

Electronic Supplementary Information

Quasi-seeded growth, phase transformation, and size tuning of multifunctional hexagonal NaLnF₄ (Ln=Y, Gd, Yb) nanocrystals via *in situ* cation-exchange reaction

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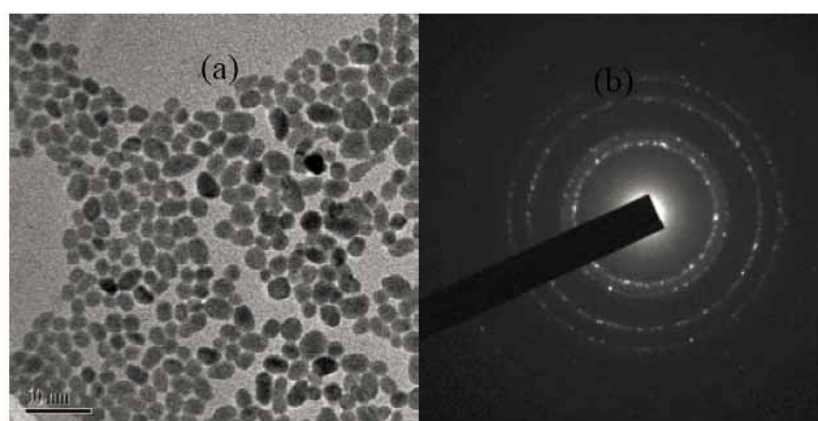


Figure S1 (a) and (b) Typical TEM image and selected electron diffraction (SEAD) pattern of the $\text{KYb}_{0.1}\text{Gd}_{0.9}\text{F}_4$ NCs.

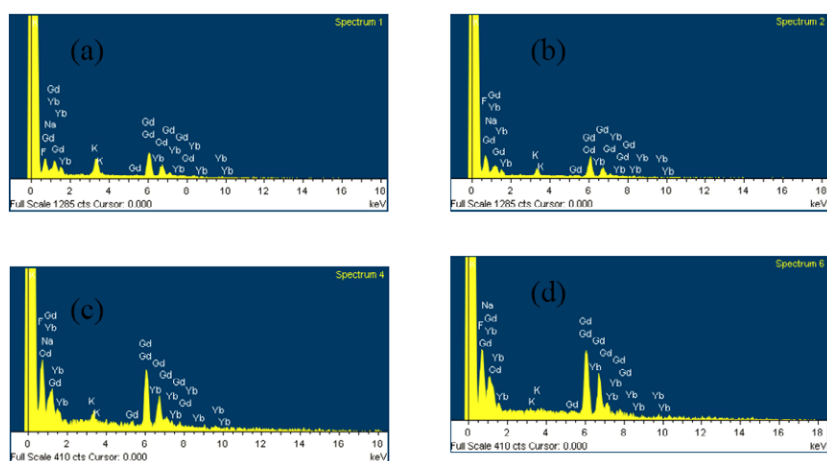


Figure S2 (a)-(d) EDS spectra taken from the oleate-capped cubic $\text{KYb}_{0.1}\text{Gd}_{0.9}\text{F}_4$ NCs reacted with 10mol% NaOA at 180°C for different time of 0 h, 2 h, 5 h, and 20 h, respectively.

