Alkali activation of waste materials: sustainability and innovation in processing traditional ceramics

Serbian Ceramic Society Conference
ADVANCED CERAMICS AND APPLICATION VIII
New Frontiers in Multifunctional Material Science and Processing

Serbian Ceramic Society
Institute of Technical Sciences of SASA
Institute for Testing of Materials
Institute of Chemistry Technology and Metallurgy
Institute for Technology of Nuclear and Other Raw Mineral Materials

PROGRAM AND THE BOOK OF ABSTRACTS

Serbian Academy of Sciences and Arts, Knez Mihailova 35
Serbia, Belgrade, 23-25. September 2019.

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Dear Colleagues,

We have great pleasure to welcome you to the Advanced Ceramic and Application Conference VIII organized by the Serbian Ceramic Society in cooperation with the Institute of Technical Sciences of SASA, Institute of Chemistry Technology and Metallurgy, Institute for Technology of Nuclear and Other Raw Mineral Materials and Institute for Testing of Materials.

Advanced Ceramics today include many old-known ceramic materials produced through newly available processing techniques as well as broad range of the innovative compounds and composites, particularly with plastics and metals. Such developed new materials with improved performances already bring a new quality in the everyday life. The chosen Conference topics cover contributions from a fundamental theoretical research in advanced ceramics, computer-aided design and modeling of a new ceramics products, manufacturing of nanoceramic devices, developing of multifunctional ceramic processing routes, etc. Traditionally, ACA Conferences gather leading researchers, engineers, specialist, professors and PhD students trying to emphasizes the key achievements which will enable the wide speared use of the advanced ceramics products in High-Tech industry, renewable energy utilization, environmental efficiency, security, space technology, cultural heritage, etc.

Serbian Ceramic Society has been initiated in 1995/1996 and fully registered in 1997 as Yugoslav Ceramic Society, being strongly supported by American Ceramic Society. Since 2009, it has continued as Serbian Ceramic Society in accordance to the Serbian law procedure. Serbian Ceramic Society is almost the only one Ceramic Society in the South-East Europe, with members from more than 20 Institutes and Universities, active in 16 sessions, by program and the frames which are defined by the American Ceramic Society activities.

This year the conference is supported by the Serbian Chapter of American Ceramic Society and European Academy of Sciences and Arts.

Prof. Dr Vojislav Mitić
President of the Serbian Ceramic Society
World Academy Ceramics Member
European Academy of Sciences & Arts Member

Prof. Dr Olivera Milošević,
President of the General Assembly of the
Serbian Ceramic Society
Academy of Engineering Sciences of Serbia Member

Conference Topics

- Basic Ceramic Science & Sintering
- Nano-, Opto- & Bio-ceramics
- Modeling & Simulation
- Glass & Electro Ceramics
- Electrochemistry & Catalysis
- Magnetic & Refractory Ceramic
- Renewable Energy, Composites & Amorphous Ceramics
- Heritage, Art & Design

Conference Programme Chairs:

Dr. Lidija Mančić SRB
Dr. Nina Obradović SRB

Conference Co-chairs:

Prof. Dr. Vojislav Mitić SRB
Prof. Dr. Olivera Milošević SRB
Prof. Dr. Rainer Gadow GER
Prof. Dr. Marcel Van de Voorde EU

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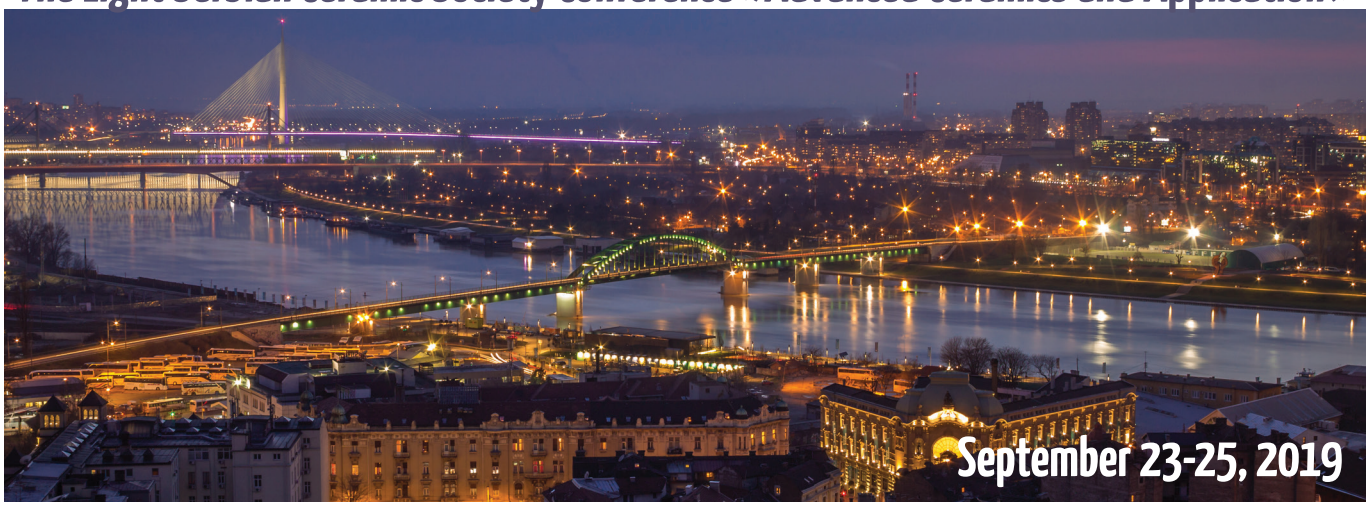
Conference Program and Abstracts

Program and Abstract's Contents

The Eight Serbian Ceramic Society Conference »Advanced Ceramics and Application«



Conference Information:

Conference venue: Serbian Academy of Sciences and Arts, Great Hall (second floor) and Halls 1, 2 (first floor), Knez Mihailova 35, Belgrade, Serbia
Conference fee: Standard fee for foreign participants: 200 EUR; Standard fee for domestic participants: 10000 RSD, Members of SCS, Keynote lecturers and PhD Students: 50% Discount; Invited lecturers have 40% Discount; Plenary lecturers & the last year winners for oral and poster presentations: Free of charge.
Invoice and bank details for Conference fee payment: Banka Intesa ad Beograd, Account No. 160-380150-55, notification: Conference fee – participant name.
Paying of the conference fee at site will be available only in cash.
Currency: The official currency in Serbia is dinar, abbreviated RSD. Money may be exchanged in all banks and authorized exchange offices. Exchange rate for 1 EUR is around 118 RSD. Cash may be taken from ATMs 24 hours a day. Credit cards are accepted in shops, hotels and restaurants.

Abstracts and papers publication: The official language of the conference is English. Conference abstracts will be published in the Book of Abstracts Conference. Papers presented at the conference can be submitted for publishing either in book or selected journals. More precisely, Serbian Ceramic Society and Springer Nature will publish each year one of Chapter book draw on the research and innovation presented at ACA Conferences in the frame of chosen topic. Beside, limited number of papers will be consider for publishing in following journals: Materials Chemistry and Physics, Journal of Ceramic Science and Technology and Science of Sintering.
Deadlines for submitting of full manuscripts will be delivered after the Conference.

Type of presentation: Visuals for oral presentations should be in Microsoft PowerPoint (.ppt or .pptx) or Adobe Acrobat Reader 9 (.pdf). Any animation or video files must be compatible with Windows 7 and Windows Media Player. Bring your presentation to reception desk at the beginning of the Conference on flash memory. Posters should be prepared in dimension: 70x100 cm. The official language on conference is English.

Additional Conference information
president@serbianceramicsociety.rs
http://www.serbianceramicsociety.rs/about.htm
Recommended places near the Conference venue:
Hotel: Hotel Palas, Topličin venac 23; http://www.palacehotel.co.rs/
Restaurant: Pivnica „Maxim 2“, Đure Jakšića 1, Belgrade (street beside conference venue)
Exchange office: „Hulk“, Vuka Karadžića 4
Tourist Information Centre: Knez Mihailova 5

Water: Tap water in Belgrade is safe to drink.

Program Overview

Date	Time	Programme		Floor, Room
September, 23, Monday	08.00-09.00	**Registration**		2nd Floor, Hall
	09.00-09.30	**Opening Ceremony**		2nd Floor, Great Hall
	09.30-09.40	**Short Break**		2nd Floor, Great Hall
	09.40-11.10	**Plenary Session 1**		2nd Floor, Great Hall
	11.10-11.30	**Coffee Break & Photo Session**		2nd Floor, Hal
	11.30-13.00	**Plenary Session 2**		2nd Floor, Great Hall
	13.00-15.00	**Buffet Lunch**		Club SASA
	15.00-16.30	**Plenary Session 3**		2nd Floor, Great Hall
	16.30-16.50	**Coffee Break**		2nd Floor, Hal
	16.50-18.05	**Keynote Session**		2nd Floor, Great Hall
	20.00	**Conference dinner (with invitations)**		
September, 24, Tuesday	08.00-09.00	**Registration** **Posters Installation**		Club SASA
	09.00-10.25	**Session: Basic Ceramic Science & Sintering** Hall 2		1st Floor
	10.25-10.45	**Coffee Break**		1st Floor, Hall
	10.45-13.00	**Session: Nano-, Opto- & Bio-Ceramic** Hall 2		1st Floor
	13.00-14.00	**Buffet Lunch**		Club SASA
	14.00-16.15	**Session: Magnetic Ceramic and Heritage, Art & Design** Hall 2		1st Floor
	16.15-16.30	**Coffee Break**		1st Floor, Hall
	16.30-18.00	**Poster Session**		Club SASA
September, 25, Wednesday	09.30-11.00	**Session: Electrochemistry & Catalysis Hall 1**	**Session: Glass & ElectroCeramics Hall 2**	1st Floor
	11.00-11.15	**Coffee Break**		
	11.15-12.35	**Session: Modeling & Simulation Hall 1**	**Session: Energy, Refractory, Cements Hall 2**	
	12.45-13.30	**Annual meeting of the Serbian Ceramic Society**		
	13.30-14.15	**American Ceramic Society Serbian Chapter Round Table**		
	14.15	**Buffet Lunch**		Maxim 2

Monday, September 23rd, 2019

08.00 – 09.00 **Registration** **Hall, 2nd Floor**

Great Hall, 2nd Floor

09.00 – 09.30 **Opening Ceremony of the Seventh Serbian Ceramic Society Conference: Advanced Ceramics and Application**

Prof.dr Vojislav Mitić, Dr. Olivera Milošević, Prof. Vladimir Pavlović, Dr. Dušan Jovanović, Marcel Van de Voorde, Branislav Brindić, President of SASA Academician Vladimir Kostić, Representatives of MNTR, High Representatives of the Government RS

09.30 - 09.40 **Short break**

Great Hall, 2nd Floor

09.40 – 11.10 **Plenary Session 1**

Chairpersons: Olivera Milošević, Eugene Medvedovski

09.40 – 10.10 **PL 1 Modification and Construction of Cathode Materials for Advanced Li-ion Batteries**

Cheng-Yu Wu, Hao Yang, Yang Wang, Yi-Chun Jin and Jenq-Gong Duh
Department of Material Sciences and Engineering,
National Tsing-Hua University, Hsinchu, Taiwan

10.10 – 10.40 **PL 2 Ceramics to metal joining for next generation power devices**

Katsuaki Suganuma
The Institute of Scientific and Industrial Research, Osaka University, Japan

10.40 - 11.10 **PL 3 Interface Engineering in Perovskite-based Nanocomplex Ceramics for High Dielectric & Piezoelectric Performances**

S. Wada[1], R. Kayanuma[1], Y. Isobe[1], K. Matsumoto[1],
S. Ueno[1], I. Fujii[1], C. Moriyoshi[2], Y. Kuroiwa[2]
[1]Material Science and Technology, University of Yamanashi,
4-4-37 Takeda, Kofu, Yamanashi 400-8510, Japan
[2]Department of Physical Science, Hiroshima University,
1-3-1 Kagamiyama, Higashi-Hiroshima, Hiroshima 739-8526, Japan

11.10 - 11.30 **Coffee Break and Photo Session** **Hall, 2nd Floor**

Great Hall, 2nd Floor

11.30 - 13.00 **Plenary Session 2**

Chairpersons: Walter Arnold, Vladimir Pavlovic

11.30 - 12.00 **PL 4 Advanced Ceramics and Coatings for Mineral and Oil & Gas Processing and Power Generation and the Technology Importance for Ceramic Manufacturing**

Eugene Medvedovski

Endurance Technologies Inc., Calgary, AB, Canada

12.00 - 12.30 **PL 5 Zirconia/Alumina Meta-Material for Biomedical Applications: Experience for Sintering and Real Practice**

S.Kulkov, A.Buyakov, D.Kulbakin and I.Kazantsev, A.Tsukanov

Tomsk State University, Institute of Strength Physics and Material Sciences RAS and Medical clinic

12.30 - 13.00 **PL 6 How first principles methods can be used to understand and predict the properties of microwave ceramic dielectrics**

Nathan Newman, Justin Gonzales and Chris Muhich

Materials Program, Arizona State University, Tempe, AZ

13.00 - 15.00 **Buffet Lunch** **Club SASA, Mezzanine**

Great Hall, 2nd Floor

15.00 - 16.30 **Plenary Session 3**

Chairpersons: Nathan Newman, Sergei Kulkov

15.00 - 15.30 **PL 7 Rare Earth Oxides as Environmentally-Friendly Corrosion Inhibitors**

William G. Fahrenholtz

Missouri University of Science and Technology

15.30 - 16.00 **PL 8 Near-Field Imaging Using Atomic Force Acoustic Microscopy**

Walter Arnold

I.Phys. Institut, Georg-August Universität Göttingen, Germany, and Department of Materials Science and Engineering, Saarland University,Saarbrücken, Germany

16.00 - 16.30 **PL 9 Learning from Nature: Strong, Tough and Lightweight Biological/Bio-inspired Ceramic-based Composites**

Po-Yu Chen

Department of Materials Science and Engineering National Tsing Hua University

16.30 - 16.50	**Coffee Break**	**Hall, 2nd Floor**

Hall, 2nd Floor

16.50 - 18.05 **Keynote Session**

Chairpersons: Satoshi Wada, Jenq-Gong Duh

16.50 - 17.15 **KN 1 Structural and Morphological study of $NaNbO_3$ nanostructure synthesized over metallic niobium**

Beatriz Canabarro[1], Paula Jardim[1]
[1]Department of Metallurgical and Materials Engineering,
FederalUniversity of Rio de Janeiro, Rio de Janeiro, Brazil

17.15 - 17.40 **KN 2 Multimaterials 3D printing: simplifying manufacturing and reducing costs**

Rouslan Svintsitski
3DCeram Sinto, Limoges, France

17.40 - 18.05 **KN 3 Bioinspired metal oxide nanomaterials for sustainable applications**

Ziqi Sun
ARC Future Fellow, Queensland University of Technology (QUT), Australia

20.00 **Conference dinner (with invitation)**

Tuesday, September 24th, 2019

08.00 - 09.00 **Registration / Posters and Exibition Installation** **Hall, 1st Floor**

Hall 2, 1st Floor

09.00 - 10.25 **Session: Basic Ceramic Science and Sintering**

Chairpersons: Nina Obradović

09.00 - 09.30 **PL 10 Processing and properties of structural and functional ceramics at Brno University of Technology**

K. Maca[1,2], K. Drdlikova[1], T. Spusta[1,2], V. Prajzler[1]
[1]CEITEC BUT, Brno University of Technology,
Purkynova 123, 612 00 Brno, Czech Republic
[2]Faculty of mechanical Engineering, Brno University of Technology,
Purkynova 123, 612 00 Brno, Czech Republic

09.30 – 09.50 **INV-BCS 1 Thermal thin film investigations via Time Domain Thermoreflectance method on Nb_2O_5**

Lisa Mitterhuber, Elke Kraker, Stefan Defregger
Materials Center Leoben Forschungs GmbH,
Rosseggerstraße 12, 8700 Leoben, Austria

09.50 - 10.10 **INV-BCS 2 Morphological and structural characterization of spinel $MgAl_2O_4$**

S. Filipović[1], N. Obradović[1], W. G. Fahrenholtz[2], B. A. Marinković[3],
J. Rogan[4], S. Lević[5], V. Pavlović[1]
[1]Institute of Technical Sciences of the Serbian Academy of Sciences and Arts,
11000 Belgrade, Serbia
[2]Materials Science and Engineering, Missouri University of Science and Technology,
Rolla, Missouri, United States
[3]Pontificia Universidade Catolica de Rio de Janeiro,
Dept. of Chemical and Materials Engineering, Rio de Janeiro, Brasil
[4]Department of General and Inorganic Chemistry,
Faculty of Technology and Metallurgy, University of Belgrade, 11120 Belgrade, Serbia
[5] Faculty of Agriculture University of Belgrade, 11000 Belgrade, Serbia

10.10 - 10.25 **ORL- BCS 1 The effect of heating rate on densification and grain growth during pressure-less sintering of fine grained alumina and zirconia ceramics**

Vladimír Prajzler[1], Tomáš Spusta[1], Karel Maca[1,2]
[1] CEITEC, Brno University of Technology, Purkyňova 123, 612 00 Brno, Czech Republic
[2] Faculty of Mechanical Engineering, Brno University of Technology,
Technická 2896/2, 616 69 Brno, Czech Republic

10.25 - 10.45 **Coffee Break** **Hall, 1st Floor**

Hall 2, 1st Floor

10.45 – 13.00 **Session: Nano-, Opto- & BioCeramic**

Chairpersons: Lidija Mančić

10.45 - 11.10 **KN 4 XRD-XRF-Raman-IR Combined Analysis: the EU H2020 SOLSA project**

Daniel Chateigner [1], Luca Lutterotti [2] and the SOLSA Consortium[3]
[1]Normandie Université, Université de Caen Normandie, CNRS-CRISMAT, France
[2]Department of Materials Engineering,Engineering Faculty, University of Trento, Italy
[3]http://www.solsa-mining.eu

11.10 - 11.35 **KN 5 Synthesis of Ce/Ru Doped ZnO photocatalysts to the degradation of emerging pollutants in wastewater**

G. Flores-Carrasco[1,2], M. Rodríguez-Peña[3], O. Milosevic[4], A. Urbieta[3], P. Fernández[3], M.E. Rabanal[1]
[1]Universidad Carlos III de Madrid & IAAB, Dept. of Materials Science and Engineering and Chemical Engineering, Avda. Universidad 30, 28911 Leganes, Madrid, Spain
[2]CIDS-ICUAP Benemérita Universidad Autónoma de Puebla, Av. San Claudio y 14 sur, Edif. 103C C.U., Col. San Manuel, Puebla 72570, México
[3]Departamento Física de Materiales, Fac. Ciencias Físicas, Universidad Complutense, Ciudad Universitaria, 280540 Madrid, Spain
[4]Institute of Technical Sciences of the Serbian Academy of Sciences and Arts, Knez Mihailova 35/IV, 11000 Belgrade, Serbia

11.35 - 12.00 **KN 6 Hydrothermal synthesis of the oxide powders**

Srecko Stopic, Bernd Friedrich
IME Process Metallurgy and Metal Recycling of the RWTH Aachen University, Germany

12.00 - 12.20 **INV-NOB 1 Dynamic tuning of quantum light emitted from atom-like defects in hexagonal boron nitride**

Snežana Lazić[1], Sergio Pinilla Yanguas[1], Carlos Gibaja[2], Pablo Ares[2], Félix Zamora[2] and Herko P. Van der Meulen[1]
[1]Departamento de Física de Materiales, Instituto "Nicolás Cabrera" and Instituto de Física de Materia Condensada (IFIMAC), UniversidadAutónoma de Madrid (UAM), 28049 Madrid, Spain
[2]Departamento de Química Inorgánica, UAM, 28049 Madrid, Spain

12.20 - 12.40 **INV-NOB 2 ZrO_2 Based Nanomaterials: Application in Photocatalysis**

