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A Study On Different Material Characterstics of MOSFET Based Pressure Sensors

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***Abstract*— T Sensors have numerous applications starting from the medical field to area exploration. They convert physical parameters like temperature, pressure, humidness etc. into associate electrical output. The invention of piezoresistivity property of chemical element and chemical element diode to shrinking of pressure sensors. Improvement within the sensitivity is that the major issue to be thought of whereas planning pressure sensors. during this paper our effort is to review current mirror sensing based mostly MOSFET that provides high sensitivity. the combination of CMOS-MEMS technology in developing pressure sensors helps in reduction of space and improvement of sensitivity particularly in medical specialty applications like intracranial pressure sensors. within the MOSFET pressure device, the channel region of the MOSFET acts as piezoresistive material in addition as diaphragm that deflect underneath applied pressure. Stress developed attributable to applied pressure changes the drain current and therefore the output voltage created.**

***Keywords*—Short Channel Effect (SCE), Moore's Law, CMOS, Induced Barrier Lowering (DIBL), Hot Electron Effects (HECs)**

I. INTRODUCTION

The idea of integration MEMs structures with electronics on one chip is wide getting used for the event of good sensors for care and medicine applications [1]. the implementation of those integrated sensors need a sensing technique that's totally compatible with normal CMOS processes and involves less signal process electronic equipment for extracting the sensor's signal. piezoresistive impact and compound capacitance variation in MOSFET [2] square measure a number of the foremost promising rising sensing mechanisms. pressure sensors supported MOSFET embedded sensing are projected and developed by completely different researchers [3–7]. the principle of operation of the projected sensors victimization MOSFET is predicated on either the piezoresistive impact seen within the MOSFET channel or the gate capacitance variation seen in a very suspended gate MOSFET.

Just in case of the piezoresistive impact within the channel, the principle of piezoresistive pressure sensing that uses the actual fact that the resistance of the sensing material amendments with relevance the change within the applied pressure or strain is exploited [8] the piezoresistance impact of the channel and capacitance variation as a result of the suspended gate are exploited in planning the sensor.

1.1 types of pressure sensor- pressure sensors will be classified in terms of pressure ranges they live, temperature ranges of operation, and most significantly the sort of pressure they live. Pressure sensors square measure multifariously named in step with their purpose, however identical technology is also used beneath completely different names.

Absolute pressure sensor- This sensor measures the pressure relative to good vacuum.

Gauge pressure sensor- This sensor measures the pressure relative to gas pressure. a tire pressure gage is an example of gauge pressure measurement; once it indicates zero, then the pressure it's mensuration is that the same because the close pressure.

Vacuum pressure sensor - This term will cause confusion. it's going to be accustomed describe a sensor that measures pressures below gas pressure, showing the distinction between that air mass and gas pressure (i.e. negative gauge pressure), however it's going to even be accustomed describe a sensor that measures air mass relative to good vacuum (i.e. absolute pressure).

Differential pressure sensor - This sensor measures the distinction between 2 pressures, one connected to every facet of the sensor. differential pressure sensors accustomed measure several properties, like pressure drops across oil filters or air filters, fluid levels (by examination the pressure higher than and below the liquid) or flow rates (by mensuration the amendment in pressure across a restriction) most pressure sensors square measure very differential pressure sensors; as an example a gauge pressure sensor is just a differential pressure sensor within which one facet is hospitable the close atmosphere.

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Sealed pressure sensor- This sensor is comparable to a gauge pressure sensor except that it measures pressure relative to some mounted pressure instead of the close gas pressure (which varies in step with the situation and therefore the weather).

II. Literature Survey

Joy et al [1] shows a traditional sq. diaphragm with all edges fastened is sculptured and also the sensitivity is compared with the sensitivity of a circular diaphragm with fastened boundaries. equally a sq. diaphragm with 2 free ends is sculptured. The sensitivity of circular diaphragm is additionally compared with this structure a 3 dimensional FEM together with fastened edge circular and sq. diaphragm integrated with circular and sq. ring channel formed structure is to be sculptured and simulated. Bridge structured diaphragm and ring structured diaphragms square measure embedded on MOSFET and sensitivity is calculated by creating each edges of the channel fastened. Then the sensitivity is measured by creating one edge fastened and different finish free for increasing the sensitivity. Comparison between MOSFET embedded bridge structure having one free finish and also the MOSFET embedded ring structure with free boundary is finished.

Joy et al main aims at modeling a high sensitivity pressure detector with free boundary circular diaphragm integrated with circular ring channel formed structure. A free boundary ring channel formed MOSFET embedded MEMS pressure detector is simulated and a model is planned to explain the behavior of the structure. Their planned model has high sensitivity and consumes less space than existing pressure sensors.

Zhao et al [2] has given a completely unique nc-Si/c-Si heterojunction MOSFETs pressure detector is planned during this paper, with four p-MOSFETs with nc-Si/c-Si heterojunction as supply and drain. The four p-MOSFETs square measure designed and fancied on a sq. Si membrane by CMOS method and MEMS technology wherever channel resistances of the four nc-Si/c-Si heterojunction MOSFETs type a bridge. Once the extra pressure is P, the nc-Si/c-Si heterojunction MOSFETs pressure detector will leave this extra pressure P. The experimental results show that once the provision voltage is three V, length-width (L:W) quantitative relation is 2:1, and also the Si membrane thickness is 75 μm, the complete scale output voltage of the pressure detector is 15.50 mV at temperature, and pressure sensitivity is .097 mV/kPa.

