Supporting Information

Strongly Coupled Au/Fe_3O_4/GO hybrid Material with Enhanced Nanozyme Activity for Highly Sensitively Colorimetric Detection, Rapid and Efficient Removal of Hg^{2+} in Aqueous solutions

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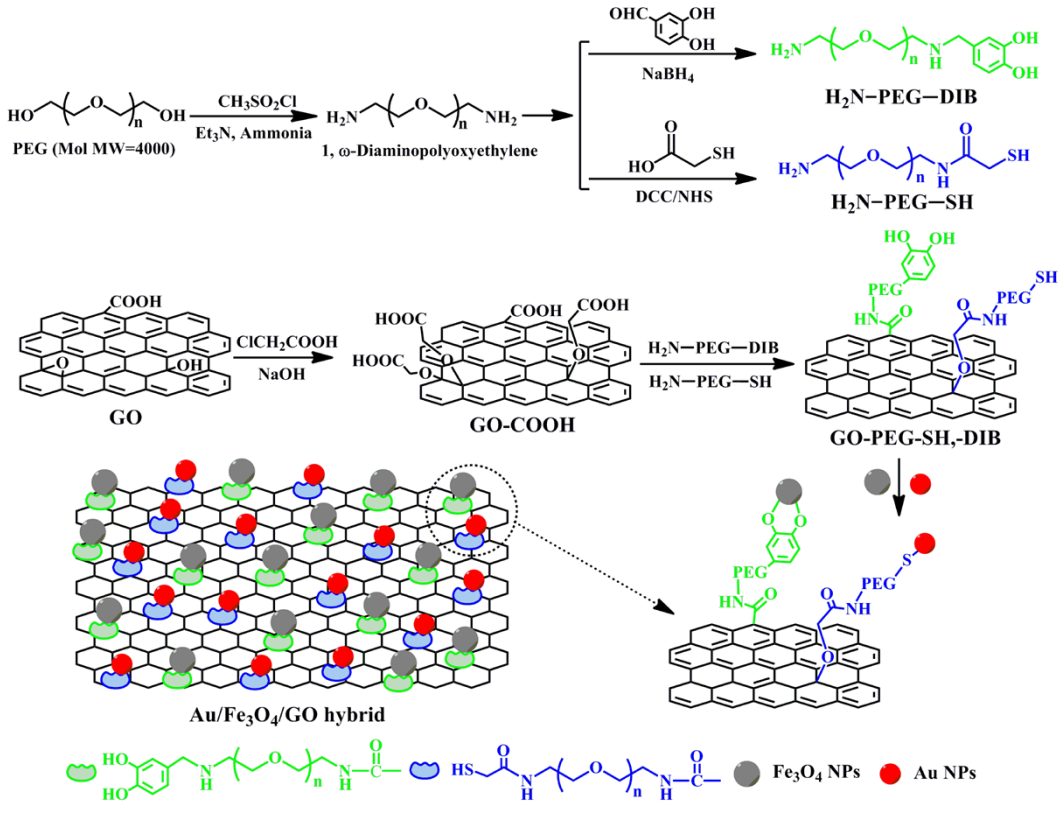

Scheme S1 The synthetic route of $Au/Fe_3O_4/GO$ hybrid.

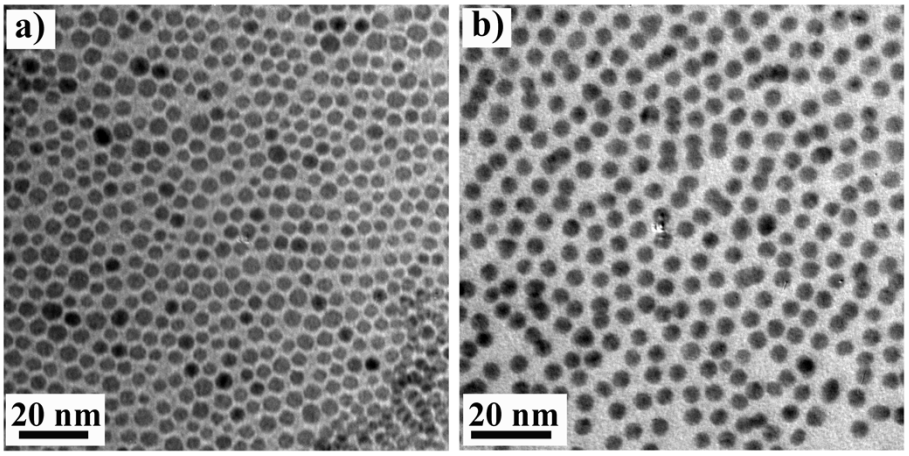

Figure S1. TEM images of as-prepared 7 nm Fe_3O_4 NPs (a) and 5 nm Au NPs (b).

