Sensors and Actuators B: Chemical
Volume 144, Issue 1, 29 January 2010, Pages 56-66

Selective hydrogen gas nanosensor using individual ZnO nanowire with fast response at room temperature

O. Lupan, V. V. Ursaki, G. Chai, L. Chow, G. A. Emelchenko,
I. M. Tiginyanu, A.N. Gruzintsev, A.N. Redkin

https://doi.org/10.1016/j.snb.2009.10.038

Abstract

In this work, we report on a single ZnO nanowire-based nanoscale sensor fabricated using focused ion beam (FIB/SEM) instrument. We studied the diameter dependence of the gas response and selectivity of ZnO nanowires (NWs) synthesized by chemical vapor phase growth method. The photoluminescence (PL) measurements were used to determine the deep levels related to defects which are presented in the ZnO nanomaterial as well as to evaluate the effect of thermal treatment in H2 atmosphere on the emission from ZnO nanowires. We show that sample annealed in hydrogen leads to passivation of recombination centers thus modifying the NWs properties.

We studied the gas response and selectivity of these ZnO nanowires to H2, NH3, i-Butane, CH4 gases at room temperature. Our results indicated that zinc oxide NWs hold a high promise for nanoscale sensor applications due to its capability to operate at room-temperature and its ability to tune the gas response and selectivity by the defect concentration and the diameter of ZnO nanowire. A method is proposed to reduce the nanosensor's recovery time through the irradiation with an ultraviolet radiation pulse. The sensing mechanisms of ZnO nanowires will be discussed.