

# Enhanced Catalytic Reduction of 4-Nitrophenol Driven by Fe<sub>3</sub>O<sub>4</sub>-Au Magnetic Nanocomposite Interface Engineering: From Facile Preparation to Recyclable Application

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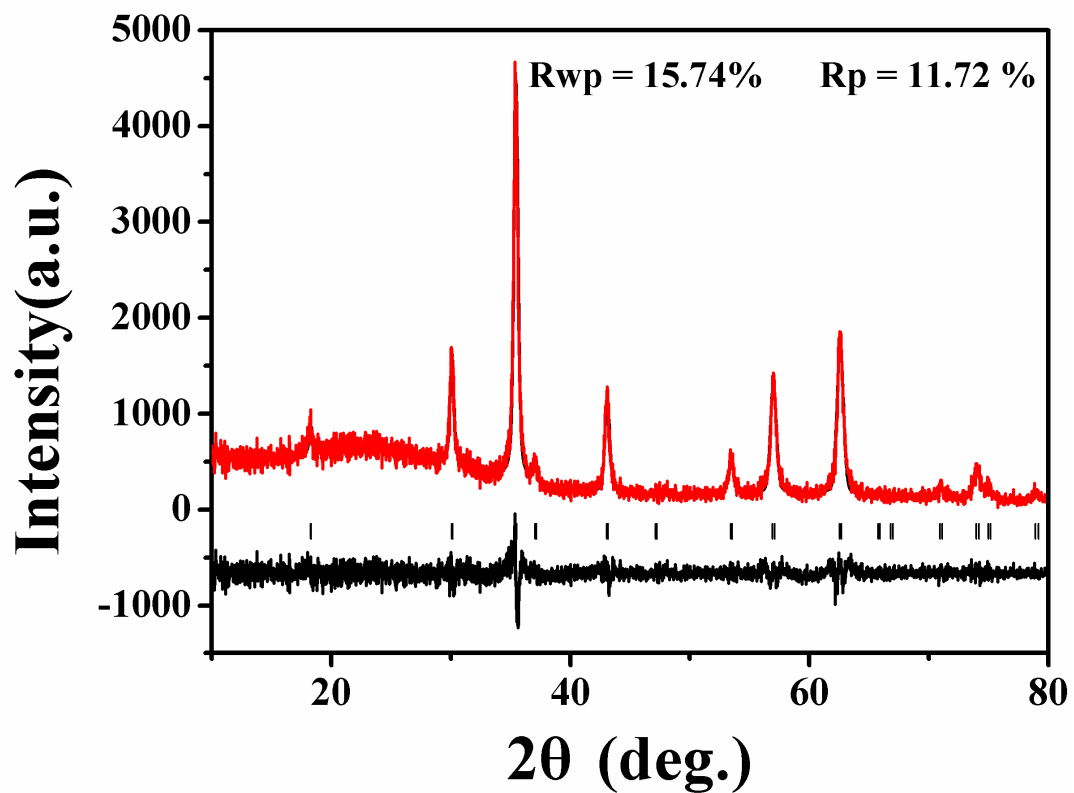
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**Abstract:** In this work, we report the enhanced catalytic reduction of 4-nitrophenol driven by Fe<sub>3</sub>O<sub>4</sub>-Au magnetic nanocomposite interface engineering. A facile solvothermal method is employed for Fe<sub>3</sub>O<sub>4</sub> hollow microspheres and Fe<sub>3</sub>O<sub>4</sub>-Au magnetic nanocomposite synthesis via a seed deposition process. Complementary structural, chemical composition and valence state studies validate that the as-obtained samples are formed in a pure magnetite phase. A series of characterizations including conventional scanning/transmission electron microscopy (SEM/TEM), Mössbauer spectroscopy, magnetic testing and elemental mapping is conducted to unveil the structural and physical characteristics of the developed Fe<sub>3</sub>O<sub>4</sub>-Au magnetic nanocomposites. By adjusting the quantity of Au seeds coating on the polyethyleneimine-dithiocarbamates (PEI-DTC)-modified surfaces of Fe<sub>3</sub>O<sub>4</sub> hollow microspheres, the correlation between the amount of Au seeds and the catalytic ability of Fe<sub>3</sub>O<sub>4</sub>-Au magnetic nanocomposites for 4-nitrophenol (4-NP) is investigated systematically. Importantly, bearing remarkable recyclable features, our developed Fe<sub>3</sub>O<sub>4</sub>-Au magnetic nanocomposites can be readily separated with a magnet. Such Fe<sub>3</sub>O<sub>4</sub>-Au magnetic nanocomposites shine the light on highly efficient catalysts for 4-NP reduction at the mass production level.

