Electronic Supplementary Information

Interconversion between KSc_2F_7:Yb/Er and K_2NaScF_6:Yb/Er Nanocrystals: the Role of Chemistry

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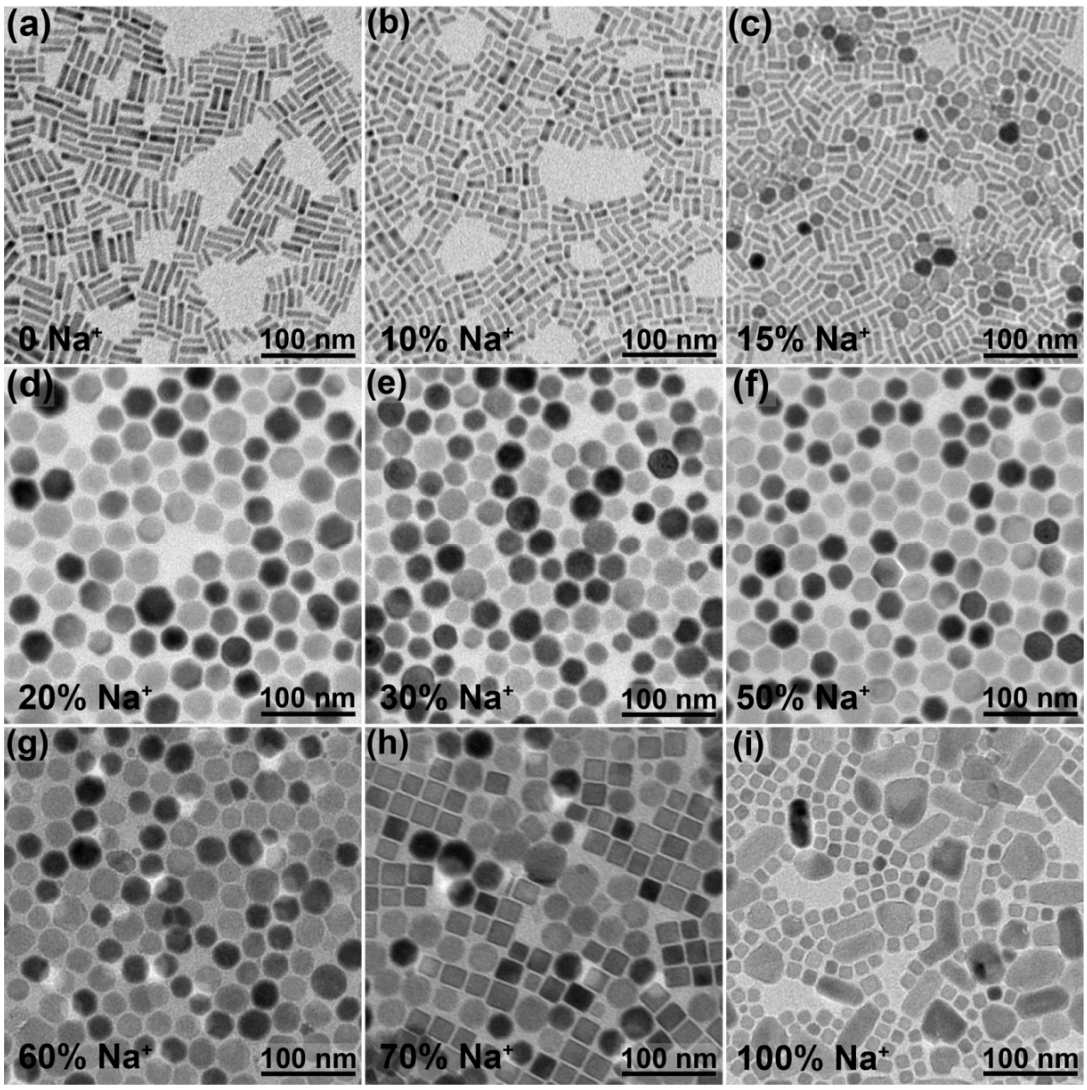

Fig. S1 TEM images of nanocrystals synthesized at consistent volumetric ratio of OA:OD at 3:17 but at varied Na^+ ratios: (a) 0, (b) 10, (c) 15, (d) 20, (e) 30, (f) 50, (g) 60, (h) 70, and (i) 100 mol%.

