

Supporting Information

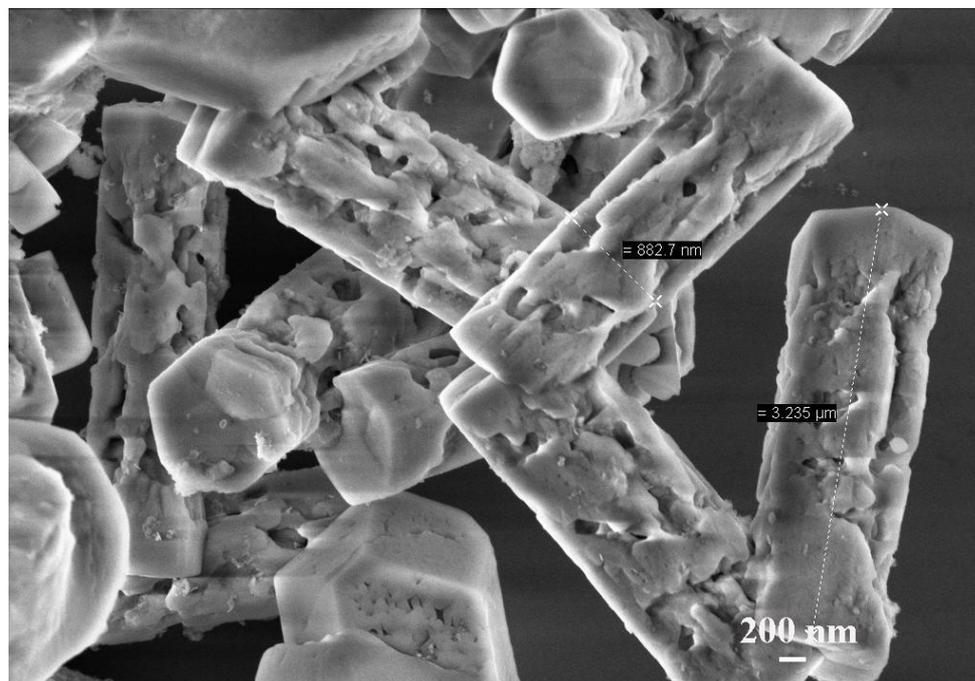


Figure S1 SEM image of synthesized NaYF₄:Yb³⁺/Er³⁺

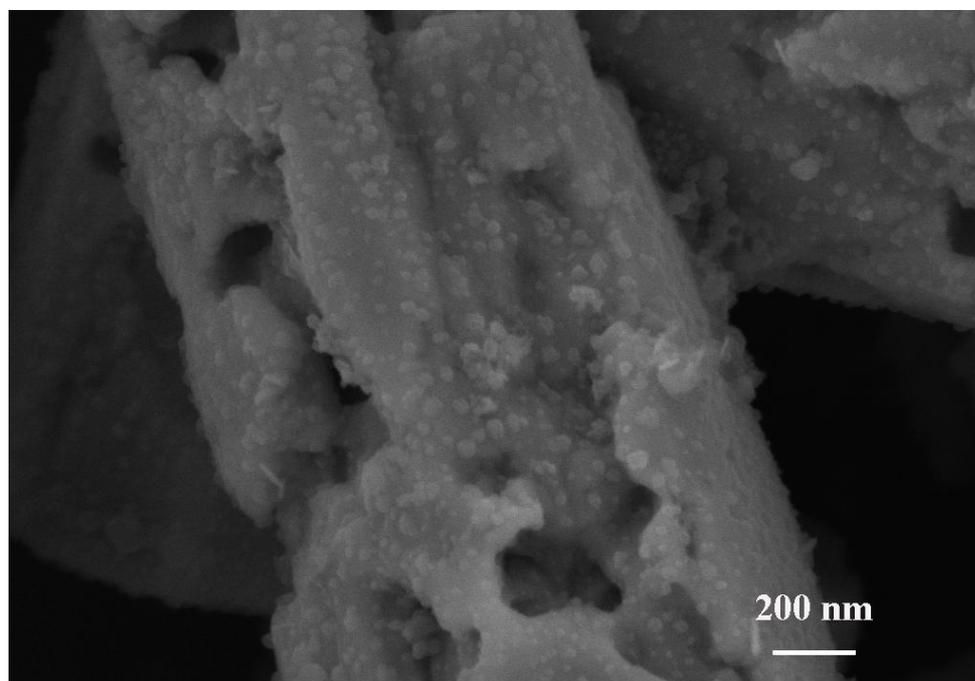


Figure S2 Higher SEM image of synthesized NaYF₄:Yb³⁺/Er³⁺

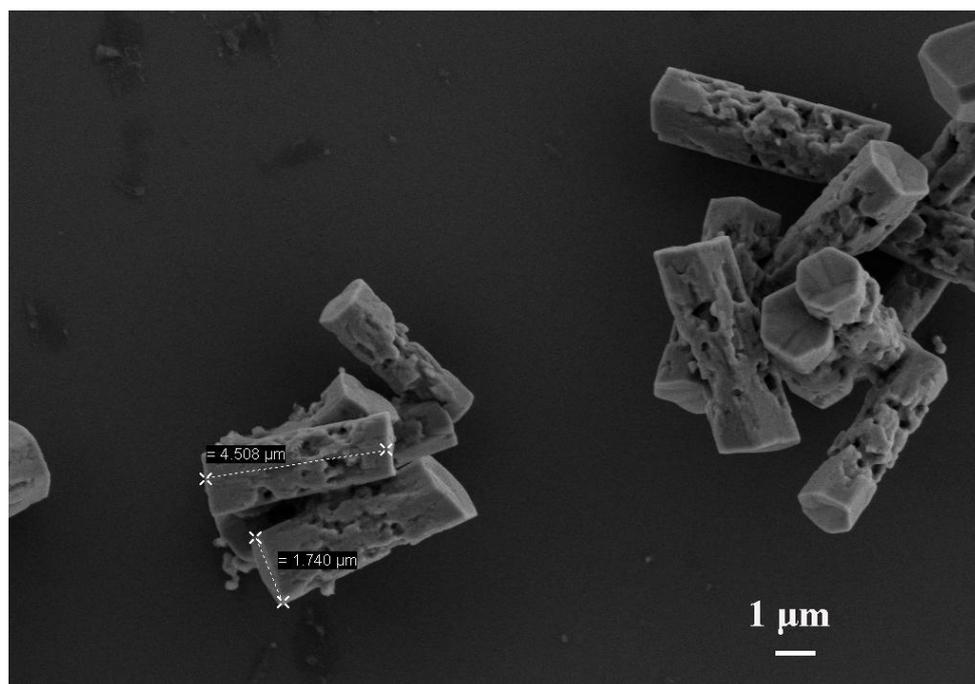


Figure S3 SEM image of synthesized $\text{NaYF}_4:\text{Yb}^{3+}/\text{Tm}^{3+}$

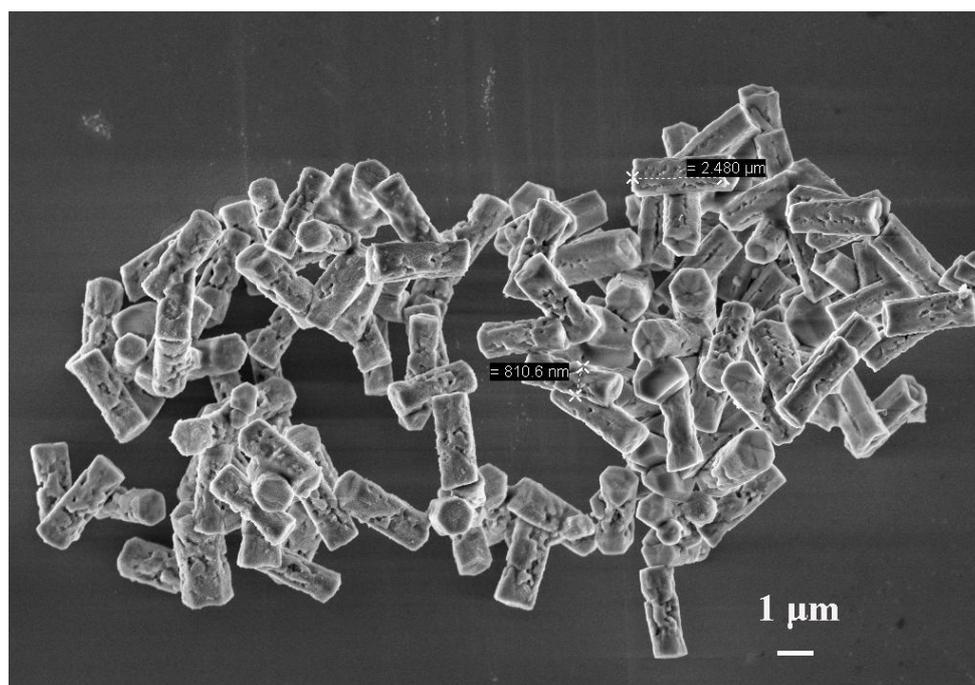


