

Electronic Supplementary Information

Luminescent metal clusters/barium sulfate composites for white light-emitting devices and anti-counterfeiting labels

Min Wang, Zhenzhen Huang, Zilong Guo and Wensheng Yang*

E-mail: wsyang@jlu.edu.cn

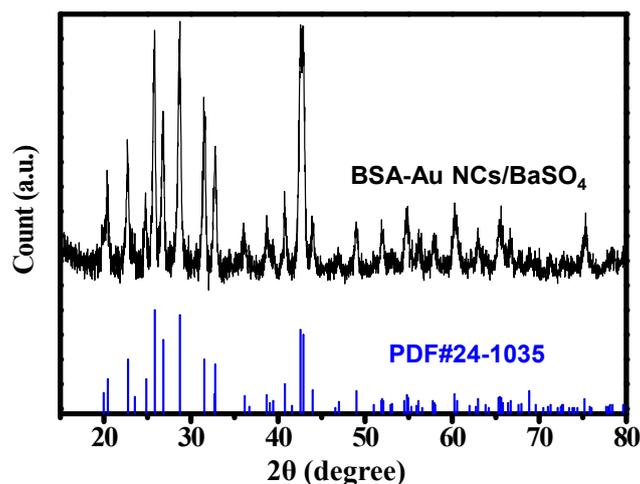


Fig. S1. XRD pattern of the powdered BSA-Au NCs/BaSO₄ composite. The peaks are well fitted to the standard pattern of orthorhombic BaSO₄ (blue). No characteristic diffraction peaks of the BSA-Au NCs at 31.82°, 45.65° and 63.70° corresponding to (111), (200) and (220) planes of face centered cubic gold were observed since they are rather weak and overlapped with those of the BaSO₄ matrix.

