

Highly stretchable and transparent dielectric gels for high-performance soft sensors and actuators

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Abstract

As soft and flexible electrical insulators, polymer dielectrics have enabled diverse modern technologies including soft actuators and sensors. However, the high voltage needed for actuators, the high sensitivity needed for sensors and the poor mechanical reliability hinders the developments in practical applications. Improving dielectric constant and lowering elastic modulus of polymer dielectrics are two efficient ways to solve those problems. Unfortunately, traditional methods to increase the dielectric constants of the elastomers, such as filling conductive particles or high-k ceramics, usually sacrifice the transparency and reduce the flexibility. Herein, we have designed a new type of polymer dielectrics: dielectric gels. By using solvents with high dielectric constants, the gels achieve a unique combination of ultra-high dielectric constant, low elastic modulus and excellent transparency, which are extremely challenging or impossible to realize by traditional polymer dielectrics. The gels exhibit high stretchability and low mechanical hysteresis. As a new kind of polymer dielectrics, we believe the dielectric gels offer new opportunities for soft robotics, sensors, electronics, optics and biomimetics.