OPTICAL AND MAGNETIC NANOCOMPOSITES CONTAINING Fe_3O_4@SiO_2 GRAFTED WITH Eu^{3+} AND Tb^{3+} COMPLEXES

L.U. Khan[1], D. Muraca[2], H.F. Brito[1], O. Moscoso-Londoño[2], M.C.F.C. Felinto[3], K.R. Pirota[2], E.E.S. Teotonio[4], O.L. Malta[5]

[1]Department of Fundamental Chemistry, Institute of Chemistry, University of Sao Paulo, Av. Prof. Lineu Prestes, 748, 05508-000, São Paulo-SP, Brazil.
[2]Institute of Physics "Gleb Wataghin", Condensed Matter Physics Department, State University of Campinas (UNICAMP), 13083-859 Campinas-SP, Brazil.
[3]Nuclear and Energy Research Institute (IPEN-CQMA), Av. Prof. Lineu Prestes, 2242, 05508-000, São Paulo-SP, Brazil.
[4]Department of Chemistry, Federal University of Paraiba, 58051-970 João Pessoa-PB, Brazil.
[5]Department of Fundamental Chemistry, Federal University of Pernambuco, 50670-901, Recife-PE, Brazil

* corresponding author: *hefbrito@iq.usp.br*

Keywords: europium, terbium, magnetite, silica, photoluminescence and magnetism

The fabrication of bifunctional nanocomposites, co-assembling photonic (RE^{3+}) and magnetic (Fe_3O_4) features into single entity nanostructures is reported through a facile method, using Fe_3O_4 as core nanoparticles, which were coated with SiO_2 shell and further grafted with Eu^{3+} and Tb^{3+} complexes. The sophisticated structural features and morphologies of the core-shell Fe_3O_4@SiO_2-(TTA-RE-L) nanomaterials were studied by Small-angle X-ray Scattering. The core mean size $\langle D_{SAXS} \rangle$, shell thickness ΔR, cluster size ξ and fractal dimension D_F were determined by fitting the experimental SAXS data, corroborating through Transmission Electron Microscopy images. The DC magnetic properties at temperatures of 2 and 300 K were explored in support to the structural conclusions from SAXS and TEM analyses. The magnetic contributions of the RE^{3+} ions to the magnetizations of the Eu^{3+} and Tb^{3+} nanocomposites were discussed. The photoluminescence properties of the Eu^{3+} and Tb^{3+} nanocomposites based on the emission spectral data and luminescence decay curves were studied (Fig.1). The experimental intensity parameters (Ω_λ), lifetimes (τ), emission quantum efficiencies (η) as well as radiative (A_{rad}) and non-radiative (A_{nrad}) decay rates were calculated and discussed, in addition, the structural conclusions from the values of the 4f-4f intensity parameters in the case of the Eu^{3+} ion. These novel Eu^{3+} and Tb^{3+} nanocomposites may act as red and green emitting layers for magnetic and light converting molecular devices.

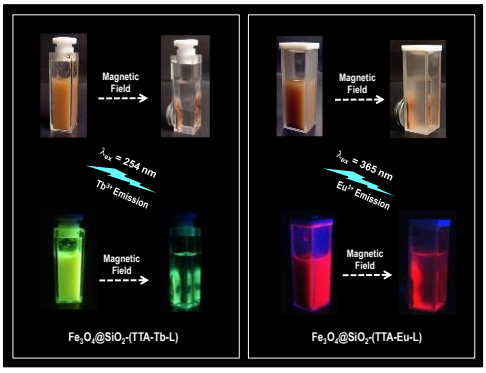

Fig. 1. Photographs of the Fe_3O_4@SiO_2-(TTA-RE-L), (RE: Eu and Tb) nanocomposites, showing magnetic separation-redispersion process of the nanomaterials in the absence and under the UV irradiation lamp.

[1] Khan, L.U.; Brito, H.F.; Hölsä, J.; Pirota, K.R.; Muraca, D.; Felinto, M.C.F.C.; Teotonio, E.E.S.; Malta, O.L. *Inorg. Chem.*, **53** (2014) 2902.