2nd International Conference on Semiconductor Materials and Technology (ICoSeMT 2021)

ABSTRACT BOOK

"Innovation Towards A Sustainable Tomorrow"

8 & 9 November 2021 | Virtual Conference

Official Website | http://icosemt.usm.my

Published by:

2nd International Conference on Semiconductor Materials and Technology (ICoSeMT 2021)

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: Abstract Book of 2nd International Conference on Semiconductor Materials and Technology (ICoSeMT 2021)

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ABOUT THE CONFERENCE

2nd International Conference on Semiconductor Materials and Technology (2nd ICoSeMT 2021) is a biennial event that is jointly organized by Institute of Nano Optoelectronics Research and Technology (INOR), Universiti Sains Malaysia (USM), Universiti Teknologi MARA Cawangan Pulau Pinang (UiTMCPP), Collaborative Research in Engineering, Science & Technology (CREST), and Industrial Centre of Innovation in Smart Manufacturing (ICI-SM), SIRIM Industrial Research (SIRIM IR), SIRIM Berhad with the Theme "Innovation Towards A Sustainable Tomorrow". The primary focus of the conference is to create an effective medium for institutions and industries to share ideas, knowledge, and expertise in the fields related to Semiconductor Materials and Technology.

This year, with the aim to promote positive innovation culture and and encourage innovation activities and from different walks of life, a sub-event entitled International Invention, Innovation & Design Expo (INoDEx 2021) is going to be held concurrently. This sub-event will be a great platform in creating opportunities for local and international participants to present their innovations and inventions. Eventually, both events will lead to interaction and future collaboration among the local and international participants.

2nd ICoSeMT 2021 solicits contributions of abstracts, papers, and posters, featuring the theme and four main topics of the conference, encompassing:

a) Optical and Electronic Materials

- Narrow and Wide Band Gap Semiconductors
- Diamond, Graphene, and Carbon Nanotubes
- Piezoelectric and Ferroelectric Materials
- Electroluminescent Materials
- Colour-Changing Materials
- Energy Storage Materials
- Dielectric Materials
- Porous Structures
- Nanostructures
- Superconductors

b) Devices

- Optoelectronics
- Sensors and Actuators
- Power Devices
- Novel Devices
- Photovoltaics
- MEMS/NEMS
- Contacts and Interconnects
- Fabrication Processes
- Integrated System Design
- Modelling and Simulation

c) Organic and Polymeric Materials

- Organic Semiconductors
- Conductive Polymers
- Polymer Electronics and Coatings
- Polymer Catalysts and Characterization
- Composite Polymers and Biopolymers
- Functional Polymers and Polymer Hybrid Materials

d) Packaging Technology

- Phosphor Technology
- Lens and Optics
- Thermal Management
- Front End Assembly Processes
- Back End Processes and Applications
- Failure Analysis and Reliability

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POSTER PRESENTATION

KEYNOTE TALK

S1

ISSUES IN MICROELECTRONICS PACKAGING

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ABSTRACT- Component level packaging is needed to protect integrated circuits from mechanical damage and to provide convenient electrical contacts for incorporating the circuits into larger systems. The choice of a type of package typically involves a trade-off between performance, reliability, and costs. A wide variety of materials: plastics, metals, ceramics, composites, etc., are used in packaging and there are many packaging technologies in use. For a better understanding of how packages degrade and eventually fail, models are being developed to describe their behavior. Calculating the thermal and mechanical properties of packages can be challenging because the dimensions of the smallest features inside a package can be much smaller than the size of the package thus requiring a fine spatial grid. The relevant time scales can range from nanoseconds for electronic signals to weeks for the diffusion of water in a package. These disparate and length scales often require that approximations be made. Some recent research on microelectronics packaging will be discussed.

KEYNOTE TALK

S2

A DIRECT EPITAXIAL APPROACH TO MONOLITHICALLY INTEGRATING InGaN MICROLEDS AND HEMTS FOR MICRODISPLAY AND VLC

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ABSTRACT- A microdisplay has a wide range of applications in smartphones, smartwatches, AR/VR systems, Helmet Mounted Displays (HMD), Head-Up Displays (HUD). Their individual pixel elements typically consist of a large number of micro-LEDs (μLEDs). Current μLEDs are far from satisfactory, as a number of fundamental challenges cannot be met by any existing technologies. Visible light communication (VLC) is an emerging technology that offers approximately 300 THz of license-free bandwidth that is four orders of magnitude larger than that available in current RF-based Wi-Fi or 5G. Unfortunately, the current approaches to the fabrication of VLC are substantially limited to μLED fabrication technologies. The conventional approach to the fabrication of μLEDs requires a combination of a standard photolithography technique and subsequent dry-etching processes. This approach unavoidably introduces damage during the dry-etching and following processing, severely degrading the optical performance of μLEDs. This issue becomes increasingly severe as the μLED dimensions decrease. The Sheffield team has developed a direct epitaxial approach to the fabrication of ultra-small and ultra-compact μLEDs for microdisplay application, leading to the 1st demonstration of ultra-small green μLEDs (3.6 μm diameter) without using dry etching (*ACS Photonics* 7, *411 (2020)*), where our μLEDs exhibit a record EQE of 9% and the narrowest spectral linewidth (*ACS Nano* **14**, 6906, (2020)). Our epitaxial integration has also led to the demonstration of a record modulation bandwidth of 1.2 GHz for VLC application (*ACS Appl. Electron. Mater.* 3, 445 (2021)) and 1st monolithically integrated μLEDs/HEMTs microdisplay on a single chip (*Adv. Mater. Technol.* ***9****, 2100214(2021)*).

KEYNOTE TALK

S3

Gbps LASER-BASED VISIBLE LIGHT COMMUNICATIONS (VLC)

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ABSTRACT- Visible light communication (VLC or LiFi) has been a topic of intense research after the idea was proposed in 2011. To date, a data rate of multiple 100s Mbps has been demonstrated using LEDs or micro-LEDs as transmitters. At KAUST, we are developing laser-based device and system technologies for Gbps VLC and underwater wireless optical communication (UWOC). In this talk, I will give a brief overview on recent deployments of Gbps VLC and UWOC systems. I will focus my discussion on recent developments of high-speed lasers, and self-powered and omnidirectional receivers for VLC and UWOC.

PLENARY TALK

S4

THE MANAGEMENT TOOLS IN MANUFACTURING FOR COMPETITIVE ADVANTAGE

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ABSTRACT- In the business world, this is the world of the fittest to survive. To this, businesses around the world always seek for improvement to stay competitive as demand from the customers particularly in the terms of price reduction. We can see the price of a computer in Malaysia. In the mid-80s, a white box PC was sold at RM 5000 at least. There was no laptop or notebook at that time. Tablet is far from available. Now a fairly good PC can be obtained at less than half this price.

In this session, it will be a sharing looking at both the hard and the soft management tools in manufacturing to stay competitive. Those who are able to exploit and constantly drive for changes that lead to improvement, innovation and breakthrough will always be in the game. Those who are not able to be in this game will eventually be out of business or being acquired by others. Some of these companies are history and some had created history.

PLENARY TALK

S5

NANOTECHNOLGY: A DRIVING FORCE IN SEMICONDUCTOR INDUSTRY

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ABSTRACT- Nanotechnology is making a revolution in manufacturing and production, creating new materials and products through novel processes for commercial purposes. New products based on nanotechnology with novel characteristics are continued to grow and benefit society like nanomaterials, particularly carbon nanotubes or graphene could offer semiconductors. Technology development towards experimental development research is moving forward on producing new products or improving existing products or processes. A newly developed method to reduce the size of semiconductor materials, dramatic improvements in the chemical, physical and structure properties of these materials continue to arise. Thus, minimizing the size in nanometer-scale of semiconductor materials has been shown to maximize the performance of semiconductors for their application in a wide range of material applications such as in energy sector, electronic device systems, automotive and etc.

PLENARY TALK

S6

ALIGNING THE ASPIRATION FOR GREATER GOOD OF INDUSTRY AND COMMUNITY

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ABSTRACT- The growth of GDP for any country relies on the ability to produce goods i.e. commodities or manufacturing. In the last 10 years, although growing, the rate of manufacturing sector in the country is slowing down and almost reaching its maintenance level. This can relates directly to the shift of demand from Western World consumers to cheaper affordable products from China and more recent competitors like Vietnam and Indonesia. Without manufacturing, Malaysian E&E sector will continue to be diluted within the global supply chain. Therefore, how can we stay strong together riding this journey?

INVITED TALK

OE1

APTASENSOR FOR MYCOTOXINS DETECTION: AN APPROACH USING NANOSTRUCTURED MATERIALS

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ABSTRACT- Mycotoxins are toxic compounds secreted by the pathogenic fungal species as their secondary metabolites. The occurrence of these mycotoxins even at a very low level could cause a serious threat to human and animal health due to their toxic effects. Thus, there has been an official regulation on the limit range of mycotoxin presence in food and feed under the European Union (EU) in order to minimize the exposure rate of mycotoxins towards human and animal healthcare. Herein, studies on the effective detection of hazardous mycotoxins using aptamermediated biosensors will be discussed. The active elements are consisted of various nanostructured materials such as graphene, MXene, and polymers. These materials were chosen as it demonstrate unique and beneficial properties, while plays a crucial role in realizing circular economy. These materials will be deposited on screen-printed electrodes to minimize the compatibility issues. It will be then functionalized to activate the sensing elements for the targeted capture of intended analytes such as deoxynivalenol, zearalenone, and ochratoxin. It is expected these novel concept of sensors provides a pathway for miniaturization and portability for effective detection of various analytes, useful for applications such as in agriculture and healthcare.

Keywords:

INVITED TALK

D1

HIGH ELECTRON MOBILITY OF 4H-SiC MOSFET UTILIZING ULTRATHIN LAYER OF SiO_2

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ABSTRACT- Here, 4H-SiC MOSFETs have been fabricated, having a peak field effect mobility of 154 $cm^2/V{\cdot}s$ and a subthreshold slope of 127 mV/dec in enhancement mode in a channel length of 2 µm. The devices employed a gate stack of ultrahin layer of 0.7 nm SiO_2, hence improved the SiO_2 / 4H-SiC interface quality and subsequently with a thick layer of ALD Al_2O_3. Thus, its impact on device performance is improved, leading to drain current enhancements of up to 120× compared with control devices fabricated using a thermally grown thick SiO_2. Such approach has sucesfully reduced the immobile C di-interstitial defects $(Ci)_2$ form at the SiO_2 / 4H-SiC interface which believed to be the source of field effect mobility limiting factor. However, mobility is also haunted by remote Coulombic scattering, which is a particular issue for deposited Al_2O_3. By performing a POA on the formed gate stack, remote Coulombic scattering is diminished. Electrical measurements at elevated temperatures confirmed that the phonon scattering governs the mobility rather than Coulombic scattering, indicating that the fabricated devices are intact.

Keywords: 4H-SiC MOSFET, channel mobility, phonon limited mobility, MOS devices, power semiconductor devices

INVITED TALK

OP1

MORPHOLOGICAL, OPTICAL AND ELECTRICAL ANALYSIS OF Ag POLYMER-NICKEL LOW TEMPERATURE TOP ELECTRODE IN SILICON SOLAR CELL FOR TANDEM APPLICATION

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ABSTRACT- Metallization is one of the important factors to produce a good quality and good performance solar cell. Front contact that made with high temperature process can cause shunting to the shallow emitter layer. The contacts produced must be thin, semi-transparent, high transmission and low resistance to be applied as the top electrode in silicon solar cell. In this study, the combination of Ag polymer and nickel have been chosen to be the top electrode. Nickel is fabricated by a doped silicon wafer is coated in electroless solution and annealed using a quartz tube furnace while Ag polymer is fabricated by screen-printing and drying in an oven at low fabricating temperature. The contacts are deposited on a phosphoric acid diffused layer on silicon wafer. The contact performance of KOH-based texturing surface as nickel attachment site and the compatibility with Ag polymer-nickel contact are studied. The thickness of Ag polymer-nickel is comparable to the Ag contact with 12 µm and 10 µm respectively. From the surface morphology analysis, there is no oxygen element found in Ag polymer-nickel contact. Then, the series resistance of Ag polymer-nickel on the textured silicon wafer is compared with the high temperature Ag contact. The series resistance value of Ag polymer-nickel contact on KOH textured silicon has recorded 2.06 Ω while the Ag contact that formed at 700 °C is 165 Ω. Besides that, the transmission within IR region has showed that Ag polymer-nickel contact has 7.25 a.u. which is higher transmission than the 6.75 a.u. of Ag contact. This has shown that Ag polymer-nickel contact can form low resistance ohmic contact with high transmission and protective against moisture physical character.

Keywords: Ag polymer-nickel, front metallization, low temperature, silicon solar cell, tandem.

INVITED TALK

OE2

RANDOM LASING FROM SEMICONDUCTOR NANOSTRUCTURES

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ABSTRACT- Nanostructures have the capability to confine light by manipulating the refractive index contrast. In a semiconducting material whereby photon gain is available gives rise to the possibility of amplifying the photons that are confined. If such amplification is achieved through stimulated emission, then lasing from this gain medium is possible. Moreover, this is achieved without the need of a physical mirror cavity. Due to this simplicity, a random laser is suitable for direct assessment of bio-analytes and biomarking applications. The properties of such lasing termed as a random laser (random due to lasing achieved through photon random walk) will be discussed. Specifically, the effect of lasing threshold on the arrangement, shape and size of nanorods will be explored. For zinc oxide nanorods, lowest threshold was obtained for nanorods with diameters of 50 – 100 nm and the best height is about 1 micrometer long. However, the most drastic changes are the density of nanorods (also known as filling factor) which will be thoroughly discussed.

Keywords: Nanolasing, zinc oxide, light trapping.

