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MNRG
MALAYSIA NITRIDES RESEARCH GROUP

6th Meeting of Malaysia Nitrides Research Group (MNRG 2022)

PROGRAMME BOOK

Virtual Conference

6th & 7th December 2022

Published by:

Institute of Nano Optoelectronics Research and Technology (INOR)
Universiti Sains Malaysia
11800 USM,
Penang, Malaysia

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Copies of this document may be obtained from Institute of Nano Optoelectronics Research and Technology (INOR), Universiti Sains Malaysia.

For bibliographic purposes, this document may be cited as: Program Book of the 6th Meeting of Malaysia Nitrides Research Group (MNRG 2022)

TABLE OF CONTENTS

ABOUT MNRG

The Malaysia Nitrides Research Group (MNRG) was founded in 2014 at Universiti Sains Malaysia (USM) with the aim to gather all the researchers working in III-nitrides semiconductors to exchange and share their experiences and research findings on all aspects of III-nitrides. The Meeting of MNRG is an event that provides an excellent platform for academicians, scientists, engineers, and practitioners to present their ongoing research activities and latest research findings on all aspects of nitrides semiconductors.

Concurrently, the meeting also provides premier opportunities for researchers to exchange idea, knowledge, and expertise in related fields. Eventually, this will inspire and encourage future collaboration among the conference participants.

This year, the MNRG 2022 event will be held virtually, featuring scientific discussions in the form of oral presentations. Topics of interest include, but are not limited to:

1) Growth
2) Characterization
3) Theory and Numerical Study
4) Nanostructures
5) Processing, Fabrication, and Packaging
6) Devices
7) Metal Oxides

ORGANIZING COMMITTEE OF MNRG 2022

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FOREWORD FROM DIRECTOR OF INSTITUTE OF NANO OPTOELECTRONICS RESEARCH AND TECHNOLOGY (INOR), UNIVERSITI SAINS MALAYSIA

Assalamualaikum and *Salam Sejahtera*.

On behalf of Institute of Nano Optoelectronics Research and Technology (INOR), it is my great pleasure to welcome all participants to the **6th Meeting of Malaysia Nitrides Research Group (MNRG 2022).** MNRG 2022 is organised by the Institute of Nano Optoelectronics Research and Technology (INOR), USM in collaboration with Collaborative Research in Engineering, Science and Technology (CREST). I am glad to witness the hard work of the committee members for breaking the norm by organising this event virtually for the first time. My heartiest congratulations to the committee members for their efforts in making this event a success.

I believe MNRG 2022 would provide the best platform for academicians, researchers, scientists, engineers, and practitioners from Malaysia and abroad particularly those from the research areas of III-nitrides to exchange ideas on latest findings and breakthrough. I am relieved to see the continual growth of MNRG since year 2014 from a small event involving local participants from III-nitrides to a bigger conference-like event that has attracted the participants from local and overseas to present their insights at wider scopes, which include but are not limited to growth, characterization, theory and numerical analysis, nanostructures, processing, fabrication and packaging, devices, metal oxides, and other related topics.

I am truly delighted with the achievement of MNRG 2022 for featuring keynote, plenary, and invited talks from prominent speakers coming from United States of America, Australia, Saudi Arabia, and Malaysia. Once again, I would like to take this opportunity to deliver my heartiest gratitude to all the committee members for their indispensable contributions towards the success of MNRG 2022. I would also like to express my appreciation to our renowned keynote, plenary, and invited speakers for their stimulating, exciting, and inspiring talks. Finally, my sincere thanks to all oral presenters, sponsors, and supporters for their great contributions. I wish all participants an enjoyable moment with us in the two-day MNRG 2022.

Thank you.

TS. DR. MOHD ZAMIR PAKHURUDDIN
Director of Institute of Nano Optoelectronics Research and Technology (INOR), USM

WELCOME MESSAGE FROM CHAIRMAN OF MNRG 2022

On behalf of the organizing committee, it is our pleasure to welcome you to the 6th Meeting of Malaysia Nitrides Research Group (MNRG 2022). This conference is jointly organized by the Institute of Nano Optoelectronic Research and Technology (INOR), Universiti Sains Malaysia (USM) and Collaborative Research in Engineering, Science & Technology (CREST).

The Malaysia Nitrides Research Group (MNRG) was initially founded in 2014 by a group of nitrides researchers at USM. It is worthy to highlight here that the MNRG is the first national platform that gathers all Malaysian researchers who are working in III-nitrides to exchange and share their experiences and research findings on all aspects of III-nitrides. Nowadays, the meeting of MNRG has become a major event for all nitrides researchers in Malaysia.

This year, due to the COVID-19 pandemic, the event of MNRG 2022 will be conducted via virtual mode. Despite the pandemic, this event has managed to attract many local participants as well as overseas participants. We are delighted to have with us in MNRG 2022, the two distinguished keynote speakers, namely Professor Dr. Shuji Nakamura, the 2014 Nobel Laurate in Physics and Dato' Dr. Mohd Sofi Osman, the industry expert with vast experiences in the field of Electrical and Electronics. In addition, MNRG 2022 also features two plenary talks from two renowned speakers, namely Professor Dr. Boon S. Ooi (King Abdullah University of Science and Technology (KAUST), Saudi Arabia) and Professor Dr. Hark Hoe Tan (Australian National University (ANU), Australia) as well as invited talks by prominent researchers from the United States of America and Malaysia. All the full papers received by the deadline will be peer-reviewed and the accepted papers will be published in one of the ISI-indexed journals, namely International Journal of Nanotechnology. Here, I would like to thank all the Scientific & Publication committee members for the amazing work.

Finally, I would like to take this chance to convey my sincere gratitude to all the committee members for their dedicated efforts to ensure the success of this event. I would like to express my heartiest gratitude to our great keynote, plenary, and invited speakers for their willingness to deliver the excellent talks. My sincere thanks to all presenters and exhibitors for their generous support and outstanding contributions. Lastly, I wish all participants have a fruitful and enjoyable meeting.

Thank you.

DR. LIM WAY FOONG
CHAIRMAN of MNRG 2022

BIOGRAPHY OF KEYNOTE, PLENARY & INVITED SPEAKERS

KEYNOTE SPEAKER 1

Dato' Dr Mohd Sofi Osman was born in Penang. Received his primary and secondary education in Penang before pursuing his engineering degree at the University of Strathclyde, Glasgow. He is married with three children.

Dato' Dr Mohd Sofi Osman joined Intel in 2015 with the acquisition of Altera Corporation, where he was the Vice President and Managing Director and led Worldwide Operations and Engineering for the Asia Pacific region since 2012. Before joining Altera, he had a 25-year career at Advanced Micro Devices (AMD), culminating in his role as Corporate Vice President and Managing Director of AMD Penang. He holds a patent in the field of the semiconductor manufacturing processes and has published papers on continuous improvement projects in backend semiconductor manufacturing. He retired from Intel in July 2016 after spending almost 30 years in the Semiconductor Industry. In 2018, he came out from retirement to work for Lumileds as Vice President and Managing Director of Lumileds Malaysia until June 2020.

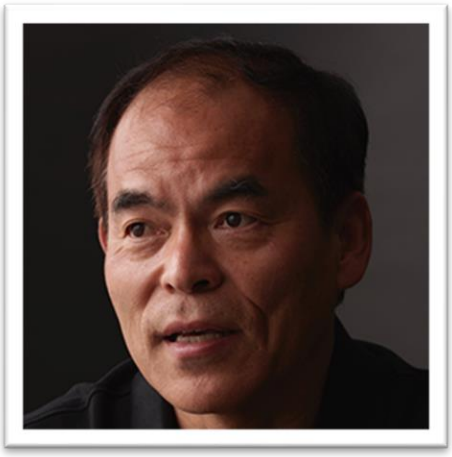
Dato' Dr Mohd Sofi Osman was in the Board of Directors at University Malaysia Perlis (UniMAP) since the organization was still known as KUKUM. He was the past Chairman of the board for University Malaysia Perlis and University Tun Hussein Onn Malaysia. He was also the Adjunct Professor at University Technology Mara (UiTM) Shah Alam and University Science Malaysia (USM).

