Electronic Supplementary Information (ESI)

Rational Design of graphitic Carbon Nitride Catalytic-Biocatalytic As a Photocatalytic Platform for Solar Fine Chemical Production From CO_2

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Contents

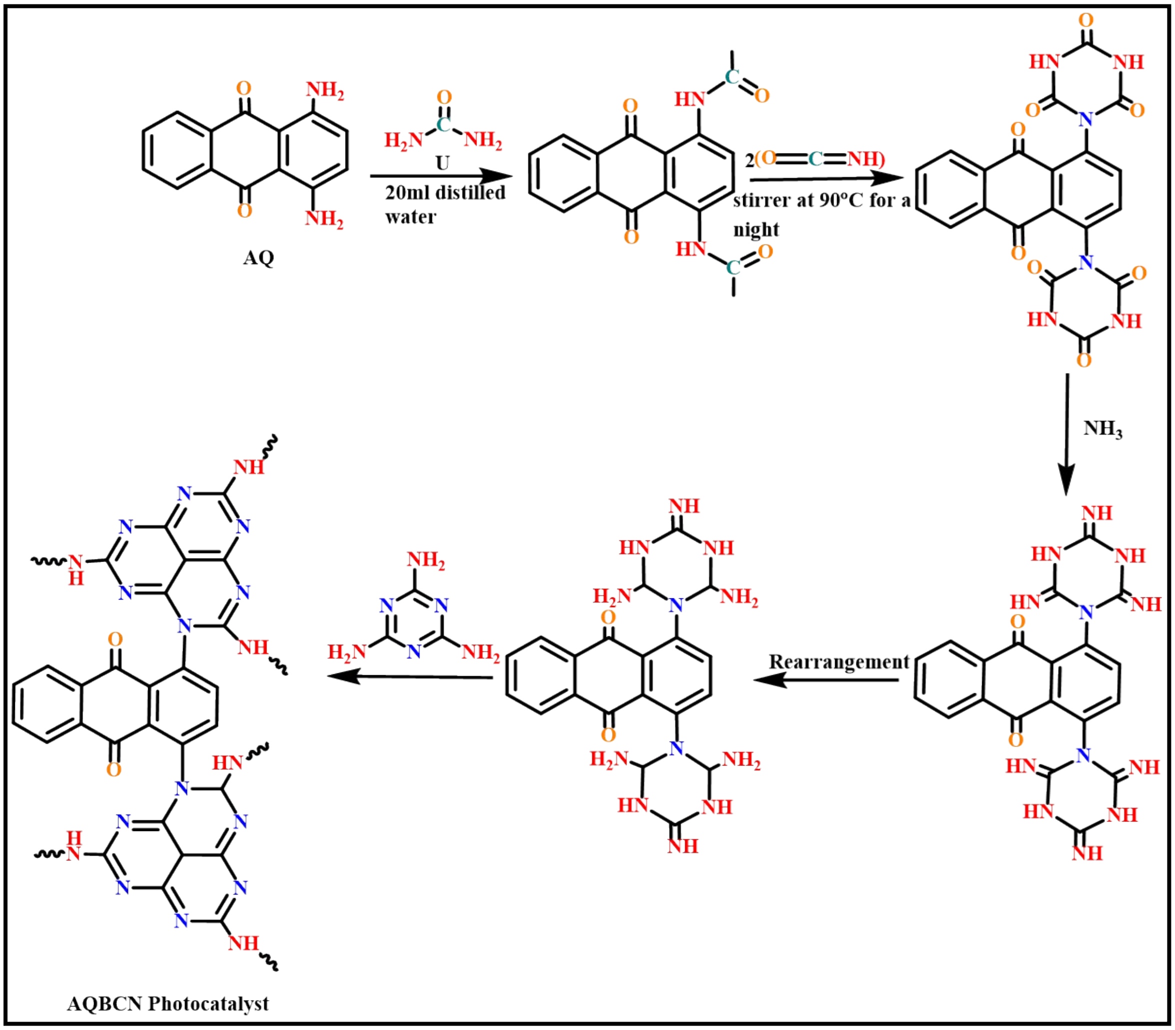
1. General remarks

All chemicals such as 1,4-diaminoanthraquinone, Urea, Pentamethylcyclopentadienyl) rhodium (III) dichloride dimer, 2, 2'-bipyridyl, diethyl ether, NAD^+, $NADP^+$, ascorbic acid (AsA), and $F_{ate}DH$ (formate dehydrogenase) were purchased from Sigma-Aldrich and used without further purification

