong, Nam-Gu, Incheon, Korea, [2]Department of Mechanical Engineering, Inha Univ., 253, Yonghuyn-Dong, Nam-Gu, Incheon, Korea
	Computer Simulation Of The Synergetic Effect Of Alloying Elements On Steels Hardenability Wojciech Sitek, Arkadiusz Jabłoński Institute of Engineering Materials and Biomaterials, Faculty of Mechanical Engineering, Silesian University of Technology, Konarskiego St.18a, 44-100 Gliwice, Poland
16:08	A Study on Machining Characteristics in Micro Pulse Electrochemical Machining of Invar Sheet Seong-Hyun Kim, Seung-Geon Choi, Woong-Kirl Choi, Eun-Sang Lee Department of Mechanical Engineering, Inha Univ., 253, Yonghuyn-Dong, Nam-Gu, Incheon, Korea
	Observations of Nucleation and Growth of Gold Nanoparticles Grown From Chloroauric Acid Solution by Using Transmission Electron Microscopy Combined With the Liquid Cell Bojan Ambrožič[1,2], Nina Kostevšek[1,2], Kristina Žužek Rozman[1], Marjan Bele[3] & Sašo Šturm[1] [1]Jožef Stefan Institute, Department for Nanostructured Materials, Jamova 39, 1000 Ljubljana, [2]Jožef Stefan International Postgraduate School, Jamova 39, 1000 Ljubljana, [3]National Institute of Chemistry, Laboratory for Chemistry of Materials, Hajdrihova ulica 19, 1000 Ljubljana
16:22	Bimorph Single Crystalline Piezoelectric Actuators for Scanning Probe Microscopy I. Kubasov, M. Malinkovich, A. Bykov, D. Kiselev, A. Temirov, S. Ksenich National University of Science and Technology "MISiS" (339), 119991, GSP-1, 4, Leninsky av., Moscow, Russia
	Characterization of Nanometric-Sized Participates Formed During Heat Treatment of Aluminium Alloy K. Matus, K. Gołombek, M. Pawlyta Institute of Engineering Materials and Biomaterials, Silesian University of Technology, 18A Konarskiego Str., 44100 Gliwice, Poland

16:36	Optimization of Photoelectrocatalytic Activity of TiO_2-based Microreactor Luka Suhadolnik[1,2], Andrej Pohar[3], Blaž Likozar[3], Miran Čeh[1] [1]Department for Nanostructured Materials, Jožef Stefan Institute, Jamova 39, SI-1000 Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova 39, SI-1000 Ljubljana, Slovenia [3]Laboratory of Catalysis and Chemical Reaction Engineering, National Institute of Chemistry, Hajdrihova 19, SI-1000 Ljubljana, Slovenia
	Coupling Vanadate Elution Ccontrol with Catalytic Properties of V_2O_5 in V_2O_5/PLGA Composite Coating Nemanja Aničić[1,2], Marija Vukomanović[1,2], Danilo Suvorov[1] [1]Advanced Materials Department, Insitute Jožef Stefan, Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Ljubljana, Slovenia
16:50	Synthesis of SiO_2/SnO_2 Nanofibers Using Templates of TEMPO-oxidized Cellulose Nanofibers Shunsuke Gunji, Yasuhiko Shimotsuma, Tetsuya Fujimoto, Kiyotaka Miura Department of Material Chemistry, Graduate School of Engineering, Kyoto University, Kyoto 615-8510, Japan
	Optimization of the Process for Obtaining Manganese Oxide (III) by Ultrasonic Spray Pyrolysis and Investigation of its Physical and Chemical Properties Tamara Yudintseva, Ella Dzidziguri, Denis Kuznetsov, Stepan Podgolin National University of Science and Technology "MISIS", Leninsky pr. 4, Moscow, Russia
17:04	Scanning tunneling microscopy studies of ultra-thin $SrTiO_3$ films on Si(001) grown by PLD Tjaša Parkelj[1], Daniel Diaz-Fernandez[1], Matjaž Spreitzer[1], Erik Zupanič[2], Danilo Suvorov[1] [1]Advanced Materials Department, Jožef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia [2]Condensed Matter Physics Department, Jožef Stefan Institute, Jamova 39, 1000 Ljubljana, Slovenia
	N-Doped Carbon Nanosheets as Renewable Electrocatalysts Maria K. Rybarczyk, Marek Lieder Gdansk University of Technology, Chemical Faculty, Department of Chemical Technology, 11/12 Narutowicza, 80-233 Gdansk, Poland
17:18	Effect of Ball Milling on Properties of Porous Ti–26Nb Alloy for Biomedical Applications G. Dercz, I. Matuła Institute of Materials Science, University of Silesia, 75 Pułku Piechoty Street 1 A, 41-500 Chorzów, Poland
	Determination of the Surface Wettability of Polymeric Hollow Fibres Tereza Brozova, Miroslav Raudensky Brno University of Technology, Faculty of Mechanical Engineering, Heat Transfer and Fluid Flow Laboratory, Technicka 2896/2, 616 69, Brno, Czech Republic, EU
19:30-21:00	**SOCIAL EVENT AT ST. BERNARDIN**

Petek – Friday 30.9.2016 Hall D	
	Predsedujoči – Chair:
9:00	PLENARY LECTURE Multilevel design of biomaterials for application in nanomedicine V. Jokanović, B. Čolović Institute of Nuclear Sciences „Vinča“ , Belgrade, Serbia
9:40	PLENARY LECTURE INCLUSION FLOTATION-DRIVEN CHANNEL SEGREGATION IN SOLIDIFYING STEELS Dianzhong Li Shenyang National Laboratory for Materials Science, Institute of Metal Research, Chinese Academy of Sciences, Shenyang, 110016, P. R. China
10:20	INVITED LECTURE Static and dynamic testing of Al alloys and effect of measurement uncertainty B. Podgornik[1], B. Žužek[1], V. Kevorkijan[2], B. Hostej[2] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]IMPOL R&R d.o.o., Partizanska 38, 2310 Slovenska Bistrica, Slovenia
10:50	3D Atom Probe Characterisation of Passive Layers on Stainless Steels G. Mori[1], A. Visser[1], C. Turk[2], F. Mendez Martin[2], M. Kapp[3], R. Fluch[3], H. Leitner[3] [1]Chair of General and Analytical Chemistry, Montanuniversitaet Leoben, Austria, [2]Chair of Physical Metallurgy and Materials Testing, Montanuniversitaet Leoben, Austria, [3]Bohler Edelstahl GmbH, Austria
11:05	Development of Eco-friendly and Non-hazardous Outdoor Bronze Protective Coatings T. Kosec[1], E. Švara[1], L. Škrlep[1] M. Kete[2], N. Gartner[1], E. Bernardi[3], C. Chiavari[4], C. Martini[6], G. Masi[5], J. Esvan[7], L. Robbiola[8] [1]National Building and Civil Engineering Institute, Dimičeva 11, SI-1000 Ljubljana, Slovenia, [2]Geida, environmental resources management, Ltd., Zapoge 37, 1217 Vodice, [3]Department of Industrial Chemistry ‘‘Toso Montanari’’, University of Bologna, viale Risorgimento 4, 40136 Bologna, Italy, [4]Interdepartmental Centre for Industrial Research “Advanced Applications in Mechanical Engineering and Materials Technology”, University of Bologna, via Terracini 28, 40131 Bologna, Italy, [5]Department of Civil, Chemical, Environmental, and Materials Engineering, University of Bologna, Via Terracini 28, 40131 Bologna, Italy, [6]Department of Industrial Engineering, University of Bologna, viale Risorgimento 4, 40136 Bologna, Italy, [7]CIRIMAT-ENSIACET (CNRS), Université Fédérale de Toulouse, 31000 Toulouse, France, [8]Laboratoire TRACES (CNRS), Université Fédérale de Toulouse, 31000 Toulouse, France
11:20	**Coffee break**
11:50	Micro-chemical and Microstructure Characterisation of High-permeability Mn-Zn Ferrites Borivoj Šuštaršič, Črtomir Donik, Aleksandra Kocijan, Matjaž Godec Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
12:05	New Ways of Joining Difficult-to-Join Materials by Mini-Thixoforming David Aišman, Bohuslav Mašek, Josef Káňa University of West Bohemia, Faculty of Mechanical Engineering, Univerzitní 22, P.O. Box 314, 306 14 Pilsen, Czech Republic
12:20	Channel Segregation Formation in 27SiMn Steel Yanfei Cao, Dianzhong Li Shenyang National Laboratory for Materials Science, Institute of Metal Research, Chinese Academy of Sciences, Shenyang 110016, China

12:35	Effect of RE on Inclusions in Highly Clean Bearing Steel Chaoyun Yang, Yikun Luan, Dianzhong LI, Lijun Xia, Yiyi Li Shenyang National Laboratory for Materials Science, Institute of Metal Research, Chinese Academy of Sciences, Shenyang 110016, China
12:50	Carbide Distribution Based On Automatic Image Analysis For Tool Steels. P. Jimbert, M. Iturrondobeitia, J. Ibarretxe, R. Fernandez-Martinez UPV/EHU, Escuela de Ingeniería de Bilbao, Paseo Rafael Moreno "Pitxitxi" 3, 48013, Bilbao, SPAIN
13:05	**LUNCH**
14:00	The Evaluation of Actual Tensile and Fracture Characteristics of Materials from the Results of Small Punch Tests Karel Matocha, Ondřej Dorazil, Miroslav Filip MATERIAL & METALLURGICAL RESEARCH Ltd., Pohranicni 31, 703 00 Ostrava Vítkovice, Czech Republic
14:15	Characterization of Aluminum Roll Bond Heat Exchanger at Elevated Temperatures Janko Ferčec, Rajko Habjanič, Dejan Ploj, Avgust Šibila TALUM d.d. Kidričevo, Tovarniška cesta 10, 2325 Kidričevo, Slovenia
14:30	Technology Reduction chromium from high chrome slag by reducing agents Si and C in the atmospheric induction melting furnace by using oxygen fuel burner Vladislav Kurka, Petr Jonšta, Zdeněk Carbol, Pavel Machovčák MATERIÁLOVÝ A METALURGICKÝ VÝZKUM s.r.o., Pohraniční 693/31, 703 00 Ostrava-Vítkovice, Czech Republic, EU, VÍTKOVICE HEAVY MACHINERY a.s., Ruská 2887/101, 703 00 Ostrava-Vítkovice Czech Republic, EU
14:45	Integration of In-Situ Electrolyte Property Measurements in AP18 Technology Electrolysis Cells Haris Salihagić Hrenko, Dragan Mikša Talum, Tovarna aluminija, d. d., Kidričevo, Tovarniška cesta 10, 2325 Kidričevo, Slovenia
15:00	Sliding Wear in Simulated Heat Affected Zone of Two 9-12% Cr Steels as a Function of Short-term Ageing Fevzi Kafexhiu[1], Igor Velkavrh[2], Bojan Podgornik[1] [1]Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]V-Research GmbH, Stadtstraße 33, 6850 Dornbirn, Austria
15:15	The Buckling of the Frame with the Columns from the I-shaped Cross-Section with Variable Web Height Bilyk S. I., Spynda V. Z. Kyiv Nationality university of building and architecture, Department of Steel and Wooden Structures, Ukraine
15:45	**Closing ceremony**

POSTRSKA SEKCIJA – POSTER SESSION
Wednesday – Friday 28. 9. 2016 (16:30)

YR1	Homogeneity Characterization of Al_{91}–Fe_5–V_2–Si_2 Master Alloy based on SDAR-OES data and Fractal Analysis of CLSM Micrographs Alecs Andrei Matei[1], Ion Pencea[2], George A. Stanciu[1], Radu Hristu[1] and Stefan G. Stanciu[1] [1]Center for Microscopy-Microanalysis and Information Processing, University Politehnica of Bucharest, Splaiul Independentei 313, sector 6, Bucharest, Romania, [2]Materials Science and Engineering Faculty, University Politehnica of Bucharest, Splaiul Independentei 313, sector 6, Bucharest, Romania
YR2	Identification of Mechanical Parameters of Composite-to-Metal Tubular Lap Joint under Torsional Loading Petr Bernardin, František Sedláček, Václava Lašová, Radek Kottner University of West Bohemia, Univerzitní 8, 306 14 Pilsen, Czech Republic
YR3	Effect of Polyethylene Glycol Molecular Weight on Drying Shrinkage and Hydration of Alkali Activated Slag Mortars and Pastes Vlastimil Bílek Jr., Radoslav Novotný, Lukáš Kalina, Miroslava Hajdúchová Brno University of Technology, Faculty of Chemistry, Materials Research Centre, Purkyňova 118, 612 00 Brno, Czech Republic
YR4	New Heat Treatment Process for Advanced High-Strength Steels Kateřina Opatová, Hana Jirková, Bohuslav Mašek, Dagmar Bublíková University of West Bohemia, RTI- Regional Technological Institute, Univerzitní 22, CZ – 306 14 Pilsen, Czech Republic
YR5	Verification and Validation of Tube Bundle Cross Flow CFD Analysis by Means of Reynolds and Strouhal Numbers Jiří Buzík, Tomáš Létal, Martin Naď, Pavel Lošák Brno University of Technology, Faculty of Mechanical Engineering, Institute of Process Engineering, Technická 2, 616 69 Brno, Czech Republic
YR6	Monitoring of Thermally Damaged Concrete by Various Ultrasonic Methods Ladislav Carbol, Michal Matysík, Zdeněk Chobola, Richard Dvořák Brno University of Technology, Faculty of Civil Engineering, Veveří 331/95, 602 00 Brno, Czech Republic
YR7	Influence of Grain Orientation on Residual Stress Distribution of Surface after Progressive Grinding of Blade Roots from Inconel 713LC Jiří Čapek[1], Kamil Gancarczyk[2], Kamil Kolařík[1], Zdeněk Pitrmuc[3], Libor Beránek[3], Nikolaj Ganev[1], Karel Trojan[1] [1]Department of Solid State Engineering, Faculty of Nuclear Sciences and Physical Engineering, Czech Technical University in Prague, Trojanova 13, 120 00 Prague 2, Czech Republic, [2]Department of Materials Science, Rzeszow University of Technology, al. Powstańców Warszawy 12, 35-959 Rzeszów, Poland, [3]Department of Machining, Process Planning and Metrology, Faculty of Mechanical Engineering, Czech Technical University in Prague, Technická 4, 166 07 Prague 6, Czech Republic
YR8	Numerical Modeling of Microstructure Evolution in the Continuous Casting of Steel T. Dobravec[1], B. Mavrič[1], R. Vertnik[1,2], A. Z. Guštin[1], B. Šarler[1,3,4] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]Štore Steel d.o.o., Quality and Development, Železarska cesta 3, 3220 Štore, Slovenia, [3]University of Nova Gorica, Vipavska 13, 5000 Nova Gorica, Slovenia, [4]Taiyuan University of Technology, 79 Yingze W St, Wanbailin, Taiyuan, Shanxi, China

YR9	Impact-Echo Method Used to Testing of High Temperature Degraded Cement Composite of Portland Cement CEM I 42,5 R and Gravel Aggregate 8/16 Richard Dvořák, Miroslav Luňák, Zdeněk Chobola, Rudolf Hela Brno University of Technology, Faculty of Civil Engineering, Veveri 331/95, 602 00 Brno, Czech Republic
YR10	Towards Reliable Characterization of Interfaces in Reprocessed HDDR Nd-Fe-B Permanent Magnets Muhammad Farhan Mehmood[1,2], Awais Ikram[1,2], Spomenka Kobe[1,2], Kristina Zuzek Rozman[1,2], Saso Sturm[1,2] [1]Department for Nanostructured Materials, Jožef Stefan Institute, Jamova 39, SI-1000 Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova 39, SI-1000 Ljubljana, Slovenia
YR11	Surface Analysis of Railway Buffers Heads Covered with Bronze Using Laser Cladding M. Sitarz, A. Kurc-Lisiecka, W. Gamon The University of Dąbrowa Górnicza, Cieplaka 1C, 41-300 Dąbrowa Górnicza, Poland
YR12	Using of Material-Technological Modelling For Designing Production Of Closed Die Forgings Khodr Ibrahim, Ivan Vorel, Štěpán Jeníček, Josef Káňa University of West Bohemia, Regional Technological Institute, Univerzitní 22, Plzeň, Czech Republic
YR13	Spark Plasma Sintering Study of HDDR Recycled Nd-Fe-B Permanent Magnets Awais Ikram[1], Muhammad Farhan Mehmood[1], Spomenka Kobe[1,2], Sašo Šturm[1,2], Kristina Žužek Rožman[1,2] [1]Department for Nanostructured Materials, Jožef Stefan Institute, Jamova 39, SI-1000 Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova 39, SI-1000 Ljubljana, Slovenia
YR14	Volume Changes of Cement Composites in the Early Stage of Setting and Hardening Barbara Kucharczyková, Petr Daněk, Dalibor Kocáb, Ondřej Karel, Libor Topolář, Petr Pőssl Brno University of Technology, Faculty of Civil engineering, Veveří 331/95, 602 00 Brno, Czech Repulbic
YR15	Self-supported Geopolymer-based Barriers for Filtration Applications Pavel Kejík, Pavel Bulejko, Tomáš Svěrák, Ondřej Krištof, Kateřina Mayerová Heat Transfer and Fluid Flow Laboratory, Faculty of Mechanical Engineering, Brno University of Technology, Technická 2896/2, 616 69, Brno, CZ
YR16	Influence of the Thermomechanical Treatment on Grain Growth Behaviour of a New Fe-Al Based Alloys with Fine Al_2O_3 Precipitates Bohuslav Mašek[1], Omid Khalaj[1], Hana Jirková[1], Jiří Svoboda[2], Dagmar Bublíková[1] [1]The Research Centre of Forming Technology, University of West Bohemia, Univerzitní 22, 306 14, Pilsen, Czech Republic, [2]Institute of Physics of Materials, Academy of Sciences Czech Republic, Žižkova 22, 616 62, Brno,
YR17	Investigation of Microporosity Formation in an AlSi10Mg Alloy Solidified Under Controlled Cooling Conditions Ramazan Kayikci[1], Selçuk Şirin[1], Murat Karabacak[1], Engin Kocaman[2] [1]Sakarya University, Faculty of Technology, Dept. of Met. Mat. Eng., Sakarya, Turkey, [2]Bulent Ecevit University, Faculty of Engineering, Dept. of Met. Mat. Eng, Zonguldak Turkey
YR18	Experimental Analysis of the Influence of Concrete Curing on the Development of its Elastic Modulus over Time Dalibor Kocáb, Monika Králíková, Petr Cikrle, Petr Misák, Barbara Kucharczyková Brno University of Technology, Faculty of Civil Engineering, Veveří 331/95, 602 00 Brno, Czech Republic

YR19	Micromechanical Characterization of Gellan Gum Based Bone Scaffolds Nela Fenclová[1,2], Daniel Kytýř[1,2], Veronika Petráňová[2], Josef Šepitka[3], Jaroslav Lukeš[3], Ana Gantar[3], Sasa Novak[3] [1]Czech Technical University in Prague, Faculty of Transportation Sciences, Konviktská 20, 110 00 Prague 1, Czech Republic, [2]Institute of Theoretical and Applied Mechanics, CAS, v. v. i, Prosecká 76, 190 00 Prague, Czech Republic, [3]Czech Technical University in Prague, Faculty of Mechanical Engineering, Technická 4, 166 07 Prague 6, Czech Republic, [3]Jožef Stefan Institute, Department for Nanostructured materials, Ljubljana, Slovenia
YR20	Numerical Modeling of Continuous Casting of Steel with Mould Electromagnetic Steering M. Maček[1], R. Vertnik[1,2], B. Šarler[1,3,4] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]Štore Steel d.o.o., Quality and Development, Železarska cesta 3, 3220 Štore, Slovenia, [3]University of Nova Gorica, Vipavska 13, 5000 Nova Gorica, Slovenia, [4]Taiyuan University of Technology, 79 Yingze W St, Wanbailin, Taiyuan, Shanxi, China
YR21	The sandwich Composite Structure Model for Low-velocity Impact Tomáš Mandys, Vladislav Laš, Tomáš Kroupa NTIS - New Technologies for information society, Faculty of Applied Sciences, University of West Bohemia, Univerzitní 8, 306 14 Plzeň, Czech Republic
YR22	In-situ testing of waterproofing injection screens Rostislav Drochytka, Vít Černý, Jindřich Melichar Brno University of Technology, Faculty of civil engineering, Vevří 331/95, 602 00 Brno, Czech Republic
YR23	The Effect of the Organic Additives on the Mechanical Fracture Properties and Shrinkage of Alkali Activated Slag Mortars Olesia Mikhailova, Hana Šimonová, Libor Topolář, Pavel Rovnaník Brno University of Technology, Faculty of Civil Engineering, Veveří 331/95, Brno, Czech Republic
YR24	Identification of Hydration Products of Tricalciumaluminate Phase in Presence of Water Containing Chromium Miroslava Mončeková, Jakub Takcz, Jaromír Pořízka, Jiří Másilko, Lukáš Kalina, Vlastimil Bílek Brno University of Technology, Faculty of Chemistry, Materials Research Centre, Purkyňova 464/118, Brno, CZ-612 00, Czech Republic
YR25	The Use of a Laser Disc for Cutting Silicon Wafers M. Musztyfaga-Staszuk, D. Janicki, P. Panek, M. Wiśniowski Silesian University of Technology, Welding Department, Konarskiego street 18a, 44-100 Gliwice, Poland, Institute of Metallurgy and Materials Science, Polish Academy of Sciences, Krakowska 22, 43-340 Kozy, Poland
YR26	Root Cause Analysis of Superheater Tubes Failure Martin Naď, Tomáš Létal, Pavel Lošák, Jiří Buzík Brno University of Technology, Faculty of Mechanical Engineering, Technická 2896/2, 616 69 Brno, CZ
YR27	Study of Thermal Technical Properties of Insulating Materials Based on Organic Fibers with Respect to Type and Properties of Row Fibers Jiří Zach, Vítězslav Novák Brno University of Technology, Faculty of Civil Engineering, Admas Centre, Veveří 331/95, 602 00 Brno, Czech Republic
YR28	Analysis of High-Alloyed Steels Microstructures Produced by Processing in the Semi-Solid State Katerina Opatova, Bohuslav Masek, David Aisman, Ludmila Kucerova University of West Bohemia, Faculty of mechanical engineering, Univerzitni 8, Pilsen 306 14, Czech Republic

YR29	Thermal And Oxidation Stability of Phenolic Resins as a Binder for Tap Hole Clay for Blast Furnace Ladislav Pařízek, Vlastimil Bílek, Jiří Švec Brno University of Technology, Faculty of Chemistry, Materials Research Centre, Purkyňova 118, 612 00 Brno, Czech Republic
YR30	Assessment of the Influence of Ambient Temperature on the Hardening of Concrete and its Elastic and Strength Properties Dalibor Kocáb, Petr Pőssl, Petr Misák, Petr Daněk, Petr Cikrle Brno University of Technology, Faculty of Civil Engineering, Veveří 331/95, 602 00 Brno, Czech Republic
YR31	Experimental Study of Measurements Techniques of Residual Properties of Concrete Subjected to High Temperature Iva Rozsypalová, Petr Daněk, Hana Šimonová, Zbyněk Keršner Brno University of Technology, Faculty of Civil Engineering, Department of Building Testing, Veveří 95, 602 00 Brno, Czech Republic
YR32	Algorithm for Visual Fiber Detection from Composite Cross–Section Hana Srbová, Lukáš Bureš, Ivan Pirner, Robert Zemčík University of West Bohemia, Univerzitní 8, 306 14 Plzeň, Czech Republic
YR33	The Assessment of Cement Mortars after Degradation High-temperature by Impact-echo Method Daniela Štefková, Libor Topolář, Karel Mikulášek Brno University of Technology, Faculty of Civil Engineering, Veveří 331/95, 602 00 Brno
YR34	Electro-oxidation of Formaldehyde Using Ni Electrodes Špela Trafela[1,2], Xuan Xu[1,2], Spomenka Kobe[1,2], Kristina Žužek Rožman[1,2] [1]Department for Nanostructured Materials, Jožef Stefan Institute, Jamova 39, SI-1000 Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova 39, SI-1000 Ljubljana, Slovenia
YR35	Gas Conductance Measurement in Molecular-flow Regime by Time Constant of Pressure Decay Tim Verbovšek[1,2], Barbara Šetina Batič[1], Janez Šetina[1] [1]Institute of Metals and Technology, IMT, Lepi pot 11, SI-1000 Ljubljana, [2]Jožef Stefan International Postgraduate School, Jamova cesta 39, 1000 Ljubljana, Slovenia
YR36	Electrodeposition of Nd-Fe-based Alloy From Aqueous Solution Xuan Xu[1,2], Špela Trafela[1,2], Spomenka Kobe[1,2], Kristina Žužek Rožman[1] [1]Department for Nanostructured Materials, Jožef Stefan Institute, Jamova 39, SI-1000 Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova 39, SI-1000 Ljubljana, Slovenia
1	Assessment of $CaO – SiO_2$ Mold Fluxes for Casting High Aluminum Steels Boštjan Arh, Franc Tehovnik, Jaka Burja, Franci Vode Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
2	Effects of Nano-Al_2O_3 Additive on Performance of Ceramic Coating Prepared by Micro Arc Oxidation on Aluminum alloy Çağatay Demirbaş, Aysun Ayday Sakarya University, Faculty of Engineering, Department of Metallurgical and Materials Engineering, Sakarya, 54187, Turkey
3	Porous HA/Alumina Composites Intended for Bone Tissue Engineering Eva Bartonickova, Jan Vojtisek, Jakub Tkacz, Jaromir Porizka, Jiri Masilko, Lukas Kalina Materials Research Centre, Faculty of Chemistry, Brno University of Technology, Purkynova 464/118, 612 00 Brno, Czech Republic

4	Chromium Reduction from Slag with High Content of Cr_2O_3 by the Help of Carbon and Silicon under Laboratory Conditions Ladislav Socha [1], Jiří Bažan [1], Zdeněk Adolf [1], Petr Jonšta [2] [1]VŠB – Technical University of Ostrava, FMME, Department of Metallurgy and Foundry, 17. listopadu 15/2172, 708 33 Ostrava – Poruba, Czech Republic, [2]VÍTKOVICE HEAVY MACHINERY a.s., Ruská 2887/101, Vítkovice, 70300 Ostrava, Czech Republic
5	Neural Network Modelling for Design and Optimization of Hot Work Tool Steel Heat Treatment Igor Belič, Bojan Podgornik Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
6	Thermal Shock Behavior and Wear Performance of Yttria and Ceria Stabilized Zirconia Thermal Barrier Coatings Manoliu Victor, Ionescu Gheorghe, Botan Mihail National Institute for Aerospace Research „Elie Carafoli" – INCAS-220 Iuliu Maniu Bd., Bucharest 6, Romania
7	A Simulation of the Weld Heat Affected Zone Microstructures Jaka Burja, Roman Celin, Danijela Skobir Balantič Institute of metals and technology, Lepi pot 11, 1000 Ljubljana
8	Lightweight High Strength Concrete with Sintered Ash Aggregate for Floor Systems Vit Cerny, Rostislav Drochytka Brno University of Technology, Faculty of Civil Engineering, Veveri 95, 602 00 Brno, Czech Republic
9	Advanced CAE Simulation of Pressures and Times Influence on Injection Molding Process and Product Karel Ráž, Zdeněk Chval University of West Bohemia in Pilsen, Regional Technological Institute, Univerzitni 22, 30614 Pilsen, Czech Republic
10	Degradation of Iron Coated with Polypyrrole in Simulated Body Fluid for Biodegradable Implants Karolina Cysewska[1], Lucia Fernandez Macia[2], Piotr Jasiński[1], Annick Hubin[2] [1]Faculty of Electronics, Telecommunications and Informatics, Gdansk University of Technology, ul. Narutowicza 11/12, 80-233 Gdansk, Poland, [2]Research group Electrochemical and Surface Engineering, Vrije Universiteit Brussel, Pleinlaan 2, 1050 Brussels, Belgium
11	Characterization of Structural Materials by Spherical Indentation Jaroslav Čech, Petr Haušild, Ondřej Kovářík Czech Technical University in Prague, Faculty of Nuclear Sciences and Physical Engineering, Department of Materials, Trojanova 13, 120 00, Praha 2, Czech Republic
12	Verification of Material-Technological Model of Closed Die Forged Part Jana Čubrová, Ivan Vorel University of West Bohemia, Regional Technological Institute, Univerzitní 22, Plzeň, Czech Republic
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New Ways of Joining Difficult-to-Join Materials by Mini-Thixoforming

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The mini-thixoforming technology allows complex near-net shape thin-walled components to be produced. Thanks to this process, it is possible to work some difficult-to-form materials, e.g. powder tool steels. A suitable modification of this technology also enables materials to be joined in semi-solid state. Joining of steel and aluminium can be an example. Thanks to the small volume of metal converted to semi-solid state and the precision control of the temperature field, it takes just tens of seconds for the whole process to complete. The forming operation itself takes tenths of a second. These specific conditions were used for experimental joining of steel and aluminium. Unlike in other experiments where it is the metal with the lower melting point which is usually melted, here it was the CPM 15V steel which was in the semi-solid state. The inserted aluminium part was not melted during forming thanks to the highly dynamic nature of the process. Therefore, a combined shape and diffusion-based joint was obtained. The temperature of forming the steel in semi-solid state was 1270 °C. The melting temperature of the aluminium alloy was almost twice as low as this value. The final products were analysed by light and scanning electron microscopy with the aid of EDS and EBSD techniques.

Observations of Nucleation and Growth of Gold Nanoparticles Grown From Chloroauric Acid Solution by Using Transmission Electron Microscopy Combined With the Liquid Cell

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Gold nanoparticles are versatile material, which is among many others applications [1] also used in experimental cancer treatment where gold nanoparticle`s phototermal effect is employed [2]. For that reason gold nanoparticle`s nucleation processes and chemical reaction kinetics need to be understood in-situ in liquid at the elevated temperature conditions [3]. In our experiments 1.5 mM water solution of gold(III) chloride trihydrate (chloroauric acid) as source of gold was used. To perform in-situ transmission electron microscopy (TEM) experiments Jeol JEM 2100 TEM equipped with Protochips Poseidon 300 liquid flow cell with a heating capability was employed. The experiments were performed at the electron dose rate of $7.7*10^8$ Gy/s. The solution was initially kept and observed at the room temperature. During that time period (7 min) no nucleation or growth of the nanoparticles was observed, indicating the stability of the solution at the selected dose rate. On the contrary, soon after the temperature was raised to 50 °C first seed particles could be observed. Detailed analysis of Au early growth stage showed that seed particles acted as an agent for the further formation of Au nanoparticles. The formation of gold nanoparticles could be explained by the process of the in-situ electron reduction of Au^{3+} to Au^0 particles [4], where the source of electrons are solvated electrons generated by the process of electron radiolysis of water [5]. It is anticipated that production of solvated electrons is increased at elevated temperature, which could explain the formation of gold nanoparticles at the elevated temperature.

1. Zhao, P. et al. *Coord.Chem.Rev*, **2013**, 257, 638-665.
2. Gong, H. et al. *Sci.Rep*, **2014**, 6080, 1-4.
3. Silva, N. et al. *Nanoscale Res Lett*, **2016**, 11, n. pag. web.
4. Wuithschick, M. et al. *ASC Nano*, **2015**, *9,* 7052-7071.
5. Schneider, N. et al, *J. Phys. Chem. A,* **2014**, *118*, 22373-22382.

Homogeneity Characterization of Al_{91}–Fe_5–V_2–Si_2 Master Alloy based on SDAR-OES data and Fractal Analysis of CLSM Micrographs

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Amorphous ribbons having Al_{91}–Fe_5–V_2–Si_2 master alloy precursors are used for reinforcing many of the composites that are frequently used in aeronautical and automotive industries [1]. These are typically manufactured by using the rapid solidification technique, which consists in melting master alloy rods of 3-5 cm length and 1 cm in diameter. During this synthesis procedure, an important focus of attentions needs to be placed on controlling the chemical and microstructural homogeneities of the precursor, which have deep implications with respect to the mechanical and physico-chemical parameters of the resulted compound. In the case of our experiment, the precursors were produced using electric arc melting technique. The Spark Discharge in Argon – Optical Emission Spectrometry (SDAR-OES) technique was used in conjunction with ASTM 826-25 standard procedure for the chemical homogeneity (CH) assessment. The microstructure homogeneity (MH) was investigated by confocal laser scanning microscopy (CLSM) and quantitatively estimated by fractal analysis, which provided numerical values of the MH measurand and facilitated a statistical inference. The conducted investigations shed more light on the fractal nature of the Al_{91}–Fe_5–V_2–Si_2 microstructure; the performed fractal dimension analysis provides strong evidence that the specimens are statistically homogeneous with a confidence level of 95%. Moreover, the statistical analysis of the CH, based on the ASTM 826-85 procedure, demonstrates that the evaluated specimens are homogeneous at “in bottle” and ”among bottles” levels.

1. S.Yaneva, K. Petrov, R. Petrov, N. Stoichev, G. Avdeev, R. Kuziak, Influence of silicon content on phase development in Al–Fe–V–Si alloys, Materials Science and Engineering: A, **2009**, 515(1–2),p. 59–65.

Coupling Vanadate Elution Ccontrol with Catalytic Properties of V_2O_5 in V_2O_5/PLGA Composite Coating

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Implant coating technology is seeking for innovative multifunctional materials. They should be able to hinder bacterial growth and stimulate cell attachment on the implant surface. Vanadium pentoxide mimics myeloperoxidase activity, i.e. catalyses transformation of hydrogen peroxide to hypohalite ions (X = Cl, Br, I):

$$H_2O_2 + X^- \rightarrow OX^- + H_2O \quad (1)$$

By exploiting myeloperoxidase-like activity of V_2O_5 via embedding inside anti-fouling paint, bacterial biofilm formation at the surface of a ship hull was prevented[1]. In adition, vanadate ions (formed when V_2O_5 dissolves in aqueos solution) at low concentrations exhibit insulin-mimicking action and *in vitro* studies confirmed proliferative effect of micromolar vanadate solutions on human cells[2]. *In vivo* studies showed acceleration of healing process in both, soft and hard tissue repair.[3]

By an efficient utilization of V_2O_5 properties described above, implant surface could be protected from bacterial biofilm formation while simultaniously cell proliferation (and consequently cell bonding to the surface) could be stimulated. This would enhance healing process and limit implant failure due to a bacterial biofilm formation.

Vanadium pentoxide is relatively soluble in aqueous media and at equilibrium, the obtained amount of vanadate ions is toxic. Thus, the necessity of effective solubility control of vanadium pentoxide requires cautions in a design of implant coating. To avoid uncontroled solubility of vanadium pentoxide, we designed production of a composite coating by embedding 1D V_2O_5 nanowires inside of poly(lactide-*co*-glucilode) acid (PLGA) matrix.

In this contribution, the influence of the V_2O_5/PLGA composite preparation process parameters will be related to the both, vanadate elution control from the composite and kinetics of halide-to-hypohalite transformation. In addition, implications for a potential applications in medicine will be discussed.

References:

1. Natalio F.; Andre R.; Hartog A. F.; Stoll B.; Jochum K. P.; Wever R; Tremel W., Nat Nanotechnol 2012, 7 530–5.
2. Jarrell, J. D.; Dolly, B.; Morgan, J. R., J. Biomed. Mater. Res. A 2009, 90, 272–281.
3. Moyer, K. E.; Saba, A. a.; Hauck, R. M.; Ehrlich, H. P., Exp. Mol. Pathol. 2003, 75, 80–88.

Assessment of CaO – SiO_2 Mold Fluxes for Casting High Aluminum Steels

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The composition of the mold flux is dependent on the composition of the steel. The essential characteristics of the casting powder are: melting point, crystallization temperature and viscosity, which effect on the heat transfer, lubricating ability and consumption. Conventional mold flux has a low basicity. When casting steels with high aluminum content, the viscosity and crystallization characteristics of the mold slag changes drastically (due to the reaction between aluminum in steel and silica in mold flux), and deteriorates mold lubrication. However, the low basicity helps to keep the slag in a low-melting region despite the steady pick-up of Al_2O_3 during the cast. The pick-up of Al_2O_3 results in further crystallization of the slag and loss of glassy phase, which adversely effects lubrication. This paper describes selection of mold flux for casting high steels with high Al content.

Effects of Nano-Al_2O_3 Additive on Performance of Ceramic Coating Prepared by Micro Arc Oxidation on Aluminum alloy

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MAO is a plasma assisted surface treatment technique used to convert the surfaces of suitable metals to a thick and hard ceramic oxide layer [1,2]. However, the ceramic coatings generally possess a foam-like structure with high bulk porosity and relatively poor mechanical properties, which restrict them from even wider technical applications [2]. Researches mainly focused on the effects of the processing parameters, such as current density, voltage, electrolytic solution for improve the mechanical properties; nowadays, nano-additive doping in the electrolyte also has studied to improve the properties of the ceramic coatings [1,3,4].

In this research, the effect of nano-Al_2O_3 additive in the electrolyte on the microstructure, phase composition, thickness and micro-hardness of MAO coatings on aluminum alloy were analyzed.

1. Nan XIANG, Ren-guo SONG, Jian ZHAO, Hai LI, Chao WANG, Zhi-xiu WANG, Trans. Nonferrous Met. Soc. China, 2015, 25, 3323-3328.
2. Kemal Korkmaz, Surface & Coatings Technology, 2015, 272, 72–78
3. Haojie Ma, Dalong Li, Chen Liu, Zhiquan Huang, Donglei He, Qin Yan, Peng Liu, Philip Nash, Dejiu Shen, Surface & Coatings Technology, 2015, 266, 151–159.
4. Yan Wang, Dongbo Wei, Jie Yu, Shichun Di, J. Mater. Sci. Technol., 2014, 30(10), 984-990.

Electron Tomography For Nanomaterials: Colouring Atoms in 3 Dimensions

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Electron tomography has evolved into a powerful tool to investigate a broad variety of nanomaterials. Most of these results have been obtained with a resolution at the nanometer scale but different approaches have recently pushed the resolution to the atomic level.
One possibilitiy to perform electron tomography with atomic resolution is by applying reconstruction algorithms based on compressive sensing [1,2]. The methodology was applied to HAADF-STEM images acquired from defect-free Au nanorods [1]. Going further is the aim to determine the type of individual atoms in hetero-nanoparticles. Using the same approach, we were able to distinguish individual Ag from Au atoms at the interface in core-shell Au@Ag nanorods [2].
Another challenge is to measure lattice strain in 3D. A well-known example of strained nanoparticles are nanodecahedra. Such particles consist of five segments bound by {111} twin boundaries, yielding a crystallographic forbidden morphology. We aimed at comparing strain investigations using 2D projection images with 3D measurements based on high resolution electron tomography reconstructions [3]. Therefore, a continuous tilt series of 2D projection images was acquired using HAADF-STEM and a dedicated alignment procedure was applied. These projection images are then used as an input for a model based tomography reconstruction algorithm. The final reconstruction is presented in Figure 1. Since the coordinates of the atoms are a direct outcome of the reconstruction, it becomes straightforward to calculate the 3D displacement map.
Also the ability to determine the crystal structure of more complex nanomaterials will be discussed.

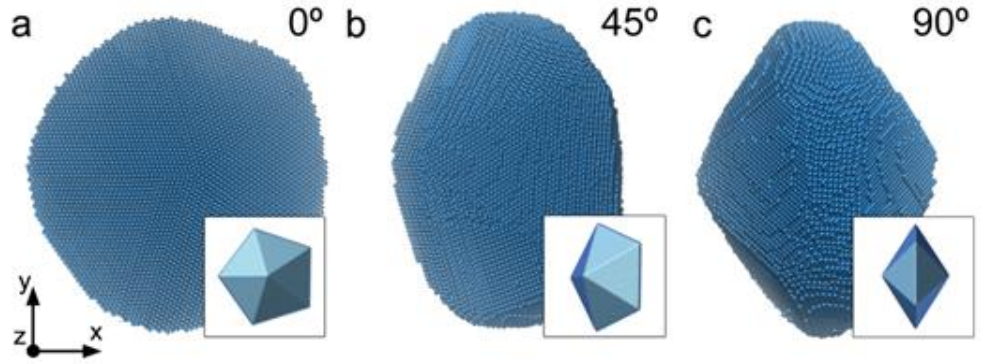

Figure 1: 3D visualizations of the reconstruction showing the atomic lattice of a Au nanodecahedron.

1. B. Goris, S. Bals, W. Van den Broek, E. Carbo-Argibay, S. Gomez-Grana, L. M. Liz-Marzan, G. Van Tendeloo, Nature Mater. 11 (2012) 930
2. B. Goris, A. De Backer, S. Van Aert, S. Gómez-Graña, L. M. Liz-Marzán, G. Van Tendeloo, S. Bals, Nano Lett. 13 (2013) 4236
3. B. Goris, J. De Beenhouwer, A. De Backer, D. Zanaga, K. J. Batenburg, A. Sánchez-Iglesias, L.M. Liz-Marzán, S. Van Aert, S. Bals, J. Sijbers, G. Van Tendeloo Nano Lett. 15 (2015) 6996-7001

Porous HA/Alumina Composites Intended for Bone Tissue Engineering

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Ceramic biomaterials based on hydroxyapatite or alumina are intensively studied due to their load-bearing application in bone tissue replacement/reconstruction and dental application[1, 2]. Here we present the study of preparation and properties of HA/alumina composites with targeted porosity. The HA powder used for composite preparation was synthetized via precipitation method under the various pH. Resulted powders were verified by XRD, Raman and FTIR analysis. The particle size was assessed via SEM and laser diffraction. As-prepared HA nanopowder was mixed with alumina powder (median 3 □m) in different weight ratios (0.5; 0.75; 0.9). Suspension with amount of 65 wt. % of powders were properly mixed and with the help of foaming agents foamed in situ. The behavior under the increasing temperature was studied by heating microscope and dried foams were sintered under the temperatures determined so. Final sintered foams were examined in vitro in synthetic body fluid which predicted behavior of bone implants in vivo. The behavior of treated samples was studied by SEM. The newly formed HA were confronted with Ca^{2+} and PO^{3-}_4 content in applied body fluid solution.

1. Bulut, B.; Demirkol, N.; Erkmen, Z. E.; Kayali, E. S., *Acta Physica Polonica A*, **2015**, *127(4),* 1094-1096.
2. Sakae, T.; Nakada, H.; LeGeros, J. P., *Journal of .Hard Tissue Biology*, **2015**, *24 (2)*, 111-121.

Numerical Investigation of Heat Transfer on the Outer Surface of Polymeric Hollow Fibers

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The use of polymeric heat exchangers has become widespread. One type of polymer heat exchanger is the polymeric hollow fiber heat exchanger (PHFHE). This heat exchanger uses plastic microchannels as the heat transfer surface. The diameter of microchannels is smaller than 1 mm. The heat exchanger consists of hundreds of such fibers, which lead to a large heat transfer area compared to the size of the whole heat exchanger (high compactness). Polymers are not generally good conductors of heat. The fibers used in this application have very thin walls (about 0.1 mm), therefore the thermal resistance of the fiber wall is not significant. These heat exchangers have heat transfer rates comparable to metal heat exchangers. Moreover, plastic heat exchangers have a number of advantages compared to metal heat exchangers, including low weight and resistance to corrosion and impurities. Another important factor is that the production of PHFHE expends two times less energy than the production of metal heat exchangers; therefore, the production of PHFHE has less negative impact on the environment.

The theory of heat transfer inside the polymeric hollow fiber is well described. However, the description of the heat transfer on the outer surface of fibers is more complex and currently is poorly described in literature.

