

Supporting Information

Dual Function of Molybdenum Sulfide/C-cloth in Enhancing the Performance of Fullerene Nanosheets based Solar cell and Supercapacitor

Aparajita Das,^a Melepurath Deepa,^{a,*} Partha Ghosal^b

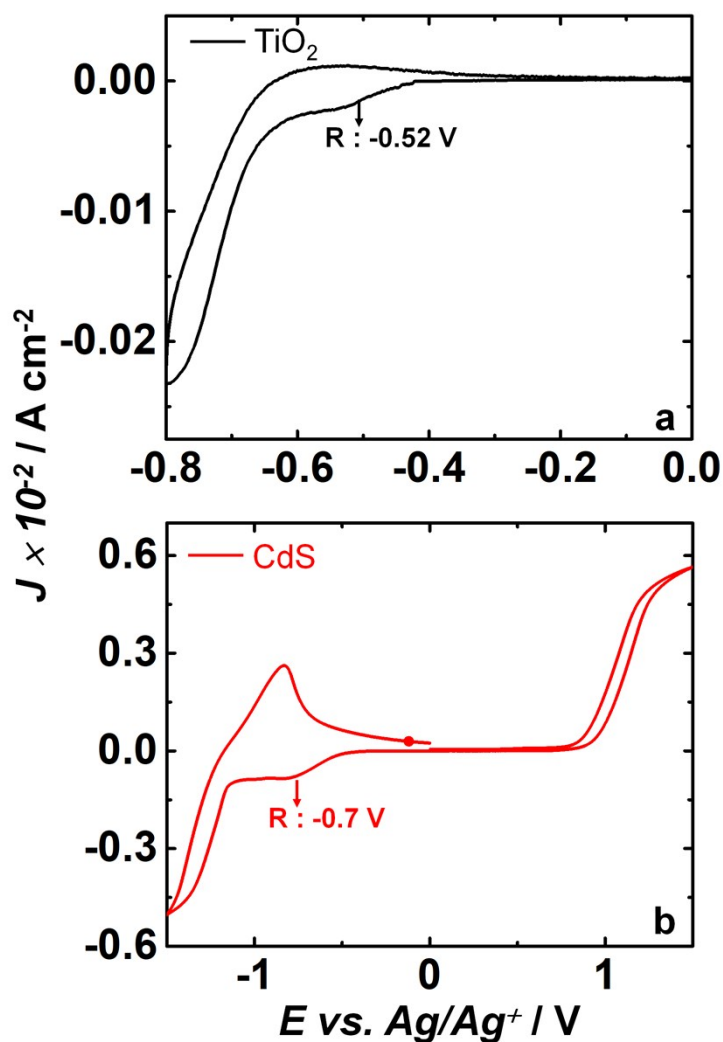


Figure S1. Cyclic voltammograms of (a) TiO₂/FTO and (b) CdS/FTO recorded in a 0.1 M KOH solution at a scan rate of 10 mV s⁻¹ and used as working electrode in three electrode electrochemical cells. Ag/AgCl/KCl is used as reference electrode and a Pt rod as the counter electrode.

The CV plots of TiO₂ and CdS shows a reduction potential peaks at -0.52 V and -0.7 V (verses Ag/AgCl/KCl) in their cathodic sweep. The potential of Ag/AgCl/KCl (verses NHE) is 0.197 V. The reduction potential of TiO₂ (verses NHE) is $E_{\text{Red}}^0 = (-0.52 + 0.197) \text{ V} = -0.323 \text{ V}$ and reduction potential of CdS (verses NHE) $E_{\text{Red}}^0 = (-0.7 + 0.197) \text{ V} = -0.503 \text{ V}$. Therefore, the conduction band (CB) or LUMO of TiO₂ (w.r.t vacuum level) is calculated to be $E_{\text{Red}} (\text{eV}) = -4.5 - (-0.323) = -4.17 \text{ eV}$ and for CdS it is $E_{\text{Red}} (\text{eV}) = -4.5 - (-0.503) = -4 \text{ eV}$ respectively. By subtracting the optical band gap energy (E_g) from CB, the valence

band energy (VB) or HOMO of TiO₂ is found to be $(-4.17 - 3.19) = -7.36$ eV and for CdS it is found to be $(-4 - 2.25) = -6.25$ eV. These values are used in energy band diagram shown in figure 3e.

