Supporting Information

Scalable Fabrication of Flexible Piezoresistive Pressure Sensors Based on Occluded Microstructures for Subtle Pressure and Force Waveform Detection

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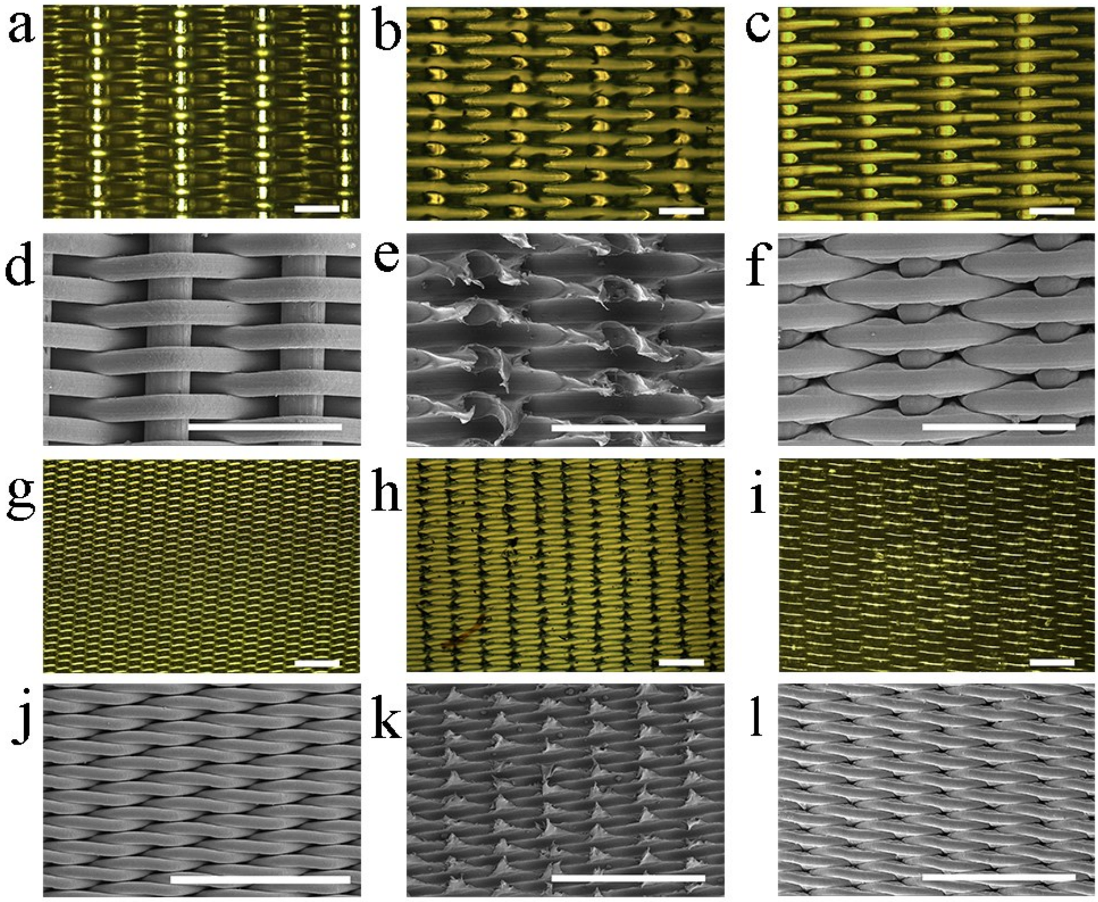

Fig. S1 (a-c) Optical microscope images of metal mesh, PVDF template and microstructured PDMS/CNS film (#400), respectively. Scale bars: 200 μm. (d-f) The surface SEM images of metal mesh, PVDF template and microstructured PDMS/CNS film (#400), respectively. Scale bar: 400 μm. (g-i) Optical microscope images of metal mesh, PVDF template and microstructured PDMS/CNS film (#2000), respectively. Scale bars: 200 μm. (j-l) The surface SEM images of metal mesh, PVDF template and microstructured PDMS/CNS film (#2000), respectively. Scale bar: 400 μm.