INVITED TALK

OE3

HIGH-PERFORMANCE LIGHT-EMITTING DIODES FOR LIGHTING AND DISPLAYS

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ABSTRACT- Artificial lighting technology has made an incredible progress from incandescent lamps and compact fluorescent lamps to white light-emitting diodes (LEDs). The so-called "lighting revolution" is now happening as the very real technical issues including the device operating luminous efficacy (the efficiency droop and thermal droop), light photometric properties, as well as the cost of ownership are being addressed. The recent rapid developments in the LED materials and devices enables high efficiency and high-performace LEDs for various industries including lighting, displays, healthcare, and agriculture. In this talk, the recent development of the LED materials and architectures will be presented.

Keywords: InGaN/GaN, III-nitride, light-emitting diodes, lighting, displays.

ORAL PRESENTATION

TOPIC A: OPTICAL AND ELECTRONIC MATERIALS

OE4

WAFER-SCALE PATTERNING OF SILICON NANOWIRE USING UV ENHANCED SUBSTRATE CONFORMAL IMPRINT LITHOGRAPHY (UV-SCIL)

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ABSTRACT- Point of care (POC) diagnostics based on bio-functionalised semiconductor devices are an important development in ultrasensitive biosensors for early detection of disease biomarkers. Silicon nanowire (SiNW) sensors, fabricated using a combined Substrate Conformal Imprint Lithography (SCIL) and ultraviolet (UV) lithography process are demonstrated on full wafers (100 mm diameter SOI). Pattern transfer from the SCIL master stamp wafer was achieved by imprinting into AMONIL resist and subsequent photocuring. The AMONIL patterned resist layer had excellent Argon / CHF_3 plasma etch resistance, leading to an effective image transfer onto the underlying silicon (Si) wafer. The techniques provide high-throughput patterning of nanostructures with high density and fidelity on a reduced timescale compared to alternative nanolithography techniques such as electron beam lithography (EBL) or direct write scanning probe microscopy (SPM) lithography. Moreover, fabrication of SiNWs via the SCIL imprint process is far more cost effective than using EBL. 271 nm SiNWs were fabricated across a full wafer. The SCIL imprint process is very repeatable (80 imprints) with wafers up to 200 mm in diameter being accommodated for. SiNWs prepared with this method were subsequently used for biosensing applications to detect the presence of the oxidative stress biomarker 8-OHdG, which has been related to prostate cancer risk

Keywords: Silicon nanowire, nanoimprint lithography, substrate conformal imprint lithography, electron beam lithography.

OE5

INFLUENCE OF THE RODS AS COLLECTOR ON MORPHOLOGY AND UNIFORMITY OF NANOFIBERS VIA ELECTROSPINNING

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ABSTRACT- Nanotechnology research has lacked to provide studies on nanofibers, the reasons are all relevant parameters affecting the manufacture of nanofibers have been studied using the electrospinning method. In this context, believing that science is in a state of constant renewal leads to the possibility to study a parameter that has not been studied before, which effects on the morphology of nanofibers. The rods chooses as a collector to the collection of nanofibers, so the effect of the distance between the rods will be studied as a parameter that effects on the morphology and uniformity of nanofiber. Field Emission Scanning Electron Microscope (FESEM) images reveal the formation of nanofibers which gradually difference according to select parameter. As this parameter has not been studied by researchers, so the effect will be studied through this study, therefore explanation of causes and the most important applications.

Keywords: Electrospinning, collector, rods, nanofibers.

OE6

IMPEDANCE AND DIELECTRIC CHARACTERISATION OF EPOXY COMPOSITES CONTAINING CARBON BLACK AND CARBON NANOTUBES

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ABSTRACT- Research in improving dielectric materials is rapidly becoming more intense as there are higher demands for novel materials with the ability to store charges. In this work, impedance characterisation and dielectric properties of epoxy composites containing Carbon Black (CB) and a mixture of CB and Carbon Nanotube (CNT), kept at 1:1 wt.% is conducted. For both cases, the total number of fillers are varied from 0.5 wt.% to 6 wt.%. At 20 Hz, the values of dielectric composites, *k* was recorded to be 2050 for 6 w t.% CB, compared to *k* = 600, for composites containing dual filler (3 wt.% CB + 3 wt.% CNT). Further analysis revealed that the 6 wt.% sample (CB + CNT) exhibited higher ac conductivity at lower frequency, compared to sample containing only 6 wt.% CB. This could be due to the reason that CNT has more conductivity effects while CB has more storage or capacitive effects. Nyquist plot of impedance for both fillers also revealed the formation of semi-circular shapes for 5 wt.% and 6 wt.%; for both CB and CB + CNT fillers. However, formation of smaller semi-circular shapes is observed for CB + CNT, compared to CB only, indicating formation of conductive network in dual filler composites. This study highlights the potential of CB in enhancing mainly the dielectric properties of epoxy composites.

Keywords: Dielectric properties, impedance properties, conductive composites.

OE7

NEARLY ZERO ULTRA-FLATTENED DISPERSION IN OCTAGONAL PHOTONIC CRYSTAL FIBER

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ABSTRACT- The Low confinement losses, relatively high nonlinearity, and wideband ultra-flattened chromatic dispersion are the crucial properties of the PCFs. Thus, In this research, a comprehensive study has been conducted to design a novel octagonal PCF (Photonic Crystal Fiber) microstructure with an ultraflattened dispersion profile through a vast range of optical communication band wavelengths with a large negative dispersion of nearly 6635 ps / nm / km at 1550 nm. This PCF design and simulative study has been made by using COMSOL multi-physics. The guiding features of the fiber have been analyzed numerically to solve the Maxwell equation of electromagnetic field by using full vector finite element method with cylindrically perfect to match layer for strongly absorb the outgoing waves from the computational region. Moreover, Octagonal rings in the cladding region provides better confinement and flattened dispersion in Oband (1260-1360 nm) and C-band (1530-1565 nm) in compare to honeycomb or hexagonal lattice structure. Our proposed model unique nearly zero ultra-flattened dispersion of ± 0.3028 ps/nm/km in a 1290 to 1620 nm with wavelength range (320 nm flat band) and low confinement loss is less than 10^{-7} dB/km in the entire band of interest. Along with, this research has been presented 7.2μm^2 effective area which is smaller than other reported fibers at 1550nm wavelength.

Keywords: Photonic crystal fiber, air filling ratio, chromatic dispersion, confinement loss, effective area.

OE8

IMPACTS OF WAFER DOPING TYPE ON STRUCTURAL AND OPTICAL PROPERTIES OF BLACK SILICON FABRICATED BY METAL-ASSISTED CHEMICAL ETCHING

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ABSTRACT- Crystalline silicon (c-Si) has long been used as a photovoltaic (PV) material. The drawbacks of c-Si include high reflection and poor light absorption, leading to high optical losses in solar cells within 300-1100 nm wavelength region. Black silicon (b-Si) is a promising material with a superior broadband light absorption. The superior absorption is achieved by introducing nanotextures on the wafer surface which suppress broadband reflection loss. B-Si is usually fabricated using metal-assisted chemical etching (MACE) process. In this work, impacts of wafer doping type on structural and optical properties of b-Si fabricated by MACE process is investigated. P-type and n-type c-Si wafers are used in the MACE process. The etching is carried out in an aqueous solution of hydrofluoric acid (HF), silver nitrate ($AgNO_3$) as well as deionized water (DI H_2O) at room temperature. The etching is carried out at various durations, from 5 to 20 minutes. Surface morphological results demonstrate formation of b-Si nanowires (NWs) with average lengths of 0.4-0.8 µm for p-type wafers and 0.8-3.0 µm for n-type wafers. The higher length of the NWs for the n-type wafers is due to the minority charge carriers which lead to higher etching rate during the MACE process. Within the 300-1100 nm wavelength region, weighted average reflection (WAR) for the p-type and n-type wafers decreases to 6.6% and 6.4% respectively after 20 minutes of etching. The corresponding improvement in broadband light absorption results in maximum potential short-circuit current density ($J_{sc(max)}$) of 38.2 and 38.8 mA/cm^2 for the p-type and n-type b-Si respectively. The potential $J_{sc(max)}$ is 39.9% and 42.1 % higher when compared to the $J_{sc(max)}$ of planar c-Si reference. The study shows the potential of the b-Si to enhance broadband light absorption which is crucial for solar cells.

Keywords: Black silicon; absorption; metal-assisted chemical etching; solar cell.

OE9

X-RAYS DIFFRACTION STUDY OF InGaN/GaN HETEROSTRUCTURES GROWN BY MOCVD TECHNIQUE AT DIFFERENT TEMPERATURES

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ABSTRACT- Indium gallium nitride / gallium nitride (InGaN/GaN) heterostructures were grown by using metal-organic vapor deposition (MOCVD) technique with two different growth temperatures (780 ºC and 800 ºC). The structural properties and crystalline quality were investigated using X-ray diffraction (XRD) technique. XRD rocking curve (RC) under ω and ω-2θ scan modes at GaN (002) and GaN (102) diffraction planes were performed to assess the film's quality and dislocations densities. Through the simulation fitting, the indium composition and the thickness of the thin films were obtained. In addition, XRD reciprocal space mappings (RSM) were obtained to assess the strain and phases between the InGaN and GaN. From the observation, an increase in the growth temperature resulted in a decrease in the full-width half maximum (FWHM) value of the InGaN (002) diffraction peak which indicated improvement to the crystalline quality of the InGaN/GaN heterostructure. Moreover, the indium composition of the InGaN/GaN heterostructure was found to decrease with an increase in growth temperature due to the thermal decomposition of In-N bond and its re-evaporation from the surface of the sample.

Keywords: III-V nitride, semiconducting indium compounds, thin film, dislocation, reciprocal space mapping.

OE10

INDIUM DOPED SPIN COATED ZnO USING THIN FILM FOR TCO APPLICATION

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ABSTRACT- Indium doped zinc oxide (IZO) thin films were fabricated on glass substrates by spin coating technique for transparent conducting oxide (TCO) studies. Effect of different indium concentration on their properties were investigated. IZO thin films were deposited on glass substrate using sol-gel spin coating techniques using zinc acetate dihydrate, indium nitrate hydrate, absolute ethanol, and monoethanolamine (MEA). The concentration of indium was varied at 1, 3, 4, and 5 at.%. to study the characteristics of the IZO thin films in terms of structural, optical, and electrical, which is to achieve high visibility of IZO as transparent conducting oxide. The UV-Vis examination of IZO thin film observed that the highest transparency of thin films was IZO with indium concentration of 4% which shows an 89% transparency while the low transparency was observed for IZO of 1% with 70% transparency. The optical band gap were calculated using Tauc's plot and was found to be in the range between 3.10 to 3.2 eV. For electrical properties, the lowest resistivity was observed for IZO thin film at 1% doping concentration with a value of 5.01 Ωcm which has a thickness of 1500 nm, while the highest resistivity was observed at IZO thin film at 5% which is 18.4311 Ωcm with the thickness of the sample at 8881 nm.

Keywords: IZO, spin coating, TCO.

OE11

CHARACTRIZATION OF NANOCRYSTALLINE SnO_2-Y_2O_3 THIN FILMS PREPARED USING CHEMICAL BATH DEPOSITION

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ABSTRACT- Nanocrystalline SnO_2-Y_2O_3 Thin Film has been successfully prepared by using chemical bath deposition method at low reaction temperature on SiO_2/Si substrates. The structural and surface morphology of the annealed sample at 500 °C for 2 h in air were investigated using X-rays diffraction, field emission scanning electron microscopy and Energy-dispersive X-ray spectroscopy. The crystallization of SnO_2-Y_2O_3 film with tetragonal rutile structure was achieved when the film was exposed to anneal at 500 ºC. Where several diffraction peaks that correspond to the (110), (101), (200), (211), (220) and (002) planes that agree very well with standard bulk SnO_2 having a tetragonal rutile structure. As well as the diffraction peak that correspond to (111) emerged at $\theta = 29.48^{o}$ is matched with bulk Y_2O_3. The surface morphology of the tested film appeared as polycrystalline with uniform nanoparticle distribution. The EDX spectra of examined film showed the film consists of O, Sn, Y, and Si elements. The cross-section image and the average thickness of the annealed SnO_2-Y_2O_3 film was approximately 330 nm. Additionally, approximately 880 nm thick layer of SiO2 is emerges on the top of the silicon substrate. This finding showed that the ability to prepare Nanocrystalline SnO_2-Y_2O_3 thin film with high quality.

Keywords: SnO_2-Y_2O_3, tetragonal rutile structure, tensile, polycrystalline.

OE12

STRUCTURAL, MORPHOLOGICAL, AND OPTICAL PROPERTIES OF LOW-COST FLUORINE, SILVER CO-DOPED ZnO NANOSTRUCTURES

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ABSTRACT- In this study, we investigate the impact of fluorine and silver co-doping in zinc oxide on the morphological, compositional, structural, and optical properties using hydrothermal method. Vertically aligned nanorods (NRs) of different dimensions were observed using field emission scanning electron microscopy (FESEM). Wurtzite hexagonal structure and polycrystalline nature of the samples were confirmed through X-ray diffraction (XRD) analysis. The crystallite size increased from 29.92 to 35.81nm and microstrains values were decreased upon co-doping. Energy dispersive X-ray (EDX) analysis confirmed the existence of zinc, oxygen, silver, fluorine, and oxygen deficiency in all the studied samples. Ultra-violet (UV) Visible analysis has shown decrement in the optical energy band gap from 3.273 to 3.179 eV upon co-doping. The additional optical characteristics comprising absorption coefficient, skin depth, optical density, extinction coefficient were also explained. Photoluminescence (PL) analysis has shown that the ZnO native visible defects were suppressed significantly upon co-doping, showing crystal quality improvement as revealed by XRD analysis.

Keywords: ZnO, fluorine, silver, co-doping, visible defects suppression.

