Supporting information for

Enhanced Piezocapacitive Response in Zinc Oxide Tetrapod-Poly(dimethylsiloxane) Composite Dielectric Layer for Flexible and Ultrasensitive Pressure Sensor

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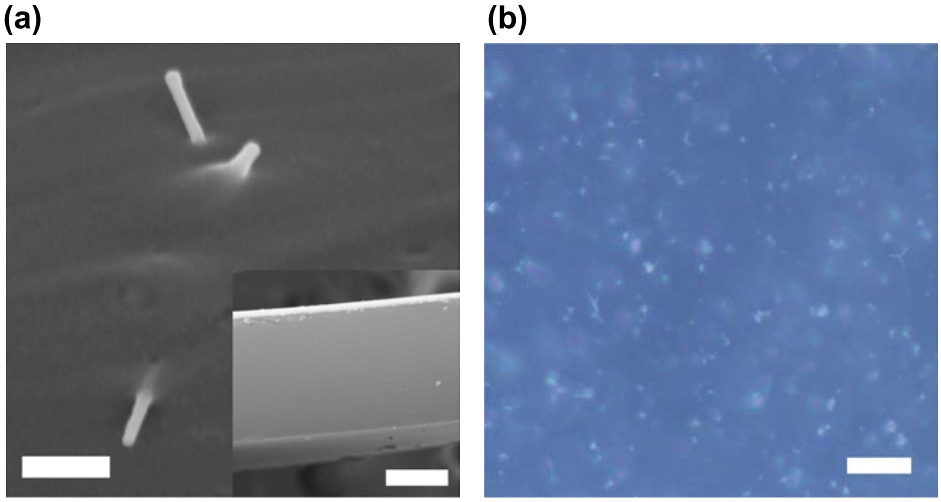

Figure S1. (a) Cross-sectional SEM images of a portion of the composite PDMS film with random distributed ZnO tetrapods (scale bar: 500 nm; inset: 100 μm). (b) Dark-field optical image of the composite film, showing randomly distributed tetrapod in the PDMS host (scale bar: 10 μm).

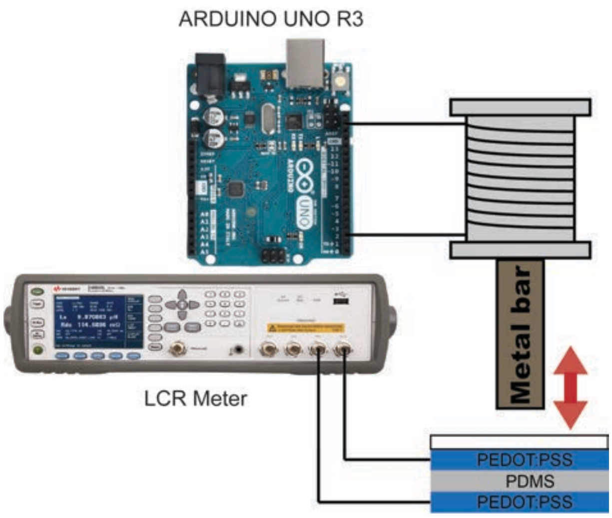

Figure S2. Schematic of a home-made characterization setup for automated mechanical application of repeated vertical force on the piezocapacitive pressure sensors. The placement and removal of pressure loads are applied by an electromagnet-controlled cylindrical metal bar (weight: 3 g). A programmed Arduino (UNO R3) platform drives the electromagnet at a frequency of 0.5 Hz. In 'Loading' state, the metal bar provides a pressure load of ~300 Pa on the sensor; in contrast, in 'Unloading' state, the metal bar is magnetically lifted by the electromagnet (moving upward for ~5 mm). The corresponding capacitances of the test sensor are recorded using the Agilent E4980A Precision LCR meter.

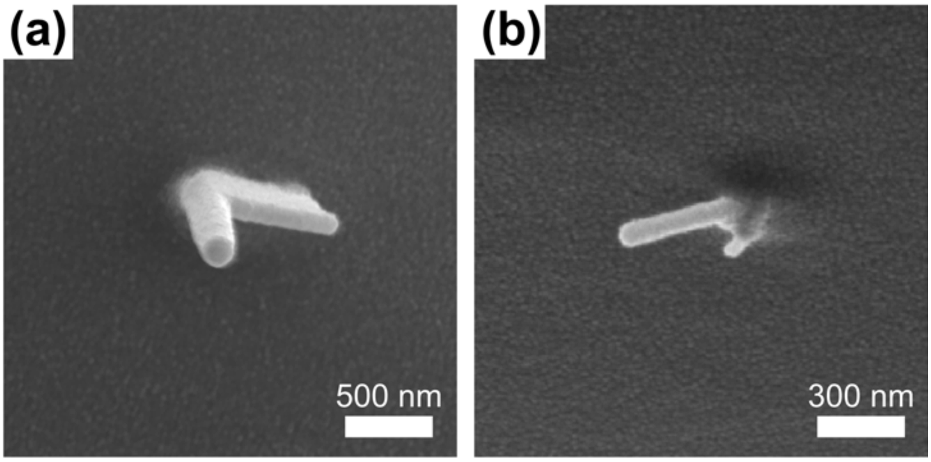

Figure S3. Cross-sectional SEM images of the ZnO tetrapod-PDMS composite (a) before and (b) after 1000 cyclic pressure loading. Both of them exhibit good interfacial compatibility between ZnO and PDMS.

