ULTRATHIN ORGANIC TRANSISTORS TOWARD NEXT-GENERATION SKIN ELECTRONICS

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An ultimate goal of biological measurement is to monitor the states of a living body in a non-invasive, continuous, and accurate manner without disturbing the natural functions or activities of the living body. Because electronic devices in direct contact with biological tissues are inevitably exposed to physical disturbances caused by physical contact, considerable efforts have been made to minimize their effects [1]. In temperature measurement, for example, it is preferable to reduce the heat capacity or thermal conductance of a sensor to suppress the effect of heat transfer from the object [2]. Furthermore, mechanical compliance with electronics is important for biological objects, because the skin is soft and has a three-dimensional structure. Flexible and/or stretchable sensors have been proposed to reduce the effects of modulus differences between the skin and the electronics [3,4].

In this talk, we will introduce the recent progress of organic transistors, which can be directly attached to the skin, as next-generation wearable electronics. First, we will show ultrathin organic transistors manufactured on a few micrometer-thick polymeric substrates (Fig. 1a) [5]. They can be conformably attached to the skin due to their superior mechanical flexibility. Their ultralightweightness significantly reduces the burden of electronics during wearing. Next, we will propose nanomesh electronics having high gas-permeability (Fig. 1b) [6]. They can be continuously attached to the skin while significantly reducing the risk caused by sweat accumulation. Indeed, we confirmed no skin inflammation by skin patch tests for the duration of one week. Finally, we will present gas-permeable organic electrochemical transistors embedded with porous solid-state polymer electrolytes (SPE) [7]. Poly(3,4-ethylenedioxythiophene)/poly(styrenesulfonic acid) (PEDOT:PSS) was formed on electrospun nanofibers by a spray coating method. The freeze-drying process was utilized to achieve the porous structure to the SPEs (Fig. 1c). We successfully demonstrated ECG signals acquisition using the gas-permeable OECTs.

(a) (b) (c)

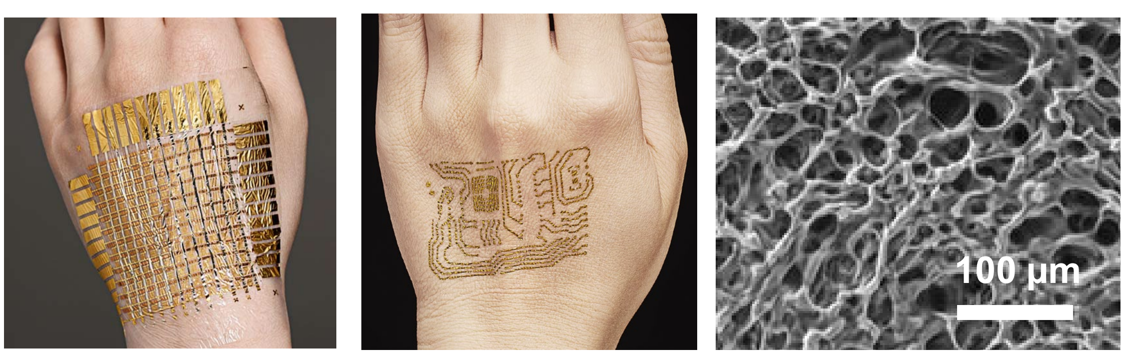

Figure 1 (a) Ultrathin organic transistor array and (b) nanomesh electrodes on hand. (c) Scanning microscopic image of porous SPE.

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