Electronic Supplementary Information

Experimental section

Materials

Sucrose powder and edible oil were purchased at local supermarket. Chloroauric acid tetrahydrate ($HAuCl_4 \cdot 4H_2O$) and sodium borohydride were obtained from Alfa Aesar China Chemical Co., Ltd (Shanghai, China). Sodium citrate and 4-nitrohenol were purchased from Sigma-Aldrich (St Louis, MO, USA). The water (≥ 18.2 M Ohm cm) was from a Millipore filtration system and used in all experiments.

Synthesis of reductive carbon dots

r-CDs were synthesized with a green and rapid "oil-bath" method. Briefly, 10 g sucrose power was added into 20 mL hot edible oil (about 250 ^oC), and the color of the mixture turned dark brown under the mechanical stirring after 5 min, indicates the formation of r-CDs. After cooling to room temperature, the r-CDs solid was put into 30 mL water, and r-CDs could be dispersed well in aqueous solution due to their excellent hydrophilic properties. After separating off small amount of edible oil, r-CDs aqueous solution was obtained.

Synthesis of sf-AuNPs/r-CDs and citrate based AuNPs (c-AuNPs)

The synthesis of sf-AuNPs/r-CDs was carried out at ambient conditions. Typically, 100 μL of $HAuCl_4$ aqueous solution (12 mM) was added into 3 mL r-CDs solution (1.5 g/L) at room temperature, and the obvious color change from yellow to red wine indicates the formation of AuNPs. The synthesized sf-AuNPs/r-CDs aqueous solution was stored at 4^oC for further use.

The citrate based AuNPs (c-AuNPs) were synthesized as reported references.[1] In a typical synthesis, a solution of 4.0 mM sodium citrate in water (100 mL) was heated in a 250 mL three-necked round-bottomed flask under vigorous stirring. When it was boiling, 1.00 mL of $HAuCl_4$ (40 mM) was then added into the above solution. Keeping the solution boiling for 30 min, the reaction was finished by cooling down and citrate stabilized AuNPs (c-AuNPs) was obtained.

Characterization

UV-vis spectra of the catalysts and catalytic reaction solution in the experiments were recorded by a Hitachi U-2900 Ultraviolet-visible absorption spectrometer (Tokyo, Japan). Transmission electron microscopy (TEM) measurements were made on a HITACHI H-8100 EM (Hitachi, Tokyo, Japan) with an accelerating voltage of 200 kV. X-ray diffraction (XRD) measurements were performed on a Tongda TD-3500 X-ray powder diffractometer (Liaoning, China) with Cu Kα radiation (λ=0.154 nm). FT-IR was measured on a Thermo Scientific Nicolet 6700 FT-IR spectrometer (Sugar Land, TX, USA). The XPS spectra of the synthesized H-CDs were measured on a Kratos AXIS Ultra DLD X-ray Photoelectron Spectroscope using Mg as the excitation source (Kratos, UK).

Catalytic reduction of 4-NP

The 4-NP (1 mM) and $NaBH_4$ (600 mM) aqueous solutions were freshly prepared before the test. Typically, in a 50 mL flask, 3 mL of $NaBH_4$ solution was mixed with 3 mL of 4-NP aqueous solution. After that, 1 mL of sf-AuNPs/r-CDs solution (containing 0. 4 mM of Au) was added to the above mixture under continuous stirring. And the final reaction volumes were adjusted to 30 mL with distilled water. All catalytic reactions were carried out at room temperature. In order to monitor the reaction, 1.5 mL of the reaction solution was taken out using a syringe at set intervals, and injected into a quartz cuvette immediately. The solution was then measured with the UV‑vis absorption spectrometer. To study the catalytic activity of r-CDs and c-AuNPs for the 4-AP reduction, equal amount of r-CDs and c-AuNPs instead of sf-AuNPs/r-CDs were added into the reaction system with the same procedure.

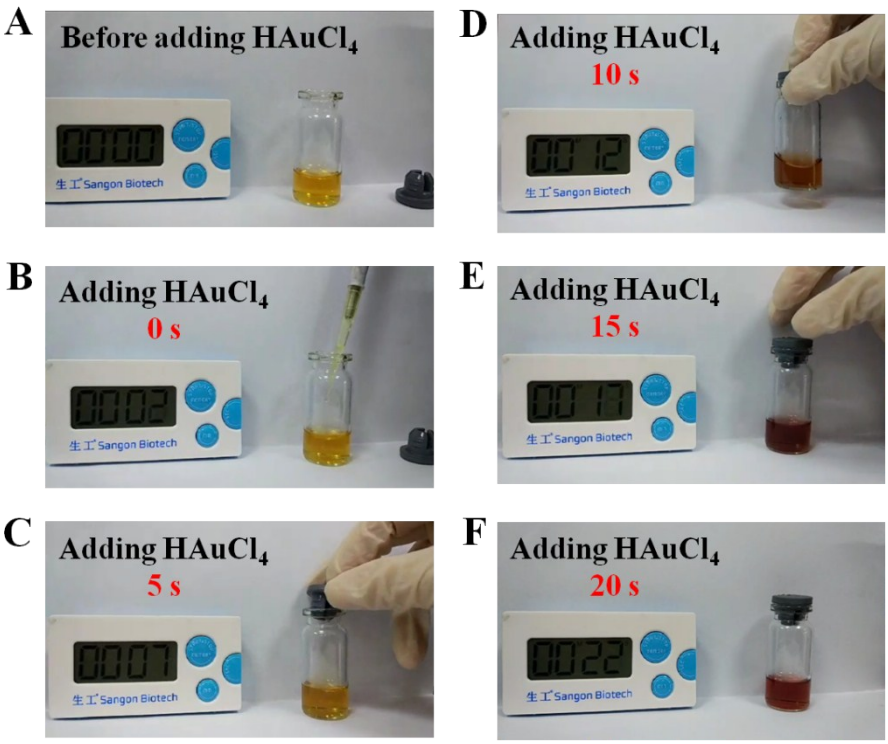

Fig. S1. The color changes of the r-CDs aqueous solution before (A) and after the addition of $HAuCl_4$ at 0-20 s (B-F).