Figure S4 SEM image of synthesized $\text{NaYF}_4:\text{Yb}^{3+}/\text{Ho}^{3+}$

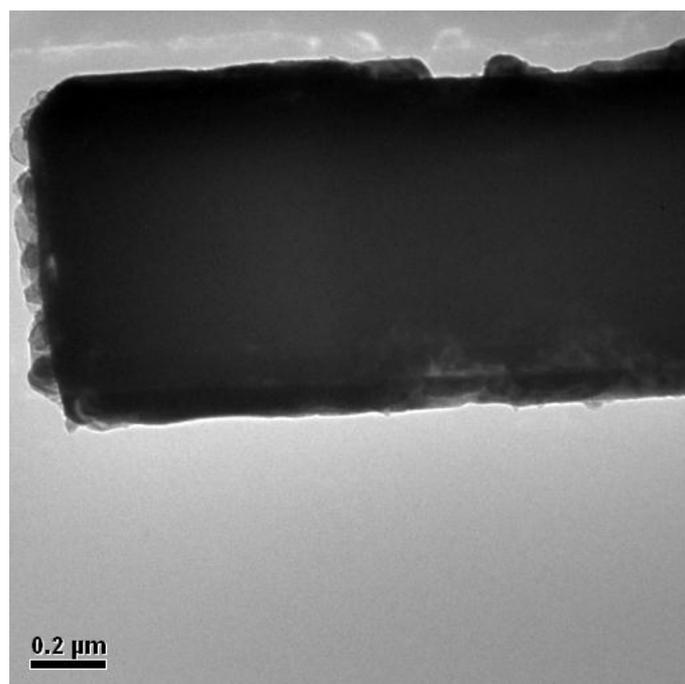


Figure S5-1 TEM image of synthesized $\text{NaYF}_4:\text{Yb}^{3+}/\text{Er}^{3+}$ nanocrystals: TEM image shows that the $\text{NaYF}_4:\text{Yb}^{3+}/\text{Er}^{3+}$ microrods have a well-defined edge, and some small particles are aggregated on its surface

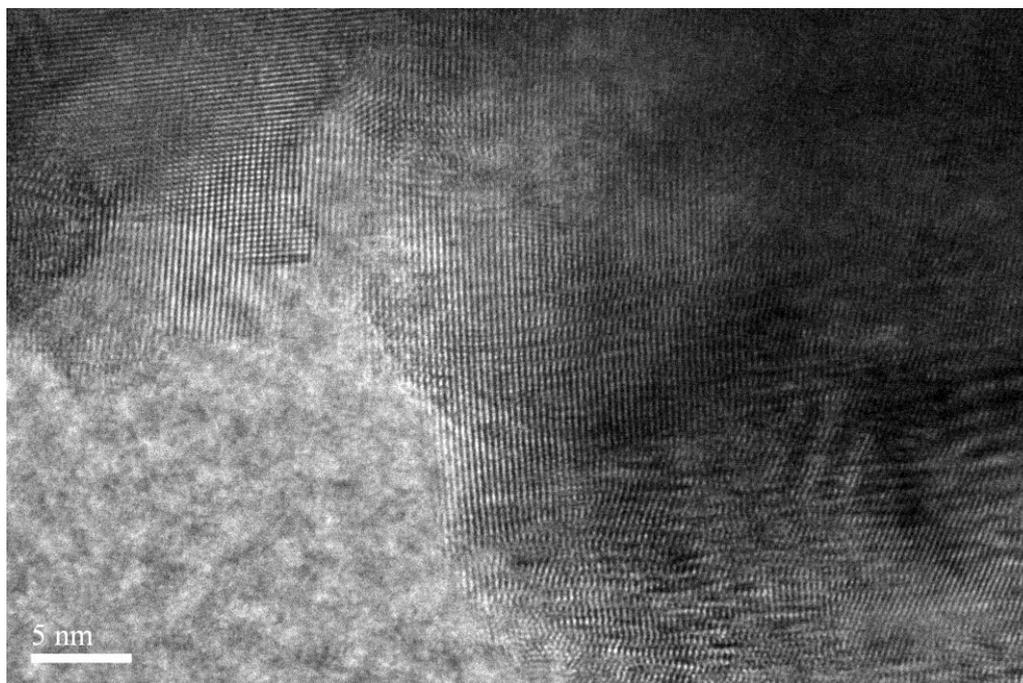
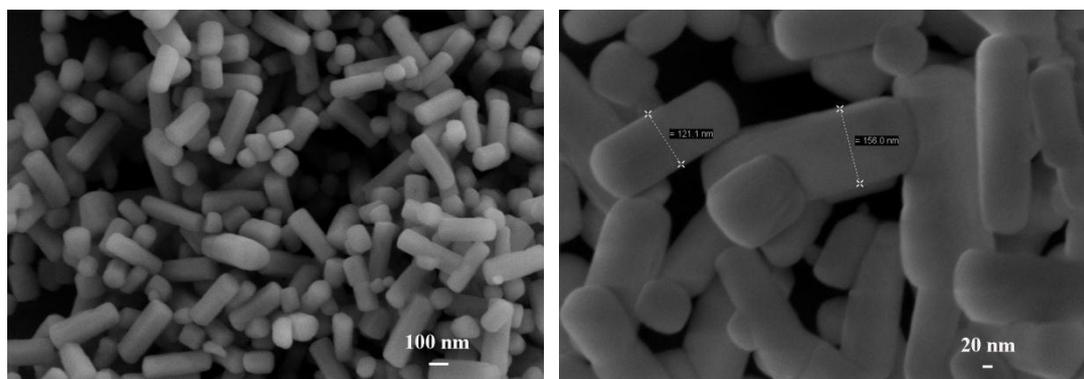