This work is devoted to the numerical modeling of heat transfer on the outer surface of polymeric hollow fibers. The main purpose of this work was to determine an optimal arrangement of polymeric hollow fibers in a PHFHE. The object of the study was a bundle of parallel polymeric hollow fibers with an outer diameter of 0.8 mm. The interaxial distance between the fibers was 2.4 mm. This study considered both water and air as cooling mediums among fibers. Using computer modeling in ANSYS CFX, the heat transfer coefficient on the outer surface of the hollow fibers was obtained. The HTC was dependent on the medium flow velocity and the angle of fibers relative to the cooling medium flow. The flow velocity varied from 0.1 to 0.5 m/s and the angle between the fiber axis and the cooling medium flow direction varied from 0^{o} to 45^{o}.

The numerical study clarified the influence of heat transfer surface geometry on the heat transfer coefficient on outer surfaces. This data was used in the development of a PHFHE.

Chromium Reduction from Slag with High Content of Cr_2O_3 by the Help of Carbon and Silicon under Laboratory Conditions

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Production of steel with high content of chromium in the electric arc furnace (hereinafter EAF) is connected with a loss of chromium based on its oxidation and then its absorption by a slag. The oxidation of chromium in the EAF occurs during particular technological operations but in various intensities. The chromium loss already occurs during the charge melting and the main part occurs during oxygen blowing into the EAF. Slag with high content of chromium has increased viscosity and it forms so called crust. Solid crust significantly limits technological processes during a production of high alloyed steels. Chromium reducibility during production of high alloyed steels is very important for the economy of production process because chromium is one of the main components and it presents a great part of raw materials´ costs [1, 2].

The paper presents the results of laboratory experiments aiming the study of chromium and its oxides behaviour together with the mechanism of its reduction by the help of silicon and carbon. Experimental heats were focused on the proposal of theoretical calculation of consumption of chosen reduction agents, reduction study under laboratory conditions at the application of alloyed steel with the chromium content of 13 wt. %, temperatures 1 600 °C and 1 650 °C together with the change of amount of reduction agents and the reduction period. Obtained original results will be used for results verification under half-operational and operational experiments which will imitate the real operational conditions in the EAF.

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1. Arh, B., Tehovik, F. *Materials and Technology,* **2007**, vol. 41, issue 5, p. 203-211.
2. Sun, S., Uguccioni, P., Bryant, M., Ackroyd, M. In *Electric Furnace Conference Proceedings*, **1997**, p. 297-300.

Neural Network Modelling for Design and Optimization of Hot Work Tool Steel Heat Treatment

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Optimization of tool steel properties and corresponding heat treatment is mainly based on trial and error approach, which requires tremendous experimental work and resources. There is a huge demand for modelling tools that would predict the mechanical properties of tool steels. The presented work focuses on the particularities of the artificial neural network (ANN) based modelling used to select and optimize vacuum heat treatment conditions. ANNs were used to model the hardness and fracture toughness on the basis of hot work tool steel composition (contents of C, Si, Mn, Cr, Mo and V) and heat treatment parameters (austenitization and tempering temperature). The model covers the 10 dimensional space therefore the required number of measured data points that would allow reliable modelling reaches 10^9. The modelling clearly deals with a sparsely sampled case. We have used the feedforward ANN with a supervised error backpropagation training scheme. The ANN was first trained and the built model was used to predict the outcome for the tool steel for the provided chemical composition and heat treatment parameters. All together 176 data points (11 steels) consisting of chemical composition, austenitizing and tempering temperature and measured hardness and fracture toughness values were used to build the model. For further steel measurements, the ANN model is first used to predict the parameters which are then compared to the measured counterparts, the quality of modelling is thus assessed, and finally the new data set is used to additionally train – fine tune the model. The model is therefore constantly being subjected to improvements. With the use of the model its reliability gets higher.
ANN model build and used in this work shows good agreement with real hot work tool steels properties and heat treatment behaviour, although being designed and trained on the basis of quite limited data set.

Microstructure Modelling with Phase Field Crystal Method

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Modern material science is based on discovery that the material properties
are not only determined by the chemical composition of the material,
as the microstructure plays a major role in the material's properties. Successful engineering of the microstructure that gives the material the desired properties requires good knowledge of the microstructure forming processes that occur during casting and material processing, and expensive experiments for fine-tuning the production process.
The latest developments in numerical models of complex materials in combination with ever increasing computational power at our disposal offer a new way of gaining insight into the microstructure forming processes and through this promise to reduce the number of experiments required to obtain the desired properties of the material.
In this presentation a recently developed method for modeling the miscrostructure formation, Phase Field Crystal method[1] (PFC) will be presented. In combination with recently developed extensions[2-7] of this method, it is possible to model the microstructure of the materials to the atomic level in samples of observable sizes. Results of numerical simulations with newly developed algorithms will be presented.

1. Elder, Katakowski, Haataja, Grant, *Physical review letters,* **2002**, *88*.
2. Goldenfeld, Athreya, Dantzig, Greenwood, Provatas, *Physical review e,* **2005**, *72*.
3. Athreya, Goldenfeld, Dantzig, Greenwood, Provatas, *Physical review e,* **2007**, *76*.
4. Elder, Provatas, Berry, Stefanovic, Grant, Grant, *Physical review b,* **2007**, *75*.
5. Greenwood, Provatas, Rotter, *Physical review letters,* **2010**, *105*.
6. Greenwood, Rottler, Provatas, *Physical review e,* **2011**, *83*.
7. Ofori-Opoku, Stolle, Huang, Provatas, *Physical review b,* **2013**, *88*.

Identification of Mechanical Parameters of Composite-to-Metal Tubular Lap Joint under Torsional Loading

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During the damage evolution of bonded joints, different modes (mechanisms) of failure can be detected. These modes include pure modes (Mode I, Mode II, Mode III) or their combinations (Mixed-mode) according to the type and the direction of loading. Some scientifically validated test methods[1] are being commonly used to obtain the fracture toughness by loading under pure Mode I, Mode II and their Mixed-mode. Moreover, another test methods[1] are established to obtain the fracture toughness by loading under pure Mode III, however, further research is required and important questions need to be answered, such as the true ratio of the strain energy release rate components of all three modes[1]. The main goal of this research is to propose method for determination of mechanical parameters of a composite-to-metal tubular lap joint under torsional loading having comparison of experiments and the finite-element model. The presumed mode of failure is Mode III or Mixed-mode with predominance of Mode III. Emphasis is placed on the widespread applicability of obtained results for similar specimens loaded under similar mode, namely for similar cylindrical tubular lap joints torsional loaded under pure Mode III.

1. P. P. Camanho, C. G. Davila, *NASA/TM-2002-211737*, **2002**

Effect of Polyethylene Glycol Molecular Weight on Drying Shrinkage and Hydration of Alkali Activated Slag Mortars and Pastes

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Although a few studies mentioning the effect of chemical admixtures on drying shrinkage of alkali activated slag (AAS) have been already published[1,2], they have not investigated it concerning molecular structure of these chemical admixtures. Therefore, the aim of this study is to explore an influence of ethylene glycol in different polymerization degrees on hydration process of AAS pastes and drying shrinkage of AAS mortars.

Ground granulated blast furnace slag was activated by liquid sodium silicate with silicate modulus of 2.1. Its dose was adjusted to maintain 4 and 8% of Na_2O in respect to weight of slag. Ethylene glycol (EG), polyethylene glycol with molecular mass about 400 g/mol (PEG400) and about 2000 g/mol (PEG2000) were used in amount corresponding to 0.5, 1 and 2% of slag weight. It was observed that while for activator dose of 4% Na_2O all the ethylene glycol based substances reduced the total heat of hydration studied through the isothermal conduction calorimetry, for 8% of Na_2O no decrease or even slight increase of the total heat induced by PEG2000 was recorded. Some differences in the heat flow curves were also recorded

Drying shrinkage tests were based on ASTM C596 and weight loss during drying was also measured. While 1 % of PEG2000 reduced drying shrinkage of AAS mortars by 13% and 2% of PEG2000 by 25%, the same content of EG had only slight or no effect. Therefore, it can be concluded that molecular mass of chemical substances plays and important role in AAS drying shrinkage reduction of AAS. Increasing content of both EG and PEG also slightly increased weight loss during drying which could be a consequence of reduced liquid saturation observed for shrinkage reducing admixtures in ordinary Portland cement based systems[3].

1. M. Palacios, F. Puertas, *Cement and Concrete Research*, **2007**, *37*, 691–702.
2. C. Bilim, O. Karahan, D. Atis, S. Ilkentapar, *Materials and design*, **2013**, *44*, 540-547.
3. P.-C. Aïtcin, R. Flatt (eds.), Science and Technology of Concrete Admixtures, 1st edition, 2015.

The Buckling of the Frame with the Columns from the I-shaped Cross-Section with Variable Web Height

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The economical development is inseparably connected with the volume increase of the construction of the quick-adjusting buildings one- to three-storied with the steel frames. The rise of the efficiency their using determines the necessity of improving the steel structures calculation theory.
The analysis of steel frame structures decisions of the different forms, producing steel structures, and review of the research works enables to separate the main directions of steel structures development, such as using of the universal elements and profiles, which have the highly-technological manufacturing, montage and are convenient during transportation. These universal elements of the steel frames are the elements with the variable cross-section and cold-formed thin-web profiles.
But there no exist enough researches, directed to the improving the calculation methods of the steel frames systems, including elements of the variable cross-section.
The determination of the problem. 1. Determinate the influence of the variability of height web of the column and influence of the configuration of the steel elements on the nature of tangential stress distribution in the web the cross-section of the elements. 2. The estimate of the influence of the girder stiffness on the buckling resistance of the I-shaped columns with the variable cross-section.
Carried out researches discovered some peculiarities of the stressed-deformed condition for the columns of frames from I-shaped cross-section with variable web height.
There was found, that the maximal tangential stresses in the I-shaped cross-section with variable web height of the beam appeared in the joint the of flange-web, not at the middle of section on the neutral axis of the cross-section of the element, like for the beams with the constant cross-section. Among that, the modulus of the maximal tangential stresses depends on sectional ratio of the area of the flange and area of the web of the beams.
Was found for the two-hinged frame, which consisted of the columns with the variable cross-section and girder with the constant cross-section.
This decision of the frame buckling resistance problem with the column of variable cross-section may be used as the testing problem for the development of roughly methods of analysis of the more difficult frame structures with the variable cross-sections of elements.
Was investigated the stability of columns with variable section. Found criterion of the buckling columns with variable cross section having a resilient supports.

References

1. Timoshenko S.P. and Gere, J.M: Theory of Elastic Stability, McGraw Hill Kogakusha Ltd., New York. 1961.
2. Vitor Dias da Silva Mechanics and Strength of Materials Springer – Verglag Berlin Heidelberg, 2006, p.529.

Corrosion Behavior Influenced by Quenching Conditiones of HTGN Martensitic Stainless Steel

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High temperature gas nitriding (HTGN) has a large impact on enhancing the corrosion behavior of martensitic stainless steels. The variation in nitriding time was investigated with respect to microstructure, surface hardness (nanoindentation), alloying element content near the surface (GDOS) and pitting corrosion resistance. The study shows that quenching in 10 bar nitrogen enhances the nitrogen content near the surface. Samples heat treated without any nitrogen addition though quenched in nitrogen, exibits an improvement of corrosion resistance. Furthermore the hardness increases too, compared to a non heat treated sample. Specimens quenched in helium also display an enhancement of the pitting corrosion resistance, however the hardness increases lesser. Simulations are supporting this assertions.

Thermal Shock Behavior and Wear Performance of Yttria and Ceria Stabilized Zirconia Thermal Barrier Coatings

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Thermal barrier coatings (TBC) become essential for protection and increasing the lifespan of working components under harsh thermal environments. The interface spallation is still a problem for TBC under critical conditions such as high temperature and high corrosion environments which give researchers a challenge in developing new technology in reducing this factor.
Three types of TBC structures were studied under point of view of wear and most perturbing factor, thermal shock. Powders consisting the feedstock for deposition, were coated by High Velocity Air-Fuel (HVAF) technique for bond coat (BC) and by Air Plasma Spraying (APS) technique with three types of zirconia based ceramics for top coat. The studied coatings consists from nanostructured yttria stabilized zirconia oxide powder (nanoYSZ), conventional yttria stabilized zirconia oxide powder and ceria stabilized zirconia oxide powder (YCSZ).
For investigation of the thermal shock behavior of the coating, a testing equipment was developed namely QTS-2 (Quick Thermal Shock) conceived by INCAS (National Institute for Aerospace Research "Elie Carafoli" Bucharest, Romania). A closed loop testing procedure for heating and cooling was created for reproducibility of tests and monitored parameters.
Tribological performances were studied by ball-on-disc arrangement against 100Cr6 steel ball, using Bruckner Universal tribometer UMT-3. The obtained results conduct for a better understanding of tribological performances of studied coating and ranking them using wear factors. The microstructure of the coatings was investigated and discussed.

Passing the Heat Parcels with Multifunctional Cantilevers: A Novel Solid-State Cooler

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The current refrigeration systems are poorly scalable and toxic due to the use of fluid-based cooling mediums (freons) and are thus not suitable for advanced cooling applications, e.g. in microelectronics. One of the emerging alternatives for scalable and efficient solid-state refrigeration is the electrocaloric (EC) effect in which a temperature change occurs with applied electric field to an insulating material.[1] These EC materials also possess good electromechanical (EM) properties, e.g. electrostriction or piezoelectric effect.

In this contribution, we propose a cooling system, which consists of an array of (1-x)$Pb(Mg_{1/3}Nb_{2/3})O_3$-x$PbTiO_3$ (PMN-PT) cantilevers. PMN-PT is a multifunctional material, coupling electrical, mechanical and thermal properties. PMN-PT can exhibit both the piezoelectric (or electrostrictive) effect and the EC effect; thus the idea is to use the EM effect to create periodic contacts between the cantilevers, passing the parcels of heat induced by the EC effect.

In the first part of the study we will show the cooling feasibility of the proposed device. Numerical analysis showed that such device will exhibit a large and highly controllable temperature span ($\Delta T \sim 13$ K).

In order to tailor the piezoelectric response of the cantilever, we also created a numerical model which enables the optimization of the cantilever structure in terms of the optimal geometry and the electrode materials for achieving large deflections (~650 μm). The model prediction was used to fabricate the optimized PMN-PT cantilevers.

The predicted high temperature spans in the device and the large cantilever deflections motivate further development of such cantilever based EC refrigeration systems.

1. Z. Kutnjak, B. Rožič, and R. Pirc, in *Wiley Encycl. Electr. Electron. Eng.*, pp. 1–19.

Determination of the Surface Wettability of Polymeric Hollow Fibres

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Heat exchangers with polymeric hollow fibres show great promise. These heat exchangers consist of hundreds of polymeric hollow fibres with outer diameters less than 1 mm and wall thicknesses of approximately 10 % of the outer diameter. Polymer heat exchangers are lightweight, affordable and easy to shape. Their packing density, which captures the ratio of the heat transfer area and volume of the heat exchanger, is large. Additionally, they can be used effectively in HVAC (heating, ventilating, and air conditioning) technology.

Wettability is an important parameter which can significantly affect the heat transfer associated with condensation. Hydrophobic and hydrophilic materials are distinguishable. The dynamic contact angle is one way to define surface wettability. This experimental study compares the influence of used polymeric material and the eventual surface finishes of hollow fibres on the dynamic contact angle.

The Wilhelmy method can be used to determine dynamic contact angle. This method was used to measure the force of the interaction of a fibre at the liquid-gas interface. The method is based on immersing and removing a sample in a liquid. The sample is hung on a balance, and when the sample contacts the liquid, the measurement of force begins. The forces experienced by the balance as the sample interacts with the surface of the liquid can be used to calculate surface tension or contact angle. The advancing and receding contact angle are defined. The advancing contact angle is determined when the probe is immersed in the liquid and the receding angle is defined during the removal from the liquid. The contact angle is also dependant on the properties of the selected liquid. Therefore, this paper also compares ethylene glycol, water, and glycerol and their impact on the dynamic contact angle.

New Heat Treatment Process for Advanced High-Strength Steels

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Today's advanced steels are required to possess high strength and ductility. It can be achieved by choosing an appropriate steel chemistry which has a substantial effect on the properties obtained by heat treatment. Steels of this group typically require complicated heat treatment which places great demands on the equipment used. The present paper introduces new procedures aimed at simplifying the heat treatment of high-strength steels.
Four experimental steels were made and cast, whose main alloying additions were manganese, silicon, chromium, molybdenum and nickel. The steels were treated using the Q-P process with subsequent interrupted quenching. The resulting structure was a mixture of martensite and retained austenite. Strength levels of more than 2000 MPa combined with 10-15 % elongation were obtained. These properties thus offer potential for the manufacture of intricate closed-die forgings with a reduced weight.

1. LONG, XY., ZHANG, FC., KANG J. Low-temperature bainite in low-carbon steel, Materials and Science Engineering, 31 January 2014, pp344-351.
2. BADESHIA, H.K.D.H. The Bainite Reaction, The Steels: Microstructure and Properties, 2006, str.129-154.
3. CABALLERO, FG., BHADESHIA, H. K.D.H. Very strong bainite, Current Opinion in Solid state and Materials Science, Vol. 8, Issues 3-4, 2004, 251-257.
4. MAŠEK, B., JIRKOVÁ, H., HAUSEROVÁ, D., KUČEROVÁ, L., KLAUBEROVÁ D. The Effect of Mn and Si on the Properties of Advanced High Strength Steels Processed by Quenching and Partitioning. Materials Science Forum, 2010, Vols. 654-656, p. 94-97.
5. JIRKOVÁ, H.; KUČEROVÁ, L., MAŠEK, B. Effect of Quenching and Partitioning Temperatures in the Q-P Process on the Properties of AHSS with Various Amounts of Manganese and Silicon. Materials Science Forum, 2012, Vols. 706-709, p. 2734-2739.
6. JIRKOVÁ, H. et al.: Influence of metastable retained austenite on macro and micromechanical properties of steel processed by the Q-P process, Journal of Alloys and Compounds, available online, Journal of Alloys and Compounds, 615 (2014) S163–S168

A Simulation of the Weld Heat Affected Zone Microstructures

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In order to achieve regions of uniform microstructure across the specimen suitable for investigations, thermal cycle simulations are applied. Usually thermal simulations are done in conjunction with weldability investigations to determine proper welding parameters for a given steel grade.
In the presented investigation a dilatometer (TA instruments DIL805A/D) with controlled heating and cooling ramp was used to simulate weld thermal cycles. Hollow cylinder specimens machined from S690QL were subjected to several weld thermal cycles in order to generate similar microstructures as in the real weld heat affected zone. A high strength steel grade S690QL and a filler welding wire Mn3Ni1CrMo were materials chosen for welding a V shaped multi-pass butt weld. The microstructures of as welded and simulated heat affected zone specimens have been investigated. A good agreement has been found between the dilatometer simulated microstructures and those in a real weld heat affected zone. It has been concluded that simulations of weld heat affected zone microstructures are possible within limits of the used dilatometer capabilities and specimen size.

Verification and Validation of Tube Bundle Cross Flow CFD Analysis by Means of Reynolds and Strouhal Numbers

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Unexpected failures during the operation of devices for heat exchange can be prevented by appropriate design. This may be achieved by using proper thermo-hydraulic and structural design. Fluid-induced vibrations present important phenomena that is commonly overlooked in structural design. Generally, effectiveness of the heat transfer in tube bundle might be intensified by increase of fluid vortices. Consequently, turbulences cause disintegration of laminar sublayers and they also homogenize fluid streams. On the other hand, turbulences cause greater and more irregular force responses acting on the tube walls. These force responses are generally caused by fluid flow or vortex excitations in wakes. The frequent negative consequence of this force responses are fluid-induced vibrations.

It is a good practice to verify and validate (V&V) results of CFD analyses [1]. The goal of this paper is to examine possibilities of V&V CFD analysis by use of Reynolds and Strouhal numbers. The state-of-the-art clearly describes influences of two above mentioned dimensionless numbers [2] also; dimensionless number parameters commonly describe behavior of fluid flow on tube bundle. Therefore, these influences of Reynolds and Strouhal numbers may be used as valuable way to V&V of CFD analysis.

A part of this paper is comparison of CFD results for V&V. They are obtained from viscous RANS (Reynolds-averaged Navier-Stokes) and SRS (Scale-Resolving Simulation) group of models. In case of RANS viscous models, k-ε realizable, k-ω standard and k-ω SST are compared. In case of SRS, SAS (Scale-Adaptive Simulation) viscous model [3] is used.

1. W. L. Oberkampf, T. G. Trucano, *Validation Methodology in Computational Fluid Dynamics (invited)*, **2000**.
2. S. Kaneko, T. Nakamura, F. Inada, M. Kato, *Flow-Induced Vibrations*, **2014**, *2nd ed.*, 15-17.
3. ANSYS Inc., *ANSYS Fluent User's Guide*, **2013**, Release 15.0, 695-758.

Channel Segregation Formation in 27SiMn Steel

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"A"-type channel segregation, as the most common casting defect in 27SiMn steel, has a significant effect on the inner quality of steel ingot and final product. A 500 kg 27SiMn steel ingot has been produced via the low-oxygen purifying technology, and the macrostructure, microstructure, inclusion, porosity and solutal segregation surrounding the channel segregation zone were characterized and analyzed in detail. It shows that within the channel, both the inclusions size and number are much smaller compared with our dissected 500 kg 1045 steel ingot, whereas the accumulations of porosities and main solutes are rather obvious. In addition, based on the classical thermo-solutal buoyancy driven macrosegregation theory, channel segregations in the body of 27SiMn steel ingot have been simulated successfully by using the multi-component continuum model, but they disappear in 1045 steel. By comparing the evolution processes during solidification of both steels, it proved that the strong thermo-solutal buoyancy in 27SiMn steel can destabilize the mushy zone and induce the formation of channel segregation. And yet, in 1045 steel it should be ascribed to other driving force such as inclusion flotation.[1, 2] Finally, both the contours of Rayleigh number in the two steels were mapped, based on which the critical value of Rayleigh number to predict the channel segregation formation in steels were proposed.

Dianzhong Li, Xing-Qiu Chen, Paixian Fu, et al., *Nature Communications*, **2014**, *5*, 5572-5579.
Yanfei Cao, Yun Chen, Dianzhong Li, Acta materialia, **2016**, *107*, 325-336.

Monitoring of Thermally Damaged Concrete by Various Ultrasonic Methods

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The performance of concrete under elevated temperatures is very complicated and difficult to characterize. With increasing temperature there is a decrease (or change) of mechanical and physical properties such as compressive strength, tensile strength, modulus of elasticity, density, etc. In this paper we examine the interaction of thermal damage processes in concrete and parameters obtained by different nondestructive ultrasonic methods. We were focused on conventional and innovative ultrasonic methods.

The conventional technique was Ultrasonic Pulse Velocity (UPV) method. The pulse velocity in a material depends on its density and its elastic properties which in turn are related to the quality and the compressive strength of the concrete.

The innovative ultrasonic methods were based on principles of Nonlinear Elastic Wave Spectroscopy. Material nonlinearities manifest themselves as resonant frequency shifts and harmonics or dumping coefficients changes. The first procedure described and tested in this article uses broadband pulse-compression signal, with variable amplitude to measure the change of fundamental frequency. The second procedure uses single harmonic ultrasonic excitation signal. We examined nonlinear changes in frequency spectra.

Surface Hardening of Ti6Al4V Alloy by Pack Siliconizing

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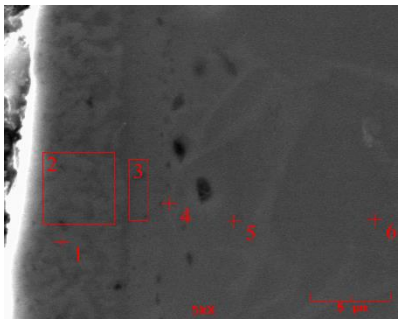
Titanium alloys are promising materials because of their excellent properties, such as high specific strength, light weight and excellent corrosion resistance making them of interest for many automotive and aerospace applications. However, titanium alloys exposed to rapid oxidation at elevated temperatures and also has poor surface wear properties [1, 2]. One of the methods for improving the oxidation resistance of Ti-based alloys is surface siliconizing. Siliconizing is one of the surface hardening process where silicon atoms diffuse into solid metal at elevated temperature [3, 4]. In our investigation silicide coating on Ti6Al4V alloy was obtained by pack siliconizing method at 1000°C for respectively 8, 10 and 12 hours using Si as Si source, Al_2O_3 powder as filler and an activator of NH_4Cl. The morphology and presence of the titanium silicide layer formed on Ti6Al4V alloy substrate was actualized by using classical metallographic techniques and X-ray diffraction analysis (XRD). A dense, compact silicide layer with a thickness of changing between 5- 10 µm were detected. Dispersion of the elements in the coating layer were investigated by using electron microscope (SEM) and elemental analysis (EDS) (Fig.1). Hardness of silicide layer were measured by using Vickers indenter and it was determined that the hardness was over 1800VSD.



Elt.	Atomic %					
	1	2	3	4	5	6
N	21.65	21.10	16.42	19.84	23.98	21.38
O	0.000	0.536	1.439	0.832	1.103	0.000
Al	0.649	0.342	0.853	8.251	8.875	10.51
Si	**14.34**	**13.12**	**20.57**	**3.219**	**1.378**	**0.690**
Ti	63.36	64.89	60.71	67.85	64.66	67.41

Fig.1. SEM image and EDS analysis of Ti6Al4V alloy pack siliconized at 1000°C for10 hours.

References

1. Dalibor Vojtìch, Tomá Kubatík, Siliconizing As a Method for Improving the Resıstance of Titanium to Oxidation, 2003, 37, 381- 384
2. D. Vojtěch, P. Novák, P. Macháč, M. Morťaniková, K. Jurek, Surface protection of titanium by Ti5Si3 silicide layer prepared by combination of vapour phase siliconizing and heat treatment, Journal of Alloys and Compounds, 2008, 464, 179, 184
3. Othman M., Yusnenti F.M.Y, MohdYusri I., Siliconizing Process of Mild Steel Substrate by Using Tronoh Silica Sand (TSS): An Experimental Investigation, Procedia CIRP, 2015, 26, 554- 559
4. http://encyclopedia2.thefreedictionary.com/Siliconizing

Lightweight High Strength Concrete with Sintered Ash Aggregate for Floor Systems

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Fly ash is a by-product of coal-fired power plants. In the building industry it is used as a fine additive to concrete, especially due to its pozzolanic activity. Use of fly ash has two main positive aspects: environmental aspect (recycling instead of landfilling) and economic (partial replacement of primary raw material reduce the price of the final product). One of the areas of use fly ash is except its direct use as admixtures is for the production of artificial aggregates based on sintered ash.
The sintered artificial aggregate can be used for lightweight concrete composite of different strength classes. With proper preparation a mixture, it is possible also produce high-strength lightweight concrete reaching strength classes LC 50/55.
Article deals with the selection of suitable ash for artificial sintered aggregate for high-strength concrete and with the capabilities to achieve the parameters of strength class LC 50/55. An important aspect of evaluating the quality of the cement composite is also synergistic interaction of aggregate joined to a cement paste. Therefore, the article discusses an evaluation of intermediate layers of aggregate/cement paste.

Study on the Machining Trend Analysis of Invar Alloy According to the FEM Analysis by the Electrode Type in Electrochemical Machining

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Invar alloy is important material used for the OLED (organic light emitting diode) shadow-mask in the mobile display industry due to its characteristics of smallest thermal expansion coefficient. Consumers in modern society demand higher display resolution. Electrochemical machining is one of the methods for obtained these high-resolution requirements. The shadow mask of invar material must consist of fine pattern. In order to machining a fine pattern, the electrochemical machining method is suitable. Electrochemical machining is a non-contact method that has advantages regarding defects like thermal strain and micro burrs compared to other non-conventional machining methods. For precision electrochemical machining using different shape electrodes, the current density should be controlled precisely. And electrode shape is required for precise electrochemical machining. The purpose of this study is to apply the FEM (Finite Elements Method) analysis in order to investigate the current density in the electrochemical machining. And also the current density distribution between invar alloy and electrode are carried out with micro electrode and micro array pattern film under same conditions by simulation methods. FEM analysis results show that using micro electrodes, current density distribution is very concentrated. And also by micro array pattern film, desired current density which is needed for electrochemical machining could be obtained easily. Through FEM analysis, to identify trends which are actually processed, and it is important data of Invar alloy machining. More precise electrochemical machining can be available by controlling the current density between the suitable type and invar alloy.

Surface Morphology Investigation of Invar Film Micro Hole Machining Using Wet Etching and Electrochemical Machining Method

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In recent years products containing micro holes has shown a remarkably growth in many fields. Wet etching and electrochemical machining are widely known as efficient precision micro hole machining methods which have no residual stress and lower surface roughness on machined products. The organic light emitting diode (OLED) invar shadow mask which contains numerous micro holes has been machined by spray type wet etching method in the field nowadays. It is used for depositing the organic compounds in order to realize the R-G-B color of the OLED. However, photoresist invar thin film etching has several existing problems: uncontrollable hole machining accuracy, non-etching area, overcutting phenomenon, etc. And also, the machined hole surface morphology and quality could be poor which is significant in organic compounds deposition process. In this study, negative type photoresist has been dry coated on 30 μm thickness invar thin film and then exposure and development have been carried out with quadrilateral hole array. After that dipping type wet etching and electrochemical machining methods have been used for machining micro holes on invar thin film. The hole surface quality, morphology and overcutting phenomenon of the two methods have been studied. Experimental results show that the surface quality and morphology of the machined holes using electrochemical machining after wet etching process can be improved. Surface treatment of wet etched invar film using electrochemical machining could be a promising issue in the fabrication of invar film shadow mask.

Advanced CAE Simulation of Pressures and Times Influence on Injection Molding Process and Product

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This paper deals with the possibilities of improving the quality of final product from plastic material. This can be done by appropriate settings of pressures and production cycle times. As a tool for this is used advanced CAE simulation with finite element method approach. Main aim of this article is to show procedure how to determine optimal level of injection pressure, packing pressure and times of all injection phases. All these parameters lead to improving of final properties of product. For each parameter is commonly given wide range of values and it is necessary to determine the most suitable value.

With usage of modern CAE simulations of injection molding were detected exact influences of each parameter on the final product. All these dependencies are in article mathematically described. Research is here focused on influence of all parameters on final product and also on technological process. As main parameters for evaluation are chosen: level of mold filling, number and size of weld lines, number of air traps and overall production times.

As a reference process for comparing is chosen process with mean values of each parameter. Influence is tested on product from high density polyethylene (HPDE). Material properties for CAE simulation are clearly described in this article. All simulations are validated by experiment performed on real injection molding machine.

Degradation of Iron Coated with Polypyrrole in Simulated Body Fluid for Biodegradable Implants

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Nowadays, there is an increasing interest to replace currently used permanent metallic cardiovascular stents with their biodegradable forms [1-3]. One promising and extensively studied material for this purpose is iron. Iron exhibits excellent mechanical properties, favorable biological properties and a high biocompatibility. However, its degradation rate and biological performance need to be controlled and optimized [1, 2]. One way to optimize the performance is coating the metal with conducting polymers [3, 4].

In this work, the degradation of polypyrrole (PPy) coated iron has been studied by odd random phase electrochemical impedance spectroscopy (ORP-EIS) in simulated body fluid at 37°C [5]. The PPy coating was electrochemically synthesized in aqueous solution of pyrrole and sodium salicylate. The latter would act as a drug that could be released from the coating during its degradation [3]. The electrosynthesis conditions of PPy were optimized with respect to its corrosion properties. Long-term corrosion tests of the coated electrodes were performed by ORP-EIS. Such technique provided the data analysis for appropriate measurements towards modeling [6]: the noise level, linearity and stationarity of the system were described. Differences in the PPy/Fe degradation and corrosion phenomena were observed within the synthesis conditions investigated. The modeling with electrical equivalent circuits allowed the quantitative description of the corrosion behaviour. Besides, the quality of the model was statistically evaluated by confronting the modeling errors against the noise levels. This way, a reliable, quantitative evaluation of the PPy/Fe degradation is attained.

1. Y. F. Zheng, X. N. Gu, F. Witte, *Mater. Sci. Eng.*, **2014**, *R77*, 1–34.
2. A. Francis, Y. Yuyun, S. Virtanen, A. R. Boccaccini, *J. Mater. Sci.-Mater. M.*, **2015**, *26(138)*, 1-16.
3. K. Cysewska, S. Virtanen, P. Jasiński, *J. Electrochem. Soc.*, **2015**, *162(12)*, E307-E313.
4. K. Włodarczyk(Cysewska), F. Singer, P. Jasiński, S. Virtanen, *Int. J. Electrochem. Sci.*, **2014**, *9*, 7997-8010.
5. K. Cysewska, L. Fernandez Macia, P. Jasiński, A. Hubin, **2016**, manuscript in preparation.
6. Y. Van Ingelgem, E. Tourwé, O. Blajiev, R. Pintelon, A. Hubin, *Electroanal.*, **2009**, *21(6)*, 730-739.

Influence of Grain Orientation on Residual Stress Distribution of Surface after Progressive Grinding of Blade Roots from Inconel 713LC

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Nickel-based superalloys are often used material for turbine blades manufacturing. The suitable selection of grinding conditions is important to maintain its properties.[1] Because of different mechanical properties of polycrystalline and single crystal material, the size and orientation of grains should have very important influence on surface residual stresses (RS) after grinding.[2] In the case of coarse-grained material, there may be a grain whose slip direction is parallel with primary grinding force. Therefore, smaller force could cause the slip and in combination with higher temperature in cutting zone, the different RS are generated.

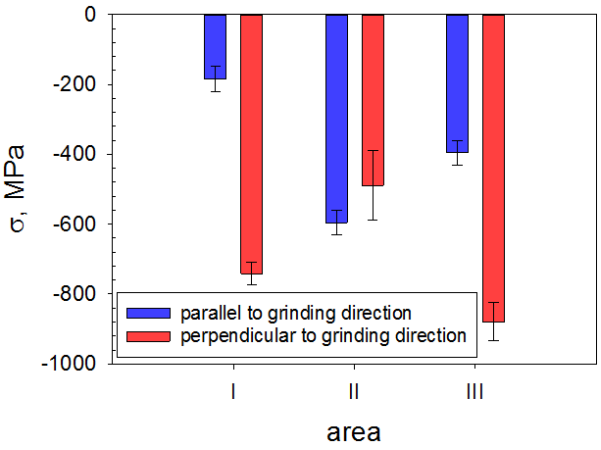

Fig. 1 RS of coarse-grained surface.

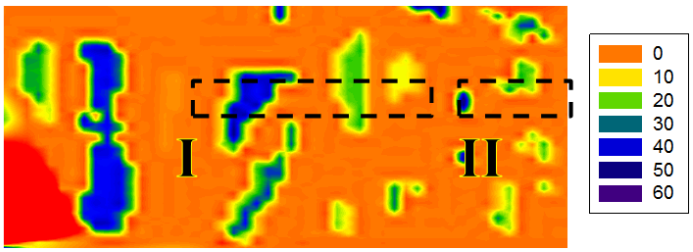

Fig. 2 The deviation of orientation of grains.

Distribution of RS on the surface ground using the same conditions is depicted in Fig. 1. The ground surface was polished to visibility of coarse-grained microstructure of bulk material. Using omega scan method[3], see Fig. 2, there is evident that irradiated area "I" contains the grain which has deviation angle approx. 45 degrees. This grain should cause the easier slip and consequently a decrease of compressive RS, see Fig. 1.

1. W. Österle, P. X. Li, *Materials Science and Engineering: A*, **1997**, 238.2, 357-366.
2. J. X. Zhang, T. Murakumo, Y. Koizumi, T. Kobayashi, H. Harada, *Acta materialia,* **2003**, 51.17, 5073-5081.
3. K. Gancarczyk, R. Albrecht, C. Olesch, K. Kubiak, J. Sieniawski, *Inżynieria Materiałowa,* **2015**, 208.6, 154-160.

Characterization of Structural Materials by Spherical Indentation

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Instrumented indentation (nanoindentation) is very effective method of material characterization in small volumes. Sharp indenters (such as Berkovich three-sided pyramid) are the most frequently used due to the simplicity of the data interpretation. On the other hand, they do not provide any information about the evolution of elastic and plastic stress-strain field. In spherical indentation, stress and strain progressively increases with penetration depth and thus stress-strain curves of the materials can be determined. Several methods have been developed, but the original Tabor formula is still successfully used[1]. However, several problems have to be considered when analyzing experimental data. The crucial one is the knowledge of actual indenter shape[2]. Any indenter did not match its ideal shape. Projected indenter area function A_p effectively corrects the imperfections of Berkovich, Vickers, or conical indenters. However, for the spherical indenters, actual projected area is not frequently used.

In this study, two spherical indenters of nominal radius 20 µm are studied. Their actual shape is determined by direct (atomic force microscopy) and indirect (indentation into the materials with known Young´s modulus) methods. It was found that the actual indenter shape deviates from its nominal geometry, which has significant effect on the stress-strain curves and yield strength of several structural materials. Corrections incorporating the actual shape were applied to obtain more accurate results.

1. Tabor, D., *The* H*ardness of Metals*, **1951**, 175 p.
2. Haušild, P., Materna, A., Nohava, J., *Materials and Design*, **2012**, *37*, 373-378.

Verification of Material-Technological Model of Closed Die Forged Part

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Today's trend is to frequently introduce new processes or innovate the existing ones. This can be seen in the forging industry as well. Innovation, however, is a risky endeavour, even more so when it involves profound changes to a manufacturing process. In order to introduce such changes, one should explore options for the new process, and use gradual optimization to obtain the best possible results. This applies to closed-die forging as well. The main market for closed-die forgings is the automotive industry which is continuously evolving. It is therefore seeking new ways to optimize various manufacturing routes. One of the advanced tools for studying complex closed-die forging processes is material-technological modelling. It relies on data measured in real-world closed-die forging operations for simulating the process in a laboratory environment without interfering with the actual production. This paper compares a real-world forged part and its material-technological model. For this purpose, microstructure characterization, phase analysis and mechanical testing were used.

Phase Composition, Microstructure and Some Mechanical Pproperties of Biomedical Ti–Ta–Mo Alloys Prepared by Powder Metallurgy Method

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In the present study, in order to develop Ni-free Ti-based biomedical alloys, the effects of Ta and Mo contents on microstructure and some mechanical properties in Ti–Ta–Mo alloys fabricated by elemental powder metallurgy were investigated.

The interest in titanium-based materials is still increasing due to their high biocompatibility, corrosion resistance, light weight, good mechanical properties and low elastic module. Titanium-based alloys also exhibit another interesting property - shape memory effect. The phenomenon of reverse martensitic transformation can be found in NiTi alloys. However, the Ni-hypersensitivity and toxicity of Ni have been observed in Ti-Ni alloys. Thus, the development of biocompatible Ni-free SMAs is strongly required. Recently, many biocompatible Ti-based alloys with shape memory effect (SME) and SE such as Ti–Mo–base have been studied by many researchers. Conventionally, these alloys are prepared by melting techniques, in arc furnace. Recently there has been significant interest in adopting new non-conventional techniques such as powder metallurgy (PM) based on a low or high-energy ball-milling process.

The blended powders different compositions, 2, 4, 6 and 8 wt.% of Ta and Mo elements obtained by 100rpm/3.0h milling under a protective argon atmosphere were used for the fabrication of Ti–Ta–Mo alloys via sintering at 1000°C per 24 hours. The X-ray diffraction results confirmed the changes in presence of the α and β. Microstructure characterization using optical microscopy, scanning electron microscopy based techniques were performed revealing that variations in the compositions cause changes in the resulting microstructures. The microhardness measurements revealed little changes of microhardness from 350 HV0.5 to 380 HV0.5. However, it is not linear relationship, because for the near-α Ti-4Ta-4Mo alloy slightly increase of microhardness is observed.

Acknowledgments
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Numerical Modeling of Microstructure Evolution in the Continuous Casting of Steel

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A two dimensional slice model [1] was developed to predict microstructure evolution in the Continuous Casting (CC) of steel. Enthalpy equation is solved at the macro level by using Local Radial Basis Function Collocation Method (LRBFCM) [2] with Multi Quadratic (MQ) shape functions for spatial discretization and explicit Euler method for time discretization. A simple microsegregation model [3] is used to determine temperature and solid fraction from the enthalpy. Temperature is interpolated to the micro level by using LRBFCM-MQ; at the micro level Gauss distribution and Kurz-Giovanola-Trivedi (KGT) [4] model are proposed to determine nucleation density as a function of local undercooling and grain growth velocity, respectively. Point Automata algorithm (PA) [5] is applied to simulate microstructure evolution, i.e., to implement nucleation and KGT equations. Model can be used to predict Equiaxed to Columnar Transitions (ECT) and Columnar to Equiaxed Transitions (CET) in the CC for different cross section of billet (figure 1).

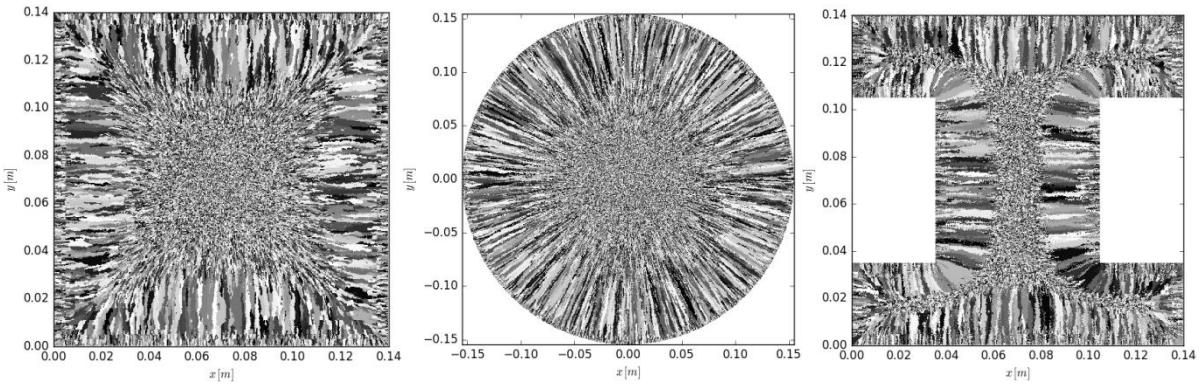

Figure 1: Final microstructure in the CC of steel for different cross sections of billet.

1. I. Vušanović, R. Vertnik, B. Šarler, *IOP Conf. Series: Materials Science and Engineering*, **2011**, *27*, 1-6.
2. B. Šarler, R. Vertnik, *Computers and Mathematics with Application*, **2006**, *51*, 1269-1282.
3. W. D. Bennon, F. P. Incropera, *International Journal of Heat and Mass Transfer,* **1987**, *30*, 2161-2170.
4. W. Kurz, B. Giovanola, R. Trivedi, *Acta Metallurgica,* **1986**, *34*, 823-830.
5. A. Z. Lorbiecka, B. Šarler, *Computers, Materials and Continua*, **2010**, *18*, 69-103.

