Supporting Information

Sono-assisted surface energy driven assembly of 2D materials on flexible polymer substrates: A green assembly method using water

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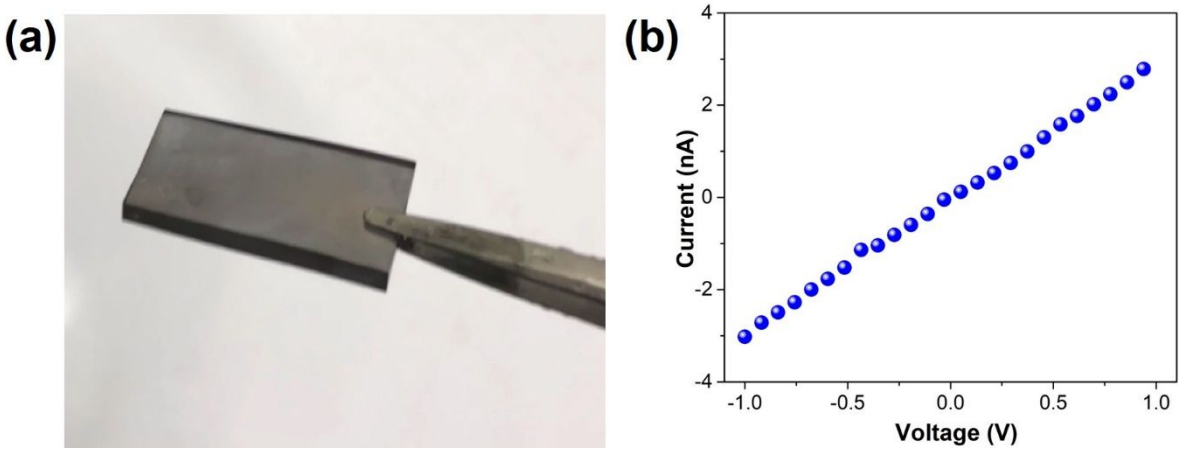

Figure S1. 10 s assembly of graphene on PDMS. (**a**), Digital camera image. (**b**), The corresponding I-V curve. Solution concentration 1 mg/mL.

