Electronic Supplementary Material (ESI) for RSC Advances.

A NIR-to-NIR upconversion luminescence system for security printing applications

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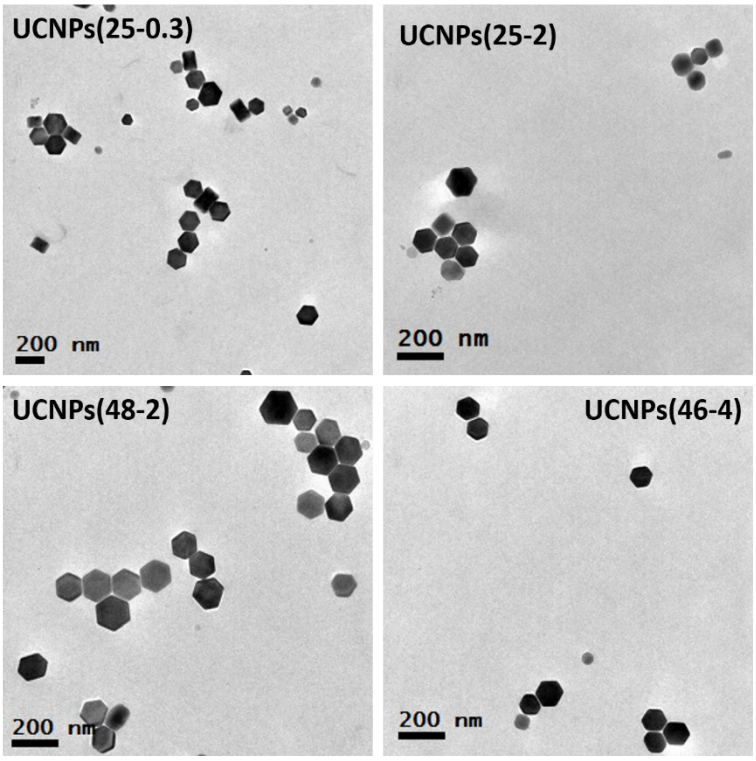

Figure S1: TEM image of synthesized UCNPs indicates hexagonal $NaYF_4$ nanoparticles

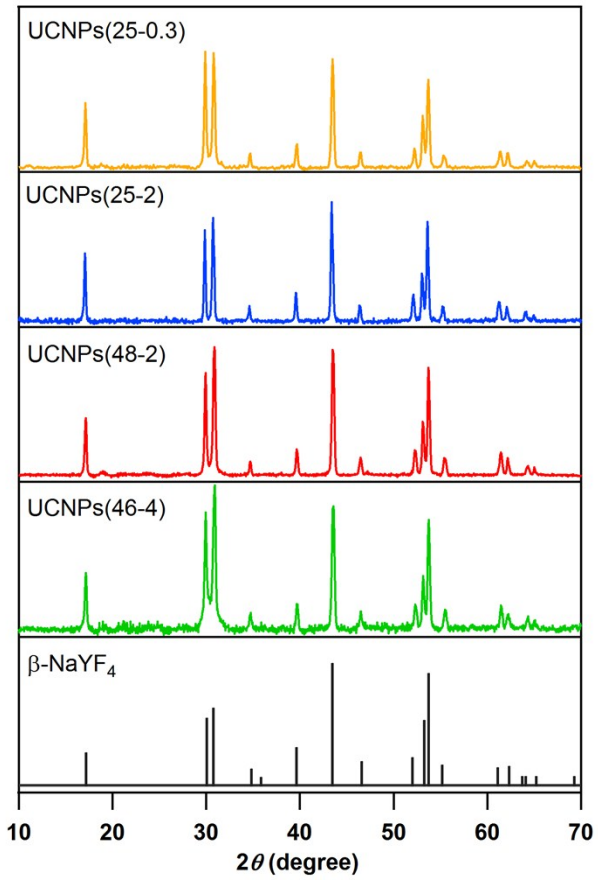

Figure S2: PXRD of synthesized UCNPs indicates phase pure β-$NaYF_4$ nanoparticles

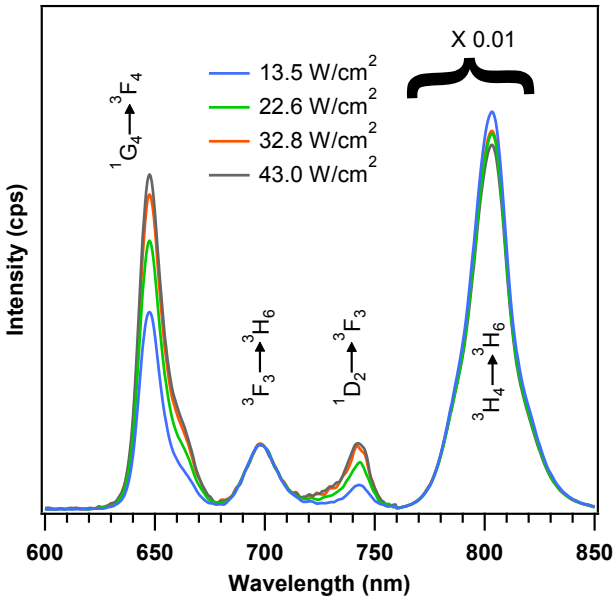

Figure S3: Power dependent emission response of blue UCNPs (25-0.3) excited with 980 nm normalized to the peak at 700 nm. The emission spectrum with bands at 700 nm ($^3F_3 \rightarrow {}^3H_6$) and 800 nm ($^3H_4 \rightarrow {}^3H_6$) show similar power dependence trends. The 800 nm emission intensity is reduced to 0.01 x of actual in order to fit in the scale.

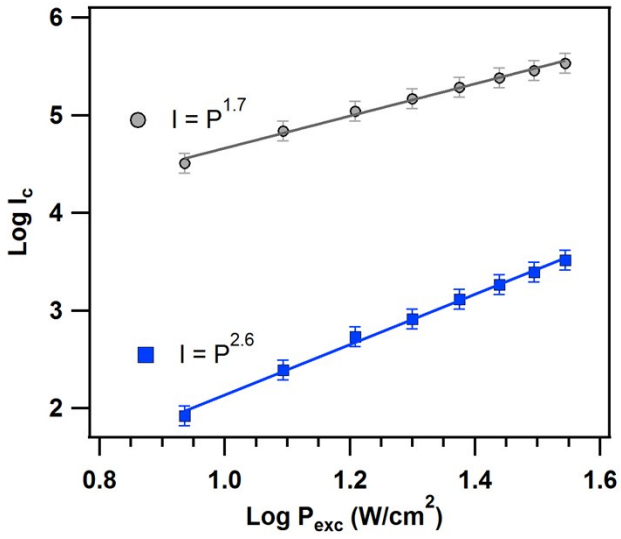

Figure S4: Dependence of blue and NIR (800 nm) upconversion intensity (I) from UCNPs(25-0.3) on 980 nm excitation power (P). Excitation was provided by a 980 nm CW laser. Blue UC exhibits a stronger power dependence relative to NIR UC due to excitation occurring via a higher-order process (three-photon vs. two-photon). The NIR-to-blue intensity ratio is 400 at 6.2 W/cm^2 excitation power, and decreases to 100 at 35 W/cm^2.