Functionalized luminescent particles: preparation and optical properties

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The incorporation of lanthanide complexes in various hosts make these materials attractive for optical applications owing to their excellent luminescence characteristics from the electronic transitions between the 4f energy levels [1, 2]. Luminescent Eu^{3+} complexes encapsulated in SiO_2 particles have increasing interest in the field of biotechnological application.

In this work, particles containing $[Eu(TMA)(H_2O)_6]$ (TMA=1,3,5-benzenetricarboxylate) were capped by an amino-functionalized silica layer using microwave oven. Determination of amino groups in the material was performed using a method involving ninhydrin.

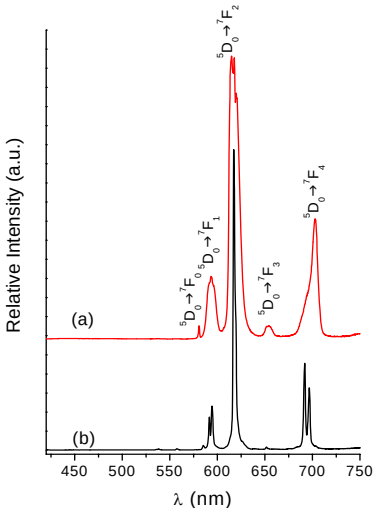

Fig.1. Emission spectra of a) $[Eu(TMA)(H_2O)_6]$ system and b) $[Eu(TMA)(H_2O)_6]$.

Fig. 1 shows the emission spectra of the complex and complex-silica under excitation at 393 nm. These spectra consist of typical narrow bands of Eu^{3+} ion assigned to $^5D_0 \rightarrow {}^7F_J$ transitions (J = 0, 1, 2, 3 and 4), presenting hypersensitive $^5D_0 \rightarrow {}^7F_2$ transition as the most prominent. Emission spectrum of the complex-silica showed an enlargement of the bands when compared to the complex emission spectrum, suggesting the existence of interactions between the silica matrix and the complex. The emission quantum efficiency was determined based on the experimental decay rates of the emitter $^5D_0$ level, lifetime (τ), and radiative (A_{rad}) rates, Table 1.

Table 1: Experimental intensity parameters (Ω_λ), emission quantum efficiency (η), lifetimes (τ), non-radiative (A_{nrad}), radiative (A_{rad}) and total (A_{total}) rates for the $[Eu(TMA)(H_2O)_6]$ complex and $[Eu(TMA)(H_2O)_6]$ with amino-functionalized silica.

Compound	A_{nrad} (s^{-1})	A_{rad} (s^{-1})	A_{total} (s^{-1})	Ω_2 (10^{-20} cm^2)	Ω_4 (10^{-20} cm^2)	R_{02}	τ (ms)	η (%)
$[Eu(TMA)(H_2O)_6]$	3820	522	4345	10,8	10,4	0,003	0,23	12
complex-silica	1826	496	2322	10,5	9,3	0,005	0,43	21

Keywords: Functionalization, luminescence, europium

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