Electronic Supplementary Material (ESI) for Nanoscale

Supporting Information

Synthesis of Rhombic Hierarchical YF_3 Nanocrystals and Their Use as Upconversion Photocatalysts after TiO_2 Coating

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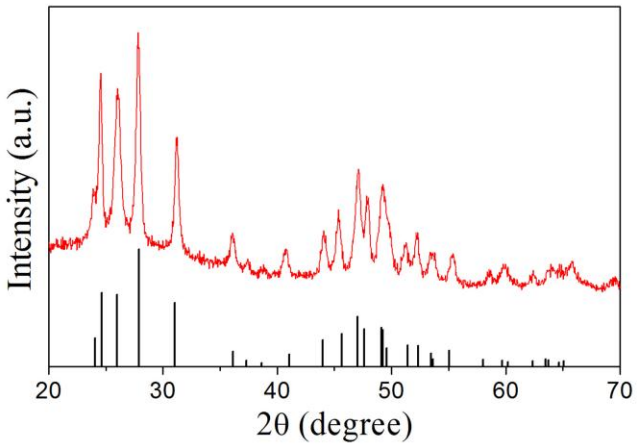

Fig. S1 XRD pattern of the synthesized YF_3 nanocrystals. Standard XRD pattern of YF_3 crystals is given below as a reference to index the diffraction peaks.

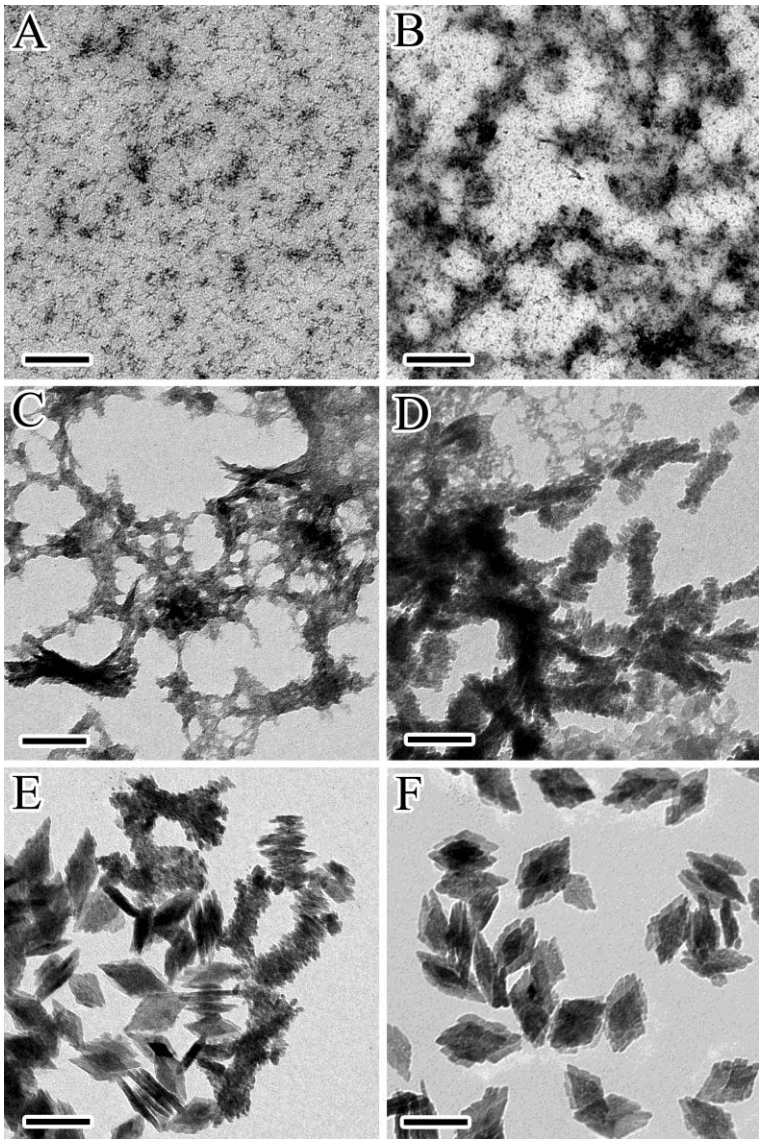

Fig. S2 Typical TEM images of the intermediate samples collected during the synthesis of YF_3 rhombic particles in Fig. 1. The samples were collected at different time intervals: (A) right after NH_4F was added at 80 ºC; (B) after heated to 160 ºC; (C) at 160 ºC for 10 min; (D) at 160 ºC for 30 min; (E) at 160 ºC for 60 min; (F) at 160 ºC for 90 min. Scale bar in all figures is 100 nm.

