Design of a MEMS Bolometer with Absorptive Element as Piezo-Protein

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Introduction:Bolometer is a thermal infrared sensor used for measuring the intensity of radiation via the heating of a material due to the radiations. A bolometer contains an absorptive element joined with another metal plate which acts as a heat sink. This paper presents a design of the said bolometer with absorptive element as a biologically sensitive material: Piezo-Protein which can be employed for biosensing applications.

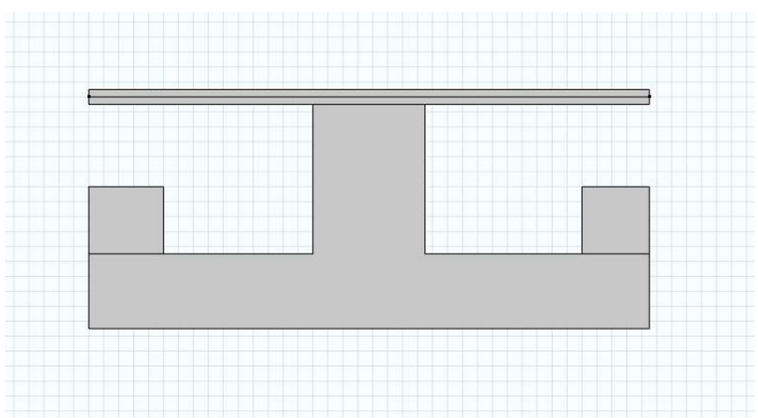

Figure 1. Schematic diagram

Computational Methods: The deflection of the plates is based on the concept of conversion of thermal energy into mechanical energy. The heat generated causes asymmetric expansion of the structure resulting in deflection. This expansion is directly proportional to the heat generated in the material governed by thermal expansion law given by:

$$\Delta l = \alpha l(T - T_{ref})$$

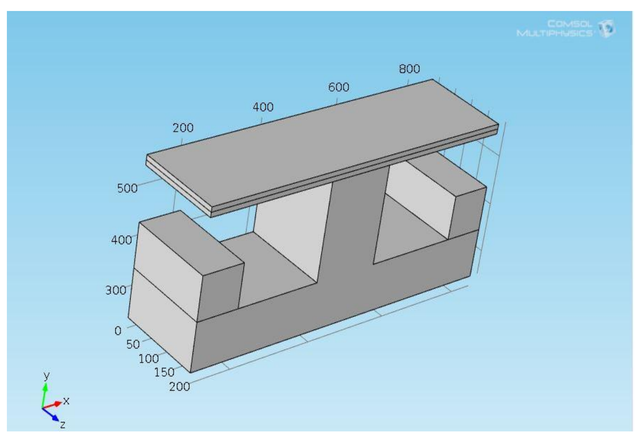

Figure 2. Proposed structure

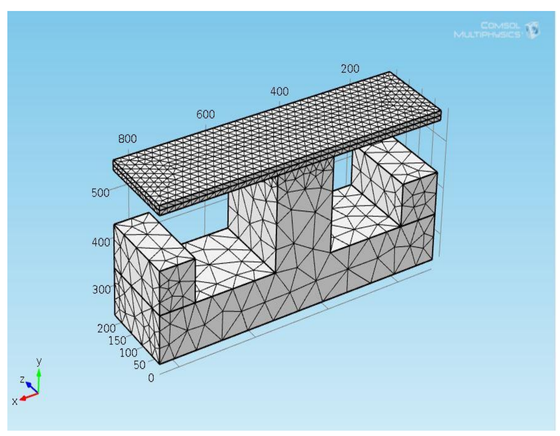

Figure 3. Mesh Analysis

Results: The proposed bolometer gives a direct voltage output which requires no external read out circuitry to measure the external radiation. Such sensors can be used in radiation sensing as well as various other biosensing applications based on the absorptive element used for estimating certain ions. The deflection of the structure and the potential distribution is shown below.

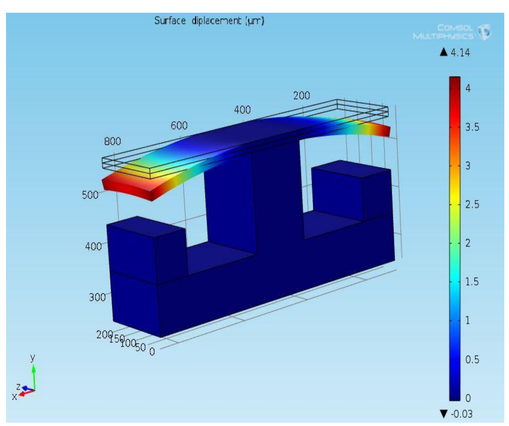

Figure 4. Deflection

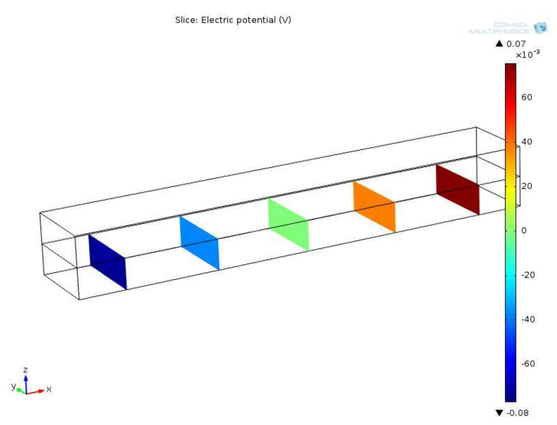

Figure 5. Potential Distribution

Conclusions: The simulation result obtained favors the direct transduction technique introduced. It has several potential applications in nuclear power plants and nuclear energy reserves where there is a necessity to monitor the amount of nuclear radiation regularly. It can be used in several biosensing applications for estimation of ions.

References:

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3. Umapathi et al, Simulation of MEMS based Bolometer for Detecting the Radiations in Nuclear Power Plants, Comsol Conference (2012)