

RESEARCH WEBINAR **SERIES 3.0/2021**

STAY MOTIVATED

WEEKLY SHARING SESSION
WITH
5 STAR UiTM RG & RIG



RESEARCH NEXUS UiTM (ReNeU)
UNIVERSITI TEKNOLOGI MARA

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Editors: Prof. Dr. Nooritawati Md Tahir, Prof. Dr. Rohana Ahmad, Assoc. Prof. Dr. Ts. Aidah Jumahat, Assoc. Prof. Dr. Norol Hamiza Zamzuri, Assoc. Prof. Dr. Mohd Rizaimy Shaharudin, Assoc. Prof. Ir. Ts. Dr. Syed Abdul Motalib Al Junid Syed Abdul Rahman, Assoc. Prof. Dr. Siti Noor Hajjar Md Latip, Assoc. Prof. Dr. Rafeah Legino, Assoc. Prof. Ts. Dr. Abdul Hadi Abdul Razak, Dr. Nurdiana Samsulrizal, Dr. Natasha Ahmad Nawawi, Dr. Noor Azliyan Azizan & Kamarulazwa Muhammad

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40450 Shah Alam
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Tel: +603-5544 2138/8254
Fax: +603-5544 8280
Email: reneu@uitm.edu.my

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FOREWORD

Stay Motivated: Weekly Sharing Session Webinar Series was conducted virtually from January to December 2021. This webinar series started its journey when the COVID-19 pandemic hit the world. This e-book is a compilation of the Fast Facts of research findings, both fundamental and applied research, presented during the sharing session by 30 RIG and RG of UiTM that have shown outstanding achievement in research and given a 5 STAR rating. This prestigious status resembles the RIG and RG groups outperformed in their respective research areas.

On behalf of ReNeU, we would like to thank all that have contributed to this e-book. We would also like to thank our researchers, presenters, participants and reviewers for their support. It is hoped that other researchers will utilize the chapters compiled to advance their knowledge and be of benefit to all.

ELECTRONIC ARCHITECTURE AND APPLICATION: ISSUES, CHALLENGES, AND OPPORTUNITIES

Syed Abdul Mutalib Al Junid^{1*}, Mohd Faizul Md Idros¹, Abdul Hadi Abdul Razak¹, Fairul Nazmie Osman¹, Abdul Karimi Halim¹, Norhazlin Khairuddin¹, Azil Bahari Alias²

¹Electronic Architecture and Application (EArA) Research Group,
Faculty of Electrical Engineering, Universiti Teknologi MARA,
40450 Shah Alam, Selangor

*E-mail: samaljunid@uitm.edu.my
ORCID ID: 0000-0002-8429-9630

Research Nexus: Cyber Technology

ABSTRACT

Malaysia is a country dependent on the Electrical and Electronics industry since early 1970, and the trend continues until today with close to 30% of GDP growth contributed by this industry segment. Not only that, but all Malaysia planning will also focus on this industry segment since they are a huge contributor to the GDP. Despite the demand for this industry, there are huge issues, challenges and opportunities in this area which influence the Electronic Architecture and Application (EArA) research group and its establishment. In this series, the EArA will highlight how the establishment impacts the segment and its contribution including the achievement recorded along since 2016. Moreover, this sharing will focus on the roadmap and milestones recorded from 2016 including the strategic partnership materialised to support the industry and technology development.

Keywords: GDP, electronic architecture & application, EArA

INTRODUCTION

Huge demand with respect to the talent, technology and research needed in the domain to maintain and sustainability of the industry sector. Therefore, this sharing will highlight the issues, challenges, and opportunities in this segment of the industry from the perspective of the Electronic Architecture and Application (EArA) research group based on the experience. Due to the industry's demand, the EArA has been established to support talent development at the early stage before becoming one of the research entities later. Therefore, this paper will focus on discussions on issues, challenges, and opportunities on the been established to focus on accelerating the talent development in IC design before expanding to the research and development comprehensively. The group was first established among the electronic design lecturers. The demand for the specific research group to focus on Integrated Circuit Design (IC Design) Electronic architecture and application (EArA) was established in 2016 to focus on electronic design and application research area specifically in solving the digital, analog, and mixed-signal design issues. Comprises of six members from integrated circuit design and embedded system backgrounds make the group comprehend in providing an excellent combination in solving the design and application issues related. Moreover, the EArA is a research domain which focuses on solving electronic design application domains which covered digital, analog and mixed-signal.

MAIN RESULTS AND DISCUSSION

EArA was established in 2016 to focus on Integrated Circuit (IC) design and embedded system research, including the application of the technology in the domain. Since that date, EArA received several national and university research grants, including PRGS, FRGS, ERGS, ScienceFund and university grants. Not only that, but EArA is also involved in the national upskilling program for IC design industries, which produced talented industrial ready engineers back since its establishment back in 2016. Moreover, in the international arena, the EArA expertise was recognized and used by several well-recognised agencies and foreign governments towards strategically improving and upscaling their human capital and technology development ranging from IC design to software development. Expansion in the energy storage design in 2017 recorded very promising technology for enhancing the lifetime and capacity of the battery in smart mobility applications and was used by one of the HiCoE research universities in their product demonstration until today. On the achievement, EArA has received numerous prestigious awards for its excellent contribution from national and international.

Moving from a small research group until the results and discussion of the work should be explicitly described and illustrated. Supporting figures, tables, and images of the results (no more than two figures and two tables) may be included in the extended abstract. All the tables, images and figures should be centred. Figures and images should be numbered (see Figure 1 for an example) and figure headers should be placed under the figure or image; as for the tables, they should also be numbered (see Table 1 for an example) and the table header should be placed at the top. References (if any) of the tables, figures and images should be presented right under the tables, figures, and images in the form of the author's surname and publication date.

CONCLUSIONS

EArA has produced numerous research outputs from its date of establishment. Expansion and internationalization will be the next focal point toward research sustainability in the future. Moreover, the strategic direction position and play by the research members have produced extreme output. The issues and challenges in the area including the partnership will be the next focus to be improved for better technology development. Moreover, the opportunities in the segment based on the real data in GDP will help to research group relevant.

EMPOWERING COMMUNITIES THROUGH COMMERCIALIZATION OF CYMBOPOGON CITRATUS (LEMONGRASS) - A SUCCESS STORY OF UiTMPG

Suhana Mohamed¹, Nur Dalila Khirul Asfar², Aznilinda Zainuddin³

¹Department of Finance, Faculty of Business and Management, Universiti Teknologi MARA
Cawangan Johor Kampus Pasir Gudang
suhana291@uitm.edu.my

ORCID ID 0000-0003-0688-9835

²School of Electrical Engineering, College of Engineering, Universiti Teknologi MARA Cawangan
Johor Kampus Pasir Gudang
nurdalila306@uitm.edu.my

ORCID ID 0000-0002-6320-0136

³School of Electrical Engineering, College of Engineering, Universiti Teknologi MARA Cawangan
Johor Kampus Pasir Gudang
aznilinda@uitm.edu.my

ORCID ID 0000-0003-1860-4454

Research Nexus: Cyber Technology

ABSTRACT

Serai Jauhar is a community empowerment initiative project that is being conducted and managed by diploma students from Universiti Teknologi MARA Cawangan Johor Kampus Pasir Gudang (UiTMPG) under the name Duta Jauhar 5.0. The project's first objective is to contribute to a 10 percent increase in the economic well-being of the target group from Kampung Sawah, Pekan Nenas, and Pontian. Second, to assist the target group in identifying, utilizing, and capitalizing on available land. Thirdly, to assist the Kampung Sawah target group in developing a unique lemongrass-based product. The one-year project was funded by the Johor State government through Yayasan Pelajaran Johor and other organizations to focus on lemongrass cultivation, create Madame Sue lemongrass powder as a product output, and educate the target community from Kampung Sawah with various entrepreneurial skills. The initiative achieved national recognition when it was presented with two prestigious awards by Yayasan Pelajaran Johor, namely *Anugerah Program Harapan Negeri Johor* and *Anugerah Program Keusahawanan Terbaik*.

Keywords: Communities, Lemongrass, Commercialization

INTRODUCTION

In 2018, 15 students known as Duta Jauhar 5.0 (DJ5.0) UiTMPG received funding from the Johor State government via Yayasan Pelajaran Johor and were selected as one of the top 30 best groups to launch an entrepreneurial social enterprise project called Serai Jauhar UiTMPG in Kampung Sawah, Pekan Nenas, Pontian, Johor Darul Takzim. Student associations represent each university, and the initiative is handled by Johor-born students from Malaysian public and private universities. Duta Jauhar, which was recently renamed Duta Mahasiswa Johor, is a program that attempts to enhance the state of Johor's society through the use of the National Blue Ocean Strategy (NBOS). This program was able to successfully integrate over 160 government and corporate agencies, as well as over 30,000 community participants, through the implementation of the Duta Jauhar Program Series in 2014. DJ5.0 UiTMPG Serai Jauhar's project initiatives throughout the program included economic transformation, agriculture hub development, product innovation, marketing strategies, and

human capital development. However, students confront additional obstacles in finishing the project. Among the challenges were the following: the target group did not have a fixed monthly income, there were still a few undeveloped lots of land in Kampung Sawah, their target group was unfamiliar with product innovation, lemongrass was sold at an unbelievable price, and the target group was complacent with traditional agriculture methods. DJ5.0 UiTMPG project solution assisted and aided the target group in increasing their monthly income by 10 percent. They encouraged the target group to plant *peha ayam* and *peha gajah* lemongrass varieties on idle land throughout Kampung Sawah as part of the agriculture hub concept. For product innovation strategy, the group assisted in the development of Madame Sue lemongrass powder, a lemongrass-based product innovation. Lemongrass product marketing via the internet platform was the marketing strategy, and successful knowledge and technology transfer by UiTMPG instructors and students to the community was the human capital development plan.

MAIN RESULTS AND DISCUSSION

DJ5.0 UiTMPG achieved a good international ranking when four members competed in the IIDEX 2018 competition to introduce their product. Madame Sue Powder Lemongrass was awarded a Diamond Award for Innovation (Young Undergraduate Inventor) and a Gold Medal in the domain of innovation (Young Inventor Undergraduate). Madame Sue Lemongrass Powder, a DJ5 UiTMPG-developed product innovation lemongrass powder, is effective in assisting in the achievement of the objectives set for the project. The lemongrass utilized to make the lemongrass powder was farmed and harvested by the target group in Kampung Sawah. DJ5.0 UiTMPG members hail from a variety of faculties at UiTM Pasir Gudang, giving them even more reason to celebrate. They established Herbalioza Resources Enterprise to further their grasp of business and their aim to contribute to society's advancement through entrepreneurship. Additionally, the Kampung Sawah target group has registered their business as Rela Tani Enterprise. Students and community members collaborated to create Madame Sue Lemongrass Powder. The product was created in collaboration with them, the community, and the firm MyCuisine Cube Sdn Bhd, a manufacturer of dry products.

CONCLUSIONS

These students were in for a difficult journey ahead of them. While attempting to execute projects as part of the joint program, they have encountered several bottlenecks, obstructions, and limitations that have caused their progress to be significantly slowed down. Nonetheless, it is only through their perseverance, a strong sense of belonging, and an optimistic mindset that they have been able to reach this point. The two prestigious awards given by Yayasan Pelajaran Johor, Anugerah Program Harapan Negeri Johor, and Anugerah Program Keusahawanan Terbaik, were in addition to several other awards received throughout their project's development. During their time as students at UiTMPG, they were not only competitive in their respective fields, but they were also capable of working as agents for community development in the Malaysian state of Johor, according to the mission statement of the university.

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ANALYSIS OF THE EFFECT OF CHARGE TRANSFER COEFFICIENT AND OPERATING PARAMETER ON THE PERFORMANCE OF A POLYMER ELECTROLYTE MEMBRANE (PEM) ELECTROLYZER

Alhassan Salami Tijani^{1*}, Nur Dini Adilla binti Abdul Ghafa¹

¹School of Mechanical Engineering, College of Engineering, Universiti Teknologi MARA (UiTM),
40450 Shah Alam, Selangor Darul Ehsan, Malaysia
alhassan@uitm.edu.my
<https://orcid.org/0000-0002-0954-718X>

Research Nexus: Energy & Environment

ABSTRACT

The purpose of this study is to analyse the effect of charge transfer coefficient (CTC) and operating parameters such as temperature, current density and membrane thickness on the PEM electrolyzer performance. The simulation is done using MATLAB to also study the efficiency of the voltage based on temperature. The outcome of the simulation shows that the value of exchange current density plays an important role on the CTC alongside the current density. Due to the smaller value of exchange current density used at cathode compared to the one at the anode, the CTC value for anode is slightly higher than at the cathode. The lowest CTC value recorded at the anode is 0.2683 and 0.0134 for cathode is 0.0134. In addition, the temperature also influences the voltage efficiency of the electrolyzer.

Keywords: PEM electrolyzer, MATLAB, charge transfer coefficient

INTRODUCTION

With this rapid development especially in developing countries regarding fossil fuels, energy crisis [1] and its environmental concerns, hydrogen has come out as one of the global alternative fuels. There are different ways to produce hydrogen including reforming, pyrolysis and electrolysis, but Polymer Electrolyte Membrane (PEM) electrolysis has become one of the essential method due to its capability of operating at high pressures based on the material used and high quality of gases purity [2]. Previous research has stated that increase of the temperature, charge transfer coefficient exchange (CTC) and current density of the electrodes will increase the performance [3]. The main purpose of this study is to analyse the effect of exchange current density and the Charge Transfer Coefficient (CTC) on the performance of the PEM electrolyzers.

