Supporting Information

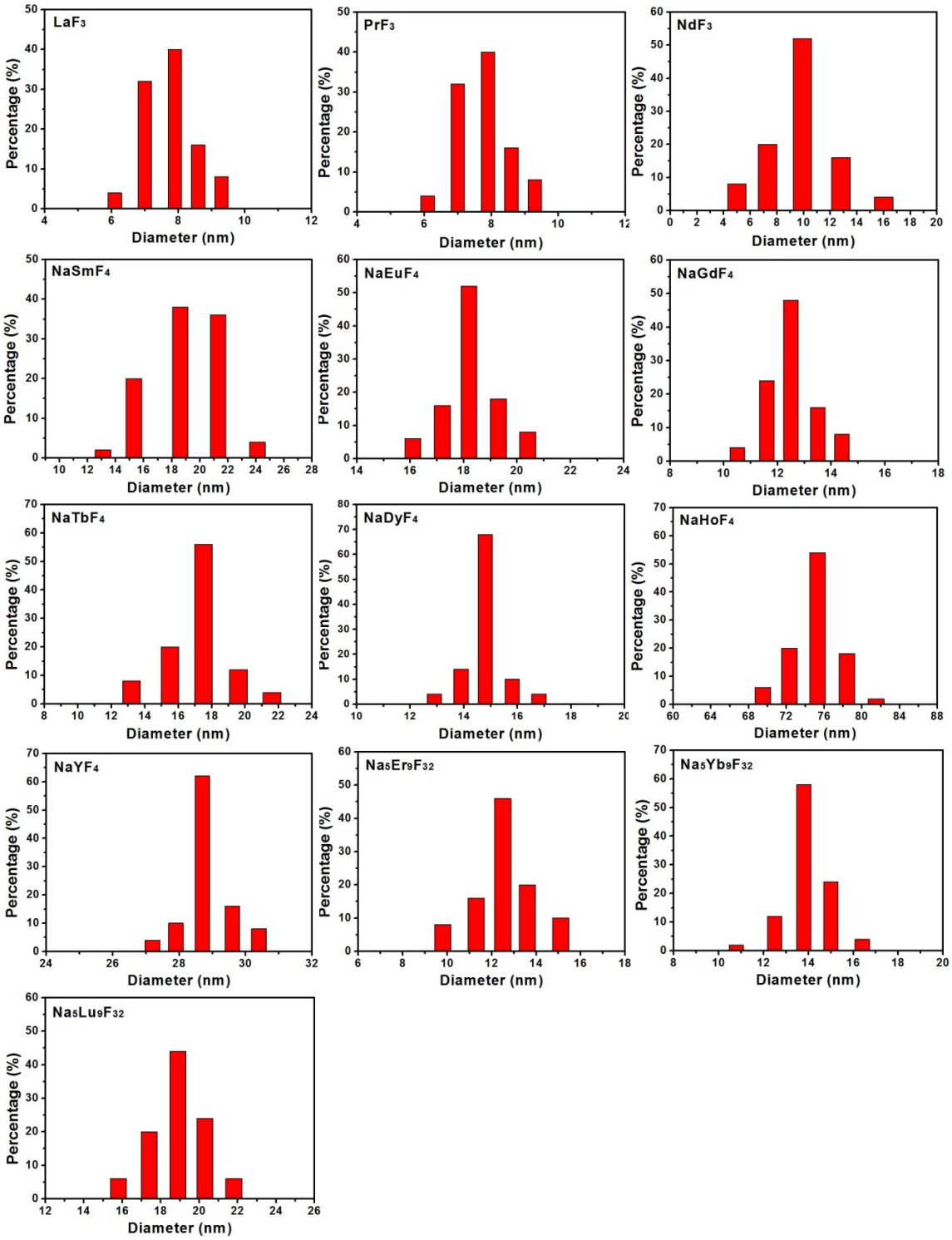

Figure S1. Particle size distribution histograms of REF_3 (RE = La, Pr, Nd), $NaREF_4$ (RE = Sm–Ho, Y), and $Na_5RE_9F_{32}$ (RE = Er, Yb, Lu) NCs.

