Electronic Supplementary Material (ESI) for Dalton Transactions.

Electronic Supplementary Information

One-pot two-step synthesis of core–shell mesoporous silica coated gold nanoparticle

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The experimental Section:

Experimental materials and equipments:

Chloroauric acid·tetrahydrate ($HAuCl_4 \cdot 4H_2O$), cyltrimethylammonium bromide (CTAB), tetraethoxysilane (TEOS), trisodium citrate dehydrate, ethanol and hydrochloric acid (HCl) were purchased from Sinopharm Chemical Reagent Co., LTD. All reagents were of analytical grade and used without any purification. The water used in experimental process was ultrapure water.

Experimental equipments included TGL-205 centrifuges (Changsha PingFan Instrument And Menter Co., LTD, China), KQ2200 ultrasonic cleaner (Kun Shan Ultrasonic Instruments Co., Ltd, China), ASAP2020M Automated Surface Area and Pore Size Analyzer (Micromeritics Instrument Corp, USA), Zetasizer Nano S90 (Malvern, United Kingdom) and Tecnai G2 20 U-Twin high resolution transmission electron microscopy (FEI, USA).

Experimental procedures:

The Au nanoparticle was prepared according to the standard sodium citrate reduction method.[1] 3.5 mL $HAuCl_4$ solution (w/v 1%) was added to 150 mL ultrapure water and heated to boiling whilst stirring. Then 6 mL sodium citrate solution (w/v 1%) was rapidly injected, and the resulting mixture was boiled for another 30 min. Then the Au colloid was cooled down to room temperature. Without any further treatment, the resultant colloidal gold solution was directly added into 11.2 mL CTAB solution (0.1 M), the mixture was stirred for another 30 min, after that, 2.4 mL NaOH solution (0.1 M) was added to adjust the pH value to 10 and the solution was went on stirring for another 10 min. According to the requirements, Au@mSiO_2 with different thickness of mSiO_2 could be obtained by changing the amount of TEOS. After adding TEOS, continued to react for 10 hours at the room temperature. Finally, equal volume of ethanol was added to the above solution for precipitation. The sediment was collected by centrifugation and redispersed in ethanol by sonication, then hydrochloric acid was added to regulate the pH value of solution less than 1, and left it for 30 minutes before another round of centrifugation. The final product of Au@mSiO_2 was got after washing by ethanol and water alternately.

Au@mSiO_2 and rodamine B were mixed together (the final concentrations of rodamine B in the mixture was 0.01mg/mL). After 1 hour, excess rodamine B was removed by centrifugation to get Au@mSiO_2-rodamine B products. The sedimentary probe was added water to restore the original concentration, and measured the fluorescent intensity of solution. Adding proper amount of PVP-k30 into the probe solution 0.5 hour later, the excess PVP-k30 was removed by centrifugation, then the potential and particle size of composite probe were measured.

The composite probe of Au@mSiO_2-rodamine B-PVP and RAW264.7 cells were co-incubated in culture medium for 24 h, then cells were washed with PBS, fixed in paraformaldehyde for 30 min, stained with DAPI for 5 min and observed fluorescence under confocal laser scanning microscope. Different concentrations of composite probe were irradiated with X-ray, the X-ray CT contrast effects were then measured.