**Keywords:** Fe<sub>3</sub>O<sub>4</sub> hollow microspheres; Fe<sub>3</sub>O<sub>4</sub>-Au magnetic nanocomposites; catalytic reduction; 4-nitrophenol

Figure S1



**Figure S1.** Pawley refinement of the XRD pattern of the pure  $\text{Fe}_3\text{O}_4$  hollow microspheres. Red dots, blue lines and olive bars represent the experimental data, the calculated date and the peak position of the sample, respectively. The bottom line in black shows the different experimental-calculated data.

Figure S2

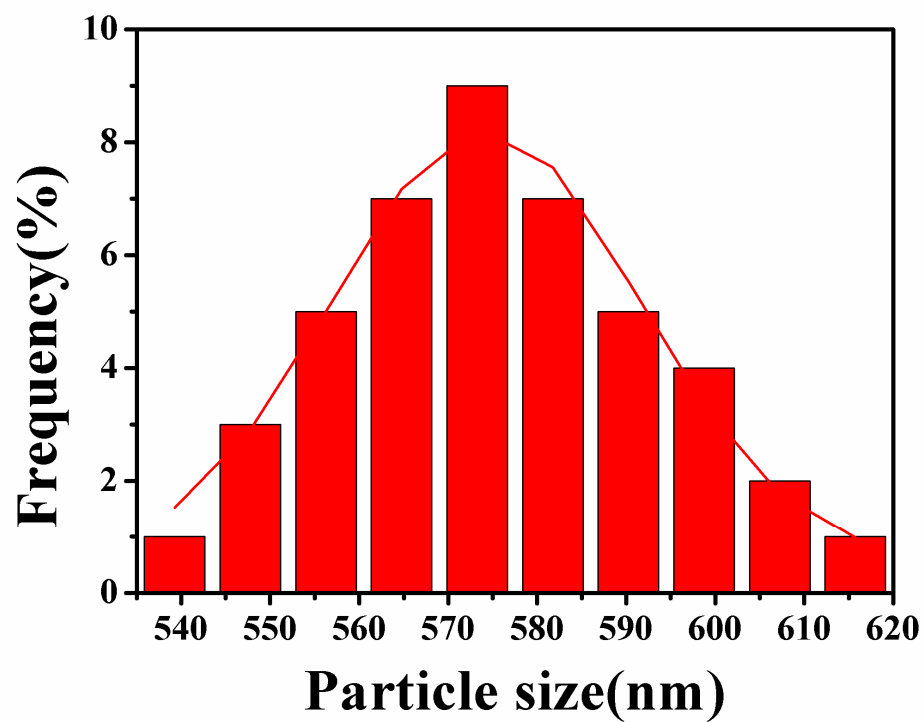
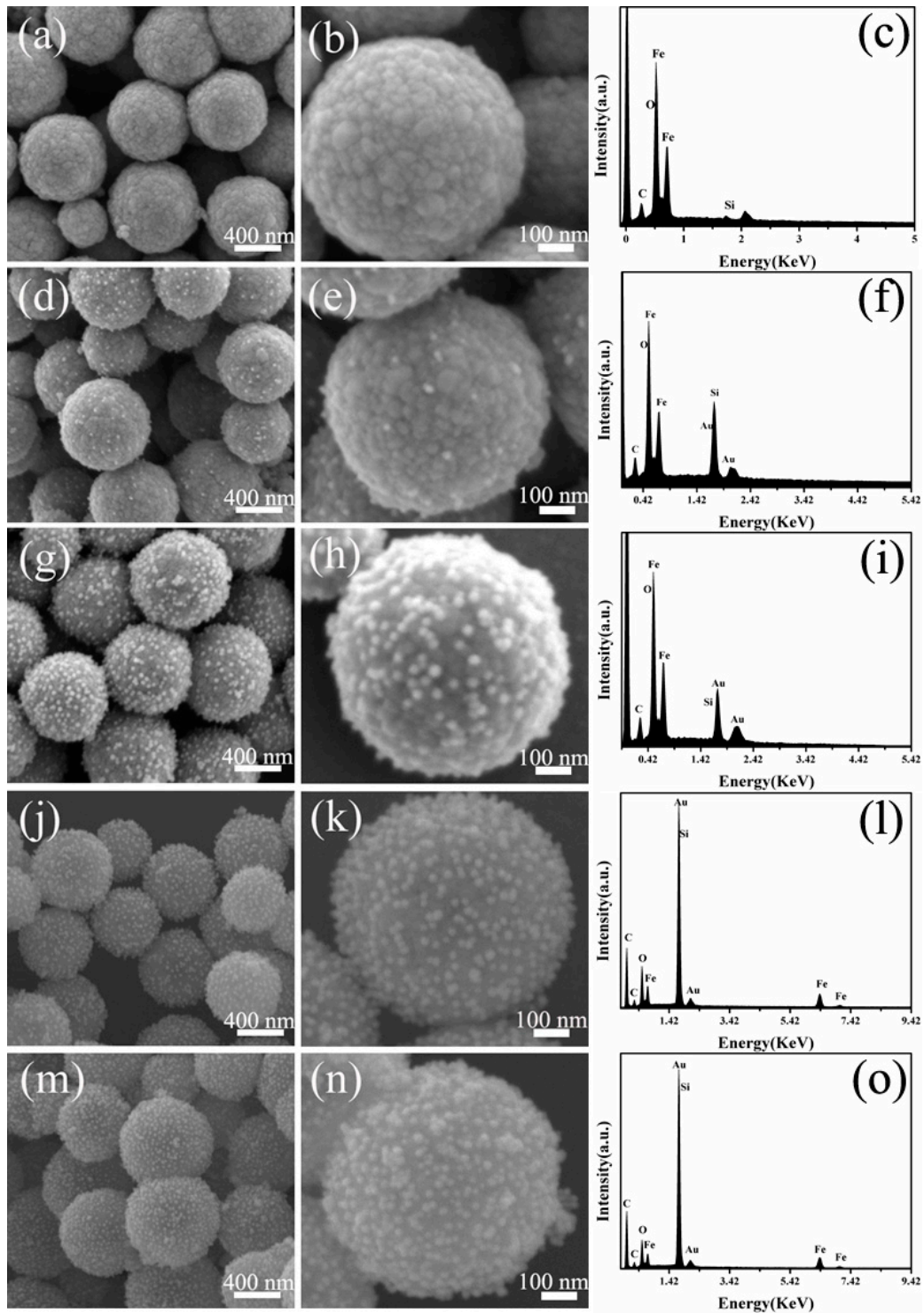