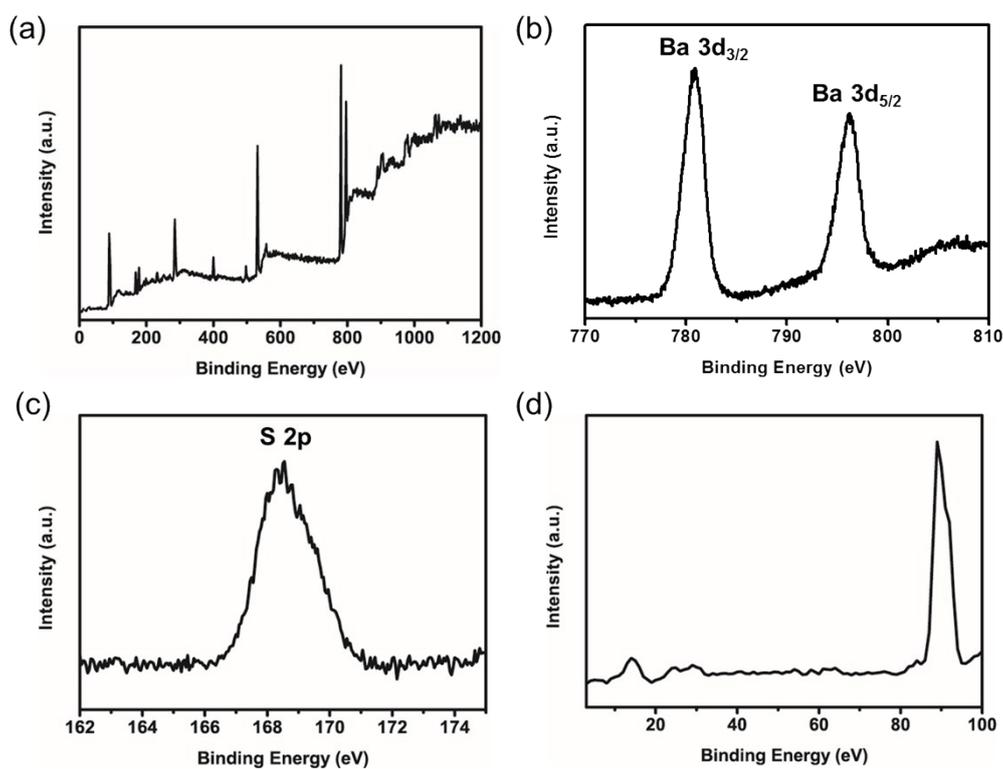


Fig. S2. XPS spectra of the BSA-Au NCs/BaSO₄ composites in the region of (a) 0–1200 eV, (b) 770–810 eV, (c) 162–175 eV and (d) 0–100 eV. The peaks of Ba 3d_{3/2} and 3d_{5/2} and S 2p could be well identified in the spectra. However, the peaks of Au 4f_{5/2} (ca. 87.7 eV) and 4f_{7/2} (ca. 84.0 eV) were not observed. These results mean that the BSA-Au NCs were mainly located in the BaSO₄ matrix but not on surface of the composite particles, suggesting the core-shell like structure of the particles.

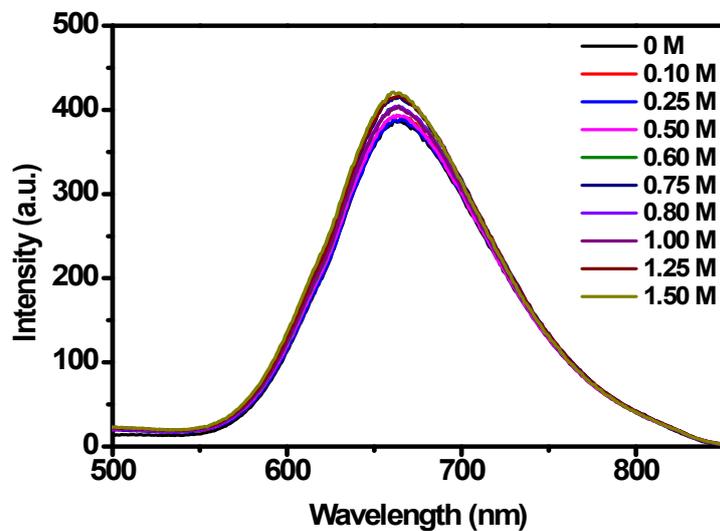


Fig. S3. Emission spectra of the BSA-Au NCs dispersed in BaCl₂ solutions with different concentrations. Emission intensity of the BSA-Au NCs changed slightly with the concentrations of BaCl₂, meaning the adsorption of Ba²⁺ ions have little effect on the emission intensity of the BSA-Au NCs.

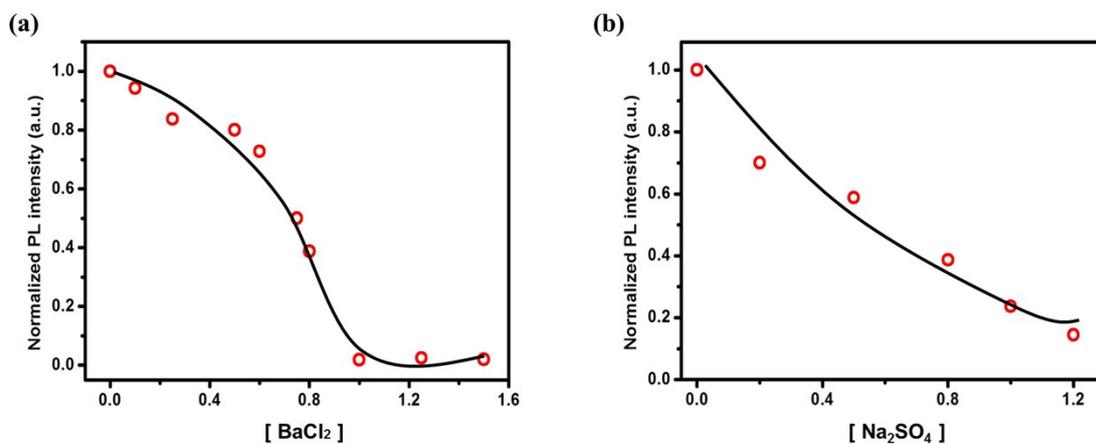


Fig. S4. Variation in emission intensity of the supernatants after centrifugation separation of the BSA-Au NCs/BaSO₄ composites prepared by altering the adding sequences of BaCl₂ and Na₂SO₄. (a) First addition of BaCl₂, and then subsequent addition of equal molar Na₂SO₄. When the concentration of BaCl₂ is more than 1 M, no red color was observed in the supernatants, indicating the complete encapsulation of the BSA-Au NCs into the BaSO₄ matrix. Thus, the molar concentrate of BaCl₂ was selected to be 1 M to prepare the composites. (b) First addition of Na₂SO₄, and then subsequent addition of equal molar BaCl₂. Red color of the BSA-Au NCs was still observable when the concentration of Na₂SO₄ was higher than 1.2 M.