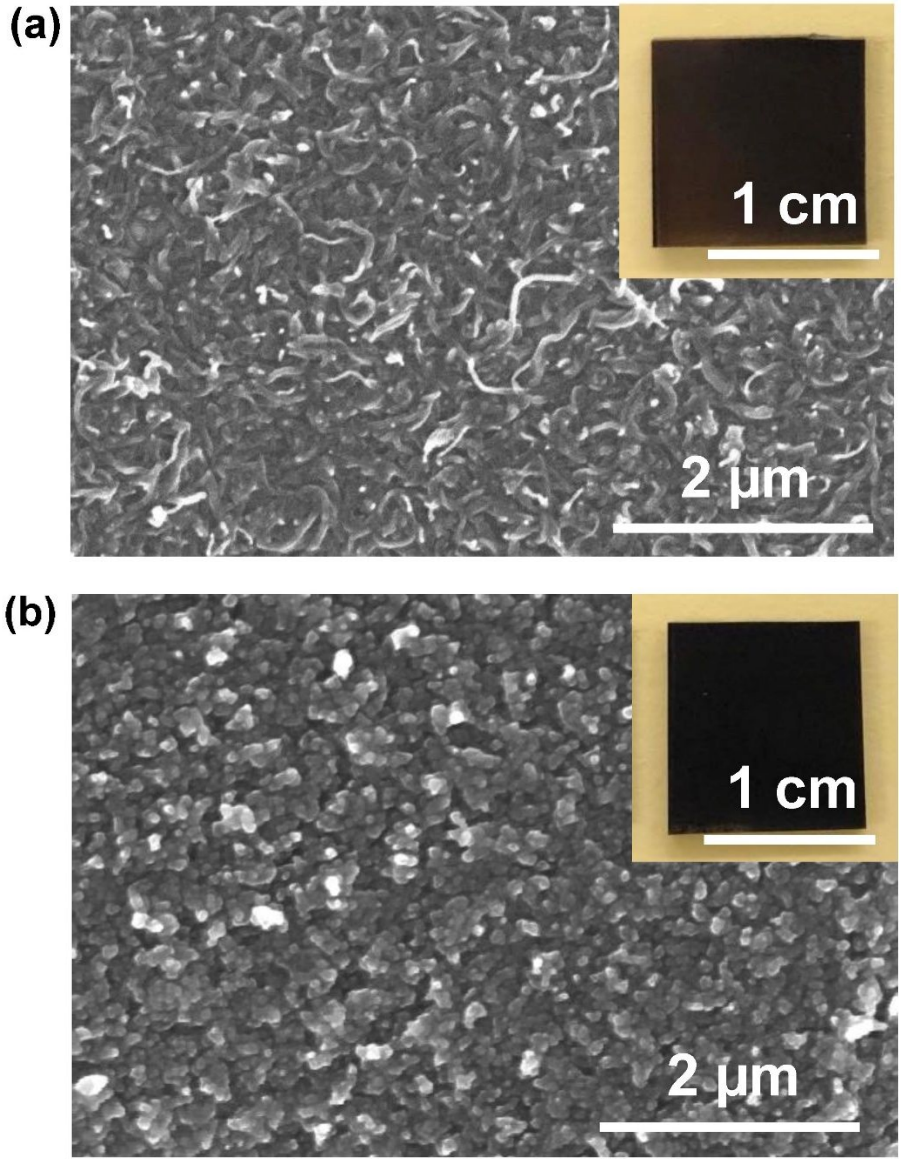

Figure S2. SEM images of assembled carbon nanotube **a** and carbon black **b** on PDMS substrates.

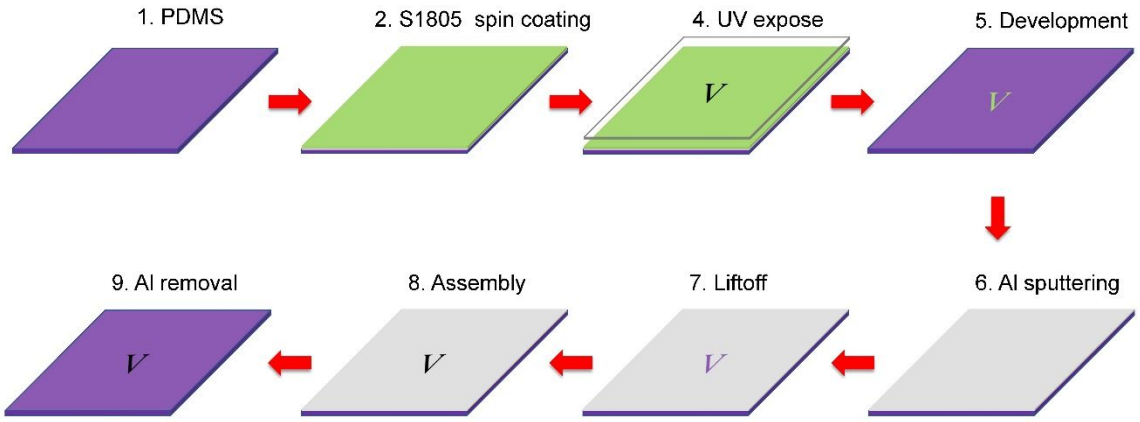

Figure S3. Sample preparation procedure for graphene assembly into a micro "V" letter.