Milica Carević, Tatjana Savić, Nadica Abazović and Mirjana Čomor
Vinča Institute of Nuclear Sciences, University of Belgrade, Belgrade, Serbia

12.40 - 13.00 **INV-NOB 3 Models and methods for testing the cells and tissues interactions with biomaterials**

Stevo Najman
University of Niš, Faculty of Medicine, Department of Biology and Human Genetics and Department for Cell and Tissue Engineering, 18000 Niš, Serbia

13.00 - 14.00 **Buffet Lunch** **Club SASA, Mezzanine**

Hall 2, 1st Floor

14.00 - 16.15 **Session: Magnetic Ceramic and Heritage, Art & Design**

Chairpersons: Snežana Lazić and Smilja Marković

14.00 - 14.30 **PL 11 Frequency and temperature dependent dielectric and magnetic properties of Manganese doped Cobalt ferrite nanoparticles**

F. A. Khan[1] and M. Z.Ahsan[2]
[1] Department of Physics, Bangladesh University of Engineering and Technology, Dhaka-1000, Bangladesh
[2] Department of Physics, Military Institute of Science and Technology Dhaka-1216, Bangladesh

14.30 - 14.55 **KN 7 New sustainable processing of RE-based magnetic materials**

Spomenka Kobe
Jožef Stefan Institute, Ljubljana, Slovenia

14.55 – 15.15 **INV-MC 1 How do preparation method and starch-encapsulation influence the magnetic properties of nanocrystalline cobalt ferrite?**

Ljubica Andjelković
Department of Chemistry, IChTM, University of Belgrade,
Studentski Trg 12-16, 11000, Belgrade

15.15- 15.30 **INV-MC 2 Ethyl cellulose based magnetic nanocomposite membranes**

Aleksandar Stajčić [1], Ivana Radović [2], Vladimir Dodevski[2],Vladan Ćosović[1], Jasna Stajić-Trošić[1], Miloš Vorkapić[1] and Dana Vasiljević-Radović[1]
[1]University of Belgrade, Institute of Chemistry, Technology and Metallurgy, Njegoševa 12, 11000 Belgrade, Serbia
[2]University of Belgrade, Vinca Institute of Nuclear Sciences, Laboratory for Materials Sciences, Mike Petrovića Alasa 12-14, P.O. Box 522, Belgrade 11000, Serbia

15.30 - 15.45 **ORL-HAD 1 Zlakusa hand-wheel pottery making as a cultural heritage and its protection**

Biljana Djordjević[1], Maja Milošević[2] and Mihovil Logar[2]
[1]National Museum in Belgrade, Serbia
[2]University of Belgrade, Faculty of Mining and Geology, Belgrade, Serbia

15.45 - 16.00 **ORL-HAD 2 Contextualizing the use of a ceramic vessel from Kostolac - Archaeoacoustic Analysis**

Dragan Novković[1], Aleksandra Nikolić[2], Zorana Đorđević[3]
[1] The School of Electrical and Computer Engineering of Applied Studies
[2] Central Institute for Conservation
[3] Institute for Multidisciplinary Research, University of Belgrade

16.00 - 16.15 **ORL-HAD 3 Interpretation of the Miniature Ceramic Artifacts**

Lidija Balj
Museum of Vojvodina, Dunavska 35, Novi Sad, Serbia

16.15 - 16.30	**Coffee Break**	**Hall, 1st Floor**

Club SASA, Mezzanine

16.30 - 18.00 **Poster Session**

Chairpersons: Suzana Filipović, Marina Vuković and Sandra Veljković

Wednesday, September, 25th, 2019

Hall 1, 1st Floor

09.30 - 11.00 **Session: Electrochemistry and Catalysis**

Chairpearsons: Predrag Banković

09.30 – 10.00 **PL 12 Ceramic-based catalysts as a sustainable solution for the challenges related to the critical raw materials (CRM)**

Zara Cherkezova-Zheleva
Institute of Catalysis, Bulgarian Academy of Sciences,
Acad. G. Bonchev St., Bldg. 11, 1113 Sofia, Bulgaria

10.00 - 10.15 **ORL- EC 1 Evaluation of the nickel state in Ni/BCY15 cermet - anode for proton conducting solid oxide fuel cell**

D. Nikolova[1], M. Gabrovska[1], E. Mladenova[2], D. Vladikova[2],
Y. Karakirova[1], Z. Stoynov[2]
[1]Institute of Catalysis, Bulgarian Academy of Sciences, Sofia, Bulgaria
[2]Acad. Evgeni Budevski Institute of Electrochemistry and Energy Systems,
Bulgarian Academy of Sciences, Sofia, Bulgaria

10.15 - 10.30 **ORL- EC 2 Bimetallic CuNi/BCY15 cermet anode for proton conducting solid oxide fuel cell**

M.Gabrovska[1], D. Nikolova[1], E. Mladenova[2], D. Vladikova[2], Z. Stoynov[2]
[1]Institute of Catalysis, Bulgarian Academy of Sciences,
Acad. G. Bonchev Str., Bldg. 11,1113 Sofia, Bulgaria
[2]Acad. Evgeni Budevski Institute of Electrochemistry and Energy Systems, Bulgarian Academy of Sciences, Acad. G. Bonchev Str., Bldg. 10, 1113 Sofia, Bulgaria

10.30 - 10.45 **ORL- EC 3 Cobalt impregnated natural and acid modified montmorillonite as catalysts in heterogeneous catalytic oxidation of nicotine in the presence of Oxone®**

I. Ilić[1], A. Milutinović-Nikolić[2], I. Gržetić[3], M. Ajduković[2],
B.Milovanović[4], T. Mudrinić[2], N. Jović-Jovičić[2]
[1]Institute of General and Physical Chemistry
Studentski trg 12/V, 11000 Belgrade, Serbia
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Center for Catalysis and Chemical Engineering, Njegoševa 12, 11000 Belgrade, Serbia
[3]University of Belgrade – Faculty of Chemistry,
Studentski trg 12-16, 11000 Belgrade, Serbia
[4]Alumina ltd., Karakaj, 75400 Zvornik, Bosnia and Herzegovina

10.45 – 11.00 **ORL-EC 4 Calcium oxide on coal fly ash cancrinite-type zeolite as a catalyst for biodiesel production**

Stefan Pavlović, Predrag Banković, Dalibor Marinković, Miroslav Stanković
University of Belgrade, Institute of Chemistry, Technology, and Metallurgy, Njegoševa 12,
11001 Belgrade

11.00 - 11.15 **Coffee Break** **Hall, 1st Floor**

Hall 1, 1st Floor

11.15 - 12.35 **Session: Modeling &Simulation**

Chairpersons: Zara Cherkezova-Zheleva

11.15 - 11.40 **KN 9 Systematic investigation of grain aggregation induced by neck evolution under sintering conditions**

Zoran S. Nikolić
University of Niš, 18000 Niš, Univerzitetski trg 2, Serbia

11.40 - 12.00 **INV-MS 1 Theoretical and experimental study of multiferroics $BiFeO_3$ and $Bi_{(1-x)}Ho_xFeO_3$**

Maria Čebela[1,2], Pavla Šenjug[2], Filip Torić[2], Teodoro Klaser[2], Željko Skoko[2], Dejan Zagorac[1] and Damir Pajić[2]
[1] Institute for Nuclear sciences "Vinča", University of Belgrade, Serbia
[2]Department of Physics, Faculty of Science, University of Zagreb, Bijenička c. 32, HR-10000 Zagreb, Croatia

12.00 - 12.20 **INV- MS 2 Brownian fractal motion and energy effect on microorganism's fluctuation**

Goran Lazovic[1], Vojislav V. Mitic[2,3], Dusan Milosevic[2]
[1]Faculty of Mechanical Engineering University of Belgrade, Serbia
[2] Faculty of Electronic Engineering University Nis, Serbia
[3] Institute Technical Sciences of SASA, Belgrade, Serbia

12.20 - 12.35 **INV- MS 3 Graph theory applied to modeling and simulation of microstructure evolution in sintering**

Branislav M. Randjelović and Zoran S. Nikolić
University of Niš, Faculty of Electronic Engineering,
Aleksandra Medvedeva 14, 18000 Niš, Serbia

14.15 **Buffet Lunch** **Maxim 2**

Hall 2, 1st Floor

09.30 - 10.55 **Session: Glass & ElectroCeramics**

Chairpearsons: Spomenka Kobe

09.30 – 09.55 **KN 8 Alkali activation of waste materials: sustainability and innovation in processing traditional ceramics**

Bartolomeo Coppola, Paola Palmero, Jean-Marc Tulliani, Laura Montanaro
Politecnico di Torino, Department of Applied Science and Technology,
Corso Duca Degli Abruzzi, 24, Italy

09.55 - 10.15 **INV- GE 1 High sensitivity characterization of the nonlinear electric susceptibility of glasses and glass-ceramics in the microwave range**

Florian Bergmann[1], Martin Letz[1], Holger Maune[2], Gerhard Jakob[3]
[1] Schott AG, Mainz, Germany
[2] Technische Universität Darmstadt, Darmstadt, Germany
[3] Johannes Gutenberg Universität Mainz, Mainz, Germany

10.15 - 10.35 **INV-GE 2 The $BaTiO_3$ ferroelectric properties within the microscale fractal nature**

Vojislav V. Mitic [1,2], Goran Lazovic [3], Chun-An Lu [4], Vesna Paunovic [1], Sandra Veljkovic [1], Nathan Newman [5], Branislav Vlahovic [6]
[1]University of Nis, Faculty of Electronic Engineering, Nis, Serbia;
[2]Institute of Technical Sciences of SASA, Belgrade, Serbia;
[3]University of Belgrade, Faculty of Mechanical Engineering, Belgrade, Serbia
[4]Industrial Technology Research Institute, Taiwan
[5]Arizona State University, Chemical and Materials Engineering (MACME), USA
[6]North Carolina Central University, USA

10.35 - 10.55 **INV-GE 3 Synthesis, characterization and application of activated carbon materials obtained from biowaste**

Vladimir Dodevski[1], Bojan Janković[2], Ivana Radović[1], Milan Kragović[1], Marija Stojmenović[1]
[1]University of Belgrade, Institute of Nuclear Sciences "Vinča", Laboratory for Materials Sciences, Mike Petrovića Alasa 12-14, P.O. Box 522, 11001 Belgrade, Serbia
[2]University of Belgrade, Institute of Nuclear Sciences "Vinča", Department of Physical Chemistry, Mike Petrovića Alasa 12-14, P.O. Box 522, 11001 Belgrade, Serbia

11.00 - 11.15 **Coffee Break** **Hall, 1st Floor**

Hall 2, 1st Floor

11.15 - 12.20 **Session: Energy, Refractory, Cements**

Chairpersons: Bartolomeo Coppola

11.15 - 11.35 **INV-ERC 1 Processing of metal-ceramic composites by Spark Plasma Sintering: application to bulk composites and joining purposes**

Dina V. Dudina[1, 2, 3, 4*], Tomila M. Vidyuk[2,5], Michail A. Korchagin[2, 3], Maksim A. Esikov[1,3], Vyacheslav I. Mali[1], Alexander G. Anisimov[1]
[1] Lavrentyev Institute of Hydrodynamics SB RAS, Lavrentyev Ave. 15, Novosibirsk, 630090, Russia
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[5]Khristianovich Institute of Theoretical and Applied Mechanics SB RAS, Institutskaya str. 4/1, 630090 Novosibirsk, Russia

11.35 - 11.50 **ORL-ERC 1 Amidoxime-based Polymers for Extraction of Uranium from Seawater**

Sinisa Vuković
Deloitte AI Insights, 22 Adelaide St, Toronto ON M5H 0A9 Canada

11.50 - 12.05 **ORL-ERC 2 Synthesis and thermal phase evolution assessment of advanced Barium-Magnesium-Alumino-Silicate powders**

Mariano Casas-Luna[1], Simona Ravaszová[2], David Jech[1], Karel Dvorak[2], Ladislav Celko[1]
[1]Central European Institute of Technology - Brno University of Technology, Brno, Czech Republic
[2]Brno University of Technology, Faculty of Civil Engineering, Institute of Technology of Building Materials and Components, Brno, Czech Republic

12.05 - 12.20 **ORL- ERC 3 Dust particles in low-pressure hydrocarbon plasmas plasmas: mechanisms of formation and suppression of formation**

O. Stepanović
Harder Digital Sova d.o.o. Niš, Serbia

12.45 - 13.30 **Annual meeting of the Serbian Ceramic Society**

13.30 - 14.15 **American Ceramic Society Serbian Chapter Round Table**

14.15 **Buffet Lunch** **Maxim 2**

Book of Abstracts

PL 1

Modificationand Construction of Cathode Materialsfor Advanced Li-ion Batteries

Cheng-Yu Wu, Hao Yang, Yang Wang, Yi-Chun Jinand, Jenq-Gong Duh
Department of Material Sciences and Engineering,
National Tsing-Hua University, Hsinchu, Taiwan

Owing to the continuous environmental degradation, much attention is paid to develop technologies that can provide better conditions for all life forms, thus improving human's environmental consciousness. Therefore, the design of renewable energy systems with energy storage devices has received much attention in recent years. For the state of the art in energy storage, lithium-ion batteries (LIBs) are the most concerned system due to its high energy density and power density.The most common commercialized LIBs consistofanode materials, cathode materials and the electrolyte of liquid solution. Among them, the development of cathode materials is the most important, which governs the capacity and working voltage of the overall battery.Inpast decades, many cathode materials in lithium ion battery have been developed in our lab, such as $LiNi_{0.5}Mn_{1.5}O_4$with high voltage characteristics and $LiMnPO_4$ with high safety and $LiNi_{0.5}Mn_{0.3}Co_{0.2}O_2$ layer-structured with high energy density.Nevertheless, some problems with these types of material remain to be resolved.Herein, the ceramic powders of$LiNi_{0.5}Mn_{1.5}O_4$and $LiMnPO_4$ have been successfully modified recently in our lab. To enhance the rate capability, the polymer-assisted method was incorporated to control the particle size of pristine $LiNi_{0.5}Mn_{1.5}O_4$, leading to a higher theoretical capacity, easier synthesis process, high voltage and relatively lower price than that of commercial $LiCoO_2$ system. On the other hand, through intrinsic/extrinsic modification of $LiMnPO_4$ cathode with Fe, Ni and C, a superior electrochemical performance could be demonstrated in half lithium ion battery.

In addition, in order to meet the application of electric vehicles (EVs), a new concept of ceramic based thin film batteries also have become an essential subject. The highly textured $LiNi_{0.5}Mn_{0.3}Co_{0.2}O_2$ thin films with c-axis (003) preferred orientation were successfully fabricatedonto the in-situ annealed Pt (111) reconstructed buffer substrate, which provides the better conductivity and crystallinity to benefit the cycling stability. It ishoped that through theseefforts the development of cathode materials would exhibit a great potential to meet the demand of next generation high power Li-ion battery.

PL 2

Ceramics to metal joining for next generation power devices

K. Suganuma
The Institute of Scientific and Industrial Research,
Osaka University, Japan

Joining ceramics to dissimilar materials is one of the essential technologies for the application of ceramics. Ceramic substrates as insulators of electronic circuits have been widely applied in the field of high power electronics as well as high frequency devices. As the next generation of transportation systems including vehicles, airplanes, and ships, are moving towards more efficient and higher electric energy density, the electric control with wide bandgap power semiconductors such as SiC/GaN has been expected to provide many benefits such as energy saving, increasing power density, shrinkage of power module, and long life time.On the other hand, the increasing power density leads temperature increase beyond 200 degree C at the semiconductor junctions. According to this abrupt temperature rise, a new technology both for joining ceramics/metalsand for thermal management is required to be established.It was found that DBAs of AlN, Si_3N_4 and Al_2O_3 can survive even in severe thermal shock test. Severe metal surface deformation is the cause of serious degradation of the assembly. The properties of surface plating have a key to suppress this surface deformation. A nondestructive inspection method has been proposed to understand the degradation of module during thermal cycling.

PL 3
Interface Engineering in Perovskite-based Nano-complex Ceramics for High Dielectric & Piezoelectric Performances

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For next-generation material science, interface engineering is very key issue, and it can be expected that new phenomena and enhanced properties are originated from interface with structure gradient region. Recently, a new technique was proposed to prepare nano-structured ceramics with heteroepitaxial interfaces between barium titanate ($BaTiO_3$, BT) and potassium niobate ($KNbO_3$, KN) prepared at low temperatures below 300 ˚C, and their dielectric and piezoelectric properties were enhanced because of their heteroepitaxial interfaces. To explain the above results, we proposed the following hypothesis, i.e., KN had larger cell volume by 0.5 % than that of BT, and BT unit cell was expanded by epitaxial junction with KN. The origin of high dielectric property of BT is considered of the large converse displacement between the Ti^{4+} ion and the O^{2-} ion octahedron. This is because in the BT unit cell, there is very space in the surrounding Ti^{4+} ion. Thus, anisotropic expansion of BT unit cell can lead to enhancement dielectric properties. On the other hand, bismuth ferrite ($BiFeO_3$, BF) had smaller unit cell volume by 1 % than that of BT. Therefore, we expected that the BT unit cell can be compressed and their dielectric properties for the BT-BF nano-structured ceramics were quite smaller than those for the BT-KN nano-structured ceramics. To confirm the above idea, we prepared BT-KN and BT-BF nano-structured ceramics were prepared by solvothermal method in this study, and their dielectric properties were compared on the view of unit cell volume change of BT. After the reaction, the compacts were washed by ethanol, and dried at 200 ˚C. The density of the compacts was again measured by the Archimedes method, and the crystal structure of the compact was investigated by XRD. The microstructure was observed using scanning electron microscopy (SEM) and transmittance electron microscope (TEM). For electric measurements, the ceramics were polished and cut into a size of 2x2x0.5 mm^3. Gold electrodes were sputtered on the top and bottom surfaces with an area of 2x2 mm^2. The dielectric properties were measured at various frequencies from 40 Hz to 10 MHz from 20 to 480 ˚C using an impedance analyzer (Agilent, HP4294A). The strain vs. electric-field (*S*-*E*) curves were measured at room temperature and 0.1 Hz using a ferroelectric character evaluation system, and a slope of the *S*-*E* curve was regarded as an apparent piezoelectric constant (d_{33}^*). These nano-complex ceramics prepared in this study were porous with a porosity of around 25 ~ 35 %. The dielectric measurements showed that for the BT-KN nano- structured ceramics with KN/BT ratio of 1, the dielectric constant was 300 at 20 ˚C and 1 MHz, while for the BT-BF nano-complex ceramics with BF/BT ratio of 1, the dielectric constant was 70 at 20 ˚C and 1 MHz. The strain vs. electric-field curves were also measured for these ceramics, and it was found that the apparent d_{33}* estimated from its slope of the strain vs. electric-field curves was almost 100 pm/V for the BT-KN nano-complex ceramics, while the apparent d_{33}* for the BT-BF nano-complex ceramics was less than 20 pm/V. To explain the results, we proposed structure-gradient region (SGR) model dependent of lattice mismatch and material hardness.

PL 4

Advanced Ceramics and Coatings for Mineral and Oil & Gas Processing and Power Generation and the Technology Importance for Ceramic Manufacturing

Eugene Medvedovski
Endurance Technologies Inc., Calgary, AB, Canada

The use of advanced ceramics, composites and coatings in the mineral, metallurgical, oil & gas, chemical processing and power generation constantly grows owing to the development of advanced materials with improved properties and their technologies according to particular application requirements. The materials include oxide and non-oxide ceramics, ceramic-ceramic and ceramic-metal composites, coatings on metallic components when functional application properties can be achieved. Some principles of selection and manufacturing of these materials are considered. The examples of the successful development and processing of wear, corrosion and thermal shock resistant ceramics, coatings and composites (e.g. fine grained materials or materials with specially designed grain sizes and phase distribution) will be discussed. The particular demands for advanced materials with high reliability and complex shapes or for coatings on complex shape steel components and long tubing with inner surface protection for a variety of applications require novel and optimized processing. Starting materials selection (from nano- to even hundreds micron particles with special particle size distributions), colloidal processing and forming method selection and development allow directional managing to obtain the required shapes, appropriate consolidation at thermal treatment and, finally, desirable ceramic or coating structure, properties and reliability of products. Some examples of the technology importance on the industrial components for mineral processing and power generation will be discussed.

