Interlocked geometry of microstructured composite elastomers for piezoresistive multimodal electronic skins

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The development of flexible and stretchable electronic skins is critical to applications including robot sensors, wearable electronics, and health monitoring systems. We herein show a novel design of electronic skin by introducing an interlocking geometry of carbon nanotube/elastomer composite films containing regular microdome-shaped arrays. The unique interlocking design of conductive composite elastomers induces a drastic change in contact area in response to multidirectional external stimuli, which leads to a giant tunneling piezo-resistance. Our electronic skins exhibit highly sensitive and multimodal detection capabilities and rapid response/relaxation time. In addition, we show that piezoresistive effect can be greatly controlled by changing features of surface microstructures such as diameter, pitch of periodic structures, and shape of microstructure. Finally, we demonstrate that wearable electronic skin arrays can detect minute environmental changes (air flow, vibration etc.) in real-time and perceive the multidirectional forces, which suggest the utility of our electronic skin in diverse areas of application such as human-health monitoring systems.