Supporting Information

**Bright White Upconversion Emission from Yb\textsuperscript{3+}, Er\textsuperscript{3+}, and Tm\textsuperscript{3+}-Codoped Gd\textsubscript{2}O\textsubscript{3} Nanotubes**

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Fig. S1 show the XRD patterns of Gd(OH)\textsubscript{3}:10\%Yb\textsuperscript{3+}/1\%Er\textsuperscript{3+}/0.7\%Tm\textsuperscript{3+} and Gd\textsubscript{2}O\textsubscript{3}:10\%Yb\textsuperscript{3+}/1\%Er\textsuperscript{3+}/0.7\%Tm\textsuperscript{3+} nanocrystals. All diffraction peaks can be readily indexed to pure hexagonal Gd(OH)\textsubscript{3} and cubic Gd\textsubscript{2}O\textsubscript{3}, which are in good agreement with the standard values for the Gd(OH)\textsubscript{3} and Gd\textsubscript{2}O\textsubscript{3} (JCPDS No.83–2037 and 11–0604), respectively. No other impurity peaks can be detected from the XRD patterns, indicating that the nanocrystals are single-phased and Ln\textsuperscript{3+} ions have effectively incorporated into the Gd(OH)\textsubscript{3} and Gd\textsubscript{2}O\textsubscript{3} host lattices.
**Fig. S1.** XRD patterns of (a) Gd(OH)$_3$:10%Yb$^{3+}$/1%Er$^{3+}$/0.7%Tm$^{3+}$ and (b) Gd$_2$O$_3$:10%Yb$^{3+}$/1%Er$^{3+}$/0.7%Tm$^{3+}$ nanocrystals. The standard data for Gd(OH)$_3$ (JCPDS No.83–2037) and Gd$_2$O$_3$ (JCPDS No.11–0604) are also presented in the figure for comparison.

**Fig. S2** shows the TGA curve of Gd(OH)$_3$:10%Yb$^{3+}$/1%Er$^{3+}$/0.7%Tm$^{3+}$ nanocrystals. It can be observed that there are two major stages of rapid weight loss at about 311°C and 420°C, indicating the existence of intermediate phase other than Gd(OH)$_3$ and Gd$_2$O$_3$ during the thermal conversion process. The weight loss for the two stages and the total weight loss are 8.86%, 4.32%, and 13.18%, respectively. The total weight loss is in agreement with the theoretical value of Gd(OH)$_3$, calculated from the reaction of its complete dehydration to produce Gd$_2$O$_3$. Since most of the rare earth compounds can exist in the form of LnOOH, this dehydration process can be supposed to be two steps: Gd(OH)$_3$ → GdOOH + H$_2$O and 2GdOOH → Gd$_2$O$_3$ + H$_2$O. The theoretical weight loss for the two processes is 8.64% and 4.73%, respectively, which is quite close to the experimental data.
Fig. S2. TGA curve of Gd(OH)$_3$:10%Yb$^{3+}$/1%Er$^{3+}$/0.7%Tm$^{3+}$ nanotubes.

Fig. S3 describes the XRD pattern for the product calcinated at 300°C. It fit well with the GdOOH, which has been well addressed by C Chang et al. (Mater. lett., 2005, 59, 1037. and Nanotechnology, 2006, 17, 1981.).

Fig. S3. XRD pattern of GdOOH:10%Yb$^{3+}$/1%Er$^{3+}$/0.7%Tm$^{3+}$