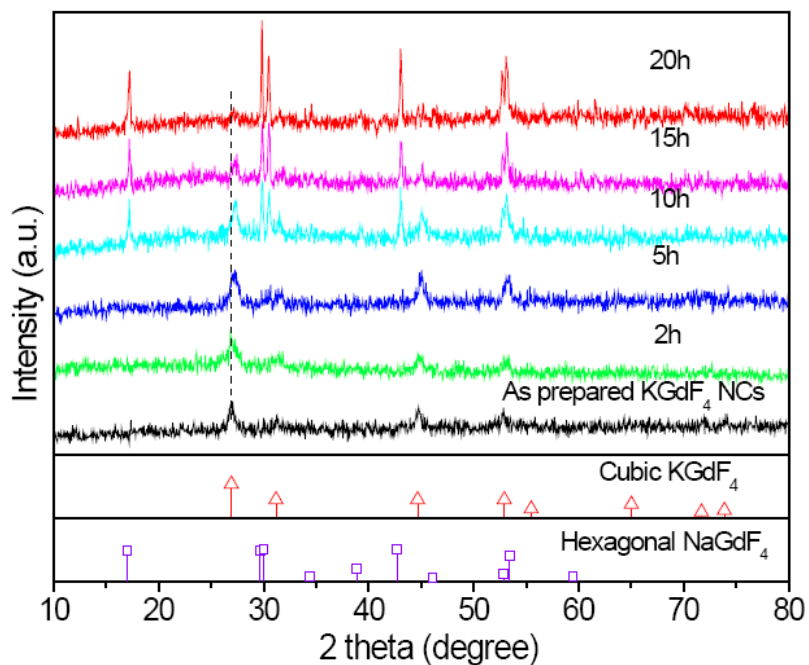


Figure S3 XRD patterns of the oleate-capped cubic $\text{KYb}_{0.1}\text{Gd}_{0.9}\text{F}_4$ NCs reacted with 10mol% NaOA at 180°C for different times. The data of cubic KGdF_4 and hexagonal NaGdF_4 are resourced from Ref. 1 and standard XRD card (JCPDS NO. 27-0699)

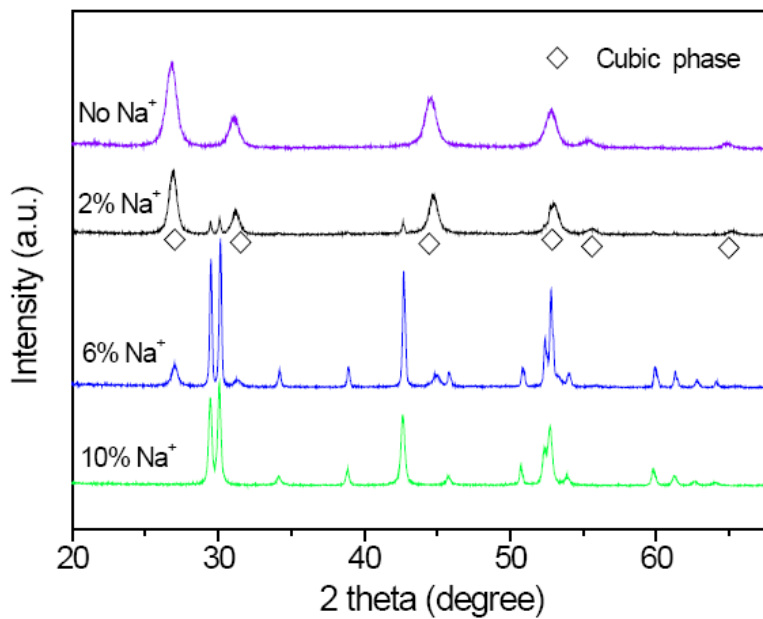


Figure S4 XRD patterns of the samples synthesized at 180°C for 20 h using precursors containing K, Na, Yb(10 mol%), Gd(90 mol%) and F with potassium: sodium molar ratios of 100: 0, 98: 2, 94:6 and 90: 10. Diffraction peaks corresponding to cubic phase are marked with diamond symbol.

