Electronic Supplementary Material (ESI) for Nanoscale.

Supplementary Information for

Selectively enhanced red upconversion luminescence and phase/size manipulation *via* Fe^{3+} doping in $NaYF_4$:Yb,Er nanocrystals

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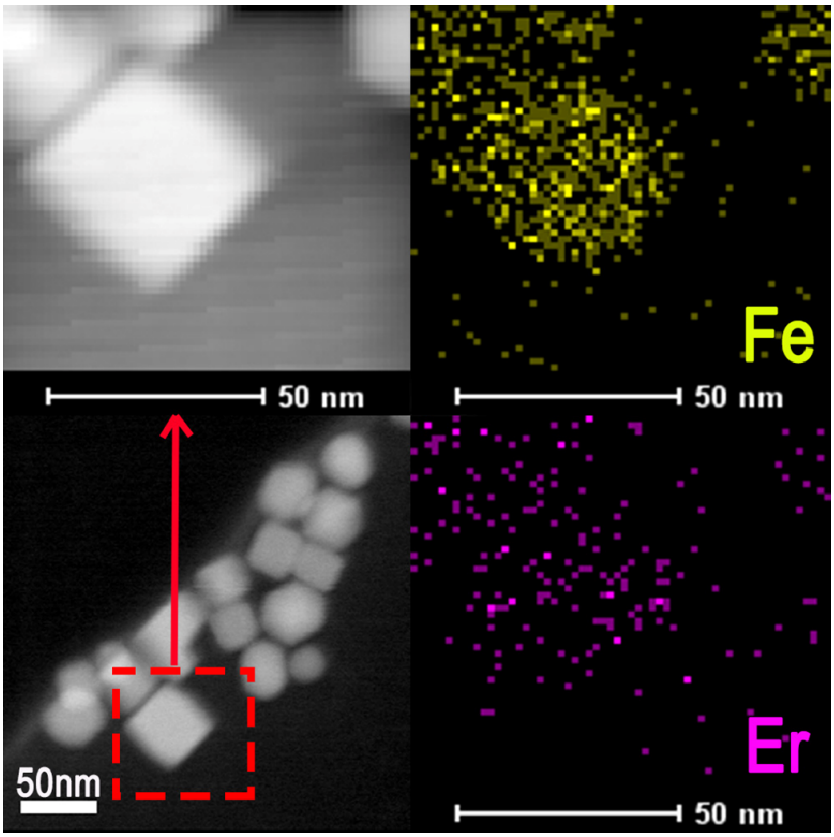

Figure S1 High-angle annular dark-field (HAADF) STEM images (on the left, upper: locally magnified image of the lower one indicated by a red square) and elemental maps (on the right) for Fe and Er of $NaYF_4$:18%Yb,2%Er,30%Fe nanocrystals.

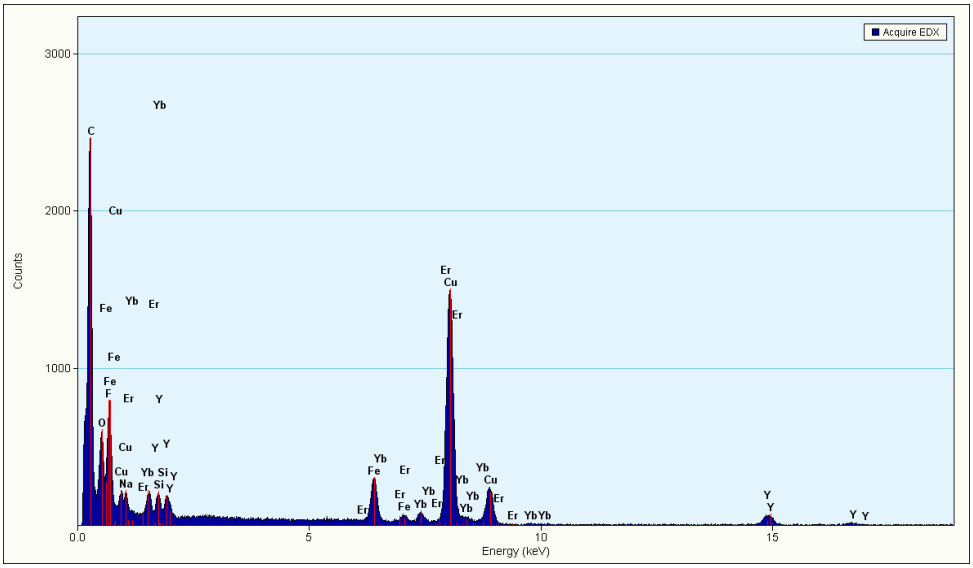

Figure S2 Energy-dispersive X-ray spectrum of 18%Yb,2%Er,30 mol%Fe-tridoped $NaYF_4$ nanocrystals.

