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A Novel Method for Development of Carbon Quantum Dot/Carbon Nitride Hybrid Photocatalyst with Response for Infrared Light Irradiation

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Experimental Section

All chemicals used in this study were purchased from Sigma Aldrich (St. Louis, MO, USA). CQD was synthesized following the procedure of previous report[please see the literature 8 in the MS] In briefly, 9 g glucose was initially dissolved in 100 mL deionized water, followed by the addition of 0.8 g NaOH and sonication for 0.5 h. Then, the pH of the obtained solution was adjusted to 7.0 with 0.1 M HCl, and dialyzed by a semipermeable membrane (MWCO 1000). The synthesized CQD with carbon content of 0.93 g/L was stored in aqueous solution for further use. Carbon nitride photocatalyst was synthesized according to our previous work: [please see the literature 15 in the MS] 10 g melamine powder in an alumina crucible with a cover was heated at 450 ^{o}C in a muffle furnace for 2 h.

Mem-CQD450 was synthesized by mixing 8 mL CQD solution with melamine aqueous solution (1 g melamine in 40 mL deionized water), followed by evaporation at 80 ^{o}C and the successive heating at 450 ^{o}C for 2 h. Mem-CQD(4mL)450, Mem-CQD(6mL)450 and Mem-CQD(10mL)450 were synthesized in the same way as mentioned above except that the amounts of CQD are 4, 6 and 10 mL, respectively.

The obtained samples were characterized by PHI5000 VersaProbe X-ray photoelectron spectrometer (XPS), JEM-2100 electron microscope (TEM), Rigaku RINT2000 X-ray diffractometer (XRD), Netzsch STA 449 F1 Jupiter thermogravimetric analysis (TGA), UV-visible (UV-Vis) spectrophotometer (Shimadzu, UV 2550) and Jobin Yvon Horiba Fluorolog3 photoluminescence spectrometer (PL).

The photocatalytic activities of all samples were performed using MO (40 mL) as the model compound under infrared light irradiation ($\lambda > 800$ nm). The concentration of MO is 4 mg/L and the amount of photocatalyst is 0.1 g. The light source is an infrared lamp and the reaction temperature was controlled at 25 oC with a water bath.

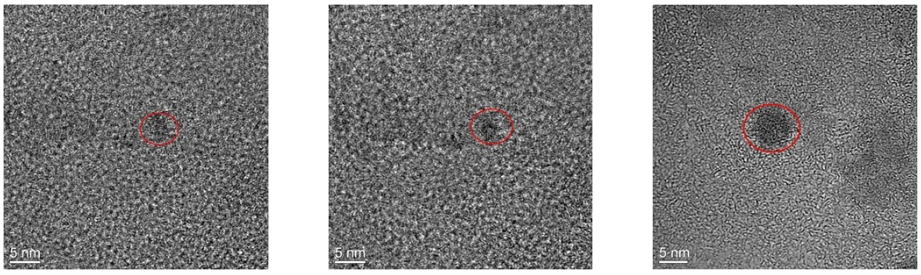


Fig S1. The high-magnification TEM images of the synthesized CQD sample at 5 nm scale.

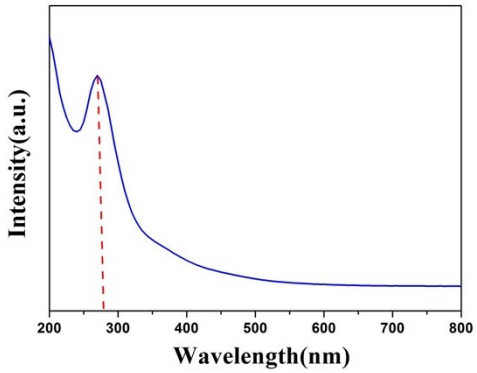


Fig S2. UV-vis absorption spectrum of the synthesized CQD sample.

