

# Analysis and Design Optimization of Laterally Driven Polysilicon Electrothermal Microgripper for Micro objects Manipulation

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**Introduction:** Electrothermal mechanism is widely used in MEMS as it provides large displacement at low voltage. Electrothermal microgripper is composed of two “hot-and-cold arm actuator” as shown in figure 1. It is widely used for pick and place purposes and find application in microrobotics, microsurgery, microfluidics.

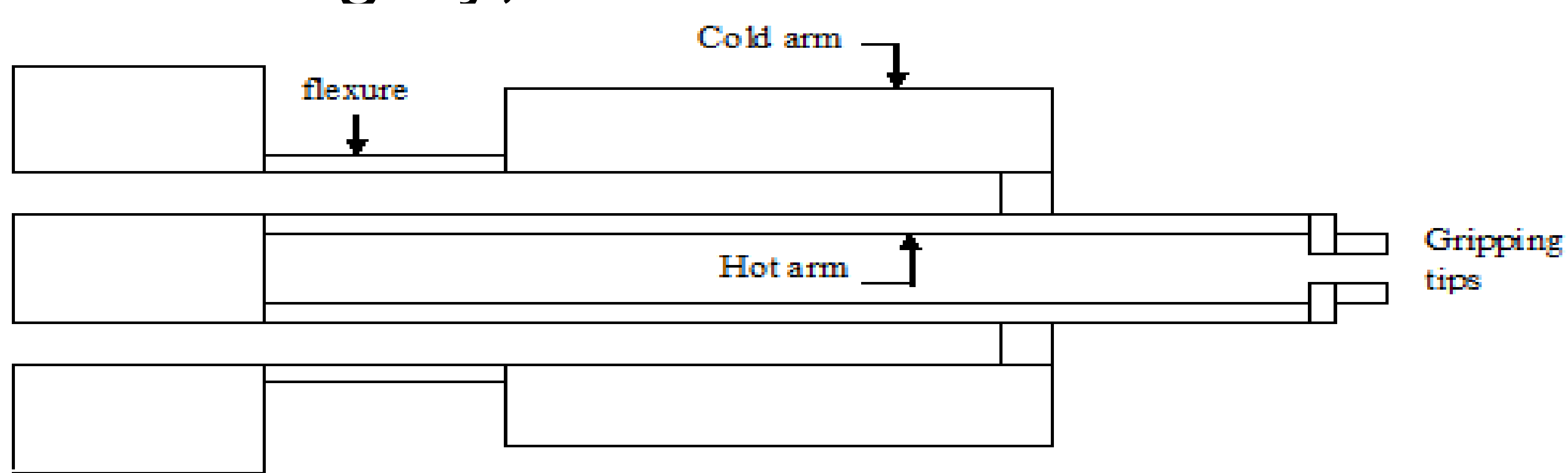


Figure 1. Design of Microgripper

**Computational Methods:** Electrothermal actuation is based on the concept of Joule heating given as:  $H=I^2R$  where  $I$  is the current flowing through the arms,  $R$  is the resistance of the arms.  $R$  is related with the dimensions as:  $R=\rho L/A$ , where  $\rho$  is the resistivity of the material,  $L$  is the length of the arm and  $A$  is the area of cross-section. One of the main advantage of this design of the microgripper is that the gripping tips remain at the room temperature as shown in figure 2. The geometry of the microgripper is optimized to explore its performance. The length of the hot arm and gap between the hot and cold arm is v