He was the past Chairman for Penang Skills Development Centre (PSDC). He was also the past President of the Free Industrial Zone Penang Company Association (Frepenca).

He is currently the Advisor to Collaborative Research in Engineering, Science & Technology (CREST) Board, a member of the CEO Faculty Program. He is currently an Adjunct Professor at the Institute of Nano Optoelectronics Research and Technology (INOR), University Science Malaysia with the mission of accelerating the research collaboration between INOR and industry players as well as assisting the advancement of research capabilities at INOR that are in line with industry's needs.

Dato' Dr Mohd Sofi Osman
Universiti Sains Malaysia, Malaysia

KEYNOTE SPEAKER 2



Professor Shuji Nakamura is a Japanese-born American electronic engineer and inventor, specializing in the field of semiconductor technology. Professor Nakamura in the Department of Materials and in Electrical and Computer Engineering in the College of Engineering, University of California, Santa Barbara, also holds the Cree Endowed Chair in Solid State Lighting & Displays. Professor Nakamura is regarded as the inventor of the blue LED, a major breakthrough in lighting technology. He is a recipient of the 2014 Nobel Prize for Physics "for the invention of efficient blue light-emitting diodes, which has enabled bright and energy-saving white light sources." He is a fellow of the U.S. National Academy of Engineering, National Academy of Inventors, and the National Inventors Hall of Fame. He is a recipient of numerous international honours including the 2006 Millennium Technology Prize, The Harvey Award (2009), the 2014 Order of Culture Award in Japan, the 2015 Global Energy Prize, the Technology & Engineering Emmy Award (2012), the 2018 Zayed Future Energy Prize, the 2020 National Academy of Science (NAS) Award for the Industrial Application of Science, and the 2021 Queen Elizabeth Prize for Engineering.

Professor Shuji Nakamura
Universiti of California Santa Barbara, United States of America

PLENARY SPEAKER 1

Prof. Tan received his B.E. (Hons) in Electrical Engineering from the University of Melbourne in 1992 and PhD in Materials Engineering from the Australian National University in 1997. He has been the past recipient of the Australian Research Council Postdoctoral, QEII and Future Fellowships. He has published/co-published over 500 journal papers and 9 book chapters. According to Google Scholar, his h-index is 63 with over 19,000 citations. He is also a co-inventor of 6 US and 2 Australian patents related to optoelectronics, photonics and photocatalysis. His research interests include epitaxial growth of low-dimensional compound semiconductors, nanostructured optoelectronic devices and ion-implantation processing of compound semiconductors for optoelectronic device applications. Prof. Tan is a Fellow of the IEEE and was the Distinguished Lecturer for IEEE Nanotechnology Council (2016 & 2017) and IEEE Photonics Society (2016-2017).

Professor Dr. Hark Hoe Tan
Australian National University, Australia

PLENARY SPEAKER 2

Boon S. Ooi (Fellow, U.S. National Academy of Inventors (NAI), OSA, SPIE, and IoP) is a Professor of Electrical and Computer Engineering at KAUST. His research interest includes the study of III-V and III-Nitride-based materials and devices and their applications to optical sensors and optical communications. He is Editor-in-Chief of the IEEE Photonics Technology Letters.

Professor Dr. Boon S. Ooi
King Abdullah University of Science and Technology (KAUST), Saudi Arabia and Universiti Sains Malaysia, Malaysia

INVITED SPEAKER 1

Tan Swee Tiam received his B.Eng. and PhD degrees from Nanyang Technological University, Singapore, in 2003 and 2007, respectively. From 2007 to 2010, he was with the Institute of Microelectronics, A*STAR, Singapore, where he spearheaded the ZnO thin film research by the world-first commercial MOCVD system. In 2010, he was instrumental in founding the LUMINOUS! Centre of Excellence for Semiconductor Lighting and Displays at Nanyang Technological University, Singapore and to oversee the research activities. He is a recipient of the 2020 Returning Expert Programme by TalentCorp Malaysia and returned to his home country joining Xiamen University Malaysia as Associate Professor and Assistant Dean (Research and Industrial Collaboration) at School of Energy and Chemical Engineering, Xiamen University Malaysia. He also serves as the Founding Director of Kelip-kelip! Center of Excellence for Light Enabling Technologies, Xiamen University Malaysia. He is a recipient of the 2022 National Outstanding Researcher Award. He has more than 18 years of research experience on optoelectronic epitaxial materials, devices, and physics and has successfully executed several large-scale research projects (>10 projects, ~US$ 40 million). He published over 111 journal publications with an h-index of 43. His scientific research work has generated a strong IP portfolio (> 30 international patents) and a spin-off company.

Associate Professor Dr. Tan Swee Tiam
Xiamen University, Malaysia

INVITED SPEAKER 2

Dr. Steven P. DenBaars is a Professor of Materials and Co-Director of the Solid-State Lighting and Energy Electronics Center (SSLEEC) at the University of California Santa Barbara. In 2005 he was appointed the Mitsubishi Chemical Chair in Solid State Lighting and Displays. Specific research interests include the growth of wide-bandgap semiconductors (AlGaInN based), and their application to Blue LEDs, Micro LED Displays, UV to visible laser diodes, high power and RF electronic devices. Prof. DenBaars has been active in entrepreneurship, having helped co-found 3 start-up companies in the field of optoelectronics and electronics. He received the IEEE Fellow award in 2005, Aron Kressel Award from IEEE Photonics Society, National Academy of Engineering Member (2012), National Academy of Inventors Fellow (2014), Quantum Device Award ISCS (2021), Central Coast Innovation Award (2021) and the Nakamura Award in Functional Materials from the AAFM Conference (2021). Prof. DenBaars has authored or co-authored over 980 technical publications, 350 conference presentations, and is highly cited with over 85,000 citations and an h-index of 144.

Professor Dr. Steven DenBaars
Universiti of California Santa Barbara, United States of America

INVITED SPEAKER 3

Dr. Wei Sea Chang received her PhD from the National University of Singapore. She is now the Senior Lecturer at the School of Engineering (Mechanical), Monash University Malaysia. She is also an adjunct assistant professor in the Department of Mechanical Engineering and Research Center for Intelligent Medical Devices, Ming Chi University of Technology, Taiwan since 2018. Her research focuses on functional electronic materials for energy-related applications, with particular emphasis on epitaxial thin film and correlated electron systems. She has extensive experience in the use of scanning probe microscopy to understand the physics of materials at the micro- and nanoscale.

Dr. Wei Sea Chang
Monash University, Malaysia

INVITED SPEAKER 4

James S. Speck is a Distinguished Professor in the Materials Department at the University of California Santa Barbara. He received as Bachelor of Science and Metallurgical Engineering in 1983 and his S.M. and Sc.D. from the Massachusetts Institute of Technology in 1985 and 1989, respectively. He joined UCSB in 1990 as an Asst. Professor. Speck's early work focused on epitaxial oxide films on semiconductors, ferroelectric thin films, and strain relaxation in highly misfitting epitaxial systems. He has worked extensively on the materials science of GaN and related alloys. Major aspects of his work on nitrides include elucidating basic growth modes and defect generation, the development of MBE growth of GaN, and the development of nonpolar and semipolar GaN, revealing the nonradiative processes in GaN LEDs, and a large body of early work on β-Ga_2O_3 . He was the recipient of the Quantum Device Award from the International Symposium on Compound Semiconductors and the IEEE Photonics Society – Aron Kressel Award. He is an inaugural Fellow of the Materials Research Society, a Fellow of the American Physical Society, and a Fellow of the National Academy of Inventors.

