

Electronic Supplementary Information

Enhanced oxidation resistance and electrical conductivity copper nanowires-graphene hybrid films for flexible strain sensors

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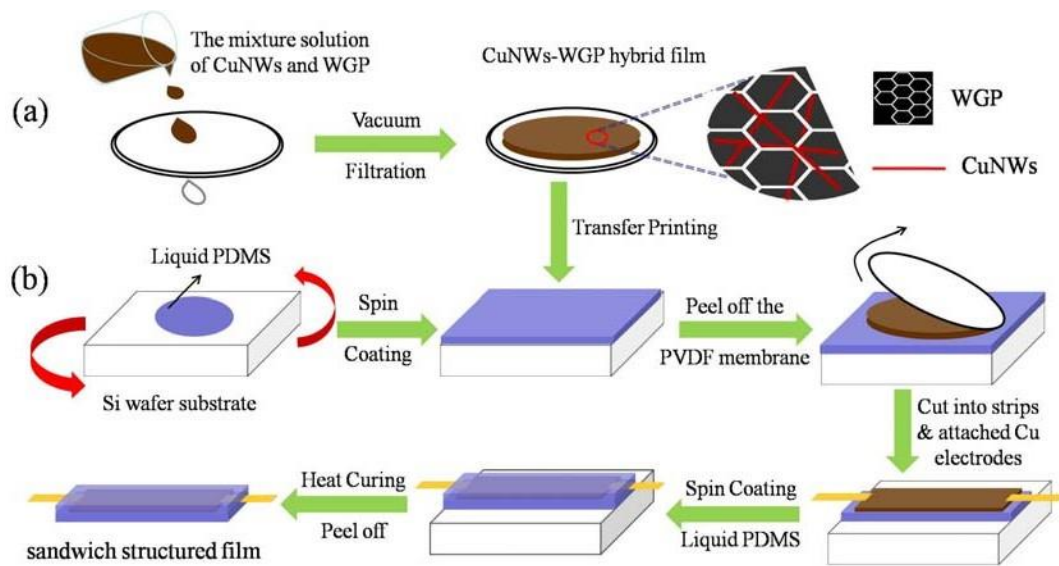


Fig. S1 Schematic of fabrication processes of (a) CuNWs-WGP hybrid film and (b) PDMS/CuNWs-WGP/PDMS sandwich structured film.

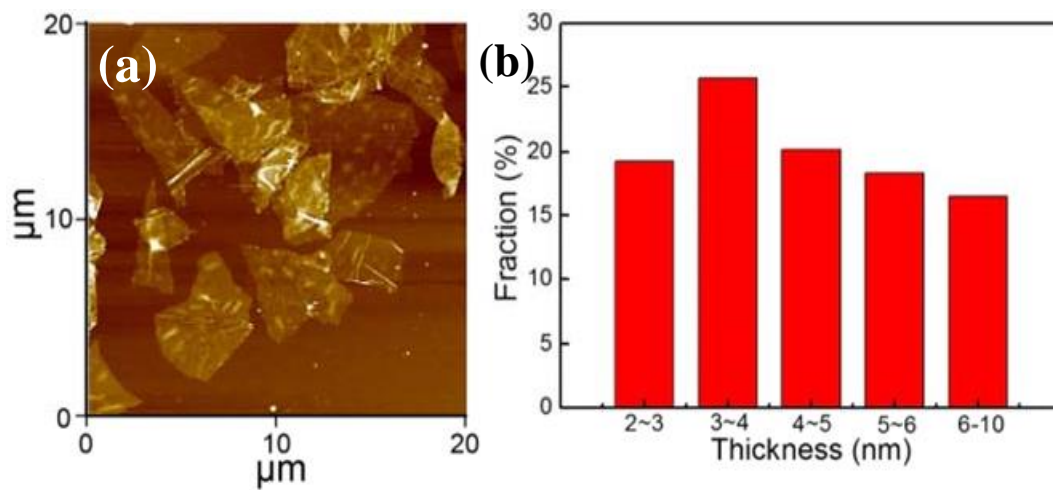


Fig. S2 (a) AFM image of WGP and (b) thickness distribution histogram of WGP.

