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Surface Modified Thermoplastic Polyurethane and Poly(Vinylidene Fluoride) Nanofiber Based Flexible Triboelectric Nanogenerator and Wearable Bio-Sensor

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Abstract : Over the last few years, nanofiber-based triboelectric nanogenerator (TENG) has caught great attention among researchers all over the world due to its inherent capability of converting mechanical energy to usable electrical energy. In this study, poly(vinylidene fluoride) (PVDF) and thermoplastic polyurethane (TPU) nanofiber prepared by Forcespinning® (FS) technique were used to fabricate TENG for self-charging energy storage device and biomechanical body motion sensor. The surface of the TPU nanofiber was modified by uniform deposition of thin gold film to enhance the frictional properties; yielded 254 V open-circuit voltage (Voc) and 86 µA short circuit current (Isc), which were 2.12 and 1.87 times greater in contrast to bare PVDF-TPU TENG. Moreover, the as-fabricated PVDF-TPU/Au TENG was tested against variable capacitors and resistive load, and the results showed that with a 3.2 x 2.5 cm2 active contact area, it can quick charge up to 7.64 V within 30 seconds using a 1.0 µF capacitor and generate significant 2.54 mW power, enough to light 75 commercial LEDs (1.5 V each) by the hand tapping motion at 4 Hz (240 beats per minutes (bpm)) load frequency. Furthermore, the TENG was attached to different body parts to capture distinctive electrical signals for various body movements, elucidated the prospective usability of our prepared nanofiber-based TENG in wearable body motion sensor application.

Keywords : biomotion sensor, forcespinning, nanofibers, triboelectric nanogenerator
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