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Analysis of Mems Based Gas Sensor

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Abstract

Mems gas sensors are easily available in the market. Gas passes through the electrodes where Reaction takes at film and Displacement observed. The proposed structure employs aluminum electrodes with lithium niobate as base piezo electric material, coated with Zinc Oxide (ZnO) film for sensing dichloromethane (DCM) gas. This paper demonstrates the method for modelling the up rooting and electrical potential of SAW gas sensor using COMSOL Multiphysics software tool

I. INTRODUCTION

A Gas Sensor is a device which helps in detecting the the presence and concentration of gases in atmosphere.[1] explained about Focused interdigital Transducer (FIDT). [2] described the three dimensional design of Focused Inter Digital Transducers that can be used in MEMS based SAW gas sensor.[3]investigated gas detection microsystem with MEMS technology. [4] clarified about comsol simulation of interdigital transducers in saw devices [5-15] papers deals with optimization models on mems based sensor.

Acoustic Wave (SAW) sensors gadgets for gas detecting utilizes uniformly set IDT's (Connect Advanced transducer) as suggested in Figure 1, for creating the mechanical vibrations utilizing RF control, faces these issue with the conventional.

The innovation of Surface acoustic wave (SAW) is a beginning for a broad range of sensor applications. Many applications have exceptionally challenging requirements such as maintenance-free (no battery), no external control, dependable life-cycle, light and little, etc. These waves are so significant that when they are utilized as MEMS based devices their speed of reaction, applications, reliability of operation etc parameters are display. These acoustic waves miniaturized scale sensors in its widest meaning can be utilized to demonstrate a number of significantly distinctive gadgets. Their common characteristic is the reality that acoustic waves are involved within the working standards. This paper analyse the performance of SAW gas sensor using COMSOL Multiphysics .

II. MODELLING USING COMSOL

COMSOL Multiphysics is a platform for finite element analysis. It permits routine physics-based client. COMSOL gives workflow for liquid ,acoustics ,electrical, mechanical, and chemical applications .

COMSOL makes a difference in giving the free hand drawing of the plan and speaking to the geometry in three dimensional. COMSOL helps in measuring the complex computational equations. The whole relocation dispersion of both routine and concentric IDTs is analysed utilizing the over condition with the number of the IDT fingers N.

The device composed of FIDTs with numerous straight fragments, as appeared in Figure. 1. The plan of the MEMS based structure incorporates characterizing the factors for the required geometry and choice of the parameters. The 3D geometry has been constructed within the drawing mode of COMSOL Multiphysics. Two-segmented FIDT are designed utilizing pieces in geometry area. Solid blocks of 1μm×0.25μm×0.5μm are made of aluminum that are situated on the corner of the base Lithium Niobate piezoelectric fabric of 3μm×4μm×1μm, 6μm×6μm×1μm measurements substrate, having polymer chemical coating made of Zinc Oxide (ZnO) of height 0.5μm and 1μm sweep.

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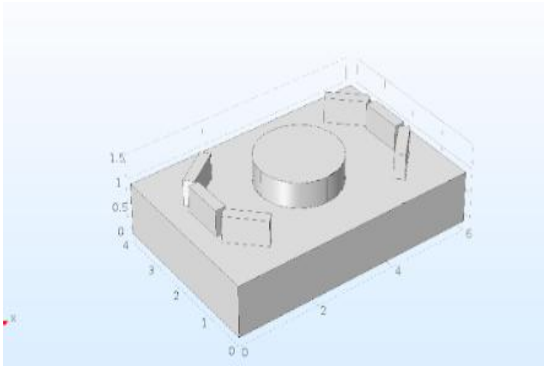

Fig-1(a)

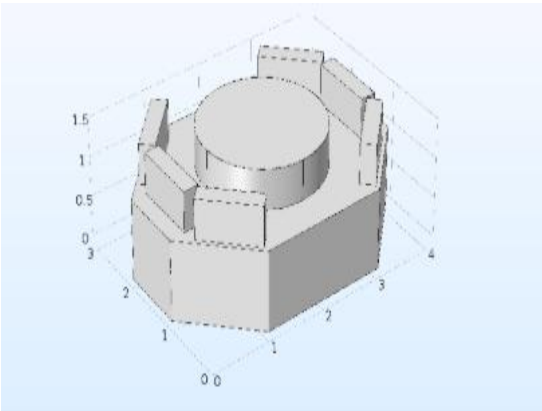

Fig-1(b)

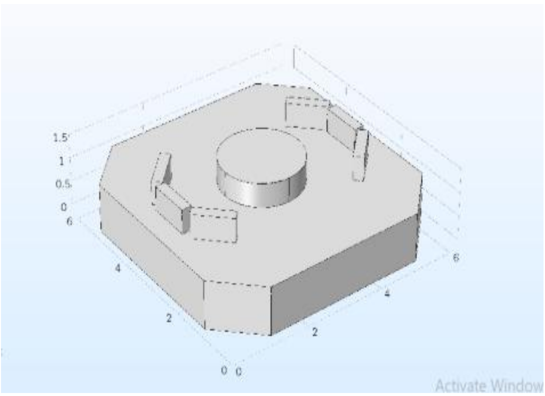

Fig-1(c)

