Supporting Information

Simultaneous spectra and dynamics processes tuning of a single upconversion microtube through Yb$^{3+}$ doping concentration and excitation power

Dangli Gao,*,a,b Xiangyu Zhang,c Bo Chong,a Guoqing Xiao,b and Dongping Tian*,a,b

aCollege of Science, Xi’an University of Architecture and Technology, Xi’an 710055, China

bCollege of Materials & Mineral Resources, Xi’an University of Architecture and Technology, Xi’an 710055, China

cCollege of Science, Chang’an University, Xi’an 710064, China

Fig. S1  Bright field optical microscope image of single NaYF$_4$: Yb/Er (x/2 mol%, x=5, 10, 20, 40 and 98) microtubes with local excitation at the central or the end part of tube. Scale bar, 50 μm.
Fig. S2  Downconversion emission spectra under 378.5 nm laser excitation with different laser power densifies of NaYF$_4$: Yb/Er (x/2 mol%, x=5, 10, 20 and 40) microtubes. Insets are the normalized emission spectra excited with different laser power densifies. The Ti sapphire femtosecond laser (Mira-900, Spectra-Physics, 76 MHz, pulse width<200 fs) equipped with a second harmonic generation (SHG) was employed as downconversion excitation source (378.5 nm laser).
Fig. S3  Downconversion emission spectra under 532 nm laser excitation with different laser power densifies of NaYF₄: Yb/Er (x/2 mol%, x=5, 10, 20 and 40) microtubes. Insets are the normalized emission spectra excited with different laser power densifies.
Fig. S4  Normalized lifetime decay curves for the green luminescence (a) and red luminescence (b) with 532 nm laser excitation in NaYF₄: Yb/Er (x/2 mol%, x = 5, 10, 20, 40 and 98) microtubes.

Fig. S5  Normalized lifetime decay curves for the green luminescence (a) and red luminescence (b) with 355 nm laser excitation in NaYF₄: Yb/Er (x/2 mol%, x = 10 and 40) microtubes.