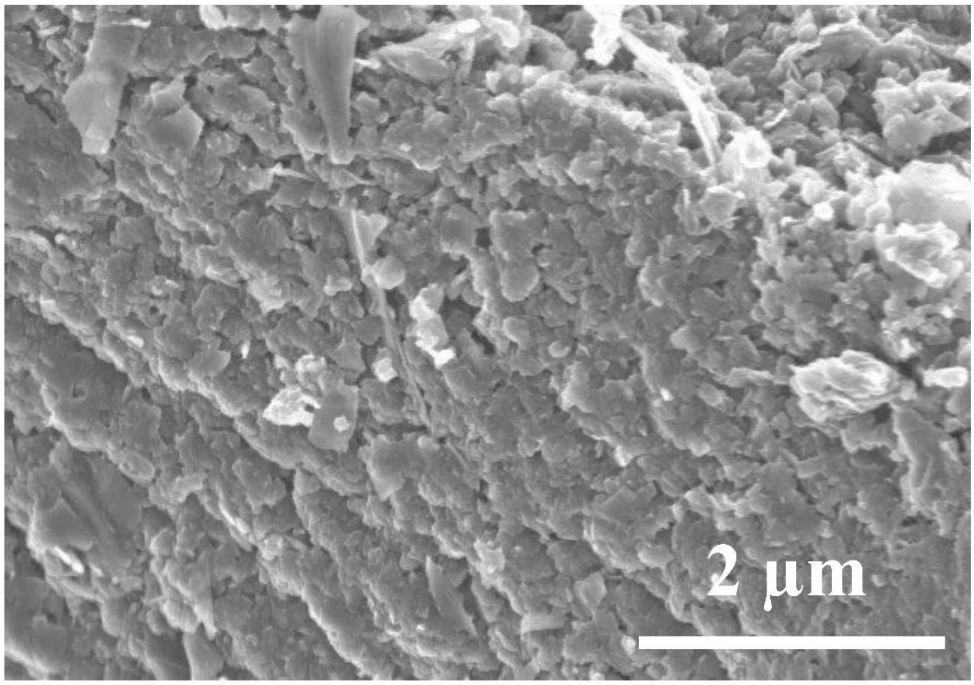

Figure S4. High magnification SEM image of assembled PDMS/graphene foam wall.

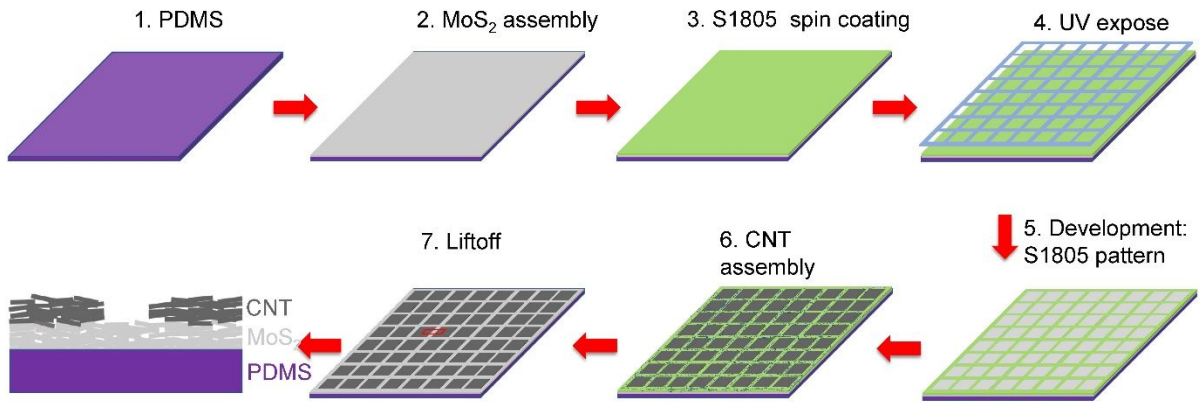

Figure S5. Combined micropatterning and multiple SASEDA processes Multiple SASEDA processes for MoS_2/CNT microscale device fabrication.