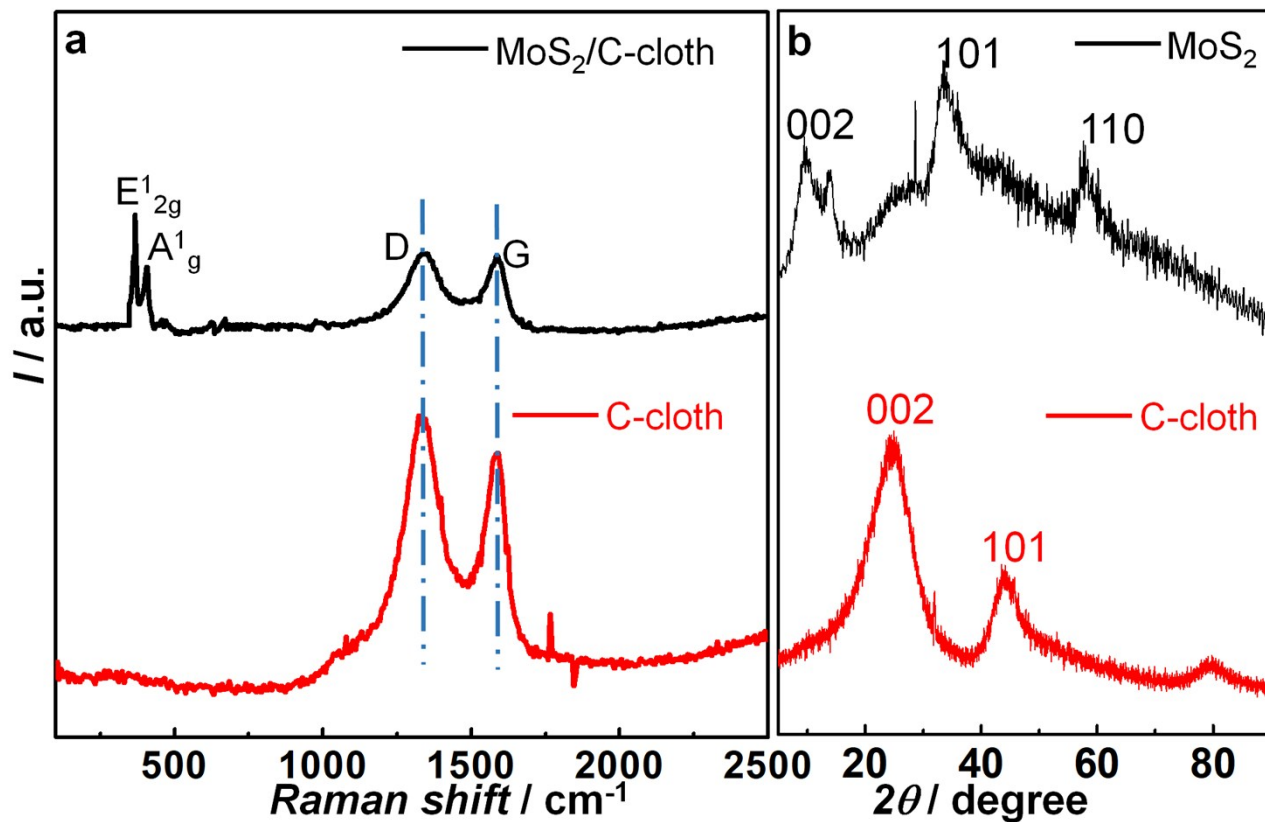


Figure S2. Raman spectra of C-cloth and MoS₂/C-cloth and (b) XRD patterns of C-cloth and MoS₂.

Table S1. Emission decay fitting parameters of photoactive films.

Sample	B ₁	τ ₁ (ns)	B ₂	τ ₂ (ns)	τ (ns)	χ ²
Glass/CdS	99.3	0.007	0.7	18.1	17.07	1.9
FTO/CdS	41.32	13.1	58.68	0.084	12.98	0.96
TiO ₂ /CdS	63.98	0.218	36.02	7.12	6.764	1.03
TiO ₂ /C ₆₀ -B/CdS	81.82	0.074	18.18	1.65	1.385	1.04
TiO ₂ /C ₆₀ -NS/CdS	10.99	0.003	89.01	0.65	0.65	1.27

Table S2. Raman data of counter electrodes.

Counter electrode	D-band (cm ⁻¹)	G-band (cm ⁻¹)	I _D /I _G
C-cloth	1335	1584	1.16
MoS ₂ /C-cloth	1339	1586	1.025

Counter	R_s (Ω)	R_{CT} (Ω)	R_{gb} (Ω)
C-cloth	20.1	4	14.2
MoS ₂ /C-cloth	23.6	1.4	19.2

Table S3. EIS parameters for counter electrode based cells in symmetric configurations.

Table S4. Solar cell parameters of large area QDSCs (1 cm²) containing 1 M Na₂S + 1 M S polysulfide based gel electrolyte under 1 sun illumination (AM 1.5, 100 mW cm⁻²).

Photoanode	MoS ₂ /C-cloth			
	J_{sc} (mA cm ⁻²)	V_{oc} (mV)	FF	η (%)
TiO ₂ /CdS				
1	5.9	675	0.49	2
2	5.95	680.4	0.49	2
TiO ₂ /C ₆₀ -B/CdS				
1	7.2	692.2	0.50	2.5
2	7.1	709	0.47	2.4
TiO ₂ /C ₆₀ -NS/CdS				
1	8	717.3	0.51	2.9
2	8.2	719.1	0.50	3

Table S5. Solar cell parameters of TiO₂/C₆₀-NS/CdS cell with MoS₂/C-cloth counter in polysulfide gel electrolyte under 1 sun illumination at different interval of time.

illumination time (min)	J_{sc} (mA cm ⁻²)	V_{oc} (mV)	FF	η (%)
0	15.5	741.1	0.46	5.3
100	12.9	746.0	0.53	5.1
200	12.5	765.5	0.54	5.2
300	11.5	804.6	0.54	5.0
400	11.0	802.1	0.52	4.6
500	10.9	785.0	0.51	4.3