# Supporting information

## Materials

Acrylic acid, acrylamide, bisacrylamide, ethylenediaminetetraacetic acid (EDTA) were purchased from Sigma (Shanghai, China). Chloroauric acid ($HAuCl_4 \cdot 3H_2O$), sodium borohydride ($NaBH_4$) and ferrous chloride tetrahydrate ($FeCl_2 \cdot 4H_2O_2$) were purchased from Alfa Aesar (Shanghai, China). Hydrogen peroxide ($H_2O_2$) was obtained from Beijing Chemicals (Beijing, China). Glucose, fructose, lactose, and maltose were purchased from Sinopharm Chemical Reagent Co. (Shanghai, China). Glucose oxidase (GOx, from Aspergillus Niger) was purchased from BBI (Ontario, Canada). Human serum was obtained from a healthy adult male. Apple juice and orange juice (100% juice content) were purchased from Huiyuan Beverage and Food Group Co. (Beijing, China). Dialysis tubing was purchased from Pierce (2000 MWCO). Fructose, lactose, maltose, and glucose stock solutions were stored overnight at room temperature before use.[1] All regents were of analytical reagent grade. All solutions were prepared with ultra-pure water (18.25 MΩ cm) from a Millipore system.

## Apparatus and Characterization

Fluorescence measurements were carried out on Jasco-FP-6500 spectrofluorometer (Jasco International Co. LTD. Tokyo, Japan) using a quartz cell of 1 cm path length at room temperature. UV-vis absorption spectra measurements were carried out on a Cary 300 UV/vis spectrophotometer at room temperature. Glucose detection assay with the hexokinase method was carried out on an automatic Biochemistry Analyzer

(Olympus AU640, Olympus America Inc., Center Valley, PA).[2] Transmission electron microscope (TEM) measurements were carried out on a JEOL JEM-2010EX transmission electronmicroscope with a tungsten filament at an accelerating voltage of 200 kV. FTIR characterization was carried out on a BRUKE Vertex 70 FTIR spectrometer. All of the photographs were taken by a digital camera (Canon, Japan).

**$H_2O_2$ trigged sol-gel transition**

A stock solution of 30% acrylamide/bisacrylamide (29:1) was prepared for use. To verify the sol-gel transition could be triggered by $H_2O_2$ through a Fenton reaction, 800 μL 30% acrylamide/bisacrylamide aqueous solutions, 50 μL $Fe^{2+}$ (1 M) and 200 μL pH 4.0 $Na_2HPO_4$ (25 mM) were mixed and give a homogeneous fluidic solution. Then, by addition of 10 μL $H_2O_2$ (10 mM) into the mixture, sol-gel transition took place immediately.

**Fluorescence detection of $H_2O_2$**

To design an optical fluorescent sensor, a stock solution of 30% acrylic acid/bisacrylamide (29:1) was prepared for use. To prepare the sensor solution, 220 μL 30% acrylic acid/bisacrylamide aqueous solutions, 30 μL $Fe^{2+}$ (100 mM), 45 μL $Na_2HPO_4$ (25 mM, pH 4.0) buffer solution and 5 μL $Ru(bpy)_3^{2+}$ (680 μM) aqueous solutions were mixed. Then, by addition 5 μL $H_2O_2$ of different concentrations into the mixture, sol-gel transition took place immediately and the volume of the gel shows a $H_2O_2$-concentration-dependent fashion. The mixture was diluted to 600 μL after incubation for 10 min at room temperature. Quantitative analysis was performed

by monitoring the fluorescence emission intensity at 586 nm of the aqueous medium with the excitated wavelength at 458 nm.

