

Two-axis Analysis of Micromirror Using Electrothermal Actuators For Optical Switching Applications

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Introduction: MEMS micromirrors are devices used in optical systems to direct light from one position to another over a range of reflection angles. The reflection angle of a micromirror can be adjusted by an actuation mechanism that rotates and moves the mirror surface. Actuation mechanisms such as electrostatic, piezoelectric, electromagnetic and electrothermal have been exclusively used in micromirror designs.

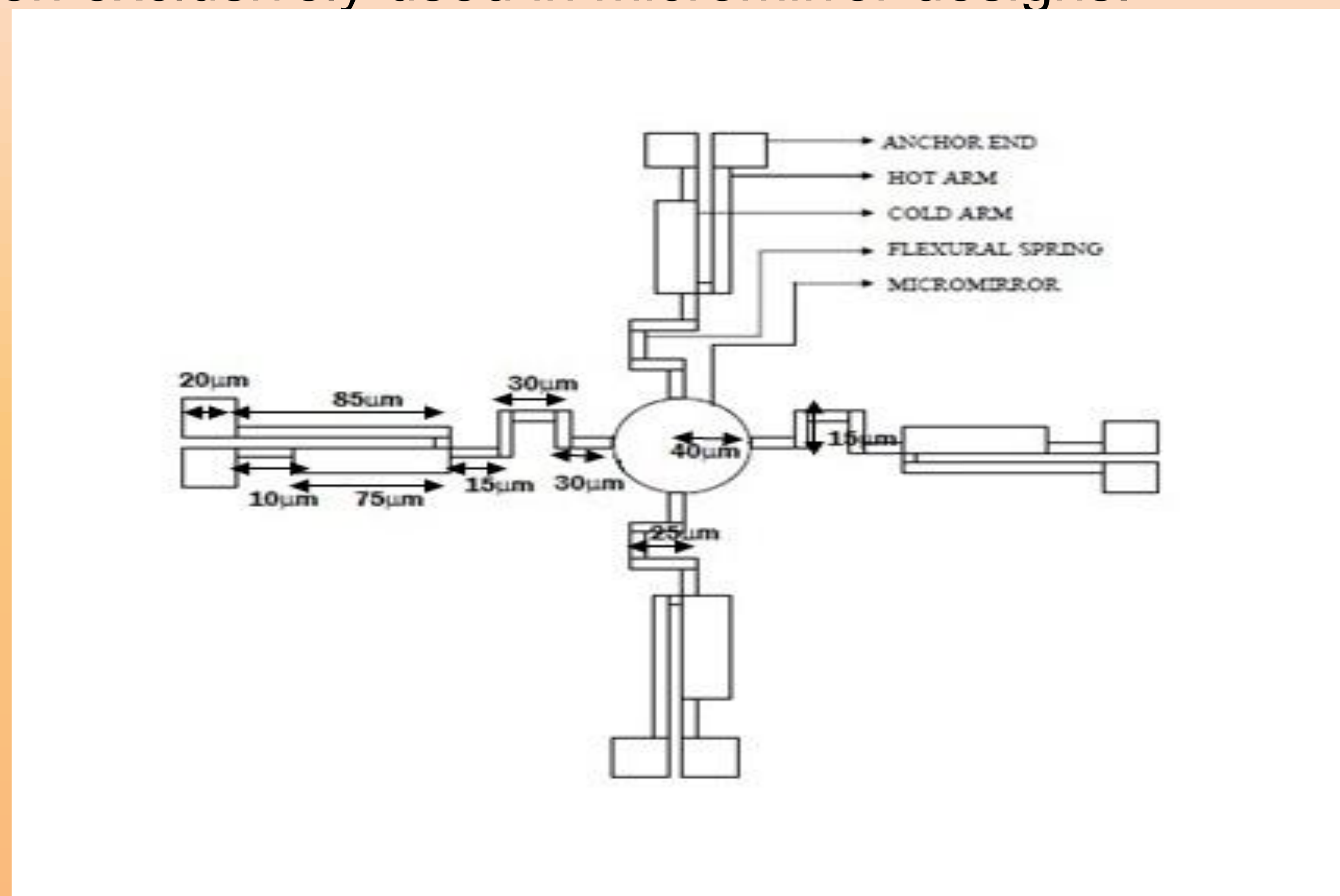


Figure 1. MEMS mirror with electrothermal actuators

Computational Methods: A 4-arm U-shaped actuator with a micromirror has been designed is shown in fig.1. When voltage is applied at the anchor end, an electric current passes through the cold and hot arms, the heat generated in the hot arm is much more than that of the cold arm. Due to ohmic heating, current density is higher in hot arm than in cold arm.

