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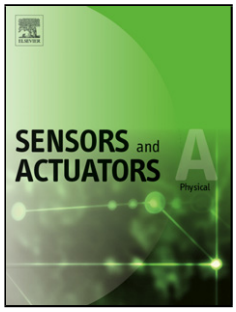

Title: A BIOINSPIRED STRUCTURE MODIFICATION OF PIEZOELECTRIC WIND ENERGY HARVESTER BASED ON THE PROTOTYPE OF LEAF VEINS

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PII: S0924-4247(18)30344-3
DOI: https://doi.org/10.1016/j.sna.2018.06.059
Reference: SNA 10864

To appear in: *Sensors and Actuators A*

Received date: 22-2-2018
Revised date: 29-6-2018
Accepted date: 29-6-2018

Please cite this article as: Wang W, He X, Wang X, Wang M, Xue K, A BIOINSPIRED STRUCTURE MODIFICATION OF PIEZOELECTRIC WIND ENERGY HARVESTER BASED ON THE PROTOTYPE OF LEAF VEINS, *Sensors and Actuators: A. Physical* (2018), https://doi.org/10.1016/j.sna.2018.06.059

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ACCEPTED MANUSCRIPT

A BIOINSPIRED STRUCTURE MODIFICATION OF PIEZOELECTRIC WIND ENERGY HARVESTER BASED ON THE PROTOTYPE OF LEAF VEINS

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Highlights:

- Artificial veins can be used for flexible piezoelectric energy harvesting element
- Structure of veins increase the energy harvesting efficiency of piezoelectric leaf
- The veins significantly change the interrelationship between structures and wind

Abstract

This paper describes a novel leaf-like piezoelectric wind energy harvester based on the venation growth algorithm, which are derived from the prototype of dicotyledonous plant leaves that have the netted distributions of veins. Some triangle polyvinylidene fluoride (PVDF) leaves are designed and fabricated to be the energy harvesting element that is driven by the vortex induced vibration in the wind flow behind a bluff body. Wind tunnel experiments were carried out to investigate and compare the performances of energy harvesting capacity of different elements. Experimental results show that the output powers of the veined structures are 4-6 times higher than that of the structure without veins. The largest root mean square of open circuit output voltage reaches 1.094V under the wind velocity of 11m/s for the 110μm thickness PVDF leaf with veins. The dynamic analysis indicates that the veins can greatly influence the mechanical coupling properties between the harvesters and the wind flow although the system has not reached a typical state of instability. It is confirmed that the presence of veins has an important effect on the efficiency of the energy harvesting system.

Keywords

Piezoelectric; Wind energy harvester; Bionic design; Vortex induced vibration

1. Introduction

With the development of distribute system, wireless sensors and wearable devices, the power supplying is one of the fundamental issue that restricts the endurance of the systems. The small-scale equipments to collect environmental energy and convert it into continuous power are considered as a viable alternative to traditional batteries [1]. Vibration is a common phenomenon in the environment. In recent years, vibration energy harvesters using piezoelectric transduction mechanism has attracted much attention due to their superior power density, ease of application, and scalability[2]. As far as applications far from fixed vibration source, the wind-induced vibration is an ideal source of energy for piezoelectric harvesters [3, 4].

There are two main methods for conversion of wind kinetic to electrical energy. The first one consists a windmill[5, 6] that can drive a piezoelectric cantilevers by impact[7], pressure[8] or contactless magic force[9]. The other method

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