ISPE 2023

NOV. 10-12, 2023

INTERNATIONAL SYMPOSIUM

ON PRECISION ENGINEERING

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General Information

2023 4th International Symposium on Precision Engineering 2023 (ISPE 2023) will be held in the Hsinhua Forest Station, Tainan City, during November 10 ~ 12, 2023. The main objective of the ISPE 2023 is to provide a major international platform for knowledge exchange and an interactive forum in integrated technologies, mechanical engineering, optics, electronics, electrical engineering and material engineering into precision manufacturing, precision measurement, precision inspection, MEMS, semiconductor and precision environmental control, etc. These are all fascinating topics related to future needs. On behalf of the ISPE 2023 organizing committee, we sincerely welcome you for participating this symposium to share your experience and research results. ISPE 2023 welcomes authors to submit papers on any branch of precision engineering and its applications, and other subjects.

Plenary Speakers

- GlobalFoundries Chair Prof. Cheng-kuo Lee
  Department of Electrical and Computer Engineering
  National University of Singapore, Singapore
- Prof. Dr. Hieng-Kiat Jun
  Department of Mechanical and Material Engineering
  University Tunku Abdul Rahman, Malaysia

Keynote Speakers

- President Dong-Sing Wuu
  Department of Applied Materials and Optoelectronic Engineering
  National Chi Nan University, Taiwan
- Distinguished Prof. Ying-Hao Chu
  Department of Materials Science and Engineering
  National Tsing Hua University, Taiwan

Invited Speakers

- Postdoctoral Scholar Sheng-Lun Liao
  Department of Chemical Engineering
  Stanford University, USA
- Prof. Ngoc Dang Khoa Tran
  Faculty of Mechanical Engineering
  Industrial University of Ho Chi Minh City, Vietnam

Honorary Chair

- President Fuh-Jyh Jan
  Department of plant pathology
  National Chung Hsing University, Taiwan
- Dean Ming-Der Yang
  Department of Civil Engineering
  National Chung Hsing University, Taiwan

Symposium Chair

- Prof. Po-Liang Liu
  Graduate Institute of Precision Engineering
  National Chung Hsing University, Taiwan
- GlobalFoundries Chair Prof. Cheng-kuo Lee
  Department of Electrical and Computer Engineering
  National University of Singapore, Singapore

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  Science Institute
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  Department of Mechanical Engineering
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  National Chung Hsing University, Taiwan
- President Dong-Sing Wuu
  Department of Applied Materials and Optoelectronic Engineering
  National Chi Nan University, Taiwan
- Chair Prof. Ray-Hua Horng
  Institute of Electronic
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  Science Institute
  University of Iceland, Iceland
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  Fuel Cell Institute
  Universiti Kebangsaan Malaysia, Malaysia
- Prof. Ngoc Dang Khoa Tran
  Faculty of Mechanical Engineering
  Industrial University of Ho Chi Minh City, Vietnam
- Chair Prof. Yu-Lin Shen
  Department of Mechanical Engineering
  University of New Mexico, USA

- GlobalFoundries Chair Prof. Chengkuo Lee
  Department of Electrical and Computer Engineering
  National University of Singapore, Singapore
- Prof. Bhaskar Kanseri
  Department of Physics
  Indian Institute of Technology Delhi, New Delhi, India
- Prof. Ho Thanh Huy
  Department of Physics and Electronic Engineering
  VNU-Ho Chi Minh University of Science, Vietnam
- Prof. Ratchatin Chancharoen
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  National Chung Hsing University, Taiwan
- Distinguished Prof. Pin Han
  Graduate Institute of Precision Engineering
  National Chung Hsing University, Taiwan
- Distinguished Prof. Dung-An Wang
  Graduate Institute of Precision Engineering
  National Chung Hsing University, Taiwan
- Prof. Chia-Feng Lin
  Department of Materials Engineering
  National Chung Hsing University, Taiwan
- Prof. Po-Liang Liu
  Graduate Institute of Precision Engineering
  National Chung Hsing University, Taiwan

- Prof. Ming-Tzer Lin
  Graduate Institute of Precision Engineering
  National Chung Hsing University, Taiwan
- Prof. and Head Cheng-Mu Tsai
  Graduate Institute of Precision Engineering
  National Chung Hsing University, Taiwan
- Prof. Congo Tak-Shing Ching
  Graduate Institute of Biomedical Engineering
  National Chung Hsing University, Taiwan
- Prof. Cheng-Chung Chang
  Graduate Institute of Biomedical Engineering
  National Chung Hsing University, Taiwan
- Prof. Hui-Min David Wang
  Graduate Institute of Biomedical Engineering
  National Chung Hsing University, Taiwan
- Assoc. Prof. Fu-Yuan Hsu
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  National United University, Taiwan
- Assoc. Prof. Sheng-Fang Huang
  Mechanical Engineering Department
  China University of Science and Technology, Taiwan
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- Assoc. Prof. Zhi-Ting Ye
  Department of Mechanical Engineering
  National Chung Cheng University, Taiwan
- Assist. Prof. Che-Hao Liao
  Department of Electronic Engineering
  National Yunlin University of Science and Technology, Taiwan
- Prof. Shih-Hung Lin
  Department of Electronic Engineering
  National Yunlin University of Science and Technology, Taiwan

Symposium Secretary

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Hsinhua Forest Station Map

Symposium Agenda

All academic events will be held at Symposium Center of Hsinhua Forest Station, Taiwan

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<tr><td>09:00~10:30</td><td colspan="2">Academic Visit or Hsinhua Forest Station Hiking Tour</td></tr>
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Plenary Speaker 1

GlobalFoundries Chair Prof. Cheng-kuo Lee

Department of Electrical and Computer Engineering
National University of Singapore, Singapore

Title of Plenary Speech

Progress in Sensors and Haptic Technology for Metaverse and Digital Twin

Abstract of Plenary Speech

With the aid of 5G-enhanced Internet of Things (IoT) infrastructure, various devices (e.g., sensors, actuators, energy harvesters, etc.) and systems have been developed toward the realization of Metaverse, which refers to a digital social network in a 3D virtual world that uses virtual reality (VR) technology to blur the boundaries between physical space and digital space. In addition to the traditional VR technologies based on visual and auditory devices, the immersive VR system also relies on wearable devices such as gloves, suits and shoes to enable full-body somatosensory perception/sensation, which has attracted a lot of attention recently. These wearable devices serve the dual purpose of sensing human motion and simulating human sensations, thus building a more profound connection between the real and virtual realms. Current haptic technology uses actuation devices based on various mechanisms, including tendon drivers, pneumatic actuators, and electrostatic actuators, to generate substantial forces that provide kinesthetic feedback, and electrotactile, vibrotactile, and thermal tactile to provide sensations to various mechanoreceptors in the skin for cutaneous stimuli. In addition, when sensors integrated with the artificial intelligence (AI) technology to enable the analysis function, such AI-assisted IoT systems, i.e., artificial intelligence of things (AIoT) system, achieve a higher level of intelligence for a wide range of applications. The integration of flexible sensors with AIoT technology not only enhances the productivity and efficiency of smart factory in the Digital Twin application scenarios but also enables more sustainable and environmentally friendly practices. It

does not only provide multi-modality sensory information to intelligent robotic manipulation, ultimately leading to improved production yields and energy saving.

Plenary Speaker 2

Prof. Dr. Hieng-Kiat Jun

Department of Mechanical and Material Engineering
University Tunku Abdul Rahman, Malaysia

Title of Keynote Speech

Overview on the application of carbon quantum dots in energy storage devices

Abstract of Keynote Speech

In recent years, alternative battery devices like supercapacitors, and electric double-layer capacitors (EDLCs) have been receiving plenty of attention. This brief review focuses on supercapacitor fundamentals and the potential application of carbon quantum dots (CQDs) in the devices. Small nanoparticles of carbon, known as CQD, which are less than 10 nm in size and contain special qualities, have become an essential tool for known specific delivery, biological research, and many therapeutic uses. The purpose of this review is also to assemble the recent research on CQDs synthesis with specific focus to biomass of coffee grounds, their characterization methods, and recent progress of CQDs in energy devices. For the synthesis of CQDs, two different types of synthesis methods i.e., a top-down approach and a bottom-up approach—are employed. The laser ablation method, electrochemical method, and arc-discharge method are examples of top-down techniques. The acidic oxidation, microwave-assisted method, and hydrothermal method are examples of bottom-up approaches. CQDs are now receiving more interest from the energy storage sector as additives in electrode material due to their distinctive electrical characteristics and critical function in hosting multiple functional groups superficially. As a result, energy density of supercapacitors has increased with the widespread usage of CQDs in electrode materials.

Keynote Speaker 1

President Dong-Sing Wuu

Department of Applied Materials and Optoelectronic Engineering
National Chi Nan University, Taiwan

Title of Keynote Speech

A novel multifunctional brightness enhancement film for display applications

Abstract of Keynote Speech

The brightness enhancement film (BEF) is one of the vital films for liquid crystal displays (LCDs), but suffers from the cosmetic, color shift and thermal stable issues due to the sharp apex angle of prism structure and multiple films stacking. Herein, we demonstrate a cheese-like porous BEF (p-BEF) with multiple advantages, i.e., brightness enhancement, diffusion, red color-shifted reduction, and the lower thermal expansion functionalities. During the UV imprinting and solvent evaporation process, the nano/submicron air pores were generated in the polymer prism structure, and the micropatterns were formed on the prism surface spontaneous. The inner pores were in the range of 30-450 nm, which met the simulation results (below 500 nm) and these can effectively scattering light to suppress the color shift due to the multiple internal reflection by the prism structure. By utilizing the pBEF into an LCD backlight, the brightness enhancement performance is corresponding to the regular BEF with additional diffuser (2-films) and up ~8% to beads prism (particle-based BEF), and the red color-shifted (Δxy) is reduced from 0.1677 to 0.1453. In addition, the p-BEF shows the wider angular intensity distribution compared with the pristine backlight stacking and lower CTE value in comparison with a regular BEF.

Keynote Speaker 2

Distinguished Prof. Ying-Hao Chu

Department of Materials Science and Engineering
National Tsing Hua University, Taiwan

Title of Plenary Speech

Epitaxial Growth and Characterization of Bi_2O_2X (X = S, Se, Te) Semiconductors

Abstract of Plenary Speech

The search for 2D semiconductors with excellent electronic performance and stability in the ambient environment is urgent. Bi_2O_2X (X = S, Se, Te), a series of air-stable layered oxides, have emerged as promising new semiconductors with excellent electronic and optoelectronic properties. Studies demonstrate that its layered nature makes it ideal for fabricating electronic devices down to a few atomic layers. Currently, these materials are synthesized by either chemical solution or vapor methods. It remains a great chance to have control of thickness and uniformity. In this study, the physical vapor deposition method is adopted for depositing these materials on various oxide substrates. A pathway to integrate with Si will also be demonstrated. For practical applications, electronic devices such as thin film transistors and optoelectronic devices such as solar cells and photodetectors will be delivered with optimized performances.

Invited Speaker 1

Postdoctoral Scholar Sheng-Lun Liao

Department of Chemical Engineering
Stanford University, USA

Title of Invited Talk

Influence of Interfacial Solvation on SEI Formation in Lithium Metal Battery

Abstract of Invited Talk

In the domain of lithium-metal batteries, the composition of the solid electrolyte interphase (SEI) significantly affects the reactions between Li and the electrolyte, as well as the overall battery performance. While many studies have focused on the correlation between SEI composition and the solvation structure in bulk solutions, few have delved into the solvation structure at the surface, which plays a pivotal role in SEI formation. In this presentation, we share our recent observations on the relationship between SEI composition and the interfacial solvation. Both experimental measurements and atomistic simulations revealed an increased probability density of anions near a polar substrate, resulting in increased anion incorporation within the SEI. This highlights the direct impact of interfacial solvation on the formation of an anion-rich SEI.

