ICREM-2024

International Conference on Radiation and Emission in Materials

Khon Kaen, Thailand

ABSTRACT BOOK

The 6th International Conference on Radiation and Emission in Materials

27-29 November 2024 Khon Kaen, Thailand

Welcome to ICREM 2024

Scope

ICREM 2024 is dedicated to exploring the cutting-edge developments in radiation and emission phenomena across a diverse range of applications. The conference will provide a platform for intellectual exchange and collaboration, featuring discussions on topics such as

- Nuclear and Plasma Radiation
- Accelerated Particle Beams
- Fundamental of light-matter interaction
- Advanced Emitting Devices
- Photovoltaics
- Radiation Detection and Devices
- Plasma Source and Applications
- Materials Characterization
- Application of Functional Materials
- Thin Film Coating and Applications
- Radiation for Agriculture and Biology

By participating in ICREM 2024, you will have the opportunity to:

- Engage in interactive sessions, keynote lectures led by experts in the field.
- Network with peers and leading professionals from around the globe.
- Discover pioneering research and technological advancements in radiation and emission.
- Contribute to a global discussion on the future directions of material sciences.

Format and location

The ICREM is an annual event – set in the end of the calendar year - gathering local and international experts and students in the field. Teamed with the world-renowned Thai hospitality and climate, the location of the ICREM is foreseen to remain in Thailand.

Boards and Committees

Conference Chairs

- Keeratiya Janpong (Thai Radiation & Particles Society and Maejo University, Chiang Mai, Thailand)
- Artit Chingsungnoen (Mahasarakham University, Mahasarakham, Thailand)

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- Sureeporn Sarapirom (Maejo University, Chiang Mai, Thailand)
- Kittikhun Prakrajang (Maejo University, Chiang Mai, Thailand)
- Patcharee Kongpak (Maejo University, Chiang Mai, Thailand)
- Phitsanu Poolcharuansin (Mahasarakham University, Mahasarakham, Thailand)

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- Thai Radiation & Particles Society
- Mahasarakam University

Co-organizers

- Thailand Center of Excellence in Physics (ThEP)
- Hub of Talents for Plasma Technology
- Nakhon Pathom Rajabhat University
- Naresuan University

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• Wiraporn Maithong	Chiang Mai Rajabhat University
• Chainarong Raktham	Uttaradit Rajabhat University
• Mati Horprathum	National Electronics and Computer Technology Center

Conference Venue

The conference venue is the Pullman Khon Kaen Raja Orchid Hotel in the city center of Khon Kaen. The hotel is easy to reach as it is only 8 km (15 minutes drive) from Khon Kaen International Airport.

Nearby attractions:

- Khon Kaen University (7 km)
- Singha Park Golf Course (14 km)
- Ubonrattana Dam Golf Course (50 km)
- Phuwiang National Park (80 km)

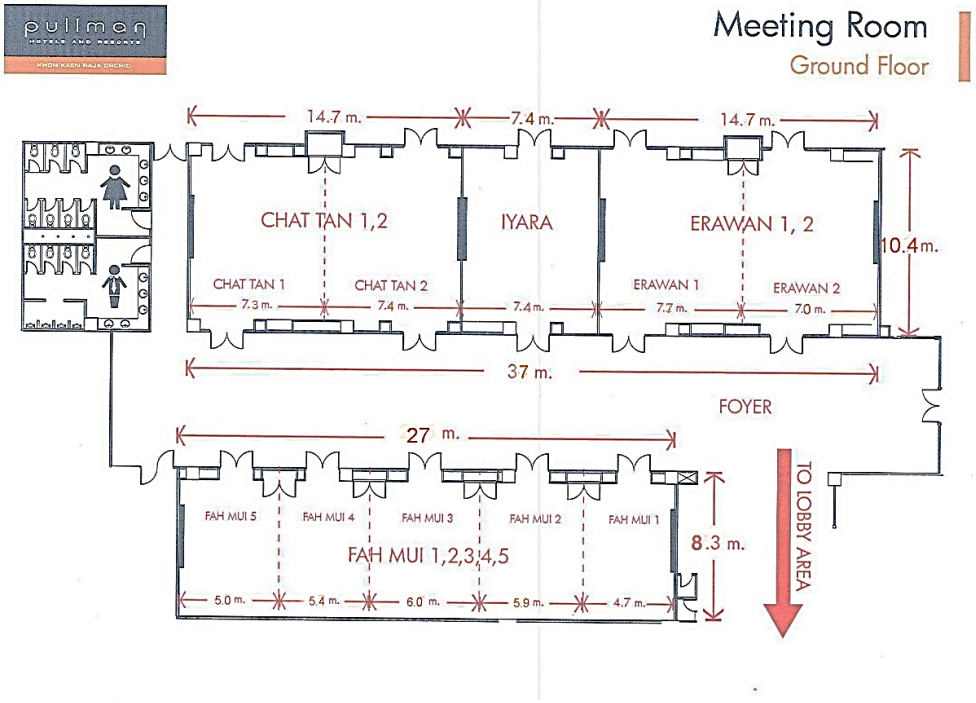
Meeting Rooms:

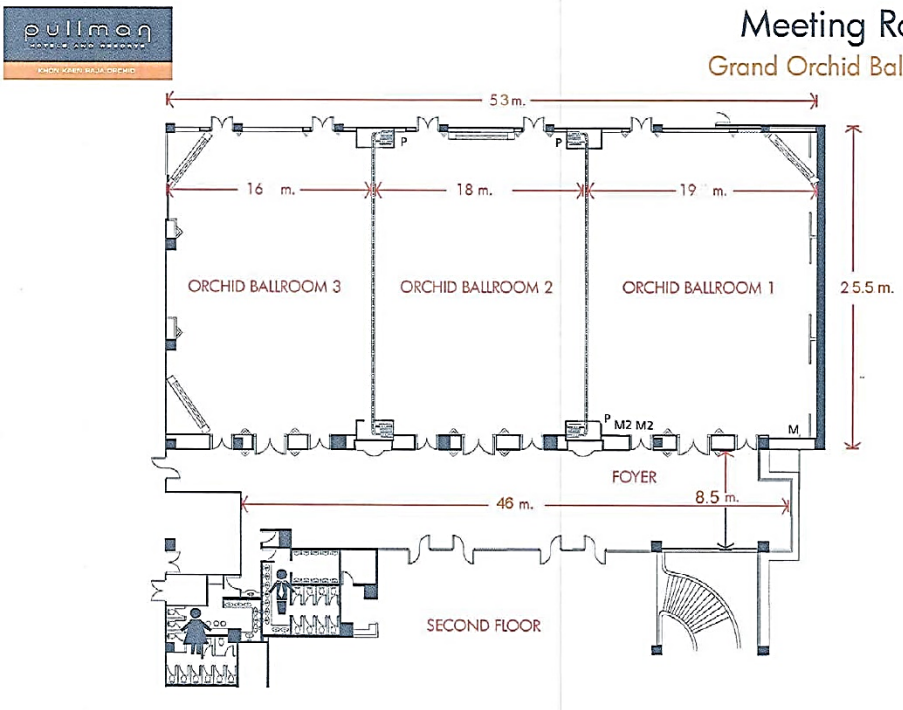
- Orchid Ballroom 2 (2nd Floor)
- Chat Than 1, 2 (Ground Floor)
- Erawan 1, 2 (Ground Floor)

Banquet:

- Sala Thai (4th Floor)

Meeting room layout





Events & Excursion




Travel Itinerary for "Happy Maha Sarakham" Tour in Kosum Phisai District, Maha Sarakham Province

Time	Activity and Location
7:30 - 9:00	Depart from Pullman Hotel, Mueang Khon Kaen District, Khon Kaen Province, to Mueang Maha Sarakham District (breakfast served on the bus)
9:00 - 9:15	Stop at Mueang Maha Sarakham District Office to pay homage to Phra Phuttha Kantara Wichai Aphisamai Thamanayok
9:15 - 10:00	Continue journey to Kosum Phisia District, Maha Sarakham Province
10:00 - 10:45	Visit Wat Klang Kosum to see the Ming Muang Buddha statue and participate in a palm leaf inscription activity
10:45 - 11:30	Explore Kaeng Tat and feed the golden-haired macaques at Kosumphi Forest Park
11:30 - 14:00	Enjoy lunch at Rai Saendee New Agriculture Farm, featuring traditional snacks and herbal drinks
14:00 - 14:45	Return to Mueang Maha Sarakham District
15:00 - 15:30	Visit Wat Phuttha Wanaram (Wat Pha Wang Nam Yen)
15:30 - 17:00	Travel back to Pullman Hotel in Khon Kaen

Acknowledgements

The ICREM 2024 conference is sponsored by

- Mahasarakham University
- Thailand Center of Excellence in Physics (ThEP)
- Hub of Talents for Plasma Technology
- Nakhon Pathom Rajabhat University
- The Materials Research Society of Thailand (MRS-Thailand)
- Naresuan University
- Synchrotron Light Research Institute (Public Organization), Thailand
- Puditec Co., Ltd.
- Astronics Technologies (Thailand) Co., Ltd.
- Union Science Trading Co., Ltd.
- Mitr Phol Sugar Co., Ltd.
- KEYENCE (Thailand) Co., Ltd.
- Dou Yee Enterprises Thailand Co., Ltd.
- Abex Technologies Co., Ltd.
- PHYWE System (Thailand) Co., Ltd.

Presentations

Invited talks:

Limited to 20 minutes, including question and answer session. Upload your presentation file on November 27, 2024 (10:00 – 16:00) at the information desk in room Iyara (Ground Floor) or before the session starts.

Contributed talks:

Limited to 15 minutes, including question and answer session. Upload your presentation file on November 27, 2024 (10:00 – 16:00) at the information desk in room Iyara (Ground Floor) or before the session starts.

Posters:

The preferred size of the poster is 80 cm × 120 cm or smaller. The poster sessions will take place on November 27, 2024 between 16:30 – 19:00. Each participant should present for 7 minutes, including questions. Please refer to the final program for the exact schedule of presentations. We kindly ask participants to be in the room Orchid Ballroom 2 for the poster presentation at least 15 minutes before the poster session starts.

The installation of the posters in the room Orchid Ballroom 2 is possible from November 26, 2024 at 18:00.

Poster awards:

The best poster presentations will be selected by the Poster Awards Committee.

Journal Submission Opportunities

We are pleased to offer ICREM 2024 participants the opportunity to submit their full papers to the following supported journals:

	**Physica Status Solidi (A): Applications and Materials Science** Journal Link
	**Engineering Access** Journal Link
	**The Thai Journal of Nanoscience and Nanotechnology** Journal Link
	**Current Applied Science and Technology** Journal Link

Participants are encouraged to submit their work to these journals, each offering rigorous peer review and publication opportunities. Further details on submission guidelines and deadlines will be provided during the conference.

Schedule

Time	Schedules	Room
November 27, 2024		
08:00 – 10:00	Registration	Orchid Ballroom 2 (2nd Floor)
09:00 – 09:45	Thai Radiation and Particles Society meeting	Erawan
09:45 – 10:00	Coffee break	Foyer
10:00 – 10:30	Opening ceremony	Orchid Ballroom 2
10:30 – 12:00	Session 1: Plenary talks	Orchid Ballroom 2
12:00 – 13:00	Lunch break	Orchid Ballroom 3 (2nd Floor)
13:00 – 14:30	Session 2: Plenary talks (cont.)	Orchid Ballroom 2
14:30 – 14:45	Coffee break	Foyer
14:45 – 16:15	Session 3: Plenary talks (cont.)	Orchid Ballroom 2
16:30 – 19:00	Poster session	Orchid Ballroom 2
19:00 – 22:00	Banquet	Sala Thai (4th Floor)
November 28, 2024		
9:00 – 10:30	Session 4, 8, 12	Orchid Ballroom 2, Chat Than, Erawan
10:30 – 10:40	Coffee break	Foyer
10:40 – 12:00	Session 5, 9, 13	Orchid Ballroom 2, Chat Than, Erawan
12:00 – 13:00	Lunch break	Orchid Ballroom 3
13:00 – 14:30	Session 6, 10, 14	Orchid Ballroom 2, Chat Than, Erawan
14:30 – 14.40	Coffee break	Foyer
14:40 – 16:15	Session 7, 11, 15	Orchid Ballroom 2, Chat Than, Erawan
16:15 – 17:00	Awards & Close Ceremony	Orchid Ballroom 2
November 29, 2024		
9:00 – 17:00	**Excursion**	

ICREM 2024 Program

Wednesday 27th November 2024		
Time	**Schedule**	**Room**
08:00 – 10:00	Registration	Orchid Ballroom 2
09:00 – 09:45	Thai Radiation and Particles Society meeting	Eravan
10:00 – 10:30	Opening ceremony	Orchid Ballroom 2
Session 1: Plenary talks Chaired by Dheerawan Boonyawan (CMU, Thailand) and Jakrapong Kaewkhao (NPRU, Thailand)		
10:30 – 11:15	(INS01) Mechanism of Ionizing Radiation and Nonradiative Recombination in Wide-band-gap Semiconductors *Su-Huai Wei, Eastern Institute of Technology, China*	Orchid Ballroom 2
11:15 – 12:00	(INS02) Converting A Thermionic RF Gun to Photo Cathode One Employing Yb Fiber Laser for Pre-bunched Free Electron Laser *Hiroyuki Hama, Tohoku University, Japan*	Orchid Ballroom 2
12:00 – 13:00	Lunch	Orchid Ballroom 3
Session 2: Plenary talks Chaired by Wisanu Pecharapa (KMUTL, Thailand) and Kittikhun Prakrajang (MJU, Thailand)		
13:00 – 13:45	(INS03) A Combination of Advanced Oxidation Processes to Tackle the Degradation of Organic Matter *Gregor Primc, Jozef Stefan Institute, Slovenia*	Orchid Ballroom 2
13:45 – 14:30	(INS04) Plasma Enhanced Biorefinery Processes Using Non-Equilibrium Atmospheric-Pressure Plasmas *Masafumi Ito, Meijo University, Japan*	Orchid Ballroom 2
14:30 – 14:45	Coffee Break	Foyer
Session 3: Plenary talks Chaired by Christian Morawe (The European Synchrotron, France) and Tipaporn Patniboon (MSU, Thailand)		

Wednesday 27th November 2024		
Time	**Schedule**	**Room**
14:45 – 15:30	(INS05) Plasma Application to Soil *Gyungsoon Park, Kwangwoon University, Korea*	Orchid Ballroom 2
15:30 – 16:15	(INS19) Recent development on glass scintillator: Application to synchrotron X-rays imaging *Jakrapong Kaewkhao, Nakhon Pathom Rajabhat University, Thailand*	Orchid Ballroom 2
16:30 – 19:00	Poster Session and Exhibition	Orchid Ballroom 2
19:00 – 22:00	Banquet	Sala Thai (4th Floor)

Oral Presentation

Thursday 28th November 2024		
Time	Schedule	Room
Session 4: Plasma Source and Applications Chaired by Phitsanu Poolcharuansin (MSU, Thailand) and Paveena Laokul (MSU, Thailand)		
9:00 – 9:20	(INS08_PS) Nonthermal bioplasma properties and its applications for dentistry: A review update intend *Phenphichar Wanachantararak, Chiang Mai University, Thailand*	Orchid Ballroom 2
9:20 – 9:40	(INS09_PS) Recent Developments of Cold Plasma Jet by a Dielectric Barrier Discharge *Duc Ba Nguyen, Duy Tan University, Vietnam*	Orchid Ballroom 2
9:40 – 10:00	(INS10_PS) Simulations of an Artificially Structured Boundary for Charged Particle Confinement *Wattanun Hongtrakul, Mahasarakham University, Thailand*	Orchid Ballroom 2
10:00 – 10:15	(O01_PS) Enhancing Plasma Cancer Therapy: Nightingale® Air Plasma-Activated Ringer's Lactate with Cannabidiol Nanoemulsion for Targeted Lung Cancer Cytotoxicity *Pipath Poramapijitwat, Chiang Mai University, Thailand*	Orchid Ballroom 2
10:15 – 10:30	(O02_PS) Plasma-Exposed Media to Skin Discoloration in the Nile Tilapia (*Oreochromis niloticus*) *Sukitar Krasaesen, Chiang Mai University, Thailand*	Orchid Ballroom 2
10:30 – 10:40	Coffee Break	Foyer
Session 5: Plasma Source and Applications Chaired by NitisakPasaja (MSU, Thailand) and Viruntachar Kruefu (MJU, Thailand)		
10:40 – 11:00	(INS11_PS) Development of DC magnetically well-type cathode and thermal plasma torch for treatment of hazardous wastes *R. Taleh, Plasmas and electromagnetic wave research laboratory, Walailak University, Thailand*	Orchid Ballroom 2

Thursday 28th November 2024		
Time	Schedule	Room
11:00 – 11:20	(INS12_PS) The Effect of Cold Atmospheric Plasma on The Surface Properties of Gelatin Films *Siti Khadijah Zaaba, Universiti Malaysia Perlis, Malaysia*	Orchid Ballroom 2
11:20 – 11:35	(O03_PS) Propagation Enhancement of Protocorms in Orchid (*Vanda coerulea* Griff. ex Lindl.) by Plasma-activated Media *Prangnapat Silapasert, Chiang Mai University, Thailand*	Orchid Ballroom 2
11:35 – 11:50	(O04_PS) Wear Resistance Improvement of Cold Work Tool Steels using Low-Temperature Plasma Nitriding *Kodchaporn Chinnarat, Mahasarakham University, Thailand*	Orchid Ballroom 2
11:50 – 12:05	(O05_PS) Utilizing Plasma-Activated Media to Sterilize Sweet Potato (*Ipomoea batatas* L.) Explants for Culture Preparation *Thanachot Tunkham, Chiang Mai University, Thailand*	Orchid Ballroom 2
12:05 – 13:00	Lunch	Orchid Ballroom 3
Session 6: Thin Film Coating and Applications Chaired by Mati Horprathum (NECTEC) and Kittikhun Prakrajang (MJU, Thailand)		
13:00 – 13:20	(INS13_TF) Evaluation of carbon bonding changes in diamond-like carbon films using synchrotron radiation *Hiroki Akasaka, Tokyo Institute of Technology, Japan*	Orchid Ballroom 2
13:20 – 13:40	(INS14_TF) Relationship between sp^2 structure and surface functionalities in DLC films for biological response *Yasuharu Ohgoe, Tokyo Denki University, Japan*	Orchid Ballroom 2
13:40 – 14:00	(INS15_TF) Diamond-Like Carbon (DLC) Films: Challenges and Applications *Anthika Lakhonchai, Synchrotron Light Research Institute (Public Organization), Thailand*	Orchid Ballroom 2
14:00 – 14:15	(O06_TF) Influence of Pulsed Acetylene Flow on Process Parameters in Reactive DC Magnetron Sputtering of Titanium Targets *Konlawat Sukhumphanpipatthana, Mahasarakham University, Thailand*	Orchid Ballroom 2

Thursday 28th November 2024		
Time	Schedule	Room
14:15 – 14:30	(O07_TF) Energy distributions of plasma ions in floating high power impulse magnetron sputtering *Nanthapat Chanapai, Mahasarakham University, Thailand*	Orchid Ballroom 2
14:30 – 14:40	Coffee Break	Foyer
Session 7: Thin Film Coating and Applications Chaired by Phenphichar Wanachantararak (CMU, Thailand) and Wattanun Hongtrakul (MSU, Thailand)		
14:40 – 15:00	(INS16_TF) X-ray mirror figure correction using differential deposition *Christian Morawe, The European Synchrotron, Grenoble, France*	Orchid Ballroom 2
15:00 – 15:20	(INS17_TF) Innovative Optical Nanostructure Thin Films for Advanced Sensors with AI-Based Data Analytics *Mati Horprathum, National Electronics and Computer Technology Center, Thailand*	Orchid Ballroom 2
15:20 – 15:40	(INS18_TF) Physical properties of binary and ternary semiconductor thin films for optoelectronic and solar cell applications *Auttasit Tubtimtae, Kasetsart University, Kamphaeng Saen Campus, Thailand*	Orchid Ballroom 2
15:40 – 15:55	(O08_TF) Preparation of multilayer amorphous carbon films by using pulsed filtered cathodic vacuum arc and linear anode layer ion source technique *Nitisak Pasaja, Maharasakham University, Thailand*	Orchid Ballroom 2
16:15 – 17:00	Awards & Close Ceremony	Orchid Ballroom 2

