26. MEDNARODNA KONFERENCA O MATERIALIH IN TEHNOLOGIJAH

3.–5. oktober 2018, Portorož, Slovenija

26th INTERNATIONAL CONFERENCE ON MATERIALS AND TECHNOLOGY

3–5 October 2018, Portorož, Slovenia

PROGRAM IN KNJIGA POVZETKOV

PROGRAM AND BOOK OF ABSTRACTS

INŠTITUT ZA KOVINSKE MATERIALE IN TEHNOLOGIJE, LJUBLJANA

26. MEDNARODNA KONFERENCA O MATERIALIH IN TEHNOLOGIJAH /
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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
P – Polimeri/Polymeric 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

26th INTERNATIONAL CONFERENCE ON MATERIALS AND TECHNOLOGY,
3–5 OCTOBER, 2018

Wednesday, 3.10.2018 Hall C

9:00	**OPENING CEREMONY – Chair of the Conference Matjaž Godec**		
9:15	**PLENARY LECTURE - Zehetbauer**		
10:00	INVITED - Legat		
10:20	INVITED - Dražić		
10:40	INVITED - Zaefferer		
11:00	**Coffee Break**		
11:20	INVITED - Conradi		
11:40	INVITED - Savilov		
12:00	INVITED - Šolić		
12:20	INVITED - Kevorkijan		
12:40	**LUNCH**		
	Hall C	**Hall D**	
	YOUNG RESEARCHERS	14:00	Žužek
14:00	Skela - Zorc	14:15	Bradaškja
14:20	Malej - Kraner	14:30	Kafexhiu
14:40	Senegačnik - Kračun	14:45	Chernyak
15:00	Mehmood - Gradišar Centa	15:00	Novotortsev
15:20	Berčič - Arbeiter	15:15	Šedek
15:40	Topole - Avsec	15:30	Kroupova
16:00	**Coffee Break**	15:45	Tropenauer
16:30	Arkhipova - Miarka	**16:00**	**Coffee Break**
16:50	Kosturek - Verbovšek	16:30	Merta
17:10	Ambrožič - Marinko	16:45	Seitl
17:30	Jovičević K. - Tominc	17:00	Wachowski
17:50	Hatić - Dobravec	17:15	Malek
18:10	Jurjevec - Gradišar	17:30	Gosar
18:30	Vidergar - Kotar	17:45	Stanciu
19:30	**POSTER SESSION WITH STANDING BUFFET - LOBBY EUROPA**		

Thursday 4.10.2018

	Hall A		Hall C
	MATERIALS IN CIRCULAR ECONOMY		**BIOMATERIALS**
9:00	**PLENARY LECTURE - Kolozsvary**	**9:00**	**PLENARY LECTURE - Dolinar**
9:40	INVITED - Burja	9:45	INVITED - A. Iglič
10:00	INVITED - Loncnar	10:15	INVITED - Schauperl
10:15	INVITED - Plesnik	10:35	INVITED - Trebše
10:30	INVITED - Medved	10:55	INVITED - Gorenšek
10:50	INVITED - Kevorkijan	**11:15**	**Coffee Break**
11:05	INVITED - Kores	11:50	INVITED - Gašperšič
11:20	**Coffee break**	12:10	INVITED - Oblak
11:50	INVITED - Kugler	12:30	INVITED - Jevnikar
12:10	INVITED - Podgornik	12:50	INVITED - Ovsenik
12:30	INVITED - Malnarič	13:10	INVITED - Grdadolnik
12:45	INVITED - Belič	**13:30**	**LUNCH**
13:05	INVITED - Kovačič	15:00	INVITED - Mavčič
13:20	INVITED - Kržan	15:20	INVITED - Kocjančič
13:40	**LUNCH**	15:40	INVITED - Cör
		16:00	**Coffee Break**
		16:30	INVITED - Stražar
		16:50	INVITED - Pompe
		17:10	INVITED - Moličnik/Drstvenšek
		17:30	Rošer
		17:50	INVITED - Zupanc
		18:10	INVITED - Pal
19:00 - 23:30	**Monfort - Conference dinner**		

Friday 5.10.2018

	Hall C
	Workshop - 3D Printing of Metallic Materials
10:00	**PLENARY LECTURE - Jägle**
10:30	INVITED - Godec
11:00	INVITED - Kara
11:30	**Coffee Break**
12:00	INVITED - Govekar
12:30	INVITED - Hagedorn
13:00	INVITED - Plank
13:30	INVITED - Brückner
14:00	INVITED - Šinko
14:30	**LUNCH**

PROGRAM 26. MEDNARODNE KONFERENCE O MATERIALIH IN TEHNOLOGIJAH
26th INTERNATIONAL CONFERENCE ON MATERIALS AND TECHNOLOGY: PROGRAM

Sreda – Wednesday 3.10.2018 Hall C	
	Predsedujoči – Chair: M. Godec, B. Šarler
9:00	**ODPRTJE – OPENING CEREMONY – Matjaž Godec**
9:15	**PLENARY LECTURE** High Efficiency of Renewable Energy Sources Through SPD-Processing of Bulk Nanostructured Solids Michael J. Zehetbauer Physics of Nanostructured Materials, Faculty of Physics, Vienna University, Boltzmanngasse 5, 1090 Wien, Austria
10:00	Specific Characteristics of Steel Corrosion in Concrete Andraž Legat, Tadeja Kosec, Miha Hren, Aleš Česen, Nina Gartner Slovenian National Building and Civil Engineering Institute, Ljubljana, Slovenia
10:20	Quantitative Cs Corrected Scanning Transmission Electron Microscopy of Crystal Structures and Defects Goran Dražić National institute of chemistry, Hajdrihova 19, Ljubljana, Slovenia
10:40	Combination of nano-indentation and electron channeling contrast imaging (ECCI) to understand the interaction of hydrogen and dislocations in a high-Mn TWIP steel Stefan Zaefferer[1], Yuchen Shan[1], and Manjunatha Madivala[2] [1]Max-Planck-Institut für Eisenforschung, Düsseldorf, Germany (Note: Provide institute, city, and country at a minimum) [2]Institut für Eisenhüttenkunde, RWTH Aachen, Intzestr. 1, Aachen, Germany
11:00	**Coffee Break**
	Hall C
	Predsedujoči – Chair: M. Godec, B. Šarler
11:20	Influence of Aging on Surface Properties of Laser-textured and Epoxy/TiO_2 Coated Stainless Steel Marjetka Conradi[1], Aleksandra Kocijan[1], Tina Sever[1] and Peter Gregorčič[2] [1]Institute of metals and technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]Faculty of Mechanical Engineering, University of Ljubljana, Aškerčeva 6, 1000 Ljubljana, Slovenia
11:40	Carbon Nanostructures and Related Materials: Synthesis, Characterization Features, Application in New Materials Design and Energy Storage Systems Serguei Savilov, Anthon Ivanov, Ekaterina Arkhipova, Nikolay Osipov, Alexander Burtsev, Eugenia Suslova, Valery Lunin M.V. Lomonosov Moscow State University, Chemistry Department, 119991, Russia, Moscow, Leninskie gory, 1, b.3
12:00	Inluence Of Sub-Zero Treatments On The Properties Of Austempered Ductile Cast Iron Sanja Šolić[1], Vlado Tropša[1], Matjaž Godec[2] [1]University North, Department of Mechanical Engineering, Ul. J. Križanića 31b, 42000 Varaždin, Croatia, [2]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
12:20	Comparative Electrochemical and Intergranular Corrosion-Resistance Testing of Wrought Aluminium-Alloy-Based End Products Varužan Kevorkijan[1], Matjaž Finšgar[2], Irena Lesjak[1], Marko Degiampietro[1], Lucija Skledar[1], Teja Krumpak[1] [1]Impol Aluminium Industry, Partizanska 38, 2310 Slovenska Bistrica, Slovenia, [2]University of Maribor, Faculty of Chemistry and Chemical Engineering, Smetanova 17, 2000 Maribor, Slovenia
12:40	**LUNCH**

	Hall C
	Predsedujoči – Chair: M. Čeh, B. Podgornik
	YOUNG RESEARCHERS
14:00	Influence of Microstructure Achieved by Various Heat Treatments on Wear Resistance of Hot Work Tool Steel Božo Skela[1,2], Marko Sedlaček[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
14:10	The Influence of Prior Hot Deformation on Microstructure Evolution During Aging in Nickel Superalloys 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
14:20	Comparison between Symmetric and Asymmetric Cold Rolling of EN AW-5454 Aluminium Alloy Jakob Kraner[1], Peter Fajfar[2], Heinz Palkowski[3] [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 [3]Department of Metal Forming and Processing, Institute of Metallurgy, Faculty of Natural and Materials Science, Clausthal University of Technology, Robert-Koch-Straße 42, DE-38678 Clausthal-Zellerfeld, Germany
14:30	Influence of Light Polarization on Micrometer and Submicrometer Surface Structures Induced by Laser Pulses Matej Senegačnik[1], Matej Hočevar[2], Barbara Šetina Batič[2], Peter Gregorčič[1,2] [1]Faculty of Mechanical Engineering, University of Ljubljana, Aškerčeva 6, 1000 Ljubljana, Slovenia, [2]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
14:40	Manufacturing of Steel Matrix Composites Reinforced with Nano-Particles Ana Kračun, Franc Tehovnik, Fevzi Kafexhiu, Bojan Podgornik Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana
14:50	TEM studies of reprocessed HDDR Nd-Fe-B powder and permanent magnets Muhammad Farhan Mehmood[1,2], Awais Ikram[1,2], Spomenka Kobe[1,2], Kristina Zuzek Rozman[1,2], Saso Sturm[1,2] [1]Department for Nanostructured Materials, Jožef Stefan Institute, Jamova 39, SI-1000 Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova 39, SI-1000 Ljubljana, Slovenia
15:00	Coatings for Contact Surfaces with Antibacterial Properties Based on Moox Nanowires in Polymer Matrix Urška Gradišar Centa, Srečo D. Škapin, Anna Belcarz, Luka Pirker, Maja Remškar Jožef Stefan Institute, Condensed Matter Physics Department, Jamova 39, Ljubljana, Slovenia Medical University of Lublin, Department of Biochemistry, Racławickie 1 Street, Lublin, Poland
15:10	Microstructure Modelling on Diffusive Timescales: Amplitude Expansion of the Phase Field Crystal Method Matjaž Berčič, Goran Kugler Faculty of Natural Sciences and Engineering, Aškerčeva Cesta 12, Ljubljana
15:20	Microstructural Changes in 8079 Aluminium Alloy With High Fe Content During High Temperature Annealing Jože Arbeiter[1], Maja Vončina[1], Darja Volšak[2], Jožef Medved[1] [1]University of Ljubljana, Faculty of Natural Sciences and Engineering, Aškerčeva 12, 1000 Ljubljana, Slovenia, [2]Impol Aluminium Industry d.d., Partizanska 38, 2310 Slovenska Bistrica

15:30	Pulsed-Electric-Current-Sintered Ti-CNT Metal-Matrix Composites Martin Topole[1,2], Elinor G. Castle[3], 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
15:40	Characterization of the Surface Chemistry and Microstructure of Retrieved Cementless Hip Endoprosthesis Klemen Avsec[1], Boštjan Kocjančič[1] , Monika Jenko[2], Drago Dolinar[1] [1]Department of Orthopedic Surgery, University Medical Centre Ljubljana, Slovenia, [2]Institute of Metals and Technology, Ljubljana, Slovenia
16:00	**Coffee Break**
16:30	Spark Plasma Sintering as a new Approach for the Synthesis of B-doped Graphene Nanoflakes Anton Ivanov, Serguei Savilov, Konstantin Maslakov, Ekaterina Arkhipova Department of Chemistry, Lomonosov Moscow State University, Leninskie gory, 1-3, Moscow, Russia
16:40	Fracture Mechanical Parameters of High Strength Concrete Evaluated by Brazilian Disc Test Petr Miarka[1], Stanislav Seitl[2], Vlastimil Bílek[3] [1]Brno University of Technology, Faculty of Civil Engineering, Institute of Structural Mechanics, Veveří 331/95, 602 00 Brno, Czech Republic, [2]Institute of Physics of Materials, Academy of Science of the Czech Republic, Žižkova 22, 616 62 Brno, Czech Republic, [3]VSB-Technical University of Ostrava, Faculty of Civil Engineering, Department of Building Materials and Diagnostics of Structures, L. Podéště 1875/17, 708 33 Ostrava, Czech Republic
16:50	The Research on the Microstructure of Ti6Al4V-AA1050 Explosively Welded Bimetallic Joint Robert Kosturek[1], Marcin Wachowski[1], Lucjan Śnieżek[1], Adam Kruk[2] [1]Military University of Technology, Faculty of Mechanical Engineering, 2 gen. W. Urbanowicza str., Warsaw, Poland, [2]Department of Physical and Powder Metallurgy, Faculty of Metal Engineering and Industrial Computer Science, AGH University of Science and Technology
17:00	Gas-Surface Interactions after Various Treatments of a Stainless Steel Surface 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
17:10	Observation and Mechanisms of Nucleation and Growth of Gold Nanoparticles Grown From Chloroauric Acid Solution by Using Liquid Cell Transmission Electron Microscopy Bojan Ambrožič[1,2], Sašo Šturm[1], Nejc Hodnik[3], Anže Prašnikar[3] [1]Jožef Stefan Institute, Jamova 39, 1000 Ljubljana, [2]Jožef Stefan International Postgraduate School, Jamova 39, 1000 Ljubljana, [3]National Institute of Chemistry, Hajdrihova ulica 19, 1000 Ljubljana
17:20	The Influence of Metal Titanium Surface Treatment on the Properties of TiO_2 Nanotubes Grown by Anodic Oxidation Živa Marinko[1,2], Luka Suhadolnik[1], Miran Čeh[1] [1]Department for Nanostructured Materials, Jožef Stefan Institute, Jamova 39, SI-1000 Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova 39, SI-1000 Ljubljana, Slovenia
17:30	Radiogenic Isotope Composition Determination: A Form of Nanoscience Used Around the Globe [1,2]Patricia Jovičević Klug, [2]Ed Hathorne, [1,2]Martin Frank [1]University of Kiel, Christian-Albrechts-Platz 4, 24118 Kiel, [2]GEOMAR (Helmholtz Centre), Wischhofstraße 1-3, 24148 Kiel
17:40	Twinning and Charge Compensation in Nb_2O_5/Ta_2O_5-doped SnO_2-CoO Varistor Ceramics Sara Tominc[1,2], Matejka Podlogar[1], Goran Dražić[2,3], Slavko Bernik[1], Nina Daneu[1], Aleksander Rečnik[1,2] [1]Jožef Stefan Institute, Department for Nanostructured Materials, Jamova cesta 39, Ljubljana, Slovenia, [2]Jožef Stefan International Postgraduate School, Jamova cesta 39, Ljubljana, Slovenia, [3]National Institute of Chemistry, Hajdrihova 19, Ljubljana, Slovenia

17:50	Effect of EMF Parameters and Geometry on Macrosegregation in Low-Frequency Electromagnetic Casting Hatić Vanja[1], Mavrič Boštjan[1] 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
18:00	Phase Field Modelling of Dendritic Growth Based on Local Meshless Solution Procedure Tadej Dobravec[1], Boštjan Mavrič[1,2] and Božidar Šarler[1,2] [1]Institute of Metals and Technnology, Lepi pot 11, 1000 Ljubljana [2]University of Ljubljana, Faculty of Mechanical Engineering, Aškerčeva cesta 6, 1000 Ljubljana
18:10	Π-Conjugated Polymers with Tubular-like Morphologies Sarah Jurjevec[1], Ema Žagar[1], Sebastijan Kovačič[1,2] [1]National Institute of Chemistry, Department of Polymer Chemistry and Technology, Hajdrihova 19, 1001 Ljubljana, Slovenija, [2]Faculty of Chemistry and Chemical Engineering, Smetanova ulica 17, Maribor, Slovenia
18:20	Synthesis of Hybrid Block Copolymers Based on Polypeptides by Ring-opening Polymerization of *N*-carboxyanhydrides Špela Gradišar, Ema Žagar, David Pahovnik National Institute of Chemistry, Department of Polymer Chemistry and Technology, Hajdrihova 19, 1000 Ljubljana, Slovenia
18:30	Axial Powder Stream Characterization and Analysis towards Increasing Powder Catchment Efficiency in Direct Laser Deposition Andrej Jeromen, Ana Vidergar, Edvard Govekar University of Ljubljana, Faculty of Mechanical Engineering, Aškerčeva 6, 1000 Ljubljana
18:40	Initial Phase Strategy in Annular Laser Beam Direct Wire Deposition Matjaž Kotar, Edvard Govekar University of Ljubljana, Faculty of Mechanical Engineering, Aškerčeva cesta 6, Ljubljana, SI-1000, Slovenia
19:30	**Poster Session with standing buffet – Lobby**

Sreda – Wednesday 3.10.2018 Hall D	
	Predsedujoči – Chair: M. Conradi, D. Jenko
14:00	Investigation of Desulfurization Unit Fan Blade Failure Borut Žužek, Jaka Burja Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
14:15	Microstructural Characterisation of Continuously Casted Slab X120Mn12 B. Bradaškja, B. Pirnar, V. Marušič, S. Kokalj, G. Klančnik RCJ d.o.o., Cesta Borisa Kidriča 44, 4270 Jesenice
14:30	Morphological Characterization of Precipitates in Tempered Martensite by Automatic Image Analysis Fevzi Kafexhiu Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
14:45	Carbon Nanotubes As A Catalytic Support For Cobalt-Based Fischer-Tropsch Catalysts: Structure Transformation And Effect Of The Surface Modification Sergei Chernyak, Alexander Burtsev, Maria Paslova, Anthon Ivanov, Evgenia Suslova, Konstantin Maslakov, Alexander Egorov, Serguei Savilov, Valery Lunin Department of Chemistry, Lomonosov Moscow State University, Leninskie Gory 1-3, Moscow, 119991, Russia

15:00	Synthesis and Properties of Cu/CNT and WO_3/CNT Composite Materials for Metallurgy and Catalysis and Electronics Novotortsev R.Y., Smirnov A., Chernyak S.A., Savilov S.V. Department of Chemistry, M.V. Lomonosov Moscow State University. Leninskie gory, 1-3, Moscow, Russia, 119992
15:15	Using Modified Strip Yield Model for Crack Growth under Variable Amplitude Loading in AA 2124 and AA 7475 Jakub Šedek, Roman Růžek VZLÚ-Czech Aerospace Research Centre, Beranových 130, 19905, Czech Republic
15:30	Casting Technologies of Manufacturing of Porous Metals and Metallic Sponges with Irregular Open-Cell Structure Ivana Kroupová, Petr Lichý, Václav Merta, Filip Radkovský VSB – Technical university of Ostrava, 17. listopadu 15/2172, 708 33, Ostrava – Poruba, Czech republic
15:45	Sustainable Waste Treatment Procedure of SPL from Aluminium Production Blaž Tropenauer[1], Dušan Klinar[2], Niko Samec[3], Janvit Golob[4], Jože Kortnik[5] [1]TALUM d.d. Kidričevo, Tovarniška cesta 10, 2325 Kidričevo, Slovenia, [2]Scientific Research Centre BISTRA Ptuj, 2250 Ptuj, Slovenia, [3]University of Maribor Faculty of mechanical engineering, Smetanova ulica 17, 2000 Maribor, Slovenia [4]Univerza of Ljubljana, Faculty of Chemistry and Chemical Technology, Večna pot 113, 1000 Ljubljana, Slovenia, [5]University of Ljubljana Faculty of Natural Sciences and Engineering, Aškerčeva 12, 1000 LJUBLJANA, Slovenia
16:00	**Coffee Break**
	Predsedujoči – Chair: D. Steiner Petrovič, J. Burja
16:30	Study of Castability of Melts for the Production of Cast Metallic Foams Václav Merta, Ivana Kroupová, Petr Lichý, Filip Radkovský VSB – Technical university of Ostrava, 17. listopadu 15/2172, 708 33, Ostrava – Poruba, Czech republic
16:45	Comparison of Fatigue Properties of S235 J2 and S355 J2 using ProFatigue software Stanislav Seitl, Petr Miarka, Jan Klusák, Sergio Blasón, Alfonso Canteli Institute of Physics of Materials, Academy of Sciences of the Czech Republic, Zizkova 22, 616 62 Brno, Czech Republic Faculty of Civil Engineering, Brno University of Technology, Veveří 331/95, 602 00Brno, Czech Republic, Department of Construction and Manufacturing Engineering, Universidad de Oviedo, 33203 Gijon, Spain
17:00	The Analysis of the Microstructure of AZ31/AA1050/AA2519 Laminate Obtained by Explosive Welding Method Marcin Wachowski[1], Robert Kosturek[1], Lucjan Śnieżek[1], Sebastian Mróz[2], Michał Gloc[3], Agnieszka Krawczyńska[3] [1]Military University of Technology, Faculty of Mechanical Engineering, 2 gen. W. Urbanowicza str., Warsaw, Poland, [2]Czestochowa University of Technology, Faculty of Production Engineering and Materials Technology, 19 Aleja Armii Krajowej st., Częstochowa, Poland, [3]Warsaw University of Technology, Faculty of Materials Science and Enginnering, 141 Woloska str., Warsaw, Poland
17:15	Characterization Of New Fillers Addition On Mechanical Strength Of Concrete Marcin Małek[1], Mateusz Jackowski[1], Wojciech Życiński[1], Marcin Wachowski[2] [1]Military University of Technology in Warsaw, Faculty of Civil Engineering and Geodesy, Poland [2]Military University of Technology in Warsaw, Faculty of Mechanical Engineering, Poland

17:30	OES Measurements of the Electron Temperature in the HMDSO Plasma Polymerization Žiga Gosar[1,2], Ivona Vasileska[3] [1]ELVEZ, d.o.o., Ulica Antona Tomšiča 35, 1294 Višnja Gora, [2]Jožef Stefan International Postgraduate School, Jamova cesta 39, 1000 Ljubljana, Slovenia, [3]Faculty of Mechanical Engineering, University of Ljubljana, Aškerčeva 6, 1000 Ljubljana, Slovenia
17:45	Correlative Optical Imaging in the Far-field and Near-field Regimes of Micro- and Nanostructured Materials Stefan G. Stanciu, Denis E. Tranca, Catalin Stoichita, Radu Hristu, George A. Stanciu Center for Microscopy-Microanalysis and Information Processing, University Politehnica of Bucharest, 313 Splaiul Independentei, 060042, Bucharest, Romania
19:30	**Poster Session with standing buffet – Lobby Europa**

Četrtek – Thursday 4.10.2018 Hall A	
	Predsedujoči – Chair: M. Godec, T. Savšek, V. Leskovšek, P. Mrvar
	Materials in Circular Economy
9:00	Effect of The Fourth Industrial Revolution on Materials Science and Surface Engineering Zoltán Kolozsváry SC Plasmaterm SA, Romania
9:40	Non-Metallic Inclusions in Steel: A Metallurgist's Perspective Jaka Burja Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia.
10:00	Slag Processing and Steelmaking Waste Management – the Challenges we are Facing Today M. Loncnar, M. Trdin SIJ Acroni, Cesta Borisa Kidriča 44, 4270 Jesenice
10:15	Beneficial Use of Waste Heat for the Ppurposes of District Heating and Sanitary Hot Water in Ravne na Koroškem Kristijan Plesnik SIJ Metal Ravne d.o.o., Koroška c. 14, SI–2390 Ravne na Koroškem, Slovenia
10:30	Aluminium, Material for Lighter Future P. Medved
10:50	Optical Emission Spectrometry (OES) data-driven on-line prediction of the amount of non-metallic inclusions in wrought aluminium alloys Varužan Kevorkijan[1], Tomaž Šustar[2], Irena Lesjak[1], Marko Degiampietro[1], Janez Langus[2] [1]Impol Aluminium Industry, Partizanska 38, 2310 Slovenska Bistrica, Slovenia, [2]C3M, Tehnološki park 21, 1000 Ljubljana, Slovenia
11:05	Cicular Economy as a Partnership with the Customer Kores
11:20	**Coffee Break**
11:50	Metallurgy Design in Automotive Industry Based on Metal Material Kugler
12:10	Wear Mechanisms And Wear Resistance of Forming Tools Bojan Podgornik Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana
12:30	Lightweight Design in Automotive Industry Based on Metal Material Vili Malnarič TPV d.o.o., Kandijska cesta 60, SI-8000 Novo mesto, Slovenia

12:45	Reflections on Modelling Igor Belič IMT, Lepi pot 11, SI-1000 Ljubljana, Slovenia
13:05	Evolutionary methods in Slovenian steel industry – case studies Miha Kovačič[1,2] [1]Štore Steel d.o.o., Železarska cesta 3, Štore, Slovenia, [2]Institute of Metals and Technology, Lepi pot 11, Ljubljana, Slovenia
13:20	Are Polymer-Based Materials Compatible with Circular Economy Principles? Andrej Kržan Department for Polymer Chemistry and Technology, National Institute of Chemistry, Ljubljana
13:40	**LUNCH**
19:00-23:30	**Monfort – Conference dinner**

Četrtek – Thursday 4.10.2018 Hall A	
	Predsedujoči – Chair: M. Jenko, D. Dolinar
	Biomaterials
9:00	Drago Dolinar[1], Monika Jenko[2], Matevž Gorenšek[3] [1]Department of Orthopaedic Surgery, University Medical Centre Zaloška 9, Ljubljana, Slovenia, [2]Institute of Metals and Technology,Lepi pot 11 Ljubljana, Slovenia, [3]MD-Medicina,Bohoričeva 5, Ljubljana, Slovenia
9:45	TiO_2 particles and Nano-structured Surfaces for Biomedical Applications Veronika Kralj-Iglič[1], Roghayeh Imani[2], Metka Benčina[3], Tina Mavrič[1,2], Ita Junkar[3], Aleš Iglič[2] [1]Laboratory of Clinical Biophysics, Faculty of Health Sciences, University of Ljubljana, Zdravstvena 5, SI-1000 Ljubljana, Slovenia, [2]Laboratory of Biophysics, Faculty of Electrical Engineering, University of Ljubljana, Tržaška 25 and Laboratory of Clinical Biophysics, Faculty of Medicine, University of Ljubljana, Zaloška 9, SI-1000 Ljubljana, Slovenia, [3]Institute J. Stefan, Jamova 39, SI-1000 Ljubljana, Slovenia
10:15	Innovative Ti-Mg Composite for Dental Implants Zdravko Schauperl[1], Amir Ćatić[2], Martin Balog[3], Peter Križik[3], Ahmed Mohamed Hassan Ibrahim[3,4] [1]Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Ivana Lučića 5, HR-10000 Zagreb, Croatia, [2]School of Dental Medicine, University of Zagreb, Gundulićeva 5, HR-10000 Zagreb, Croatia, [3]Institute of materials and machine mechanics, The Slovak academy of sciences, Dubravska cesta 9, 84513 Bratislava, Slovakia, [4]Slovak University of Technology, Faculty of Materials Science and Technology, Jana Bottu 2781/25, 917 24 Trnava, Slovakia
10:35	Material Related THA Failure Rihard Trebše Orthopaedic Hospital Valdoltra, Jadranska cesta 31, 6280 Ankaran, Slovenia
10:55	Spinal Fusion- does Optimal Material Exist? Matevž Gorenšek, Urban Brulc MD-Medicina, Sanatorij Ljubljana, Bohoričeva ulica 5, 1000 Ljubljana, Slovenia
11:15	**Coffee Break**
	Predsedujoči – Chair: Č. Oblak, M. Ovsenik

