Design of MEMS Based Polymer Microphone for Hearing Aid Application

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Introduction: This paper presents a condenser microphone for hearing aid application. The stress versus pressure and displacement versus arch length analysis has been carried out. The frequency response has also been analysed. The simulation work has been carried out in COMSOL Multiphysics.

Structure Name	Air Layer	Back Plate	Top and Bottom electrode
Dimensions	2 µm	17 µm	0.1 µm

Table 1. Structure Dimension

Computational Methods: The MCM works like a parallel plate capacitor. For a 2D model the sensor's capacitance is computed by solving the electric field in the geometry that has been deformed. The capacitance is obtained from the energy of the electric field, solved using the equation

$$C = \frac{2}{U^2}\int_{\Omega_d} W_e \, d\Omega_d$$,where

U =potential difference between plates.

W_e =electric energy density.

Ω_d =area of the dielectric (air gap).

In the 3D model, the capacitance is calculated by integrating over the surface of the capacitor according to the equation

$$C = \varepsilon \int \frac{1}{h} dA$$,where

h=the local distance across the capacitor
ε=permittivity of air.

Results: The simulation work has been carried out for the diaphragm thickness of 1µm, 2µm, 3µm and 4µm. Figure 2 gives the stress versus pressure analysis for a 1µm thick diaphragm. Figure 3 gives displacement versus arc length and figure 4 gives the resonant frequency

