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SUPPORTING INFORMATION

Alleviating Luminescence Concentration Quenching in Lanthanide Doped CaF_2 Based Nanoparticles through Na^+ Ions Doping

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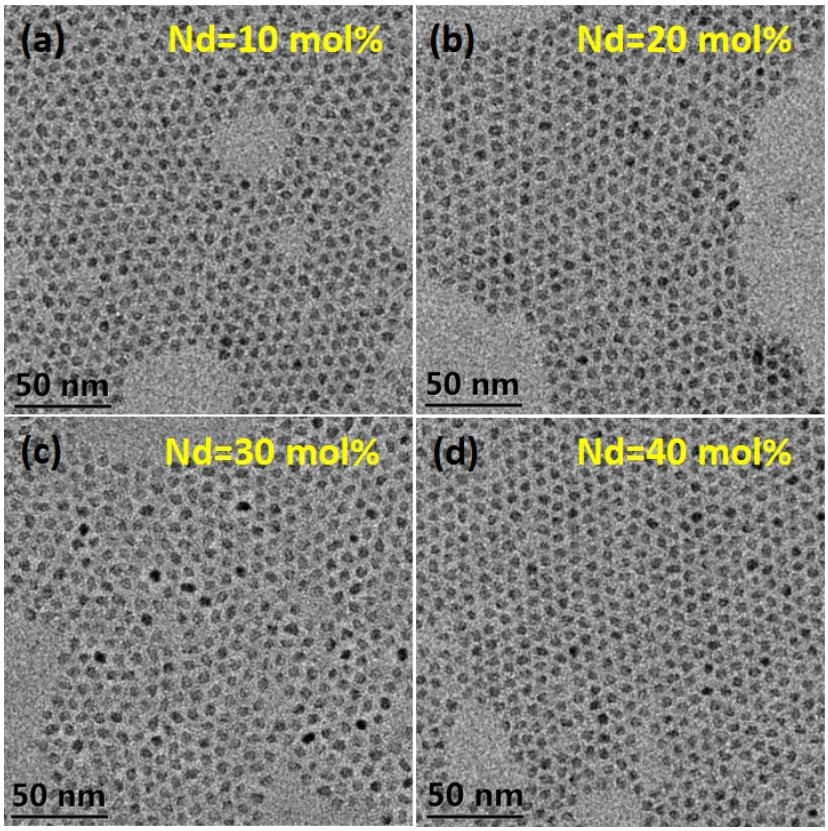

Figure S1. TEM images of CaF_2:Nd/Na nanoparticles with different Nd^{3+} doping concentrations.

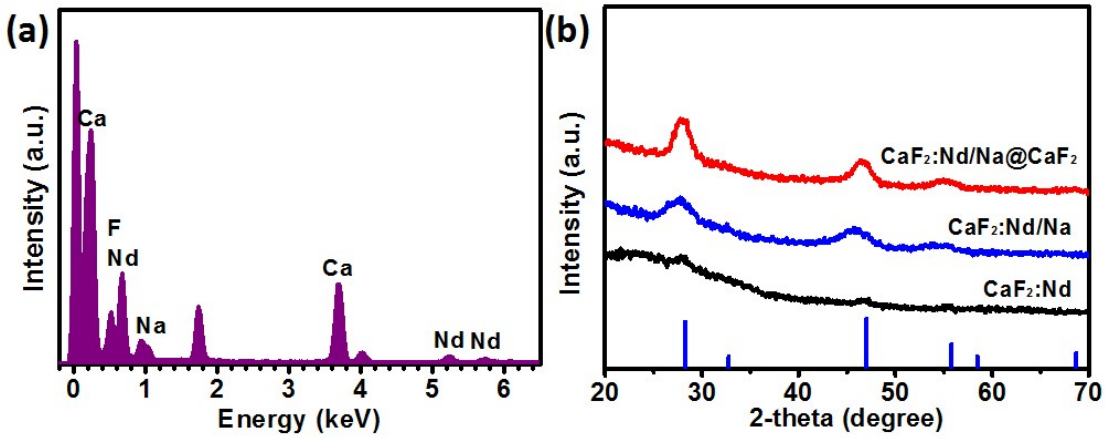

Figure S2. (a) EDX pattern of CaF_2:Nd/Na nanoparticles; (b) XRD patterns of the as-synthesized CaF_2:Nd, CaF_2:Nd/Na and CaF_2:Nd/Na@CaF_2 nanoparticles.