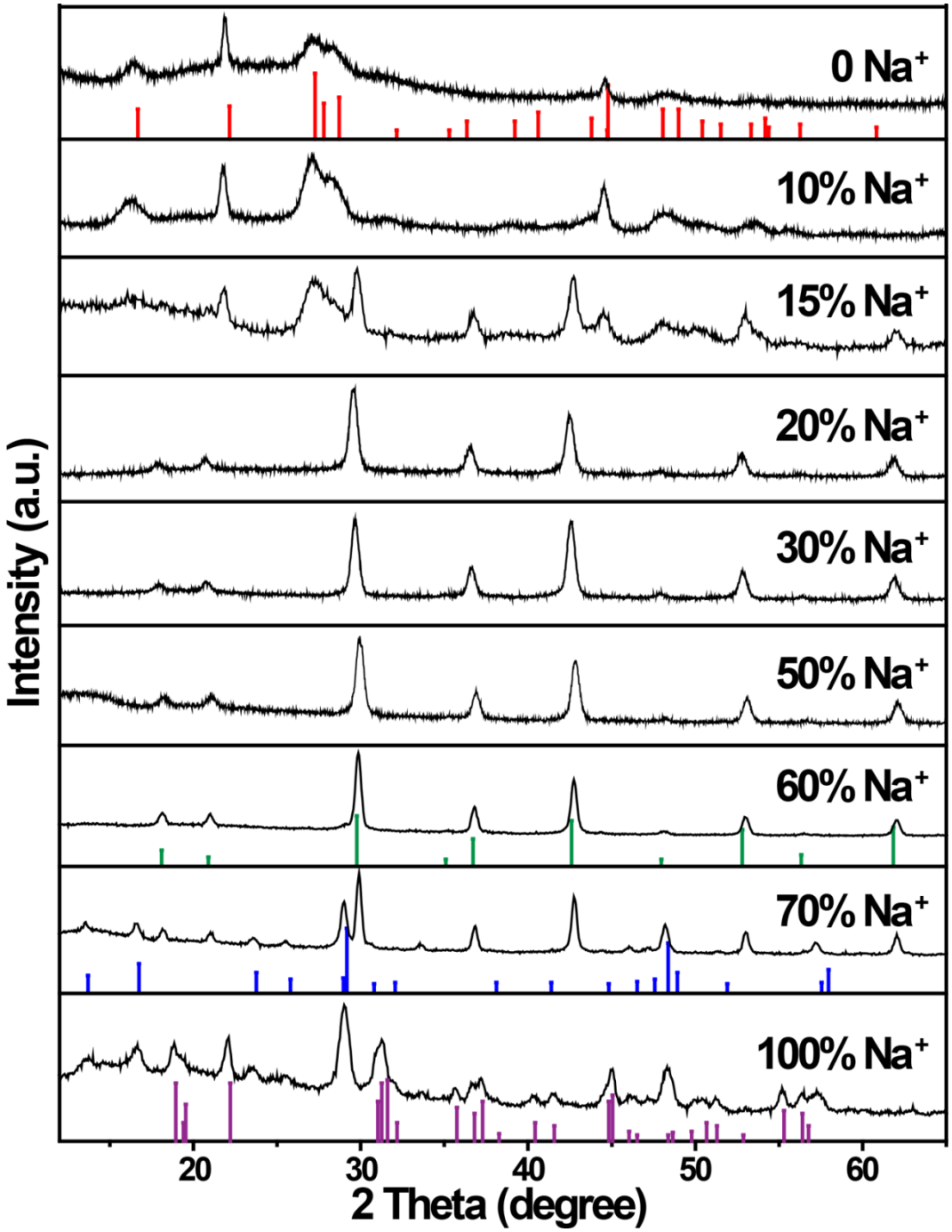

Fig. S2 XRD patterns of nanocrystals synthesized at consistent volumetric ratio of OA:OD at 3:17 but at varied Na^+ ratio: 0-100 mol%. The red, green, blue, and purple bars represent the standard XRD patterns of KSc_2F_7 (JCPDS: 39-0784), K_2NaScF_6 (JCPDS: 25-0678), $NaScF_4$ (JCPDS: 20-1152), and Na_3ScF_6 (JCPDS: 20-1153), respectively.

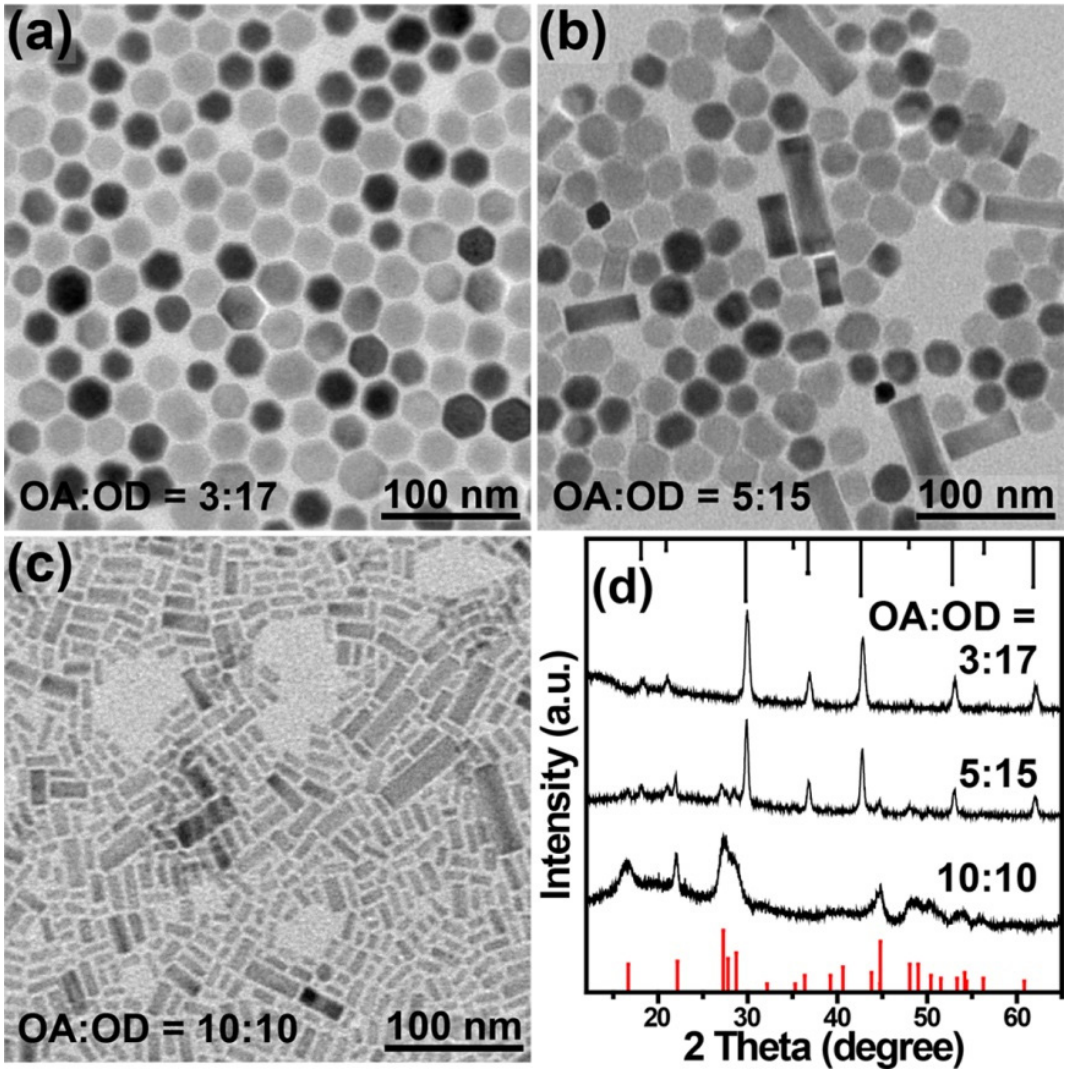

Fig. S3 TEM images of nanocrystals with Na^+ ratio of 50 mol% synthesized at varied volumetric ratio of OA:OD: (a) 3:17, (b) 5:15, (c) 10:10. (d) Corresponding XRD patterns of products in (a)-(c). The black and red bars in (d) represent the standard XRD patterns of K_2NaScF_6 (JCPDS: 25-0678) and KSc_2F_7 (JCPDS: 39-0784), respectively.