Figure S2. Particle size distribution obtained from the analysis of the TEM images for pure Fe<sub>3</sub>O<sub>4</sub> hollow microspheres.

Figure S3



**Figure S3.** SEM and corresponding EDS images of the as-prepared Fe<sub>3</sub>O<sub>4</sub>-Au nanocomposites with the different addition quantities of the gold seed colloids (Fe<sub>3</sub>O<sub>4</sub> (a,b and c), Fe<sub>3</sub>O<sub>4</sub>-Au 5 mL (d,e and f), Fe<sub>3</sub>O<sub>4</sub>-Au 20 mL (g,h and i), Fe<sub>3</sub>O<sub>4</sub>-Au 40 mL (j,k and l) and Fe<sub>3</sub>O<sub>4</sub>-Au 60 mL (m,n and o).

Figure S4

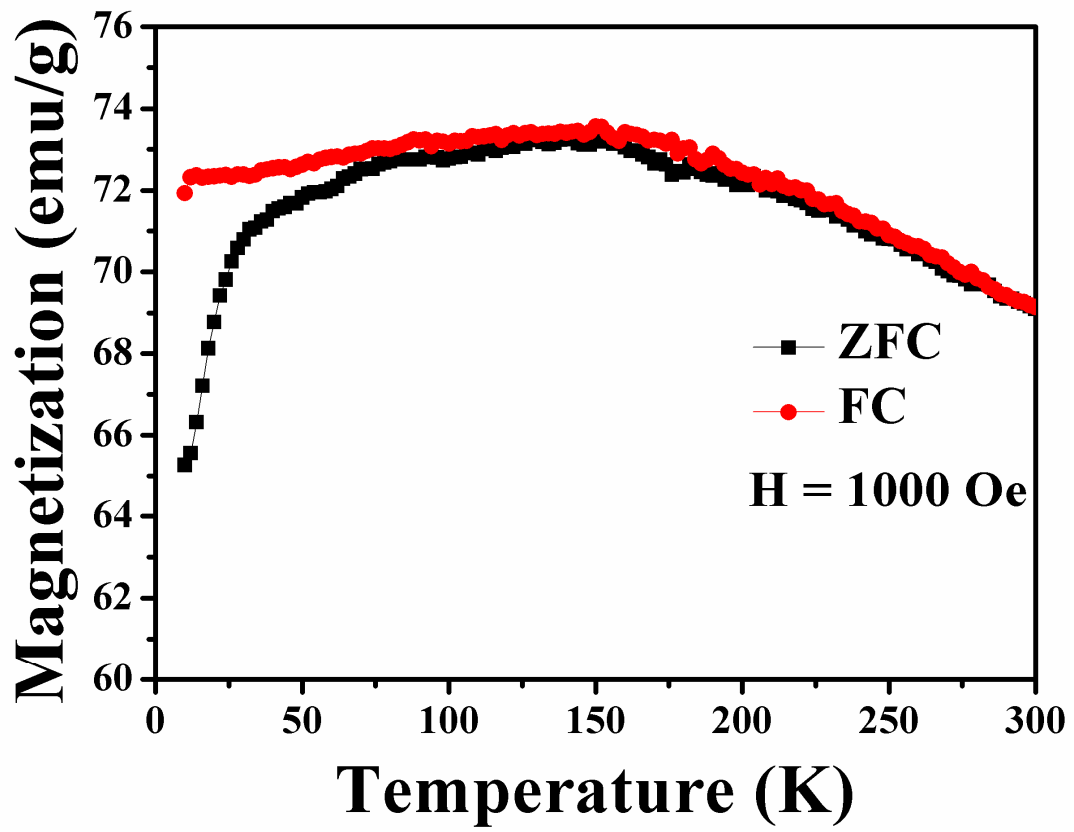


Figure S4. ZFC and FC curves of pure Fe<sub>3</sub>O<sub>4</sub> hollow microspheres under an applied field of 1000 Oe.

