The Serbian Ceramic Society
Vinča Institute of Nuclear Sciences, University of Belgrade
Institute for Multidisciplinary Research, University of Belgrade
Institute of Physics, University of Belgrade

PROGRAM AND THE BOOK OF ABSTRACTS

1st Conference of the Serbian Ceramic Society

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Belgrade, Serbia
1CSCS-2011

Edited by:
Snežana Bošković
Zorica Branković
Jasmina Grbović Novaković

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PROGRAM:

THURSDAY, 17.03.2011. NEW BELGRADE MUNICIPAL HALL

8^{00}-9^{00} **REGISTRATION**

9^{00} -9^{30} **OPENING CEREMONY**

9^{30} - 10^{00} COCKTAIL

Chairman: S. Bosković, Z. Dohčević-Mitrović

10^{00} - 10^{45} ***Plenary lecture***

Marija Kosec
POLAR CERAMICS: NEW APPLICATIONS, NEW COMPOSITIONS, NEW STRUCTURES
Electronic Ceramic Department, Jozef Stefan Institute, Ljubljana, Slovenia

1. Synthesis and Processing

Chairman: S. Bosković, Z. Dohčević-Mitrović

10^{45} - 11^{15} ***Invited lecture***

Aleksandar Rečnik[1], Nina Daneu[1], Thomas Walther[2], Takashi Yamazaki[3], Masahiro Kawasaki[4] and Werner Mader[2]
STRUCTURE AND CHEMISTRY OF BASAL-PLANE INVERSION BOUNDARIES IN Sb_2O_3-DOPED ZnO
[1]Jozef Stefan Institute, Ljubljana, Slovenia,
[2]Anorg. Chemie, Univ. Bonn, Bonn, Germany,
[3]Depr. of Physics, Tokyo University of Science, Tokyo, Japan,
USA Incorporation, Peabody, Massachusetta, USA

Oral presentations

11^{15} - 11^{30} **Branko Matovic, Biljana Babic, Milena Rosic, Jelena Dukic, Ana Radosavljevic-Mihajlovic, Snezana Boskovic**
SYNTHESIS AND CHARACTERIZATION OF (Ba, Yb) DOPED CERIA ELECTROLYTES
Vinca Institute of Nuclear Sciences, Materials Science Laboratory, Belgrade Serbia

11^{30} - 11^{45} **B.M. Jović, U. Lačnjevac, V.D. Jović**
THE NON-NOBLE METAL COMPOSITES AS CATODES FOR HYDROGEN EVOLUTION: Ni-MoO_x COATINGS
Institute for Multidisciplinary Reserach, Belgrade, Serbia

11^{45} - 12^{00} **Coffee break**

Chairman: **V. Srdić, V. Urbanovich**

12^{00} - 12^{15} **U. Lačnjevac, B.M. Jović, V.D. Jović**

THE NON-NOBLE METAL COMPOSITES AS CATODES FOR HYDROGEN EVOLUTION: Ni-MoO_2 COATINGS
Institute for Multidisciplinary Reserach, Belgrade, Serbia

12^{15} - 12^{30} P. **Gautham, M. Winterer**
SPARK PLASMA SINTERING
Technische Institut Universitaet Darmstadt, Germany

12^{30} - 12^{45} **Anja Došen[1], Rossman Giese[2]**

THE ADVANTAGES OF THE THERMAL X-RAY DIFFRACTION: BRUSHITE EXAMPLE
[1]Department of material science, INS Vinca, Serbia,
[2]Geology Department, State University of New York at Buffalo, USA

12^{45} - 13^{30} **Lunch break**

13^{30} - 14^{30} **Poster session (C1-C3)**

2. Ceramics Nanostructures

Chairman: **G. Branković, S. Bernik**

14^{30} - 15^{00} ***Invited lecture***

Vladimir Urbanovich
THE INVESTIGATIONS IN THE FIELD OF NANOSTRUCTURED BULK MATERIALS BASED ON HIGH-MELTING POINT COMPOUNDS OBTAINED BY HIGH PRESSURE SINTERING
Scientific-Practical Materials Research Centre NAS of Belarus, Minsk, Belarus

Oral presentations

15^{00} - 15^{15} **Sanja Milošević, Željka Rašković, Sandra Kurko, Ljiljana Matović, Nikola Cvjetićanin, Jasmina Grbović Novaković**
THE INFLUENCE OF VO_2 ON HYDROGEN DESORPTION PROPERTIES OF MgH_2
[1]Material science Laboratory, Vinča Institute of Nuclear Sciences, Serbia,
[2]Faculty of Physical Chemistry, University of Belgrade, Serbia

15^{15} - 15^{30} **Marko Radović, Zorana Dohčević-Mitrović, Aleksandar Golubović, Zoran V. Popović**
SPECTROSCOPIC ELLIPSOMETRY INVESTIGATION AND MODELING OF BAND GAP IN Fe DOPED CERIA NANOPARTICLES
Center for Solid State Physics and New Materials, Institute of Physics, Belgrade, Serbia

15^{30} – 15^{45} **Lidija Mancic, Katarina Marinkovic, Ivan Dugandzic, Vesna Lojpur, Olivera Milosevic**
SOFT CHEMISTRY ROUTES FOR SYNTHESIS OF 3D AND 1D NANOSTRUCTURES
Institute of Technical Science of Serbian Academy of Sciences and Arts, Serbia

15^{45} - 16^{00} **Coffee break**

3. Structural Ceramics and Bioceramics

Chairman: **T. Volkov-Husović, B. Babić**

16^{00} - 16^{30} ***Invited lecture***

Krzysztof Haberko, Radoslaw Lach
CERAMIC MATRIX COMPOSITES IN ALUMINA AND YAG SYSTEM- PREPARATION AND PROPERTIES
Department of Special Ceramics, AGH University of Science and Technology, Krakow, Poland

Oral presentations

16^{30} - 16^{45} **Marijana Majić, Lidija Ćurković**
FRACTURE TOUGHNESS OF ALUMINA CERAMICS DETERMINED BY INDENTATION TECHNIQUE
Faculty of Mechanical Engineering and Naval Architecture, University of Zagreb, Croatia

16^{45} - 17^{00} **Dusan Bucevac, Biljana Babic, Snezana Boskovic**
EFFECT OF HEAT TREATMENT ON MECHANICAL PROPERTIES OF SiC-TiB_2 COMPOSITES
Department of material science, INS Vinca, Serbia

17^{00} - 17^{15} **Ivan Djordjevic[1], Namita Roy Choudhury[2], Naba Dutta[2], Sunil Kumar[2], Endre Szili [3], David Steele[3]**
BIODEGRADABLE CITRIC-ACID BASED POLYESTER ELASTOMERS FOR TISSUE ENGINEERING APPLICATIONS
[1]Institute for Multidisciplinary Research, University of Belgrade,
[2]Ian Wark Research Institute, University of South Australia,
[3]Mawson Institute, University of South Australia

FRIDAY, 18.03.2011, NEW BELGRADE MUNICIPAL HALL

8^{00} - 9^{00} **REGISTRATION**

Chairman: **Z. Popović, K. Haberko**

9^{00} - 9^{45} ***Plenary lecture***

J.C. Schoen, A. Hanneman, M. Jansen
MODELING STRUCTURE AND PROPERTIES OF AMORPHOUS SILICON BORON NITRIDE CERAMICS
Max-Planck Institute for Solid State Research, Struttgart, Germany

4. Theoretical Modelling

Chairman: **Z. Popović, K. Haberko**

Oral presentations

9^{45} – 10^{00} **D.Zagorac, J.C. Schön, I. Pentin, M. Jansen**
STRUCTURE PREDICTION AND ENERGY LANDSCAPE EXPLORATION IN THE ZINC OXIDE SYSTEM
Max Planck Institute for Solid State Research, Stuttgart, Germany

10^{00}- 10^{15} **Radojka Vujasin[1], Milan Senćanski[2], Miljenko Perić[3]**
THEORETICAL INVESTIGATION OF THE STRUCTURE OF BC_2
[1]Department of Material Sciences, VINČA Institute of Nuclear Sciences, University of Belgrade, Belgrade, Serbia,
[2]Innovation center of the Faculty of Chemistry, University of Belgrade, Belgrade, Serbia,
[3]Faculty of Physical Chemistry, University of Belgrade, Belgrade, Serbia

10^{15} – 10^{30} **Igor Stankovic[1], Aleksandar Belic[1], Milan Zezelj[1], Aleksandar Golubovic[2], Maja Scepanovic[2]**
MODELING OF AGGLOMERATION DYNAMICS OF NANO-PARTICLE SUSPENSIONS
[1]Scientific Computing Laboratory, Institute of Physics, University of Belgrade, Belgrade, Serbia
[2]Center for Solid State Physics and New Materials, Institute of Physics, University of Belgrade, Belgrade, Serbia

10^{30} – 10^{45} **Coffee break**

5. Electroceramics and Solid Oxide Fuel Cells

Chairman: **B. Stojanović, M. Kosec**

10^{45} – 11^{15} ***Invited lecture***

Bernik Slavko[1,2],Matejka Podlogar,[1,2] Nina Daneu[1,2], Aleksandar Recnik[1,2]
LOW-DOPED ZnO-BASED VARISTOR CERAMICS WITH BROAD RANGE OF BREAK-DOWN VOLTAGES
[1]Jozef Stefan Institute, Ljubljana, Slovenia,
[2]Center of Excellence NAMASTE, Ljubljana, Slovenia

11^{15} – 11^{45} ***Invited lecture***

Victor Fruth[1], Eniko Volceanov[2], Cristian Andronescu[1], Rares Scurtu[1], Silviu Preda[1], Zorana Dohcevic-Mitrovic[3], Zoran Popovic[3]
PREPARATION AND CHARACTERIZATION OF DOPED LANTHANUM GALLATE (LSGM) ELECTROLYTE IN ACTIVATED MICROWAVE FIELD
[1]Institute of Physical Chemistry Ilie Murgulescu, Bucharest Romania,
[2]Metallurgical research Institute, ICEM SA Bucharest, Romania,
[3]Institute of Physics, Center for Solid State Physics and New Materials, Belgrade, Serbia

Oral presentations

$11^{45} – 12^{00}$ **Milan Zunic[1], Aleksandar Radojkovic[1], Zorica Brankovic[1], Goran Brankovic[1]**
SYNTHESIS AND CHARACTERIZATION OF ANODIC SUBSTRATES FOR IT-SOFCs BASED ON PROTON CONDUCTORS
[1]Institute for Multidisciplinary Research, Belgrade, Serbia

$12^{00} – 12^{15}$ **G. Branković[1], Z. Marinković Stanojević[1], Z. Jagličić[2], M. Jagodič[2], L. Mančić[3], A. Rečnik[4], Z. Branković[1]**
MECHANOCHEMICAL SYNTHESIS OF PURE AND DOPED BISMUTH MANGANITE MULTIFERROICS
[1]Institute for Multidisciplinary Research, Belgrade, Serbia
[2]Institute of Mathematics, Physics and Mechanics, Ljubljana, Slovenia
[3]Institute of Technical Sciences SASA, Belgrade, Serbia
[4]Jozef Stefan Institute, Ljubljana, Slovenia

