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Adsorption-desorption cycle of chemisorbed CO_2 on the surface of SnO_2 and Co-SnO_2 for room temperature gas sensor

Mohamed A Basyooni
Nanyang Technological University, Singapore

Undoped and cobalt doped Tin oxide (SnO_2 and SnO_2: Co) thin films of varying thickness were successfully fabricated by the sol-gel spin coating technique. The samples were characterized by X-ray Diffraction (XRD) and Scanning Electron Microscope (SEM). The effect of the number of layers on the structural and optical properties of SnO_2 and SnO_2: Co films were studied. The crystallite size of the pure SnO_2 films increased from 7.7 to 31.1 nm by increasing the number of layers from 12 to 24. The crystallinity of the film was enhanced when the annealing temperature was increased from 400 to 500oC. However, it reduced by incorporating Co atoms. Transmittance and optical band gap of the SnO_2 film decreased by increasing the number of layers or after Co doping. The 8% Co-doped film shows relatively higher sensitivity for CO_2 gas at Room Temperature (RT) compared to un-doped SnO_2 film with a rate of 0.116/sccm for Co-SnO_2. In this study, the carbon dioxide gas acted as an oxidizing agent that caused the increase in the electrical resistance of the sensor signified by the increase in voltage reading. The trapped negative charges in the oxygen species caused an upward band bending in the SnO_2 film, thus increasing its resistance compared to the situation before CO_2 gas exposure. The response and recovery times increased as the CO_2 concentration increased. These results demonstrate the possibility of optimizing the physical properties of the SnO_2 film for sensing and optoelectronic applications

Biography

Mohamed A Basyooni has completed M.Sc. degree in Experimental Physical Chemistry with honors at Nanophotonic and Applications Lab, Faculty of Science, Beni-Suef University in 2016. Now, he is a Ph.D. research student at Department of Nano Science and Nano Engineering, Institute of Science and Technology, University of Konya Necmettin Erbakan-Turkey and Institute of Materials Research and Engineering (IMRE)-Singapore. He was working in semiconductor technology for many years to develop a room temperature gas sensors based on metal oxide semiconductors nanostructure thin films. He developed a room temperature gas sensor with more than 80% sensitivity towards carbon dioxide based on novel wrinkle porous net-work nanostructure-based sodium doped zinc oxide, published in Nature. Currently, he is working in energy efficient materials, vanadium dioxide (VO_2) based smart coatings and the gas sensing behavior.

Mohamed.basyooni@nriag.sci.eg

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