Solvothermal preparation of ultrasmall monodisperse hexagonal upconverting nanoparticles: a microwave approach

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Lanthanide-doped upconverting nanoparticles (UCNP) of the $MREF_4$ (RE= Gd,Yb,Tm; M= alkali) formula show the fascinating property of converting biologically benign, low energy Near-Infrared (NIR) photons into high energy, visible light with narrow emission bands[1]. Consequently, the absence of sample autofluorescence associated with long emission lifetimes make them ideal probes in Biology for imaging and tracking[2]. Very small nanoparticles are highly desirable to explore subcellular features. However, such a size reduction has a strong negative impact on the upconversion efficiency[3] as the emission is sensitive to the surface-to-volume ratio as well as to the nature of the host crystal phase (hexagonal phase being required). Therefore, the preparation of sub-5 nm, bright nanoparticles remains a challenge. Sticking to a solvothermal nanoprecipitation route, we have tackled this issue through systematic studies of the reaction's temporal thermal profile (nucleation and growth). In this talk we will show the superiority of microwave oven over standard heating devices and disclose an original procedure to reach highly homogeneous beta-phase crystals with size below 5nm.

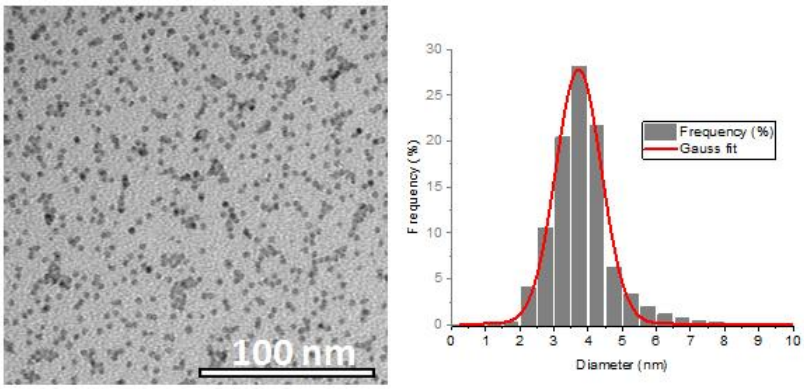

Figure 1. β-Na(Yb-Gd)F_4:Tm of 3.5 nm diameter (FWHM = 1.6 nm)

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