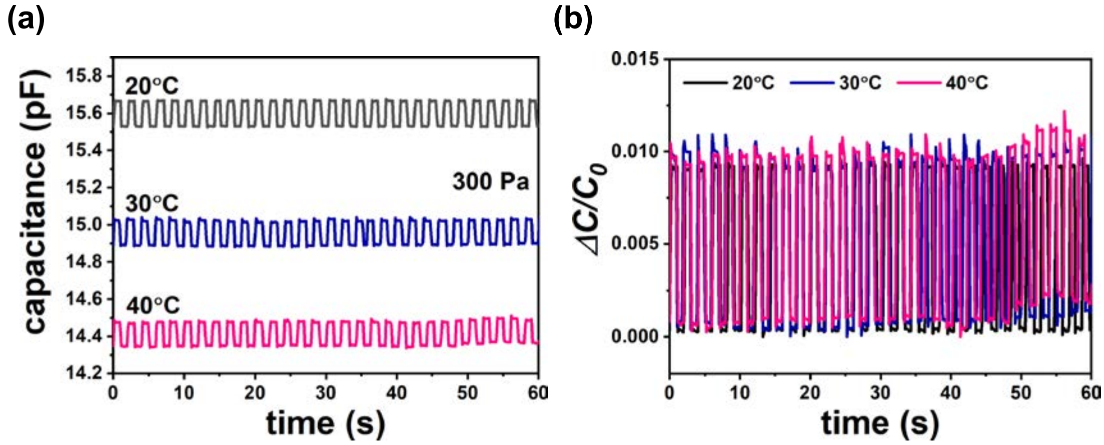

Figure S4. (a) Measured capacitance and (b) relative capacitance change for a ZnO tetrapod-PDMS capacitor operating at 20°C, 30°C, and 40°C, respectively (characterized by repeatedly loading-unloading a pressure of 300 Pa).

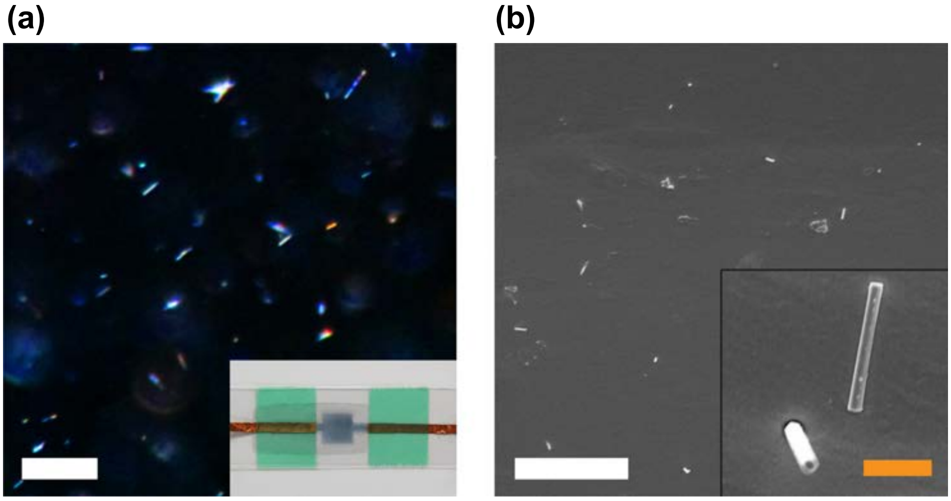

Figure S5. (a) Dark field optical image and photo image of a ZnO nanowire (1.0 wt% loading)-PDMS capacitor containing randomly distributed nanowires (scale bar: 10 μm). Note that much obvious nanowires can be observed from optical microscope directly. (b) Cross-sectional SEM images of a portion of the ZnO nanowire-PDMS composite film with random distributed ZnO nanowires (scale bar: 5 μm; inset: 1 μm).

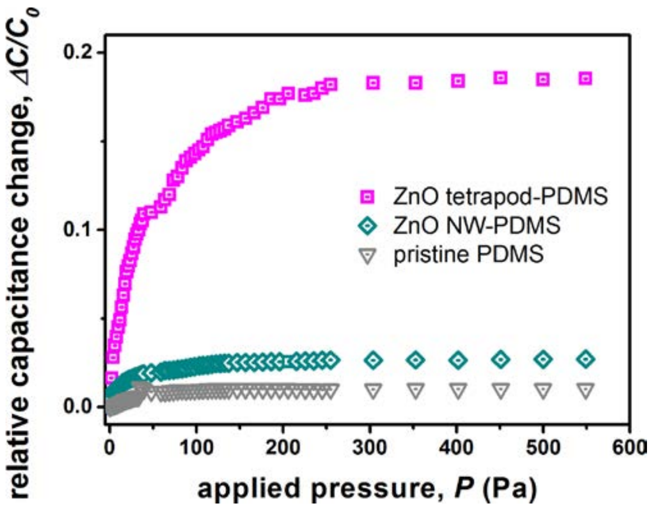

Figure S6. Plots of relative change in capacitance ($\Delta C/C_0$) versus applied pressure (P) using different piezocapacitive devices: ZnO tetrapod-PDMS, ZnO nanowire-PDMS, and pristine PDMS (sensing area: 10 mm × 10 mm).