Professor Dr. James S Speck
Universiti of California Santa Barbara, United States of America

PRESENTATION SCHEDULE

ORAL PRESENTATION (DAY 1)

TIME	PRESENTATION SESSION	MODE OF PRESENTATION /ABSTRACT ID
	CHAIRPERSON: Ts. Dr. Mohd Syamsul Nasyriq Samsol Baharin	
0930 am	**Arrival and Registration of Guest and Participant**	**Live**
0935 am	**Doa Recital**	**Live**
0940 am	**Welcoming Address** by ***Chairman of MNRG 2022, Dr. Lim Way Foong***	**Pre-Recorded Video**
0945 am	**Opening Remarks** by ***Director of INOR, Ts. Dr. Mohd Zamir Pakhuruddin***	**Pre-Recorded Video**
0950 am	***KEYNOTE TALK 1:*** **TITLE: The Role of Advanced Materials** *Dato' Dr. Mohd Sofi Osman, Universiti Sains Malaysia, Malaysia.*	**Live / S1**
1035 am	**Online Group Photo Session/ Break/ Advertisement Video**	
ORAL SESSION 1: GROWTH		
	CHAIRPERSON: Dr. Lim Way Foong	
1040 am	***INVITED TALK 1:*** **TITLE: Spectra-Enhanced Light-Emitting Diodes and Its Applications** *Assoc. Prof. Dr. Tan Swee Tiam, Xiamen University Malaysia, Malaysia.*	**Live / IT1**
1105 am	**Characteristics of InGaN/AlN Heterostructure Grown By Using MOCVD Technique** *Ahmad Sauffi Yusof, Zainuriah Hassan, Sha Shiong Ng, Mohd Anas Ahmad, Way Foong Lim, Sidi Ould Saad Hamady, Nicolas Fressengeas*	**Pre-Recorded Video / A1**
1125 am	**Effects of GaN Cap Layer Towards Ohmic Contact of AlGaN/GaN High Electron Mobility Transistor** *Najihah Fauzi, Shaili Falina, Masafumi Inaba, Hiroshi Kawarada, Mohd Syamsul*	**Pre-Recorded Video / A2**
1145 am	**Analysis of the Influence of the Traps on the AlGaN/GaN MOSHEMT Characteristics for Low Leakage Power Devices**	**Pre-Recorded Video / A3**

	Naeemul Islam, Mohd Syamsul Nasyriq Samsol Baharin, Alhan Farhanah Abd Rahim, Muhammad Firdaus Akbar Jalaludin Khan, Nor Azlin Ghazali, Ahmad Shuhaimi Abu Bakar, Mohamed Fauzi Packeer Mohamed	
1205 pm	**Laser Synthesis Route of GaN Nanocrystals for Optical Sensor Protection** *Mohamad Aizat Abu Bakar, Sabah M. Mohammad, Siti Noraiza Ab Razak, Mundzir Abdullah*	**Pre-Recorded Video / A4**
1225 pm	**Numerical Study on the Optimization of AlGaN-based Deep Ultra-violet Light Emitting Diodes Multi Quantum Wells** *M. Mazwan, S.S. Ng, Mohd Syamsul, Ahmad Shuhaimi, Mohd Nazri Abd. Rahman, Omar Al- Zuhairi, Alhan Farhanah Abd Rahim*	**Pre-Recorded Video / A5**
1245 pm	**Break/ Advertisement Video**	
	CHAIRPERSON: Dr. Faezah Jasman	
1430 pm	***PLENARY TALK 1:*** **TITLE: III-V Nanostructures for Optoelectronic Device Application** *Prof. Dr. Hark Hoe Tan, Australian National University, Australia.*	**Live / S3**
ORAL SESSION 2: NANOSTRUCTURES		
1505 pm	**Fabricate Ultraviolet Photodetector Using Au Nanoparticles Decorated ZnO NRs/ GaN** *Shireen Mohammed Abed, Sabah M. Mohammad, Z. Hassan, Suvindraj Rajamanickam, A. Muhammad, M. A. Ahmad*	**Pre-Recorded Video / B1**
1525 pm	**Investigation into Poly (9,9-di-n-octylflourenyl-2,7-diyl) (PFO) Coated Zinc Oxide Nanorods on ITO Substrates** *Suvindraj Rajamanickam, Sabah M. Mohammad, Ibrahim Abdul Razak, A. Muhammad, Shireen Mohammed Abed*	**Pre-Recorded Video / B2**
1545 pm	**Comparison of Anisotropy Characterization by Conventional Optical and Photoelectric Methods** *Tiankun Wang, Sha Shiong Ng*	**Pre-Recorded Video / B3**
1605 pm	**Break/ Advertisement Video**	

	CHAIRPERSON: Dr. Quah Hock Jin	
1615 pm	***INVITED TALK 2:*** **TITLE: Recent Advances in III-Nitride for UV and Visible Photonics Materials and Devices** *Prof. Dr. Steven DenBaars, Universiti of California Santa Barbara, United States of America.*	**Pre-Recorded Video / IT2**
ORAL SESSION 3: METAL OXIDES		
1640 pm	**Enhanced Breakdown Voltage for p-GaN Gate AlGaN/GaN High-Electron-Mobility Transistor (HEMT) with Triple Trenches: A Simulation Study** *Muhaimin Haziq, Norshamsuri Ali, Shaili Falina, Hiroshi Kawarada, Mohd Syamsul*	**Pre-Recorded Video / C1**
1700 pm	**Effects of Post-deposition Annealing in Argon-Oxygen-Argon Ambient on Physical and Electrical Characteristics of Thulium Oxide Passivation Layer on Silicon** *Junchen Deng, Hock Jin Quah*	**Pre-Recorded Video / C2**
1720 pm	**The Effect of Varying Oxidizing Conditions for Transformation of Metallic Cerium to Cerium Oxide Films** *Ainita Rozati Mohd Zabidi,, Zainuriah Hassan, Way Foong Lim*	**Pre-Recorded Video / C3**
1740 pm	**Energy Band Gap Investigation of Al Nanoparticles/Polystyrene Nanocomposite Foils** *Hameed Naser, Sabah M. Mohammad, Haider Mohammed Shanshool, Z. Hassan, Nabeel Z. Al-Hazeem*	**Pre-Recorded Video / C4**
1800 pm	**END OF DAY 1**	

ORAL PRESENTATION (DAY 2)

TIME	PRESENTATION SESSION	MODE OF PRESENTATION /ABSTRACT ID
ORAL SESSION 4: DEVICES		
	CHAIRPERSON: Dr. Mundzir Abdullah	
0900 am	***PLENARY TALK 2:*** **TITLE: Heterogeneous Integration of Wide-Bandgap Semiconductors: GaN and Ga_2O_3** *Prof. Dr. Boon S. Ooi, King Abdullah University of Science and Technology (KAUST), Saudi Arabia and Universiti Sains Malaysia, Malaysia*	**Pre-Recorded Video / S4**
0935 am	**Mechanical Stress Study on Advanced 1 mm2 VCSEL Modeling Packaging** *Khairul Mohd Arshad, Muhamad Mat Noor, Asrulnizam Abd Manaf, Hiroshi Kawarada, Shaili Falina, Mohd Syamsul*	**Pre-Recorded Video / D1**
0955 am	**Break/ Advertisement Video**	
ORAL SESSION 5: GROWTH		
	CHAIRPERSON: Dr. Faezah Jasman	
1020 am	***INVITED TALK 3:*** **TITLE: Nanoscale Phenomena At III-Nitrides by Advanced Atomic Force Microscopy** *Dr. Wei Sea Chang, Monash University Malaysia, Malaysia.*	**Live / IT3**
1040 am	**Thickness Dependence of Nonlinear Properties of Indium Tin Oxide (ITO) Films Deposited on Soda Lime Glass** *R.I.M. Asri, M.A.A. Bakar, N.A. Hamzah, M.A. Ahmad, M. Abdullah*	**Pre-Recorded Video / A6**
1100 am	**Effects of Different Post-Deposition Annealing Temperature of RF Magnetron Sputtered Ga_2O_3 Thin Films in Argon Ambient** *Puteri Haslinda Megat Abdul Hedei, Zainuriah Hassan, Hock Jin Quah*	**Pre-Recorded Video / A7**
1120 am	**Effects of Post-Deposition Annealing of CeO_2 Passivation Layer Spin Coated on Silicon Substrate in Nitrogen Ambient**	**Pre-Recorded Video / A8**

