Supporting Information

Tiled Monolayer Films of 2D Molybdenum Disulphide Nanoflakes Assembled at Liquid/Liquid Interfaces

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Stability of Particles at Interfaces

The effects of gravity can be neglected if the ration between gravitational forces and capillary forces is sufficiently low. These can be compared using the dimensionless bond number

$$Bo = \Delta\rho g d^2/\gamma_{12} \quad \text{(S1)}$$

Where $\Delta\rho$ is the difference in density between the phases present, g = 9.8 ms^{-2} is the acceleration of gravity, d is the characteristic length of the system taken as the diameter of the flakes or particles at the interface and γ_{12} is the interfacial tension between the immiscible liquids. Here $\Delta\rho \approx 4000$ $kg.m^{-3}$, γ_{12} = 55 mNm^{-1} and d is taken as 10^{-6} m, giving Bo = 8 x 10^{-7}, showing that capillary forces clearly dominate.

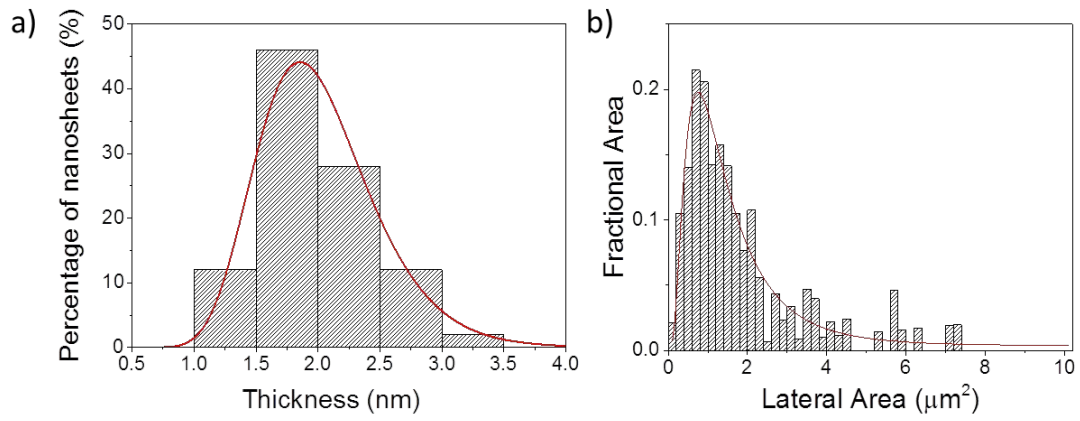

Figure S1: a) thickness (n = 50) and b) lateral area (n > 600) histograms for the MoS_2 dispersion separated by cascade centrifugation at 8-12 kRPM. Thickness histogram added again for completeness.