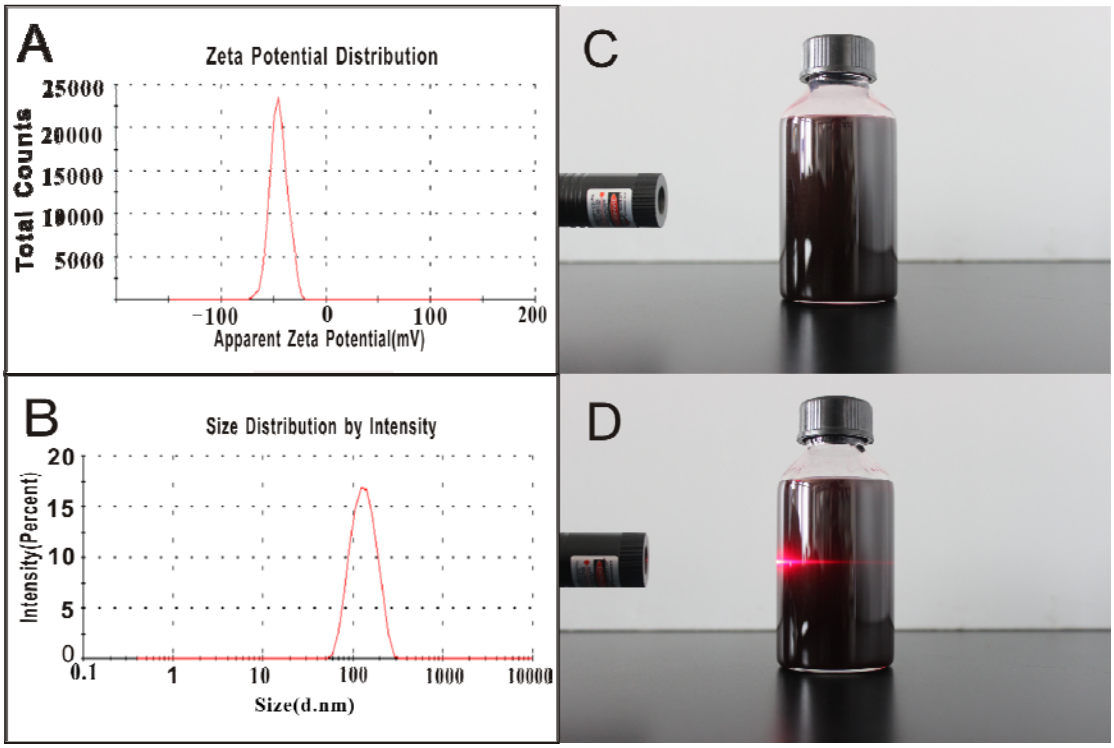

Fig. S1 Zeta potential (A) and particle size (B) distribution of Au@mSiO$_2$; the physical maps of Au@mSiO$_2$ under white light (C) and the irradiation of laser beam (650±10 nm) (D). The concentration of particle in bottle is 4 times higher than the original concentration.

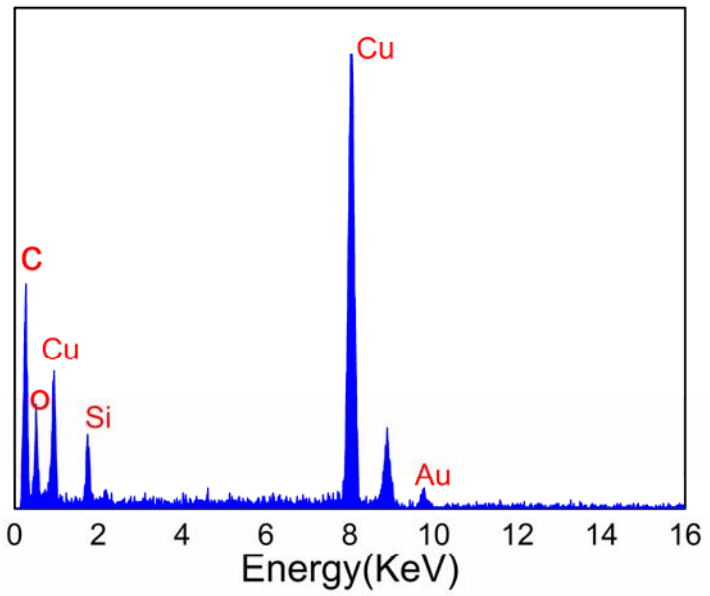

Fig. S2 Energy Dispersive X-Ray Spectroscopy (EDX) of Au@mSiO$_2$.

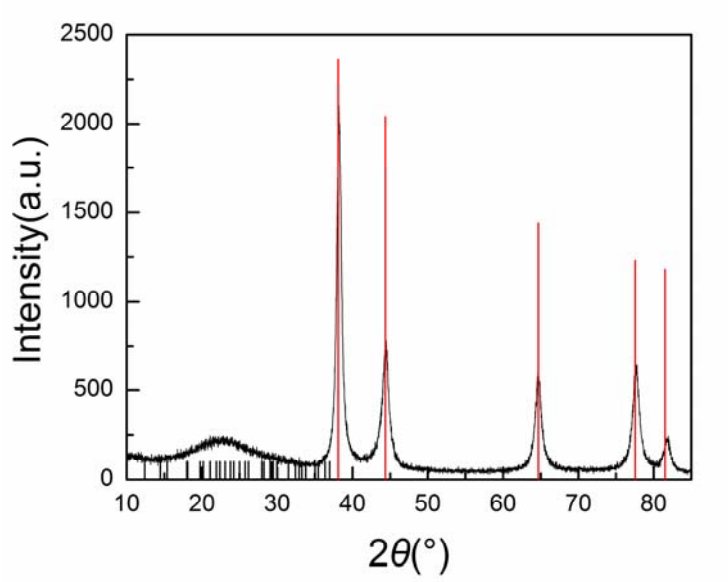

Fig. S3 X-ray angle diffraction pattern of Au@mSiO_2. The red lines correspond to the characteristic diffraction peaks of Au, the corresponding JCPDS standard card number is No. 02-1095; the black lines correspond to the characteristic diffraction peaks of SiO_2, the corresponding JCPDS standard card number is No. 50-0057.

