Supplementary Information

Graphitic Carbon Nitride Nanoribbon for Enhanced Visible-light Photocatalytic H2 Production

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Experimental Section

Materials

Melamine (99.5 %), HNO₃ (99.5 %) and H_2SO_4 (98 wt %) were purchased from Aladdin (Shanghai, China) and used as received without further purification. The water used throughout all experiments was purified through a Millipore system.

Synthesis of GCRN nanoribbon

Pristine $g-C_3N_4$ was prepared as described elsewherer. Melamine (5 g) in an open crucible was heated in the air with the heating rate of 3°C min⁻¹ to 550 °C and kept for 4 h. The product was collected and ground to powder for characterization and performance measurements.

GCRN was obtained by controllable tailoring of as prepared g-C₃N₄ in H₂SO₄ and HNO₃ aqueous solution. Typically, g-C₃N₄ (0.5 g) was despersed in 100 mL HNO₃ aqueous and then add 50 mL H₂SO₄, following ultrasonically dispersed for 1 hour and the resultant sample was obtained by washing with vast distilled water for several times and centrifugation before drying at 60°C. In addition, the H₂SO₄/HNO₃ ration is one of the keys to get GCRN.

Photocatalytic mesurement

Photocatalytic tests were carried out using reaction vessel connected to a closed glass gas system. Hydrogen production was performed by dispersing 0.1 g catalyst powders in an aqueous solution (80 mL) containing triethanolamine (15 vol%) as a sacrifical elevtron donor. 3 wt% Pt nanoparticles (H₂PtCl₆·6H₂O) were introduced by an *in suit* photodeposition method. Before irradiation the solution was evacuated several times to remove air completely and then the solution was irradiated under visible light by using a 500 W Mercury lamp with a cutoff light filter (λ >420 nm). During the photocatalytic reaction, the evolved gased were analysed by using a gas chromatograph to determine the amount of evolved hydrogen accoring the standard curves.

Quantum efficiency calculation

The apparent quntum yield (AQY) for H_2 evolution was measured using a 420 nm band-pass filter. The average intensity of irradiation was measured as 5.2 mW·cm⁻ ² (ILT 950 spectroadiometer) and irradiation area was controlled as 8 cm². The produced H_2 molecules reached to 39.7 µmol in 3 h, and the AQY was estimated as:

AQY (%) =
$$\frac{\text{number of reacted electrons}}{\text{number of incident photos}} \times 100\%$$

 $= \frac{\text{number of evolved H}_2 \text{ molecules}}{\text{number of incident photos}} \times 100\%$

Number of incident photos = $\frac{5.2 \times 10^{-3} \times 8 \times 3600 \times 6 \times 420 \times 10^{-9}}{6.626 \times 10^{-34} \times 3 \times 10^{-8}} = 1.9 \times 10^{21}$ $AQY (\%) = \frac{2 \times 6.02 \times 10^{23} \times 39.7 \times 10^{-6}}{1.9 \times 10^{21}} \times 100\% = 2.4\%$

Sample characterization instrument

The morphologies of the samples were characterized by scanning electron microscope (SEM, FEI Quanta FEG), transmission electron microscopy (TEM, Hitachi H-8100) and atomic force microscopy (AFM, Bruker Dimension Icon). Specific surface area was recorded by nitrogen adsorption-desorption isotherm measurements at 77 K (BET, NOVA 2200e). X-ray diffraction analysis (XRD) was carrided out on a D/Max 2500 V/PC X-ray diffractometer using Cu (40 kV, 30mA) radiation in the range of 10°-90°. The compositions was recorded with X-ray photoelectron spectra (XPS, PHI Quantera II system). Fourier transform infrared spectroscopy (FTIR) was employed using FT-IR NICOLET-4700 in the range 500-4000 cm⁻¹. The ultraviolet-visible (UV-vis, UV5800) spectra was used to monitor the dispersion performance of the samples. The photoluminescence (PL) spectra were obtained using PerkinElmer LS55 fluorescence spectraphotometer (PerkinElmer Instruments, U.K.) at an excitation wavelength of 325 nm at room

temperature. The PL lifetime was carried out on a combined steady state spectrometer (Hydra Harp 400, Pico Quant) using a time-corrected single photo counting system at room temperature. The electronic property was characterized by Electron paramagentic resonance (EPR, Bruker model A300 spectrometer) in dark at room temperature.

Figures:



Figure S1: The SEM image of GCNR.



Figure S2: N_2 adsorption-desorption isotherms at 77 K.



Figure S3: XRD patterns of pristine g-C₃N₄ and GCRN.



Figure S4: XPS survey spectra.



Figure S5: O 1s XPS spectra of PCN and GCNR.



Figure S6: FTIR spectra of pristine $g-C_3N_4$ and GCRN.



Figure S7: Digital photo of prepared $g-C_3N_4$ solution by treatment of different HNO₃:H₂SO₄ volum ratios.From left to right: (1) HNO₃ : H₂SO₄=3:1; (2) HNO₃: H₂SO₄=2:1; (3) HNO₃:H₂SO₄=1:1; (4) HNO₃:H₂SO₄=1:2; (5) HNO₃:H₂SO₄=1:3.