Uniform YF_3:Yb,Er up-conversion nanophosphors of various morphologies synthesised in polyol media through an ionic liquid.

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Abstract

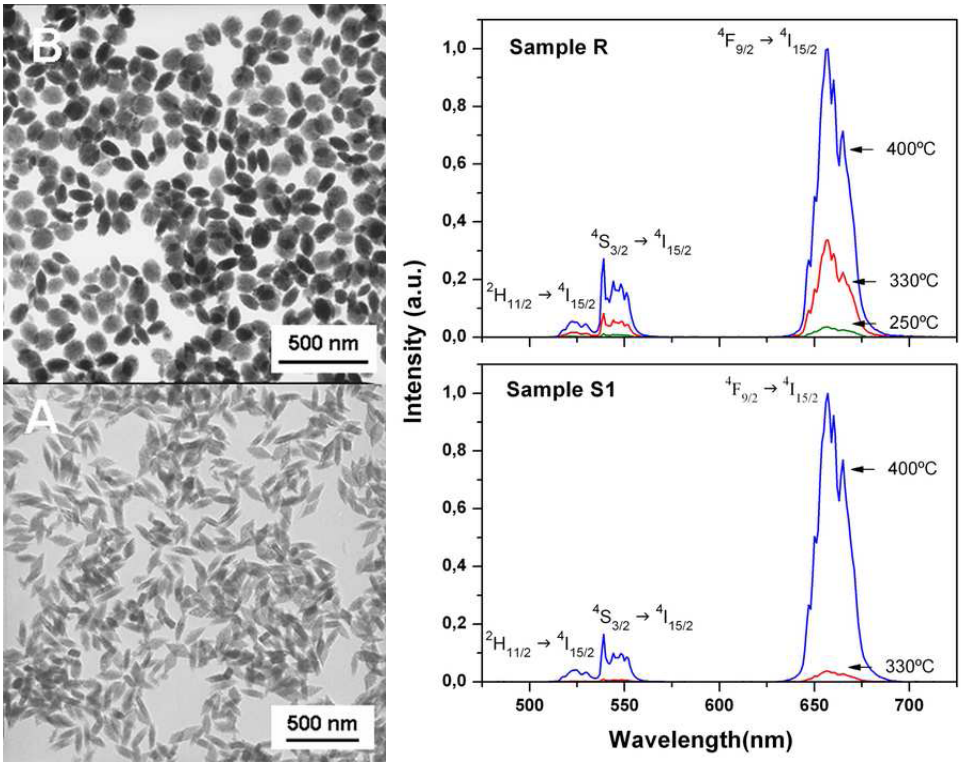
We describe a facile procedure for the synthesis at low temperature (120ºC) of waterdispersible uniform YF3:Yb,Er up-conversion nanophosphors of various morphologies (rhombic and spheroidal) by homogeneous precipitation in polyol solutions containing different lanthanide salts and an ionic liquid (1-Butyl, 2-methylimidazolium tetrafluoroborate) as fluoride source. It is shown that the shape of the obtained nanoparticles is mainly determined by the nature of both, the polyol and the lanthanide precursors, which also affects to their colloidal stability in water suspensions. These morphological differences are explained on the basis of a different mechanism of particle formation. The efficiency of the up-conversion processes in the synthesised rhombic and spheroidal nanoparticles is also comparatively analysed and the observed differences are justified on the basis of the different impurities incorporated to the nanophosphors during their synthesis process.

Key words: Nanoparticles · Luminescence · Rare earth · Yttrium fluoride · Upconversion.

References:

[1] Nuñez NO, Ocaña M, Nanotechnology, **18** (2007) 455606.
[2] Nuñez NO, Míguez H, Quintanilla M, Cantelar E, Cussó F, Ocaña M, Eur J Inorg Chem, (2008) 4517.
[3] Ocaña M, Rodriguez-Clemente R, Serna CJ, Adv Mater, **7** (1995) 212.
[4] Cao C, Qin W, Zhang J, Zhang J, Wang Y, Jin Y, Wei G, Wang G, Wang L, J Nanosci Nanotechnol, **8** (2008) 1384.
[5] Li Z and Zhang Y, Nanotechnology, **19** (2008) 345606.
[6] Weng F, Chen D, Wang Y, Yu Y, Huang P, Lin H, Ceram Int, **35** (2009) 2619.
[7] Zhang T, Guo H, Qiao YM, J Lumin, **129** (2009) 861.
[8] Wang GF, Qin WP, Zhang JS, Zhang JS, Wang Y, Cao CY, Wang LL, Wei GD, Zhu PF and Kim R, Opt Mater, **31** (2008) 296.
[9] Wang GF, Qin WP, Wei GD, Wang LL, Zhu PF, Kim RJ, Zhang DS, Ding FH, Zheng KZ, J Fluor Chem, **130** (2009) 158.
[10] Wei Y, Lu F, Zhang X, Chen D, Materials Letters, **61** (2007) 1337.

Figures:



(a) **(b)**

(a) TEM images of YF_3:Yb,Er nanoparticles [samples R (A) and S1 (B)] obtained at 120ºC in different solvents from different Y precursors and variable solvent/IL ratio, (b) Comparison of the intensities of the Er^{3+} up-conversion emissions for samples R and S1 annealed at different temperatures. The different bands have been labelled according with the corresponding optical transition, arising from different emitting Er^{3+} levels and ending in the Er^{3+} ground state (4I15/2).

Dispersion of rhombic Er,Yb;YF_3 nanophosphors (sample R) in water showing UC luminescence sample when excited at 980 nm: (left) total UC, (center) UC viewed through a red filter, (right) UC viewed through a green filter. The photograph has been taken using a LUMIX DMC-digital camera (1 second exposure at ISO 400).