

Fig. S1 Yb/Er: KMnF₃ NCs with different Zn²⁺ concentration (x%) in the initial solution: (a) XRD patterns; (b) and (c) are the TEM and HRTEM images of x=40, respectively; (d) and (e) are the TEM image and EDS pattern of x =50, respective

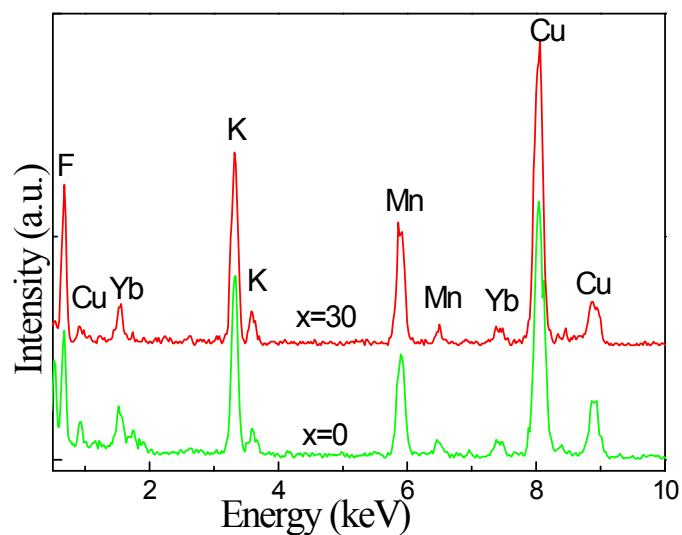


Fig. S2 EDS patterns of Yb/Er: KMnF₃ NCs with different Zn²⁺ concentration (x%, x=0, x=30) in the initial solution.

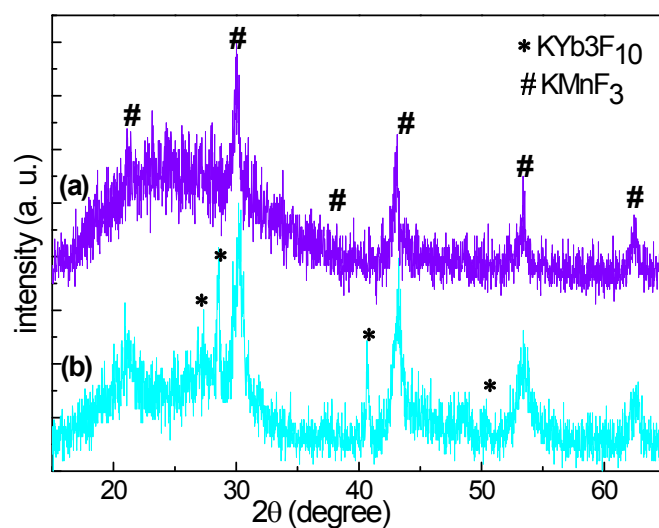


Fig. S3 XRD patterns of Yb/Er: KMnF₃ NCs with Zn²⁺ : Mn²⁺ ratio at 30:70 (a), and Yb/Er: KMnF₃ NCs with Zn²⁺ : Mn²⁺ ratio at 0: 50 (b).