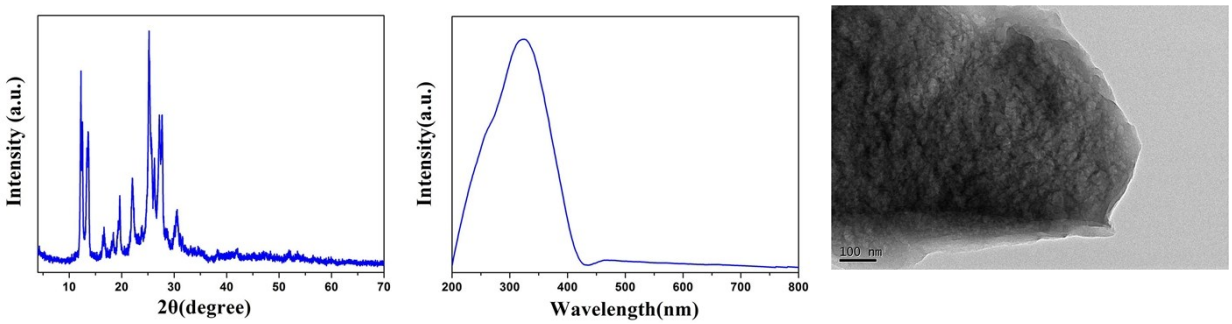
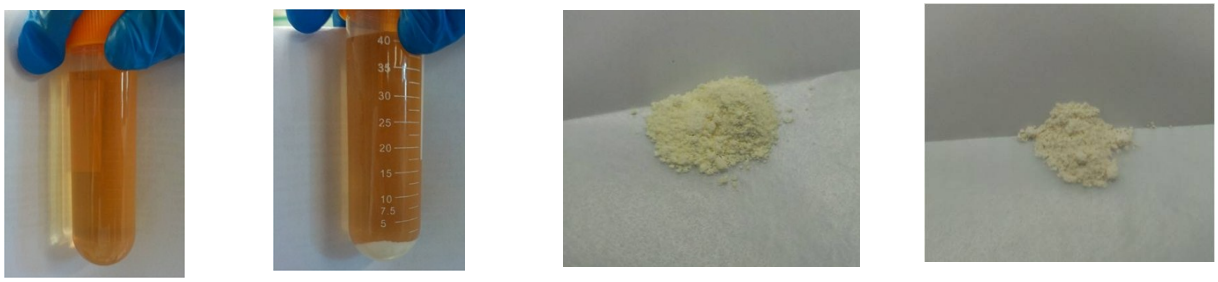


Fig S3. XRD pattern (left), UV-vis absorption spectrum (middle) and TEM image (right) of the synthesized Mem450 sample.



a b c d

Fig S4. Pictures of (a) CQD solution; (b) Mem450-CQD suspension after stirring for 10 h; (c) Mem450; (d) The precipitant obtained by centrifugation of Mem450-CQD suspension.

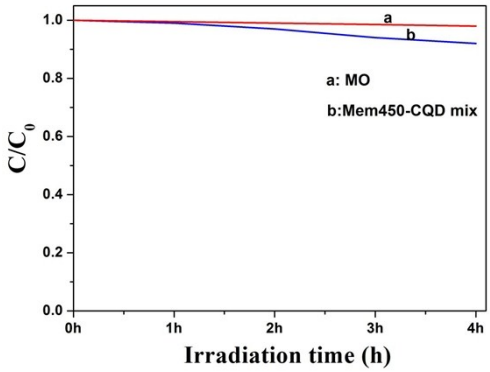
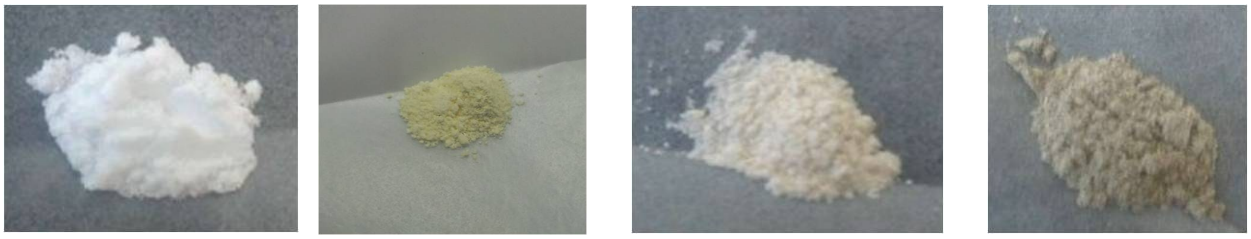


