27. MEDNARODNA KONFERENCA O MATERIALIH IN TEHNOLOGIJAH

16.–18. oktober 2019, Portorož, Slovenija

27th INTERNATIONAL CONFERENCE ON MATERIALS AND TECHNOLOGY

16–18 October 2019, Portorož, Slovenia

PROGRAM IN KNJIGA POVZETKOV

PROGRAM AND BOOK OF ABSTRACTS

INŠTITUT ZA KOVINSKE MATERIALE IN TEHNOLOGIJE, LJUBLJANA

27. MEDNARODNA KONFERENCA O MATERIALIH IN TEHNOLOGIJAH /
27th INTERNATIONAL CONFERENCE ON MATERIALS AND TECHNOLOGY

PROGRAM IN KNJIGA POVZETKOV / PROGRAM AND BOOK OF ABSTRACTS

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Legenda – Legend:
MM – Kovinski materiali/Metallic materials
CM – Kompozitni materiali/Composite materials
C – Keramika/Ceramic
MGM – Magnetni materiali/Magnetic Materials
MS – Modeliranje in simulacija procesov in tehnologij/Mathematical modeling and computer simulation of processes and technologies
NN – Nanoznanost in nanotehnologije/Nanosciences and nanotechnologies

YR – Mladi raziskovalci/Young researchers

27th INTERNATIONAL CONFERENCE ON MATERIALS AND TECHNOLOGY,
16–18 OCTOBER, 2019

Wednesday, 16.10.2019

9:00	**OPENING CEREMONY – Chair of the Conference Matjaž Godec, Hall C**		
9:15	**PLENARY LECTURE – Kingshott**		
	Hall C **Nanomaterials**		**Hall D** **Biomaterials**
10:00	**PLENARY LECTURE – Chakraborti**	10:00	**Ahčan**
10:45	Podgornik	10:15	**PLENARY LECTURE – Trampuž**
11:05	**Coffee Break**	11:00	Dolinar
11:30	Savilov	**11:15**	**Coffee Break**
11:50	Kunaver	11:45	Godec
	Hall C – Young researches session	12:00	Manojlović
12:10	**Opening YR ČEH, Podgornik**	12:15	Kralj-Iglič
12:20	Topole – P. Jovičević K.	12:30	Iglič
12:40	Verbovšek – Kraner	**12:45**	**LUNCH**
13:00	Malej		
13:10	**LUNCH**	14:30	Trebše
		14:45	Milošev
14:30	Skela – Zorc	15:00	M. Ovsenik
14:50	Paul – Dobravec	15:15	Kopač
15:10	Hribar – Hudelja	15:30	Čatić
15:30	Nandy – Foder	15:45	Grguraš
15:50	Čontala – Ďurica	16:00	Mavčič
16:10	**Coffee Break**	**16:15**	**Coffee Break**
16:40	Xu – Koblar	16:40	Cör
17:00	Lojen – Kušter	16:55	Hočevar
17:20	Vuga – Korent	17:10	Lončar – T. Malgaj
17:40	Życiński – Jackowski	17:30	Žarkovič G. – R. Ovsenik
18:00	Lasica – Nuzhnyj	17:50	Trost – Golež
		18:10	Primožič
19:30 – 22:00	**POSTER SESSION WITH STANDING BUFFET – LOBBY EUROPA**		

Thursday 17.10.2019

	Hall C – Magnetic materials		**Hall D – Biomaterials**
09:00	**PLENARY LECTURE – Burkhardt**	09:00	Pernat
09:45	**Schrefl**	09:15	Tadel Kocjančič
10:15	McGuiness	09:30	Jenko
10:35	Stambolić	09:45	Zupanc
10:55	**Coffee Break**	10:00	Kocjančič
11:30	Tomše	10:15	Smrke
11:50	Žužek Rožman	10:30	Jeverica
12:10	Žagar Soderžnik	**10:45**	**Coffee Break**
12:30	**LUNCH**	11:15	Lapoša
14:00	Soderžnik	11:30	Pompe
14:20	Podmiljšak	11:45	Feizpour
14:40	Jenuš	12:00	Moličnik
		12:15	Drstvešek
	Hall C – Characterisation	**12:30**	**LUNCH**
15:00	**Kothleitner**	14:00	Avsec – Merčun
15:30	Zaefferer	14:20	Bošnjak – B. Medved
15:50	**Coffee Break**	14:40	M. Malgaj
16:20	Zavašnik	14:50	Žigon
16:40	Kovač	15:05	Novak
17:00	Primc	15:20	Papst
17:20	Jurči	15:35	Gorgieva
17:40	Podlogar	**15:50**	**Coffee Break**
18:00	Ptačinova	16:20	Vodičar
		16:35	Gorenšek
		16:50	Belič
		17:05	M. J. Klug
19:00 – 22:20	**Monfort – Conference dinner**		

Friday 18.10.2019

	Hall C – Workshop – 3D Printing of Metallic Materials		**Hall D – Metallic Materials**
09:00	**Opening 3D Workshop chairs – Godec and Podgornik**	09:00	Žužek
09:10	Pambaguian	09:20	Kevorkijan
09:40	Waldhauser	09:40	Malek
10:10	Godec	10:00	Conradi
10:40	Romainville	10:20	Klančnik
11:10	**Coffee Break**	10:40	Kafexhiu
11:30	Lopez	**11:00**	**Coffee Break**
12:00	Schlasche	11:30	Eltugral
12:30	Podgornik	11:50	Kubašek
13:00	Podlipec	12:10	Merta
13:20	Govekar	12:30	Šalej Lah
		12:50	Raška
		13:10	Terčelj
13:40	**Closing ceremony, LUNCH**		

PROGRAM 27. MEDNARODNE KONFERENCE O MATERIALIH IN TEHNOLOGIJAH
27th INTERNATIONAL CONFERENCE ON MATERIALS AND TECHNOLOGY: PROGRAM

Sreda – Wednesday 16.10.2019 Hall C	
	Predsedujoči – Chair: M. Godec, B. Šarler
9:00	**ODPRTJE – OPENING CEREMONY – Matjaž Godec**
9:15	**PLENARY LECTURE** New Micro- and Nanostructured Biomaterial Surfaces based on Colloidal Crystals Peter Kingshott Department of Chemistry and Biotechnology, Polymer Nanointerface Engineering Group, Swinburne University of Technology, Melbourne, VIC, Australia
10:00	**PLENARY LECTURE** Data-driven Evolutionary Optimization in Metallurgical and Materials Engineering Nirupam Chakraborti Department of Metallurgical & Materials Engineering, Indian Institute of Technology, Kharagpur 721 302, India
10:45	Influencing Parameters and Measurement Uncertainty in Mechanical Testing of Al Alloys B. Podgornik[1], B. Žužek[1], F. Kafexhiu[1], M. Sedlaček[1], F. Vode[1], R. Rezar[1], B. Hostej[2], V. Kevorkijan[2] [1]Institute of Metals and Technology, Lepi pot 11, SI-1000 Ljubljana, Slovenia, [2]IMPOL R&R, Partizanska ul. 28, SI-2310 Slovenska Bistrica, Slovenia
11:05	**Coffee Break**
11:30	High Density Carbon and Metal-Carbon Structures by Spark Plasma Sintering Serguei Savilov, Eugenia Suslova, Sergei Chernyak, Anton Ivanov, Natalia Kuznetsova M.V. Lomonosov Moscow State University, Chemistry Department, 119991, Russia, Moscow, Leninskie gory, 1, b.3
11:50	Nanocrystalline Cellulose From Laboratory To Pilot Plant Production And Its Use Matjaž Kunaver[1], Ema Šušteršič jagodič[2] [1]National Institute of Chemistry, Hajdrihova 19, SI-1000 Ljubljana, Slovenia, [2]Helios d.o.o., Količevo 65,SI-1230 Domžale, Slovenia
	Hall C – YOUNG RESEARCHERS
	Predsedujoči – Chair: M. Čeh, B. Podgornik
12:10	**Opening YR – Čeh, Podgornik**
12:20	Field-Assisted Sintering of Ti-CNT Metal-Matrix Composites Martin Topole[1,2], Elinor G. Castle[3], Theo G. Saunders[3], Črtomir Donik[1], Michael J. Reece[3], Paul J. McGuiness[1,2] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova 39, 1000 Ljubljana, Slovenia, [3]School of Engineering and Material Science, Queen Mary University of London, Mile End Rd, London E1 4NS, UK
12:30	Deep Cryogenic Treatment of High Speed Steels Patricia Jovičević Klug[1,2], Bojan Podgornik[1] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova cesta 39, 1000 Ljubljana, Slovenia
12:40	Preparation of the System to Study Thermal Transpiration in Stainless Steel Tubes 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

12:50	Characterization of Metal Powders Jakob Kraner[1], Jožef Medved[2], Matjaž Godec[1], Irena Paulin[1], [1]Institute of Metals and Technology, Lepi pot 11, SI-1000 Ljubljana, Slovenia, [2]Departmant of Materials and Metallurgy, Faculty of Natural Sciences and Engineering, University of Ljubljana, Aškerčeva cesta 12, SI-1000 Ljubljana, Slovenia
13:00	The Influence of Composition and Prior Deformation on Precipitation During Aging of Nickel Alloy 625 Simon Malej[1], Jožef Medved[2], Barbara Šetina Batič[1], Franc Tehovnik[1], Jaka Burja[1], Franci Vode[1], Boštjan Arh[1], Matjaž Godec[1] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, [2]Faculty of Natural sciences and Engineering, Aškerčeva cesta 12, 1000 Ljubljana
13:10	**LUNCH**
14:30	Correlations of microstructural characteristic of tool steels on mechanical properties and wear behavior Božo Skela[1,2], Marko Sedlaček[1], Fevzi Kafexhiu[1], Bojan Podgornik[1,2] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova cesta 39, 1000 Ljubljana, Slovenia
14:40	Decarburization Of Hypoeutectoid Carbon Steel C22 During Isothermal Annealing In Air At Temperatures $A_{C1} < T < A_{C3}$ Matija Zorc, Milan Bizjak, Borut Kosec, Aleš Nagode Faculty of natural sciences and engineering, Department of materials and metallurgy, Lepi pot 11, 1000 Ljubljana
14:50	Comparing Measurements With Different Catalytic Probes in RF and MW Plasma Paul D.[1], Zaplotnik R.[1], Primc G.[1], Vesel A.[1], Lojen D.[1], Mozetič M.[1], Hančič A.[2] [1]F4, Institute Jožef Stefan, Teslova ulica 30, SI-1000 Ljubljana, [2]TECOS, Slovenian tool and die development center Kidričeva ulica 25, SI-3000 Celje
15:00	Development of Meshless Method for an Accurate Phase-Field Modelling of Dendrites with Arbitrary Orientations Tadej Dobravec[1], Boštjan Mavrič[1,2], and Božidar Šarler[1,2] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]Faculty of Mechanical Engineering, Aškerčeva cesta 6, 1000 Ljubljana, Slovenia
15:10	Improvement of foamed glass production sustainability with the use of hydrated sodium silicate Uroš Hribar[1,2], Matjaž Spreitzer[1], Jakob König[1] [1]Advanced Materials Department, Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova cesta 39, 1000 Ljubljana, Slovenia
15:20	Feather-light, cellulose-nanofiber-reinforced γ-Al_2O_3 foams H. Hudelja[1,2], A. Kocjan[1,2] [1]Department for nanostructured materials, Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate school, Jamova cesta 39, 1000 Ljubljana, Slovenia
15:30	On the role of Ca, Zn and Al for ductilization of Mg alloys Supriya Nandy, Stefan Zaefferer, Dierk Raabe Max-Planck Institut für Eisenforschung, Max-Planck Straße 1, Germany-40237
15:40	Effect of Titanium and Vanadium Addition on Final Mechanical Properties of S1100QL Steel J. Foder[1], B. Bradaškja[1], G. Klančnik[1]* 1RCJ d.o.o., Cesta Franceta Prešerna 61, Jesenice, 4270 Jesenice

15:50	Topochemical Conversion of $Bi_4Ti_3O_{12}$ Nanoplatelets to $MTiO_3$ (M = Sr, Ca, Ba) Nanoparticles under Hydrothermal Conditions Alja Čontala[1,2], Nina Daneu[1], Matjaž Spreitzer[1] and Marjeta Maček Kržmanc[1] [1]Jožef Stefan Institute, Advanced Materials Department, Jamova cesta 39, 1000 Ljubljana, Slovenia [2]Jožef Stefan International Postgraduate School, Jamova cesta 39, 1000 Ljubljana, Slovenia
16:00	Investigation of Microstructure of Differently Sub-Zero Treated Vanadis 6 Cold Work Tool Steel Juraj Ďurica, Jana Ptačinová, Peter Jurči, Matej Pašák, Martin Kusý Slovak University of Technology in Bratislava, Faculty of Materials Science and Technology in Trnava, Jána Bottu 2781/25, 917 01 Trnava, Slovakia, EU
16:10	**Coffee Break**
16:40	Selective recovering $Nd_2Fe_{14}B$ grains from Nd−Fe−B magnets by anodic etching Xuan XU,[1,2] Saso STURM,[1,2] Zoran SAMARDZIJA,[1] Kristina Z. ROZMAN[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
16:50	Electrochemical deposition of Ni in LC TEM Maja Koblar[1,2], Sandra Drev[1], Bojan Ambrožič[1,2], Špela Trafela[1,2], Kristina Žužek Rožman[1], Sašo Šturm[1], MiranČeh[1] [1]Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova 39, 1000 Ljubljana, Slovenia
17:00	PTFE hydrophylization in inductively coupled RF plasma Dane Lojen[1,2], Alenka Vesel[1], Gregor Primc[1], Miran Mozetič[1], Rok Zaplotnik[1] [1]Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova cesta 39, 1000 Ljubljana
17:10	Determination of a new ternary Laves phase in Al-Cr-Sc system combining EDS, Rietveld refinement and single-crystal methods M. Kušter[1,2], A. Meden[3], Z. Samardžija[1], M. Vončina[4], P. Boulet[5], E. Gaudry[5], B. Markoli[4], J.-M. Dubois[1,2], S. Šturm[1] [1]Jožef Stefan Institute, Department for Nanostructured Materials, Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Ljubljana, Slovenia, [3]Faculty of Chemistry and Chemical Technology, Department of Inorganic Chemistry, Ljubljana, Slovenia, [4]Faculty of Natural Sciences and Engineering, Department of Materials and Metallurgy, Ljubljana, Slovenia, [5]Institut Jean Lamour, Equipe Metallurgie et Surfaces, Nancy, France
17:20	Development of a Meshless Numerical Model for Solving Three-dimensional Elasto-plastic Problems Gašper Vuga[1], Boštjan Mavrič[1,2], Božidar Šarler[1,2] [1]Faculty of Mechanical Engineering University of Ljubljana, Aškerčeva cesta 6, 1000 Ljubljana, Slovenia, [2]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
17:30	Effect of deformation ratio on texture development in hot-deformed Nd-Fe-B magnets Matic Korent[1,2], Kristina Žagar Soderžnik[1], Marko Soderžnik[1] [1]Jožef Stefan Institute, Department for Nanostructured materials, Jamova 39, Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova 39, Ljubljana, Slovenia
17:40	A study of the workability and mechanical properties of grinded corn cob on concrete Wojciech Życiński, Marcin Małek, Mateusz Jackowski, Waldemar Łasica Military University of Technology in Warsaw, Faculty of Civil Engineering and Geodesy, Poland
17:50	Characterization Of New Recycled Polymer Shots Addition On Mechanical Strength Of Concrete Mateusz Jackowski, Marcin Małek, Wojciech Życiński, Waldemar Łasica, Mariusz Owczarek Military University of Technology in Warsaw, Faculty of Civil Engineering and Geodesy, Poland
18:00	Characterization of Recycled Glass-Cement Composite Mechanical Strength Waldemar Łasica, Marcin Małek, Zbigniew Szcześniak Military University of Technology in Warsaw, Faculty of Civil Engineering and Geodesy, Poland

18:10	Stability and dynamics of variable cross-sectioncantilever steel structures. Tsyupyn E.I., Nuzhnyj V.V., Bilyk A.S. Department of Steel and Wooden Structures, Kyiv National University of Civil Engineering and Architecture, Povitroflotskyi Ave., 31, 49600, Kyiv, Ukraine
19:30-22:00	**Poster Session with standing buffet – Lobby EUROPA**

Sreda – Wednesday 16.10.2019 Hall D	
	Predsedujoči – Chair: D. Dolinar, M. Jenko
10:00	Complex Tissue Defect Reconstruction After Rhinectomy Using 3D Planning Uroš Ahčan[1], Vojko Didanovic[2], Aleš Porčnik[1] [1]Department of Plastic Surgery and Burns, Ljubljana University Medical Centre, Ljubljana, Slovenia [2]Department of Maxillofacial and Oral Surgery, Ljubljana University Medical Centre, Ljubljana, Slovenia
10:15	**PLENARY LECTURE – TRAMPUŽ** The complex interactions between biomaterial, microbe and host Andrej Trampuž, Charité Berlin
11:00	Surface Phenomena and Osteointegration of Cementless Ti6Al7Nb Hip Endoprostheses Drago Dolinar, Matevž Gorenšek Department of Orthopedic Surgery, University Medical Center Ljubljana, Zaloška 9, 1000 Ljubljana, Slovenia, MD Medicina Ljubljana, Bohoričeva 5, 1000 Ljubljana
11:15	**Coffee Break**
	Predsedujoči – Chair: V. Kralj-Iglič, A. Iglič
11:45	Different Approaches to Achieving Biodegradability with an Fe-Mn Alloy Matjaž Godec[1], Irena Paulin[1], Črtomir Donik[1], Matej Hočevar[1], Jaka Burja[1], Peter Gregorčič[2] Aleksandra Kocijan[1] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]Faculty of Mechanical Engineering, Aškerčeva cesta 6, 1000 Ljubljana, Slovenia
12:00	Comparison of Bearing Surfaces in Cementless Primary Hip Arthroplasty – Ceramic on Metal Versus Metal on Metal Slavko Manojlović Faculty of medicine, University of Banjaluka, Bosnia and Herzegovina
12:15	Spontaneous curvature of healthy human spine as a parameter of bipodal stance contour [1]Kralj-Iglič V, [1]Drab M, [1,2]Rehakova V, [3]Leban J, [3]Vengust R, [2]Daniel M, [4]Bračun Š [1]Laboratory of Clinical Biophysics, Faculty of Health Sciences, University of Ljubljana, Ljubljana, Slovenia, [2]Laboratory of Biomechanics, Czech Technical University in Prague, Prague, Czech Republic, [3]Department of Orthopaedic Surgery, University Clinical Centre Ljubljana, Ljubljana, Slovenia, [4]Physiotherapeutica, Medvode, Slovenia

12:30	Titanium nanostructures for modification of vessel stents Ita Junkar[1], Metka Benčina[1], Janez Kovač[1], Katjuša Mrak-Poljšak[2], Katja Lakota[2], Snežna Sodin-Šemrl[2], Veronika Kralj-Iglič[3,4], Miran Mozetič[1], Aleš Iglič[4,5] [1]Department of Surface Engineering and Optoelectronics, Jožef Stefan Institute, Jamova 39, SI-1000, Ljubljana, Slovenia, [2]Department of Rheumatology, University Medical Centre Ljubljana, Vodnikova 62, SI-1000, Ljubljana, Slovenia, [3]Laboratory of Clinical Biophysics, Faculty of Health Sciences, University of Ljubljana, Zdravstvena 5, SI-1000 Ljubljana, Slovenia, [4]Laboratory of Clinical Biophysics, Chair of Orthopaedics, Faculty of Medicine, University of Ljubljana, Zaloška 9, SI-1000 Ljubljana, Slovenia, [5]Laboratory of Physics, Faculty of Electrical Engineering, University of Ljubljana, Tržaška 25, SI-1000 Ljubljana, Slovenia
12:45	**LUNCH**
	Predsedujoči – Chair: M. Ovsenik, Č. Oblak, R. Trebše, I. Kopač
14:30	Patient Specific Computer Aided Elective Orthopedic Procedures - State of the Art Rihard Trebše, Rene Mihalič, Bogdan Ambrožič, Janez Mohar, Jurij Štalc, Benjamin Marjanovič Valdoltra Orthopaedic Hospital, Jadranska c. 39, 6280 Ankaran, Slovenia
14:45	Corrosion Phenomenon of Modular HIP Implants Ingrid Milošev[1,2] Vesna Levašič[2], Andrej Cör[2,3], Rihard Trebše[2] [1]Jožef Stefan Institute, Jamova c. 39, 1000 Ljubljana, Slovenia, [2]Valdoltra Orthopaedic Hospital, Jadranska c. 39, 6280 Ankaran, Slovenia, [3]University of Primorska, Faculty of Health Sciences, Polje 42, 6210 Izola, Slovenia
15:00	Biophysical propertis of super elastic NiTi archwires Maja Ovsenik MF UNI-Ljubljana, UMC Stomatology clinic Ljubljana, Slovenija
15:15	Contemporary digital technology for post and core fabrication: a pilot study measuring cement thickness Domen Kanduti, Igor Kopač Faculty of Medicine, University of Ljubljana,Slovenia
15:30	Qualitative analysis of 3D printed CoCr for metal-ceramic crowns and bridges Amir Ćatić[1], Zdravko Schauperl[2], Sanja Šolić, Črtomir Donik[3], Irena Paulin[3], Aleksandra Kocijan[3], Matjaž Godec[3] [1]UNIZG, School of Dental Medicine, Department of Fixed Prosthodontics, [2]UNIZG, Faculty of Engineering and Naval Architecture, Laboratory for materials, [3]IMT, Institute of Metals and Technology, Ljubljana
15:45	Mechanical Properties and Ageing of Different Zirconia Ceramics for Monolithic Fixed Dental Prostheses Nina Grguraš Lestan, Čedomir Oblak University of Ljubljana, Department of Prosthodontics, Faculty of Medicine, Dental clinic Ljubljana, Slovenia
16:00	Clinical outcomes of titanium alloy SL-PLUS® femoral stem (Zweymüller): 2,013 total hip arthroplasty cases with up to 25 years of follow-up Blaž Mavčič, Samo Roškar, Vane Antolič University Medical Centre Ljubljana, Dept. of Orthopaedic Surgery, Zaloška 9, SI-1000 Ljubljana, Slovenia
16:15	**Coffee Break**
16:40	Wear particles and lymphocytes in tissue around failed joint prostheses Andrej Cör Valdoltra Orthopaedic Hospital, Jadranska 33, 6280 Ankaran, Slovenia

16:55	Behaviour of human osteoblast-like cells on nanosecond laser-textured 316L surfaces Matej Hočevar[1], Peter Gregorčič[1,2], Barbara Šetina Batič[1], Veno Kononenko[3], Damjana Drobne[3], Matjaž Godec[1] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, [2]Faculty of Mechanical Engineering, University of Ljubljana, Aškerčeva 6, 1000 Ljubljana, Slovenia, [3]Department of Biology, Biotechnical Faculty, University of Ljubljana, Večna pot 111, SI-1000 Ljubljana, Slovenia

	YOUNG RESEARCHER. PhD STUDENTS
	YRS Commission: M. Ovsenik, Č. Oblak, I. Kopač, D. Dolinar, M. Jenko
17:10	Detection of aluminum oxide in periprosthetic tissue in patients which required revision surgery after aseptic joint failure [1]Monika Jenko, [2]Drago Dolinar, [3]Damjana Drobne, [3]Sara Novak, [4]Gregor Marolt, [5]Andrej Cör, [3]Maja Lončar [1]Inštitut za kovinske material in tehnologije, Lepi pot 11, 1000 Ljubljana, [2]Ortopedska klinika, Zaloška cesta 9, 1000 Ljubljana, [3]Biotehniška fakulteta, Jamnikarjeva ulica 101, 1000 Ljubljana [4]Fakulteta za kemijo in kemijsko tehnologijo, Večna pot 11, 1000 Ljubljana, [5]Ortopedska bolnišnica Valdoltra, Jadranska cesta 31, 6280 Ankaran; Biotehniška fakulteta, Jamnikarjeva ulica 101, 1000 Ljubljana
17:20	Adhesion to zirconia ceramics: A problem solved? Tine Malgaj[1], Andraž Kocjan[2], Peter Jevnikar[1] [1]Department of Prosthodontics, Faculty of Medicine, University of Ljubljana, Hrvatski trg 6, Ljubljana, Slovenia [2]Department for Nanostructured Materials, Jožef Stefan Institute, Jamova 39, Ljubljana, Slovenia
17:30	Characterization of new and retrieved titanium dental implants materials S. Žarković Gjurin[1], M. Jenko[2,3], Č. Donik[2], Č. Oblak[1] [1]Department for Prosthetic Dentistry,Medical Faculty, Dental Division, University of Ljubljana, Slovenia, [2]Institute for metals and Technology, IMT, Lepi pot 11, 1000 Ljubljana Slovenia, [3]MD-RI Institute for Materials Research in Medicine, Bohoričeva 5 Ljubljana, Slovenia
17:40	Evaluation of Microbial Flora In Patients with Gingival Enlargement During Treatment with Fixed Orthodontic Appliance Rok Ovsenik[1], Miha Pirc[2], Jasmina Primožič[3], Rok Schara[4], Boris Gašpirc[5] MF UNI-Ljubljana, UMC stomatology clinic
17:50	Soldering of Periodontal Tissues by a Diode Laser-Activated Indocyanine Green Chitosan Membrane Mojca Trost[1], Boris Gašpirc[2] [1]Community Health Centre Lenart, Maistrova ulica 22, 2230 Lenart, [2]Department of Oral Medicine and Periodontology, Faculty of Medicine, University of Ljubljana
18:00	Three-Dimensional Assessment of Jaw Morphology A. Golež[1], A.Arhar[2], J.Primožič[1], M.Ovsenik[1] [1]Department of Orthodontics and Dentofacial Orthopaedics, Faculty of Medicine, University of Ljubljana, Slovenija, [2]Orthos Institute, Ljubljana, Slovenia
18:10	Three-dimensional assessment of back asymmetry J Primožič, M Ovsenik, A Zhurov, S Richmond, V Antolič Community health center Piran, Portorož, Slovenia
19:30-22:00	**Poster Session with standing buffet – Lobby Europa**

Četrtek – Thursday 17.10.2018 Hall C	
	Predsedujoči – Chair: S. Kobe, P. McGuiness
	Magnetic Materials
9:00	**PLENARY LECTURE** Circular economy measures for NdFeB magnets: Development of an eco-labelling and grading system for traceability and better recycling in theory and practice C. Burkhardt, B. Podmiljsak, S. Kobe
9:45	Micromagnetic optimization of permanent magnetic materials Johann Fischbacher, Alexander Kovacs, Thomas Schrefl Department of Integrated Sensor Systems, Danube University Krems, Viktor Kaplan-Straße 2E, 2700 Wiener Neustadt, Austria
10:05	Recycling Rare Earths Magnets Paul McGuiness Institutte of Metals and Technology, Lepi pot 11, Ljubljana, Slovenia
10:35	Circular Recycling of SmCo Magnet Slurry A. Stambolič, Č. Donik, P.J. McGuiness, M. Godec IMT, Lepi pot 11, 1000 Ljubljana, Slovenia
10:55	**Coffee Break**
11:30	Towards Improved Performance with Permanent-Magnet Electric devices Tomaž Tomše[1], Sašo Šturm[1,2], Kristina Žužek Rožman[1,2], Spomenka Kobe[1,2] [1]Jožef Stefan Institute, Department for Nanostructured Materials, Jamova 39, SI-1000 Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova 39, SI-1000 Ljubljana, Slovenia
11:50	Recycling and reprocessing of end-of-life Nd-Fe-B permanent magnets Kristina Žužek Rozman[1,2,] Awais Ikram[1], Xuan Xu[1,2], Farhan Mehmood[1,2], T. Tomše[1,2], R. Sheridan[3], A. Walton[3], Muhammad Awais[3], Spomenka Kobe[1,2,] Sašo Šturm[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, [3]School of Metallurgy and Materials, University of Birmingham, Edgbaston, Birmingham, B15 2TT, United Kingdom
12:10	Using Electron Holography to Investigate the in Tb-doped Nd-Fe-B Magnets Kristina Žagar Soderžnik[1], Sašo Šturm[1], András Kovács[2], Aleksei Savenko[3], Marko Soderžnik[1], Rafal E. Dunin-Borkowski[2], Joachim Mayer[2,4], Spomenka Kobe[1] [1]Department for Nanostructured Materials, Jožef Stefan Institute, Ljubljana, Slovenija, [2]Ernst Ruska-Centre for Microscopy and Spectroscopy with Electrons, Forschungszentrum Jülich, Germany, [3]Thermo Fisher Scientific, Germany, [4]RWTH Aachen, Aachen, Germany
12:30	**LUNCH**
14:00	Infiltration effect on the coercivity of heavy rare-earth-free Nd-Fe-B ribbons Marko Soderžnik[1], Matic Korent[1,2], Boris Saje[3], Spomenka Kobe[1] [1]Jožef Stefan Institute, Department for Nanostructured materials, Jamova 39, Ljubljana, Slovenia [2]Jožef Stefan International Postgraduate School, Jamova 39, Ljubljana, Slovenia [3]Kolektor Magnet Technology GmbH, Essen, Germany
14:20	A success story for more than 30 years: From basic research to the industrial innovation of magnet materials at Jožef Stefan Institute, Slovenia B. Podmiljšak, K. Žužek Rožman, S. Šturm, M. Soderžnik, S. Kobe Institut Jožef Stefan, Jamova cesta 39, 1000 Ljubljana, Slovenia

14:40	Ferrite-based magnets consolidated by spark plasma sintering: towards rare-earth-free magnets for energy storage Petra Jenuš [1], Andraž Kocjan [1,2], Claudio Sangregorio[3], Michele Petrecca[3,4], Blaž Belec[5], César de Julian Fernandez[5] [1]Department for Nanostructured Materials, Jožef Stefan Institute, Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Ljubljana, Slovenia, [3] ICCOM – CNR and INSTM, Sesto Fiorentino, Italy, [4]Dept. of Chemistry, University of Florence, Sesto Fiorentino, Italy, [5]IMEM – CNR, Parma, Italy
	Characterisation
	Predsedujoči – Chair: K. Soderžnik Žagar, M. Soderžnik
15:00	Spectroscopic STEM imaging in 2D and 3D G. Kothleitner, M. Albu, W. Grogger, G. Haberfehlner, F. Hofer Institute for Electron Microscopy and Nanoanalysis, Graz University of Technology, and Graz Centre for Electron Microscopy, Graz, Austria
15:30	Measurement of the Local Residual Stress Distribution Using Cross-Correlation EBSD and Ring Core Milling Stefan Zaefferer[1], Fady Archie[1], Avinash Hariharan[1], Anirudda Dutta[1], Heena Kanchandani[1], Matjaz Godec[2] [1]Max-Planck-Institut für Eisenforschung, Max-Planck-Str. 1, 40237 Düsseldorf, Germany, [2]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana
15:50	**Coffee Break**
16:20	TEM Analysis of the Oxidation Scale Grown on Iron Aluminides Janez Zavašnik[1,2], Jian Peng[2], Martin Palm[2] [1]Jožef Stefan Institute, Jamova c. 39, 1000 Ljubljana, Slovenia, [2]Max-Planck-Institut für Eisenforschung GmbH; D-40237 Düsseldorf, Germany
16:40	Application of Secondary ion mass spectrometry ToF-SIMS technique for chemical analyses of surfaces and thin films Janez Kovač Jožef Stefan Institute, Jamova 39, Ljubljana, Slovenia
17:00	How to Smart-tune Surface Properties of Materials by Plasma Gregor Primc[1,2] [1]Jožef Stefan Institute, Jamova cesta 39, 1000 Ljubljana, Slovenia, [2]Plasmadis d. o. o., Teslova ulica 30, 1000 Ljubljana, Slovenia
17:20	Microstructural changes in high-alloyed iron alloys by sub-zero treatments Peter Jurči Slovak University of Technology in Bratislava, Faculty of Materials Science and Technology in Trnava, Institute of Materials Science, Jána Bottu 25, 917 24 Trnava, Slovakia
17:40	SEM and TEM Characterization of Different Materials using FIB Technology Matejka Podlogar[a], Tina Radošević[a], Blaž Leskovar[b], Zoran Jovanović[a], Aleš Omerzu[c], Elena Tchernychova[d], Nina Daneu[a], Sašo Šturm[a] [a]Institute Jožef Stefan, Jamova cesta 39, Ljubljana, Slovenia; [b]Faculty of Natural Sciences and Engineering, University of Ljubljana, Aškerčeva cesta 12, Ljubljana, Slovenia; [c] Physics Department, University of Rijeka, Radmile Matejčić 2, Rijeka, Croatia; [d] National Institute of Chemistry, Hajdrihova ulica 19, Ljubljana, Slovenia
18:00	Microstructural Characterization of Ledeburitic Tool Steel after Sub-Zero Treatment and Tempering Jana Ptačinová, Juraj Ďurica, Peter Jurči, Matej Pašák, Martin Kusý Slovak University of Technology in Bratislava, Faculty of Materials Science and Technology in Trnava, Institute of Materials Science, Jána Bottu 25, 917 24 Trnava, Slovakia
19:00	**Monfort – Conference dinner**

Četrtek – Thursday 17.10.2019 Hall A	
	Predsedujoči – Chair: B. Kocjančič, Š. Tadel Kocjančič
	Biomaterials
9:00	Percutaneous implantation of self-expandable left atrial appendage occluders for prevention of thromboembolic complications of atrial fibrillation Andrej Pernat Cardiology department, University Medical Centre Ljubljana, Zaloška 7, 1000 ljubljana, Slovenia
9:15	Extracorporeal Membrane Oxygenation (ECMO) in Patients with Acute Respiratory Failure Špela Tadel Kocjančič University Medical Centre Ljubljana, Centre for intensive internal medicine, Ljubljana
9:30	Grit-Blasted Surfaces of Ti6Al7Nb Alloy Cementless HIP Endoprostheses D. Dolinar[1,3], M. Jenko[2,3], M. Godec [2], B. Črtalič[4], M. Andolšek Črtalič[4], M.Gorenšek[5,3] and Č .Oblak[6] [1]Dept for Orthopaedic Surgery, University Medical Centre Ljubljana, Slovenia [2]Institute for Metals and Technology, Ljubljana Slovenia [3]MD-RI Institute for Materials Research in Medicine, Ljubljana, Slovenia [4]FerroČrtalič, Dolenjske Toplice, Slovenia [5]MD Medicina, Ljubljana Slovenia, [6]MF, University Ljubljana Slovenia
9:45	Using new designs of reverse shoulder arthroplasty for rotator cuff deficiency Oskar Zupanc[1], Timon Zupanc[2] Martinčič David[1], Meglič Uroš[1] [1]University Medical Centre Ljubljana, 1000 Ljubljana, Slovenija [2]University of Belgrade School of Medicine, Dr. Subotića 8, 11 000 Belgrade, Serbia
10:00	New method to evaluate long term results of Perthes disease Boštjan Kocjančič[1], Veronika Kralj-Iglič[2], Drago Dolinar[1] [1]University Medical Center Ljubljana, Department of Orthopaedic Surgery, Slovenia [2]Zdravstvena fakulteta, Univerza v Ljubljani
10:15	Coated spine implants – a risk factor for surgical site infection? Mirza Bišćević, Barbara Smrke Hospital Prim.dr. Abdulah Nakaš Banja Luka, BiH, University Medical Centre Ljublja
10:30	Sonication for orthopaedic implant-associated infection diagnostics – solution or complication? Samo Jeverica Institute of Microbiology and Immunology, Faculty of Medicine, University of Ljubljana, Zaloška 4, 1000 Ljubljana, Slovenia
10:45	**Coffee Break**
	Predsedujoči – Chair: A. Moličnik, O. Zupanc
11:15	Secondary breast reconstruction using 3D template enhanced innervated free DIEP flap Andrej Lapoša, Uroš Ahčan Department for Plastic Surgery and Burns, University Medical Centre Ljubljana, Slovenia
11:30	Case report of Ceramic Acetabular Fracture in Total Hip Arthroplasty with Ceramic-on-Ceramic Articulation B. Pompe[1], D. Freizpour[2], L. Zore[1], M. Jenko[2,3], D. Dolinar[1,3] [1]Department for Orthopedic Surgery, University Medical Center Ljubljana, Slovenia, [2]Institute of Metals and Technology, Ljubljana, Slovenia, [3] MD-RI Institute for Materials research in Medicine
11:45	Nano-Characterization of Wear Debris of Ceramic-on-Ceramic Bearing in Total Hip Replacement Darja Feizpour[1], Monika Jenko[1], Borut Pompe[2], Boštjan Kocjančič[2], Matjaž Godec[1], Drago Dolinar[2] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia [2]Department for Orthopedic Surgery, University Medical Center Ljubljana, Zaloška cesta 7, 1000 Ljubljana, Slovenia

12:00	3D Printed Acetabular Endoprosthesis in Major Acetabular Revisions Andrej Moličnik[1], Urska Kostevšek[2], Tomaž Brajlih[2], Igor Drstvenšek[2] [1]University Medical Centre Maribor, Ljubljanska ulica 5, Maribor, Slovenia, [2]University of Maribor, Faculty of Mechanical Engineering, Smetanova ulica 17, Maribor, Slovenia
12:15	Thermodynamic effect on selective laser melted biomedical implants Snehashis Pal, Tomaz Brajlih, Andrej Moličnik, Igor Drstvenšek Faculty of Mechanical Engineering, University of Maribor, Smetanova ulica 17, 2000 Maribor, Slovenia, University Medical Centre Maribor, Ljubljanska ulica 5, Maribor, Slovenia
12:30	**LUNCH**
	YOUNG RESEARCHERS
	Predsedujoči – Chair: D. Dolinar, A. Iglič, M. Jenko
14:00	Effect of Autoclave or Plasma Oxygen Gaseous Sterilization on Surface Properties of Ti6Al7Nb Alloy Femoral STEMS K. Avsec[1], M. Jenko[2,3], M. Godec[2], A. Vesel[4], M. Mozetič[4], B. Kocjančič [1], D. Dolinar [1,3] [1]Department for Orthopaedic Surgery, University Medical Centre Zaloška 9, 1000 Ljubljana, Slovenia [2]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, [3]MD-Ri Institute for Materials Research in Medicine, Bohoričeva 5, 1000 Ljubljana
14:10	Titanium Coated PEEK For Spinal Interbody Fusion: The Best Of Both Worlds? Aljaž Merčun, Miha Vodičar Ortopedska klinika, Zaloška cesta 9
14:20	Titan vs Polyetheretherketone (PEEK) Cages in Interbody Fusion: Review Klemen Bošnjak[1], Matevž Topolovec[1, 2], Rok Vengust[1] [1]Department of Orthopaedic Surgery, University Medical Centre Ljubljana, Zaloška c. 9, 1000 Ljubljana, Slovenia, [2]Department of Spine Surgery, Valdoltra Orthopaedic Hospital, Jadranska c. 31, 6280 Ankaran, Slovenia
14:30	Hemodialysis Catheters: Different Citrate Locking Solutions and Biofilm Bojan Medved, Rafael Ponikvar
14:40	New Medium Cut-Off Membrane for Hemodialysis Marija Malgaj, Jadranka Buturović Ponikvar Department of Nephrology, Center for Acute and Complicated Dialysis, University Medical Centre Ljubljana
	Predsedujoči – Chair: M. Jenko, I. Belič
14:50	Ultrahigh Molecular Weight Polyethylene (UHMWPE) with Improved Wear and Oxidation Resistance for Use in Arthroplasty Monika Jenko[1], Jože Grdadolnik[2], Drago Dolinar[3], Matevž Gorenšek[4], Majda Žigon[5] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]National Institute of Chemistry, Hajdrihova 19, p.p. 660, SI-1001 Ljubljana, Slovenia, [3]University Medical Centre Ljubljana, Department of Orthopaedic Surgery, Zaloška 9, 1000 Ljubljana, Slovenia, [4]MD Medicina, d.o.o., Bohoričeva 5, 1000 Ljubljana, Slovenia, [5]Faculty of Polymer Technology, Ozare 19, 2380 Slovenj Gradec, Slovenia
15:05	Structural changes of ultra-high molecular weight polyethylene upon gamma irradiation Jože Grdadolnik[5], Urban Novak[*], Majda Žigon[2], Luka Snoj[3], Monika Jenko[1], Drago Dolinar[4] [1]Institute of Metals and Technology, Ljubljana, [2]Faculty of Polymer Technology, Slovenj Gradec, [3]Reactor Physics Department, Jozef Stefan Institute, Ljubljana, [4]Dept. for Orthopedic Surgery University Medical Centre, Ljubljana, [5]Theoretical Department, National Institute of Chemistry, Ljubljana