**Fluorescence detection of glucose**

20 μL GOx (40 mg/mL) and 200 μL of glucose (40 mM) were dissolved in 0.5 mM $Na_2HPO_4$ (pH 7.0) buffer and the mixture was kept at 37 $^oC$ in a water bath for 1h. Then, the incubation solution was diluted to different concentration and taken out to add to the reaction mixture, which contain 220 μL 30% acrylic acid/bisacrylamide aqueous solutions, 30 μL of 100 mM $Fe^{2+}$, 45 μL of 25 mM $Na_2HPO_4$ (pH 4.0) buffer solution and 5 μL of 680 μM $Ru(bpy)_3^{2+}$ aqueous solutions. Sol-gel transition took place immediately and the volume of the gel is glucose-concentration-dependent. The mixture was diluted to 600 μL after incubation for 10 min at room temperature. Quantitative analysis was performed by monitoring the fluorescence emission intensity at 586 nm of the aqueous medium with the excitated wavelength at 458 nm and collected within a range of 520-700 nm.. In control experiments, 5 mM maltose, 5 mM lactose, and 5 mM fructose were used instead of glucose for the experiment [1].

**Synthesis of acrylic acid modified AuNPs**

Briefly, 10 μL of acrylic acid was added into 20 mL $HAuCl_4$ (1 mM) solution and the resulting solution was then kept continuously stirring for 10 min. Then, under vigorous stirring, 600 μL $NaBH_4$ (10 mM) was added slowly and the resulting solution was then kept continuously stirring for 15 min until an orange-red mixture was obtained. The mixture was stored in a refrigerator at 4 °C and then diluted to 2-fold for use after incubate for 3 days. The concentration of the prepared AuNPs

dispersion was determined with UV-vis spectrometry reported previously and found to be 5.6 nM in this study.

**$H_2O_2$ induce AuNPs aggregation**

To verify the aggregation of AuNPs was induced by $H_2O_2$ through a Fenton reaction, 5 μL $Fe^{2+}$ (20 mM, in the form of [Fe(EDTA)]) was added to a 190 μL AuNP dispersion (5.6 nM), after that, 5 μL $H_2O_2$ (0.4 mM) was added and the resulting solution was allowed to incubate for 10 min. UV-vis absorption spectra were collected within a range of 300-800 nm at room temperature. As control experiments, sole addition of 5 μL $Fe^{2+}$ (20 mM) or 5 μL $H_2O_2$ (0.4 mM) to the 190 μL AuNP dispersion (5.6 nM) was examined.

**Colorimetric detection of $H_2O_2$**

For colorimetric detection of $H_2O_2$, 5 μL $Fe^{2+}$ (20 mM, in the form of [Fe(EDTA)]) was added to a 190 μL AuNPs dispersion (5.6 nM), after that, 5.0 μL $H_2O_2$ of different concentrations was added and the resulting solution was allowed to incubate for 10 min. UV-vis absorption spectra were collected within a range of 300-800 nm at room temperature.

**Colorimetric detection of glucose**

10 μL of 40 mg/mL GOx and 200 μL of glucose (10 mM) were dissolved in 0.5 mM $Na_2HPO_4$ (pH 7.0) buffer and the mixture was kept at 37 $^oC$ in a water bath for 1h. Then, the incubation solution was diluted to different concentration and taken out 5 μL to add to the AuNPs-$Fe^{2+}$ solution, which containing 190 μL AuNPs dispersion (5.6 nM) and 5 μL $Fe^{2+}$ (20 mM, in the form of [Fe(EDTA)]). UV-vis absorption

spectra were collected within a range of 300-800 nm at room temperature. In control experiments, 0.5 mM maltose, 0.5 mM lactose, and 0.5 mM fructose were used instead of glucose for the experiment[1].

**Colorimetric detection of glucose**

For glucose determination in human serum, the sample was firstly treated by spin dialysis at 10 000 rpm for 40 min and then diluted 2-fold using 0.5 mM $Na_2HPO_4$ buffer (pH 7.0) for the incubation with GOx in the next step. For glucose determination in fruit juice, apple juice or orange juice were firstly treated by centrifugation at 12 000 rpm for 40 min and the supernatants were diluted 7.5-fold using 0.5 mM $Na_2HPO_4$ buffer (pH 7.0) for the incubation with GOx[3]. For colorimetric detection, the incubation solution was diluted further before added to the detection solution.

**Reference**

[1] Y. J. Song, K. G. Qu, C. Zhao, J. S. Ren and X. G. Qu, *Adv. Mater.*, 2010, **22**, 2206.

