



ISPET 2026

OCT. 2-4, 2026

THE 7TH INTERNATIONAL SYMPOSIUM ON PRECISION ENGINEERING AND TECHNOLOGY

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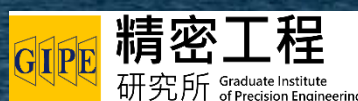


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<http://www.nchu.edu.tw>



National University of Singapore
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精密工程

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General Information

The 2026 7th International Symposium on Precision Engineering and Technology 2026 (ISPET 2026) will be held at Talmud Hotel Kaohsiung LoveRiver, Kaohsiung City, Taiwan, from October 2 ~ 4, 2026. ISPET 2026 aims to establish a strong integration between precision engineering and intelligent sensing technologies. The symposium serves as a major international platform for knowledge exchange and interdisciplinary collaboration in advanced manufacturing, precision measurement and inspection, semiconductor technologies, MEMS/NEMS, optics, electronics, electrical engineering, materials science, and environmental control systems. In response to the rapid development of smart systems and digital transformation, ISPET 2026 features dedicated tracks on sensing technologies, sensor systems and architectures, signal conditioning and data acquisition, IoT-enabled sensing, embedded and wireless sensor networks, and AI-driven sensing and intelligent data analytics. These emerging directions highlight the essential role of sensor-integrated systems in next-generation precision manufacturing and smart technologies. On behalf of the organizing committee, we sincerely invite researchers, engineers, and industry professionals worldwide to participate in ISPET 2026 and share their latest research achievements and practical innovations. The symposium welcomes paper submissions in all areas of precision engineering, intelligent sensing systems, and related interdisciplinary technologies.

Plenary Speakers

- Chair Prof. and Department Chair, Ying-Hao Chu
Department of Materials Science and Engineering,
National Tsing Hua University, Taiwan
- GlobalFoundries Chair Prof. Cheng-Kuo Lee
Center for Intelligent Sensors and MEMS,
National University of Singapore, Singapore
Department of Electrical and Computer Engineering,
National University of Singapore, Singapore
National Center for Advanced Integrated Photonics, Singapore

Keynote Speakers

- Prof. Yu-Lin Shen
Department of Mechanical Engineering,
University of New Mexico, USA
- Prof. Silvano Donati
University of Pavia and HiSiPIC, IEEE Life Fellow, OSA
Emeritus Fellow

Invited Speakers

- Assoc. Prof. Wei-Sea Chang
Department of Materials Science and Engineering,
National Yang Ming Chiao Tung University, Hsinchu, Taiwan
- Assoc. Prof. Jyoti Jaiswal
Department of Physics, Rajiv Gandhi University,
Arunachal Pradesh, India
- Prof. Chao-Cheng Kaun
Research Center for Applied Sciences, Academia Sinica, Taiwan
- Prof. Ngoc Dang Khoa Tran
Faculty of Mechanical Engineering,
Industrial University of Ho Chi Minh City, Vietnam
- Assoc. Prof. Dr. Teeranoot Chanthasopeephan
Mechanical Engineering Department,
King Mongkut's University of Technology Thonburi, Bangkok, Thailand
- Assoc. Prof. Ratchatin Chancharoen
Mechanical Engineering Department,
Robotics and AI Program Chulalongkorn University, Thailand
- Assoc. Prof. Kyungwho Choi
School of Mechanical Engineering,
Sungkyunkwan University, Suwon-si, Korea

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National Chung Hsing University, Taiwan
- Dean Ming-Der Yang
College of Engineering,
National Chung Hsing University, Taiwan

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IOP Fellow (FInstP), Professor, National Chung-Hsing University, Taiwan
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National University of Singapore, Singapore

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University of New Mexico, USA

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- Prof. Shih-Hung Lin
Department of Electronic Engineering,
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- Prof. Chil-Chyuan Kuo
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Talmud Hotel Kaohsiung LoveRiver, Kaohsiung City, Taiwan



Symposium Agenda

All academic sessions will be held at Talmud Hotel Kaohsiung LoveRiver, Taiwan.

The banquet will be held at Hai Pa Wang Restaurant Kaohsiung.

Time	Activity		
2 October, 2026 - Only Registration			
15:00~17:00	Registration & Welcome Reception		
3 October, 2026 - Symposium Day			
08:00~08:30	Registration		
08:30~09:45	Invited Talk & Oral Session (1)	Poster Exhibition	
09:45~10:00	Group Photo & Coffee Break		
10:00~10:10	Opening Ceremony		
10:10~10:55	Plenary Speech (1) Cheng-Kuo Lee		Moderator Kyungwho Choi
10:55~11:40	Keynote Speech (1) Yu-Lin Shen		
11:40~12:40	Lunch Time		
12:40~13:25	Plenary Speech (2) Ying-Hao Chu		Moderator Chao-Cheng Kaun
13:25~14:10	Keynote Speech (2) Silvano Donati		
14:10~14:25	Coffee Break		
14:10~16:00	Poster Session		
14:25~15:25	Invited Talk & Oral Session (2)		
15:25~16:40	Invited Talk & Oral Session (3)		
16:40~17:55	Invited Talk & Oral Session (4)		
17:55~18:05	Closing & Oral Awards		
19:00	Banquet		
4 October, 2026 - Academic Visit			
09:00~14:00	Explore Pier-2 Art Center — Optional Self-Paid Excursion		

Plenary Speaker 1



Chair Prof. and Department, Ying-Hao Chu

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

Title of Plenary Speech

Bismuth-Based 2D Semiconductors: A New Era for Silicon-Integrated Electronics and Functional Native Interfaces

Abstract of Plenary Speech

Two-dimensional (2D) bismuth oxychalcogenides ($\text{Bi}_2\text{O}_2\text{X}$), where $\text{X} = \text{S}, \text{Se}, \text{Te}$, have emerged as an extraordinary material platform for next-generation nanoelectronics owing to their high carrier mobility, moderate band gaps, and exceptional ambient stability. In this plenary talk, we present our systematic journey in tailoring the electronic landscapes of these ternary non-van der Waals semiconductors, transitioning from fundamental transport optimization to monolithic silicon integration and the discovery of functional native oxide interfaces. Previously, we established robust, nonvolatile modulation of $\text{Bi}_2\text{O}_2\text{Se}$ channel conductivity by integrating a ferroelectric layer to electrically tune the semiconductor's Fermi level and band alignment. To resolve the long-standing challenge of p-type 2D electronics, we developed an area-selective, low-temperature pulsed laser doping process using Zn^{2+} substituents to replace Bi^{3+} sites, successfully achieving p-type polarity modulation and demonstrating high-performance vertical p-n homojunctions and CMOS logic inverters. Furthermore, through monotonous sulfur-selenium alloying, the carrier transport was optimized, yielding a peak field-effect electron mobility of $215 \text{ cm}^2\text{V}^{-1}\text{s}^{-1}$ and an on/off ratio of 10^6 at a critical S:Se ratio of 4:6 with a Bi_2SeO_5 gate dielectric. Building upon these achievements, we report three major, yet-to-be-published advancements that push these materials toward practical semiconductor applications. First, addressing the integration bottleneck on industry-standard silicon, we demonstrate the direct epitaxial growth of tetragonal

$\text{Bi}_2\text{O}_2\text{Se}$ on silicon (Si) substrates enabled by a thin epitaxial SrTiO_3 buffer layer. This monolithic integration bypasses the degradation typically induced by conventional transfer techniques, achieving high-quality single-crystalline domains on Si. Second, we unveil the experimental evidence of electrically switchable ferroelectric polarization in Bi_2SeO_5 at room temperature. Conventionally utilized as a passive, high-k native gate dielectric or passivation layer, we demonstrate that the non-centrosymmetric structural distortion in Bi_2SeO_5 natively hosts robust, switchable polarization. This discovery enables an "all-native" ferroelectric field-effect transistor architecture with atomically sharp, defect-free interfaces. Third, to elucidate the fundamental mechanism of this transformation, we present our comprehensive *in-situ* investigation tracking the continuous thermal oxidation of $\text{Bi}_2\text{O}_2\text{Se}$ into ferroelectric Bi_2SeO_5 . Utilizing real-time, *in-situ* high-resolution transmission electron microscopy, *in-situ* X-ray photoelectron spectroscopy, and *in-situ* Raman spectroscopy, we have mapped the dynamic oxygen diffusion pathways and localized structural reconstruction with atomic precision. These findings pave a new way for fabricating self-assembled, silicon-compatible 2D ferroelectric electronics.

Plenary Speaker 2



GlobalFoundries Chair Prof. Cheng-Kuo Lee

Center for Intelligent Sensors and MEMS

National University of Singapore,

Department of Electrical and Computer Engineering

National University of Singapore,

National Center for Advanced Integrated Photonics, Singapore

Title of Plenary Speech

CMOS Photonics Circuits Enabled Photonic Neural Networks and Edge AI Sensing

Abstract of Plenary Speech

With the growing demand for energy-efficient AI applications, the rapid development of photonic neural networks (PNNs) represent a strategy for integrating photonics with AI computing architectures. PNNs harness multiple degrees of freedom of light, *i.e.*, wavelength, amplitude, phase, mode, and polarization, to encode and manipulate large volumes of data in parallel. Through optical multiplexing, PNNs enable high-throughput, low-latency computation while reducing energy consumption compared with electronic counterparts. The development of AlN/Si-based CMOS photonics circuits have been developed as a near-sensor edge computing (NSEC) platform which pushes the boundary of real-time AI by combining electro-optic microring resonators (MRRs) and thermo-optic interferometers (MZIs) to achieve low-latency neural computation directly at the sensing layer. Demonstrated with high accuracy in multimodal gesture and gait classification tasks (96.77% and 98.31%, respectively), and achieving latency under 10 ns with energy consumption below 0.34 pJ, such platforms are paving the way for privacy-preserving, always-on AI hardware for healthcare, robotics, and immersive interaction systems. Overall, the fusion of AI-enhanced photonic sensing, on-chip neuromorphic computing, and flexible sensor integration represents a paradigm shift for future edge AI sensing systems. As optical edge computing continues to mature, it will

become a cornerstone in the transition from centralized cloud AI to energy-efficient, responsive, and context-aware edge intelligence. Looking ahead, the convergence of AI, photonic integration, and edge computing will catalyze the next wave of intelligent systems that are no longer confined to centralized data centers or limited by power and latency bottlenecks. Future edge AI sensing architectures will evolve toward using CMOS photonics circuits enabled computing and sensing integrated chips which can achieve perception, inference, and adaptation in real time. Ultimately, the long-term vision is a world where every object, environment, and human interaction is seamlessly sensed, interpreted, and enhanced in real time.

Keynote Speaker 1



Prof. Yu-Lin Shen

*Department of Mechanical Engineering
University of New Mexico, U.S.A.*

Title of Keynote Speech

On the Applicability of Wafer Curvature Measurement to Determine Stress in Porous Thin Films

Abstract of Keynote Speech

The widespread use of Stoney's equation to determine thin-film stress from wafer curvature measurement assumes a continuous, defect-free thin film. However, its applicability to thin films with internal heterogeneity – such as voids and microcracks – remain unclear since these microscopic features generate highly nonuniform stress and deformation fields in the thin film. This problem can be tackled with systematic numerical simulations. We employed finite element analyses to investigate void-containing thin films bonded to thick substrates under thermal mismatch loading. By comparing curvature-derived average film stresses with direct mechanical simulations of standalone films, the validity of Stoney's equation in both the elastic and plastic regimes can be assessed. Our results demonstrate that Stoney's equation reliably predicts the average film stress for elastic and early plastic deformation, regardless of void distribution and porosity. On the other hand, with extensive plasticity, the substrate constraint alters local deformation behavior, leading to discrepancies between curvature-converted stress and the intrinsic flow stress of the porous film. These findings provide critical guidance for interpreting curvature-based stress measurements and highlight the role of interfacial constraint in modulating damage evolution.

Keynote Speaker



Prof. Silvano Donati

*University of Pavia and HiSiPIC, IEEE Life Fellow, OSA
Emeritus Fellow*

Title of Keynote Speech

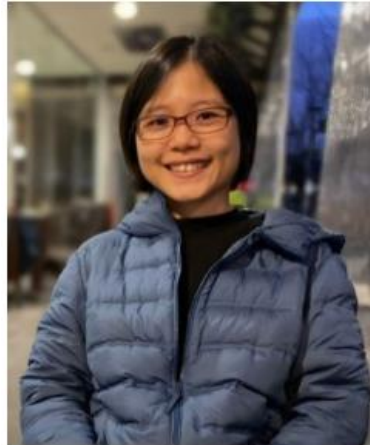
Sensing by Self-Mix Interferometry

Abstract of Keynote Speech

In this talk, we describe the principle of operation of self-mixing interferometer, a coherent configuration for the measurement of dimensional and kinematic quantities such as: displacement, distance, vibration amplitude, thickness, angle, and curvature, and also physical quantities like: coupling factors, line width, alfa-factor, and index of refraction. In the measurement arrangement, the laser undergoes self-injection at weak level, leading to an amplitude and frequency modulation driven by external optical path length. We will describe the development of a straightforward displacement-measuring instrument, based on up/down counting of fringes, and then we extend the measurement to the practical case of a diffuse (non-cooperative) target, introducing the speckle-pattern statistics, corrected by a BST (bright speckle tracking) technique, shown capable of covering displacements up to 1-m with mm-resolution and accuracy. For sub-mm vibrations, we will report on the implementation of two-channel (or, referenced) vibrometer, based on analogue processing of the self-mix signal, removing the speckle-related amplitude errors thanks to a servo-loop concept, so that the instrument is capable of true differential operation, and covers a dynamic range of amplitudes extending from a noise-limited minimum of $100 \text{ pm}/\sqrt{\text{Hz}}$ to about 500 mm with good linearity. The vibrometer allows the non-contact measurement of the mechanical frequency response and, even more unusual, of the hysteresis cycle (or the stress/strain diagram) of a sample under test. Additional examples of a number of surprising measurements performed by

self-mix will be finally surveyed, *i.e.*, the absolute distance meter, the thickness, angles and return echoes measurements as well as that of laser parameters like linewidth and alpha-factor. An outlook on perspectives and future perspectives of self-mix will conclude the talk.

Invited Speaker 2



Assoc. Prof. Wei-Sea Chang

*Department of Materials Science and Engineering
National Yang Ming Chiao Tung University, Hsinchu, Taiwan*

Title of Invited Talk

Magnetron-Sputtered High-Entropy Ceramic Thin Films for Dielectric Capacitor: A Process Development Study

Abstract of Invited Talk

High-entropy ceramics (HECs), which incorporate five or more cations into a single-phase solid solution, have attracted great interest in dielectric property tuning and energy storage applications due to their compositional flexibility. However, depositing high-entropy ceramic thin films via magnetron sputtering remains challenging, particularly in achieving stoichiometric transfer from the ceramic target, controlling phase formation, and maintaining film integrity. This work presents ongoing efforts to develop a reliable magnetron sputtering process for high-entropy ceramic thin films intended for capacitor and dielectric storage applications. Key process parameters, including sputtering power, working pressure, temperature and substrate conditions, are being systematically investigated to establish their influence on film composition, phase stability, and microstructure. These preliminary findings are guiding process refinement toward better film quality for subsequent dielectric evaluation, laying the groundwork for future structure–property studies in high-entropy ceramic thin films for dielectric energy storage.

Invited Speaker 3



Assoc. Prof. Jyoti Jaiswal

*Department of Physics, Rajiv Gandhi University
Arunachal Pradesh, India*

Title of Invited Talk

Surface and Interface Engineering of 2D MXenes for High-Performance Enzyme-Free Biosensing and Healthcare Diagnostics

Abstract of Invited Talk

The growing need for reliable, low-cost, flexible, and real-time healthcare diagnostics has driven the development of enzyme-free electrochemical sensing platforms that overcome the stability and environmental limitations of conventional enzymatic biosensors. Two-dimensional (2D) MXenes, particularly $\text{Ti}_3\text{C}_2\text{T}_x$, offer a promising platform owing to their high electrical conductivity, large electroactive surface area, tunable surface chemistry, and mechanical flexibility. This talk presents our recent efforts toward engineering $\text{Ti}_3\text{C}_2\text{T}_x$ MXenes and their heterostructures for high-performance enzyme-free cholesterol sensing. Our initial study demonstrated that *in-situ* etched $\text{Ti}_3\text{C}_2\text{T}_x$ MXene can function as a flexible enzyme-free cholesterol sensing electrode, achieving sensitive detection at low concentrations while exhibiting good selectivity, reproducibility, flexibility, and stability [1]. Building on this platform, we subsequently developed MoS_2 -intercalated $\text{Ti}_3\text{C}_2\text{T}_x$ MXene heterostructures to tailor the surface and interfacial properties of the sensing electrode. The optimized $\text{Ti}_3\text{C}_2\text{T}_x/\text{MoS}_2$ heterostructure exhibited improved charge-transfer kinetics and electrochemical response, enabling sensitive non-enzymatic cholesterol detection over a broad concentration range, together with excellent selectivity, flexibility, and long-term stability [2]. These studies demonstrate how rational surface and interface engineering of 2D MXenes can regulate electrochemical processes and enhance sensing performance. Overall, this work establishes a structure–interface–property relationship for designing flexible and robust enzyme-free biosensors and highlights the potential of engineered

MXene-based platforms for next-generation wearable, portable, and point-of-care healthcare diagnostics.

Invited Speaker 4



Prof. Dr. Chao-Cheng Kaun

Research Center for Applied Sciences, Academia Sinica, Taiwan

Title of Invited Talk

Computational Modeling of Nanoelectronics and Emerging Materials

Abstract of Invited Talk

Using first-principles calculations based on density functional theory (DFT) and the non-equilibrium Green's function method, we investigate performance of transition-metal-dichalcogenide (WSe_2 , WS_2 , and MoS_2) channeled field-effect transistors and enhanced low-temperature photoluminescence in α - $\text{CsPbI}_3/\text{WS}_2$ heterostructures for nanoelectronic applications. Effects of biasing, contacting, configuring and quantum interfering are addressed. Using first-principles calculations based on DFT, we explore the bandgap tuning of NiFeV layered double hydroxides for optoelectronic and catalytic devices. Effects of compositing and cation ordering are identified. Moreover, we study the efficiencies of polymer-protected perovskite quantum dot films for LED backlighting and polymer-promoted solid-state electrolytes for lithium metal batteries. Effects of polymer-adsorbing and -interfacing are highlighted.

Invited Speaker 5



Prof. Ngoc Dang Khoa Tran

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

Title of Invited Talk

Data-Driven Modeling and Optimization of Surface Roughness and Vibration in End Milling Using a Wireless Sensor Tool Holder

Abstract of Invited Talk

Processing difficult-to-cut materials with optimal surface integrity is essential for advanced manufacturing. Tool vibration degrades 12X18N10T stainless steel machining. The best cutting settings for this tough material require measuring vibrations. Traditional wired vibration-monitoring systems often lose signal quality due to the distance between sensors and the cutting zone. This project collects high-quality, real-time data from a Bluetooth-enabled wireless vibration-monitoring device in the tool holder. A study used a 2^3 factorial design and ANOVA to analyze the impact of cutting speed (v), feed per tooth (S), and depth of cut (t) on surface roughness (Ra) and vibration amplitude (A). The model showed high reliability ($R^2 \geq 90\%$), with cutting speed (v) significantly affecting vibration amplitude (A) and feed per tooth (S) significantly affecting surface roughness (Ra). The optimal settings for Derringer's desirability multi-objective optimization method were (v 45 mm/min), (S 0.02 mm/tooth), and (t 0.2 mm), resulting in an approximate surface roughness (Ra) of $3.07 \mu\text{m}$ and a vibration amplitude (A) of 0.01196 mm. The study also establishes "feasible machining zones" with ($Ra \leq 0.4 \mu\text{m}$ and $A \leq 0.04 \text{ mm}$) for intelligent, adaptive control in Industry 4.0 compatible milling systems.

Invited Speaker 6



Assoc. Prof. Dr. Teeranoot Chanthasopeephan

Mechanical Engineering Department

King Mongkut's University of Technology Thonburi, Bangkok, Thailand

Title of Invited Talk

From Flexibility to Intelligence: Advancements in Soft Robotics

Abstract of Invited Talk

Recent advancements in robotics and artificial intelligence have brought about a new innovation, driven by the emergence of soft robotics and embedded intelligence. This talk will explore the exciting convergence of these two cutting-edge fields, showcasing how soft robots—known for their flexible, adaptable structures—are redefining applications across industries such as healthcare, agriculture, and beyond.

We will uncover the fundamental principles that make soft robotics unique, including the novel materials and sensors that enable these robots to interact safely and effectively with complex environments. In parallel, we will examine the crucial role of embedded intelligence: the integration of advanced AI algorithms directly into robotic systems, empowering them with real-time perception, autonomous decision-making, and enhanced versatility.

The talk will highlight the latest research trends, and the key challenges that researchers and engineers face when deploying soft robots endowed with intelligent capabilities. By gaining insight into these breakthroughs, we can better imagine a future in which soft, intelligent robots augment human abilities, enhance safety, and deliver smarter, more adaptive automated solutions.

