MEMS Micro Motor Powered By Laterally Driven Thermal Actuator

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Abstract

Over the years micro motors have grown in prominence due to their compact nature. Mainly there are two types of micro motors - electromagnetic micromotors and electrostatic micromotors. In this study, an alternate type of micromotor powered by thermal actuator was designed and investigated. This novel micromotor is based on the crank rocker mechanism and it was investigated for its design, working principle and the fabrication process. In this, the thermal actuator converted the thermal energy in the circuit into linear motion. This linear motion in the thermal actuator was converted into rotatory motion upon contact with the four-bar linkage. The temperature variations in the thermal actuator were recorded as a function of the variations in the input voltage. Due to the joule losses, increasing the input voltage led to an increase in the temperature and thermal expansion of the thermal actuator. This thermal expansion led to structural displacement of the thermal actuator and the variations of this displacement with respect to the input voltage were recorded. These structural deformations in the thermal actuator were made use of to attain a displacement in the crank rocker so as to attain a rotatory motion in one of its arms - which acted as a micromotor.

Reference

[1]. W, Zhang et al, Electrostatic micromotor and its reliability, Microelectronics Reliability, Volume 45, 1230-1242 (2005)
[2]. L, Fan et al, Integrated Movable Micromechanical Structures for Sensors and Actuators, IEEE Transactions on Electron Devices, Volume 35, 724-730 (1988)
[3]. SK, Roy, A Survey Mems Micromotor Assemblies & Applications, International Journal of Engineering Research and General Science, Volume 3, 59-62 (2015)
[4]. RL, Tarazón, In Micromanufacturing Engineering And Technology (Second Edition) (2015)
[5]. GR, Liu et al, In The Finite Element Method (Second Edition) (2014)