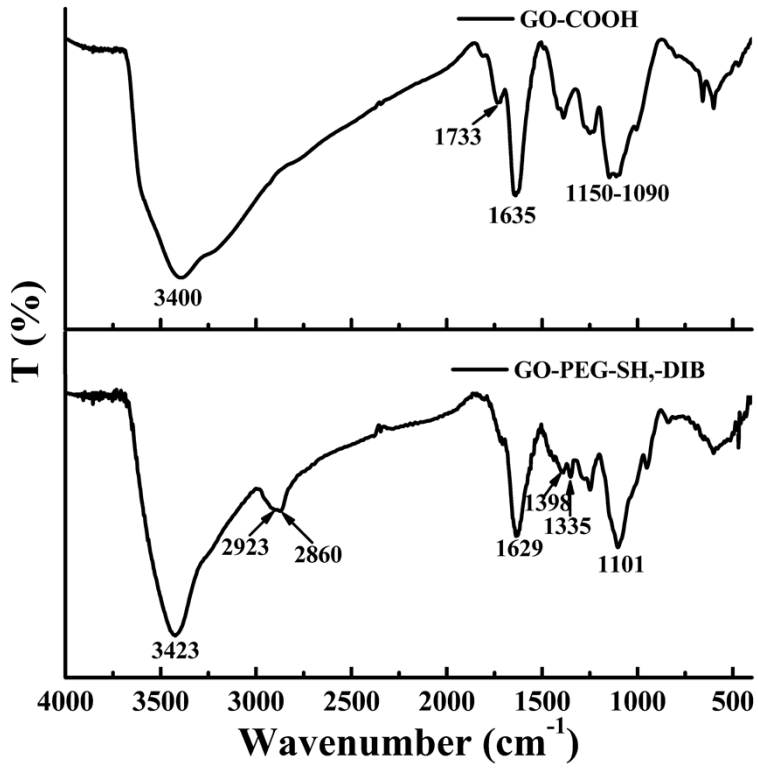

Figure S2. Fourier transform infrared (FTIR) spectrum of GO-COOH, GO-PEG-SH,-DIB.

