SYNTHESIS OF LANTHANIDE FLUORIDE NANOPARTICLES OF VARYING SHAPE AND SIZE

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Luminescent materials are of great interest for a variety of optical applications including new display technologies and lasers. A number of inorganic compounds doped with lanthanides trivalent ions are known to exhibit interesting luminescent properties. We are investigating the preparation of luminescent inorganic nanoparticles coated with organic surfactants with the objective of incorporating these luminescent inorganic materials into organic environments such as polymer matrices. Recent scientific literature demonstrates a growing interest in new methods of nanoparticle synthesis, driven primarily by an ever increasing awareness of the unique properties and technological importance of nanostructured materials. Major issues associated with nanoparticle preparation include the control of particle size and internal structure. We have explored several synthetic routes for the preparation of nanoparticles containing rare earth elements. The fabrication of nanoparticles within reverse microemulsions has been shown to be a convenient route to monodisperse particles of controllable size. This method as been studied for some years and has been widely used for metal, semi-conductor and oxide nanoparticle synthesis [1]. To the best of our knowledge, it has not yet been applied to the preparation of nanoparticles of lanthanides salts. Yttrium fluoride nanoparticles of varying crystallinity, shape and size are prepared by precipitation in reverse microemulsions of water in cyclohexane stabilized with polyoxyethylene isooctylphenyl ether [2]. YF_3 particles obtained by the classical microemulsion method are found to be monodisperse amorphous spheres, with controllable diameters between 6 and 50 nm. Furthermore, particles of the same material obtained by a relatively minor variation of this method are found to be monodisperse single crystals of octahedral and triangular shapes (Figure 1). The size of the crystalline particles can be varied between about 25 and 350 nm. The formation of single crystals can be attributed to the slower incorporation of the precipitant into the micelles when introduced in this fashion.

Reference:

[1] Pileni, M. P. ***Langmuir*** **1997**, *13*, 3266-3276.

[2] Lemyre, Jean-Luc; Ritcey, Anna M. ***Chem. Mater.*** **2005**, in press.

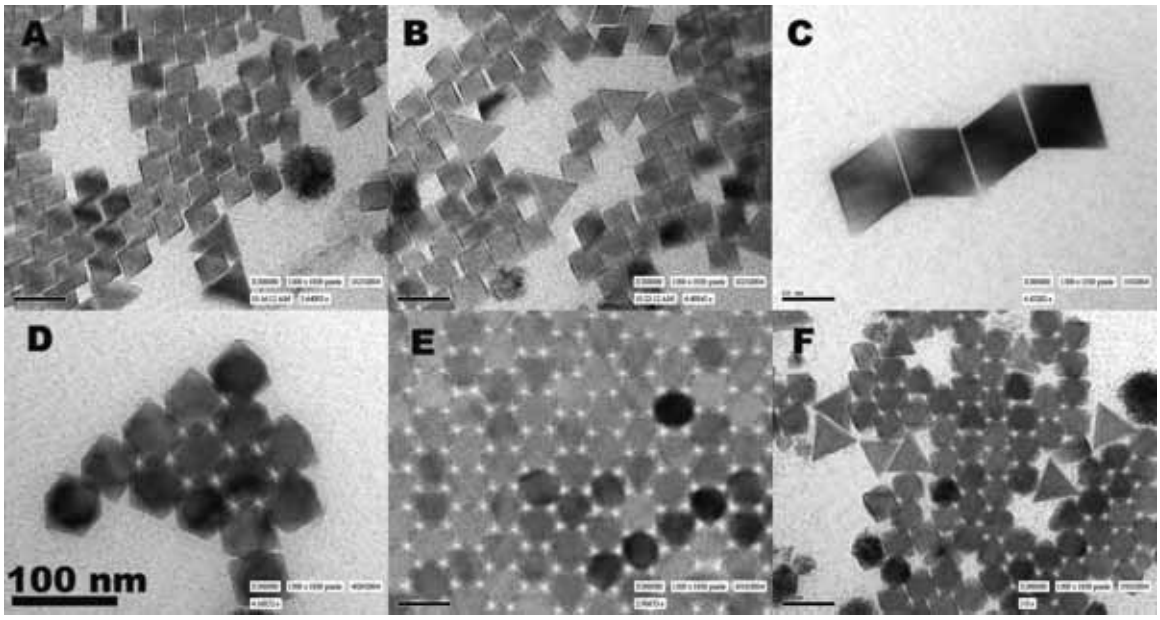

Figure 1: Different morphologies of LnF_3 nanoparticles obtained by adding aqueous NH_4FHF to a microemulsion containing $LnCl_3$. a) and b) typical mixtures of predominant YF_3 particles morphologies, c) YF_3 quadrilateral shaped particles, d) YF_3 hexagonal particles, e) self-assembly of YF_3 hexagonal particles, f) ErF_3 particles.