## Supplementary Information

# Synthesis of double-shell hollow magnetic Au-loaded ellipsoids as highly active and recoverable nanoreactors

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**Figure Captions**

**Fig. S1** TEM of $Fe_2O_3$ ellipsoids.

**Fig. S2** Magnified TEM of $Fe_2O_3$@$CeO_2$@H-$SiO_2$ (a) and $Fe_2O_3$@$TiO_2$@H-$SiO_2$ (b).

**Fig. S3** TEM (a) and HRTEM (b) of cracked Fe@$CeO_2$-Au@H-$SiO_2$.

**Fig. S4** FTIR pattern of $Au(en)_2Cl_3$ compounds.

**Fig. S5** (a) UV-vis spectra of 4-NP before (black line) and after (red line) adding $NaBH_4$ and 4-AP (blue line) solution; (b) UV-vis spectra for the reduction of 4-NP by $NaBH_4$ without catalysts at 0 h and 24 h; (c) Reduction process of 4-NP catalyzed by catalysts: (1) pure 4-NP solution, (2) 4-NP solution with $NaBH_4$, (3) complete conversion of 4-NP into 4-AP over catalysts.

**Fig. S6** TEM and EDS analysis of Fe@$CeO_2$-Au (a, c) and Fe@$TiO_2$-Au (b, d).

