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Energy Generation Using MEMS Based Piezoelectric System

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Introduction: The main concentration is on the generation of the electrical energy from the piezoelectric material. Now a day's most of the devices have become portable due to the MEMS technology. So MEMS technology is preferred almost in all fields. The basic principle involved here is the PIEZOELECTRIC EFFECT which causes crystal to deform and generate the electrical signals i.e., voltage. The work is carried out in virtual environment to check the power generated after the deformation of the piezoelectric crystal.

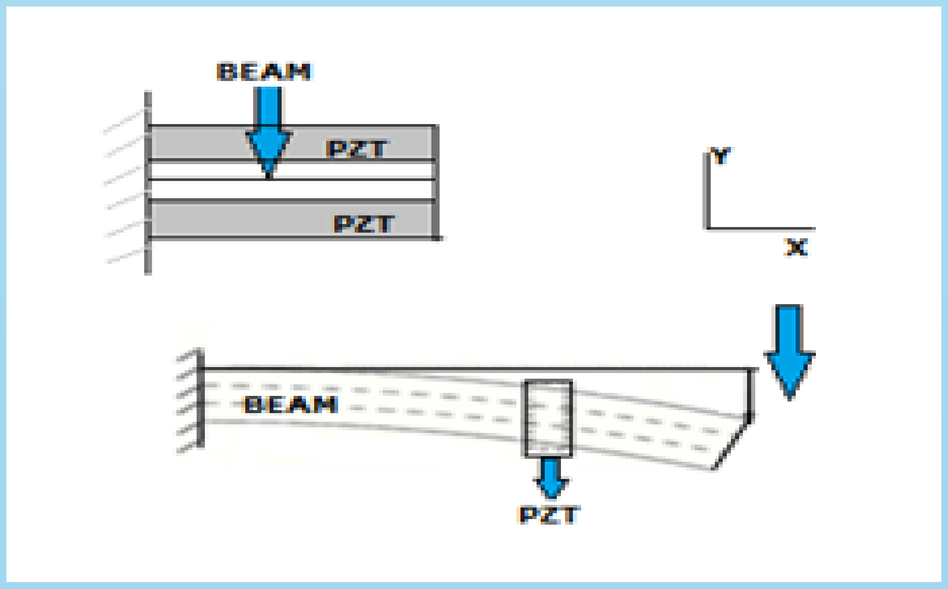

Figure 1. Piezoelectric Effect

Conclusions: The experiment is carried out on different models to check the maximum displacement of the crystal by varying the parameters like length of the crystal i.e. the deformation area. Various voltages are generated for various models and the efficient model is predicted to be correct. Hence, the model with higher output voltage rating is the desired model.

Computational Methods: The design consists of a piezoelectric block (quartz crystal) enclosed within an aluminium block. The pressure is applied to this crystal to generate the required output that is the voltage.

$$V = g * tb * stress$$

Results : The MEMS based Energy Generator is designed using COMSOL Multiphysics. The mechanical shear actuated beam gets deformed when the stress is applied on it. Different readings are tabulated for different models and the deformation (displacement) is observed.

Models	Crystal length in milli-meter	Voltage milli volt
MODEL 1	0.003	5.91
MODEL 2	0.0045	7.34
MODEL 3	0.005	7.78
MODEL 4	0.008	11.27
MODEL 5	0.01	15.19
MODEL 6	0.02	24.85
MODEL 7	0.03	33.42
MODEL 8	0.035	41.16
MODEL 9	0.04	48.22
MODEL 10	0.045	53.35

Table1: Output of various models in milli-volts

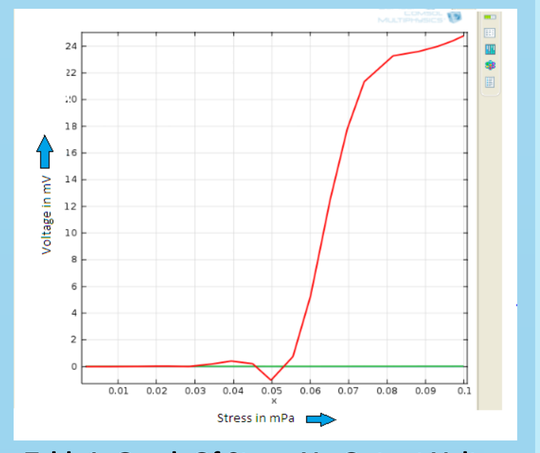

Table1: Graph Of Stress Vs. Output Voltage

References:

1. Timothy Eggborn, "Analytical Models to Predict Power Harvesting with Piezoelectric Materials" Thesis submitted to Virginia Polytechnic Institute and State University.

