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Advanced vapour sensing materials : Existing and latent to acoustic wave sensors for VOCs detection as the potential exhaled breath biomarkers for lung cancer

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Abstract

Lung cancer is the leading cause of death worldwide and has a significant impact on public health across society. Among all types of cancer , lung cancer is typically silent and it is commonly diagnosed at a later stage where treatment is rarely achievable. There is an urgent need for the development of the early diagnosis of lung cancer for an improved survival rate. Preliminary research shows that lung cancer is accompanied by increased oxidative stress which generates volatile organic compounds (VOCs). Hence, breath analysis offers the most promising solution for the early diagnosis of lung cancer as it is non-invasive and radiation free. Potential VOCs biomarkers in exhaled breath associated with oxidative stress and lipid peroxidation have been discussed to provide a quick approach to the diagnosis of lung cancer . Although gas chromatography–mass spectroscopy (GC–MS) able to analyze the VOCs biomarker , it is bulky, high cost, required expertise to handle and consumes a lot of time. Hence, the sensor -based technique provides the solution to overcome the limitation. Recently, acoustic wave sensors such as quartz crystal microbalance (QCM) and surface acoustic wave sensors (SAW) have been used to identify the presence of VOCs in various applications. This is due to its high selectivity, good reproducibility, and fast response sensing materials . The selection of vapour sensing materials plays a crucial role in developing a highly sensitive and selective and fast response acoustic wave sensors . For this purpose, various types of sensing layers from metal oxides, polymers, biopolymers and composites have been studied. We present a critical review of advanced vapour sensing materials that are primarily used in acoustic wave sensors in identifying the presence of various VOCs . Criteria to evaluate the performance of the acoustic wave sensors such as resonance frequency and sensitivity are also discussed. © 2021 Elsevier B.V.

Author keywords

Acoustic wave sensor ; Biopolymer; Breath analysis; Composites; Lung cancer ; Volatile organic compound

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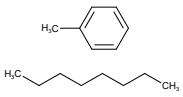
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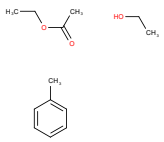
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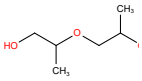
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Engineering controlled terms

Acoustic surface wave devices; Acoustic waves; Biological organs; Biomarkers ; Biomolecules; Biopolymers; Composite materials ; Diagnosis; Gas chromatography; Mass spectrometry; Phospholipids; Volatile organic compounds

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Funding text 2

ALIZA AINI MD RALIB obtained her B. Eng. in Computer and Information Engineering (Electronics) from International Islamic University Malaysia in 2006. Both her MSc and PhD in Electronics Engineering are also from IIUM in 2011 and 2016 respectively. She previously work at Intel Microelectronics Malaysia as layout design engineer from 2006–2009. From 2009 to 2016, she was a Research Assistant at Universiti Tenaga Nasional Malaysia and IIUM. Since 2016, she has been Assistant Professor with the Electrical and Computer Engineering Department, International Islamic University Malaysia. Her research interests include Micro Electro-mechanical (MEMS), CMOS-MEMS acoustic wave resonators, electroacoustic sensors, piezoelectric thin film and MEMS piezoelectric energy harvesting. Upon completion of her PhD, she decided to work on the development of acoustic wave sensors for breath analysis as noninvasive solution for early detection of critical disease. Her work has been published both locally and ...

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