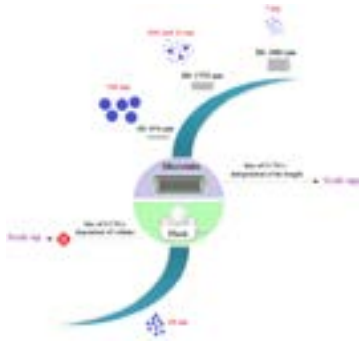
Alireza Kavand et al., J Nanomed Nanotechnol 2017, 8:6(Suppl)
DOI: 10.4172/2157-7439-C1-058

Preparation of ultrasmall monodisperse upconversion nanocrystals and their size control using an intensified heat treatment process

Alireza Kavand, Christophe A Serra, Delphine Chan-Seng, Nicolas Anton and **Thierry Vandamme**
Université de Strasbourg, France

This presentation will show a simple and efficient method to produce ultrasmall hexagonal-phase upconversion nanocrystals (UCNCs) to be used as luminescent labels for biomedical applications. Preparation of nanosized hexagonal-phase UCNCs is a great challenge but many methods have been reported to synthesize efficiently UCNCs in the size range 15 to 50 nm. One of the easiest and most convenient approach is the co-precipitation method that involves nucleation (precipitation step) and growth of particles (heat treatment step). In the case of the synthesis of ultrasmall UCNCs (sub-10 nm), some researchers have used lanthanide dopant while others have changed some operating parameters to achieve a rapid nucleation rate such as different mixed ligands, shorten heat treatment time etc. But these strategies induced the undesired effect of increasing the energy barrier between cubic phase and hexagonal phases. Herein we report on a modified heat treatment procedure to achieve monodisperse ultrasmall UCNCs in good yields. We used stainless steel microtubes with different inner diameters and lengths for the heat treatment step and compared the results with the standard batch method using a simple flask. Microtubes filled with the UCNCS nuclei solution were placed in a thermoregulated oven at (300°C) for 120 min. It was found that the sizes and properties of UCNCs were influenced by the type of heat treatment device (flask or microtube) which was never reported until now. Nanoparticles produced with the bigger tube (ID: 4083 µm) showed ultrasmall size (around 7 nm) and narrower size distribution (PDI 0.2), while the nanoparticles obtained using a smaller tube (ID: 876 µm) or produced with the flask showed bigger sizes about 700 nm and 50 nm respectively (PDI: 0.5 and 0.3). The length of the microtube was found not to affect significantly the particle size which is an important factor for future scale up. However, for the same formulation, the volume of the flask (5 and 21 mL) did affect quite noticeably the size of the UCNCs obtained (50 and 190 nm respectively). The presentation will aim also at introducing our latest results regarding the continuous-flow heat treatment in microtubes.



Scheme 1: Schematic representation of the synthesis of UCNCs using different heat treatment devices

Biography

Alireza Kavand obtained his BS degree in Chemistry from the University of Zanjan and his Master's degree in Polymer Chemistry from the University of Tehran (Iran). Currently, he is a member of the CMP group as PhD student at Institute Charles Sadron (France). His current research interests are polymer synthesis based on peptide, microfluidic system and upconversion nanoparticles for drug delivery application.

Alireza.kavand@ics-cnrs.unistra.fr