Electronic Supplementary Material

Enhancing upconversion via constructing local energy cluster in lanthanide doped fluoride nanoparticles

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Supplementary Figures

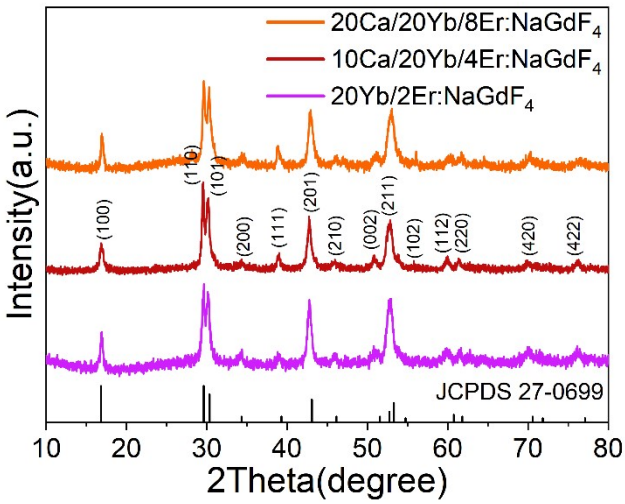

Figure S1. XRD patterns of the as-prepared 20Yb/2Er: $NaGdF_4$, 20Yb/4Er/10Ca: $NaGdF_4$ and 20Yb/8Er/20Ca: $NaGdF_4$ NPs.