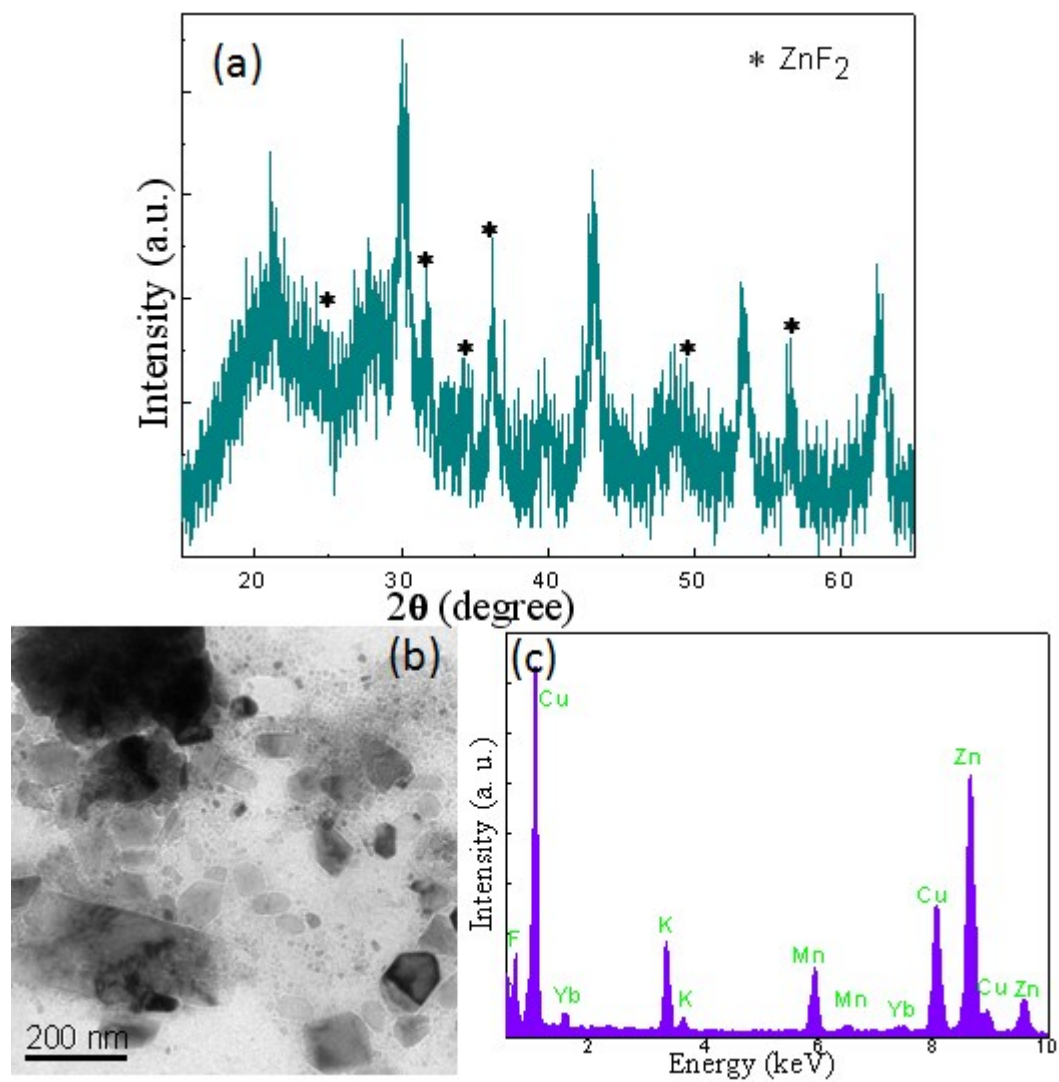


Fig. S4 Yb/Er: KMnF_3 NCs prepared with prolonging the reaction time to 5h: (a) XRD pattern, (b) TEM image, (c) EDS pattern.

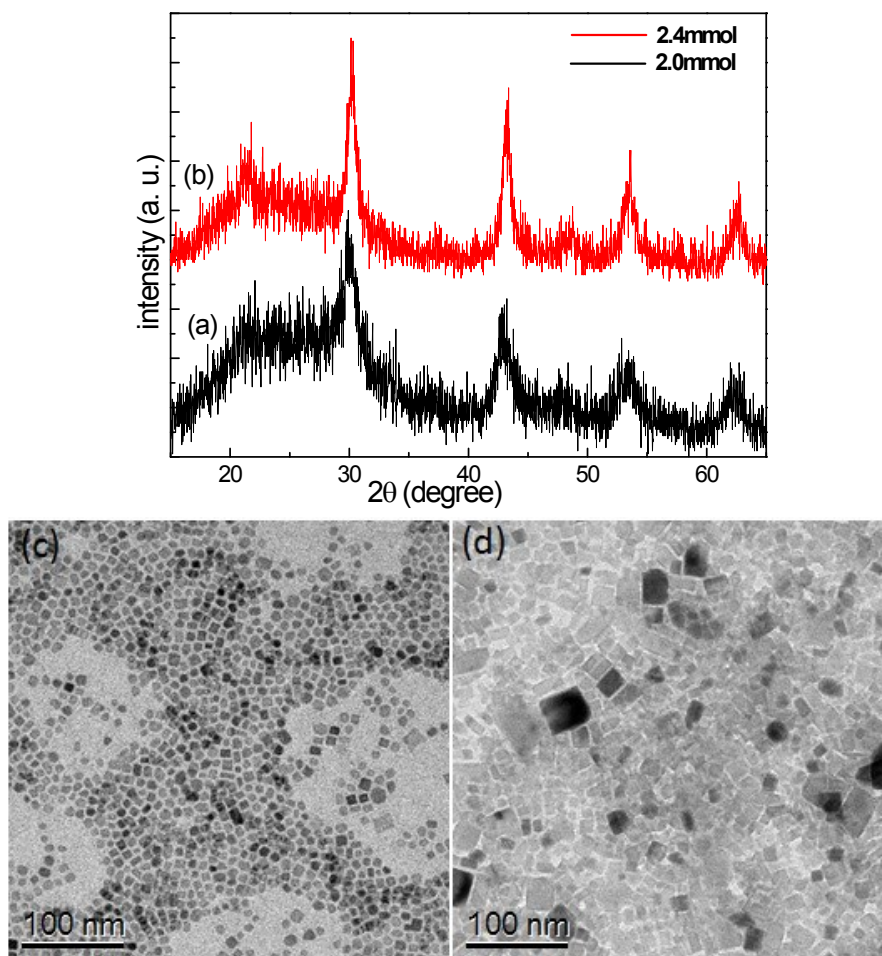


Fig. S5 XRD patterns of Yb/Er: KMnF_3 NCs prepared with different F⁻ concentration, (a) 2.0mmol, (b) 2.4mmol; (c) and (d) are the TEM images of (a) and (b), respectively.