Invited Speaker 2

Prof. Ngoc Dang Khoa Tran

Faculty of Mechanical Engineering
Industrial University of Ho Chi Minh City, Vietnam

Title of Invited Talk

Design and analysis of compliant bistable gripper for large circle objects

Abstract of Invited Talk

Compliant bistable grippers play an important role in applications of grasping, holding, and releasing various objects with the advantages of energy saving and high precision. This study presents the design of a compliant gripper composed of a bistable mechanism and connected with rigid-body clamping jaws. The mechanism is capable of clamping round objects of large diameter. Numerical methods are used to predict nonlinear behavior. A curved operating trajectory has been calculated for the clamping jaw to be able to clamp enormous circle objects firmly. An optimization method is applied to the design of the gripper structure in order to clamp and hold objects with a wide range of diameters. One prototype is designed to grip circular objects with a diameter of 65 to 75 millimeters. Analysis of the structural properties was conducted by using numerical methods and simulations, which resulted in an error of 3%. A demonstration of the correctness of the numerical method was also provided by the experiment. Analysis of the interaction effects between objects and bistable structures is performed. Objects with a larger diameter will have a reduced ability to grip tightly and will experience greater stress as a result. The gripper has the potential to be utilized in robotics, MEMS, and medical applications.

Oral Sessions

Nov. 11, 2023

Session 1

Precision manufacturing machines and technologies

Session Chair: Prof. Chil-Chyuan Kuo

Department of Mechanical Engineering

Ming Chi University of Technology

08:45~10:00	I-1	Influence of Interfacial Solvation on SEI Formation in Lithium Metal Battery *Sheng-Lun Liao* Department of Chemical Engineering, Stanford University, USA
	O-12	*Ab Initio* Studies of Work Function Changes of NO Adsorption on $ZnGa_2O_4$(111) Surface for Gas Sensors *Jhih-Hong Shao, Jun-Kai Chyou†, and Po-Liang Liu** Graduate Institute of Precision Engineering, National Chung Hsing University, Taiwan
	O-13	Computational Analysis of Electronic Structures and Defect Formation Energy in Aluminum-Doped $ZnGa_2O_4$: An *Ab initio* Study *Cheng-Lung Yu[1], Ping-Jui Hsieh[†,1], Jine-Du Fu[2], and Po-Liang Liu[*]* [1] Graduate Institute of Precision Engineering, National Chung Hsing University, Taiwan [2] MAX VANTAGE WH CO. LTD, Taiwan
	O-14	First-Principles Studies of Adsorption Energy for Deprotonated Triazole Molecules on Cu(111) *Ying-Hao Chen[1], Ramteja Saragandla[†,2], Yi-Ke Yang[1], Daniel K. H. Shen[3], and Po-Liang Liu[*,1]* [1] Graduate Institute of Precision Engineering, National Chung Hsing University, Taiwan [2] Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology, India [3] Inno Solution Technology Co., Ltd., Taiwan

Nov. 11, 2023

Session 2

Micro-manufacturing and assembly technologies

Session Chair: Postdoctoral Scholar Sheng-Lun Liao
Department of Chemical Engineering
Stanford University, USA

14:30~15:35	I-2	Design and analysis of compliant bistable gripper for large circle objects *Ngoc Dang Khoa Tran* Faculty of Mechanical Engineering Industrial University of Ho Chi Minh City, Vietnam
	O-5	Computational Analysis of Triazole Compounds for Copper Corrosion Control in Chemical Mechanical Planarization *Ying-Hao Chen[1], V Venkata Durga Sai[†,2], Yi-Ke Yang[1], Daniel K. H. Shen[3], and Po-Liang Liu[*,1]* [1] Graduate Institute of Precision Engineering, National Chung Hsing University, Taiwan [2] Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology, India [3] Inno Solution Technology Co., Ltd., Taiwan
	O-6	Understanding the Impact of Copper Corrosion Inhibitors on $Cu_2O(111)$ Surfaces in Chemical Mechanical Planarization using *Ab initio* method *Ying-Hao Chen[1], Kshetrimayum Chingkhei Meitei[†,2], Daniel K. H. Shen[3], and Po-Liang Liu[*,1]* [1] Graduate Institute of Precision Engineering, National Chung Hsing University, Taiwan [2] Vel Tech Rangarajan Dr. Sagunthala R&D Institute of Science and Technology, India [3] Inno Solution Technology Co., Ltd., Taiwan

14:30~15:35	O-11	Fatigue behavior of rotary friction welding of acrylonitrile butadiene styrene and polycarbonate dissimilar materials *Chil-Chyuan Kuo*[*,1,2,3,4] *and Naruboyana Gurumurthy*[†,1,5] [1] Department of Mechanical Engineering, Ming Chi University of Technology, Taiwan [2] Research Center for Intelligent Medical Devices, Ming Chi University of Technology, Taiwan [3] Department of Mechanical Engineering, Chang Gung University, Taiwan [4] Center of Reliability Engineering, Ming Chi University of Technology, Taiwan [5] Department of Mechanical Engineering, Presidency University Rajankunte, India
	O-15	FABRICATION OF THE HOLLOW MICROPILLAR ARRAY USING THE MASKED STEREOLITHOGRAPHY Tsung Hung Lin[†,*] Department of Mechanical and Electro-Mechanical Engineering, National Ilan University, Taiwan

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Session 3

Green manufacturing and smart technologies

Session Chair: Prof. Che-Hao Liao
Department of Electronic Engineering
National Yunlin University of Science and Technology, Taiwan

16:00~17:00	O-2	Design of compact automotive low-beam headlight with liquid silicone rubber light guide *Chia Chun Hu, Yang Jun Zheng, Po Chih Chuang, and Zhi Ting Ye†,** Graduate institute of Opto-Mechatronics, Department of Mechanical Engineering National Chung Cheng University, Taiwan
	O-1	Utilizing recycling-reflection color-purity enhancement films to enhance the color purity of full-color Micro LEDs *Po Hsiang Tsai†, Chia Chun Hu, Jun Yi Wu, and Zhi Ting Ye** Graduate institute of Opto-Mechatronics, Department of Mechanical Engineering National Chung Cheng University, Taiwan
	O-8	Growth of MoS_2/PtS_2 van der Waals Heterobilayer for Acetone Gas Sensor Applications *Yan-Si Jiang†,1, Xiang-Bin Yang[1], Yi-Chen Hsiao[1], Yi-Zhen Zhang[1], Yao-Chin Wang[2], and Sin-Liang Ou*,1* [1] Department of Biomedical Engineering, Da-Yeh University, Taiwan [2] Department of Computer Science and Information Engineering, Cheng Shiu University, Taiwan
	O-9	Coating of Sr-doped Hydroxyapatite by Magnetron Sputtering on 3D-Printed Titanium-Alloy for Biomedical Implant Applications *Bo-Yan Zhang†,1, Yu-Rui Chen[1], Shi-Hua Deng[1], Jane-Yii Wu[2], Chun-Ming Chang[3], Yao-Chin Wang[4], and Sin-Liang Ou*,1* [1] Department of Biomedical Engineering, Da-Yeh University, Taiwan [2] Department of Medicinal Botanicals and Foods on Health Applications, Da-Yeh University, Taiwan [3] Taiwan Instrument Research Institute, National Applied Research Laboratories, Taiwan [4] Department of Computer Science and Information Engineering, Cheng Shiu University, Taiwan

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Session 4

Applied science, engineering and technologies

Session Chair: Prof. Zhi-Ting Ye
The Department of Mechanical Engineering
National Chung Cheng University, Taiwan

17:00~18:00	O-3	AlN SAW Humidity Sensing Enhancement with ZnO Nanorods Prepared by Hydrothermal Method *Zhong-Hong Yen†, Che-Hao Liao, Chien-Sheng Huang, and Shih-Hung Lin** Department of Electronic Engineering, National Yunlin University of Science and Technology, Taiwan
	O-4	Resistive switching behavior of $SrTiO_3$ prepared by RF magnetron sputtering method *Min-Chen Cai†, Yu-Ting Liu, Che-Hao Liao, and Shih-Hung Lin** Department of Electronic Engineering, National Yunlin University of Science and Technology, Taiwan
	O-10	β-$(AlGa)_2O_3$ UVC Photodetector Implemented by Thermal Interdiffusion Alloying Method *Che-Hao Liao†, Jui-En Kuo, Zhong-Hong Yen, Chien-Sheng Huang, and Shih-Hung Lin** Department of Electronic Engineering, National Yunlin University of Science and Technology, Taiwan
	O-7	Light spectral analysis of color images enables non-invasive direct bilirubin detection *Chia Hsuan Chen†,1 and Chun Wei Tsai*,2* [1] ML Precision Process Equipment Division, Marketech International Crop, Taiwan [2] Graduate Institute of Photonics and Optoelectronics, National Taiwan University, Taiwan

Poster Session

Poster No.	Paper Title
P-1	3D printing technology in electronic circuit blocks using LEGO ® concept *Yen-Ming Chen† and Chien-Ming Chen** Department of Electro-Optical Engineering, National Taipei University of Technology, Taiwan
P-2	Moving the cursor based on brainwave signals generated by eye's movements *Cheng-Yao Hong†, Chun-Cheng Kao, Tsai-Chun Hong, Ching-Hui Chuang, Pei-Chung Liu, and Chien-Ming Chen** Department of Electro-Optical Engineering, National Taipei University of Technology, Taiwan
P-3	Effect of Isolation Process on Device Performance of Red Micro-LEDs *Yen-Ru Chen†,1, Po-Hsiang Wang[2], Po-Liang Liu[1], and Dong-Sing Wuu*,3,4* [1] Department of Graduate Institute of Precision Engineering, National Chung Hsing University, Taiwan [2] Department of Chemical Engineering, National Chung Hsing University, Taiwan [3] Department of Materials Science and Engineering, National Chung Hsing University, Taiwan [4] Department of Applied Materials and Optoelectronic Engineering, National Chi Nan University, Taiwan
P-4	A Materials Genome Approach for Studying Thin-Film Heterostructures on Flexible Muscovite Mica Substrates *Sheng-Yuan Jhang†, Jia-Wei Dai, and Po-Liang Liu** Graduate Institute of Precision Engineering, National Chung Hsing University, Taiwan
P-5	Study of Wide Field-of-view Scanning in LIDAR System by Using Spatial Light Modulator *Ting-Chun MI†,*, Yao-Hsuan Yu, and Cheng-Mu Tsai* Graduate Institute of Precision Engineering, National Chung Hsing University, Taiwan

P-6	A CNN-BASED OCCLUSION DIAGNOSIS SYSTEM WITH DATA AUGMENTATION USING GENETIC ALGORITHM *Wei-Fan Hsieh[†,*,1], Yu-Cheung Chen[1], Cheng-Mu Tsai[1], Chuan-Wang Chang[2], and Pai-Yu Ko[1]* [1] Graduate Institute of Precision Engineering, National Chung Hsing University, Taiwan [2] Department of Computer Science and Information Engineering, National Chin-Yi University of Technology, Taiwan
P-7	Design and Implementation of Classroom Air Conditioning Monitoring and Energy Management System *Ching-Wei Lee[†,*] and Yao-Chin Wang* Department of Computer Science and Information Engineering, Cheng Shiu University, Taiwan
P-8	Applications of Computer Vision and Image Recognition in Smart Factories *Tat Cam Minh[†,*] and Yao-Chin Wang* Department of Computer Science and Information Engineering Cheng Shiu University, Taiwan
P-9	The Impact of Generative Pre-training Programming Project Course on Junior High School AI Learning Effectiveness *Jui-Hao Wang[†,*] and Yao-Chin Wang* Department of Computer Science and Information Engineering, Cheng Shiu University, Taiwan
P-10	Ga_2O_3 nanorods synthesized by hydrothermal method for sensing of pH value *Hsin-Yu Chou[1], Min-Han Chiang[†,1], Jung-Lung Chiang[2] and Dong-Sing Wuu[*,1,3]* [1] Department of Materials Science and Engineering, National Chung Hsing University, Taiwan [2] Ph.D. Program, Prospective Technology of Electrical Engineering and Computer Science, National Chin-Yi University of Technology, Taiwan [3] Department of Applied Materials and Optoelectronic Engineering, National Chi Nan University, Taiwan