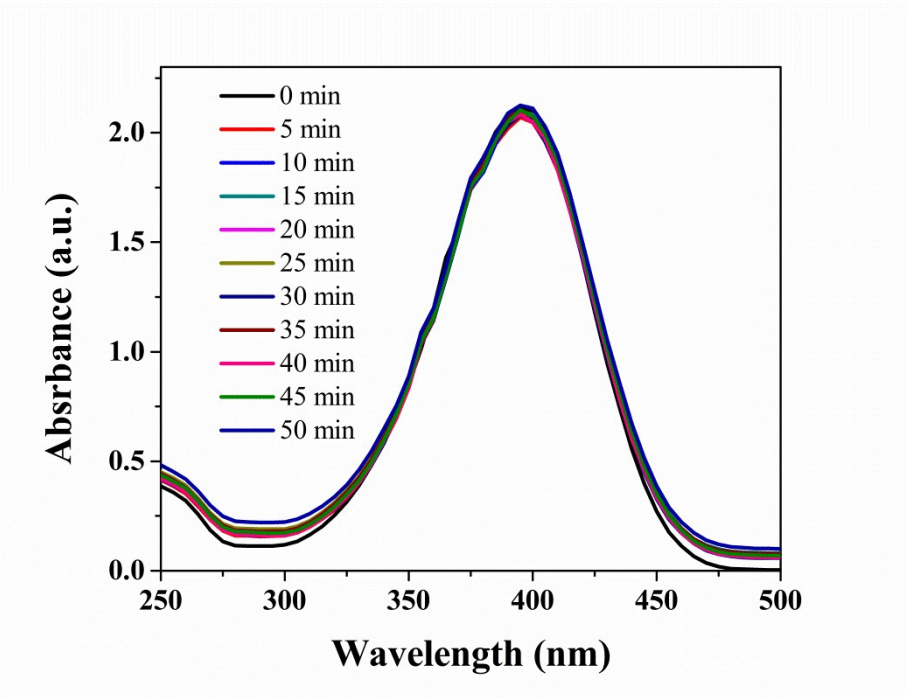

Fig. S2. UV–vis absorption spectra during the catalytic reduction of 4-NP without catalyst.

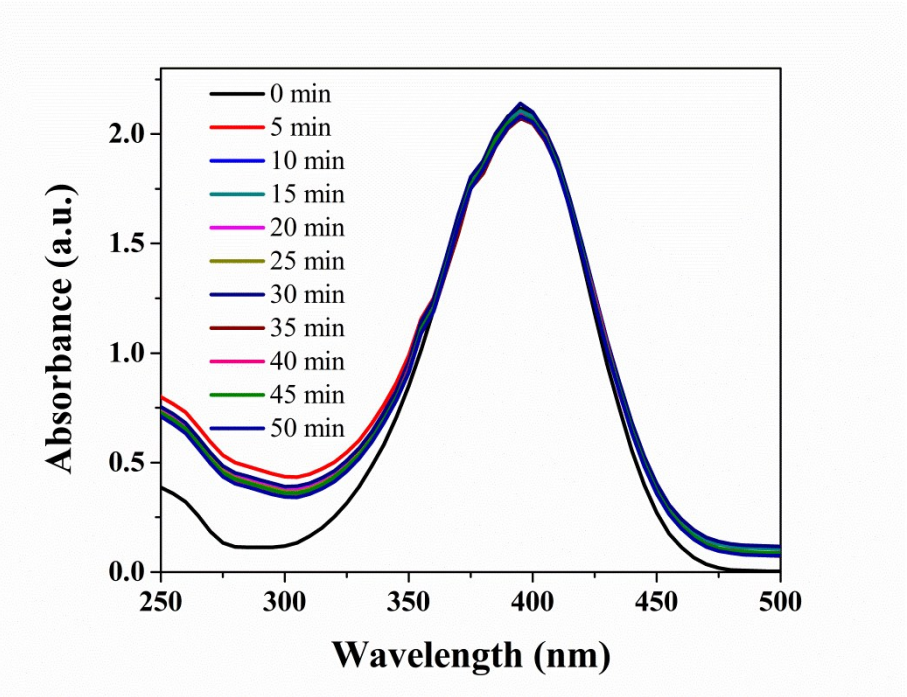

Fig. S3. UV–vis absorption spectra during the catalytic reduction of 4-NP with r-CDs alone as catalyst.

Table 1. Comparison with other methods for synthesis of AuNPs based on carbon materials without using strong reducing agents (RT: room temperature).

Materials	**Reducing agents**	**Temperature**	**Time**	**References**
Au/CQDs	Carbon quantum dots from ethylene glycol	37 °C	10 min	2
Au@CDs	Carbon dots from graphine dots	100 °C	80 min	3
Au NPs	Carbon dots from PEG	RT	5 min	4
r-CD/AuNPs	Carbon dots from lampblack	40-100 °C	1-24 h	5
AuNPs/C-dots	Carbon dots from ethylene glycol	RT	20 min	6
Au NP@C-dot	Carbon dots from citric acid	RT	1-4 h	7
AuNPs@CDs	Carbon dots from citric acid and urea	RT	3 h	8
AuNPs/C NC	Carbon dots from ethylene glycol	30 °C	3 h	9
sf-AuNPs/r-CDs	r-CDs from sucrose	RT	<30 s	This work

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