Invited Speaker 8



Assoc. Prof. Ratchatin Chancharoen

*Mechanical Engineering Department,
Robotics and AI Program Chulalongkorn University, Thailand*

Title of Invited Talk

Time-Multiplexed Self-Sensing and Physics-Informed Digital Twin Control of a Thermoelectric Peltier Module

Abstract of Invited Talk

This work presents a temperature-control framework for a thermoelectric Peltier module that combines time-multiplexed self-sensing with physics-informed digital twin estimation. Conventional Peltier control typically relies on dedicated temperature sensors for feedback, which can introduce additional hardware, installation constraints, and measurement delay. In the proposed approach, the electrical excitation of the thermoelectric module is periodically interrupted or modulated to obtain self-sensing information related to its thermal state. These measurements are combined with a physics-informed dynamic model to estimate the cold-side temperature and support closed-loop control. Experimental characterization of the thermoelectric system is used to identify its transient and steady-state thermal behavior, including a thermal time constant of approximately 23 s and a cold-side temperature approaching $-25\text{ }^{\circ}\text{C}$ under the investigated operating conditions. A time-multiplexed actuation and sensing strategy is then implemented to balance cooling performance with state-observation requirements. The proposed framework demonstrates the feasibility of using the thermoelectric device not only as an actuator but also as part of the sensing mechanism. This approach provides a foundation for compact, sensor-reduced, and model-assisted thermal management systems in embedded cooling, laboratory instrumentation, and intelligent mechatronic applications.

Invited Speaker 9



Assoc. Prof. Kyungwho Choi

*Mechanical Engineering Department,
Sungkyunkwan University, Korea*

Title of Invited Talk

Development and Application of Organic Materials for Multifunctional Applications

Abstract of Invited Talk

The thermoelectric effect enables the conversion of temperature gradients into electrical energy, offering potential in energy harvesting and sensor technologies. Conventional inorganic thermoelectric materials suffer from limitations such as brittleness and processing difficulty. This study explores organic thermoelectric materials as a flexible and functional alternative. Organic thermoelectric films were fabricated using carbon nanotubes (CNTs) and conductive polymers. Interface effects between CNTs and polymers were analyzed to assess performance. CNTs were also incorporated into OPC cement and polyurethane sponges via impregnation and dip-coating methods, respectively. Finally, CNTs were added to thermoplastic polyurethane (TPU) for 3D printing applications. CNT/polymer composites demonstrated enhanced thermoelectric output and enabled body-temperature-activated chemical sensing. CNT-impregnated cement retained low thermal conductivity while improving compressive strength and exhibiting thermoelectric behavior. CNT-treated polyurethane sponges showed both thermoelectric and triboelectric effects, indicating potential for load sensing. CNT/TPU 3D-printed structures revealed reduced EMI shielding and enabled internal structural modeling. This study presents a novel methodology for synthesizing multifunctional organic thermoelectric composites. The findings highlight promising applications in smart infrastructure, wearable sensors, and EMI shielding. The approach lays groundwork for future development of intelligent materials and high-performance computing systems.

Oral Sessions

Oct. 3, 2026

Session 1

Applied Science, Engineering and Emerging Technologies

Session Chair: Asst. Prof. Fa-Cheng Su

Industrial and Smart Technology Program, Academy of Circular Economy, National Chung Hsing University, Nantou 540, Taiwan

08:30~09:45	I-9	Development and Application of Organic Materials for Multifunctional Applications <i>Kyungwho Choi</i>[†] Mechanical Engineering Department, Sungkyunkwan University, Korea
	I-4	Computational Modeling of Nanoelectronics and Emerging Materials <i>Chao-Cheng Kaun</i>[†] Research Center for Applied Sciences, Academia Sinica, Taiwan
	O-1	Thermal Integration of Bi₂O₂Se Toward Monolithic Semiconductor-Dielectric Platforms <i>Yu-Hsien Lee</i>^{1,†}, <i>Y.J. Lin</i>², <i>P.W. Lin</i>², <i>W.T. Chen</i>³, <i>C.M. Hsu</i>⁴, <i>P.L. Liu</i>⁴, <i>Hiromichi Ohta</i>⁵, <i>Y.H. Lee</i>⁶, <i>Y.C. Chen</i>⁶, and <i>Y.H. Chu</i>^{1,*} ¹ Department of Materials Science and Engineering, National Tsing Hua University, Hsinchu, Taiwan ² Department of Materials Science and Engineering, National Yang Ming Chiao Tung University, Hsinchu, Taiwan ³ College of Semiconductor Research, National Tsing Hua University, Hsinchu, Taiwan ⁴ Graduate Institution of Precision Engineering, National Chung Hsing University, Taichung, Taiwan ⁵ Research Institute for Electronic Science, Hokkaido University, Hokkaido, Japan ⁶ Department of Physics, National Cheng Kung University, Tainan, Taiwan

	O-2	Configurational Entropy as a Design Knob for Tunable Ferroelectric-to-Relaxor Behavior in Perovskite Thin Films <i>Chun-Chung Hsu^{1,†}, Yu-Hsien Lee¹, Yi-Chun Chen², Yi-De Liou³, Ming-Hao Lee⁴, and Ying-Hao Chu^{1,*}</i> ¹ Department of Materials Science and Engineering, National Tsing Hua University, Hsinchu, Taiwan ² Department of Physics, National Cheng Kung University, Taiwan ³ Department of Electrophysics, National Yang Ming Chiao Tung University, Taiwan ⁴ Center for Condensed Matter Sciences, National Taiwan University, Taiwan Research Institute for Electronic Science, Hokkaido University, Hokkaido, Japan ⁵ Department of Physics, National Cheng Kung University, Tainan, Taiwan
	O-3	Device Scaling Effects on the Performance of Delta-Doped High-κ β-Ga₂O₃ MOSFETs <i>Siddharth Rana^{1,†}, Chun-Kai Huang², Jun-Ting Ye¹, and Ray-Hua Horng^{1,3,4,*}</i> ¹ Institute of Electronics, National Yang Ming Chiao Tung University, Hsinchu 30010, Taiwan, R.O.C. ² Institute of Pioneer Semiconductor Innovation, National Yang Ming Chiao Tung University, Hsinchu 30010, Taiwan, R.O.C. ³ Thin Film Physics Division, Department of Physics, Chemistry and Biology (IFM), Linköping University, SE-581 83 Linköping, Sweden ⁴ Electronic and Optoelectronic system research Lab., Industrial Technology Research Institute, Hsinchu 310401, Taiwan, R.O.C.

Session 2

Micro-Manufacturing, Sensor Devices and Assembly Technologies

Session Chair: Assoc. Prof. Wei-Sea Chang

Department of Materials Science and Engineering, National Yang Ming Chiao Tung University, Hsinchu, Taiwan

14:25~15:25	I-6	From Flexibility to Intelligence: Advancements in Soft Roboticsailored 2D-MoSe₂ Materials with Metal Dopants for Scalable Non-Enzymatic Biosensing Applications <i>Teeranoot Chanthasopeephan[†]</i> Mechanical Engineering Department King Mongkut's University of Technology Thonburi, Bangkok, Thailand
	O-4	A Respiratory Monitoring System Utilizing Microcantilever Structure <i>Yun-Ching Hung^{1,†}, Wen-Chi Lee¹, Lung-Ming Fu², and Chia-Yen Lee^{1,*}</i> ¹ Department of Materials Engineering, National Pingtung University of Science and Technology, Pingtung, Taiwan ² Department of Engineering Science, National Cheng Kung University, Tainan, Taiwan
	O-5	Multi-Objective Optimization Design of an Interior Permanent Magnet Synchronous Motor Using a Multi-Strategy Per-Target Composite Surrogate Model <i>Yi-Kai Chen¹, Jheng-Han Chen^{2,†}, Li-Tung Chang³, Shinn-Horng Chen⁴, Cheng-Yi Chen⁵, and Chun-Chieh Chang^{6,*}</i> ¹ Department of Mechanical Engineering, National Kaohsiung University of Science and Technology; a2271581@gmail.com ² Department of Electrical Engineering, Cheng Shiu University; wind923766@gmail.com ³ Department of Mechanical and Electro-Mechanical Engineering; m143020102@nsysu.edu.tw ⁴ Department of Mechanical Engineering, National Kaohsiung University of Science; shchen@nkust.edu.tw ⁵ Department of Electrical Engineering, Cheng Shiu University; k0464@gcloud.csu.edu.tw ⁶ Department of Electrical Engineering, Cheng Shiu University; 8094@gcloud.csu.edu.tw

	O-6	GELATIN-ASSISTED EXFOLIATION OF FREESTANDING ZnO PIEZOELECTRIC THIN FILMS FOR SKIN-ATTACHABLE SENSING <i>Tsai-Jou Chuang^{1,†}, Jyh-Ming Wu², and Ying-Hao Chu^{2,*}</i> ¹ Department of Materials Science and Engineering, National Yang Ming Chiao Tung University, Hsinchu, Taiwan; shanachung11@gmail.com ² Department of Materials Science and Engineering, National Tsing Hua University, Hsinchu, Taiwan
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Session 3

Precision Mechanical Systems and Manufacturing Technologies

Session Chair: Assoc. Prof. Dr. Teeranoot Chanthasopeephan

Mechanical Engineering Department, King Mongkut's University of Technology Thonburi,
Bangkok, Thailand

15:25~16:40	I-2	Magnetron-Sputtered High-Entropy Ceramic Thin Films for Dielectric Capacitor: A Process Development Study <i>Wei-Sea Chang</i>[†] Department of Materials Science and Engineering National Yang Ming Chiao Tung University, Hsinchu, Taiwan
	O-7	AI-Driven Bio-Inspired Microstructured Interface Design for Enhancing the Mechanical Performance of Friction-Welded Joints <i>Chil-Chyuan Kuo</i>^{1,2,*} and <i>Armaan Farooqui</i>^{1,†} ¹ Department of Mechanical Engineering, Ming Chi University of Technology; D141GP051@mail2.mcut.edu.tw ² Research Center for Intelligent Medical Devices, Ming Chi University of Technology
	O-8	Multiphysics-Guided Predictive Maintenance of Polymer Gear Systems Using Triboelectric–Vibration Signal Fusion and Machine Learning <i>Chil-Chyuan Kuo</i>^{1,2,*} and <i>Huezaimie Nizam</i>^{1,†} ¹ Department of Mechanical Engineering, Ming Chi University of Technology; F14118804@mail2.mcut.edu.tw ² Research Center for Intelligent Medical Devices, Ming Chi University of Technology
	O-9	Laser-Engineered Perovskite Oxide Films on Flexible Mica for Tribological Charge Harvesting <i>Bo-Syun Chen</i>^{1,†}, <i>Ying-Hao Chu</i>^{1,*}, and <i>Jyh-Ming Wu</i>¹ ¹ Department of Materials Science and Engineering, National Tsing Hua University, Hsinchu, Taiwan

	O-10	Epitaxial Ag/Fluorophlogopite SERS Sensors for Extreme Temperature Environments <i>Yu-Jen Hsiao</i>^{1,†} and <i>Ying-Hao Chu</i>^{2,*} ¹ Department of Materials Science and Engineering, National Yang Ming Chiao Tung University, Hsinchu City, Taiwan; jana20021214@gmail.com ² Department of Materials Science and Engineering, National Tsing Hua University, Hsinchu City, Taiwan; yhchu@mx.nthu.edu.tw
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Session 4

Green Manufacturing, Energy and Smart Technologies

Session Chair: Asst. Prof. Jen-Chuan Tung

Center for General Education, Chang Gung University, Taoyuan 33302, Taiwan

16:40~17:55	I-3	Surface and Interface Engineering of 2D MXenes for High-Performance Enzyme-Free Biosensing and Healthcare Diagnostics <i>Jyoti Jaiswal</i>[†] Department of Physics, Rajiv Gandhi University Arunachal Pradesh, India
	I-5	Data-Driven Modeling and Optimization of Surface Roughness and Vibration in End Milling Using a Wireless Sensor Tool Holder <i>Ngoc Dang Khoa Tran</i>[†] Faculty of Mechanical Engineering Industrial University of Ho Chi Minh City, Vietnam
	I-8	Time-Multiplexed Self-Sensing and Physics-Informed Digital Twin Control of a Thermoelectric Peltier Module <i>Ratchatin Chancharoen</i>[†] Mechanical Engineering Department Robotics and AI Program Chulalongkorn University, Thailand

Poster Session

Poster No.	Paper Title
P-1	Matrix Analysis of EMIB Technology-Taking Patents as an Example <i>Shiuh-Ming Chang</i>^{1,*} and <i>Min-Chieh Chuang</i>^{2,†} ¹ Associate Professor, Department of Mechanical and Automation Engineering, Taiwan Steel University; csmoo@tsust.edu.tw ² Graduate student, Department of Mechanical and Automation Engineering, Taiwan Steel University of Science and Technology; Shanks7432@gmail.com
P-2	Matrix Analysis of Reflective Coating Technology-Taking Patents as an Example <i>Shiuh-Ming Chang</i>^{1,*} and <i>Chih-Hung Lu</i>^{2,†} ¹ Associate Professor, Department of Mechanical and Automation Engineering, Taiwan Steel University; csmoo@tsust.edu.tw ² Associate Professor, Department of Mechanical and Automation Engineering, Taiwan Steel University; a0915129176@gmail.com
P-3	Arrhenius Energy Sensing the Integrity of HK/MG nMOSFET after DPN Treatment under Thermal Heating <i>Ming-Han Wang</i>^{1,†}, <i>Wei-Lun Huang</i>², <i>Wen-Ching Hsieh</i>³, <i>Wen-How Lan</i>⁴, and <i>Mu-Chun Wang</i>^{2,*} ¹ Department of Mechanic Engineering, National Central University, Taiwan; wangminghan0507@gmail.com ² Department of Electronic Engineering, Minghsin University of Science and Technology, Taiwan; louis0926791839@gmail.com ³ Department of Semiconductor and Electro-Optical Technology, Minghsin University of Science and Technology, Taiwan; wchsieh@must.edu.tw ⁴ Department of Electrical Engineering, National University of Kaohsiung, Taiwan; whlan@nuk.edu.tw

P-4	Electrical Efficiency of Nano-node HK/MG nMOSFETs Treated by Different DPN Nitrogen Concentration <i>Ming-Han Wang^{1,†}, Mei-Yuan Zheng², Wen-Ching Hsieh³, Wen-How Lan⁴, and Mu-Chun Wang^{2,*}</i> ¹ Department of Mechanic Engineering, National Central University, Taiwan; wangminghan0507@gmail.com ² Department of Electronic Engineering, Minghsin University of Science and Technology, Taiwan; nana3728901@gmail.com ³ Department of Semiconductor and Electro-Optical Technology, Minghsin University of Science and Technology, Taiwan; wchsieh@must.edu.tw ⁴ Department of Electrical Engineering, National University of Kaohsiung, Taiwan; whlan@nuk.edu.tw
P-5	Dynamic Road Condition Simulation and Motor Characterization Platform for Hybrid Vehicles <i>Cheng-Yu Chiang^{1,†}, Shan-Ting Chuang², Cheng-Che Yang³, Chun-Chieh Chang^{4,*}, and Cheng-Yi Chen⁵</i> ¹ Department of Electrical Engineering, Cheng Shiu University, Kaohsiung, Taiwan; s099120@gmail.com ² Department of Electrical Engineering, Cheng Shiu University, Kaohsiung, Taiwan; p49537485@gmail.com ³ Department of Electrical Engineering, Cheng Shiu University, Kaohsiung, Taiwan; p1215104@gcloud.csu.edu.tw ⁴ Department of Electrical Engineering, Cheng Shiu University, Kaohsiung, Taiwan; 8094@gcloud.csu.edu.tw ⁵ Department of Electrical Engineering, Cheng Shiu University, Kaohsiung, Taiwan; k0464@gcloud.csu.edu.tw
P-6	Multi-Field Responses in High-Entropy KNN-based Thin Films <i>Tsung-Ting Hou^{1,†}, Yu-Hsien Lee¹, and Ying-Hao Chu^{1,*}</i> ¹ Department of Materials Science and Engineering, National Tsing Hua University; ss114031531@gapp.nthu.edu.tw

P-7	From Single-Atom Sites to Intelligent Self-Powered Nanocomposites for Precision Ammonia Sensing: A Comprehensive Review <i>Doha Mosad Elshishtawy Hassan Elshishtawy</i>^{1,†,*} and <i>Tz-Feng Lin</i>² ¹ Department of Nanotechnology and Nanoelectronics Engineering, Zewail City of Science and Technology, Giza, Egypt; dohaelshenaw15@gmail.com ² Advanced Materials Innovation Technology Lab, National United University, Miaoli, Taiwan; tflin@nuu.edu.tw
P-8	A Three-Path Switched-Capacitor Voltage-to-Frequency Converter with an Active Sub-Hertz Baseline-Rejection Loop for Gas-Sensor Front-Ends. <i>Jen-Kai Chi</i>^{1,†} and <i>Chih-Han Chen</i>^{1,*} ¹ Department of Electrical Engineering, Fu Jen Catholic University, New Taipei City 242062, Taiwan R.O.C; 162821@mail.fju.edu.tw
P-9	A Temperature-Stable Digitally Controlled Oscillator for SoC <i>Ze-Cheng Lu</i>^{1,†} and <i>Chih-Han Chen</i>^{1,*} ¹ Department of Electrical Engineering, Fu Jen Catholic University, New Taipei City, Taiwan 242062; 162821@mail.fju.edu.tw
P-10	Response-Time-Calibrated Deep Learning for Streaming Mixed-Gas Analytics on Metal-Oxide Sensor Arrays <i>Guan-Syun Chen</i>^{1,†} and <i>Chih-Han Chen</i>^{1,*} ¹ Department of Electrical Engineering, Fu Jen Catholic University, New Taipei City 242062, Taiwan; 162821@mail.fju.edu.tw
P-11	Supervised Machine Learning for Vertical Gas–Liquid Two-Phase Flow Regime Classification Using <i>Tzu-Hsuan Kuo</i>^{1,†,*}, <i>Shao-Wen Chen</i>¹, <i>Min-Song Lin</i>¹, and <i>Meng-Yun Lee</i>¹ ¹ Institute of Nuclear Engineering and Science, National Tsing Hua University, Hsinchu, Taiwan

P-12	Matrix Analysis of Universal Chiplet Interconnect Express Technology - Taking Patents as an Example <i>Shiuh-Ming Chang^{1,*} and Wei-Chen Huang^{2,†}</i> ¹ Associate Professor, Department of Mechanical and Automation Engineering, Taiwan Steel University; csmoo@tsust.edu.tw ² Graduate student, Department of Mechanical and Automation Engineering, Taiwan Steel University of Science and Technology; a0915129176@gmail.com
P-13	Simulation of silicon nitride grain size and mechanical strength prediction using a three dimensional multi sphere model <i>Zhong-Wei Zhang¹, Hsing-Chiao Lo^{2,†}, and Po-Liang Liu^{3,4,*}</i> ¹ Graduate Institute of Precision Engineering, National Chung Hsing University, Taiwan; good041109@gmail.com ² Graduate Institute of Precision Engineering, National Chung Hsing University, Taichung 40227, Taiwan; a744787@gmail.com ³ Graduate Institute of Precision Engineering, National Chung Hsing University, Taichung 40227, Taiwan; pliu@dragon.nchu.edu.tw ⁴ Department of Applied Materials and Optoelectronic Engineering, National Chi Nan University, Nantou 54561, Taiwan; pliu@dragon.nchu.edu.tw
P-14	Effect of Surface Modification on the Mechanical and Thermal Properties of Chemically Recycled Carbon Fiber Reinforced Polycarbonate Composites <i>Hung-Chin Liu¹, Chien-Hung Liu^{2,*}, and Ming-Yuan Shen^{3,†,*}</i> ¹ Department of Mechanical Engineering, National Chin-Yi University of Technology, Taichung, Taiwan. R.O.C.; murphy900416@gmail.com ² Department of Mechanical Engineering, National Chung Hsing University, Taichung, Taiwan. R.O.C.; carusliu@email.nchu.edu.tw ³ Graduate Institute of Precision Engineering, National Chung Hsing University, Taichung, Taiwan. R.O.C.; myshen@nchu.edu.tw

P-15	Engineering of Cu-Integrated Single-Crystal β-Ga₂O₃ Thin Films for High-Power Devices <i>Ping-Hsien Wu^{1,†}, Tzu-Ming Chan¹, Chih Chen², Ray-Hua Horng³, and Ying-Hao Chu^{1,*}</i> ¹ Department of Materials Science and Engineering, National Tsing Hua University, Hsinchu, Taiwan ² Department of Materials Science and Engineering, National Yang Ming Chiao Tung University, Hsinchu, Taiwan ³ Institute of Electronics, National Yang Ming Chiao Tung University, Hsinchu, Taiwan
P-16	First-Principles Calculations of the Structural Properties of LaAlO₃(001)/SrTiO₃(001) Heterointerfaces <i>Jun-Kai Chyou¹, Chao-Pin Chen^{1,2,†}, and Po-Liang Liu^{1,3,*}</i> ¹ Graduate Institute of Precision Engineering, National Chung Hsing University, Taichung 402202, Taiwan ² Department of Aeronautical Engineering, Chaoyang University of Technology, Taichung 413310, Taiwan ³ Department of Applied Materials and Optoelectronic Engineering, National Chi Nan University, Nantou 545301, Taiwan
P-17	Direct Bonding of Graphene-Copper Composite to Glass Using Sn-4Ag-3.5Ti Active Filler Without Flux in Air <i>Ting-Wei Na^{1,†}, Jhih-Hong You¹, Yu-Cheng Lin¹, and Shih-Ying Chang^{1,*}</i> ¹ Department of Mechanical Engineering, National Yunlin University of Science and Technology, Yunlin 64002, Taiwan
P-18	Development of High-Efficiency Ruthenium-Based Anodes and Nanosilver CO₂ Reduction Catalysts for a Zero-Gap Alkaline Anion Exchange Membrane CO₂ Electrolysis System <i>Fa-Cheng Su^{1,†,*}</i> ¹ Industrial and Smart Technology Program, Academy of Circular Economy, National Chung Hsing University, Nantou 540, Taiwan; fachsensu@dragon.nchu.edu.tw

