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Supporting Information

Paper-based Flexible Strain and Pressure Sensor with Enhanced Mechanical Strength and Super-hydrophobicity that can Work Under Water

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44 **Table S1**. Comparisons of the reported various paper-based strain sensors with this work.

Conductive materials	Main methods	Response time (s)	Gauge factor	Super-hydrophobicity	Work under Water	encapsulation	Publication year	Reference
Graphite	pencil drawn	0.11	536.6	no	Not mentioned	Not mentioned	2015	1
AgNWs/LDHs	screen printing	0.12	Not mentioned	no	Not mentioned	Not mentioned	2015	2
Graphite	meyer-rod coating	0.0196	804.9	no	Not mentioned	Not mentioned	2016	3
CB	dip-coating	0.24	4.3	no	Not mentioned	Not mentioned	2017	4
rGO	drop-casting	Not mentioned	66.6	no	Not mentioned	Not mentioned	2017	5
CB	screen-printing	0.000625	647	no	Not mentioned	Not mentioned	2017	6
Graphite/CB	papermaking	0.36	27	no	Not mentioned	Not mentioned	2018	7
ITO NPs	hand-painting	Not mentioned	41.98	no	Not mentioned	Not mentioned	2019	8
CB/rGO	spraying	0.13	14.6	no	Not mentioned	Not mentioned	2019	9
HPM	brush coating	0.24	19.1	no	Not mentioned	Not mentioned	2020	10
MCG	direct-laser writing	0.166	73	no	Not mentioned	Not mentioned	2020	11
Graphene	meyer-rod coating	Not mentioned	3.82	no	Not mentioned	Not mentioned	2020	12
Ag nanowires	papermaking	Not mentioned	10.2	no	Not mentioned	Not mentioned	2020	13
MoS_2 Pencil	hand writing	Not mentioned	13	no	Not mentioned	Not mentioned	2021	14
CB/CNT	dip-coating	Not mentioned	7.5	yes	Not mentioned	Not mentioned	2019	15
Carbon ink	soaking-drying	0.34	Not mentioned	yes	Not mentioned	Not mentioned	2021	16
Ag/MWCNTs	sputter coating	0.078	263.34	no	yes	yes	2021	17
Graphite nanoplates	papermaking	0.3	18.99	yes	yes	Not mentioned	-	this work

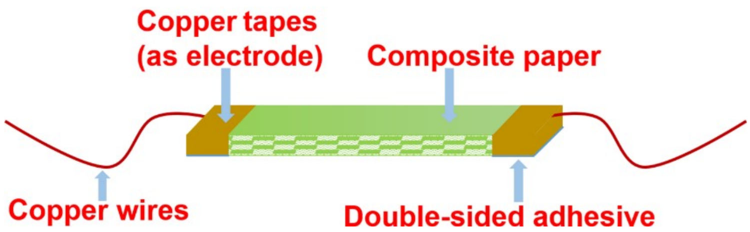

Figure S1. Structure diagram of the paper-based sensor for strain and pressure detection.

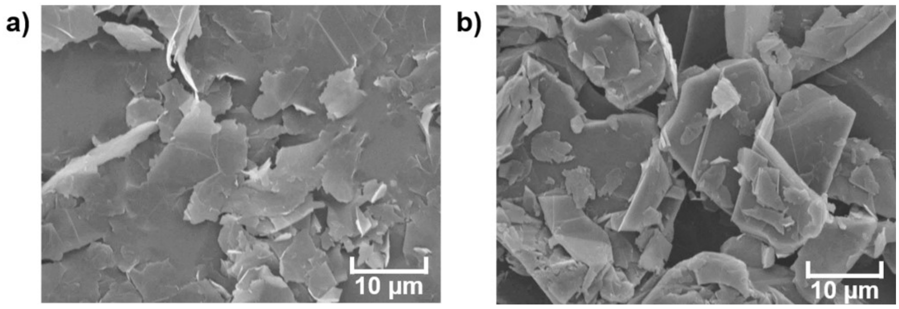

Figure S2. SEM images of (a) graphite nanoplates and (b) graphite powders.

