Supporting Information

Upconversion Luminescence and Temperature Sensing Properties of $NaGd(WO_4)_2$: Yb^{3+}/Er^{3+}@SiO_2 Core-Shell Nanoparticles

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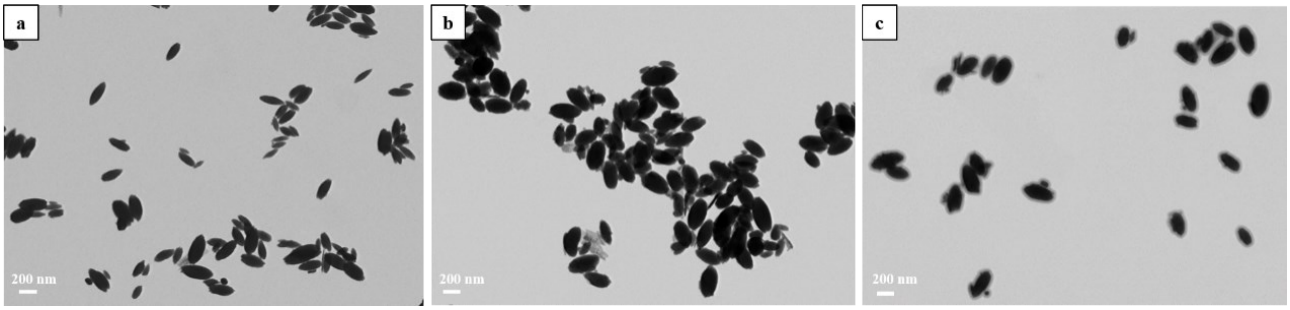

Figure S1. STEM images of core NGW:Yb^{3+}/Er^{3+} UCNPs (a) before annealing and (b) annealed at 600 ℃ for 3 h, and (c) core-shell NGW:Yb^{3+}/Er^{3+} @SiO_2 UCNPs annealed at 600 ℃ for 3 h.

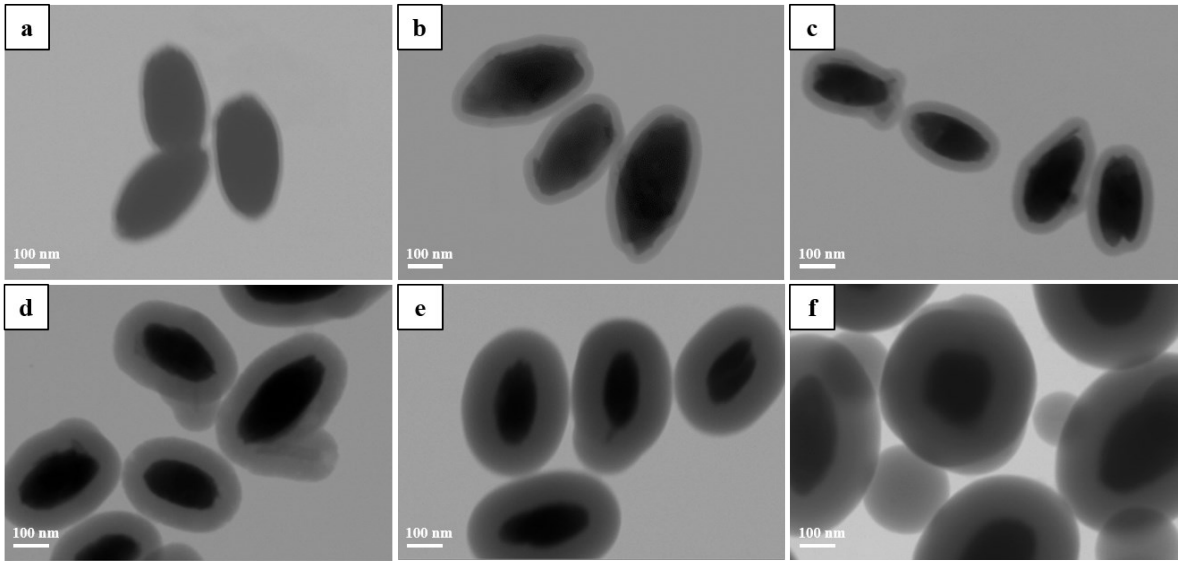

Figure S2. STEM images of core-shell NGW:Yb^{3+}/Er^{3+}@SiO_2 UCNPs with different amounts of TEOS: a) 10 μL, b) 20 μL, c) 40 μL, d) 80 μL , e) 160 μL, and f) 320 μL.