15:20	Treatment of implant-associated infections Lea Papst[1,2] [1]Department of Infectious Diseases, University Medical Centre Ljubljana, Ljubljana, Slovenia, [2]Faculty of Medicine, University of Ljubljana, Ljubljana, Slovenia
15:35	Bio Polymeric Composite Membranes for Guided Tissue Regeneration S. Gorgieva[1], L. Verestiuc[2], M. Butnaru[2], S. Jeverica[3] and K. S. Kleinschek[1] [1]Institute of Engineering Materials and Design, University of Maribor, Slovenia, [2]Department of Biomedical Sciences, Grigore T. Popa University of Medicine and Pharmacy, Iasi, Romania, [3]Institut of Microbiology and Immunology, University of Ljubljana, Slovenija
15:50	**Coffee Break**
	Predsedujoči – Chair: M. Jenko, D. Dolinar
16:20	MAGEC Growing Rod System For Early Onset Scoliosis Miha Vodičar, Matevž Gorenšek Department of orthopedic surgery, University medical center Ljubljana, Zaloška cesta 9, 1000 Ljubljana, MD Medicina Ljubljana
16:35	The science and characteristics of hyaluronic acid soft-tissue fillers and their use in aesthetic medicine Samo Gorenšek Skin dermatologija, Peričeva 37, 1000 Ljubljana, Slovenia
16:50	Mechanical Resonance of Femoral Part of Hip Prosthesis as Possible Cause of Aseptic Loosening Igor Belič[1], Beno Klopčič[2], Andraž Logar[2], Monika Jenko[1,3], Drago Dolinar[4,3], Matevž Gorenšek[5,3], Boštjan Kocjančič[4] [1]Institute of Metals and Technology, Ljubljana, [2]BOSCH REXROTH d.o.o., Škofja Loka, [3]MD-RI Institute for Materials Research in Medicine, [4]Dept for Orthopedic Surgeon, UMC Ljubljana, [5]MD-Medicina Ljubljana
17:05	High Sensitive Magnetoelectric Composite Sensors for Biomagnetic Field Sensing Applications M. Jovičević Klug[1], L. Thormählen[1], S. D. Toxværd[2], V. Röbisch[1], D. Meyners[1], R. Knöchel[2], M. Höft[2], E. Quandt[1], J. McCord[1] [1]Institute for Materials Science, Kiel University, Kiel, Germany, [2]Institute of Electrical and Information Engineering, Kiel University, Kiel, Germany
19:00-22:00	**Monfort – Conference dinner**

Petek – Friday 18.10.2019 Hall C	
	Predsedujoči – Chair: M. Godec, B. Podgornik
	Hall C – Workshop – 3D Printing of Metallic Materials
09:00	**Opening 3D Workshop chairs – Godec, Podgornik**
09:10	Additive Manufacturing at ESA From Technologies to Applications Developments Laurent Pambaguian ESA – European Space Agency, Keplerlaan 1, NL-2200 AG Noordwijk, The Netherlands
09:40	Additive manufacturing of metals - A comparison of the most important processes Wolfgang Waldhauser, Richard Görgl, Michael Görtler, Benjamin Meier JOANNEUM RESEARCH Forschungsgesellschaft mbH, MATERIALS - Institute for Surface Technologies and Photonics, Leobner Strasse 94, A-8712 Niklasdorf, Austria
10:10	Hierarchical Structure Formation of Additive Manufactured 316L Stainless Steel Using Industrial Selective Laser Melting Process Parameters Matjaž Godec[1], Stefan Zaefferer[2], Bojan Podgornik[1], Mario Šinko[2], Elena Tchernychova[1,3] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]Max Planck Institute for Iron Research, Max-Planck Strasse 1, Düsseldorf, Germany, [3]MARSI, Prešernova cesta 6, 8250 Brežice, Slovenia, [4]Nacional Institute of Chemistry, Hajdrihova 19, 1000 Ljubljana, Slovenia
10:40	The Vanguard Initiative 3DP Pilot: concept and opportunities for metal 3D Printing Jean-François Romainville Network Manager of the 3DP Pilot, Expert in Innovation Policy and industrial change at IDEA Consult
11:10	**Coffee Break**
11:30	Multi-Material processing in Additive Manufacturing E. López[1], J.C. Schab[1], F. Marquardt[1], M. Riede[1], F. Brückner[1,2], C. Leyens[1,3] [1]Fraunhofer Institute for Material and Beam Technology, Winterbergstraße 28, 01277 Dresden, Germany, [2]Luleå University of Technology, 97187 Luleå, Sweden, [3]Technische Universität Dresden, Faculty of Mechanical Engineering, Institute of Materials Science, 01069 Dresden, Germany
12:00	Software Tools For Dealing With The Challenges Of Industrial Additive Manufacturing John Schlasche Additive Works GmbH E-mail: schlasche@additive.works
12:30	Tribological properties of 3D printed parts B. Podgornik[1], M. Godec[1], M. Šinko[2] [1]Institute of Metals and Technology, Lepi pot 11, SI-1000 Ljubljana, Slovenia, [2]MARSi, Prešernova c. 6, SI-8250 Brežice, Slovenia
13:00	SiEVA 3D LAB – An inovative business model connecting economic and academic sector Boštjan Podlipec SiEVA 3D LAB
13:20	Universal laser direct deposition head and stability of the wire deposition process Edvard Govekar, Matjaž Kotar, Andrej Jeromen University of Ljubljana, Faculty of Mechanical Engineering, Askerceve cesta 6, SI-1000 Ljubljan
13:40	**Closing Ceremony, LUNCH**

	Predsedujoči – Chair: J. Burja, D. Feizpour
	Hall D –Metallic Materials
09:00	Investigation of Failure of a Transportation Conveyor Belt Pulley Borut Žužek, Jaka Burja Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
09:20	Electrochemical industrial testing of painted aluminum alloys to determine corrosion susceptibility Irena Lesjak, Tjaša Ahej, Varužan Kevorkijan Impol Aluminium Industry, Partizanska 38, 2310 Slovenska Bistrica, Sloveni
09:40	Influence Of Silicone Carbide Addition On Mechanical Properties Of Concrete Marcin Małek, Mateusz Jackowski, Wojciech Życiński, Waldemar Łasica Military University of Technology in Warsaw, Faculty of Civil Engineering and Geodesy, Poland
10:00	Manipulation Of Stainless Steel Wettability And Friction In Different Environments By Adsorption Of TiO_2 Nanoparticle Coatings M. Conradi[1], A. Kocijan[1], T. Kosec[2] and B. Podgornik[1] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, [2]Slovenian National Building and Civil Engineering Institute, Dimičeva ulica 12, 1000 Ljubljana
10:20	Effect of Microsegregation on the Material Response against Abrasion and Impact Wear – Boron Low Alloyed Steels G. Klančnik[1], S.Kokalj[1], A.Skumavc[2], R.Robič[1], U.Klančnik[3], J.Kokošar[1] [1]RCJ d.o.o., Cesta Franceta Prešerna 61, Jesenice, 4270 Jesenice, [2]SIJ Acroni d.o.o.; Cesta Borisa Kidriča 44, 4270 Jesenice, [3]Štore Valji d.o.o., Železarska cesta 3, 3220 Štore
10:40	Nano-Indentation Measurements on the $AlCoCrFeNi_{2.1}$ CCA as a Function of Chemistry and Grain Orientation Fevzi Kafexhiu Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
11:00	**Coffee Break**
11:30	Environmentally Friendly Synthesis of Sustainable Carbons for Future Directions Nurettin Eltugral[1], Hamza Simsir[1], Selhan Karagoz[2] [1]Department of Metallurgical and Materials Engineering, Karabük University, 78050, Karabük, Turkey, [2]Department of Chemistry, Karabük University, 78050 Karabük, Turkey
11:50	The effect of processing parameters on mechanical and corrosion properties of Zn-Mg-Ca/Sr ternary alloys considered for medical applications Jiří Kubásek[1], Jaroslav Čapek[2], Drahomír Dvorský[1], Jan Pinc[2], Lukáš Lacina[3] [1]Department of Metals and Corrosion Engineering, Institute of Chemistry and Technology, Prague, Technická 5, 16628, Prague, Czech Republic, [2]Institute of Physics of the Czech Academy of Sciences, Na Slovance 1999/2, 182 21, Prague, Czech Republic, [3]Department of Oral and Maxillofacial Surgery, First Faculty of Medicine, Charles University, Kateřinská 32, 121 08, Prague, Czech Republic
12:10	Manufacturing of Cast Metal Sponges from Copper Alloys Václav Merta[1], Ivo Lána[2] [1]VSB – Technical university of Ostrava, 17. listopadu 15/2172, 708 33, Ostrava – Poruba, Czech republic, [2]Slévárna a modelárna Nové Ransko, s.r.o., Nové Ransko 234, 582 63, Ždírec nad Doubravou, Czech Republic
12:30	The influence of chemical composition and heat treatment on mechanical properties and formability of aluminium alloy EN AW- 5454 Alenka Šalej Lah[1], Maja Vončina[1], Peter Fajfar[1], Darja Volšak[2], Jožef Medved[1] [1]Department for Materials and Metallurgy, Faculty of Natural Sciences and Engineering, University of Ljubljana, Aškerčeva 12, Ljubljana, Slovenia, [2]Impol FT d.o.o., Partizanska 38, 2310 Slovenska Bistrica, Slovenia

12:50	Dynamic Response of Material during the High-Speed Impact Jan Raška, Martin Oberthor Czech Aerospace Research Centre (VZLÚ), Beranových 130, 199 05 Praha – Letňany, Czech Republic
13:10	Oxidation at thermal fatigue and early spalling of material from of Hi-Cr roller steel M. Drobne, U. Klančnik, P. Fajfar, G. Kugler and M. Terčelj University of Ljubljana, Faculty of Natural Sciences and Engineering, Aškerčeva 12, 1000 Ljubljana, SI-Slovenia. Štore steel, Štore
13:40	**Closing Ceremony, LUNCH**

POSTRSKA SEKCIJA – POSTER SESSION
Sreda – Wednesday 16. 10. 2019 (19:00)

YR1	Influence of Melt Distance from Gate on Surface Quality Martin Reznicek, Martin Ovsik, Michal Stanek, Adam Dockal Tomas Bata University in Zlín, nám. T. G. Masaryka 5555, 760 01 Zlín
YR2	Increased ignition temperature of magnesium-based quaternary alloy by alloying with Ca, Y and Gd Jiří Kubásek[1], Drahomír Dvorský[1], Peter Minárik[2], Dalibor Vojtěch[1] [1] Department of Metals and Corrosion Engineering, Institute of Chemistry and Technology, Prague, Technická 5, 16628, Prague, Czech Republic, [2] Department of Physics of Materials, Faculty of Mathematics and Physics, Charles University, Ke Karlovu 3, 121 16, Prague, Czech Republic
YR3	Stability of Basalt Fibres Reinforcement in Alkali-Activated Systems Petr Hrubý, Lukáš Kalina, Jaromír Pořízka, Jiří Másilko, Magdalena Kimm, Thomas Gries Brno University of Technology, Faculty of Chemistry, Purkyňova 118, 612 00 Brno, Czech Republic
YR4	Deep Cryogenic Treatment of High Speed Steels M2, M3:2 and M35 Patricia Jovičević Klug[1,2], Bojan Podgornik[1] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova cesta 39, 1000 Ljubljana, Slovenia
YR5	Hyperelastic Material Characterization: A Comparison between Material Constants Rohitha Keerthiwansa, Jakub Javorik, Jan Kledrowetz Department of Production Engineering, Faculty of Technology, Tomas Bata University in Zlin, nam. T.G. Masaryka 5555, 760 01 Zlin, Czech Republic.
YR6	High Temperature and Corrosion Properties of New Developed Fe-Al-O based OPH Alloy Omid Khalaj[1], Ehsan Saebnouri[2], Hana Jirková[1], Ondrej Chocholaty[2], Jiří Svoboda[3] [1]Regional Technological Institute, University of West Bohemia, Univerzitní 22, 306 14, Pilsen, Czech Republic, [2]Department of material and metallurgy, University of West Bohemia, Univerzitní 22, 306 14, Pilsen, Czech Republic, [3]Institute of Physics of Materials, Academy of Sciences of the Czech Republic, Žižkova 22, 616 62, Brno, Czech Republic
YR7	Induced Effects On The Functionalized Ti-based Surfaces By Oxygen Plasma Treatment Eva Levičnik[1], Metka Benčina[1], Ita Junkar[1], Aleš Iglič[2], Miran Mozetič[1] [1]Jožef Stefan Institute, Department of Surface Engineering, Jamova 39, SI-1000 Ljubljana, Slovenia [2]Laboratory of Biophysics, Faculty of Electrical Engineering, University of Ljubljana, Tržaška 25, SI-1000 Ljubljana, Slovenia
YR8	Formation and Influence of Magnesium-Alumina Spinel on Properties of Refractory Forsterite-Spinel Ceramics Martin Nguyen, Radomír Sokolář Brno University of Technology, Faculty of Civil Engineering, Institute of Technology of Building Materials and Components, Veveří 331/95, 602 00 Brno, Czech Republic
YR9	Influence of Applied Electron Radiation on Properties of Polyamide 11 Surface Layer Martin Ovsik, Petr Fluxa, Michal Stanek, Adam Dockal, Martin Reznicek Tomas Bata University in Zlín, Vavrečkova 275, 760 01 Zlín, Czech Republic
YR10	Synthesis and crystallization process of advanced BaO-MgO-Al_2O_3-SiO_2 system, as an attractive protective coating material Simona Ravaszová[1], Karel Dvořák[1], Mariano Casas Luna[2], David Jech[2], Ladislav Čelko[2] [1]Brno University of Technology, Faculty of Civil Engineering, Institute of Technology of Building Materials and Components, Veveri 331/95, 602 00 Brno, Czech Republic, [2]Brno University of Technology, Central European Institute of Technology, Purkyňova 123, 612 00 Brno, Czech Republic

YR11	Study of Recycling Effect to Polyamide 6 on Tensile Properties at Elevated Temperature Vojtech Senkerik, Petr Fluxa, Martin Ovsik, Martin Reznicek, Michal Stanek Tomas Bata University in Zlin, nam. T. G. Masaryka 5555, 76001 Zlin, Czech Republic
YR12	Optimization of Injection Molding Process Parameters Michal Stanek, Petr Fluxa, Martin Ovsík, Martin Reznicek, Vojtech Senkerik Tomas Bata University in Zlin, nam. T.G. Masaryka 5555, 76001 Zlin
1	Electromagnetic stirring in continuous casting process Boštjan Arh, Franc Tehovnik, Franci Vode Institute of Metals and Technology, Lepi pot 11, Ljubljana, Slovenia
2	Behavior of Polyether Based Shrinkage Reducing Admixtures in High Alkaline Environment Eva Bartonickova, Vlastimil Bilek Jr., Vojtech Enev, Jan Vojtisek, Lukas Kalina Materials Research Centre, Faculty of Chemistry, Brno University of Technology, Purkynova 118, 612 00 Brno, Czech Republic
3	Titan vs Polyetheretherketone (PEEK) Cages in Interbody Fusion: Review Klemen Bošnjak[1], Matevž Topolovec[1, 2], Rok Vengust[1] [1]Department of Orthopaedic Surgery, University Medical Centre Ljubljana, Zaloška c. 9, 1000 Ljubljana, Slovenia, [2]Department of Spine Surgery, Valdoltra Orthopaedic Hospital, Jadranska c. 31, 6280 Ankaran, Slovenia
4	Modification Of 1.2343 Steel with Zirconium Jaka Burja, Barbara Šetina Batič, Mitja Koležnik, Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, SIJ Metal Ravne d.o.o., Koroška cesta 14, 2390 Ravne na Koroškem Slovenia
5	Effect of rotary swaging, wire drawing and their combination on the resulting properties of nickel based alloy wires. Jana Čubrová, Kateřina Mertová, Michal Duchek COMTES FHT a.s., Průmyslová 995, 334 41 Dobřany,
6	Impact of Different Chemical composition on biodegradablility of Fe-Mn Alloys Črtomir Donik, Irena Paulin, Aleksandra Kocijan, Matjaž Godec Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, EU
7	Implementation of Natural Fillers in Polyethylene and the Resulting Mechanical Properties Adam Dockal, Martin Ovsik, Petr Fluxa, Michal Stanek, Vojtech Senkerik Tomas Bata University in Zlín, Vavrečkova 275, 760 01 Zlín, Czech republic
8	ToF-SIMS Analyses of Thin Oxide Layers by Dual Beam Depth Profiling Jernej Ekar, Tatjana Filipič, Janez Kovač Jozef Stefan Institute, Jamova 39, Ljubljana, Slovenia
9	Characterization of acoustic absorption properties of composite material Žiga Gosar ELVEZ d.o.o., Ulica Antona Tomšiča 35, 1294 Višnja Gora, Slovenija Mednarodna podiplomska šola Jožefa Stefana, Jamova cesta 39, 1000 Ljubljana
10	The characteristics of flow field inside water model of an industrial continuous steel caster Jurij Gregorc[1] and Božidar Šarler[1,2] [1]Laboratory for Fluid Dynamics and Thermodynamics, Faculty of Mechanical Engineering, Aškerčeva 6, SI 1000 Ljubljana, Slovenia, [2]Laboratory for Simulation of Materials and Processes, Institute of Metals and Technology,

11	Preparation and Investigation of High Entropy Alloys Agnieszka Guštin, Borut Žužek, Bojan Podgornik Institute of Metals and Technology, Laboratory for Mechanical Testing, Lepi pot 11, 1000 Ljubljana, Slovenia
12	Effect of Hot-top and Mould Geometry on Macrosegregation in direct-chill and low-frequency electromagnetic casting of aluminium alloys Hatić Vanja[1], Mavrič Boštjan[1,2] and Šarler Božidar[1,2] [1]Institute of Metals and Technology, Ljubljana, Slovenia, EU, [2]University of Ljubljana, Faculty of Mechanical Engineering, Ljubljana, Slovenia, EU
13	Monitoring the Effect of Quartz Sand Replacement by amorphous Silicate Raw Material on the Microstructure of Calcium Silicate Composites Jana Húšťavová, Vít Černý, Rostislav Drochytka Brno University of Technology, Faculty of Civil Engineering, Veveri 331/95, 602 00 Brno, Czech Republic
14	Effect of Amino Alcohol Admixtures in Alkali-Activated Materials Lukáš Kalina, Vlastimil Bílek Jr., Eva Bartoníčková Brno University of Technology, Faculty of Chemistry, Purkyňova 118, 612 00 Brno, Czech Republic
15	Comparison of the WAAM and SLS Additive Manufacturing of Maraging Steel M. Lindič, D. Klobčar, N. Mole, A. Nagode
16	Surface Wettability, Topography and Bioactivity of TiO_2/Epoxy Coatings on AISI 316L Stainless Steel A. Kocijan, M. Conradi, M. Hočevar Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia
17	Effect of “gypsum-like” powder characteristics on elements fabricated via binder jetting additive manufacturing Lidija Korat, Andraž Legat Slovenian National Building and Civil Engineering Institute, Dimičeva 12, 1000 Ljubljana, Slovenia
18	Determination of minimal required depth of milling needed for obtaining the desired surface quality in machining of multi-layer metal materials Uroš Župerl[1], Tomaž Irgolič[2], Miha Kovačič[3] [1]University of Maribor, Faculty of mechanical engineering, Smetanova 17, 2000 Maribor, Slovenia, [2]Var d.o.o, Gornja Radgona, Slovenia, [3]Štore steel, Železarska cesta 3, 3220 Štore, University of Ljubljana, Faculty of mechanical engineering, Aškerčeva 6, 1000 Ljubljana, Slovenia
19	Difference in microstructure in EN AW 2011 aluminium alloy Tjaša Kranjec[1], Tina Sever[1], Andraž Kocjan[1], Irena Paulin[1], Matjaž Godec[1], Peter Cvahte[2] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2] IMPOL 2000, Partizanska 38, 2310 Slovenska Bistrica
20	The Use of Highly Disintegrating Precursors in the Production of Cast Metal Foams Ivana Kroupová, Petr Lichý, Ivo Lána VSB-Technical university of Ostrava, Faculty of Materials Science and Technology, Department of Metallurgy and Foundry, 17. listopadu 2172/15, 70800, Ostrava-Poruba, Czech republic
21	Refining of Aluminum Alloy Melts Using Graphite Rotors Petr Lichý[1], Markéta Bajerová[2], Ivana Kroupová[1] [1]VSB-Technical university of Ostrava, Faculty of Materials Science and Technology, Department of Metallurgy and Foundry, 17. listopadu 2172/15, 708 00, Ostrava-Poruba, Czech republic [2]JAP INDUSTRIES s.r.o., Bystřice 1260, 739 95 Bystřice, Czech republic
22	Phase composition of lava and blast furnace slags Nataša Lipovšek[1], Samo Smolej[2], Matjaž Godec[1], Matjaž Knap[2], Jakob Lamut[2] [1]Institute of Metals and Technology, Lepi pot 11, SI-1000 Ljubljana, Slovenia, [2]Univerza v Ljubljani, Naravoslovnotehniška fakulteta, Aškerčeva cesta 12, 1000 Ljubljana

23	The Effect of Boron and Vanadium Addition on the Structure and Properties of AlCrN Coating Krzysztof Lukaszkowicz, Justyna Galeja Silesian University of Technology, Faculty of Mechanical Engineering, Konarskiego St. 18a, 44-100 Gliwice, Poland
24	AES and XPS study of nitrocarburized and oxidized steel surfaces I. Velkavrh[1], Đ. Mandrino[2], B. Podgornik[2] [1]V-Research GmbH, Stadtstrasse 33, 6850 Dornbirn, Austria [2]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
25	Influence of cold deformation on microstructure and mechanical properties of pure titanium and TiAl6V4 Kateřina Mertová, Jan Palán, Michal Duchek COMTES FHT a.s., Průmyslová 995, Dobřany, 334 4
26	Possibilities of Using Waste Perlite in Production of Aerated Autoclaved Concrete for Thermal Insulating Purposes Jana Húšťavová, Pavlína Šebestová, Lenka Mészárosová, Vít Černý and Rostislav Drochytka Brno University of Technology, Veveří 331/95, 602 00 Brno, Czech Republic
27	Self-healing Aluminium Alloys – ECCI investigation of the mechanism Irena Paulin[1], Črtomir Donik[1], Stefan Zaefferer[2], Matjaž Godec[1] [1]Institut of metals and technology, Ljubljana Slovenia, [2]Max-Planck-Institut für Eisenforschung GmbH, Düsseldorf, Germany
28	Wear Resistance of Hot-Work Tool Steel Gašper Puš, Bojan Podgornik Institute of Metals and Technology, Laboratory for Mechanical Testing, Lepi pot 11, 1000 Ljubljana, Slovenia
29	Use of Numerical Simulation in the Production of Porous Metal Casting Filip Radkovský, Marek Gebauer VSB – Technical university of Ostrava, 17. listopadu 15/2172, 708 33, Ostrava–Poruba, Czech Republic
30	Influence of Different Strain Rates During Tensile Test on the Measured Mechanical Properties Rok Rezar, Borut Žužek, Agnieszka Guštin, Bojan Podgornik Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
31	Ensuring Temperature Homogeneity in the Process of Solution Annealing of Duplex Heavy Steel Plates on the Heat Treatment Line – HTL R. Robič[1], D. Trako[2], A. Silić[2], S. Cumbo[2], F. Mencinger[2] [1]RCJ d.o.o., Cesta Franceta Prešerna 61, 4270 Jesenice [2]SIJ Acroni d.o.o., Cesta Borisa Kidriča 44, 4270 Jesenice
32	Use of surface texturing in fine blanking tools – Influence on fatigue life and tribological properties Marko Sedlaček Institute of Metals and Technology, Lepi pot 11, Ljubljana, Slovenia
33	Spot the Difference – Microstructure of Modified 2011 Aluminum Alloy Undergoing Different Treatments Tina Sever[1], Tjaša Kranjec[1], Irena Paulin[1], Matjaž Godec[1], Peter Cvahte[2] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]IMPOL 2000, Partizanska 38, 2310 Slovenska Bistrica, Slovenia
34	The Influence of Low-Temperature Plasma Nitriding on the Wear and Corrosion Properties of Additive Manufactured 316L Stainless Steel Danijela Skobir Balantič, Črtomir Donik, Aleksandra Kocijan, Bojan Podgornik, Matjaž Godec Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia

35	The influence of class C fly ash on the properties of ceramic body Radomir Sokolar, Martin Nguyen Brno University of Technology, Faculty of Civil Engineering, Institute of Technology of Building Materials and Components, Veveri 95, 602 00 Brno
36	ACR in dolomitic concrete as an autogenous self-healing process d P. Štukovnik[1], V. Bokan Bosiljkov[1], M. Marinšek[2] [1]University of Ljubljana, Faculty of Civil and Geodetic Engineering, [2]University of Ljubljana, Faculty of Chemistry and Chemical Technology
37	Evolution of Microstructure During Hot Compression Test of Alloy Inconel 625 Franc Tehovnik, Franci Vode, Simon Malej, Barbara Šetina Batič, Arh Boštjan Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana
38	Some aspects of transfer functions use for description of hot deformability of steels Franci Vode, Franc Tehovnik, Simon Malej, Boštjan Arh, Bojan Podgornik IMT, Lepi pot 11, SI-1000 Ljubljana

Complex Tissue Defect Reconstruction After Rhinectomy Using 3D Planning

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Two patients, after total nasal defect, underwent a two-stage nose reconstruction using prefabricated free tissue transfer with the help of preoperative 3D planning.
In the first stage, an innervated osteocutaneous radial forearm flap was raised according to the preoperative markings with the help of a biocompatible 3D template. After an osteotomy of the radius, an L-shaped bone framework was reconstructed using a titanium micro-plate. A custom-made titanium coated cage was used as a template for the inner lining of the nose. The "neo-nose" was reattached to the forearm and healed by primary intention, retaining the exact and predicted shape of the titanium cage. In the same procedure a tissue expander was placed under the forehead skin to expand it for the second stage.
After five weeks the second stage was performed. The prefabricated, well-vascularised "neo-nose" was re-raised, including a lateral antebrachial cutaneous nerve, and transferred to the face. End-to-end anastomoses were performed on facial artery and vein; coaptation of the donor nerve was made to a branch of the infraorbital nerve. The bone framework was fixed to the facial skeleton using a titanium micro-plate. A pre-expanded paramedian forehead flap was used for the external coverage of the nose.
In both patients, careful preoperative 3D planning was performed enabling precise and predictable result. 3D planning of complex facial tissue reconstruction can drastically improve patient's outcome and can facilitate physical and social rehabilitation. In these two patients a fully functional and aesthetically pleasing nose was reconstructed.
Keywords: Total nasal reconstruction, tissue prefabrication, innervated osteocutaneous radial forearm free flap

Electromagnetic Stirring in Continuous Casting Process

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Columnar to equiaxed transformation of a steel depends on thermal conditions of solidification line. The ratio of temperature gradient/solidification speed and chemical composition defines the liquid-solid region. Segregation adversely affects the subsequent processing of castings and mechanical properties of finished products. The application of electromagnetic stirring (EMS) technique promotes the formation of an equiaxed crystalline zone in the strand. It creates a refined solidified structure, the reduction in the content and improvement in the quality of the surface, sub-surface and the inner structure of the cast product. In the present paper we illustrate the effect of the EMS on macrostructure and microstructure of the continuous-casted billets, installed bellow the mould in the secondary cooling zone. The size of the columnar grains obtained by the EMS decreases, whereas the zone of equiaxed crystalline zone increases. There are narrower columnar grains, where crystals are thinner and shorter. The equiaxed crystals in the globular central part of the billets obtained by the EMS are smaller. The axial cracks and shrinkage cavity is dispersed into central porosity. Periodical V segregations in the axial direction of the billets obtained without the EMS change into the central zone V segregations in the billets obtained by the EMS. The number of inclusions in the area influenced by stirring is reduced below the location of the EMS (sub-surface) and at the intermediate area of the cross section of the billet. In the middle of the cross-section area of the billet obtained by the EMS, the number of inclusions is greater. Due to the higher segregation of alloying elements in the central cross section of the cast billet without the EMS, the microstructure is more bainitic. The smaller columnar and globular grains in the case of medium and high-carbon steels cast by the EMS, result in a less pronounced banding properties. The ferrite and perlite bands are narrower and shorter.

Effect of Autoclave or Plasma Oxygen Gaseous Sterilization on Surface Properties of Ti6Al7Nb Alloy Femoral STEMS

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Background: Zweymüller uncemented hip endoprosthesis with SL-PLUS femoral stem has been used for the last two decades, nowadays made of forged Ti-6Al-7Nb alloy. Grit-blasted surface roughness 4-8 µm enhances bone ingrowth. Approximately 10 % of these implants fail prematurely due to aseptic loosening, infection or latent infection. Our aim is to evaluate the impact of material and roughening procedure on clinical outcomes of hip arthroplasty and compare them with the new stems of different producers. The aim is to investigate the effect of cleaning and sterilization procedures of retrieved and new femoral stem on surface wetting properties, roughness and cell response

Material and Methods: The retrieved ZM type Ti6Al7Nb femoral stems were selected from the register of the Orthopaedic Clinic of University Medical Centre Ljubljana and two new femoral stems for comparison. Both new and retrieved stems were sterilized by classical autoclave procedure and for comparison by plasma oxygen gaseous sterilization. Surface wettability was determined by measuring the static contact angle of a water drop, whereas the surface energy was calculated from static contact angles using two liquids water and diiodomethane (DI). The most hydrophobic stem was treated in RF plasma reactor of oxygen plasma (pressure 50 Pa, current through the coil 0.3 A for min).

Results: The surface of the femoral stems is hydrophobic. There is no significant difference when comparing wettability of the new and retrieved stems. The wettability of the investigated femoral stems was quite similar. Because there were no significant differences between different hips, we choose a hip with the most hydrophobic surface further plasma treatment to change its wettability. When applying the water drop to the plasma sterilized surface, it completely wetted the surface – no drop was formed on the surface, therefore it was not possible to measure the contact angle for water only the contact angles for diiodomethane.

Conclusion The surface of the femoral stems sterilized by autoclave method is hydrophobic. There is no significant difference when comparing wettability of the new and retrieved stems. After plasma treatment the surface of the stem changed from hydrophobic to super-hydrophilic.

Mechanical Resonance of Femoral Part of Hip Prosthesis as Possible Cause of Aseptic Loosening

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Mechanical resonance is the property of a mechanical system that responds to the oscillations coming from the outside of the observed system. The response amplitude of the system is the highest when the frequency of oscillations matches the system's natural frequency (its resonance frequency). It is known that resonance may cause swaying motions and even catastrophic failure in improperly constructed structures. The phenomenon is known as resonance disaster. Sonic energy enters the system through excitation and is dissipated through damping. Damping can be internal (within the material) or external (mounting of an object).
Six retrieved stems of hip endoprostheses were studied. For each of them sonograms were made, showing a very distinctive and narrow resonance curves with one major resonance peak followed by several higher harmonic peaks. Simulation of endoprostheses standing waves was also performed resulting in the demonstration of various standing wave modes depending on the observed frequency.
Results clearly show that, due to the geometry and the used material, the observed endoprostheses have a very distinctive sonic resonance characteristics. The resonance is excited by the sound coming from outside (or inside) of the human body. The energy of resonance movement of the endoprosthesis is dissipated through the endoprosthesis – bone interface. A long-term exposure to the resonance oscillations adds to other causes of aseptic loosening of endoprostheses.

Behavior of Polyether Based Shrinkage Reducing Admixtures in High Alkaline Environment

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The geopolymes and alkali-activated materials (AAM) are still up-to-date due to interesting potential in building utilization. The attractiveness is mainly due to worldwide growing carbon dioxide taxes and decreasing amount of the limestone natural sources essential for ordinary Portland cement production[1]. Suitable sources with substantial latent hydraulicity can be found in the field of secondary silicate materials, i.e. various types of slags from metal´s manufacturing, some bottom ash from waste management or rice husk from biotechnology manufacturing, activated by high alkaline solutions (i.e. hydroxides or carbonates solutions or water silicate glasses)[2].
Mortars and concretes prepared from AAM overalls provide high durability and good chemical resistance[3]. The substantial technological issue was found in the occurring high shrinkage phenomena. The study, how to suppress it, is one of the challenges need to be solved.
Shrinkage reducing admixtures (SRA) based on polyether compounds typically used in ordinary Portland concretes can be here applied. The previous study showed the interesting results in the shrinkage development suppression with using the polyethylene glycol additives.[4]
This work deals with the study of the polyethylene glycol´s behavior in high alkaline environment and their usage in alkali-activated blast furnace slag system. The influence of the degraded and/or non-degraded form in the drying shrinkage development was studied. The ethylene glycol in monomer form and polyethylene glycols (Mw = 400, 2000, 10 000) were mixed with sodium hydroxide solution (50 wt. %). The stability of the chemical structure after various time of incubation was observed by Raman and FT-IR spectroscopy. The treated samples were applied as a standard SRA additive, so the surface tension characterization, the workability and the strength development on mortars were determined. The obtained results showed the time influence on the admixture stability and pointed to ongoing reactions in the high alkaline system.

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Titan vs Polyetheretherketone (PEEK) Cages in Interbody Fusion: Review

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Spinal interbody fusion is an accepted surgical method in degenerative spine conditions (1, 2). With the aid of interbody devices, fusion between two adjacent vertebrae is achieved. Many authors evaluated Titanium and Polyetheretherketone (PEEK) cages for bony fusion, with different results reported in literature.

Titanium displays good corrosion resistance, low density and the ability to enhance cell adhesion and osseointegration (1, 3). While Titanium has favorable fusion rates, it has some significant shortcomings. High radiodensity causes imaging artefacts and hinders accurate assessment of fusion (2, 3). Because of the difference in Titanium and bone elasticity, cage subsidence is caused, with the cage sinking into the adjacent vertebral body (1, 4).

PEEK is a hydrophobic polymer with elastic properties closer to cortical bone (1, 5). This contributes to lower stress generation between PEEK cages and vertebral endplates, resulting in lower subsidence rates (1, 5). Additionally, it is radiolucent which allows a clearer assessment of bony fusion (4, 5). However, PEEK is chemically inert and only allows cell adhesion to a limited degree (1-3). Because of lower PEEK osseointegration micromotion might be induced between cage and vertebral endplate surfaces, leading to focal bone resorption and osteolysis (2, 4).

To address the shortcomings of both materials, new PEEK composites with Titanium coating are under development (3).

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Modification Of 1.2343 Steel with Zirconium

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The effects of zirconium additions on non-metallic inclusions in 1.2343 steel were investigated. Laboratory steel charges in a 20 kg vacuum induction melting furnace with additions of Zr were made. The products of Zr additions were identified and analysed by optical and electron microscopy. The results show that Zr oxides, nitrides and sulphides in complex non-metallic inclusions. Oxygen, nitrogen and sulphur were additionally analysed. The chemical compositions were used for the calculation of element activities for further thermodynamic calculations. Thermodynamic reactions were considered to explain the formation of non-metallic inclusions.

Circular Economy Measures for NdFeB Magnets: Development of an Eco-labelling and Grading System for Traceability and Better Recycling in Theory and Practice

C. Burkhardt, B. Podmiljsak, S. Kobe

Magnets are one of the most crucial materials necessary for modern Europe, as they are integral to energy conversion across the renewable energy and electric mobility sectors [1]. Unfortunately, even though the alloying constituents of NdFeB magnets have been classified as EU Critical Raw Materials and 90 % are produced outside of the EU, there is still no circular economy to reuse and capture value for these types of materials [2].

With the prediction that the need for RE magnets will double in the next 10 years [3,4], this problem becomes even more urgent. At present, the only way to recover end of life (EOL) magnets from waste streams of electric and electronic equipment is by shredding and recycling by chemicals and pyrometallurgical routes, which is expensive and energy intensive [5].

Another problem is that the quality of the recollected materials varies significantly, especially with respect to alloying constituents and state of corrosion and employed corrosion protection, with no classification system for recyclate grades of EOL NdFeB magnets.

To enable a circular economy ecosystem for NdFeB magnets, a whole range of measures is necessary:

a) the development of an eco-labelling system for newly produced RE permanent magnets to clearly identify different magnets types and qualities in order to categorise the EOL NdFeB magnets by technical pre-processing requirements,

b) using the highly effective HPMS process (Hydrogen Processing of Magnetic Scrap) for re-processing extracted materials directly from NdFeB alloy,

c) better treatments to eliminate pre-processing residue which contaminates the HPMS process,

d) upgrading the magnetic properties of EOL NdFeB magnets by tailoring the microstructure, phase ratio and phase composition, and

e) developing industrial up-scalability, including thorough life cycle assessments.

The feasibility of the above proposed measures will be discussed and related to actual results generated in the EU-funded projects Maxycle and SUSMAGPRO, which will have a great impact by overcoming existing low recycling rates due to poor collection, high leakages of collected materials into non-suitable channels, and inappropriate interface management between logistics, mechanical pre-processing and metallurgical metals recovery.

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Qualitative Analysis of 3D Printed CoCr for Metal-Ceramic Crowns and Bridges

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3D printed CoCr for metal-ceramic crowns and bridges have become a standard in prosthetic dentistry. Still, aesthetic and functional durability of metal-ceramic crowns and bridges with 3D printed metal-base in correlation to the production methods has not been extensively investigated, so it has been used without relevant data on material characteristics, nor evidence-based conclusions and clinical recommendations regarding the material. Production phases have significant influence on the final products' characteristics. However, there is no standard for 3D printed metal production workflow, no input atomized powder control, and SLS machine settings are often left to the laboratory technician to master and optimize for their own benefit. This results in unstandardized final product with questionable mechanical characteristics and ceramic bonding strength. 3D printed CoCr metal-base for metal-ceramic crowns and bridges in form of test tubes and actual crowns and bridges will be analyzed for its precision, volume definition, build-up parameters, surface chemistry characteristics and mechanical characteristics.
Objectives:

- Understand the production process of 3D printed CoCr and its influence on the quality of the final product,
- Learn the indications and limitations of 3D printed CoCr,
- Understand the importance of standardization and quality control in 3D printed CoCr from both the raw material and the production process aspects.