[2] DIN EN ISO 15197: In Vitro Diagnostic Test Systems Requirements for Blood Glucose Monitoring Systems for Self-Testing in Managing Diabetes Mellitus (ISO 15179:2003). Geneva: World Health Organization, 2003.

[3] V. Sanz, S. de Marcos, J. R. Castillo and J. Galban, *J. Am. Chem. Soc.*, 2005, **127**, 1038.

Table S1. Zata potential of the nanoparticles

| Sample | Zeta potential (mV) |
|---|---|
| Acrylic acid-AuNPs | -8.97±0.55 |
| Acrylic acid-AuNPs-$H_2O_2$-$Fe^{2+}$ | -15.25±1.15 |

Table S2. Different method for determination of glucose in three real samples.

| Samples | Fluorescence method (mM) | Colorimetric method (mM) | Hexokinase method (mM) |
|---|---|---|---|
| Human serum, | 5.24 | 5.29 | 5.27 |
| apple juice | 102.76 | 115.18 | 107.83 |
| orange juice | 111.62 | 136.73 | 117.53 |

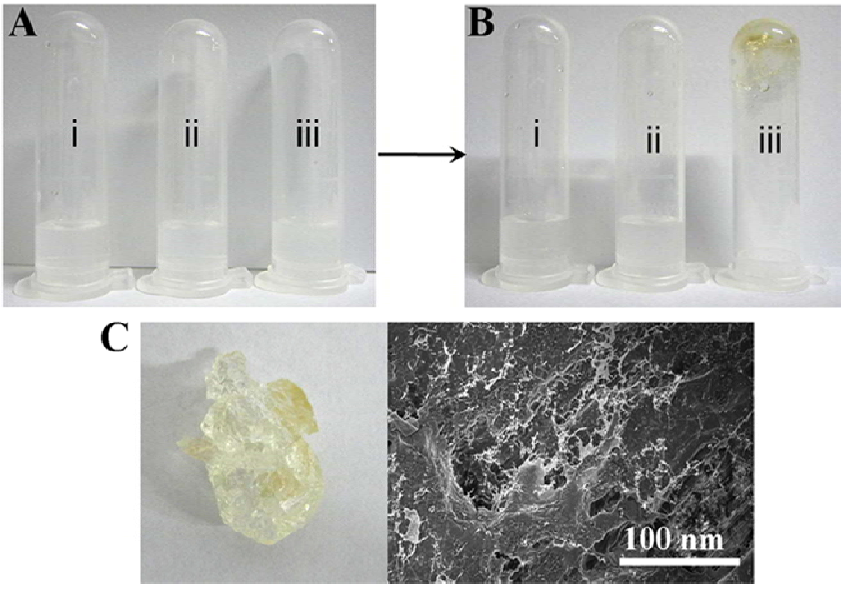


**Fig. S1** Optical images of the sol-gel transition of acrylamide/bisacryl-amide aqueous solutions. (A) i-iii, the aqueous solution of 800 μL30% acrylamide/bisacrylamide (29:1) in 200 μL pH 4.0 $Na_2HPO_4$ (25mM) buffer. (B) i, addition 50 μL $Fe^{2+}$ (1 M) to Ai. ii, addition 50 μL H2O2 (50 mM) to A ii. iii, addition 50 μL $Fe^{2+}$ (1 M) and 50 μL $H_2O_2$ (50 mM) to Aiii. (C) Optical photograph (left) and SEM image (right) of the hydrogel.

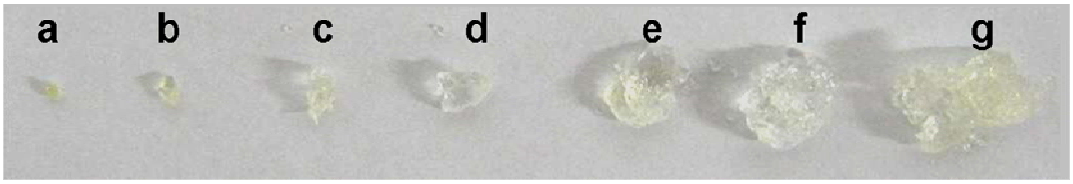


**Fig. S2** Optical images of the hydrogel formation in response to different $H_2O_2$ concentration in acrylamide/bisacrylamide-pH 4.0 $Na_2HPO_4$-$Fe^{2+}$ system. a: 50 μM; b: 100 μM; c: 250 μM; d: 500 μM; e: 1 mM; f: 2 mM; g: 5 mM.

