

XVI  
**ECerS**  
CONFERENCE

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**XVI CONFERENCE AND EXHIBITION  
OF THE EUROPEAN CERAMIC SOCIETY**



**ABSTRACT BOOK**

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and Politecnico di Torino



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DI TORINO**

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**NANOCASTING SYNTHESIS OF MESOPOROUS SnO<sub>2</sub> FOR HUMIDITY SENSOR APPLICATION**S. SAVIC<sup>1</sup>, K. Vojisavljevic<sup>2</sup>, M. Pocuca-Nesic<sup>2</sup>, N. Knezevic<sup>1</sup>, V. Djokic<sup>3</sup>, V. Ribic<sup>2</sup>, G. Brankovic<sup>2</sup><sup>1</sup> Biosense Institute, Group for nano and microelectronics, University of Novi Sad, Novi Sad, SERBIA<sup>2</sup> Institute for Multidisciplinary Research, Department of Material Science, University of Belgrade, Belgrade, SERBIA<sup>3</sup> Faculty of Technology and Metallurgy, University of Belgrade, Belgrade, SERBIA

This work presents the fabrication of humidity sensor based on SnO<sub>2</sub> sensing material derived by the nanocasting process using hydrothermally obtained KIT-5 as a hard template.

In a typical wet impregnation process, the infiltration of Sn precursor into mesoporous silica KIT-5, and later evaporation of the solvent were conducted to fill pores to 15 % of the template pore volume. The calcination and removal of the template were performed to obtain the desired mesoporous SnO<sub>2</sub>. The obtained powder (P) was mixed with a 10 % ethyl-cellulose in  $\alpha$ -terpineol solution (S) and acetic acid (A) in the weight ratio P:S:A=7:69.7:23.3 to form a homogeneous paste which was further deposited by doctor blade technique onto alumina substrate with screen printed Pt/Ag electrodes. The film was subjected to a specific drying regime and finally calcined at 550 °C for 5 h.

The obtained SnO<sub>2</sub> nanoparticles as well KIT-5 template were characterized using X-ray diffraction (XRD) spectroscopy, Brunauer–Emmett–Teller (BET) analysis and Transmission Electron Microscopy (TEM). Cross section and surface morphology of SnO<sub>2</sub> film were characterized by Field Emission Scanning Electron Microscopy (FESEM). The humidity sensing properties of the mesoporous SnO<sub>2</sub> sensor were investigated in a JEIO TECH TH-KE-025 temperature and humidity climatic chamber in the range 30–90 % RH. Complex impedance spectra of the as-fabricated sensor were analyzed at room temperature and 50 °C with a HIOKI 3532-50 LCR HiTESTER in a frequency range 42 Hz - 1 MHz.

Nitrogen adsorption isotherms of KIT-5 showed high specific surface area of 610 m<sup>2</sup>g<sup>-1</sup> and average pore diameter of 5.2 nm while those values for SnO<sub>2</sub> sample were 33 m<sup>2</sup>g<sup>-1</sup> and 19.9 nm respectively. Even though that mesoporous ordering of nanocasted negative replica was observed by TEM, the presence of agglomerates in SnO<sub>2</sub>, as well as the relatively low specific surface area of 33 m<sup>2</sup>g<sup>-1</sup>, confirm its partial degradation. Diffraction patterns from TEM display well-defined rings typical for cassiterite SnO<sub>2</sub>. The impedance measured at 42 Hz, at room temperature, and in the range 40-90% RH reduced 509 times, while at 50 °C it reduced 48 times. The sensor exhibited quick response (5 s) and recovery time (16 s) when it exposed to humidity change from 37% RH to 90% RH, and relatively low hysteresis of 3.2% observed at 40% RH and at room temperature showing its promising capacity as a humidity sensor.

**Keywords:** nanocasting, tin oxide, humidity sensors



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**Organizing Secretariat**



AIM Group International  
Florence Office  
[info@ecers2019.org](mailto:info@ecers2019.org)

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