An Optimal Piezoelectric Beam for Acoustic Energy Harvesting

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Abstract

This study presents a novel piezoelectric beam structure for acoustic energy harvesting. The beams have been designed to maximize output energy in areas where the noise level is loud such as highway traffic. The beam consists of two layers (copper and polyvinylidene fluoride) that convert the ambient noise's vibration energy to electrical energy. The piezoelectric material's optimum placement have been studied, and its best positon is obtained on the substrate for the maximum yield. Unlike previous studies, which the entire beam substrate used to be covered by a material, this study presents a modest material usage and contributes to lowering the harvester's final production cost. Additionally, in this study, an electrical model was developed for the sensor and a read-out circuitry was proposed for the converter. Moreover, the sensor was validated at different noise levels at various lengths and locations. The simulations were performed in COMSOL Multiphysics® and MATLAB® and report a maximum sound pressure of 140 dB from 100 dB point sources in an enclosed air-filled cubic meter chamber.

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