Electronic Supplementary Information

for

$NaYF_4:Yb^{3+}/Er^{3+}$ Nanoparticle-Based Upconversion Luminescence Resonance Energy Transfer Sensor for Mercury(II) Quantification

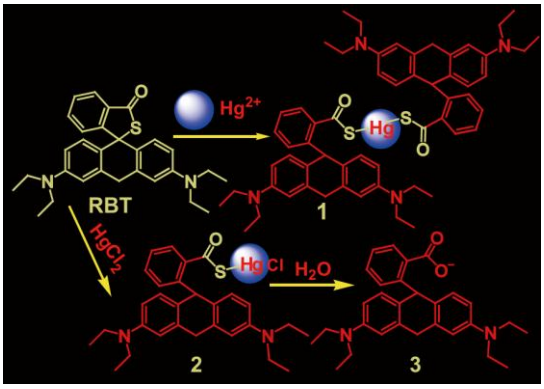

Figure S1. Formation scheme of the luminescent RBT derivates. This mechanism is depicted according to the reported paper.[1]

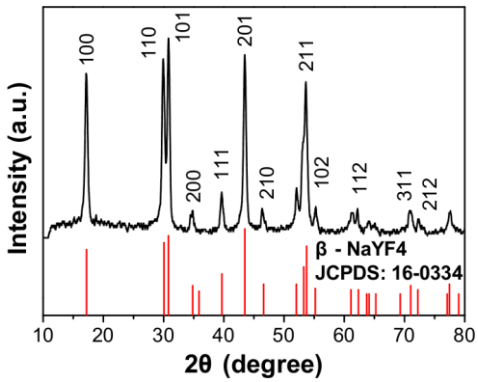

Figure S2. Powder X-ray diffraction pattern of $NaYF_4$:15%Yb^{3+},5%Er^{3+} (UCNPs).

FTIR analysis: The strong vibration peak located at 3425 cm^{-1} of NLSS (Figure S3A, d) is not found in the spectrum of UCNPs@RBT (Figure S3A, g and S3B), which indicates that the surfactant (NLSS) has already been removed after a thorough dialysis. The transmission bands at 1736 cm^{-1} in UCNPs@RBT (Figure S3A, g and S3B) is assigned to the symmetric (υ_s) stretching vibrations of carbonyl group (C=O) in the phospholipid, which are in accordance with the spectrum (Figure S3A, e), primarily indicating that the phospholipids have been coated onto the UC nanoparticles. The vibration peak located at 2966 cm^{-1} and vibration peaks less than 1671 cm^{-1} are identical to those of RBT (Figure S3A, f), suggesting the successful encapsulation of RBT onto the UCNPs. The wide vibration peak around 2800-2950 cm^{-1} of Triton X-100 (Figure S3A, c) is not observed in the spectrum of UCNPs@RBT (Figure S3A, g and S3B), suggesting no Triton X-100 being left. It should be mentioned that the main vibration of the polyethylene-block-poly-(ethylene glycol) (PE-b-PEG) is O-H and C-H vibration. But these two vibrations are not easy to be distinguished from the corresponding vibration of carboxylated phospholipids and RBT. Therefore, we can not identify the existence of PE-b-PEG on the surface of UCNPs@RBT. However, if no PE-b-PEG was used in the surface functionalization, the water-stability of the nanoparticles was not good, which confirmed in reverse the existence of PE-b-PEG on the particle surface. So, the FTIR results indicated the successful fabrication of UCNPs@RBT nanocomposites.

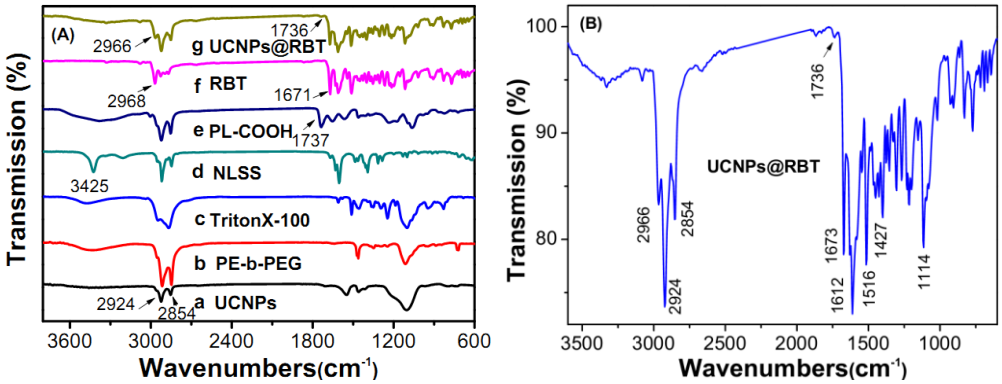

Figure S3. (A) FTIR spectra of (a) $NaYF_4$:15%Yb^{3+},5%Er^{3+} (UCNPs), (b) polyethylene-block-poly- (ethylene glycol) (PE-b-PEG), (c) Triton X-100, (d) N-Lauroyl Sarcosine Sodium (NLSS), (e) 2-dioleoyl-sn-glycero-3-phosphethanolamine-N-(succinyl) (sodium salt) (PL-COOH), (f) Rhodamine B thiolactone (RBT) and (g) RBT-modified $NaYF_4$:15%Yb^{3+},5%Er^{3+} (UCNPs@RBT). (B) FTIR spectrum of UCNPs@RBT with high resolution.

(1) Shi, W.; Ma, H. M., *Chem. Commun.* **2008**, 1856-1858.