CYSC
2021

14TH ECerS CONFERENCE
FOR YOUNG SCIENTISTS IN CERAMICS

BOOK OF ABSTRACTS

October 20-23, 2021
Faculty of Technology Novi Sad
Novi Sad, Serbia

14th ECerS CONFERENCE for YOUNG SCIENTISTS in CERAMICS

PROGRAMME and BOOK OF ABSTRACTS

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Programme and Book of Abstracts of The ECerS 14th Conference for Young Scientists in Ceramics (CYSC-2021) publishes abstracts from the field of ceramics, which are presented at traditional international Conference for Young Scientists in Ceramics.

Editors-in-Chief
Prof. Dr. Vladimir V. Srdić
Dr. Andraž Kocjan
Dr. Maria Canillas Perez

Publisher
Faculty of Technology, University of Novi Sad
Bul. cara Lazara 1, 21000 Novi Sad, Serbia

For Publisher
Prof. Dr. Biljana Pajin

Printing layout
Vladimir V. Srdić, Marija Milanović, Ivan Stijepović

Press
SAJNOS, Novi Sad

CIP – Каталогизација у публикацији
Библиотека Матице српске, Нови Сад

666.3/.7(048.3)

CONFERENCE for Young Scientists in Ceramics (14 ; 2021 ; Novi Sad)

Programme and book of abstracts / 14th ECerS Conference for Young Scientists in Ceramics (CYSC-2021), October 20-23, 2021, Novi Sad ; [editor-in-chief Vladimir V. Srdić, Andraž Kocjan, Maria Canillas Perez]. - Novi Sad : Faculty of Technology, 2021 (Novi Sad : Sajnos). - XX, 142 str. : ilustr. ; 24 cm

Tiraž 130. - Registar.

ISBN 978-86-6253-136-0

a) Керамика - Технологија - Апстракти
COBISS.SR-ID 48093961

Preface

Dear colleagues and guests we have the pleasure to once again welcome you all to Novi Sad, Serbia as the venue for the 14th ECerS Conference for Young Scientists in Ceramics. The event is jointly organized by the Faculty of Technology Novi Sad, University of Novi Sad and the European Ceramic Society (ECerS) and its Young Ceramists Network (YCN).

The ECerS Conference for Young Scientists in Ceramics is the conference with more than twenty years of tradition. In the beginning in 1998 it was only national conference and it grew constantly to become the international event with participants coming from all over the world. This year we have the honour to co-host biannual ECerS 2021 Student Speech Contest where young ceramist research students, representing each of the ECerS member countries, will give an oral presentation of their research achievements that is evaluated by a jury.

In this year of pandemics and crisis we are happy to able to bring scientists from 28 different countries to Novi Sad, Serbia. In this way we will have an opportunity to hear 114 oral presentations given by young scientists and 19 presentations within ECerS 2021 Student Speech Contest together with 9 invited talks of the more experienced scientists and experts. We are sure that these numbers could have been much higher if there wasn't for pandemics. Nevertheless, we are proud to again bring together young scientists and promote their research and their achievements. This conference continues to serve as the meeting point for young people working in the vast field of ceramics, the place where they could broaden their knowledge but also their network of contacts. Within four days of the event young researchers will have a chance to exchange ideas and learn a lot from their peers and senior colleagues. This was and it will always be a basic idea behind the conference which is well recognised within ceramic scientists community. The topics covered by the conference include various aspects of the ceramics including processing, characterisation and application of advanced and traditional ceramics but also cutting edge results in the modelling and physics of the ceramic materials and structures. Thus, we are confident that the participants will have the opportunity to hear a lot of new results, to learn new concepts and ideas and to expand their knowledge.

All of this could not be possible without the help of our sponsors and co-organizers and we want to express our deepest gratitude to all of them. First of all, we want to acknowledge the JECS Trust Fund of the European Ceramic Society for being our greatest financial benefactor. Also, we are thankful to the Serbian Ministry of education, science and technological development which once again endorsed the conference financially. At the end, we would like to thank to all the people in the local organizing committee and colleagues from YCN who participated in the preparations of the Conference.

