Electronic Supplementary Material (ESI) for Sustainable Energy & Fuels.

Supplementary Information

Archetypical 2D Sheet-Like Cu_2MoS_4 for All-Solid-State Symmetric Pseudocapacitors with Ultra-Steady Performance Efficiency

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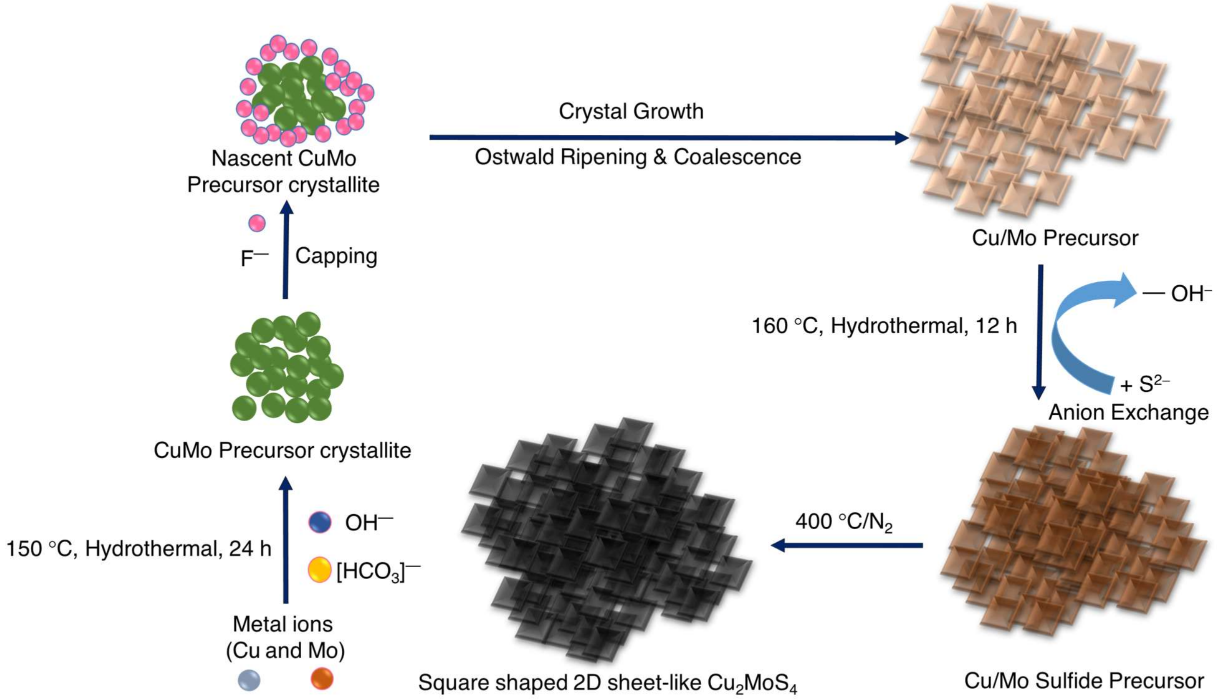
Table S1. Attributions of the peaks in the survey XPS spectrum of Cu_2MoS_4.

Sl. No.	**Binding Energy (eV)**	**Attributions**
1	952.30	Cu $2p_{1/2}$
2	932.50	Cu $2p_{3/2}$
3	565.00	Cu 3p
4	531	O 1s
5	506	Mo 3s
6	411	Mo 3p
7	392	Mo 3p
8	284	S 2s
9	228.6	Mo 3d
10	161	S 2s
11	120	Cu 3s
12	74.25	Cu 3p
13	37.26	Mo 4p



Scheme S1. Plausible growth mechanism and formation of square shaped 2D sheet-like Cu_2MoS_4.[s1]