Fig S5. Methyl orange (MO) photodegradation by Mem450-CQD mixture under infrared light irradiation ($\lambda > 800$ nm). The concentration of MO is 4 mg/L and the amount of Mem450-CQD is 0.1 g.



Mem Mem450 Mem-CQD-mix Mem-CQD450

Fig S6. Pictures of Mem, Mem450, Mem-CQD-mix and Mem-CQD450 samples.

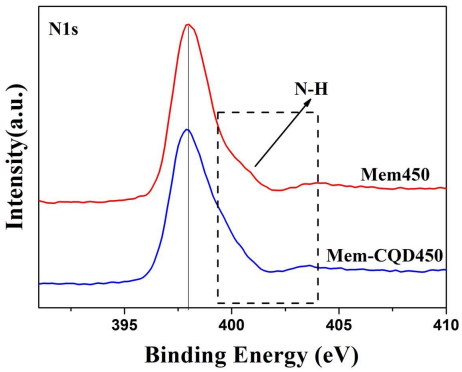


Fig S7. XPS spectra of Mem-CQD450 and Mem450.

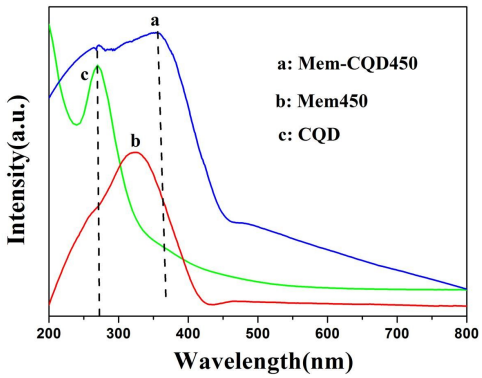


Fig S8. UV-Vis absorption spectra of Mem-CQD450, Mem450 and CQD.

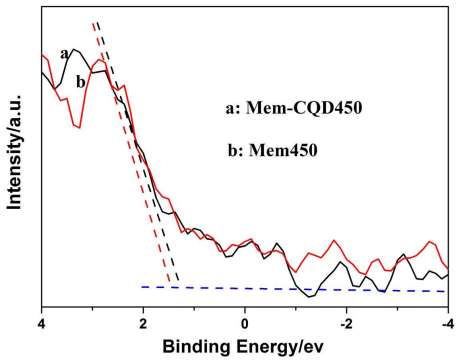


Fig S9. VBXPS spectra of Mem-CQD450 and Mem450 samples.

