

Supporting Information

Ce Dopant Effects on NaYF₄ Particle Morphology and Optical Properties

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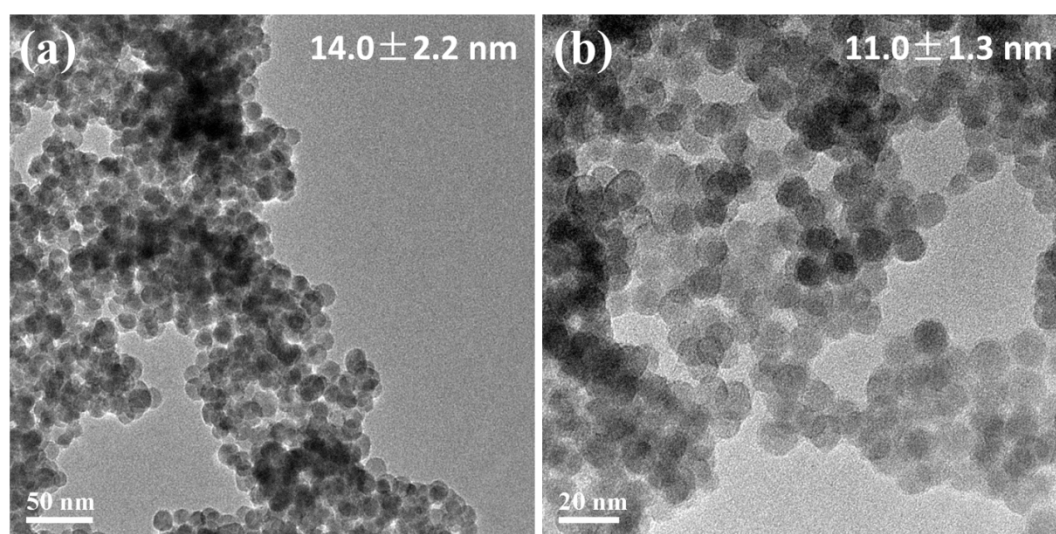


Figure S1. TEM images of N-NPs with Ce concentration of (a) 20 and (b) 50 mol%.
The size distribution of particles is given in the images.

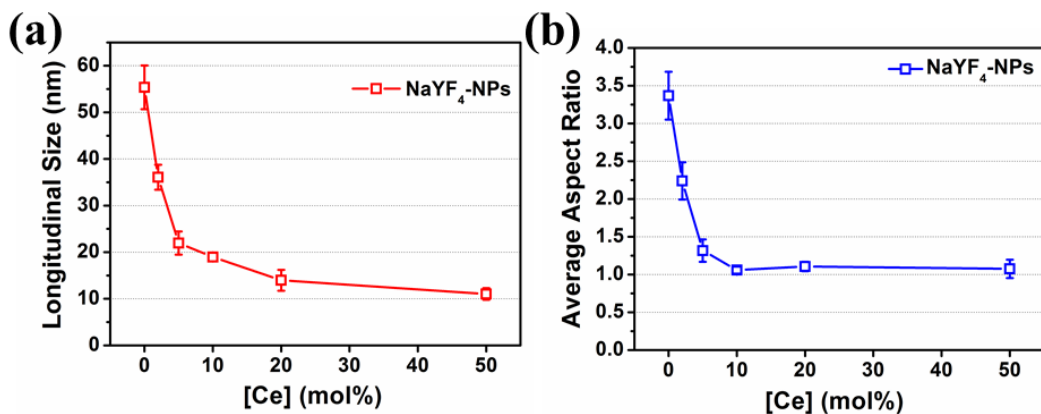


Figure S2. Average longitudinal dimension and aspect ratio of N-NPs with Ce concentrations from 0 to 50 mol%.