11:50	Primary and Secondary Stability of Short Titanium-zirconium Dental Implants in Posterior Maxilla Rok Gašperšič Department of Oral Medicine and Periodontology, Faculty of Medicine, University of Ljubljana,Vrazov trg 2, 1000 Ljubljana, Slovenia
12:10	The Influence of Biomechanics on Prosthetic Rehabilitation with Titanium Short Dental Implants Čedomir Oblak Department of Prosthodontics, Faculty of Medicine, University of Ljubljana, Vrazov trg 2, 1000 Ljubljana, Slovenia
12:30	The effects of Metal Surface Treatment on Dental Ceramics Bond Strength to Titanium Alloy Peter Jevnikar, Maja Antanasova University of Ljubljana, Faculty of Medicine, Vrazov trg 2, 1000 Ljubljana, Slovenia
12:50	Characterization of the surface chemistry and microstructure of new and in-vivo-exposed Titanium-Nickel Shape-Memory Alloy and Stainless Steel AISI 304 Archwires Maja Ovsenik[1], Matjaž Godec[2], Janez Kovač[3], Drago Dolinar[4], ČedomirOblak[5], Tadeja Kosec[6], Monika Jenko[2] [1]Department of Orthodontics and Jaw Orthopaedics, Faculty of Medicine, University of Ljubljana, [2]Institute of Metals and Technology, Ljubljana, [3]Jožef Stefan Institute, Ljubljana, [4]Department of Orthopedic Surgery, University Medical Centre Ljubljana, [5]Dental Prosthodontics, Faculty of Medicine, University of Ljubljana, Slovenian Building and Engineering Institute, Ljubljana, Slovenia
13:10	The Application of Vibrational Spectroscopy in Structural Studies of Ultra-High Molecular Weight Polyethylene Used for Joint Replacements Urban Novak and Jože Grdadolnik Theoretical Department, Laboratory for biomolecular structure, National Institute of Chemistry, Hajdrihova 19, SI-1000 Ljubljana
13:30	**LUNCH**
	Predsedujoči – Chair: B. Mavčič, B. Kocjančič
15:00	Endoprostheses and Up To 9 Years of Follow-Up Blaž Mavčič, David Martinčič, Marko Špiler University Medical Centre Ljubljana, Dept. Orthopaedic Surgery, zaloška 9, SI-1000 Ljubljana, Slovenia
15:20	Complications With Total Knee Arthroplasty Boštjan Kocjančič Department of Orthopaedic Surgery, University Medical Centre Ljubljana, Zaloška 9, 1000 Ljubljana, Slovenia
15:40	Histological Picture of Wear Particles and Corresponding Biological Response in Periprosthetic Tissue Andrej Cör Valdoltra Orthopaedic Hospital, Jadranska 33, Ankaran, Slovenia
16:00	**Coffee Break**
	Predsedujoči – Chair: O. Zupanc, A. Moličnik
16:30	Computer Assistance in Hip Arthroscopy – Current Status Klemen Stražar[1], Uroš Meglič[1], Darij Kreuh[2], Uroš Vovk[2] [1]Department for Orthopaedic Surgery, University Medical Center Ljubljana, Zaloška 9, 1000 Ljubljana, Slovenia, [2]Ekliptik d.o.o., Teslova ulica 30, 1000 Ljubljana, Slovenia
16:50	Introducing a New Method for Joint Surface Analysis Klemen Bošnjak, Borut Pompe Department of Orthopaedic Surgery, University Medical Centre Ljubljana, Zaloška 8, 1000 Ljubljana, Slovenia

17:10	Use of Additively Manufactured Patient Specific Instruments in Clinical Praxis Igor Drstvenšek[1], Urška Kostevšek[1], Tomaž Brajlih[1], Snežana Stevic[4], Nataša Ihan Hren[2], Matjaž Merc[3], Andrej Moličnik[3] [1]University of Maribor, Faculty of Mechanical Engineering, Smetanova ulica 17, Maribor, Slovenia, [2]University of Ljubljana, Faculty of Medicine, Vrazov trg 2, Ljubljana, Slovenia, [3]University Medical Centre Maribor, Ljubljanska ulica 5, Maribor, Slovenia, [4]University of Priština-Kosovska Mitrovica, Faculty of Medicine Kosovo
17:30	Additive Manufacturing in Orthodontics Anita Fekonja[2], Nejc Rošer[3], Igor Drstvenšek[1] [1]University of Maribor, Faculty of Mechanical Engineering, Smetanova ulica 17, Maribor, Slovenia, [2]University of Maribor, Faculty of Medicine, Taborska ulica 8, Maribor, Slovenia, [3] Interesansa - Institute for Production Technologies and Development, Teslova ulica 27, Ljubljana, Slovenia, [4]University of Priština-Kosovska Mitrovica, Faculty of Medicine Kosovo
17:50	Significance of Radiographic Parameters in Diagnosis and Tretment of Bony Impingement of the Elbow Oskar Zupanc, Uroš Meglič Department of Orthopaedic Surgery, University Medical Centre Ljubljana, Zaloška 9, 1000 Ljubljana, Slovenia
18:10	Obtaining Accurate Dimensioned Selective Laser Melting Product Focusing on Manufacturing Parameters and Building Orientations Snehashis Pal[1], Vanja Kokol[1], Nenad Gubeljak[1], Miodrag Hadzistevic[2], Radovan Hudak[3], Igor Drstvensek[1] [1]Faculty of Mechanical Engineering, University of Maribor, Maribor, Slovenia, [2]Faculty of Technical Sciences, University of Novi Sad, Novi Sad, Serbia, [3]Faculty of Mechanical Engineering, Technical University of Kosice, Kosice, Slovakia
19:00-23:30	**Monfort – Conference dinner**

Petek – Friday 5.10.2018 Hall C	
	Predsedujoči – Chair: B. Podgornik, R. Šturm
	Workshop – 3D Printing of Metallic Materials
10:00	Impact of the Process Gas Atmosphere in Laser Additive Manufacturing – desired and undesired effects Eric A. Jägle[1,2], Anoop Kini1, Michael Haines[3], Markus Benjamin Wilms[4], Christian Baron[1], Hauke Springer[1], Nobuo Nakada[2], Dierk Raabe[1] [1]Max-Planck-Institut für Eisenforschung GmbH, Max-Planck-Str. 1, 40237 Düsseldorf, Germany, [2]Tokyo Institute of Technology, 4259 Nagatsuta-cho, Midori-ku, Yokohama, Kanagawa, 226-8503, Japan, [3]University of Tennessee-Knoxville, Knoxville 37996, TN, USA, [4]Fraunhofer Institut für Lasertechnik, Steinbachstrasse 15, 52074 Aachen, Germany
10:30	Metallurgical Aspects of the Additive Manufacturing of Metallic Materials - Microstructure & Mechanical Properties 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-planc Institute for Steel Research, Max-Planck Strasse 1, Duesseldorf, Germany [3]MARSI, Prešernova cesta 6, 8250 Brežice, Slovenia [4]Nacional Institute of Chemistry, Hajdrihova 19, 1000 Ljubljana, Slovenia
11:00	3IGITAL: intelligent components, digital production cells and smart applications. Tapping the next technological dimension of industrial 3D Printing Güngör Kara Chief Digital Officer (CDO) at EOS
11:30	**Coffee Break**
12:00	Laser direct metal deposition: from droplets to wire and powder deposition Edvard Govekar Katedre za sinergetiko, Aškerčeva cesta 6, SI-1000 Ljubljana, Slovenia
12:30	Towards In-Situ Process Control for Powder Bed Laser Melting Yves Hagedorn Aconity 3D, Germany
13:00	3D Nano-Printing via Focused Electron Beams: Principles and Applications Harald Plank[1,2] [1]Christian Doppler Laboratory DEFINE, Institute of Electron Microscopy and Nanoanalysis, Graz University of Technology, 8010 Graz, Austria, [2]Graz Centre for Electron Microscopy, 8010 Graz, Austria
13:30	New materials in laser-based Additive Manufacturing Frank Brueckner[a,c], Michael Mueller[a,b], Juliane Moritz[a], Stefan Polenz[a], Jakob Schneider[a,b], Elena Lopez[a], Mirko Riede[a], André Seidel[a], Eckhard Beyer[a,b], Christoph Leyens[a,b] [a]Additive Manufacturing and Printing, Fraunhofer-Institute for Material and Beam Technology, Winterbergstr. 28, 01277 Dresden, Germany, [b]Technische Universität Dresden, Helmholtzstr. 7, 01069 Dresden, Germany, [c]Luleå University of Technology, 971 87 Luleå, Sweden
14:00	Šinko
14:30	**LUNCH**

POSTRSKA SEKCIJA – POSTER SESSION
Sreda – Wednesday 3. 10. 2018 (19:30)

YR1	Effect of Fillers on Thermal and Electrical Properties of Alkali/Alkaline-Earth Borosilicate Glass Composite Sealant for Solid Oxide Fuel Cell Applications Sueng-Ho Baek, Sung Park and Jae Chun Lee Department of Materials Science and Engineering, Myongji University, Yongin, Korea
YR2	Improvement of High Temperature Properties of New Generation Fe-Al-O Oxide Precipitation Hardened Steels Omid Khalaj[1], Hana Jirková[1], Bohuslav Mašek[2], Jiří Svoboda[3] [1]Regional Technological Institute, University of West Bohemia, Univerzitní 22, 306 14, Pilsen, Czech Republic, [2]COMTES FHT a.s., Průmyslová 995, 334 41 Dobřany, Czech Republic, [3]Institute of Physics of Materials, Academy of Sciences of the Czech Republic, Žižkova 22, 616 62, Brno, Czech Republic
YR3	Assessment Of The Cement Boards Building Plate In The Czech Republic Miloslav Novotný, Karel Šuhajda, Miloslav Novotný Brno University of Technology, Veveří 331/95, 602 00 Brno
YR4	Production of Cast Porous Metal With a Regular Internal Structure Filip Radkovský, Ivana Kroupová, Václav Merta, Petr Lichý Vysoká škola báňská – Technická univerzita Ostrava, 17. listopadu 15/2172, Ostrava – Poruba,708 33
YR5	Influence of Different Load Cells and Testing Rates on the Scattering of Tensile Test Results Rok Rezar, Borut Žužek, Agnieszka Guštin, Bojan Podgornik Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
YR6	Usability of by-products as a Siliceous Component in Autoclaved Aerated Concrete Technology Pavlína Šebestová, Vít Černý, Rostislav Drochytka Brno University of Technology, Faculty of Civil Engineering, Veveri 331/95,602 00 Brno, Czech Republic
YR7	Sol-gel Technique Of Obtaining Oxide Eutectic Sintering Aids For Silicon Carbide Ceramics Evgeny Nazarov, Maksim Mararakin, Maria Vartanyan, Nikolay Makarov D.Mendeleyev University of Chemical Technology of Russia, 125047, 9, Miusskaya sq., Moscow, Russia
YR8	Wear-Resistant Ceramics Based On Alumina With An Eutectic Modifier Nikolay Makarov, Dmitry Vershinin, Dmitry Antonov D.Mendeleyev University of Chemical Technology of Russia, 125047, 9, Miusskaya sq., Moscow, Russia
YR9	Polymer Matrix-bonded Polyester Fibers as a Substitute for Materials Used in the Cores of Vacuum Insulation Panels Vítězslav Novák, Jiří Zach Brno University of Technology, Faculty of Civil Engineering, Veveří 331/95, 602 00 Brno, Czech Republic
1	Ceramic Membrane from Saudi Raw Materials for Water Treatment Saad Aljlil National Center for Water Technology, King Abdulaziz City for Science and Technology, Riyadh, Saudi Arabia
2	Toughening and Reinforcement of High Impact Polystyrene Fares D Alsewailem[1] and Abdulrahman Alaameri[2] [1]King Abdulaziz city for science and technology (KACST), P.O.Box 6086, Riyadh 11442, Saudi Arabia, [2]King Saud University, P.O.Box 145111, Riyadh 4545, Saudi Arabia

3	Content of δ-ferrite and the Influence of the Heat Treatment on its Transformation in the Austenitic Stainless Steel SS2343 B. Arh, F. Tehovnik, F. Vode, S. Malej Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia
4	Evaluation of Surfactant Leaching from Fine-Grained Alkali-Activated Slag-Based Composites Using Surface Tension Measurement Vlastimil Bílek Jr., Lukáš Kalina, Eva Bartoníčková Brno University of Technology, Faculty of Chemistry, Materials Research Centre, Purkyňova 118, 612 00 Brno, Czech Republic
5	Influence of Specific Surface Area of the Quartz Sand on Character of the autoclaved Calcium Silicate Composite Jana Húšťavová, Vít Černý, Rostislav Drochytka Brno University of Technology, Faculty of Civil Engineering, Veveri 331/95,602 00 Brno, Czech Republic
6	Influence of a chemical composition on the Corrosion of a Biodegradable Fe–Mn alloys Črtomir Donik, Aleksandra Kocijan, Irena Paulin, Matjaž Godec Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana
7	Association Rules and Prediction Quality of Continuously Cast Slabs Zdeněk Franěk[1], René Pyszko[2] [1]Silesian University in Opava, School of Business Administration in Karvina, Univerzitní nám. 1934/3, 733 40 Karviná, Czech Republic, [2]VŠB – Technical University of Ostrava, 17. listopadu 15/2172, 708 33 Ostrava – Poruba, Czech Republicn
8	The design of Water Model Experiment for Fluid Dynamics of Continuous Casting of Steel Billets Jurij Gregorc[1] and Božidar Šarler[1,2] [1]Laboratory for Fluid Dynamics and Thermodynamics, Faculty of Mechanical Engineering, University of Ljubljana, Aškerčeva 6, SI 1000 Ljubljana, Slovenia, [2]Laboratory for Simulation of Materials and Processes, Institute of Metals and Technology, Lepi pot 11, SI 1000 Ljubljana, Slovenia
9	Preliminary Characterization of AlCrFeNiTi Alloys Agnieszka Guštin, Borut Žužek, Bojan Podgornik Institute of Metals and Technology, Laboratory of Mechanical Testing, Lepi pot 11, 1000 Ljubljana, Slovenia
10	Human Osteoblast-Like Osteosarcoma Cell Adhesion on Nanosecond Laser-Textured 316L Stainless Steel 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, Slovenia, [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, 1000 Ljubljana, Slovenia
11	Influential Parameters in Selected Precursors for Alkali Activation Process Barbara Horvat[1], Alenka Pavlin[2], Vilma Ducman[1] [1]Slovenian National Building and Civil Engineering Institute, Dimičeva ulica 2, 1000 Ljubljana, Slovenia [2]Termit, Drtija 51, 1251 Moravče, Slovenia
12	TEM of Fe-aluminides with Additions of Mo, Ti and B Darja Jenko, Martin Palm Institute of Metals and Technology, Lepi pot 11, SI-1000 Ljubljana, Slovenia, Max-Planck-Institut für Eisenforschung GmbH, Max-Planck-Straβe 1, 40237 Düsseldorf, Germany

13	Metallic Biomaterials in THA Monika Jenko[1], Matevž Gorenšek[2], Boštjan Kocjančič[3], Klemen Avsec[3] and Drago Dolinar[3] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]MD-Medicina, Sanatorium, Bohoričeva 8, 1000 Ljubljana, Slovenia, [3]Dept. of Orthopaedic Surgery, University Medical Centre, Ljubljana, Slovenia
14	Nanostructured Superhydrophilic and Superhydrophobic TiO_2/Epoxy Coatings on AISI 316L Stainless Steel Aleksandra Kocijan[1], Marjetka Conradi[1], Črtomir Donik[1], Matej Hočevar[1], Damjana Drobne[2] and Matjaž Godec[1] [1]Institute of Metals and Technology, Lepi pot 11, SI-1000 Ljubljana, Slovenia, [2]Biotechnical Faculty, University of Ljubljana, Jamnikarjeva 101, SI-1000 Ljubljana, Slovenia
15	HAZ Integrity of 500 HB Abrasion Resistant Steel G. Klančnik[1], S. Kokalj[1], A. Skumavc[2] [1]RCJ d.o.o., Cesta Franceta Prešerna 61, Jesenice, 4270 Jesenice, [2]SIJ Acroni d.o.o., Cesta Borisa Kidriča 44, 4270 Jesenice
16	Microstrucure Caracteristic Steel Slags Nataša Lipovšek[1], Matjaž Godec[1], Samo Smolej[2], Matjaž Knap[2], Jakob Lamut[2] [1]Institute of Metals and Technology, Lepi pot 11, SI-1000 Ljubljana, Slovenia, [2]NTF – OMM, UL, Aškerčeva 12, SI-1000 Ljubljana, Slovenia
17	Optimization of Press-Fit Process – Case Study Gašper Gantar[1], Peter Göncz[1], Miha Kovačič[1,2,3] [1]College of Industrial Engineering, Mariborska cesta 2, Celje, Slovenia, [2]Štore Steel d.o.o., Železarska cesta 3, Štore, Slovenia, [3]Institute of Metals and Technology, Lepi pot 11, Ljubljana, Slovenia
18	Principles For Structure Formation Management in Alumina And Zirconia Ceramics Processing Nikolay Makarov, Dmitry Antonov D.Mendeleyev University of Chemical Technology of Russia, 125047, 9, Miusskaya sq., Moscow, Russia;
19	Investigation of an Fe-Si-Mn-Al alloy high-temperature oxidation behavior Darja Steiner Petrovič[1], Gašper Novak[2], Aleš Nagode[3], Djordje Mandrino[1] [1]Institute of Metals and Technology, Ljubljana, Slovenia, [2]RCJ, d.o.o., Jesenice, Slovenia, [3]University of Ljubljana, FNSE, Ljubljana, Slovenia
20	Development of the lightweight traffic-light boom with high strength characteristics through GFRP materials Min Seok Moon, Myeong Han Yoo, Jong Il Rho, Joon Hyuk Song, Na Ra Park, Won Tae Kim, Je Ha Oh Korea Institute of Carbon Convergence Technology, #110-11, Banryong-ro, Dukjin-gu, Jeonju, Korea
21	Modelling and Simulation of Electroslag Remelting - Part 1: Model Formulation Katarina Mramor[1,2], Boštjan Mavrič[1,2] and Božidar Šarler[1,2] [1]Institute of Metals and Technnology, Lepi pot 11, 1000 Ljubljana, [2]University of Ljubljana, Faculty of Mechanical Engineering, Aškerčeva cesta 6, 1000 Ljubljana
22	Carbon Nanostructures and Related Materials: Synthesis, Characterization Features, Application in New Materials Design and Energy Storage Systems Serguei Savilov, Anthon Ivanov, Ekaterina Arkhipova, Nikolay Osipov, Alexander Burtsev, Eugenia Suslova, Valery Lunin M.V. Lomonosov Moscow State University, Chemistry Department, 119991, Russia, Moscow, Leninskie gory, 1, b.3
23	Influence of Different Surface Irregularities on Fatigue Properties of Coated Cold Work Steel M. Sedlaček, B. Žužek Institute of Metals and Technology, Lepi pot 11, Ljubljana, Slovenia

24	Microstructure and Mechanical Properties of Rapidly Solidified 5083 Al-alloy Danijela Skobir Balantič, Irena Paulin, Borut Žužek, Barbara Šetina Batič, Matjaž Godec Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana
25	Class C fly Ash for 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
26	Mechanical and Bicompatible Properties of Continuous Vertical Cast NiTi Rod Aleš Stambolić[1], Monika Jenko[1], Aleksandra Kocijan[1], Borut Žužek[1], Damjana Drobne[2], Rebeka Rudolf[3,4] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]Biotechnical Faculty, Department of Biology, Večna pot 111, 1000 Ljubljana, Slovenia, [3]University of Maribor, Faculty of Mechanical Engineering, Smetanova 17, 2000 Maribor, Slovenia, [4]Zlatarna Celje d.o.o., Kersnikova 19, 3000 Celje, Slovenia
27	Surface Analysis of Overlayers on Biodegradable Mg Alloys After Immersion in Simulated Body Fluid Darja Steiner Petrovič[1], Djordje Mandrino[1], Božidar Šarler[1], Jelena Horky[2], Andrea Ojdanic[3], Michael Zehetbauer[3], Dmytro Orlov[4] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia, [2]Austrian Institute of Technology, Viktor Kaplan Straße 2, 2700 Wiener Neustadt, Austria, [3]University of Vienna, Faculty of Physics, Physics of Nanostructured Materials, Boltzmanngasse 5, 1090 Vienna, Austria, [4]Lund University, LTH, Division of Materials Engineering, 22363 Lund, Sweden
28	Study of WC-X-WC (X=Cr, W, Zr) Diffusion Couples Prepared by Spark Plasma Sintering Barbara Šetina Batič[1], Borut Žužek[1], Jaka Burja[1], Petra Jenuš[2], Matej Kocen[2], Saša Novak[2] [1]Institute of Metals and Technology, Lepi pot 11, 1000 Ljubljana, Slovenia [2]Jožef Stefan Institute, Ljubljana
29	Microstructural Changes in Cement Mortars due to Alkali-Carbonate Reaction P. Štukovnik[1], V. Bokan Bosiljkov[1], M. Marinšek[2] [1]University of Ljubljana, Faculty of Civil and Geodetic Engineering, [1]University of Ljubljana, Faculty of Civil and Geodetic Engineering, [2]University of Ljubljana, Faculty of Chemistry and Chemical Technology
30	Influence of the Annealing Temperature on the Mechanical Properties of the Superaustenitic Stainless Steel UHB 904L F. Tehovnik, B. Arh, F. Vode, S. Malej, J. Burja IMT, Lepi pot 11, 1000 Ljubljana, Slovenia
31	Calculation of Convective Heat Transfer Coefficient Franci Vode, Simon Malej, Boštjan Arh, Franc Tehovnik IMT, Lepi pot 11, SI-1000 Ljubljana
32	Study on Manufacturing and Characteristics of thermally Conductive Composite Sheet Using Graphite-polymer Myeong Han Yoo[1], Min Seok Moon[1], Jeha Oh[1], Na Ra Park[1], Won Tae Kim[1], Sung Mo Yang[2], Shin Jae Kang[2], Joon Hyuk Song[1] [1]Korea Institute of Carbon Convergence Technology, #110-11,Banryong-ro, Jeonju, Republic of Korea, 54853, [2]Division of Mechanical System Engineering, Chonbuk National University, #562, Baekje-daero, Jeonju, Republic of Korea, 54896

Ceramic Membrane from Saudi Raw Materials for Water Treatment

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Billions of barrels of wate water are generated every day from different sources in Saudi Arabia. These waste waters are not suitable for any type of utilization or for discharge without any treatment. This study demonstrates the necessity and purpose of a treatment with the fabrication of ceramic filters, which are designed to obtain high recovery with good filtrate rate during the treatment of mud suspension. A ceramic filter was fabricated using extrusion method from economical silica, waste glass powder and some organic additives (Carboxyl Methyl Cellulose and Corn Starch). The length of the fabricated ceramic filter is 150 mm with the tdiameter of the inner and outer wall being 5 mm and 10 mm, respectively. The dried samples were sintered at temperatures of 1000^{o}C 3 hours of time respectively. The average porosity of sintered supports was 35% and it provided high corrosion resistance with ≤0.5% mass loss in both acidic (pH 3) and basic (pH 10) media. The performance of ceramic filter is studied by cross-flow microfiltration via transmembrane pressure for 1.0 bar of mud suspension. The results showed that the mud suspension separation efficiency are more than 99%. These results indicate that the fabricated filter could be used for microfiltration of waste water.

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Toughening and Reinforcement of High Impact Polystyrene

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In this research high impact polystyrene (HIPS), a rubber toughened general-purpose polystyrene, was further toughened by melt blending with maleated ethylene-propylene (EP-g-MA) and reinforced by compounding with glass fibers (GF). The goal behind incorporating reinforcement agents, i.e. GF, was to compensate for the reduction in stiffness of HIPS upon toughening with EP-g-MA. HIPS pellets were blended and compounded with EP-g-MA and GF at various weight percentages ranging from 0 to 10 wt% alternatively, while HIPS content was kept at 90 wt% in all prepared samples. ASTM specimens for Izod Impact strength (ASTM 265D) and tensile strength (ASTM D 1708) were prepared by melt blended and compounding of all constituents in the cup of a mini lab molder (LME) and then injection into specified molds. It was shown by the results of this study that one may increase both stiffness and toughness of HIPS by proper addition of combined EP-g-MA as a resilience modifier and GF as a stiffness enhancer. Composites with EP-g-MA content greater than 3 wt% had significantly increased in toughness while stiffness remained fairly unchanged.

Observation and Mechanisms of Nucleation and Growth of Gold Nanoparticles Grown From Chloroauric Acid Solution by Using Liquid Cell Transmission Electron Microscopy

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Gold nanoparticles are versatile material, which is among many others applications [1] also used in experimental cancer treatment where gold nanoparticle's photothermal effect is employed [2]. For that reason gold nanoparticle's nucleation mechanisms need to be understood in-situ in liquid at the elevated temperature conditions [3]. In our experiments 1.5 mM water solution of chloroauric acid as source of gold was used. Experiments were performed using liquid cell transmission electron microscopy technique (LCTEM) at constant electron dose rate of 10^8 Gy/s and temperatures up to 50 °C. The solution was initially observed at the room temperature as a control. During that (control) period no nucleation or growth of the nanoparticles was observed – indicating the stability of the solution at the selected dose rate. On the contrary, soon after the temperature was raised to 50 °C first seed particles could be observed. Later seed particles acted as nuclei for the growth of additional gold layer. We propose formation of these complex gold NPs could not be explained with a single (classical) nucleation mechanism, but as a combination of several competing ones. Firstly LaMer mechanism explains abrupt start of formation of seed particles. Secondly precipitation of FCC Au^0 could be explained with a mechanism of indirect nucleation path using redox reactions, as the einverionment in the liquid cell at elevated temperatures is more reductive. At the same time $AuCl_4^-$ is still dissolved in water and when pH is increased as a result of radiolysis $(Au)OH_3$ precipitates around FCC Au^0.

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Microstructural Changes in 8079 Aluminium Alloy With High Fe Content During High Temperature Annealing

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Aluminium alloys often undergo certain high temperature heat treatments, such as solution heat treatment or homogenization. In this research microstructural changes of an 8079 aluminium alloy with high Fe content were investigated, after being exposed to a high temperature annealing at 600 °C for 4, 6, 8, 10 and 12 h. Microstructural changes were observed with an optical microscope and a scanning electron microscope. EDS analysis was used to determine the type and composition of eutectic Fe-phases and all measurements were compared to the as-cast state. Thermodynamic calculations were performed using ThermoCalc software. By combining the calculated data with DSC analysis performed on each sample, characteristic temperatures and stable intermetallic phases were determined. Results have shown, that the 4 h annealing process at 600 °C is insufficient to transform the metastable Al_6Fe eutectic phase into a stable $Al_{13}Fe_4$. This transformation is visible in the microstructure of samples annealed for longer periods of time.

Content of δ-ferrite and the Influence of the Heat Treatment on its Transformation in the Austenitic Stainless Steel SS2343

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Stainless steel properties and performance are strongly related to its microstructure, especially the amount and distribution of δ-ferrite. In the case of castings and welds, these depend on chemical composition and on the cooling rate during and after solidification. Paper determining the content of δ-ferrite in laboratory SS2343 steel, using metallographic methods and magnetic method. Ferrite fraction were in order of 10,7 to 14,6 %. The transformation i.e. decomposition of δ-ferrite during annealing was analysed in temperature range of 1050–1250 °C through 5 or 40 minutes. Analysis of chemical composition was showed differences in the distribution of element between δ-ferrite and austenite with respect to the temperature and time of annealing steel.

Spark Plasma Sintering as a new Approach for the Synthesis of B-doped Graphene Nanoflakes

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Carbon-based nanostructured materials are widely used in catalysts, composites and energy storage devices. Doping with heteroatoms, such as oxygen, nitrogen, and boron, is an effective way to modify chemical and electronic properties of these materials. The substitution of carbon atoms in graphene layers with nitrogen or boron makes carbon materials n- or p-type semiconductive. Moreover, such modification not only improves the surface wettability of carbon material but also introduces pseudocapacitance that is especially important for electrochemical applications. Present work focuses on the synthesis of B-doping graphene nanoflakes (GNFs) and their application as an electrode material in supercapacitors. There are two main approaches to dope carbon structure with boron. The first one is an in-situ method in which carbon material is doped during synthesis. This method involves metal-containing catalysts which can contaminate the produced material. The other approach is based on post-treatment of the synthesized material with boron precursor. In our work we used plasma spark sintering (SPS) as a new and effective way of the post-synthesis introduction of boron into graphene layers of GNFs. For this purpose, GNFs were preliminarily oxidized by HNO_3 and then annealed in inert atmosphere at 500 °C to create the defect sites on the carbon surface. Produced material was sintered by SPS with 10, 20, and 30 wt. % of amorphous boron at 1200 °C for 5 minutes at 4.7 kN pressure. XPS spectra of sintered B-CNFs show the contribution from B–B, B–O and B–C species. The content of B–C in graphene layers was found to increase from 6.8 to 16.9 at. % with increasing the total B-content in the sintering material, while the total boron level achieved 36.2 at. %. The boron content in the B-GNFs obtained by XPS significantly exceeds the previously reported values [1], [2].

