

A highly shape-adaptive coaxial fiber based electronic skin for self-powered tactile sensing

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Abstract

As the most promising candidate to emulate natural skin for reconstructing the tactile sensation of damaged skin or endowing the perception of prosthesis and robotics, electronic skin can mimic the functions of biological skin through converting external stimuli into electronic signals. Accompanied by the fast and massive development of wearable devices, electronic skin with a highly shape adaptive structure are required. In addition to the conformal materials such as fibrous membranes and fabrics, self-powered system is also an important emerging trend to achieve the flexible and deformable electronic skin due to it without bulky batteries. Here we design a coaxial fiber based piezoelectric electronic skin for imitating the human somatosensory system without external hard power supply. We prove that the coaxial structure can enhance the piezoelectric properties of the fibers by synergistic effect. The sensitivity of as-fabricated electronic skin is $11.04 \text{ mV} \cdot \text{kPa}^{-1}$, which can respond quickly to the stimulus of external force, and it also possess a superior durability. Furthermore, it has been demonstrated that such flexible electronic skin can detect and quantify various joint-related human motions. Additionally, when enlarging it into the desired pressure sensing matrix, it hold the capability for discriminating the different shape of the objects, which can applied in real-time tactile mapping. We envision that this fiber based electronic skin has substantial demand and application in the development of artificial systems, such as healthcare monitoring technologies advanced smart robotics, human-machine interfaces and next-generation prosthetics. And this emerging intelligent wearable electronics is expected to accelerated the intelligentize process of our life.

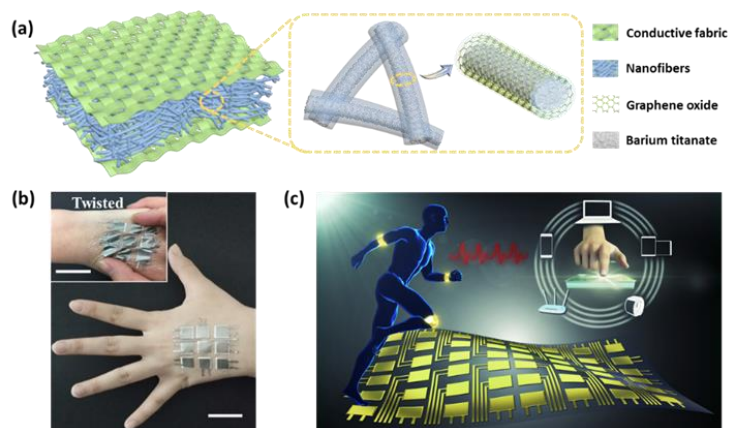


Figure1: (a) Schematic illustration of a single unit of electronic skin. (b) Optical photograph of an electronic skin. Scale bar = 3 mm. (c) Illustration of the concept of an electronic skin.