Electronic Supplementary Information (ESI)

Light-induced synthesis of photoluminescent carbon nanoparticles for Fe^{3+} sensing and photocatalytic hydrogen evolution

Pengju Yang,[a,b] Jianghong Zhao,[a*] Jian Wang,[a,b] Baoyue Cao,[a,b] Li Li[a] and Zhenping Zhu[a*]

Experimental section

Preparation of CNPs:

All chemicals were analytical-grade and used without further purification. Firstly, glucose (9 g) was dissolved in deionized water (160 mL) to form a clear solution, then HCl (40 mL, 36-38 wt%) was dropped into the glucose solution. Afterwards, the mixed solution was irradiated under 300 W high pressure Hg lamp under 18 ℃ to 20 ℃. After 12 h irradiation, a yellow solution was obtained. The obtained CNPs solution was then dialyzed with dialysis membrane (molecular weight 3500) for 3 days, and finally the product was obtained.

Measurement of photocatalytic performance and sensor of the obtained CNPs:

The water splitting reactions were performed using a closed system with an inner-irradiation-type Pyrex reactor. About 30 mL CNPs solution (2.1 mg CNPs) was added into 180 mL methanol aqueous solution (30 mL methanol, 150 mL water). The mixed solution was degassed by Ar purging before the reaction and was irradiated with 300 W xenon lamp (160 mW/cm^2). The temperature of the solution was maintained at 18 ℃ to 20 ℃ by using cool flowing water. The amounts of hydrogen were measured via gas chromatography (Beifen-Ruili: SP-2100, MS-5Å column, TCD, Ar carrier).

For the detection of various metal ions, $Fe(NO_3)_3 \cdot 9H_2O$, $NiNO_3 \cdot 6H_2O$, $Zn(NO_3)_2 \cdot 6H_2O$, $Mg(NO_3)_2 \cdot 6H_2O$, $AgNO_3$, $Cu(NO_3)_2 \cdot 3H_2O$, $Ca(NO_3)_2 \cdot 4H_2O$, $Cd(NO_3)_2 \cdot 4H_2O$, $Cr(NO_3)_3 \cdot 9H_2O$, $Co(NO_3)_2 \cdot 6H_2O$, KNO_3, $Mn(NO_3)_2$and $NaNO_3$ have been used as different metal ion sources. Five milliliters of the CNPs aqueous solution

(0.07 mg/mL) was mixed with different metal ions. The PL emission spectra were recorded after reaction for 10 s. The excitation wavelength was fixed at 360 nm for all the PL emission spectra.

Characterization:

TEM images were obtained using a JEOL JEM-2010 microscope with an accelerating voltage of 200 kV. FTIR was performed using a Nicolet Magna-IR 550-II spectrometer with KBr pallets. Raman spectra were recorded on a LABRAM-HR in plus laser Raman spectrometer with excitation wavelength 514 nm. UV-Vis absorption spectroscopy was carried out through placing the CNPs solution in a 1-cm quartz cuvette and analyzed using a Shimadzu UV-3600 UV-Vis-NIR spectrophotometer at room temperature. PL emission spectra were measured on a Hitachi F-7000 FL spectrophotometer. XPS was carried out on a Thermo ESCALAB 250 XPS spectrometer with Al Kα (hν = 1486.6 eV) radiation. To eliminate the effect of sample surface charging the shift of the XPS peak of carbon (C1s whose binding energy is 284.8 eV) was used. XRD analysis was conducted on a D8 Advance Bruker X-ray diffractometer with Cu Kα radiation (λ = 0.15406 nm) operating at 40 kV. Elemental analysis was carried out on an elemental Analyzer (vario EL CUBE). The light intensity was measured using an Optical Power Energy Meter Model.842.PE. The dynamic light scattering for size distribution and zeta potential were measured on a Nano ZS90 Particle Size and Zeta Potential Analyzer (Malvern).

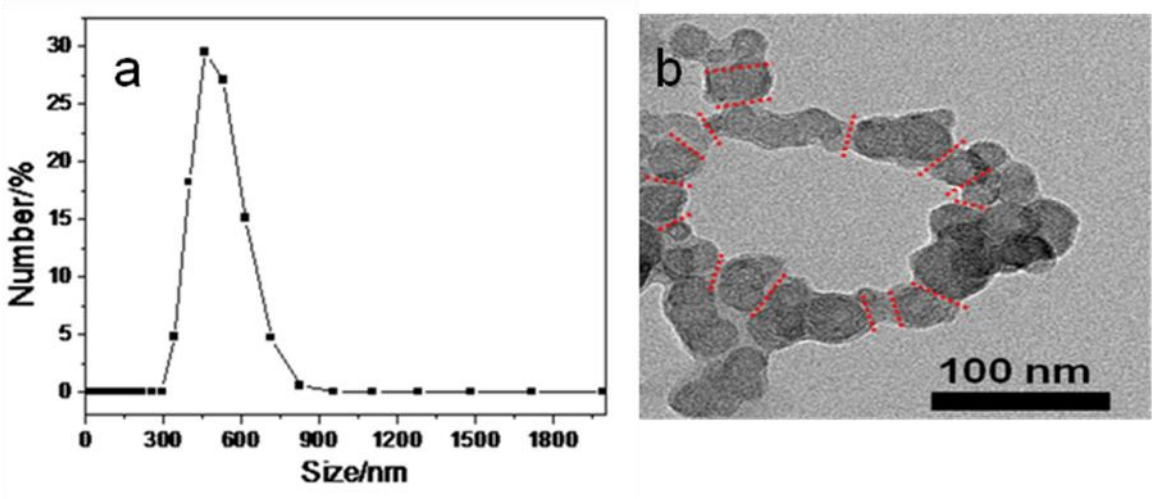

Fig S1 Size distribution of CNPs by dynamic light scattering (a) and TEM image of the CNPs (b)