PL 5

Zirconia/Alumina Meta-Material for Biomedical Applications: Experience for Sintering and Real Practice

S.Kulkov, A.Buyakov, D.Kulbakin and I.Kazantsev, A.Tsukanov
Tomsk State University, Institute of Strength Physics and Material Sciences RAS and Medical clinic

It has been studied a porous ceramics sintered from nanopowders obtained by plasma spray technique. The porosity of ceramic was up to 75 %. The aim of the work is the investigation of densification, structure and mechanical properties of materials based on zirconia-based powders produced by plasma spray synthesis and sintered at different temperatures.

It has been shown that structure of the sintered ceramic has a system of cell and rod elements. These structures formed by stacking hollow powder particles. There were three types of pores in ceramics: large cellular hollow spaces, small interparticle pores which are not filled with powder particles and the smallest pores in the shells of cells. The cells generally did not have regular shapes.

The size of the interior of the cells many times exceeded the thickness of the walls which was a single-layer packing grains. The increase of the pore space in the ceramics was accompanied by the decrease of the average size of voids inside the cells and the average grain size.

The stress-strain diagrams for ceramics with porosity higher than 20 % are non-liner, and sintered ceramic with a high porosity has a very similar behavior as compare with natural bone and can be used as perspective material for bone replacement.

These material already used for real medical practice. The application of the developed method of ceramic frame prelamination in microsurgical flaps can be widely used in reconstructive and plastic surgery of complex anatomical defects.

PL 6

How first principles methods can be used to understand and predict the properties of microwave ceramic dielectrics

Nathan Newman, Justin Gonzales and Chris Muhich
Materials Program, Arizona State University,
Tempe, AZ

Miniaturization of microwave systems requires low-loss temperature-compensated ceramics with enhanced dielectric constants. Despite their practical importance, a lack of a strong fundamental understanding of the mechanisms has prevented the development of accurate quantitative predictions of the microwave dielectric properties.

I will review the experimental and theoretical work that can be used to accurately predict the microwave dielectric constant, the loss tangent and the temperature coefficient of resonant frequency of commonly-used host microwave dielectric compounds (e.g. niobate and tantalate perovskites), as well as when doped with the most common impurities in commercial microwave dielectrics(e.g. Ni, Co, Mn, Zr). I will also describe how this understanding has allowed us to engineer switchable ultra-high Q dielectric microwave resonators and filters that be turned from a low-loss "on" state to a high-loss "off" state at small magnetic fields.

PL 7

Rare Earth Oxides as Environmentally-Friendly Corrosion Inhibitors

William G. Fahrenholtz
Missouri University of Science and Technology

The goal of this research was to use rare-earth compounds to replace chromates, cadmium, and other toxic materials that are widely used for corrosion protection of structural metal alloys. This presentation will review research from our group on the use of abundant rare-earth materials and other environmentally-friendly coatings for corrosion protection applications. Three different research areas will be discussed in which coatings containing hazardous compounds were replaced to reduce the environmental impact by eliminating sources of hazardous waste. The deposition mechanisms and corrosion inhibition mechanisms for cerium-based conversion coatings will be discussed with emphasis on electrochemical interactions in the near-surface region. The second coating type is epoxy-polyamide primers in which a praseodymium-based inhibitor has replaced chromates. Research revealed that the coatings protect by a dissolution-reprecipitation mechanism driven by local electrochemistry. Finally, research on replacement of cadmium from aerospace electrical connectors will be discussed. In this case, coatings based on zinc-nickel alloys that utilize a passivating layer were examined. The presentation will also describe the commercialization of these technologies.

PL 8

Near-Field Imaging Using Atomic Force Acoustic Microscopy

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Phys. Institut, Georg-August Universität Göttingen, Germany, and
Department of Materials Science and Engineering, Saarland University, Saarbrücken,Germany

Ultrasound is combined with atomic force microscopy to achieve the lateral resolution of scanning probetechniques for ultrasonic imaging and quantitative local measurement of elasticity and damping. Atomic force acoustic microscopy (AFAM) exploits the vibrational modes of AFM cantilevers which range from 10 kHz to several MHz. In these modes the cantilever vibrates in contact mode in one of its flexural or torsional resonances. Images can be obtained with the contrast depending on the local indentation modulus, M, and the local damping Q^{-1}. The latter is composed of the tip-sample surface friction and the internal friction in the contact zone. The lateral resolution is defined by the tip-sample contact radius $a_c \approx$ 10 nm or less.The AFAM technique allows also measuring$M$and Q^{-1}quantitatively.

Data will be presented formetallic glasses, for metals with a pronounced microstructure, for a $La_{0.6}Sr_{0.4}MnO_3$ (LSMO) thin film, for nanocrystalline materials, and for piezo-and ferroelectric ceramics. In the latter, the interrelated local elastic properties and the ferroelectric domain configuration will be presented experimentally and theoretically.

PL 9

Learning from Nature: Strong, Tough and Lightweight Biological/Bio-inspired Ceramic-based Composites

Po-Yu Chen
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Department of Materials Science and Engineering
National Tsing Hua University

Most natural materials are composites whose mechanical properties are often outstanding, considering the weak constituents from which they are assembled. These biological composites, which have risen from hundreds of million years of evolution, are inspiring scientists and engineers in the design of novel materials. In this talk, the Materials Science and Engineering approach is applied to elucidate the structure-property-function relationship of selected ceramic-based biological materials investigated in our group, such as abalone shells, antlers, alligator/armadillo osteoderms, reptilian eggshells, and cuttlebone. The intricate and ingenious hierarchical structures as well as organic/inorganic interfaces are responsible for the outstanding mechanical performance, especially toughness, of biological composites. Toughening mechanisms, such as crack deflection/twist, collagen fiber bridging, uncracked ligament bridging, micro-crack formation, interlocking sutures, are observed and discussed. Several novel concepts and approaches to synthesize bio-inspired ceramic/polymer composites are illustrated. For example, abalone nacre-inspired ceramic/polymer multilayer coatings are synthesized by a hybrid sputtering/PLD system. Cuttlebone-inspired ceramic scaffold and ceramic/polymer composites are fabricated by freeze casting and polymerization. Learning from Nature can overcome the limitation of materials and lead to novel designs and synthesis of bio-inspired composites with exceptional performance and multifunctionality.

PL 10

Processing and properties of structural and functional ceramics at Brno University of Technology

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In the first part of the presentation, the newly established research centre CEITEC BUT (Central European Institute of Technology, Brno University of Technology) will be introduced with special attention paid to the activities of Advanced Ceramic Materials research group. The research projects of this group are focused on basic and applied science in the field of structural (e.g. transparent and non-transparent ceramics armours for ballistic and high-temperature applications, ceramics prepared exploiting plasma treatment of ceramic powders and by rapid sintering) and functional (e.g. lead-free piezoceramics, multiferroics, transparent luminescent ceramics). In the second part of the presentation the newest results in the field of luminescent transparent alumina ceramics and rapid sintering of alumina and zirconia ceramics will be discussed in details.

This work is a part of the project 5SA14857, that has received funding from the European Union's Horizon 2020 research and innovation programme under the Marie Skłodowska-Curie Action and it is co-financed by the South Moravian Region under grant agreement No. 665860. The authors also acknowledge the support of the Ministry of Education, Youth and Sports (MEYS) of the Czech Republic under grant no. LTT18013. The research has also been financially supported by the MEYS of the Czech Republic under the project CEITEC 2020 (LQ1601).

PL 11

Frequency and temperature dependent dielectric and magnetic propertiesof Manganese doped Cobalt ferrite nanoparticles

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This paper reports the series of investigation on the temperature dependent dielectric properties of Manganese doped $Co_{1+x}Mn_xFe_{2-x}O_4$ nanoparticles. The investigated samples were prepared via solid state reaction route using planetary ball milling technique for different time duration.The relative dielectric constant and D-factor of the investigated samples are presented in figure-1 as a function of frequency in logarithmic scale.The nature of variation of relative dielectric constant of the investigated sample at x = 0.375 and x = 0.5 with the increase of frequency demonstrates the normal behavior for selected temperature 77K and 300K as seen from figure-1(a) and 1(b). However, the relaxation single peaks are noticed at 100 kHz for selected temperature 148K, 165K and 236K, which mark the ferrimagnetic to ferromagnetic transition. This transition may have originated from the dominance of anisotropy energy at low temperature.The values of relative dielectric constant for both the samples are found to be higher than that at the room temperature, which show the relative dielectric constant to be strongly dependent on temperature.The values of D-factor for both the samples are observed to be much lower in the low temperature region (below room temperature) and exhibiting the normal variation with the increase of frequency The higher values of relative dielectric

constant makes the samples suitable to be used in the space born applications. The magneto-impedance have shown a mixed metallic and semiconducting behavior at different frequency regime. Compared to bulk samples a significant change in the magnetoelectric properties have been observed which is assumed to be due to the nanocrystalline structure of the material.

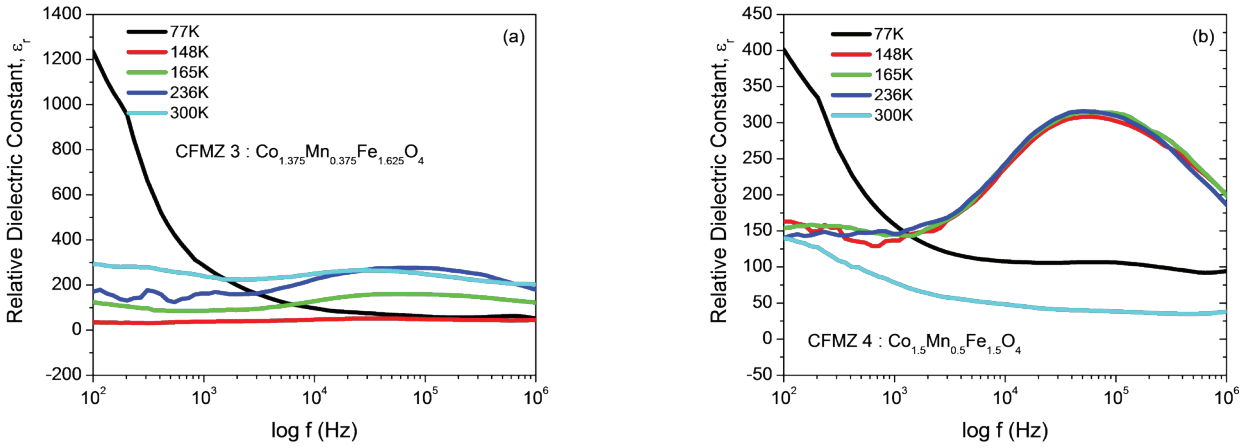

Figure-1: Relative dielectric constant of $Co_{1+x}Mn_xFe_{2-x}O_4$ for (a) x=0.375 (b) x=0.5

PL 12

Ceramic-based catalysts as a sustainable solution for the challenges related to the critical raw materials (CRM)

Zara Cherkezova-Zheleva

Institute of Catalysis, Bulgarian Academy of Sciences, Acad. G. Bonchev St., Bldg. 11, 1113 Sofia, Bulgaria

What is the criticality of some raw materials in regards of EU perspective? Criticality assessment and the strategy of EU Commission will be discussed. The problem solutions include design of advanced CRM-free or low content materials, together with CRM rational use, enhanced recycling and sustainable mining.

Heterogeneous catalysts are advanced high-technology materials that often contain one or more CRM such as Cr, rare earths and platinum group metals, etc. Application of ceramics in catalysis is a large and growing field of research and innovations. However ceramics have also a great potential in partial or complete substitution of traditional catalysts, based on CRMs. Ceramic-based catalytic materials are a key factor in preparation of non-CRM or ultra-low CRM-contained catalysts both as an active catalytic substance and as a support of catalytically active phase. The research activities in this fast-moving area are focused on the development of new concepts for design and synthesis of non-CRM catalysts with the same or better activity and selectivity compared to the current ones. Improvement of full material life-cycle of obtained non-CRM catalysts together with better recycling, reuse and repair of CRM-based catalysts are open areas for new ideas, scientific and innovative projects.

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KN 1

Structural and Morphological study of $NaNbO_3$ nanostructure synthesized over metallic niobium

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Sodium niobate has gained scientific attention due to its properties as semiconductivity, piezoelectricity, and photoactivity, that combined can be used as a piezo phototronic device. Motivated by the potential efficiency improvement, this material can be synthesized in the nanoscale by alkali hydrothermal route followed by heat treatment. In this study, it was used metallic niobium as a substrate and also as a precursor to obtaining the oriented growth of sodium niobate nanocrystals. In order to use this system composed by a nanostructured layer of $NaNbO_3$ supported on metallic niobium as a possible piezo phototronic device, it is necessary to understand its nanostructure organization. Structural and morphological properties of sodium niobate nanostructure were obtained using X-ray powder diffraction (XRPD), scanning and transmission electron microscopy (SEM/TEM) and the $NaNbO_3$/Nb interface was analyzed by energy dispersive X-ray spectroscopy (EDX) of a lamella cut by focused ion beam (FIB). The results revealed the formation of 1D nanostructured orthorhombic perovskite $NaNbO_3$ ($P2_1ma$). Electron tomography analyses showed that the dimensions and morphology (nanowires or nanoribbons) of the 1D nanocrystals could change depending on the synthesis conditions. Combining TEM images and electron diffraction of nanowires and nanoribbons scrapped off from the substrate, it was possible to determine the crystallographic growth direction. EDX mapping of FIB lamella revealed the presence of Nb_2O_5 at the $NaNbO_3$/Nb interface.

KN 2

Multimaterials 3D printing: simplifying manufacturing and reducing costs

Rouslan Svintsitski
3DCeramSinto, Limoges, France

3D printing lets users push back production limits. Ceramics are no exception to the rule. To open up this technology to a wider spread of professionals 3DCeram is sharing its maker experience to propose multi-material solutions. Thus the new Ceramaker Hybrid is able to print several materials at the same time and can manufacture smart design parts.

Since more than 10 years, 3DCeram pioneered the application of 3D printing of ceramics. 3DCeram launched a new ceramic 3D printer with a native resolution of 30 μm, which will complete its innovative offer:

- Turnkey 3D printing ceramic Lines including Ceramaker printers and all associated services.
- Ceramic 3Dmix dedicated to the CERAMAKER printer and on demand formulations: development based on YOUR ceramic.
- On-demand 3D printing production. High quality parts, made of 3DMix ceramic pastes developed by 3DCeram.

KN 3

Bioinspired metal oxide nanomaterials for sustainable applications

Ziqi Sun
ARC Future Fellow, Queensland University of Technology (QUT), Australia

Learning from nature takes ideas from natural species to develop novel functional materials. Based on this concept, bio-inorganic materials (biomineralization), bio-inspired structured materials, bio-nanomaterials, hybrid organic/inorganic implant materials (bonelike composites), and smart biomaterials have been developed. In our research, by mimicking the well-ordered multiscale structures of natural interfaces or surfaces, many inorganic nanomaterials with bio-inspired structures and functions have been designed. For example, we designed fly-eye inspired superhydrophobic anti-fogging nanomaterials that have a low adherence force to water droplets and thus resist fogging-induced ice build-up even when exposed in extreme environments. The development of the fish-scale bio-inspired inorganic nanostructures, which have similar multiscale structures and multiple-functions to that of the natural targets, greatly extends the applications of bio-inspired materials to fields from micromechanical devices to heavy-duty machines as protective coatings against mechanical damage and chemical corrosion, as optical elements in optical devices and photovoltaic energies, and as low-drag or low-friction surfaces in gaseous, liquid, and solid media, etc. Therefore, we believe that the design of bio-inspired nanostructures could provide a new approach for develop novel multifunctional nanomaterials in the future.

KN 4

XRD-XRF-Raman-IRCombined Analysis: the EU H2020 SOLSA project

Daniel Chateigner[1], Luca Lutterotti[2] and the SOLSA Consortium[3]
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[2]Department of MaterialsEngineering,EngineeringFaculty, University of Trento, 38123 Trento, Italy
[3]http://www.solsa-mining.eu

The SOLSA project aims to construct an analytical expert system for on-line-on-mine-real-time mineralogical and geochemical analyses on sonic drilled cores, an unprecedented challenge both in terms of instrumental, methodological and software developments.

Two instrumental developments will be carried out during this European project, one at the laboratory scale (ID1) deserving methodological testing and the other at the operational on-mine scale (ID2). At present, only ID1 is achieved for first tests. This instrument will perform simultaneously x-ray diffraction experiments, coupled to x-ray fluorescence, Raman and IR spectroscopies. It consists in a 4-circles diffractometer equipped with a curved position sensitive detector and a Cu microsource, a fluorescence detector, and an innovative system of fiber optics and mirrors to achieve Raman and IR probing. All the four experiments will be able to probe a flat surface sample within approximately the same sampled volume.

In order to benefit of the complementarity of the four techniques, an expert system able to refine all datasets has to be developed. For the x-ray diffraction and fluorescence parts, the actual Combined Analysis methodology is operational for structure, microstructure, texture, stress, phases and element analyses. Complementing the Combined Analysis approach by Raman and IR spectroscopies is targeted in this project to help phase identifications and quantifications. In this aim the expert system will use Open Databases, either already existing like the Crystallography Open Database, or under development like the Raman Open Database.

We will illustrate the actual state-of-the-art Combined Analysis, and envision its near-future developments within the spectroscopies context.

The Combined Analysis vision
for future. D. Chateigner (Ed.)
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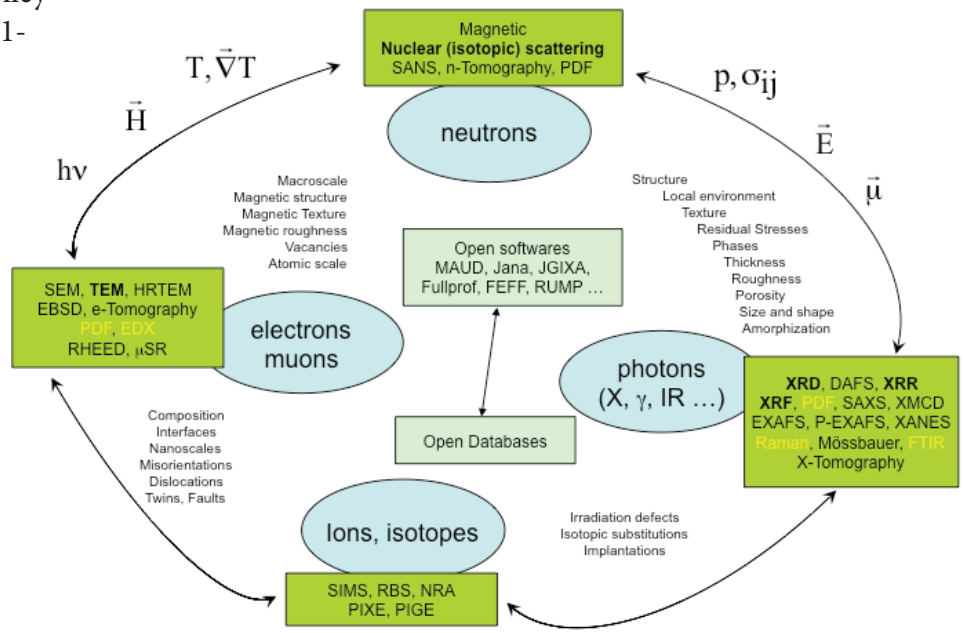

KN 5

Synthesis of Ce/Ru Doped ZnO photocatalysts to the degradation of emerging pollutants in wastewater

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Semiconductor nanoparticles (NPs) and nanowires (NWs) of doped ZnO systemwith different dopant content have been synthesisedby Polyol-Mediated Thermolysis (PMT) process and Vapour-Solid (VS) reaction. The average crystallite size, morphology, specific surface area,anddirect band gap havebeen evaluated. The structural and functional characteristics have been studiedby X-Ray Diffraction techniques (XRD), Field Emission Scanning Electron Microscope (FESEM), High Resolution Transmission Electron Microscopy (HRTEM), Brunauer, Emmett and Teller (BET) method, UV-Vis Diffuse Reflectance Spectra (DRS), UV-Vis Spectroscopy, and Photoluminescence measurements (PL). Also, the photocatalytic activities of pure and doped ZnONPs were evaluated by removal rate of Methylene Blue (MB) under UV irradiation (365 nm) at room temperature. XRD patterns revealed the commonhexagonal ZnOWurtzite-type structures with apreferred orientation of (101) plane.Secondary phases as CeO_2, Ce_2O_3, Ce, RuO_2, Ru_3O_4, Ruhave been

identified. For both dopant, Ceand Ru, and for all the concentrations in the precursor solution, FESEM and HRTEM showed NPswith morphologies ranging from spherical/ellipsoidal to hexagonal.The size of NPs was observed to decrease (from ~30 to ~16 nm) with increasing doping concentration due to the interaction between the Ce-O-Zn or Ru-O-Zn ions. EDS results confirmed the incorporation of Ce or Ru ions into ZnO lattice.Using the Kubelka-Munk treatment on the diffuse reflectance spectra, the direct band gap energy has been estimated to be slightly lower than 3.0 eV in both, the Ce andRu-doped samples.Compared with pure ZnO NPs, the PL spectra of the doped NPs showed red-shifted UV emission and an enhanced blue emission with the typical broad green-yellow emission. The results showed that photocatalytic efficiency of doped ZnO NPs was always enhanced.

