Comparative analysis of MEMS pressure sensor using graphene and carbon nanotube as piezoresistive material

By Salimun, NL (Salimun, Nor Liana) [1] ; Ralib, AAM (Ralib, Aliza Aini Md) [1] ; Rahim, RA (Rahim, Rosminazuin Ab) [1]

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Abstract

Pressure sensors are essential to ensure the efficiency of the health monitoring system such as rehabilitation and ergonomic application. Compared to traditional health monitoring, miniature size for low power consumption, flexibility, biocompatibility, rapidity, and low-cost sensors are among the essential parameters. Micro-Electro-Mechanical System (MEMS) pressure sensors offer very small size where it can respond rapidly to a very small changes in pressure with high sensitivity and excellent linearity. Selection of piezoresistive material is crucial to enhance the performance of MEMS pressure sensor. Silicon-based MEMS piezoresistive pressure sensor suffers from brittleness and poor scalability. As such, carbon nanomaterial such carbon nanotube and graphene offer promising solutions as piezoresistive materials. To the best of our knowledge, there has been limited findings on the analysis of different type of carbon-based piezoresistive pressure (Graphene and CNT) sensors in terms of change of resistance, linearity and sensitivity through finite element simulation. Hence, the aim of this paper is to compare and analyze two different carbon nano materials (graphene and carbon nanotube) that act as piezoresistive materials for MEMS pressure sensor with combinational Dash & E-shape design. Finite element simulation results show that graphene-based MEMS piezoresistive pressure sensor shows high sensitivity of 0.6458 mV/V center dot mmHg. As on linearly increasing the output voltage, it is noticed that graphene performs well with 99% linearity compared to CNT by applying only 1 V biased voltage. Hence, this analysis opens the path to show that carbon-based MEMS piezoresistive pressure sensor based on carbon nanomaterial has potential to be implemented for various potential applications, including human-interactive electronics.

Keywords

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Author Information

Corresponding Address :	Ralib, Aliza Aini Md	(corresponding author)

Int Islamic Univ Malaysia, Dept Elect & Comp Engn, VLSI MEMS Res Unit, Kulliyyah Engn, Kuala Lumpur, Malaysia
E-mail Addresses :
alizaaini@iium.edu.my
Addresses :
[1] Int Islamic Univ Malaysia, Dept Elect & Comp Engn, VLSI MEMS Res Unit, Kulliyyah Engn, Kuala Lumpur, Malaysia
E-mail Addresses :
alizaaini@iium.edu.my

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