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By applying fixed boundaries to lower base of the rectangle so that the expansion only takes place in upwards direction. The region is shown in figure 2 colored grey. The remaining region shown as blue where heat flows can take place.

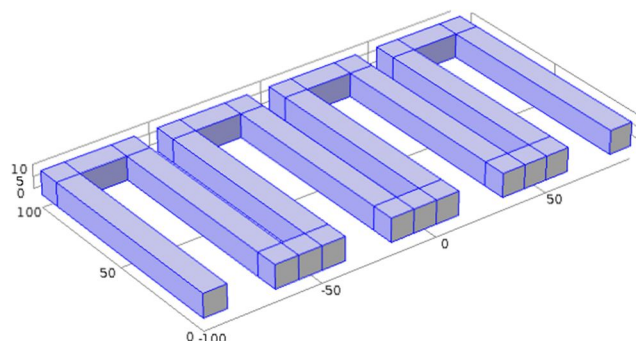


Figure 2: Fixed boundaries (lower base)

Figure 3 indicates applying of structural materials to the geometries found in green shading. A copper beryllium composite is connected to the device to analyze the thermal extension of the geometry. The thermal stress physics is applied to the device to analyze displacement of the device due to thermal expansion of device.

The heat flux is given conduction only. The heat source is a constant heat source of $1 \times 10^8 \text{ W/m}^3$. The air cooling at the limits is communicated utilizing a consistent warmth exchange coefficient of 7000 W/m^2 and a surrounding temperature of 298 K . The articulation for warm development requires strain reference temperature for the copper beryllium compound, which for this situation is 293 K . [6]

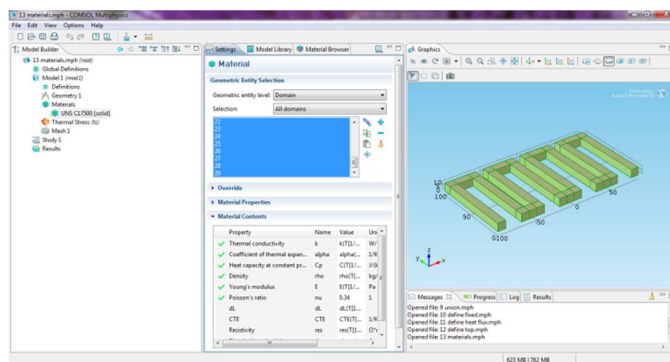


Figure 3: Applying material

Figure 4 shows the meshed geometry. Mesh generation is one of the most critical aspects of engineering simulation. Too many cells may result in long solver runs, and too few may lead to inaccurate results. COMSOL Meshing innovation gives a way to adjust these prerequisites and acquire the correct work for every recreation in the most robotized way possible

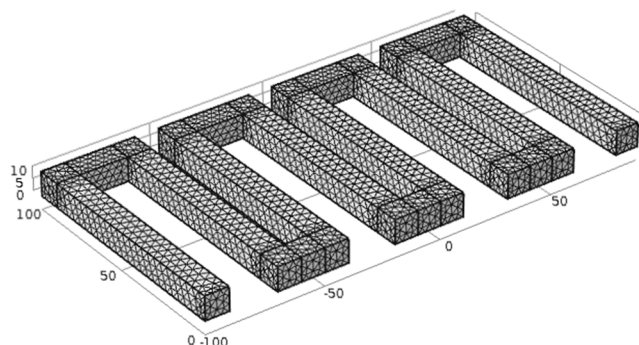


Figure 4: meshed geometry

III. RESULTS

When we utilize 298K as outer temperature then the greatest displacement is $0.0453 \mu\text{m}$ for the geometry. The accompanying figure 5 demonstrates the aggregate displacement in the device utilizing copper beryllium amalgam