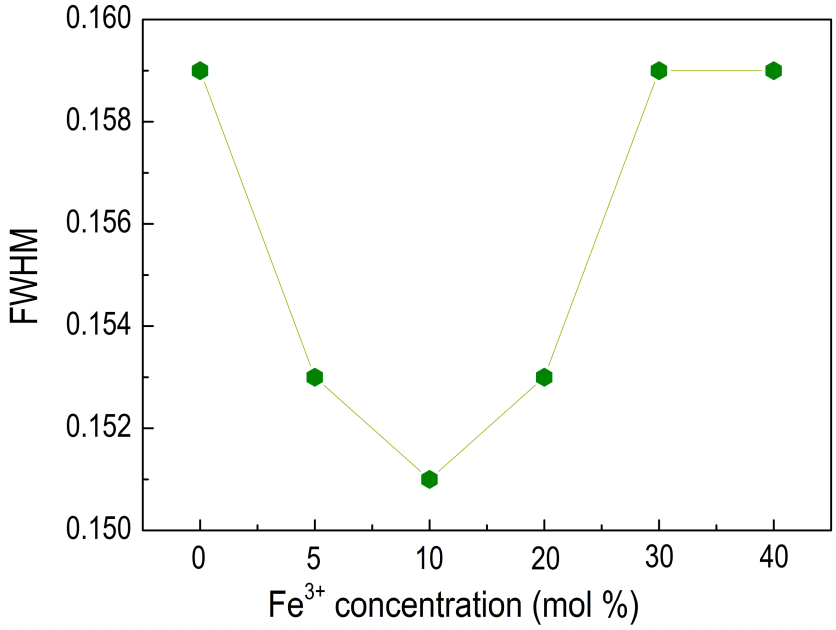

Figure S3 Full Width at Half Maximum (FWHM) of the X-ray diffraction peaks at 2θ= 30.8° for the samples with various Fe^{3+} doping concentrations.

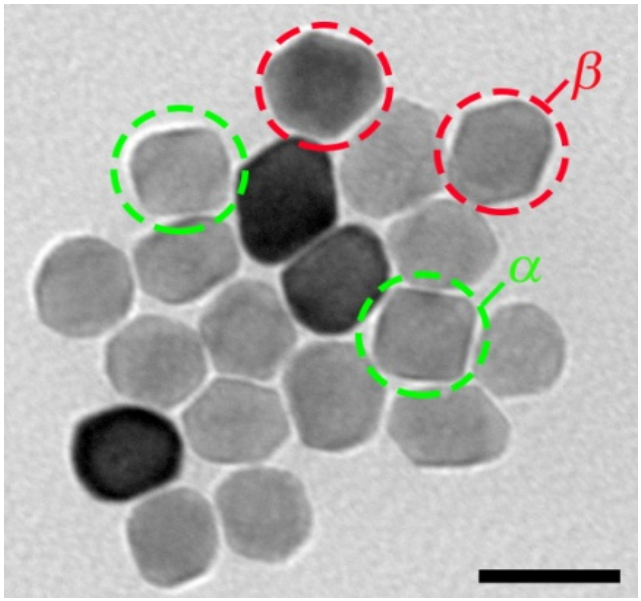

Figure S4 A typical TEM image of $NaYF_4$:18%Yb,2%Er,30 mol%Fe nanocrystal with mixed phases of hexagonal and cubic structure (green circle: cubic-α; red one: hexagonal-β) .