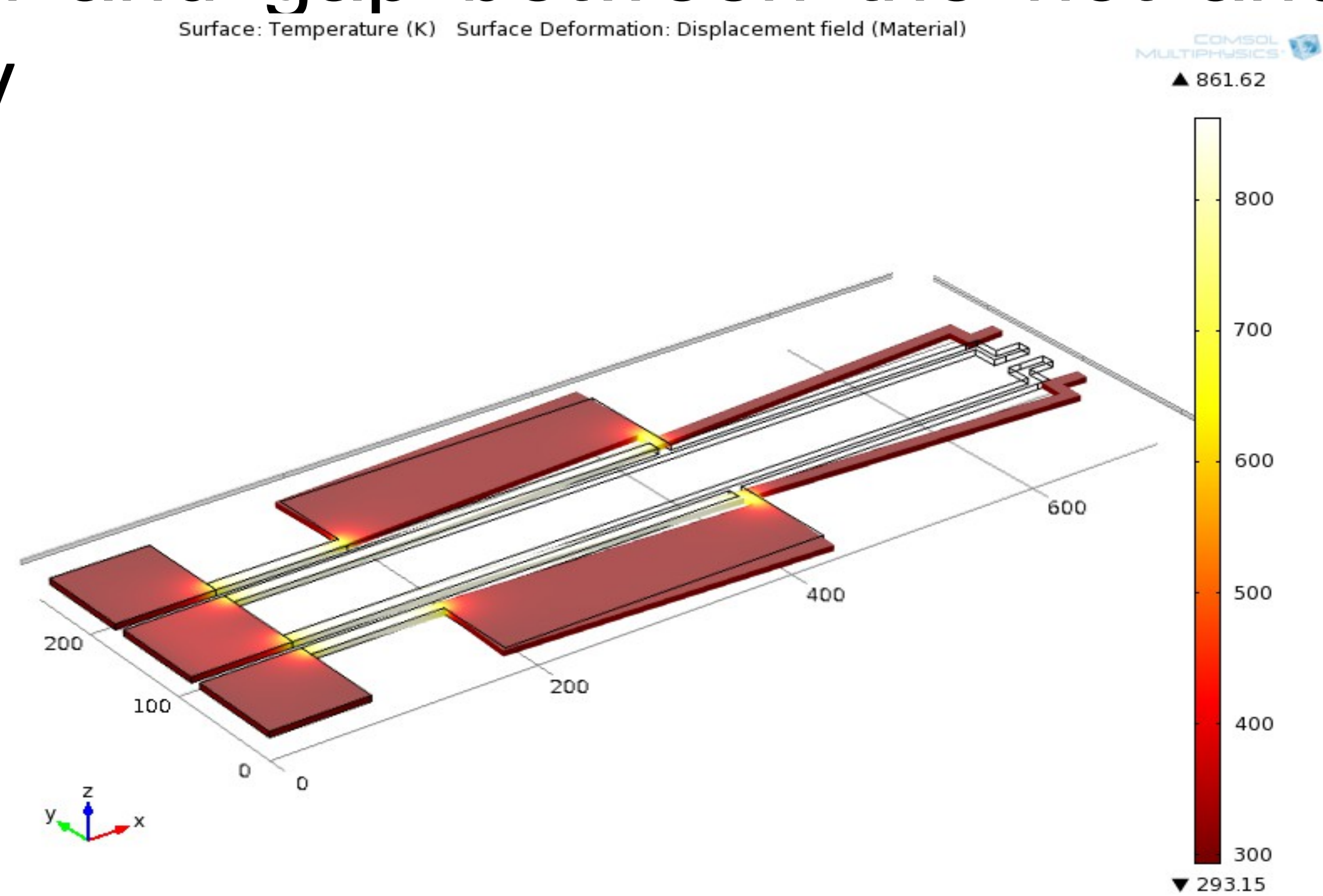


Figure 2. Temperature Profile of the Microgripper

**Results:** The length of the hot arm( $L_h$ ) is varied from 500 $\mu$ m to 700 $\mu$ m and the gap between the hot and cold arm( $G_b$ ) is varied from 15 $\mu$ m to 5 $\mu$ m, and the corresponding displacements shown in table 1.

