Electronic Supplementary Material (ESI) for Nanoscale

Supporting Information

Controlled synthesis and optical spectroscopy of lanthanide-doped $KLaF_4$ nanocrystals

Rui Liu,[ab] Datao Tu,[a] Yongsheng Liu,[a] Haomiao Zhu,[a] Renfu Li,[a] Wei Zheng,[ab] En Ma,[a] and Xueyuan Chen*[a]

[a] *Key Laboratory of Optoelectronic Materials Chemistry and Physics, Fujian Institute of Research on the Structure of Matter, Chinese Academy of Sciences, Fuzhou, Fujian 350002, China.*
[b] *Graduate University of the Chinese Academy of Sciences, Beijing 100049, China.*

*Corresponding author, E-mail: xchen@fjirsm.ac.cn

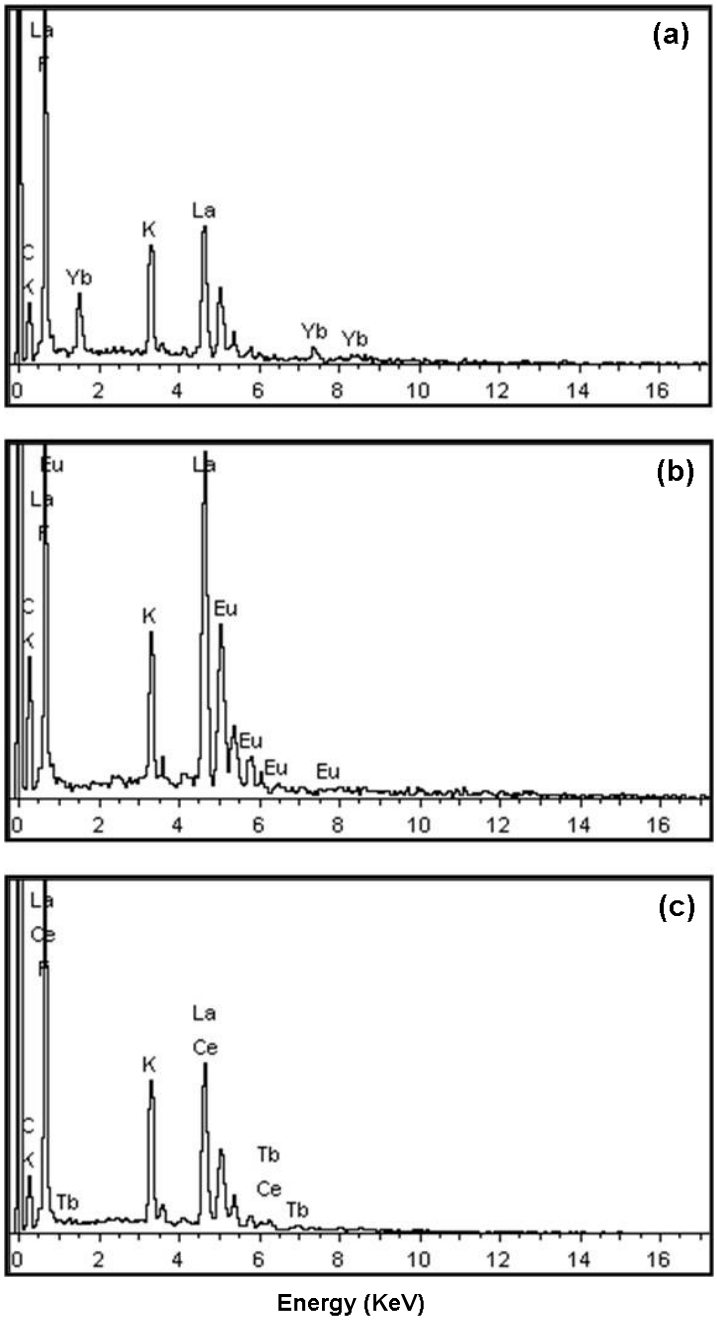

Fig. S1 Energy dispersive X-ray spectrum (EDS) analysis of (a) $KLaF_4$:$0.02Er^{3+}$/$0.18Yb^{3+}$, (b) $KLaF_4$:$0.05Eu^{3+}$ and (c) $KLaF_4$:$0.05Ce^{3+}$/$0.05Tb^{3+}$ nanocrystals (NCs), revealing successfully doping of Er^{3+}/Yb^{3+}, Eu^{3+} or Ce^{3+}/Tb^{3+} into $KLaF_4$ host.