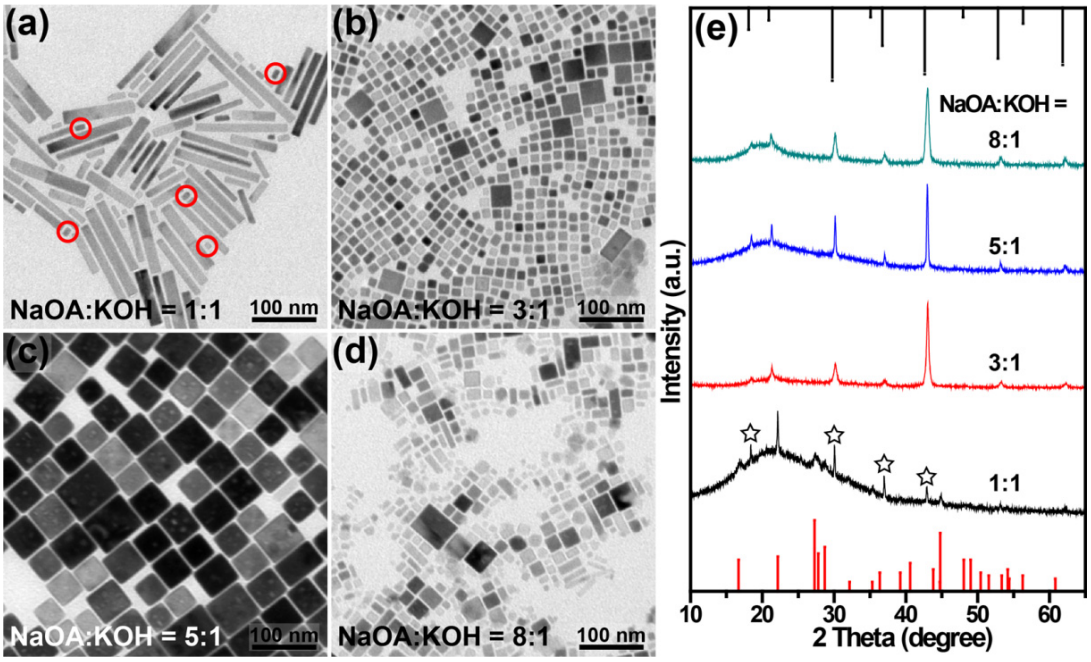

Fig. S4 (a-d) TEM images and (e) XRD patterns of nanocrystals obtained by the phase transition from KSc_2F_7:Yb/Er to K_2NaScF_6:Yb/Er at varied molar ratio of NaOA:KOH: (a) 1:1, (b) 3:1, (c) 5:1, and (d) 8:1. Red circles in (a) represent the partially converted K_2NaScF_6:Yb/Er nanocrystals. The corresponding XRD patterns in (e) are the nanocrystals shown in (a)-(d). The black and red bars in (e) represent the standard XRD patterns of K_2NaScF_6 (JCPDS: 25-0678) and KSc_2F_7 (JCPDS: 39-0784), respectively. The stars in (e) suggest the K_2NaScF_6 phase.

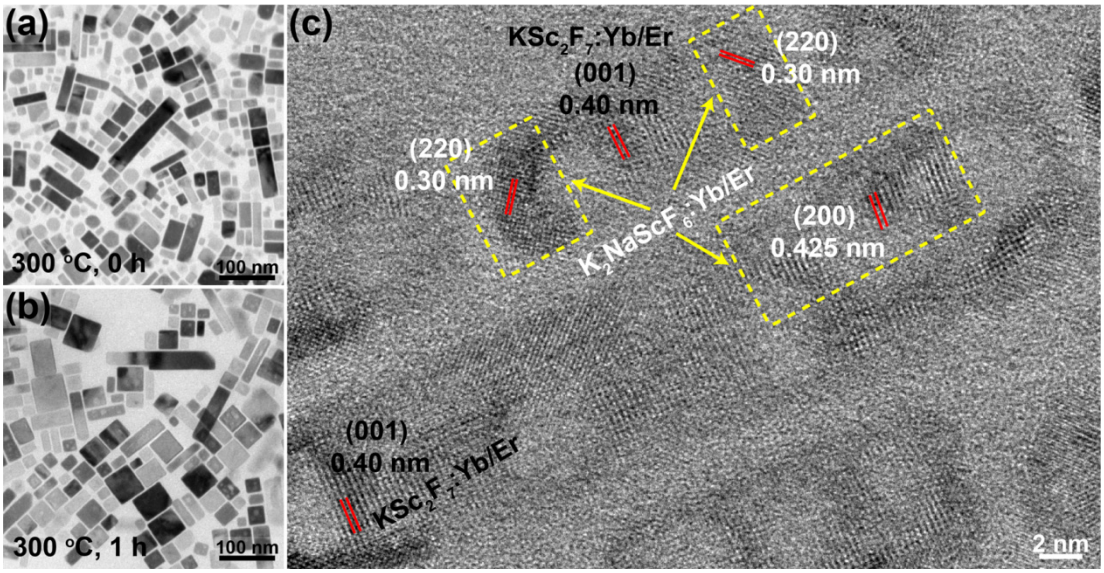

Fig. S5 TEM images of nanocrystals during the conversion process of KSc_2F_7:Yb/Er to K_2NaScF_6:Yb/Er nanocrystals: (a) Sample 3, (b) Sample 5. (c) HRTEM image of nanocrystals selected from Sample 2. The yellow-dotted rectangles in (c) represent the area of K_2NaScF_6 phase found in KSc_2F_7:Yb/Er nanocrystals.

Table S1 Information of the samples obtained during the conversion process of KSc_2F_7:Yb/Er to K_2NaScF_6:Yb/Er nanocrystals with molar ratio of NaOA:KOH at 5:1.

