

Full Text from Publisher

Find PDF

Export...

Add to Marked List

## Finite Element Simulation of Miniaturized ZnO/Si SAW Sensor for Rapid Detection of Dichloromethane Gas

By: **Norazlina, N** (Norazlina, Nur Latini Binti Mohamad)<sup>[1]</sup>; **Ralib, AABM** (Ralib, Aliza Aini Binti Md)<sup>[1]</sup>; **Saidin, N** (Saidin, Norazlina)<sup>[1]</sup>

### ADVANCED SCIENCE LETTERS

Volume: 24 Issue: 11 Pages: 8966-8969

DOI: 10.1166/asl.2018.12385

Published: NOV 2018

Document Type: Proceedings Paper

[View Journal Impact](#)

### Conference

Conference: 3rd International Conference on Education (ICOED)

Location: Melaka, MALAYSIA

Date: NOV 07-09, 2017

Sponsor(s): Malaysian Tech Scientist Assoc

### Abstract

Air quality control is very crucial as poor air quality can lead to chronic respiratory organ diseases. Hence, detection of numerous toxic and hazardous gas is utmost significance. A low cost and high sensitivity gas sensor is crucial to monitor the excessive presence of the dangerous gas that can harm human's health. In recent years, various type of gas sensors have been developed for various applications such as medicine, industry, automotive and environmental monitoring. One of the harmful gas is the dichloromethane gas. Dichloromethane (DCM) gas, CH<sub>2</sub>Cl<sub>2</sub> is widely used in industry due to its organic characteristics. However, the excessive of the amount of the gas could bring harm to human's health. Hence, a lot of sensing devices have been developed including surface acoustic wave (SAW) gas sensor. This paper presents the 2D finite element simulation of miniaturized ZnO/Si SAW gas, sensor for rapid detection of DCM gas. Using a powerful finite element analysis software known as COMSOL Multiphysics, the gas sensor is modelled according to the specific criteria using 2D approach. The effect of different thickness of ZnO thin film as piezoelectric layer is investigated on the SAW propagation characteristics. The resonance frequency of simulated ZnO/Si SAW gas sensor is 300 MHz with wavelength of 11.67 μm. The shift in frequency is the measurement used to measure the changes occurred to sense the presence or absence of DCM gas. The shift of resonance frequency is observed in the absence and presence of dichloromethane gas. This work has high potential to realize single chip gas sensor due to its silicon compatibility for rapid detection of harmful gas for environmental monitoring.

### Keywords

Author Keywords: [Surface Acoustic Wave \(SAW\)](#); [Gas Sensor](#); [Dichloromethane](#); [Silicon Compatible](#)

KeyWords Plus: [VAPOR](#)

### Author Information

Reprint Address: Ralib, AABM (reprint author)

+ Int Islamic Univ Malaysia, Kulliyah Engr, Elect & Comp Engr Dept, Kuala Lumpur, Malaysia.

### Addresses:

+ [ 1 ] Int Islamic Univ Malaysia, Kulliyah Engr, Elect & Comp Engr Dept, Kuala Lumpur, Malaysia

### Funding

Funding Agency	Grant Number
Research Initiative Grant Scheme under International Islamic University Malaysia	RIGS16-083-0247 RIGS15-145-0145
Ministry of Higher Education Malaysia	

[View funding text](#)

### Citation Network

In Web of Science Core Collection

0

Times Cited

Create Citation Alert

25

Cited References

[View Related Records](#)

### Use in Web of Science

Web of Science Usage Count

6

7

Last 180 Days

Since 2013

[Learn more](#)

### This record is from:

Web of Science Core Collection  
- Conference Proceedings Citation Index-Science

### Suggest a correction

*If you would like to improve the quality of the data in this record, please [suggest a correction](#).*

## Publisher

AMER SCIENTIFIC PUBLISHERS, 26650 THE OLD RD, STE 208, VALENCIA, CA 91381-0751 USA

## Categories / Classification

Research Areas: Science & Technology - Other Topics

Web of Science Categories: Multidisciplinary Sciences

## See more data fields

◀ 1 of 2 ▶

## Cited References: 25

Showing 25 of 25 [View All in Cited References page](#)

(from Web of Science Core Collection)