Data-driven Evolutionary Optimization in Metallurgical and Materials Engineering

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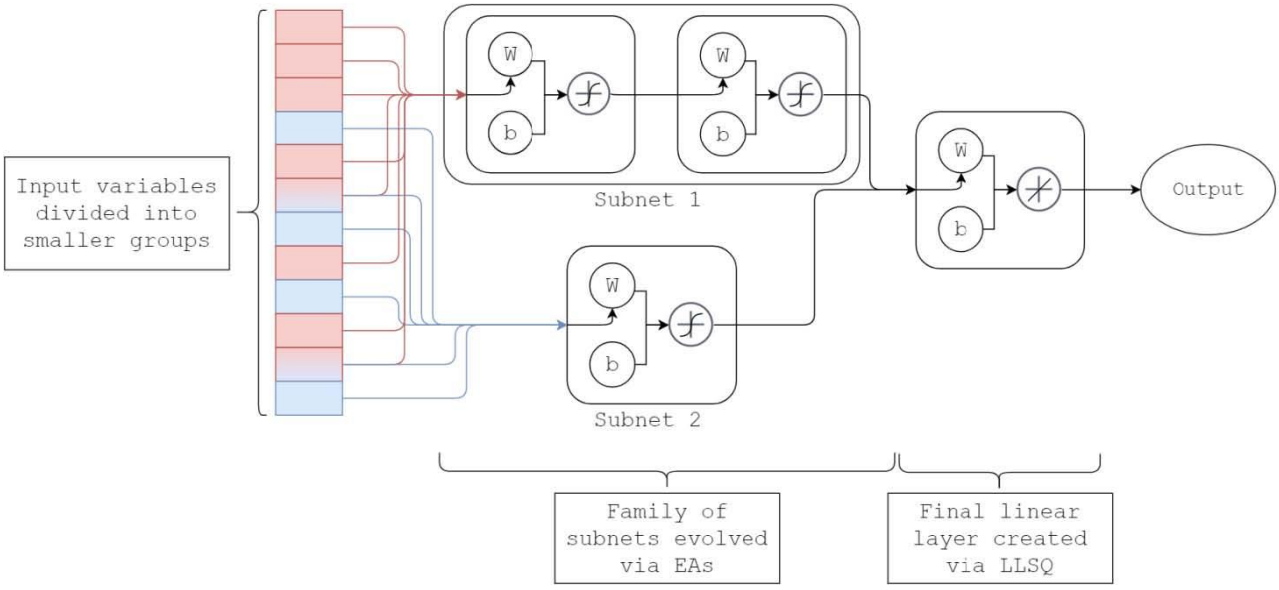
In this presentation I will talk about some recent algorithms EvoNN (Evolutionary Neural Net) Bi-objective Genetic Programming (BioGP) and EvoDN2 (Evolutionary Deep Neural Net) developed by me and my global collaborators which are now being widely used in diverse areas of metallurgical and materials research. Among them BioGP is now integrated in the commercial Kimeme software, the flagship product of Cyber Dyn Srl, an Italian software company. Open source codes of these algorithms are also available from me. These algorithms are based upon a nature inspired approach, trying to mimic some basic aspects of evolutionary biology in a non-biological context, for example, the materials related problems, and follow the principles of multi-objective optimization. The starting point is the noisy data from diverse sources that could be either from industry, experiments or simulation and the next step is to create a set of optimum models following an intelligent strategy for avoiding the random noise in the original information. For a given system, several such models can be created for various conflicting *objectives* pertinent to the system in hand, and all these algorithms allow the users to optimize them simultaneously following the concepts of *Pareto Optimality,* which tends to find out the best possible tradeoffs between these conflicting requirements. Once a model is created, it also allows the users to evaluate the interaction between the decision variables, following a simple, intuitive approach.

In presentation the basic working principles of these algorithms will be explained in a nut shell and their efficacy will be demonstrated based upon some recently conducted studies on blast furnace iron making and some special steel developments conducted in my group. The results obtained using these three in house softwares will be shown and analyzed along with the information obtained through the commercial software Kimeme that provides the users with several alternate strategies.



The schematics of EvoDN2 algorithm

Manipulation of Stainless Steel Wettability and Friction in Different Environments by Adsorption of TiO_2 Nanoparticle Coatings

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We present functionalization of AISI 316L surface by adsorption of hydrophilic epoxy and epoxy/TiO2/epoxy coatings and hydrophobic epoxy/fluoroalkylsilane functionalized, FAS-TiO2/epoxy coatings. Besides different wettability, the coatings differ also in morphology and average surface roughness. This enables a study of the combined effect of surface wettability and morphology on the friction coefficient and wear resistance. Experiments were performed in dry and distilled water environments as well as in simulated physiological solution (Hank's solution). In the case of dry friction, lower coefficient of friction is achieved for both TiO2 coatings compared to pure epoxy coating. In water environment the same level of friction is shown for all three coatings, indicating that friction level is defined by water itself. In Hank's solution, however, the wettability and implementation of TiO2 nanoparticles regulate the friction level through the reactions between the elements of the coating. Friction is reduced for hydrophilic epoxy/TiO2/epoxy coating, increased for hydrophobic epoxy/FAS-TiO2/epoxy and has no effect on pure epoxy coating. Finally, results show that coatings reinforced with TiO2 nanoparticles provide better protection of the steel surface as well as better resistance to mechanical and tribological loading provided by the formation of patches of coating material rich in Ti.

Topochemical Conversion of $Bi_4Ti_3O_{12}$ Nanoplatelets to $MTiO_3$ (M = Sr, Ca, Ba) Nanoparticles under Hydrothermal Conditions

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$MTiO_3$ (M= Sr, Ca, Ba) perovskites are interesting functional materials with high potential for (photo)catalytic, ferroelectric and piezoelectric applications.[1,2] In particular, anisotropic perovskite nanoparticles (i.e. nanoplatelets, nanoneedles) attain high attention, because many physical properties depend on crystallographic orientation. Due to the centrosymmetric nature of $MTiO_3$ perovskite phases above the Curie temperature, the particles do not tend to grow in anisotropic morphologies at temperatures typical for hydrothermal synthesis. This obstacle may be overcome by topochemical conversion of anisotropic template particles to $MTiO_3$ with preservation of the precursor morphology. In this study, plate-like $Bi_4Ti_3O_{12}$ template nanocrystals were prepared in molten salt[3] and further transformed to $MTiO_3$ (M = Sr, Ca, Ba) under alkaline hydrothermal conditions. The reaction mechanism was studied in detail for the conversion of $Bi_4Ti_3O_{12}$ to $SrTiO_3$ platelets. $SrCl_2{\times}6H_2O$ was used as a strontium source and reaction was performed in 4 M NaOH medium at 200 °C for 1 to 15 hours. The transformation starts by dissolution of $Bi_4Ti_3O_{12}$ from the side of the plate like crystals, where $(Bi_2O_2)^{2+}$ and $(Bi_2Ti_3O_{10})^{2-}$ layers of the $Bi_4Ti_3O_{12}$ structure are exposed. The dissolution process provides Ti^{4+} ions for epitaxial growth of $SrTiO_3$ on $Bi_4Ti_3O_{12}$. Nucleation of $SrTiO_3$ starts at the edges of both basal faces (upper and lower surface) of the $(Bi_2O_2)^{2+}$ terminated template crystals. Further dissolution/precipitation process leads to the formation of dissolution notch, progressing from the side to the interior of the $Bi_4Ti_3O_{12}$ template crystals, while epitaxial growth of $SrTiO_3$ continues from the edges of the basal surface towards the center of the basal plane until complete conversion to (100) oriented $SrTiO_3$ plates. Controlling the epitaxial growth through the quality of the template surface and reaction conditions (concentration of reactants, temperature, duration, etc.) was found to be crucial for the formation of $SrTiO_3$ platelets. Deviations from ideal conversion conditions lead to 2D-nanoframes or cube-like $SrTiO_3$ nanoparticles rather than particles with the targeted plate-like morphology. Similarly, as for $SrTiO_3$, the transformation from $Bi_4Ti_3O_{12}$ to $BaTiO_3$ and $CaTiO_3$ was investigated. The obtained morphologies of $MTiO_3$ (M = Sr, Ca, Ba) particles will be discussed in correlation with the template quality and reaction conditions.

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Wear Particles and Lymphocytes in Tissue Around Failed Joint Prostheses

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The longevity of total joint prosthesis is limited by the generation of wear debris and its subsequent biologic response in periprosthetic tissue. Histological examination provides essential information about size; shape and types of wear particles and also biological response of periprosthetic tissue to wear particles. Host response to wear particles deposition in periprosthetic tissue is fundamentally similar, whatever the nature of the implant-derived foreign material. Innate, non-specific foreign body response is mediated by macrophages which are specialised phagocytic cells. Beyond the role of macrophages and innate non-specific foreign body response, the mechanisms of interaction between lymphocytes and wear particles are not completely understood.

Wear particles induce an adaptive immune response, histologically demonstrated by the presence of lymphocytes within periprosthetic tissue. Diffuse lymphocytes in periprosthetic tissue around different types of joint prostheses have been described; however no specific attention has been given to this infiltration since lymphocytes are well-known to be a player in the periprosthetic cellular immune response in aseptic loosening. Immunohistochemically most of lymphocytes were determined as T cells, however, no correlation between metallosis and the extent of T lymphocyte infiltration in periprosthetic tissue was found.

A pronounced perivascular lymphocyte accumulation, termed aseptic lymphocyte-dominated vasculitis-associated lesion (ALVAL) is commonly seen in periprosthetic tissue in response to the deposition of Co-Cr wear particles derived from metal-on-metal (MoM) articulation. A cell-mediated immune response occurs when sensitised T lymphocytes recognise an antigen on macrophages and proliferate and release lymphokines which attract and activate macrophages and other lymphoid cells. In most cases the extend of perivascular lymphocyte reaction correlate with the amount of wear, however, it was noted that in a small number of cases relatively low wear had heavy ALVAL response and that a few had high wear with a minimal ALVAL response. Morphology of this reaction is similar to the Type IV hypersensitivity reaction. However, not all patients with failed metal on metal implants have demonstrated an immune response when challenged by metal ions that compose these implants, suggesting other non-allergic mechanism may exist by which metal ions more directly affect implant loosening. Perivascular accumulation of lymphocytes has also been observed following metal on polyethylene articulation. It has been proposed that endothelium is a central regulatory component in trans-endothelial lymphocytes migration.

Histopathological findings in periprosthetic tissue reflect the pathobiology of the host innate and adaptive immune response to wear particle deposition but should always be interpreted in the context of all clinical, radiological, microbiological and allergological data.

Effect of Rotary Swaging, Wire Drawing and their Combination on the Resulting Properties of Nickel Based Alloy Wires.

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This paper investigates influence of drawing and rotary swaging parameters such as the area reduction on the tensile properties of nickel based alloy wires. The rotary swaging and the wire drawing were used to increase mechanical properties. Furthermore, the effect of the combination of these processes on the resulting hardness cross-section of the wires was studied. In case of the rotary swaging the highest amount of cold deformation (the increased value of hardness) is located in the middle of the wire. This can be explained by formation of deformation cones oriented to the center of the wire. On the other hand, the highest amount of cold deformation is located on the surface (closely under the surface layer) on the drowned wires. The reason is that the interest is centered in achieving large cross section reductions during wire drawing process. In addition, largest approach angle is used in order to avoid redundant shear. Thanks to the combination of the rotary swaging and the wire drawing could be achieve negligible differences in hardness across the wire diameter. The mechanical properties and the microstructure in the longitudinal and transverse direction and the hardness profile HV of nickel base alloy wires were compared in this investigation.

Development of Meshless Method for an Accurate Phase-Field Modelling of Dendrites with Arbitrary Orientations

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A meshless numerical method is developed for an accurate solution of the phase-field model for solidification of dendrites with arbitrary orientations. The radial basis function-generated finite difference (RBF-FD) method and the forward Euler scheme are used for the spatial and temporal discretization of the phase-field equations, respectively. The phase-field equations are solved on regular and scattered node distributions in order to assess the influence of node distribution to the solution. The numerical method is verified by comparing the dendrite growth velocity to the solution obtained by the Green function method. The size of the primary trunk in the case of a dendrite aligned with the axes of the computational coordinate system is chosen as a reference solution for assessment of the performance of the method at an arbitrary preferential growth direction. We show for the first time that the use of the RBF-FD method on scattered node distribution provides a robust approach towards the accurate phase-field modelling of dendritic solidification at an arbitrary preferential growth direction.

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Implementation of Natural Fillers in Polyethylene and the Resulting Mechanical Properties

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In recent years, materials with natural fillers begin to be used for manufacturing of window frames and various linings. These compounds can replace the natural materials such as wood and stone. The main reasons to use these fillers are price (which is lower than that of a polymer) and rigidity. The resulting product is strong, hard, light, possesses a long term resistance against wind abrasion and takes on the appearance of wood and stone. The type of filler has a significant effect on the final properties of the material. In the past, however, insufficient attention was paid to the effect of natural fillers upon the injection molded product mechanical properties.

First, the test samples were measured by depth sensing indentation (DSI), which is a contemporary instrumented hardness test utilized to gain the micro-mechanical properties. Micro Combi Tester made by Anton Paar company was used for these tests. Then, the measurements were evaluated by the Oliver and Pharr method. The goal of this study was to prepare a low density polyethylene (LDPE) filled with varying natural fillers, e. g. finely grounded wood, coarsely grounded wood and slate) and its subsequent granulation.

The implementation of these fillers led to an increase of mechanical properties, e. g. indentation hardness and modulus, by up to 100 % in comparison to the virgin material. The goal of this study was to evaluate the effect of natural fillers, such as wood and slate, on the mechanical properties of the tested materials.

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Surface Phenomena of Zweymüller Cementless Hip Endoprostheses

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Background: Cementless, Zweymüller, hip endoprostheses with SL-PLUS® and Alloclassic ZM or Variall femoral stem was introduced in 1970's, stem is nowadays made of wrought Ti6Al7Nb alloy with the grit blasted surface. It shows excellent secondary stability as proven by high rates of radiographic osseo-integration and often lower rates of revision for aseptic loosening than cemented stems. Since introduction it gaining in popularity with the average life time of 15 to 20 years. Last 20 years more than 2,000 Zweymüller endoprostheses was implanted in a single tertiary hospital in UMC Ljubljana. Our aim is to evaluate the impact of the grit blasted surface on the longevity of ZM cementless hip endoprostheses.
Materials and Methods: The retrieved and new Ti6Al7Nb stems were investigated (selected hip endoprostheses – premature failed due to: aseptic loosening -10; infection-10, latent infecition-10, new -5), using contact angle (water) measurements and profilometry for hydrophilicity, wetting properties and roughness (Bruker Alicona) respectively and scanning electron microscopy (SEM) with EDS, EBDS and FIB (Zeiss Gemini 2 Cross Beam 550), were used to examine surface chemical composition, and morphology and phase analysis. X-ray photoelectron spectroscopy (XPS), Auger electron spectroscopy (AES) (Thermo Scientific-Microlab 310F) for surface analysis, Corrosion resistance of alumina grit-blasted and polished surface of Ti6Al7Nb alloy were investigated by the electrochemical experiments, carried out in a simulated physiological Hank´s solution at pH=7.8 and 37 °C. The potentiodynamic curves were recorded using a BioLogic® Modular Research Grade Potentiostat/Galvanostat/FRA Model SP-300 with an EC-Lab® software V11.10., after 1 h of sample stabilization at the open-circuit potential (OCP), starting the measurement at 250 mV vs SCE more negative than the OCP. The potential was then increased, using a scan rate of 1 mV/s.
Results: Sterilization effects the surface properties of Ti6Al7Nb alloy – hydrophilicity/ hydrophobicity [2,3]. We found Al_2O_3 corundum particles contamination on the grit-blasted surfaces of new and retrieved implants. These residues are potential problems -third body wear and probably induction for osteolysis and aseptic loosening. Microstructure of wrought Ti6Al7Nb alloy contains small grains, the majority alpha (hcp)Ti with a small amount of Ti beta grains (bcc) structure. The microstructures of the new and retrieved implants are similar [1]. The thicknesses of the thin oxide films on the Ti6Al7Nb (primarily of TiO_2) were estimated using AES and XPS depth profiling. The Ti, O and C Auger peaks were detected in the AES analysis. The estimated oxide thickness was about 7 nm, consisting primarily of TiO_2. The corrosion rate was calculated for 8.6 µm/year.
Conclusion We need to investigate in details the minimizing of the residual particles on grit blasted implant surface. The results of this study confirmed that the key role in corrosion performance of investigated materials the formation of compact outer oxide layer, which prevents the penetration of aggressive ions and therefore enhances anticorrosion performance of material. The surface-chemistry results showed that thin oxide films on the Ti alloys prevent further corrosion, improve the biocompatibility, and affect the osseointegration. It is obvious that we need to keep an optimal microstructure with regards to the corrosion and mechanical properties, which can be controlled through the production parameters and could be standardized in the near future.

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Impact of Different Chemical composition on biodegradablility of Fe-Mn Alloys

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Fe-based biodegradable alloys such as Fe–Mn are interesting for biodegradable implants, however their corrosion rate for the targeted applications is too low. The purpose of research was evaluating biodegradability of Fe–Mn 20 alloy processed and increasing the amount of Mn up to 35 wt%. Increasing the biodegradability with alloying elements and increasing the strength hardness and reduce the grain size of the alloy we add Si up to 8 wt%. In present study, we report the influence of three different chemical compositions on the biodegradability of Fe–Mn alloys potentially used for medical applications. Corrosion properties and in-vitro biodegradability were investigated by light microscopy, scanning electron microscopy, X-ray diffraction and immersion tests in Hank's solution.
XPS revealed the oxide layers on the Fe–Mn alloy consists mainly of Fe_2O_3 and FeO, with the content of Mn in the oxide layer being significantly higher than in the bulk material. EDS cross section analyses corroborated significantly higher content of Mn on the surface in oxidized layer compared to the bulk Fe–Mn. This could be directly related as one of the explanations for increased corrosion rate. Using the results of the potentiodynamic electrochemical measurements with additional EIS measurement, we were able to clearly demonstrate the increased biodegradability of three modified Fe–Mn alloys.
Keywords: biodegradability, Fe–Mn alloys, corrosion measurements, XPS, SEM.

Thermodynamic Effect on Selective Laser Melted Biomedical Implants

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Many patient specific implants (PSI) are nowadays produced using selective laser melting of Titanium alloys. The main objective of PSI is to fit the surrounding bone tissue, enable good osteointegration and provide mechanical stability and durability. While the fitting and some aspects of osteointegration mainly depends on the modelling process, the mechanical properties mainly depend on the processing parameters of the SLM process. Several thermodynamic effects, which occur in Selective Laser Melting (SLM) process, influence the metallurgical, mechanical, and chemical properties of a component. Metallurgical and mechanical properties include microstructure, porosity, hardness, ductility, tensile and surface properties. Whereas, corrosion resistance depends on the metallurgical properties of the component. These properties depend on several phenomena included in melting, fusion and solidification functions. The phenomena can be regulated with the proper states of the fabricating parameters. There are several parameters included in the environment, powder layer properties, and laser scanning strategies. Whereas, the technological parameters included in energy density namely laser power, scanning speed, hatch spacing, and layer thickness lead egregious role on these phenomena and eventually, lead the product properties as well as productivity. These technological parameters consequence several physical behaviors of the material and that influence melting quality, spattering, stability and viscosity of melt pool, balling effect, inert gas entrapment, oxidation, air behavior at the action zone, fusion, cooling rate, and solidification process. Carrying out several experiments with Ti-6Al-4V alloy specimens, this paper is going to present the influences of laser powers, scanning speeds, hatch spacings and remelting on the characteristics of the components.

Investigation of Microstructure of Differently Sub-Zero Treated Vanadis 6 Cold Work Tool Steel

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The microstructure, the phase constitution and hardness of Cr-V ledeburitic cold work tool steel Vanadis 6 subjected to sub-zero treatment with several soaking time in temperature –75 °C have been investigated. The metallurgical aspects include increasing carbide count and reducing the amount of retained austenite so wear resistant and dimensional stability are better as compared to conventionally heat treated material. The matrix is martensitic with certain amount of retained austenite, irrespectively to the time of sub-zero treatment. The amount of retained austenite is dependent on soaking time and has been significantly decreased. The microstructures have been characterized using the light microscopy, scanning electron microscopy and X-ray diffraction. The microstructure of sub-zero treated steel contains eutectic, secondary and increased count of small globular carbides. The count of small globular carbides for conventionally heat treated samples was several times lower in comparison with sub-zero treated samples. The count of small globular carbides was increased more than four times. These particles have size of up 500 nm but 100 nm in most cases. The hardness has been increased as compared to no sub-zero treated samples as a consequence of the reduction in amount of retained austenite and increased count of small globular carbides.

Increased Ignition Temperature of Magnesium-Based Quaternary Alloy by Alloying with Ca, Y and Gd

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Magnesium, as the lightest structural metal available, attracted high scientific interest over the last decades. Some of the main constraints considering the utilization of magnesium in aviation are its flammability and subsequent inability to self-extinguish after the fire source is removed. In present, none of the magnesium-based commercial alloys has been optimized for their ignition and flammability properties. Generally, elements that have high solubility limit in magnesium matrix and form only thermally stable intermetallic phases are considered as good candidates for materials with increased ignition temperature. In this context Ca, Gd, and Y seem to be promising candidates. Present work studies the effect of these elements in quaternary magnesium alloy on microstructure condition and ignition temperature. Three different materials containing 0.5 – 2 wt. % of Ca, 1 – 4 wt. % of Gd and 1 – 4 wt. % of Y was prepared in the as-cast state and subsequently studied. The relation between microstructure, the formation of oxides and ignition temperature of materials are discussed. Obtained results showed the especially huge effect of Ca and Y addition on ignition temperature which reach almost 1100 °C for the alloy with the highest concentration of selected elements. This research was funded by the Czech Science Foundation (project no. 19-08937S) and specific university research (MSMT no. 21-SVV/2019).

ToF-SIMS Analyses of Thin Oxide Layers by Dual Beam Depth Profiling

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Time of Flight Secondary Ion Mass Spectrometry (ToF-SIMS) is often used method for surface and thin film characterization. This method is based on the precise mass detection of ions and ionized molecules emitted from the surface region of 1–2 nm in depth due to the surface bombardment with ion beam in ultra-high vacuum ambient. In this way elemental and molecular composition of analysed surface may be characterized. In order to get insight into the subsurface chemistry additional ion beam is employed for controlled erosion of the surface layer of the sample. Usually a beam of Cs^+, O_2^+ or Ar^+ ions of energy 0.5–2 keV is used for sputtering of crater during depth profiling and a focused ion beam of Bi^+ ions with energy 30 keV is used as analytical beam for analyses of the bottom of the crater. Oxygen gas in small quantities can be also leaked into the vacuum chamber as it works as an oxidizing agent and promotes ionization of analyte, especially by forming metal oxides detected as negative ions. We applied this so-called dual beam depth profiling for characterization of thin oxide layers formed on Ti-based implants and on ferritic steel plate exposed to different plasma treatment. We will discuss optimization of analytical conditions and limitations of used method.

Environmentally Friendly Synthesis of Sustainable Carbons for Future Directions

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Hydrothermal carbonization is a sustainable, environmentally friendly, low-cost process. This method involves the processing of biomass at moderate temperatures (≤ 250 °C) to produce robust carbon materials, *i.e.* hydrochars, with different morphologies. The physical and/ or chemical properties of hydrochars are significantly affected by many factors such as, feedstock type, temperature, hydrothermal processing time, additives, etc. Therefore, a close control of these parameters is of importance to produce well defined hydrochars. There have been many attempts to produce functional hydrochars which can be considered as promising starting materials for certain applications. Therefore, we have been focusing on the synthesis conditions for producing the hydrochars as well as modifying them with metal nanoparticles, *i.e.* silver, gold, at different processing conditions to investigate the resulting structural and morphological properties.

Nano-Characterization of Wear Debris of Ceramic-on-Ceramic Bearing in Total Hip Replacement

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With around 1.3 million implantations of biomaterials worldwide per year, total hip replacement (THR) is considered as one of the most frequently performed implantations of biomaterials in orthopaedics. Ceramic-on-ceramic (COC) bearings, based in alumina or zirconia, are one of the prominent materials for such intervention. Studies about the reaction of tissues on organic and inorganic particles are a topic of a multitude of medical disciplines. Especially in the field of surgical disciplines like orthopaedics, particle studies that investigate the influence of the abrasion of different prosthetic materials on the peri-prosthetic tissue are undertaken to find out about the evidence on their respective biocompatibility.

In this case study artificial hip parts were constructed of COC bearings (femoral head and acetabular inner cup), a Ti-Al-V acetabular metal outer cup, and a corundum grit-blasted Ti-Al-V femoral stem. The aim of the study was to determine what kind of wear-debris particles were present in the tissue, what was their composition and possible crystal structure.

The debris particles were obtained by dissolving the tissue sample in 95–97 % sulfuric acid, washing the remains with distilled water, filtering them, and finally cleaning them with ethanol and leaving them to dry, and as such were used for the different, above-mentioned investigation techniques. Extracted debris particles were further prepared for the TEM with the drop-casting technique on a lacy formvar/carbon-coated Cu grid and analyzed at 200 kV. The particles were mainly agglomerated, which was clearly visible from the STEM elemental mapping, and were between a few µm to around 10 nm in size. Their shape varied from rods, rectangular and rounded. The larger particles usually had sharp edges, and the smallest particles in the nm range were usually a rounded shape. Some particles were amorphous and some crystalline.

Effect of Titanium and Vanadium Addition on Final Mechanical Properties of S1100QL Steel

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S1100QL is ultrahigh-strength micro-alloyed structural steel used in heavy–lifting industry. Micro-alloying additions like vanadium, boron, niobium and vanadium are used to achieve the required mechanical properties with proper metallurgical strategy. Titanium addition is used for boron protection as well as for austenite grain size control. However, many researchers argued that coarse TiN particles formed during the solidification can trigger cleavage fracture and thus severely reduce the impact toughness of the steel. The influence of the titanium as also the influence of vanadium was studied by producing experimental alloys with three different micro-alloying additions (Nb-B, V-Nb-B and Ti-Nb-B). Three experimental alloys were hot-rolled and heat treated under comparable conditions for detail microstructure analysis and mechanical testing. Microalloying combination V-Nb-B showed best response in terms of tensile properties, which can be related to the precipitation hardening of ferrite. Highest Charpy impact toughness values were achieved using Ti-Nb-B micro-alloyed steel for given chemical composition.
Key words: steel, microalloying, titanium, vanadium, niobium, boron, mechanical properties

Different Approaches to Achieving Biodegradability with an Fe-Mn Alloy

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Metallic biomaterials can play an important role in the repair or replacement of bone tissue that has become diseased or damaged. However, the plates, screws and pins used to secure serious fractures must be removed by a second surgical procedure after the tissue has healed sufficiently. This repeated surgery increases the costs to the healthcare system and the risks to the patient. To overcome these problems, biodegradable materials can be used, which temporarily support the healing tissue, but then completely degrade over time. Where heavy loads are not required, poly-lactic acid materials are used today. Otherwise, intensive research is ongoing in the field of metal biodegradable implants based on magnesium, zinc and iron. Fe-Mn alloys are promising candidates for biodegradable metallic materials because of their excellent mechanical properties, which are usually obtained during a multi-stage forming process. However, the biodegradability rate is usually not sufficient and lasts too long. In order to speed up the corrosion rate we use different approaches: alloying elements, grain-boundary engineering and the surface laser texturing of conventionally produced Fe-Mn alloys. There are also possibilities to use an additive manufacturing process to make biodegradable Fe-Mn alloys by choosing the proper selective-laser-melting processing parameters, by mixing different nanoparticles with the Fe-Mn powder and to increase the surface area of the final product that leads to superior bone-tissue regeneration.

Keywords: biodegradable metallic materials, Fe-Mn, additive manufactured, corrosion

Hierarchical Structure Formation of Additive Manufactured 316L Stainless Steel Using Industrial Selective Laser Melting Process Parameters

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The industrial selective laser melting processing parameters used created a specific microstructure of dislocation cells that spread throughout the volume of the produced material. Such a dislocation stable structure is responsible for higher yield strength compared to forged reference material. In present work quantitative correlations between the mechanical and the structural properties of AM-processed 316L stainless steel were demonstrated.
The investigations have been carried out by electron backscatter diffraction (EBSD), electron channelling contrast imaging (ECCI) and transmission electron microscopy. EBSD reveals grain size and shape as well as the density of geometrically necessary dislocations, TEM-based EDX and EELS yield the local chemical composition. ECCI, as a still new technique, permits direct observation and quantification of dislocations on bulk specimens and thus allows inspection of a large surface area. With this technique it was found that the sample consists of tube-shaped dislocation cells, bounded by dense dislocation walls. These cells are identified to correspond to slightly misoriented dendritic structures that grow during the rapid solidification of the material. This suggestion is also supported by the fact the chemistry is different between cell wall and cell interior. Based on microscopy observation a model of hierarchical structure growth were proposed.
Keywords: Additive manufacturing, Hierarchical structure, Dislocation cells, ECCI, Electron microscopy

Three-Dimensional Assessment of Jaw Morphology

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Introduction. Conventional diagnostics in orthodontics and dentofacial orthopaedics are based both on clinical examination, study cast analysis and radiographs to evaluate jaw morphology.
Conventional photographs and radiographs are routinely used for diagnosis and treatment planning. However, these methods are limited as they are a 2D representation of jaws, which are a 3D object. In addition, the unnecessary irradiation of children is unfavourable. Non-invasive 3D scanners have been proven to be safe and reliable in assessing the characteristics and growth of jaws in several case-controlled studies. In order to obtain 3D measurements dental casts have to be digitalized, which can be achieved either by scanning the dental stone models or by using an intraoral scanner. Until recently, the transverse discrepancy between the upper and lower jaw was evaluated by measuring the linear intercanine and intermolar distances. However, this method could be biased in assessing the transverse dimension due to a malposition or buccal tipping of the teeth; therefore the objective assessment of jaw morphology may be unreliable. 3D morphological techniques of jaw morphology assessment have been verified as a useful, reliable and repeatable assessment tool. As a simple and non-invasive method it is increasingly replacing standard diagnostic methods such as x-rays and linear measurements of dental study models. Instead of linear measurements it utilises surfaces and volumes to evaluate morphological characteristics of the jaws.
Aim. Evaluation of jaw morphological characteristics in children with unilateral functional crossbite.
Subjects and methods. A retrospective case-controlled longitudinal research on 55 children. Divided between a group with transverse discrepancy of unilateral functional crossbite (UFCB) and a group of healthy untreated children. Study casts of their jaws were digitalized with an optical 3D model scanner, which uses a laser and camera to obtain the shape of an object by a process of triangulation. Morphological traits of the jaws were analysed in a computer program. In order to measure the jaw surface, gingival surface area and calculate the jaw volume, the boundaries had to be defined. The gingival and distal planes were used as boundaries for the palate. The gingival plane was created by connecting the midpoints of the dento-gingival junction of all primary teeth. The distal plane was created through the two points at the distal of the second primary molar perpendicular to the gingival plane. A palatal surface, surface of the gingival plane and volume of the palate was then calculated. In the mandible, mylohyoid plane was used as the lower boundary and the gingival surface of the lower jaw, surface of the mandible and volume of the mouth floor were calculated.
Results. Maxillary and mandibular morphological traits were compared between the UFCB and the control group of children. The results of our study showed that maxillary morphological characteristics of the UFCB group were significantly smaller while the mandibular ones were significantly larger compared to the control group. After the orthopaedic treatment of the UFCB group using palatal expansion the jaw morphological traits no longer differed compared to the control group. The values of their morphological traits were equal to the values to of the children in the control group.
Conclusion. 3D contemporary measurements of jaw morphology such as jaw surface, jaw volume and gingival surface area of jaw morphology assessment were shown as a useful, reliable and repeatable assessment tool.
Even though conventional diagnostics in orthodontics and dentofacial orthopaedics are still a golden standard in everyday clinical practice, the 3D contemporary technology may in the future contribute to improve accuracy and allow better diagnosis of morphological irregularities of the jaws. The main advantage of this method is its non-invasiveness which is especially appreciated as a diagnostic tool in growing children.

The science and Characteristics of Hyaluronic Acid Soft-Tissue Fillers and their Use in Aesthetic Medicine

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Over the last 20 years, hyaluronic acid (HA) fillers have become the most popular injectable biomaterial for soft tissue correction. Dermal fillers are commonly used in aesthetic medicine to shape the face or to treat signs of facial ageing. With the increasing number of available HA fillers and the multiplication of facial treatments all over the world, there has been a need from physicians to better understand the HA fillers science.

HA is a naturally-occurring component of the extracellular matrix. It is a glycosaminoglycan (GAG) polymer consisting of repeated disaccharide units of glucuronic acid and N-acetylglucosamine. Approximately 50 % of the body's total HA is in the skin, where it acts as a scaffold for the extracellular matrix, providing rigidity, hydration and turgor whilst allowing cellular movement and regeneration. It is also important in protecting the skin from free radical damage, particularly against UVA and UVB. HA is rapidly metabolised in the tissues, with one third of total body HA being turned over daily.

Variability in methods used to manufacture HA fillers have given rise to differences in properties such as degree of cross-linkage, particle size and concentration. These properties are vital in determining the clinical performance of the filler. Chains of hyaluronic acid are linked using hydrogen bonds, forming stable complexes. This makes HA more resistant to degradation and therefore enables it to last for several months in the skin.

Different physicochemical properties of the HA-gel relate to the clinical outcome. For example, the gel strength as measured by rheology has been said to relate to the lifting capacity and tissue integration. Rheological characteristics represents an essential tool to guide physicians in the selection of the most appropriate HA fillers, administration techniques and depths of injection for their clinical applications. A better knowledge of these HA fillers' rheological parameters can help the physicians to optimize their aesthetic outcomes, safety and patient satisfaction

Once injected, fillers are subject to shearing, vertical compression and stretch from muscle movements, compression and gravity. It is our role as practitioners to understand the way fillers will behave when injected into a particular area or layer of the skin and to choose the most appropriate dermal filler to achieve the desired aesthetic result. Fillers used to treat different parts of the face have very different desirable qualities.

Bio Polymeric Composite Membranes for Guided Tissue Regeneration

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Guided tissue regeneration (GTR) is a method utilized to regenerate the tooth supporting tissues affected by periodontal disease. More than 8 % of adults aging between 20 and 64 have periodontal disease, and ~ 5 % of them have moderate to severe form related to diabetes, osteoporosis and other systematic cardio-, cerebrovascular and respiratory diseases. The cell-occlusive, space making, tissue integrative, clinically manageable, biocompatible are attributes to ˝ideal˝ membrane, for which the large diversity of (non)biodegradable, and bioactive materials have been use. Despite diversity, their limited success have been reported. This work focus on new GTR membranes, systematically engineered as graded, multilayer composites, based on bacterial cellulose and gelatin protein. The major idea is site-specific introduction of the morph-chemical and structural triggers within a single material, to emulate the complex ECM of periodontal tissues (Figure 1).
The interlayers integration, physiological stabilization and µ-structuring, were achieved through combination of perodate-medited oxidation of BC, freeze/thawing treatment and carbodiimide crosslinking chemistry. The post mineralization process using fast, 10x SBF-mediated procedure adapt formation of bone-regeneration- relevant minerals. Selected fibroblast and osteoblast cell lines were used for in vitro assessment of biological performance of processed composites, the cytotoxicity, membrane integrity, barrier function and bone regeneration function. For bacterial management, the antimicrobial peptide nisin was post-synthetically introduced, demonstrating activity against periodontal pathogens *E. faecalis*, *P. intermedia* and *F. nucleatum* at amounts as lower as 10 µg/sample.

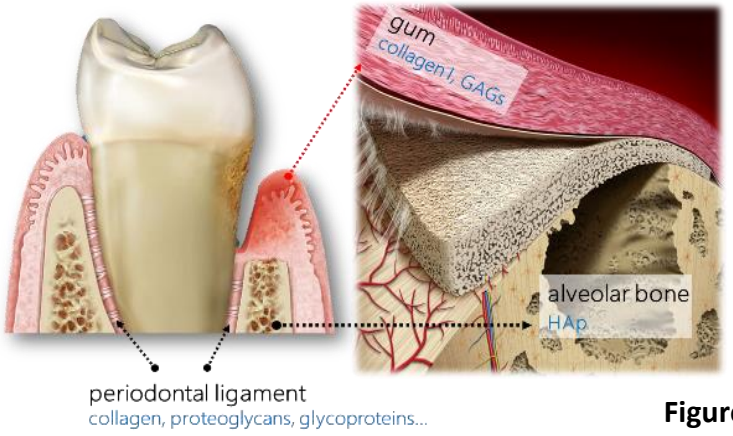

Figure 1

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Characterization of acoustic absorption properties of composite material

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From the environmental point of view, the demands for noise reduction are increasing, which opens up the need for new load bearing construction materials with improved vibration accuracies. Sound absorbing materials are used to modify the sound field in indoor and outdoor spaces.
One of these materials with improved vibroacoustic properties is composite material such as inorganic glass mineral wool. Thermal and acoustical insulation product made from inorganic glass mineral wool pre-formed into boards and bonded by a thermosetting resin. Inorganic glass mineral wool is known as highly flexible material. In addition to all of these mechanical properties, it is very highly acoustic absorptive material. For comparison of acoustic absorption properties we a material of rubber was used. There are a lot of waste tires in the world. The incineration of these tires is inappropriate for the environment; therefore new methods for using this waste are being thought. We will use a minced rubber from the old shovels of car tires.
The absorbent material is added in order to reduce the amount of acoustic energy offset. This property is important if the material, for example the wall, is close enough to the source of noise. Absorption of the wall reduces the sound of the sound from the wall. Inorganic glass mineral wool should be used as one of the possibilities for use for the noise barrier of railways, which takes place in specified sections of the line at the prescribed speed.
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Universal Laser Direct Deposition Head and Stability of the Wire Deposition Process

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Laser direct metal deposition is an additive manufacturing process where a deposited metal layer is formed by feeding of metal material into the melt pool, generated on the fed workpiece surface by a laser beam. The process can be used in stand-alone machines for coating, repair, and printing of 3D components or in hybrid machines where additive process is combined with subtractive processes to achieve final quality of the printed component. In the presentation, an universal annular laser beam direct deposition head (DDH) [1,2], which enables axial feeding and deposition of the metal material in the form of a powder [3] or a wire [4] into the center of the melt pool, is presented. Advantages of the deposition head and process with respect to the form of the metal material are discussed with emphasis on the stability of the wire deposition process. In the case of the wire, the annular laser beam DDH enables a simultaneous heating of the wire-end and workpiece surface in a predefined proportion, which has been shown to be an influential process parameter. In relation to this several laser wire deposition process initialization strategies with different initial wire-end positions were proposed and analyzed [4]. It was shown that transition into stable stationary wire deposition process is governed by the stability of the initially formed molten bond between the wire-end and the melt pool, which is influenced by precise synchronization of mutually dependent laser beam power, wire and workpiece feeding time profiles. Additionally, the laser beam workpiece irradiation proportion parameter, introduced to characterize the simultaneous heating of the wire-end and workpiece surface, was shown to be very influential for process stability and properties of the deposited metal layer.

