The Serbian Society for Ceramic Materials
Institute for Multidisciplinary Research (IMSI), University of Belgrade
Institute of Physics, University of Belgrade
Center of Excellence for the Synthesis, Processing and Characterization of Materials for use in Extreme Conditions “CEXTREME LAB” - Institute of Nuclear Sciences “Vinča”, University of Belgrade
Faculty of Mechanical Engineering, University of Belgrade
Center for Green Technologies, Institute for Multidisciplinary Research, University of Belgrade
Faculty of Technology and Metallurgy, University of Belgrade
Faculty of Technology, University of Novi Sad

PROGRAMME and the BOOK of ABSTRACTS

5CSCS-2019

5th Conference of the Serbian Society for Ceramic Materials
June 11-13.2019. Belgrade Serbia

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Branko Matović
Zorica Branković
Aleksandra Dapčević
Vladimir V. Srdić

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SPECIAL THANKS TO

Република Србија
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HUMIDITY SENSOR BASED ON MESOPOROUS SnO_2 FABRICATED VIA NANOCASTING TECHNIQUE

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In this contribution, the mesoporous SnO_2 was fabricated via nanocasting, where the hydrothermally processed silica KIT-5 with a high specific surface area of 610 m^2/g and pore volume of 0.72 cm^3/g was used as a hard template. Following the two precursor loading/calcination steps of the wet impregnation process, the appropriate amount of the Sn- precursor solution was used to fill up 15 % of the total pore volume of the silica template with SnO_2. This synthesis route with a template etching by 2M NaOH solution resulted in nanocast SnO_2 with Brunauer-Emmett-Teller specific surface area of 33 m^2/g, where SnO_2 nanoparticles of 8–10 nm formed the ordered domains along with fractions of disordered regions, as confirmed by the transmission electron microscopy (TEM). Based on the Barrett-Joyner-Halenda model from the desorption branch of the N_2 adsorption/desorption isotherms, the pore size of SnO_2 is centered at 8.6 nm, demonstrating quite open and accessible pore structure of the material. Wide-angle X-ray diffraction (XRD) measurement confirmed the formation of the tetragonal SnO_2 phase. Because of the low Si content after the template etching (< 0.5%, confirmed by EDS analysis), formation of substantial amounts of $SnSiO_3$ can be excluded, and no evidence for such phase was found in the XRD.

The as prepared SnO_2 nanocast was further used to fabricate a few micron thick film by the doctor blade technique on alumina substrate provided with interdigitated Pt/Ag electrodes. The sensor response of the film towards humidity was tested measuring the change of the complex impedance of the sample exposed to a humid climate chamber environment with the relative humidity (RH) ranging from 40% to 90% at 25 °C and from 30% to 90% at 50 °C. The value of impedance measured at 100 Hz and 25 °C was reduced 132 times within the RH range of 40 % to 90 %, while it tended to decrease in a moderate manner at 50 °C under the same frequency and RH range. The film exhibited remarkably rapid response (4 s) and quick recovery time (6 s) when exposed to RH change from 37% to 90% at 25 °C. Such a fast response/recovery time and relatively low hysteresis of 4% observed under 50 % RH and 25 °C indicate the promising potentials of nanocasted SnO_2 to be used as an active layer for humidity sensors.