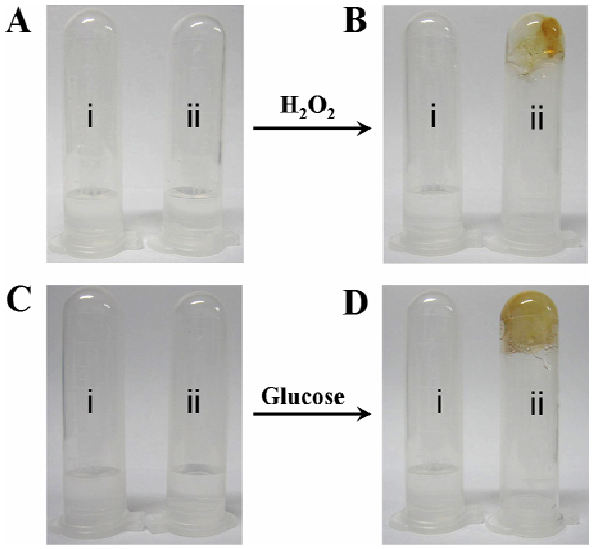


**Fig. S3** Optical images of the sol-gel transition of acrylic acid/bisacrylamide aqueous solutions in response to $H_2O_2$. (A) i, ii, the aqueous solution of 800 μL 30% acrylic acid/bisacrylamide (29:1) with 50 μL $Fe^{2+}$ (1 M) in 200 μL pH 4.0 $Na_2HPO_4$ (25mM) buffer. (B) i, addition 50 μL water to Ai. ii, addition 50 μL $H_2O_2$ (50 mM) to Aii. (C) i, ii, the aqueous solution of 800 μL 30% acrylic acid/bisacrylamide (29:1) with 50 μL $Fe^{2+}$ (1 M) in 200 μl pH 4.0 $Na_2HPO_4$ (25mM) buffer. (D) i, addition 50 μL water to Ci. ii, addition 50 μL glucose (50 mM)-GOx solution, which has been incubated in pH 4.0 $Na_2HPO_4$ (25 mM) buffer solution at 37 $^oC$ for 1h, to Cii.

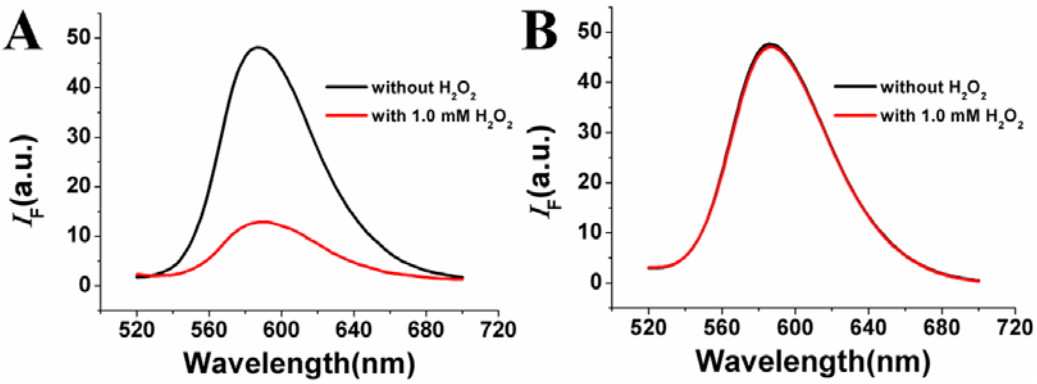


**Fig. S4** Fluorescence spectra of $Ru(bpy)_3^{2+}$ in the aqueous medium of pH 4.0 PBS-acrylic acid/bisacrylamide-$Fe^{2+}$-$Ru(bpy)_3^{2+}$ system (A) and pH 4.0 PBS-acrylamide/bisacrylamide-$Fe^{2+}$-$Ru(bpy)_3^{2+}$ system (B). Excitation wavelength was 458 nm.