KN 6
Hydrothermal synthesis of the oxidepowders

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The high demand for new materials, such as oxides, and composites, raises the need for an advanced synthesis of different materials, which are crucial for technological applications. Different process synthesis routes, such as atomization, reduction in aqueous phase, crystallization, chemical precipitation, high pressure reaction in autoclave, and electrolysis, can be used to create controlled powder characteristics with specific properties for a particular application or industry. Advances in synthesis explores a range of materials and techniques used for powder metallurgy and the use of this technology across a variety of application areas such as medicine, catalysis and automotive industry.The main aim of this work is the synthesis of nanosilica and magnesium carbonate in an autoclave. Hydrothermal synthesis with a process design of a carbonation process will be presented. Depending on the reaction parameters such as a temperature, pressure and stirring speed,it is possible to control the morphological characteristics of the obtained particles.

KN 7
New sustainable processing of RE-based magnetic materials

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Rare-Earth Transition Metal permanent magnets (RETM-PM) are vital components in the rapidly-developing renewable energy sector, where the motors require strong magnets with the ability to operate at temperatures well over 100°C. To achieve high coercivity, remanence and consequently high energy product (the figure of merit for PM) at elevated temperatures, the addition of heavy rare earths (HREs) to the basic Nd-Fe-B composition is needed. However, HREs are on the very top of the list of Critical Raw Materials (CRM) published by the EC in 2017.

In the frame of the "Magnetic Materials Group" of IJS, Ljubljana, we have developedaninnovative, and sustainable way to drastically decrease the amount of HREs needed for the highest-level performance of PM. In the second part of the talk, we will focus on the need for recycling of the end-of-use (EoU) RETM-PM.

To drastically reduce the use of HREs, we focused on developing a new method, which was designed to enable us to achieve the properties needed for high-temperature applications with the lowest amount of scarce elements. With our new inventive technique, further transferred to pilot production, we could minimize down to 0.2 at % the amount of HREs used whereas the improvement of coercivity was 30 % with minimal loss in remanence. The total saving of the HREs turned to be 16-times less for the same performance, which is a significant contribution to the world economy and clean, sustainable environment. In studying the mechanism for such an improvement in coercivity without significantly decreasing the remanence, a detailed microstructure investigation was performed by using high-resolution transmission electron microscopy.

Besides the use of these newly developed high energy magnets for electric and hybrid cars as well as wind turbine generators,anothervital application is as the source of the magnetic field in the development of the new magnetic cooling devices.

Since Europe lacks any significant REE deposits that can be exploited to reduce its import dependency, it is essential to be ahead of another rare-earth crisis, like the one witnessed in 2009–2010. European industry needs approximately 2,000–3,000 tons/year of REEs, all of which have to be imported. Producers of REE-based permanent magnets use the vast majority of these REEs. At the same time, the current recycling rate for REEs contained in these magnets is a pitiful < 1%. Whatever theway we look at this, the recovery, reprocessing and reuse of REE permanent magnets represent the only viable route to ensuring a sustainable future for this critical European industry (nearly everything that uses electricity also uses magnets).

With a view at sustainability and circular economy, we will present our continuous efforts to develop and demonstrate innovative pilot plants at Technology Readiness Levels (TRLs) 6–7 for the clean and sustainable recycling of these most critical raw materials from secondary EoUPM sources in the EU.

We are investigating different ways to recycle and reprocess the EoU Nd-Fe-B PMs. As it is vital for the applications to keep or even surpass the properties of the original magnets, we are utilizing a contemporary technique of spark plasma sintering (SPS) that assures a minimized grain coarsening in the ~500 nm range. So far, we have demonstrated an improvement in coercivity of the raw powder up to H_C = 1120 kA/m with BH_{max} = 95 kJ/m^3, that matches the one achieved in fresh HDDR+SPS-ed samples. From the perspective of chemical recycling of the EoU Nd-Fe-B magnets, we will report on a successful synthesis of Nd-Fe-based deposits using ionic liquids. The XRD, VSM, thermomagnetic, Mössbauer and HRTEM/EDXS/EELS studies are going to be discussed with regards to the properties of the obtained Nd-Fe-deposits.

KN 8

Alkali activation of waste materials: sustainability and innovation in processing traditional ceramics

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Environmental issues linked both to OPC production and waste management brought researchers to find new solutionsfor the production of more eco-efficient binders. In this frame, alkali-activated materials are receiving increasing attention. They are obtained by reaction of an alkali metal source, generally sodium or potassium, with amorphous calcium-aluminosilicate precursors. More recently, also the reuse of mining wastes was investigated due to the impressive production of sludges and muds which do not have practical applications and shall be landfilled. The aim of our researches was to investigate the use of semi-crystalline/high-crystalline by-products in the production of alkali-activated materials. Thus, two different powders were used: an alumino silicate mud, composed by quartz, feldspars, biotite and dolomite; and a carbonatic one, composed of calcite and small amounts of dolomite. Both powders were alkali-activated using a solution of NaOH and Na_2SiO_3. Pastes were produced mixing the activating solution and the powder in different liquid/solid ratiosandinvestigatingthe use of waste glass powder as further source of amorphous silica. Samples were oven-cured for 24h at 60-80 °C and then cured in different environments (dry, humid and immersed in water) for other 27 days before testing physical and mechanical properties. Very promising results were obtained in terms of compressive strength (about 30 MPa for the aluminosilicate sludge and up to 45 MPa for the carbonatic one), showing their potential as innovative building products.

KN 9

Systematic investigation of grain aggregation induced by neck evolution under sintering conditions

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Agglomeration in solid-liquid mixtures observed in gravity-induced liquid phase sintered samples was attributed to settling as a result of gravitational force, as well as weak interaction forces. Such an evolution of the skeleton structure is usually influenced by some topological constraints. The presence of topological constraints in the grain network (the aggregate) triggers the time evolution of the microstructure so that as the time progresses the grain boundary slowly migrates via topology changes.

The primary task of this paper will be the development of a new computer simulation method to treat topological constraints and their influence on three-dimensional (3D) grain aggregation described by skeletal structure evolution during sintering. The topological analysis will be accomplished by the introduction of solid grains represented by 3D domains and appropriate solid skeletons which will be introduced by the formation of skeleton units and their transformation to a large solid skeleton of connected skeleton units arranged in a long chain.

In the initial stages, the sintering process results in the formation of irregularly shaped aggregates which are solid skeleton structures on small length scales. As sintering time progresses and the aggregates become larger (i.e. solid skeletons become longer), the interparticle center-to-center distances within the aggregates decrease but the sintering process slows down. The aggregation rate will be determined by process conditions such as sintering temperature and material-dependent sintering mechanisms, where Brownian motion has been usually used to simulate aggregation by chainlike skeletons.

From a simulation point of view, few microstructural features that appear important in controlling the compact macrostructure are solid contact, grain coordination number, and dihedral angle. Skeleton structures will be computed by geometrical limitation for two grains in contact with an observable dihedral angle. Once formed, grain contacts grow to satisfy the dihedral angle, and beyond that point, neck growth is paced by the rate of grain growth. In that sense, the aggregation model will be modified to include a finite interparticle neck and dihedral angle. Grain rearrangement and densification (sintering) will be incorporated into the model by defining free settling and more realistic extended settling algorithms for gravity-induced grain walks and Brownian motion algorithm for random grain walks within multi-grain sintering model. Although both free settling and extended settling processes are usually defined as sequential, there may be overlap between them. The effect of sintering on aggregate evolution will be investigated in simulations of a 3D model experiment.

The computer simulation method defined in this way will provide an effective methodology for treating topological constraints and their influence on grain aggregation during sintering. The two most important features in this approach will be that the method can recognize and resolve topological constraints in large-scale random grain arrays and that the sintering law (the neck growth) can be arbitrarily chosen. The advantage of such a model is that it does not need any special geometric assumptions because the microstructural development will be simulated based on a set of simple local rules and overall neck growth law.

INV-BCS 1

Thermal thin film investigations via Time Domain Thermoreflectancemethod on Nb_2O_5

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The on-going miniaturization trend in the field of microelectronics has created new thermal challenges due to increasing processing speeds in combination with continuous size reduction and hence increasing power densities. Smaller chip-sizes increase the difficulty to mitigate heat, resulting in reliability and performance loss of devices. The operating temperature ofdevices hampers linearly their performance and increases their failure rate exponentially. Thus, it is necessary to develop heat dissipation strategies, which requires knowledge of the thermophysical properties of its constituent thin films in the nanometer regime.

The determination of these thermophysical properties can be donewith the Time Domain Thermoreflectance (TDTR). The thermal transient can be recorded in picosecond time resolution, providing the thermal diffusivity of nanometer thin filmsand the thermal interface resistances. Here, the TDTR method is presented by the example of Niobium pentoxide (Nb_2O_5) film, which can be found in optical applications, solar cells, gas sensors, and microelectronic devices.The investigations with the TDTR allow ananalysis ofthethermophysical propertiesin terms of their structure (crystalline and amorphous), thickness and temperature dependency.

INV-BCS 2

Morphological and structural characterization of spinel $MgAl_2O_4$

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Magnesium aluminate has spinel structure and very good mechanical, chemical, and thermal properties. Owing to these properties, it has a wide range of applications includingrefractory ceramics, optically transparent ceramic windows and armors. Its low dielectric permeability and low loss tangent enable itsusing for integrated electronic devices, as well. Furthermore, as a porous ceramic, magnesium aluminate has important application as humidity sensor, catalyst and filter for waste water purification.

In this paper, synthesis and characterization of $MgAl_2O_4$ was performed. Stochiometric ratio of MgO and Al_2O_3powders was mixed and calcined within the temperatures range 1500-1800 °C to produce pure spinel phase. Thereafter pellets were crushed and treated in planetary ball mill for 60 minutes to obtained fine grain. All powders, calcined and milled, were examined for phase composition, crystal structure, and morphology. The obtained results showed that by increasing the temperature denser samples but more fragile have been synthesized. Milling for 1 hour leads to crumble of bigger particles and getting finer, single phase powders. XRPD and Raman spectroscopy showed disorder in crystal structure after milling.

INV-NOB 1

Dynamic tuning of quantum light emitted from atom-like defects in hexagonal boron nitride

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Two-dimensional semiconductors, including hexagonal boron nitride (h-BN), haverecently been recognized as potentially very important materials for quantum photonics. Monolayers, multilayers and crystals of h-BN have been shown to host robust, high-temperature, polarized and ultrabright single photon emitters originating from vacancy-related localized mid-gapdefects. On-chip solutions, however, require controllable quantum sources that can be operated on-demand and with the possibility for in-situ control of the photon emission wavelength. To date, spectral tuning of quantum light emitted from h-BN defects has only been demonstrated experimentally over a few meV range by static strain. Here, we demonstrate the dynamic real-time control of luminescent intrinsic defects in h-BN flakes characterized by spatially, polarization- and time-resolved micro-photoluminescence as well as photon correlation spectroscopy. When subjected to the propagating surface acoustic wave (SAW), the emission wavelength of the optically probed defects is periodically modulated by the acousto-mechanical coupling. The SAW-induced modulationis further combined with spectral detection filtering for temporal control of the emitted photons. In this way, spectral tunability and on-demand emission of single photons can be achieved simultaneously. This study shows a great promise for the use of sound for scalable integration of h-BN emitters in nanophotonic and quantum information technologies.

INV- NOB 2

ZrO_2 Based Nanomaterials: Application in Photocatalysis

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Advanced oxidation processes (AOPs) as processes that utilize hydroxyl radicals ($OH^{\bullet}$) for oxidation of diverse organic pollutants have received considerable attention in last decades, especially in wastewater treatment. Photocatalysis (as AOP) initiated by Solar light, as free and most abundant light source, is considered as easiest way to produce $OH^{\bullet}$ radicals. However, designing suitable photocatalyst that can be easily activated by Solar light, keeping it highly effective in degradation in wide spectra of organic pollutants, is still a challenge.

Zirconia (ZrO_2) is well-known transparent ceramic material commonly used as a catalyst and catalyst support, sorbent and oxygen sensor. Due to its wide band-gap (~ 5.0 eV) it needs UV light (less than 5% of Solar light) to be activated, so it's not an obvious choice for photocatalyst. However, once activated, with conduction band potential placed at -1.0V (vs.NHE) and valence band potential placed at +4.0V(vs.NHE), it has ability to produce not only $OH^{\bullet}$ but also superoxide ($O_2^{\bullet -}$) radicals. In order to exploit its "pros" and overcome its "cons", we developed series of zirconia based materials and tested theirphotocatalyticefficacy in degradation processes of various model compounds.

INV-NOB 3

Models and methods for testing the cells and tissues interactions with biomaterials

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A material is considered biocompatible if it enables the body to function without complications or adverse side effects and to generate the most appropriate and useful cells' and tissues' response, optimizing the clinically relevant effect. Biocompatible material needs to be evaluated through its interaction with the biological environment. Biocompatibility testing of the interactions between biomaterials, cells and tissues includes *in vitro*, *in vivo* (animal experiments) and clinical evaluation. *In vitro* models are relatively simple, reproducible, relatively cheap, and fast, require small amount of the material and minimize the use of animals for testing purposes. The disadvantages of these models are uncertainness of the clinical relevance and that chronic effects cannot be tested. After *in vitro*, more comprehensive studies are being done on experimental animal models. Real simulation of the state of the body is possible and biocompatibility and safety can be determined in a more realistic biological environment. Disadvantages are a higher price, long duration and ethical issues. The choice of models and testing methods depends on the location, nature and duration of the body contact with the material intended for medical use. The evaluation of the implanted material and surrounding tissue can be done using a number of methods such as histological, physicochemical, biochemical, immunological, hematological, genetic, radiographic, ultrastructural, etc. Clinical trials are the final step in the evaluation process of interactions biomaterials-cells/tissues.

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INV-MC 1

How do preparation method and starch-encapsulation influence the magnetic properties of nanocrystalline cobalt ferrite?

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To investigate the influence of the preparation method on the magnetic properties, cobalt ferrite nanoparticles were carefully designed by five different routes. To control the particle size and enhance dispersibility inan aqueous medium, starch, a natural and biocompatible compound, was used for coating suchmagnetic powders. The presence of a single-phase spinel structure was confirmed in all cases by X-ray powder diffraction (XRPD). Scanning electron microscopy (SEM) and transmission electron microscopy (TEM) analyses indicatedthat the nanostructured particles were uniform in size and shape. According to the Fourier transform IRspectra of the coated samples, additional bands originating from starch appeared, indicating successful functionalization.The magnetic measurements separated samples into two groups. The slight increase of saturation magnetization value for starch-coated samples prepared by co-precipitation, ultrasonically assisted co-precipitation and microwave assisted hydrothermal methods can be explained by the incomplete starch coverage. Moreover, coating procedure could initiate agglomerate breakage, followed by re-ordering of magnetic moments.The magnetic properties and agglomeration effect decreased for starch-functionalized nanomaterials in comparison to their as-prepared analogs, synthesized in mechanochemical and microemulsion manner, giving the courage for their further biomedical and technological applications.

INV-MC 2

Ethyl cellulose based magnetic nanocomposite membranes

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The focus of this study is on the preparation and characterization of magnetic nanocomposite membranes for gas separation. Magnetic nanoparticles of strontium ferrite ($SrFe_{12}O_{19}$) were incorporated into ethylcellulose via solvent casting method, in order to promote oxygen diffusion against nitrogen. The influence of the nanoparticle content on the mechanical and separation properties of the nanocompositewas investigatedusing micro Vickers method and tensile test. In order to identify the structures formed by membrane processing, various analyzes were performed, such as scanning electron microscopy (FESEM), atomic force microscopy (AFM), and infrared spectroscopy with Fourier transformation (FTIR). The permeability of magnetic nanocomposite membranes was tested by monitoring the output pressure change of the nitrogen and oxygen mixtures, as well as pure nitrogen. It has been established that all of the starting components have remained intact during processing, indicating that an appropriate processing method was chosen. Nanocomposite membranes with a higher content of magnetic nanoparticles have shown a significant improvement in mechanical properties compared to pure ethylcellulose, with high permeability. These findings have shown that nanocomposite membranes based on ethylcellulose are an excellent candidate for gas separation.

INV-GE 1

High sensitivity characterization of the nonlinear electric susceptibility of glasses and glass-ceramics in the microwave range

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The 5G mobile communication standard aims to provide massive data rates to an increasing number of devices. This requires the use of higher frequencies and the efficient use of the available frequencies. A major challenge in the efficient use of frequencies is cross talk between channels due to passive intermodulation (PIM). Due to the large differences in the intensity of receiving and transmitting channels, even tiniest intermodulation levels need to be controlled. One source of intermodulation is the nonlinear response of dielectrics to the electric field. However, it is hard to characterize the intrinsic material nonlinearity as the nonlinearity of the setup itself produces intermodulation. Following a resonator method exciting eigenresonances of three coupled cylindrical dielectric resonators enables to measure nonlinear behavior at high field strengths and allows isolating the resonators' material nonlinearities from other intermodulation sources. The setup enables to measure a third order nonlinear term being 10^{-10} times smaller than the linear response at electric field amplitudes of a few V/mm. We report on the characterization measurements of the nonlinearity of glasses and glass ceramics.

INV-GE 2

The $BaTiO_3$ ferroelectric properties within the microscale fractal nature

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The electronic ceramics applications based on ferroelectric and dielectric properties have enormous grow in function of very high microelectronics integrations. We used nano $BaTiO_3$ with different versions of Y_2O_3 additives. We consolidated samples by sintering process in temperature interval from 1200 C to 1350 C. Here we also present some results as a "pre-coating" process for $BaTiO_3$nano structure. This was quite original experimental process effected on different ferroelectrics characteristics between the grains. By our approach these relations between the grains corresponding to our ideas for fractal microelectronics properties integrations. The fractal nature analysis has been applied, too. We applied the complex fractal corrections between the grains and pores surfaces, including the particles Brownian's Motion between the boundaries. This is completely new approach to the phenomenas of the ferroelectrics, dielectric and in general electronic properties integrations. we are on the way to create the correlation between the processing, structural and advance electronic properties for modern applications.