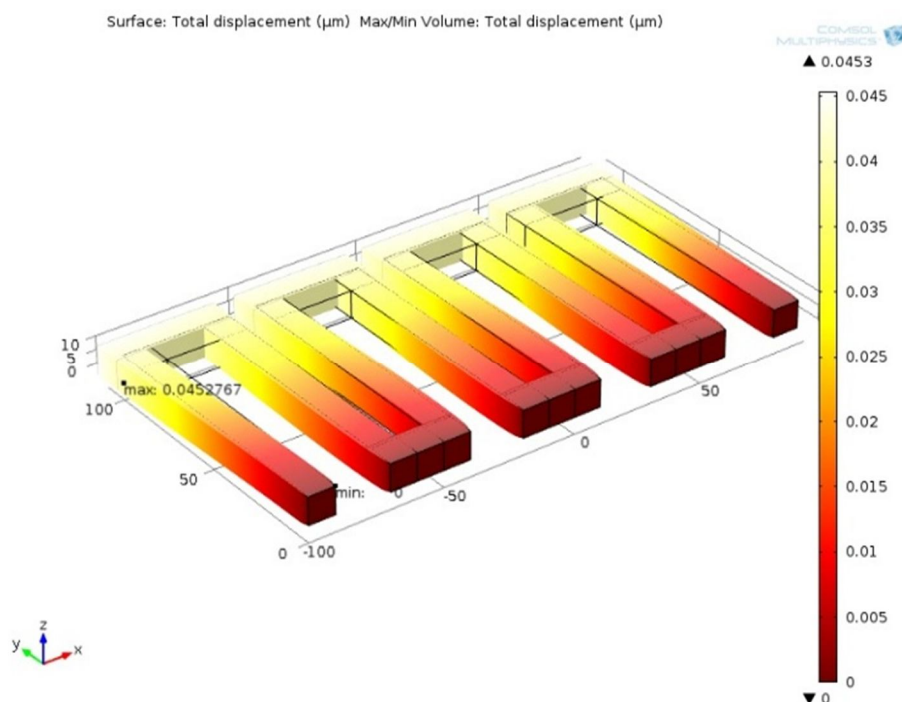


Figure5: Displacement of the Device

The accompanying figure demonstrates the displacement of a bend that takes after the top inward edges of the device from left to right

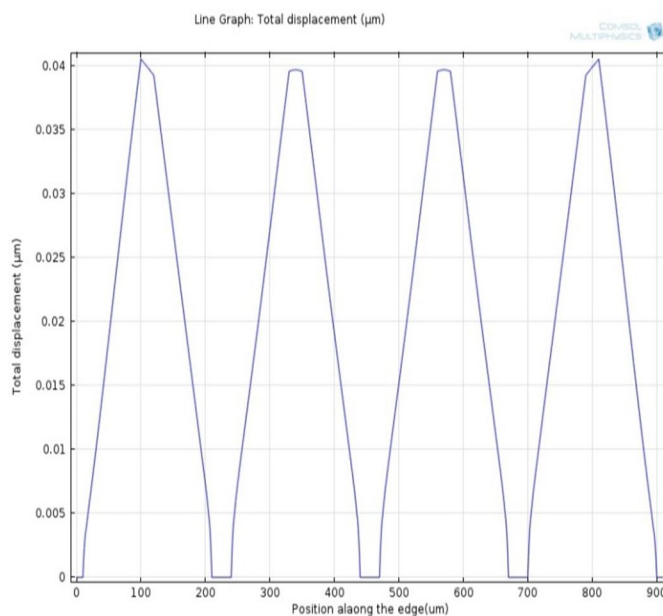


Figure6: Displacement vs Position graph

When we use 298K as external temperature then the maximum displacement is $0.0071 \mu\text{m}$ for the geometry. The following figure 7 shows the total displacement in the device using polysilicon.

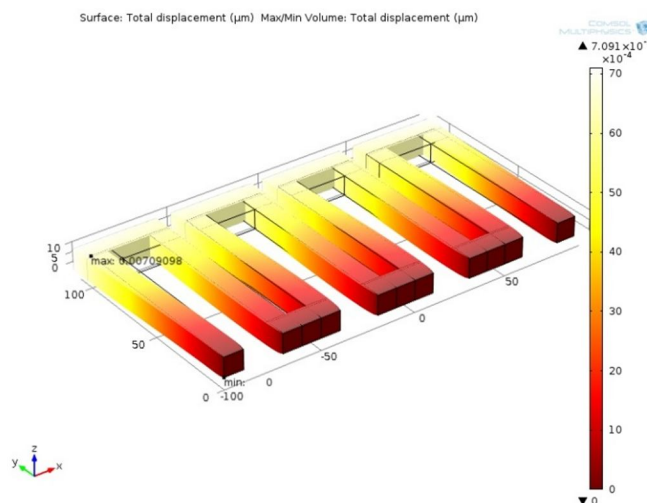


Figure7: Displacement of the Device

The following figure shows the displacement of a curve that follows the top inner edges of the device from left to right.