	Kammutty Musliyarakath Abdul Shekkeer, Kuan Yew Cheong, Hock Jin Quah	
1140 am	**Structural, Morphological, and Electrical Characteristics of CeO_2 Films Deposited at Different Thicknesses onto Si Substrate** *Saad Milad Ali Nsar, Zainuriah Hassan, Kuan Yew Cheong, Way Foong Lim*	**Pre-Recorded Video /A9**
1200 pm	**Effects of Wet and Dry Oxidation on Indium Gallium Nitride Thin Films Grown by Metal Organic Chemical Vapour Deposition Method** *Mohd Nashaaain Nordin, Way Foong Lim, Ahmad Sauffi Yusof, Mohd Syamsul Nasyriq Samsol Baharin, Zainuriah Hassan*	**Pre-Recorded Video / A10**
1220 pm	**Break/ Advertisement Video**	
ORAL SESSION 6: CHARACTERIZATION		
	CHAIRPERSON: Ts. Dr. Mohd Syamsul Nasyriq Samsol Baharin	
1430 pm	***KEYNOTE TALK 2:*** **TITLE: Developments of UV-LEDs** *Professor Dr. Shuji Nakamura, Universiti of California Santa Barbara, United States of America.*	**Pre-Recorded Video / S2**
1515 pm	***INVITED TALK 4:*** **TITLE: Towards Efficient Green → Yellow GaN-BASED LeDS** *Prof. Dr. James S. Speck, Universiti of California Santa Barbara, United States of America.*	**Pre-Recorded Video / IT4**
1540 pm	**Online Group Photo Session/ Break/ Advertisement Video**	
1545 pm	**Closing Remarks** by ***Chairman of MNRG 2022, Dr. Lim Way Foong***	**Pre-Recorded Video**
1600 pm	**END OF DAY 2**	

LIST OF ABSTRACTS

LIST OF ABSTRACTS

KEYNOTE TALK

PLENARY TALK

INVITED TALK

ORAL PRESENTATION

TOPIC A: GROWTH

TOPIC B: NANOSTRUCTURES

TOPIC C: METAL OXIDES

TOPIC D: DEVICES

KEYNOTE TALK

S1

THE ROLE OF ADVANCED MATERIALS

Dato' Dr Mohd Sofi Osman

Institute of Nano Optoelectronics Research and Technology (INOR),
Universiti Sains Malaysia, Penang, MALAYSIA

ABSTRACT- Citing from the World Economic Forum report, 65% of children in schools today will ultimately end up working in completely new job types that do not yet exist. The continuous advancing of technology with the development of advanced materials will make future products more complex and sophisticated. Technology, equipment, processes, talents and others could not move the new products into this complexity and sophistication without the involvement of advanced materials as part of the equation. Hence, the need for advanced materials as game changer. Unfortunately, this is not that straight forward. People are used to using existing materials for a very long time and all the manufacturing techniques are already setup for it. Nevertheless, its crucial for new advanced materials to be introduced. These new materials aren't perfect materials because the method or process can cause defects and make it less effective. But, it will be worthwhile to make the effort to switching to these new materials for competitive advantage.

S2

DEVELOPMENTS OF UV-LEDs

Shuji Nakamura

Materials & ECE Departments
Solid State Lighting and Energy Electronics Center
University of California Santa Barbara
Santa Barbara, CA 93106 USA

ABSTRACT- The development of high-efficient UV-LEDs with an emission wavelength from 330nm to 246nm is described. n-AlGaN and n-superlattice (SL) AlGaN grown at low V/III ratio of 10 is a key to obtain a high-efficient UV-LED. A short period SL of p-AlGaN with polarization doping contributes to increase the hole concentration of p-type layers dramatically. Using these growth conditions and structures, UV-B LED with an emission wavelength of 280nm~290 nm has a peak external quantum efficiency (EQE) and wall plug efficiency (WPE) of about 10% with a value of the voltage as same as the photon energy.

PLENARY TALK

S3

III-V NANOSTRUCTURES FOR OPTOELECTRONIC DEVICE APPLICATION

Hoe Tan*

ARC Centre of Excellence for Transformative Meta-Optical Systems
Department of Electronic Materials Engineering
Research School of Physics
The Australian National University
Canberra, ACT 2600, Australia

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ABSTRACT- Group III-V semiconductors have revolutionised electronics and optoelectronics due to their superior physical and optoelectronic properties including high carrier mobility, direct bandgap and band structure engineering capability. Reducing the device size to nanoscale brings many unique properties, such as large surface-area-to-volume ratio, high aspect ratio, carriers and photons confinement effect. In this talk I will present and discuss our III-V nanostructure research activities at The Australian National University, focusing on (i) nanowires, (ii) shape engineering and (iii) hexagonal boron nitride.

(i) Nanowires are usually grown by the so-called vapour-liquid-solid growth mechanism or the selective area growth techniques. Device applications of these nanowires such as lasers, solar cells and electrodes for photoelectrochemical water splitting will be presented.

(ii) Our work on selective area growth of III-V nanostructures shows the possibility of obtaining other functional nanostructures beyond the limitation of rod-like nanowires and opening the way to more advanced device geometries, such as nanomembranes and micro-rings. Our micro-ring lasers have excellent cavity due to the atomically flat facets and operate in the whispering gallery mode. They are important components for integrated photonics applications as light from can these devices can be efficiently coupled to on-chip waveguides. By coupling the micro-ring laser to a nanowire antenna, we can also tune its emission directionality.

(iii) Hexagonal boron nitride (hBN) is a two-dimensional, wide-bandgap semiconductor which is well-known for its thermal and chemical stability, passivation properties and, more recently, as single photon emitters which has applications in quantum computing and cryptography. However, hBN is currently limited to 1-2 mm in size, which is impractical in real applications. I will introduce our work on growing wafer-scale hBN for applications as single photon sources, templates for van der Waals epitaxy and SERS applications.

Keywords: Field-effect-transistors, III-nitride, Integration.

S4

HETEROGENEOUS INTEGRATION OF WIDE-BANDGAP SEMICONDUCTORS: GaN and Ga_2O_3

Boon S. Ooi*

King Abdullah University of Science & Technology (KAUST), KSA

*Corresponding Author: boon.ooi@kaust.edu.sa

ABSTRACT- Group-III nitride materials are one of the most important semiconductor systems after silicon due to their versatile properties, which enable a large number of applications, such as solid-state lighting, LED displays, deep UV-NIR devices, high power electronics, etc. To increase the versatility of this material system for a broader application, we have successful demonstrated epitaxial growth of high-quality III-N materials and devices on unconventional substrates, such as silicon, quartz and metals. Recently, we have also showed the viability of hybrid integration of Group-III nitride and oxide-semiconductor membranes to form high-performance optoelectronic devices.

