CLEMSON MECHANICAL ENGINEERING

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Design Optimization to Improve Thermal Sensitivity of Bimetallic Beam

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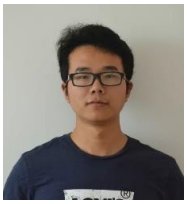
Biography

I got my B.S. degree in June, 2013, in Wuhan University of Technology in China and M.S. degree in May, 2016, in University of Louisiana at Lafayette in USA. My research interests focus on material & structure design and Finite Element Analysis.



Overview

In this presentation, design and optimization of bimetallic cantilever beam under thermal loading using analytical and numerical models are presented. In order to achieve a higher thermal sensitivity, larger tip deflection of the bimetallic beam without failure is set to be the objective of this study. Material and geometry parameters, such as Coefficient of Thermal Expansion(CTE), Young's modulus, width and thickness ratio, are studied. Based on their effects on the deflection, optimal combinations of Young's modulus ratio and thickness ratio are presented. Furthermore, structure design is introduced to further improve the thermal sensitivity. The effect of periodic vacancies with various sizes, distributions and shapes is investigated.

Motivation

Bi-material cantilever beam has been utilized in the characterization of physical parameters such as humidity, temperature, and coefficient of thermal expansion(CTE). In order to improve the thermal sensitivity of bimetallic cantilever beam, as well as the temperature sensor in the future, this study was carried out.

State of the Art

Several analytical mathematical models have been established to calculate the curvature and tip deflection. The effect of some material parameters have been investigated. However, optimization of material properties and geometry is still not fully explored.

Intellectual Merit

The problem addressed in this study is the material optimization and structure design of thermal sensor made of bimetallic cantilever beam.

Broader Impact

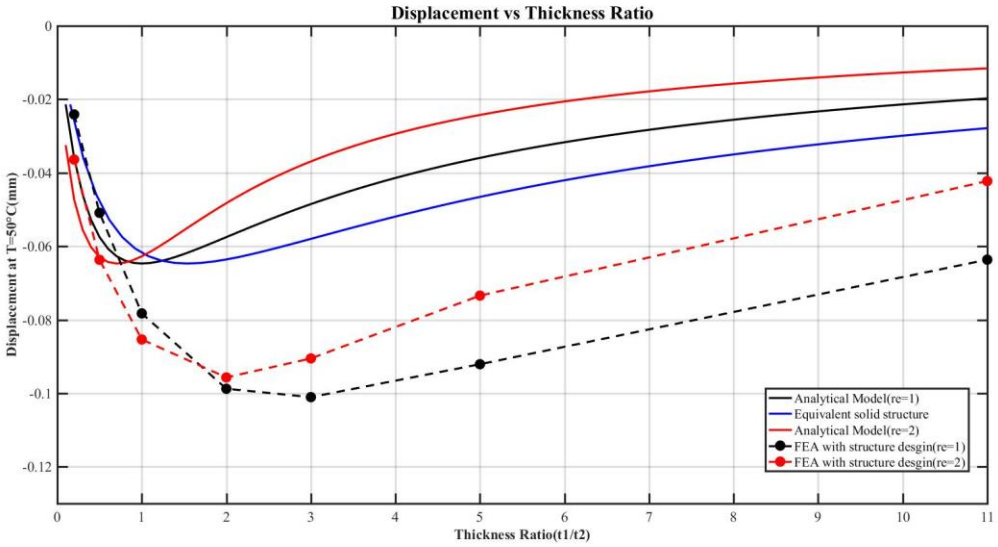
Material optimization and structure design aims at achieving optimal performance at lowest cost, enormously increasing the benefit of manufacturing industry.

Research Approach

Finite Element Analysis and Orthogonal method.

Findings to Date

Results show that the material optimization will increase the thermal sensitivity several times and structure design will improve the thermal sensitivity by about 100%.



Conclusions

A complete methodology to optimize material properties and design geometry is expected. The methodology should be able to be employed to any general anisotropic structure.

References

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[2] Chu, W.H., Mehregany, M. and Mullen, R.L., 1993. Analysis of tip deflection and force of a bimetallic cantilever microactuator. Journal of Micromechanics and Microengineering, 3(1), p.4.