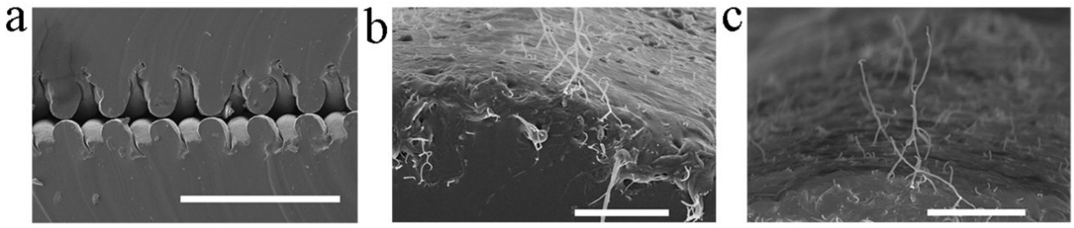

Fig. S2 SEM images of the structure for the sensor and the surface for the microstructured PDMS/CNS film. (a) The SEM image of the occluded architecture of the flexible pressure sensor. It shows the individual convex microstructure on the top film contacting with that on the bottom film by tip-to-tip arrangement. Scale bar: 400 μm. (b) The SEM image simultaneously contains surface and cross-section of microstructured PDMS/CNS film from an angle of cross-section. Scale bar: 5 μm. (c) The SEM image contains surface status of microstructured PDMS/CNS film from an angle of cross-section. Scale bar: 5 μm. Obviously, (b) and (c) show that CNS was partly embedded into the surface of the microstructured PDMS film, thereby ensuring mechanical and electrical stability of the flexible pressure sensor.

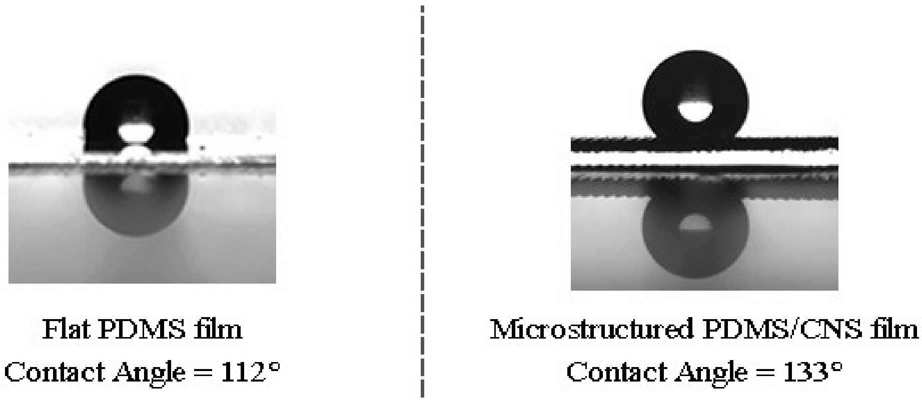

Fig. S3 Contact angles of flat PDMS film and microstructured PDMS/CNS film (#900), respectively. The larger contact angle of the mPDMS/CNS film indicates that it's more hydrophobic.

