

# Luminescent nanothermometers based on upconversion nanoparticles for applications in nanomedicine

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Measuring cancer cells temperature at the cellular level allows diagnosis of pathologies and optimization of therapeutic processes.  $\text{Er}^{3+}$  ion present strong temperature dependence of relative intensity of its two green luminescence bands.<sup>1</sup> Lanthanide-based upconversion nanoparticles (UCNPs) present unique advantages, such as deep tissue penetration, low auto-fluorescence background and low photo-damage.<sup>2</sup> This work involved the design of a multifunctional system based on UCNPs aiming its application as a thermometer at the nanoscale.  $\text{NaGdF}_4$  UCNPs doped with the ions  $\text{Yb}^{3+}/\text{Er}^{3+}$  were obtained via thermal decomposition method<sup>3</sup> and characterized in terms of morphological, structural and emission properties.  $\text{NaGdF}_4:\text{Yb}^{3+}:\text{Er}^{3+}$  upconverting nanocrystals in the hexagonal phase showed to be more suitable for application as a temperature-sensor, due to its lower red-to-green emission ratio and higher thermal sensitivity, in respect with the cubic phase. UCNPs were coated with a silica shell to achieve sufficient water dispersibility and presented suitable properties for application as a temperature sensor.

1. Jaque, D.; Vetrone, F. *Nanoscale*, **2012**, 4, 4301.

2. Barreto, J. A.; O'Malley, W.; Kubeil, M.; Graham, B.; Stephan, H.; Spiccia, L.; *Adv. Mater.* **2011**, 23, H18.

3. Hemmer, E.; Quintanilla, M.; Légaré, F.; Vetrone, F.; *Chem. Mater.*, **2015**, 27, 235.

The authors would like to thank CNPq (grant number 141253/2014-2) and CAPES (99999.010867/2014-07) for the financial support.