Supplementary Information (SI)

Graphene Quantum Dots Modified ZnO+Cu Heterostructure Photocatalysts with Enhanced Photocatalytic Performance

Yan Li*, Lifeng Wang, Juan Ge, Jun Wang, Qiyao Li, Wan Wan, Boping Zhang, Xiaoguang Liu, Wendong Xue

School of Materials Science and Engineering, University of Science and Technology Beijing, Beijing 100083, China.

*Corresponding author: E-mail: liyan2011@ustb.edu.cn (Yan Li); Tel: +86 10 62333140

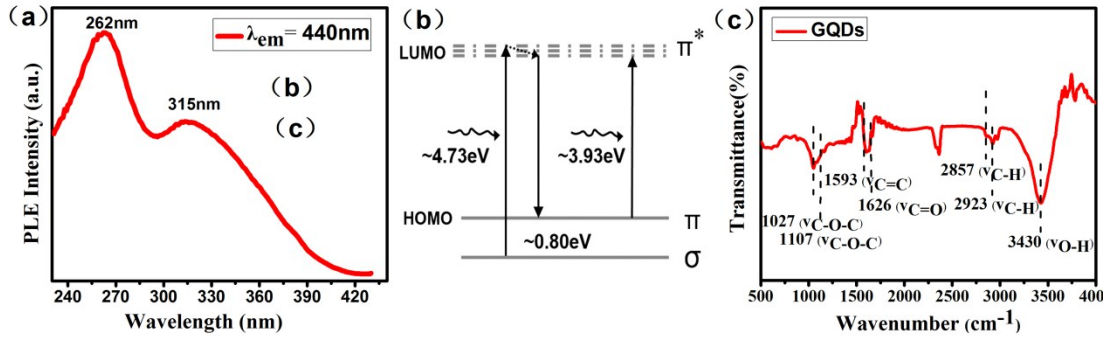

Fig. S1 PLE spectrum with the detection wavelength of 440 nm (a), typical electronic transitions (b), and FT-IR spectrum (c) of GQDs.

The PLE spectrum(Fig. S1a) has two peaks, centered at 262 nm (4.73 eV) and 315 nm (3.93eV), with an energy difference of 0.80 eV(Fig. S1b). It confirms that the PL emission of GQDs comes from two electronic transition states: π-π* electronic transition state of C=C and n-π* electronic transition state of C=O.[24] The FTIR spectrum (Fig. S1b) shows the existence of various oxygen containing functional groups in GQDs, such as –OH group at *ca*. 3430 cm^{-1}, C=O group at *ca.* 1626 cm^{-1} and C-O-C group at *ca.* 1027 cm^{-1}.

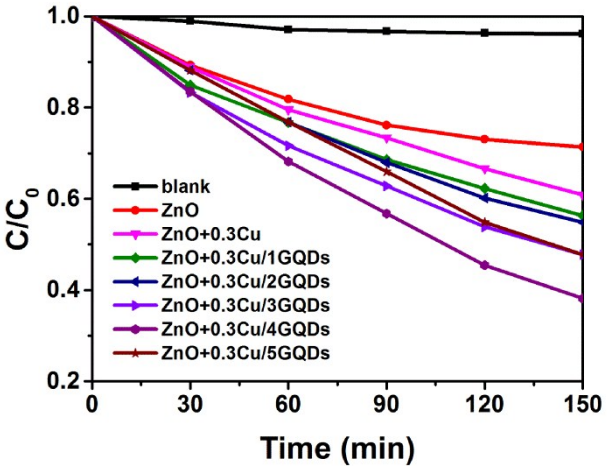

Fig. S2 Various samples of photodegradation performance of RhB aqueous solutions after exposure to UV irradiation for 2.5 h under the protection of nitrogen gas.

To accurate determine the experimental results and eliminate the influence of dissolved oxygen, the photocatalytic reaction in RhB aqueous solutions were also conducted under the protection of nitrogen gas. The photodegraded curves were shown in Fig. S2. Without photocatalyst, RhB aqueous solution has

very low photodegraded ratio. As the addition of photocatalysts, especially the ones modified by Cu NPs and GQDs, the photocatalytic activity increased dramatically. With varying GQDs layer from 1 to 4, the photocatalytic efficiency increases gradually. But when the layer is above 4, and the photocatalytic efficiency decreases. These result are similar to our original results of photocatalysts in atmospheric environment and solid state.

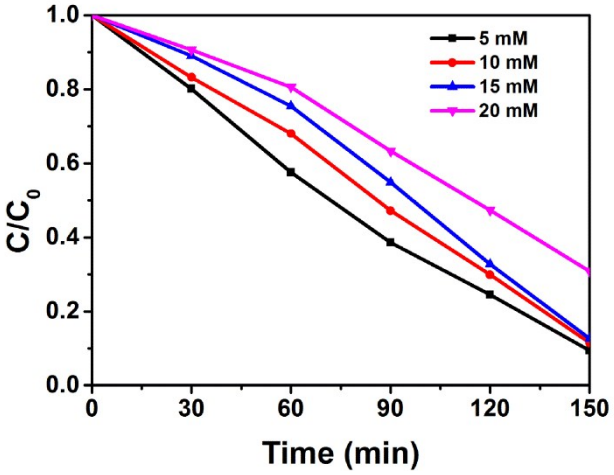

Fig. S3 The different degradation rate among various concentration of RhB (5, 10, 15, 20 mM)

Various concentration of RhB (5, 10, 15, 20 mM) layer were prepared on the film of ZnO+0.3Cu/4GQDs to investigate the influence of degradation rate between the concentration of dye and photocatalyst. The results in Fig. S3 show that when increasing the concentration of RhB from 5 mM to 20 mM, the photodegraded rate decreased gradually. It demonstrates that the photodegraded rate is related to RhB concentration, the lower concentration the higher photodegraded rate.