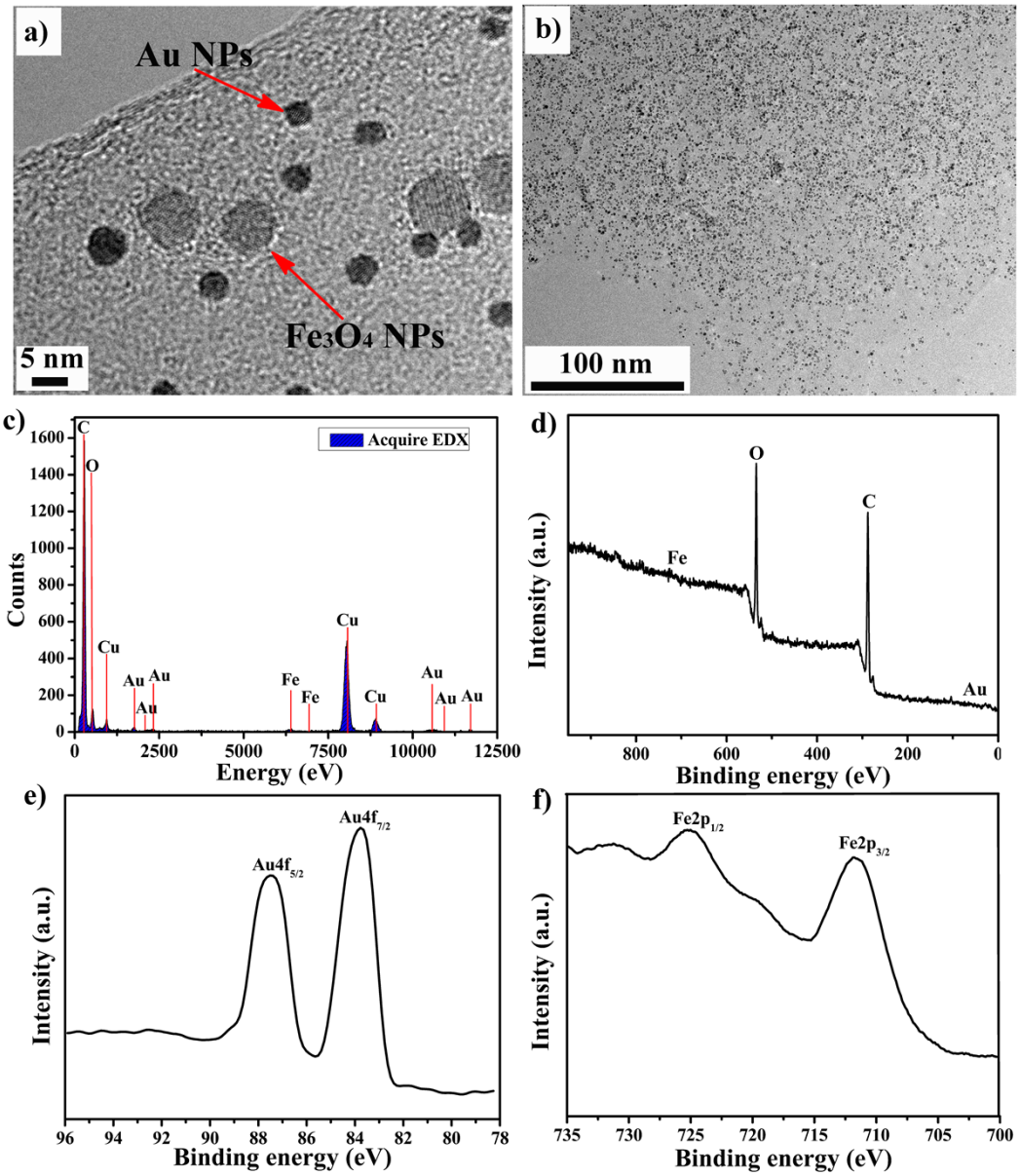

Figure S3. (a, b) Different magnification TEM images of Au/Fe_3O_4/GO hybrid. (c) EDX spectra of the as-synthesized Au/Fe_3O_4/GO hybrid. (d, e, f) XPS spectra of the as-synthesized Au/Fe_3O_4/GO hybrid. (e) The spectrum in the Au 4f region. (f) The spectrum in the Fe 2p region.