Dye-Sensitized Solar Cells Counter Electrode Based on Carbon Nanomaterials

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Dye-sensitized solar cells DSSCs are an attractive alternative to conventional crystalline silicon solar cells because of its low-cost, relatively high photon-to-current conversion efficiency for low energy consumption and simple fabrication process [1]. The dye-sensitized solar cell consists of the following components: a photoanode, a dye, an electrolyte, and a counter electrode. The counter electrode is a crucial element, in which triiodide is reduced to iodide by electrons flowing through the external circuit [2]. Platinum is the most used material for a counter electrode in DSSCs, due to its electrocatalytic activity towards I^{3-} reduction. However, use of platinum may not be a suitable option because of its high cost [1,2]. In this paper carbon nanoelements were used as alternative materials for platinum because of their unique properties such as high corrosive resistance, high reactivity for triiodide reduction and low costs (Fig.1).

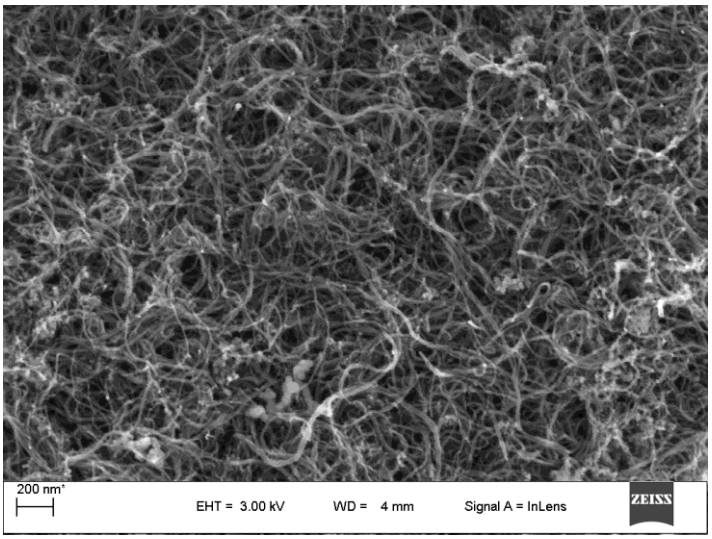

Fig.1. SEM images of carbon nanotubes surface topography

1. Sara Thomas, T. G. Deepak, G. S. Anjusree, T. A. Arun, Shantikumar V. Nair, A. Sreekumaran Nair, *Journal of Material Chemistry A*, **2014,** *2*, 4474-4490.
2. L.A. Dobrzański, M. Prokopiuk vel Prokopowicz, K. Lukaszkowicz, A. Drygała, M. Szindler, Graphene oxide film as semi-transparent counter electrode for dye-sensitized solar cell, *Journal of Achievements in Materials and Manufacturing Engineering,* **2015,** *73 (1)*, 13 – 20.

Alternative Evaluation of Grindability of Pozzolanic Materials fFor Cement Production

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Ecological way to reduce CO_2 emission in cement production is usage of blended cements with active pozzolan [1]. Part of this issue is adjustment of granularity of input materials. This is often made by grinding of input components. All conventional methods for evaluation of grindability require specific grinding instrument. These grinding instrument do not have another practical usage, so they are not really common. This paper focuses on alternative evaluation of grindability. Inspired by VTI method used in coal industry, new method was created [2]. First modification in methodology was usage of planetary mill instead of porcelain drum mill. Other modification was in measurement of undersize with laser granulometry. This method was then tested on clinker, slag, and recycled glass, which can also be used as active pozzolan in blended cement [3]. Also, co-milling measurements were made on combinations of clinker and pozzolan. These results were then used for calculation of grindability index, which can be used for comparison properties. Modification of VTI methodology has positive impact on evaluation of grindability, especially in area of fine particles, thanks to usage of laser granulometry and at the same time makes use of more commonly available grinding apparatus.

1. C. Meyer, Y. Xi, Use of recycled glass and fly ash for precast concrete, Journal of materials in civil engineering, 11 (1999), 89–90
2. Standard: GOST 15489.1: Brown coals, Hard coals, Anthracite and Combustible shales. Methods for VTI determination of coefficient of grindability
3. A. Khmiri, B. Samet, M. Chaabouni, A cross mixture design to optimise the formulation of a ground waste glass blended cement, Construction and Building Materials, 28 (2012) 1, 680-686

The Influence of Aliovalent Addition on the Point Defect Structure In Nonstoichiometric Zinc Oxide

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The influence of lithium and chromium addition on the point defect structure in ZnO zinc oxide has been studied as a function of temperature (973-1173 K) and oxygen pressure (30-10^5 Pa) using microthermogravimetric technique. All obtained results were explained in terms of doping effect, assuming that univalent lithium as well as trivalent chromium ions dissolve substitutionaly in cation sublattice of zinc oxide. It has been found that appropriate concentrations of both aliovalent additions increase the deviation from stoichiometry of zinc oxide and thereby predominant point defect concentration. Obtained data strongly suggest that the point defect structure of zinc oxide is rather complicated. For relatively low oxygen pressures at a given constant temperature, the predominant defects are, namely, interstitial cations and quasi-free electrons, while cation vacancies and electron holes predominate at higher oxygen pressures.
In the present work the doping effect was also applied to calculate in indirect way [1] the predominant point defect concentration in metal-excess $Zn_{1+y}O$ as well as in metal-deficient $Zn_{1-y}O$ zinc oxides. The experimentally obtained data of pressure dependence of nonstoichiometry in lithium doped zinc oxide were used for calculation of interstitial cation concentration in pure $Zn_{1+y}O$. On the other hand, pressure dependence of nonstoichiometry in chromium doped zinc oxide was used for calculation of cation vacancy concentration in pure $Zn_{1-y}O$. It can be concluded that applied method of investigation of point defect concentration in metal oxides seems to be good choice in the case of oxides stable in extremely high oxidant pressures with relatively low concentration of native point defects.

Z. Grzesik, *High Temperature Materials and Processes*, **2015**, 34, 461-468.

Lithium-Sulfur Battery System Performance Evaluation Using Impedance Spectroscopy Measurements

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Lithium-sulfur secondary batteries are a promising new design of energy systems that offer higher theoretic specific capacities (1675 mAh/g) and energy densities (2500 Wh/kg) in comparison to well-known lithium ion batteries (180 mAh/g; 440 Wh/kg)[1]. Successful engineering of lithium-sulfur system would enable fast progress of a wide array of applications. All changes that happen during the complex discharge and charge process are not yet understood, which in turn means that theoretic performance of the battery is seldom reached.

We have employed the use of impedance spectroscopy measurements in between galvanostatic cycling of battery cells to determine different contributions to the cell resistance. We followed the change through various levels of charge and through multiple cycles of battery use. Different binary electrolyte mixtures consisting of two solvents and a lithium salt were used.

By this complex experiment we were able to determine various electrolyte performance and how using different components in the binary electrolyte composition changes each contribution to the internal resistance of the battery cell. By assembly of symmetrical anode-anode and cathode-cathode cells from two cycled batteries and measuring their impedance spectra[2], we were able to estimate which part of the resistance is dominated by which component of the battery cell.

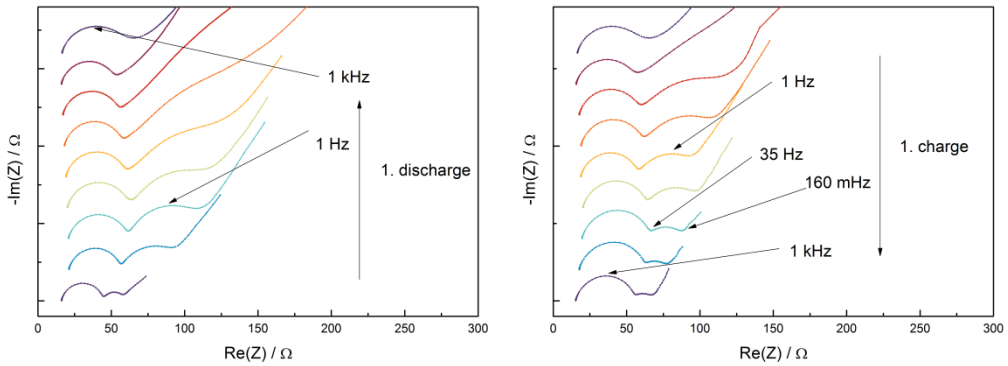

Figure 1: Change in impedance spectra during first discharge and charge (ionic liquid based electrolyte)

The work done receives funding through Helis project (European Union's Horizon 2020 research and innovation program under Grant Agreement No. 666221).

1. Rosenman, A., Markevich, E., Salitra, G., Aurbach, D., Garsuch, A., Chesneau, F.F., *Advanced Energy Materials*, **2015**, 1500212.
2. Waluś, S., *Accumulateur Lithium / Soufre : développement et compréhension des mécanismes électrochimiques* (PhD thesis), **2015**, page 215.

Analysis of the Long-Term Service Life of Coatings Based on Alkali-Activated Matrices Exposed to Chemically Aggressive Environments

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In most cases, the negative effects of the external environment on building structures are eliminated by means of a barrier protection or coating system. In the overwhelming majority of cases, the materials used for the secondary protection are based on organic substances. However, these types of coatings show clear limits when exposed to chemically aggressive environments. One material which has the potential to overcome such drawbacks is secondary protection based on alkali-activated substances. In reality, the matrices of these materials are generally formed by the polycondensation of aluminosilicates. This set of reactions results in the creation of Si – O – Al structures.

The article examines the development of coating systems that are based on alkali-activated materials in order to obtain coatings applicable to building structures (i.e. primarily reinforced concrete structures) exposed to chemically aggressive environments. Matrices combining slag and metakaolin that are activated by soluble glass seem to be very promising. We present the long-term effects (i.e. 720 days) of selected types of aggressive environment. The effects of both gas and liquid aggressive environments were tested. Aggressive fluids were selected so as to represent environments in which reinforced concrete structures are typically used. The effects of individual types of aggressive environment were evaluated using a set of physico-mechanical parameters (adhesion of the coating system to substrate, coating film thickness, etc.) as well as physico-chemical analyses, the latter used to analyse in detail the microstructure of a coating, i.e. changes caused by the effects of aggressive environments.

The Effect of the Wear of Rotor Pins on Grinding Efficiency in a High-speed Disintegrator

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One of the directions in the field of milling, which have been intensively examined recently, is high-energy milling (HEM). One type of HEM is high speed grinding (HSG) in high-speed disintegrators. The high-speed disintegrator works on the principle of the pin mill with two opposite counter-rotating rotors [1]. This type of mill is particularly suitable for grinding and activation of fine powder materials [2]. The high-speed disintegrator has several advantages, such as a very intensive and continual refining process [3]. One disadvantage is that its grinding pins are prone to abrasion. If the pins are damaged due to abrasion, the efficiency of grinding may decrease [4]. The effect of the wear of the pins on grinding efficiency was observed in this paper. The laboratory disintegrator DESI 11 with cubic pins was used. Portland clinker was chosen for the experiment, because its average hardness is 6 to 7 according to the Mohs scale [5], and there are several methods for the evaluation of its fineness such as the Blaine method or laser granulometry. The input fineness of the clinker was 400 m^2/kg according to Blaine. This material was continuously fed into the mill. After each kilogram of the milled material, a sample of the milled clinker was taken and the weight loss of the rotors was measured. The fineness of each sample was measured immediately using Blaine and laser granulometry. Next to the weight loss, the wear of the rotors was measured using the 3D optical scanner ATOS Triple Scan. A two percent weight loss of the rotors brought only a three percent reduction of the final fineness. However, the loss of five percent resulted in as much as ten percent.

1. Hanykýř, V., Kutzendörfer, J.: *Technologie keramiky*, **2000**, Silis
2. Hint J. A, *The basic problems of mechanical activation*, **1977** SKTB Disintegrator, Tallinn, Reports of the 5th Symposium on mechanochemistry and mechanics of hard materials, pp. 14 - 32,
3. Baláž P., Mechanochemistry in Nanoscience and Minerals Engineering, **2008**, Springer-Verlag Berlin Heidelberg, 414 p.
4. Gahlin, R., Jacobson, S., *The particle size effect in abrasion studied by controlled abrasive surfaces*, **1999** WEAR Vol 224, pp.118-125
5. Hewlett P. C., Lea's Chemistry of Cement and Concrete 4, **(2003)**, Elsevier

Impact-Echo Method Used to Testing of High Temperature Degraded Cement Composite of Portland Cement CEM I 42,5 R and Gravel Aggregate 8/16

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The goal of study was to find a correlation between the response of the impact-echo tests and the fire-damage. The present paper examines the potential applicability of the Impact-echo method for analyzing the concrete composite samples.

Specimens type A were prepared according to the following mix design (for 1 m^3): 345 kg Portland cement CEM I 42,5 R Mokrá, 848 kg quartz sand 0/4 mm Zabcice, 980 kg gravel aggregate 8/16 Olbramovice, 2,8 kg super-plasticizer Sika Viscocrete 2030 and 160 kg water. Consistency 550 mm flow a cone. The specimens were 28 days soaked in water and then dried at first in the laboratory temperature and then 48 hours in a ceramic furnace at temperature 110 °C. The concrete specimen were heated in programmable laboratory furnace Rohde KE 130B at the heating rate of 5 °C/min. Selected temperatures T= 200 °C, 400 °C, 600 °C, 800 °C, 1000 °C and 1200 °C were maintained for 60 minutes.

To generate the signal, a hammer of a mass of 70,5 g, originally suspended from a hinge, was released to fall down on the specimen from a height of 5 cm. The response was picked up by an S3 type piezoelectric sensor whose output voltage was fed into Handyscope HS3, which is a two-channel, digital, 16 bits oscilloscope. The fast Fourier transform technique was used to transform the recorded waveform into the frequency domain for each of the output signals. Obtained results were compared with the changes in the bulk density and flexural bending strength of these specimens. We were able to track the progress of the structure changes in the course of elevated temperature induced degradation by using a confocal microscope. A strong correlation, which was disclosed between thus obtained results shows that the frequency inspection carried out by means of the Impact-echo method makes a convenient tool to assess the quality and durability of these composite materials when exposed to elevated temperature.

Towards Reliable Characterization of Interfaces in Reprocessed HDDR Nd-Fe-B Permanent Magnets

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The transition toward new and better technologies, which are relying on hard magnets are unavoidably linked to a stable supply of HREs, in the recent past already hindered due to the various geo-political and economic reasons. One promising way to tackle this problem is to develop an efficient recycling route for permanent magnets at the end of life cycle, by a proper reprocessing of used scrap magnets into new functional magnets with only little or negligible loss of overall magnetic performance*.

It is clear that the application of different magnet recycling routes will inevitably influence the resulting microstructure of the recycled product and hence the overall magnetic performance of the final magnet. Thus, the reliable characterization of the microstructural features by the use of different high spatial resolution techniques of transmission electron microscopy (TEM) is important for the overall development of a successful process to recycle magnet assemblies.

In view of this, we have identified several key aspects for setting the characterization protocols, which will allow consistent study of Nd-Fe-B microstructural features, like for example triple pockets, grain boundary films and phases. That includes the development of the platform for a complete specimen preparation and characterization in a protective atmosphere. The second key aspect is related to the proper selection of the most suitable TEM analytical techniques for combined high spatial analysis of heavy and light elements, including oxygen. In the present study we are going to tackle all these aspects, step by step, by applying reprocessed Nd-Fe-B magnets fabricated by spark plasma sintering. The first results of structure-chemistry analysis of grain boundaries and triple pockets by using high-resolution scanning TEM (STEM) combined with electron energy-loss spectroscopy (EELS) at the nanometer scale will be presented.

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Katholieke Universiteit Leuven, Leuven Belgium.

Micromechanical Characterization of Gellan Gum Based Bone Scaffolds

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Regeneration of human bone tissue damaged by injuries or by degenerative diseases using biodegradable bone scaffold is one of the promising alternatives to the established treatment methods. To ensure proper function of the scaffold its structural, mechanical and permeability properties have to be investigated and optimized. To increase hydrogel gellan gum (GG) primal stability the material is reinforced by bioactive glass (BAG) particles. This paper is focused on monitoring of BAG particles distribution and material properties mapping employing scanning electron microscopy (SEM) observation and nanoindentation measurement.

Topological and element content inspection were performed using SEM in SE, BSE and EDX scanning modes. Micromechanical properties of the GG-BAG were determined using dynamic nanoindentation method nanoDMA (nanoscale Dynamic Mechanical Analysis). Based on these methods influence of BAG concentration for local hardness, storage, loss and complex modulus was obtained.

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Characterization of Aluminum Roll Bond Heat Exchanger at Elevated Temperatures

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Aluminum and its alloys have increasingly become used as heat exchangers in thermal-solar applications, due to their unique properties such as good formability and corrosion resistance. By means of roll bond technology heat exchangers with a complex channel system can be produced. Therefore the roll bond technology has great useful value in solar thermal techniques, as it achieves a higher thermal performance. The development of heat exchangers aims at greater performance, which requires temperature increase of the transmission medium. During service life heat exchangers are exposed to elevated temperatures, which can result in material damage. For that reason the understanding of aluminum behavior at elevated temperature is of great importance for designers of heat exchangers. This research work presents tensile and temperature creep properties for aluminum and aluminum-zirconium alloys. High temperature tensile and creep testing has been conducted in a range from ambient temperature up to 280 °C. The research showed a large reduction of mechanical properties at elevated temperatures for aluminum and aluminum-zirconium alloys. Improvement of material properties on heat exchangers at elevated temperature can be achieved by optimization of thermo-mechanical process parameters. Tensile and temperature creep properties of aluminum and aluminum-zirconium alloys have also been measured to determine the influence of temperature and strain rate on the creep fatigue life. The present paper describes influences and material behavior of aluminum and aluminum-zirconium alloys at elevated temperatures.

Asociation Rules and Prediction Quality of Continuously Cast Slabs

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In the paper there are summarized basic analytical and empirical pieces of knowledge on searching dependences of the influence of thermal process being in progress during steel casting in the continuous casting of semi-finished products – slabs, on their quality assessment and as well the influence of thermal processes on the quality of final products rolled of slabs. The course of thermal processes at continuous steel casting has the significant influence on the quality of slabs. The assessment of the quality of slabs on the machinery of continuous steel casting is an inseparable part of the information system of the metallurgical plant. This assessment works on the data collection and storing the necessary data for an effective assessment between measured and qualitative quantities. The paper describes the proposal of the concept of quality slab prediction and then also the quality of final rolled products. For this purpose they are used statistical methods, especially mining association rules and logistic regression. On the basis of usage of the system for monitoring the casting parameters[1] and based on the application of statistical methods was determined association rules quality prediction of slabs.

1. Franěk, Masarik, Šmíd, Determination of the cause of the formation of transverse internal cracks on a continuously cast slab, Materialy in Technologie, 2015, *vol 2*, 285–290.

Electrocaloric Properties of Multilayer $0.9Pb(Mg_{1/3}Nb_{2/3})O_3$-$0.1PbTiO_3$ Elements

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Cooling devices based on the electrocaloric (EC) effect are a promising alternative in refrigeration as a substitute for, or as an extension of the conventionally used vapor compression systems.[1,2] Lead-based relaxor ferroelectrics, such as $0.9Pb(Mg_{1/3}Nb_{2/3})O_3$-$0.1PbTiO_3$ (PMN-PT), are characterized by high dielectric permittivity and polarization, and a large change of polarization with temperature, thus resulting in large EC temperature changes (ΔT_{EC}).[3,4] For achieving the desired ΔT_{EC} of a few K in bulk ceramics, the electric field amplitudes in the range of 100 kV/cm are required. By decreasing the thickness of the EC elements, the applied voltage is reduced.

In the contribution we present PMN-PT multilayer elements with the individual layer thickness of a few 10 µm. Such elements operate at a much lower applied voltages than the bulk ceramics, while the outer dimensions remain comparable, and so does the cooling power.

The PMN-PT ceramic powder was prepared by mechanochemical activation. The multilayer elements were fabricated from the tape casted ceramic tape, on which internal platinum electrodes were screen-printed, and which was afterwards stacked, laminated and cut into the final shape. The samples were sintered at 975 °C for 2 and 8 h. The results of the microstructural analysis of the sintered elements, their low- and high- electric field dielectric properties, and the results of indirect electrocaloric measurements are presented and compared to the properties of bulk ceramics shaped by dry compaction of the same powder.

References:

1. M. Valant, *Prog. Mater. Sci.*, **2012**, 57, 980-1009.
2. U. Plaznik et al., *Appl. Phys. Lett.*, **2015**, 106, 043903-1- 3.
3. X. Moya et al., *Nat. Mater.*, **2014**, 13, 439-450.
4. M. Vrabelj et al., *Eur. Ceram. Soc.*, **2016**, 36, 75-80.

Different Approaches to Avoiding Lead Deficiency in PMN-PT Thin Films

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Single crystals of $Pb[Mg_{1/3}Nb_{2/3}]O_3$-$PbTiO_3$ (PMN-PT) exhibit a variety of traits favorable for sensing and actuating purposes, such as piezoelectric constant d_{33} as high as 2800 pC/N and electromechanical coupling coefficient over 90 %.[1,2] Their thin-film counterparts offer performance enhancements for low-voltage ferroelectric microelectromechanical systems with capabilities of generating large strains or sensing miniscule ones.[3,4] Due to the complex chemical composition of this system a major challenge in processing both bulk and thin-film PMN-PT is to prepare them in a phase-pure form, i.e. avoid the appearance of the undesired pyrochlore phase.[5] In processing bulk ceramics this issue is tackled by employing the columbite method.[6] In thin film fabrication different approaches are necessary. Although one of the advantages of pulsed-laser deposition (PLD) is the stoichiometric transfer of material,[7] in the case of multicomponent targets containing highly volatile elements such as Pb, complications still tend to appear. In this contribution several routes towards achieving pure-perovskite growth will be discussed. Firstly, utilizing targets with excess amounts of PbO can expand the processing window for obtaining pure-phase films. Therefore, PMN-PT thin layers were grown from ceramic stoichiometric (67/33) and Pb-enriched (10-20 mol. % PbO excess) targets. Secondly, since the bonding of Pb to the substrate is strongly influenced by the surface morphology and chemistry, we used $SrTiO_3$ substrates with different miscut angles (<0.5° and 4°) and terminations (TiO_2 and SrO). Furthermore, $SrRuO_3$ and $LaNiO_3$ were deposited as electrode layers and their influence on the subsequent growth was examined. Influence of the different approaches on the crystalline quality of the thin films will be discussed.

1. S.E. Park, T.R. Shrout, *Journal of Applied Physics*, **1997**, *87*, 1804–1811.
2. R. Zhang, B. Jiang, W. Cao, *Journal of Applied Physics*, **2001**, *90*, 3471-3475.
3. J.P. Maria, W. Hackenberger, S. Trolier-McKinstry, *Journal of Applied Physics*, **1998**, *84*, 5147-5154.
4. S.H. Baek, et al., *Science*, **2011**, *334*, 958-961.
5. G.H. Heartling, *Journal of the American Ceramic Society*, **1999**, 82, 2341-2359.
6. S.L. Swartz, T.R. Shrout, *Materials Research Bulletin*, **1982**, 17, 1245-1250.
7. J. Schou, *Applied Surface Science,* **2009**, 255, 5191-5198.

Surface Analysis of Railway Buffers Heads Covered with Bronze Using Laser Cladding

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Railway buffers during the operation are staying in almost permanent contact with each other, creating friction node in the point of contact of two railway buffer heads [1]. In consequence of overcoming track curves, turnouts and unevenness of track, the railway buffer heads moves relative to each other causing friction, which results in its wear. When the wear is excessive, it might be a reason to withdrawn vehicle from service, it causes flattening of buffer head, and in consequence its abnormal cooperation. To avoid this phenomenon the buffer heads should be covered with graphitized grease, but this method has many disadvantages. Accordingly, it was found that it would be beneficial to cover the buffer head with bronze using laser cladding (fig. 1). In this article is presented the metallographic and mechanical analysis of the newly created top layer of railway buffer head.

Fig. 1 The railway buffer head covered with bronze layer

This layer will allow to resign from currently used, adverse method of protecting the buffer head against excessive wear. In the article is also presented the metallographic analysis of steel S355J2, which is using, in accordance with [2], as a constructional material to produce the railway buffer heads.

1. W. Gamon, Movement analysis of cooperating railway buffer heads, Archives of Transport, **2015**, *vol*, 33, 4–15.
2. EN 15551+A1:2011 Railway Applications - Railway Rolling Stock - Buffers

The Study of the Hydration Process of Ternesite Clinker

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Ternesite, $Ca_5(SiO_4)_2SO_4$, is used in the cement production currently. Its application is mainly associated with the issue of reduction of CO_2-emissions. Ternesite is one of two key phases of calcium-sulfoaluminate cement [1, 2]. Some investigators [3, 4, 5, 6] claim that this phase is nearly inert or very low reactive and it hydrates only after later age of hydration. Presence of alumina ions in water contributes to increasing of the reactivity of ternesite, rigid framework is then formed. In order to improve knowledge in this field, process of hydration of neat ternesite clinker under specific conditions of exposure was observed in this study. Ternesit was prepared by firing of raw meal consisting of high calcium limestone, microsilica and calcium sulfate hydrate. The dosage of respective oxides was 5 mol of CaO, 2 mol of SiO_2 and 1 mol of SO_3. The burning was carried out in laboratory kiln at temperature of 1150 °C, soak 1 h. The resulting ternesite clinker was subsequently crushed, hydrated and separately cured in four settings. Kinetics of hydration process was monitored in water and in environment of saturated carbonic acid, at two different temperatures of 5 and 40 °C. Mineralogical composition of hydrated samples was analyzed both by X-Ray Diffraction analysis (XRD) and by Differential Thermal Analysis (DTA) in particular ages of hydration. Morphology of chosen samples was observed using Scanning Electron Microscopy (SEM). Based on the results, it can be claimed that rate of decomposition of ternesite was related to conditions of storage. The rate of decomposition was significantly accelerated by the environment of carbonic acid and also by the elevated temperature. Presence of calcium carbonates in mineralogical forms of calcite, vaterite and aragonite, coupled with gypsum and thaumasite was identified.

HeidelbergCement, Issue ZKG International, **2013**
BERETKA, J., DE VITO, B., SANTORO, L., SHERMAN, N.,VALENTI, G.L. *Waste Management*, **1996**, *16*, 231-235
LUDWIG, H.-M., ZHANG, W., *Cement and Concrete Research*, **2015**, *78*.
RECIO DOMINGUEZ, I., GÓMEZ-MILLÁN, J., ALVAREZ, M., DE AZA, S., CONTRERAS, L., DE AZA, A. H., *Journal of the European Ceramic Society,* **2010**, *30*.
BULLERJAHN, F., SCHMITT, D., BEN HAHA, M., Cement and Concrete Research. **2014**, *59*.
BULLERJAHN, F. BEN HAHA, M, *Cement International*, **2013**, *11*.

The Structure and Properties of Laser Beam Welded Joints of the Low Alloy Hhigh Strength Steel DOCOL 1200M with Martensitic Structure

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High strength steel type AHSS is commonly used in automotive industry, because of possibility for weight reduction of car body sheets and load-bearing elements with simultaneously increasing mechanical properties in comparison with conventional steels. Another advantage of AHSS steel is relatively low cost, thanks to a small amount of alloying elements in this steel. Despite the fact that steel was designed with the aim of connecting it through the processes of bonding, for some types of steel it is still difficult to find correct method and welding parameters. The big challenge is welding of high strength steel DOCOL 1200M with a martensitic structure, primarily used for the production of car bumpers, side beams and other elements to ensure safety of car users. This article presents the effect of heat input (25 J/mm to 55 J/mm) of a laser beam welding on low alloy high strength steel with a martensitic structure DOCOL 1200M with a thickness of 1.8 mm on the properties and structural changes in the welded area. Conducted non-destructive testing allowed to classified examined welded joints in level B according to standard ISO 13919-1. Conducted destructive testing proved that increasing of heat input provides increase of plastic properties while reducing mechanical properties of welded joint below the strength of the parent material. Based on the results, it was found that using low energy of a laser beam (25 J/mm) it is possible to obtain weld joints, with DOCOL 1200M steel, with strength equal to the strength of the parent material, which welded joints it is difficult to achieve by the arc welding methods using steel with such high tensile strength (1200 MPa).

[1] Chen B., Yu H., *International Journal of Minerals, Metallurgy and Materials*, **2012**, *vol. 19*, p. 525.
[2] Lee H., Park K., *Journal of Constructional Steel Research,* **2012,** *vol. 74*, pp. 134–139.
[3] Górka J., *Archives of Metallurgy and Materials*, **2015,** *vol. 60*, pp. 469-475.

Temperature Dependent Impact Resistance of Polymer Material

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The quality of the polymer product is defined by its functionality and durability. Functionality and durability of this system depend on the structure of the material in the product. Changes in the structure of materials at the macro scale will cause a change of material characteristics, which are taken as an advantage of polymers in solving a given problem. Material properties of a given polymer material depend on the boundary conditions that result in modification of the structure. Research work presents how temperature influences on change of material properties in such a way that the material due to the impact absorbs more energy. Such a material could be used to protect a variety of objects due to the impact. The objective is to present the dependence of the damping properties of the product in the impulse loading in dependence on the temperature and the material. Determination of physical characteristics, which we have identified, can be dissipated at a certain temperature. In the experiment, we confirm the assertion that it is possible to change the damping properties of the polymeric material with temperature. It was confirmed that rapid increase in impact resistance corresponds to transition from brittle to ductile type of failure.

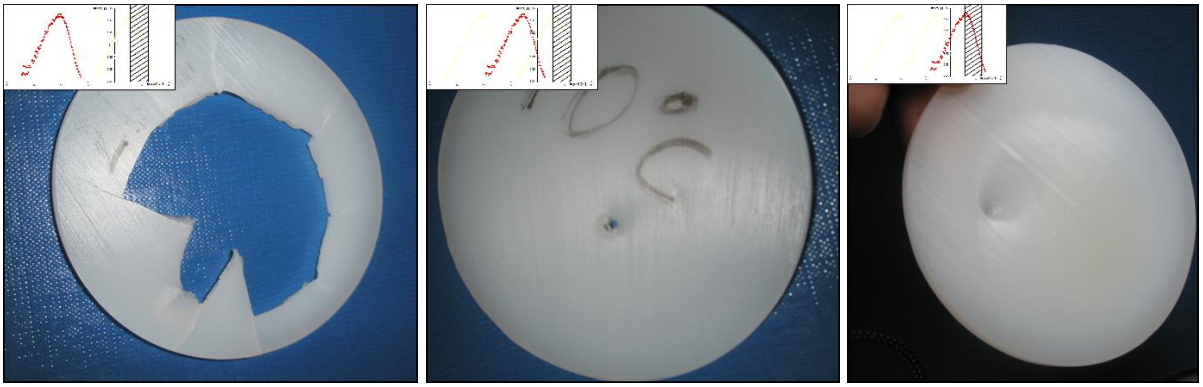

Figure 1: High-rate impact characterization, examples of PA6 impact behavior at different temperatures

1. Emri I., von Bernstorff B.S., Cvelbar R., Nikonov A.; Re-examination of the approximate methods for interconversion between frequency- and time-dependent material functions; Journal of Non-Newtonian Fluid Mechanics, Elsevier 2005.
2. Cvelbar R.; Interkonverzacija materialnih funkcij viskoelastičnih materialov. PhD thesis, University of Ljubljana, 2005.
3. Emri I., Nikonov A., Zupančič B., Florjančič U.; Time-dependent behavior of ropes under impact loading: a dynamic analysis. Sports Technology, 2008, 4-5, 208-219.

Chromium-based Oxidation Resistant Coatings For Protection Of Engine Valves In Automotive Vehicles

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Engine valves in automotive vehicles are working in very sever conditions due to rather high temperatures (about 1173 K) and aggressive atmosphere of combustion gases. Consequently, high temperature corrosion of valves constitutes an important problem in automobile industry. Recently, this problem starts to be more and more important, as a result of increasing of working temperature in modern car engines and application of alternative fuels, like biofuels, liquid petroleum gas (LPG), compressed natural gas (CNG), etc., the combustion products of which are very aggressive [1,2]. Thus, protection of engine valves against high temperature corrosion is urgently needed.

In this work a new generation of thin chromium-based high temperature inexpensive coatings is demonstrated, which could be commonly used in automobile industry for protection of engine valves. It has been shown that such coatings, in contrast to rather thick and thereby expensive TBC corrosion-resistant coatings, contain a very small amount of chromium, which is, however, high enough for formation of continuous layer of highly protective Cr_2O_3 oxide during initial stage of oxidation. The stability and further growth of this chromium oxide layer is a result of outward chromium diffusion from the protected material. Thus, the proposed novel coatings play only the role of initiator for the formation of Cr_2O_3 layer and then they disappear relatively fast. In spite of this fact, the better oxidation resistance of valve steels covered by thin novel coatings is observed during much longer period of time than life-time of these coatings under isothermal or thermal shock conditions. Consequently, obtained results strongly supports the idea of tailoring a new generation of inexpensive coatings for mass-application in protection of engine valves against high temperature corrosion.

1. Z. Grzesik, G. Smola, K. Adamaszek, Z. Jurasz, S. Mrowec, *Corros. Sci.*, **2013**, 77, 369-374.
2. Z. Grzesik, G. Smola, K. Adamaszek, Z. Jurasz, S. Mrowec, *Oxid. Met.*, **2013**, 80, 147-159.

Synthesis of SiO_2/SnO_2 Nanofibers Using Templates of TEMPO-oxidized Cellulose Nanofibers

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Nanofibers have remarkable properties such as high mechanical strength, high specific surface area, and high electrical conductivity. In particular, SnO_2 nanofibers are expected to be one of key materials for gas sensing devices due to their unique electrical features. Although nanofibers are conventionally produced by several ways, such as electrospinning, it is difficult to synthesize nanofibers with a diameter of ten nanometers or less. Here we report on the synthesis of SiO_2/SnO_2 nanofibers with a diameter of about 8 nm by using very thin templates of TEMPO-oxidized cellulose nanofibers (TOCN) [1]. Because the initial TOCN surface is covered with the carboxyl groups, the substitution of the surface functional groups into the hydroxyl groups attached with 3-aminopropyl trimethoxysilane (APTMS) was performed. And then, sol-gel processes to the surface hydroxyl groups brought $TOCN/SiO_2/SnO_2$. After the combustion of TOCN, SiO_2/SnO_2 nanofibers with a diameter of about 8 nm were successfully synthesized (Fig. 1). It can be interpreted that the obtained SiO_2/SnO_2 nanofibers have the core/shell structures similar to previously synthesized SiO_2/TiO_2 nanofibers [2]. The core and shell are composed of the amorphous SiO_2 and the rutile phase SnO_2 nanocrystals, respectively. The obtained SiO_2/SnO_2 nanofibers exhibit a high specific surface area of 322 m^2/g. We have also evaluated that the free standing sheet of the synthesized SiO_2/SnO_2 nanofibers show the stable and repeatable detection of acetone which is a type of the volatile organic compounds (Fig. 2).

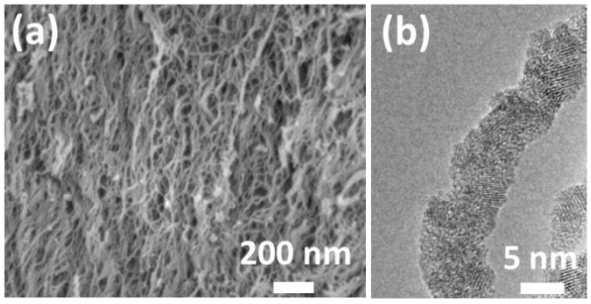

Fig. 1 (a) SEM image and (b) TEM image of SiO_2/SnO_2 nanofibers

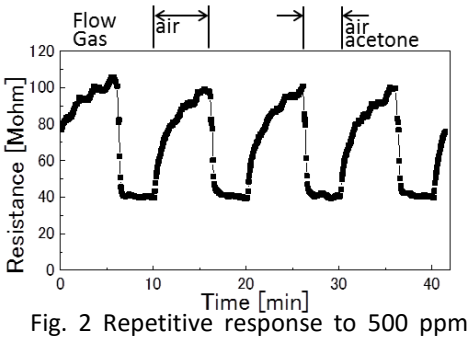

Fig. 2 Repetitive response to 500 ppm acetone gas at 300 °C

1. A. Isogai, T. Saito, H, Fukuzumi, *Nanoscale*, **2011**, *3*, 71-85
2. S. Gunji, Y. Shimotsuma, K. Miura, *J. Sol-Gel. Sci. Technol.*, **2016**, *79*, 151–159

Effect of Geometry and Electromagnetic Design on the Solidification of Direct Chill Aluminium Billets Under the Influence of Low Frequency Electromagnetic Field

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A low frequency electromagnetic casting (LFEC) simulator is used to simulate direct chill casting. Transport of heat, mass and momentum is calculated in order to simulate the solidification of aluminium alloys. Mixture formulation of transport equations is used to handle the two-phase solidifying flow. Equations of electromagnetic field are also calculated in order to obtain the Lorentz body force, which has an effect on the fluid flow. The fluid flow and EMF equations are fully coupled in both directions. All time-dependent partial-differential equations are solved with a diffuse approximate meshless numerical approach. An explicit time stepping scheme is used. The computational node arrangement is generated automatically. Arrangement is irregular and has a spatially variable density, which made it possible to perform calculations of complex inflow geometries with sharp or curved cornering edges. Additionally the node arrangement is time dependent and automatically adapted according to changes in the mushy zone position. Simulations are performed for an aluminium alloy Al-5.25wt%Cu billet with a diameter of 240 mm. Effects of inflow geometry design and coil position are investigated in the presentation.

1. Bennon, W.D., Incropera, F.P., *International Journal of Heat and Mass Transfer*, **1987**, *30*, 2161–2170.
2. Bennon, W.D., Incropera, F.P., *International Journal of Heat and Mass Transfer*, **1987**, *30*, 2171–2187.
3. Košnik, N., Vertnik, R., Šarler, B., *Materials Science Forum*, **2014**, *790–791*, 390–395.
4. Košnik, N., Guštin, A.Z., Mavrič, B., Šarler, B., *IOP Conference Series: Materials Science and Engineering*, **2015**, *117*, 12052.
5. Mavrič, B., Šarler, B., *IOP Conference Series: Materials Science and Engineering*, **2015**, *84*, 12099.
6. Sophy, T., Sadat, H., *Revue Européenne Des Éléments*, **2002**, *11*, 989–1004.
7. Vertnik, R., Založnik, M., Šarler, B., *Engineering Analysis with Boundary Elements*, **2006**, *30*, 847–855.
8. Vreeman, C.J., Incropera, F.P., *International Journal of Heat and Mass Transfer*, **2000**, *43*, 687–704.
9. Zhang, H., Nagaumi, H., Zuo, Y., Cui, J., *Materials Science and Engineering: A*, **2007**, *448*, 177–188.
10. Zhang, H., Nagaumi, H., Zuo, Y., Cui, J., *Materials Science and Engineering: A*, **2007**, *448*, 189–203.

Improvement of S355J2 Steel Mechanical Properties by Heat Treatment

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S355J2 (1.0577) is standard carbon steel which is commonly used in building engineering. Heat transfer and fluid flow laboratory is equipped by a testing device called Karusel. It enables to simulate heat treatment processes. It is equipped by two different nozzle sizes cooling headers so it is possible to simulate cooling line with hard and soft cooling regimes (hard in high temperature area and soft in low temperature area).
An austenitic steel plate was used for first tests. A heat transfer coefficient was obtained and used for simulations to predict the cooling regime for full scale experiment.
S355J2 carbon steel samples were embedded by thermocouples to measure the temperature drop in the material. Dimensions of these samples were 100 x 100 mm and the thickness of them was 5, 12 and 20 mm. The main idea of this research was to improve the standard material properties. The initial temperature of samples was 930 °C and it was hold for more than 10 minutes. Then each sample was cooled down to the target equalization temperature of 600 °C in the whole body. This means that cooling was stopped when the surface temperature was lower than 600 °C and body center temperature was higher than 600 °C.
Mechanical properties of heat treated samples were tested. A material hardness was significantly improved up to 10 mm from the sprayed surface. Two samples were chosen for tensile and Charpy pendulum impact tests. The strength was improved up to 820 MPa. The impact energy was improved four times up to 200 J.

Designing High Gain Antenna Using Metamaterial Embedded Technique

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Nowadays, metamaterials[1] are being used in antenna engineering to enhance antenna's performances due to its extraordinary characteristics. In this paper, a metamaterial embedded technique is introduced to enhance antenna gain for a printed monopole antenna. The proposed antenna composed of a rectangular shape metamaterial embedded patch, microstrip-fed line and a partial ground plane.

The finite integration technique (FIT) based on Computer Simulation Technology (CST) Microwave Studio is utilized in this study. The effective parameters (effective permittivity, effective permeability, and effective refractive index) of proposed metamaterial are analyzed. The antenna performances parameters comprising return loss, radiation efficiency, gain, and radiation pattern are studied to validate antenna performances.

The experimental and numerical results show that the proposed metamaterial loaded antenna operates over a wide frequency range about 2 GHz (10 to 12 GHz). Figure 1 indicates reflection coefficient of proposed antenna with and without metamaterial superstrate. The one-dimensional metamaterial superstrate leads to enhance antenna gain about twice compared to antenna without metamaterial at 11.5 GHz X-band.

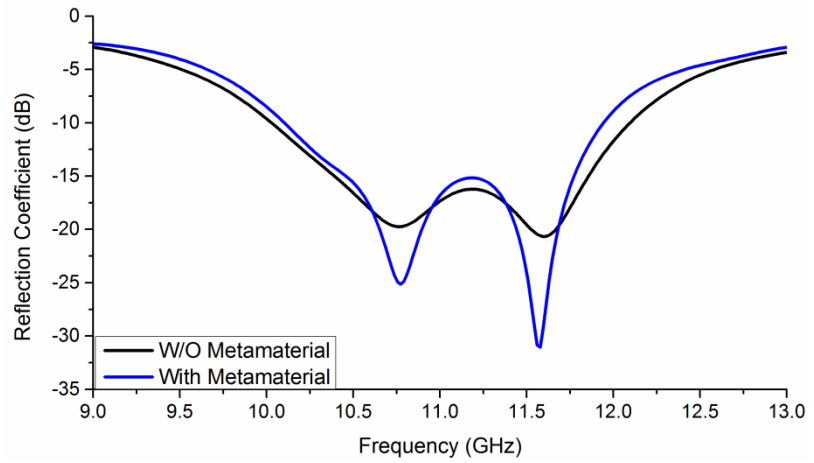

Fig. 1. Reflection coefficient of proposed antenna.