OE13

IMPACT OF PRECURSOR CONCENTRATION ON THE STRUCTURAL, OPTICAL AND ELECTRICAL PROPERTIES OF SPIN COATED LOW TEMPERATURE PROCESSED ZnO QUANTUM DOTS BASED FLEXIBLE THIN FILM

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ABSTRACT- Zinc oxide quantum dots (ZnO QDs) prepared with varying concentration through precipitation method were deposited on flexible ITO/PET substrates using spin-coating technique. Various characterization tools were utilized to investigate the structural, optical and electrical properties of the films. The crystallinity of the films was found to improve with increasing concentration as evident from the X-ray diffraction (XRD) and field emission scanning electron microscopy (FE-SEM) studies. The average nanograin size and bandgap was increased and decreased respectively, from ~5 nm to ~8 nm and 3.29 eV to 3.24 eV with increase in concentration from 0.2 M to 0.7 M. The films exhibited decent optical transparency up to 81%. Columnar structure growth of the films is revealed by AFM results. All the ZnO films exhibited n-type semiconducting property as indicated by the electrical measurements with carrier mobility and low resistivity of 5.89 to 8.54 cm^2/Vs and 11.84 x 10^{-3} to 13.13 x 10^{-3} Ωcm respectively. Based on the properties of the ZnO film grown at 0.3 M, it is envisaged to be a potential candidate for flexible photovoltaic and display applications.

Keywords: ZnO quantum dots, flexible substrate, ZnO thin film, optical properties, electrical properties.

OE14

THE PERFORMANCE OF HOLLOW PYRAMIDAL MICROWAVE ABSORBER BY USING DIFFERENT SLOT SIZE ARRAY

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ABSTRACT- Microwave absorbers are frequenctly used in defence, electromagnetic compatibility (EMC)/electromagnetic interference (EMI) reduction and anechoic chamber application. Conventional electromagnetic (EM) absorbers have some constraints in practical handling due to heavy weight. The researchers are focusing on the development of high performance and lighweight microwave absorber. İn this paper, a lightweight and simple design configuration of different slot size array implemented on hollow pyramidal microwave absorber are carried out. There are two different designs of different slot size array are calculated based on frequency 3GHz, 6GHz and 9GHz. Both designs use the same frequency of interest on hollow pyramidal microwave absorber but has an opposite slots size arrangement namely different slots size 3GHz, 6GHz, 9GHz and different slots size 9GHz, 6GHz, 3GHz. The opposite arrangements of frequency slots are investigated and observed towards their absorption performance. The absorption is measured using the NRL free space arch method in the frequency range of 1GHz to 12GHz covering L, S, C and X band. The measurement of absorption performance obtained by the different slot size array at frequency arrangements 9GHz, 6GHz, 3GHz design is up to -44.23dB on X-band. The measurement results for both designs show a good absorption performance as to exhibit below than -20dB especially at high frequency band. The proposed designs are identified as the new technique to improve the efficiency of microwave absorption performance. The findings of the proposed designs have the potential to achieve absorption improvement over a broad frequency range applications.

Keywords: Electromagnetic compatibility (EMC), electromagnetic interference (EMI), slot array, absorption, microwave absorber.

OE15

ELECTRICAL PROPERTIES OF GaN CAP LAYER FOR AlGaN/GaN HEMT

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ABSTRACT- Metal organic chemical vapour deposition (MOCVD) was used to growth AlGaN/GaN HEMT on a sapphire substrate. The structures of AlGaN/GaN were optimised by varying the thickness of the GaN cap while the composition is $Al_{0.25}Ga_{0.75}N$. The electrical characteristic of AlGaN/GaN heterostructures were investigated with different thickness of GaN cap and without GaN cap. Samples with GaN cap layer thickness of 3.0 nm, 2.5 nm, 2.0 nm, 1.5 nm, and 1.0 nm were growth. Hall Effect Measurement was used to quantify electron mobility and sheet carrier concentration in all samples. High Resolution X-Ray Diffraction (HRXRD) was utilised to investigate the structural characteristics of the materials.

Keywords: AlGaN/GaN, HEMT, GaN cap.

OE16

ATOMIC STRUCTURE FOR AlN GROWN ON DIFFERENT SAPPHIRE ORIENTATION VIA NUMERICAL STUDY

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ABSTRACT- We present a numerical study of atomic structure for AlN when the crystal was assumed grown on different orientation of sapphire substrate. The change of the AlN atomic structure with sapphire orientation was associated to the interface between the AlN and the sapphire. The results from this study would provide a guideline in selecting suitable orientation of sapphire for obtaining desirable AlN crystals. In particular, for reducing threading dislocation density in the AlN/sapphire templates for developing UV LEDs.

Keywords: AlN; Sapphire interfaces, Atomic structure, electronic structure, crystal.

OE17

OPTICAL MICROFIBER LIQUID REFRACTOMETER: THE EFFECT OF TAPER WAIST

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ABSTRACT- A simple tapered multimode fiber (MMF) optic sensor is proposed and demonstrated as a refractometer for liquid samples application. The working mechanism of such device is based on the intensity modulated transmission of the tapered fiber when it is immersed in solutions with increasing refractive index. The tapered fiber is fabricated using heat-pulling method to achieve a waist diameter of 40, 50 and 75µm over the length of 18 mm. The performance of the tapered fiber with different waist has been evaluated on samples of ethylene glycol solution and glycerol. The obtained results show good correlation with the data provided by a commercial refractometer. The main advantages of this sensor are the feasibility of using fiber optics which enables miniaturization, easier to fabricate and handle while providing high accuracy measurement.

Keywords: Tapered fiber optics, Evanscence wave, refractive index.

OE18

EFFECT CRYSTALLINITY OF TiO_2/Ag/$SrSnO_3$ FOR CONDUCTIVITY PHOTOANODE DSSC

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ABSTRACT- Commercialisation of Dye-Sensitized solar cells (DSSC) still discouraging compared to the conventional silicon solar cell due to the low performance. Despite this, DSSC is still among a unique emerging device in Third-Generation photovoltaic technology that is made up from nanomaterial and possess flexibility structure. Five essential of DSSC mechanism are transparent conductive substrate, dye-sensitizer, electrolyte, counter electrode and the vital for capturing dye for photon excitation is photoanode structure. Commonly, TiO_2 becomes a benchmark for photoanode material for DSSC application as it exhibits a wide bandgap and excellent stability under light irradiation. However, energy conversion at the interfacial cell is relatively poor due to low electron mobility. Hence, optimization of semiconductor TiO_2 thin film photoanode is an essence improvement for DSSC performance. In this present study, a new multilayer nanomaterial photoanode of nanoflower TiO_2 Ag-doped with embedded $SrSnO_3$ using hydrothermal and RF Sputtering method was introduced to create disperse nanoparticle on NF-TiO_2. Thıs preliminary study is investigating the relationshiop between the conductivity and crystallinity of this modified NF-TiO_2/Ag/$SrSnO_3$ photoanode using XRD, FESEM, EDX, Raman spectroscopy and Four-Point probe. A study was undertaken to discover the effect of resisitivity and conductivity toward the quality of NF-TiO_2/Ag/$SrSnO_3$ DSSC photoanode.The highest crystallinity of substrate showed the best of conductance of electrical properties,. This investigation could facilitate the performance of multilayer of TiO_2-photoanode based DSSCs towards enhancement efficiency.

Keywords: DSSC, TiO_2, hydrothermal method, RF sputtering, Raman spectroscopy.

OE19

RAY TRACING OF PEROVSKITE THIN FILMS FOR SOLAR WINDOWS

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ABSTRACT- Perovskite solar cell represents an emerging photovoltaic technology. With the latest record efficiencies exceeding 25% coupled with low fabrication cost and tunable transparency, perovskite solar cells are appealing for applications as solar windows. For these applications, the perovskite solar cells need to be semi-transparent to allow incident light to pass through while generating electricity. However, semi-transparency compromises light absorption in the solar cells. In this work, OPAL 2 is used to perform ray tracing simulation on perovskite thin films based on methylammonium lead triiodide ($CH_3NH_3PbI_3$) and methylammonium lead tribromide ($CH_3NH_3PbBr_3$) for solar windows. The thicknesses of both perovskite materials are varied between 100 nm and 500 nm. The ray tracing is carried out within 300-1000 nm wavelength region with AM1.5G solar spectrum (at normal incidence) as the illumination source. From the ray tracing, light transmission and light absorption in the solar cells are investigated. Besides, short-circuit current density (J_{sc}) and average visible transmission (AVT) within 400-800 nm spectral region are examined. Perovskite solar cells based on $CH_3NH_3PbI_3$ demonstrate absorption edge up to wavelength of 800 nm. The light absorption increases when the perovskite thickness is increased from 100 nm to 500 nm. The J_{sc} improves from 11.71 mA/cm^2 to 21.07 mA/cm^2 due to the increased thickness. On the other hand, the AVT drops from 45% (at 100 nm) to 13% (at 500 nm). For perovskite solar cells based on $CH_3NH_3PbBr_3$, the absorption edge is shifted to 550 nm due to increased band gap. The J_{sc} increases from 3.49 mA/cm^2 to 7.25 mA/cm^2 when the thickness is increased. However, the AVT drops from 74% (at 100 nm) to 59% (at 500 nm). The findings from this work show that a trade-off is required when maximizing the J_{sc} from the solar cells while maintaining reasonable transparencies through the solar windows.

Keywords: Ray tracing, perovskite, solar cell, solar window.

OE20

SYNERGISTIC EFFECT OF ALUM DOPED TiO_2 FOR PHOTOELECTRODE MODIFICATION IN DYE SENSITIZED SOLAR CELL (DSSC)

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ABSTRACT- Titanium dioxide (TiO_2) photoelectrode is an important component of the DSSC fabrication and is reported to have significant effect to the performance of the device. One of the techniques that has been widely applied was the TiO_2 photoelectrode treatment through doping. One of the potential candidates for doping material is Alum that has long been employed in water treatment to increase dye adsorption. However, best to our knowledge there is no research on Alum-doped TiO_2 in DSSC has been published. In this study, the effect of Alum as a doping element on the TiO_2 photoelectrode was investigated. The FESEM, EDXs, and XRD techniques were used to characterise the photoelectrodes, while UV-Vis and FTIR were used to explore the dye characteristics. Finally, measurements of the I-V characteristic, IPCE, and EIS were utilised to evaluate the overall performance of DSSCs. The conductivity of the Alum- doped TiO_2 enhanced the DSSC when compared to the bare TiO_2, according to the findings. The short circuit current density (J_{sc}), open circuit voltage (V_{oc}), fill factor (FF), and efficiency for treated and untreated TiO_2 were 8.42 mA/cm^2, 411.74 mV, 0.238, 0.827 percent and 3.43 mA/cm^2, 382.26 mV, 0.342, 0.448 percent, respectively, according to the photovoltaic characteristics. To summarise, doping alum in TiO_2 improves the performance and efficiency of the DSSC device.

Keywords: DSSC, alum, TiO_2, doping, efficiency enhancement, dopant.

OE21

EFFECT OF SILVER NITRATE CONCENTRATION ON THE MORPHOLOGICAL, STRUCTURAL AND OPTICAL PROPERTIES OF ZnO NANORODS

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ABSTRACT- In this paper, the effect of silver nitrate ($AgNO_3$) concentration on the morphological, structural and optical properties of zinc oxide (ZnO) nanorods were investigated. ZnO nanorods were grown using the hydrothermal method on p-type silicon substrates and the concentration of $AgNO_3$ selected are 0.00 mmol, 0.22 mmol, 0.44 mmol, and 0.66 mmol respectively. The morphological investigation was undertaken using field emission scanning electron microscopy (FESEM) and showed that the diameter of the ZnO nanorods was reduced upon adding $AgNO_3$. Energy dispersive X-ray (EDX) analysis showed the presence of the elements zinc, oxygen, silicon, and silver for all four samples. The structural properties of the ZnO nanorods are analyzed from the X-ray diffraction (XRD) results. Photoluminescence (PL) analysis has shown that the addition of $AgNO_3$ has suppressed the deep-level emission (DLE) of ZnO nanorods in the visible spectrum, indicating a decrease in the formation of defects in ZnO nanorods due to zinc and oxygen interstitials and vacancies. Further analysis using Ultraviolet-visible (UV-Vis) and Fourier-transform infrared (FTIR) spectroscopy is given in this paper.

Keywords: ZnO, silver, doping, visible defects suppression, hydrothermal method.

OE22

EFFECT OF Mn INCORPORATED INTO $LiNbO_3$ CRYSTAL STRUCTURE ON THE STRUCTURAL, ELECTRONIC AND OPTICAL PROPERTIES USING FIRST-PRINCIPLES STUDY

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ABSTRACT- The investigation on structural, electronic and optical properties of lithium niobate ($LiNbO_3$) and manganese (Mn)-doped $LiNbO_3$ are investigated using a first-principles study. The first-principles calculation in this work is implemented using CASTEP computer code with GGA-PBE correlation. The crystal structure used for this calculation was rhombohedral $LiNbO_3$ with a space group of *R3c*. The total energy at different Mn positions was calculated to determine the suitable position before doping with Mn. The band structure and density of states are calculated to analyze the effect of Mn doping on the electronic properties of $LiNbO_3$. The calculation for Hubbard U correction is performed using GGA-PBE+U for Nb 4d state with U = 11 eV and Mn 3d state with U = 2 eV. $LiNbO_3$ having a wide band gap energy of 3.77eV. $LiNbO_3$ doped with Mn shows a reduction in the band gap energy which is 0.7564 eV. The reduced band gap energy might be proven advantageous for photovoltaic and photocatalysis activities which require high optical absorption in visible region. The dielectric constant and refractive index of $LiNbO_3$ and Mn-doped $LiNbO_3$ are also calculated. The optical absorption results suggest there is a shift in the absorption edge towards the visible region in comparison with the $LiNbO_3$. The enhanced optical absorption in Mn-doped $LiNbO_3$ making it a promising material for photovoltaic and photocatalysis applications.

