



UNIVERSITI
TEKNOLOGI
MARA

Universiti Melaka

V-MIEX

28 JUNE
06 JULY
2022

VIRTUAL-MELAKA INTERNATIONAL INTELLECTUAL EXPOSITION

ROAD TO COMMERCIALISATION

V-MIEX BOOK



V - MIIEX BOOK

'ROAD TO COMMERCIALISATION'

EDITORS AND COMPILERS:

Dr. Nur Hayati Abd Rahman
Dr Syukri Abdullah
Wan Hasmat Wan Hasan
Aini Qamariah Mohd Yusof
Norazlan Anual
Dr. Khairunnisa Abd Samad
Nordianah Jusoh @ Hussain
Rozana Othman
Norlela Abas
Azira Rahim

COVER DESIGN:

Adi Hakim Talib

PUBLISHED BY:

Division of Research and Industrial Linkages
UiTM Cawangan Melaka
KM26 Jalan Lendu,
78000 Alor Gajah, Melaka
Tel: +606-5582094 / +0606-5582190 / +606-5582113
Email: miixuitm@gmail.com
Website: <https://www.miiex.my/>
ISBN: 978-967-2846-04-8

All right reserved. No parts of this publication may be produces, stored in retrieval system or transmitted in any form by any means, electronic, mechanical, photocopying, recording, or otherwise without permission of the copyright holder.

FOREWORD

ASSOC. PROF TS. DR MOHD RASDI ZAINI
Rector
Universiti Teknologi MARA (UiTM) Cawangan Melaka



Welcome to Virtual-Melaka International Intellectual Exposition 2022 (V-MIIEEX 2022). It is an honour for me on behalf of UiTM Melaka Branch to thank all of you for joining the programme and we are proud to inform you that this is the 12th year consecutively, UiTM Melaka Branch is organizing this exposition.

V-MIIEEX 2022 is a platform to improve the commercialization collaboration among industries and communities and at the same time, we also give the opportunity to academicians and students to share ideas and increase their potential innovation products with the industries and communities through their projects. This exposition also serves as a platform to cultivate and upload the nation's innovation culture by presenting new ideas and research by young people, especially from academia, universities, college, high schools, and primary school students.

The economy and development of the country faced a challenging phase in 2021 due to the Covid-19 pandemic. We faced changes in business, education, society, and lifestyle. However, the pandemic proved to be a blessing in disguise as it somehow gave people ideas which would be beneficial to improve their lifestyle and solve problems that might occur in the future. Besides, the new digital landscape also inspires more innovation and new ideas that contribute to various activities such as business and industries. As a university that encourages the "Research, Innovation and Commercialization", this exhibition is organized to encourage more commercialization of products that are beneficial to scholars, industries, and communities to tackle such issues to improve our present and future life.

Since 2009, UiTM Melaka Branch has successfully become the organizer for this innovation exposition. We are not only successful in organizing the exposition, but I would proudly say that we have also successfully embarked on commercialized products. With the number of participants for this year's exhibition, we believe that more commercialized products will be produced in line with the theme for this year, "Road to Commercialisation".

This exposition would never happen without dedication, teamwork, and commitment. A round of applause should be given to the committee teams as the backbone of this exposition. Their hard work, effort, and time made this exposition possible.

Finally, I would like to conclude this brief remark by thanking all the participants and stakeholders for joining the exposition, we hope that this collaboration never ends here.

Thank you.

FOREWORD



DR. NUR HAYATI BINTI ABD RAHMAN
Deputy Rector Research & Industrial Linkages
Universiti Teknologi MARA (UiTM) Cawangan Melaka

It is a great pleasure to welcome all the participants and presenters to the Virtual Melaka International Intellectual Exposition (VMIIEX 22). I am delighted that through this periodic event, we managed to bring together scholars and professionals from various fields to engage through this virtual platform where ideas and breakthrough are discovered and leveraged for commercialization potential.