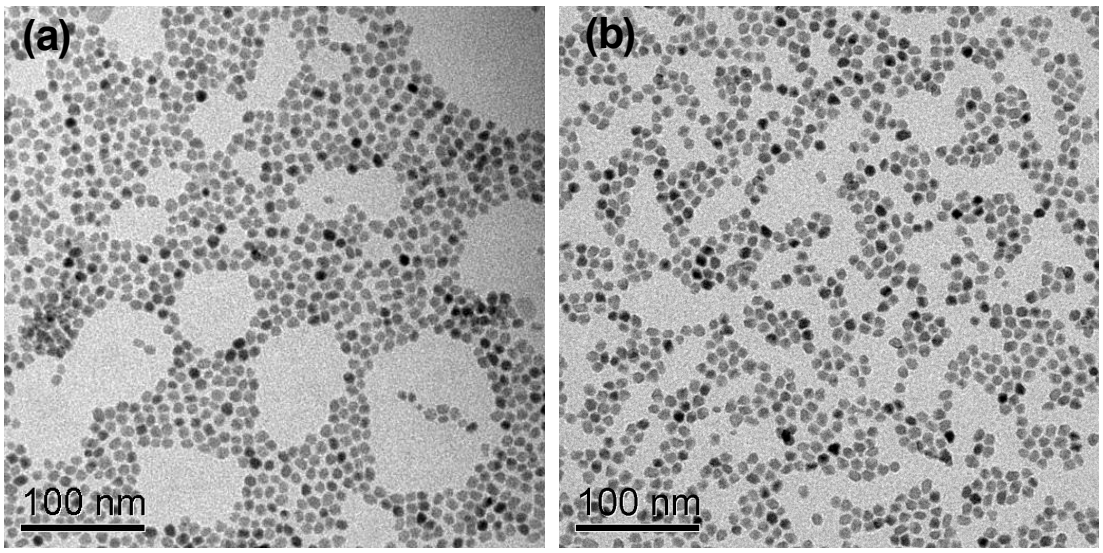

Fig. S2 TEM images of (a) $KLaF_4$:0.05Eu^{3+} and (b) $KLaF_4$:0.05Ce^{3+}/0.05Tb^{3+} NCs.

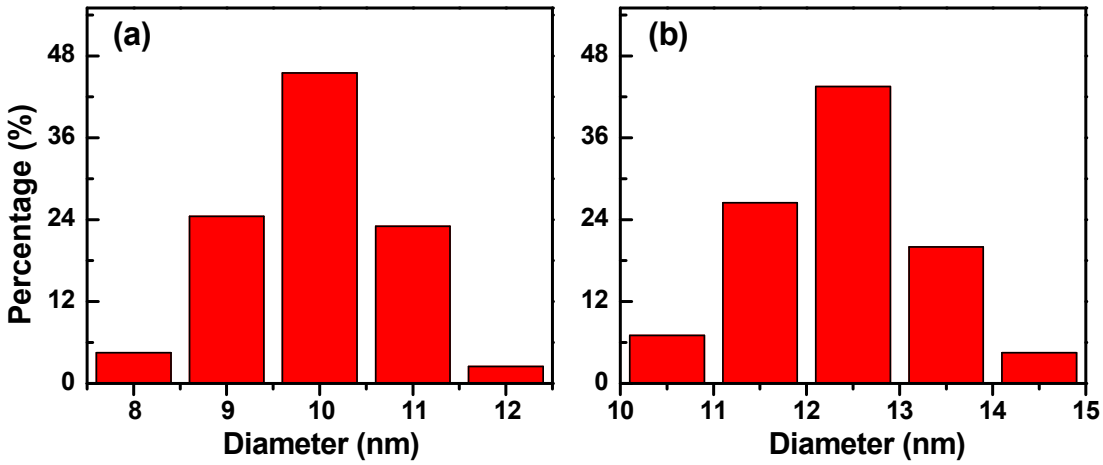

Fig. S3 Histograms of size distribution of (a) $KLaF_4:0.02Er^{3+}/0.18Yb^{3+}$ core-only and (b) $KLaF_4:0.02Er^{3+}/0.18Yb^{3+}@KLaF_4$ core/shell NCs, estimated from corresponding TEM images of Figs. 2a-b by randomly counting 200 nanoparticles. The average diameter was increased from 9.9 nm in core-only NCs to 12.4 nm in core/shell NCs, which demonstrates a thin $KLaF_4$ layer (~1.3 nm) coated on the inner core.