Keywords: $LiNbO_3$, Mn-doped $LiNbO_3$, first-principles study, optical and electronic properties.

OE23

ENHANCING THE PROPERTIES OF NANO-POROUS Si USING ELECTROCHEMICAL ETCHING TECHNIQUE

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ABSTRACT- Silicon (Si) was used to fabricate porous Si using a photo-assisted electrochemical etching technique. The objective of this study was to investigate the effect of different etching duration on porous Si structural properties. The Si sample was etched using HF based electrolyte solution to form porous Si. The current density was fixed throughout the etching process while etching duration were varied. The Si samples were etched under the illumination of incandescent lamp during the etching process. Afterwards, the porous Si samples were characterized using field emission scanning electron microscopy (FESEM), atomic force microscopy (AFM) and high resolution x-ray diffraction (HR-XRD) for the structural analysis. FESEM results showed that the average pore diameter and porosity increased as the etching duration increased. AFM analysis supported the FESEM results as the surface roughness in root mean square (RMS) and average pore depth for the porous Si samples also increased along with the etching duration. XRD results showed that porous Si sample etched for longer etching duration has higher peak intensity in comparison to the other porous Si samples which indicated the sample has a high porosity with an improvement in the uniformity of pore formation.

Keywords: Electrochemical Etching, Etching Duration, Porous Si.

OE24

ELECTRONIC STRUCTURE AND OPTICAL PROPERTIES OF STRAINED TYPE-II $InAs_xSb_{1-x}$/InAs QUANTUM DOTS FOR MID-INFRARED APPLICATIONS

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ABSTRACT- InSb-based self-assembled quantum dots (SAQDs) are very promising for the mid-infrared (3-5 μm) optical range. We have analyzed the electronic structure and optical properties of $InAs_xSb_{1-x}$/InAs dots. In this paper, we present the results of the modeling of electronic structure and optical properties from photoluminescence (PL) measurement for $InAs_xSb_{1-x}$/InAs SAQDs, focusing on the effects of SAQD morphology and composition. In particular, we analyze the electronic structure of $InAs_xSb_{1-x}$/InAs SAQD of various shapes, aspect ratios and compositions. We also suggest a method of assessing the geometry and composition of $InAs_xSb_{1-x}$/InAs quantum dots using their optical spectra and limited microscopy information. The calculated transition energies agree well with the experimental results. The results show that the geometry of the dot can be estimated from the optical spectra if the composition is known, and vice versa.

Keywords: InSb-based self-assembled quantum dots, type-II band alignment, photoluminescence (PL) measurement, electronic structure, optical properties.

OE25

EFFECTS OF NITROGEN FLOW RATES ON PROPERTIES OF AlGaN THIN FILMS PREPARED BY CO-SPUTTERING TECHNIQUE

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ABSTRACT- Due to a wide energy bandgap of aluminium gallium nitride (AlGaN) thin films ranging from 3.11 to 6.4 eV, AlGaN is promising for various electronic devices. AlGaN were deposited through a combination of RF magnetron sputtering and HiPIMS. Although the effects of N_2 flow have been studied, they did not show the AlGaN crystal structure. Therefore, the study continues at a low Ar/N_2 ratio and investigates the structural and morphological properties of the films. Through the use of various laboratory equipment, such as X-ray diffraction (XRD), Raman spectroscopy, and atomic force microscopy (AFM), the researchers were able to study the effects of N_2 flow rate on the structure and morphological features of AlGaN film. XRD results show that AlGaN films deposited with more than 3 sccm N_2 flow have polycrystalline AlGaN structure and AlGaN films at 1 sccm N_2 flow show only Al crystal structure. The AFM results show the surface roughness of the AlGaN films getting smooth and lower roughness at N_2 flow rates of 1 to 5 sccm. The surface morphology of AlGaN films deposited at 5 sccm N_2 flow rates had uniform grain size distribution and the grain size was relatively small. The low ratio of N_2 flow by using the co-sputtering technique provides a significant effect on AlGaN thin films deposition.

Keywords: AlGaN films, nitrogen flow, co-sputtering, HiPIMS, RFMS.

OE26

TEXTURED POLYIMIDE SUBSTRATE FOR ENHANCED LIGHT ABSORPTION IN FLEXIBLE BLACK SILICON

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ABSTRACT- This paper presents investigation on textured polyimide (PI) substrate for enhanced light absorption in flexible black silicon (bSi). Flexible bSi with thickness of 60 μm is used in this work. To texture the PI substrate, copper-seeding technique is used. A copper (Cu) layer with a thickness of 100 nm is coated on PI substrate by sputtering. The substrate is then annealed at 400 ^{o}C in air ambient for different durations of 60, 90 and 120 min. With 90 min of annealing, root mean square (RMS) roughness as larger as 130 nm, peak angle at about 24^{o} and the angle distribution of up to 87^{o}. With this texturing condition, the flexible bSi exhibits maximum potential short-circuit current density (J_{max}) of 40.33 mA/cm^2, or 0.45 mA/cm^2 higher compared to the flexible bSi on planar PI. The enhancement is attributed to a significantly enhanced light scattering at the flexible bSi/textured PI interface. The findings from this work demonstrate that the optimization of the PI texturing via Cu-seeding process leads to a significant enhancement in the long wavelengths light absorption and potential J_{max} in the flexible bSi absorber.

Keywords: Polyimide, absorption enhancement, flexible black silicon.

OE27

A DFT+U STUDY ON THE STRUCTURAL, ELECTRONIC AND OPTICAL PROPERTIES OF Ti-, Ag- AND Cu-DOPED ZnO

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ABSTRACT- The structural, electronic and optical properties of pure zinc oxide (ZnO) and transition metal (Tm)-doped ZnO using Tm elements from titanium (Ti), silver (Ag) and copper (Cu) were investigated by a first-principles study based on density functional theory (DFT) as implemented in the pseudo-potential plane wave in CASTEP computer code. The calculations based on the generalized gradient approximation for Perdew-Burke-Ernzerhof for solids with Hubbard U (GGA-PBEsol+U) were performed by applying Hubbard corrections U_d = 5 eV for Zn *3d* states, U_p = 9 eV for O *2p* states and U_d = 1 eV – 10 eV for Ti *3d*, Cu *3d* and Ag *4d* states. The crystal structure used in this calculation was hexagonal wurtzite ZnO with a space group of $P6_3mc$ and supercell 2×2×2. The total energy was calculated to determine the best position for Ti, Ag, and Cu dopants. The density of states (DOS) shows that Tm-doped ZnO has a lower bandgaps value than pure ZnO due to impurity energy levels from Ti *3d*, Cu *3d* and Ag *4d* states. These results are important for the basic understanding of the *3d* and *4d* Tm doping effect ZnO and have a wide range of applications in designing high-efficiency energy harvesting solar cells.

Keywords: First-principles, Tm-doped ZnO, Hubbard correction, electronic properties.

OE28

FABRICATION OF PS/Al NANOCOMPOSITES AS FOILS AND EVALUATION OF THEIR OPTICAL PROPERTIES

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ABSTRACT- Polymer/Al nanocomposites have shown great potential in optical devices due to their good optical properties. The nanocomposites were fabricated by mixing the Al nanoparticles with polystyrene (PS) as polymer matrix. Different concentrations (0, 1, 5, 10, 15 mg) of Al nanoparticles were used. The casting method was used to prepare the PS/Al nanocomposites as foil. UV-Vis spectrophotometer was used to investigate the optical properties of samples such as transmittance and absorption. The optical constants are calculated such as, refractive index, absorption coefficient and optical band gaps. The samples showed high absorption in the UV range.

Keywords: Optical properties, PS/Al nanocomposites, UV-Vis.

TOPIC B: DEVICES

D2

INVESTIGATION ON ABSORPTION AND PHOTOCURRENT IN SILICON ABSORBER WITH VARIED PYRAMID TEXTURE ANGLES BY RAY TRACER

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ABSTRACT- Planar crystalline silicon (c-Si) wafer reflects around 40% of the incident light, which results in a high reflection loss in solar cells. The high reflection loss makes light-trapping inevitable in the solar cells. With wet chemical etching, upright pyramids with varying texture angles are produced on the surface of the c-Si. The varying angles affects optical and electrical properties of the solar cells. In this work, ray tracing is used to investigate the effects of pyramid texture angle towards light absorption and photocurrent in 250 µm-thick c-Si absorber. Upright pyramids with texture angles of 10-50^{o} are investigated. Planar c-Si absorber is used as a reference. When the pyramid angle increases, broadband reflection in the c-Si reduces due to enhanced light scattering, which leads to improved light absorption within 300-1100 nm wavelength region. At angle of 50^{o}, weighted average reflection reduces to 14.7% and broadband absorption increases. In passivated emitter rear cell (PERC) solar cell, planar solar cell exhibits short-circuit current density (J_{sc}) of 26 mA/cm^2 and conversion efficiency of 13.6%. When upright pyramids (with 50o texture angle) and silicon nitride anti-reflective coating are incorporated on the solar cell, the J_{sc} increases to 39 mA/cm2 and the conversion efficiency improves to 20.5%. The performance improvement is attributed to enhanced light-trapping and light-coupling effects in the solar cell.

Keywords: Silicon, light-trapping, absorption, ray tracing.

D3

OPTIMIZATION OF 1 µm GATE LENGTH InGaAs-InAlAs pHEMT

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ABSTRACT- A pseudomorphic High Electron Mobility Transisitor (pHEMT) cut-off frequency (f_T) and maximum oscillation frequency (f_{max}) determined by the role of its' gate length (L_g). Theoretically, to obtain a L_g of 1 µm, the gate's resist opening must be a 1 µm wide. However, after the coat-expose-develop (C-E-D) process, the L_g became 13 % larger after metal evaporation. This enlargement is due to both resist thickness and its' profile. Thus, this research aims to optimize the 1 µm Gate Length InGaAs-InAlAs pHEMT C-E-D process, where the dilute AZ®nLOF™ 2070 resist with AZ® EBR solvent technique has been used to solve the L_g enlargement problem. The dilution theoretically allows the changing of a resist thickness to different film thickness using the same coating parameters. Here, for getting a new resist which simply called AZ 0.5 µm, the experiment important parameters such as the coater's spin speed of 3000 rpm and soft bake at 110 ^oC for 5 min are executed. Finally, L_g metallization using AZ 1 µm by using standard process and AZ 0.5 µm using an optimized process are compared. In capitulate, the outcome of the optimization has reached that it is possible to get a nearly sub-µm range gate's opening using a diluted resist, and at the same time retaining a high resolution and undercut profile.

Keywords: Gate length**,** pHEMT, metal thermal evaporation, lithography.

D4

TEMPERATURE DEPENDENCE OF ELECTRICAL CHARACTERISTICS OF ZnO FIELD EFFECT TRANSISTORS WITH AZO AND ALUMINIUM SOURCE/DRAIN CONTACT

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ABSTRACT- ZnO nanowire field-effect transistor (FET) with aluminium-doped ZnO (AZO) and aluminium (Al) bilayer source/drain contact was fabricated by using top-down fabrication method. The temperature dependence of the electrical properties of the device was investigated in the temperature range of 200 – 300 K to clarify thermally activated carrier generation and carrier transport mechanisms in the conducting channel. With the increased in the temperature, the transfer curve show a parallel shift toward more negative gate voltage direction with a negative shift of the threshold voltage, an increase in the subthreshold slope and a field-effect mobility. The decreased in threshold voltage may have happened due to the trap density or the defect states existed during the fabrication process. The transistors show typical behaviour of the electrical characteristics with different temperatures. It shows the stability of this transistor operates at low temperature. These characteristics are also an indication of the measurement accuracy, thus consequently implies that these nanowire FETs are more reliable and stable which provides a promising platform for low temperature fabrication process and choice of better ohmic contact for various electronic applications. However, according to the temperature specifications of commercial displays, the transistors have to work in the temperature range between 243 K and 360 K. For this purpose, the variation with temperature of electrical characteristics in the temperature range above 300 K is also an important piece of information need to be considered in the future works.

Keywords: ZnO nanowire, field-effect transistor, temperature dependence, top-down nanowire, atomic layer deposition.

D5

HUMIDITY SENSOR PERFORMANCE BASED COMPOSITE ZnO/SnO_2 NANOROD STRUCTURE USING DIFFERENT ZnO SEED LAYER

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ABSTRACT- The nucleation layer is used to relax the strain caused by the lattice and thermal mismatch. The humidity sensor's properties are ext, remely sensitive to crystalline ZnO thin films. Directly growing high-quality ZnO on an amorphous substrate is difficult. This is due to the retention of the self texture and the force of the crystalline buffer layer, both of which limit growth to a specific crystallographic relationship. This paper investigates performance of nanocomposited ZnO/SnO_2 nanorod structure deposited at two different ZnO seed layer (ZnO seed A and ZnO seed B) for humidity sensor aplication. ZnO seed A and ZnO seed B were deposited using two different method which were sputtering method and spin coating method respectively. Nanocomposited ZnO/SnO_2 nanorod structure that has been prepared on ZnO seed A and ZnO seed B using thermal chemical vapor deposition (CVD). The structural properties have been characterized using field emission scanning electron microscopy (FESEM) (JEOL JSM 6701F). Base on the FESEM image the size of ZnO seed A and ZnO seed B were ranging around 75 to 85 nm and 17 to 21 nm respectively. The results analyzed were for nanocomposited ZnO/SnO_2 nanorod structure size on ZnO seed A and ZnO seed B were ranging 35nm to 50nm and 18 nm to 28 nm respectively. The sensor properties were characterized by using current-voltage (I-V) measurement (Keithley 2400). Nanocomposited ZnO/SnO_2 nanorod structure on ZnO seed A performed highest sensitivity with 265 ratio compare to Nanocomposited ZnO/SnO_2 nanorod structure on ZnO seed B with 73 ratio of sensitivity.