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Characterization of the Surface Chemistry and Microstructure of Retrieved Cementless Hip Endoprosthesis

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Objective: Cementless femoral stems are currently preferred for total hip replacements (THRs) worldwide, as well as in Slovenia. Improvements in stem design, instrumentation and surgical techniques have made this technology highly successful, reproducible, and applicable to the majority of patients requiring a THR. However, there are ongoing developments in some aspects of stem design that influence the clinical results, the incidence of complications and their inherent adaptability in accommodating the needs of individual patients. In the frame of the doctoral thesis *Studies of surface phenomena and osteointegration of cementless hip endoprostheses* the retrieved and new stems of TiAlNb were examined in detail to find the causes of premature failure. This is because a better understanding of the physico-chemical processes on the surface of the implants in connection with human tissue and liquids is needed for the successful osteointegration and longevity of the implants.
Methods: The aim of this study was a detailed analysis of the clinical results of retrieved implants and furthers a surface-chemistry and microstructure analysis of retrieved and new TiAlNb stems. Scanning Electron Microscopy (SEM) was used for the morphological visualization, energy-dispersive x-ray spectroscopy (EDS) for the chemical analysis, electron back-scatter diffraction (EBSD) for the texture and phase analysis, atomic force microscopy (AFM) and Auger electron spectroscopy (AES) and X-ray photoelectron spectroscopy (XPS) for the surface-chemistry analyses and for the depth profiling the characteristic elements.
Results The EDS and EBSD analyses results showed the microstructure of TiAlNb stems, which consist of alfa and beta phases. The surface roughness was also determined. The purity of the basic material was characterized using a promising new method.
Conclusion: Preliminary results showed the microstructure and surface chemistry of TiAlNb cementless hip stems. Future work involves studies of degradation of investigated stem, especially bio-tribo-corrosion and modification of surfaces with multifunctional coatings to prevent aseptic loosening and to improve osteointegration.

Reflections on Modelling

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The aim of the contribution is to provide the understanding of a different modelling aspects. It is intended for practitioners who daily come across the different practical modelling problems. Mathematics has always provided the set of generally understood tools to aid the scientific work. Problems described by mathematical formalisms are considered to be "framed into the model". Such models are referred to as mathematical or scientific. Scientific modelling is an activity aiming to make a particular part or feature of the world easier to understand and to predict. There are several different types of models (modelling) such as conceptual, operational, mathematical, graphical etc. Today modelling is an essential and inseparable part of various scientific disciplines, where each of which has their own ideas about specific types of modelling. The collection of methods, techniques and meta-theory about all kinds of specialized scientific modelling is growing rapidly consequently the field is getting extremely hard to follow.

A scientific model seeks to represent empirical objects, phenomena, and physical processes in a logical and possibly objective way. All models are simplified reflections of reality that, despite being approximations, can be extremely useful. Building and disputing models is fundamental to the scientific community. The scientific debate often concerns which is the better model for a given task. Computer models allow scientists to use computational power to simulate, visualize, manipulate and gain intuition about the entity, phenomenon, or process being represented. Such models use "what we know" to come to "what we do not know". This can be a very slippery terrain.

Modelling often represent a substitute for direct measurement and experimentation, allowing for faster and often far more concise understanding of a problem.

The relation between modelling, simulation, and regulation is explained. Some fundamental problems regarding modelling such as the critical sampling, artificial intelligence approaches and finally the direct collision with chaos are briefly explained.

Microstructure Modelling on Diffusive Timescales: Amplitude Expansion of the Phase Field Crystal Method

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Engineering the best microstructure of a material for a given application is one of the key challenges of modern material science. As the properties of the material depend on the chemical composition of the material and its microstructure, the task requires good understanding of complex relationships between chemical composition, casting and material processing processes and the resulting microstructure. The development of new materials is hindered by the complexity of the relationships between all parameters and high costs of experiments.

New advances in numerical modeling promise to bring models that can accurately model all processes involved across many different time and spatial scales that influence the final microstructure, and therefore reduce the requirements for costly experiments. As in a typical industrial setup the final product size is measured in meters with production times measured in hours, influenced by processes occurring on scales measuring in nanometers, occurring in microseconds, the difference in scales is enormous. Therefore it is essential to develop good models that can effectively bridge the differences in scales. One of such methods recently developed is the Phase Field Crystal method[1] (PFC) with its extensions[2-7]. The amplitude expansion phase field crystal model (APFC) can be used to model microstructure of the materials, as it can resolve the material on microscopic level, while on the other side it can also be applied on an adaptive mesh, which results in relative large sizes of the modeled domains. In this presentation, recently developed algorithms improving the APFC method will be presented.

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Evaluation of Surfactant Leaching from Fine-Grained Alkali-Activated Slag-Based Composites Using Surface Tension Measurement

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Nowadays, there are many efforts to reduce CO_2 emissions in building industry, particularly through the use of some alternative binders to those based Portland cement. One promising group of such binders includes binders based on alkali-activated slag (AAS). However, extensive drying and autogenous shrinkage and associated cracking prevent AAS being widely utilized in practice.
Possible solution can be application of shrinkage reducing admixtures[1–3], whose molecules are present in pore solution, reduce its surface tension and thus mitigate AAS shrinkage. However, if AAS comes in contact with water SRAs can be leached and its effectiveness reduced[4]. This work tries to evaluate amount of surfactant leached from the AAS-based mortar specimens using very simple surface tension (ST) measuring technique.
For these purposes mortars based on AAS without and with 2 % of PEG varying in molecular weight were prepared. Waterglass with SiO_2 to Na_2O ratio equal to 2.2 was used at the doe corresponding to 8 % Na_2O with respect to the slag weight. Mortar specimens were prepared and sealed for 24 hours. Then they were demolded and immersed in demineralized water whose ST was monitored over time. During the early stages (minutes and hours) ST dropped rapidly, while remained approximately constant after few days which points out organic molecules are leached from AAS specimens very quickly. Quantification of leached PEG was carried out using calibration curve. It was observed that relatively small fraction of PEGs can be leached out which indicates that organic molecules are rather bound in matrix unable to reduce ST of pore solution.

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Microstructural Characterisation of Continuously Casted Slab X120Mn12

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X120Mn12 or Hadfield steel is a high manganese steel mainly intended for dynamic loads due to work-hardening phenomena, containing 1.05 – 1.20 wt. % of C and 11.50 – 14.00 wt. % of Mn. These types of high carbon steel grades, characterized by a wide solidification interval, are prone to segregation. In the macro segregation zone microstructure variation and consequently variation of functional properties are expected to some extent. Qualities like GX120Mn13 are cast into final shapes, without plastic deformation to control final austenite grain size and properties. Additionally, where uniform through section properties are demanded, refined metal melt, free from excessive non-metallic inclusions, are cast into ingots or on vertical continuous casting machines and through controlled processing maps rolled into steel plates for additional off-line heat treatment. Both routes, compared to single strand-bow type continuous caster, have lower yield and productivity. Especially the last one due to low casting speed.

Optimized chemical composition was set to minimize negative phosphorus and other eutectic formations. Adjusted technological parameters of steel enabled reliable production in SIJ-Acroni plant and adequate as-cast microstructure for further quarto plate production. Abrasion resistant steels such as X120Mn12 grades can now also be reliably produced on the bow-type continuous caster.

In this study, the as-cast microstructure of continuously casted (CC) slab was investigated with focus on grain boundary carbide precipitation and overall homogeneity of the inner structure of CC slabs. The degree of segregations was experimentally determined using FE-SEM with EDX in relation with thermodynamic predictions using commercial program Thermo-Calc. The influence of the segregations type on the further processing was also evaluated.

The aim of the present work was to characterize the as-cast microstructure and the different phase constituents regarding to the stability of the casting process.

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New materials in laser-based Additive Manufacturing

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Laser systems are an excellent tool to achieve a very precise and accurate layer wise positioning of material in Additive Manufacturing. Based on beneficial properties of the laser beam as well as highly flexible machine setups, a broad range of materials can be deposited in a defect-free quality. This enables various applications in branches like aerospace, space, medical technology or mechanical engineering.

A major aim in laser-based Additive Manufacturing is the use of more and more advanced materials with beneficial properties such as low density, good high-temperature performance or superior thermal conductivity. Hybrid process setups and sensor systems can yield an exact temperature tailoring to overcome the challenge of cracking or other process related issues.

Another approach to enhance part capabilities is the processing of multi-material systems. By means of several powder inlets in one nozzle systems, the chemical composition of the deposited material can be locally tailored. Hence, the right materials can be specifically used just where they are needed.

This presentation discusses latest development work in laser-based Additive Manufacturing to use advanced materials, but also multi-materials within one component. Various examples demonstrate the benefit of novel materials and how they can be used in potential applications.

Non-Metallic Inclusions in Steel: A Metallurgist's Perspective

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Non-metallic inclusions are an unavoidable phenomenon in steel. They are the product of the interactions between alloying elements during the steel melt preparation and/or solidification. The most common are oxide non-metallic inclusion. The origins of the oxide inclusions are in the nature of iron and steel production. Oxygen is used to produce steel, pig iron is converted into steel by oxygen blowing. Oxygen is also ever-present in our atmosphere and is therefore a constant companion. Sulphur on the other hand is the product of using coke to reduce iron ore. Sometimes it is even intentionally added to the steel to improve machinability.

The problem occurs when the steel properties are negatively affected by non-metallic inclusions. Here a set of complex and often conflicting mechanisms to achieve “clean steel” comes into play. The understanding of non-metallic inclusion formation and their nature is often misunderstood by non-metallurgists and the problem is far from trivial. Some of the difficulties and problems when facing non-metallic inclusion control and their effect on the steelmaking process will be discussed.

Carbon Nanotubes As A Catalytic Support For Cobalt-Based Fischer-Tropsch Catalysts: Structure Transformation And Effect Of The Surface Modification

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Fischer-Tropsch synthesis (FTS) is an industrial-scale process to obtain synthetic hydrocarbons via catalytic hydrogenation of carbon monoxide over cobalt or iron based catalysts. The present study is devoted to the properties of carbon nanotubes (CNTS) as a support for Co-catalysts in FTS. Traditional oxide supports for FTS catalysts possess well-known disadvantages such as low thermal conductivity and reactivity to the active metals, which, respectively, causes local overheating and decreases reaction rate. CNTs provide both the high dispersion of metal nanoparticles and the uniform heat distribution over catalyst bulk, so this material is promising for the application in FTS. At the same time, carbon surface itself cannot effectively stabilize cobalt particles; therefore functionalization is used to provide active centers for metal anchoring. In this work we consider the nitric acid treatment of CNTs and its effect on the Co/CNT catalytic activity, selectivity, and stability.
One of the main drawbacks of oxidized carbon supports is low thermal stability of the surface functional groups. We found that only about 25 % of the initial oxygen remained on the support surface after catalyst synthesis, activation and FTS tests for 70 h [1]. Structural transformations of the CNT surface were studied by nitrogen adsorption, TEM, and Raman spectroscopy. As the etching of the material under hydrogen atmosphere was observed we proposed soft regeneration for such systems. This regeneration includes air oxidation and reduction stages that were chosen based on the results of thermal analysis.
The reported study was funded by RFBR according to the research project № 18-33-00390.

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Influence of Aging on Surface Properties of Laser-textured and Epoxy/TiO_2 Coated Stainless Steel

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This work presents the results of a few-month observation of wetting and corrosion properties of fiber-laser-textured (SP-020P-A-HS-S-A-Y) stainless steel AISI 316L. The samples were prepared either uncoated by varying the distance between laser-produced micro(μ)-channels leading to different surface roughnesses or laser-textured and coated with epoxy resin, or with epoxy resin filled with FAS-TiO_2 nanoparticles (epoxy/FAS-TiO_2). We performed a comparative study on the samples kept under ambient conditions and in conditions with reduced air pressure and humidity. Optical profilometry and scanning electron microscopy were used to analyze the average surface roughness and morphology of laser-textured steel surfaces. Contact angles were monitored on a daily basis for all samples under ambient conditions and in conditions with reduced air pressure and humidity. Potentiodynamic measurements were performed on fresh-prepared and aged uncoated and coated laser-textured samples. The results have shown that superhydrophobicity of steel can be achieved either indirectly by aging the laser-textured surface or directly by application of the epoxy/FAS-TiO_2 coating. Ambient conditions have a significant impact on changes of wettability of laser-textured steel without coatings, but they do not affect the aging of coated laser-textured surfaces. Coated surfaces show improved corrosion resistance compared to uncoated laser-textured surfaces.

Histological Picture of Wear Particles and Corresponding Biological Response in Periprosthetic Tissue

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Implant loosening secondary to osteolysis is the most common mode of failure of joint prosthesis. The generation of wear debris from any part of the prosthesis is unavoidable. Wear particles from polymers such as polyethylene and polymethylmetacrylate, metals and ceramics induce an extensive biological cascade of adverse cellular responses, in which macrophages are the main cellular type involved in this hostile inflammatory process. Consequently, granulomas (nodules consisting of inflammatory cells phagocytizing foreign bodies) with central necrosis, fibrosis or scar tissue can form within the synovial-like interface membrane (SLIM)[1]. Histological analysis of SLIM obtained during implant revision surgery has been considered important for wear particle identification, and for classification of the biological reactions to wear particles.

In Orthopaedic Hospital Valdoltra, tissue samples for histological analysis are taken during almost all revision surgeries. Wear particles in the SLIM are analysed according to their size, shape, colour and properties observed by conventional light microscopy, under polarized light and after histochemical stains. The cellular components of SLIM, composed of macrophages, giant cells, fibroblasts, synovial cells and lymphocytes, are determined according to a modified Mirra classification[2]. The comprehensive histological algorithm of SLIM proposed by Krenn et al.[3], as a common platform for multicentric implant retrieval studies, is used.

Due to the continuous development of new materials and combinations for artificial joint prostheses, standardised histological examination of SLIM provides a useful tool for determining the cause of implant failure and for identifying wear particles by routine light microscopy examination and providing essential information for risk assessment of implant performance to national implant registries and public health agencies. It also serves as a base for advanced analysis of implant wear, molecular gene expression and cytokine production.

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Influence of Specific Surface Area of the Quartz Sand on Character of the autoclaved Calcium Silicate Composite

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The physically-mechanical properties of the calcium silicate composites are structure-dependent. It is necessary to check the properties of the raw materials to ensure the required quality of calcium hydro silicate microstructure. One of the decisive features is the specific surface area of the siliceous material. The particle size significantly affects their solubility during autoclaving and thus incorporating silica into the microstructure. This paper deals with the influence of particle size of quartz sand on the properties and structure of the composite. Two types of sand were used with three different specific surfaces. Tested values of specific surface area of the quartz sand were 1300 cm^2/g, 2600 cm^2/g and 3600 cm^2/g. The sand was mixed with lime with a molar ratio of calcium oxide to silicon dioxide of 0.73 and 1.00. The calcium silicate composites were expose to a hydrothermal treatment at 190 °C for an isothermal endurance time of 4, 8 and 16 hours. Mechanical properties were determined on the treated samples. The samples were further studied by microstructure by X-ray diffraction analysis and scanning electron microscopy.

Phase Field Modelling of Dendritic Growth Based on Local Meshless Solution Procedure

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A novel local meshless numerical method for solution of phase field model describing single dendrite growth from pure melt [1] is developed. Local radial basis function collocation method [2] and explicit Euler scheme are used for spatial and temporal discretization of phase field equations, respectively. Polyharmonic splines [3] are used as radial basis functions while the local interpolation problem is augmented with monomials yielding simple, accurate and flexible numerical tool. In the analysis of the numerical method, the mean phase field, the size of dendrite trunk and the tip velocity at different values of order of meshless method, computational node density, time step and preferential growth direction are analysed. Advantages and shortcomings as well as further developments of the novel numerical method are discussed.

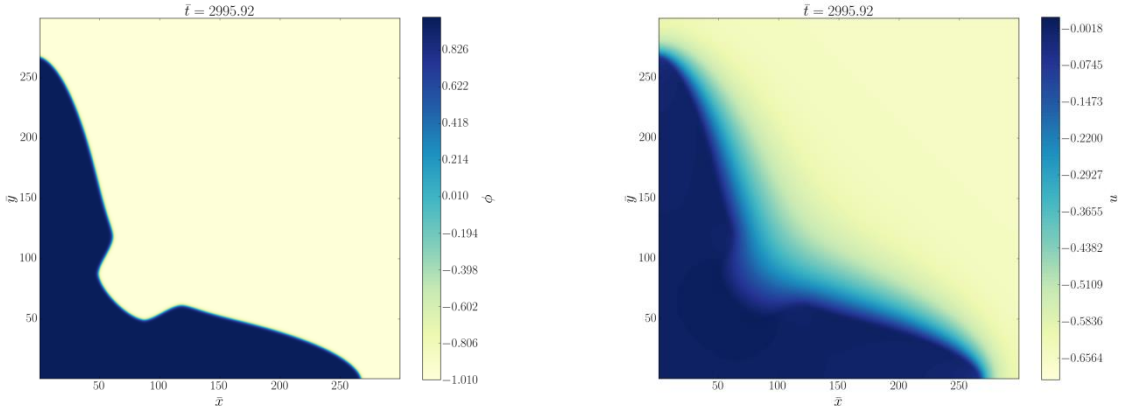

Figure 1: Typical simulation result of dendrite growth: phase field (left) and temperature field (right).

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Biomaterials in Advanced Orthopaedics

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Biomaterials are at the forefront of important advances in health sciences. Given the aging population and the growing number of chronic illnesses, which represent major challenges for the public health sector, the demand for more sophisticated medical products is expected to increase in the coming years, hence the need for ongoing research into state-of-the-art technology. Biomaterials are used in medical devices that interact with biological tissues. These include supporting tissues, such as skin, bones and teeth, as well as blood and various substances. Biomaterials can be composed of metals and metal alloys, ceramics, polymers or naturally sourced materials. There are many examples of these applications: orthopaedic prostheses, heart valves, implants, hydrogel contact lenses, etc.

The endoprosthetics of hip- and knee-joint replacements is currently the most common and successful method in advanced surgery to treat degenerative joint disease, for relieving pain and for correcting deformities. While these surgeries have positive outcomes, approximately 10 % of the implants fail prematurely. The most common causes for revision surgeries are aseptic loosening and implant infection. Recent studies point to the potential connection between implants that have been reported to fail aseptically and latent occult infections that might have been missed prior to the time of the diagnosis.

The UMC research group is working on clinical orthopaedics and together with IMT Ljubljana and BF, FE UL run a cooperation on investigations of surface chemistry and microstructure for new and retrieved implants of metallic and polymer materials, and the modification and synthesis of novel surfaces with the aim to prevent the premature failure of knee and hip endoprostheses.

A better understanding of the physico-chemical processes on the surface of the implants in connection with human tissue and liquids is needed for the successful osseointegration and longevity of the implants. The investigations included: (i) studies of surface chemistry and the microstructure of metallic biomaterials, (ii) studies of infected retrieved implants using sonication and microbiological analyses of sonication rests, (iii) investigations of infected soft tissue at the site to implants due to the release of nano metal and polymer debris using advances in microbiological methods, (iv) studies of the formation and removal of biofilms from the surfaces of different biocompatible materials (hydrophob and hydrophyl) and (v) studies of modified nanostructured surface coatings on metallic biomaterials with the purpose to understand and upgrade the oseeointegration of implants.

Recently, a cooperation between the UMC Orthopaedic department and the worldwide recognized group from Charité Berlin was established.

The results will be presented in several common contributions of UMC and IMT during the conference.

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Influence of a chemical composition on the Corrosion of a Biodegradable 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 to evaluate the biodegradability of Fe–Mn 20 alloy processed by increasing the amount of Mn up to 35 wt % to increase the corrosion rate/biodegradability; and Si up to 8 wt %, as alloying element to increase the strength and the hardness and reduce the grain size of the alloy. In this study, we report the influence of three different chemical compositions on the biodegradability of Fe–Mn alloys potentially used for medical implants. Corrosion behaviour and in-vitro biodegradability were investigated by light microscopy, scanning electron microscopy, X-ray diffraction and immersion tests in Hank's solution. XPS revealed that the oxide layer 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. EDS cross section analyses reviled significantly higher content of Mn on the surface in oxidized layer compared to the bulk Fe–Mn composition which is one of the explanations for increasing corrosion rate. Using the results of the potentiodynamic electrochemical measurements with additional EIS measurement, we were able to clearly demonstrate the increased biodegradability of the modified Fe–Mn alloys.

Quantitative Cs Corrected Scanning Transmission Electron Microscopy of Crystal Structures and Defects

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In the lecture some recent results from the structural analysis of selected materials using probe Cs-corrected STEM will be displayed and the influence of the atomic level structure on the material properties will be discussed. The main emphasis will be on the point defects, planar crystal defects, such as twin boundaries and ferroelectric domain walls.

One of the examples will be ferroelectric (Ba,Sr)TiO_3 based materials that undergo at a Curie temperature (Tc) a phase transition from a non-centrosymmetric polar ferroelectric phase to a paraelectric phase. Recently it have been shown that cubic $BaTiO_3$ phase exhibits breaking of nominal centric symmetry and exhibits polarization which is probably linked to the presence of polar nano-regions. Our aim was a direct visualisation of this polar nano-regions. The chemical composition fluctuations (Ba/Sr ratio) in BST was correlated with appearance of polar nano-regions. The methodology, error estimation and results obtained from ABF and HAADF images, acquired with Cs probe-corrected STEM will be explained and discussed.

Another example will be multiferroic bismuth ferrite (BiFeO3) with high electrical conductivity localized at domain walls (DWs). Recently, we have reported a direct experimental evidence that in contrast to the usually assumed oxygen vacancies, the dominant defects in $BiFeO_3$ are bismuth vacancies along with compensating electron holes, associated with the presence of Fe^{4+} that can explain the local conductivity of domain walls. Novel method for local vacancy concentration determination will be explained.

In the field of catalysis the structure and defects in Cu_3Pt nanoparticles and graphene-Fe-N clusters used for proton exchange membrane fuel cells will be addressed and correlated with the properties.

Additive Manufacturing in Orthodontics

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In recent years, digitalization and additive manufacturing (AM) opened new perspectives in the field of personalized complex medical and dental prostheses production. AM could be very useful also in orthodontics because of complex shape of teeth and customized production of appliances. We have tested additively manufactured clear aligners for treating orthodontic malocclusion. The treatment began with a three-dimensional scan of the patient's study cast and occlusion, followed by a treatment simulation using the software for orthodontic planning and design of teeth models in normal occlusion. Aligners were made from a thermoplastic polyurethane (TPU) foil by thermoforming it over the model made by laser sintering. In the future, the aligners will be directly produced by stereolitography out of photocuring resins that correspond to the medical devices directive 93/42/ECC for production of Class IIa medical devices. Apart from relatively well known clear aligner treatment, we have developed a new aligner for a treatment of Class II malocclusions in growing patients. The fixed sagittal guidance (FSG) appliance is individually designed to fit perfectly on the upper molars. It consists of a crown (cobalt-chromium alloy) and occlusal inclined plane made of SR Chromasit material (pressure/heat-curing micro filled veneer material). The crown has been designed using 3D computer design software for dental applications and produced by selective laser melting technology. After finishing the FSG it has been bonded on both upper molars. During closing of the jaw, the appliance provides guidance anteriorly and inferiorly to correct the sagittal and vertical deficiency. The individually made FSG appliance was effective in treating Class II malocclusion deep bite in growing patients and produced favorable and measurable dentofacial and skeletal changes. These two different types of appliances present the first use of additive manufacturing for orthodontic praxis in Slovenia. The results show a great potential and future perspectives of additive manufacturing in orthodontic treatment.

Association Rules and Prediction Quality of Continuously Cast Slabs

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The paper summarizes the basic analytical and empirical findings from analysis of dependences of the influence of thermal processes continuous casting machine for steel (hereinafter CCM) on quality of slabs, and also the influence of thermal processes on the quality of final products rolled from slabs, mainly steel sheets. The course of thermal processes at continuous steel casting has a principal influence on the quality of slabs and thus also on the entire economics of production in the steel works, as well as in the whole metallurgical plant.
The assessment of the quality of steel slabs on CCM is an inseparable part of the information system of the metallurgical plant. This assessment woks on the basis of collection and storage of the data that are necessary for an efficient assessment of dependencies between the measured and qualitative quantities. The data acquired by measurement at sequence casting, by chemical analysis, as well as data entered by the steel shop operators are stored and archived. In this manner, a time line of huge amount of data generate continuously.
The issue describes the proposal of the concept of efficient storage of these data and of their use both for operational control of production and for statistic evaluation of long-dated data and quality optimisation. Such approach requires creation of super-structural software for standard information system of the steel shop. This proprietary software gives to technologists on the slab CCM a possibility not only to analyse the history of casting, but also to perform long-term monitoring and optimisation of production.
Practical part of the paper presents analysis of mathematical or statistical methods for the assessment of slab casting process, which enable also prediction of slab quality, as well as quality of the final rolled products. This analysis are substantiated by statistical data analysis of concrete data. The author has used his experience gained at processing of extensive data files from continuous casting machines at metallurgical plants in Czech Republic.
The research results allow you to correct the settings of the selected parameters and optimize them, which reduces or eliminates defects on the slabs.

Primary and Secondary Stability of Short Titanium-Zirconium Dental Implants in Posterior Maxilla

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Introduction: Implant success and loading protocol are dependent on good implant stability and that can be affected by bone quality and quantity in addition to the implant material and surface characteristics. In areas of limited bone volume and poor bone quality such as in posterior maxilla, short implant usage is controversial and the outcome of such treatment might me influenced by selection of implants with healing-promoting material and surface features. Our aim was to evaluate primary (mechanical) and secondary (biomechanical) stability of titanium-zirconium 4 mm long dental implants with SLActive surface characteristics by means of resonance frequency method.
Materials and methods: One 10 mm and one or two 4 mm long titanium-zirconium, SLActive dental implants were inserted in 11 patients. All subjects presented limited vertical bone availability due to the expanded maxillary sinus antrum. All implants were placed following the standard implantation protocol and insertion torques and implants stability quotients recorded with the aid of the Ostell Mentor Device at time of insertion (primary stability) and at least 4 months latter (secondary stability).
Results: In 10 cases, bone quality was of type III and in one case of type IV. Among 17 (n = 17) 4 mm long and 11 (n = 11) 10 mm long implants, the mean ISQs obtained with magnetic device were 59 $\pm$ 13 (range 14 – 72) and 67 $\pm$ 7 (range 52 – 78). One 4 mm implant failed to integrate. Secondary stability measurements of 16 (n = 16) remaining 4 mm implants increased to 65 $\pm$ 11 (range 37 – 79) (p = 0.035) and 10 mm implants to 77 $\pm$ 7 (range 60 – 83) (p 0.004). Initial insertion torques for 4 mm and 10 mm implants were 11 $\pm$ 33 Ncm (range) and 11 $\pm$ 33 (range) Ncm (p = 0.01). We were able to screw the suprastructure with 35 Ncm after successful osteointegration on all 4 mm and 10 mm implants. Splinted crowns combining 4 and 10 mm implants were used in all cases.
Conclusion: Despite relatively good secondary stability of 4 mm long implants, splinted crowns combining 4 and 10 mm implants may contribute to better distribution of forces in the treatment with prosthesis supported by short titanium-zirconium SLActive dental implants in posterior maxilla.

Metallurgical Aspects of the Additive Manufacturing of Metallic Materials - Microstructure & Mechanical Properties

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In additive manufacturing the powder is melted layer by layer using laser in order to get the final 3D object. During the additive manufacturing process the material is rapidly melted and solidified several times and also heated and re-heated and annealed for several times and all these influence on the development of the microstructure.
The aim of the current work is to understand the microstructure formation of stainless steel 316L on nano level and to correlate microstructure to the mechanical properties of additive manufactured metallic parts. Metallic parts was additive manufacture in EOS 280 selective laser melting machine.
Mechanical properties of cast, forged and additive manufactured stainless steel 316L were compared and correlate to the microstructures. The drastic variations in the steel‘s microstructure play a crucial role in the final mechanical properties of the material. The AM-SLM 316L stainless-steel sample stands out by overpassing the tensile strength requirements by over 100 MPa and the yield strength by almost 3 times. Such improved yield properties are closely connected to the defects that are formed in the material during additive manufacturing.
The as-built 316L has a hierarchical structure with subgarins and cells. The cell walls are built from dislocations and have the segregation of Mo and other elements. Along the cell walls, there are sometimes very well ordered, distributed oxide nanoparticles. All these imperfections in the microstructure can explain the superior mechanical properties

OES Measurements of the Electron Temperature in the HMDSO Plasma Polymerization

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In this work were made out absolute measurements of the electron density in the ECR discharge plasma at moderate pressures by optical emission spectroscopy (OES). The range of plasma parameters suitable for nanostructuring, functionalization and optimal wettability of polymer material in a reasonable treatment time was evaluated. The flux of positively charged oxygen ions was varied between discharge parameters. The flux of neutral atoms was varied independently from discharge parameters (and thus the ion flux) using a movable recombinator. The corresponding fluences was achieved by variation of treatment time. Plasma parameters were measured by electrical and catalytic probes, optical spectroscopy and mass spectrometry, while surface finish by atomic force and scanning electron microscopies. The optimal range of plasma parameters was determined in a big industrial reactor of volume 6000 liters. The coupling of discharges suitable for achieving the optimal range of plasma parameters as determined with high performance computer was studied for large reactors first theoretically and then experimentally using alternative electrode configurations. Once optimal plasma parameters were achieved in the large size reactor the production of components for automotive industry went on. Variations in the discharge parameters and the electron temperature of HMDSO plasma have been investigated in the pressure range of 1×10^{-2} to 7×10^{-2} mbar at MF plasma of power up to 9 kW. The plasma electron temperature in the above ranges of gas pressures and input powers has been measured and determined using optical emission spectroscopy (OES) from the intensity ratios of spectral lines. The OES results agree qualitatively and quantitatively with the data obtained using the double probe. The results of the research activity were optimized production parameters of process in automotive industry.