THERMODYNAMICS OF PEM ELECTROLYZER

The experimental setup consists of a PEM electrolyzer stack, water tank, heater, temperature control, flow control, multimeter, hydrogen and oxygen tank as shown in Figure 1. From the electrochemical

reaction above, it can be seen that the water will react with the electrical energy to generate or separate the hydrogen and oxygen. At both of the electrodes, the half reactions are as follows:

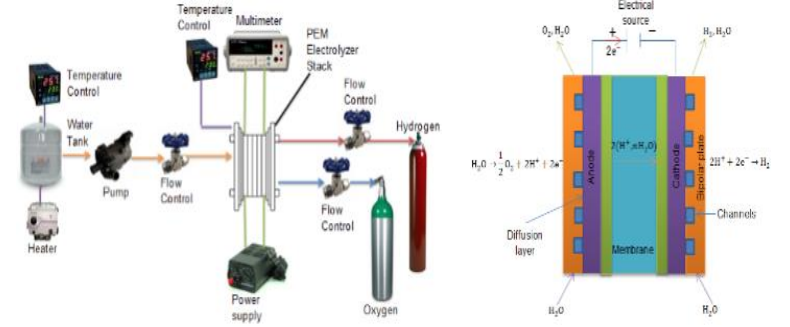
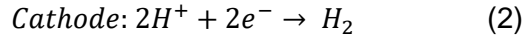
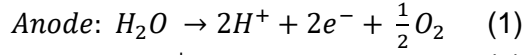


Figure 1 PEM electrolyzer flow analysis

The total amount of cell voltage in an electrolytic cell is the combination of a few others voltage which is expressed as follows:

$$V_{op} = V_{rev} + \eta_{act} + \eta_{ohmic} + \eta_{diff} \quad (3)$$

where V_{rev} is reversible voltage, η_{act} is activation overvoltage, η_{ohmic} is ohmic overvoltage and η_{diff} is diffusion overvoltage. The overvoltage will directly reduce the efficiency of the electrolyzer [6].

MAIN RESULTS AND DISCUSSION

Figure 2a shows that simulation is in agreement with experimental data from. Figure 2b shows the effect of temperature on polarization at various temperatures. The simulation result shows that the smaller the value of the temperature, the higher the operating voltage. Significantly, this shows that at lower temperature a greater amount of energy is needed to separate the water molecule into hydrogen and oxygen. Figure 2c shows that the thicker the membrane, the higher the operating voltage which means the thinner membrane will decrease the amount of losses. Thickest membrane required higher operating voltage in order to surpass the ohmic resistance. However, the effect of the membrane thickness is only distinct from 0.2 A/cm^2 current density.

Figure 2d presents the effect of exchange current density on the anode side at various temperatures while the other four graphs present the cathode side. It can be observed that the temperature also plays an important role on the activation overvoltage. The simulation shows that as the temperature increases from 20°C to 80°C , the value of specific electrode charge transfer coefficient also increases although the number is smaller. By comparing anode and cathode side, the charge transfer coefficient on the anode side is slightly higher than the cathode side. Obviously, one of the main reasons for the result is due to the smaller value of exchange current density on the anode compared to the cathode.

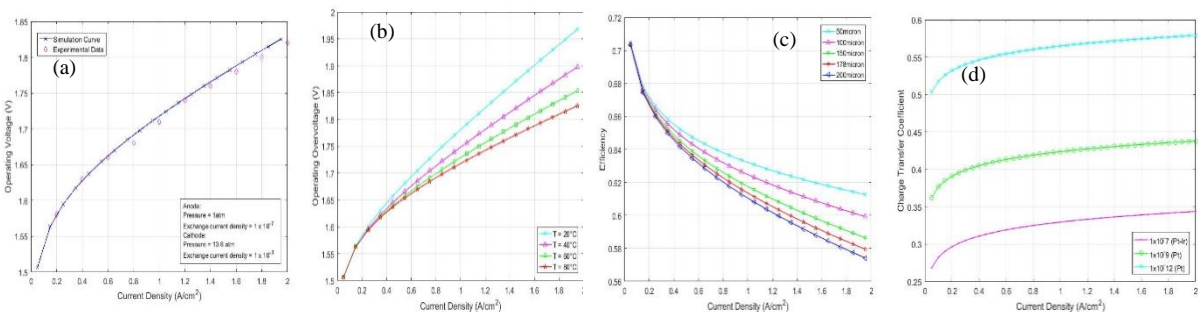


Figure 2. (a) Validation of simulation with experiment (b) Effect of temperature on polarization at various temperatures (c) Effect of membrane thickness on efficiency (d) Effect of exchange current density on charge transfer coefficients (anode at 20°C)

CONCLUSIONS

In conclusion, this study focuses on the performance analysis of the PEM electrolyzer based on the exchange current density, charge transfer coefficient (CTC) and other operating parameters such as temperature and current density on the PEM electrolyzer performance. From the result it can be seen that the value of the CTC varies based on the current, change with the temperature and change in the electrode properties. As the current density increases, the values of the CTC also increase slowly for the anode side and slightly faster for the cathode. The anode side also has a higher CTC value than cathode due to the difference in value used for the exchange current density. Clearly, the temperature plays a vital role in the electrolysis process as the higher temperature produces higher CTC value and the lowest temperature produces the lowest efficiency for the electrolyzer. Fundamentally, higher the current density leads to higher activation overvoltage while higher exchange current density results in lower activation overvoltage. From this study, the perfect operating temperature recommended for the operating process of the electrolysis is at 80°C. This is because at this temperature, the activation value is at the lowest and the efficiency at the highest. The limitation of this study is the study conducted by using only a single cell stack electrolyzer.

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EXPERIMENTAL STUDIES OF THE COUNTERFLOW HEAT PIPE THERMOELECTRIC GENERATOR HEAT EXCHANGER

Muhammad Fairuz Remeli, Baljit Singh

Energy Conservation for

Automotive Research Group

School of Mechanical Engineering

College of Engineering

Universiti Teknologi MARA (UiTM) Shah Alam, Malaysia

fairuz1299@uitm.edu.my

baljit@uitm.edu.my

ORCID ID: <https://orcid.org/0000-0002-7203-4053>

Research Nexus: Energy & Environment

ABSTRACT

This research explores different ways of waste heat recovery and conversion to electricity using a thermoelectric generator (TEG). For this purpose, a lab-scale prototype of the waste heat recovery and conversion system was designed and tested. This top bench system consists of thermoelectric generators (TEGs) attached between two finned heat pipes. The heat pipe connected to the hot side is considered an evaporator. The one that connects to the cold side is called a condenser. The system is called a heat pipe thermoelectric generator (HP-TEG). Two air ducts were used to separate hot and cold air flow, and they were thermally connected using eight HPTEG modules. The hot exhaust gas was simulated using a 2kW electric heater installed in the hot duct. A theoretical model was developed to predict the thermal and electrical performances of the waste heat recovery system. The experimental result showed that the system could produce 4.3 W of maximum electrical power with 58% of heat exchanger effectiveness.

Keywords: Thermoelectric power generator (TEG), Waste heat, Industrial heat recovery.

INTRODUCTION

Converting waste heat to electricity can be realized by using a thermoelectric generator (TEG). The TEG is a device that can convert thermal energy into electricity based on the Seebeck effect. A thermoelectric generator (TEG) is a solid-state energy converter that can directly convert waste heat into electricity. The TEG can operate without moving parts, vibration, and noise. It is a very reliable device capable of generating power even at the low-temperature difference between the heat sources and sink. The TEG is ideal for waste heat recovery since the operating cost is negligible compared to other costs as the energy input is free. The primary challenge of thermoelectric power generation is its low heat-to-electricity conversion efficiency which is typically around 5% [1]. This research aimed to develop a passive heat transfer and heat-to-work conversion system for simultaneous heat recovery and power generation. This system is designated as a heat pipe thermoelectric generator (HP-TEG) as shown in Figure 1. The basic concept of the system consists of thermoelectric generators (TEGs) sandwiched between two heat pipes, one connected to the hot side of the TEG, and the other connected to the cold side of the TEG.

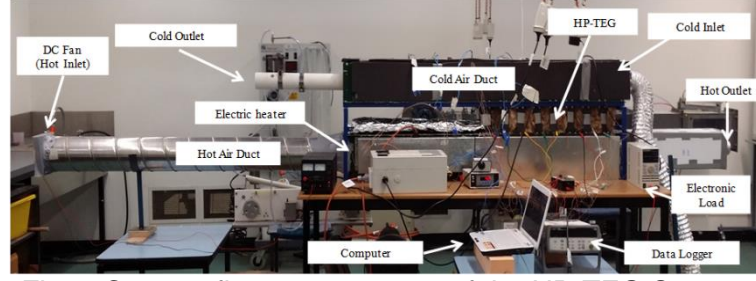


Fig. 1 Counter flow arrangement of the HP-TEG System.

MAIN RESULTS AND DISCUSSION

Figure 2 presents a comparison between the theoretical predictions and the experimental data for the heat transfer rate and MPP of the counterflow HP-TEG. The theoretical prediction of the heat transfer rate rose steadily with increasing air face velocity on the cold side, $V_{cold\ air}$. It is apparent from the graph that the theoretical model was able to closely forecast the system's thermal behavior for the airspeed range between 0.9 m/s - 1.6 m/s with a deviation less than 3%. The deviation became larger (about 4.0 - 4.5%) when $V_{cold\ air}$ exceeded 1.6 m/s. After this point, the experimental heat transfer rate remained close to constant at approximately 900 W. One of the possible reasons for this behaviour was the contraction at the outlet of the cold air duct. The contraction occurred because the duct outlet was connected to a 72 mm diameter round pipe. At a higher air velocity, the pressure loss and the back pressure due to the contraction became more dominant and influenced the heat transfer rate. It was difficult to measure the airflow in the main rectangular duct for the chosen air velocity range because of the low observed pressure drop. Therefore, the measurement was performed in the smaller round pipe and the air flow contraction was unavoidable. The maximum power point (MPP) generated by the HP-TEG was plotted against $V_{cold\ air}$. It was found that the MPP increased with increasing air face velocity. The theoretical MPP was slightly over-predicted compared to the experimental data with a less than 26% deviation. The higher heat transfer rate was achieved with rising $V_{cold\ air}$, the higher heat transfer rate resulted in higher TEG hot side temperature. Conversely, the temperature of the TEG cold side decreased with increasing $V_{cold\ air}$. As a result, the temperature gradient across the TEG increased and caused the MPP to increase.

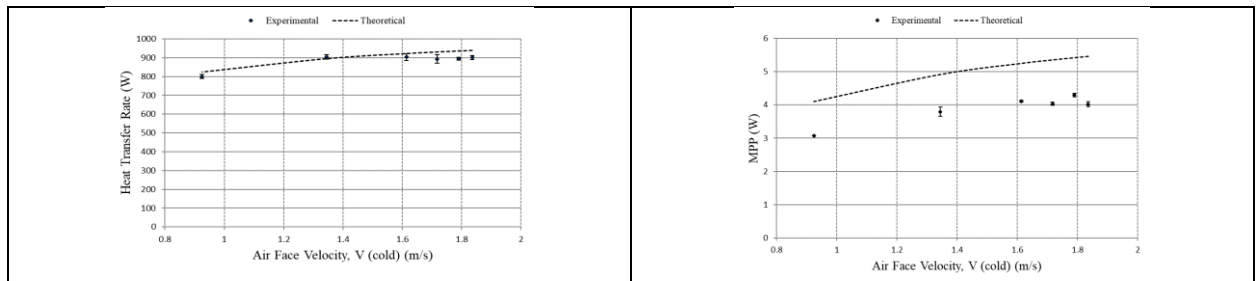


Figure 2. The heat transfer rate and MPP versus the air face velocity

CONCLUSIONS

A counterflow heat exchanger test rig was developed using two separate air ducts. These two ducts were thermally connected with eight modules known as the heat pipe thermoelectric generator (HP-TEG). The module consisted of thermoelectric generators (TEGs) sandwiched with two finned heat pipes. These finned heat pipes acted as an evaporator and condenser which were installed in the hot air and cold air ducts, respectively. The HP-TEG system allowed the heat transfer through the module

from the hot air source to the cold air stream. The proposed HP-TEG module has enabled the system to recover heat and produce power simultaneously. A theoretical model for the counterflow HP-TEG was developed using the effectiveness-NTU method. The model was able to predict the thermal and electrical performances, including the effectiveness of the heat exchanger and the maximum power output. It was found from the testing that the effectiveness of the HP-TEG heat exchanger increased with increasing cold air velocity due to the high-temperature gradient developed between the two ducts. Also, the power output rose at the maximum value of 4.3 W with increasing cold air velocity. It was revealed that the thermal model agreed well with testing data with a deviation of 2.3%.

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INTELLIGENT SYSTEM FOR POWER DISTURBANCE MONITORING IN POWER QUALITY

Mohd Abdul Talib Mat Yusoh¹, Ahmad Farid Bin ABidin²

¹ Power System Planning and Operations Research Group (PoSPO)
School of Electrical Engineering, College of Engineering, Universiti Teknologi MARA 40450 Shah Alam, Malaysia

mohd.abdul.talib@uitm.edu.my
<https://orcid.org/0000-0002-4503-826X>

² Power System Planning and Operations Research Group (PoSPO)
School of Electrical Engineering, College of Engineering, Universiti Teknologi MARA 40450 Shah Alam, Malaysia

ahmad924@uitm.edu.my
<https://orcid.org/0000-0001-5260-762X>

Research Nexus: Energy & Environment

ABSTRACT

Power disturbances monitoring is one of the important aspects on dealing Power Quality (PQ) issue in electrical system. The aims of conducting monitoring process are to identify the real culprit which contribute to the PQ problem. One of the vital steps in dealing the PQ is the monitoring process of power disturbance. This monitoring process is very important to give a right direction towards proposing the correct mitigation technique. In order to produce reliable monitoring technique, the devices which has a flexibility on accommodating the software and hardware part need to be deployed. The software is need for algorithm development such as signal processing, Artificial Intelligent (AI) as well as statistical analysis. Hence, this paper focus on how the power disturbance monitoring system is developed to accommodate the real data acquisition need and pave a path towards intelligent system for power disturbance monitoring in PQ perspective.

