

First principal investigation of structural, morphological, optoelectronic and magnetic characteristics of sprayed Zn: Fe₂O₃ thin films

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Abstract: Undoped and Zn-doped Fe₂O₃ thin films were grown through spray pyrolysis. Zinc doping effect on the physical properties was investigated in detail. X-ray diffraction analysis confirms that all the Fe₂O₃ thin films showed a rhombohedral structure. The surface morphological study shows an interesting dendrite structure. The estimated band gaps energies were increased from 2.13 to 2.21 eV for indirect transition and from 1.80 to 1.85 eV for direct transition as function of doping ratio which was increased from 2 to 8 at. % Zn. The resistivity value (ρ) of un-doped Fe₂O₃ thin film is $6.06 \times 10^4 \Omega \cdot \text{cm}$ and as adding Zn ions, ρ consequently decreased to 52 $\Omega \cdot \text{cm}$ for 6 at. % Zn-doped Fe₂O₃ thin films. Vibrating sample magnetometer (VSM) measurements showed an increase of the saturation magnetization with the Zn²⁺ insertion. Further, a ferromagnetic behavior was observed.

Keywords : Ferromagnetic, semiconductor, Fe₂O₃, Zinc doping, Low resistivity