Design of MEMS Based 4-Bit Shift Register

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Abstract

This paper presents a unique design of MEMS shift register that can perform shifting operation same as logic devices that are composed of solid-state transistors. The MEMS shift register design inherits all the advantages from MEMS switches and thus is expected to have more applications than MEMS switches. One unique feature of this device is that it can perform all types of shifting mechanisms, but with different electrical and mechanical interconnects. The model consists of multiple switches working on the principle of electrostatic actuation. The shift register has 3 stages with each stage having 4 switches and each switch is one bit implementation of a 4 bit shift register. The basic model is shown in fig.1 and fig.2. The design is modeled and simulated using COMSOL Multiphysics® simulation tool using the Electromechanics interface of the Structural Mechanics module. Fig.3 and fig.4 are the results, which represent deflection of cantilever and voltage levels, signifying shifting operation of logical 1 and 0. In comparison to conventional digital shift register, MEMS based shift register has dimensions 100x60 µm which is very small as compared to conventional shift register which has dimensions ranging from 1-4mm. Since the basic logical switching operation is indicated by a mechanical deflection of a cantilever, the proposed system is accurate and reliable.

Figures used in the abstract

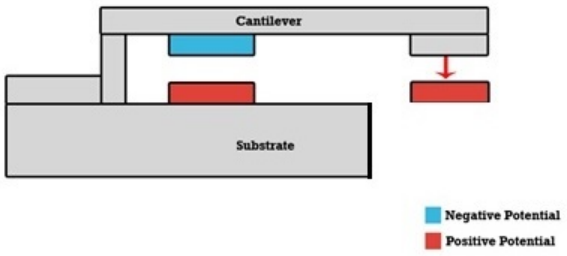

Figure 1: Side view of MEMS switch.

Figure 2: Front view of switch when off and on.

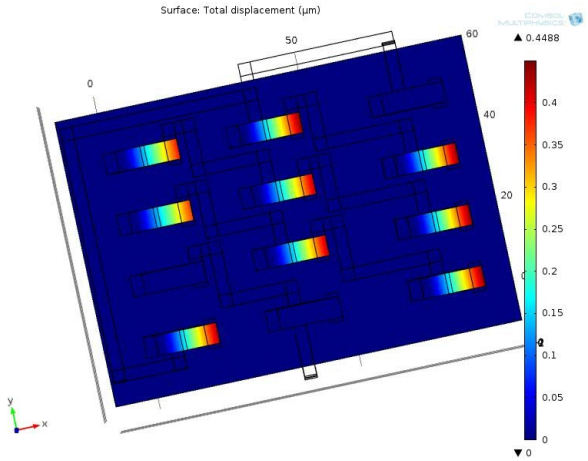

Figure 3: Deflection of cantilevers.

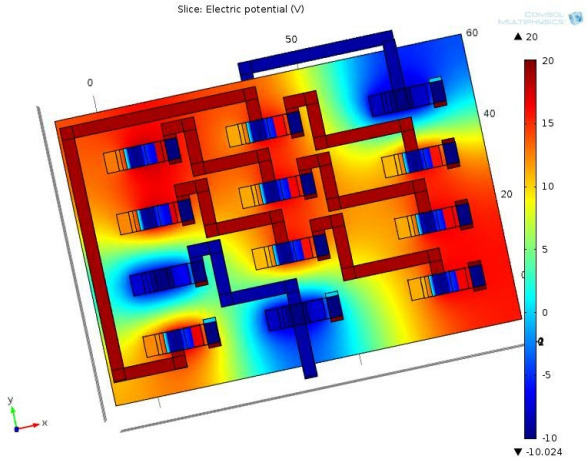

Figure 4: Voltage levels.