Modeling and Performance Analysis of MEMS Based Sensor used for Monitoring Process Chambers in Semiconductor Manufacturing

N.Siddaiah, A.Kavya, B.Mounisha, A.Gopi

***Abstract:** At present mems based totally included fuel sensors have numerous advantages which includes ease of array fabrication, small length and specific thermal manipulation capabilities and exact analysis were conducted to take a look at the resonance modes of various sensor configurations which includes fixed- stop association and spring board association fashions have been constructed based totally at the formatted masks format technique sequences and layer thickness. Thermo-electro mechanical simulations had been additionally performed for this device. During those simulations evaluation of frequency degrees, displacement. In this paper exact analysis of frequency levels and displacement levels are calculated with the aid of designing and modeling of MEMS fuel sensor in MEMS Simulation Tool.*

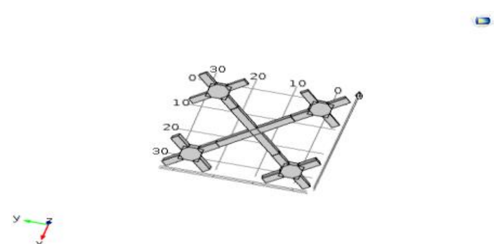
***Keywords:** Eigen Frequency, displacement, MEMS gas sensor, furnace, process chambers, semiconductor material.*

I. INTRODUCTION

Mems gasoline sensors is a method of generation used to create tiny gadgets or systems that combine electrical and mechanical additives. The semiconductor business is moving unyieldingly towards sensor driven managing as increasingly stringent ecological issues emerge, and as increasing wafer sizes devote dealing with errors restrictively high priced[2]. The use of Integrated Circuits batch processing techniques that could range few micro meters to millimeters. These devices have potential to experience control and actuate at the micro scale and generate outcomes on macro scale. Silicon-based sensors, that are handiest one form of semiconductor primarily based sturdy state sensor. One essential elegance of those sensors emerges as minor departure from Field-Effect Transistors (FETs). In a FET one has a flimsy channel of conductance at the outside of the silicon, which is limited through the voltage linked to a metal film (a door) remote from the channel of conductance via a moderate encasing layer (Silicon dioxide)[3].

The superb intrigue is produced in Integrated Circuit (IC) innovation to deliver devices, pH-delicate covers and particle specific films in Ion sensitive Field-Effect Transistors (ISFETs), catalysts in catalyst sensitive discipline effect transistors (EnFETs), antibodies or antigens in immimo-FETs (ImmFETs), and complete tissue layers in BioFETs [4]. By and big, FET-primarily based compound sensors are immediately no longer nicely suitable for lengthy haul, in-line compound research, and their development is for the most component designed for disposable biomedical-kind applications. Silicon-based concoction sensors aren't as of now created economically in substantial amounts, but other semiconductor sensors, in view of squeezed powders. They are affordable when contrasted with unique fuel detecting implies and for a few reasons. For instance, semiconductor metal oxide .Sensors of a $Sn0_2$ fabric is artificially inactive and furthermore free from oxidation in air. [8]. The sensor was designed and modeled for various parameters. The performance was improved and can be used as biosensor as well as gas sensor [14].The gas sensor are activated in characterization through optical and dielectric force gradient excitation techniques. In optical excitation LAZER beam was used and in dielectric force gradient scheme combination of A.C and D.C signals was used [15].

Design Methodology



Many stable nation fuel sensors used to degree a diffusion of gases such as oxygen , hydrogen , carbon monoxide ,methane etc. are primarily based on the interaction between an electrical system (the sensing element) and a chemical gadget (the size fuel).he understanding of the operation of these fuel sensors has advanced in recent years through the application of sophisticated experimental techniques and the improvement of specialized fashions. However, greater complete models are clearly needed.

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II. FIGURES AND TABLES

POLYSILICON:

