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Wind Energy Harvester Based on Triboelectricity: Large-Scale Energy Nanogenerator

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Abstract : With the rapid development of wearable electronics and sensor networks, batteries cannot meet the sustainable energy requirement due to their limited lifetime, size and degradation. Ambient energies such as wind have been considered as an attractive energy source due to its copious, ubiquity, and feasibility in nature. With miniaturization leading to high-power and robustness, triboelectric nanogenerator (TENG) have been conceived as a promising technology by harvesting mechanical energy for powering small electronics. TENG integration in large-scale applications is still unexplored considering its attractive properties. In this work, a state of the art design TENG based on wind venturi system is demonstrated for use in any complex environment. When wind introduces into the air gap of the homemade TENG venturi system, a thin flexible polymer repeatedly contacts with and separates from electrodes. This device structure makes the TENG suitable for large scale harvesting without massive volume. Multiple stacking not only amplifies the output power but also enables multi-directional wind utilization. The system converts ambient mechanical energy to electricity with 400V peak voltage by charging of a 1000mF super capacitor super rapidly. Its future implementation in an array of applications aids in environment friendly clean energy production in large scale medium and the proposed design performs with an exhaustive material testing. The relation between the interfacial micro-and nano structures and the electrical performance enhancement is comparatively studied. Nanostructures are more beneficial for the effective contact area, but they are not suitable for the anti-adhesion property due to the smaller restoring force. Considering these issues, the nano-patterning is proposed for further enhancement of the effective contact area. By considering these merits of simple fabrication, outstanding performance, robust characteristic and low-cost technology, we believe that TENG can open up great opportunities not only for powering small electronics, but can contribute to large-scale energy harvesting through engineering design being complementary to solar energy in remote areas.

Keywords : triboelectric nanogenerator, wind energy, vortex design, large scale energy
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