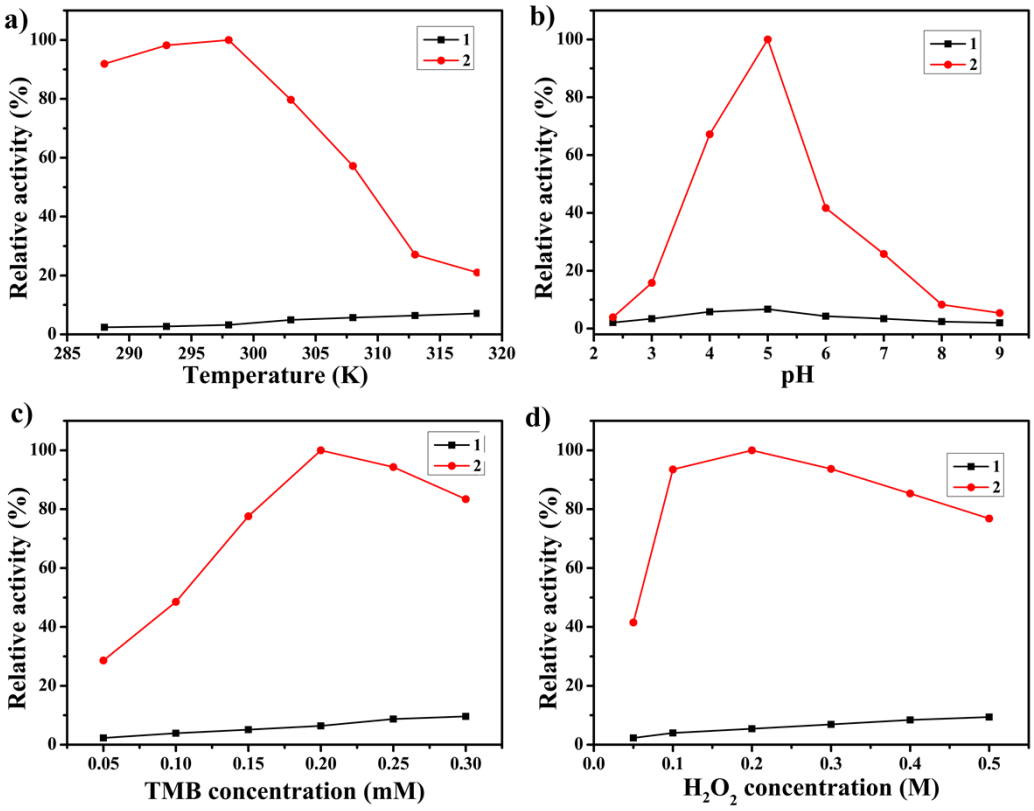

Figure S4. The mercury-stimulated peroxides-like catalytic activity of $Au/Fe_3O_4/GO$ hybrid is dependent on temperature (a), pH (b), TMB concentration (c) and H_2O_2 concentration (d) in the absence (1) and presence (2) of Hg^{2+}. Experiments were carried out using 0.20 mM TMB, 0.20 M H_2O_2, 5 μM Hg^{2+} with the same amounts of the $Au/Fe_3O_4/GO$ hybrid (5 nM Au NPs) in citric acid–disodium hydrogen phosphate buffer (25 mM pH 5.0).

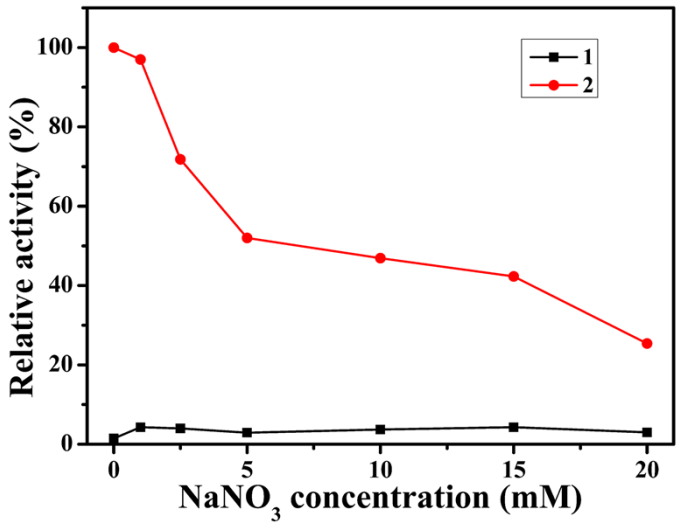

Figure S5. The mercury-stimulated peroxidase-like activities of the $Au/Fe_3O_4/GO$ hybrid in the presence of $NaNO_3$ at various concentrations in the absence (1) and presence (2) of Hg^{2+}. Experiments were carried out using 0.20 mM TMB, 0.20 M H_2O_2 in citric acid–disodium hydrogen phosphate buffer (25 mM pH 5.0).