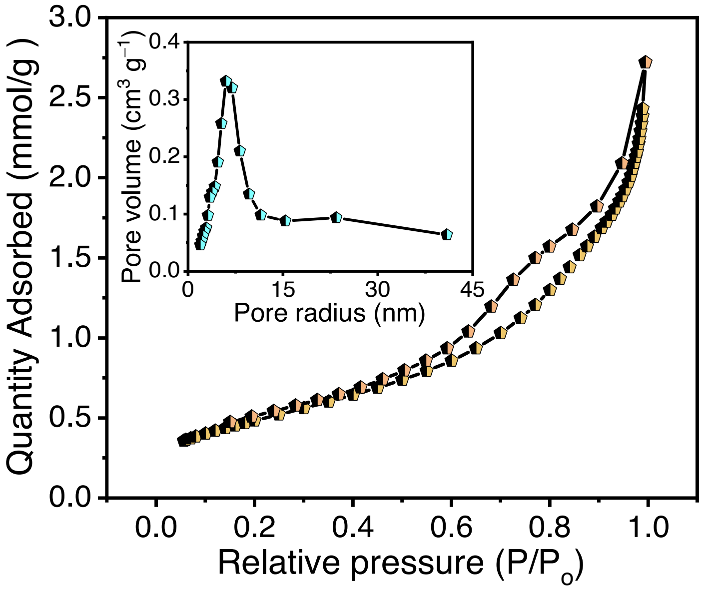


Fig. S1 BET N_2 adsorption-desorption isotherm of Cu_2MoS_4; inset shows the BJH pore size distribution plot of Cu_2MoS_4.

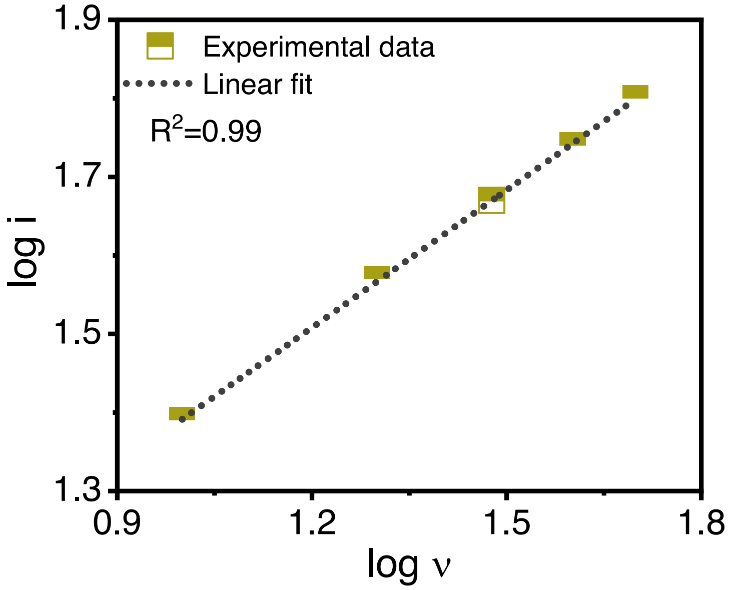


Fig. S2 *log i* vs. *log ν* plot of Cu_2MoS_4, when studied as the positive electrode material.

Table S2: Comparison of the specific capacitance of Cu_2MoS_4 with the reported Cu and Mo based oxides/sulfides in 3 electrode set up.

SI. No.	**Sample Name**	**Specific Capacitance @ Current density**	**References**
1	Cu_2O	144 F g^{-1}@1 A g^{-1}	s2
2	RGO/Cu_2O/Cu	98 F g^{-1}@1 A g^{-1}	s3
3	Cu_2O-GN	416 F g^{-1}@1 A g^{-1}	s4
4	CNT@CuS	122 F g^{-1}@1.2 A g^{-1}	s5
5	H-CuS	536 F g^{-1}@8 A g^{-1}	s6
6	CuS	237 F g^{-1}@0.5 A g^{-1}	s7
7	PPy/MoO_3	687 F g^{-1}@1 A g^{-1}	s8
8	MoO_3/C	331 F g^{-1}@1 A g^{-1}	s9

