Design and Analysis of Multilayered MEMS Microphone Using COMSOL Multiphysics®

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Abstract

The initial step in the recording process is the transduction of sound pressure waves into electromagnetic signals. The main type of transducer in audio recording is the microphone. The microphone changes air pressure variations into electric signals which vary proportionally. There are several types of microphone: dynamic (moving coil and ribbon), capacitor (also known as condenser) are the main types. Each type has particular strengths and weaknesses. Choosing a microphone is much like selecting an instrument: there is no single ideal microphone for a given situation, but some types sound better than others for particular applications. Choosing appropriate microphones makes the job of recording easier, since processing like equalization can be obviated if a certain microphone produces the desired sound directly. While it helps to understand the basic principles of microphone design, there is no substitute for experience and experimentation. In this project, we report a design of MEMS microphone that is based on the application of porous silicon in improving the sensitivity of bulk micro machined capacitive pressure sensors. The property of a low Young's modulus of porous silicon and its dependence on porosity have been exploited to obtain a higher sensitivity compared to pressure sensors with single crystalline silicon membranes. The behavior of this membrane was studied for various values of porosity and thickness of the porous silicon layer the sensitivity of the composite silicon/porous silicon membrane is found to be higher showing improvement with an increase in the porosity and thickness of the porous silicon layer. Various designs are carried out and detailed analyses of the designs are made.
Keywords - MEMS, Titanium Dioxide, Polysilicon, microheater

Figures used in the abstract

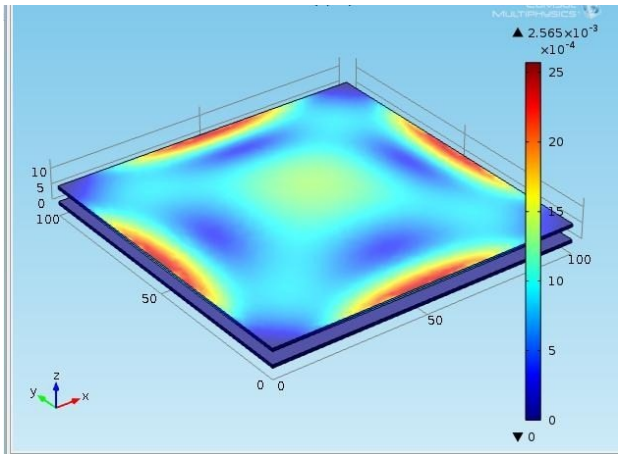

Figure 1: Simulated results for single layered microphone

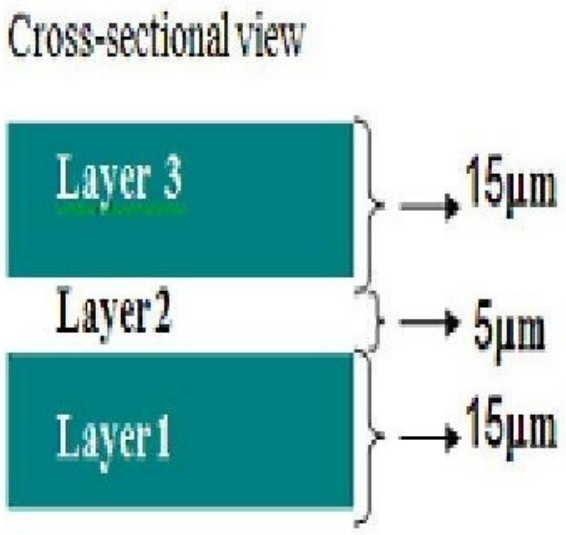

Figure 2: Cross sectional view of single layered MP

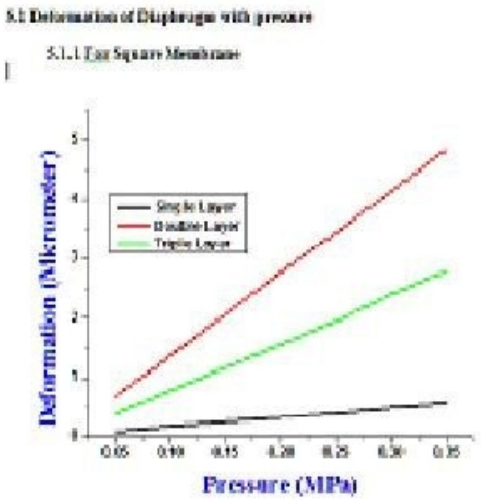

Figure 3: Sensitivity comparison of different layered MP