$12^{15} – 12^{30}$ **Matejka Podlogar[1,2], Jacob J. Richardson[3], Nina Daneu[1,2], Aleksander Rečnik[1,2], Damjan Vengust[1], Slavko Bernik[1,2]**
LOW-TEMPERTATURE AQUEOUS SYNTHESIS AND CHARACTERISTICS OF TRANSPARENT ZINC OXIDE FILMS ON GLASS SUBSTRATE
[1]Jožef Stefan Institute, Ljubljana, Slovenia,
[2]Center of Excellence NAMASTE, Ljubljana, Slovenia,
[3]Materials Department, University of California, Santa Barbara, USA

$12^{30} – 12^{45}$ **Coffee break**

6. Silicates, Refractories, Cements and Traditional Ceramics

Chairman: **M. Komljenović, B. Matović**

Oral presentations

$12^{45} – 13^{00}$ **Z. Baščarević, Lj. Petrašinović-Stojkanović, M.Komljenović, N. Jovanović, V. Bradić**
APPLICATIONS OF FLY ASH AS A SECONDARY RAW MATERIAL FOR BUILDING MATERIALS PRODUCTION
Institut for Multidisciplinary Research, Belgrade, Serbia

$13^{00} – 13^{15}$ **Vesna Svoboda[1], Radmila Jančić-Heinemann[2], Suzana Polić-Radovanović[1]**
THE ROLE OF EXPERIMENTAL RESEARCH ON CERAMICS IN THE IDENTIFICATION OF INTANGIBLE CULTURAL HERITAGE
[1]Central Institute for conservation in Belgrade, Serbia,
[2]Faculty of Technology and Metallurgy, University of Belgrade, Serbia

$13^{15} – 13^{30}$ **Sanja Martinović[2], Milica Vlahović[2], Marija Dimitrijević[1], Marina Dojčinović[1], Aleksandar Devečerski[3], Branko Matović[3], Tatjana Volkov-Husović[1]**
PROPERTIES OF LOW CEMENT HIGH ALUMINA CASTABLE SINTERED AT 1300 °C
[1]University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia,
[2]Institute for Technology of Nuclear and Other Raw Mineral Materials, Belgrade, Serbia,
[3]Insitute of Nuclear Science "Vinca", Material Science Laboratory, Belgrade, Serbia

$13^{30} – 13^{45}$ **Sanja Martinovic[2], Marija Dimitrijevic[1], Jelena Majstorovic[3], Branko Matovic[4], Tatjana Volkov-Husovic[1]**

MODELING OF STRENGTH DEGRADATION DURING THERMAL STABILITY TESTING OF LOW CEMENT HIGH ALUMINA CASTABLE

[1]University of Belgrade, Faculty of Technology and Metallurgy, Belgrade, Serbia,
[2]Institute of Nuclear and Other Raw Materials,Belgrade,Serbia,
[3]University of Belgrade, Faculty of Mining and Geology, Belgrade, Serbia,
[4]Institute of Nuclear Sciences Vinca, Materials Science Laboratory, Belgrade, Serbia

$13^{45} – 14^{15}$ **Lunch break**

$14^{15} – 15^{15}$ **Poster session (C4-C7)**

15^{00}- 18^{00} Students Speaking Contest

20^{30} **Conference dinner at "Zlatni bokal", Skadarlija**

Dear colleagues,

On behalf of all chairs and members of all committees of 1st Conference of the Serbian Ceramic Society (1CSCS-2011) and The Serbian Ceramic Society, it is our great pleasure to welcome you to Belgrade and Serbia on March 17-18th this year. The Serbian Ceramic Society brings together the scientists and engineers working in the fields of research and application of ceramic materials. In Serbia, ceramics have rather long tradition involving both traditional and advanced ceramics for modern technologies. Scientists, the members of the Society, are dealing also with very attractive topics like nanostructured ceramics and the newest types of ceramic composites. Regular activities of The Serbian Ceramic Society include organizing highly interesting lectures for the members, but also Students Meetings, which have taken place in Novi Sad under the sponsorship of the European Ceramic Society each year since 1998. In addition, the Serbian Ceramic Society publishes, since 2007, the Journal "Processing and Application of Ceramics" which is becoming ever more attractive to authors from abroad. The aim of the 1CSCS-2011 is to allow the scientists to exchange the most recent results and technical advances in the development, characterization and application of ceramic materials in order to foster basic knowledge on those materials and to improve contacts for future scientific cooperation and networks. The Scientific and Organizing Board and The Serbian Ceramic Society cordially invite all our colleagues from around the world to take part in the Conference, and to enjoy the company of colleagues in scientific discussions and during the social events of the Conference. The Student Speaking Contest for young researcher from Serbia in the field of ceramic materials will be organized during this Conference.

President of Program Committee

Dr. Snežana Bošković

THE BOOK OF ABSTRACTS

APPLICATION OF THICK FILM SEGMENTED THERMISTORS AS WATER FLOW SENSORS

Obrad S. Aleksic[1], Maria Vesna Nikolic[1], Branka Radojcic[2], Miloljub D. Lukovic[1], Pantelija M. Nikolic[3]

[1]Institute for Multidisciplinary Research, Belgrade, Serbia
[2]Faculty of Electrical Engineering, University of Belgrade, Serbia
[3]Institute of Technical Sciences of SASA, Belgrade, Serbia

Thick film segmented thermistors were realized by screen printing and firing of $NiMn_2O_4$ nickel manganite paste. Their main properties were measured in a climatic chamber and analyzed by a mathematical/physical model. Two types of water flow sensors were constructed, realized and tested: micro-flow sensor and volume flow sensor. Their construction was based on cold and self-heating segmented thermistors. The self-heated thermistor response to water flow change at different input water temperatures was measured and fitted using the exponential thermistor law. The main sensors parameters such as sensibility turn down ratio and time inertia were defined from the experimental curves. The results obtained were compared with other liquid flow sensors.

PHOTOLUMINESCENCE AND RAMAN SPECTROSCOPY OF Pr-DOPED CERIA NANOCRYSTALS

Sonja Aškrabić, Nenad Lazarević, Zorana Dohčević-Mitrović, Maja Šćepanović, Branko Matović, Zoran V. Popović

Center for Solid State Physics and New Materials, Institute of Physics, Belgrade, Serbia

$Ce_{1-x}Pr_xO_{2-\delta}$ ($0 \leq x \leq 0.2$) nanocrystals were investigated by photoluminescence and Raman spectroscopy. Vibrational modes observed in Raman spectra at ~540cm^{-1} and ~598 cm^{-1} were ascribed to oxygen vacancy induced defect spaces. Photoluminesence measurements were performed with incident photon energy of 2.8 eV. Maximum of the visible light emission found at the energies lying below the band gap originated from defect-induced electronic states. The variation of the position and the intensity of the luminescence band suggested the domination of different type of defect spaces in the samples with lower Pr^{4+} content ($x \leq 0.1$) compared to those with higher one. Raman measurements supported this finding.

FLY ASH UTILIZATION – CONVERTING WASTE MATERIAL INTO USEFUL PRODUCTS

Zvezdana Bascarevic[1], Miroslav Komljenovic[1], Ljiljana Petrasinovic-Stojkanovic[1], Natasa Marjanovic[1], Violeta Nikolic[1], Zoran Miladinovic[2], Mihajlo Rsumovic[3]

[1]Department of materials science, Institute for multidisciplinary research, Belgrade, Serbia
[2]Institute of General and Physical Chemistry, Belgrade, Serbia
[3]Highway Institute, Belgrade, Serbia

Fly ash (FA) is the major combustion residue from coal firing thermal power plants. Only a part of this waste is utilized, mostly by cement and concrete industry, the remainder being placed in dumps. An attractive way to utilize FA is synthesis of a new class of high performance materials for construction, called geopolymers. In this work, geopolymers were synthesized by reaction of FA with highly concentrated alkali and alkali silicate solution. It is shown that the nature of the activating solution plays an important role in development of mechanical and microstructural properties of the geopolymers.

LOW-DOPED ZnO-BASED VARISTOR CERAMICS WITH BROAD RANGE OB BREAK-DOWN VOLTAGES

Bernik Slavko[1,2], Matejka Podlogar[1,2], Nina Daneu[1,2], Aleksander Rečnik[1,2]

[1]Jožef Stefan Institute, Ljubljana, Slovenia
[2]Center of Excellence NAMASTE, Ljubljana, Slovenia

Exceptional current-voltage nonlinearity of the ZnO-based varistor ceramics results from doping of ZnO with varistor dopants in typical amounts 7-10 wt.%. Such compositions are set in accordance to the notion that mechanism controlling the grain-growth is reduced grain-boundary mobility caused by the spinel particles. Spinel-forming dopants such as Sb_2O_3, TiO_2 and SnO_2 also result in the formation of inversion boundaries (IBs) in the ZnO grains. We have identified an IB-induced grain-growth mechanism which primarily controls the microstructure development. Exploiting it we prepared varistor ceramics with break-down voltages ranging from 60 to 350V/mm at addition of only about 3 wt.%. of varistor dopants.

RELAXOR BEHAVIOR OF $BaBi_4Ti_4O_{15}$

J.D.Bobić[1], M.M.Vijatović Petrović[1], S. Greičius[2], J. Banys[2], B.D.Stojanović[1]

[1]Institute for Multidisciplinary Research, University of Belgrade, Serbia
[2]Faculty of Physics, Vilnius University, Lithuania

Dense $BaBi_4Ti_4O_{15}$ ceramics were prepared by conventional solid state reaction from appropriate oxide mixture. Dielectric properties were investigated in a wide range of temperatures and frequencies. A modified Curie-Weiss relationship is used to study the diffuseness behavior of a ferroelectric phase transition. The dielectric relaxation rate follows the Vogel-Fulcher relation with $E_a = 0.013$ eV, $\nu_0 = 2.09 \times 10^8$ Hz and $T_f = 651$ K. Impedance investigations show only a single semicircle which can be ascribed to the grain component for all investigated temperatures. The calculated values of activation energy E_a is 1.02 eV.

THE CORRELATION BETWEEN THE INITIAL CERAMIC PARTICLES AND FINAL PRODUCTS

Milesa Srećković[1], Željka Tomić[2], Zoran Fidanovski[3], Stanko Ostojić[4], Predrag Jovanić[5], Ljubomir Vulićević[6],Aleksandar Bugarinović[7], Bojana Bokić[8]

[1] Faculty of Electrical Engineering, Belgrade, Serbia
[2] IRITEL A.D., Belgrade, Serbia
[3]School of computing, Union University, Belgrade, Serbia
[4]Faculty of Technology and Metallurgy, Belgrade, Serbia
[5]Institute for Multidisciplinary Research, Belgrade, Serbia
[6]Techical Faculty, Čačak, Serbia
[7]Telekom Srpske, Bjeljina, Bosnia and Hercegovina
[8]Institute of Physics, Belgrade, Serbia

The correlation between the initial ceramic particles and final products sintered from them depends on the schedule and type of sintering technology as well as from the initial conditions.