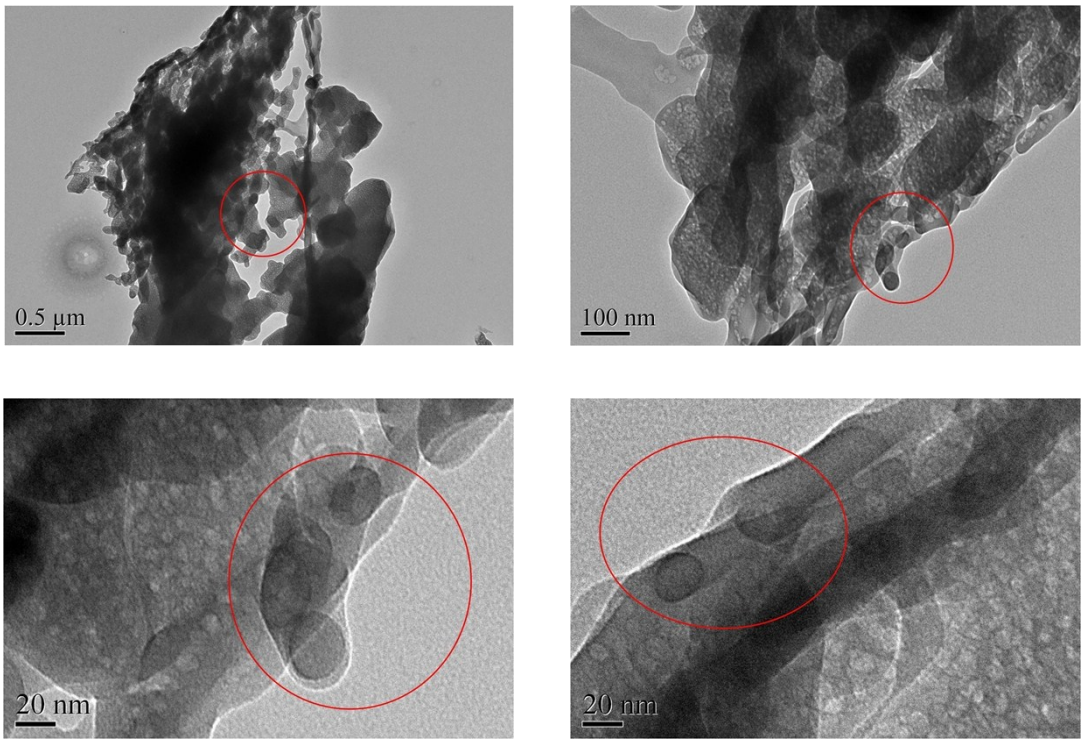
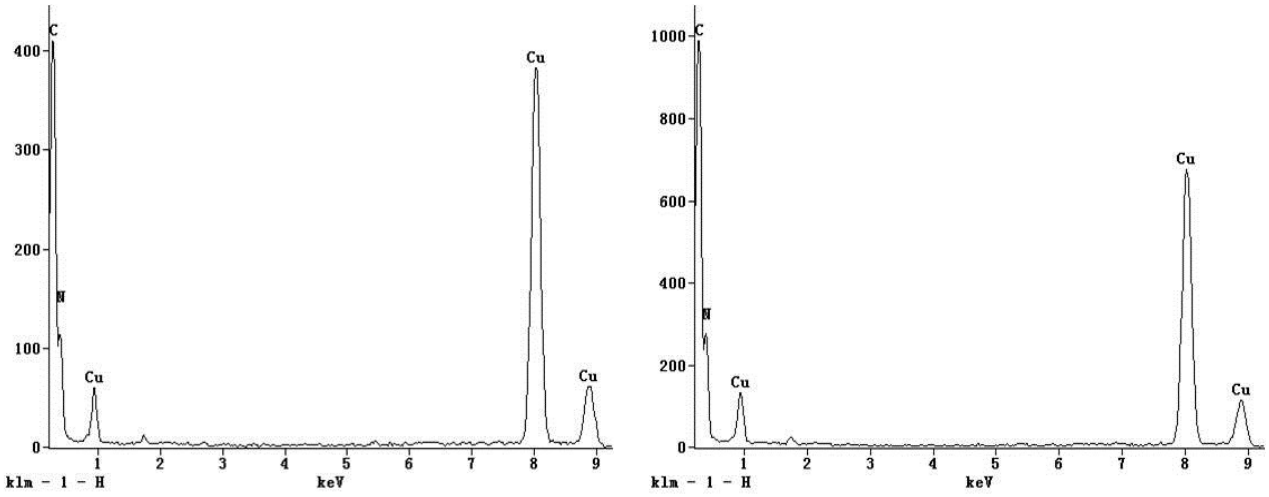


Fig S10. High-resolution TEM images of Mem-CQD450 sample.