Figure S5-2 HRTEM image of synthesized $\text{NaYF}_4:\text{Yb}^{3+}/\text{Tm}^{3+}$ nanocrystals: HRTEM image shows the $\text{NaYF}_4:\text{Yb}^{3+}/\text{Tm}^{3+}$ nanocrystals have a high crystallinity.



Figure S5-3 HRTEM image of synthesized NaYF₄:Yb³⁺/Ho³⁺ nanocrystals: HRTEM image shows NaYF₄:Yb³⁺/Ho³⁺ nanocrystals have clear and continuous fringe lattice.

Figure S5 TEM image of NaYF₄:Yb³⁺/Er³⁺ nanocrystals (**Figure S5-1**), HRTEM image of NaYF₄:Yb³⁺/Tm³⁺ nanocrystals (**Figure S5-2**) and HRTEM image of NaYF₄:Yb³⁺/Ho³⁺ nanocrystals (**Figure S5-3**)



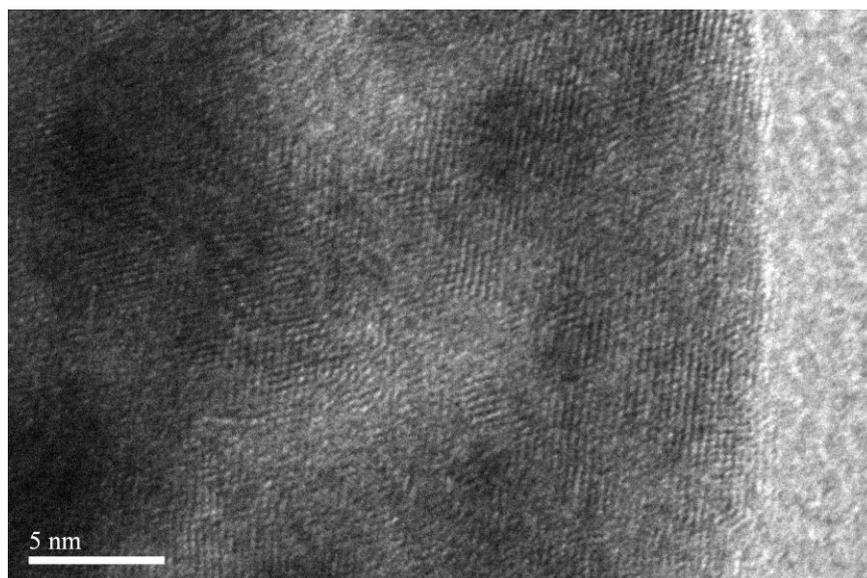


Figure S6-1 SEM image (top-left), higher SEM image (top-right) and HRTEM image (down) of synthesized NaGdF₄:Yb³⁺/Er³⁺

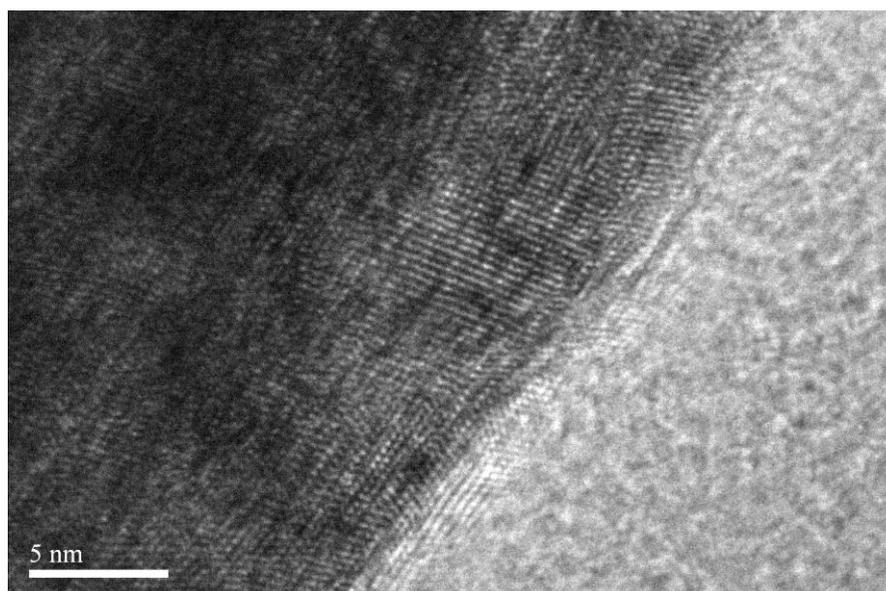
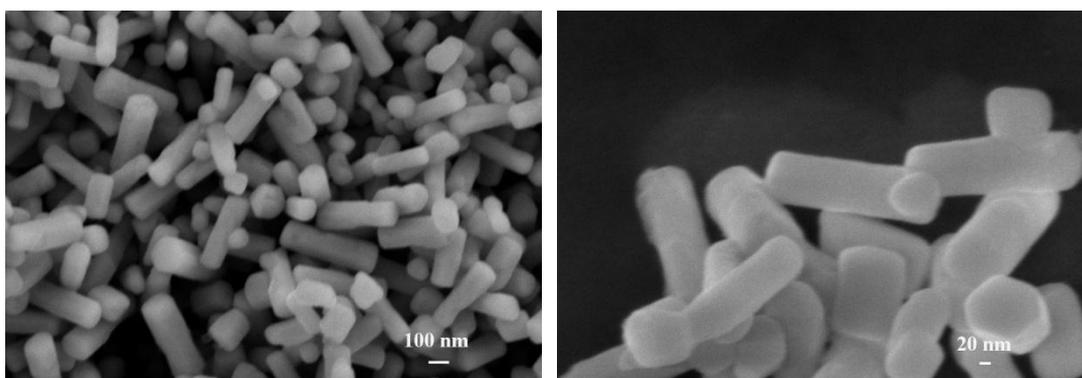