Once the provision voltage and L:W quantitative relation square measure identical because the higher than, and also the Si membrane thickness is 45μm, the complete scale output voltage is 43.05 mV[2], and pressure sensitivity is 2.153 mV/kPa. Therefore, the detector has higher sensitivity and sensible temperature characteristics compared to the standard piezoresistive pressure detector.

At present, the varied varieties of pressure sensors used embody piezoresistive pressure sensors, capacitance pressure sensors, electricity pressure sensors, resonator pressure sensors, and vacuum electronics pressure sensors, etc.

Zhao et al [2] has stated about the trend in recent researches, modification of capacitance, channel thickness, threshold voltages and channel mobility to design and fabrication related data of various researches in his paper like Yan et al. [18] in 2001 given a type of MOSFET based pressure detector. Li et al. [19] designed associated in fancied an integrated pressure detector with stress sensitive MOS operational electronic equipment in 2001. Zhang et al. [20] planned a completely unique MEMS pressure detector with MOSFET in 2008. Jachowicz et al. [21] of the Warsaw University of Technology fancied a pressure sensitive field impact electronic transistor (PSFET) in 2002. Fernández-Bolanõs et al. [17] reportable the fabrication and electrical characterization of a completely unique pressure detector supported a suspension-gate MOSFET (SG-MOSFET) employing a new polyimide method. Garcia et al. designed a pressure sensitive differential electronic equipment, whose sensitivity was one.29 mV/kPa, and power was 3μW. the most structure of the MOSFET pressure sensors is suspension gate structure, and differential structure of double tube, etc.

In manuscript by Zhao-hua et al.[3] 2012 supported the metal-oxide-semiconductor field impact electronic transistor (MOSFET) stress sensitive development, a less power MOSFET pressure detector is planned. Compared with the standard piezoresistive pressure detector, this pressure detector displays high performances on sensitivity and power consumption. The sensitivity of the MOSFET detector is raised by eightyseven, meantime the ability consumption is minimized by 20%. Authors conclude that, The piezoresistive pressure microsensor is one reasonably the foremost wide used pressure sensors for automotive, aerospace, biomedicine, and lots of different applications.[1−4] it's typically composed of a Si membrane and a bridge circuit with four piezoresistors.

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III. GRAPHICAL COMPARISION

TABLE 1.
Summary [16]

Membrane thickness &aspect ratio	Offset Voltage for 1V input(mV)	Sensitivity (mV/ Volt(BAR)	Maximum deviation in the linearity(%)
10µm, 500µmX750µm	8.7	5.81	0.06 upto 3bar
10µm, 500µmX1125µm	8.7	10.3	2.90 upto 3bar
15µm, 500µmX875µm	8.7	1.8	.36 upto bar

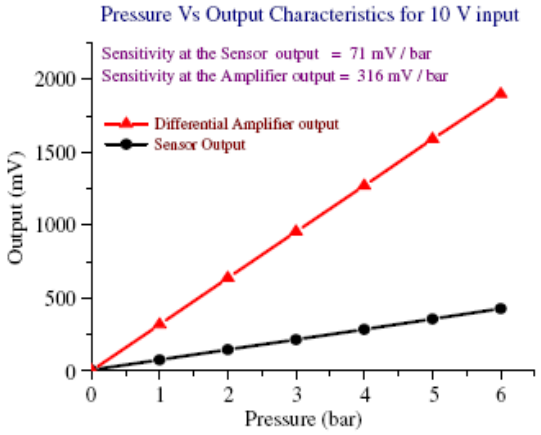

Fig. 1 Summary of Results on the packaged pressure sensors [16]

Table one it is seen that the nonlinearity is well inside one hundred and twenty fifth within the devices having smaller magnitude relation ratio's whereas the device having facet ratio 1250/500 shows a nonlinearity of two.9% and also the sensitivity of this device is sort of double that of the device with ratio 750/500. These numbers yet again illustrate that increasing the magnitude relation enhances the sensitivity and at identical time worsens the one-dimensionality significantly. An output voltage of zero.956 V was obtained with the repacked MOS integrated sensing element at three bar gauge pressure with ten V input to the integrated chip. The Integrated sensing element showed wonderful one-dimensionality. For a full scale output of zero.956 V at three bar pressure, the utmost nonlinearity of zero.2% has been achieved. Even for a full scale output of one.59 Volts at five bar pressure, the utmost one-dimensionality is found to be inside zero.3%. The pressure versus output voltage characteristics of the ultimate repacked device area unit shown in Graph one.

IV. CONCLUSION

Thus, once learning all the views from the assorted authors the MOSFET based mostly pressure sensing elements sensor are studied for its optimised performance and enhancing the sensitivity of the sensors whereas decreasing the dimensions of them. The essential ideas and necessities of atomic number 14 micromachining are given delivery out the importance of appropriate material for MEMS. The paper offers a bird's eye read of the various kinds of pressure sensors so focuses on the small print of the piezoresitive pressure sensors. The materials with higher k value will overcome all the challenges in reducing the MOSFET. These MOSFET based mostly sensors that area unit smaller enough is employed in varied applications within the field of bioscience and technology in keeping with the requirement and availableness.

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