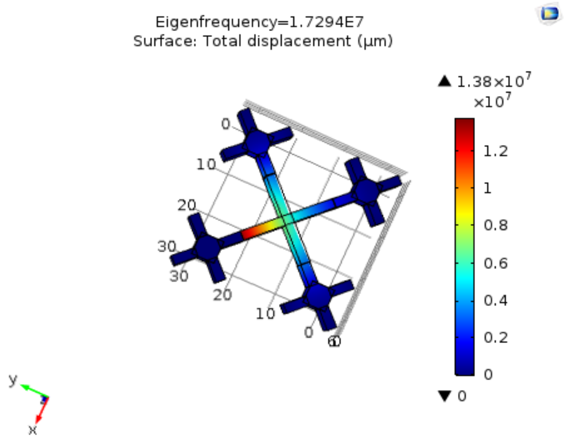

Fig . a

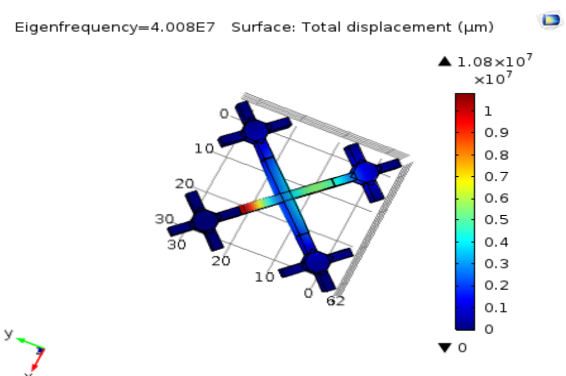

Fig . b

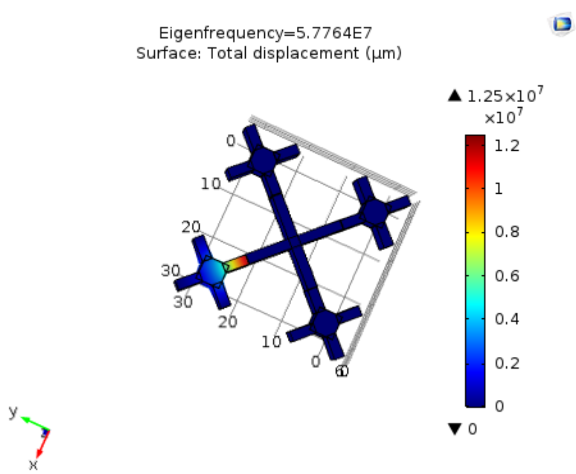

Fig . c

The four ends of the modules are fixed and when it is placed in a furnace, chemical reactions takes place based on the type of gas and displacement varies. By taking the difference of initial mass value and final mass value we can identify the gas in the furnace.

Table 1 . Polysilicon: Before reaction with Methane

Eigen Frequency	Total Displacement(**micrometer**)
1.7294E7	1.38*10^7
2.2016 E7	2.86*10^7
4.008 E7	1.08*10^7
4.8047 E7	6.25*10^7
4.8446 E7	6.56*10^7

Table 2 . Polysilicon: After reaction with methane

Eigen Frequency	Total Displacement **(micrometer)**
0.0082996	17.42*10^6
0.011661	18.9*10^6
0.015799	17.1*10^6
0.022899	22.29*10^6
0.036921	17.29*10^6

Polysilicon is an appealing material to shape a stomach for weight sensors because of numerous points of interest including extraordinary controllability of the film thickness, accessibility of a dielectric film for prevalent confinement, and reasonableness for high-temperature applications. The four ends of the modules are fixed and when it is placed in a furnace, chemical reactions takes place based on the type of gas and displacement varies. By taking the difference of initial mass value and final mass value we can identify the gas in the furnace.

Theory

To quantify the different layer thicknesses of the micro hotplate. The tentatively estimated thicknesses are recorded. Subsequent to setting up the ideal lattice estimate and careful layer thicknesses, resounding frequencies for the gadget were gotten utilizing FEA techniques.

This examination predicts that the initial three methods of the resounding recurrence of the gadget will be around 612, 1522, and 1530 kHz, separately, for every one of the four postgame plans,

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and 134, 382, and 676 kHz for a springboard or two post course of action[11].

Subsequent to acquiring the full frequencies of the gauge gadget, the impact of mass on the resounding recurrence was gotten next. A basic forecast of the full recurrence of a structure is given by[12]:

Abbreviations and Acronyms

Define abbreviations and acronyms the first time they are used in the text, even after they have already been defined in the abstract. Abbreviations that incorporate periods should not have spaces: write “WARSE”. Do not use abbreviations in the title unless they are unavoidable.

Equations

$$f_n = \frac{1}{2\pi}\sqrt{\frac{k}{m}} \quad (1)$$

Where ‘K’ is the Boltzmann constant [k=**1.3807** x 10^{-23} joule s per Kelvin (J. K^{-1})] and ‘m’ is the mass of the gas. English, please get a native English-speaking colleague to proofread your paper.

III. CONCLUSION

In this work, the frequency levels and displacement levels are determined. This equipment is placed in a furnace and the displacement values are calculated at the fixed ends. Using these, differences in initial displacement value and final displacement value, we can find which gas is generated in the furnace. The results and tabular columns values depict the presence of gases in the chambers.

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