Keywords: Power Disturbance, Power Quality, Artificial Intelligent

INTRODUCTION

Power Quality (PQ) can be defined as the electrical system work properly without any interruption or less efficient with specific characteristics voltage [1]. A good power quality is a steady supply voltage that stays within the prescribed range, steady Alternating Current (AC) frequency close to the rated value i.e. 50Hz and 60Hz, and smooth voltage curve waveform. The existence of the issue related to PQ which known as power disturbances can cause a major effect to the electric system such as damage in equipment, insulation failure, malfunction of data processing equipment, tripping of protection device and many more [2]. The growths of sensitive equipment led to the importance of power quality term. Apart from that, there are many methods that has been develop by the previous researcher with the purpose to reduce and prevent these problems.

With the purpose of this study, the intelligent system for power disturbance monitoring in power quality must be carried out. The challenge for the power system utilities is to provide a good power supply to their customer. It is a duty of the utility to take the responsibility of the reliability of power. Meanwhile, for the customers, it became their main tasks to protect their electric equipment. Due to the increasing of the mass application of power electronic equipment and machinery that has been used for all kind of industrial processes the foremost reason is economic value.

According to [3] the electrical are more aware to the problem which associated to PQ. The underperformance PQ in any premises which occupied by electrical user could incur the high financial losses to them. All of these costs are related to the plant downtime, equipment replacement, lost work in process and additional labor cost. This is supported by [4], even by a minor interference of disturbances it has a major economic impact on the industrial customers and the extensive of interruption damage their equipment and harms practically for the daily operations.

Hence, this paper describes on a framework which has been developed to monitor the disturbance monitoring technique based on PQ perspective. The intelligent system needs to be developed to produce fast monitoring system to identify the power disturbance which occur in the electrical system. The intelligent system could minimize the human need to solve the issue related to power disturbance. Currently, the intelligent technique has been become more prevalent due to the rapid use of Artificial Intelligent (AI), Signal Processing (SP) and Big data Analytic. However, the focus on this paper will contrite on AI and SP as both approaches has been deeply studied by the author. The framework of monitoring the power disturbance based on SP and AI is elaborated throughout this paper. This framework could be used as the main direction on conducting any research related to power disturbance monitoring system.

MAIN RESULTS AND DISCUSSION

The main disucssion of this part elaborating on how the intellignet system of power disturbance monitoring being developed. The main framework of the Intellgient system system for power disturbace monitoring can be described into three different stage namely, case, feature extraction and decision making as shown in Figure 1.

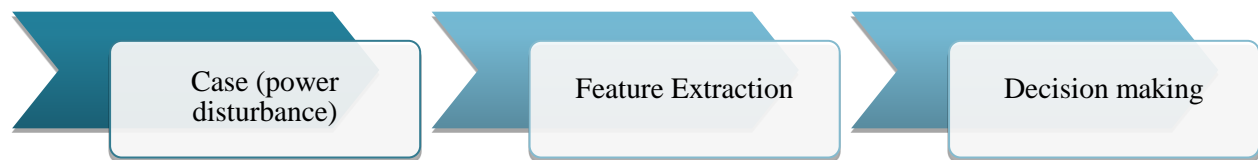


Figure 1. Framework of the Intelligent system for PQ disturbance monitoring

As for the first stage, the system needs to train by feeding the information regarding the case which occur in the electrical system. In this stage, in order to gather the disturbance which might occur in the system, the existing PQ analyzer need to be installed. By installing this PQ analyzer, the disturbances might be captured by the analyzer. These disturbances are e further used as information the train the intelligent system. In this condition, the expert view in PQ area need to be considered in order to identify different type of disturbance and identify the source of disturbance. Most of time, the number disturbances which capture from PQ analyzer are not enough to be fed to the intelligent system. Then, it is important to obtain the data from the simulation process. As for simulation process, the correct modelling needs to developed so that the simulation disturbance is identical to the real disturbance.

At the second stage, signal processing technique and statistical technique based on rigorous Mathematical tools has been deployed. The using of time frequency signal processing technique such as Discrete Wavelet Transform (DWT) and S-Transform (ST) has been exploited for extracting features of disturbances. Fig. 2 shows the example ST for feature extracting purpose. This process has clearly distinguished the disturbances' feature as compare to normal feature. Later, this feature has been fed to the 3rd stage namely decision-making stage to identify the correct disturbance. Most

of decision making in 3rd stage is conducted base on Artificial Intelligent (AI) which give the decision based on the human's need by imitating the human's brain function through computer application.

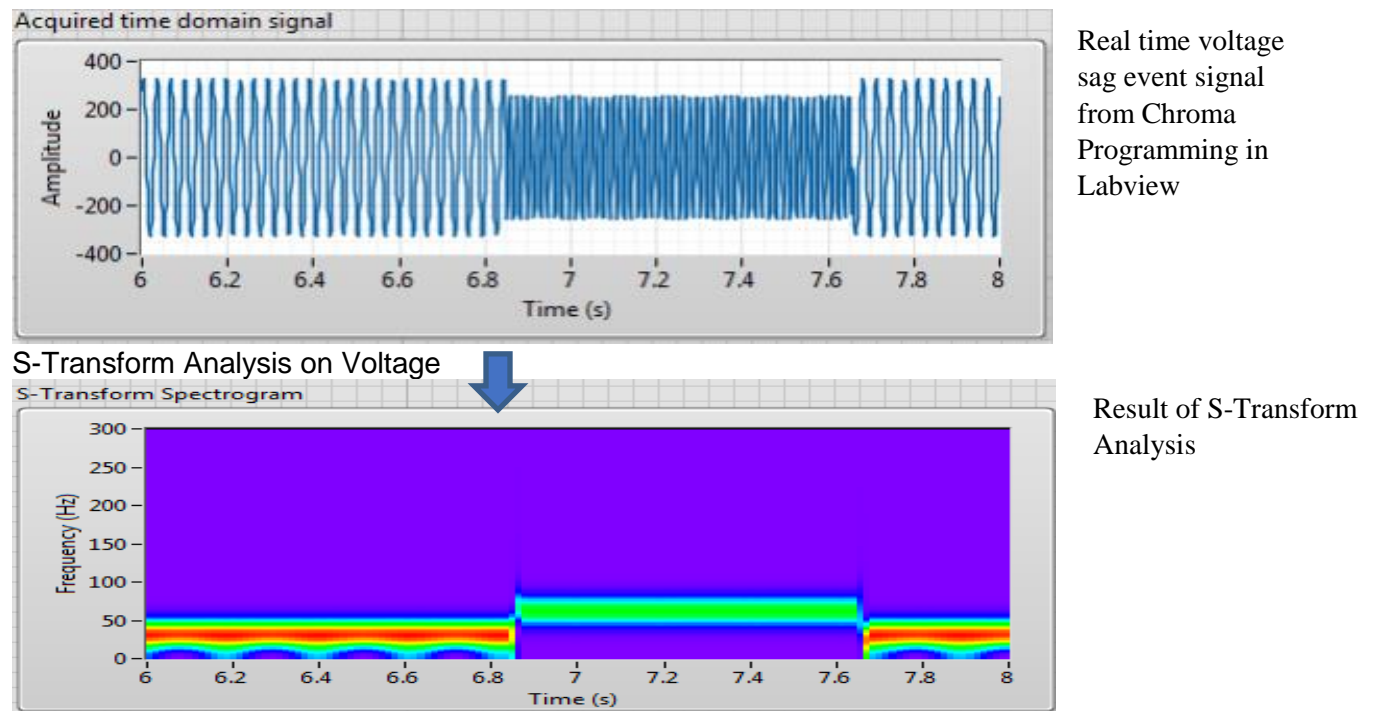


Figure 2 Example of Feature extracting process based on ST

CONCLUSIONS

The study of the power quality in its monitoring and understanding of its effects become more important through years. The proper monitoring should be able to minimize the financial losses by pinpointing the root of cause related to power disturbance in electrical system. The inability to pinpoint the correct root of causes, could deteriorate the performance of equipment, lead to electrical hazard and reduce the lifespan of equipment. In the era IR 4.0, this monitoring process become more interesting due to availability of advance computing tools. With the emerging of smart grid, distributed generation, and new type of electrical load produce difference type of PQ scenario and lead to the new challenge in power disturbance monitoring process. Power disturbance monitoring is remaining the relevant area to be explored due to demand to deliver good quality of power to electrical user.

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THERMOELECTRIC GENERATOR HEAT EXCHANGER FOR RECOVERY OF WASTE HEAT FROM INTERNAL COMBUSTION ENGINE EXHAUST

Baljit Singh¹, Muhammad Fairuz Remeli²

^{1,2}Energy Conservation for
Automotive Research Group
School of Mechanical Engineering
College of Engineering
Universiti Teknologi MARA (UiTM) Shah Alam, Malaysia
¹baljit@uitm.edu.my
ORCID ID: <https://orcid.org/0000-0002-7203-4053>
²fairuz1299@uitm.edu.my

Research Nexus: Energy & Environment

ABSTRACT

The internal combustion (IC) engine is a well-known heat source. Besides producing mechanical energy, the combustion process generates a lot of waste heat. The IC engine is a critical component in transportation and a variety of other industries. The conversion efficiency of a typical IC engine is only 35-40%, which results in a large amount of waste heat being rejected. Potentially useful energy can be extracted from the waste heat. This can help to improve the IC engine system's performance. The thermoelectric generator can be used to generate electricity from IC engine waste heat energy (TEG). This project's goal was to show that TEG can be used to convert exhaust waste heat into useful electrical energy. In order to characterise the electrical properties of two TEGs, they were individually tested and also tested in series and parallel configurations. Series TEG connections have improved and increased voltage generation, but parallel TEG connections are more stable. The system demonstrated that TEGs can be used to recover waste heat from an IC engine, resulting in improved and more efficient performance.

Keywords: Thermoelectric generator (TEG), Waste heat, Electrical power

INTRODUCTION

An IC engine is a heat engine in which fuel is burned within the engine itself. Fuel and air are combined in the combustion chamber to produce the working fluid. The chemical energy will be converted into mechanical work by the reaction in the combustion channel. Carbon dioxide makes up 80% of the greenhouse gases in the atmosphere, according to a study by the European Commission. The transportation sector is responsible for 25% of the carbon dioxide in the atmosphere because it burns fossil fuels in an internal combustion engine [1]. The conventional efficiency of an internal combustion engine is around 30-35%, with the remainder of the energy being lost as waste heat dissipation into the atmosphere and as engine cooling. In an internal combustion engine, waste heat can be recovered to help reduce energy loss. The IC engine's overall efficiency will be improved as a result. A 10% reduction in fuel consumption and an improvement in both the IC engine and the hybrid electric vehicle in terms of energy recovery from waste heat could be achieved. [2,3]. The energy released in the cooling system and the exhaust gas can be recovered as a waste heat source in the engine. Engine coolant loses heat at a lower temperature than the heat that is expelled through the exhaust. A thermoelectric generator can be used to recover waste heat from exhaust heat [4]. A typical IC engine's exhaust temperature ranges from 300 to 500 degrees Fahrenheit. As a result, if

the exhaust system is constricted, the temperature can rise to 1200 °C [5]. The method of capturing and transferring the waste heat back to the system as an additional energy source is known as waste heat recovery. The IC engine's heat is classified as "high temperature" because it exceeds 400 degrees Celsius. Using a waste heat recovery process is made easier by the higher quality of waste heat that is produced at higher temperatures. The IC engine's waste heat can be converted to electrical power using a thermoelectric generator (TEG). To put it another way, it will directly convert heat into electricity. Because it is a solid piece of equipment, the thermoelectric generator also runs quietly [7]. A temperature gradient between the hot and cold sides of TEG is what drives the device's operating principle, which is based on the Seebeck principle. Modules of TEG are subjected to the temperature difference between the hot and cold sources. Seebeck effect thermoelectric generators have efficiencies of 5% to 10%. [8].

The term "heat exchanger" refers to a device that allows heat to be transferred from one fluid to another while preventing the two fluids from mixing. The heat exchanger will receive the heat from the exhaust. Distribution of heat velocity will be affected by the heat exchanger's shape and size. As the speed of the gas rises, so does the amount of heat that can be transferred. In the previous experiment, the heat exchanger developed for waste heat from an IC engine increased the efficiency of the system for waste heat conversion. To see how much power TEGs can generate, a simple heat exchanger was used in this experiment. Various array configurations were used to test TEGs (series and parallel). TEG output was compared across various thermoelectric generator electrical connections as part of the research conducted.

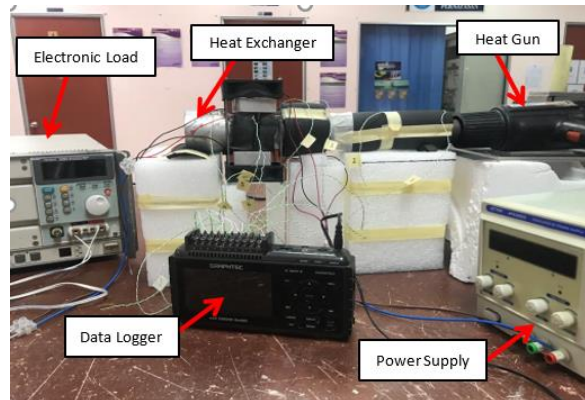


Fig. 1 Counter flow arrangement of the HP-TEG System.

