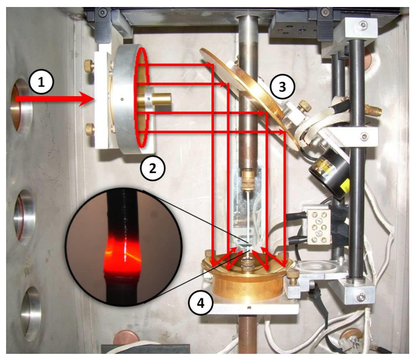
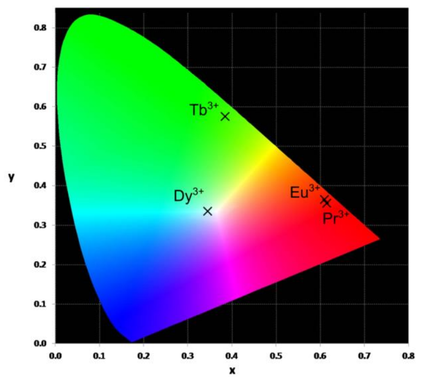
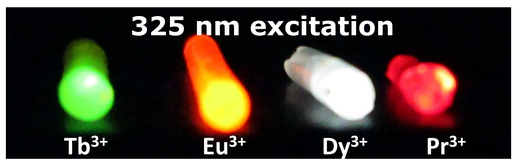
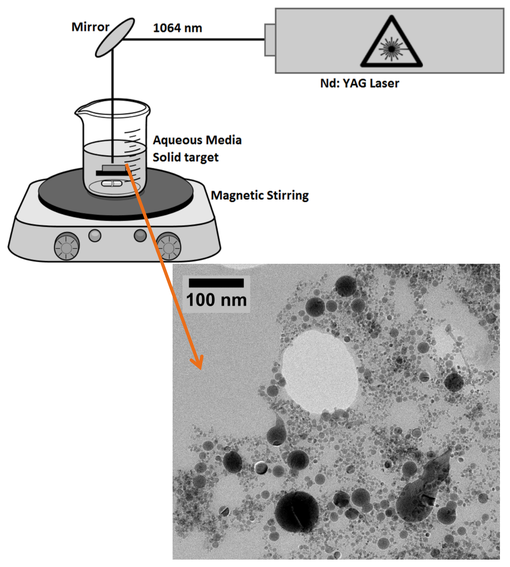
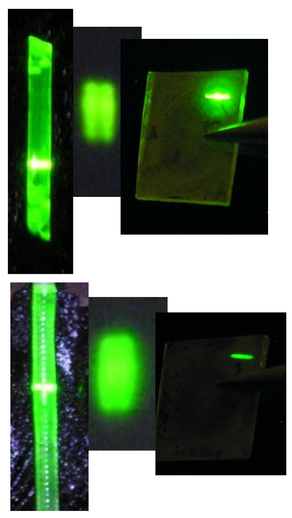
Luminescence in Ln^{3+} doped YSZ Phosphors











980 nm excitation

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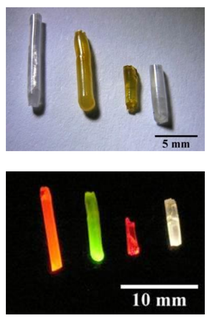
Objectives

- Production of Ln^{3+} doped YSZ single crystals by laser floating zone (LFZ);
- Study the optical properties of the produced phosphors and evaluate its viability as efficient phosphors for solid state lighting;
- Production of up-converting nanoparticles (NPs) by pulsed laser ablation in liquid (PLAL), a promising technique to produce stable colloidal solution, free of chemical precursors, in biocompatible solvents, important for biological labeling;
- Study the up-conversion properties of Er^{3+} doped YSZ NPs;
- Evaluate the effect of Yb^{3+} sensitizer on the Er^{3+} luminescence.