In this talk, I will discuss selected GaN-nanowire based UV and visible devices that we successfully demonstrated using self-assembly molecular beam epitaxy (MBE) growth method on 2D materials, metal and glass substrates. Direct 3D/2D hybrid epitaxy and membrane based-devices such as UV detector and visible LEDs will be presented.

INVITED TALK

IT1

SPECTRA-ENHANCED LIGHT-EMITTING DIODES AND ITS APPLICATIONS

Swee Tiam Tan*

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ABSTRACT- InGaN/GaN light-emitting diodes (LEDs) have been regarded as an excellent candidate for future lighting and display sources, thanks to their energy efficiency and longer lifetime as well as the potential for high photometric quality. Today the LED market is increasing with the strong demand on backlighting for flat-panel displays and smartphones, while tremendous efforts have been devoted for the development of advanced applications such as visible light communication, micro-displays and spectra-enhanced light sources. In this talk, the recent development of the LED applications will be presented.

Keywords: Spectra-enhanced, Light-emitting diodes, GaN, Optoelectronics, Nanoluminophors.

IT2

RECENT ADVANCES IN III-NITRIDE FOR UV AND VISIBLE PHOTONICS MATERIALS AND DEVICES

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ABSTRACT- The developments of high performance InGaN based RGB micro-light-emitting diodes (μLEDs) and Blue and Green Laser Diodes are discussed. Through novel epitaxial growth and processing, and transparent packaging we have achieved external quantum efficiencies as high as 58% EQE at 450nm for microLEDs. The critical challenges of μLEDs, namely full-color scheme, decreasing pixel size and mass transfer technique, and their potential solutions are explored. Recently, we have demonstrated efficient microLEDs emitting in the blue to green at dimensions as small of 1 micron. Using strain relaxation methods we have also extending the wavelength range of the InGaN alloys as into the red with emission as long as 640nm. Red InGaN based red MicroLEDs with efficiencies of 6% has been fabricated, and they display superior temperature performance in comparison to AlGaInP based devices. Recently, we have employed novel ALD passivated deep recessed ridge etching and porous GaN to make novel blue and green laser diodes. Green laser diodes with emission wavelengths as long as 524nm have been achieved using novel porous GaN waveguides.

Keywords: MicroLEDs, Green Laser Diodes, Red, InGaN, ALD, Porous, GaN.

IT3

NANOSCALE PHENOMENA AT III-NITRIDES BY ADVANCED ATOMIC FORCE MICROSCOPY

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ABSTRACT- In the light of growing interest to nanoscale properties and surface behaviorsof materials, atomic forcemicroscopy was used to study the III-nitride surfaces and interfacesand thenanoscale electric phenomena. With the combined used of Kelvin probe force microscopy and piezoresponse force microscopy to capture surface behaviors of III-nitrides, we reveal that the driving mechanism inInGaN/GaN MQWs can be attributed to the combination of the light-induced surface electric field and converse piezoelectric effect that involves the three-way coupling between its electronic, piezoelectric, and optical properties, exemplifying the piezo-phototronic effect. This suggests that the coupling between quantum effect and piezo-phototronic effect InGaN/GaN MQWs can be tuned by manipulating the strain condition of their MQWs, e.g. by varying the amount of MQWs indium content or through externally applied stress/strain. Strong coupling between optical, electrical, and mechanical properties in III-nitride materials and heterostructures enable them to offer tremendous opportunities for next-generation electronic devices. Meanwhile, AFM has been used to improvethe understanding of InN surface charges and the fundamental properties, such as topography, electrical and mechanical properties of InN. We believe that the surface potentialbehaviorcan be linkedtodefects, which can provide insights into the growth optimization of InN thin film.

IT4

TOWARDS EFFICIENT GREEN → YELLOW GaN-BASED LEDs

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ABSTRACT- In this presentation, we review recent work on the origins of the excess volage in long wavelength GaN-based LEDs – we show that the excess voltage is due to large polarization barriers between the InGaN QWs and GaN quantum barriers and the large band offsets between the wells and barriers. V-defecst are inverted hexagonal pyramids with $\{10\bar{1}1\}$ sidewall planes and form during conditions of kinetically lmited growth. These defects, when properly engineered, provide low energy pathways for carrier injection as demonstrated by state-of-the-art device simulations. We detail the structure of V-defects using scanning transmission electron microscopy and scattering contrast microscopy.

Keywords: Green LED, Red LED, V-defect, Efficiency.

ORAL PRESENTATION

TOPIC A: GROWTH

A1

CHARACTERISTICS OF InGaN/AlN HETEROSTRUCTURE GROWN BY USING MOCVD TECHNIQUE

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ABSTRACT- The tunable wide direct bandgap (covering a broad range of spectral regions) of III-nitride semiconductors, particularly indium gallium nitride (InGaN), has credited this material as a promising candidate for optoelectronic devices such as solar cells and photodetectors with the ability to have a selective or narrow response. However, developing such a device is not a straightforward process due to phase separation and composition inhomogeneity in InGaN ternary alloy. Thus, it is crucial to rigorously optimize the growth process and carry out an in-depth characterization to suppress those defect formation and obtain a high-quality InGaN active layer, which is suitable for the subsequent device fabrication process. In this work, a series of InxGa1-xN epilayers were epitaxially grown over a commercial 2” AlN/sapphire template using Taiyo Nippon Sanso Corporation (TNSC) metal-organic chemical vapor deposition (MOCVD) SR4000-HT system. Then, to study the effect of the indium incorporation process and the correlation with its physical properties, the InxGa1-xN epilayers were grown at a different temperature setting from 860°C to 820°C. The structural, morphology and optical properties of the grown structure were investigated using X-ray diffraction (XRD), atomic force microscopy (AFM) and ultraviolet-visible (UV-Vis) spectrophotometer, respectively

Keywords: InGaN, MOCVD, III-nitride semiconductor.

A2

EFFECTS OF GAN CAP LAYER TOWARDS OHMIC CONTACT OF AlGaN/GaN HIGH ELECTRON MOBILITY TRANSISTOR

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ABSTRACT- The different thicknesses of the GaN cap layer from 1 nm to 2.5 nm for open-gate Chromium (Cr) AlGaN/GaN HEMT structures have been investigated. The use of the GaN cap layer to achieve good ohmic contact is studied using the transfer length method (TLM) measurements. Increasing thickness reduces the contact resistance of the devices, resulting in a higher drain current. However, a thicker GaN cap layer induces parallel conduction in the devices, causing too ohmic contacts that lower the sensitivity of the devices, which gives limitations in sensing applications. This study indicates that 1 nm of GaN cap layer offers the optimal ohmic contact for device performance.

Keywords: GaN cap, AlGaN/GaN HEMT, TLM, Ohmic contact.

A3

ANALYSIS OF THE INFLUENCE OF THE TRAPS ON THE AlGaN/GaN MOSHEMT CHARACTERISTICS FOR LOW LEAKAGE POWER DEVICES

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ABSTRACT- AlGaN/GaN metal oxide semiconductor high electron mobility transistors (MOSHEMTs) are very attractive for high-power, high-frequency, and high-temperature applications with low gate leakage current. However, charge trapping at the insulator/AlGaN interface is believed to limit the performance of AlGaN/GaN MOSHEMTs. This research investigates the trapping effects of TCAD device simulation on Silvaco Software. Thus, it is obverse that changing the donor or acceptor traps density with trap energy at HfAlO/AlGaN interface, which impacts the I_D vs. V_{GS}, I_D vs. $V_{DS,}$ and Transconductance characteristics curve. Moreover, it also influences the interface charge, 2DEG density, and threshold voltage (Vth). On the contrary, varying donor or acceptor trap energy does not illustrate a significant impact on the characteristics curve because both donor and acceptor traps are fully ionized. Eventually, it is summarized that the I vs. V characteristics curve of the AlGaN/GaN MOSHEMT is highly influenced by the effective positive charge density at the HfAlO/AlGaN interface.

