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A simplistic two-step route to synthesize titanium dioxide structures and their application as humidity and ethanol vapor sensors

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Titanium dioxide (TiO_2) structures have been extensively used among metal oxide semiconductors owing to their comprehensive industrial applications as gas sensor, humidity sensor, solar cells, photocatalyst and laser diodes. Here, a low cost and simplistic process of synthesizing TiO_2 structures by sol-gel method is reported. The as-synthesized structures were tested for humidity sensing properties in bulk as well as thin film form for relative humidity (Rh) levels ranging from 8% to 90%. Doctor-blade technique was employed to make the film sensor while a pellet of 8 mm diameter was used as the bulk sensor reference. The sensors showed a quality response at low Rh values at room temperature; a condition required for an ideal sensor. The stability of the bulk and film sensors was tested over five cycles and the response observed was stable as well as reproducible. While the change in resistance for bulk sensor was observed to be in the range of 10^3 to 10^6 Ω, it ranged from 10^8 to 10^{11} Ω in the case of film sensor. Experiments on ethanol vapor sensing in the range from 0-400 ppm (parts per million) have shown that the sensors are selective towards ethanol vapors and have exhibited good response at higher concentrations (~300 ppm) in thin film form without showing any saturation. X-ray diffraction studies, scanning electron microscopy, ultraviolet-visible spectroscopy have been employed to investigate the structural, morphological and optical properties of the synthesized samples. It is observed that the as-synthesized samples have anatase phase, no distinct morphology and a band-gap of 3.3 eV. Both the pellets as well as film sensor demonstrate the sensing behavior at room temperature and ambient pressure. Further, the sensors have not been heated between cycles, which show that the sensor's capacity to adsorb and absorb the test gas/vapor is good and therefore the sensor is recyclable.

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Biography

Rupali Nagar is working at Symbiosis Institute of Technology, Pune, India as an Assistant Professor in the Department of Applied Science. She has completed her PhD from Indian Institute of Technology Delhi (IIT) and continued her research while working at Indian Institute of Technology Madras (IIT) as Project Officer till 2012. Her research interests include studying nanomaterials for energy and gas sensing applications.

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