Variation of Hot Arm Length

Hot arm length ( $\mu$ m)	Displacement( $\mu$ m)
500	7.36
600	7.7
700	11.08

Variation of Gap between the Arms

Gap( $\mu$ m)	Displacement( $\mu$ m)
15	6.71
10	7.7
5	9.22

Table 1. Variation of Displacement

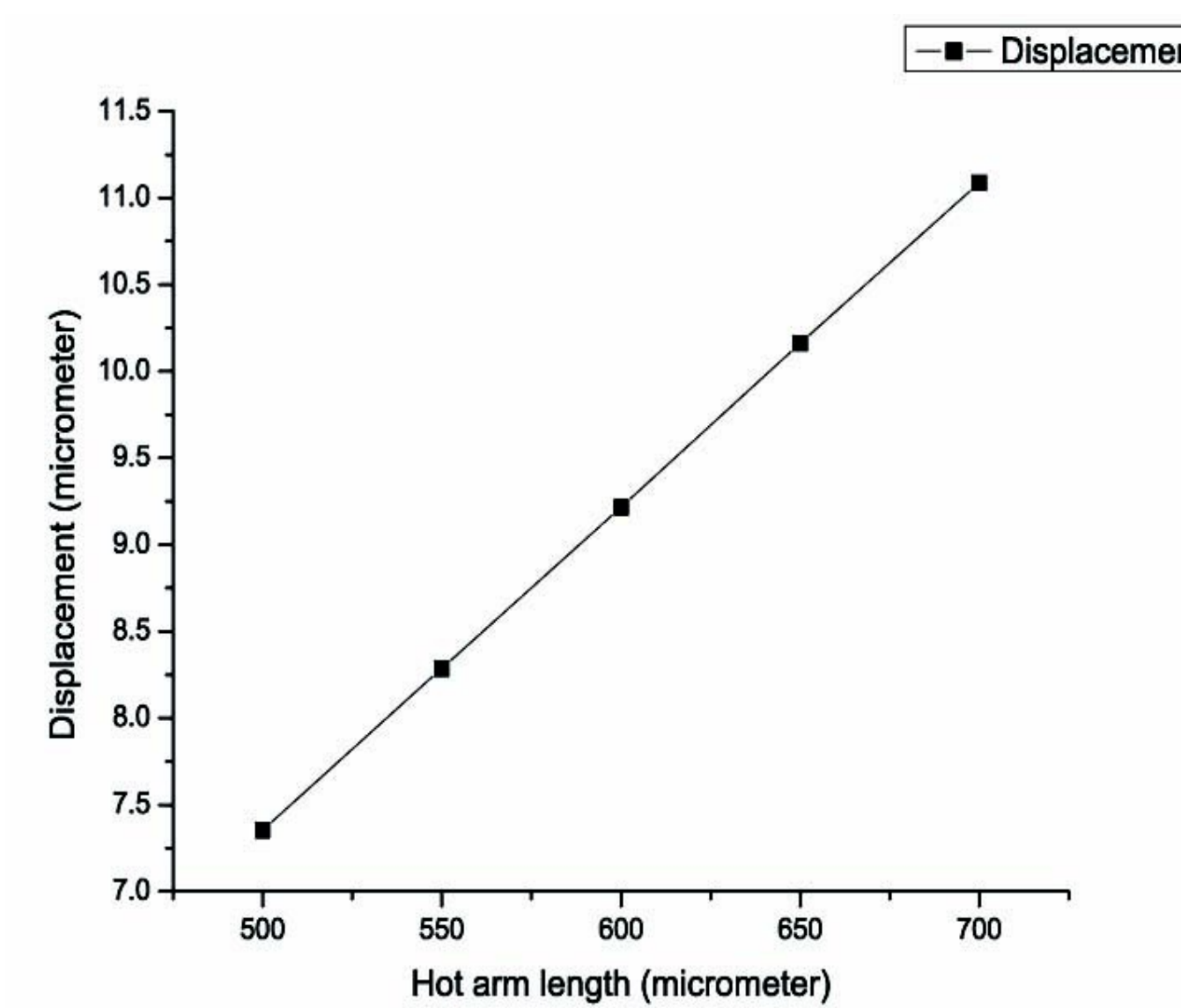


Figure 4. Displacement vs.  $L_h$

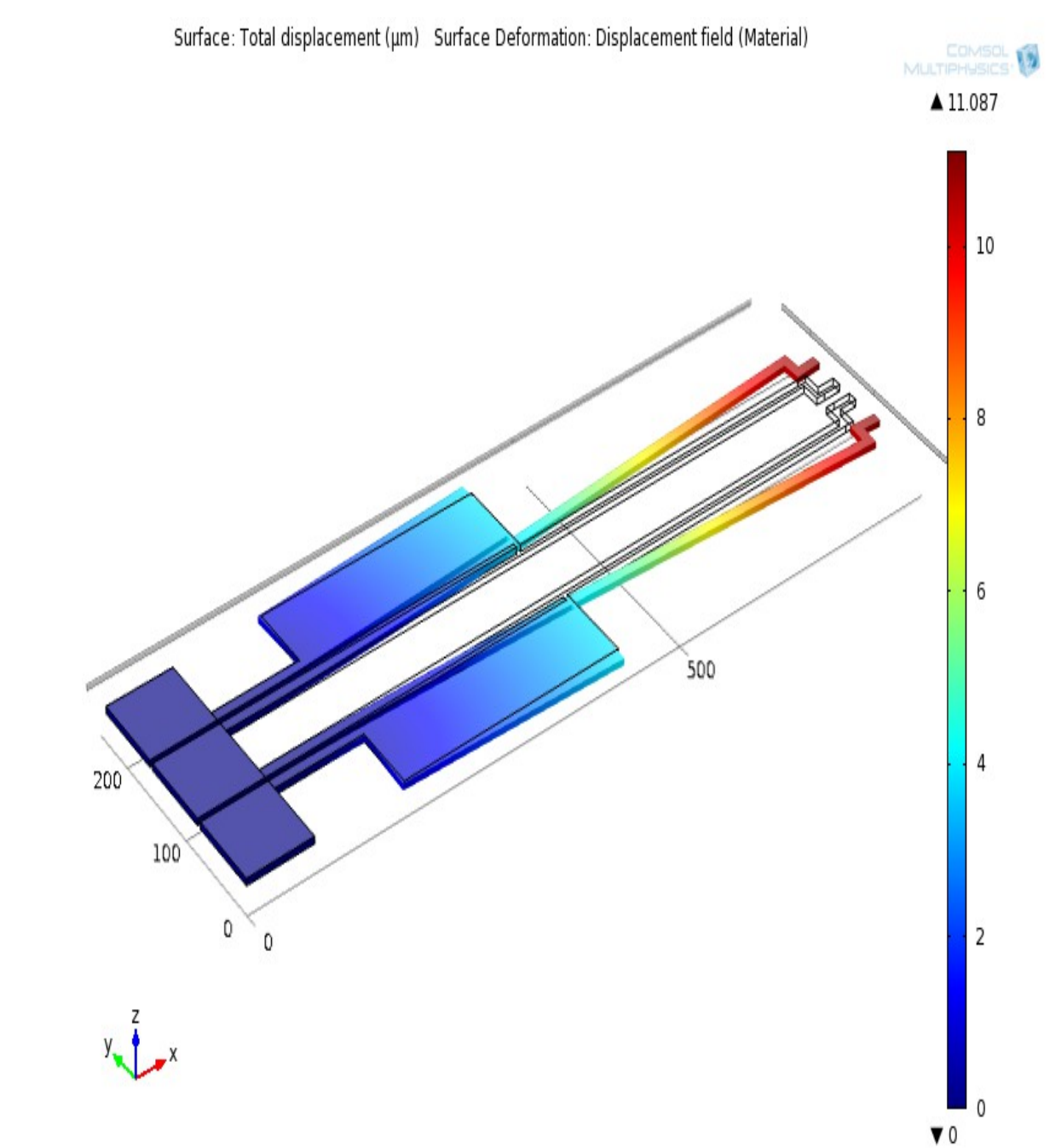
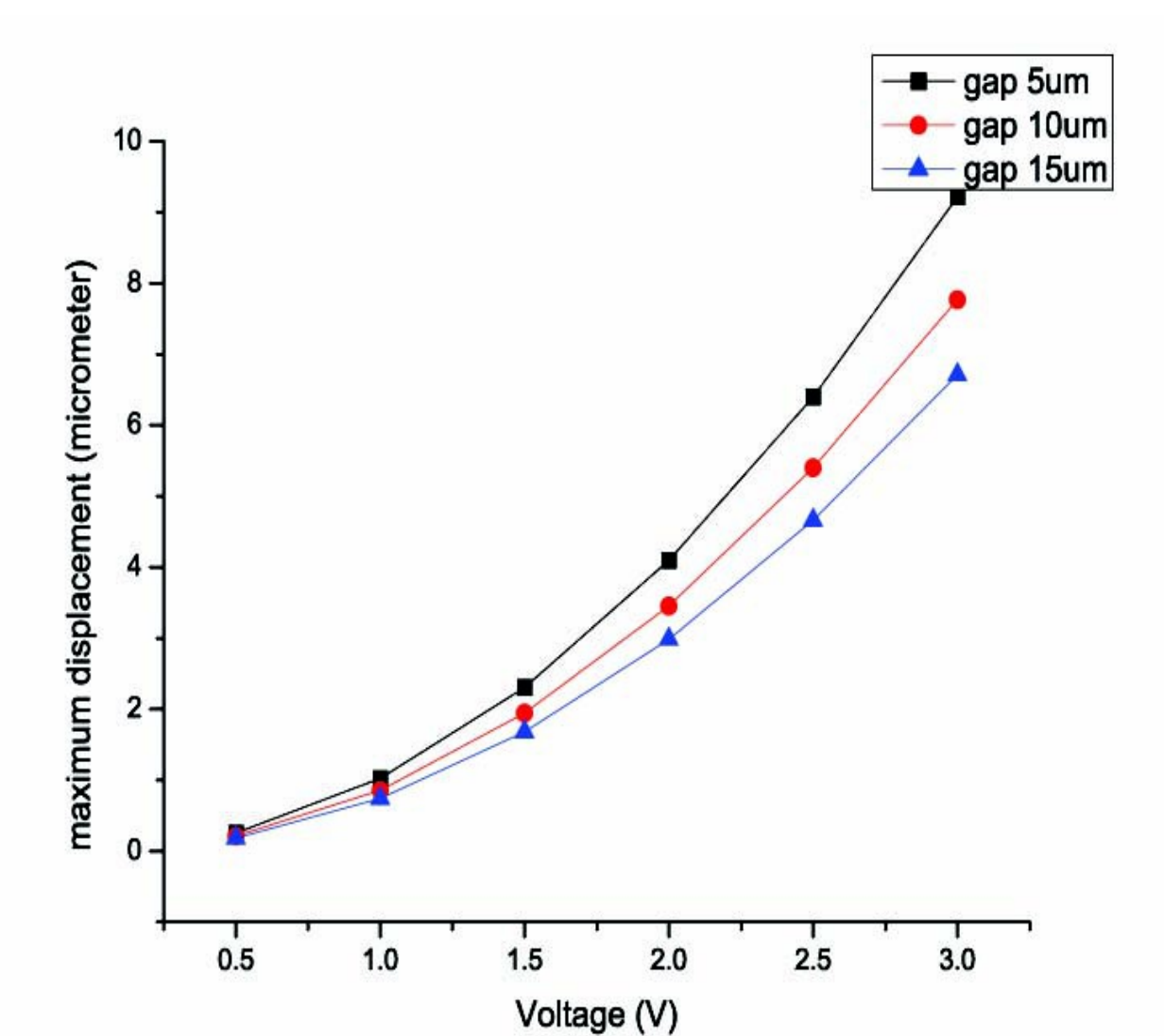


Figure 3. Displacement with.



**Conclusions:** Longer hot arms and narrower gaps between the hot and cold arm results in greater displacements. Further improvements can be realized by varying the other dimensions of the gripper.

## References:

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