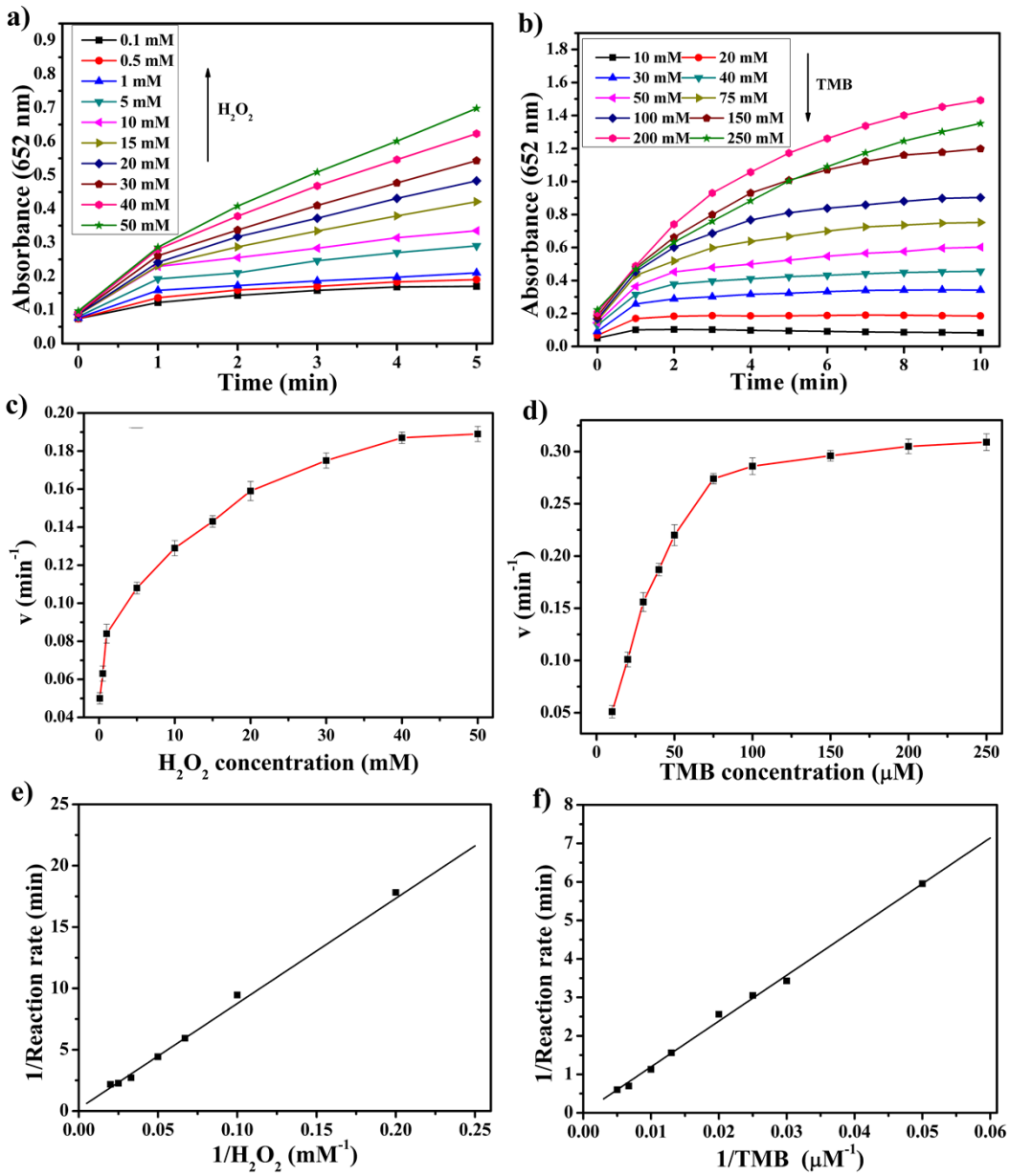

Figure S6. (a, b) Time-dependent absorbance changes at 652 nm of TMB reaction solutions catalyzed by the Au/Fe_3O_4/GO hybrid in the presence of different concentrations of H_2O_2 and TMB. (c, d) Steady state kinetic assays of Au/Fe_3O_4/GO hybrid. Experiments were carried out in citric acid–disodium hydrogen phosphate buffer (25 mM pH 5.0) using Au/Fe_3O_4/GO hybrid (0.5 nM Au NPs) at room temperature. (c) TMB concentration was fixed at 0.20 mM for the Au/Fe_3O_4/GO hybrid, and the H_2O_2 concentration was varied. (d) H_2O_2 concentration was fixed at 0.20 M for the Au/Fe_3O_4/GO hybrid, and the TMB concentration was varied. Error bars shown represent the standard error derived from three repeated measurements. (e, f) The corresponding double reciprocal (Lineweaver-Burk) plots of the mercury-stimulated peroxides-like catalytic activity of the Au/Fe_3O_4/GO hybrid.

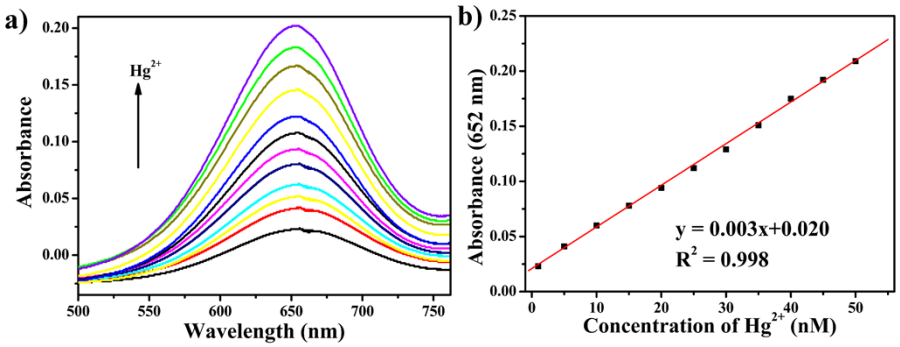

Figure S7. (a) The changes of absorption spectra after the addition of Hg^{2+} from 1-50 nM. Experiments were carried out using $Au/Fe_3O_4/GO$ hybrid (5 nM Au NPs), 0.20 mM TMB, 0.20 M H_2O_2 in citric acid–disodium hydrogen phosphate buffer (25 mM pH 5.0). (b) The standard curve at low concentration of Hg^{2+}.