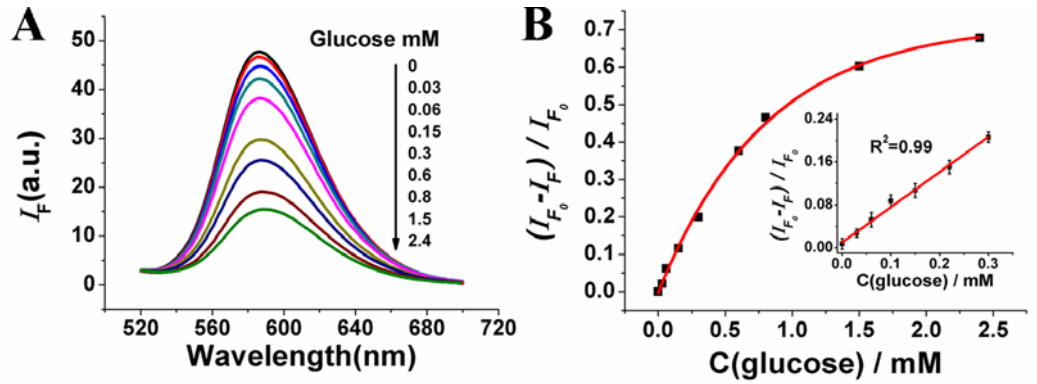


**Fig. S5** Sensitivity tests of the sol-gel detection of glucose. (A) Fluorescence emission spectra of the aqueous medium of pH 4.0 PBS-acrylic acid/bisacrylamide-$Fe^{2+}$-$Ru(bpy)_3^{2+}$ system after addition of different concentration of glucose (after incubated with GOx). (B) Quantification of glucose concentration by monitoring the relative fluorescence intensity ($(I_{F0}-I_F)/I_{F0}$), where $I_{F0}$ and $I_F$ are fluorescence emission intensity at 586 nm of the aqueous medium without or with glucose. Excitation wavelength was 458 nm.

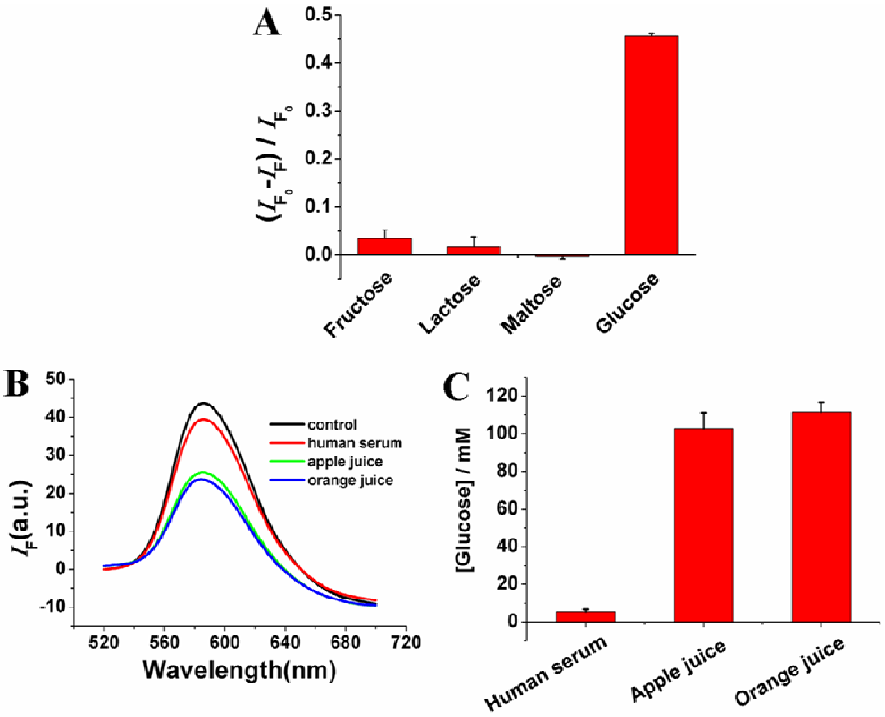


**Fig. S6** (A) Selectivity analysis for glucose detection by monitoring the relative fluorescence. The analyte concentrations were as follows: 5 mM fructose, 5 mM lactose, 5 mM maltose, and 0.8 mM glucose. The error bars represent the standard deviation of three measurements. (B) The fluorescence spectra for different samples (buffer solution or diluted human serum and fruit juice samples) after incubation with GOx. Human serum, apple juice, and orange juice were diluted 40-, 150-, and 150-fold, respectively. (C) The glucose concentration in the sample according to the calibration curve of Fig. S5B.

