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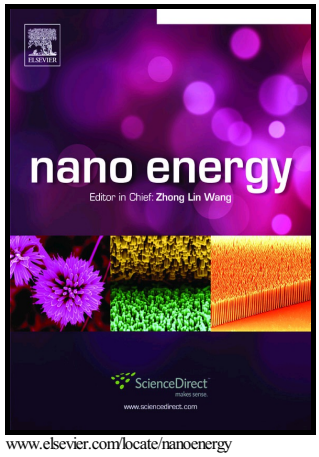

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Self-powered triboelectric touch sensor made of 3D printed materials

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Abstract

A novel approach of fabricating vertical-contact separation mode triboelectric nanogenerator employing three-dimensional (3D) printed functional layers and mechanical spring is presented with the ultimate goal of direct integration of triboelectric sensors with smart 3D objects. Commercially available elastomer TangoBlack is investigated for the first time as soft active triboelectric layer, and rigid polymers, acrylonitrile butadiene styrene (ABS) and polyamide (PA), are considered as active triboelectric layers and spring mechanism in a triboelectric touch sensor. Amongst rigid layers, the spring mechanism is prepared using 3D printed PA material since it exhibits structural rigidity along with flexibility. TangoBlack is measured to be slightly above other commercial rigid positive layers in the triboelectric series. We implement a polydimethylsiloxane (PDMS) layer printed by direct ink writing which demonstrates, when pairing with TangoBlack, ~300% higher average power output than nearest other pairs considered. The touch sensor behavior is evaluated for varying operational active areas, frequencies and applied forces using an automated setup, and for hand and finger tapping. For the load resistance of 273.7 MΩ, hand tapping at 2.0±0.1 Hz provides peak power (P_P) of 1.2 mW (peak power density of 186.4 μW/cm^2), whereas figure tapping at