Keywords: ZnO/SnO_2, nucleation side, ZnO seed layer, sputtering, spin coating.

D6

POTENTIAL OF WATER-BASED PHOSPHORIC ACID AS EMITTER JUNCTION ON n-SI WAFER

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ABSTRACT- Silicon solar cells are well known as major technology used in solar photovoltaic technologies due to high lifetime and higher efficiency performance. The conventional process of silicon solar cell well known involving highly toxidity process which is harmful to environment and human health. This paper discusses the potential of water-based phosphoric acid (H_3PO_4) as emitter formation on n-type Si wafer. The emitter is formed by using deeply-doped (DD) method since this process will make H_3PO_4 fully coated on n-Si wafers. Variable of temperature and time have been investigated. High and low temperature drive-in process was carried out in order to activated the phosphorous coated on the n-Si wafers in conventional quartz tube furnace. The variation of sheet resistance (R_{sh}) from diffused H_3PO_4 on n-Si wafers with different time and temperature gained with range of 5 to 100 Ω/sq. These resistance was measured from front and back surface of n-Si wafer and show consistency of R_{sh} between front and back surface. High temperature process between 875ºC to 975ºC of H_3PO_4 on n-Si wafers result deeper-junction. While, at low temperature of 700ºC to 850ºC show an outcome of shallower-junction. The junction depth (xj) was calculated based on mathematical calculation which is depend on time, temperature, peak doping, and base doping of n-Si wafers. Peak doping are estimated by using PC1D software by using R_{sh} values from the experimental results. The junction depth before and after PSG removal on n-Si wafers at low temperature diffusion process of H_3PO_4 have an outcome at range 0.08801 µm to 4 µm. Meanwhile, at high temperature is around 4 µm to 28.844 µm. Thus, the R_{sh} values increases as junction depth is reduced. So, the diffusion process by using phosphorous (H_3PO_4) on n-Si via simulations can be evaluated properly and in a good agreement with experiment data.

Keywords: Emitter junction, junction depth, phosphoric acid, sheet resistance, silicon.

D7

ANALYSIS OF TRANSMISSION PERFORMANCE FOR FINE PITCH INTERCONNECTS

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ABSTRACT- IC interconnect technology plays an important role to produce smaller chips with more functionality for high frequency applications. Compared to conventional bonding wire, insulated wire bonding is a disruptive technology with a layer of thin insulation coating (~100 nm) that enables more wires density, wires touching and crossing. To date, past researchers have performed various studies on the free-air-ball, ball bond, stitch bond process optimization as well as reliability of the conventional bonding wires and insulated wires. However, there are limited studies on the electrical performance of bonding wire. This paper employed electromagnetic field 3D modelling and analysis to understand the electrical characteristic of conventional gold and copper bonding wires as well as insulated wires with various set parameters at high frequency. The modelling simulations were performed according to Joint Electron Device Engineering (JEDEC) 97 standards. The frequencies used in this experiment ranged from 1 MHz to 20 GHz. The bonding wire structure was fixed via S-loop mode as standard looping. Various modelling case studies were carried out, including different wires material, wire diameters, insulation thickness and bonding height. The effect of return loss and insertion loss based on single wire looping are established and discussed in details. Next, case study on cross talk for Near End Cross Talk (NEXT) and Far End Cross Talk (FEXT) modelling simulations were performed on bonding wires. Based on the key findings, it was observed that insulated wires have comparable performance compared to conventional wires across all frequencies. In conclusion, understanding on the electrical performance for insulated wire technology is important to enable more innovations in IC semiconductor packaging.

Keywords: Wire bonding, insulated bonding wire, S parameters, interconnect technology.

D8

FABRICATION UV ZnO NRs PHOTODETECTOR BASED ON SEEDED SILICONE (SI) SUBSTRATE VIA THE DROP-CASTING TECHNIQUE

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ABSTRACT- In this study, ultraviolet (UV) metal-semiconductor-metal (MSM) photodetector fabricated based on zinc oxide nanorods (ZnO NRs) growth on seeded Silicone (Si) substrate. The drop-casting technique was used as a simple and low-cost method to deposit the ZnO seed layer on bare silicon (bSi). The morphological, structural and optical properties of the synthesised thin films are studied, using field emission scanning electron microscopy(FESEM), atomic force microscopy (AFM), X-ray diffraction (XRD), UV-VIS spectroscopy and PL spectroscopy. Semi-Vertically high-density ZnO nanorods were effectively produced using a hydrothermal deposition approach on ZnO seeded that fabricated by the drop-casting method. The development of the wurtzite ZnO phase with a preferential orientation along (002) direction and increased crystallinity is confirmed by XRD analysis.PL spectroscopy analysis proves the formation of a wurtzite structure with high crystallinity and fewer defects. The optical band gap was estimated from reflectance by (3.27 eV). As well as the performance of the fabricated MSM devices was investigated by current-voltage (I–V) measurements. The photodetection mechanism of the fabricated device was discussed.

Keywords: ZnO nanorods, hydrothermal, drop casting method, UV, photodetector.

D9

EFFECTS OF NOTCH STRUCTURES ON THE TRANSFER AND DC PERFORMANCES OF AlGaN/GaN HEMT DEVICES

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ABSTRACT- Lateral GaN devices, with their substantial critical breakdown field and increased mobility of 2-dimensional electron gas, are particularly promising for future power applications. Due to the high power and frequency performances, these properties have many potential applications, including power amplifier technology, pressure sensor, and space and radar area. However, even with low power consumption by design, further improvements are required in many areas, including reliability issues and switching loss, usually contributing to significant power loss. This research's objective concerned the impact of variation of notch structures on the transfer and DC performances of HEMT devices. In this work, three structures of AlGaN/GaN HEMT have been initially designed, namely Typical, Structure 1, and Structure 2. Typical refers to conventional AlGaN/GaN HEMT architecture without any notch and is denoted as model Type-1. Meanwhile, Structure 1 and 2 refer to various designs with notches; the earlier denotes to model type-2 until type-7, whereas model type-8 until type-13 for the latter. Hence overall, there are 13 simulated models, which have been achieved using COMSOL Multiphysics computer software, incorporating the devices' electrical, structural, and piezoelectric effects. Based on the results, the notch-structure HEMTs show better electrical characteristics than conventional HEMT architecture, particularly the type-7 model

from Structure 1 with double notch designs. Higher transconductance, maximum drain current, and breakdown voltage are among the improvements seen, benefiting from the notch structure at the barrier layer.

Keywords: High electron-mobility transistor, AlGaN/GaN, power devices, current-voltage characteristics, 2DEG, notch.

D10

COMPARISON OF THE ELECTRICAL PERFORMANCE OF AlN AND HfO_2 PASSIVATION LAYER IN AlGaN/GaN HEMT

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ABSTRACT- Different material thickness with medium and high dielectric constant can impact the performance and reliability of high electron mobility transistor device. With varying the thickness of the passivation layer, the effect of it towards the device performance is still unclear. In this paper, two different insulator layer with a medium dielectric and a high dielectric constant namely Aluminium Nitride (AlN) and Hafnium Oxide (HfO_2) were used as passivation layer in AlGaN/GaN high electron mobility transistors (HEMT). AlN and HfO_2 performance were simulated via COMSOL software by varying the thickness. The maximum drain and gate voltage were investigated and drain current output were compared between the two materials. A correlation between material dielectric constant and layer thickness is presented. The passivation layer thickness of 10nm at V_{ds}=6V and V_{gs}=5V, HfO2 outperforms AlN with the output drain current of 40mA compared to 32mA.It was also observe that HfO_2 are able to attain higher drain voltage at thickness of 10nm, 20nm and 30nm passivation layer compare to AlN but current remain constant at 60mA when layer thickness is 20nm above. Moreover, out of all the thickness simulated for high dielectric HfO_2, the optimum thickness was 20nm and above it would not impact the current output as it remains stagnant with current output of 60mA. Alternatively, for low dielectric AlN, thickness more than 20nm would not

increase the current output instead the current output were reduced by half of the current output at 20nm thickness.

Keywords: Dielectric constant, AlGaN/GaN, passivation layer, aluminium nitride, hafnium oxide, breakdown voltage, HEMT.

D11

CHARACTERIZATION OF BREATH SENSOR AT DIFFERENT FREQUENCIES IN OUTDOOR CONDITION

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ABSTRACT- This paper investigates a breath sensor device that is designed to detect the moisture in human bulk matrix at outdoor condition. Human's bulk matrix is rich in moisture and carbon dioxide apart from the 872 volatile organic compounds emanating from the human breath. Human breathing effort is a respiration process that involves inhalation and exhalation modes. The human bulk matrix is a product of the latter. Most research in the human breath analysis is concentrating on both human bulk matrix and breathing pattern. The aim of this study is to characterize the fabricated breath sensor at different input wave frequencies in outdoor environment. In this study, an outdoor experiment was carried out using the breath sensor device that is connected to the input waveform from the frequency generator and the output reading is captured using the oscilloscope. A single exhaled breath originated from the human subject is required to activate the breath sensor. This method is easier and simpler, and the output wave result is generated by the oscilloscope at real time. The result indicates that the investigated breath sensor is suitable for clinical and healthcare monitoring. Early studies indicate that the breath sensor can diagnose diseases related to breathing problems such as sleep apnoea, asthma, and strokes.

Keywords: Breath sensor, human breath, breathing pattern, outdoor.

D12

OPTO-ELECTRONIC CHARACTERISATION OF GaAsBi/GaAs MULTIPLE QUANTUM WELLS FOR PHOTOVOLTAIC APPLICATIONS

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ABSTRACT- A series of p-i-n diodes containing GaAsBi quantum wells with GaAs barriers, ranging from 3 to 63 periods was grown using molecular beam epitaxy. Opto-electronic characterisation was performed to investigate its absorption performance as the third 1eV junction material in a multi-junction solar cell.
Current-voltage measurements of the devices demonstrate good diode behaviour with ideality factors between 1 and 2 and clear differences in the dark current values between strained and strain-relaxed devices. The increase in dark currents with relaxation in GaAsBi is relatively small and far smaller than one would expect for InGaAs of the same strain. In addition to that, the absorption edge of the material is substantially shifted with the addition of relatively little bismuth, proving that Bi can reduce the bandgap with less strain introduced to the structure. However, the devices have poor carrier extraction when light is absorbed during photocurrent measurements. This may be caused by hole trapping in the valence band. Carrier extraction enhancement leading to more photocurrent can be achieved by applying a slight reverse bias around -1 to -2 V when the measurement was taken.
Overall, GaAsBi/GaAs multiple quantum wells are a promising alternative for a 1 eV junction in multiple junction solar cells if the issue of hole carrier trapping and the high dark currents can be overcome.

Keywords: GaAsBi, MQW, p-i-n diode, responsivity, optoelectronic.

D13

EFFECT OF INDIUM IN P-LAYER OF InGaN GREEN LEDs

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ABSTRACT- This work demonstrates the introduction of indium in p-layer, which includes p-AlGaN electron blocking layer (EBL) and p-GaN layer. Three different indium flow rates were introduced in the p-layer of the InGaN green LEDs, which were 13 µmol/min, 22 µmol/min and 34 µmol/min, respectively. An LED without indium in the p-layer was also included for comparison. The surface roughness of the LEDs was reduced when indium was introduced in the p-layer. By comparing the LEDs with indium in the p-layer, the green LED with 22 µmol/min of indium flow rate exhibited the smoothest surface. Electroluminescence (EL) measurement showed that the peak wavelength of the green LEDs was slightly blue-shifted as the indium was introduced in the p-layer. Moreover, the light output power (LOP) of the green LEDs was doubled when the indium was introduced in the p-layer, regardless of the indium flow rate. Hall-effect measurement revealed that the hole concentration of the green LED increased while the resistivity decreased when indium was introduced in the p-layer, especially with 22 µmol/min of indium flow rate. *I-V* curves measurement showed that the green LED with 22 µmol/min of indium introduced in the p-layer had the lowest forward voltage of 3.90 V. It is worth highlighted that the improvement in LOP and voltage of the InGaN green LEDs can be further studied in future work.

Keywords: Indium flow rate, surface, light output power, hole concentration, forward voltage.

TOPIC C: ORGANIC AND POLYMERIC MATERIALS

OP2

THERMOMECHANICAL AND DIELECTRIC PROPERTIES RELATIONSHIP OF HYBRID CARBON BLACK AND NANO SILICA EPOXY COMPOSITES

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ABSTRACT- Multifunctional materials refer to the types of materials that possess enhanced mechanical, electrical, and thermal properties. In this work, nano silica and Carbon Black (CB) are added to epoxy polymer as an effort to improve the thermomechanical and dielectric properties of the composites. Filler loadings are varied from 0.1 wt.%, up till 5 wt.%. The thermomechanical properties are measured from Dynamic Mechanical Thermal Analysis (DMTA) while the dielectric properties are measured from Vector Network Analyser (VNA). The synergistic effects of combining both fillers (keeping them at 1:1 wt.% ratio) are also assessed. It was found that the value of glass transition temperature, T_g, increased from 56.85°C (neat epoxy) to 59.8°C (5 wt.% CB). The T_q values further increased to 64.7°C, for 5 wt.% hybrid fillers (2.5 wt.% silica + 2.5 wt.% CB), demonstrating the synergistic effects by employing dual fillers. By adding single and dual fillers, the values of storage Modulus, E' remains almost constant for both glassy (40°C) and rubbery region (100°C), regardless of the loadings employed. The values of real permittivity, ε' was also measured for dual fillers in the frequency range between 300 kHz to 18 GHz. The highest value of ε' was 819 F/m, which was measured for 1.5 mm sample thickness of 5 wt.% hybrid fillers (2.5 wt.% silica + 2.5 wt.% CB). This study highlights the thermomechanical and dielectric properties improvement of epoxy composites by incorporating dual fillers.

