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UV-Enhanced Room-Temperature Gas-Sensing Properties of ZnO-SnO2 Nanocomposites Obtained by Hydrothermal Treatment

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Abstract : Gas detection is important for controlling industrial, and vehicle emissions, agricultural residues, and environmental control. In last decades, several semiconducting oxides have been used to detect dangerous or toxic gases. The excellent gas-sensing performance of these devices have been observed at high temperatures (~250 °C), which forbids the use for the detection of flammable and explosive gases. In this way, ultraviolet light activated gas sensors have been a simple and promising alternative to achieve room temperature sensitivity. Among the semiconductor oxides which exhibit a good performance as gas sensor, the zinc oxide (ZnO) and tin oxide (SnO2) have been highlighted. Nevertheless, their poor selectivity is the main disadvantage for application as gas sensor devices. Recently, heterostructures combining these two semiconductors (ZnO-SnO2) have been studied as an alternative way to enhance the gas sensor performance (sensitivity, selectivity, and stability). In this work, we investigated the influence of mass ratio Zn:Sn on the properties of ZnO-SnO2 nanocomposites prepared by hydrothermal treatment for 4 hours at 200 °C. The crystalline phase, surface, and morphological features were characterized by X-ray diffraction (XRD), high-resolution transmission electron (HR-TEM), and X-ray photoelectron spectroscopy (XPS) measurements. The gas sensor measurements were carried out at room-temperature under ultraviolet (UV) light irradiation using different ozone levels (0.06 to 0.61 ppm). The XRD measurements indicate the presence of ZnO and SnO2 crystalline phases, without the evidence of solid solution formation. HR-TEM analysis revealed that a good contact between the SnO2 nanoparticles and the ZnO nanorods, which are very important since interface characteristics between nanostructures are considered as challenge to development new and efficient heterostructures. Electrical measurements proved that the best ozone gas-sensing performance is obtained for ZnO:SnO2 (50:50) nanocomposite under UV light irradiation. Its sensitivity was around 6 times higher when compared to SnO2 pure, a traditional ozone gas sensor. These results demonstrate the potential of ZnO-SnO2 heterojunctions for the detection of ozone gas at room-temperature when irradiated with UV light irradiation.

Keywords : hydrothermal, zno-sno2, ozone sensor, uv-activation, room-temperature
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