The distribution and description of particles obtained by various methods (including laser) can offer much, depending on the measuring techniques and data processing. By one definition, the description of particles is defined by 80 parameters, with each one having its importance dependent on further handling method.

In this paper, for chosen initial particles, obtained by several different techniques and material types, the analysis is performed and significant parameters are determined. Present and specifically developed steps are used.

MECHANOCHEMICAL SYNTHESIS OF PURE AND DOPED BISMUTH MANGANITE MULTIFERROICS

G. Branković[1], Z. Marinković Stanojević[1], Z. Jagličić[2], M. Jagodič[2], L. Mančić[3], A. Rečnik[4], Z. Branković[1]

[1)] Institute for Multidisciplinary Research - University of Belgrade, Serbia
[2)] Institute of Mathematics, Physics and Mechanics, Ljubljana, Slovenia
[3)] Institute of Technical Sciences SASA, Belgrade, Serbia
[4)]Jozef Stefan Institute, Ljubljana, Slovenia

In this work the formation of pure and doped $BiMnO_3$ (BMO) nanocrystalline perovskite powder produced by high-energy milling was studied. Dopants (La^{3*} and Sr^{2*}) were used in order to stabilize BMO metastable multiferroic phase. The crystal structure and the amount of crystalline and amorphous phases in the powder as a function of milling time were determined with X-ray powder diffraction using the Rietveld refinement. The BMO perovskite can be formed directly from the highly activated nano-sized constituent oxides after 240 min of milling time and subsequently grows over the course of the milling. The morpology, structure and chemical composition of the powder were investigated by scanning and transmission electron microscopy. No traces of contamination from milling media were detected. A clear ferromagnetic transition occurred in range from 65-75 K depending on composition. The magnetic hysteresis behavior is similar to that of a soft ferromagnet. The magnetic properties of the obtained BMO powders were found to change as a function of milling time in a manner consistent with the variation in the nanocomposite microstructure.

EFFECT OF HEAT TREATMENT ON MECHANICAL PROPERTIES OF SiC-TiB_2 COMPOSITES

Dusan Bucevac, Biljana Babic, Snezana Boskovic

Department of material science, INN Vinca, Serbia

Dense SiC-TiB_2 composites with 24 vol% TiB_2 were fabricated by pressureless sintering at 1940 ^oC in the presence of liquid forming additives of Al_2O_3 and Y_2O_3. The effect of post-sintering heat treatment on microstructure and mechanical properties of SiC-TiB_2 composite was presented. Heat treatment at 1970 ^oC considerably improved the strength and fracture toughness of the sintered samples while maintaining high density. The elongation of α-SiC grains during heat treatment was found to be responsible for an increase in fracture toughness. The presence of liquid phase assisted the elongation of grains which in turn activated crack bridging and crack deflection toughening mechanisms. Maximum strength of 540 MPa was found to be the result of improved fracture toughness.

ELECTRICAL PROPERTIES OF THIN FILMS ON CONDUCTING SUBSTRATES MEASURED USING A LIQUID ELECTRODE

Nebojša Čebašek[1], Ingvild Lorentzen[1], Truls Norby[1,2]

[1]NorECs Norwegian Electro Ceramics AS, Gaustadalleen 21, NO-0349 Oslo, Norway.
[2]University of Oslo, Centre for Materials Science and Nanotechnology, FERMIO, Gaustadalleen 21, NO-0349 Oslo, Norway.

Measuring electrical properties of thin ceramic film is challenging because typical electrodes have grain sizes larger than the film thickness and may damage the film. Here, we measure electrical conductivity and dielectric constant using a ProboStat™ sample holder cell with a silicone gasket and brass cylinder holding a conducting liquid top electrode (e.g. Ga, Hg or ionic liquid). Films tested include proton conducting Ca:$LaPO_4$ and were produced using Atomic Layer Deposition (ALD) and Pulsed Layer Deposition (PLD). The method ensures fully covering and non-destructive contact between film and electrode and can be applied up to a few hundred °C and in vacuum or controlled atmospheres.

CHARACTERIZATION OF SINTERED MAGNESITE MICROSTRUCTURAL AND XRD ANALYSIS

Maria Čebela, Ana Radosavljević Mihajlović, Vesna Maksimović, Branko Matović

Department of material science, INN Vinca, Serbia

"Sintered magnetite", the basic raw material for production of refractory materials based on magnesium oxide, is heated at a temperature of 1500-1600 ° C. The samples were investigated through their phase conversions at this temperature range. All the changes were monitored by optical microscope and XRD analyses. Microstructure examination was carried out in the cross section. In order to quantify the grain size and to determine the value of the intercept L_3 which is equivalent to the average grain size, line method was used. The results indicate the presence of MgO phase. Bond phase along the grain boundary were observed.

HYDROTHERMALLY ASSISTED COMPLEX POLYMERIZATION METHOD FOR BST POWDER SYNTHESIS

Jovana Ćirković[1], Katarina Vojisavljević[1], Maja Šćepanović[2], Goran Branković[1], Zorica Branković[1]

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Barium strontium titanium oxy-carbonate $(Ba_{0.8}Sr_{0.2})_2Ti_2O_5 \cdot CO_3$, which is common intermediate phase in synthesis of barium strontium titanate (BST), has been obtained by hydrothermal treatment of BST citric precursor solution, previously prepared by complex polymerization method (CPM). The thermally induced phase evolution from oxy-carbonate to pure BST was followed using DSC, SEM, X-ray diffraction analysis and Raman spectroscopy at various temperatures up to 1200°C. The proposed synthesis route has been proven as a better and faster method for $(Ba_{0.8}Sr_{0.2})_2Ti_2O_5 \cdot CO_3$ powder preparation as compared to conventional CPM route. The method was found efficient for production of high purity crystalline BST powders, with small grain size and good dielectric properties at temperatures $T \geq 700°C$.

SiC SYNTHESIS USING DOMESTIC MINERAL RESOURCES

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We demonstrate the possibility of using domestic Mg-silicate (sepiolite, white), as SiO_2 source and novolac resin (as carbon source), for synthesis of fine β-SiC powders at relatively low temperatures (1673-1873 K). Carbothermal reduction process is greatly influenced by chemical treatment (HCl) of sepiolite and catalyst addition (Fe, FeSi).

BIOGENIC MATERIALS

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Biomineralization refers to the process by which living organisms form inorganic solids. These biological objects and their complicated architectures and morphologies differ from man/made synthetic analogues. Drosophila melanogaster is a fruit fly, a little insect about 3mm long, of the kind that accumulates around spoiled fruit. It is also one of the most valuable of organisms in biological research, particularly in genetics and developmental biology. However a little works is done in field of materials science.

In this work Drosophila wings are used as a template for obtaining inorganic thin films. Field Emission Scanning Electronic Microscopy was used for analyzing of resulting materials.

IMAGE ANALYSIS OF CAVITATION DAMAGE ON ALUMINA BASED REFRACTORY MATERIAL

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Alumina is the most cost effective and widely used material in the family of engineering ceramics, Alumina based refractory specimens were investigated for possible application as cavitation resistant material. Cavitation damages of the alumina based specimen were tested by the modified vibratory cavitation setup. Image analysis was used for surface analysis during testing and the mean diameter, roundness and fractal dimension of the destructed surface area were measured.

The mathematical model for surface destruction is proposed for surface deterioration, dimensions of surface damage and the shape factors of surface damage.

BIODEGRADABLE CITRIC-ACID BASED POLYESTER ELASTOMERS FOR TISSUE ENGINEERING APPLICATIONS

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The synthesis and fabrication of polyester elastomers using non-toxic and biocompatible reactants such as citric acid (CA) is a topical research area in tissue engineering applications. The most important feature of such synthetic biomaterials is their controllable structural integrity that strongly influences interfacial behaviour in biological environment. We demonstrate that the chemical structure, morphology, physical integrity and surface chemistry of the synthesized co-polyester can be controlled by simply varying the initial CA concentration in reaction mixture. The results from investigation of in vitro biological response to CA-based polyester elastomers will also be presented

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THE ADVANTAGES OF THE THERMAL X-ray DIFFRACTION: BRUSHITE EXAMPLE

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Thermal X-ray diffraction has been widely applied in the ceramics industry and research. In this paper we show the importance of the thermal XRD in materials research on the example of the mineral brushite $CaHPO_4 \cdot 2H_2O$. Two powdered brushite samples were mixed with an internal standard and analyzed continuously over a range of temperatures by the thermal XRD and the subsequent phase transitions were observed. Brushite loses water in two steps and forms monetite $CaHPO_4$, which transforms to γ-$Ca_2P_2O_7$, β- $Ca_2P_2O_7$ and α- $Ca_2P_2O_7$. We describe the instrumental setup and procedure, as well as different possibilities of sample analysis provided by these techniques.

MORPHOLOGY AND CYTOTOXICITY OF HYDROXYAPATITE/LIGNIN COMPOSITE COATINGS

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The ceramic-polymer biomaterials are being investigated to enhance the implant integration. Hydroxyapatite ($Ca_{10}(PO_4)_6(OH)_2$, HAP) is often used due to its chemical similarity to the main bone mineral. Lignin (Lig), as a poliphenolic natural polymer, was used to produce HAP/polymer coatings. The purpose of this work was to investigate the effect of Lig on morphology and phase composition of electrodeposited HAP/Lig coatings. The surface structure was characterized by XRD, SEM, ATR- FTIR and XPS. MTT test has been conducted in order to determine the cytotoxicity of coatings. The HAP/Lig coatings exhibited improved protection of HAP lattice decomposition during sintering, due to hydrogen bonds established between hydroxyapatite and lignin.

SYNTHESYS-STRUCTURE-PROPERTIES OF DENSE AND POROUS RUTILE FABRICATED BY HYDROLYSIS PROCEDURE

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Dense and porous ceramics were fabricated from rutile. Controlled hydrolysis method was applied to synthesize rutile from organometallic precursor. Rutile with different porosity was fabricated at the temperatures of 1100, 1200, and 1300°C for 1 to 3 h holding at maximal temperature. Rutile with density 95%TD was fabricated at 1300°C/2h. The variation of E – modulus (E), shear modulus (G) and Poisson's ratio (μ) with porosity (θ) can be approximated by the following relations:

$E = 270.2 \exp(-0.043\theta)$, $G = 112.3 \exp(-0.043\theta)$ and

$\mu = 0.293 \exp(-0.005\theta)$.

Open celled ceramics with controlled porosity from 50-60% were fabricated by use of C-fibers, polyurethane foam and H_20_2. On the base of integral porosity, pore size and inter-pores communication as well as mechanical properties porous rutile created by H_20_2 as porogen could be defined as the most suitable biomaterial having in mind its bioinert properties.

