A Study of Geometrical Shape of Central Plate in Electrostatic Actuation

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Introduction: This study is performed to check the geometry which is best suited for electrostatically actuated central plate MEMS switch. To perform this study it is necessary to keep the actuation voltage and area of the geometry same for all the designed models.

Modeling in COMSOL:

The area of circle is calculated by using formula πr^2 with 'r' radius of circle as 25µm, the area calculated is 1.964e-9 m^2. Keeping this area as a constant the geometrical area of plates like square and rectangle are calculated by formulae: Area of circle = area of square = area of rectangle ($\Pi r^2=a^2=lb$). Where 'a' is length of the side of square, 'l'and 'b' are the length of the sides of rectangle

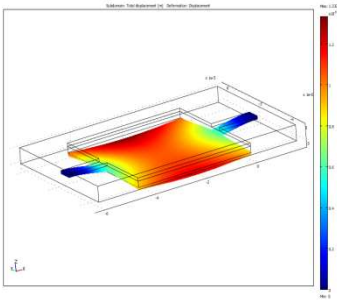

Figure 1. Centrally suspended Square plate.

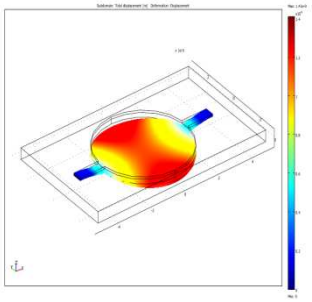

Figure 2. Centrally suspended circular plate.

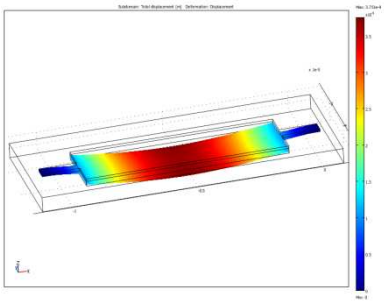

Figure 3. Centrally suspended Rectangular plate.

Results: From the simulation of the above designed models it is observed that rectangular central plate has good deflection compared to other two geometrical shapes of central plate.

Table 1. Deflection observed for different geometries.

Geometrical shape	Deflection
Square	1.333nm
Circle	1.41nm
Rectangle	3.75nm

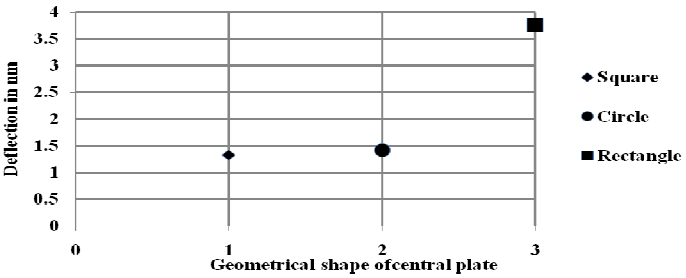

Figure 5. Plot of deflection versus shape of central plate

Conclusions: Comparing all the geometrical shapes of the central plate, rectangular suspended plate shows maximum deflection for electrostatic actuation compared to other shapes, Hence rectangle is best suited geometry for switches.

References:

1. Anil K. Chinthakindi,Electrostatic Actuators with Intrinsic Stress Gradient, *Journal of The Electrochemical Society*, 149(8) H146-H152 (2002).
2. Guchuan Zhu, *Lahcen Saydy,* A Robustness Approach for Handling Modelling Errors in Parallel-Plate Electrostatic MEMS Control, *Journal of microelectromechanical systems*, vol. 17, issue No. 6, December 2008.
3. Chang Liu, A text book on "Foundation of MEMS" Electrical and computer Department, University of Illionis at Urbana-Champaign Pearson Education International.