

Electronic Supplemental Information for

Ultraviolet and electric field activated photopolymer-ferroelectric nanoparticle composite for performance enhancement of triboelectric nanogenerators

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S1. Experimental Section

Fabrication of triboelectric nanogenerator

The TENGs were fabricated as follows, First, an ITO (100 nm)-coated PET (60Ω/sq, Sigma Aldrich) was cleaned by acetone, IPA, DI water, and blow-dried with N₂. Next, BaTiO₃ NPs were spincoated at 2000 rpm for 30 s on the pre-cleaned PET using the solution containing 0.4 g (99.9%, 200nm, tetragonal, US Research Nanomaterials, Inc.) of BTO NPs in 10 mL of acetone. Next, a photoresist layer (AZ5214E, AZ Electronic Materials, USA) was spin-coated on the BTO NPs/ITO/PET at 2000 rpm for 30 s, followed by pre-baking on a hotplate at 95 °C for 120 s. Lastly, the fabricated device was poled at 100°C while applying a direct electric field of 100 kV/cm for 5 h.

UV treatment for surface functionalization

The photoresist-coated PETs were exposed under 365 nm ultraviolet (UV) [30 mW/cm²] for 120 s after prebake process.

Characterization

The output voltage and current were measured using an oscilloscope (LeCroy, LT354) and a current preamplifier (Stanford Research Systems, SR 570), respectively. A custom-built pushing machine was used to perform the cyclic contact/release motions. The scanning electron micrographs (SEMs) were obtained using a Hitachi S-4800. Tetragonal phase of BTO NPs was confirmed by a high-resolution Raman spectrometer (LabRAM HR-800, HORIBA JOBIN YVON).

S2. Equivalent model of TENG

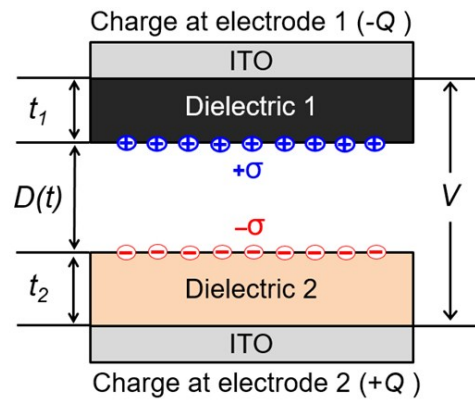


Figure S1. Schematic representation of the contact-mode triboelectric nanogenerator. The magnitude of output potential (V) is in proportion to the generated surface charge density (σ).

S3. Power generation mechanism of TENG

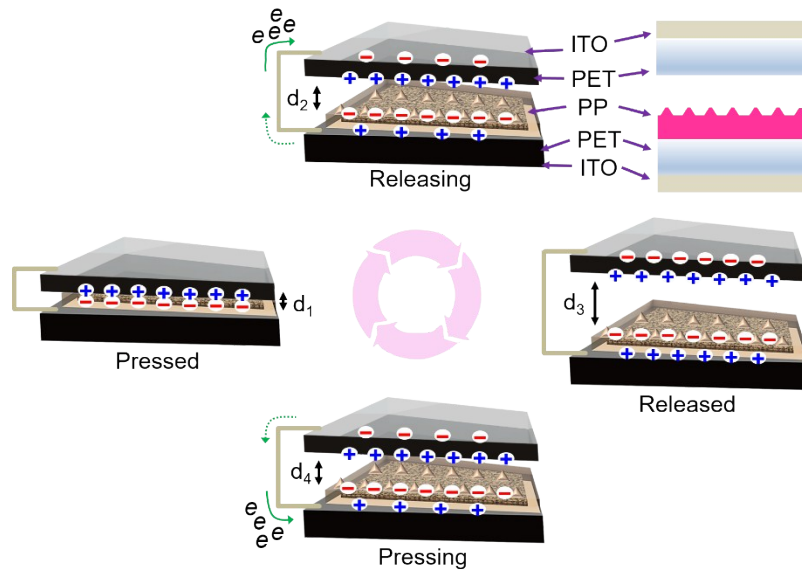


Figure S2. Schematic illustration of output power generation mechanism of the TENG with the contact pair of PET and UV functionalized PP with pyramid patterns.

The power generation mechanisms for the AC output of contact-mode TENG using PET : functionalized pyramid PR pair are schematically described. When the PR surface are brought into contact with PET surface by the push machine, the potential difference is induced between them due to the charge transfer, charging PET surface more positively and PR surface more negatively. Also, as the two surfaces are separating, these opposite triboelectric charges produce a potential difference across the top and the bottom electrodes. It drives the electrons to flow from the top to the bottom electrode through an external load until the potential difference between the two electrodes is balanced. Next, when the two separated surfaces move toward to a contact again, the potential difference will be disappeared and transferred electrons will flow back to the top ITO electrode through an external load, generating electrical current pulse in a reverse direction.

S4. Measured charge density before/after poling process

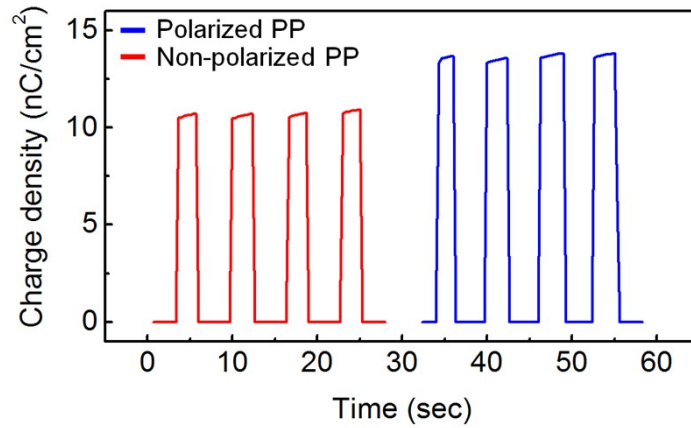


Figure S3. Measured surface charge density of the TENG with the contact pair of PET and UV functionalized PP with pyramid patterns before/after poling process. The charge density was clearly increased from 10.5 nCcm⁻² to 13.5 nCcm⁻² due to the ferroelectric charge coupling of BaTiO₃ NPs embedded in the PP.