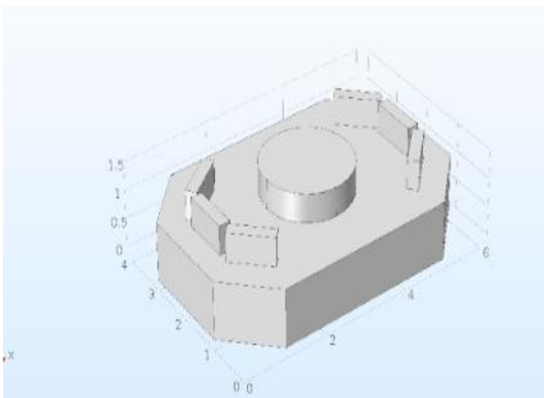

Fig-1(d)

Figure 1.modelling design of FIDT in SAW sensor(a-model1,b-model2,c-model3,d-model4)

III. SIMULATION

The simulations are performed using the COMSOL Multiphysics, which is designed particularly to strengthen the numerical modulation of resounding recurrence of SAW gas sensor. It comprises of to begin with meshing the geometry as appeared in figure 2. Then investigation of deformation at sound made. The out-of-plane strain component is zero, considering that the SAW is created in the model plane, which the sensor is thick in the out-of-plane course. The sensor is uncovered to 100 ppm of DCM in discuss at barometrical pressure and room temperature. Any impacts of the DCM adsorption on the fabric properties other than the thickness are ignored.

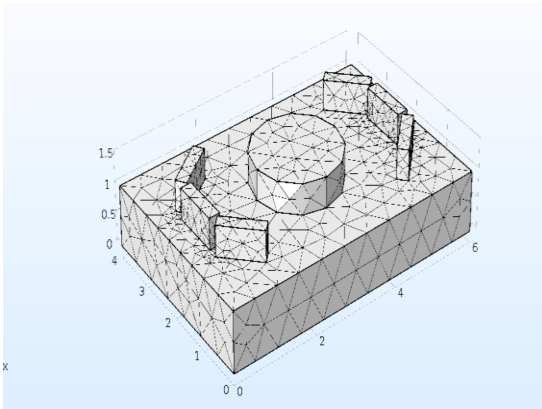

Fig-2(a)

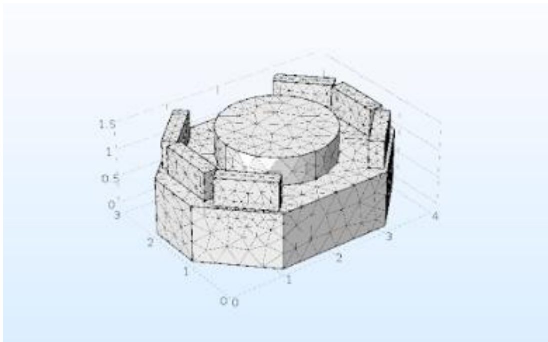

Fig-2(b)

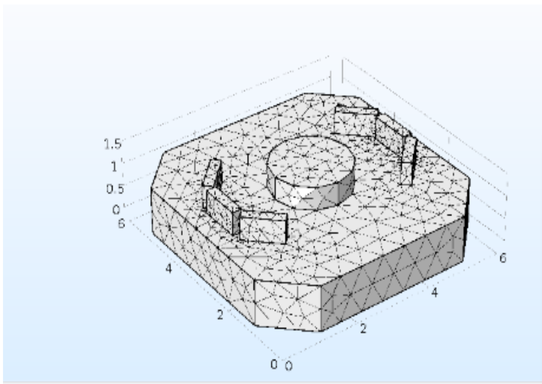

Fig-2(c)

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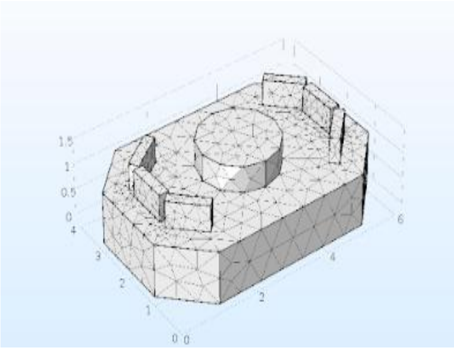

Fig-2(d)

Figure 2.Meshing in COMSOL Multiphysics(a-model1,b-model2,c-model3,d-model4)

The closeness of the aluminum IDT electrodes and the ZnO film cause the lowest SAW mode to part up in two Eigen solutions, the least one speaking to a arrangement resonance, where engendering waves meddled constructively and the other one a parallel resonance. These two frequencies create the edges of the halt band, within which no waves can yield through the IDT. Regeneration exploits irregular boundary conditions and relocations be the same along both vertical boundaries of the geometry. This implies that the wavelength will be an numbers division of the width of the geometry. So the most reduced SAW Eigen mode has its wavelength rise to the width of the geometry, 4 µm. The Eigen frequency of this mode is replicated by 4 µm that gives the speed of the wave being circulated.

