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Synthesis and luminescent properties of Eu^{3+}-complex silica particles for biomarkers

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Abstract – This work reports the preparation and photoluminescent properties of the fluorescent hybrid silica particles obtained on the basis of the aggregation model. In the particles, the fluorescent Eu^{3+} chelate molecules were covalently bound to silicon atoms to protect the particles from dye leaking in bio-applications. Determination of amino groups in the material was performed. Luminescent properties of Eu^{3+} chelate and amino-functionalized material were compared.

Particles have been utilized in diagnostics for decades and they have lately aroused increasing interest because of the recognition of their potential in modern diagnostic applications. The fluorescence labeling and techniques have been used extensively in bioscience, medical diagnosis and other fields [1]. The employment of lanthanides as probes in bioanalytical assays requires development of chelate systems which fulfill all the requirements set by specfic binding, chelate stability, ease of use and high emission intensity [2].

Particles were obtained from alcoholic solutions of tetraethoxisilane (TEOS) and 3-aminopropyl-triethoxysilane (APTS), in the presence of ammonia, water and $[Eu(acac)_3(H_2O)_3]$ complex (acac = acetylacetone). Determination of amino groups in the material was performed using a method involving ninhydrin.

Emission spectrum of the particle (Fig. 1a) showed an enlargement of the bands when compared to the complex emission spectrum (Fig. 1b). No differences in line position were observed. Narrow lines are assigned to $^5D_0 \rightarrow {}^7F_{0\text{-}4}$ transitions. Complex and system present mono-exponential decay curves, corroborating the observation of one line at arround 580 nm assigned to $^5D_0 \rightarrow {}^7F_0$ transition. The emission quantum efficiency was determined based on the experimental decay rates of the emitter $^5D_0$ level, lifetime (τ) (Table 1).

Table 1: Experimental intensity parameters (Ω_λ), emission quantum efficiency (η) and lifetimes (τ) for the $[Eu(acac)_3(H_2O)_3]$ [3] complex and $[Eu(acac)_3(H_2O)_3]$ with amino-functionalized silica.

Compound	Ω_2 (10^{-20} cm^2)	Ω_4 (10^{-20} cm^2)	R_{02}	τ (ms)	η (%)
$[Eu(acac)_3(H_2O)_3]$	29,6	12,1	0,016	0,29	32,6
$[Eu(acac)_3(H_2O)_3]$ with amino-functionalized silica	7,25	10,1	0,008	0,34	14,1

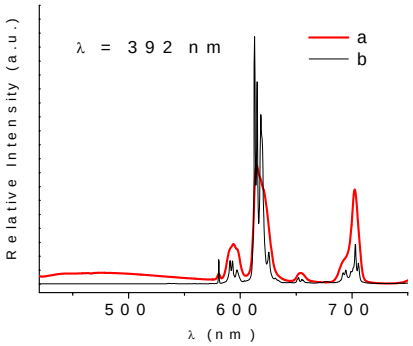

Figure 1: Emission spectra of $[Eu(acac)_3(H_2O)_3]$ complex and $[Eu(acac)_3(H_2O)_3]$ with amino-functionalized sílica.

References

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