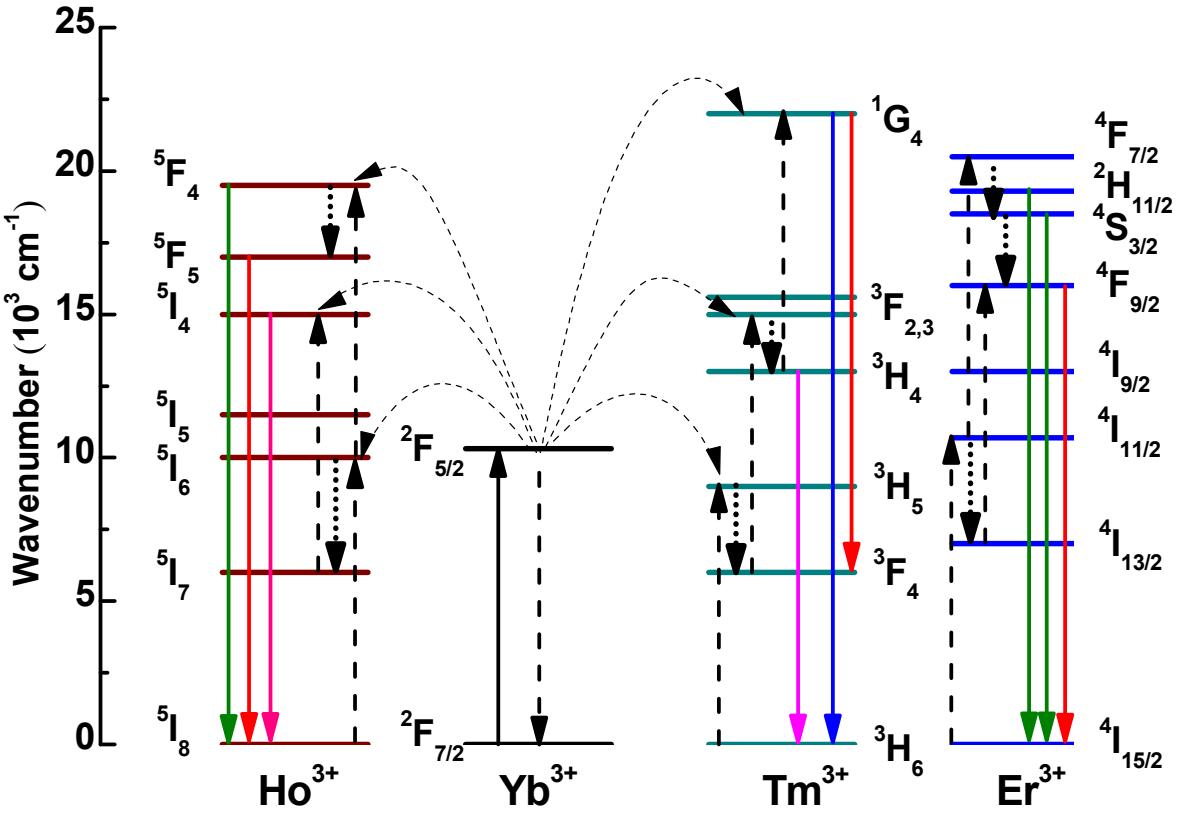

Fig. S4 Schematic energy level diagrams showing typical upconversion (UC) processes for (a) Ho^{3+}, (b) Tm^{3+} and (c) Er^{3+} via the sensitization of Yb^{3+}. The dashed, dotted and full arrows represent the excitation, nonradiative relaxation, and emission processes, respectively..

