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Enhanced Energy Harvesting Performance in lead-free Multi-layer Piezoelectric Electrospun Nanofiber Mats for Self-Powered Wearable Sensors

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Abstract

In this work, an improved performance multilayer piezoelectric nanogenerator (M-PENG) is demonstrated by alternating layers of Barium titanate nanoparticles (BT NPs) and Graphite nanosheets (GNS) embedded P(VDF-TrFE) nanofibers (NFs) mats. Prior to fabricating M-PENG, the BT NPs and GNS-embedded P(VDF-TrFE) NFs with different dopants concentrations are optimized. The optimized composite NFs mats are being used to fabricate M-PENGs. The performance of M-PENG in terms of V_{oc} is gradually improved as the number of layers are increased up to six layers beyond that the performance is almost saturated. The superior electrical throughput (such as V_{oc} ~ 350 V, and I_{sc} ~ 6 μA) of six layers (6L) M-PENG in comparison to all other multi-layered PENGs is exhibited. Owing to superior piezoelectric charge co-efficient (d_{33} ~ 285 pC.N^{-1}) and higher power density (P) ~ 3.6 W.m^{-2} in comparison to recently published electrospun NFs-based PENGs, the 6L M-PENG operates a range of consumer electronic components such as capacitors and light emitting diodes. Finally, the 6L M-PENG is implemented in the wireless healthcare system by transferring the pulse response, coughing, and different body movement responses wirelessly to a smartphone to establish the Internet of Things (IoT) based remote healthcare monitoring system.

Keywords: P(VDF-TrFE), Composite nanofiber, BaTiO3, Graphite nanosheet, Multi-layered PENG

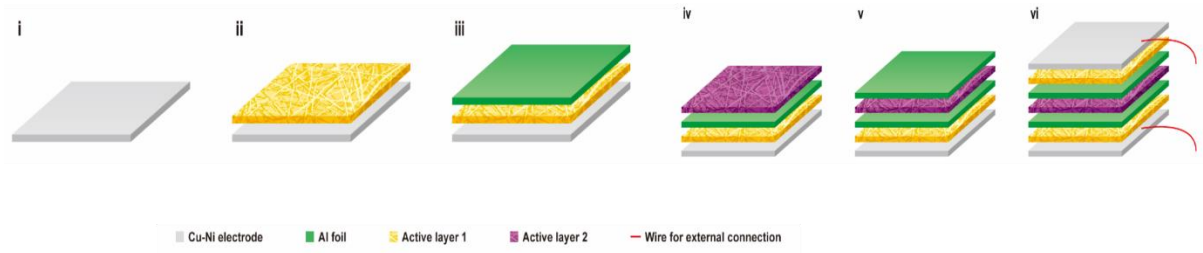

Fig. 1. Step by step multilayered PENG fabrication process.

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