Graphene Hydrogel Based Counter Electrode for High Efficiency Quantum Dot Sensitized Solar Cells

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Preparation of CdSeTe-sensitized photoanodes.

Mesoporous TiO_2 film were prepared by screen printing method according to our previous work.[1] It is composed of a 9.0 μm transparent layer and a 6.0 μm scattering layer. The synthesis CdSeTe QDs, ligand exchange for receiving water-soluble QDs, and deposition of QDs on TiO_2 film are all referred to that reported.[2-4] The as-sensitized electrodes were then immersed in $TiCl_4$ aqueous solution (containing 0.02 M $TiCl_4$ and 0.01 M thioglycolic acid) at 40 °C for 30 min followed by rinsing with water and ethanol alternately. Finally, the electrodes were coated with ZnS for four cycles by immersing them into 0.1 M $Zn(OAc)_2$ and 0.1 M Na_2S solutions in ethanol for 1 min/dip in turn and followed by coating with SiO_2 through soaking the electrodes in 0.01 M tetraethyl orthosilicate ethanol solution for 2 h with subsequently rinsing with ethanol and dried in air.

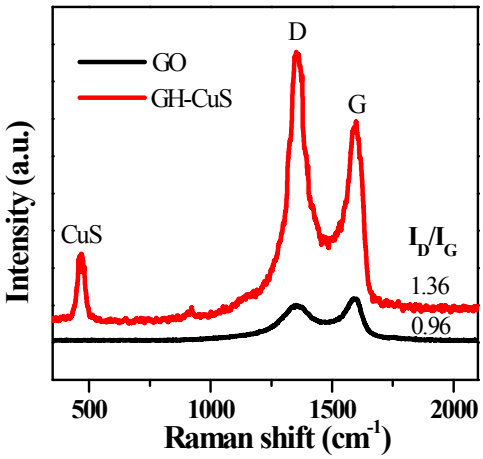

Figure S1. Raman spectra of GO and GH-CuS hybrid.

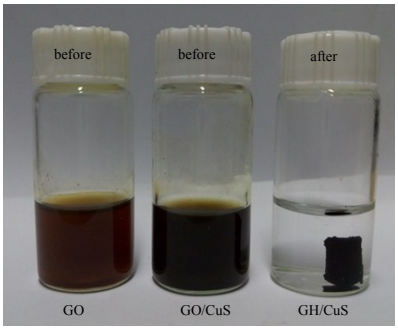

Figure S2. Photograph of homogeneous aqueous dispersion of GO, the mixture of GO and CuS, and the resultant cylinder of GH-CuS.

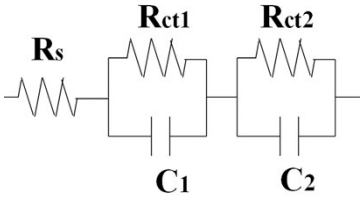

Figure S3. Equivalent circuit for fitting EIS in this work.

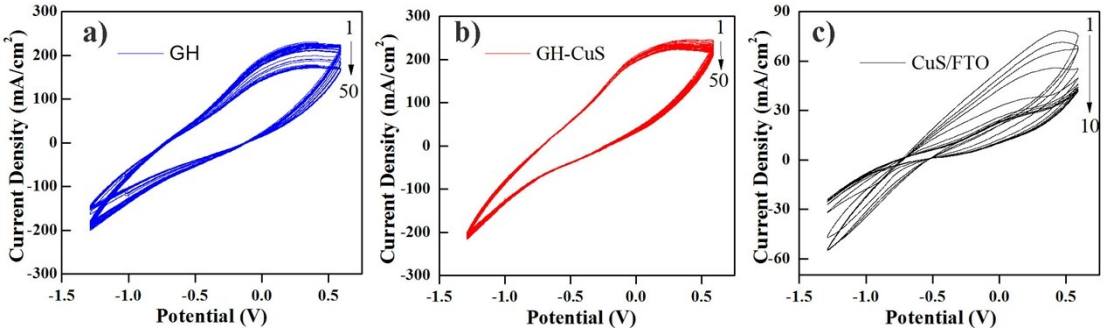

Figure S4. CV curves of GH, GH-CuS, and CuS/FTO

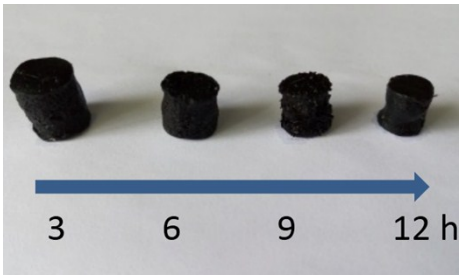

Figure S5. Photograph of GH-CuS cylinders prepared under different hydrothermal reaction times.