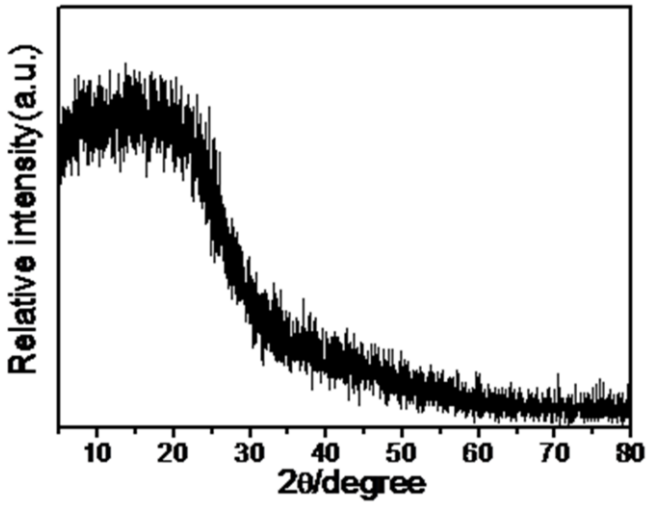

Fig S2 XRD patternof the CNPs

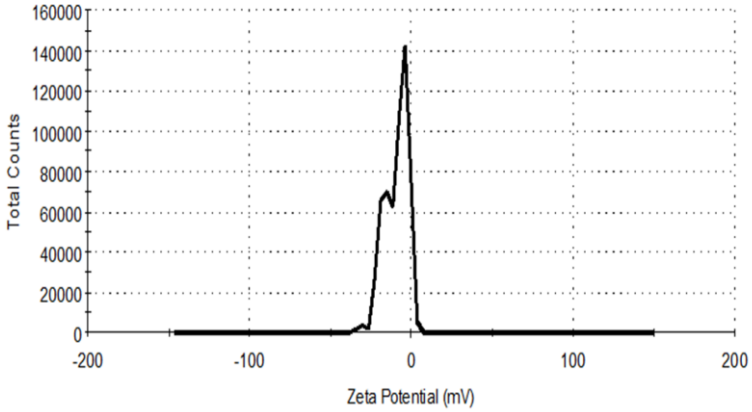

Fig S3 Zeta potential of the CNPs

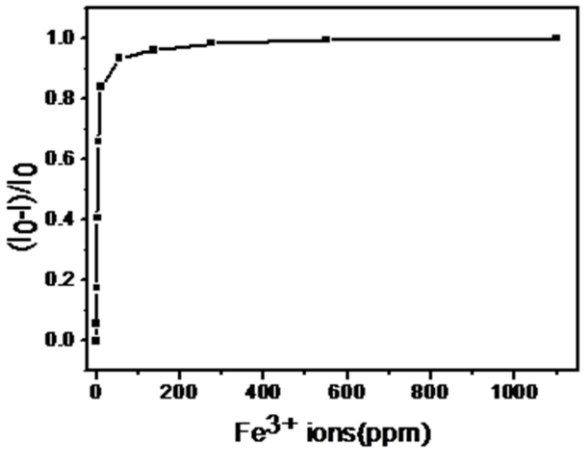

Fig S4 Dependence of $(I_0-I) / I_0$ on the concentrations of Fe^{3+} ions within the range of 0 - 1100 ppm

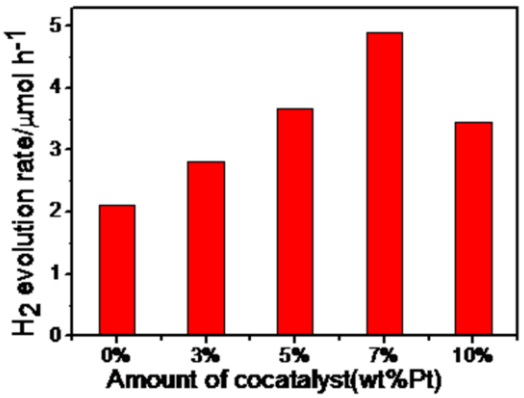

Fig S5 Dependence of the hydrogen evolution rate on the Pt load on the CNPs

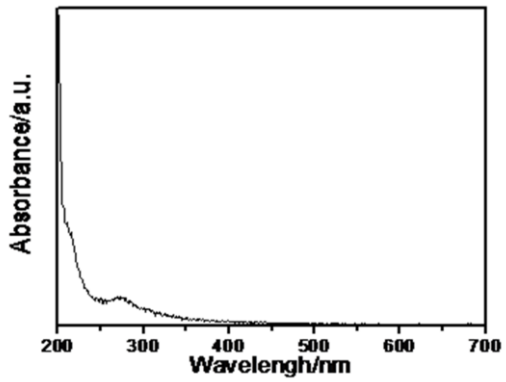

Fig S6 UV-visible adsorption spectrum of glucose aqueous solution