Luminescent and Magnetic Composites: Study of Iron Oxide Induced Luminescence Quenching of Eu^{3+} ion

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The bifunctional nanomaterials, co-assembling photonic and magnetic features into single entity nanostructures are remarkable for applications, such as biosensors for medical diagnosis and ionizing radiation scintillation. The preparation of these nanomaterials are accessible through facile methods, using iron oxide as core nanoparticles and RE^{3+} materials as luminescent center. The magnetic properties are usually due to the core Fe_3O_4 nanoparticles, however, the magnetic moments of the RE^{3+} ions are also contributed to the whole magnetization of these nanostructures. In addition, rare earth ions exhibit well-defined narrow emission bands in different spectral ranges from visible to near-infrared due to their 4f intraconfiguration transitions, giving the bifunctional nanomaterials efficient luminescent behavior. In the present work, the preparation strategy and characterizations of the bifunctional $Fe_3O_4@Y_2O_3:Eu^{3+}$ $Fe_3O_4@SiO_2@Y_2O_3:Eu^{3+}$, $Fe_3O_4@SiO_2@Ag@Y_2O_3:Eu^{3+}$ and α-$Fe_2O_3@Y_2O_3:Eu^{3+}$ materials are discussed. The DC magnetic properties (MH and ZFC/FC curves) and photoluminescence behavior of the RE^{3+} composites based on the emission spectral data and luminescence decay curves are studied. 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 are calculated, in addition, based on these parameters iron oxide induced luminescence quenching of Eu^{3+} ion is studied.

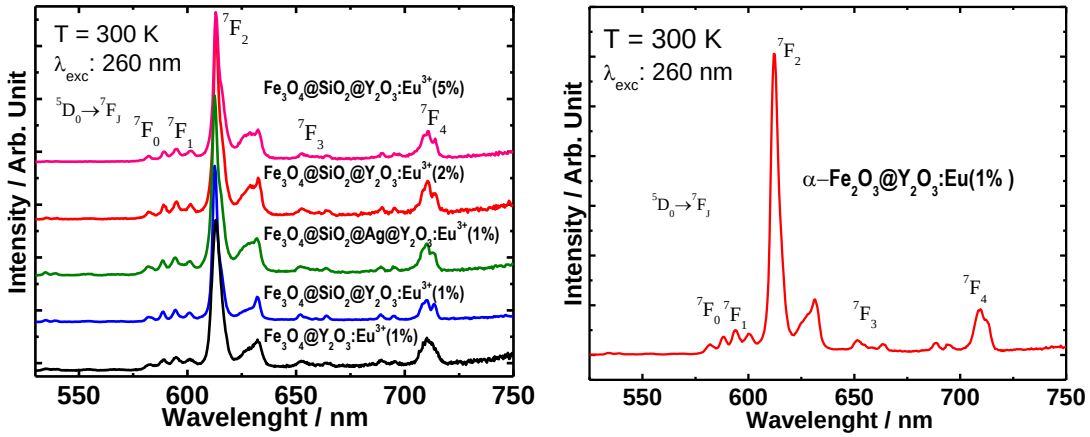

Figure: Emission spectra of $Fe_3O_4@Y_2O_3:Eu^{3+}$, $Fe_3O_4@SiO_2@Y_2O_3:Eu^{3+}$ and $Fe_3O_4@SiO_2@Ag@Y_2O_3:Eu^{3+}$ (left) as well as α–$Fe_2O_3@Y_2O_3:Eu^{3+}$ (right) materials.

References

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.* **2014**, *53*, 12902.
2. Khan, L. U.; Muraca, D.; Brito, H. F.; Moscoso-Londoño, O.; Felinto, M. C. F. C.; Pirota, K. R.; Teotonio, E. E. S.; Malta, O. L.; *Journal of Alloys and Compounds* **2016**, *686*, 453.

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