P-19	One-Step Solvent-Free Synthesis of Nitrogen-Doped Carbon Dots with Tunable Photoluminescence and Structural Properties <i>Zhi-Yu Lin</i>^{1,†} and <i>Fa-Cheng Su</i>^{1,*} ¹ Industrial and Smart Technology Program, Academy of Circular Economy, National Chung Hsing University, Nantou 540, Taiwan; baijsktc@gmail.com
P-20	Rapid Preparation of Nitrogen-Doped Carbon Dots via a One-Step Solvent-Free Autoclave Method and Characterization of Their Optical Properties and Structure <i>Chia-Jou Liu</i>^{1,†}, <i>Wei Chieh Liu</i>^{2,†}, and <i>Fa-Cheng Su</i>^{1,*} ¹ Industrial and Smart Technology Program, Academy of Circular Economy, National Chung Hsing University, Nantou 540, Taiwan; amy18190243@gmail.com ² Department of Medical Applied Chemistry, Chung Shan Medical University; a0939609132@gmail.com
P-21	Matrix Analysis of CoPoS Technology - Taking Patents as an Example <i>Shiuh-Ming Chang</i>^{1,*} and <i>Ming-Wei Lin</i>^{2,†} ¹ Associate Professor, Department of Mechanical and Automation Engineering, Taiwan Steel University; csmoo@tsust.edu.tw ² Graduate student, Department of Mechanical and Automation Engineering, Taiwan Steel University of Science and Technology; rtyf789001@gmail.com
P-22	An Automated Machine Learning Framework for Vaccine Adverse Event Severity Prediction Using Medical Text Embeddings <i>Ting-Wei Hu</i>¹, <i>Yi-Shou Chen</i>¹, <i>Yu-Rui Huang</i>¹, <i>Jun-Wei Chen</i>¹, and <i>Meng-Han Yang</i>^{1,*} ¹ Department of Computer Science and Information Engineering, National Kaohsiung University of Science and Technology; c112151162@nkust.edu.tw; c112151151@nkust.edu.tw; smalldogq@gmail.com; d41014107@gmail.com; menghanyang@nkust.edu.tw

P-23	Design a low-burden intelligent enhancement and alternative communication input system <i>Jia-Hong Wei^{1,†}, Yeou-Jiunn Chen¹, and Chung-Min Wu^{2,*}</i> ¹ Department of Electrical Engineering, Southern Taiwan University of Science and Technology, Tainan 710301, Taiwan; MB420110@stust.edu.tw, chenyj@stust.edu.tw ² Department of Intelligent Automation Engineering, National Chin-Yi University of Technology, Taichung 411030, Taiwan, cmwu@ncut.edu.tw
P-24	Optimization of a Blue-Light LED Illumination System Based on a High-Reflectivity Enclosed Cavity <i>Te-Yu Chien¹, Tai-Cheng Liu¹, Wen-Ching Ko¹, Chang-Hsiung Chen¹, Shih-Chi Lee¹, and Hsun-Ching Hsu^{1,†,*}</i> ¹ Industrial Technology Research Institute, Taiwan
P-25	Automated Optical Design and Fabrication-Tolerance Analysis of a Silicon Micro ring Modulator <i>Chen-Feng Lin^{1,†}, Bo-Han Tang¹, Ren-Xiang Luo¹, Yan-Wei Chen¹, Yao-Shou Liu¹, and Cheng-Mu Tsai^{1,*}</i> ¹ Graduate Institute of Precision Engineering, National Chung Hsing University, Taiwan
P-26	High-Efficiency O-Band Grating Coupler via Multi-Stage Refractive-Index-Based Inverse Design <i>Ren-Xiang Luo^{1,†}, Bo-Han Tang¹, Chen-Feng Lin¹, Yan-Wei Chen¹, Yao-Shou Liu¹, and Cheng-Mu Tsai^{1,*}</i> ¹ Graduate Institute of Precision Engineering, National Chung Hsing University, Taiwan

P-27	Automated Optical Design of a Two-Lens Varifocal Eyeglass System from -4 D to $+2$ D Using a Python Driven Genetic Algorithm <i>Yao-Shou Liu^{1,†}, Cheng-Mu Tsai^{1,*}, Bo-Han Tang¹, Yan -Wei Chen¹, Chen-Feng Lin¹, and Ren-Xiang Luo¹</i> ¹ Graduate Institute of Precision Engineering, National Chung Hsing University, Taiwan
P-28	Head Displacement Tracking Technology Combining LiDAR Depth Maps and High-Resolution Neural Networks <i>Yan-Wei Chen^{1,†}, Cheng-Mu Tsai^{1,*}, Bo-Han Tang¹, Yao-Shou Liu¹, Chen-Feng Lin¹, and Ren-Xiang Luo¹</i> ¹ Graduate Institute of Precision Engineering, National Chung Hsing University, Taiwan
P-29	A Two-Stage Multimodal Model for Pulmonary Fibrosis HRCT Reporting and Lesion Scoring <i>Bo-Han Tang^{1,†}, Cheng-Mu Tsai^{1,*}, Chuan-Wang Chang², Yan-Wei Chen¹, Chen-Feng Lin¹, Ren-Xiang Luo¹, and Yao-Shou Liu¹</i> 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-30	Optical Design for Biconical Collimation Lens <i>Yin-Yin Hu¹, Wen-Hsun Hsieh^{1,†}, Bo-Jyun Chen¹, Wei-Hung Chao¹, and Pin Han^{1,*}</i> ¹ Graduate Institute of Precision Engineering, National Chung Hsing University, Taiwan
P-31	<i>Ab initio</i> Study of MoTe₂/Muscovite Heterostructures <i>Chun-Che Lee^{1,†}, Chin-Chen Chen¹, Hsing-Chiao Lo¹, and Po-Liang Liu^{1,2,*}</i> ¹ Graduate Institute of Precision Engineering, National Chung Hsing University, Taichung 40227, Taiwan ² Department of Applied Materials and Optoelectronic Engineering, National Chi Nan University, Nantou 54561, Taiwan

P-32	A Microfluidic Device for Rapid Enrichment of Malachite Green in Aquaculture Farming Environments <i>Sheng-Zhuo Lee^{1,†,*}, Hsin-Meng Wang¹, Cheng-Meng Tsai¹, and Lung-Ming Fu^{1,2}</i> ¹ Department of Engineering Science, National Cheng Kung University, Tainan, 701, Taiwan ² Graduate Institute of Materials Engineering, National Pingtung University of Science and Technology, Pingtung 912, Taiwan
P-34	50V-Driven Electroosmotic Pump for Tactile Actuator Applications <i>Huan-Yu Lai^{1,†}, Cheng-Wei Hsieh¹, Yu-Chuan Su^{1,*}, and Chien-Hsun Chu²</i> ¹ National Tsing Hua University, Taiwan; wade20030201@gmail.com ² Industrial Technology Research Institute, Taiwan; cch7759@itri.org.tw
P-35	The Development of Photo-curable Alumina-Kaolin Ceramics slurry for Bottom-up Vat Photo-polymerization <i>Atharva Ningannavar^{1,†} and Jia-Chang Wang^{2,*}</i> ¹ Graduate Institute of Manufacturing Technology, National Taipei University of Technology (NTUT); atharvaningannavar701@gmail.com ² Department of Mechanical Engineering, National Taipei University of Technology (NTUT)
P-36	Design and Simulation of a Secondary Optical System for 12V MicroLED Automotive Courtesy Lighting <i>Yu-Cheng Liang^{1,†} and Chun-Wei Tsai^{1,*}</i> ¹ Department of Electronic Engineering, National United University, Miaoli 360302, Taiwan
P-37	Thermal Stability, Microstructural Evolution, and Magnetic Properties of Re/B-Doped FeCoTaZr Soft Magnetic Thin Films for High-Temperature HAMR Applications <i>Yu-An Chien^{1,†}, Jia-Shi Chu¹, and Jai-Lin Tsai^{1,*}</i> ¹ Department of Materials Science and Engineering, National Chung Hsing University, Taichung 40227, Taiwan; yee20041018@email.com

P-38	Phase Formation in Pulsed-Laser-Deposited High-Entropy (Ca,Sr,Ba,Mg,Sm,Bi,Na)TiO₃ Thin Films: Effects of Substrate. <i>Chin-Chieh Hsu^{1,†}, Hui-Tung Yang², and Wei-Sea Chang^{2,*}</i> ¹ Department of Materials Science and Engineering, National Yang Ming Chiao Tung University, Hsinchu, Taiwan; hsucc.en14@nycu.edu.tw ² Department of Materials Science and Engineering, National Yang Ming Chiao Tung University, Hsinchu, Taiwan; dut0726.en15@nycu.edu.tw
P-39	A Systematic First-Principles Study on the Phase Stability and Martensitic Transitions in Os₂XZ Heusler Alloys <i>Jen-Chuan Tung^{1,†}, Shun-Hsiang Hsu², and Po-Liang Liu^{2,3,*}</i> ¹ Center for General Education, Chang Gung University, Taoyuan 33302, Taiwan; jctung@mail.cgu.edu.tw ² Graduate Institute of Precision Engineering, National Chung Hsing University, Taichung 40227, Taiwan; sam73488@gmail.com, pliu@dragon.nchu.edu.tw ³ Department of Applied Materials and Optoelectronic Engineering, National Chi Nan University, Nantou 54561, Taiwan; pliu@dragon.nchu.edu.tw
P-40	Atomic-ordering and chemical-tuning control of Berry-curvature-driven anomalous Hall and Nernst effects in XCuMnZ quaternary Heusler compounds. <i>Jen-Chuan Tung^{1,†}, Chi-Hsuan Lee², and Po-Liang Liu^{3,4,*}</i> ¹ Center for General Education, Chang Gung University, Taoyuan 33302, Taiwan; jctung@mail.cgu.edu.tw ² Research Center for Applied Sciences, Academia Sinica, Taipei, 115201, Taiwan ³ Graduate Institute of Precision Engineering, National Chung Hsing University, Taichung 40227, Taiwan; sam73488@gmail.com, pliu@dragon.nchu.edu.tw ⁴ Department of Applied Materials and Optoelectronic Engineering, National Chi Nan University, Nantou 54561, Taiwan; pliu@dragon.nchu.edu.tw
P-41	Simulation Thermal Effects in a Silicon Photonics with a Graphene Thin Film <i>Cheng-Hsi Tu^{1,†} and Chun-Wei Tsai^{1,*}</i> ¹ Department of Electronic Engineering, National United University, Miaoli 360302, Taiwan

P-42	Development of a Dynamic Sensor System for Plant Water Transport <i>Jie-Ning Huang^{1,†}, Chih-Hsuan Wu¹, and Yu-Pei Huang^{2,*}</i> ¹ Shanghua Montessori Educational Research Experimental School ² Department of Electrical Engineering, National Quemoy University
P-43	Silicon-Integrated Bi₂O₂Se/Pb(Zr_{0.2}Ti_{0.8})O₃ Heterostructure for Ferroelectric Gate Modulation toward FeFETs <i>Xian-Ye Jiang^{1,†}, Tsung-Ting Hou², and Ying-Hao Chu^{3,*}</i> ¹ Department of Materials Science & Engineering, National Tsing Hua University, Hsinchu, Taiwan; aa110031148@gapp.nthu.edu.tw ² Department of Materials Science & Engineering, National Tsing Hua University, Hsinchu, Taiwan; easonhouutt@gmail.com ³ Department of Materials Science & Engineering, National Tsing Hua University, Hsinchu, Taiwan; yhchu@mx.nthu.edu.tw

Abstract Collections

No. O-1

TITLE: Thermal Integration of Bi₂O₂Se Toward Monolithic Semiconductor-Dielectric Platforms

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ABSTRACT

Bi₂O₂Se (BOSe) is a promising layered semiconductor for next-generation electronic and optoelectronic applications owing to its high carrier mobility and unique layered structure. However, thermal processing during thin-film growth and device fabrication can induce substantial thermal stress through thermal expansion mismatch between the film and substrate, while simultaneously promoting oxidation of BOSe. Understanding these thermally activated processes is therefore essential for reliable BOSe-based device integration.

To address thermally induced stress in BOSe thin films, establishing their intrinsic thermal expansion behavior is essential, as CTEs measured from epitaxial films are inevitably influenced by substrate constraint. We therefore investigate the Bi₂O₂X family (BOX, X = S, Se, Te) using in-situ high-temperature reciprocal space mapping (RSM) on both substrate-supported and freestanding films, together with first-principles calculations. The freestanding measurements and calculations reveal a nearly constant intrinsic out-of-plane/in-plane CTE ratio (C/A) across the BOX series of approximately 2.9 and 3.1, respectively. Using these intrinsic values as a benchmark, the substrate-constrained C/A ratios range from 2.6 to 3.8 on SrTiO₃, while remaining close to 3.4 on Si, revealing distinct substrate-induced modifications of thermal expansion. These results provide a quantitative basis for understanding and managing thermal stress in BOSe-based thin-film integration.

Beyond thermal stress management, thermal oxidation is further employed to transform epitaxial BOSe into its native Bi₂SeO₅ (O5) oxide. *In situ* high-temperature X-ray diffraction directly tracks the BOSe-to-O5 phase evolution and identifies a processing window of 350-450°C for stabilizing the α -O5 phase. Thickness-dependent oxidation experiments further reveal a power-law relationship between oxidation time and film thickness, $t \propto L^n$, with $n \approx 1.3$, suggesting that the transformation is closer to a reaction-limited than a diffusion-limited process. RSM and ϕ -scan measurements confirm that the resulting α -O5 maintains a well-defined epitaxial relationship after oxidation.

Complementary Raman spectroscopy, X-ray photoelectron spectroscopy, and UV-visible spectroscopy further confirm the structural and chemical transformation from BOSe to O5. Raman spectroscopy identifies the characteristic lattice vibrational modes associated with the structural transition, while X-ray photoelectron spectroscopy reveals the evolution of the Se oxidation state from Se²⁻ in BOSe to Se⁴⁺ in O5. Furthermore, electrical characterization demonstrates the ferroelectric behavior of α -O5 through polarization–electric field (P–E) hysteresis and a characteristic butterfly-shaped capacitance–voltage (C–V) response, confirming that the thermally formed O5 functions as a ferroelectric oxide rather than merely a passive oxidation product.

Overall, this work establishes thermal engineering as a key strategy for both managing thermal stress and enabling functional material transformation in BOSe-based systems. The direct integration of BOSe with its native functional oxide provides a promising route toward simplified semiconductor-dielectric interfaces and

highly integrated device architectures. This concept may further offer new opportunities for the development of next-generation electronic and optoelectronic devices.

Keyword: Bi₂O₂Se; Thermal expansion; Thermal Oxidation

No. O-2

TITLE: Configurational Entropy as a Design Knob for Tunable Ferroelectric-to-Relaxor Behavior in Perovskite Thin Films

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ABSTRACT

Ferroelectric materials are generally selected according to their intrinsic transition temperature, polarization characteristics, and operating temperature range. This limits the flexibility of material design when different applications require different combinations of polarization response and thermal stability. In this work, we demonstrate configurational entropy as a practical materials-design parameter for continuously tuning high-entropy perovskite thin films from conventional ferroelectric behavior toward a relaxor state, thereby allowing their functional characteristics to be adjusted for different operating conditions.

Epitaxial Pb-based perovskite thin films with systematically varied B-site configurational entropy were prepared by incorporating Mg, Nb, Ta, Ni, Zr, and Ti into the same material platform. Their structural and electrical evolution was examined by X-ray diffraction, reciprocal space mapping, temperature and frequency-dependent dielectric measurements, and polarization–electric field characterization. As the configurational entropy increases, the long-range ferroelectric state is gradually weakened and the films exhibit increasingly relaxor-like behavior. Structurally, the lattice becomes less anisotropic, while diffuse-scattering analysis shows that the characteristic polar nanoregion size decreases from approximately 9 nm to 6-7 nm, indicating shorter-range polar correlations.

This evolution is most clearly reflected in the dielectric response. The temperature of the dielectric maximum can be shifted over a range of nearly 190 K through compositional tuning, accompanied by a broader and more frequency-dependent dielectric response. These changes demonstrate that the ferroelectric-to-relaxor transition can be continuously controlled rather than being fixed by a single composition.

Importantly, this tunability is achieved without sacrificing the useful field-driven polarization of the films. The P–E loops progressively become slimmer with reduced remanent polarization while maintaining substantial saturation polarization, consistent with the development of relaxor behavior. At the same time, the higher-entropy compositions show a clear improvement in high-temperature stability. At 523 K, the retained polarization increases from approximately 75% to nearly 90% as the material is tuned toward a stronger relaxor state.

These results show that configurational entropy provides a direct way to adjust the balance between ferroelectric order, relaxor behavior, and thermal stability within the same material system. Instead of selecting among materials with fixed intrinsic properties, the dielectric transition and high-temperature polarization response can be deliberately shifted toward the requirements of a target operating environment. This entropy-based approach therefore offers a flexible strategy for application-oriented design of ferroelectric and dielectric thin films.

Keyword: Ferroelectric; Relaxor ferroelectric; High entropy; Polar Nano Region

No. O-3

TITLE: Device Scaling Effects on the Performance of Delta-Doped High- κ β -Ga₂O₃ MOSFETs

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ABSTRACT

Scaling the dimensions of metal-oxide-semiconductor field-effect transistors (MOSFETs) offers a direct route to higher current density, but the associated changes in gate electrostatics and high-field behavior remain closely tied to the gate dielectric[1,2]. In this work, the effects of gate dielectric engineering and device scaling are investigated in delta-doped β -Ga₂O₃ MOSFETs. The devices employ a delta-doped Ga₂O₃/(Al_{0.21}Ga_{0.79})₂O₃ heterostructure incorporating heavily and lightly doped Ga₂O₃ layers[3,4] over a UID Ga₂O₃ epilayer. HfO₂ and Al₂O₃/HfON/HZO were used as the gate dielectric structures, and devices with source-drain spacings of 20, and 7 μ m were fabricated and benchmarked. As the device dimensions were reduced, both structures showed an increase in on-current together with a decrease in on-resistance, indicating improved current conduction in the scaled devices. The Al₂O₃/HfON/HZO MOSFET with a 7 μ m source-drain spacing achieved a maximum on-current of 22 mA/mm, a minimum on-resistance of 0.40 k Ω ·mm, and an Ion/Ioff ratio of 10⁸. The HfO₂ devices, however, showed better electrostatic control, with lower drain-induced barrier lowering and interface trap density. They also provided higher breakdown voltage, reaching 469 V. The capacitance-voltage characteristics showed a larger hysteresis window for the Al₂O₃/HfON/HZO devices, consistent with the higher interface trap density and increased charge trapping in the multilayer dielectric. At the same time, the high- κ stack provided stronger gate coupling and facilitated carrier accumulation in the channel, which contributed to the improved on-state current[5]. The results demonstrate that scaling can substantially improve the current-driving capability of delta-doped β -Ga₂O₃ MOSFETs, while the choice of gate dielectric strongly influences their electrostatic and breakdown characteristics. The combined use of device scaling and dielectric engineering therefore provides a practical approach for balancing on-state and high-voltage performance in β -Ga₂O₃ MOSFETs.

Keyword: High- κ ; delta doping; Ga₂O₃; MOSFETs

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No. O-4

TITLE: A Respiratory Monitoring System Utilizing Microcantilever Structure

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ABSTRACT

In recent years, respiratory monitoring systems have attracted significant attention because of their applications in healthcare, disease diagnosis, and real-time physiological monitoring[1]. However, conventional respiratory sensors often require complex structures or external power sources, which limit their development toward miniaturized and wearable devices[1,2]. In this study, a micro-electromechanical systems (MEMS)-based airflow sensor based on a free-standing microcantilever structure was developed for respiratory monitoring applications. The microcantilever structure was fabricated using silicon-based microfabrication processes, including photolithography, E-beam deposition, reactive ion etching (RIE), and wet etching. Cantilevers with different aspect ratios were designed to investigate the relationships between structural geometry and airflow sensitivity. When airflow passes through the sensing region, the microcantilever experiences mechanical deformation induced by aerodynamic force, resulting in resistance variation[3]. The resistance change is converted into an electrical signal through a Wheatstone bridge circuit and analyzed using Arduino and LabVIEW systems for real-time respiratory waveform detection. The sensing performance of microcantilevers with different geometries was evaluated under various airflow velocities. The results show that longer cantilever structures exhibit higher sensitivity due to larger deformation responses under airflow loading. The proposed MEMS-based respiratory sensor demonstrates advantages including compact size, simple structure, high sensitivity, and potential integration with wearable respiratory monitoring devices[4-6]. The study provides a promising approach for the development of low-cost and real-time respiratory healthcare monitoring systems.

Keyword: airflow sensor; MEMS; microcantilever; respiratory monitoring; Wheatstone bridge

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No. O-5

TITLE: Multi-Objective Optimization Design of an Interior Permanent Magnet Synchronous Motor Using a Multi-Strategy Per-Target Composite Surrogate Model

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ABSTRACT

The interior permanent magnet synchronous motor (IPMSM) features a complex magnetic circuit and strong coupling among multiple performance objectives, rendering finite element analysis (FEA)-based optimization computationally intensive. Moreover, a single surrogate model often struggles to maintain consistently high predictive accuracy across performance targets with distinct nonlinear characteristics. To improve both motor performance prediction and design-space exploration efficiency, this study proposes a Multi-Strategy Per-Target Composite Surrogate (MS-PTCS) framework for multi-objective optimization of IPMSMs. First, an FEA-based performance dataset is established, from which uniformly distributed training samples are selected according to the stratified sampling principle of Latin Hypercube Sampling (LHS). During model development, multiple modeling strategies and surrogate algorithms are integrated, and the best-performing model for each individual performance target is selected according to its predictive accuracy on the validation dataset. For design-space exploration, LHS is employed to generate a large number of candidate designs, whose performance is rapidly evaluated using the MS-PTCS framework. A comprehensive ranking mechanism incorporating design constraints and efficiencies at two operating points is then applied to identify superior candidate designs. The results demonstrate that, while satisfying all design constraints, the efficiency at 1900 rpm increases from 81.73% to 85.20%, corresponding to an improvement of 3.47 percentage points, while the efficiency at 10000 rpm remains at 93.20%. Furthermore, FEA revalidation confirms that the average relative errors are below 2%. These findings indicate that the proposed MS-PTCS framework can effectively approximate FEA results using a limited number of training samples, substantially reduce the computational burden associated with extensive simulations, and enhance the efficiency of multiobjective design-space exploration for IPMSMs.