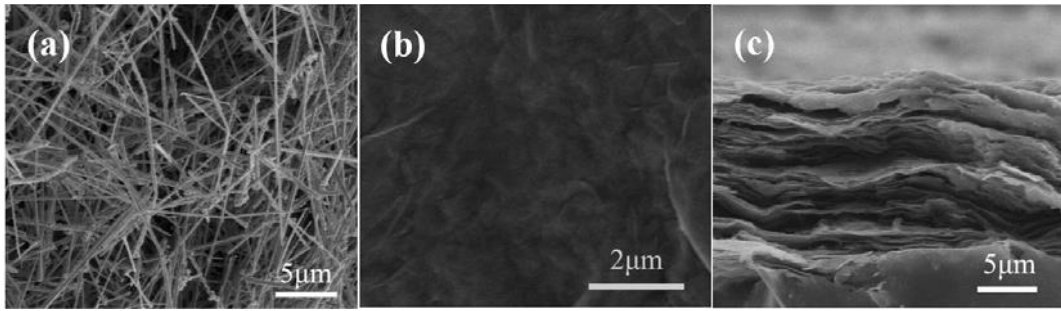


Fig. S3 (a) SEM image of CuNWs film; (b) Top-view and (c) cross-section SEM images of WGP film.

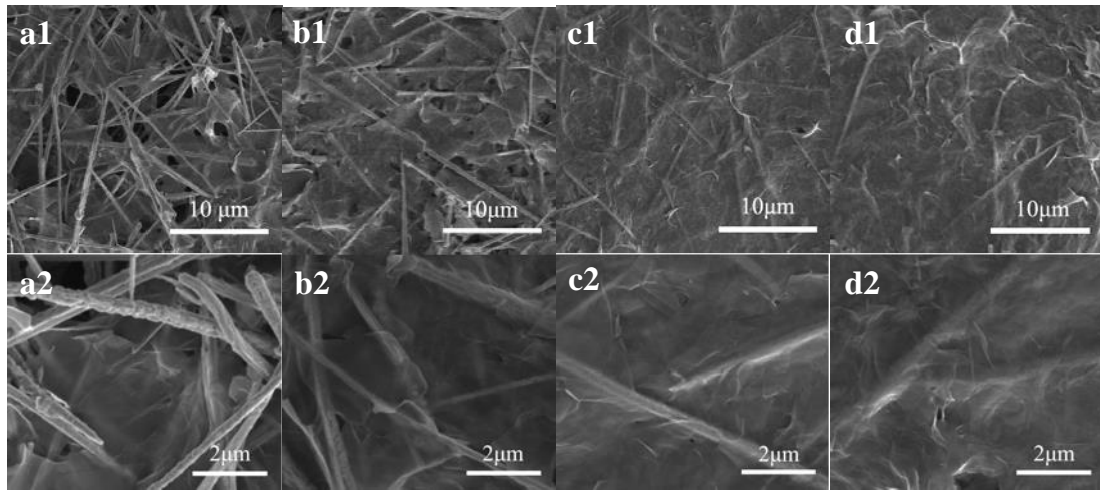


Fig. S4 SEM images of the WGP-CuNWs hybrid films with various contents of WGP under different magnifications: (a1 and a2) 20.0 wt%, (b1 and b2) 33.3 wt%, (c1 and c2) 40.0 wt% and (d1 and d2) 80.0 wt%.

Table S1 The square resistance and electrical conductivity of the hybrid films (33.3 wt% WGP) with different thickness

Sample	Thickness (μm)	Square Resistance ($\Omega \text{ sq}^{-1}$)	Electrical Conductivity (S m^{-1})
1	2.3	119.20	3.65×10^3
2	3.1	36.47	8.84×10^3
3	11.2	8.84	1.01×10^4
4	23.4	3.14	1.36×10^4
5	38.2	0.73	3.58×10^4

