Enhanced Hydrogen Gas Sensing Performance of ZnO Nanowire-Based Semiconductor Sensors

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Abstract

ZnO nanowire-based hydrogen sensors were fabricated using a low-temperature hydrothermal method at 95 °C for 4 hours. The vertically aligned nanowires, with diameters of 80–150 nm, provided a large surface area and abundant active sites for hydrogen adsorption. Compared with ZnO thin-film sensors, the nanowire devices exhibited enhanced sensitivity, with a response ratio (Ig/Ia) of 2.45 at 10 ppm H_2 and 1.15 at 1 ppm. The sensors also demonstrated fast response and recovery, with less than 2 % variation during repeated cycles, confirming excellent stability and reproducibility. XPS analysis revealed 22.1 % oxygen vacancies, which facilitated charge transfer and accelerated surface reactions. These results verify that ZnO nanowire sensors offer high sensitivity, low power consumption, and strong potential for next-generation MEMS-based hydrogen detection applications.

Keywords

ZnO nanowires, hydrogen gas sensor, metal-oxide semiconductor (MOS), MEMS.