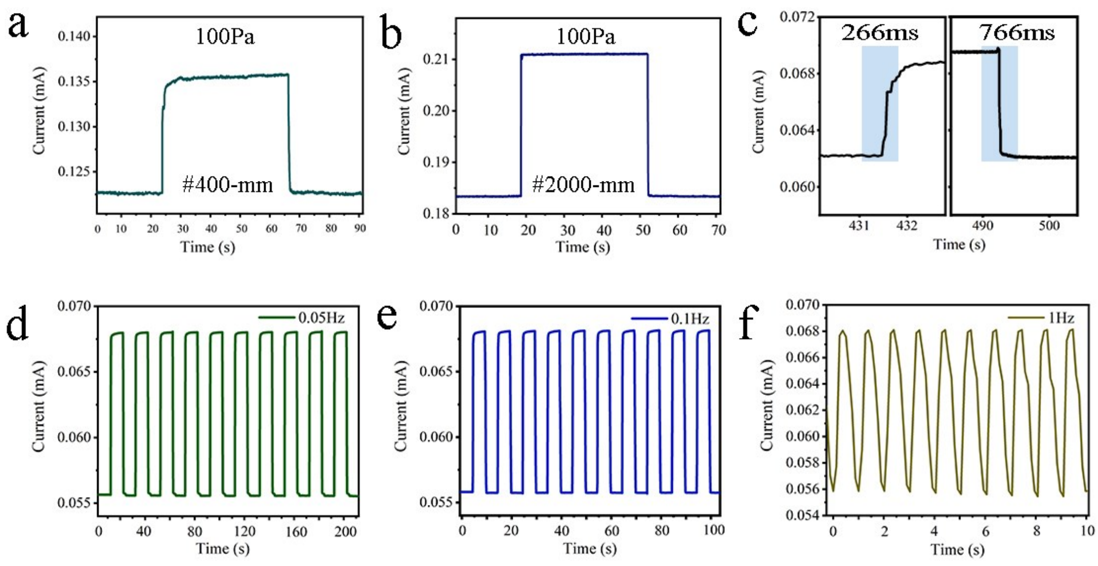

Fig. S4 (a-b) Responses of 100 Pa loading on #400 and #2000 occluded pressure sensors, respectively. (c) Responsive and recovery time of the occluded pressure sensor. (d-f) Different frequency responses of #900 occluded sensor under 0.05, 0.1 and 1 Hz, respectively.

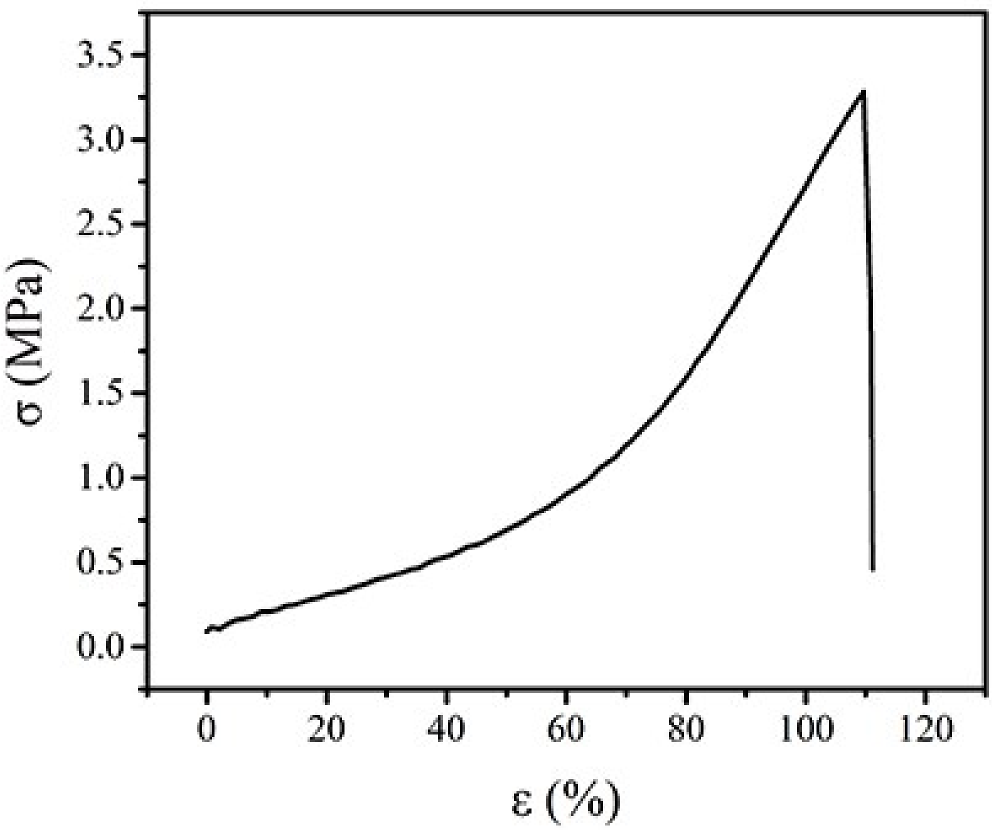

Fig. S5 Stress-strain curve of microstructured PDMS/CNS film. The Young's modulus of the mPDMS/CNS film is 5.67 MPa on average and the elongation at break is about 110%, proving excellent flexiblility of the sensor.