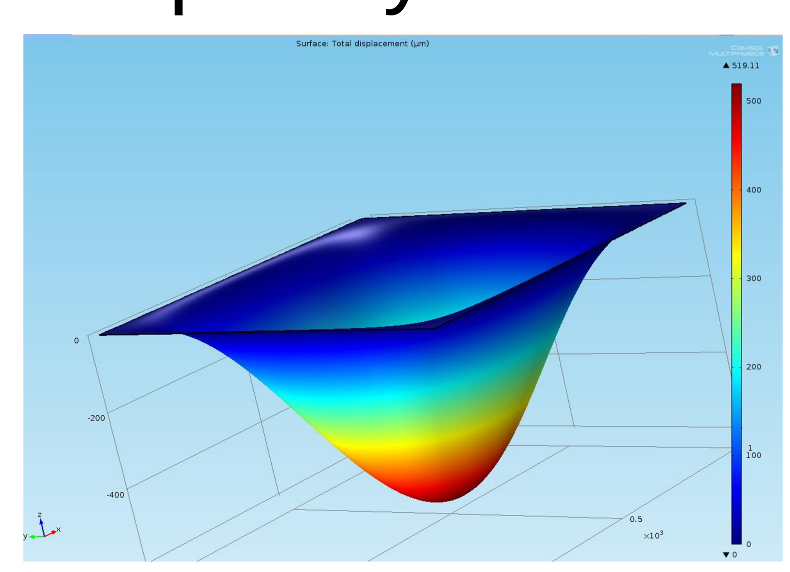

Fig1

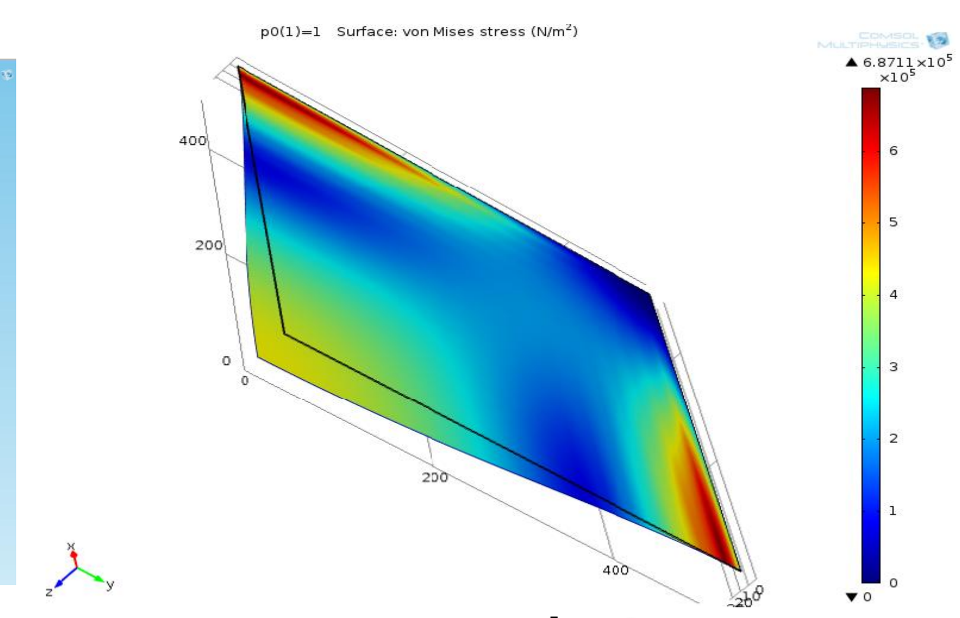

Fig2

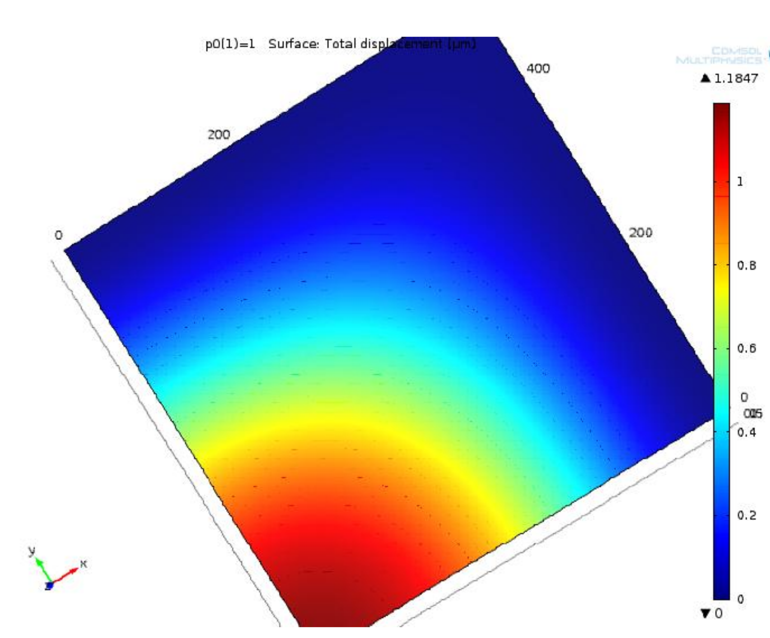

Fig3

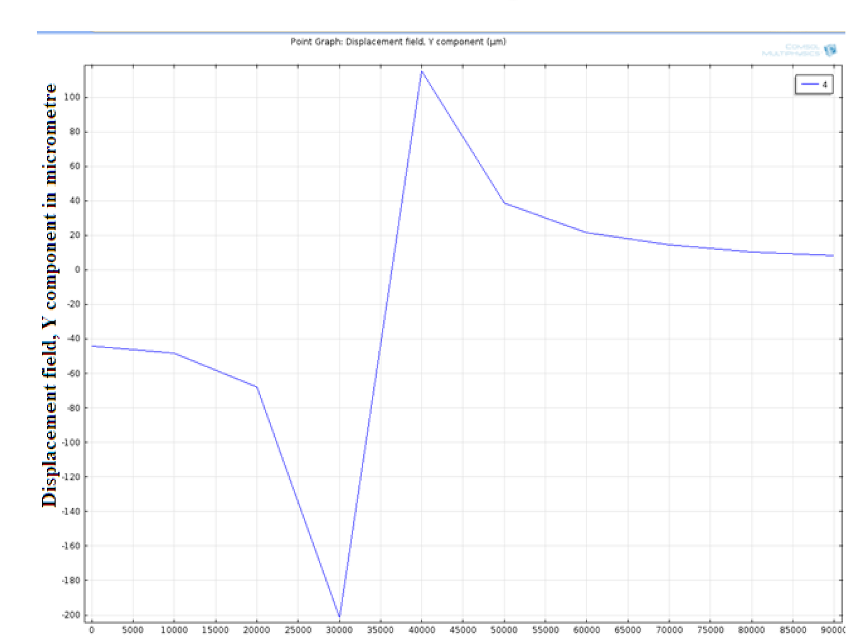

Fig4

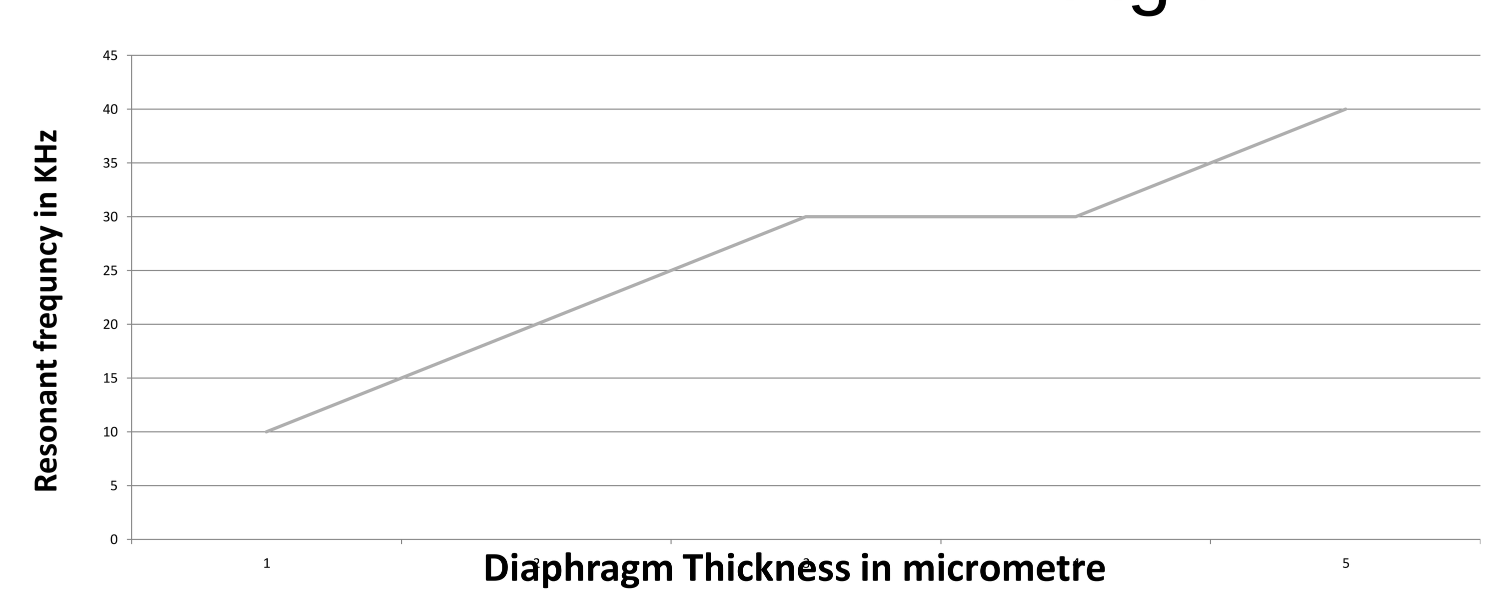

Fig5

Fig 1 : Total Displacement of 2 µm microphone Diaphragm
Fig 2 : Stress versus pressure
Fig 3 : Displacement versus arc length
Fig 4 : Resonant Frequency of 5µm thick diaphragm
Fig 5 : Resonant frequency versus diaphragm thickness

Conclusions: The stress and displacement decreases with increase in diaphragm thickness and resonant frequency increases with increase in diaphragm thickness .

Excerpt from the Proceedings of the 2012 COMSOL Conference in Bangalore