Figures used in the abstract

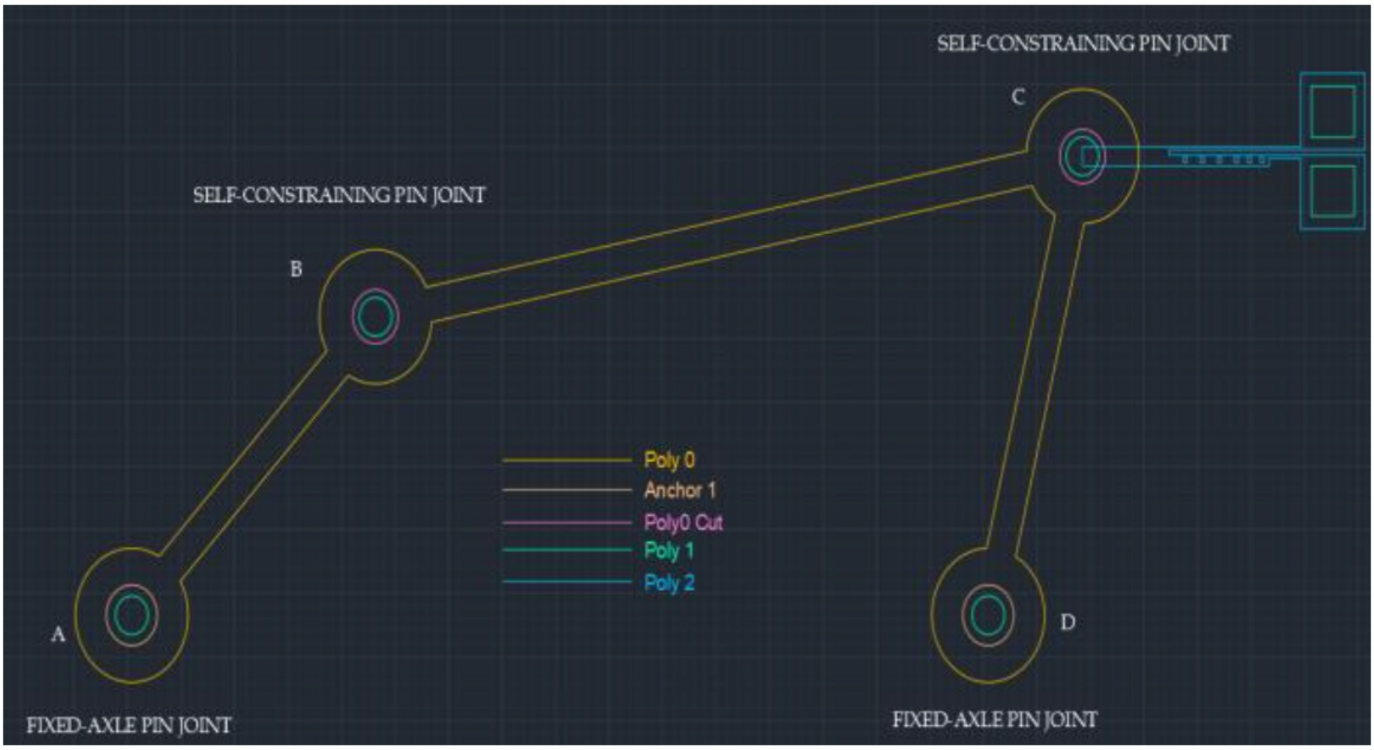

Fig. 1: Design Layout for Fabrication of Micromotor

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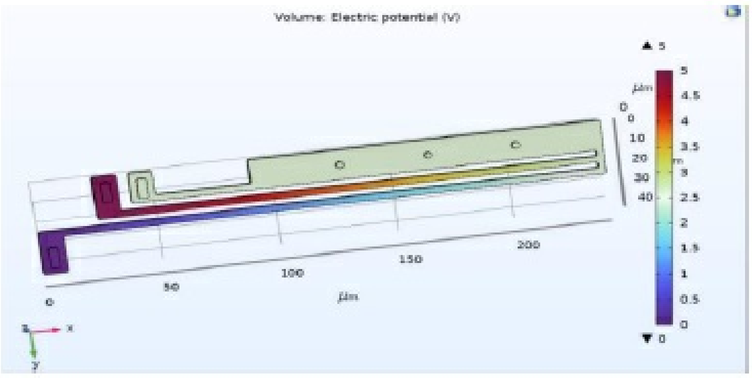