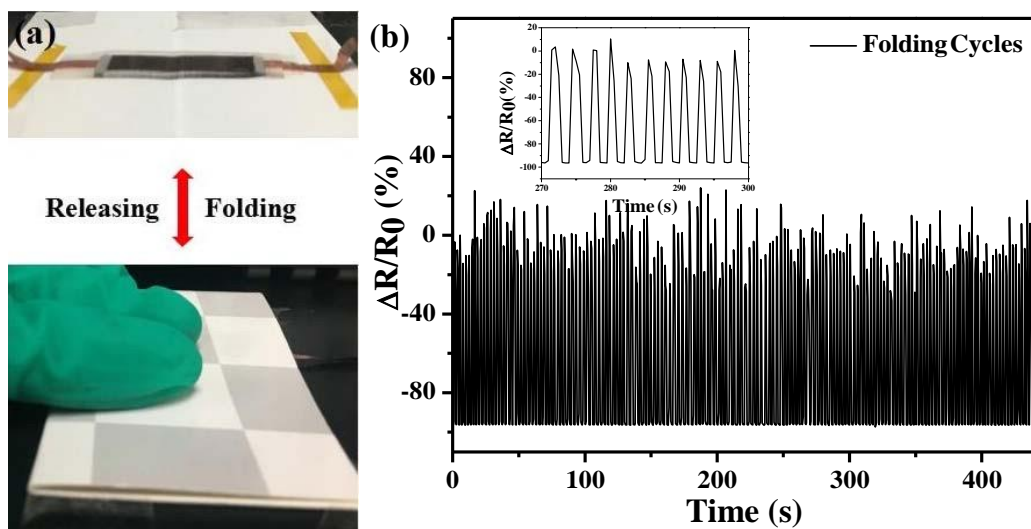


Fig. S5 (a) Photos of the folding/releasing cyclic test. (b) The resistance change of the sandwich structured film with cyclic folding from 0° to 180° .

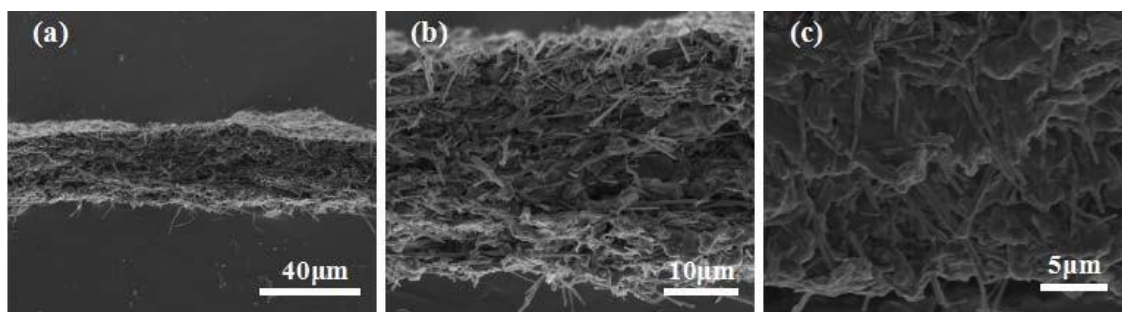


Fig. S6 Cross-section SEM images of PDMS/CuNWs-WGP/PDMS sandwich structured film with different magnifications.

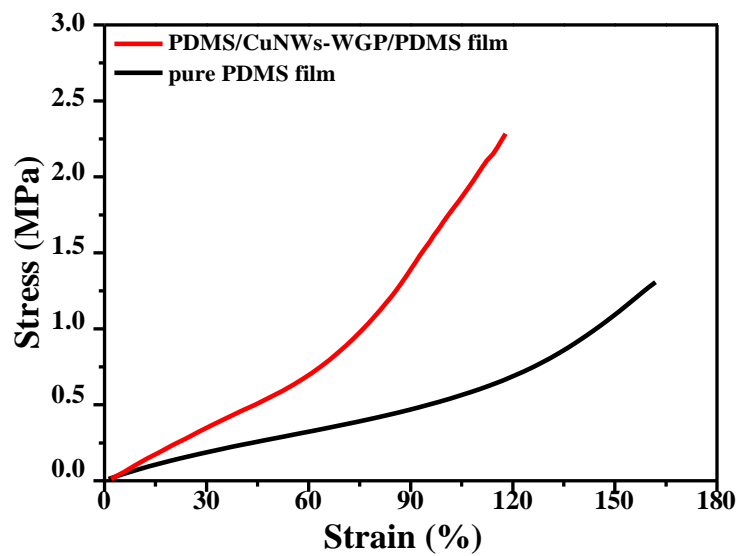


Fig. S7 The strain-stress curves of pure PDMS film and PDMS/CuNWs-WGP/PDMS sandwich structured film.