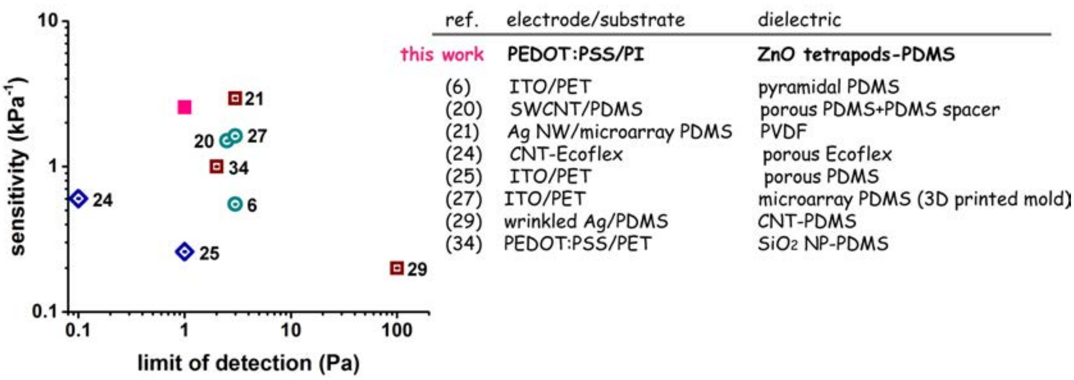

Figure S7. Comparison of the ZnO tetrapod-PDMS capacitive pressure sensor with other representative capacitive sensors in terms of both sensitivity and limit of detection.[6,20,21,24,25,27,29,34]

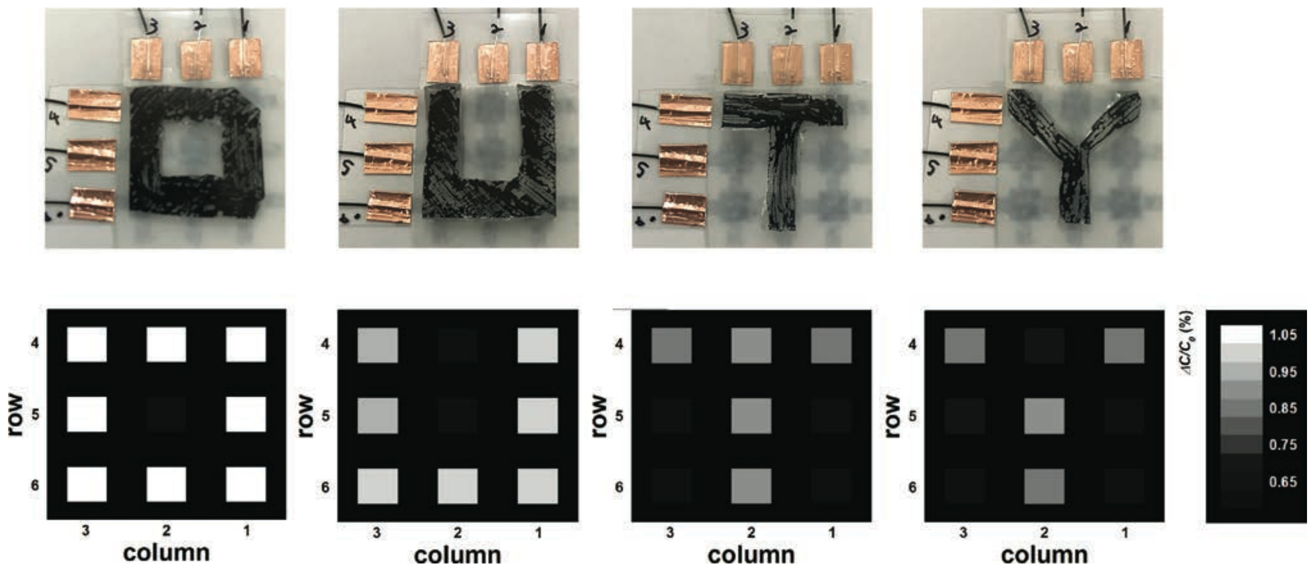

Figure S8. Spatial pressure distribution test of a 3 × 3 array of the proposed composite capacitive pressure sensor with 1.0 wt% loading of ZnO tetrpaods. Four different rubber objects with D (1.25 g), U (1.10 g), T (0.83 g), and Y (0.50 g) shapes, were placed on the sensor array, respectively. The gray level in the bar scale represents the magnitude of the relative capacitance change of each pixel (each sensing area: 5 mm × 5 mm; pixel interval: 5 mm).