Structural, optical, dielectric and enhance gas sensing properties of Mg-Zn spinel ferrite nanoparticles

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Abstract

Spinel ferrites Mg-Zn nanoparticles were synthesized by wet chemical co-precipitation process. The structural, optical, dielectric and gas sensing properties to various gases were investigated. Formation of the spinel cubic structure was confirmed by X-Ray diffraction data and Fourier transform infrared spectroscopy. Average crystallite size was estimated 13±2 nm by Scherrer's formula. Morphological analysis was studied using scanning electron microscopy. UV– Vis absorption spectroscopy displayed that the energy band gap of Mn-Zn magnetic nanoparticles decreases from 2.49 to 2.16 eV by increasing doping contents. The positions of absorption bands are composition dependent which could be attributed to the variation in cations oxygen bond distances. The dielectric constant and dielectric loss decreases with increase in frequency and reaches a constant value at higher frequencies. The gas sensing characteristics of Zn doped Mg ferrites for three gases were gained by measuring the resistance as a function of compositions, response time in air and gas. Spinel Mg-Zn ferrite nanoparticles sensitivity of different gases like CO_2, O_2 and N_2 at room temperature has been compared. The high sensitivity in order of $CO_2 > O_2 >> N_2$ was observed and showed good response time of (~1min) to CO_2, which warrant their applications as a gas sensors.

Keywords: Co-precipitation, X-Ray Diffraction, Fourier Transform Infrared Spectroscopy, Morphological analysis, Dielectric Properties, Sensitivity, Response time, Gas sensing properties.