Keywords: Rutile, hydrolysis procedure, sintering, porosity

EFFECT OF SURFACE FUNCTIONALIZATION AND PROCESS PARAMETERS ON SYNTHESIS OF MESOPOROUS SILICA CORE-SHELL PARTICLES

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Mesoporous silica particles, material with high surface area and pore sizes in the range of 2-50 nm, possess high surface free energy and they have attracted much attention for numerous applications in adsorption, separation, catalysis and drug delivery. Different mechanisms for the formation of mesoporous silica particles were suggested, but the aggregation growth model is broadly accepted. This model states that particle growth occurs due to an aggregation of primary particles which are nucleated in a supersaturated solution, producing a porous structure. However, pores could be closed during aging in the solution due to the dissolution/reprecipitation process. Thus, depending on the synthesis parameters, the structure of prepared silica particles may vary from isolated dense particles to porous agglomerates with different pore size and shape, pore size distribution and pore volume.

Mesoporous silica particles were prepared from highly basic sodium silicate solutions, having different silica modulus and SiO_2 concentrations, by adding sulphuric acid at different temperatures. Pore structure of prepared silica particles (aggregates) is strongly influenced by processing conditions and easy controllable in broad range of the specific surface area, pore size, pore volume and size distribution. It is shown that there is a clear correlation between volume of absorbed oil and processing parameters used in preparation of silica aggregates. Thus, oil absorption is higher in the samples prepared from sodium silicate solution with higher SiO_2 concentration and at higher synthesis temperature.

PREPARATION AND CHARACTERIZATION OF DOPED LANTHANUM GALLATE (LSGM) ELECTROLYTE IN ACTIVATED MICROWAVE FIELD

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Sr and Mg substituted $LaGaO_3$ (LSGM) is a promising solid electrolyte for intermediate temperature solid oxide fuel cells (IT-SOFC). In this contribution LSGM powders, prepared by a modified Pechini route, were densified using an 2.45 GHz activated microwave field for developing a dense stable electrolyte layer.

The sintered samples were characterized using scanning electron microscopy (SEM-EDAX), and X-ray diffraction (XRD), FTIR and Raman spectroscoy. The sintering shrinkage of the compact was measured with a dilatometer. The electrical behavior was evaluated by Impedance Spectroscopy (IS) in the temperature range 850-300°C.

With an optimized sintering annealing schedule, a fine grained microstructure without any undesirable phase was obtained.

NEW CERAMIC FOAMS FOR HOT GAZES FILTERING PREPARED FROM POLYMER COMPOSITES.

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The new ceramic foams were obtained by gelcasting method using raw kaolin as ceramic oxide and an acrylic monomer as gel forming source.

The compression properties were determined, elastic (Young's) modulus, compression strength and elongation at break of the dry green bodies were obtained from uniaxial compression measurements. All samples were characterized by scanning electron microscopy (SEM), X ray diffractometry (XRD), and detailed thermal analysis (DSC, DTA/TG coupled with a FTIR spectrometer)

The measurements of pressure drops of various obtained samples, allowed choosing the best procedures for obtaining various ceramic foams for the filtering of solid particles from hot gases, as those from thermal centrals.

MECHANICAL PROPERTIES OF BIOMORPHIC SILICON CARBIDE CERAMICS

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Biomorphous β-SiC ceramics were produced from linden wood by impregnation with tetraethyl orthosilicate (TEOS), followed pyrolysis and high temperature treatment at 1580 °C. Six specimen groups included charcoal and five groups with different number of impregnation were analyzed. Flexural and compressional strength of charcoal and woodlike SiC ceramic were characterized using three-point and compression testing. Mechanical properties increased slightly with number of impregnation cycles. Ultrasonic pulse velocity testing (UPVT) was used to determine dynamic young modulus of elasticity. Laser surface modification was studied by interaction with Nd:YAG laser, operating at two wavelengths and pulse duration of 150 ps.

SURFACE PROPERTIES OF Fe^{3+} DOPED TITANIUM DIOXIDE NANOPOWDERS

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Titanium dioxide powders, doped with different amounts of Fe^{3+} ions (0.2 – 5 mass %), were synthesized by acid-catalyzed sol-gel method in a non-aqueous medium. The obtained powders were characterized by X-ray diffraction (XRD), scanning electron microscopy (SEM). The isoelectric point of samples was investigated in KNO_3 solution. Careful investigation of porous structure was provided by application of nitrogen adsorption-desorption method. Structure analysis showed that the obtained nanopowders exhibited the anatase crystal structure, independent of the amount of iron dopant. Unlike crystal structure, porosity parameters are strongly affected by the amount of iron ions incorporated in TiO_2 lattice.

CERAMIC MATRIX COMPOSITES IN ALUMINA AND YAG SYSTEM – PREPARATION AND PROPERTIES

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The preparation technique of the particulate composite materials in the alumina/YAG system was elaborated. Within alumina particles suspension yttria precursor was precipitated with ammonium carbonate. Drying and calcination at 600^{o}C resulted in the mixture of alumina and yttria particles, the latter being much finer than alumina particles. This mixture was additionally homogenized by short attrition milling in an aqueous suspension. Sintering of such powders results in the materials composed of YAG inclusions of sizes smaller than shown by alumina grains and evenly distributed within the matrix. YAG particles result from the reaction of Y_2O_3 with Al_2O_3 during heat treatment. YAG inclusions limit effectively grain growth of the alumina matrix,

Keywords: Ceramic matrix composites, alumina, YAG

CHARACTERISTICS OF THE LASER INTERACTION WITH CHOSEN CERAMIC MATERIALS

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Chosen ceramic materials of laboratory products important for microelectronics, microwave techniques and medical applications, have been exposed to pulsed laser beams in various regimes of operation (free generation, Q-switched and femto second regimes are included with different frequencies and number of pulses). Characteristic damages in these regimes are analyzed by the techniques of SEM, optical microscopy, micro hardness, etc. Obtained micrographs later served for image analysis by using quantification methods and corresponding tools for image processing. According to chosen processing, the information on the source itself (the laser), and power distribution in the beam, material resistance (hardness) to fluencies can be obtained.

ATTACHMENT OF PIEZORESISTIVE SILICON PRESSURE SENSOR DIES USING LOW MELTING POINT GLASS

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This paper gives comparison and discussion of adhesives used for attachment of silicon piezoresistive pressure sensor chips. Special attention is placed on low pressure sensor chips because of their extreme sensitivity on stresses which can arose from packaging procedure and applied materials. We used commercially available adhesives: „Scotch Weld 2214 Hi-Temp“ from “3M Co.” or „DM2700P/H848“ from „DIEMAT“, USA. First of them is aluminum filled epoxy adhesive and second is low melting point glass paste. Comparing test results for low pressure sensor chips we found that low melting point glass (glass frit) is better adhesive for this application. Furthermore, glass frit enables high temperature operation of low pressure sensors.

THE NON-NOBLE METAL COMPOSITES AS CATODES FOR HYDROGEN EVOLUTION: Ni-MoO_x COATINGS

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The procedure of deposition of Ni-MoO_x coatings from the Watt's type bath containing MoO_3 powder particles onto Ni mesh, under the conditions of simulated industrial deposition for commercial cathodes, has been presented. The morphology was investigated by SEM, the composition by EDS and the phase composition by XRD techniques. The polarization characteristics for hydrogen evolution on the Ni-MoO_x coatings were investigated in 32 wt.% NaOH at 90 ^oC and compared with the one recorded for the commercial De Nora's coating (DN). It was shown that the best Ni-MoO_x coating exhibits almost identical polarization characteristics as the commercial one. The reaction mechanism for MoO_3 phase deposition has been proposed.

VARIABILITY OF STRUCTURAL AND MAGNETIC PROPERTIES OF NANOCRYSTALLINE SPINEL FERRITES

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Nanocrystalline spinel ferrites, with the general formula MFe_2O_4 (M is a divalent cation) are an important class of nanostructured materials with their potential in ceramic, electrochemical, magnetic, ferroelectric, catalytic and biomedical applications. Using a low temperature synthesis of such materials it is possible to obtain ultra fine particles. The crystal structure, microstructure and magnetic properties of series of nanocrystalline spinel ferrites have been studied by XRD, HRTEM, Mössbauer spectroscopy and SQUID measurements. The Rietveld analysis of the powder diffraction data have been performed (using Fullprof software) to obtain quantitative microstructural information (e.g. the cation distribution, the crystallite size, microstrain). More sophisticated models have been used to explain magnetic behavior of an assembly of nanostructured particles, which include microscopic mechanisms such as spin disorder, surface contributions and the presence of interparticle interactions (exchange and/or dipolar). The saturation magnetization of investigated nanostructural vs. bulk spinel ferrites is discussed in term of a competition between the site exchange of cations and the spin canting phenomena. For a selected example, the variation in the particle anisotropy energy, extracted from the magnetic measurements in high and low external magnetic field, is well describe accounting for the interparticle interaction and the surface effects on the energy barrier.

FABRICATION ZrO_2 AND ZrO_2/SiC BY CARBOTHERMAL-REDUCTION REACTIONS OF $ZrSiO_4$

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The synthesis of zirconia/silicon carbide (ZrO_2/SiC) and ZrO_2 powders are obtained by carbothermal reduction of natural mineral zircon ($ZrSiO_4$). The influence of carbon to $ZrSiO_4$ ratio is investigated for a three range of compositions (C/ZrSiO4 = 3, 5 and 7) and temperatures (1473–1973 K). The zircon powder was mixed with activated carbon as a reducing agent and heat treated in a controlled flow atmosphere of Ar. Phase evaluation and phase content were followed as a function of temperature and C/$ZrSiO_4$ ratio. The obtained powders were characterized by means of ex-situ X-ray diffraction and SEM/EDS investigation.

PROPERTIES OF SBA-15 / CARBON CRYOGEL NANOCOMPOSITES AS A FUNCTION OF SYNTHESIS CONDITIONS

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Ordered mesoporous silica SBA-15 materials were synthesized by using Pluronic P123 (non-ionic triblock copolymer, $EO_{20}PO_{70}O_{20}$) as a template, under acidic conditions. SBA-15 / carbon cryogel composites were obtained by the sol-gel polycondenzation of resorcinol and formaldehyde, in the presence of different amount of SBA-15, followed by freeze drying, and subsequent pyrolysis. These materials were characterized by nitrogen adsorption-desorption measurements, X-ray diffraction and scanning electron microscopy. Samples have high specific surface (350-520 $m^2\ g^{-1}$), developed meso- and microporosity and amorphous structure. Porous structure is function of the silica/carbon ratio and can be controlled by concentration of starting solution.

POLAR CERAMICS: NEW APPLICATIONS, NEW COMPOSITIONS, NEW STRUCTURES

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The contribution briefly summarizes the properties and application of polar ceramics. In addition to capacitors, sensors, actuators, medical transducers, piezo-motors, new applications include energy harvesting using the piezoelectric effect, and efficient cooling using the electro-caloric effect.