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The Characteristics of Flow Field Inside Water Model of an Industrial Continuous Steel Caster

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The flow of molten steel in a mold during continuous casting process is nowadays most often studied using numerical approach [1-4]. Without any doubt, the experimental data on mold part of the casting process are of key importance as they provide an insight into flow behaviour (essential in the design phase of numerical models) and can be used to validate developed numerical tools. The latter motivated the development of a water model experimental system [5]. Numerous research groups have used water models to study the flow of liquid during continuous casting of steel in the past. Studies were related to different aspects of flow in the mold [6-10]. The behaviour of the primary jet as well as the secondary flow recirculation inside the caster has been experimentally investigated using 2D Particle Image Velocimetry. Measurements were conducted at several cut planes (locations) for a wide range of casting speeds. The influence of casting speed on general flow field around SEN are shown.

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Mechanical Properties and Ageing of Different Zirconia Ceramics for Monolithic Fixed Dental Prostheses

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Objective: The development of dental ceramics follows the introduction of new mainly computer-controlled dental laboratory technologies and new clinical indications. The aim of the study was to evaluate the performance of multi-unit posterior monolithic zirconia fixed dental prostheses (FDPs).
Methods: After a mean observation period of 39.8 ± 16.7 months a total of 20 patients received 33 monolithic posterior zirconia FDPs with minimally invasive preparations of the abutment teeth. Three to six unit FDPs were bilaterally supported, had uniform connector diameter of 9 mm^2 and were luted with resin-modified glass ionomer cement. Clinical evaluations were performed one week, 6 months and thereafter annually after completed treatment. Caries and periodontal status of the abutment teeth were evaluated by assessing pocket depth, attachment level, plaque control, bleeding on probing and tooth vitality. Aesthetic qualities and functional performance of FDPs were evaluated according to the rating scales represented by Cvar and Ryge. Using Kaplan-Meier survival analysis, survival rate was assessed.
Results: The survival rate of posterior multi-unit monolithic zirconia FDPs after a mean observation period of more than 3 years was 93.9 %. No chipping or debonding was observed, two FDPs had to be replaced, first due to an endodontic complication of the abutment teeth and second due to fracture in the connector area of five-unit maxillary FDP.
Conclusions: Considering short observation time, the monolithic zirconia FDPs are an appropriate treatment option for prosthetic rehabilitation in the posterior region of dental arches. If the integrity of the surface is well polished, intact and without microscopic surface defects, they exhibit excellent mechanical properties, good marginal stability and good clinical survival.
Keywords: zirconia; ceramics; monolithic; dentistry; fixed dental prostheses

Preparation and Investigation of High Entropy Alloys

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This study represents a part of research work performed within the project: '*HEAMODELL – High entropy alloys with predictable mechanical properties by computational modelling'.*

High entropy alloys (HEA) are new materials, considered a future alternative for conventional superalloys. HEAs are alloys having at least four major elements in 5-35 at. % concentration range. Many studies shows that these alloys often exhibit unusual properties, which could be useful for some industrial applications. The main goal is to develop a multi scale model for selection of HEA compositions with predictable mechanical and oxidation properties for targeted applications in aeronautical jet engines.

Preparation and investigation of newly developed HEAs are presented. The preliminary characterization of AlCrMnNbTiV alloys, selected as the potential HEA alloys due to the extensive thermodynamic calculations prepared by Thermo-Calc software, are analysed.

The HEA samples had been prepared by induction melting in cold copper mold and remelted. Typical sample size and mass was ~ 10 cm length, 1.5 cm diameter and 20 g, respectively. In order to investigate mechanical properties, the hardness measurements by Vickers with 1 kgf and 10 kgf load, was carried out. The chemical composition, crystallographic and microstructural analyses were also examined.

Depending on the goals of the project, technical requirements of HEA alloys and the achieved mechanical characterization it was concluded that the preliminary alloys fulfil the requirements for oxidation resistance, however they do not achieve the appropriate mechanical properties.

Effect of Hot-top and Mould Geometry on Macrosegregation in direct-chill and low-frequency electromagnetic casting of aluminium alloys

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A meshless numerical model has been developed for prediction of macrosegregation in direct-chill casting (DCC) and low-frequency electromagnetic casting (LFEC). The volume averaging method is used to implement the conservation equations for mass, momentum, energy, and species for the interpenetrating solid and liquid phase. The momentum conservation equation is affected by the Lorentz force. Thereby the melt flow is coupled with the electromagnetic field. The meshless diffuse approximate method is used to solve the induction and the conservation equations. The subdomains contain 14 computational nodes. The Gaussian weight function is used in the weighted least squares type of minimisation process. The explicit-Euler scheme is used for time stepping. The automatic adaptive generation of computational node arrangement decreases the calculation time and in a straightforward way enables generation of computational nodes for arbitrary shaped geometries. The effect of realistic inlet geometries of casting devices on the solidification process can thus be investigated with much less effort. The castings of round billets from aluminium alloys are investigated. Simulations are performed for the classic and for the electromagnetic DC casting. The aim is to estimate the inlet geometry effects on temperature, flow pattern and macrosegregation of round Al-5.25wt %Cu alloy billets with a 120 mm radius. The results include a comparison of sump shape and dimensions, temperature distribution, melt flow structure and magnitude, and macrosegregation pattern as a function of shape of the hot-top and mould.

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Behaviour of Human Osteoblast-Like Cells on Nanosecond Laser-Textured 316L Surfaces

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Considerable effort is being devoted to the surface engineering of biomaterials in order to improve and understand the material-cell interactions in various applications. Within this context, laser surface texturing presents an excellent alternative to other surface modification technologies, due to its flexibility, simplicity, precise control over the morphology and wettability of the modified surface, without affecting the properties of bulk material. **The main idea** of this study is to employ nanosecond Nd:YAG laser pulses at high fluences for texturing AISI 316L stainless steel aiming at improving and controlling material-cell interactions.

Scanning electron microscopy (SEM), X-ray diffraction (XPS), optical 3D surface measuring system and contact angle goniometer were employed for surface characterization of non-treated and laser-textured samples.

Results show that laser texturing greatly modifies surface morphology, topography, roughness, wetting properties, thickness and chemistry of the surface oxide layer.

Subsequently we studied the effect of laser-texturing on human osteoblast-like cells (MG63) and their behaviour *in vitro* after 1, 3 and 7 days of exposure using fluorescence (viable staining) microscopy, cell cytotoxicity assays (Resazurin, NRU and CBB assay) and SEM microscopy for cell distribution and morphology evaluations.

We observed higher number of attached viable cells on laser-textured surfaces in majority of samples. There was only one exception where surface exhibited cytotoxic effect already after 1 day, as seen by lower cell density (fluorescence and SEM microscopy) and by lower cell metabolic activity, the amount of cellular proteins and lysosomal integrity, based on cytotoxicity assessment test.

SEM microscopy proved to be a very good method to study subtitle difference among samples in cell-surface interactions in terms of cell distribution, orientation, cell surface morphology and cell shape. Nanosecond laser surface texturing presents flexible, simple and chemical free approach that can be applied to most metallic materials without affecting the properties of bulk material.

Improvement of Foamed Glass Production Sustainability with the Use of Hydrated Sodium Silicate

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Insulation materials have a strong impact on energy efficiency of buildings which are one of the main energy-consumers, representing 40 % of all consumed energy in EU. Improving the properties of thermal insulation materials and/or energy efficiency of their production process can therefore have a major impact on efficient energy-consumption.

Foamed glass (FG) is a thermal insulation material commercially produced in an energy-intensive process in order to obtain a product with good properties. Mixture of waste cathode-ray-tube-panel (CRT) glass, carbon and Mn_3O_4 results in a FG with appealing pore structure when direct-sintered in an inert atmosphere. The aim of this research is to transfer the process on related mixture to air atmosphere in order to produce FG with similar properties by a lower energy-intensive process. For the expansion to happen, premature reaction between carbon from foaming mixture and oxygen from air has to be prevented. Addition of water glass to the foaming mixture is a possible solution for the problem of premature reaction.

Effect of water glass on foaming process was investigated by measuring the pre- and post-reaction densities of the samples, hot-stage microscopy, thermal analysis (TA) coupled with mass spectrometer (MS) and gas chromatography (GC). Foaming mixtures contacting water glass and missing either carbon, Mn_3O_4 or both additives resulted in very similar densities, while a larger expansion was evidenced for the mixture containing all the additives, i.e. the density was up to 25 % lower. The increased content of water glass in the foaming mixture lead to a decrease in the density and an increase in the degree of open porosity.

The results indicate that water glass protects part of the carbon from low-temperature reaction with oxygen and thus promotes the high-temperature reaction with Mn_3O_4, leading to extensive expansion of FG. The addition of water glass therefore allows the transfer of the process to air atmosphere. However, pore structure of as prepared FG is moderately degenerated in comparison to FG prepared in an inert atmosphere. Structure of pores can be improved by further optimizing the process by adjusting the process parameters and the amount of additives.

Stability of Basalt Fibres Reinforcement in Alkali-Activated Systems

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Alkali-activated systems (AAS) are a suitable alternative to the Ordinary Portland cement (OPC). AAS has many favourable properties like earlier and higher initial mechanical strengths, lower hydration heat, better durability when exposed to high temperatures or aggressive environments in contrary to OPC.[1] Basalt fibres (BF) represent suitable reinforcing material for cementitious materials because of its mechanical and thermal properties same as a good price/properties' ratio. The essential issue limiting the possibility of using these fibres in the AAS is their stability and durability under a highly alkaline environment. There is a significant inconsistency across the publications in this case. Some of them[2] stated good stability while others like[3,4] reported low stability when exposed to alkaline solutions. Hence, the verification of BF stability in an environment simulating the AAS is fundamental to a successful implementation as reinforcement to the matrix. Accelerated leaching tests with the evaluation of loss of mass, loss of tensile strength as well as a chemical composition changes of the fibres and leaching solutions were done using various techniques XPS, SEM or ICP-OES. Noticeable loss of mass same as deterioration of tensile properties accompanied by simultaneous dissolution of the fibres was observed.

A high-quality adhesion between the fibres and the matrix and formation of the interfacial zone is necessary for the effective stress transfer realization beside the other factors like volumetric fibre fraction or fibres/fabric orientation and distribution.[5] The transition zone properties were studied using the SEM-EDX in this study. Poor or none adhesion between the BF and AAS matrix was found out.

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Feather-light, Cellulose-nanofiber-reinforced γ-Al_2O_3 Foams

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Ultralight ceramic materials with high porosity and high surface area are important in applications such as catalysis, thermal insulation and adsorption. There is a lot of incentive to employ simple and green processes for the preparation of highly porous, lightweight ceramic materials with large specific surface area, yet with no loss in mechanical strength and rigidity due to increase in porosity. Conventional processes for porosity introduction mostly encompass partial sintering, sacrificial fugitives, replica templates or direct foaming, and in some cases, even a combination of mentioned techniques.[1] However, most of these techniques require sintering, which has adverse effects on porosity and surface area.

In the present work, γ-Al_2O_3 ceramic foams with a hierarchical porosity and high specific surface area were prepared via freeze casting of aqueous suspensions containing mesocrystalline γ-Al_2O_3 2D nanosheet-like particles, hierarchically assembled into globular, micron-sized entities. For this purpose, abundant amounts of γ-Al_2O_3 powder were prepared by exploiting the AlN powder hydrolysis, followed by calcination.[2] As obtained powder was dispersed in water and the effects of dispersant, divalent cations and/or cellulose nanofibers (CNF) addition on the suspension stabilisation, rheological properties and freeze casting behaviour were studied in detail. The foams were analysed for pore size distribution, specific surface area, thermal conductivity and compressive strength.

As-prepared green bodies showed low relative densities (2.3-8.9 %) with hierarchical porosity, i.e., macropores (1-100μm) which were a consequence of ice growth during the freezing process, while mesopores (4-7 nm) originated from the mesocrystalline nature of the assembled nanosheets of the starting powder. Latter also contributed to the foams high surface areas (~160 m^2/g) and low thermal conductivities (0.08-0.18 W/mK). Addition of CNF fibres turned out to be not only beneficial in terms of improved porosities, since as produced foams were feather-light, but also gave rise to remarkable strengths and rigidness rarely seen in highly porous green bodies.

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Monitoring the Effect of Quartz Sand Replacement by amorphous Silicate Raw Material on the Microstructure of Calcium Silicate Composites

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Quartz sand is the main raw material for the production, of autoclaved calcium silicate composites. However, its resources are rapidly dwindling, and alternative siliceous raw materials need to be sought and tested for replacement. Most often they are raw materials containing amorphous silica. Amorphous silica is more readily soluble than crystalline silica, and thus may contribute to the formation of a superior microstructure of the calcium silicate composite through calcium hydrate phases. This paper is focused on determining the optimal replacement rate of amorphous silica raw material for crystalline silica sand, while describing changes in microstructure of calcium silicate composites. The replacement rate was graded to 0 %, 25 %, 50 %, 75 % and 100 %. Hydrothermal treatment conditions are based on the real production of autoclaved aerated concrete, so a temperature of 190 °C and an isothermal holding time of 7 hours was chosen. To study the effect of the ratio of raw materials on microstructure, X-ray diffraction analysis supported by scanning electron microscopy images was used.

Titanium Nanostructures for Modification of Vessel Stents

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Titanium and titanium alloys exhibit a unique combination of strength and biocompatibility, which enables their use in medical applications and accounts for their extensive use as implant materials. In cardiovascular applications, titanium stents are commonly employed to enlarge the lumen wall and to restore blood flow through the affected blood vessel. Although titanium alloys are extensively used for stent application they still lack desired biological responses. Namely, mostly due to restenosis. Therefore the long term success of stent implantation depends mainly on avoiding the aggregation of platelets as well as on appropriate proliferation of endothelial cells and controlled proliferation of smooth muscle cells. The presented work provides an elegant solution for prevention of platelet and smooth muscle cell adhesion and activation on stent surfaces, while obtaining surface conditions to support the growth of human coronary artery endothelial cells. This was achieved by surface nanostructuring and chemical activation of the surface. Specific nanostructured surfaces of titanium were obtained by electrochemical anodization, while appropriate chemical properties were attained by treatment of titanium oxide nanotubes by highly reactive oxygen plasma. Our results show that a combination of nanostructuring and plasma modification of the surfaces is an effective way to achieve desired biological responses necessary for implantable materials, such as stents.

Characterization Of New Recycled Polymer Shots Addition On Mechanical Strength Of Concrete

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This work summarized the experimental results of modified concrete samples by recycled polymer shots. The amount of polymer shots were equal: 5, 10, 15 wt. % of cement amount. The main purpose of this research was to characterize the final mechanical strength of concrete samples and investigate the basic physio-chemical properties of new fabricated concrete. The concrete mixtures were prepared using new laboratory calculated recipe with polymer shots, basalt as an aggregate, deflocculant based on polycarboxylates and portland cement (42,5 MPa). After 28 days mechanical properties such as compressive strength and bending strength have been characterized. The initial and final binding time were determined. SEM micrographs, LM photo were done. Thermal conductivity was also measured. Additionally the thingness test was investigated. Presented research shows that the tested samples containing polymer shots exhibit lower mechanical properties than samples without modifications. In compression with reference sample rest of the investigated properties are higher. These kind of concrete are very perspective for application in civil engineering in special building construction in future.

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Grit-Blasted Surfaces of Ti6Al7Nb Alloy Cementless HIP Endoprostheses

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Background: The premature failure of cementless hip endoprostheses can be caused by wear-particle-induced aseptic loosening. To enhance the osteointegration of cementless titanium hip implants numerous techniques have been developed to increase the surface roughness. The most widespread mechanical method for surface roughening is blasting using highly purified corundum. The aim of our studies was to investigate the effect of particulate debris from a corundum-blasted titanium implant alloy on the mechanical instability of the joint, on pain increases with detrimental biologic responses, on osteolysis, component loosening and premature implant failure, and to find the optimal grit-blasted surface.
Materials and Methods: The forty Ti6Al7Nb alloy samples were prepared from retrieved femoral stems as a substrate with a polished surface as the starting point for the application of different roughening procedures (blasting material such as SiC, corundum Al_2O_3, optimal blasting conditions in terms of pressure, time and cleaning of the blasted surface using different methods and also an oxygen plasma gaseous treatment) at FerroČrtalič, a leading company for surface-treatment technologies. The surface wettability, surface roughness, surface chemistry and microstructure, using static water-angle contact measurements and scanning electron microscopy with energy-dispersive x-ray spectroscopy were investigated.
Results: On the surface and near the surface of the retrieved and new femoral stems the corundum contamination was found. We used different corundum granulation with the purpose to achieve the 4–8-µm surface roughness and to avoid corundum contamination near the surface. The results of the optimal roughening procedure will be presented. Soft tissue near the femoral hip endoprosthesis obtained during the revision surgery of some patients contains corundum particles.
Conclusion: Corundum particles can cause wear-particles-induced aseptic loosening. The optimal grit-blasting surface modification by highly purified corundum as well as cleaning of the residual corundum on the surface must be achieved to avoid aseptic loosening of the hip endoprostheses.

Sonication for Orthopaedic Implant-Associated Infection Diagnostics – Solution or Complication?

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Orthopaedic implant-associated infections are a major complication of primary arthroplasty or fracture fixation surgery. Traditionally, microbiologic diagnostics relied on multiple (3-5) periprosthetic tissue cultures for isolation of causative agents. However, this procedure was lacking sensitivity and relied on good sampling technique. Furthermore, it was difficult to process explanted orthopaedic material such as prosthesis or fixation devices in a microbiological laboratory due to its physical characteristics.

Sonication of explanted material, a procedure in which an explanted material is aseptically transferred to a sterile container, submerged into sterile solution (i.e. saline or Ringer) and sonicated with a low energy ultrasound waves to dislodge biofilm-associated bacteria was a major advancement in microbiologic diagnostics of these infections. First and many subsequent reports showed a significant increase in both sensitivity and specificity of PJI diagnostics. In addition, the method was more suitable for liquid-based culture diagnostic, now popular in microbiologic laboratories.

More than 20 years after the first publication of removed prosthesis sonication by Tunney et al. (1) and more than 10 years after the seminal paper from Trampuz et al. (2), we look at the adoption of sonication as a method in clinical microbiology laboratories and review the latest literature with respect to comparison of sonication to other diagnostic methods. Finally, we discuss the major strengths and limitations of the method in everyday clinical practice and reflecting our local results and experiences.

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Deep Cryogenic Treatment of High Speed Steels M2, M3:2 and M35

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A systematical approach in deep cryogenic treatment (DCT) was implemented on the high-speed steels (HSS) *M2, M3:2* and *M35*, which are one of the most commonly used HSS in tool industry. DCT is a process, where a material is subjected to temperatures below -160 °C, normally to temperatures of liquid nitrogen (-196 °C) or liquid helium (-269 °C)[1–4]. DCT treatment induces changes in properties and microstructure, which are promoted due to movement of dislocations, formation of new grains, alteration of crystal structure, changes in grain size, change of solubility of atoms and new phase formation. The performance of HSS tools is strongly reliant on the selection of chemical composition, accurate design, tool manufacturing accuracy and application of appropriate heat treatment – DCT[4]. DCT changes properties of HSS by increasing hardness, toughness, corrosion and wear resistance, as well as reducing density of defects in crystal structure[5,6] etc. This study was focused on the changes of mechanical and tribological properties by implementing DCT and comparing these to conventional treatments with respect to the HSS chemical composition (main alloying elements) and basic heat treatment parameters (austenitizing and tempering temperature) when combined with the application of DCT. Study also provides well predefined systematical approach to DCT of HSS.

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Deep Cryogenic Treatment of High Speed Steels

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In this study, a systematical approach in deep cryogenic treatment (DCT) is implemented onto selected high speed steels (HSS) *M2, M3:2* and *M35*, which are one of the most commonly used HSS in tool industry. HSS are commonly used for broaches, drills, milling cutters, tool bits, gear cutters, saw blades, jointer and planer blades, punches, etc.[1,2]. The special type of cryogenic treatment DCT is a process, where material is subjected to temperatures below -150 °C, normally to temperatures of liquid nitrogen (-196 °C)[3–6]. Sub-zero treatment causes changes in microstructure, which are induced due to formation of new grains, movement of dislocations, changes in grain size, alteration of crystal structure, change of solubility of atoms, and lastly new phase formation. The performance of HSS and later of produced tools are dependent on the selection of chemical composition, proper design, tool manufacturing accuracy and application of proper heat treatment, including DCT[6]. It is expected, that DCT of HSS reduces density of defects in crystal structure and tensile strength, increases hardness and wear resistance of HSS as well as improves its toughness, wear resistance and corrosion resistance[7,8]. This research focuses on the analysis and understanding of these induced changes with respect to the HSS chemical composition (main alloying elements) and basic heat treatment parameters (austenitizing and tempering temperature) when combined with DCT. With this, the research provides well defined systematical approach study dealing with DCT of HSS.

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High Sensitive Magnetoelectric Composite Sensors for Biomagnetic Field Sensing Applications

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The diagnostics of biomagnetic fields has developed in the last years allowing detection of magnetic fields in the range of few fT/√Hz in the low frequency regime [1]. Such fields can be detected with SQUID sensors that are considered as a gold standard for biomagnetic measurements. However, such measurement devices are large, expensive and unpractical, as they require cooling with liquid nitrogen. For this reason, new sensors are being developed, that allow detection of biomagnetic signals without the previously mentioned limitations. One type of such sensors are composite magnetoelectric sensors. These sensors are constructed from a piezoelectric and a magnetostrictive material bounded together with a substrate allowing the transformation of magnetic field signals into voltage signals. The sensors output is enhanced by designing them in a cantilever form and utilizing the mechanical resonance of it by six orders of magnitude [2]. To make the sensors flexible in terms of frequency readout, a special technique called magnetic frequency conversion (MFC) [2] is used. For MFC a second magnetic signal is applied to modulate the biomagnetic signal, with the frequency set to the difference between the resonance frequency and frequency of the biomagnetic signal. By mixing the two signals, the ending signal is formed, that falls in the resonance frequency of the sensor, leading to the enhanced output and readout of the biomagnetic signal. Within this research, several modifications have been made to increase the sensitivity of the sensors. One of the newest and crucial improvement was done by implementing a special magnetic structure called antiparallel exchange bias (APEB) as the magnetic phase. The new structure allows the suppression of the magnetic noise that was previously plaguing these sensors [4]. With the improved sensors, a limit of detection of 50 pT/√Hz at 10 Hz could be reached. The sensors also indicate for the first time a limitation of the noise level due to thermomechanical noise with the MFC technique. The new APEB structure has opened many opportunities for further advancement of the sensors towards producing highly sensitive, ultra-low noise biomagnetic sensors.

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Ferrite-based Magnets Consolidated by Spark Plasma Sintering: towards Rare-Earth-Free Magnets For Energy Storage

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The intensive research of ferrite-based ceramic permanent magnets has again been revived, due to the so-called rare-earth crisis. [1, 2] In particular, a quest to enhance ferrites' energy product (BH_{max}), is still underway. Large BH_{max} values are found in magnets combining substantial magnetisation at remanence (M_R) with high coercivity. Both parameters are influenced by materials properties, such as crystalline and shape anisotropy and particle' size.

Here, the influence of composition, particle size, sintering conditions and exposure to the external magnetic field before compaction on microstructure and consequently magnetic properties of strontium ferrite (SFO)-based hybrid composites will be presented.

Powders' mixtures of commercial SFO powder consisting of micron-sized, isotropic particles, or alternatively hydrothermally (HT) synthesised SFO with hexagonally-shaped platelets with a diameter of 1 □m and thickness up to 100 nm, and a soft magnetic phase, with high magnetization, in various ratios were sintered with Spark Plasma Sintering (SPS) furnace. Starting powders and hybrid magnets were examined by means of phase composition (XRD) and microstructure (TEM, SEM). Their magnetic properties were evaluated with vibrating sample magnetometer and permeameter.

Depending on the concentration and composition of the soft phase the M_R of the composite can be altered. Application of external magnetic field before the consolidation induces the anisotropy in commercial, and HT synthesised SFO, leading to the increase in the M_R of hybrid magnets. Moreover, sintering with SPS promotes the alignment of HT synthesised SFO particles in the axial direction of the applied pressure, which is also the direction of SFOs' easy axis and thus the enhancement in M_R is perceived leading to the M_R/M_S higher than 0.7. Besides, after SPS almost no grain growth was observed, which is beneficial for exploiting advantages of nanosized-induced phenomena also in bulk sintered samples.

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Microstructural Changes in High-Alloyed Iron Alloys by Sub-zero Treatments

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Recent investigations revealed and confirmed that sub-zero treated ledeburitic steels differ from those after room temperature quenching in four key aspects: i) They contain considerably reduced retained austenite amounts, ii) The martensite of sub-zero treated materials is refined as compared with that generated by room temperature quenching, iii) Significantly enhanced number of small carbides (size 100 – 500 nm) is generated by sub-zero treatments, iv) accelerated precipitation rate of nano-sized carbides, resulting from sub-zero treatments was evidenced.
The obtained results imply that the extent of these microstructural changes depends on the temperature and duration of sub-zero treatments, and that it is also material-dependent. The obtained results imply that the extent of these microstructural changes depends on the temperature and duration of sub-zero treatments, and that it is also material-dependent, i.e. the response of various steel grades on this kind of treatment differ considerably one from each others. A comprehensive overview of impact of sub-zero treatments on microstructural characteristics of various high-carbon and high-alloyed steels is the main topic of the current paper.

Nano-Indentation Measurements on the $AlCoCrFeNi_{2.1}$ CCA as a Function of Chemistry and Grain Orientation

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The purpose of the present study is to apply Nano-indentation as a method for evaluation of mechanical behavior of two chemically and structurally different phases in the eutectic $AlCoCrFeNi_{2.1}$ complex concentrated alloy (CCA) as a function of grain orientation. The alloy having a microstructure of alternating soft FCC ($L1_2$) and hard BCC (B2) phases was produced by vacuum induction melting and ingot casting. Instrumented Nano-indentation using the Berkovich indenter in the Anton Paar Micro Combi Tester (MCT^3)[1] and applying the Oliver-Pharr method[2] according to the standards ISO 14577 and ASTM E2546 was applied on a polished sample. The maximum load of 4 mN was kept for 1 s before unloading at a rate of 24 mN/min – the same as the loading rate. For a better statistics, a total of 400 indentations were performed in form of a matrix with dimensions 20 x 20 indentations and the spacing between indentations of 5 μm. Afterwards, EDS and EBSD analyses were performed at each indentation position in order to determine the chemical composition and lattice orientation, respectively, and correlate the latter two with the results from the Nano-indentation.

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Effect of Amino Alcohol Admixtures in Alkali-Activated Materials

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One of the most important technological problems associated with the alkali-activated materials (AAM) is the high shrinkage. The possible solution how to decrease the extensive drying shrinkage of these materials is the use of shrinkage reducing admixtures (SRA). The promising group of SRA, from the perspective of using in AAM, represents amino alcohols. However, the efficiency to reduce drying shrinkage strongly depends on their chemical structure. The study is consequently focused on the molecular architecture of amino alcohol surfactants in relation to the affected properties of alkali-activated blast furnace slag systems. Selected amino alcohols were tested in terms of the ability to reduce the surface tension of pore solution as well as to influence the drying shrinkage, hydration mechanism and mechanical properties of AAM. The study confirms that the length and branching of alkyl chain connected to the amino group play the key role of SRA efficiency. Amino alcohol surfactants with high-carbon alkyl chain decreased dramatically both surface tension and drying shrinkage, but simultaneously negatively affected the mechanical properties. Conversely, the 0.5 wt. % addition of the surfactants with a low molecular weight such as 2-(Methylamino)ethanol showed the slight improvement in flexural and compressive strength after 7 and 28 days. At the same time, the observed drying shrinkage was reduced by 30 % compared to the reference sample.

Hyperelastic Material Characterization: A Comparison between Material Constants

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Data fitting is an essential part of the process of obtaining material constants for the hyperelestic models. However, due to inadequate experimental data, single data set, i.e. uniaxial data, is often used for fitting. Despite frequent use of the method, it is proven that this effort provides an inaccurate forecast for the characterization. Therefore, as an alternative method, combined data fitting s recommended.
In this research work, the of results of taking average of constant values after separately fitting uniaxial data and biaxial data are compared with the material constants obtained through combined data fitting. Objective of this work is to investigate the superiority of combined data fitting against the average of individual data set fitted constant values. For the examination, three models, Mooney 2, Moony 3, Ogden and Yeoh were selected. Data collected through laboratory experiments for uniaxial data and biaxial data are used in fitting efforts.

Surface Wettability, Topography and Bioactivity of TiO_2/Epoxy Coatings on AISI 316L Stainless Steel

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Improved cell attachment and resistance to bacterial adhesion are two critical features for an effective biomaterial design. The appropriate surface modification of the substrate is therefore crucial for desirable biological response. We prepared two sets of sandwich structured coatings on the AISI 316L substrate with as-received TiO_2 nanoparticles and fluoroalkylsilane ($C_{16}H_{19}F_{17}O_3Si$, FAS) functionalized TiO_2 nanoparticles with the aim to improve biocompatibility and antibacterial properties. Contact angle measurements were used to evaluate wetting properties the coatings. Epoxy and epoxy/TiO_2/epoxy coatings were hydrophilic compared to strongly hydrophobic epoxy/FAS-TiO_2/epoxy coating. The average surface roughness of epoxy/FAS-TiO_2/epoxy coating was higher compared to the epoxy/TiO_2/epoxy coating due to the formation of agglomerates. The biocompatibility evaluation revealed that the cell attachment was significantly higher on epoxy/FAS-TiO_2/epoxy and epoxy/TiO_2/epoxy coatings compared to pure epoxy coating. We also observed improved antibacterial properties of epoxy coatings with the addition of both, as-received and functionalized nanoparticles.

Electrochemical Industrial Testing of Painted Aluminum Alloys to Determine Corrosion Susceptibility

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This work describes industrial electrochemical testing of painted aluminum alloy sheets. The following electrochemical techniques were employed: chronopotentiometry, electrochemical impedance spectroscopy, and cyclic polarization curve measurements. A series of 37 measurements were carried out for each test. Chronopotentiometry measurements were performed from the moment of the sample immersion, in between electrochemical impedance spectroscopy measurements, until the start of the cyclic polarization curve measurements. This technique served to determine corrosion potential and galvanic action of a material in case of materials coupling. Electrochemical impedance spectroscopy was employed to determine corrosion mechanisms of different painted aluminum alloys and to determine polarization resistance values – an indication how the metallic material is resisting in transferring electron to the electroactive species in solution. Cyclic polarization technique served to evaluate localized corrosion action in terms of pitting and crevice corrosion. Furthermore, the repassivation ability was checked.
In general, electrochemical measurements showed that all the tested samples were highly resistant to corrosion in 5 wt. % NaCl solution.

High Temperature and Corrosion Properties of New Developed Fe-Al-O based OPH Alloy

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Fe-Al-O based materials are nowadays under lots of development because of their number of special properties. However, lack of strength at high temperatures, limited ductility at ambient temperatures and corrosion resistance are so far has hindered any wider application of these materials. Recently, a new Fe-Al oxide precipitation hardened (OPH) steel was developed by the Authors to improve the mechanical properties and oxidation resistant. The new OPH alloy developed by dissolving a specific amount of oxygen in the matrix while the components were preparing by mechanical alloying which let the fine dispersion of Aluminium oxides precipitate during hot consolidation. A series of tests were performed to evaluate the thermomechanical properties and corrosion resistance under 3.5 % NaCl solution. The results show that the corrosion resistance as well as mechanical properties improved while the production of such material has lower cost compare to traditional ones.
Keywords: OPH, Corrosion, Oxidation, Microstructure, Fe-Al-O

New Micro- and Nanostructured Biomaterial Surfaces based on Colloidal Crystals

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Complex colloidal crystals are a promising material that is attracting interest in the areas of photonic band gap devices, electronics, displays, chemical sensors and biosensors, and biomaterials and tissue engineering. One of the challenges with decorating surfaces with colloidal crystals is to create ordered structures over large surface areas (cm^2). This presentation will discuss how using controlled solvent evaporation it is possible to surface engineer new types of patterns and structures on surfaces with a range of colloids of different size, chemistry and shape. Precise spatial control of chemistry on surfaces provides an essential platform for the directed attachment of bioactive molecules and control over cell and bacterial attachment and growth. In addition, the crystal layers can be used as masks against deposition of plasma polymers and/or metals such as gold to create complex patterns of dimensions ranging from ms to sub 100 nms and are useful for post-modification with different chemistries for site-specific immobilisation of biomolecules. This includes using chemistries for preventing non-specific adsorption of proteins and attachment of cells, including new ways of generating high graft density polymer brushes. Also we demonstrate that the colloidal crystals can be sued to selectively graft cell adhesive or antimicrobial peptides that enhance the growth of mammalian cells or kill bacteria respectively. In terms of mammalian cells we are targeting using colloidal crystals to direct stem cell fate in specific cell types and even using them the generate induced pluripotent stem cells (iPSCs) from somatic cells such as fibroblasts. The presentation will also demonstrate the importance of using surface sensitive analytical tools to prove the presence of the different surface chemistries. These include x-ray photoelectron spectroscopy (XPS), SEM, and high resolution time-of-flight secondary mass spectrometry (ToF-SIMS) imaging. Finally, the presentation will provide details of cell and bacterial attachment results to polymers and biopolymer surfaces where the properties have a profound effect on the responses. The potential of these new materials in biointerface science is discussed.

Effect of Microsegregation on the Material Response against Abrasion and Impact Wear – Boron Low Alloyed Steels

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Special wear resistant steels are essential in applications with extreme abrasion conditions. They are normally produced by continuous casting process (CC). Casted slabs with casting history and related (internal) quality are then hot rolled into heavy plates of desired thickness and heat treated to gain the final properties. This paper focuses on the casting part where the solidification interval of boron steels is studied. The target is overall finer and consistent plate microstructure for consistent and improved wear performance. This can be achieved by adapting correct chemical composition, production route as also by controlling the intensity of alloy segregations in the slab. One of the key parameters is the maximum allowed superheat before casting. This can be controlled by knowing the exact liquidus temperature of steel grade. Additional, the cooling regime can be adopted by knowing the correct solidus temperature. Alloy segregations observed in plates of higher thicknesses can be intensified by increased mould geometry to satisfy the total reduction ratio for final plate thickness. Segregations influence the final transformed microstructures by affecting the strain hardening kinetics and static recrystallization by hot rolling and the final hardness and through wear performance.
Wear performance was studied on the samples of selected chemical composition in relation to final microstructure.
Key words: Abrasion, Impact, DTA, Solidification, Thermodynamic calculation

Electrochemical Deposition of Ni in LC TEM

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Liquid cell (LC) transmission electron microscopy (TEM) has attracted significant interest in recent years because of the need to understand the dynamical processes taking place at solid/liquid interface during the electrochemical processes. The ex-situ and in-situ results showed that dendritic growth of many metals from the solutions is possible using the electrochemical LC (1–3). In our work we focused on electrochemical nucleation and growth of Ni in the LC TEM. The experiments were carried out in a commercial LC holder by Protochips Inc. in Jeol JEM-2100, operated at 200 kV. 1 mM $NiSO_4$ in distilled water was encapsulated in the holder with a static spacer of 50 nm. Depending on the applied potential (in the range from –0.2 mV to –1.5 mV) vs working electrode we were able to deposit Ni (Figure 1a,b) at the working electrode. However, at higher electron beam dose, the nucleation of Ni nanoparticles occurred also from the solution due to highly active radicals which are formed as a consequence of radiolysis of the water due to high energy electrons (Figure 1c). In order to fully understand the mechanism of electrochemical deposition of metals from solutions, one should be able to explain the competing contribution to nucleation and growth due to electrochemistry and radiolysis in a LC TEM.

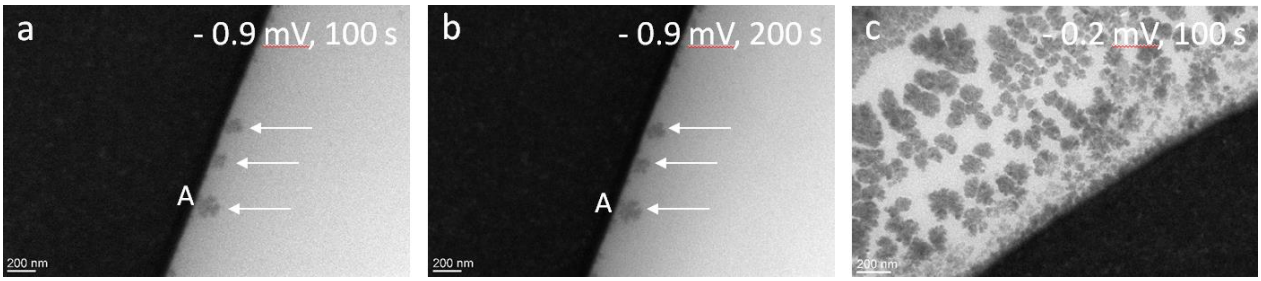

Figure 1: (a,b) BF TEM micrographs of Ni deposits at applied potential of -0.9 mV after 100 s and 200 s at low electron beam dose. Ni deposits are clearly observed at the electrode/liquid interface. (c) Nucleation of Ni nanoparticles from the solution due to radiolysis of the water at high dose of electron beam.

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Comparison of the WAAM and SLS Additive Manufacturing of Maraging Steel

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The paper presents a comparison of the SLS and WAAM additive manufacturing of 18 % Ni maraging steel. Due to the specificity of the processes, the produced microstructure of the material in as built condition is much different. Consequently, this is reflected in mechanical properties of additively manufactured product in as-build condition. To improve mechanical properties a heat treatment is used, which is much different for the particular additive manufacturing process due to different heat input. With both processes a set of samples was build. For WAAM a welding robot and MIG-CMT was used. Samples made with both technologies were heat treated. A mechanical tests and metallographic analysis was done in as-build and in heat treated condition and results were compared. The proper heat treated enables a homogenisation of microstructure and improves the strength and hardness, and toughness of samples, compared to samples in as-build condition. The mechanical properties of both additive manufacturing processes in heat treated condition are similar.

New Method to Evaluate Long Term Results Of Perthes Disease

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Background: An assessment of the long-term results of Legg-Calvé-Perthes disease is important for two reasons. The first is because of the risk that affected hips may develop osteoarthritis later in life, and the second is the determination of the prognostic criteria of hips at the time of disease and at skeletal maturity which could predict that risk. There are few long-term studies because of the difficulties in finding these patients after a prolonged period.
Methods: In order to study the effect of hip and pelvis geometry on development of the hip after Legg-Calvé-Perthes disease, we determined the resultant hip force and contact hip stress distribution in a population of 135 adult hips of patients who had been treated for Legg-Calvé-Perthes disease in childhood. Contra-lateral hips with no record of disease were taken as the control population. Biomechanical parameters were determined with two mathematical models: the model for resultant hip force in one-legged stance, and the model for contact hip stress. These models which constitute the method HIPSTRESS use as an input the geometrical parameters assessed from standard anteroposterior radiographs. We also compared clinical and radiological data of 66 conservatively and 113 operatively treated hips at the beginning of the disease and at the last follow- up.
Results: Hips that were subject to Legg-Calvé-Perthes disease in childhood had in adulthood considerably (25 %) and statistically significantly ($p < 10^{-8}$) larger femoral heads, and considerably (21 %) and statistically significantly ($p < 10^{-8}$) smaller Wiberg centre-edge angles. There was no difference in resultant hip force and in peak contact hip stress between the test and the control populations, but there was a considerable (148 %) and statistically significant ($p < 10^{-8}$) difference in the contact hip stress gradient index, expressing an unfavourable (steep) decrease of contact stress at the lateral acetabular rim. Most of the 179 treated hips belonged to men (83 %), who were treated between ages 2.3 and 17.6, the average time to follow- up was 25.8 years. For the conservatively treated patients Catterall and Herring scores were significantly lower at the time of the disease ($p < 0.01$, p < 10-4), while at the follow-up Stulberg score was significantly lower ($p < 10^{-4}$) and HHS (Harris Hip Score) higher ($p= 4 \times 10^{-6}$), whereas the difference in Kellgren – Lawrence score was not significant. This suggests a comparably good outcome for operatively treated patients, with both groups having a good average HHS and ROM (Range Of Motion).
Conclusion: Our findings indicate an increased risk of early coxarthritis in hips which are subject to Legg-Calvé-Perthes disease, and support the suggested role of hip stress distribution in development of the hip bones. Patients in our series are doing fine in the third decade after the treatment of Legg-Calvé-Perthes disease, results of our series are comparable with the ones published in the literature. HIPSTRESS method was successfully introduced as a novel method for predicting long term results of Perthes disease.

