Conformal Triboelectric Nanogenerator with Graphene Electrode and Their Applications in Wearable electronics

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Abstract

Recently, the human-machine interfaces as well as the healthcare system have experienced great advancement by the introduction of implanted and skin-mounted electronics.[1] Nevertheless, the power supplying system has not caught up with the technological advances of such electronics. Among the various form of innovative power supplier such as thin-film batteries, wearable solar cells, micro-supercapacitors and wearable thermoelectric, triboelectric nanogenerators (TENGs), which convert the mechanical contact of two different materials into useful electrical power are suitable for the skin-mounted electronics because the mechanical contact is the clean, sustainable and sufficient energy source in daily life or even in a human body.[2] However, the thick thickness of the devices disables the direct integration of the TENGs into a human body, resulting in significant drawbacks in user mobility and sustainability in power supply.

Herein, we introduce the conformal triboelectric nanogenerators (CTENGs) that incorporates into a human body, generating electrical power via contact to the various foreign objects such as clothes and fingers. The thin thickness of the CTENGs less than 2.4 μm and low Young's modulus of the electrification material enables conformal contact to the uneven surface of the human skin. The modest triboelectric effect of the electrification material was enhanced via simple plasma treatment up to 3800% in terms of effective output power. Consequently, we present two practical applications of the CTENGs; 1) conformal power generator module that generates electrical power from the contact between fabrics and skin and 2) conformal self-powered interface system that transforms analogous information of human motion into the digital signal. We believe our approaches provides novel routes for the sustainable healthcare system as well as the self-powered interface system.

References

[1] D. –H. Kim, J. Viventi, et al., Nat. Mater. **9** (2010) 511.
[2] X. Pu, L. Li, H. Song, C. Du, Z. Zhao, C. Jiang, G. Cao, W. Hu, Z. L. Wang, Adv. Mater., **27** (2015) 2472.

Figures

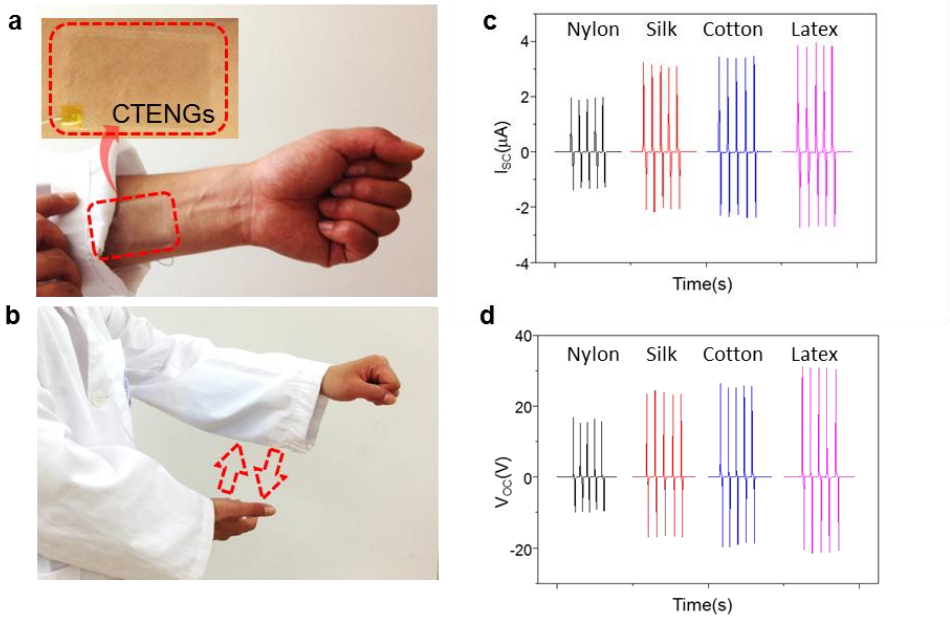

Figure 1 a. Optical image of the CTENGs on a forearm. b. The motion through which CTENGs brought into contact with the clothes to generate electicity. c and d. the generated shortcircuit current and open circuit voltage with contact to various fabrics, respectively