The majority of polar ceramics are based on lead-containing compositions. The contribution presents an overview of recent research in lead-free polar ceramics. The need for enhanced performances requires new approaches in processing. The case-studies include modified alkaline niobates and multiferroic $BiFeO_3$ceramics with enhanced functional properties obtained by improved powder synthesis. The improved performance of alkali-niobate-based single crystals prepared by solid state crystal growth is presented. Finally, extremely efficient ferroelectric bending actuators and ferroelectric thin films with a giant electro-caloric effect are discussed.

THE NON-NOBLE METAL COMPOSITES AS CATODES FOR HYDROGEN EVOLUTION: Ni-MoO_2 COATINGS

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The deposition of composite Ni-MoO_2 coatings onto Ni mesh from the nickel chloride-ammonium chloride electrolyte containing suspended MoO_2 powder particles, under simulated industrial deposition conditions for commercial cathodes, has been presented. The morphology of the obtained coatings was investigated by SEM, the composition by EDS and the phase composition by XRD techniques. The polarization characteristics for hydrogen evolution on the obtained Ni-MoO_2 coatings were investigated in the 32 wt.% NaOH at 90 ^oC and compared with the one recorded for the commercial De Nora's coating (DN). It was shown that the best Ni-MoO_2 coating posses identical polarization characteristics as the commercial one. By the cross section and XRD analysis of deposited samples it was confirmed that MoO_2 powder particles were occluded by the Ni deposit, being uniformly distributed in the deposit.

RHEOLOGICAL PROPERTIES OF AQUEOUS Al_2O_3 SUSPENSIONS

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The aim of the present work was to investigate rheological behavior of alumina suspensions, considering different amounts of polyvinyl alcohol as a binder. Three different aqueous suspensions were prepared, containing 60, 70 and 80 wt.% of alumina powder.

Spinel was added as a sintering agent and Darvan 821-A as a dispersant, in the amount of 0.08 and 0.4 wt.% of dry powder weight, respectively.

The alumina suspensions flow curves were recorded and fitted satisfactorily to the power law, Herschel-Bulkley and Bingham models.

Obtained results indicate that apparent viscosity of alumina suspensions increases with increasing Al_2O_3 and polyvinyl alcohol amount.

CHARACTERIZATION OF BARIUM BISMUTH TITANATE OBTAINED BY MECHANOCHEMICAL SYNTHESIS

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Barium bismuth titanate, $BaBi_4Ti_4O_{15}$ (BBT) was prepared by homogenization and sintering of mixture of stoichiometric quantities of $BaTiO_3$ and $Bi_4Ti_3O_{12}$ obtained via mechanochemical synthesis. The reaction mechanism of $BaBi_4Ti_4O_{15}$ formation and the characteristics of BBT powders and ceramics were studied using XRD, Raman spectroscopy and SEM. The results confirmed that $BaBi_4Ti_4O_{15}$ was formed by tetragonal symmetry. Only 4 Raman modes are clearly observed. Ba^{2+} ions randomly occupy the Bi sites of a pseudo-perovskite layer and may enter in a bismuth oxide layer. $BaBi_4Ti_4O_{15}$ ceramics possess the plate-like structure typical for layered structure materials.

INFLUENCE OF pH VALUE ON PARTICLE SIZE AND MORPHOLOGY OF ZINC OXIDE POWDERS OBTAINED BY SOLVOTHERMAL SYNTHESIS

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Zinc oxide powders have been synthesized from ethanolic zinc acetate solutions in the presence of lithium hydroxide by the solvothermal method. In this work we have considered the influence of pH value on morphology and size of ZnO particles for temperature 200°C and reaction time 2 h. The ZnO powder microstructure was controlled using X-ray diffraction and field emission scanning electron microscopy. Grain size of ZnO particles ranges in the interval (40–200) nm depending on pH value. Increasing of pH value result in decreasing of particle size, changing from hexagonal to round particle form and uniforming of particle shape and size.

FRACTURE TOUGHNESS OF ALUMINA CERAMICS DETERMINED BY INDENTATION TCHNIQUE

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Fracture toughness (K_{IC}) of high purity cold isostatically pressed alumina ceramics was determined from the size of cracks induced by Vickers hardness testing at the wide range of loads. The observed cracks appeared at following loads: 4.905, 9.81, 29.43 and 49.05 N. For the fracture toughness calculation different models were compared. It was found that fracture toughness increases by increasing applied load for all applied models, which is explained by indentation size effect. The fracture toughness overestimation can lead to product malfunction. Therefore, the use of the Anstis model, which gives the smallest fracture toughness values, is suggested.

SOFT CHEMISTRY ROUTES FOR SYNTHESIS OF 3D AND 1D NANOSTRUCTURES

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The optimum performances in photonic devices can be achieved by employing ultrafine nanostructured particles with well-defined morphological and structural characteristics. Soft chemistry routes are widely applied today in the preparation of such materials. When three-dimensional (3D) nanostructures are considered, highly spherical particles obtained through rapid and continues spray pyrolysis process are demonstrated to have superior optical emission characteristics. On the other side, batch hydrothermal process is shown to be one of the simples technique for the obtaining of one-dimensional (1D) nanostructures with unique properties, especially with respect to their excellent optical response. Progress in ultrafine powders processing for advanced light source application (rare-earths oxides) and efficient photocatalytic devices (TiO2-based materials) developing will be reviewed.

MULTIFERROIC $BiFeO_3$ CERAMICS OBTAINED FROM MECHANOCHEMICALLY SYNTHESIZED POWDERS

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Multiferroic $BiFeO_3$ (BFO) compounds were processed by using both mechanochemical synthesis and post-milling annealing at the temperature of 810^{o}C for 1h. The phase composition and structure of obtained powder and ceramic samples were characterized by X-ray diffraction and scanning electron microscopy with energy dispersive spectroscopy. We employed dielectric and magnetic measurements in order to systematically record the behaviors of the BFO ceramics below and above magnetic transition point. The dielectric anomaly around the magnetic transition temperature T_N = 367^{o}C signifies coupling between polarization and magnetization. It appears that the local inhomogeneities as well as oxygen nonstoichiometry across the sample volume have majority roles in governing all the properties.

MODELING OF STRENGTH DEGRADATION DURING THERMAL STABILITY TESTING OF LOW CEMENT HIGH ALUMINA CASTABLE

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Application of nondestructive testing methods such are ultrasonic measurements and image analysis on thermal stability testing will be presented. Modeling of the strength degradation during testing will be based on ultrasonic measurement and degradation of the samples analysis. Samples based on low cement high alumina castable sintered at 1300 °C will be used for the experiment. Obtained results will be compared to experimental values in order to verify the model.

Key words: strength degradation modeling, ultrasonic measurements, image analysis, thermal shock, low cement high alumina castable.

SYNTHESIS AND CHARACTERIZATION OF (BA, YB) DOPED CERIA ELECTROLYTES

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Nanometric size (Ba, Yb) doped ceria powder particles with fluorite-type structure were obtained by applying self-propagating room temperature methods. Tailored composition was: $Ce_{0.95-x}Ba_{0.05}Yb_xO_{2-\delta}$ with fix amount of Ba – 0.05 and "x" ranging from 0.05 to 0.2. Powder properties such as specific surface area, crystallite and particle size and lattice parameters have been studied. Roentgen diffraction analyses (XRD), BET, SEM were used to characterize the samples at room temperature. Also, high temperature treatment was used to follow stability of solid solutions as well as grows of crystallites. It was found that average diameter of crystallites is in the range of 3-5 nm. However, these crystallites gradually grow with increasing heat temperature, changing the specific surface area from 105 m^2/g to 20 m^2/g. Williamson-Hall plots were used to separate the effect of the size and strain in the nanocrystals. The Rietveld refinement was employed for some samples to get the structural information of the synthesized powder.

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OXYGEN REDUCTION REACTION ON ANODICALLY FORMED TITANIUM-DIOXIDE – FILM SIZE INFLUENCE

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Oxygen reduction reaction (ORR) was investigated. This reaction is especially interesting as being a main cathodic reaction in fuel cells. ORR on anodically formed titanium-dioxide was studied in 0,1M NaOH solution. Different film thickness was anodically formed on different final potentials (0V, 1V and 2V). Titanium-dioxide film formed on lowest final potential shows greatest current density on the potential of oxygen electrode (potential of non polarized oxygen electrode), than films formed on other two final potentials. This shows that TiO_2 layer formed on the smallest final potential have the best catalytically performances for oxygen reduction.

PHASE AND DEMOGRAPHIC STATISTICAL ANALYSIS OF URINARY STONES

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The idea of this paper is to investigate the phase composition and demographic distribution of urinary stones Serbian patients of both sexes. To determine the phase characteristics, we were use a method of X-ray diffraction analysis. X-ray diffraction analysis of the samples indicate the presence of the following phases: Whewelite ($CaC_2O_4 \cdot H_2O$) and Weddelite ($CaC_2O_4 \cdot 2H_2O$) from oxalate, Apatite ($Ca_5(PO_4)_3X$), Brushite ($Ca(HPO_4) \cdot 2H_2O$) and Struvite ($MgNH_4PO_4 \cdot 6H_2O$) from phosphate, as well as Uricite ($C_5H_4N_4O_3$) and L – cystine ($C_6H_{12}N_2O_4S_2$). The SEM analysis confirmed the obtained structure.

THE INFLUENCE OF VO_2 ON HYDROGEN DESORPTION PROPERTIES OF MgH_2

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Hydrogen storage is a key enabling technology for the development of hydrogen and fuel cell power technologies in transportation, stationary, and portable applications. On-board hydrogen storage is considered to be the most challenging aspect for the successful transition to a hydrogen economy. Modified nanostructure materials offer promise for superior hydrogen storage due to short diffusion distances, new phases with better capacity, reduced heats of adsorption/desorption, faster kinetics. We have investigated the possible use VO_2 as a possible destabilization agent of MgH_2 by means of DTA, XRD and SEM analysis. It has been shown that use of nanostructurated VO_2 dramatically decrease the MgH_2 desorption temperature.

INVESTIGATION OF Cl^- AND SO_4^{2-} ANION ABSORPTION IN NATURAL SOILS

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In this paper, the results of vertical chloride and sulphate anions migration in soil are presented. The soil was contaminated with NaCl and $CuSO_4$. Anions migartion were monitored during one hydrological year (425 days). First sample was taken after 150 days and next following sample was taken after 50 days. Before the profile contamination physical and chemical analisys of soil has been done. The obtained results shows that chloride concentration in soil was in the range from 0,67 $mgkg^{-1}$ up to 11,92 $mgkg^{-1}$, while sulphate concentration was in the range from 0,65 $mgkg^{-1}$ up to 9,79 $mgkg^{-1}$.