Sample	Information
Sample 1	KSc_2F_7:Yb/Er
Sample 2	0 h at 250 °C after adding NaOA
Sample 3	0 h at 300 °C after adding NaOA
Sample 4	0.5 h at 300 °C after adding NaOA
Sample 5	1 h at 300 °C after adding NaOA
Sample 6	2 h 300 °C after adding NaOA

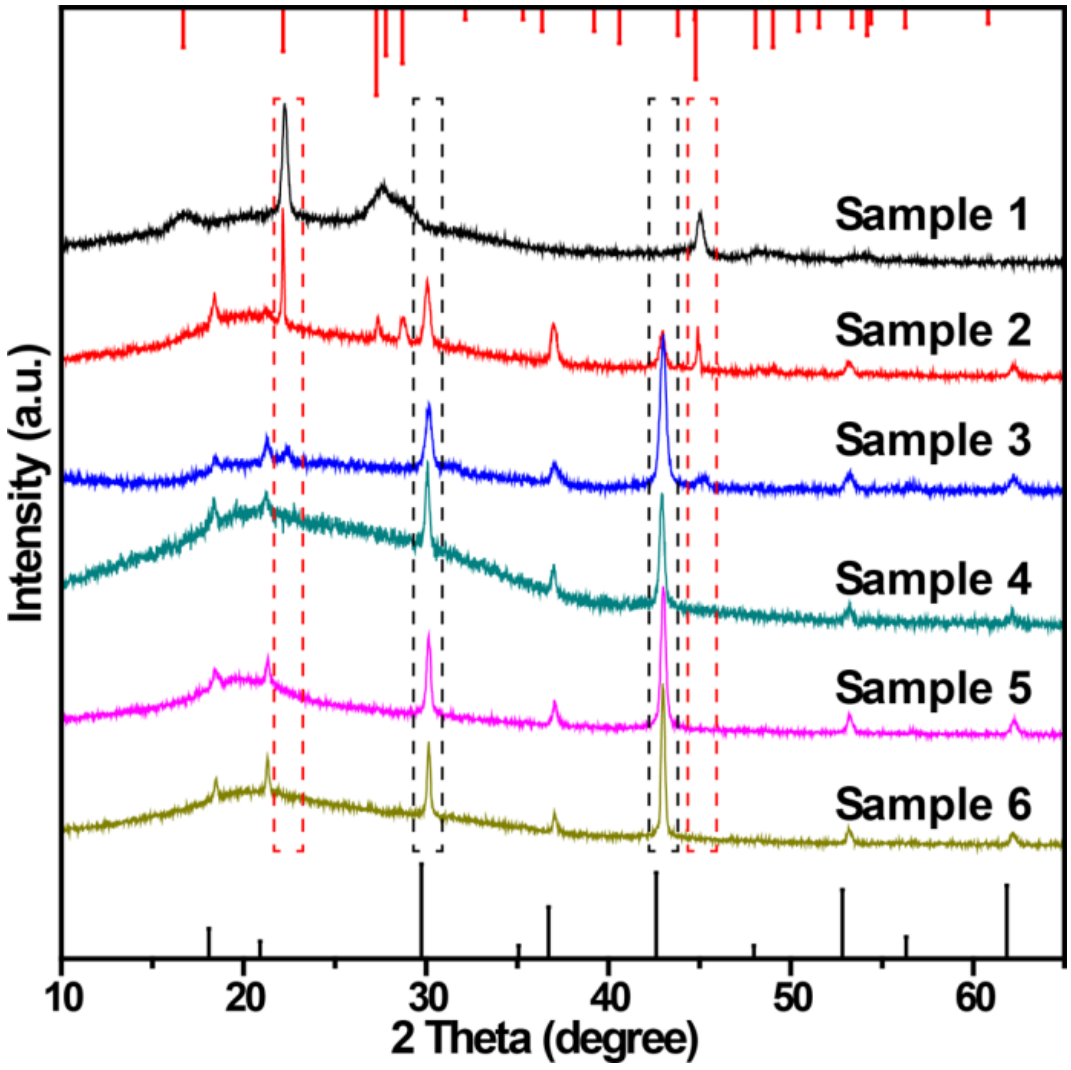

Fig. S6 XRD patterns of nanocrystals during the conversion of KSc_2F_7:Yb/Er to K_2NaScF_6:Yb/Er nanocrystals. The black and red bars represent the standard XRD patterns of K_2NaScF_6 (JCPDS: 25-0678) and KSc_2F_7 (JCPDS: 39-0784), respectively.

