Effect of oxygen partial pressure on the structural, optical and gas sensing characterization of nano structured Gadolinium doped cerium oxide thin films deposited by laser ablation technique

P.Nagaraju[1], Y.Vijayakumar[1, 2] and M.V.Ramana Reddy[3]

[1] Department of Physics, CMR Technical Campus, Hyderabad, Telangana State, India.
[2]Department of Textiles Engineering, Chemistry and Science, NC State University, USA.
[3]Department of Physics, Osmania University, Hyderabad, Telangana State, India.

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Abstract

10 mole % Gadolinium doped cerium oxide thin films are deposited on ultrasonically cleaned quartz substrate at various oxygen partial pressures with optimized deposition conditions by using laser ablation technique. Structural investigations carried out by X-ray diffraction, atomic force microscopy and Raman spectroscopy. Optical properties are derived from transmission UV- Vis spectroscopy. Gas sensing characterization has been carried out by chemiresistive method. X-ray diffraction studies reveal that all the deposited thin films at different oxygen partial pressures have shown polycrystalline nature with cubic fluorite structure. And the preferred orientation is observed along the (200) direction. Crystallite size is increased with increasing oxygen partial pressure. The atomic force microscopy studies show the formation of uniform and dense nanocrystallites with a smooth surface morphology. The root mean square (rms) roughness of the thin film is increased with increasing oxygen partial pressure. The formation of cubic fluorite structure is confirmed by Raman peak appearing at 464 cm^{-1} due to the F_{2g} active mode. Optical transmission studies reveal that the optical band gap is decreased with increasing oxygen partial pressure. The films are investigated for the detection of acetone vapour. The effects of the operating temperature and gas concentration on the performance of the sensor are investigated. The sensor response and recovery times are also measured.

Key words

Gadolinium doped ceria, oxygen partial pressure, XRD, rms roughness and gas sensor.

Corresponding author
Dr.P.Nagaraju, nagarajuphysics@gmail.com