- Advanced vapor recognition materials for selective and fast responsive surface acoustic wave sensors: A review** Times Cited: 65  
By: Afzal, Adeel; Iqbal, Naseer; Mujahid, Adnan; et al.  
ANALYTICA CHIMICA ACTA Volume: 787 Pages: 36-49 Published: JUL 17 2013
- Title: [not available] Times Cited: 1  
By: Arabshahi, S.; Dousti, M.; Tavakoli, M. B.; et al.  
International Journal of Engineering Research and Applications Volume: 2 Pages: 2120 Published: 2012  
[\[Show additional data\]](#)
- A review of gas sensors employed in electronic nose applications** Times Cited: 366  
By: Arshak, K.; Moore, E.; Lyons, G.M.; et al.  
Sensor Review Volume: 24 Issue: 2 Pages: 181-98 Published: 2004
- Surface acoustic wave based H<sub>2</sub>S gas sensors incorporating sensitive layers of single wall carbon nanotubes decorated with Cu nanoparticles** Times Cited: 34  
By: Asad, Mohsen; Sheikhi, Mohammad Hossein  
SENSORS AND ACTUATORS B-CHEMICAL Volume: 198 Pages: 134-141 Published: JUL 2014
- Layered SAW gas sensor based on CSA synthesized polyaniline nanofiber on AlN on 64 degrees YX LiNbO<sub>3</sub> for H-2 sensing** Times Cited: 47  
By: Atashbar, M. Z.; Sadek, A. Z.; Wlodarski, W.; et al.  
SENSORS AND ACTUATORS B-CHEMICAL Volume: 138 Issue: 1 Pages: 85-89 Published: APR 24 2009
- A Wireless Surface Acoustic Wave-based Tire Pressure and Temperature Sensing Module** Times Cited: 1  
By: Chang, Hsing-Cheng; Hung, San-Sah; Chen, Ya-Hui; et al.  
PROCEEDINGS OF THE 5TH INTERNATIONAL CONFERENCE ON INFORMATION ENGINEERING FOR MECHANICS AND MATERIALS Book Series: AER-Advances in Engineering Research Volume: 21 Pages: 440-444 Published: 2015
- Surface acoustic wave ultraviolet sensors based on ZnO nanorods** Times Cited: 2  
By: Chen, Yung-Yu; Ho, Cheng-Hsiu; Wu, Tsung-Tsong  
2015 9TH INTERNATIONAL CONFERENCE ON SENSING TECHNOLOGY (ICST) Book Series: International Conference on Sensing Technology Pages: 406-411 Published: 2015
- Simulation and Fabrication of SAW-Based Gas Sensor with Modified Surface State of Active Layer and Electrode Orientation for Enhanced H-2 Gas Sensing** Times Cited: 4  
By: Hasan, Md. Nazibul; Maity, Santanu; Sarkar, Argha; et al.  
JOURNAL OF ELECTRONIC MATERIALS Volume: 46 Issue: 2 Pages: 679-686 Published: FEB 2017
- Layered WO<sub>3</sub>/ZnO/36 degrees LiTaO(3)SAW gas sensor sensitive towards ethanol vapour and humidity** Times Cited: 40  
By: Ippolito, S. J.; Ponzoni, A.; Kalantar-Zadeh, K.; et al.  
SENSORS AND ACTUATORS B-CHEMICAL Volume: 117 Issue: 2 Special Issue: SI Pages: 442-450 Published: OCT 12 2006
- Flexible surface acoustic wave resonators built on disposable plastic film for electronics and lab-on-a-chip applications** Times Cited: 81  
By: Jin, Hao; Zhou, Jian; He, Xingli; et al.  
SCIENTIFIC REPORTS Volume: 3 Article Number: 2140 Published: JUL 5 2013

11. **Fiber-Optical Sensors: Basics and Applications in Multiphase Reactors** Times Cited: 17  
 By: Li, Xiangyang; Yang, Chao; Yang, Shifang; et al.  
 SENSORS Volume: 12 Issue: 9 Pages: 12519-12544 Published: SEP 2012
  