P-11	Using various statistical methods to examine the association between severe mental illness and subsequent ischemic/hemorrhagic stroke *Chia-He Cho and Meng-Han Yang†,** Department of Computer Science and Information Engineering, National Kaohsiung University of Science and Technology, Taiwan
P-12	Bifacial Solar Photovoltaic Modules Combined With Microporous Sound Insulation Panels *Yu-Cheng Qiu†, Wen-Dui Chen, Zhen-Yi Kang, and Rui-Tang Chen** Department of Semiconductor and Electro-Optical Engineering, Southern Taiwan University of Science and Technology, Taiwan
P-13	E-Mode Phototransistor with enhanced UV-Visible rejection ratio based Zinc Gallium Oxide grown by metalorganic chemical vapor deposition *Siddharth Rana†,1,2,3, Soumitra Shubhankar Mohanta[1], Jitendra Pratap Singh[2] and Ray Hua Horng*,1* [1] Institute of Electronics, National Yang Ming Chiao Tung University, Taiwan [2] Department of Physics, Indian Institute of Technology Delhi, India [3] International College of Semiconductor Technology, National Yang Ming Chiao Tung University, Taiwan
P-14	The effect of oxide-based nanofillers on cobalt-based gel-state dye-sensitized solar cells *Yi-Hong Liao†,1, Wen-Yi Tsao[1], and Chih-Liang Wang*,1,2* [1] Graduate Institute of Precision Engineering, National Chung Hsing University, Taiwan [2] Department of Materials and Engineering, National Tsing Hua University, Taiwan
P-15	Microfluidic colorimetric system using PVA-based for detecting nitrite in foods *Xuan-Xiang Fang†,1, Yu-Che Cheng[1], Cheng-Xue Yu[1], To-Lin Chen[1] and Lung-Ming Fu*,1,2* [1] Department of Engineering Science, National Cheng Kung University, Taiwan [2] Graduate Institute of Materials Engineering, National Pingtung University of Science and Technology, Taiwan

P-16	Microfluidic detection system for VEGF detection in peritoneal dialysate *Sheng-Han Ye[†,1], Ching-Ti Wang[1], Kuan-Hsun Huang[1], and Lung-Ming Fu[*,1,2]* [1] Department of Engineering Science, National Cheng Kung University, Taiwan [2] Graduate Institute of Materials Engineering, National Pingtung University of Science and Technology, Taiwan
P-17	Preparation of amorphous gallium oxide by MOCVD and study of growth orientation and alignment through thermal annealing *Chih-Yang Huang[†,*,1], Ray-Hua Horng[2], and Fu-Gow Tarntair[2]* [1] Institute of Pioneer Semiconductor Innovation, National Yang Ming Chiao Tung University, Taiwan [2] Institute of Electronics, National Yang Ming Chiao Tung University, Taiwan
P-18	A Green Joining Technique for Dissimilar Polymeric Rods Built With Fused Deposition Modeling *Chil-Chyuan Kuo[*,1,2], Hong-Wei Chen[†,1], Jing-Yan Xu[1], Chong-Hao Lee[1], and Song-Hua Hunag[3]* [1] Department of Mechanical Engineering, Ming Chi University of Technology, Taiwan [2] Research Center for Intelligent Medical Devices, Ming Chi University of Technology, Taiwan [3] Li-Yin Technology Co., Ltd, Taiwan
P-19	Rotary friction welding of polyetheretherketone polymer rods using variable rotational speed *Chil-Chyuan Kuo[*,1,2,3,4], Hua-Hsin Liang[†,1], Song-Hua Hunag[5] and Shih-Feng Tseng[6]* [1] Department of Mechanical Engineering, Ming Chi University of Technology, Taiwan [2] Research Center for Intelligent Medical Devices, Ming Chi University of Technology, Taiwan [3] Department of Mechanical Engineering, Chang Gung University, Taiwan [4] Center of Reliability Engineering, Ming Chi University of Technology, Taiwan [5] Li-Yin Technology Co., Ltd, Taiwan [6] Department of Mechanical Engineering, National Taipei University of Technology, Taiwan

P-20	Structural evolution and magnetic properties of metal-organic framework MIL-100(Co, Fe) annealed in an inert gas *Wen-Jing Chen†, Yi-Qi Feng, Li-Huai Huang, Zhen-Jia Yu, Yu-Huei Lin, You-Rong Zhong, Xin-Yi Ye, Chien-Chih Chen, and Ying-Zhen Chen** Department of Applied Physics, National Pingtung University, Taiwan
P-21	Tuning in structure and magnetic behaviour of sodium-doped spinel iron-manganese oxide nano powders *Yu-Huei Lin†, Yi-Qi Feng, Wen-Jing Chen, Li-Huai Huang, Zhen-Jia Yu, You-Rong Zhong, Xin-Yi Ye, Chien-Chih Chen, Chun-Rong Lin, and Ying-Zhen Chen** Department of Applied Physics, National Pingtung University, Taiwan
P-22	An Investigation of Abrasive Spiral Polishing for Complex Surface Finishing *Hsinn-Jyh Tzeng, Ching-Jung Yang†* Department of Mechanical Engineering, Southern Taiwan University of Science and Technology, Taiwan

Abstract Collections

No. O-1

TITLE: Utilizing recycling-reflection color-purity enhancement films to enhance the color purity of full-color Micro LEDs

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ABSTRACT

However, during the process of color conversion from micro LEDs to quantum dots (QDs), some incident wavelengths cannot be entirely absorbed by the QDs. This leads to emitted wavelengths that comprise both the incident wavelengths and those converted by the QDs, resulting in a compromise in color purity. In this study, we propose the use of a recycling-reflection color-purity-enhancement film (RCPEF) to address this issue. The RCPEF reflects incident wavelengths multiple times, thereby preventing wavelength mixing after the conversion by QDs. This specialized film only allows light of a specific wavelength to pass through, causing blue light to be reflected back to the red and green QDs layer.

Keyword: LEDs, quantum dots, color purity, color-purity-enhancement film

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No. O-2

TITLE: Design of compact automotive low-beam headlight with liquid silicone rubber light guide

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ABSTRACT

In traditional automotive headlight designs, there are mainly two types: reflector-based and fisheye refractor-based. The common issue with both of these methods is the large size and heavy weight of the headlight fixtures. In this study, we propose a novel compact and weather-resistant design for automotive low-beam headlights using high-durability Liquid Silicone Rubber (LSR) as the light guide material. This design comprises a high-power LEDs light source, a weather-resistant LSR light guide, and an aspheric biconvex lens. The light emitted from the LEDs light source is guided and confined within the LSR light guide using the principle of total internal reflection, which adjusts the light distribution and generates a cutoff line inside the light guide. The light is then projected onto the aspheric biconvex lens to form an illumination pattern that complies with the ECE R112B automotive low-beam headlight regulations. The dimensions of the light source module are 9cm (LX)× 7.3cm (WX) × 4.07cm (HX). Its effective light output efficiency under ECE R112B reaches 40%, with a uniformity of 46.3%. This design offers a compact and efficient solution for automotive low-beam headlights, meeting the necessary regulatory requirements for illumination while maintaining a reduced size and weight.

Keyword: light emitting diodes, ECE R112B, liquid silicone rubber, headlamp, optical design, cutoff line

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No. O-3

TITLE: AlN SAW Humidity Sensing Enhancement with ZnO Nanorods Prepared by Hydrothermal Method

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ABSTRACT

Surface Acoustic Wave (SAW) devices have found applications in wireless communication and hold potential for a wide range of sensing applications [1]. Among the piezoelectric materials, ZnO is a popular choice for constructing sensing films in SAW devices due to its straightforward synthesis process and impressive chemical stability. In contrast, AlN is considered a promising material for SAW due to its exceptional piezoelectric properties and high speed of sound. In this study, we investigated the growth of ZnO nanorod (NRs) structures within the sensing region of AlN SAW devices to combine both materials to enhance their sensing capabilities.

Subsequently, the photolithography technique was utilized to imprint 30 sets of interdigital transducers (IDTs) with a spacing of 10 μm, composed of aluminum electrodes onto the AlN/c-plane sapphire substrate. In the sensing region, ZnO nanorods (NRs) were cultivated through a hydrothermal approach, and the microstructure of this region was examined via scanning electron microscopy (SEM). We delved into the impact of varying nanorod shapes on the overall device performance. Furthermore, we assessed the humidity-sensing characteristics of these devices using a vector network analyzer.

The findings reveal that the growth morphology, aspect ratio (L/W), and vertical alignment of the nanorods can be effectively controlled by adjusting parameters like molar concentration, pH value, and growth duration in the hydrothermal process [2]. Specifically, when using a molar concentration of 0.003 M, maintaining a solution pH of 6.78, and conducting growth for 0.5 hours, the ZnO nanorods exhibited a relatively low rod density, consistent rod height, and a highly vertical alignment. Consequently, the device displayed a frequency shift of 1123 kHz and a sensitivity of 14.04 kHz/%RH. These values signify a 1.8-fold enhancement in sensing capabilities compared to the device lacking nanorods (Δf: 623 kHz, S: 7.79 kHz/%RH). Moreover, the device showcased a sensing time of 62 seconds and a recovery time of 27 seconds across a range of environmental humidity levels from 10 to 90% RH. These results indicate a 98% reduction in sensing time and a 61% reduction in recovery time compared to the device without nanorods.

The AlN SAW humidity sensor equipped with the ZnO Nanorods, characterized by their exceptional sensitivity and rapid response, which enhanced the humidity sensitivity 1.8 times and reduced the response time by 60% (recovery time) when compared that without ZnO nanorods, holds the potential for versatile use in a wide range of applications, including but not limited to liquid and bio-sensing applications.

Keyword: AlN, SAW, ZnO nanorods, humidity sensor

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No. O-4

TITLE: Resistive switching behavior of $SrTiO_3$ prepared by RF magnetron sputtering method

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ABSTRACT

The rapid rise and widespread adoption of technologies such as Big Data and the Internet of Things (IoT) have created a need for more efficient, scalable, and reliable storage solutions. Resistive random access memory (RRAM), as an emerging non-volatile storage technology, has great potential. However, RRAM technology still faces some challenges, including lowering the set voltage, improving storage stability, and reducing energy consumption. Traditional one-time programmable (OTP) or write-once-read-many (WORM) storage devices are widely used to store identification information [1], non-editable databases, and security applications. As system-on-a-chip (SoC) technology advances, on-chip encryption becomes increasingly important, further increasing the demand for WORM memory [2].

In this study, $SrCO_3$ and TiO_2 powders were mixed at a 1:1 molar ratio, ball-milled for 24 h, and then dried. A box-type high-temperature furnace was used to sinter at 1400 °C for 4 h. Radio frequency magnetron sputtering technology was used to deposit $SrTiO_3$ films with different thicknesses at different sputtering times (60, 45, 30, and 15 minutes) under 60 W power and argon atmosphere. Subsequently, the sputtering time was selected to be 30 minutes, and different sputtering atmospheres with $Ar:O_2$ ratios (40:0, 35:5, 30:10) were applied, followed by annealing at 600 °C for 4 hours. Finally, an approximately 200 nm thick aluminum electrode was deposited via electron beam evaporation and annealed at 400 °C for 1 h. Evaluating the characteristics of $SrTiO_3$ WORM memory is performed by Keysight B1500A semiconductor component analyzer.

The research results show that when the deposition time is 60, 45, 30 and 15 minutes, the 30-minute deposition exhibits a relatively low set voltage (V_{set}). Subsequent adjustments to the gas ratio showed a minimum V_{set} of 3.1 V and a R_{on}/R_{off} ratio of 10^7 for $Ar:O_2$=35:5. To evaluate the data retention capability of $SrTiO_3$ (STO) WORM, a voltage pulse of 1 V was used to examine changes in resistance retention time. Both the off and on states can last longer than 10^4 s, with an observed switch/resistance ratio of 10^7. Additionally, the memory's resistance to read disturbance was confirmed using constant voltage stress. The resistance is unaffected by constant read voltage, and an OFF/ON ratio of 10^7 is maintained for over 10^4 s under this read disturbance test.