2. Instruments and measurements

Diffuse reflectance spectra (DRS) were recorded on the Shimadzu UV-1800 spectrometer. Fourier transform infrared spectroscopy (FTIR) spectra were obtained on a Nicole 6700 (made by Thermo Scientific, USA). The test specimen was prepared by the KBr-disk method. A powder X-ray diffractometer (D8 Advance Eco made by Bruker, Germany) was used for crystallinity. Scanning electron microscope (SEM) images and electron dispersive X-ray spectroscopy (EDS) were obtained on JSM 6490 LV (made by JEOL, Japan). Nano-zetasizer (NZS90) was used for zeta-potential and particle size studies. Laser power-dependent PL studies were performed using a 405 nm (3.06 eV) diode laser (Cube, coherent) equipped with a cooled charge-coupled (CCD) detector (Princeton Instruments, PIXIS 100B). High-performance liquid chromatograph (HPLC) used for the analysis of the production of formic acid (Model: LC-20AP, made: Shimadzu, Japan).

3. Synthesis of AQBCN photocatalyst



Scheme S1. Synthesis of AQBCN photocatalyst using AQ and U via copolymerization method.

4. XRD images of AQ monomer

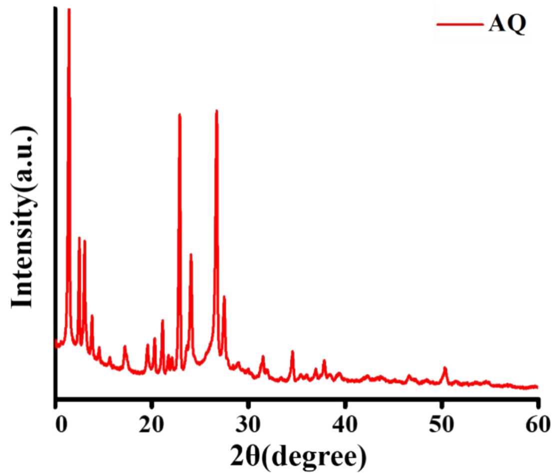


Fig. S1. X-ray diffraction pattern of AQ monomer.

