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Enhanced UV and ethanol vapour sensing of a single 3-D ZnO tetrapod alloyed with Fe_2O_3 nanoparticles

Oleg Lupan, Vasile Postica, Jorit Gröttrup, Abhishek K. Mishra, Nora H. de Leeuw, Rainer Adelung

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Abstract

Fabrication of multifunctional devices based on nano- and microstructures of a single semiconducting oxide is an important step for a better understanding of their maximum sensing properties and the base for the development of bottom-up nanotechnologies. In this work we have fabricated, for the first time devices based on a single or two interconnected ZnO tetrapods (T), doped with Fe and alloyed with Fe_2O_3nanoparticles (NPs) and microparticles (MPs) in order to improve their sensing properties towards ultraviolet (UV) sensing and ethanol vapour (EtOH). Compared to pristine ZnO-T improved UV and gas sensing properties of Fe-doped ZnO-T were observed. By Fe_2O_3-alloying of Fe-doped ZnO-T further improvement in sensing properties was obtained with a reduced influence of the relative humidity (RH) on the sensing response. A gas sensing mechanism was proposed and discussed in detail based on the alloyed Fe_2O_3 NPs and MPs. The results presented here demonstrate the efficiency of doping and alloying of single ZnO microstructures with other semiconducting oxides to improve their sensing properties, including the decrease in influence of RH on the gas response and the rapidity of the sensors.