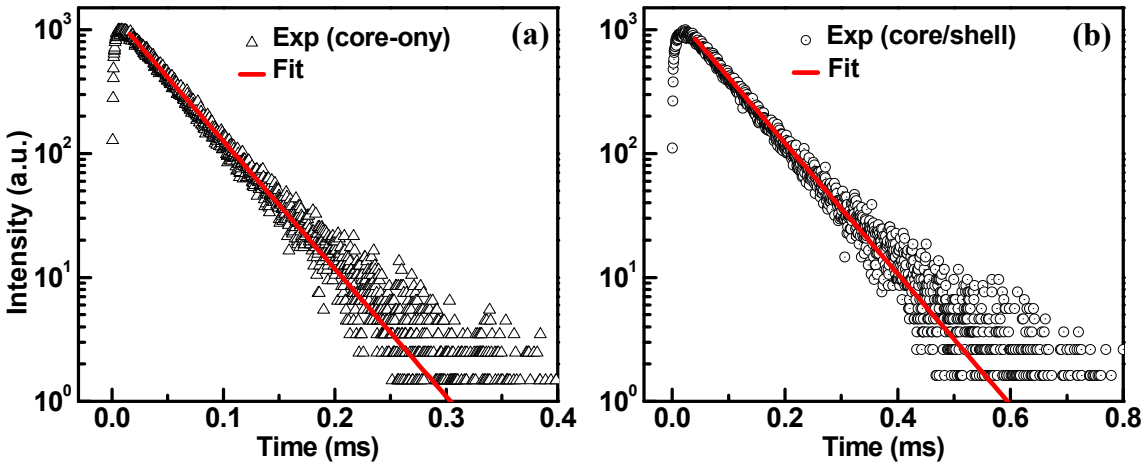

Fig. S5 UC luminescence decay curves of (a) $KLaF_4$:0.02Er^{3+}/0.18Yb^{3+} core-only and (b) $KLaF_4$:0.02Er^{3+}/0.18Yb^{3+}@$KLaF_4$ core/shell NCs by monitoring the $^2H_{11/2} \rightarrow {}^4I_{15/2}$ transition of Er^{3+} at 521 nm upon excitation at 980 nm. By fitting with a single exponential function, the UC lifetimes of $^2H_{11/2}$ in core-only and core/shell NCs were determined to be 41 and 84 μs, respectively.

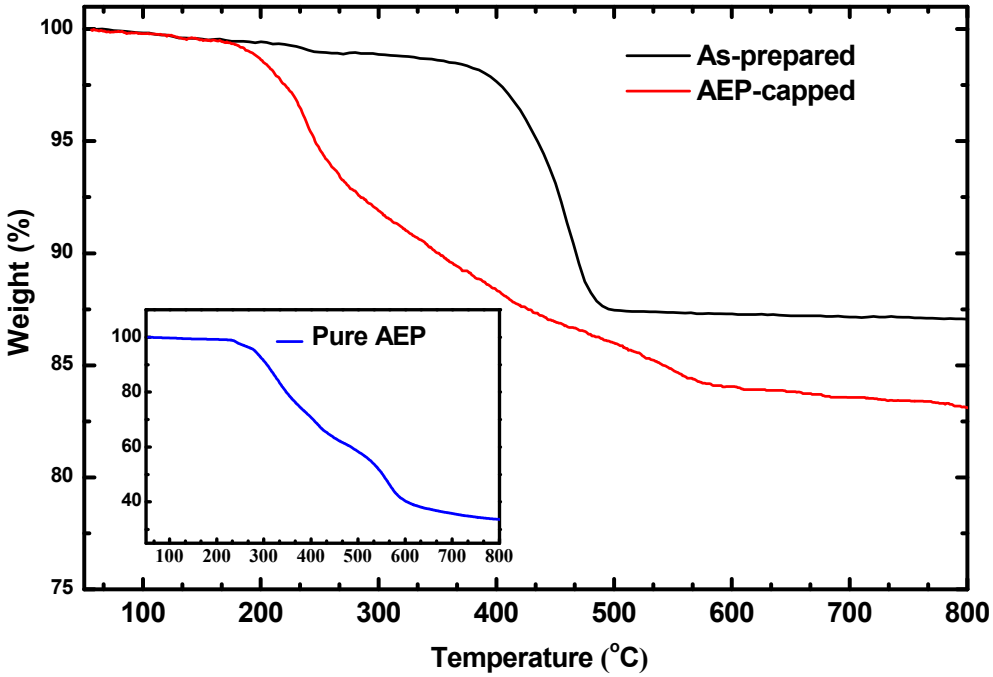

Fig. S6 Thermogravimetric analysis (TGA) of as-prepared and AEP-capped $KLaF_4$ NCs, respectively. The inset shows the TGA curve of pure AEP. The major stages of weight loss of as-prepared and AEP-capped $KLaF_4$ NCs are different. Similar TGA behaviors observed for AEP-capped NCs and pure AEP indicate the AEP capping on the surface of the NCs after ligand exchange.

