

Design and Simulation of MEMS Inertial Sensor for Detection of Sleep Apnea

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Abstract: Sleep Apnea is the serious sleep disorder where breathing continuously starts and stops. There are many types of Sleep Apnea are, Obstructive Sleep Apnea, Central Sleep apnea and Complex Sleep Apnea Syndrome. In this paper, comb drive resonator consists of folded beam, anchors, movable comb, fixed comb, input substrate and output pad. To detect Sleep apnea the comb drive resonator application is developed, which works with the airflow during the breath delivered while sleeping. Due to the force applied from the airflow, the displacement of the proof mass of the proposed structure is varied. Comb driver resonator was designed and analyzed in FEM tool COMSOL Multi Physics.

Index Terms: Diesel, Kerosene, Cantilever, Sensor, Sensitivity

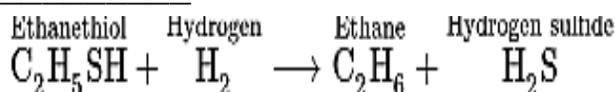
I. INTRODUCTION

In petroleum the hydrocarbons are the major components which together form the petrol. The petrol is refined into different forms to form various types of petroleum utilities. It also consists of different contaminants. In the first stage the different sizes of hydrocarbons are removed, in the second stage the different contaminants are removed which usually cause the pollution, inefficient burning and damages the engine sometimes.

The various petroleum contaminants are as follows:

A. 1) Sulfur:

This is the most common contaminant in fact the oil rate is determined by the sulphur content in it. Despite the fact that early miners tasted oil to decide how sweet or sour it was, satisfactoriness isn't the reason we care about sulphur in oil. A grouping of simply 0.5% sulphur will make unrefined petroleum "sharp," which implies longer refining and increasingly costly gas and different items at last. The greater part of this sulphur is found as hydrogen sulphide gas, a harmful, toxic, noxious gas some of the time called "sewer gas." Most hydrogen sulphide in oil results from the rot of natural issue[1]. Hydrogen sulphide is in reality entirely combustible, so it could be utilized as a fuel on the off chance that it were not for the way that it is likewise destructive in moderately low fixations. Hydrogen sulphide influences the sensory system, respiratory framework, and may even have added to a few mass annihilations in Earth's past. This lethal gas must be expelled from oil so as to make it more secure for use. The hydrogen sulphide would then be able to be utilized to create unadulterated sulphur, an exceptionally esteemed mechanical component utilized in the generation of manure. It is additionally made into sulfuric corrosive. Hydrodesulfurization (HDS) is a process to remove sulphur from petrol. Thus, hydrodesulfurization is a hydrolysis reaction. Using ethanethiol (C_2H_5SH), a sulphur compound present in some petroleum products, as an example[2], the hydrodesulfurization reaction can be simply expressed as



Vanadium:

Vanadium is a normally happening "substantial metal," a name that gets from its moderately high nuclear mass on the occasional table of components. Substantial metals are all around harmful, including such natural names as mercury, lead, cadmium, and arsenic. Vanadium is no special case to this standard and is all vanadium mixes are viewed as lethal.

Past poisonous quality, vanadium is likewise an oxidant and is the primary segment in fuel (especially diesel fuel) that prompts "high temperature erosion." During burning of hydrocarbon, vanadium in the oil responds with different contaminants like sodium and sulphur to deliver mixes known as vandates that expansion the consumption of steel by evacuating the "passivation" or dormant layer that normally shields steel from ecological components that reason erosion (rust). Fundamentally, vandates are salts and they increment the rate at which steel motor and fumes parts rust the way tossing salt on a metal builds the rate at which its rusts. Vanadium likewise adds to the consumption of oil transport pipelines, boats, and tanker trucks[3].

Iron

Iron taints oil mostly because of erosion in pipelines, ships, and trucks. The primary issue with iron is that it can prompt slop develop in siphons, refinery exchangers, and other fuel conveyance frameworks

Zinc

Zinc is one of a kind contaminants since it never happens as a characteristic part of oil. The main zinc in oil originates from reusing greasing up oils (engine oil and water powered oil). The primary issue with zinc is that it meddles with the expulsion of salts from oil. Expanded salt dimensions mean expanded consumption of refinery frameworks, motor parts, and so forth. If you are using Word, use either the Microsoft Equation Editor or the MathType add-on (<http://www.mathtype.com>) for equations in your paper (Insert | Object | Create New | Microsoft Equation or MathType Equation). "Float over text" should not be selected.

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II. LITERATURE SURVEY

NilanjanaDas et, al, (2010), [4]performed the experiment to tidying up of oil hydrocarbons in the subsurface environment is a real-world problem. A better understanding of the component of biodegradation has a high natural significance that depends on the indigenous microorganisms to transform or mineralize the organic contaminants. In this manner, in view of the present audit, it might be reasoned that microbial corruption can be considered as a key segment in the clean-up system for oil hydrocarbon remediation. BijayThapaet,al(2012)[5]has been discussed the upsides and downsides of utilizing bioremediation process for the remediation of oil contaminants in soil. Bioremediation alongside different procedures have been utilized to remediate oil hydrocarbon contaminants in soil in past. Further inquiries about in this field can result in the advancement of most effective and less tedious advances. Likewise, further research is basic to explore its application past the lab scale and to build up the energy of corruption[6]