INV-GE 3

Synthesis, characterization and application of activated carbon materials obtained from biowaste

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The main objective of this research is to obtain carbonaceous material and active carbon material by the carbonization process in an inert atmosphere, activation with CO_2, then the hydrothermal synthesis method with the emphasis on phosphoric acid activation as well as a combination of carbonization and hydrothermal synthesis. It is also given an insight into the optimization of the parameter of the process of obtaining active carbon material, that is, how the process parameters affect the final product. Different precursors of biowaste for obtaining carbon materials were used.

The initial composition of the precursor as well as the final product (active carbon materials) were analyzed using a proximative and ultimate method. The active area surface, volume and pore size was determined using the BET method. Verification of surface-active reaction groups in the identified structures was carried out through Fourier-transform infrared (FTIR) spectroscopy.. Morphology of resulting activated carbon materials has been investigated by scanning electron microscopy (SEM) and X-ray diffraction (XRD). Energy efficiency or thermal power was measured using a calorimetric bomb.

The application of the obtained materials is reflected in the fact that we removed the waste, we prevented the pollution of nature, and on the other hand we have obtained material that can be used for various purposes, for example, air filters, water, superconductors, etc.

INV-MS 1

Theoretical and experimental study of multiferroics$BiFeO_3$ and $Bi_{(1-x)}Ho_xFeO_3$

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Among the different types of multiferroic compounds, bismuth ferrite ($BiFeO_3$; BFO) stands out because it is perhaps the only one being simultaneously magnetic and strongly ferroelectric at room temperature.$BiFeO_3$ and $Bi_{1-x}Ho_xFeO_3$ ultrafine nanopowders were synthesized by the hydrothermal method. Here we use simple, low-cost and energy-saving hydrothermal method, which has advantages over the conventional methods. The influence of Ho doping on the crystal structure and magnetic properties of bismuth ferrite (BFO) nanopowders was investigated. The diffraction pattern was recorded at room temperature and atmospheric pressure in the absence of any re-heating of the sample. A fitting refinement procedure using the Rietveld method was performed which showed the incorporation of Ho^{3+} ions in the $BiFeO_3$ crystal lattice, where they substitute Bi^{3+} ions. All the samples belong to *R*3*c* space group.In addition, theoretical investigation using bond valence calculations have been performed in order to mimic pure and Ho doped $BiFeO_3$ compounds produced in the experiment. Various BFOpolymorphs were investigated as function of holmium concentration and final optimization of crystal structures has been performed on *ab initio* level using Density Functional Theory (DFT).Furthermore, electronic and magnetic properties of $BiFeO_3$ were investigated using combination of experimental and theoretical methods.Magnetic behavior of synthesized materials was investigated by SQUIDmagnetometer in wide temperature interval (2-800 K). Splitting between the zero-field-cooled and field-cooled magnetization curves becomes more pronounced as the Ho concentration is increased, pointing to the development of weak ferromagnetic moment, which is usually connected with uncompensated spins or spin canting. Hysteresis loops show the same fact, attaining higher magnetization with more Ho included,andbecomingwider, i.e. magnetically harder.
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INV-MS 2

Brownian fractal motion and energy effect on microorganism's fluctuation

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There are many results which have been reported based on fractal nature analysis in the field of electronics ceramics and generally in material sciences. Also, there have been some basic results from the Brownian motion electronic particles view. In this presentation we further developed new ideas how to find some more natural particles motion with higher level of precision. So, for biomimetic ideas we established relations of these fluctuations based on some similarities with the microorganism's motions. Our results, until now a day research presenting high level of investigations agreement expressed by the Brownian motion fractality. In that sense, we present here our the newest results based on fractal analysis applied in experiments with microorganisms under the some energy influences in the form of different vibrations, from mechanical to all other. Our results definitely confirm the real nature of these motions explained by Brownian motion characterization.

INV-MS 3

Graph theory applied to modeling and simulation of microstructure evolution in sintering

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Three-dimensional modeling and simulation of sintering are usually based on domain methodology in which solid skeleton evolution is introduced by the definition of skeleton units determined by the equilibrium dihedral angle and the formation of large solid skeletons arranged in a long chain of connected solid phase domains (grains). In such a system microstructure evolution can be simulated by simultaneous computation of the displacement of the center of mass, induced by the driving force of the sintering process, i.e. by the reduction of overall free energy due to the decrease of specific surface area and compact interfaces.

Classical mathematical approaches assume the geometry and topological aspects of the multi-grain model described by means of a network in which grain centers are identified by vertices and a link (center-to-center distance) joins a pair of vertices, where the length of the link between them can be computed as the Euclidean distance function. In general, the network corresponding to such a model of connected grains is thus made up of a unique, interconnected set of closed polygons.

All of the mentioned and many more problems can be very elegantly described and modeled using graph theory. The special advantage of this methodology is a simple mathematical approach and relatively simple visual connection of technological parameters and phenomena that characterize the process of sintering. Moreover, if the problem of modeling the sintering process were completely mapped to graphs, then it would be possible to realize the more efficient simulation of microstructural evolution during sintering. It is also possible to use different algorithms for graph operations (through matrices), as well as parallel algorithms for fast calculations on a large data set typical for multi-grain models with a huge number of grains.

Hence, we will redefine usually used a methodology for modeling and simulation of microstructural evolution under sintering conditions by the introduction of graph theory. In this paper, we will define so-called graph unit which will be applied to solid skeleton evolution induced by neck growth and other diffusion phenomena.

INV-ERC 1

Processing of metal-ceramic composites by Spark Plasma Sintering: application to bulk composites and joining purposes

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This talk will review our research activities in the area of metal-ceramic composites processed by sintering. We are interested in finding ways to tailor and design the microstructure of composites, for which we use a combination of two non-equilibrium processing methods – high-energy ball milling and Spark Plasma Sintering (SPS). Both reactive and non-reactive processing routes are used. The structure and phase formation of TiC-Cu, Ti_3SiC_2-Cu and WC-Ni composites during SPS will be presented along with mechanical properties and electrical conductivity of the bulk materials. The role of melting at the inter-particle contacts during SPS will be discussed. The interaction of metallic alloys with graphite contacting the sample during SPS will be given particular attention, as this interaction becomes especially important for materials sintered from mechanically milled powders. Our most recent studies are aimed at finding brazing materials and SPS conditions to reliably join copper with graphite. Ti-Cu alloys as brazing materials are currently being evaluated. Results of the structural studies of the interfaces formed during SPS of Cu/brazing layer/graphite systems and corresponding phase changes will be reported and discussed.

ORL-BCS 1

The effect of heating rate on densification and grain growth during pressure-less sintering of fine grained alumina and zirconia ceramics

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Conventional pressure-less sintering in air atmosphere is the most appropriate technique for the mass production of dense alumina and zirconia ceramics with complex shapes. Although it is experimentally simple and inexpensive process, it is difficult to produce fine-grained ceramics due to a microstructure coarsening which occurs during holding time at sintering temperature. Modifications of time-temperature sintering schedule, among them an application of rapid heating, were suggested as a possible solution to enhance densification and retain grain growth. In our approach we used the so-called sequential sintering up to 1550°C with conventional, rapid and extremely rapid heating rates of 5°C/min, 100°C/min and 1000°C/min, respectively, to investigate a densification and a grain growth behavior during the heating stage of the sintering process. Results indicate that fast heating accelerates densification as well as grain growth. The grain size evolution was a linear function of the relative density in the intermediate sintering stage - independent on a heating rate. The grain growth in the final sintering stage was exponential and more

pronounced in case of rapid heating compared to conventional heating rate. Possible explanations are given and benefits/drawbacks of the rapid heatingare discussed.

ORL-HAD 1

Zlakusa hand-wheel pottery making as a cultural heritage and its protection

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The hand-wheel pottery making in Zlakusa, western Serbia, survived until nowadays, as one of the last in the Region, thanks to the specific raw materials, modeling technique and technological procedure. This kind of potter's wheel, usually named as a "slow wheel", is considered to be the first potter's wheel. The coiling technique of modeling is characteristic of them. The so-called "fast wheels" or kick-wheel, moved with a leg or by means of a stick, exclusively intended for the wheel-throwing technique, were created somewhat later. It is considered as a more advanced device, but, in spite of that, the hand-wheel was preserved as a better solution in some cases, like in case of Zlakusa pottery making. Intentions of changing of the manufacturing procedure in Zlakusa, using easier ways of production, like kick-wheel, i.e. electric wheel and molds increased recently. Nevertheless, the quality of the final products made in a non-traditional way decreased significantly. How to deferens original products from the false ones was the real problem because their close resemblance. The analyzed samples of Zlakusa pots showed significant differences, from the way of braking to the final results. Nevertheless, further investigations will be necessary to establish the standards that will guarantee the quality and the originality of the Zlakusa vessels.

ORL-HAD 2

Contextualizing the use of a ceramic vessel from Kostolac - Archaeoacoustic Analysis

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Museum artefact is a medium for cultural transmission and a bearer of cultural information. In this paper, the impact of contemporary analytical techniques application on tangible cultural heritage is addressed in the context of the Niche construction theory. This is done by juxtaposing archaeoacoustic analysis and the interpretation of a large, high-fired ceramic vessel, found in the Celtic grave in Kostolac, Serbia, dated in 3rd century B. C. Although it is generally assumed to be an everyday object, the concrete purpose of this vessel stays unclear. Some of its physical characteristics – tree-parted rim profile, massive foot, significant height of about 70 cm, and the absence of handles - suggest that it might had been used as a percussion musical instrument. In this research, the object is first decoded through acoustic measurements, showing a strong frequency resonance at around 80 Hz. This coincides with the resonance of basic rhythmic-percussive musical instruments that have been used in music practice throughout the history. The object is then interpreted in a subjective process of making sense and story contextualization through the Four Resources Model of Literacy, aiming at overlapping cultural niches the object belongs to, as well as meanings and social relations it embodies.

ORL-HAD 3
Interpretation of the Miniature Ceramic Artifacts

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Miniature ceramic artifactsoriginated from different period of prehistory, they are found from Neolithic to the Iron Age. They are very common archaeological findings on prehistoric settlements, but some of them are found on necropolis, as offerings in the burials. The largest number of these artifactsare small pots which are differently shaped and resemble the kitchenutensils. It is interesting that these pots often represent a precise copy of the kitchen pottery that were used at that time, just in miniature size. In addition to them, there are miniature figurines of animals and people, ritual objects, rattles, different types of tools and various tokens. In the attempts of the interpretation of these objects there are several different points of view. Some scholars see them as ritual objects–mostly offerings, others see in them objects for some special purpose and some interpret them as children's toys. Although these artifacts could have been used for different purposes, with careful observation of their shape and traces of making and use, which can be seen on their surface, as well as by analysis of their context of the findings on the archaeological site, with key evidence provided by fingerprints that are found on some of them, the most of them could be interpreted as children's toys.As such, they are providing us opportunity to have a glimpse into the daily life in the prehistoric times with giving us precious information about growing up in ancient societies.

ORL-EC 1
Evaluation of the nickel state in Ni/BCY15cermet - anode for proton conducting solid oxide fuel cell

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The yttrium-doped barium cerate $BaCe_{0.85}Y_{0.15}O_{2.925}$ (BCY15) is well-known proton conductive electrolyte. It is used as an anode ceramic matrix for synthesis of Ni-based cermet anode with application in proton conducting solid oxide fuel cell (pSOFC).

Metallic Ni is deposited on BCY15 ceramic matrix by wet-reduction with hydrazine ($2Ni^{2+}+N_2H_4+4OH^- \rightarrow 2Ni^0+N_2+4H_2O$) by application ofaqueous and non-aqueous approach. It is established that application of non-aqueous medium anode preserves ceramic matrix structure and improved electrochemical performance of Ni/BCY15 cermet.

Aiming to explain finding for higher pSOFC activity of Ni/BCY15 synthesized inethylene glycolmedium,the evaluation of the nickel state in Ni/BCY15 cermet is performed by Scanning Electron Microscopy,Electron paramagnetic resonance and X-ray photoelectron spectroscopy.

The synthesis in ethylene glycol medium induces fine dispersion of the nickel metal phaseby obtaining$Ni^0$with smaller particle size and the interaction strength between Ce^{3+} ions and Ni^0 is stronger as well as Ni dispersion is a little better compare to in aqueous medium synthesis. These findings are explanation for higher pSOFC activity of Ni/BCY15 synthesized inethylene glycolmedium.

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ORL-EC 2

Bimetallic CuNi/BCY15 cermet anode for proton conducting solid oxide fuel cell

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Nowadays, the ceramic–metal composites (cermets) containing Y-doped barium cerate, $BaCe_{0.85}Y_{0.15}O_{2.925}$ (BCY15) as anode ceramic matrix and metal nickel are utilized as proton conducting solid oxide fuel cell (pSOFC) anodes. An efficient mode to improve the electrocatalytic activity of Ni-cermets is to combine it with other transition metal.

A low-temperature wet chemical approach for simultaneously impregnation of BCY15 with Ni and Cu metallic particles was presented aiming to avoid the traditional ceramic high-temperature processes. The bimetallic (CuNi/BCY15) and monometallic (Ni/BCY15) powders were studied by XRD, TPR and SEM techniques. The electrochemical characterization of the produced anode cermets was performed by electrochemical impedance spectroscopy after high-temperature sintering followed by H_2-reduction.

The comparative study disclosed the positive effect of Cu presence in the bimetallic CuNi/BCY15 anode cermet that is related to (i) appearance of electronic conductivity still at the beginning of reduction under N_2 treatment followed by gradually increasing portions of H_2 and (ii) earlier start of the reduction as opposed to the monometallic Ni/BCY15.

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ORL-EC 3

Cobalt impregnated natural and acid modified montmorilloniteas catalysts in heterogeneous catalytic oxidation of nicotine in the presence of Oxone®

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Nicotine i.e. (S)-3-(1-methylpyrrolidin-2-yl) pyridine is an alkaloid present in significant quantities in tobacco leaves and can be found in wastewaters as an aftermath of tobacco manufacturing. Natural Wyoming originated montmorillonite (Wy-M) and acid modified montmorillonite (Wy-M_A) were impregnated by wetness capillary method using $Co(NO_3)_2$ solution. The amount of introduced cobalt corresponded to cation exchange capacity of each sample. The samples were calcinated at 450°C during 6 hours and denoted as Co/Wy-M and Co/Wy-M_A. These catalysts were used for nicotine degradation in the presence of Oxone® ($2KHSO_5 \cdot KHSO_4 \cdot K_2SO_4$). The changes in the chemical and phasecomposition ofWy-M, Wy-M_A,Co/Wy-M and Co/Wy-$M_A$were monitored using X-ray fluorescence (XRF) and X-ray diffraction (XRD), respectively.The powerful sulfate radicals for nicotine oxidation were generated by activation of Oxone®in the presence of transition metal cation (Co^{2+}) incorporated into the catalysts structure. The process of nicotine oxidation was investigated at 30° C and 50 °C, while thenicotine concentration was monitored

using a UV-Vis spectrophotometer at λ_{max}=261 nm. The obtained results showed efficient degradation of stable nicotine molecule in heterogeneous Fenton-like reaction using cobalt impregnated natural and acid modified montmorillonite as catalysts.

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ORL-EC 4

Calcium oxide on coal fly ash cancrinite-type zeolite as a catalyst for biodiesel production

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This paper discloses the synthesis of new supported catalyst in which the main components of the catalyst, catalyst support and active component, derived from waste material, and its catalytic properties tested in the reaction of the production of biodiesel. Cancrinite-type zeolite catalyst support was synthesized from coal fly ash using hydrothermal technique with NaOH as the activation reagent in a rotating PTFE autoclave reactor. The active component, CaO, was derived from waste chicken eggshells by calcination at 900 °C. Supported catalytic material was synthesized by impregnation. The content of CaO in the prepared catalysts was varied from 5 to 20 wt%. The catalysts were characterized using XRD, FT-IR, SEM, N_2-physisorption, and Hg-porosimetry. The methanolysis of sunflower oil was carried out in a batch reactor at 60 °C, with methanol to oil molar ratio of 12:1, and catalyst concentration of 4 wt.%. The fatty acid methyl ester content (% FAME) was analyzed using HPLC method. Structural information related to phase identification and vibration of chemical bonds in molecular units indicates that a multiphase zeolitic structure was obtained. The structure of cancrinite-type zeolite was found to be dominantly present. It was found that the catalyst impregnated with 20% of CaO gave the highest FAME percentage of 96.46 for the reaction time of 2 h.

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ORL-ERC 1

Amidoxime-based Polymers for Extraction of Uranium from Seawater

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The goal of the project was to design and manufacture a polymer that would extract uranyl, UO_2^{+2}, from seawater in three years. I will present publicly available results from my 6 publications that show how the goal was accomplished. Focus will be on the computational design of a receptor for uranyl, simulation of a polymer caring the receptor, and the experimental verification of the successful design.

ORL-ERC 2

Synthesis and thermal phase evolution assessment of advanced Barium-Magnesium-Alumino-Silicate powders

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Family of Barium-Alumino-Silicates (BAS)represents,due to low thermal expansion coefficient and high resistance against harsh environments, an alternativecoating material systemto Yb-silicate environmental barriers for ceramic matrix composites.The main drawback limiting their use is thermalphase transition that is accompanied by a significant volume change, causing microcracks and consequent rapid coating failure. Thus, the successfulphase stabilization of BAS is required, and can be accomplishedby the addition ofother compounds, such as lithium, magnesium and/or calcium oxide. The stabilizedBAS system in Celsian phase keeps theoutstanding properties without the phase transition when exposed to high temperatures or vapours.In the present study, magnesium oxide (MgO) was selected with the aim to produceBarium-Magnesium-Alumino-Silicate (BMAS) powders by means of solid state reaction. The chemical composition and thermal stability have been assessed up to 1200°Cthrough *in-situ* X-ray diffraction and differential thermal analysis techniques. Results show that BMAS system based on the amount of MgO addition can be produced eitherin Hexacelsian or Celsian phase.

ORL-ERC 3

Dust particles in low-pressure hydrocarbon plasmas plasmas: mechanisms of formation and suppression of formation

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Reactive plasmas are nowadays widely used for technological applications and to produce composite materials and components for various purposes. Plasmas are used in several processes:etching, sputtering, surface cleaning, deposition etc.During all these processes spontaneous particle formation can occur. The aim of this work is to study the polymerization processes in reactive hydrocarbon plasmas leading to dust particle formation. Additional emphasis was placed on the mechanism of suppression of dust particles formation and the role of hydrogen atoms (H)during these processes.For this purpose the so-called double plasma experiment was performed. Particles are generated in RF (13.56MHz) reactor filed argon/acetylene plasma.The gas decomposition leads to particle generation and growth. Very high frequency (144.1 MHz) hydrogen plasma (H_2) was used as an additional H fraction in the precursor gas.The H_2 plasma can be operated in the fully recombined mode injecting just the H atoms (and possibly excited H_2 molecules). Formation of particles was monitored measuring the intensity of scattered laser light. Chemical composition and polymerization processes were monitored measuring the mass spectra of ions with mass spectrometry and mass spectra of neutral species with rest gas analyzer.

During the polymerization processes the mass spectra of both positive ions and neutrals show peaks at masses 26, 27which can be attributed to C_2H_2, C_2H_3,$C_2H_2^+$,$C_2H_3^+$, respectively, and50, 51 ant 74corresponding tohigher hydrocarbons. After the injection of additional amount of H atoms into the argon/acetylene plasmathe mass spectra of both the ions and the neutrals clearly show a simultaneous decrease in the intensity of peaks in mass spectra while the intensity of scattered laser light exhibits increase.