MAIN RESULTS AND DISCUSSION

The comparison of series and parallel TEG can be referred to in Figure 2a and Figure 2b based on current and power obtained from the TEG connections. It clearly shows that the performance of multi-TEGs is better than one TEG in the system. Based on Figure 12, the current decreased steadily as the output voltage increased. The maximum current obtained in series was at 0.48 A while in parallel was at 0.86 A at 250 °C waste heat source. By comparing the results of series and parallel TEGs, the electrical characteristics generated in the series were relatively in large voltage with a small current that leads to the electrical better efficiency of the system, since this will minimise electrical heating losses due to resistance. Therefore, the efficiency of the system will increase. Apart from that, the current produced by TEG in parallel array connection was higher with lower value of voltage.

As shown in Figure 2a and 2b, the output power increased until it reached the maximum power point of the system. The value of the highest power output of series and the parallel connection was slightly different, with series connection at 252 mW while parallel connection at 250 mW. The experimental results show the performance of the series TEG connection is better than a parallel connection in

terms of power generation. However, parallel array is more reliable than series connections whereby the TEGs can still operate in the case of failure of other TEGs. If one of the TEG fails, the parallel pathway allows electricity to flow through another way compare to a series that only had one pathway of current to flow. It will not affect the other TEG if one of them failed in the connection.

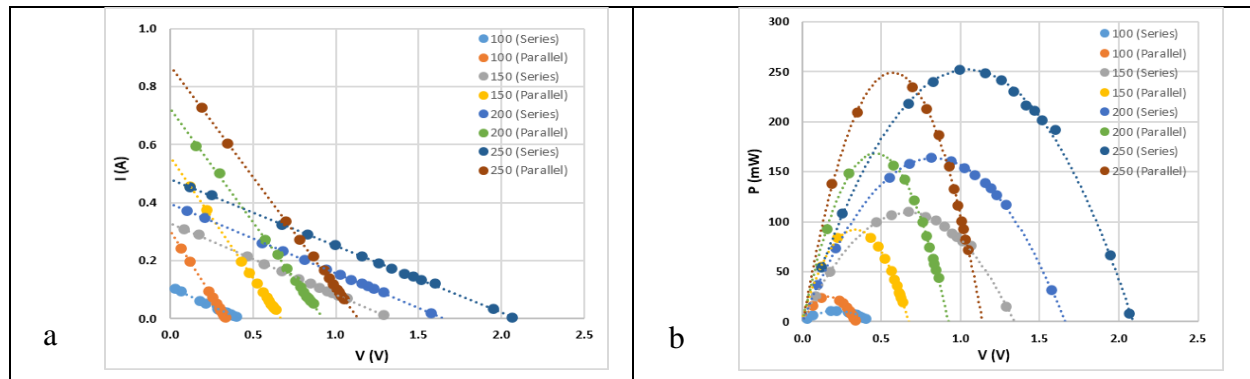


Figure 2. The current and voltage curve (a) and power output of TEGs (b).

CONCLUSIONS

For a waste heat recovery system in the internal combustion engine, a thermoelectric generator was used to conduct a power generation analysis. The goals of the project had been met. Using multiple TEGs in the system resulted in the best electrical characterization compared to using only one TEG. TEG 1 performed better than TEG 2 in the experiment because of the TEG's location. TEG 1 was able to achieve a maximum output power of 183 mW at a hot temperature of 250 °C in the experiment. TEG1 outperformed TEG2 due to the buoyancy effect, which directed the majority of heat upwards to the first TEG. The series connection was found to produce a higher system voltage and, as a result, the greatest possible output power. Using the series TEG connection, the maximum power output was 252 mW at a temperature of 250 degrees Celsius. The parallel array configuration, on the other hand, is thought to be more reliable than the TEG series. Temperatures were also influenced by the distance from the heat source that was measured. As the distance from the source of the heat increases, the heat will be dissipated. TEG was installed at a distance of 20.75 centimetres from the waste heat source's inlet. It affected the voltage and power generated by varying temperatures. Air-cooled TEG was capable of receiving 80.1 °C of maximum heat and 58.1 °C of cold temperature.

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URBAN NEIGHBOURHOOD AND HEALTHY LIFESTYLE: A STUDY OF RELATIONSHIP

Ling, Hoon Leh Oliver*, Siti Nur Afifah Mohamed Musthafa, Shamirah Rosli,
Marlyana Azyyati Marzukhi, and Jamalunlaili Abdullah.

Environmental and Social Health Research Group
Faculty of Architecture, Planning and Surveying,
Universiti Teknologi MARA, 42300 Puncak Alam, Selangor, Malaysia.
**oliver3979@uitm.edu.my*

Research Nexus: Health and Wellbeing

ABSTRACT

Living an active lifestyle will upkeep the health of residents and prevent them from chronic disease. A study was carried out to analyse the relationship between urban land use planning (neighbourhood environment) and a healthy lifestyle with a focus on physical activity in Subang Jaya city. A questionnaire survey and site observation were carried out in the neighbourhood area. As a result, the study found that the neighbourhood environment (urban planning factors) was weakly influencing the level of physical activities (the healthy lifestyle) and affecting the health of residents. It is recommended, all the stakeholders in the urban development and construction industries should contribute towards a friendly environment for a healthy life especially encouraging an active lifestyle.

Keywords: Health, Neighbourhood, Physical activity, Urban

INTRODUCTION

Environmental health comprises aspects of human health that are determined by factors in the environment. Globally, nearly one-quarter of all deaths and the total disease burden can be attributed to the environment. Proper planning in urban planning such as the provision of safe resources (e.g. water, air and food) and a safe/conducive environment (home, work, leisure, sports, recreation and transportation) is an important contributor to a healthy lifestyle. Based on Siti Nur Afifah et.al (2015) human health especially Non-Communicable Diseases (NCD) is related to human lifestyle including physical activities. The human lifestyle especially physical activity is much related to urbanisation and land-use patterns. The benefits of physical activity on health is confirmed by recent global reviews for a developed country. However, this evidence is not clear for developing countries (WHO 2008).

Based on Mansor and Harun (2014) to fight NCD, living an active lifestyle will upkeep the physical and mental health of urban residents and prevent them from chronic disease. With good food habits and daily physical activity, people will be well on their way to a healthy lifestyle. However, this is the concern of this matter where in Malaysia the level of a healthy lifestyle is still low. According to Bernama (2016), only 40% of Malaysians adopted a healthy lifestyle by making sports a culture. He also stated that obesity which leads to heart diseases, hypertension and diabetes among Malaysians was getting more serious due to the unhealthy lifestyle and lack of participation in sports. It is related to the condition of the built environment that discourage active living include a lack of quality lighting; a lack of access to open spaces and sports and recreation facilities; rundown houses and neighbourhoods; poor aesthetics; and locked stairwells in workplaces and public buildings (Edwards & Tsouros, 2006).

Based on World Health Organization (2017) the top global death is NCD. The main types of NCD are cardiovascular disease, cancer, chronic respiratory and diabetes. The highest percentage that contributes to NCD is cardiovascular. Based on the Department of Statistics Malaysia (2017), Ischemic disease that included cardiovascular disease was the principal cause of death until 2016. According to WHO (2017), there are two types of factors that contribute to the disease. Modifiable factors are unhealthy diet and physical inactivity. Metabolic factors are the raised of blood pressure, obesity, high blood glucose level and high-level fat in the blood.

This study was carried out to analyse the relationship between urban land use planning (neighbourhood environment) and a healthy lifestyle with a focus on physical activity in Subang Jaya city. The data collection was carried out with a questionnaire survey and site observation for the aspects of urban land use or neighbourhood environment, and healthy lifestyle (physical activity) of the residents. Statistical tools, *i.e.* frequency, cross-tabulation, correlation and regression tests were used to analyse the relationship between urban neighbourhood conditions and land uses, and residents' healthy lifestyles.

MAIN RESULTS AND DISCUSSION

In this study, the Pearson correlation coefficient was used to examine and test the strengths of the associations of the independent variables with the dependent variables. Table 1 shows the findings of the correlation analyses that examined the relationships between human health status and factors with the level of physical activity and neighbourhood environment. Based on the results below, all the independent variables had a significant relationship with health status & factors. These were physical activity ($r(383) = -0.151, p < 0.05$), and neighbourhood environment ($r(383) = 0.110, p < 0.05$), neighbourhood environment had a very low positive relationship which tend to have very low level of health status & factors. From the analysis, the correlation between health status & factors and physical activity showed a very low negative correlation. This means that the residents with a very low physical activity tended to have very low levels of health status & factors. Accordingly, overall, the level of physical activity and neighbourhood environment were significant as they had a significant relationship with the health status of Malaysian neighbourhood residents.

	Physical Activity	Health Status & Factors	Neighbourhood Environment
Physical Activity	1		
Health Status & Factors	-0.151**	1	
Neighbourhood Environment	0.004	0.110*	1

Note: * Correlation is significant at the 0.05 level (2-tailed).

** Correlation is significant at the 0.01 level (2-tailed).

CONCLUSIONS

The study showed a significant correlation between neighbourhood environment and physical activity with health status. However, the correlation was weak. It can be concluded that the neighbourhood environment (urban planning factors) was weakly influencing the level of physical activities (the

healthy lifestyle) and affecting the health of residents. Other factors were also influencing the healthy lifestyle and health status of people besides the urban planning/environmental aspects. For the recommendation, all the stakeholders in the urban development and construction industries should contribute towards the health of people through their quality design, planning and development for a healthy urban or neighbourhood environment.

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ELECTRICAL PROPERTIES OF CELLULOSE ACETATE–MAGNESIUM TRIFLATE–ETHYLENE CARBONATE BASED GEL POLYMER ELECTROLYTE

Siti Zafirah Zainal Abidin^{1,2}

¹ Faculty of Applied Sciences, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia.

² Ionic Materials and Devices (iMADE) Research Laboratory, Institute of Science, Universiti Teknologi MARA, 40450 Shah Alam, Selangor, Malaysia.

szafirah@uitm.edu.my

<https://orcid.org/0000-0002-3467-0366>

Research Nexus: Industrial Technology

ABSTRACT

Biopolymer Cellulose Acetate (CA) can contribute as a stable thick film, which is mechanically strong that make them as a suitable candidate for host of conducting film. Plasticized gel polymer electrolytes (GPEs) that belonging to polymer–salt–plasticizer interaction systems are prepared by using the mixture of Cellulose Acetate, 30 wt.% of Magnesium triflate (MgTf) and 0–50 wt.% of Ethylene Carbonate (EC). Electrical properties of GPE had been determined by using electrochemical impedance spectroscopy (EIS). The ionic conductivity at room temperature (303 K) and elevated temperature were measured. This GPE offered the best value of ionic conductivity which by addition of 40 wt.% of EC into the CA–MgTf complexation. Temperature dependent conductivity study reveals that the ionic conductivity increases with increasing temperature and it obeyed the Arrhenius rule where implying the ionic conductivity to be thermally assisted. The electrical properties of the GPE with the highest conductivity is analysed by using electrical permittivity and electric modulus formalism studies.

Keywords: Biopolymer, Cellulose Acetate, Magnesium Triflate, Electrical Properties

INTRODUCTION

Electrochemical Impedance Spectroscopy (EIS) is a powerful method of characterizing many of the electrical properties of materials and their interfaces with electronically conducting electrodes. This technique involves alternating current (AC) signals for studying the conductivity of electrolytes and electrode–electrolyte interfacial effects. EIS is an effective tool to understand the charge transport and conduction mechanism in electrolytes. The charge transport can be due to the charge displacement, dipole reorientation (charge hopping) and space charge formation. Gel polymer electrolytes (GPEs) had gained growing attention with characteristics of both solid and liquid electrolytes. Several polymer matrices have been used as GPE hosts to analyse their likely applications batteries [1]. Cellulose acetate is used as polymer since it has a number of excellent properties as a polymeric gelling agent to build a good conducting electrolyte. There is non-toxic nature, availability of renewable resources, low cost and biodegradable [2]. In this current study, Magnesium salt had been attracted to be an interesting candidate as a dopant in the polymer matrix due to its performance capabilities that were close to Lithium salt. The addition of plasticizer to a polymer host is to enhance ionic conductivity and mechanical stability of polymer electrolytes. Cellulose Acetate and Magnesium triflate based with different compositions (between 0–50 wt.%) of Ethylene Carbonate well-prepared by using solution casting technique.

MAIN RESULTS AND DISCUSSION

Dielectric loss is a measure of energy losses to align dipoles and move electric charges due to polarity changes of electric field, whilst also related to the conductivity of material. Frequency response of dielectric loss of highest conducting CA–MgTf–EC complexation-based gel polymer electrolyte in the temperature regime (303–363 K) are represented in Figure 1. The steep increase in dielectric loss towards lower frequency region is strongly ascribed to the motion of free Mg^{2+} ions from MgTf salt within the electrolyte systems. These values of dielectric loss are not correlate with the bulk dielectric processes, but due to the electrode polarization and space charge effects have occurred at the interface of electrode and electrolyte. When the values of frequency are very low, Mg^{2+} ions get sufficient time to build up at the interface before the electric field changes the direction. The properties of a large value owned by dielectric loss at lower frequency region is called conductivity relaxation mechanism.

