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Asymmetric Energy Harvesting Strategy for Asymmetric Impedance Devices: Triboelectric Nanogenerator

Abstract: Energy harvesting is a technology that converts energy present in the surrounding environment into electrical energy for storage. Mechanical energy harvesting utilizes vibration, movement, and pressure changes, allowing energy to be collected regardless of environmental conditions. Triboelectric nanogenerators (TENGs) are particularly noted for their ability to consistently convert energy at a steady efficiency, regardless of the magnitude of external forces, making them suitable for harvesting irregular energy sources. TENGs operate as capacitive impedance energy devices, forming displacement currents and generating output based on impedance variations. Inevitably, TENGs exhibit two states of maximum and minimum impedance during operation, leading to differences in harvested energy due to charge balancing effects at each impedance state. This study analyzes the enhancement of charge balancing effects within the structure of TENGs to improve energy harvesting. It also proposes energy harvesting strategies based on the asymmetric impedance characteristics of TENGs and the resultant asymmetric charge transfer in energy management circuits.These findings suggest that optimizing the initial/repeated charge balancing and minimizing capacitive loads are crucial for maximizing TENG output power in practical applications.

Keywords: Energy harvesting, Triboelectric nanogenerator (TENG), Asymmetric impedance, Charge balancing, Energy management circuit

Biography: Jiwon Jeong is a Ph.D. candidate at Gyeongsang National University in South Korea. His research interests include sustainable energy and sensor technology. As an applied physics major, he is interested in the understanding of various systems through physical modeling. Currently, he is researching triboelectric nanogenerators and solar cells, and is preparing for employment opportunities in abroad.

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