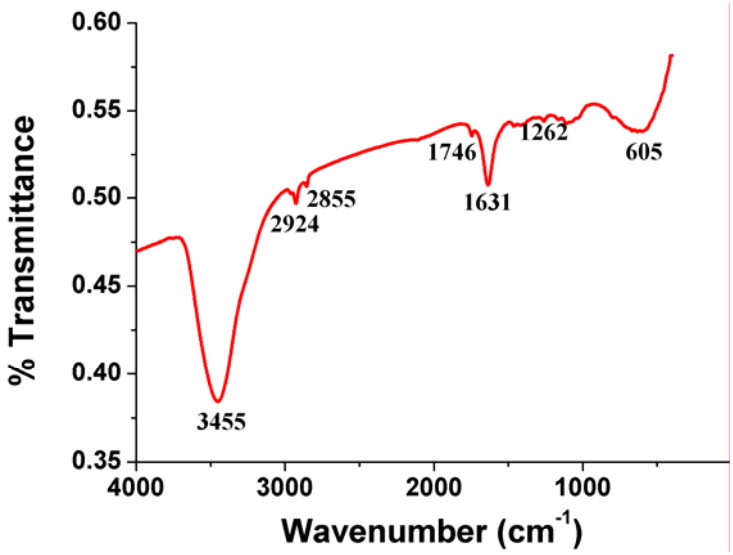


**Fig. S7** FTIR Spectra of acrylic acid modified AuNPs.

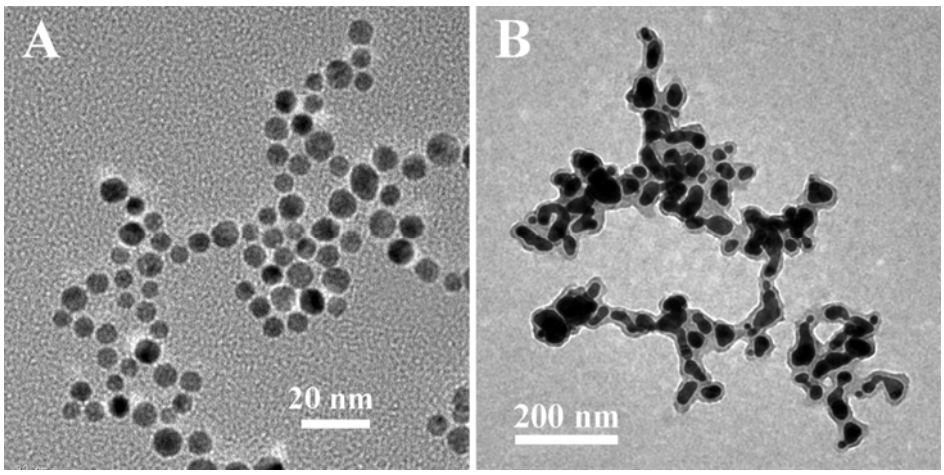


**Fig. S8** TEM images of (A) acrylic acid modified AuNPs, (B) 0.5 mM $Fe^{2+}$ (in the form of [Fe(edta)]) and 12.5 μM $H_2O_2$ added.