Thursday 28th November 2024		
Time	Schedule	Room
Session 8: Advanced Emitting Devices, Photovoltaics, Application of Functional Materials Chaired by Siriyaporn Sangaroon (MSU, Thailand) and Kamonporn Panngom (MJU, Thailand)		
9:00 – 9:20	(INS20_PV) Boosting Performance in Carbon-based Perovskite Solar Cells through Advanced Charge Transporting Layers *Pipat Ruankham, Chiang Mai University, Thailand*	Chat Than
9:20 – 9:40	(INS21_FM) Enhancement in photocatalytic performance of $BiVO_4$ by rare-earth doping via photon up-conversion process and phase transformation *Wisanu Pecharapa, King Mongkut's Institute of Technology Ladkrabang, Thailand*	Chat Than
9:40 – 10:00	(INS27_FM) Electrospinning Nanofibers and Their Applications for Energy Storage *Somchai Sonsupap, King Mongkut's Institute of Technology Ladkrabang, Thailand*	Chat Than
10:00 – 10:15	(O09_FM) Hydrophobic-to-Hydrophillic Conversion of Graphitic Carbon Nitride by Gamma-Irradiation *Tosapol Maluangnont, King Mongkut's Institute of Technology Ladkrabang, Thailand*	Chat Than
10:15 – 10:30	(O10_FM) Development of High-Performance $LiFePO_4$/Graphene for Lithium-Ion Batteries *Phurida Kokmat, Thammasat University, Thailand*	Chat Than
10:30 – 10:40	Coffee Break	Foyer
Session 9: Accelerated Particle Beams Chaired by Auttasit Tubtimtae (KU, Thailand) and Kridsanaphong Limtragool (MSU, Thailand)		
10:40 – 11:00	(INS22_APB) Study of space plasma radiation and space weather effects on plasma environments near Earth during the passages of high-speed solar wind *Thana Yeeram, Mahasarakham University, Thailand*	Chat Than
11:00 – 11:15	(O11_APB) Development of Electron Beam Irradiation Station for FLASH Radiotherapy Experiment at Chiang Mai University *Sakhorn Rimjaem, Chiang Mai University, Thailand*	Chat Than

Thursday 28th November 2024		
Time	Schedule	Room
11:15 – 11:30	(O12_APB) Simulation of Electron Transportation through Different Oxygen Concentration of Water Material by Using GEANT4-DNA toolkit *Surawadee Khammee, Chiang Mai University, Thailand*	Chat Than
11:30 – 11:45	(O13_APB) Development of Mid-Infrared Free-Electron Laser System at PCELL *Supasin Sukara, Chiang Mai University, Thailand*	Chat Than
12:00 – 13:00	Lunch	Orchid Ballroom 3
Session 10: Materials Characterization Chaired by Theerachai Bongkarn (NU, Thailand) and Aurawan Rittidech (MSU, Thailand)		
13:00 – 13:20	(INS23_MC) Microwave Plasma Catalysis for Greenhouse Gases Reforming: Role of metal-load catalysts *Dheerawan Boonyawan, Chiang Mai University, Thailand*	Chat Than
13:20 – 13:40	(INS24_MC) Synchrotron Soft X-ray Technique for Diamond-Like Carbon Film: Challenges and Applications *Sarayut Tunmee, Synchrotron Light Research Institute (Public Organization), Thailand*	Chat Than
13:40 – 14:00	(INS25_MC) A sequential O_2/Ar plasma etching for power output enhancement of triboelectric nanogenerator *Viyada Harnchana, Khon Kaen University, Thailand*	Chat Than
14:00 – 14:15	(O14_MC) Design and Development of Dysprosium-Doped Phospho-Tellurite Glass for White LED and Laser Applications *Wiraphat Thanyaphirak, Nakhon Pathom Rajabhat University, Thailand*	Chat Than
14:15 – 14:30	(O15_MC) Effective calibration materials from Tb^{3+}/Eu^{3+} co-activated aluminum sodium calcium borate glasses for luminescence spectrometer *Nawarut Jarucha, Nakhon Pathom Rajabhat University, Thailand*	Chat Than
14:30 – 14:40	Coffee Break	Foyer

Thursday 28th November 2024		
Time	Schedule	Room
Session 11: Materials Characterization Chaired by Viyada Harnchana (KKU, Thailand) and Kwanruthai Wongsaprom (MSU, Thailand)		
14:40 – 15:00	(INS26_MC) Harnessing Piezoelectricity: Advanced PVDF Composite Smart Strap for Enhanced Wrist Motion Detection *Dae Joon Kang, Sungkyunkwan University, Republic of Korea*	Chat Than
15:00 – 15.20	(INS07_MC) 3D PDMS for Mechanoresponsive Scatterers *Seok Woo Jeon, Korea University, Korea*	Chat Than
15:20 – 15:35	(O16_MC) Semiclassical Boltzmann Theory of Electrical Transport in Twisted Bilayer Graphene *Phicharn Phommajak, Mahasarakham University, Thailand*	Chat Than
15:35 – 15:50	(O17_MC) Arrowroot starch, Corn starch, and Polyvinylpyrrolidone (PVP) as capping agents in the synthesis of silver nanowires (AgNWs) for use as the flexible transparent conductive electrodes (FTCE) of the alternating current electroluminescence (AC-EL) devices *Suteeporn Kidtang, Khon Kaen University, Thailand*	Chat Than
15:50 – 16:05	(O25_RAB) Evaluation in Phenotype and Genotype of Gamma Radiated Chili Pepper Using Molecular Techniques *Orapin Saritnum, Maejo University, Chiangmai, Thailand*	Chat Than
16:15 – 17:00	Awards & Close Ceremony	Orchid Ballroom 2

Thursday 28th November 2024		
Time	Schedule	Room
Session 12: Plasma Innovation and Applications in Agriculture, Bioscience & Healthcare Chaired by Choncharoen Sawangrat (CMU, Thailand) and Pradoong Suanpoot (MJU, Thailand)		
9:00 – 9:20	(STEP01) Plasma-driven syntheses, control and functionalization of three-dimensional carbon nanomaterials *Hiroki Kondo, Kyushu University, Japan*	Erawan
9:20 – 9:40	(STEP02) Generation of pulsed discharges over water surface and their applications for environment and agriculture *Katsuyuki Takahashi, Iwate University, Japan*	Erawan
9:40 – 10:00	(STEP03) Recognition of plasma rice and its multi-omics analysis *Feng Huang, China Agricultural University, China*	Erawan
10:00 – 10:20	(STEP04) Harnessing Non-Thermal Plasma Technology for Enhanced Water Environmental Protection *Peerapong Pornwongthong, King Mongkut's University of Technology North Bangkok, Thailand*	Erawan
10:20 – 10:35	Coffee Break	Foyer
Session 13: Plasma Innovation and Applications in Agriculture, Bioscience & Healthcare (cont.) Chaired by Pradoong Suanpoot (MJU, Thailand) and Peerapong Pornwongthong (KMUTNB)		
10:35 – 10:55	(STEP08) Innovative Optimization of Plasma-Activated Water for Advanced Microbial Control in Agricultural Processing *Choncharoen Sawangrat, Chiang Mai University, Thailand*	Erawan
10:55 – 11:15	(STEP05) Application of Nonthermal Plasma in Agriculture: Enhancing Seed Germination, Growth, and Bioactive Compound Production *Ihn Han, Kwanwoon University, Korea*	Erawan

Thursday 28th November 2024		
Time	Schedule	Room
11:15 – 11:35	(STEP06) Effect of Low-Pressure Cold Plasma Treatment on Black Afara and Caeruleum Seeds for Germination *Pradoong Suanpoot, Maejo University (Phrae Campus), Thailand*	Erawan
11:35 – 11:55	(STEP07) Effects of Atmospheric Pressure Air Plasma Synthesized Dinitrogen Pentoxide on Plant Function Control *Toshiro Kaneko, Tohoku University, Japan*	Erawan
12:00 – 13:00	Lunch	Orchid Ballroom 3
Session 14: Nuclear and Plasma Radiation Chaired by Artit Chingsungnoen (MSU, Thailand) and Teerawong Laosuwan (MSU, Thailand)		
13:00 – 13:20	(INS28_NPR) Compact Neutron emission spectrometer in magnetic confinement fusion *Siriyaporn Sangaroon, Mahasarakham University, Thailand*	Erawan
13:20 – 13:40	(INS29_NPR) Charting of Radiative-Emission and Radiation-Interaction Data from the First Year Operation of Thailand Tokamak-1 *Somsak Dangtip, Thailand Institute of Nuclear Technology, Thailand*	Erawan
13:40 – 13:55	(O18_NPR) Conceptual design of electrode biasing system in Thailand Tokamak-1 *Poramate Chunpang, Mahasarakham University, Thailand*	Erawan
13:55 – 14:10	(O19_NPR) Soft X-ray Measurement in Thailand Tokamak-1 Utilizing Newly Designed Soft X-ray Imaging System *Sawarin Buakham, Mahasarakham University, Thailand*	Erawan
14:10 – 14:25	(O20_NPR) Investigation of Runaway Electron Behavior in Thailand Tokamak-1 via Bremsstrahlung Emission Using MCNP Simulation *Arreerat Kunkanha, Mahasarakham University, Thailand*	Erawan
14:25 – 14:40	(O21_NPR) Improving Neutron and Gamma-Ray Detection Accuracy: Characterization of EJ-301 Scintillation Detector Performance at the Fast Neutron Laboratory *Chawidpol Sangthong, Mahasarakham University, Thailand*	Erawan

Thursday 28th November 2024		
Time	Schedule	Room
14:40 – 14:45	Coffee Break	Foyer
Session 15: Nuclear and Plasma Radiation, Fundamental of light-matter interaction, Radiation for Agriculture and Biology Chaired by Teerasak Kamwanna (KKU, Thailand) and Thanayut Kaewmaraya (KKU, Thailand)		
14:45 – 15:05	(INS30_RAB) Simulating the biological effects of charged particles in space with small ion accelerators *Harry J. Whitlow, Uppsala University, Sweden*	Erawan
15:05 – 15:25	(INS31_RAB) Nitrogen-Fixed Fertilizer via Air Plasma: Effects on Sugarcane Phenotype *Kazunori Koga, Kyushu University, Japan*	Erawan
15:25 – 15:40	(O22_NPR) Sensor-Driven Machine Learning Approaches for Identifying Plasma Position in Thailand Tokamak-1 *Shitiphat Soysangwarn, Satriwitthaya 2 School, Thailand*	Erawan
15:40 – 15:55	(O23_RAB) Optimization of Anthocyanin Induction in Butterfly Pea Using Full Factorial Design and Plasma Techniques *Norrapon Vichiansan, Chiang Mai University, Thailand*	Erawan
15:55 – 16:10	(O24_FLI) Review of NO_3 UV Absorption Spectroscopy and Simulation of Reactive Species Diffusion in Atmospheric Pressure Plasma *Nattwut Palee, Chiang Mai University, Thailand*	Erawan
16:15 – 17:00	Awards & Close Ceremony	Orchid Ballroom 2

Poster Presentation (Orchid Ballroom 2)

Poster ID	Title
P01_FM	Adhesion properties of diamond-like carbon film and silicon interlayer deposited on DC53 cold wok tool steels *Suchanan Sutthirak and Pittayarat Kongjun, Mahasarakham University, Thailand*
P02_FM	Preparation of potassium tungsten bronze particles by ball milling process for infrared and thermal shielding applications *Phonlawee Pinthong, King Mongkut's Institute of Technology Ladkrabang, Thailand*
P03_FM	Fabrication of composite carbon nanofibers with silver particles for high-quality membranes for antimicrobial water filtration *Tanayt Sinprachim, King Mongkut's Institute of Technology Ladkrabang, Thailand*
P04_MC	Impact of Gd_2O_3 addition on the radiation shielding properties of zinc barium borate glasses and the absorbed dose in the MRCP-AM phantom by Monte Carlo simulation *Chalermpon Mutuwong et al., Nakhon Pathom Rajabhat University, Thailand*
P05_MC	Investigation of the Structural, Thermal, Dielectric, and Physical Properties of Li_2O-B_2O_3-TeO_2 Oxide Glass was added with transition metals for Thermoelectric Applications *Kitipun Boonin and Peerapong Yamchumporn, Nakhon Pathom Rajabhat University, Thailand*
P06_MC	Enhanced Luminescence and Scintillation Properties of Tb^{3+}ion -Doped Tellurite Glasses for Potential X-Ray Screen Applications *Patarawagee Yasaka, Nakhon Pathom Rajabhat University, Thailand*
P07_MC	Analysis of Ce^{3+} obtained borophosphate glasses with different alkali oxide additives for scintillation applications *Natthakridta Chanthima, Nakhon Pathom Rajabhat University, Thailand*
P08_MC	Characterization of $Ni_{0.475}Zn_{0.475}Li_{0.025}Al_{0.025}Fe_2O_4$ doped ($Ba_{0.91}Ca_{0.09}Ti_{0.916}Sn_{0.084}O_3$-0.1wt% ZnO-0.1wt% MnO_2) multiferroic composites ceramics prepared via the solid-state combustion technique *Theerachai Bongkarn, Naresuan University, Thailand*
P09_MC	A Novel Tb^{3+}/Dy^{3+} codoped fluoro-silicophosphate scintillating glass with energy transfer mechanism for solid state lighting and X-ray detecting materials *Piyachat Meejitpaisan et al., Nakhon Pathom Rajabhat University, Thailand*

Poster ID	Title
P10_MC	Preparation and Photocatalytic Activity of ZnO Nanoparticles *Luriya Chokbandit and Suchanya Ruangngam, Mahasarakham University, Thailand*
P11_MC	Effect of Diatomite on Porous Structure and Plant Growth-Promoting Fungi Immobilization in Calcined Clay Pellets *Bhoowadol Thatawong, Naresuan University, Thailand*
P12_MC	Enhanced dielectric, ferroelectric, and ferromagnetic properties of $Ba_{0.97}Ca_{0.03}Ti_{0.94}Sn_{0.06}O_3$-$Mn_{0.85}Zn_{0.15}Ni_{0.15}Fe_2O_4$ multiferroic ceramic composite *Widchaya Somsri, Naresuan University, Thailand*
P13_MC	Physical and optical properties of tungsten doped ZnO particles prepared via co-precipitation method *Wisanu Pecharapa, King Mongkut's Institute of Technology Ladkrabang, Thailand*
P14_MC	Polyvinylpyrrolidone/chitosan/nanocellulose Composite Films for Soluble Material Applications *Natchapon Rattanaanothaikul, King Mongkut's Institute of Technology Ladkrabang, Thailand*
P15_MC	Reflux-Hydrothermal Synthesis and Comprehensive Characterization of rGO-SnO_2/SnS_2 Nanohybrids *Sirorat Moollor, Maejo University, Thailand*
P16_MC	Hydrothermal Synthesis of Ultrafine n-n SnO_2/SnS_2 Structure: Effect of Reaction Time on Physical Properties *Suwimol Chuchit, Maejo University, Thailand*
P17_MC	Influences of Gamma Radiation and Sputtering Power on the Optical and Electrical Properties of Indium Tin Oxide Films *Nalutporn Phiboon, Thammasat University, Thailand*
P18_PA	Strategic policies for advancing emerging low-carbon technologies: The case of plasma solutions for decarbonizing challenging sectors *Kaja Primc, Institute for Economic Research, Ljublijana, Slovenia*
P19_PA	Effect of multiple cylinder-type DBD plasma gas on soil microorganisms and plant growth *Wirinthip Ketya et al., Kwangwoon University, Korea*

Poster ID	Title
P20_PA	Electrical Property of Silk Sheet after Plasma Treatment *Panthip Kingkaewcharoenchai, Mahasarakham University, Thailand*
P21_PA	Improvement of Antioxidant Activity of Sericin by Plasma Treatment *Chanya Sonpanya, Mahasarakham University, Thailand*
P22_APB	The effects of focused 1-MeV proton beam irradiation on linear low density polyethylene film *Kunpisit Kosumsupamala, Shibaura Institute of Technology, Japan*
P23_RD	Charged particles and scintillation properties in CaF_2(Eu) scintillators using Compton coincidence technique *Wuttichai Chaiphaksa, Supakit Yonphan, and Jakrapong Kaewkhao, Nakhon Pathom Rajabhat University, Thailand*
P24_RD	Impact of firing conditions on phase formation, microstructure, dielectric and ferroelectric characteristics of BCZT-$Li_{0.3}Y_{0.3}$ ceramics prepared using the solid-state combustion technique *Tawat Suriwong and Theerachai Bongkarn, Naresuan University, Thailand*
P25_RD	The Synthesis of Radiochromic Film using Polyvinyl Alcohol Solution Casting with Photosensitive Compounds *Rapeepan Luejai, Maejo University, Thailand*
P26_RD	Graphene-wrapped iron/PVDF composites as X-ray radiation shield *Kanokphon Laprak, Akkawat Ruammaitree, Thammasat University, Thailand*
P27_RAB	The possibility study of 18F-FAPI and 18F-NOTA-Octreotide synthesis using a multipurpose synthesizer CFN-MPS100 for cancer diagnosis via molecular imaging *Tarinee Boonyawan, ChiangMai University, Thailand*
P28_RAB	Effects of Gamma Radiation and Plasma Treatment on Growth, Morphological Characters, and Agronomic Traits of Jerusalem Artichoke at Seedling and Mature Stages *Ratchanee Puttha, Maejo University, Thailand*
P29_RAB	Effectiveness of Microwave irradiation in Reducing Microbial Load on *Wolffia globosa* *Preuk Choosung, Maejo University, Thailand*

Poster ID	Title
P30_PS	The Potential of Plasma Activated Water for Sustainable Agriculture *Worawalan Sonhom et al., Srinakharinwirot University, Thailand*
P31_TF	Influence of DLC film thickness in gas barrier performance deposited on polyethylene terephthalate sheets using PECVD method *Ukit Rittihong and Sarayut Tunmee, Synchrotron Light Research Institute (Public Organization), Thailand*
P32_TF	Discharge Current Behavior in Reactive High Power Impulse Magnetron Sputtering during Acetylene Flow Ramping *Jirakit Chitkaew, Mahasarakham University, Thailand*
P33_TF	The Effect of Electrolyte Temperature on the Optimization of Optical and Electrochromic Properties of WO_3 Films Prepared by Sputtering and Anodization *Weerawat Thongsuk, Thammasat University, Thailand*
P34_TF	Effect of Sputtering Power and Film Thickness on the Electrochromic Properties of WO_3 and $TiWO_3$ Films *Kedkanda Yompa, Thammasat University, Thailand*
P35_TF	Development of High-Precision Multilayer Coating System for Synchrotron Beamline Optics *Phakkhananan Pakawanit, Synchrotron Light Research Institute (Public Organization), Suranaree, Thailand*
P36_TF	Fabrication of Polyvinylidene Fluoride/Silver Nanowire Composites for Triboelectric Nanogenerator Application *Wimonsiri Yamklang, Khon Kaen University, Thailand*
P37_TF	Power Output Enhancement of Triboelectric Nanogenerator by TiO_2-Ag Nanoparticles *Weeraya Bunriw, Khon Kaen University, Thailand*

Invited Talks

INS01_PLS

Mechanism of ionizing radiation and nonradiative recombination in wide-band-gap semiconductors

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Abstract:
Wide-band-gap (WBG) oxides such as α-SiO_2 is often used in MOS devices as well as gate dielectrics and substrates in emerging modern electronic devices. When applied in space, nuclear, and avionic technologies, major defects are induced by continuous ionizing irradiation, which can cause degradation and even failure of the MOS and emerging devices through defect-induced nonradiative recombination. Therefore, uncovering the fundamental mechanism of the defect-induced nonradiative recombination is at the heart of assessing the reliability of MOS and emerging devices in the extreme environments.