2. Henry Sodano , Elizabeth A. Magliula, Gyuhae Park , Daniel J. Inman, " ELECTRIC POWER GENERATION USING PIEZOELECTRIC DEVICES", This paper appears from Center for Intelligent Material Systems and Structures, Virginia Polytechnic Institute and State University, Blacksburg, VA 24061, USA.

3. Henry A. Sodano, Daniel J. Inman, Gyuhae Park. "A Review of Power Harvesting from Vibration using Piezoelectric Materials" *The Shock and Vibration Digest / May 2004*.

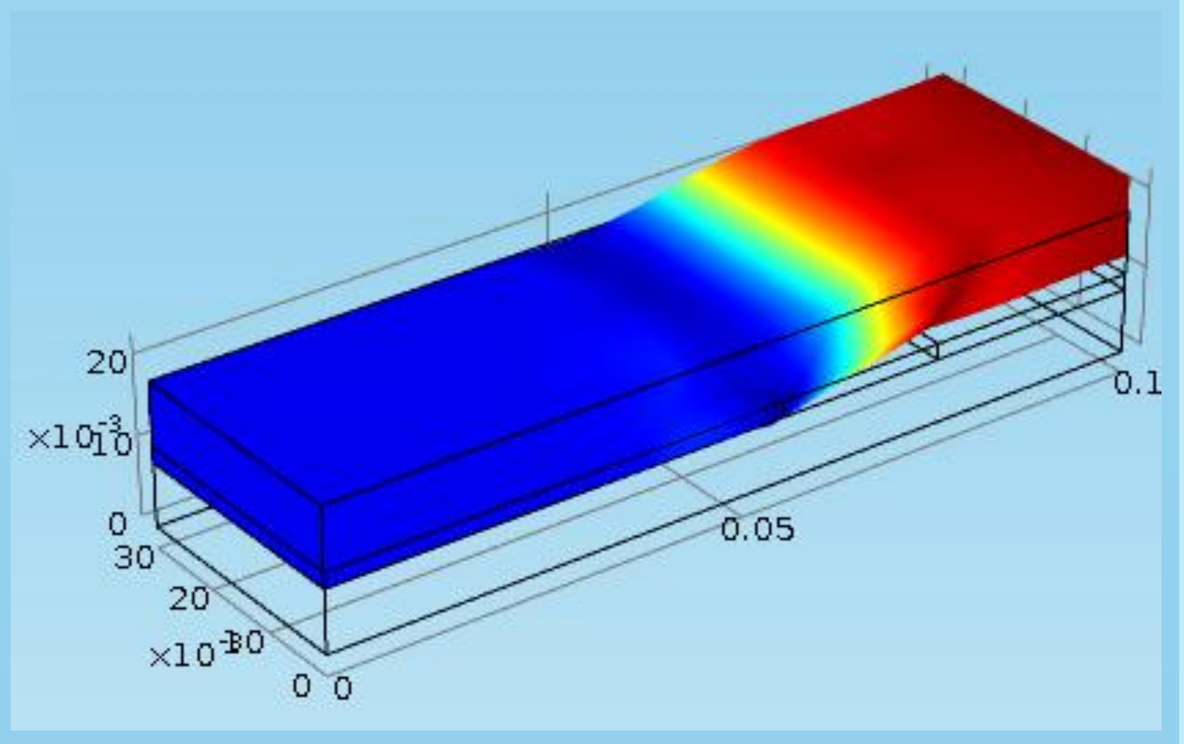

Figure 2. Deformed Shear Actuated Beam