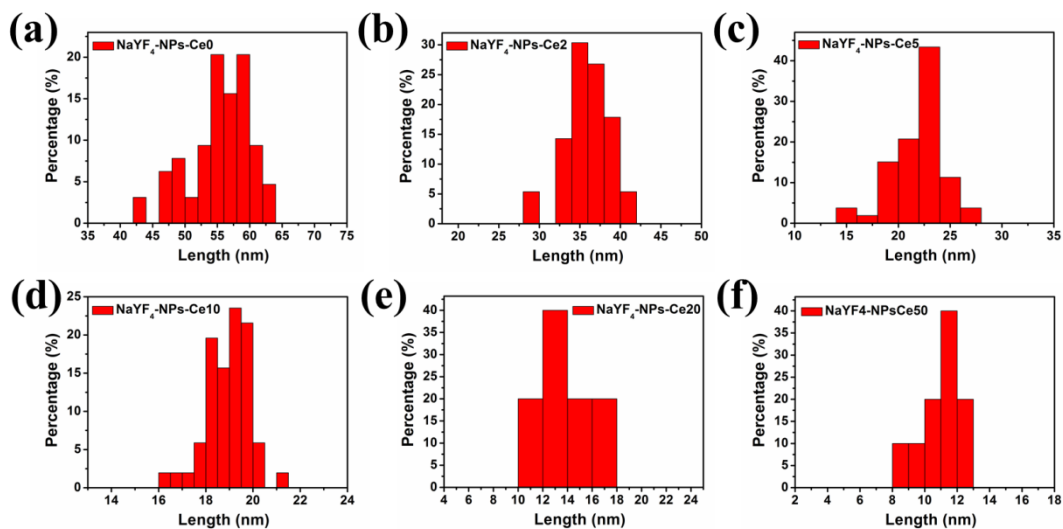


Figure S3. Size distributions of N-NPs with Ce concentration from 0 to 50 mol%.

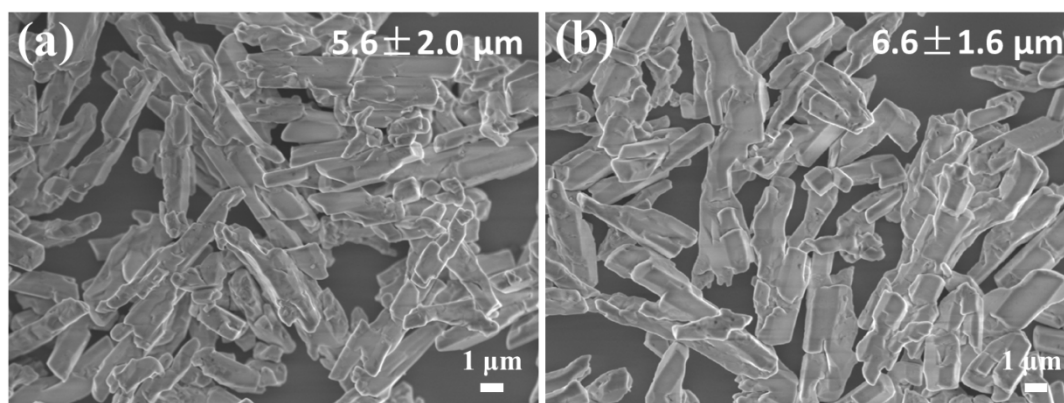


Figure S4. SEM images of N-NPs with Ce concentration of (a) 2 and (b) 5 mol%. The

distribution of the longitudinal dimension of particles is given in the images.

Table S1. EDX analysis results of N-MPs-Ce10, N-MPs-Ce20 and N-MPs-Ce50.

	Na (at%)	Y (at%)	F (at%)	Ce (at%)	Yb (at%)	Er (at%)
N-MPs-Ce10	11.5	13.4	66.1	2.9	5.5	0.5
N-MPs-Ce20-microparticle	18.6	7.3	65.5	4.4	3.8	0.4
N-MPs-Ce20-submicroparticle	0.0	0.0	68.4	29.7	1.8	0.1
N-MPs-Ce50-microparticle	7.6	5.5	67.5	14.3	4.7	0.5
N-MPs-Ce50-submicroparticle	0.0	0.0	69.1	28.9	1.5	0.4

