Electronic Supplementary Information(ESI)

Upconversion-luminescent/magnetic dual-functional sub-20-nm core-shell SrF_2:Yb,Tm@CaF_2:Gd heteronanoparticles

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Figure S1. Optical path image of spectroscopic UCL measurement

Details about calculation of excitation light spot size

When wheel of the chopper was placed on the position of excitation spot, the measured intensity of chopped LD was shown in **Figure S2**. By single exponential fitting of the decay part, fall time (τ) was extracted to be 43.4 μs. Distance (*r*) of the light spot to shaft of the wheel was 4.5 cm, rotational speed of the wheel was 49.5 round per second (99 Hz for 2-slot wheel), the following relationship would be satisfied,

$$\frac{D}{2\pi r} = \frac{\tau}{T}$$

D is diameter of the light spot, *T* is time cost by wheel to rotate one round, which is $1/49.5$ s, so $D \approx$ 0.06 cm.

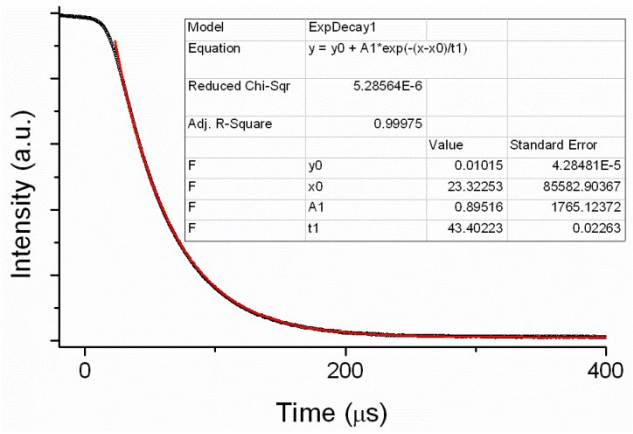

Figure S2. Chopped LD intensity v*ersus* time

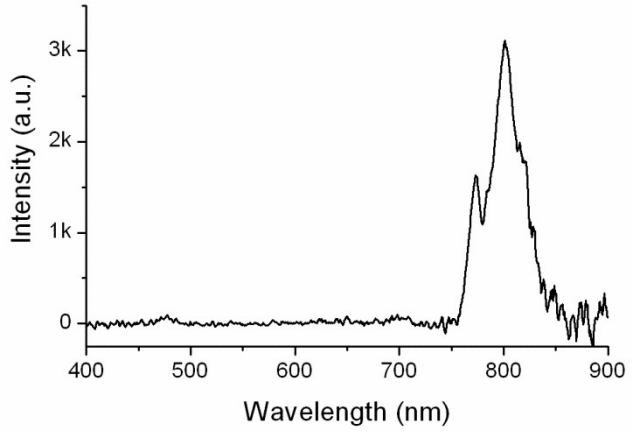

Figure S3. UCL spectrum of core-shell SrF_2:Yb,Tm@CaF_2:Gd nanoparticles' aqueous colloidal dispersion with concentration of 2.6 wt% under 8.8 W/cm^2 LD excitation at 975 nm

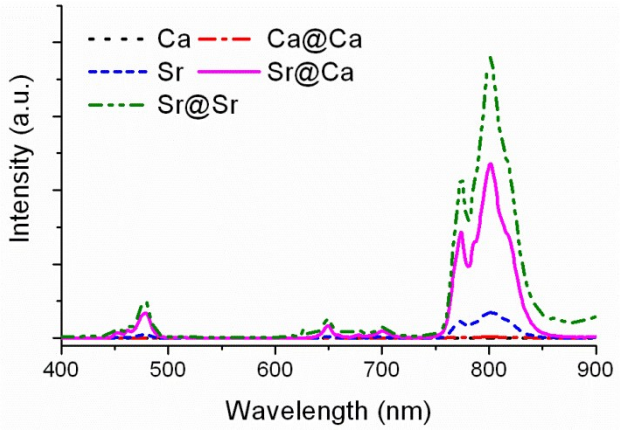

Figure S4. UCL spectra of samples with the same amount (10 mg sample/mL solvent) in the colloidal dispersions

