Electronic Supplementary Material (ESI) for Physical Chemistry Chemical Physics.

Electronic Supplementary Information

Depleted Upconversion Luminescence in $NaYF_4:Yb^{3+},Tm^{3+}$ Nanoparticles via Simultaneous Two-Wavelength Excitation

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1. The influence of particle concentration on depletion efficiency

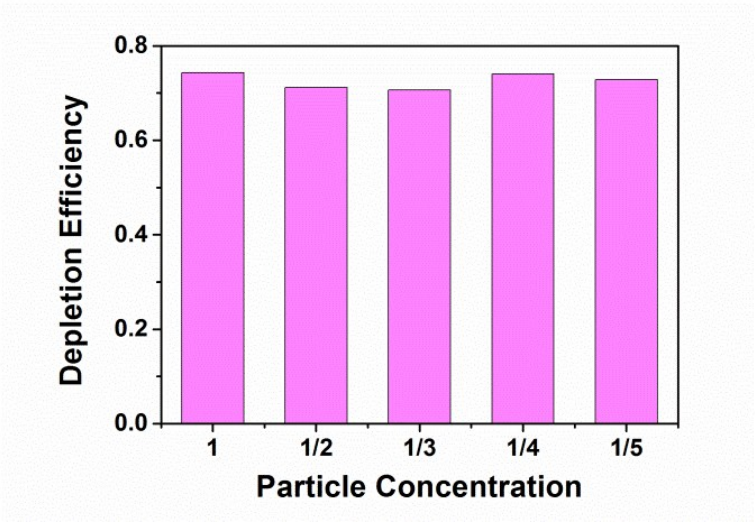

Fig. S1 The influence of particle concentration on depletion efficiency of 456 nm emission in $NaYF_4$:20%Yb^{3+},1%Tm^{3+} UCNPs excited by 980 nm (8.6 W cm^{-2}) and 1550 nm (36.6 W cm^{-2}) lasers. 1 means the initial particle concentration. 1/2, 1/3, 1/4, and 1/5 represent the concentration is one-half, one-third, one-quarter, and one-fifth of the initial particle concentration, respectively.

2. The UCL spectra of different doping concentrations of Tm^{3+} ion

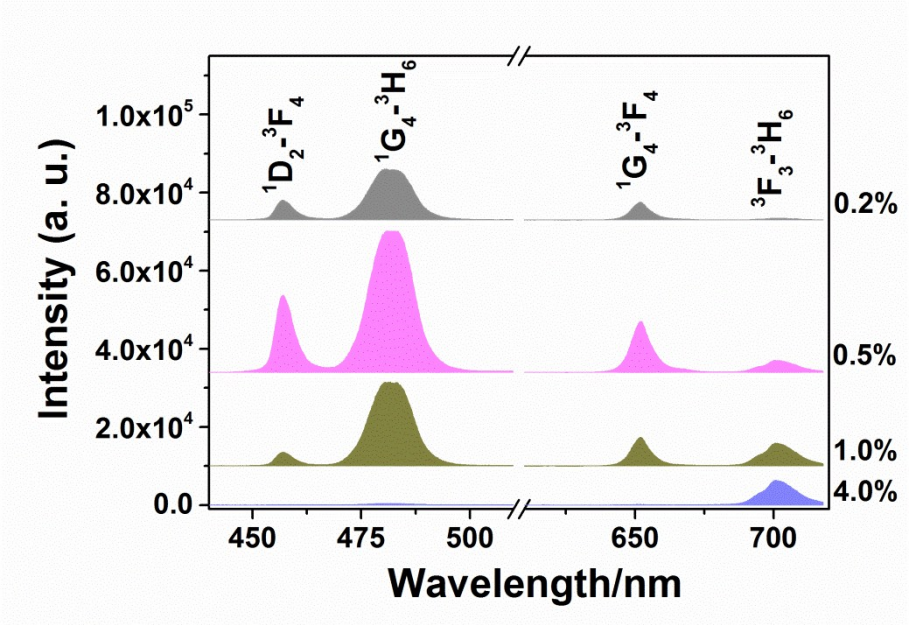

Fig. S2 The UCL spectra of Yb^{3+}/Tm^{3+} codoped UCNPs with different doping concentrations of Tm^{3+} ion.

3. Ion distance of different contents of Tm^{3+} ion

Ion distance is mainly dependent on ion concentration. Here, we give an estimation method. We roughly regard that Tm^{3+} ions equably distribute in the nanocrystals.

For *x*% Tm^{3+} doped nanoparticles, there is one Tm^{3+} ion existing in *y* unit cells. $y = {}^{100}/_{x}$ is the number of unit cells. The ion distance *d* can be obtained from the formula: $d = a \times \sqrt[3]{y}$, where a is the interplanar distance. High resolution TEM image of Tm^{3+} doped nanoparticles in Fig. S3 shows that a is 0.51 nm.

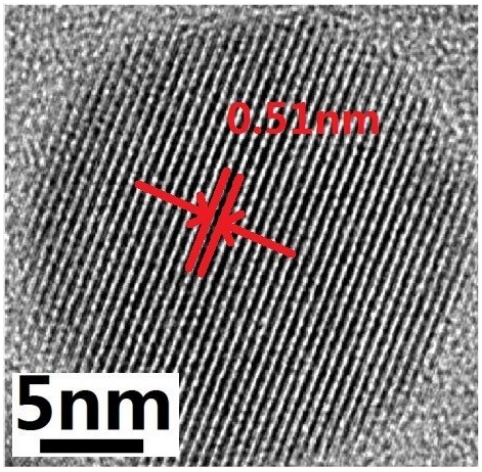

Fig. S3 HRTEM image of Tm^{3+} doped nanoparticles.

The ion distances of different contents of Tm^{3+} ion doped nanoparticles are calculated and shown in Table S1.

Table S1 Ion distance in different contents of Tm^{3+} ion.

Contents	0.2%	0.5%	1%	4%
Ion distance	4.0 nm	3.0 nm	2.4 nm	1.5 nm