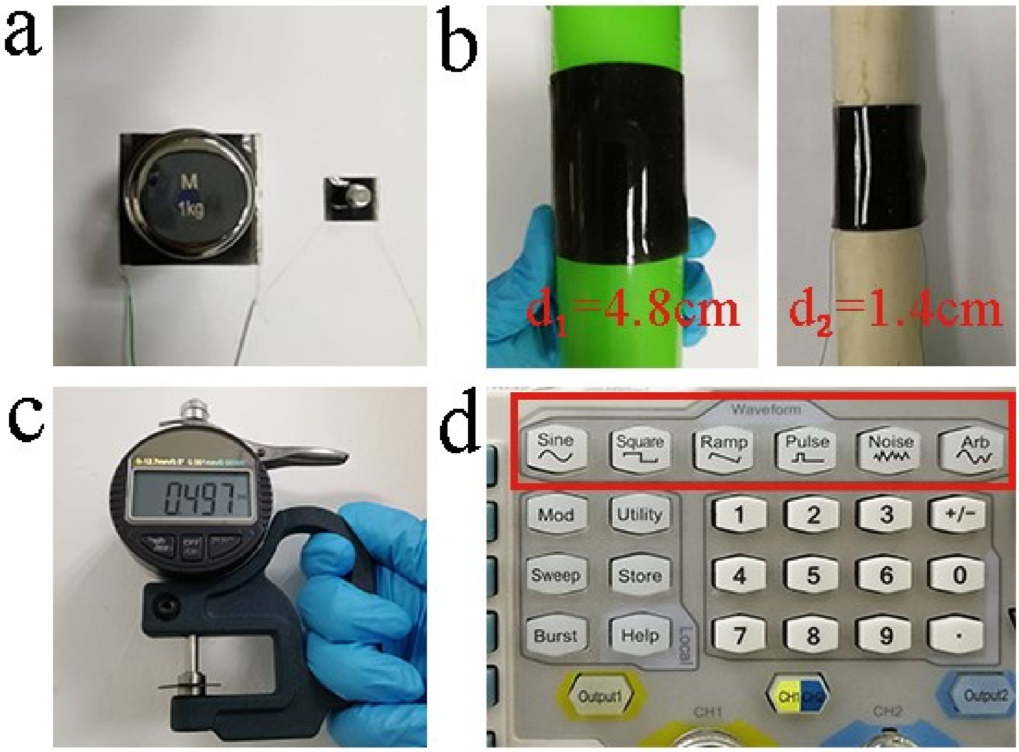

Fig. S6 (a) Actual photographs exhibit that a 1 kg counterweight applying on a 6 cm × 6 cm pressure sensor and a 10 g counterweight on a 2 cm × 2 cm sensor, showing the ability of both miniature and scalability. (b) The photographs for the 6 cm × 6 cm flexible pressure sensor wrapping a big plastic tube (d_1 =4.8 cm), and the 2 cm × 2 cm one wrapping a small rubber tube (d_2 =1.4 cm), which demonstrate the potential of the sensors to detect the leakage of gas and also confirm the competence of the sensor to adapt to various dimensions and shapes of different practical objects. (c) The demonstration for the thickness of microstructured PDMS/CNS film which could be easily tuned through doctor-blading. (d) Five waveforms (Square, Sine, Ramp, Pulse, and Arb) of input pressure signals on the panel of the home-made machine which was used in the testing experiment.