5. SEM image of AQ monomer

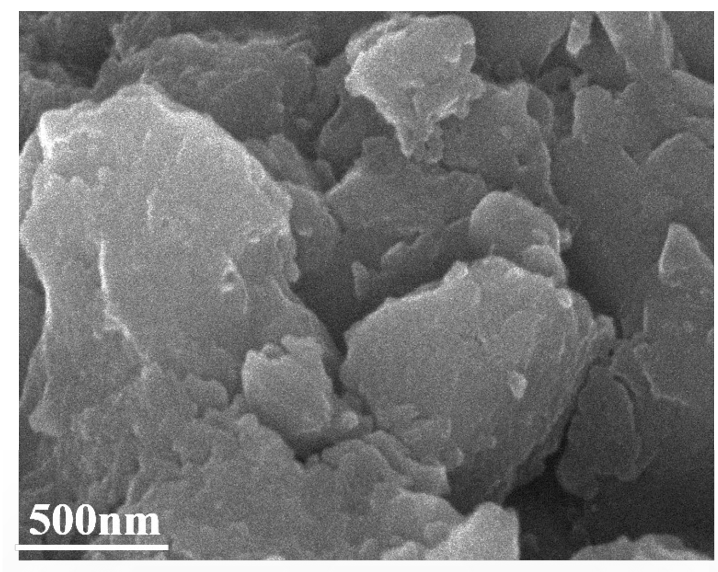


Fig. S2. SEM image of AQ monomer at 500nm**.**

6. Energy-dispersive X-ray spectroscopy studies

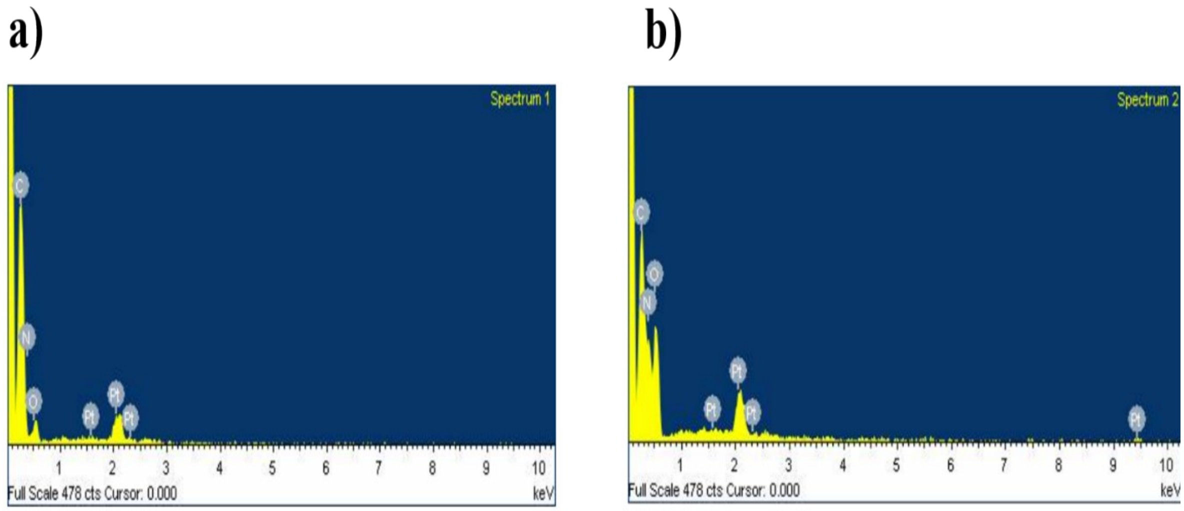


Fig. S3. Energy-dispersive X-ray spectroscopy of a) AQ, and b) AQBCN photocatalyst.