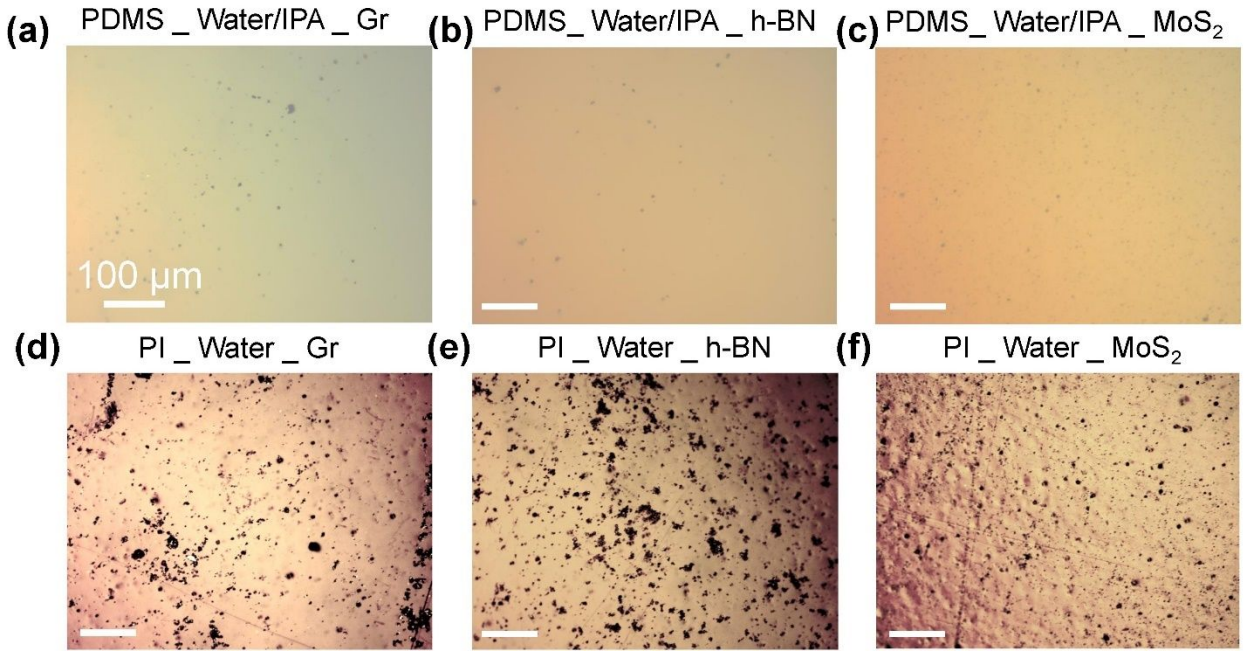

Figure S6. Optical images of static assembled samples. (**a**) (**b**) (**c**) are graphene, h-BN, and MoS_2 assembly on PDMS in water/IPA, respectively. (**d**) (**e**) (**f**) are graphene, h-BN and MoS2 assembly on PI in water, respectively. The scale bares are 100 µm.

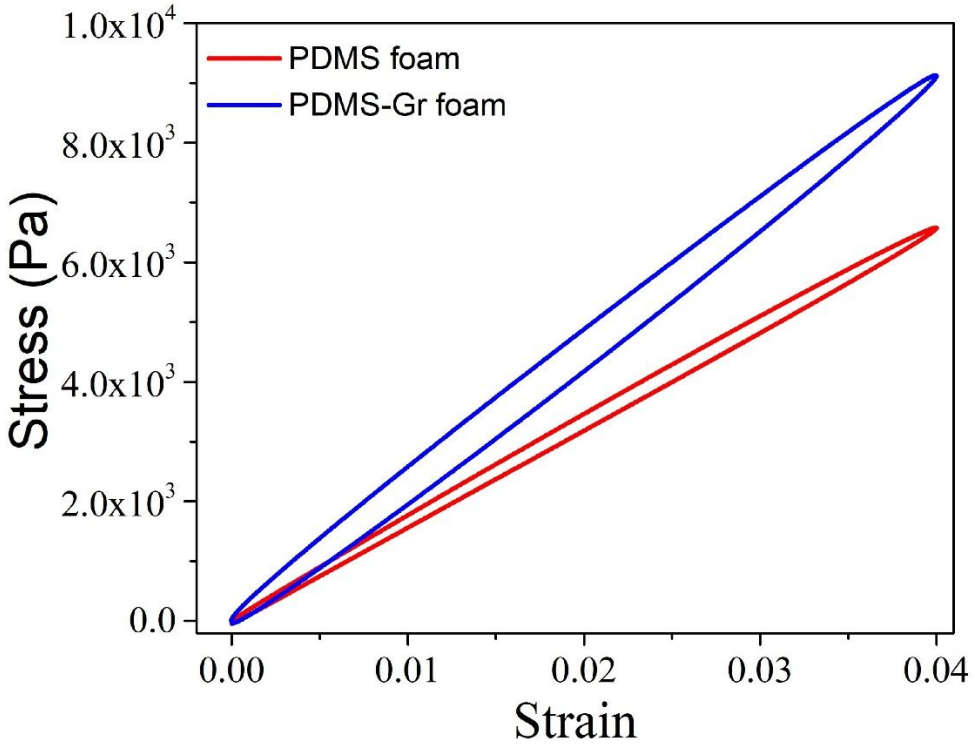

Figure S7. Mechanism properties of pure PDMS foam and assembled graphene/PDMS foam