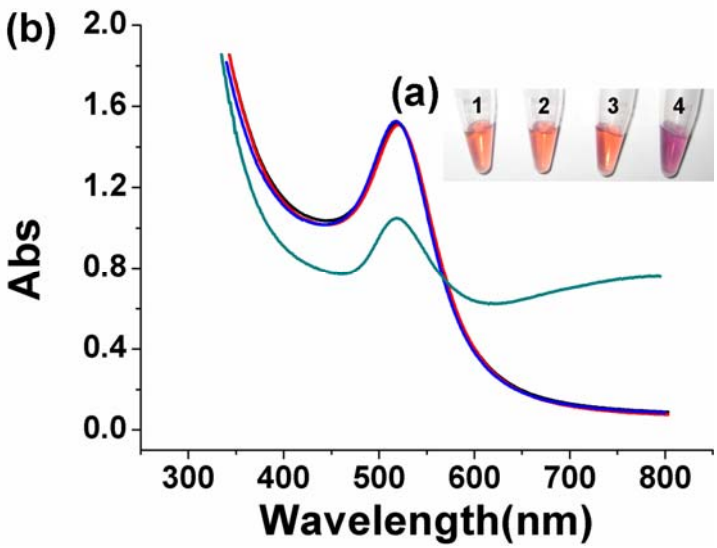


**Fig. S9** $H_2O_2$-induced aggregation of AuNPs. (a) Photographs and (b) UV/Vis spectra of AuNPs dispersions, prepared first by addition of 5 μL $H_2O$ (black curve, vial 1), 5 μL $H_2O_2$ (0.5 mM; red curve, vial 2), 5 μL $Fe^{2+}$ (20 mM, in the form of [Fe(edta)]; blue curve, vial 3) or 5 μL $H_2O_2$ (0.5 mM) and 5 μL $Fe^{2+}$ (20 mM, in the form of [Fe(edta)]; green curve, vial 4) to 190.0 μL AuNPs (5.6 nm).

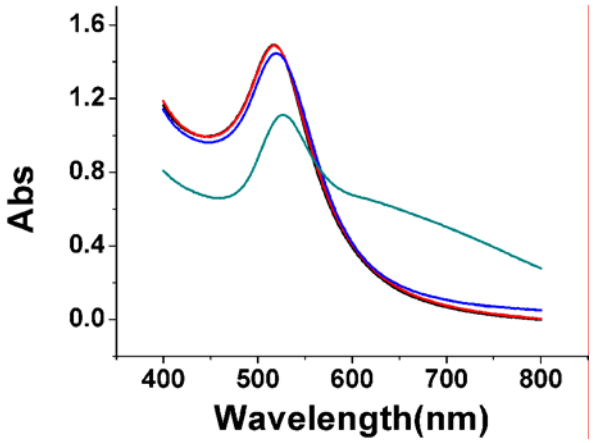


**Fig. S10** Glucose-induced aggregation of AuNPs. UV/Vis spectra of AuNPs dispersions, prepared first by addition of 5 μL $H_2O$ (black curve), 5 μL glucose (1.5 mM; after incubated with GOx, red curve), 5 μL $Fe^{2+}$ (20 mM, in the form of [Fe(edta)]; blue curve) or 5 μL $H_2O_2$ (1.5 mM, after incubated with GOx) and 5 μL $Fe^{2+}$ (20 mM, in the form of [Fe(edta)]; green curve) to 190.0 μL AuNPs (5.6 nm).

