Study of Pull-in Voltage in MEMS Actuators

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Abstract

Abstract: Micro cantilevers are the basic MEMS structures, which can be used both as sensors and actuators in MEMS. The actuation principle of micro cantilever is based on the measurement of change in cantilever position as result of applied stimulus. The objective of this work is to study concept of pull-in voltage and how to reduce the same. The proposed work is carried out by using COMSOL Multiphysics® software which is based on the finite element method (FEM).Model [figure 1] is simulated by selecting the Electromechanics interface of the Structural Mechanics module of COMSOL Multiphysics® software. Voltage is applied to the upper cantilever beam and lower contact electrode is made as ground. Pull-in voltage has been tried to reduce by increasing the common area between cantilever beam and contact electrode and by reducing thickness of the cantilever beam. The common area between cantilever beam and contact electrode dimension is increased and the pull-in voltage is reduced from 19.7V to 12.1 V [Figure 2]. Similarly the thickness of the cantilever beam is decreased from 1µm to 0.25µm in the steps of 0.25µm then pull-in voltage is reduced from 57V to 7.2V [Figure 3].

Reference

[1] W. C. Young, Roark's Formulas for Stress and Strain", McGraw-Hill, New York, 1989.
[2] C. Liu, Foundations of MEMS by electrostatic sensing actuation.
[3] S. P. Pacheo P. B. Linda, K. Clark, Design of low actuation voltage RF MEMS Switch (1999).

Figures used in the abstract

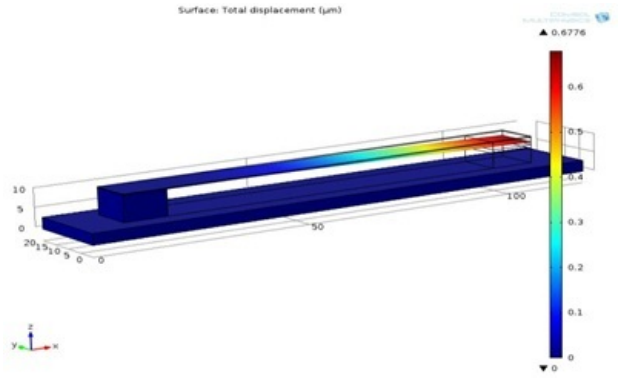

Figure 1: Simulated model of MEMS actuator.

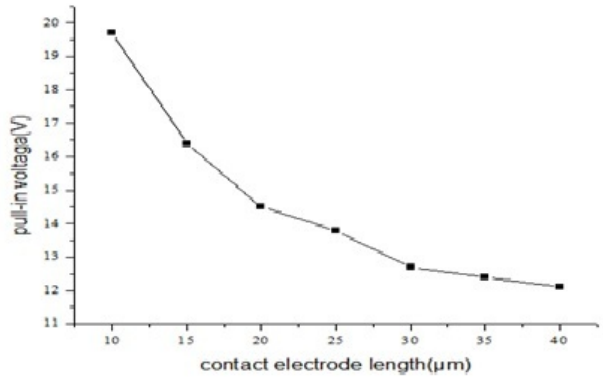

Figure 2: Figure shows variation of pull-in Voltage wrt contact electrode length.

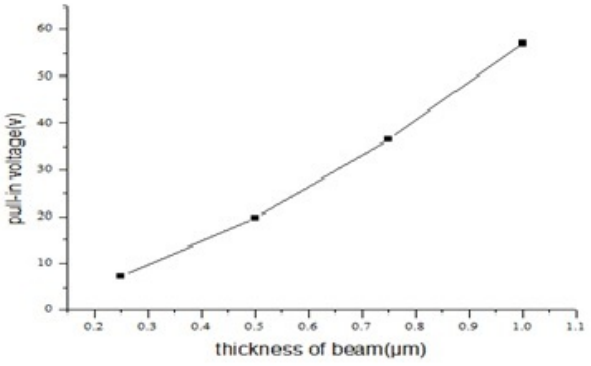

Figure 3: Figure shows variation of pull-in Voltage wrt thickness of cantilever beam.