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Arrayed porous polydimethylsiloxane/barium titanate microstructures for high-sensitivity flexible capacitive pressure sensors

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Abstract

Flexible and wearable devices have been gaining attention in recent years. Compared with other types of pressure sensors, capacitive pressure sensors provide more advantages including simple structure, high stability and reliability, and lower power consumption. This study proposed the flexible capacitive pressure sensors with a double dielectric layer of a porous micro-pillar composite structure of polydimethylsiloxane (PDMS) as the dielectric layer. To further enhance the sensitivity, barium titanate (BT) particles were mixed in the PDMS due to their high relative permittivity. Moreover, finite element analysis (FEA) was utilized to simulate the displacement of the dielectric layer under applying external pressure. The FEA simulation results showed that the proposed structure of the dielectric layer could effectively enhance the sensitivity of the flexible capacitive pressure sensor. Furthermore, the flexible capacitive pressure sensor demonstrates a superb performance with a high sensitivity of 7.847 kPa^{-1}, a low detection limit of 0.21 Pa, and a fast response and release time of 20 ms and 25 ms. The developed sensors have an excellent sensing capability and can be applied widely for monitoring of heartbeat, sensing of the robot arm, measuring of floor height, detecting of weights of objects, and real-time monitoring of healthcare.

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Keywords

Flexible capacitive pressure sensor; Dielectric layer; Porous micro pillar composite structure; Polydimethylsiloxane; Barium titanate particle

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