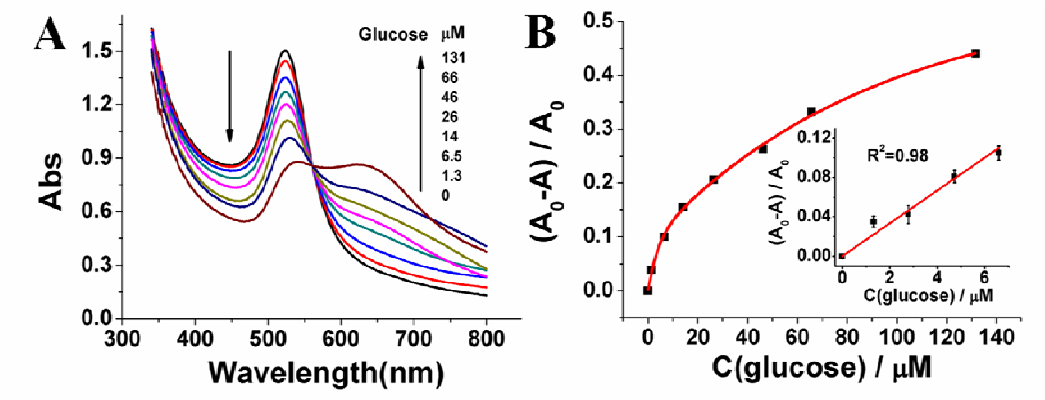


**Fig. S11** (A) UV/visible absorption spectra of AuNPs-$Fe^{2+}$ reaction mixture after addition of different concentration of glucose (after incubated with GOx). (B) Quantification of glucose concentration by monitoring the relative UV/visible absorption at 519 nm: $A(0)_{519}$ -$A_{519}$ /$A(0)_{519}$, where $A(0)_{519}$ and $A_{519}$ are UV/visible absorption at 519 nm of the reaction mixture without or with glucose.

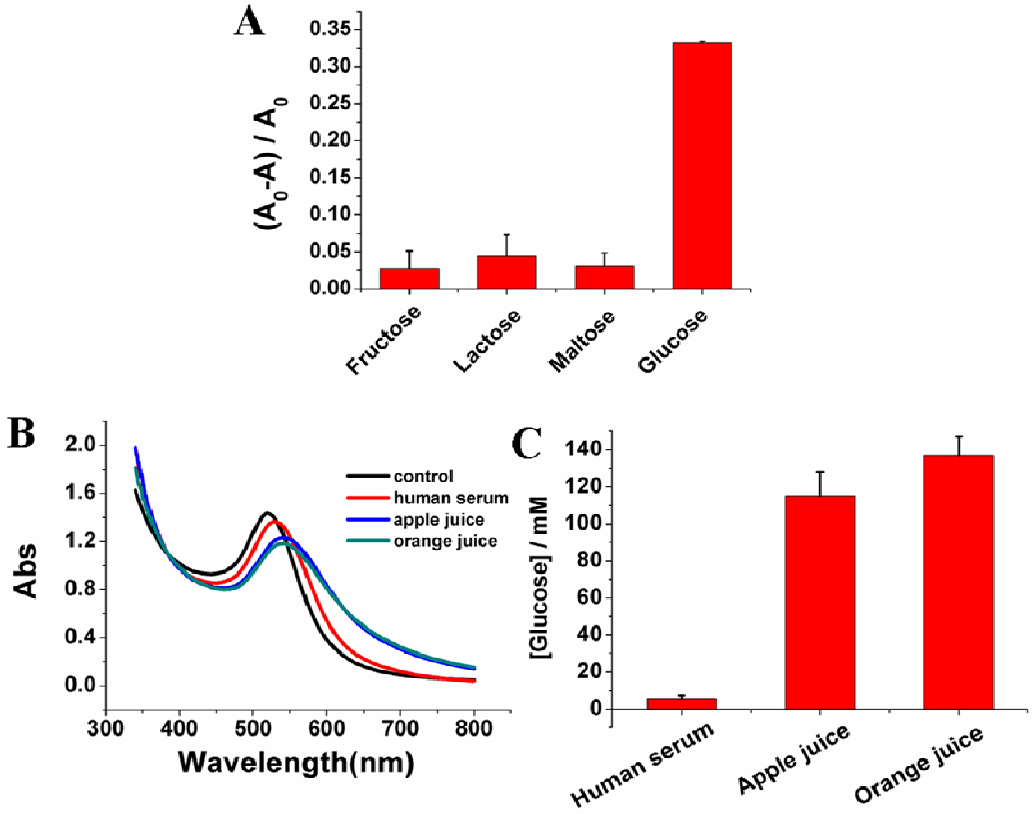


**Fig. S12** (A) Selectivity analysis for glucose detection by monitoring the relative relative UV/visible absorption at 519nm of the AuNPs reaction solution. The analyte concentrations were as follows: 0.8 mM fructose, 0.8 mM lactose, 0.8 mM maltose, and 0.066 mM glucose. The error bars represent the standard deviation of three measurements. (B) The fluorescence spectra for different samples (buffer solution or diluted human serum and fruit juice samples) after incubation with GOx. Human serum, apple juice, and orange juice were diluted 1000-, 5000-, and 5000-fold, respectively. (C) The glucose concentration in the sample according to the calibration curve of Fig. S11B.