Design, Simulation and Optimization of Bimorph Piezoelectric Energy Harvester

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Abstract

Piezoelectric energy conversion has received great attention for vibration-to-electric energy conversion over the last five years. A typical piezoelectric energy harvester is a unimorph or a bimorph cantilever located on a vibrating host structure, to generate electrical energy from base excitations. In this paper we have tried to maximize the output voltage of the piezoelectric energy harvester by changing the dimensions of the proof mass and the bimorph piezoelectric layer. We have also used different piezoelectric materials like PZT in a bimorph cantilever beam configuration and maximised the power output. Another less common material that is studied is Aluminium Nitride (AlN) which has a smaller piezoelectric and dielectric constant but has advantages in material deposition and in compatibility with standard CMOS process has been simulated.The results range from maximum to minimum using different combinations of the affecting parameters using Taguchi's orthogonal array for optimization of the parameters. The designed bimorph piezo energy harvesting system was modeled using COMSOL Multiphysics and the observed parameters are compared to the analytical results.

Figures used in the abstract

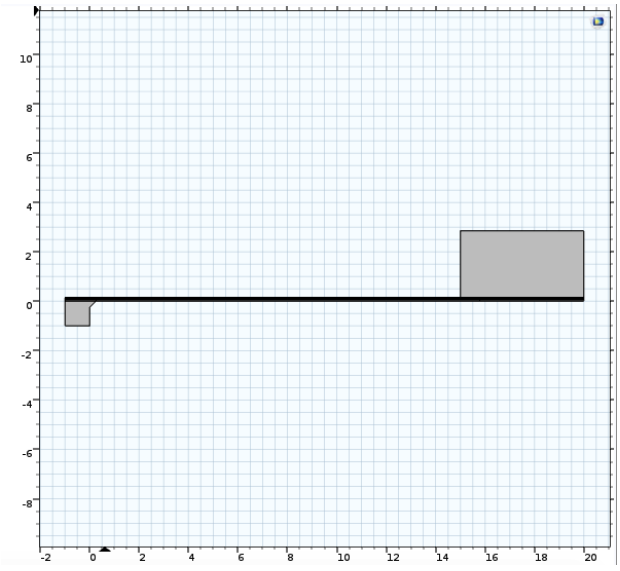

Figure 1: Structure of a bimorph piezoelectric harvester in COMSOL Multiphysics.

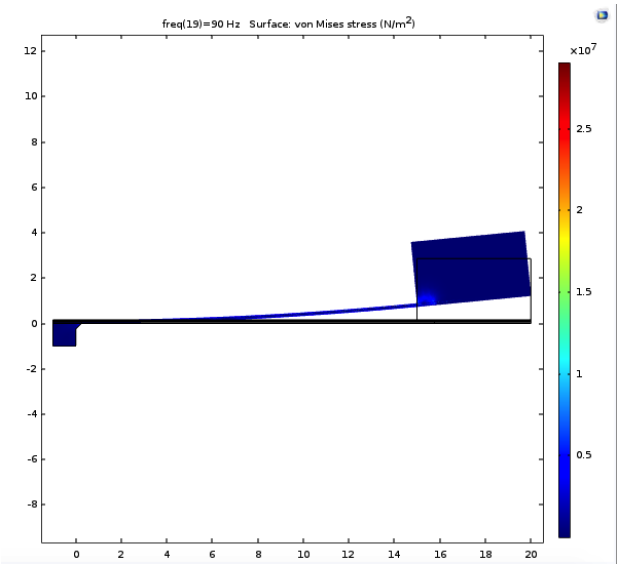

Figure 2: Simulated result of minimum stress of piezoelectric energy harvester for experiment run 9.

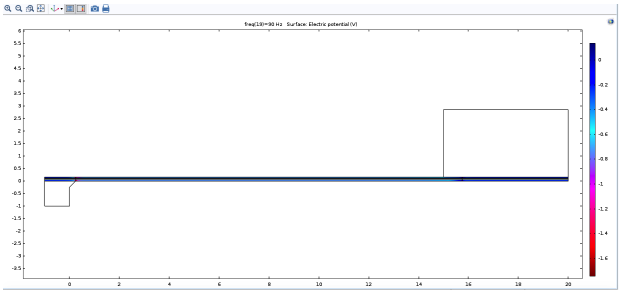

Figure 3: Simulation results showing maximum electric potential for piezoelectric energy harvester for experiment run 9.