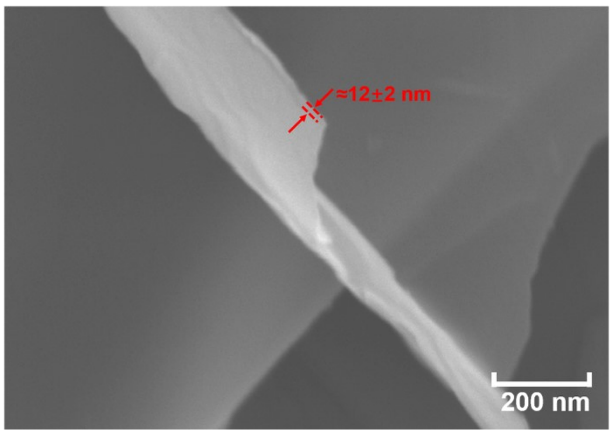

Figure S3. FESEM images of graphite nanoplates

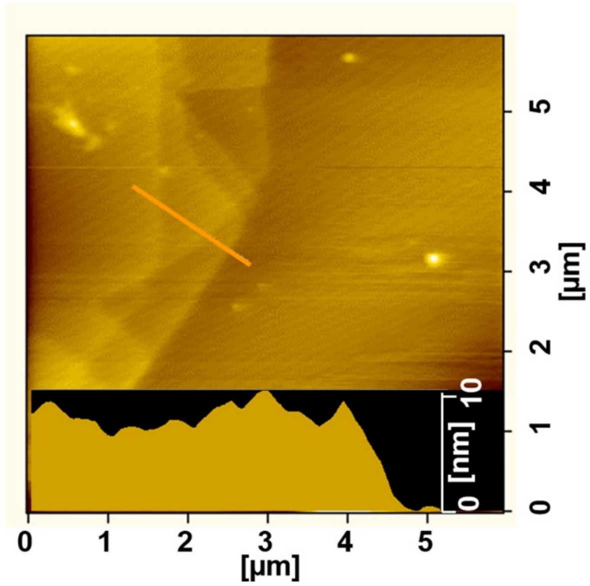

Figure S4. AFM image of graphite nanoplates with corresponding height profile.

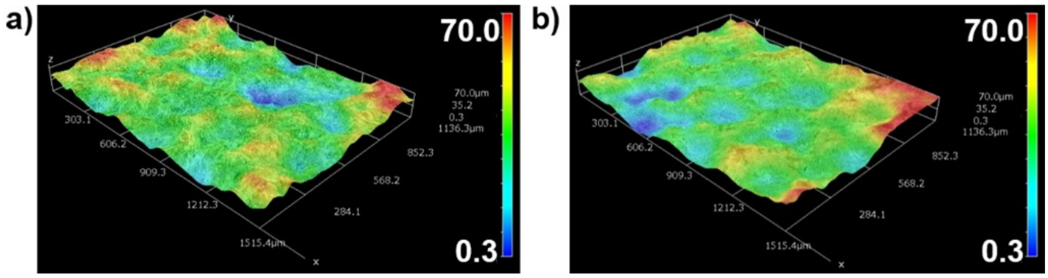

Figure S5. 3D images of the composite paper (a) before and (b) after coating AKD.

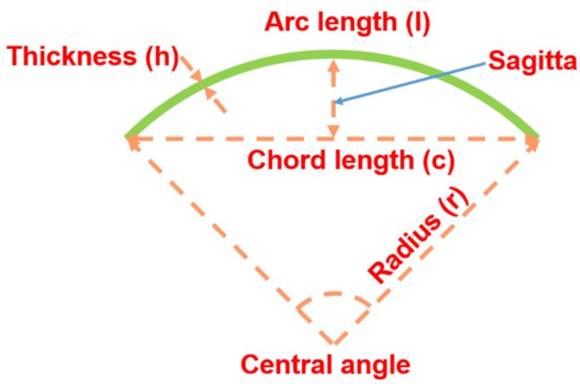

Figure S6. Schematic model for calculation of the strain under bending. The sagitta was measured before the calculation.

