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A. Resmini, U. Anselmi-Tamburini, S.M. Emamjomeh, V. Paolucci, I.G. Tredici, C. Cantalini

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The Influence of the Absolute Surface Area on the NO_2 and H_2 gas responses of ZnO Nanorods Prepared by Hydrothermal Growth

A. Resmini[a,*], U. Anselmi-Tamburini[a], S. M. Emamjomeh[b], V. Paolucci[b], I.G. Tredici[a], C. Cantalini[b]

[a] Department of Chemistry, Via Taramelli 12 University of Pavia, I-27100, Pavia, Italy

[b] Department of Industrial and Information Engineering and Economics, Via G. Gronchi 18, University of L'Aquila, I-67100 L'Aquila, Italy

Corresponding author: alessandro.resmini01@universitadipavia.it*

Abstract.

In this paper we report the influence of the absolute surface area (ASA) and aspect ratio (L/D) of hydrothermally grown ZnO nanorods (NRs) on the NO_2 and H_2 gases relative responses (RRs) in the 20 ppb -1 ppm and 50 ppm-1000 ppm concentrations range. We used films of NRs characterized by different geometrical features, such as diameter, length, L/D and ASA, obtained using different growth times, but all showing a well-defined hexagonal shape and an alignment perpendicular to the substrate. Values of L/D up to 129 and NRs lengths up to 14 μm have been obtained; one of the highest reported for quasi-one-dimensional ZnO nanostructures obtained through solution-based one-pot syntheses. Electrical tests at 150 °C (NO_2) and 200 °C (H_2) carried out using films of NRs presenting different L/D evidenced a direct relationship between the increase of the ASA and L/D and gas RRs. The influence of geometrical and chemical characteristics, such as diameter, size and surface-defects concentration is also discussed in light of the existing literature. Cross sensitivity, investigated measuring the H_2 (target) response in the presence of NO_2 (interfering) gases as well as dynamic and cumulative NO_2 gas reproducibility test are also presented. Beside the considerable interference played by NO_2 to the H_2 response, our long NRs demonstrate an excellent reproducibility of the electrical signal and fast recovery of the base line, evidencing the absence of irreversible chemisorption or sample-surface "history-related" phenomena.

Keywords

ZnO, nanorods, number density, hydrothermal growth, sensor, NO_2, H_2, cross sensitivity