9	MoO_3	603 F g^{-1}@1 A g^{-1}	s10
10	MoS_2	366 F g^{-1}@0.5 A g^{-1}	s11
11	MoS_2	231 F g^{-1}@1 A g^{-1}	s12
12	MoS_2-rGO	387 F g^{-1}@1.2 A g^{-1}	s13
13	**Cu_2MoS_4**	**1055 F g^{-1}@1 A g^{-1}**	**This work**

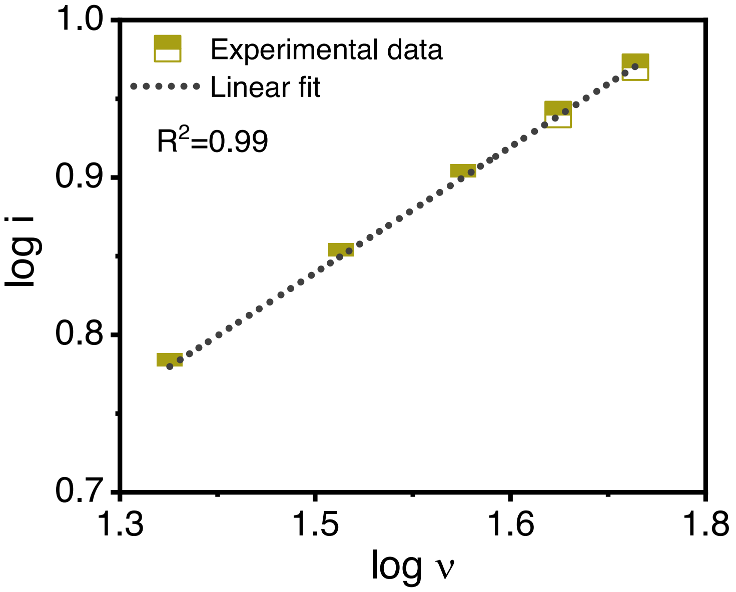


Fig. S3 *log i* vs. *log ν* plot of Cu_2MoS_4, when studied as the negative electrode material.

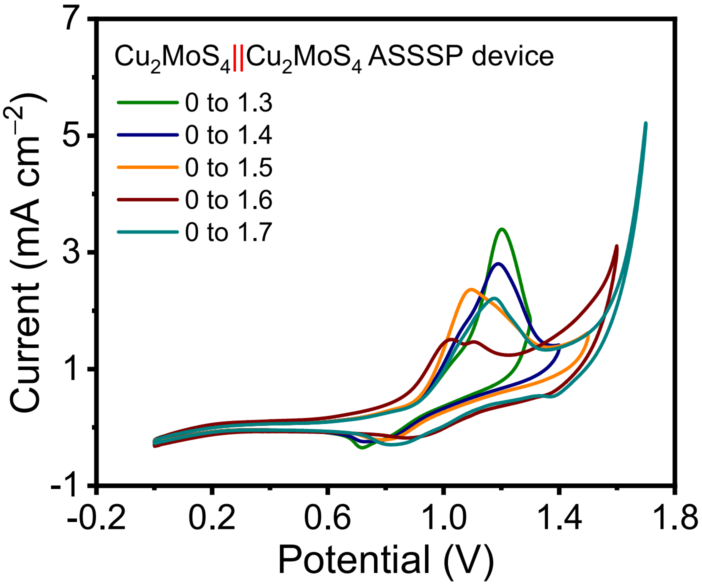


Fig. S4 *Current* vs. *potential* plots of $Cu_2MoS_4||Cu_2MoS_4$ ASSSPC device at different potential windows.

Table S3. Comparison of the charge transfer resistance of Cu_2MoS_4 with the reported electrode materials (for symmetric supercapacitors) in 3 electrode set up; comparison of the energy density, power density and cyclic stability of the Cu_2MoS_4 || Cu_2MoS_4 ASSSPC device with the reported symmetric supercapacitor devices.