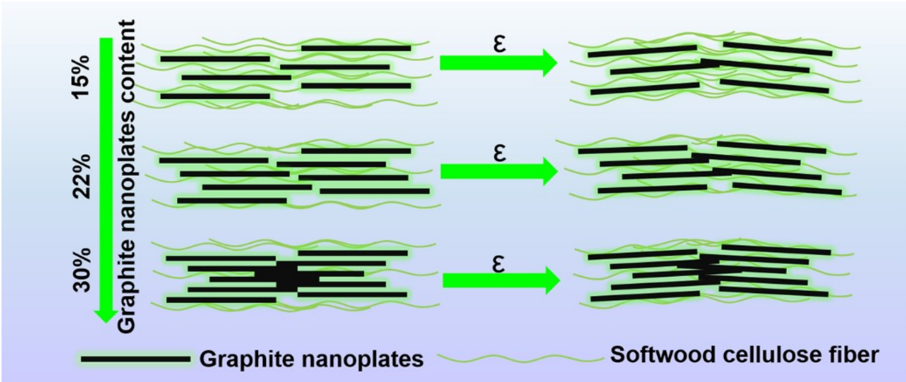

Figure S7. Illustration of the sensor under strain with different content of graphite nanoplates.

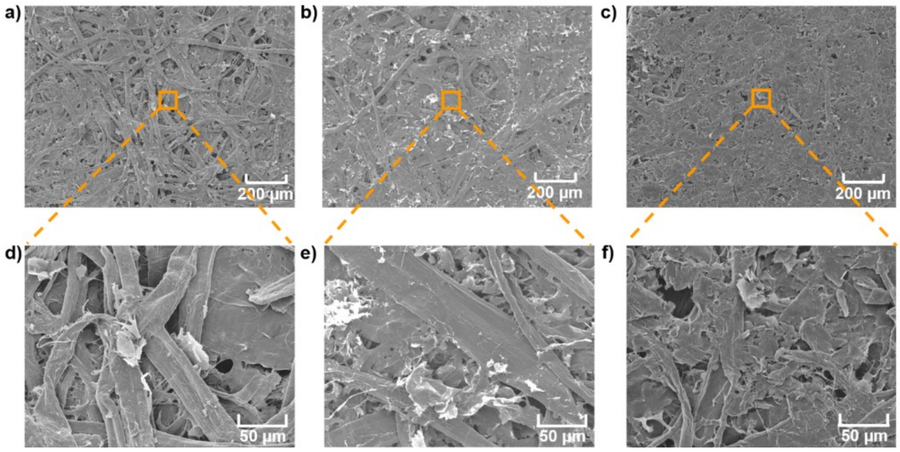

Figure S8. SEM images of the composite paper with graphite nanoplates content of (a, d) 15 *wt*%, (b, e) 22 *wt*% and (c, f) 30 *wt*%.

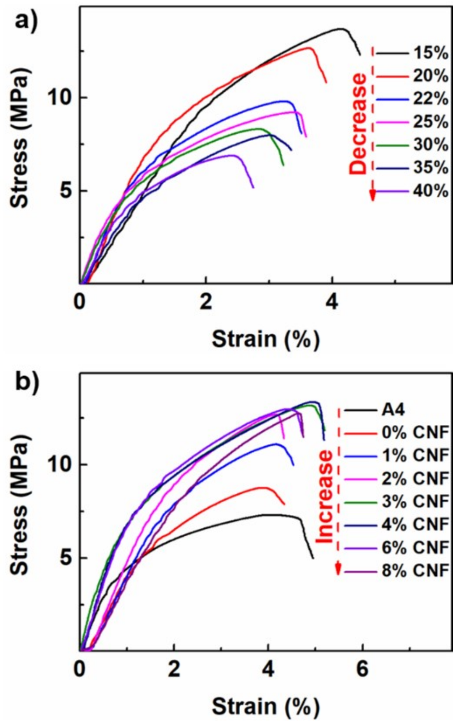

Figure S9. a) Stress-strain curves of the composite paper with different content of graphite nanoplates. b) Stress-strain curves of the composite paper with different content of CNF.