Keywords: Glass transition temperature, permittivity, synergistic effects.

OP3

UTILIZATION OF SAWDUST AS AN ABSORBING MATERIAL IN ANTI-MICROWAVE BRICK WALLS MANUFACTURING

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ABSTRACT- The developments of communications technology bring changes in human life, and the positive aspects of these technology innovations make life more accessible. However, the use of communications technology at a certain frequency will produce radiation that could negatively affect human health. Thus, various studies have been performed to obtain a corresponding material to reduce the levels of exposure against the pollution of the electromagnetic wave signal. This study aims to build anti-microwave brick walls and analyze the absorption performance of the anti-microwave brick walls by using sawdust as an absorbing material. Sawdust is a waste product generates from woodworking processes such as sawing, sanding, and milling. Recently, the application of using a by-product from numerous sources in construction works has been increasing. Along with environmental protection, numerous studies were conducted on the recycling of waste products as construction resources. In this project, sawdust was used as an absorbing material in brick production by mixing with Portland cement. The absorption performance of the anti-microwave brick walls was measured by using Naval Research Laboratory (NRL) arch free space method, and the frequency range of 1GHz to 12GHz is used. The result of the absorption performance shows in the graph of absorption (dB) versus frequency (GHz). The result shows that brick contains a high percentage of sawdust produces good absorption performance at a low-frequency band (2-4GHz), while brick contains a low percentage of sawdust produces good absorption performance at a high-frequency band(4- 12GHz).

Keywords: Anti-microwave brick wall, waste products, sawdust, absorbing material, Naval Research Laboratory.

OP4

PVA NANOFIBERS EMBEDDED WITH DIFFERENT CONCENTRATION OF ZnO PREPARED BY ELECTROSPINNING METHOD

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ABSTRACT- Electrospinning is a fiber forming method and had been applied in applications such as filtration, drug delivery and artificial skin. Commonly in elecrospinning, the starting liquid was filled in a syringe attached with a metallic needle. After electrical charges was supplied at the needle, the solution would also be electrically charged. When voltage supplied is higher than the critical voltage, the solution at the apex of Taylor cone would be ejected towards substrate attached to grounded collector in form of jet. After arriving on the substrate, the jet will settle on the susbtrate surface in form of solid fibers. Here, the liquid used were ZnO particles of different concentration dispersed in polyvinyl alcohol (PVA) solution. ZnO is a biocompatible and non-toxic material and has great properties that is very beneficial in cancer therapy, antibacterial, antifungal, cell growth and tissue regeneration. Electrospun fibers can help in delivering or integrating ZnO in needed medical situation. For this purpose, this study investigated the effects of adding ZnO particles on the structure of fibers produced. It was found that other than increment of ZnO particles in the PVA-ZnO fibers as ZnO concentration being increased, no other significant changes was observed on the fibers orientation and structure. The diameters of PVA-ZnO fibers also only slightly differs compared to the pure PVA fibers with no ZnO. Hence if there are needs of ZnO to be integrated with PVA fibers for medical, pharmaceutical or any other purposes, it can be done without damaging or changing the quality of final fibers product.

Keywords: Electrospinning, nanofibers, PVA, ZnO.

OP5

REMOVAL OF CONGO RED DYE USING GREEN KYLLINGA WEED EXTRACT AND MEDIATED-SILVER NANOPARTICLES AS CATALYSTS

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ABSTRACT- This study describes the ability of green kyllinga weed extract (GKWE) with silver nanoparticles (AgNPs) as catalysts for the removal of congo red (CR) dye from synthetic coloring wastewater. The experiment was carried out in batch mode. Different parameter such as effect of pH (2 – 12), amount of AgNPs as catalyst (0.5 – 4.5 mL), initial of CR dye concentration (20 – 100 mg/L) and amount of GKWE (0.5 – 2.0 mL) were evaluated for the removal of CR dye for 30 mins reaction times. The catalytic activity of GKWE with AgNPs on removal of CR dye was analysed using UV-vis spectroscopy. The CR removal was achieved between 91.2% and 96.7% at optimum condition which are at pH 2, 0.5 mL of 2 mM AgNPs as catalyst, 60-100 mg/L of initial CR dye concentration and 1 mL amount of GKWE were used. The result showed that the combination between GKWE and AgNPs had a synergy interaction in enhancing the removal of CR dye from coloring wastewater via coagulation-flocculation and sedimentation process.

Keywords:

OP6

DIELECTRIC PROPERTIES OF EPOXY COMPOSITES CONTAINING SILVER NANOPARTICLE AND CARBON NANOTUBE OVER THE X-BAND FREQUENCY

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ABSTRACT- Materials with high dielectric properties have becoming an interest due to its important applications mainly in the area of electronics and energy storage. This study focuses on the assessment of dielectric properties of epoxy composites containing silver nanoparticles and carbon nanotube (CNT) composite materials. Both permittivity and reflective properties of these samples was measured using Vector Network Analyser, within the X-band frequency range of 8.2 – 12.4 GHz. Samples were prepared at various loading (0.1 wt.% - 5 wt.%), with various thickness of (0.5 mm, 1.0 mm, 1.5 mm, and 2.0 mm). Regardless of the fillers' loading and sample thickness, it was found that the values of real permittivity, er' remains constant along the frequency range. At the same sample thickness, it was found that the values of both er' and er'' increases as loading increases, indicating the function of silver nanoparticle and CNT in enhancing the dielectric and electrical conductivity properties of epoxy composites, respectively. The highest value of er' is recorded to be 5 F/m (at f = 8.2 GHz), which is measured at 5 wt.% loading and 0.5 mm sample thickness. Measurement on S11 parameters at f = 8.2 GHz indicated that the SER values are in between 9 dB and 15 dB, with no obvious pattern is observed, regardless of the fillers loading and sample thickness.This study highlights the dielectric properties improvement of epoxy composites by incorporating dual fillers.

Keywords: Permittivity, dual fillers, electromagnetic shielding, X-band frequency.

OP7

FABRICATION OF NANOCOMPOSITE PDMS/GRAPHENE AS FLEXIBLE SUBSTRATE AT DIFFERENT GRAPHENE CONCENTRATION

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ABSTRACT- Nowadays, conductive and flexible electronics have attracted great demands and attention in the field of stretchable and wearable electronic devices due to their high electrical conductivity, large surface area and biocompatibility. In this work, polydimethylsiloxane (PDMS) was composited with different drops of graphene solution to produce flexible, conductive and optically transparent PDMS/Graphene composite using the drop-cast method. The dielectric constants of PDMS and PDMS/Graphene composite were measured using Agilent dielectric probe. I-V characterization was used to measure the conductivity of the flexible substrate in flat and bending conditions. The UV-VIS was used to measure the transmittance properties of the substrate. Comparing the electrical properties of the pristine PDMS substrate with graphene composited PDMS substrates, the current shows a slight decrease due to the physical morphology of PDMS/Graphene composite that creates a small hole on the surface. No significant changes can be found between 1 drop, 2 drops, 3 drops and 4 drops of graphene in PDMS solution. For the dielectric measurement, the result of composited PDMS/Graphene sample had shown a lower value of dielectric constant (1.1 F/m) compared to pure PDMS (2.33 F/m). This shows that the existence of graphene in PDMS reduces the dielectric constant of pristine PDMS. The result of UV-VIS shows the samples with 4 drops of graphene having the lowest visible transmittance. The PDMS/Graphene composite can be concluded as a dielectric material with a lower dielectric constant. It has the potential to be used as a conductive substrate for further flexible interconnect materials since it has a unique electrical feature and robust mechanical strength.

Keywords: PDMS, graphene, flexible substrate, dielectric constant.

OP8

CHARACTERIZATION OF NATURAL DYE EXTRACTED FROM MEDICINAL LEAF OF MITRAGYNA SPECIOSA FOR DYE-SENSITIZED SOLAR CELLS

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ABSTRACT- Dye-sensitized solar cells (DSSCs) based on natural sensitizers have become a topic of significant research because of their urgency and importance in the energy conversion field and with the following advantages such as simple fabrication, low-cost solar cell, and the usage of nontoxic materials. In this paper, natural dyes extracted from ketum (Mitragyna speciosa-MS), spinach (Spinacia oleracea-SO), curry (Murraya koenigii-MK), papaya (Carica papaya-CP) and henna (Lawsonia inermis-LI) were investigated as a sensitizer in the fabrication of dye-sensitized solar cells (DSSCs). The ultraviolet–visible (UV–vis) spectroscopy, Fourier transform infrared spectroscopy (FTIR), current to voltage characteristics (I-V) and open-circuit voltage decay (OCVD) were employed to characterize the natural dye and the fabricated DSSCs. Based on the UV–vis results, all extracted dyes contains both chlorophyll- a and chlorophyll-b pigments, which is excellent pigment required for the charge-carriers generation in the energy harvesting process from the sunlight. In this regard, dye pH and chemical bonding of the respective dyes play the significant role that contributed their overall performances of the DSSCs. The best performance of DSSC was obtained at MS dye, with the values of open circuit voltage (V_{oc}) short-circuit current density (J_{sc}), fill factor (FF) and a noticeable power conversion efficiency (PCE) of DSSC being 0.400 V, 1.35 mA/cm^2, 0.264 and 0.137 %, respectively. In this study, it showed that natural sensitizers such as the novel MS have a potential candidate used as natural sensitizer due to low cost, less toxicity, environmentally-friendly, wide availability and easy to prepare and satisfactory energy conversion efficiency.

Keywords: Dye-sensitized solar cell (DSSC), mitragyna speciosa, spinacia oleracea, murraya koenigii, carica papaya, lawsonia inermi, energy conversion efficiency.

TOPIC D: PACKAGING TECHNOLOGY

PT1

INTERFACIAL DELAMINATION VALIDATION ON FAN-OUT WAFER-LEVEL PACKAGE USING FINITE ELEMENT METHOD

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ABSTRACT- Fan-out wafer-level package (FOWLP) is a very promising packaging technology with good thermal and electrical performance. FOWLP exhibits beneficial features such as low profile, high I/O density, low cost, and more efficient. Currently, several FOWLP packages, either through chip-first or chip-last process, were utilized for wireless, telecom, IOT, and automotive applications. The package experiences large temperature variations while manufacturing which can cause internal stresses. In particular, the mismatch between the coefficient of thermal expansion (CTE) of epoxy molding compound (EMC) and the substrate during curing and cooling down to room temperature causes the internal stresses in the package that results to interfacial delamination. In this study, the interfacial delamination in FOWLP individual package is evaluated using the stress-based damage index through the finite element analysis in ANSYS software package. The warpage simulation was performed right after the postmold curing of the molded wafer. The model was validated by comparing the warpage result of glass wafer from simulation to the existing experimental result from literature. And then, from the warpage simulation of glass wafer, the region on the package with extensive stresses was located and examined which may cause interfacial delamination. The information obtained from the stress analysis of molded wafer will be helpful to study the possible interfacial failure of FOWLP individual package when subjected to thermomechanical loads.

Keywords: Interfacial delamination, fan-out wafer-level package, finite element method, virtual crack closure technique.

PT2

MODELLING AND THERMAL SIMULATION FOR 1mm^2 VSCEL CHIP

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ABSTRACT- The Vertical Cavity Surface Emitting Laser VSCEL thermal resistance, Rth is an essential metric that reflects its thermal properties and dependability. The Rth for all device/ packaging is determined by two key components or factors: the thermal pad and the chip size dimension. Three types of packaging were introduced with different material such as ceramic, lead frame and print circuit board, PCB based for the thermal simulation. During research, multiple software were introduced: Solid Work and Auto Cad for modeling with a 3D dimension, and ANYS for thermal simulation. By the end of the study, it had been determined that the optimal packaging was suitable and capable of performance while utilising the 1mm2 VSCEL chip, based on the Rth and heat dissipation findings.

Keywords: Thermal resistance, VSCEL, heat dissipation.

POSTER PRESENTATION

P1

COMPARISON ON THE PERFORMANCE OF MOS CAPACITOR SIMULATED USING SILVACO TCAD TOOLS

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ABSTRACT- Metal oxide semiconductor (MOS) capacitor is a trilayer device that comprises of metal, dielectric and semiconductor layer. The advancement of MOS technology has greatly give huge improvement to MOS devices which lead to scaling down he MOS devices. On top of it, reduction in the dielectric thickness also has coming to an end so an alternative of using material with high mobility carrier as semiconductor base material is investigated. The first objectives of this work are to study the performance of MOS capacitor by varying the base material from conventional material which is silicon (Si) to germanium (Ge) and composite silicon -germanium (SiGe). The second objective is to replace the silicon dioxide (SiO_2) to other dielectric material which is silicon nitride (Si_3N_4) since SiO_2 has disadvantage when the dielectric thickness is reduce below 10nm. This project is simulated using Silvaco TCAD tool and the performance of the simulated MOS capacitor is evaluated based on the capacitance-voltage (C-V) and current-voltage (I-V) characteristics. Result show the performance of the MOS capacitor increased when Ge and SiGe are used as the base material. with incorporation Si_3N_4 as dielectric layer with VT of 4.15 V and 4.28 V while the C_{max} value for both devices is 2.61×10-14F and 1.30×10-14F, respectively. Based on the obtained results, Ge is chosen as the best material to be used as the semiconductor layer supported by recent researchers.

Keywords: MOS Capacitor, Ge, SiGe, C-V, I-V.