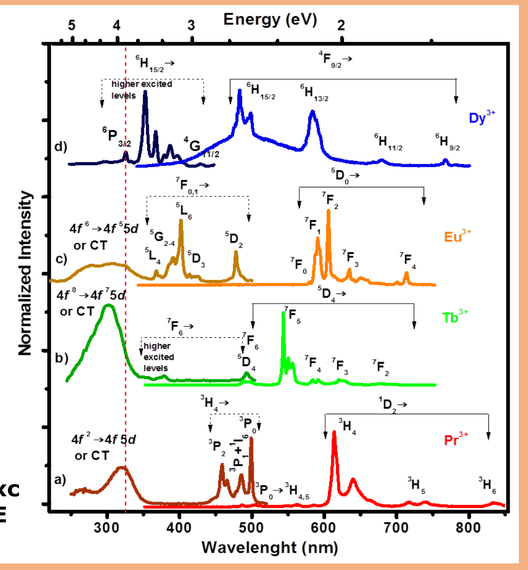
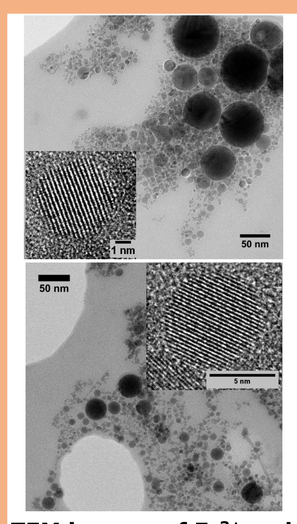
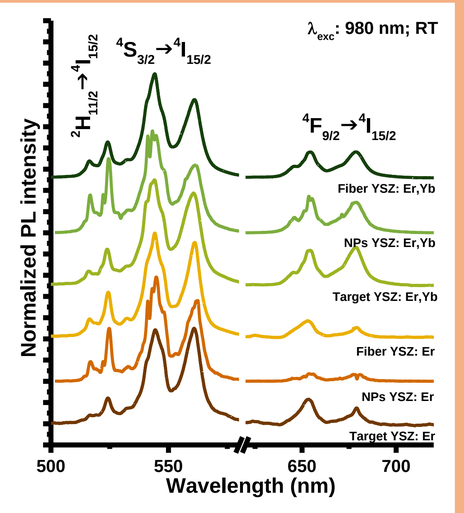


Photo of doped single crystals without excitation and under 325 nm excitation; PL (λ exc = 325 nm) and PLE spectra.

Methods and techniques

- LFZ was used to grow 3 mol % Eu^{3+}, 3 mol % Pr^{3+}, 3 mol % Tb^{3+} and 0.1 mol % Dy^{3+} YSZ single crystals at 40 mm/h;
- Pulsed laser ablation in water was used to produce YSZ nanoparticles doped in 1 mol % Er and co-doped with 1 mol % Er and 1 mol% Yb, using a 1064 nm Nd:YAG pulsed laser;
- The optical properties of NPs and single crystals were analysed by photoluminescence (PL) and photoluminescence excitation (PLE);
- The morphology and size distribution of NPs were characterized by TEM whereas the crystalline phase was analysed by Raman spectroscopy.



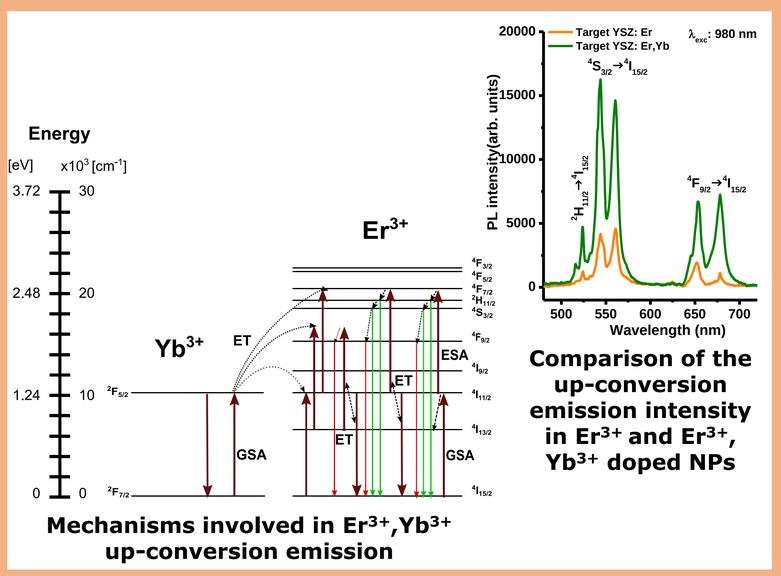


TEM images of Er^{3+} and Er^{3+},Yb^{3+} doped NPs

PL spectra under 980 nm excitation

Results

- Optical activation of Ln^{3+} was achieved both in single crystals and NPs without the need of additional treatment;
- Color emission from zirconia based phosphors could be successful tuned by changing the lanthanide dopant and adjust the ion concentration;
- White emission YSZ:Dy^{3+} seems to be a very promising result since it could be a new approach for white lighting;
- PLAL was successfully used to produce Er^{3+} and Er^{3+}, Yb^{3+} doped NPs with spherical shape and high degree of crystallinity;
- Green and red visible up conversion was observed with 980 nm wavelength photon excitation. A higher intensity of the green and red Er^{3+} luminescence was found in the presence of the Yb^{3+} sensitizer-



Mechanisms involved in Er^{3+},Yb^{3+} up-conversion emission

Comparison of the up-conversion emission intensity in Er^{3+} and Er^{3+}, Yb^{3+} doped NPs

Publications

M.R.N. Soares et al., Mater. Lett 65, 1979 (2011);
M.R.N. Soares et al., J. Appl. Phys. 109, 013516 (2011);
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M.R.N. Soares et al., J. Mater. Chem. 21, 15262 (2011);
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M.R.N. Soares et al., Proc. of SPIE 8626, 862607-2 (2013);
M.R.N. Soares et al., Physica Status Solidi (b) 250, 815 (2013).

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