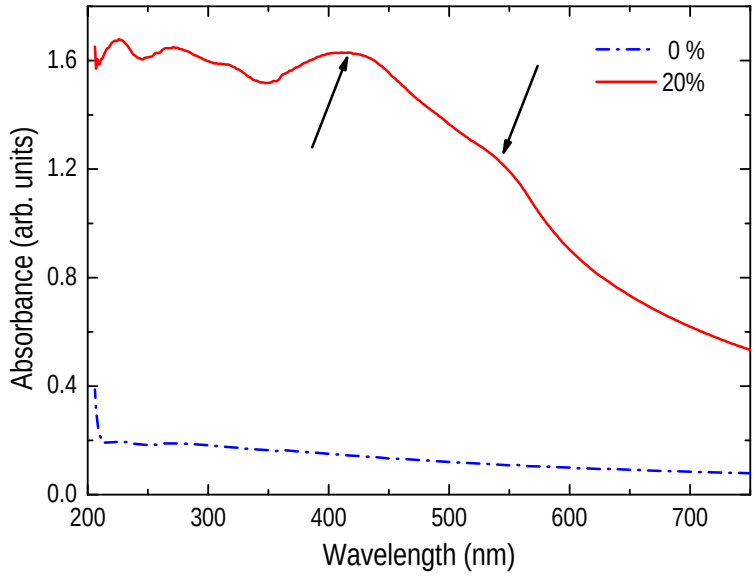

Figure S5 UV-vis absorption spectra of $NaYF_4$:Yb,Er codoped with 20 mol% Fe^{3+} and Fe^{3+}-free $NaYF_4$:Yb,Er nanocrystals.

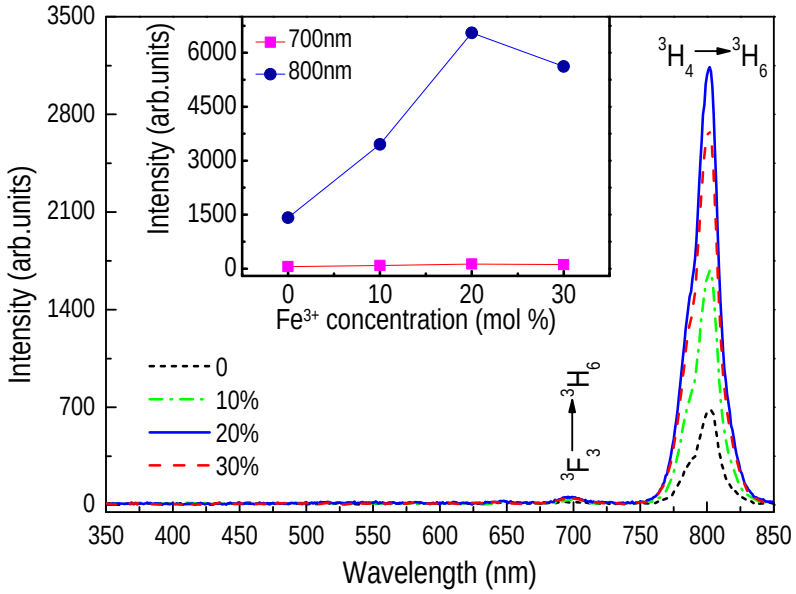

Figure S6 Upconversion luminescence (UCL) spectra of NaYF4:Yb,Tm,xFe (x=0, 10, 20 and 30 mol%) nanocrystals under the excitation of 980 nm diode laser. Inset: integrated intensity of $^3F_3 \rightarrow {}^3H_6$ and $^3H_4 \rightarrow {}^3H_6$ transitions, respectively, as a function of Fe^{3+} doping concentration.

