OPTIMIZATION OF SMART DIAPHRAGM MATERIAL FOR PRESSURE SENSOR IN VENTILATORS

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Introduction: A medical ventilator is an imperative device used to save life by delivering an assortment of air and oxygen into and out of the patients' lungs to administer breathing or to assist obligatory breathing. The proposed work utilises the **piezoelectric material** for the pressure range implemented in the commercial models designed using Silicon. The piezoelectric materials selected for the sensing application are Lead Zirconate Titanate PZT-4, 5A and PZT-8. The simulation tool used for the analysis is COMSOL Multiphysics 4.4.

Structural Modelling: COMSOL Multiphysics 4.4. Piezoelectric devices module has been used to simulate a few 3D structures. A square diaphragm using PZT-4, 5A and PZT-8 has been designed. The figure.1 shows the square diaphragm modelled for the application. A predefined user controlled normal sized Free tetrahedral mesh was constructed. The stress, volumetric strain, total displacement and electric potential has been studied for 1.8E5 x 1.8E5 x 162nm.

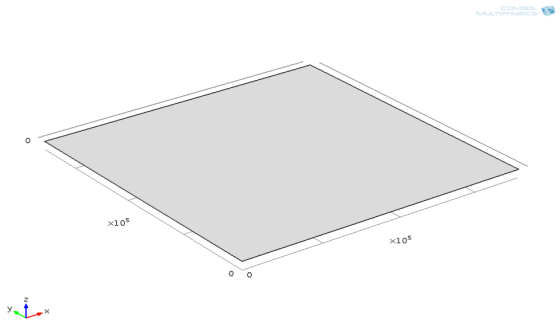

Figure 1. 3D Diaphragm model

Results: The different piezoelectric material exhibit maximum stress, maximum displacement and minimum strain as tabulated in table.1.

Table 1. Diaphragm analysis of selected PZT materials

PARAMETERS	PIEZOELECTRIC MATERIAL
Maximum displacement	PZT-5A
Maximum stress	PZT 5A,8
Minimum strain	PZT 8

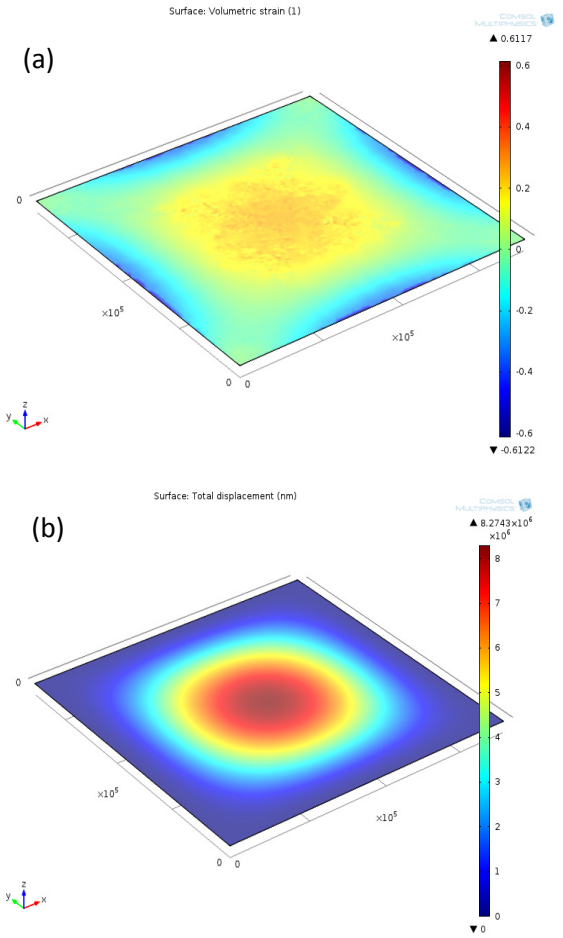

Figure 2. Simulated results of PZT 8 showing (a) strain and (b) displacement

Conclusion: The diaphragm designed is analyzed with various pressure inputs and the distribution of displacement, stress and strain is interpreted. On considering the strain obtained for different materials PZT-8 is found to be optimum for diaphragm design.

References:

1. P. Eswaran and S. Malarvizhi, "Design analysis of MEMS Capacitive Differential Pressure sensor For Aircraft Altimeter", International Journal of Applied Physics and Mathematics, Vol.2, pp.14-20

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