XVI

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ABSTRACT BOOK

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POLITECNICO DI TORINO

S01 - INNOVATIVE PROCESSING AND SYNTHESIS - *Invited Lectures* 5

S01 - INNOVATIVE PROCESSING AND SYNTHESIS - *Oral Presentations* 18

S02 - HT PROCESSES AND ADVANCED SINTERING - *Invited Lectures* 135

S02 - HT PROCESSES AND ADVANCED SINTERING - *Oral Presentations* 144

S03 - MODELLING OF CERAMICS - *Invited Lectures* 185

S03 - MODELLING OF CERAMICS - *Oral Presentations* 195

S04 - ADVANCED STRUCTURAL CERAMICS, COMPOSITES AND REFRACTORIES *Invited Lectures* 225

S04 - ADVANCED STRUCTURAL CERAMICS, COMPOSITES AND REFRACTORIES *Oral Presentations* 241

S05 - CERAMICS AND GLASSES FOR HEALTHCARE - *Invited Lectures* 340

S05 - CERAMICS AND GLASSES FOR HEALTHCARE - *Oral Presentations* 352

S06 - CERAMICS FOR ENERGY CONVERSION AND STORAGE - *Invited Lectures* 395

S06 - CERAMICS FOR ENERGY CONVERSION AND STORAGE - *Oral Presentations* 405

S07 - FUNCTIONAL CERAMICS - *Invited Lectures* 467

S07 - FUNCTIONAL CERAMICS - *Oral Presentations* 476

S08 - SILICATE CERAMICS - *Invited Lectures* 544

S08 - SILICATE CERAMICS - *Oral Presentations* 556

S09 - CERAMICS IN CULTURAL HERITAGE AND ART - *Invited Lectures* 616

S09 - CERAMICS IN CULTURAL HERITAGE AND ART - *Oral Presentations* 620

POSTER SESSION 1 647

POSTER SESSION 2 768

POSTER SESSION 3 886

35 - ABS 647

ELECTRICAL AND MECHANICAL PROPERTIES OF ALUMINA DOPED WITH TRANSITION METAL OXIDES SINTERED AT 1400°C

S. FILIPOVIC [1], N. Obradovic [1], S. Markovic [1], I. Balac [2], A. Djordjevic [3,4], V. Pavlovic [1]

[1] *Institute of Technical Sciences of SASA, Belgrade, SERBIA*
[2] *2Faculty of Mechanical Engineering, University of Belgrade, Belgrade, SERBIA*
[3] *School of Electrical Engineering, University of Belgrade, Belgrade, SERBIA*
[4] *Serbian Academy of Sciences and Arts, Belgrade, SERBIA*

Corundum (alpha-alumina) is one of the most exploited materials in ceramic industry due to its good physico-chemical properties, mechanical properties, and, importantly, due to its low cost. Advantageous properties, such as hardness, dielectric and thermal properties, and refractoriness, open the door to a wide range of applications of corundum. Porous alumina ceramics is often used for filters and as a catalytic substrate, whereas dense alumina ceramics is frequently used in automotive and aerospace industry. Hence, there is a great interest in exploring this type of ceramics. The aim of this work is to explain the influence of preparation parameters (mechanical activation, addition of transition metal oxides, and sintering conditions) on the final electrical and mechanical properties of alumina.
As a starting powder, a mix of a few alumina modifications (α-, κ-,γ - Al2O3) was used. It was doped with 1 wt % of Mn2O3, Cr2O3, and NiO, respectively. Three of the obtained mixtures were homogenized and three were ball milled for 60 min. Particle size analysis, SEM, and EDS were performed in order to demonstrate changes in the microstructure after milling. DTA/TG analyses were used to determine all characteristic temperatures. After sintering at 1400 oC in an air atmosphere, mechanical, electrical, and physico-chemical properties of the obtained ceramics were determined.
Results showed that the mechanical treatment lead to a decrease in temperatures of phase transitions and sintering for approximately 100 oC. Incorporation of cations of transition metals into the crystal lattice of alumina was noticed. Activated and sintered samples showed a higher tensile strength and higher relative dielectric permittivity then the sample doped with Cr2O3.
The main conclusion of this investigation is that the mechanical activation has the dominant influence on lowering the characteristic temperatures of all detected phase transitions and sintering processes. Using a mixture of several crystalline phases of alumina as a starting powder alleviates the incorporation of transition-metal cations into the alumina crystal lattice, leading to changes in microstructures of the prepared ceramics. Finally, changes in the microstructure and lattice disordering have the dominant influence on the final mechanical properties.

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Website

Organizing Secretariat

AIM Group International
Florence Office
info@ecers2019.org

www.ecers2019.org