Figure S6-2 SEM image (top-left), higher SEM image (top-right) and HRTEM image (down) of synthesized NaGdF₄:Yb³⁺/Tm³⁺

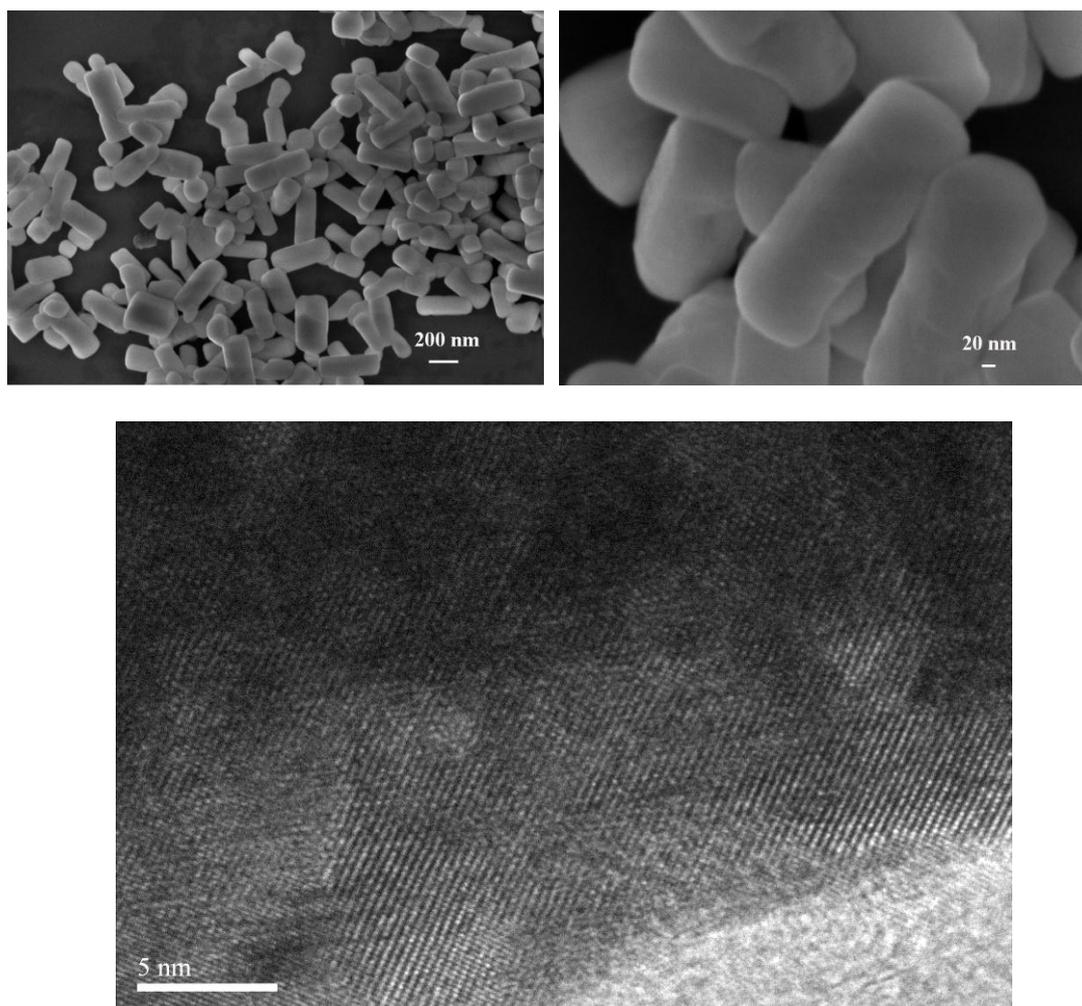


Figure S6-3 SEM image (top-left), higher SEM image (top-right) and HRTEM image (down) of synthesized $\text{NaGdF}_4:\text{Yb}^{3+}/\text{Ho}^{3+}$

Figure S6 SEM and TEM images of the synthesized $\text{NaGdF}_4:\text{Yb}^{3+}/\text{Er}^{3+}$ (**Figure S6-1**), $\text{NaGdF}_4:\text{Yb}^{3+}/\text{Tm}^{3+}$ (**Figure S6-2**) and $\text{NaGdF}_4:\text{Yb}^{3+}/\text{Ho}^{3+}$ (**Figure S6-3**)