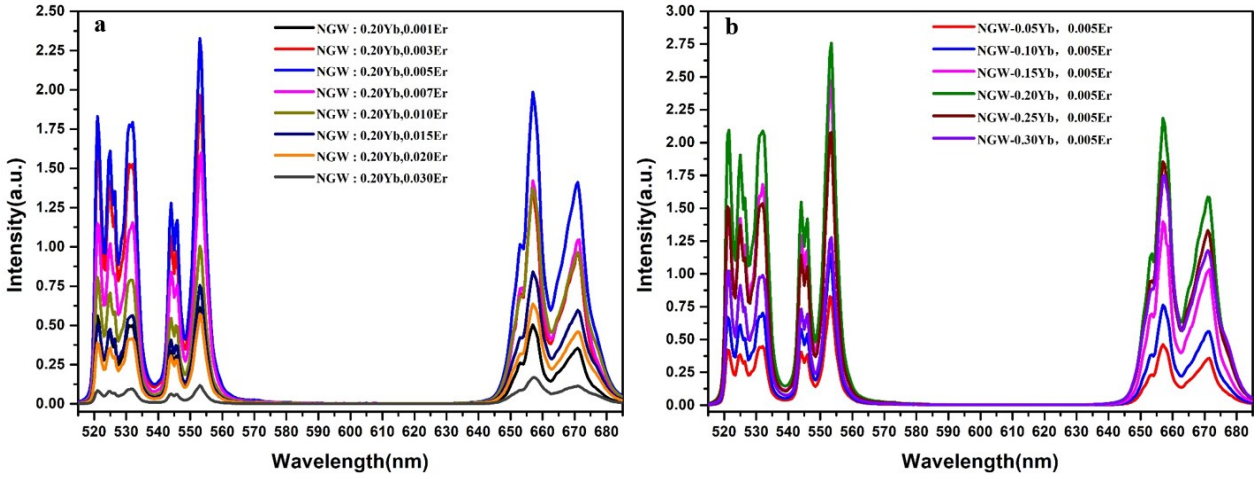

Figure S3. Concentration dependent UC emission spectra of (a) 20 at%Yb^{3+}-x at%Er^{3+}: $NaGd(WO_4)_2$ (x = 0.1, 0.3, 0.5, 0.7 , 1.0, 2.0 and 3.0) and (b) x at%Yb^{3+}-0.5 at%Er^{3+}: $NaGd(WO_4)_2$ (y = 5, 10, 15, 20, 25 and 30) UCNPs.

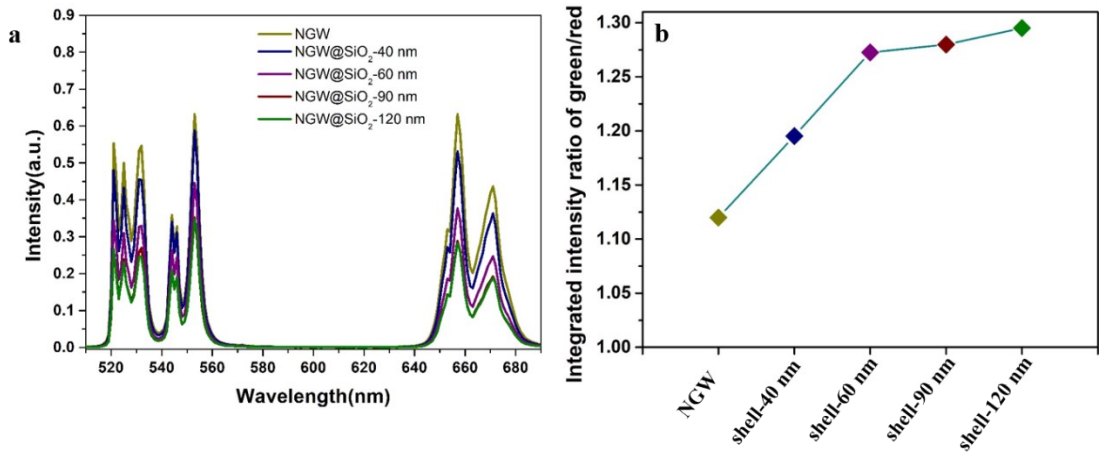

Figure S4. UC luminescence for the core-shell NGW $Yb^{3+}/Er^{3+}@SiO_2$ UCNPs with different shell thickness under excitation of 980 nm laser. (a) UC emission spectra. (b) Integrated intensity ratio of green and red emission. (power density of 56 mW/cm^{-2}).