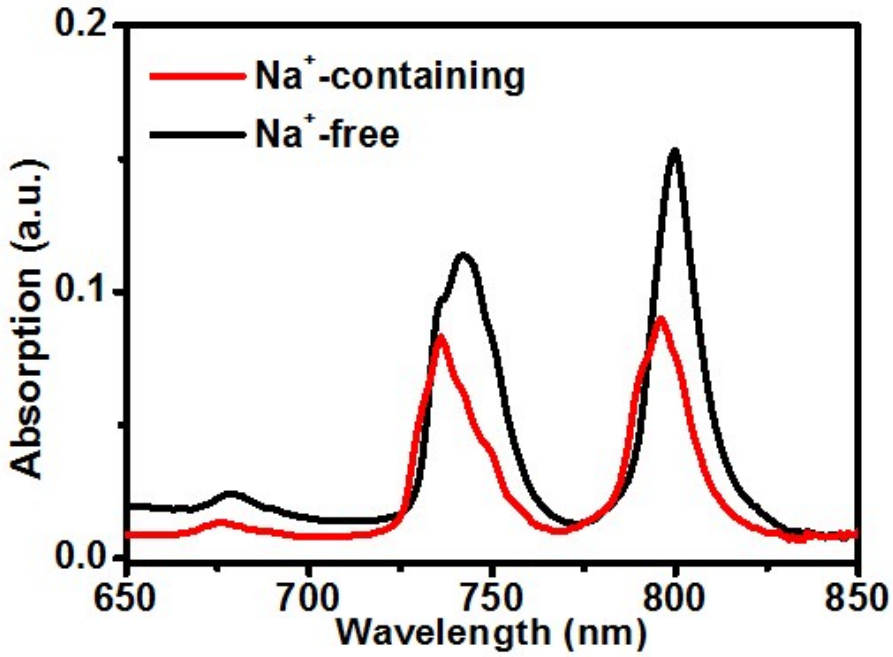

Figure S3. Visiable - Near-infrared absorption spectra of the CaF_2:Nd samples codoped with and without Na^+ ions dispersed in cyclohexane (0.1 mmol·ml^{-1}). The absorption peak at around 740 nm, 800 nm are the results of the transitions from $^4I_{9/2}$ to $^4F_{7/2}$, $^4I_{9/2}$ to $^4F_{5/2}$ of Nd^{3+} ions, respectively.

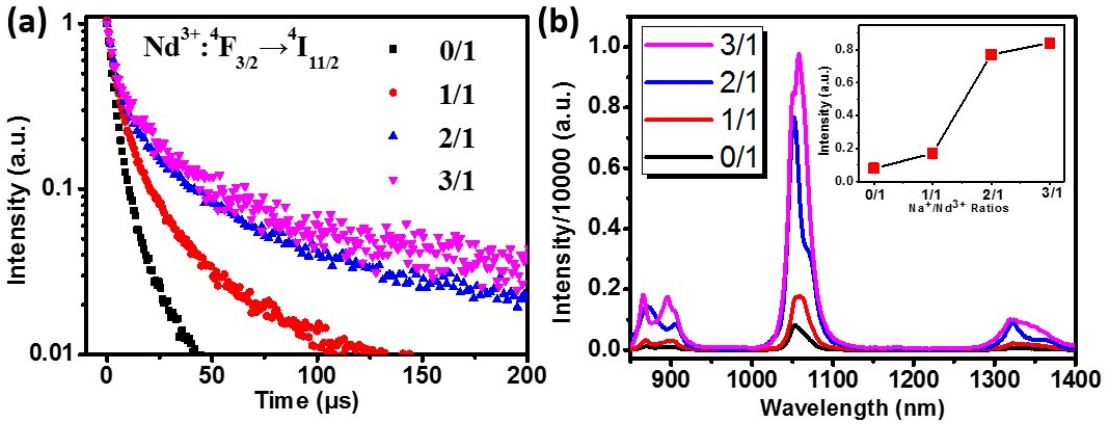

Figure S4. (a) Decays of PL emission at 1052 nm in CaF_2:Nd(10 mol%)/Na nanocrystals doped with different ratios of Na^+/Nd^{3+} under 800 nm laser excitation; (b) NIR PL spectra of CaF_2:Nd(10 mol%)/Na nanocrystals doped with different ratios of Na^+/Nd^{3+} under 800 nm laser excitation. Inset in (b): PL intensity at 1052 nm as a function of Na^+/Nd^{3+} ratios.

Table S1. Energy transfer parameters versus concentration from fitting Eq.(1) to fluorescence decay data of CaF_2:Nd samples with different Na^+ doping. A_{ss} is an abbreviation for $(4/3)\pi^{3/2}n_a(\alpha)^{1/2}$. W, n_a and α are defined in the experimental section, and $1/\tau_{tail}=1/\tau_0+W$, $\tau_0=262$ μs.