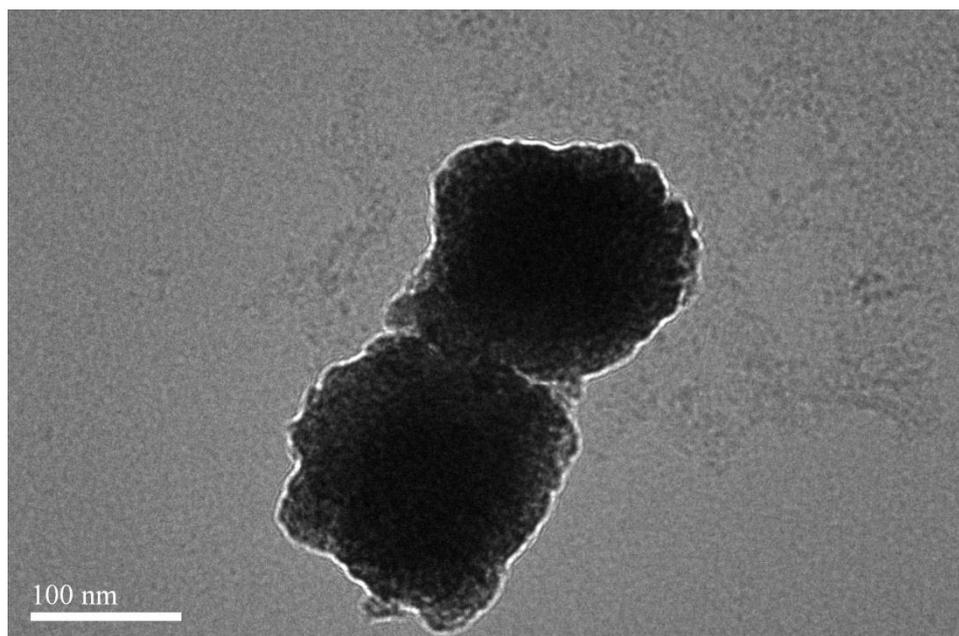


Figure S7 TEM image of the precursors formed at room temperature

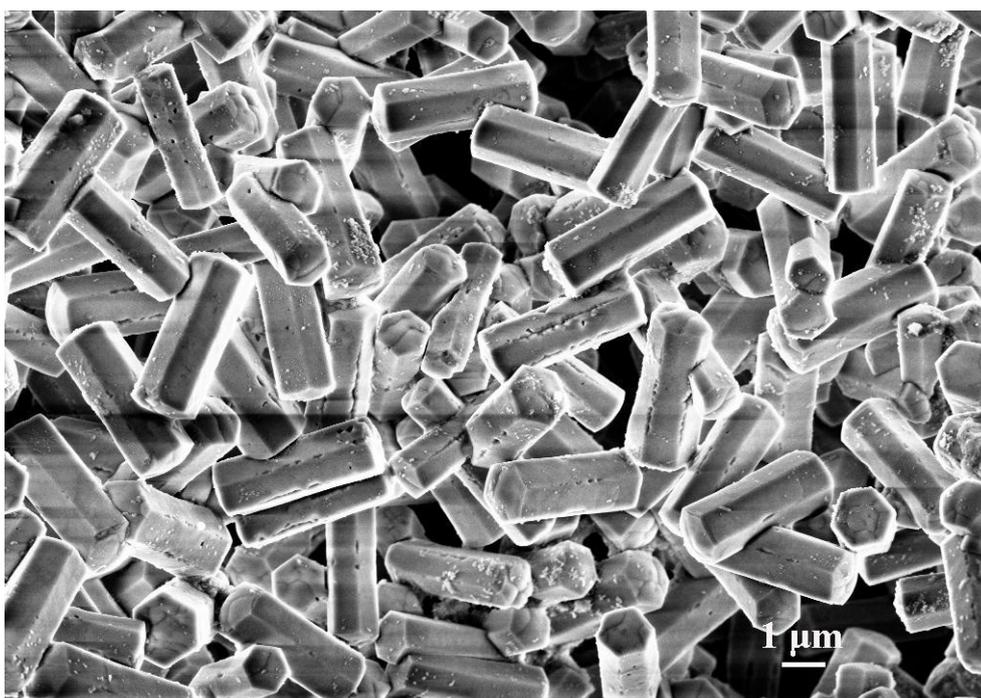


Figure S8 SEM image of the precursors formed at 200 °C

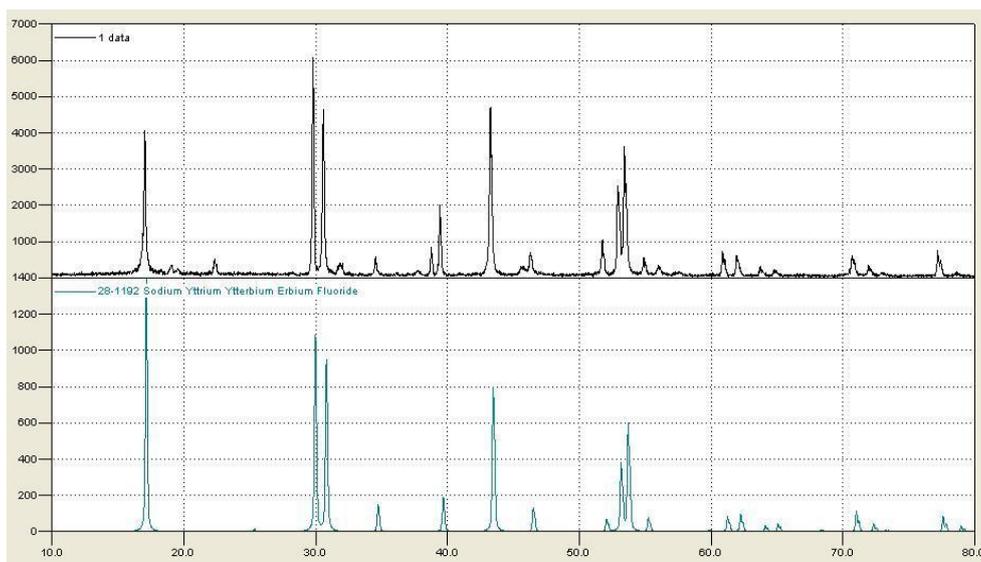


Figure S9 XRD pattern of the synthesized $\text{NaYF}_4:\text{Yb}^{3+}/\text{Er}^{3+}$ nanocrystals

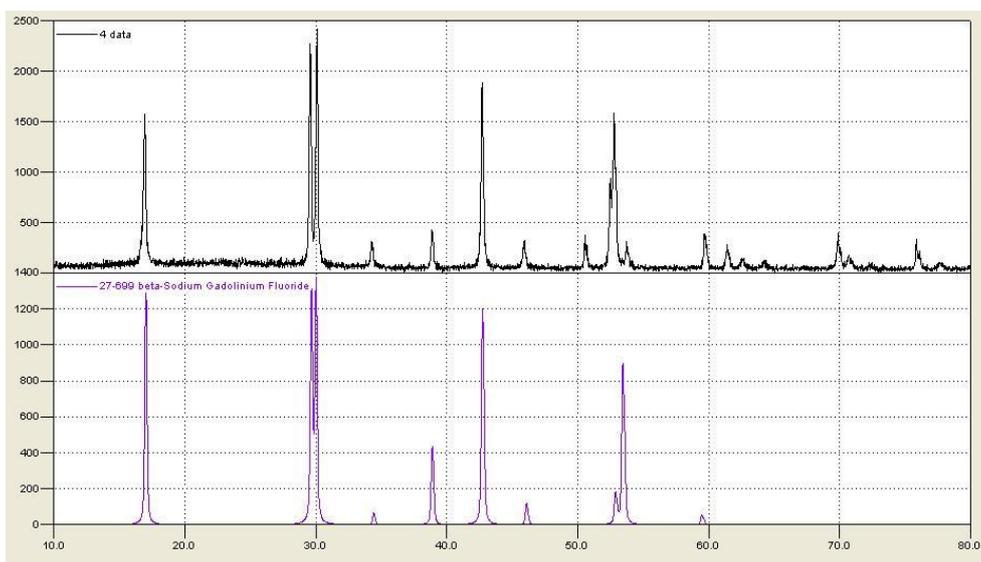
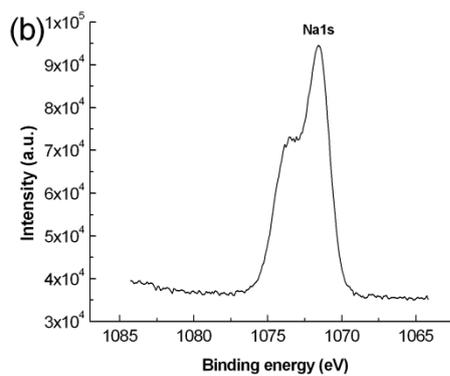
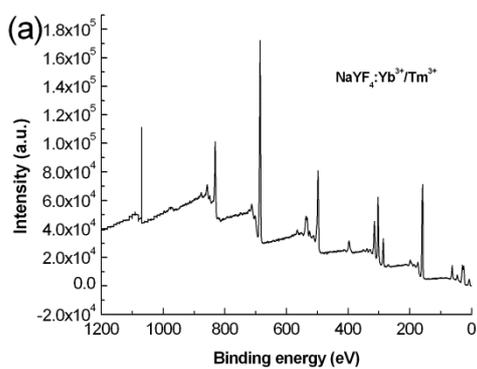


