

Fluorescent detection of 4-nitrophenol and  $\alpha$ -glucosidase activity  
based on 4-nitrophenol regulated fluorescence of silicon  
nanoparticles

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## **Chemicals and Materials.**

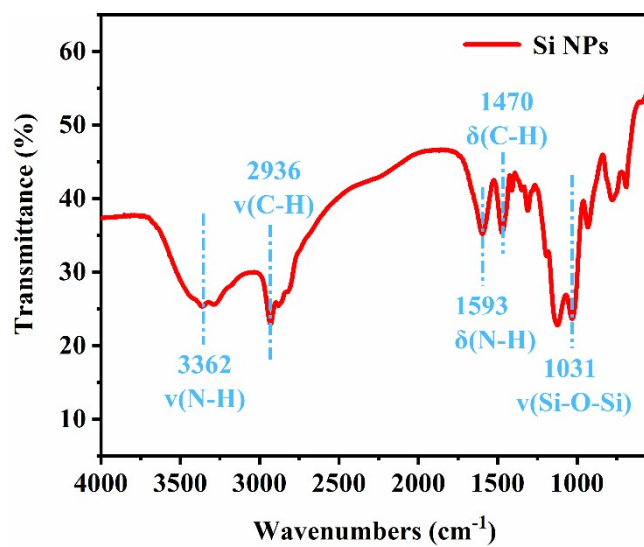
N-[3-(trimethoxysilyl)propyl]ethylenediamine (DAMO), *p*-aminophenol (AP), NPG, aspartic acid (Asp), 3-nitrophenol (3-NP), 2-nitrophenol (2-NP), Zn(NO<sub>3</sub>)<sub>2</sub>, NaCl, KCl, MgCl<sub>2</sub>, NH<sub>4</sub>Cl, NiCl<sub>2</sub>, Co(NO<sub>3</sub>)<sub>2</sub>, MnCl<sub>2</sub>, FeCl<sub>3</sub>, FeSO<sub>4</sub>, NaF, NaCl, NaBr, NaI, NaNO<sub>3</sub>, Na<sub>2</sub>CO<sub>3</sub>, Na<sub>2</sub>SO<sub>4</sub>, Na<sub>2</sub>SO<sub>3</sub>, disodium edetate dihydrate (Na<sub>2</sub>EDTA), aspartic acid (Asp) and histidine (His) were obtained from Aladdin Co. Ltd. (Shanghai, China).  $\alpha$ -glucosidase ( $\alpha$ -Glu), bovine serum albumin (BSA), glucose (Glu), catechol (Cchol), hydroquinone (HQ), benzoic acid (BA), phenol (Ph), resorcinol (Rsnol), 4-nitrophenol (4-NP), alkaline phosphatase (ALP), acetylcholinesterase (AChE), lysozyme (Lys), glucose oxidase (GOx), and trypsin were purchased from Sigma-Aldrich (St. Louis, MO). Pancreatin (Pan) and pepsin was bought from Macklin Biochemical Technology Co. Ltd. (Shanghai, China).

## **Apparatus and Characterization.**

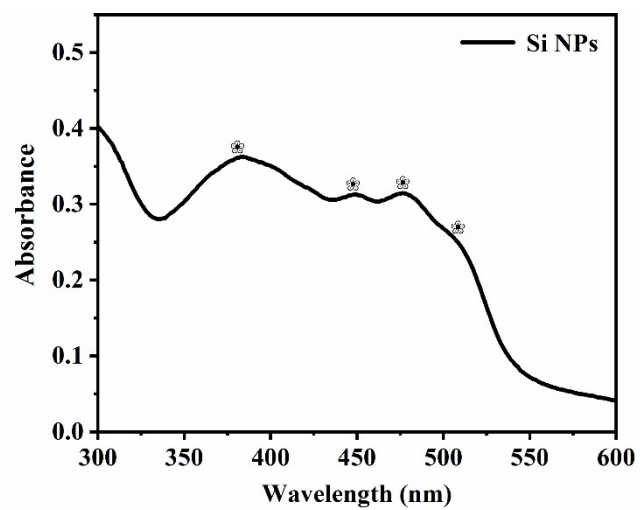
Fluorescence spectra were recorded by a Shimadzu RF-6000 spectrofluorometer (Shimadzu, Japan). UV-vis spectra were acquired with a UV-8000 spectrophotometer (Metash, China). The morphology of Si NPs was characterized by using a Jeol JEM-2100 Plus transmission electron microscope (TEM, Japan) operated at 100 kV. X-ray photoelectron spectroscopy (XPS) study was carried out using the ESCALAB MK II spectrometer (VG Scientific) with Al K $\alpha$  radiation as X-ray source. X-ray powder diffraction (XRD) pattern was collected on D8 ADVANCE (Germany) using Cu K $\alpha$  radiation generated at 40 kV and 40 mA. Fourier transform infrared (FTIR) data were acquired with a VERTEX 70 Fourier transform infrared spectrometer (Bruker).