M. I. Hossain, M. T. Islam, M. R. I. Faruque, N. Misran, *Materials*, **2015**, 8(1), 57–71.

A New Compact Multiple Concentric Split-Ring Negative Refractive Index Metamaterial for Dual Band Application

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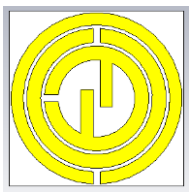
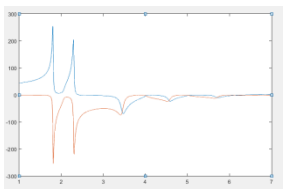
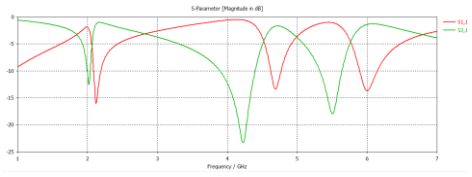
Artifical material acts as left-handed metamaterial when it shows negative effective permittivity and negative effective permeability simultaneously over a certain frequency range. To integrate different conponents in a device is an important matter for improving miniaturized, high performance, low cost and vigorous multiband design for various frequency range. To achieve multifunctional performance of the design at reduced dimension and cost is the main issue to implement multiband design.Metamaterial based multiple concentric split-ring resonators used is one of the suitable technique to realize above mentioned phenomenon. The compactness of the metamaterial be governed by improved effective medium ratio, which is the important factor of the metamaterial research. In microwave applications, various analyses have been performed using a novel split-H-shaped metamaterial for multi-band operation where as the metamaterial design was very big size and the effective medium ratio was too small [1]. For microwave imaging applications, a miniaturized antenna with negative index metamaterial based on modified SRR and CLS unit cell used for ultra-wideband, on the contrary, the metamaterial embedded antenna dimension was large and the effective medium ratio also was large [2]. In this paper, the proposed a new compact multiple concentric split-ring metamaterial size is 1.0 cm × 1.0 cm × 0.16 cm which includes all geometrical parameters to fit the design inside the substrate area. The finite-difference time-domain method based Computer Simulation Technology (CST) is adopted to investigate this design where an incident electromagnetic wave travelling along the positive z-axis with an E-field polarized along the y-axis. The perfect magnetic conductor (PMC) and the perfect electric conductor (PEC) boundary conditions have been utilised along the x-axis and y-axis respectively. Along the z-axis, two waveguide ports were placed in the unit cell. Figure 1 (a) indicates the design geometry of the proposed unit cell structure. The results of the reflection and transmission coefficient of the metamaterials indicated in Figure 1 (b) and the characteristics of proposed metamaterial is shown in Figure 1 (c). The results of the propos ed metamaterial depict multi-band metamaterial response over frequency range from 1 to 7 GHz. The effective medium ratio of the metamaterial unit-cell is 14.86. The results illustrate the double-negative and single-negative metamaterial characteristics of the unit-cell and arrays over the multiple frequency band. The sizes and transmission coefficients of the proposed compact multiple concentric split-ring metamaterial are suitable for the L-band and C-band applications.







1. Islam S. S., Faruque, M. R., & Islam, M. T., Materials, **2014**, 7, 4994-5011
2. Islam M. M., Islam, M. T., Samsuzzaman M., Faruque, M. R., Misran N. & Mansor F. M. Materials, **2015**, 8, 392-407

Characterization of Stainless Steel Corrosion Processes in Concrete by the Use of Various Monitoring Techniques

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Concrete does not adequately protect steel against corrosion. Different processes, such as carbonation, chloride penetration, hydration and external loads, change concrete characteristics and, in turn, impact the corrosion behavior of embedded steel. Using stainless steel rebars as a measure to reduce corrosion rate at critical areas can prevent spalling of concrete and reduction in structural capacity, thus increasing the lifespan of reinforced concrete structures.

In this study five different physical and electrochemical techniques will be used to monitor corrosion of stainless steel embedded in mortar specimens. Three techniques do not require custom designed sensors. These are electrochemical impedance spectroscopy (EIS), coupling current measured through a resistor between two rebars and Galvapulse technique, which measures potential and polarization resistance through an electrode applied to the mortar surface. The other two techniques are: electrical resistance (ER) sensor and coupled multi-electrode array (CMEA). Corrosion will be initiated through cyclic ponding with sodium chloride solution. Materials used will be AISI 304 steel and mortar made out of Portland cement (CEM I).

Measurements by the use of different physical electrochemical techniques will be analyzed, compared and assessed. A detailed investigation of the type of stainless steel corrosion in concrete will be conducted. The results will also be compared with carbon steel corrosion measurements previously conducted in identical conditions. At the end of the exposure period, after specimens will have been demolished, different microscopy techniques will be used to assess the validity of electrochemical measurements.

Using of Material-Technological Modelling For Designing Production Of Closed Die Forgings

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Production of forgings is a complex and demanding process which consists of a number of forging operations and, in many cases, includes post-forge heat treatment. An optimized manufacturing line is a prerequisite for obtaining prime-quality products which in turn are essential to profitable operation of a forging company. Problems may, however, arise from modifications to the manufacturing route due to changing customer needs. As a result, the production may have to be suspended temporarily to enable changeover and optimization. Using material-technological modelling, the required modifications can be tested and optimized under laboratory conditions outside the plant without disrupting the production. Thanks to material-technological modelling, the process parameters can be varied rapidly in response to changes in market requirements. Outcomes of the modelling runs include optimum parameters for the forging part's manufacturing route, values of mechanical properties, and results of microstructure analysis. This article describes the use of material-technological modelling for exploring the impact of the amount of deformation and the rate of cooling of a particular forged part from the finish-forging temperature on its microstructure and related mechanical properties.

Spark Plasma Sintering Study of HDDR Recycled Nd-Fe-B Permanent Magnets.

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From an economic and environmental aspect, the industrial development of Nd-Fe-B permanent magnets is associated with high costs. So it is vital to recycle and reprocess them, with properties close, or in the best case comparable to the properties of the original magnets. Previous results [1-2] demonstrated a recovery > 90 % of coercivities (H_{Ci}) and energy products (BH_{max}) with conventional vacuum sintering (~1100 °C) of recycled rare-earth magnets. Our research work is based on using spark plasma sintering (SPS) technique, which enables a minimized grain growth for restoration of the magnetic performance of the recycled magnets. Anisotropic HDDR powder produced from bulk recycled magnets with a mean particle size ~200 µm, with a nominal composition: $Nd_{13.4}Dy_{0.67}Fe_{78.6}B_{6.19}Nb_{0.43}Al_{0.72}$, and H_{Ci} 830 – 870 kA/m and B_r ~ 0.92 T, was used as a raw material. In our experiments we used the graphite molds; the SPS was performed in a temperature range of 650 – 850 ^{0}C under a constant 50 MPa uniaxial pressure. We demonstrated an improvement of coercivity of the raw powder to H_{Ci} = 1025 – 1120 kA/m and BH_{max} = 90 – 95 kJ/m^3. The remanence was slightly reduced to B_r = 0.72 – 0.74 T. This can be attributed to a partial loss of texturing or incomplete densification. The microstructural investigation will help us to understand the level of magnetic properties (coercivity and remanence), which were achieved. The restriction in attaining better properties will give the direction in which our further investigations will be performed. We will vary and adjust the powder particle size distribution and optimize the SPS parameters (temperature, time, heating rate & pressure).

References

1. A. Walton, Han Yi, N. A. Rowson, J. D. Speight, V. S. J. Mann, R. S. Sheridan, A. Bradshaw, I. R. Harris, A. J. Williams, “The use of hydrogen to separate and recycle neodymium-iron-boron-type magnets from electronic waste”, Journal of Cleaner Production, Vol. 104, pg. 236-241, (2015).
2. M. Zakotnik, C. O. Tudor, “Commercial-scale recycling of NdFeB-type magnets with grain boundary modification yields products with ‘designer properties’ that exceed those of starting materials”, Waste Management” Vol. 44, pg. 48–54, (2015).

Production of Fe-Co-Cr-Ni-Al high Entropy Alloy via ECAS and Investigation of Heat Treatment Effects on Sintered Alloy

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Most conventional alloys are based on one principal element. Different kinds of alloying elements are added to the principal element to improve its properties, forming an alloy family based on the principal element. High-entropy alloys (HEAs) represent an emerging class of materials that are generally composed of five or more primary metallic components in equiatomic or nearly equiatomic concentrations. Each principal element should have a concentration between 5 and 35 at. %. The basic principle behind is that significantly high mixing entropies of solid solution phases enhance their stability as compared with intermetallic compounds.

In this study, it was investigated fabrication of high entropy alloy containing wt.%25 Fe-wt%25 Co-wt.%25 Cr-wt.%15 Ni-wt.%10 Al via Electric Current Activated (Assisted) Sintering (ECAS) process and to investigate effect of heat treatment (homogenizing) on sintering samples. Heat treatments were performed in open atmospheric furnace at 800, 900, 1000 °C for 10 hours. Microstructures of sintered and heat treated samples were investigated by optic and scanning electron microscopes, phases in samples were analyzed by XRD and their hardness was measured by Vickers hardness tester.

References

1. T.M. Butler, J.P. Alfano, R.L. Martens, and M.L. Weaver, *The Journal of The Minerals, Metals & Materials Society (TMS)*, 2015, 16, 246-259
2. M.H. Tsai and J.W. Yeh, *Materials Research Letters*, 2014, 2, 107-123
3. B.S. Murty, J.W. Yeh, S. Ranganathan, *High-Entropy Alloys*, USA, 2014
4. Daniel O. Svensson, *Master Thesis, Chalmers University of Technology*, 2015

The Design and Operation of a Multiband Antenna with an Asymmetric, X-shaped Ground Plane on a Composite Epoxy Material

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In this paper, a multiband patch antenna is presented with an asymmetric, X-shaped ground plane. Microstrip patch antennas are extensively used in recently developed wireless communication systems because of their regular low profile, light weight, conformal design, low cost, and ease of manufacture and integration [1,2]. The proposed antenna is constructed using circular and rectangular slots using a 50 Ω microstrip transmission line. The High Frequency Structural Simulator (HFSS), a commercially available software package, is used for the simulation. The antenna generates four separate resonances over the X-band (8 GHz-12 GHz) and Ku-band (12 GHz-18 GHz). The antenna has a measured impedance bandwidth (2:1 VSWR) of 480 MHz and 360 MHz on the X-band and bandwidths of 520 MHz and 400 MHz on the Ku-band. The antenna prototypes have been effectively integrated. The omni-directional radiation characteristics have been determined over the entire frequency spectrum over interest. This multiband antenna is determined to be acceptable for X- and Ku-band applications.

1. J. Anguera, A. Andujar, C. Garcia, *IEEE Transactions on Antennas and Propagation* **2013**, 61(7), 3782–3789.
2. J. –S. Row, S.-W. Wu, *IEEE Transactions on Antennas and Propagation,* 56(9), 2826-2832.

A Wideband Negative Refractive Index Metamaterial for UWB Filter Application

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Metamaterials are artificially constructed material that may have extraordinary electromagnetic properties. This exotic properties have good prospect in many electromagnetic applications like, electromagnetic cloak design, antenna design, filter etc. [1,2]. This paper reveals the development of a new wideband negative refractive index (NRI) metamaterial-based ultra wideband (UWB) filter for stopband applications. Initially, a new pi-shaped metamaterial was designed on an FR-4 substrate material and it exhibits negative refractive index propery in the wideband region in the microwave regime. The measured result for the metamaterial is presented and it shows good conformity with the numerical result. The metamaterial was then applied for designing a filer that covers ultra wide band region of stop band in conjunction of a little pass band resonance in the microwave region. Experimental result for filter was provided as well that also comply well with the simulated result.

1. D. Schurig, J. J. Mock,1 B. J. Justice, S. A. Cummer, J. B. Pendry, A. F. Starr, D. R. Smith, *Science,* **2006**. **314**, 977-980.
2. B.-I. Wu, W. Wang, J. Pacheco, X. Chen, T. Grzegorczyk and J. A. Kong, *Progress In Electromagnetics Research*, **2005,** 51, 295–328.

Computer Simulation Of The Synergetic Effect Of Alloying Elements On Steels Hardenability

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The development of aided system for selection of structural alloy steels for machine parts indicates that it is necessary to have a computational model for predicting hardenability, adequate to the experimental results. Hardenability models proposed in the literature [1-4] do not indicate the adequacy of the full experimental data, probably due to incomplete verification for too small or unrepresentative data set.

The paper presents a new, computer-aided modeling method of synergistic effect alloying elements on hardenability structural alloy steels, machine toughening alloy steels and machine carburizing steels with a full verification of the results for calculations based on experimental data. The basis for the design of neural networks are the experimental results obtained from the standards, steel producers catalogs, industry literature, including information on the chemical compositions and the corresponding hardness on Jominy hardenability curve. Based on the results of experimental research Jominy hardenability method using neural network and multiple regression developed and fully validated models of the relationship between hardenability and chemical composition of the constructional and machine steels for predicting the course of the Jominy hardenability curves on the basis of chemical composition. All procedures adopted in the work was based on a very comprehensive set of experimental data containing information on the chemical compositions (ie. C, Mn, Si, Cr, Ni, Mo, Cu) and the character of changes hardness at a distance from the face of the Jominy sample (15 points) for approx. 500 heats of steels of various chemical compositions.

1. Grossmann M. A., Transactions of the Metallurgical Society of AIME, 1942, vol. 150, p. 227-255.
2. Crafts W., Lamont J.L., Transactions of the Metallurgical Society of AIME, 1944, vol.11, p.157-167.
3. Hodge J.M., Orehoski M.A., Transactions of the Metallurgical Society of AIME, 1946, vol. 167, p.502-512.
4. Jatczak C.F., Metallurgical Transaction, 1973, vol. 4, p. 2267-2277.
5. Sitek W., Jablonski A., Journal of Achievements in Materials and Manufacturing Engineering, 2015, vol. 72 iss. 1, p.32-38.

Oxidation of Molybdenum by Low Energy Ion Bombardment

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CoCrMo alloy is currently one of the most important alloys for biomedical applications. This material is characterized by superior wear resistance, hardness and high corrosion resistance and is now frequently used for the metal-on-metal hip resurfacing joints.[1] The release of metal ions due to corrosion is thought to have adverse affects on the surrounding body tissue and ultimately leads to failure of the implant. Thus it is important to fully understand the oxidation mechanisms of CoCrMo alloy that seems to be quite complex[2] and also requires a very good knowledge of the oxidation mechanisms of pure metals: cobalt, chromium and molybdenum.

In this study, we compare oxidation of molybdenum by low-energy oxygen ion beams with the thermal oxidation processes in oxygen atmosphere within an analytical ultrahigh vacuum chamber, using x-ray photoemission spectroscopy (XPS). A similar study has been carried out on NiTi alloys[3].

Thermal oxidation of molybdenum requires temperatures above 350 °C.[4] At lower temperature the Mo surface remains almost unaffected. In contrast, oxygen ion bombardment of molybdenum surface at room temperature leads to the formation of thin oxide films. The fitting procedure clearly shows contributions of various oxidation states of Mo, Mo(IV), Mo(V) and Mo(VI). At the initial stage of irradiation, rapid surface oxidation was observed, indicating the ion bombardment is more efficient in creating molybdenum oxide films then thermal oxidation.

1. J. Black, *Biological Performance of Materials: Fundamentals of Biocompatibility*, 3rd ed., Marcel Dekker, New York, **1999**, p. 127.
2. I. Milošev, H.-H. Strehblow, *Electrochimica Acta*, **2003**, *48,* 2767-2773.
3. M. Petravic, M. Varasanec, R. Peter, I. Kavre, M. Metikos-Hukovic, and Y.-W. Yang, *Journal of Applied Physics*, **2014**, *116*, 243703-243708
4. S. I. Castaneda, I. Montero, J. M. Ripalda, N. Diaz, L. Galan, and F. Rueda, *Journal of Applied Physics,* **1999***, 85,* 8415-8418.

TEM Characterization of Au Nanoparticles Synthesized by Redesigned Ultrasonic Spray Pyrolysis

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Nanoparticles have recently received a lot of attention from the scientific community. Ultrasonic Spray Pyrolysis (USP) is a bottom-up method of nanoparticle production where the nanoparticles are built by joining atoms or smaller particles together. USP can be used for a variety of precursor solutions, producing nanoscaled particles from many different materials, from metal oxides and sulfides, to pure metallic particles, nanocomposites, semiconductor, carbon particles and others.
In this work we present the characterization of three AuNPs types synthesized though USP methods from *$HAuCl_4(s)$*. Characterization was carried out by Transmission Electron Microscopy (TEM; JEOL 2100), Electron Diffraction (ED/TEM; JEOL 2100), Energy Dispersive Spectroscopy (EDS/TEM; JED-2300) and Optical Emission Spectrometry with Inductively Coupled Plasma (ICP-OES; Agilent 720). The AuNPs` sizes for each experiment were determined from a set of 10 TEM micrographs using ImageJ software, with samples of approximately 500 nanoparticles per particle size distribution.
The results suggested that the sizes and morphologies of AuNPs depend on the starting Au concentrations and the temperatures in the first heating zone. Starting Au concentrations in the precursor solution and aerosol droplet size determine the rate of evaporation and diffusion (along with other factors: temperature, gas flow, tube diameter, relative humidity). The rate of droplet evaporation can determine the shape of the product and can lead to solid, hollow and irregular shapes of nanoparticles. An investigation of the gold nanoparticles` electron diffractions enabled us to find the possible growth of Au nanocrystal types which was finally the base for setting up the synthesis mechanisms of gold nanoparticles.

Biomaterials for Hip and Knee Endoprosthesis

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Aseptic loosening and periprosthetic joint infection are the main causes of failure for joint arthroplasty. With the increasing number of primary and revision joint replacement surgeries, strategies to facilitate these failure modes have become very important. The recent investigations in this field have focused on the design of implant coatings and surface modification to prevent infection and to promote osseointegration as well as prevent the microbial susceptibility. Both coating functions are required to achieve long-term life time of the implant.

In the preliminary investigation we have studied metallic biomaterials, most frequently used in orthopedics for hip and knee prosthesis such as titanium alloys, CoCrMo alloys, of the recognized manufacturers used in orthopedics in Slovenia.

The main goal of our work was characterization of chemical composition, microstructure and particularly the surface of biomaterials for hip and knee prosthesis used at the Orthopedic Clinic of University Medical Center Ljubljana. We have investigated the new hip and knee as well as long time used knee prostheses by advanced integrated spectroscopy analytical techniques. The results of chemical analysis by ICP-OES and XRF showed that chemical composition of long time used femoral knee CoCrMo alloy as well as tibial part of Ti6Al4V alloy are comparable with the new one, according to the request of ASTM 75F and ASTM F136 standards.

We have studied the self-protective oxide films on metallic biomaterial surfaces using AES and XPS methods. The results showed that self-protective oxide layer on CoCrMo alloy, 2 nm thick, is the mixture of Co and Cr oxides; on Ti6Al7Nb alloy, 5 nm thick, is the mixture of TiO_2 and small amount of Al_2O_3 and Nb_2O_5, and on Ti6Al4V, 7 nm thick, is the mixture of TiO_2 and small amount of Al_2O_3. The self-protective oxide film prevent further corrosion and improve biocompatibility.

Investigation of Samples Obtained from the Recycling of Waste Electrical and Electronic Equipment

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Recycling is a process of reprocessing used materials into raw materials for producing new products. The high value of metals has always been the main reason for recycling. In the last decade, recycling activities are being promoted to conserve natural resources and reduce pollution. Waste electric and electronic equipment (WEEE) is typically made from different types of materials, which results in complexity of recycling. The number of electronic devices will continue to increase and therefore also the volume of generated e-waste. Different types of sorting equipment, which are used in recycling process, are described.

The purpose of the study was to analyze the fractions and alloys obtained from the recycling of waste electrical and electronic equipment. Samples were weighed prior and after melting in order to estimate the approximate proportion of the organic compounds. The X-ray fluorescence (XRF) technique was used to determine the chemical composition. Thermodynamic equilibrium phase diagrams of produced alloys were calculated using the software ThermoCalc. The article includes an explanation of the origin of elements in the tested samples. The possibilities of further recovery of fractions obtained from WEEE recycling were investigated.

Carbide Distribution Based On Automatic Image Analysis For Tool Steels.

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There are many studies about carbide[1] or oxide[2,3] size and particle density in steels using image processing software even for nanoscale particle sizes[4]. But in these studies there is almost no information about the homogeneity or heterogeneity of this carbides distribution. One of the inconvenient of this kind of particle distribution calculation is the amount of images needed to have a reliable quantification. The methodology to perform a statistically representative quantification of the microstructure was developed using Scanning Electron Microscope (SEM) images. The methodology consists of, acquiring the required number of micrographs that represent the bulk material. Then, the micrographs were binarized using Auto local threshold algorithms in Fiji, an open source image processing software package. Subsequently, the binarized images were quantified in terms of: centroids, number of particles and sizes. In order to have a significant representation of the homogeneity of the particles under study, the distribution was estimated as the mean of the minimum distances to the closest four neighbours. All the image analysis was done automatically.
This methodology has been developed to analyze the carbide distribution when tool steels are cryogenically treated. It is stated in the scientific literature that cryogenic treatment produces a precipitation of fine carbides in the microstructure of different tool steel alloys[5]. In this study two samples of the AISI A8 medium-alloy tool steel were analyzed. One of the samples followed a conventional heat treatment process of austenization, quenching and two tempering and the second sample followed a final cryogenic treatment at –172 °C after the conventional heat treatment. Results using this automatic image analysis methodology revealed a homogeneous distribution of the precipitated fine carbides in the microstructure after the cryogenic treatment. Cryogenically treated sample also increased the number of fine carbides in the microstructure in comparison with the conventionally treated one. This increase of the homogeneously distributed fine carbides can lead to an improvement in the wear resistance of the AISI A8 when cryogenically treated.

1. C. Revilla et al., *Materials and Design*, **2014,** *62*, 296–304.
2. S.F. Li et al., *Materials and Design,* **2016**, *90,* 318–329.
3. M. Nagini et al., *Materials Science & Engineering A*, **2015**, *620*, 490–499
4. C. Solenthaler et al., *Materials Science & Engineering A*, **2015**, *647*, 294–302.
5. S. Akincioglu et al., *Int J Adv Manuf Technol*, **2015,** *78*, 1609–1627.

Multilevel design of biomaterials for application in nanomedicine

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Design of biomaterials at multilevel is very important topic for various areas of nanomedicine, as they are: tissue engineering, drug and/or active substances encapsulation for in advance controlled kinetics of their releasing and synthesis of therapeutics and imaging agents with very complex function, capable to make diagnosis of diseased cells and tissues and subsequent their treatment.
All these areas of application of multilevel design are very attractive topics, which are the subject of research of many research groups worldwide. Bone tissue or any other tissue engineering have become the main strategy for permanent repair various defects, since the use of auto- and allografts is accompanied with the source limitation and immunologic rejection due to their natural origin. As many investigations showed, biodegradable porous 3D structures, known as scaffolds, are the most promising solution, because they act as a temporary physical support until their total degradation and replacement by new bone, (which is one of the main topic of our investigations in the past decade), and on the other hand, their porosity enables cell growth and facilitates tissue regeneration and vascularization. These scaffolds should also be biocompatible, osteoinductive and osteoconductive, possessing mechanical properties matching those of the tissue they are replacing, and geometrically and functionally designed to mimic the native ECM environment. In our investigations this is achieved by specific composite scaffold construction, named ALBO-OS, with ceramic part which mimics bone structural hierarchy and thin polymer layer which improves mechanical properties and cell attachment and proliferation.
Biocompatibility and biofunctionality of so designed scaffold were evaluated in vitro by numerous everywhere used assays and particularly in vivo by the test of acute systematic toxicity performed on mice, and the test of cutaneous irritation and biofunctionality assays performed on rabbits. All performed in vivo tests, and particularly the most important assay of biofunctionality, revealed extraordinary results which underline its real potential for clinical application.
The investigations related to the rate differentiation of the stem cells approved all these findings. In all these experiments, the multilevel design of scaffold was the most important factor for obtaining so exceptional results.
The second example is dedicated to the multilevel design of ceramic carriers for controlled releasing of drugs or other active substances. The experimental and theoretical approach of the modelling of such structures is investigated. The exceptionally interesting results show that geometrical design of particles is the most important for predicable events of drag releasing in long time. This design is some kind of “fingerprint” of physical periodical field in which this structure is generated. The obtained results were the base of new insight in kinetics of drug release which is fully controlled by geometrical multilevel design of ceramic carriers, opening new area of kinetics, which we called discrete kinetics.
Such kind of observation were the base of new endodontic mixes with excellent physical and biological properties, particularly expressed over dentine bridge, which thickness in our investigations has a values almost two times higher values than in the case any systems found in literature.
This short explanation clearly shows that multilevel biomaterials design is very inspirational topic, which enables many interesting and promising solution, for application in human medicine.
Very important fact, as it is well-known, that nanotopography, which is strongly expressed in our various solution of multilevel structures, significantly affect to the level of integrin clustering as well as focal adhesion formation, regulating the functions and differentiation of stem cells, as it was shown in our investigations. Therefore, topographical regulation of adhesion probably affect out of

cytoskeleton signaling cascades, activating through adhesion BMP signaling pathway and supporting stem cell differentiation and their migration in our multilevel designed structures. Due to such specific scaffold design, it was possible control and promotes cell adhesion, growth and proliferation, besides of the requested good mechanical support for seeded cells and efficient interaction with the cells, which promote cellular functions including adhesion, differentiation, morphogenesis, migration and proliferation.

All these functions can be further promoted by using corresponding signaling polymers/biopolymers, particularly with RGD motifs, as thin films on the surface of multilevel designed structures, with in advance predictable cell response, what is topic our recent investigations.

Influence of Nanotopography and Chemistry on in Vitro Biological Response

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Cardiovascular disease presents the major cause of death in the modern world. The treatment of diseased blood vessels is commonly done by implementation of stents, which help to enlarge the lumen wall and restore the blood flow. Stents are made of hemocompatible and durable material such as titanium (Ti). However post-surgical complications are commonly observed, due to platelet adhesion and activation on the surface which leads to thrombosis. Moreover the adhesion and proliferation of endothelial cells is still far from optimal. Thus the aim of our work was to study the influence of nanotopography and plasma modification on adhesion and activation of platelets as well as on proliferation of human coronary artery endothelial cells (HCAEC). Electrochemical anodization process was used for fabrication of TiO_2 nanotubes with different diameters (15, 50 and 100 nm) and afterwards treatment with radiofrequency plasma was employed. Surface properties of nanotubes before and after plasma treatment were studied by scanning electron microscopy (SEM) and atomic force microscopy (AFM), while chemical composition was studied by X-ray photoelectron spectroscopy (XPS). The influence of different surface properties on adhesion of platelets was studied by SEM, while proliferation and adhesion of HCAEC was studied by immunofluorescence microscopy (IFM). Results of our study showed that all plasma treated surfaces provide better environment for proliferation of HCAEC and significant reduction in adhesion and activation of platelets. The nanotopographic features also influence on biological response, as endothelial cells function less optimally on nanotubes with 100 nm in diameter. The influence of nanotopography on platelet adhesion was also observed, as platelet adhesion and activation was the highest on 15 nm nanotubes.

Sliding Wear in Simulated Heat Affected Zone of Two 9-12% Cr Steels as a Function of Short-term Ageing

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Ever-increasing tribological applications operate at severe temperature conditions where materials are subjected to deteriorating mechanisms such as thermal fatigue, creep, ageing, etc., and at the same time they must withstand mechanical wear due to sliding contacts with pairing elements. Steam turbine valves, gate valves, valve heads, stems, seats and bushings, contacting surfaces of the carrier elements, etc., represent some examples of such applications. The goal of the present study is to evaluate the potential of two tempered-martensitic 9-12 % Cr steels, namely X20CrMoV121 and X10CrMoVNb91 as an alternative materials for applications that operate under combined effect of mechanical wear and elevated temperature conditions. The focus of our work is to understand the effect of microstructural changes in weld heat affected zone on wear properties of the selected materials.

With longer and higher tempering temperature, the number of carbide precipitates decreased, while their relative spacing increased. Prior to tempering, the morphology of the steel matrix (grain size, microstructure homogeneity) governed the wear resistance of both steels, whereas after tempering, wear response was determined by the combination of number, size, and distribution of carbide particles. After tempering, a larger number of stable $M_{23}C_6$ carbides was observed in the steel X20CrMoV121 as compared with the steel X10CrMoVNb91, which resulted in lower wear rates. It was observed that for both steels, a similar combination of number density and size distribution of carbide particles provided the highest wear resistance.

Thickness Determination of Corrosion Layers Using XPS Depth Profiling

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The study deals with the methodology and thickness determination of the corrosion layers of ferritic steel samples using X-ray photoelectron spectroscopy (XPS) equipped with the ion gun source system enabling the destructive depth profiling. It is well known that XPS is one of the most used technique for both determining the thickness and chemical composition of passive films or corrosive layers. Unfortunately, the thickness of ion gun etched layers could be estimated only for simple samples and standards. The corrosion layers are heterogeneous material with varied composition, therefore the etching rate is always specific for each corrosion layer. The results of this work provide the possibility to the fast and easy determination of the ion gun sputtering effect with exact settings for the multi compound chemical structures. The knowledge related to the thickness of corrosion or passivation layers would greatly help in their characterization.

Determination of Frictional Resistance in the Model Fforming Pprocess by Finite Element Method with Consideration Given to Plastic Strain of the Material

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This article presents the results of investigations on friction forces in the model cold forming of sections made of S235 structural steel. Plastic strain of the tested material was taken into consideration in the model process. The process was conducted using a specially designed device – tribometer [1.2]. This device allowed the tests to be carried out for different material feed rates and strain degrees as well as the changes in pressure and displacements to be determined on a continuous basis during the process. The forces of friction between the tool and the material of section during the forming process were determined by strain gauge method. This paper concerns the use of the finite element method (FEM) with application of the reverse test methodology.
In order to document the effects of plastic deformation in structure of the sections subjected to model forming, the metallographic investigations were carried out. The structural observations were conducted in bright field and polarised light in the so-called Nomarski contrast using light microscope with magnification of 2000X.

1. **Lenik K., Borowski G**., *Stand for testing friction processes.(in Polish) WUP PL-170088B1 patent.*
2. **Korga S., Lenik K**., *The application of a tribotester prototype to sliding friction simulations and wear computations by means of FEM. Les problemes contemporains du technosphere et de la formation des cadres d'ingenieurs,* (**2011)** 61-64.

The Effects of Hot Deformation Parameters on the Size of Dynamically Recrystallised Austenite Grains of HSLA Steel

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This paper presents the results of investigations on the effects of hot deformation parameters in compression test on the austenite grain size in HSLA steel (0.16 % C, 0.037 % Nb, 0.004 % Ti, 0.0098 % N). The axisymmetric compression tests were performed on test specimens of 7mm in diameter and 8.4mm in length using the Gleeble 3800 simulator. The compression process was conducted in the temperature range T_{def} from 900 °C to 1100 °C at a strain rate $\dot{\varepsilon}$ 1 s^{-1}÷15.9 s^{-1} and strain degree ε from 0.2 to 1.2. Before deformation, test specimens were austenitised at T_A of 900 ÷ 1250 °C. The heating of test specimens was conducted by resistance method, in an argon atmosphere, using the simulator. Immediately following the compression test, the test specimens were cooled in water to stop the effects of hot plastic deformation in structure of the steel. To reveal the primary austenite grain boundaries, the etching with saturated solution of picric acid at 70 °C was used. The metallographic observations of the primary austenite grain were conducted in bright field and polarised light using light microscope with magnification of 2000X. The measurement of austenite grain size was taken normatively by counting the number of intersections with grain boundaries. The results of primary austenite grain size obtained by experimental method were compared to those obtained by analytical method[1,2].

1. **Kalinowska - Ozgowicz E.,** Structural and mechanical factors of the strengthening and recrystallization of hot plastic deformation of steels with microadditives, (język polski), Open Acces Library, **2013**, vol 20, 1÷246,
2. **Kuziak R.**, The modelling of structural changes and phase transitions in thermoplastic steel treatments, Institute for Ferrous Metallurgy (in Polish), Gliwice, **2005**.

Structure and Mechanical Properties of Austenitic Steels Affecting by the Sigma Phase due to Exposure

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The paper deals with the change of the structure and mechanical properties of the several types widely applied austenitic steels used in supercritical power industry after their exposure at the working temperature. The grades TP347 HFG, Super 304H and HR3C representing most widely used grades were chosen in this study. The effect of plastic deformation applied during the bending of tubes on the mechanical properties and the structure was also studied. The bend radii R60, R80 and R100 were on the matter. The positive effect of solution annealing on the structure was studied too. The change in the mechanical properties (yield stress, tensile strength) considering small wall thickness of the tubes were studied using small punch tests and miniaturized tensile tests.
From the results obtained it can be concluded that the mechanical properties and the microstructure have been influenced due to even one year of exposure at the working temperature significantly. Various amount of σ-phase was found, especially on the pulled part of the bend (extrados), even when the tubes were exposed only to thermal exposure without any loading. The effect of the heat treatment and the bend radius on the mechanical properties and the structure was also evident. Drop in fracture energy due to the presence of the σ-phase in the structure was clearly detected from force - displacement record of the small punch test.

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Three-Dimensional (3D) Characterization of Materials Using High-resolution FIB Tomography

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In material science, three-dimensional information became increasingly important with the deeper understanding of the influence of nano- and microstructures on macroscopic properties. Focused ion beam (FIB) tomography cover an important part of the dimensional space, which is inaccessible by other 3D microscopic techniques. The method is based on alternating procedure of FIB-slicing and scanning electron microscopy (SEM) imaging to acquire 3D data stack which may contain structural, chemical or crystallographic information. Recently, introduction of high end FIB-SEM systems, opened possibility to process larger volumes at higher resolutions. However, long term continuous FIB operation, which is needed to acquire higher voxel matrix, represents several challenges like: precise correction of sample drift, controlling slice thickness in z-direction as well as ensuring electron-optics stability of the microscope through the whole process. To overcome all the difficulties, automation of several individual processes related to 3D data stack acquisition is crucial.
In this work fully automated FIB serial sectioning process with active drift compensation algorithm, slice thickness determination and auto focusing routine is presented. Within the automated routine, high contrast “in column” detectors and pre-monochromated electron beam has been introduced in order to provide Z-contrast signals at high-resolution conditions. The method was demonstrated on three different materials, with complex microstructures, which are used in real system applications related to energy harvesting, conversion and energy storage. For each material case, experimental milling and imaging have been optimized in order to obtain high quality 3D reconstruction with phase contrast information. Individual phases were identified from EDXS elemental maps and further segmented according to their grey levels. Several geometrical, topological and statistical parameters were estimated, using quantification of 3D dataset.
The presented analytical method can be used as a tool for quantitative characterization of primary microstructural parameters and complex topological features of several modern materials.

1. M. Cantoni, L. Holzer, *MRS buletin*, **2014**, *vol. 39*, 354-360.
2. G. Brus, H. Iwai, A. Sciazko, M. Saito, H. Yoshida, *Journal of Power Sources*, **2015**, *vol. 288*, 199-205.
3. K.P. Mingard, H.G. Jones & M.G. Gee, *Journal of Microscopy*, **2014**, *vol. 253*, 93–108.

Effect of TiO_2 on Doped Bioactive Glass Hydroxyapatite Pelletized

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Replacement' of bone by a bioactive implant is one of the main research topics of today's orthopedics. A bioactive implant should be reliable, economic and biologically compatible. Its mechanical properties must be in accordance with the implanted bone. Calcium hydroxyapatite (CHA) ceramics are effectively used as re- placement materials of bone [1]. Hydroxyapatite (HA), formulated as $Ca_{10}(PO_4)_6(OH)_2$ [2], which has a great biocompatibility with human organism and formed an inorganic part of the bone is used as a biomaterial to repair hard tissues and their configurations [3]. In this study, the production of porous materials was investigated as well as It was made into pellets addition of different weight bioactive glass and nano-Titanium dioxide (n-TiO_2) powders. The samples were sintered at 1200 °C. After that, density and porosity were measured quantities. Materials were prepared as metallographic for SEM image analysis. Samples of hardness and fracture toughness values were calculated. However, phase composition was examined by x-ray diffraction analysis. As a result, the produced material showed a uniformly sintered.

1. KORKUSUZ, Feza, KORKUSUZ Pelek, Acta Ortop Traumatol Turc 31 : 63-67, 1997
2. TAS, A. Cüneyt, Biomaterials, 2000, 21.14: 1429-1438.
3. AHMADZADEH, Elham, TALEBNIA, Farid, TABATABAEI, Meisam, HOSSEIN, Ahmadzadeh, MOSTAGHACI, Babak, Biology and Medicine, 2016, 12.5: 1387-1395.

The Volume Changes of Cement Composites in the Early Stage of Setting and Hardening

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The article deals with the volume changes of the cement composites. It presents the results of an experimental assessment of the development of cement composite volume changes especially in the early stage of their setting and hardening. The measurement of shrinkage was performed using a modified test device made by Schleibinger Geräte Teubert u. Greim GmbH. Shrinkage drains of 1000 mm in length and with 60x100 mm in cross-section were used for recording the length changes measured along the central axis of the specimen. The drains were filled with concrete and placed onto a special weighing table which allowed continuous recording of mass losses caused by free drying of the specimen surfaces. In this way, the mass losses and changes in the length of the concrete in the shrinkage drains were measured simultaneously. Along with this measurement, the acoustic emission method was employed for the continuous non-destructive monitoring of changes in the internal structure, especially at an early age. The outputs of the measurement are presented as diagrams which display the relationship between the relative length changes, mass losses and the time of cement composites ageing. Events recorded by means of acoustic emission and temperature measured inside the specimens are also presented in the paper.

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Self-supported Geopolymer-based Barriers for Filtration Applications

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Compact filtration barriers are mostly prepared using ceramic, glass or metal powders joined together via the sintering process which lifts the costs due to its high energy consumption. But there are another ways to create bonds between grains of a powder to ensure certain values of mechanical properties yet maintain the porosity features which are vital for filtration. There is also a group of materials which possess all qualities to replace those aforementioned without high temperature treatment. Geopolymers – materials investigated and somewhere already used in building constructions – are prepared mainly at ambient (or slightly elevated) temperature via a solution mechanism having the strength of sintered materials and one other remarkable advantage – secondary raw materials incorporation.

The main aim of the work was to prepare compact porous bodies for filtration applications without significant heat treatment. Porous barriers were prepared from a geopolymer binder based on an alkali-activated blast furnace slag and power plant ash used to aggregate shale particles. The mechanical properties of the prepared materials were tested for comparison with currently used materials. The influence of processing conditions on the mechanical properties of the prepared materials was studied. The structure of the materials was studied using optical microscopy, and characterized by porosimetry.

Based on the results of the experiments it was concluded that the mechanical properties are sufficient to use the filtration barriers as self-supported. Filtration barriers based on this material can be used as a support for a membrane or as a filtration barrier itself and have the potential to replace sintered metal or ceramic membranes in many applications with benefit of lower costs and secondary raw materials utilization.

Characterization of Structure and Magnetic Properties in Ce-based Bulk Amorphous Glass

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Amorphous or glassy alloys are characterized by its frustrated structure, which reflects a lack of long range order [1]. Since the amorphous state can be transformed into crystalline with the input of thermal energy, glasses are considered to be metastable materials. With heating above the crystallization temperature (Tx), the precipitation of crystallites occurs, and the intermetallic phase starts to grow. Due to lack of grain boundaries and structure disorder, glassy alloys can exhibit superior properties compared to their crystalline counterparts. These advantages include higher strength and hardness, increased corrosion resistance, good magnetic properties [2] and the possibility of thermoplastic forming [3]. Our study focuses on synthesis and characterization of rare-earth based metallic glasses. The large difference in size of constituent atoms (Al, Ce, Fe, Cu), eutectic-assisted suppression of crystallization and partial immiscibility of Fe and Cu play a role in stabilization of the amorphous alloy. Production of amorphous alloys included arc-melting and rapid quenching on a rotating copper wheel, resulting in thin ribbons. Subsequent grinding yielded amorphous powders. The composition of (Al1-xCex)62Fe13Cu25 where x=0.75, was found to be disordered, and therefore it was selected for further investigation. The metallic glass powder was subjected to pulsed electric current sintering (PECS) to yield bulk amorphous glass. Due to fast heating rate and consolidation temperature below that of Tx, the crystallization can be hindered. Heat treatment at the temperature above crystallization (230 °C) was used to trigger the precipitation of primary crystals. The structure was verified using X-ray powder diffraction and the magnetic properties were characterized with SQUID. The heat treatment of 1 min does not result in a significant change of the structure or magnetic properties. However, higher annealing times of 10, 100 and 1000 min gives increasingly higher crystallinity. This consequence is due to the growth of hexagonal AlCe3 phase. The magnetization of the specimens increases with prolonged time of annealing and can be correlated with the higher content of AlCe3. Coercivity, on the other hand, decreases with longer time.

The impact of a heat treatment on the magnetic properties is expected to be even bigger when we use a rare-earth with a higher magnetic moment, e.g. Gd. Therefore, the current Ce-rich composition in the future will be replaced with Gd-rich one. Additionally, a composite made of Ce- and Gd-based ribbons will be prepared, exploring the evolution of magnetic properties when low and high magnetic moment based rare earth alloys are consolidated into a composite.

References:

1. J.F. Sadoc, J. Non. Cryst. Solids 44 (1981) 1.
2. A.L. Greer, E. Ma, MRS Bull. 32 (2007) 611.R
3. J. Schroers, Adv. Mater. 22 (2010) 1566.

Evaluation of Three-point Bending Fracture Tests of Selected Concrete: Mechanical Fracture and Acoustic Emission Parameters

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Authors focus attention on mechanical fracture and acoustic emission (AE) parameters obtained from records of three-point bending fracture tests on concrete specimens with initial notch. Total nine sets of specimens were tested. Three specimens at the age of 28 days were tested in each set. Concrete of each set of specimens was different in dosage of Portland cement CEM I 42.5 R and amount of used superplasticizer which resulted in different water to cement ratio of particular mixtures. The Effective Crack Model (ECM) was used to evaluate the load vs deflection diagrams to obtain modulus of elasticity, effective fracture toughness and specific fracture energy. Modulus of elasticity, tensile strength and specific fracture energy were also subject of identification via inverse analysis based on artificial neural network, which aim is to transfer the input data obtained from the fracture test to the desired material parameters. Resistance to stable and unstable crack propagation was quantified via evaluation of load vs crack mouth opening displacement diagrams using Double-*K* fracture model supported by identified parameters. The similar results for fracture toughness obtained by two different methods, ECM and Double-*K* model, was observed. The AE technique was used to monitor damage process taking place in specimens.
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1. Karihaloo BL, Fracture Mechanics and Structural Concrete. New York: Longman Scientific & Technical, **1995**.
2. Komárková T, Králíková M, Kocáb D, Misák P, Stavař T. Advanced Materials Research, **2015**, *1122*, 141–144.
3. Kumar S, Barai SV, Concrete Fracture Models and Applications. Berlin: Springer, **2011**.
4. Lehký D, Keršner Z, Novák D, *Advances in Engineering Software*, **2014**, *72*, 147–154.
5. Nevile AM, Properties of Concrete. Harlow: Pearson Education Limited, **2011**.
6. Reinhardt HW, Cornelissen HAW, Hordijk DA, *Journal of Structural Engineering*, **1986**, *112(11)*, 2462–2477.
7. Sagar RV, *National Seminar & Exhibition on Non-Destructive Evaluation*, India, **2009**, 225–228.

Influence of the Thermomechanical Treatment on Grain Growth Behaviour of a New Fe-Al Based Alloys with Fine Al_2O_3 Precipitates

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To obtain superior high temperature creep strength, the transformation of fine-grained structure to large grains by abnormal grain growth or recrystallization is an important process in oxide dispersion strengthened (ODS) alloys. The processing of the steel is enabled by powder metallurgy, which utilizes powders consisting of a Fe-Al metal matrix with a large O content prepared by mechanical alloying and their hot consolidation by rolling. The Thermomechanical characteristics of new ODS alloys with Fe-Al matrix are investigated from the viewpoint of changes in grain size distribution. Recrystallization and grain growth were quantified upon heating up to 1200 °C, which is the typical consolidation temperature for standard nanostructured ferritic steels. The allowance of normal grain growth during pre-anneals or hot work to preserve abnormal grain growth ability was investigated. The results show that new ODS alloys are significantly affected by the thermo-mechanical treatment leading to microstructural changes. Their analysis is performed using different analytical methods such as optical microscopy, scanning electron microscopy and X-ray diffraction analysis.
Keywords: Grain Growth, ODS alloys, Steel, Fe-Al, Al_2O_3

Research Clinker-free Cementitious Materials Synthesized with the Use of Energy Efficient Technology for Composite Binder Materials

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In this study were investigated the characteristics of cementitious materials which have been synthesized by the processing of metallurgical slag in vortex layer, and compared with market of cement samples.

