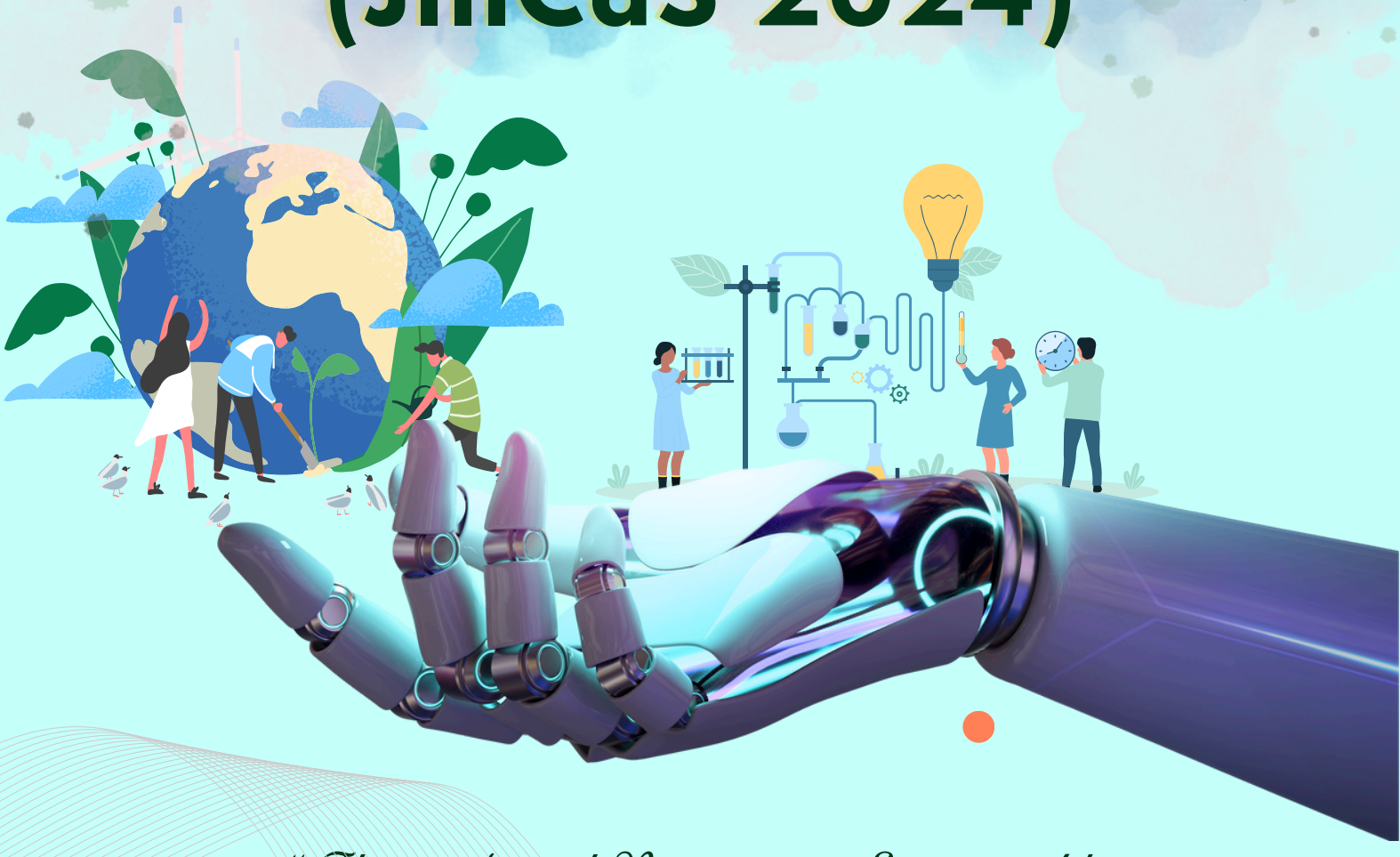
UNIVERSITI TEKNOLOGI MARA

JIIICaS 2024
JOHOR INTERNATIONAL INNOVATION, INVENTION COMPETITION AND SYMPOSIUM

PROCEEDINGS OF JOHOR INTERNATIONAL INNOVATION INVENTION COMPETITION AND SYMPOSIUM 2024 (JIIICaS 2024)



"Flourish and Nurturing Sustainable Innovation for a Prosperous Nation"

JIICOS 2024
JOHOR INTERNATIONAL INNOVATION, INVENTION COMPETITION AND SYMPOSIUM

Editorial Board

e ISBN: 978-967-0033-25-9

Published in Malaysia by
Universiti Teknologi MARA Cawangan Johor
Kampus Pasir Gudang
81750 Masai