Contemporary Digital Technology for Post and Core Fabrication: a Pilot Study Measuring Cement Thickness

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Background. Fabrication of a custom cast metallic post and core with direct technique is an established clinical procedure for the treatment of endodontically treated teeth with extensive loss of hard dental tissue. Nowadays computer-assisted digital CAD/CAM technologies can be used in fabrication of post and core. Digital techniques shorten the necessary clinical and laboratory procedures and make fabrication easier, quicker and accurate.
Methods. Intact extracted single-rooted permanent maxillary incisors were used. For each tooth one metal post was fabricated with digital technique using SLM fabrication technology (group A) or one by casting (group B). All the posts were cemented with zinc phosphate cement. All teeth were sliced perpendicular to the axis of the post. The thickness of the cement layer was measured with an optical microscope with 60x and 100x magnification lens. The average cement thickness was compared between both groups.
Results. The average cement thickness for group A was 36.76 ± 17.29 µm in cross-section 1 62.38 ± 15.24 µm in cross section 2 129.42 ± 38.37 µm in cross-section 3 and 142.76 ± 36.35 µm in cross section 4. For group B the average cement thickness was 18,18 ± 4,6 µm in cross-section 1,. 15.36 ± 5.41 µm in cross-section 2 25.41 ± 13.42 µm in cross section 3 and 23.69 ± 13.44 µm in cross section 4.

Effect of “Gypsum-like” Powder Characteristics on Elements Fabricated via Binder Jetting Additive Manufacturing

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Layering or additive manufacturing (3D printing) is a rapidly expanding research field in material science, which offers almost unimaginable opportunities in the development of advanced materials [1-3]. The advantages of this technology is in terms of high product added value because it is efficient, economical and scalable, allowing manufacturing production of the final products, in addition to being environmentally-friendly by generating little to no waste [4]. Using such layer-by-layer technology, elements are fabricated by means of specialized digital geometric models, where the powder-based process creates layers by printing liquid binder on the powder base material. Nowadays, commercially available powders for binder jetting are based on calcium sulphate (“gypsum-like”) and used for different purposes. In order to utilise a by-product, such as calcium sulphate dihydrate (gypsum), a sufficient level of fundamental knowledge is needed about the mineralogical, chemical and physical properties of the powders, as well as further hydration and dehydration reactions, binding mechanisms, and the properties of the fabricated elements.

This study aims to experimentally investigate the effect of the “gypsum-like” powder material characteristics on the elements fabricated via binder jetting additive manufacturing. Firstly, understanding the characteristics of commercially available powders for binder jetting, and secondly it is crucial to characterize synthetic gypsum, as an industrial by-product, for improving accuracy, material compatibility and the mechanical properties of latter printed elements. Several experimental techniques were used for the determination of the morphology and microstructural properties, specific surface area, chemical and mineral composition of the powder materials. The results suggested that the significant role and final effect on the deposition process has morphological characteristics, especially particle size, shape and size distribution.

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Effect of Deformation Ratio on Texture Development in Hot-Deformed Nd-Fe-B Magnets

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Green technologies are vital for preserving and maintaining sustainable environment via wind turbines, electric vehicles and electric generators [1]. For such applications, Nd-Fe-B magnets are the most suitable choice due to their high energy product, $(BH)_{max}$. The largest $(BH)_{max}$ value of 433 kJ/m^3 was reported for high-performance anisotropic hot-deformed (HD) Nd-Fe-B magnet [2]. Among several options to produce HD magnets, spark plasma sintering (SPS) process is one of the promising. Mainly due to use of low temperatures and short processing times. Note that both parameters are crucial for hindering the grain growth, which would eventually lead to reduced coercivity [3].
We studied the detailed mechanism of initial stages of deformation process in SPS. HD magnets were prepared in two stages as usually. In the first step, the hot-pressed (HP) magnet was prepared from critical heavy rare-earth (HRE)-free melt-spun ribbons to achieve fully dense magnet. In the second step, the HP magnet was plastically deformed at rather low pressure (40 MPa) and with different deformation ratios. The latter determines the percentage of the anisotropic alignment of $Nd_2Fe_{14}B$ grains along the pressing directions. Strong texturing of the $Nd_2Fe_{14}B$ grains lead to increased remanence and consequently to higher $(BH)_{max}$, which was proved by preparation of HD magnets with different deformation ratios. Furthermore, the simulations of hysteresis behaviour of HD magnets with different deformation ratios were calculated based on Stoner-Wohlfarth model.

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Spectroscopic STEM Imaging in 2D and 3D

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Atomic-resolution imaging with a spherical aberration-corrected scanning transmission electron microscope (STEM) is now widely used for the study of interesting, complex material systems. This is owed both to the flexibility in detecting the electrons scattered off from matter, but also to the improved efficiency in collecting spectroscopic signals. High-angle annular dark-field imaging is routine and has become a quantitative technique [1]. Developments like high-brightness guns and monochromators, improved electron energy-loss spectrometers (EELS) or X-ray (EDXS) detector concepts, have enabled elemental-specific imaging at that scale, and allow for a correlation of structural and chemical information [2,3,4]. The simultaneous collection of all these signals at various tilt angles even, defining the technique of STEM-EELS/EDXS tomography, has given unprecedented insight into the 2D and 3D structural and physico-chemical make-up of TEM specimens [5,6,7,8]. While the principal acquisition of large multi-modal data sets has become more straightforward, the data processing and the interpretation of the spectroscopic intensities now appear rather challenging.

For 2D, classical compositional analysis with core-loss EELS and EDXS signals, when executed accurately, still suffers from a multitude of ill-defined parameters and intensity conversions into concentrations for a particular quantification scheme often rely on “best-guess” quantities, such as sample densities, absolute thicknesses, theoretical ionization cross-sections, solid and take-off angles etc [9]. A recently described analysis concept tries connecting EDX and EELS signals in a common analysis framework helping to reduce the need for estimates [10, 11]. Secondly, the complex physics of scattering of the electron probe along aligned atomic columns produces a nonlinear relation between signal and composition and there is no longer a simple relationship between the observed analytical intensities from the projected atomic positions. Different approaches to recover the true concentrations from inelastic images, taken under strong channeling conditions, have been proposed [12,13,14]. Often image simulations and a calculation of the underlying scattering dynamics are required to “correct” the experiment. Alternatively, acquisition schemes to reduce the effects of channeling by tilting or precessing the beam [15] have been suggested.

When going to 3D tomography, linking two or more signals in the reconstruction is even more challenging. By introducing different variational norms and penalty terms for correlated reconstructions, our recently introduced total generalized variation (TGV) approach seems to deliver the most faithful 3D chemical phase reconstructions from unsharp interfaces [16]. Also for monochromated low-loss EELS tomography, some of the early issues in mapping and interpreting the evanescent fields of particle plasmons could be overcome [17,18,19,20,21], and recently, a novel tomography scheme lifted some of the restrictive conditions to compute the photonic local density of states, an important quantity in nano-optics [22,23,24].

Overall, the STEM represents a quantitative instrument which is capable of providing numerical data on the properties of thin specimens. The talk aims to give an overview to spectroscopic imaging in 2D and 3D and its challenges in the mentioned areas.

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Application of Secondary Ion Mass Spectrometry ToF-SIMS Technique for Chemical Analyses of Surfaces and Thin Films

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Over the years many different techniques have been developed to analyses different aspects of the surfaces and ultra-thin films. Among them Secondary ion mass spectrometry – ToF SIMS, X-ray photoelectron spectroscopy-XPS or ESCA and Auger electron spectroscopy – AES are the most widely used surface analysis techniques. All three techniques are available in our laboratory for characterization of surfaces, thin films and nanostructures with very high surface sensitivity (1-5 nm). Secondary ion mass spectrometry – SIMS, is a very sensitive technique analysing ionized molecules and atoms, which are emitted in vacuum when a surface is bombarded by focused energetic primary ions. SIMS technique provides information on chemical and molecular composition of surfaces and thin films. Sensitivity of the technique is in ppm range, it is possible to detect hydrogen and isotopes of different elements. It is particularly suitable for characterization of surfaces of organic materials. From the acquired mass spectra it is possible to identify a type of molecules present on the surface. Scanning the highly focused ion beam allows chemical imaging of surfaces and preparation of two dimensional maps of elements and molecules on the surface with lateral resolution of 60 nm. In combination with an additional ion beam for sputtering it is possible to remove surface layer and analyses depth distribution of elements and molecules in subsurface region what is particularly useful for analysis of thin films and coatings. In this way three dimensional 3D distribution of elements and molecules can be obtained.
In this presentation some examples of ToF-SIMS surface analyses of contamination on organic materials, corrosion protective coatings, thin organic coatings, medical materials as well as depth profiling of thin film structures will be presented.

Determination of Minimal Required Depth of Milling Needed for Obtaining the Desired Surface Quality in Machining of Multi-Layer Metal Materials

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Machining of multi-layer metal materials is an important manufacturing activity in sheet-metal forming tools making industry. Process to make these advanced and difficult to cut materials is laser engineered net shaping (LENS). It uses a laser to melt metal powders into structures layer by layer, based on developed CAD model. Despite the very good achievement of laser cladding regarding surface roughness and surface corrugation, it is still necessary to after-machine the deposited layers by employing grinding processes. The grinding process is time consuming, therefore in this study the grinding is replaced with end-milling. The first goal of this study was to determine the influence of LENS machine parameters on the resulting roughness of the produced surface. The second, main goal of this study was to determine the minimum required depth of milling, which is needed for obtaining the desired surface quality of N6 grades or better. Knowing the thickness of the deposited layer of metal material is fundamental for determining the minimal required depth of cutting. Therefore, a software using cross-section metallographic images of deposited layers for thickness measuring is developed. The research employs an artificial neural network (ANN) and genetic programming method (GP) for estimating the produced surface roughness and minimum required depth of milling during the machining of 16MnCr5/316L four-layered metal material with a solid carbide ball-end mill. Model predictions were compared with experimental data and were found to be in good agreement. Experimental results demonstrate that this two methods can accurately predict surface roughness and minimum required depth of milling.
To build and test the prediction models, machining experiments were carried out on the CNC milling machine (type HELLER BEA01), under dry cutting conditions.

Spontaneous Curvature of Healthy Human Spine as a Parameter of Bipodal Stance Contour

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Sagittal equilibrium of bipodal posture imposes the development of the shape of the spine. It is indicated that non-local effects of the spine are of utmost importance for maintaining the equilibrium. In order to describe the effects of the local deformation of the spine constituents on the shape of the spine, we constructed a mathematical model in which the spine (from sacrum to the most exposed point on the thorax) was represented by a two dimensional curve with a given spontaneous curvature. The equilibrium shape of the curve was determined by minimization of its bending energy at relevant constraints and boundary conditions. A phase diagram of equilibrium shapes, determined by the curvature at the sacrum and the dimensionless spontaneous curvature (ζ_0) was elaborated. For some model parameters the shape predicted by the model agreed well with the shape of a contour of a healthy human spine in the sagittal plane of the body. The model was then used for fitting (with respect to ζ_0) the shapes of contours of 31 healthy human subjects in the standing position, obtained from X-ray pictures. It was found that the dimensionless spontaneous curvature strongly negatively correlated with the curvature at sacrum (Pearson coefficient 0.7, $p < 0.0001$). Also, it was found that the values of ζ_0 were obtained within a rather large range between -16.6 and -3.9. Dimensionless spontaneous curvature ζ_0 is a potential parameter reflecting the clinical status of the spine. Assessment of this parameter in cohorts with different pathologies is needed to validate the model.

Characterization of Metal Powders

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The additive manufacturing has significantly increased the use of metal powders. Beside the stainless and maraging steels, as initial used powders for additive manufacturing, the non-ferrous metal powders became popular too. Pure aluminium and aluminium alloy powders were compared and discussed on chemical composition, mechanical and thermal properties and also on microstructure. The high powder flowability is commonly mentioned as the most important property for usage in additive manufacturing. The spherical shape of powder parts and the parts granulation between 20 µm and 150 µm, for aluminium alloys between 10 µm and 75 µm, were recommended for the appropriated parameters. The metal powder with these conditions is possible to produce only with gas atomisation with inert gas. At the same time this metal powder production is the most expensive. In the comparison to the gas atomisation with pressured air and water atomisation the aluminium powder can be produced for 5 % to 25 % lower price. The reductions of powder production costs have influence also on reduction of additive manufacturing product's final price. The flowability of gas atomised powder with inert gas is higher as the one of gas atomised powder with compressed air or water atomised but the flowability of both letter isn't so bad that the powder can't be appropriate for additive manufacturing. The major difference between gas atomised and water atomised AlSi12 powder is in oxide layer. Observed with SEM-EDS the oxide layer around each powder particle of water atomised AlSi12 powder was 2 µm. Higher laser power must be used for successful printing in comparison to the gas atomised powder. Nevertheless the AlSi10Mg is the most often mentioned aluminium alloy for additive manufacturing even though the DSC analyses have shown some possible problems with that alloy. On cooling curves for that alloy, in the solidification area due to different phase formations, much more energy changes have been observed than of pure aluminium powder. Due to very fast temperature and energy changes in additive manufacturing the separate phases, which have positive influence on the mechanical properties, do not have enough time to segregate and that way the properties are not as expected.

Difference in Microstructure in EN AW 2011 Aluminium Alloy

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The aim of this work is microstructural characterization of aluminium EN AW 2011 alloy with addition of 0.17 and 0.32 wt% of Si. The samples from production came in different shapes (disks, rods) and states, i.e. cast, homogenized and after several thermomechanical treatments denoted as (F, T6 and T8). In order to determine the amount of secondary phases, we took 6 optical micrographs from each sample. This investigation is part of the project MARTIN (Modeliranje termomehAnskega pRocesiranja aluminijevih zliTIn za vrhuNske izdelke), where the aluminium alloys was delivered from IMPOL d.o.o. company.

Optical microscopy indicates that there are two secondary phases, one being lighter and another darker. Further analysis of phases using SEM shows that they differ in chemical composition, dark phase is rich in (Pb, Bi), whereas the lighter one is $AlCu_2$, also known as θ-phase. At the Institute of Metals and Technology (IMT), we have developed a computer program (*Python* language), which enables automatic quantitative analysis of dark and light secondary phases on metallographic images acquired by ZEISS AxioImager light microscope Z2m with AxioVision software. The essential advantage of our program compared to existing applications like *ImageJ (Fiji),* is faster processing and ease of use. All samples were taken longitudinally at half the radius (d/4) on disks (cast and homogenised) or rods (F, T6 and T8). In cast and homogenized samples, morphology of secondary phase is isotropic, whereas in rods the morphology is anisotropic because of the orientation in the extrusion direction.

The results indicate that in investigated aluminium alloys, the amount of the secondary phase is different at different states. In disks, the amount of secondary phase decreases after homo-genization, for both alloys. In case of rods, differences are not that obvious, partly due to error of method itself, since the pores, cracks, etc. are also considered as secondary phase. On the other hand, expected differences between the thermomechanical treatments are small, within the scope of experimental error.

The Use of Highly Disintegrating Precursors in the Production of Cast Metal Foams

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The paper is devoted to the field of manufacturing of cast metallic foams – porous metal materials – with stochastic arrangement of inner cavities.
Mastering of inexpensive ways of manufacturing of metallic foams without requiring equipment for production facilities with investment-intensive machines and equipment is a prerequisite for full utilization of the application potential of this material. That´s why the experimental part of the present work was devoted to the casting technologies of the production of metal foams based on conventional foundry processes.
In the experiment, casting method for the manufacturing of metal foams were tested, namely infiltration of molten metal into mould cavities filled with precursors.
It has been verified that metallic foams can be produced by a common casting process using existing technologies and currently used materials. By these methods, foams with irregular internal structure can be prepared from materials that are normally processed in the foundry operations. Particular attention was paid to the use of highly disintegrating or water-soluble precursor materials. It is assumed that a thorough knowledge of the production parameters and conditions will contribute to the expansion of the foundry assortment, which can also increase their competitiveness on a global scale.

The effect of Processing Parameters on Mechanical and Corrosion Properties of Zn-Mg-Ca/Sr Ternary Alloys Considered for Medical Applications

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Zinc-based alloys are considered as possible materials for the manufacture of various medical biodegradable implants like fixation devices for fractured bones or even arterial stents. These applications require specific mechanical and corrosion properties, which is not generally easy to meet for similar materials. Although corrosion rate is lower compared to the competitive magnesium-based alloys, the combination of proper yield strength, ultimate strength and plasticity for both tension and compression loading is generally the biggest issue of zinc-based materials. Present work deals with the study of Zn-08Mg-02Ca (wt. %) and Zn-08Mg-02Sr (wt. %) ternary alloys processed in various ways including casting, thermal treatment and extrusion at various parameters. Obtained results indicate a huge effect of thermal treatment and extrusion on microstructure conditions and related mechanical characteristics, especially on elongation to fracture. Materials prepared by extrusion at lower temperatures were characterized by tensile yield strength about 300 MPa and elongation over 10 %. Corrosion rate seems to be not highly affected by processing parameters and meets the requirements for biodegradable materials. Presented work discusses the main relation between observed mechanical and corrosion properties and microstructure conditions related to material processing. This research was funded by the Czech Science Foundation (project no. 18-06110S) and specific university research (MSMT no. 21-SVV/2019).

Nanocrystalline Cellulose from Laboratory to Pilot Plant Production and Its Use

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A highly efficient and eco-friendly procedure for rapid preparation of nanocrystalline cellulose (NCC) from biomass was developed and optimized for pilot plant production. It was achieved by liquefaction of amorphous part of cellulose, lignin and hemicelluloses in ethylene glycol under acidic catalysis. The feedstock can be any cellulose containing biomass or its waste.

Lignocellulosic biomass was dispersed in glycol and methane sulfonic acid (3 %) was used as a catalyst. During the liquefaction reaction liquefaction the amorphous part of cellulose, lignin and hemicelluloses were liquefied and the NCC was isolated as a residue, rinsed with a mixture of glycol and water and centrifuged. The product was a NCC suspension in water or any polar organic solvent. The crystallinity index was from 75 % to 84 % and the yield was more than 67 % when using cotton as the starting material. The NCC was characterized by SEM microscopy, X-ray diffraction and NMR spectroscopy. The average particle size was between 200 nm and 500 nm, with diameter from 15 nm to 30 nm. The method was also tested in the pilot plant reactor with 250 lit capacities. The utilization of ultrasound during the liquefaction reaction decreased the reaction time for 40 %.

The utilization of NCC in different applications was examined and results will be presented here. Thus produced NCC was used in water based acrylic coatings improving the scratch resistance, as reinforcement in different polymer composites increasing the mechanical strength, in packaging films enhancing the barrier properties and in paper production improving the printability.

The LCA analysis proved the eco-friendliness of the process since the impact on the environment is much reduced if compared to well establish methods.

Determination of a New Ternary Laves Phase in Al-Cr-Sc System Combining EDS, Rietveld Refinement and Single-Crystal Methods

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A ternary alloy with a nominal composition of the $Al_{52}Cr_{14}Sc_{34}$ (at. %) was prepared by applying arc melting technique, followed by an annealing step at 990 °C for 240h to reach thermodynamic equilibrium. A precise scanning electron microscopy (SEM) combined with quantitative energy-dispersive x-ray spectroscopy (EDS) analysis revealed the existence of two phases, a binary precipitates of $AlCr_2$ and a new ternary phase with composition $Al_{51}Cr_{14}Sc_{35}$ (at. %) (Fig. 1a). X-ray powder diffraction pattern (XRPD) confirmed that the crystal structure of the ternary phase belongs to the Laves phase family with the structure type of $MgZn_2$ (C14) and space group P63/mmc. Based on crystallochemical principles of atoms involved in the given crystal structure it was assumed that Sc is situated at Wyckoff site of 4f while Al and Cr over the sites 2a and 6h. First, Rietveld refinement was performed on powder from a bulk specimen to determine the exact Al/Cr ratio of these mixed sites. The calculated occupancies were 0.63 Al and 0.37 Cr for site 2a and 0.89 Al and 0.11 Cr for site 6h. Overall composition from calculated sites is $Al_{55}Cr_{12}Sc_{33}$. A single-crystal X-ray diffraction analysis was performed from individual ternary phase crystal grain extracted from the bulk specimen with an approximate size of 20 µm in diameter to further refine the crystal structure. Refined parameters (Fig. 1b) of single crystal were 0.53 Al and 0.47 Cr for site 2a and 0.89 Al and 0.11 Cr for site 6h, giving an overall composition of $Al_{53.3}Cr_{13.3}Sc_{33.3}$, which is consistent with EDS results.

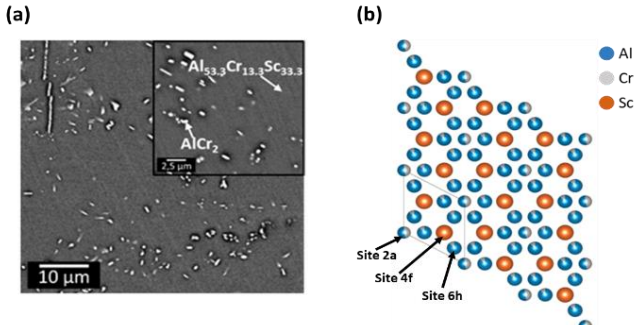

Figure 1: (a) SEM micrograph combined with EDS of the sample $Al_{52}Cr_{14}Sc_{34}$. (b) The crystal structure model of the ternary Laves phase in [0 0 0 1] zone axes.

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Secondary Breast Reconstruction using 3D Template Enhanced Innervated Free DIEP Flap

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Autologous breast reconstruction has become the golden standard of reconstruction after oncologic treatment for breast cancer. Its advantages are even more profound in cases of secondary breast reconstruction, where there's a deficiency of soft tissue and skin envelope. For the purpose of achieving a better aesthetic result, the principle of 3D template enhanced secondary breast reconstruction was developed at our department. In recent years the concept of innervated autologous breast reconstruction has evolved. Combining both methods enables us to achieve a reconstructive result, that comes close to the goal of reconstructing "like with like".
In order to pursue this goal, patients, who are candidates for secondary autologous breast reconstruction are invited for a preoperative planning, where the contralateral healthy breast is scanned and a mirrored 3D template of the healthy breast is created. The breast is then reconstructed with autologous tissue (deep inferior epigastric perforator flap) using 3D template from the contralateral healthy breast. Additionally, a coaptation of the anterior branch of the 3rd intercostal nerve with the dominant lateral intercostal nerve innervating the DIEP flap is performed. To evaluate the results, patients are requested to complete the BREAST-Q questionnaire before the reconstruction and at the end of the follow up. The sensibility of the flap is tested on predefined areas of the reconstructed breast in intervals of 6, 12 and 24 months after the reconstruction.
According to previous studies sensibility of the reconstructed breast after innervated autologous breast reconstruction contributes significantly to the satisfaction of patients. In selected patients breast reconstruction using 3D template from the contralateral healthy breast can produce results that are superior to traditional methods of autologous tissue shaping, as in the cases of secondary breast reconstruction the weight of the removed breast and postmastectomy skin envelope is not available.
With the advantages of both methods combined, we are one step closer to the ideal reconstructed breast.
Keywords: autologous breast reconstruction, imaging, three-dimensional, free tissue flap, micro-surgery, nerve transfer

Characterization of Recycled Glass-Cement Composite Mechanical Strength

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Presented work summarize the results of mechanical strength of recycled glass-cement composite. The composite material was fabricated using portland cement CEM I 52,5N. As an aggregate the 100 % of recycled glass bottles were added. The final recipe was calculated using experimental laboratory method includes aggregates: 0/2 mm of glass bottles, glass flour 0/0,2 mm, deflocculant based on polyacrylate and hydrophobic additive based on surfactants. In this work three kind of recycled glass-cement composite were compared (reference, with zeolite addition and with fly ash addition into the matrix). The main purpose of this research was to increase the use of recycled materials such as bottle glass and fly ash in industry. After 28 days of curing the mechanical properties: compressive strength, bending strength and splitting strength were widely investigated. SEM and LM micrographs and chemical composition of additives were characterized. Additionally, the thermal properties were measured. Used glass aggregate increase mechanical strength and thermal properties of fabricated composites. Moreover, the final composite was 16 % lightest than usually concrete. These kinds of composites are very perspective for future application in civil engineering in special building construction.

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Induced Effects On The Functionalized Ti-based Surfaces By Oxygen Plasma Treatment

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Low-pressure oxygen (O_2) plasma treatments were shown to be very effective surface modification techniques for biomaterials, in terms of biofunctionality enhancement and improvement in biocompatibility. In biomedical engineering, modification of surfaces by plasma treatment may play an essential role as it can optimize surface properties for various applications (1). As biomaterials, like titanium (Ti) and nitinol (NiTi), have attracted attention due to its use in implantable biomedical devices, due to their suitable yield strength, high biocompatibility, relatively low weight, and great resistance to corrosion (2).

Ni-Ti alloys due to its unique combination of properties, including shape memory and super-elastic capability, make it very attractive for vascular stent material (3,4). In order to improve surface adhesive properties an investigation between O_2 plasma treated Ti-based alloys and the whole blood was studied. Knowing that thrombus response can be caused by platelet activation the bioactive Ti-based alloys were treated with non-thermal O_2 plasma. Characterization of the TiO_2 surface chemical composition and morphological features after plasma modification was done with X-ray Diffraction (XRD) Spectroscopy Analysis and Scanning Electron Microscope (SEM) Analysis. O_2 plasma treated surfaces showed significantly reduced adhesion and activation of platelets with comparison with untreated Ti-based foil. O_2 plasma treatment effectively improves biocompatibility and reduces adhesion of platelets (thrombogenic events).

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Refining of Aluminum Alloy Melts Using Graphite Rotors

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The presented paper is focused on the study of refining of aluminum alloy melts. The quality of castings is given by the basic material, ie. input material (furnace charge), respectively its subsequent melting and subsequent metallurgical modifications. From the point of view of the profitability of production, less quality input materials are currently used, which, although they correspond to the required chemical composition, may contain a large amount of impurities not only from the original input material, but also from the processes of its processing. From the point of view of cost reduction, in addition to rejected castings, the residues of gating and chipping from machining are used as charge materials in foundries. However, the melt thus prepared is heavily contaminated with gases and inclusions.

The aim of the paper is therefore to verify the use of graphite rotors of degassing units for the possibility of refining aluminum melts. The experiments were conducted under laboratory and pilot plant conditions using plant equipment.

The refining efficiency was monitored depending on the type and shape of the graphite rotor and the refining medium used. The achieved purity of the resulting melt was evaluated for the Dichte Index and the final cast microstructure.

Phase Composition of Lava and Blast Furnace Slags

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Steel is produced by two technological processes. About two thirds follows technological route: iron ore reduction in blast furnace and pig iron conversion into steel using oxygen converter. While the second one where recycling of previously used steel in Electric arc furnace covers the rest. Both technological paths are followed by secondary refining processes.
In the process of pig iron production the blast furnace slag comes out as a by-product. The blast furnace slag was compared with the lava from different still operational volcanos. Phase composition of the blast furnace slags can be represented in a four component system $CaO – MgO – SiO_2 – Al_2O_3$. Besides the oxides of the blast furnace slag the lava's phase composition contains also K, Ti, Fe and in smaller amounts also other elements.

PTFE Hydrophylization in Inductively Coupled RF Plasma

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Polytetrafluoroethylene (PTFE) is widely used due to its good physical and chemical resistance (inert properties due to C-F bond). However, due to its highly hydrophobic surface (low surface energy), PTFE usage for membranes (reverse osmosis, purification), coating and adhering properties is inadequate[1,2]. Several chemical methods for PTFE hydrophilization exist. To achieve proper hydrophilization, these methods unfortunately require environmentally unfriendly chemicals, such as elemental sodium, liquid ammonia or sodium naphthalate[3]. Gaseous plasma (containing highly energetic reactive species: ions, neutral atoms, electrons and UV, VUV radiation) represents an alternative method for PTFE hydrophilization with much lower environmental impact.

PTFE foil samples were initially processed by different none-equilibrium cold low pressure RF plasmas. The aim was to optimize processing parameters such as treatment time, generator power, gas pressure and the distance of the treated sample from glowing plasma. In plasma certain ions have sufficient energy to brake C-F bonds, which leads to fluorine subtraction and bonding of certain plasma particles on the PTFE surface. Preliminary XPS data on a single plasma treated sample showed a huge reduction in surface F/C ratio from 2.18 to 0.13, but the water contact angle (WCA) was only reduced from 111° to around 95°. By using a combination of different plasmas, further contact angle reductions were achieved. At best, WCA was reduced to the value of approximately 15°.

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Detection of Aluminum Oxide in Periprosthetic Tissue in Patients which Required Revision Surgery after Aseptic Joint Failure

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Total joint replacement surgery is a common, generally successful and cost-effective procedure in all of surgery. The problem is that all arthroplasty cases implants evoke an initial inflammatory reaction, which generally subsides over few weeks. The finally outcome of the operation is depended on the characteristics of the implant, the precision of the surgical technique and the biological age of the host. However, prosthetic failures occur in approximately 1-2 % of arthroplasty cases due to aseptic loosening. One of the reasons for revision surgery can be wear implant particles (Pajarinen J., Lin T-H., Sato T., Yao Z., Goodman B. S., 2014; Rao J. A., Gibon E., Ma T., Yao Z, Smith R. L. and Goodman B. S., 2012). Particles, which are part of implant, are phagocytosed by macrophages. Activated macrophages produce pro-inflammatory factors and cytokines that induce an inflammatory reaction that activates osteoclast leading to aseptic loosening (Abu-Amer Y., Darwech I. and Clohisy C.J., 2007). The aim of our research was to develop a method to evaluate the chronic inflammatory reaction and elemental distribution in histological sections of periprosthetic tissue. We hypothesize that surface of the implant after blasting residues a large degree of Al_2O_3 particles which are found in the surrounding tissue of the implant. With different histology approaches and ICP-MS we are going to figure out if periprosthetic tissue contains debris of aluminum oxide. We harvested perprosthetic tissue from currently 72 patients which undergoes revised joint replacement after aseptic loosening of implants. All patients had titanium alloy implants, which surface was blasted with corundum to facilitate the ingrowth of bone. We discuss the applicability of using conventional histology and LA-ICP-MS to generate qualitative maps of elemental distribution in thin tissue sections of tissue surrounding the implant. Laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) has been efficiently employed to generate qualitative and quantitative maps of elemental distribution in thin tissue sections of a variety of biological samples.

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Multi-Material Processing in Additive Manufacturing

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Among other things, Additive Manufacturing processes like Laser-Metal-Deposition (LMD) allow the near-net-shape construction of complex 3D-components, the possibility of functional integration, production lead time reduction as well as the processing of materials which are difficult to handle conventionally. In addition to these advantages, application fields can be extended by systematic processing and tailored combinations of multiple materials with different beneficial properties on one component.
Comparable to naturally grown structures, different multi-material combinations can be produced. In these terms, for instance (i) sharp (discontinuous) and (ii) graded (continuous) material transitions can be manufactured by LMD. Furthermore, the deposition of (iii) composite structures consisting of filler particles in a matrix and the production of (iv) in-situ alloyed layers is feasible. Phenomena such as segregation, varying absorption degrees or thermal stresses, which present a challenge in LMD multi-material processing, result in the requirement for material specific process modifications.
In this lecture, process- and material-related challenges as well as developed solutions for successful LMD multi-material processing are presented and discussed using selected industry-relevant examples.

The Effect of Boron and Vanadium Addition on the Structure and Properties of AlCrN Coating

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Coatings produced by physical vapour deposition are recognised as one of the very interesting premium technologies for protection and modification of products surface, due to the real possibility to synthesise materials with unique physical and chemical properties [1]. One of the most effective coatings of this type is the AlCrN hard coating. AlCrN coatings have been developed for high-temperature wear applications, such as cutting tools or die casting moulds due to their unique mechanical properties and oxidation resistance [2]. The review of the state of knowledge in the field of AlCrN coatings produced by physical vapour deposition technique indicates that so far not fully used all the technological possibilities associated with the optimization of the chemical composition of this type of coatings. Perspective from the point of view of increasing the mechanical and tribological properties, it seems appropriate to introduce additions in the form of boron (B) and/or vanadium (V) to the AlCrN coating.

The AlCrBN, AlCrVN and AlCrVBN coatings were deposited in the arc plating PVD unit PLATIT π1511. Tests using the TEM and HRTEM confirmed a nanocrystalline structure of the investigated coatings. Basing on the XRD analysis the fcc type of the crystal structure was proposed for that coatings. The chemical bonding of particular elements in the tested coatings was evaluated by XPS. In sliding dry friction conditions, the investigated coatings reveal high wear resistance. The coatings demonstrated a dense cross-sectional morphology as well as good adhesion to the substrate. Compared to previous work the modification of the chemical composition of the AlCrN coating by the addition of boron and vanadium increases its mechanical and tribological properties compared to the addition of silicon or titanium currently used.

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The Influence of Composition and Prior Deformation on Precipitation During Aging of Nickel Alloy 625

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The research covers the influence of niobium, aluminum and titanium on precipitation of the secondary phases during aging of annealed and hot deformed samples. The microstructure was characterized by SEM. The EBSD and EDS methods were employed to characterize deformed samples, grain structure and the various phases. The mechanical properties were characterized by hardness measurements and tensile tests. Different temperatures and reductions during prior hot rolling had a large influence on size, distribution and preferential precipitation sites of γ'' during aging stage at 700 and 750 °C. Of the researched elements, the niobium was the most influencing one. At lower to medium average fraction of niobium (~3.3 wt. %) the deformed samples promoted the precipitation of γ''. On the other hand, the precipitation of γ'' was retarded in annealed samples. Higher average fraction of niobium (> 4 wt. %) promoted the precipitation of γ'' in annealed and deformed samples.

Influence Of Silicone Carbide Addition On Mechanical Properties Of Concrete

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In this work the results of chemical modification of concrete based on portland cement by silicon carbide F140 in addition of 5, 10 and 15 wt. % of concrete amount into the mixture as a filler was summarized. The main goal of this study was to characterize influence and wt. % of content addition of new commercial fillers on the concrete mechanical strength. The reference recipe of concrete was calculated using three equation method including three type of conditions: strength, tightness and water demand. For concrete production white portland cement (42,5 MPa), basalt aggregate, water and deflocculant based on polycarboxylate was used. To characterize basic properties of studied concrete SEM and LM observations, chemical composition, slump cone test was widely investigated. Thermal properties was also investigated used thermal analyzer. Samples of concrete were characterized by compressive strength and bending tests after 28 days of curing process. Obtained results were compare with reference samples of concrete without chemical addition of silicon carbide. This study was proven that all chosen modifications revealed increase effect on final mechanical strength of researched concrete samples. Thermal conductivity was also increasing. These kind of concrete are very perspective for application in civil engineering and new building technologies in future.

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New Medium Cut-Off Membrane for Hemodialysis

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Hemodialysis (HD) is the predominant treatment method of acute and chronic end-stage renal disease (ESRD). ESRD results in the retention of uremic toxins which are classified into small (<500 Da) and middle-molecular (500 Da-60 kDa) water-soluble solutes and protein-bound substances. While conventional high-flux HD removes small solutes and smaller-sized middle molecules, clearance of larger middle molecules and protein-bound substances is poor. Studies have associated middle molecules to pathological features of uremia, such as immune dysfunction and inflammation, as well as a risk factor for cardiovascular diseases and higher mortality in dialysis patients. Medium cut-off (MCO) dialyzers utilize a novel class of membranes designed to increase the removal of larger middle molecules in HD. Most recently designed MCO dialyzer is made of polyarylethersulphone-polyvinylpirrolidone (PES-PVP) membrane (Theranova®), which has novel properties: the membrane structure is aassimetric and has 3 distinct layers (a very thin inner, a sponge-like intermediate and a finger-like macro-porous outer layer). This structure enables higher clearance of middle molecules and only limited albumin loss despite of increasing pore sizes. During HD, blood is exposed to an extracorporeal circuit which activates thrombogenic pathways and clotting, which in turn decreases HD efficiency, and may be associated with increased inflammation and accelerated atherosclerosis in dialysis patients. Therefore, effective intradialytic anticoagulation is required. While unfractionated heparin (UFH) is still the most commonly used intradialytic anticoagulant, regional anticoagulation with citrate has been established as the best possible method of intradialytic anticoagulation, particularly in patients with active bleeding or a higher risk of bleeding.

The purpose of our study is to compare the efficiency and biocompatibility of citrate and heparin anticoagulation during HD with PES-PVP membrane, which has never been done. The research will be performed as a prospective clinical trial and will include 35 patients. Every patient will have 2 HD procedures with PES-PVP membrane in a randomized order: 1 with UFH and 1 with 8 % trisodium citrate. We will compare the efficiency of both types of anticoagulation by measuring clearance of small and middle molecules: serum concentration of uremic toxins (urea, creatinine, β2-micro-globulin, phosphate) before and after HD, total dialysate concentration of β2-microglobuline and phosphate, sieving coefficient (SC) after 15 minutes and just before the end of HD. Biocompatibility will be evaluated by measuring activation of: complement (serum concentration of C3a and C5a), leukocytes (serum concentration of myeloperoxidase) and thrombocytes (serum concentration of PF4). We will also monitor complete blood count for occurrence of leukopenia and thrombo-cytopenia. We will measure all the parameters of biocompatibility before, after 15 min and 1 hour and at the end of HD. After the HD electron microscopy of the membrane will be done to evaluate adsorption of cells and formation of blood clots on the membrane.

We expect to show statistically higher clearance and biocompatibility of HD with PES-PVP with citrate anticoagulation in comparison to heparin anticoagulation. Findings could represent the basis for routine use of PES-PVP membrane in maintenance HD, which could lead to reduced risk of cardiovascular diseases and to lower mortality rate in dialysis patients. However, to prove that, additional randomized clinical trials would be needed.

Adhesion to Zirconia Ceramics: A Problem Solved?

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Establishing a durable bond between the hard dental tissues and the surface of the zirconia ceramic dental restorations is difficult due to the increased chemical stability of zirconia. Surface pre-treatment of the zirconia restorations with a nanostructured alumina coating (NAC) establishes a substantially stronger and durable bond than air-particle abrasion. However, it is crucial to integrate the synthesis of NAC to completely comply with everyday dental laboratory practices.

