Electronic Supplementary Information (ESI) for:

One-pot synthesis of Au@TiO₂ core-shell nanocomposite and its catalytic properties

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Experimental section

Reagents Poly(oxyethylene) nonylphenyl ether (Igepal CO-520) was bought from Aldrich. Titanium (III) chloride (20% in 3% hydrochloric acid) was purchased from Alfa Aesar. HAuCl₄•4H₂O and cyclohexane were obtained from Shanghai Chemical Factory (Shanghai, China) and used as-received without further purification. Water used for preparation of aqueous solutions was purified using a Millipore-Q water purification system.

Synthesis of Au@TiO₂ The Au@TiO₂ nanocomposite (Au@TiO₂) was synthesized by combining the reverse micelle technique with a redox reaction between Au (III) and titanium (III). Reverse micelle systems were formed by poly(oxyethylene) nonylphenyl ether, cyclohexane, and an aqueous solution of metal precursors. Reverse micelles containing the gold precursor were prepared as follows. Poly(oxyethylene) nonylphenyl ether (1.6 mL) was added to 4 mL of cyclohexane, and the mixture was stirred using a Teflon-coated magnetic stir bar. HAuCl₄ aqueous solution (0.4 mL, 6.25 mM) was added into a cyclohexane/poly(oxyethylene) nonylphenyl ether mixture with vigorous stirring to give a clear solution. 0.4 mL aqueous solution containing 100 μL titanium (III) chloride (20% in 3% hydrochloric
acid) was added into the cyclohexane/poly(oxyethylene) nonylphenyl ether mixture to give reverse micelles containing the cerium precursor. These two reverse micelle solutions were mixed for 1 h at 60 °C, giving a red suspension indicating the occurrence of the redox reaction of Au (III) with titanium (III) to Au NPs and TiO₂ within a single micelle. After cooling to room temperature, 8 mL of ethanol was injected into the mixture to break the reverse micelles and the mixture was stirred for 0.5 h. The red precipitate was collected by centrifugation (13000 rpm), washed with ethanol and re-dispersed in ethanol.

**Apparatus** UV-vis detection was carried out on a Cary 50 UV–vis spectrophotometer (Varian, USA). TEM and HRTEM images were obtained with a TECNAI G2 high-resolution transmission electron microscope operating at 200 kV. X-ray diffraction (XRD) analysis was carried out on a D/Max 2500 V/PC X-ray diffractometer using Cu (40 kV, 30 mA) radiation.

**Catalytic reduction toward p–nitrophenol** The aqueous solutions of p-nitrophenol (10 mM) and NaBH₄ (3 M) were freshly prepared. 2.5 mL of an aqueous solution containing 25 μL Au@TiO₂ was added into a quartz cuvette. Then, 25 μL of the mixture containing 12.5 μL p–nitrophenol solution and 12.5 μL of NaBH₄ solution was injected into the cuvette to start the reaction, and the intensity of the absorption peak at 400 nm was monitored by UV-vis spectroscopy as a function of time. After each round of reaction, another 25 μL of mixed aqueous solution was added to the reaction solution. This step was repeated nine times to explore the
stability of the catalysts. As comparison, we also investigated the catalytic activity of uncapped Au NPs and TiO$_2$.

![XRD pattern of Au@TiO$_2$ sample](image1)

**Fig. S1** The XRD pattern of the Au@TiO$_2$ sample.

![Energy-dispersive X-ray image of Au@TiO$_2$ nanocomposite](image2)

**Fig. S2** Energy-dispersive X-ray image of the as-synthesized Au@TiO$_2$ nanocomposite.
Fig. S3 The typical TEM images of the obtained sample when the reverse micelle method was not used.

Fig. S4 (A-C) The typical TEM images and (D) The UV-visible absorption of the obtained samples with different reaction time at 60°C: 0 h (A), 3 h (B), and 6 h (C).
**Fig. S5** UV-visible absorption spectra of (A) Au@TiO$_2$ and (B) Au catalysts before and after five cycles of use.

**Fig. S6** Values of K$_{app}$ for successive reactions employing Au and Au@TiO$_2$ as the catalyst.

**Fig. S7** C/C$_0$ versus reaction time for the reduction of 4-NP over TiO$_2$ nanocomposite. C$_0$ and C was the absorption peak at 400 nm initially and at time t.
**Fig. S8** (A-C) C/C₀ and ln(C/C₀) versus reaction time for the reduction of 4-NP over Au@TiO₂ nanocomposite at different reaction temperatures. C₀ and C was the absorption peak at 400 nm initially and at time t. (D) The Arrhenius plots for reactions catalyzed by Au@TiO₂ nanocomposite. The activation energy (Eₐ) can be calculated from the slope of the linear fitting.

**Table S1.** Summary of the reaction rate constant (k) at three different temperatures for the Au@TiO₂ nanocomposite.

<table>
<thead>
<tr>
<th>T (K)</th>
<th>273.15</th>
<th>298.15</th>
<th>310.15</th>
</tr>
</thead>
<tbody>
<tr>
<td>k (min)</td>
<td>0.1009</td>
<td>0.115</td>
<td>0.12</td>
</tr>
</tbody>
</table>

Note: Eₐ=3.6 KJ/mol, according to the Arrhenius equation (ln k=ln A-Eₐ/RT).