Since 2009 UiTM Cawangan Melaka has held twelve Invention and Innovation Design competitions and this year we are very honoured to have the second year of VMIIEX organized in digital platform. This has proven that despite the global challenges due to the recent pandemic, it is never an issue for UiTM Melaka to continuously organize this yearly prestigious event and to support the ministry's aspiration in leveraging creativity and innovation in the new norm.

VMIIEX 22 is organized with no sole objectives of accomplishing the University's KPI but instead we are determined to make this programme as the place to help heighten commercialization collaboration in research and innovation with the industry and community through joint exhibitions from various external organizations.

Our aspiration is to also provide exposure and opportunities to academic staff as well as students from public and private universities to engage in direct excellent scholarly activities with the industry and community through activities that can be measured and assessed. As for the Research and Industrial Linkages Office of UiTM Melaka, this exhibition is seen as the platform that can encourage active collaboration and knowledge transfer with industries; objectively to support various activities that will benefit all stakeholders from the various government agencies, local and international universities, industries and communities.

Through the theme of "Road to Commercialization" this year, V-MIIEX 22 is committed to have this event as a boulevard to inspire and cultivate creativity and innovation to the numerous levels of inventors through exposure on latest technologies, astonishing ideas and creative designs with great potential to be commercialized. For this year, we proudly introduce a special category which is the "Endemic Challenge" as the provision to the government of Malaysia's goal of moving towards the endemic.

To ensure that the competing products in this exhibition is not exclusively for the purpose of competition, V-MIIEX 22 is dedicated for the commercialization of highly potential innovation products, which is attained through its active collaboration with tailored needs industries. The commercialization effort was not for income generation purpose only but it aimed to spearhead the development of quality products in line with industrial needs and community benefit.

Therefore, it is a great honour for me on behalf of the Research and Industrial Linkages Office as well as the organizing committee to have all participants in this competition and I would like to express my highest gratitude especially to the Rector of UiTM Melaka and all strategic partners and sponsors for supporting the event.

To finish, I sincerely wish VMIIEX 22 a remarkable success. I believe that this will not be the only collaboration between UiTM Melaka and the respective partners and linkages, but a beginning of a long and fruitful cooperation in future.

Thank you very much.

road to commercialisation...

WAN HASMAT WAN HASAN
Project Director V-MIIEEX 2022
Universiti Teknologi MARA (UiTM) Cawangan Melaka



Assalamualaikum and Warmest Greetings.

It gives me an enormous pleasure, on behalf of the organizing committee to welcome all participants and presenters to the Virtual -Melaka International Intellectual Exposition 2022 (VMIIEX '22) with the theme "Road to Commercialisation". We are honoured and glad to welcome all participants to this biennial event.

This is the second time that we have organized this biennial event virtually. V-MIIEEX 22 is an innovation competition, in which, innovation products, ideas and systems related to various science and technological fields are exhibited as a solution for the presented problems.

V-MIIEEX22 expectantly will be a platform that gathers experts from academies, scientists, and researchers, locally and internationally, to contribute towards the growth of scientific and technological knowledge in each participant's specialisation and expertise.

The competition also serves as a platform to give fresh exposure to the various level of inventors, as well as to encourage the culture of innovation design focused on latest technologies and related to new norms technologies and inventions due to COVID-19.

V-MIIEEX 22 is also hoped to be an avenue for gathering and disseminating the latest knowledge on ideas and acquisition of innovation among the participants. It is hoped that the competition will be able to open the mind of the participants towards latest technologies and design. It is also in line with the government's aspiration to encourage innovation activities in Malaysia.

As a final note, I would like to congratulate my fellow committee members for their tremendous effort, which have been critical to the event's success. In addition, I would like to thank our co-organizer, event sponsors and supporters. Optimistically, we wish that all new knowledge that is discovered, invented, or innovated will drive towards our future sustainability.

Thank you.

