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Highly flexible graphene-polydimethylsiloxane pressure-strain sensors with proximity-sensing capability

Flexible strain sensors are necessary for providing electronic skins with the ability to detect motions and pressure to enabling their use in health applications and robotics. In this context, strain sensors should simultaneously guarantee a high sensitivity and flexibility, with a fast response when applied to the detection of various human motions. Here, we demonstrate a flexible strain sensor composed of graphene flakes encapsulated by elastomer films with a high sensitivity and stretchability. The liquid-exfoliated graphene flakes were coated by spray on the first elastomer film and then encapsulated by the second elastomer film. The encapsulated graphene sensor exhibited a high gauge factor, fast responsivity, and high durability. It is stretchable up to 290% and highly bendable. As an additional key feature, proximity sensing to detect remote motions of a distant object was demonstrated, owing to the unique characteristic of graphene, i.e., variations in the electrostatic doping of graphene in response to the interaction between the surface charges of the elastomer and the electrostatic charges of the remote object. Our work introduces a novel route for the fabrication of flexible graphene sensors with the proximity-sensing capability, which are useful for wearable smart devices and human motion detection.