Single Jersey Wearable Tribo-Electric Nano Generator

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ABSTRACT

Renewable energy harvesting devices open new avenues for developing new green materials in the energy sector and increase the potential for tribo-electric nanogenerators (TENGS). The TENGs have diverse applications in wearable devices for health monitoring, motion sensing, and sports applications. Limited research has been published to develop single and multicellular jersey lightweight, flexible, breathable wearable triboelectric nanogenerators (SJ- WTENGs). Energy harvesting through human body movement is cheaper as it does not utilize resources like fossil fuel or carry out nuclear reactions. Two approaches have been adopted to fulfill the green energy research; Energy harvesting from the Piezoelectric effect and energy harvesting from the Triboelectric effect. The piezoelectric effect termed a Piezo Electric Nano Generator (PENG) is based on electric current generation in crystalline structure when a force/pressure is applied resulting in an increase of free electrons in the conduction band due to the breaking of crystalline bonds. On the other hand, the Triboelectric Nanogenerator (TENG) concept was discovered by John Carl in 1757 that the materials are either negatively or positively charged. Since materials acquire charges to exhibit the Tribo-electric effect. A tribo-electric effect/charging is observed when there is a separation between the surfaces of the two tribo-electric materials, after bringing those in close contact with each other. The higher the magnitude of polarity between two tribo-electric materials, the more the electrical charge generation.

In a presented work a simple, lightweight, and easy to develop Single Jersey Wearable Tribo- Electric Nano Generator (SJ-WTENG) was constructed using Cotton and Acrylic fabrics (Triboelectric series materials). Fabrics were also coated with Maghemite (γ-Fe_2O_3) nanoparticles (13 nm) to increase the electrical conductance of the samples. Compression and Vertical contact-separation modes were adopted for studying the performance of the developed samples. Along with a Single WTENG sample, the outputs of two samples connected in series were also measured. To study the effect of developed Maghemite nanoparticle coating, non- coated fabrics WTENGs were also constructed and tested. Results confirmed that the application of Maghemite nanoparticles was useful in augmenting the output of the proposed SJ-WTENG design. The proposed system can be used to power the battery-powered IOT (Internet of Things)devices, widely used in medical and body sensor network applications.

Keywords: Green Chemistry, Nanomaterials. Textile Sensor Applications, Wearable IOT Devices.