ABOUT V-MIIEEX

The world after COVID-19 is unlikely to return to the world that was. Despite the challenging pace during the pandemic, the strong rebound is expecting in this exciting year 2022. Malaysia is welcoming the great prospects ahead with positive impact on the country's economy and development. Hence, the hope for greater opportunities motivates for more creative thinkers to come up with innovative ideas that can be put forward to be harnessed to overcome similar problems in the future. V-MIIEEx 2022 is one of these platforms which contribute relevant ideas that could help communities of all walks of life cope with this pandemic.

UiTM has identified research, innovation, and commercialization to be among the core components and strategic effort towards becoming a well-known and prominent university. Aside from realizing this goal, with these components and efforts, fostering the development of knowledge, generating financial stability of the university, and producing knowledgeable academicians are also potentially achievable.

By having invention and innovation competition yearly, UiTM Cawangan Melaka is confident that it could further enhance creative and innovative abilities among staff and students. In support of the government notion which upholds the importance of innovation, UiTM Cawangan Melaka has taken the initiative of organising the Virtual Melaka International Intellectual Exposition (V-MIIEEx).

In instigating and nurturing the continuous culture of inventing and innovating, this event is an ideal platform for lecturers, administrative staff, students, and the public to showcase and commercialize their products or prototypes as well as novel ideas. The first IID which was held nationally in UiTM Cawangan Melaka in 2009, has successfully gathered and displayed more than 37 inventions and innovations. Accordingly, to continue this strong passion towards inventing and innovating, the IID competition should be continued and celebrated.

With that, the Division of Research and Industrial Linkages will be organising its 12th IID competition, the Virtual - Melaka International Intellectual Exposition (V-MIIEEx 2022) with the theme, 'Road To Commercialisation'. V-MIIEEx 2022 hopes to welcome 200 competing products to be showcased and commercialized, at the same time, attract attention of related and matching industry.

Objectives

1. Encourage and instill passion towards inventing and innovating among UiTM Cawangan Melaka staff, students and academicians of local and international higher education institutions;
2. Highlight distinguished talents of skillful inventors and exhibit intellectual products, inventions and innovations among local and private tertiary institutions, government and private agencies, including international participants;
3. Become an effective Business Matching platform for participating research products, matching industries and partnering government agencies;
4. Recognise, inspire and promote invention and innovation products to be patented and commercialized;
5. Increase passion towards inventing and innovating through research and boost interests of government and non-government agencies to obtain consultancy services from a line up experts of higher education institutions and UiTM Cawangan Melaka.

Optimization of Ultra-Sensitive Humidity Sensor from Multistructured Metal Oxide-based Semiconductor via Hybrid Deposition Methods

N. E. A. Azhar^{1,2, a, *}, K. A. Eswar^{1,3,4, b}, M. Maryam^{1,3,5, c}, M. F. Malek^{1,3, d},
F. S. Husairi^{1,3, e}, M. Rusop^{1,2, f}

¹NANO-SciTech Lab (NST), Centre for Functional Materials and Nanotechnology (FMN),
Institute of Science (IOS), Universiti Teknologi MARA (UiTM), 40450 Shah Alam,
Selangor, Malaysia

²NANO-ElecTronic Centre (NET), School of Electrical Engineering, College of Engineering,
Universiti Teknologi MARA (UiTM), 40450 Shah Alam, Selangor, Malaysia

³Faculty of Applied Sciences, Universiti Teknologi MARA (UiTM), 40450 Shah Alam,
Selangor, Malaysia

⁴Faculty of Applied Sciences, Universiti Teknologi MARA (UiTM) Sabah Branch, Tawau
Campus, 91032 Tawau, Sabah, Malaysia

⁵Faculty of Applied Sciences, Universiti Teknologi MARA (UiTM) Perak Branch, Tapah
Campus, 35400 Tapah Road, Perak, Malaysia

^anajwaezira@yahoo.com, ^bmaryam6328@uitm.edu.my, ^ckevinalvin86@uitm.edu.my,
^dmfmalek07@uitm.edu.my, ^ehusairi5840@uitm.edu.my, ^frusop@uitm.edu.my