### **Synthesis of Si nanoparticles (Si NPs)**

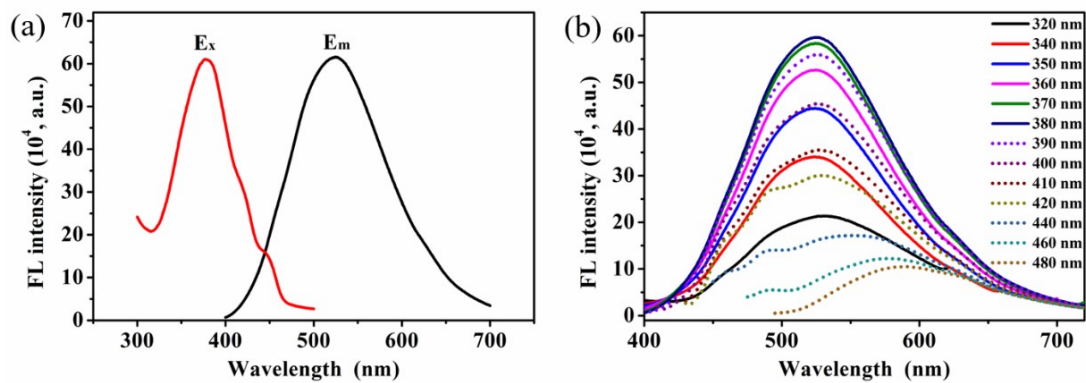
Si NPs were synthesized according to our previous work<sup>1</sup>. Typically, 3.2 mL of DAMO and 1.2 mL of AP 10 mM solution were thoroughly mixed with 15.6 mL of ultrapure water, and then being incubated at 70 °C for 20 min. The resulted orange-red Si NPs were cooled to room temperature, purified with a dialysis bag (500 Da) against ultrapure water for 6 h, and then stored at 4 °C.