12. **Surface acoustic wave devices for sensor applications** Times Cited: 33  
 By: Liu Bo; Chen Xiao; Cai Hualin; et al.  
 JOURNAL OF SEMICONDUCTORS Volume: 37 Issue: 2 Article Number: UNSP 021001 Published: FEB 2016
  
13. **Response Mechanism for Surface Acoustic Wave Gas Sensors Based on Surface-Adsorption** Times Cited: 12  
 By: Liu, Jiansheng; Lu, Yanyan  
 SENSORS Volume: 14 Issue: 4 Pages: 6844-6853 Published: APR 2014
  
14. **Surface Acoustic Wave Gas Sensor** Times Cited: 1  
 By: Multiphysics, C.  
 SURFACE ACOUSTIC WAV Volume: 3 Pages: 1-20
  
15. **A Novel MEMS based surface acoustic wave gas sensor for carbon dioxide detection in hot-process areas** Times Cited: 1  
 By: Oberoi, A.; Sinha, R.  
 P I N T E L C S E N S A P P L Article Number: e001 Published: 2014
  
16. **Simulation of ZnO Enhanced SAW Gas Sensor** Times Cited: 1  
 By: Plessis, H. G.; Perold, W. J.  
 SIMULATION ZNO ENHAN Pages: 1-4 Published: 2013
  
17. **Finite Element Modeling of SAW Resonator in CMOS technology for single and double interdigitated electrode (IDT) structure** Times Cited: 5  
 By: Ralib, Aliza Aini Md; Nordin, Anis Nurashikin; Hashim, Uda  
 2013 IEEE REGIONAL SYMPOSIUM ON MICRO AND NANO ELECTRONICS (RSM 2013) Pages: 1-4 Published: 2013
  
18. **SILICON COMPATIBLE ACOUSTIC WAVE RESONATORS: DESIGN, FABRICATION AND PERFORMANCE** Times Cited: 4  
 By: Ralib, Aliza Aini Md; Nordin, Anis Nurashikin  
 IIUM ENGINEERING JOURNAL Volume: 15 Issue: 2 Pages: 23-41 Published: 2014
  
19. **Resonant Frequency Characteristics of a SAW Device Attached to Resonating Micropillars** Times Cited: 17  
 By: Ramakrishnan, N.; Nemade, Harshal B.; Palathinkal, Roy Paily  
 SENSORS Volume: 12 Issue: 4 Pages: 3789-3797 Published: APR 2012
  
20. **Ultra High Frequency Thin Film SAW Devices** Times Cited: 1  
 By: Rodriguez-Madrid, J. G.; Iriarte, G. F.; Calle, F.  
 ULTRAHIGH FREQUENCY Published: 2013
  
21. **A ZnO nanorod based layered ZnO/64 degrees YX LiNbO(3)SAW hydrogen gas sensor** Times Cited: 75  
 By: Sadek, A. Z.; Wlodarski, W.; Li, Yx; et al.  
 THIN SOLID FILMS Volume: 515 Issue: 24 Pages: 8705-8708 Published: OCT 15 2007
  
22. Title: [not available] Times Cited: 1  
 By: Sidhik, S.; Ittiah, J. V.; Gangopadhyay, T. K.  
 American Journal of Electronics and Communication Volume: II Pages: 27 Published: 2015
  
23. **Tapered Optical Fiber Sensor for Label-Free Detection of Biomolecules** Times Cited: 75  
 By: Tian, Ye; Wang, Wenhui; Wu, Nan; et al.  
 SENSORS Volume: 11 Issue: 4 Pages: 3780-3790 Published: APR 2011
  
24. **Performance Prediction and Sensitivity Analysis of SAW Gas Sensors** Times Cited: 6  
 By: Tsai, Jinn-Tsong; Chiu, Kai-Yu; Chou, Jyh-Horng  
 IEEE ACCESS Volume: 3 Pages: 1614-1619 Published: 2015
  
25. **Highly sensitive ultraviolet detector using a ZnO/Si layered SAW oscillator** Times Cited: 43  
 By: Wei, Ching-Liang; Chen, Ying-Chung; Cheng, Chien-Chuan; et al.  
 THIN SOLID FILMS Volume: 518 Issue: 11 Special Issue: SI Pages: 3059-3062 Published: MAR 31 2010

Clarivate

Accelerating innovation

