

# Combinatorial Investigation of Magneto-luminescence Properties of Bi-functional Nanostructures of Iron-oxide@Ternary doped Rare-Earth Fluorides

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The preparation of novel triply-doped bifunctional  $\text{Fe}_3\text{O}_4/\text{ZnS}@\text{LaF}_3:\text{xCe}^{3+}, \text{xGd}^{3+}, \text{yTb}^{3+}$  ( $\text{x} = 5; \text{y} = 5, 10$  and  $15$  mol.%) nanocomposites with efficient optical and magnetic features have been reported. The ZnS semiconductor functionalized  $\text{Fe}_3\text{O}_4$  particles were coated with  $\text{LaF}_3:\text{RE}^{3+}$  materials via chitosan assisted co-precipitation method. The iron oxide of size  $\sim 7.2$  nm and trigonal structure of bifunctional nanostructure were confirmed from x-rays diffraction and high resolution transmission electron microscopy. The static magnetic measurements supported and manifested superparamagnetic behavior of the materials at 300 K. A broad emission band was observed in the blue region (400-550 nm) due to the sulphur vacancy on the surface of  $\text{Fe}_3\text{O}_4/\text{ZnS}$  nanocomposite. For triply doped bifunctional nanostructure, the excitation spectra revealed broad absorption bands centered at around 270 nm, which attributed to the  $4f(^7F_{7/2}) \rightarrow 5d$  interconfigurational transition of the  $\text{Ce}^{3+}$  ion accompanied by narrow absorption lines arising from the  $4f-4f$  intraconfigurational transitions of the  $\text{Tb}^{3+}$  ion. The emission spectra of the nanocomposites showed characteristic narrow emission lines assigned to the  $^5D_4, ^7F_j$  transitions ( $J = 6-0$ ) of the  $\text{Tb}^{3+}$  ion. The energy transfer process from the  $\text{Ce}^{3+}-\text{Gd}^{3+}-\text{Tb}^{3+}$  ions was also presented and discussed. Further, the structural, photoluminescence and magnetic properties of  $\text{Fe}_3\text{O}_4/\text{ZnS}@\text{LaF}_3:\text{RE}^{3+}$  suggested efficient candidature for the magnetic light-converting molecular devices (MLMCDs) and high energy radiation detection.