Electronic Supplementary Information (ESI)

Synthesis of gold nanorod/neodymium oxide yolk/shell composite with plasmon enhanced near-infrared luminescence

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1. Experimental Section

Preparation of AuNR@Nd$_2$O$_3$ yolk/shell nanocomposites: The AuNRs were firstly synthesized using a seed-mediated growth method.$^1$ The freshly prepared AuNRs solution was centrifuged at 10,000 rpm for 10 min and resuspended in defined volume of ultrapure water. Fig. ESI-1a shows the TEM images of AuNRs. The surfactant was exchanged from CTAB to oleate according to the method described previously.$^1$ For the synthesis of AuNR@Nd$_2$O$_3$ core/shell composite, 5 mL of oleate-coated AuNRs aqueous solution was added to 14 mL of ultrapure water, followed by injection of Nd(NO$_3$)$_3$ (0.01 M, 0.5 mL) and HMT (0.2 M, 0.5 mL) aqueous solution. The resulting mixture was gently stirred till a well-dispersed solution was achieved. After incubated in an oven at 85°C for 3 h, the solution was centrifuged at 8,000 rpm for 8 min and resuspended in 5 mL of ultrapure water. The above steps were repeated for three times, the final AuNR@Nd$_2$O$_3$ yolk/shell nanocomposites were obtained as shown in Fig. ESI-1b.

Preparation of Nd$_2$O$_3$ hollow nanoparticles: The Nd$_2$O$_3$ hollow nanoparticles were prepared by using an electrolyte etching method.$^{2,3}$ In detail, 1,2-DMPII and I$_2$ were first dissolved in the mixing solution of acetonitrile/ butyl cyanide [85/15, v:v]. Then, 1 mL of 1.2 M 1,2-DMPII solution, 1 mL of 0.1 M I$_2$ aqueous solution and 40 μL of LiI aqueous solution are mixed together. An appropriate amount of the electrolyte solution was injected into 5 mL of the AuNR@Nd$_2$O$_3$ yolk/shell composite aqueous solution. The mixture was sonicated for different time to achieve composite contain various length AuNR. After 4 h etching, the AuNRs totally disappeared and the hollow Nd$_2$O$_3$ HNPs were obtained as Fig. ESI-1c shows.
Fig. ESI-1 Low magnification and single particle TEM images of original AuNRs (a), AuNR@Nd$_2$O$_3$ yolk/shell nanocomposites (b) and Nd$_2$O$_3$ hollow nanoparticles (c). The insets in (b) and (c) are size distribution of AuNR@Nd$_2$O$_3$ yolk/shell and Nd$_2$O$_3$ hollow nanoparticles.

2. Characterization

Extinction spectra were recorded on TU-1810UV-Vis-NIR spectrophotometer (Purkinje General Instrument Co. Ltd Beijing, China). Transmission electron microscopy (TEM) images were obtained on a JEOL 2100F transmission electron microscope at an accelerating voltage of 200 kV. The excitation source for the fluorescence spectra was a Ti:Sapphire laser (Mira 900, Coherent) at 730 nm. An 830 nm cut filter was used to filter the exciting noise and a tunable neutral density filter was used to adjust the excitation intensity, respectively. The near-infrared luminescence spectra were recorded by a spectrometer (Spectrapro 2500i, Acton) with liquid nitrogen cooled CCD (SPEC-10:100B, Princeton)
Fig. ESI-2 Emission spectra of composites after etching for 0 h (a), 0.5 h (b), 1.0 h (c), 2.0 h (d), 3.0 h (e) and 4.0 h (f). The spectra are fitted into Gaussian lines. The green and the blue lines present the emission bands at 865 nm and 873 nm of Nd$^{3+}$. The gray lines present the baseline.

References