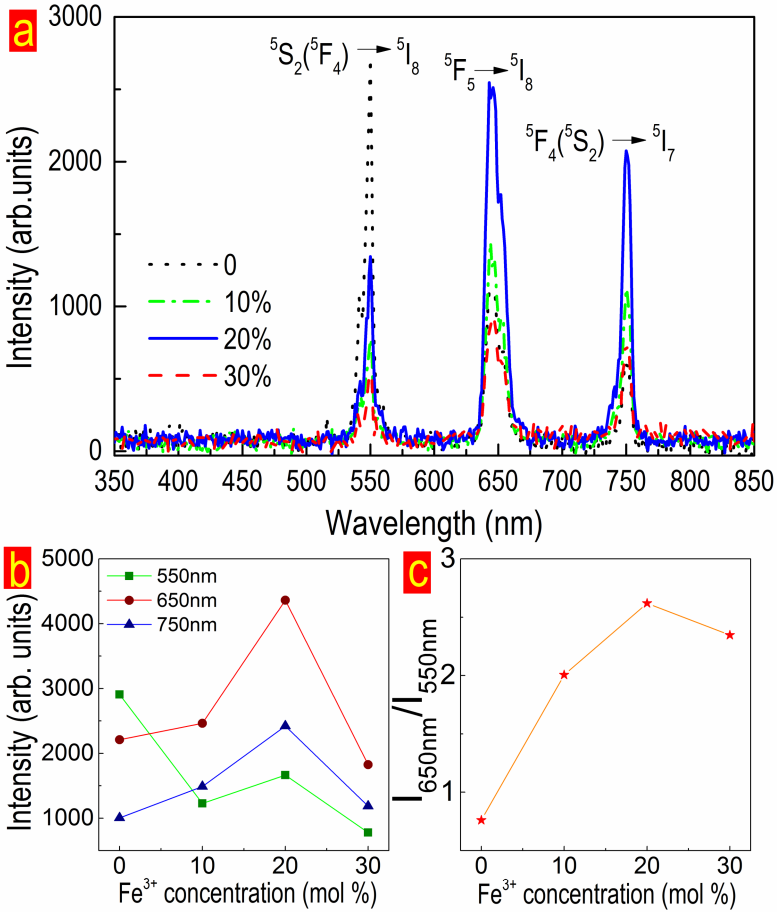

Figure S7 (a) UCL spectra of $NaYF_4$:Yb,Ho,xFe (x=0, 10, 20 and 30 mol %) under the excitation of 980 nm diode laser. (b) The integrated intensity of emissions at 550, 650 and 750 nm in dependence on Fe^{3+} doping concentration, respectively. (c) Calculated intensity ratio of 650 nm to 550 nm emissions as a function of the Fe^{3+} contents.

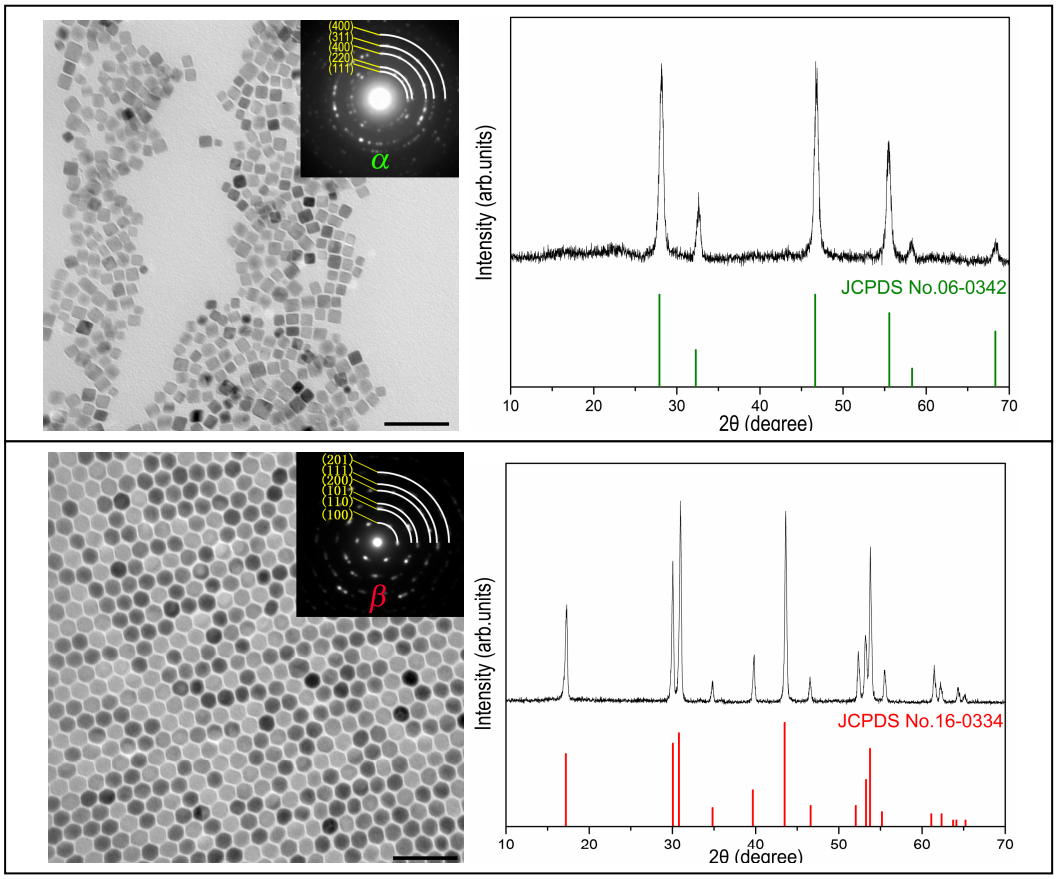

Figure S8 (left) TEM images of $NaYF_4$:Yb,Er with pure cubic (upper) and hexagonal (lower) phases, respectively; (right) XRD patterns, correspondingly.