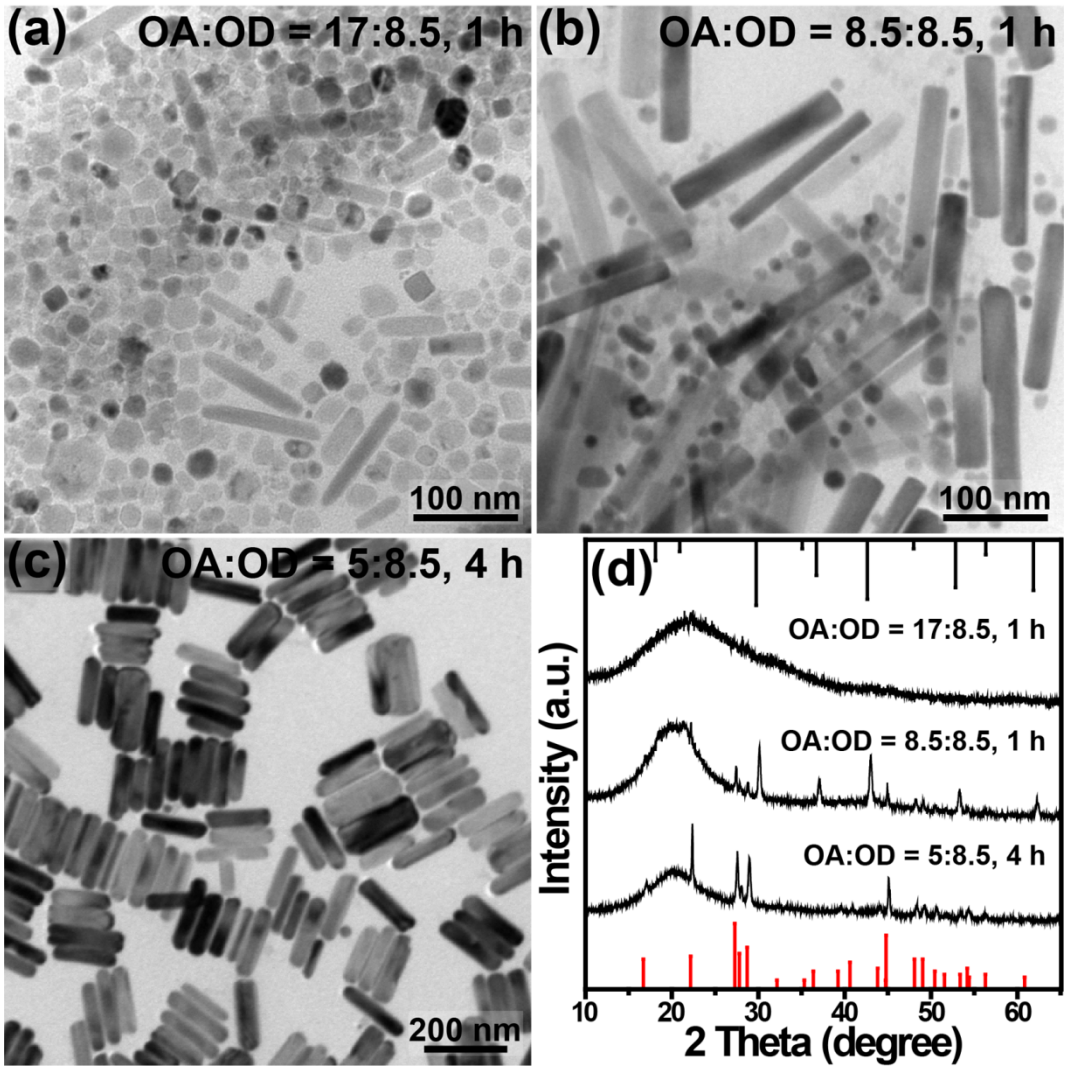

Fig. S7 (a-c) TEM images and (d) XRD patterns of nanocrystals obtained during the conversion process of K_2NaScF_6:Yb/Er to KSc_2F_7:Yb/Er nanocrystals under varied experimental conditions: (a) OA:OD = 17:8.5 for 1 h, (b) OA:OD = 8.5:8.5 for 1h，and (c) OA:OD = 5:8.5 for 4 h. The black and red bars in (d) represent the standard XRD patterns of K_2NaScF_6 (JCPDS: 25-0678) and KSc_2F_7 (JCPDS: 39-0784), respectively.

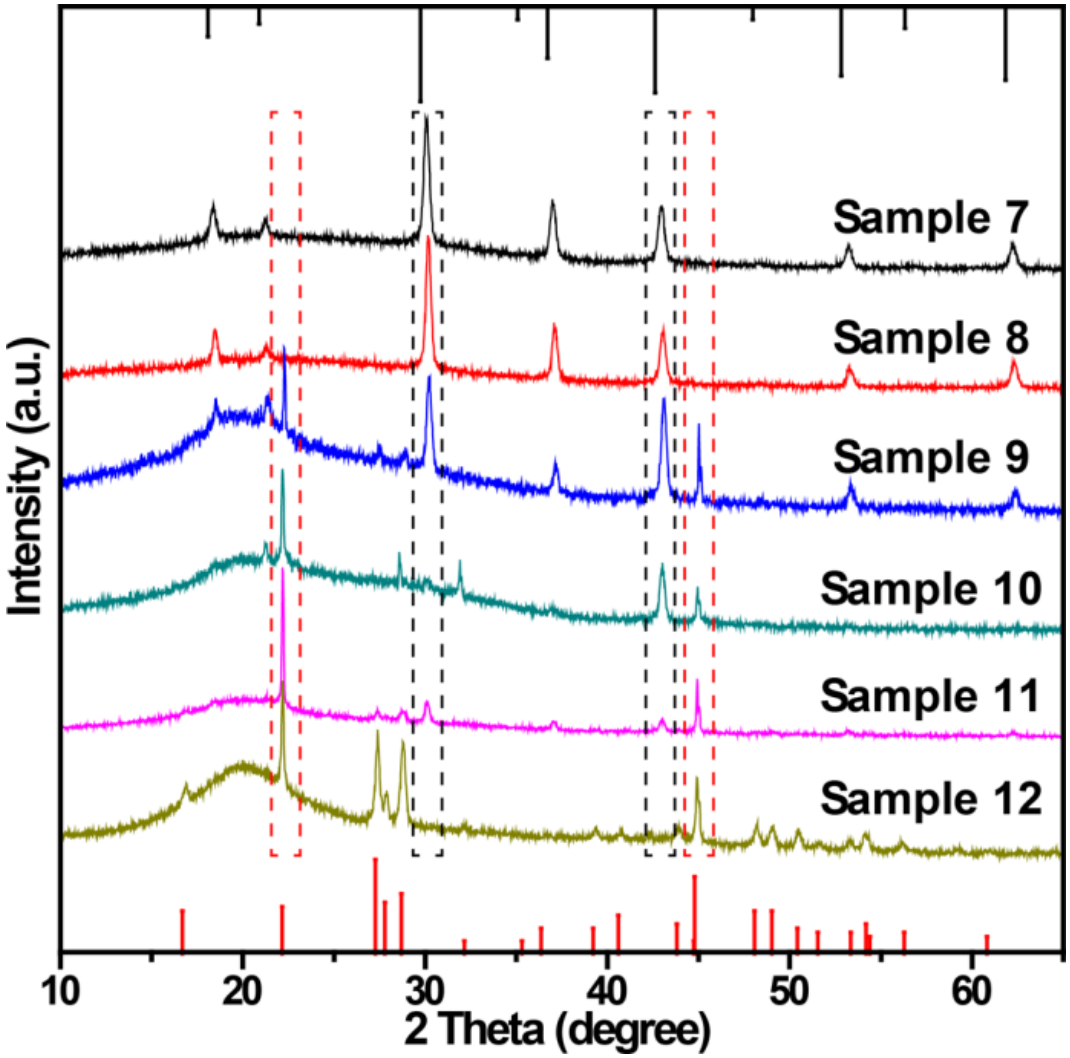

Fig. S8 XRD patterns of nanocrystals during the conversion process of K_2NaScF_6:Yb/Er to KSc_2F_7:Yb/Er nanocrystals. The black and red bars represent the standard XRD patterns of K_2NaScF_6 (JCPDS: 25-0678) and KSc_2F_7 (JCPDS: 39-0784), respectively.