The use of metallurgical wastes as a source of raw materials for composite building materials is an urgent problem, since for 1 ton of cast iron produced 900 kg of slag. The chemical composition of metallurgical slag is similar with the cement clinker and the amorphous structure of it allows to obtain cementitious materials. As the processing method was used an innovative technique - processing granulated blast furnace slag in the vortex layer. Using this method, as opposed to tumbling mills, significantly reduce energy consumption - up to 3 times, as well as improve the quality of the material - specific surface area of 3.5 m^2 / g (drum mill - 1-2 m^2 / g).

The dependence of the structural characteristics of ground granulated slag was treated in the vortex layer at different modes. The method of low-temperature absorption and diffraction of the laser beam showed the dependence of the specific surface area and average particle size of ground slag on the operating mode of the vortex layer device. It is found that the average particle size of our sample is in the range of 10 - 20 microns, whereas that of the market cement is 16.6 micron. Structure of samples was studied by scanning electron microscopy. Also the change of phase composition was investigated by x-ray diffraction - the processing crystallization of amorphous slag is observed, which leads to the formation of phases which have cementitious properties.

To assess the strength properties, the samples of concrete on the basis clinker-free cementitious were prepared. The effect of the additives NaOH, Na_2CO_3, fly ash and SiO_2 on the strength characteristics was also studied. It is found that the maximum strength of 43.5 MPa has the sample obtained with the addition of NaOH.

A Study on Machining Characteristics in Micro Pulse Electrochemical Machining of Invar Sheet

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Invar is a 36 % nickel iron alloy that has the low thermal expansion among all metals and alloys at temperatures ranging from room temperature up to approximately 230 °C. Invar alloy is ductile, easily weldable, and has machinability similar to austenitic stainless steel. Due to the low thermal expansion characteristic of Invar, it is used as shadow mask in display device such as UHDTV, Organic Light Emitting Diode. In this study, Micro Pulse Electrochemical Machining (MPECM) which is non-contact ultra precision machining method has been investigated to manufacture invar sheet alloys and the surface characteristics of invar sheet after MPECM has been studied and basic experimental research on invar sheet MPECM has been carried out. The voltage frequency and duty ratio which influence the machined surface quality and machining accuracy have been investigated as different parameters. The optimum parameters which could obtain fine surface quality have been determined with voltage frequency and duty ratio analysis. The experimental results show that the voltage frequency of MPECM is the vital parameter which influences the surface quality. And also, by controlling duty ratio, the surface quality and machinability could be ideally controlled. Furthermore, machining depth and machinability of invar sheet due to various parameters with voltage frequency has been investigated according to different duty ratio conditions in MPECM.

Investigation of Microporosity Formation in an AlSi10Mg Alloy Solidified Under Controlled Cooling Conditions

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Formation of microporosity is one of the most seen problems in cast metal production with aluminium alloys. Since it harms the pressure tightness and the mechanical properties such as tensile and fatigue strengths its minimization in the critical sections has been subject to number of investigations. One of the most used methods to investigate microporosity formation is the directional solidification which provide for control of influential factors such as thermal gradient and solidus velocity.

In this study, microporosity formation in an AlSi10Mg alloy has been investigated under unidirectional solidification with different temperature gradients and solidus velocities. A modified Bridgeman furnace having four different thermally controlled zones was adopted to create pre-defined cooling conditions during the solidification of castings. Porosity formation was investigated by means of density measurements and results obtained from experiments were used for regression analysis to find mathematical correlation between porosity formation and solidification parameters namely thermal gradient and solidus velocity.

Results showed that the amount of porosity decreased with increasing temperature gradient while it increases with increasing solidus velocity. Mathematical model obtained from regression analysis was used for modelling using a 3D casting simulation program. Results obtained with modelling show good agreement with the results obtained from experimental castings.

Can Ultrasonic Wave Propagation Predict Mechanical Properties in Polymers?

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Ultrasonic (US) wave propagation is a non-destructive technique that can determine elastic modulus ($\boldsymbol{C}$) of metals and ceramics, by measuring the speed of US wave propagation through a sample (v) and its density (ρ_0): $\boldsymbol{C} = v^2\rho_0$. Assuming the same rule applies for polymers, this theory was extended to viscoelastic behavior of polymers[1] however, the results were not comparable to other methods like DMA[2]. We have realized this, when measuring US wave propagation of hydrogel composite materials used for scaffolds in tissue engineering.

By using bottom-up approach, we have started from the atomic scale and explained how US waves propagate through a polymer. Based on such understanding of the phenomena, we have derived an equation for a model of US wave propagation through polymers that shows much better agreement with US wave propagation measurements. This model could potentially correlate results of US wave propagation with molecular orientation in polymers.

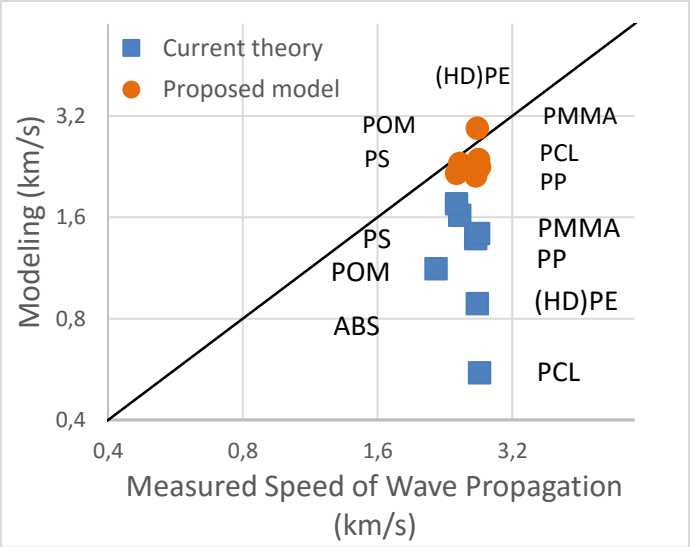

Figure 1: Comparison between current wave propagation theory (blue square markers) and proposed wave propagation model (orange circle markers). Results closer to the diagonal line are better.

1. James, E.M., *Physical Properties of Polymer Handbook*, **2007**.
2. Lionetto, F., Montagna, F., Maffezzoli, A., *Applied Rheology*, **2005**, 15, 326–335.

Utilization of Excavation soils in the Form of Self-compacting Grouts

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Treatment soil from excavation and unsuitable materials has a long history. It is carried out mainly for the reason in order to improve its use for construction purposes. Nowadays earth works are carried out by depositing loose soils and their subsequent compaction. Unsuitable soils are disposed to landfill. These technologies are relatively time and financially expensive, so it is trying to find a suitable alternative, possible for re-use of soil.

One way of improving soil properties is its stabilization, which is performed by means of additives (binders), plasticizing additives, fluidity-improving additives or other materials and methods. Stabilization primarily aims to improve the strength of soil and that's why increase resistance to softening soil. By adding additives to soils is an improvement in many of its technical characteristics. Still, however, the properties of the treated soil depend on the character of soil, the type and length of curing and the method and quality of construction. Addition of lime contributes to improvement of workability, but not to increase strength. Lime has a major influence on the amount of water in soil, the viscosity and stabilization of soil.

Choice of binder depends on the properties of soil and its technical application. In fact, should be the amount and type of added binder in accordance with the content of clay minerals in the soil. The precise values of the quantities and the effect of binder on the soil, for the formation of grouts suitable parameters, may be determined after performing laboratory tests. Self-compacting grouts can be used both for filling more complex excavations and easy to create a stable and totally straight foundation for concrete board.

Influence of Pb Dosage on Immobilization Characteristics of Different Type of Alkali-Activated Mixtures and Mortars

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Alkali-activated matrices based on blast furnace slag are suitable materials for immobilization of hazardous material such as heavy metals. This paper is focused on comparing of immobilization characteristics of various inorganic composite materials based on blast furnace slag and influence of various dosage and type of heavy metal (Pb) on mechanical properties and fixation ability of prepared matrices. Blast furnace slag, fly ash and sand were used as raw materials and sodium water glass was used as alkaline activator. $Pb(NO_3)_2$ serves as a source of heavy metal and was added both in solid state and in aqueous solution in various dosages. The immobilization characteristics were determined by leaching tests and the content of Pb in eluate was measured by inductively coupled plasma atomic emission spectroscopy (ICP-OES). The microstructure of matrices and distribution of Pb within the matrix was determined by scanning electron microscopy (SEM) equipped with Energy dispersive X-ray spectroscopy (EDS). Increasing dosage of heavy metal had negative impacts on mechanical properties of prepared matrices. The leaching tests confirm the ability of alkali-activated materials to immobilize heavy metals. With increasing addition of Pb increased its content in eluates.

Development of Eco-friendly and Non-hazardous Outdoor Bronze Protective Coatings

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Copper and copper alloys such as bronze tend to oxidize into thermodynamically more stable state. One of these processes is spontaneous patination (ageing of bronze) or it can be patinated deliberately by different chemical compounds by a process called artificial patination.

The objectives of this study is to find the eco-friendly and non-hazardous protection of outdoor bronze that are already patinated.

Two different bronze alloys, supplied by an artistic foundry (Livartis d.o.o., Slovenia), are used as substrates: a modern silicon bronze (Cu-3Si-1Mn) that is used in contemporary art, artificially black patinated with K_2S ("liver of sulphur"), and a historical quaternary bronze (Cu-6.5Sn-4Zn-2Pb), patinated by artificial ageing in conditions which closely simulate outdoor exposure (runoff and stagnant rain conditions).Preliminary results about surface characterization will be presented.

Two development of two type of the coatings for protection of patinated bronze substrates will be presented, namely fluoropolymer type of coating and spray sol gel coating. The performance of protective coatings will be assessed by electrochemical methods in artificial acid rain and, in the case of the most promising ones, by severe accelerated ageing involving environmental parameters (runoff, UV radiation ...). The effectiveness of the protection of bronze surfaces will be discussed.

This study is a part of B-IMPACT (Bronze-IMproved non-hazardous PAtina CoaTings) project, funded within the European M-ERA.Net consortium. Project aims at developing innovative eco-friendly and non-hazardous protective coatings for the protection of bronze surfaces exposed to the outdoor environment (http://www.b-impact.eu, info@b-impact.eu). This project of 24 months, starting from March 2015, is coordinated by the Slovenian National Building and Civil Engineering Institute and involves academic partners (University of Toulouse (F), University of Bologna and University of Ferrara (I)), together with SME partners for coating research (Geida d.o.o., Slovenia), coating formulation and production (Pylote SAS and C2M Aurochs Industrie, France), and toxicity assessment (Ecamricert SRL, Italy).

Joining of Carbon Fibre Composites and Foams for Impact Energy Absorption

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Common property of composites and foams is their low specific weight. A utilization of these two materials in suitable combination allows the creation of lightweight impact energy absorbers where composite layers advantageously distribute impact forces into foam layers. This paper deals with carbon fibre reinforced plastic (CFRP), expanded polystyrene (EPS), and open-closed cell foam (OCCF). EPS is crushable foam commonly used in personal protective equipment, OCCF is modern energy absorbing material having different mechanical response according to strain rate. The aim of this work was the investigation of the impact force response of these materials. The response was investigated experimentally using a drop tower designed by the authors and numerically using the finite element method in ABAQUS software. The obtained results were used in design of a versatile sport helmet. The helmet consists of outer CFRP shell, EPS liner which fit tightly the CFRP shell, and inner OCCF liner (see Fig 1).

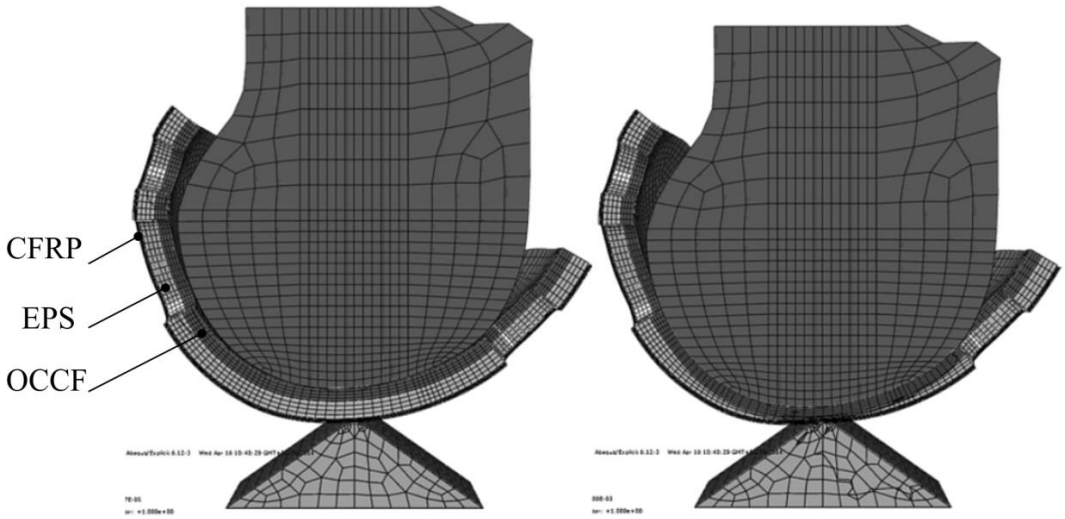

Fig. 1. Numerical simulation of helmet test according to ČSN EN 1078 (before and during impact).

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Increasing the Tensile Strength and Elongation of 16MnCrS5 Steel Using Genetic Programming

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Štore Steel Ltd is one of the largest spring steel producers in Europe. Štore Steel makes more than 1400 steel grades, with different chemical composition. Among them is 16MnCrS5 steel, which is generally used for the fabrication of case-hardened machine parts for several applications (e.g. bars, rods, plates, strips, forgings) where combination of wear resistance, toughness and dynamic strength is essential. These qualities can be easily correlated with tensile strength, which depends on chemical composition and heat treatment after rolling. Also elongation should be taken into account. In the paper, modeling of tensile strength and elongation with genetic programming is presented and compared with linear regression modeling. The chemical composition (content of C, Mn, S and Cr) and heat treatment regime (GKZ and BG annealing) data were used for modeling. According to modeling results, higher tensile strength with improved elongation was achieved.

Distribution of Al_2O_3 Reinforcement Particles in Austenitic Stainless Steel Depending on Their Size and Concentration

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Austenitic stainless steel reinforced with 0,5, 1,0 and 2,5 wt% Al_2O_3 particles was produced by conventional casting route. The purpose of this investigation was to study the influence of reinforcing Al_2O_3 particles concentration and size on their distribution in reinforced austenite stainless steel. In this study, an innovative pre-dispersion approach for the addition of nanoparticles into a steel melt was designed. To ensure that the Al_2O_3 particles would be homogenous dispersed in steel matrix, CaSi particles were used as the pre-dispersion medium.

In the frame of this work, austenitic stainless steels dispersed with Al_2O_3 particles were produced by conventional casting method and their microstructure investigated with light microscopy (LM), scanning electron microscopy (SEM) and auger electron spectroscopy (AES) techniques. The ImageJ commercial software was used to calculate and determine the particles distribution. Based on the experimental results the dispersion of the Al_2O_3 particles in the steel matrix is non-homogeneous and concentrated in certain areas. With the EDS and AES analysis it was confirmed that the bright, small spot-like features represent the Al_2O_3 particles, without any clear indication of intermetallic reactions between the particles and the steel matrix. The results of the particle distribution analysis show that at the mass fraction 0,5 to 1,0 wt% of Al_2O_3 with a mean particle size of 500 nm and 50 nm, respectively, the distribution of particles is relatively homogeneous throughout the cast ingot with a very small deviations. However, when the mass fraction has increased to 2,5 wt% the concentration ratio of particles distribution decreases toward the bottom of the cast ingot. In this case also the size of particles starts to play a role, the larger particle size leading to an increased degree of incorporating particles in the steel matrix. Larger the particles more particles are found in the cast ingot. Results indicate that the Al_2O_3 particles are more homogeneous distributed in the case when CaSi particles were used as pre-dispersion medium.

Keywords: nano-particles, microstructure, reinforcement, steel

Experimental Analysis of the Influence of Concrete Curing on the Development of its Elastic Modulus over Time

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The modulus of elasticity is one of the most important properties of concrete, especially during structural analyses of buildings. It is, among others, an important parameter in the calculation of concrete element deflection or during the design of pre- or post-tensioned structures. The modulus of elasticity is not a specific number. It is a property with a high variability of the final values, which depends on concrete composition (together with other factors). Some of the significant factors, which influence the final value of the elastic modulus of concrete, are also the means and quality of its curing, especially at the early stage of its setting and hardening. Apart from maintaining the temperature within the correct limits, it is important to focus on the moisture content of the concrete while it is being cured.

The purpose of the experiment being described was to determine the development of the dynamic as well as static modulus of elasticity for structural concrete with different curing methods over time. The experiment used 4 series of prism-shaped specimens of the nominal dimensions of 100 × 100 × 400 mm made from air-entrained and non-air-entrained concretes of the C 30/37 strength class. A half of the specimens in each series were exposed to laboratory conditions during curing and the other half was stored under water. Based on the evaluation of the experimental measurements, it can be said that the manner of storage has a significant influence on the development and final values of the static and dynamic modulus of elasticity.

1. Rui Vasco Silva, Jorge de Brito, Ravindra Kumar Dhir, *Journal of Cleaner Production,* **2016,** *112,* 2171-2186.
2. Yong Zhou, Jie Gao, Zhihui Sun, Wenjun Qu, *Construction and Building Materials,* **2015,** *98,* 137-145.
3. Bao Dong Liu, Wen Juan Lv, Lin Li, Peng Fei Li, *Construction and Building Materials,* **2014,** *69,* 133-142.
4. Mohd. Shariq, Jagdish Prasad, H. Abbas, *Construction and Building Materials*, **2013,** *41,* 411-418.
5. Samir N. Shoukry, Gergis W. William, Brian Downie, Mourad Y. Riad, *Construction and Building Materials,* **2011,** *25,* 688-696.

Bimorph Single Crystalline Piezoelectric Actuators for Scanning Probe Microscopy

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Modern nanotechnologies are impossible without scanning probe microscopes (SPM). These devices give an opportunity to study objects with atomic resolution and to modify a surface. One of the most important parts of SPM is piezoelectric positioning system. Usually this system is based on actuators made of PZT-ceramics. However, such disadvantages of ferroelectric PZT ceramic as creep, non-linear character of deformation vs. applied voltage dependence, narrow range of operating temperatures limit the possibility to create highly precision actuators based on this material. On the other hand, piezoelectric single crystals do not possess these drawbacks, demonstrate high thermal and electrical stability and almost do not degrade but have too low piezoelectric coefficients. Previously several methods to solve this problem were presented [1-3]. One of them is formation of bidomain structures in plates of ferroelectric crystals such as lithium niobate ($LiNbO_3$) and lithium tantalate ($LiTaO_3$) [3]. The bidomain plates with appropriate quality bend according to bimorph scheme when voltage is applied. In this study, we managed to create single crystalline bidomain actuators of large area (up to 10 cm^2) in plates of 0.5 mm thickness. The actuators demonstrated strongly linear dependence of deformation on applied voltage without hysteresis and creep. Movements up to 1000 μm were reached when the actuator was fastened as a console. Bimorph actuators based on single crystal lithium niobate and lithium tantalate can be used for exact positioning in probe microscope devices, for laser resonators adjustment and as wave guides with exact variable geometrical characteristics.

1. A. Kawamata, H. Hosaka, T. Morita, *Sensors Actuators A Phys.*, **2007**, *135*, 782–786.
2. V. Y. Shur, I. S. Baturin, E. A. Mingaliev et al, *Appl. Phys. Lett.*, **2015**, *106*, 053116.
3. A. S. Bykov, S. G. Grigoryan, R. N. Zhukov. et al., *Russ. Microelectron.*, **2014**, *43*, 536-542.

Impact Toughness of Laser Welded Butt Joints of New Grade Steel STRENX 1100MC

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Continuous and dynamic development in the field of steel metallurgy, plastic forming, and heat treatment leads not only to improve mechanical properties and overall performance of modern structural steels, but also to implementation of completely new grades of advanced high strength steels (AHSS) and super high strength steels (SHSS), such as STRENX 1100MC. This new steel grade shows the strength and yield point (1100 MPa) of quenched and tempered low alloy steels, while the low carbon equivalent at a level similar to the typical thermomechanically rolled, fine-grained, microalloyed steels. To be able to use such high strength and performance of this steel grade in practice, it is necessary to provide at least similar properties of the welded joints. However, there is currently no method of conventional arc welding, which would be able to provide such high mechanical properties of welded joints. Therefore, the industry attention is focused on laser welding, which offers a much wider technological capabilities. However, so far there is no information about laser welding of the new grade STRENX 1100MC steel. Therefore, the detailed influence of energy input of autogenous laser welding by means of a modern disk solid state laser on the structure of weld metal, heat affected zone and mechanical properties of 5.0 mm thick butt joints of STRENX 1100MC was studied. Laser welding trails were conducted in a wide range of energy input from approx. 100 up to 400 J/mm. The studies have shown no tendency to cracking of butt joints, despite low energy inputs of laser welding. However, a significant decrease of hardness was reveled in the heat affected zone. The static tensile strength was found to be little lower (approx. 8% lower) compared to the tensile strength of the base material. It was also found a strong relationship between impact toughness of the test joints and energy input of laser welding. However, the impact toughness of laser welded joint was significantly lower compared to the base material. The article attempts to explain the drop in toughness and static tensile strength with respect to the structural transformations of weld metal and heat affected zone, depending on the welding parameters, especially energy input, and thus heat conditions of welding.

Technology Reduction chromium from high chrome slag by reducing agents Si and C in the atmospheric induction melting furnace by using oxygen fuel burner

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The present paper presents the design, implementation and subsequent analysis of experiments based on theoretical calculation and comparing it with actually achieved degree of reduction in chromium slag. Main goal of the work is chromium reduction from the slag with a high content of Cr_2O_3 by using reducing agents carbon in the form of anthracite and silicon in the form of ferroalloys of FeSi. Reduction Technology of chromium from slag was proposed and experimentally realized for transmission to a big metallurgical unit electric arc furnace. Average contents of elements in the melt during the reduction amounted to 16 % Cr, 5 % Ni and 1 % Mo. In an atmospheric induction melting furnace experimental melting were made performed by using an oxygen fuel burner which was designed a made for those experiments.
Key words: Stainless steel, slag, chromium, carbon, silicon, ferrosilicon

Synthesis-Related Properties of the Spark Plasma Sintered Electroconductive ZrO_2/TiN Ceramic Composites

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Fully dense 3 mol% yttria-stabilized tetragonal zirconia (3Y-TZP; ZrO_2) ceramics is difficult and expensive to machine with conventional machining techniques, such as grinding and cutting with diamond tools, due to its superior mechanical properties. An alternative is using electrical discharge machining capable of machining of dense ceramics. However, the requirement which has to be fulfilled is achieving appropriate electrical conductivity (above 10-30 mS cm^{-1})[1] of the otherwise insulating material. This can be achieved by incorporation of an electro-conductive phase into zirconia matrix.[2,3] However, the appropriate amount of the electro-conductive phase (in our case TiN) should be homogeneously introduced into the zirconia matrix to provide the necessary conductivity, while not significantly deteriorating the material`s excellent mechanical properties.
In the present study various synthesis routes will be presented for the preparation of ZrO_2/TiN powders with different amounts of TiN. The synthesized powders were then sintered in the Spark Plasma Sintering furnace to obtain dense ZrO_2/TiN ceramic composites. The samples were analyzed for microstructural homogeneity, relative density, grain size, phase composition, indentation toughness and hardness and for the electrical conductivity. It will be shown that the synthesis-related homogeneous distribution of the nanosized TiN particles in the ZrO_2 matrix is a prerequisite for the preparation of the electro-conductive ZrO_2/TiN ceramic composite by Spark Plasma Sintering. When attained, the zirconia ceramic composite with decreased amount of conductive phase can be prepared and thus preserving mechanical properties while being suitable for electrical discharge machining.

1. König W., Dauw D.F., Levy G., Panten U., *Ann. CIRP*, **1988**, *37*, 623–631.
2. Salehi S., Van der Biest O., Vleugels J., *J. Eur. Ceram. Soc.*, **2006**, *26*, 3173-3179.
3. Vleugels J., Van der Biest O, *J. Am. Ceram. Soc.*, **1999**, *82*, 2717–2720.

A Study on the Effect of Additive Composition on Copper Pillar Morphology

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In the fabrication of semiconductor devices, Cu electroplating process has been extensively used for micro-interconnect formation process [1]. In general, Cu electroplating is performed in a acid plating bath made up of inorganic components (copper sulfate, chloride ion, and sulfuric acid) and organic additives including suppressor, accelerator, and leveler. The organic additives play very critical roles in changing the shape, uniformity of deposits [2]. In the case of Cu pillar for flip chip packaging, a flat surface on the top of Cu pillar is required for implementation of the stacking materials like Sn-Ag solder [3].

In this study, Cu pillar with flat surface was successfully electroplated onto photoresist(PR) patterned Si wafer by controlling composition of the three organic additives. In order to understand mechanism of additive composition, correlation between characteristics of additives (functional group, molar mass, adsorption, and electrochemical behavior) and copper deposits was investigated by galvanostatic potential transient measurements, contact angle measurement, quartz crystal microbalance, confocal laser scanning microscopy and scanning electron microscopy. Based on above investigation, we will identify a key factor of additive composition on formation of Cu pillar, and apply electroplating technology to many part of electronic devices from wide pillar to fine-pitch micro-bump.

1. N. T. Nguyen, E. Boellaard, N. P. Pham, V. G. Kutchoukov, G. Craciun, P. M. Sarro, journal of micromechanics and microengineering **2002**, *12*, 395-399.
2. W.C. Chen, T.T. Huang, C.H. Lai, S.W. Chou, C.H. Shih, ECS Transactions, **2013**, *52*, 453-460.
3. S. Chung, E. Kuo, M. Tseng, IMPACT 2009. 4th International. IEEE, **2009**, 432-435.

Controlled Nitriding Used for Improving the Durability of the Steel Bushing Part

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Nitriding layers developed at 793K during gaseous nitriding of AISI4140 steels for the application of steel bushing part were investigated. The gas atmosphere of dissociation of ammonia gas was checked from nitriding potential (Kn), which could be obtained by observation of partial pressure of hydrogen gas. The microstructural evolution of compound layer were studied by using optical microscopy and scanning electron microscopy. The durability test was performed by using accelerated life test. It was observed that surface hardness was about 600Hv after nitriding treatment and case depth was about 0.5mm after nitriding treatment of 1440 min. The compound layer was composed of γ'(Fe4N) and ε(Fe2-3N). The thickness of compound layer was grown up to 16 μm simultaneously during nitriding treatment of 1440 min. The kinetics of compound layer growth was discussed with modified lehrer diagram of AISI4140 steels, which was obtained from the thermodynamic calculation. The steel bushing part which was developed by applying controlled nitriding had improved durability in comparison with steel bushing part manufactured by conventional nitriding process.

Preparation and Characterization of the Composite Based on Polyethylene and Surface Modified Oak Wood Flour

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The aim of this work was to improve interfacial compatibility of lignocellulosic material with medical polymers to improve the physico-mechanical properties. As the main modification method was applied plasma treatment that is non-toxic and quick method able to modify surface energy of filler or polymer matrix. Surface modification can be achieved by several methods, i.e.: mechanical treatment, flame treatment, wet chemical etching by strong oxidizing acids, corona or plasma treatment. The last listed method seems to be the most effective as well as environmental friendly. Plasma treatment of polymer materials in air as a carrier gas is an effective tool to modify the surface via incorporation of oxide containing groups onto the surface structure, i.e.: hydroxyl, carbonyl, carboxyl, ether, hydroperoxide, etc. Some of the groups are unstable and system leads to the reaction forming active radicals.
An oak wood flour was surface-modified by using non-thermal 40 kHz and 2.45 GHz plasma treatment. In order to evaluate the possible improvement of wood flour surface properties, the modification was performed with air as carrier gas. The untreated and treated samples were characterised by dynamic contact angle measurement and X-ray Photoelectron Spectroscopy (XPS). The overall outcome indicated slight chemical and physical surface changes, which vary according to the reactor frequency.

Fatigue Analysis of Electric Heating Element

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Electric heating elements are commonly used in environments, where precise control of temperature is required. Although the temperature in the heating element may vary significantly, resulting stress field fluctuations are usually well below yield strength of the material due to coil-like designs that allow as much free dilatation as possible. However, its importance can rise in cases, where a lot of heating cycles are involved. Depending on a control element settings, the heating element may undergo many cycles in a short time period, which combined with changing stress may lead to high cycle fatigue damage.

This paper investigates methods of fatigue prediction in tubular heating elements. Key part of every method is precise stress estimation. The stress is caused by uneven temperature distribution through the heating element tube wall, which is affected by balance of the heat generated in the tube and the environment. Analytical as well as finite element analysis solutions to the stress distribution are devised. The methods are applied to a particular case of heating element used in experimental apparatus, where precise temperature regulation is crucial. The resulting stresses and fatigue estimations are compared.

Improper settings of heating element controller can cause unexpected failure of the element, which is often quite expensive. Therefore, accurate failure prediction may aid operators in choosing controller setting that will keep the temperature within acceptable boundaries without significant reduction of the heating element lifetime.

Inclusion Flotation-Driven Channel Segregation in Solidifying Steels

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Channel segregation, which is featured by the strip-like shape with compositional variation in cast materials due to density contrast-induced flow during solidification, frequently cause the severe destruction of homogeneity and some fatal damage. An investigation of its mechanism sheds light on the understanding and control of the channel segregation formation in solidifying metals, such as steels. We discover a new force of inclusion flotation that drives the occurrence of channel segregation. It originates from oxide-based inclusions (Al_2O_3/MnS) and their sufficient volume fraction-driven flotation becomes stronger than the traditionally recognised inter-dendritic thermosolutal buoyancy, inducing the destabilisation of the mushy zone and dominating the formation of channels. This study uncovers the mystery of oxygen in steels, extends the classical macrosegregation theory, and highlights a significant technological breakthrough to control macro-segregation.

Effects of Rare Earth Elements on Graphite Formation in Thin-Walled Gray Cast Irons Containing High Mn Contents

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Recently, the necessity for the development of high strength thin-walled cast iron has been gradually increased due to the severe exhaust gas regulation such as EURO-6 and Tier-4. The regulation for the transportation systems issues was to accelerate research activities for development of high performance cast irons over GC250 grade in many countries such as Japan, Sweden and so on. In the metallurgical point of view, the most important and difficult technologies are to increase the carbon nucleation rate and to refine size of the nucleated carbon under high cooling rate in thin-walled cast iron. It was reported that the addition of optimum amount of rare earth elements promotes the carbon nucleation and disturbs the chill formation. When rare earth elements such as La and Ce are added S containing cast iron melt with high content Mn, the rare earth sulfide forms by the reaction between S and R.E. and Mn plays an important role during sulfide formation process. The rare earth sulfide can be an effective heterogeneous nucleation site for the carbon nucleation, so that the frequency of carbon formation and the strength are increased and microstructure are improved. In the present study, the effects of R.E. addition on carbon nucleation in cast iron with high contents Mn has been analyzed. The rare earth formation and carbon nucleation processes were observed by the quenching experiments. On the basis of the experimental results from the quenching experiments, we classified the types of rare earth sulfides and their roles. Also, the carbon nucleation step was proposed in view of (Mn, R.E.)S formation.

Microstructures and Archaeometallurgical Characterization of a Medieval Axe

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The manufacture of various types of metal tools is linked closely to the technological development of metallurgy. Characterization of materials used in the manufacture of tools found during archaeological excavations can provide valuable insight into the technological processes of ore extraction and metalworking. Iron-based products could be made by various means. Direct reduction ranks among the earliest methods of iron ore smelting. The reduction of iron ore at temperatures of approximately 1250 °C produces wrought iron. The iron lump, or bloom, was formed during the reduction in a solid state. Later, smelting techniques were developed that involved the production of wrought iron or steel by the refining of pig iron in a furnace. These techniques involved the liquefying of pig iron only.

The following contribution presents the results of analyses carried out on a medieval iron axe made by forging and forge welding. Investigations of historical objects shed light onto the metalworking techniques used by our ancestors, which are also part of our cultural and technological heritage. At the same time, they reveal innovative approaches to solving technological challenges. Innovation in production has always been a key factor in stimulating progress.

The Mechanisms of Hardness Increase of Composite Surface Layers during Laser Gas Nitriding of Ti6Al4V Alloy

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Laser gas nitriding (LGN) is considered to be one of the methods to improve tribological behavior of titanium alloys. However, a common problem during laser nitriding of titanium alloys in pure gaseous nitrogen is cracking of such layers, due to excessive hardness, as reported by many researches. Vickers hardness of laser nitrided surface layers on the substrate of titanium or titanium alloys may reach over 2000 HV, or even 2300 HV, as reported by S. Mridha, T.N. Baker and C. Hu [1,2]. Since the first trials of laser nitriding of titanium in the early eighties, numerous studies were carried out by means of different lasers operating at continuous wave or pulsed mode [3]. However, a few publications in the world literature can be found on application of the new generation of high power diode lasers in the process of titanium nitriding. Therefore the attempts of surface nitriding of the most commonly used titanium alloy Ti6Al4V by a high power laser with unique beam characteristics have been made. Crack-free titanium matrix composite surface layers were produce in a wide range of processing parameters. The microhardness level and its distribution across the layers depend on the processing parameters. The highest measured microhardness was 2400 HV 0.2 directly under the top surface of nitrided zone. It was found that hardness is dependent not only on the population and volume fraction of dendritic precipitations of titanium nitrides but also on the atomic ratio N/Ti in the TiN_X compounds. Since the titanium nitrides at stoichiometric ratio exhibit the highest hardness, the share of stoichiometric TiN determines the maximum hardness of the surface layers. Precipitation of stoichiometric titanium nitride requires a sufficiently long time and high amount of nitrogen, thus the highest concentration of TiN occurs in the region directly under the top surface of nitrided layers, near liquid/gas (gaseous nitrogen) interface.

1. S. Mridha S., T.N. Baker, J. Mater. Proc. Technol., 1998, 77, pp. 115–121.
2. C. Hu, T.N. Baker, Mater. Sci. Eng.,1999, A265, pp. 268–275.
3. S. Katayama, et al., Proc. of the ICALEO'83, USA, 1983; pp. 127–134.

Oxide Scales Damaging Evaluation

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Presented article is devoted to oxide scale behavior on tubes in the area of steam generation. The main attention is focused on methods for stress and strain estimation on inner tube surfaces (steam side). On-line diagnostic possibilities of these phenomena are discussed. Attention is paid to methods for estimation of acting strains which are commonly demanded by accessible methods for this degradation process evaluation [1]. The analytical solution of oxide scale layer behavior and its validation by finite element analyses is described in the article.

Oxide scales occurrence in power industry devices is very common. However, inappropriate operating conditions or material selection may lead to serious problems with existing oxide scales. Exfoliation (or another degradation process) of the oxide scales leading to tube blockage or erosion on turbine may occur [2].

Formation of hard and brittle oxides, namely magnetite (Fe_3O_4), is connected with high temperatures on steam side of the tube [3]. Reaction rate is rising with increasing temperature. Oxide scales act as insulator while thermal conductivity of the oxides is only 5 % of the base alloy thermal conductivity. To ensure output temperature of steam, it is necessary to increase flue gas temperature by 0.6–1.1 °C for every 0.03 mm of the oxide thickness [4]. This results in higher tube temperature due to insufficient cooling.

It is known, that even small increase of operation temperature may significantly decrease life-time of the device [5]. Therefore, detail knowledge of oxide scale behavior is very valuable for operation control and precise life-time planning.

1. M. Schütze, P. F. Tortorelli, a I. G. Wright, „Development of a Comprehensive Oxide Scale Failure Diagram", *Oxid. Met.*, roč. 73, č. 3–4, s. 389–418, dub. 2010.
2. S. R. J. Saunders a N. L. McCartney, „Current Understanding of Steam Oxidation - Power Plant and Laboratory Experience", *Mater. Sci. Forum*, roč. 522–523, s. 119–128, 2006.
3. Steve LABRECK, Dan KASS, Tom NELLIGAN, „Ultrasonic Thickness Measurement of Internal Oxide Scale in Steam Boiler Tubes", 2006.
4. T. J. Wardle, „Creep-rupture assessment of superheater tubes using nondestructive oxide thickness measurements", in *BR-1697 ICOLM (International Conference on Life Management and Life extension of Power Plants) Xian, PR China*, 2000.
5. P. J. Ennis a W. J. Quadakkers, „Implications of steam oxidation for the service life of high-strength martensitic steel components in high-temperature plant", *Int. J. Press. Vessels Pip.*, roč. 84, č. 1–2, s. 82–87, led. 2007.

Effect of RE on Inclusions in Highly Clean Bearing Steel

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Effect of different RE contents on inclusions in highly clean bearing steel was studied via adding highly pure rare earth elements. Inclusions in bearing steel were characterized and analyzed with metallographic microscopy, scanning electron microscopy, energy disperse spectroscopy and Image-Pro Plus software. The results showed that a suitable amount of RE can not only make inclusions more dispersed and smaller, but also modify irregular shaped Al_2O_3 and strip MnS into spherical or ellipsoidal rare earth-inclusions. With an increase in the RE addition, inclusions increase gradually in size and their morphology becomes more and more irregular, which lowers the metallurgical quality of highly clean bearing steel. In addition, increasing the RE amount causes the transition of main growth mechanism of inclusions from precipitation-grown to aggregation-grown. Considering inclusions modification and bearing steel performance optimization, RE contents in highly clean bearing steel should be controlled around 0.020% (mass fraction).

Simulation in Metallurgical Processing: Recent Developments and Future Perspectives

A. Ludwig, M. Wu, A. Kharicha

This plenary talk briefly addresses the most important topics concerning numerical simulation of metallurgical processes, namely, multiphase issues (particle and bubble motion and flotation/ sedimentation of equiaxed crystals during solidification), multiphysics issues (electromagnetic stirring, electro-slag remelting, Cu-electro-refining, fluid–structure interaction, and mushy zone deformation), process simulations on graphical processing units, integrated computational materials engineering, and automatic optimization via simulation. The present state-of-the-art as well as requirements for future developments are presented and briefly discussed.

Numerical Modeling of Continuous Casting of Steel with Mould Electromagnetic Steering

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Continuous casting of steel with mould electromagnetic stirring (M-EMS) is modeled in two steps. First electromagnetic field and force are calculated. Then the time averaged force is put into the liquid flow and solidification solver. This is possible since the time scale of electromagnetic field is much smaller than of the liquid flow and the effect of the conducting molten steel flow on electromagnetic field is small.

The majority of the previous work in this field was done with commercial software. Our group has already developed a meshless library for modelling turbulent liquid flow and solidification phenomena during continuous casting[1,2]. The easiest way to include M-EMS for a preliminary study has been with using already existing software. Open source FEM solver Elmer[3] was used.

The effects of M-EMS on the turbulent flow field in a geometry similar to the new 2015 Store Steel caster are shown.

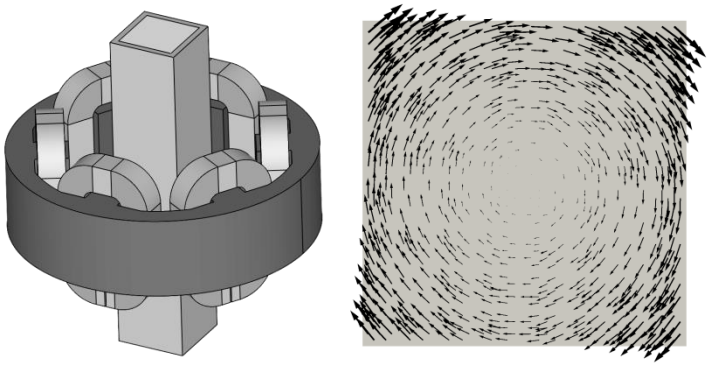

Figure 1: A sample geometry of the M-EMS (left) and the time averaged force on the horizontal plane in the mould (right).

1. R. Vertnik, B. Šarler, *Computer Modeling in Engineering and Sciences*, **2009**, *44*, 65–95.
2. R. Vertnik, B. Šarler, *IOP Conference Series: Materials Science and Engineering,* **2016**, *117*, 012069
3. Elmer — open source multiphysical simulation software. Available online at www.csc.fi/web/elmer (accessed 30 August 2016).

Permalloy Thin Films for AMR Sensors

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Magnetoresistance (MR) is a phenomenon that reflects the effect of external magnetic field on to resistance change of certain materials. Among know MR the anisotropic magnetoresistance phenomenon (AMR) is widely used in field of position sensors and encoders due to its robustness comparing to optical ones.

Response of AMR sensors strongly depends on properties of chosen soft ferromagnetic material. Very common materials are Ni_xFe_{1-x} alloys, known under commercial name Permalloy with typical concentration close to 0,8 when fulfills demands for high anisotropy and low critical coercitivity. Properties of thin layers however depend on deposition parameters (pressure, temperature, deposition rate, applied magnetic field), subsequent annealing and of course on the layer thickness. Conditions should be set in the way to obtain highly oriented crystalline structure. In absence of external field during film deposition the correct condition leads usually to the (111) preferred orientation of film with easy axis of magnetisation perpendicular to the surface. For other orientations of easy axis external magnetic field during deposition or subsequent annealing of 5 – 15 kA/m is essential.

In our work we concentrate efforts in order to sputter deposit permalloy films from $Ni_{80}Fe_{20}$ target without external magnetic field. Therefore we are limited in variation of only power and pressure, which which influence the deposition rate and constitution [1] of deposited films. Effects of subsequent annealing at temperatures from 150°C to above 400°C in 10% H_2nitrogen were studied too.

First results are encouraging as revealed by ad hoc measurements of response of single AMR resistor on to periodic magnetic field with period $2L$ = 4 mm.

1. A. V. Svalov, R. Aseguinolaza, A. Garcia-Arribas, I. Orue, J. M. Barandiaran, J. Alonso, M. L. Fernández-Gubieda, and G. V. Kurlyandskaya, IEEE TRANSACTIONS ON MAGNETICS, **2010**, VOL. 46, NO. 2, 333–336

The Fractographical Analysis and Numerical Model of Sub-surface Crack Formation

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The application of surface layers significantly improved the fatigue life in the high-cycle region. The main causes of an improvement of fatigue strength are high compressive residual stresses introduced within the diffusion zone. Since such layer hinders the dislocation motion, the predominant failure mechanism in high cycle fatigue region is the sub-surface crack growth. The sub-surface cracks are also typical features of fracture in the ultra-long high cycle fatigue. In the case of ultra-long fatigue, the sub-surface cracks are typical also for samples without surface treatment.
The sub-surface crack initiates on the non-metallic inclusion. In case of ultra-long fatigue, the crack growth is affected by the hydrogen embrittlement. This work deals with modeling of sub-surface crack formation. The finite element models are used for analysis of stress and strain state in the sample with internal crack during fatigue process. Most theoretical models of crack works with assumption that the crack initiation phase and crack growth phase are separated by precisely defined limit length of crack. Theoretical model which is discussed in this work, combines initiation and propagation phase, the definition of boundary length of crack is not needed for calculation of difference between the two phases of fracture process. Results obtained using the theoretical model are compared with the results of fractographical analysis. The influence of hydrogen embrittlement was simulated by changes in mechanical properties of materials during the fatigue process.
Acknowledgements The authors greatly acknowldge the financial suport provided by: Specific research project SV2016: *„Měření únavové pevnosti kovových materiálů pod korozí“.*

1. Stepan Major, Karel Slámečka, Marta Kianicová, Jaroslav Pokluda, *17th ECF*, **2008**, *17*, 1143–1148.
2. Karel Slámečka, Jaroslav Pokluda, Marta Kianicová, Stepan Major, *Int. J. of Fatigue*, **2010**, *32*, 921-928.

