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Structural, Magnetic and Optical Properties of Erbium Doped Magnetite Nanopowders

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Abstract—*Magnetite (Fe_3O_4) nanoparticles are widely used functional materials due to excellent physical and chemical properties directed towards many applications. These have physical properties such as large surface area, good suspension stability and strong adsorption ability, thereby imparting specific magnetic, electrical and optical properties well suited for chemical, mechanical, electronic communications, biomedical, environmental protection and military applications. [1-2] The unique f-electron configuration of rare elements offers the shielding of 4f electrons by 5d and 6s electrons from environmental impact. It has been observed that rare earth doping in ferrites, enhances the structural, magnetic and optical properties. [3-5] In this work, we investigate the effect of erbium doping on the properties of magnetite.*

In the present investigation, magnetite nanoparticles having formula $Fe_{3-x}Er_xO_4$ (where x = 0 to 0.05) have been synthesized using a convenient low temperature co-precipitation route. The change in structural, magnetic and optical properties has been studied as a function of doping level. The samples have been characterized using XRD, TEM, VSM and UV-Vis spectroscopy. X-Ray diffraction (XRD) patterns have been used to calculate the strain. TEM images show the formation of rod like structures with erbium doping. VSM studies indicate enhancement in magnetization with erbium doping at x=0.01. Band-gaps are calculated using UV-Vis spectroscopy by Tauc plots. An increase in band-gap is found with erbium doping. Band-gap for undoped particle is 2.12 eV which increases to 2.31 to 2.42 eV with erbium doping. Hence this technique can be used in band-gap tailoring.

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