Designing and Simulating the Performance Analysis of Piezoresistive Fluid Flow Pressure Sensor

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Introduction: In this work, we present the performance analysis of novel micro machined piezoresistive fluid flow pressure sensor. The principle of the sensing mechanism is based on the deflection of four sensing Si membranes. The fluid passes through it causes the deflection of these sensing layers which leads to the electrical output for the flow.

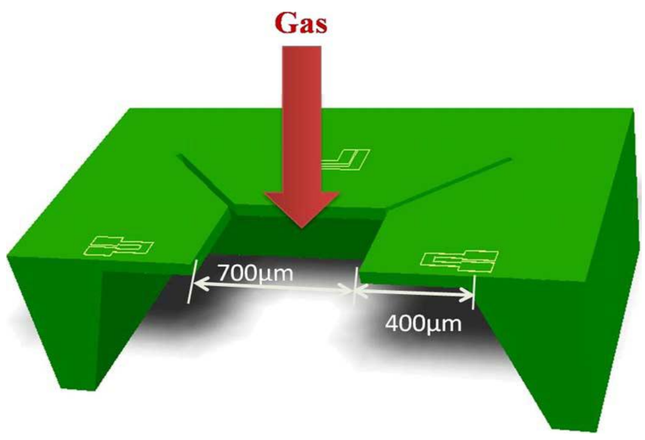

Figure 1. Schematic diagram of flow sensor.

Computational Methods: 3D geometry was designed using COMSOL Multiphysics 4.2a. For the change in input velocity of the fluid the total displacement (w) and stress (σ) were analysed.

$$w = \frac{3\Delta P L^4}{2Eh^3} \qquad \sigma = \frac{3\Delta P L^2}{h^2}.$$

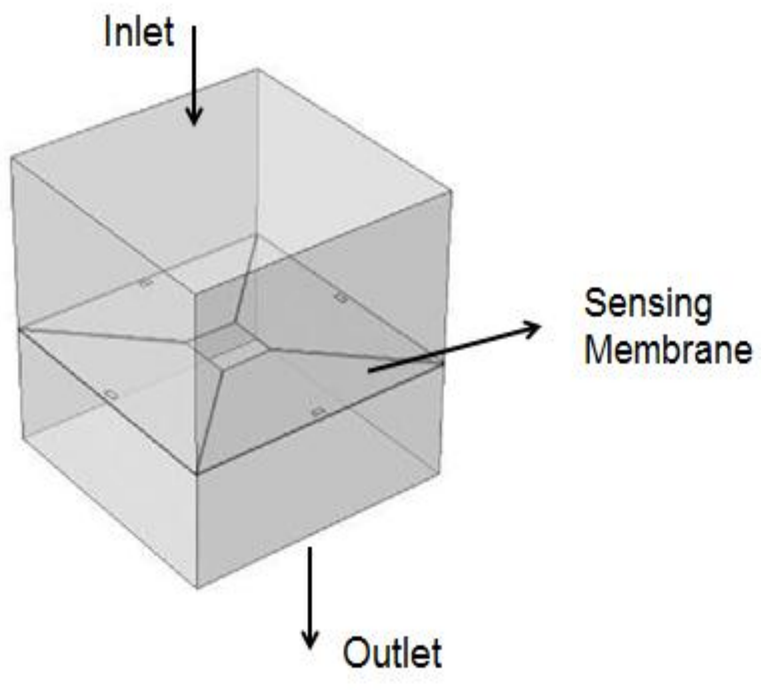

Figure 2. Geometry of Flow Pressure Sensor

Results: The results of simulation shows the maximum displacement of the sensing membrane. Also, it is observed for different input velocity of the fluid.