Abstract

The word humidity stands for the water vapor content in gases and are essential in everyday life where maintaining the suitable humidity level in the atmosphere improves health and quality of life. Significantly amid our COVID-19 pandemic, recent studies on the effects of temperature and humidity on the spread of COVID-19 had shown that one of the contributing factors in reducing the spread of COVID-19 virus is warm and wet climates hence the use of humidity sensor is required in detecting relative humidity (RH) level in the air. Commonly used sensing materials that are used in fabricating humidity sensors are metal oxide semiconductors particularly Titanium dioxide (TiO₂) and zinc oxide (ZnO) nanomaterial due to their unique properties and boost excellent performances when applied to devices. Moreover, compared to organic materials substitution, metal oxides semiconductor not only has higher advantages in terms of producing higher quality humidity sensing device, but it can also be easily synthesized at much lower production cost. Therefore, our study will be focusing on the optimization of ultra-sensitive humidity sensor (USHS) from Multistructured Metal Oxide-based Semiconductor via various deposition techniques. An eco-friendly niobium-doped TiO₂ and ZnO based metal-semiconductor-metal (MSM) humidity sensor has been fabricated and the high humidity sensor sensitivity had been investigated. Methods such as electrodeposition, spin-coating and microwave assisted ultrasonic techniques have been employed to synthesize the multi-structured metal oxides. Field emission scanning electron microscope (FESEM) images had shown uniformly distributed TiO₂ and ZnO nanostructures with diameter ranging from 30 to 48.9 nm and length ranging between 0.4 to 1.82 μm. XRD results also had shown that these materials have high crystalline structures and the niobium doped TiO₂ and ZnO based MSM humidity sensor showed the highest sensitivity of 258.63 at 90 %RH also exhibiting ultra-sensitive, high stability and faster response.

Keywords: TiO₂, ZnO, Nanostructures, Humidity sensor

1. INTRODUCTION

Metal oxide-based multifunctional materials and one-dimensional nanostructures research and studies are rapidly expanding due to their nature of unique characteristics and novel applications where one of the many nanostructured materials commonly pursued would be zinc oxide (ZnO) whose excellent properties can boost electrical devices performances and many more. Zinc oxide is classified as a semiconductor in group II-VI, whose covalence is on the boundary between ionic and covalent semiconductors. A broad energy band (3.37 eV), high bond energy (60 meV) and high thermal and mechanical stability at room temperature make it attractive for potential use in electronics, optoelectronics and laser technology. The piezo- and pyroelectric properties of ZnO mean that it can also be used as a sensor, converter, energy generator and photocatalyst in hydrogen production. Titanium dioxide (TiO₂) is also one of the suitable candidates to be used in sensing application due to its higher electron mobility, more stable, less sensitive to oxygen and moisture. Sreekantan et. al had discussed on some of the TiO₂ NTAs benefits are high mechanical stability, large surface area, highly uniform morphologies and unique nanoarchitecture with less interfacial grain boundaries, which enhanced electron-hole separation. Introduction of dopant in the materials are also discussed in this study where doping is the process when there is modification of crystal lattice of semiconductor by addition of foreign atoms which leads to increase the electrical properties (conductivity) of semiconductor. Doping process is dependent on type of the dopant that can result either in *n*-type or *p*-type semiconductor. Liu et. al had mentioned that wherever the dopant is added (*n*-type or *p*-type), the semiconductor becomes more conductive whereas Alivov et al. reported the high surface area were needed in several semiconductor device nanostructured device for doping process. They found that the desired *p*-type doping in these nanostructured films is difficulty to achieve because of self-compensation effects of shallow donor oxygen vacancies. The Nb has characterized by high energy and affinity to oxygen. When the oxygen soluble in the niobium matrix, the niobium occupied octahedral interstitial sites which increase the temperature in the range of 500°C to 1915°C. The oxygen in solid solution will lead to increase the lattice parameter of metallic niobium and which decrease and increase hardness and the ductility of the metal.