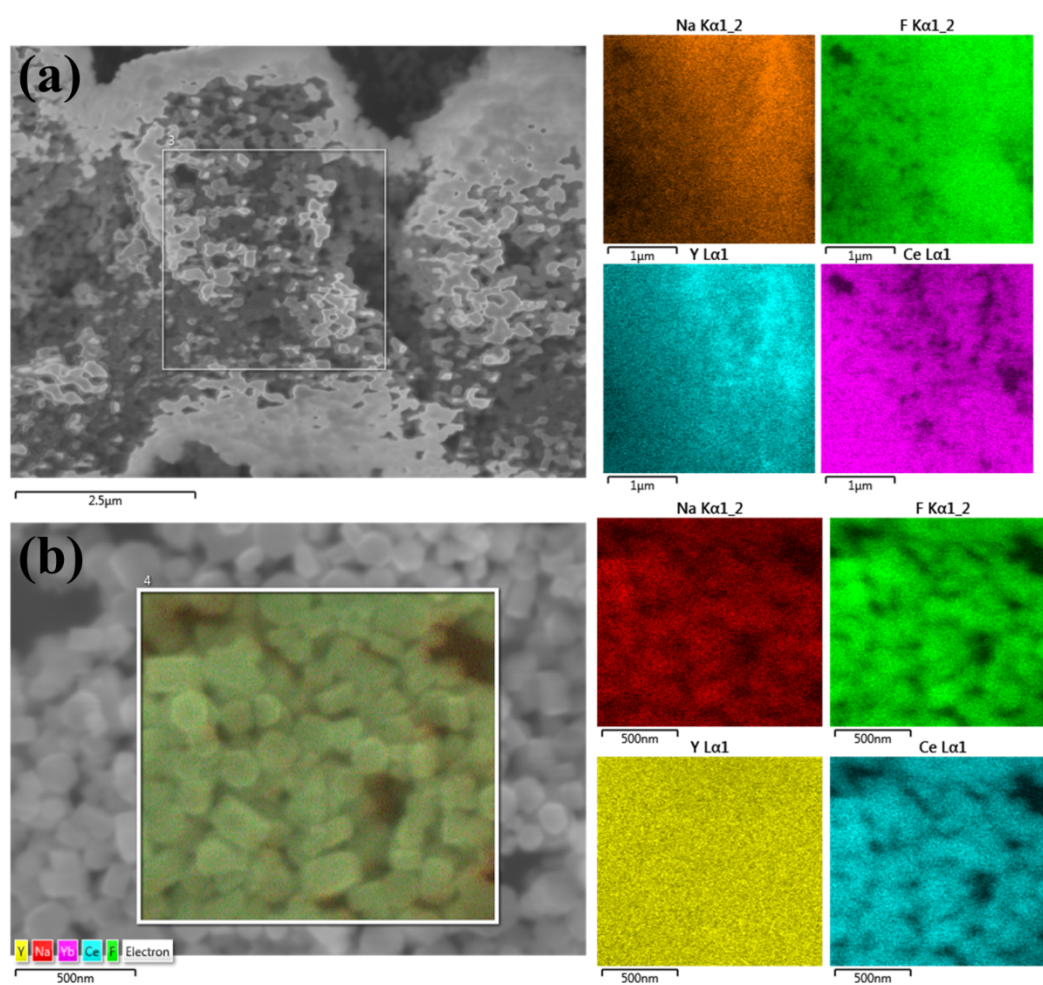


Figure S5. EDX image mapping of N-MPs-Ce50 at different regions: (a) region of microparticle; (b) region of submicroparticles.