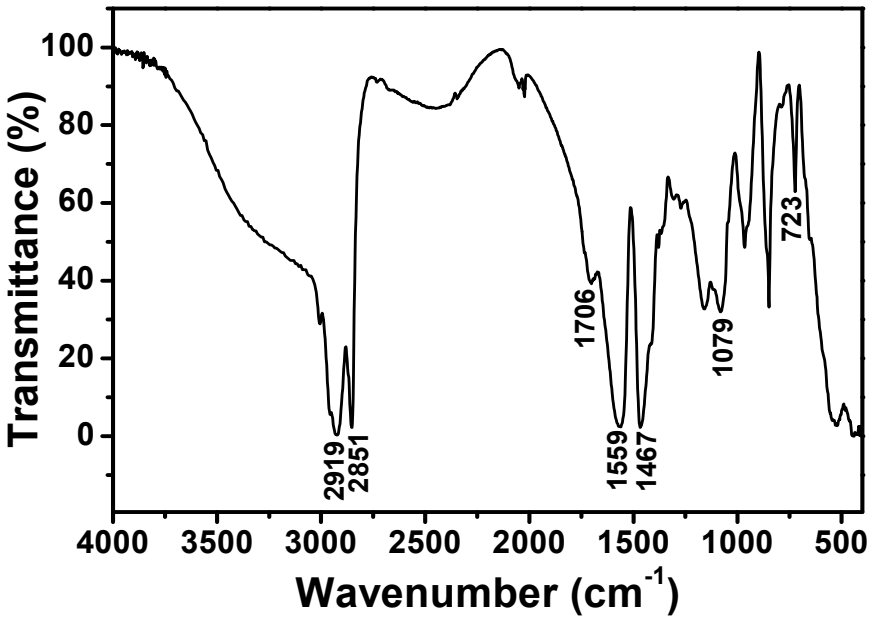

Figure S2. FT-IR spectrum of representative $NaGdF_4$ NCs.

The oleic acid (OA) ligand plays an important role in the formation of monodisperse NCs, which provides the as-prepared NCs with excellent stability and solubility in non-polar solution. The presence of the OA ligand can be confirmed by the FT-IR spectrum of $NaGdF_4$ NCs (**Figure S2**). As shown, the absorption peaks at 2919 cm^{-1} and 2851 cm^{-1} can be assigned to the symmetric (ν_s) stretching vibrations of $-CH_3$ group and $-CH_2$ groups, respectively.[s1] The peaks at 1706 cm^{-1} is associated with the C=O stretching vibration. The peaks at 1559 and 1467 cm^{-1} can be ascribed to the asymmetric (ν_{as}) and symmetric (ν_s) stretching vibration of the carboxylic group (-COOH), respectively.[s2,1f,1g] The peak at 723 cm^{-1} is assigned to the in-planar swing of (CH_2) n ($n > 4$).[s3] Thus, it can be concluded that the as-prepared $NaGdF_4$ NCs have been capped by OA molecules, which endow the NCs with hydrophobic surfaces and lead to good dispersibility in non-polar cyclohexane solvent.