**Fig. S7** TEM (a) and EDS analysis (b) of Fe@$SiO_2$-Au@H-$SiO_2$.

**Table S1 Comparison of Au-loaded nanocatalysts for the reduction of 4-NP**

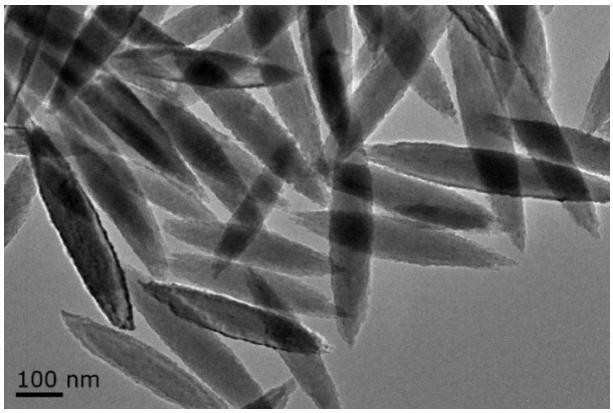


**Fig. S1** TEM of $Fe_2O_3$ ellipsoids.

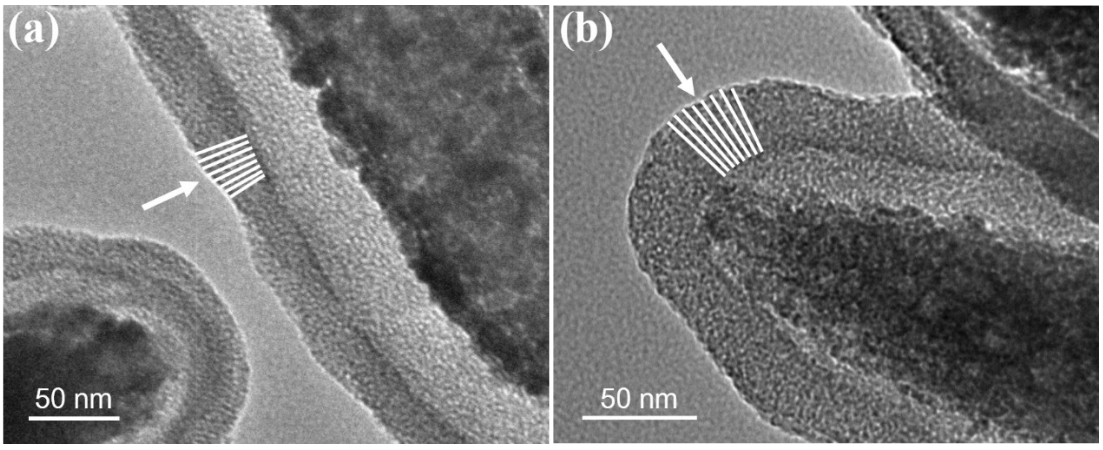


**Fig. S2** Magnified TEM of $Fe_2O_3$@$CeO_2$@H-$SiO_2$ (a) and $Fe_2O_3$@$TiO_2$@H-$SiO_2$ (b).

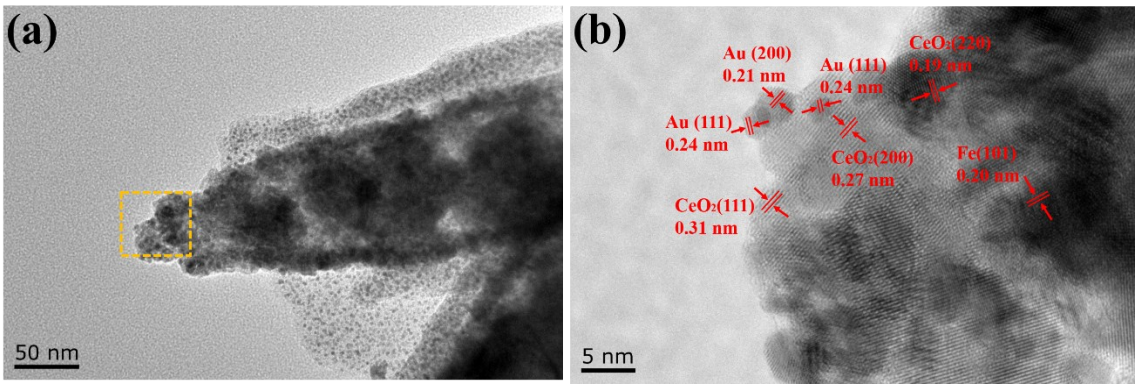


**Fig. S3** TEM (a) and HRTEM (b) of cracked Fe@$CeO_2$-Au@H-$SiO_2$.

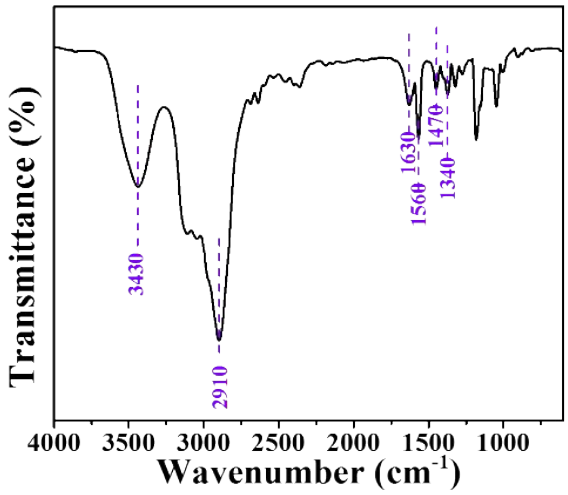


**Fig. S4** FTIR pattern of $Au(en)_2Cl_3$ compounds.

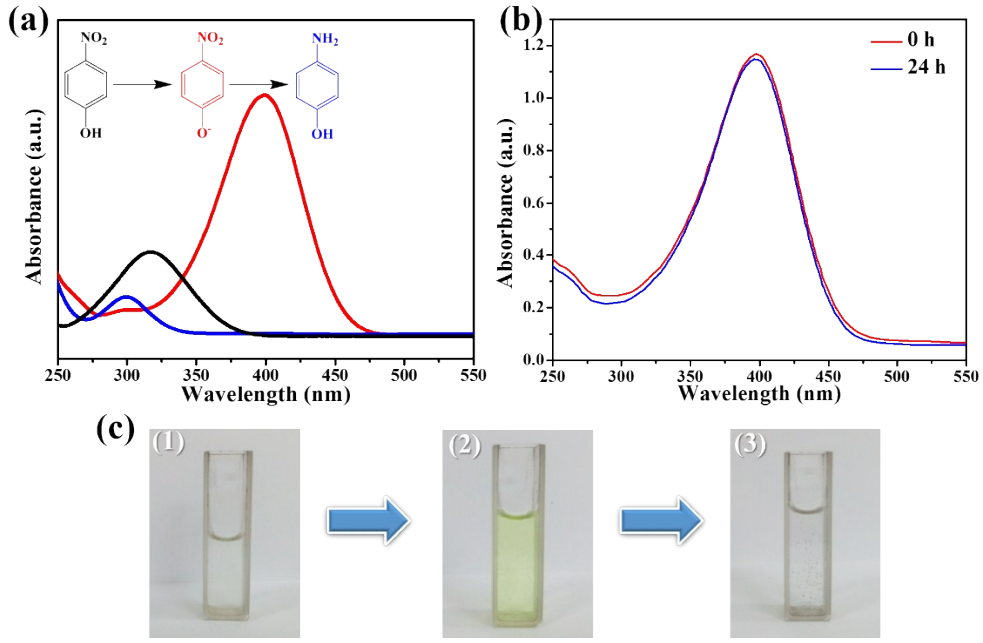


**Fig. S5** (a) UV-vis spectra of 4-NP before (black line) and after (red line) adding $NaBH_4$ and 4-AP (blue line) solution; (b) UV-vis spectra for the reduction of 4-NP by $NaBH_4$ without catalysts at 0 h and 24 h; (c) Reduction process of 4-NP catalyzed by catalysts: (1) pure 4-NP solution, (2) 4-NP solution with $NaBH_4$, (3) complete conversion of 4-NP into 4-AP over catalysts.