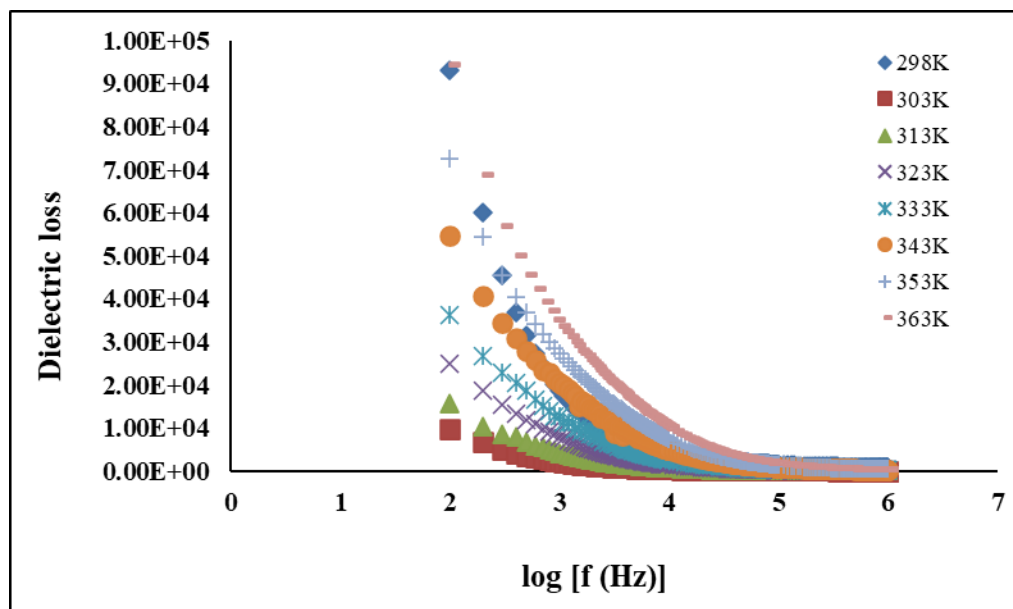


Figure 1 Variation of dielectric loss of optimized CA–MgTf–EC complexation-based gel polymer electrolyte as a function of frequencies at various temperatures.

CONCLUSIONS

The ionic conductivity of CA–MgTf based gel polymer electrolyte at room temperature was enhanced by adding Ethylene Carbonate as plasticizer. The dielectric behavior of the highest conducting sample from PGE indicates strong dependence on frequency and temperature.

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INTEGRATED SENSORS: SENSING MATERIALS TO ELECTRONIC SYSTEMS

Wan Fazlida Hanim Abdullah, Sukreen Hana Herman, Nik Raikhan Nik Him

College of Engineering, Universiti Teknologi MARA (UiTM), 40450 Shah Alam, Selangor, Malaysia.

wanfaz@uitm.edu.my

<http://orcid.org/0000-0002-5628-6568>

Research Nexus: Industrial Technology

ABSTRACT

We present an overview of our work on integrating sensor modules. For a specific element in an environment/host to be successfully detected and processed in a computational system in an integrated flow, there must be a sensing system that is able to detect the element, convert it to voltage and transfer it to a computational network. The sensing mechanism needs to be realizable in a form that can be manufactured to capture the mechanism through corresponding changes in parameters. When the sensing material that is coupled with a transducing device is proven to be able to show electrical behaviour, the sensing layer is then a suitable candidate to be used in a sensor system. The sensing layer then is required to interact with an interfacing circuit where the sensor electrical parameter can be extracted and converted into electrical signal in the form of current/voltage. The circuit technique will also have to ensure that the readings are reliable, with any possibility of misleading information be avoided or compensated. Once in the form of voltage, when sufficiently conditioned, the voltage is then ready to be processed connected to an information processing system involving processing units, controller systems and connectivity such as in an IoT framework. We share our complete material science front to IoT system setup for Extended -Gate Field Effect Transistor sensing systems for pH with linearity >50 mV/pH and constant biasing instrumentation amplifier for a direct voltage output.

Keywords: ISFET, readout circuitry, internet-of-things,

INTRODUCTION

We have developed an extended-gate field-effect sensing system consisting of a TiO_2 and Ta_2O_5 for Extended -Gate Field Effect Transistor sensing systems for pH and nitrate with constant biasing instrumentation amplifier miniaturized using 0.35-micron CMOS technology fabricated through the Multi-Purpose Wafer (MPW) program allowing parallel measurements.

MAIN RESULTS AND DISCUSSION

We have developed sensing layers for pH (between 4-10), EC (between 5-10 mS/cm) and nitrate (presence/absence at 100 ppm for soil sensing). A constant-current constant-biasing circuit sensing technique to allow detection for pH, EC and nitrate have been designed within 5% variation of current-voltage operating conditions set by sensing layer. A prototype of an integrated multimodal sensor readout circuitry with IoT for low power connectivity has been designed. Figure 1 shows transfer characteristics and sensitivity of fabricated TiO_2 thin film towards pH detection can be

obtained. Transfer characteristic graph yields voltage sensitivity value when the V_{REF} reading at I_{DS} of 100 μA for each measurement in pH buffer solutions was extracted.

For the biasing circuit, the use of a pair of voltage followers that are in feedback with each other is the ideal way to ensure the voltage does not deviate due to any external effects. Resistors serves as the potential difference to initiate current flow as well as serving to match the impedance of the FET on the other side of the feedback loop. Constant current source and sink are used to ensure current flowing throughout the loop does not deviate due to factors like temperature. Simulating this circuit has proven to be very successful at providing a linear response at output with regards to change in gate voltage at the transducing FET to emulate a voltage response from a sensing layer. Since current sources and sinks and the EGFET itself are prone to be affected by temperature, experiments were made to study the best thermally compensated components and design. The circuit was fabricated based on IC design on multipurpose wafer of 0.35 micron Silterra CMOS technology. The finished layout is shown in Figure 2.

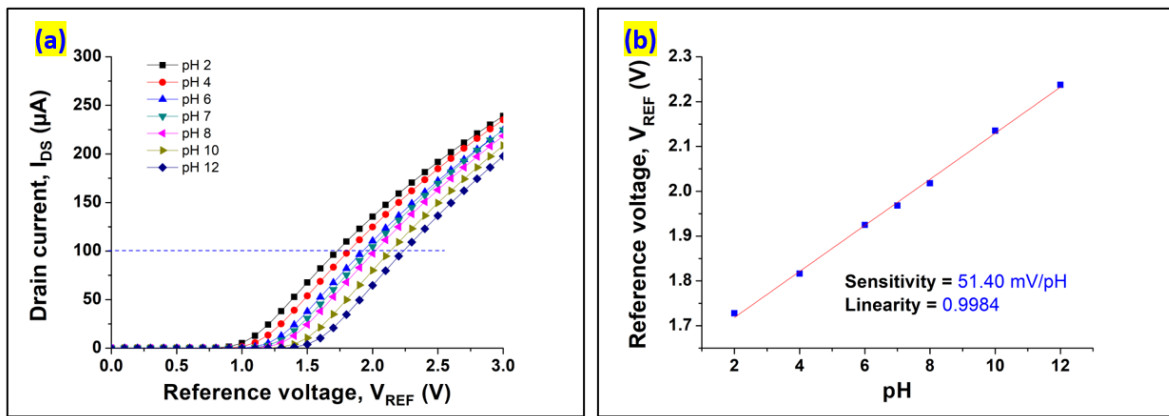


Figure 1: Transfer characteristics and sensitivity plot.

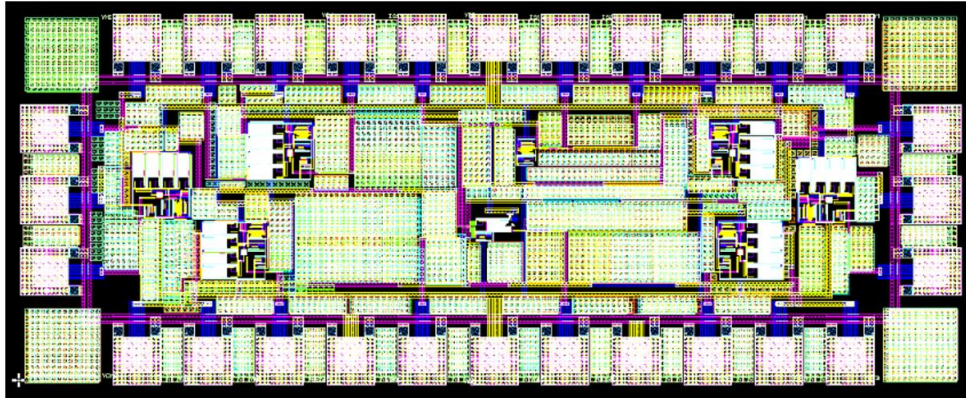


Figure 2: The layout design of the integrated CVCC readout interfacing circuit array

CONCLUSIONS

The development of a solid-state semiconductor/metal alloy extended -gate FET sensor has been achieved with sensitivities comparable to ISE glass electrodes. The development of circuit modules incorporating the transducing FET as part of the circuit has been shown to be made manufacturable on an array using standard CMOS technology techniques.

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HIGHLY FLUORESCENT CARBON QUANTUM DOTS FOR ENVIRONMENTAL AND ENERGY APPLICATIONS

Nagamalai Vasimalai

Department of Chemistry, B.S. Abdur Rahman Crescent Institute of Science and Technology,
Chennai-48, India

E-mail: vasimalai@crescent.education

ORCID ID: 0000-0001-5937-3387

Research Nexus: Industrial Technology

ABSTRACT

In recent years, carbon-based nanomaterials such as carbon nanotubes, fullerenes, graphene and nanodiamonds have attracted widespread attention. However, the preparation and separation of nanodiamonds are difficult; CNTs, fullerenes and graphene have poor water solubility and difficulty in providing strong fluorescence in visible areas, which greatly limits their application. Carbon quantum dots (CQDs) is a new class of carbon nanomaterials with sizes below 10 nm. During the past few years, much progress has been achieved in the synthesis, properties and applications of CQDs. Compared to traditional semiconductor quantum dots and organic dyes, photoluminescent CQDs are superior, because of their high aqueous solubility, facile synthesis, easy functionalization and high resistance to photobleaching, good biocompatibility [3]. Hence, it is highly potential and has extensively been used in several fields including, sensor, catalysis, bioimaging, drug delivery, supercapacitor and solar cells. This research work covers CQDs synthesis from small molecule and kitchen waste material and their white light emitting diode (WLED) and sensor applications. The synthesized CQDs were well characterized by several techniques and the obtained CQDs are stable for several months. Finally, we have applied them for white light emitting diode (WLED) and sensor applications.

Keywords: carbon quantum dots, fluorescence, nanomaterial.

INTRODUCTION

In recent years, carbon-based nanomaterials such as carbon nanotubes, fullerenes, graphene and nanodiamonds have attracted widespread attention. However, the preparation and separation of nanodiamonds are difficult; CNTs, fullerenes and graphene have poor water solubility and difficulty in providing strong fluorescence in visible areas, which greatly limits their application. Carbon quantum dots (CQDs) is a new class of carbon nanomaterials with sizes below 10 nm. CQDs is an accidental discovery, during the purification of single-walled carbon nanotubes through preparative electrophoresis in 2004 [1]. CQDs with fascinating properties have gradually become a rising star as a new nanocarbon member due to their unique properties and great potential in various applications [2]. Carbon quantum dots (CQDs) are novel zero-dimensional carbon-based nanomaterials known for their small size and relatively strong fluorescence characteristics [4,5]. Therefore, there is still a need to synthesize CQDs by green method. Hence, CQDs have been prepared from small molecules and kitchen waste by microwave assisted methods. The synthesized CQDs were well characterized

by several techniques and the obtained CQDs are stable for several months. Finally, we have applied them for white light emitting diode (WLED) and sensor applications.

RESULTS AND DISCUSSION

Coriander leaves and maltose have been used separately in the synthesis of CQDs by microwave assisted method. Waste Coriander leaves CQDs (WCL-CQDs) and maltose CQDs (M-CQDs) show their fluorescence at 420 and 450 nm, respectively (Fig. 1). Interestingly after the addition of silver ions into M-CQDs, the fluorescence was quenched and the color of the solution was changed from green to colorless. Based on the quenching of fluorescence of M-CQDs, we have calculated the LOD and it was found to be 0.57 nM (3S/m) Fig.1A. We have proposed a possible mechanism for the sensing of silver ions. Further, we have successfully applied our system for the detection of silver ions in environmental samples.

On the other hand, we have applied WCL-CQDs for LED application, the green emissive WCL-CQDs became white after mixing quinine sulphate and WCL derived chlorophyll. The chromatocity diagram shows the white light property and the photograph of WLD-CQDs, quinine sulphate and WCL derived chlorophyll solution mixture white color under UV light. Moreover, we have successfully prepare polyvinyl Alcohol film with white LED solution mixture.

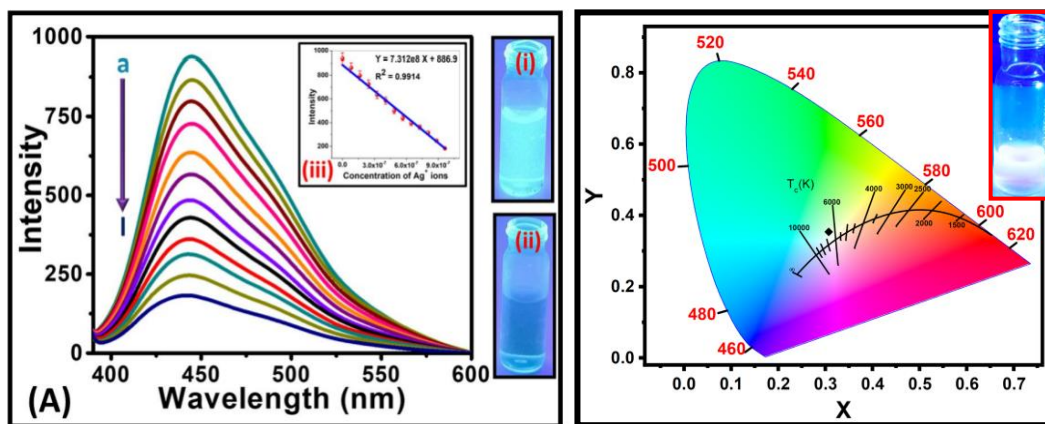


Fig. 1. (A) (A) Emission spectra of M-CQDs in the presence of different concentration silver ions (a) 0, (b) 0.82, (c) 1.6, (d) 2.4, (e) 3.3, (f) 4.1, (g) 4.9, (h) 5.7, (i) 6.7, (j) 7.3, (k) 8.1 and (l) 8.8×10^{-7} M. Insert: Photographs (i) before and (ii) after the addition 8.8×10^{-7} M of silver ions (iii) Linear range calibration curve. (B) Chromaticity diagram of white emissive solution of WCL-CQDs. Insert: Photographs of white emissive solution under UV light.