In our in vitro study, the effect of various dental laboratory firing procedures, such as glaze, veneer and regeneration firings of zirconia on the temperature-dependent phase evolution of NAC was studied and related to the resin cement shear bond strength provided by commonly used zirconia surface treatments. When the NAC was fired at 900 and 1050°C and topotactically transformed to γ- or a mixture of δ- and θ-aluminas, it provided highest and clinically acceptable bond-strengths (>20Mpa) not affected by thermocycling.

In minimally invasive dentistry, replacement of anterior teeth with resin-bonded fixed dental prostheses (RBFDPs) represents a potentially successfull treatment modality. In these type of restorations, however, limited bonding surface of zirconia restoration may lead to a premature debonding. In these cases an enhanced bond strength to zirconia ceramics offered by NAC would be preferable for establishing a long-term clinical success of the restoration. In order to study the clinical performance of NAC coated RBFDPs a clinical study has been designed, where 20 missing anterior teeth have been replaced with coated or air-borne particle abraded RBFDP. The average observation period was 0.82 years and the longest 1.45 years. The survival of the restorations in both groups was 100 %, with the success rate of 90 %. While only one restoration debonded in each group due to a traumatic injury, preliminary results suggest that NAC offers a potentially reliable clinical zirconia pretreatment alternative.

AES and XPS study of nitrocarburized and oxidized steel surfaces

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DIN 31CrMoV9 (1.8519) steel samples were initially treated by salt bath- (SNC), gas- (GNC) and plasma-nitrocarburizing (PNC) and afterwards oxidized for increased corrosion protection. Thickness and hardness of the oxide and compound layer were measured. Surface topographies and microstructures were analyzed by optical microscopy, laser scanning microscopy and scanning electron microscopy (SEM), while detailed chemical compositions of the sample surfaces were determined with energy-dispersive X-ray spectroscopy (EDX). Tribological tests for characterization of wear and frictional behaviours of the treated samples were performed under unlubricated sliding conditions. Here, results of Auger electron spectroscopy (AES) depth profiling and X-ray photo-electron spectroscopy (XPS) are presented. They show that, while different nitrocarburising processes yield similar layers, oxide layer properties can be significantly different. Main conclusions from surface spectroscopies analysis can be summarized as:

- On salt bath-nitrocarburized (SNC) samples, the thickest oxide layer was formed.
- On SNC samples, Fe_3O_4, FeO and Fe_2O_3 were formed.
- On gas- and plasma-nitrocarburized samples primarily Fe_2O_3 was formed.

Comparison of Bearing Surfaces in Cementless Primary Hip Arthroplasty – Ceramic on Metal Versus Metal on Metal

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After 60 years of the hip arthroplasty, the aim is to construct the implant that is stable, resistant to shocks, inert to body fluids and long-lasting. Researches are conducted in the field of implant materials, design and new bearing surfaces.
The first goal of this study was to prove that CoM is not inferior bearing surface to MoM, using femoral heads larger than 38 mm.The second objective was to detect early complications in meaningful early periprosthetic osteolysis,loosening,and pseudotumors.
Prospective study included 51 patients (34 men, 17 women), mean age 56.5 years, during period April 2011-Jully 2019. All surgeries were performed by the same surgical team, following the same surgical protocol, in period April 2011-September 2011. The same acetabular cup and femoral stem were implanted to all patients, but the femoral head were metal (26 patients) and ceramic (25 patients), sizes 42-58 mm. Evaluation of functional outcome was done by HHS, and WOMAC index. The radiological outcome was done using postition of components, component stability, osteolysis by Gruen and Charnley-DeLey. The monitoring periods were: preoperativelly, immediately postoperative, 6 weeks, 6 months, 1 and 2 years postoperatively. CCS was defined. Today, all patient are in regular annual telephone contact. One patient was lost from study after 6 years because he had changed his country of residence.
During the early follow up period (first two years) stability of both components was satisfactory, acetabular or femoral osteolysis were not observed. Functional score values were at the level of good function after 6 months, and after 1 and 2 years it were maintained. No dislocations, infections and thromboembolic complications were observed. Trendelenburg sign was postoperatively positive in one patient. Heterotopic ossification Brooker I and II occured in 2 patients. Five years after surgery, we had one revision in one patient for an implant infection (MoM) that developed 8 month after biliary sepsis. Intraoperatively, there were no pseudotumors or any signs of metallosis in the patient. Today, all patients have no problems, good functional status and quality of life according to a telephone survey.
In this follow up we observed that CoM is not inferior bearing surface to MoM using femoral heads larger then 38 mm, and in some indicators is even better. We did not observe early osteolysis or pseudotumors in both groups of patient.
Keywords: Total Hip Replacement; Surface-Coated Materials; Osteolysis; Loosening

Clinical Outcomes of Titanium Alloy SL-PLUS® Femoral Stem (Zweymüller): 2,013 Total Hip Arthroplasty Cases with up to 25 years of Follow-up

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Zweymüller uncemented hip endoprosthesis with SL-PLUS® femoral stem has been used for the last 25 years with unchanged design, made of forged titanium alloy Ti-6Al-7Nb with double-taper straight stem of rectangular cross-section. Its grit-blasted 4-8 µm surface roughness enhances bone ingrowth. So far, there has been no report on >2,000 Zweymüller endoprostheses from a single center with >20 years of follow-up. Our aim was to evaluate the impact of surgeon, season of the year and patients age/gender on clinical outcomes of hip arthroplasty in 2,013 consecutive SL-PLUS® femoral stems from a single tertiary hospital.

Retrospective implant survival analysis included all patients who received SL-PLUS® between 1. 1. 1993 and 31. 05. 2017 with Kaplan-Meier and Cox regression (for covariables: age, gender, operated side, season of the year, surgeon). In the cohort of 2,013 primary Zweymüller SL-PLUS® femoral stems (1,042 female / 971 male) implanted at mean 58 ± 11 years of age and 21,335 observed component-years, 154 (7.7 %) femoral stems required at least one surgical revision (0.72 revisions per 100 component-years, 30 retained, 129 removed), 50 (2.5 %) were lost for follow-up and 280 (13.9 %) died unrevised. Survival without SL-PLUS® removal at 5/10/15/20 years after the primary operation was 96/94/93/88 % respectively. Cox regression found statistically significant reduction in implant removal risk if the primary implantation was performed in winter (odds ratio 0.51 in comparison to spring, 95 % confidence interval 0.31-0.83, $p < 0.01$) and by particular surgeons ($p = 0.02$).

Presented data corroborate excellent results of the Zweymüller SL-PLUS® femoral stem from arthroplasty registries. In terms of observed component years, this is the largest single-center study of this implant so far and the first to show a statistically significant impact of the season at primary operation and the surgeon on the risk for subsequent revision surgery.

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Recycling Rare Earths Magnets

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Recycling rare earths has attracted a great deal of interest since the rare-earth crisis of 2010-2011. However, despite funding from research agencies, the quantity of recycled rare earths continues to hover at around 1%. Of all the products where rare earths are used, permanent magnets look to offer the best option for economic recycling. There are three routes to the recycling of the rare earths in permanent magnets: 1) direct re-use of the old magnets in new devices; 2) reprocessing the old magnets into new magnets; and 3) extracting the rare earths from the old magnets for use in new applications. Direct re-use, which is certainly the most environmental and economic option, is hampered by the fact that old magnets tend to have poorer properties than contemporary ones and the sizes are simply wrong. Extracting the rare earths from old magnets provides the greatest flexibility, but the current best option, hydrometallurgical processes, produces a great deal of waste. The reprocessing of old magnets into new magnets, something that magnet manufacturers already have a lot of experience with as regards their own internal recycling, appears to be far and away the most attractive option. In this presentation we will look at the factors that affect the recycling of rare-earth magnets and look at some of the more successful attempts to alleviate the problem of rare-earth magnets being produced, used and then dumped.

Hemodialysis Catheters: Different Citrate Locking Solutions and Biofilm

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Hemodialysis is a method of treatment acute and end-stage renal failure. Hemodialysis requires a vascular approach, which may be an arteriovenous fistula, graft, or hemodialysis catheter. Precurved non-tunneled jugular hemodialysis catheters have been established as a permanent vascular approach in recent years, particularly in elderly patients with associated diseases. The most important complications of using hemodialysis catheters in long-term are thrombosis and infection. To avoid these complications, hemodialysis catheters are filled in interdialysis period with trisodium citrate solution after each procedure, which prevents catheter thrombosis and has an antimicrobial effect, preventing infection and critical biofilm growth in the hemodialysis catheter lumen. So far, little research has been done to investigate the efficiency of different concentrations of trisodium citrate on biofilm and the safety of its use. Higher concentrations of trisodium citrate more effectively prevent thrombosis or blood clot formation and are more effective in preventing infections and biofilm formation, but due to their potential side effects, their use is limited.

Use of hemodialysis catheters is a major risk factor for bacteremia in dialysis patients, and prolonged use of hemodialysis catheters increases the risk of inadequate blood flow due to thrombosis of hemodialysis catheters. Biofilm is formed in the lumen and on the surface of hemodialysis catheters. It is a collection of microorganisms covered with a dense matrix and is involved in infections of hemodialysis catheters inserted into patients. Dissemination of the biofilm in dialysis patients may results in bacteremia and endotoxemia.

The purpose of our study is to compare the effect of two different concentrations of trisodium citrate solution (30 % and 4 %) on biofilm formation in hemodialysis single-lumen jugular hemodialysis catheters and to determine the effectiveness of preventing hemodialysis catheter dysfunction.

The research will be performed as a prospective controlled clinical trial. About 60 patients will be included in the study. In the patients to be included, after the simultaneous insertion of two jugular catheters, one catheter will always be filled with 30 % trisodium citrate solution, the second catheter with 4 % trisodium citrate solution in the interdialysis period. In the included patients we will compare time to onset of hemodialysis catheter dysfunctions and possible catheter related infections: bacteremia or sepsis. In the selected patients we will examine by electron microscope catheter inner surface and the morphological characteristics of the biofilm. Microbiological characteristics of the biofilm will be evaluated by microbiological method (sonication) of the catheter segment and cultivation on solid and liquid media.

Occurrence of hemodialysis catheter dysfunction, morphological parameters and microbiological characteristics of the biofilm in the lumen of hemodialysis catheter are expected to be statistically different using different concentrations of trisodium citrate solutions (30 %, 4 %). The data obtained will help us to understand the adverse events occurring with the use of hemodialysis catheters, filling with different concentrations of trisodium citrate solutions, and will guide us to use one of the investigated citrate solutions (30 % or 4 %) with the greater potential in preventing biofilm formation and dysfunction.

Titanium Coated PEEK For Spinal Interbody Fusion: The Best Of Both Worlds?

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Degenerative spine disorders often require surgical intervention. Spinal interbody fusion is a rapidly evolving procedure with advances in terms of approach and implant design and material selection. The fundamental goals of this procedure are pain relief and functional status improvement. The role of interbody devices or cages is restoration of disc height, mechanical load transmission and stress shielding until arthrodesis occurs.

Most commonly used materials for manufacturing cages represent PEEK (Polyetherether-keton) and titanium alloys. Titanium became widely used since discovery of its excellent osteointegration capacity. Downsides of the titanium are radioopacitiy and its high module of elasticity (≈110 GPa), which is considerably higher than cortical bone's (≈5 GPa). This represents hazard for subsidence and implant failure. On the other hand PEEK's module of elasticity (≈4 GPa) is similar to the cortical bone's, along with the advantage of radiolucency[1]. Drawbacks are inert and hydrophobic nature of the material that may lead to poor osteointegration, the so called "PEEK-halo effect"[2].

Most appropriate implant selection would thus include the ability of the surface of the implant to integrate into the bone (titanium), structural similarity to cortical bone – module of elasticity (PEEK), and radiolucency to allow for assessment of placement and fusion (PEEK). With these principles in mind a titanium coated PEEK (Ti-PEEK) was developed.

Studies report of Ti-PEEK's superior in-vitro osteogenic potential and less cytotoxicity in comparison to PEEK[3]. Micro-CT imaging and histological analysis confirmed bone ongrowth on the titanium coated PEEK surfaces, compared to fibrous tissue along PEEK's surfaces[4]. Study of ovine lumbar fusion also found boney ingrowth and ongrowth on the Ti-PEEK, leading to greater construct stability compared to regular PEEK[5]. A prospective single surgeon study reports fusion rate of 95 % (20 patients) in ALIF procedure using Ti-PEEK with a mean follow up of 15 months[6].Several other studies found out improved or identical fusion rates with Ti-PEEK compared to PEEK[1]. Wear and loss of coating material during impaction were found to be significantly greater in Ti-PEEK compared to normal and porous PEEK[7,8], and recently published study reports that porous PEEK was associated with improved osteogenic differentiation and greater implant fixation rate compared to smooth PEEK and Ti-PEEK[9].

Conclusion: Studies promote Ti-PEEK as a safe material combination that could theoretically improve fusion and fusion rates, although long-term studies are necessary for confirmation. Adjustments of coating methods are in place in order to reduce the wear during impaction.

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Manufacturing of Cast Metal Sponges from Copper Alloys

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The paper deals with the possibilities of production of metal foams using conventional foundry production processes and technologies. Particular attention is paid to the "two-stage investment casting process using an evaporative polyurethane (PUR) pattern". This method produces a metallic porous material, which is usually called a "metal sponge". These metal sponges excel among other types of metal foams with high porosity (up to 97 %), and especially because the pores are open and fully interconnected. It is therefore a material with a wide range of applications in functional components such as filters, heat exchangers or catalyst carriers.
One of the most important factors in the production of these thin-walled castings with a very complex structure is to achieve sufficient castability. This is typically achieved by relatively specific process conditions such as the use of reduced or elevated pressure (or a combination of both) while using relatively high pouring temperatures as well as mould temperatures. Although these conditions are advantageous in terms of the required castability, they have relatively unfavorable effect on the solidification process. A number of defects adversely affecting the mechanical and utility properties of these castings occurs in the case of higher overheating. It is therefore necessary to find a suitable compromise for each casted material to obtain high quality castings.

Influence of Cold Deformation on Microstructure and Mechanical Properties of Pure Titanium and TiAl6V4

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The research explores comparison and influence of cold deformation of commercially pure titanium grade 2 and grade 4 to commonly known titanium alloy TiAl6V4. Possible usage of these deformed material is discussed in this paper. These tree materials were subjected to rotary swaging at ambient temperature. The purpose of this process was to achieve high strengthening effect while maintaining sufficient plastic properties for further material processing of all materials. Pure titanium of both grades was successfully cold deformed with total area reduction of 90 %. Only small surface damages were observed on the surface of deformed pure titanium. On the other hand, the need of annealing among the steps of cold deformation for titanium alloy TiAl6V4 was demonstrated. High strengthening effect was obtained on each material. The titanium grade 4 and titanium alloy reached ultimate strength higher than 1 000 MPa and 1 400 MPa respectively after processing. In addition, the hardness profile in traversal direction of the deformed materials was discussed. The higher hardening effect in the middle section of the wires was shown. The microstructure investigation helped to reveal the structural changes and clarify the material properties.

Possibilities of Using Waste Perlite in Production of Aerated Autoclaved Concrete for Thermal Insulating Purposes

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Enormous production of both communal and industrial waste is significant feature of current times. For this reason, seeking ways of utilization of such wastes is still topical hand in hand with efforts for maximal preservation of natural resources. This paper addresses possible replacement of sand used for production of autoclaved aerated concrete. Aspects observed included influence of partial and complete replacement of filler with waste perlite on physical-mechanical properties (for example bulk density, strength) and changes in micro-structure influenced by replacement of various amounts of primary raw materials (10, 30, 50, 70 and 100 %) with secondary raw material, i.e. formation of porous structure, its characteristics and mineralogical composition, in particular formation of tobermorite.

Corrosion Phenomenon of Modular HIP Implants

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The modular hip prostheses consist of a femoral stem, a femoral head, and an acetabular component. In orthopedic surgery modular prostheses were introduced in the 1990s and, unlike so called monolithic prostheses, allow the surgeon more options in selecting the femoral head material and, above all, the possibility of a change in the femoral offset, resulting in the length of the limb. In addition to these advantages, however, the modularity of the prosthesis represents an additional source of dissolution of the metal in the head/neck cavity. Since 2009, there have been many examples of corrosion revisions in the neck of modular prostheses in literature, which is clinically demonstrated as groin pain, swelling, and the operation of yellowish fluid and the occurrence of pseudotumor (1,2). Increased blood metal concentration, especially cobalt, was observed in patients. Histological analysis showed the presence of lymphocytes, metal particles, necrosis and granulation tissue (1,2).

At Valdoltra Orthopedic Hospital, dual modular prostheses with femoral neck were used extensively, in particular Profemur Z (Wright Medical) (3). Analysis of 32 explant prosthetic components with Profemur Z femoral component and femoral neck of titanium alloy and a femoral head of stainless steel or cobalt alloy will be presented. The revised components were evaluated with respect to the degree of corrosion, composition and morphology of corrosion products and impact on histological image of the periprosthetic tissue.

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3D Printed Acetabular Endoprosthesis in Major Acetabular Revisions

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Revision total hip arthroplasty (THA) in cases of large acetabular bone defects can be challenging especially in cases of major non-contained acetabular defects with a limited bone stock or in the presence of pelvic discontinuity (Paprosky type 3A or 3B). Achieving revision goals in terms of anatomy (bone stock restoration), stability and long-term fixation and biomechanics could be done with various techniques and devices available. Most defects could be treated with standard "techniques", but large non-contained defects involving both columns remain problematic.

Standard, ***double*** and ***jumbo cups*** provide good long term results but are not always suitable for large structural defects on both columns because they need large contact areas for osteointegration and they don't allow major bone stock restoration. "***High hip rotation center"*** technique could be used in superior but again limited bone stock insufficiency with awareness of leg length discrepancy and abductor muscle tension problem. ***Rings*** and ***cages*** (with or without ***impaction bone graftin***g) allows optimizing position for better stability, because on second stage cemented cup (all-poly, dual mobility) could be placed in more optimal position in terms of biomechanics (version, inclination, hip centre). Bone stock restoration is possible with this technique if there is enough containment and host bone contact but it is not successful in large structural deficiencies. In large, non-contained defects good structural support could be achieved with ***augments*** or ***structural allografts*** when good primary stability is possible, however augments cannot restore the bone stock and the allografts may fail before osteointegration.

Development of **custom-made acetabular components (CAC**) was driven by idea to overcome the problems of primary stability and hip biomechanics restoration in most severe cases of bone deficiency. The stability of such an implant could be optimized by maximizing host-bone contact trough customized shape of implant, by customized screw fixation, by customized and guided (with custom guides) bone defect preparation for optimal defect-implant fitting and by additional fixation trough three flanges that fit the iliac, ischial and pubic bone. Customization of hemispherical cup placement into the implant allows optimal hip centre, inclination and anteversion angle and hence the biomechanical restoration of joint. Designing of those implants is based on 3D models produced from CT scans trough the evaluation of specific bony situation and proposal of virtual implant solution according to mentioned biomechanical and fixation issues. Implant, model and guides are manufactured with additive manufacturing techniques with selective laser melting. In case of implant, focused laser beam melts Titanium powder layer-by-layer to produce the final implant with all planned information (shape, fixation, surface, final cup position). Presented will be our short to mid-term results, preoperative planning, intraoperative issues, and complication with this treatment option for large acetabular bone defects.

On the role of Ca, Zn and Al for Ductilization of Mg Alloys

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Magnesium and its alloys are promising light-weight structural materials. Their application, however, is impeded by limited room temperature-(RT) ductility and strong crystallographic anisotropy. One reason for these effects is the easy activation of basal slip compared to all other deformation systems. It has been shown that the addition of Ca and Al leads to a significant improvement of the RT ductility, similar to the effect of yttrium [1]. In our research, we investigate the effect of dilute addition of Ca, Al and Zn in Mg alloy on the RT ductility. To this end, we employed electron backscatter diffraction (EBSD)-based slip trace analysis to measure the relative activity of different slip systems in tensile-deformed various Mg-Ca-Al(-Zn) alloys. From this we show that particularly the addition of Ca and Zn significantly improve ductility and changes the relative critical resolved shear stresses (CRSS) of the different slip and twinning systems. Various reasons for this effect are discussed, including intrinsic changes of CRSS by Ca and grain boundary strengthening by Zn.

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Formation and Influence of Magnesium-Alumina Spinel on Properties of Refractory Forsterite-Spinel Ceramics

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The forsterite refractory ceramics is mostly used in cement industry as a lining of the rotary kiln and also as a lining of metallurgical furnaces for its high refractoriness up to 1850°C. Another significant property of forsterite is its coefficient of linear thermal expansion used in electrotechnical industry for ceramic-metal joints. Addition of aluminium oxide into the raw material mixture results in creation of magnesium-alumina spinel ($MgO \cdot Al_2O_3$) which improves sintering and mechanical properties of forsterite ceramics. Inexpensive source of aluminium oxide is fly ash. Utilization of fly ash, secondary energetic product of coal-burning power plants, is important for the environment and sustainable development. This paper evaluated the transformation of mullite ($3Al_2O_3 \cdot 2SiO_2$) from fly ash into magnesium-alumina spinel and its influence during synthesis and resulting properties of fired forsterite refractory ceramic body.
Forsterite-spinel ceramics was synthesized from olivine, calcined magnesite and 0-20 % of fly ash powders. X-ray diffraction analysis was used to determine mineralogical composition, thermal analyses were used to determine the formation of spinel and behaviour during firing and scanning electron microscopy (SEM) to determine the morphology of crystal phases. Refractoriness of pyrometric cones, refractoriness under load, thermal shock resistance, water absorption, porosity and mechanical properties were also determined on fired test samples. Transformation of mullite resulted in small amount (under 20 %) of spinel in the forsterite ceramics. Test results showed that presence of magnesium-alumina spinel improved sintering, bulk density, microstructure, thermal shock resistance and mechanical properties in comparison with pure forsterite refractory ceramics.

Structural Changes of Ultra-High Molecular Weight Polyethylene Upon Gamma Irradiation

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Ultra-high molecular weight polyethylene (UHMWPE) has been in use in total joint replacements for well over four decades. It is used as a cup or liner material which slides past a metal femoral head. Although considering all chemical and mechanical properties, UHMWPE is currently the ideal polymer for such use, any small deviations in the chemical structure of the polymer may result in a change of mechanical behavior of the replaced joint. UHMWPE represents the weakest point in artificial joints.

It has been found that the wear rate depends on aging due to oxidative degradation of the UHMWPE material. Aging may occur in UHMWPE by the oxidation reaction of free radicals produced in components during high-energy ion irradiation in the cross-linking process. Thus, we will present a recent study of structural and oxidative changes of UHMWPE exposed to several different doses of gamma irradiation. The application of infrared and Raman spectroscopy enables direct observation of oxidative processes as well as a cross-linking process due to exposition to gamma irradiation. In the proposed talk we will present the general practicability of vibrational spectroscopy for improving the functionality of UHMWPE in a replacement arthroplasty.

Biophysical Propertis of Super Elastic NiTi Archwires

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New biomaterials are being constantly developed to respond to the need for better mechanical properties and biocompatibility. In the early 1960s, a nickel–titanium alloy was developed by W. F. Buehler, a metallurgist investigating nonmagnetic, salt resisting, waterproof alloys for the space program me at the Naval Ordnance Laboratory in Silver Springs, Maryland, USA (Buehler *et al*. 1963). The thermodynamic properties of this intermetallic alloy were found to be capable of producing a shape memory effect when specific, controlled heat treatment was undertaken The alloy was named Nitinol, an acronym for the elements from which the material was composed; *ni* for nickel, *ti* for titanium and *nol* from the Naval Ordnance Laboratory. Nitinol is the name given to a family of intermetallic alloys of nickel and titanium which have been found to have unique properties of shape memory and super-elasticity. The super-elastic behavior of Nitinol wires means that on unloading they return to their original shape before deformation. As the alloy has greater strength and a lower modulus of elasticity compared with stainless steel, there may be an advantage in the use of NiTi in orthodontic treatment.

NiTi wires were first used in orthodontics by Andreasen& Hilleman (1971), who observed differences in the physical properties of Nitinol and stainless steel orthodontic wires that allowed lighter forces to be used.The strength and resilience of NiTi wires meant there was a reduction in the number of arch wire changes necessary to complete orthodontic treatment. Rotations of teeth could be accomplished in a shorter time, without increasing patient discomfort. Nitinol wires showed better resistance to corrosion so were felt more appropriate for intraoral use than stainless steel wires. Andreasen & Morrow (1978) observed the unique properties of Nitinol, including its outstanding elasticity (which allows it to be drawn into high-strength wires) and its ‘shape memory’ (which allows the wire when deformed, to ‘remember’ its shape and return to its original configuration). The most important benefits of Nitinol wire were its construction as a resilient, rectangular wire that allowed simultaneous rotation, leveling, and tipping and torqueing movements, to be accomplished early in treatment of malocclusion.

Evaluation of Microbial Flora In Patients with Gingival Enlargement During Treatment with Fixed Orthodontic Appliance

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Backgrounds. Gingival enlargement is a common complication of treatment with fixed orthodontic appliance, due to increased plaque retention areas and consequently accumulation of dental plaque, which results in anaerobic conditions, suitable for periodontopathogenic bacteria.
Methods. 21 pacients with fixed orthodontic appliances and gingival enlargement in the upper dental arch were included in the study. For determination of periodontopathogenic bacteria *Aggregatibacter actinomycetemcomitans*, *Porphyromonas gingivalis*, *Prevotella intermedia*, *Tannerella forsythia* and *Treponema denticola* molecular microbiological method GenoType Test System was used.
Results. Three types of periodontopathogenic bacteria, *A. actinomycetemcomitans, T. forsythia and T. denticola*, were found to be present.
Conclusions. During treatment with fixed orthodontic appliance special care is advisable, since this kind of environment is suitable for periodontopathogenic bacteria.

Influence of Applied Electron Radiation on Properties of Polyamide 11 Surface Layer

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Thermoplastics usage in technical practice grows nowadays due to their advantages, such as low weight, good mechanical properties, excellent chemical resistance and low processing temperatures. There are different modification methods for improving these properties, especially thermoplastics cross-linking.

This article deals with the influence of radiation cross-linking of polyamide 11 (PA 11) upon the mechanical properties. The aim of this study is providing more detailed knowledge of the relation between the radiation dosage and the properties of cross-linked PA 11 and its mechanical behaviour. Electron beam unmodified and modified PA 11 test samples were exposed to the electron radiation of dosages from 0 to 198 kGy, which were graded at 33 kGy. The surface layer properties of modified PA 11 were tested by a state-of-the-art indentation technique, which detects the immediate change in the indentation depth in dependence on the applied force. The evaluation of the measured mechanical properties (indentation hardness, modulus and creep) was done by the OLIVER and PHAAR method.

A significant influence of the radiation cross-linking on the PA 11 mechanical properties improvement was confirmed by the measurements. This enhancement grows with the increasing radiation dosage. Due to the electron radiation modification of PA 11, the mechanical properties of the surface layer were increased by up to 59 % compared with the unaltered material. Radiation crosslinking is an important thermoplastic modification method by which the desired properties can be achieved in a relatively short period of time. The main advantage is that the process is executed on the final product.

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Comparing Measurements With Different Catalytic Probes in RF and MW Plasma

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Studies of low pressure plasma are often focused on the density of reactive particles, ranging from ions, free electrons to meta-stable neutral atoms and molecules. While most of those particles have a specific use in plasma, be it etching, sterilization, etc. depending on the material, we have focused on neutral particles. There are many methods for determining the chemical structure and measuring the density of neutral particles, such as NO titration. self-excited electron plasma resonance spectroscopy (SEERS), optical emission spectroscopy (OES), and in our case, catalytic probes, which is the focus of this study. We measured radiofrequency (RF) and microwave (MW) plasma discharges of several different gasses: oxygen, hydrogen, nitrogen and carbon dioxide. We measured neutral atom density using both a standard catalytic probe and an optical catalytic probe, latter of which gave us results for density in real time. Our main focus was comparing responses of different catalytic probes, which all had a chromel-alumel thermocouple and a tip made of some catalytic material. Most measurements were done using a cobalt tip in different shapes (disc, tile, etc.). We also used a tip made of nickel in the shape of a disc and a tip made entirely of nickel foam. Lastly, we used two smaller and similar catalytic probes, one with a cobalt tip, and the other with a gold tip. In this study we present the measurements of neutral atom density versus the input power of the generator, real power (input power minus reflected power), pressure and distance between the tip of the probe and the area of discharge (in our case, the coil inducing the RF plasma discharge). We compare the responses of probes with different tip surface areas, and the different temperature responses that each depending on the chemical composition of the probe tip.

Treatment of implant-associated Infections

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Biomedical implants have revolutionized medicine and have significantly improved patients' quality of life. Invasive devices and implants are inserted for treatment in nearly all anatomical locations of the body; currently more than 500,000 medical devices are registered for use on the global market. However, implants have a risk of becoming infected, which is one of the most serious complications that can have catastrophic consequences for the patient. Implant-associated infections are the result of complex interactions between the pathogen, the implant and the host immune response to both. Because bacteria causing implant-associated infections form biofilms on biomaterials, have mechanisms to evade host immune system and can even modify host immune response these infections are notoriously difficult to treat. Conventional management of implant infections usually consists of the removal of the implant and antibiotic therapy that can be applied systemically and/or locally. Especially in orthopaedic surgery there are many materials that are used as carriers for local antibiotic delivery: polymethyl methacrylate bone cement, calcium-sulfate beads, hydrogels, synthetic bone substitutes and so on. When possible, antibiotics that are active against biofilm should be used for systemic therapy of implant-associated infections (i.e. rifampicin for staphylococcal infections and fluoroquinolones for infections caused by Gram-negative bacilli). New therapeutic options that are currently under investigation include phage therapy, use of antimicrobial peptides and quorum-sensing inhibitors. Also, modifications of microtopology and nanotopology of the implant surface that interfere with bacterial adhesion and formation of biofilm are being investigated.

Applications of Computational Thermodynamics to Inclusion Control for Clean Steel Processing

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The Mn and V alloyed steel, which has a ferrite-pearlite composite microstructure, have been widely used as automotive parts such as crankshafts, push rods, rotating bearings, etc. due to its excellent machinability and high-strength. However, the product performance can be significantly affected by the steel cleanliness. The $MgAl_2O_4$ spinel inclusion, which generally formed during the ladle refining process, potentially causes nozzle clogging as well as surface defects in products. Hence, it is crucial to predict and control the inclusion composition during the ladle refining process. In the present study, the effect of CaO/Al_2O_3 (=C/A) ratio of the ladle slag on the formation behavior of non-metallic inclusions in the Mn-V-alloyed steel was investigated using both the experimental method and refractory-slag-metal-inclusion (ReSMI) multiphase reactions simulation. The formation behavior of inclusion was strongly affected by the activity of MgO in the initial slag at the early stage of the reaction. However, since the MgO activity converged to unity due to MgO dissolution from refractory to slag during the reaction, the formation behavior of inclusion was affected by the activity of CaO and Al_2O_3 in the slag rather than that of MgO at the final stage of the reaction. From the experimental results and ReSMI process simulation, the formation behavior of inclusions could be divided into three cases according to the C/A ratio of the slag as follows; 1) C/A < 1.5; Alumina → Spinel → Spinel + Liquid oxide, 2) 1.5 < C/A < 2.5; Alumina → Spinel → Liquid oxide, 3) C/A > 3.0; Alumina → Spinel → Liquid oxide → Magnesia. Therefore, it was concluded that the C/A ratio of the ladle slag should be controlled from about 1.5 to 2.5 in order to suppress the harmful solid inclusions such as spinel during secondary refining processes.
Key words: Mn-V-alloyed steel, Cleanliness, Spinel, Inclusion, Ladle refining, Slag

Self-healing Aluminium Alloys – ECCI Investigation of the Mechanism

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Imagine aluminium alloys with high strength, good corrosion resistant and well transformability with a new property – possibility of a self-healing process. The outstanding light metals are being developed.

Aluminium alloys are employed extensively for aircraft and automobile applications. In both cases the application is limited by slow fatigue damage evolution during service. If crack growth could be postponed the life span of components would be increased and the frequency of inspections reduced. An intriguing concept to achieve this is the incorporation of self-healing mechanisms into engineering materials. Self-healing of damage is an important concept in biological materials but is, so far, not so common in engineering materials. Aluminium alloys, particularly, have been considered because they show, even at room temperature, high mobility of atomic species which allows dynamic precipitation in areas with high strain and/or damage.

In our study aluminium alloy of series AA 7xxx is being developed. Homogenized alloys were solution-annealed and quenched to obtain supersaturated alloys. These was submitted to different thermal treatments, including underaged, fully aged, and overaged conditions. The state of precipitation was followed by hardness measurements and SEM as well as TEM observations of selected samples. Microstructures of selected samples from different stages of testing and ageing were investigated with respect to their precipitation state and dislocation density using different electron microscopy techniques, mostly SEM with belonging analytics; EDX (electron x-ray diffraction), EBSD (electron backscattered diffraction) and ECCI (electron channelling contrast imaging.

Percutaneous Implantation of self-Expandable Left Atrial Appendage Occluders for Prevention of Thromboembolic Complications of Atrial Fibrillation

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Atrial fibrillation (AF) is the most common persistent arrhythmia, affecting up to 2 % of population. Presence of AF increases the risk of ischemic stroke up to 5-fold, and cardiogenic cerebrovascular events carry more mortality risk than do ischemic strokes of other etiologies.[1] For decades, prevention of AF associated thrombembolism was based on blood thinners, such as warfarin, and more recently, direct anticoagulant drugs. However, risk of bleeding associated with this drugs, as well as other factors complicating this therapy, resulted in considerable undertreatment, and less than ideal patient compliance, resulting in a number of unprotected patients with ongoing stroke risk.[2] It has been shown, that approximately 90 % of intracardiac thrombus formation in the setting of AF occurs in the left atrial appendage (LAA). Based on that fact, minimally invasive interventional tecniques of LAA mechanical occlusion have been developed, as an alternative for the patients with contraindication for anticoagulants. During the procedure, a self expandable umbrela-like device is introduced trans vascular via a guiding catheter into the left atrium. Then, it is positioned in the body or the neck of the LAA. The device consists of a nitinol cage with a thin polyethylene/polyester membrane covering the surface facing the LA. In that way, the LAA is excluded from the blood flow, and any potential thrombembolisation from this site is prevented. Data from randomized studies, and registries, has shown, that this treatment provides comparable thrombembolism prevention rates to oral anticoagulants, with lower risk of life threatening bleeding.[3] At our institution, first procedures were performed in 2010, and after several years hiatus, reinstituted in the 2018. Within the last 6 months, six patients were successfully implanted with the device, without complications. On follow up, echocardiographic control confirmed correct device position, and absence of blood flow in the LAA. In summary, percutaneous implantation of the LAA occluding device represents effective, and safe alternative method for the prevention of AF associated trhrombembolism in the patents with contraindication for anticoagulant drugs.

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SiEVA 3D LAB – An Inovative Business Model Connecting Economic and Academic Sector

Boštjan Podlipec
SiEVA 3D LAB

The main objective of the presentation will be to demonstrate very successful innovative business model connecting economy and academic sector. The achievements of the SiEVA 3D LAB's one-year operation will also be presented.
SiEVA d.o.o. is a company created by leading companies of Slovenian automotive industry with the aim of conducting research and development activities in the fields of automotive industry. In recent years there has been a significant advance in 3D metal printing technology. The benefits of 3D metal printed parts resulted with increasing demand for this technology also in automotive sector. To take advantage and to be active part of new technology, SiEVA decided to establish 3D metal printing laboratory. SiEVA presented this idea to private and public sector which resulted in successful collaboration of private companies and academic sector – the establishment of 3D LAB on Faculty of mechanical engineering in Ljubljana in October 2018. The demand for 3D metal printing products exceeded all expectations and in one year we successfully completed more than 80 different prints in which we made more than 650 products using tool steel and aluminium powder.

SEM and TEM Characterization of Different Materials using FIB Technology

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The focused ion beam (FIB) instrument is widely used for fundamental material studies and also for fabrication of nanostructures for different purposes. The working principle is similar to a scanning electron microscope (SEM), where a focused beam of electrons is used to interact with the sample surface, mostly for nondestructive imaging. Energetically higher focused ion beam (FIB) in contrast can be used for milling, etching and can be also used to accurately deposit small amount of various materials. FIB instrument is combined with both SEM and FIB columns with injection systems. Consequently, imaging as well as material manipulation in range of few nano to few tents of micrometers is possible.

Instrument, available at CENN Nanocenter, Ljubljana, is used for cross-section analysis, nano-pattering, TEM sample preparation, 3D tomography and deposition of thin conductive films via ion-beam induced deposition. I will present how several different materials were prepared for cross-sectional and transmission electron microscopy (TEM) analysis. Hydrothermally grown TiO_2 film on Ti foil and nanoporous anodic aluminum oxide (AAO) film were etched with gallium ions (FIB source) all the way to the substrate. We identified morphology of individual crystals, film thickness, size and shape of pores and we also analyzed the contact between film and substrate. The two main advantages of TEM sample preparation using FIB compared to the conventional preparation are that with FIB we can precisely choose the region where to investigate and that dimensions of prepared sample are much smaller, we used the latter at NdFeB magnets. We confirmed orientation relationship of newly grown iQc phase on TiB_2 and growth habit in multi-structure of graphene oxide (GO), strontium titanate (STO) and silicon substrate was analyzed. And finally, we also showed how to prepare powders thicker than 100 nm. In particular, we thinned TiO_2 crystals to investigate its internal structural relations.

Case report of Ceramic Acetabular Fracture in Total Hip Arthroplasty with Ceramic-on-Ceramic Articulation

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Female of 64 years, was admitted to Clinics for Orthopaedic surgery, UMC Ljubljana, Slovenia, in December 2010 due to advanced arthrosis of the right hip. She has undergone total hip arthroplasty surgery - EcoFit endoprothesis, femur 8,75 lateral with acetabulum size 48, ceramic inlay and short ceramic head size 32.

In 2017 she reported pain and crepitations of the prothesis during the movements of right hip. She got local block injection in the trochanteric region. X-ray showed good position of prothesis. In December 2018 the patient reported pain in the right trochanteric hip region which exuberates during minimal movements. She limps when walks. X- ray of pelvis with hips presented cranialization of implanted head together with acetabular changes in the inferior part of the right hip endoprothesis. It has been speculated that ceramic parts have fractured and there have been soft tissue reaction due to ceramics.

In January 2019 she went for revision surgery due to fracture of ceramic implants of EcoFIt prothesis. Cemented double mobility prothesis together with matching femoral head was implanted. Additionally there was a lot of reactive soft tissue removed around the hip joint due to methalosis. Few days after she dislocated the prothesis and another revision surgery was made the size of the head was changed for XL. One week after she dislocated her hip (3rd time) an was rated with closed reposition. A month later she dislocated right hip again. Revision surgery was made with double mobility implant (PolarCup 55/28, stem 5 Link) and Muller ring. During rehabilitation she luxated her right hip two times more and was treated with closed reduction.

In April 2019 the patient went for a surgery where we released fibrous and necrotic tissue around right hip area as well as fixation of greater trochanter with the polypropylene mash and transposition of m. gluteus maximus to the insertion. Three weeks after this surgery patient came back with periprothetic infection. She went for a revision surgery and removal of the implant. Staphylococcus Aureus was treated with antibiotics and patient ended with 6 cm shortening of the right leg. She is able to walk with walker on a short distance.