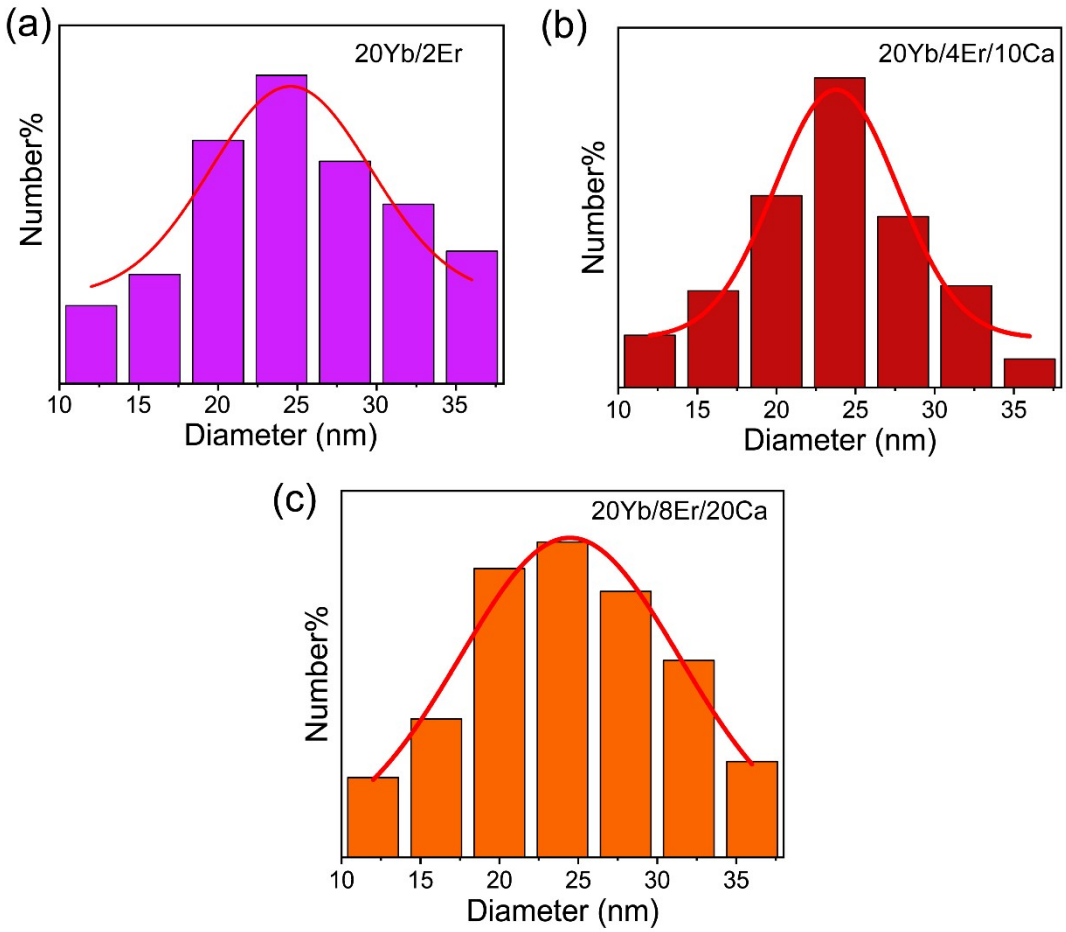

Figure S2. Histograms of particle size distributions for the 20Yb/2Er: $NaGdF_4$ (a), 20Yb/4Er/20Ca: $NaGdF_4$ (b), 20Yb/8Er/20Ca: $NaGdF_4$ NPs (c).

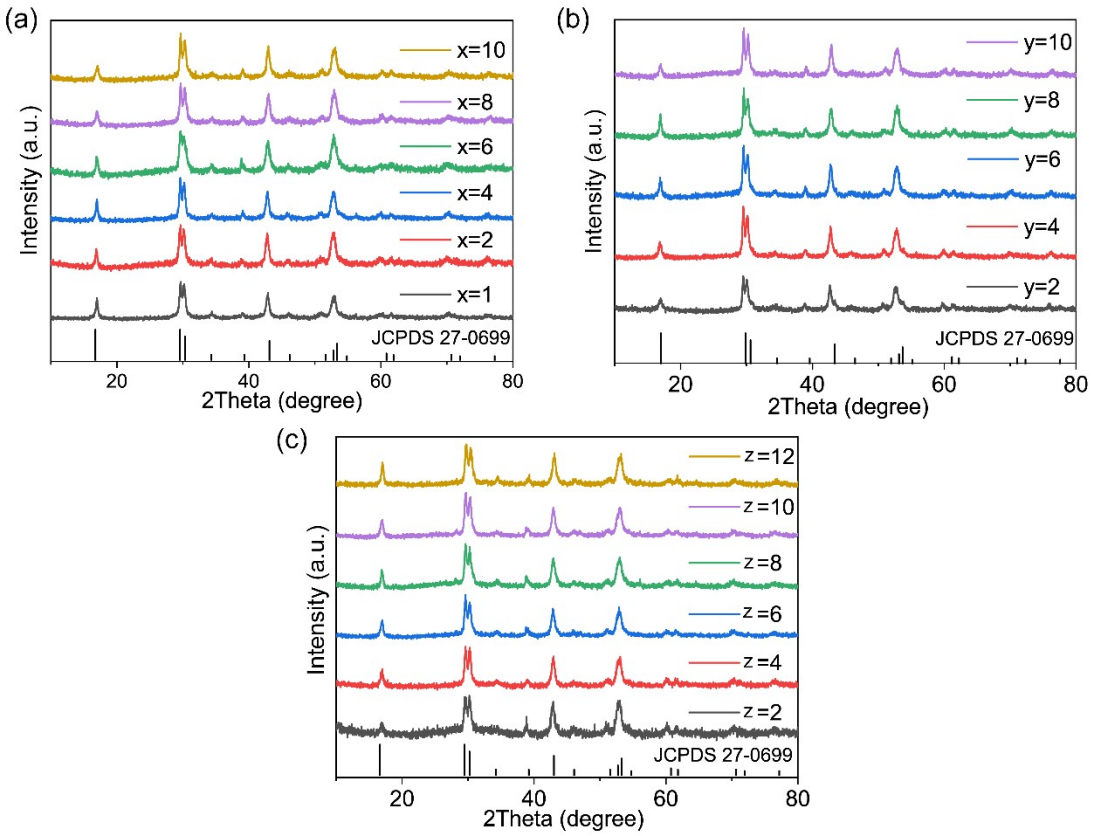

Figure S3. XRD patterns of the as-prepared 20Yb/xEr: $NaGdF_4$ (x = 1, 2, 4, 6, 8, 10) (a), 20Yb/yEr/20Ca: $NaGdF_4$ (y = 2, 4, 6, 8, 10) (b), 20Yb/8Er/zCa: $NaGdF_4$ (z = 2, 4, 6, 8, 10, 12) NPs (c).