Na^+/Nd^{3+}	τ_{tail} (μs)	W (s^{-1})	A_{ss} ($s^{-1/2}$)
0/1	21	44500	297
1/1	98	6387	336
2/1	209	972	350
3/1	212	900	352

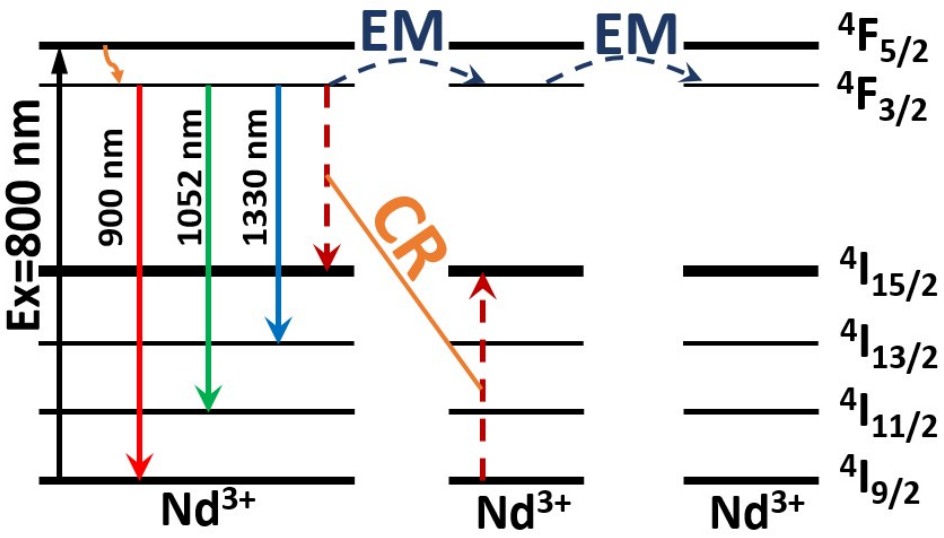

Figure S5. Mechanism of generation of the NIR PL emissions upon 800 nm laser irradiation, the cross-relaxation (CR) process and energy migration process (EM) between Nd^{3+} ions.

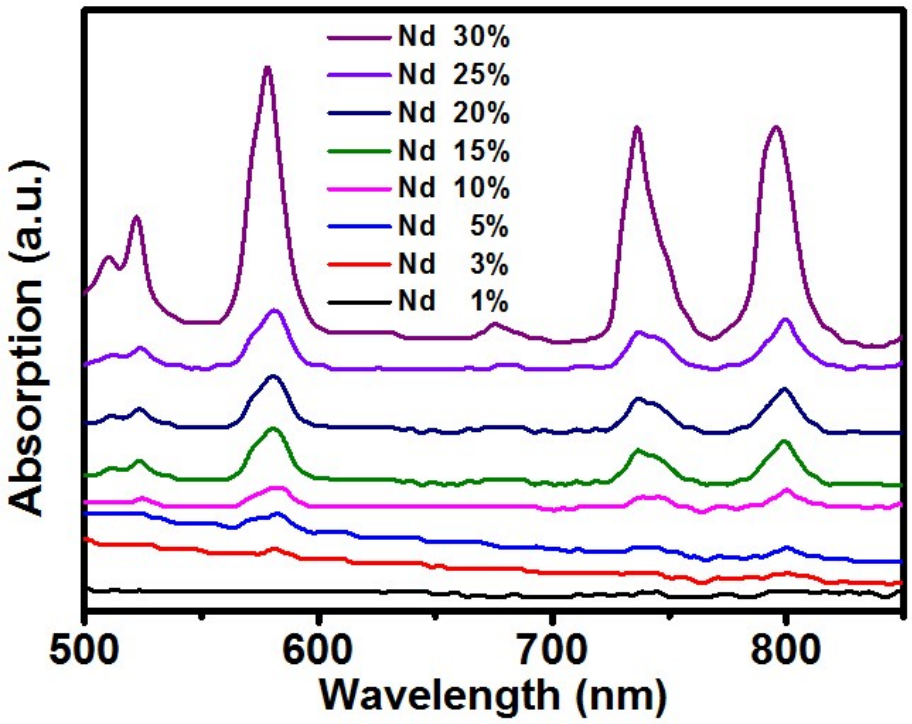

Figure S6. Absorption spectra of CaF_2:Nd samples with different Nd^{3+} doping contents.