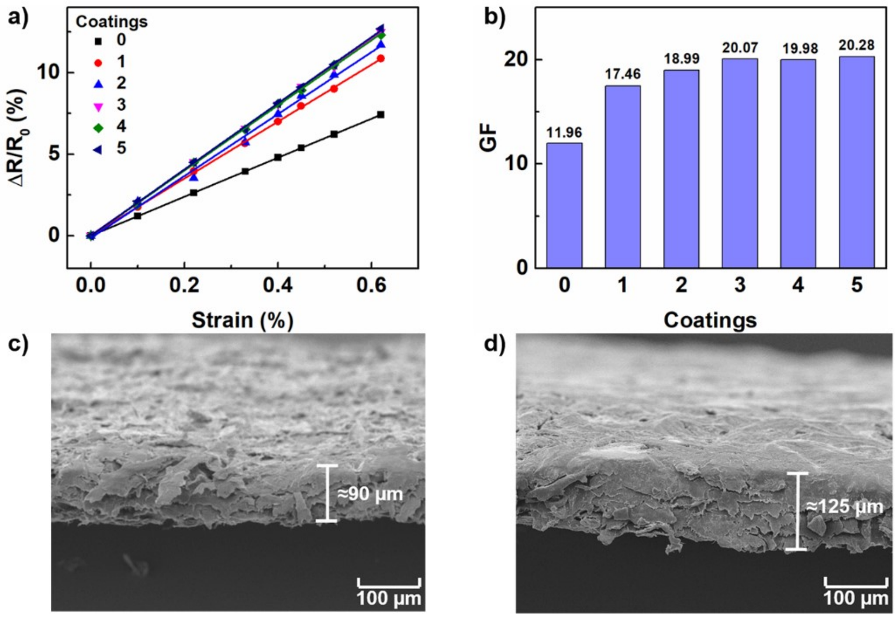

Figure S10. (a) Resistance change ratio ($\Delta R/R_0$) under various bending strains (ε) of the paper-based sensor with different coating times of AKD, and (b) the corresponding GF. Cross-section SEM images of the composite paper (c) before and (d) after coating AKD.

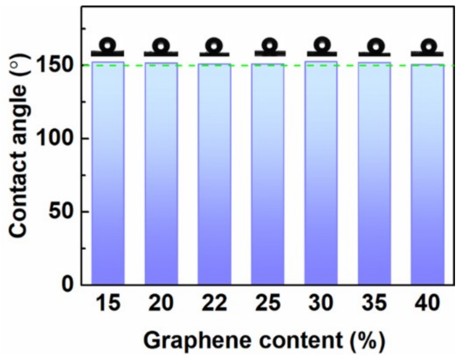

Figure S11. The water contact angle of the composite paper with different graphite nanoplates content after two times of AKD coating.

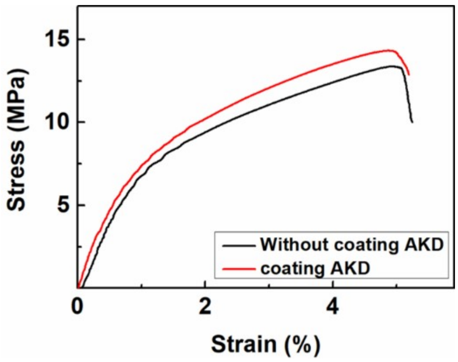

Figure S12. Stress-strain curves of the composite paper with and without coating AKD.

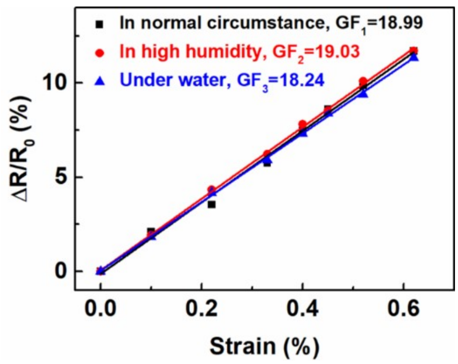

Figure S13. Resistance change ratio as function of the bending strain applied in normal circumstance (RH=27%), in high humidity (RH=80%) and under water.

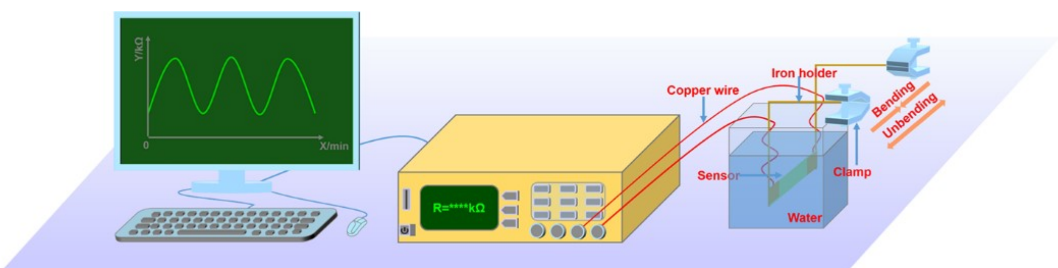

Figure S14. Illustration of the testing setup of the sensor for 1000 bending-unbending cycles under water.

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