Size and temperature effect on the photoluminescent properties of Europium-doped silica nanoparticles

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Optical fibers containing rare-earth (RE) doped nanoparticles are investigated to develop new devices such as fiber lasers or amplifiers [1]. Thanks to this route, alteration of the spectroscopic properties of RE ions have been already reported [2,3]. However, the broad size distribution of vitreous nanoparticles does not allow to discriminate between the role of their composition and their size on the luminescent properties as already reported for crystalline nanoparticles [4]. In this context, we take advantage of the sol-gel process to prepare vitreous nanoparticles with controlled sizes to study their luminescent properties before and after annealing at 900°C and compare their properties with the Eu-doped silica bulk.

The classic sol-gel process remains one of the most important approach for the preparation of such nanoparticles with diameter larger than 50 nm using the Stöber method [5]. Smaller ones (around 10 nm, see Fig. 1.a) can be obtained by Sol-Gel in reverse micro emulsion method (water in oil) [6, 7]. In this case, the hydrolysis and the polycondensation take place in the hydrophilic micelles that play the role of nanoreactors.

For this study, silica nanoparticles with several molar contents of europium (0.2, 0.5 and 1%) were prepared in one step.

All nanoparticles were characterized by Transmission Electron Microscopy (TEM) and Inductively Coupled Plasma Mass Spectrometry (ICP-MS). The effects of the size of the nanoparticles and their Eu content (see Fig. 1.b) as well as the annealing temperature effect on their photoluminescent properties have been investigated. These correlations and results will be presented and discussed.

(a) (b)

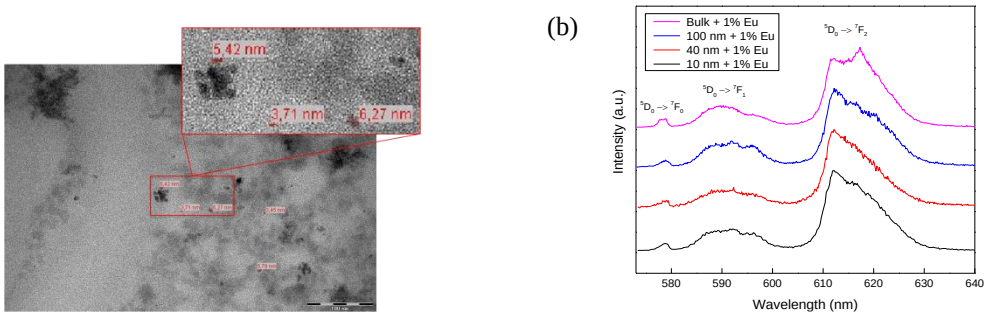

Fig. 1. a. TEM image of Eu-doped silica nanoparticles (~10 nm diameter)
b. Emission spectra of 1% Eu-doped silica bulk and nanoparticles of various diameters

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