III. RESULTS AND DISCUSSIONS

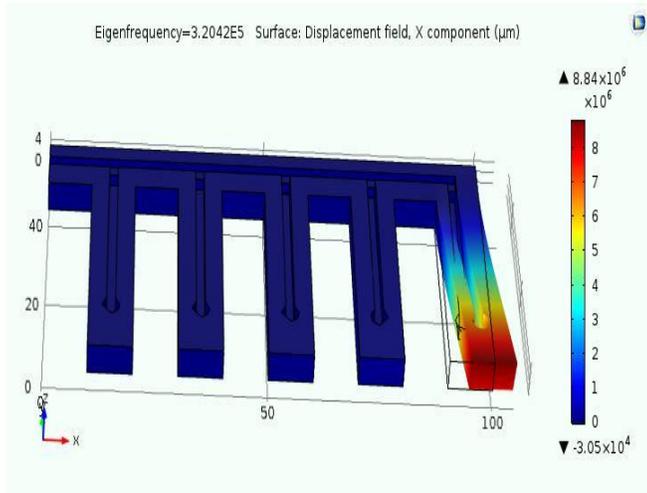


Figure1: Design of Cantilever sensor

The above figure is Cantilever sensor for detection of petrol contaminants. Here we have obtained displacement of 8.84×10^6 for the highest eigenfrequency of 3.2042Hz. Here we have obtained displacement of 3.06×10^4 for the lowest eigenfrequency of 1.4708Hz.

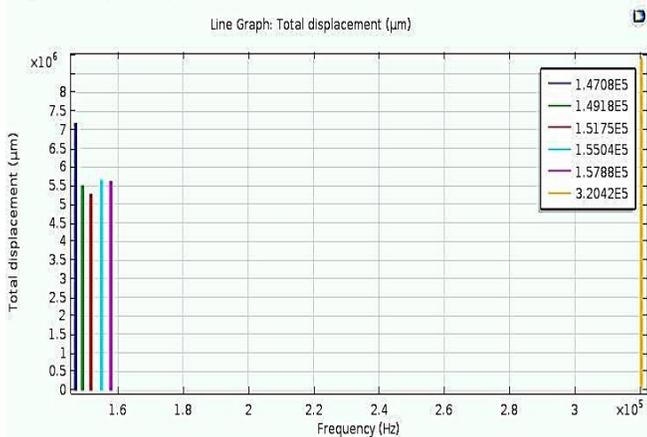


Figure2: Graph showing Frequency vs Total displacement

In the above graph along x axis we have frequency and along y axis we have total displacement. Here in this design frequency vs displacement graph is non linear.

Table:1 Displacements for various Eigne Frequencies

| Eigen Frequency | Displacement |
|-----------------|--------------|
| 1.4708E5 | 7.1 |
| 1.4918E5 | 5.5 |
| 1.5175E5 | 5.3 |
| 1.5504E5 | 5.6 |
| 1.5788E5 | 5.6 |

Table 1 Table Shows Eigen Values and Displacements

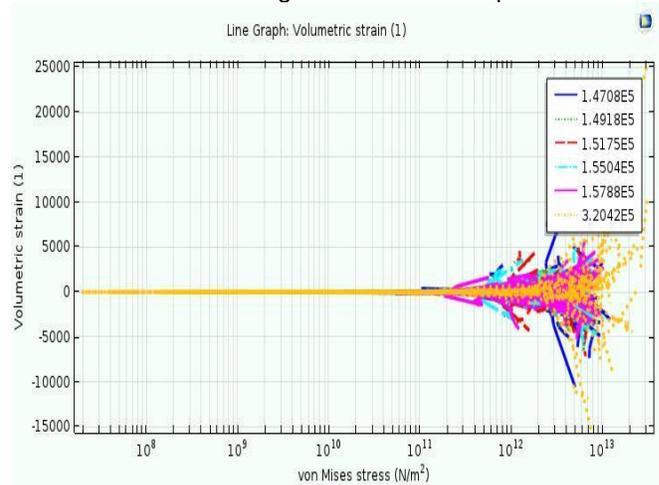


Figure 3 Graph showing Stress Vs Strain

The Figure 3 shows the stress and strain graph.The Stress Vs strain graph is a non linear curve which originates at 0 and later the graph becomes non linear curve.

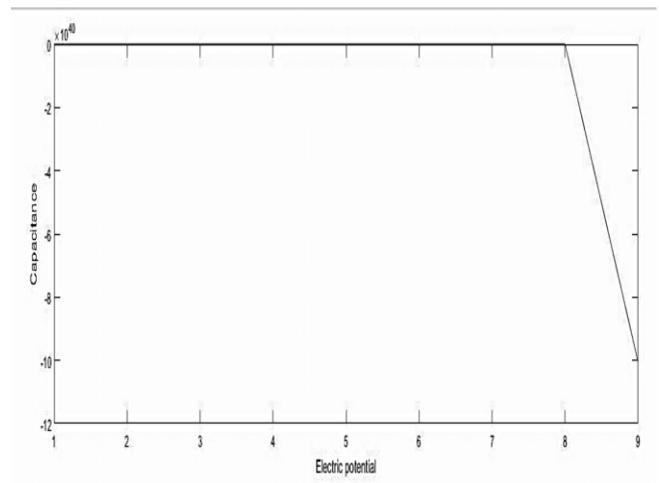


Figure 4:Graph showing Electric potential Vs Capacitance

In the above graph along x axis we have Electric potential and along y axis we have capacitance. The graph for Electric potential Vs capacitance is nonlinear.

IV. CONCLUSION

Micro Cantilever structures are very sensitive in showing the variations in displacements and gives accurate output parameters like displacement, voltage and capacitance. Here the detection mechanism of ingredients in petrol is mass sensing. The amount of ingredient reacted with the layer laid on cantilever applies a force on the surface of cantilever and produces a displacement. The displacement sensitivity is measured and its value is 8.84×10^6 . This process has been done for different variety of contaminant materials and tested. This process includes non-hazardous procedure, quick response and low power requirement.

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