Novel Topotactic Transformation Route Towards Monodisperse YOF:Ln$^{3+}$ (Ln=Eu, Tb, Yb/Er, Yb/Tm) Microcrystals with Multicolor Emissions

Senwen Yuan,$^a$ Baiqi Shao,$^a$* Yang Feng,$^{a,b}$ Shuang Zhao,$^{a,b}$ Jiansheng Huo,$^{a,b}$ Langping Dong,$^{a,b}$ and Hongpeng You$^a$$^*$

$^a$State Key Laboratory of Rare Earth Resource Utilization, Changchun Institute of Applied Chemistry, Chinese Academy of Sciences, Changchun 130022,

$^b$University of the Science and Technology of China, Hefei 230026, P. R. China

**Synthesis of Y(OH)$_3$ Micro Hexagonal prisms.** NaOH solution (2M) was added into 35 mL aqueous mixture containing 0.25 mmoL Y$_4$O(OH)$_9$NO$_3$ until the pH value was 12. After stirring for 10 min, the mixture was sealed in 50 mL Teflon-lined autoclave and maintained at 200 °C for 12 h. After the reaction was finished, the white products were collected and washed with deionized water and absolute ethanol twice in turn, and air dried at 60 °C overnight.

**Synthesis of β-NaYF$_4$ Micro Hexagonal Bundles.** 30 mL aqueous solution containing 30 mmoL NaF was added into 10 mL aqueous mixture containing 0.25 mmoL Y$_4$O(OH)$_9$NO$_3$. After stirring for 10 min, the mixture was sealed in 50 mL Teflon-lined autoclave and maintained at 180 °C for 12 h. After the reaction was finished, the white products were collected and washed with deionized water and absolute ethanol twice in turn, and air dried at 60 °C overnight.
Figure S1. EDS pattern of the Y(OH)$_{2.02}$F$_{0.98}$ intermediate product. The peak at about 8 keV comes from the Cu substrate.

Figure S2. SEM images of the final products with different NaF-Y$_4$O(OH)$_9$NO$_3$ feeding ratios (row) and reaction temperature (column). NaF-Y$_4$O(OH)$_9$NO$_3$ feeding ratio in Row1 is 5-0.25, in Row2 is 10-0.25, and in Row3 is 20-0.25; reaction temperature in column A is 120 °C, in column B is 150 °C, and in column C is 180 °C.
Figure S3. XRD patterns of the intermediate products and the final product with different NaF-Y₄O(OH)₉NO₃ Feeding Ratios (row) and Temperature (column). In each panel, the lower part is the intermediate product, and the upper part is the final product. NaF-Y₄O(OH)₉NO₃ feeding ratio in Row1 is 5-0.25, in Row2 is 10-0.25, and in Row3 is 20-0.25; reaction temperature in column A is 120 °C, in column B is 150 °C, and in column C is 180 °C.

Figure S4. SEM images of the final products with different NH₄F-Y₄O(OH)₉NO₃ feeding ratios (A) 0.5-0.25, (B) 1-0.25, (C) 1.5-0.25, and (D) 2-0.25. The scale bars are 5 μm.
Figure S5. The XRD patterns of the intermediate products (left panel) and the final product (right panel) with different NH$_4$F-Y$_2$O$_3$(OH)$_9$NO$_3$ feeding ratios (A) 0.5-0.25, (B) 1-0.25, (C) 1.5-0.25, and (D) 2-0.25.