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Controlling triboelectric nanogenerators via mechanical energy conversion systems

Triboelectric Nanogenerators (TENGs) are a promising renewable energy technology. Many applications have been successfully demonstrated, such as self-powered internet-of-things sensors and many wearables, and those portable power source devices are useful in daily life due to their light weight, cost effectiveness, and high-power conversion. To boost TENG performance, many researchers are working to modulate the surface morphology of the triboelectric layer through surface-engineering, surface modification, material selection, etc. Although triboelectric material can obtain a high charge density, achieving high output performance that is predictable and uniform requires Mechanical Energy Conversion Systems (MECSs), and their development remains a huge challenge. Many previous works do not provide a MECS or introduce only a simple mechanical system to support the TENG integration system device. However, those kinds of designs cannot boost the output performance or control the output frequency wave-form. Currently, some MECS designs use transmission conversion components such as gear-trains, cam-noses, spiral springs, flywheels, or governors that can provide the step-up, controllable, predictable, and uniform output performance required for TENGs to be suitable for daily applications. In this review, we briefly introduce various MECS designs for regulating the out-put performance of TENGs. First, we provide an overview of simple machines that can be used when designing MECSs and introduce the basic working principles of TENGs. The following sections review MECSs with gear-based, cam-based, flywheel-based, and multiple stage designs and show how the MECS structure can be used to regulate the input flow for the energy harvester. Last, we present a perspective and outline for a full system design protocol to correlate MECS designs with future TENG applications.

Recent Publications

1. Huynh ND, Choi D. Mechanical Conversion and Transmission Systems for Controlling Triboelectric Nanogenerators. Nanoenergy Advances. 2022; 2(1):29-51.
2. Huynh, N. D., Lin, Z. H., & Choi, D. (2021). Dynamic balanced hybridization of TENG and EMG via Tesla turbine for effectively harvesting broadband mechanical pressure. Nano Energy, 85, [105983].
3. Designable Skin-like Triboelectric Nanogenerators Using Layer-by-Layer Self-Assembled Polymeric Nanocomposites. Habtamu Gebeyehu Menge, Nghia Dinh Huynh, Hee Jae Hwang, Soyoung Han, Dukhyun Choi, and Yong Tae Park. ACS Energy Letters 2021 6 (7), 2451-2459

Biography

Nghia Dinh Huynh has completed his PhD in 2021 from Kyung Hee University, South Korea under the supervision of Dr. Dukhyun Choi. His research focuses on triboelectric nanogenerator fabrication and system design for efficient energy harvesting and self-powered systems. Currently, he has 13 publications that have been cited over 230 times, and his publication H-index is 6. He has been serving as a reviewer member of MDPI journals (Materials, Micromachines, Sensors).

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