P2

STUDY OF STRAINED-SiGe CHANNEL P-MOSFET USING SILVACO TCAD: IMPACT OF CHANNEL THICKNESS AND Ge-COMPOSITION

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ABSTRACT- Compressively strained SiGe is an interesting channel material for sub 45 nm p-MOSFETs because of its superior hole mobility (up to 10X over bulk Si channels) and compatibility with current Si manufacturing technologies. In this work, the impact of heterostructure composition and SiGe channel thickness on the electrical characteristics of MOSFETs are investigated. Using strained Si0.8Ge0.2 p-MOSFETs, the thickness was altered to a few thicknesses of 3nm, 5nm, 7nm, and 9nm respectively. The optimal thickness was then used for several Ge compositions (x = 0.2, 0.25, 0.3, 0.35, and 0.4). The project was realized utilising computer-aided SILVACO TCAD (Technology-Computer Aided Design) tools, with ATHENA tools creating the p-MOSFET structure and ATLAS tools doing device simulation. The strained-Si1-xGex p-MOSFET and the Si p-MOSFET were compared in terms of their performances. The Id-Vg and Id-Vd characteristics, as well as the threshold voltage, VTH extraction, were the focus of the device simulation. Specifically, the extracted value of the VTH for 7nm thickness strained-Si0.8Ge0.2 p-MOSFET is lower than other different thicknesses and the Si p-MOSFET which is VTH=0.074V. The lower threshold voltage of the 7nm thickness strained-Si0.8Ge0.2 with 7nm thickness is lower than that of the Si p-MOSFET, indicating that strained-Si1-xGex contributed to the decreased power consumption. In addition, the extracted IDmax for strained-Si0.8Ge0.2 p-MOSFET with 7nm thickness provided higher IDmax compared to conventional p-MOSFET and other thicknesses. As compared to Si p-MOSFETs, the output characteristics of strained-Si1-xGex demonstrated a drain current improvement.

Keywords: Strained SiGe, p-MOSFET, thickness, Ge percentage, threshold voltage.

P3

ENHANCED CATALYTIC EMBEDDED POROUS SILICON FOR IMPROVED HYDROGEN GAS SENSING

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ABSTRACT- In this work, the PS substrate was prepared using the technique of electrochemically etching of n-type Si (100) wafer at a constant current density of 10 mA/cm^2 for 10 mins under the illumination of incandescent white light. After PS formation, Ge pieces were thermally evaporated onto the two PS substrates in a vacuum condition. This was then followed by the deposition of the ZnO layer onto the Ge/PS substrate by the same method using commercial 99.9% pure ZnO powders. The three samples were identified as PS, Ge/PS and ZnO/Ge/PS samples respectively. Pd finger contacts were deposited on the PS and embedding PS (Ge/PS and ZnO/Ge/PS) to form Pd on PS hydrogen sensors using RF magnetron sputtering. The performance of the PS and embedded PS as hydrogen sensors were examined and discussed. SEM and EDX suggested the presence of substantial Ge and ZnO inside the uniform circular pores for Ge/PS and ZnO/Ge/PS samples respectively. Raman spectra showed that good crystalline Ge and ZnO nanostructures embedded inside the pores were obtained. For hydrogen sensing, Pd on ZnO/Ge/PS Schottky diode exhibited dramatic change of current after exposure to H_2 as compared to PS and Ge/PS devices. It is observed that the sensitivity increased exponentially with hydrogen flow rate for all the sensors. The ZnO/Ge/PS showed more sensitivity towards H_2 than that of PS and Ge/PS especially at high flow rate of H_2 with higher current gain (69.11) and shorter response (180s) and recovery times (30s).

Keywords: Porous Silicon, Ge, ZnO, thermal Evaporation, H_2 sensor.

P4

SURFACE MORPHOLOGICAL AND OPTICAL CHARACTERISTICS OF ETCHED ZnO/GLASS AT VARIOUS H_2O_2 CONCENTRATIONS

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ABSTRACT- We utilise hydrogen peroxide (H_2O_2) solution as an effective etchant for zinc oxide (ZnO) thin films with well-controlled etching and low surface roughness values that is also easy, inexpensive, and ecologically friendly. The ZnO thin films are grown on the soda-lime glass substrate by a radio frequency (RF) sputtering machine. The objective of the project is to evaluate the surface morphological and optical properties of etched ZnO/glass at different H_2O_2 concentrations and etching times and to fabricate ZnO thin films on glass substrate by using the RF sputtering method. To achieve the objective, factors such as H_2O_2 concentrations of 10%, 20%, and 30% are used, with an etching duration of 30 seconds and 60 seconds. After the etching procedure, UV-Visible Spectroscopy (UV-Vis), Optical Microscope, Scanning Electron Microscope (SEM), and Filmetric are used to examine the structural features, surface morphology, refractive index, and thickness of ZnO thin films produced on the glass substrate. The thickness and refractive index results indicate that increasing the quantity of H2O2 causes an increase in light absorption in the samples. The UV-Vis absorbance and transmittance results indicate that the combination of 30% H_2O_2 and 60 sec is the best because the light is easily reflected and absorbed to the surface of the sample.

Keywords: Zinc oxide, ZnO, wet etching, hydrogen peroxide, glass.

P5

EFFECTS OF THERMAL AND MICROWAVE HEAT TREATMENTS ON STRUCTURAL PROPERTIES OF GaN-BASED BLUE LED

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ABSTRACT- Light-emitting diodes (LEDs) are regarded as the most important light source in next-generation solid-state lighting. In recent years, the solid-state lighting market is dominated by gallium nitride (GaN) based LEDs. For this reason, the research was carried out to satisfy the curiosity to investigate the effects of heat treatment on the structural properties of the LED sample. Homegrown GaN-based blue LED samples were used, and two series of heat treatments were carried out, i.e., (i) thermal annealing at normal ambient for 15 min at different temperatures and (ii) microwave (MW) heat treatments at normal ambient for 5 min and 15 min under different MW powers. The results reveal that both thermal annealing and MW heat treatments play a significant effect on the crystalline quality of the samples. The result demonstrated that MW heat treatment is better than that of the thermal annealing treatment for improving the crystalline quality. From the XRD rocking curve of GaN (002) diffraction peak, the results show that the sample annealed at 750°C has the lowest screw and edge dislocations. On the other hand, the sample subjected to 800 W MW heat treatment for 5 min exhibits the lowest screw and edge dislocations.

Keywords: III-V nitride, semiconducting indium compounds, dopant activation, wide band gap semiconductor, dislocation.

P6

ZnO NANORODS AS A NANOSENSOR PREPARED BY HYDROTHERMAL METHOD FOR METHANOL DETECTION IN AQUEOUS SOLUTION

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ABSTRACT- In this study, zinc oxide (ZnO) nanorods were produced hydrothermally with the aid of a zinc oxide seeds layer to create an electrode for detecting methanol. On an indium tin oxide (ITO) substrate, zinc oxide nanorods were produced and aggregated in well-aligned nanorods. Field emission scanning electron microscopy (FESEM) and water contact angle were used to evaluate the morphology and wettability of the ZnO/ITO electrode. Nanorods were ranged from 62 to 90 nm in diameter. Using three electrodes from the current-potential (I-V) technique in 0.5 M phosphate buffer saline (PBS) solution, the ZnO/ITO electrode was utilised to detect methanol in the range of 0.10 mM-5 M. The ZnO/ITO electrode exhibited remarkable 0.30 $\mu AmM^{-1}.cm^{-2}$ sensitivity with the 0.42 mM detection limit and a linear correlation coefficient (R^2) of 0.9327. This result thus proved the potential of the ZnO/ITO electrode to be used as a methanol sensor in an aqueous solution

Keywords: ZnO nanorods, nanosensor, methanol, aqueous solution, hydrothermal.

P7

NANOMANIPULATION OF FUNCTIONALIZED GOLD NANOPARTICLES ON GaN

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ABSTRACT- Gold nanoparticles (AuNPs) is known for its high surface area to volume ratio which acts as an excellent receptor when placed in between electrodes in sensors application. Microelectrodes which are bar and needle shape pointed ends with two arrangements; comb and castle wall configurations were designed to be used for fabrication of electrodes to observe the relation between geometry of electrodes and dielectrophoresis of AuNPs on gallium nitride (GaN) substrates. The dielectrophoretic behaviour and electrical properties were analyzed before and after the drop cast of AuNPs using current-voltage (I-V) curve method with manual probing. Resistance values of each sample were calculated under reverse bias condition. The effect of design on the nanomanipulation of AuNPs will be discussed.

Keywords: Dielectrophoresis, drop casting, gold nanoparticles, GaN.

P8

EFFECTS OF INDIUM COMPOSITION ON THE SURFACE MORPHOLOGICAL AND OPTICAL PROPERTIES OF InGaN/GaN HETEROSTRUCTURES

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ABSTRACT- In this work, the effects of indium composition on surface morphology and optical properties of indium gallium nitride / gallium nitride (InGaN/GaN) heterostructures were investigated. The InGaN/GaN heterostructures were grown on flat and patterned sapphire substrates using a metal-organic chemical vapour deposition reactor with a trimethylindium flow rate of 368 sccm. The indium composition of the InGaN epilayers were controlled by applying different substrate temperatures. The surface morphology and optical properties of the heterostructures were assessed using several characterization tools. From the i.e., field emission scanning electron microscopy and atomic force microscope images, InGaN/GaN shows significantly different surface morphologies and topographies as the indium composition increases. From the Raman measurements, weak lattice vibrational modes of the InGaN were detected because these modes were masked by the strong GaN modes. The energy band gap InGaN epilayers was estimated from the photoluminescence and ultraviolet-visible measurements. Through this study, relationship between the indium composition and the surface morphological and optical properties were gathered and discussed.

Keywords: III-V nitride, semiconducting indium compounds, epitaxy, wide band gap semiconductor, energy efficiency.

P9

GROWTH OF AlN LAYER BELOW 1180°C VIA METAL ORGANICS CHEMICAL VAPOR DEPOSITION

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ABSTRACT- In this work, aluminum nitride (AlN) layers were grown on sapphire substrate with a relatively low deposition temperature below 1180°C using a metal organics chemical vapor deposition (MOCVD) growth technique. Under this condition, trimethylaluminum (TMAl) with different preflow time was elaborately introduced, in particular, after the nucleation layer was formed to elucidate its effects on the quality of deposited AlN layers. From x-ray diffraction measurement in both (002) and (102) reflections, it was found that an average threading dislocation density (TDD) of the AlN layer without TMAl preflow was around 1.59×10^9 cm^{-2}. By applying the TMAl preflow for 30 seconds, the average TDD of the corresponding AlN layer was successfully reduced to 1.27×10^9 cm^{-2}. Besides, as observed from atomic force microscopy measurement, the AlN layers exhibited a smoother surface with the lowest root mean square roughness of 1.17 nm. In conclusion, the results from this work suggested that with a proper introduction of TMAl preflow time, a high quality AlN layer can be obtained at a relatively low deposition temperature below 1180°C.

Keywords: Trimethylaluminum preflow, dislocations, surface roughness, low temperature.

P10

ENHANCING PHOTOCATALYTIC ACTIVITY OF Cr DOPED $SrTiO_3$ IN TERMS OF ELECTRONIC STRUCTURE AND OPTICAL PROPERTIES : A DFT + U INVESTIGATIONS

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ABSTRACT- A systematic investigation based on spin-polarized DFT + U has been carried out to study the electronic structure and optical properties of Cr doped $SrTiO_3$ as compared to pure $SrTiO_3$. The exchange and correlation interaction was treated with the generalized gradient approximation (GGA) of Perdew–Burke–Ernzerhof (PBE). To reproduce the experimental band gap of 3.2 eV in $SrTiO_3$, the GGA + U_p + U_d approach was adopted to describe the correlation effects, which can predict the corrected electronic structure and optical properties. The on-site corrections are typically applied to the d or f orbitals of transition metal oxides; however, the band gaps are still underestimated with respect to the experimental values. The calculated band gap of pure $SrTiO_3$ is improved to 3.25 eV using GGA + U method by choosing appropriate U values, which is in good agreement with experimental value. The results show that the hybridization between orbitals from Cr and Ti states leads to the formation of fully occupied and delocalized intermediate states near the valance band of $SrTiO_3$. The doping of Cr is well explained by the partial and total density of states which is affected by incorporating dopant in pure $SrTiO_3$. Optical properties also affected by doping Cr. The calculated optical absorption of Cr doped $SrTiO_3$ also verified the improved visible light absorption by donor-acceptor doping. The doping of Cr in $SrTiO_3$ affects positively in electronic structure and optical properties that give a good indicator for photocatalytic water splitting.

Keywords: Doping, density functional theory, band gap, density of states, optical properties.

P11

STUDY OF POROUS III-V SURFACE STRUCTURE VIA ETCHING PROCESS: EFFECT OF PORE DEPTH

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ABSTRACT- In this project, the surface structure of III-V semiconductor which is GaAs was manipulated to enhance the optical and electronic properties of the semiconductor. This project involved the designing and fabrication of nonporous and porous GaAs structure using SILVACO TCAD tools. The porous GaAs with different pore depth was designed, fabricated virtually and simulated to determine the effect of pore depth on the optical and electrical properties of GaAs semiconductor. The objective of this work was to find the optimum pore depth to enhance the optical and electrical properties of the porous GaAs structure. The pore depth of porous GaAs structure was varied with 2 μm, 4 μm, 6 μm and 8 μm. Subsequently, the electrical and optical properties of the structure were compared. The porous GaAs was then tested for the potential optoelectronic device which was photodetector. The non-porous and porous GaAs photodetctor was compared systematically through current-voltage(I-V) characteristic, current gain, and spectral response. The result showed that the porous GaAs photodetector has better performance in terms of electrical and optical properties than the non-porous GaAs photodetector. The highest current gain among all the structure was the porous structure with 6 μm pore depth with the gain value of 3.22. For optical properties, the spectral response showed current intensity of 11.370 μA recorded at peak wavelength of 880nm. Therefore, porous structure of GaAs is good to be used for optoelectronic device application such as photodetector.

