

MEMS Electrostatic Acoustic Pixel

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Abstract

The growth of the electronics industry demand better components for the electronic systems. Such components need to be improve to keep up with the evolution of the digital era. The loudspeaker design has not been changed for almost a century [1-5]. The acoustic transducer is the last analog component needed for a true digital audio system.

The direct digital method of sound reconstruction using CMOS-MEMS arrays was reported in [6,7], where they had arrays of micro-speakers in a single chip. We want to validate the feasibility of using an electrostatic membrane to develop arrays of membranes to reconstruct the sound.

We will use COMSOL Multiphysics to simulate the behavior of a hexagonal structure with six cantilever tethers, shown in Figure 1. The structure is 5 μ m thick polyimide and has an integrated metal layer on top of it for a bias voltage. The hexagonal plate is separated by an air gap of 3 μ m from the bottom electrode and 3 μ m air gap from the top electrode. We will use the AC/DC Module to extract the pull-in voltage needed to displace the membrane up and down toward the active electrode. Also an acoustic simulation will be performed to calculate the approximate acoustic output from a hexagonal plate drawn from a 1mm diameter circumference.

The simulation should reveal important information regarding the audible pressure change needed with the proposed structure dimensions. Our past analytical calculations suggest that a single element should generate 19dB of acoustic pressure, with a 3 μ m displacement.

Reference

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Figures used in the abstract

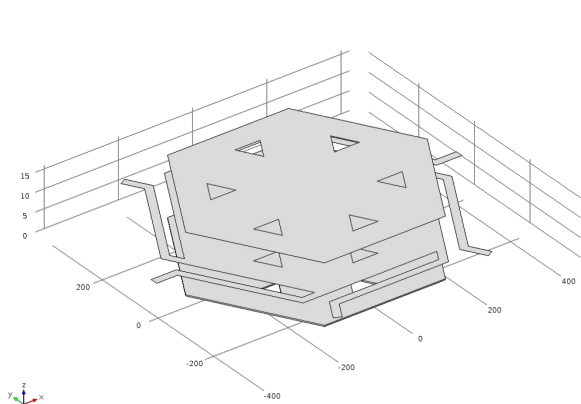


Figure 1: Isometric view of the bottom, middle and top electrodes of the hexagonal devices. Each plate is separated by the thickness of the structural layer ($5\mu\text{m}$ polyimide) and $3\mu\text{m}$ air gap.

Figure 2

Figure 3

Figure 4