A Robust Self-Powered Triboelectric Sensor for Risk Mitigation in Seismic Scenarios: IoT Communication and Dimensional Monitoring

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Abstract-

Currently, there is an increasing need for low-cost detectors that can measure ground motion with high sensitivity and selectivity. Triboelectric nanogenerators (TENGs) have arisen as low-cost self-powering sensing devices that can be used in multiple applications that involve vibration and motion, such as in earthquake detection. In this work, a TENG-based seismic device (SEISTENG) is designed with the purpose of detecting either 2D or 3D vibrating motion. This device is based on low-cost TENGs and comprises the walls of a 3D-printed polylactic acid box with a sliding metal ball inside and rolling on its horizontal base. The TENG transducer dynamical properties for a high-frequency range (0.5–50 Hz), long duration operation, and robustness were measured. The SEISTENG was validated by simulating the 1995 Kobe earthquake on a biaxial vibration table and the 2011 Lorca earthquake on a triaxial system, demonstrating its ability to detect seismic excitation signals with high accuracy (2D or 3D SEISTENG). The technology produced a response comparable to that of the commercial piezoelectric sensor D220-A4BR-1305YB, and its signals could be monitored remotely in real time using an FPGA-based STEMlab board, a LabVIEW interface, and Internet of things (IoT) platforms.

Index Terms- Layers, Nanogenerators, Oscillation, Power, Sensors

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