Editors

rare-earth (RE) additives were used to improve the mechanical properties of ZrB_2-SiC composites. Phase and morphologies of the ZrB_2 based composites were characterized by X-Ray Diffraction and Scanning Electron Microscopy. Both the room temperature (hardness, strength, fracture toughness) and high temperature (ablation resistance) properties were investigated. The results showed that homogeneous microstructure and nearly fully dense ZrB_2-25vol.%SiC composites with a relative density above 99% were obtained after sintering at the temperature of 1600 °C under the pressure of 70 MPa for 10 min. During sintering, the additives were completely transformed into ZrB_2 and SiC particles, which were homogeneously distributed in the ZrB_2 matrix. The RE-based additives were also uniformly distributed at the grain boundaries of ZrB_2. The mechanical properties of ZrB_2-SiC composite, such as hardness, strength and fracture toughness, were slightly improved by the addition of RE additives. Most importantly, the ablation resistance of ZrB_2-based materials was significantly improved by the addition of RE additives, and further improved with their increasing amounts.

Acknowledgement: This work was supported by the Slovak Research and Development Agency under the contract no. APVV-17-0328 and SK-SRB-18-0022. The support the Joint Mobility Projects under the CAS-SAS agreement (project No. SAV-18-12 and SAV-21-04) is also acknowledged.

OC-12

PHYSICO-MECHANICAL PROPERTIES OF COMPOSITES 90 wt.% Al_2O_3 - 10 wt.% ZrO_2 (Y_2O_3, CeO_2)

Mariia Smyrnova-Zamkova[1], Viktor Garashchenko[2]

[1]*Frantsevich Institute for Problems of Materials Science, Kyiv, Ukraine*

[2]*V. Bakul Institute for Superhard Materials NAS of Ukraine, Kyiv, Ukraine*

e-mail: smirnovazamkova@ukr.net

Al_2O_3 – based ceramics reinforced with ZrO_2 particles (ZTA-composites) belongs to disperse-strengthened materials in which α-Al_2O_3 matrix is strengthened by pure ZrO_2 particles or ZrO_2-based solid solutions. The properties of ZTA-ceramics are determined by transformation toughening and microcracking and are largely depending on the properties of starting powders.

To study the effect of heat treatment temperature of the starting powders on the microhardness of ZTA-composites we used hydrothermal nanocrystalline powder of composition (wt.%): 90 Al_2O_3 - 10 ZrO_2 (Y_2O_3, CeO_2) (90 AZG). The composition of ZrO_2-based solid solution was (mol%): 90 ZrO_2–2 Y_2O_3–8 CeO_2.

Nanocrystalline powders were produced by hydrothermal synthesis in an alkaline medium and were thermal treated in the range of 400–1300 °C with step 150 °C. For experiments samples were formed by cold uniaxial pressing and sintered in air at 1500 °C for 1.5 h. The relative density of the samples after sintering varied from 0.95 to 0.98. A

tetragonal ZrO_2-based solid solution (T-ZrO_2) and α-Al_2O_3 were identified in the sintered samples by XRD method. Porous fine-grained microstructures with a sufficiently homogeneous distribution of T-ZrO_2 and α - Al_2O_3 were formed in the samples (Fig. 1).

550 °C 850 °C 1450 °C

Figure 1. Dependence of the ZTA-composites microstructures after heat treatment at 1500 °C on the annealing temperature of the starting powders (Scale bars – 20 μm)

Table 1. Dependence of ZTA-composites microhardness on the temperature of starting powders heat treatment

	The temperature of starting powders heat treatment, °C						
	400	550	700	850	1000	1150	1300
Microhardness, MPa	186	217	213	209	203	202	215

The dependence of microhardness of ZTA-composites on heat treatment temperature of starting powders is given in the Table 1. The improving of ZTA-composites consolidation processes during microstructural design will achieve the required set of their physical and mechanical properties.

OA-13

N-DOPED CARBON DOTS IMPROVE FINGERPRINT IMAGING

Ivana Milenković[1], Manuel Algarra[2], Juan M. Lázaro-Martínez[3], Enrique Rodríguez-Castellón[3], Ksenija Radotić[1]

[1]*Institute for Multidisciplinary Research, University of Belgrade, Beograd, Serbia*

[2]*Department of Inorganic Chemistry, Faculty of Science, University of Malaga, Malaga, Spain*

