Supporting Information

Graphene Oxide Stabilized Cu_2O for Shape Selective Nanocatalysis

Chenglin Hong, Xin Jin, Jennifer Totleben, Jessica Lohrman, Ethan Harak, Bala Subramaniam, Raghunath V. Chaudhari, Shenqiang Ren

1. Synthesis of cCu_2O in the absence/presence of graphene oxide (GO)

It is found that Cu^{2+} was hydrolyzed by adding NaOH initially. The $Cu(OH)_2$ thus formed was gradually reduced to Cu_2O with prolonged reaction time in the presence of $NH_2OH{\cdot}HCl$. It is important to note that orange colored particles were observed as early as 20 min. SEM analysis divulges that the particles are amorphous. The addition of GO to Cu^{2+} lowers the reduction rates to some extent. And the final Cu_2O-GO mixture shows greenish yellow at 60 min.

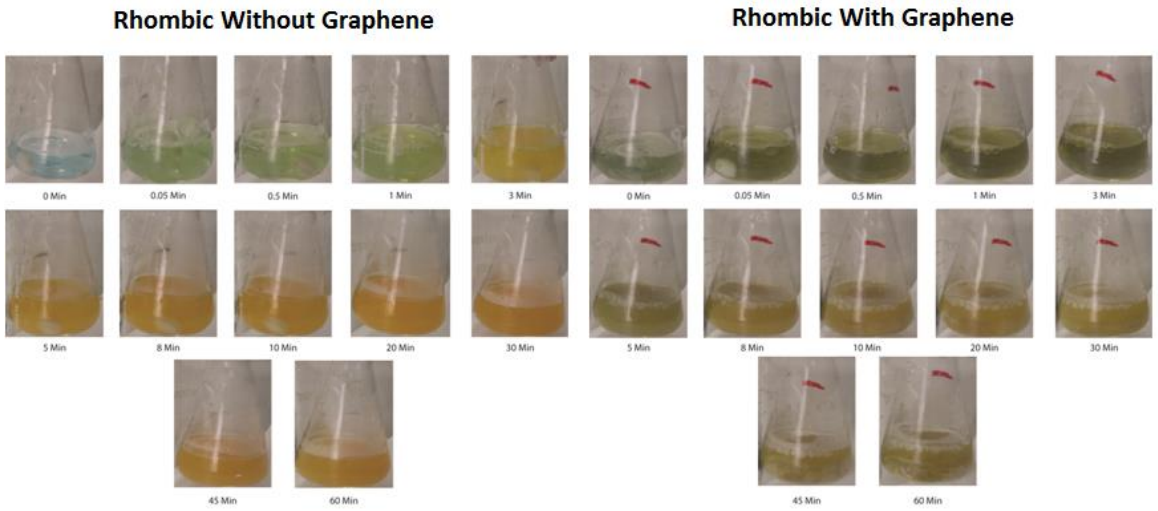


Figure S1. Growth of rCu_2O particles with and without GO

2. Light absorbance of Cu_2O with/without GO

Photocatalytic measurements were done on the Cu_2O with and without GO. After the nanocrystals were weighed in a centrifuge tube, 27 mL of 30 mg/mL methyl orange was added. The mixture was then allowed to stir in the dark for 30 minutes so the cuprous oxide nanocrystals could absorb onto the methyl orange particles. After this, approximately 2.5 mL of the mixture was drawn out and was placed in a cuvette where its absorbance was measured. After the absorbance was measured, the solution was placed in a 50 °C water bath to ensure isothermal conditions. A 500 W/120 V lamp that had an intensity of 46.1 mW/cm^2 was

immediately placed within 6-8 cm away from the solution that was being stirred. After 10 minutes, another 2.5 mL of solution was drawn out and was placed in the UV-vis spectrophotometer where the absorbance was taken. This was done again every 10 minutes until 90 minutes was reached.

Figure S2 show that the absorptions of the cubic shape without graphene increased and decreased randomly with time. The unstable graph meaning that the cubic shape without graphene was unstable. The cubic shape with graphene, however, was much more stable because the absorption only decreased slightly with time.