In this study, a sputtering method was used to fabricate a resistive switching memory device based on $SrTiO_3$, and the dependence of the resistive switching characteristics on different deposition times and atmosphere ratios was studied. $Al/SrTiO_3/n^+$ Si memory exhibits a R_{ON}/R_{OFF} ratio of up to 10^7 and good WORM characteristics. Due to the good thermal stability of the STO material, the retention times of all devices in this study exceeded 10^4s.

Keyword: $SrTiO_3$, Memory, WORM, Data retention, Set Voltage

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No. O-5

TITLE: Computational Analysis of Triazole Compounds for Copper Corrosion Control in Chemical Mechanical Planarization

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ABSTRACT

This study employed first-principles density functional theory calculations to investigate the adsorption behavior of various triazole molecules, including 1, 2, 3-triazole (123TA), 1, 2, 4-triazole (124TA), and Benzotriazole (BTAH), on the Cu(111) surface both before and after deprotonation in the chemical mechanical polishing/planarization (CMP). Adsorption energy calculations demonstrate that 123TA may be absorbed into the Cu(111) surface by creating bridge bonds between its single or twin nitrogen atoms and copper. The adsorption energy of 123TA is -0.335 eV, which is greater than that of 124TA and BTAH, whereas the distance between nitrogen atoms and copper is 2.61 Å. The highest adsorption energy of 124TA is -0.29 eV, with an atomic bond length of 2.41 Å between the nitrogen atom and the copper atom. The highest adsorption energy of BATH is -0.31 eV, with atomic bond lengths of 2.85 Å ~ 2.819 Å between the nitrogen and copper atom. In comparison among 123TA, 124TA, and BTAH, 123TA exhibits the highest adsorption energy at -0.335 eV, followed by BTAH with the second-highest adsorption energy at -0.31 eV, and 124TA-1 with a lower adsorption energy of -0.29 eV. This research contributes valuable insights into the development of semiconductor manufacturing technologies by suggesting the potential application of triazole-based compounds as efficient copper corrosion inhibitors in CMP procedures.

Keyword: First-principles study, adsorption energy, triazole molecules, chemical mechanical polishing, chemical mechanical planarization

No. O-6

TITLE: Understanding the Impact of Copper Corrosion Inhibitors on $Cu_2O(111)$ Surfaces in Chemical Mechanical Planarization using *Ab initio* method

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ABSTRACT

This study employs first-principle calculations based on the density functional theory to investigate the adsorption energy of copper corrosion inhibitors on $Cu_2O(111)$ surfaces. Copper corrosion is a significant concern in various industries, and the development of effective inhibitors is of paramount importance. The copper corrosion inhibitors mentioned in this paper include the compounds 1, 2, 3- and 1, 2, 4-triazole, benzotriazole, 1-hydroxybenzotriazole, and naphthotrizole. The investigation starts by analyzing the adsorption energies of these inhibitors on $Cu_2O(111)$ surfaces to evaluate their potential in preventing copper corrosion. Studies on the adsorption of copper corrosion inhibitors on $Cu_2O(111)$ surfaces revealed that 1, 2, 4-triazole and 1, 2, 3-triazole molecules exhibited the highest adsorption energies at 1.626 eV and 1.562 eV, respectively. These high adsorption energies signify a strong and favourable interaction between these triazole compounds and the $Cu_2O(111)$ surface. The adsorption energies of 1-hydroxybenzotriazole, benzotriazole, and naphthotrizole molecules on $Cu_2O(111)$ surfaces are also 1.071, 1.264 and 1.524 eV, respectively. Although these values are slightly lower than those of the triazole compounds, they still demonstrate a substantial affinity for the $Cu_2O(111)$ surface. A significant discovery of this study is the identification of 1, 2, 4-triazole as the inhibitor with the strongest adsorption effect on $Cu_2O(111)$ surfaces. This result underscores the potential of 1, 2, 4-triazole as an effective copper corrosion inhibitor, as its strong adsorption energy suggests it can form a stable protective layer on the $Cu_2O(111)$ surface, mitigating corrosion effectively. In conclusion, the study found that 1, 2, 4-triazole exhibits the strongest adsorption effect on $Cu_2O(111)$ surfaces, highlighting its potential as a copper corrosion inhibitor and contributing to the advancement of corrosion prevention in various industrial applications.

Keywords: First-principles calculation, copper, cupreous oxide, adsorption energy, triazole molecules

No. O-7

TITLE: Light spectral analysis of color images enables non-invasive direct bilirubin detection

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ABSTRACT

Bilirubin, a yellow pigment, is generated through the breakdown of hemoglobin in red blood cells and is subsequently metabolized by the liver for elimination from the body. Elevated levels of total bilirubin in the body can lead to skin and tissue damage, resulting in a condition known as jaundice or hyperbilirubinemia. Urine test paper is a common non-invasive method for detecting direct bilirubin, but it is limited to qualitative analysis and lacks quantitative capabilities. In this study, we employed LEDs as the light source. Images were captured using a smartphone and assessed for red (R), green (G), and blue (B) color values to establish a linear relationship between spectral changes in the test paper image and direct bilirubin concentration. This approach successfully enabled non-invasive bilirubin detection.

Keyword: LEDs, test paper, non-invasive method, direct bilirubin

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No. O-8

TITLE: Growth of MoS_2/PtS_2 van der Waals Heterobilayer for Acetone Gas Sensor Applications

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ABSTRACT

At present, the use of the high-temperature furnace tube combined with chemical vapor deposition process is the main method for growing the two-dimensional (2D) transition-metal dichalcogenide (TMDC) materials, especially for the 2D monolayer [1, 2].

In this study, chemical vapor deposition (CVD) was used to grow van der Waals hetero-bilayer of MoS_2/PtS_2 on sapphire substrates. Different from the traditional process of growing two-dimensional thin films using the high-temperature furnace tube equipment (the substrate was placed horizontally), we used a special metal stage to allow the substrate to be placed vertically. During the film's growth process, MoO_3 powder, PtO_2 powder and sulfur powder were employed as source materials, and Ar was used as the carrier gas.

Based on the measured results, the monolayers (MoS_2 and PtS_2) and hetero-bilayer of MoS_2/PtS_2 with high-quality and high-uniform can be grown on large-area substrates (2 cm × 3 cm) by using the novel process. Especially for the MoS_2 monolayer, the triangle-shaped monolayers were almost all closely connected together to form a large-area monolayer film. In addition, considering this MoS_2 monolayer as a template, the PtS_2 monolayer can be directly prepared on this template, forming a high-quality hetero-bilayer of MoS_2/PtS_2. Finally, the above-mentioned two-dimensional thin films were used to fabricate gas sensors for detecting acetone gas. The results show that these three two-dimensional thin films all have the potential to detect acetone gas, and the hetero-bilayer of MoS_2/PtS_2 has a significantly higher sensitivity, which is expected to be applied to the detection of diabetes.

Keyword: MoS_2 monolayer, PtS_2 monolayer, MoS_2/PtS_2 heterobilayer, chemical vapor deposition, acetone gas, gas sensor

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No. O-9

TITLE: Coating of Sr-doped Hydroxyapatite by Magnetron Sputtering on 3D-Printed Titanium-Alloy for Biomedical Implant Applications

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ABSTRACT

Hydroxyapatite has similar chemical properties and crystal structure to the hard tissue of biological bone. Additionally, it possesses several advantages, such as good biocompatibility, excellent osteoconductive properties, high thermal stability, and so on. Therefore, hydroxyapatite thin films is often coated on the surface of biomedical implants, thereby improving the properties of implant materials [1, 2].

In this study, HA and Sr-doped HA thin films were grown on silicon substrates and 3D printed titanium-alloy substrates by magnetron sputtering. During the film's growth process, the HA and Sr-doped HA targets were used. The substrate temperature (consisting of 27, 100, 200, 300, 400 and 500 °C) was the main modulation parameter. For the analyses of these thin films, scanning electron microscopy (SEM), transmission electron microscopy (TEM), x-ray diffraction (XRD), x-ray photoelectron spectroscopy (XPS), contact angle measurement, electrochemical corrosion experiment, nano-indentation measurement and cytotoxicity test were used.

The experimental results showed that the Ca atoms were successfully replaced by Sr atoms in Sr-doped HA films. The results of cytotoxicity tests revealed that the survival rate of osteoblast cells can be improved obviously when the content of Sr in the film was increased.

Keyword: Sr-doped hydroxyapatite, thin films, magnetron sputtering, titanium alloy, biomedical implant, cytotoxicity test

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No. O-10

TITLE: β-$(AlGa)_2O_3$ UVC Photodetector Implemented by Thermal Interdiffusion Alloying Method

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ABSTRACT

Due to their wide bandgap properties, oxides are highly anticipated for transparent electronics, solar-blind photodetectors, and advanced power devices [1]. Yet, enhancing the performance of β-Ga_2O_3-based devices for shorter response wavelengths or creating tunable deep-UV photodetectors is essential. We introduce the Thermal Interdiffusion Alloying (TIA) technique to tackle this challenge, offering simplicity and precise control. TIA has been proven effective in producing β-$(AlGa)_2O_3$ films with adjustable Al% content and improving crystal quality, surpassing alternative deposition methods. Extensive material analysis also elucidates the Ga-Al atom interdiffusion process. As a result, we have successfully fabricated a deep-UV photodetector with a 233 nm response wavelength using our TIA method.

To create a wide-range bandgap-tunable deep ultraviolet photodetector, we tailored the response wavelength by adjusting the Al content in β-$(AlGa)_2O_3$ (bandgap > 4.9 eV). We achieved this by depositing monoclinic β-Ga_2O_3 single crystal thin films on sapphire (α-Al_2O_3) substrates through pulsed laser deposition (PLD) and annealing them at various temperatures. This method facilitated the development of single-phase β-$(AlGa)_2O_3$ thin films with the desired Al composition on c-plane sapphire substrates [2]. Following the photodetector device fabrication, we applied a 20nm/200nm Ti/Au layer, annealed it using RTP, and then patterned the interdigital electrodes by photolithography and a lift-off process. Ultimately, we could assess the photodetection characteristics, response wavelength, and response time.

The XPS spectra offer insights into the bandgap of the initial β-Ga_2O_3 film (4.9 eV) and the annealed β-$(AlGa)_2O_3$ thin film (5.3 eV). This disparity proves Ga/Al atom interdiffusion at the β-Ga_2O_3/α-Al_2O_3 interface. The SIMS analysis involving depth profiling of Al, Ga, and O elements in the 72 nm-thick as-deposited β-$(Ga)_2O_3$ film and in β-$(AlGa)_2O_3$ films annealed for varying durations (3, 6 hours) at 1000°C. SIMS revealed that the diffusion of Al atoms from the sapphire substrate into the annealed thin film resulted in higher Al content, and Ga atoms from the thin film into the sapphire substrate caused an increase in the thickness of the annealed β-$(AlGa)_2O_3$ film from 163 to 178 nm. This thickness increase was more pronounced with longer annealing times and higher temperatures.

The characteristics of two UV photodetectors (PDs), one subjected to a 1000°C-3-hour thermal interdiffusion process and one without, at different biases. The β-Ga_2O_3 PD exhibited an on-state photocurrent ranging from 0.1 to 1 μA (less than 1 nA for the β-$(AlGa)_2O_3$ PD), with off-state dark current at approximately 10^{-13} to 10^{-12} A for the β-Ga_2O_3 PD (10^{-15} A for the β-$(AlGa)_2O_3$ PD). The responsivity of the β-Ga_2O_3 PD measured 6.2 A/W at 255 nm, whereas the β-$(AlGa)_2O_3$ PD yielded 0.014 A/W at 233 nm, both under a 5 V bias. These high I_{photo}/I_{dark} ratios (>10^5) were attributed to their low dark current. We have demonstrated the tunable response wavelengths (255 and 233 nm). The rise-time/fall-time of the β-Ga_2O_3 PD was 1.82/0.38 sec, a significant improvement observed in the annealed β-$(AlGa)_2O_3$ PD (0.98/0.11 sec) due to the thermal annealing-induced crystal rearrangement process.