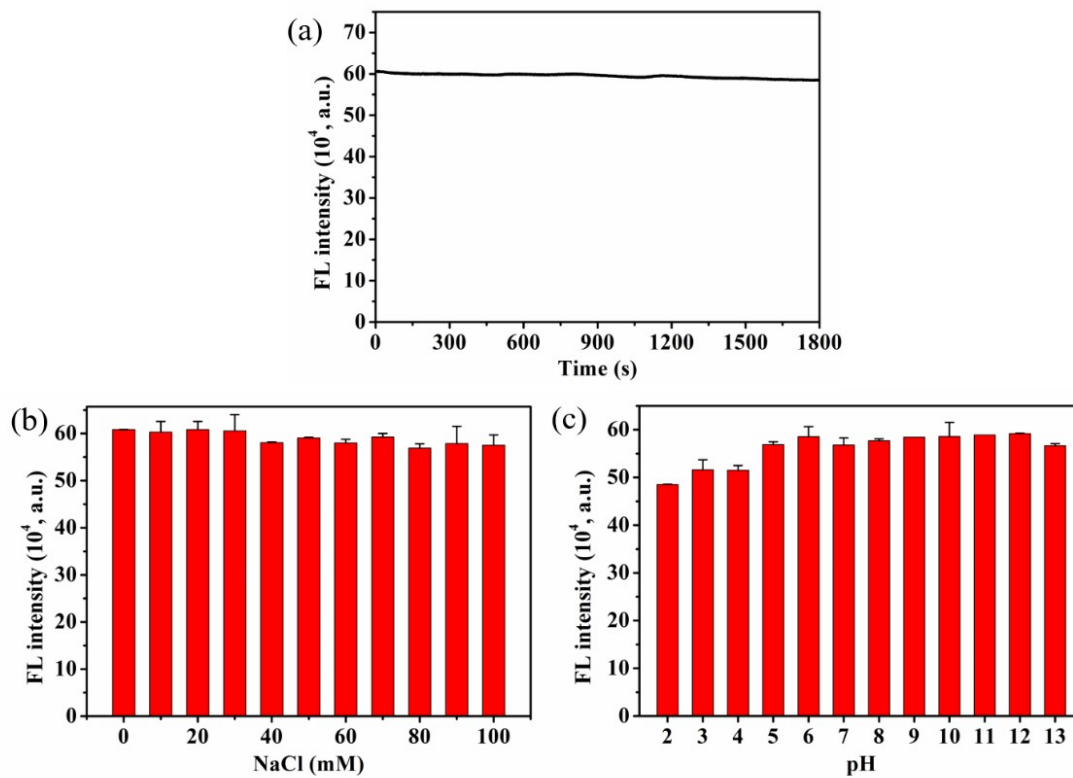
**Fig.S1** FT-IR spectrum of the Si NPs.



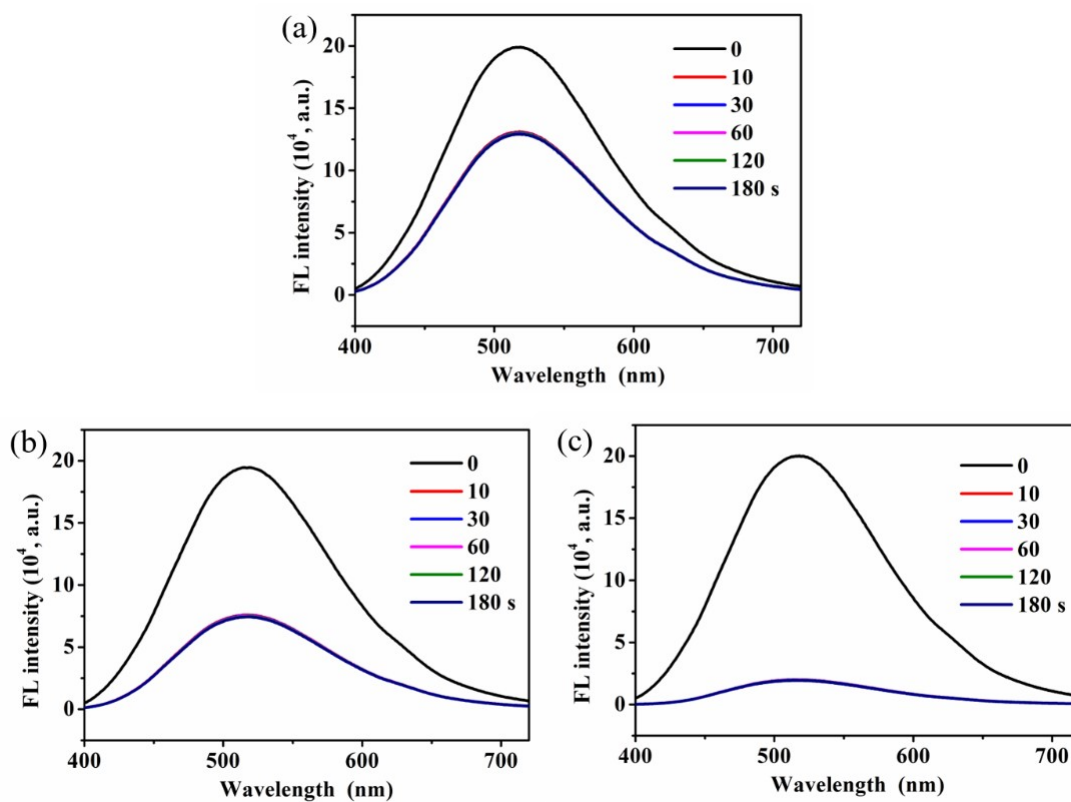
**Fig.S2** UV-Vis absorption spectrum of Si NPs.