Keywords: GaN, MOSHEMT, Trap, Density, TCAD, Characteristics Curve, Power devices, Semiconductor devices, Wide bandgap.

A4

LASER SYNTHESIS ROUTE OF GaN NANOCRYSTALS FOR OPTICAL SENSOR PROTECTION

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ABSTRACT- The hazards of lasers come in the form of accidental irradiation on the sensitive surface well over the damages threshold. Semiconductor photodiode for measuring high-power laser is prone to overexposure which degrades the sensor resulting in poor measurement. Hence, the need for optical limiters to reduce the incident laser intensity on the sensor once it is above the sensor threshold. Among semiconductors, GaN possesses good potential due to its direct wide band gap and is known for durability under extreme conditions. Gallium nitride substrate is transformed into nanocrystals via pulsed laser ablation technique under three different optical energies. The GaN nanocrystals are deposited on quartz substrate via drop cast for further analysis. SEM, EDS, DLS, XRD, UV-VIS, and PL confirm the synthesized GaN nanocrystals formation. An optical limiting test is conducted and reveals the OL threshold capability at 2.3 kW. The GaN nanocrystal works well for optical sensor protection against high-power lasers.

Keywords: Gallium nitride, Nanocrystal, Laser ablation, Optical limiting.

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A5

NUMERICAL STUDY ON THE OPTIMIZATION OF ALGAN-BASED DEEP ULTRA-VIOLET LIGHT EMITTING DIODES MULTI QUANTUM WELLS

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ABSTRACT – Solid-state ultra-violet light emitting diodes (UV-LEDs) based on aluminium gallium nitride (AlGaN) semiconductors have drawn considerable attention because their energy can be tuned from 3.4 eV (GaN) to 6.2 eV (AlN) by changing Al content. Subsequently, AlGaN-based UV-LEDs with a full wavelength coverage of UV spectral range (400–200 nm) can be fabricated. However, their external quantum efficiency, especially the deep UV-LEDs, is still much lower than commercially available blue LEDs. In an effort to improve the efficiency of the AlGaN-based deep UV-LEDs, the effects of the thicknesses, pairings, and Al composition of multi quantum wells (MQWs) are examined using self-consistent simulation software. The normalized simulation results show that the emission wavelength is blue shifted as the Al composition increased in single quantum well UV-LEDs. The simulation also assessed the effect of the barrier and well configuration and discovered that changing the numbers of quantum well pair leads in a considerable variance in device power.

Keywords: Quantum well, Aluminium gallium nitride, Deep ultra-violet, Light emitting diodes, Self-consistent simulation software

A6

THICKNESS DEPENDENCE OF NONLINEAR PROPERTIES OF INDIUM TIN OXIDE (ITO) FILMS DEPOSITED ON SODA LIME GLASS

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ABSTRACT - Transparent conducting indium tin oxide (ITO) thin films with various thickness (100, 150, 200 and 250 nm) were successfully deposited on soda-lime glass substrates by metal oxide electron beam evaporation at room temperature. The deposited thin films were post annealed via rapid thermal processor (RTP) in vacuum environment at 550 ℃ for 3 min. This work focused on the influence of different thickness of ITO thin films toward nonlinearity properties. All deposited ITO thin films were investigated in detail on the structural, linear, and nonlinear optical properties. The structure and the optical properties of ITO thin films were analyzed by X-ray diffraction (XRD), Field Emission Electron Microscopy (FESEM) and the UV-VIS spectrophotometer, respectively. The nonlinear optical properties of ITO thin films were successfully investigated by Z-scan technique. It was found that the crystallinity improves, while the transmittance decreases as the film thickness was increasing. The deposited thin film with better crystallinity has a positive nonlinear refractive index.

Keywords: ITO thin film, Thickness, Nonlinear properties, z-scan technique.

A7

EFFECTS OF DIFFERENT POST-DEPOSITION ANNEALING TEMPERATURE OF RF MAGNETRON SPUTTERED Ga_2O_3 THIN FILMS IN ARGON AMBIENT

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ABSTRACT - In this work, the relationship between structural, morphological, optical, and electrical properties of gallium oxide (Ga_2O_3) thin films with variation of annealing temperature was investigated. The Ga_2O_3 thin films were deposited on silicon substrate using radio frequency (RF) magnetron sputtering. These as-deposited Ga_2O_3 thin films were subjected to different post-deposition annealing of 400, 600, 800, and 1000°C for 60 min in argon ambient. The grazing incidence X-ray diffraction was done to analyse the structural properties of the Ga_2O_3 thin film. Subsequently, the Ga_2O_3 thin films were characterized using atomic force microscopy to attain the three-dimensional surface topographies. The thickness was estimated based on the cross-sectional field emission scanning electron microscopy images and the elemental composition were characterized using energy-dispersive X-ray spectroscopy. The current-voltage characteristics of the investigated Ga_2O_3 thin films subjected to different post-depositional annealing temperatures were also presented.

Keywords: Gallium oxide, Silicon, Sputtering, Grazing incidence X-ray diffraction, Annealing.

A8

EFFECTS OF POST-DEPOSITION ANNEALING ON CeO_2 PASSIVATION LAYER SPIN COATED ON SILICON SUBSTRATE IN NITROGEN AMBIENT

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ABSTRACT - The metal-organic decomposed cerium oxide (CeO_2) precursor was deposited on a silicon (Si) substrate using the spin coating technique. The as-deposited CeO_2 passivation layer was subjected to post-deposition annealing at 600, 700, 800, and 900°C for 30 min in nitrogen (N_2) ambient. The grazing incidence X-ray diffraction (GIXRD) characterization has revealed the formation of polycrystalline CeO_2 passivation layers, and further characterization of the elemental composition of the investigated passivation layers was carried out using energy-dispersive X-ray (EDX) spectroscopy. Moreover, the CeO_2 passivation layer was characterised using atomic force microscopy (AFM) to attain three-dimensional surface topographies as well as root-mean-square roughness. The thickness of the CeO_2 passivation layer was estimated based on the X-ray reflectivity (XRR) measurements. The metal-oxide-semiconductor characteristics of the investigated CeO_2 passivation layers deposited on Si substrate were also reported in this work.

Keywords: Cerium oxide, Silicon, MOS capacitor, Nitrogen, Annealing.

A9

STRUCTURAL, MORPHOLOGICAL, AND ELECTRICAL CHARACTERISTICS OF CeO_2 FILMS DEPOSITED AT DIFFERENT THICKNESSES ONTO Si SUBSTRATE

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ABSTRACT- Cerium oxide (CeO_2) films of different thicknesses were prepared by spin coating different layers (1, 3, 5, and 7) of the films onto the silicon (Si) substrate, followed by post-deposition annealing at a horizontal tube furnace under the flow of nitrogen and oxygen gas. Thickness of the CeO_2 films was measured by cross-sectional studies using field emission scanning electron microscopy while the presence of cubic fluorite phases of CeO_2 oriented in (111), (200), (220), and (311) planes was confirmed using grazing incident X-ray diffraction. Further analysis using coefficient of texture suggested the preferred orientation of the CeO_2 films at (200) direction. Surface topography and roughness analysis using atomic force microscopy revealed that vertical growth of CeO_2 films has taken place and the average grain size was in an increasing trend with respect to the film thickness. The acquisition of the highest accumulation capacitance level of capacitance-voltage characteristic of the 5-layer deposited CeO_2 film suggested that this sample possessed the highest dielectric constant (k) value. The findings from structural, morphological and electrical studies were presented in this work.