2. OBJECTIVE

To fabricate and optimize ultra-sensitive humidity sensor (USHS) from Multistructured Metal Oxide-based Semiconductor via various deposition techniques.

3. NOVELTY & INVENTIVENESS

The niobium-doped TiO₂ and ZnO based metal-semiconductor-metal (MSM) humidity sensor is a new material development as compared to commercialized sample. The 2-dimensional (2D) nanostructure (nanotubes) of morphologies of niobium-doped ZnO and TiO₂ based nanomaterials have larger surface area, superior quality of electronic and optical properties as well as multi-functional sensing behavior as compared to organic and other metal oxide semiconductors. Moreover, novel fabrication process of the humidity sensor is optimized focusing on electrodeposition method. This research also addresses the flagship area related to RMK 11 which is focusing on the developing of green technology such as solar cells, catalysis and chemical sensors which required modification of metal oxides morphologies to enhance

the efficiency of the devices.

4. PRACTICALITY & USEFULNESS

This project will definitely benefit many parties as well as extending the bubbles of knowledge in liquid phase synthesis. In Malaysia specifically, the synthesis methods used are usually focused on the dry phase synthesis which requires expensive materials and equipment resulting in higher production cost. On the contrary, by introducing our electrodeposition method, this process can be carried out in ambient environment which minimizes the production cost. In addition, by fabrication and optimization of this niobium-doped TiO₂ and ZnO based metal-semiconductor-metal (MSM) humidity sensor properties it could certainly promotes multifunctional selectivity behaviour and high efficiencies applications that may led to newer opportunities in disciplines as diverse as physics, chemistry, biology, medicine and engineering. Due to the metal oxide-based semiconductor produced at lower cost method with higher productivity and performances, this nanomaterial thin film can also be used in domestic, industrial, electronics and semiconductor and residential application in addition to the fabrication of humidity sensor device. Industries like chemical, refineries, metal, or others where furnaces are also in need humidity sensors as high humidity reduces the amount of oxygen present in the air.

5. CONCLUSION

It can be concluded that the fabrication and optimization of niobium-doped TiO₂ and ZnO based metal-semiconductor-metal (MSM) humidity sensor had been succesful in significantly increasing the performances of the device in terms of ultra-sensitivity, high stability and faster response.

REFERENCES

- Asib, N. A. M., Husairi, F. S., Eswar, K. A., Afaah, A. N., Mamat, M. H., Rusop, M., & Khusaimi, Z. (2020). Developing high-sensitivity UV sensors based on ZnO nanorods grown on TiO₂ seed layer films using solution immersion method. *Sensors and Actuators, A: Physical*, 302. doi:10.1016/j.sna.2019.111827
- C. Liu, H. Lu, J. Zhang, J. Gao, G. Zhu, Z. Yang, F. Yin, and C. Wang (2018). Chemical Crystal facet-dependent p-type and n-type sensing responses of TiO₂ nanocrystals, *Sensors Actuators B Chem.*, 263, 557–567.
- Esgin, H., Caglar, Y., & Caglar, M. (2022). Photovoltaic performance and physical characterization of Cu doped ZnO nanopowders as photoanode for DSSC. *Journal of Alloys and Compounds*, 890. doi:10.1016/j.jallcom.2021.161848
- Sreekantan S., Arifah K., Ly N. T., Nguyen V. C., Hoa T., Shankar K. (2011). Formation of TiO₂ Nanotubes via Anodization and Potential Applications for Photocatalysts, Biomedical Materials and Photoelectrochemical Cell. *IOP Conf Ser Mater Sci Eng*, 21(012002):1–18.
- Y. Alivov, Y. Ding, V. Singh, and P. Nagpal (2014). Titanium-dioxide nanotube p-n homojunction diode, *Appl. Phys. Lett.*, 263501 (105), 263501–1–263501–3.