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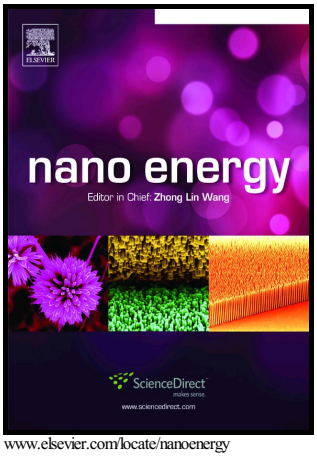

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Freestanding-electret rotary generator at an average conversion efficiency of 56%: theoretical and experimental studies

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Abstract

Harvesting ambient mechanical energy is a crucial method to gain low-cost, clean and sustainable electric energy for self-powered electronics. Herein, we develop a freestanding-electret rotary generator and the explicit analytical solutions of the output current, voltage and average power are obtained from its theoretical model. The maximum average output power and the matched load resistance can be estimated directly from simple formulas. The generator using an inexpensive micro-nano-structured PTFE electret film achieves an open-circuit voltage with an amplitude of 650 V and a conversion efficiency about 56% with 10.5 mW output power at a rotation rate of 750 rpm. We find that the opposite charges injected into the back of the electret during the charging process tremendously counteract the effect of the charges on the front and reduce the output power. Eventually the theoretical and experimental results are very close when the net charge density is used instead of the surface charge density.

Keywords: energy harvesting, electret, electrostatic induction, rotary generator, freestanding.