**Fig.S3** (a) Excitation fluorescence spectrum and emission fluorescence spectrum of Si NPs. (b) Emission spectra of Si NPs at different excitation wavelengths.

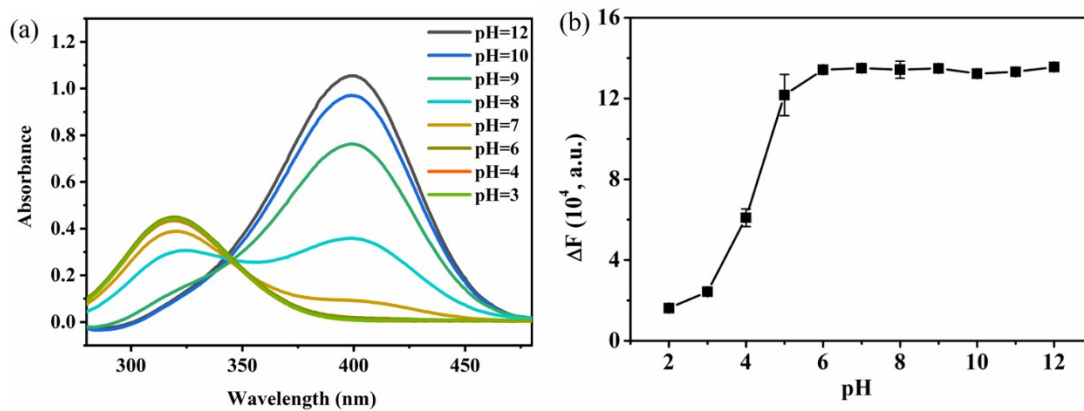


**Fig.S4** (a) Fluorescence intensity of Si NPs after irradiation for different times under 376 nm UV light. (b) Fluorescence intensity in the presence of different concentrations of NaCl. (c) Fluorescence intensity of Si NPs at different pH.

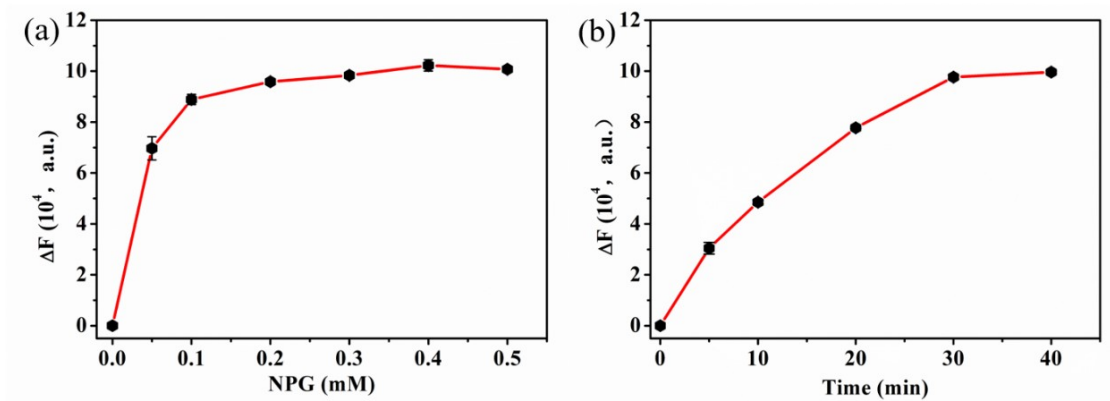


**Fig.S5** The fluorescence spectra of Si NPs after reacting with (a) 30, (b) 50 and (c) 150  $\mu$ M of 4-NP for different times.

