

Synthesis and characterization of dip-coated ZnO–CuO composite thin film for room-temperature CO₂ gas sensing(Article)

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Abstract

In this work, ZnO–CuO composite thin film is prepared to achieve CO₂ gas sensing at room-temperature. To achieve this purpose, a sol-gel dip-coating method was used to prepare the composite ZnO–CuO thin films on a glass substrate by varying the precursor solution Zn/Cu molar ratio of 0.3, 0.5, and 0.7. The crystal structure of the films was determined by X-ray diffraction, indicating that the films were polycrystalline in nature with the presence of monoclinic CuO and hexagonal wurtzite ZnO phase, which was further confirmed by Raman spectroscopy. The homogeneous and porous surface morphology of the composite films obtained were observed by scanning electron microscopy. Optical properties and band gap measurements were explored by ultra-violet/visible spectroscopy and the direct band gap of synthesized ZnO–CuO composite film was found to decrease from 1.54 to 1.45 eV, depending on

the precursor solution Zn/Cu molar ratio. Various effective parameters on the performance of CO₂ gas sensing, including the molar ratio of Zn/Cu, porous surface, water contact angle, film thickness, grain size, optical and electrical properties were investigated. Results demonstrated that the higher molar ratio (0.7) and thicker film (318 ± 5 nm) with the porous surface of ZnO–CuO composite films exhibited the highest sensing ($\sim 48\%$) response to 10,000 ppm CO₂ at room-temperature. The obtained results suggest a direction for room-temperature ZnO–CuO composite-based sensor as efficient, fast as well as sensitive for CO₂ detection. © 2023

Author keywords

Carbon dioxideComposite coatingCopper II oxideDip-coatingRoom-temperatureSensorThin filmZinc oxide

Indexed keywords

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