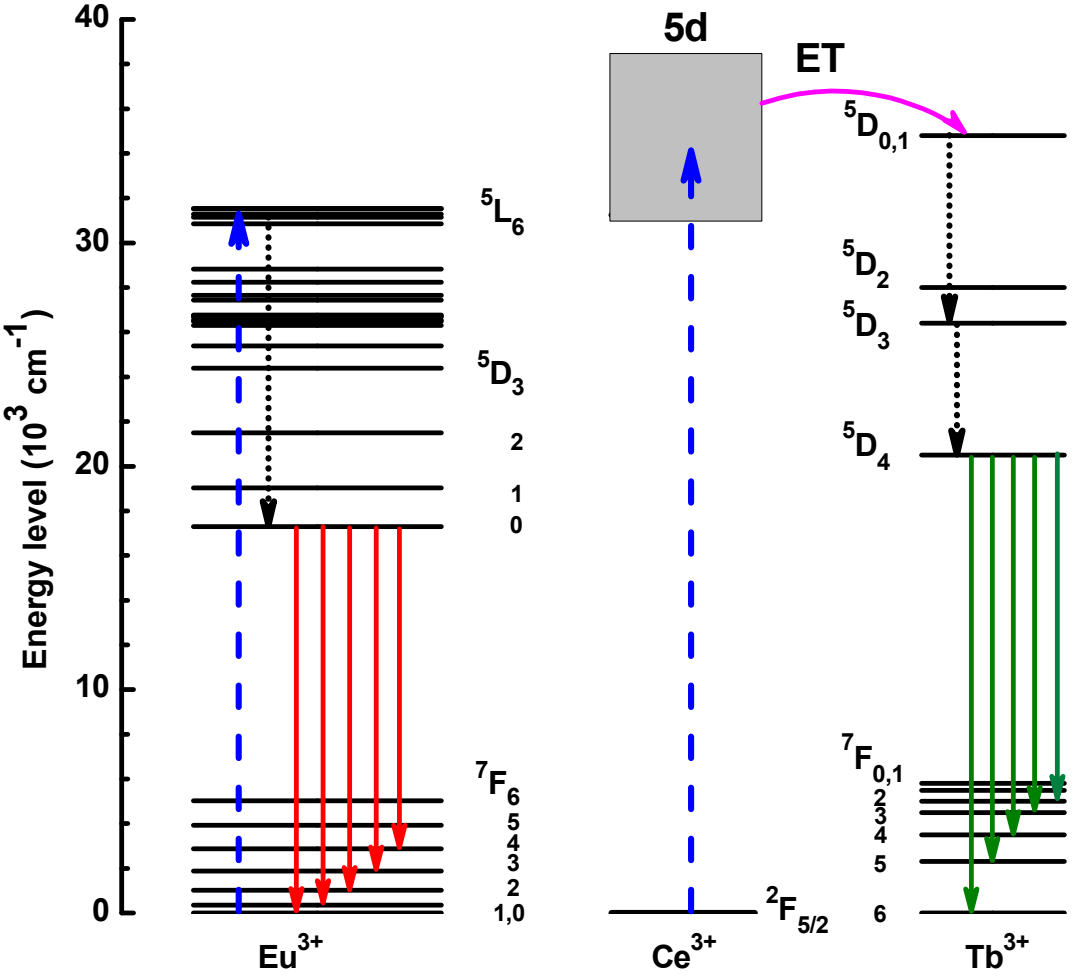

Fig. S7 Schematic energy level diagrams showing downconversion processes for (a) Eu^{3+} and (b) Ce^{3+}/Tb^{3+} ions in $KLaF_4$ NCs. The dashed, dotted and full arrows represent the excitation, nonradiative relaxation, and emission processes, respectively.