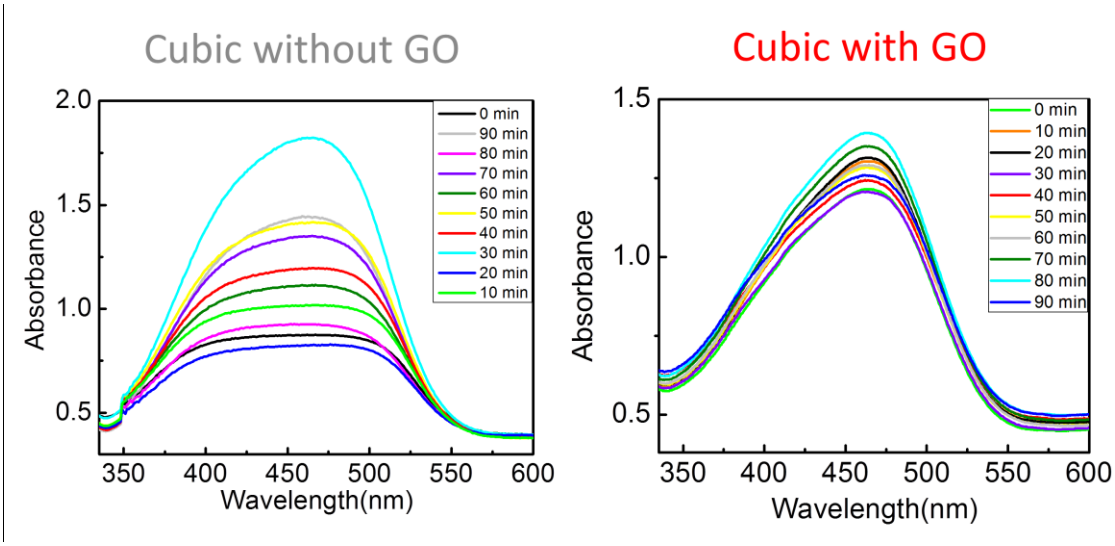


Figure S2. Growth of cCu_2O particles with and without GO

Figure S3 below shows the absorbance graphs of Cu_2O in the rhombic shape with and without graphene oxide.For the Cu_2O nanocrystals in the rhombic shape, the absorption graphs were unstable with and without graphene because the absorptions decreased continuously with time.

The same two samples of r Cu_2O with/without GO that were made to take the pictures in Figure S4 were allowed to sit for 4 days. The Figure S4 below shows the Cu_2O with GO is more stable than Cu_2O without GO.