Conventional single-defect-mediated Shockley−Read−Hall model for nonradiative recombination suggests that the nonradiative carrier recombination rate in WBG semiconductors would be negligible because the single-defect level is expected to be either far from valence-band-maximum (VBM) or conduction-band-minimum (CBM), or both. However, this model falls short of elucidating the substantial nonradiative recombination phenomena often observed experimentally across various WBG semiconductors. Here, we propose that owing to more localized nature of defect states inherent to WBG semiconductors, when the defect charge state changes, there is a pronounced structural relaxation around the local defect site. Consequently, a dual-level nonradiative recombination model should be more realistic in WBG semiconductors. In this case, electron and hole trap levels are different, could be closer to the CBM for the electron trap and closer to the VBM for the hole trap, respectively, therefore, significantly increasing the corresponding electron and hole capture rates, enhancing the overall process of nonradiative recombination, and explains the experimental observations.

Taking technically important SiO_2 as an illustrative example, I will explain the dual-level model to elucidate the mechanism of nonradiative carrier recombination in WBG semiconductors. Our findings demonstrate strong alignment with available experimental data, reinforcing the robustness of our proposed dual-level model. Our fundamental understanding, therefore, provides a clear physical picture of the issue and can also be applied to predict the defect-related nonradiative carrier recombination characteristics in other WBG materials.

Keywords: Ionizing radiation, Nonradiative recombination, Wide-band-gap semiconductors, First-principles calculations

INS02_PLS

Converting A Thermionic RF Gun to Photo Cathode One Employing Yb Fiber Laser for Pre-bunched Free Electron Laser

Hiroyuki Hama[1,*], Kodai Kudo[1], Ken-ichi Nanbu[1], Toshiya Muto[1], Shigeru Kashiwagi[1], Fujio Hinode[1], Ikuro Nagasawa[1], Ken Takahashi[1], Kotaro Shibata[1], Hiroki Yamada[1], Anjali Kavar[1], Hayato Abiko and Kazuyuki Sakaue[2]

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Abstract:
THz wave is wonderful prove for materials such as phonon excitation in crystal, surface plasmon in metallic nanoparticles, Cooper pair oscillation in superconducting material, collective vibration of macro molecule, and etc. Additionally, new nonlinear phenomena can be expected in spintronic devices if the peak electromagnetic field is greatly higher than
10 MV/cm (3.3 T/cm). Recent advanced laser technology has reached several tens MV/cm already.

Although coherent transition radiation from 100 fs (or less) short bunches of electrons is intense as well-known, it is very difficult to exceed 10 MV/cm practically. However, we found a possibility of which oscillator free electron laser (FEL) optical bunches reach ~100 MV/cm employing a pre-bunched configuration [1]. Extreme nonlinear interactions of THz electromagnetic fields with matter are indeed the next frontier in nonlinear optics. The test accelerator t-ACTS (test Accelerator as Coherent THz Source) at Tohoku University has employed an ITC (independently tunable cells) RF electron gun with a CeB_6 thermionic cathode. We are going to introduce a photocathode of CeB_6 or Cu cathode to increase the bunch charge and synchronize with round-trip frequency of an FEL optical resonator.

Currently t-ACTS supplies a bunch-charge of 5 pC, whereas the goal is to increase it more than 50 pC for the pre-bunched FEL. Since back-bombardment phenomena gets stronger with the bunch-charge, the photocathode RF gun is an attractive solution to avoid the back bombardment in higher bunch charge operation. We presume that the bunch charge can be increased along with the reduction in back-bombardment. If we provide appropriate laser pulse duration and RF phase. Number of bunches per macro-pulse decreases in the photocathode operation because it is difficult to oscillate the pumping laser at RF frequency (2856 MHz). However, since the intensity of coherent radiation is basically proportional to the square of the charge per bunch, increase of the bunch charge may be much effective. The laser system includes a Yb fiber laser oscillator (wavelength: 1047 nm), a multi-pass amplifier, and a fourth harmonic generation (262 nm). The assembly of the oscillator has almost completed, and a work for synchronization with RF is on the way. We will report on the progress of laser system development.

Keywords: Photocathode RF gun, Pre-bunched free electron laser, Yb fiber laser

References (Optional):
[1] H. Hama *et al.,* "Intense coherent terahertz generation from accelerator-based sources", Nuclear Instruments and Methods in Physics Research A, 2011, pp. S57-S61

INS03_PLS

A Combination of Advanced Oxidation Processes to Tackle the Degradation of Organic Matter

Gregor Primc[1], Rok Zaplotnik[1], Miran Mozetič[1], Arijana Filipić[2], David Dobnik[2], Ion Gutierrez-Aguirre[2], Robert Roškar[3], Jurij Trontelj[3], Martin Petkovšek[4], Matevž Dular[4], Mojca Zupanc[4]

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Abstract:
Water contamination is a pressing global issue due to water-transmissible microbes (viruses, bacteria) and micropollutants, such as pharmaceuticals and endocrine-disrupting chemicals (EDCs). Waterborne viruses like norovirus, hepatitis A, and rotavirus pose significant public health risks as they can spread rapidly through contaminated water sources, leading to widespread outbreaks of gastrointestinal and other illnesses. Simultaneously, micropollutants such as pharmaceuticals and EDCs, which enter water systems through agricultural runoff, wastewater discharge, and improper disposal of drugs, can persist in the environment due to their resistance to conventional water treatment methods. The combined presence of these pollutants in water sources underscores the need for improved water treatment technologies and regulatory measures to protect both human health and the environment from their harmful effects.

Some water cleaning systems use UV disinfection, which is cost-effective but susceptible to water turbidity, requiring frequent filter maintenance. Others use membrane filtration to a lesser extent, but this method also requires regular filter cleaning. To combat the spread of pathogens and the degradation of micropollutants, we have explored the combination of two advanced oxidation techniques: hydrodynamic cavitation and gaseous plasma. We have patented an innovative device [1] and performed systematic measurements using the MS2 bacteriophage, a surrogate for human enteric viruses. We achieved a 5-log inactivation rate, and the method proved non-cytotoxic, making it an environmentally friendly disinfection approach, as no chemicals were used [2]. Concerning micropollutants, we evaluated the removal rates, yield, and characteristic half-lives ($t_{1/2}$) achieved by combining two AOPs for 10 substances simultaneously.

Keywords: Advanced oxidation processes, Degradation, Inactivation, Water matrix

References:
[1] G. Primc, R. Zaplotnik, M. Mozetič, A. Filipić, I. Gutierrez-Aguirre, D. Dobnik, M. Dular,M.Petkovšek. US Patent, US11807555B2, USPTO, 2023.
[2] Arijana Filipić, David Dobnik, Ion Gutierrez-Aguirre, Maja Ravnikar, Tamara Košir, ŠpelaBaebler, Alja Štern, Bojana Žegura, Martin Petkovšek, Matevž Dular, Miran Mozetič, RokZaplotnik, and Gregor Primc. Environment International, 182, 108285-1-108285-10 (2023).

INS04_PLS

Plasma Enhanced Biorefinery Processes Using Non-Equilibrium Atmospheric-Pressure Plasmas

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Abstract:
Recently, biorefinery processes, which convert inedible biomasses such as waste wood, rice strow and so on to energy and other beneficial byproducts, are attracting a lot of attention to achieve SDGs. The processes, however, have some difficulties in converting it to beneficial byproducts due to the rigid structure of biomass.

In this study, we employed non-equilibrium plasmas to enhance the biorefinery processes. For example, we developed an atmospheric-pressure glow discharge plasma to treat biomass solutions such as rice straw including lignocellulose for producing bio ethanol. [1-3]

Moreover, we reported that oxygen-radical irradiation using a non-equilibrium atmospheric-pressure plasma can reduce bacteria such as *Escherichia coli* (*E. coli*) and promote plant- growth simultaneously even in neutral pH solutions containing amino acids. Especially, the oxygen-radical irradiation in the solution containing L-tryptophan, which is a kind of amino acid, have a very strong bactericidal effect of 6 log-reduction for *E. coli* within 1 minute. [4]

We also have revealed that the oxygen atoms convert L-Trp to a beneficial short-lived species, which leads to lethal metabolic disorders of *E. Coli*.[5]

Acknowledgements:
This work was partly supported by JSPS KAKENHI Grant Number JP19H05462 and 22H01213.

Keywords: Non-equilibrium atmospheric-pressure plasma, Biorefinery, Hydroponics, Bioethanol, L-tryptophan, Bactericide

References

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INS05_PLS

Plasma Application to Soil

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Abstract:
Soil contaminated with organic waste has a high risk of emerging pathogenic microorganisms and disturbing nutrient cycling. In this study, we investigated whether gas generated using plasma device with four pairs of cylinder type DBD electrodes can reduce the microbial load in organic waste contaminated soil and increase the fertility of soil for plant growth. Approximately 50% of bacterial cells and 40% of fungal spores in nursery soil and approximately 10–29% of aerobic natural microbiota in field soil were eradicated after soils were treated with gas generated using four pairs of DBD electrode plasma for 60 min. The richness of microbial species in field soil was not significantly changed after plasma gas treatment although several bacterial and fungal species were more sensitive to plasma gas. Spinach growth and nitrate level were significantly elevated in plasma-gas-treated field soil. Our data suggest that plasma-generated-gases can reduce soil microbial load with no significant changes in the soil microbial community and enhance plant growth in the treated soil. This work was supported by the National Research Foundation of Korea (NRF) (2020R1F1A1070942 and 2021R1A6A1A03038785).

Keywords: Atmospheric pressure non-thermal plasma, Soil, Microorganisms, Plant growth, Organic waste contamination

INS07_MC

3D PDMS for Mechanoresponsive Scatterers

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Abstract:
Smart chromatic materials, capable of altering optical transmittance through light scattering in response to external stimuli, are gaining significant attention due to their potential applications in smart windows, privacy protection, electronic displays, and more. However, the advancement of these scatterers—primarily activated by electric fields—faces challenges such as high energy consumption, slow response times, and limited stability. Recently, mechanoresponsive scatterers have emerged, utilizing strain-driven reconfigurations of surface or internal structures. These scatterers offer rapid response times and are simpler to fabricate, with the added benefit of requiring no energy to maintain their transparency or opacity. This novel approach shows great promise in overcoming the limitations of current technologies. In this presentation, I will discuss the latest developments in mechanoresponsive scatterers featuring 3D nanoporous structures from my research group, along with their potential applications. Additionally, I will introduce a groundbreaking design concept for mechano-scatterers that operate in compression mode, offering advantages such as ultra-thin profiles (less than 100 microns), minimized changes in area and film thickness during operation, and localized adjustments in transmission areas.

Keywords: PnP, Mechanoscatterer, 3D nanostructure, PDMS

References (Optional):
[1] H. Chen, et. al. Nature Communications, online (2024)
[2] H. Chen, et. al. ACS Nano, 16, 68 (2022)
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INS08_PS

Nonthermal bioplasma properties and its applications for dentistry: A review update intend

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Abstract:
Recently, the nonthermal bioplasma properties advanced into low-temperature applications as potential candidates by sources operating in atmospheric pressure environments. Their characteristics on key functional components are of paramount importance for the successful adoption of the technology by dentistry. These gases contain highly reactive particles such as excited atoms, oxygen and nitrogen reactive species. The main reactive oxygen species (ROS) include ozone, atomic oxygen, superoxide, hydroxyl radicals and hydrogen peroxide. ROS present key roles in cell signaling pathways and redox reactions, with potential for biomedical applications. They would be important with the radicals' diffusive propagation into cells or tissues. The current review article intends to summarize the significant works on the possible role of plasma properties in the bioscience medicines and dental field. For this, the biological cells related to infection, microorganisms of aggregates or congregations can adhere to the root canal walls, forming biofilm layers which could be treated by using the bioplasma interactions. The review highlights future research needs regarding the complex mechanisms of interaction with plasma species. Bioplasma is a novel technology that can both negatively and positively affect the functional components in dentistry. Current challenge directions in this field are also pointed out.

Keywords: Bioplasma, Applications, Dentistry

References (Optional):
[1] Choi. Eun Ha, Kaushik. Nagendra Kumar, Hong. Young June, et al. Journal of the Korean Physical Society, 80, 817–851 (2022).
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INS09_PS

Recent Developments of Cold Plasma Jet by a Dielectric Barrier Discharge

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Abstract:
Cold plasma jet devices are gaining interesting and promising practical applications due to their unique functionality, reactive surface or chemical reactions at atmospheric conditions. Specifically, a cold plasma jet is a nonthermal plasma with a jet temperature that is closely room temperature and consists of energetic electrons, radicals, ions, excited gas molecules, and photons, while the temperature of gas molecules is closely room temperature. Consequently, when the plasma jet interacts with an objective surface (solid or liquid), it induces activated surface or chemical reactions above these energetic species. Here, we summarize our recent development in a cold plasma jet by a dielectric barrier discharge (DBD) configuration. The most useful DBD plasma jet is a coaxial DBD with two electric rings covered outside a dielectric tube, which provides a parallel electrical field with the jet flow for a long plasma jet and reduces gas temperature. However, with this configuration, two electrodes are not isolated with a dielectric insulator layer, not including ambient air, suggesting electrical arcing between electrodes and requiring a long distance between two electrodes. We proposed immersion of two electrodes inside a liquid dielectric chamber, resulting in a short electrode distance, long plasma jet with low temperature [1], and comfortable electrical analysis [2]. Regarding saving inert plasma gas and controller plasma chemistry, the coaxial double DBD [3] or multi-bore DBD [4] configuration is suitable for these purposes. Moreover, DBD plasma jet challenges are discussed and suggested for future development.

Keywords: Cold plasma jet, Immersion oil, Coaxial double DBD jet, Multi-bore plasma jet

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INS10_PS

Simulations of an Artificially Structured Boundary for Charged Particle Confinement

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Abstract:
An edge-confined single-species plasma will relax to create a potential energy hill that climbs from the boundary. This hill represents a potential well for species of the opposite sign and can be a means to confine the second species. With this ultimate application in mind, we have studied the relation between the plasma temperature, number of particles confined, and the electrostatic potential well that forms in a fully non-neutral plasma of electrons in a trapping volume with an artificially structured boundary (ASB). An ASB is a structure that produces periodic short-range static electric and magnetic fields for confining a plasma. To perform a detailed analysis on this topic, simulations using a particle-in-cell code have been performed. By varying configurational elements of the ASB such as bias on the boundary electrodes and internal radius of the structure, coupled with a course thermalization process and a prescribed threshold for particle leakage, potential well values were determined for a range of plasma temperatures and confinement conditions. Maximum well depths were observed below a threshold plasma temperature in each configuration. The study gives insight into the limitations on primary particle confinement with this type of structure and optimal conditions for the formation of a potential well that can be utilized to confine a second species. A first foray at simulating the introduction of a second species is also described.

Keywords: Plasma simulation, Artificially structured boundary, Charged particle confinement, Particle-in-cell method

INS11_PS

Development of DC magnetically well-type cathode and thermal plasma torch for treatment of hazardous wastes

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Abstract: The 30 kW DC plasma torch system with the well-type cathode (WTC) has been developed to generate thermal plasma above 1200 0C, which is adding the external magnetic coil on the cathodic part of the torch as shown in Figure 1. The well-type torch is hollow cylindrical copper's 5 mm thickness, whose cathode electrode and anode electrode was 150 mm in each length, the diameter is 22 mm through the center, The gap between both electrodes is 1.5 mm isolated with a swirl gas ring. Under the experimental conditions at 0.5 - 0.8 MPa compressed air is applied to both sides of the torch, the airflow rate is 60 L/min and 120 L/min from the sides, and above, as followed. the thermal plasma has been generated, their maximum current is 200 A and 160 V, the length is about 30 cm, its diameter about 3 to 5 cm wide, recognized UV emission has been present.

In this work, the 500 G of the magnetic field produced by an external solenoid has been developed, to drive the arc root and reduce the cathode erosion damage [2,3]. The result shows the necessity of a magnetic field, a rotational arc root inside the cathode surface, and electrode life hours are compared with the case of un magnetic field-driven has been present. Finally, the knowledge of this work to extend electrode life and applied to the system to be suitable for the disposal of infectious wastes.

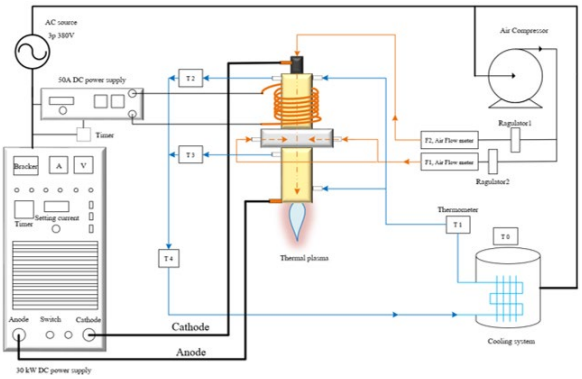

Figure 1 30 kW DC plasma torch system with the well-type cathode (WTC) and external magnetic field.

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INS12_PS

The Effect of Cold Atmospheric Plasma on The Surface Properties of Gelatin Films

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Abstract:
This study explores the impact of Cold Atmospheric Plasma (CAP) treatment on the surface properties of gelatin films aimed at enhancing their application in biomedical. Gelatin, a naturally occurring, biocompatible, and biodegradable polymer, was used to prepare films through a solvent casting method. CAP treatment was applied to modify the surface properties of these films without altering their bulk characteristics. The modifications induced by CAP were characterized using a variety of analytical techniques, including Scanning Electron Microscopy (SEM), Fourier Transform Infrared Spectroscopy (FTIR), X-ray Diffraction (XRD), and Water Contact Angle (WCA) measurements. The SEM analysis revealed changes in surface morphology, such as crack formation and pore development, while FTIR spectra indicated chemical alterations at the molecular level. XRD analysis showed shifts in peak intensity and position, reflecting changes in the crystalline structure. WCA measurements demonstrated increased wettability, suggesting the introduction of hydrophilic functional groups. These findings indicate that CAP treatment can significantly enhance the surface characteristics of gelatin films. This study provides a comprehensive understanding of CAP's role in optimizing the performance of gelatin-based drug delivery systems and highlights its potential for broader applications in biomedical fields.

Keywords: Wear resistance, Titanium-containing hydrogenated amorphous carbon, Dual magnetron sputtering, Anode layer ion source

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INS13_TF

Evaluation of carbon bonding changes in diamond-like carbon films using synchrotron radiation

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Abstract:
Diamond-like carbon (DLC) films, have hard and a low friction coefficient on sliding with steel, are amorphous films consisting of sp^2 and sp^3 hybridized bonding carbon and hydrogen atoms. From these fine mechanical properties, these films usually applied to sliding surface as a solid lubricant. These properties are considered that the high hardness of the film is attributed to the sp^3 hybridized bonding carbon, and the low friction coefficient can be attributed to the sp^2 hybridized bonding carbon. The carbon hybridized bonding ratio, $sp^2/(sp^3+sp^2)$, is important factor and correlated with the film properties[1]. Because the bond energies of these carbon hybrid orbitals are close each other, the evaluation methods are limited, and in most cases, X-ray absorption spectroscopy is applied, which utilizes the difference in X-ray absorption energy between the electrons in these two hybrid orbitals. In this study, changes of the $sp^2/(sp^3+sp^2)$ carbon bonding ratio by sliding and laser irradiation were investigated using X-ray photoemission electron microscopy. These observations were carried out at the BL3.2 beamline at Synchrotron Light Research Institute, Thailand. About sliding, the inside and outside of the sliding marks was observed to estimate the change. When a SUJ2 ball was slid 50000 times at 1 N, the amount of sp^2 hybridized bonding carbon increased inside of the sliding marks except center area, and the center area observed a tendency for sp^3 hybridized bonding carbon to be higher than the sides[2]. On of this reason might be heating by sliding was affects to hybridized bonding change of carbon. Thus, DLC films were treated by laser heating, and similarly observed the changes in the distribution of the $sp^2/(sp^3+sp^2)$ ratio inside of irradiation area. The irradiation area showed convex shape, and the $sp^2/(sp^3+sp^2)$ carbon bonding ratio increased the closer to the center[3]. These results suggested that the frictional heat generated by sliding is one of the reasons that changes the bonding state of carbon in DLC films.

