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Nanometric morpho-structural characterization of mesoporous metal oxide semiconductors for chemo-resistive gas sensors

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SnO_2 and ZnO are among the most studied semiconductor oxides for applications as gas sensing devices for detecting and monitoring the presence of toxic gases such as CO, NO, NO_2. Enhanced sensing properties have been recently reported on gas sensor based on SnO_2-ZnO composites due to the formation of hetero-junction between ZnO and SnO_2 grains and the contribution of a depleted layer at the intergrain ZnO-SnO_2 interfaces. The sensing characteristics can be further improved by adding metallic nanoparticles with a catalytic activity, like Pt or Pd. Along with the electrical properties of such a complex system, morphology plays an essential role in facilitating and enhancing the interaction with the surrounding gas. In our work, ZnO doped SnO_2 mesoporous system for gas sensors has been prepared using solvothermal methods in various experimental conditions. Aiming for a proper optimization of the gas sensing properties, the above mentioned system has been decorated with Pd using wet spray method. This work presents an in depth structural and morphological study by combined techniques of analytical electron microscopy on the mesoporous SnO_2-ZnO systems decorated with Pd in function of the synthesis conditions. Electron tomography has been employed for a complete, 3D investigation of the Pd clusters distribution within the mesoporous SnO_2-ZnO matrix. By a proper image segmentation Pd clusters have been successfully isolated in the surrounding ZnO-doped SnO_2 matrix, thus allowing more complex correlations between the micro/nano-structure and the gas sensing properties.

Keywords: *mesoporous metal oxide semiconductors, gas sensors, SnO_2, ZnO.*

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Conflicts of Interest

The authors declare no conflict of interest.

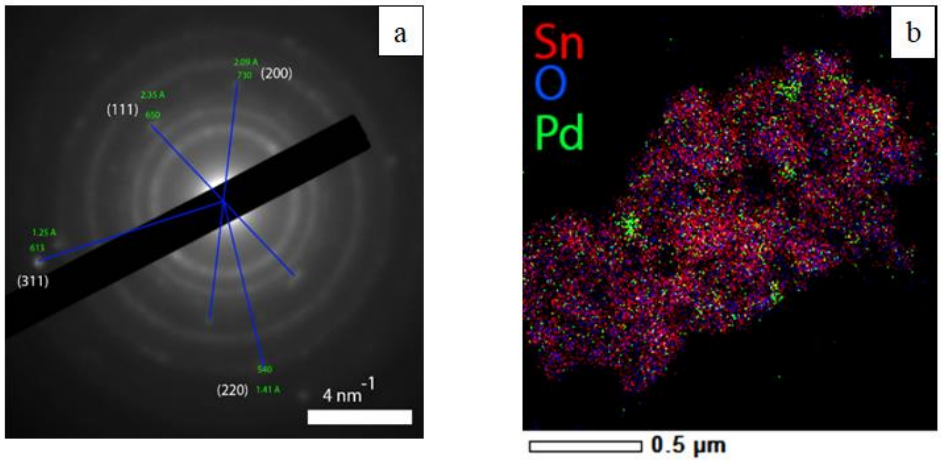

Figure 1. (a). SAED pattern taken on a region from the Pd-SnO10ZnO-Bj sample and (b) the elemental STEM-EDS map showing regions having dimensions of 100 nm, having a high amount of Pd.

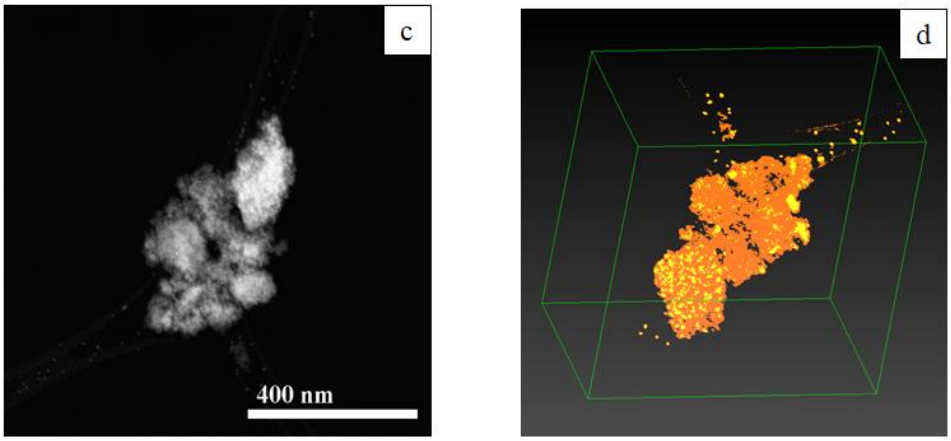

Figure 2. (c). Dark-Field STEM image taken on the Pd-Sn10Zn sample and (d) the 3D segmented reconstruction showing Pd clusters

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