P1

Synthesis and characterization of $BaTi_{(1-x)}Er_xO_3$: (x=1, 2, 3, 5, 7, 10)

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$BaTiO_3$ (BTO) is a ferroelectric material that exhibits the photorefractive effect and piezoelectric properties, for use in multilayer capacitors, thermistors, and electro-optic devices. BTO shows tetragonal distortion of the cubic perovskite structure. The main goal of this work was the investigation of structural and optical properties of $BaTiO_3$ ceramics doped with different concentrations of erbium (Er^{3+}) prepared by molten salt reaction method. As a lanthanide element, Er exhibits sharp adsorption spectra in visible, ultraviolet and infrared light. This phosphor was characterized by XRD, photoluminescence (PL) and decay measurements. The PL measurements showed that the intensity of luminescence increased with increasing doping concentrations up to critical concentration of Er and then decreased at higher concentrations due to the concentration quenching effect. Peak positions attributed to the f-f transitions of erbium shows typical emissions ($^2H_{11/2}$/ $^4S_{3/2}\rightarrow{}^4 I_{15/2}$) at 523 and 552 nm respectively. The above results showed that Er^{3+} doped BTO phosphor might be useful for optical applications.

P2

Temperature sensing with Dy^{3+} doped $Na_{0.25}K_{0.25}Bi_{0.5}TiO_3$ probe

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Luminescent thermometry is extensively investigated because it provides sensitive contactless temperature measurments. This method is proposed for measurements at place which are difficult to access and in a nanoscale environments.
Here, we present synthesis and termographic properties of $Na_{0.25}K_{0.25}Bi_{0.48}Dy_{0.02}TiO_3$ (NKBT) .This material was synthesized by a solid-state reaction using TiO_2, Bi_2O_3, Na_2CO_3, K_2CO_3 and Dy_2O_3 as precursor materials. Starting powders were ball milled in etanol for 12h, and sintered at 850°C for 4h. X-ray diffraction measurements showed that NKBT sample has tetragonal perovskite structure (space group P4bm). The photoluminescent spectra showed the caracteristic emission bands of Dy^{3+} ions. The dominant band in the blue region (λ=477nm) corresponds to magnetic-dipole transition $^4F_{9/2}\rightarrow{}^6H_{15/2}$, while the one in the yellow region (λ=574nm) corresponds to electric-dipole $^4F_{9/2}\rightarrow{}^6H_{13/2}$ transition. The small intensity high-energy band (λ=457nm) originating from $^4I_{15/2}\rightarrow{}^6H_{15/2}$ transition, provides the possibility to use this type of emitting material as temperature sensor in luminescent thermometry. We have used the ratio of intensities of two specific emission bands (emissions from $^4F_{9/2}$ and $^4I_{15/2}$ excited states to the $^6H_{15/2}$ ground state). Data analysis showed that thermometry with this probe shows $2\%K^{-1}$ relative sensitivity and temperature resolution of 0.5K over the complete temperature range (293-483 K).

P3
Different Methods of Clay Application for Humans

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Minerals are imperative for humanity. As a natural source of all minerals, clays can be beneficial to human health. The use of clay minerals for food, medicinal purposes, in pharmaceutical formulations, spas, beauty treatments is almost old as mankind. Clay has no toxic elements in concentrations that can harm a human body. Bentonite, montmorillonite, pascalite, and other types of natural clays were applicable since prehistoric times. Concerning the physical and chemical composition of bentonite clay, it was useful as a cleaning agent for humans, mammals, birds, reptiles and insects. The aim of this work is examination of the clay applications in order to improve human health. The application of characterization analyses and thermal treatment were used for the characterization of bentonite clay, sampled from Prisjan, a village in Serbia. Considering historical development of clay, a relationship between clay and organic matter, the impact of clay on life development cycle, this work examines different methods of clay applications to improve our lives.

P4
Evaporative Cooling of water through the porous column from the Network gravitational flow

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This paper investigates the cooling of water by a evaporation-based system. A key component of this system is the porous column of a network filled with granular zeolite or activated carbon. The evaporation process takes place on an outer surface, which cools on the basis of latent heat of evaporation. Fresh chilled water is then used for different technological purposes. The advantage of this system is a gravitational flow that is not energy-intensive. The disadvantage is the limited flux (m3 / m2h), because in increasing the flow rate there is an increased flow along the perimeter of the column, which reduces the contact surface of the adsorbent water, thereby eliminating the porous flow effect. This column can serve as an adsorbent of some organic matter from water or as an ion exchanger for some geothermal or salt water. If this column was placed in a scattered form of greenhouse, then the sea water desalination would be done. Water flow through the column is non-stationary. The water tempearture was cooled at a flux from 100 ml/cm2min an interval of 15 minutes from 1 to 2oC. The column length is 100 cm and the collet diameter is 2.54 cm. The proportion of water evaporating in relation to the initial quantity was 4.86%, 4.93%, 5.57% by 35, 40 and 45°C, respectively.

P5

The usage of different fluoride sources during solvothermal synthesis of UCNPs in hydroxyl-carboxyl chelated precursor

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There is a great interest for the synthesis of rare earth (RE) doped up-converting nanoparticles (UCNPs) which morphological and luminescence properties are well suited for application in optoelectronics, forensics, security and biomedicine. The synthesis of such particles usually comprises decomposition of organometallic compounds in an oxygen-free environment followed with coating of biocompatible layer or ligands exchange. In this work hydroxyl-carboxyl (HO-C) type of chelators (citric acid and sodium citrate) are used for the stabilization of $NaYF_4$:Gd,Yb,Er UCNPs during solvothermal treatment of rare earth nitrate salts with different fluoride sources (NaF, NH_4F and NH_4HF_2). The x-ray powder diffraction (XRPD) showed that all powders contain the mixture of cubic and hexagonal $NaYF_4$:Gd,Yb,Er phase in nano and micro-sized particles respectively. However, the content of later one prevails in samples obtain when Na-citrate is used as chelator, regardless of which fluoride source is used for precipitation. Additionally, variation of the particles size and shape is detected with a variation of fluoride type. All particles have hydrophilic surface due to retention of citrate ligands and emit intense green light emission centered at 519 and 539 nm ($^2H_{11/2}$,$^4S_{3/2}\rightarrow{}^4I_{15/2}$) when excited with near infrared light.

P6

Barium titanat - electronic ceramics and further Brownian motion fractal analysis development

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Considering that until now there has been a positive fractal dimension of the charge carrier trajectories in doped $BaTiO_3$-ceramics, it would be interesting to consider its complex variant. The trajectories then have a new logarithmic scaling symmetry. It adversely affects to the conductive properties of these materials. AC conductivity studies of various $BaTiO_3$ or similar ceramics produced equivalent circuits with impedance spectra, usually within the framework of CPE elements serial connection (CPE - constant phase element). CPE, as a as a consequence of complex fractal dimension have a new behavior. Dielectric frequency spectra can be described in similar relations.

P7

Electronics ceramics grain boundaries and complex fractal dimension

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Analysis of ceramic grain boundaries, esspecially for $BaTiO_3$, is also important for its dielectric and conductive properties. In this regard, the fractal analysis was highlighted. The grain contacts geometry based on intergranular contact surface fractal morphology was the subject of our long term research. A new approach based on complex dimension fractal geometry and correlation between microstructure-nanostructure and rare-earth properties and other additives doped $BaTiO_3$-ceramics and electronics properties, is applied . In addition to the continuous type of scaling typical for real standard fractal objects, complex objects are considered here, which also have a discrete scaling symmetry with logarithmic space period. That rely on their appearance on the various , micro and macro, electrical and other properties of $BaTiO_3$-ceramics.

P8

Complex fractal dimension and possible application in electronic ceramics

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Considering the extremely growing exigency for further miniaturization and a higher level of packaging of electronic circuits and components, this paper is aimed at developing a more sophisticated application of fractals. In this sense, the progress in the development of the mathematical-physical tool in further upgrading of fractal microelectronics is presented here. Barium titanate samples with bayi yttrium samples are used as the experimental basis under conditions of using the highest levels of nanotechnology, especially grain deposition. In this regard, the ideas of complex fractal analysis will be elaborated in this paper. Examples of complex fractal dimensions are known in the literature. The relationship between fBm (Fractional Brown motion) and Bm is given by the left-sided Riemann-Liuville fractional integral

$$B_H(t) = \frac{1}{\Gamma(H+0.5)} \int_a^t dB(t') \cdot (t-t')^{H-0.5}.$$

When is H=0.5, in the above equation, fBm and Bm is matching.For H >0.5 the process is positive, and for H <0.5 negatively correlated. It shows that the imaginary part of the fractal dimension is translated into log-periodic modulation, which completes the behavior by leading a degree law, and is based on discrete fractal symmetry.

In particular, complex Brownian motion can be generated based on 1d complex Brownian motion in matlab code. There is also a corresponding fractional calculus of complex order. Other parallels with electrical processes in $BatiO_3$ ceramics are also possible.

This paper reveals a new perspective on the enriched and more accurate integration of electronic parameters between grain and pore, especially in the domain of Brownian particle motion.

P9

The Rare earth Neodymium Zinc Titanite properties in microwave telecommunications and fractal nature structure analysis

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In this paper we present the research results on dielectric properties based on Rare earth Neodymium Zinc Titanites (NZT). These results show that we have a stable perovskite structure and the other structure search suggest that the monoclinic crystal structure could be proposed for NZT. Modelling and simulation were used in this research to define the atomic position and crystal structure of NZT. The compositions have very specific dielectric properties which could useful in microwave telecommunications. It is very important to reduce the size, weight and microelectronic devices coast for future applications. So, the new miniaturization, better packaging and higher level of integrations, by using multi-layer processes and advanced interconnection methods are very important for modern telecommunications. In that sense, some new results and knowledges about fractal nature in materials, electronic ceramics and perovskites are very important for new fractal microelectronics applications for modern communications and IT technologies. Instead of classic semiconductor technologies, which are not anymore so much perspective and promising in this area. Finally, all of these aspects are very important for microanthena systems in telecommunications.

P10

Structural and Dielectric Properties of Rare earth Neodymium Zinc Titanite

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Using the high -resolution x-ray diffraction (XRD) analysis, scanning electron microscopy (SEM), and temperature-dependent microwave resonator characterization the dielectric properties and phase assemblage of Rare earth Neodymium Zinc Titanite (NZT) was investigated in this research work. NZT ceramics samples were prepared via mixed oxide. The result shows that it is distrustful to be a stable perovskite structure, in fact something comparable to Ilmenite structure, nevertheless further research shows that the monoclinic structure can be purposed for NZT. The Modelling and simulation were used in this study to define the atomic position and structure of NZT.

In conclusions, single-phase ceramics of NZT; have been synthesised at every sintering temperature 1250-1675°C. NZT has the temperature coefficient of resonant frequency 47 MK^{-1}, Quality factor was 42000 at frequency of 4.33 GHz and relative permittivity 36. The crystal structure of NZT is monoclinic with Bravais Lattice P and space group of $P2_1/n$. Kikuchi line shows that this material has a single phase. These compositions have promising dielectric properties and can be used in microwave telecommunications.

P11

Indium ion implantation effects on the structural, optical and electrical properties of GaAs and Si wafers

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In this paper we report a study on the effects of implanted In^+ ions into GaAs and Si - semiconductors with direct and indirect band gap, respectively. Both systems, (In,Ga)As and (In)Si, are of great interest for fundamental investigations of their structures as well as for the development of technological applications with enhanced electronic and optical properties.
In^+ ions were implanted into n-type GaAs (100) and n-type Si (100) at acceleration energy of 60 keV and the fluences of 1×10^{14} ion/cm^2, 5×10^{14} ion/cm^2, 1×10^{15} ion/cm^2 and 2×10^{15}ion/cm^2.It is well known that after ion implantation process substrate crystal structure is quite damaged due to the formation of point defects and dislocations which can strongly influence the semiconducting properties. In order to remove structural damage, after implantation all samples were annealed by rapid thermal annealing at temperatures 900ºC-1000ºC.

As-implanted and annealed samples were characterized for the structural changes and results are presented together with optical and sheet resistance measurements. Change in crystallinity of the samples was monitored by transmission electron microscopy, while chemical composition was determined by energy dispersive X-ray spectroscopy. Spectroscopic ellipsometry in the wavelength range 260 nm-2066 nm was performed in order to determine optical parameters and change in energy band gap. Atomic force microscopy was used to determine changes in surface roughness. Damage introduction during ion irradiation and its removal during a thermal annealing are key issues which are highlighted.

P12

Chemical processes in the formation of carbon based nanoparticles and suppression of nanoparticle synthesis by hydrogen atoms

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This contribution discusses the polymerization and growth process of carbon nanoparticles. The formation of particles in plasmas is a well-known phenomenon since Langmuir and his co-workers have discovered the existence of small solid particles (dust) in glow discharges. Particle formation has been observed during plasma processes in the fabrication of electronic circuits, for example. Since these particles cause severe defects of the final products they are considered as a main source of contamination and called "killer particles".

The focus in this contribution is on the mechanism of suppressing the formation of nanoparticles and we present the results about the role of H atoms in the nanoparticle formation investigated in a double plasma experiment. The experiment consists of two parts: rf 13.56 MHz acetylene plasma and 144.1 MHz H_2 plasma as an additional H fraction in the precursor gas. The H_2 plasma can be operated in the fully recombined mode injecting just the H atoms (and possibly excited H_2 molecules). Formation of particles

was monitored measuring the intensity of scattered laser light. Chemical composition and polymerization processes were monitored measuring the mass spectra of ions with mass spectrometry and mass spectra of neutral species with rest gas analyzer.

The ion mass spectra during the polymerization process shows in addition to peaks at mass 26 and 27 that the most dominant peaks are at masses 50, 51 and 74 which can be attributed to $C_2H_2^+$,$C_2H_3^+$, $C_4H_2^+$, $C_4H_3^+$and $C_6H_2^+$, respectively. As soon as the H atoms are injected into the plasma the mass spectra of both the ions and the neutrals clearly show a simultaneous decrease in the intensity of peaks in mass spectra and increase of intensity of scattered laser light. This is clear evidence that particle formation is suppressed as soon as the second discharge is switched on.

P13
Correlation between structural and optical properties of a:C-H films and hydrogen content

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Amorphous hydrogenated carbon films (a-C:H) films have wide variety of applications depending on their characteristics. When there have certain concentration of carbon atoms with unsaturated bonds they are soft, graphite-like and such films are excellent lubricants. On the other hand, when they contain small amount of hydrogen atoms and high concentration of carbon atoms in diamond order they are very hard and excellent protection layers.

For all this applications understanding of the film formation mechanisms, controlling the film growth and understanding the influence of H-atoms, ions and neutralsduring the polymerization process as well as on the film properties is indispensable. For this purpose we employed the so-called double plasma experiment: rf 13.56 MHz Ar/CH_4/C_2H_2 plasma and 144.1 MHz H_2 plasma as an additional hydrogen fraction in the precursor gas. The H_2 plasma can be operated in thefully recombined mode injecting just the H atoms (and possibly excited H_2 molecules) into the operating plasma.

The chemical composition of the plasma was *in-situ* monitored with plasma process monitor and rest gas analyzer. The film growth and optical properties were *in-situ* monitored with ellypsometer. The structure of deposited films was characterized by means of Raman spectroscopy and Fourier infrared spectroscopy, and surface roughness with atomic force microscopy.

Investigations show that the sputtering yield of the amorphous carbon films is drastically enhanced due to the combined action of argon ions and H-atoms. Consequently the growth rate of these films in methane or argon discharges is strongly reduced in the presence of an additional flux of atomic hydrogen.

P14

Application of magnetite/3D-printed wollastonite hybrid sorbent for As(V) removal from water

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The maximal allowed concentration (MAC) for As(V) in water decreased from 50 to 10 μg/l, by considering the harmful effects of arsenic on the environment and human health. In order to achieve the established rigorous requirements, it is necessary to develop new materials and design new forms of adsorbents that can reduce the concentration of arsenic in drinking water. In this paper, the synthesized magnetite/3D-printed wollastonite hybrid sorbent was used to remove As(V) from aqueous solutions. 3D-printed wollastonite was obtained using the 3D-printing technique from methylhydrocyclosiloxane and calcium carbonate as precursors. Synthesis of adsorption material was carried out by depositing magnetite from an iron(II)-sulfate solution by potassium hydroxide on 3D-printed wollastonite.

The adsorption properties of the hybrid adsorbent depend on the properties of magnetite and its porosity. This could be achieved by modifying the processes of depositing magnetite on the porous 3D-printed wollastonite. Characterization of the obtained material was performed using FTIR, SEM and TG-DTA. An investigation of the sorption properties of hybrid adsorbents was carried out for As(V) removal - one relative to the starting pH value of the solution, the adsorbent mass, the temperature and the adsorption time. Determination of adsorption parameters was performed by applying Langmuir, Freundlich and Dubinin- Radushkevich equations. Kinetics, using pseudo-first, pseudo-second and second order equations, as well as diffusion rate were determined using Veber-Moris and HSDM models. Determination of kinetics and adhesion parameters at three different temperatures enabled the calculation of thermodynamic and activation parameters of the adsorption process, which contributed to a better understanding of the adsorption mechanism.

P15

The thermal conductivity phenomena of synthetized diamonds in lighted by fractal nature corrections and analysis

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The grain size, as well as the contact between the grains, have a big impact on the thermal conductivity in nanocrystalline films and the thermal conductivity is constant in the entire film. This can be concluded because there is a linear dependence of thermal resistance from the thickness of the nanocrystalline diamond

film. The results of testing the dependence of the thermal conductivity on the grain size clearly indicate that the increase of the grain size increases the thermal conductivity. In addition, especially in diamonds, grain size is not the only one that determines thermal conductivity. Also, the contact resistance between the grains has a major impact. It is influenced by the ratio of sp^3 / sp^2 bonds due to the higher cohesion energy of the grain boundary. The various resistance which can occur between the contact of the grains can explain the large differences which are occurring in the thermal conductivity of thin films that have the same grain size. The main goal od this research is to explain phenomena of thermal conductivity in nanocrystalline films and to establish the correlation with fractal nature.

P16

Histological evaluation of vascularization in hydroxyapatite-based implants loaded with adipose-derived mesenchymal stem cells and platelet-rich plasma

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The application of adipose-derived mesenchymal stem cells (ADSCs) in bone tissue engineering (BTE) has shown to be a good strategy for the treatment of bone defects. Due to crucial importance of vascularization in bone tissue regeneration, the aim of this research was to examine the impact of implants composed of bone mineral matrix (BMM) carrier, platelet-rich plasma (PRP) and adipose-derived mesenchymal stem cells (ADSCs) *in vitro* induced into endothelial and osteogenic cells, on vascularization in an ectopic osteogenic model. The implants composed of non-induced ADSCs combined with PRP and loaded onto BMM carrier represented the control. Two types of implants were compared at histological level. The presence of blood vessels and immunoexpresion of endothelial-related protein markers were more pronounced in the implants with co-implanted ADSCs in comparison with the implants that contained uninduced ADSCs. Therefore, the application of ADSCs that were previously *in vitro* induced into endothelial and osteogenic cells and than mixed with PRP and loaded onto BMM carrier is a promising approach in BTE.

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P17

Collagen production and tissue infiltration in hydroxyapatite-based implants loaded with macrophages and blood clot

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Bone tissue engineering is promising tool for large bone defects' healing. It provides possibility to use biomaterials in combination with cells and growth factors in order to facilitate bone reparation process. Reparation is initiated by blood clot (BC) formation and cells' infiltration, whereby macrophages are considered to be alpha and omega in controlling all successive events. Goal of entire process is to establish normal tissue architecture which refers to appropriate collagen production and cell colonization. We used experimental approach where BMM combined with BC and macrophages was imitating conditions in damaged bone to see whether initially inclusion of these component in ectopic implants would improve collagen production and tissue infiltration compared to implants consisted of BMM and BC. Histological and histomorphometrical estimation of implants was carried out. More organized collagen fibers and higher tissue ingrowth along with more pronounced tissue vascularization was noticed in implants which initially consisted of all three components compared to other implant type. Obtained results indicate that growth factors and cells from BC as well as macrophages' secretory products can assist BMM in leading bone tissue reparation toward direction that suits bone healing.

