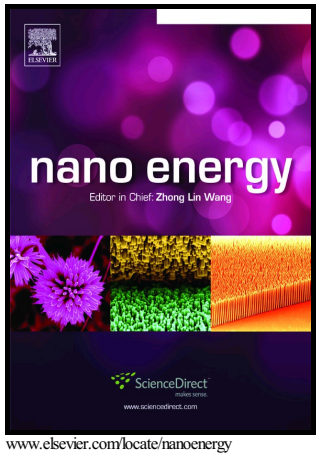

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Self-powered Triboelectric Nano Vibration Accelerometer Based Wireless Sensor System for Railway State Health Monitoring

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Abstract

Vibration exists everywhere especially in the public railway operation system. The vibration acceleration is the key factor to monitor and evaluate the structure health of the railway equipment. In this paper, a kind of self-powered triboelectric nano vibration accelerometer (TEVA) is presented. A low frequency spring mass vibration model is built to calculate the vibration sensitive performance and the electric output of the TEVA. The prototype of the TEVA is demonstrated and characterized through the railway vibration simulation platform. It has been testified that TEVA can successfully harvest the low frequency vibration energy and convert it to electrical power to achieve the self-powered vibration acceleration monitoring system. The output current and voltage of TEVA are also sensitive to the vibration acceleration from 1.07m/s^2 to 1.25m/s^2 linearly. Hence it can be used as a self-powered nano vibration accelerator for the fault diagnosis. In addition, the generated electricity is used for charging the lithium battery (from 1.5V to 3.1V) which supplies power to the ZigBee module. The experiment shows that the charged battery through TEVA can support the wireless communication between ZigBee modules, with temperature and humidity sensors embedded on it. The temperature and humidity on the train are 22 degree Celsius and 35%RH respectively. Therefore, the vibration energy can be harvested and stored for the power supply of wireless sensor network nodes in the near future.

[1] Xuejun Zhao and Guowu Wei contributed equally to this work

Graphical abstract