Study Of Modified Railway Wagon Side Using Composite Materials – Virtual Research Using FEM Method And Experimental Research Using Resistance Strain Gauge Technology

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This paper presents the methodology of experimental research in order to identify the behavior of the composite panel connections used to strengthen the side of the freight wagon. The study was divided into two stages, the first stage involved research in virtual reality using finite element methods, which aim was to identify states of deformation, stress, displacements and forces acting on the wall of the railway wagon model. For this purpose was created a geometric model of the positions and research object. The result of FEM analysis were points of comparison in which the resistance strain gauges placed on the experimental model the test bench and the wall itself. The second stage of the study included the restoration of loads that were broadcast on the computer model, on the actual model. The measurements were carried out using measuring equipment HBM MGC plus - registration of force and displacement and measuring chain using modules CANHEAD where measurements were made of all strain gauges. At the points where the clear was to determine the main direction of deformation, where glued uniaxial or biaxial strain gauges. While on the composite panels and steel plates where placed triaxial strain rosettes. Deformation of the rosettes were calculated in the DAQ software Catman to reduced tensions with the hypothesis von Misses. The results of both studies were compared, allowing fine-tune the computer model to further, more advanced research, thus reducing

Acknowledgements
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References

1. Buchacz A., Baier A., Świder J., Jamroziak K., Majzner M., Żółkiewski S., Wróbel A.: Experimental Tests of Chosen Fiber-metal Laminates. Monograph 374. Silesian University of Technology Press, Gliwice 2012.
2. An. Wróbel, M. Płaczek, A. Buchacz, M. Majzner, Study of mechanical properties and computer simulation of composite materials reinforced by metal, International Journal of Materials and Product Technology, 2015 vol. 50 iss. 3/4, pp. 259-275

Microstructural Changes of Turbine in Turbocharger

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During service time turbo chargers are loaded by complex mechanical and thermal stresses that reflect on microstructure. The study presents microstructural changes of turbine in turbocharger made from Inconel 713C. Optical microscopy and scanning electron microscopy was conducted in different places of turbine and showed microstructural changes like MC carbide decomposition and coarsening of γ' phase in interdendritic areas. In the hub of the turbine, MC carbides show little decomposition. But in upper part of the blades MC carbides were almost absent because of the higher temperatures. On the MC carbides and at the dendrite boundaries, phases rich in Cr, Mo and C were observed, most likely secondary $M_{23}C_6$ carbides. The γ' strengthening phase is uniformly distributed in γ dendrites and have cubic morphology in the hub of the turbine. While in upper parts of the blades, the coarsening of γ' is observed.

Examining the Springback Behavior of AA2024-T3 Alumimum Alloy Sheet Metal by Using Alternative Testing Method

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Geometric and dimensional accuracy of the sheet metal products is one of the main problems due to springback. Using the trail-and-error method to determine the amount of springback is still prevalent even it increases the product cost and also extends the production time. Therefore, developing new methods to obtain data about the springback properties of the specific material and predict springback deformations before the tooling design operations has a great importance in the industry. In the present study, a new and simple testing method was designed and tested to solve the signified problem. To that end, a kind of air bending die set was used. The bending tests were performed by using a CNC milling instead of press brake or tensile testing device which are typically used bendability studies. One millimeter thick AA2024-T3 aluminum alloy sheet was used as workpiece material. Bending velocity, angle and punch radius was stated as variables of experiments and final bending angle was used to examine the amount of springback. Also commercial simulation program eta/DYNAFORM 5.9.2 was used to investigate the usability of FEM tools for the new method. In the finite elements method, the shell element type of which element size is 4, was defined. Barlat was selected as the material model. The experimental and simulation studies showed that the amount of springback resembles to results calculated using springback formula that is used in literature. It is also observed that the springback properties of materials are affected by punch radius, bending angle and velocity. And as a result, the method could be suggested as a new tool to obtain more info about the material instead of trail-and-error method.

AES Analysis of PVD Deposited Spectrally Selective Nanocoatings

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Physical Vapour Deposition (PVD) was used to prepare surface modified metallic materials: multilayered spectrally selective coatings with individual layer's depth in nanolayer domain. Optical properties of the coatings on both types of substrate were found to perform well their intended function.

Coatings were deposited onto Cu and Al substrates. Deposited coatings were investigated by Auger Electron Spectroscopy (AES) profiling technique. Chemical composition as well as oxide state estimation along the profile were obtained from the measurements. For both types of substrates these results were found to be consistent with coatings profiles expected from the depositon procedure.

The sandwich Composite Structure Model for Low-velocity Impact

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The contribution is focused on finite element simulation of sandwich composite structure subjected to transverse low-velocity impact. The composite structure consist of fiberglass woven composite skin and low-density foam core. The user defined material model considering non-linear elastic and damage of composite skin was implemented into Abaqus software using VUMAT subroutine. The non-linear behavior of foam core was modeled using Low-Density Foam material model. Material parameters of composite skin and foam core were determined during previous work[1, 2]. The experimental testing of transverse low-velocity impact was performed on sandwich composite square plate using drop test machine designed by authors. The responses of sandwich plate in form of deflections in tree selected points on the upper skin surface were measured using laser sensors. The contact force-time dependency during the impact event was obtained using the force sensor in the head of impactor. The results between the numerical model of sandwich structure square plate and experimental data were compared. The occurrence of damage was visually compared too, the impact events ware recorded using the high-speed camera.
This publication was supported by the project LO1506 of the Czech Ministry of Education, Youth and Sports.

1. Progressive Failure Analysis of Composite Sandwich Beam in Case of Quasistatic Loading; Tomáš Mandys, Tomáš Kroupa, Vladislav Laš, *Materials and Technology*, **2014**, vol. 48, 593-597.
2. Identification of Material Characteristics of Sandwich panel; Robert Zemčík, Tomáš Kroupa, Hynek Purš, *Bulletin of Aplied Mechanics*, **2011**, *vol* 26, 26-30.

Modification of Polyvinylalcohol-acetate for Preparation of MDF Composites

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Paper deals with the modification of polyvinylalcohol-acetate for use in macrodefect-free composites (MDF). These materials are characterized by the absence of defects in the structure and high mechanical performance. Therefore, MDF composites are a promising type of material that could be used in the future for construction purposes. The basic deficiency of MDF composites is insufficient resistance to water or moisture, accompanied by a significant decrease in strength. Increased moisture resistance could be achieved by grafting suitable functional groups on the polymeric chain and the subsequent cross-linking. The study is focused on optimization of the number of functional groups and the cross-linking conditions. The number of grafted functional groups was determined by UV-VIS and FT-IR spectroscopy. The solubility of the cross-linked samples was measured by rheological measurements.

The Evaluation of Actual Tensile and Fracture Characteristics of Materials from the Results of Small Punch Tests

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The present paper summarizes the procedures described in CWA 15627 „Small Punch Tests Method for Metallic Materials“ Part B for determination of tensile and fracture characteristics of metallic materials from the results of Small Punch tests together with the corrections of this document proposed in the frame of its prospective conversion to European standard. The corrections were proposed on the base of the experiences obtained in the period 2007 – 2016 in MATERIAL & METALLURGICAL RESEARCH, Ltd.

Effect of Ball Milling on Properties of Porous Ti–26Nb Alloy for Biomedical Applications

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The current study has been investigating the effect of the ball-milling variable of time on the structural characteristics and pore morphology of a biomedical porous Ti–26Nb (at.%) alloy. A open-cell porous material has been synthesized by mechanical alloying and sintering. Commercially available elemental metal powders of Ti and Nb were used as starting materials. Elemental metal powders with a nominal composition of Ti–26Nb (at.%) were milled in a planetary ball mill. During testing the powders were milled for the two milling times: 50 and 70 h. Respectively, during the shorter time of milling was applied speed of 200 min^{-1}, and for the longer milling time was applied speed of 400 min^{-1}. The powders were cold pressing under 750 MPa pressure and next sintering at 1000°C for 24 h. The effects of milling time of powder on microstructure, mechanical properties of the porous structure were investigated by optic microscopy (OM), scanning electron microscopy (SEM), X-ray diffraction (XRD), microhardness, nanoindentation and nanomachining tests. Hardness and elastic modulus were calculated from the load–displacement data obtained by nanoindentation using a three-sided pyramidal diamond (Berkovich) indenter tip.
The X-ray diffraction results confirmed the presence of the α and β phases. Thorough analysis of the diffraction patterns revealed an increase lattice parameters for the 70 h of milling. In summary, it should be pointed that the material has a hierarchical structure, which was received at successive stages of milling. The observed grain are composed of many smaller grains, which size was decreased with increasing of the time of milling. Observation of the powder morphology after various stages of milling leads to the conclusion that with the increase of the milling time the size of the powder particles increases due to the predominance of cold welding over the fracture mechanism between the powders.

Acknowledgments
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Characterization of Nanometric-Sized Participates Formed During Heat Treatment of Aluminium Alloy

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Aluminium alloys are among the most frequently used materials in industry; this is due to their low weight and the high possibility of shaping their properties. These alloys have their properties through proper heat treatment, through which they obtain the fine structure with the high content of the precipitations. During age hardening of aluminium alloy, the precipitation process occurs and strongly influences on mechanical properties of alloys. Due to the small size, complex chemical composition and crystallographic structure, precipitation in aluminium alloys have not been characterized so far sufficiently. The aim of the article is to present issues related to characterization of participates occurs during age hardening of aluminium alloy with the addition of antimony, as the intermetallic phase component. Aluminium and antimony form an intermetallic phase AlSb, which may serve as the nuclei for crystallization growth of other precipitates. Furthermore, the addition of antimony enhances the contrast of TEM images.

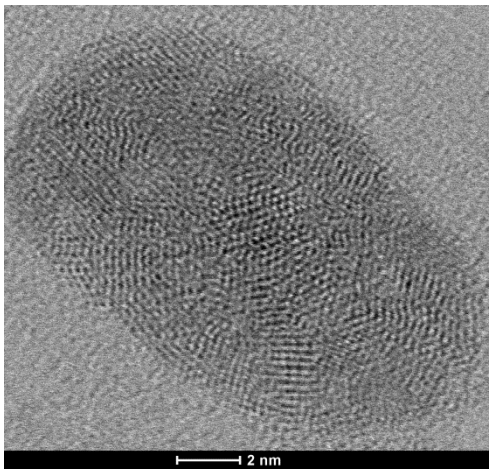

Fig. 1. BF image of nanometric intermetallic precipitate in aluminum matrix

Keywords: Phase identification, Precipitates characterization, TEM, Heat Treatment

Modelling of Viscoplasticity during DC Casting of Aluminium Alloys by a Meshless Method

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The plastic deformation due to small yield stress in the coherent mushy zone can result in hot tearing and cracking of the billet during DC casting process of aluminium alloys. This reduces the plant productivity and lowers the quality of the product. In recent years, a significant effort was invested in developing viscoplastic models of the DC casting process (1, 2).
In this contribution we apply the meshless local radial basis function collocation method (3) to the problem of viscoplastic deformations of the billet during DC casting. The new method has already been successfully applied to the modeling of solidification and macrosegregation (4), continuous casting of steel, including turbulent flows (5), electromagnetic breaking (6) and hot rolling (7).
The implemented viscoplastic model calculates deformations, stress and plastic strain of the billet during the steady-state of the semi-continuous DC casting process. The temperature field, which drives the viscoplastic phenomena, is calculated by the accompanying heat and mass transfer models. The assessment of the influence of the casting parameters on the plastic deformation of the billet is given.

1. Kumar et al., *Technische Mechanik*, **2011**, *32*, 342-357.
2. Hao et al., *Metallurgical and Materials Transactions A*, **2010**, *41*, 2067-2077.
3. Šarler, R. Vertnik, *Computers & Mathematics with Applications*, **2006**, *51(8)*, 1269-1282.
4. Kosec et al., *Computers Materials and Continua*, **2011**, *22*, 169.
5. Vertnik, Šarler, *Computer Modeling in Engineering and Sciences (CMES)*, **2009**, *44*, 66.
6. Mramor et al., *Computer Modeling in Engineering and Sciences (CMES)*, **2013**, *92*, 327-352
7. Hanoglu et al., *Procedia Engineering*, **2011**, *10*, 3173-3178

In-situ testing of waterproofing injection screens

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Almost all types of building structures in our environment are affected by rising wetness. Especially in old historical buildings this could produce huge problem in the statics. One of the most efficient and suitable solutions of this problem is to create waterproofing injection screen in the base of the structure. This screen is realized by gels, that are injected into the lines of boreholes and subsequently penetrates the building material thus create the screen that stops water from rising above it further into the structure.

Main object of this paper is testing of waterproofing injection gel in real life buildings and structures. Tested objects were for example building in areal of Faculty of civil engineering, apartment building, municipal house, chapel or brick fence.

1. MELICHAR, J.; DOHNÁLEK, P.; DROCHYTKA, R., Advanced Materials Research, **2014**, 1000, 219 - 222

Durability of Materials Based on Polymer-silicate Matrix and Lightweight Aggregate During Action of Aggressive Effects with High Temperatures

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During assessing the lifetime of newly developed building materials it is essential to focus on the possibility of a combination of several adverse effects simultaneously. Selecting the simulation realistic exposure conditions depends on the planned use of the material in the construction. Relatively common and frequent option is water containing chloride ions attack, when there are changes of positive and negative temperatures. Some structures are also at increased risk of fire or amplify its negative effects (e.g. transport tunnels). Scientific publications, which present the results of research into the problems of resistance of composites based silicate (cement) matrix, focus on the assessment of adverse effects and aggressive environment separately. The paper presents the results and findings of the research into monitoring the gradual degradation of newly developed composite materials. These materials are formed by a polymer-silicate matrix and mixture of fillers containing a significant proportion of lightweight aggregate. This aggregate is produced by self-burning of raw materials from alternative sources. The matrix also contained a greater proportion of alternative raw materials – specifically, high temperature ash and blast furnace slag. The proposed formulas were tested after various times of exposure in aggressive environments – 45 and 90 days. In every exposition time were tested materials:
reference (i.e. without adverse and aggressive exposure);
exposed repeatedly to the changes of positive and negative temperature and a solution of chloride ions (in common conditions – chemical defrosting substances);
exposed repeatedly to the changes of positive and negative temperature and a solution of chloride ions, followed by heat stress up to 1000 °C.
Assessment of degradation degree was carried out by the physico-mechanical, physico-chemical and microstructural methods. It was found that the alternating effect of negative temperatures, the water and chloride ions has not a significant influence on the decrease of thermal resistance of developed materials – polymer-silicate matrix based composites.

Properties Laser Welding of S420 and IF Steel Sheets

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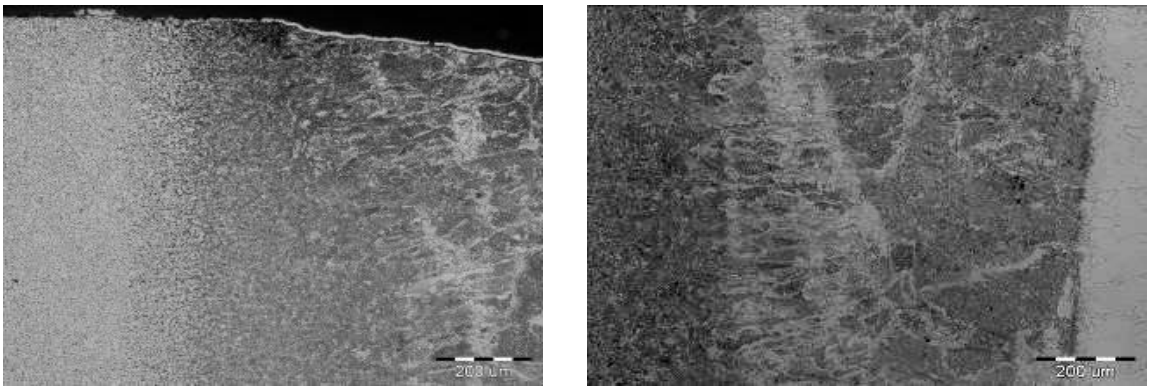
The study deals with two different kind of automotive steels HSLA steels. The first kind is Interstitial Free Steel (IF) from type of HSLA (High Strength Low Alloy) and the second one is S420 steel (Micro-Alloyed Steel). In this paper basic material parameters influenced by laser welding are taken. Laser welding does not influence significantly the strength, stiffness and absorbing capacity of steels. One of the options of complex assessment of welding property of non-alloy, micro-alloy, and medium-alloy steels to castings is a determining of carbon equivalent according to the relation (1):

$$C_E = C + \frac{Mn}{6} + \frac{Cr}{5} + \frac{Ni}{15} + \frac{Mo}{4} + \frac{Cu}{13} + \frac{P}{2} + 0.0024.a_0\ [wgt\%] \quad (1)$$

The metallographic analysis confirmed the formation of favourable structure of weld metal and heat affected zone. Obtained results showed that by laser welding method is possible to create the high quality welded joints with positive mechanical properties suitable for automotive industry.



a b

Microstructure of welded steel (a) HAZ on the S420 steel side, (b) HAZ and FZ

Acknowledgement
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The Effect of the Organic Additives on the Mechanical Fracture Properties and Shrinkage of Alkali Activated Slag Mortars

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It is known that the production of Portland cement consumes considerable energy and contributes a large volume of CO_2 to the atmosphere. One of alternative materials is alkali-activated binder using industrial by-products containing silicate materials. Alkali-activated slag binders have many advantages, but also have disadvantage as a high level of autogenous and especially drying shrinkage, which causes a deterioration of the mechanical fracture properties. This paper presents the effect of shrinkage-reducing admixture Peramin SRA 40, polymer polyethylene glycol 1000 and polypropylene glycol on shrinkage and mechanical properties of alkali-activated slag mortars. These admixtures were used in amount 0–2.0 % weight of slag. The results show that with increasing content of admixtures compressive and flexural strength decreased. On the other hand, promising results with respect of shrinkage reduction were obtained particularly for PPG where its 1 and 2 % doses reduced liner shrinkage of the reference mortar approximately by up to 70 %. The minimum decline of shrinkage was observed for 1 % Peramin SRA. Fracture tests with method of acoustic emission during this testing were explored.

1. Dakhane et al., Elucidating the Crack Resistance of Alkali-Activated Slag Mortars Using Coupled Fracture Tests and Image Correlation, 2016, vol. 99, No. 1, 273–280
2. Q. Li et al, Fracture properties and response surface methodology model of alkali-slag concrete under freeze–thaw cycles, Construction and Building Materials, 2015, vol. 93, 620–626

Deformation and Improvement of IR Transmission of Single-crystal Silicon by Direct Current Heating

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Pyroelectric infrared sensors, used in motion sensors and other similar devices, are required to efficiently detect infrared radiation with a wavelength of approximately 9 µm. Silicon produced using the Czochralski method (CZ-Si), can be obtained at low prices but can only be used for IR rays in a relatively narrow band around 1.2–6 µm since the oxygen eluted from the quartz crucible is trapped in the crystal, which results in the presence of absorption near 9 µm that arises from interstitial oxygen.
We confirmed that deformation occurred at about 800 °C when CZ-Si was pressure- and heat-treated by the pulse heating method (spark plasma sintering, SPS), while at the same time, the absorption peak of CZ-Si, which had been a major issue for the infrared transparent material in the vicinity of 9 µm, was also confirmed to have been reduced within a short of about 30 minutes time (see Fig. 1). The absorption coefficient in the vicinity of 9 µm, which was derived from the interstitial oxygen, decreased the most at 800 °C, and the absorption derived from the stretching mode of Si–O observed in the vicinity of 9.7 µm reached its maximum at 800 °C. This is considered to have been due to the migration of interstitial oxygen via clusters to change the material into amorphous SiO_2. We have also succeeded in manufacturing a silicon lens at around 800 °C, about 600 °C lower than the molding temperature for hot pressing method, by using a SPS system (see Fig. 2).

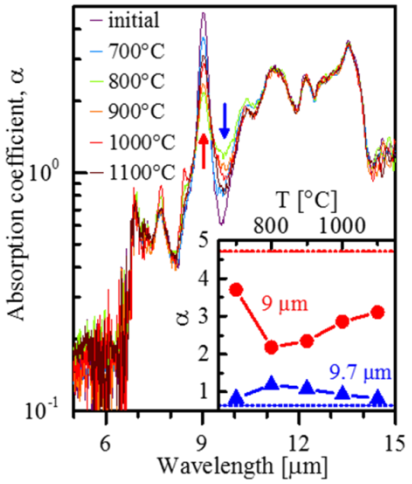

Fig.1 Relationship between attainment temperature and absorption coefficient

Fig.2 Si lens formed at 800 °C with SPS

The Effect of Environmental Properties on Surface Condition of Dental Archwire during Tribocorrosion

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During medical treatment dental archwires are exposed to different types of damage factors such as electrochemical processes and mechanical wear. Simultaneous action of corrosion and wear is called tribocorrosion. Environmental factors that affect electrochemical properties of dental alloys are the composition of saliva, pH changes due to frequent drinking of soft drinks, inflammatory state of the mouth tissue, etc. Wear of dental alloys is affected by the combination of the material of the dental archwire and brackets, eating and chewing habits. Also oral jewelry sometimes represents a treat due to possible galvanic effect of the combination of different metals in mouth environment.
Tribocorrosion experiments on two different types of dental archwires, stainless steel AISI 304 and NiTi alloy will be performed. Two different states, as-received and after in-vivo exposure, will be examined. The electrochemical testing will be performed in artificial saliva. To determine the effect of different oral environment, research on the presence of fluoride and various pH of artificial saliva will be included. Differences between states and materials will be determined with friction force measurements and current response during tribocorrosion experiments. Corrosion products and dental plaque will be analyzed with SEM/EDS analyses and optical microscope. Also, the leaching of metal species in saliva during long term exposer and during the simulation of wear will be conducted by ICP-MS.
The contributions of electrochemical, chemical and mechanical wear will be evaluated from tribocorrosion experiments. The effect of the environment, which can result in greater defects of dental archwires and thus cause complications in dental treatment, will be evaluated.

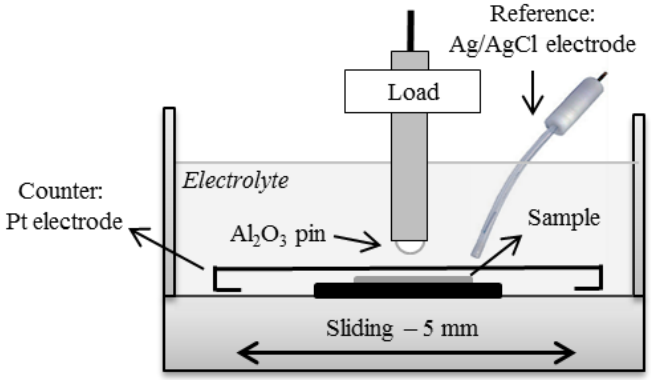

Figure: Set-up of tribocorrosion experiment

Identification of Hydration Products of Tricalciumaluminate Phase in Presence of Water Containing Chromium

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Tricalciumaluminate is the most reactive phase what means that it reacts as the first phase of Portland clinker in the whole hydration process.
The present of different metal oxides can change all hydration process. Chromium is always present component of Portland clinker not because it is added substance but it is contaminant coming from raw materials. Chromium is oxidized from (III) to (VI) during the burning of clinker. Hexavalent chromium is extreme toxic and cause skin irritation and allergic reaction. Therefore, the European Community Obligation (directive 2003/5C/EC) regulated that the soluble chromates level must not exceed 2 ppm limit. Reducing agents (most often ferrous sulphate heptahydrate) have to be used for reduction of hexavalent chromium.
The aim of this research was to describe the processes regarding hydration of Portland clinker, specifically focus on forming hydration products of C_3A in the present of hexavalent and trivalent chromium. Trivalent chromium ions were formed by addition of corresponding amount of ferrous sulphate heptahydrate.
This paper suggests the substitution of trivalent and hexavalent chromium into hydration products of C_3A. It was verified using UV/VIS analysis of solution acquired by filtration of hydration suspense. Almost all chromium was depleted in two minutes from the start of reaction. Identification of hydration products was carried out via Raman microscopy and subsequently confirmed by SEM-EDS.

3D Atom Probe Characterisation of Passive Layers on Stainless Steels

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Passive layers determine corrosion properties of many metals and alloys such as stainless steels, aluminum, titanium, and refractory metals and their alloys. Passive film structure, thickness and defect density is important to understand localised corrosion phenomena such as pitting, crevice and intergranular corrosion. The very limited thickness of passive films - in many cases in a range of a few nanometers - makes them difficult to visualise and to investigate them directly.
By means of 3D atom probe, passive layers have been investigated and characterised for different stainless steels with respect to chemical composition, thickness and structure. Results show that thickness and density of passive layers can vary significantly with alloying content and additional alloying elements such as manganese. Whereas a high chromium austenitic stainless steel is protected by a thick and dense chromium rich passive layer, high manganese austenitic stainless steels can show a thinner passive layer with several manganese rich sublayers.

The Use of a Laser Disc for Cutting Silicon Wafers

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The research studies in the photovoltaic field are oriented to reduce the costs of electrical energy produced with the use of photovoltaic cells to the level competitive to the costs of energy produced from conventional energy sources. It is necessary to eliminate the technological process with expensive and difficult to automate operations and replace them with cheap ones whose production can be automated to obtain the above objective. In various areas for instance in engineering not only in photovoltaic industry are widely used laser technologies. Laser processing has become a key technology for the industrial production of crystalline solar cells. Lasers are mainly used in photovoltaic for cutting wafers or silicon films, glass panels and as well thin-film modules. In the article were presented the preliminary arrangements of the influence of laser cutting of the quality of silicon wafers cut edges, to obtain their minimal deformation.

Highlights:

This paper presents the application of lasers in photovoltaics, mainly including laser cutting issues, which will be used to analyze the improve the quality of the cut edges of the silicon wafers using a rarely used for this purpose laser disk.

Laser cutting is one of thermal separation material methods used to produce the photovoltaic elements, which without additional processing are used for further processing.

The topography of both surface and cross section of formed edges of the wafers with laser using scanning electron microscope.

Width of the interstice of cutting wafers were measured using stereoscopic light microscope.

Roughness of the cutting surface of cross-section of sample was measured using confocal laser scanning microscope.

Root Cause Analysis of Superheater Tubes Failure

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Superheater tube failure is listed among major causes of fossil fuel fired boiler outage, therefore, it is necessary not only to identify and repair it in case of failure but also to eliminate the root cause of this problem. As there may be multiple reasons of failure in such exposed equipment as superheater, thorough investigation of more than one probable cause is usually required.
This article is focused on failure analysis of the boiler located in the chemical plant. After a leakage was discovered, several cracks on the superheater tubes were identified as its main cause. It was necessary to assess the extent of the damage, to detect the root cause of this damage and to propose corrective actions. Two problematic locations with cracks were identified during the visual inspection; the first at the superheater tube bends and the second in a weld joint between the superheater and a transfer pipe.
As a first step, material microstructure and composition analyses of tubes were carried out in those critical locations. Even though small weaknesses in microstructure were found, the main cause of the tube failure was not identified. As the next probable cause, thermal dilatation stresses were investigated using finite element analysis (FEA). The support system, consisting of fixed, spring and sliding supports as well as the compensator were included in the analysis that confirmed the thermal dilatation stresses as the major cause of the failure. Based on the results, a new technical solution of supports was suggested and verified by FEA.

Improved Manufacturing Techniques and Use of Materials Based Cluster Systems

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In modern conditions of intensive development of new production technologies and the use of different materials, including nanomaterials, the challenge of choice and methodologies to solve this problem. One of these methods is the use of cluster approach [1], which is widely used in various industries and is based on a systems theory, decision-making criteria [2] and synergy [3]. This substantial essence due to the ability to create a single system optimized set needed for the values of technology, methods of manufacture of any product of the highest quality and availability management adapted to ensure minimum energy costs and maximum performance implementations of the final project. Effective use of the clusters is constrained by lack of information on the cluster system that is especially true in the construction industry, limited skills and experience in established and participation in the activities of such systems. The main areas to overcome this situation is increasing the degree of awareness that can be achieved through the implementation of information management transactions, online promotion and conduct targeted workshops, outreach activities and joint projects with organizations that make up the sectoral structure of the cluster. As part of these areas the authors made relevant research in the development and implementation of the cluster approach on the example of the structure of low buildings with high quality advanced materials by creating a new system of representation in the form of building products with low levels of energy to create and operate it in the real world. The results of the research are: increasing the level of awareness and training potential participants in the cluster; develop criteria for assessing optimizing the management decisions of a cluster in order to improve production technology and application of advanced materials.

References

[1] - Sokolenko S.I. Clusters in the global economy/S.I. Sokolenko// - K .: Lohos. 2014.- 848s.
[2] - Nazarenko I.I. System analysis of technical objects/I.I. Nazarenko, V.N. Harnets, A.T.Sviderskyy and others.// - K .: KNUCA, 2007.- 156s.
[3] - Nazarenko I.I. Design and construction of machines and equipment for processing industries/I.I. Nazarenko, I.N. Bernik// - K .: Publishing House “Word”, 2014.- 546s.

Study of Thermal Technical Properties of Insulating Materials Based on Organic Fibers with Respect to Type and Properties of Row Fibers

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Properties of fibrous insulation materials are dependent on type and kind of fibers of which they are composed. In the field of materials based on organic fibers must also often take into account the fact that the resulting material properties are affected not only by selecting a suitable kind of fibers, but also selecting a suitable type of fibers of one type. Individually type and kind of fibers are not different only in size but also in their structure. Some types of fibers are porous and have a significantly different behavior from the inorganic fibers.
The paper describes results of research work and study of thermal mechanical properties of insulating materials based on organic fibers with respect to type and properties of row fibers.

Analysis of High-Alloyed Steels Microstructures Produced by Processing in the Semi-Solid State

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Semi-solid processing of steels is not widely used in practice due to its technical complexity. But thanks to unusual process conditions and rapid solidification, it is possible to produce unconventional microstructures even on conventional steels. Mini-thixoforming is an innovative method of forming a small amount of the material. It enables production of components of complex shape with excellent mechanical properties. Hard formable materials, such as steels produced by powder metallurgy, were processed by this method. Using steels with appropriate alloying, it is possible to achieve unique microstructures. Their main advantage is elimination of carbide network. In contrast with conventional microstructures of high-alloyed steels, the carbides of thixoformed steels are distributed in the austenitic matrix. Furthermore, certain volume fraction of martensite occurs in the microstructure in the form of M-A constituents. The main principle of developing this type of microstructure is to use high-temperature carbides, mainly vanadium-based ones. For a better understanding of microstructure development depending on the influence of alloying elements, a detailed chemical analysis was performed. The 3D display of chemical analysis shows structural distribution of individual elements in the volume of these materials after mini-thixoforming. To complement the information on the phase state of the microstructure, X-ray phase analysis was also performed.

LIFE+ RusaLCA – An Advanced Water Purification Method with Utilization of Zero – Valent Iron Nanoparticles

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The aim of the project is to reduce the consumption of drinking water from natural sources by utilization of municipal wastewater, which is cleaned in the conventional small aerobic wastewater treatment plant (SWTP), in order to make it suitable for reuse. Nowadays this water is not suitable for reuse due to a high content of microorganism, organic matter and inorganic substances. Within the scope of the LIFE+ RusaLCA project, the innovative approach of nanoremediation of water from SWTP with utilization of nanoparticles of zero – valent iron (nZVI) has been extensively studied. Different types of nZVI exist, depending of the synthesis procedure (top-down vs. bottom-up approach). Generally, they all have diameters of approx. 50 nm and a body-centered cubic elemental iron core (Fe^0), which is enveloped by a shell consisting of iron (hydr)oxides. However, they have different content of available Fe^0 and of trace elements. They also differ among themselves in the degree of crystallinity, reactivity and in their microstructural characteristics. These distinctions are reflected in effectiveness and efficiency of specific type of nZVI for water remediation as we have proved with our experimental work. Generally, all nZVI types induce same nanoremediation mechanisms that are based on Fe^0 corrosion reactions. Dissolved Fe^{2+} triggers Fenton's chemical reaction, which produces reactive oxidative species that inactivate bacteria and degrade organic matter. The inorganic contaminants are reduced to less mobile and bioavailable species, are adsorbed onto surface sorption sites, or are co-precipitated with iron hydroxides. Nanoparticles are after nanoremediation transformed into non-reactive agglomerated iron hydroxide micro-particles that are separated from the water by sedimentation.

The major differences among different types of nZVI, that influence effectiveness and efficiency of water nanoremediation, are availability of Fe^0, degree of crystallinity, and their chemical composition. Some types of nZVI proved to be insufficiently reactive, and some even released toxic trace elements during nanoremediation. Nonetheless, it was proved that nZVI is a powerful tool for water remediation.

Softening Kinetics in the Process of Relaxation of Stresses after Hot Deformation of HSLA Steel

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The paper presents the results of investigations concerning the hot plastic deformation of HSLA steel (0.16%C, 1.48%Mn, 0.037%Nb, 0.004%Ti, 0.0098%N), particularly the kinetics of static thermally activated processes. The influence of the parameters of hot deformation and the duration of isothermal holding on the steel softening by the relaxation of stresses have been investigated [1, 2]. The tests were performed making use of the compression method, applying a simulator Gleeble 3800. The relaxation was tested during the isothermal holding after the hot compression of HSLA steel at a strain rate of 1.0 s^{-1} and temperature of 850÷1100 °C, the degree of deformation amounting from 0.14 to 0.6 after austenitizing at 1200 °C. The results of soft annealing have been gathered in RTT diagrams (Recrystallization, Temperature, Time). Besides that the samples were metallographically observed using a light and transmision electron microscope (TEM). The tests were carried out on samples previously cooled down immediately after their deformation and relaxation. It has been found that in the course of isothermal holding of the steel there occurs a recovery and static and metadynamic recrystallization. The kinetics of these processes depend mainly on the temperature and degree of deformation of the steel. An essential refinement of the prior size of the austenite grains was detected at the temperature of deformation amounting to 900 °C and the strain ε in the range from 0.4 to 0.6.

Reference

[1] L.P.Karjalainen, J.Perttula, ISIJ Internationale, Vol. 36 (1996), No.6, pp. 729-736
[2] E.Kalinowska-Ozgowicz, Structural and mechanical factors of the strengthening and recrystallization of hot plastic deformation of steels with microadditives, Open Access Library, Volume 20 (2) (2013) 1-146

Simulation of the Manufacturing Process of Mechanically Lined CRA Pipes

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Mechanically lined or sleeved corrosion resistant alloy (CRA) pipes are used for onshore and offshore oil and gas flow lines and pipelines. The major advantage of this type of pipelines is a typically 30-60 % lower cost than the cladded pipes due to the use of mechanical bonding instead of metallurgical bonding. In addition to cost reduction, the manufacturing time is shorter than that required for the metallurgical bonded CRA pipes. However, lateral buckling of the liner in mechanically sleeved CRA pipes caused by thermal heating and internal pressure is a serious problem which needs to be resolved. Lateral buckling is directly related to the gripping force between the CRA liner and the carbon steel pipe. It is known that establishing higher gripping forces eliminates the buckling problem. The most effective way to achieve such high forces is by the thermo-hydraulic expansion process. In this study, simulation of the manufacturing process of mechanically lined CRA pipes is performed using the commercially available ABAQUS^{TM} finite element software. Process parameters such as the hydraulic pressure, process temperature and cooling rate are investigated. Results reveal that increasing the temperature differential between the two pipes, or shortening the hydraulic loading and unloading time durations is helpful to increase the residual contact pressure.

Technological aspects of manufacturing of ultra-fine CP Titanium GRADE 2 using CONFORM SPD and rotary swaging

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SPD (Severe plastic deformation) processing of materials offers great potential associated with enhancement of their properties by refining the initial grain structure. The present experiments involved mechanical working of commercial-purity titanium by the CONFORM SPD technique, which is one of the SPD methods, and by rotary swaging. The CONFORM SPD processing was carried out in the 180–220 °C temperature interval. The objective was to work the material at as low temperatures as possible in order to avoid softening processes, and to accomplish maximum strengthening through microstructure refinement. Three passes through the machine were completed. The greatest degree of work hardening was achieved in the first pass. In the next passes, the contributions from work hardening were minor. The processing in the CONFORM SPD machine did not reduce the ductility of the material. Subsequently, the wires were rotary-swaged. The response of their properties was markedly different. The reason is that rotary swaging does not belong to SPD techniques. It causes rapid work hardening and reduces the ductility of the material.

1. KUBINA, Tomáš, Jaromír DLOUHÝ, Michal KÖVER, Mária DOMÁNKOVÁ a Josef HODEK. PREPARATION AND THERMAL STABILITY OF ULTRA-FINE AND NANO-GRAINED COMMERCIALLY PURE TITANIUM WIRES USING CONFORM EQUIPMENT. *Materials and technology*. 2015, **2015**(49), 1-5. ISSN 1580-2949.

Thermal And Oxidation Stability of Phenolic Resins as a Binder for Tap Hole Clay for Blast Furnace

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The aim of this study is to investigate the stability of a phenolic resins used as a binder in carbon ceramics used in tap hole clays for blast furnaces.

The tap hole clays are normally made from mixture of inorganic refractory materials such as chamotte, sand, graphite, silicon carbide (SiC) … and organic binders. As binders are used tar, pitch and other tars distillation products together with phenolic resins (novolacs and resoles) which are used in order to increase the hardening speed. Unfortunately the tar and its products contain an amount of benzo[a]pyrene and other carcinogenic compounds. It leads to the tendency to lower the portion or completely replace the tar in mixtures. The main problem of use only phenolic resins is their lower thermal and oxidation stability. The possible solutions for it are stabilizers and additives, which improve the properties of binders during heat treatment.

In order to investigate the influence of the various additives and stabilizers on the properties mentioned above, the simple system based on the phenolic resin (novolac or resol type), sand, SiC and additives were prepared. They were cured and fired at various temperatures in air atmosphere to obtain the information about the oxidation stability. The information about the thermal stability of phenolic resins with additives was obtained by differential thermal analysis together with thermogravimetric analysis, which describes the changes of pure phenolic resins.

1. Qilang Lin, Jintu Li, Youjie Yang, Zhihuang Xie, *Journal of Analytical and Applied Pyrolysis*, **2010**, vol. 87, Pages 29-33
2. Tzu-Tsung Tseng, Hong-Mao Wu, Chun-Nan Chen, Chia-Chin Cheng, Jun-Yen Uan, Weite Wu, Wenjea J. Tseng, *Ceramics International*, **2012**, Volume 38, Pages 967-971
3. C.S. Bitencourt, A.P. Luz, C. Pagliosa, V.C. Pandolfelli, *Ceramics International*, **2015**, vol. 41, Pages 13320-13330
4. Feng Liang, Nan Li, Xuan-ke Li, Wen Yan, *New Carbon Materials*, **2012**, vol. 27, Pages 283-287
5. Ichitaro Ogawa, Takayoshi Yamamoto, Tsuyoshi Hagio, Hisayoshi Yoshida and Kazuo Kobayashi, Yogyo-Kyokai-Shi, *International Journal of High Technology Ceramics, **1986***, vol. 2, Page 323
6. Han, Fa, Wen Dong Xue a Xiao Xiao Huang, *Advanced Materials Research*, **2011**, Pages 660-664

Scanning tunneling microscopy studies of ultra-thin $SrTiO_3$ films on Si(001) grown by PLD

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Epitaxial $SrTiO_3$ (STO) films grown on Si(001) can serve as pseudo-substrates for the integration of multifunctional oxides with Si and can lead to the development of novel devices exploiting different functionalities on a single chip. STO has a unit cell that closely matches a large number of complex oxides that exhibit properties like ferroelectricity, high-temperature superconductivity and piezoelectricity, and have a wide variety of technological applications. Epitaxial STO films on Si have conventionally been manufactured by molecular beam epitaxy. An alternative method that offers tunable deposition rates and stoichiometric transfer is pulsed-laser deposition (PLD), which, however, results in only a limited quality of the layer. Furthermore, to the best of our knowledge, no study on the morphology and local structural properties of STO layers on Si at different growth stages have been reported that could enable us to improve the structural quality of the STO.

In our study the Si(001) substrates are prepared first by depositing a ½ monolayer (ML) of Sr on the clean and reconstructed surface, in order to passivate its reactivity and to reduce the lattice mismatch between the STO and the Si. The subsequent growth consists of cycles with separate stages that include the deposition of the STO, its oxidation and, finally, high-temperature recrystallization. The influence of the number of pulses per oxidation and recrystallization stage on the STO crystallinity, interface structure and composition, as well as the surface morphology, have been studied, and it has been found that the best results are achieved in the case when the thickness of the separate layer is limited to 2 MLs with an oxygen pressure of 10^{-6} mbar and a temperature below 500–545 °C. The main contribution of the study is based on a unique *in-situ* analyses of the as-prepared samples, which provide us with a better insight into the growth mechanism of STO on Si and to further improve the final quality of the layer.

Characterisation of Biodegradable FeMn17 alloy

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Biodegradable alloys are required for medical applications involving temporary implants that must last for a certain time period. Fe-based alloys were produced to last longer than Mg- or Zn-based alternatives, while retaining a biodegradable characteristic so that no additional operation is necessary in order to remove the implant. This investigation of commonly used Fe-based alloys was directed towards a better corrosion resistance; while our aim was to produce a material that will corrode easily, but would initially still have mechanical properties like Fe-based materials.
The purpose of this research was to evaluate the biodegradability of cast FeMn17 alloy processed by hot rolling and annealing. Hot rolling and annealing influenced mechanical and corrosion properties of produced FeMn17 alloy. Corrosion behaviour and in vitro biodegradability were investigated by light microscopy, scanning electron microscopy, X-ray diffraction and immersion tests in Hank's solution. Compared to pure Fe, cast FeMn17 alloy has better biodegradability (higher corrosion rate). We showed that hot rolling additionally improves biodegradability, while annealing process lowers biodegradability of FeMn17 alloy.

Monitoring Thermal Loaded Concrete Specimens by Acoustic Emission Method

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Fire response of concrete structural members is dependent on the thermal, mechanical, and deformation properties of concrete. These properties vary significantly with temperature and also depend on the composition and characteristics of concrete batch mix as well as heating rate and other environmental conditions. This paper presents the effects of a high temperature on selected physical properties of concrete. The main aim of the article is the evaluation of the monitoring concrete properties loaded in a few thermal steps up to 1200 ^{o}C. Therefore, the concrete specimens were heated in a programmable laboratory furnace at a heating rate of 5 °C/min. The specimens were loaded at six temperatures, i.e. 200 °C, 400 °C, 600 °C, 800 °C, 1000 °C and 1200 °C were maintained for 60 minutes. The acoustic emission activity and some material characteristics were evaluated in a three-point bending test.

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Calculation of thermal loadings of HPDC tools

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High pressure die-casting process (HPDC) is a permanent mould casting technology. During one cycle the heat from melt is transported into a steel tool which is a reason for heating of a tool. In order to prevent overheating the heating-cooling system is positioned in the tool. Cooling-heating system heats up the tool at the beginning of the casting process and cools the tool in further production of castings. During cyclic thermal loadings stresses are introduced into the tool which brings to damages that can be detrimental. Paper describes the problems at conventional tool with defect analysis of a tool as a result of thermal loading. On basis of analysis of existing tool made by ProCAST software the critical spots in a part of a tool were determined and compared with experimental results. Change of heating-cooling system in a tool was prepared and verified.