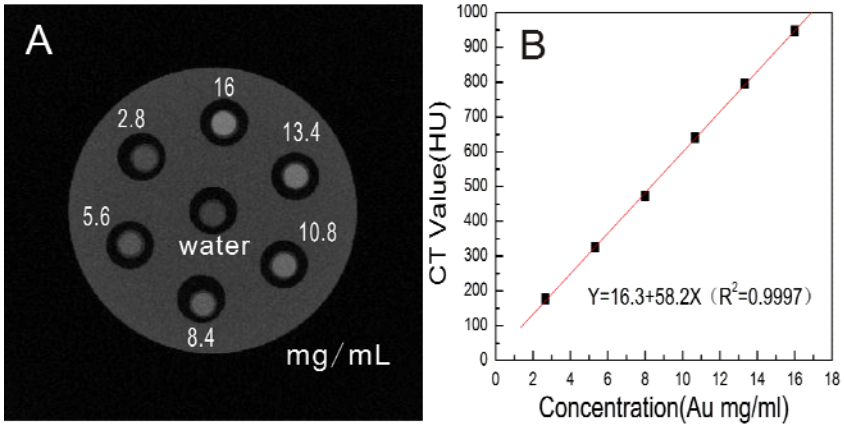

Fig. S4 (A) CT images of Au@mSiO_2-rodamine B-PVP suspended in water. The concentrations (mg/mL) of each sample were provided beside the respective images. (B) CT hounsfield unit (HU) plot of Au@mSiO_2-rodamine B-PVP at various concentrations was in the range from 2.8 to 16 mg/mL. The concentrations of probe were labeled with Au concentrations as standard.

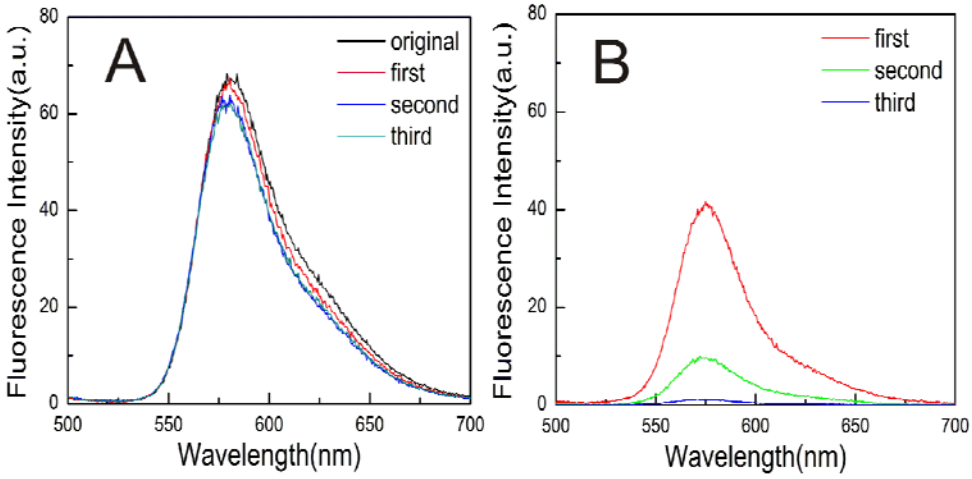

Fig. S5 The fluorescent maps of composite probe and supernatant rodamine B in water (Figure A is probe fluorescence, figure B is supernatant fluorescence). In figure A, the curves including fluorescent curve of original mixture, named "original"; the fluorescent intensity of first centrifugal precipitation which was restored original concentration by adding water, named "first"; two rounds centrifugation, named "second"; three rounds centrifugation, named "third". In figure B, the supernatant fluorescence of one round, named "first"; two rounds, named "second", three rounds, named "third". The excitation wavelength is at 480 nm.