SI. No.	**Symmetric device**	**Charge transfer resistance in 3 electrode set up (R_{ct})**	**Energy density ($W\ h\ kg^{-1}$)**	**Power density ($W\ kg^{-1}$)**	**Retention (%) in Cyclic Stability (No. of cycles)**	**References**
1	Fe_3O_4/Graphene || Fe_3O_4/Graphene	–	19.2	800.2	94% (3200)	s14
2	MnO_2 || MnO_2	1.2 Ω	12.7	87	83% (3000)	s15
3	N, S co-doped PCFF || N, S co-doped PCFF	–	16.3	147	79% (10000)	s16
4	NiS_2 || NiS_2	–	7.97	500	90% (1500)	s17

5	MoS_2/CC || MoS_2/CC	4.3 Ω	5.42	128	96.5% (5000)	s18
6	MnO_2 || MnO_2	31.42 Ω	23	1923	92% (2200)	s19
7	MoS_2/CC || MoS_2/CC	0.51 Ω	11.1	250	87.9% (1000)	s20
8	$NiCo_2O_4$ || $NiCo_2O_4$	–	30.50	750	86% (500)	s21
9	CMS/Ni || CMS/Ni	0.48 Ω	23.61	1000	87.7% (3000)	s22
10	$CuCo_2O_4$ || $CuCo_2O_4$	1.89 Ω	16.87	8200	100.94 (3000)	s23
11	FeS || FeS	5.15 Ω	2.56	726	91% (1000)	s24
12	f-CFP || f-CFP	–	5.2	326	99% (5000)	s25
13	PGBC || PGBC	0.51 Ω	6.68	100.2	84% (5000)	s26
14	HCP || HCP	–	9.67	-	90.2% (10000)	s27
15	NCF || NCF	–	1.35	2900	95.8% (1000)	s28
16	rGO-PMo_{12} || rGO-PMo_{12}	–	17.20	130	89% (5000)	s29
17	PANI@CNFs || PANI@CNFs	10.5 Ω	10.04	225	81% (1000)	s30
18	HN-CNFs/GNs || HN-CNFs/GNs	–	6.3	344.1	99% (5000)	s31
19	CuS/MnS@NF || CuS/MnS@NF	–	2.54	174.7	78% (2500)	s32
20	Cu_2MoS_4 || Cu_2MoS_4	0.45 Ω	30.53	5649	97.1 (10,500)	This work

Table S4. Comparison of the relaxation time of the Cu_2MoS_4 || Cu_2MoS_4 ASSSPC device with the reported symmetric/asymmetric supercapacitor devices.

Sl. No.	**Electrode Material**	**Symmetric/Asymmetric supercapacitor device**	**Relaxation time (τ_0)**	**Reference No.**
1	Carbon/Carbon supercapacitors	Carbon || Carbon	4.9 seconds	s33
2	$CoFe_2O_4$ thin film	$CoFe_2O_4$ || $CoFe_2O_4$	174 milliseconds	s34
3	Ti-rich TiO_2 tubular nanolettuces	Ti-rich TiO_2 || Ti-rich TiO_2	1.7 seconds	s35
4	3D cross-linked graphene	NPFG-0.3 || NPFG-0.3	28.4 milliseconds	s36
5	Manganese oxide	MnO_2 || $NiCo_2O_4$	14 milliseconds	s37
6	α-Fe_2O_3 thin film	α-Fe_2O_3 || α-Fe_2O_3	9 milliseconds	s38
7	V_2O_5 encapsulated MWCNTs	V_2O_5/MWCNT || V_2O_5/MWCNT	5.6 milliseconds	s39
8	MnO_x/Au multilayers	MnO_x/Au || MnO_x/Au	5 milliseconds	s40
9	Silicon nanowires (SiNWs)	SiNWs || SiNWs	3.5 milliseconds	s41
10	Graphene on metal template	Metal graphene || Metal graphene	1.8 milliseconds	s42
11	Polymer-derived carbyne	Carbyne || Carbyne	1.2 milliseconds	s43
12	Graphene	Printable graphene || Printable graphene	1 millisecond	s44
13	Cu_2MoS_4	Cu_2MoS_4 || Cu_2MoS_4	0.5 millisecond	This work

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