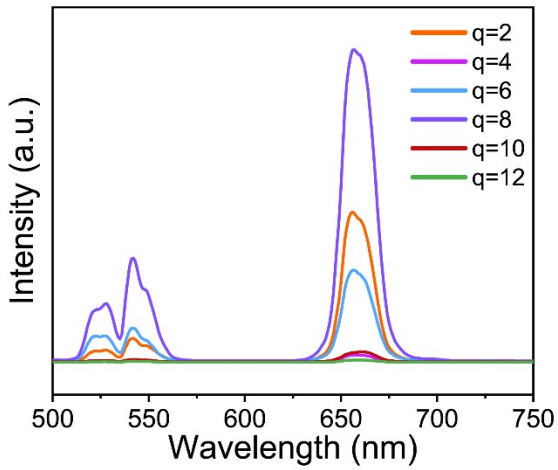

Figure S4. UC emission spectra of the 20Yb/qEr/10Ca: $NaGdF_4$ NPs (q = 2, 4, 6, 8, 10, 12) prepared at the reaction temperature of 200 ^oC and heating time of 10 hours.

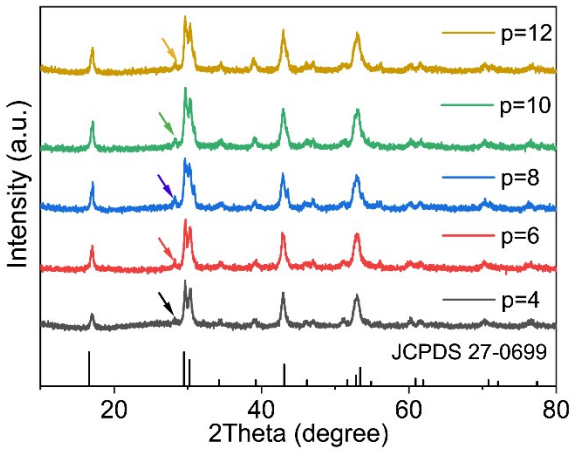

Figure S5. XRD patterns of the as-prepared 20Yb/pEr/30Ca: $NaGdF_4$ (p = 2, 4, 6, 8, 10, 12).

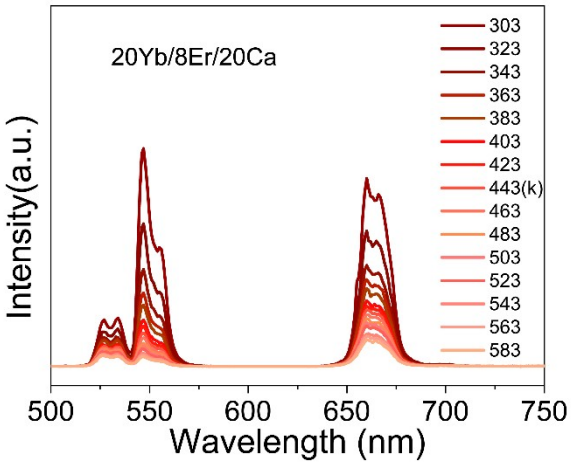

Figure S6. Temperature dependent UC spectra of the20Yb/8Er/20Ca: $NaGdF_4$ NPs

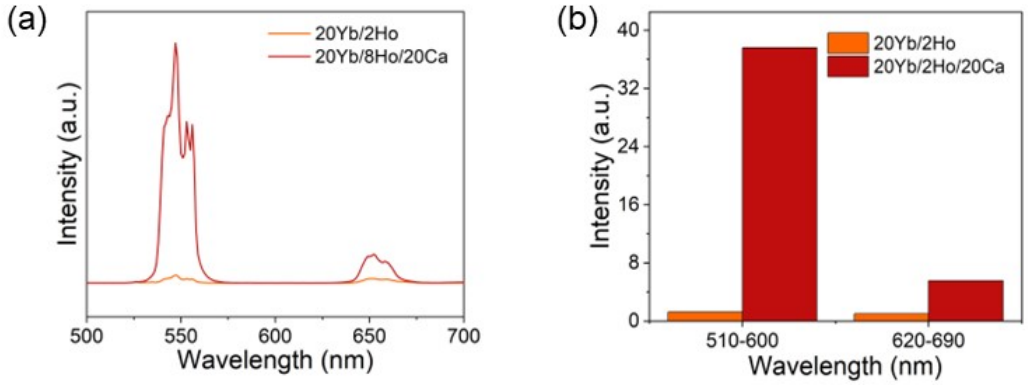

Figure S7. (a) UC emission spectra and (b) integral intensity variations of the 20Yb/2Ho: $NaGdF_4$ and 20Yb/8Ho/20Ca: $NaGdF_4$ NPs.