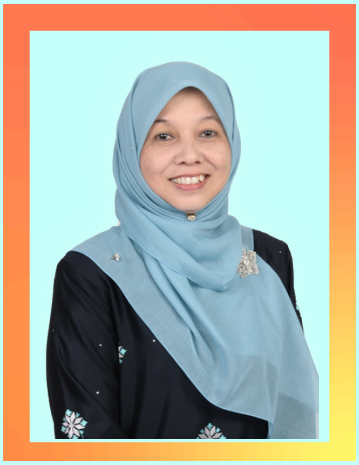
Preface

In the name of Allah, the Almighty who gives us the enlightenment, the truth, the knowledge and with regards to Prophet Muhammad (peace be upon him) for guiding us to the straight path. We thank to Allah for giving us guidance and strength to write this e-book.

This e-book compiles the extended abstracts that submitted to Johor International Innovation Invention Competition and Symposium 2024 (JIIICaS2024), where JIIICaS2024 is a virtual platform for all creative minds to share and present their invention and innovation. Each abstract gives a brief background on the innovation or project.

We hope that this e-book will help the readers to get to know the innovation done by the students and get some ideas to develop future innovation products.

Foreword Rector



Assalamualaikum warahmatullahi Wabarakatuh, Salam Sejahtera, Salam Malaysia MADANI and Salam UiTM Dihatiku.

In the name of Allah, the Most Gracious, the Most Merciful.

It is a great honor to welcome you to the Johor International Innovation, Invention, Competition, and Symposium 2024 (JIIICaS 2024). This event connects various disciplines, focusing on education and engaging educators, students, researchers, and innovators from all walks of life.

Innovation is not just about ideas; it demands perseverance, creativity, and determination to turn those ideas into reality. The remarkable projects showcased today highlight the dedication and spirit of all participants. Initiatives like this not only explore new technologies but also cultivate skills and leadership among our youth. At Universiti Teknologi MARA (UiTM) Johor Branch, we are fully committed to fostering a dynamic culture of innovation, promoting the commercialization of new products, and encouraging meaningful collaborations with industry and society.

As we celebrate this event, I would like to extend my heartfelt gratitude to all sponsors, judges, the College of Computing, Informatics and Mathematics, UiTM Pasir Gudang Campus as the event organizer, as well as to the researchers and participants for their hard work in making this event a success. Let us continue striving for innovation and excellence. May the ideas presented today inspire us and lay the groundwork for future achievements.

Thank you.

Associate Professor Dr. Saunah Zainon
Rector
Universiti Teknologi MARA (UiTM)
Johor Branch

(A-ST063) ADVANCING SUSTAINABLE AND RAPID PRODUCTION OF HYDROGEN VIA NOVEL BOROPHENE CATALYST

Yen Yiin Lee[1], Swee Pin Yeap[2], Kah Hou Teng[3]

[1]Department of Chemical & Petroleum Engineering, Faculty of Engineering, Technology & Built Environment, UCSI University, 56000, Cheras, Kuala Lumpur, Malaysia
[2]UCSI-Cheras Low Carbon Innovation Hub Research Consortium, 56000, Cheras, Kuala Lumpur, Malaysia
[3]Department of Mechanical & Mechatronics Engineering, Faculty of Engineering, Technology & Built Environment, UCSI University, 56000, Cheras, Kuala Lumpur, Malaysia

Corresponding author: leeyenyiin@gmail.com (Lee Yen Yiin)

ABSTRACT

Hydrogen is a renewable energy resource with potential to replace fossil fuels and does not cause environmental concerns during energy generation. However, current mass-production methods involve fossil fuels, prompting urgent research into green hydrogen generation. The recent emergence of borophene oxide (BO), a material resembling graphene, has been theorized to enhance hydrogen production when used as a catalyst. Nevertheless, practical test in such application was not done. Thus, in this project, borophene was synthesized via modified Hummers' method and used to hydrolyze sodium borohydride, a reaction that produces hydrogen to proof the mentioned theory. Plate-like BO was successfully produced and characterized. More importantly, the experimental results showed that BO performed significantly better than TiO_2, a common photocatalyst in where BO was able to produce 50 mL of H_2 in only 90 s. However, further doping the BO with Fe reduced the catalytic performance and took at least 3.33 times longer than BO to produce 50 mL of H_2. Despite this, the project has successfully proven the catalytic properties of borophene in hydrogen production and borophene could be utilized in the future in the generation of sustainable energy.