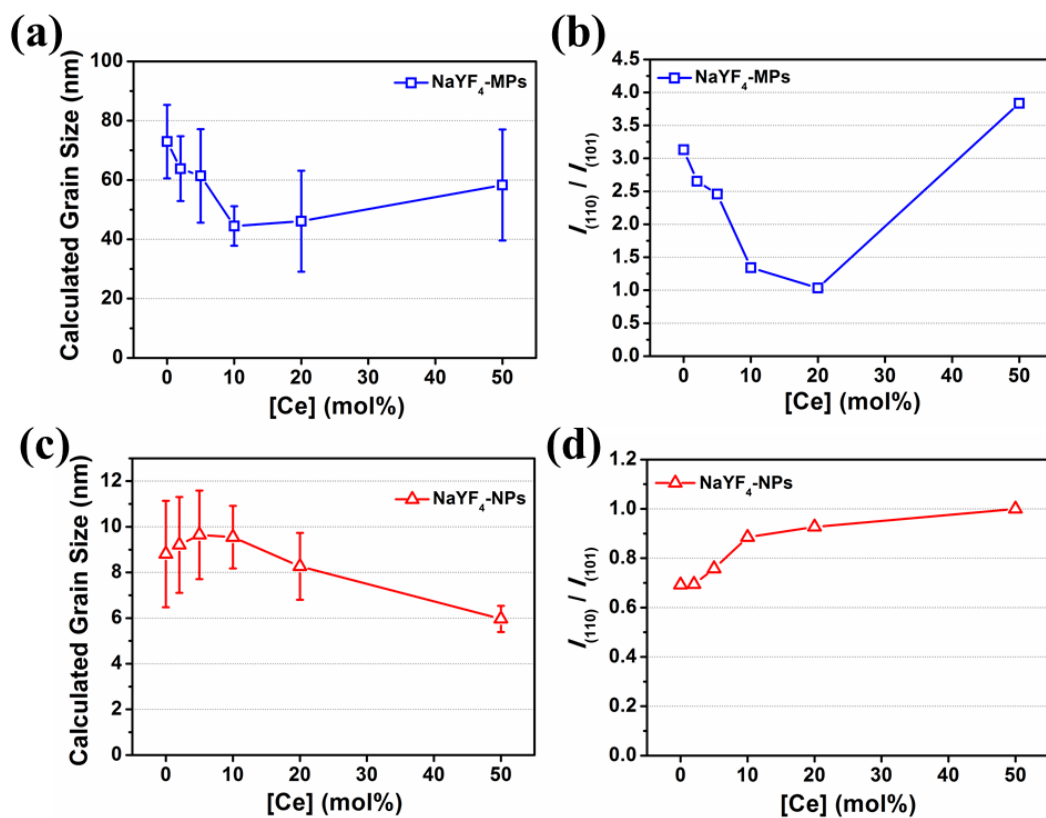


Figure S6. The calculated grain size (a, c) using the Scherrer equation and intensity ratio of (110) to (101) planes (b, d) from XRD patterns of N-MPs (a, b) and N-NPs (c, d) with Ce-doping concentration ranging from 0 to 50 mol%.

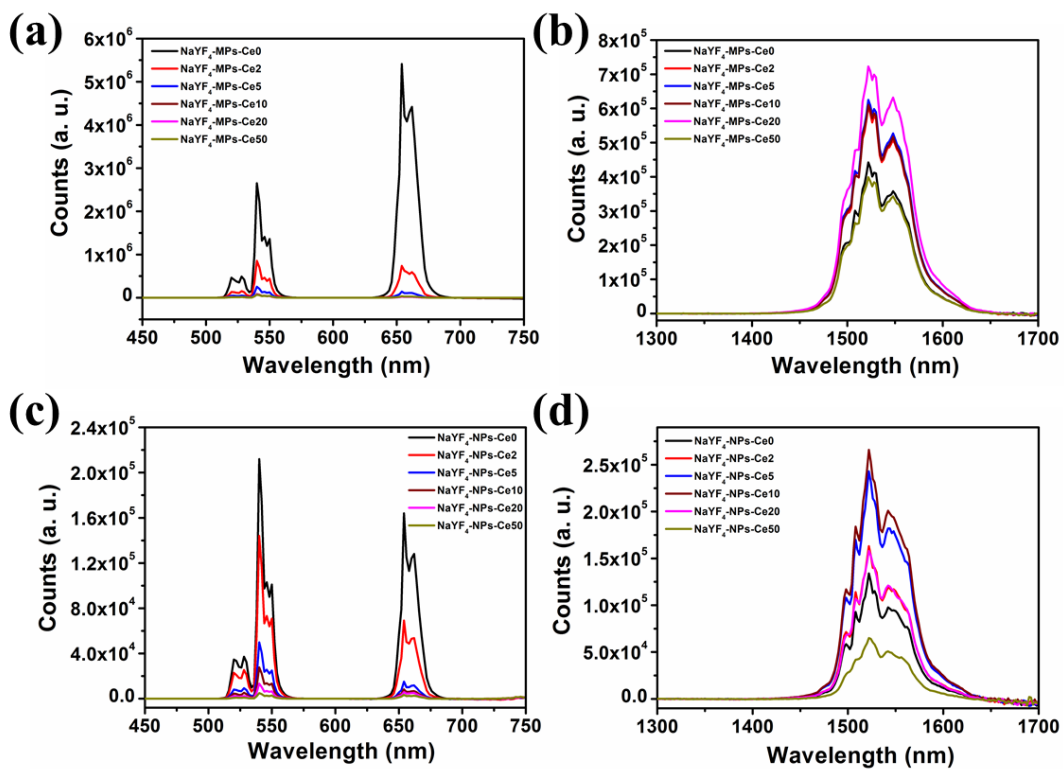


Figure S7. Up-conversion visible (a, c) and down-shifting infrared emissions (b, d) of N-MPs (a, b) and N-NPs (c, d).

Table S2. The fitted decay constants of time resolved emission spectra at 1530 nm for N-MPs and N-NPs using a double exponential equation.

N-MPs	τ_1 (μ s)	Standard error	τ_2 (μ s)	Standard error	N-NPs	τ_1 (μ s)	Standard error	τ_2 (μ s)	Standard error
Ce0	3741.8	14.1	3741.8	14.1	Ce0	342.8	4.4	2146.4	10.9
Ce2	3901.9	13.3	3901.9	13.3	Ce2	2213.9	10.7	353.7	5.6
Ce5	3932.7	13.1	3932.7	13.1	Ce5	433.4	12.0	2406.2	12.1
Ce10	3457.4	9.3	3457.4	9.3	Ce10	474.8	12.2	2480.4	13.8
Ce20	3115.5	7.3	3115.5	7.3	Ce20	1502.6	2.7E-6	1502.6	2.7E-6
Ce50	1692.4	3.2	1692.4	3.2	Ce50	939.5	6.0	213.3	2.8