Spinal Fusion- does Optimal Material Exist?

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Spinal fusion (spondylodesis) remains a gold standard for the treatment of instability, deformity and degenerative disease of the spine. Over the past 40 years surgical techniques and implant-device (cage) technology for spinal fusion have changed significantly. Design and materials have evolved with one common goal, to develop suitable implants that would
address all three major issues of the procedure: stability, restoration of lordosis and osteointegration. Historically, two main materials have been utilized in the creation of cages: titanium (Ti) and polyetheretherketone (PEEK). The focus of spinal surgeons is constantly shifting from one material to another, because of the aggressive, commercial drive from the industry. The choice of optimal spinal interbody fusion device was always a matter of controversy. Therefore, this presentation aims to provide an overview of the different materials and designs from the biomechanical and also clinical aspect.

Synthesis of Hybrid Block Copolymers Based on Polypeptides by Ring-opening Polymerization of *N*-carboxyanhydrides

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Polypeptide-based hybrid block copolymers are very interesting biomaterials for various biomedical applications. Well-defined synthetic polypeptides are prepared by ring-opening polymerization (ROP) of *N*-carboxyanhydride (NCA) monomers derived from α-amino acids. Since the propagation during ROP of NCA proceeds through the amine end-group, the primary amines are the most commonly used initiators. On the other hand, ROP of several other heterocyclic monomers, like epoxides, cyclic esters and cyclic carbonates proceed through the hydroxyl end-groups. Due to this reason, the preparation of polypeptide-based hybrid block copolymers demands transformation of the end-hydroxyl group of macroinitiator to the amine group, which is usually accomplished either through the multi-step reactions or a macroinitiator is synthesized from the multifunctional initiator bearing the amine protected group.

Recently, we developed a method where the hydroxyl-functionalized (macro)initiators have been successfully applied for ROP of NCA in the presence of an acid catalyst (methanesulfonic acid, MSA).[1] During the initiation step, the MSA catalyzes opening of the NCA ring by the hydroxyl group, and simultaneously suppresses further chain propagation by a protonation of the formed amine group. Only after the completion of initiation, the chain propagation is started by the addition of a base that deprotonates the ammonium groups. This synthetic procedure have enabled us to prepare well-defined homopolypeptides and polypeptide-based hybrid block copolymers by using the hydroxyl functionalized poly(ethylene glycol) or poly(styrene) macroinitiators. Moreover, we developed a method for sequential ROP of the cyclic ester / carbonate and the NCA monomers to prepare the hybrid block copolymers of polyester/polycarbonate and polypeptide in a one-pot manner.[2]

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Coatings for Contact Surfaces with Antibacterial Properties Based on Moox Nanowires in Polymer Matrix

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Contact surface is the area of an object, which can be under people touching a way of spread of the disease. The contact surfaces are frequently colonized by various microorganisms (e.g. bacteria, fungi). Some of them can form biofilms for their sheltering against disinfection. Therefore, to coat a contact surface with a coating with antimicrobial function represents a promising approach to avoid bacterial growth on the different surfaces used in hospitals and in industrial environments (e.g. food packaging, healthcare and hygienic products, textiles, filters, membranes,…). A strong need for a development of new antibacterial materials originates from the growing resistance of bacteria to antibiotics and due to scientific reports on the toxicity of copper, zinc and silver nanomaterials, which are currently in use for this purpose. Recently, it was found that MoO_3 particles express a pronounced antibacterial effectiveness [1,2], which depends on surface morphology, and crystal structure. MoO_3 nanoparticles in an aqueous medium form molybdic acid [1]. Acidic environment slows down or/and prevents bacterial and fungal growth [3]. The antifungal activity of the MoO_3 against *Candida albicans* and *Aspergillus niger* was also reported [3].
For a long-term anti-bacterial activity of the nanocomposite coatings, we incorporated the MoO_{3-x} nanoparticles [4] into polymer matrix composed of biocompatible, bioinert, water-soluble polyethylene oxide (PEO)/polyvinylpyrrolidone (PVP) and non-soluble poly(vinylidene fluoride-co-hexafluoropropylene (PVDF-HFP) polymers. We will present electron microscopy and XRD studies, results of dissolution of MoO_{3-x} in water, optical absorbance results, lattice vibration studies, and preliminary antibacterial testing of activity against *Staphylococcus epidermidis* ATCC 12228 strain.

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The Application of Vibrational Spectroscopy in Structural Studies of Ultra-High Molecular Weight Polyethylene Used for Joint Replacements

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Ultra-high molecular weight polyethylene (UHMWPE) has been in use as an articulating surface in total joint replacements for well over four decades. The clinical experience of these implant components is generally considered a success. However, polyethylene (PE) wear particles have been observed to generate at the articulating surfaces and have been implicated as a limiting factor in the service life of the implant. It has been found that the wear rate depends on various factors including 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 cross-linking process. However, aging related changes in material properties due to oxidative degradation are still not completely understood although are recognized to be a significant factor affecting wear of articulating surfaces.

Therefore, we applied infrared and Raman spectroscopies to investigate the structural morphologies of several different types of UHMWPE. Both spectroscopies noninvasively probe raw materials as well as completed joint replacements before or after application. The spectra reveal the information of structure and impact of additives on crosslinking of PE chains. This structural information may be further correlated to mechanical properties of applied PE.

In proposed talk we will present the general practicability of vibrational spectroscopy for improving the functionality of PE in a replacement arthroplasty.

The design of Water Model Experiment for Fluid Dynamics of Continuous Casting of Steel Billets

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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]. 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 [5-10]. Without any doubt, the experimental data on mold part of the casting process are of key importance as they provide an insight into flow behavior (essential in the design phase of numerical models) and can be used to validate the developed numerical tools. The latter motivated the development of a water model experimental system that is geometrically similar to a real billet caster at Štore Steel company and can replicate similar flow conditions at safe, ambient conditions. The developments starting from the geometry of a real caster to completed laboratory experimental system as well as early stage visualization results on general flow field around SEN at industrial casting speeds are shown.

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Preliminary Characterization of AlCrFeNiTi 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 high grade steels and superalloys. The main goal of the project 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. Therefore, selected HEA alloys would need to satisfy several mechanical properties at high temperatures up to 1200 °C.

This work represents the preliminary characterization of AlCrFeNiTi alloys selected as the potential HEA alloys due to the extensive thermodynamic calculations prepared by Thermo-Calc software. First, the chemical composition, crystallographic and microstructural analyses were examined. In order to establish mechanical properties hardness measurements (HV1, HV10) and the compression test were performed. The results of preliminary testing are briefly presented and discussed.

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. Based on the obtained measurements further thermodynamic calculations and the selection of new alloy systems will be carried out.

Towards In-Situ Process Control for Powder Bed Laser Melting

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Powder Bed Laser Melting (PBLM) is increasingly applied for series produc-tion in automotive, medicine and aerospace. Main drivers for this ongoing development are increased design capabilities compared to conventional manufacturing methods alongside with a constantly extending range of appli-cable materials. Furthermore, recent machine developments allow for in-creased productivity, rendering PBLM competitive for distinguished applica-tions. Besides these main drivers, process stability remains one central chal-lenge for general industrial implementation. This challenge may be tackled by extensive process control, based on coaxial thermal emissivity sensing. One precondition for in-situ process control is establishment of a correlation between sensor data and both, macroskopic and microstructural part proper-ties. The present work provides a first approach for establishment of the cor-relation of sensor data gathered by means of pyrometry, applied process pa-rameters and resulting part properties for stainless steel 1.4404.

Application of a Rolling Simulation in Steel Industry

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In this work a previously created meshless rolling simulation system [1,2], which has been developed to be used by the industry, is put on a sensitivity tests by simulating slightly changed rolling schedules from a steel factory. A rolling mill in a steel factory has many prescribed rolling schedules which are already properly functioning. However, if there is a need to adjust a specific groove shape or try a new groove geometry, then it is crucial to simulate it first before actually building the physical rolling schedule. The main goal of this research is to compare the both reactions from the simulator and the industry when a designer has to tune a groove shape to get more accurate results or to save any excess rolled material at the end.

A rolling schedule which consists of 6 rolling stands is considered in the simulation and during the 5^{th} roll pass, the groove width is reduced by 2 mm for tuning. After the simulations with nominal and changed schedules are run, the difference in the effective stress near the corner of the adjusted groove is increased by more than 50 MPa. Afterwards it is observed by the industry that the increase exceeds the maximum pressure limit during that roll pass. Therefore, a clear excessive usage of the roll, where the maximum stress increased is simulated, is seen by the industrial experiments.

It is has been clearly shown in this work that, the developed rolling simulator based on advanced meshless solution is capable of simulating the consequences of specific groove adjustments applied in a rolling schedule which is almost impossible to foresee for designers without actual rolling. This work has been supported by the program group P2-0162, the project L2-9246 by Slovenian Grant Agency and Štore Steel d.o.o.

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Effect of EMF Parameters and Geometry on Macrosegregation in Low-Frequency Electromagnetic Casting

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A comprehensive meshless numerical model was developed for the simulation of macrosegregation in low-frequency electromagnetic casting of aluminium alloys. The model uses mass, momentum, energy and species conservation equations to simulate the solidification of billets. Electromagnetic field equations are coupled with the fluid flow and used to calculate the Lorentz force. Volume-averaging formulation of transport equations is used to handle the two-phase solidifying flow. The effect of floating grains and solidification shrinkage on melt flow and macrosegregation is neglected. The microsegregation is determined from the linearized phase diagram with the lever rule. All time-dependent partial-differential equations are solved with the meshless diffuse approximate method. An explicit time stepping scheme is used. The use of meshless method and automatic computational node generation made it possible to investigate complex inflow conditions, including sharp and curved edges in a straightforward way. A time dependent adaptive computational node arrangement is used to decrease the calculation time. The macroscopic transport model results are used in two other independent models to solve the solid mechanics and microscopic grain growth equations. A casting case of an aluminium alloy billet with the radius of 120 mm and Al-5.25wt %Cu alloy is simulated as an example. The electric current magnitude and frequency are varied in order to study the effect on the macrosegregation pattern. Furthermore, the effect of inflow geometry is also investigated. Three different designs of the hot-top part of geometry are simulated and the results are compared and discussed.

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Effect of Fillers on Thermal and Electrical Properties of Alkali/Alkaline-Earth Borosilicate Glass Composite Sealant for Solid Oxide Fuel Cell Applications

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Solid oxide fuel cells (SOFCs) require seals that can function in harsh, elevated temperature environments.[1] Long-term stability of sealing glass up to 30,000 hours is still a major issue preventing the practical application of SOFCs.[2,3,4] A glass composite seal for solid oxide fuel cells has been studied to maintain a hermetic seal even after exposing to more than 30 thermal cycles for over 10,000 consecutive hours. The temperature was cycled between 450 °C to 750 °C. During the cycles, the composite seal showed stable normalized leak rates of < 0.006 sccm cm^{-1} at 750 °C. To achieve such a long-term cyclic sealing performance, the composition of the sealing material has been designed so that the thermal expansion coefficient change can be less than 3 % after a heat treatment at 750 °C for 500 hours. Furthermore, by incorporating alumina filler in the alkali/alkaline-earth borosilicate base sealing glass, structure of the base glass was further self-strengthened at sealing temperature. High temperature electrical conductivities of glass composite seals with different types of fillers were discussed to explain strengthening of the base sealing glass.

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Human Osteoblast-Like Osteosarcoma Cell Adhesion on Nanosecond Laser-Textured 316L Stainless Steel Surfaces

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Although stainless steel is widely used in medicine due to good combination of mechanical properties durability, ease of fabrication and low cost, it often exhibit insufficient biocompatibility. The mechanical performance of material is governed by its bulk properties, while biocompatibility is determined by the properties of its surface. Therefore, considerable effort is being devoted to the surface engineering of biomaterials in order to improve the material-cell interactions. Laser surface processing enables modification on micro- and nanoscale that significantly change surface properties and influence cellular adhesion. Within this context, the response of human osteoblast-like osteosarcoma cells (MG63) to laser textured 316L stainless steel was investigated. Surface texturing was carried out by a nanosecond laser at high fluences. Surface properties of non-treated and laser textured samples were analysed using scanning electron microscopy (SEM), X-ray photoelectron spectroscopy (XPS), optical 3D surface measuring system and contact angle goniometer was employed for surface wettability measurements. The influence of micro- and nanoscale transformation on MG63 cell behaviour was assessed by *in-vitro* study using fluorescence (viable staining) and SEM microscopy after 24 h of exposure. Surface characterization revealed significant differences in surface morphology, chemistry and wettability after laser texturing. Non-treated sample exhibit hydrophobic grain-like structured surface that transforms to hierarchical micro- and nanostructured surface covered with thick oxides super-hydrophilic nature. After 24 hours of exposure, cells tend to attach in higher numbers to non-treated surface. On the other hand, we observed that cells respond to the laser-textured surfaces. Cells tend to attach and preferentially align on the surface between laser-induced micro-grooves oriented in a specific direction. Furthermore, nanostructured oxide surface also induces changes in surface morphology of cells while no cytotoxic effects were observed. Nd:YAG 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.

Influential Parameters in Selected Precursors for Alkali Activation Process

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Alkali activation materials present potential future in building industry, especially due to low costs of preparation, low energy needs for synthesis, waste consumption and no waste production. They are produced from waste materials containing enough SiO_2 and Al_2O_3 for matrix formation "O-Si-O-Al-O" after chemical reaction with added alkali activator (alkali, alkali glass) [1, 2].
Final goal of our project is to prepare lightweight porous insulating alkali activated foams [3] from waste material from Termit, which could be used in building industry. Therefore several waste materials in our previous work were tested and ones that showed highest compressive strength were selected for thorough investigation according to potential influential parameters. Precursors that were tested were: mixture of fly and bottom ash, slag, raw material for ceramics, foundry sand and rock wool, with bigger focus on mixture of fly and bottom ash due to high daily amounts of its production. Parameters that were varied in the synthesis were: ratio precursor to alkali to alkali-glass, molarity of alkali, alkali, alkali glass, amount of liquid compound, preparation of precursor. Results were compared to alkali activated materials prepared with theoretically calculated needed amounts of additives according to chemical analysis of precursors. Combination of parameters that gave highest compressive strength was used further in our project.

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TiO_2 particles and Nano-structured Surfaces for Biomedical Applications

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Industrial development and research have led to creation of many new materials, including materials composed of, or consisting of, nano-sized particles and nano-structured surfaces. Improved techniques for observation have revealed that nano-sized structures may be important in biological systems. We have elaborated methods for syntesis of titanium dioxide nanoporous microbeads and nanotubular surfaces controlled radius, growing on titanium foil [1,2]. In the lecture, results of this work will be presented, as well as the results of the interaction of these materials with biological membranes and cells, and theoretical background leading to better understanding the observed features [1,2].

In the second part of the lecture the gadolinium-enriched TiO_2 microspheres (beads) possess controlled multifunctional properties. Mesoporous semiconductor TiO_2 microspheres were enriched with gadolinium to improve their photoluminescence functionality and to make them applicable in optical and magnetic resonance imaging (MRI) due to improved spin relaxation for MRI. Additional applicability stems from the enhanced generation of reactive oxygen species (ROS) under UV-A light irradiation [3]. Gadolinium-enriched microspheres were integrated into MG-63 osteosarcoma cell lines, which means they are biocompatible. The principal advantage of the use of gadolinium-doped TiO_2 microspheres is the possibility of their simultaneous use for cancer diagnosis (MRI) and treatment (ROS production upon UV irradiation) [3]. Namely, doped TiO_2 microspheres can be simultaneously used both for locating cancer cells (i.e. diagnostics via MRI) as well as for killing cells (i.e. therapy), which is the result of the formation of ROS when TiO_2 microspheres in cancer tissue are exposed to UV light [3]. The essential concept here is that cancer cells and normal cells have different dynamics of accepting TiO_2 microspheres. Cancer cells accept them faster (more) than healthy cells, which is fatal for cancer cells once exposed to UV-A light [3].

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Impact of the Process Gas Atmosphere in Laser Additive Manufacturing – desired and undesired effects

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Usually, the only requirement for the chemistry of the process gas in Laser Additive Manufacturing is a low oxygen content, i.e. a completely inert atmosphere. However, often a low oxygen content remains, leading to oxide inclusions in the produced alloy. In this presentation, we will show some examples of such undesired oxygen pickup. Subsequently, we turn to the question if the process atmosphere can be used intentionally to react with the feedstock material to produce materials with improved properties. First, we show that a deliberately increased oxygen content can be used to produce oxide-dispersion strengthened steel. Next, we show that nitrogen as process gas can be taken up in limited amounts by the melt and has an impact on the phase stability, e.g. the austenite stability of stainless steel. We conclude with some remarks about the potential for increased stability towards balling behavior by using a tailored process atmosphere.

TEM of Fe-aluminides with Additions of Mo, Ti and B

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Iron aluminides are of considerable technological interest in many applications due to their excellent oxidation and sulfidation resistance especially at elevated temperatures in hostile environments, in combination with their relatively low density and cost. However, the drawbacks of iron aluminides for their practical use are their insufficient strength, creep resistance and ductility. Different mechanisms for strengthening Fe-Al-based alloys at high temperatures were proposed and considered, such as solid solution hardening, strengthening by coherent or incoherent precipitates and increasing the long-range order. In this respect, the Fe-aluminides with addition of Mo, Ti and B seems to be very interesting since alloying with Mo increases the wet corrosion resistance of the alloys because it has the strongest passivation effect in acidic conditions, and also increases the critical temperature of D03 to B2 transition.

Two alloys were investigated in this work, prepared from high purity Fe (99.98 wt%), Al (99.99 wt%), Mo (99.99 wt%), W (99.99 wt%), B (99.99 wt%) and Ti (99.99 wt%) by vacuum induction melting under argon. Nominal composition of the first alloy was Fe 70.5 at%, Al 26 at%, Mo 2 at%, Ti 0.5 at% and B 1 at %, and the second alloy was Fe 68.5 at%, Al 26 at%, Mo 1 at%, Ti 0.5 at% and B 1 at%. Samples for transmission electron microscopy (TEM) were prepared by focused ion beam (FIB) using Helios NanoLab 650 DualBeam System (FEI, USA). Thin foils were observed and investigated in TEM at 200 kV using JEM-2200FS (JEOL, Japan).

After annealing at 1000 ^{o}C for 100 h the eutectics coarsened and complex boride precipitates were distributed inhomogeneously along the grain boundaries. Our interest in this work was to determine the crystal structure of the complex boride phase since it is not known, and to establish if there is any relationship between the boride and the matrix phase using various TEM techniques as high-resolution TEM (HR TEM) imaging, energy-dispersive X-ray spectrometry (EDS), selected area electron diffraction (SAED) and scanning TEM (STEM).

Metallic Biomaterials in THA

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Background: The endoprosthetics of total hip and knee-joint replacements is currently the most common and successful method in advanced surgery to treat degenerative joint disease for relieving pain and for correcting deformities. When a metallic biomaterial is implanted into living tissue the surface properties of the material play a critical role in the interactions between the biological environment and the implant. Therefore, a detailed microstructure characterization is required to determine the role of prematurely failed implants that determine the biological responses, such as the composition and the structure of the surface oxide film, the surface contamination and the surface topography.
Methods: We investigated the surface chemistry and microstructure of both retrieved and new hip and knee implant components of Ti alloys (Ti6Al4V, Ti6Al7Nb) and the cast CoCrMo alloy in detail, using advanced electron spectroscopy techniques, field-emission scanning electron microscopy, FE-SEM (topography), X-ray energy-dispersive spectroscopy (EDS analysis), electron backscatter diffraction (EBSD, crystallographic orientation, phases) and the surface analytical techniques Auger electron spectroscopy (AES) and X-ray photoelectron spectroscopy (XPS). All the retrieved implants were sent for sonication in Ringer's solution for cleaning and pathology analysis. Later, they were dried and stored in special sterile medical bags. All the X-ray images of the implants in the patients are stored in the database of the University Medical Centre, Department of Orthopaedic Surgery. We will present the findings from the clinical and materials science points of view**.**
Results: The microstructure of the Ti6Al4Valloy contains small grains, which are mainly alpha hexagonal close-packed (hcp) Ti-type, and some small grains of beta Ti-(bcc) body-centred cubic structure. The microstructure of theTi6Al7Nb alloy similarly 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 components are very similar. In the cast CoCrMo alloys, the face-centred cubic (fcc) and the hexagonal close-packed (hcp) crystalline structures co-exist. The microstructure consists of larger Co grains with an hcp structure, and small areas that correspond to embedded carbides that were identified as $M_{23}C_6$ type. The depletion of Cr in the surroundings of the $Cr_{23}C_6$ precipitates was found using SEM EDS line and EBSD analyses. We analysed the uniformity of the grain structure and the porosity. The thicknesses of the thin oxide films on the Ti6Al4V and Ti6Al7Nb (primarily of TiO_2) were estimated using AES 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 amount of Al_2O_3 is below the detection limit and no V was detected on the surface. The AES depth profile of a thin oxide film on the CoCrMo alloy exhibits a 2-nm thickness of thin oxide film, primarily a mixture of Cr_2O_3andCo oxides.
Conclusions: 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 processing parameters and could be standardized in the near future.

The Effects of Metal Surface Treatment on Dental Ceramics Bond Strength to Titanium Alloy

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Various metal processing routes involve exposure to a number of heating and cooling conditions that can result in variations in metal microstructure and surface characteristics. The latter could ultimately affect the strength of porcelain bonding in porcelain-fused-to-metal (PFM) dental prostheses. The aim of this study was to determine the effect of thermo-mechanical cycling on the shear bond strength (SBS) of dental porcelain to Co-Cr and Ti-based alloys fabricated by casting, milling, or by selective laser melting (SLM). In addition, the effects of abrasion by airborne alumina particles and of the application of bonding agent on the strength of bonding between dental porcelain and titanium alloys fabricated by milling and by SLM were examined.
Porcelain bond strength was determined with mechanical cycling (10^5-cycles, 60N-load). SBS test-values and failure modes were recorded. The thickness of oxide layers on intact Ti-based substrates was measured using Auger-electron-spectroscopy (AES). To study the effects of surface airborne-particle abrasion and subsequent application of bonding agent on the strength of porcelain bonds to Ti-alloys, groups were subjected to the fully crossed experimental protocol of abrasion with airborne Al_2O_3 particles at 2 bars (intact control group; abrasion with 110 µm particles) and bonding agent application (no bonder – control; bonder).
The mean SBS values differed according to the metal-ceramic combination ($p < 0.0005$) and to the fatigue conditions ($p < 0.0005$). The failure modes and interface analyses suggest stronger adhesion of porcelain to Co-Cr than to Ti-based alloys. The titanium-ceramic bond strength, however, correlated negatively with the pre-oxidation temperature. Air passivation at room temperature following airborne-particle abrasion of SLM titanium, together with bonding agent application, resulted in a titanium-ceramic bond (36.73 ± 4.90 MPa) stronger than that of alternatively prepared titanium-ceramic systems. Ti-based alloys are more susceptible than Co-Cr to reduction of the porcelain bond strength following thermo-mechanical cycling.

Radiogenic Isotope Composition Determination: A Form of Nanoscience Used Around the Globe

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In recent years nanoscience has shown increasing interest in researching the effects of metallic nanoparticles on the environment and organisms living in it. Latest research on silver nanoparticles has shown the high impact effects that such metallic particles can do[1]. Nevertheless, most topics of research in nanoscience is bounded to only the chemical element of the particles and not on the type isotopes that can be bound in metallic nanoparticles. Isotopes can deliver significant changes in a whole spectrum of research fields: from behavior of solid crystals such as Li crystals[2] to impact of industry onto the environment[3]. In this research we present one of such utilizations by exploiting radiogenic isotopes of Nd and Sr for tracing and dating of different materials. The information about the isotopic composition of these two elements gives the possibility to indicate the source of weathering inputs, water mass mixing, and particle dynamics in a water column. Moreover, the changes of such a composition can give indications about the changes of the environment. The results of seawater samples collected from the Mozambique Channel show nutrient-like pattern for the REE concentrations and enrichment of REEs in the surface water due to lithogenic input. Sediment samples confirm the lithogenic input from the different river catchment areas and also trace the source of sediment into the channel. The main result is that the water mass dynamics and lithogenic input of the sediment are strongly controlled by seasonal changes and mesoscale eddies. With these results we demonstrate the great importance and potential of using radiogenic isotopes in nanosciences for applications in environmental research.

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Π-Conjugated Polymers with Tubular-like Morphologies

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Conjugated microcellular polymers composed of alternative phenylene and ethynylene units were synthesized by Sonogashira cross-coupling polymerization of 1,4-diiodobenzene, 2,5-dimethoxy-1,4-diiodobenzene and 2,6-diiodo-4-nitrophenol within the solution or high internal phase emulsion (HIPE). Results revealed the tubular-like 2D network formation with high specific surface areas of 450 m^2g^{-1} when appropriate solvents were chosen to carry out the solution polymerization. On the other hand, polymerization within the HIPEs revealed the 3D hierarchically structured polyHIPE morphology. The polyHIPE morphology is characterized by macropores and interconnecting pores, both typically highly polydisperse in size with standard deviations of the order of tens of percent of the mean sizes. Hence, polyHIPEs have relatively low surface area, typical 3 – 20 m^2g^{-1}, which hampers their applicability in the areas such as heterogeneous catalysis, liquid chromatography and solid-phase extraction. The combination of the 3D polyHIPE [1] and 2D tubular-like network [2] morphology within one piece material will be presented.

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Morphological Characterization of Precipitates in Tempered Martensite by Automatic Image Analysis

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Image analysis in materials science often requires a certain level of automation, especially when analyzing a large number of features in a micrograph, where manual analysis would be extremely time consuming if not impossible. The level of automation depends mainly on the contrast between features to be analyzed and background, e.g., carbides in a steel matrix.
The aim of the present work is to improve the automatic morphological characterization of a large number of precipitates in two tempered martensitic steels, X20 and P91, in terms of accuracy and speed. SEM images at magnifications 3k to 20k were acquired, depending on the size and number density of precipitates. Precipitates appear brighter on a darker background, however both of them express a non-uniform gray value intensity that in many areas of micrograph is equal for both the precipitates and the background, which makes it impossible to perform a simple thresholding segmentation. Thus advanced segmentation techniques employing sophisticated algorithms along with image preprocessing in order to improve the segmentation performance itself were applied.
It was found that there is no general image processing and segmentation technique, no matter how sophisticated it is, which can be applied for different images, even from the same material. Thus different combinations of image processing and segmentation algorithms should be applied for each image in particular, in order to achieve acceptable levels of characterization accuracy.

3IGITAL: intelligent components, digital production cells and smart applications. Tapping the next technological dimension of industrial 3D Printing

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Chief Digital Officer (CDO) at EOS

With its broad variety of application opportunities industrial 3D printing is one of the innovation drivers behind future digital manufacturing, facilitating the optimization of supply chains and the production of highly innovative components. As catalysts and technical consultants for innovative companies EOS supports customers in successfully mastering digital change processes – from digital smart factories for industrial 3D printing all the way to additively manufactured 'intelligent' components. '3IGITAL' is the way forward and we are already tapping the next technological dimension for the future: intelligent components – additively produced by a digitalized production cell – for smart applications.

Optical Emission Spectrometry (OES) Data-driven On-Line Prediction of the Amount of Non-Metallic Inclusions in Wrought Aluminium Alloys

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Numerous research efforts have been made to develop an ***on-line***, fast and cost-effective industrial method for determining the amount, type and size of non-metallic inclusions in wrought aluminium alloys. One very promising approach is to use the data obtained by optical emission spectroscopy (OES).

In order to separate the peaks corresponding to particular inclusions from the peaks obtained from various microstructural features in the matrix, an advanced, computer-assisted filtering of the OES spectrum of the wrought aluminium alloys is necessary. The methodology developed in this work is based on big-data-driven predictions of whether the on-line analysing sample is good or bad, based on the customer requirements. The big data with a sufficient amount of relevant data necessary for data-driven predictions was established by the systematic quality control of samples of AA6082 using optical and SEM microscopy and by analysing the same surface using OES. By following a machine-learning process, an algorithm was developed that was capable of recognizing sets of characteristic peaks in the OES spectrum, which enabled the on-line division of the samples into good and bad, based on criteria received from the casting house.

The quality of the predictions was monitored by calculating the Precision, Recall and F-measure. Based on a learning set of 100 samples from the regular production, the following values were obtained: Precision =58,8 %; Recall = 100 %; F-measure =74,1 %.