CONCLUSION

WCL-CQDs and M-CQDs have successfully synthesized by microwave assisted method. The synthesized CQDs were well characterized by UV-vis, fluorescence, HR-TEM, Raman, XRD and FT-IR spectral techniques. The synthesized CQDs are highly stable for several months, and consequently have been applied for sensor and WLED applications. This new synthesis protocol of CQDs together and their potential application in the energy and environment sector will provide an insight in the field of nanotechnology, materials science.

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FABRICATION OF RESISTIVE-TYPE HUMIDITY SENSOR USING METAL OXIDE NANOSTRUCTURES

M.H. Mamat^{1*}, A.S. Ismail¹, N. Parimon¹, M.Z. Musa¹, M.F. Malek¹, N. Vasimalai², I.B. Shameem Banu², and M. Rusop¹

¹NANO-ElecTronic Centre (NET), School of Electrical Engineering, College of Engineering, Universiti Teknologi MARA (UiTM), 40450 Shah Alam, Selangor, Malaysia
E-mail: mhmamat@uitm.edu.my
ORCID ID: 0000-0002-6640-2366

²School of Physical and Chemical Sciences, B.S. Abdur Rahman Crescent Institute of Science & Technology, Vandalur, Chennai 600 048, India
E-mail: vasimalai@crescent.education
ORCID ID: 0000-0001-5937-3387

Research Nexus: Industrial Technology

ABSTRACT

In the past decade, humidity sensors have been widely studied and considered in various applications including agriculture, food industries, climate monitoring, chemical storage, healthcare, and semiconductor industries. The studies have been focused to prepare a humidity sensor with good humidity sensing performance and low cost, which is required for large-scale volume and to fulfil the rigorous performance obligations of the emerging areas. In this research, resistive-type humidity sensors were fabricated using zinc oxide (ZnO), titanium dioxide (TiO₂) and nickel oxide (NiO) nanostructures. These nanostructures were produced and grown on substrates using solution immersion methods. This method is a cost-effective fabrication process, which could produce nanostructure films in large scale. The results obtained in this research show that metal oxide nanostructures in the form of ZnO nanorod arrays, flower-like TiO₂ nanorod arrays and NiO nanoball/nanosheet structures are good candidates for humidity sensing applications. These nanostructures produce high humidity sensing sensitivity and could provide potential humidity sensing applications in the emerging areas.

Keywords: humidity sensors, zinc oxide, titanium dioxide, nickel oxide, solution immersion method

INTRODUCTION

The application of metal oxide nanostructured materials has a lot of advantages over bulk materials, consisting of fast response and high sensitivity, and miniaturization of the device structure that somehow reduces the power consumption for the sensing device. Metal oxide nanostructured materials are also important for advanced energy conversion and storage devices [1, 2]. Thus far, several studies have highlighted the factors that are associated with the high performance of metal oxide nanostructured-based devices in correlation with a high surface-to-volume ratio, surface defects, charge carriers, and high porosity [3]. Additional proficiency of charge separation in attribution to the existence of surface trap states in metal oxide nanostructured materials is also important to enhance the performance of sensing devices. Metal oxide nanostructures such as zinc oxide (ZnO), titanium dioxide (TiO₂) and nickel oxide (NiO) have been among the most attractive materials among researchers during the last decades as an alternative material due to its unique and

excellent properties in optics, electronics, and photochemistry. These materials are physically stable and chemically robust to the environment. The photocatalytic characteristic of ZnO, TiO₂ and NiO also seemly to be utilized in degradation of organic pollutants in wastewater treatment [4], and oxidation of harmful CO gas under the UV irradiation [5]. The affinity to change the electrical resistance when exposed to most gases such as oxygen, ammonia, alcohol, pollution such as nitrogen dioxide and others also made it applicable for the application of gas sensors [6]. In addition, these nanostructures provide excellent characteristics for water adsorption and thus have been implemented in a field of humidity sensors. Humidity responses generated through ZnO, TiO₂ and NiO nanostructures have grown interest and extensively investigated until recently, as their promise in abundant decent applications. In this research, ZnO, TiO₂ and NiO nanostructures have been prepared via solution immersion process at low temperature. Humidity sensors have been fabricated using these nanostructures in resistive-type and their performances were investigated. The results obtained in these works suggested that these nanostructures facilitate good humidity sensing performance with high sensitivity.

MAIN RESULTS AND DISCUSSION

In this research, humidity sensors have been successfully fabricated using ZnO nanorod arrays, flower-like TiO₂ nanorod arrays and NiO nanoball/nanosheet structures [7-9]. Our study has introduced a novel solution immersion method to synthesize and deposit ZnO, TiO₂ and NiO nanostructured films on glass substrate at low temperature below 150 °C using Schott bottles. These Schott bottles used to replace stainless steel-based autoclave, which has been commonly utilized for the growth of metal oxide nanostructures. The autoclave equipment also requires high temperature setup to produce metal oxide nanostructures on the substrate. The utilization of Schott bottles has sped up and opened opportunities for extensive research and development on facile and rapid growth of metal oxide nanostructures in various applications particularly for humidity sensing. The main purpose of this research is to fabricate metal oxide of ZnO, TiO₂ and NiO nanostructured film using simple methods for high performance humidity sensor applications. Several processing parameters such as deposition time and doping have been studied to produce ZnO, TiO₂ and NiO nanostructured films with good performance. The fabricated humidity sensor was analysed via a two-terminal probe measurement unit in the humidity chamber. The humidity sensing of the ZnO nanorod array film-based sensor shows good performance with a sensitivity of 1.53. The sensitivity value is further enhanced by tin (Sn) doping which yields a sensitivity of 3.72. By coating with SnO₂ nanoparticles, the sensitivity of the humidity sensor is improved to 6.28. These improvements suggested that the doping process and small pore channels induce good interaction of water molecules on the nanostructure surface. Meanwhile, the humidity sensing characteristic of flower-like TiO₂ nanorod array-based devices was also investigated. This TiO₂-based device shows good humidity sensing sensitivity of 196. This high sensitivity is attributed to the high density of flower-like nanorods, which effectively traps water molecules. In addition, a humidity sensing device was also fabricated using NiO nanoball/nanosheet structures. The sensitivity value recorded for this NiO-based device is 169. The small pores exist between NiO nanoparticles network layers are believed to facilitate more sites for water molecule adsorption and produce high sensitivity of the humidity sensor. These results suggested that ZnO nanorod arrays, flower-like TiO₂ nanorod arrays and NiO nanoball/nanosheet structures are suitable and reliable for humidity sensing applications with high sensitivity.

CONCLUSIONS

In summary, metal oxide nanostructures in forms of ZnO nanorod arrays, flower-like TiO₂ nanorod arrays and NiO nanoball/nanosheet structures were successfully prepared on the substrate using

solution immersion method. The results indicate that the devices made from these nanostructures produce high humidity sensing sensitivity. The sensitivity values recorded for the humidity sensing devices are 6.28, 196, and 169 using ZnO nanorod arrays, flower-like TiO₂ nanorod arrays and NiO nanoball/nanosheet structures, respectively.

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DIFFERENT ALIGNMENT OF ELETROPLATING SUBSTRATES TO COATING PERFORMANCE

Koay Mei Hyie¹, Salina Budin², Nik Rozlin Nik Mohd Masdek³, Zuraidah Salleh⁴, M. H. A. Kamal⁵

¹School of Mechanical Engineering, College of Engineering, Universiti Teknologi MARA, Cawangan Pulau Pinang, Kampus Permatang Pauh, 13500 Permatang Pauh, Pulau Pinang, Malaysia.

koay@uitm.edu.my

²School of Mechanical Engineering, College of Engineering, Universiti Teknologi MARA, Cawangan Pulau Pinang, Kampus Permatang Pauh, 13500 Permatang Pauh, Pulau Pinang, Malaysia.

salinabudin@uitm.edu.my

³School of Mechanical Engineering, College of Engineering, Universiti Teknologi MARA, Shah Alam, 40450, Selangor, Malaysia.

nikrozlin@uitm.edu.my

⁴School of Mechanical Engineering, College of Engineering, Universiti Teknologi MARA, Shah Alam, 40450, Selangor, Malaysia.

szuraidah@uitm.edu.my

⁵School of Mechanical Engineering, College of Engineering, Universiti Teknologi MARA, Shah Alam, 40450, Selangor, Malaysia.

hilmi805@gmail.com

Research Nexus: Industrial Technology

ABSTRACT

Corrosion is a major issue that happens in metal. To ensure no corrosion happens, the metal must be protected by a corrosion resistant coating layer during the electroplating process. Co-Ni- Fe elements are expected to be a good protection layer in corrosion. In this study, different cathode positions of the mild steel substrate were investigated. Two samples placed in horizontal and vertical alignment towards the platinum anode in the electroplating process. The coating deposition time was set at 30 minutes. The electrolyte temperature was constant at 50° C. The mild steel coated with Co-Ni-Fe single layer was tested by using Scanning Electron Microscope (SEM) to observe the surface texture. It is found that the substrate hung at horizontal position gave a smooth surface and better surface roughness, which recorded at 0.407 μm . On the other hand, Vickers microhardness result showed that the same sample at horizontal position performed better surface hardness than the sample placed at vertical position. From this study, it is believed that the position of the cathode used in electroplating process plays an important role on the quality coating for mild steel based product.

Keywords: coating, Co-Ni-Fe, cathode position

INTRODUCTION

The existence of steel corrosion is one of the biggest problems that industrial sector is facing now. It seriously affects the material life span and performance of the steel equipment¹. The electroplating method is used to perform Co- Ni-Fe alloy coating to protect the steel from corrosion. It is chosen because it is the most versatile, and simpler method in coating preparation². The major drawback of electroplating is the concurrent evolution of hydrogen at the cathode (substrate) during electroplating process. This problem is common and may result in a low cathode current efficiency. Moreover, any current devoted to hydrogen evolution at the cathode is considered wasted and may cause hydrogen

embrittlement³. Thus, this problem should be avoided by carefully controlling the electroplating process parameter including position of cathode. Previous work done on the investigation of horizontal and vertical carbon anode effect⁴. This study reported the effect of horizontal and vertical cathode alignment towards anode on the coating surface performance such as surface texture, hardness and surface roughness. The substrates underwent a pre-treatment process to remove unwanted material or contaminants. Then the mild steel samples were placed at cathode acting as substrate whereas platinum plate acting as anode. Two samples were produced in a process to investigate the horizontal and vertical position towards the anode. The current supplied was in the range between 0.9 A to 1.0 A. The condition of electroplating process was maintained at 50°C and 30 minutes of plating time. The coating performance of coated sample was checked by Scanning Electron Microscope (SEM), surface roughness and Vickers microhardness testing.

MAIN RESULTS AND DISCUSSION

Based on Figure 1, the surface of sample placed horizontally towards anode shows smoother surface compared to the sample placed vertically. There are some agglomerates found in Figure 1 (b). It was observed that a lot of gas bubbles produced at the sample when the substrates were aligned at the vertical position. The generation of bubbles caused by concentrated current distribution at the vertical part and resulted in hydrogen embrittlement. The surface crack was observed at the sample experienced hydrogen embrittlement, as shown in Figure 1 (b). The gas was trapped inside the coating and pits were formed. Permanent voids may be trapped inside the coating, which may rise to the defect in the coating layer⁵. Those pits and agglomerates made the coating surface became rough. This phenomenon was not favorable to coating as a protection layer to corrosion. The surface roughness, (Ra) obtained by the sample placed horizontally was 0.407 μm , which was smoother than the sample placed vertically towards the anode (0.741 μm). The microhardness also shows the same trend where the sample aligned horizontally exhibited higher hardness (143.4 HV) compared to vertical alignment of substrate, which recorded as 85.9 HV of microhardness. This difference may due to the current flow equally to all of the substrates in horizontal position at larger anode area coverage, that led to better coating performance.