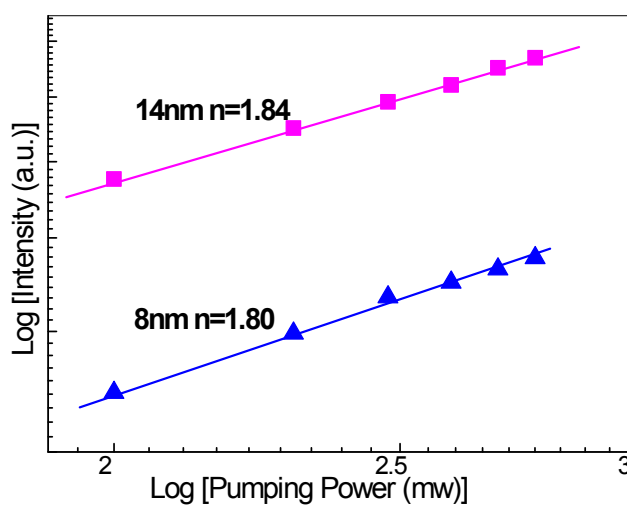


Fig. S6 Log-log plots of UC emission intensity versus pumping power for Yb/Er: KMnF_3 NCs with 8nm and 14nm.

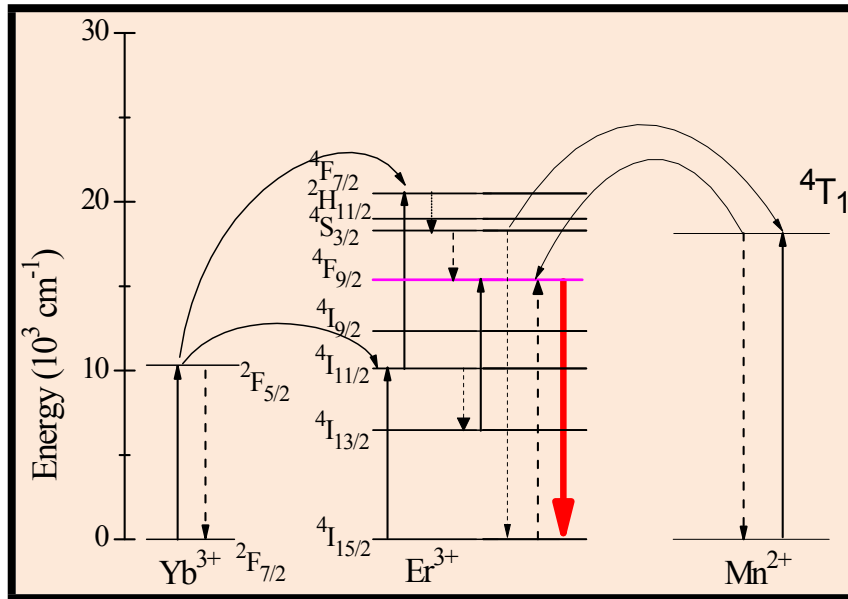


Fig. S7 The possible upconversion energy transfer mechanism.

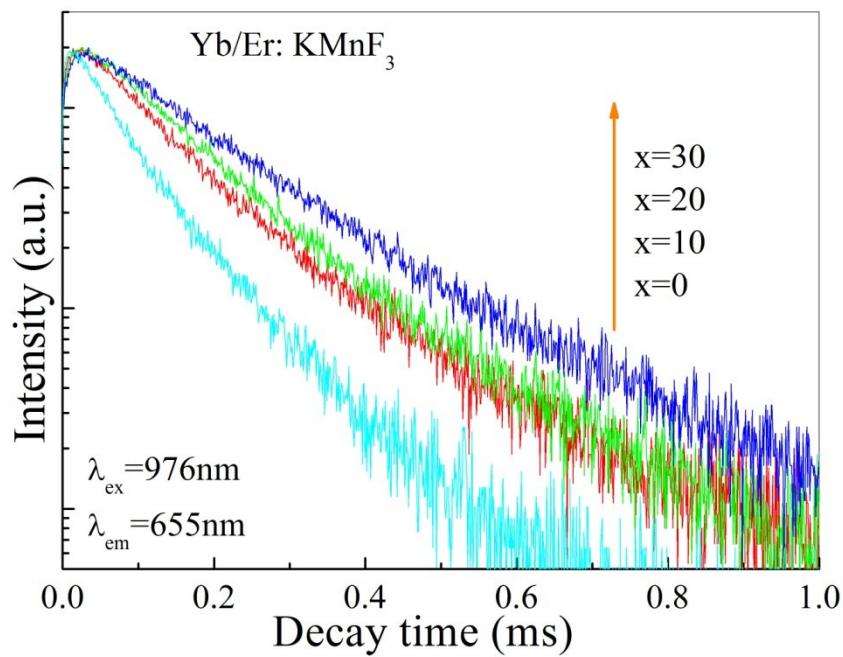


Fig. S8 UC luminescent decay curves of Yb/Er: KMnF₃ NCs with different Zn²⁺ concentration (x%, x= 0, 10, 20, 30): ${}^4F_{9/2} \rightarrow {}^4I_{15/2}$ transitions of Er³⁺.