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P18

Characterization of $MgAl_2O_4$ sintered ceramics

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Single crystalline phase $MgAl_2O_4$ is made from the predetermined composition of MgO-Al_2O_3 powder mixture by using ball-milling. Mixtures of MgO and Al_2O_3 are treated in planetary ball mill for 30, 60, 90 and 120 minutes, in air. The aim of this experiment was to examine phase composition, microstructure, and densification behavior of all sintered samples and to find out which sample has the best features for further use. After sintering in dilatometer at 1500 °C, XRD patterns and SEM images were recorded. The results show that mechanical activation is an efficient method to improve the densification behavior of $MgAl_2O_4$ sintered specimens. With the prolonged milling time, densities increased, reaching the maximum value of 2.8 g/cm^3 for sample activated 120 minutes.

P19

Electrical Characteristics of Ho doped $BaTiO_3$ Ceramics Using New Measurement Method

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In this paper, electrical characteristics of Ho_2O_3 doped $BaTiO_3$ ceramics were shown, using new method for measuring samples. The $BaTiO_3$ doped samples were sintered at 1320°C for 4 hours. The concentration of the additives were from 0.05 to 1.0 at% Ho. The density was ranged from 83% to 91% of theoretical density (TD). The samples of $BaTiO_3$ ceramics doped with Ho_2O_3 are characterized by spherical and irregular polygonal grains. The average grain size for samples doped with low content of Ho_2O_3 (0.05 at% Ho) ranged from 10 μm to 30 μm. An increase in dopant concentration causes a decrease in the average grain size in the investigated samples. So it is for samples doped with 1.0 at% Ho, grain size range between less than 1 μm – 2 μm. The variation of dielectric permittivity with temperature were measured in the temperature range from 30°C to 180°C and the frequency range from 100 Hz to 1 MHz. For measurement electrical characteristic a new method was used, which implemented to automate the sampling and to enable measurement without a human factor. The software application is connected via USB communication to a microcontroller, which measures the temperature in the furnace. When the temperature reaches the defined value, the microcontroller sends information to the software application. Then the application through GPIB communication activates the LCR meter, which measures the defined parameters of the tested samples. Based on parameters such as dielectric constant (ε_r), tangent losses ($tan\ \delta$) and impedance, the characteristics of the tested samples were determined. Using the Curie-Weiss law and modified Curie-Weiss law, based on the measured values of the parameters, the Curie constant and the exponent of nonlinearity were determined.

P20

Evolution of structural and functional properties of the Fe/$BaTiO_3$ system under the influence of mechanochemical activation and heating treatment

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Powdery mixtures of 30 mass % Fe and 70 mass % $BaTiO_3$ were activated in the planetary ball mill within the time intervals of 30 min to 300 min. The activated powder was pressed under 392 MPa pressure, into disc-shaped samples with 8 mm diameter and thickness of 1.5 mm. The pressed samples of activated powder were sintered at the temperature of 1200 ^{0}C in the air atmosphere for two hours.

XRD analysis showed that with the rise of activation time, $BaTiO_3$ (110) reflection decreases in intensity, whereas the intensity of (200) reflection rises, with barium-titanate changing its crystallinity from orthorhombic and tetragonal to cubic symmetry due to the impact of the crystalline grains size, varying from 39 nm to 137 nm.

The system shows the highest relative content of Fe_2O_3 for 90 min activation time. Further increase in the activation time leads to a decrease in FeO and Fe_3O_4 content and the growth of pure iron content from $t_{activation}$ = 150 min. In the sample activated for 270 min, the Fe content reaches the highest relative value followed by the local maximum of 0.13% in microstrain value and the locally minimal dislocation density of 674 nm^{-2}, indicating the incorporation of iron from its oxide phases into the barium-titanate matrix.

The complex dielectric permittivity reaches the lowest of 176.9 pF/m in the sample activated for 90 minutes and the highest of 918.07 pF/m in the sample activated for 180 min. This sample also shows the highest dissipation factor over the entire frequency band up to 500 MHz, reaching a maximum of 50% at a frequency of 431 MHz.

After the heating to 300 ^{0}C and subsequent cooling to room temperature, the most prominent increase in mass magnetization value of 95% shows the sample activated for 300 min.

P21
Cavitation demage morphology of glass-ceramics based on basalt

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Cavitation is a kind of wear and represents formation, growth and collaps of steam or vapor gas bubbles in a flowing fluid. Collaps of the bubble creates shock waves and micro–jet that are damaging materials in contact with the fluid that flows. It has been shown that the impact formed by collapsing cavitation bubbles cause damage and mass loss of the material, i.e., cavitation erosion. Basalt–based glass ceramics obtained by processes of melting, casting and thermal treatment of the basalt aggregate proved to be suitable for use in conditions of high cavitation loads. The experiment was conducted using an ultrasonic vibration method with stationary sample (ASTM G32 standard). A change in the sample mass in function of the cavitation time was monitored for the evaluation of cavitation resistance. The level of degradation of the sample surface was quantified using the image analysis. The change in the morphology of the sample surface with the test time was followed by scanning electron microscopy. Analyzing the progression of erosion samples of glass-ceramics, it can be concluded that the mass loss is small, for 120 min exposure is 3.53 mg, with a cavitation rate of 0.03 mg/min and total surface damage of the sample of 12%. This technical ceramics shows high resistance to the effect of the cavitation.

P22
The influence of DBD plasma treatment on the dielectric loss tangent and surface morphology of fibrous polymeric materials

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The aim of this work was to investigate the influence of dielectric barrier discharge (DBD) plasma treatment during 30 and 60 seconds on the fibrous polymeric materials made of cotton, polyethylene terephthalate and polypropylene by recording the frequency dependence of the dielectric loss tangent. Furthermore, the changes in the sample surface morphology were observed using scanning electron microscopy (SEM). By comparing the frequency dependence of the dielectric loss tangent, the same trend

with increasing the frequency was noticed for both untreated and treated samples, after 0.5 h as well as 2 and 7 days after plasma treatment. The changes in the value of dielectric loss tangent are small, but it can be noticed that the plasma effect on the cotton sample was maintained after 7 days, which is less noticeable for the samples made of polyethylene terephthalate and polypropylene. The SEM analysis of the cotton sample showed micro cracks on its surface as a result of plasma etching, while the polyethylene terephthalate fibers appeared darker and rough after the plasma treatment. The changes were more obvious on the samples treated 60 seconds compared to samples treated 30 seconds. There are no significant changes in the polypropylene sample surface morphology.

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P23
Characterization of diatomsceous earth from Kolubara mining basin, Serbia

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Diatomaceous earth is of sedimentary origin consists mainly of accumulated skeletons formed as a protective covering of the diatoms. Usually, high absorption capacity of diatomaceous earth provides its wide use as heat insulation, filter, and absorbent material. Starting raw material, diatomaceous earth from surface coal mine Kolubara, Serbia, was characterized using X-ray fluoroscence (XRF), X-ray diffraction (XRD), scanning electron microscopy (SEM) were employed to the phases and microstructure of the diatomaceous earth. In addition, concentrations of activity of natural radionuclides ^{40}K, ^{226}Ra and ^{232}Th and anthropogenic radionuclide ^{137}Cs in diatomaceous earth were determined by gamma spectrometry with HPGe detector. It was found that the activity concentrations were in the range of 150-190 Bq / kg for ^{40}K, 5-12 Bq / kg for ^{226}Ra and 22-33 Bk / kg for ^{232}Th. In all samples, the concentration of anthropogenic radionuclide ^{137}Cs was below the detection limit. This research shows that this material is environmentally safe for further use.

P24
Characterisation of clay from Kolubara mining basin, Serbia

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During coal exploitation in the Kolubara mining basin, Serbia, clay is deposited as accompanying mineral. The aim of the present study is to analyze the activity concentrations of terrestrial (^{226}Ra, ^{232}Th and ^{40}K) and anthropogenic (^{137}Cs) radionuclides in clay collected from Kolubara mining using the high-resolution gamma spectrometer with HPGe detector and evaluate external ionizing radiation exposure in outdoor air. The total absorbed gamma dose was in the range of 39-44 nGy/h. In addition, inductively coupled plasma spectroscopy (ICP), X-ray diffraction (XRD), X-ray fluoroscence (XRF), Scanning electron microscopy (SEM) clay from Kolubara mining basin, Serbia, were used. Also, this study is indicative that clay from Kolubara mining is not a significant source of radiation and is suitable for potential use clay in advanced environmental protection area.

P25

Dielectric properties of biocomposites of polypropylene with of wheat, barley, and cellgran

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The increasing problem of environmental pollution sets the task to develop environmentally-friendly materials from renewable resources that can be easily destroyed or recycled. Inexpensive biomasses like bran or granules from maize cobs have the great potential for use in sustainable bio based composite materials. Biocomposites which consist of biomass and polymers have proved to be a good alternative for conventional non-renewable and limited fossil fuel resources.

In this study, the dielectric properties (effective relative dielectric permeability and dielectric loss tangent) of biocomposites of polypropylene with of wheat, barley and cellgran were studied. Samples of pure isotactic polypropylene, isotactic polypropylene/bran, and isotactic polypropylene/cellgran were prepared using Brabender plastograph and hydraulic hot press. Isotactic polypropylene was blended with various proportions of wheat, barley, and cellgran (20%, 30%, and 40%). Dielectric properties were measured in the frequencies range from 30 Hz to 30 kHz at room temperature of 23 °C. The obtained results showed that samples with biomasses have higher values of dielectric properties in comparison with pure isotactic polypropylene in the entire frequency range. Also, the values of the dielectric properties increase with increasing concentration of biomasses. Furthermore, it was found that increasing frequency provokes the decrease of the dielectric properties of tested samples.

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P26

Is the oscillatory Briggs-Rauscher reaction a new system detector for Li, Na, and K doped tungsten-phosphate bronzes?

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The Briggs-Rauscher (BR) reaction is visually the most interesting oscillating reaction, in which the oxidation of malonic acid ($CH_2(COOH)_2$) by a mixture of hydrogen peroxide (H_2O_2) and iodate (KIO_3) is catalyzed by metal ion (usually Mn^{2+}) in acidic aqueous solution. In this paper, the influence of Li, Na, K doped tungsten-phosphate bronzes on BR oscillatory dynamics was investigated. The same mass (0.07 g) of Li, Na, K doped bronzes were added to the BR reaction solution consisting of 7 ml $[CH_2(COOH)_2]$=0.28 M,

5 ml [$MnSO_4$]=0.04 M, 5 ml [$HClO_4$]=0.15 M, 5 ml [KIO_3] =0.38 M, 3 ml [H_2O_2]=9.80 M. The obtained results were compared with basic BR oscillogram, as well as with oscilogram obtained in the presence of undoped tungsten-phosphate bronze. According to the obtained results, the effects of doped bronzes on the BR oscillatory dynamics can be divided into two groups:

i) the reduction of oscillatory period duration and

ii) the drastically change of the form of BR oscillogram,

when doped tungsten-phosphate bronze presence compared to basic oscillogram, or oscillogram with undoped tungsten-phosphate bronze added. The results revealed that BR oscillatory reaction could be used as an innovative method for distinguishing of Li, Na and K doped bronzes.

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P27
Corrosion of coal fly ash glass

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The increasing production of coal fly ash waste from thermal power plants has compounded environmental and economical problems worldwide. Considerable research has been undertaken because of the environmental problems presented by the fly ash. The goal is to produce usable material from waste. The aim of this paper is to produce glass from fly ash and limestone that will have high resistance to dissolution and leaching. Obtained glass could have wide application in industry.

Coal fly ash was mixed with 37% limestone and melted in electric furnace at T=1500 °C during t=1 h. The obtained glass sample was black, without visible residual gas bubbles. X-ray powder diffraction (XRD) analysis confirmed the quenched melt to be amorphous.

To determine the chemical durability, glass sample was crushed and then sieved to grain size of 0.3-0.5 mm. The corrosion test was performed in a distilled water, HCl, and NaOH solutions (0.01 M) at T = 95 ^{0}C for t =2h using 2 g of samples and 70 ml of solution.

The results of corrosion test revealed a high durability of the glass sample. Potential application of this material would include use as: building blocks, anticorrosive container lining, matrix material in which radioactive wastes and heavy metals could be successfully solidified into the glass structure.

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Characterization of different bioactive phosphate glasses

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Due to their potential bioactive properties, different types of phosphate based glasses have been considered for bone tissue engineering and drug delivery applications. In this experiment, four different compositions of glasses ($42P_2O_5{\cdot}40CaO{\cdot}5SrO{\cdot}10Na_2O{\cdot}3TiO_2$, $46P_2O_5{\cdot}40CaO{\cdot}SrO{\cdot}10Na_2O{\cdot}3TiO_2$, $42P_2O_5{\cdot}40CaO{\cdot}5La_2O_3{\cdot}10Na_2O{\cdot}3TiO_2$ and $46P_2O_5{\cdot}40CaO{\cdot}La_2O_3{\cdot}10Na_2O{\cdot}3TiO_2$ (mol %)) were obtained by standard melt-quenching method. The crystallization and sintering behavior of glasses have been studied by using DTA, HSM and XRD methods. For all of the glass compositions the sintered phosphate glass-ceramic samples contained certain bioactive phases (α-$Ca_3(PO_4)_2$, β-$Ca_3(PO_4)_2$, β-$Ca_2P_2O_7$, β-CaP_2O_6). Based on the glass properties, the use of these glasses in obtaining the bioactive glass scaffolds with a suitable interconnected porous structure is achievable. Bioactive scaffolds have potential to aid the bone regeneration process by giving cell a temporary template to grow into, provoking bone cell activity. Also, glasses with stable uniform porous structure and high surface area can be used as porous carriers for controlled drug delivery.

P29

Nanomaterials application in Dentistry

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Biomaterials in medicine and dentistry is a relatively new phenomenon dating back to the 1950's yet, today, an estimated 20 million individuals have an implanted medical device. Nanotechnology is matter at nanometer level and the application of the same to medicine is called nanomedicine. This technology, which deals with matter in nanodimensions, has widened our views of poorly understood health issues and provided novel means of diagnosis and treatment. Researchers in the field of dentistry have explored the potential of nanoparticles in existing therapeutic modalities with moderate success. In regards to biomaterials, nanotechnology has gained an increasing interest by researchers, particularly in case of dental implants. This is mainly due to the impact of nanoparticles on host responses at both cellular and tissue levels. The growing interest in the dental applications of nanotechnology is leading to the emergence of a new field called nanodentistry. Dentistry is frequently facing revolutions in order to provide a most reliable and comfortable therapeutic options for the patients. Recently nanotechnology has emerged as a new science exploiting specific phenomena and direct manipulation of materials on nanoscale. Application of nanotechnology in dentistry holds promise for the maintenance of comprehensive dental care by employing nanomaterials including tissue engineering and ultimately nanorobots.

P30

Hydrogen production with Ni-based LDH derived catalysts

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The hydrogen purification is a key point to prevent the CO catalyst poisoning effect in the fuel cell anode technology. The conversion of CO by water vapor, named water-gas shift reaction (WGSR) is one of the economic routes traditionally applied for reduction of CO and production of pure hydrogen. In this context, the development of highly active and stable catalysts for efficient upgrading H_2-rich gas streams for fuel cells applications is of primary importance.

The aim of this work was to combine the favorable features of NiAl layered double hydroxides (LDHs) and supported gold nanoparticles in design of novel catalytic systems of improved efficiency for WGSR. The structure, texture and catalytic behavior of the co-precipitated NiAl (Ni^{2+}/Al^{3+}=2.5) and Mg-doped NiAl ((Ni^{2+}+Mg^{2+})/Al^{3+}=2.5) samples were compared with those of the same Au-promoted materials by means of XRD analysis, N_2 physisorption and activity test.

It was found that hydrogen production by WGSR is strongly affected by the amount of nickel in the catalysts. The availability of nickel in both Ni^{2+} and Ni^{3+} oxidation states on the catalyst surface as well as the adsorption and activation of CO molecule on the gold particles contributed to improve WGS performance.

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Application of the Ti-doped carbon nanohybrids for wastewater purification from dyes

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Carbon nanotubes (CNTs) have exceptional properties of tubular structure such as aspect surface-to-volume ratio, mechanical strength, electrical and thermal conductivity, which undertake them in numerous applications such as manufacture of membranes, ceramics, electronic devices, fuel cells, and thermal insulators. The attractive application of CNTs is for wastewater purification from dyes due to of their superior properties.

The current study deals with concentrate on the preparation of carbon xerogel/carbon nanotubes (CX-CNTs) nanohybrids doped with titanium particles (Ti) as the photocatalyst source in order to get the final product noted as CX-CNTs-Ti. The mass ratio of CX-CNTs/Ti was set to 4:1. The adsorption and photodegradation performances toward the removal of methylene blue (MB) dye from aqueous solutions were determined at dose of photocatalyst nanohybrids 10 and 20 mg and initial concentrations of MB dye 10 and 25 mg/L. The samples were investigated using field-emission scanning electron microscope (FE-SEM), High resolution transmission electron microscopy (TEM) and N2 adsorption-desorption isotherm at 77K.

The study disclosed that the CX-CNTs-Ti nanohybrid exhibits excellent adsorptivity and photoactivity

properties toward the removal of MB dye during dark and visible light conditions. This finding is attributed to the presence of titanium particles coated the surface of CX-CNTs which act as active sites.

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P32

Characterisation and optical properties of unmodified and modified CdSe/ZnS quantum dots in pol(methyl-methacrylate) and 3-mercaptopropyltrimethoxysilane

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The aim of this work is characterization of polymer nanocomposites based on poly (methyl methacrylate) (PMMA) matrix with embedded core-shell CdSe/ZnS quantum dots (QD`s). The modification of CdSe/ZnS quantum dots in PMMA interface was achieved with 3-mercaptopropyltrimethoxysilane (MPTMS). The optical properties and fluorescence of nanocomposite were investigated as consequence of interface modification. The optical properties were analyzed through FTIR and Raman. In polymer nanocomposite was established dipole-dipole bonding between S-H group of silane coupling agent and carbonyl groups of the polymer matrixes. Raman spectrum confirms a presence of alloyed layer at the core-shell interface. Time-resolved laser induced fluorescence measurements confirmed slight blue shift in CdSe/ZnS quantum dots in PMMA composite without interface modification, while there was a slight red shift with modified particles. Oxidation effects in quantum dots were removed with the use of PMMA as a host, and the core remained active, which was confirmed with FTIR analysis and time-resolved laser induced fluorescence measurements.

P33

Generalized Lorentz model description-Caputo-Fabrizio fractional derivative approach, of electrical, dielectric, conductive and magnetic processes in materials

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In this study, generalized Lorentz model is basic one-particle model in the framework of dielectric, conductive and/or magnetic responses of materials.

AC conductivity studies of various $BaTiO_3$ or similar ceramics produced equivalent circuits with impedance spectra, usually within the framework of RCPE elements serial connection (CPE - constant phase element) or Cole element. This element, in the generalized Lorentz model, corresponds to Čaputo fractional derivative, who, as operator, contains a singular integral kernel in itself. However, in the literature,

fractional derivatives with a non singular integral kernels have recently emerged. One of them is a Caputo-Fabrizio fractional derivative.

In this work, physical basics and all three behaviors (dielectric, conductive and magnetic) of materials and their relationships are considered in the case of electric or magnetic alternate fields, which are the tools for experimental measurements.

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Comparative Studies of BCY15 /Ni-Cu and BCY15 /Ni Cermet by Impedance Spectroscopy

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Yttrium-doped barium cerate (BCY15) with perovskite-type structure was used for the preparation of Ni-based BCY15 anode for proton conducting solid oxide fuel cell (pSOFC).

A low-temperature wet chemical approach for integration of Ni or Ni/Cu metallic particles in BCY15 was introduced aiming to avoid the traditional ceramic high-temperature processes. The bimetallic (BCY15/Ni-Cu) and monometallic (BCY15/Ni) powders were characterized by different physical-chemical methods. The electrochemical characterization of the produced cermet was performed by impedance spectroscopy.

