Supporting information

Synthesis and Properties of Near Infrared-absorbing Magnetic-optical Nanopins

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Synthesis of IO-Au NPINs

The IO-Au NPINs were synthesized according to a two-step procedure (see reference 17) with modificaitons. Firstly, 10 uL of 10 mM $Ag(NH_3)_2^+$ ions, which were prepared by mixing ammonia with $AgNO_3$, were added to 100 uL of 1mg/mL IO NPs (SHP 25, Ocean Nanotech) and stirred for 30 min. After purification (by centrifugation) and reconstitution with 0.25 mL water, 100 uL of 10 mM $NaBH_4$ was added to reduce the silver ions. After 40 min, the Ag-decorated IO NPs were purified by three times of centrifugation and redispersed in 500 uL water. Secondly, 1.5 mL of growth solution containing 0.4 mM $HAuCl_4$, 0.1 M CTAB and 0.08 mM $AgNO_3$ was prepared, followed by addition of ascorbic acid (4 mM final concentration). Then, Ag-decorated IO NPs (22 uL) were injected and the solution changed to blue color within several minutes, indicating the growth of IO-Au NPINs. The same procedure was used to prepare spherical IO-Au NPs without silver nitrate in the growth solution and anisotropic IO-Au NPs with 5 time lower concentration of ascorbic acid.

NP Characterization

The absorption spectra of the IO and IO-Au NPINs were measured using a VIS-NIR absorption spectrometer (Ocean Optics, Dunedin, FL). The magnetic properties were measured using a vibration sample magnetometer (Dexing Magnets, China). The size and morphology of the NPs were examined with a JEM1200EX II TEM (JEOL Ltd, Tokyo, Japan).

SERS measurement

The IO-Au SERS NPs (nanospheres and nanopins) were prepared by direct adsorption of QSY 20 (Invitrogen, Grand Island, NY), followed by stabilization with mPEG-SH (Laysan Bio Inc, Arab, AL). The ratios of QSY and mPEG-SH to IO were $5x10^4$. The SERS signals were collected from 0.01 nM IO-Au SERS NPs on a ProRaman-L porter Raman spectrometer (Enwave Optronics, Irvine, CA). The signals were detected with a CCD camera cool to -60^{o}C. The excitation wavelength was 785 nm and the power was 10 mW. The acquisition time was 0.1s.

Photothermal experiment

To examine the photothermal effect of the nanoparticles, 808 nm CW NIR light from a portable diode laser (Power technologies, Little Rock, AR) was delivered to the nanoparticle solution (100 uL) with specified concentration in a 1.7 mL microcentrifuge tube. The laser beam was 1 cm in diameter and the power density was 0.55 W/cm2. A thermocouple was inserted into the solution perpendicular to the laser path to measure the temperature of the solution.

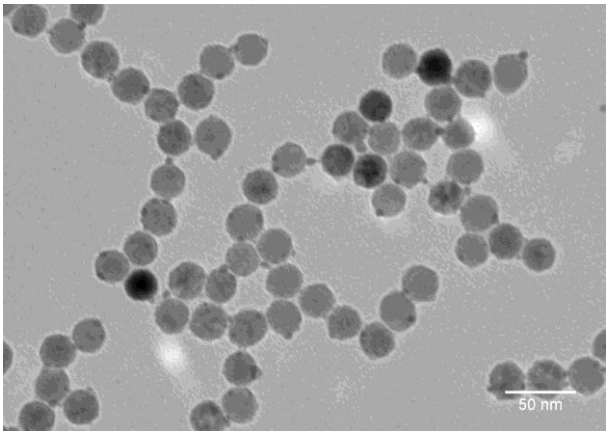

Fig. S1 TEM image of Ag-decorated IO NPs.