7. Particle size studies

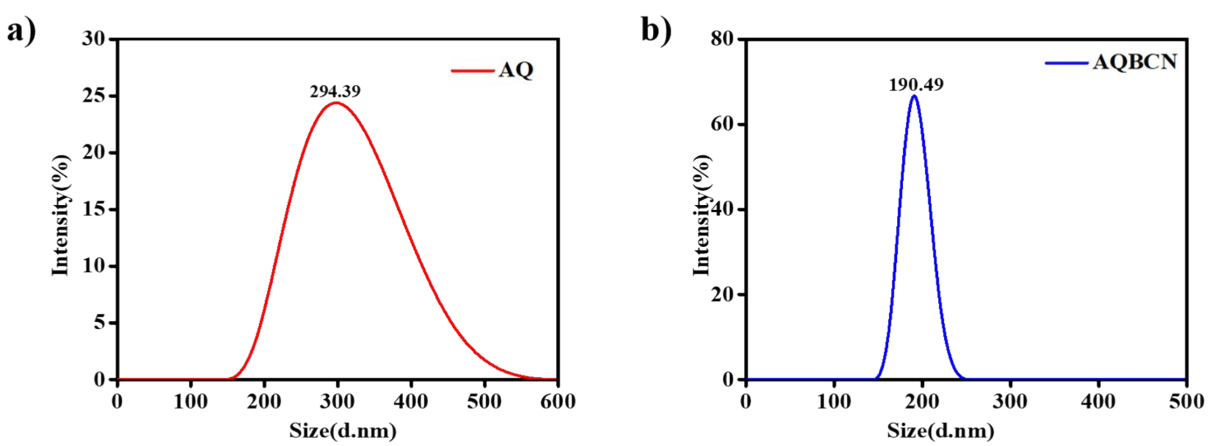


Fig. S4. Particle Size studies of a) AQ monomer, and b) AQBCN photocatalyst

8. Zeta potential studies

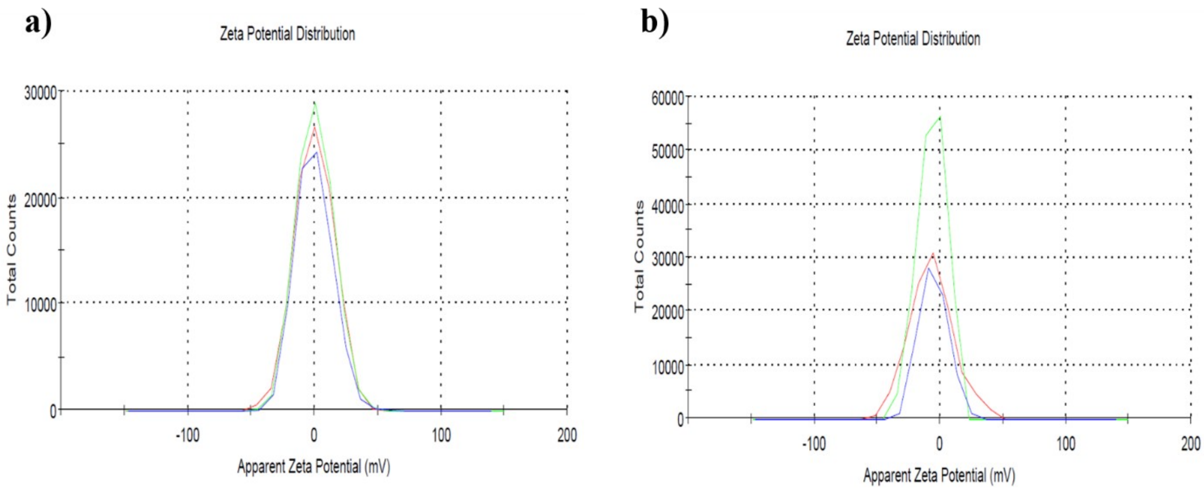


Fig. S5. Zeta potential studies of (a) AQ monomer(-0.207mV) and (b) AQBCN photocatalyst(-0.501mV).

9. **Diffuse reflectance spectra (DRS)**

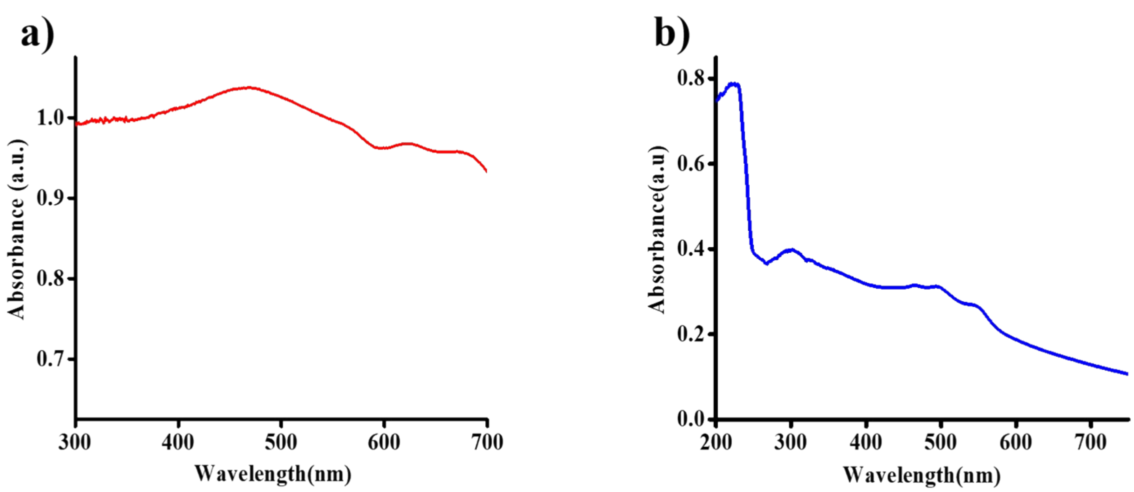


Fig. S6. UV-Vis diffuse reflectance spectra (DRS) (a) AQ and, (b) AQBCN photocatalyst.

