Synthesis and characterization of $NaLnF_4@NaYF_4$ nanoparticles for possible theranostic applications.

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In cancer research, it has been increasing the number of works searching alternative therapies for chemotherapy and radiotherapy, due to the severe side effects that are associated to them. In this context photothermal (PTT) and photodynamic therapies (PDT) are interesting ideas for cancer treatment. Upconversion nanoparticles (UCNP) are being extensively studied for this purpose.[1,2] This work shows the synthesis and characterization of two systems of core@shell UCNP with interesting spectroscopic properties for use in PDT. UCNP were synthesized by the thermal decomposition method in the pure hexagonal phase, and were characterized by TEM as spheroidal core@shell nanoparticles with a shell thickness of nearly 3 nm. The strategy of an "active-shell" consisting in the shell doping with 20 mol% of Yb(III) was adopted for both NP systems, and their luminescent properties were compared with the "inactive shell" ones. For the $NaYbF_4$:Gd:Tm:Ho@$NaYF_4$ system, the combination of Tm(III) and Ho(III) doped ions resulted in white emission under 980 nm excitation. This sample also presented the possibility of anchoring with any photosensitizer molecule with absorption band around 650 nm for PDT and simultaneous imaging in the Visible or NIR region. The $NaGdF_4$:Pr:Er:Yb@$NaYF_4$ NP show the main emission at 540 nm and were anchored with Rose Bengal molecule that generates oxygen reactive species including singlet oxygen ($^1O_2$). The emission properties of the $NaGdF_4$:Pr:Er:Yb@$NaYF_4$ NP were adequate for the RB absorption and the first results of $^1O_2$ detection were made using the probe DPBF and also by direct measurement of $^1O_2$ emission in 1270 nm. These preliminary results indicates that the association of the two kinds of NP here presented may be a proposal for theranostic applications using only NIR (980 nm) incident radiation.

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2. Wu, X.; Zhang, Y.; Takle, K.; Bilsel, O.; Li, Z.; Lee, H.; Zhang, Z.; Li, D.; Fan, W.; Duan, C.; Chan, E. M.; Lois, C.; Xiang, Y.; Han, G.; *ACS Nano* **2016**, *10, 1066.*

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