Keyword: Ga_2O_3, Oxide, UVC, photodetector

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No. O-11

TITLE: Fatigue behavior of rotary friction welding of acrylonitrile butadiene styrene and polycarbonate dissimilar materials

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ABSTRACT

Understanding the fatigue behaviours of weld joints is significant in engineering practice. Rotary friction welding (RFW) can join the additively manufactured polymer components. Until now, no research has focused on the fatigue behaviour of polymer components jointed by RFW. This study investigates the fatigue life of ABS/PC dissimilar components fabricated by RFW and proposes the fatigue mechanism based on failure structure. This work uses five different cyclic loads and rotational speeds to investigate fatigue life. The fatigue life of RFW of ABS/PC dissimilar rods is better compared with the pure ABS and pure PC specimens due to weld and integrity microstructural changes resulting from the combination of ABS and PC materials. The number of cycles to rupture of RFW of ABS/PC dissimilar components (y) can be determined by the cyclic load (x) according to the prediction equation of $y= -838.25 x^2 - 2035.8 x + 67262$. The fatigue life of RFW of ABS/PC dissimilar components will increase with increased rotational speed. The number of cycles to rupture (y) can be determined by the different rotational speed (x) according to the prediction equation of $y=315.21 x^2 + 2710.4 x + 32124$.

Keywords: Rotary friction welding, Fatigue life, Fatigue failure mechanism, Number of cycles to rupture, Rotational speed, Cyclic load

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No. O-12

TITLE: *Ab initio* Studies of Work Function Changes of NO Adsorption on $ZnGa_2O_4$(111) Surface for Gas Sensors

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ABSTRACT

This work employs *Ab initio* studies based on the density functional theory to evaluate the adsorption behaviour of nitric oxide on clean, Pt-, Pd-, Au-, Ag-doped, and oxygen-terminated $ZnGa_2O_4$(111) surfaces. The surface work function change is used to evaluate the adsorption behaviour of nitric oxide on $ZnGa_2O_4$(111) surfaces. Compared to the observed 0.23 eV work function change for nitric oxide adsorption on the clean $ZnGa_2O_4$(111) surface, the Ag-doped $ZnGa_2O_4$(111) surface demonstrates an increased work function change of 0.35 eV. Moreover, when nitric oxide is adsorbed onto oxygen molecules present on $ZnGa_2O_4$(111), it readily reacts with these oxygen molecules to form NO_2-like molecules. This reaction results in a significant work function change of 0.54 eV, leading to a 2.33-fold increase in sensitivity for nitric oxide detection. In an oxygen-rich environment, the Ag-doped $ZnGa_2O_4$(111) surface demonstrates the highest work function change of 0.50 eV among all the doped noble metals. The interaction between NO molecules and oxygen surface atoms on ZnGa2O4(111) enhances the performance of the $ZnGa_2O_4$(111) surface for nitric oxide sensing. Our results are consistent with previous experimental findings.

Keyword: *Ab initio* Studies, $ZnGa_2O_4$, NO, work function, adsorption energy

No. O-13

TITLE: Computational Analysis of Electronic Structures and Defect Formation Energy in Aluminum-Doped $ZnGa_2O_4$: An *Ab initio* Study

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ABSTRACT

This research conducted an *Ab initio* investigation into the electronic structures and defect formation energies of both undoped and aluminum-doped $ZnGa_2O_4$. The study further explored the luminescence properties of $ZnGa_2O_4$-based long-lasting phosphors, both with and without activators, aligning with the characterization of $ZnGa_2O_4$. Our findings emphasize that doping $ZnGa_2O_4$ with aluminum atoms results in the creation of split energy levels that are essential for activating luminescence. Computational analyses indicate that the highest and lowest defect formation energies in $ZnGa_2O_4$ are positioned at -1.1 eV and -8.20 eV, respectively. The electronic structure reveals impurity energy levels at 1.52 eV, 1.88 eV, 2 eV, and 3.98 eV. These significant impurity energy levels notably reduce the energy gap required for carrier transitions from the valence band to the conduction band, decreasing it from 5.08 eV to 4.37 eV. Additionally, the electron energy range at the lower end of the valence band, spanning from -0.4 eV to -9.3 eV, exhibits a broad valence band characterized by an absorption spectrum of 8.9 eV

Keyword: *Ab initio* study, long-lasting phosphors, $ZnGa_2O_4$, defect formation energy, luminescence

No. O-14

TITLE: First-Principles Studies of Adsorption Energy for Deprotonated Triazole Molecules on Cu(111)

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ABSTRACT

This study employs first-principles calculations based on the density functional theory to investigate the deprotonated triazole compounds 1, 2, 3-triazole (123TA), 1, 2, 4-triazole (124TA), and benzotriazole (BTAH) in the chemical mechanical polishing/planarization (CMP). Our results show that the deprotonated triazole molecule can exist either in the form of monodentate adsorption with a single nitrogen atom or in the form of bidentate adsorption involving two nitrogen atoms. This is determined by employing the adsorption energy calculation method to investigate its adsorption behaviour on the surface, with a focus on the impact of the deprotonated state on the Cu(111) surface. The deprotonated 123TA molecule exhibits the highest adsorption energy of -3.07 eV on the Cu(111) surface with a 1.97 Å bond length between the nitrogen atoms and copper. Our research indicates that 123TA exhibits significant adsorption onto the Cu(111) surface, forming bridge bonds with copper atoms. Deprotonating the triazole molecule can reduce the atomic bond length between the copper atom and the nitrogen atom. Stable interactions are formed between the deprotonated triazole molecule and copper surface atoms, resulting in the formation of bridge bonds with the Cu(111) surface. This specific bonding arrangement helps elucidate the underlying mechanics of chemical mechanical polishing. It also demonstrates how these compounds can enhance the precise removal of material layers during the CMP procedures and enables a comprehensive analysis of the interactions between deprotonated triazole molecules and the Cu(111) surface. These findings hold practical significance for enhancing CMP procedures and advancing our understanding of atomic-level surface chemistry.

Keyword: First-principles study, adsorption energy, triazole molecules, chemical mechanical polishing, chemical mechanical planarization.

No. O-15

TITLE: FABRICATION OF THE HOLLOW MICROPILLAR ARRAY USING THE MASKED STEREOLITHOGRAPHY

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ABSTRACT

This study presents a low-cost method to fabricate the hollow micropillar array using the masked stereo-lithography. There are two kind of the mask stereolithography technologies based on the classification of mask generators: the digital light processing (DLP) and liquid crystal display (LCD). The LCD technique is the simple vat-photopolymerization technique which uses a liquid crystal display, to irradiate each resin layer with UV light and display itself acts as the mask generator. Each pixel can be set either to its transparent or opaque, to form a mask. The resolution of the pixels was with a minimum feature size [1]. Fabrication of the hollow micro-pillar array was the LCD screen as a mask to create an image of each layer and to hardens each layer thickness. The process of the masked stereo-lithography comprises the 3D model, the slicing software for 3D printing, 3D printer, and cleaned. Each designated exposure time, the structure was carefully removed, thoroughly cleaned with alcohol, and subjected to sonication to ensure complete removal of any uncured resin. The experimental results showed that the hollow micropillar array in resin could be formed. The hollow micropillar array printed successfully with 50 μm layer thickness. Fabrication the higher of the micro structural height, the hole diameter was the smaller. The hollow micropillar array has been apply for high-capacity drug screening and higher heat transfer coefficient [2][3].

Keyword: hollow micro-pillar, array, stereolithography

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No. P-1
TITLE: 3D printing technology in electronic circuit blocks using LEGO ® concept

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ABSTRACT

In recent years, the Additive Manufacturing (AM), also known as 3D printing, has become increasingly mature and can now be applied to circuit design. This study explores the application of 3D printing for modular electronic circuits using LEGO ® concept. Traditional electronic components or modules often require soldering to assemble onto Printed Circuit Boards (PCBs). Taking an LED flashing circuit as an example, this paper divides the circuit into several components to be treated as circuit modules. These modules are designed using SolidWorks software and imported into a dual-nozzle 3D printer capable of fusion deposition modeling. Conductive sections of the modules are created using Polylactic Acid (PLA) filament infused with conductive carbon material known as Carbon Black (CB) as the conductor, while non-conductive sections and the external appearance of the circuit are made using pure PLA filament. Connectors used for module interconnections have been tested for proper conductivity, and electronic components within the modules are placed during the printing process.

This paper successfully designs a 3D printed circuit with the capability to be disassembled and reassembled, offering a more diverse range of possibilities for assembling electronic components or modules.

Keyword: 3D printing, three-dimensional circuit, additive manufacturing, fused-deposition modelling

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No. P-2
TITLE: Moving the cursor based on brainwave signals generated by eye's movements

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ABSTRACT

In various literature, numerous products have been developed that allow operators to communicate with automated devices through methods such as sound and gestures. The technology of eye-controlled cursor manipulation offers us a novel form of human-machine interaction. This research utilizes the Emotive EPOCX headset, with the primary collection of signals coming from the F7, F8, AF7, and AF8 electrodes. By detecting the position of the visual area using EMOTIV brainwave monitoring, cursor movement can be controlled directly by the movement of the eyes. When both AF3 and AF4 exhibit upward waveforms, it indicates an upward movement of the eyes, while when both AF3 and AF4 exhibit downward waveforms, it indicates a downward movement of the eyes. Although initially, the waveforms of eye movement upwards and blinking appear very similar, they exhibit different characteristics after undergoing band-pass filtering. The signal waveforms of the left frontal lobe (AF3) and the right frontal lobe (AF4) are opposite in AF3 and AF4 signals. When the waveform of the left frontal lobe is upward while the waveform of the right frontal lobe is downward, it represents a leftward eye movement. When the waveform of the left frontal lobe is downward while the waveform of the right frontal lobe is upward, it represents a rightward eye movement.

The technology of eye-controlled cursor manipulation provides us with a novel form of human-machine interaction. This approach proves to be an effective communication tool, particularly in situations involving mobility challenges or speech difficulties.

Keyword: human-machine interfaces, non-invasive human-machine interfaces, electroencephalogram

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No. P-3

TITLE: Effect of Isolation Process on Device Performance of Red Micro-LEDs

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ABSTRACT

This study explores the variations in different isolation process when using AlGaInP epitaxial materials to manufacture pixels with an 80x80 μm² size. Individual devices are arranged into a 3x3 pixel array, and dry etching and ion implantation are used as insulation methods to define the emitting pixels for micro-LED fabrication. Backside emission measurements are conducted using flip-chip bonding to eliminate light obstruction caused by metal deposition and enhance light extraction efficiency. The results for different isolation process are discussed, including current-voltage characteristics, optical output power, external quantum efficiency, and electroluminescence spectral analysis.

Keyword: Micro-LED, AlGaInP, isolation process, Chip-on-Bond, Ion implantation

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No. P-4

TITLE: A Materials Genome Approach for Studying Thin-Film Heterostructures on Flexible Muscovite Mica Substrates

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ABSTRACT

With the rapid development of flexible electronic devices, traditional epitaxial substrates have gradually been replaced by flexible substrates, which have huge economic benefits. The polymers are often used as flexible substrate materials for flexible electronic devices sold on the market. However, polymer substrates suffer from problems such as poor thermal stability, low solvent resistance, and low thermal expansion coefficient. Layered muscovite mica materials have emerged as a new solution. Muscovite mica is a two-dimensional layered structure material that can be easily cut into flakes. Mica flakes exhibit mechanical flexibility, optical transparency, and high thermal stability. In this research project, we use a novel materials genome method to study new thin-film heterostructures on flexible muscovite mica substrates. We have successfully developed a novel artificial intelligence-generated heterostructure to study of the GaN(001)/Muscovite(001) heterostructure. The results indicate that the GaN thin film atomic arrangement, characterized by the gene T1, is epitaxially grown on the muscovite substrate models characterized by gene arrangements S1 and S3. It is estimated that the heterojunction can form 12 Ga-O bonds, and the calculated lowest interface energy is −1.21 eV/Å^2. The outcomes of this project play a crucial role in shortening the research and development cycle for new materials. This approach has direct application in the semiconductor industry, offering a novel artificial intelligence-generated superlattice structure. Through this artificial intelligence-generated heterostructure method, it not only enhances critical technologies in emerging semiconductor processes, materials, and components but also increases the competitiveness of the entire industry supply chain.