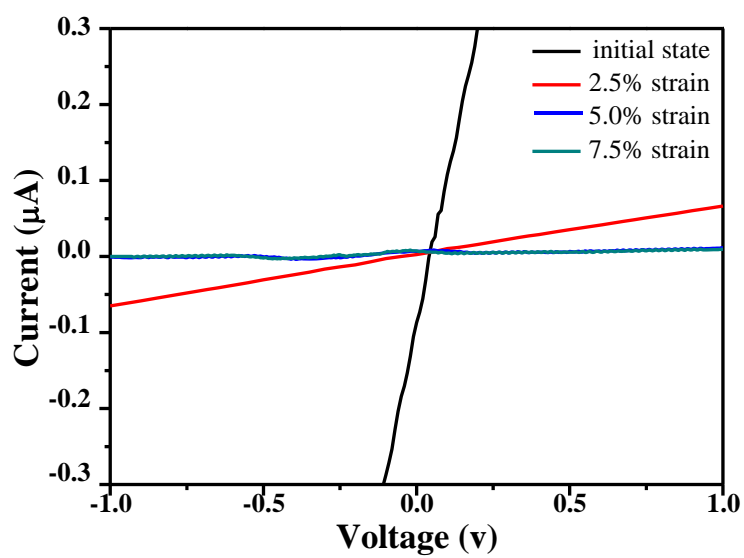


Fig. S8 Current-voltage curves of the sandwich structured film for different levels of strain.

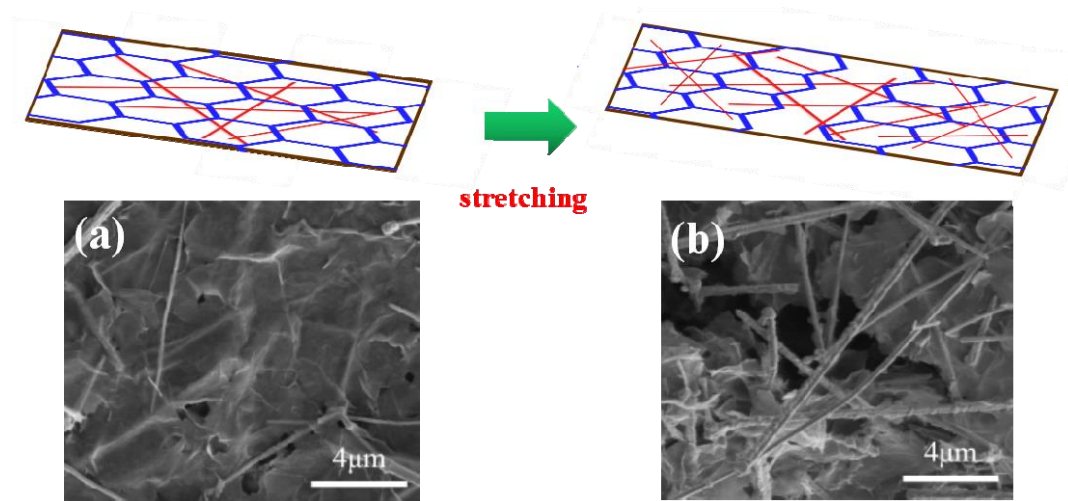


Fig. S9 The schematic diagram and SEM images of the sandwich structured film under (a) initial state and (b) stretching state, respectively.

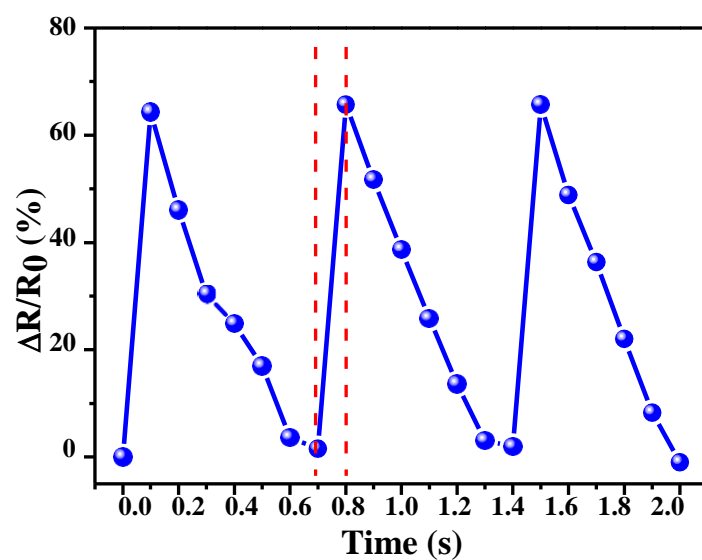


Fig. S10 Relatively resistance variation of the flexible strain sensor as a function of time. Dashed lines indicated the positions of peaks and valleys of the curves during stretching of the sensor.