Keywords: CeO_2, thickness, Dielectric constant, Nitrogen, Oxygen.

A10

EFFECTS OF WET AND DRY OXIDATION ON INDIUM GALLIUM NITRIDE THIN FILMS GROWN BY METAL ORGANIC CHEMICAL VAPOUR DEPOSITION METHOD

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ABSTRACT- The indium gallium nitride (InGaN) films grown on undoped-GaN/sapphire substrate using metal organic chemical vapour deposition (MOCVD) were subjected to wet and dry oxidation to study the feasibility of obtaining indium gallium oxide (InxGayOz) using the two methods. Atomic force microscopy (AFM) and field emission scanning electron microscope (FESEM) were used to examine surface topography and surface morphology of the films, respectively. Elemental composition present in the films was determined using energy-dispersive X-ray (EDX) while crystalline structure of the films was revealed using grazing incidence X-ray diffraction (GIXRD). Results indicated that surface of the InGaN films could be converted to polycrystalline InxGayOz films after the wet and dry oxidation.. Detailed studies were presented.

Keywords: Wet oxidation, Dry oxidation, Indium gallium nitride, Indium gallium oxide, Polycrystalline.

TOPIC B: NANOSTRUCTURES

B1

FABRICATE ULTRAVIOLET PHOTODETECTOR USING Au NANOPARTICLES DECORATED ZnO NRs/ GaN

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ABSTRACT- In this work, surface plasmon resonance (SPR) generated by gold (Au) nanoparticles (NPs) was used to improve the ultraviolet (UV) photodetector (PDs) based on n-ZnO nanorods (NRs)/GaN was fabricated. Initially, the ZnO nanoparticles were grown on a seeded p-GaN substrate, which facilitated the growth of high-density ZnO nanorods in different directions and deposited Au NPs on the surface of the ZnO NRs by the photo-deposition method, where Au NPs liquid was prepared in advance via laser ablation. Due to their inherent broad bandgap characteristics, and unique electrical, optical, and structural features, ZnO and GaN materials are frequently employed to create UV photodetectors for visible-blind ultraviolet (UV) photodetectors (PDs).The defect emission levels of ZnO NRs promote surface plasmon resonance in Au NPs and enhance the electromagnetic field of Au NPs, which energises a good number of electrons from Au NPs getting passed over the barrier height of the Au NP/ZnO interface. The Au nanoparticles (NPs) effectively improved the optical and electrical properties on the surface of the ZnO NRs. The responsivity and sensitivity of the ZnO NRs UV photodetectors were enhanced via the use of Au Nps.

Keywords: Au nanoparticles, ZnO nanorods, Surface plasmon resonance (SPR), UV photodetectors, Photo-deposition method.

B2

INVESTIGATION INTO POLY (9,9-DI-N-OCTYLFLUORENYL-2,7-DIYL) (PFO) COATED ZINC OXIDE NANORODS ON ITO SUBSTRATES

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ABSTRACT- A comparison study was done on the effect of adding poly (9,9-di-n-octylfluorenyl-2,7-diyl) (PFO) thin layer on zinc oxide (ZnO) nanorods grown hydrothermally on indium tin oxide (ITO) substrates. Field emission scanning electron microscope (FESEM) images shows the coating of PFO thin films on the ZnO nanorods. Atomic Force Microscopy (AFM) topology shows the surface of the coated sample is smoother with reduced surface roughness and Energy Dispersive X-ray (EDX) spectra of the coated sample confirms the presence of the polymer on the ZnO nanorods. X-ray Diffraction (XRD) studies shows PFO film is in amorphous phase and (002) intensity peak corresponding to the c-orientation of the ZnO nanorods decreases after coating. UV-Vis spectra of coated sample shows small presence of PFO peak alongside near-band edge emission peak of ZnO and bandgap of coated sample reduces slightly after coating.

Keywords: PFO polymer; ZnO nanorods; FESEM; UV-Vis, Current-voltage.

B3

COMPARISON OF ANISOTROPY CHARACTERIZATION BY CONVENTIONAL OPTICAL AND PHOTOELECTRIC METHODS

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ABSTRACT- Anisotropy is an important feature of structures and materials. However, its linear dichroism (LD) optical characterization signal is always weak. In this study, an electric method based on Ga-based PiN on-chip structure is proposed to characterize the anisotropy. The anisotropy behavior from both the optical and electric methods was studied and compared. Besides that, the inner mechanism of the electric method to exhibit the anisotropy property is studied. In order to verify the accuracy of this electric method, different configurations, including various structures and materials with anisotropy, and different base materials, GaN, Ga_2O_3, and GaAs are used. All those comparison results show that the electric method can characterize the anisotropy of different configurations as accurately as the conventional optical method. Besides the accuracy, the electrical method also provides many new advantages. The collected electrical signal can be easily tuned and improved by the electrical way, which will not change the feature of the object. Compared to the conventional method, the collected signal is not affected by the condition of the environment, such as the drawbacks of the substrate used for supposing the structure or material. In summary, this Ga-based on-chip electric method makes the anisotropy characterization more efficient and convenient.

Keywords: Ga-based PiN structure, Anisotropy, Linear dichroism, Photocurrent.

TOPIC C: METAL OXIDES

C1

ENHANCED BREAKDOWN VOLTAGE FOR p-GaN GATE AlGaN/GaN HIGH-ELECTRON-MOBILITY TRANSISTOR (HEMT) WITH TRIPLE TRENCHES: A SIMULATION STUDY

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ABSTRACT - This study presents an analysis of AlGaN/GaN high-electron-mobility transistor with a triple trench structure (TT-HEMT) for the enhancement of breakdown voltage. The simulation procedure is achieved using COMSOL Multiphysics, in which trenches made of gallium nitride (GaN) are constructed between the undoped GaN and aluminum nitride (AlN) nucleation layer, each positioned directly beneath the source, gate, and drain contacts. Based on our findings, the formation of a triple trench design enhances the device's breakdown voltage by 96% compared to a conventional HEMT (C-HEMT). The impact of several design parameters, such as the p-GaN doping concentration and the trench thickness, which influences the electrical performance, are also investigated. The proposed device structure exhibits superior electrical properties for high-power applications.

Keywords: AlGaN/GaN, High-electron-mobility transistor (HEMT), COMSOL Multiphysics, breakdown voltage (BV).

C2

EFFECTS OF POST-DEPOSITION ANNEALING IN ARGON-OXYGEN-ARGON AMBIENT ON PHYSICAL AND ELECTRICAL CHARACTERISTICS OF THULIUM OXIDE PASSIVATION LAYER ON SILICON

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ABSTRACT- Thulium oxide (Tm_2O_3) passivation layer was deposited on silicon substrate via radio frequency magnetron sputtering. The as-deposited Tm_2O_3 passivation layer was subjected to different post-deposition annealing temperatures of 500, 600, 700, and 800ºC in nitrogen-oxygen-nitrogen ambient. The grazing incidence X-ray diffraction characterization has revealed that polycrystalline Tm_2O_3 passivation layers were formed after the post-deposition annealing process. The elemental composition of the investigated Tm_2O_3 passivation layers were characterized using energy-dispersive X-ray (EDX) spectroscopy revealing that nitrogen ions were incorporated into the investigated passivation layers. The surface morphologies and three-dimensional topographies of the investigated passivation layers were characterized using field emission scanning electron microscopy and atomic force microscopy, respectively. The electrical characteristics of the investigated Tm_2O_3 passivation layers were also reported in this work.

Keywords: Thulium oxide; Passivation layer, Annealing; grazing incidence X-ray diffraction, Nitrogen.