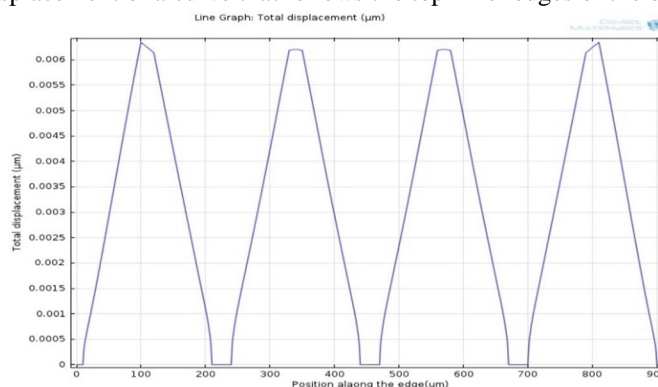


Figure8: Displacement vs Position graph

When we use 298K as external temperature then the maximum displacement is 0.0642 μm for the geometry. The following figure 9 shows the total displacement in the device using aluminum.

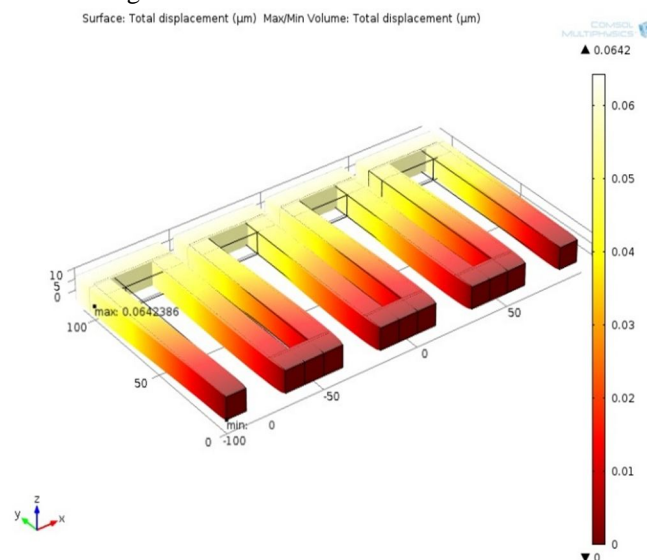


Figure9: Displacement of the Device

The following figure shows the displacement of a curve that follows the top inner edges of the device from left to right.

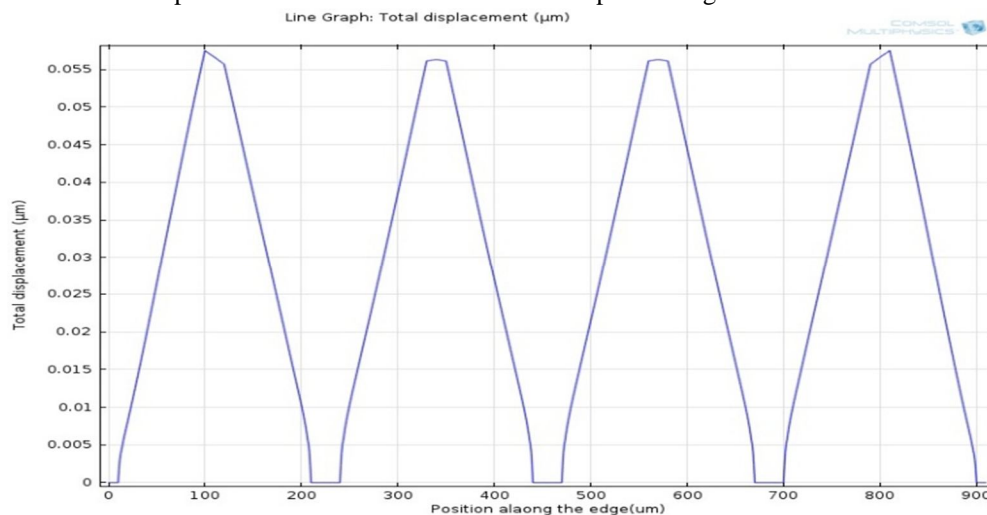


Figure10: Displacement vs Position graph

When we use 298K as external temperature then the maximum displacement is $0.0709 \mu\text{m}$ for the geomtry. The following figure 11 shows the total displacement in the device using magnesium.