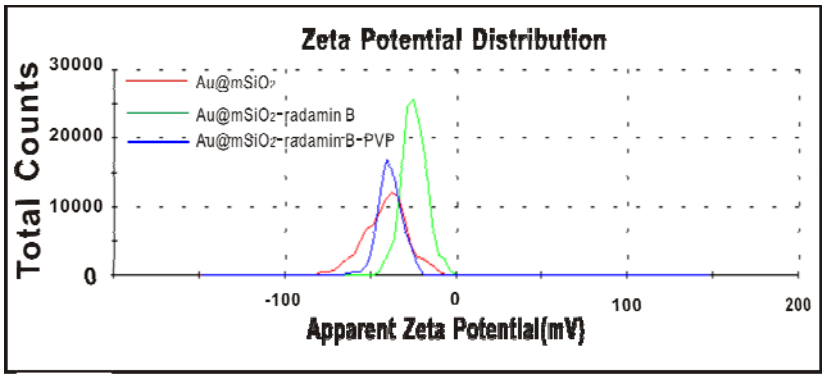

Fig. S6 Composite probe zeta potentials of $Au@mSiO_2$, $Au@mSiO_2$-rodamine B and $Au@mSiO_2$-rodamine B-PVP.

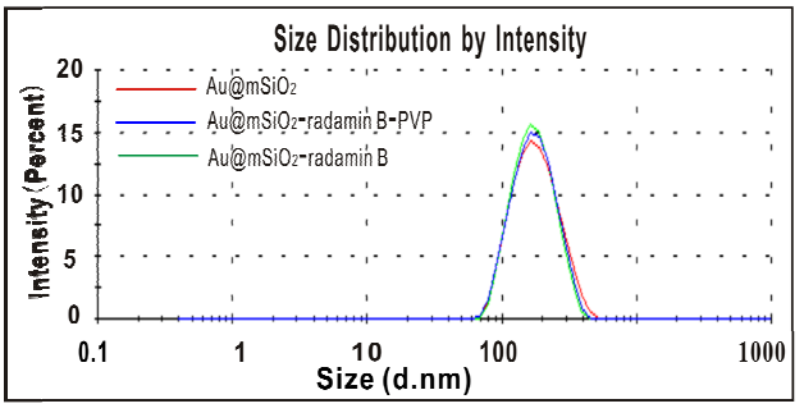

Fig. S7 Composite probe hydrated diameters of $Au@mSiO_2$, $Au@mSiO_2$-rodamine B and $Au@mSiO_2$-rodamine B-PVP.

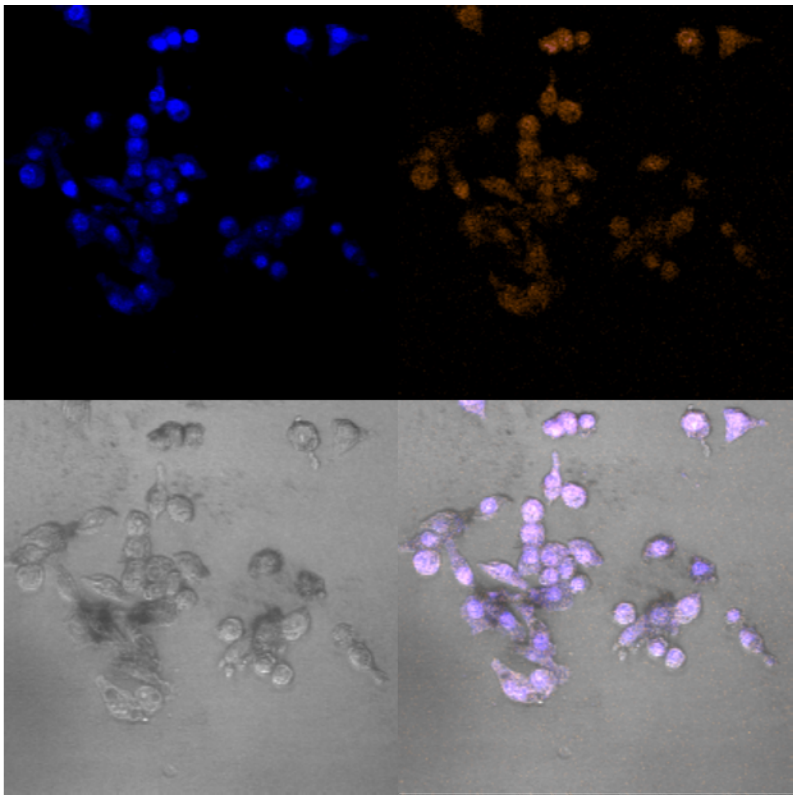

Fig. S8 The fluorescent images of RAW264.7 cells incubated with probe under confocal laser scanning microscope. Co-stained with DAPI.

[1] Y. C. Cao, X. F. Hua, X.X. Zhu, Z. Wang, Z. L. Huang, Y. D. Zhao, H Chen and M.X. Liu, *J. Immunol. Methods*, 2006, **317**, 163-170.