Figure S10 XRD pattern of the synthesized $\text{NaGdF}_4:\text{Yb}^{3+}/\text{Er}^{3+}$ nanocrystals



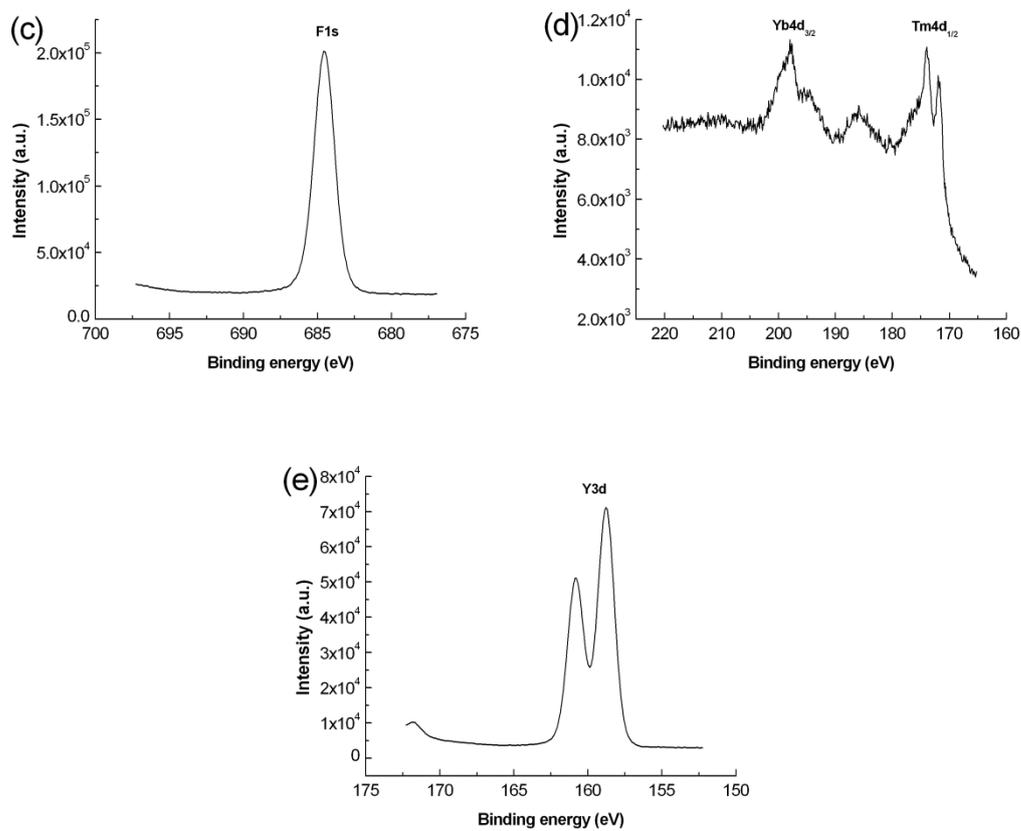
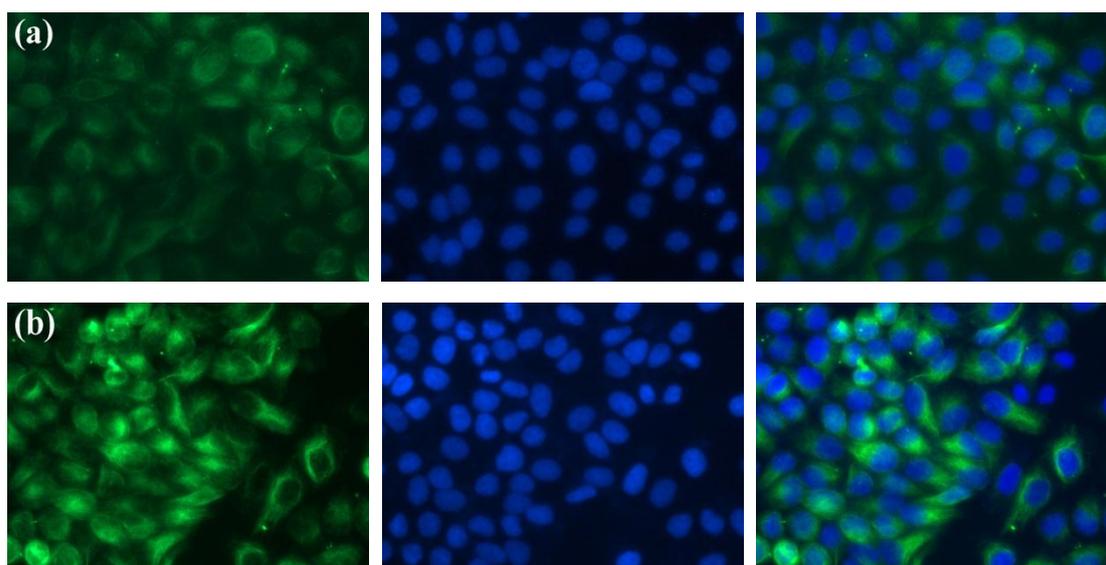


Figure S11 XPS spectra of NaYF₄:Yb³⁺/Tm³⁺ nanorods, the survey spectrum (a), Na1s region (b), F1s region (c), Yb4d and Tm4d region (d), Y3d region (e).