Static and dynamic testing of Al alloys and effect of measurement uncertainty

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The growing demand for the reduction of pollution, more sever control of the emissions and better fuel-efficiency constitutes the driving force behind weight reduction in the automotive industry. The characteristic properties of aluminium and aluminium alloys make them one of the most important non-ferrous metals today and the ideal candidates to replace heavier materials like steel in cars to respond to the weight reduction demands. When compared to structural steels, Al alloys have much better strength to weight ratio, good formability, good corrosion resistance, as well as a good recycling potential, thus giving them a very broad field of application.

In order to properly use materials in design, especially when it comes to light alloys a complete understanding and information on their mechanical properties, such as hardness, elastic modulus, yield and ultimate strength, and elongation must be obtained. It is also vital to know how the properties are affected by the conditions of a specific application of the material. Thus, design of critical automotive components also requires knowledge of the material fatigue behavior, where relatively small fluctuations in stress or presence of small surface and subsurface defects may lead to fatigue crack initiation and failure under otherwise innocuous loading conditions. Factors such as the size of the part, surface condition, loading direction and loading rate may all result in changes in static and dynamic properties and must be considered in design. Furthermore, as the design of automotive parts is constantly pushed toward the limits of the material deviations from the defined material properties and excessive measuring uncertainty can lead to unexpected premature failure of the component. Therefore, reliable determination of material strength, especially yield and ultimate tensile strength, and fatigue resistance with low uncertainty is crucial when selecting material for dynamically stressed automotive components.

There are many different contributions to the uncertainty of measured results. The major contribution normally comes from the tested material and test equipment. However, variations in testing parameters, like temperature, strain rate, etc., have been found to have a large effect on uncertainty contribution not related to test equipment. Other contributions relate to sample's design, manufacturing, preparation and surface quality as well as to eventual human errors.

In this talk different methods of static and dynamic testing of Al alloys aimed for highly stressed automotive components will be reviewed and correlations between very simple hardness measurement, and tensile and high cycle fatigue test results discussed. However, the main focus will be on evaluating the effect of different material and metrology factors, including material inhomogeneity and type of Al alloy, number of measurements or samples, specimens design, sampling, preparation, machining and surface quality, specimen size, type of testing machine and environment as well as human error on hardness, tensile and high cycle fatigue test results and measurement uncertainty when performed on Al alloys.

Thermophysical properties measurement of scale layer on steel substrate using flash method

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Most of the steel is processed at very high temperature. The hot steel surface is in contact with surrounding atmosphere and reacts with oxygen which is contained in it. Ferrite oxides are formed on surface. These oxides are called scales. Scales form very complex layer on the surface. Sales are mostly porous and composed of various scales such as Wüstit (FeO), Hematite (Fe_2O_3) and Magnetite (Fe_3O_4). Steel grades contain various additives, and one of the most common is silicon, which forms Fe_2SiO_4 (fayalite). Other additives such as aluminum, chrome, nickel, molybdenum form even more complex scales. Although scales form relatively thin layer on the surface it was confirmed that they need to be included in simulations of steel heat treatment as they can significantly change cooling rate due to the Leidenfrost effect during spray water cooling. Only a limited number of publications describing the thermophysical properties of scales can be found. Mainly due to various porosity of scales, which significantly change thermophysical properties, the real properties need to be measured to have accurate data for numerical simulations. One of well-known and accurate method is Flash method. However, this method is used only for samples from one material. Scale to be measured are fragile and cannot be detached from the steel substrate. This contribution describes improved flash method for measurements of thermophysical properties of scale layer on steel substrate (diffusivity, thermal conductivity, and product of mass density and specific heat). Steel sample covered by scales is heated by laser pulse from one side and temperature response is measured by very sensitive infrared sensor on the opposite side. Complex two-dimensional rotationally symmetric numerical model of this measurement is used by two-dimensional inverse algorithm for computing the thermophysical properties of scales. An example of measured thermophysical properties of scale layer formed on high-silicon steel are presented and compared with data published for common steel.

Investigation of Magnesium Intercalation into a Spinel Manganese Oxide

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Current research on magnesium battery systems is focused on finding a suitable cathode material and electrolyte, compatible with metal anode. In present work a set of techniques is used to investigate spinel-type manganese oxide as cathode material in absence of suitable non-aqueous electrolyte. Intercalation of magnesium ions into spinel $LiMn_2O_4$, known for its ability to host magnesium ions[1], was investigated. Electrochemical delithiation and magnesiation were performed with cyclic voltammetry (Figure 1). Peaks at 0.3 V on cathodic and –0.1 V on anodic side correspond to magnesium intercalation.

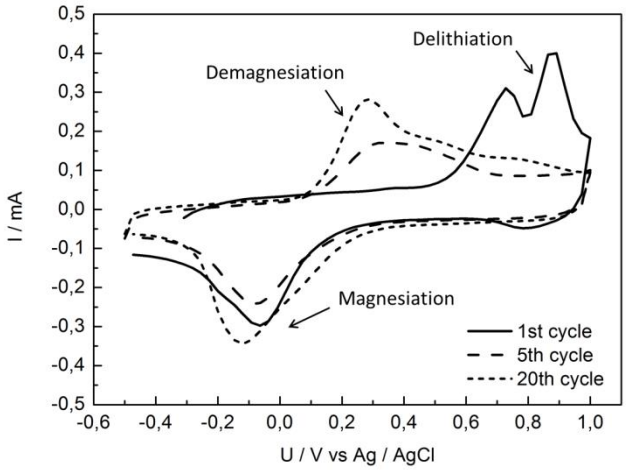

Figure 1: Cyclic voltammogram of $LiMn_2O_4$ in 0,1 M $Mg(NO_3)_{2(aq)}$ in potential window between –0.5 and 1.0 V vs Ag / AgCl at sweep rate 5 mV s^{-1}. Peaks indicating magnesium intercalation are visible.

Structure changes occurring during delithiation and insertion of magnesium were evaluated using XRD. Successful intercalation of magnesium was confirmed with EDX mapping. HRTEM images were obtained for further characterization and visualization of material.
Presented set of techniques can be used for assessment of potential cathode materials in aqueous electrolytes and confirmation of successful magnesium intercalation into host materials.

1. Kim C., Phillips P. J., Key B., Yi T., Nordlund D., Yu Y. S., Bayliss R. D., Han S. D., He M., Zhang Z., Burrell A. K. Klie R. F., Cabana J., *Adv. Mater.*, **2015**, *27*, 3377-3384.

Assessment of the Influence of Ambient Temperature on the Hardening of Concrete and its Elastic and Strength Properties

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Next to compressive strength, the modulus of elasticity is an important property for the design and behaviour of concrete structures sensitive to deformation (pre-stressed elements, slender structures, etc.). The concrete modulus of elasticity in compression is a material property, which can, due to various influences, reach very different values within one strength class of concrete. For this reason, it is necessary to know the factors that have the greatest influence on the modulus of elasticity and compressive strength at the same time. One of those factors is ambient temperature, which influences both these properties in the early stage of setting and hardening. If the low ambient temperature causes the concrete to not attain a sufficient value of modulus of elasticity and compressive strength, significantly more severe deformations may occur together with serious problems e.g. during early pre-stressing of the concrete element (as early as the age of 24 hours).
The goal of the experiment was to assess the degree of the influence a low ambient temperature has on the development of concrete modulus of elasticity and compressive strength especially in the early stage of its hardening. The tests used a concrete of the strength class C 35/45, which is used in the production of pre-stressed bridge beams. The object of examination was the time development of the increase in the value of elastic modulus and compressive strength of concrete hardening at three different ambient temperatures – 20 °C (reference temperature), 10 °C and 5 °C (the hydration process is nearly halted). During the evaluation of the experiment, the obtained test results were compared with dependencies published earlier. Based on an evaluation thus performed, it can be said that the progression of the growth of both moduli of elasticity and compressive strength is similar, however, it does not entirely correspond to the described dependencies.

1. Samir N. Shoukry, Gergis W. William, Brian Downie, Mourad Y. Riad, *Construction and Building Materials*, **2011**, *25*, 688-696.
2. Jin-Keun Kim, Sang Hun Han, Young Chul Song, Cement and Concrete Research, *Effect of temperature and aging on the mechanical properties of concrete Part I. Experimental results*, **2002**, 32, 1087-1094
3. Jin-Keun Kim, Sang Hun Han, Seok Kyun Park, Cement and Concrete Research, *Effect of temperature and aging on the mechanical properties of concrete Part II. Prediction model*, **2002**, 32, 1095-1100
4. Fatma Karagol, Ramazan Demirboga, Waleed H. Khushefati, *Construction and Building Materials*, **2015**, 76, 388-395
5. Md. Safiuddin, Sudharshan N. Raman, Muhammad Fauzi Mohd. Zain, *Materials*, **2015**, 8, 8606-8623

Monitoring and simulation of unsteady states in continuous casting

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Continuous casting comprises simultaneous thermal, mechanical and chemical processes ongoing in the casting machine. Although this technology seems to an external observer to be robust and steady, in reality the process is unsteady featuring fluctuations in physical quantities and even in a strand structure, which can be often identified only by a special monitoring system. Selected causes of the process variability are discussed in the paper. The first are deterministic changes induced by operator's actions, the second are deterministic periodic variations excited by the mould oscillation and the third are spontaneous quasi-periodic sub-harmonic oscillations or stochastic fluctuations typical for non-linear and multidimensional nature of the system. Significant influence has a non-linear dependence of heat transfer coefficient under cooling nozzles on strand surface temperature due to the Leidenfrost phenomenon [1].
Knowledge of the state of the fluctuating process is a precondition to achieve quality and defect-free production. Modern continuous casting machines are equipped with diagnostics systems for breakout and quality prediction as well as numerical models functioning as software sensors enabling monitoring the strand cooling and solidification. The correctness of the simulations results depends on the accuracy of boundary conditions. Techniques and difficulties of determination of immediate and detailed values of boundary conditions are also discussed [2]. Modelling of unsteady behaviour of the casting process is therefore characterized by uncertainty. Selected results of process monitoring and simulation including the effect of the Leidenfrost nonlinearity are shown and analysed in the paper.

1. Chabičovský, M., Hnízdil, M., Tseng, A., Raudenský, M. International journal of heat and mass transfer, **2015**, 88, 236-246.
2. Pyszko, R., Příhoda, M., Fojtík, P., Kováč, M. Metalurgija = Metallurgy, **2012**, 51, 149-152.

Possibilities of Injection Molding Simulations of Hardly Producible Parts from PBT Material

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This article is focused on possibilities of advanced injection molding simulations. Parts made from plastic materials are in almost all technical systems. Nowadays is used everywhere a lot of various parts, which are because of theirs parameters hardly producible. Examples are components of electronical systems, mainly various connectors from material polybutylene terephthalate (PBT). These connectors are long in one direction and their geometry is with high number of various small holes. This leads to problems during injection molding. Movement of melted plastic material is slow and also number of weld lines is high. Main aim of this article is comparing of different variants of injection molding process and demonstration of CAE advanced methods usage. This approach leads to optimized production of plastic connectors. During simulation is used accurate material model of PBT which is clearly described.

Results leads to mathematical description of dependence between all injection molding parameters and results from this technological process. Mainly are described temperatures and pressures in various moments of injection process. Results of research describe all influences on quality of product. This is done by evaluation of geometrical, optical and mechanical properties of final connector. As an example is used connector with 54 independent contacts. Validation of simulation is performed by comparing with real experiment.

Alkali-Activated Slag Composite with Graphite as Conductive Filler

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Electric properties of the conductive concrete are of great importance to its application in building construction and other fields.[1–3] In this study, graphite powder as an electric conductive filler was added into alkali-activated slag mortar in order to enhance its conductive properties. The amount of graphite was ranging from 1 to 30 % of the slag mass. The effect of graphite powder on the mechanical properties, specific conductivity, dielectric constant and microstructure was investigated. The results showed that addition of graphite by up to 10 % improved electric properties of alkali-activated slag measured in AC mode. Higher amounts of filler did not show further improvement in electric properties but caused a strong deterioration of the mechanical properties.

1. Han B, Yu X, Ou J, *Self-Sensing Concrete in Smart Structures*, Butterworth Heinemann, Oxford, **2014**.
2. Ding Y, Chen Z, Han Z, Zhang Y, Pacheco-Torgal F, *Construction and Building Materials*, **2013**, *43*, 233-241.
3. He Y, Lu L, Jin S, Hu S, *Construction and Building Materials*, **2014**, *53*, 131-137.

Experimental Study of Measurements Techniques of Residual Properties of Concrete Subjected to High Temperature

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Elevated temperatures caused by fire initiate changes of mechanical and physical characteristics of concrete (HAGER, 2013). The paper is aimed to determination of the sensitivity of testing techniques used for evaluation of the actual condition of the concrete structures applied to the structure damaged by fire.

The slabs 1300x2300x150 mm of ordinary hardened concrete (except this to be tested in the virgin conditions) were heated to elevated temperature according to standard temperature-time curve (EN 1991-1-2) up to required temperature (for each slab 300, 500, 700 a 900 °C) and rested at the nominal temperature for sixty minutes. After heating process and gently cooling down to the ambient temperature were produced testing specimens (core samples, cubes and prisms) from each slab. The concrete specimens were tested by using of standard testing approaches to determine mechanical characteristics (e.g. compressive and tensile strength).

Degradation of the mechanical parameters were determined by percentage of differences of the values set on concrete specimens and slabs after exposition to high temperatures and subsequent cooling. The values were compared with the parameters obtained by testing the concrete without temperature exposure plate. The amount of degradation of parameter determines the sensitivity of the testing technique to assess the concrete structure.

1. Hager, Izabela. Behaviour of cement concrete at high temperature. *Bulletin of the Polish Academy of Sciences: Technical Sciences* [online]. **2013**, *vol* 1, p. 145-154 [cit. 2016-01-25]. http://yadda.icm.edu.pl/baztech/element/bwmeta1.element.baztech-article-BPG8-0098-0020.
2. *EN 1991-1-2: Eurocode 1: Actions on structures - Part 1-2: General actions - Actions on structures exposed to fire*, **2002**, Brussels

New Approach in Treatment Tool Steels

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The traditional materials as tool steels are still widely used for theirs mechanical properties and wear resistance. Because of relatively high price compared to low alloy steels is trend to get the most out of the material's possibilities. The mechanical properties of all kinds of materials are dependent not only on their chemical composition but also on their structure and morphology, which can be modified using various kinds of heat or thermomechanical treatments. One non-conventional method which can significantly modify a structure is treating the material in a semi-solid state.
The experimental programme was aimed at describing the influences of a variety of technological parameters on structural development. The material chosen for the experiment was X210Cr12 tool steel. The initial state of this steel is ledeburitic with primary chrome carbide. After semi-solid metal forming the microstructure is more than 95% retained austenite, predominantly in polyhedral form. The remaining interstitial spaces are filled with a lamellar carbide network. Unfortunately, due to carbides network has the final microstructure high brittleness. Inserted deformation and properly heat treatment could reinforce the microstructure and caused decreasing of grain size. All the steel samples were heated to a semi-solid state, then deformed and cooled under controlled conditions. Their morphology, portion of individual phases and the influence of recrystallization structures was then investigated. Deformation was carried out either in a single step or in several incremental steps. All regimes with individual types of deformation were repeated at various cooling conditions. Furthermore, deformation below solidification assisted the recrystallization of the structure and resulted in significant refinement of grain size. The morphology and microhardness of the carbide network was strongly influenced by the cooling rate. As the cooling rate increased, the network became finer and its hardness grew rapidly from 620 HV0.5 to 960 HV0.5.

N-Doped Carbon Nanosheets as Renewable Electrocatalysts

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It was shown that chitosan, a natural biomaterial, can be successfully utilized as nanocarbons precursor [1, 2, 3]. Chitosan is an N-deacetylated product of chitin which leads to their usage as Nitrogen in-situ dopants into carbon framework. To extend the potential applications, chemical and physical modification is commonly used to tailor, in particular, the electronic properties and catalytic activity of these carbonaceous structures. The carbon sheets, apart from a large specific surface area, also provide porosity, chemical inertness, intrinsically low toxicity, long-term operation stability or/and good electrical conductivity

Here, we demonstrate the successful synthesis method of a high-surface-area and one-dimensionally structured micro- and/or mesoporous carbon material. The carbonization of chitosan leads to amorphous and partially graphitized carbon with electrocatalytic activity which can be tuned as well as the ORR applications exhibiting the high reaction onset potential and stable cycling performance in alkaline electrolytes.

Our results show that besides the total nitrogen content and the type of nitrogen group (pyridinic or graphitic), also the amount of carbon 'kinks' and/or surface roughness strongly influence the ORR activity. The onset potential reached 0.735–0.761 V vs. RHE for oxygen reduction reaction (ORR) in alkaline media.

1. A. Kucinska and A. Cyganiuk and J. P. Lukaszewicz, *Carbon*, **2012**, 50, 3098-3101.
2. M.K. Rybarczyk, M. Lieder and M. Jablonska, *RSC Adv*., **2015**, 5, 44969-44977.
3. L. Zhao, N. Baccile, S. Gross, Y. Zhang, W. Wei, Y. Sun, M. Antonietti and M.-M. Titirici, *Carbon*, **2010**, 48, 3778-3787.

Integration of In-Situ Electrolyte Property Measurements in AP18 Technology Electrolysis Cells

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The optimal electrolyte structure (Na_3AlF_6 with the addition of AlF_3, CaF_2 and Al_2O_3) used in the Hall-Heróult electrolysis process is crucial to the electrolysis process stability, as well as the energy and material efficiency. The electrolysis process is dynamic and consists of a number of variables which have to be maintained within the required limits.

The purpose of the integration of in-situ electrolyte property measurements in Aluminum Pechiney 18 technology electrolysis cells lies in the optimization of the primary aluminum production process. *The classical approach* to maintaining the stability of the electrolysis process provides for periodic measurements of the chemical composition (XRD analysis) and the electrolyte temperature, whereas 8 to 12 hours may pass between the sampling and corrective measures on the cell. Because of the strong links between the AlF_3 excess in the electrolyte and the temperature, there is a risk that the technological measures do not comply with the current state which, given the time lag, may prove different from the analyzed. Furthermore, due to the large number of samples and necessary steps in the sample preparation phase, mix-ups of samples are also very likely. With *a modern approach* (in-situ temperature, AlF_3 excess, Al_2O_3 and CaF_2 concentration and super-heat temperature measurements), key parameters can be measured and appropriate steps taken in real-time, whereas the risk of errors almost eliminated. Within 3 to 4 minutes, the results are transferred through a wireless network into a process computer. Thus, the swifter entry of data enables the optimization of process parameters that have a crucial impact on the functioning of electrolysis cells.

This article also includes a comparison between in-situ results and classical methods for 20 Aluminum Pachiney 18 technology electrolysis cells.

Main Features of Experimental Techniques for Carbon Nanomaterials Characterization

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Quasi-molecular solids, such as carbon nanotubes (CNTs) and graphenes, have been widely studied during last years. Due to a unique set of physicochemical and mechanical characteristics, they are promising objects for practical use, in particular, for the production of diverse composite materials. The synthesis of multi-walled CNTs is technologically most simple, and, depending on the synthesis conditions, they can represent a system of either concentrated embedded cylinder (cy-CNTs) or cones (co-CNTs) from graphene sheets. The surface of cy-CNTs consists of sp^2-hybridazed carbon atoms which makes it fairly inert, whereas the near-surface layer of co-CNTs contain both sp^2- and sp^3-hybridized atoms, making them more active in chemical interactions. Graphenes, depends on the size, can have comparable amount of both types of carbon atoms.

Development of new effective selective adsorbents for organic compounds and different ions, materials for physiologically active substances delivery, filled polymers, new catalysts, *etc*. are impossible without preliminary functionalization of CNTs by carboxyl or hydroxyl groups, which, also, open ways to their subsequent modification with more advanced fragments. In generally, there is no analytical technique, providing all the information about CNMs. Only few analytical techniques are suitable for mass qualitative analysis of chemically modified CNTs – thermal analysis with IR and mass spectral control of outgoing gases, elemental CHNSO analysis and X-ray photoelectron spectroscopy (XPS). Among these techniques CHNSO and thermal analysis allow to determine the general contents of oxygen in the material, while XPS can be used only to distinguish surface groups. There also some indirect, but effective, techniques for make similar estimations, such as bomb calorimetry. Present lecture is focused on correlations of the experimental results obtained by different analytical methods of structures carbon nanomaterials analysis and search for the unified set of techniques for their characterization during mass production.

Numerical modelling used in the design of complex components made from composite materials

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The article deals with the use of numerical simulations for the design and optimization of parts with complicated shapes made from composite materials. Composites are increasingly being used in conventional applications. This development is especially thanks to virtual prototyping, which allows a significant reduction in the development costs of these parts. An airbox designed for a light single-seat racing car was chosen as a representative example.
Optimization is primarily focused on maximum reduction of the component with adequate stiffness and strength and all this also with regard to the manufacturing technology of the component. Composite fabrics in combination with foam cores were used to ensure the maximum stiffness of the part. The high performance epoxy resin was used as the matrix. In order to find the best option, an advanced CAE simulation on the basis of the Finite Element Method was used with a special module designated directly for creating models from alternative materials. Maximum stress failure criterion was used to evaluate the strength of the part. A 3D model for the numerical simulation follows all the layers of the composite materials, including cuts, notches, resin drops and precise calculation of the main directions of the fibres and their distortion or overlap caused by more complex shaped surfaces.

Surface Modification of Silica with Biodegradable Amphiphilic Polymer for Controlled Release Applications

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The aim of this work was surface modification of nanosilica particles with biodegradable amphiphilic polymer based on chitosan-grafted-polylactic acid (Si-Cs-g-PLA) for optimization of immobilization and controlled release capacity of bioactive substances. Doxorubicin hydrochloride (DOX) was chosen as a model bioactive compound. The analyzed Si-Cs-g-PLA was compared with pristine Si nanoparticles. The results show successful surface modification of Si particles (Figure 1). The modified systems proved enhanced loading capacity for DOX. In addition, release profile of DOX from Si-Cs-g-PLA particles presented significant burst effect reduction with presence of controllable lag-phase.

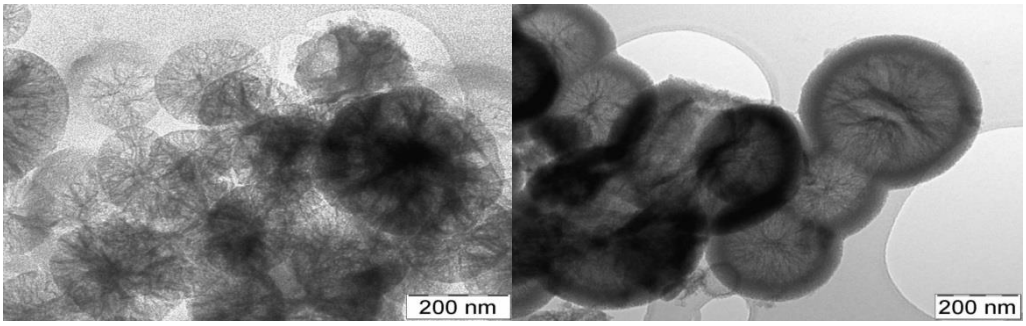

Figure 1: TEM pictures of pristine (left) and surface modified (right) silica particles.

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Method Covering Ageing for Evaluation of Fatigue Parameters of Cement Based Composites with Waste Aggregates

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Concrete, mortars and other cement based composites are the most commonly applied construction materials in the world. The environmental aspects that are related with production and using of cement and concrete have got a growing importance. Waste materials can be used or processed to produce materials that are suitable as aggregate or filler in concrete. This paper introduces the values of the fatigue parameters of several types of concrete made with various amount of waste materials.

For this purpose, sets of specimens were prepared and tested in three-point bending configuration under static (compressive strength values) and cyclic loading (fatigue parameters − Wöhler curves). The experimentally obtained results (both mechanical and fatigue) of various types of concrete are compared and the level of waste for practical application is discussed.

Figure 1 Set up for measuring of fatigue properties

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Preparation of TiS_2-based thermoelectrics with high S/Ti ratio

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Thermoelectric materials based on non-toxic, abundant, and low-priced titanium disulphide have been recognised as possible alternative for the so-far best performing alloys comprised of Bi-, Sb- and Pb-tellurides applied for near-room and mid-temperature applications.[1] Several studies[1-5] have demonstrated a promising potential of TiS_2 below 670 K, with power factor over 1.7 mW/mK at room temperature[2], and thermoelectric figure-of-merit (ZT) up to 0.5 at 700 K.[4] However, temperatures above 770 K, which are necessary for the solid-state synthesis of TiS_2 and its derivatives, induce self intercalation of Ti-atoms into van der Waals gap due to deviation from stoichiometry caused by sulphur volatilisation. Presence of Ti atoms in the intercalation sites affects the charge-carrier concentration and consequently significantly influences the thermoelectric properties.[1,2] Such structural changes also significantly reduce the rate of intercalation of other species.[6] Moreover, sulphur losses during the solid-state synthesis and consolidation have been found to deteriorate thermoelectric properties in several TiS_2-based materials, such as $Ti_{1-x}Ta_xS_2$, Cu_xTiS_2 and $(MS)_{1+x}(TiS_2)_2$ (M = Pb, Bi, Sn).[3-5] Therefore, the ability to prepare highly stoichiometric bulk TiS_2 (high S/Ti ratio) is of crucial importance for the subsequent engineering of the optimal transport properties for the best thermoelectric performance. We have synthetized nearly stoichiometric TiS_2 powders by a solid-state synthesis directly from the constituent elements and applied optimized pulsed-electric-current sintering conditions in order to consolidate TiS_2-based materials without significant sulphur deficiency. Influence of S/Ti stoichiometry on the thermoelectric response of some best performing TiS_2-base materials such as Cu_xTiS_2 will be discussed in the presentation.

1. Guilmeau, E. et al., Physical Chemistry Chemical Physics, 2015, 17, 24541-24555.
2. Beaumale, M. et al., Acta Materialia, 2014, 78, 86-92.
3. Beaumale, M. et al., Journal of Applied Physics, 2014, 115, 043704-7.
4. Guilmeau, E. et al., 2011, Applied Physics Letters, 99, 2-4.
5. Wan, C. et al., Journal of Electronic Materials, 2011, 40, 1271–1280.
6. Thompson, A., et al., Mater. Res. Bull., 1975, 10 915–920.

Microstructural Evaluation of Ni-SDC Cermets from 2D and/or 3D Images

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Solid oxide fuel cells (SOFC) are energy conversion systems to produce electrical energy with minimal environmental impact. They exhibit several additional advantages over conventional power generation systems such as long term operation, high power density, high energy-conversion efficiency low emissions of CO, CO_2, NO_x, SO_2 modularity, ability to utilize high temperature exhaust for energy-cogeneration and high flexibility to various fuel types. Modern SOFC systems operate at so called intermediate temperatures between 600-800 ^oC. At such operating temperatures a superb ionic conductor i.e. samaria doped ceria (SDC), cathode material based on perovskite structure i.e. various manganites, ferites or cobaltites, and anode cermet i.e. Ni-SDC are normally utilized. Anode layer in SOFC is typically a composite and should ensure electronic and ionic conductivity throughout the material as well as gas permeability. Additionally, in an operating cell fuel is electrochemically oxidized at the Ni/SDC/fuel interface, called the triple phase boundary (TPB) region. In order to meet all the necessary criteria the anode microstructure should be carefully tailored where metallic Ni, ceramic SDC and pores form continuous phases. For this purpose, exact and accurate microstructural determination is crucial in predicting material's performances in an operating cell. Microstructure parameters are normally determined from 2D microscope images. However, in an anode cermet critical topological features determining the material's suitability are also connectivity and tortuosity, describing the nature of contact between grains of primary phase or between phases and the transport pathways in the pores, respectively. The later parameters can most accurately be established from 3D microstructural information. Therefore, the aim of this work is to compare 2D and 3D microstructural analysis of a Ni-SDC cermet and to emphasize benefits or difficulties each analytical approach is offering.

Investigation of the carbide precipitates in the materials for the thermal power plants

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X20CrMoV12.1 is one of the steels that are often used in power plants for steam pipes due to its excellent combination of high-temperature strength, toughness and creep strength. They are suitable for working in temperature range of 470-530 °C and pressure up to 18 MPa.[1]
To allow increases (temperature of a 720 °C and pressure of a 35 MPa), advanced materials for use in ultra-supercritical steam generators were developed. These materials are ferritic/martensitic steel alloys with 9-12 % chrome, austenitic stainless steel alloys and nickel-base alloys. High-strength ferritic 9-12 Cr steels for use in steam generators are available up to 650 °C. Such steels are P91 to P92, austenitic steels grades 18-8 to 18-25 like Super 304H, as well as the high nickel content alloys like Inconel 617 and 740.[2]
Using scanning electron microscopy the influence of the tempering time on the carbides formation and the change of their distribution was investigated for the steel X20CrMoV121 and the nickel alloy Inconel 617.
It was found out that by short tempering of steel X20CrMoV121 stringers of cementite particles are formed at great number of ferrite grain boundaries and sub-boundaries. By longer tempering, the content of chromium in particles increases up to 20 % Cr and $M_{23}C_6$ starts to nucleate.
The grain boundaries in the nickel alloy Inconel 617 are almost completely covered with $M_{23}C_6$.

1. A. Kostka, *Acta Materialia*, **2007**, 55, 539–550.
2. F. Abe, *Engineering*, **2015**, 1, 211-224.

Kinetics and Mechanism of High-Temperature Reduction of NiS and CoS Sulphides

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Despite of many years of investigations, transition metal sulfides are still a group of materials relatively poorly examined in terms of physicochemical properties [1]. This situation applies also to reduction process of sulphides to the metallic state. In fact, only limited number of studies have been done so far in this field and they focused mainly on solving the problem of low rate of the reduction process of sulphides, which as a result of the thermodynamic limitations is very important for industry [2-4]. Being active in this area of research we started rather long-term studies to obtain new information on the kinetics and mechanism of reduction process of sulphides. The aim of the first stage of this work, described in this paper, was to get kinetic data of reduction process of CoS and NiS to metallic phase in an argon atmosphere containing hydrogen, without the use of substances accelerating the process. In this work, the starting sulphide materials were prepared by direct sulphidation of pure cobalt and nickel, respectively, in an atmosphere containing sulphur vapors. The kinetics of the reduction process have been determined in microthermogravimetrical apparatus with a sensitivity of 10^{-7} g.

It has been found that the rate of the reduction process is highly temperature-dependent and it follows the linear law for both tested sulfides. An activation energy for CoS reduction equals 107 kJ / mol and it is slightly higher than the activation energy of the reduction of NiS (103 kJ / mol). Reduction mechanism of both studied sulphides is different to some extend. Namely, metallic cobalt precipitations during reduction of CoS start to occur on a surface of the sulphide phase and gradually propagate into the material. In contrast, reduction of NiS occurs mainly by precipitation and growth of metal phase inside of sulphide matrix. Moreover, rather complex morphology of the nickel-based material virtually doesn't change during reduction. On the other hand, reduction of the CoS results in significant surface development and gain in complexity of morphology.

1. Z. Grzesik, K. Przybylski, in: W. Gao, Z. Li (Eds.), Development in high temperature corrosion and protection of materials, *Woodhead Publishing in Materials*, **2008**, 599-638
2. F. Habashi, R. Dugdale, Metallurgical Transactions, **1973**, 4, 1865-1871
3. I.D. Shah, P.L. Ruzzi, Metallurgical Transactions B, **1978**, 9B, 247-253
4. T.C. Tan, J.D. Ford, Metallurgical Transactions B, **1984**, 15B, 719-723

Microcleanness Evaluation of Al-killed Steels during Treatment at Units of Secondary Metallurgy

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Crucial function of steel refining is to remove and/or modify non-metallic inclusions. Formation of non-metallic inclusions during steel production is inevitable. Moreover, their excessive number, unsuitable morphology, shape, size, arrangement etc. can lead to problems, e.g. during casting, forming, heat treatment. Finally, the non-metallic inclusions can negatively influence the properties of final products. The knowledge about formation, evolution and behaviour of particular types of non-metallic inclusions is necessary for elimination of inclusions' sources and better steel microcleanness [1, 2].

The paper presents the results of operational experiments focused on the study of formation and modification of non-metallic inclusions during treatment of Al-killed steels at units of secondary metallurgy. Operational heats were focused on the analysis of influence of deoxidation and slag-making agents, to lining wearing, to treatment period in the ladle or type of technology of inert gas blowing for better steel microcleanness. Proper evaluation of microcleanness was carried out using of microscope SEM. Results present the number, distribution and analysis of non-metallic inclusions and its implementation into the ternary diagrams.

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1. Stolte, G. *Secondary Metallurgy,* Verlag Stahleisen GmbH, **2002**. 216 p.
2. Fruehan, R.J., et. al. *The Making, Shaping and Treating of Steel*. Steelmaking and Refining Volume, Pittsburgh: AISE Steel Foundation, **2010**, 768 p.

The Refractoriness of Dual Binding System Kaolin-Calcium Aluminate Cement

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Dual binding system kaolin – calcium aluminate cement is very useful for the production of refractory products (chamotte, castables) or whitewares. Calcium aluminate cement is able to increase strength of green body based on kaolin very intensively.
The effect of different ratio between kaolin and calcium aluminate cement on the fire resistance properties (refractoriness, firing shrinkage) and physico-mechanical properties (strength, porosity, mineralogical composition, color) will be investigated for different kinds of calcium aluminate cements according to alumina content (50 and 70 %). The results will be discussed with phase diagram CaO-Al_2O_3-SiO_2.

Algorithm for Visual Fiber Detection from Composite Cross–Section

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This work is focused on analyzing fiber distribution in composite material cross–section. First, an application for obtaining the so-called ground truth data is proposed in Python with the use of OpenCV, Open source computer vision [1]. The application enables the user to see a digital photograph of composite cross–section obtained using Scanning Electron Microscopy (SEM) in different modes and to determine the fiber circular area by defining three bounding points at minimum. The fiber center position and radius is calculated by least square method.
Second, an algorithm for automatic fiber detection is proposed using OpenCV and Python. The image of composite cross–section is subjected to image preprocessing, binarization and segmentation as well as many other digital image processing methods [2].
Results of the application for ground truth data and of the algorithm for fiber detection are compared by histograms depicting the fiber radii distribution. These results are required for modelling unidirectional long-fiber composite materials on microscopic scale and determining material properties of substituents of unit cell representing the representative volume of the material [3].

1. OpenCV-Python Tutorials, *http://opencv-python-tutroals.readthedocs.io/en/latest/index.html.* **2013**
2. Železný M. Digital Image Processing (in Czech), *Lectures*, Department of Cybernetics, Faculty of Applied Sciences, University of West Bohemia.
3. Srbová, H., Kroupa, T., Zemčík, R.: Identification of the initial failure and damage of substituents of a unidirectional fiber-reinforced composite using a micromodel. **2014**, *Materials and Technology*, *48 (4)*, pp. 549-553., ISSN 1580-2949.

Analysis of coatings on the surface of nitinol formed by ALD process

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Nitinol is nearly equiatomic shape memory alloy of nickel and titanium, which is as a result of its good mechanical properties, high corrosion resistance and biocompatibility primarily used in medicine as stents, for flexible parts of surgical instruments, and due to superelastic properties also in dentistry. Nitinol is, because of the application in the human body, in contact with aggressive medium which increases the possibility of the occurrence of corrosion. A consequence of corrosion activity is also nickel releasing that can induce toxic, allergic and hypersensitive reactions in the human body. Therefore, a nitinol surface should be passivated with a coating of appropriate thickness.

On nitinol surface TiN and TiO_2 layers were deposited using Atomic Layer Deposition (ALD) technique. ALD is a thin film deposition method in which a film is grown on a substrate by exposing its surface to alternate gaseous species (precursors). The precursors are inserted in reactor as a series of sequential pulses. In each of these pulses the precursor molecules react with the surface so that the reaction terminates once all the reactive sites on the surface are consumed. By varying the number of cycles it is possible to grow layers uniformly and with high precision on arbitrarily complex and large substrates. Such obtained samples were analyzed for biocompatibility and corrosion resistance in comparison to nitinol without coating.

Comparison Of Physicochemical Properties Of Al_2O_3 Layers Applied On The Surfaces Of cpTi And Ti6Al7Nb Alloy Using ALD Method

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Literature data show that the ALD is a very important method of depositing layers due to the mechanical and physicochemical properties of the surface. In the literature, little space is devoted to layers of Al_2O_3, which could also have a major impact on improving the physicochemical properties of metallic biomaterials. Therefore, the aim of completed research was to determine the influence of Al_2O_3 layer formed by the ALD method on the physicochemical properties of metallic biomaterials. Based on the results, a beneficial effect on pitting and crevice corrosion resistance of applied Al_2O_3 layer was determined, compared to initial state, devoid of the layer, regardless of the substrate used. On the other hand, the performed surface wettability tests showed no influence of ALD temperature in the obtained angle values. Proposing appropriate conditions for the surface treatment using ALD method has a prospective meaning and will contribute to the development of technological process with defined parameters of oxide layers manufacturing on implants used in bone surgery.

FEM Modelling on the Mechanical Behavior of Polycrystalline Gadolinium Cylinders

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As reported elsewhere [1], the metallographic analyses of the polycrystalline gadolinium cylinders exhibited a microstructural anisotropy in the extrusion and extrusion transversal directions. The dimensions of the as-delivered Gd cylinders represented the main limitation for preparing appropriate specimens to be mechanically tested also in the extrusion transversal direction using compression tests. Therefore, the strain distribution during compression loading was simulated using FEM simulations. A FEM for the simulation of the elasto-plastic response of the Gd substrate was performed using the commercial program ABAQUS. A solid model of the specimen with 23445 3D elements of the C3D8 type was selected, while the tool parts were modelled as rigid surfaces. For this purpose the flow curve obtained in the extrusion direction was used as the input data for the FEM model.

In this study, a simplified approach for the determination of the anisotropic properties during deformation is used. Anisotropic properties were defined by Hill's anisotropic coefficients as constants throughout the plastic deformation. One of the most important results of the lab-scale study for determining anisotropic material flow are the final shapes of compressed specimens. Therefore, also in the present case of gadolinium cylinders, the geometry of the simulated compression of the cigar specimen is compared with the experimental results. Based on the obtained dimensional similarity of the FEM model and the measured specimens the macroscopic anisotropy of the analysed Gd substrate is evaluated.

D. Steiner Petrovič, R. Šturm, I. Naglič, B. Markoli, T. Pepelnjak, Microstructural Anisotropy of Magnetocaloric Gadolinium Cylinders: Effect on the Mechanical Properties of the Material, *MATERIALS*, **2016,** *9*, Article Number: 382, DOI: 10.3390/ma9050382.

Waste technological sludge as replacement of alkali activator in non-traditional concrete

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This paper is focused on the preparation, mechanical properties and study of microstructure of alkali activated concrete using special alkali activator – waste technological sludge. Low calcium fly ash (LCFA) and blast furnace slag (BFS) were used as raw materials. Waste technological sludge containing high amount of alkalis was used as a alkali activator. Four concrete mixtures with various BFS/LCFA ratios were prepared to determined workability, mechanical properties and shrinkage. Microstructure was examined by using of scanning electron microscopy (SEM) equipped with energy dispersive detector (EDS). Early age compressive strength of prepared concrete was approximately 10 MPa and after 28 days reached more than 50 MPa. The addition of LCFA caused the decrease of shrinkage. Mineralogical and microstructural analysis identified that the main binder products are Al containing CSH gel with alkali ions in the structure and NASH geopolymeric gel. The results demonstrate that prepared non-traditional concrete has comparable properties to traditional concretes and more it reduce the price of final material and its ecological impact.

Optimization of Photoelectrocatalytic Activity of TiO_2-based Microreactor

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A new type of a highly efficient photoelectrocatalytic microreactor with immobilized TiO_2 photocatalyst was designed and assembled. The active part of the microreactor was made of TiO_2 nanotubes grown on titanium coils by anodic oxidation process. Such nanotubes are particularly suitable for use in photocatalytic reactors since they are rigidly attached to the metal titanium support and cannot be washed away. The photocatalytic activity of microreactors with different design was investigated by measuring the degradation of caffeine and phenol at different flow rates, UV light intensities, applied external electrical potentials and supporting electrolyte conductivity. It was found out that the most important parameter influencing the degradation rate is applied electrical potential. The highest initial phenol concentration used, approximately 45.7 mg L^{-1}, was completely mineralized at an applied potential of 16 V, a UV-light intensity of approximately 2.8 mW cm^{-2}, and a flow rate of 50 µL min^{-1}. Using a different electrode configuration inside the photoelectrocatalytic microreactor as well as a different degradation measuring principle, 1 ml of 40 mg L^{-1} caffeine was fully decomposed in 55 minutes when an anodic bias potential of 4 V was applied.

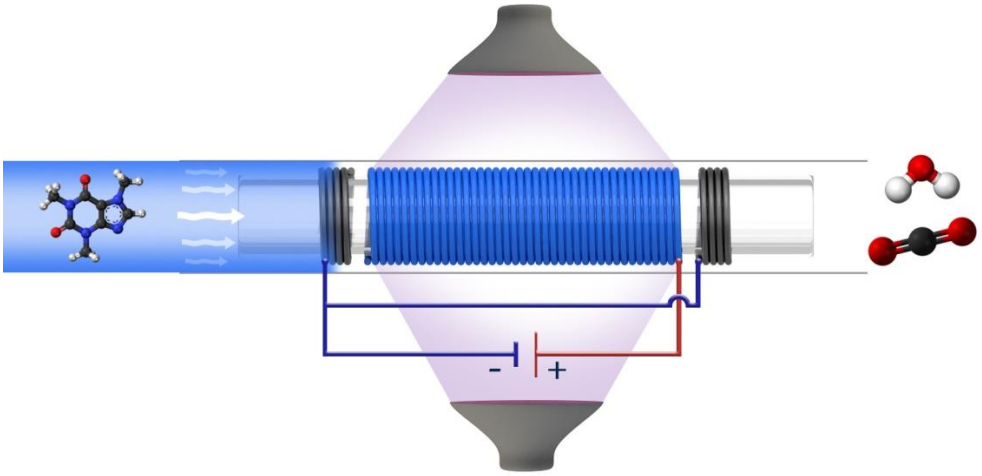

Figure 1: Schematic presentation of the caffeine degradation inside a coil-type photoelectrocatalytic microreactor.

Microstructure characterization of reinforce W-composite as plasma facing material

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Up to now in fusion experiments such as TEXTOR, ASDEX Upgrade and JET pure metal tungsten has been used in all plasma-facing components due to its superior thermo-physical properties. In DEMO fusion reactor, still under development, materials incorporated in diverter will have to withstand even more extreme in-service conditions: extreme temperatures, high ion/neutron flux and high heat load of ~10 MW/m^2, combined with thermal stresses & cycling. Despite tungsten's favorable properties, there are also several disadvantages that we must overcome, especially in terms of mechanical properties at high temperatures.

Mechanical properties are structure-sensitive, related to various types of defects and imperfections in crystal lattice of metals. Grain size and shape, sub-grain structures, crystallite orientation, arrangement and amount of vacancies and impurities all effects tensile properties (yield strength and ductility), creep properties (creep rate) and ductile-brittle fracture.

Reinforcement of W-matrix with carbide-refractory particles can significantly improve mechanical properties [1]. As an alternative, we used W_2C and WC particles for W-matrix reinforcement. With SEM and TEM analytical methods for microstructure characterization of reinforced W-WC and W-W_2C composites we will determinate grain size, phase composition and analyses grain boundaries to further understand the effect of WC and/or W_2C particles on mechanical properties of tungsten composite.