Keyword: Interior Permanent Magnet Synchronous Motor (IPMSM); Per-Target Model Selection; MultiOperating-Point Optimization

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No. O-6

TITLE: GELATIN-ASSISTED EXFOLIATION OF FREESTANDING ZnO PIEZOELECTRIC THIN FILMS FOR SKIN-ATTACHABLE SENSING

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ABSTRACT

The rising health awareness and the rapid progress of wearable electronics have made the monitoring of physiological signals an increasingly important target for materials research. A body-attachable sensor must conform to soft, curved tissue rather than sit rigidly upon it, operate without an external power supply, and be inexpensive and free of toxic reagents. Piezoelectric materials address the second requirement directly [1], and zinc oxide is well suited to body-worn use owing to its strong response along the polar c-axis together with its demonstrated biocompatibility in biofluids [2]. The remaining difficulty is a material one: high-quality piezoelectric oxides require growth temperatures of several hundred degrees and are therefore deposited on rigid substrates, while the polymer substrates that conform to skin cannot survive such processing. Synthetic fluorophlogopite mica resolves part of this conflict, combining flexibility with thermal stability above 1000°C and supporting quasi-van der Waals epitaxy of functional oxides [3], yet the residual mica carrier retains appreciable stiffness and prevents the device from following the folds of skin. Established release routes such as sacrificial-layer etching and laser lift-off demand aggressive etchants or costly equipment [4].

Here, c-axis-oriented ZnO films were deposited by RF magnetron sputtering on Pt-coated fluorophlogopite mica at 500°C, yielding about 400 nm in one hour without hydrothermal thickening or post-annealing, and were released by gelatin-assisted exfoliation: a cast gelatin layer shrinks on drying, generating in-plane tensile stress sufficient to overcome the van der Waals bonding between mica layers, and is subsequently dissolved in hot water. The only consumables are food-grade biopolymer and water, and no toxic waste is generated. Using Pt as a model layer, a crack-free freestanding film of $2 \times 3 \text{ cm}^2$ was obtained and attached conformally to human skin, following the skin folds. X-ray diffraction shows that the ZnO(0002) reflection is retained without peak shift or additional phases after exfoliation while the mica reflections vanish, and the as-grown film exhibits a rocking-curve width of about 0.23° . Under cyclic compressive loading through a 5 mm PDMS layer, a $1 \times 1 \text{ cm}^2$ Pt/ZnO/Pt device delivered open-circuit voltages of about 0.2, 0.4 and 0.6 V and peak currents of about 4.7, 9.0 and 10.8 nA at compressions of 1, 2 and 3 mm, corresponding to transferred charges of roughly 0.2, 0.5 and 0.6 nC. The capacitance inferred independently from charge and from voltage was consistent at about 1.1 nF across all three conditions, and a zero-intercept fit of charge against estimated force gave an effective piezoelectric charge coefficient of approximately 6.2 pC/N, between that of typical sputtered polycrystalline ZnO and bulk ZnO.

The released device was then placed over the carotid artery, where it produced an electrical response that disappeared when the device was displaced to adjacent tissue, indicating that the signal originates from arterial pulsation rather than from body motion. The release mechanism is purely mechanical, the same platform extends to any functional oxide grown on mica

In conclusion, gelatin-assisted exfoliation offers a simple, etchant-free and inexpensive route to freestanding piezoelectric oxide films, and the resulting devices combine centimeter-scale area, conformal attachment to skin and self-powered output.

Keyword: gelatin-assisted exfoliation; freestanding thin film; zinc oxide; RF magnetron sputtering; piezoelectric sensor; pulse monitoring; wearable sensor

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No. O-7

TITLE: AI-Driven Bio-Inspired Microstructured Interface Design for Enhancing the Mechanical Performance of Friction-Welded Joints

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ABSTRACT

This study utilizes artificial intelligence to bridge a critical gap in manufacturing by analyzing how surface microstructures influence metal–polymer friction joints—a process typically hindered by highly complex, nonlinear interactions [1]. By pairing experimental laser-textured, bio-inspired surfaces with a conditional generative adversarial network (cGAN), the researchers successfully modeled and predicted how specific geometric textures impact key variables like heat generation, polymer infiltration, and overall joint strength in aluminum–PEEK hybrids [2]. Mechanical testing revealed that a lotus-inspired surface texture delivered the highest bending strength at 113.7 MPa, while the predictive cGAN model demonstrated exceptional accuracy and high-fidelity structural rendering [3,4]. Ultimately, feature importance analysis proved that groove depth is the most critical factor driving joint performance, confirming that combining biomimetic surface engineering with AI-assisted design provides an efficient path toward developing stronger hybrid structures in alignment with sustainable development goals [5].

Keyword: Artificial intelligence; Artificial neural networks; Rotary friction joining; Aluminum-PEEK cylindrical hybrids

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No. O-8

TITLE: Multiphysics-Guided Predictive Maintenance of Polymer Gear Systems Using Triboelectric-Vibration Signal Fusion and Machine Learning

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ABSTRACT

Polymer gears are increasingly used in lightweight transmission systems, but their performance is often limited by wear and thermal degradation during operation [1]. This study proposes a novel triboelectric-induced current sensing method for polymer gear condition monitoring, alongside vibration and surface temperature measurements as a multiphysics monitoring approach [2]. Experiments were conducted using PLA gears under different loading conditions ranging from 10 kg to 17 kg. The results showed that the induced current signal followed distinct running-in, steady-state, and failure behaviours throughout the gear lifecycle. Increasing load accelerated wear progression, increased vibration and surface temperature, and promoted severe thermal degradation once the operating temperature exceeded the glass transition temperature of PLA. Surface observations further revealed significant wear damage and burn mark formation under high-load conditions, highlighting the relationship between thermal effects and wear mechanisms. To investigate the predictive capability of the proposed sensing approach, Long Short-Term Memory (LSTM) and Gated Recurrent Unit (GRU) models were developed to learn and predict the temporal evolution of the induced current signal [3,4]. In addition, a predictive maintenance framework was established by integrating induced current, vibration, temperature, and machine learning analysis for gear condition assessment. The findings demonstrate that triboelectric-induced current sensing offers a promising alternative for real-time condition monitoring and predictive maintenance of polymer gear systems while providing deeper insight into thermal degradation and surface wear mechanisms [5].

Keyword: Polymer gear; Triboelectric-induced current; Surface wear mechanism; Machine learning

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No. O-9

TITLE: Laser-Engineered Perovskite Oxide Films on Flexible Mica for Tribological Charge Harvesting

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ABSTRACT

Tribological charge harvesting based on contact-separation motion provides a promising route for converting repetitive mechanical interactions into electrical signals for self-powered sensing and mechanical monitoring [1]. However, the charge output of such systems is strongly governed by surface morphology, interfacial charge trapping, film continuity, contact area, and external load resistance. In this work, Nb-doped SrTiO₃ (NbSTO) thin films on flexible mica substrates were developed as oxide surfaces engineered by laser processing for tribological charge harvesting [2]. This study focuses on the relationship among laser-induced surface nanostructuring, contact and separation behavior, interfacial electrostatic coupling, and charge collection in the device.

Substrates of single-crystal SrTiO₃ and NbSTO were first used as reference systems to clarify the surface modification mechanism before transferring the process to flexible mica-based devices. KrF excimer laser processing generated granular nanostructured surfaces, increasing the effective contact area at the interface between PTFE and the oxide surface. Controlled post-treatment further regulated surface defect states and charge transport behavior. Under the optimized surface treatment condition, the triboelectric output reached 73.3 nA and 172.8 V, indicating that the enhanced response arises from the combined effects of surface texturing, defect regulation, charge trapping, and leakage suppression.

Based on this surface engineering strategy, NbSTO films were deposited on flexible mica substrates to form bendable tribological charge harvesting devices [3]. Structural and morphological analyses, including XRD, SEM, and TEM cross sectional observation, confirmed the NbSTO/mica film structure and revealed the surface morphology evolution after laser processing. The triboelectric output increased with improved NbSTO coating formation, reaching representative values of 54.5 nA/cm² and 114.5 V. Laser surface modification after film deposition further enhanced the charge generation capability by introducing nanostructured features on the NbSTO film surface.

COMSOL simulations showed an increased interfacial potential distribution for the developed NbSTO coating, supporting the role of film continuity and surface charge collection in strengthening electrostatic coupling. Load resistance analysis was further performed to evaluate the power output behavior of the tribological device, with the maximum power density reaching approximately 25 mW/m² under a high resistance load condition. Device optimization using an enlarged active area and improved charge collection design increased the current output up to 853.0 nA and the voltage output up to 337.5 V, which was sufficient to light 40 LEDs. These results demonstrate that laser engineered NbSTO/mica thin films provide a tribological surface platform for flexible autonomous sensing, wearable electronics, and low maintenance mechanical monitoring applications.

Keyword: Tribological system; Contact electrification; Laser surface engineering; Nb-doped SrTiO₃; Flexible mica; Load resistance; Self-powered sensing

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No. O-10

TITLE: Epitaxial Ag/Fluorophlogopite SERS Sensors for Extreme Temperature Environments

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ABSTRACT

Surface-enhanced Raman scattering (SERS) is an indispensable technique for ultra-sensitive, non-destructive chemical fingerprinting and trace detection. While flexible, transparent SERS platforms are demanded for conformal in-situ sampling, their deployment in harsh thermal environments is restricted by substrate limitations. Conventional polymers suffer cryogenic embrittlement causing microcracking and delamination, whereas elevated temperatures induce structural softening and thermal expansion mismatch. Furthermore, rigid silicon substrates lack optical transparency and mechanical flexibility. To resolve these bottlenecks, this study establishes a resilient SERS sensor architecture via epitaxial growth of high-crystallinity Ag nanocrystals on atomically smooth, dangling-bond-free fluorophlogopite substrates. High-temperature DC magnetron sputtering at 400°C for 20 seconds yielded spatially uniform Ag nanocrystals with an average lateral dimension of 101 nm, a vertical height of 12 nm, and dense interparticle nanogaps averaging 3.5 nm. X-ray diffraction (XRD) revealed a sharp Ag (111) profile with a narrow full width at half maximum of 0.19°, demonstrating high epitaxial ordering on the fluorophlogopite surface. To quantitatively elucidate the electromagnetic enhancement mechanism, three-dimensional finite-difference time-domain (FDTD) simulations imported morphology models reconstructed from high-resolution scanning electron microscopy (SEM) images, analyzing the hotspot quantity of $|E| > 15$ across the array. The simulation results revealed that the hotspot quantity of $|E| > 15$ is critically governed by nanostructure geometry, demonstrating that smaller interparticle nanogaps in the 3 to 4 nm regime combined with larger nanoparticle dimensions synergistically intensify localized surface plasmon resonance coupling, drastically multiplying the hotspot quantity of $|E| > 15$ within the junctions. Benefiting from this optimized geometry, atomic-scale substrate flatness, and dense hotspot network, the fabricated sensor achieved an outstanding electromagnetic enhancement factor of 3.3×10^6 (evaluated across the characteristic vibrational modes of Rhodamine 6G (R6G)); noticeably, silver nanocrystals grown on fluorophlogopite exhibited markedly superior SERS enhancement performance compared to those deposited on conventional silicon substrates. In concentration-dependent calibrations, the lowest measurable concentration of R6G reached 10^{-11} M. Optical path characterization contrasting direct front-side excitation with through-substrate collection yielded a quantitative 4.8-fold signal intensity ratio, verifying the viability of backside non-destructive sampling. Under dynamic mechanical stress, the platform showed outstanding resilience; under a 3.5 mm bending radius (2.86% tensile strain), spatial mapping revealed a minimal gap deviation of merely 11%, effectively preventing plasmonic decoupling and maintaining a stable Raman enhancement within the same order of magnitude. Shelf-life stability assessments demonstrated that after 10 weeks of continuous atmospheric exposure, the enhancement factor remained robustly preserved at $\sim 10^6$, verifying high resistance against ambient degradation. The sensor maintained dependable operational integrity across an extreme thermal window from -80°C to 100°C . In cryogenic food-safety testing, the sensor achieved clear, through-substrate identification of 2 ppm malachite green on curved biological fish scales at -80°C . In elevated-temperature industrial diagnostics, the platform facilitated stable in-situ vibrational monitoring of 35 ppm toxic carbon monoxide (CO) gas at 100°C without mechanical failure, highlighting its practical potential for industrial exhaust emission monitoring. These findings demonstrate that integrating

fluorophlogopite epitaxy with SEM-guided nanogap engineering yields a dependable, thermally and mechanically resilient sensor platform for high-precision chemical monitoring in extreme environments.

Keyword: fluorophlogopite; SERs; extreme temperature; silver nanoparticle

No. P-1

TITLE: Matrix Analysis of EMIB Technology-Taking Patents as an Example

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ABSTRACT

This study analyzes patent technology related to Embedded Multi-die Interconnect Bridge (EMIB). The analysis covers a total of 3,691 patents with filing dates between January 1, 2020, and May 31, 2026, comprising domestic publications (64) and grants (83); US publications (1,118) and grants (830); Japanese publications (78) and grants (65); European publications (220) and grants (82); South Korean publications (4) and grants (2); Mainland China publications (789) and grants (73); WIPO/PCT filings (273); Southeast Asian publications (3); and other publications (5) and grants (2). The study examines the patent landscape by analyzing inventors, primary applicants, applicant countries, patent attorneys/agents, International Patent Classification (IPC) codes, publication/grant years, and filing dates. Notably, inventor Joydeep Ray holds 165 patents; Intel Corporation leads as the primary applicant with 2,311 patents, followed by Nvidia Corporation with 364 patents, both actively building their EMIB patent portfolios. At the three-level IPC classification, the G06F category—designating "Electric Digital Data Processing"—accounts for the highest volume, with 1,346 patents.

Utilizing global patent search systems to analyze EMIB technology enables a clear understanding of the field's core technologies, key national research teams, corporate developers, and the expertise of leading individual innovators. Furthermore, this analysis allows developers to effectively avoid infringing on existing patented designs, thereby reducing development time and labor costs, while also leveraging alliances to lower overall development expenses.

Keyword: EMIB; Electric Digital Data Processing; global patent search system

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No. P-2

TITLE: Matrix Analysis of Reflective Coating Technology-Taking Patents as an Example

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ABSTRACT

This paper analyzes the patent technology of reflection coating, focusing on patent applications filed between January 1, 2020 and May 31, 2026, totaling 8719 patents. The analysis covers domestic publications (86), domestic announcements (193), US publications (1543), US announcements (1744), Japanese publications (96), Japanese announcements (94), European publications (340), European announcements (199), Korean publications (25), Korean announcements (22), mainland China publications (1259), mainland China announcements (1034), mainland China designs (1), WIPO (PTC) (2059), other publications (17), and other announcements (7). The analysis considers the inventor, first applicant, first applicant's country of origin, agent, IPC, publication year, and application date to explore the patent landscape of reflection coating technology. The inventor, HAGEN, JAN, holds 83 patents, and the first applicant holds numerous patents. Semiconductor Manufacturing Company Ltd. has the most patents (171), and Samsung Electronics Co., Ltd. has 135. They are also actively pursuing patents related to reflective coatings. Their largest number of IPC Tier 3 patents are G02B patents (2432), which are based on optical components, systems, or instruments.

Analyzing reflective coatings using a global patent search system can effectively reveal the core of the current technological field, the expertise of national research teams, company developers, and individual technical leaders. Furthermore, it allows for effective avoidance of others' patented designs during development, reducing development time and manpower, and leveraging alliances to lower development costs.

Keyword: reflective coating patent technology; optical components; global patent search system

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No. P-3

TITLE: Arrhenius Energy Sensing the Integrity of HK/MG nMOSFET after DPN Treatment under Thermal Heating

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ABSTRACT

High related-dielectric material (High- κ , HK) as a gate dielectric incorporating the metal gate (MG) [1,2] is an available trend in the nano-node process era to promote the drive current enhancing the chip performance in the operation of signal speed. After atomic-layer depositing the layer of HK gate dielectric on metal-oxidesemiconductor field-effect transistor (MOSFET), the dielectric quality essentially needs a nitridation and annealing treatment process, such as decoupled-plasma nitridation (DPN) [3,4], to be reinforced. However, if the repairs of hafnium oxide or zirconium oxide after DPN treatment are not flawless, the bulk trap will be formed and the gate leakage will be raised, indirectly deteriorating the integrity of HK gate dielectric. At the room temperature, the current-voltage and capacitance-voltage method [5] is able to probe this relationship between electrical performance and process variation. In terms of the temperature in IC increased, the established device model seems more questionable. Utilizing the Arrhenius equation [6] under thermal heating to extract the activation energy (E_a) is a good choice to bridge the temperature effect and the bulk trap in HK gate dielectric causing the level of gate leakage. Furthermore, the test pattern of an nMOSFET with channel width/channel length ($10\text{ }\mu\text{m}/0.033\text{ }\mu\text{m}$) is usually with a protection diode to eliminate the damage coming from the back-end processes. While the gate voltage is swept from $-V_{DD}$ to $+V_{DD}$, the activation energy during the temperature change from 25°C to 125°C can be shown with both, the pn junction and the gate dielectric. Through this extraction analysis, the established device model [7] is possible to be more methodical. Ultimately, the process improvement for yield enhancement [8] has a solid foundation.

Keyword: Arrhenius energy; high- κ ; nano-node process; DPN; MOSFET; treatment; yield; device model

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No. P-4

TITLE: Electrical Efficiency of Nano-node HK/MG nMOSFETs Treated by Different DPN Nitrogen Concentration

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ABSTRACT

Entering the nano-node process generations [1], promoting the drive current of metal-oxide-semiconductor field-effect transistors (MOSFETs) is an urgent task to make sure the electrical performance of IC operation in the competition of the AI-era [2] or high-performance computing products [3]. There are several available methods to enhance the drive current. One of these methods is used the high related-dielectric material (High- κ , HK) [4] as a gate dielectric incorporating the metal gate (MG) instead of silicon dioxide as gate dielectric due to the capacity of charge storage up to six times. However, adopting the HK gate dielectric still faces couple tricky issues, such as the adjustment of process production line, novel product integration, and process development including the reliability evaluation. Avoiding the increase of interface states on the channel surface, one interfacial layer is formed as a buffer between HK gate dielectric and channel surface. Employing a decoupled-plasma nitridation (DPN) process [5] is a good way to eliminate the bulk traps in gate dielectric and interface states on the channel. In the DPN process, the annealing temperature, nitrogen or ammonia concentration, and treatment time are the primary factors. In this work, the nitrogen concentration is treated as a variable with 8% and 16%. Furthermore, with the electrical measurement for these tested wafers, all of the major concerned parameters with the threshold voltage (V_T), drive current (I_{ON}), trans-conductance (G_m), sub-threshold swing (SS), drain-induced barrier lowering (DIBL), and punch-through voltage [6] are more or less influenced. The variation of these parameters under the different test device patterns, such as short-channel lengths or short-channel widths, is more distinct. Adding a back bias, the difference of these parameters is ramped up a little. Speculating the possible causes is the flaw bonding of high- κ gate dielectric with atomic-layer deposition process [7]. Although the higher nitrogen concentration shows the better electrical performance due to the efficacy improvement of traps, it is still not perfect, at least acceptable. These beneficial data can contribute the process and yield improvement.

Keyword: Nano-node process; high- κ ; AI-era; DPN; nitrogen; MOSFET; treatment; yield, drive current.

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No. P-5

TITLE: Dynamic Road Condition Simulation and Motor Characterization Platform for Hybrid Vehicles

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ABSTRACT

With the advancement of green energy and carbon reduction policies, permanent magnet synchronous motor drive systems play a key role in the development of vehicles such as electric-assisted bicycles (E-Bikes) and automated guided vehicles (AGVs). However, the development of current drive algorithms faces technical and safety gaps, including the difficulty of pure software simulations to reproduce actual physical limitations, such as nonlinear saturation, and the high costs and non-reproducible environments associated with real-world road testing. To bridge these gaps, a compact, multifunctional motor characteristic measurement and verification platform, which combines the automated measurement of comprehensive characteristic and efficiency curves with active, diversified vehicle road condition simulations, was successfully developed. In terms of motor performance measurement, the fully automated measurement of five major characteristic curves was achieved. By utilizing LabVIEW to develop a parallel three-loop and producer-consumer architecture, 13 core electrical and mechanical physical parameters, including those at the DC terminal, variable-frequency PWM terminal, and mechanical shaft terminal, were systematically measured. Regarding vehicle resistance simulation, active loading capabilities for diverse hill-climbing and time-varying resistance simulations were implemented, enabling the dynamic application of continuously varying road resistances based on vehicle dynamics. A wide range of resistance levels, from light loads (rolling resistance) to heavy loads (steep slope resistance), were tested on this platform. The nonlinear trends of power and dynamic energy efficiency as impedance varied significantly were accurately captured with a dynamic update rate of 30 ms. Under sudden, continuous, and steep impedance disturbances, excellent dynamic update speed and adjustment capabilities were demonstrated, and a transient recovery time of less than 1.5 seconds for closed-loop speed tracking was recorded. This platform offers high safety, cost-effectiveness, and engineering debugging value, providing a highly practical verification tool for energy management in smart vehicles.