Table S2 Information of the samples obtained during the conversion process of K_2NaScF_6:Yb/Er to KSc_2F_7:Yb/Er nanocrystals under volumetric ratio of OA:OD at 5:8.5.

Sample	Information
Sample 7	K_2NaScF_6:Yb/Er
Sample 8	2 h at 300 ^oC after adjusting OA/OD
Sample 9	2.25 h at 300 ^oC after adjusting OA/OD
Sample 10	2.5 h at 300 ^oC after adjusting OA/OD
Sample 11	3 h at 300 ^oC after adjusting OA/OD
Sample 12	4 h at 300 ^oC after adjusting OA/OD

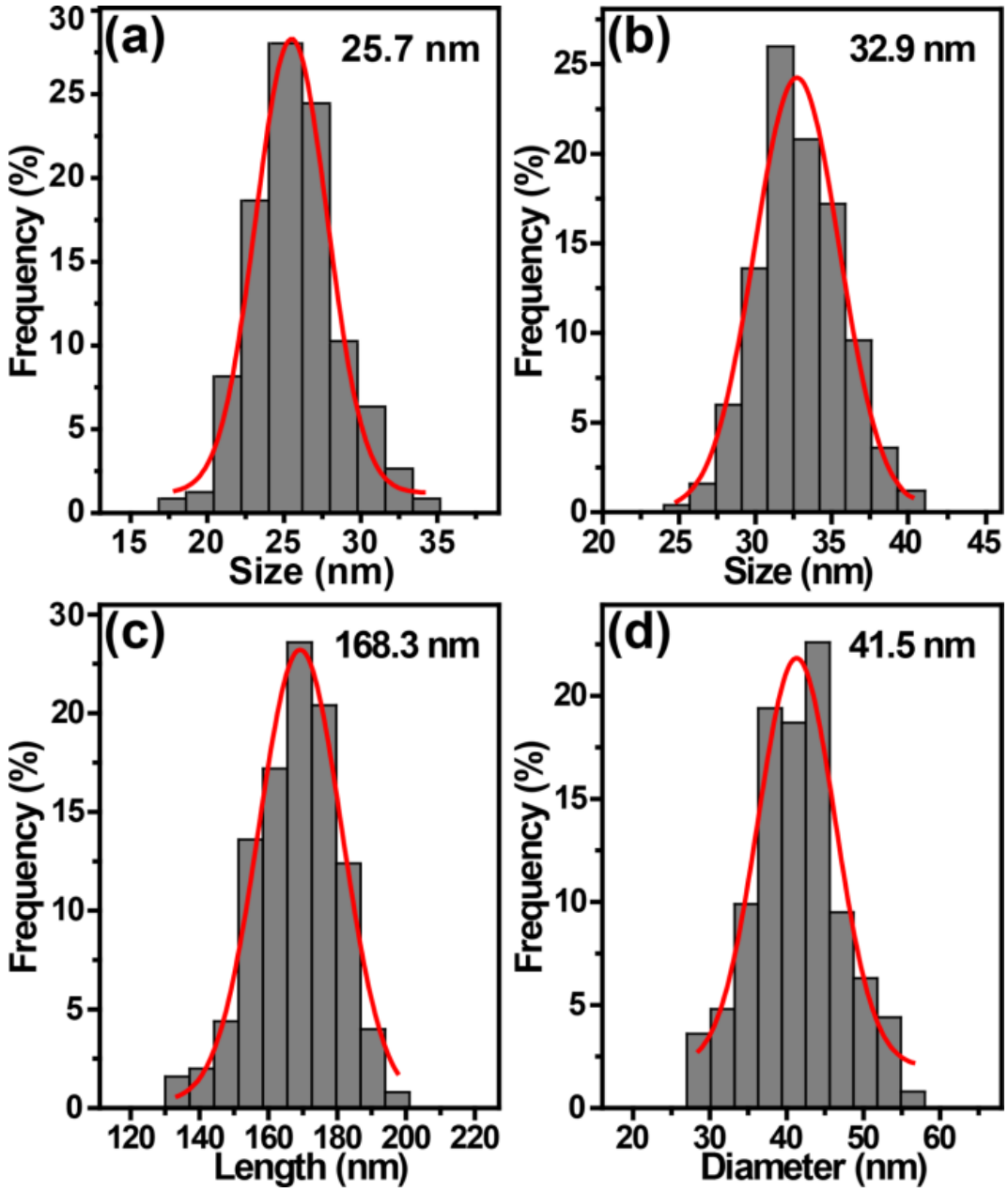

Fig. S9 The size distributions of (a) Sample 7 and (b) Sample 8. The (c) length and (d) diameter distributions of Sample 12.

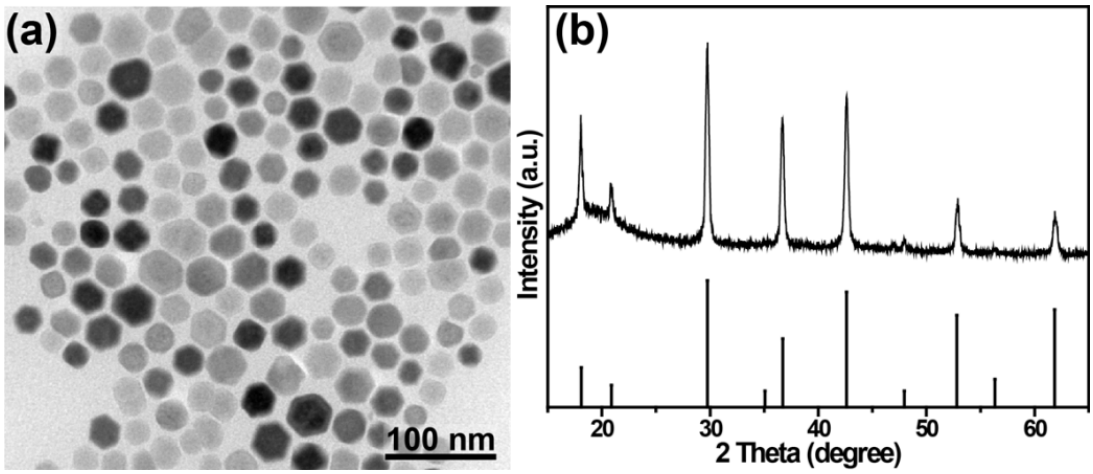

Fig. S10 (a) TEM image and (b) XRD pattern of K_2NaScF_6:Yb/Er nanocrystals synthesized at volumetric ratio of OA:OD at 3:17 with 4 h. The bars in the bottom of (b) represent the standard XRD patterns of K_2NaScF_6 (JCPDS: 25-0678).

