Serbian Ceramic Society Conference

# ADVANCED CERAMICS AND APPLICATION IX

## New Frontiers in Multifunctional Material Science and Processing

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

# PROGRAM AND THE BOOK OF ABSTRACTS

Serbian Academy of Sciences and Arts, Knez Mihailova 35
Serbia, Belgrade, 20-21. September 2021.

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Dear colleagues and friends,

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

It is nice to host you here in Belgrade in person. As you probably know, Serbia launched a vaccination campaign at the beginning of this year, so up to date more than 50 percent of the adult population has been vaccinated. Since there is no one statistic to compare the COVID19 outbreaks and fears for loved ones in different countries, we believe that we all suffer similarly during this pandemic. That is why we appreciate even more your positive attitude and readiness to travel in this uncertain time. We understand that some of you had to cancel your lectures in the last minute due to the travel limitation in your countries, but we hope that you will come next year. We deeply hope that the ACA IX Conference will be worth remembering, that you will respect all COVID-19 safety measures at SASA building, that you will have a nice time here and that ultimately you will return to your home safely. We are very proud that we succeeded in bringing the scientific community together again and fostering the networking and social interactions around an interesting program on emerging advanced ceramic topics. The chosen topics cover contributions from fundamental theoretical research in advanced ceramics, computer-aided design and modeling of new ceramics products, manufacturing of nanoceramic devices, developing of multifunctional ceramic processing routes, etc.

Traditionally, ACA Conferences gather leading researchers, engineers, specialists, professors and PhD students trying to emphasize the key achievements which will enable the widespread use of the advanced ceramics products in the High-Tech industry, renewable energy utilization, environmental efficiency, security, space technology, cultural heritage, etc.

Serbian Ceramic Society was initiated in 1995/1996 and fully registered in 1997 as Yugoslav Ceramic Society, being strongly supported by American Ceramic Society. Since 2009, it has continued as the Serbian Ceramic Society in accordance with Serbian law procedure. Serbian Ceramic Society is almost the only one Ceramic Society in South-East Europe, with members from more than 20 Institutes and Universities, active in 16 sessions. Part of our members are also members of the Serbian Chapter of ACerS since 2019. Their activities in the organization of this conference is highly recognized. To them and all of you thanks for being with us here at ACA IX.

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

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

**Conference Topics**

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

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**INV**

## Electronic Properties of BZT Nano-Ceramic Grades at Low Frequency Region

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Barium zirconium titanate ceramics were prepared using solid state reactions of $BaCO_3$, $TiO_2$ and $ZrO_2$ at elevated temperatures. The prepared BZT was mechanically activated in the planetary ball mill from 0-120 min to achieve different powder grades from micro- to nano-sized particles. After the powder characterization by XRD and SEM the samples were pressed in disc shape and sintered at 1100 and 1200 °C in the air. The sintered samples were characterized by SEM. After that the silver epoxy electrodes were deposited on sintered disc samples. The disc samples capacitance and resistivity were measured in the low frequency region from 1 Hz to 200 kHz using a low frequency impedance analyzer. Sintering temperatures and powder grades were used as parameters. Finally, specific resistance ρ, dielectric permittivity (ε' + jε") and tgδ were obtained from the impedance measurements. The trends in electronic properties were analyzed: the relaxation effect of the space charge (inter-granular electric charges) vs. sintering temperature and ceramic grades. These show that mechanical activation has a significant effect on electrical properties, resulting in generally improved overall performance.

**INV**

## Influence of solvothermal synthesis parameters on $NaY_{0.65}Gd_{0.15}F_4$:$Yb_{0.18}Er_{0.02}$ UCNPs structural, morphological and optical characteristics

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Monosized Up-Converting NanoParticles (UCNPs) with biocompatible surface and unique optical properties attract a great interest as new cell markers or drug delivery systems. The uppermost UC efficiency of β-$NaYF_4$:Yb/Er phase is due to its hexagonal *P63/m* space group

arrangement which could accommodate higher concentration of dopants at shorter distance. Stabilization of this phase in nanoparticles is usually achieved through thermal decomposition of organic precursors in the presence of solvents with a high boiling point. Here, for the same purpose, we used gadolinium co-doping during chitosan assisted solvothermal processing of inorganic precursor salts. Precursor concentration, solvent type, and synthesis time were varied in order to determine their influence on the β-$NaY_{0.65}Gd_{0.15}F_4$:$Yb_{0.18}Er_{0.02}$ phase crystallization. The XRPD analysis showed that lower surplus of fluoride ions during synthesis leads to formation of $Y_{0.65}Gd_{0.15}F_4$:$Yb_{0.18}Er_{0.02}$ orthorhombic phase, while the increase of fluoride content or prolongation of the processing time enhances formation α-$NaY_{0.65}Gd_{0.15}F_4$:$Yb_{0.18}Er_{0.18}$ phase. Along with it, the changes of UCNPs morphology from spindle to spherical shape is detected. All samples emit intense green emission due to the ($^2H_{11/2}$, $^4S_{3/2}$) → $^4I_{15/2}$ electronic transitions, after been excited with infrared light (λ=978 nm).

## INV
## Nonlinear laser scanning microscopy for imaging of the cells labeled by up-converting $NaYF_4$:Yb,Er nanoparticles

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The Nonlinear Laser Scanning Microscopy (NLSM) contributes to the cell labeling through addressing two main issues: photobleaching and phototoxicity. Moreover, an increase of the penetration depth and a reduction of background autofluorescence are achieved.We have used a multidisciplinary approach combining expertise in material science, nanoparticles synthesis and characterization, cancer cell and tissue labeling, and high resolution imaging, in order to accomplish *in vitro* imaging of the cancer cells. We have imaged the oral squamous carcinoma cells and human gingival cells. We have demonstrated that we are able to take high contrast images. We have shown position of the nanoparticles in cells, through co-localization of the cell auto-fluorescence and the nanoparticles up-conversion.We plan to improve our abilities through further optimization of the up-converting nanoparticles (smaller and brighter particles) and microscopy technique.