Keyword: Hybrid vehicles; dynamic road condition simulation; motor efficiency analysis

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No. P-6

TITLE: Multi-Field Responses in High-Entropy KNN-based Thin Films

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ABSTRACT

The development of next-generation sustainable piezoceramics hinges on overcoming the intrinsic performance bottlenecks in lead-free systems. Although (K,Na)NbO₃ (KNN) is considered a promising candidate, it inherently suffers from inferior electromechanical coupling and restricted multi-field responses due to its strong domain pinning and rigid long-range ferroelectric order [1]. To address this bottleneck, we utilize systematic high-entropy engineering to induce intense local structural disorder [2]. By intentionally introducing multiple elements to tailor the configurational entropy, we effectively destabilize the conventional rigid domain structures. This strategy drives a distinct property evolution from a medium (0.7R) to a high (1.5R) A-site configurational entropy state in epitaxial quinary perovskite (K,Na,Ba,Sr,Bi)(Nb,Ti,Fe)O₃ (KNN-BSB) thin films, which were deposited on SrTiO₃ (100) substrates using pulsed laser deposition.

We observe a systematic structural and microstructural transition driven by the high-entropy effect. Reciprocal space mapping reveals that the low-entropy baseline exhibits a strain-relaxed state with a pronounced c/a axial ratio, characterized macroscopically by rigid macro-domains and typical square P–E hysteresis loops. In contrast, increasing the configurational entropy beyond 1.2R drives the film into a fully coherent, strained epitaxial configuration. The local random fields effectively break down the long-range ferroelectric coupling and suppress the tetragonal distortion. Consequently, the c/a ratio is reduced to near unity, stabilizing a highly dynamic, pseudo-cubic structure. This entropy-driven domain miniaturization is evidenced by the pronounced slendering of P–E loops. Crucially, these slimmer P–E loops signify a drastically lowered energy barrier for polarization rotation; the highly flexible structure allows the polarization vectors to be effortlessly perturbed by external electric and thermal fields. Ultimately, at the 1.5R limit, the system completely fragments into polar nanoregions (PNRs), marking the transition into an ultra-responsive relaxor phase [3]. Because these dynamic PNRs are extremely sensitive to external stimuli, this microstructural softening perfectly mirrors the macroscopic performance, driving a steep, continuous upward trend in both piezoelectric and pyroelectric coefficients. Moreover, these highly dynamic PNRs allow the KNN-BSB films to overcome rigid substrate clamping effects, unlocking an outstanding $d_{33} = 64$ pm/V and a giant pyroelectric output that surpasses the baseline by orders of magnitude.

In summary, this comprehensive correlation establishes entropy engineering as a transformative strategy to overcome the intrinsic performance limitations in complex oxides. By successfully unlocking giant electromechanical and pyroelectric responses through microstructural softening, these entropy-tuned KNN-BSB thin films emerge as highly competitive candidates for next-generation, eco-friendly advanced sensor materials and micro-devices.

Keyword: relaxor ferroelectric; lead-free; high entropy; piezoelectric; pyroelectric

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No. P-7

TITLE: From Single-Atom Sites to Intelligent Self-Powered Nanocomposites for Precision Ammonia Sensing: A Comprehensive Review

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ABSTRACT

Ammonia (NH₃) is widely utilized in industrial processing, energy production, and agriculture, yet its corrosive and toxic properties demand strict environmental oversight. Continuous and reliable sensing technologies are thus essential to safeguard human health, maintain industrial integrity, and avert toxic emissions. Driven by rapid advancements in digital transformation and smart systems, the integration of precision gas sensing with energy-autonomous platforms is central to next-generation smart technology. To address this evolving landscape, this review classifies NH₃ sensing materials by functional role rather than composition alone. We systematically trace the design trajectory from single-component materials and isolated single-atom active sites to heterojunctions and self-powered hybrid nanocomposites. Furthermore, key engineering hurdles such as room-temperature operation, humidity cross-sensitivity, signal drift, and the discrepancy between theoretical limits of detection (LOD) and experimental benchmarks are critically discussed. Overall, NH₃ sensor design is best guided by role-based rather than component-counting logic: the most practical sensor is the least complex architecture that meets application-specific requirements for sensitivity, recovery speed, humidity tolerance, and stability under realistic operating conditions.

Keyword: ammonia gas sensors; heterojunction; self-powered sensors; gas sensing kinetics

No. P-8

TITLE: A Three-Path Switched-Capacitor Voltage-to-Frequency Converter with an Active Sub-Hertz Baseline-Rejection Loop for Gas-Sensor Front-Ends

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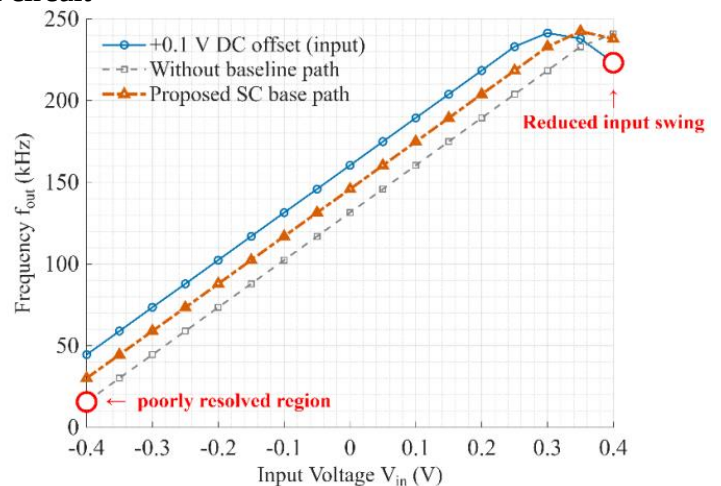
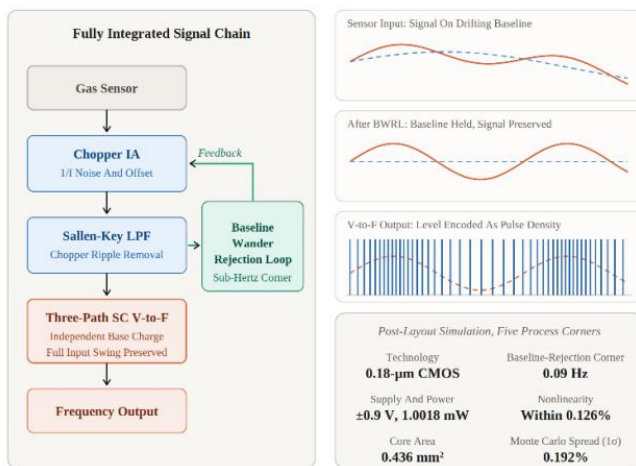
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ABSTRACT

Metal-oxide gas sensors produce a weak response superimposed on a large, slowly drifting baseline. Conventional readout chains transmit this signal as an analog voltage and remove the drift digitally, requiring a high-resolution ADC and leaving the signal vulnerable to attenuation along long interconnects [1]. This work presents a fully integrated analog front-end built on two blocks. The first is a three-path switched-capacitor voltage-to-frequency converter with signal, reference, and independent base-charge injection paths. Injecting the base charge directly into the integrating node raises the minimum output frequency without consuming input swing, avoiding the poorly resolved low-input region of conventional converters without the swing loss of a DC-offset remedy [2]. Base frequency and conversion gain are set by capacitor ratios and the sampling clock, so both track across process variation. The second is an active switched-capacitor baselinewander rejection loop enclosing the signal chain, forming a sub-hertz high-pass response that suppresses drift in the analog domain before frequency encoding with a single integrator. A chopper-stabilized instrumentation amplifier and a Sallen-Key low-pass filter complete the chain, implemented in 0.18- μm CMOS in 0.436 mm² at 1.0018 mW from ± 0.9 V. Post-layout simulation across five process corners gives 30.44 dB gain, 113.1 dB CMRR, a 0.092 Hz corner, and nonlinearity within 0.126%; a 1000-run Monte Carlo shows only 0.192% basefrequency dispersion, confirming the ratio-defined behavior.

Keywords: gas sensor; analog front-end; voltage-to-frequency converter; switched-capacitor circuit; baseline drift; chopper stabilization; CMOS readout integrated circuit



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No. P-9

TITLE: A Temperature-Stable Digitally Controlled Oscillator for SoC

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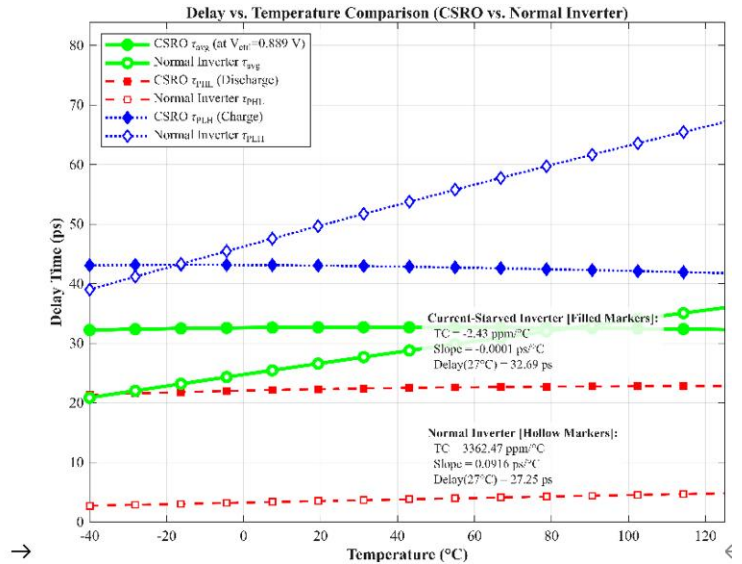
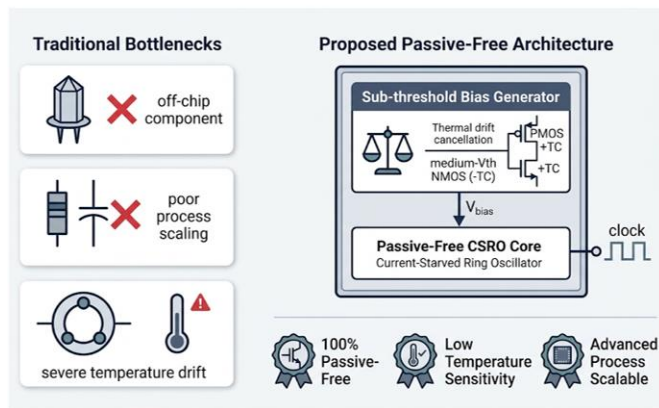
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ABSTRACT

This paper presents a fully integrated, passive-component-free ring oscillator that achieves low thermal sensitivity, eliminating the area and process-scaling penalties associated with conventional RC/LC-based on-chip oscillators. The key insight is that the thermal sensitivity of a current-starved ring oscillator (CSRO) is fundamentally governed by the stability of its bias current: suppressing rise-/fall-time variation across temperature requires a bias generator whose output remains stable over the operating temperature range. To this end, the proposed architecture adopts a subthreshold voltage-reference bias generator built upon a stacked-PMOS topology [1], which inherently provides a temperature-compensated reference without relying on any passive resistors or capacitors. The resulting stable bias current governs the charging and discharging currents of the CSRO delay-cell stages, thereby suppressing thermal drift at the oscillator output. Transistor sizing is co-optimized to balance bias current stability against silicon area, and an integrated configurable frequency divider scales the core oscillation frequency to the target output frequency. Fabricated in a 180nm CMOS process, post-simulation shows the prototype can achieve a temperature coefficient of 379.39 ppm/°C across -40 °C to 125 °C after a three-point trim, while consuming 80.79 μ W from a 1.8V supply and occupying an active area of 3095.81 μ m² at room temperature.

Keyword: on-chip oscillator; passive-free; temperature compensation; subthreshold bias circuit; current-starved ring oscillator



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No. P-10

TITLE: Response-Time-Calibrated Deep Learning for Streaming Mixed-Gas Analytics on Metal-Oxide Sensor Arrays

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ABSTRACT

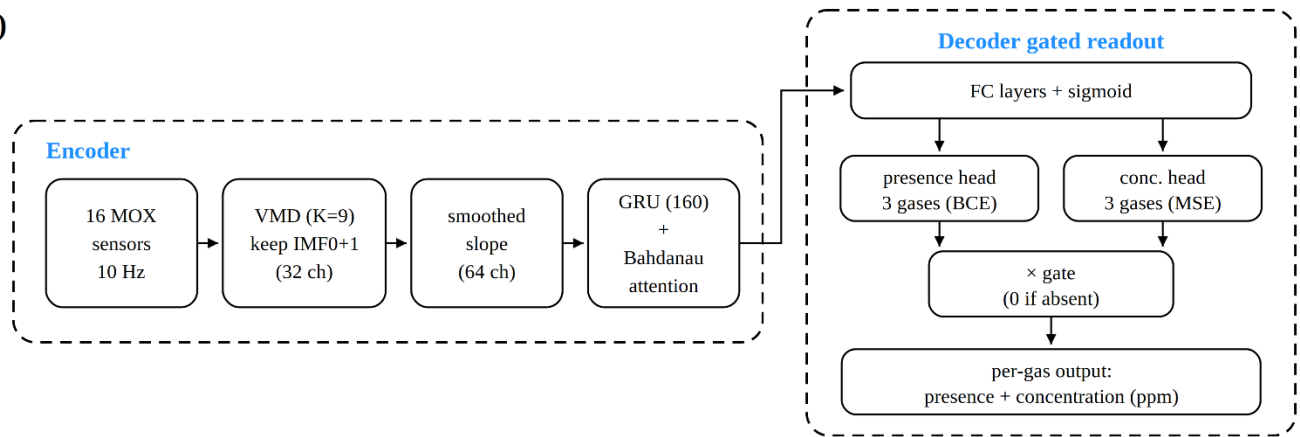
Metal-oxide (MOX) gas-sensor arrays with deep learning are a mainstay of continuous mixed-gas monitoring, but their reported accuracies are obtained offline, on complete recordings, whereas a deployed instrument must estimate the instant each sample arrives. The gap is set by the sensing physics: the MOX response develops over time constants of tens of seconds, so the concentration prevailing at a given instant has not yet appeared in the signal, and no causal estimator can recover it. A compact dual-task network — a variational mode decomposition front-end, a gated recurrent encoder with attention, and separate presence and concentration heads — was evaluated on two public 16-channel MOX dynamic-mixture recordings under segment-level ten-fold cross-validation, offline and in an emulated streaming pipeline, with the analysis window offset from the target instant to sweep the available latency. Offline it reached 99.8% exact-combination identification and R^2 of 0.95/0.96/0.98 for carbon monoxide, ethylene, and methane; identification was essentially unaffected in streaming (99.7%), but the best instantaneous estimate fell to 0.59/0.73/0.85. Accuracy rose monotonically with allowed latency for every model tested, and a 30 s look-ahead recovered 0.91/0.97/0.98. That delay is predictable rather than arbitrary: first-order fits to the sixteen channels gave a median response time constant of 32.4 s, so roughly one array-median time constant suffices. Instantaneous quantification is therefore a physical limit, and the practical answer is a dual-stream readout emitting gas identity immediately, and a precise concentration one time constant later.

Keyword: gas concentration estimation; gas detection; real-time systems; recurrent neural networks; variational mode decomposition

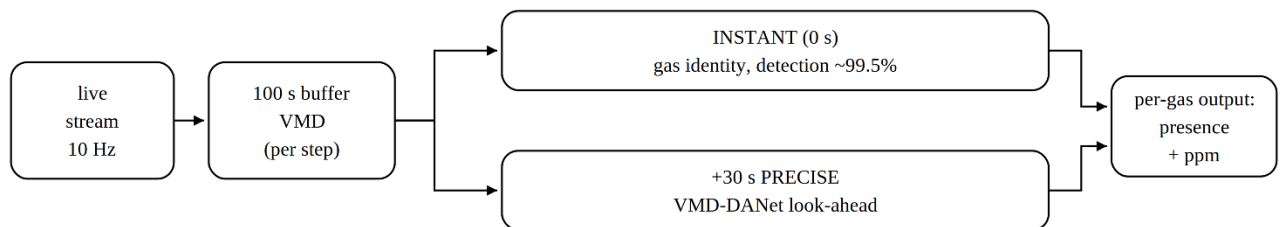
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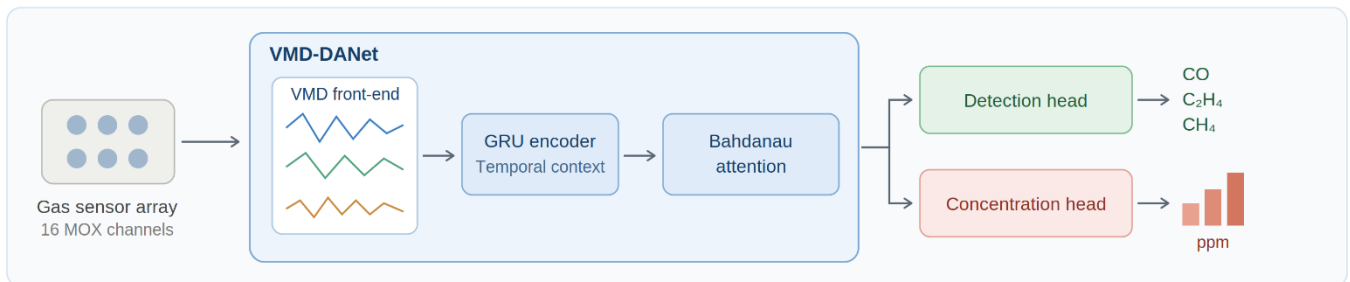
(a)



(b)



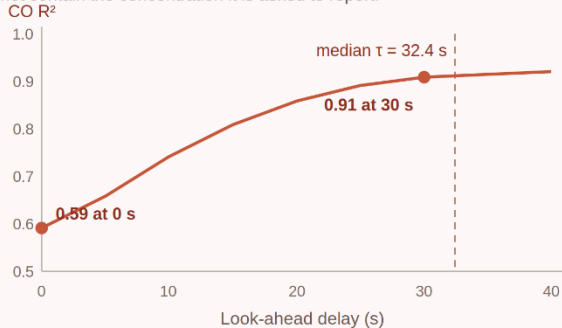
Response-time-calibrated deep learning for streaming mixed-gas analytics



Offline: 99.8 % exact-combination identification, concentration R² up to 0.98

The physical limit: sensor response time

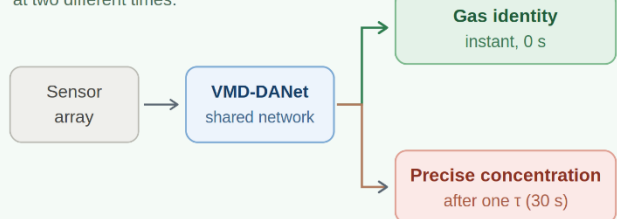
The MOX response develops over tens of seconds, so an instant reading cannot contain the concentration it is asked to report.



Accuracy is bounded by how far the response has developed, not by the model.

Deployment: two readouts, one network

The split is at the output, not the model — the same network is read at two different times.



Identity needs only that the sensors have started to react — 99.7 %.

Concentration needs the response to develop — R² 0.91 / 0.97 / 0.98.

The delay is not tuned; it follows from sensor characterisation.

No. P-11

TITLE: Supervised Machine Learning for Vertical Gas-Liquid Two-Phase Flow Regime Classification Using PDF Features of Void-Fraction and Multi-Range Differential-Pressure Signals

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ABSTRACT

Reliable flow-regime identification is important for monitoring and safe operation of gas-liquid two-phase systems. Previous studies show that void-fraction and differential-pressure fluctuations contain regime-dependent information [1,2,3]. This study evaluates a sensor-data-analytics method for vertical upward air-water flow using void fraction (VF), narrow-range differential pressure (NDP), and wide-range differential pressure (WDP). A total of 685 operating conditions were labeled as bubbly (246), slug (290), churn (117), or annular flow (32) using the Mishima-Ishii and Taitel-Barnea-Dukler maps [4,5]. NDP and WDP tap spacings were 10 and 80 cm. For each signal, a normalized probability density function (PDF) was constructed, and standard deviation, skewness, and Pearson kurtosis were extracted. Decision tree (DT) and random forest with 200 trees (RF200) [6] were compared using full-data evaluation. DT accuracies were 93.87%, 97.37%, and 96.64% for VF, NDP, and WDP, whereas RF200 achieved 96.06%, 98.25%, and 98.98%, respectively. WDP with RF200 gave the highest accuracy, 2.34 percentage points above DT. Standard deviation was the dominant feature for VF and WDP, whereas skewness dominated NDP. PDF-based features therefore characterized the present dataset effectively, and WDP with RF200 performed best among the evaluated configurations. Because the same 685 samples were used for training and evaluation, these values are full-data (training-set) accuracies; independent experiments are required to assess generalization to unseen conditions.

Keyword: gas-liquid two-phase flow; flow regime classification; void fraction; differential pressure; random forest; sensor data analytics

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No. P-12

TITLE: Matrix Analysis of Universal Chiplet Interconnect Express Technology-Taking Patents as an Example

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ABSTRACT

This study analyzes patent technology related to Universal Chiplet Interconnect Express (UCIe), covering a total of 1,406 patents with filing dates between January 1, 2020, and May 31, 2026. The dataset comprises domestic publications (76) and granted patents (20); US publications (660) and granted patents (162); Japanese publications (18) and granted patents (5); European publications (81) and granted patents (3); South Korean publications (2) and granted patents (3); Mainland China publications (109) and granted patents (62); WIPO (PCT) filings (202); and other publications (3). The analysis examines inventors, primary applicants, applicants' countries of origin, patent attorneys/agents, International Patent Classification (IPC) codes, publication/grant years, and filing dates to map the patent landscape of UCIe technology. Key findings include Kia Silverbrook holding 98 patents, while Intel Corporation leads with 260 patents, followed by Samsung Electronics Co., Ltd. with 120 patents—demonstrating active strategic positioning in this field. Regarding IPC codes, the G06F category—designating "Electric Digital Data Processing"—accounts for the highest volume, with 819 patents.