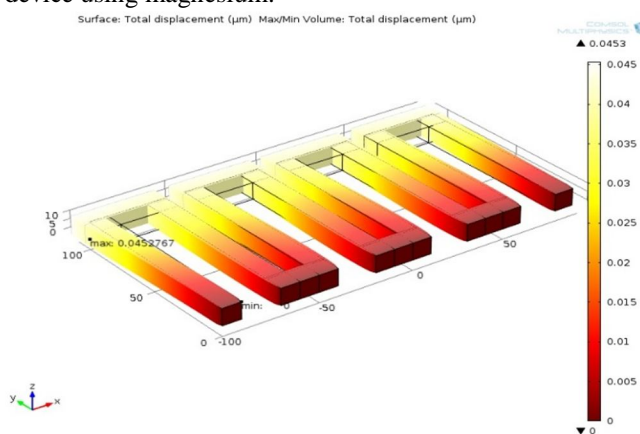


Figure11: Displacement of the Device

The following figure shows the displacement of a curve that follows the top inner edges of the device from left to right.

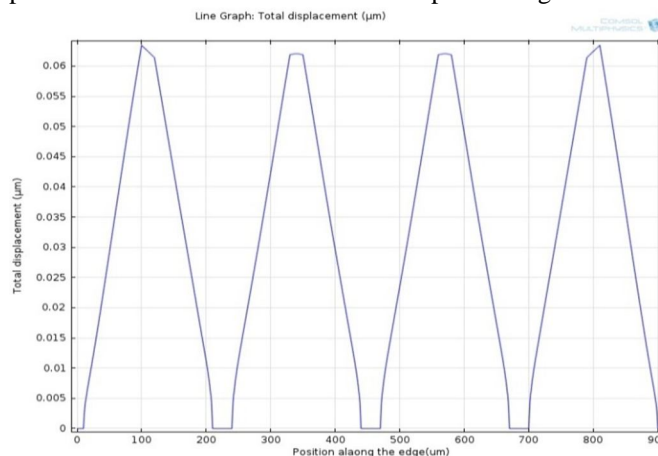


Figure12: Displacement vs Position graph

When we use 298K as external temperature then the maximum displacement is $0.0812 \mu\text{m}$ for the geomtry. The following figure 13 shows the total displacement in the device using lead.

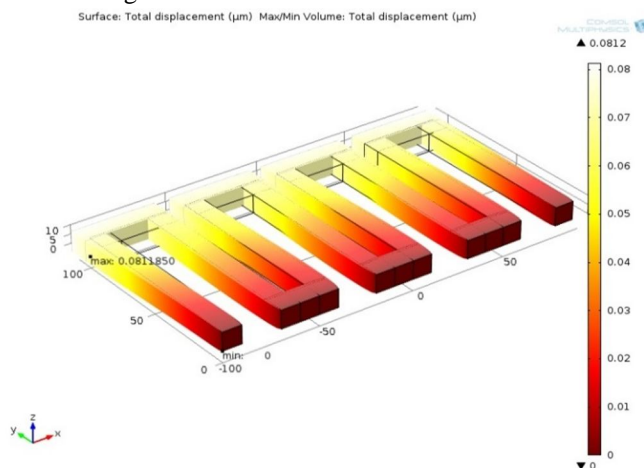


Figure13: Displacement of the Device

The following figure shows the displacement of a curve that follows the top inner edges of the device from left to right.