C3

THE EFFECT OF VARYING OXIDIZING CONDITIONS FOR TRANSFORMATION OF METALLIC CERIUM TO CERIUM OXIDE FILMS

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ABSTRACT - A direct current (DC) sputtering technique was conducted to deposit metallic cerium (Ce) films on n-type Si (100) substrates. Post-sputter oxidation at 800ºC in dry oxygen, nitrogen/ oxygen/ nitrogen and wet oxygen ambient for 30 min successfully transformed as-deposited Ce films to cerium oxide (CeO_2) films. The effect of varying oxidizing conditions on structural, morphological, optical and electrical properties of the CeO_2 films were investigated in this study. Crystalline phase and orientation of CeO_2 films were characterized by grazing incidence X-ray diffraction (GIXRD) while surface morphology of the CeO_2 films was evaluated by using a field emission scanning electron microscope (FESEM). Root-mean-square (RMS) roughness determined by atomic force microscopy (AFM) analysis discerned that CeO_2 films oxidized in wet oxygen ambient attained a rougher surface when compared to dry oxygen and nitrogen/ oxygen/ nitrogen ambient. In comparison, the lowest energy bandgap observed in the CeO_2 obtained by oxidation in wet oxygen ambient due to the presence of hydrogen (H_2) molecules.

Keywords: CeO_2 thin film, DC sputtering, Ambient, Hydrogen, Grazing incidence X-ray diffraction (GIXRD).

C4

ENERGY BAND GAP INVESTIGATION OF Al NANOPARTICLES /POLYSTYRENE NANOCOMPOSITE FOILS

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ABSTRACT- In this work, polystyrene/aluminium (PS/Al) nanocomposites were fabricated based on the various concentrations (0, 1, 5, 10, and 15 mg) of Al nanoparticles using the casting method. UV-Visible transmittance spectra of PS/ Al nanocomposites as foils, and the trend of neat PS and resulting PS/Al nanocomposites were studied. The neat PS polymer did not show any peak in the spectra. However, the resulting transmittance was decreased with the increase of the Al NPs nanofillers. Linear absorption coefficient (α) has shown the presence of absorption. The energy gap is calculated for all samples. The energy dispersive X-ray (EDX) analysis confirms the high purity of as-prepared samples. The results show decreasing in energy gap of samples as the concentrations of Al nanoparticles in the nanocomposites are increased.

Keywords: Aluminium Energy gap, Casting method, Nanocomposites, Polystyrene.

TOPIC D: DEVICES

D2

MECHANICAL STRESS STUDY ON ADVANCED 1 mm2 VCSEL MODELING PACKAGING

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ABSTRACT - Biometric technology is utilised in identification and security systems. The most recent technology is to employ vertical cavity surface emitter laser (VCSEL) technology for that purpose. The current package with VSCEL featured a diffuser on the lens, which caused the lens to crack during the heat cycle test before reaching 1000 hours, as required by the automotive standard at -40 °C to 260 °C. Based on this, the new package was designed for a 1mm^2 VCSEL chip with a top diffuser that has a transparent behaviour similar to a lens diffuser and may prevent cracking during heat cycle testing. The package was created with the SolidWorks 2017 and AutoCAD Mechanical 2017 tools, as well as the Ansys Mechanical Structural FEA Analysis programme for mechanical stress modelling. The results reveal that the entire package can withstand mechanical stress without causing damage to any of the packets.

Keywords: Mechanical stress; VCSEL.

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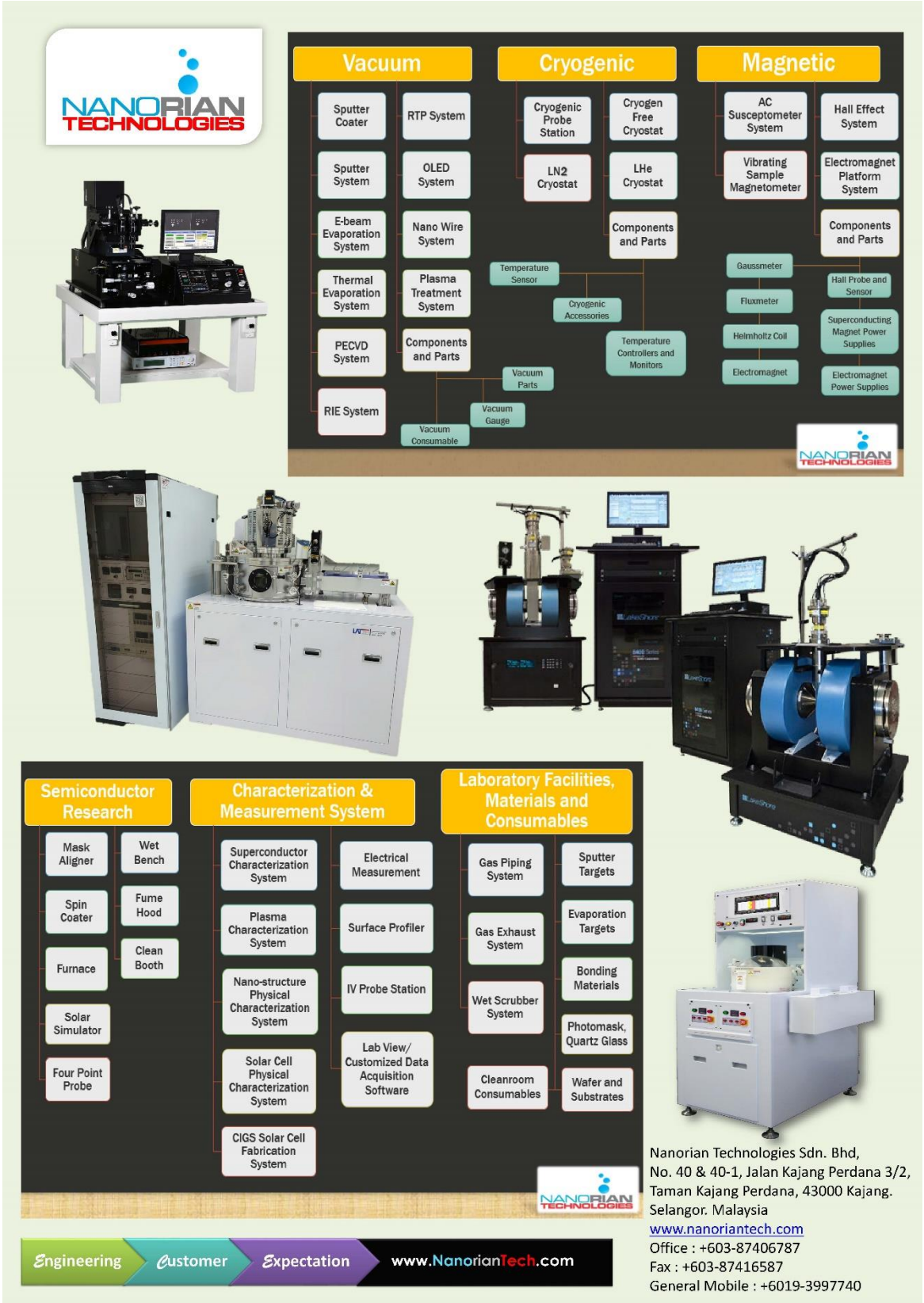

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ACKNOWLEDGEMENT

The organizing committee is very grateful for the support and generosity of the following contributions towards the success of this MNRG 2022:

- Institute of Nano Optoelectronics Research and Technology (INOR)
- Collaborative Research in Engineering, Science & Technology (CREST)
- Millenial Technologies
- Orioner Hightech Sdn. Bhd.
- Nanorian Technologies Sdn. Bhd.
- NEB Niaga Enterprise
- Inno Lab Engineering Sdn Bhd.

The organizing committee also wishes to extend its gratitude to individuals who had given support and assistance towards the success of this meeting.

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