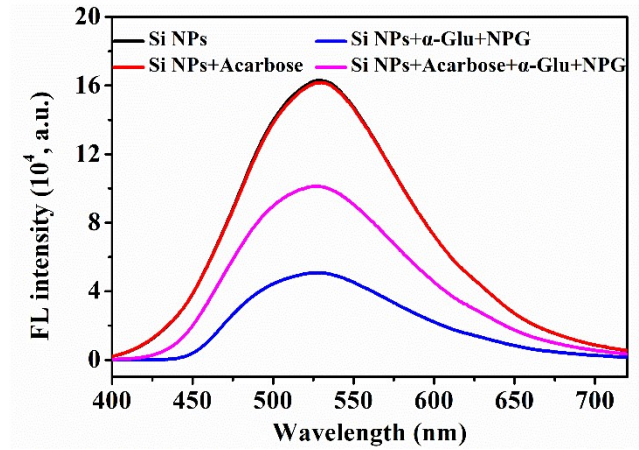




**Fig.S6** (a) UV-Vis absorption spectra of 4-NP and (b) fluorescence intensity change of Si NPs induce by 4-NP at different pH values.



**Fig.S7** Relationship between the change of Si NPs fluorescence intensity and the concentration of (a) NPG in the system and (b) incubation time.



**Fig.S8** Fluorescent spectra of Si NPs in the presence of Acarbose,  $\alpha$ -Glu + NPG and Acarbose,  $\alpha$ -Glu + NPG.

**Table S1.** Comparison of the proposed method with other reported methods for 4-NP detection.

Method	Linear range ( $\mu\text{M}$ )	LOD ( $\mu\text{M}$ )	Detection time (min)	Recovery (%)	Ref.
Electrochemistry	1.0–300	0.6	7	95.9–104.4	2
Electrochemistry	0.1–120	0.02	30	99.0–102.3	3
Electrochemistry	0.1–50	0.01	11	97.4–100.6	4
Fuel Cell	0.05–20	0.031	15	96.0–108.2	5
Colorimetry	0.005–1, 1–50	0.0035	1	97.0–110.0	6
Fluorescence	0.14–21	0.064	–	97.0–100.5	7
Fluorescence	0.05–50	0.009	5	97–105	8
Fluorescence	0.5–14	0.036	9	93.8–105.3	9
Fluorescence	0.5–70	0.201	1	98–106	10
Fluorescence	0.2–8	0.051	8	92.7–109.2	11
Fluorescence	1–40	0.34	2	98.1–106.3	12
Fluorescence	0–12	0.15	–	94.6–106.3	13
Fluorescence	0.05–5	0.0138	1	99.4–100.2	14
Fluorescence	0.5–60	0.26	1	96.8–103.8	15
Fluorescence	0.5–60	0.074	immediately	98.4–103.8	This work

**Table S2.** Comparison of the proposed method with other reported methods for  $\alpha$ -Glu detection.

Materials	Substrate	Mode	Linear range (U mL <sup>-1</sup> )	LODs (mU mL <sup>-1</sup> )	Ref.
$\beta$ -CD-CQDs	NPGlu	Fluorometry	0.01–0.06	0.6	16
CDs	NPGlu	Fluorometry	0.2–10	10	17
SiQDs-MnO <sub>2</sub> NS	AAG	Fluorometry	0.02–2.5	7	18
PBA-CQD	NPGlu	Fluorometry	1.14–17.35	0.33	19
MnO <sub>2</sub> NS-OPD-AuNCs	AAG	Fluorometry	0.2–8	30	20
F-PDA-CoOOH	AAG	Fluorometry	0.002–0.08	1.65	21
CTAB-AuNRs	AAG	Colorimetry	0.0025–0.045	0.5	22
pAPG-AuNPs	pAPG	Colorimetry	0.01–1.1	4	23
AuNPs-I-Cys-GOx	Maltose	Colorimetry	0.0025–0.5	1	24
f-FeNC	NPGlu, etc	Colorimetry	0.005–0.04, 0.04–0.1	0.27	25
SA-Pt/CN	$\alpha$ -Arbutin	Colorimetry	0.01–8	3.8	26
Si NPs	NPGlu	Fluorometry	0.0005–0.06	0.094	This work

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