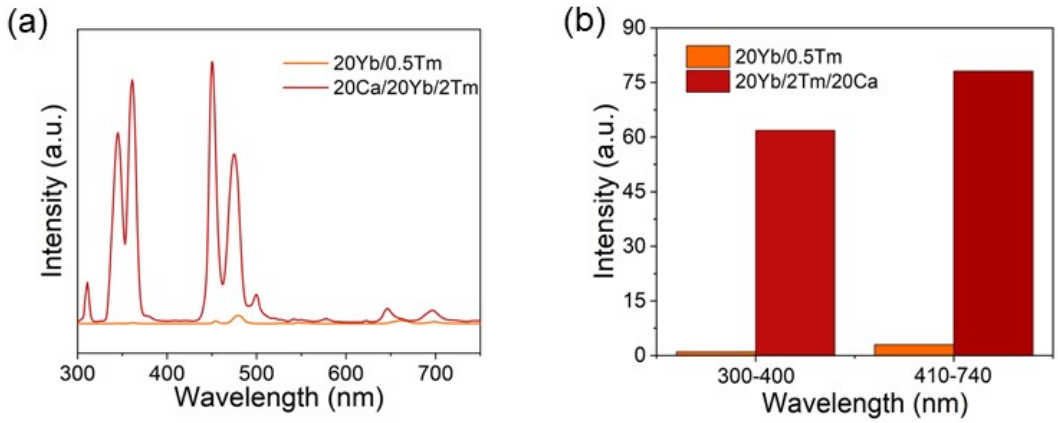

Figure S8. (a) UC emission spectra and (b) integral intensity variations of the 20Yb/0.5Tm: $NaGdF_4$ and 20Yb/2Tm/20Ca: $NaGdF_4$ NPs.

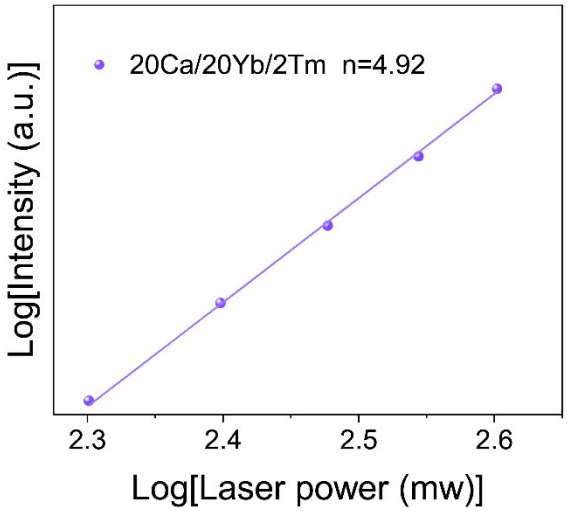

Figure S9. Log-log plots of UC emission intensity versus pumping power for the 20Yb/2Tm/20Ca: $NaGdF_4$ NPs.

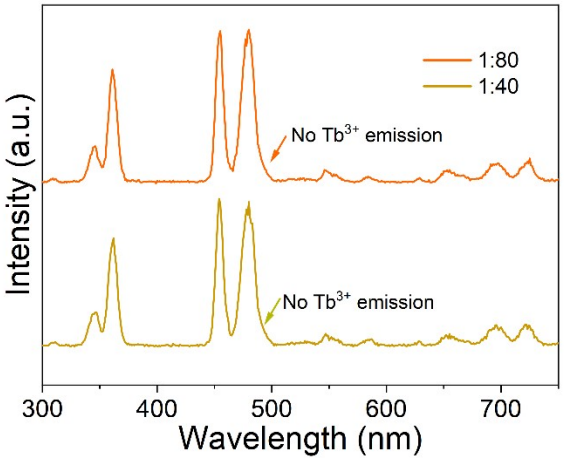

Figure S10. UC spectra of the mixed 20Yb/2Tm/20Ca: $NaYF_4$ NPs and the 15Tb: $NaGdF_4$ NPs with different ratios.