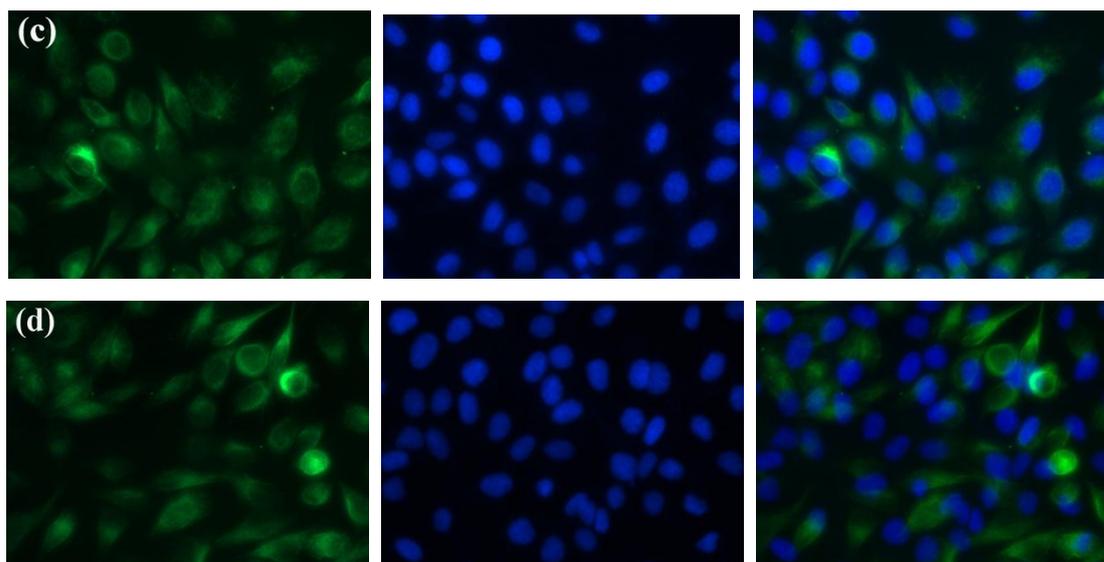
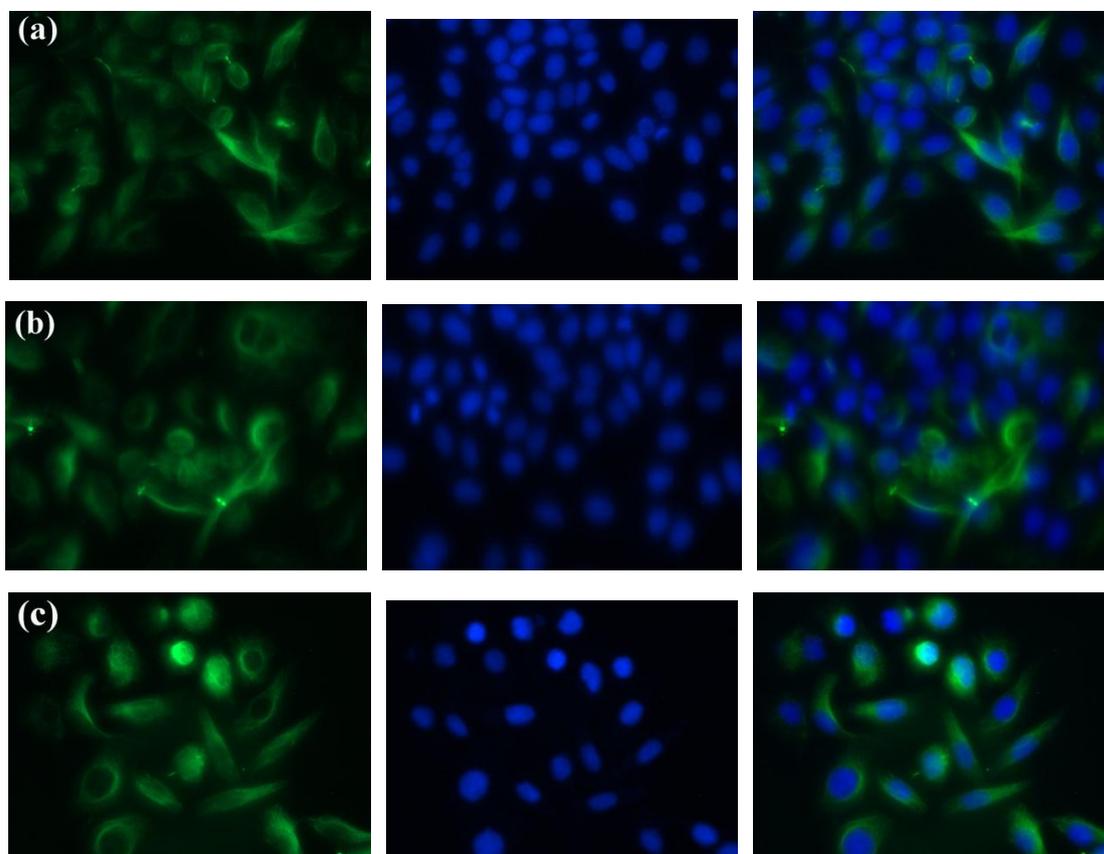


Figure S12-1. Fluorescence imaging of GES-1 cells before and after incubation with different concentration of NaGdF₄:Yb³⁺/Er³⁺ nanocrystals **after 1 day** by a fluorescence microscope (LEICA, DFC300 FX), control cells (a), with 20 µg/mL NaGdF₄:Yb³⁺/Er³⁺ nanocrystals (b), with 50 µg/mL NaGdF₄:Yb³⁺/Er³⁺ nanocrystals (c) and with 100 µg/mL NaGdF₄:Yb³⁺/Er³⁺ nanocrystals (d). Note that: Left column, fluorescent images of cell skeleton in green field; middle column, fluorescent images of cells nucleus in blue field; right column, overlay of left and middle columns.



