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Synthesis and characterization of K2YbF5 upconversion nanoparticles

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Many avenues exist for synthesizing upconversion nanoparticles (UCNPs), such as hydrothermal, solvothermal, solid-state reactions, thermal decomposition, amongst others. Here we compare three hydro-solvothermal synthesis processes for producing K2YbF5:Er and K2YbF5:Tm UCNPs, each having a different order of addition of reagents. The first method (A) adds together potassium hydroxide, oleic acid, and ethanol; followed by the lanthanide ions, and finally potassium fluoride. The second method (B) mixes the lanthanide ions, oleic acid, and ethanol first; followed by potassium hydroxide, and finally potassium fluoride. The third method (C) is similar to the second one, except that potassium hydroxide and potassium fluoride are mixed together first before being introduced into the system. The resulting nanoparticles were characterized via scanning electron microscopy (SEM), energy dispersive spectroscopy (EDS), photoluminescence spectra (PL), and near-edge x-ray absorption fine structure (NEXAFS) spectroscopy on the Australian synchrotron soft-X ray beam line. SEM images reveal that all particles are crystalline with shapes ranging from microrods to hexagonal. EDS confirmed presence of dopant ions only for particles produced via method A, while NEXAFS spectra confirmed presence of dopant ions in all doped crystals, with their expected NEXAFS structure confirming the oxidation state of the ion within the nanocrystal. Thus there is evidence of dopant ions incorporated within the crystal; however, more quantitative techniques must be applied to properly ascertain the doping concentration and the quantum efficiency of the upconversion processes occurring within the synthesized particles.

Level of Expertise

Student

Presenter Gender

Man

Pronouns

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Which facility did you use for your research

Australian Synchrotron

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Yes

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No

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