Keywords: Porous III-V, surface structure, etching, optoelectronic device, SILVACO TCAD.

P12

RAPID THERMAL ANNEALING PROCESS TOWARD ENHANCEMENT OF ITO THIN FILMS

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ABSTRACT- Transparent conducting indium tin oxide (ITO) thin films with 100 nm thickness were successfully deposited on soda-lime glass substrates. Deposition of ITO thin film was conducted by metal oxide electron beam deposition at room temperature. The deposited films were annealed via rapid thermal processor (RTP) in vacuum environment. This work focused on the influence of annealing time (1 to 4 min) and different annealing temperature (400 to 550 ℃) by RTP. All ITO deposited films were investigated in detail on the structural, electrical and optical properties. Both annealing time and annealing temperature by RTP strongly influenced the structural, electrical and optical properties of ITO thin films. Results showed that the annealing treatment by RTP improved the crystallinity and surface roughness. It lead to higher transmittance of ITO thin films (93 -95 %) and is suitable for a blue light emitting diodes (LEDs) application. Furthermore, higher annealing temperature also enhanced film electrical performance. The optical and electrical characteristics of the ITO thin films in this study have been compared with other result of studies that applied different technique of annealing treatment.

Keywords: ITO thin film, rapid thermal annealing, structural, electrical and optical properties.

P13

EFFECT OF CAPPING AGENT ON THE SHAPE AND CATALYTIC ACTIVITY OF PtPd BIMETALLIC ALLOY NANOSTRUCTURES

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ABSTRACT- Platinum (Pt) is widely employed as an electrocatalyst to oxidize small organic molecules and low carbon chain aliphatic alcohol such as methanol and ethanol. Nonetheless, Pt catalyst has some limitations due to its high cost and prone to be poisoning by CO molecules. It has been reported that incorporating other metals with Pt can improve the catalytic performance and reduce the utilization of noble metal Pt. Recently, Platinum-Palladium (PtPd) bimetallic alloy nanostructures have received much attention due to their potential application in fuel cells, especially for portable power devices. The combination of Pt with Pd has a crucial impact on the electronic structure of Pt, resulting in superior electrocatalytic activities for a specific reaction owing to the formation of Pt-Pd bonds. In this work, PtPd nanostructures have been synthesized via the chemical reduction method with different capping agents (i.e. PVA, PVP and PEG), whilst the strong reducing agent, NaBH4 was used in this study to reduce the metal salt into zero-valent PtPd nanostructures. Field-emission scanning electron microscopy (FESEM) that coupled with energy-dispersive x-ray spectroscopy (EDX) and cyclic voltammetry (CV) were used to investigate the morphology and catalytic activities of the synthesized PtPd. Both PtPd synthesized with PVP and PEG exhibit nanosponges structures, whereas PtPd synthesized in PVA demonstrates large interconnected network structures. EDX analysis confirmed the presence of Pt and Pd elements in all the prepared samples. Pt-Pd nanosponges with PVA and PEG exhibits lower ECSA indicating small active sites, which reduces its catalytic function. The ECSA value for PtPd with PVP is 1.045 m2 /g, whereas without stabilizing agent is 13.533 m2 /g. This study concludes that the presence of a capping agent influence the morphological structure yet tend to blocks the active surface sites and reduces the catalyst's efficiency to perform a redox reaction at the surface.

Keywords: PtPd, bimetallic, capping agent, methanol oxidation, catalyst.

P14

POROSIFICATION ANALYSIS IN ACPEC POROUS UNDOPED GaN NANOSTRUCTURE USING THE IMAGE PROCESSING METHOD

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ABSTRACT- The alternating current photo-assisted electrochemical (ACPEC) etching of porous undoped GaN is carried out in the same KOH electrolyte concentration as in the typical dc constant current electrochemical etching technique. UV illumination is utilised to aid in the formation of electron-hole pairs, with etching occurring via oxidation and, as a result, the semiconductor surface dissolving. This research examines their quantitative structural properties utilising FESEM images and mathematical morphological analysis. The non-destructive investigation of porous GaN nanostructures employing adaptive image analysis methods to acquire quick, objective, and quantitative information can be used to evaluate its quality. The MATLAB software was utilised to implement the algorithm used in this study. The distributions of the pores' maximum, minimum, and average radii were calculated. Furthermore, by estimating the areas occupied by the pores, the porosity of the structures was determined. The GaN thin films have a homogenous nanoarchitecture of porous structures with perfect hexagonal shape, according to FESEM micrographs. Quantitative results were obtained and correlated with fabrication process features, revealing the control of pores throughout the formation process to be reliable and promising.

Keywords: Porous GaN, image analysis methods, nanostructure.

P15

SPEECH-BASED GENDER RECOGNITION USING LINEAR PREDICTION COEFFICIENTS AND MEL-FREQUENCY CEPSTRAL COEFFICIENT

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ABSTRACT- Gender discrimination and awareness are essential in human life such as in social, education, workplace and economic sectors. This attribute is manifested naturally in many ways such as gait, body gesture, facial, including speech. Automatic gender recognition system is an intelligent machine inspired by the highly advanced skills of human cognitive and developed through adequate training using acoustic features to recognize the gender of a speaker as being male or female. The system consists of two sub-systems namely, the front end and the back end. The front end's purpose is to retrieve gender-related information from a speech signal and represent it using a set of feature vectors. The challenge of this task is to obtain salient features out of highly varying speech signal. The back end consists of machine learning technique(s) to classify the acoustic features into male or female class. This paper proposes extraction of features using Linear Prediction Coefficients and Mel-frequency Cepstral Coefficients for comparison of best performance. The audio data is obtained from 93 speakers uttering words emphasizing vowels. The classification algorithms proposed are Discriminant Analysis and Artificial Neural Network. The expecting experimental results for this two-class problem are above 90% accuracy rate for overall class and also to identify which class results in better recognition rate.

Keywords: Linear predictive coefficients, mel-frequency cepstral coefficients, artificial neural network, discriminant analysis, gender recognition system.

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THE EFFECT OF V-PITS ON ELECTRONIC AND OPTICAL PROPERTIES AND INTERNAL QUANTUM EFFICIENCY OF GaN-BASED GREEN LIGHT-EMITTING DIODES

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ABSTRACT- Strains and V-shaped pits are essential factors for determining the efficiency of GaN-based light-emitting diodes (LEDs). While the insertion of an InGaN/GaN superlattice (SL) with a lower In content before the growth of InGaN/GaN multiple quantum wells (MQWs) is known to increase the efficiency of LEDs, the actual mechanism is still debated. Therefore, this study aims to systematically investigate the effect of SL periods on internal quantum efficiency (IQE). The blue MQW active region consisting of 6 pairs of $In_{0.18}Ga_{0.82}N$/GaN was grown by metal-organic chemical vapour deposition (MOCVD) on 0, 10, 20, and 30 periods of $In_{0.02}Ga_{0.98}N$/GaN SL. The field emission secondary electron microscope (FESEM) and atomic force microscopic (AFM) were carried out to identify the hexagonal v-pits diameter propotional to the number of SL periods. The correlation between v-pits diameter and IQE were studied using temperature-dependent photoluminescene (PL) measurements. Based on temperature dependent PL measurements, we found that the potential barrier formed by the V-pit during the low-temperature growth of an InGaN/GaN SL dramatically increases the IQE of InGaN quantum wells (QWs) by suppressing non-radiative recombination at threading dislocations (TDs). Further, XRD measurement was performed to identify the structural quality of the MQW layer with different period of SL. Our findings suggest the potential of implementing optimized V-pits embedded in an InGaN/GaN SL as a beneficial underlying layer for the realization of highly efficient GaN LEDs.

Keywords: GaN, light emitting diodes, V-shaped pits, strain.

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HOLLOW PYRAMIDAL TRIANGLAR SLOTTED GEOPOLYMER MICROWAVE ABSORBER PERFORMANCE

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ABSTRACT- In recent year, the development of the electronic devices is rapidly grow and that was used in entire world but electronic devices generate the electromagnetic wave (EM) radiation that can affect the people's health and interference normal operation of other electronic devices. Hence the researchers performed an analysis in the field of microwave absorption to reduce the risk of electromagnetic (EM) radiation. One of significant thing in designing the microwave absorber is material. The material is used in designing microwave absorber as know as Radiation Absorber Material (RAM) to absorb the electromagnetic wave event, rendering it less visible for radar detection. This study aims to build effetive RAM for microwave abosber by using geopolymer binding process on pyramidal slotted design. In material industry, geopolymer has a several benefit which is lightweight and highly resistant to the environment. In order to design durable microwave absorber and good absorption properties, geopolymer technique is used by adding RAM at geopolymer process. To form geopolymer binding, sodium hydroxide (NaOH) and sodium silicate (Na_2SiO_3) solution are mixed. Both of these chemical substances will produce a strong alkaline solution to form a geopolymer binder. The geopolymer binding was completed by adding RAM which is Powder Activator Carbon (PAC) in the alkaline solution. The ratio of NaOH, Na_2SiO_3 and PAC was investigating to form good microwave absorber. Measurement had been done successfully via far field measurement using arch method at 1 GHz to 12 GHz. The absorptivity of geopolymer material is taken at each frequency band covering the L, S, C and X bands. The result is compared with their maximum absorption in each frequency band and also shows geopolymer material produces good absorption performance. The highest absorption performance is up to -45.32d.

Keywords: Microwave absorber, geopolymer, absorbing material, pyramidal slotted absorber.

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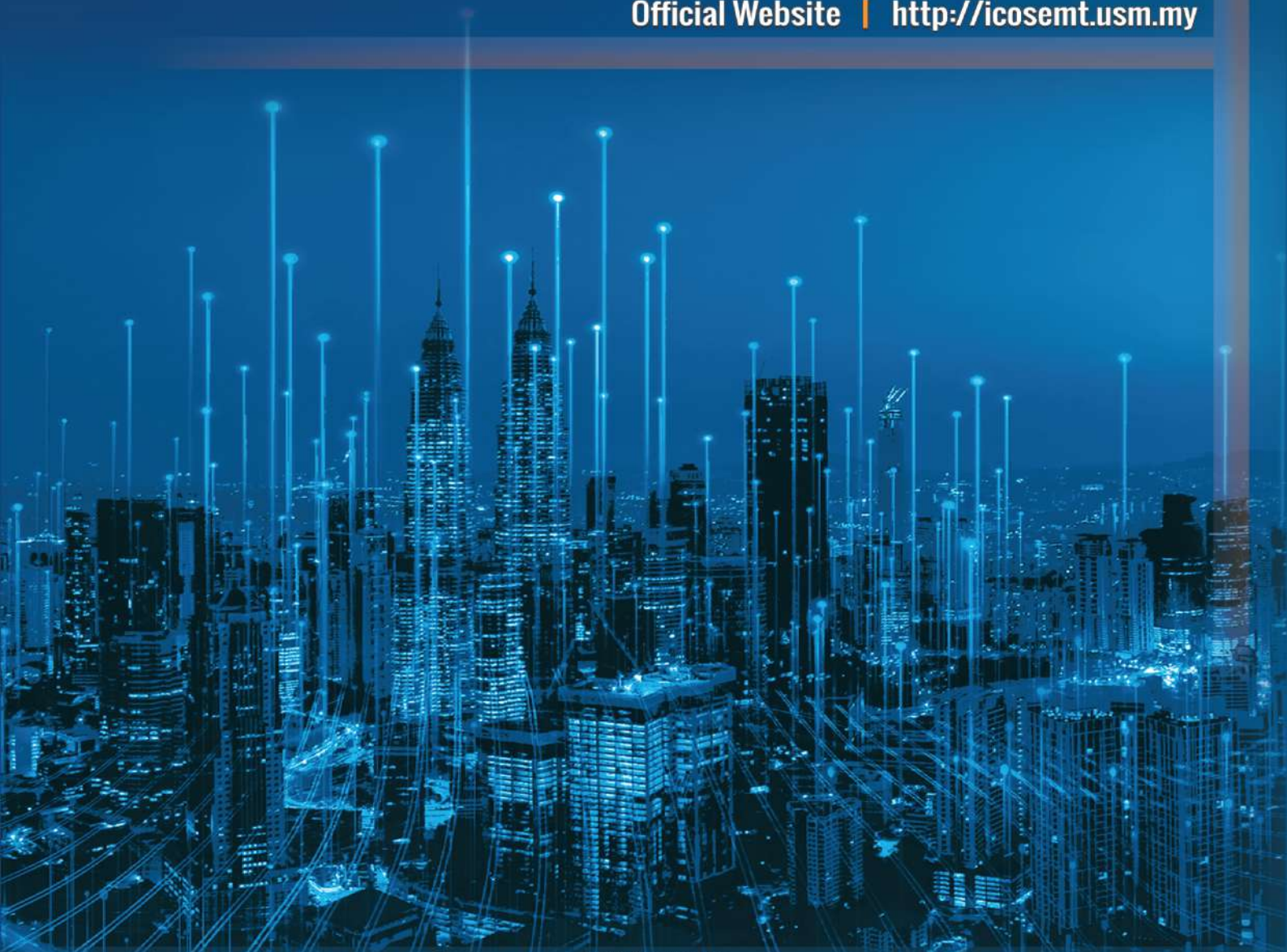

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Institute of Nano Optoelectronics Research and Technology (INOR), Universiti Sains Malaysia (USM)

Faculty of Electrical Engineering and Department of Applied Sciences Universiti Teknologi MARA Pulau Pinang Branch

Collaborative Research in Engineering, Science and Technology (CREST)

Industrial Centre of Innovation in Smart Manufacturing (ICI-SM), SIRIM Industrial Research (SIRIM IR), SIRIM Berhad