Supplementary Materials

Synthesis, Optical Properties, and Sensing Applications of $LaF_3:Yb^{3+}/Er^{3+}/Ho^{3+}/Tm^{3+}$ Upconversion Nanoparticles

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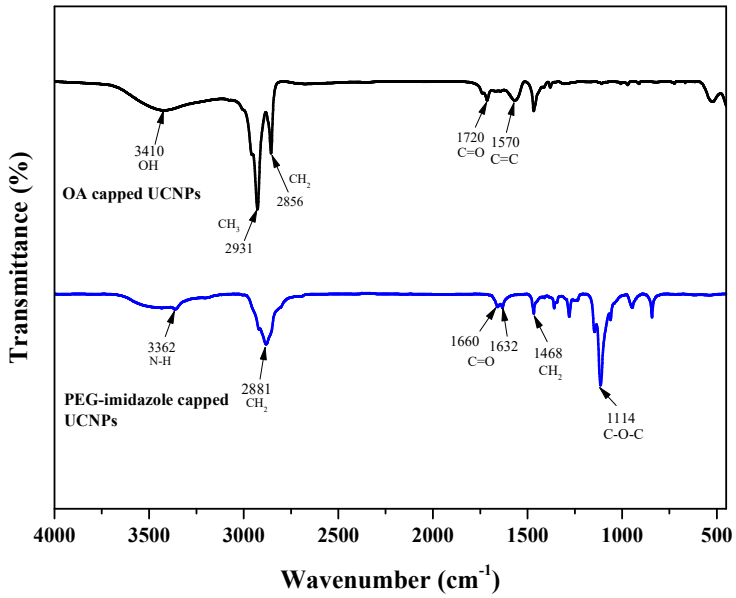
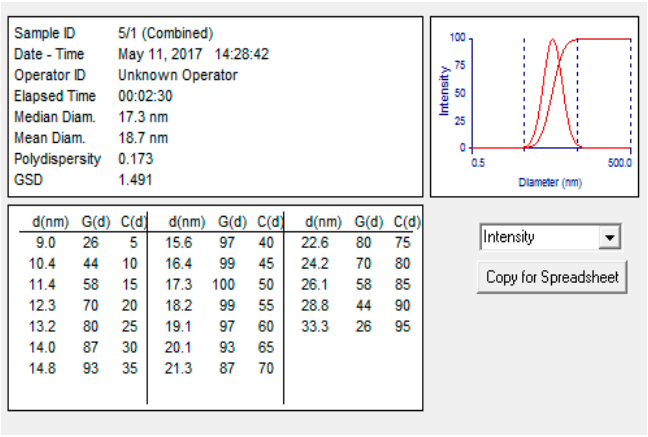


Figure S1. Fourier transform infrared spectra of oleate-capped UCNPs and PEG-imidazole capped UCNPs (after ligand exchange).



d(nm)	G(d)	C(d)	d(nm)	G(d)	C(d)	d(nm)	G(d)	C(d)
9.0	26	5	15.6	97	40	22.6	80	75
10.4	44	10	16.4	99	45	24.2	70	80
11.4	58	15	17.3	100	50	26.1	58	85
12.3	70	20	18.2	99	55	28.8	44	90
13.2	80	25	19.1	97	60	33.3	26	95
14.0	87	30	20.1	93	65			
14.8	93	35	21.3	87	70			

Figure S2. Dynamic light scattering (DLS) analysis of the $LaF_3:Yb^{3+}_{0.20},Er^{3+}_{0.02}@LaF_3:Yb^{3+}_{0.20}$ core/shell UCNP after ligand exchange.

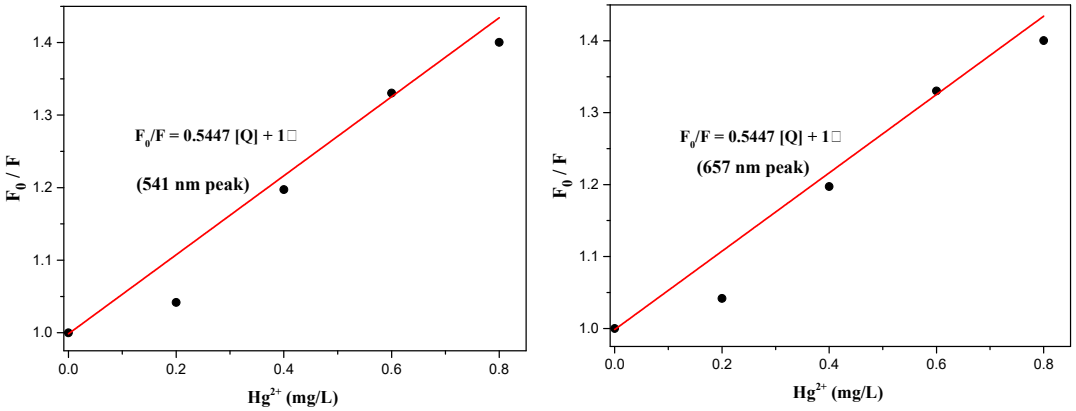


Figure S3. Stern-Volmer plots of two main emission bands for Hg^{2+} induced quenching of the $LaF_3:Yb^{3+}_{0.20},Er^{3+}_{0.02}@LaF_3:Yb^{3+}_{0.20}$ UCNPs.