[3]*Department of Organic Chemistry and IQUIMEFA-CONICET, Faculty of Pharmacy and Biochemistry, University of Buenos Aires, C1113AAD, Ciudad Autonoma de Buenos Aires, Argentina*

e-mail: ivana.milenkovic@imsi.rs

Fingerprints analysis has been used as a powerful and reliable tool for individual identification in forensic science for more than a century. Some traditional techniques used toxic agents, so the application of fluorescent biocompatible materials, such as N-

Carbon Dots (N-CDs), can be used as-received and it is non-toxic, as opposed to a lead carbonate powder routinely used by the police. N-CDs have recently gained the attention of scientists because of their stable luminescence, hydrophilicity, chemical inertness, photo-bleaching resistance, easiness of their functionalization, and low cost. In this research, N-CDs were obtained in a simple step process using the hydrothermal treatment of polyvinylpyrrolidone (PVP), as an N source, and further used for the detection of fingerprints through fluorescent imaging. A brightness emission at 495 nm of N-CDs was related to their structural and chemical properties. Detailed surface characterizations with ss-NMR, XPS, and fluorescence spectroscopies, suggested that the negative charge of the functional groups promoted electrostatic interactions between the charged N-CDs surface functional groups (amine, carboxylic, and amide) and the secretion components present in the thin layer of fluid left on the surface upon its direct contact with human fingers. Based on biometric identification, the obtained results were validated by the scientific protocol of the Police Automated Fingerprint Identification System (AFIS).

OA-14

EFFECT OF TWO-STEP SINTERING PARAMETERS ON GRAIN SIZE DISTRIBUTION IN BARIUM TITANATE CERAMICS

Abolghasem Nourmohammadi, Nima Fakhrolmobasheri
Department of Nanotechnology, Faculty of Chemistry, University of Isfahan, Isfahan, Iran
e-mail: abolghasem.nourmohammadi@gmail.com

It is well-known that the mechanical, dielectric, piezoelectric, and ferroelectric properties of ceramics depend on their microstructure and grain size. Grain size control in the submicron range can improve the mechanical properties of ceramics; however, it will decrease their dielectric, piezoelectric, and ferroelectric properties. In addition, most of the Pb-free dielectric, piezoelectric, and ferroelectric ceramics such as barium titanate (BTO) require high-temperature sintering for high-density fabrication. However, high-temperature sintering may lead to abnormal grain growth in barium titanate ceramics. Thus, abnormally large grains form in the BTO ceramics mixed with small grains during sintering. Thus, abnormally large grains form in the BTO ceramics mixed with small grains during sintering. Since grain boundaries act as sinks for porosity depletion, the abnormal grain growth effect inhibits porosity depletion during the sintering and produces porous ceramics, which weakens their dielectric, piezoelectric, and ferroelectric properties because the pores or vacuum have no dielectric, piezoelectric, or ferroelectric effect [1].

Some impurities such as La^{3+} ions are well-known to control grain size in BTO ceramics [2], but this approach will increase the ceramic dielectric loss. Therefore, it is suggested to control the grain size of the pure BTO ceramics to improve both the

mechanical and electrical properties. Some researchers have suggested two-step sintering of fine/ultrafine powders for this purpose. For example, in 2007, Karaki *et al.* suggested the fabrication of high-density barium-titanate ceramics (5.91 g/cm^3) by the two-step sintering approach using hydrothermally synthesized $BaTiO_3$ nanoparticles of 100-nm average size [2]. Here, the effect of two-step sintering parameters on grain size distribution is investigated in BTO ceramics to identify the optimum two-step sintering parameters for the ceramic dielectric properties.

A commercially available $BaTiO_3$ micropowder, CAS No. 208108, Sigma-Aldrich GmbH, was used as the starting material. The starting powder was deagglomerated for 20 h in a planetary ball mill system using 1-cm stabilized ZrO_2 balls to achieve suitable submicron powders. The produced powders were shaped into small pellets by a lab-scale uniaxial press machine and subsequently compacted by a cold isostatic press (CIP) to achieve samples with uniform green density before sintering. Different two-step sintering regimes were examined to evaluate the effect of two-step sintering parameters on the grain size distribution and the ceramic dielectric properties. Notably, the fabrication of high-density and pure $BaTiO_3$ ceramics necessitates sintering about 1300 °C; however, dense and homogeneous microstructures were developed here, after sintering about 1240 °C. The average grain size of the samples and the grain size distribution were calculated from the SEM images. The dielectric properties and loss were measured on a digital LCR-meter instrument.

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