Three-Dimensional Assessment of Back Asymmetry

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Aim. The aim was to develop a non-invasive landmark independent three-dimensional method for the assessment of back asymmetry in children.
Subjects and Methods. A group of 70 subjects (36 boys, 34 girls; 6.8 ±1.2 years) in the pre-pubertal growth phase was included. Back scans were obtained with the subjects in a standing position using a three-dimensional stereophotogrammetric scanner. Back asymmetry was assessed qualitatively and quantitatively on colour deviation maps of superimposed mirrored three-dimensional back scans. The assessment was performed at different tolerance levels, starting at 2 mm, which was determined as the lowest technically possible tolerance level, based on twenty repeated scans. In order to determine the most valid tolerance level for the assessment of back asymmetry, the diagnostic accuracy was tested at the 2 mm, 4 mm, 6 mm, and 8 mm tolerance levels. As the golden standard we used a dichotomized state variable, based on the actual vertical calculated distances between the Y coordinates of two corresponding left and right reference points on 3D scans. In particular, the absolute vertical distance between the left and right shoulder, the absolute vertical distance between the left and right scapula and the absolute vertical distance between the left and right pelvis were dichotomized and a positive value was assigned when the distance was greater than either 2 mm, 4 mm, 6 mm or 8 mm threshold level. ROC curves were generated and the area under the curve calculated at different tolerance levels. Furthermore, for each tolerance level, the cut-off point with the highest sensitivity and specificity values was also determined. To quantify the full method error, the method of moments variance estimator was used on 20 pairs of randomly selected repeated recordings and was calculated as mean and 95% confidence interval.
Results. The greatest area under the ROC curve, showing at least a good method was seen for the assessment of back asymmetry at the 2 mm and 4 mm tolerance levels, with areas under the curve of 0.93 and 0.87, respectively. While for the 6 mm and 8 mm tolerance levels, the areas under the curve were below 0.70, indicating a poor method for the assessment. The cut-off point for the assessment of back asymmetry at the 2 mm tolerance level with the highest sensitivity (0.82) and specificity (1.00) was 14.2%, while for the 4 mm tolerance level it was at 1.2%, with the sensitivity of (0.86) and specificity (0.75). However, the method error calculated on repeated measurements was 1.6% (1.2%-2.6%) of asymmetry, which is higher than the cut-off point at the 4 mm tolerance level.
Conclusions. The use of a landmark independent stereophotogrammetric method is valid and reliable for the assessment of back asymmetry in children. The most valid level at which asymmetry could be detected was determined to be the 2 mm tolerance level.

Wear Resistance of Hot-Work Tool Steel

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In industrial processes, forming tools are exposed to complex loading, such as wear, plastic deformation and fatigue, which often results in tool damage and failure. Hardness, as a basic characteristic of the tool is not sufficient anymore, therefore it is necessary to take into account the entire spectrum of mechanical properties and parameters, including wear resistance and formability. The purpose of research was to perform tribological investigation of hot-working tool steel, subjected to different heat treatment parameters. Experimental results have been used to analyze the dependence of the tool steel wear resistance on the heat treatment conditions. Furthermore, correlations have been made between mechanical properties and wear resistance, which will enable users of hot work tool steel to select proper mechanical properties and corresponding heat treatment for selected applications.

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Additive Manufacturing at ESA From Technologies to Applications Developments

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Additive Manufacturing has emerged as a game changing technology in Space Industry less than 20 years ago. Since then, the number of people involved in Additive Manufacturing has exploded and today, two parallel paths are followed in parallel with strong interactions between those. One the one hand, the Additive Manufacturing Technologies are matured based on a better understanding of the Additive Manufacturing processes and the impact they have on materials properties. On the other hand, space parts are developed under the leadership of end users dealing with e.g. structures, mechanisms, optics, radio-frequencies. The presentation will present a selection of technologies and applications developed within technology programmes and enabling today the installation of the first Additively Manufactured parts on ESA space missions.

Tribological properties of 3D printed parts

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In contrast to conventional, subtractive manufacturing methods, additive manufacturing (AM) is based on an incremental layer-by-layer manufacturing. As such, most relevant AM technologies commonly use powder or wire as a feedstock which is selectively melted by a focused heat source and consolidated in subsequent cooling to form a part without the need for intermediate shaping tools. It is a free form fabrication method, which in recent years has also been successfully applied to the manufacturing of geometrically complex commercial metal components. Especially laser based melting methods have gain great interest allowing the use of different alloys and steel powders.
Laser based melting processes produce parts or components from digital information piece-by-piece or layer-by-layer with the overall geometry being determined by laser paths, projection patterns or a combination of the two. This simultaneously defines the final geometry of the component and determines its material properties. However, each layer thickness and the strength of the bonds between the layers are determined by the raw material, the manufacturing equipment and the process parameters, thus influencing the final properties. From a design perspective the challenge of additive manufacturing is to understand the limitations and opportunities of these new processes and mainly to understand the effect of different process parameters in order to be able to optimize it for a specific application.
The most important and studied parameters, affecting integrity, microstructure and properties of laser-based AM parts are laser power and scan speed. However, there are also other aspects including heat treatment and build-up direction. Thus, the aim of our research work was to study effect of building direction and post heat treatment on wear properties of maragin steel parts produced by direct metal laser sintering and how these properties correlate with obtained mechanical properties. Investigation was performed on EOS M280 DMLS system, including vertical, horizontal and 45° build-up of different test specimens made from maraging steel powder. After additive manufacturing specimens were subjected to different heat treatments and wear and mechanical properties evaluated in different building directions. Investigation results show strong influence of the building direction on the obtained anti-wear properties, with the horizontal building direction providing the best wear resistance under dry sliding conditions.
Keywords: additive manufacturing, building direction, heat treatment, microstructure, wear resistance

Influencing Parameters and Measurement Uncertainty in Mechanical Testing of Al Alloys

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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.

In order to boost further research and development and especially to properly use materials in design, a complete understanding and information on their properties, such as elastic modulus, yield and ultimate strength, hardness, formability etc. must be obtained. It is also vital to know how these properties are affected by the conditions of a specific application of the material and its use. Factors such as the size of the part, surface condition, heat treatment, loading direction, rate and type of loading may result in changes to these properties that 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 properties and its response on thermal and mechanical loading is crucial when developing and selecting material for automotive components.

Measurement results in industry, used for development, conformity check, decisions, design as well as legal actions must be obtained under well-defined conditions and with sufficient accuracy and reliability. The simplest way to express the reliability of results are repeatability, described as a standard deviation, and measurement uncertainty. Over the last decades, various concepts and procedures of uncertainty evaluation were proposed and discussed. However, with the publication of the Guide to the Expression of Uncertainty in Measurement (GUM), first published in 1993 and edited in 2008, an importance of measurement uncertainty in the modern context of quality assurance has been recognized and a unified method for its evaluation and expression accepted worldwide.

The aim of the work was to examine and identify influencing parameters in terms of measurement uncertainty in mechanical testing of Al alloys and to determine measurement uncertainty when it comes to hardness, strength, formability, dynamic behavior and heat treatment of Al alloys.

A success story for More than 30 years: From Basic Research to the Industrial Innovation of Magnet Materials at Jožef Stefan Institute, Slovenia

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At the Jožef Stefan Institute, a leading Slovenian research organization in the field of natural sciences and technology, systematic and consistent research of permanent magnets is traced way back to the 1980. In the last twenty years, this initiative concentrates within the Department for Nanostructured Materials, within a research group specialized on magnetism, magnetic materials, and magnetic characterization. The fact that a world-wide recognized research group on magnetic materials is present in a relatively small country of Slovenia is in many ways associated with an exceptionally high concentration of companies focused on the production and implementation of various types of permanent magnets. The research collaboration has been always motivated by the on-going strategy of industry-driven basic research close to industrial innovation. It is therefore not surprising that during the rare earth crises approximately ten years ago, where European magnet industrial sector was nearly collapsing, all of the related Slovenian companies not only survived, but also strengthen their positon in the European region and worldwide.

In this presentation we will uncover historical backgrounds and current research strategies, which led to the on-going miracle of magnet industry in Slovenia, which will be shown through the prism of various success stories from basic-research driven industrial innovation, to the high impact implementation of the circular economy and problem-solving approaches during the production of different magnet types. These research strategies include, but are not restricted to, development of high-end corrosion protection for magnetic powder, failure analysis during the magnet production and the development of novel magnetic materials for state-of-the-art magnetic traction sensors for the robotic industry.

How to Smart-tune Surface Properties of Materials by Plasma

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Nowadays numerous industries – such as electro, automotive, semiconductor, even medical and agricultural fields – employ plasma technologies for tailoring surface properties of various materials. For achieving this, one can use different well-known wet chemical treatments, which are effective, but represent a burden for the environment. Plasma, the fourth state of matter, is well known as almost or in some cases completely ecologically benign technique for tailoring materials' surface properties. Laboratory-scale reactors (even more so large industrial ones) can be hard to operate with, because plasma is a complex mixture of charged particles, neutral particles and UV light, therefore it can have more than one effect on the treated material's surface. Material modification is dependent on the so called plasma parameters (temperature and density of plasma particles, dissociation and ionization fraction, Debye length…), which are further dependent on discharge parameters (type of gas, pressure, applied power, E and M field). The best way to achieve repeatable and desired material treatment is by monitoring and controlling plasma parameters, rather than discharge parameters. It is somewhat easier to control discharge parameters, but plasmas are capricious, because plasma parameters may change without changing the discharge parameters. Besides material treatment, we will take a look at an advanced method for measuring radical density (a plasma parameter) in real time employing a laser optic catalytic sensor[1,2]. We will mainly focus on electrode-less inductively coupled discharge.

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Microstructural Characterization of Ledeburitic Tool Steel after Sub-Zero Treatment and Tempering

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Microstructural characterization of ledeburitic tool steel Vanadis 6 after sub-zero treatment and tempering has been examined. The samples were heat treated using following schedules: heating to the austenitizing temperature (T_A = 1050 ^{o}C) in a vacuum furnace, hold at the final temperature for 30 min. and nitrogen gas quenching (5 bar). The sub-zero treatments consisted of immediate (after quenching) immersion of the material into the liquid helium (-269 °C), hold at the soaking temperature and removal the samples to be heated to a room temperature. Double tempering has been performed at the temperatures from the range 170 – 530 °C, whereas each tempering cycle was realized with a hold of 2 h. Typical heat treated microstructure of ledeburitic steels consists, besides of the martensitic matrix with certain amount of retained austenite, of several types of carbides – eutectic, secondary and small globular carbides. In sub-zero treated steel the amount of retained austenite is significantly reduced. The population density of small globular carbides increase as a result of sub-zero treating. Tempering of the material resulted in decrease in population density of small globular carbides with increasing the tempering temperature. The hardness of sub-zero treated material is higher than that of conventionally quenched one. Also, this tendency is preserved when the steel is low-temperature tempered. On the other hand, the hardness of conventionally quenched steel becomes higher than that of SZT one when tempered at the temperature of secondary hardening.

Use of Numerical Simulation in the Production of Porous Metal Casting

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The article describes the design and optimization of foundry production of a porous metal. The formation of porous metal by infiltration of liquid metal into the mould cavity appears to be the fastest and most economical way. But even here, it is not possible to do it without the proper production parameters. For that reason a 3D model of a particular casting is first created in the Rhinoceros 4.0 software and then the entire production process will be designed and optimized using the numerical simulation in the MAGMASOFT® 5.4 software. To create cavities in the casting the use of sand cores is considered and the used unit bentonite mixture (UBM) will be the mould material. With simulations of pouring and solidification of the casting the right conditions for the real production can be defined exactly and the time and financial costs connected with the occurrence of non-conforming pieces can be saved. Thus the aim is to ensure the production of sound castings, which would find their use in the field of energy, specifically as heat exchangers.

Dynamic Response of Material during the High-Speed Impact

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The material of the aircraft structure must resist to the high-speed impact – it means the impact of the bird or of the hail at the flight speed (bird-strike or hail-strike). Proof of this resistance can be made by experimental or by the numerical way. The recent development of the numerical methods takes advantage of the numerical way. However, the necessity to verify used numerical models creates new challenges on the experiments. The goal is to measure and to record a great deal of data during the very short time of the high-speed impact.

Use of the high-speed load cells makes possible to record the time-dependent force response of the impact event. However, the major difficulty of this approach is the existence of the parasitic resonances. The experimental stand, the support of the studied specimen, has the eigen dynamic response and in consequence, the final measured dynamic response is coupled with the stand structure one. The objective of the stand design is therefore to minimize these parasitic resonances, due to the stand structure dynamics.

In this way, the special equipment for the experimental research of the dynamic response during the high-speed impact was designed, optimized by means of FEM numerical simulations and manufactured. The impacts series of the artificial (gelatinous) bird, ejected from the pneumatic gun into the plate aluminum alloy specimens were carried out. After, the residual part of the parasitic resonances was eliminated by the signal post-processing of the load cells records.

The experimental results obtained confirm the feasibility of the proposed approach. Due to appropriate, optimized design of the equipment and due to the signal post-processing of the load cells records, the parasitic resonances are practically eliminated and the real time-dependent force response of the impact event is determined.

Synthesis and crystallization process of advanced BaO-MgO-Al_2O_3-SiO_2 system, as an attractive protective coating material

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One way to increase turbine efficiency and reduce pollutant emissions would be to work in harsh environments with high temperature and corrosion environments. Therefore, it is essential to develop new materials that are able to withstand environmental and mechanical conditions. Such coatings are usually a combination of ceramic layers that can better counteract aggressive environments and protect the substrate. For many years, many ceramic systems have been developed and studied as thermal and ecological barriers. However, the costs and stability of such materials still require research and improvement for decreasing the price of production costs, maintaining the best protective properties. The barium aluminosilicate ($BaAl_2$ Si_2O_8 = BaO · Al_2O_3 · $2SiO_2$, BAS) is studied because of its high chemical stability and low thermal expansion coefficient, which makes it one of the most attractive protective coating materials. The main aim of this article is laboratory preparation of advanced BMAS powder by solid state reaction and physicochemical characterization of the resulting BMAS powder, focusing on the microstructure and phase analysis. Microstructure is observed from the viewpoint of changes on its crystallinity. The analyzing of the crystallinity changes of BMAS powder is based on the measuring of the full width of half maximum of diffraction line in selected crystallographic directions during the heating up to 1200 °C and cooling down in Anton Paar HTK 2000 high-temperature chamber.

Influence of Different Strain Rates During Tensile Test on the Measured Mechanical Properties

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Tensile tests were performed on aluminium alloy 2030 with aim to investigate how different strain rates affect on yield strength, tensile strength, and elongation during tensile test. We used method A1 according to the standard SIST EN ISO 6892-1:2017 for reference state, where test speed was 0.00025 s^{-1} for yield strength and 0.0067 s^{-1} for tensile strength and elongation determination. Test speeds were than decreased and increased by a factor of 10, 100 and 1000, respectively. Measurements were made with the type B samples (DIN 50125). Tensile test machines used included servo-hydraulic and twin-spindle type machine, equipped with 250 kN and 50 kN load cells. Detailed analysis of the test results for yield strength (MPa), tensile strength (MPa) and elongation (%) at different strain rates will be presented.

Influence of Melt Distance from Gate on Surface Quality

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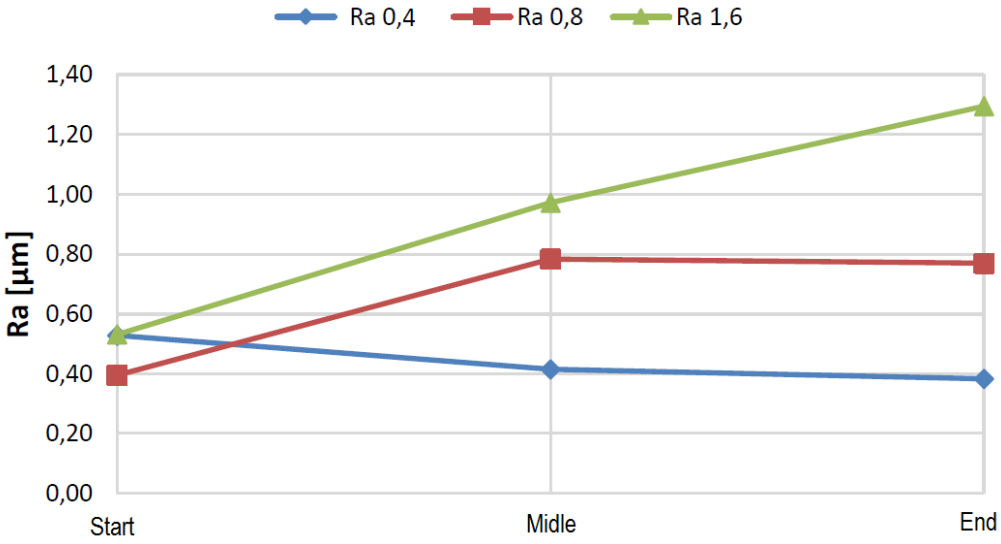
Injection moulding is currently one of the most utilized technology in plastics industry. This trend is caused by the numerous advantages that the injection moulding process provides, e. g. high productivity, low product cost, great repeatability, the ability to create diverse shapes. However, there are some negative aspects of this technology, especially the high acquisition price of the mould. This cost depends on the complexity of the mould as well as the customer requirements for the surface quality of the product, which is corresponding with the surface quality of the mould. The ability of the material to copy the surface of the mould is governed by many factors, for example roughness of the mould surface and the injection moulding parameters.



The visualization of roughness in points with varying distance from the gate

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Ensuring Temperature Homogeneity in the Process of Solution Annealing of Duplex Heavy Steel Plates on the Heat Treatment Line – HTL

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Duplex stainless steels belong to the corrosion resistant steels, which contain high content of chromium (≈ 22%) and nickel (≈ 5%). These steels are additionally alloyed with molybdenum and nitrogen. They are characterised by very good mechanical properties, especially yield strength – $Rp_{0.2}$ and tensile strength – R_m. They are resistant to pitting and stress corrosion cracking and **they have good weldability and reasonable formability**.

In SIJ Acroni, the part of production process in the manufacture of duplex heavy steel plates is heat treatment on the heat treatment line – HTL. The process on the HTL line consists of sandblasting, solution annealing (in the high temperature furnace – HTF) and quenching (MFQ).

During heating, the maximum allowed temperature deviation between the furnace (HTF) and duplex heavy steel plates is essential for ensuring a high-quality heat treatment.

To ensure the temperature homogeneity, it is necessary to follow a specific technical specifications and other criteria that are consistently used, which is also ensured by the relevant standards. Two of the standards that define the process of preparing and performing temperature measurements and which must be followed when performing control measurements and is also presented in the poster, are ASTM A991 and NORSOK M – 650, Annex B and Annex C.

Key words: duplex heavy steel plates, temperature homogeneity, HTL, solution annealing, quenching

The Vanguard Initiative 3DP Pilot: Concept and Opportunities for Metal 3D Printing

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Network Manager of the 3DP Pilot, Expert in Innovation Policy and industrial change at IDEA Consult

The main objective of the presentation will be to shed light on the objectives and characteristics of the Vanguard Initiative 3DP Pilot in order to inform conference's participants about the possible opportunities offered to them by the Pilot.
The Vanguard 3DP Pilot is a structural and cross-regional partnership that aims at accelerating market uptake of 3DP applications in the EU through the development of industry-led, transregional demonstration platforms that connect 3DP capabilities and actors (companies, facility centres, universities etc.) that were operating in largely disconnected and fragmented value chains in Europe. The 3DP Pilot supports the emergence and implementation of industry-driven cross-regional demonstration projects. Many of these cases are related to metal printing.
In the coming months, the Vanguard 3DP Pilot will undertake, among others, the actions described below. Participants interested in contributing to / benefiting from these actions are welcome to join!

- To strengthen the network of demonstration service providers and end-users looking for solutions (incl. metal 3D Printing) in the network(s);
- To identify and support the implementation of additional business cases;
- To address transversal industry-bottlenecks such as certification, skills, awareness and funding.

The influence of Chemical Composition and Heat Treatment on mechANICAL PROPerties and Formability of Aluminium Alloy EN AW- 5454

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The study of the influence of chemical composition and heat treatment on mechanical properties and formability of the selected commercial aluminum alloy EN AW- 5454 was made. The main properties of the alloy 5454 from the 5xxx series are very good corrosion resistance and formability. From the cast slab a 50 mm thick slice was taken in the width cross-section in the slab canter. One half of the slice was homogenized for 10 hours at temperature 530 °C. The as-cast and homogenized samples were investigated using light and scanning electron microscopy. For the study of the influence of the heat treatment on the selected alloy, samples in the as-cast state were annealed in the laboratory furnace at the temperature of 530 °C for 4, 6, 8, 10 and 12 h. For the study of the influence of the chemical composition on the selected alloy, four different samples were produced: first without additions, second with addition of 1 wt. % Mn, third with 3 wt. % Mg and fourth with addition of both elements, manganese and magnesium. The XRF analyses confirmed the desired chemical composition of all four produced alloys. The half of each alloy samples were homogenized at the same temperature and time as the base alloy in as-cast state. The hot deformation behavior of different alloys has been investigated by means of hot cylindrical compression tests carried out on a thermomechanical simulator Gleeble 1500D. The high influence of the thermomechanical parameters on the formability of the selected alloy can be seen by comparing flow curves.

The work was co-financed by the Republic of Slovenia, the Ministry of Education, Science and Sport, and the European Regional Development Fund in the framework of the project MAteRials and TechnoLogies for New Applications (MARTINA, Grant No.: OP20.00369).

High Density Carbon and Metal-Carbon Structures by Spark Plasma Sintering

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Quasi-molecular solids, such as carbon nanotubes (CNTs) and graphenes, have been widely studied last years. Due to their physicochemical and mechanical characteristics, they are promising objects for practical use, in particular, for the production of diverse composite materials for catalysis, adsorption, electronics and energy storage. One of the main challenges of their wide practical use – is a low value of the density. It can be overcome using different physical and chemical approaches. From the viewpoin of the technology, chemical inertness and thermal stability as well as density, spark plasma sintering (SPS) which is well developed for metals and ceramics is highly perspective. This technique allow to produce compact materials of different shapes under high pressure and temperatures reached by passing of pulsed electrical current through the sample. These features provide high speed consolidation of the powder with certain mass transfer and unstable phases decomposition. As a result it becomes possible to fabricate dense and consolidated sampleas of different shapes without the addition of binding materials and complicated multi-staged technological procedures. The products of sintering of CNTs and 2D few layers graphene-like structures (GNF) proceeded under different pressures and temperatures have been investigated by thermal analysis, electron microscopy, Raman spectroscopy, gas and liquid sorbtometry. It was found that the growth of temperature and pressure increased the density up to 1.9 $g \cdot cm^{-3}$ and electrical conductivity of 3000 Sm/m for GNF. It all the cases is accompanied by the disappearance of macropores and the growth of meso- and micropores numbers. The total pore volume as well as BET surface area decreased. The CNT structure after 1000^{o}C and 15 MPa was found to became much less defect with 3D networks formation, while GNF undergo graphitisation. These frameworks from SPS of CNTs regularly decorated by cobalt oxide and cobalt nanoparticles were also obtained and characterized. The appearance of carbon shell all-around 4–10 nm Co particles was observed at temperature more than 600°C. Electrical conductivity of the composites was found to be in the range of 500–12500 Sm/m and increase with Co content. Magnetic experiments demonstrated soft magnetization of the samples and the coercivity of 200–300 Oe.

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Software Tools For Dealing With The Challenges Of Industrial Additive Manufacturing

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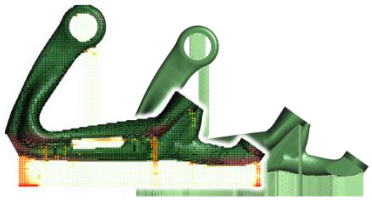
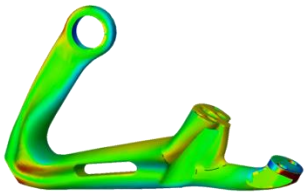
As the integration of powder based Additive Manufacturing into industrial production increases, a number of challenges gain in importance. Though it is one of the most significant advantages of Additive Manufacturing, the flexibility and degrees of freedom provided by the technology is also an often-underestimated challenge to production costs and continuous part quality.
This talk will shed some light on common problems such as process induced deformation, the need for part and print job individual support structure as well as print job individual thermal histories and material properties.
In this context, simulation-based approaches for dealing with these issues as well as their implementations into the Software suite Amphyon will be presented and compared to experimental data.

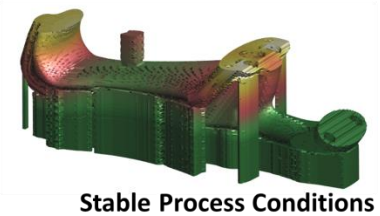


Optimized Support Structure



Compensated Deformation

Stresses



Stable Process Conditions

Micromagnetic Optimization of Permanent Magnetic Materials

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The development of permanent magnets containing less or no rare-earth elements is linked to profound knowledge of the coercivity mechanism. Prerequisites for a promising permanent magnet material are a high spontaneous magnetization and a sufficiently high magnetic anisotropy. In addition to the intrinsic magnetic properties the microstructure of the magnet plays a significant role in establishing coercivity. The influence of the microstructure on coercivity, remanence, and energy density product can be understood by using micromagnetic simulations. With advances in computer hardware and numerical methods, hysteresis curves of magnets can be computed quickly so that the simulations can readily provide guidance for the development of permanent magnets. In particular micromagnetic simulation can address the impact of grain size and grain shape on coercivity. The simulations show that for rare-earth free phases such as $L1_0$ FeNi small, needle shaped grains are beneficial. A small grain size becomes increasingly important if the chemical ordering of L10 FeNi is imperfect. Similarly, elongated grains can improve coercivity in $Nd_2Fe_{14}B$ magnets provided that the grain boundary phase is paramagnetic. Grain boundary phases are shown to impact coercivity considerably. Grain boundaries and interfaces may act both as pinning and as nucleation site. If two grains are in direct contact and exchange coupled, partial domain walls form at the interface between the grains. From there reversed domains can easily nucleate. This effect reduces the coercive field in rare-earth reduced permanent magnets in the $ThMn_{12}$ structure to about 10 percent of the anisotropy field. By computing the energy barrier for thermally induced magnetization reversal, micromagnetic simulations can show the weak spots in the microstructure, where magnetization reversal is initiated.

Work supported by the NOVAMAG project (EU H2020, Grant Agreement No. 686056) and the Japan Science and the Technology Agency (JST): CREST.

Use of Surface Texturing in Fine Blanking Tools – Influence on Fatigue Life and Tribological Properties

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Surface texturing is a way of changing the surface topography by generating micro-pores or micro-channels with the purpose for easier achieving elastohydrodynamic lubrication and reducing friction in very difficult operating conditions. Surface texturing has been successfully used in the application of sliding bearings, sliding surfaces of machine machines, cylinders of internal combustion engines and mechanical seals.

The use of hard protective coatings is practically unavoidable in modern industry. Protective coatings are now for some time already an indispensable component in the manufacture of high quality cutting tools. With a variety of coatings, cutting tool life can be extended, improve processing parameters and surface quality, reduce friction and increase the corrosion and oxidation resistance. For each type of work piece material certain type of protective coating is necessary and thus ensuring optimal function of cutting tools.

On the other hand, the use of protective coatings in the process of fine blanking is limited to the simpler geometries of the tools and only a few coatings, mainly due to the demanding conditions of dynamic impact loading, wherein even the smallest error on the surface can cause a failure of the punching tool.

Merging technologies of surface texturing and protective coatings has already been proven to be a promising way of reducing the amounts of lubricants and increased wear resistance, especially in slow moving systems. Unfortunately, very little is known about the behaviour of coated surfaces under dynamic loading and impact of surface structures, defects and cavities on the dynamic properties of the coated surface. With the implementation of surface textures, we enter the tensions into the surface, which can act as the starting point for the formation of cracks under the dynamic loading. This can lead to the failure of functionality of the coating and tool itself.

Purpose of this investigation was to investigate influence of surface texturing sequence (before or after TiAlN hard coating deposition) on fatigue and tribological properties. For testing fatigue properties polished hourglass-type test specimens and for tribological properties plate samples made from cold work tool steel were surface textured using picosecond laser. Outer diameter of dimples was set to 65 ± 2 μm and depth to ~10μm. High cycle fatigue tests at different stress levels were carried out using a servo hydraulic fatigue testing system. For tribological properties lubricated tests were performed in block-on-ring configuration under different contact conditions using PAO8 oil as a lubricant. Evaluation test using textured and not textured simplified fine blanking tool was performed. It was established that sequence of surface texturing can have influence on fatigue and tribological properties.

Study of Recycling Effect to Polyamide 6 on Tensile Properties at Elevated Temperature

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Plastics recycling is a waste management process that leads to its reuse. Waste from plastics production (such as injection molding cold runner, defective products) can take on a large volume that can be used in many ways. It is a waste that can be processed without various properties enhancing additives. In order to use this waste, it must be crushed into smaller particles. However, the crushing of the waste material brings differently sized particles that exhibit different properties than the virgin material after additional processing.

This work deals with recycling of primary pure polymer waste from production. Studied material was polyamide 6. There are investigated different sized particles of crushed polyamide 6 on tensile properties. Prepared mixtures contained from small dust particles to large particles similar to the original size of the virgin material.

The measurement was carried out at an elevated temperature of 100 °C, because the products of this polymer are often used at these temperatures. The properties of the prepared mixtures are compared with the virgin polyamide 6. The results show that dust particles have the greatest changes on tensile properties.

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Spot the Difference – Microstructure of Modified 2011 Aluminum Alloy Undergoing Different Treatments

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In the scope of project MARTIN (Modeliranje termo-mehanskega procesiranja aluminijevih zlitin za vrhunske izdelke) we are investigating properties of modified aluminum alloys. Modified alloy 2011 will be used to create a numerical model to aid engineering aluminum alloys in the future. We compared microstructure of as-received cast, and homogenized alloy discs of alloy 2011, modified with 0.17 and 0.32 wt% Si. Additionally we analyzed extruded rods with some additionally thermo-mechanical treatments.

Light (LM) and scanning electron microscopy (SEM) with electron backscatter diffraction (EBSD) were used to determine their grain size and orientation. Light microscopy suffices for cast and homogenized samples, however the extruded rods pose a challenge. Their microstructure is too fine for light microscopy and can thus only be observed with EBSD. Sample preparation is crucial for obtaining good quality Kikuchi patterns to index the crystal lattice. Preparing the extruded as-received rods without additional treatment proves to be most challenging due to the amount of deformation. Grain morphology doesn't significantly differ between samples, modified with 0.17 or 0.32 wt% Si, but we observed the effects of different treatments.

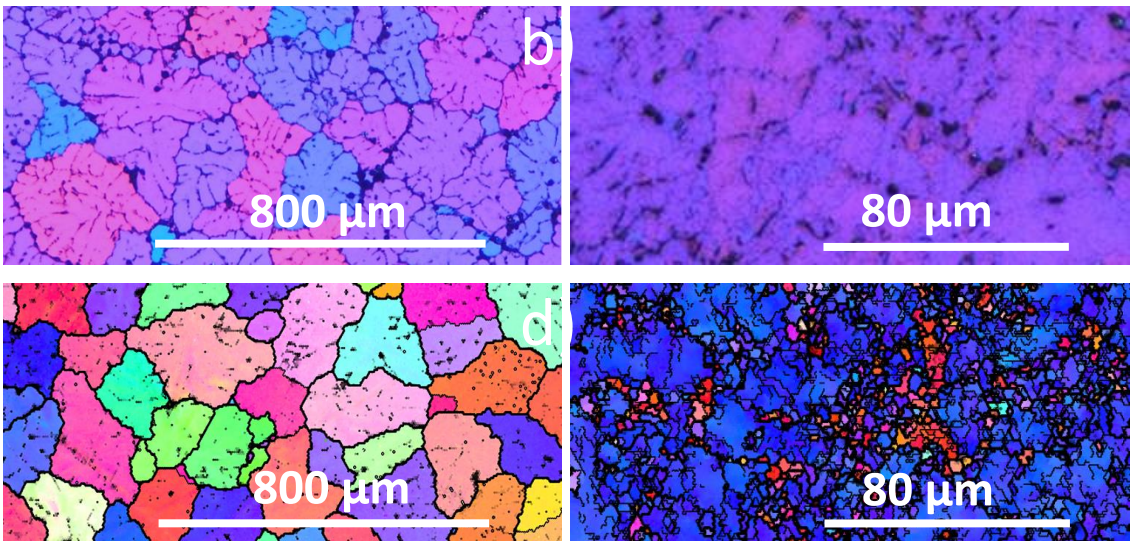

Figure 1: Microstructure of alloy 2011 with 0.17 wt% Si: a) optical micrograph of cast disc, c) optical micrograph of extruded and artificially aged rod, c) IPFZ map of cast disc, d) IPFZ map of extruded and artificially aged rod.

Correlations of Microstructural Characteristic of Tool Steels on Mechanical Properties and Wear Behavior

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Wear is the removal of the material from the surface of a solid body as a result of mechanical action of the counter-body. In order to establish wear properties wear tests are performed combining different contact loads, sliding speeds and changing environment.

Wear may combine effects of various physical and chemical processes proceeding during the friction between two counteracting materials, but state of the material is too often ignored. Hardness is still the main driving parameter regarding the wear. From microstrutural point of view, it is very important to see how type, size and distribution of the carbides affects the wear behaviour and mechanical properties. Different chemical composition of steel and the associated heat treatment results in different carbide types and volume fractions.

In order to investigate that, four tool steels were chosen (1. 2379, 1.2990, 1. 2363 and SITHERM S361R) that were produced via conventional metallurgical process and having different chemical composition in order to achieve variations in microstructures and mechanical properties. Furthermore, they were heat treated in a horizontal vacuum furnace using the austenitization temperatures recommended from the suppliers and tempered in such a manner to achieve similar hardness values (~ 49 HRc). Similar hardness was chosen in order to investigate influence of different carbides. Microstructure of tempered martensite with carbides type of M_7C_3, $M_{23}C_6$, and MC were found in tool steels with varying their volume fraction and size, depending of the tool steel type.

Mechanical properties were evaluated by the means of fracture toughness tests and hardness measurements.

Wear resistance was evaluated by using model testing apparatus for reciprocating sliding wear experiments. Air blowing during reciprocating sliding was also applied in order for in situ removal of wear debris, which in some cases resulted in significantly improved wear resistance. Behaviour of microstructure and especially hard carbide particles in the initial stages of the wear process was observed and proposed, conducting unidirectional pin-on-plate tests for very short period (few cycles). Where low fraction with small mean size of carbides is present in the matrix they are rapidly fractured, smoothed and glazed away. On the other hand, when microstructure containing higher fraction and larger carbides, they stay intact in the surface for longer period. Microcutting of large carbides is also present.

The Influence of Low-Temperature Plasma Nitriding on the Wear and Corrosion Properties of Additive Manufactured 316L Stainless Steel

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Additive manufactured austenitic stainless steel 316L was solution treated at 1060 °C for 30 minutes and low-temperature plasma nitrided at 430 °C. Corrosion resistance, wear behaviour, microhardness and changes in the microstructure were studied and compared to the properties of their commercial counterparts nitrided under the same condition. It was found out that the post-treated low-temperature plasma nitriding improves the corrosion and wear resistance of the AM samples. The obtained values are close to the values of conventional fabricated and nitrided 316L. Solution treating itself (without further nitriding) did not show any significant impact on those properties. Dislocation density, observed by electron channelling contrast imaging (ECCI) of solution treated AM sample is significantly lower compared to AM as-built and conventional fabricated 316L.

Coated Spine Implants – a Risk Factor for Surgical Site Infection?

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Surgical site infection (SSI) after posterior spondylodesis of thoracic and lumbal spine is the most common surgical complication, and a reason for revision surgery. There are many risk factors for SSI, such as comorbidities, age of patient, duration of surgery, type of implants, etc. Aim of this work is to analyze is the coating of spine implants a risk factor for the early SSI.

In our study we have analyzed the incidence of deep SSI after posterior spondylodesis performed on our Spine department during last 10 years (May 2008. – May 2018.). Including criteria were: posterior spondylodesis with transpedicular screws from Th1 to S2 due to different indications (injuries, degenerative diseases, deformities, tumors, etc), and absence of clinical signs of local or general infection prior the surgery.

Four hundred eighty nine patients with 505 surgeries have been included in this study, with average follow up of 4.3 years (2.0-10.5 y.). Early SSI (within a month after the surgery) has appeared at 13 patients (2.57 %). In the group of 153 patients whose titanium implants were uncoated, only 2 infections has been noted (1.31 %). The rest of 11 patients with early SSI were from group of 352 patients with coated spine implants (3.12 %). Type of implants we have used in some surgery was depended only by implant availability at that moment, and not by any other reason (diagnosis, age, etc.). All 13 patients with SSI have been treated by revision surgery as sooner as possible (thorough debridement, prolonged drainage, and antibiotic therapy according the instructions of infectologist). MSSA and MRSA were the main species in the both groups, while ESBL-producing Klebsiella has caused infection only in two patients from “coated” group. Other risk factors like diabetes, polytrauma, duration of preoperative hospitalization, duration of surgery, and advanced age were more common in group of 13 SSI patients, then in the other group of 492 patients without SSI.

In spite the fact that patients in our two groups were not stratified by age, diagnosis, presence of comorbidities, duration of surgery, or other risk factors that might influence on development of early SSI, its incidence was almost 2.5 times higher in the “coated” in comparison to the “uncoated” group (statistically insignificant $p>0.05$, $Chi^2= 0.773$). The larger cross-sectional study might confirm statistical significance, like in many other studies that support usage of uncoated titanium implants.

Key words: coating, titanium, implants, spine, infection, treatment

Infiltration Effect on the Coercivity of Heavy Rare-Earth-Free Nd-Fe-B Ribbons

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Medium magnetic performance to weight ratio makes polymer-bonded magnet indispensable in automotive applications [1]. The magnetic powders, used for polymer bonded magnets are mainly produced by the gas atomization and melt-spinning [2]. Several magnetic powders can be used for such purposes, namely ferrites, Sm-Fe-N, SmCo, Nd-Fe-B and/or combination of all. Since the magnetic powder is blended with non-ferromagnetic binder, the remanent magnetization is diluting as the volume percent of the binder is increasing. Therefore, they can be classified as medium-performance isotropic bonded magnets. However, the coercivity of the magnet is not related to the magnetic powder/non-ferromagnetic binder ratio but to the chemistry and microstructural features. Nd-Fe-B melt-spun ribbons material are composed of randomly oriented $Nd_2Fe_{14}B$ grains with the size of single magnetic domain [3]. Therefore, they have a huge potential for higher coercivity than sintered Nd-Fe-B magnets in which a typical grain size is few microns [4]. There exist several ways to improve the coercivity of Nd-Fe-B magnets. One way is to decouple the $Nd_2Fe_{14}B$ grains by infiltration of low eutectic Nd-based alloys which we propose in this study. Detailed microstructural analyses showed that non-ferromagnetic $Nd_{70}Cu_{30}$ was successfully infiltrated between the grains, which prevented their physical contact; Leading to weaker intergrain exchange coupling. The results of such a process is more than 20 % improvement in coercivity while the remanence is accordingly decreased due to the lower amount of ferro-magnetic phase.