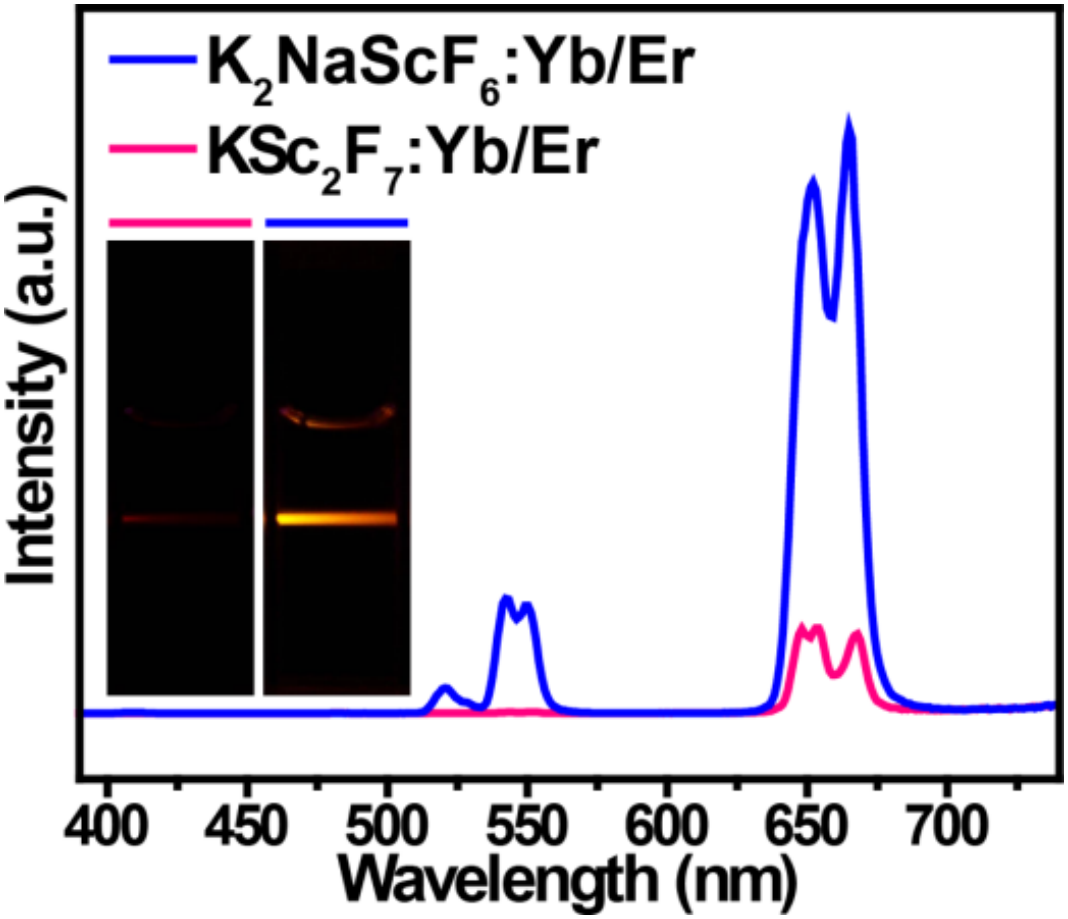

Fig. S11 The upconversion emission spectra and corresponding digital photographs of KSc_2F_7:Yb/Er (Sample 1) and K_2NaScF_6:Yb/Er (Sample 7) nanocrystals excited with 980 nm laser.