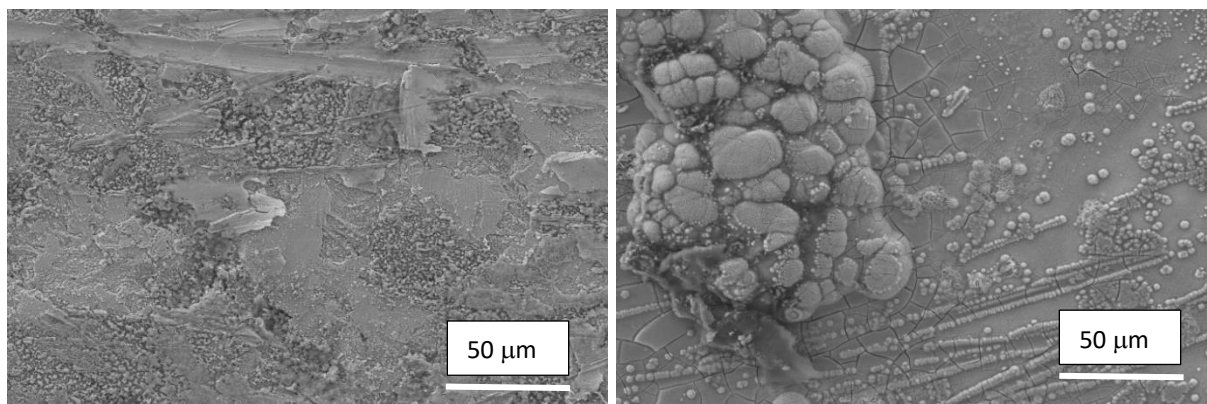


Figure 1. SEM images for Co-Ni-Fe coated mild steels placed (a) horizontal (b) vertical towards anode

CONCLUSIONS

Hydrogen gas produced near the cathode during electroplating can adversely affect the quality of the metal coating. The alignment between cathode and anode in electroplating setup is thus a major factor to reduce the hydrogen embrittlement defect. A smoother coating surface and better hardness

was performed by the mild steel cathode (substrate) when the two substrates were aligned in horizontal rather than vertical position. Further study should focus on the amount of bubbles influenced by different current densities and their effect to the corrosion performance of the Co-Ni-Fe coating.

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MORPHOLOGY AND MOISTURE MANGEMENT OF GRAPHENE OXIDE COATED POLYPROPYLENE FILTER FACEMASKS

Nor Dalila Nor Affandi¹, Noor Najmi Bonnia^{1,2}

¹Textile Research Group, Faculty of Applied Sciences, Universiti Teknologi MARA, 40450 Shah Alam, Selangor

E-mail : dalila@uitm.edu.my

ORCID ID : <https://orcid.org/0000-0003-2739-6570>

²Materials Science and Technology, Faculty of Applied Sciences, Universiti Teknologi MARA, 40450 Shah Alam, Selangor

E-mail : noornajmi@uitm.edu.my

ORCID ID : <https://orcid.org/0000-0001-9550-8445>

Research Nexus: Industrial Technology

ABSTRACT

Nowadays, graphene oxide (GO) has been employed by many researchers due to its desired properties. In this study, GO was used to enhance the comfort properties of the polypropylene (PP) filter facemask fabric. Scanning Electron Microscope (SEM) and X-ray Spectrometer (EDX) were used to identify the morphology and structure of the GO coated PP filter fabric. The samples' comfort properties were measured using the moisture management test (MMT). The SEM showed bumping pieces, coarse and chunky, of sharp GO on the PP filter fabric. The GO coated PP filter fabrics also exhibited very good to excellent moisture management compared to the uncoated samples. In a nutshell, the presence of GO in PP filter fabric enhances the breathability and comfort properties of the fabric. It is recommended to conduct a questionnaire survey on the consumer perception of the comfort properties of the GO coated PP filter mask. The results of the survey questions can strengthen and support the experimental analysis through the analysis of consumer perception.

Keywords: Graphene oxide, filter facemask, moisture management

INTRODUCTION

Coronavirus Disease 2019, known as COVID-19, is a novel Wuhan-born (China) pneumonia disease confirmed by the World Health Organization on 12 January 2020, before an outbreak in all countries. Malaysia also has the highest cases of COVID-19 among Southeast Asians [1]. Covid 19 diseases can pose a risk of infecting care workers and everyone in the country [2]. Therefore, face masks are necessary, and several types of masks are used, especially during airborne infectious pandemics. A facemask covers the nose and mouth and reduces the wearer's risk of inhalation of hazardous airborne particles. Existing masks, however, have several drawbacks, including a lack of breathability [3]. Hence, the current study aims to improve the breathability of the facemask materials by incorporating graphene oxide (GO) in the facemask. Graphene can be used in various applications, including sensor applications, coating, biotechnology and medicine, thermal management, water purification, and facemasks [4]. Alen et al. (2019) reported that graphene oxide (GO) could increase the permeability of membrane materials. This is due to the capability of the gas particles to pass through the surfaces of GO [5]. This statement shows the feasibility of incorporating GO in facemask

material, which can contribute to the excellent permeability of the facemask material. In the current study, the polypropylene sample fabric was boiled in deionised water for 5 minutes at 100°C. The GO solution was sonicated with deionised water for an hour. The sample fabric was immersed in a dispersed graphene oxide solution for 30 minutes. The GO was then combined with the facemask material as part of the research process. The GO coated facemask materials were tested for morphological structures and moisture management to determine the comfort properties of the facemask material. By undertaking the study, the comfort properties of the GO coated facemask materials can be determined. Hence, enhanced properties of polypropylene filter fabric were developed, which will benefit the facemask end-users.

MAIN RESULTS AND DISCUSSION

As Figure 1, graphene oxide (GO) has successfully attached to the fabric. When the GO concentration increases from 0.01% to 0.02%, more GO are deposited on the filter facemask fabric. From the EDX analysis, the GO PP filter fabric has a carbon and oxygen percentage of 93.7% and 6.25%, indicating the presence of GO in the PP filter fabric. The existence of oxygen and carbon in GO was also reported by Han et al. (2018) [6]. Overall moisture management capacity (OMMC) is an index that indicates the fabric's overall ability to manage liquid moisture transport, which includes three aspects of performance. In Figure 2, the uncoated PP filter fabric gives the lowest scale of overall moisture management improvement, which is 3.5 (good to perfect rating). The 0.01% GO coated PP fabric exhibits the second-highest scale, which is 4 (excellent rating) and the 0.02% GO coated fabric shows the largest scale, which is 5 (excellent rating) of OMMC. Due to the hydrophobicity character of the PP filter, it enables moisture wicking at a low absorption rate and spreading speed [7]. The presence of GO in the PP filter fabric increases the pore volume (voids), resulting in better fabric moisture control.

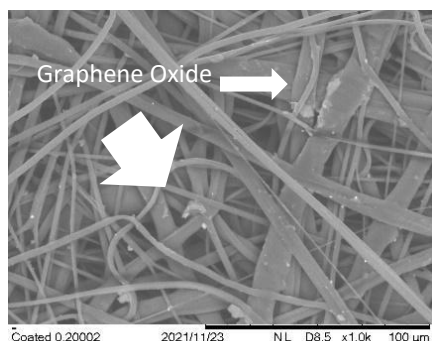


Figure 1: SEM image of GO coated polypropylene filter facemask fabric

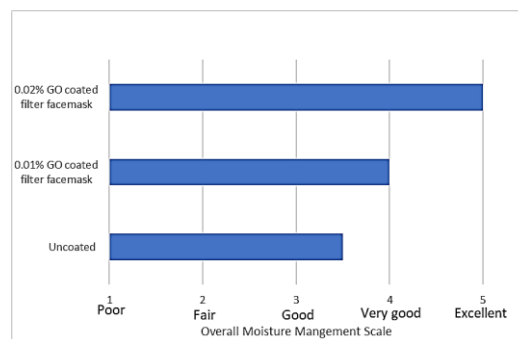


Figure 2: Moisture management of uncoated filter facemak, 0.01% of GO coated filter facemask and 0.02% of GO coated filter facemask.

CONCLUSIONS

The SEM analysis showed the bumping pieces, coarse and chunky, of sharp graphene oxide (GO) for 0.01% and 0.02% GO coated polypropylene (PP) filter fabrics. Meanwhile, the EDX result analysis proved the presence of GO in the PP filter fabric. The carbon (C) element has a more outstanding elemental composition than the oxygen (O) element in the GO coated PP filter fabric. The moisture

management test can be used to identify the comfort properties and breathability of the PP filter fabric mask. From the analysis, the overall moisture management capacity for the moisture management test is improved by adding GO to the PP filter fabric. A study on the consumer perception of the comfort properties of the GO coated PP filter mask is recommended in a future study.

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ISSUES ON THE USE OF ONLINE LEARNING AMONG UNIVERSITY STUDENTS DURING COVID-19 PANDEMIC

Azleen Ilias¹, Nasrudin Baidi², Erlane K Ghani³, Fazlida Mohd Razali⁴

¹Department of Accounting and Finance, College of Business Management and Accounting,
Universiti Tenaga Nasional, Malaysia
E-mail: azleens@uniten.edu.my
ORCID ID: [0000-0001-7788-6282](https://orcid.org/0000-0001-7788-6282)

²Department of Accounting and Finance, College of Business Management and Accounting,
Universiti Tenaga Nasional, Malaysia
E-mail: nasrudin@uniten.edu.my
ORCID ID: [0000-0001-5280-1246](https://orcid.org/0000-0001-5280-1246)

³Faculty of Accountancy, Universiti Teknologi MARA Selangor, Malaysia
E-mail: erlanekg@uitm.edu.my
ORCID ID: 0000-0001-5539-0569

⁴Accounting Research Institute, Universiti Teknologi MARA, Malaysia
Email: fazlida@uitm.edu.my
ORCID ID: [0000-0002-3688-4616](https://orcid.org/0000-0002-3688-4616)

Research Nexus: Social Creativity and Innovation

ABSTRACT

This study investigates the issues pertaining to the use of online learning among the university students in Malaysia during the COVID-19 pandemic. Using a qualitative approach via online interview involving 147 accounting students from public and private universities in Malaysia, this study finds seven challenges that might limit the intention to use online learning among students. The challenges are assessment administration, social interactions, technical, connection and data, time and support, motivation, preferences and intention, and learners' understanding. The findings of this study contribute to the existing corpus of knowledge and implicates the need for universities to strategize for effective online learning.

Keywords: Online learning, Accounting, University students

INTRODUCTION

COVID-19 pandemic and its rapid escalation coupled with the MCO implementation has caused the Malaysian's education system to do online learning. Online learning provides a virtual learning environment that engages students in various activities involving a multitude of subjects through audio-visual platforms (Al-Rahmi, Alias, Othman, Alzahrani, Alfarraj, Saged, & Rahman, 2018). However, studies have suggested that students often face numerous challenges in relation to online learning. Muilenberg and Berge (2005) divided these challenges into assessment administration, social interactions, technical, connection and data, time and support, motivation, preferences and intention, and learners' understanding. This study utilises the responses of 147 accounting students from public and private universities in Malaysia. This study was conducted during the COVID-19 pandemic by employing online interview method using various online platforms. The opinions of the students were recorded and subsequently transferred to Microsoft word before to ATLAS.ti for analysis

based on codes. This study finds seven challenges that limit students' intention to use online learning. The challenges are administrator's assessment, communication issues that limit social interaction during an online learning session, technical issues, lack of Internet connection and insufficient data capacity. Other issues raised were lack of motivation, preferences, intention and students' level of understanding about online learning. This study provides insights on how to improve online learning in future and subsequently, suggests strategies to motivate students and help them continually use the online learning platform (Anshari, Alias, Sabtu & Hamid, 2016).

MAIN RESULTS AND DISCUSSION

Assessment Administration

One of the issues obtained from the interviews is assessment administration. That is, how the lecturers conduct the assessments during COVID-19 pandemic. The students commented that all the assessments were carried out online and due to this, the students faced difficulties and insufficient time to submit the assessments on time. Therefore, it is suggested that lecturers to show some concern on the assessment and recognise the students' needs, time allotted, the delivery method used and accessibility to the internet prior to conducting any assessment on assignments or examinations.

Social Interactions

Online learning to a certain extent, become a disruptive mechanism with any vague or obscure kind of communication. Most of the students raised the issue of limited communication, which could impact the important features of the learning process. The findings in this study show limited communication between students indicating a challenge to take part in online learning. Therefore, there is a need to maintain a good level of interaction between the lecturers and students during online learning in order to avoid miscommunication and improve students' level of satisfaction (Taat & Francis, 2020).

Technical, Connection and Data

Most students have raised concern on unstable Internet connection, lack of devices and insufficient data. A stable Internet connection and sufficient data are considered important elements since 66 students had raised these common issues. For example, the issue related to Internet connection required for joining online classes, examinations and assessments. This study shows that the few of the students faced limited connectivity contributing to the challenge in implementing a good e-learning program (Moakofhi, Leteane, Phiri, Pholele & Sebalatlheng, 2017).

Time and Support

This study finds that during this pandemic, students spent time on online learning while neglecting time for themselves. This study finds that students allocated so much time to meet their lecturers' expectations. This study also finds that at the early stage of online learning, most students face the challenge of time management when allocating time for learning and assessments. However, students who used more effective learning strategies are more skilled in time management; thus, they are expected to be less likely to encounter problems related to lack of time (Henderikx, Kreijns, Castaño Muñoz, & Kalz, 2019). Time has also been identified as a perceived barrier to students' commitment to online learning and consequently, their learning (Muilenberg & Berge, 2005).

Motivation

This study finds that students' motivation can also affect preferences and intentions to further pursue online learning. However, these challenges led the students to become demotivated. This study finds that motivation is related to how students anticipate the use of online learning. The main reason for resistance to using online learning is the low-level of motivation towards any change (Panigrahi, Srivastava & Sharma, 2018). Meanwhile, motivation was identified to arise due to the expectation of rewards as well as interest and enjoyment to continue participating in online learning (Wang & Hou, 2015).

Preferences and Intention

This study also finds that together with motivation, the students would tend to be more positive towards the use of online learning. The students mentioned that they are open to online learning provided the learning platform or tools are appropriate. However, during the COVID-19 pandemic, the students were asked to use various platforms available but not necessarily effective. Therefore, the lecturers need to ensure that the teaching and learning platforms are conducive for the students.

Learners' Understanding

The lack of understanding among students is a challenge at the early stages of using online learning due to limited social interaction and motivation during online learning. They noted that it is more difficult to grasp the knowledge via online learning as compared to face to face learning. Therefore, how lecturers deliver knowledge content, appropriateness of knowledge, clarification of misunderstandings and increase students' motivation is important in online learning (Panigrahi et al., 2018).