Keyword: Van der Waals epitaxy, muscovite mica, two-dimensional materials, materials genome, first-principles calculations

No. P-5

TITLE: Study of Wide Field-of-view Scanning in LIDAR System by Using Spatial Light Modulator

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ABSTRACT

With the advancement of science and technology, LIDAR-related research and applications have been constantly innovating. Bin Lv and others studied the data integration of LIDAR systems used in road traffic in 2019 [1]. The data that can be integrated include the time analysis of pedestrians crossing the road [2], driver behavior analysis [3, 4], safety assessment of passers-by and vehicles [5].

This study proposed utilizing spatial light modulator (SLM) can realize the function of LIDAR (light detection and ranging) scanning. However, there is a limitation in SLM and its range of scanning is ±2 degrees. So, it is unable to realize the wide field of view of scanning. We proposed the solution that can increase the range of scanning of SLM, and the concept of solution is from telescope system. The description and partial hardware of typical telescope can be replaced by SLM. The SLM is substituted for the objective of telescope system and we can obtain wide collimated beams output of eyepiece. Generally, human eyes can receive ±20 degrees of FOV. It means that we can get ±20 degrees output of collimated beams when SLM is substituted for the objective. Namely, adding an eyepiece behind the SLM is able to have ±20 degrees output of collimated beams. As stated above, we proposed a prototype of LIDAR scanning system of SLM and the concept of solution is from telescope system. Then we design the eyepiece system which can increase the angle of scanning from ±2 degrees to ±20 degrees. This study includes the design of eyepiece in Zemax software, data verification in Matlab, equipment set-up and measurement of light spot.

Keyword: spatial light modulator (SLM), LIDAR, light point scanning

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No. P-6

TITLE: A CNN-BASED OCCLUSION DIAGNOSIS SYSTEM WITH DATA AUGMENTATION USING GENETIC ALGORITHM

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ABSTRACT

This paper proposes an intelligent approach for diagnosing dental occlusion using a Convolutional Neural Network (CNN) to predict three types of tooth occlusion: open bite, deep bite, and normal bite. In addition to CNN, other models such as Deep Neural Networks (DNN), K-Nearest Neighbor (KNN), Decision Trees, and Random Forests were also explored. Given the insufficient and imbalanced real training data, a genetic algorithm (GA) was utilized to simulate the mating process between parents, generating offspring to augment the data and create more samples. The initial dataset, comprising 258 real data points provided by dentists, was split into 948 training data points after expansion, while 54 real data points were reserved for verification purposes. The proposed method improves the CNN's accuracy on the training data from 80% to nearly 95% and from 60% to nearly 85% on the testing data.

Keyword: Bite, Remote consultations, Diagnostic recommendations, GA, CNN

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No. P-7

TITLE: Design and Implementation of Classroom Air Conditioning Monitoring and Energy Management System

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ABSTRACT

To ensure electrical safety on campus and create a more comfortable learning environment, the Executive Yuan announced the national policy of "Air Conditioning in Every Classroom" for primary and secondary schools in July 2020. The Ministry of Education subsequently approved the "Public Junior High and Elementary School Electrical System Improvement and Air Conditioning Installation Program."

This study aims to utilize cost-effective hardware and software components to check whether the air conditioning units in various classrooms on campus are properly turned off. When it detects that the temperature inside a classroom is significantly lower than the outdoor ambient temperature, it can notify the duty personnel to inspect and address the issue. This is in line with the goal of energy conservation, carbon reduction, and cost reduction.

The system proposes a remote monitoring module that utilizes a temperature and humidity sensor DHT11), an ESP8266 development board, and the Arduino programming platform as the platform for temperature sensing, signal processing, and data transmission. Two sets of models are established for indoor and outdoor environments. When there is a significant temperature difference detected between the two sets, it can be determined that the air conditioning unit in a particular classroom is not turned off. Subsequently, the temperature data sensed at that moment is transmitted via Wi-Fi to the monitoring personnel, who can then promptly assign on-site personnel to investigate.

Keywords: Energy Management System, Sensor, Arduino, DHT11, ESP8266

(a) (b)

Fig.1 The architecture system diagram and output information

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No. P-8
TITLE: Applications of Computer Vision and Image Recognition in Smart Factories

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ABSTRACT

As the times progress, many jobs have now been replaced by robots, a phenomenon well-known in the industrial sector as Industry 4.0. Here, we have utilized an Arduino Uno development board to create a simple recognition device, using an OV2640 camera for image recognition. From a technical perspective, we primarily employ machine learning to train the machine's recognition abilities, and the collection of a substantial number of photos helps enhance the machine's recognition capabilities. We have developed software on a computer that allows us to store photos of items identified as either high-quality or defective, along with detailed item data. This article primarily focuses on the recognition of different types of screws and their quality.

Keyword: Machine Learning, Image Recognition, Industry 4.0

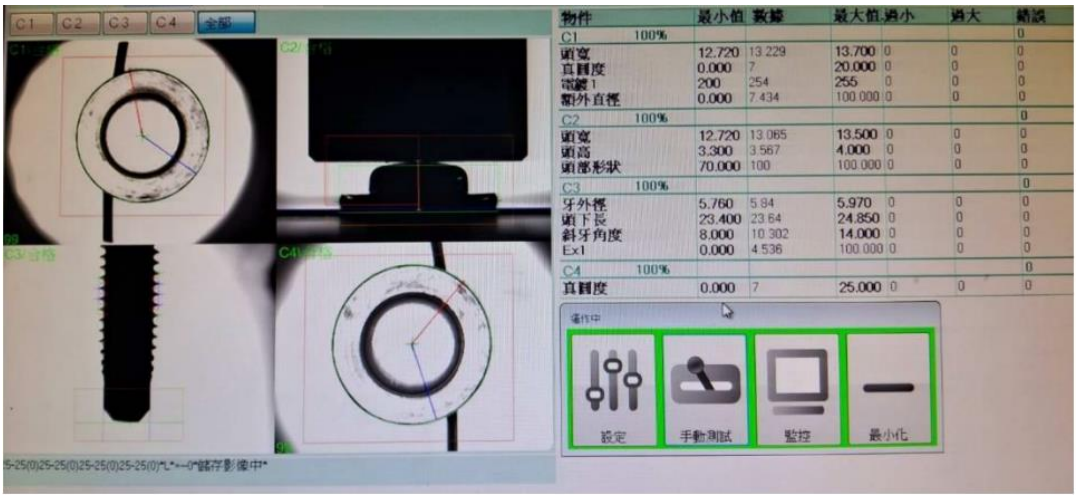

Fig.1 actual measurement screenshot of optical inspection with machine vision

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No. P-9

TITLE: The Impact of Generative Pre-training Programming Project Course on Junior High School AI Learning Effectiveness

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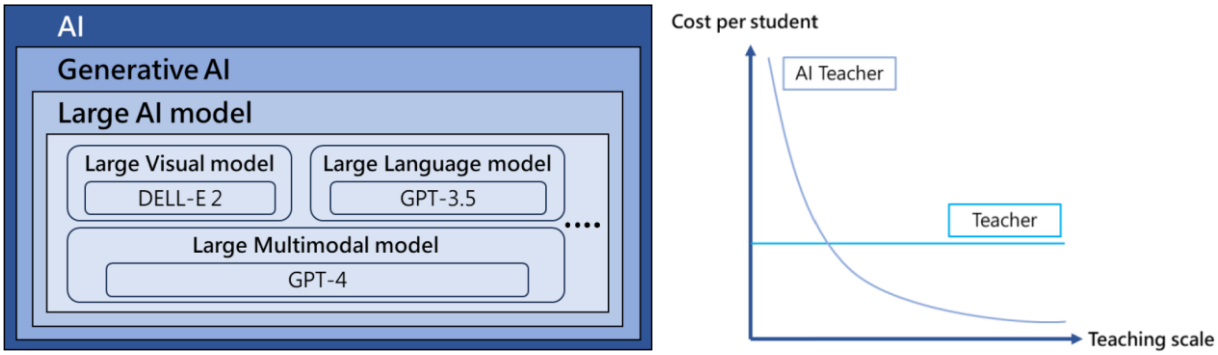
ABSTRACT

In recent years, the rapid development of Artificial Intelligence (AI) technology has garnered widespread attention in the field of education. The middle school stage is a crucial period for students to grasp fundamental AI concepts and skills. This study aims to investigate the impact of a generative pre-training program in programming on the learning outcomes of middle school students in AI. The course combines generative models and programming to provide a foundation in deep learning, with the goal of nurturing students' AI skills. This research employed an experimental approach, dividing middle school students into two groups: one group participated in the generative pre-training program in programming, while the other attended a traditional AI learning course. The results indicate that students who participated in the generative pre-training programming course achieved better results in multiple aspects. Participants in the course demonstrated superior mastery of AI foundational knowledge, including an understanding of machine learning and deep learning. Secondly, these students exhibited higher proficiency in practical applications, enabling them to develop and deploy basic AI applications. Additionally, the application of generative pre-training models enhanced their self-directed learning abilities, enabling them to better comprehend and adapt to the evolving field of AI. The course also sparked creativity and problem-solving skills in students. Through real-world projects and challenges, students learned to think critically and solve problems, crucial skills required in the field of AI. The results of this study highlight the significantly positive impact of the generative pre-training program in programming on middle school students' AI learning outcomes. This course, which integrates deep learning and programming, provides students with rich learning opportunities, enhancing their AI skills, problem-solving abilities, and creativity. Therefore, it is recommended that schools and educational institutions consider adopting similar courses to better cultivate the next generation of AI professionals.

Keywords: Generative Pre-training, Middle School Students, AI Learning, Educational Impact, Curriculum Design



(a) (b)

Fig1.(a) AI Generated Content model classification, (b) A Generative AI teacher and teacher's relationship between teaching scale and cost per student.

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No. P-10

TITLE: Ga_2O_3 nanorods synthesized by hydrothermal method for sensing of pH value

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ABSTRACT

In this work, hydrothermal (HT)-synthesized gallium oxide (Ga_2O_3) nanorods were applied on indium tin oxide (ITO) glass substrates to create a pH- sensing device [1,2]. Extended-gate field-effect transistors (EGFETs) were designed for pH sensing, and the response to pH levels ranging from 1 to 11 was tested using both chemical bath deposition (CBD) and high-pressure hydrothermal methods. Two sensor con-figurations, Ga_2O_3(CBD)/ITO/glass and Ga_2O_3(HT)/ITO/glass, were immersed in solution pH1 to 11 and cultured medium for hydrogen ion sensing. The results demonstrated that, for pH sensing in different samples, both IDS-VDS analysis and IDS-VGS analysis showed superior linearity and sensitivity with the HT method.

Keyword: hydrothermal, Ga_2O_3 nanorods, pH sensing, Extended-gate field-effect transistors (EGFETs), chemical bath deposition (CBD)

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No. P-11

TITLE: Using various statistical methods to examine the association between severe mental illness and subsequent ischemic/hemorrhagic stroke

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ABSTRACT

Schizophrenia is a severe mental disorder. In 2019, there were approximately 20 million cases worldwide. People with schizophrenia have higher suicide rates and more physical health problems than the general population, which reduces their average life expectancy by about 20 years [1, 2]. Bipolar disorder, on the other hand, is a severe form of mood disorder. According to the survey by the World Health Organization, bipolar disorder accounts for about 1% of the world's population and is one of the 20 leading causes of disability in the world. Moreover, the risk of death for patients with bipolar disorder is twice that of the general population, causing a huge burden on society [2, 3]. According to the research literatures, patients with these severe mental illnesses have been found to be at higher risk of developing cardiovascular diseases [3-5]. However, the association between severe mental illness and cerebrovascular disease has not yet been confirmed, making this research topic a clinical challenge.