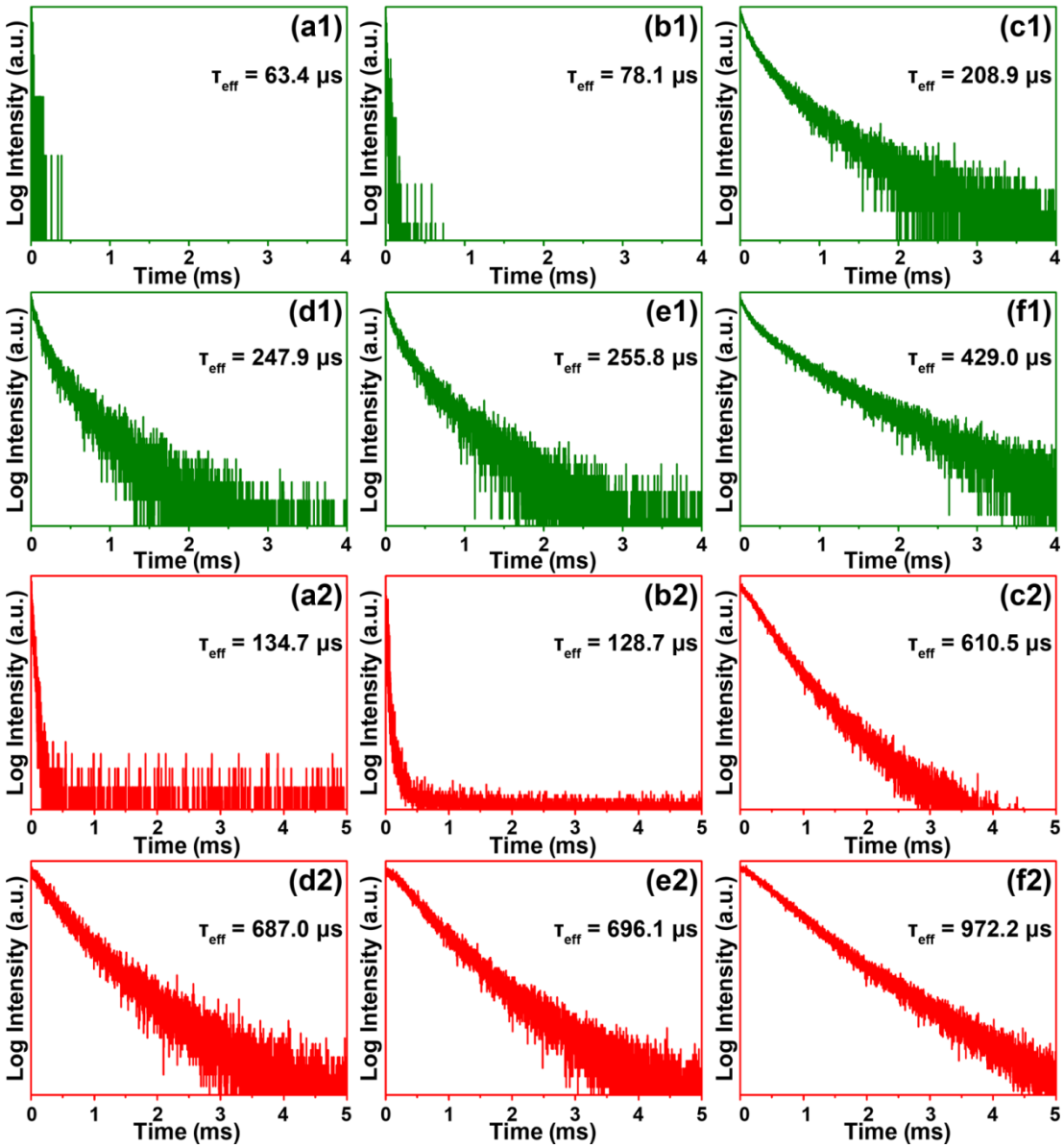

Fig. S12 Decay curves of upconversion luminescence emission at (a1-f1) 549 and (a2-f2) 655 nm for samples obtained during the conversion process of KSc_2F_7:Yb/Er to K_2NaScF_6:Yb/Er nanocrystals: (a) Sample 1, (b) Sample 2, (c) Sample 3, (d) Sample 4, (e) Sample 5, and (f) Sample 6.

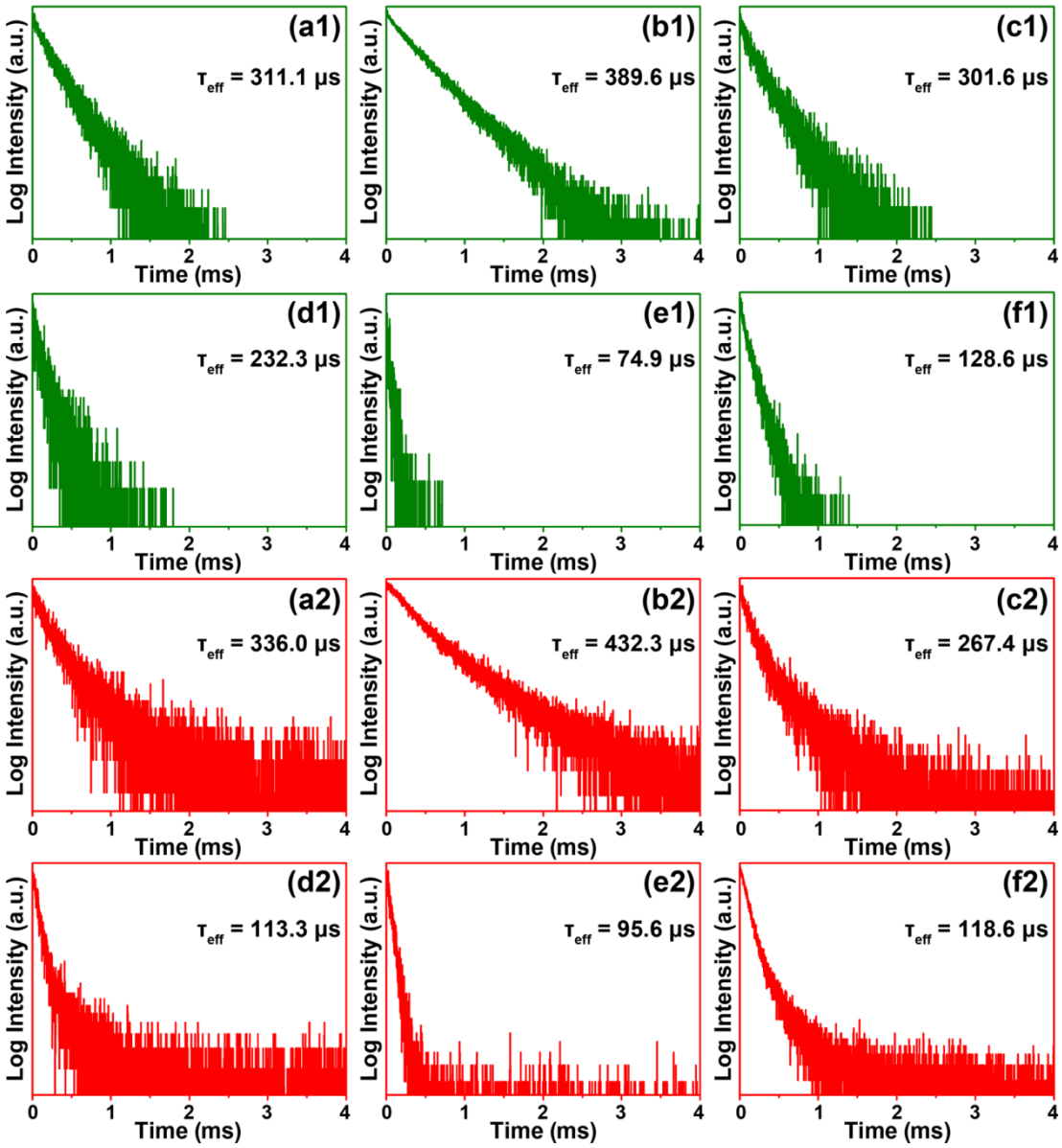

Fig. S13 Decay curves of upconversion luminescence emission at (a1-f1) 549 and (a2-f2) 655 nm for samples obtained during the conversion process of K_2NaScF_6:Yb/Er to KSc_2F_7:Yb/Er nanocrystals: (a) Sample 7, (b) Sample 8, (c) Sample 9, (d) Sample 10, (e) Sample 11, and (f) Sample 12.