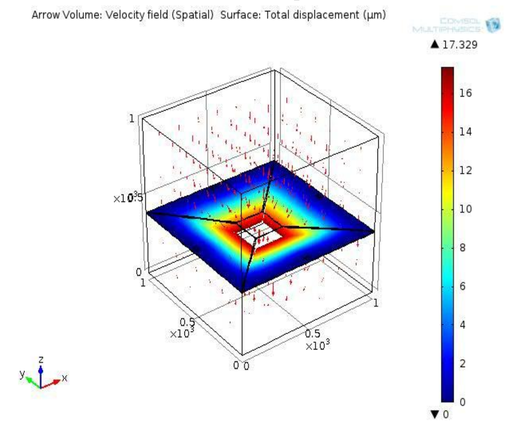

Figure 3. Total displacement for Gasoline input

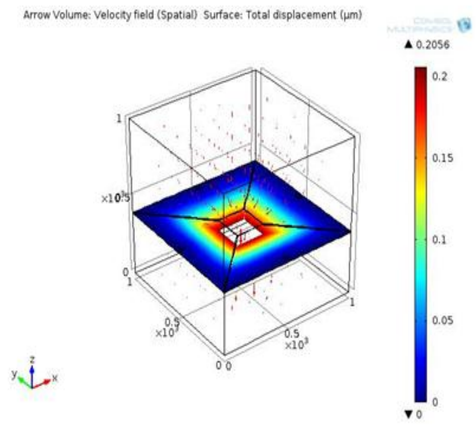

Figure 4. Total displacement For Air input

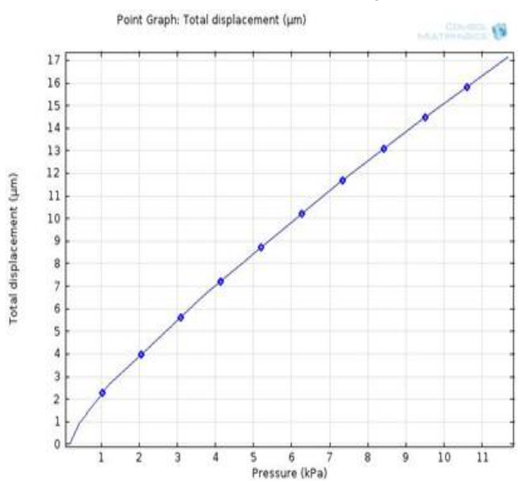

Figure 5. Displacement vs. pressure (Gasoline)

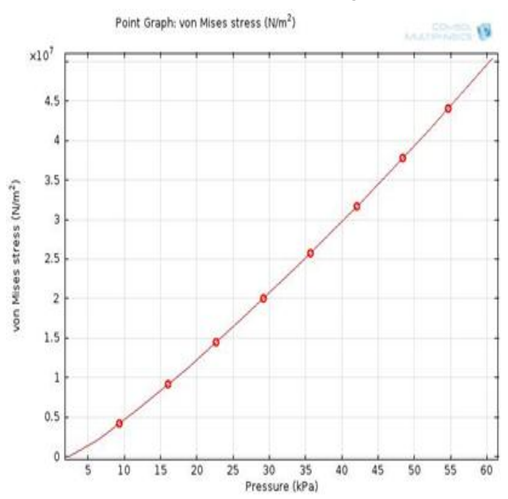

Figure 6. Stress vs. pressure (Gasoline)

Parameters	Velocity	Total displacement	Stress
Air	1 m/s	0.2056 µm	2.891×10^6 N/m^2
Gasoline	1 m/s	17.329 µm	4.856×10^8 N/m^2

Table 1. Results of simulation for Air and Gasoline

Conclusions: The novel flow pressure sensor is designed and its performance is analysed for two different kinds of inputs such as air and gasoline. The sensor exhibits better response for gasoline input than air input. Hence, this simple sensor can be effectively implemented for the application like flow measurement of fuel tanks in automobiles.

References:

1. D. Li and T. Zhao, “Monolithic integration of a micromachined piezoresistive flow sensor With Integrated Signal-Conditioning Circuit,” *J. Micromech. Microeng.*, vol. 20, p. 035024, 2010.