1. Pintsuk, G., 4.17 - Tungsten as a Plasma-Facing Material A2 - Konings, Rudy J.M, in Comprehensive Nuclear Materials. 2012, Elsevier: Oxford. p. 551-581.

Validation of polyurethane foam crash behavior

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The passive safety has become a new area of the rail vehicles design. This contribution is focused on the passive safety of the railway vehicles interiors. In the field of rail vehicles interior passive safety the computer simulations are most widely used. The computer simulations must be based on relevant material data. For some usual materials (eg. steel, aluminium, ..) the material data are ascertainable. The interiors of rail vehicles contain quite specific materials frequently. One of the material with more complicated mechanical properties is polyurethane foam (PUR). The aim of this paper is to present validation of material parameters for specific polyurethane foam by experiment.
The mechanical properties of polymeric foams were experimentally evaluated under static loading and impact during room temperatures. The results of experiments are available in the literature [1] and [2]. The foam is considered as an important element of the interior, which can protect the occupants from aggressive deceleration by controlled energy absorption. An optimal material is able to absorb the kinetic energy of impact and holding a strength below a force limit.
The occupant injury will be result of collision between specific human body part and whole structure of impacted interior feature. In case of collision with padded seat, the description of seat crash behavior is complicated. Main influences are connected with soft parts of structure. The final mechanical behavior during impact will be result of PUR prestressed by upholstery material. The prestress of PUR is significant but difficult measurable. The best way for material properties validation is test close to conditions during occupant impact.

1. Avalle M., Belingardi G., Montanini R., International Journal of Impact Engineering, 2001, Characterization of polymeric structural foams under compressive impact loading by means of energy-absorption diagram, 455–472.
2. Paulino M., Teixeira-Dias F., InTech, 2012, On the Use of Polyurethane Foam Paddings to Improve Passive Safety in Crashworthiness Applications.

The Assessment of Cement Mortars after Degradation High-temperature by Impact-echo Method

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Thanks the terrorist attacks on the worldwide interest in the design of structures for fire greatly increased. One of the advantages of concrete over other building materials is its inherent fire-resistive properties. The concrete structural components still must be able to withstand dead and live loads without collapse even though the rise in temperature causes a decrease in the strength and modulus of elasticity for concrete and steel reinforcement. In addition, fully developed fires cause expansion of structural components and the resulting stresses and strains must be resisted.
This paper reports the results of measurements by Impact-echo method and measurement by ultrasound. Both methods are based on the acoustic properties of the material which are dependent on its condition. These acoustic methods allow identifying defects and are thus suitable for monitoring the building structure condition [1]. The results are obtained in the laboratory during the degradation of composite materials based on cement by high-temperature.
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J. Blitz, G. Simpson, *Ultrasonic Methods of Non-Destructive Testing*, Springer-Verlag, New York, LLC, **1991**, ISBN 978-0-412-60470-6.

Transmission Electron Microscopy in Liquid Environments - a Powerful Tool for Dynamic Studies of Nucleation and Growth Phenomena of Nanomaterials

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Significant advances in the development of novel functional nanomaterials can be achieved by using suitable microscopy methods that allow in situ dynamic investigations of nucleation and early growth stage of nanomaterials from solutions [1]. For example, to achieve desired morphology and size distribution of nanoparticles, their nucleation and growth pathways need to be thoroughly understood. However, the mechanisms controlling the nucleation and growth of nanoparticles are often difficult to assess and are typically studied by indirect methods. On the contrary, in-situ transmission electron microscopy (TEM) combined with the specialized liquid cell offers both, unprecedented experimental and characterization tools for a direct study of nanoparticle's birth and early growth dynamics in various solutions.
The wealth of information that can be achieved from the so-called Liquid TEM will be demonstrated through the nucleation and growth studies of yttria-based precursors, a model system for the development of up-conversion phosphor materials with great potential ranging from theranostics to photovoltaics. We will show how temperature controlled nucleation of yttria precursors by urea precipitation method can be facilitated inside the TEM when the temperature in the specialized liquid flow cell is raised above 90°C. Finally, the strategies to limit and control the effects of intense electron beam to the radiolytic decomposition of water, which can have serious detrimental effect on the nucleation and growth dynamics of the final products, will be emphasized.

Ross, F. M., *Science*, **2015**, 350 (6267), aaa9886-9.

Micro-chemical and Microstructure Characterisation of High-permeability Mn-Zn Ferrites

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There are only a few people who remember and perhaps know that high-quality metallic and ceramic hard and soft magnetic materials are still produced in two factories (Magneti Ljubljana and Magna Kolektor) at Stegne Ljubljana, former big location of Iskra concern. Not only this, both factories are still in Slovenian hands and in EU almost the only producers of magnetic cores. Its high quality is the result of constant research and development of Slovenian researchers and technologists working in/for these two factories in the last more than 40 years. Technology of manufacturing, characterisation and types of soft magnetic ceramic Mn-Zn ferrites will be presented in this contribution. The practical case study of micro-chemical and microstructural analyses will show the way, how to find out the reasons for unexpected low values of initial permeability of selected ***E*** shaped ferrite cores shown in regular batch production.

Improving of the Workability of Heat Treated AlMg5 Aluminium Alloy Subjected to the ECAP Process Through Inter Pass Annealing

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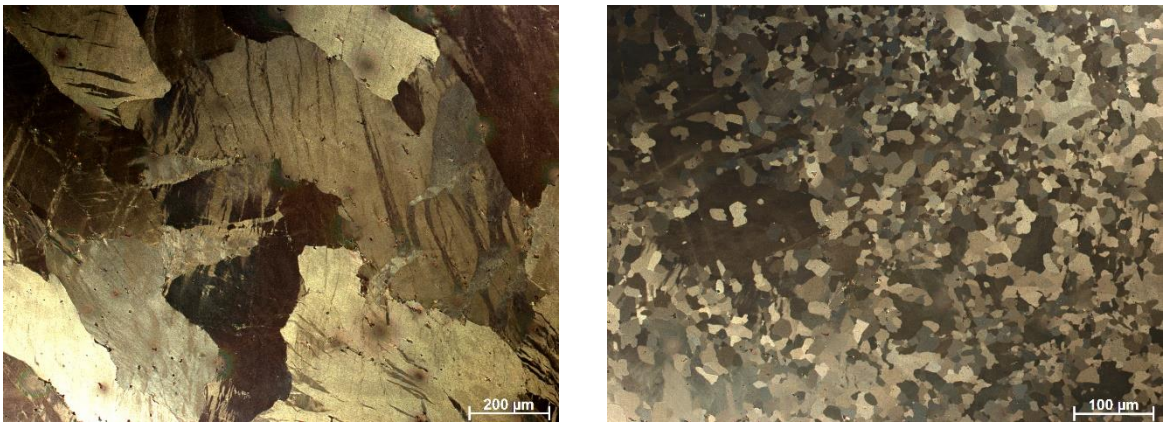
Aluminum alloys are being considered for increased usage as a material for producing lightweigh parts in automotive industry. The Al-Mg alloys are increasingly used for manufacturing components that require moderate strength and workablity. However, it is known that increased amount of magnesium in aluminium alloys result in change of properties of these allos such as the work hardening rate, dynamic strain aging effect, dislocation generation, grain refinement and thus the mechanical properties and workablility. For this reason it is necessary to enhance ductility of Al-Mg alloy before plastic deformation, which can be performed by subjecting the alloy to precipitation treatment. The study shows that the workability of the AlMg5 aluminium alloy can be increased through the precipitation treatment, however even that fact, after more than two ECAP pass the sample start to crumble. To increase the workability of the plastic worked material, inter pass annealing was applied. It was found that there is possibility to obtain fine grained structure (Fig. 1a-b) of the as annealed material through the recrystallization and increase ductility of the severe platic deformated material. It was also found that further plastic deformation result in obtaining material with better mechanical properties (hardness and tensile strenght) in comparison to material without inter pass annealing. To characterize the structure evolution of material at different stages of treatment light and electron microscopy was used.



a) b)

Figure 1. Microstructure of the AlMg5 aluminium alloy subjected to the a) 2 ECAP pass route Bc, b) 2 ECAP pass route Bc and annealed at 350 °C for 30 min

Evolution of Microstructure during Hot Deformation Alloy Inconel 625

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Inconel nickel-chromium alloy 625 is used for its high strength and outstanding corrosion resistance. The strength of Inconel alloy is derived from the stiffening effect of molybdenum and niobium on its nickel-chromium matrix; thus precipitation-hardening treatments are not required. This combination of elements is also responsible for superior resistance to a wide range of corrosive environments of unusual severity as well as the high-temperature effects such as oxidation and carburization.
Hot compressions tests of Inconel 625 superalloy were conducted using a expansion deformation simulator at different strain between 1000 °C and 1200 °C with a different strain rate. Optical microscope and scanning electron microscope were employed to investigate the microstructure evolution and nucleation mechanisms of dynamic recrystallization.

Synthesis of Silicon-Carbon Films by High-Frequency Deposition

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Silicon-carbon diamond-like films are a promising class of amorphous materials. Due to its unique physical properties – high hardness, low coefficient of friction, high chemical resistance and radiation resistance, they find an application in various fields of industry, mainly as protective coatings.

There are many methods of synthesis of diamond-like films. However, currently the development of new technologies is an important task.

This work presents a method of silicon-carbon films production by high-frequency deposition from the vapor mixture. This method is based on the diamond-like films synthesizing technology described by Parkhomenko *et al.*[1] Here we managed to resolve the main drawback of this technology - the uncontrollable amount of background impurities in the resulting films.

The specimens described in this work were investigated by atomic force microscopy and ESCA. The absence of background impurities in the samples, and the presence of the ratio of sp2 and sp3 links, typical for silicon-carbon films[2]. The method of receiving allows creating doped silicon-carbon films with well-defined physical properties, primarily conductivity, eliminating the influence of background impurities.

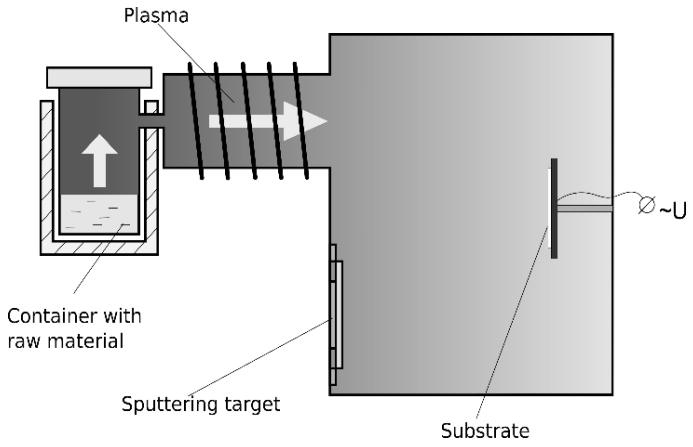

Figure 1. Schematic view of an apparatus for growing doped silicon-carbon films

1. Yu. Parkhomenko, M. Malinkovich, E. Scryleva, M. Shupegin, *Izvestia vuzov*, **2005,** *3*, 12-16. (In Russian)
2. Angus J. C., Hayman C. C., *Science,* **1988**, *241*, 913-921.

Dependence of Size of Eutectic Cells on Cooling Rates at Verified HTC during Solidification of M42 Super High Speed Steel Ingot

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Cooling rates during ingot solidification of M42 super high speed steel (SHSS) influences decisively on obtained microstructure and consequently also on success of following hot deformation process. Thus establishment of relationship between cooling rates and size of eutectic cells needed for design of ingot shape and size is required. For this task reliable values for HTC from solidified ingot on mould were needed. In this contribution using verified heat transfer coefficient (HTC) a FEM simulation (using ProCast package) of time evolutions of temperature field during solidification of M42 SHSS in industrial ingot was carried out. A special designed thermocouple assembly was applied that enabled direct measurement of temperature during longer solidification (cooling) time of ingot and HTC from melt to mould has been adjusted regarding to measured temperatures. Results about accordance of calculated and simulated time courses of temperature indicate on considerably higher values for HTC as it was assumed in various investigations so far. For selected cooling rates typical microstructures were characterized and relationships between average size of eutectic cells as well as size of dendrites and cooling rates were studied. Reliability of calculated cooling rates in ingot was additionally verified by laboratory simulation of solidification at cooling rate of 0.16 K/s since at approximately this cooling rate a new type of eutectic carbides, which have detrimental effect on hot deformability, begin to precipitate. The lowest FEM calculated values for cooling rates in ingot were slightly higher in comparison to laboratory simulated.

Computer Simulation of Mini-thixoforming

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Thixoforming is an innovative technology in metal processing, which combines the advantages of casting and forging. Thixoformed material is formed in the semi-solid state. The processed alloy is heated to the transition temperature between solid and liquid in order to obtain improved material properties.

Computer simulations for thixoforming technology are logically divided into solution approaches in fluid dynamics and solid mechanics codes, rare in combination of both physics areas.

The aim of the research was to verify the suitability of simulation programs and find effective procedure of computer modeling for real mini-thixoforming equipment. For the simulation of solidification, mechanical and thermo-physical properties of materials used was selected thermodynamic modeling tool for exploring the equilibrium and phase relationships JMatPro which is based on CalPhaD and extended by various models. For the simulation of the main process was due to the initial conditions of the temperature field of the mini-thixoforming system, the approach of solid mechanics' solution was selected and program DEFORM™ was used. This finite element method code allows simulate technological processes and following virtual optimization.

In this study, the results of numerical simulations were verified by experiments of semi-solid processing technology with mini-thixoforming equipment. Generally, the results of pilot computer simulations and experiments are in good agreement.

Microstructural and Electrical Properties in (Co,Nb)-doped SnO_2 Vvaristor Ceramics

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Metal oxide varistors are widely used as adaptable resistors (varistors) for the protection of electrical and electronic components from unwanted power surges.[1] Compared to commercial ZnO-based varistors, SnO_2-based elements have many advantages like better temperature resistance, thermal conductivity and less secondary phases. The main problem in SnO_2-based ceramics appears to be densification and grain growth. To address these issues, different dopants are used.[2] In this work we investigated the effect of Nb doping on twinning, grain growth and microstructure development in functional SnO_2-based varistor ceramics.

For our study we selected a simple system, SnO_2 with the addition of CoO and Nb_2O_5. We prepared the following compositions: (99-x) mol% SnO_2 + 1 mol% CoO + x mol% Nb_2O_5, with x= 0.1, 0.5, 0.75, 1.0, 2.0 and sintered at 1400°C for 5 hours. Phase composition of the samples was investigated by X-ray powder diffraction (XRD). In samples with the addition of only CoO (Co^{2+}) and samples with the lowest addition of Nb_2O_5 (Nb^{5+}), a secondary spinel-type phase Co_2SnO_4 is formed, whereas in the samples with higher additions of Nb_2O_5, increased solid solubility of both dopants in SnO_2 (Sn^{4+}) is observed due to

$Co^{2+} + 2Nb^{5+} \rightarrow 3Sn^{4+}$ replacement reaction. Microstructures of the samples were analyzed by field-emission scanning electron microscopy (FEG-SEM). Additions of Nb_2O_5 to the SnO_2-CoO binary system have a dramatic effect on SnO_2 grain growth; the average grain size is significantly increased, whereas the porosity rate decreased. The addition of CoO improves SnO_2 densification, Nb_2O_5 also triggers the formation of twin boundaries in SnO_2 grains. While binary SnO_2-CoO system showed poor nonlinearity (α = 6), the composition with 1mol% Nb_2O_5 into SnO_2-CoO ceramics resulted in excellent nonlinear properties (α = 50), where most of SnO_2 grains contain at least one {101} twin boundary and microstructures display high density with almost no porosity.

1. M.M. Shahraki, M.A. Bahrevar, S.M.S. Mirghafourian, *Ceram. Int*., **2015,** *41*, 6920-6924
2. G. Hu, J. Zhu, H. Yang, F. Wang, *J. Mater. Sci.: Mater. Electron.* **2013**, *24*, 2944-2949

Stress Corrosion Cracking of Dissimilar Austenitic 316L and Duplex 2205 Stainless Steels Welded Joints

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The paper describes structure and corrosion resistance of dissimilar stainless steels welded. Investigations focused on stress corrosion resistance of welded joints. The susceptibility to stress corrosion cracking (SCC) was determined in slow strain rate tests (SSRT) with the strain rate of 2.2 x 10-6 s-1 . Chloride SCC was determined in the 35% boiling water solution of MgCl2 environment at 125oC. Hydrogen assisted SCC tests were performed in synthetic sea water under cathodic polarization condition. The supplementary tests in an inert environment were also performed. Butt joints between duplex 2205 and austenitic 316L steels were performed with the use of submerged arc welding (SAW) method. The plates 15 mm in thickness were welded with heat input up to 3.5 kJ/mm using duplex steel filler metal. Microstructure examinations and corrosion tests were carried out.

Based on investigations it was shown that place of the lowest resistance to chloride stress corrosion cracking is heat affected zone at duplex steel side of dissimilar joins. That phenomenon was connected with undesirable structure of HAZ comprising large fraction of ferrite grains with acicular austenite phase. The presence of fine M23C6 and M7C3 carbides were also found. Hydrogen assisted SCC tests showed that significant reduction in ductility of duplex 2205 steel occurred at current density of 10 mA/cm^2. The 316L steel remains almost immune to SCC in these conditions.

1. J. Nowacki, P. Rybicki, Influence of heat input on corrosion resistance of SAW welded duplex joints. Journal of Achievements in Materials and Manufacturing Engineering, Vol. 17, 1-2 (2006), 113-116
2. T. Nelson, J. Lippold, M. Mills, Nature and evolution of the fusion boundary in ferritic-austenitic dissimilar weld metals, Part 1: Nucleation and growth; Welding Journal 78 (10) (1999), 329–337.
3. L. Karlsson, Welding of dissimilar metals. Welding in the World, 36 (1995), 125-132

Electro-oxidation of Formaldehyde Using Ni Electrodes

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In this study we used modified Ni thin film as an electrode for electro-oxidation of formaldehyde, which are promising to be used as an effective electrochemical sensor. The general Ni electrode was characterized by cyclic voltammetry, scanning electron microscopy and atomic force microscopy. Ni thin film was deposited on Au substrate by the electro-deposition from acidic $NiSO_4$ solution with subsequent modification in 1 M KOH using potentiostatic techniques. The use of modified Ni thin film (Ni-OOH) as a catalyst for the electro-oxidation of formaldehyde in alkaline media was studied by cyclic voltammetry and chronoamperometry methods. It was found that Ni thin film shows a catalytic activity towards formaldehyde oxidation at room temperature, but Au substrate not. Results showed that modified electrode plays an important role in improving the electron transfer between Ni-OOH and formaldehyde, because we observed a current response at potential range from 0.5 V to 0.8 V vs. Ag/AgCl. Moreover, the effects of various parameters such as formaldehyde concentrations and scan rates on the electrocatalytic activity of this modified electrode have also been investigated. In cyclic voltammetry studies we showed that the height of the oxidation peak of formaldehyde increases with the increasing the aldehyde concentration. From the electrochemical measurements, SEM and AFM analysis we can conclude that the modified Ni thin film exhibited a higher specific activity to a smooth Ni electrode as proposed in literature [1]. We believe this is due to the rougher Ni surface and connected higher amounts of adsorbed –OOH groups that promote the HCHO oxidation.

1. Rahim, M.A., R.A. Hameed, and M. Khalil, *Nickel as a catalyst for the electro-oxidation of methanol in alkaline medium*. Journal of power sources, 2004. **134**(2): p. 160-169.

Fundamentals and Applications of Spray Forming

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Spray forming is a process to generate preforms like billets, tubes or rings with homogenous and fine microstructure with cannot achieved by casting. The process has been developed several year ago and is commercially used for different base alloys (Fe, Cu, Al, Si). This presentation covers a fundamental process description and gives an overview of the devepments and applications of spray formed materials in the past 20 years. Lastest research results and future trends are included as well.

Durability of FRP/Wood Bonds Glued by Epoxy Resin

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The durability of glued timber members is significantly influenced by the type of adhesive used and its ability to carry the strain arising from the wood adherend volume changes. It is necessary to ensure good adhesion between both adherends to achieve suggested properties, which generally mean to assure suitable adhesive and wood properties. Different studies were made for FRP/wood bonds durability using different types of adhesives. The optimal results of adhesion were achieved by using the formaldehyde based adhesives (1,3); contrary different results were found using the epoxy resins (2,4). Moreover, positive results were found using primering treatments before gluing process. The principal of epoxy failure of wood bonds in wet conditions has not been yet sufficiently described. For this purpose, the experimental works on bond durability using epoxy resin for FRP/wood assemblies were undertaken. The paper describes the properties of FRP/wood bondline, which was set with different wood species commonly used in timber branch in the region of Middle Europe (oak, spruce, fir and larch). The FRP fabric (GFRP, CFRP) were tested onto above mentioned wood species within further wood characterization, such as the bulk density, porosity, optic microscopic analysis of the wood cell elements. Moreover, electron microscopy was utilised to determine the types of cohesive/adhesive failures on bondlines in a detail. The durability of all the reinforced wood assemblies by FRP fabrics was verified by exposing them into the different hygrothermal exposures. The final durability of FRP/wood assemblies was stated within the tensile shear strengths; simultaneously within the wood failure criterion of the shear area of single-lap joint; both requirements stated according to standard EN 302-1.

1. Trimble, B. S., Durability and Mode-I Fracture of Fiber-Reinforced Plastic (FRP)/Wood Interface Bond, MSc. Thesis: West Virginia University.
2. Raftery, G. M., Harte, A. M., Rodd, P. D. *International Journal of Adhesion & Adhesives,* **2009**, *29,* 101-110.
3. GangaRao, H. V. S. *Wood Design Focus.* **1997**, 13-18
4. Alexander, J. P., Shaler, S. M., Gardner, D. J. *Proc. of Wood Adhesive*, **2000**.

Treatment of Oxidized Inconel at Elevated Temperatures in Hydrogen Plasma

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Inconel 625 samples with a surface oxide film composed of chromium oxide with a thickness of approximately 700 nm were exposed to microwave hydrogen plasma at elevated temperatures to determine the suitable parameters for reduction of the oxide film. The hydrogen pressure during plasma treatment was set to 60 Pa. Plasma was created by a microwave discharge in a quartz glass tube to allow for a high dissociation fraction of hydrogen molecules. Auger electron depth profiling (AES) was used to determine the decay of the oxygen in the surface film, X-ray diffraction was used (XRD) to measure structural modifications and X-ray photoelectron spectroscopy (XPS) was used to study changes in the oxidation state of the elements. Changes in the surface morphology were determined by scanning electron microscopy (SEM) and atomic force microscopy (AFM). During hydrogen plasma treatment, the oxidized Inconel samples were heated to elevated temperatures using focused solar radiation. The sample temperature was measured with a pyrometer. The results showed that reduction of the oxide film started at temperatures of approximately 1300 K (considering the emissivity of 0.85) and the oxide was reduced in about 10 s of treatment as revealed by AES. The XRD showed somehow sharper substrate peaks after the reduction. Samples treated just in neutral hydrogen atmosphere under the same conditions have not been reduced up to approximately 1500 K indicating usefulness of plasma treatment.

Corrosion Behavior of Automotive Hot-End Components Under Combined Wet Corrosion and Molten Salt Attack

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Automotive hot-end components have to ensure reliable performance under aggressive environmental conditions. Operating temperatures up to 900 °C, the presence of wetness and the attack of chloride-containing de-icing salts make extensive requirements to the durability of insulated hot-end components.

The corrosion resistance of these systems against the combined attack by wet corrosion and corrosion by molten salts has been investigated under alternating environmental conditions. Due to the diverse geometries of field components it was necessary to develop a generic experimental approach and a proper sample design. 3 layer samples, consisting of an inner steel shell, made of AISI 441, an adjacent insulation mat and an outer steel shell, made of AISI 304, have been tested. Contributions of wet corrosion and corrosion by molten salts to the total corrosion rate have been evaluated. The influences of temperature, oxygen in air, wetting by water, amount of salt and of insulation material have been quantified. Temperature was between 25 and 900 °C. 4 wt.-% NaCl + 1 wt.-% $CaCl_2$ as well as a dry salt mixture of NaCl and $CaCl_2$ in a ratio of 4:1 have been used as aggressive species.

Results show that wetting time, temperature and amount of deposited salt are the key parameters that determine lifetime.

Modified Compact Tension Test: Numerical Support for Processing of Experimentally Obtained Values

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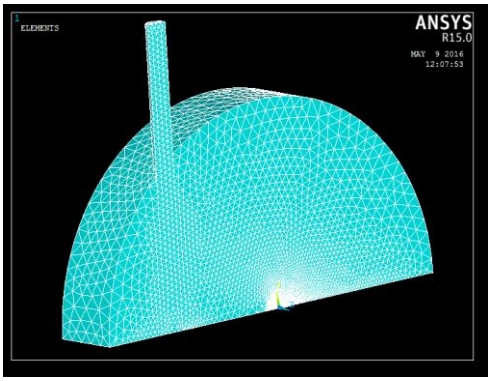
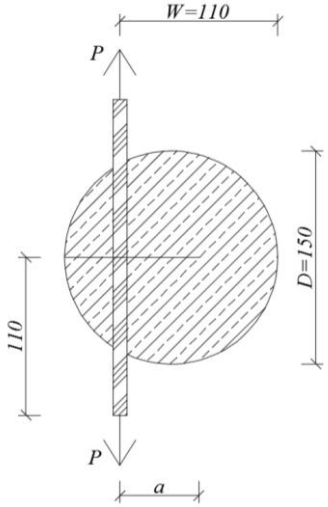
The modified compact tension (MCT) test is a test configuration which has been derived from standard compact tension test. This configuration is commonly used for metallic materials testing and obtaining their fracture mechanics parameters. It is not proper for tests on quasi-brittle materials due to it's complicated shape (steel-concrete interface). The geometry of the MCT test specimen follows the standard variant of the CT test. In both cases the notch is applied to the specimen. Since it is a quite new test configuration a lot of research needs to be done before it can be used widely.

In cooperation between IPM, BUT, US and UO a number of specimens were prepared and experiments were performed. In this paper the outputs of the experiments will be processed and the values of fracture mechanics parameters will be obtained and discussed using the outputs – calibration curves – from previous and newly performed numerical simulations.





1. Seitl, S., Viszlay, V., Cifuentes, H. Canteli, A. Transactions of the VŠB – Technical University of Ostrava, Civil Engineering Series., **2015**, Vol. 15(2)
2. Cifuentes, H., Lozano, M., Holušová, T., Medina, F., Seitl, S., Canteli, A. Anales de Mecánica de la Fractura, **2015**, Vol. 32, 208–213

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Use of Laplacian Transformation for Description of Hot Deformation Stress-strain Curves for Steels

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Study of hot deformation of steels is for decades driving force in improvement of steel grades and economics of steel production and even today improvements in hot deformability process lead to better microstructural and consequently mechanical properties.
Hot deformation test were carried out on TA Instruments 805 D/A deformation dilatometer, for which the samples are cylindrical 10mm long and with a 5mm diameter. Experimental setup provides dense data of strain stress (ϕ, σ) curve, which enable wide range of numerical model approaches. Laplacian transformation is used for description of (ϕ, σ) relationship in *s* space as transfer function. Simplicity and efficiency of dynamical system description using Since obtained transfer function is of lumped-parameter type, resulting models enable fast computations. Transfer function parameters are determined by numerical optimization technique. Obtained model accuracy is mostly below 1 % and therefore method seems promising.

Influence of Bainite Fraction on Improving Mechanical Properties of Quenched and Tempered High Silicon Steel

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Martensitic steels are characterized by high strength which, on the other hand, is offset by considerable brittleness. This drawback can be partly corrected by tempering, at the cost of reduced final strength. If steel is alloyed with a sufficient amount of silicon, an optimum heat treatment sequence can produce a mixed microstructure consisting of martensite and carbide-free bainite. In various microstructures of this composition with identical grain size, mechanical properties would be dictated predominantly by the fraction of bainite. This article deals with designing a heat treatment sequence for a low-alloy steel. It is part of a research into the impact of bainite fraction on mechanical properties of materials with martensitic-bainitic microstructure. At an appropriate ratio of martensite and bainite, a steel with 0.43 % C can exhibit strengths above 2200 MPa at A_{5mm} elongation more than 18 %.

Gas Conductance Measurement in Molecular-flow Regime by Time Constant of Pressure Decay

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Knowing the precise value of conductance of elements (e.g., tubes and orifices) in vacuum systems is of great importance in vacuum metrology, as well as in industrial applications. It is defined, at pressure difference Δp, as $C = \frac{q_{pV}}{\Delta p}$, where *pV*-flow rate from the chamber with a volume *V* equals to $q_{pV} = V\frac{dp}{dt}$. Conductance of tubes depends not only on their geometry and dimensions, but on the roughness of tube's inner surface as well.

A system for measuring conductance of different tubes with the pressure decay method was built. Here, a vacuum chamber is connected to a turbopump via a long tube. Due to the turbopump's high pumping speed (relative to expected tube conductance), ideal vacuum is assumed at the pumping end of the tube. Pressure in the vacuum chamber therefore decays as $p(t) = p_0 \exp\left(-\frac{C}{V}t\right) = p_0 \exp(-t/\tau)$. Knowing volume of the chamber, the tube's conductance can be calculated from the time constant τ of pressure decay as $C = \frac{V}{\tau}$.

Construction of the measurement system and analysis of different influential quantities which contribute to the measurement uncertainty are discussed here. System enables conductance measurements with very high precision (less than 0.5%) so it is suitable for studies of the influence of surface conditions on the tube conductance.

Effect of the Aggregate Type on the Properties of Natural Hydraulic Lime-based Mortars

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Lime mortars represent an indispensable building material that have been used for centuries in civil engineering. Considering the necessity of numerous restoration work on historical buildings, a research of the applicability and suitability of various types of plasters for repairing the historical plasters have been developed. In the current restoration practice, the mortars based on aerial or hydraulic lime with siliceous aggregate are used on repair / reconstruction of historical plasters.
J. Lanas itemized that the use of crushed limestone aggregate improves the strength of mortars and plasters based on aerial, dolomitic or hydraulic lime [1-3]. This may be due to the similarity of the binder matrix with the limestone aggregate structure, as well as a good packing of the aggregate with angular edges. Calcite contained in the filler acts as crystallization nuclei for the crystallization of calcium carbonate from calcium hydroxide, and thereby it accelerates a carbonation process. The resulting properties of lime mortars do not depend only on the type of aggregate, but also on its contamination, origin and a degree of hardening. For example, the using chalk-based limestone aggregates leads to a reduction in strength and durability of lime mortars [4]. For this reason, it is needed to know the characteristics of the aggregate and the results obtained for the particular aggregate cannot be generally applied for the similar type of aggregate.
This work presents the applicability of Czech local crushed limestone aggregate to natural hydraulic lime-based mortars. The role of aggregates on the properties of mortars is examined by comparing a siliceous and limestone aggregate and its quantity in the mortar. It was found that limestone aggregate slightly increased the flexural strength, porosity, water adsorptive capacity and carbonation rate of the mortars. By contrast, compressive strength of the mortars was higher while using the siliceous aggregate.

1. Lanas, J. et al. *Cement and Concrete Research*, **2003**, Vol. 33 (11), 1867–1876.
2. Lanas, J. et al. *Cement and Concrete Research*, **2004**, Vol. 34 (12), 2191–2201.
3. Lanas, J. et al. *Cement and Concrete Research*, **2006**, Vol. 36 (5), 951–960.
4. Pavía, S. et al. *Materials and Structures*, **2008**, Vol. 41, 559–569.

Optimization of the Process for Obtaining Manganese Oxide (III) by Ultrasonic Spray Pyrolysis and Investigation of its Physical and Chemical Properties

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The very promising method of obtaining nanopowders is the spray pyrolysis method.
It is the most large-scale way to produce fine powders. The method consists in that the mixture of salt solutions, converted by an ultrasonic atomizer in an aerosol state, transferred by the carrier gas into the hot cell, where an instantaneous expansion of the particles is hapenning; the resulting oxide product is collected on a filter.[1] Optimization of the process of obtaining manganese oxide (III) by this method has been our top priority.
There have been studied in detail the final composition of the microspheres, sizes of the microspheres and nanoparticles of which they are composed (Figure 1) and wall thickness, the specific surface area, moisture and residual salts in the samples, thermal properties of the material.

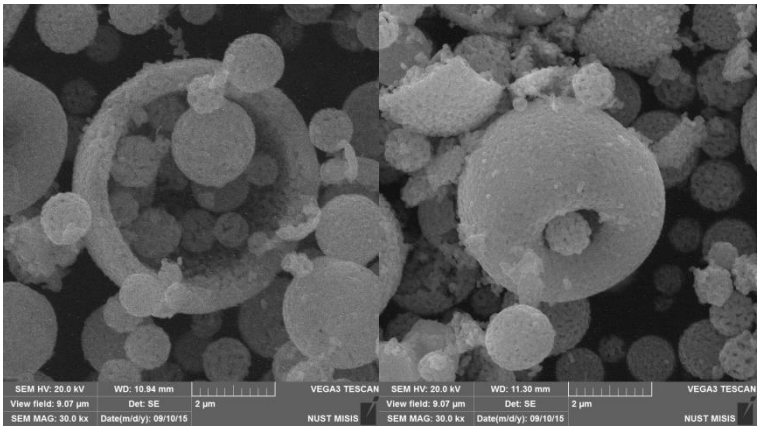

Figure 1 – Images captured with the scanning electron microscope Tescan Vega 3, nanostructured Mn_2O_3 microspheres aged at high temperatures, obtained by ultrasonic spray pyrolysis.

Subsequently this material with improved thermal characteristics to be used as one of composes the polymer nanocomposite. Polymer nanocomposites for flammability applications are attractive because the formation of a nanocomposite not only improves the fire properties but can also improve other properties (e.g., mechanical properties)[2], and it has the potential to bring true multifunctionality to materials.

1. A. Abrutis, G. Teiserskis, V.Garcia Kubilius, *Journal of Membrane Science,* **2004**, *240*, 113-122.
2. Alexander B. Morgan, Charles A. Wilkie, *Flame Retardant Polymer Nanocomposites, Wiley*, **2007**.

Electrodeposition of Nd-Fe-based Alloy From Aqueous Solution

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The Nd-Fe-based alloys i.e $NdFe_{12}N_x$ are of great interest because of their good intrinsic magnetic properties that lead to extremely high energy products which can be extensively used in many different fields connected to permanent magnetism. In this study binary Nd and Fe were electrochemically co-deposited onto the copper substrate from aqueous chloride solution containing glycine and citrate salts as the complexing regents. The initial electroplating behaviour was studied by cyclic voltammetry which indicated that the reduction potential of Fe^{2+} became more positive by adding glycine and more negative by adding citrate. The reduction potential of Fe^{2+} shifted negatively with the presence of both glycine (0.36 M) and citric acid (0.018 M) at Ph 3.0. Due to the very negative standard potential metallic Nd from Nd^{3+}- based electrolyte cannot be deposited independently, but the literature reports that the co-deposition with Fe-group metal is possible [1]. In this study we have successfully deposited Nd-Fe-based thin film with thickness of several micrometres using galvanostatic mode. The effects of solution composition and deposition conditions on the deposit composition and morphology were investigated by scanning electron microscope (SEM) coupled with energy dispersive X-ray spectroscope (EDS). Results revealed that substantially increased Nd deposit content has been achieved with the increasing concentration of citrate ions in solution and with an increased applied current density, as well as the depositing time, while the deposits were very coarse and cracks were formed at the same time. We propose the composition of a stable electrolyte at pH3.0 where the concentration of citrate ions should be less than 0.04 M in order to avoid the precipitation of $Nd(OH)_3$. The conditions for depositing Nd-Fe alloys were scanned at different applied galvanostatic conditions, with the maximum content of Nd (19.59 at.%) in Nd-Fe film at the current density of 100 $mA \cdot cm^{-2}$. This study shows a promise in depositing rare-earth-based alloys from water-based solutions.

1. Yang, Z.-n., et al., *Electroplating mechanism of nanocrystalline NdFeB film.* Transactions of Nonferrous Metals Society of China, 2015. **25**(3): p. 832-837.

Investigations on the Relationship Between Crystallographic Character of Grain Boundaries and their Functional and Mechanical Properties in Various Engineering Materials

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Grain boundaries are important defects in crystalline solids because they influence a large number of properties, like strength of ductile materials, fracture resistance and corrosion resistance of various metals, or efficiency losses in polycrystalline solar cells. The exact correspondence between the properties and the crystallographic nature of grain boundaries is in many cases not well understood which is mainly due to the fact that grain boundaries are characterized by 8 degrees of freedom, namely 5 rotational parameters and 3 translational ones. The translational parameters are very difficult to measure and it is not clear whether they are independent of the others. The rotational parameters, that is the grain boundary misorientation (3 parameters) and the grain boundary plane, can however be measured using 3D or pseudo-3D orientation microscopy. With these techniques, we are able to study the influence of all parameters on grain boundary properties.
In the presentation, we will introduce the various techniques and show application examples. In particular, we will present results on the corrosion of grain boundaries of austenitic stainless steels in aqueous acid solutions and in salt melts, on fracture resistance in DP steels and on the influence on the performance of CdTe solar cells.

Advanced CAE Simulation of Pressures and Times Influence on Injection Molding Process and Product

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This paper deals with possibilities of injection molding simulation usage for further structural analysis. These following analysis can predict mechanical properties of the final product.
Because plastic parts made by injection molding don't have in their entire volume exactly same properties, it is difficult to predict them. As properties dependent on molding process can be mentioned for example stiffness, thermal stability, strength and many others.
Generally, is before creating first design of mold performed injection molding analysis. From results is possible determine the main paramters such as filling of mold, material properties in specified points of interest, weld lines or fibres orientation. These material data is possible to use as input data for material model in load analysis of final product. With this knowledge can be evaluated mechanical properties and in case of need changed design of product. In this stage of design process are changes not so expensive.
The entire process is described on the sample for mechanical tensile test. As a first step is simulated injection molding process in software Moldex 3D and then are transferred material data to finite element method programme NX Nastran. In this programme is than performed analysis with correct material data.

Assesment of the development dynamics of the construction walling materials in Ukraine

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To provide housing for the population of Ukraine at the level of the European Union and achieving rates of development in neighboring Belarus, our country should increase the pace of construction in four times.

The results of the study of world walling building materials market and forecast of its development are presented below.

It was proposed to split walling materials according to the design, out of which carried out the construction of bearing (or self-supporting) enclosing walls. Materials may be used for the construction of exterior walls, but a much greater amount of them is used in the construction of demising walls and interior partitions. As construction materials (elements) for enclosing walls in Ukraine are used ceramic and silicate bricks (including front, clinker bricks and ceramic blocks); small autoclaved aerated concrete blocks, precast elements for housing construction or civil engineering (concrete products); wooden products. At the same time, structural materials for the installation of demising walls and interior partitions, in addition to the above, include materials and products for systems of drywall, plaster boards, gypsum boards; wood materials: wood-boards, OSB boards and fiberboard; magnesite boards and materials for translucent walls. [1]

In the overall balance of building materials, a significant amount takes silicate brick production, which has significant advantages over other ceramic products and claydite. These include: a high degree of mechanization, relatively short production cycle, low specific fuel consumption and, therefore, a lower cost. This silicate brick has high consumable operating properties: the correct form, the exact size, high strength and freezing resistance.

Existing construction experience shows that calcium silicate bricks can be used not only as a structural material, but as well as facing. As a wall material silicate bricks have been used for over 100 years. Based on its consumer properties its most appropriate use it a front wall material for walls and fencing material for demising walls and partitions. In the first case, the market requires high-strength bricks, including color. The second area of application is related to high density of silica brick, making it almost ideal soundproof material. The main disadvantage of ordinary silica brick, which is used as a front material, is that in the long-term operation in the cities where the existing metallurgical, chemical and other companies with high emissions to air, the surface of bricks become contaminated and dirty, losing aesthetic appearance. Face brick, which is used for facades, meets higher requirements: strength, density, preservation of corners and edges.

A system of ponderability indicators of the walling materials used in enclosure structures, and in separation and partition walls in under development in the Kyiv National university of building and architecture (KNUBA).

References

[1] - Zakharchenko P.V., Gavrysh O. M. Reference on materials market for domestic construction and decoration of the premises (according to data for 2014). KNUCA. - K.: SEA Pavlenko, 2015.

Primary Carbides Morphology Modification in AISI D2 Tool Steel, with Rare Earth Elements

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Tool steels are widely used today in the manufacture of cutting tools, dies and molds. They are generally characterized by high levels of wear resistance, strength and toughness. The OCR 12 steel belongs to the group of cold work steels, which are not resistant to softening at elevated temperatures and are used in applications not involving prolonged or repeated heating. Such applications include woodworking, stamping and pressing tools.

The wear resistance of tool steels is strongly dependent on the amount, shape, distribution and type of the carbides present in the microstructure. Thus, it is essential to study the carbides in the material and to develop methods to control their properties.

We have successfully modified the cast microstructure of the OCR12 steel by addition small amount of rare earth (RE) elements. The as-received OCR 12 steel was remelted in the argon atmosphere and deoxidized by aluminum, calcium and titanium. Rare earth elements in the form of Ce mischmetal were added in three steps. Thus we obtained three series of samples with 0,015, 0,026 and 0,028 wt % of RE. All three samples show that the modification was successful as the morphology of primary Cr_7C_3 carbides is greatly changed in comparison to non-modified samples.

Nanofibrillated Cellulose as a Reinforcing and Toughening Agent of the Poly(3-hydroxybutyrate)

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Biopolymers are versatile materials appointed by the unique physical, mechanical and biological properties. In view of highly demanding engineering applications, where mechanical performance is of the main importance, their properties are however not entirely adequate, hence a continuous search towards new compounds is underway. Today nanotechnology drags the major scientific breakthroughs that make the development of advanced nanocomposite materials to be on the rise. By combining components of organic origin we have the ability to create green nanocomposites, providing the positive environmental benefits with respect to ultimate disposability and raw material use. Nevertheless the progress towards real-world applications does not only rely on the favourable material properties, but equally on easy integration or transformation of the differentially formed components into their macroscopic assemblies, without compromising their unique features.

The aim of the study was to identify and validate the reinforcing potential of nanofibrillated cellulose (NFC) to improve the final properties of poly(3-hydroxybutyrate) (PHB) matrix. The research deals with the preparation of PHB/NFC nanocomposites by using the native state of raw materials and extrusion processing technology. To obtain a uniform dispersion of the reinforcing filler within a host matrix, PHB powder was first dispersed in water, mixed with NFC in aqueous suspension and then freeze dried to eliminate the water phase from the ensuing system. Dried batch was afterward extruded and added to the granulated PHB matrix in different weight proportions. Nanocomposites of various formulations were subsequently produced with injection moulding technology. Morphological properties of nanocomposite components were investigated by scanning electron microscopy (FE-SEM), while mechanical properties of the final material formulations were determined by tensile testing. Compared to the polymer reference (E_t = 1.3 GPa; σ_M = 20.3 MPa; ε_b = 2.4 %), the Young modulus (E_t = 1.7 GPa) and tensile strength (σ_M = 26.3 MPa) were significantly improved for nanocomposites containing high contents of cellulose nanofibrils along with decisively improved values of the elongation at break (ε_b = 3.07 %). According to the results presented, it is possible to produce strong and tough bionanocomposite materials through the use of native form of NFC, whereby its proportion dictates the final material properties.