

A Synapse-inspired Structural System for Highly Stretchable Electronic Skin

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Abstract

The pressure sensation is the core of haptics, which can be achieved by pressure sensor in an electronic skin. Although varieties of multifunctional sensors can be fabricated by adopting diverse microstructures and functional materials, achieving an electronic skin with superior sensing capabilities under large-scale deformations is rarely reported previously. Herein, inspired by the microstructure of synapse in the nervous system, a highly stretchable electronic skin comprising of synapse-inspired structural system is designed and fabricated. The electronic skin possesses stable response and long-term durability in sensing pressure due to the improved strain isolation and restrained interfacial failure, no matter what deformations the electronic skin may undergo, such as stretching, bending, or even twisting. Experimental studies and finite element analyses show that the mechanical properties allow this electronic skin to apply in large motions including bending states of fingers and wrists. This advanced development of electronic skin demonstrates potential applications in intelligent robots, bionic prostheses, health monitoring, human-machine interface and other fields.

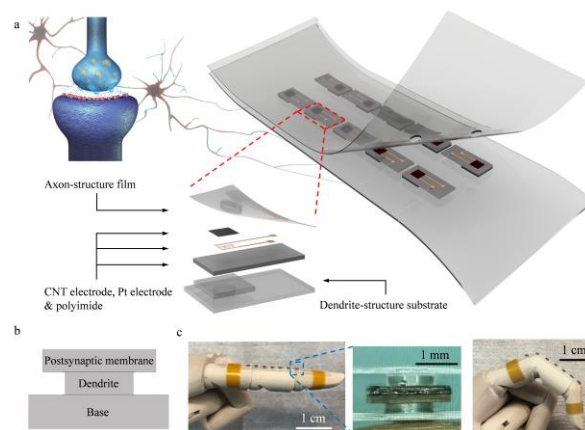


Figure 1: a) A representative layout for the highly stretchable electronic skin with a synapse-inspired structural system. The synapse-inspired structural system consists of axon-structure film covered with embossments, piezoresistive sensor chips (PSCs), and dendrite-structure substrate. The axon-structure film is the encapsulation layer, and the dendrite-structure substrate is the supporting layer. The pressure applied to axon-structure film can be transmitted into the PSCs, consequently, converted into measurable impedance. b) A cross sectional view for a representative unit of the dendrite-structure substrate which consists of postsynaptic membrane part, dendrite part, and base part. c) A highly stretchable electronic skin is attached to an artificial hand whether the finger is straight or flexural.