Fig. 5: Electric Potential across Thermal Actuator

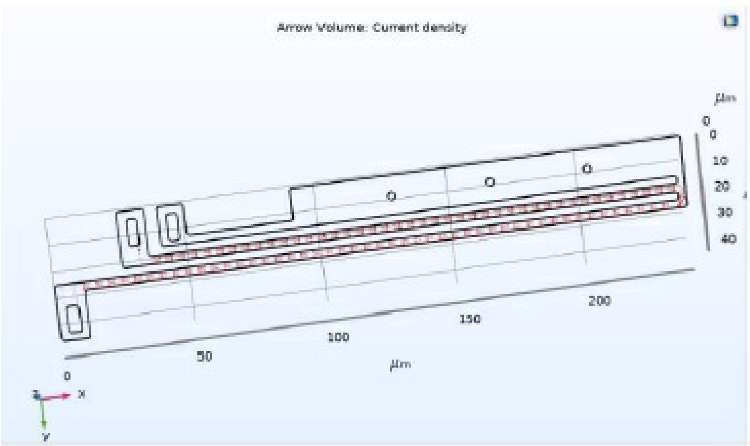

Fig. 6: Movement of Current Density across Thermal Actuator

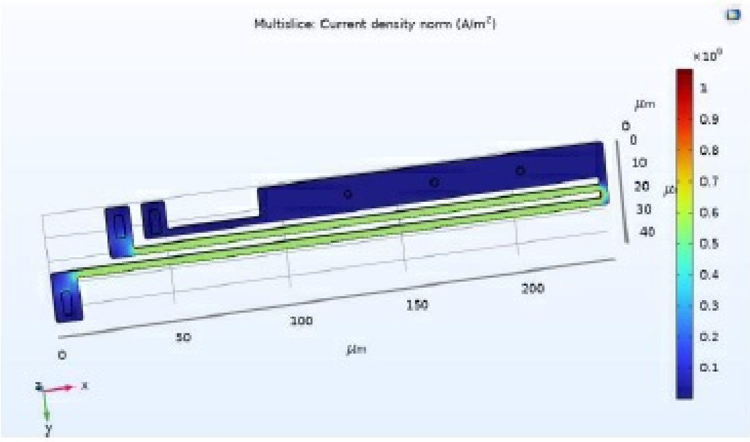

Fig. 7: Current Density Norm across Thermal Actuator

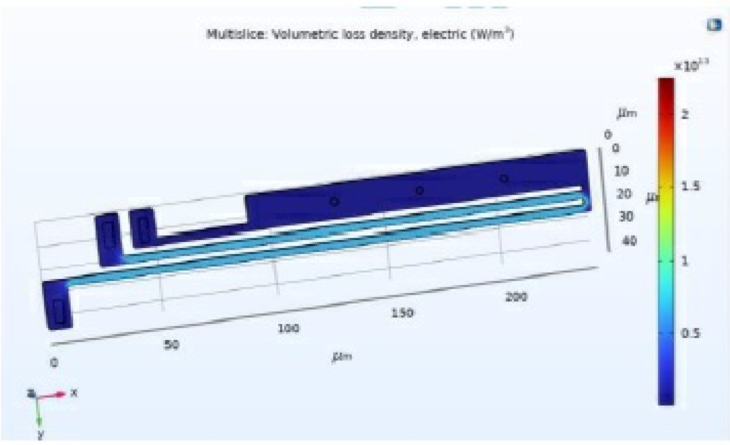

Fig. 8: Volumetric Loss Density across Thermal Actuator

Figure 2 : Electrical Simulations

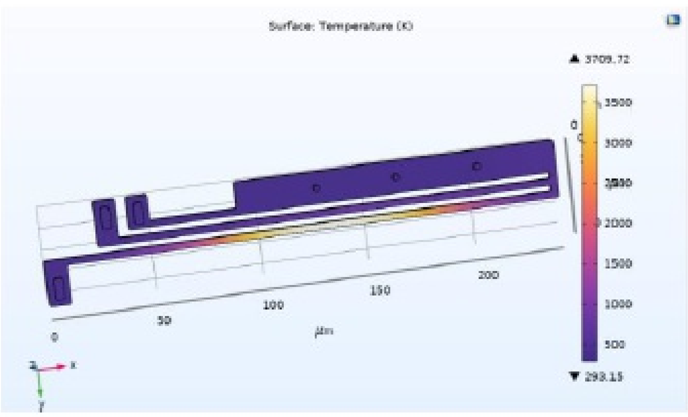

Fig. 9: Surface Temperature of Thermal Actuator

Figure 3 : Thermal Simulation

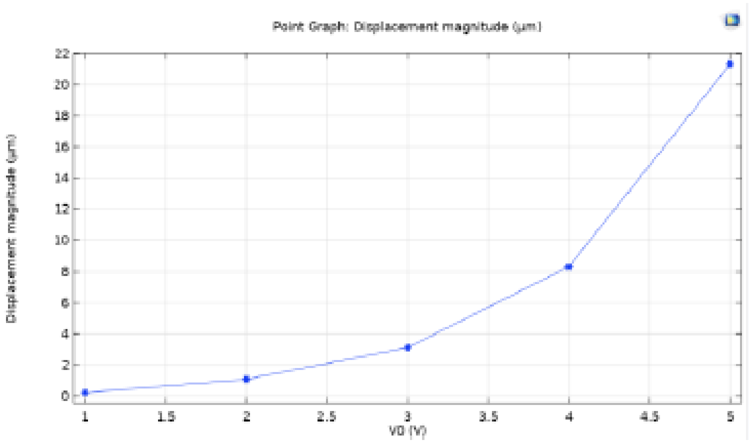

Fig. 12: Plot of Displacement with 1-5V input voltage

Figure 4 : Structural Simulation