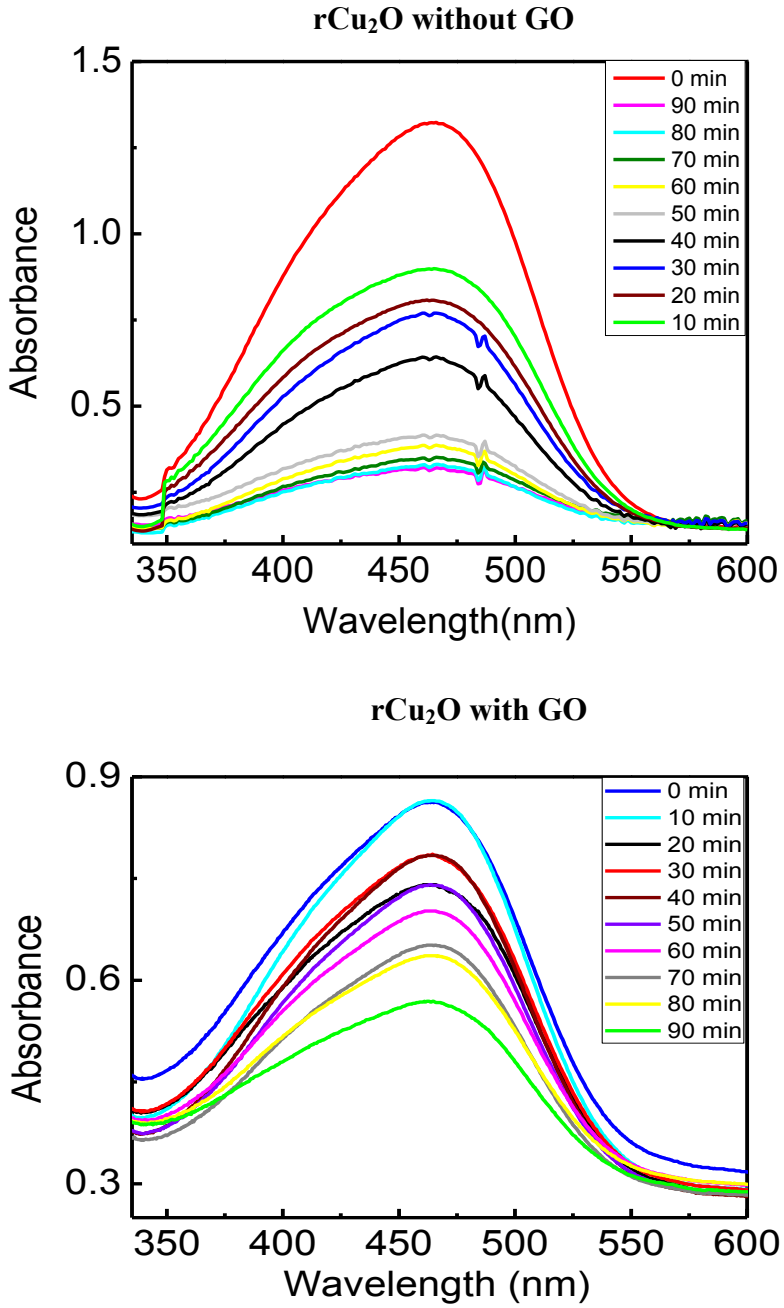


Figure S3. The effect of GO with Cu_2O in the rhombic dodecahedral shape

The Effect of GO on the rCu_2O

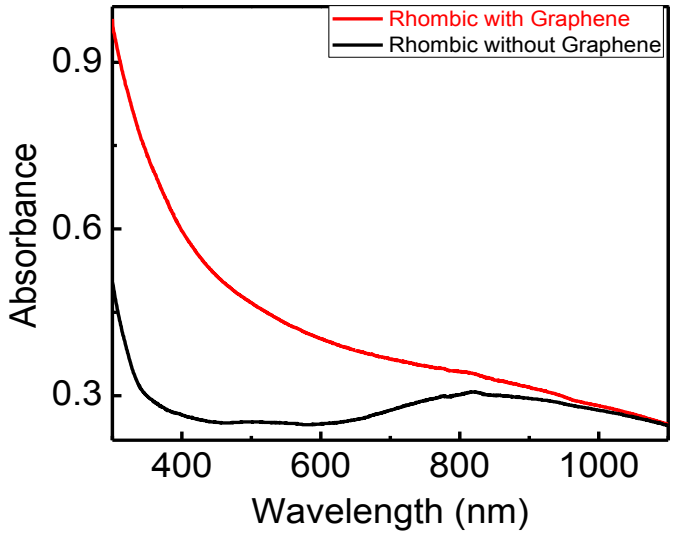


Figure S4. Absorbance spectrum of Cu_2O nanocrystals in the rhombic shape 4 days after synthesis

3. The Surface morphology of rCu_2O and cCu_2O with/without GO

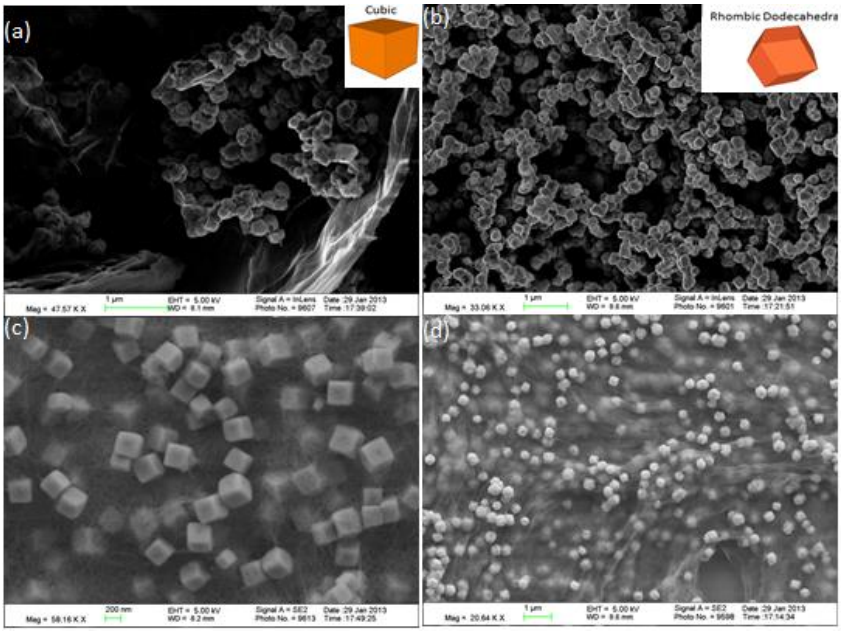


Figure S5. Surface morphology of cCu_2O and rCu_2O in without GO (a-b) and GO (c-d) systems

We find that approximately 200 nm Cu_2O particles with cubic and rhombic shapes could be obtained even without adding GO during their growth. But those nanoparticles tend to group or

aggregate with each other in the aqueous solution, as seen in Figures S5 (a) and (b). With the introduction of GO, the dispersion and shape uniformity were found to be significantly improved due to the electronic interaction between Cu precursors and hydroxyl and carboxyl groups on GO surfaces. We observed that there were almost no drawbacks or defects in the Cu_2O nanoparticles which grew on GO template.

