Highly Sensitive, Wearable, and Multimodal All-Carbon Electronic Skin Capable of Simultaneously Detecting Tactile and Biological Stimuli

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The development of an electronic skin (e-skin) with multimodal responses as well as high sensitivity is desired to more plausibly emulate human skin. In particular, the effective combination of biological detection with tactile sensing in a single pixel remains a challenging task for implementing an e-skin beyond the capabilities of human skin, and remains explored.

Herein, we describe a highly sensitive, wearable, and multi-stimuli responsive sensor platform based on hierarchically engineered elastic carbon nanotube microyarns, which is capable of simultaneously detecting heterogeneous external subtle stimuli. Multimodal output electric signals can be effectively manipulated as a change of resistance or capacitance under mechanical deformations (including pressure and flexion), touch, temperature or humidity gradient, and even chemical variables with different dipole moments or pH. Fig.1 shows that all-carbon skin sensors can simultaneously detect pressure, flexion, touch, and even chemical variables with different dipole moments (water and dodecane). We believe that piezocapacitive e- skin suggested by us will be an effective way to implement human-interactive smart robots capable of recognizing the robot-human-environment interface and to enable in-situ human monitoring capable of detecting biological markers as well as tactile stimuli.

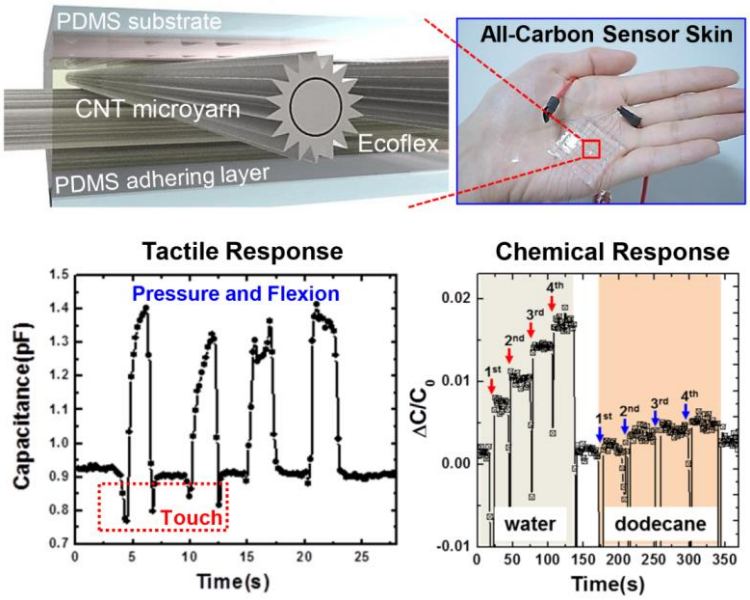

Fig. 1. Heterogeneous multimodal responses of wearable all-carbon electronic skin

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