(1) (2)

Fig S11. (1) EDX results of the Mem450 part in Mem-CQD450 (the area surrounded by blue circle in the TEM image of Mem-CQD450); (2) EDX results of the CQD part in Mem-CQD450 (the area surrounded by red circle in the TEM image of Mem-CQD450).

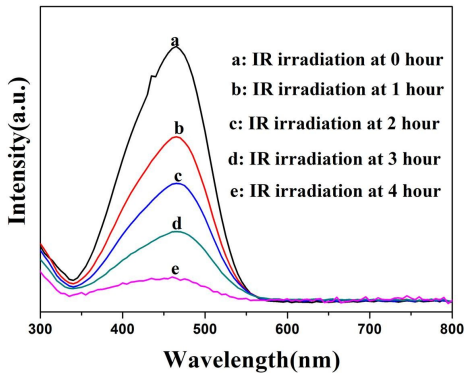


Fig S12. UV-vis spectra of MO during the photodegradation process by Mem-CQD450 under infrared light irradiation (λ>800 nm).

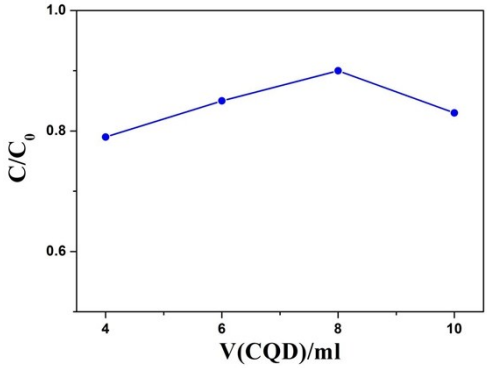


Fig S13. Comparison of MO photodegradation activities by Mem-CQD(4mL)450, Mem-CQD(6mL)450, Mem-CQD450 and Mem-CQD(10mL)450 under infrared light irradiation for 4 hours (λ > 800 nm).

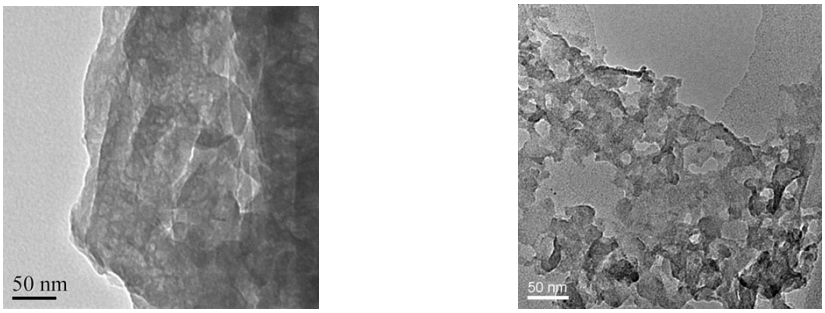


Fig S14. TEM images of Mem550 (left) and Mem-CQD550 (right) samples.

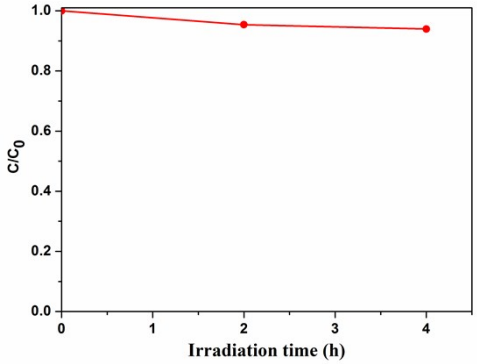


Fig S15. The photodegradation of methyl orange (4 mg/L) by Mem-CQD550 under infrared light irradiation ($\lambda > 800$ nm).