Further improvements (of the filtration procedure and the algorithm) along with a continued validation of the predicted quality with established quality-control procedures are necessary before this method will be validated to use in the regular quality control.

Comparative Electrochemical and Intergranular Corrosion-Resistance Testing of Wrought Aluminium-Alloy-Based End Products

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In this study, the results of the electrochemical corrosion resistance testing (ECRT) of the automotive wrought aluminium alloys were compared with the result obtained by measuring the intergranular corrosion (IC). The industrial testing of IC is particularly important since it is recognized as the main mechanism of the stress-corrosion cracking (SCC) of high-strength aluminium alloys. Because the conventional methods of stress-corrosion testing of high-strength aluminium alloys are often time consuming, demanding and costly to be performed frequently in industry, the possibilities for cost-effective and highly repeatable ECRT for the stress-corrosion resistance of aluminium alloys has been considered and practically evaluated in this work. The main difficulty in predicting the IC behaviour based on the results of the ECRT is in the fact that electrochemical fatigue results in a different corrosion attack on the surface of the aluminium-based products. On the other side, the measure of the IC is often under the operator's influence, which is not the case in ECRT and thus this represents an important advantage of the electrochemical method.
The purpose of this study was to correlate the results of these two methods, enabling the accumulation of the appropriate filtered and structured data for high-quality data-driven predictions of the most stress-corrosion resistive compositions of wrought aluminium alloys. In addition, the establishment of such correlations between the corrosion-resistance data obtained by IC and ECRT is useful for designing and implementing new industrial methods for monitoring the stress corrosion of high-strength aluminium alloys.

Improvement of High Temperature Properties of New Generation Fe-Al-O Oxide Precipitation Hardened Steels

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The increase of efficiency in power engineering is conditioned by improvement of high temperature properties of structural materials. The new Fe-Al-O oxide precipitation hardened (OPH) steel was developed by the Authors to dissolve a required amount of O in the matrix during mechanical alloying and let fine dispersion of Al oxides precipitate during hot consolidation. Compare to oxide dispersion strengthened (ODS) ferritic steels, excellent oxidation resistance is guaranteed by using 10 % Al in the matrix. To improve the high temperature properties of OPH, a series of thermo-mechanical tests were performed and the microstructures were investigated by metallographic analysis. The results show homogeneous fine-grained microstructure with dispersion of very fine (nearly invisible) alumina precipitates. Also the grain growing were observed within different temperature by different annealing times.

Nanostructured Superhydrophilic and Superhydrophobic TiO_2/Epoxy Coatings on AISI 316L Stainless Steel

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Stainless steels are commonly used materials in biomedical applications because of their good mechanical properties, high corrosion resistance and biocompatibility. Surface modification by polymer coatings presents an essential approach to enhance their surface characteristics. In the present study we focus on the development of nanostructured TiO_2/epoxy coatings on the surface of AISI 316L stainless steel to enhance the mechanical properties and to promote the surface biocompatibility. We succeeded to significantly influence the corrosion behaviour, wetting properties and biocompatibility of coated AISI 316L stainless steel by altering surface topographical and chemical features. Superhydrophobic fluoroalkylsilane (FAS)-TiO_2/epoxy and superhydrophilic as-received TiO_2/epoxy coatings were successfully fabricated, resulting not only in opposite wetting characteristics but also in different average surface-roughness properties. This was reflected in the formation of larger agglomerates in the FAS-TiO_2/epoxy coating, making the superhydrophobic surface more rough compared to the superhydrophilic surface. The electrochemical measurements showed a significant improvement in terms of the corrosion stability of the epoxy coatings with the addition of TiO_2 nanoparticles compared to pure epoxy coating, especially in the case of superhydrophobic FAS-TiO_2/epoxy coating. The addition of nanoparticles provides better barrier properties due to the prolonged penetration of the electrolyte through the coating. The biological evaluation showed a significant variation in cell abundance, size and shape as well as the surface structure of the cells. The superhydrophilic TiO_2/epoxy coating on AISI 316L stainless steel was more favourable surface for bone osteosarcoma cells (MG-63) compared to superhydrophobic FAS-TiO_2/epoxy coating. We found that both surface topographical and chemical cues modulate the cell morphology and spreading. We have shown that surfaces with hydrophilic nature and low surface roughness were in general more appropriate for cell attachment compared to superhydrophobic coating with higher surface roughness.
The beneficial effect of TiO_2 nanoparticles incorporated in the epoxy coating on AISI 316L stainless steel was mainly demonstrated in terms of improved corrosion stability with moderate cell adhesion. In order to select an appropriate barrier coating for biomedical applications it is necessary to consider a higher corrosion resistance as well as a suitable biocompatibility, which are both strongly influenced by the wettability. In fact, a compromise between the enhanced corrosion stability and the moderate cell adhesion of the superhydrophilic TiO_2/epoxy coatings showed a good basis for further research, especially if we consider the antibacterial properties of TiO_2.

Complications With Total Knee Arthroplasty

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Most complications in total knee arthroplasty (TKA) are infrequent and can be prevented or treated readily if anticipated and recognized. Complications associated with any major surgical procedure, including those related to anesthesia, comorbid medical conditions, medications, and allergic reactions, can also occur.

Most common complications recognized among orthopedic surgeons are bleeding (Postoperative bleeding requiring surgical treatment), wound complications (failure of wound healing requiring reoperation or a change in TKA protocol), thromboembolic disease (symptomatic thromboembolic event requiring more intensive, nonprophylactic anticoagulant or antithrombotic treatment during the first 3 months after TKA), neural deficit (postoperative sensory or motor neural deficit), vascular injury (intraoperative vascular injury requiring surgical repair, bypass grafting, or stenting), collateral ligament injury (intraoperative or early postoperative collateral ligament injury requiring repair, reconstruction, a change in prosthetic constraint, revision surgery, or TKA protocol), instability, malalignment, stiffness, Periprosthetic joint infection, periprosthetic fracture, extensor mechanism disruption, patellofemoral or tibiofemoral dislocation, bearing surface wear and osteolysis, implant loosening, implant fracture or tibial insert dissociation.

Most of complications require surgical intervention and if recognized during surgery can be promptly repaired. Most postoperative complications require Reoperation (return to the operating room) or Revision (revision of one or more of the TKA implants (femur, tibia, tibial insert, or patella)).

Aseptic loosening of the joint implant is most often caused by wear of the prosthetic components. It is the most common long-term problem associated with TKA, although the number of people who develop loosening is decreasing as prosthetic materials and surfaces are improved. Osteolysis and wear are the most common complication for implant failure. It is usually asymptomatic until aseptic loosening is reached.

HAZ Integrity of 500 HB Abrasion Resistant Steel

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Abrasion resistant quarto plates are thermally cut into pieces and welded into products where sufficient wear resistance against minerals and gravel is needed. Additionally, there are increased demands for increased resistance against impacts, for example in earth moving equipment. A precaution to prevent failure of a component during operation is a proper orientation of welds to prevent direct interaction between weld and impact materials. In the case of chamfering operation for blade construction, the blade with achieved degree of Heat Affected Zone – HAZ cracking sensitivity is usually directly put into contact with the counter-body. To keep the integrity of the components, the integrity of HAZ is crucial. Blades are usually manufactured from 500 HB low alloyed quenched steel. The specifics of chamfering are that the heat affected section is above the nominal thickness of a plate. A changed heat sink capacity influences the achieved cooling rate, the creation of residual stresses and consequently influences the HAZ cracking sensitivity. All precautions are needed to reduce distortion which could lead to cold cracking in the workshop or in the field. Each thermal operation on quenched quarto plates influences to some extent the basic material with changes in microstructure and hardness profile with the formation of HAZ. In the present case-study the chamfering operation was performed using thermal cutting method to take advantage of the increased cutting speed and related critical cooling rate in HAZ. Additional arc-welding was carried out on the cut edge to simulate y-groove weld cracking test. The aim of the work was to maximize the sensibility of thermally cut HAZ to cold cracking to understand the type of defects formed when the buildup stresses reach a critical range localized in the local stress concentrations in HAZ.

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Effect of The Fourth Industrial Revolution on Materials Science and Surface Engineering

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The unprecedented development in science and technology is strongly influencing the general concept also on materials science. The increasing interest in development of composites, nano-, bio- and info materials remodel our concept on applied materials and even more on the expected trends in the related field. Additive manufacturing imposes new expectations on materials and their processing. The paper presents a brief overview on the most important aspects of changes and development in materials science and their effect on industrial development.
An important segment of materials science is surface engineering and the development of new materials has an inevitable effect on its orientation as well. As the bulk materials and their surface present an integrated, graded system new materials or the new process technology of the materials in use need significant changes in surface engineering technologies as well. The most significant trends in surface engineering are outlined with an accent on process control and modelling. A few considerations on emergence of materials constraints and aspects of materials education are also treated, as part of expected progress but also of the efforts for a sustainable development.

Circular Economy as a Partnership with the Customer
Krožno gospodarstvo kot partnerstvo s kupcem

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Talum, as a modern production company, is a world leader in a narrow circle of the most efficient producers of primary aluminium. Already in 2001, Talum transformed into a manufacturer that combines primary and secondary aluminium to produce its products. We were one of the first primary producers to undertake a new business model which considers sustainable development and introduces a circular economy. In recent years, the proportion of secondary, so called circular aluminium increased, and with the latest projects, we are expecting further growth. In the year 2017, we have become the world leading manufacturer of slugs for tubes and aerosol cans. With the modernization of technological equipment and research and development activities, Talum will be able to offer our customers complete cycle of recycling. We concluded with our customers a partnership for conversion of aluminium process scrap back into slugs. The same slugs will be again used as a raw material for the production of aerosol cans. With this unique procedure the energy efficiency of slug production is increased and, on the opposite, the carbon footprint of the production of the aerosol cans is decreased. Aluminium aerosol cans and tubes, produced from such slugs, are eco friendlier and sustainable, which increase competitive advantage of Talum customers on the market.

Talum kot sodobno proizvodno podjetje sodi v svetovnem merilu v ozek krog najučinkovitejših proizvajalcev elektroliznega aluminija. Že leta 2001 se je Talum prelevil v proizvajalca, ki kombinira primarni in sekundarni aluminij za izdelavo svojih proizvodov. Bili smo eden prvih primarnih proizvajalcev, ki se je lotil novega poslovnega modela, ki upošteva trajnostni razvoj in uvaja krožno gospodarstvo. Zadnja leta smo povečevali delež sekundarnega oz. krožnega aluminija, z najnovejšimi projekti, ki so v teku, pa pričakujemo še dodatno rast. V letu 2017 smo postali vodilni proizvajalec rondic za izdelavo tub in aerosol doz na svetu. S posodobitvijo tehnološke opreme in z razvojno-raziskovalnimi aktivnostmi bomo edini proizvajalec rondic, ki bo svojim kupcem lahko ponudil rondice, ki so deloma ali v celoti proizvedene na podlagi krožnega gospodarjenja. S kupci je podjetje Talum sklenilo partnerstvo za predelavo procesnega odpada, ki nastane pri proizvodnji aerosol doz in tub. Le-tega Talum uporabi kot vhodno surovino v proizvodnji rondic za istega kupca, ki tako proizvedene rondice ponovno uporabi v proizvodnji tub ali aerosol doz. S tem se poveča energetska učinkovitost proizvodnje rondic, zniža se ogljični odtis proizvedene aerosol doze in tube, zaradi trajnostnega in ekološko prijaznejšega izdelka pa se poveča konkurenčna prednost Talumovih kupcev na trgu.

The Research on the Microstructure of Ti6Al4V-AA1050 Explosively Welded Bimetallic Joint

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One of the most interesting materials with superior ballistic resistance are light alloys laminated composite plates. The appropriate technology to produce this composites is the explosive welding method. In this study the Ti6Al4V and AA1050 have been successfully bonded in explosive welding process. The microstructure of the obtained bimetal joint was examined by scanning electron microscopy on the samples prepared using ion polishing method. The scanning electron microscopy observations allowed to investigate the grains size in the joint area, as well as, have revealed the presence of the melted zones in the joint area, which were formed as the result of local mixing of the both joined materials. In order to investigate the melted zones in terms of presence of the intermetallic compounds, the transmission electron microscopy observations with SAED were performed. The obtained results allowed to identify the intermetallic compounds which occur in the melted zones. The scanning electron microscope observations indicated on the severe plastic deformation of both jointed materials in the joint zone. The analysis of the microstructure of the joint zone with particular emphasis on the melted zones have been performed.

Initial Phase Strategy in Annular Laser Beam Direct Wire Deposition

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Laser direct wire deposition (LDWD) has many benefits compared to a powder based deposition process like 100 % material efficiency, cheaper material, no powder related health and security concerns. However the process initial transient phase is very sensitive to process parameters and related laser beam energy input compared to powder deposition, where the initial transient phase is very robust. In the later all the redundant powder is just bounced off the workpiece surface, as long the insufficient energy to form a melt pool is provided by a laser beam. On the contrary in LDWD process in the case of too low energy input or improper wire-end initial location and feeding, wire can hit the workpiece surface and consequently deform whereas in the case of too high energy input at wire-end a droplet is formed which is pulled up by surface tension. This results into unstable transient phase and unsuccessful LDWD process. Additionally, in conventional LDWD process, where a laser beam is directed perpendicular to the workpiece and wire is fed laterally, the related process asymmetry can cause several disturbances like wire bending and unstable melt pool formation. In our case LDWD process was performed by an annular laser beam which ensures symmetrical and simultaneous heating of an axially fed wire and workpiece in controllable proportion. This can be beneficial in transient and related stationary phase of the process. In the presented work two different process initial phase strategies with respect to the initial wire-end have been investigated: one with wire-end on the workpiece surface, and one with wire-end above workpiece surface. Experimental results of deposition of a 0.6 mm diameter Ni wire on a SS 304 workpiece show that in general for a successful initial phase that lead into a stable stationary LDWD process it is crucial to form a stable molten bond between wire and workpiece. Both strategies can ensure a stable transient phase and enables transition into stationary phase of the process. However, during the initial transient phase of the process it is crucial to precisely synchronize the laser beam power time profile with wire and workpiece feeding which both depend on the initial position of the wire-end.

Evolutionary Methods in Slovenian Steel Industry – Case Studies

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Store Steel Ltd. is one of the biggest spring steel producers in Europe. Steelmaking in Štore begins with scrap melting in an electro-arc furnace in steel plant. The melting bath is discharged into the casting ladle. After achieving proper melt temperature from the melting bath the billets are continuously cast. After the heating of (already cooled down) billets, they are hot rolled in the strand of rolls in the rolling plant. Through the roll grooves with different shapes and dimensions the cylindrical, square or flat steel bars can be produced. Additionally the rolled material can be heat treated, straightened, controlled (automatic control line for detecting surface defects, inner defects and mixed material, magnetic particle inspection, manual ultrasonic inspection), cut, peeled, polished, chamfered and finally packed and stored. The last are usually conducted in cold finishing plant. Genetic algorithms and genetic programming, which are representatives of artificial intelligence methods, which imitate natural evolution, have been widely used in Štore Steel Ltd. production. The practical implementations of evolutionary methods are presented according to their production location or phenomena occurrence. In the end of the article also future researches are revealed.

Optimization of Press-Fit Process – Case Study

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The press-fit process is an efficient, low-cost method for joining parts. The parts that must be joined interfere with each other's occupation of space; therefore, contact dimensions and their tolerances influence the quality of assembly. The traditional method for the selection of contact dimensions and their tolerances is based on engineering experience. The idea of the research work presented in this paper is to optimize the press fit process at the early stage of development process, involving prediction and optimization of joining force and consequently prediction and minimization of the reject rate. Accordingly, several finite element (FE) simulations of the press-fit process for predicting joining forces were conducted, considering input parameter variations (material properties: yield stress, hardening exponent; geometry: shaft diameter, guide diameter of the core, functional diameter of the core; friction coefficient). Based on FE simulations and 47 different input parameter variation results, the empirical models for predicting joining force using linear regression, genetic programming and response surface methodology (RSM) method were obtained. The response surface methodology model outperformed linear regression and genetic programming models. By using response surface methodology and stochastic Monte Carlo simulation, the reject rate was also determined. The predicted and the actual reject rates for selected process parameters were 1.4 % and 1.5 %, respectively. Consequently, the press-fit process can also be optimized to reduce the reject rate using the same Monte Carlo simulation. The results of the analysis show that the reject rate can be reduced from 1.4 % to 0.2 %.

Manufacturing of Steel Matrix Composites Reinforced with Nano-Particles

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Steel matrix composites reinforced with nano-particles are being investigated worldwide in recent years, owing their promising properties, thus being suitable for large number of functional and structural applications [1-4]. It has been shown that steel matrix composites can provide superior mechanical strength while maintaining or even improving other important engineering properties, such as toughness, damping capacity, wear resistance, creep behaviour as well as electrical and thermal properties [5-8]. However, for the large-scale production of steel matrix nano-composites, the main problem to face is the low wettability of ceramic nano-particles, which does not allow the preparation of steel matrix composites by conventional casting processes since the result would be an inhomogeneous distribution of particles within the matrix [9-11].

The purpose of this work was to study the distribution homogeneity and incorporation of nano-particles in the steel matrix, the thermodynamic stability of different nano-particles in the steel melt, the effect of nano-particles surface energy modification, and the influence of nano-particles type on mechanical properties and wear resistance. In addition, it was also attempted to answer the question of how such nano-particle reinforced steel can be successfully produced by conventional casting methods. The main drawback of the casting method is the agglomeration of the particles and poor interface between the particles and the metal matrix. The results show that through a proper insertion method, nano-particles can be successfully introduced into the metal matrix. The nano-particles were successfully incorporated into the steel matrix with no signs of clustering and intermetallic reactions taking place between the nano-particles and the steel matrix. This led to improved mechanical properties as well as the wear behaviour of the stainless steel, achieved by using conventional casting routes. However, properties were found to depend on the type of reinforcing nano-particles, with the best results shown by Al_2O_3, Y_2O_3 and TiB_2 nano-particles.

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Comparison between Symmetric and Asymmetric Cold Rolling of EN AW-5454 Aluminium Alloy

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Comparison was performed between symmetric and asymmetric rolling of EN AW-5454 aluminium alloy. Asymmetry can be introduced into most commonly used metal forming process via different ways. In our case rolling with different speed rotation of rollers was used. General purpose was to find out the impact of asymmetric rolling for specific aluminium alloy. Investigation was especially directed to verification of improved mechanical properties. That way, three different mechanical tests and metallographic analyses (LOM, EBSD) were performed on samples, deformed with different deformation ratio (33 % and 44 %) and with different factor of asymmetry (1.0, 1.5 and 2.0). To come closer to industrial desires, mentioned tests and analysis were done on deformed and on soft condition heat-treated (1h 400 °C) samples. Numerical simulations for planed rolling types were created before laboratory rolling. Most of the attention was on non-desirable ski effect and stress condition differences in deformation zone. Results of measured rolling parameters show that asymmetric rolling provided better results because of higher deformations with lower rolling force at the same set height of roll gap (4.0 mm and 3.1 mm). Appearance of ski effect with asymmetric rolling was, for our rolling type, more influenced by factor of asymmetry than by deformation ratio. Between tensile test samples taken in rolling (0°), transverse (90°) and diagonal (45°) direction, asymmetrically deformed samples reached higher tensile and yield strength values as symmetrically rolled samples. After heat treatment, values of tensile strength, yield strength and elongations were very similar, which can be an indicator of successful heat treatment. As alternative for Erichsen test of deep drawing properties, in case of thicker samples, plastic strain ratio test was performed. The higher values of so called Lankford factor were obtained in asymmetrically deformed rolled samples. That is also indicator of higher planar anisotropy especially in diagonal direction. After heat treatment planar anisotropy was better eliminated in asymmetrically rolled samples with higher factor of asymmetry. Because of higher deformation ratio with asymmetric rolling, hardness of those samples was also higher. More important, the measured hardness differences in cross sections were lower in asymmetrically rolled samples than in symmetrically rolled samples. Production of more homogenous material with asymmetric rolling is preserved also after heat treatment and confirmed with average size of crystal grains on top, centre and bottom position of samples's cross section. Average size of crystal grains increased with higher factor of asymmetry. Created texture components, in symmetric and asymmetric rolling are different in deformed condition and in heat-treated condition. In asymmetrically rolled samples, regardless of deformation ratio, asymmetry factor or the condition of samples, higher volume fraction of shear texture components were obtained, than in symmetrically rolled samples.

Casting Technologies of Manufacturing of Porous Metals and Metallic Sponges with Irregular Open-Cell Structure

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The paper is focused on the possibilities of manufacturing of unique material, on which has been given a great deal of attention in many areas of human activity in recent years – metallic foam. This porous metal material has unique features that can be combined with each other. Thanks to these properties, metallic foams can be used in a wide range of sectors of human activity from vehicle construction, thermal engineering to medicine. However, the application potential of these materials is limited by the economic demands of their production technologies. In most cases, these are costly methods based on complicated procedures and the use of non-standard and expensive input materials.
The presented work is devoted to the development of the production processes of metallic foams, which are based on conventional casting technologies. The use of standard casting processes and standard materials will make it possible to classify the range of metallic foams amongst affordable materials, thereby making full use of its application potential. Casting technology also offers the possibility of producing very complex parts, both with a solid surface layer and without it. The experimental part is focused on the development and subsequent optimization of the casting processes of manufacturing of cast metal foams with irregular inner cell structure. The whole experiment is then divided into two main directions of research: the development of a two-stage investment casting process using disposable evaporable polymeric pattern and the development of technology of infiltration of molten metal into mould cavity filled with precursors.

Are Polymer-Based Materials Compatible with Circular Economy Principles?
Ali so materiali na osnovi polimerov skladni z načeli krožnega gospodarstva?

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Principles of a Circular economy are entering the mainstream of European policies on resource and waste management. The relatively popular »Zero waste« concept is an extreme extension of this approach. We are now facing the task of implementing these principles in real life. Although some improvements that lead to higher efficiency are simple to implement, there are many products and materials that are proving to be very difficult to align with a practical and economically feasible circular approach with a high resource conservation level.

Plastics and other polymer-based materials are an especially difficult group due to their great variety, their broad area of application in virtually all spheres of human activity and their low value, which makes investment in their conservation unattractive. Examples of products burdened with such issues can be found in packaging, on the broad consumption side, or composites on the technical side. The challenge presented by plastics and polymers is reflected in the European Strategy for Plastics in a Circular Economy that outlines a range of focused actions designed to improve the situation. The understanding that plastics and polymer-based materials are a serious obstacle to a circular economy is reflected in renewed interest and funding available for research and development in recycling technologies, new materials, sustainable product design, improvements in waste management practices and assessment of environmental effects of plastics and polymer-based materials.

Specific Characteristics of Steel Corrosion in Concrete

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Corrosion of reinforcing steel is one of the main sources for the reduced service life of concrete structures. This process can be initiated by two mechanisms: carbonation of concrete and ingress of chloride ions. Basically, steel corrosion in concrete is a combination of electrochemical processes, but due to concrete porous structure, specific physical parameters strongly influence these processes. Mechanical loading of structural elements can also affect steel corrosion processes in concrete.

In this lecture specific characteristics of steel corrosion will be presented and explained. Benefits and limitations of various techniques for measuring, monitoring and characterisation of these processes will be presented. Certain protective measures and rehabilitation techniques for corroded reinforced concrete structures will also be described. Specific outcomes of laboratory and in-field research activities within numerous national and international projects performed at the Slovenian National Building and Civil Engineering Institute (ZAG) will receive considerable attention. In the end, particular open questions that determine further research will be highlighted.

Microstrucure Caracteristic Steel Slags

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Steel is the most used and produced metallic material in the world. Slag is also produced during the steelmaking process. The slag is liquid, a homogeneous or heterogeneous solution of metal and non-metal oxides, sulphides, phosphates, etc. It binds products that form in the melt during the steelmaking process and would affect the steel's properties. It also transfers the flame or arc heat to the melt, protects against oxidation and is an isolator, protecting the melt against excessive heat losses.

Slag properties and its role depend on the technological procedure and steel grade. The slag is a by-product of the steelmaking process, which is why its chemical composition must be planned for use as a safe secondary raw material.

Slag microstructural characteristics, from older technological processes to phase analysis of modern oxidation and refining slags will be shown.

Slag Processing and Steelmaking Waste Management – the Challenges we are Facing Today

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The world is facing unprecedented environmental challenges and the transition to sustainable materials management, along with the transition towards a sustainable energy system, is now recognized as the path forward. Such a strategy will have to be based on resource efficiency, recovery and recycling, and a multitude of synergetic and complementary actions are required from all parties involved.
Environmental care is central to SIJ Acroni's activities. The company constantly monitors emissions of wastes, gasses and waste water. Additionally, the company is introducing environmentally-friendly technological processes that have the least impact on the environment. In the field of steelmaking waste management, the company has recognized steelmaking slags and steelmaking wastes as valuable raw materials. The company's strategy is to reduce the amount of residues generated and to use the remains as products in high-quality steels or as saleable products. Within a reasonable time period SIJ Acroni intends to move from a linear economy model, characterized by an extensive use of the Earth's resources and an inability of recycling most of it, to a circular business model – a systemic concept that loops production and consumption cycles in order to regenerate, not exhaust, natural resources, and promises significant economic, societal and environmental benefits. Following the circular business model is the right way to create a green concept for steelmaking slags and steelmaking wastes management.
A novel metallurgical concept focuses on:

- converting steelmaking residues into saleable products
- investigating and modelling the steelmaking residue usage, with an emphasis on an increased extraction of valuable-metals from the residues.

To have more control over the steelmaking slag treatment, in August 2018 SIJ Acroni took over the activities of processing its own steelmaking slags. This was also done to consolidate the operation of the SIJ Group according to the principle of circular economy.
In the lecture the transition towards a green metallurgical concept for steelmaking slags and steelmaking waste management is presented, with emphasis on the challenges we are facing today.

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Principles For Structure Formation Management in Alumina And Zirconia Ceramics Processing

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Alumina and zirconia based ceramics are promising materials for advanced applications due to high strength, hardness, wearability, crack resistance. However, processing of such ceramics is extremely energy-intensive, and new technological approaches are developed within the 'composition-structure-property-technique' framework in order to suggest routes for obtaining novel materials with improved mechanical behavior and reduced sintering temperatures.

The paper discusses methods for managing structure formation in oxide ceramics during sintering by adding eutectic modifiers. First, a classification of eutectics was introduced based on reduced sintering temperature (eutectic melting point to ceramics sintering temperature ratio). Principles for selecting eutectic compositions were determined that included acid-base properties of melt; modifier cation-oxygen binding energy; liquid phase formation temperature in the multi-component system; solid phase surface wettability with eutectic melt; viscosity and surface tension of melt; and phase boundary surface geometry[1, 2]. It was found that an internal process 'controlling signal' in case of eutectic sintering aids were the type and size of alumo-oxygen cybotaxic groups[2].

This allowed to develop energy-efficient techniques of manufacturing alumina and zirconia ceramics with excellent mechanical properties. These included ceramic materials for milling bodies (firing temperature 1500 °C, density 3.52-3.80 g/cm^3, alumina content 87-95 %, wear (corundum milling) < 0.01 %/h), and special purpose ceramics: high-refractory heat-resistant zirconia ceramics (working temperature up to 2500 °C, compression strength 65-75 MPa, heat resistance over 30 cycles); patented alumina ceramics for circuit substrates and vacuum-tight metal-ceramic units (bending strength approx. 350 MPa; dielectric constant 9.5-10.0; loss tangent (1-3)·10^{-4} @ 1 MHz); high-strength alumina and Al_2O_3-ZrO_2 ceramics with reduced sintering temperature (firing temperature 1300-1550 °C, bending strength 400 MPa, crack resistance 5 MPa·m$^{1/2}$)[3].

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The Influence of Prior Hot Deformation on Microstructure Evolution During Aging in Nickel Superalloys 625

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The influence of deformation and heat treatment on the microstructure evolution in the nickel superalloy 625 was investigated in this work. Deformation dilatometry and a combination of hot rolling and high temperature furnaces were used, where both the deformation and heat-treatment parameters were controlled. The microstructure was characterised by SEM, where the EBSD and EDS methods were employed to characterise the grain structure and the various phases. Hardness and tensile tests were conducted to better understand the influence of different treatments on the mechanical properties. For the nickel superalloy 625 different intermetallic phases, like γ''-Ni_3Nb, δ-Ni_3Nb and secondary carbides, like $M_{23}C_6$ are known to precipitate in different temperature zones. Different treatments had complex influence on the microstructure evolution and consequently also mechanical properties. Different temperatures and reductions during hot rolling had a large influence on size, distribution and preferential precipitation sites of secondary phases during aging phase.

