



## Supplementary Materials: Electrodeposition from a Graphene Bath: A Sustainable Copper Composite Alloy in a Graphene Matrix

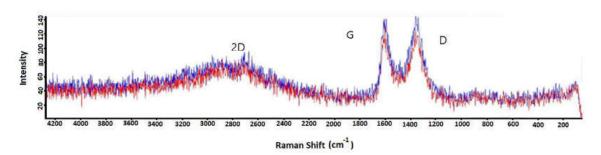
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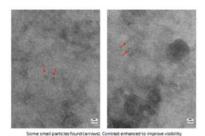
## Supplement S1: Graphene quantum dots and Raman Spectrum



Sample analyzed by Raman, TEM and UV-Vis Spectroscopy and Florescence spectroscopy.

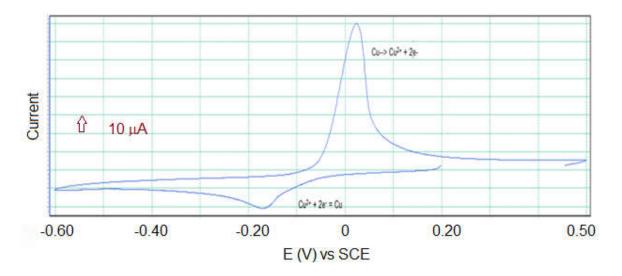


Raman spectrum of GQD placed on a substrate for recording. Blue and green represent two different runs of the same sample.

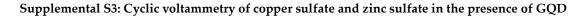


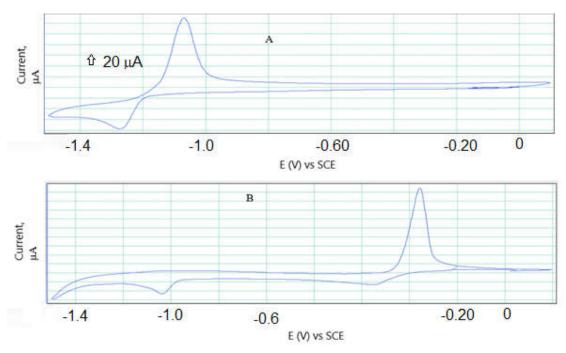
GQD sample under TEM for size Scale 5 nm

Supplemental S2: Cyclic Voltammetry of Copper Sulfate



Cyclic voltammetry of 5 mM Copper sulfate in  $0.1\,M\,K_2SO_4$  with glassy carbon working electrode. Sweep rate 20 mV/s





Upper curve: Cyclic voltammetry of 5 mM zinc sulfate in 0.1 M K<sub>2</sub>SO<sub>4</sub> at glassy carbon working electrode. Sweep rate: 20 mV/s

Lower curve: Cyclic voltammetry of 5 mM zinc sulfate and 5 mM copper sulfate in 0.1 M K<sub>2</sub>SO<sub>4</sub> containing 1ml GQD at glassy carbon working electrode. Sweep rate: 20 mV/s

## Supplemental S4: Excel Files of Current-Time Transients Sheet 10

Excel file giving Potential-step electrolysis results Sheet 10. Other sheets in excel show our different efforts to understand the mechanism.

| Quantitativ | e Result |       |             |          |              |      |                   |
|-------------|----------|-------|-------------|----------|--------------|------|-------------------|
| Analyte     | Result   |       |             | Std.Dev. | Calc.Proc    | Line | Intensity         |
| С           | 97.082   | %     |             | [97.721] | Quan-FP      | C Ka | 0.0008            |
| Cu          | 2.884    | %     |             | [0.015]  | Quan-FP      | CuKa | 3.5037            |
| Zn          | 0.034    | %     |             | [ 0.002] | Quan-FP      | ZnKa | 0.0572            |
| Profile     |          |       |             |          |              |      |                   |
| [cps/uA]    | с        |       | [cps/uA] Cu |          | [cps/uA] Zn  |      |                   |
|             |          |       | 0.5         | CuKa     |              | 0.5  |                   |
| 0.06        |          |       |             | 3        |              | 1.   |                   |
|             |          |       | 0.4         |          |              | 0.4  |                   |
| ]           |          |       |             |          |              |      |                   |
| 0.04        |          |       | 0.3         |          |              | 0.3  |                   |
| 1           |          |       |             |          |              |      |                   |
|             | _        |       | 0.2         |          |              | 0.2  |                   |
| 0.02        |          |       |             | - 11     |              |      |                   |
| 1           |          |       | 0.1-        |          |              | 0.1- |                   |
| 1           | ∧ c Ka   | 7     |             |          | Λ            |      |                   |
| 0.00        | 0.5      | 1.0   | 0.0         | 7.5 8.0  | 8.5 9.0[keV] | 0.0  | 8.5 9.0 9.5 [keV] |
| 0.0         | 0.5      | 1.0 [ | keV]        | 1.5 0.0  | 8.5 9.0[keV] | 0.0  | 0.0 9.0 9.3 [keV] |

Supplement S5: XRF Recording of the Electrodeposited Composite

| Roughness  |  |                                  |   |                     |   |   |
|--|--|----------------------------------|---|---------------------|---|---|
|  |  |                                  |   |                     |   |   |
|  |  |                                  |   | 512.8 m<br>-475.8 m | Results         Image Rew Mean         Image Standard Deviation         Image Standard Deviation         Image Standard Deviation         Image Surface Area         Image Resolution         Image Resolution         Image Resolution         Image Ray         Image Ray         Image Ray         Image Ray         Image Ray         Raw Mean         Advance Area         Projected Surface Area         Projected Surface Area         Sufface Area         Projected Surface Area         Sufface Area         Projected Surface Area         Sufface Area         Ray Ophines Rmax         Skewness         Kutrois         R2         R2 Count         Preak Count         Valley Count         Max Peak ht (Rp)         Average Max Depth (Rom)         Average Max Depth (Rom)         Line Density | 1028.09 nm<br>0.6610 nm<br>143 nm<br>844 nm<br>33.1 µm <sup>3</sup><br>23.4 %<br>143 nm<br>856 nm<br>1025 nm<br>-0.512 nm<br>1025 nm<br>-0.512 nm<br>143 nm<br>844 nm<br>22.9 µm <sup>3</sup><br>24.8 µm <sup>4</sup><br>24.8 µm <sup>4</sup><br>24.8 µm <sup>4</sup><br>24.8 µm <sup>3</sup><br>24.8 µm <sup>3</sup><br>24.8 µm <sup>3</sup><br>24.8 µm <sup>4</sup><br>25.6 %<br>143 nm<br>834 nm<br>0.556<br>2.86 %<br>0.00 nm<br>0.00 nm<br>0.00 nm<br>0.00 nm<br>0.00 µm |
| S Parameters Inputs Calculate S Parameters Stop Band Inputs Use Threshold Fight Feature Direction Number Histogram Bins X Aisis Boundary Particles Particle Filter Sigma Peak Inputs Peak threshold reference Pace | 1:<br>No<br>Off<br>0.00000 nm<br>Above<br>512<br>Absolute<br>Yes<br>No<br>1.00000<br>Off<br>Zero | Height ( <u>4,94 µm + 4,97 µ</u> | - | 50 µm               |   |   |

Supplement S6: AFM Images and Roughness Details

