Polymer Based Piezoelectric Energy Microgenerator

V. Janicek[1], M. Husak[1]
[1]Department od Microelectronics, FEE CTU, Prague
Technicka 2, 16627 Prague, Czech Republic
janicev@fel.cvut.cz
Phone: +420224355854

Interest of the work

This paper describes a concept of self-powered microsystem which can be used for applications totally isolated from the outside world. It is obvious that the supply energy needs to be generated inside the system. This makes a self-powered microsystem concept [Fig.1] possible.

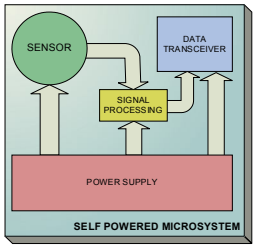

Fig.1 – Self-powered microsystem

An unconventional solution is to design a microgenerator to convert mechanical vibrations into electrical energy with help of the piezoelectric effect. But today's most used piezoelectric material PZT was substituted by more flexible polymer material PVDF.

Objectives

The proposed electromechanical microgenerator is essentially a resonant mechanical serpentine structure [Fig.2] based on cantilever modifications.

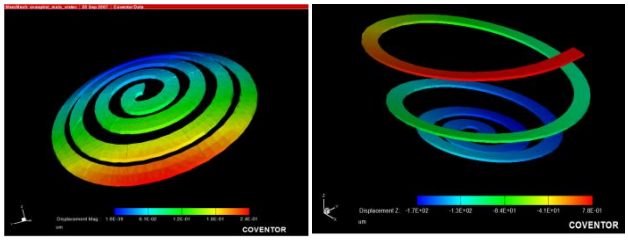

Fig.2. Basic resonant structure of the generator

The base PVDF layer is coated on both planar sides with a conductive metal layer. These layers act as electrodes for electric charge harvesting. Vibration energy harvesters can be employed to harvest energy from vibrations and vibrating structures, a general requirement independent of the energy transfer mechanism is that the vibration energy harvesting device operates in resonance at the excitation frequency. Most energy harvesting devices are single resonance frequency based. To obtain the lowest possible resonant frequency it is necessary to design layout with long cantilevers. But this condition is limiting the resulting area occupied by the generator. There have been designed several different layouts (Fig.3) of the micro generator with different resonant frequency.

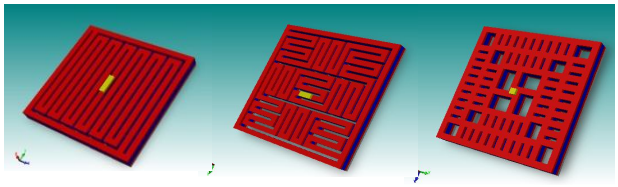

Fig.3. Generator Topology

Main Contributions

Proposed design shows approx. an output power of 4µW at frequency around 45Hz. Simulations were made in CoventorWare. The most important aspect is the power generation efficiency to surface ratio. On Fig.4 are visible displacements magnitudes of 40µm with generated voltage of about 100V. The generated charge is much more crucial in the design of the whole sensor chain.

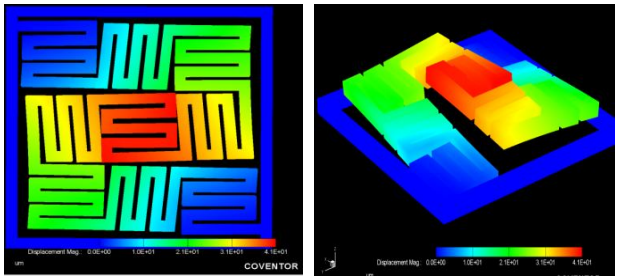

Fig.4 – Examples of simulated generator layouts

Higher output can be achieved by building "sandwich" structure – multiple PVDF layers on each other. This unconventional low cost solution of supplying integrated MEMS with electrical energy shows great efficiency.

Resonant frequency of micro-generator is crucial parameter to obtain the maximum energy out from the design. There are tunable layouts in development which can be used in applications with broad frequency range.This work has been supported by the 6th FP (PolyApply).