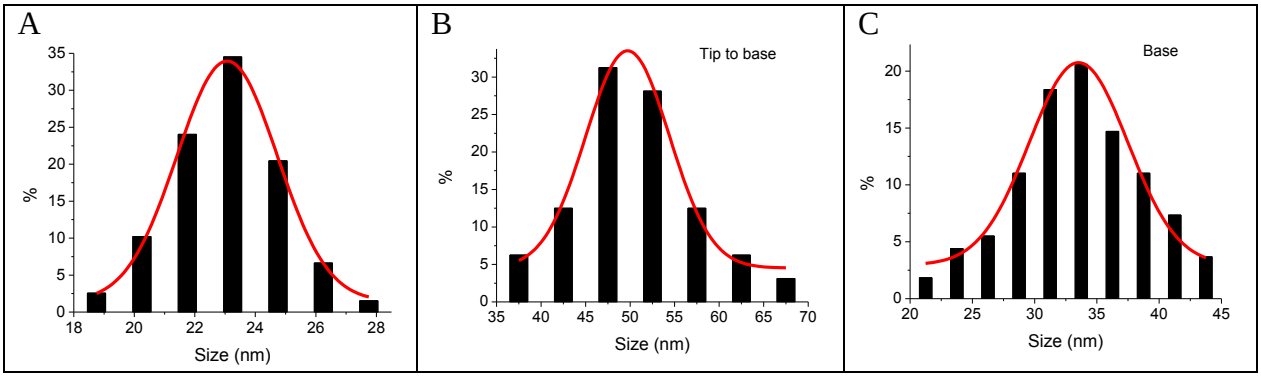

Fig. S2 Size distribution of IO NPs (A) and IO-Au NPINs (B&C).

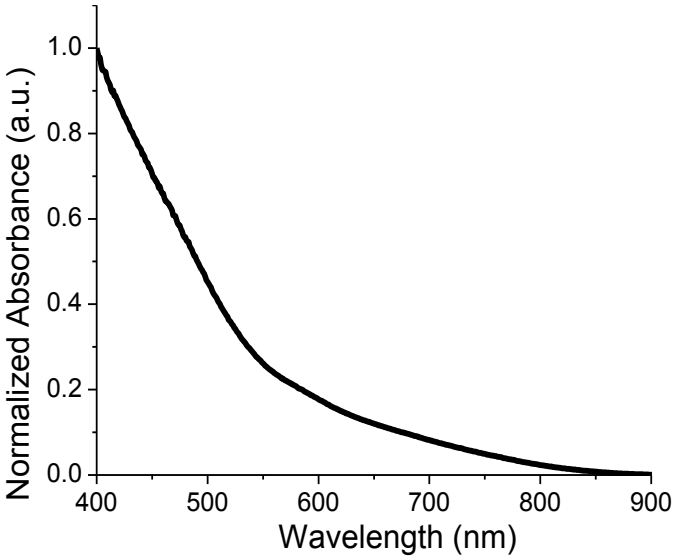

Fig. S3 Absorption spectrum of IO NPs.

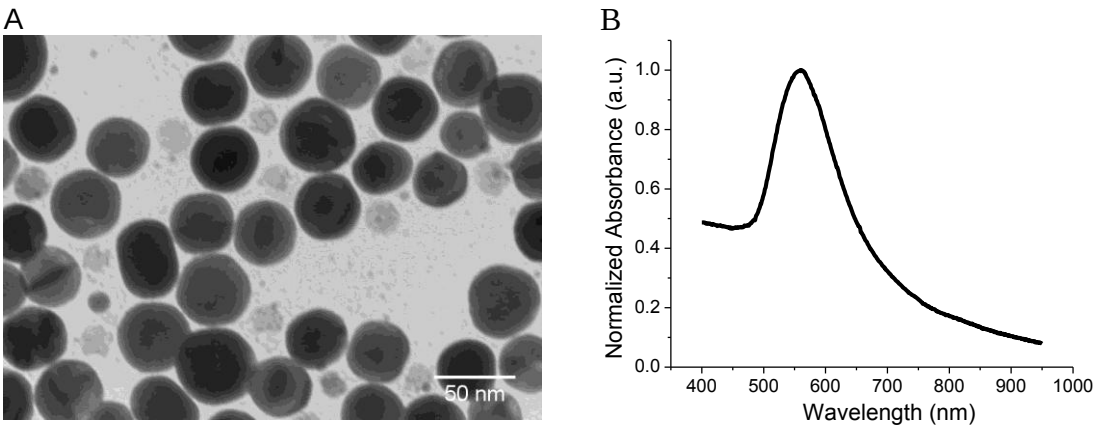

Fig. S4 TEM image (A) and absorption spectrum (B) of IO-Au nanospheres. The NPs are 40-50 nm in size with SPR absorption around 560.