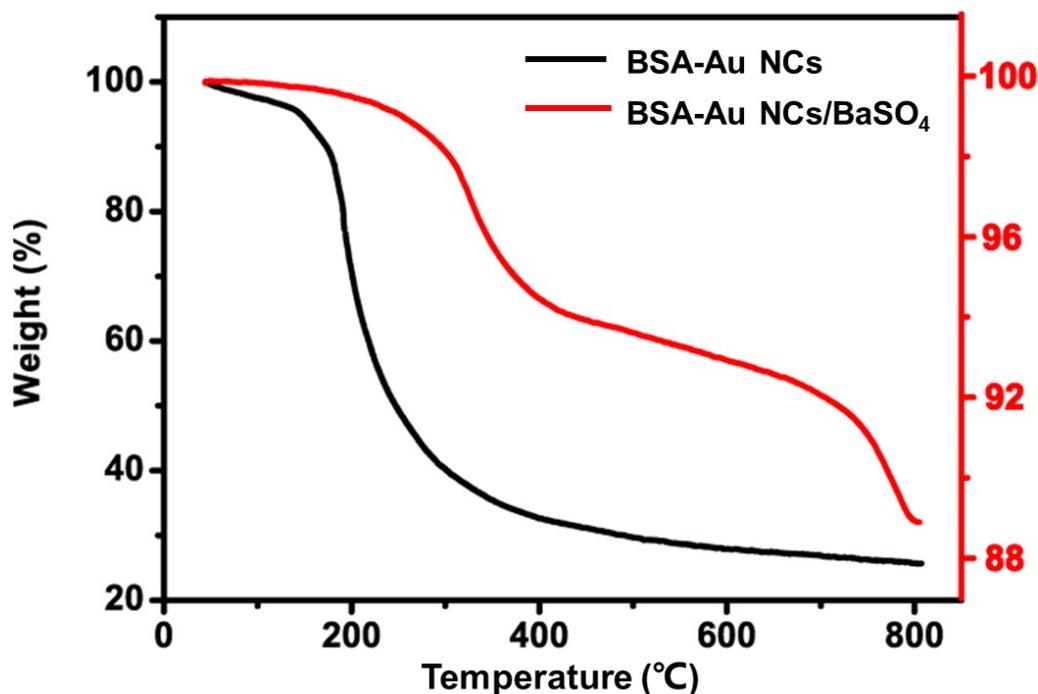


Fig. S5. TGA thermograms of the BSA-Au NCs (black curve) and the BSA-Au NCs/BaSO₄ composite (red curve). According to the experimental section, when the concentration of BaCl₂ is 1 M (5 ml, corresponding to 1.1670 g BaSO₄), the NCs could be completely incorporated into BaSO₄ matrix. After centrifugation, weights of dried powders of the BSA-Au NCs/BaSO₄, 11-MUA-Au NCs/BaSO₄ and GSH-Cu NCs/BaSO₄ composites were 1.2057, 1.1950 and 1.1854 g, respectively. After subtraction of the weight of BaSO₄, the weights of the BSA-Au NCs, 11-MUA-Au NCs and GSH-Cu NCs were derived to be 38.7, 28.0 and 18.4 mg, corresponding to weight ratios of 3.21%, 2.34% and 1.55% respectively. A weight loss of 4.25 % was identified for the pure BSA-Au NCs when the temperature exceeded 100 °C and only a weight loss of 0.01% was identified for the BSA-Au NCs/BaSO₄ composite at the same temperature, corresponding to a weight of 0.31% for the BSA-Au NCs, indicating the improved thermal stability of the BSA-Au NCs in the composite.