The goal of this study was to use various statistical methods to examine whether severe mental illness increases the risk of subsequent ischemic/hemorrhagic stroke. We used the publicly shared medical database MIMIC, which contains de-identified electronic medical record data for thousands of patients admitted to intensive care units and/or emergency department wards. First, we selected patients with schizophrenia and/or bipolar disorder from MIMIC as cases. Next, after age and gender matching, we retrieved control samples without any mental disorder from the database. Finally, we queried all diagnostic information of each case patient and control sample from MIMIC, and select diagnoses of heart disease, diabetes, hyperlipidemia, hypertension, and neurological diseases as covariates. The analysis methods used in this study include various independence tests, such as t-test, chi-square test, etc., to determine whether the covariate values have statistically significant differences between the case group and the control group. In addition, we used survival analysis to estimate whether severe mental illness increased the risk of ischemic/hemorrhagic stroke, including the Kaplan-Meier method and Cox proportional hazard model. The log-rank test was used to verify whether there were statistically significant differences between the survival functions produced by the analysis.

The analysis results of this study show that the hazard ratio (HR) of severe mental illness to subsequent ischemic stroke is 1.278 (95% confidence interval (CI) = 1.163-1.405, p-value < 0.01). The HR of severe mental illness to subsequent hemorrhagic stroke was 1.198 (95% CI = 1.020-1.407, p-value < 0.05). Severe mental illness therefore only slightly increases the risk of subsequent stroke. However, the analysis results of the log-rank test found that within 900 days of follow-up, the survival rate of the case group was significantly lower than that of the control group. So severe mental illness still increases the risk of stroke in the early stages of follow-up. The research team will continue to retrieve more types of reference data from MIMIC, such as treatment drug prescriptions, biochemical test results, etc., to perform a more complete analysis. We hope to accurately verify the relationship between severe mental illness and cerebrovascular disease, and further explore the mechanisms leading to their association.

Keyword: schizophrenia, bipolar disorder, ischemic stroke, hemorrhagic stroke, MIMIC database, Kaplan-Meier method, Cox proportional hazard model, log-rank test

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No. P-12

TITLE: Bifacial Solar Photovoltaic Modules Combined With Microporous Sound Insulation Panels

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ABSTRACT

Solar energy is an important direction in the development of green energy. However, the installation of solar panels requires a large land area, which will impact the development of agriculture and fisheries. Therefore, we have conducted research to develop a solar module that combines transparent microporous sound insulation board, which can replace the sound barriers on the both sides of highways and generate electricity. At the same time, this approach can help avoid conflicts with farmers and fishermen over land use. Taiwan's north-south highways have a total length of 1,160 kilometers, making them an excellent installation site. In this study, we will develop transparent microporous sound insulation panels, as shown in Figure 1, and investigate their sound insulation effectiveness through various perforation techniques.

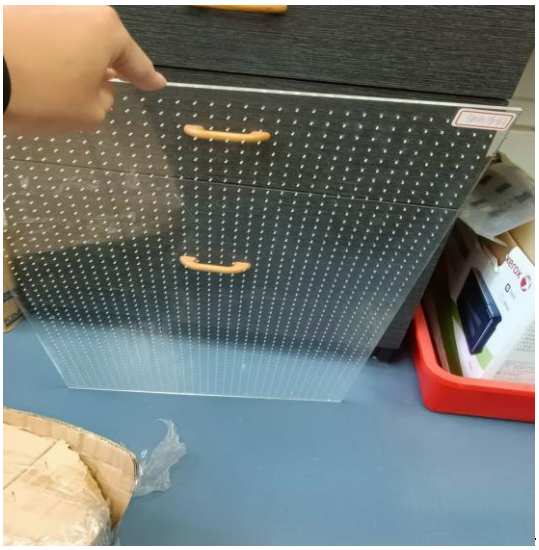

Fig.1: microporous sound insulation board

Keyword: Microporous, Solar Photovoltaic Modules, Sound Insulation

Microporous sound insulation technology, which was proposed by Professor Ma Dayou in 1997, is effective in isolating annoying mid to high-frequency noise. In this study, acrylic panels (PMMA) with thicknesses of 5mm, 6mm, and 8mm were used as sound Insulation panels. Precision CNC machining and laser perforation techniques were employed with perforations smaller than 1mm and the overall porosity is less than 1%.

According to our results, the 5mm thick acrylic panel showed good sound insulation performance across the frequency range from 1000Hz to 5000Hz, as shown in Figure 2. In contrast, slanted microporous PMMA panels did not perform as well as vertically oriented ones, leading us to focus on creating vertical microporous 6mm and 8mm PMMA sound insulation panels.

The data for 6mm thick PMMA, as shown in Figure 3, and 8mm thick PMMA, as shown in Figure 4, both demonstrated good sound insulation performance across the frequency range from 1000Hz to 5000Hz, Comparing with 5mm, 6mm and 8mm PMMA sound insulation panels, the 8mm PMMA sound insulation panels shows the best sound insulation effect.

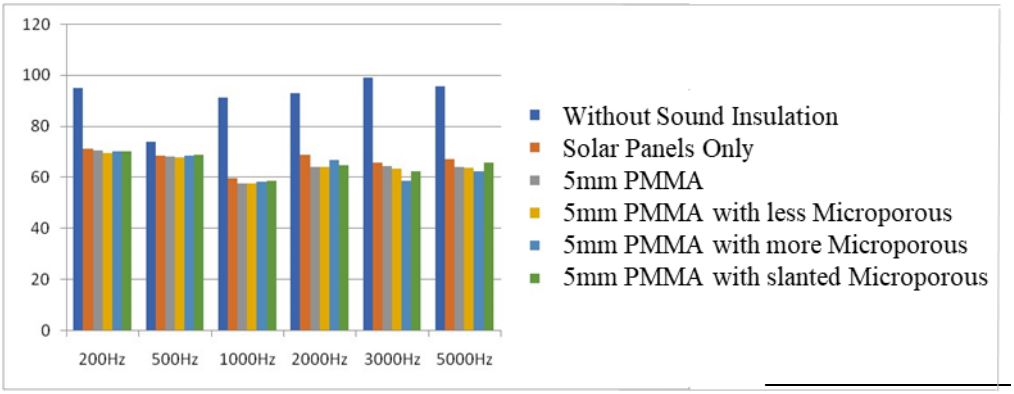

Fig.2: Sound insulation data of 5mm thickness sound insulation board

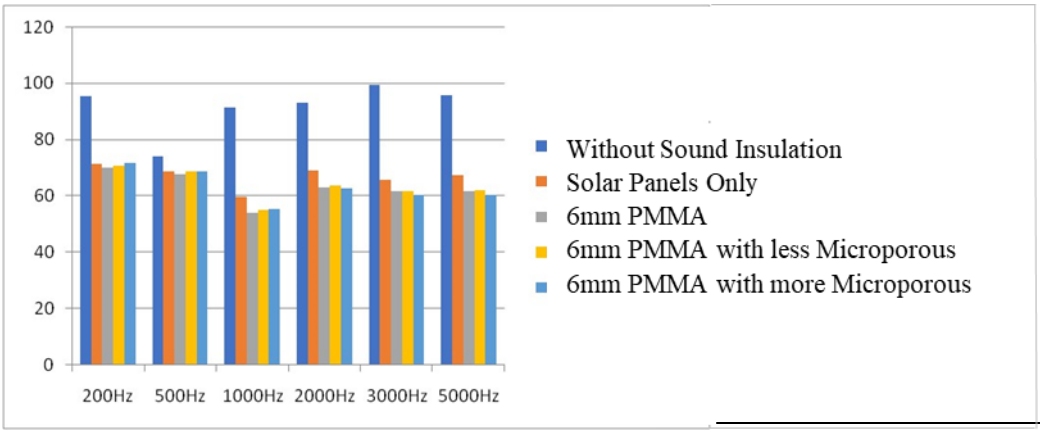

Fig.3: Sound insulation data of 6mm thickness sound insulation board

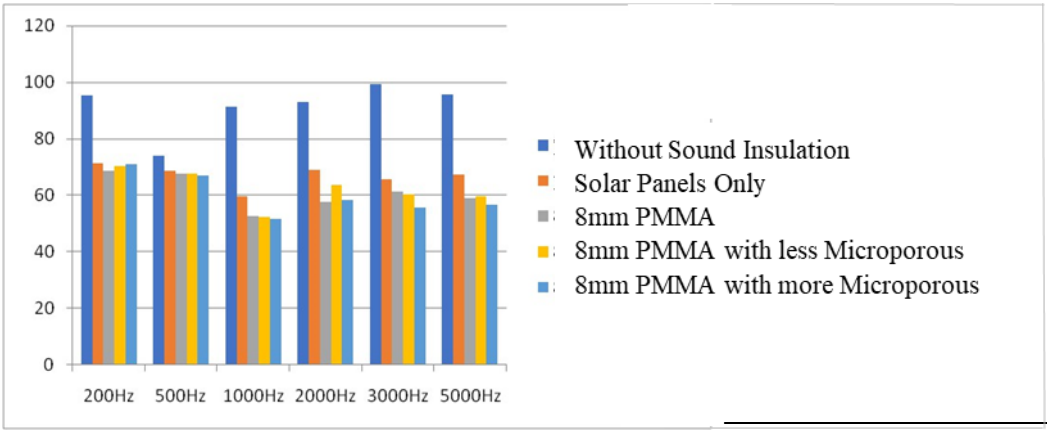

Fig.4: Sound insulation data of 8mm thickness sound insulation board

In summary, our research has successfully developed solar sound insulation modules with excellent soundproofing capabilities. The results indicate that thicker sound insulation panels perform better in terms

of sound isolation. Moreover, the use of precision-perforated microporous with a higher density results in better high-frequency sound insulation. Such sound insulation solar modules not only effectively reduce noise disturbances for residents near highways but also provide a significant source of green energy, contributing to the reduction of the country's carbon emissions.

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No. P-13

TITLE: E-Mode Phototransistor with enhanced UV-Visible rejection ratio based Zinc Gallium Oxide grown by metalorganic chemical vapor deposition

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ABSTRACT

Ultraviolet (UV) radiations comprises a range of electromagnetic wavelengths spanning from 400 nm down to 10 nm. This spectrum is further divided into distinct regions, which include UV-A (400–320 nm), UV-B (320–280 nm), and UV-C (280–10 nm). Notably, UV-C is characterized as solar-blind radiations, as these wavelengths are absent in natural sunlight. The detection of ultraviolet (UV) radiation has garnered substantial attention from researchers due to its diverse range of applications such as tracking ozone holes, flame detection, missile tracking, ensuring secure optical communication, and solar blind detection etc [1]. The capability to manipulate the device's potential through external bias is critical in tuning low dark current and increasing photoresponsivity. Among various types of photodetectors, the phototransistor is gaining increasing attention because of its exceptionally high responsivity, which proves advantageous for detecting extremely weak light signals. Researchers have successfully fabricated phototransistors using a variety of materials, including α-IGO [2], Ga_2O_3, MgZnO [3], ZnO [4], and Zinc Gallium Oxide (ZGO) [5]. ZGO is a ternary oxide characterized by a wide bandgap of approximately 5.2 eV bandgap and exceptional optical characteristics [6]. These properties make it a good candidate for UV detection. In this study, ZGO based phototransistor was fabricated with channel width and length of 250μm and 20 μm, respectively. The source-drain electrodes were constructed by depositing a stack of Ti/Al/Ni with respective thicknesses of 50 nm, 75 nm, and 25 nm. Aluminum oxide, with a thickness of 30nm, serves as the gate dielectric material, and a layer of nickel with a thickness of 150 nm was deposited to form the gate contact. The transmission length measurement analysis showed that sheet resistance, transfer length, and specific contact resistivity of the film to be 276 MΩ/□, 0.28 μm, and 21.63 Ω/mm^2 respectively. The switching from E-mode to D-mode phototransistor occurs on applying the 240 nm UV light and the threshold voltage transistor shifts from 5 V to about -16 V with On/Off current ratio to be 10^6. The responsivity of the device was found to be 128.5 A/W at 240 nm and the rejection ratio ($R_{240/470\ nm}$) to be ~ 10^5 at V_{GS} = -10 V.

