Stiction in MEMS RF Switches

Final Research Paper for MEMS class
December 2010, Olin Year 2

MEMS is a 'special-topics' ECE course at Olin. The multidiscliplinary field is studied in terms of structure designs, fabrication techniques, and the future of MEMS devices in the semiconductor industry. It is the class that really got me interested in the semiconductor field, a branch of Electrical Engineering that I want to help bring into renewable energy.

Aim: Final research paper studying the phenomena of **stiction**, the main cause of failure of Microelectromechanical systems. What possible solutions exist and how do their **processes, advantages, disadvantages, and manufacturing** contribute to their effectiveness? Stiction is the sticking force that comes in between surfaces that touch, and when the attractive surfaces forces between them are too strong, they cannot be separated again. The MEMS device stops operating due to sticking failure.

Solution: In this paper, the causes and calculations of the stiction force are discussed. The paper places special focus on the **Radio Frequency MEMS switch** (2 types shown), used to switch RF signals transmitted across the world. The switch is applied to RF circuits to open and close a contact at very fast rates to stop and send signals in the gigahertz range of frequencies.

The MEMS switch is manufactured as a DC contact switch or a DC shunt capacitive switch. The mechanics behind each switch, the fabrication of each switch, and the force of stiction each can encounter, are the target topics of this paper.

Possible solutions include the use of rough surfaces, anti-stiction coatings, partial dielectric charging, and getters or supercritical drying of microstructures on the device. Fully reliable solutions to remove stiction are yet to be found in the world of MEMS.

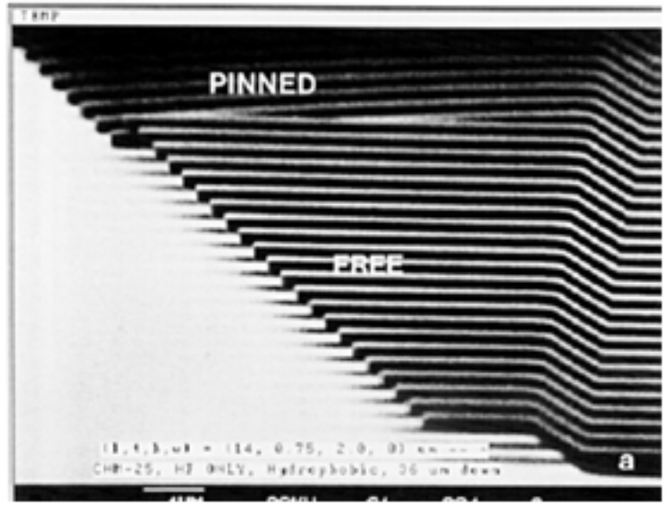
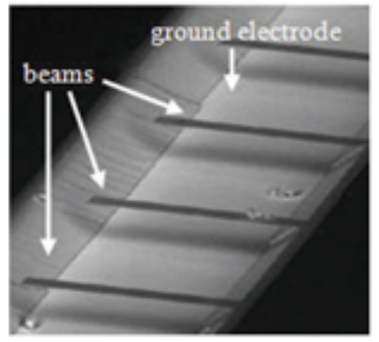
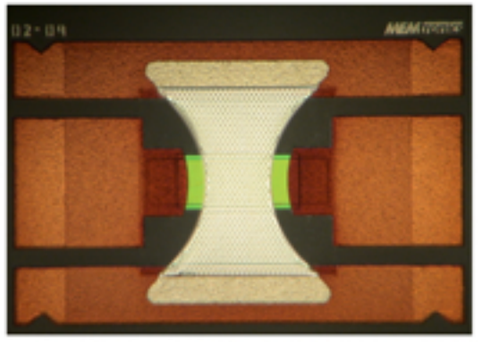


Illustration of stiction in cantilever beams



Cantilever Switch (side view)


Capacitive Switch (top view of membrane)