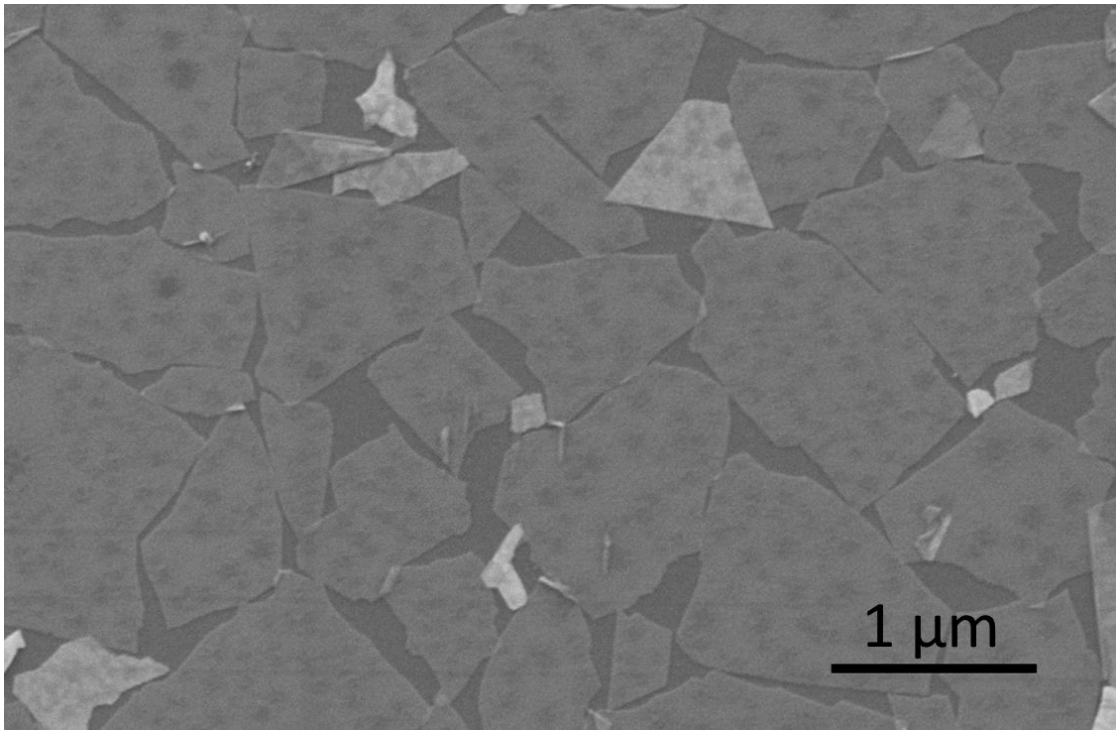

Figure S2: High magnification (50000 x) SEM image of liquid/liquid interface assembled thin film.

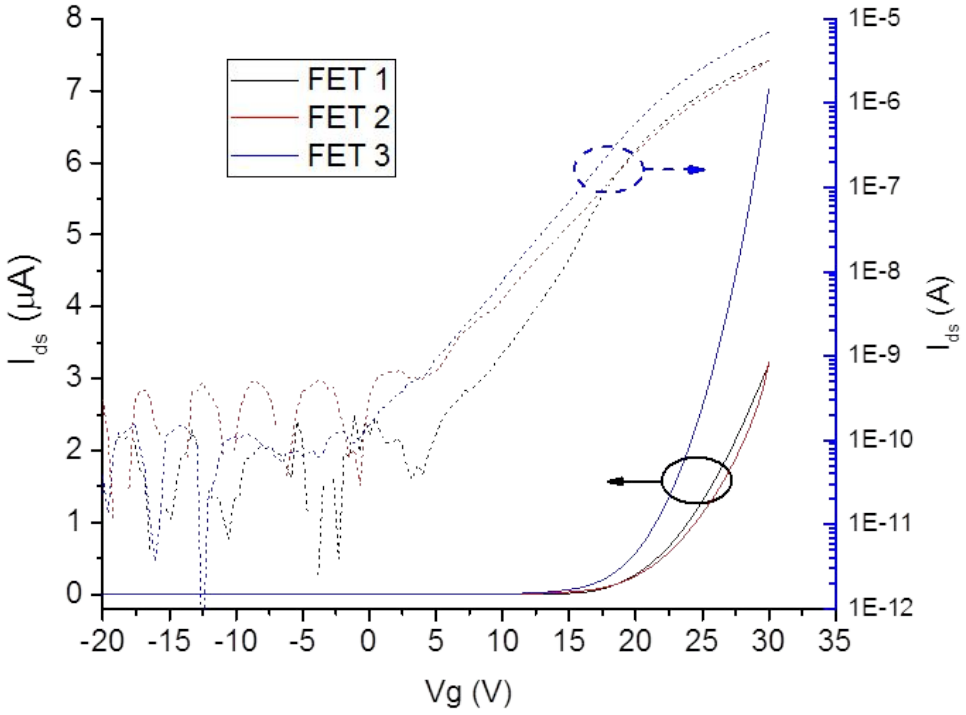

Figure S3: Three example FETs assembled in the same manner as reported in the main body (FET3 is the demonstrator device in the main body). Mobilities extracted from the I_{ds}/V_g curves are 0.28, 0.443, and 0.726 for FET1, FET2, and FET3 respectively.

