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H2 gas sensing properties of a ZnO/CuO and ZnO/CuO/Cu2O Heterostructures

N. Ababii, V. Postica, M. Hoppe, R. Adelung, O. Lupan, S. Railean, T. Pauporté, B. Viana

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Abstract

The most important parameters of gas sensors are sensitivity and especially high selectivity to specific chemical species. To improve these parameters we developed sensor structures based on layered semiconducting oxides, namely CuO/Cu2O, CuO:Zn/Cu2O:Zn, NiO/ZnO. In this work, the ZnO/CuxO (where x = 1, 2) bi-layer heterostructure were grown via a simple synthesis from chemical solution (SCS) at relatively low temperatures (< 95 °C), representing a combination of layered n-type and p-type semiconducting oxides which are widely used as sensing material for gas sensors. The main advantages of the developed device structures are given by simplicity of the synthesis and technological cost-efficiency. Structural investigations showed high crystallinity of synthesized layers confirming the presence of zinc oxide nanostructures on the surface of the copper oxide film deposited on glass substrate. Structural changes in morphology of grown nanostructures induced by post-grown thermal annealing were observed by scanning electron microscopy (SEM) investigations, and were studied in detail. The influence of thermal annealing type on the optical properties was also investigated. As an example of practical applications, the ZnO/CuxO bi-layer heterojunctions and ZnO/CuO/Cu2O three-layered structures were integrated into sensor structures and were tested to different types of reducing gases at different operating temperatures (OPT), showing promising results for fabrication of selective gas sensors.