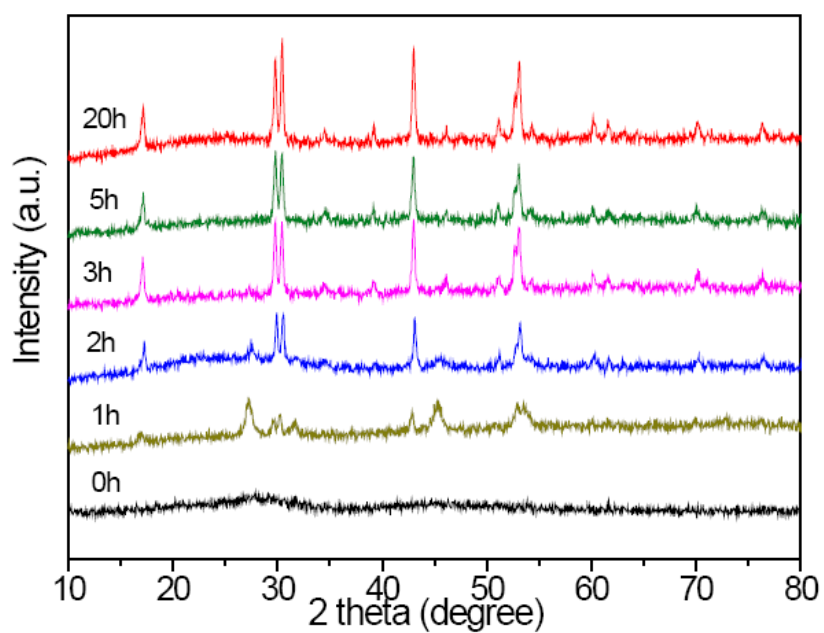


Figure S5 XRD patterns of the NaYb_{0.1}Gd_{0.9}F₄ samples synthesized for different time durations at 180 °C using precursors with a potassium: sodium molar ratio of 90:10.

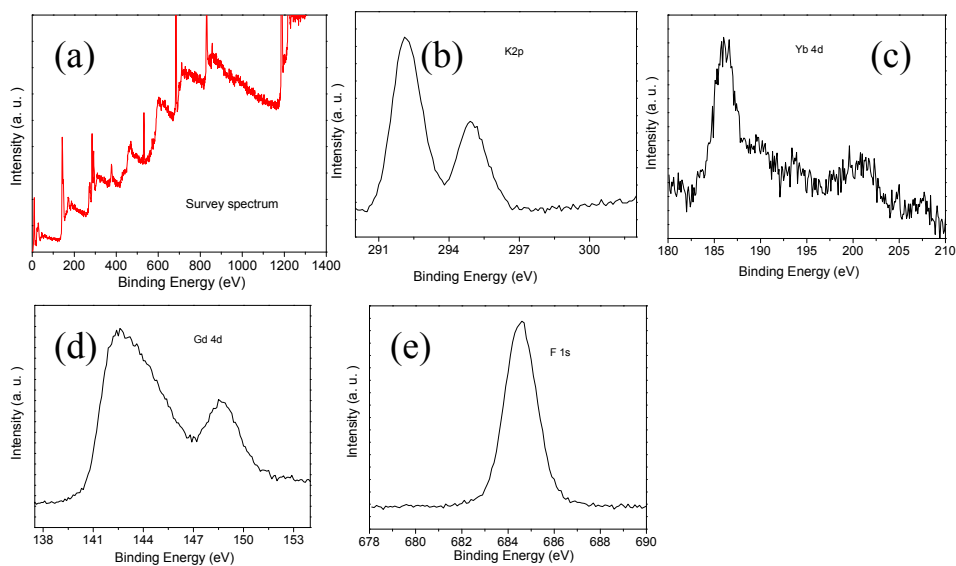


Figure S6 (a) Survey spectrum of the $\text{KYb}_{0.1}\text{Gd}_{0.9}\text{F}_4$ NCs synthesized at 180 °C. (b)-(e) the corresponding K 2p, Yb 4d, Gd 4d, F 1s XPS spectra, respectively. The C 1s peak is used as the reference.