Characterization Of New Fillers Addition On Mechanical Strength Of Concrete

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In this work the results of chemical modification of concrete based on portland cement by zeolite, metakaolinite, micromethakaolinite in addition of 5, 10 and 15 wt. % of concrete amount into the slurry as a filler was summarized. The main goal of this study was to characterize directly influence and wt. % of content addition of new commercial fillers on concrete mechanical strength. The reference recipe of concrete was basic and contained three parts of aggregates: 0.125–0.250; 0.250–0.500 and 0.500–1.000 mm. For concrete production white cement (42.5 MPa), 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 done. Samples of concrete were characterized by compressive strength and bending tests after 1, 7, 14 and 28 days of curing process. Obtained results were compare with reference samples of concrete without chemical addition. This study was proven that all chosen modifiers revealed increase effect on final mechanical strength of researched concrete samples and are very perspective for application in civil engineering and new building technologies in future.

Lightweight Design in Automotive Industry Based on Metal Material

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Greater performance of the vehicle along with lower consumption and lower emissions are undoubtedly the result of a lower weight of vehicle. Due to higher ecological standards in terms of emission reduction in production, use and decommissioning of vehicles (the so called »from cradle to grave«), and application of principles of circular economy, the automotive suppliers are facing requirements to reduce weight of each individual part, component or the entire system of the vehicle.

Our guideline to reduce weight of a vehicle is the lightweight concept, which can be achieved using the right material in the right place and in the right amount. This involves developing and using new materials whose improved functionality and technological applicability (higher strength, proper ductility, formability and joinability) with low carbon footprint and acceptable price can enable implementation of lightweight design. In order to use them properly, good knowledge of their static and dynamic properties and joinability is required. Such knowledge and relevant information are a prerequisite for efficient development and optimisation of lightweight products which TPV as well as other established development suppliers conduct in a 3D virtual environment intended for design and advanced numerical simulations.

In company TPV, the development of automotive assemblies having a bearing function involves using suitable 3D tools which require good knowledge of chemical, metallurgical and mechanical properties of materials used and establishment of a corresponding database in the form of development guidelines.

Investigation of an Fe-Si-Mn-Al alloy high-temperature oxidation behavior

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X-ray diffraction (XRD) spectra of an Fe-Si-Mn-Al alloy sample were measured at a series of increasing temperatures (from room temperature to 1200 ^{o}C). Two main phases were identified (apart from Feα): cubic Fe_3O_4 and rhombohedral Fe_2O_3. With temperature increase their ratio changes as observed from diffraction peak intensities. In spite of complex chemistry of initial material no further phases were identified. Approximately around 900 ^{o}C intensity of diffraction peaks corresponding to Feα as well as to both iron oxides decreases sharply. Several new diffraction peaks appear that, as can be argued from their intensity vs temperature dependance, belong to at least 2 crystal phases. Surface sensitive X-ray Photoelectron Spectroscopy (XPS) and Auger electron spectroscopy (AES) of sample's surface after XRD measurements at increasing temperatures were also performed. Of all non-ferrous elements initially present in the alloy, as verified by X-Ray Fluorescence (XRF), only Si and Cu were detected on sample's surface after the end of the variable temperature XRD measurements. Structural and stoichiometric considerations based on XRD measurements and chemical compositions determined by surface spectroscopy measurements suggest that sample's surface is covered with Fayalite-like compound (Fe_2SiO_4) and/or iron oxide/hydroxide of FeO_x stoichiometry, where x = 1.5 – 2.

The Influence of Metal Titanium Surface Treatment on the Properties of TiO_2 Nanotubes Grown by Anodic Oxidation

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Titanium dioxide (TiO_2) is widely used material for photocatalytic applications due to its appropriate band-gap value, nontoxicity, low price and chemical inertness. For most photocatalytic applications TiO_2 is used in the form of powders or as porous thin films; however, in our current studies we used TiO_2 as photocatalyst in the form of nanotubes which were grown by anodic oxidation of metal titanium foils. The advantage of anodic oxidation is that the thin film of grown ordered TiO_2 nanotubes is firmly adhered to the titanium metal substrate. Since the surface treatment of starting titanium metal foil may predefine the morphology of TiO_2 nanotubes during anodic oxidation and subsequent thermal treatment, the aim of our study was to determine how different metal surface treatments influence the growth process and final morphology of grown two-dimensional TiO_2 nanotubes' array. For this purpose, two titanium foils with different chemical compositions and factory shaping were chosen as starting materials. Prior to anodic oxidation, the surfaces of both foils were either mechanically treated by using standard metallographic procedures or were electro-polished under different conditions. Grain size distribution in titanium foils and surface roughness was measured before and after surface treatment. Microscopic observations (OM and SEM) of all initial and anodized surfaces were performed as well. FSEM was used to observe the diameter and length of TiO_2 nanotubes. The photocatalytic activity of TiO_2 nanotubes was measured by caffeine degradation under UV irradiation with a high-precision UV-Vis-IR spectrophotometer. Our preliminary results showed that electro-polishing influences the number of starting nucleation sites for TiO_2 nanotubes growth that defines the final diameter of nanotubes while the length of nanotubes primarily defines photocatalytic activity.

Cohort Analysis of 110 Bone Defect Reconstructions with MUTARS® Modular Endoprostheses and Up To 9 Years of Follow-Up

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Our aim was to analyze midterm results of the MUTARS® modular endoprosthetic system in 107 limb-preserving reconstruction cases after tumor resection or revision surgery with up to 9 years of follow-up. The study included all patients who were operated at our institution due to tumor resection between January 1, 2009 and December 31, 2017 and had bone defect reconstruction with MUTARS® modular system[1]. In the course of follow-up, all complications were recorded, either nonmechanical (haemathoma, infection, local tumor recurrence) or mechanical (loosening, implant breakage, periprosthetic fracture, luxation).

The study included 110 patients (63 sarcomas, 23 metastases, 5 benign aggressive tumors, 3 plasmocytomas, 16 arthroplasty revisions) with implanted MUTARS® modular endoprostheses of total femur (3), proximal femur (31), distal femur (41), proximal tibia (9), arthrodesis (2), proximal or distal humerus (16) and pelvic endoprosthetic reconstruction (8). The mean follow-up period of unrevised patients was 35 ± 27 months (range 2 – 99 months). We recorded 4 local tumor relapses and 20 patients died by the end of the observation period due to progression of oncological disease. Out of total 26 patients requiring surgical revision, 17 (16 %) endoprostheses had to be at least partially replaced/removed eventually. The overall deep-infection rate was 6 %. Cumulative incidences of implant failure due to mechanical reasons were 10 % altogether, 13 % after minimum 2 years of follow-up and 14 % after minimum 5 years of follow-up. Endoprosthesis survival and complication rates at our institution are comparable to the previously published data[1,2] of clinical institutions involved in development of silver-coated MUTARS® endoprostheses. It remains to be seen whether long-term follow-up over 10 years will corroborate the promising mid-term results.

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TEM studies of reprocessed HDDR Nd-Fe-B powder and permanent magnets

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

The present study is about the investigation of HDDR NdFeB powder and SPSed (spark plasma sintering) magnets sintered at different temperatures combined with post-sinter annealing step, with the aim to clarify the mechanism of microstructure evolution in relation to their final magnetic properties. The TEM studies showed unreacted Nd and Fe rich phases in the original HDDR NdFeB powder. The SPS magnet sintered at 650^{o}C showed thick grain boundary regions. The EDX analysis showed that these regions contain relatively higher Nd concentrations as compared to $Nd_2Fe_{14}B$ grains. The post-annealed SPSed samples at 750^{o}C for 15 minutes revealed the formation of Nd-rich precipitates along the grain boundary phase as well as inside $Nd_2Fe_{14}B$ grains. The coercivity enhancement of the annealed samples is attributed to the thermodynamically equilibration of the SPSed samples during the post-annealing process.

Exaggerated grain growth was identified in magnets sintered at 850^{o}C and post-annealed at 750^{o}C for 15 minutes. The appearance of the exaggeratedly grown grains is believed to be the major cause of the coercivity decrease.

From these results, it was concluded that the SPSed and post-sintered annealing processes have inevitably influence on the resulting microstructure and hence the overall magnetic performance of the final magnets.

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Study of Castability of Melts for the Production of Cast Metallic Foams

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The paper deals with the topic of metal foams and other highly porous metallic materials, focusing on the possibilities of their production using conventional foundry production processes and technologies. In the framework of the selected technology for the production of cast metal foams (sponges) – the two-stage investment casting process using a polyurethane (PUR) pattern, particular attention is paid notably to the study of castability as a technological characteristic which is a limiting factor for the production of such castings. This paper summarizes the previous knowledge in the field of production methods and possibilities of application of cast metallic porous materials, and also presents a theoretical analysis of the castability, especially in terms of the factors that influence it. The aim of this paper is the experimental study of castability in the form of monitoring the influence of selected process parameters of the given technology and the subsequent evaluation for the purpose of defining optimal conditions of the process.

Fracture Mechanical Parameters of High Strength Concrete Evaluated by Brazilian Disc Test

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Nowadays, high performance concrete is used more frequently because of the many advantages compared to traditional concrete. Despite the use of advanced material, standards for structural design do not fully use materials' potential. This can be minimized by using fracture mechanical properties in structural analysis. The fracture mechanical properties help to perform advanced structural analysis, especially when some of the structural elements have a crack. The load presence on the structure can be combination of tension and shear – mixed mode I/II load [1]. Therefore, it is necessary to perform test, which covers mixed mode loading conditions.

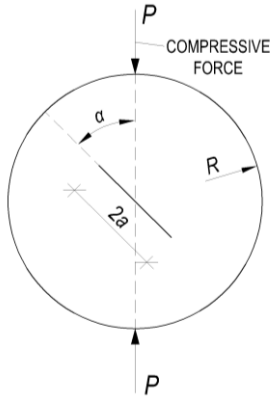

Figure 1: Brazilian disc test

This contribution evaluates fracture mechanical properties of high strength concrete [2] under the mixed mode I/II. The generalized maximum tangential stress (GMTS) criterion was used for the evaluation [3].

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Use of Additively Manufactured Patient Specific Instruments in Clinical Praxis

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In the last decades, additive manufacturing (AM) has offered aid in medical reconstruction and planning procedures to help surgeons reestablishing functionality of injured or otherwise affected body parts in their patients. Using a combination of Computer Assisted Design (CAD), high medical skills and latest AM technologies, it is now possible to offer patients a treatment that is better planned, highly predictable and more reliable as compared to traditional surgical procedures.

Additve Manufacturing Laboratory at Faculty of Mechanical Engineering, University of Maribor, has been supporting surgeons from many hospitals in Slovenia and abroad for more than 15 years. In this period many different surgical fields have been investigated and many new knowledge and experiences gathered. All these show that AM has a huge potential in the surgical field mainly due to its particularities that are in line with the additive technologies requirements (e.g. one-off production, complicated shapes, rapid development, etc.)

First cases of AM supported surgery in our laboratory covered the area of cranial and maxillofacial surgeries for which implants and surgical guides were custom made for each patient. First orthopedic cases soon followed with bespoke resection guides that enabled for precise and faster replacement of shoulder, hip and knee joints. Similar technique has been used to manufacture patient specific drill guide templates that enabled optimal pedicle

screw placement. The method has been evaluated by performing a clinical study involving the

manufacture of templates for the lumbar and sacral regions that enabled simultaneous multiple-level screw implanting. The latest research has been dedicated to a newly developed method and implants for hip revision surgeries that has been clinically tested and proved themselves effective by completely reestablishing hip biomechanics.

Development of the lightweight traffic-light boom with high strength characteristics through GFRP materials

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GFRP (Glass Fiber Reinforced Plastics) is famous and widely used to the lightweight material in all fields of the industry. The GRFP has an excellent creep property under the high sustained loading, a graceful chemical corrosion resistance, and it has a superior insulation performance. (1)
Generally, the traffic light system is consists of the pole, support bar, wire and signal lamp made by the steel materials. Nowadays, a steel wire is eliminating from the steel support bar. It has replaced the round pipe to polygon shape support bar through robust design.
In this paper, we attempt to the CFRP's insulation performance apply for the traffic boom structure. Because in the street we can easily see the street lamp and traffic light made from the steel structure. It has a very stable structure. However, when the installation of the steel lamp, a worker's feels very labor intensive and a worker has obvious physical fatigue.
In this paper is focus on the lightweight material application to the GFRP support boom. It will reduce the support boom's weight about 30 % compared to steel boom. This GFRP support boom is making by the pultrusion process. It is related to the insulation performance on the traffic boom.
The GFRP support bar is evaluated the mechanical properties of the tensile strength, bending strength, porosity, durability test, and insulation performance test.

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Modelling and Simulation of Electroslag Remelting
Part 1: Model Formulation

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A mutiphysics model was formulated for the electroslag remelting (ESR) [1, 2] process, encompassing fluid mechanics, solid mechanics and electromagnetic field components. The model is formulated in axisymmetry. The formulation involves a coupled set of volume-averaged conservation equations for transport of mass, momentum, enthalpy and concentration of alloying elements. The model considers incompressible thermo-fluid flow, electromagnetic field, solidification, viscoplastic deformation of the mushy zone, and thermal strains accumulated in the material.
The governing equations of the model are solved by a novel strong-form meshless method [3], which allows for efficient discretization of the areas where phase change is occurring.
The solution procedure of the model is divided into two parts. In the first part the thermo-fluid model is solved in the melting part of the melting ingot and in the second part the solidification model is coupled with solid mechanics model [4, 5] to additionally describe the mechanical stresses in the solidifying ingot. The results of the model predict the shape of the melting and solidification front, the distribution of alloying elements and the mechanical stresses appearing in the ingot.

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Polymer Matrix-bonded Polyester Fibers as a Substitute for Materials Used in the Cores of Vacuum Insulation Panels

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The paper discusses the use of alternative raw materials for the manufacturing of VIP (Vacuum Insulation Panels). VIP are thermally insulating boards with a fibrous core at an extremely low pressure. The research is focused on substituting glass fibers with polyester fibers in VIP cores. The polyester fibers are thermally bonded using BiCo fibers, which, once they have cooled, form the matrix of the composite VIP core.
It was proved that polyester fibers bonded with BiCo fibers show great promise; most notably in terms of their excellent thermal insulation properties, which they retain for a long time.

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Assessment Of The Cement Boards Building Plate In The Czech Republic

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The article deals with the methodology of the assessment and the state of the facade of the perimeter cladding facade from the fiber-cement boards in view of the fulfillment of the conditions of the technical legislation valid in the Czech Republic. This is mainly an assessment of the quality and appearance of the material of the tiling. It also describes the general methodology of the procedure of visual assessment of facade tiles and demands for their quality. The model object for the purpose of assessment in practice is a civil building in the Beskydy foothills. The object was judged both by visual methods according to the valid legislation and by testing the material of the tiling in the laboratory. The article is based on two main standards, namely ČSN ISO 13822 (73 0038): Design principles for structures – Evaluation exists. construction and ČSN P 74 7251: 2015 Folded cladding, tiles and panel cladding – Requirements for casting accuracy, quality and appearance. Backgrounds from the fiber-cement board manufacturer are also used.

Synthesis and Properties of Cu/CNT and WO_3/CNT Composite Materials for Metallurgy and Catalysis and Electronics

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Carbon nanotubes (CNTs) have been intensively studied because of their remarkable electronic, mechanical properties and unique one-dimensional (1D) structures. Due to their nanosize features, extraordinary mechanical strength and thermal stability, carbon nanotubes have been considered as ideal candidates to substitute for the conventional ligating components in multifunctional composite steels.

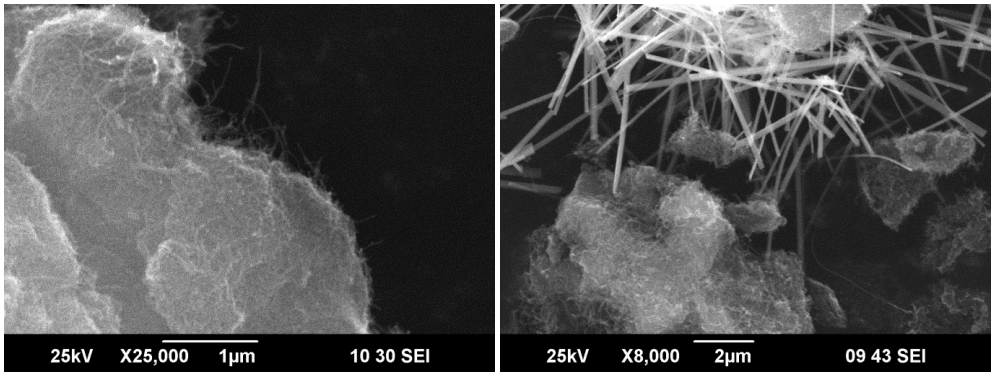
Up to now one of the main approaches to improve mechanical properties of the final composites as well as dispersive properties of carbon materials in coatings is decoration of CNTs by metals or metal oxides. Also such materials are applicable in industrial catalysis and electronic industry.

There are some ways to prepare coated CNT, like chemical vapor deposition (CVD), sol-gel method or impregnation by metal precursors with its further decomposition. Present work deals with supercritical fluid technique (SCF) application for this reason.

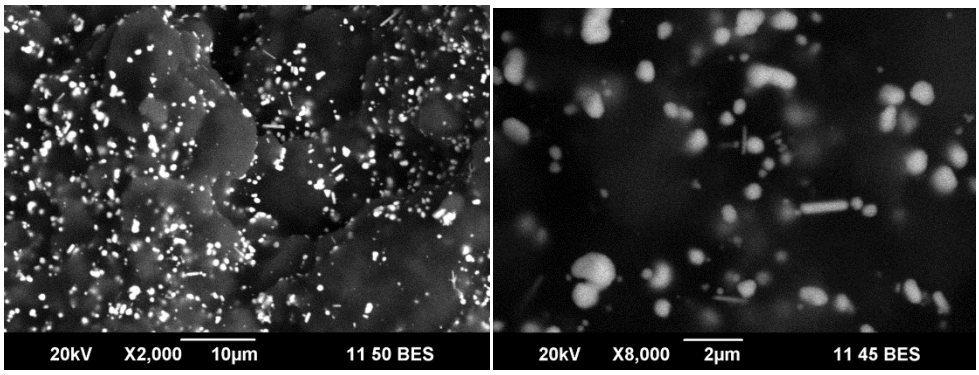
In recent years, supercritical fluids have been widely utilized in material science because of low viscosity, high diffusivity, near zero surface tension, and strong solvent power for many of small molecules. The flexibility of SCFs, in terms of tunable solvation strength and access to high operating temperatures and pressures, enables the synthesis of a variety of nanostructured metal and other materials.

A fluid media, water and n-hexane were used, since their critical parameters and low cost. As a source of metal $Cu(NO_3)_2*3H_2O$ and $(NH_4)_{10}[H_2W_{12}O_{42}]$ $*4H_2O$ we used. The condition of one-step synthesis CNT-composites was changed from 320 – 450 ^oC, 8 – 30 MPa and 0.5 – 67 hours.

CNT-composite materials with Cu and WO_3 nanoparticles, obtained in supercritical solvents, have been characterized by XRD, SEM and HRTEM. It was found, that their size, morphology and type of particles immobilization on CNTs depends on all the variable parameters – reaction time, temperature and pressure. It was shown that the increase of time and temperature led to decreasing of size Cu and WO_3 particles without CNT coating. So, we can widely change a sizes of composites by changing of condition of supercritical fluids.



Pic.1 Initial CNT and CNT with tungsten bronze whiskers.



Pic.2 CNT with cupper particles.

The Influence of Biomechanics on Prosthetic Rehabilitation with Titanium Short Dental Implants

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Objective: The success of prosthetic rehabilitation in partial edentulous posterior areas of maxilla with 4 mm titanium implants is yet not well known. The use of short implants influence to higher crown to implant (C/I) ratio, that consequently affects the altered mechanical load and biological response. The purpose of the study was to evaluate the crown to implant (C/I) ratio on prosthetic rehabilitated patients with titanium short dental implants within the first year of prosthetic loading on 4 mm implants in posterior maxilla.
Materials and methods: Between July 2016 and May 2018, 11 patients (6 women, 5 men; mean age 59.7 years) were restored with titanium SLActive dental implants (TL Roxolid, Straumann, Swiss). Partial edentulous patients in posterior maxilla were rehabilitated with at least one 10 mm long implant connected to one or more short (4 mm) implants by fixed dental prostheses (FDPs). Periapical radiographs were made immediately after inserting the implants (baseline), after finishing prosthetic rehabilitation and thereafter yearly. The C/I ratio was measured from radiographs using an image analysis software. Survival rates of prostheses were recorded.
Results: Twenty-nine implants (thirteen 10 mm implants and sixteen 4 mm implant) placed in eleven patients were evaluated. 11 metal ceramic FDPs (five FDPs supported with one 10 mm implant and two 4 mm implants; four FDPs supported with one 10 mm implant and one 4 mm implant and four FDPs supported with two 10 mm implants and one 4 mm implant) were fabricated with computer aided design and computer aided machining (CAD/CAM) from Co-Cr dental alloy. The mean value of C/I ratio for 10 mm implants was 0.71 (SD: 0.24; range 0.30-1.12) and C/I ratio for 4 mm implants was 1.30 (SD: 0.45; range 0.70-1.89). Survival rate of prostheses were 100 %.
Conclusions: Prosthetic rehabilitation in posterior maxilla with 4 mm dental implants connected with standard dental implants in one piece metal FDP results high survival rate. The implant splinting contributes to better biomechanical loading of implant-supported prosthesis despite the high C/I ratio of short dental implants.

Characterization of the surface chemistry and microstructure of new and in-vivo-exposed Titanium-Nickel Shape-Memory Alloy and Stainless Steel AISI 304 Archwires

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Nickel-titanium (NiTi) shape-memory alloys (SMAs) have been used in the manufacture of orthodontic wires because of their shape-memory properties, pseudo-elasticity, high ductility, and resistance to corrosion and excellent biocompatibility. NiTi SMAs have a greater strength and a lower modulus of elasticity when compared with stainless steels. The pseudo-elastic behaviour of NiTi wires means that on unloading they return to their original shape by delivering light continuous forces over a wider range of deformation, which is claimed to allow dental displacements.

The aim of this study is a surface-chemistry and microstructure analysis of new and in-vivo-exposed NiTi and SS archwires. Scanning Electron Microscopy (SEM) was used for the morphological visualization, Auger Electron Spectroscopy (AES) and X-ray Photoelectron Spectroscopy (XPS) were used for the surface-chemistry analyses and for depth profiling the characteristic elements of the archwires. A simple, non-destructive Thickogram procedure was used to corroborate the thickness estimates for the thinnest oxide layers, Cr_2O_3 on the new SS.

When exposed to air or biological liquids at body temperature, NiTi alloys, similar to AISI 304 l stainless steel, spontaneously form a thin TiO_2 oxide passive film of 4-10 nm thickness, and in the case of SS a thin Cr_2O_3 film of 1–2- nm thickness[1-3].

The AES and XPS results showed that thin oxide films on (a) a new NiTi archwire is TiO_2 with small amounts of Ni, thickness 4 nm, (b) the in-vivo-exposed NiTi archwire showed a 80-nm-thick carbon-rich layer containing also O, Ca, P and Cl. The elements Ni and Ti increase beneath the C-layer. This layer growth during in-vivo exposure is of organic origin, dental plaque.

On the surface of the new SS is a very thin Cr_2O_3, 1–2-nm thickness and in-vivo-exposed SS the thick layer of dental plaque was also found. The SS sample is covered with a 60–80-nm-thick layer rich in carbon, wherein also O, N, Ca, K, Na and Si are present. This layer was formed during exposure of the SS sample. It is thinner than a deposited layer on the in-vivo-exposed NiTi sample.

The oral cavity is a complex dynamic environment that often undergoes a rapid and substantial change in temperature and pH. It is involving biological interactions contributed by a continuous flow of saliva and microbiological activity, and for that reason dental plaque growth was found on the in-vivo-exposed NiTi and SS archwires.

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Obtaining Accurate Dimensioned Selective Laser Melting Product Focusing on Manufacturing Parameters and Building Orientations

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Dimensional accuracy is the most important aspect of a product manufacturing. Additive manufacturing (AM) technology is becoming an important production technology in low volume production and as such receives a lot of attention in terms of part quality management. Selective laser melting (SLM) is one of the AM technologies that are widely used for production of metal parts. In SLM process few to tens of micron-sized powder particles are used to produce the desired product. Though there is high flexibility in product design aspect, it is still a challenge to produce a product with accurate dimension as planned in a CAD model. Energy density (ED) and its technological parameters, laser power, scanning speed, hatch spacing, and layer thickness are the main factors that influence the manufacturing process characteristics. Besides that, building orientation is a considerable factor to produce the accurate dimensioned product. Ti-6Al-4V alloy products manufactured by SLM are being widely used in the fields of aerospace, automobile and biomedical applications where the most accurately dimensioned products are required. Hence, this study has gone through several combinations of the technological parameters as well as building orientations to obtain the accurate dimensioned Ti-6Al-4V alloy products. Three steps have been followed in this study. In the first step, seven sets of different scanning speed have been chosen which influenced ED. The obtained optimum ED (65 J/mm^3) from the first step was kept constant in the next steps. The optimal range of scanning speed has been observed between 400 to 800 mm/s. Five sets of specimens were produced in the second step with combinations of different laser power, scanning speeds and building orientation. Longitudinally vertical built up specimen is seemed the best building orientation by observing first and second step. The vertical orientation has been chosen for each set in third step. The accurate dimensioned product is obtained manufactured in longitudinally vertical direction with 65 W laser power, 805 mm/s scanning speed, 49.5 µm hatch spacing, 25 µm layer thickness and 65 J/mm^3 ED.

3D Nano-Printing via Focused Electron Beams: Principles and Applications

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3D-printing of functional structures has emerged as an important technology in research and development. While being reliable on the micro and sub-micron scale, the extension to the nanoscale is still a challenging task. Among the very few direct-write techniques on that scale, focused electron beam induced deposition (FEBID) is one of the promising candidates as this technology allows fabrication of functional nano-structures on almost any material and substrate morphology in a single-step process. Based on strong fundamental progress in recent years, FEBID was demonstrated to be capable of fabricating complex, freestanding 3D nano-architectures with individual branch diameters down to 20 nm [1,2]. Together with the increasing availability of precursors with different functionalities, FEBID is advancing from a versatile research tool into a predictable and reliable 3D nano-printer, which opens up new opportunities for advanced applications.

In this contribution, we start with the basic principles of 3-dimensional printing via FEBID, complemented by simulations for deeper insight into the fundamental processes that are operative [3]. Next, we briefly introduce a recently released computer aided design software (3BID) [4], which allows the reliable and easy design of complex 3D objects (see Figure 1). In the following, we present a variety of 3BID based proof-of-principle studies to demonstrate the capabilities of this direct-write technology. This ranges from scientifically oriented applications, such as plasmonics [1], magnetics [5] and nano-mechanics [6] toward industrially relevant concepts for scanning probe microscopy related tip fabrication, such as electrical, thermal and optical 3D nano-probes (see Figure 2). Finally, we overview some of the remaining challenges and provide an outlook on future activities.

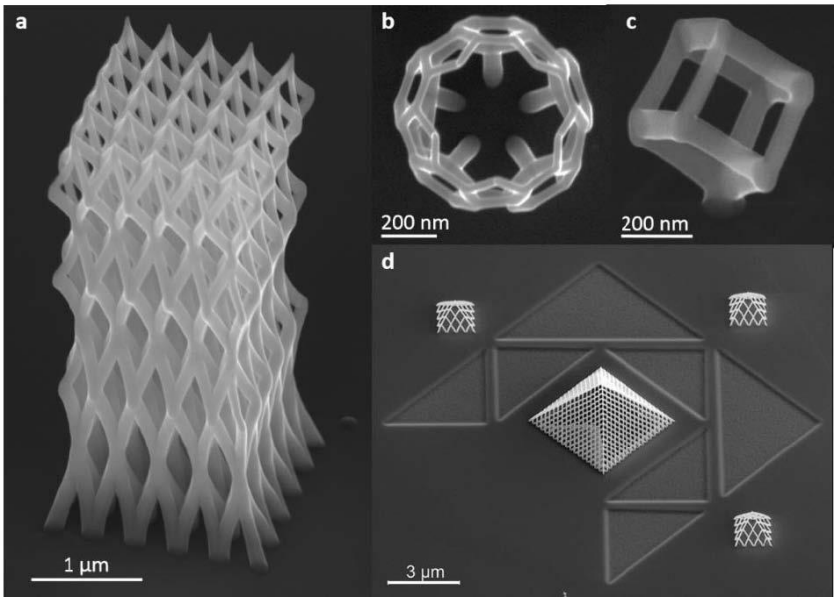

Figure 1. Direct-write 3D nano-printing of meshed-like platinum-carbon 3D nano-architectures: (a) sponge tower, (b) open Buckyball, (c) i-cube, (d) 3BID-model of the glass pyramid of the Louvre in Paris on a FIB-pre-structured silicon substrate. All images are SEM side views except (b), which is imaged from top.