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The Influence of Class C Fly Ash on the Properties of Ceramic Body

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Class C fly ash (fluidized fly ash) according to ASTM C618 is a secondary raw material from the process of combustion of the fine milled mixture of coal with limestone (or dolomite) in fluidized-bed boilers of coal-fired power plants at lower temperatures (usually up to 900 °C) in comparison with the classic combustion of pure coal on fire grates where the burning temperature is up to 1450 °C. Higher content of CaO according to chemical analyse in the form of anhydrite $CaSO_4$ especially is typical for class C fly ashes. The use of this type of fly ash is not typical for fired (ceramic) materials just due to its mineralogical composition.
The aim of the article is to evaluate the possibility of the class C fly ashes utilization in ceramic (fired) materials in connection with anhydrite decomposition during the firing. The question of sulphur dioxide emissions in flue gas vs. efflorescence of fired body will be discussed especially in connection with mineralogical composition, physical-mechanical properties and microstructure of fired body.

Circular Recycling of SmCo Magnet Slurry

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The basic idea behind SmCo magnet slurry recycling was that all the components involved in the recycling process could then be re-used in further recycling processes. Therefore the name circular recycling. To achieve our goal, first SmCo magnet slurry, provided by Magneti Ljubljana d.d., Slovenia, was leached in 4 M HCl acid solution at elevated temperature. Subsequently, the cobalt was extracted from HCl acid water phase with organic ionic liquid Aliquat 336 as organic phase. Usually ionic liquids are diluted with other organic solvents, since the ionic liquids are very viscous. Because organic solvents are health harmful, irritating, flammable and environmentally questionable, we worked with pure ionic liquid. To reduce their viscosity, the extractions were performed at elevated temperature. The effects of time, concentration of HCl acid in the aqueous phase and the effect of the organic phase/aqueous phase (O/A) ratio on the extraction efficiency of cobalt were examined. All measurements of Sm and Co concentrations were made in the aqueous phase using Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES), and the concentrations of Sm and Co in organic phase were calculated from the mass balance. By optimizing cobalt extraction, over 98 % of cobalt extraction with zero co-extraction of Sm into the organic phase was achieved in 1 extraction step.

Optimization of Injection Molding Process Parameters

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Injection molding represents the most important process for manufacturing plastic parts. It is suitable for mass producing parts, since raw material can be converted into a molding by a single procedure. In most cases finishing operations are not necessary. An important advantage of injection molding is that with it we can make complex geometries in one production step in an automated process. Optimization of injection molding process serves for finding ideal conditions during production of plastic parts and observing their dimensions, shapes and properties. It is possible to determine the appropriate injection pressure, velocity, value and time of packing pressure, etc. by optimization. The paper is dealing with description of MoldflowPlastics Xpert (MPX) system and its usage in optimization of injection molding process on real part during its production.

ACR in Dolomitic Concrete as an Autogenous Self-Healing Process d

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This paper investigates the process of alkali-carbonate reaction (ACR) on concrete and it influence on self-healing process. The autogenous self-healing of concrete is known and described by many authors. The main mechanism of autogenous self-healing could be future hydration of unhydrate cement, recrystallization of portlandite leached form bulk paste and formation of calcite.
The investigation samples of self-compacting concretes (SCC) were prepared with Portland cement clinker (CEM I) and typical Slovenian dolostone and subsequently exposed to accelerated ageing condition simulated by 1M NaOH at 60 °C or deionized water at 60 °C. The conducted research revealed, that complete ACR process included the dedolomitization followed by the formation of so called ”Ca halo” and new Mg-Al, Mg-Si and/or Mg-Al-Si gel phases. During the dedolomitisation, some of the liberated CO_3^{2-} ions migrated toward the edge of a decaying aggregate grain, consuming Ca^{2+} ions from portlandite and consequently precipitated as $CaCO_3$ (“Ca halo”). The so formed “Ca halo“ is deposited into pores and cracks in the cement paste (Figure 1) and could represent type of autogenous self-healing in concrete.

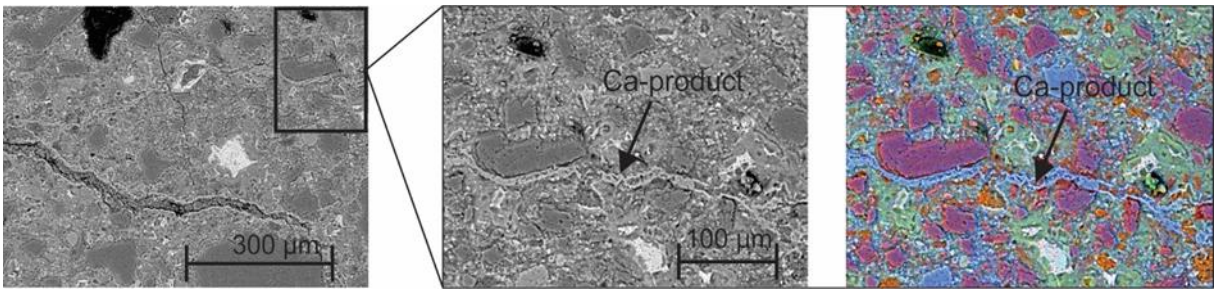

Figure 1: Crack in cement paste filled with secondary Ca-products (“Ca halo”) as a consequence of the ACR.

Extracorporeal Membrane Oxygenation (ECMO) in Patients with Acute Respiratory Failure

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Extracorporeal membrane oxygenation (ECMO) is a method for oxygenation and removal of carbon dioxide in patients with respiratory failure in whom we can not achieve that with standard methods of invasive mechanical ventilation.
The method works as a extracorporeal bypass of blood, which we take from one central vein, then the blood goes through an oxigenator and returns oxygenated and free of carbon dioxide to another central vein. The system is run by a pump with steady non-pulsatile flow.
We use two standard ECMO types. For respiratory failure alone we use veno-venous ECMO, for heart failure we use veno-arterial ECMO. We can also combine more types of ECMO according to the patient´s needs.
We started to use ECMO in 2009, the number of patients is increasing each year. The majority of patients with the need of ECMO has influenza, pneumococcal pneumonia or Legionella species.
With this new method even the patients who would otherwise (even 10 years ago) die of respiratory failure. have a greater possibility to survive

Evolution of Microstructure During Hot Compression Test of Alloy Inconel 625

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This research provides an overview of structural changes that occur during hot compression of Inconel 625 superalloy. Microstructure evolution plays an important role in processing of materials at elevated temperature that is of paramount importance concerning mechanical properties of material. In this work the hot compression of alloy, specifically the hot deformation behaviour, is investigated. Specimens were hot compressed at temperature between 1000 and 1200 °C with different strain rate. Microstructural changes were examined, with the accent on recrystallization. Hot compressions tests of Inconel 625 superalloy were conducted using a deformation dilatometer to the strain level of 0.7. Optical microscope and electron backscatter diffraction technique (EBSD) were employed to investigate the microstructure evolution and nucleation mechanisms of dynamic recrystallization.

Oxidation at thermal fatigue and early spalling of material from of Hi-Cr roller steel

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Štore steel, Štore

On tested samples made from Hi-Cr roll steel which were subjected to thermal fatigue the study of oxidation behaviour on Gleeble 1500D was carried out. The test samples were computer guided heated on maximal temperatures of 500, 600 and 700 °C and internal water cooled. Our observation was focused on role of oxidation at degradation of test surface layer, i.e. its main characteristics, in relation to test temperature and microstructure characteristics of used roll steel. Oxidation is considerably accelerated by “appropriate” characteristics of eutectic and primary carbides, i.e. their size (area), morphology, orientation regarding to water cooled surface, chemical composition, their sequence, test temperature, etc. Selected cases where oxidation reached emphasized extension will be given and explained. Obtained results thus represent contribution to explanation of conditions which lead to accelerated oxidation behaviour that can lead to early spalling of increased size material from roll surface layer.
Keywords: Thermal fatigue, Hi-Cr roll steel, Extensive Oxidation, Spalling.

Towards Improved Performance with Permanent-Magnet Electric devices

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Rare-earth (RE) permanent magnets of the NdFeB-type are now some of the most important engineering materials. They are integral parts of a wide range of devices, e. g. computers, sensors, consumer electronics, magnetic resonance imaging (MRI) and energy conversion devices such as electric motors and generators[1].

Sintered NdFeB magnets offer the highest maximum energy products, which makes them most suited for use in compact electric devices. A substantial industrial and academic effort has been made to improve their magnetic properties by tailoring the microstructure and composition through optimization of the manufacturing process[2]. However, new and innovative approaches are needed in order to i) address the growing demand for the RE elements neodymium and (the coercivity-enhancing) dysprosium and ii) further improve the performance of electric devices. Firstly, we considered the limitations of conventional sintering methods regarding the complexity of the magnet's geometry. In order to eliminate the material wastage associated with the post-sintering machining, a spark plasma sintering (SPS) approach with a large design freedom is proposed for the manufacture of anisotropic net-shaped NdFeB magnets. Secondly, we showed that a number of electric devices would benefit from using magnets with a locally enhanced intrinsic coercivity and a multicomponent magnet approach was developed[3]. The next step is to combine both approaches to develop a material-waste-free production route for net-shaped, multicomponent magnets with the reduced use of the scarce and critical elements. Such magnets could substantially improve the compactness of electric devices and boost their performance, thus contributing to a faster transition from a fossil-fuel-based energy-and-transportation system to a low-carbon society.

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Field-Assisted Sintering of Ti-CNT Metal-Matrix Composites

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Titanium is being used in various commercial applications where its excellent corrosion resistance and high yield strength can be used to the full extent, with the chemical industry and aeronautics being just two of them. Although it has the highest strength-to-density ratio of all the metallic elements, there are other properties where it is lacking, and specific improvements would extend the applicability of the material. These improvements can be achieved in various ways, one of them being the formation of metal-matrix composites using carbon nanostructures, like carbon nanotubes (CNTs), as the reinforcement phase.

Commercially pure, spherical, titanium particles were mixed with multi-walled carbon nanotubes in accordance with (1-x)Ti–(x)CNT, where x = 0.1, 0.2, 0.5, 0.75 and 1.0 wt %. The mixing was performed in a planetary ball mill with a rotation speed of 300 rpm for 2 hours, a ball-to-powder ratio of 20 and with the addition of 2.0 wt % stearic acid that acted as a surface agent. The composites were sintered with a field-assisted sintering technique at a temperature of 850 °C and an applied pressure of 50 MPa for 10 minutes. And the second sintering regime with temperatures around 1000 °C, 70 MPa applied pressure and shorter times.

The microstructures of the compacts were analyzed with optical and scanning electron microscopes and their Vickers hardness values were measured according to the SIST EN ISO 6507-1 standard. The densities of the compacts were measured using Archimedes' method. Transmission electron microscopy (TEM) was used to determine the state of the CNTs inside the composites.

The results show successful compaction, even with such short sintering times, since the compacts were fully dense. The TEM analysis showed that the CNTs retained their tubular form and were dispersed around the particle boundaries. The Vickers hardness increased when more CNTs were introduced to the composite.

Patient Specific Computer Aided Elective Orthopedic Procedures – State of the Art

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Among bone surgeries, 95 % is based on some sort of bone and joint angular analysis before and during surgery. To correctly perform this type of bone surgeries, it is necessary to analyse the preoperative bone geometry, and to perform either a surgical correction of the angles or reproduce the anatomy and fix it afterwards with one of the orthopaedic implants.
For example we may plan to implant an artificial knee implant in a degenerate knee with an important axial deformation, where angular correction is necessary as well as resurfacing of the degenerated joint surfaces. In contrary on an anatomically correct but degenerated hip joint, it is necessary to replace the surfaces but it is important to maintain the geometry and the angles.
Despite the recent technical achievements more than 90 % of bone and joint surgeries are performed freehand and only exceptionally with the aid of image intensifier, rulers and mechanical protractors. The precision is thus mostly dependent on surgeon's experience, insight, subjective intraoperative recognition of bony landmarks, patient position on the table, surgical approach and other less important factors. Only exceptionally and mostly for study purposes commercial computer aided navigation is adopted in the few centres where the technology is ready available.
There are two technical solution for the problem:
For the first the preoperative CT scan is mandatory for the acquisition of bony geometry. It is than necessary to apply the acquired anatomy to the actual bone within the surgical field. Only after this has been synchronized the device can guide our surgical procedure. During the process the patient is submitted to considerable dose of radiation, the surgical time is prolonged, increasing the incidence of complications. The solution is good for rarely performed complex osteotomies.
The other solution involves intraoperative acquisition of the important bony anatomy and the navigation of the surgical steps based on the acquire landmarks. The execution of the bone cuts during the osteotomy is best solved with the first technique. Osteotomies are still mostly freehand, or carried out with the prior installation of guidewires, which, however, cannot always be placed due to soft tissue that is in the way. The control of the execution of bone cuts is carried out by means of intraoperative x-rays producing always a two-dimensional display of three-dimensional problem. Particularly challenging are osteotomies, which require the simultaneous correction of angles in several planes or osteotomies, where it is necessary to simultaneously perform multiple bone cuts. Due to the limited control over the performance of bone osteotomies during surgery, the clinical results are worse than expected, the operation can be prolonged, cuts and corrections suboptimal and exposure to X-ray radiation high. Technical optimization of these procedures significantly improves the clinical output and repeatability of these procedures and shorten the length of the operations and reduce radiation exposure.
We are going to present the technical developments and application of computer aided technologies in: (i) Shoulder problems (ii) Spine pathologies (iii) Pelvic osteotomies (iv)Hip socket implantation (v)Lower limb corrections (vi)Foot and ankle surgeries.

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Soldering of Periodontal Tissues by a Diode Laser-Activated Indocyanine Green Chitosan Membrane

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Background: Surgical treatment of periodontal disease requires tight closure of surgical wounds. Drawbacks of suturing are the risk of infection, opening of the wounds and scarring at the site of sutures. Recently developed chitosan membrane with the addition of indocyanine green (ICG) offers an alternative to the sewing material and barrier membranes. The aim of the study was to assess the usefulness of the ICG chitosan membrane in the closure of surgical wounds and as a substitute of membranes for guided tissue regeneration (GTR).

Materials and Methods: In this *in vitro* study, we utilized 50 extracted human teeth and 30 samples of gingiva and ten samples of oral mucosa, both of porcine origin. We have produced chitosan ICG membrane sized 5x7mm and welded them with a diode laser to the gingiva, oral mucosa, and root surface. Histological analysis was used to detect possible thermal damages. Rising of the temperature on the surface of the tissue during laser welding was determined from the temperature profiles recorded with ThermaCAM P45 thermal camera (FLIR Systems, USA). The strength of the linkages of the chitosan ICG membrane to the gingiva, oral mucosa and root surface were measured on a universal tearing machine Instron 4301 (Instron Corp., USA). To determine differences in mean maximum temperature and forces necessary to rupture linkages between the groups tested, we used parametric tests (t-test, ANOVA and LSD "post-hoc" test). For the level of statistical significance was assumed $p < 0.05$

Results: Laser welding of chitosan ICG membrane to the gingiva, oral mucosa and root surface was successful and without any significant thermal tissue damage The maximum temperature measured on the root surface during the welding chitosan ICG membrane was 42.6 ± 9.5 ° C and was significantly lower than for the later welding of the gums at the already welded on the membrane in the tooth (55.2 ± 8.0 ° C) (P = 0.005).Measured tear forces in three groups of laser welded gingiva, and oral mucosa ranged from 0.14 ± 0.05 N in the group gingival epithelial welding, over 0.06 ± 0.01 N in the group of gingiva welded on connective tissue side, to 0.06 ± 0.02 N in the group of oral mucosa.Tear forces in four groups of laser welded chitosan ICG membranes to the root surface and in the group of gingiva, welded to the root surface ranged from 1.41 ± 0.14 N in the group 0°, 0.89 ± 0.15 N in the group 30°, 0.80 ± 0.14 N in the group 60°, 0.52 ± 0.16 N in the group 90° and 0.85 N ± 0.18 N in the group of gingiva welded to the root surface.

Conclusions: Within the limits of our study, we can conclude that laser soldering of oral mucosa and gingiva with can be a complement to the closure of mucosal and periodontal surgical wounds, but it does not replace suturing wounds. Due to the favourable tensile strength of chitosan ICG membrane to the root surface and due to chitosan material properties ICG membrane is potentially useful for replacing nonresorbable membranes. Laser soldering of the gingiva to the root surface can additionally stabilize closure of the periodontal surgical wound.

Stability and dynamics of variable cross-sectioncantilever steel structures

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The tasks of stability and dynamics problem (1…5) for building structures with the variable cross-section are reviewed at this article. The basic equationswere obtained for deflection, bending moments, angles of rotation for the structures with linear and parabolic cross-section stiffness changing laws. There were solved a number of problems of stepped structuresstability and dynamics, for the case, when each of the parts has a different degree for cross-section stiffnesschange.

We obtained a criterion for cantilever element rational height analysis of variable stiffness cantilever element.

The research results can be used for a tower structures analysis.

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Preparation of the System to Study Thermal Transpiration in Stainless Steel Tubes

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When two vacuum chambers, containing gas at different temperatures, are connected with a tube, an equilibrium is established. Due to different temperatures of the chambers, pressures inside the chambers are different, depending on the flow regime. In Molecular regime pressures follow the equation $\frac{p_1}{p_2} = \left(\frac{T_1}{T_2}\right)^{\gamma}$. Here, pressure p_1 and temperature T_1 correspond to the chamber at one end of the tube, and p_2 and T_2 to the chamber at the other end. This effect is called thermal transpiration and often results in errors of pressure measurements in vacuum systems, where parts of it are at different temperatures. An example of this is the capacitance diaphragm vacuum gauge, which is usually heated to around 45 °C.

In order to study this effect, a thermally insulated system has been built. It is composed of two stainless steel tubes (for direct comparison of a treated and an untreated tube surface), two pressure gauges, and a thermally insulated box, connected to a thermostat.

This setup enables us to study the effect of surface roughness of a stainless steel tube on the exponent γ, while regulating and maintaining a constant temperature at one end of the tubes. In this work, thermal transpiration is presented, and an overview of the built system is shown.

Some Aspects of Transfer Functions use for Description of Hot Deformability of Steels

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Mathematically transfer functions (TFs) are used for simple description of highly dynamical relations between two signals, where order of TF defines complexity of such relation between observed two signals.

In this poster is presented description of strain – stress relationship using 3^{rd} and 2^{nd} order TF, where 3^{rd} order TF yield in about 1 % accuracy and 2^{nd} order TF about 3 % accuracy.

Compressive tests at temperatures suitable for hot deformation are carried out at constant strain rates. Interesting property of TF models if that they are able to calculate response for non-constant strain rates, which suits industrial hot working conditions. Simulation of stress response for three different strain curves are calculated to present TF model ability to calculate response on arbitrary strain curve.

Another very important aspect of TFs use for hot deformability description of steels is that TFs are decades long supported on most control and automation platforms such as Programmable Logical Controllers (PLCs) and Programmable Automation Controllers (PACs). In control, automation and electronic design branches TFs are traditionally used for compact description of highly complex and complicated inter-relations as well as response calculations on arbitrary input excitations.

Obtained transfer function is a lumped-parameter type and therefore resulting models enable fast computations, which in conjunction with TFs calculation on PLCs and PACs makes TFs models for hot deformability a suitable candidate for both real-time applications, such as Automatic Gauge Control in rolling mills etc. and for off-line applications where high- accuracy is required.

MAGEC Growing Rod System for Early Onset Scoliosis

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Our aim is to present the ongoing experience and extended follow-up results with magnetic growing rods for early onset scoliosis treatment. We aim to present our cases and comment on our views compared to the literature. We commenced magnetic growing rods (Magec, Nuvasive specialized orthopedics, CA, USA) implantation in 2014.The standardized implantation and correction methods have not differed since then. We distract the rods three mm every three months, concave side first. We monitor the first year of distractions by ultrasonography, and perform radiological follow-up every 9 to 12 months, sooner in case of inconclusive ultrasonography. We monitor time of follow-up, Cobb angle of the major curve, and T1 to S1 height preoperatively, postoperatively and at the latest follow-up. The levels of the screws, the fused levels, and any adverse events are marked. Our series consist of nine patients with median follow-up of 24 months. One patient was converted to magnetic growing rods from standard growing rods after seven months. All patients have secondary scoliosis; two suffer from muscular dystrophy, three from spinal muscular atrophy, two from cerebral palsy, one from Ehlers Danlos syndrome and one form Prader Willi syndrome. Mean preoperative Cobb angle of major curve was 82^{o} (48^{o} -96^{o}), 43^{o} (21^{o} -60^{o}) postoperatively, 44^{o} (24^{o} -58^{o}) at the latest follow-up. Mean T1 to S1 height was 296 (242-337) mm preoperatively, 337 (286-437) mm postoperatively, 352 (303-456) mm at final follow-up. In two patients we experienced screw insertion problems, therefore three screws were inserted instead of two for better purchase. We had no major complications. Our results show that magnetic growing rods are a safe alternative to standard growing rods in early onset scoliosis treatment. They enable fairly good curve corrections, spinal growth and prevent deformity deterioration until definitive fusion.

Development of a Meshless Numerical Model for Solving Three-dimensional Elasto-plastic Problems

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Hot rolling of steel is a complex physical process that requires coupled thermo-elasto-plastic treatment. We have implemented a module in the existing in-house software environment, with which we solve partial differential equations in a meshless manner. The developed module allows iterative solution of nonlinear elasto-plastic problems [1]. We have assumed von Mises model with isotropic hardening and small-strain approximation. For space discretization we used local colocation method with polyharmonic radial basis functions [2]. For solving constitutive equations a closest point projection algorithm is implemented. We verified our algorithm on elasto-plastic deformation of a cube under tensional load. The solution is compared to a solution obtained by finite-element method based commercial package Abaqus and was found to have a perfect fit. The developed algorithm will be implemented as a module in a simulation system for hot rolling [3, 4] where ideal plastic deformation is assumed at the present.

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Selective recovering $Nd_2Fe_{14}B$ grains from Nd−Fe−B magnets by anodic etching

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The end-of-life Nd−Fe−B permanent magnets scraps are an important secondary rare earth elements resource with a high recycling potential. The state-of-the-art direct re-use recycling methods[1,2] are regarded as the best ecological and economical recycling routes, with the limiting parameter being the oxygen increase upon repeated recycling, due to the non-separated rare earth oxides. In this study, a novel concept for recycling sintered Nd−Fe−B magnet by recovering the $Nd_2Fe_{14}B$ grains using an acid-free etching method at room temperature is presented. The procedure is based on the anodic etching of sintered Nd−Fe−B magnets in a non-aqueous dimethylformamide (DMF)-0.3 mol L^{-1} $FeCl_2$ bath. Selective recovery of $Nd_2Fe_{14}B$ grains was realized within the applied current density < 5 mA cm^{-2} based on the etching priority of phases: metallic Nd > intergranular $NdFe_4B_4$ > matrix $Nd_2Fe_{14}B$. The total energy consumption of the proposed recycling route is estimated to be ~2.99 kWh kg^{-1}, that is comparable to the state-of-the-art methods. The presented direct electrochemical route i.e., from magnet to $Nd_2Fe_{14}B$ grains provides a novel sustainable recycling approach that is environmentally friendly and easily scalable[3].

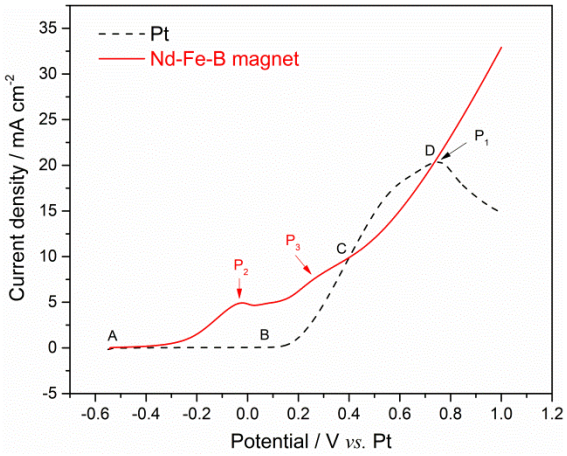

Fig. 1 Linear sweep voltammetry of a Pt wire working electrode (black dashed curve) and the initial Nd−Fe−B magnet scrap (red solid curve) in DMF containing 0.3 mol L^{-1} $FeCl_2$, 40 mV s^{-1}, room temperature.

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Additive Manufacturing of Metals − A comparison of the Most Important Processes

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The term "additive" (generative) refers to all manufacturing processes in which the material is added layer by layer to produce a component. This is in contrast to the classical subtractive manufacturing processes such as milling, drilling and turning, where material is removed to produce the final component. The layer construction principle makes it possible to produce geometrically complex structures, which cannot be realized with conventional manufacturing methods, or only at great expense. Whereas in the early days these processes, known as "rapid prototyping", were mostly used only for the production of models and prototypes, today this technology is increasingly being used as "3D printing" for the industrial production of components and products. Among the eight processes known today for 3D metal printing, LMD (Laser Metal Deposition) and SLM (Selective Laser Melting) are predicted to have the greatest potential[1,2,3]. The lecture will compare these two methods and show the limits and possibilities using application examples.

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Measurement of the Local Residual Stress Distribution Using Cross-Correlation EBSD and Ring Core Milling

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Cross-correlation electron backscatter diffraction (CC-EBSD) is an established method to measure the distribution of in-grain (i.e. type III) residual stresses (RS) [1] at the micrometre level. The technique is based on the comparison of EBSD patterns of test positions with one from a reference position. It currently allows measurement and mapping of elastic strains in the order of 10^{-4}. The most significant shortcoming of the technique is that it requires a reference pattern which is, at best, taken from a strain-free (i.e. stress-free) reference position inside the same crystal. In a sample with RSs, however, such a position does not really exist. As a consequence, type I and and type II RSs remain undetermined. This is particularly problematic when local fracture, e.g. along grain or phase boundaries, is to be investigated.

A method which allows measurement of type I and type II RSs with relatively good spatial resolution is the ring core milling method, developed mainly by Korsunsky et al. [2]. It is based on the measurement of relaxation of a small area of a sample under RSs when cutting it free from the surrounding material, e.g. by milling a ring-shaped trench around the area of interest using a Ga^+ ion beam. This method has been applied, for example, to proof the existence of tensile RSs in a martensitic steel [3]. We now work on a combination of ring core milling and CC-EBSD which allows to measure all types of RSs with good resolution in microstructures. This allows to assess the height of RSs in a 316 stainless steel produced by additive manufacturing.

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Characterization of New and Retrieved Titanium Dental Implants Materials

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Dental oral implants serve as a reliable treatment option for replacing the missing teeth. It is very important for an ideal implant material to be biocompatible and of adequate strength, corrosion, wear and fracture resistance. The most important step in the stability of the implant is a structural and functional connection between the implant surface and the newly formed bone, which is called osseointegration. It comprises of a cascade of complex physiological mechanisms. Implant's surface characteristics and roughness are the most important in achieving the biomecahanical concept of secondary stability.

Nowdays dental implants may be made from metals, ceramics or even polymers. Titanium and its alloys have shown long-term success and survival, therefore they have become a golden standard. Nontheless, there is a high incidence of perimplantitis and perimucositis connected to titanium dental implants. Further along, there might be even some allergy-like tissue reactions, which for time being are still not scientifically proven.

We have investigated new and retrieved dental implants materials, Ti, Ti6Al4V alloy and CoCrMo alloys using light microscopy, scanning electron microscopy (SEM) for surface morphology and microstructure and energy x-ray dispersive spectroscopy (EDS) for chemical analysis.

The results showed that surface of the implants Ti and Ti6Al4V were roughened by corundum blasting, and the contamination with Al_2O_3 (corundum) was found not only on the surface but also near the surface of both new and retrieved dental implant. It is assumed that retained corundum contamination on the surface of Ti or Ti alloy affects the osseointegration and longevity of the implant which will be studied in details.

TEM Analysis of the Oxidation Scale Grown on Iron Aluminides

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The revival of iron aluminides, besides their good oxidation and wear resistance and lower density, is also related to their low cost, making them an attractive alternative to steels or superalloys [1]. Unfortunately, their aqueous corrosion resistance, especially under acidic conditions, is only mediocre compared to that of cast iron. The intensive research of a thin oxide scale formation was conducted to address this shortcoming, yielding somehow contradicting results [2,3,4]. As recent systematic investigations report the beneficial effect of pre-oxidation and substantial increase of the corrosion resistance [5], we performed a detailed investigation of the protective oxide scale, based on high-resolution EM methods.

The continuous oxide scale, about 2 µm thick, consist of two distinct layers of about the same thickness [6,7]. The top layer is a mixture of alumina and spinel grains, while the lower layer is formed by elongated pillar-like pure alumina grains, preferentially grown along the c-axis. The columnar alumina grows into the Fe_3Al matrix, terminated by low-index Wulff facets, which additionally improve metal-oxide adhesion. As the corrosion is expected to progress mainly along the grain boundaries, the change of microstructure and chemical segregation between layers can additionally protect the matrix by a combination of reduced permeability via grain boundaries, and improved corrosion resistance of high-purity underlying alumina pillars.

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Using Electron Holography to Investigate the in Tb-doped Nd-Fe-B Magnets

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High coercivity Nd-Fe-B permanent magnets play an important role in rapidly-growing renewable energy sector. To retain the coercivity at high operating temperature, heavy-rare-earth elements (HRE), are added using grain-boundary diffusion (GBD) process. The addition of HRE results in a significant improvement of the coercivity due to the increase of the intrinsic resistance to demagnetization.[1]

In the present study, we report on the investigation of magnetic properties and the distribution of the Tb_4O_7 in the $Nd_2Fe_{14}B$ magnet. $Nd_2Fe_{14}B$ magnet was coated with Tb_4O_7 powder and annealed. During annealing process Tb diffused along grain boundaries (GB) into the outer parts of Nd-Fe-B grains, thus forming core-shell grains with Tb-rich shell and Nd-Fe-B core. Magnetometry measurements showed that the coercivity gradually decreases towards the central part of the magnet, where it is still around 30 % higher when compared with the untreated magnet.[2,3] Although magnetic measurements clearly indicate the presence of Tb it is not clear what is the actual amount of Tb in central regions of magnets, how they are distributed in the microstructure and if it is possible to distinguish the magnetisation flux between soft magnetic shell and hard magnetic core. For that purpose we applied the Cs-corrected STEM: FEI Titan 80-200 equipped with SuperX electron dispersive X-ray (EDX) spectrometer and electron energy-loss (EEL) spectrometer and FEI Titan 80-300 equipped with electron biprism to perform electron holography. As complementary method, atom probe tomography (APT) was used using 3D atom probe LEAP 4000x HR.

In order to analyse the core-shell region a lamella was prepared from the representative core-shell grains and the interface between the shell and the core was examined using EELS and APT. Detailed line-scans and spectrum image maps were performed at this interface. The estimated width of the transition area between the shell and the core was 20 nm. Further studies focused on the electron holography of core-shell grains investigating the domain wall width and magnetic flux inside the grains.

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Ultrahigh Molecular Weight Polyethylene (UHMWPE) with Improved Wear and Oxidation Resistance for Use in Arthroplasty

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In total hip, knee, shoulder and ankle arthroplasty, the ultrahigh molecular weight polyethylene (UHMWPE) has been used as a material of choice since the year 1962, when it was clinically introduced by Sir John Charnley. Due to the linear polymer chains and high molecular mass (from 2 to 7 millions) UHMWPE is resistant to wear and possesses good mechanical properties.
In this contribution, will present the development of a highly crosslinked UHMWPE (HXLPE) with improved properties in comparison to conventional UHMWPE. HXLPE of the first generation was clinically introduced in 1990s and possessed a high resistance to wear but reduced mechanical properties. However, HXLPE of the second generation, introduced in 2005-2008, showed improved mechanical properties and oxidation resistance, while maintaining a high resistance to wear. Differences in properties of HXLPEs of the first and second generations will be explained by differences in their structures as a consequence of various treatment processes.

Decarburization Of Hypoeutectoid Carbon Steel C22 During Isothermal Annealing In Air At Temperatures $A_{C1} < T < A_{C3}$

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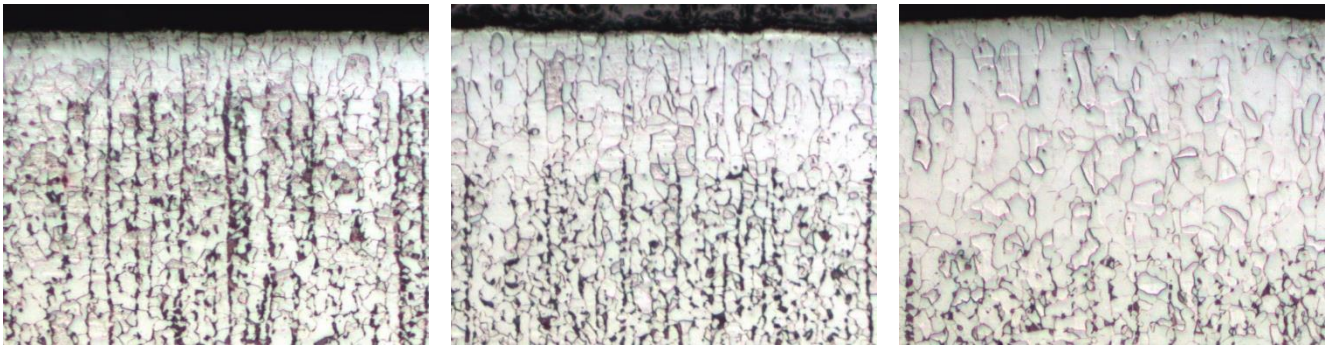
The research focused on the effects of annealing times and temperatures on the thickness of the decarburized layer of hypoeutectoid carbon steel C22. This steel has a dual-phased ferrite-austenite microstructure in $A_{C1} < T < A_{C3}$ temperature range. The dual-phased microstructure presents a challenge for the precise determination of kinetics of the decarburization. The degree of decarburization of samples was mainly researched metallographically. Theoretical calculation of the depth of decarburization was made using Van-Ostrand-Dewey equation. Even though it was primarily meant for the calculation of decarburization of austenite at $T > T_G$ it was found out that it is also suitable for the calculation of the decarburization at $A_{C1} < T < A_{C3}$. This equation presented a basis for a model that was created during this research, which can be used to calculate the theoretical depths of decarburization for exact experimental conditions used in this research. The results show a high degree of matching and can also be used in practice when dealing with the same annealing times, annealing temperatures and material.



t_a = 5 min t_a = 60 min t_a = 120 min

Figure 1: An example of an increase in the thickness of the decarburized layer with longer annealing times in C22 steel at 835 °C (magnification: 100x)

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Using New Designs of Reverse Shoulder Arthroplasty for Rotator Cuff Deficiency

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Introduction. Management of rotator cuff deficiency shoulder (RCD) is still challenging, indeed, and remains a subject of controversy. Several surgical options are available, but none of them is satisfactory. Latissimus dorsi or pectoralis major transfers should be reserved for patients under 65 years with intact subscapularis tendon and low grade osteoarthritis (Fukuda < 3). In older patients surgical arthrolysis or in association with acromioplasty, biceps tenotomy, anterosuperior capsular reconstruction and/or subacromial "ballon" insertion could relieving pain but has little effects on range of motion (ROM). However, reverse shoulder arthroplasty (RSA) is effective in reducing pain and also improve ROM. Finally, it have the best short and medium-term results in patients with RCD .
Methods. Between 2010 and 2014 we used Promos RSA in 62 patients for treatment RCD shoulder with or without osteoarthritis. RSA were performed by three surgeons. All patients were evaluated by independent examiner who performed a clinical pre-operative and post-operative evaluation (follow up of 25 to 38 months) by using Constant-Murley Score, DASH Score, Oxford Shoulder Score and U-Penn Score, as well as by measuring active shoulder ROM.
Results. Two RSP were revised for infection and one for humeral loosening, one because of humeral fracture. In one we remove RSA because of the infection. Finally, 60 patients were included in this series and all of them showed improvement of outcome (Constant Score 28.8 to 59.3, DASH Score 53.9 to 20.8, Oxford Score 19.7 to 39.9, U-Penn Score 25.2 to 59.3). ROM was better in postoperative vs. preoperative evaluation (abduction 106° vs. 46°, forward flexion 116° vs. 51°, external rotation 31° vs. 9°, internal rotation 28° vs. 8°). The pain during activities was reduced on average by 6 grades on VAS and all results were statistically significant ($p<0.05$).
Conclusion. Results of the early designs were apparently poor, although they were not subjected to rigorous clinical research. Authors reported greater pain relief and better function with the fundamental change of Grammont's design. We also confirmed those in our group of patients with RCD shoulder, which have excellent pain relief and significantly improve active elevation. However, RSA requires ongoing prospective studies, with challenges and controversies remaining around present-day designs.

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A study of the Workability and Mechanical Properties of Grinded Corn Cob on Concrete

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This work summarizes the results of concrete modification based on portland cement by grinded corn cob into the matrix. The main purpose of this study was to characterize directly influence addition of grinded corn cob on concrete mechanical properties as eg. compressive, tensile strength, tightness and water demand. The recipe of concrete was based on portland cement (CEM I), basalt aggregate, water and deflocculant based on polycarboxylate. To characterize compounds SEM and LM observations, chemical composition, sieve curve, slump cone test, setting time were widely done. Samples of concrete were characterized by compressive strength and bending tests after 28 days of curing. Obtained results was compare with reference concrete without modification. Research was proven that all chosen modifiers exhibit increase effect on final mechanical properties of studied concrete and are very perspective for future application in civil engineering.

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Recycling and Reprocessing of End-of-life Nd-Fe-B Permanent Magnets

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From economic and environmental aspects the industrial development of Nd-Fe-B permanent magnets (PMs) are associated with high costs, therefore recycling them is one of the currently hottest topic in EU. In the frame of the MSCA-ITN-DEMETER http://etn-demeter.eu/ we are investigating ways to recycle and reprocess the end-of-life Nd-Fe-B PMs. As it is vital for the applications to keep or even surpass the properties of the original magnets we are utilizing a contemporary technique of spark plasma sintering (SPS) that assures a minimized grain coarsening in the ~500 nm range. The end-of-life hard disk drives Nd-Fe-B PMs were reprocessed via HDDR process. SPS experiments were performed in a temperature range of 650 – 850 ^{0}C under a constant 50 MPa uniaxial pressure. We have demonstrated an improvement of coercivity of the raw powder to H_C = 1025 – 1120 kA/m with BH_{Max} = 90 – 95 kJ/m^3, that matches the one achieved in fresh HDDR+SPS-ed samples. The results are supported by XRD, FEG-SEM, TEM, EDXS; EELS studies. From the perspective of chemical recycling of the end-of-life Nd-Fe-B magnets we report on a successful electrochemical recycling the Nd-Fe-B magnets and the electrochemical synthesis of Nd-Fe-based deposits using the ionic liquids (ILs) i.e 1-ethyl-3-methylimidazolium dicyanamide electrolytes at elevated T, directly using metal chlorides as precursors by pulse plating technique.

Nd-Fe-B pemanent magnets, recycling, reprocessing, spark plasma sintering, electrodepositon

Investigation of Failure of a Transportation Conveyor Belt Pulley

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An investigation of a premature conveyor belt pulley shaft failure was conducted. Signs of rough machining were present on the shaft surface near the fracture. Metallographic investigations revealed subsurface cracking and additional signs of surface welding. The welding on the shaft outer radius induced internal stresses. The reasons for surface welding remain unknown. Furthermore, the base material (42CrMo4) was inappropriately heat treated. This resulted in inappropriate mechanical properties, especially in low values of impact toughness. The combination of poor material heat treatment, surface welding and dynamic loads resulted in inevitable cracking and consequent failure of the shaft.