Li+ ion doping: an approach for improving the crystallinity and upconversion emissions of NaYF4:Yb3+, Tm3+ nanoparticles

Published in: Nanoscale

DOI: 10.1039/c3nr01916k

Citation for published version (APA):
Supporting Information

Li$^+$ ions doping: An Approach for Improving the Crystallinity and Upconversion Emissions of NaYF$_4$: Yb$^{3+}$, Tm$^{3+}$ Nanoparticles

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**Figure S1.** Pump power dependence of the violet (452 nm) and blue (479 nm) emission of NaYF₄: Yb³⁺, Tm³⁺ nanocrystals: (a) 0 mol% Li⁺, (b) 5 mol% Li⁺, (c) 7 mol% Li⁺, (d) 10 mol% Li⁺, (e) 15 mol% Li⁺.

As shown in Fig. S1, the $n$ values of all the samples of NaYF₄: Yb³⁺, Tm³⁺ nanocrystals introducing Li⁺ ions were smaller than that of NaYF₄: Yb³⁺, Tm³⁺ nanocrystals.
Figure S2. Temporal evolutions of UC luminescence from $^1D_2$ levels of Tm$^{3+}$ ions in NaYF$_4$: Yb$^{3+}$, Tm$^{3+}$ co-doped with Li$^+$ ions (0, 5, 7, 10, 15 mol%) corresponding to (a–e) by monitoring the UC emissions centered at 452 nm under excitation of a 980 nm laser, black circles experimental data; coloured solid line fitting by: 

$$I(t) = I_0 - A_1 \exp(-t / \tau_1) + A_2 \exp(-t / \tau_2)$$
**Figure S3.** Temporal evolutions of UC luminescence from $^1$G$_4$ levels of Tm$^{3+}$ ions in NaYF$_4$: Yb$^{3+}$, Tm$^{3+}$ co-doped with Li$^+$ ions (0, 5, 7, 10, 15 mol%) corresponding to (a–e) by monitoring the UC emissions centered at 479 nm under excitation of a 980 nm laser, black circles experimental data; coloured solid line: fitting by: 

$$I(t) = I_0 - A_1 \exp(-t/\tau_1) + A_2 \exp(-t/\tau_2)$$