Conducting a global patent search for Universal Chiplet Interconnect Express (UCIe) provides valuable insights into the core of this technological field, identifying national research teams, corporate developers, and the expertise of leading individual innovators. Furthermore, such analysis enables developers to effectively avoid infringing on existing patented designs, thereby reducing development time and labor costs, while leveraging industry alliances to lower overall development expenses.

Keyword: Universal Chiplet Interconnect Express; Electrical Digital Data Processing; global patent search system

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No. P-13

TITLE: Simulation of silicon nitride grain size and mechanical strength prediction using a three dimensional multi sphere model

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ABSTRACT

This study addresses the demand for high-strength, high-thermal-conductivity ceramic substrates in high-power semiconductor devices by investigating the relationship between grain size evolution and mechanical strength during the sintering process of silicon nitride (Si_3N_4). As power density has increased from 0.01 W/cm^3 in 1970 to nearly 100 W/cm^3 , the thermal stability and mechanical strength of materials have become critical issues (1, 2). Silicon nitride, due to its high strength 600-800MPa and toughness $6\text{-}8 \text{ MPa}\cdot\text{m}^{1/2}$, is considered the most promising material for packaging substrates. This study employs a three-dimensional multi-particle model and the Monte Carlo method, incorporating grain boundary energy and wetting conditions ($2\gamma_{\text{sl}} \leq \gamma_{\text{GB}}$), to establish a model of random particle stacking and liquid-phase infiltration(3-5). It also accounts for the effects of particle size distribution, composition, and interfacial energy to simulate microstructural evolution during the early stages of sintering. Grain size was defined as the average of the maximum span in three axes, and the mechanical strength of the material was further predicted using the Hall-Petch relationship(6). Simulation results showed that grain size increased significantly with the addition of sintering aids. Specifically, when MgO was fixed at 2 wt% and Y_2O_3 was increased from 2 wt% to 8 wt%, the grain size increased from $0.71 \mu\text{m}$ to $0.84 \mu\text{m}$; whereas, with Y_2O_3 fixed at 2 wt%, an increase in MgO from 2 wt% to 8 wt% resulted in a grain size increase from $0.72 \mu\text{m}$ to $0.96 \mu\text{m}$, indicating that MgO has a more significant effect on grain coarsening. Concurrently, the decrease in coordination number and contact degree with increasing liquid phase indicates that the system transitions from a solid-phase-controlled structure to a liquid-phase-dominated structure. Further substitution of the grain size into the Hall-Petch equation reveals that flexural strength decreases with increasing grain size; when the additive content increases from 2 wt% to 8 wt%, the strength decreases from approximately 938 MPa to 818 MPa, exhibiting the typical trend of strength reduction due to grain coarsening.

Keyword: Ceramic substrates; Silicon nitride; Monte carlo simulation; Bending strength

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No. P-14

TITLE: Effect of Surface Modification on the Mechanical and Thermal Properties of Chemically Recycled Carbon Fiber Reinforced Polycarbonate Composites

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ABSTRACT

The primary objective of this study is to investigate the recycling and high-value application of carbon fiber reinforced polymers (CFRP) derived from wind turbine blade spars. Chemical recycled carbon fibers (CrCF) were recovered via chemical degradation and subsequently surface-treated using a self-developed fiber modifier. These modified fibers were then compounded with thermoplastic polycarbonate (PC) resin to fabricate carbon fiber reinforced thermoplastic polymers (CFRTP). The study evaluates the fiber-matrix interface, as well as the mechanical and thermal properties of the resulting composites.

The results indicate that while chemical degradation preserves the structural integrity of the fibers, residual degradation agents on the fiber surface can interfere with the reaction with interface modifiers, leading to inferior mechanical properties in composites reinforced with unmodified fibers. However, the proposed modification technique significantly mitigates this deficiency. Furthermore, the removal of the original sizing during recycling leaves the fiber surface devoid of polar functional groups, hindering the formation of strong interfacial bonding with the thermoplastic resin and consequently compromising the mechanical performance of the composites.

The application of the surface modification treatment to the CrCF effectively enhances interfacial adhesion with the PC matrix, thereby significantly improving both the mechanical and thermal properties of the composites. Although the presence of residual surface sulfides on the chemically recycled fibers initially resulted in poor mechanical performance, the cleaning and modification process reversed this trend. Consequently, the modified composites exhibited increases in mechanical strength of up to 17-19%, improvements in modulus of up to 15-16%, and enhancements in thermal properties of up to 5-8%.

Keyword: Carbon fiber reinforced thermoplastic polymers (CFRTP); Chemical recycled carbon fibers (CrCF); Surface modification; Mechanical and thermal properties

No. P-15

TITLE: Engineering of Cu-Integrated Single-Crystal β -Ga₂O₃ Thin Films for High-Power Devices

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ABSTRACT

The limited thermal conductivity of β -Ga₂O₃ ($\sim 10 \text{ W m}^{-1} \text{ K}^{-1}$) presents a major challenge for its implementation in high-power electronics, despite its attractive ultra-wide bandgap ($\sim 4.8 \text{ eV}$) and high critical electric field ($\sim 8 \text{ MV/cm}$) [1]. The accumulation of heat during high-power operation can lead to elevated device temperatures and degradation of device performance and reliability. Integrating Ga₂O₃ with a highly thermally conductive material provides a potential approach to improve heat dissipation while maintaining the advantages of the semiconductor. In particular, Cu offers both high thermal conductivity and electrical conductivity, making it a promising material for multifunctional integration with Ga₂O₃.

Here, a deposition-based heterogeneous integration process is developed to combine single-crystal Ga₂O₃ thin films with Cu. The Ga₂O₃ films were epitaxially grown on two-dimensional mica substrates through van der Waals epitaxy, providing a weakly bonded interface suitable for subsequent film release [2]. The crystalline quality of the films was evaluated by X-ray diffraction, with rocking-curve analysis exhibiting a full width at half maximum of approximately 0.3° . Following growth, a thin Cu seed layer was deposited on the Ga₂O₃ surface and subsequently thickened by electroplating. During electroplating, the accumulated deposition stress generates a driving force for interfacial separation at the weakly bonded β -Ga₂O₃/mica interface. As a result, the Ga₂O₃ thin film is spontaneously released from the mica substrate while remaining integrated with the electroplated Cu layer. This process combines film transfer and Cu integration into a single process sequence, avoiding a separate mechanical or chemical transfer step and reducing the complexity of heterogeneous integration.

The resulting Ga₂O₃/Cu structure demonstrates the feasibility of integrating single-crystal Ga₂O₃ thin films with a highly thermally conductive metal through a deposition and electroplating process. Electrical functionality was further demonstrated using a Ga₂O₃/NiO p-n junction fabricated on the transferred structure, which exhibited clear rectifying behavior and a breakdown voltage exceeding 500 V. The proposed process combines film transfer and Cu integration into a simplified process sequence, providing an engineering route for heterogeneous integration of Ga₂O₃ thin films with Cu with potential applications in thermal management and high-power electronics.

Keyword: β -Ga₂O₃; Heterogeneous integration; Cu heat-dissipating electrodes; High-power devices

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No. P-16

TITLE: First-Principles Calculations of the Structural Properties of LaAlO₃(001)/SrTiO₃(001) Heterointerfaces

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ABSTRACT

In this study, *ab initio* density functional theory (DFT) calculations were employed to investigate the structural characteristics and interfacial thermodynamics of LaAlO₃ thin films epitaxially grown on SrTiO₃ (STO) substrates[1-5]. The calculated lattice constants and angles exhibit excellent agreement with available experimental data. Surface energy analysis reveals values of 0.068~0.180 eV/Å² for LaO-terminated LAO(001), 0.085~0.186 eV/Å² for AlO₂-terminated LAO(001), 0.029 eV/Å² for SrO-terminated STO(001), and 0.058 eV/Å² for TiO₂-terminated STO(001). Conforming to experimental observations, the LaO and SrO terminations possess lower surface energies than their AlO₂ and TiO₂ counterparts, respectively, indicating superior thermodynamic stability. Crucially, the heterointerface formed by depositing a polar LAO(001) film onto a SrO-terminated STO(001) substrate yields the lowest heterointerface energy (ranging from – 0.0620~0.0503 eV/Å²). This demonstrates that the continuous, AlO₂/SrO-bonded configuration represents the most energetically favorable structure for heteroepitaxial growth, consistent with empirical findings.

Keyword: *ab initio* study; heterostructure; interface energy; surface energy; 2D-material

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No. P-17

TITLE: Direct Bonding of Graphene-Copper Composite to Glass Using Sn-4Ag-3.5Ti Active Filler Without Flux in Air

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ABSTRACT

With the rapid development of Beyond 5G high-frequency communications and advanced semiconductor packaging technologies, glass substrates with low dielectric loss and excellent surface flatness have become key materials for next-generation packaging substrates [1]. However, heterogeneous joining between extremely smooth glass and copper has long faced technical challenges associated with low interfacial adhesion and delamination induced by thermal stress [2, 3]. In this study, Sn-4Ag-3.5Ti active filler was used to bond graphene-copper composite to glass in air without the use of flux under ultrasonic assistance. The effects of ultrasonic vibration on the interfacial reactions between the ultrahigh-conductivity graphene-copper composite and soda-lime glass were investigated [4, 5]. Shear strength tests were conducted at room temperature and 200°C to evaluate the high-temperature performance and joint reliability of the graphene-copper/soda-lime glass joints. The results show that ultrasonic vibration promotes metallurgical interfacial reactions between the filler metal and the substrates, with Cu₆Sn₅ forming at the graphene-copper/filler interface. The highest bonding shear strength was achieved at a bonding temperature of 330°C with 60 seconds of ultrasonic vibration. Under these conditions, the average shear strengths at room temperature and 200°C were 15.54 and 10.35 MPa, respectively. To evaluate long-term reliability at elevated temperature, the joints were isothermally aged at 180°C for 100 hours. After aging, the average shear strength was 10.2 MPa.

Keyword: graphene-copper composite; glass; ultrasonic-assisted joining; active filler

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No. P-18

TITLE: Development of High-Efficiency Ruthenium-Based Anodes and Nanosilver CO₂ Reduction Catalysts for a Zero-Gap Alkaline Anion Exchange Membrane CO₂ Electrolysis System

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ABSTRACT

This research aims to develop a zero-gap alkaline anion exchange membrane (AEM) CO₂ electrolysis system integrated with high-efficiency ruthenium-based anodes and nanosilver catalysts for electrochemical CO₂ reduction reaction (CO₂RR). The study focuses on improving reaction efficiency, product selectivity, and long-term operational stability. Gas diffusion electrodes (GDEs), membrane electrode assemblies (MEAs), and zero-gap reactor configurations will be integrated to investigate the effects of catalyst composition, electrode structure, and operating conditions on current density, Faradaic efficiency, and energy efficiency. Nanosilver catalysts are expected to enhance CO selectivity, while ruthenium-based anodes will improve oxygen evolution reaction (OER) kinetics and reduce cell voltage. In addition, ion transport, water management, and carbonate migration within the AEM system will be analyzed to improve operational durability. The proposed system is expected to achieve high CO₂ conversion efficiency under high current density and low operating voltage, providing an important foundation for carbon recycling and net-zero carbon emission technologies.

Keyword: Ruthenium catalyst; Silver nanoparticles; Oxygen evolution reaction; CO₂ reduction reaction; Anion exchange membrane; Zero-gap electrolyzer; CO₂ electrolysis

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No. P-19

TITLE: One-Step Solvent-Free Synthesis of Nitrogen-Doped Carbon Dots with Tunable Photoluminescence and Structural Properties

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ABSTRACT

Carbon dots (CDs) exhibit diverse properties, including fluorescence, facile synthesis, and various surface functional groups, showing potential for applications in optical materials. In this study, o-phenylenediamine (o-PDA) and ethylenediaminetetraacetic acid (EDTA) were used as precursors. Equal amounts (0.5 g each) of o-PDA and EDTA were ground and thoroughly mixed, followed by placement in a sealed high-pressure autoclave. Without the addition of any solvent, the mixture was heated at a ramping rate of 5°C/min to 200°C and maintained for 6 h to synthesize carbon dots. The optical and structural properties of the obtained products were characterized using UV-Vis absorption spectroscopy, photoluminescence (PL) spectroscopy, fluorescence quantum yield measurements, Fourier-transform infrared spectroscopy (FTIR), Raman spectroscopy, and X-ray diffraction (XRD). The UV-Vis spectra exhibited characteristic absorption features at approximately 240-245, 270, and 325-340 nm, which were associated with the typical $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$ electronic transitions of carbon dots [1]. PL analysis showed that as the excitation wavelength increased from 300 to 400 nm, the main emission peak gradually shifted toward longer wavelengths, indicating excitation-dependent photoluminescence behavior [2]. In addition, under 365 nm UV irradiation, the unfiltered sample exhibited purple fluorescence, whereas the filtered sample showed more distinct blue fluorescence. The fluorescence quantum yield decreased from 2.92% to 2.19% after filtration, indicating that the filtration process affected the photoluminescence properties of the samples. Structural characterization showed that the reaction products contained oxygen- and nitrogen-containing functional groups, as revealed by FTIR analysis. Raman spectra exhibited characteristic D and G bands at approximately 1350 and 1580 cm^{-1} , respectively. The calculated ID/IG ratio was approximately 0.085, indicating the presence of sp^2 carbon structures [3]. The XRD pattern exhibited a broad diffraction peak in the 2θ range of approximately 20-25°, with a maximum at approximately 21°, and no distinct sharp crystalline diffraction peaks were observed. These features are consistent with the typical amorphous and disordered carbon structures reported for carbon dots [4]. Overall, fluorescent o-PDA/EDTA carbon dots were successfully synthesized via a one-step solvent-free autoclave method. The resulting materials exhibited characteristic optical absorption, excitation-dependent photoluminescence, oxygen- and nitrogen-containing functional groups, and disordered sp^2 carbon structures. Furthermore, the changes in fluorescence color and quantum yield before and after filtration demonstrate that post-treatment can influence the photoluminescence behavior of the material, providing a basis for further optimization of its optical properties and potential applications.

Keyword: Carbon dots; o-Phenylenediamine (o-PDA); Ethylenediaminetetraacetic acid (EDTA); Solvent-free method; Photoluminescence

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No. P-20

TITLE: Rapid Preparation of Nitrogen-Doped Carbon Dots via a One-Step Solvent-Free Autoclave Method and Characterization of Their Optical Properties and Structure

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ABSTRACT

Carbon quantum dots (CQDs), also known as carbon dots (CDs), are carbon-based nanomaterials typically smaller than 10 nm [2]. Their favorable fluorescence properties, abundant surface functional groups, relatively low production cost, and simple preparation make them promising materials for optical applications, bioimaging, sensing, and energy technologies [2]. This study investigated the optical and structural properties of products prepared from o-phenylenediamine (o-PDA) and m-phenylenediamine (m-PDA) [1-3]. One gram of each precursor was ground for 10 min, thoroughly mixed, and thermally treated in a sealed high-pressure reactor at 200°C for 6h. After cooling, the resulting powdered products were collected and subjected to structural and optical characterization. Under 365 nm ultraviolet (UV) irradiation, both products exhibited fluorescence, with the fluorescence becoming more pronounced after filtration [1-3]. UV-Vis spectroscopy revealed absorption peaks at approximately 220 and 285-290 nm for the o-PDA-derived product, while the m-PDA-derived product exhibited absorption peaks at approximately 230 and 290 nm [1,2]. These absorption features were attributed to π - π^* transitions associated with conjugated carbon structures and n - π^* transitions arising from nitrogen-containing functional groups [1-3]. The FTIR spectra exhibited characteristic absorption bands at 3200-3500, 1500-1650, 1200-1350, and 700-900 cm^{-1} , corresponding to N-H stretching, aromatic C=C stretching and N-H bending, C-N stretching, and aromatic C-H out-of-plane bending vibrations, respectively [1,2]. Raman spectroscopy revealed characteristic D and G bands at approximately 1350 and 1500-1600 cm^{-1} , respectively [1-3]. The D band was indicative of defect or disordered structures, whereas the G band was associated with sp^2 -conjugated carbon structures [1-3]. Notably, the m-PDA-derived product exhibited stronger Raman signals, suggesting differences in the carbonization behavior and defect structures between the two PDA isomers [2]. Furthermore, XRD analysis of the o-PDA-derived product revealed sharp diffraction peaks at approximately 9°, 18°, and 20°, suggesting the presence of crystalline structures or residual unreacted precursors following thermal treatment [1,2].

Keyword: Carbon dots (CDs); o-Phenylenediamine (o-PDA); m-Phenylenediamine (m-PDA); Fluorescence; Optical properties

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No. P-21

TITLE: Matrix Analysis of CoPoS Technology-Taking Patents as an Example

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ABSTRACT

This paper analyzes patent technology related to Chip-on-Substrate (CoPoS) packaging. The analysis covers 49 patents with filing dates ranging from January 1, 2020, to May 31, 2026. The dataset comprises domestic publications (4) and granted patents (2); US publications (6) and granted patents (2); Japanese publications (1); European publications (3); Mainland China publications (15) and granted patents (1); WIPO (PCT) filings (5); and other publications (9) and granted patents (1). The study examines the technology landscape by analyzing inventors, primary applicants, applicants' countries of origin, patent attorneys/agents, International Patent Classification (IPC) codes, publication/grant years, and filing dates. Key findings include inventor Tang Xinlu holding 7 patents; Shanghai Xianfeng Technology Co., Ltd. leading as the primary applicant with 7 patents; and AO Kaspersky Lab holding 6 patents and actively building a patent portfolio in this field. Regarding IPC codes, the H10W classification—covering general packaging, interconnect structures, connectors, and other structural details for semiconductor devices—accounted for the highest number of patents (13).

Utilizing global patent search systems to analyze CoPoS technology enables a comprehensive understanding of the field's core technologies, key national research teams, corporate developers, and the expertise of leading individual innovators. Furthermore, this analysis facilitates the avoidance of existing patented designs during the development phase, thereby reducing development time and labor costs, while also offering opportunities to lower costs through strategic alliances.

Keyword: CoPoS; general packaging; global patent search system

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No. P-22

TITLE: An Automated Machine Learning Framework for Vaccine Adverse Event Severity Prediction Using Medical Text Embeddings

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ABSTRACT

Vaccine safety surveillance relies heavily on identifying potential severe adverse events from passive reporting databases to reduce the manual case review burden [1-3]. This study proposes a machine learning framework combining medical text embeddings to automate the severity prediction of vaccine adverse events. Utilizing 40,058 influenza vaccine reports from the Vaccine Adverse Event Reporting System (VAERS, 2014-2025) [4], unstructured symptom narratives were converted into 768-dimensional dense vectors using the S-PubMedBert-MS-MARCO model [5, 6], combined with structured demographic attributes (age and sex). To address high feature dimensionality and class imbalance (22.55% positive cases), original 768D embeddings and Principal Component Analysis (128D PCA, retaining 90.88% variance) were evaluated across XGBoost, Support Vector Machine (SVM), and Multi-Layer Perceptron (MLP) classifiers. Hyperparameters were systematically optimized via Optuna targeting the Area Under the Precision-Recall Curve (AUCPR). Experimental evaluation on an independent test set of 8,012 samples demonstrated that XGBoost achieved the highest positive-class identification performance, yielding an AUCPR of 0.8611 (ROC-AUC 0.9225) using 768D features and 0.8591 (ROC-AUC 0.9191) with 128D PCA. SVM exhibited strong overall discrimination with ROC-AUCs of 0.9274 (768D) and 0.9239 (128D PCA), while MLP yielded lower AUCPRs (0.7630 and 0.7410, respectively). Notably, 128D PCA feature reduction significantly suppressed computational overhead while retaining over 99.7% of XGBoost's peak AUCPR performance. Integrating domain-specific medical text embeddings, PCA dimensionality reduction, and gradient boosting provides a highly scalable and computationally efficient pipeline for automated vaccine safety risk screening.

Keyword: Vaccine Adverse Event Reporting System (VAERS); Medical Text Embeddings; Severity Prediction; Principal Component Analysis (PCA); Gradient Boosting (XGBoost)

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No. P-23

TITLE: Design a low-burden intelligent enhancement and alternative communication input system

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ABSTRACT

Augmentative and Alternative Communication (AAC) supplements or replaces speech and supports users in expressing needs, ideas, feelings, and information. For users with limited oral expression, slow speech, or difficulty relying on speech alone, Chinese communication may require repeated symbol selection and sentence construction, increasing everyday communication burden. This study aims to develop a smart AAC system based on low-burden input design that reduces the operations required for Chinese input and sentence construction while preserving flexible communication across different abilities and situations. The study is informed by previous work on AAC word recommendation and core-vocabulary communication support [1,2], as well as related applications of intelligent agents, proactive assistance, and digital technologies for communication and care [3-6].

The proposed system (Figure 1) integrates image selection, initial Zhuyin input, full Zhuyin input, voice input, and text input. Candidate words are generated from the current input and personalized using historical communication records. The system records user identification, expression content, previous word, input mode, usage time, and system version, and summarizes word frequency, word-pair association, recent use, and time-period preference. These factors are normalized and combined for candidate-word ranking. To further reduce the effort required to search for words and construct sentences, an intent prediction stage is incorporated before final ranking. Current input, linguistic context, and personal usage behavior are used to estimate possible communication intent, and intent relevance is combined with personalized information to re-rank candidates.

