Room temperature synthesis of β-$NaGdF_4$:RE^{3+} (RE = Eu, Er) nanocrystallites and their luminescence

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Keywords: β-$NaGdF_4$, nanoparticles, room-temperature synthesis, erbium, gadolinium

Hexagonal β-$NaGdF_4$ is well established as a host lattice for upconversion luminescence materials [1]. Nanomaterials capable of upconversion luminescence are currently receiving high interest for application in biological imaging [2]. Moreover, β-$NaGdF_4$ doped with Eu^{3+} is an efficient quantum cutting material [3]. A room temperature synthesis was developed for phase pure β-$NaGdF_4$ nanocrystallites as well as 5% Eu^{3+} or 5% Er^{3+} doped material by converting rare earth acetates and NaCl in a 1:2 ratio with a variable excess of NH_4F in ethylene glycol within 24 hours. Since the thermodynamic stability of the hexagonal phase decreases along the lanthanide series [4], a larger amount of NH_4F was required for the synthesis of samples doped with the smaller Er^{3+} ions than for Eu^{3+} doped or pure $NaGdF_4$.

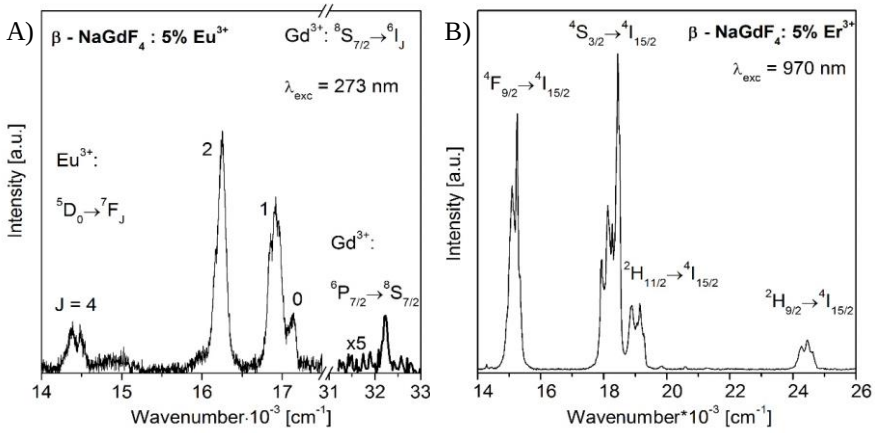

Fig. 1. A) Emission spectrum of β-$NaGdF_4$: 5% Eu^{3+} nanocrystallites for Gd^{3+} excitation at 273 nm (36630 cm^{-1}); B) Upconversion luminescence of β-$NaGdF_4$: 5% Er^{3+} nanocrystallites under 970 nm (10309 cm^{-1}) excitation.

The Eu^{3+}-doped samples show red $^5D_0 \rightarrow {}^7F_J$ luminescence after Eu^{3+} excitation at 394 nm or Gd^{3+} excitation at 273 nm and 308 nm. The Er^{3+}-doped samples show green and red upconversion luminescence from the $^2H_{11/2}+{}^4S_{3/2} \rightarrow {}^4I_{15/2}$ and $^4F_{9/2} \rightarrow {}^4I_{15/2}$ transitions, respectively, after 970 nm excitation.

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