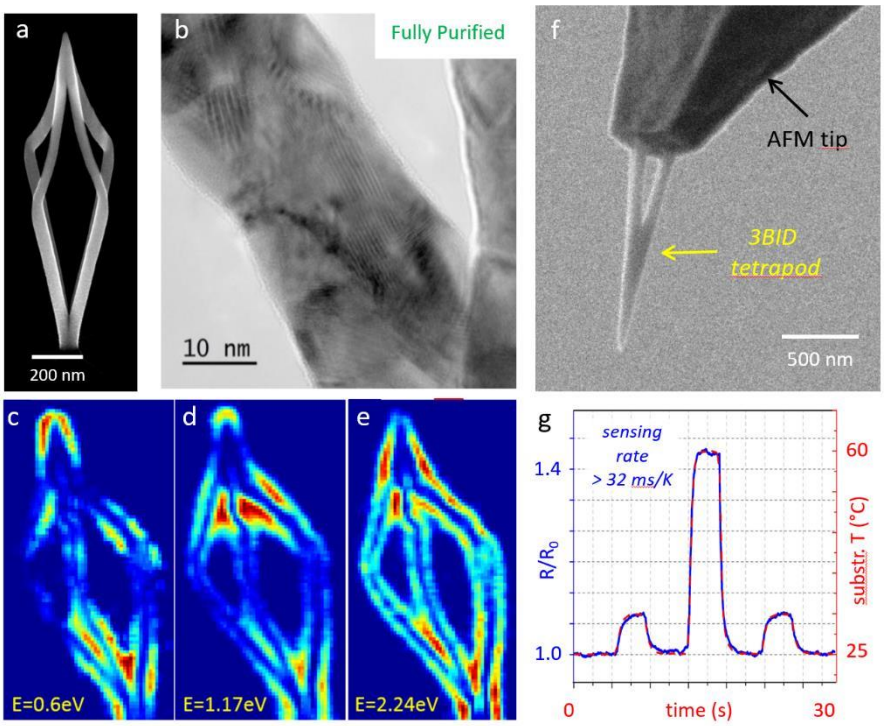

Figure 2. 3D structures for plasmonic (a-e) and thermal nano-probing (f-g). (a) shows a freestanding Au-C 3D structure which is transformed into pure Au via purification (b). (c-e) STEM-EELS characterization at different energies, which confirm plasmonic activities. (f) 3BID tetrapod on top of a FIB pre-processed self-sensing cantilever for further application as thermal nano-probe. (g) shows the timely response by electric current readout through the 3D tetrapod revealing sensing rates of 32 ms/K.

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Beneficial Use of Waste Heat for the Ppurposes of District Heating and Sanitary Hot Water in Ravne na Koroškem

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Steel industry is an energy-intensive sector since most production processes run at elevated temperatures. The iron and steel sector consumes approx. 19% of total energy in industry, making it the leading energy consumer in the EU.

There are many sources where superflous heat develops at SIJ Metal Ravne, however, they are mostly at a lower temperature potential (40 °C), with lower power and they are dispersed around the whole area of the company. The key part of project was a thorough analysis of the available sources of superflous sources of heat and finding proper sinkholes. We joined our efforts together with Petrol in a way that this superflous heat is used for central heating of Ravne town and/or it provides Sanitary hot water for the company location during the whole year. We decided for the use of the superflous heat source which is the most efficient for SIJ Metal Ravne from the cost view since superflous heat from the cooling system of electric UHP furnace is at a relatively high temperature potential (70 - 80 °C) and of proper power – approx. 3 – 4 MW.

This is the first project of this kind in Slovenia which is meant for a useful application of waste heat developed in steelmaking industry, using modern technology and innovative system solutions for integration of a smart, efficient and sustainable heating system with growth potential. This will provide industry and towns with energy saving, better quality of air and increased benefits for the society we live in. Based on circular economy, we designed a target-oriented cooperation among business sector, local communities and public research institute for preparation of new busines models with end consumers in the centre. This innovation opens the door for steelmaking industry and local community to a joint target which is a transition into more efficient energy systems with low carbon emissions based on engaging natural local relations, renewable sources of energy, the use of waste heat and in compliance with the principle of sustainable development.

Wear Mechanisms And Wear Resistance of Forming Tools

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The lifetime and performance of forming tools and dies is limited by a number of reasons, such as thermal fatigue cracking, erosion, corrosion, local adherence of the formed material to the tool surface, and gross fracture. Beside that, the surface finish of the formed part is a critical quality parameter in many forming operations. The major obstacles to generation of superior quality and smooth surfaces are tool wear, including abrasive and adhesive wear as well as fatigue. However, in many cases the main limiting factor is adhesion of work material to the tool surface also known as galling, which is also the dominant cause for tool failure in sheet metal forming and forging processes. Tool wear and adhesion of work material cause aesthetic problems for the work-peace and generates high contact pressure and unstable friction conditions, being very unfavorable for the forming process.

The main focus on improving wear resistance and tribological properties of forming tools has been on developing tool steels with improved fracture toughness and lately on thermal conductivity as well as by modifying lubricants for better retention and permeability at the tool/work-peace contact area. Nevertheless, wear and galling can successfully be hindered also by different thermo-chemical treatments and modification of the tool surface. One way of modifying the microstructure to improve wear resistance of the tools is proper thermo-chemical treatment, i.e. quenching and tempering, deep cryogenic treatment, nitriding, etc. The other option is the use of hard wear resistant coatings (i.e. cladding, PVD, CVD), which has started to compete successfully with the traditional thermo-chemical treatments. However, a complex shape of forming tools, which makes them difficult to coat, and high galling tendency of commercial hard coatings limit their use in forming operations. Furthermore, as compared to high-speed steels, cemented carbide and ceramic materials used in cutting tool applications, tool steels have a lower load-carrying capacity.

The aim of the presentation is to make an overview of wear mechanisms experienced in forming application and to review various engineering techniques and approaches in improving wear resistance of forming tools.

Introducing a New Method for Joint Surface Analysis

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Introduction: Congruency between created patellar surface and femoral component impacts intraarticular stress and strain distribution and contributes to arthroplasty success. We introduce a new method for surface scanning purposes and contact evaluation. Patellofemoral congruency between resurfacing, retention of an unresurfaced patella and patelloplasty, were compared using an intraoral scanner, which is a novelty in orthopaedics.
Methods: In our prospective clinical study two patients underwent a total knee arthroplasty (Genesis II, Smith & Nephew), their patellar surcafes were scanned using a TRIOS® intra-oral scanner (3Shape). Data were acquired as a cloud of points. The contact area between them and the endoprothesis CAD model was examined with Cloud Compare, throughout 0°-120° of knee flexion. To achieve best proximity without surface overlap, the ICP algorithm was used. The distance between the surfaces was measured using the Cloud-to-mesh function.
Results: Distance differences for each patellar surface type were compared in SPSS using ANOVA test. Up to 75° of flexion the average contact magnitude was 2.436 ±0.459 mm using nonresurfacing method, 2.569 ±0.269 mm using resurfaced method and 3.367 ±0.493 mm using patelloplasty. Above 90° of flexion, the average contact magnitudes were 3.857 ±0.682 mm, 4.430 ±0.671 mm and 4.771 ±1.067 mm using nonresurfacing, resurfacing and patelloplasty respectively. All measured differences were statistically significant ($p<0.001$).
Conclusions: The right choice of patellar managament can improve contact and congruency, thus improving the quality of endoprosthesis implantation. Joint surface scanning using an intra-oral scanner has proved to be an effective method.

Production of Cast Porous Metal With a Regular Internal Structure

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The article deals with casting methods of producing of porous metal, it is focused on materials with a regular arrangement of internal cells. Currently, there are two areas dealing with porous metal: optimization of already used casting technologies – manufacturing of porous metal with a regular cell structure using sand cores and the possibility of the usage of this material. Cast metallic foams have a wide range of applications such as: construction, transport, heat exchangers etc. for their outstanding properties: reduced weight sufficient strength to absorb the impact energy or the possibility of heat conduction.

Influence of Different Load Cells and Testing Rates on the Scattering of Tensile Test Results

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With aim to determine the repeatability as well as to identify possible reasons for the deviation in tensile test results among different laboratories a dedicated interlaboratory comparison between IMT and three other laboratories was performed.
Tensile tests were performed according to the SIST EN ISO 6892-1:2010 B30 method with the extensometer on the specimen up to the rupture. Measurements were made with the type A and type B samples (DIN 50125). Tensile test machines used included servo-hydraulic and twin-spindle type machines, equipped with four different load cells, 25 kN, 50 kN, 250 kN and 300 kN.
Measurement uncertainty and results deviation analysis was carried out by analyzing the test results for yield strength (MPa), tensile strength (MPa), elongation (%) and modulus of elasticity (GPa). Detailed analysis revealed, that beside material itself, different load cells used, as well as the strain rate of specimen applied, which hasn't always complied with the standard and recommendations, have a considerable influence on the deviation in tensile test results.

Carbon Nanostructures and Related Materials: Synthesis, Characterization Features, Application in New Materials Design and Energy Storage Systems

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Carbon is a really unique element since it forms at the same time myriads of organic substances and have various allotropes, considering as inorganic. Sometimes, they exhibit invers properties, e.g. graphite and diamond. Present work is focused on different carbon forms – nanotubes, nanofibers, carbon ribbons, carbon coils, few layers graphene fragments or nanoshells, carbon foams – obtained by pyrolysis of hydrocarbons. While fist four samples a geometrically anisotropic, others – exhibit 2D and 3D structure. Moreover, these materials contain the number of different functional groups and can be obtained with heterosubstitution, where B or N atoms are located within graphene layers. Application of different physical approaches, e.g. spark plasma sintering (SPS) and thermal treatment, as well as chemical synthesis allow to obtain the number of related materials with different density (up to 1.9 g/cm^3), porosity, surface area and chemical properties.

Differerent experimental techniques can be used for their characterization. The correspondance between the results of the SEM, HRTEM, ED, XRD, XPS, thermal and elemental CHNS, O – analysis as well as vibrational spectroscopy are discussed. It is shown that Raman spectroscopy, for example, open wide perspectives to trace the behavior of the material as well as point out the mehanism of their transformation. These methods also allow to determine the types and amount of functional groups on the surface and in the bulk of material.

Due to the unique properties of the CNMs and possibility of their adjustment, they can be used in creation of new materials. The most remarkable are hybrid carbon polymer composite and electrode materials for energy storage. At the first case the addition of few percents of CNTs to latex emulsions, PMMA or PC allow to reach outstanding adhesive and mechanical characteristics. At the second – they increase the electrical conductivity and electron transfer rate in oxide matrix or acting by themselves due to high surface area in double layer supercapacitors.

Innovative Ti-Mg Composite for Dental Implants

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Although implant materials present a group of biomaterials with drastic course of development over the last fifty years, some of demands posed on them are still unanswered. Reduction of stress-shielding effect and sufficient biocompatibility which are crucial during osseointegration process and determine outcome of the endosseous implantation, are yet to be accomplished. Intensive activities are directed to lowering Ti implants' Young's modulus while preserving sufficient values of other mechanical properties. Some attempts were aimed at obtaining low modulus β-type Ti alloys by addition of alloying elements such as Zr, Nb, Ta and Mo. Although all these elements have shown to have a non-toxic effect on human body their high price and melting points, much higher than that of Ti matrix, presented major issues for high volume production.

This presentation report on the development of the innovative Ti-Mg composite which would address previously mentioned issues of implant material. Ti was chosen as a matrix material to provide all beneficial properties, which made it favorable implant material in the last 30 years, such as high specific strength, non-toxic behavior and high corrosion resistance. Two of its major disadvantages, high E and bioinertness at the implant-tissue interface are reduced by introducing Mg as a second component. Firstly, present Mg reduces E compared to conventional Ti alloys. Secondly, it provides basis for selective biodegradation of implant by creating pores at the surface and volume of implant where there is exposure to corrosive medium. As a result of formation of porous structure E is further reduced in addition to beneficial increases of implants surface roughness. Furthermore, released Mg enhances osteoinduction, osteoconduction and osseointegration.

This innovative Ti-12 vol. % Mg composite is produced using a cost-effective powder metallurgy process, where a mixture of elemental Ti and Mg powders is extruded at low temperature to sound profiles. Microstructure comprises filaments of degradable Mg component which are arrayed along extrusion direction and are homogenously distributed within permanent bioinert Ti matrix. Compared to CP Ti Grade 4 this material has significantly lower modulus of elasticity (92,1 GPa) and density (4,12 g/cm^3) while other mechanical properties are comparable with CP Ti. Fatigue performance of Ti-Mg composite tested according to ISO 14801 standard for endosseous dental implants are equal to the one of the reference material.

Corrosion test show the elution of Mg phase from the specimen surface and formation of pores enhancing macro and micro roughness which can lead to better osseointegration of implant and bone.

Influence of Different Surface Irregularities on Fatigue Properties of Coated Cold Work Steel

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Powder Metallurgy cold work tool steels have a higher toughness but relatively low fracture toughness. Any irregularities on the surface therefore can act as crack initiation points. Aim of this paper is to show the influence of different irregularities on the surface on the fatigue properties of cold work tool steel. For this reason polished hourglass-type test specimens, made from cold work tool steel (K890), were modified using picosecond laser ablation, achieving parabolic shape of the cavity. Outer diameter of cavity was set to 65 ± 2 µm and depth to ~10 µm. Additionally, influence of TiAlN hard coating deposition on fatigue life was also investigated. Influence of coating deposition before or after making irregularities on the surface was analysed. High cycle fatigue tests at different stress levels were carried out using a servo hydraulic fatigue testing system. After the tests fractographic analyses were performed and fractured surfaces compared with the fatigue properties. It was found that coating deposition prolong the fatigue life. The sequence of surface texturing has also an effect on fatigue life behaviour. If laser texturing is done after coating deposition it suffers in fatigue life properties. From lover magnification fractured surface looks like a quasi-ductile fracture but a closer look reveals that there is very little of plastic deformation and some small flat regions can be seen with a clear evidence of brittle fracture mechanism with cleavage. Due to low fracture toughness of investigated steel no fatigue striations of crack growth steps was found on the fractured surfaces.

Comparison of Fatigue Properties of S235 J2 and S355 J2 using ProFatigue software

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The use of S355 J2 and S235 J2 steels in civil engineering to design structures elements of cranes, bridges or simple engineering parts allows material and economical savings meeting the strict construction requirements. The knowledge of the fatigue resistance of material plays the key role during design and maintenance of the civil engineering structures. In the paper the fatigue properties (Wöhler curve) of S355 J2 and S235 J2 are analysed using probabilistic models. The data consist of results from low cycle and high cycle fatigue and different number of various investigated specimens. In particular, the software ProFatigue is used for derivation of the probabilistic *S–N* field and fatigue crack growth from experimental fatigue data of steels. The results obtained are compared with the customary (Basqin's formula) Wöhler-curve, represented as a straight lines in a double-logarithmic scale (bilinear model).

Acknowledgements
The Czech Science Foundation under the contract No. 17-01589S supported this research. This paper has been worked out under the "National Sustainability Programme I" project "AdMaS UP – Advanced Materials, Structures and Technologies" (No. LO1408) supported by the Ministry of Education, Youth and Sports of the Czech Republic.

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Influence of Light Polarization on Micrometer and Submicrometer Surface Structures Induced by Laser Pulses

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The surface morphology on micrometer and submicrometer scale can be efficiently controlled by laser pulses. Such laser-induced micro/nano structuring leads to significant improvement of surface functionalities and opens up completely new possibilities in the field of surface engineering, which is important for a wide range of applications in the fields of photonics, tribology, heat transfer, wettability, and biomedicine [1-4]. Several laser-system parameters, including pulse frequency, energy, wavelength, scanning-line separation and scanning velocity significantly influence the final result. However, one of important parameters is also polarization of light, which refers to the direction of the electric field oscillations. It plays an important role in case of laser-induced periodic surface structures (LIPSS) that appear when the solid surface is irradiated by polarized laser pulses at (low) fluences near the fluence threshold for laser ablation [5,6]. In this case, LIPSSs period usually scales with the wavelength, while its orientation depends on the polarization of light. By increasing the pulse fluence and, consequently, ablation, LIPSS are overwritten by larger and deeper structures, like micrometer holes. Also in this case, polarization plays an important role, since the absorption of laser light in material depends on incident angle and polarization of light, as defined by Fresnel equations.

In this contribution, we will show the influence of polarization of light on the shape of microstructures that are induced at low and high fluences. The surface is processed by nanosecond and picosecond laser pulses. In case of low fluences, LIPSS appear on the surface. Our results show that its period decreases by number of pulses that are irradiated on the same spot. On the other hand, when high fluences are used, the holes of diameter around 1 μm can be drilled. The presented results reveal that in case of linear polarization their shape is elliptical. This we theoretically explain by introduction of complex refractive index into the Fresnel equations. The elliptical shape becomes circular, if circularly-polarized or non-polarized light is used. The surface micrometer and submicrometer structures are analyzed by scanning electron microscoply (SEM). Additionally, electron backscatter diffraction (EBSD) is used to show that fluence threshold for laser ablation depends on crystal orientation.

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Influence of Microstructure Achieved by Various Heat Treatments on Wear Resistance of Hot Work Tool Steel

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Heat treatment of the tool material is in addition to chemical composition, of crucial importance, because it determines material properties such as the hardness, strength, toughness, ductility, elasticity and wear properties of the tool. The wear behaviour and wear resistance of the material is in a great manner related to the tempering conditions and prevailing wear mechanism[1]. Steels are often considered as being homogeneous and isotropic materials having specific properties they have to meet depending on the application. However, detailed examination of the microstructure shows just the opposite. Therefore, the aim of this research was to evaluate influence of different heat treatment conditions on fraction and type of carbides, and their influence on the wear resistance and behaviour of subsurface microstructure of the selected hot work tool steel using the model testing.

In order to obtain microstructures with different amount of carbides in the matrix of modified 1.2367 hot work tool steel, two different austenitization temperatures where chosen based on the various dilatometry experiments. Austenitizing temperatures of 1030 °C and 1150 °C were chosen, with the latter one resulting in complete dissolution of carbides (carbo-nitrides). Investigation included set of as quenched as well as tempered specimens, heat treated in a horizontal vacuum furnace. Used austenitizing temperatures resulted in martensite microstructure with different volume fraction of undissolved carbides (carbo-nitrides), as well as prior austenite grain size. Upper austenitizing temperature resulted in a great increase in prior austenite grain size. Thus the toughness of the material was influenced, while maintaining similar hardness level of about 58 HRC after quenching. Effect of microstructure on wear resistance was evaluated by reciprocating sliding wear tests carried out at room temperature, using 100Cr6 and ceramic Al_2O_3 balls as counter-body material in order to simulate adhesive and abrasive wear, respectively. Also unidirectional pin-on-disc sliding tests were carried out on as quenched specimens in order to analyse effect of the normal load on the wear mechanisms.

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Microstructure and Mechanical Properties of Rapidly Solidified 5083 Al-alloy

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The aim of the research is to produce Al alloys at the laboratory level, which will have superior properties, especially high strength, temperature stability and corrosion resistance.
For this purpose, the aluminium-magnesium alloy 5083 was rapidly solidified by means of melt spinning technique. Received ribbons were cut to small pieces and cold compacted to produce cylindrical billets which were plastically consolidated during subsequent hot extrusion process. As a result, rods of 8 mm in diameter were obtained. In the same way the Al alloys 5083 with increased contents of Mn were also prepared.
The microstructural characterization showed that the grains in the extruded material are generally small, 70 % of the grains have an average size of 1 µm, 22 % of the grains are between 1 and 3 µm, and the remaining grains are smaller than 1 µm or larger than 5 µm.
Mechanical tests of the extruded material showed a tendency of increased tensile strength and yield strength. The base alloy has a tensile strength Rm of about 330 MPa, while the extruded material showed an increased tensile strength of about 350 MPa and the tensile strength of the alloy with added Mn exceeded 400 MPa. A higher Mn content means greater tensile strength and a higher yield strength, as well as increased contraction. At the same time, samples with a higher Mn content have better temperature stability.

Class C fly Ash for 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. The fluidized technology is one of the most up-to-date methods for burning of coal and other sorts of fuel in thermal power plants. In conjunction with desulphurization, this is the most efficient method for the limitation of harmful emissions (especially sulphur dioxide) in the air. High content of CaO and SO_3 (chemical analysis) in the form of anhydrite $CaSO_4$ is typical for class C fly ashes.
The aim of the article is to evaluate the possibility of the class C fly ashes utilization in ceramic (fired) materials in connection with the risk of anhydrite decomposition during the firing and increasing of sulphur dioxide emissions in flue gas. The properties of ceramic body with the admixture of class C fly ash will be discussed (mineralogical composition, physical-mechanical properties, microstructure).

Mechanical and Bicompatible Properties of Continuous Vertical Cast NiTi Rod

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For Continuous Vertical Cast (CVC) NiTi rod, mechanical and biocompatible properties were investigated.
The results of the microhardness measurements with HV0.1 show the average Vickers hardness value 583 HV0.1 of CVC NiTi rod and that Vickers hardness slightly increases towards the center of the rod as a consequence of the formatted microstructure. The results of the tensile, compressive and 4-point bonding test show typical curves for brittle materials. The obtained results indicate that the fracture of the CVC NiTi rod sample occurs before the material enters the plastic deformation region. Therefore, CVC NiTi rod is unsuitable for strain hardening.
The biocompatible properties were measured through cytocompatibility and corrosion properties of CVC NiTi rod. A commercial NiTi alloy was used to monitor the biocompatible properties.
The cytocompatibility of the CVC NiTi rod was tested with the submersion of the samples to the HUVEC cell solution, where HUVEC cells adhered to the samples surface. The results show that the number of adhered HUVEC cells and the proportion of viable HUVEC cells on the samples surface of CVC NiTi rod is smaller than on commercial NiTi.
The corrosion properties were performed in simulated physiological saline at body temperature. Results show that the corrosion properties of CVC NiTi rod are poorer in comparison with the commercial NiTi.

Correlative Optical Imaging in the Far-field and Near-field Regimes of Micro- and Nanostructured Materials

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Optical nanoscopy techniques are gaining increasing interest as resolution capabilities lying in the nanoscale realm represent vital requirements for achieving further breakthroughs in key domains such as medicine, biology or materials science. Among these, Apertureless Scanning Near-Field Optical Microscopy (ASNOM) holds significant potential for advancing beyond the state-of-the-art our current understanding of the structural, chemical and optical features of advanced micro- and nanostructured materials (and of their interaction with biological samples), through the prism of its proprietary label-free contrast mechanisms. However, the penetration of ASNOM in the above mentioned domains is partially biased by data interpretation, which is not always straightforward. One way to alleviate this situation is to correlate ASNOM data sets with well understood data sets collected with mature imaging techniques. In this purpose we have recently developed a multimodal imaging system capable to collect optical data sets on overlapping field-of-views by several ASNOM and far-field Laser Scanning Microscopy (LSM) techniques. Moreover, this system incorporates as well a series of Scanning Probe Microscopy variants, which are useful for placing optical data sets into a topographic context. The contrast mechanisms of the incorporated imaging techniques provide complementary information, which plays an important role in facilitating nanoscale data understanding and interpretation. We present this imaging architecture and showcase a series of results collected on various micro- and nanostructured materials in the frame of innovative correlative-imaging assays. A main focus of attention is placed on the characterization of advanced materials with applications in biomedicine and biotechnology.

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Surface Analysis of Overlayers on Biodegradable Mg Alloys After Immersion in Simulated Body Fluid

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Two binary and one ternary solid solution treated biodegradable Mg-alloys were investigated after bio-corrosion immersion tests in simulated-body-fluid (SBF). Different types of overlayers appeared. These overlayers on binary alloys Mg-Ca, Mg-Zn, and the ternary Mg-Zn-Ca alloy were analyzed by Auger Electron Spectroscopy (AES) and/or X-ray Photoelectron Spectroscopy (XPS).

AES was first attempted, but due to the extreme charging of the surface no useful spectra could be obtained. This charging is also responsible for low quality of the SEM imaging where it causes extreme brightness of the upper surfaces. Nevertheless, at 60° tilt of the sample, lateral surface of the grain in the crack can be well observed and a rough estimate of the overlayer thickness can be made as of the order of 100 µm.

Further XPS analysis revealed that typical bio-corrosion products in form of overlayers on all investigated alloys, i.e., Mg-Ca, Mg-Zn, and Mg-Zn-Ca consisted of Mg, Ca, P and O. Their concentration ratios (c(Ca)+c(Mg))/c(P) and (c(Ca)+c(Mg))/c(O) correspond to $M_3(PO_4)_2$ where *M* is Ca or Mg.

Computer Assistance in Hip Arthroscopy – Current Status

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Femoroacetabular impingement (FAI) is the most common indication for hip arthroscopy. Femoral type (CAM) of FAI is treated by arthroscopic osteoplasty. Its goal is to correct deformed femoral head and to avoid further FAI and damage to the joint. According to the literature, in 5 – 10 % of cases revision surgery is needed after hip arthroscopy, in 80 – 90 % of all revisions due to insufficient correction of the femoral head-neck deformity.[1] Computer navigation was suggested to improve accuracy of arthroscopic osteoplasty and to decrease demand for revision but none of the previously tested surgical navigation systems has been used routinely in praxis.

We have introduced computer navigated arthroscopic osteoplastic based on kinematic planning from CT based 3-D model using electromagnetic navigation system Guiding Star. Its accuracy was tested on 16 pairs of CT based 3-D printed models of CAM deformed hips.[2] The conclusion of this experimental case control study was that computer navigation significantly decreased incidence of persisted CAM deformity. The maximum depth of persisted CAM in navigated group was significantly lower than in non-navigated group (1.06 mm and 3.13 mm, respectively). It was roughly estimated that navigated osteoplasty was performed with accuracy being twice better compared to non-navigated osteoplasty.

According to results of our study, navigation improves accuracy of arthroscopic correction of CAM deformity. New method has been used in clinical praxis in more than 40 patients with positive experience.[3] Its influence on the clinical outcome has yet to be tested. Some technical advances of the navigation system with knowledge from robotic assistance may be considered to further improve accuracy of arthroscopic osteoplasty.

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Usability of by-products as a Siliceous Component in Autoclaved Aerated Concrete Technology

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Current trends are more often focus on use of secondary raw materials that have a positive economic and environmental impact. The research focused on the maximum use of secondary raw materials in the production of high performance autoclave aerated concrete (AAC). This type of aerated concrete is characterized by a higher bulk density and compressive strength than regular AAC. The increase the bulk density was achieved by increasing the quartz sand volume and by adjusting the amount of the mixing water. Quartz sand was replaced by slag, foundry sand, fireclay lining and heating plant ash of the steel producer. The substitution of quartz sand by secondary raw materials was 10 % and 30 % amount. The samples were autoclaved in a laboratory autoclave at 7 hours of isothermal duration on 190 °C and saturated water vapour pressure of 1.4 MPa. Autoclaving mode has been selected with given to real production technology. On the produced samples were determined physical-mechanical parameters and microstructure analysis was performed. Microstructure analysis was performed using XRD analysis and SEM microscopy. The results show that sand substitution by secondary raw material is possible without significant changing properties.

Using Modified Strip Yield Model for Crack Growth under Variable Amplitude Loading in AA 2124 and AA 7475

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The crack growth in metal materials under variable amplitude loading is influenced by interaction effects due to different cycle levels. The simulation of crack growth under such conditions is difficult. The Strip Yield Models (SYM) are widely used [1]. Under certain loading sequences the thickness effect of the specimen appears resulting in different crack growth. The crack growth in M(T) specimens made from aluminium alloys 7475-T7351 and 2124-T851 with different thicknesses was investigated using 2 flight loading sequences. During tests, the thickness effect occurred in case of AA 7475, but in case of AA 2124 did not (see Fig.1). The original SYM is not sensitive to specimen thickness so the modification was implemented based on variable constraint factor α according to FE analysis of M(T) specimen. The crack growth curves for AA 7475 determined by modified Strip Yield Model show the dependency on the thickness and behave similarly to test curves as shown in Fig.1. The thinnest specimen (2 mm) shows 150 % longer life than the thickest one (8 mm). In AA 2124 no thickness influence was observed for both, the SYM prediction and experimental results. The only exception was slightly longer life predicted for the thinnest specimen. Using modified Strip Yield Model resulted in more precise life prediction.