Part of this work was supported by JSPS KAKENHI Grant Numbers 17KK0111 and 23K22626, and The Precise Measurement Technology Promotion Foundation. This research was conducted with the cooperation of Dr. Tunmee, Dr. Rittihong, and staffs for BL3.2 of SLRI, as well as the master's students of the Ohtake and Akasaka Lab. at Tokyo Tech. I would like to express my gratitude.

Keywords: Hydrogenated amorphous carbon film, Laser irradiation, Sliding test, $sp^2/(sp^3+sp^2)$ carbon bonding ratio, Synchrotron radiation

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INS14_TF

Relationship between sp^2 structure and surface functionalities in DLC films for biological response

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Abstract:
Diamond-like carbon (DLC) films exhibit a range of desirable properties, including a low friction coefficient, high wear resistance, chemical inertness, corrosion resistance, and biocompatibility [1]. Typically, DLC films deposited via chemical vapor deposition (CVD) processes contain a higher hydrogen content compared to those produced by physical vapor deposition (PVD) processes. Various structural models have been proposed to describe the architecture of DLC films. Notably, the "ternary phase diagram" model, which considers the formation of DLC concerning the sp^2, sp^3, and hydrogen content, suggests that the DLC structure consists of sp^2 clusters embedded within a sp^3 matrix [2]. To enhance the performance of biological devices through DLC film coatings, it is crucial to optimize and select the appropriate type of DLC film to achieve the best results. In this study, we investigated the relationship between film structure and surface functionalities in various types of DLC films and their influence on cell behavior.

In this study, five types of DLC films were deposited using both CVD and PVD techniques. The optical constants and film structures were characterized using spectroscopic ellipsometry, Raman spectroscopy, X-ray photoelectron spectroscopy (XPS), and near-edge X-ray absorption fine structure (NEXAFS) spectroscopy. NIH-3T3 cells were seeded onto the DLC film surfaces and incubated at 37°C in an atmosphere of 5% CO_2 and 95% air with 100% relative humidity to assess cell behavior on each DLC film. The cells were cultured in D-MEM/F-12 medium for 24 hours. The optical measurements revealed that the r.f. CVD-type DLC film exhibited a lower extinction coefficient compared to the other DLC films. Previous reports suggest that a lower extinction coefficient corresponds to smaller C-C sp^2 cluster sizes [3]. Consistent with this, Raman, XPS, and NEXAFS measurements indicated that the r.f. CVD-type DLC film had a smaller C-C sp^2 cluster sizes and fewer oxygen functional groups. Analysis of cell behavior showed that the presence of oxygen functional groups influenced cell adhesion to the DLC film surface. The r.f. CVD-type DLC film, characterized by a lower C=O bond ratio and extinction coefficient (k), significantly enhanced cell aggregation.

In summary, classifying various types of DLC films based on their extinction coefficient (k), an important optical property, may facilitate the optimal selection of DLC surfaces for biological applications, such as spheroid formation.

Keywords: DLC films, Cell allegations, sp^2 cluster size

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INS15_TF

Diamond-Like Carbon (DLC) Films: Challenges and Applications

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Abstract:
Diamond-like carbon (DLC) film is an amorphous carbon-based coating material that consists of diamond (sp^3-hybridization carbon atom), graphite (sp^2-hybridization carbon atom), and degrees of hydrogenation. The chemical structure of DLC films regarding the coordination of carbon and hydrogen atoms is one of the most critical factors governing the quality of DLC films. The wide range of applications of DLC film demonstrates its excellent and outstanding properties, such as high hardness, low friction coefficient, high corrosion and wear resistance, and biocompatibility. Therefore, there has been much interest in numerous industrial applications, such as automotive parts, microelectronic devices, cutting tools, biomedical components, magnetic data storage, food packaging, and the petroleum industry. This work is a collaboration between PTT Exploration and Production Plc (PTTEP) and Synchrotron Light Research Institute (Public Organization) to develop the DLC coating machine prototype for the petroleum industry. The main challenge of the petroleum industry is the corrosion and erosion problem of engineering parts in oil and gas exploration, for example, choke valve, booster compressor valve pipelines, and coupling. These parts are exposed to extreme conditions such as high temperature, pressure, and corrosive environments. This challenge results in high maintenance costs and opportunity loss due to production breakdown. The DLC film coating on engineering parts has excellent potential to extend the part's operational life and energy-saving, decrease costs, meet the use of the petroleum industry, and reduce maintenance.

Keywords: Diamond-like carbon (DLC) films, Petroleum industry, Corrosion resistance

INS16_TF

X-ray mirror figure correction using differential deposition

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Abstract:
The surface figure of x-ray mirrors can be improved by differential deposition of thin films. To achieve the required corrections, WSi_2 layers of variable thickness were deposited through beam-defining apertures of different openings. The substrates were moved in front of the particle source with specific velocity profiles that were calculated with a deconvolution algorithm. Two different DC magnetron sputter systems were used to investigate the correction process. WSi_2 was selected as a promising material since it conserves the initial substrate surface roughness and limits the film stress to acceptable levels.

Height errors were evaluated before and after each iteration using off-line visible light surface metrology. Several Si mirrors were used to study the impact of the initial shape errors on the performance of the correction approach. On 300 mm long flat mirrors the shape errors were routinely reduced by a factor of 20-30 down to levels below 0.3 nm RMS.

This work describes the experimental techniques and discusses the achieved accuracy. Correcting a larger number of mirrors provides statistics and allows to correlate the performance of the technique to the individual figure errors. The use of two deposition systems that operate on different length scales provides additional options to optimize and to speed up the process.

Keywords: X-ray mirrors, Differential deposition, Figure correction, Magnetron sputtering, Fizeau stitching metrology

INS17_TF

Innovative Optical Nanostructure Thin Films for Advanced Sensors with AI-Based Data Analytics

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Abstract:
Optical nanostructures, with their unique optical properties and large surface-to-volume ratios, have recently emerged as a key player in a wide range of optical sensor applications. In this study, we explore the fabrication techniques using the magnetron sputtering technique and the optical spectroscopic characterization of these optical nanostructure materials developed at OEC, NECTEC, Thailand. These techniques offer a high degree of flexibility in developing various nanostructure films and large-scale coatings, making them essential for industrial production. The PVD method, when combined with oblique angle deposition (OAD), glancing angle deposition (GLAD), and the solid-state dewetting (SSD) process, enables the fabrication of uniform nanostructure arrays, including plasmonic nanostructures for surface-enhanced spectroscopic and localized surface plasmon resonance (LSPR) sensors chip. For metal oxide materials, controlling kinetic energy during film growth achieves high-porosity waveguide films with enhanced chemical gas sensitivity, allowing for greater molecular diffusion and adsorption on the nanostructure sensors. In addition to high-sensitivity optical sensors, the nanostructure can be arranged in an array form to assist in constructing an artificial pattern recognition in the sensor chip-based AI sensing strategy. This allows for the integration of various nanostructures into the substrate chip. Therefore, the combination of data processing to extract meaningful information spectra and data analysis as machine learning has been proposed and discussed to achieve high accuracy, sensitivity, and selectivity. Our ultimate goal is to make pioneering contributions to the field of optical sensing nanomaterials and optical sensing platforms, enabling their extensive applications in agriculture, forensic science, disease diagnosis, and other relevant areas, thereby demonstrating the practical implications of our research.

Keywords: Optical nanostructure thin film, Plasmonic sensors, Advanced sensor devices, GLAD, OAD, SSD, Metal oxide thin film

INS18_TF

Physical properties of binary and ternary semiconductor thin films for optoelectronic and solar cell applications

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Abstract:
Currently, metal chalcogenide and oxide materials have attracted much attention due to their excellent optical and electrical properties for various applications such as photovoltaic, nonlinear optical, memory, and optoelectronic devices. The synthesis of binary and ternary semiconductor compounds in the form of quantum dot, thin film, and nanoparticles (NPs) or polycrystalline material for various optoelectronic applications was highlighted. In our study, binary and ternary semiconductor thin films were synthesized using various methods such as spray pyrolysis, chemical bath deposition (CBD), and dip coating in accordance with various distinctive conditions and parameters. Then, the morphological, linear/non-linear optical, dispersion, optoelectrical, and electrical properties were examined and discussed. It noteworthy that our synthesized thin film materials show a further promising optical system in optoelectronic and nonlinear optical devices and an absorber layer for solar cell applications.

Keywords: Binary and ternary semiconductors, Optoelectronic devices, Nanoparticles, Thin film

INS19_PLS

Recent development on glass scintillator: Application to synchrotron x-rays imaging

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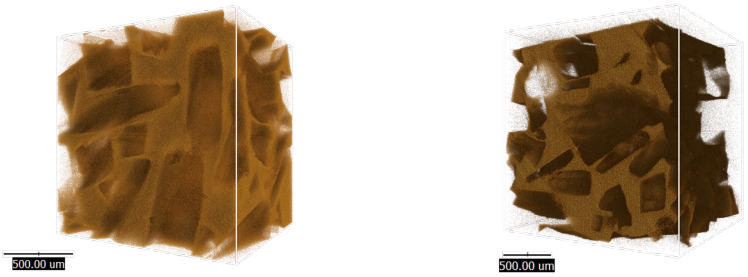
Abstract:
Glass scintillator is one of alternative radiation detection material, which several advantages properties for example, much cheaper and easier production than crystal, non-hygroscopic, shapable and chemical ratio can be adjusted. Generally, glass can not make emission by itself. It is important to dope for creating luminescence center in glass matrix. Lanthanide ions are very popular to use as dopant and show excellent luminescence properties. There are sharp and stable emission from f-f transition of lanthanide ion with less sensitive to ligand, while f-d transition shows very fast timing resolution, which very good for counting mode of detection. However, glass scintillator application still limited. In this talk, scintillation mechanism of glass will be explained. The recent development of glass scintillator will be discussed and potential application to synchrotron x-rays imaging will be addressed.

Keywords: Glass; Scintillator, X-rays; Imaging



Synchrotron x-rays imaging of sponge from (left) YAG:Ce scintillation crystal (right) glass scintillator

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INS20_PV

Boosting Performance in Carbon-based Perovskite Solar Cells through Advanced Charge Transporting Layers

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Abstract:
The performance of perovskite solar cells (PSCs) depends on the quality of the charge-transporting layer. In the n-i-p device configuration, the electron transporting layer (ETL) is a substrate for perovskite crystal growth. The quality of the ETL is crucial for controlling the perovskite crystal quality and efficiently gathering photogenerated electrons by the perovskite layer, impacting overall device efficiency and stability. Tin oxide (SnO_2) has become an excellent alternative to ETL because of its high electron mobility and low photocatalytic activity. However, the SnO_2 suffers from intrinsic defects resulting from low-temperature synthesis, which leads to charge carrier recombination and reduction in photocurrent. In this work, a water-soluble polymer is utilized to treat the intrinsic defects of the SnO_2 ETL. This involves adding the polymer to an aqueous precursor SnO_2 colloidal solution before it is deposited as the ETL. When the polymer-modified SnO_2 ETL was used in double-cation-based PSCs, the average power conversion efficiency (PCE) was improved compared to the pristine PSCs. Additionally, carbon nanodots were added to the solution to enhance the conductivity of the SnO_2 films. Conductance mapping, observed by conductive atomic force microscopy (c-AFM), showed higher conductance values in the SnO_2 film containing carbon nanodots than those of the pristine SnO_2 film. The PSC with a maximum power conversion efficiency was achieved when both the polymer and the carbon nanodots were applied. Furthermore, findings from multiple technical characterizations suggest that the high-quality SnO_2 films were created and proved effective in enhancing charge transfer at the SnO_2/perovskite interface. More detailed information will be provided. This modification method is expected to offer a simple and cost-effective approach for high-efficiency PSC production in the industry.

Keywords: Perovskite solar cells, Electron transporting layer, Hole transporting layer, Carbon electrode, Stability

INS21_FM

Enhancement in photocatalytic performance of $BiVO_4$ by rare-earth doping via photon up-conversion process and phase transformation

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Abstract:
Sonochemical synthesis is an effective process for preparing various optically functional nanomaterials without further post treatment process. In this work, this facile technique was employed for synthesizing $BiVO_4$ that is recognized as an effective visible driven photocatalyst. The catalytic activity of $BiVO_4$ can be further enhanced by co-doping with specific rare-earth elements including Erbium (Er) and (Yb)ytterbium. The effect of both Er and Yb doping content on physical, optical and photocatalytic properties of $BiVO_4$ was investigated. It is found that both dopants have significant influence on crystal phase transformation from monoclinic phase of bare $BiVO_4$ to tetragonal phase when doped with specific doping content. This phase transformation can effectively assist the retardance of electron-hole pair recombination, hence improving photocatalytic activity of $BiVO_4$ host. Er and Yb co-doping can also induce the photon up-conversion by making infrared absorption then generating visible emission that can further increase the catalytic performance. This mechanism can be proposed to make $BiVO_4$ active under infrared irradiation.

Keywords: Sonochemical, Bismuth vanadate, Rare-earth doping, Photon up-conversion.

INS22_APB

Study of space plasma radiation and space weather effects on plasma environments near Earth during the passages of high-speed solar wind

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Abstract:
The Sun provides radiation fluxes and charged particles in the solar wind emitted from the solar corona into interplanetary space in which their variations greatly depend on solar magnetic activity. These variabilities induce variations of space plasma and solar-terrestrial effects known as space weather in magnetosphere, ionosphere, and thermosphere. Space weather is critically important in the modern society relying on space technology such as satellite communication, navigation and tracking operations such as the Global Navigation Satellite System (GNSS). We focus on the solar modulation of near Earth Galactic cosmic rays (GCRs) as observed by neutron monitors at Doi Inthanon. GCRs are energetic charge particles originated mainly in supernova remnants transporting to inner solar system and suffering variations in various timescales due to the solar wind. High-speed solar wind (HSS) emanating from solar coronal hole is a main contribution factor for space plasma radiation and space weather effects near Earth during low solar magnetic activity. The remarkable space weather concerning HSS are such as recurrent geomagnetic storms, satellite anomalies/failures by electrostatic discharge in GEO satellites, thermospheric drag of LEO satellites, ionospheric storms, and various phenomena in the magnetosphere and atmosphere of the Earth.

Keywords: recurrent geomagnetic storm**,** high speed solar wind, space weather, Galactic cosmic ray, satellite anomaly

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INS23_MC

Microwave Plasma Catalysis for Greenhouse Gases Reforming: Role of metal-load catalysts

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Abstract:
Plasma catalysis, a field on the cusp of a breakthrough, is set to revolutionize various applications, particularly in the environmental sphere. The emergence of distinct benefits such as low-temperature operation, high selectivity, and improved energy efficiency is a clear sign of the innovative potential of this field. The use of microwave-discharge plasma, with its high gas conversion, selective reactions, energy efficiency under electrode-free configuration, high electron density, and potential for easy scale-up at high gas throughput, is an exciting and innovative approach when this high energy efficiency is combined with the selectivity and stability of a downstream metal-loaded catalyst.

We present examples of I) microwave plasma-CO_2 hydrogenation: the comparative CO_2 conversion of Cu^0 and Cu^{II}-based zeolite resulting catalysts with $Cu^0 > Cu^{II}$ contents (reduced form) provided higher CO_2 conversion than those containing $Cu^{II} > Cu^0$, the BET results indicated that their pore sizes were lower than those of 3% Cu with reduction, which might cause the blockage of the active sites**.** And II) Enhanced reforming of CO_2 and CH_4 for hydrogen production through the mesoporous catalyst of K- and Ca-promoted Ni/Al_2O_3 derived from MIL-53(Al). Selectivities and catalytic activities by Ni5/AlMIL were dramatically raised where inherent properties of porous derived-MIL-5(Al) Al_2O_3 support materials could influence selectivity due to the large surface area and well dispersion of active sites.

Keywords: Microwave plasma catalysis, Greenhouse gases reforming, Metal-load catalysts

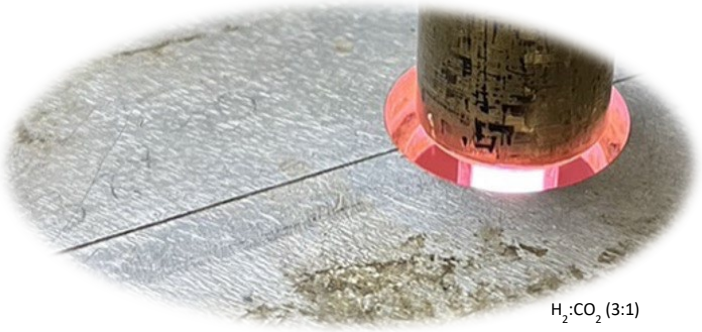

Fig. 1 Microwave plasma discharges at 2.45 GHz with an H_2:CO_2 ratio of 3:1

INS24_MC

Synchrotron Soft X-ray Technique for Diamond-Like Carbon Film: Challenges and Applications

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Abstract:
The development of diamond-like carbon (DLC) films for industrial applications is one of the in-house projects of Synchrotron Light Research Institute (SLRI), which has been established to set up a DLC film deposition system using radio frequency plasma-enhanced chemical vapor deposition (RF-PECVD) technique. The project's main objective is to find suitable deposition methods and parameters to apply DLC films for gas pipeline production, which is related to PTT Exploration and Production Plc (PTTEP) applications. DLC film is widely used in many other applications, including cutting tools, petroleum, automotive, electronics, food packaging, and medical industries. With the synchrotron light available at SLRI, the near-edge X-ray absorption fine structure (NEXAFS) technique is the main characterization method that can be effectively used to determine, qualitatively and quantitatively, the chemical information of DLC films. One of the main pieces of information from NEXAFS is the ratio of the sp^2 and sp^3 chemical bonds, which directly affects the mechanical and chemical properties of DLC films and can be adjusted by the deposition conditions to achieve the desired properties suitable for different applications.

Keywords: Synchrotron Light, Diamond-Like Carbon, NEXAFS Analysis, Corrosion Resistance

INS25_MC

A sequential O_2/Ar plasma etching for power output enhancement of triboelectric nanogenerator

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Abstract:
Triboelectric nanogenerator (TENG) is a new energy harvesting technology, which now become one of the most efficient approaches to harvest mechanical energy by convert it into electricity. Energy conversion efficiency is a function of triboelectric charge density, which is dependent on surface structure and chemistry. In this work, the surface modification using a two-steps plasma etching has been developed for enhancing energy conversion performance in polytetrafluoroethylene (PTFE) triboelectric nanogenerator (TENG). Enhancing surface area by a powerful O_2 and Ar bipolar pulse plasma etching without the use of CF_4 gas has been demonstrated for the first time. TENG with modified surface PTFE using a sequential two-step O_2/Ar plasma has a superior power density of 9.9 Wm^2, which is almost thirty times higher than that of a pristine PTFE TENG. The synergistic combination of high surface area and charge trapping sites due to chemical bond defects achieved from the use of a sequential O_2/Ar plasma gives rise to the intensified triboelectric charge density and the enhancement of power output of PTFE-based TENG. The effects of plasma species and plasma etching sequence on surface morphologies and surface chemical species were investigated by a field emission scanning electron microscopy (FESEM), atomic force microscopy (AFM), and X-ray photoelectron spectroscopy (XPS). The correlation of surface morphology, chemical structure, and TENG performance was elucidated.

Keywords: Plasma etching, Surface modification, Triboelectric nanogenerator, Energy harvesting

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INS26_MC

Harnessing Piezoelectricity: Advanced PVDF Composite Smart Strap for Enhanced Wrist Motion Detection

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Abstract:

This presentation delves into the creation of an innovative smart wrist strap based on a Polyvinylidene Fluoride (PVDF) composite, designed for highly accurate wrist motion detection. PVDF, known for its superior piezoelectric properties, is a promising material for sensors and energy harvesting applications. However, its β-phase, which is key for such applications, remains thermodynamically unstable, posing a challenge to its practical utility. To address this, we developed a composite material that combines PVDF with reduced graphene oxide (rGO) and ionic liquids (IL), significantly enhancing the β-phase content through self-poling effects and improved dispersion. This PVDF-rGO-IL composite exhibits piezoelectric responses in multiple directions, providing accurate detection of rapid strain changes. The smart strap's design for wearable technology efficiently converts wrist movements into electrical signals while being lightweight and energy-efficient. Raman and XRD analyses verify the enhanced β-phase content, which reaches as high as 98.23%, offering superior dielectric and piezoelectric properties. This advancement paves the way for new-generation wearable devices that are more precise, comfortable, and energy-efficient.