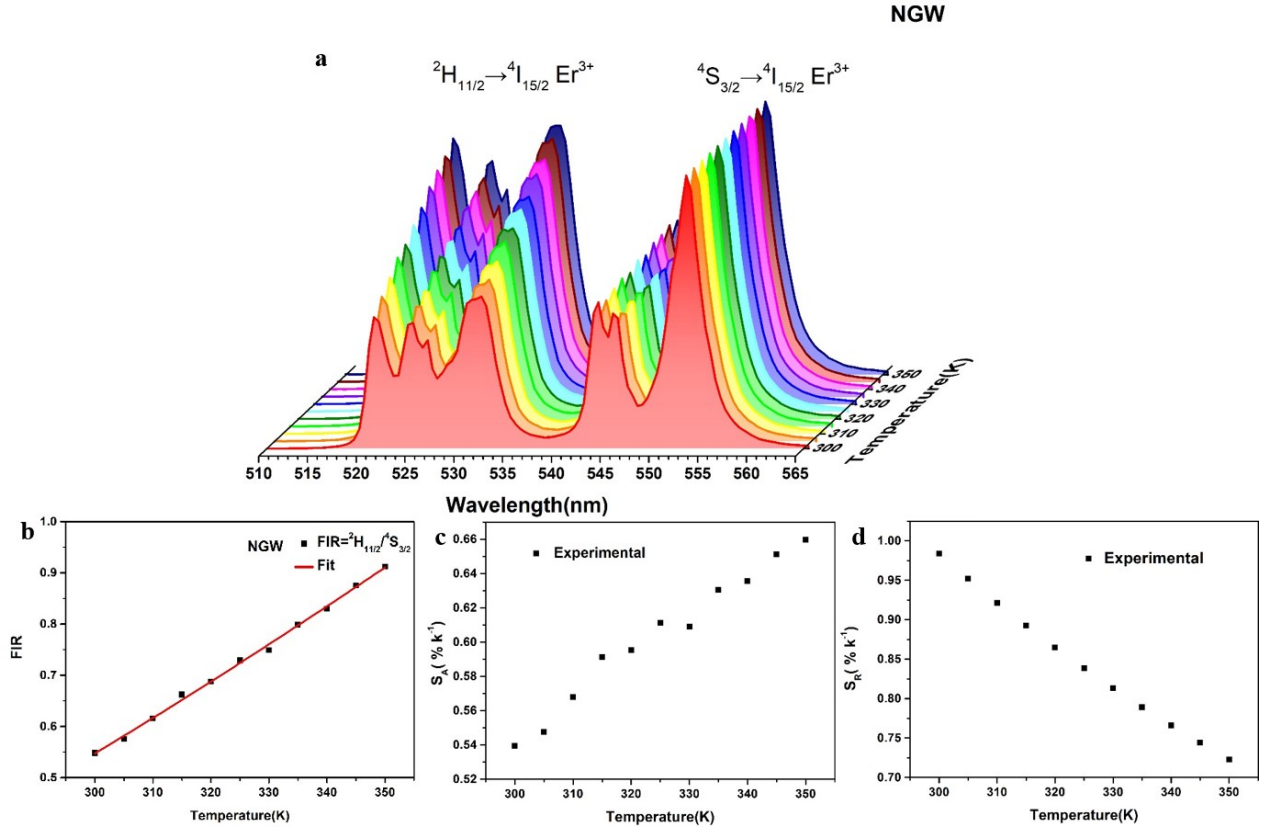

Figure S5. FIR analysis of the $^2H_{11/2}$ and $^4S_{3/2}$ levels emission for the core NGW:Yb^{3+}/Er^{3+} UCNPs in the temperature range from 300 K to 350 K. (a) UC emission spectra under 980 nm laser excitation. The spectra are normalized to the emission peak at 553 nm. (b) FIR, (c) S_A, and (d) S_R versus temperature.