Optical and Magnetic Nanocomposites Containing Fe_3O_4@SiO_2 Grafted with Eu^{3+} and Tb^{3+} Complexes

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The fabrication of bifunctional luminescent and magnetic nanocomposites, co-assembling two different photonic (RE^{3+}) and magnetic (Fe_3O_4) features into single entity nanostructures is reported. Their preparation is accessible through a facile method of multistep syntheses, using Fe_3O_4 core nanoparticles as a precursor, which were coated with SiO_2 shell and further grafted with Eu^{3+} and Tb^{3+} complexes. These novel Fe_3O_4@SiO_2-TTA-Eu(L) and Fe_3O_4@SiO_2-TTA-Tb(L), L: TTA, TC, AB and AMB optical and magnetic nanocomposites show interesting superparamagnetic and photonic properties. The DC magnetic properties (M-H and ZFC/FC magnetization curves) at temperatures of 2 and 300 K were studied and investigated the influence of SiO_2 coating and RE^{3+} complexes on the saturation magnetization (M_S), magnetic coercivity (H_C) and blocking temperatures (T_B) of the nanomaterials. The paramagnetic contributions of the RE^{3+} ions to the whole magnetizations of the Eu^{3+} and Tb^{3+} nanocomposites were also studied. Even though magnetite is a strong luminescence quencher, the coating of the Fe_3O_4 nanoparticles with SiO_2 has overcome this difficulty. The photoluminescence properties of the Eu^{3+} and Tb^{3+} nanocomposites based on the emission spectral data and luminescence decay curves were studied. The experimental intensity parameters (Ω_λ), lifetimes (t), emission quantum efficiencies (η) as well as radiative (A_{rad}) and non-radiative (A_{nrad}) decay rates for the Eu^{3+} nanocomposites 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 nanomaterials may act as the emitting layer for the red and green light for magnetic and light converting molecular devices (MLCMDs).