IV. RESULTS AND DISCUSSION

Utilizing COMSOL Multiphysics computer program surface displacement at sound & resonance are analysed as in figure 3.

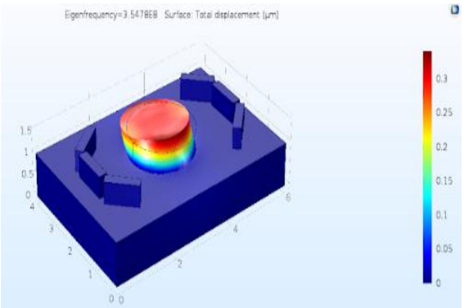

Fig-3(a)

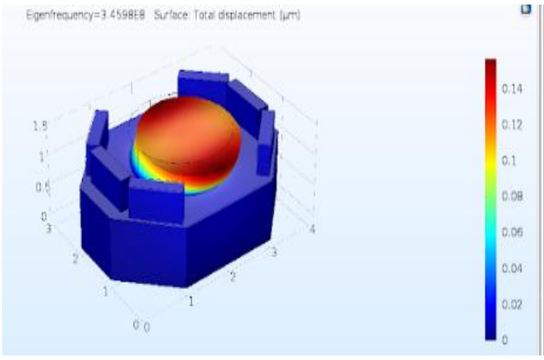

Fig-3(b)

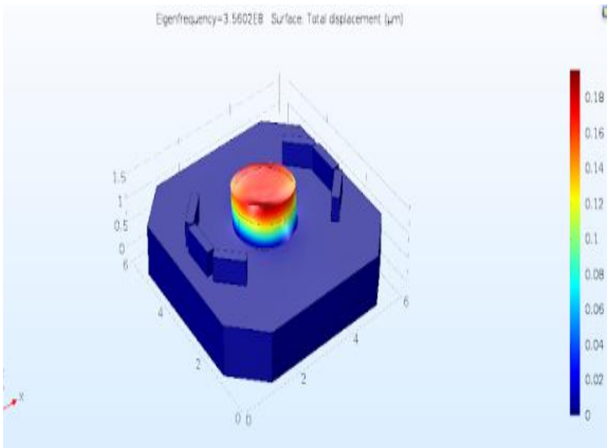

Fig-3(c)

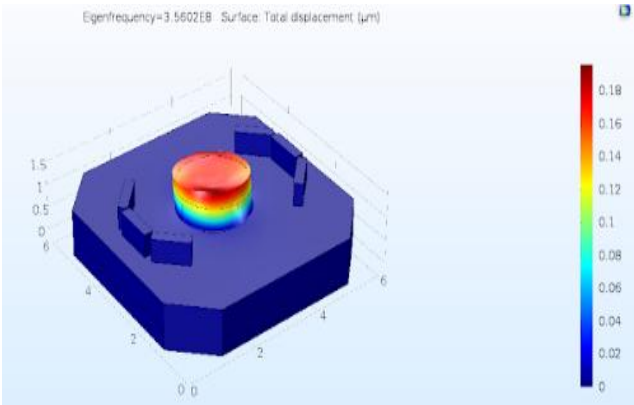

Fig-3(d)

Figure 3.Total Surface displacement at Resonance for FIDT design. (a-model1,b-model2,c-model3,d-model4)

Among all the above design structures the hexagonal structure of dimensions 4µm×6µm has more displacement.

Table 1:

Model	Dimensions(µm)	Eigen frequency	Displacement(µ meter)
1	4×6	354.78E8	0.3×10^{-3}
2	4×6	354.87E8	0.3×10^{-3}
3	6×6	356.02E8	0.18×10^{-3}
4	3×4	345.98E8	0.14×10^{-3}

Table 2:

Parameter	Proposed Model	Literature [1] model
Total surface displacement at resonance	1.855×10^{-3}	0.3×10^{-3}

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Table 2 describes about comparison between the proposed model and literature model displacement values. The proposed model is more sensitive than literature model. So ,it can be used in various applications.

V. CONCLUSIONS

This Analysis focusses on the investigation of structures of a Focused-IDT design of MEMS based SAW gas sensor, when subject to mass stacking. Outlined show makes a difference in finite component level of modelling the surface displacement at resonance frequencies.

This study helps in designing sensor for various gas detection.Thissensor is utilized in recognizing of dangerous gas in chemical, steel, manufacturing. Also it has application in bio-medical field for patient monitoring frameworks & sedate conveyance etc.

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