4. Photocatalytic activity of rCu_2O at Cu_2O to GO ratios

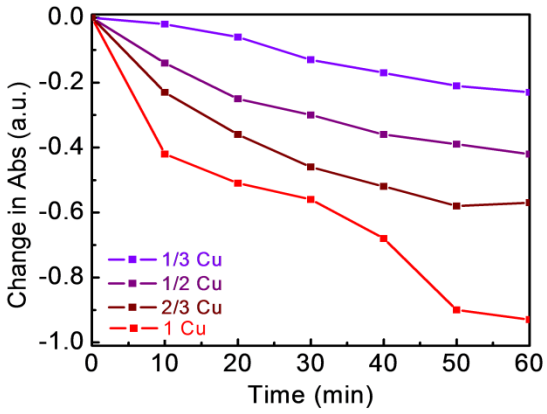
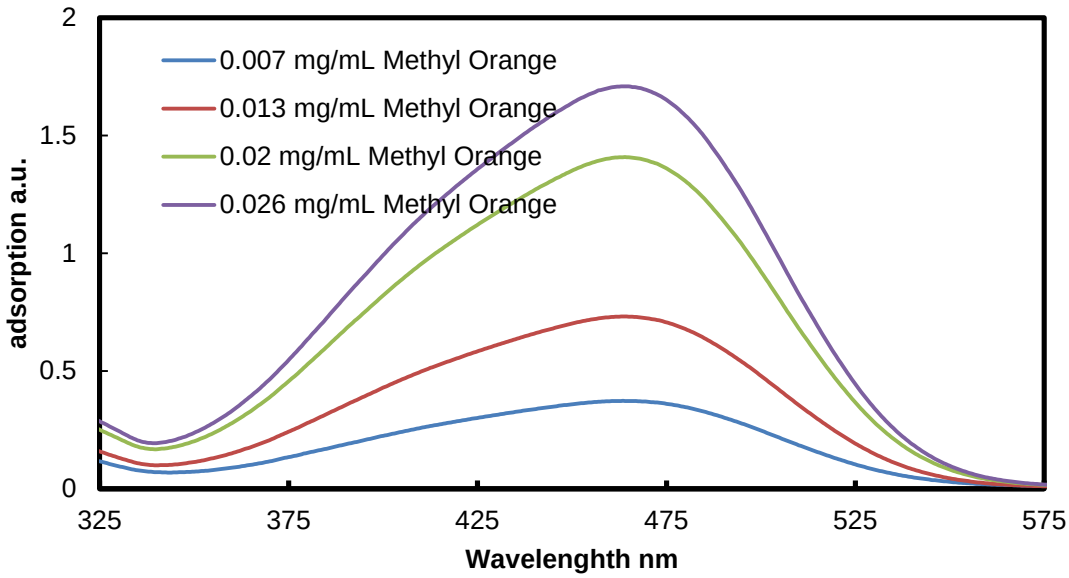


Figure S6. Photocatalytic activity of rCu_2O at Cu_2O to GO ratios

The presence of GO is important because it will influence the structural properties of Cu_2O particles. To better understand the role of GO during the growth of Cu_2O and its impact on the photocatalytic activity of Cu_2O, a series of experiments with various Cu2O/GO ratio were further carried out. Figure S6 shows the catalytic behaviors of Cu_2O under 1/3, 1/2, 2/3 and 1/1 Cu_2O/GO ratios. It must be noted that the amounts of Cu_2O charged when we measured the photocatalytic activity are identical in the four cases. We find that as the ratio of Cu_2O/GO increases, the photocatalytic activity of Cu_2O is enhanced under our reaction conditions.