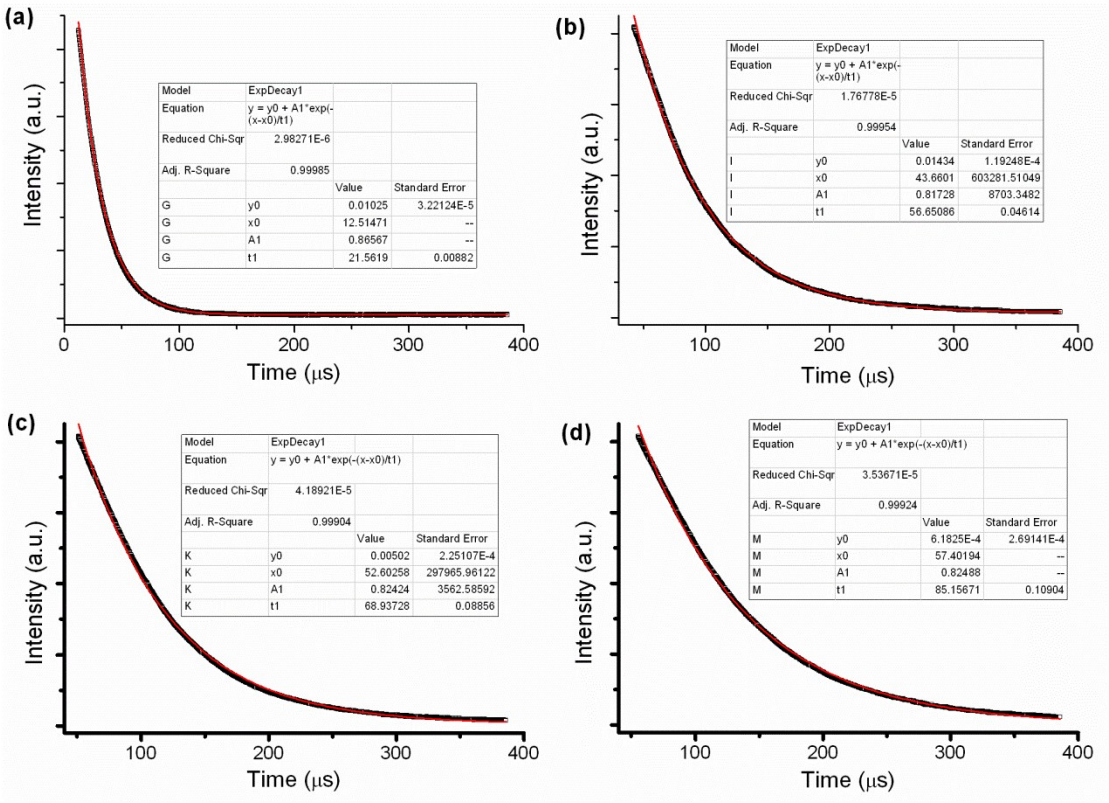

Figure S5. Single exponential fittings to the decay part of Figure 2(c). (a) chopped LD intensity, (b) SrF_2:Yb,Tm, (c) SrF_2:Yb,Tm@CaF_2:Gd, (d) SrF_2:Yb,Tm@SrF_2:Gd

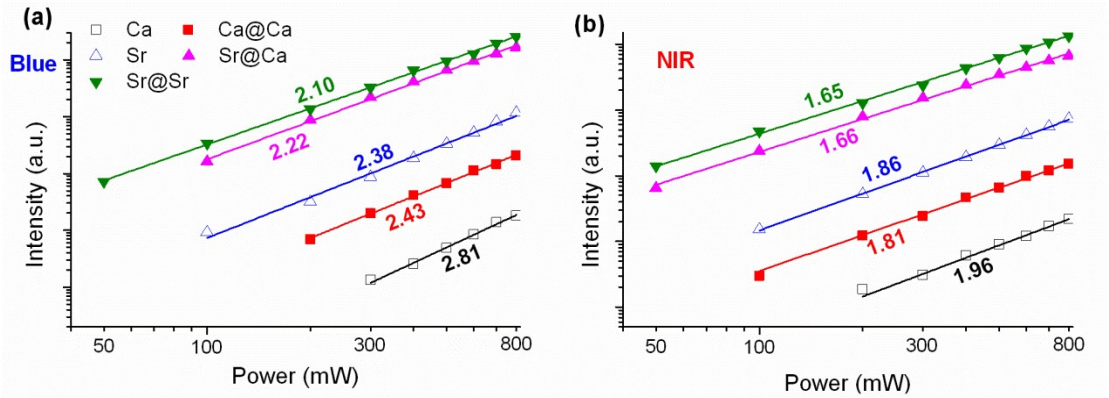

Figure S6. Power dependence of five samples in colloidal dispersions under 975-nm LD excitation