The presentation will cover the synthesis and characterization of this advanced composite, its application in motion detection, and its broader implications for wearable electronics. By capturing complex motion dynamics, this smart strap technology represents a major step forward in energy harvesting and precision sensing for wearable devices.

Keywords: PVDF composite, Piezoelectricity, Wearable technology, Motion detection, Energy-efficient devices

INS27_FM

Electrospinning Nanofibers and Their Applications for Energy Storage

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Abstract:
Electrospinning is a highly versatile and scalable technique for fabricating nanofibers with unique structural properties, including high surface area, tunable porosity, and mechanical flexibility. These characteristics make electrospun nanofibers ideal candidates for enhancing energy storage systems, such as lithium-ion batteries (LIBs), supercapacitors, and fuel cells. This work reviews the latest advancements in the use of electrospun nanofibers in energy storage applications, highlighting the performance improvements in terms of charge-discharge cycles, ion diffusion, and overall energy capacity. In LIBs, electrospun nanofibers serve as high-performance anodes and cathodes, leveraging materials like carbon, silicon, and transition metal oxides to improve battery efficiency. Supercapacitors also benefit from nanofiber electrodes that offer superior electrochemical stability and higher energy density. Furthermore, the integration of nanofibers into fuel cell membranes enhances ion exchange and catalyst performance. Additionally, the flexibility of nanofibers paves the way for innovative applications in flexible and wearable energy devices. This presentation will explore the latest developments, challenges, and future directions in the application of electrospun nanofibers for next-generation energy storage solutions, emphasizing their potential to revolutionize the field through improved performance and design flexibility.

Keywords: Electrospinning, Nanofibers, Energy Storage, Lithium-ion Batteries, Supercapacitors, Fuel Cells, Flexible Devices.

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INS28_NPR

Compact Neutron emission spectrometer in magnetic confinement fusion

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Abstract:
Understanding the transport of fast ions is crucial for achieving high-performance plasmas and advancing the development of fusion power reactors. In fusion devices, fast ions are primarily generated by auxiliary systems such as neutral beam injection (NBI) and ion cyclotron range of frequencies (ICRF) waves. One of the effective diagnostics for studying fast ions is the neutron emission spectrometer, since fast ions always leave their characteristics on neutrons in the $D(D,n)^3He$ reaction. In thermonuclear fusion, neutron spectroscopy has traditionally been used to measure fuel ion temperature by analyzing the neutron energy distribution. However, with intense NBI heating of deuterium plasma in fusion devices such as the Large Helical Device (LHD) in Gifu, Japan, the role of neutron spectroscopy has significantly evolved. This change is attributed to the neutron spectrum deviating from a Maxwellian distribution during NBI heating, resulting in significant Doppler shifts in neutron energy. In the LHD, the confinement of passing and helically-trapped fast ions under the NBI and ICRF waves heated plasma has been extensively investigated [1] using a comprehensive set of neutron diagnostics [2]. To enhance our understanding of the slowing-down process of fast ions and the excitation mechanisms of fast-ion-driven magnetohydrodynamic instabilities, measurements of fast-ion energy distribution were conducted using the compact neutron emission spectrometer (CNES). The CNESs, based on conventional EJ-301 liquid scintillation detector [3] and based on newly developed Cs_2LiYCl_6:Ce scintillation detector enriched with ^7Li (CLYC7) [4], capable of both tangential and perpendicular line-of-sight measurements, have been operational in the LHD. With the tangential line-of-sight CNES, we observed a significant Doppler shift effect in the deuterium-deuterium neutron energy caused by high-energy fast ion injection via tangential NBI [5]. Using the perpendicular line-of-sight CNESs, we obtained a double-humped shaped spectrum, with the peaks possibly corresponding to the large Larmor motion of fast ions injected by perpendicular NBI [6,7].

Keywords: Fusion device, Neutron spectroscopy, Large Helical Device, Liquid scintillation detector, CLYC7 scintillation detector

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INS29_NPR

Charting of Radiative-Emission and Radiation-Interaction Data from the First Year Operation of Thailand Tokamak-1

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Abstract:
Thailand Tokamak-1 (TT-1) has started its operation more than a year ago. Different sensors probing various aspects of the discharging plasma were employed to form a diagnostics system. The discharging tokamak plasma was used both as a source in radiative emission processes and as an interacting media in wave-plasma processes. For example, H_a-spectral line shape is specifically observed and utilized to follow various physical, atomic, and molecular processes in the discharging hydrogen plasma. Optical emission is recorded with a hi-speed camera as still image of many electronic transitions inside the main plasma. Plasma interaction to the tokamak wall often adds more brief but intense "dirty" emission lines to the main hydrogen plasma. The 337-mm infrared from an external HCN plasma source after interacting with the tokamak plasma does offer an insight to the plasma density. X-ray emission is also monitored to reveal interruptions in the main plasma which often leads to immature plasma extinguishing. Using these diagnostic systems, we have collected data for more than one thousand two hundred shots in the first year. Some results of the same and "clean" plasma discharges are analyzed and cross-checked and will be presented in this contribution.

Keyword: Thailand Tokamak, magnetic probe, H_a. HCN, Soft X-ray, Hard X-ray

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INS30_RAB

Simulating the biological effects of charged particles in space with small ion accelerators

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Abstract:
Galactic Cosmic Radiation (GCR) and Solar Energetic Particles (SEP) are energetic Charged Particles (CP) in the space environment. For long duration interplanetary and lunar manned space missions, CP can present an enhanced radiation exposure hazard for astronauts as well as cultivation of their food. This is because the spacecraft trajectories take them outside of the shielding effect of Earth's magnetosphere. Studies are urgently needed not only to understand the effects of space CPs on biological tissues, but also develop mitigations such as radioprotectant pharmaceuticals and also how it effects space agriculture. Irradiation tests with high energy (GeV) ions with of live test animals is one approach. However, this is slow becasue the animals may need to be followed over their lifetime and also animal husbandry and the use of a large accelerator facility is expensive.

Irradiation of biological tissue-cultures with1- 10 MeV energy protons from small accelerators, such as used in research on ion beam cancer therapy, give the possibility to reduce, refine and replace (the 3Rs for animal-model research) study into the effect of space CPs. This poses the question as to how well the low-energy protons represent the wide range of energy (1 MeV – 100 GeV) and atomic number ($Z_1 \leq$ ~83) of space radiation.

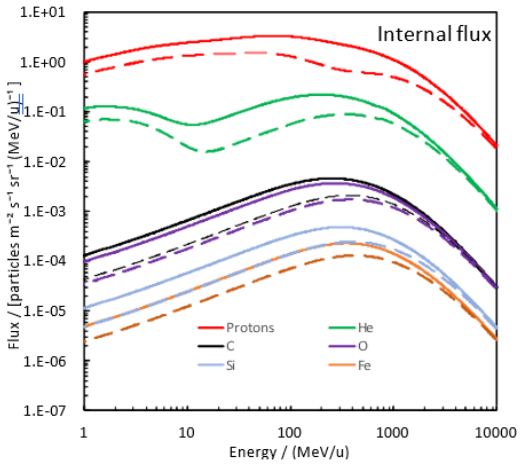

Figure 1: Differential space-CP flux inside a spacecraft. The solid and dashed lines represent solar minimum and maximum [1,2].

The first step was to predict the differential CP flux inside of the spacecraft using a standard ISO model [1,2]. (Figure 1.) These showed that the flux depended strongly on solar magnetic conditions. Notably the low energy (< 100 MeV) proton flux increased about 10_3 times under Coronal Mass Ejection (CME) event. From this data it was found that under normal solar magnetosphere conditions, the dose from the CP flux would was far below the level (~200 mGy) for Acute Radiation Syndrome (ARS). For long duration missions at total absorbed dose could cause stochastic effects. However, under a bad CME conditions the flux was sufficient exceed the onset of ARS. Most damage to cells is to the DNA. The biological effects are mostly cell death, sessility or reproductive failure.

This is through single/double strand breaks that lead to cell death. The physical mechanism for introducing DNA damage is by direct hits to the DNA and indirect damage from free radicals such are reactive oxygen and nitrogen species produced by radiolysis. In penetrating matter the vast majority of the energy of CP is lost by creating δ- electrons that break chemical bonds in the DNA and other molecules. Consequently, direct and indirect DNA damage from space-CPs will depend on the fluence and energy loss which in turn are related to the absorbed dose. It is straightforward to calculate the number of direct DNA hits based on the geometric DNA cross section. Figure 2 shows the number of direct genome hits and the fluence per unit dose with CP energy.

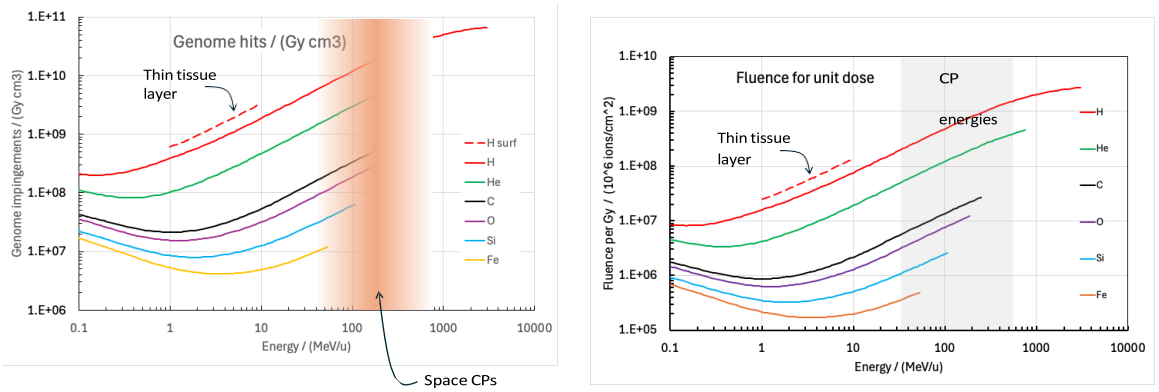

Figure 2: (Left) Direct genome hits per unit absorbed dose. (Right) CP fluence per unit absorbed dose

Consideration of Figure 2 (Left) shows that the number of genome hits/Gy is greatest for protons which is due to their smaller stopping force compared to CP with greater Z_1. Since the level of direct DNA damage also depends on dE/dx compared to the electron impact DNA damage threshold energy and this will be smaller for higher energy ions. Furthermore, dE/dx is greatest at the end of range implying tissue irradiation with 1-10 MeV protons represent a worse case for simulating direct DNA damage by space-CP. Indirect DNA damage is governed by the absorbed dose which also depends on dE/dx. Figure 2 (Right) shows that the fluence needed to deposit 1 Gy is greatest for protons than CP with greater Z_1. Hence, the indirect DNA damage per CP will be smaller for protons compared to greater Z_1 CP. Space CPs slow down in tissue and the maximum absorbed dose is a maximum when they have slowed to low energies of a few MeV. Taken together with the large Z_1 dependence of the Space-CP fluxes (Figure 1) this implies that irradiation of thin layers of tissue with 1-10 MeV protons is representative of the worst case irradiation of space CP in thick tissues.

Keywords: Galactic Cosmic Radiation (GCR), Solar Energetic particles absorbed dose. DAN damage, simulation of space charged particles

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INS31_RAB

Nitrogen-Fixed Fertilizer via Air Plasma: Effects on Sugarcane Phenotype

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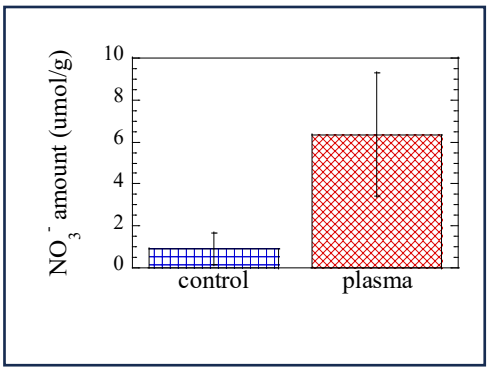
Abstract:
To enhance sustainable agricultural productivity, nitrogen fixation via plasma has garnered significant attention due to its ability to produce nitrogen fertilizer using Air, H_2O, and electricity [1]. Combining solar cells and plasma enables in-situ nitrogen fixation without CO_2 emissions, unlike the conventional Haber-Bosch (H-B) method, which relies on fossil fuels and emits CO_2 [2,3]. In this study, we analyzed the phenotypic response of sugarcane cultivated with plasma-irradiated organic fertilizer. The figure illustrates the concentration of NO_3^- before and after Air plasma treatment of leaf mold, which led to a sevenfold increase in NO_3^-. NO_2^- levels increased by only 0.2% compared to NO_3^-, indicating that NO_3^- is the primary product. The sugarcane was cultivated from October 2021 to March 2023. We monitored the growth over time, and no differences were observed in the first 150 days post-planting. However, after that period, the sugarcane treated with plasma-irradiated fertilizer showed accelerated growth, with a 17% increase in harvest weight, despite no change in stem diameter. These findings demonstrate the effectiveness of plasma-irradiated fertilizers.

Keywords: Non-thermal plasma, Nitrogen fixation, plasma agriculture.
Acknowledgments: This work is supported by JST A-STEP JPMJTR20RU and JST COI-NEXT.



Amount of nitrate ion in leaf mold

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STEP01

Plasma-driven syntheses, control and functionalization of three-dimensional carbon nanomaterials

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Abstract:
Carbon nanomaterials, such as fullerene, carbon nanotubes (CNT), graphene sheets, and so forth, play indispensable roles in nanotechnology research and applications. Due to their unique self-organized nanostructures and properties, various types of applications using them are expected and have been developed. For example, graphene sheets and carbon nanotubes are well known as a promising candidate of channel materials for highly sensitive sensor devices. On the other hand, carbon nanowalls (CNWs) are a type of nanographene material that consists of multilayer graphene grown perpendicular to a substrate and has a unique three-dimensional structure. Due to their high aspect ratio, specific surface area, and stability without bundling even in liquid, they are expected to be used as anodes for battery devices and biosensors. Hydrogenated amorphous carbon (a-C:H) thin film is essential as a hard mask for plasma etching to fabricate 3D flash memory. To realize a-C:H films with higher plasma etching resistance, further innovation in film formation methods using plasma-enhanced chemical deposition (PE-CVD) is desired. Furthermore, in recent years, heteroatoms-doped carbon nanocomposite materials that exhibit catalytic activity are attracting much attention as non- platinum catalysts. Especially, nitrogen (N)-doped nanographene materials are well-known to have high catalytic activity. Pyridinic-N is known as a key component to express catalytic activity [1].

Plasma-assisted techniques are widely used in academic research and industry as a powerful method for thin film deposition and nanomaterial synthesis. However, plasma processes are generally complicated processes that involve a variety of active species, making it difficult to elucidate the mechanism of their synergy and control the process. Efforts have been made mainly in academic research to measure active species in process plasmas and elucidate their generation mechanisms [2]. Therefore, we developed a radical-injection plasma-enhanced CVD (RI-PECVD) apparatus equipped with two plasma sources: a 100 MHz capacitively coupled plasma (CCP) and a 2.54 GHz microwave-excited surface wave plasma (SWP), and have clarified the deposition mechanisms of various carbon nanomaterials, such as CNWs and a-C:H, based on measurements of active species [3-4]. On the other hand, in recent years, attempts have been made to control this complicated plasma process using machine learning approaches. However, since learning models are black boxes, it is difficult to understand their mechanisms of plasma-excited reactions. In recent years, on PECVD to deposit carbon hard masks for plasma etching, based on active species measurement using quadrupole mass spectrometry and a contribution analysis method based on game theory, we succeeded in quantitatively clarifying the interactions between active species [5].

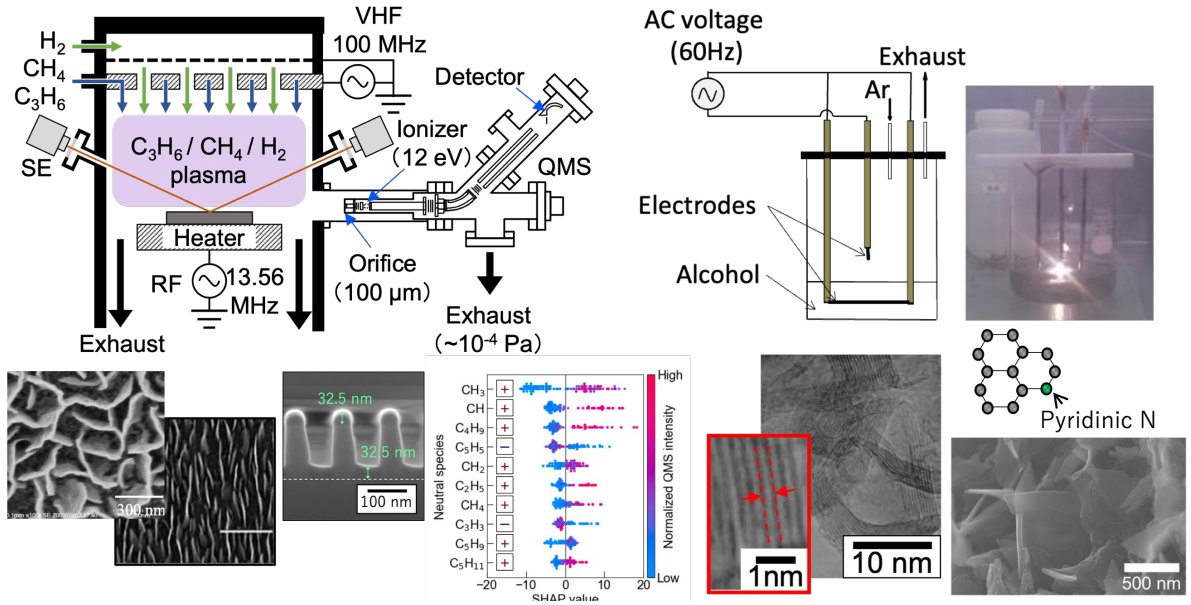
On the other hand, we have also developed a new high-speed synthesis method for functional nanographene materials using gas-liquid plasma with alcohols [6]. Its synthesis mechanism has been clarified by analyzing active species in the gas phase and measuring products in the liquid phase. Furthermore, in the nanographene material synthesized using this method, pyridinic nitrogen is essentially involved in the expression of catalytic activity [7].

In this way, analysis based on active species measurement allows us to scientifically interpret complex plasma processes and lead to innovations in new processes and materials.

Plasma processing is an essential technology for research into nanomaterials and nanoelectronics. Combining conventional reactive species measurements with informatics techniques will enable us to quantitatively interpret the interactions between reactive species, which is expected to lead to revolutionary innovations in science and technology.

Acknowledge: The recent research results I will introduce in this talk were obtained while I was working at Nagoya University. I would like to express my sincere gratitude to my long- time collaborators at the center for low-temperature plasma sciences (cLPS), Nagoya University.

Keywords: plasma-enhance chemical vapor deposition (PECVD), in-liquid plasma, carbon nanowalls, hydrogenated amorphous carbon (a-C:H), machine learning



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STEP02

Generation of pulsed discharges over water surface and their applications for environment and agriculture

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Abstract:
Plasma discharges produce various powerful oxidizing agents, such as hydroxyl radicals and ozone, which have high oxidation potential. These species play an important role in the decomposition of persistent organic compounds in wastewater. Because highly concentrated oxidants are directly produced inside plasma, plasma realizes high speed wastewater treatment without pretreatment of samples such as pH adjustment. The pulsed discharge plasma generated over water surface and inside bubbles is highlighted as a highly efficient method for plasma generation and radical supply into wastewater [1].