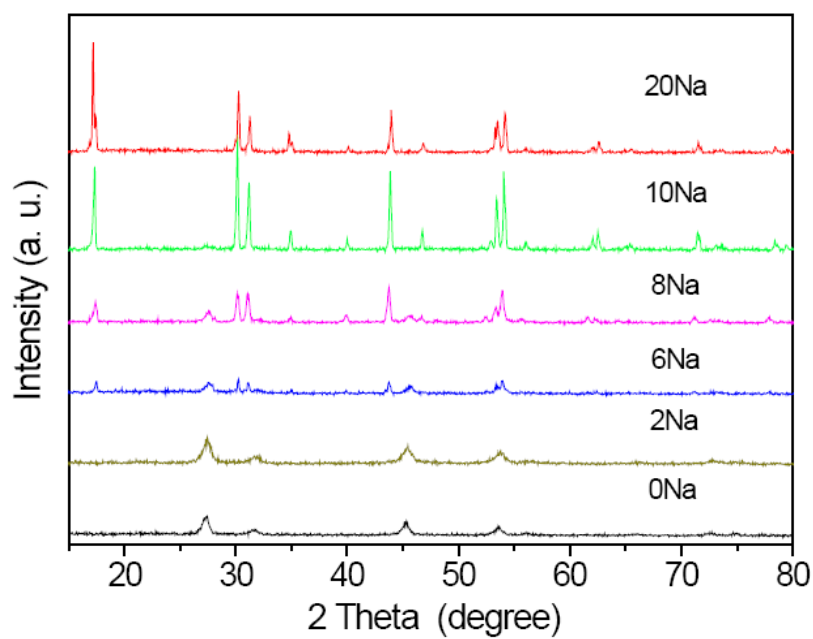


Figure S7 XRD patterns of the samples synthesized at 190 °C for 20h with different potassium: sodium molar ratios using precursors containing K, Na, Y, and F.

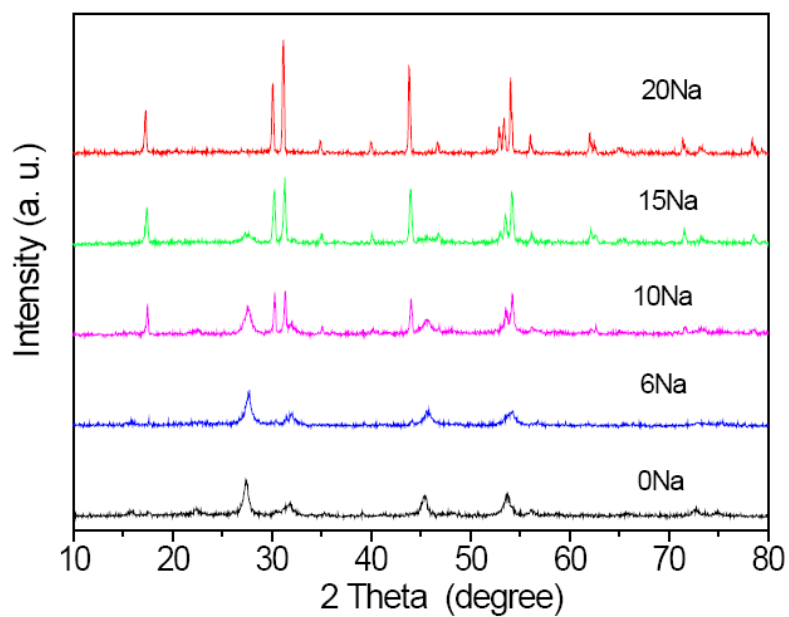


Figure S8 XRD patterns of the samples synthesized at 190 °C for 20h with different potassium: sodium molar ratios using precursors containing K, Na, Yb, and F.

