Synthesis, thermal sensing and photothermal conversion efficiency of Ho,Tm:Y_2O_3 colloidal nanocrystals with different morphologies

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Yttrium oxide (Y_2O_3) possesses interesting properties such as a broad transparency range (0.2-8 µm) with a band gap of 5.6 eV, high thermal conductivity, high refractive index and low phonon energy, which have made it an attractive choice as host material for lanthanide (Ln) ions for optical applications.[1,2] However, the majority of applications developed up to now have been designed to the bulk Y_2O_3 materials. In this work, we evaluate the properties as luminescent nanothermometers and photothermal agents of the Ho,Tm: Y_2O_3 doped nanomaterials with different morphologies.

Cubic Y_2O_3 colloidal nanocrystals were synthesized via the thermolysis reaction, incorporating the dual role of two organic surfactants (oleic acid and oleylamine) and the non-coordinating agent 1-octadecene. Y_2O_3 nanocrystals with different morphologies ranging from nanospheres, broken-edges-planar triangles, fully planar triangle, heart-like and nanowires-to-rods structures were synthesized. The different morphologies were obtained by incorporation of different additives, such as $NaNO_3$ and NaCl. All the nanocrystals obtained were characterized structurally, demonstrating that in all cases pure body-centered cubic (bcc) Y_2O_3 with spatial group *Ia*-3 was produced. Possible mechanisms for the production of such different morphologies will be discussed.

The nanocrystals were doped with Ho^{3+} and Tm^{3+}, without observing any disturbance on the structure or morphology of the samples due to the presence of dopants. They were tested as luminescent nanothermometers operating in the short-wavelength infrared (SWIR) region via excitation at near infrared (808 nm). The light-to-heat conversion efficiency of the nanocrystals was also studied by the method on the integrating sphere. The potential use of these nanocrystals as self-assessed photothermal agents for hyperthermia applications will be discussed, taking into account the effect of the different shapes of the nanocrystals.

References

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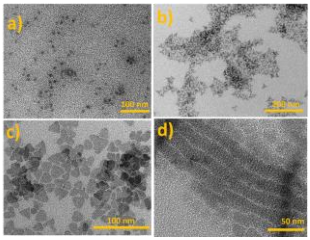
Figure 1: Y_2O_3 colloidal nanocrystals with different morphology: a) nanospheres, b) broken-edge triangle, c) heart like and d) nanowires-to-rods like



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