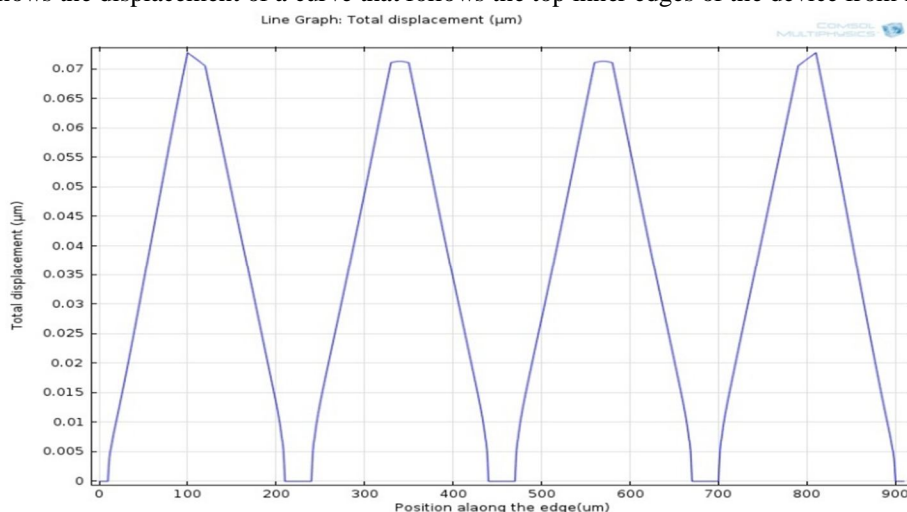


Figure14: Displacement vs Position graph

When we use 298K as external temperature then the maximum displacement is $41 \mu\text{m}$ for the geomtry. The following figure 15 shows the total displacement in the device using SU8.

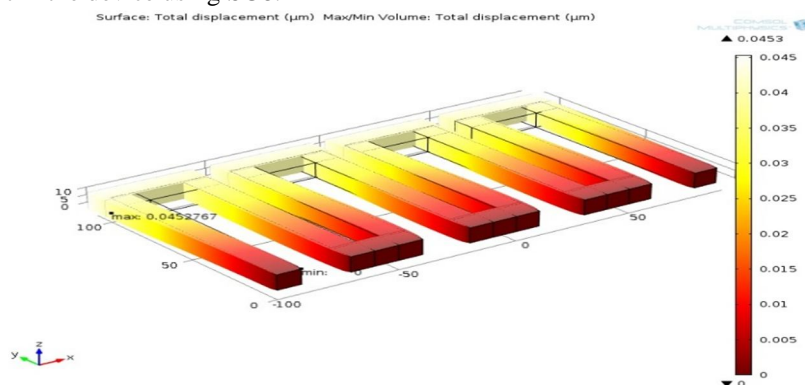


Figure15: Displacement of the Device

The following figure shows the displacement of a curve that follows the top inner edges of the device from left to right.

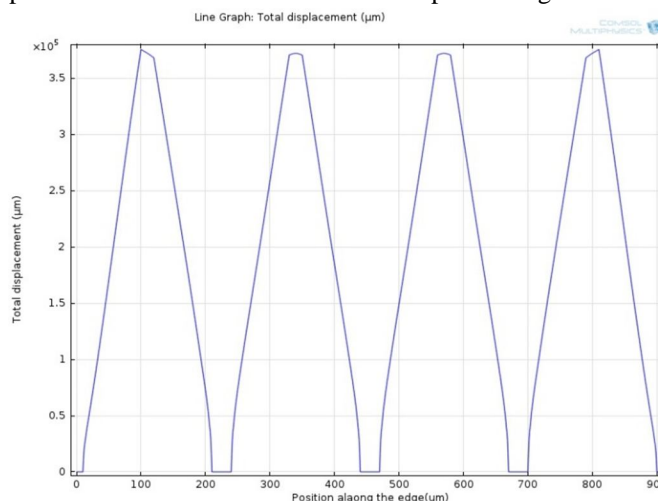


Figure16: Displacement vs Position graph

IV. CONCLUSION

It is concluded that when we utilize 298K as outside temperature and copper beryllium composite as structural material then the most extreme displacement is $0.0453 \mu\text{m}$ for the geometry. When we utilize same outside temperature and poly silicon as structural material then the most extreme displacement in the device is $0.0071 \mu\text{m}$. Again with same outside temperature and aluminum as structural material then the greatest displacement in the gadget is $0.0642 \mu\text{m}$. With same outside temperature and magnesium as structural material then the most extreme displacement in the device is $0.0709 \mu\text{m}$. When we utilize 298K as outer temperature then the most extreme displacement is $0.0812 \mu\text{m}$ for the device utilizing lead as structural material. When we employ SU8 as structural material with 298K as external temperature then the highest displacement is $41 \mu\text{m}$ for the geometry, which is very lofty as compared to other materials. So we conclude that by using SU8 as structural materials we can get high level of displacement in thermal actuators.

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