Modeling of MEMS Based Bolometer for Measuring Radiations from Nuclear Power Plant

S. Nisitha *1 , T. Satyanarayana #2 , S. Sreeja 1

1.Department of EIE, Lakireddy Bali Reddy Engineering College, Mylavaram, Andhra Pradesh, India.

2.NPMASS Centre, Department of EIE, Lakireddy Bali Reddy Autonomous Engineering College, Mylavaram, Andhra Pradesh, India

Introduction: The word 'bole' means ray. Bolometer is a thermal infrared sensor that measures the power of incident radiation. It absorbs electromagnetic radiation and temperature is increased. This temperature increase results in the deformation of absorptive element.

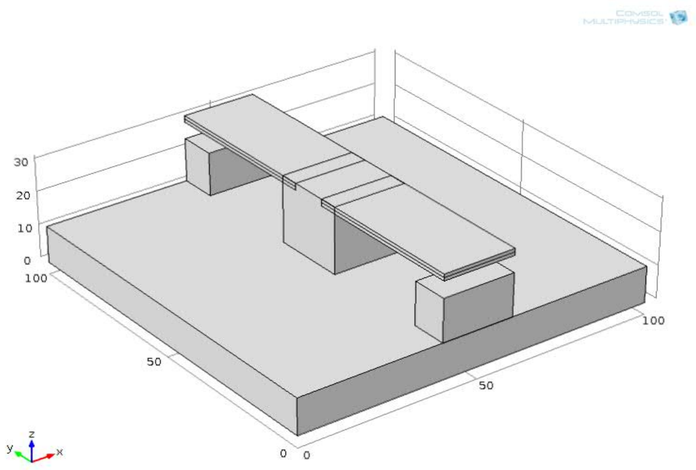

Figure 1: Model of bolometer

Design : The device consists of two micro plates on either side of the support. One of the micro plates is made of material with high CTE and the other is made of material of low CTE. Silicon is added to base and central support. Copper is added to the two links and aluminum, tungsten are added to the plates.

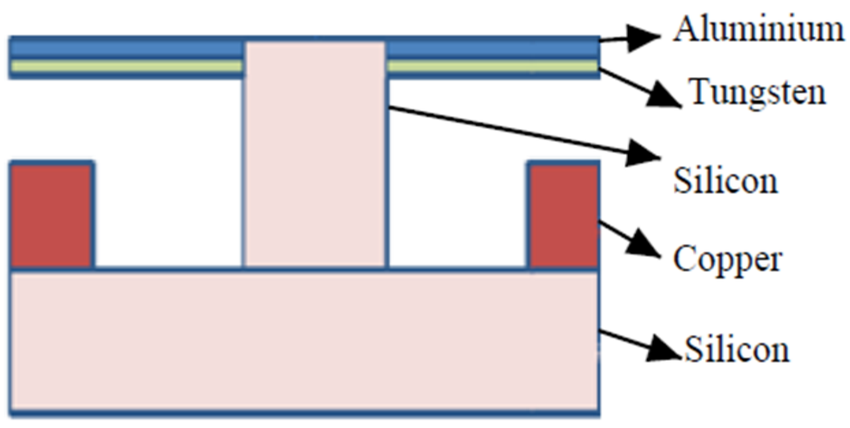

Figure :2 structural details of bolometer

Property	value
Thermal conductivity	160[W/mK]
Heat capacity	900[J/kg×K]
Co-efficient of thermal expansion	23M[1/K]
Heat density	2700[Kg/m^3]

Table 1: Thermal properties of aluminium

Property	value
Thermal conductivity	173[W/mK]
Heat capacity	1340[J/kg×K]
Co-efficient of thermal expansion	4.5M[1/K]
Heat density	17800[Kg/m^3]

Table 2: Thermal properties of tungsten

Results: The proposed micro bolometer has been simulated and the pressure distribution across the device the device is shown in the figure. With the applied stress, metal plates are deformed and touches the copper link. The maximum stress is found to be 7.9435×10^{-7}N/m^2. This changes the resistance of the absorptive element. By measuring the change in resistance of the metal we can determine the intensity of the incident radiation. These studies would be useful in making of bolometers that prevent the people from powerful radiations

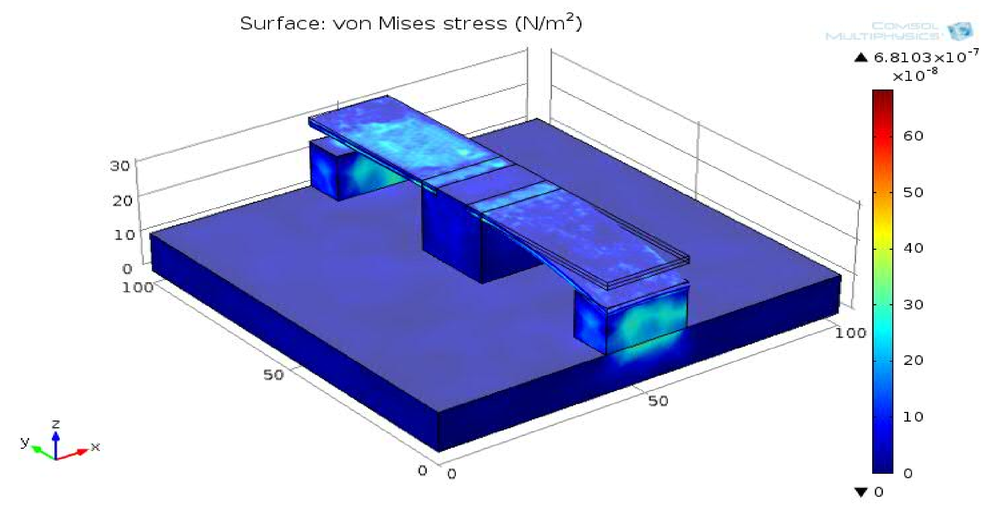

Figure 3: pressure distribution

Conclusions: In the view of protection around the nuclear plant bolometer is designed and simulated using COMSOL 4.3 a. The maximum pressure distribution is found to be 7.45×10^{-15}N/m^2

References: 1. MEMS-Based Uncooled Infrared Bolometer Arrays – A Review by Frank Niklaus, Christian Vieider, Henrik Jakobsen.

2. Risks of Nuclear Power Bernard L. Cohen, Sc.D. Professor at the University of Pittsburgh.