Various methods to generate a pulsed discharge in contact with water have been proposed. Figure 1 (a) and (b) show schematic illustrations and photographs of examples. The simplest method is to generate discharge that propagates and spreads over the water surface by using a high-voltage electrode placed above stationary water, as shown in Figure 1 (a). The chemical species generated in the plasma discharge are dissolved into the water and react with organic compounds in the water as described later. The discharges generated inside bubbles as shown in Figure 4 (c), which are produced by injecting gas into water using a gas feed tube, have been widely investigated. This method has advantages such as a high ratio of water surface to gas volume, easy control of the gas purity and components, easy use in various fields and automatic water circulation.

In the plasma generated in the gas phase, various chemically active species such as ozone (O3), oxygen radicals (O), and hydroxyl radicals (OH) are produced and dissolved at the water surface. Since these species have a high oxidation potential, they can contribute to wastewater treatment, i.e., the decomposition of organic compounds and the inactivation of bacteria. The production reactions are initiated by the impacts of high-energy electrons on neutral molecules. The lifetime and diffusion constant of OH in the gas phase are on the order of 10^{-5} s and 10^{-10} m^2/s, respectively, and the diffusion length is several tens of μm. The lifetime of dissolved OH is on the order of 10^{-6}~10^{-7} s with penetration lengths on the order of 10^{-5}~10^{-6} m.

The decomposition of persistent organic compounds dissolved in wastewater, such as 1,4-dioxane anddichloromethane acid by radicals produced in the plasma discharge is demonstrated, and their mechanisms are discussed. These persistent compounds, which have strong toxicity and stability, can be efficiently decomposed and removed quickly from solutions by plasma treatment as shown in figure 2. Furthermore, the treatment of nutrient solutions used in hydroponic systems for plant cultivation is also introduced as a novel application of plasma, and the effects of bacterial inactivation, decomposition of allelochemicals and improvement in plant growth by plasma are demonstrated as shown in figure 3.

Keywords: Pulsed discharges, Plasma over water surface, Hydroxyl radicals, Ozone, Plant growth

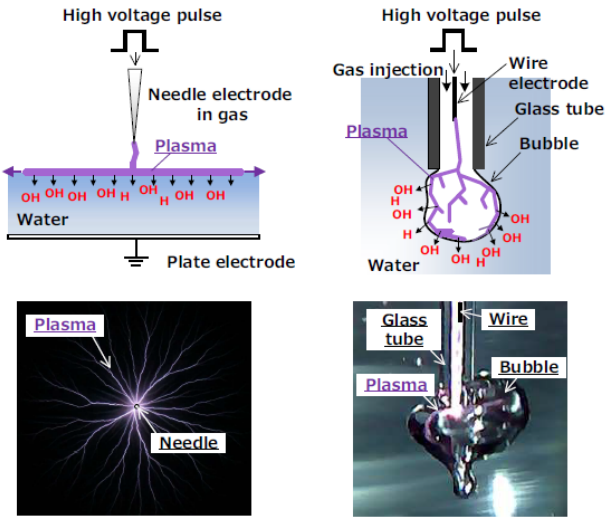

Figure 1. Schematic illustrations and photographs of pulsed discharge in contact with water generated (a) above stationary water surface, (b) inside bubble

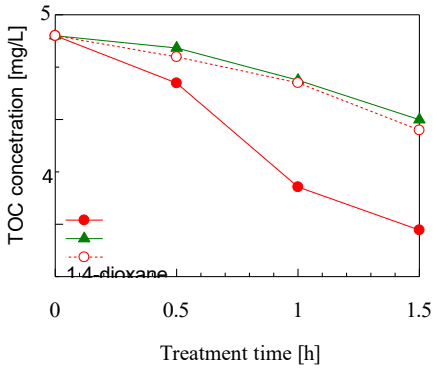

Figure 2. Time change of the TOC concentration of 1,4-dioxane solution by plasma treatment.

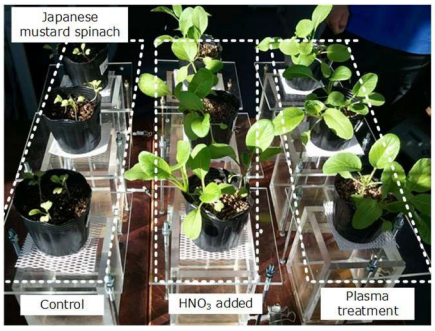

Figure 3. Photograph of Japanese mustard spinach seedlings after 28 days of cultivation using plasma-treated nutrient medium-supplied soil.

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STEP03

Recognition of plasma rice and its multi-omics analysis

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Abstract:
Plasma technology can be applied in different stages of agricultural production with increasing yield and improving quality. It can reduce the dependence on pesticides and fertilizers in the process of rice cultivation, protect the ecological environment, which is considered to be an ideal new green technology for agriculture. In this study, different plasma strategies were used in rice field planting. The promotion effects of plasma on rice growth and quality depend on plasma treatment methods and treatment parameters. In order to effectively recognize plasma rice and evaluate the effect of plasma treatment on rice growth, the recognition models were constructed. In order to reveal the mechanism of gene and metabolism regulation of plasma rice, multiple omics analyses were employed. The results show the practical application of plasma in agriculture and the advantages of the multidisciplinary combination of plasma, agriculture and computer science.

Keywords: plasma rice, evaluation, multi-omics analysis

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STEP04

Harnessing Non-Thermal Plasma Technology for Enhanced Water Environmental Protection

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Abstract:
Non-thermal plasma (NTP) technology is gaining attention as a cutting-edge method for tackling pressing water quality challenges. This presentation delves into the underlying mechanisms by which NTP operates to treat contaminated water, emphasizing its efficacy in degrading pollutants, neutralizing pathogens, and breaking down persistent organic compounds. Key factors that influence NTP's performance are explored in depth. Additionally, the presentation examines recent technological advancements in NTP systems, including innovations that enhance scalability, cost-effectiveness, and integration with conventional water treatment methods. By showcasing various case studies and ongoing research initiatives, this discussion highlights NTP's promise as a sustainable and versatile solution for improving water quality. The broader implications of NTP for environmental protection, including its role in supporting global clean water access initiatives and promoting ecosystem resilience in the face of pollution, are also addressed. Ultimately, this presentation aims to underscore NTP's potential as a transformative technology in the quest for sustainable water management.

Keywords: Sustainability, Green technology, Water treatment innovation, Disinfection, Physicochemical treatment

STEP05

Application of Nonthermal Plasma in Agriculture: Enhancing Seed Germination, Growth, and Bioactive Compound Production

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Abstract:
Nonthermal plasma (NTP) is an ionized gas with high-energy electrons, offering a promising eco-friendly approach to agriculture. This study investigates the effects of NTP on onion seed germination and growth, while analyzing the bioactive compounds in onion extracts using mass spectrometry (MS) to assess potential increases in antioxidant and anticancer properties.

Onion seeds were treated with NTP, and their germination rates and growth were monitored. The extracts from treated onions were analyzed using gas chromatography-mass spectrometry (GC-MS) to identify changes in the concentration of bioactive compounds like flavonoids and phenolic acids, known for their antioxidant effects. The antioxidant activity of the extracts was measured using the DPPH radical scavenging assay, and anticancer effects were tested on cancer cell lines.

Results showed that NTP treatment significantly improved both germination rates and growth compared to untreated controls. GC-MS analysis revealed increased concentrations of antioxidant compounds in NTP-treated extracts, particularly flavonoids and phenolic acids, which correlated with stronger antioxidant activity. Additionally, the treated onion extracts exhibited enhanced anticancer activity.

The findings suggest that NTP can enhance seed germination, crop growth, and the functional properties of crops by increasing bioactive compounds. This technology offers a sustainable alternative to chemical fertilizers and pesticides, contributing to the development of functional foods with added health benefits. NTP also shows potential for strengthening crop resistance to stress and diseases, supporting its broad application in agriculture.

Keywords: Non-thermal biocompatible plasma, Plasma-based fertilization, Disinfection, agriculture.

Funding: Ministry of Education (2021R1A6A1A03038785 and 2022R1F1A107410513)

The 6th International Conference on
Radiation and Emission in Materials (ICREM2024)
November 27-29, 2024, Khon Kaen, Thailand

STEP06

Effect of Low-Pressure Cold Plasma Treatment on Black Afara and Caeruleum Seeds for Germination

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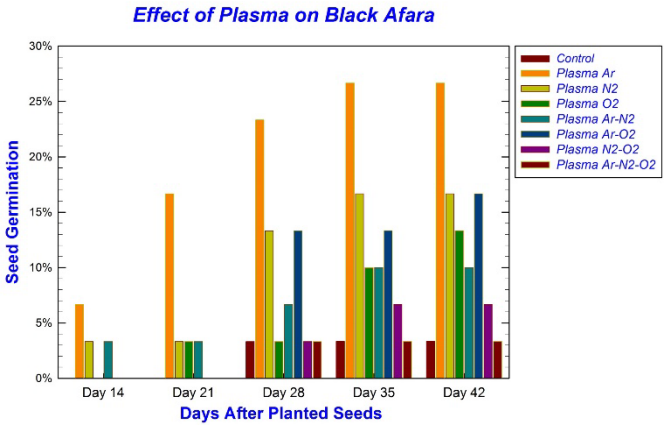
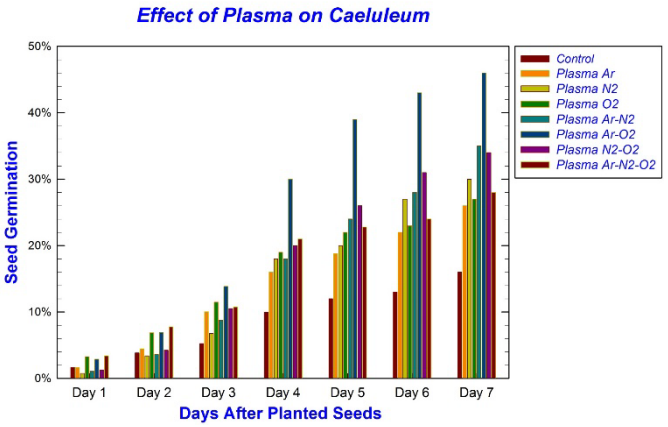
Abstract:
Low-pressure cold plasma (also referred to as low-temperature plasma) treatment of Black Afara (*Terminalia ivorensis* A. Chev) and Caeruleum (*Calopogonium caeruleum* (Benth.) Suav.) has garnered significant research interest in agriculture due to its potential to enhance seed germination. Preliminary studies conducted at Maejo University, Phrae Campus, have explored its effects on improving growth rates.

A capacitively coupled plasma (CCP) system operating at 13.56 MHz was used to generate plasma using Ar, O_2, N_2, and mixed gases. The plasma was produced in a 50-liter cylindrical stainless-steel chamber under a pressure range of 100–200 mTorr, with an RF power input of 150 W. Seeds of Black Afara were treated for 30 minutes, while Caeruleum seeds were treated for 60 minutes. Results demonstrated a significant increase in germination rates compared to untreated seeds under optimal operating conditions.

The findings highlight the potential of plasma treatment in agricultural applications. Implications of these results and directions for further research will be discussed.

Keywords: Black Afara, Caeruleum, Low-pressure cold plasma, Low-temperature plasma





The 6th International Conference on
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November 27-29, 2024, Khon Kaen, Thailand

STEP07

Effects of Atmospheric Pressure Air Plasma Synthesized Dinitrogen Pentoxide on Plant Function Control

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Abstract:
Sustainable farms, namely, farms that grow plants without using chemical pesticides or chemical fertilizers, are becoming increasingly recognized as important in many countries around the world. To realize the sustainable farms, atmospheric pressure plasma (APP) technology, enabling to convert air molecules into multi-functional reactive oxygen and nitrogen species (RONS) with electricity, has been of great interest and extensively investigated. In particular, air APP devices, working only with air and electricity, can potentially allow for ubiquitous supply of RONS [1], which can be applied in a wide range of fields such as medical, agricultural, and environmental fields [2]. Recently, we have developed a new composite air APP device consisting low temperature and high temperature plasma reactors (Fig.1), enabling to supply RONS with fine control and good reproducibility [3]. Specifically, its ability to generate high density dinitrogen pentoxide (N_2O_5) with high selectivity (Fig.2) is quite unique and could accelerate scientific and industrial N_2O_5 applications. As an example of the N_2O_5 applications, three research results on plant function control will be presented in this talk.

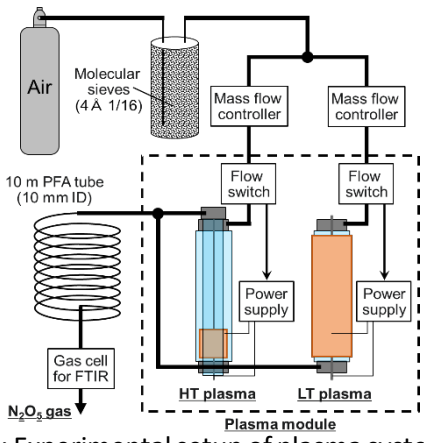

Fig.1: Experimental setup of plasma system for N_2O_5 production.

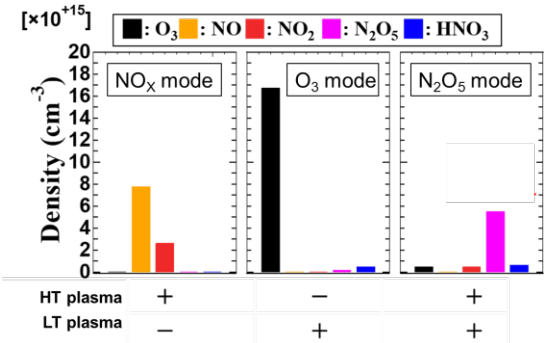

Fig.2: Density of reactive species generated using high- and/or low-temperature plasma reactors.

First, plasma synthesized N_2O_5 gas was used as a nitrogen fertilizer. Nitrogen-deficient plants supplied with medium treated with N_2O_5, were able to overcome nitrogen deficiency, similar to those provided with medium containing a conventional nitrogen source. However, prolonged direct exposure of plants to N_2O_5 gas adversely affected their growth. On the other

hand, short-time exposure of plants to N_2O_5 gas mitigated its toxicity and was able to support growth [4,5].

Second, metabolomic analyses at three different exposure levels were performed to assess the effects of N_2O_5 on basil leaves. It was found that cinnamaldehyde increased in a dose-dependent manner, accompanied by transcriptional activation of the cinnamoyl-CoA reductase CCR2 gene. Phenolic acids also increased with increasing doses. These results suggest that N_2O_5 exposure increases several valuable secondary metabolites in sweet basil leaves via plant defense responses [6].

Third, activation effects of plant immunity were found in pathogen inoculation test using *Arabidopsis thaliana*, exposed to N_2O_5 gas [7]. Gene expression analysis with RNA-seq and qRT-PCR showed that the N_2O_5 gas exposure activated the signaling pathways for jasmonic acid (JA) and ethylene (ET), which are important phytohormones for plant immunity (Fig.3). These results indicate that N_2O_5 gas can be used as a plant activator and also indicates that those N_2O_5 effects were pronounced when the plants were placed in high humidity conditions. N_2O_5 gas-liquid interface reaction on the leaf might have contributed to these effects.

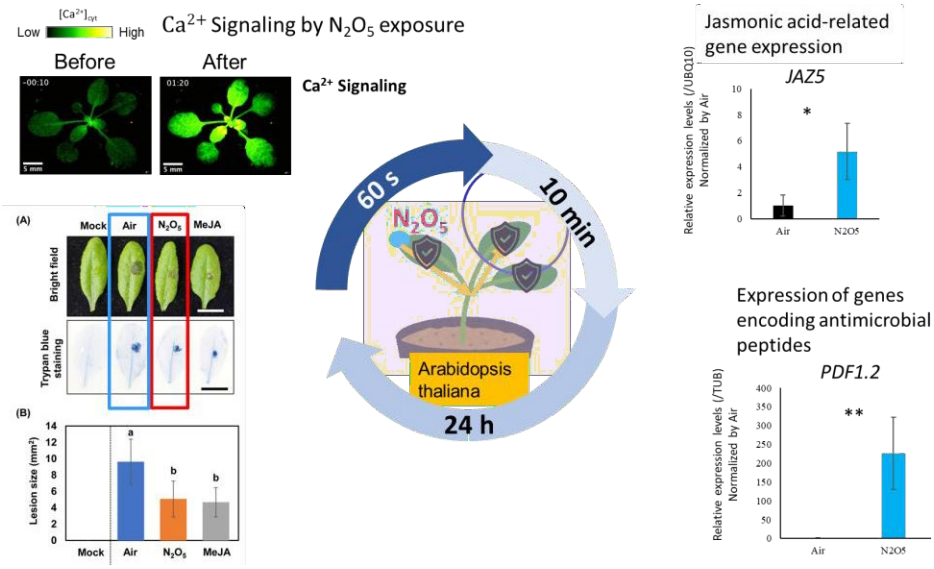

Fig.3: Activation of plant immunity by plasma synthesized N_2O_5.

Keywords: atmospheric pressure air plasma, dinitrogen pentoxide, secondary metabolism, plant immunity, plant fertilization, sustainable farm

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STEP08

Innovative Optimization of Plasma-Activated Water for Advanced Microbial Control in Agricultural Processing

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Abstract:
The rapid expansion of the global population is poised to significantly impact various sectors worldwide, particularly the food and agriculture industries [1]. According to the United Nations, the global population is projected to reach 9.7 billion by 2050 and could peak at nearly 11 billion by around 2100 [2]. Food contamination is one of the most crucial issues of food safety and food security. Food contamination can occur at any stage, from farm to fork, including production, processing, shipping, and distribution [3]. Moreover, approximately 600 million people worldwide suffer from foodborne infections, resulting in 420 thousand deaths and the loss of 33 million healthy life years (DALYs) [4]. Conventional treatment methods to prevent food contamination are insufficient in preserving the fresh qualities of food such as texture, color, and nutritional quality. Recently, plasma activated water (PAW) gain a significant attention in food and agriculture application due to its effectiveness on microbial inactivation. This study utilized a pinhole plasma jet discharge system to generate PAW for the removal of microbes on bird's eye chili. Additionally, the novelty of this study lies in designing a PAW system model for agricultural cooperatives using the Quality Function Deployment (QFD) methodology. A maximum of 82.54% microbial removal rate on bird's eye chili could be achieved under the optimal condition (e.g., exposure time = 20 min, Ar gas flow rate = 5 L/min, and O_2 mixture = 2% Ar gas). The model up-scaling, cost (Figure 1), and estimation of electrical power usage of PAW system for agricultural cooperatives is also proposed. However, scale-up and lack of long-term stability and safety data are two challenges of plasma activated water. Therefore, further investigations on consistency in microbial removal and long-term effects on treated agricultural products are still required.

Keywords: Plasma Activated Water, Microbial Inactivation, Reactive Oxygen and Nitrogen Species, Model Up-scaling, Quality Function Deployment

Contributed Talks

O01_PS

Enhancing Plasma Cancer Therapy: Nightingale® Air Plasma-Activated Ringer's Lactate with Cannabidiol Nanoemulsion for Targeted Lung Cancer Cytotoxicity

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Abstract:
Non-thermal plasmas possess a wide range of biomedical applications owing to their distinctive capacity to generate direct and indirect reactive oxygen and nitrogen species (RONS). Nightingale® stands as a non-thermal air plasma device, adhering to IEC standards and carrying the CE certification, ensuring its safety in medical applications. In this study, Nightingale® was employed to activate lactated Ringer's injection (LRI) for the *in vitro* inactivation of lung cancer cells, specifically A549 and H1299. Nightingale®, a medical non-thermal plasma device, generated N_2, OH, H_α, and O species as confirmed by emission spectra analysis. Optimal plasma-activated Ringer's injection (PA-LRI) conditions or PA3-LRI (3 min, 111.6 J) achieved significant cell death in lung cancer cells (A549: 59.4%, H1299: 20.4%) with minimal impact on normal WI-38 cells (10.5%). Optimized cannabidiol nanoemulsion (CBD-NE) exhibited enhanced stability and dose-dependent cytotoxicity against lung cancer cells. Combining PA3-LRI with 2 μM CBD-NE further increased anti-tumor effects (A549: 78.7%, H1299: 45.1%) while protecting normal cells (<5.6% mortality), suggesting CBD counteracts reactive oxygen and nitrogen species (RONS) effects. This study highlights the potential of combining PA-LRI and CBD-NE as promising strategies for selective and effective lung cancer treatment.

