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Abstract

The development of highly sensitive and stretchable pressure sensors is an emerging technological goal to realize the accurate real-time measurement of signals in a living body for health monitoring and medical applications. Designing various microstructures of PDMS film, such as micro pillar, micro pyramid, micro sphere and microdome, is the most common way to realize high sensitivity and fast response time of the sensors.
COMSOL Multiphysics® 5.3a was used to analyze how the shape and density of the microstructures influence the performance of the sensor, which provides theoretical guidance for fabricating pressure sensors with high sensitivity and broad measurable pressure range. The simulation of the sensors with different microstructures was conducted using a stationary current solver in the AC/DC Module of COMSOL Multiphysics® 5.3.
Two in-plane electrodes were settled, where one was connected to the ground and another was the terminal with 1V potential. The sensitive layer was contacted with the in-plane electrodes, with microstructures facing down. A displacement was applied on the top surface of the sensitive layer, resulting in the change of contact area with the electrodes and thus causing the resistance change of the pressure sensor with applied pressure. Microstructures including ellipsoids, hemispheres, pyramids and cylinders with the same scale were designed and the corresponding sensing process were simulated. The contributions of the microstructures density were also simulated and the relationship between density and sensitivity was acquired.

Figures used in the abstract

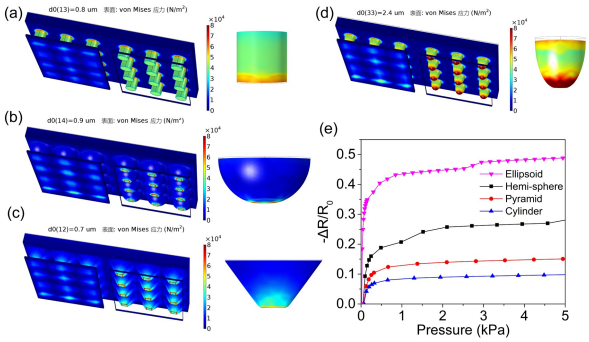

Figure 1: Surface Von Mises stress of pressure sensors with (a) micro cylinders, (b) micro hemispheres,(c) micro pyramids and (d) micro ellipsoids, respectively. (e) COMSOL simulation of -△R/R0 versus pressure plot.