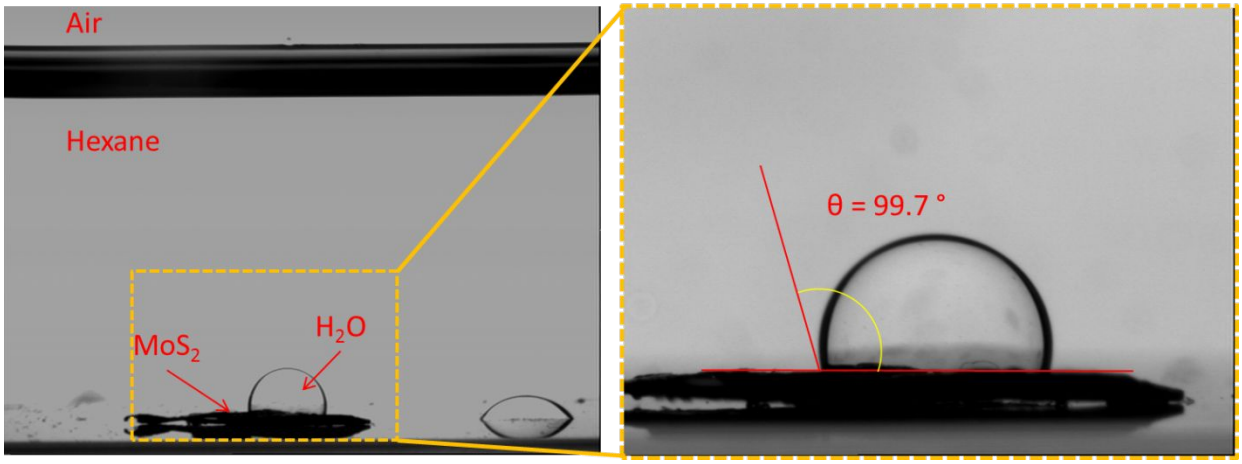

Figure S4: 3 Phase contact angle measurement of water droplet on MoS_2 surface in hexane environment.

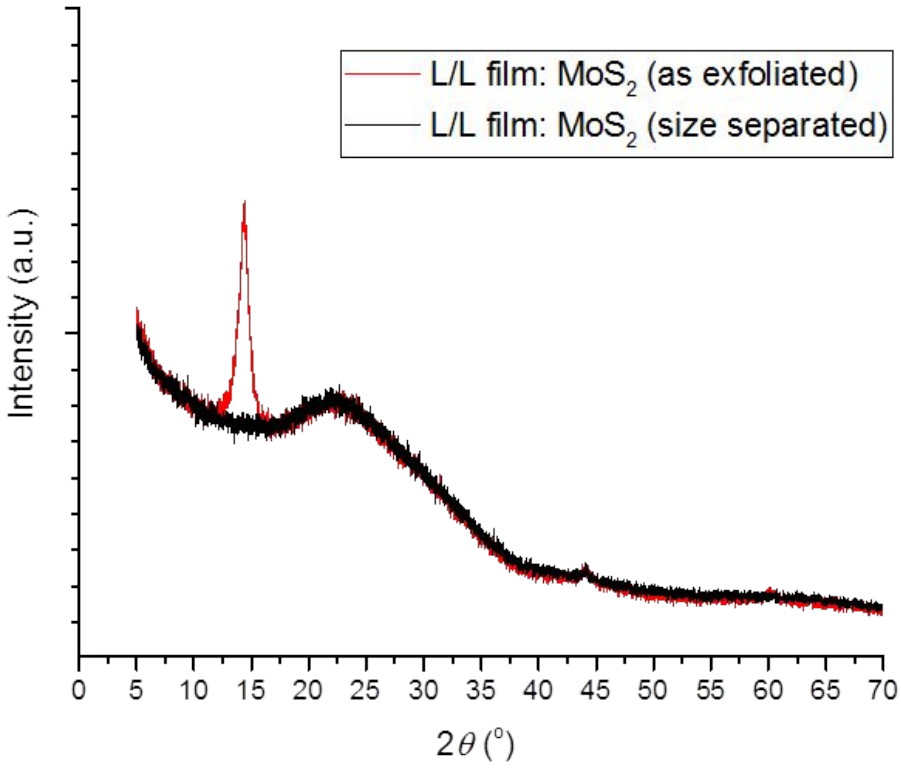

Figure S5: XRD patterns for liquid/liquid interface assembled thin films of MoS_2 flakes as prepared, and size selected to narrow size distribution (average flake thickness 2 nm, 1-2 monolayers MoS_2). The 002 peak is not visible in the size selected film indicating the presence of less than 5 MoS_2 monolayers and therefore the ultrathin nature of the film and the lack of flake overlap.[1,2]

Device type	Mobility	on/off	Processing temp (°C)	reference
Single crystal	0.2	10	N/A	**55**
CVD Grown MoS_2 FETs	6	10^5	850	**62**
	10	10^8	1000	**63**
	0.02	10^3	650	**64**
	0.68	$<10^4$	700	**65**
	24	10^6	750	**66**
Solution processed MoS_2 FETs	0.0004	22	200	**10**
	0.1	600	N/A	**67**
	0.3	2	50	**68**
	10	10^6	400	**57**
	<0.1	<10	450	**69**
	0.73	10^5	200	**This work**

Table S1: Values used in the main text graph (Figure 6). References correspond to the main body references section.

References

(1) Ramakrishna Matte, H. S. S.; Gomathi, A.; Manna, A. K.; Late, D. J.; Datta, R.; Pati, S. K.; Rao, C. N. R. MoS_2 and WS_2 Analogues of Graphene. Angew. Chemie Int. Ed. **2010**, 49, 4059–4062.

(2) Rao, C. N. R.; Nag, A. Inorganic Analogues of Graphene. Eur. J. Inorg. Chem. **2010**, 27, 4244–4250.