Table S1. Parameters extracted from *J-V* and EIS of GH-CuS CEs prepared at different hydrothermal reaction times.

Time	V_{oc}(V)	J_{sc}(mA/cm^2)	FF(%)	PCE(%)	R_s(Ω)	R_{ct1}(Ω)	R_{ct2}(Ω)
3 h	0.739	19.93	60.99	8.98	2.89	0.79	1.45
6 h	0.742	20.24	62.93	9.45	2.72	0.73	1.02
9 h	0.752	20.40	65.03	9.97	2.61	0.67	0.62
12 h	0.753	20.41	65.08	9.99	2.54	0.65	0.61

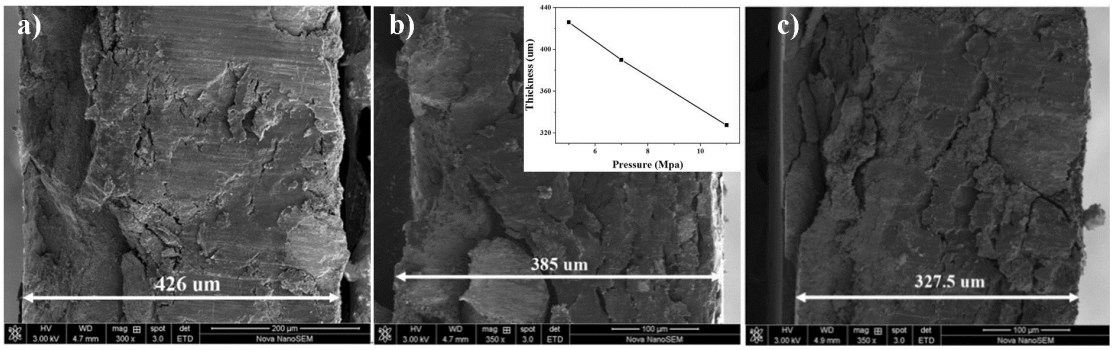

Figure S6. FESEM images of GH-CuS CEs prepared at different pressures of 5 (a), 7 (b), 11 Mpa (c) and linearity of the film thickness vs pressure (inset in b).

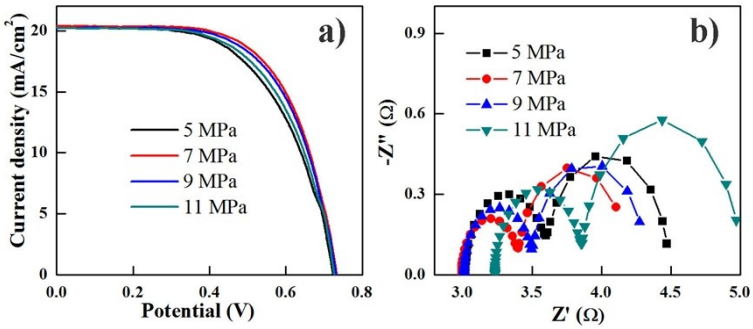

Figure S7. *J-V* and EIS for GH-CuS CEs with different pressures.

Table S2. Parameters extracted from *J-V* and EIS of GH-CuS CEs prepared at different pressures

Pressure	V_{oc}(V)	J_{sc}(mA/cm^2)	FF(%)	PCE(%)	R_s(Ω)	R_{ct1}(Ω)	R_{ct2}(Ω)
5 MPa	0.739	20.26	63.95	9.57	3.02	0.58	0.88
7 MPa	0.756	20.37	65.16	10.03	2.99	0.40	0.79
9 MPa	0.755	20.22	63.93	9.76	3.01	0.49	0.82
11 MPa	0.747	20.28	63.51	9.62	3.23	1.14	0.62

References

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