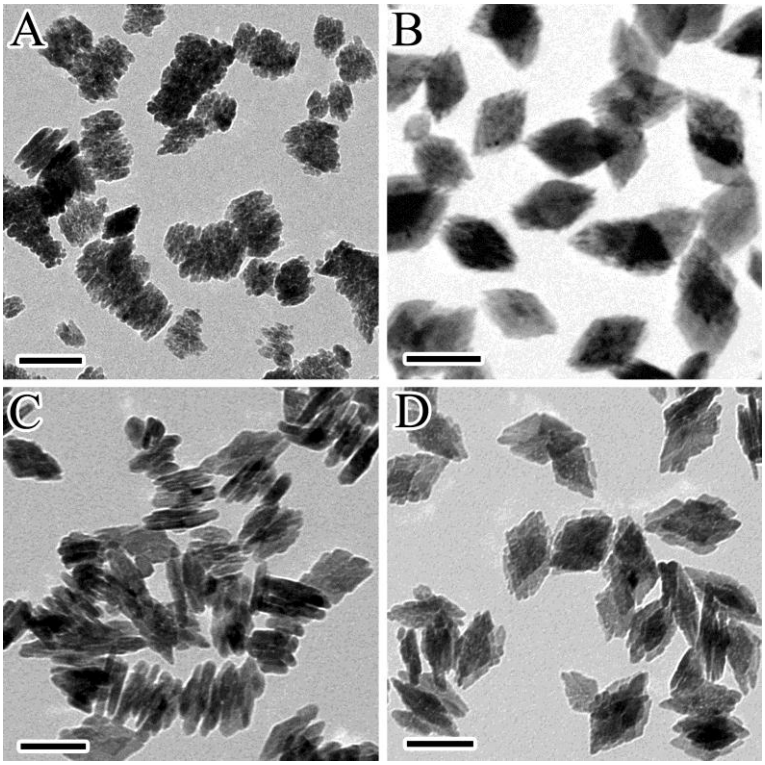

Fig. S3 TEM images of the YF_3 nanoparticles obtained under the same condition as that in Fig. 1, except the difference as follows: (A) free of water; (B) 0.2 mL water; (C) without PVP; (D) 0.224 g PVP. Scale bar in all figures is 100 nm. In the absence of a small amount of water (1 mL), a reaction process of 20 h is needed to formulate the similar hierarchical morphology. When too much water is added (more than 4 mL) in this system, the system temperature cannot reach 160 ºC due to the low boiling point of water, and as a result, only irregular morphology can be obtained.

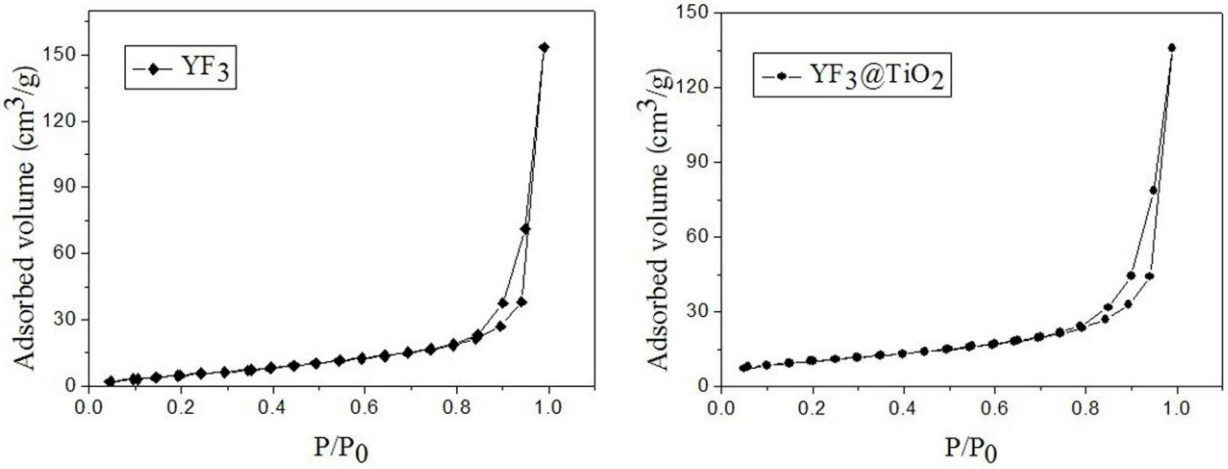

Fig. S4 N_2 adsorption-desorption isotherm of (A) hierarchical YF_3:Yb,Tm nanocrystals and (B) annealed YF_3:Yb,Tm@TiO_2 particles. Effective surface area of the YF_3:Yb,Tm nanocrystals are 25.86 m^2/g, suggesting that such a hierarchical nanostructures possesses a relatively high surface area. After a TiO_2 layer was coated and annealed, surface area of the core-shell particles could reach 36.47 m^2/g, indicating that these hierarchical cores could provide good templates to formulate TiO_2 shells with high surface area. When calculated based on the weight of TiO_2, these TiO_2 shells have a surface area about 110.67 m^2/g, which is higher than that from commercial P25 measured under the same condition (52.27 m^2/g).

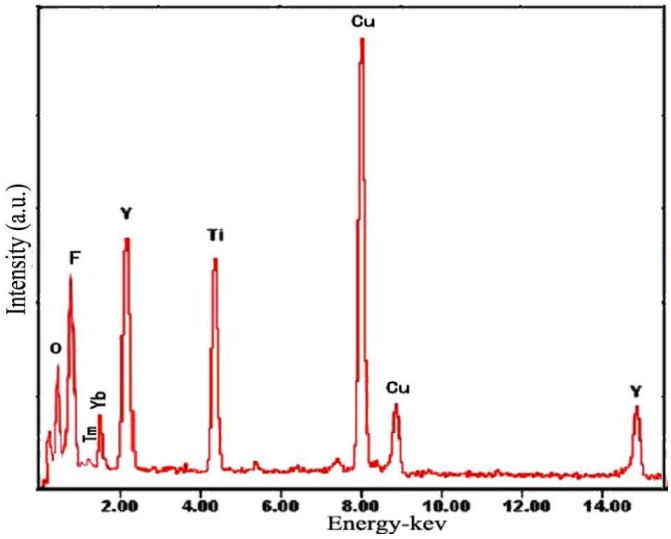

Fig. S5 EDX spectrum of the annealed YF_3:Yb,Tm@TiO_2 particles. The elements Y, F, Yb and Tm are from the core nanocrystals, while the elements Ti and O are from the shells. The element Cu is attributed to the copper grid used in the TEM and EDX characterizations.