The purpose of this work is a deeper insight into the electrochemical performance of the anode materials obtained by the new preparation approach and evaluation of its effectiveness. The kernel is the metallic phase oxidation level during the sintering step performed at high temperature (1250°C) in air. For this purpose comparative study of the reduction process which follows the high temperature sintering was carried out. The analysis of the results shows that in the bimetallic anode electronic conductivity is registered before the reduction while in the Ni-based BCY15 cermet no electronic conductivity is observed. This result shows that the presence of highly conductive Cu brings to lower oxidation which opens possibility for introduction of the wet chemical approach in the preparation of pSOFC.

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P 35

The effect of the initial pH on decolorization and degradation of tartrazine in the reaction with Oxone®, using Co(II) impregnated aluminum-pillared montmorillonite as a catalyst

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Standard clay rich in montmorillonite was modified by means of Na-exchange process and used in pillaring process with $Al(NO_3)_3$ in the presence of NaOH. Obtained pillared clay was impregnated with Co^{2+} using incipient wetness impregnation method, calcined (CoAP) and applied as a catalyst in catalytic oxidation of tartrazine in the presence of Oxone® (peroxymonosulfate). The catalyst was characterized by chemical, XRD and textural analysis. The morphology was monitored by SEM coupled with EDS. The influence of pH of the initial dye solution on decolorization process was investigated in the pH range from 2 to 11 at 50 °C. Decolorization was monitored at wavelength λ=426 nm, using UV-Vis spectroscopy. Above tartrazine pKa (9.4) this peak was shifted to 399 nm. Besides decolorization of tartrazine solution also the formation, followed by degradation of tartrazine oxidation products, was studied. At pH>10 under the same reaction conditions, the process was almost negligible. On the other hand at 6<pH<8 the reaction was the fastest, while somewhat slower for 2<pH<4. CoAP was found to be efficient catalyst in Oxone® induced catalytic degradation of both tartrazine and products of its degradation in the pH range bellow tartrazine pKa.

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P 36

Biomimetic precipitation of calcium phosphate layer on three-dimensional mineral-polymer structures for effective infiltration of osteogenic factors

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This work aimed at solving the fundamental problem of modifying the surface of mineral - polymer materials by biomimetic application of active calcium phosphates for the effective adsorption of growth factors. The method of deposition of calcium phosphate on the material includes the stage of formation of the biomimetic active layer of amorphous calcium phosphate on the surface. The formation of such a layer is initiated by the transition of calcium and phosphorus ions through buffer solutions, which simulate the composition of the extracellular fluid of the body. Because of a change in the product of ionic activities in a liquid and with the presence of corresponding centers, calcium phosphate biomimetic crystallization occurs on the surface of the material. Using modern research methods, the effect of solution concentration

and exposure time on the surface microstructure, phase composition and properties of materials has been established. In the course of the project, experimental three-dimensional samples based on sodium alginate and calcium phosphate (granules TKF and OKF) were obtained. The effect of pretreatment of the surface of mineral - polymer matrices with weakly concentrated solutions of acids - various concentrations, processing time on the formation of the surface layer of calcium phosphate is studied.
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P 37
Electrochemical oxidation of glucose on cobalt – clay based electrode

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This work describes the application of novel non-enzymatic electrode material based on pillared clay modified with cobalt (CoAP) to catalyse the electrochemical oxidation of glucose. The incorporation of cobalt species into previously aluminium pillared clay was performed using incipient wetness impregnation method. The final product was characterized by XRD, XRF, SEM and N_2-physisorption. The electrode was prepared by embedding the obtained CoAP into carbon paste electrode. The electrocatalytic performance of the electrode in reaction of electrooxidation of glucose in alkaline solution was evaluated using the cyclic voltammetry. The results showed that the presence of cobalt in pillared clay exhibited enhanced electrocatalytic performance toward glucose oxidation. The experimental conditions such as concentration of OH^- ion and the amount of CoAP in carbon paste were optimized. Three different CoAP:carbon black ratios (30:70, 50:50 and 70:30) and OH^- concentrations (0.1, 0,5 and 1 M) were examined. The highest current response of glucose was obtained using electrode that contained equal amounts of carbon black and CoAP. Also the increase of OH^- ion concentration in glucose solution was beneficial. Evaluation of the CoAP based electrode in analytic detection of glucose under here defined optimal conditions is ongoing.

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P 38
Differences between various types of Zlakusa pottery manufacture

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In a technological sense, manufacture of pottery has evolved with the invention of new industrial processes, but old, archaic ways have not been forgotten. Traditional hand-wheel manufacture is characteristic for some parts of western Serbia, and is still used in Zlakusa. The main goal of this work was to show differences between modern and traditional ways of manufacture on the basis of texture, appearance, fracture, and color, applying several techniques. The investigation was carried out on three samples manufactured differently by hand-turned wheel, electrically powered wheel and casted from a mold. Observing the samples, there were significant differences in color especially after firing, presence of horizontal lines or absence of such, followed by smoothness or roughness of the surface. Application of dark-field microscopy gave a numerical representation of mentioned surface differences, while color specification shows differences in temperature regime and atmospheric conditions in the furnaces. Further investigation is needed in an effort to investigate mineral phases that are occurring after sintering and their differences in terms of manufacture processes.

P 39

Thermal and Thermomechanical Properties of Organic-Inorganic Nanocomposites Prepared from Polyurethane Network and Mesoporous Silica Nanoparticles

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Polyurethane (PU) networks based on poly(dimethylsiloxane) (PDMS) and hyperbranched polyester (HBP) possess unique properties such as chemical stability, good thermal behavior, good surface and mechanical properties, making these materials good candidates for coating applications. The silica addition in polymer typically leads to a significant improvement of mechanical and thermal properties due to good filler dispersion, good compatibility with the matrix, and the presence of a strong interaction between reinforcements and the polymer matrix.

In this paper, polyurethane-mesoporous silica nanocomposites (PU-MSNs) were prepared in the form of films, from hydroxyl-terminated PDMS, 4,4'-methylenediphenyl diisocyanate and HBP of the second pseudogeneration as the precursors. PU-MSNs, having 50 wt. % of the soft PDMS segment, were prepared containing 1 wt% of different type of MSNs (MSN with non-modified surface and surface-modified MSNs, with 3-(trihydroxysilyl)propyl methylphosphonate (FOMSN) and 2-[methoxy(polyethyleneoxy)6-9propyl]trimethoxysilane (PEGMSN)). Thermal properties of PU-MSN films were investigated by DSC and TGA, while thermomechanical properties were determined by DMTA. The glass transition of hard segment of PUS-MSNs was higher than that of pure PUS network, implying that PUS-MSNs exhibit higher degree of microphase separation. Thermal stability of the prepared PUS-MSNs was improved with addition of the mesoporous nanosilica nanoparticles as compared to pure PUS network. The PU-MSN films prepared with surface-modified MSNs feature better thermal and thermomechanical properties in comparison to materials obtained using non-modified MSN.

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Analytical modeling of ICP-OES and XRF procedures for detection of the main elements in traditional brick clays

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Comparison of two instrumental analytical techniques, i.e. X-ray fluorescence (XRF) and inductively coupled plasma-optical emission spectrometry (ICP-OES), for measuring of the concentrations of major elements (Si, Al, and Fe) found in the traditional brick clay was conducted. Sixty-nine samples of clays from various Serbian deposits were analyzed and characterized in order to evaluate the possibility of

their employment as a raw material in the ceramic industry. Concentrations of Si, Al and Fe in clays were primarily determined using ED XRF analyzer. ICP-OES analysis on digested clays (using a microwave-assisted combination of nitric, hydrochloric and hydrofluoric acids digestion) was applied to confirm XRF data. The analytical modeling of the obtained results showed that concentrations of Si, Al and Fe determined via XRF method correlated with high linearity with concentrations of Si, Al and Fe acquired by ICP-OES measurements. Statistical F-test and t- test applied on the data of both methods showed very small differences between results obtained by these two techniques. Namely, the results of ICP-OES analysis confirmed XRF measurement of concentrations of Si, Al and Fe in investigated clays, which suggests that XRF is a quick and good alternative for the chemical analysis that allows much larger sampling regimes in relatively shorter times.

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Fractal nature and porosity of bio-ceramics

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Hydroxyapatite scaffold is a type of bio-ceramic. These bio-ceramics and its cellular design have similarities with the morphologies in nature. From these points of view, is very important to control the structure, especially the porosity which is very important for bio-ceramics applications. We analyzed the porosity by fractal nature characterization, and successfully reconstructed pore shape, which is important for predicting ceramic morphology. We applied SEM analysis on bio-ceramic samples, with different five magnifications for the same pore structure. This is important for fractal analysis and pores reconstruction. As a part of characterization, we calculated the fractal dimensions based on measurements. On this way we completed the fractal characterization of porosity and confirmed possibilities for successful porous shapes reconstruction. In this paper we confirmed, the firs time, fractal nature successful application in the area of bio-ceramics.

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2D Fractal interpolation by IFS and microorganisms Brownian motion

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In this paper we will consider Fractal Interpolation Function (FIF) based on the theory of Iterated Function Systems (IFS), applied on sub-microorganisms motion. This is a part of idea to recognize some biomimetics similarities in motion of microorganisms applicable for electronic particles Brownian character of fluctuations in ceramics materials. We extended our fractal nature analysis based on this phenomenology in nature. We had some samples of microorganisms in liquid medium. The area of experiments was under the influences of energy impulses like mechanical vibrations, even the energy influences when we apply the music in area around the samples. It was recognized the Brownian motion character in experimental

fluctuation. There is a great interest for new ideas development how to control transformation of electronic particles chaotical Brownian fluctuations. Here we developed on very important tool for more complex electronic parameters and particles analysis.

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Use of clinker brick in contemporary architectronic buildig facade design

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With the growing awareness of the importance of implementation of adequate design principles, also rise the need for the improvement of environmental and sustainable materials. The material which is specially discussed in this paper is clinker brick, and its use for construction of facades of buildings having different uses.

Brick as a material has been present in architecture and human living for centuries. This material of outstanding characteristics has been permanently developing. Clay is the basic and main constituent of each brick. Due to such composition and continuous development of products, facade bricks meet the growing demands of modern life and provide optimum construction of the facade. Apart from that, they meet the corresponding esthetic criteria and requirements.

Clinker brick is obtained from the fired clay at temperatures over 1.000 degree Celsius. Sintering closes the pores, which makes clinker bricks almost completely water non-absorbent. It makes it extremely resistant and insensitive to high temperatures, frost and chemical agents. Clinker brick is a warm and agreeable natural product. It is an environmental building material. Its durability is very long, estimated to more than 100 years. It absorbs heat very well, it can be used multiple times and be recycled. Clinker brick is available in multiple colors and forms of various surface structures. Natural, ceramic color of clinker brick, which is generated during the firing process, it is durable and does not fade in time.

Clinker bricks are resistant and architectonically adaptable, which makes them ideal cladding for façade surfaces. They can be combined with different materials. They achieved the level of quality which can meet different requirements and technical standards. Also, by combining various types of façade bricks, it is possible to form complex designs of façade surfaces. Thus, building corners can be rounded, each entrance can be separately designed, while the arches above the windows or doors can also be distinctly designed. A considerable visual effect on the façade is achieved by different brick patterns. This makes possible the distinctive design of facades, which acquire originality.

The paper shows some of the prominent examples of facades constructed using clinker bricks.

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The fractal nature analysis applied on grain formation SAC305/OSP Cu and SAC305-0.05Ni/OSP Cu solder joints

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The first time that we have application of fractals on alloys. In this case we used alloys SAC305/OSP Cu and SAC305-0.05Ni/OSP Cu solder joints. The samples have been prepared on our standard technological procedure. Diameter of balls: 250~300 microns, conditions of solder balls: SAC305 (Sn-3.0Ag-0.5Cu (wt%)), SAC305-0.05Ni. Also, we have used OSP (Organic Solderability Preservative) Copper substrate and IMCs (Intermetallic Compounds) form inside the solder ball and at the interface between ball and substrate. We were adding Ni alters the grain structure of solder balls and the formation of IMCs. We shaped of IMCs at the interface transfer from scallop type to layer type. Three interpenetrating columnar arrows are used to indicate that dendrites grow and converge at 60 angles to fill the space in a valley. Thus, dendrites from each twin orientation will "interlace" with the others to fill space. We prepared microstructures with five different magnifications for further fractal analysis. The results confirmed successful application of fractals in this area of materials science alloyed, by the grains and shapes reconstructions and fractal dimensions analysis.

P 45

The neural networks idea applied on fractal microelectronics inergranular relations

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Artificial neural networks present structures which basically map input-output data. They are applied on data clustering, pattern recognition, signal noise reduction. They are established in the manner signals are processed in biological neural networks. Signals are processed using elements which represent artificial neurons. Each neuron has a simple function to process input signal, as well as adjustable parameter which has an influence to change output signal. Massive parallelism in signal processing is applied. Total neural network output presents the sum of large number neurons outputs. Main idea of this paper is to connect fractal nature analysis results and neuron networks. Based on our previous research, there is a intergranular microimpedance where it is introduced the complex fractal correction. There is very important interests to connect all of these microimpedances by neural network with the goal to compare the results in the frame of standard bulk sample measurements and fractal nature microelectronics phenomenology.

P 46
Friction at Nanoscale

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In many technical fields a contact between two surfaces is very important and often the subject of research. The numerous physical phenomena that occur at the contact between two materials indicate the complexity of the processes that take place at the macro, micro or nanoscale. Therefore, friction, lubrication and wear are the subjects that have been attracting attention for many years, especially as part of tribological investigations. The research has shown that these three components are of fundamental importance for surfaces in contact. The aim of this research is to describe friction, and lubrication as a process to control friction, especially at the atomic level. At the atomic and molecular scale there is apossibility to form very thin film with the property to spontaneously assemble themselves into ordered structures. One of the procedures to make these ultrathin organic films of controlled thickness is to prepare self-assembled monolayers. These monolayers are described as a model system to study boundary lubrication.

P 47
High Frequency Magnetoimpedance Characterization of Fe-based Amorphous Wires

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In this work magnetoimpedance (MI) effect of Fe-based amorphous wires with nominal composition $Fe_{73}Cu_1Nb_3Si_{13.5}B_{9.5}$ is presented. The MI measurements were performed in the longitudinal direction of $\boldsymbol{l}$ = 15mm long and $\boldsymbol{d}$ = 150 mm of diameter samples. The impedance was measured by LCR HiTester by four-point method in an axial magnetic field produced by Helmholtz coils. MI effect is dependent on a skin-effect penetration depth $\boldsymbol{d_m}$, i.e. on the driving frequency $\boldsymbol{f}$ as well as on the external magnetic field $\boldsymbol{H_{ex}}$.

MI ratio defined as $DZ / Z = [Z(H_{ex}) - Z(H_{max})] / Z(H_{max})$ was investigated in dc magnetic field up to the maximum value of H_{max} = 7.42 kA/m. The frequency of MI-effect measurements ranged from 50 Hz to 4.5 MHz and sinusoidal current amplitude was $\boldsymbol{I_{cc}}$ = 7 mA.

Critical frequency of about 30 kHz (when $\boldsymbol{d_m} \approx \boldsymbol{d}/2$) was noticed as the point with the initial increase of the MI-effect. As the maximum MI effect was observed at f = 700 kHz, the high frequency magnetoimpedance characterization at $\boldsymbol{f} \in$ (700 kHz, 4.5 MHz) were performed.

Correlation between MI effect with electromagnetic skin effect i.e. penetration depth were examined. Possible applications as a weak magnetic field sensor were discussed in the sense of the anisotropy field H_k increase with driving frequency increase.

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Isotope – like effect in $YVO_4:Eu^{3+}$ nanopowders

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The yttrium orthovandate (YVO_4) belongs to the group of important metal vanadates, MVO_4 (M = Bi, Y, Fe, Cr, In, etc) because of its wide range of applications, especially in photonics [1,2]. Excellent thermal stability, robustness and other physicochemical properties of YVO_4 ensured it to be a very used material in optical devices [3]. Very convenient thing about YVO_4 is that it is a attractive host material that could be well excited under UV light irradiation i.e. the vanadate group, $V^{5+} – O^{2-}$ in $YVO_4:Eu^{3+}$ is excited and in that way phonon energy is transferred to the doped rare – earth (RE) ions. [4]
In this paper we describe synthesis and characterization of YVO_4 and Eu^{3+} doped YVO_4 nanopowders. Two methods of preparation were used - Solution Combustion synthesis and Classical Ceramic method and compared. Morphology and structure of all samples were characterized with AFM and XRD. Raman spectroscopy was used to discuss the isotope effect. It is confirmed that doping with Eu ions results in change of Raman spectra of doped samples - new modes arise and intensity of existing ones change. Influence of different preparation methods on isotope effect is presented with detailed calculations of shifted modes.

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P 49

Kinetic and thermodynamic study of titanium hydride (TiH_2) dehydrogenation process

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Titanium is known to have a large affinity for hydrogen. Hydrogenation leads to the formation of titanium hydrides which present different stoichiometry such as TiH_2, TiH, $TiH_{1.5}$ [1]. TiH_2 is mainly used in pyrotechnic and metallurgical areas, hydrogen storage media [1] and for preparation of the hydrogenated titanium alloys and ceramics based composites with biomedical applications [2]. Therefore, the TiH_2 dehydrogenation process is important to be studied from the kinetic point of view, in order to understand the processes undergoing and to further develop the above mentioned applications; however, until now the TiH_2 dehydrogenation kinetics is not clear and needs supplementary investigation.

The non-isothermal dehydrogenation of TiH_2 powder was studied using thermogravimetry (TG) and differential scanning calorimetry (DSC) in the temperature range 25 – 900 °C, at the heating rates of 5,

7, 10, 12 and 15 K/min. Commercial TiH_2 (100-150 mm; water atomised; >98 %; Merck) was used in this work. TiH_2 was structurally and morphologically characterized by X-ray diffraction and scanning electron microscopy (SEM).

The TiH_2 mass rapidly decreases between 474 °C and 670 °C due to the release of hydrogen, with a maximum rate of decomposition at 579 °C corresponding to a sharp peak on the DTG curve (at 10 K/min). Above 670 °C (when the remaining mass was about 98.6% of gross mass), the TG curve indicates the gain in mass due to the slight oxidation of Ti in the presence of the oxygen incorporated in Ti network. The results showed that upon heating TiH_2 undergoes a series of transformations in a three-step process. The kinetic parameters corresponding to these transformations were studied by advanced kinetic methods [3] (isoconversional, IKP, Prez-Maqueda *et al.* criterion and Master plot) and reported here; also, the TiH_2 dehydrogenation "activation" thermodynamic parameters were calculated.

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P 50
Impact resistant bio-modified epoxy

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Growing need for high performance materials has raised environmental concerns and turned research community towards natural, renewable resources. This research presents bio-modified epoxy that exhibits high impact and thermal resistance. Scanning electron microscopy (FESEM) and infrared spectroscopy with Fourier transformation (FTIR) were performed in order to prove morphological and structural changes in epoxy, giving some new insight in load transfer during impact and disappearance of bonds in epoxy due to the addition of honey. Energy controlled impact test has been performed to compare impact energy absorption between new material and pure epoxy. The results have shown that bio-modified epoxy can withstand several impacts with full recovery, while pure epoxy breaks at first impact. In addition, absorbed energy values increased during four impacts, after which they started to decrease. Thermal analysis performed in the range from 30 to 500 ˚C revealed increased stability in bio-modified epoxy. Presented results revealed high potential of synthesized material, and could broaden the use of epoxies without synthetic reinforcements.

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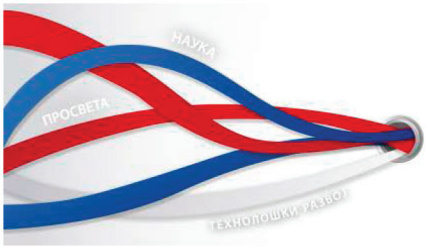

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