Modeling and Analysis of Thermal Bimorph Using COMSOL Multiphysics®

Rachita Shettar[1], Dr B G Sheeparamatti[1]
1. Basaveshwar Engineering College, Bagalkot, Karanataka, India

Introduction: The main objective of this work is to investigate the maximum deformation in bimorph actuator for varying temperatures. Deformation increases with increase in length of actuator. Thus, temperature produces thermal strain and thermally induced deformation and this makes the microstructure into a thermal actuator.

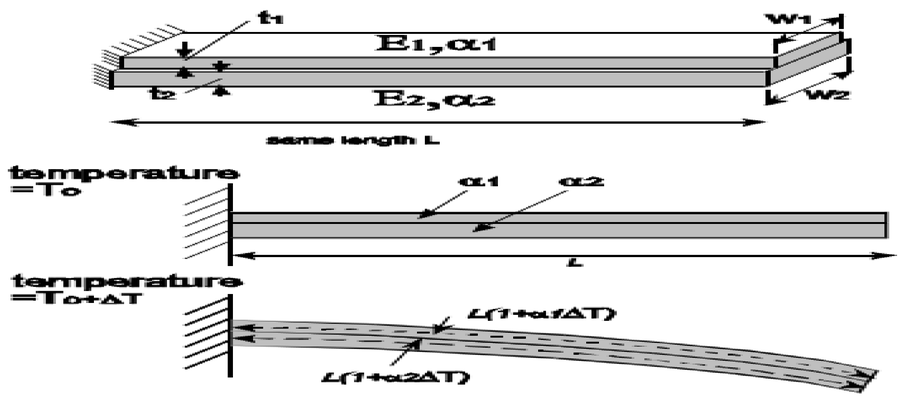

Figure1 Thermal bimetallic bending ($\alpha_1 > \alpha_2$)

Computational Methods: Let beam curves under uniform change in temperature of ΔT, assume the shape of the section of an arc with length of the arc being L. The radius of curvature of the arc **r** can be calculated using this formula.

$$\frac{1}{r} = \frac{6 w_1 w_2 E_1 E_2 t_1 t_2 (t_1 + t_2)(\alpha_1 - \alpha_2)\Delta T}{(w_1 E_1 t_1^{\,2})^2 + (w_2 E_2 t_2^{\,2})^2 + 2 w_1 w_2 E_1 E_2 t_1 t_2 (2t_1^{\,2} + 3t_1 t_2 + 2t_2^{\,2})}$$

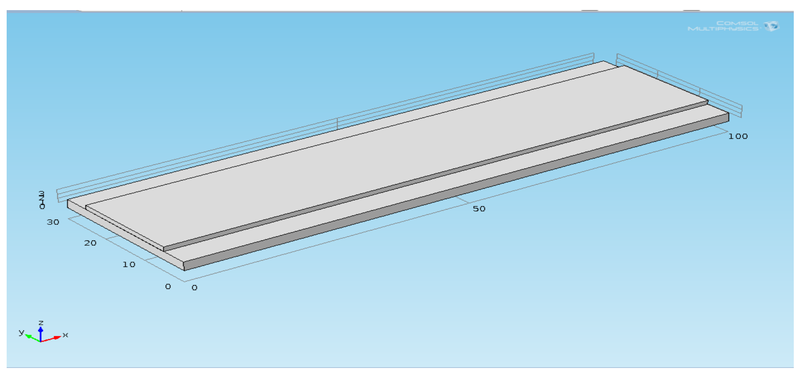

Figure 2 Geometry of thermal bimorphs actuator using COMSOL

Results:

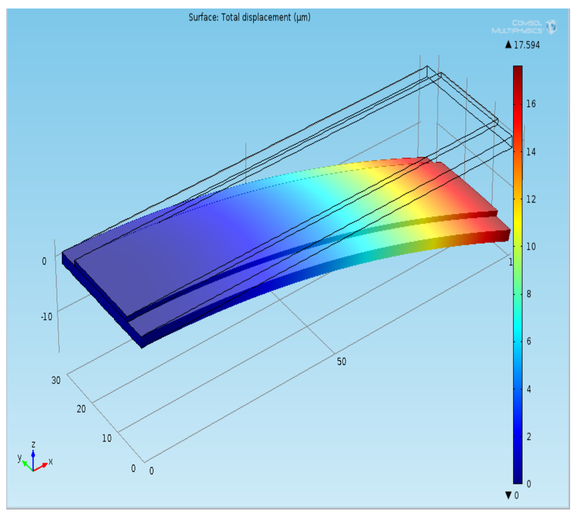

Figure 3 Total displacement is 17.594μm

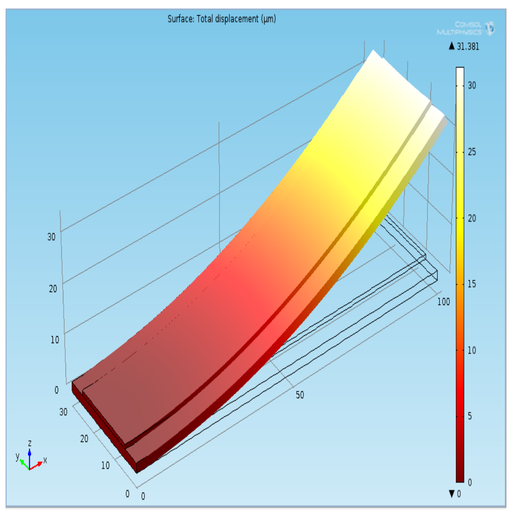

Figure 4. Temperature distribution

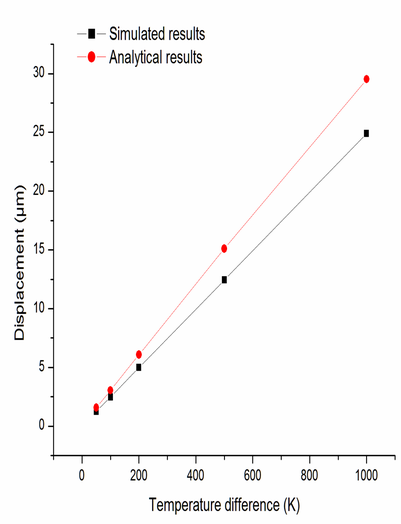

Figure 5. Comparison of Simulated and analytical

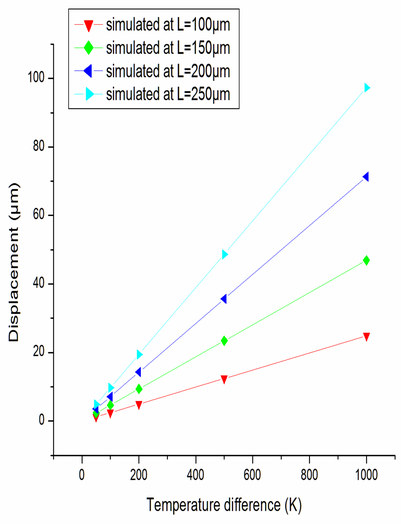

Figure 6 increase in deformations

Conclusions: The modeling and simulation results of a thermal bimorph is capable of producing increasing displacement for varying temperatures.

References:

1. Sagnik Pal and Huikai Xie, “Analysis and Simulation of Curved Bimorph Microactuators” ISBN 978-1-4398-3402-2 Vol 2,2010
2. Younghnk Cho, Beomjoon Kim, Seokkwan Hong, Jeongjin Kang, “Fabrication and Characterization of thermally actuated bimorph Probe for Living Cell Measurements with Experimental and Numerical Analysis” Vol 20 No 3, pp 297-309,2006.
3. Chang Liu, “*Foundations of MEMS*”, Pearson International Edition, 2006.