Results: By applying 10V, the maximum Stress obtained in the device is 3985 N/m².The stress increases exponentially with increasing voltage. The maximum Displacement is 3.65µm shown in fig.3 and its graph plot is shown in fig.5. The maximum current density obtained is 5388.6 A/m² is shown in fig.2 and its graph plot is shown in fig.4.

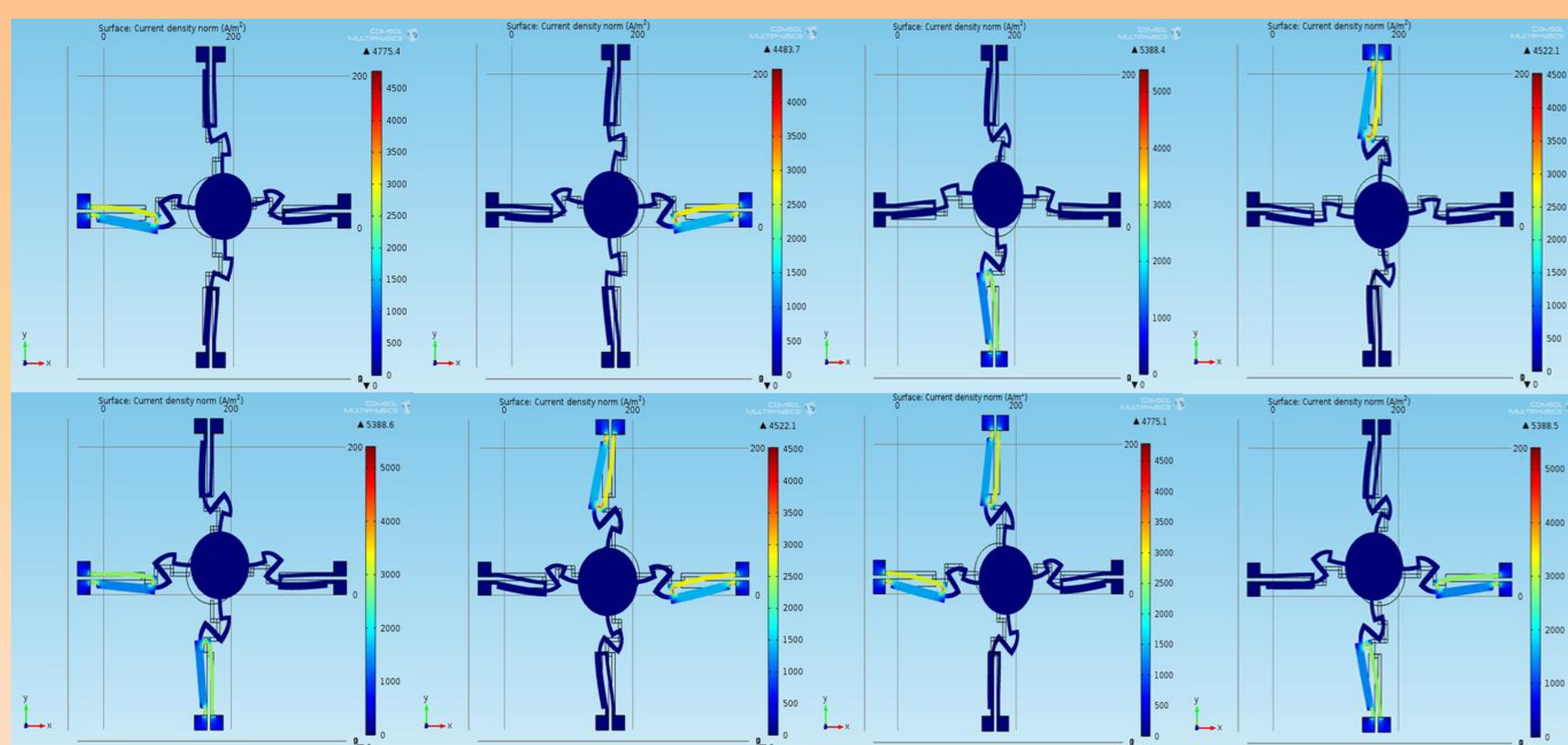


Figure 2. Current density obtained for 10V

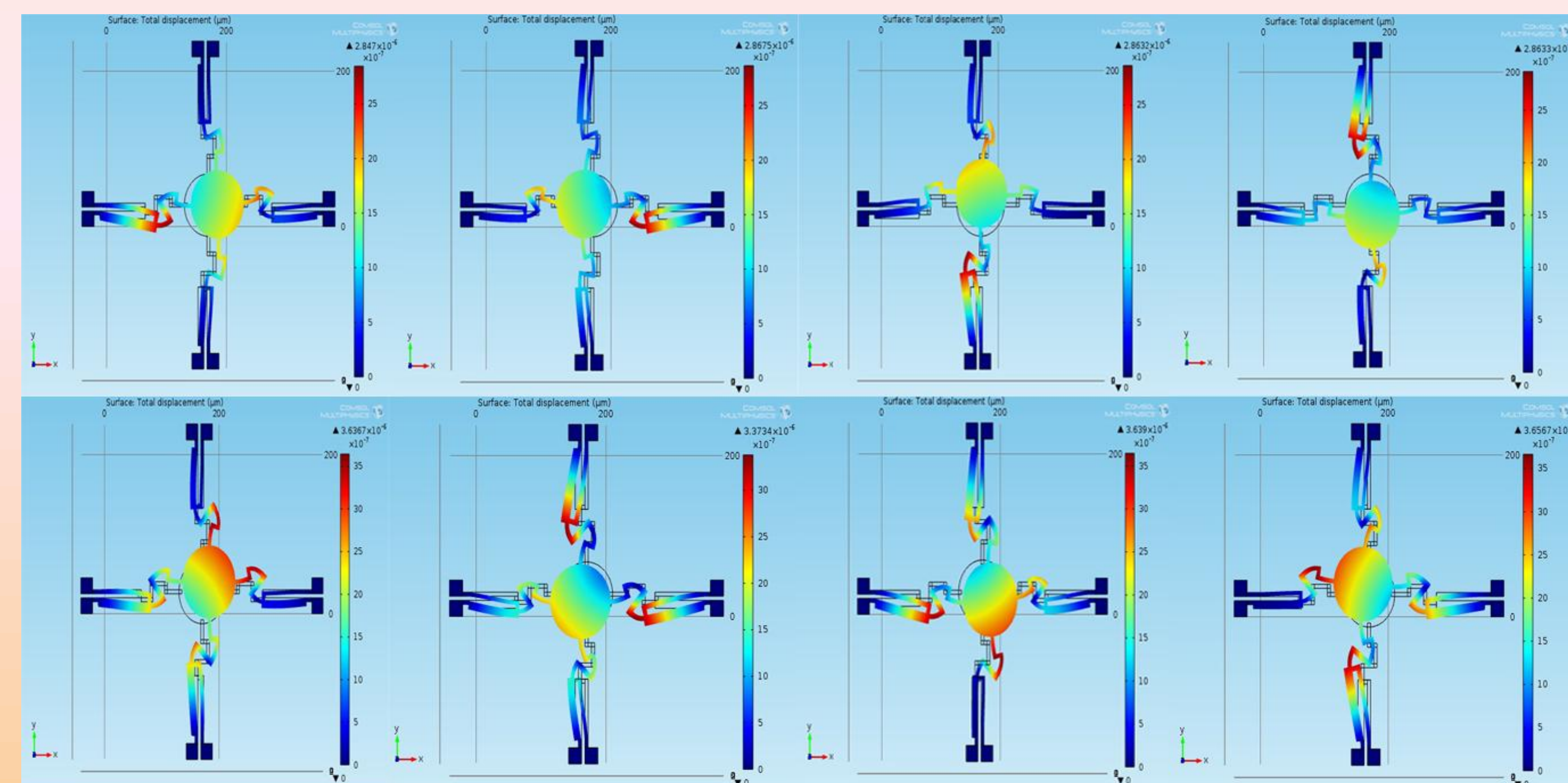


Figure 3. Displacement obtained for 10V

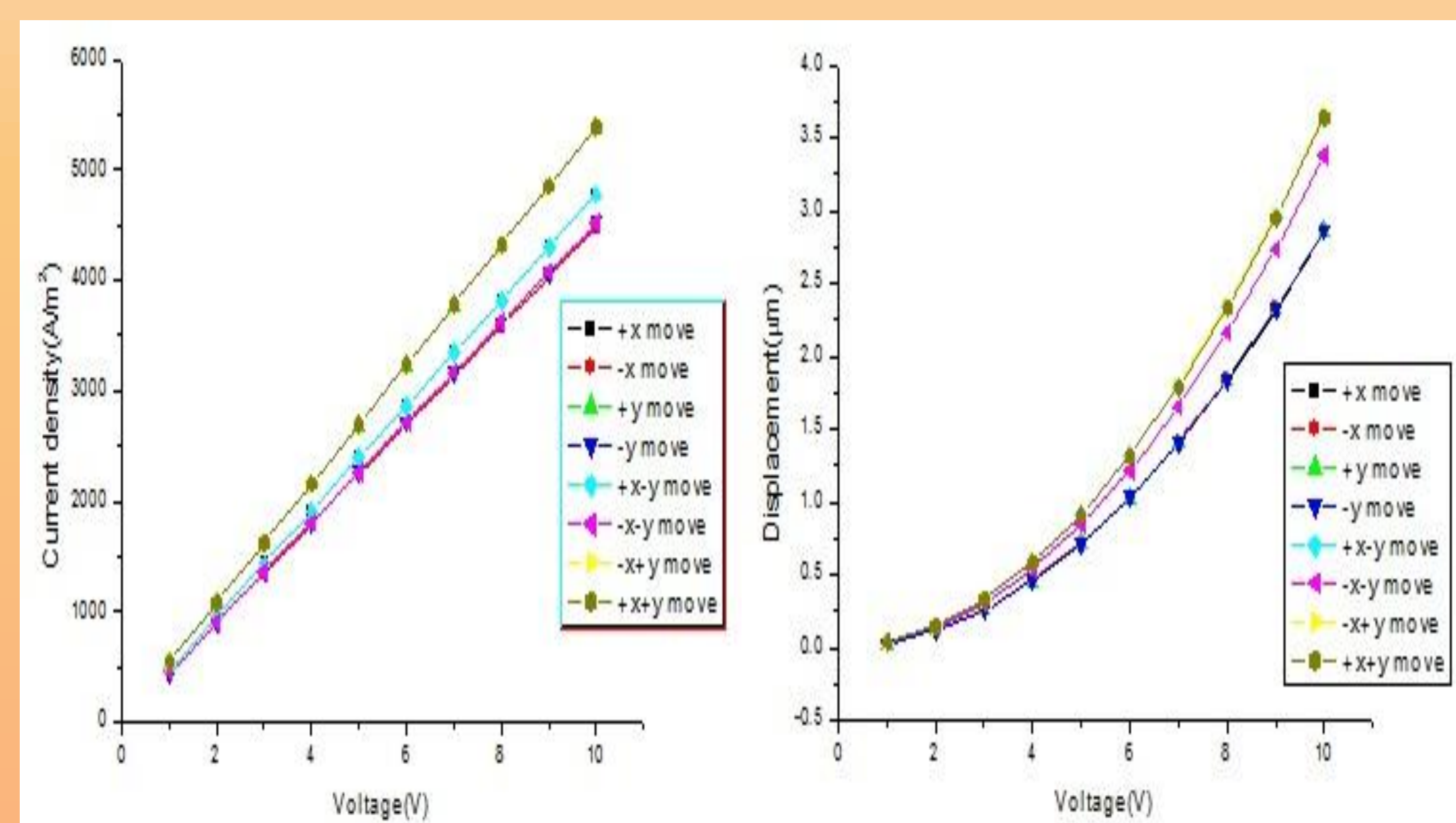


Figure 4. Voltage Vs Current density

Figure 5. Voltage Vs Displacement

Conclusions: MEMS based electro thermal actuators and micromirror was designed and its behaviour has been analysed using COMSOL Multiphysics 4.2a. The driving voltage is given in the anchor end which produces larger displacement. For various applied voltage, it produces displacements in eight different directions.

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References:

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