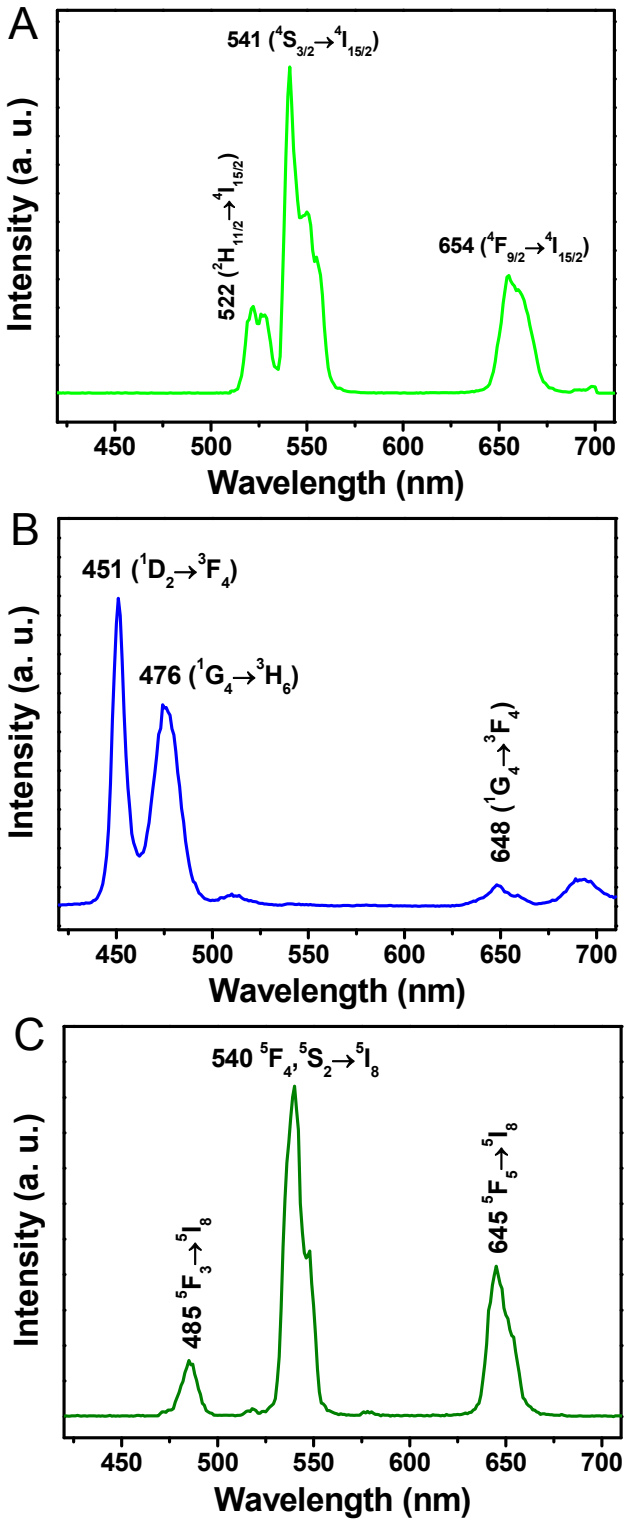

Figure S3. NIR-to-visible UC emission spectra of LaF_3:Yb/Er (A), LaF_3:Yb/Tm (B), and LaF_3:Yb/Ho NCs (C).

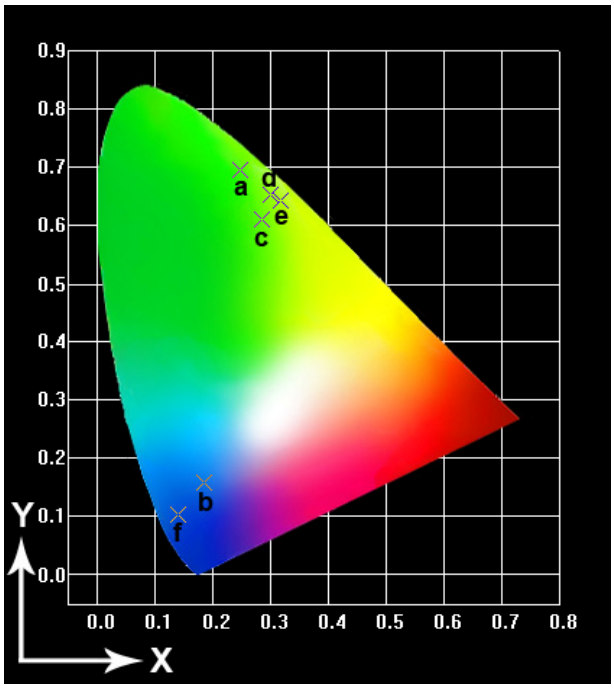

Figure S4. CIE chromaticity diagram of $NaGdF_4$:Yb/Er (a), $NaGdF_4$:Yb/Tm (b), $NaGdF_4$:Yb/Ho (c), $Na_5Lu_9F_{32}$:Yb/Er (d), $Na_5Lu_9F_{32}$:Yb/Ho NCs (e), and $Na_5Lu_9F_{32}$:Yb/Tm (f).

References:

S1. (*a*) Y. T. Tao, *J. Am. Chem. Soc.*, 1993, **115**, 4350; (*b*) D. L. Allara, R. G. Nuzzo, *Langmuir*, 1985, **1**, 45; (*c*) N. E. Schlotter, M. D. Porter; T. B. Bright, D. L. Allara, *Chem. Phys. Lett.*, 1986, **132**, 93; (*d*) L. K. Chau, M. D. Porter, *Chem. Phys. Lett.*, 1990, **167**, 198.

S2. L. Y. Wang, Y. D. Li, *Nano Lett.*, 2006, **6**, 1645.

S3. X. M. Zhang, Z. W. Quan, J. Yang, P. P. Yang, H. Z. Lian, J. Lin, *Nanotechnology*, 2008, **19**, 075603.