

# First principal investigation of structural, morphological, optoelectronic and magnetic characteristics of sprayed Zn: Fe<sub>2</sub>O<sub>3</sub> thin films

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**Abstract:** Undoped and Zn-doped Fe<sub>2</sub>O<sub>3</sub> 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 Fe<sub>2</sub>O<sub>3</sub> 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 Fe<sub>2</sub>O<sub>3</sub> thin film is  $6.06 \times 10^4 \text{ } \Omega \cdot \text{cm}$  and as adding Zn ions, ρ consequently decreased to  $52 \text{ } \Omega \cdot \text{cm}$  for 6 at. % Zn-doped Fe<sub>2</sub>O<sub>3</sub> thin films. Vibrating sample magnetometer (VSM) measurements showed an increase of the saturation magnetization with the Zn<sup>2+</sup> insertion. Further, a ferromagnetic behavior was observed.

**Keywords :** Ferromagnetic, semiconductor, Fe<sub>2</sub>O<sub>3</sub>, Zinc doping, Low resistivity