CONCLUSIONS

This study suggests that universities should improve their online assessment methods. Besides, the universities need to ensure a suitable platform for online learning, such as Microsoft Team, GoogleMeet and Zoom, and effectively being used by the lecturers and students. Since there is limited interaction between lecturers and students during online learning, hence, online meetings should be conducted so that students can discuss course matters in order to develop a better understanding of the subject. Students should be given simple assignments so that they meet the expectations of online learning. In addition, limitations in the form of technical issues, lack of Internet connection and insufficient data are common challenges related to online learning conducted outside the university campus. Therefore, this study also suggests that students need to allow to continue their studies in the universities. This also includes students who have to submit recorded video presentations. Finally, the universities need to continuously provide support to their students to in order to sustain their motivation to learn online by using various online platforms.

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Facing Forward, Reverse Thinking: Anticipating Future Digital Customer Relationship Management

Mohd Raziff Jamaluddin¹, Muhammad Iskandar Hamzah², Abdul Kadir Othman³

¹Faculty of Hotel and Tourism Management, Universiti Teknologi MARA, Bandar Puncak Alam, Selangor, MALAYSIA

¹raziff@uitm.edu.my

¹ORCID ID: 0000-0001-8585-3771

^{2,3}Faculty of Business and Management, Universiti Teknologi MARA, Bandar Puncak Alam, Selangor, MALAYSIA

ORCID ID: ²0000-0002-8794-2409, ³0000-0001-5174-573

Research Nexus: Social Science and Innovation.

ABSTRACT

This paper provides an overview of the drastic changes in digital customer relationship management by examining selected cases from the Asian hotel and tourism industries. A paradigm shift is a common term used throughout the pandemic; thus, it is critical to investigate this notion and evaluate related research. It is concluded that demand anticipation, procurement efficiency, and capacity planning would be the way ahead for the hospitality and tourism industries to thrive in the market until the industry can fully recover around 2024

Keywords: Paradigm shift, Digital, Customer Relationship Management

INTRODUCTION

Kuhn (1962) creates the term “paradigm shift” to describe a significant change in scientific experimentation. The main goal is to start changing how we do things. In other words, Kuhn (1962) proposes that people should change how they look at things and approach problems. According to Rodriguez-Sickert et al. (2015), a paradigm shift is a radical change that manifests itself as a rapid migration of the knowledge community towards the new and superior paradigm.

This study provides an overview of the paradigm shift in consumer behavioral studies, focusing on progress in the hotel and tourism industries in light of rapid technological change. During the COVID-19 pandemic, four views emerged: i) model (framework), ii) process (procedures), iii) technology (business model), and iv) people (workforce). The primary goal of this study is to examine a significant paradigm shift that occurred in several key Asian markets and to provide a potential framework that can be used in the future to address consumer behavioral change.

The term paradigm shift is always linked with humans in the literature, where humans develop habits based on knowledge (what), skills (how), and desire (why), making it critical to examine the educational process to produce a successful paradigm shift. Czapiewsk and Janc (2019) define “the educational paradigm shift” as a transformation in perspective and role of education and formal skills in society, the labor market, and development processes. When we examine the economy’s socioeconomic profile, we see that Millennials represent 40% of the traveling segment, driving future travel products and services. This may spark a new wave of research into this market, as it will account for half of all travel spending in ten years. The millennials heavily rely on gadgets and

technology in traveling and require connectivity to use social networks, mobile apps, and cashless facilities.

The travel industry is adapting to these changes in the tourism ecosystem and will do so indefinitely (Economic Intelligence Center, 2017). Sales promotion tools remained critical in destination marketing communication to convert target audiences from information seeking to select and purchase. Information is critical in today's environment, especially when the world is under lockdown. People rely on the internet to be informed and entertained while adhering to the stay-at-home policy. It is not all unfortunate for the economy, as China, the world's largest internet user, can achieve incredible things with the online business, where a sale of USD1 to 1% of the population may produce USD117 million each year. The scenario illustrated here may provide marketers with an opportunity to analyze the captive market during the pandemic.

DISCUSSION

Online intermediaries play a vital role in the digital world, and they may be more powerful than physical intermediaries. However, they are also affected during the pandemic. The goal of maximizing satisfaction and minimizing dissatisfaction had to be adjusted during the pandemic due to the social distancing protocol. Tourist arrivals in the Asia Pacific region plummeted by 83 percent in 2021 compared to the previous year. International arrivals will stay intact in 2022 due to the Chinese government's outbound travel restrictions, and it is hoped that the ban will be lifted shortly after the Winter Olympics conclude. In relation to this news, capacity planning needs to be adjusted. The hotel and tourism players must shift to the "flexibility" paradigm. To remain robust and agile in a changing environment. Industry players must adapt and respond relatively to external forces. Based on the thorough literature search, the three factors are listed: i) demand anticipation, ii) procurement efficiency, and iii) capacity planning. Hospitality and tourism players must anticipate last-minute orders, set a pessimistic target, and expect last-minute cancellations for demand anticipation. The new sales equation must incorporate the elements of systematic and unsystematic risk in sales projection. So far, the industry has been unable to rely on accurate data and depends on the shrinking domestic market.

Next, for procurement efficiency, industry players must negotiate with suppliers to obtain economies of scale with a slightly reduced quantity. The contract must consider the industry's need to modify the optimal level of stocks to optimize warehouse utilization during a low turnaround. Utilizing classic models like Business Model Canvas (BMC) seems to be one of the alternatives to anticipate future digital customer relationship management, as suggested by Boroh (2021). In digital customer relationship management, the company must leverage online features, including social media (Facebook, Instagram, TikTok, Twitter, WeChat, and Whatsapp) and media engagements (social media influencers) as pandemic initiatives.

Finally, it is time for hospitality and tourism industry stakeholders to delve into the concept of anti-consumerism for capacity planning purposes. Kotler (2019) proposed a paradigm shift in the capacity planning, requiring the firm to reconsider the role of marketing in the organization. The critical paradigm that requires major revision is how marketers are accountable for creating wants through responsible consumption. Aside from that, knowing the domestic business environment is critical at this stage since the trajectory of government policies, belief systems, business rules and regulations, and corporate governance will determine the direction of the domestic economy in the near future. Understanding the cyclical changes in the domestic economic environment should be easier and, as the saying goes, "low hanging fruit." However, the challenge for the domestic economy is to predict the most active and high-quality market segment that can contribute to income generation.

CONCLUSIONS

COVID-19 has placed a new emphasis on relationships, with a virtual sales environment being the key to revenue momentum if the organization has the skillset of selling solutions rather than products. It is concluded that demand anticipation, procurement efficiency, and capacity planning would be the way for the hospitality and tourism industries to thrive in the market until the industry can fully recover around 2024. Thorough research is needed to fully grasp the new benchmark as the competitive threshold for the industry. In the short run, policymakers should look into repositioning and upgrading products and services to stay competitive. Online travel and tourism services should be improved to optimize digital channels and technology. On the other hand, scholars must take bold action to argue the prior models and provide a new variable that can be applied in the short and long run.

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COMMUNITY PROJECT: AUTISM FRIENDLY MOSQUE

Naffisah Mohd Hassan¹, Noor'ain Mohamad Yunus¹, Siti Noorsuriani Maon¹ and Sri Fatiany Abdul Kader Jailani¹

¹Faculty of Business and Management, Univeriti Teknologi MARA, Cawangan Selangor, Kampus Puncak Alam

naffi885@uitm.edu.my

<https://orcid.org/0000-0001-5349-4647>

noorainyunus@uitm.edu.my

<https://orcid.org/0000-0001-6789-123X>

sitinoor123@uitm.edu.my

<https://orcid.org/0000-0002-3295-8817>

fatiany@uitm.edu.my

<https://orcid.org/0000-0002-0895-0970>

Research Nexus: Social Creativity and Innovation

ABSTRACT

A series of programs called Autism Friendly Mosque which was initiated by the Research Group (RG) Sustaining Quality of Life (SQL). This program was introduced to avoid negative perceptions from the public since most Muslim parents do not bring their autistic children to the mosque. The program collaborated between Government agencies such as the Department of Federal Territory Islamic Affairs (JAWI) and several NGO's including The National Autism Society of Malaysia (NASOM) and mosques throughout Malaysia was part of the community engagement for the research. The initial AFM community service program had attracted more than 45 children with autism and their parents were invited to join this program together with more than 50 volunteers. Series of programs have been carried out since then, such as lessons on performing prayers and reading IQRA and Ablution. Unfortunately, in the current pandemic situation, this program was done virtually. "Walking in the shoes of a child with an autism spectrum disorder: making visiting the religious centre (mosque) easier" was a program organised on 11 April 2020 using Social Media platform and Facebook Live. The program received an overwhelming response from parents, caregivers and participants throughout Malaysia. These programs were aimed to open societies' mind-set and accept those in the spectrums and to put more attention to figure out ways to communicate with them. With the belief that all people are born different but equal and valuable, the RIG from FBM UiTM, NGOs and JAWI hoped that the program achieved its objectives especially to encourage Muslim parents to bring their children with autism to the mosque so that they can enjoy equal and harmonious lives.

Keywords: Autism Friendly Mosque; Children; Quality of Life

INTRODUCTION

The development of autism spectrum disorder in Malaysia is increasing and putting pressure on families, especially mothers and fathers. It is not an issue in our country but an issue that is being addressed at the global level. According to Haziq and Akma (2019), the disorder of children with ASD is associated with long-term disorders and if not curbed and addressed immediately has a stressful effect on parents, especially in the imbalance of family institutions leading to critical depression.

Isolation can be debilitating for sociable people but for at least 67 million people who suffer from autism worldwide, that isolation can become a lifelong issue. One in every 88 children is estimated to suffer from some degree of autism and the society are trying to improve understanding of the disorder among the general public, who often think such children are simply naughty or misbehaving. Therefore, to avoid negative perceptions from the public, most Muslim parents will not be able to bring their autistic children to mosque. Visiting the mosque is an important part of the lives of Muslims. It is not only a place to pray in congregation, but to learn, partake in community activities, seek help, and connect with other Muslims. Unfortunately, visiting the mosque can be very difficult for people with Autism Spectrum Disorder (ASD), and their families. Some families have even stopped going to the mosque as it became too difficult. Therefore,

MAIN RESULTS AND DISCUSSION

A program called Autism Friendly Mosque was initiated by RIG Sustaining Quality of Life, FBM UiTM together with several NGO's and mosque all over Malaysia as part of our community engagements research. As part of this initiative, more than 45 children with autism as well as their parents were invited to join these programs so far since April 2018 together with more than 50 volunteers. Several activities involving these kids and their parents such as lesson on performing prayer, reading IQRA and Wudu'.

A series of Autism Friendly Mosque have been conducted since 2018. The following are the details of the programs:

- AUTISM FRIENDLY MOSQUE 1.0 was held at Masjid Jamek Sultan Abdul Samad Kuala Lumpur on 1 April 2018.
- AUTISM FRIENDLY MOSQUE 2.0 in collaboration with Perbadanan Putrajaya was conducted at Surau Jumaat Mahmoodiah, Putrajaya on 11 Ogos 2018.
- AUTISM FRIENDLY MOSQUE 3.0 in collaboration with Dewan Bahasa Pustaka at Masjid Jamek Sultan Abdul Samad Kuala Lumpur on 19 April 2019
- VIRTUAL AUTISM FRIENDLY MOSQUE 4.0 in collaboration with JAWI on 11 April 2020
- AUTISM FRIENDLY MOSQUE 5.0 in collaboration with ZAYAN FM on 13 April 2021

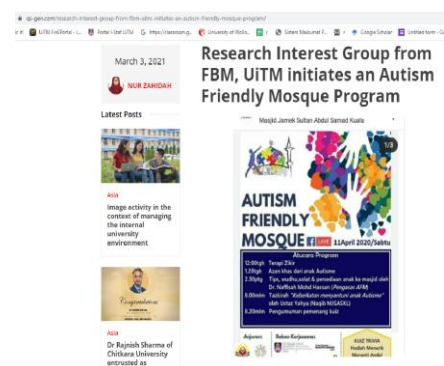
AFM projects had reached media attention. The following are the media coverage of each program:

[AFM 1.0](https://www.hmetro.com.my/hati/2018/04/329326/didikan-rohani-anak-autism) - <https://www.hmetro.com.my/hati/2018/04/329326/didikan-rohani-anak-autism>

[AFM 2.0](https://www.pressreader.com/malaysia/berita-harian-malaysia/20180428/282316795650611) - <https://www.pressreader.com/malaysia/berita-harian-malaysia/20180428/282316795650611>

[AFM 3.0](https://www.jkm.gov.my/jkm/uploads/files/BH-1%20OGOS%202018.pdf) - <https://www.jkm.gov.my/jkm/uploads/files/BH-1%20OGOS%202018.pdf>

[AFM 4.0](https://qs-gen.com/research-interest-group-from-fbm-uitm-initiates-an-autism-friendly-mosque-program/) - <https://qs-gen.com/research-interest-group-from-fbm-uitm-initiates-an-autism-friendly-mosque-program/>



CONCLUSIONS

In conclusion, from these activities, it is hoped that the society will be able to open their mind and accept those in the spectrums and to put more attention to figure out ways to communicate with them. Believing that all people are born different but equal and valuable, we hope that Autism Friendly Mosque programs achieves its objectives specially to encourage Muslim parents to bring their children with autism to mosque so they can enjoy equal and harmonious lives. From a different perspective, we hope that this community service responsibility project was served as a platform for the university staff and students to engage with the needs to care those who in need around us exclusively the minority community such as kids with special needs. other minority groups in the society, how to reach to them and eventually help them or support to improve quality of life.

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