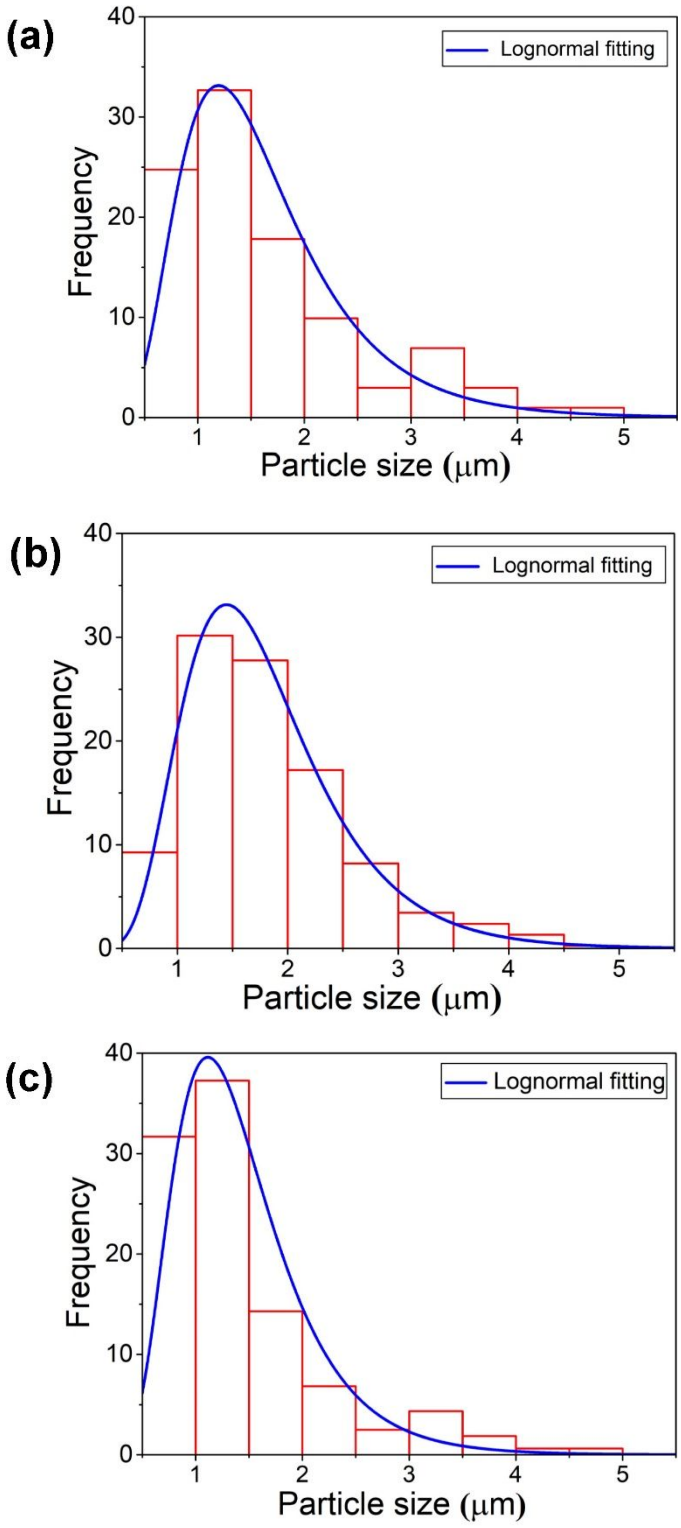

Figure S8. Size distribution of graphene C-300 (**a**), h-BN (**b**) and MoS_2 (**c**). The projected area diameters were calculated and summarized. At least 100 particles were measured for each sample.