Keyword: Zinc Gallium Oxide, phototransistor, metalorganic chemical vapor deposition

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No. P-14
TITLE: The effect of oxide-based nanofillers on cobalt-based gel-state dye-sensitized solar cells

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ABSTRACT

The cobalt-based electrolytes have been paid much attention in dye-sensitized solar cells (DSSCs) because of their slight corrosion and lower visible light absorption. However, the large size of the cobalt redox couple with higher viscosity limits the penetration of electrolytes into the TiO_2 film, resulting in the poor dye regeneration and thereby affecting the device performance. In this regard, the optimization of the TiO_2 film by controlling the addition of ethyl cellulose is proposed for the increase in the porosity of the film, which can successfully improve the penetration of the electrolyte within the film. The performance of DSSCs based on the cobalt-based electrolyte with a conversion efficiency of 17.43% can be made under the indoor condition by the optimization of the film thickness and $TiCl_4$ post-treatment process. The gel-state DSSCs based on cobalt-based electrolytes are further developed and introduced in this study to improve the stability and efficiency of DSSCs by using the microwave synthesized ZnO as nanofillers in cobalt-based electrolytes.

Keyword: dye-sensitized solar cells, $TiCl_4$ post-treatment, zinc oxide, microwave-assisted synthesis

No. P-15

TITLE: Microfluidic colorimetric system using PVA-based for detecting nitrite in foods

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ABSTRACT

Among the various commonly used food preservatives, nitrite and nitrate are the most widely used and can effectively inhibit the growth of bacteria, which easily form nitrosamines in acid environments. In the human body, excessive Nitrosamines may cause methemoglobinemia disease that inhibits the ability of red blood cells to release oxygen to tissues. Therefore, fast detection of food preservatives Nitrosamines is important. In view of this, this study uses PVA provides good carrier properties and can effectively release the reagent to perform the reaction after food sample intervention, to detect the Nitrosamines concentration in food.

In this study, a microfluidic colorimetric setup consisting of a colorimetric PVA-chip device and a microanalysis device [1, 2], for the detection of nitrite concentration in food samples. In this system, a 5 μl volume of the real food sample is inject into the reaction zone of the colorimetric PVA-chip device. Within this zone, the nitrite sample undergoes a reaction with an embedded Griess reagent, resulting in the formation of a pink-colored complex. The fully reacted liquid is pushed into the detection area through the design of the microfluidic chip. A cellphone camera captures a color image of the reaction complex, which is then processed using self-made RGB software to detect the nitrite concentration. In this study, the ratio of reagents and RS ratio were discussed, and a standard curve was established to feasibility of this study.

Keyword: Microfluidics, PVA-chip device, Nitrite, Griess reagent

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No. P-16
TITLE: Microfluidic detection system for VEGF detection in peritoneal dialysate

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ABSTRACT

Taiwan exhibits the highest global incidence of chronic kidney disease (CKD) [1] [2]. Among them, most patients with end-stage renal disease require renal replacement therapy (RTT), include peritoneal (PD) and dialysis, hemodialysis (HD). This study approaches from the perspective of peritoneal dialysis (PD) [3] [4] patients, employing microfluidic technology to detect the VEGF biomarker in peritoneal dialysis fluid, to avoid and prevent peritoneal sclerosis in PD patients.

In this study, based on Enzyme enzyme-linked immunosorbent assay (ELISA) method and microfluidic technology, include PMMA microfluidic chip, and a detection platform incorporating a microspectrometer, replacing the traditional enzyme immunoassay analyzer. Through the design of microfluidic channels helpful the sample and reagent mixture, the ELISA reagents are sealed in the microchip, and a finger pump is used to push the ELISA reagents. The reaction is completed on the microchip, and then a micro spectrometer is used to detect the reaction zone to decide the VEGF concentration in PD fluid.

The results show, based on microchip ELISA best incubation time is 30 min, optical path thickness is 3.8 mm, and surface modification method has higher slope than original. Create a standard curve to decide the PD fluid VEGF concentration, in blind experiment result correlation coefficient of 0.9994 and a recovery rate of 94.07%.

Keyword: Vascular endothelial growth factor (VEGF), Peritoneal Dialysis (PD), Microfluidics, Biosensor

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No. P-17

TITLE: **Preparation of amorphous gallium oxide by MOCVD and study of growth orientation and alignment through thermal annealing**

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ABSTRACT

In the past research on gallium oxide, we learned that gallium oxide has six different types of crystalline phases *α, β, γ, δ, ε*, and *κ*. Regarding how changes in oxygen content and temperature can change gallium oxide from an amorphous state There are few studies on conversion into single crystal and polycrystalline forms. This study uses organic chemical vapor phase metal deposition to first grow a beta-type gallium oxide buffer layer of about 40nm on the sapphire substrate, and then adjusts it with oxygen. The grown gallium oxide was converted into an amorphous form, and subsequent heat treatment in an oxygen environment was performed to study the growth behavior and growth arrangement of the upper amorphous gallium oxide into beta-type gallium oxide.

Keyword: MOCVD, amorphous, gallium oxide

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No. P-18

TITLE: A Green Joining Technique for Dissimilar Polymeric Rods Built With Fused Deposition Modeling

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ABSTRACT

In practice, the feature of adhesive bonding is that it can be bonded with dissimilar materials. However, it is not suitable for industrial application due to its low bonding efficiency. Fusion bonding of thermoplastic materials is known for weldability. Friction welding (FW) is a green manufacturing technology in the field of welding. According to practical experience, material extrusion (MEX) process is widely used in the automotive industry, ranging from lightweight tools, functional parts, and testing models. Therefore, FW of dissimilar polymer rods is capable of manufacturing green products swiftly and economically. In this study, a green manufacturing technique of joining dissimilar polymer rods was proposed and the effects of rotational speed on the joint characteristics of friction welded dissimilar polymer rods fabricated by MEX process was investigated experimentally. Shore surface hardness test, impact test, and three-point bending test, and differential scanning calorimetry analysis were carried out of the weld joints. The impact energy for FW of PLA and PLA, PLA and ABS, PLA and PLA filled with GF, PLA and PLA filled with CF, PLA and PC, and PLA and PA rods can be increased by approximately 1.5, 1.5, 1.3, 1.3, 2.1, and 1.5 times by increasing the rotational speed from 330 rpm to 1350 rpm. The bending strength for FW of PLA and PLA, PLA and ABS, PLA and PLA filled with GF, PLA and PLA filled with CF, PLA and PC, and PLA and PA rods can be increased by about 1.3, 1.7, 1.3, 1.2, 1.2, and 1.2 times by increasing the rotational speed from 330 rpm to 1350 rpm. However, the surface hardness of the weld bead is not proportional to the rotational speed. The average surface hardness of the weld bead was increased by approximately 5% compared with the surface hardness of the welding base materials.

Keyword: Friction welding, Material extrusion process, Green products, Mechanical properties

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No. P-19

TITLE: Rotary friction welding of polyetheretherketone polymer rods using variable rotational speed

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ABSTRACT

Polyether ether ketone (PEEK) is widely employed in various applications, including pumps, bearings, or piston parts. PEEK is also used in medical implants. Most PPEK manufacturing methods include additive manufacturing, injection molding, grinding, pulse laser drilling, or incremental sheet forming. Rotary friction welding (RFW) is a promising bonding technique in many industries. However, very few studies have focused on the RFW of PEEK.Conventionally, the number of revolutions is fixed during the welding process. Remarkably, the rotary friction welding of PEEK polymer rods using variable rotational speed is investigated in this study. The advantage of CNC controlled RFW of PEEK using variable rotational speed is reduction in cycle time.

Keyword: Polyether ether ketone, Rotational fricton welding, Polyether ether ketone

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No. P-20

TITLE: Structural evolution and magnetic properties of metal-organic framework MIL-100(Co, Fe) annealed in an inert gas

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ABSTRACT

The metal–organic framework MIL-100(Co, Fe) particles were prepared by a hydrothermal synthesis method involves using $Co(NO_3)_2 \cdot 6H_2O$, $Fe(NO_3)_3 \cdot 9H_2O$ and 1,3,5-Benzenetricarboxylic acid well dissolved in the deionized water in a Teflon lined steel autoclave. The obtained MIL-100(Co, Fe) based nanocomposite particles (NCPs) in the presence of 10 mole % cobalt nitrates were annealed at the temperatures TA between 300 °C and 900 °C in an argon gas. The structure of samples was characterized with X-ray powder diffraction (XRD), Raman spectroscopy, Fourier transform infrared spectroscopy (FTIR) and transmission electron microscope (TEM) techniques. Magnetic transition and characterization were characterized by the thermogravimetric analyzer (TGA) with a small permanent magnet and vibrating sample magnetometer (VSM). The XRD spectra show that the MIL-100(Co, Fe) annealed at 400 °C ≤ TA ≤ 600 °C contains pure cubic spinel ferrite (CSF) phases. For TA ≥ 700 °C, the XRD patterns are dominated by the body-centered cubic (BCC) structural phase. However, a minor CSF phase was detected at TA=700 °C. The mean crystallite size of the CSF and BCC phases in NCPs varied from 14.0 to 17.2 nm and from 42.1 to 44.3 nm, respectively. Magnetic measurements show that the MIL-100(Co, Fe) annealed at 300 °C is a pure paramagnet while the samples annealed at TA ≥ 400 °C exhibits ferromagnetic behaviors. The saturation magnetization increases with increasing mean crystallite size for both CSF and BCC structural phases. Two magnetic ordering temperatures TM were detected at about TM1=572 °C and TM2=770 °C in the recorded TGA curves. Both TM1 and TM2 correspond to the Curie temperature of spinel cobalt-iron ferrites and Co-Fe alloys, respectively.

Keywords: hydrothermal synthesis method, nanocomposite particles, spinel ferrites, alloys, saturation magnetization, magnetic ordering temperatures.

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No. P-21

TITLE: Tuning in structure and magnetic behaviour of sodium-doped spinel iron-manganese oxide nano powders

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ABSTRACT

Iron manganite spinels $Fe_xMn_{3-x}O_4$ system has been actively studied for a long time due to specific physical properties depending on the composition and great practical potential in such areas as biomedicine, lithium-ion batteries, water treatment, supercapacitors, and so on. In the present work, we focused on the synthesis of sodium-doped $Fe_{1.1}Mn_{1.9}O_4$ nano powders by combustion method and the study of the effect of sodium content [$Fe1.1(Na_xMn_{1-x})_{1.9}O_4$; $0 \leq x \leq 0.3$] on the structural and magnetic properties of obtained nanopowders by various methods. The mean crystallite sizes, depending on the Na content and structures, of all samples are between 20 and 50 nm. Based on the results of magnetic measurements, it was found that the saturation magnetization first increases with an increase in the sodium content and reaches its maximum value at $x = 0.15$, and a further increase in x leads to a decrease in the saturation magnetization. In addition, the Curie temperatures exhibit a decreasing trend with an increase in the sodium concentration. The influence of cation redistribution on the observed changes has been discussed.

Keyword: nano powders, spinels, combustion method, saturation magnetization, Curie temperatures

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No. P-22
TITLE: An Investigation of Abrasive Spiral Polishing for Complex Surface Finishing

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ABSTRACT

This study explores the application of spiral polishing technology for precision machining of complex surfaces. The method involves the transmission of abrasive particles through a high-speed rotary screw to achieve a fine processing surface and remove fine burrs. The proposed techniques aim to enhance surface roughness and achieve high-quality results with greater precision and efficiency compared to traditional methods. To conduct the experiment, polishing equipment with helical rotation and quick abrasive transmission was designed and manufactured. Various parameters, including abrasive particle size, concentration, gap, revolution speed, and machining time, were observed to determine the material removal rate and surface roughness. The study identified optimal processing conditions that combine maximum material removal rate and the lowest surface roughness. This low-cost and highly efficient technology holds potential applications in industries that require precision machining of complex surfaces.

Keywords: Spiral polishing, Surface roughness, Material removal rate

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