5. Calibration of absorbance and methyl orange concentration



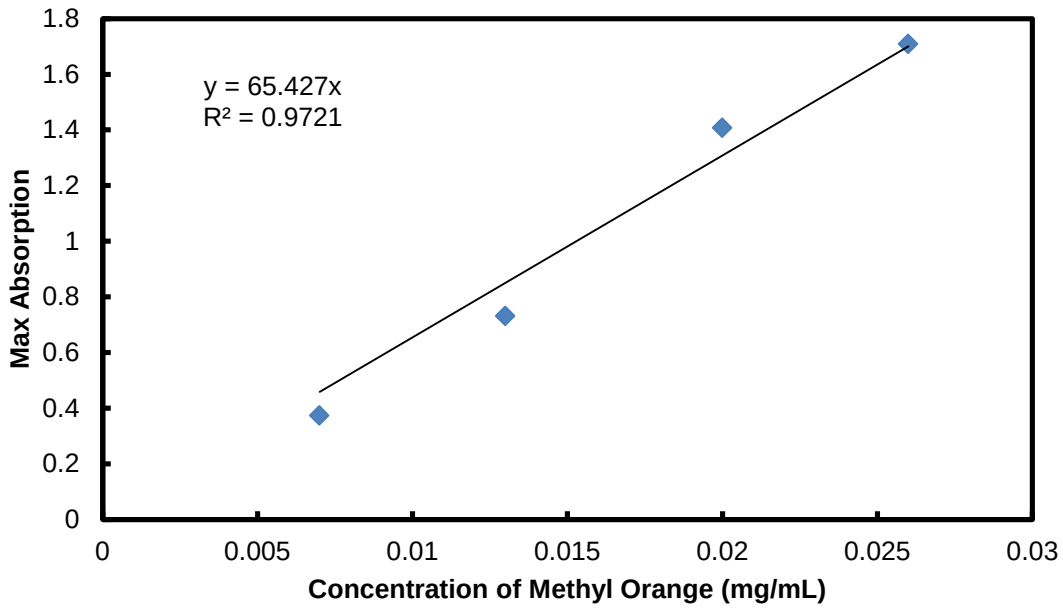


Figure S7. Calibration curve of methyl orange

6. Degradation of methyl orange in the presence of GO (0.02 mg/ml) at 30 ^{o}C

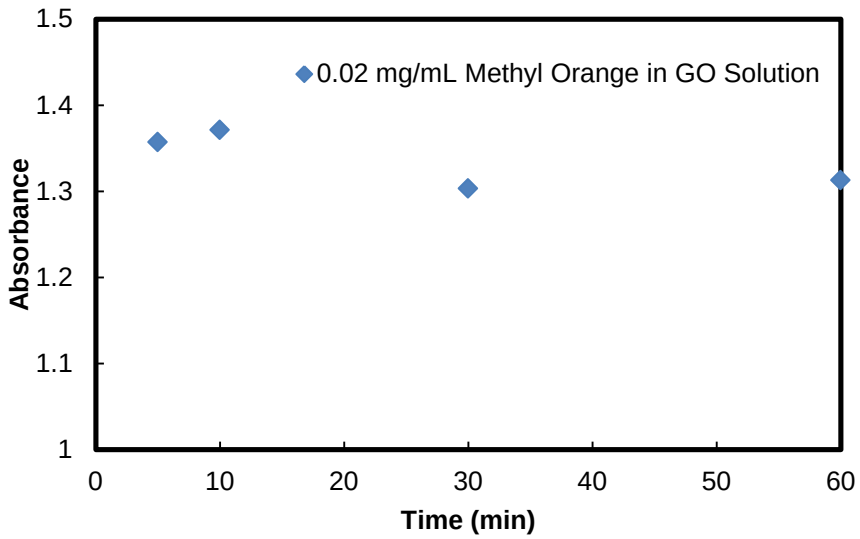


Figure S8. Degradation of methyl orange in the presence of GO

Absorbance measurement shows that negligible degradation of methyl orange occurs in the presence of GO.

7. XRD of Cu_2O sample

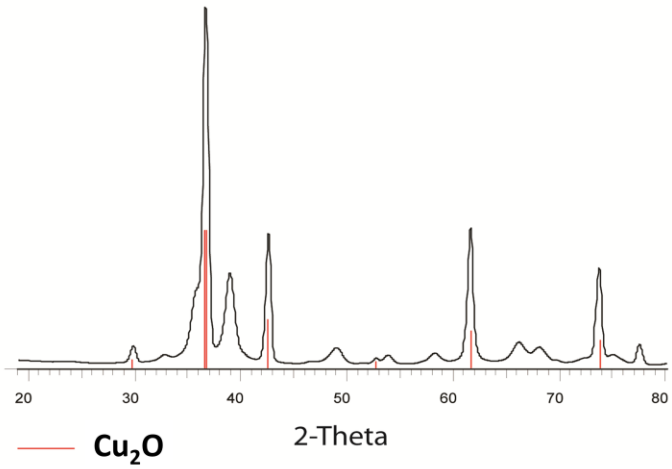


Figure S9. X ray diffraction of Cu_2O sample