10. Reusability experiment of AQBCN photocatalyst

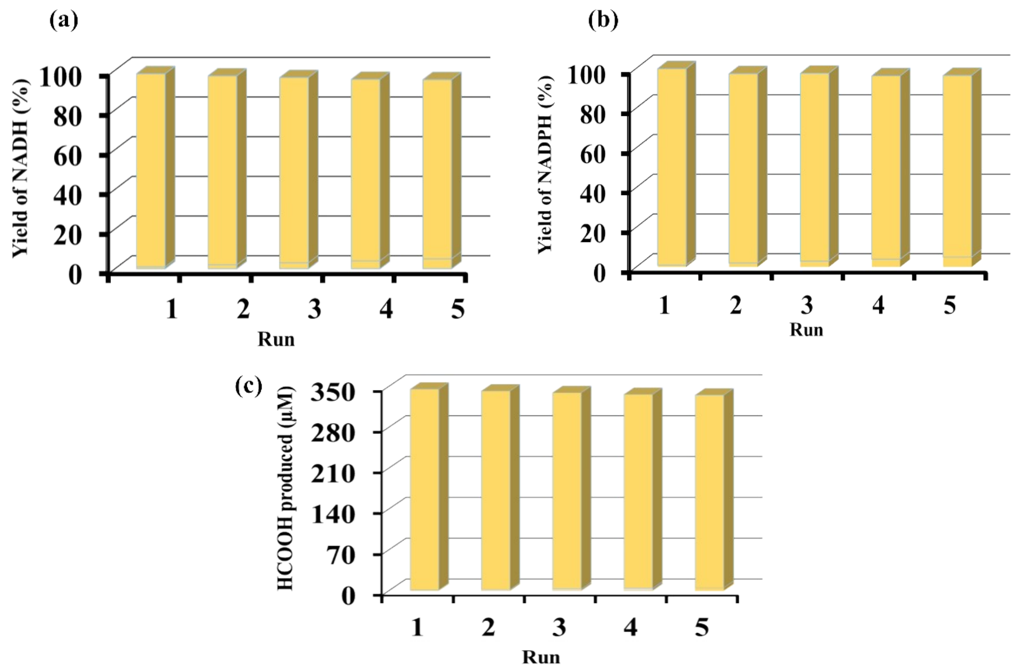


Fig.S7. Recycling experiments for 1,4-NADH/NADPH regeneration and HCOOH production from CO_2. The reaction medium contains (a) 1,4-NADH regeneration [β–NAD^+ (1.24 μmol), AsA (0.1mmol), CpM complex (0.62 μmol), and AQBCN photocatalyst (0.5mg) in 3.1 mL of sodium phosphate buffer (100 mM, pH~ 7.0)], (b) 1,4-NADPH regeneration [β–$NADP^+$ (1.24 μmol), AsA (0.1mmol), CpM complex (0.62 μmol), and AQBCN photocatalyst (0.5mg) in 3.1 mL of sodium phosphate buffer (100 mM, pH 7.0)] and (b) HCOOH production from CO_2 under solar light [β–NAD^+ (1.24 μmol), AsA (0.1mmol), CpM (0.62 μmol), F_{ate}DH (3 units) and AQBCN photocatalyst (0.5mg) in 3.1 mL of sodium phosphate buffer (100 mM, pH 7.0)].

11. Characterization of recycled AQBCN photocatalyst

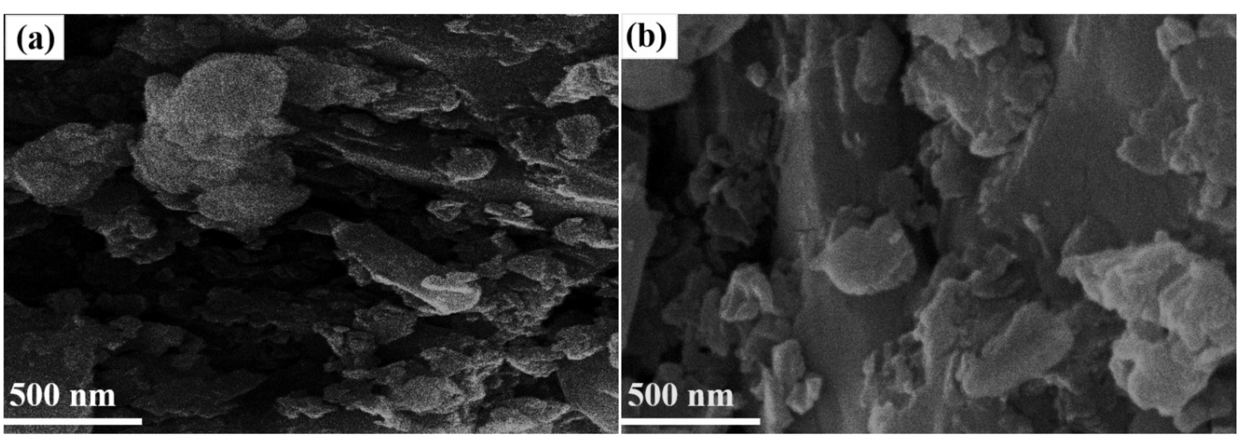


Fig. S8. SEM images of AQBCN photocatalyst (a) before recycling experiment (b) after the recycling experiment of HCOOH production.