Electronic Supplementary Material (ESI) for Nanoscale Horizons.

Core-Shell NPs (Fe@Au): The preparation Fe@Au has been carried out on previously synthesized Fe_3O_4 NP seeds and a subsequent reduction of gold acetate in on the seed solution.

- Fe3O4 NPs seeds were obtained by thermal reduction of iron oxide precursor. Briefly, 0.71 g Fe(acac)3 were mixed in 20 mL of phenyl ether with 2 mL of oleic acid and 2mL of oleylamine in inert atmosphere with vigorous stirring. After solution 2.58 g of 1,2-Hexadecanediol were added. The solution was heated up to 210 °C and refluxed for 2 h, and finally cooled down to room temperature.

- To growth the gold shell 5 ml of the Fe3O4 NP solution are diluted in 15 ml of phenyl ether. Then, 410 mg of Au(OOCCH3)3, 1.55 g of 1,2-hexadecanediol, 0.25 mL of oleic acid and 1.5 mL of oleylamine were added. Under argon atmosphere and vigorous stirring, the reaction solution was heated to 190 °C, kept at this temperature for 1.5 h, and finally cooled down to room temperature.

After cooling 50 mL of ethanol was added to into the solution and the material was precipitated by centrifugation. The resulting power NPs were redispersed in chloroform for optical measurements.

Dumbbell NPs [Fe(Au)]: The synthesis of the Fe(Au) NPs has been carried out by injection of gold precursor during the growth of Fe_3O_4 NPs.

- A Gold precursor solution was prepared before to start the synthesis of the iron oxide seeds. This consisted of 40 mg of $HAuCl_4 \bullet (H_2O)_3$ and 0.5 mL of oleylamine and 1.675 g of 1,2-hexadecanediol mixed in 5 ml of octadecene (ODE) and stirred under inert gas flow at 120 ºC for 20 min.

- For the Fe_3O_4 NPs 1.694 g of oleic acid, 1.675 g oleylamine and 2.023 g 1,2-hexadecandiol where mixed in 20 ml ODE and stirred under inert gas flow at 120 ºC for 20 min. Then under a blanket of nitrogen, 0.30 ml $Fe(CO)_5$ were injected into the solution and the temperature was increased to 310ºC. After 3 min, the above gold precursor solution was inject. The mixture was kept to reflux (~310°C) for 45 min, cooled down to room temperature, and exposed to air for an extra hour to ensure the complete reduction of the iron oxide precursor.

After cooling, 50 mL of ethanol were added into the solution and the material was precipitated by centrifugation. The resulting power NPs were redispersed in chloroform for the optical measurements.

Cross-linked NPs Fe—Au: the Fe—Au system was prepared by cross-linking of previously synthesised iron oxide and gold NPs.

- Fe3O4 NPs: 0.7 g of Fe(acac)3 were dissolved in 10 ml of benzyl ether and 10 ml of oleylamine under inert environment at 120 ºC for 1h. Afterwards, the solution was warmed up to 310ºC to start the iron oxide precursor reduction. After 45 min, the solution was cooled down to room temperature and 50 ml of ethanol was added to precipitate the NPs by centrifugation.

- Au NPs: 0.1 g of HAuCl4 were dissolved in 20 ml of ODC with 2 ml of oleylamine. The resulting solution was heated up to 80ºC and kept at this temperature for 2 h. After cooling down to room temperature, 50 ml of ethanol was added to precipitate the NPs by centrifugation.

- Au-PEG solution was prepared by removing 7 mg of NPs from the precipitated Au NPs to be redispersed in toluene (2mL). In another solution, 2 mg of HS-PEG-COOH (MW = 3400) were dissolved in 2 mL of dimethyl formamide. These two solutions were mixed and vigorously stirred overnight. The resulting Au-PEG NPs were separated by centrigugation after adding toluene, and then re-dispersed in 1 ml of water. Free ligands were removed by dialysis with a dialysis bag (MWCO 10,000) for one hour in water. After that the water is changed to continue dialysis overnight.

- Au—Fe: The above Au-PEG suspension in water was mixed with 1 ml of toluene containing 1 mg of Fe3O4 NPs. The formed biphasic mixture was vigorously stirred overnight to transfer the Fe3O4 NPs from the organic to the aqueous phase. The obtained Au-PEG-Fe3O4 conjugates were separated by centrifugration after adding 10 ml of toluene and 3 ml of ethanol. The precipitate was re-dispersed in 2 ml of water. Excess surfactants were removed by dialysis overnight.