Simulation of a New PZT Energy Harvester with a Lower Resonance Frequency Using COMSOL Multiphysics®

H. Elbahr[1], T. Ali [2], A. Badawi [1], S. Sedky[1]

[1]Zewail City of Science and Technology - Cairo, Cairo, Egypt
[2]Zewail City of Science and Technology - Cairo, Cairo, Egypt; Cairo University, Cairo, Egypt

Abstract

Energy harvesting from environmental vibration nowadays is feasible because of natural oscillations like that caused by air or liquid flow and by exhalation or the heartbeat of a human body. This vibration frequency is typically low (in order of less than 1 kHz). Accordingly, low-frequency vibration based energy harvesting systems are an important research topic; these systems can be used for wearable or implantable devices.

Piezoelectric vibration based harvesters are not expensive and do not require external voltage sources, making them a viable alternative to implement the energy harvesting system.

In this paper a macro-scale uni-morph piezoelectric cantilever with non-traditional geometry is investigated by using the COMSOL Multiphysics® software for the generation of electrical energy; piezoelectric energy harvester consists of an active piezoelectric layer (PZT-5H), steel substrate and titanium proof mass.

The proposed structure is simulated and the results are compared with other traditional geometries. Simulation results demonstrated that the new cantilever structure has a lower resonance frequency and higher average strain than the rectangular structures, which makes it suitable for wearable or implantable devices.

Figures used in the abstract

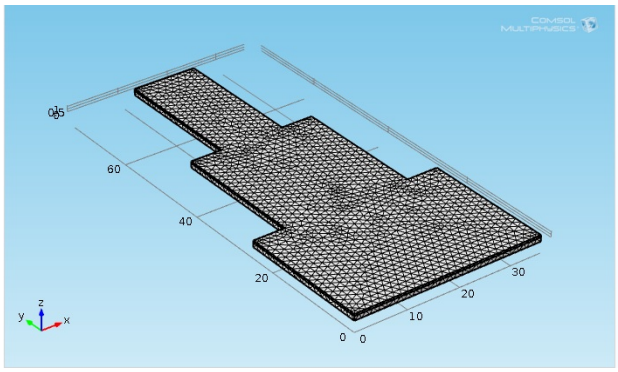

Figure 1: Proposed Piezoelectric cantilever.

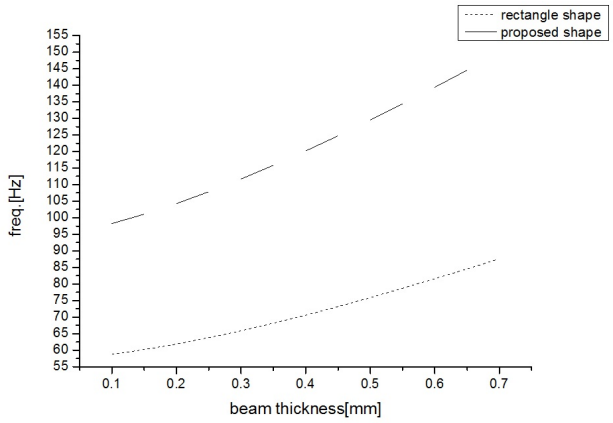

Figure 2: The resonance frequency versus beam thickness.