SYNTHESIS OF Tm^{3+}:Lu_2O_3 LAYERS ON SILICA SPHERES VIA MODIFIED PECHINI SOL GEL PROCESS

E. W. Barrera [1], *C. Cascales*[2], *M. C. Pujol*[1], *J. J. Carvajal*[1], *X. Mateos*[1], *M. Aguiló*[1] *and F. Díaz*[1]

[1]*Física i Cristal·lografia de Materials i Nanomaterials (FiCMA-FiCNA), Universitat Rovira i Virgiil (URV), Campus Sescelades, c/ Marcel.lí Domingo, s/n, E-43007 Tarragona, Spain*

[2]*Instituto de Ciencia de Materiales de Madrid, CSIC, Calle Sor Juana Inés de la Cruz, Cantoblanco, E-28049 Madrid, Spain*

elixirwilliam.barrera@estudiants.urv.cat

The importance in the last years of materials for optical applications has push the development of new class of structured materials in form of core-shell particles, used as activators or host materials in optical applications [1]. Many methods have been developed to fabricate core-shell structured materials such as sol-gel process, layer-by-layer technique [2], template-directed self assembly method [3], etc. One of the compounds more used as core is the amorphous silica, because the size and morphology could be controlled with reliability by the Stöber method [4]. For layer deposition, the Pechini method offers homogeneous mixing of the starting materials, good control of stoichiometry, fine particle size and uniform morphology [5]. In the modified Pechini method the chelating agent, the citric acid, is replaced by the ethylendiaminetetraacetic acid (EDTA), which poses a major chelating capacity forming stable metal ion-EDTA complexes [6].

Nanosize Tm^{3+}:Lu_2O_3 @ SiO_2 core-shell powder (5 at. %) have been prepared by the modified Pechini method. The complex gel was prepared by the evaporation of the water solvent, from the aqueous solution of the rare earth nitrates and EDTA as chelating agent. Amorphous spheres of silica with a mean size of 100 nm (Alfa Aesar) were used as core. By the pyrolysis of the gel at 573 K and sintering process at 973 K we obtain the nanostructured powder. The morphology was studied by Environmental Scanning Electron Microscopy (ESEM) showing fine particles and Transmission Electron Microscopy (TEM) shows the formation of the surrounding layer, and X-ray powder diffraction pattern shows the crystallization of the Tm^{3+}:Lu_2O_3 and the expected cubic structure and $Ia\bar{3}$ space group. The increased value of unit cell parameter indicates the substitution of Thulium ion in Lutetium sites.

References:

[1]M. Yu, J. Lin, J. Fang, Chem. Mater, 17, 1783-1791, (2005).

[2] P. Schuetzand, F. Caruso, Chem. Mater. 14, 4509, 2000

[3] S. R. Hall, S. A. Davis, S. Mann, Langmuir 16, 1454, 2000

[4] W. Stöber, A. Fink, E. Bohn, J. Colloid Interface Sci. 26, 62. 1968.

[5] M. P. Pechini, US Patent Specification 3330697.

[6] M. Galceran, M.C. Pujol, M. Aguiló, F. Díaz, Mat. Science Eng. B 146 (2008) 7–15

Figures:

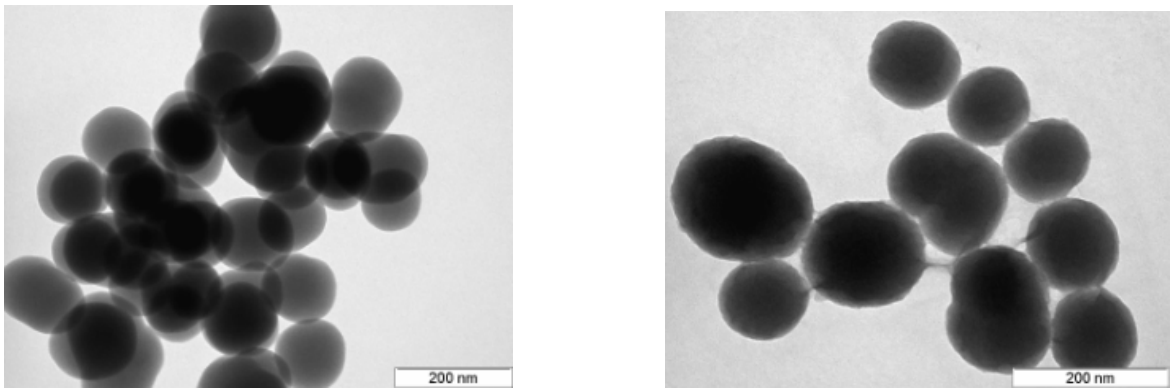

Figure 1 TEM graphs of silica nanospheres as obtained from the supplier (left), final core-shell structured nanoparticles (right).

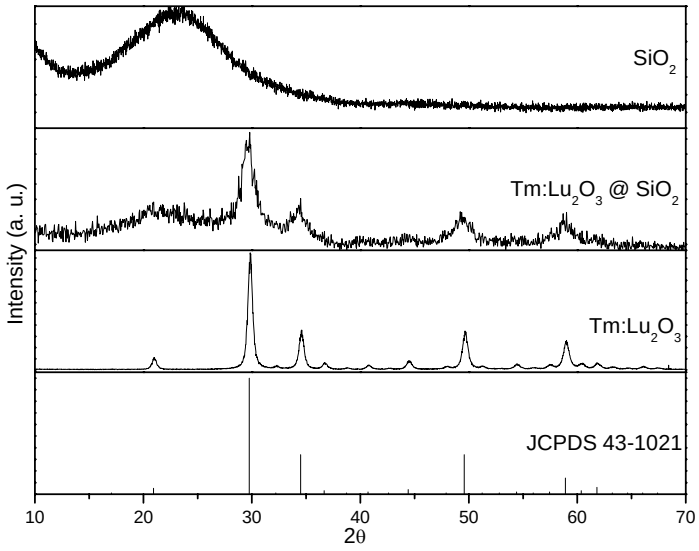

Figure 2 X-ray powder diffraction patterns for SiO_2 (no annealed) (a), Tm^{3+}:Lu_2O_3@SiO_2 core shell particles treated at 973 K (b), Tm^{3+}:Lu_2O_3 powder (c), and the JCPDS card 43-1021 for Lu_2O_3 (d).