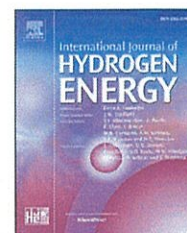


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Hydrogen gas sensing properties of WO₃ sputter-deposited thin films enhanced by on-top deposited CuO nanoclusters

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ABSTRACT

Magnetron-based gas aggregation cluster source (GAS) was used to prepare high-purity CuO (cupric oxide) nanoclusters on top of sputter-deposited thin film of tungsten trioxide (WO₃). The material was assembled as a conductometric hydrogen gas sensor and its response was tested and evaluated. It is demonstrated that addition of CuO clusters noticeably enhances the sensitivity of the pure WO₃ thin film. With an increasing amount of CuO clusters the sensitivity of CuO/WO₃ system rises further. When CuO clusters form a sufficiently thick and compact layer, the resistance response is reversed. Based on the sensorial behavior, conventional and near-ambient pressure X-Ray photoemission spectroscopies, and resistivity measurements, we propose that the sensing mechanism is based on the formation of nano-sized p-n junctions in between p-type CuO and n-type WO₃. The advantages of the GAS technique for preparing sensorial and/or catalytically active materials are emphasized.

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Introduction

The hydrogen (H₂) energy market is rapidly growing and there is a strong interest in development of fast, stable and sensitive hydrogen gas sensors [1]. One of the most often explored approaches are chemiresistors based on metal-oxide semiconductors (MOs) [2–4]. The main effort has been put into an improvement of the sensitivity, selectivity, stability and

durability of the sensors [4]. Less attention has been paid to a development of new preparation methods that are compatible with thin-film microcircuit technology and also allowing large-scale production of the sensors. This is, however, a vital requirement for full integration of nanostructured sensorial materials into modern devices [5], such as on-chip fuel-cells. Last but not least, there is an effort to employ economically and environmentally reasonable materials for sensor production.

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