THE CALCIFICATION OF COLLAGEN BY HAP FUNCTIONALIZED CARBON MATERIALS

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Bone is composed of two phases. The organic phase is made of collagen fibrils assembled in broad fibers acting as a template for mineralization. The mineral phase comprises hydroxyapatite (HAP) crystals grown between and inside the collagen fibers. We have developed a material using functionalized carbon nanotubes, carbon fibers and glasy carbon as scaffold to initiate in vitro mineralization. Mentioned carbon materials are functionalized with carboxylic groups prior to decorating. All samples were dispersed in ultra-pure water and incubated for 2 weeks in a synthetic body fluid with dispersed HAP, in order to induce the calcification of the functionalized carbon materials. Atomic force microscopy (AFM) and transmision electron microscopy (TEM) showed that Ca^{2+} and PO_4^{3-} ions were deposited as round-shaped nodules. Raman spectroscopic studies confirmed the HAP formation, and image analysis made on TEM pictures showed that HAP were packed around and inside the carbon materials together. All three types of investigated carbon materials leading to successful calcification of collagen. This suggests that it takes the presence of carbon materials to prevent it from calcification of collagen, independent of the structures of the material.

EFFECT OF SURFACE FUNCTIONALIZATION AND PROCESS PARAMETERS ON SYNTHESIS OF MESOPOROUS SILICA CORE-SHELL PARTICLES

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Core-shell silica with a mesoporous structure has found increasing application in many areas, including heterogeneous catalysis, adsorption, molecular separation, enzyme immobilization etc. Core-shell particles were formed by deposition of primary particles from highly basic sodium silicate solution on silica core particles (having size of ~0.45 μm) prepared by hydrolysis and condensation of tetraethylortosilicate. To enable attractive electrostatic interactions between silica core and primary silica particles, core particles were functionalized with 3-aminopropyltriethoxysilane (covalent functionalization) and poly(diallyldimethylammonium chloride (non-covalent functionalization), respectively. Electric charge of core particles functionalized with APTES was positive at pH values below 8.2, while that of PDDA functionalized particles was positive in whole pH interval which resulted in formation of uniform and continuous shell. On the other side, the effect of process parameters (temperature, SiO_2 concentration) on the size of primary silica particles synthesized from highly basic sodium silicate solution and consequently the pore size in the shell was investigated. It was found that higher temperature and the SiO_2 concentration induced higher particle size of primary silica particles.

CHANGES IN ELECTRICAL PROPERTIES OF HEMATITE DOPED WITH Ni

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We have studied the effects of Ni doping on the electrical properties of bulk α-Fe_2O_3. Starting powders of α-Fe_2O_3 were doped with different amounts of Ni (1, 2, 5 and 10 wt.% NiO) and homogenized for 15 minutes in a planetary ball mill, followed by sintering. The phase composition of sintered samples was analyzed by XRD and EDS analysis. AC and DC electrical resistivity/conductivity as a function of temperature was measured. Ni doping increased electrical conductivity, while increase in temperature induced changes in the conduction mechanism.

AN AB INITIO STUDY OF Mg-H PHASE DIAGRAM

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Ab initio calculation investigations of atom-by-atom H incorporation in various Mg structures, and formation of consecutive phases up to MgH_2 have been performed using FP-LAPW+LO (APW+lo) method, as implemented in WIEN2k code. The preferential paths of H incorporation are established and details of atomic (Mg-H, H-H, Mg-Mg) interactions at various H-concentrations revealed. In that way processes governing H absorption and distribution in different Mg phases, and mechanisms of phase transitions are determined from the first principles at atomic scale level. Such an understanding provides the opportunity for materials adjustments, which could be important for practical applications of Mg hydrides.

SINTERING AND CRYSTALLIZATION OF PEG AND La (III)-DOPED MESOPOROUS ALUMINA OBTAINED BY THE SOL-GEL METHOD

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Sintering and crystallization of PEG-La (III)-doped alumina samples prepared from Al-alkoxide were investigated. Isothermal sintering experiments showed that the sintering mechanism of alumina samples is surface diffusion. The specific surface areas of alumina samples heat-treated at 1000 to 1200 °C were greatly increased by the addition of PEG + 0.03 mol La (III) / mol Al (III) to the boehmite sol. Even after 5 h at 1200 °C, PEG-La (III)-doped alumina samples maintain a rather good specific surface area (65 m^2 g^{-1}) in relation with the non-doped and very slow transformation of θ- Al_2O_3 into α- Al_2O_3.

PILLARED CLAYS AS DIGESTIVE TRACT MRI CONTRAST AGENTS

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Gastrointestinal tract MRI generally gives poor results because of the lack of suitable contrast agents. Today's obtainable paramagnetic-based contrasts show side effects like the presence of artifacts arising from clumping, black bowel and diarrhea.

In this MRI study we propose the usage of the pillaring method for paramagnetic metal encapsulation in bentonite, showing that iron-pillared bentonites could be successfully used as MRI contrast agents, altering the longitudinal and transverse relaxation times of fluids in contact with the clay minerals. Relaxation effects of synthesized samples were compared with the effects of Gd-DTPA contrast and commercial clays such Smecta and green clay.

STRUCTURE OF SPHENE MONOCRYSTALS FROM LEŠNICA RIVER DEPOSITS

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River drift Lešnica, from which sphene crystals are separated for analysis, consists of a large number of minerals of different grain size.

Sphene was analyzed by different methods. Density was measured by pycnometer, the color was determined by tristimulus colorimetry, infrared spectroscopy was done and chemical analysis by microprobe. In the end crystal structures of sphene1 and sphene2 are determined by X-ray single crystal diffraction. The structures were refined in space groups C2/c and the P21/c, and then transformed into the new space group A2/a and P21/a.

Structural formula obtained from the analysis of microprobes was taken:

$$(Ca^{2+}_{1,008}Mn^{2+}_{0,002})_{1,010}\,(Ti^{4+}_{0,901}Fe^{3+}_{0,033}Al^{3+}_{0,060}P^{5+}_{0,001})_{0,995}Si^{4+}_{1,024}O^{2-}_{5}$$

APPLICATIONS OF FLY ASH AS A SECONDARY RAW MATERIAL FOR BUILDING MATERIALS PRODUCTION

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Chemical and mineralogical composition, as well as its physical properties, makes fly ash from thermal power plant attractive raw material for building materials production. Several potential applications of this waste material are investigated. Research of possibility of utilization of fly ash as a raw material for Portland cement clinker production, for production of ceramic and glass-ceramic materials, as well as for new binding materials, was performed. Utilization of waste material, fly ash, as secondary raw material could significantly to the better handling of mineral resources and the improvement of the ecological situation.

NANOCRYSTALLINE SOLID SOLUTIONS CeO_2-Bi_2O_3

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A series of nanocrystalline solid solutions CeO_2-Bi_2O_3 were synthesized by applying the method based on self-propagating room temperature reaction (SPRT) between bismuth and cerium nitrates and sodium hydroxide. X-ray powder diffraction (XRPD) and Rietveld's structure refinement method was applied to characterize prepared powder and its microstructure (size-strain). Raman spectral studies conformed that obtained powder is single phase. Differential thermal analysis (DTA) and scanning electron microscopy (SEM) were also employed to characterize obtained powders. Sintering of powder samples was followed by optical dilatometry. Specific surface area of obtained powder was measured by Brunauer-Emmet-Teller (BET) method.

SYNTHESIS AND MICROSTRUCTURAL CHARACTERISATION OF Ca-COBALTITES THERMOELECTRIC COMPOUND

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The misfit-layered compounds of Ca-Co-O system exhibit high thermo-electric power, low thermal conductivity, low resistivity, and high thermal stability. The solid-state formation of the $Ca_3Co_4O_9$ and $Ca_3Co_2O_6$ compounds at relatively low temperatures is rather slow, so the methods for pre-treatment and pre-reaction of the powder mixtures are critical for a successful synthesis of single-phase, dense and homogenous samples.

We studied the synthesis of $Ca_3Co_4O_9$ and $Co_3Co_2O_6$ compounds without or with treatment of the starting powder mixtures with mechano-chemical activation by high-energy milling or attrition-milling. After sintering at different temperatures microstructures of the samples were analysed and compared.

INFLUENCE OF THE ANNEALING ATMOSPHERE ON THE MORPHOLOGY OF LNO THIN FILMS

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Lanthanum nickelate ($LaNiO_3$, LNO) with its perovskite structure and metallic conductivity is a possible candidate for electrode material in ferroelectric devices. In this work, LNO thin films were obtained by chemical method from polymeric citrate precursors. LNO precursor solution was deposited on Si (100) and [Pt (111) / Ti / SiO_2 / Si] substrates. Thin films were thermally treated in air and oxygen atmosphere. Annealing temperature was 700 °C, based on DTA and XRD analyses of precursor solution. Polycrystalline, homogenous, dense, crack-free LNO thin films were obtained. Annealing atmosphere had a great influence on grains' morphology and size.

LOW-TEMPERTATURE AQUEOUS SYNTHESIS AND CHARACTERISTICS OF TRANSPARENT ZINC OXIDE FILMS ON GLASS SUBSTRATE

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Transparent and conductive ZnO films can replace ITO (indium tin oxide), which is nowadays widely used for liquid crystal and plasma displays, touch panels, organic light-emitting diodes, gas sensors, anti-static and anti-reflection coatings, solar cells, etc.

In this work transparent ZnO films on a glass substrate were prepared with a low-temperature aqueous synthesis below 100°C. After the optimisation of all three steps of the synthesis films with a 75 % transparency and a specific resistivity 1.5 10^4 Ωcm were prepared. The preparation of the substrate, growth of the ZnO films and their characteristics will be presented and discussed.

SYNTHESIS AND CHARACTERIZATION OF CERAMIC COMPOSITE MATERIALS BASED ON SILICON-CARBIDE AND CORDIERITE MATERIALS

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Composite materials based on SiC and cordierite materials offer combination of properties that are desirable for high-temperature structural applications such as: high thermal stability, low thermal expansion coefficient, good thermal conductivity and good thermal shock resistance. Cordierite was synthesized from spinel, quartz and alumina and used as starting material for SiC/cordierite composite ceramics with weight ratio 70:30. Thermal stability of composite materials was investigated by water quench method. Microstructural investigation of samples after quenching was conducted by SEM and phase analysis was done by XRD.

SOLVOTHERMAL SYNTHESIS OF TI DOPED ZnO

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Titanium doped zinc oxide powders were synthesized by solvothermal method. Polycrystalline powders of ZnO with different amounts of Ti -$Zn_{1-x}Ti_xO$ (x=0, 1, 2, 5, 7.5, 10 at%) were obtained from ethanolic solution of zinc acetate dihydrate in the presence of lithium hydroxide and titanium citrate. Reaction was conducted in autoclave at 225 ^{0}C and 42 bar for 6 h. Detailed structural analysis was carried out using X-ray diffraction (XRD) and scanning electron microscopy (SEM). Based on obtained results mechanism of Ti incorporation in ZnO lattice was discussed.

CHEMICAL STABILITY AND ELECTRICAL PROPERTIES OF Nb DOPED $BaCe_{0.9}Y_{0.1}O_{3-\delta}$ AS A HIGH TEMPERATURE PROTON CONDUCTOR FOR IT-SOFC APPLICATION

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$BaCe_{0.9-x}Nb_xY_{0.1}O_{3-\delta}$ (where x = 0.01, 0.03 and 0.05) fine powders were synthesized by auto-combustion reaction to investigate the influence of Nb concentration on chemical stability and electrical properties of $BaCe_{0.9}Y_{0.1}O_{3-\delta}$. The dense electrolyte pellets were formed from powders after being uniaxially pressed and sintered at 1600ºC for 5h. Chemical stability in a CO_2 atmosphere at 750ºC was determined by X-ray powder diffraction. Conductivities of the sintered samples have been measured within the temperature range of 500-750ºC in different atmospheres (dry and wet argon, wet hydrogen). The highest conductivities were obtained at 750ºC in wet hydrogen reaching the value of $3{,}26 \cdot 10^{-3} Sm \cdot cm^{-1}$.

