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Development of Bionic Nanomembranes Towards Wearable Electronics

ウェアラブルデバイスを指向したバイオニックナノ薄膜の開発

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Wearable electronics are expected to lighten the burden of medical inspection and treatment imposed on patients by measuring biological information continuously and automatically. Such devices should be small, light, thin and flexible with sufficient adhesiveness to the biological tissue (e.g., skin) during the operation. In this regard, we focused on free-standing polymeric nanofilms with a huge size aspect ratio ($\geq 10^6$ depending on the size of the substrate). In this study, we report flexible, adhesive and conductive nanofilms consisting of poly(3,4-ethylenedioxythiophene)/ poly(styrenesulfonate) (PEDOT:PSS). A fabrication process based on a water-soluble supporting layer is proposed that provides for the easy production of conductive nanofilms having a very large surface area with typical thickness of tens-to-hundreds of nanometers, similar to the thickness of biological membranes. Such bionic nanofilms can be manipulated by tweezers, and folded/unfolded in water many times without suffering from cracks, disaggregation or from loss of conductive properties (Figure 1). After collecting the nanofilms on rigid or soft substrates, they retain their functionality. Structural and functional properties of the conductive nanofilms are described by means of their thickness, topography, conductivity and Young's modulus. Strong dependences of these properties on residual water, post-deposition treatments and environmental moisture are clearly evidenced. Possible applications are foreseen in the field of sensing and actuation, as well as in the biomedical field, such as smart substrates for tissue engineering and wearable electronics[1), 2)].

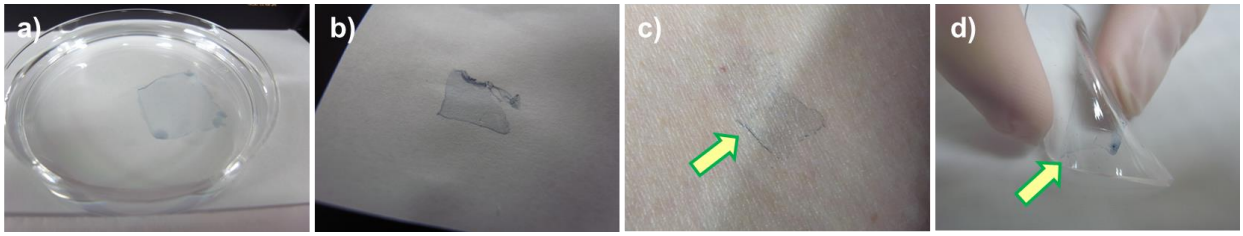

Figure 1. Conductive nanofilms (*ca.* 2 cm × 2 cm) transferred to various substrates: a) Free-standing PEDOT:PSS nanofilms floating in water, and collected on b) paper, c) human skin and d) flexible rubber.

References

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[2] Greco, F., Fujie, T., Ricotti, L., Taccola, S., Mazzolai, B., Mattoli, V. *ACS Appl. Mater. Interfaces*, **5**, 573-584 (2013).