Vibrational piezoelectric energy harvester's performance using lead-zirconate titanate versus lead-free potassium sodium niobate

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Abstract

Piezoelectric energy harvester (PEH) is considered as a robust power source, which can power electronic devices by scavenging small magnitudes of energy from ambient vibration. The fundamental advantage of PEH lies in the inherent ability of the piezoelectric material to generate electricity depending on the amount of vibration applied to the material. Although lead zirconate titanate (PZT) is the most common type of piezoelectric material used, the toxicity of PZT damages the environment and causes health issues, thus necessitates the need for the discovery of lead-free piezoelectric material. Hence, potassium sodium niobate (KNN) was chosen to eradicate the toxicity of the PZT material. In this paper, the performance of KNN energy harvester was compared with a commercial lead-based material using finite element modelling. Both harvesters showed a comparable output power of 0.104 mW for KNN and 0.115 mW for PZT, respectively. The recorded maximum output voltage of KNN was 0.952 V when resonated at 2097.7 Hz. KNN also rank among the best piezoelectric energy harvester compared to the commonly reported electromechanical coupling coefficient and figure of merit. The proposed KNN energy harvester provides a very promising solution to substitute lead-based energy harvester in the future.

Keywords

Author Keywords: lead-free; lead zirconate titanate; potassium sodium niobate; piezoelectric; energy harvester
KeyWords Plus: FILM; PZT; FREQUENCY; CERAMICS; DOPANT

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