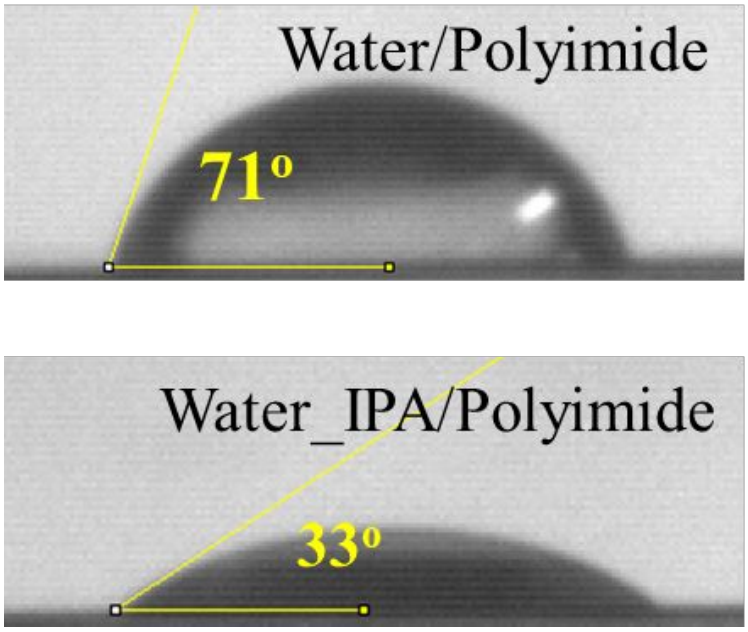

Figure S9. Contact angle data on polyimide substrate for water and water/IPA (1:1).

Table S1. Calculated interfacial energy and separation energy.

	γ_{pn}	γ_{ps}	γ_{ns}	W_{psn}	W_{pns}
PDMS/Water/Gr	11.62	38.84	13.89	41.11	-13.33
PDMS/Water/h-BN	22.1	38.84	2.95	19.69	-13.79
PDMS/Water/MoS_2	10.12	38.84	11.96	40.68	-16.76
PDMS/Water_IPA/Gr	11.62	3.91	5.31	-2.4	13.02
PDMS/Water_IPA /h-BN	22.1	3.91	8.37	-9.82	26.56
PDMS/Water_IPA /MoS_2	10.12	3.91	3.27	-2.94	9.48
Polyimide/Water/Gr	24.47	11.2	13.89	0.62	27.16
Polyimide/Water/h-BN	12.96	11.2	2.95	1.19	4.71
Polyimide/Water/MoS_2	19.2	11.2	11.96	3.96	19.96

Table S2. The summary of surface tension and surface tension components

	Surface tension	Dispersive components	Polar components	Reference
Water	72.75	22.10	50.65	1
Water/IPA (1:1)	25.13	16.96	8.17	1
Graphene	53.0	39.1	13.9	2
MoS_2	44.5	32.09	14.41	3
h-BN	58.27	27.99	30.28	4
PDMS	19.8	19.0	0.8	5
Polyimide[a)]	37.2	29.1	8.1	

[a)]The surface tension and components of polyimide were calculated using the contact angles from Figure. S9 and the Fowkes surface energy theory: [2]

$$\gamma_l(\cos\theta + 1) = 2\,(\gamma_l^{di}\gamma_s^{di})^{1/2} + 2\,(\gamma_l^{po}\gamma_s^{po})^{1/2}$$

where γ_l^{di} and γ_l^{po} are the liquid dispersive and polar components, respectively, and γ_s^{di} and γ_s^{po} are the solid dispersive and polar components, respectively. θ is the contact angle.

Supplementary References

1. Shen, J.; He, Y.; Wu, J.; Gao, C.; Keyshar, K.; Zhang, X.; Yang, Y.; Ye, M.; Vaita, R.; Lou, J. *et al.* Liquid Phase Exfoliation of Two-Dimensional Materials by Directly Probing and Matching Surface Tension Components. *Nano Lett.* **2015**, *15*, 5449-5454.

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