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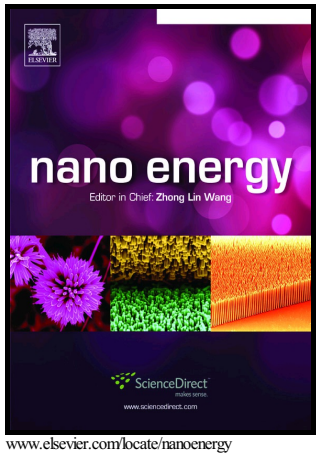

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A Hybridized Electromagnetic-Triboelectric Self-Powered Sensor for Traffic Monitoring: Concept, Modelling, and Optimization

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Abstract

We report a hybridized electromagnetic-triboelectric generator that consists of four units of freestanding triboelectric nano generators (TENG) and four electromagnetic generators (EMG) that can be used as a self-powered sensor for road traffic monitoring. The proposed hybridized nano generator converts the periodical mechanical load over the speed bumper into electricity. We optimize the geometry of the electromagnetic component for the purpose of high power generation. With combination of TENG and EMG, it is shown that the proposed device is capable of the power and voltage generation even with very small displacements and low frequencies. Depending to the triggering frequency, TENG or EMG dominates the power generation considering different mechanical loads. The hybridized nanogenerator can deliver output volume power density of 20.96 $\frac{W}{m^3}$ and 50.81 $\frac{W}{m^3}$ for TENG and EMG components in frequency of 1 Hz, respectively. The proposed nano generator not only has the potential to be implemented for sensing applications and traffic monitoring due to its high output voltage, but also is capable of power harvesting to act as a self-powered monitoring system. With the global interest toward developing smart cities, the proposed self-powered device can address the traffic monitoring challenges of those cities by providing online traffic information.

Keywords: Hybridized nano generator, Electromagnetism, Triboelectricity, Speed bumper, Traffic monitoring.

1. INTRODUCTION

Nowadays, exploiting renewable energy sources has remarkably started to receive noticeable recognition as the paramount technique for power supplying sensors and actuators. As

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