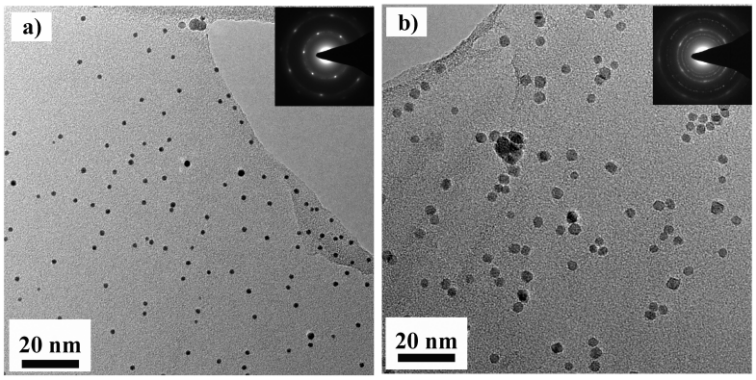

Figure S8. TEM images of Au/GO (a) and Fe_3O_4/GO (b), inset: the selected area electron diffraction of Au/GO and Fe_3O_4/GO.

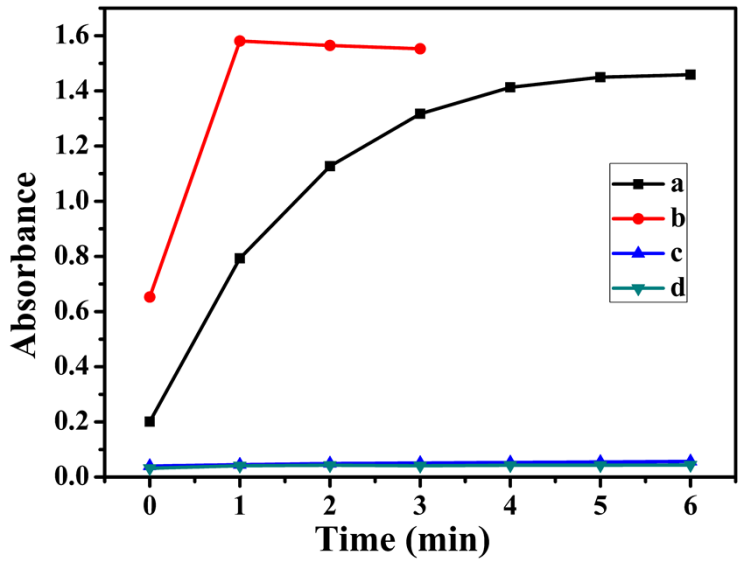

Figure S9. Enhancing effects of Hg^{2+}-stimulated peroxidase mimic catalytic activity on the citrate-capped $Au/Fe_3O_4/GO$ in the absence (a) and presence (b) of sodium borohydride ($NaBH_4$). Effects

of Hg^{2+}-stimulated peroxidase mimic catalytic activity without $Au/Fe_3O_4/GO$ in the absence (c) and presence (d) of sodium borohydride ($NaBH_4$). All the samples were tested in citric acid–disodium hydrogen phosphate buffer. Au NPs, 5.0 nM; Fe_3O_4 NPs, 20 μM; Hg^{2+}, 5.0 μM; TMB, 0.20 mM; H_2O_2, 0.20 M.

Table S1. The kinetic parameters of mercury-stimulated peroxidase mimetic catalytic activity of the Au/Fe_3O_4/GO hybrid in citric acid–disodium hydrogen phosphate buffer (25 mM, pH 5.0). K_m is the Michaelis constant, V_{max} is the maximal reaction velocity.

Sample	*Substance*	K_m *(mM)*	V_{max} *(nM* s^{-1}*)*
Au/Fe_3O_4/GO	TMB	0.102	3367.8
Au/Fe_3O_4/GO	H_2O_2	113	7936.5

Table S2. Determination of Hg^{2+} in real water samples.

Samples	Spiked Hg^{2+} (nM)	Absorbance at 652 nm	Proposed Method (nM)	By AAS (nM)
Yellow river	0	0.015	< 10	< 1
1	10	0.072	11 ± 0.5	10.37 ± 0.062
2	20	0.114	21 ± 0.5	20.52± 0.087