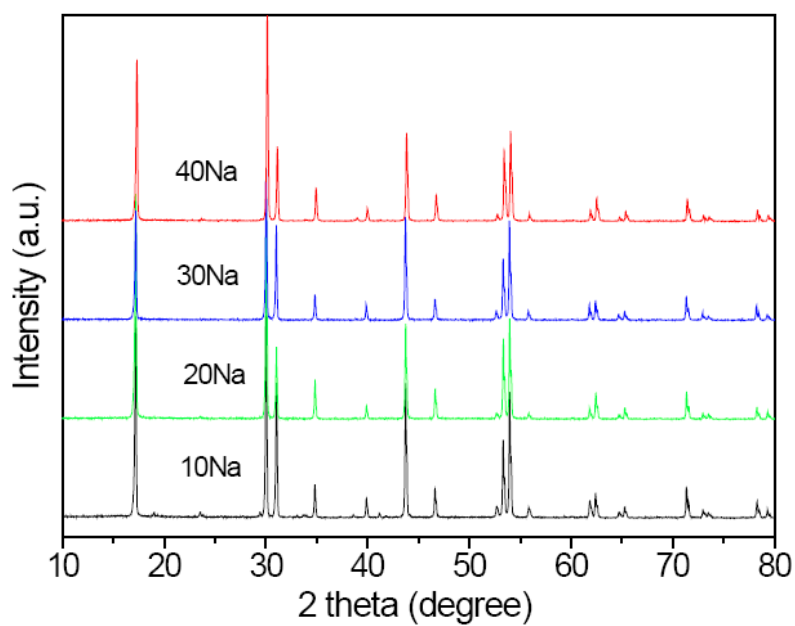


Figure S9 XRD patterns of the samples synthesized at 210 °C for 20h with different potassium: sodium molar ratios using precursors containing K, Na, Yb, and F.

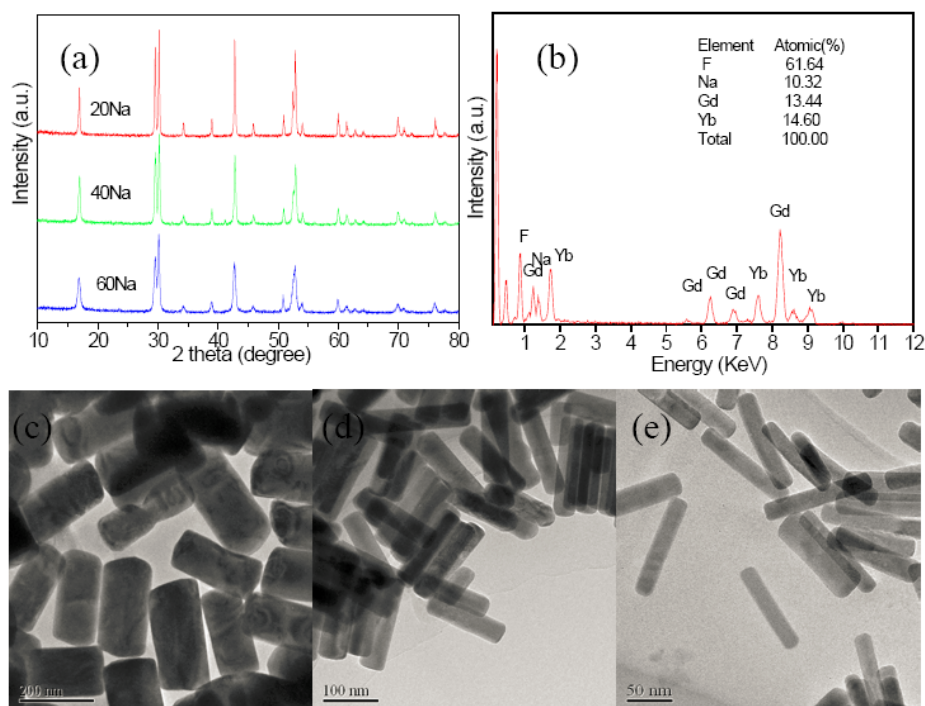


Figure S10 (a) XRD patterns of the samples synthesized at 210 °C for 20 h using precursors containing K, Na, 45mol% Gd,55mol%Yb and F with different potassium: sodium molar ratios of 80:20, 60:40 and 40:60, respectively. (b)EDS spectrum of the sample synthesized at 210 °C for 20h with potassium: sodium molar ratio of 20:80 using precursors containing K, Na, 45mol% Gd, 55mol%Yb and F. No signals from K are detected. (c)-(f) Typical TEM images of the samples synthesized for 20h at 210 °C using precursors containing K, Na, 45mol% Gd,55mol%Yb and F with different potassium: sodium molar ratios of 80:20, 60:40 and 40:60, respectively.

Reference

1. L. W. Yang, Y. Y. Zhang, J. J. Li, Y. Li, J. X. Zhong and P. K. Chu, *Nanoscale*, 2010, **2**, 2805-2810.