Bistable Vibration Energy Harvester as a MEMS Device

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Abstract

Microelectromechanical (MEMS) energy harvesters have brought more researchers' attention to this field due to recent advances in micro/nano-fabrication of smart materials. While many previous studies have been tried to lower resonance frequency and improve the operational bandwidth of MEMS energy harvesters, the existence of a universal solution to tackle these problems is still missing in this field. In the current study, we propose a unique multi-components structure to address the mentioned issues associated with the micro-scale bistable energy harvesters. This bistable system is made of a main buckled beam, in which buckling is created with a compressive load. Two cantilever arms are connected to the main beam via a torsional rod, which has the role of transferring motion between the buckled beam and arms. In order to reduce the first natural frequency of the whole system, a tip mass is attached to the end of each cantilevered arms, making them less rigid and helping the whole system first natural frequencies dominated by these arms.

A new modeling approach was performed to develop snap-through regime plots for both macro and MEMS-scale of the proposed system, which shows its functionality as a piezoelectric bistable energy harvester. Furthermore, various steps of the fabrication process including plasma-enhanced chemical vapor deposition (PECVD), physical vapor deposition (PVD), and deep reactive-ion etching (DRIE) have been performed to deposit different layers of a MEMS device. Details of each fabrication step as well as the possibility of testing the final fabricated device are discussed in more details.

Biography of Presenter

Masoud Derakhshani is a Ph.D. candidate in mechanical engineering at the University of Louisville. He received both his B.Sc. and M.Sc. in mechanical engineering from Mazandaran University and Iran University of Science and Technology respectively in Iran and was awarded the UofL graduate school fellowship to start his Ph.D. in 2015. His research interests mostly focus on the field of dynamics and vibrations as well as MEMS devices and has some publications in these areas. Currently, the project that he is involved in includes both nonlinear dynamics and fabrication process of a unique-designed MEMS-scale vibration energy harvester.