SYNTHESES OF Pb-CERAMIC FROM ZEOLITE PRECURSORS: XRPD REFINEMENT AND SEM/EDS ANALYSIS

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The Pb-ceramic was syntheses by process of thermally induced phase transformation of Pb-exchange LTA and FAU zeolites. Both frameworks collapse into amorphous intermediate products after heating between 600 and 650 °C. Prolonged heating of the intermediate product over 1100°C results directly in formation of a disorder Pb $feldspar_{LTA}$ [a =8.4171(4) Å, b=13.0532(4) Å, c=7.1722(4) Å, β=115.35(3)°] and Pb-$feldspar_{FAU}$ [a=8.426(4) Å, b=13.0608(4) Å, c=7.1773(4) Å, β=115.36(3)°] phase. The phase conversions in the temperature range investigated were followed by thermal (DTA/TGA), XRPD, and SEM/EDS analyses. The results showed that the Pb-ceramic could be obtained by process of thermally induced phase transformation of Pb-exchange zeolites.

SPECTROSCOPIC ELLIPSOMETRY INVESTIGATION AND MODELING OF BAND GAP IN FE DOPED CERIA NANOPARTICLES

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We have investigated optical properties of $Ce_{1-x}Fe_xO_{2-\delta}$ (x=0.01,0.03,0.05) nanocrystals using spectroscopic ellipsometry. In order to obtain more precise value of the optical band gap, several analytical models were applied to analysis complex dielectric function of these nanomaterials. Samples were synthesized using hydrothermal method and average particle size was evaluated from the x-ray diffraction data. Raman spectroscopy was used to monitor phase separation as well as oxygen vacancy concentration. From the analysis of band gap behavior we have concluded that optical absorption edge shifts more towards visible spectral range as the dopant content increases (up to 5%) as a consequence of additional defect states formed in the gap. Shifting of the optical band gap in these types of materials can have significant impact in various applications such as photocatalysis and solar cells technologies.

APPLICATION OF AFM IN QUALITY CONTROL OF THERMAL MEMS SENSORS FABRICATION

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Atomic force microscopy (AFM) is a powerful technique for characterization of MEMS structures and sensors at micro/nano scale. AFM offers possibility of 2D and 3D presentation of the specific parts of sensor structure, line or area analysis of the topography, estimation of the layer thickness, estimation of the width of sensor elements etc. Using contact AFM mode such analysis of the IHTM thermopile based MEMS sensors was performed. AFM analysis included study of quality of the sputtered metal layer, control of the layer hight and control of the dimensions of all elements photolithographically formed in materials used for sensor fabrication.

IMPROVEMENT OF HYDROGEN STORAGE PROPERTIES OF MgH_2 BY α AND β -SiC

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Modification of MgH_2 by structural destabilization by ball milling leads to improved desorption behaviour of MgH_2. We investigated the H storage properties of composites obtained by ball milling of MgH_2 with two different crystallographic SiC phases (α and β) to emphasis the effect of crystallographic variation to the morphology of samples and consequently on desorption properties. It has been shown that desorption properties has been significantly improved by SiC addition. TPD spectra show the differences regarding existence of intermediate temperature peak. In the sample milled with hexagonal SiC this peak originates both from H_2 and H_2O, while in the sample milled with cubic phase it only comes from H_2O.

STRUCTURE AND CHEMISTRY OF BASAL-PLANE INVERSION BOUNDARIES IN Sb_2O_3-DOPED ZnO

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The atomic structure and the chemistry of basal-plane inversion boundaries (IBs) in Sb_2O_3-doped ZnO were investigated by quantitative transmission electron microscopy techniques. Electron microdiffraction and high-resolution transmission electron microscopy were used to determine the orientation of the polar c-axis on both sides of the IB and the translation state between the inverted ZnO domains. A combination of EDS and HAADF-STEM and HRTEM methods allowed us to determine the exact amount and the arrangement of antimony in the boundary layer.[ref] The IB plane consists of a highly ordered $SbZn_2$ monolayer in which the cations occupy octahedral interstices of the structure constituting a honeycomb superstructure with a three-fold (3m) in-plane symmetry.

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FAR INFRARED AND MICROSTRUCTURAL STUDIES OF MECHANICALLY ACTIVATED NICKEL MANGANITE

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Nickel manganite powder was mechanically activated in a high energy planetary ball mill for 5-60 min. Then the powders were pressed and sintered for 60 minutes at 900^0C, 1050^0C and 1200^0C. Morphological changes of nickel manganite ceramics were monitored using scanning electron microscopy, while changes in structural characteristics were followed using X-ray diffraction. Far infrared reflectivity spectra at room temperature for all sintered samples were recorded in the frequency range between 50 and 1200 cm^{-1}. Transversal and longitudinal optical modes were calculated for six ionic oscillators (four strong, and two shoulders) belonging to the partially inverse spinel structure of nickel manganite.

MODELING STRUCTURE AND PROPERTIES OF AMORPHOUS SILICON BORON NITRIDE CERAMICS

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Silicon boron nitride is the parent compound of a new class of high-temperature stable amorphous ceramics constituted of silicon, boron, nitrogen, and carbon, featuring a set of properties that is without precedent, and represents a prototypical random network based on chemical bonds of predominantly covalent character.[1] In contrast to many other amorphous materials of technological interest, a-$Si_3B_3N_7$ is not produced via glass formation, i.e. by quenching from a melt, nor by sintering of □m-size powders consisting of binary nitrides BN and Si_3N_4. Instead, one employs the so-called sol-gel route starting from single component precursors such as TADB ($(SiCl_3)(NH)(BCl_2)$).

Many of the exciting properties of these ceramics are closely connected to the details of their amorphous structure. To clarify this structure, it is necessary to employ not only experimental probes on many length scales (X-ray, neutron- and electron scattering; complex NMR experiments; IR- and Raman scattering), but also theoretical approaches [2]. These address the actual synthesis route to a-$Si_3B_3N_7$,[3] the structural properties [4], the elastic [4] and vibrational properties, aging [5] and coarsening [6] behaviour, thermal conductivity [7] and the metastable phase diagram both for a-$Si_3B_3N_7$ [8] and possible crystalline and/or amorphous silicon boron nitride phases with compositions different from (Si_3N_4) : (BN) = 1:3.[9] Here, we present a comprehensive overview over the insights gained using molecular dynamics and Monte Carlo simulations to explore the energy landscape of a-$Si_3B_3N_7$, model the actual synthesis route and compute static and transport properties of a-$Si_3B_3N_7$.

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MODELING OF AGGLOMERATION DYNAMICS OF NANO-PARTICLE SUSPENSIONS

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We present molecular dynamics (MD) simulations of aggregation dynamics of nano particle suspension during gel formation. Our aim is to parameterize mass balance (Smoluchowski) equation and reproduce observed dynamics in the simulations. Molecular dynamics results shows that coagulation transforms initial homogeneous configuration into phase-separated state with exponential cluster size distributions. If particle density is sufficiently high, formed clusters will further agglomerate into a single cluster spanning the system. The conclusions obtained by modeling are compared with measured structural characteristics of nano-porous anatase TiO_2 produced under different conditions by sol-gel process.

MINERALOGICAL, CHEMICAL AND CERAMIC PROPERTIES OF BEVTONITE CALY OF THE DEPOSIT GREDA-FEDERATION OF BOSNIA AND HERCEGOVINA

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Based on mineralogical and technological investigations in the deposit “Greda”, important quantities of ceramic clay, composed of montmorillonite have been determined. Representative samples of the deposit were chemical, thermal and physical characterized with X-ray diffraction, N2 adsorption-desorption, chemical analysis, differential thermal analysis and SEM. The main mineral association consists of montmorillonite, in subordinate quantities occur kaolinite, quartz and pyrite was determined by XRPD analysis. The chemical composition generally shows high silica and alumina contents in all samples, the major extrafarmework cations are Ca2+ and Mg2+. Based on technological and mineralogical research, bentonite from this deposit is a high-quality raw material for use in ceramic industry.

ULTRASHORT LASER PULSE MODIFICATIONS OF Al_2O_3 COATING DEPOSITED ON TiAlN/TiN MULTILAYER

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Al_2O_3 ceramic was deposited on multilayered TiAlN/TiN/steel system and irradiated by ultrashort femtosecond laser. Surface morphological changes as a function of laser pulse energy were considered. Nano- and microjoule Ti:sapphire lasers were employed, with the wavelength of ~800 nm and pulse duration ~200 fs. The corresponding intensities were around 10^{11} W/cm^2 for nJ, and 10^{14} W/cm^2 for μJ pulses. Sample surface and composition were characterized before and after laser irradiation using optical microscope, scanning electron microscope (SEM) and energy dispersive analysis (EDS). The condition for single pulse Al_2O_3 ablation from the investigated system was estimated to be ~1.5 μJ.

THE ROLE OF EXPERIMENTAL RESEARCH ON CERAMICS IN THE IDENTIFICATION OF INTANGIBLE CULTURAL HERITAGE

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Pottery is the most durable artifact in archeology that could be used to determine the technological level, as well as helpful identification of ancient people's life. Existence of the technological method of ancient man that evolved in response to their environment is the subject of research in experimental archeology and evidence of existence of the intangible cultural heritage.

Studying the neolith technology and possible interaction with later cultures includes multidisciplinary study. Initial research is aimed to classification, structure and artifacts studies that could lead to assumptions about the preparation technique of pottery from archaeological site of Pločnik.

MICROSTRUCTURE AND PHASE COMPOSITON OF NATURAL CLAYS

Tamara Tuvić[1], Uroš Jovanović[1], Velibor Andrić[1], Ljubomir Vulićević[2], Jasmina Grbović Novaković[1], Ana Radosavljević Mihajlović[1], Vladimir Pavlović[3], Nenad Ivanović[1]

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The paper show preliminary results of structural analysis of natural clays as possible material for heavy ions absorption from polluted water. Microstructure and phase composition of clays has been determinated by SEM, XRD, ICP and particle size distribution measurements on samples coming from four different minds in Serbia. All clays are complex mixer of phyllosilicates and tectosilicates with different ratio of montmorillonite, quartz, epidote, muscovite and dolomite phase giving rise to the different colors. The samples show sponge like morphology with average particle size over 300 μm except sample with chemical composition: 225g Si/kg ,135 Fe, g/kg, 9 Ca, g/kg , 16 Al, g/kg where the particle size is less than 10 μm.