Figure S5

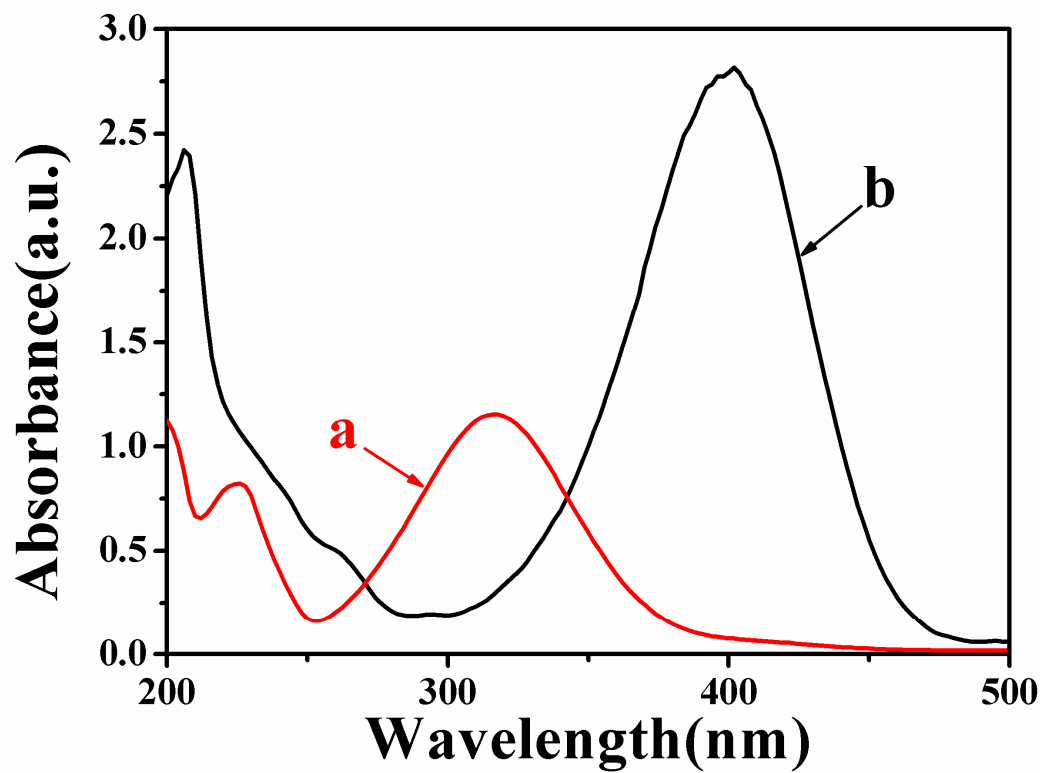


Figure S5. UV-Vis absorption spectra of 4-NP before (red line) and after adding  $\text{NaBH}_4$  solution (black line).

Figure S6

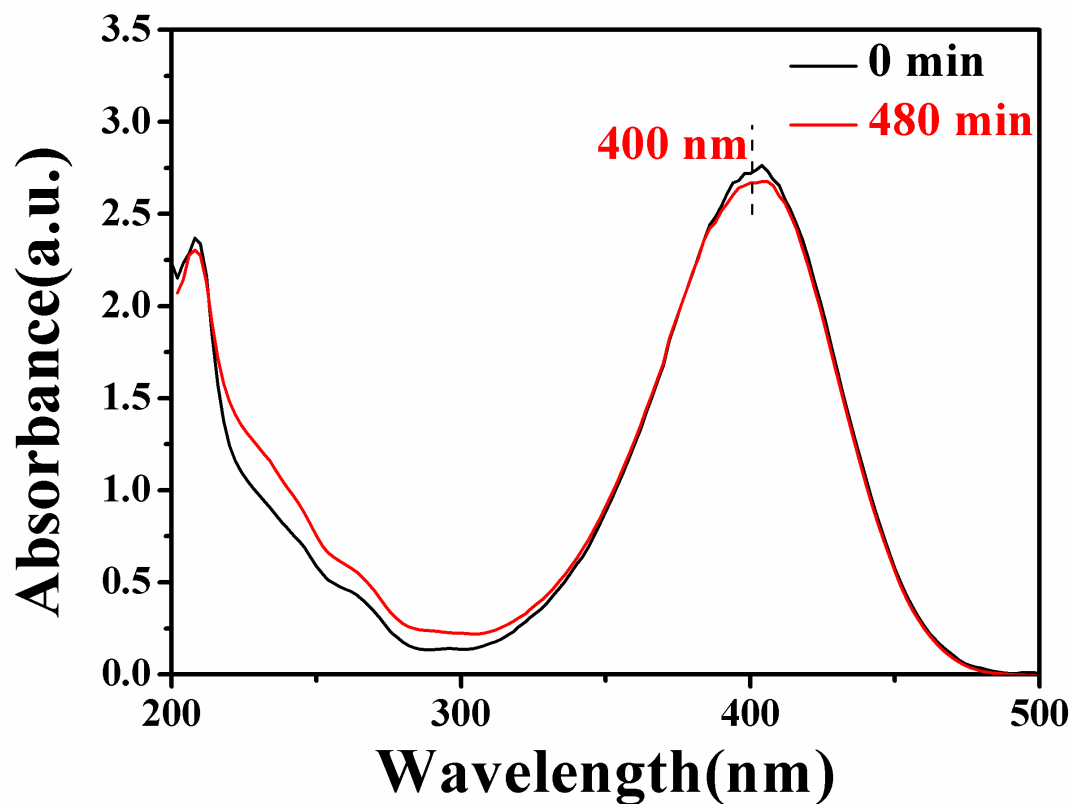


Figure S6. UV-Vis absorption spectra of 4-NP catalyzed by pure Fe<sub>3</sub>O<sub>4</sub> hollow microspheres in presence of NaBH<sub>4</sub> before and after 480 min.