As far as we know, this study is the pioneering investigation into the synergistic cytotoxic effect of combining PA-LRI with CBD-NE against lung cancer cells. Our discoveries unveil promising pathways for merging plasma and nanotechnology in medicine, presenting potential clinical applications and intriguing prospects. Comprehensive research is essential to unravel the mechanisms of CBD action and the cytotoxic impact of combining PA-LRI and CBD-NE on tumor cells. Subsequent *in vivo* studies involving diverse cancer cell types are imperative.

Keywords: Nightingale®, Non-thermal compact air plasma jet, Plasma-activated lactated Ringer's injection, Cannabidiol nanoemulsion, Lung cancer cells

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O02_PS

Plasma-Exposed Media to Skin Discoloration in the Nile Tilapia (*Oreochromis niloticus*)

Sukitar Krasaesen[1], Pongphun Sukum[1], Chakkrapong Kuensean[2]*, Udomluk Sompong[3], Sureeporn Sarapirom[4] and Dheerawan Boonyawan[1]

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Abstract:
Nile Tilapia (*Oreochromis niloticus*) compared to Red Tilapia (*Oreochromis niloticus/Oreochromis mosambicus*), noting that the latter's value has doubled due to costly and time- consuming hybrid breeding practices. Red Tilapia's higher market value is linked to the predominance of male fish, which constitutes 95% of the population, reducing reproductive efficiency and leading to a misconception among farmers that Red Tilapia is sterile. The study explores plasma-exposed media (PEM) as a non-invasive and eco-friendly method to increase the economic value of Nile Tilapia by altering its skin pigmentation as the dissolved reactive oxygen and nitrogen species (RONS) affect breeding and potentially cause cell mutations. Specifically, PEM induces skin discoloration in Nile Tilapia to enhance pigment expression and, consequently, the fish's market value. The experiment involved treating 50 ml of distilled water with plasma exposure time durations (2.5, 5.0, 7.5, 10, and 20 minutes) and treating 4- stage tilapia eggs at these conditions for 30 seconds each. The resulting RONS were analyzed using Optical Emission Spectroscopy (OES), while the media properties were examined using a UV-visible spectrophotometer and a Fluorescence Spectrophotometer. The study aims to assess the effectiveness of PEM in inducing color changes in Nile Tilapia and to understand the role of RONS in melanin synthesis.

Keywords: Plasma-exposed media, Reactive oxygen and nitrogen species (RONS), Skin discoloration, Nile Tilapia, Aquaculture.

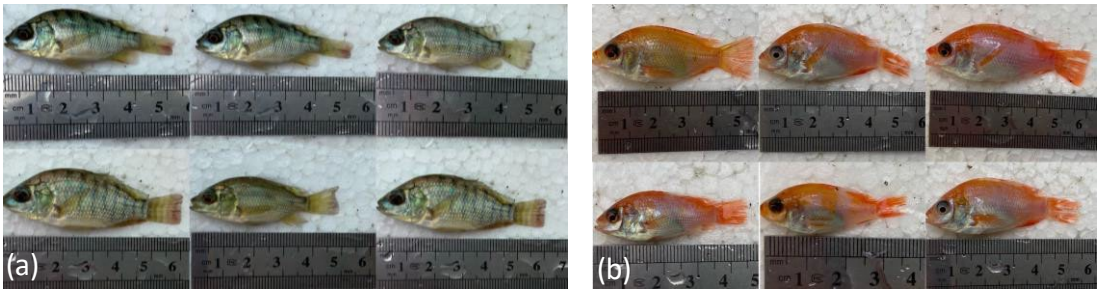

Figure 1. The 73 days age of Nile Tilapia (a) Control and (b) Skin discoloration

O03_PS

Propagation Enhancement of Protocorms in Orchid (*Vanda coerulea* Griff. ex Lindl.) by Plasma-activated Media

Prangnapat Silapasert[1*], Sureeporn Sarapirom[2], Pranom Yangkhammannd[3] and Dheerawan Boonyawan[1]

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Abstract:
Orchids are an important economic crop in Thailand, with an annual export value of no less than 1,000 million baht. Among the many types of orchids exported, the most prominent and famous genus is Vanda, especially *Vanda coerulea* Griff. ex Lindl., known for its beautiful and distinctive petal color, which is rare in other orchid species. At present, atmospheric pressure plasma technology has gained significant attention in the agricultural sector. Plasma technology is considered a promising solution for sustainable and safe agricultural food production. Plasma generates reactive oxygen and nitrogen species (RONS), which have a positive effect on seed germination and plant growth. This research aims to study the impact of plasma-activated media (PAM) on orchid protocorms in the tissue culture process. The plasma arc is operated using ambient air, and the plasma properties are measured using optical emission spectroscopy (OES) to detect the light emission type. The culture medium (PAM) is stimulated with plasma for 2.5, 5, and 7.5 minutes, respectively, and the concentration of RONS in PAM is measured using UV-visible spectroscopy (UV-Vis) and Photoluminescence Spectroscopy (PL). Future work will investigate which RONS species highly affect Protocorms orchid growth.

Keywords: *Vanda Coerulea* Griff.ex Lindl, Reactive oxygen nitrogen species, Plasma-activated media, Protocorms

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O04_PS

Wear Resistance Improvement of Cold Work Tool Steels using Low-temperature Plasma Nitriding

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Abstract:
In this study, the plasma nitriding experiments were conducted in a bipolar pulsed plasma reactor at plasma nitriding temperatures of 350, 375, 400, 425 and 450 °C with hydrogen ratios of 100, 200, 300, 400 and 500 sccm for 4, 8 and 12 hours, respectively. The average surface hardness was determined using the Vickers microhardness test, while the hardness in the depth profile was determined by nanoindentation using the elastic stiffness procedure (ESP). The thickness of the nitride layer was estimated from the SEM cross-sectional image. The microstructure of the nitride phase was investigated by X-ray diffraction. The elemental composition was analyzed in depth using the GD-OES (Glow Discharge Optical Emission Spectroscopy) technique, and the friction coefficient and wear rate were evaluated in a ball-on-disk test. For the DC53 samples subjected to plasma nitriding, the phases of the nitriding steel ε-Fe_3N were found to correspond to crystal planes (110), (002), (111), (112) and (300) and γ'-Fe_4N to crystal planes (111), (220) and (311). Vickers microhardness measurements at a load of 0.2 kg showed that the plasma-nitrided workpiece had a maximum hardness of 1121.5 ± 69.2 HV for 4 h at 400 °C and a hydrogen ratio of 200 sccm. With increasing temperature and duration of plasma nitriding, the nitrogen diffuses more strongly from the outer surface into the interior of the workpiece, resulting in a thicker nitrided layer. The maximum nitrogen content of around 11 % by mass was reached after a plasma nitriding time of 12 hours at a maximum depth of 20 µm.

Keywords: Low-temperature plasma nitriding, Bipolar-pulsed frequency, Cold work tool steels, Wear resistance

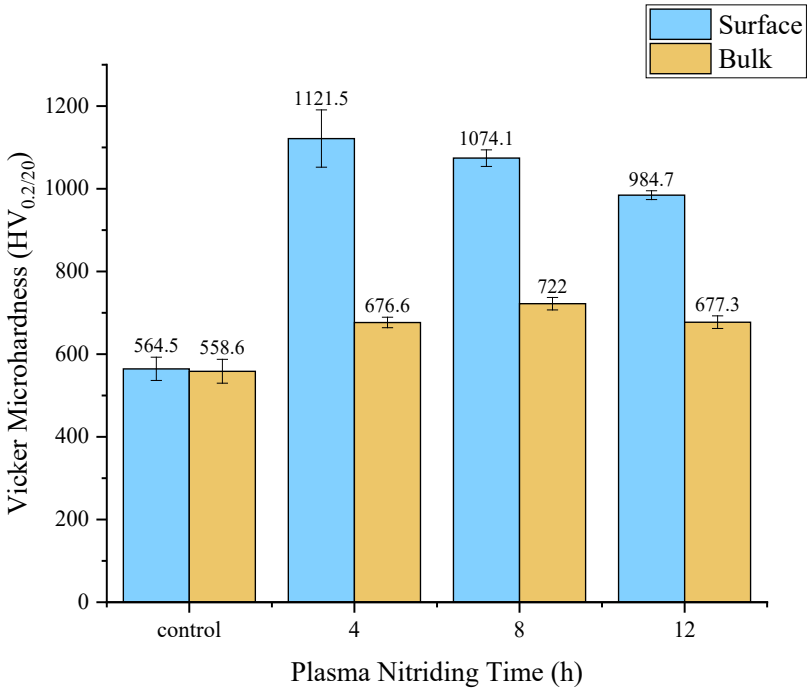

Figure 1. Vickers Microhardness of DC53 tool steels undergone plasma nitriding at different nitriding time at 400 °C.

O05_PS

Utilizing Plasma-Activated Media to Sterilize Sweet Potato (*Ipomoea batatas* L.) Explants for Culture Preparation

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Abstract:
Disease free sweet potato (*Ipomoea batatas* L.) plantlet is highly sought after and widely consumed; however, its production remains limited. This is primarily attributable to the difficulties associated with the surface sterilization of explants, which consume time and consequently increases costs. As a result, potential buyers are often hesitant to invest in sweet potato plants for cultivation, favoring traditional propagation methods such as cuttings. Unfortunately, such practices can facilitate the transmission of pathogens within cultivation fields, leading to diminished yields, plummeting market prices, and challenges in exportation. Typically, surface sterilization involves chemical agents such as sodium hypochlorite (NaClO), chloroxylenol (C_8H_9ClO), and alcohol (C_2H_6O). The selected mother plants must be robust, healthy, disease-free, and meticulously cleaned for effective sterilization. Young shoots or Axillary bud are preferred, as they are more likely to develop into new plants successfully. However, improper preparation or contamination of the explants can lead to plant mortality, while excessive application of sterilizing agents may harm the tissues, resulting in stunted growth. These factors highlight significant limitations inherent in traditional sterilization methods.

Considering these challenges, Plasma-Activated Media (PAM) emerges as an innovative alternative. This approach eliminates the need for harsh chemicals, effectively preserving plant tissue integrity while eliminating microbial contaminants through the reactive oxygen nitrogen species (RONS).

In this study, plasma arc discharge was employed to generate PAM at varying concentrations, with adjustments made to both power and treatment duration to optimize sterilization efficacy. To evaluate the effectiveness of PAM, a comparison was made with traditional methods using sodium hypochlorite at concentrations of 1-5%. Properties of plasma were observed using optical emission spectroscopy (OES), while the characteristics of PAM were assessed using UV-visible spectroscopy (UV-Vis). The experimental results indicated that PAM could effectively reduce the presence of *Phytophthora* spp. fungi, demonstrating its potential as a superior alternative to conventional sterilization techniques.

Keywords: Sweet Potato, Plasma-Activated Media (PAM), Surface Sterilization, Explants, Tissue Culture

O06_TF

Influence of Pulsed Acetylene Flow on Process Parameters in Reactive DC Magnetron Sputtering of Titanium Targets

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Abstract:
This study investigates the impact of pulsed acetylene gas flow on process parameters during reactive DC magnetron sputtering. The experiments were conducted using a titanium target with argon as the sputtering gas at a constant flow rate of 20 sccm. Acetylene was introduced as the reactive gas in a square pulse pattern, with three distinct phases: phase 1 (no acetylene flow), phase 2 (constant acetylene flow at 10 sccm), and phase 3 (acetylene flow off). The sputtering process was examined under the different discharge powers to assess the influence of power on the process dynamics. The results reveal that during phase 1, the target voltage (V_{tar}) stabilized at approximately -270 V with a total pressure (p_{tot}) of 17.3 mTorr. In phase 2, with the introduction of acetylene, V_{tar} rapidly changed to around -550 V. The total pressure correspondingly increased to 19.5 mTorr. In phase 3, upon termination of acetylene flow, p_{tot} rapidly returned to baseline levels, while V_{tar} exhibited a delayed recovery, particularly at the lower power, where the voltage did not return to its initial value within the observed time frame. In contrast, at a higher discharge power, V_{tar} more quickly approached its initial value. These findings can be explained by considering the interaction between the carbon deposition on the target surface and the process parameters. During acetylene introduction, the carbon layer accumulates on the titanium target. As a result, the effective electron emission yield of the target surface is modified, reflecting in the observed changes in V_{tar}. During shutting off the acetylene, the carbon layer at the target surface is gradually removed by sputtering process. The higher power causes a higher removing rate, facilitating a quicker return to the clean titanium surface. The implications of this work are significant for optimizing reactive sputtering processes, particularly in applications requiring precise control of thin film deposition.

Keywords: Reactive DC magnetron sputtering, Electron emission yield, Target poisoning, Carbon layer

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O07_TF

Energy distributions of plasma ions in floating high power impulse magnetron sputtering

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Abstract:
High power impulse magnetron sputtering (HiPIMS) is a sputtering-based thin film deposition technique providing high ionized flux fraction of the sputtered species. As a result, HiPIMS offers the opportunity to improve microstructure and properties of the deposited films. In a typical HiPIMS configuration, the anode of the magnetron is electrically grounded. Thus, the most probable energy of the bombarding ion at the substrate is limited in the range of 1-5 eV. In this work, we propose a floating HiPIMS to increase the most probable energy of the plasma ions. In the floating configuration, anode of the magnetron can be biased with a given voltage above ground. The time resolved ion energy distributions have been investigated using a retarding field ion energy analyzer located at the typical substrate position. The results show that the energy distributions for are characterized by a single-peak Gaussian-like function. The most probable ion energy (E_{most}), assigned by the energy at the peak of the distribution, is found to be high at the initial phase ($t \approx$ 0-60 μs) of the pulse and reduce to a constant value during the main phase ($t \approx$ 60-100 μs). The anode bias voltage of larger than +50 V can increase Emost to larger than +30 eV during the initial phase and to larger than +10 eV during the main phase. This work demonstrates that the floating configuration offers an alternative method to adjust the energy of bombarding ions during film growth, providing an opportunity to optimize the properties of the deposited films.

Keywords: High power impulse magnetron sputtering, Ion energy distribution, Anode biasing

O08_TF

Preparation of multilayer amorphous carbon films by using pulsed filtered cathodic vacuum arc and linear anode layer ion source technique

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Abstract:
In this work, multilayer amorphous carbon films (*ta*-C/*a*-C:H) composed of different carbon structures were fabricated by pulsed filtered cathodic vacuum arc (P-FCVA) and linear anode layer ion source (L-ALIS) techniques. The microstructure as well as the mechanical, tribological and corrosive properties of films were systematically investigated. The results showed that the multilayer coatings comprised 22 alternating *ta*-C and *a*-C:H layers with a total thickness of 1.2 - 1.3 µm. The hardness of the multilayer films reached a maximum of 49.70 GPa, which increased with increasing sp^3 content of the films. Compared to the SUS304 substrate, the multilayer films exhibited a much lower coefficient of friction between 0.07 and 0.10 and a lower wear rate of about 8,466 times, with the M-1 film having the lowest wear rate of 2.87×10^{-7} mm^3/Nm. The anti-wear performance was mainly attributed to the good lubricating properties of the carbon coatings in combination with the vertical load support provided by the *ta*-C layers and the prevention of crack propagation due to the many interfaces in the multilayer structure. In addition, the multilayer coatings exhibit excellent corrosion resistance due to the higher sp^3 content, which helps to reduce pitting corrosion and delays the diffusion of corrosive media.

Keywords: Multilayer amorphous carbon coating, Pulsed filtered cathodic vacuum arc (P-FCVA), Linear anode layer ion source (L-ALIS), Anti-wear performance, Corrosion resistance

O09_FM

Hydrophobic-to-Hydrophillic Conversion of Graphitic Carbon Nitride by Gamma-Irradiation

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Abstract:
The hydrophilic nature of graphitic carbon nitride (g-C_3N_4) is well known, leading to its applications when in contact with water such as photocatalysis or supercapacitor. To prepare hydrophilic g-C_3N_4, chemical modifications with e.g. fluorine- or silicon-containing agents are typically performed. Contrary to this knowledge, it will be presented herein that gamma irradiation (up to 400 kGy) of g-C_3N_4 induces its hydrophilic-to-hydrophobic conversion without the incorporation of foreign elements. The hydrophobicity is deduced from the smaller amount of adsorbed water by thermogravimetric analysis. This is consistent with the diminished water-induced conductivity observed by impedance spectroscopy. The samples at different doses of gamma-irradiation were characterized by X-ray diffraction, IR spectroscopy, N_2 adsorption/desorption, and scanning electron microscopy coupled with energy dispersive X-ray analysis.

Keywords: Layered materials, Conductivity, Impedance spectroscopy

O10_FM

Development of High-Performance $LiFePO_4$/Graphene for Lithium-Ion Batteries

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Abstract:
The smart design of cathodes is crucial for enhancing the performance of lithium-ion batteries (LIBs). Lithium iron phosphate (LFP) is widely used as a cathode material due to its attractive properties, including excellent thermal stability, high working voltage, low cost, and non-toxicity. However, LFP has limitations such as slow lithium-ion diffusion and poor electrical conductivity. Graphene, with its remarkable properties such as superb thermal conductivity, high carrier mobility, and intrinsic strength (130 GPa) is well-suited for enhancing cathode materials. In this work, graphene was synthesized using the calcination of sucrose (as a carbon source) and ferric chloride (as a precursor) at 700 ℃ for 6 hours under an argon flow. X-ray diffraction patterns of the sample prepared without iron showed peaks at 26° corresponding to the (002) graphene plane and an interlayer spacing of 3.43 Å. The LFP/Graphene composites were synthesized using a solvothermal method and labeled as LFP/G-1 and LFP/G-2, representing LFP-to-Graphene ratios of 1:1 and 1:2, respectively. The samples were investigated, and the specific capacity of LFP/G-1 was found to be 170.89 mAh g^{-1} at a 0.1C discharge rate and 163.78 mAh g^{-1} at 1C. Meanwhile, the specific capacity of LFP/Al (without graphene) was 98.42 mAh g^{-1}. These results suggest that co-modifying LFP with graphene is a promising technique for improving LFP performance.

Keywords: Graphene, Lithium-ion battery, $LiFePO_4$/Graphene composites, Solvothermal method

O11_APB

Development of Electron Beam Irradiation Station for FLASH Radiotherapy Experiment at Chiang Mai University

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Abstract:
FLASH radiotherapy (FLASH-RT) is a widely studied cancer treatment method that delivers radiation at dose rates significantly higher than those used in conventional radiotherapy. This technique has gained significant attention due to its ability to minimize side effects on healthy tissues while maintaining its effectiveness in targeting cancerous tumors. However, the roles of particle beam parameters have not yet been fully understood for a successful FLASH-RT, and a systematic study needs to be conducted. At the PBP-CMU Electron Linac Laboratory (PCELL) of Chiang Mai University, a project to develop an electron beam irradiation system for FLASH-RT research is ongoing. Electron beams, with energy ranging from 10 to 25 MeV, a macropulse duration of up to 5 microseconds, a microbunch length in the order of sub-picosecond to picosecond, and a tunable high beam current, are well-suited for FLASH-RT experiments. A systematic study is being conducted to optimize the electron beam parameters and design an experimental station equipped with electron beam diagnostic devices and irradiation apparatus. This contribution presents the design and progress of the experimental station, along with its expected performance and proper experimental procedures.