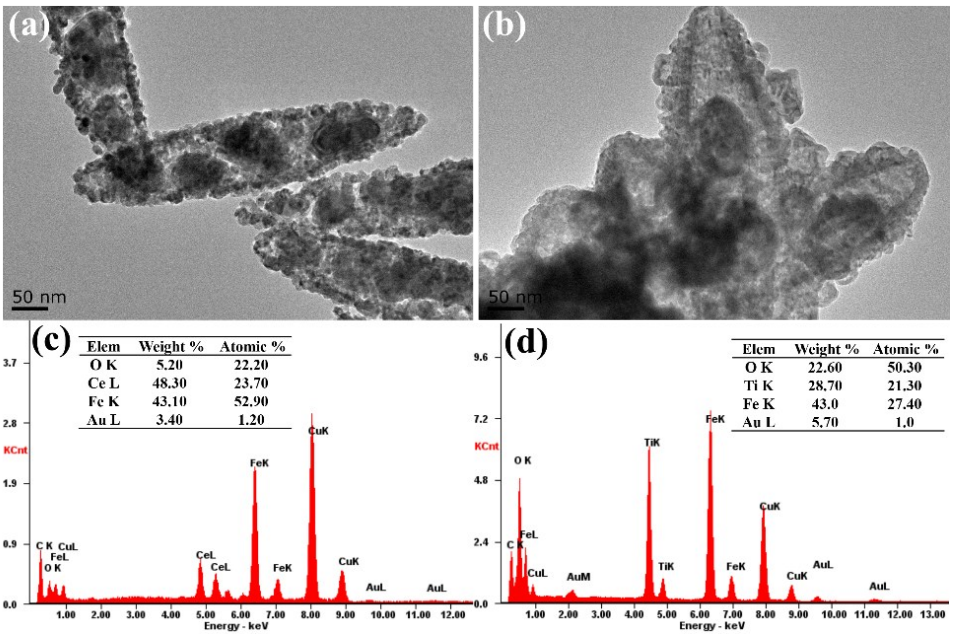


**Fig. S6** TEM and EDS analysis of Fe@$CeO_2$-Au (a, c) and Fe@$TiO_2$-Au (b, d).

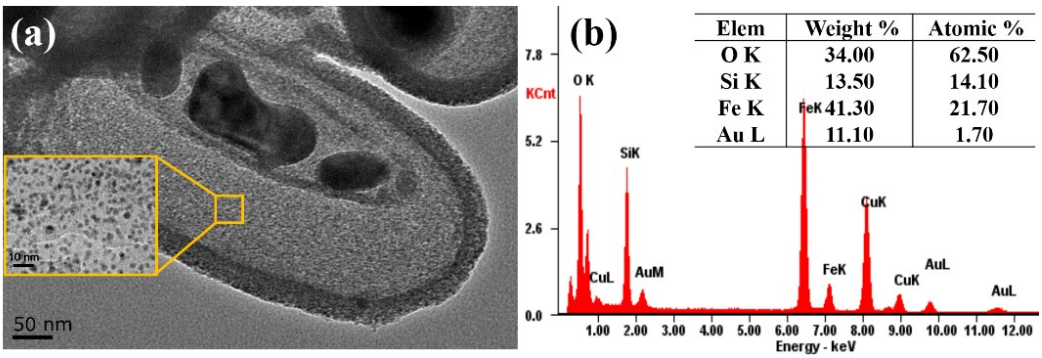


**Fig. S7** TEM (a) and EDS analysis (b) of Fe@$SiO_2$-Au@H-$SiO_2$.

**Table S1 Comparison of Au-loaded nanocatalysts for the reduction of 4-NP**

| Sample | $k$ ($s^{-1}$) | $k_{nor}$ ($k/m$) ($s^{-1}g^{-1}$) | Ref. |
|---|---|---|---|
| Fe@$CeO_2$-Au@H-$SiO_2$ | $10.92\times10^{-3}$ | 242.67 | This work |
| $Fe_2O_3$@$CeO_2$-Au@H-$SiO_2$ | $8.02\times10^{-3}$ | 178.22 | This work |
| Fe@$CeO_2$-Au | $6.34\times10^{-3}$ | 140.89 | This work |
| Fe@$TiO_2$-Au@H-$SiO_2$ | $9.85\times10^{-3}$ | 218.89 | This work |
| $Fe_2O_3$@$TiO_2$-Au@H-$SiO_2$ | $7.62\times10^{-3}$ | 169.33 | This work |
| Fe@$TiO_2$-Au | $6.03\times10^{-3}$ | 134.0 | This work |
| Fe@$SiO_2$-Au@H-$SiO_2$ | $8.27\times10^{-3}$ | 183.78 | This work |
| Au-Pt/$SiO_2$/Fe ellipsoid | $2.70\times10^{-2}$ | 108 | 1 |

