NUMERICAL OPTIMIZATION OF THE CAPACITIVE MICRO-SWITCH

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The paper deals with design optimization of a capacitive micromachined switch consisting of a thin membrane suspended over a central conductor. The aim is to achieve as small necessary electrostatic pull-in force as possible while ensuring fast switching. Optimum parameters are searched using fast linear and nonlinear beam models verified by the finite element method.

Key words: *capacitive micro-switch, MEMS, FEM, optimization*

1. Introduction

Electrostatically actuated thin plates and beams are often used as switches in microelectromechanical systems (MEMS). Reduction of cost and improvement of performance require a proper design, taking into account coupled load effects and nonlinear deformation of thin structural elements.

The schematic view of a capacitive micromachine switch is shown in Figure 1. The device consists of an elastic thin metal plate, called bridge, bonded at the ends on a substrate. It is suspended over a dielectric film deposited on the central conductor. Applying an electrostatic potential between the bridge and the central conductor, the electrostatic force pulls the bridge downwards (pull-in). Because of its elastic behavior, the bridge starts to move upwards when the electrostatic force is removed (switch-off).

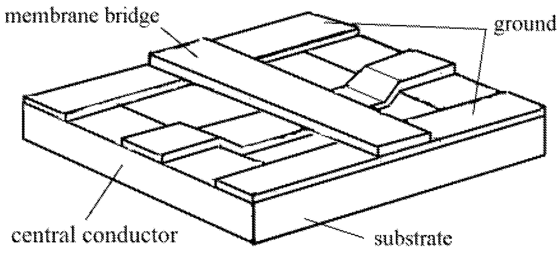

Fig.1: Schematic view of the capacitive micromachine switch

Best performance can be achieved if the necessary (critical) pull-in voltage is small and the switching speed is large. These two requirements lead to opposite design concepts: the critical pull-in voltage is small, if the bridge is soft, however, the switch-off is fast, if it is stiff.

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