Keywords: Borophene; Graphene; Hydrogen; Green Energy; Hydrogen Evolution Reaction

1.0 INTRODUCTION

Hydrogen (H2) has emerged as an alternative to fossil fuels due to its exceptional properties of zero pollution emissions and high energy which has drawn considerable interest recently in energy utilization as a clean energy carrier. On 5 October 2023, the Malaysian government introduced the Hydrogen Economy Roadmap (HETR) to establish itself as a prominent hydrogen-based economy, generating revenues exceeding RM400 billion by 2050 Thus, this research may be able to contribute efforts to the Malaysian Government in HETR. Extensive research was done to produce renewable hydrogen which is environmentally friendly as it does not produce

greenhouse gas emissions during production. One such method proposed is the hydrolysis of hydrogen-rich compounds, such as sodium borohydride. Traditionally graphene (Gr) has been used in $NaBH_4$ hydrolysis, however, borophene, a crystalline atomic monolayer of boron, emerged as a new technology with greater catalytic activity potential than graphene in hydrogen evolution reaction which is theorised due to its outstanding properties which enable high catalytic activity from its extreme electron deficiency and abundant active sites.

2.0 OBJECTIVE

1. To synthesize BO and characterize its physicochemical properties.
2. To evaluate the effects of various process parameters (reaction time, catalyst and reactant amounts) on H2 production.
3. To compare the kinetic profiles of H2 production induced by various commonly used catalysts alongside borophene.

3.0 METHODOLOGY

Borophene was produced using a modified Hummer's method. Borophene itself is highly soluble in water which is attributed by its hydrophilic properties and being a nanocatalyst which has a high surface ratio over volume ratio, contributing its ability as a catalyst.

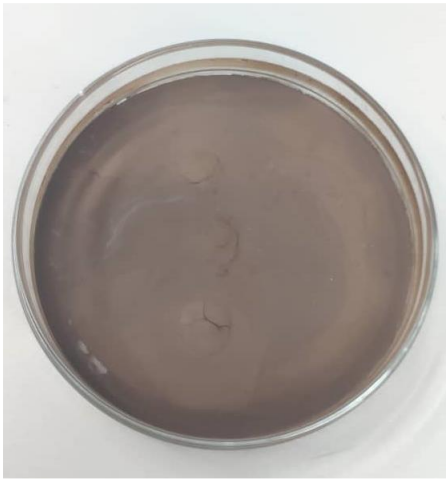


Figure 1: Synthesized dried BO.

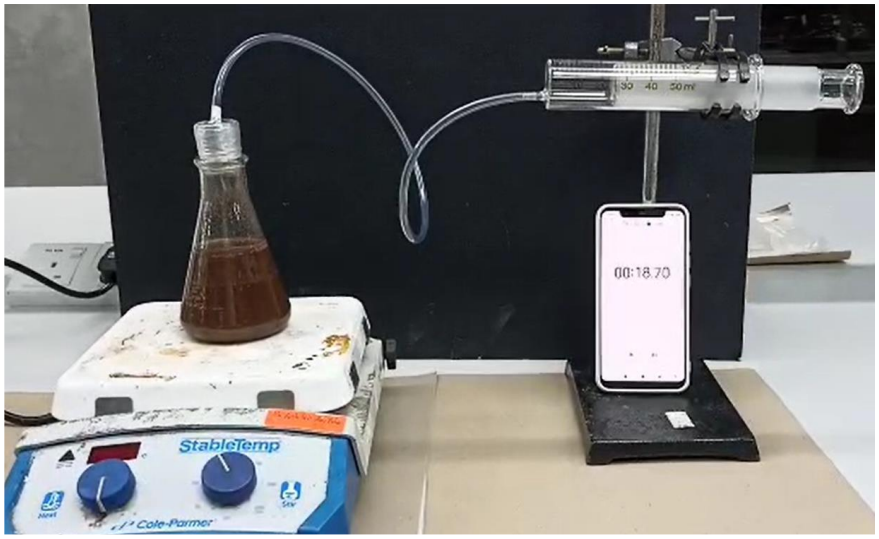


Figure 2: Setup of $NaBH_4$ hydrolysis.

4.0 RESULTS

This study showed that the synthesis of BO as a novel catalyst for the purpose of H_2 production via $NaBH_4$ hydrolysis. Research on the comparison between nanomaterials (as catalysts) is scarce and limited, which makes this study necessary. Here, the H2 production of NaBH4 hydrolysis was carried out with BO and TiO_2.

5.0 CONCLUSION

The experimental results showed that BO performed significantly better than TiO2, a common photocatalyst in where BO was able to produce 50 mL of H2 in only 90 s. However, further doping the BO with Fe reduced the catalytic performance and took at least 3.33 times longer than BO to produce 50 mL of H2. Despite this, the project has successfully proven the catalytic properties of borophene in hydrogen production and borophene could be utilized in the future in the generation of sustainable energy