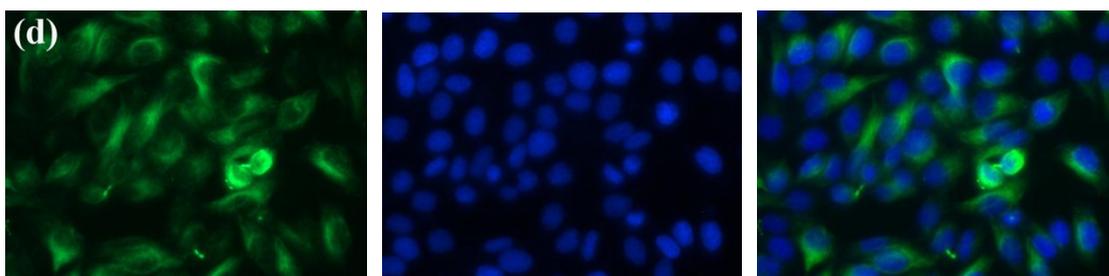


Figure S12-2. Fluorescence imaging of GES-1 cells before and after incubation with different concentration of NaGdF₄:Yb³⁺/Er³⁺ nanocrystals **after 2 day** by a fluorescence microscope (LEICA, DFC300 FX), control cells (a), with 20 µg/mL NaGdF₄:Yb³⁺/Er³⁺ nanocrystals (b), with 50 µg/mL NaGdF₄:Yb³⁺/Er³⁺ nanocrystals (c) and with 100 µg/mL NaGdF₄:Yb³⁺/Er³⁺ nanocrystals (d). Note that: Left column, fluorescent images of cell skeleton in green field; middle column, fluorescent images of cells nucleus in blue field; right column, overlay of left and middle columns.

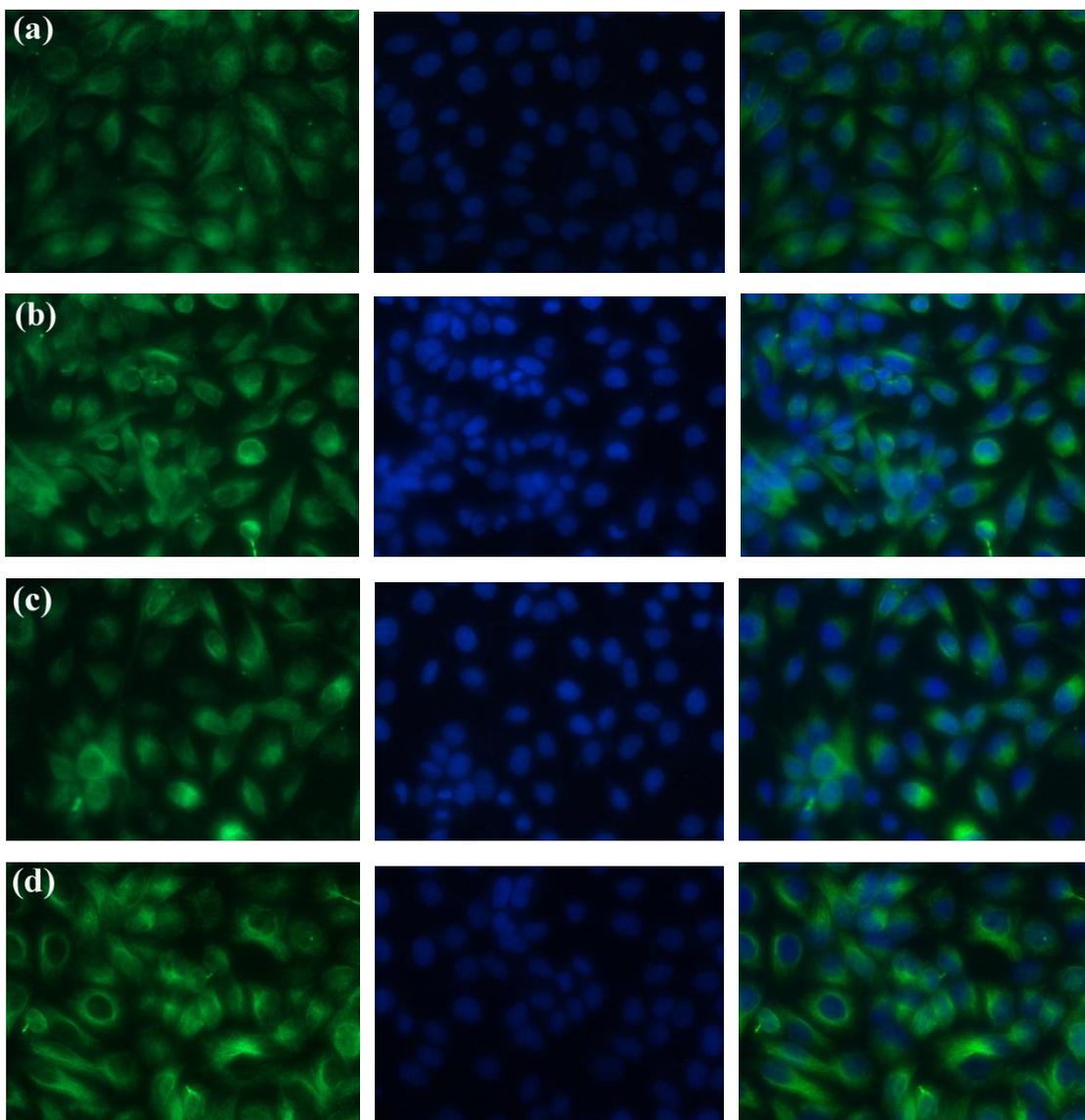


Figure S12-3. Fluorescence imaging of GES-1 cells before and after incubation with

different concentration of $\text{NaGdF}_4:\text{Yb}^{3+}/\text{Er}^{3+}$ nanocrystals **after 3 day** by a fluorescence microscope (LEICA, DFC300 FX), control cells (a), with $20 \mu\text{g}/\text{mL}$ $\text{NaGdF}_4:\text{Yb}^{3+}/\text{Er}^{3+}$ nanocrystals (b), with $50 \mu\text{g}/\text{mL}$ $\text{NaGdF}_4:\text{Yb}^{3+}/\text{Er}^{3+}$ nanocrystals (c) and with $100 \mu\text{g}/\text{mL}$ $\text{NaGdF}_4:\text{Yb}^{3+}/\text{Er}^{3+}$ nanocrystals (d). Note that: Left column, fluorescent images of cell skeleton in green field; middle column, fluorescent images of cells nucleus in blue field; right column, overlay of left and middle columns.

Figure S12. Fluorescence imaging of GES-1 cells before and after incubation $\text{NaGdF}_4:\text{Yb}^{3+}/\text{Er}^{3+}$ nanocrystals at different days, after 1 day (**Figure S12-1**), after 2 day (**Figure S12-2**) and after 3 day (**Figure S12-3**).



Figure S13. Photonic image of 0.1 g $\text{NaGdF}_4:\text{Yb}^{3+}/\text{Er}^{3+}$ nanorods dispersed in 10 mL deionized water.