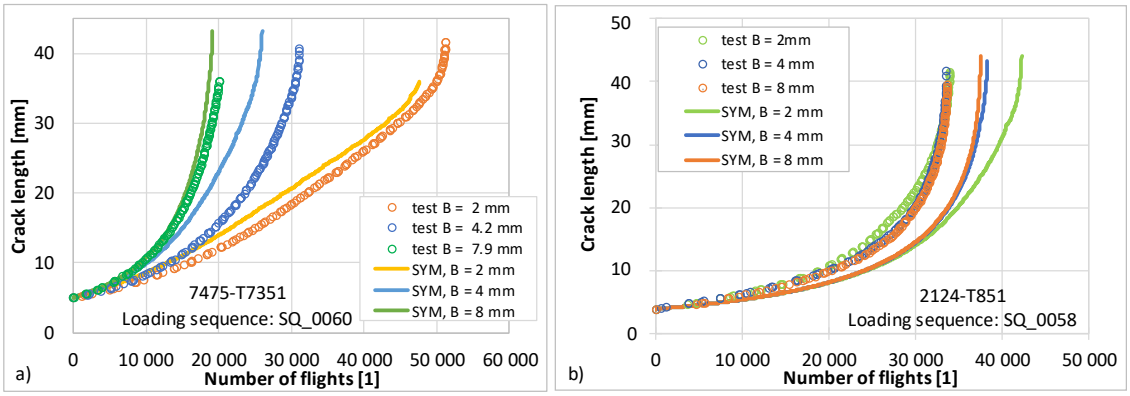

Fig.1: Comparison of crack growth curves for test and simulation SYM; a) AA7475 b)AA 2124

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Inluence Of Sub-Zero Treatments On The Properties Of Austempered Ductile Cast Iron

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A deep cryogenic treatment (DCT) is a heat-treatment procedure where the material is subjected to subzero temperatures before tempering to obtain dimensional stability, but also to improve the abrasive, fatigue and wear resistance. DCT is very popular in research, with reports covering tool steels, maraging steels, cast irons, annealing steels, hard metals, aluminum, and others. The main mechanisms contributing to the improvement of mechanical and tribological properties of steel are the completion of austenitic transformation and the precipitation of nanometric eta-carbides evenly dispersed by the martensitic matrix. Recent studies have provided a more detailed insight into the mechanisms mentioned, including the formation of nano-martensite during the DCT and the plastic deformation of the primary martensite that follows the martensitic conversion with the partial dissolution of the carbide and the formation of carbon clusters.

ADI has become an important engineering material in recent years due to its interesting combination of properties, such as very good strength-to-weight ratio, good toughness, high wear resistance, and excellent fatigue strength in combination with the low cost, design flexibility, and good machinability. As a result of these properties, which are a consequence of the ADI's specific microstructure that consists of needle-like bainitic ferrite (α_B) and high-carbon austenite (γ_{HC}), ADI is increasingly used in the automotive industry as a substitute for steel and aluminium parts. The study investigated the influence of a deep cryogenic treatment on the abrasive wear resistance of ADI austempered in the upper ausferrite area as well as the microstructural changes that occurred during the deep cryogenic treatment and the subsequent tempering. The obtained results show that the DCT, in combination with different tempering temperatures, affects the matrix microstructure of the ADI, which leads to an increase in both the abrasion wear resistance and the hardness.

Study of WC-X-WC (X=Cr, W, Zr) Diffusion Couples Prepared by Spark Plasma Sintering

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Materials that are used in the fusion reaction must withstand a very demanding environment, so novel materials must be engineered as an alternative to already present materials. One possible choice to serve as an armor for high thermally loaded parts of the fusion reaction would be a fine grained cemented carbide, but Co and Ni, which are used as binder phase conventionally, need to be replaced by low-activation elements.

The aim of this work was to experimentally validate the feasibility of alternative binder materials in the preparation of cemented WC carbides. Based upon thermodynamic calculations, three diffusion couples were prepared by spark plasma sintering (SPS) at 1900 °C for further analysis: WC-Ta-WC, WC-Cr-WC and WC-Zr-WC. A detailed microstructural analysis of resulting phases was performed by scanning electron microscopy and electron backscatter diffraction.

In this contribution, we will present the results of microstructural characterization of the diffusion couples. Due to high temperatures during the SPS process, we observe formation of W_2C phase and different carbides based on the binder phase.

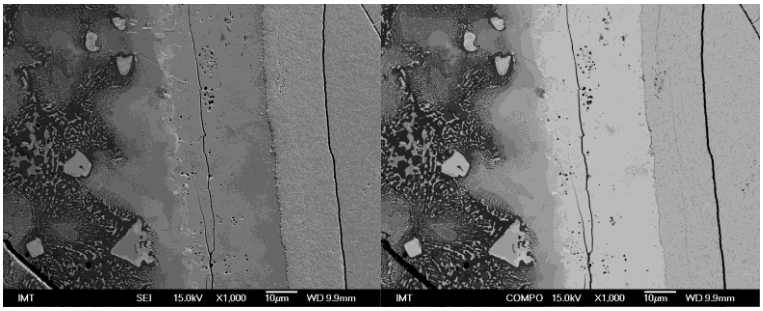

Figure 1: SE and BE images of WC-Cr-WC diffusion couple.

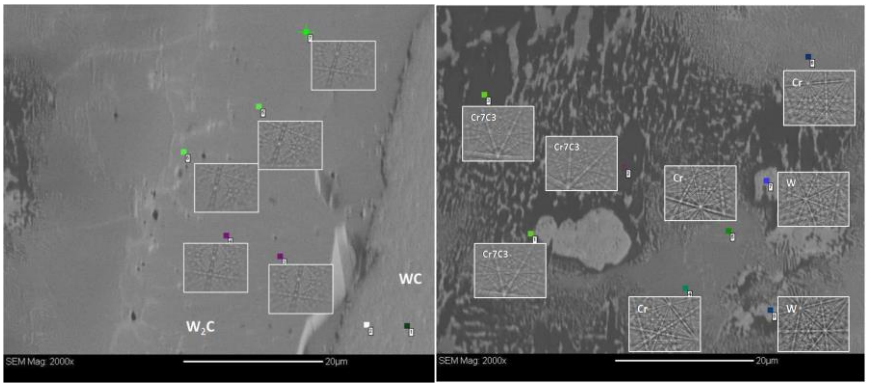

Figure 2: Diffusion couple WC-Cr-WC. Left: W_2C layer forms between the WC and Cr. Right: In the molten Cr layer, we observe Cr_7C_3 carbides and pure W islands.

Microstructural Changes in Cement Mortars due to Alkali-Carbonate Reaction

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This paper investigates the process of alkali-carbonate reaction (ACR) on cement mortar. The mortar was prepared using Portland cement CEM I, according to SIST EN 197-1, and typical Slovenian dolostone. Hardened mortar bars (40 x 40 x 160 mm) were exposed to accelerated ageing conditions simulated by 1M NaOH at 60 °C or deionized water at 60 °C. The aged mortar samples were investigated using optical microscopy, SEM, and XRD. The obtained results revealed that chemical reactions characteristic for the ACR progressed in all analysed samples (Figure 1 a and b). In the NaOH aged samples, dolomite grains smaller than 2 mm in diameter went through a complete dedolomitisation process in a 2 year period. Additionally, new Mg-Al, Mg-Si (Figure 1 c) and Mg-Al-Si gel-like phases were detected at the aggregate-cement paste interface. The less alkaline environment in the case of H_2O aged samples resulted in considerably slower ACR reaction.

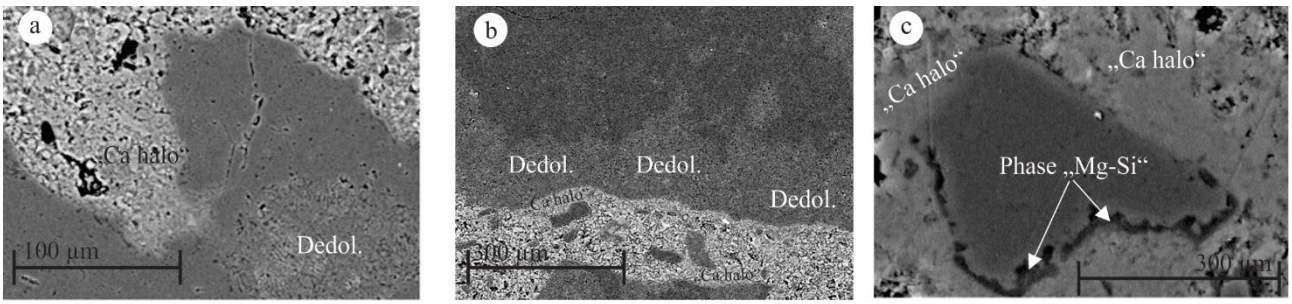

Figure1: The aged sample of cement mortar after one year: a) in deionized water at 60 °C, b) in 1M NaOH at 60 °C, c) the new Si -Mg phase in mortar sample exposed to 1M NaOH at 60 °C for one year.

Influence of the Annealing Temperature on the Mechanical Properties of the Superaustenitic Stainless Steel UHB 904L

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Superaustenitic stainless steel UHB 904L with high Mo concentration widely used in applications that require good toughness and corrosion resistance. Given certain thermal histories, UHB 904L may be susceptible to the formation of potentially detrimental intermetallic phases, such as the sigma phase. The formation of sigma phase is promoted by high concentrations of Cr and Mo, while elements such as carbon, nickel and nitrogen retard its formation. Samples of UHB 904L were exposed to isothermal annealing within the temperature range between 800-1140 °C, with ageing times varied between 0,5 h in 8 h, followed by water quenching. Microstructural analysis showed that sigma phase forms up to 1000 °C. Optical and electron microscopy and Auger electron spectroscopy were used.

Twinning and Charge Compensation in Nb_2O_5/Ta_2O_5-doped SnO_2-CoO Varistor Ceramics

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In varistor ceramics, grain growth studies are of particular interest, because understanding the growth process can be beneficially used for controlling the microstructure development and also for tailoring grain size-dependent electrical properties, such as the threshold voltage[1]. Unlike in ZnO varistor ceramics, where the role of dopants on microstructure evolution is well understood[2], these effects have not yet not been fully examined in SnO_2 ceramics.

In our previous work[3] (Co,Nb)-doped SnO_2-based varistors system was proposed, which presents excellent nonlinear properties (α = 50), matching those of ZnO-based varistors and highly dense microstructure with almost no porosity. Already a small addition of Nb_2O_5 (0.1 mol %) triggers a three-fold increase in growth rate via the diffusion induced grain boundary mobility (DIGM) due to the formation of oxygen vacancies in the grain boundary region. We also confirmed that the formation of twins is related to Nb_2O_5 addition, while Nb segregates along the twin boundaries, which are the most probably a result of yet unexplained sequence of topotaxial replacement reactions. In the present study, different amounts of Ta_2O_5 were introduced into 1 mol % CoO- doped SnO_2-based varistor system to resolve mechanism of twinning. Also, the effect of Ta doping on microstructure development, grain growth and electrical properties will be discussed.

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Pulsed-Electric-Current-Sintered Ti-CNT Metal-Matrix Composites

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Titanium, with its excellent corrosion resistance and high yield strength, is being used in various commercial applications where such properties are necessary (chemical industry, aeronautics). Even though it possesses the highest strength-to-density ratio of all the metallic elements, there are other properties where improvements would be very beneficial. One of the routes to achieving improvements is to form titanium-based metal-matrix composites using carbon nanostructures, like carbon nanotubes (CNTs), since they possess extraordinary electrical and mechanical properties and possess an extremely high thermal conductivity coefficient.

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 addition of 2.0 wt % of stearic acid that acted as a surfactant. The composites were sintered with a pulsed-electric-current sintering device at a temperature of 850 °C and an applied pressure of 16 kN for a duration of 10 minutes.

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.

Material Related THA Failure

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During the whole era of total joint replacements (TJR) there were problems with materials used for TJR. Early replacements performed by Gluck eighteenth century failed due to biologic materials very prone to infections. In the early nineteen century, the material related problems continued particularly with bio-glass implants prone to fractures and insufficient fixation of metal implants of that period. This was the reason why the first large scale TJR did not start until the 1960-ties when Charnley introduced a lucky combination of methyl-methacrylate bone cement for fixation of surgical steel stems and polyethylene cups and a similar but metal-on-metal combination was introduced by Mc Kee and Farrar.

The metal on polyethylene worked well but soon failures started to diminish the early enthusiasm. Eventually Harris realized that the problem was related to particles released during wear of the bearing couple. Consequently the orthopedic community together with the industrial partners started to overcome the problem by introducing new bearing options, such as ceramic-on-ceramic and metal-on-metal. Wear was of course not the only but the most predominant problem of artificial joints in the seventies and eighties. Important but less studied were the problems with fixation, stability, joint geometry reconstruction, infection range of motion and function. In the same fashion as for tribological problems orthopedic surgeons and medical companies tried to solve the issue by never ending introduction of new implants, solving some problems but also introducing new ones. The quest to find the optimal materials for implants is far from solved although the main problems are changing.

By the end of nineties in Valdoltra Orthopedic Hospital, we suspected an increased incidence of problems associated with artificial hips with a metal-on-metal bearing couple. In the context of the analysis of this phenomenon and to prevent further potential trouble with the newly introduced artificial joints we established, as the first in Slovenija, in 1998, a team for medical biomaterial studies led by Prof. Milošev. The primary focus was into artificial joint survival analysis, tribology, and corrosion. In order to achieve that Valdoltra arthroplasty registry was formed as well as a retrieval registry for components explanted during revision total joint arthroplasties. Methods for analyzing failed material were designed to fulfill the quest of minimizing material related problems for the problems.

Material related TJR failures still predominate. Among the most popular are the corrosion issues related to bearing size, combination, modularity. Wear is not yet completely eliminated, and implant fractures continue to cause revision occasionally. There is also a forgotten problem of non-wear related bone implant interface failure which has been not yet extensively studied but is the reason for an important part of TJR failures.

Sustainable Waste Treatment Procedure of SPL from Aluminium Production

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Over the history of Aluminium production, the industries still search feasible and environmental friendly solution for treatment of Spent Potlining (SPL) as a waste product of the primary aluminium production process. SPL viable treatment is a global challenge for the primary aluminium industry, as is declared as a mixed hazardous waste contain first cut as mainly carbonaceous and second cut as mainly refractories materials. Some different possible solutions – options to this problem have been investigated. The latest techniques to treat SPL are presented with the highlight of chemical treatment technology. Laboratory tests confirmed that SPL treatment model cannot be feasible and viable within partial solutions. The systemic solution can only concorde a wide range of contemporary demands. Partly the cause is the allotropic form of the produced carbon cathodes and partly also the impurities in the waste material that disable effective one phase treatment. Laboratory investigations of reactive leaching open the possibilities of material utilization of SPL widely. The preliminary inquiry confirms the interdisciplinary approach leads to open solutions possible to give products of market interest or value as the main goal of circular economy.

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Sol-gel Technique Of Obtaining Oxide Eutectic Sintering Aids For Silicon Carbide Ceramics

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Sol-gel technique has proved to be an efficient and simple method for producing nano-sized powders of both single and complex inorganic substances, in recent research it has also been found useful for obtaining powder batches with pre-designed composition[1]. The present research discusses a modification of this method used to make oxide eutectic compositions in $MgO-Al_2O_3-Y_2O_3$ (MAY) and $CaO-Al_2O_3-Y_2O_3$ (CAY) ternary oxide systems, which hold much promise as sintering aids for silicon carbide ceramics[2].

The aim of the research was to investigate the influence of various initial components on microstructure and phase composition of eutectic batches (oxide content, % wt.: 32.0 CaO, 37.0 Al_2O_3, 31.0 Y_2O_3, and 6.1 MgO, 43.0 Al_2O_3, 50.9 Y_2O_3; melting points 1675 and 1775 °C for CAY and MAY systems respectively). Eutectic batches were obtained from water solutions of crystallohydrate nitrates, sulphates and chlorides of respective metals. Gels were formed by adding water-soluble polymer (polyvinyl alcohol), and subjected to microwave drying, as suggested in[3]. Xerogels were calcined at 900 °C in air; sample phase composition and microstructure were studied by XRD and SEM.

Precurson anion is shown to have notable influence on powder microstructure, and to some extent – on phase composition. Powders derived from oxidizing media (nitrate and sulphate-based gels) had higher specific surface, more defect structure close to amorphous state, and were composed by poorly formed crystals. Chloride-based gels showed higher degree of structural and phase perfection, as seen by XRD and SEM results. Thus, a proper choice of starting materials allows to control and modify reactivity and sintering behavior of powders without compromising their properties.

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Gas-Surface Interactions after Various Treatments of a Stainless Steel Surface

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The nature of interactions between gas molecules and surfaces plays an important part in vacuum technology and metrology. Effective tangential momentum accommodation coefficient (ETMAC), defined as the relative change in tangential velocity of a particle after scattering from a surface, is often used to quantify these interactions. In this work, comparison of ETMAC values is presented after different treatments of a stainless steel surface. Here, the surface is that of a long cylindrical tube through which flow of different pure gases (He, Ne, CH_4, N_2, Ar, and Kr) is established. ETMAC was calculated directly from gas flow conductance of the tube in the molecular flow regime. Conductance was determined using pressure decay method, which is discussed elsewhere. First, ETMAC was determined for six gases on an electropolished surface with low roughness (Ra < 250 nm). Then, several treatments were done, after which ETMAC was up to 7 % lower, depending on the gas used. Finally, the tube was chemically etched in an acid solution, resulting in a macroscopically rougher surface (Ra = 630 nm), resulting in an increase in ETMAC of up to 12 % from electropolished values.

In spinning rotor gauges, pressure is determined from the deceleration rate of a free-floating spinning stainless steel sphere, where ETMAC is the parameter that needs to be calibrated. For comparison with the tube, ETMAC was determined for two rotor spheres in as-received condition, and again after same treatment steps, as done on the tube.

Results were found to be reproducible, and a strong dependence of ETMAC on the gas used was revealed.

Wear-Resistant Ceramics Based On Alumina With An Eutectic Modifier

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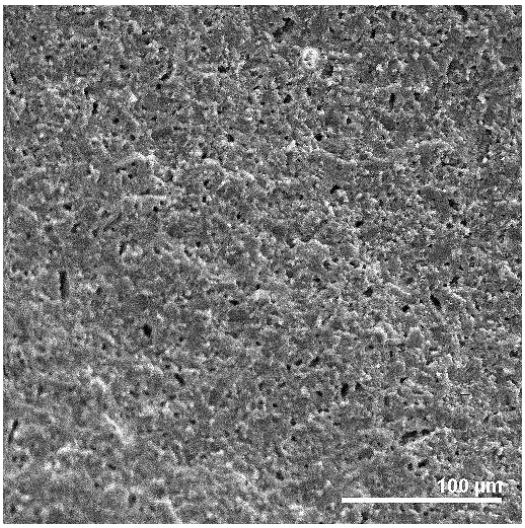
Alumina based ceramics due to high strength, hardness, wearability, crack and heat resistance are widely implemented for various applications. Wear resistance is greatly influenced by structure and phase composition of the material[1], and researchers aim at producing high-strength ceramics with reduced sintering temperature and fine fully crystalline structure. One of the possible routes here is to use eutectic sintering aids[2].

The present paper addresses an alumina-based ceramic material for milling bodies and a method for obtaining thereof. Starting materials were commercially available alumina and an eutectic additive in CaO-ZnO-Al_2O_3-SiO_2 system that was obtained by solid-state reaction. Sinterability of experimental batches was studied at 1350–1550 °C, and the limiting stage of the process was shown to be diffusion mass transfer through liquid phase. Samples fired at 1500 °C demonstrated excellent mechanical properties and highest degree of structure perfection (see Figure). Matrix phase was formed with corundum crystals with mean size of 4–6 μm, the additive segregated as a secondary crystalline phase on grain boundaries. Glassy phase content didn't exceed 1,5 % vol., and closed porosity was below 2 %.



Microstructure of alumina ceramics with eutectic sintering aid fired at 1500 °C in air

Mean density of such samples with alumina content of 87-95 % wt. reached 3.63 g/cm^3, and mean bending strength of 360 MPa. Wear tests in electrofused corundum milling showed weight loss below 0.01 %/h, which is 10 to 15 times less as compared with commercially available uralite milling bodies.

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Axial Powder Stream Characterization and Analysis towards Increasing Powder Catchment Efficiency in Direct Laser Deposition

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Direct laser deposition (DLD) of metal powder is an established and rapidly evolving additive manufacturing process. In the process, a laser beam is directed onto a surface of a metal workpiece to generate a melt pool into which a gas-carried metal powder stream is injected from a nozzle. By the workpiece feeding, a deposited layer is formed. Process efficiency and mechanical and metallurgical properties of the deposited layer depend besides the inherent process parameters also on the distribution of the gas-carried metal powder stream. In addition, a powder catchment efficiency (PCE), which is an important process characteristic, directly depends on the powder stream distribution at the workpiece surface. In order to maximize the PCE, one should be able to 1) characterize the powder stream distribution, 2) determine its influencing factors including nozzle geometry, process parameters, and powder properties, and 3) optimize the factor values. In this contribution, a new optical characterization method is presented, which Mertaparticles in the axially symmetrical powder stream. Employing this method, the influential factors of the powder stream diameter were studied in the case of powder stream emerging from a single discrete nozzle by using Taguchi's orthogonal arrays design of experiments. The influential factors studied were particle size, carrier gas volume flow, powder mass flow, and nozzle outlet divergence angle. As a result, the most influential factor was identified to be the nozzle outlet divergence angle, followed by the powder mass flow and particle size. The carrier gas volume flow showed almost no influence. Based on the presented results, guidelines for the powder stream diameter optimization are given, which would lead to increase of powder catchment efficiency in DLD process.

Calculation of Convective Heat Transfer Coefficient

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For temperature prediction models in metallic industry, the most often way is to measure temperature in the desired body at certain spots and instantaneously measure also temperature of the furnace wall or air or some other combined boundary condition. Since alloy thermal data are usually available, the only unknown parameter of model is heat transfer coefficient, assuming initial conditions and geometry of the system are known. In case of forced convection furnaces for heating aluminum alloys, convective heat transfer mechanism dominates. Supposing radiative and conductive heat transfer coefficients are constant, one can determine convective heat transfer using Implicit Extended Kalman Filter (IEKF). Stability is sufficient during transient reheating conditions, meanwhile in steady-state reheating conditions determination of conductive heat transfer coefficient using IEKF may be unstable.

The Analysis of the Microstructure of AZ31/AA1050/AA2519 Laminate Obtained by Explosive Welding Method

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Explosive welding is a solid state process used for the metallurgical joining of two or more dissimilar metals. In this process, energy of controlled detonations is utilized to accelerate one metal plate into another. As a result of collision, an atomic bond is formed. This paper describes a study of AZ31 magnesium alloy – AA1050 aluminium alloy – AA2519 aluminium alloy laminate. The test material was obtained by the method of explosive welding in direct configuration AZ31/AA2519 with the intermediate layer made of AA1050 alloy. The microstructure of the bonds was evaluated using light (LM), scanning electron (SEM) and transmission electron microscopes with SAED technique, while chemical composition was assessed using energy dispersive spectroscopy (EDS). It has been found that the bonding areas are characterized by a specific chemical composition and microstructure. Between joined materials, a strongly defected transition zones were formed and melted areas with altered chemical compositions were observed. It was also demonstrated that the explosive welding process has a significant impact on the microstructure of the welded plates due to formation of brittle intermetallic phases.

Study on Manufacturing and Characteristics of thermally Conductive Composite Sheet Using Graphite-polymer

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Electronic equipment that is being used recently automotive, electric electronic fields, etc. are being sought lighter, thinner, smaller, and multi-function. In particular, in small portable devices has increased the demand for weight reduction, the more heat is generating by the integration of the circuit. Flexible heat radiation composite material can be given to characteristic of the metal and the ceramic material while maintaining the advantages, such as flexibility, low cost, light weight, products in the form of a variety of conventional polymeric material as it is. We developed a graphite-polymer sheet for a development of a flexible sheet with excellent vertical thermal conductivity. To increase the vertical thermal conductivity with flexible, Folding Endurance according to the content ratio of the graphite and the binder was measured. Finally, vertical thermal conductivity increased through a process that eliminates the pores in the Graphite-polymer sheet. The binder is PVA that solid content is 10 %. By mixing the PVA and Graphite from 9:1 to 6:4 in the graphite-polymer sheet has produced. Graphite sheet has coated three times, and the thickness of the sheet was 150±10μm. Folding Endurance test result, the graphite and binder weight ratio is 7:3 was excellent on the graphite-polymer sheet. The vertical thermal conductivity of Graphite-polymer sheet is measured using a thermal conductivity analyzer (Thermocon M100, Han Tech), vertical thermal conductivity has measured on the thermal equilibrium 60 °C for 40minutes. Measurement results vertical thermal conductivity was 1.836W/mk. Because of the air gap with graphite interior and between the graphite and the graphite was limited to the thermal conductivity and determined that vertical thermal conductivity is not high enough. Improve the vertical thermal conductivity of graphite-polymer sheet, a gap has pressed by applying roll-pressing process. Vertical thermal conductivity of the compressed sheet thickness from 130 μm to 80 μm by roll-pressing process is 4.16W/mk. A flexible heat radiation sheet, that is, the graphite-polymer sheet can be applied efficiently to the heat radiation of the electronic circuit or the LED lamp.

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Combination of nano-indentation and electron channeling contrast imaging (ECCI) to understand the interaction of hydrogen and dislocations in a high-Mn TWIP steel

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Hydrogen embrittlement is one of the key problems for the application of high strength steels and, therefore, of high research interest. Nevertheless, a number of issues prevent from direct investigation of these mechanisms. First, hydrogen is practically invisible to most observation techniques and can, therefore, only be observed indirectly. As a consequence, it is usually not clear whether hydrogen interacts with dislocations, grain boundaries or other defects in a microstructure. Second, hydrogen is highly mobile in microstructures and may, therefore, quickly leave a material during an observation campaign.

The electron channelling contrast imaging (ECCI) technique applied in SEM may contribute to solve some of the problems, as it allows direct observation and quantification of lattice defects (dislocations, stacking faults, grain boundaries, elastic strain regions) close to the surface of bulk samples. The bulk nature of the sample allows keeping much larger hydrogen quantities in the material than TEM thin foils and it enables performance of (quasi) in-situ deformation experiments.

For our research we observed and quantified the formation of dislocations and stacking faults during nano indentation into a material with and without hydrogen charging. Different crystal orientations were selected from a polycrystal and 25 indentations were done in every crystal. The dislocation structures formed under these indents were quantitatively analysed in terms of number, curvature, and length. A very clear difference between samples with and without hydrogen was found and interpreted in terms of stacking fault energy and Peierls potential change.

High Efficiency of Renewable Energy Sources Through SPD-Processing of Bulk Nanostructured Solids

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Over the last two decades the processing method 'Severe Plastic Deformation–SPD' has impressively demonstrated that nanostructured materials with superior mechanical properties can be produced 'top-down' in bulk shape which cannot be achieved with traditional 'bottom-up' methods [1]. Now, the optimization of functional properties has been coming into the focus of the community's research [2, 5], not at least since outstanding successes were reached such as world-records in the figure-of-merit (ZT) of SPD-thermoelectrics [3, 5], and in the reproducibility in the hydrogen storage of SPD-processed hydrogen storage materials [4, 6]. Recent investigations suggest that a high density of SPD- induced lattice defects other than of classical grain boundaries can be equally or even more beneficial with respect to functional properties. For example, in case of thermoelectrics, SPD-induced dislocations and/or particular dislocation arrays seem to be most effective in increasing the ZT value. Also in case of soft magnetic materials, regular dislocation arrays from SPD which form low-angle zero-strain nanocrystal boundaries promise new low-coercivity and high-magnetostriction materials, while in case of hydrogen storage, thermally stable SPD-induced vacancy clusters seem to govern the formation / dissolution of the hydride phase [5, 6]. With the know-how to be obtained from systematic investigations, it should be possible to tailor specific defect structures on the nanoscale for optimum functional materials performances with very promising perspectives to practical application.

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Investigation of Desulfurization Unit Fan Blade Failure

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A catastrophic failure of nickel alloy fan blade from a flue-gas desulfurization (FGD) unit was investigated. Investigated blade broke after just 5 years of service. The fan had operated at 60 °C with 750 revolutions per minute at the time of failure. Due to the unusually short life time of the blade fractographic, metallographic (LM, SEM) and chemical analysis (XRF) together with impact toughness (KV) and hardness measurements (HV) were performed. Although the mechanical properties of the material such as impact toughness were satisfactory, the blade itself had metallurgical imperfections such as non-metallic inclusions and excessive shrinkage and gas porosity confirmed by SEM and EDS analysis. Unusual dimples were present on the surface of the broken blade, as well as on the other intact blades in the fan. The surface defects that led to the catastrophic failure were the result of improper production process that can be linked directly to the casting system. Surface defects (porosity) are unusual for castings, these were in fact defects that occurred in the riser and were exposed to the surface during the removal of utility casting system elements (riser).