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THE INVESTIGATIONS IN THE FIELD OF NANOSTRUCTURED BULK MATERIALS BASED ON HIGH-MELTING POINT COMPOUNDS OBTAINED BY HIGH PRESSURE SINTERING

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Recently the scientific and practical interest in nanostructured materials based on high-melting point compounds has increased. It is hoped that new superhard materials can be obtained because the transition to nanocrystalline state is accompanied by increase of hardness. Secondly it connects with the hope to reach of increase another important characteristic as fracture toughness.

The main problem of consolidation of particle nanostructured materials is the achievement of full densification and conservation of the nanocrystalline structure of sintered samples. Conventional sintering and hot pressing methods are not acceptable due to intensive recrystallization process. Currently, high energy consolidation techniques – various static and dynamic techniques of high pressure, as well as electric discharge compacting are the most promising routes to fabricate powder nanocrystalline materials. High pressure sintering is one of such methods. It allows to keep the nanostructure of initial powder and to obtain sintered highly dense material with small grain size.

The highly dense ceramics based on Si_3N_4, AlN, TiN, BN micro- and nanopowders has obtained using high pressure sintering. The hardness and fracture toughness of Si_3N_4-TiN nanocomposites reach up to 19-25 GPa and to 8-10 $MPa*m^{1/2}$ respectively. This ceramics can be used for cutting tools. Thermal conductivity AlN ceramics for electronics is of 145-185 W/(m*K).

EBONEX® BASED PLASTIC-BONDED MATERIAL FOR BIPOLAR PLATE IN Pb-ACID BATTERY

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Several samples of oxygen deficient titanium oxides (TiO, Ti_4O_7, Ti_5O_9, Ti_6O_{11}) or their mixtures were prepared using mechanochemical procedure followed, in some cases, by thermal treatment. The prepared oxides, mixtures identical or similar to Ebonex® powder, and original Ebonex® powder have proceeded into plastic–bonded foil electrodes using a low density polyethylene. The electrodes were tested for corrosion stability in real Pb-acid battery conditions and their conductivities were compared. If contact resistance to cathode and anode active mass can be overcome, some investigated samples are very promising for application as current collector in extremely aggressive H_2SO_4 surrounding.

EFFECT OF ANTIMONY DOPING ON PROPERTIES OF BARIUM TITANATE CERAMICS

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Nanopowders of pure and antimony doped barium titanate were synthesized by polymeric precursors method. Sintering was performed at 1300 ^oC for 8 h. XRD analysis showed formation of cubic crystal structure in all nanopowders and tetragonal in ceramics. The influence of antimony concentration on structure change and microstructure development was analyzed. The significant dielectric properties modification as a consequence of antimony doping was noticed. The electrical resistivity measurements pointed out that antimony concentration influenced on materials change from insulator to semiconductor.

VARIATION IN OPTICAL AND ELECTRONIC PROPERTIES OF ZnO INDUCED BY MECHANICAL MILLING AND THERMAL TREATMENT

Katarina Vojisavljević[1], Maja Šćepanović[2], Mirjana Grujić-Brojčin[2], Slavica Savić[1], Jovana Ćirković[1], Tatjana Srećković[1]

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Zinc oxide ceramics have been prepared from ZnO powders obtained by mechanical milling for 300 min in air in different high-energy mills. Structural disorder induced in ZnO powder by mechanical activation (MA) and partial structural ordering observed after proposed thermal treatment (TT) in ZnO ceramic has been characterized by XRD and Raman spectroscopy. The influence of defect creating during MA and TT on optical and electronic properties of ZnO has been analyzed using spectroscopic ellipsometry and photoluminescence spectroscopy. It was found the strong influence of intrinsic and extrinsic defects on band-gap widening and change in PL spectra shape and intensity.

PROPERTIES OF LOW CEMENT HIGH ALUMINA CASTABLE SINTERED AT 1300 °C

Sanja Martinović[2], Milica Vlahović[2], Marija Dimitrijević[1], Marina Dojčinović[1], Aleksanadr Devečerski[3], Branko Matović[3], and Tatjana Volkov-Husović[1]

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The low cement castable was synthesized, cured, and then sintered at 1300C with a dwell time of 3 hours. The prepared alumina based refractory material used in this investigation had 98.11 % of Al_2O_3 and 1.22 % CaO. XRD analysis was applied to detect phases in LCC matrix. The purpose of this study was to investigate possibility of using loe cement castable as material with promising cavitation resistance. Cavitation damages of the LCC specimens were performed by using the modified vibratory cavitation set up. Cavitation resistance of the samples was measured by mass loss and monitoring the surface degradation during testing using image analysis. Samples exhibited very good cavitation resistance, as they were stable till 180 minutes, with damage below 30 % from original surface. Based on the obtained results it could be concluded that this material can be successfully applied in the conditions where the cavitation resistance is needed.

THEORETICAL INVESTIGATION OF THE STRUCTURE OF BC_2

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Boron carbide, BC_4, is a material of great practical importance and thus its formation from the other boron and carbon containing compounds has been subject of numerous experimental and theoretical investigations. We present the results of an ab initio quantum mechanical study of BC_2, one of the key species leading to the formation of boron carbide under various experimental conditions. This molecule has a very interesting structure in its electronic ground state and accurate computation of the corresponding thermodynamic functions is connected with a number of non-trivial problems.

VARISTORS OBTAINED FROM NANOSIZED ZNO PRECURSOR FOR HIGH FREQUENCY APPLICATIONS

M. Vuković, M. Žunić, G. Branković, Z. Branković

Intitute for Multidisciplinary Research-University of Belgrade, Belgrade, Serbia

Nanosize ZnO particles were used to obtain small-grained varistors for telecommunication demands. Doped ZnO nanoparticles were synthesized by refluxing ethanolic solution of 96 mol.% $Zn(CH_3COO)_2$, 0.1 mol.% $Mn(CH_3COO)_3x2H_2O$ and 0.3 mol.% $Co(CH_3COO)_2x4H_2O$. Colloidal solution was adjusted to pH=7.00 and solvothermaly treated at 200°C/6h. Particles showed unifom grain size and morfology, with the mean grain size of about 50 nm. ZnO was mixed with previously prepared spinel phase ($Zn_{1.971}Ni_{0.090}Co_{0.030}Cr_{0.247}Mn_{0.090}Sb_{0.545}O_4$) and γ-Bi_2O_3 (6 Bi2O3·MnO_2) in several mass ratios. Pellets were uniaxialy pressed and sintered under 1000°C/1h. Varistors were characterized by SEM, XRD density and electrical measurements (α, J_l, K_c). Results showed apparent correlation between varistor properties, grain size and amount of secondary phases.

STRUCTURE PREDICTION AND ENERGY LANDSCAPE EXPLORATION IN THE ZINC OXIDE SYSTEM

D.Zagorac, J.C. Schön, I. Pentin, M. Jansen

Max Planck Institute for Solid State Research, Stuttgart, Germany

Recent developments in experimental solid state chemistry have offered us new possibilities in controlling synthesis routes [1], especially by varying the pressure range (from the effective negative pressures of -1 GPa to +100 GPa) [2]. Similarly, the development of new theoretical methods and tools makes it worthwhile to reinvestigate apparently well-known systems [3]. In order to gain new insights in the ZnO system, we performed global explorations of the energy landscape using Simulated Annealing (SA) [4] with an empirical potential, both at standard and elevated pressure (up to 100 GPa) in order to identify possible new ZnO modifications. Next, the structures found were locally optimized on ab initio level (DFT and Hartree-Fock). The energy E(V) and enthalpy H(p) as function of volume and pressure, respectively, were computed for these modifications, and their electronic structure was analyzed. The results were in good agreement with experiment. Furthermore, we employed the threshold algorithm (TA) [5] to explore the barrier structure of the landscape of ZnO as function of the number of formula units Z in the simulation cell (Z = 1,…,6). In addition to the TA runs, we also performed prescribed path (PP) [6] studies where we analyzed structures and the barriers separating them on the landscape as function of pressure and temperature.

Besides the well-known structure types (wurtzite, sphalerite and rock-salt), many new interesting modifications were found in different regions of the energy landscape, partly as side-products of the TA and PP runs, e.g. the "5-5" type, the NiAs type, and the β-BeO type. Furthermore, we observed many distorted variations of the six main types. Of particular interest were many new structures built-up from various combinations of structure elements of these types, exhibiting different stacking order with different numbers of formula units per simulation cell.

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$Gd_{9.33}(SiO_4)_6O_2$ OXYAPATITE SYNTHESIZED BY SOL-GEL COMBUSTION METHOD

Slavica Zec, Svetlana Ilić, Marija Stojmenović, Dušan Bučevac, Branko Matović, Snežana Bošković

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Investigations of Ln-silicates with the apatite type of structure have shown high oxide-ion conductivity and therefore can be used as new solid electrolytes. In this study synthesis of $Gd_{9.33}(SiO_4)_6O_2$ oxyapatite was performed from ethanol-water solution of gadolinium nitrate, tetraethyl orthosilicate (TEOS) and glycine by sol-gel combustion method. X-ray diffraction (XRD) analyses confirmed that the nanocrystalline structure of $Gd_{9.33}(SiO_4)_6O_2$ was formed during combustion reaction at the molar ratio glycine:nitrate ion=0.4. Produced $Gd_{9.33}(SiO_4)_6O_2$ powder was calcined at 600 ºC, then uniaxialy pressed and sintered at 1550 ºC for 4 h. Relative density of sintered material was 83%.

SYNTHESIS AND CHARACTERIZATION OF ANODIC SUBSTRATES FOR IT-SOFCs BASED ON PROTON CONDUCTORS

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Cermet anode substrates based on high temperature proton conductors Ni-$BaCe_{0.9}Y_{0.1}O_{3-\delta}$ (Ni-BCY10) were prepared using wet chemical method. The microstructural properties of sintered pellets were investigated using X-ray diffraction analysis and field emission scanning electron microscopy. Impedance spectroscopy measurements were used for evaluation of electrical properties of the anode pellets. The high conductivity values of reduced anodes confirmed the percolation through Ni particles even for anode with reduced amount of nickel. Fuel cell tests were carried out and fuel cells with the cermet anode showed higher power output comparing to the fuel cells with platinum electrode.

APPLICATION OF NANOPARTICLES Ca/Co-HAP IN REPARATION OF ALVEOLAR BONE

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Deficit of bone tissue causes great problems in dentistry. If the damage of the bone tissue is small, balanced activity of osteoblasts and osteoclasts can rapair it independently. When greater damage occures it is necessary to facilitate the biological potential for reparations, precisely for these reasons we used nanoparticle biomaterial Ca / Co-HAp in this study. The research was conducted on rats. Assessments and repair consolidation of the alveolar bone were performed by histopathologic and SEM analysis. The best results were obtained in the experimental group of animals where Ca / Co-HAp was mixed with autologous plasma. When we implanted the nanocomposites mentioned above, there was an intense formation of new bone from which it indicates that the Ca / Co-HAp is the material of choice for rapid repair of the alveolar bone.

Key words: nanoparticles Ca / Co-Hap, the alveolar bone, repair, SEM.

AUTHOR INDEX

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