The prototype is implemented with a Web-based front end, Google Apps Script back end, and Google Sheets data structure. The current system supports multimodal input, candidate-word recommendation, sentence completion, speech output, usage-record updating, contextual intent classification, and important-message notification. After message transmission, contextual routing distinguishes general expressions, requests, emotional expressions, pain or physical discomfort, and emergency situations. For high-priority messages, user confirmation is required before notification, while dedicated binding and QR codes associate the AAC user with designated recipients for LINE-based caregiver notification. Preliminary functional verification confirms the intended input, recommendation, selection, speech-output, and record-update workflow.

The proposed design provides a feasible framework for combining low-burden multimodal input, personalized candidate-word recommendation, and intent-aware ranking in a Chinese AAC system. Its main contribution is to extend candidate recommendation beyond fixed vocabulary ordering by incorporating individual communication history together with an estimate of the user's current communicative purpose. Future user studies will compare candidate-word hit rate, Top-1 and Top-3 recommendation accuracy, sentence completion time, number of operations, input error rate, task completion rate, and user satisfaction. These evaluations will determine whether intent-aware personalization can measurably reduce communication effort while maintaining user control over the final expression.

Keyword: Augmentative and Alternative Communication; low-burden input; multimodal input; personalized recommendation; intent prediction

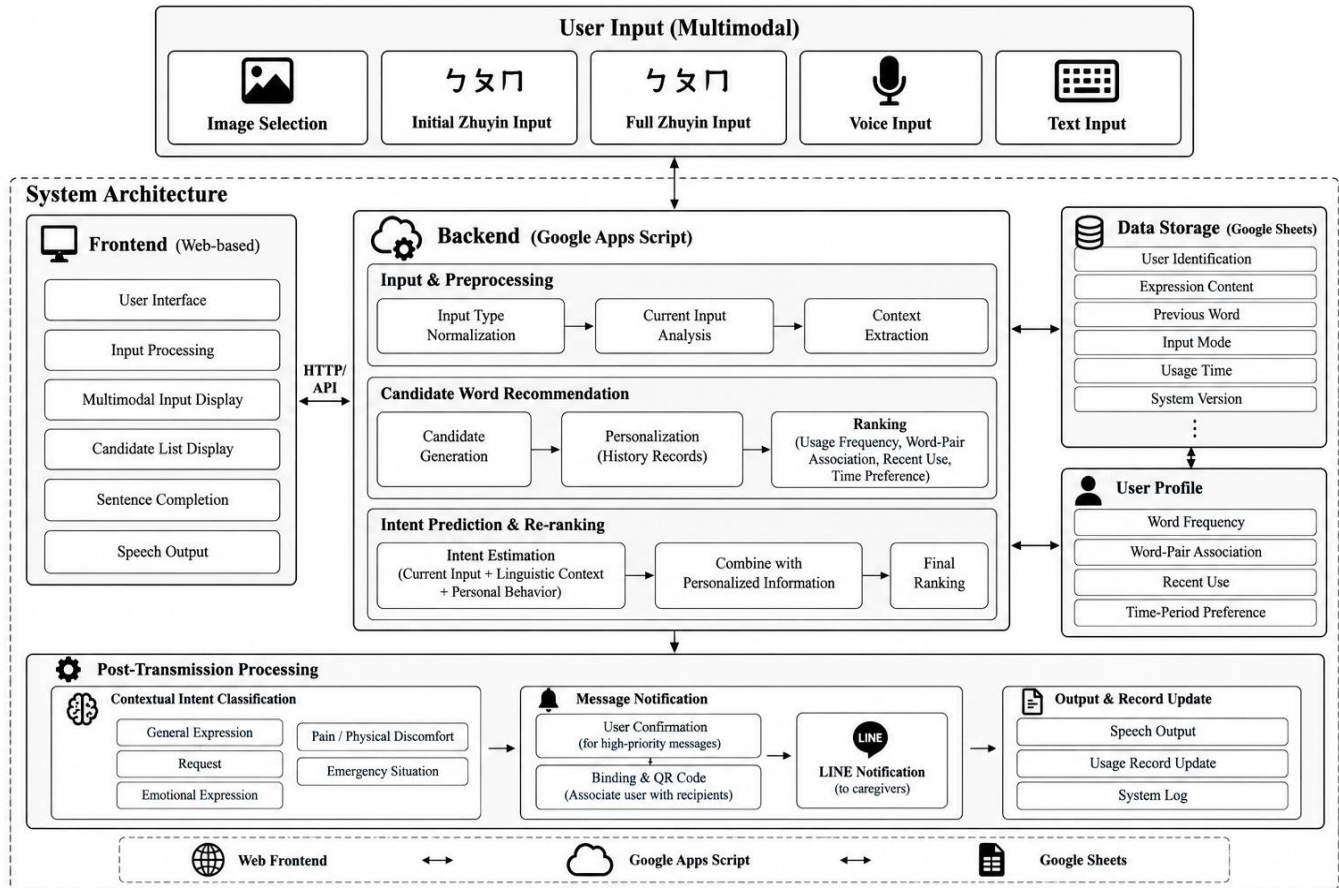


Figure 1. System Architecture of the Proposed AAC System

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No. P-24

TITLE: Optimization of a Blue-Light LED Illumination System Based on a High-Reflectivity Enclosed Cavity

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ABSTRACT

For research articles, abstracts should give a pertinent overview of the work. We strongly encourage authors to use the following style of structured abstracts, but without headings: (1) Background: Place the question addressed in a broad context and highlight the purpose of the study; (2) Methods: briefly describe the main methods or treatments applied; (3) Results: summarize the article's main findings; (4) Conclusions: indicate the main conclusions or interpretations. The abstract should be an objective representation of the article and it must not contain results that are not presented and substantiated in the main text and should not exaggerate the main conclusions.

Keyword: Highly Reflective Enclosed Cavity; Photosynthetic Photon Flux Density; Illumination Uniformity

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No. P-25

TITLE: Automated Optical Design and Fabrication-Tolerance Analysis of a Silicon Micro ring Modulator

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ABSTRACT

Silicon micro ring modulators (MRMs) are promising building blocks for wavelength-division-multiplexed optical interconnects because of their compact footprint, low switching energy, and compatibility with silicon photonic integration. However, their optical response is strongly influenced by the ring radius, bus-to-ring coupling gap, waveguide geometry, and fabrication variations [1]. This study establishes an automated simulation workflow for the optical design and evaluation of a silicon MRM using Lumerical and the Python application programming interface in Visual Studio Code.

A side-coupled micro ring structure is constructed on a 220-nm silicon-on-insulator platform. Lumerical MODE is used to calculate the effective and group indices of the guided mode, while FDTD or INTERCONNECT is used to obtain the through-port transmission spectrum. The ring radius and coupling gap are swept automatically, and Python scripts are used to identify the resonance wavelength and calculate the free spectral range, loaded quality factor, extinction ratio, and insertion loss.

To represent the modulation mechanism at the initial optical-design stage, a controlled effective-index perturbation is applied to the ring waveguide. The resulting resonance shift and transmission variation at a fixed laser wavelength are then evaluated. In addition, fabrication tolerance is investigated by varying the waveguide width and coupling gap around the selected geometry. This approach allows the optical design and automated analysis to be completed before a more complex electrical junction model is introduced.

The proposed workflow combines electromagnetic simulation, parameter sweeping, and reproducible data processing in a manageable research scope. It can subsequently be extended by importing voltage-dependent carrier distributions from Lumerical CHARGE to construct a complete electro-optic model of the micro ring modulator [2].

Keyword: Silicon photonics; Micro ring modulator; Automated simulation; Tolerance analysis

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No. P-26

TITLE: High-Efficiency O-Band Grating Coupler via Multi-Stage Refractive-Index-Based Inverse Design

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ABSTRACT

We report a perfectly vertical O-band silicon grating coupler with an ultrahigh simulated coupling efficiency of 92.02 percent at 1310 nm. The multi-stage workflow combines continuous refractive-index topology optimization, beta continuation, exact silicon and silicon dioxide reconstruction, and depth-only refinement under an 80 nm minimum horizontal feature constraint. Exact-material conversion reduces efficiency to 64.74 percent, whereas depth refinement recovers 27.28 percentage points and yields 0.361 dB coupling loss. Independent reopening confirms the final result. The design serves as a high-performance reference before etch-depth quantization and three-dimensional validation.

Keyword: perfectly vertical grating coupler; silicon photonics; topology optimization; O-band

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No. P-27

TITLE: Automated Optical Design of a Two-Lens Varifocal Eyeglass System from -4 D to +2 D Using a Python-Driven Genetic Algorithm

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ABSTRACT

Variable focus eyeglasses offer a dynamic solution for vision correction, yet optimizing optical parameters across a continuous tuning range remains computationally challenging. Traditional local optimization methods often trap in local minima when handling complex multi-lens configurations. This study presents the design and optimization of a two-lens varifocal eyeglass system with a refractive power tuning range of -4D to +2D. To overcome optimization bottlenecks, a Genetic Algorithm (GA) was implemented in Python and integrated with Zemax OpticStudio via the ZOS-API. The optical variables—specifically radii of curvature, thickness, and glass materials—were encoded as individual chromosomes within the GA framework. Operating in a standalone application mode, the Python script iteratively updated the Zemax lens data editor. The Zemax Merit Function was directly utilized as the fitness evaluator to iteratively minimize optical aberrations and maximize overall image quality across the specified tuning spectrum.

Keyword: ZEMAX; Lens Design; Varifocal eyeglasses; Genetic algorithm

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No. P-28

TITLE: Head Displacement Tracking Technology Combining LiDAR Depth Maps and High-Resolution Neural Networks

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ABSTRACT

The goal of this project is to utilize LiDAR or ToF cameras to acquire 3D point cloud data of the human face and develop a system capable of real-time detection of head translation and rotation—with applications such as monitoring head posture prior to CT scans.

The current processing pipeline involves converting the 3D point cloud into a 2D depth image via orthographic projection within a fixed range, while preserving the 3D coordinates and depth information corresponding to each 2D pixel. The depth image is mapped using fixed minimum and maximum depth limits and visualized with the "TURBO" colormap; this ensures consistent color representation across different depths, preventing color shifts caused by variations in the depth range between images.

Regarding facial feature detection, the plan is to first use YOLO to detect the facial Region of Interest (ROI) and then feed this ROI into an HRNet keypoint detector to predict the locations of facial landmarks, such as the tip of the nose. Once the 2D keypoints are obtained, the previously preserved 2D-to-3D correspondence is used to back-calculate the 3D coordinates of these landmarks. To mitigate depth noise from individual pixels, a local neighborhood (e.g., 5×5) around the predicted point can be sampled; after excluding invalid depth values, the median of the valid 3D points is calculated.

Tracking only the nose tip allows for a reliable estimate of 3D displacement but is insufficient to fully characterize head rotation. Therefore, the system can be extended to track at least three non-collinear 3D facial landmarks—such as the nose tip, the corners of the eyes, and other stable features—and subsequently use the Kabsch algorithm, SVD, or ICP to compute the rigid-body transformation between consecutive frames.

Keyword: AI; Image recognition; AOI(List three to ten pertinent keywords specific to the article yet reasonably common within the subject discipline.)

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No. P-29

TITLE: A Two-Stage Multimodal Model for Pulmonary Fibrosis HRCT Reporting and Lesion Scoring

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ABSTRACT

Pulmonary fibrosis is a progressive interstitial lung disease, and high-resolution computed tomography (HRCT) is routinely used to assess lesion patterns, spatial distribution, and severity. However, manual image interpretation and radiology report preparation are time-consuming and may vary among radiologists. This study proposes FibroCT-Bio, a two-stage multimodal system for generating case-level radiology reports and predicting slice-level lesion scores from chest HRCT images. In the first stage, a Swin Transformer image encoder and a Bio_ClinicalBERT text encoder extract visual and clinical text representations, respectively. Multi-positive contrastive learning aligns these representations in a shared semantic space, while image augmentation and paraphrase-based text augmentation increase training diversity. In the second stage, the case pathway converts features from six predefined HRCT slices into visual prefixes and combines them with a learnable soft prompt to condition BioGPT, which generates a case-level report organized into Findings and Impression sections. In parallel, the slice pathway predicts quantitative scores for honeycombing (H), traction bronchiectasis (TB), reticulation (R), and traction bronchiectasis with ground-glass opacity (TB+GGO) to support final report integration. Experimental evaluation showed that FibroCT-Bio achieved a corpus BLEU-4 score of 21.56%, a mean METEOR score of 48.06%, and a mean ROUGE-L score of 42.92% for full-report generation. Clinical label evaluation yielded a precision of 65.31%, recall of 73.91%, F1 score of 69.34%, and CRG score of 62.50%. Analysis of an individual case indicated that the generated report captured several fibrosis-related findings and their spatial distributions. These results support the feasibility of combining multimodal alignment, report generation, and lesion scoring for pulmonary fibrosis HRCT.

Keyword: pulmonary fibrosis; chest CT; multimodal learning; report generation; deep learning

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No. P-30

TITLE: Optical Design for Biconical Collimation Lens

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ABSTRACT

Designing hyperbolic optical surfaces for specific refraction targets, such as light collimation, requires the precise determination of surface parameters. This study presents a mathematical approach using geometric optics, Snell's law, and differential calculus to derive the hyperbolic parameter for a lens interface. The theoretical derivation is cross-validated through 3D computer-aided design (CAD) modeling in SolidWorks and ray tracing simulations in Zemax OpticStudio [1]. For a given incident angle of 30° and an initial lens parameter of 20.1 μm , the analytical method successfully determined the secondary hyperbolic parameter as 17.20. The CAD model closely matched the calculated intersection coordinates at (27.23, 15.72). Furthermore, converting these geometric values into optical design parameters yielded a radius of curvature of 0.0147 mm and a conic constant of -1.7323 , which were successfully verified through optical simulation. The proposed analytical workflow provides a reliable foundation for determining hyperbolic lens parameters, demonstrating high consistency between theoretical calculations and optical engineering software.

Keyword: hyperbolic lens; geometric optics; Snell's law; ray tracing; Zemax OpticStudio; optical design

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No. P-31

TITLE: *Ab initio* Study of MoTe₂/Muscovite Heterostructures

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ABSTRACT

As semiconductor device dimensions continue to approach the physical limits of conventional silicon-based materials, two-dimensional (2D) materials with atomically thin structures and the ability to form van der Waals heterostructures have emerged as promising candidates for heterogeneous integration in the post-Moore era [1]. Among the family of 2D materials, transition metal dichalcogenides (TMDCs) are among the most representative semiconducting 2D materials for electronic and optoelectronic applications. In particular, MoTe₂ exhibits excellent electrical conductivity, strong optical activity, a tunable bandgap, high sensitivity, and good stability, making it a promising candidate for a wide range of applications, including energy storage, catalysis, sensing, solar cells, photodetectors, and transistors [2]. MoTe₂ possesses three major structural phases, namely T_d, 2H, and 1T' phases. The surface stability of MoTe₂ thin films and the energetic properties of their interfaces with substrates can significantly influence material growth and heterostructure design [3]. Muscovite mica exhibits atomically flat surfaces and excellent cleavage properties; however, different K⁺ surface terminations formed upon cleavage may affect its surface and interfacial stability [4]. In this study, first-principles calculations based on density functional theory (DFT) [5-7] were employed to investigate the surface and interfacial stability of MoTe₂/muscovite heterostructures under different potassium chemical potentials. The calculated surface energies of MoTe₂ thin films range from 0.016 to 0.021 eV/Å², with monolayer 1T'-MoTe₂ exhibiting the lowest surface energy of 0.016 eV/Å². The surface stability of muscovite varies with the potassium chemical potential. Under K-rich conditions, K-terminated muscovite is the most stable, whereas under K-poor conditions, partially K-terminated muscovite is energetically favored. Under K-rich conditions, the heterostructure composed of monolayer T_d-MoTe₂ and K-terminated muscovite exhibits the lowest interfacial energy of -0.033 eV/Å². In contrast, under K-poor conditions, the heterostructure composed of monolayer 1T'-MoTe₂ and partially K-terminated muscovite exhibits the lowest interfacial energy of 0.017 eV/Å².

Keyword: first-principles; TMDCs; muscovite; surface energy; interfacial energy

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No. P-32

TITLE: A Microfluidic Device for Rapid Enrichment of Malachite Green in Aquaculture Farming Environments

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ABSTRACT

Malachite green (MG) is a synthetic dye. It is widely used in aquaculture due to its strong antimicrobial activity, low cost and ready availability [1]. However, MG and its major metabolite, leucomalachite green (LMG), are highly toxic and may lead to irreversible adverse health effects. Both compounds can also accumulate in aquatic products and the surrounding environment, thus posing serious risks to human health and ecosystems [2]. The traditional detection of MG generally relies on sophisticated analytical instruments, time-consuming analysis and often requires destructive sampling of fish tissues. Recent studies have, thus, explored aquaculture water as a non-invasive alternative for the monitoring of MG contamination with promising results [3]. Nevertheless, the relatively low residual concentrations of MG in aquaculture water, combined with interference from dissolved and suspended substances, continue to hinder sensitive and reliable detection [4].

Therefore, this study developed a rapid microfluidic enrichment system comprising a disposable microfluidic chip and a dedicated enrichment device. After the water sample was introduced into the mixing chamber, MG was adsorbed onto magnetic zeolitic imidazolate framework-8 (MZIF-8) through π - π interactions and hydrogen bonding. The device had been enhanced with magnetic stirring via a servo motor and temperature control modules to enhance adsorption efficiency and shorten processing time. After adsorption, MG was eluted with a reduced volume of elution solution to increase its concentration. The proposed system always achieved a 10-fold enrichment of MG in water samples with recoveries ranging from 104% to 109%. These results indicate that the developed system can effectively enhance the detectability of MG in aquaculture water and has great potential for the quantitative analysis of MG in real aquaculture samples.

Keyword: Malachite green; Microfluidics; ZIF-8; Enrichment

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No. P-34

TITLE: 50V-Driven Electroosmotic Pump for Tactile Actuator Applications

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ABSTRACT

This paper presents the design and optimization of an electroosmotic pump (EOP) for tactile actuator applications. Through systematic device-level optimization, the proposed device achieves comparable or superior pumping performance at 50 V, a threefold reduction in operating voltage compared with prior work [2]. Numerical simulations were used to investigate key design parameters and correlate device characteristics with output flow rate and stall pressure, guiding device fabrication, packaging, and characterization.

Electroosmotic pumps (EOPs) are solid-state micropumps that generate fluid flow through electro-osmosis, requiring no moving parts and offering silent, precise actuation. These properties make EOPs attractive for a wide range of applications, including miniaturized liquid chromatography, drug delivery, electronics cooling, and haptic feedback systems [1]. In haptics, EOP arrays embedded beneath flexible surfaces enable shape-changing displays and reconfigurable tactile feedback [2], and stacked EOP configurations have demonstrated compact tactile actuators capable of generating substantial output force [3]. However, existing EOP-based tactile actuators typically require high operating voltages, limiting their practicality in wearable and power-constrained applications. To address this limitation, this work systematically optimizes the EOP at the device level, investigating electrode design, porous media selection, and surface modification with sodium lignosulfonate, a low-cost and bio-derived polyelectrolyte.

As illustrated in Fig. 1, the EOP consists of carbon cloth electrodes, a porous media, adhesive spacers, and a housing, assembled in a compact sandwich structure with UV-laser-patterned copper conductors for electrical connection. Numerical simulations were conducted to investigate the effects of electrode hole-array density and porous-media thickness on output flow rate and stall pressure. The results indicate that a higher hole density enhances stall pressure by maximizing electrode perimeter length, while porous-media thickness has minimal effect on stall pressure because the electroosmotic driving term and the hydraulic resistance both scale with thickness. Three porous media, namely modified NKK-TF4030, GF-3, and GF-F, were characterized using carbon cloth electrodes and a propylene carbonate/ethylene carbonate (PC/EC) working fluid. As shown in Table 1, modified NKK-TF4030 outperforms the other media at all tested voltages. At 50 V, it achieves a stall pressure of 9 kPa and a maximum flow rate of 8.41 mL/min, exceeding GF-F at 150V (8 kPa, 7.55 mL/min). These results demonstrate that sodium lignosulfonate modification of the porous medium, combined with optimized electrode design, enables a threefold reduction in operating voltage while maintaining competitive pumping performance. This reduced operating voltage relaxes the requirements on high-voltage drive circuitry, facilitating integration into wearable haptic devices.

