Synthesis and characterization of KY_3F_{10} nanoparticles

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KY_3F_{10} bulk crystals doped with rare earth have been largely studied for photonic applications. Nanocrystals however can be used in the development of transparent ceramics [1] and display applications, for example, once they are expected to have the same properties. The preparation of these materials is also attractive as they can be prepared by the coprecipitation method [2]. Thus, the aim of this work is to obtain KY_3F_{10} nanoparticles via the coprecipitation method in aqueous solution, evaluating the feasibility of their preparation using HCl or HNO_3 as solvents of the oxide precursors and NH_4HF_2 as a fluorinant agent. Nd, Yb and Tm doped KY_3F_{10} nanocrystals were also synthesised for spectroscopic studies related to their up conversion properties. The preparation was done by dissolving the rare earths oxides in hot concentred acid. After drying most acid, a hot KF aqueous solution was added, followed by addition of NH_4HF_2 hot aqueous solution. A white precipitate was formed within few seconds. The solution remained under strong stirring for several hours. The powder was separated by centrifugation, alternated by washing several times with NH_4HF_2 solution and two times with methanol and then dried on a warm surface. X ray diffraction analysis (XRD) shows only KY_3F_{10} cubic phase (Fm m) peaks for all syntheses performed with HCl addition. Additional peaks were found for doped materials prepared with HNO_3. All the XRD patterns show a broadening of peaks in comparison with the bulk crystal due to the small particles size. Particles diameter between 10 and 200 nm were obtained by Dynamic Light Scattering (DLS) technique. All the samples prepared with HCl showed an endothermic peak about 990°C (KY_3F_{10} melting point) when subjected to heating in thermal analysis by Differential Scanning Calorimeter (DSC).

[1] P. Aubry et al. Optical Materials 31 (2009) 750
[2] C. Sassoye etr al. Optical Materials 31 (2009) 1177