| | | | |
|---|---|---|---|
| Au/rGO aerogel | $3.16\times10^{-2}$ | 63.17 | 2 |
| Au-MOF | $6.64\times10^{-2}$ | 13.28 | 3 |
| Au/P(OEGMA-*co*-MQ)-GO | $8.67\times10^{-3}$ | 96.30 | 4 |
| Au/cubical $Co_3O_4$ | $5.\ 0\times10^{-3}$ | 33.3 | 5 |
| Au/$TiO_2$ sphere | $1.32\times10^{-4}$ | 38.8 | 6 |
| Au/PDA-$Fe_3O_4$ | $5.50\times10^{-3}$ | 110 | 7 |
| Au/PDA-graphene | $5.83\times10^{-3}$ | 3.0 | 8 |
| Au/graphene hydrogel | $3.17\times10^{-2}$ | 31.7 | 9 |
| Au-Sn/$SiO_2$/$Fe_3O_4$ | $2.86\times10^{-2}$ | 5.71 | 10 |
| Au/$TiO_2$ nanofiber | $4.07\times10^{-3}$ | 40.67 | 11 |
| Hollow tubular C/Au/$TiO_2$/$SiO_2$ | $5.51\times10^{-3}$ | 10.2 | 12 |
| Au/$Fe_3O_4$ | $1.05\times10^{-2}$ | 5.25 | 13 |
| Au-$Fe_3O_4$/graphene sheet | $1.14\times10^{-2}$ | 2.86 | 14 |
| $CeO_2$/Au/$SiO_2$ | $1.28\times10^{-2}$ | 51.3 | 15 |
| Au/PMMA | $7.90\times10^{-3}$ | 2.26 | 16 |

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