Keyword: electroosmosis; wearable device; surface modification; micropump; haptic feedback

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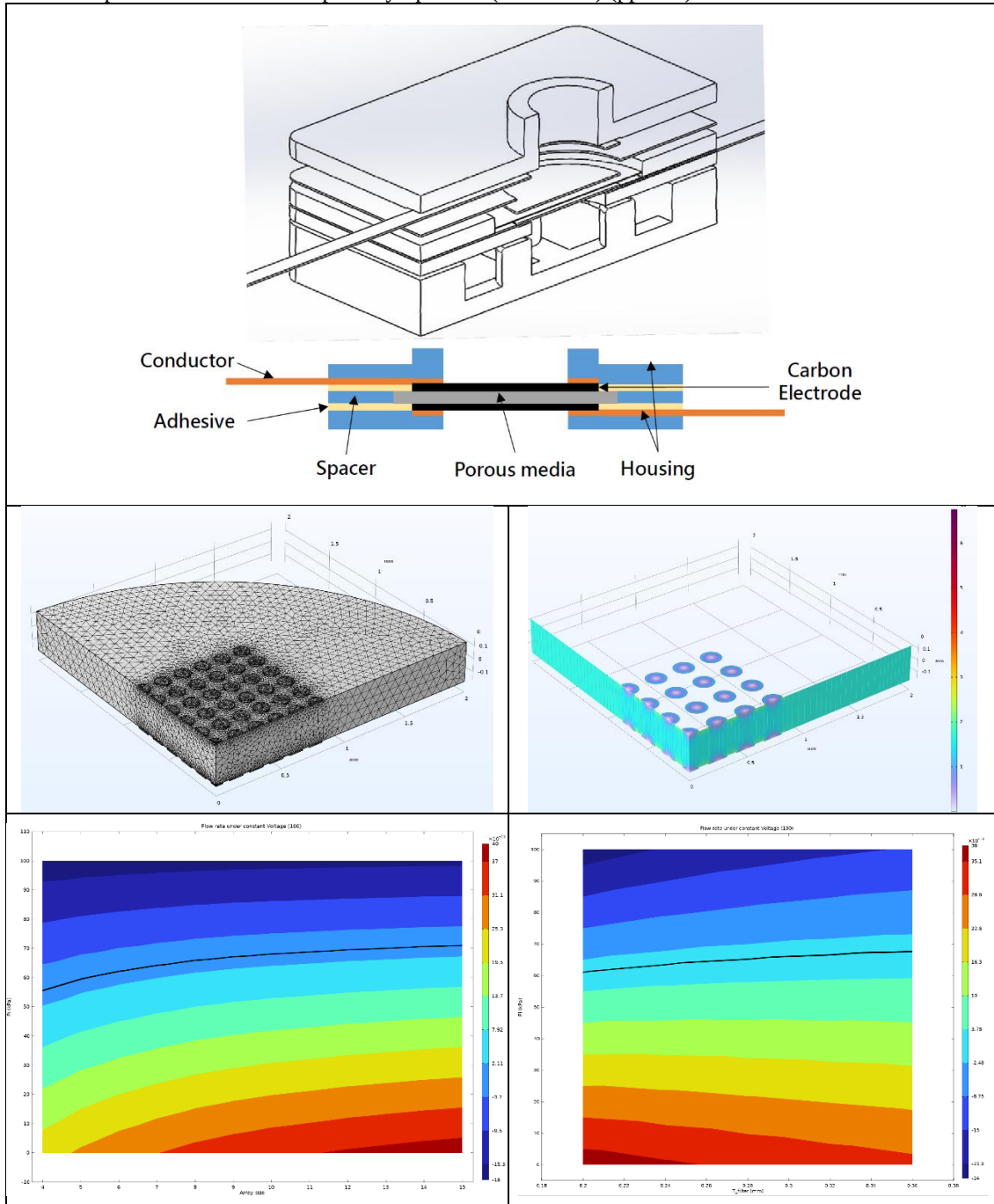


Figure 1: Schematic of EOP structure and COMSOL simulation

Table 1: Characteristics of various electroosmotic pumps

Electrode	Carbon cloth			
Porous media	Modified NKK-TF4030		GF-F	
Voltage (V)	Stall pressure	Max. flow rate	Stall pressure	Max. flow rate
50	9 kPa	8.41 mL/min	2 kPa	2.21 mL/min
100	14 kPa	13.39 mL/min	6 kPa	5.17 mL/min
150	16 kPa	26.77 mL/min	8 kPa	7.55 mL/min

No. P-35

TITLE: The Development of Photo-curable Alumina-Kaolin Ceramics slurry for Bottom-up Vat Photopolymerization

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ABSTRACT

High-performance alumina Al_2O_3 is widely recognized as a premier structural ceramic thanks to its high hardness, outstanding resistance to wear and corrosion, and exceptional thermal stability. It plays a vital role in controlling microstructural grain growth, which significantly improves the material's overall mechanical toughness and structural integrity. Although pure alumina offers exceptional mechanical strength, its high sintering temperature and lack of liquid-phase vitrification present key processing challenges.

As highlighted by Gu et al., high-tech industries including aerospace, electronics, nuclear engineering, energy storage, and biomedicine increasingly require large-sized alumina ceramic components featuring intricate, highly precise structural designs [1]. Translating alumina's superior mechanical and thermal properties into these complex architectures presents a severe challenge for traditional manufacturing. Conventional routes such as powder injection molding, die pressing, and subtractive machining suffer from rapid tool wear, elevated risks of catastrophic cracking, extended production cycles, and costly secondary finishing processes required to meet tight dimensional tolerances. To overcome these physical and economic constraints, ceramic additive manufacturing (AM) technologies have emerged as a transformative alternative. By comparing the efficiency of stereolithography and digital light processing (DLP) technology in 3D printing ceramic parts, the application of 3D printing technology in ceramic production is gradually increasing [2]. A comparative review by Chen et al. highlights, vat photopolymerization (VPP) technologies including Digital Light Processing (DLP) and Stereolithography (SL) hold a clear edge in accuracy, feature resolution, and surface quality over alternative ceramic 3D printing routes [3,4]. While powder-based (eg, SLS, SLM) and extrusion-based (eg, DIW, FDM) systems are physically constrained by powder grain size and nozzle diameters resulting in coarser resolution ranges (μm to mm scale) and "Low" to "Medium" surface quality slurry-based light polymerization operates cleanly at strict micron (μm) down to nanometer (nm) levels.. By relying on light-driven polymerization to cure fine liquid slurries layer-by-layer rather than thermal energy or binder jetting, VPP achieves exceptional optical exposure control.

As demonstrated by MA et al., adding SiO_2 to Al_2O_3 generates an Al-Si-O liquid phase that drives the in-situ synthesis of mullite, forming interlocking, rod-like grains that impede crack propagation while reducing thermal conductivity [5]. Alternatively, Incorporating kaolin ($\text{Al}_2\text{Si}_2\text{O}_5(\text{OH})_4$) overcomes limits by releasing reactive silica at high firing temperatures to form a molten glass phase that fills micro-pores, driving full densification at reduced temperatures. To realize this mechanism, a stable 45 vol% ceramic suspension (90:10 wt% Al_2O_3 -alumina to kaolin mineralizer) was formulated within an optimized HDDA/TMPTA (40:60 vol%) photocurable resin containing 3 wt% BYK-111 dispersant and 0.3 wt% Irgacure 819 photoinitiator using high-shear dispersion and 24 h zirconia ball milling. Green bodies were fabricated using a bottom-up 405 nm LCD-VPP (Mighty 4K, Phrozen Technology, Taiwan) platform at a 0.05 mm layer thickness. Guided by the TG-DSC analysis reported by Ma et al. [6], the green bodies underwent a tailored 73.4 h thermal cycle consisting of multi-stage debinding followed by reaction sintering at 1400°C for 120 min. Rheological characterization

revealed pronounced pseudoplastic shear-thinning behavior with an operational viscosity below 5 Pa·s at 30 s⁻¹, effectively suppressing particle sedimentation at rest while enabling rapid fluid recoating during printing. Manual dimensional verification confirmed high printing accuracy, with overall variations restricted to –7.33% to +1.13% across all axes. The customized multi-stage debinding schedule ensured defect-free binder elimination preventing internal pore pressure, micro cracking, and delamination. Thermal processing culminated in reaction sintering at 1300°C, yielding an 8% linear shrinkage and driving the green density of 1.90 g/cm³ to a sintered density of 2.50 g/cm³ via sequential pore collapse and alumina–kaolin phase transformation. Furthermore, the incorporation of 10 wt% kaolin successfully promoted in-situ liquid-phase reaction sintering, achieving full structural densification while slashing the required sintering temperature from 1600°C down to 1300°C. This integrated approach establishes a scalable, energy-efficient manufacturing framework for producing dense, high complex-shaped structural ceramic components with good dimensional precision.

Keyword: Vat photopolymerization; Reaction sintering; Alumina-kaolin composite; Slurry rheology; Ceramic additive manufacturing; Thermal debinding

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No. P-36

TITLE: Design and Simulation of a Secondary Optical System for 12V MicroLED Automotive Courtesy Lighting

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ABSTRACT

In modern automobiles, welcome lights and other automotive lighting equipment have become standard equipment, and the voltage used is 12V. Traditional high-voltage LED modules mostly use independent chips connected in series and electrical connections are completed by wire bonding [1]. In order to make MicroLED have the advantages of compact size and high integration, we integrate positive and negative electrode structures in a single semiconductor chip and form a high-voltage light-emitting element through internal multi-junction series and metal wiring. There is no need for external wire bonding to connect multiple chips, so there is no chip spacing, avoiding the non-light-emitting area between traditional chips. However, its wider initial emission angle will cause the light to be scattered over a larger range, thereby reducing the effective illumination [2]. Therefore, this study developed a secondary optical system for a 12V single-chip MicroLED for automotive welcome lighting. We established a 3D model for a MicroLED with a chip size of $0.6 \times 0.6 \text{ mm}^2$ and an emission wavelength of 459nm. The model integrates a PMMA aspherical lens and a hollow hemispherical reflector to change the light path and make it point to the target plane 342.3mm away from the light source. We evaluated the optical performance of a 12V MicroLED, a 12V MicroLED with an aspherical lens, and a 12V MicroLED with an aspherical lens and a hemispherical reflector on a target plane by comparing their light power distribution, horizontal angular distribution, and radiant intensity distribution. The 12V MicroLED exhibits a wide horizontal angular distribution of approximately $\pm 55^\circ$, while the aspherical lens reduces this to approximately $\pm 42^\circ$. The lens-reflector structure achieves the highest central light concentration and increases the peak radiant intensity from 0.039 mW/sr for the MicroLED to 0.053 mW/sr with the lens, ultimately reaching 0.094 mW/sr with the complete secondary optics system.

Keyword: secondary optics; aspheric lens; radiant intensity; Micro-Light-Emitting Diode (MicroLED); hemispherical reflector



Fig1. Automotive welcome lighting schematic diagram

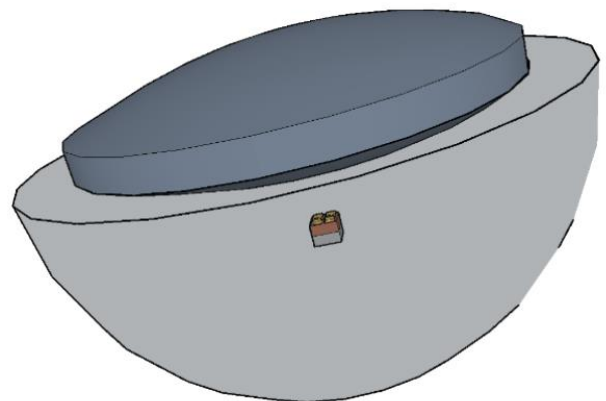


Fig2. Secondary optical system design schematic diagram

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No. P-37

TITLE: Thermal Stability, Microstructural Evolution, and Magnetic Properties of Re/B-Doped FeCoTaZr Soft Magnetic Thin Films for High-Temperature HAMR Applications

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ABSTRACT

With the surging demand for cloud computing and big data, the recording density of hard disk drives is confronting the superparamagnetic limit. While heat-assisted magnetic recording (HAMR) can overcome this bottleneck, the induced high temperatures readily trigger crystalline coarsening and magnetic degradation in the underlying soft underlayer (SUL). In this study, single-layer and bilayer FeCoTaZrBRe thin films were deposited via magnetron sputtering: the single-layer system verifies the capacity of the refractory element Re to suppress atomic restructuring and maintain soft magnetic properties under extreme thermal budgets, whereas the bilayer architecture incorporates a chemically inert Ru capping layer to prevent oxidation and preserve structural integrity during ultra-high-temperature vacuum annealing. Structural analyses indicate that the lattice strain effect induced by synergistic B and Re co-doping effectively suppresses the crystallization kinetics of the α -FeCo phase and interlayer interdiffusion. Consequently, the films retain a low coercivity (H_c), stable saturation magnetization (M_s), and superior surface smoothness (R_a) even after annealing at 700°C. These results demonstrate a markedly broadened thermal processing window, establishing a pivotal material platform for next-generation, ultra-high-density magnetic recording media.

Keyword: Heat-assisted magnetic recording (HAMR); Soft underlayer (SUL); Magnetron sputtering; Thermal stability

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No. P-38

TITLE: Phase Formation in Pulsed-Laser-Deposited High-Entropy (Ca,Sr,Ba,Mg,Sm,Bi,Na)TiO₃ Thin Films: Effects of Substrate

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ABSTRACT

High-entropy perovskite oxides derived from BaTiO₃ offer a compositional route to tune dielectric and ferroelectric properties, but how substrate and thermal processing govern phase formation in thin films remains unclear. Here, 200-nm (Ca_{0.2}Sr_{0.2}Ba_{0.2}Mg_{0.15}Sm_{0.15}Bi_{0.05}Na_{0.05})TiO₃ (CSBMSBNT) films were grown by pulsed laser deposition using a KrF excimer laser ($\lambda = 248$ nm) on two substrate systems: LSMO-buffered SrTiO₃ (111) at 700°C, followed by 30 min post-annealing in 1 atm O₂, and Pt(111)/Ti/SiO₂/Si at 450-600°C with identical post-annealing conditions. Structure was examined by θ -2 θ X-ray diffraction and surface morphology by atomic force microscopy over $5 \times 5 \mu\text{m}^2$ areas. XRD reveals epitaxial growth on LSMO/STO with a shoulder peak adjacent to the substrate (111) reflection, indicating partial lattice matching and preferred orientation along the pseudo-cubic direction, whereas films on Pt-based commercial substrate stacks exhibit additional reflections that match minor peaks in the bulk pattern, suggesting competing nucleation pathways. AFM shows smooth surfaces on both substrates with granular morphology, indicating that substrate choice primarily influences crystallinity and phase purity rather than surface roughness. These results demonstrate that achieving high-quality crystallinity on commercially relevant Pt-based substrate stacks requires further optimization of deposition temperature and oxygen partial pressure to suppress secondary-phase formation and enable practical high-entropy ferroelectric devices for energy storage applications.

Keyword: high-entropy perovskite; BaTiO₃; thin film; pulsed laser deposition; X-ray diffraction; substrate effect

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No. P-39

TITLE: A Systematic First-Principles Study on the Phase Stability and Martensitic Transitions in Os₂XZ Heusler Alloys

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ABSTRACT

The structural, electronic, magnetic, and martensitic properties of forty-two Os₂XZ Heusler alloys ($X = \text{V, Cr, Mn, Fe, Co, and Ni}$; $Z = \text{Al, Ga, In, Si, Ge, and Sn}$) were systematically investigated using density functional theory (DFT). Both cubic regular (*cr*) and cubic inverse (*ci*) atomic orderings were considered to determine the energetically favorable ground states and their associated magnetic configurations. Most compounds preferentially stabilize in the regular cubic phase, whereas Os₂CoIn and Os₂NiIn exhibit a transition toward the inverse structure due to enhanced orbital hybridization under expanded lattice environments. The calculated magnetic states display strong sensitivity to chemical ordering and valence electron concentration, ranging from nonmagnetic to ferro- and ferrimagnetic configurations. Electronic structure analyses reveal that the phase stability is governed by the competition between exchange splitting and chemical bonding effects near the Fermi level. In Os₂VGe, a large density of states at Fermi level (E_F) induces a Stoner type instability, and the resulting spontaneous spin polarization stabilizes the magnetic regular phase. In contrast, the inverse phase of Os₂NiIn is energetically favored because E_F falls within a pseudogap region, suppressing magnetic ordering and lowering the electronic energy. Furthermore, tetragonal distortion calculations demonstrate that all investigated systems exhibit pronounced martensitic tendencies, with the tetragonal phases consistently possessing lower energies than their cubic counterparts. The martensitic instability is closely associated with symmetry-reducing induced splitting of degenerate *d* states near the Fermi level, which reduces the electronic energy through a band mechanism. These results establish a unified microscopic picture linking chemical ordering, electronic instability, magnetism, and tetragonal distortion in Os₂-based Heusler alloys, and provide theoretical insight into the design of martensitic and spintronic Heusler materials.

Keyword: Heusler alloys; rare alloys; elastic constants; magnetic semiconductor; first-principles calculation

No. P-40

TITLE: Atomic-ordering and chemical-tuning control of Berry-curvature-driven anomalous Hall and Nernst effects in XCuMnZ quaternary Heusler compounds.

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ABSTRACT

We investigate the structural, magnetic, and anomalous transport properties of XCuMnZ ($X = \text{Fe, Co, Ni}$; $Z = \text{In, Sn, Sb}$) equiatomic quaternary Heusler compounds using first-principles calculations combined with Wannier interpolation. Among the three possible atomic configurations, the Type II structure is found to be energetically favorable and stabilizes robust ferromagnetism. Selected compounds, such as CoCuMnSb , exhibit half-metallic behavior with integer magnetic moments following the Slater–Pauling rule. The anomalous Hall conductivity is shown to originate from Berry-curvature hotspots induced by spin–orbit coupling near the Fermi level, with particularly large values observed in NiCuMnSb . In addition, a pronounced anomalous Nernst conductivity is identified in CoCuMnIn , highlighting its potential for transverse thermoelectric applications. These results demonstrate that anomalous transport in Mn-based quaternary Heusler compounds can be effectively tuned via chemical substitution and atomic ordering.

Keyword: Heusler alloys; Anomalous Hall effect; Anomalous Nernst conductivity; first-principles calculation

No. P-41

TITLE: Simulation Thermal Effects in a Silicon Photonics with a Graphene Thin Film

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ABSTRACT

In the current era of silicon photonics advancement [1], integrating novel materials to boost chip performance is essential for enhancing operational efficiency and stability. This study proposes the integration of a graphene thin film [2] onto the top surface of silicon photonic chips to address critical thermal management issues. By leveraging the exceptional thermal conductivity of graphene (1800 W/m·K), this approach facilitates rapid heat dissipation, thereby significantly improving the chip's thermal profile.

Literature has demonstrated that graphene's large heat conductivity, high carrier mobility, and wide light absorption spectrum response can be utilized to enhance the performance of silicon photonics. The integration of a graphene film extends the bandwidth (>40 GHz) and broadens the operating wavelength range (1550 nm to 2000 nm). Building upon these findings, what I want to investigate is the working temperature response of silicon photonic chips to graphene films, as well as the temperature difference before and after the deposition of the graphene film.

Keyword: Silicon Photonics Chip; Graphene; Graphene film; Temperature Effects

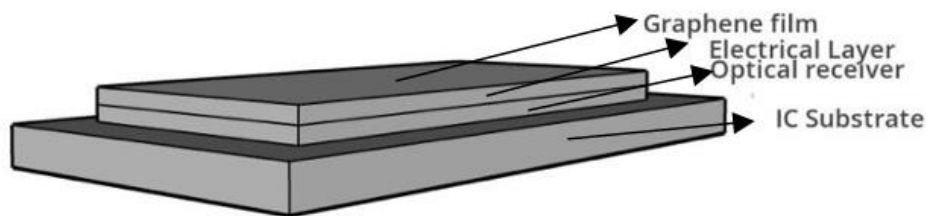


Fig1.Imaging a graphene thin film on the top of chip

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No. P-42

TITLE: Development of a Dynamic Sensor System for Plant Water Transport

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ABSTRACT

This study aims to develop an integrated dynamic plant water sensor system by measuring the electrical impedance and capacitive characteristics of plants. The system utilizes an LCR meter for real-time acquisition of impedance and capacitance data, integrated with an automated measurement program and a data visualization interface to enable continuous data logging and analysis. To verify system performance, watering experiments were conducted on white pomelo (*Citrus grandis*) to evaluate the system's real-time response time and measurement accuracy in detecting variations in plant moisture. The results demonstrate the successful establishment of a sensing system for plant moisture-related physiological indicators, providing an objective benchmark for long-term, data-driven irrigation management strategies.

Keyword: dynamic water sensing; electrical impedance; plant water physiology

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No. P-43

TITLE: Silicon-Integrated Bi₂O₂Se/Pb(Zr_{0.2}Ti_{0.8})O₃ Heterostructure for Ferroelectric Gate Modulation toward FeFETs

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ABSTRACT

Ferroelectric polarization provides a means to electrically modulate charge transport in semiconductor channels, offering a potential route toward non-volatile electronic devices. Extending ferroelectric/2D-semiconductor heterostructures into practical device platforms requires not only effective integration of the active materials but also compatibility with a silicon-based platform. Bi₂O₂Se (BOSE) is structurally compatible with SrTiO₃ (STO), enabling epitaxial integration with perovskite oxides [1]. Meanwhile, STO-buffered Si provides a pathway to transfer this epitaxial oxide heterostructure from oxide substrates toward silicon integration [2]. Building on reported BOSe/Pb(Zr_{0.2}Ti_{0.8})O₃ (PZT) heterostructures [3], this work investigates the epitaxial integration of BOSe/PZT on STO-buffered Si as a materials platform toward future ferroelectric-gated devices.

A BOSe/PZT/SrRuO₃ (SRO)/STO/Si heterostructure was fabricated by pulsed laser deposition. The crystallographic structure and epitaxial relationships were investigated by X-ray diffraction. Surface morphology was characterized by atomic force microscopy, and the ferroelectric response of the PZT layer after BOSe integration was evaluated by piezoresponse force microscopy. Electrical characteristics were further investigated through polarization–electric field (P–E) and capacitance–voltage (C–V) measurements of the MFS structure and compared with those of the corresponding metal–ferroelectric–metal (MFM) structure.

The BOSe layer exhibited a clear in-plane epitaxial relationship with the underlying oxide layers, with an RMS surface roughness of approximately 2 nm. PFM measurements confirmed that the ferroelectric response of PZT was retained after BOSe integration. The MFS structure exhibited reproducible hysteresis in both P–E and C–V characteristics, with a memory window of approximately 3 V in the C–V response. Comparison with the corresponding MFM structure further showed that incorporation of the BOSe semiconductor modifies the electrical response of the heterostructure, indicating its contribution to the electrostatic coupling within the MFS structure.

These results demonstrate direct epitaxial integration of BOSe and PZT on an STO-buffered Si platform while retaining the ferroelectric response of the PZT layer. The observed ferroelectric switching and electrical hysteresis establish a structural and electrical basis for further investigation of bottom-gated BOSe ferroelectric field-effect transistors.

Keyword: Pulsed laser deposition, Epitaxy, Bi₂O₂Se, Ferroelectric oxide, Si integration

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