

## Author's Accepted Manuscript

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PII: S2211-2855(16)30625-5  
DOI: <http://dx.doi.org/10.1016/j.nanoen.2016.12.061>  
Reference: NANOEN1712

To appear in: *Nano Energy*

Received date: 26 December 2016  
Accepted date: 30 December 2016

Cite this article as: Changsheng Wu, Ruiyuan Liu, Jie Wang, Yunlong Zi, Long Lin and Zhong Lin Wang, A Spring-Based Resonance Coupling for Hugely Enhancing the Performance of Triboelectric Nanogenerators for Harvesting Low Frequency Vibration Energy, *Nano Energy*, <http://dx.doi.org/10.1016/j.nanoen.2016.12.061>

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# A Spring-Based Resonance Coupling for Hugely Enhancing the Performance of Triboelectric Nanogenerators for Harvesting Low-Frequency Vibration Energy

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## Abstract

Low-frequency vibration is a ubiquitous energy that exists almost everywhere, but a high efficient harvesting of which remains challenging. Recently developed triboelectric nanogenerator (TENG) provides a promising alternative approach to conventional electromagnetic and piezoelectric generators, with the advantage of low cost and high output voltage. In this work, a mechanical spring-based amplifier with the ability of amplifying both the vibration frequency and amplitude is integrated with TENG to improve its low-frequency performance by up to 10 times. A new scheme for evaluating TENG using the average output power is proposed and the process of choosing an appropriate time interval for analysis is demonstrated. It takes into account the temporal variation in electrical output and offers a more accurate and convincing evaluation of TENG's performance in practical working environment compared to previously used instantaneous power. This work serves as an important progress for the future development and standardization of TENG, especially for harvesting low-frequency vibration energy as well as a great prospect of blue energy.

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