Keywords: FLASH radiotherapy experiment, High-dose rate irradiation, Electron beam irradiation

O12_APB

Simulation of Electron Transportation through Different Oxygen Concentration of Water Material by Using GEANT4-DNA toolkit

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Abstract:
High dose rate radiotherapy or "FLASH radiotherapy (FLASH-RT)" is the heated issue to widely take an interest. The challenging area of FLASH therapy has been focused on the mechanism of FLASH therapy. Since DNA damage is related to oxygen in a cell. The depletion of oxygen has played a major part in FLASH therapy. The aim of this work is to simulate of an electron beam penetrating in different oxygen concentration of water material by using the GEANT4-DNA, Monte Carlo simulation toolkit. In GEANT4-DNA, a 1 km-cubic water box was created. An oxygen concentration in a water box was varied from pO_2 = 0% to pO_2 = 50%, with 1% of each step. An electron beam was injected in a water box. Oxygen depletion was recorded end at 1 μs of post-radiation time. We found that the oxygen depletion was changed when pO_2 increased. This supports that an oxygen concentration related to a radiation on normal and tumor cell.

Keywords: GEANT4-DNA Simulation, FLASH-RT, Oxygen depletion

O13_APB

Development of Mid-Infrared Free-Electron Laser System at PCELL

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Abstract:
At the PBP-CMU Electron Linac Laboratory (PCELL), a system to generate oscillator-type free-electron laser (FEL) in mid-infrared regime (MIR) is being developed as a light source for advanced research applications, such as time-resolved spectroscopy. The oscillator FEL is produced by a relativistic electron beam passing through an undulator system within an optical cavity. This work presents the design of the MIR-FEL generation, transportation and the optical cavity installation at PCELL. The system was designed using computer simulations with GENESIS 1.3, and key components were constructed and installed based on these results. The optical cavity is designed with a length of 5.353 m, consisting of two concave mirrors placed upstream and downstream of a 1.6-meter undulator. FEL simulations reveal that the designed system will generate MIR-FEL wavelengths ranging from 9.5 to 15.5 μm with an average power of up to 10 W for electron beam energies between 22 and 25 MeV. Recently, the key components of the optical cavity have been installed and aligned using two He-Ne lasers. Additionally, the MIR-FEL transportation system has been designed with a total length of approximately 20 meters.

Keywords: Mid-infrared free-electron laser, MIR-FEL, Optical cavity design, FEL simulation

O14_MC

Design and Development of Dysprosium-Doped Phospho-Tellurite Glass for White LED and Laser Applications

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Abstract:
This research delves into the multifaceted properties of dysprosium-doped phospho-tellurite glass, highlighting its physical, structural, optical, and luminescence characteristics. X-ray diffraction (XRD) analysis was employed to confirm the amorphous nature of the sample, while Fourier transform infrared (FTIR) spectroscopy was utilized to identify the vibrations of functional groups within the glass matrix. Optical properties were investigated through absorption spectra, revealing distinct peaks corresponding to transitions from the $^6H_{15/2}$ ground state to the $^6F_{3/2,5/2,7/2,9/2,11/2}$, and $^6H_{11/2}$ excited states. Luminescence analysis identified two primary emission peaks at $^4F_{9/2}\rightarrow{}^6H_{15/2}$ (blue) and $^4F_{9/2}\rightarrow{}^6H_{13/2}$ (yellow) transitions. The combination of these emissions produced white light, which was validated for use in white light-emitting diodes (W-LEDs) using Commission Internationale de l'Éclairage (CIE) chromaticity coordinates. Additionally, Judd-Ofelt (JO) parameter analysis reinforced the material's promising potential for laser applications.

Keywords: Phospho-tellurite, Luminescence, Judd-Ofelt, Amorphous, Dysprosium

O15_MC

Effective calibration materials from Tb^{3+}/Eu^{3+} co-activated aluminum sodium calcium borate glasses for luminescence spectrometer

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Abstract:
This study focuses on the development of a novel calibration material utilizing glass doped with Eu_2O_3 and Tb_2O_3. The unique luminescent properties of these dopants were exploited to create a reliable and stable reference material for the luminescence spectrometer. The Eu^{3+} and Tb^{3+} ions in the glass exhibit characteristic emission peaks that are well-resolved and intense, making them ideal for calibration purposes. Eu^{3+}-doped aluminum sodium calcium borate glasses with the addition of Tb^{3+} ions (Tb^{3+}/Eu^{3+}NCAB) were fabricated by the melt-quenching technique. To ensure measurement reliability, this study conducted measurements under two different stimulations photoluminescence and radioluminescence, verifying consistent peak positions. Under excitation, Eu^{3+} ions exhibit strong red emissions, predominantly around 613 nm, attributed to the $^5D_0$ to $^7F_2$ transition. In contrast, Tb^{3+} ions show prominent green emissions centered around 544 nm, corresponding to the $^5D_4$ to $^7F_5$ transition. The co-activated of Eu_2O_3 and Tb_2O_3 enables energy transfer between Tb^{3+} and Eu^{3+} ions, influencing the overall luminescent output. The findings suggest that this Tb^{3+}/Eu^{3+}NCAB glass could serve as a highly effective calibration standard in both research and industrial settings.

Keywords: Calibration, Photoluminescence, Radioluminescence, Tb^{3+}/Eu^{3+} glasses

O16_MC

Semiclassical Boltzmann Theory of Electrical Transport in Twisted Bilayer Graphene

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Abstract:
Twisted bilayer graphene (TBG) has recently been received great attentions due to the appearances of flat dispersions at low energies and a superconducting phase at relatively high temperatures when compared to the Fermi energy. In this work, we utilized the Bristritzer and MacDonald [1] model to generate TBG's band structure. This model exhibits flat band near Fermi energy at the magic angles. We calculated the relaxation time for an electron-impurity scattering process in TBG at various twisted angle using semiclassical Boltzmann Theory. We found that the relaxation time becomes lowest at the energy corresponding to the flat band. Furthermore, we calculated the electrical conductivity. We found that the electrical conductivity at low temperature is lowest at the magic angle 1.05°.

Keywords: Graphene, Electrical conductivity, Boltzmann theory

References:
[1] R. Bistritzer and A. H. MacDonald et al., Proceedings of the National Academy of Sciences, 108, 12 233-12 237 (2011).

O17_MC

Arrowroot starch, Corn starch, and Polyvinylpyrrolidone (PVP) as capping agents in the synthesis of silver nanowires (AgNWs) for use as the flexible transparent conductive electrodes (FTCE) of the alternating current electroluminescence (AC-EL) devices

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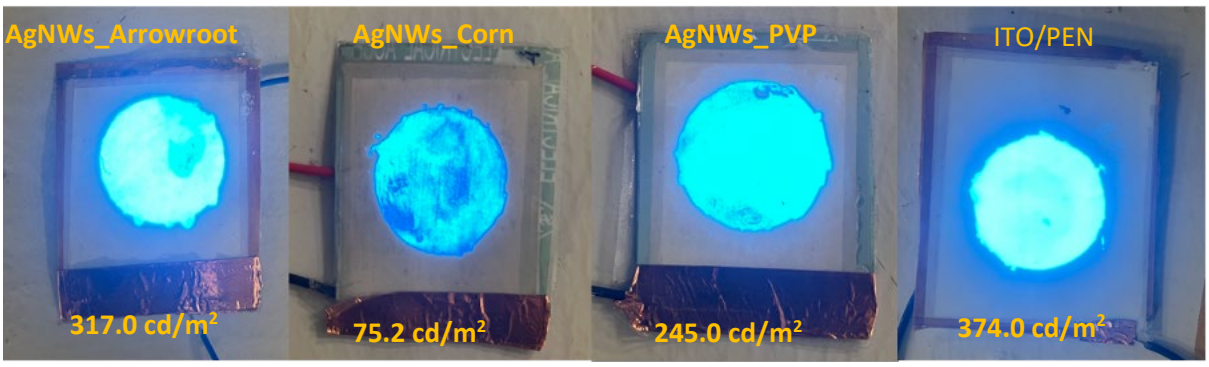
Abstract:
This study explores the role of capping agents in synthesizing silver nanowires via the polyol method, focusing on arrowroot starch, corn starch, and PVP. Arrowroot starch effectively produces silver nanowires with a uniform diameter of 72.0 ± 31.0 nm, while corn starch results in significant nanoparticle clustering. PVP, although yielding larger diameters, leads to uneven wire structures. The sheet resistance and transmittance values for flexible transparent conductive electrodes were measured. The results reveal that arrowroot starch, corn starch, and PVP provide the sheet resistance and transmittance values of 17.0 ± 4.1, 364.6 ± 175.2, 82.5 ± 30.0 Ω/sq and 48.9, 31.0 and 47.1%, respectively. Regarding electroluminescent applications, the illuminance rates were 317.0 cd/m² for arrowroot starch, 75.2 cd/m² for corn starch, and 245.0 cd/m² for PVP. The results indicate that arrowroot starch is a superior capping agent, producing consistently small and uniform silver nanowires with excellent electrical conductivity and transparency. This makes it ideal for applications in transparent conductive films.

Keywords: Silver nanowires, Polyol, Transparent conductive electrode



The luminescence characteristics of AC-EL devices that utilize FTCEs coated with AgNWs, employing capping agents from arrowroot starch, corn starch, and PVP. The devices are compared with the ITO/PEN film.

O18_NPR

Conceptual design of electrode biasing system in Thailand Tokamak-1

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Abstract:
An electrode biasing system was designed and installed in plasma fusion devices such as CHS [1], Heliotron J [2], and LHD [3], enabling researchers to precisely control the electric potential within the plasma. This capability is essential for investigating how variations in the electric potential affect plasma stability, confinement, and performance. In 2024, through collaboration between the National Institute for Fusion Science, Japan, and Thai researchers, an electrode biasing system was designed for the Thailand Tokamak-1 (TT-1), marking a significant step forward in improving plasma performance in TT-1. Figure 1 shows a schematic cut view of the TT-1 and the electrode biasing system. The electrode biasing system consists of several key components, including: 1) a vacuum chamber and gate valve, which provide the necessary isolation and control over the plasma environment; 2) a driving system with controllable mechanisms, allowing precise positioning and movement of the electrode probe within TT-1; 3) an electrode probe made of graphite, designed to apply a controlled bias voltage directly to the plasma; 4) a programmable power supply, capable of delivering the required voltage and current waveforms to the electrode; and 5) an electronics system that monitors and controls the biasing process, ensuring stable and accurate operation during experiments. The full installation of the electrode biasing system in TT-1 is expected to be completed by December 2024, with the first operation anticipated at the beginning of 2025. Measurements from the electrode biasing system will provide crucial insights into plasma behavior and confinement mechanisms in TT-1.

Keywords: Electrode biasing system, Thailand Tokamak-1, Plasma potential

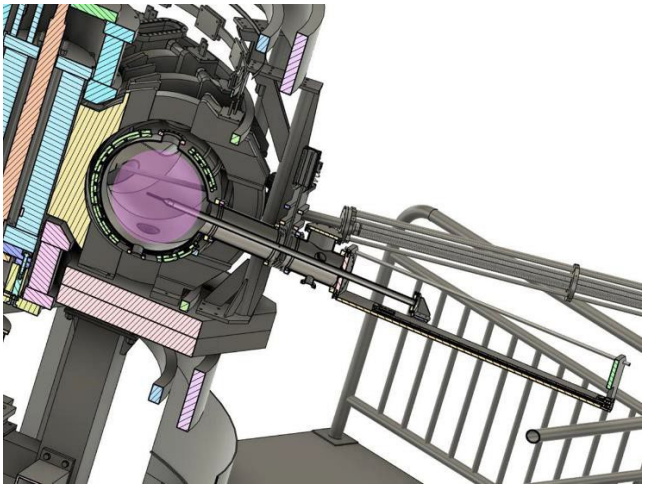

Figure 1. A schematic cut view of the TT-1 and the electrode biasing system.

References:

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[2] K. Shimizu et al., Plasma Fusion Res. 10, 3402061 (2015).
[3] S. Kitajima et al., Nucl. Fusion 51 083029 (2011).

O19_NPR

Soft X-ray Measurement in Thailand Tokamak-1 Utilizing Newly Designed Soft X-ray Imaging System

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Abstract:

Soft X-ray imaging (SXRI) is a crucial diagnostic technique in fusion devices, offering valuable insights into the behavior and dynamics of the plasma core [1]. By capturing X-ray emissions from the plasma, this technique enables researchers to study key phenomena such as electron temperature distribution, plasma instabilities, disruptions, and magnetohydrodynamic (MHD) modes [2]. The Thailand Tokamak-1 (TT-1) has been successfully operating, achieving a plasma current of up to 100 kA, a toroidal magnetic field strength of 1.52 T, and hydrogen plasma with an electron density of approximately 1×10^{19} m^{-3} and an electron temperature in the range of 100-400 eV. These operational parameters mark significant progress in Thailand's fusion research capabilities and lay the groundwork for more advanced plasma studies. Despite the relatively low electron temperature, bremsstrahlung and line radiation from impurities can still generate detectable soft X-ray signals. These emissions provide valuable diagnostic information, allowing researchers to probe the core plasma and understand energy losses, impurity transport, and other critical aspects of plasma behavior. This underscores the importance of X-ray diagnostics, such as SXRI, for studying plasma behavior and characterizing the plasma in TT-1, as detailed in this work. Figure 1 provides a schematic cutaway view of the TT-1 and the SXRI system. The SXRI will be installed at the TT-1's upper port. The SXRI system comprises several key components, including a Be foil, pinhole plate, CsI(Tl) scintillator, lens, fiber optic cable, and a fast camera. These components work together to capture and transmit X-ray images with high spatial and temporal resolution. The Be foil, pinhole plate, and CsI(Tl) scintillator are housed in a movable capsule, enabling adjustments to the SXRI's field of view, which allows for flexible imaging of different regions of the plasma.

Keywords: Thailand Tokamak-1 (TT-1), Soft X-ray diagnostic, Soft X-ray imaging system

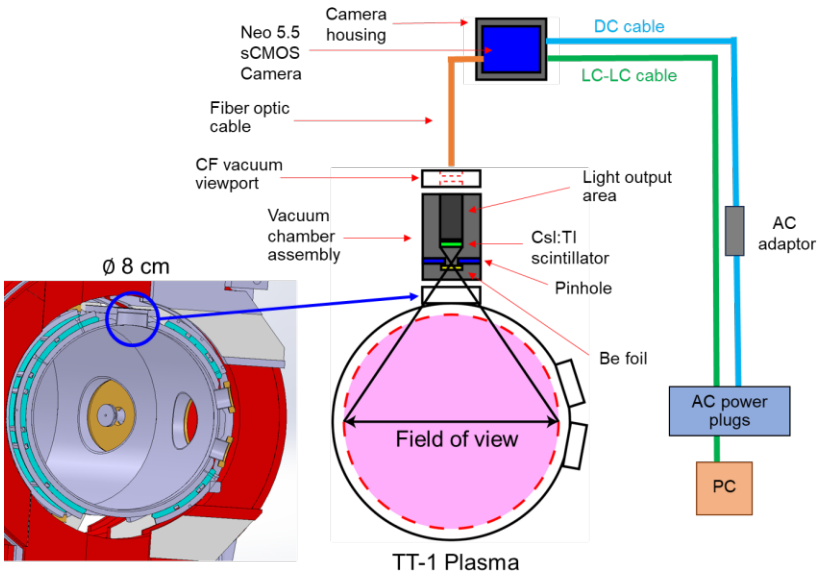

Figure 1. Shows a schematic diagram of SXRI in TT-1.

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[1] A. Wingen, et al., J. Comput. Phys. 289, 83-95 (2015).
[2] S. Ohdachi, et al., Plasma Fusion Research 2, S1016 (2007).

O20_NPR

Investigation of Runaway Electron Behavior in Thailand Tokamak-1 via Bremsstrahlung Emission Using MCNP Simulation

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Abstract:
Understanding runaway electron (RE) behavior is crucial for the safe operation of fusion devices, as REs have the potential to cause significant damage on plasma-facing components. One common method for studying REs involves measuring hard X-rays (HXR) emitted from bremsstrahlung during high-energy RE events that occur in the vicinity of the plasma-facing components. To gain deeper insights into RE behavior, HXR measurements have been conducted in various fusion devices [1-2]. Since 2023, Thailand Institute of Nuclear Technology (Public Organization) have been operating the Thailand Tokamak-1 (TT-1). TT-1 is a small-scale tokamak with a major radius of 0.65 m and a minor radius of 0.21 m, capable of driving a plasma current of up to 100 kA and achieving a toroidal magnetic field strength of 1.52 T. In TT-1, bremsstrahlung emissions are anticipated from high-energy REs as they lose energy through collisions with the TT-1 wall, producing HXR radiation that spans from a few hundred keV to several MeV. To enhance the observation and measurement of REs via their bremsstrahlung emissions, the Monte Carlo N-Particle (MCNP) code was employed to estimate bremsstrahlung radiation within TT-1. A comprehensive three-dimensional model of TT-1 was developed, encompassing the plasma-facing components, vacuum vessel, toroidal field coils, and poloidal field coils. Electron sources with varying energies and distributions (see Figure 1) were used to simulate bremsstrahlung generation during electron-material interactions within TT-1. The resulting bremsstrahlung emissions at the detector position were analyzed under various conditions, including electron source velocity, detector positioning, and collimator effects (see Figure 2). The findings from this study will directly support the installation of detectors for investigating hard X-rays from bremsstrahlung emissions during RE events in TT-1.

Keywords: Thailand Tokamak-1 (TT-1), Bremsstrahlung Emissions, Monte Carlo N-Particle (MCNP) Code, Runaway Electrons

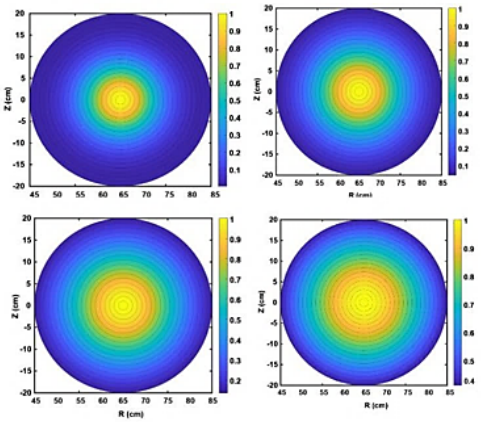

Figure 1: The modeled runaway electron distribution in TT-1.

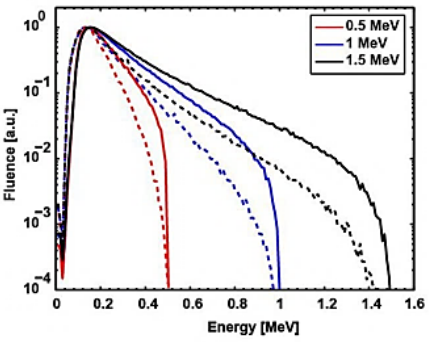

Figure 2: The bremsstrahlung emissions spectrum energy expected to be observed at the detector position when the high-energy electron source was 0.5 MeV, 1 MeV, and 1.5 MeV and circulated with a pitch angle of 180 degrees (solid line) and 90 degrees (dashed line)

References:

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O21_NPR

Improving Neutron and Gamma-Ray Detection Accuracy: Characterization of EJ-301 Scintillation Detector Performance at the Fast Neutron Laboratory

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Abstract:

The EJ-301 liquid scintillation detector was deployed for use in the compact neutron emission spectrometer on the Large Helical Device (LHD) in Japan [1-2] due to its high detection efficiency, fast signal decay time, and excellent neutron/gamma-ray discrimination capability. Prior to its installation in the LHD, the detector was characterized in a mixed neutron/gamma-ray radiation field at the Fast Neutron Laboratory of Tohoku University, Japan [3]. This study utilized neutron energies ranging from 2.34 MeV to 5.54 MeV. Precise fast-neutron energies at the detector position were calculated using the TRIM code in conjunction with a two-body kinematic calculation. Various fast component time windows were optimized to evaluate the neutron/gamma-ray discrimination capabilities of the detector. The figure-of-merit (FOM) was then analyzed to quantify the discrimination between gamma-ray and neutron pulses. A relatively high FOM, exceeding 1.4, was achieved when the fast component time window was set to a value greater than 26 ns for the lower neutron energy of 2.34 MeV, while for the higher neutron energy of 5.54 MeV, the FOM was approximately 1 (see Figure 1). The results confirmed that neutrons were effectively discriminated from gamma-rays (see Figure 2). The study demonstrated that high neutron/gamma-ray discrimination capability was consistently achieved across all incident neutron energies ranging from 2.34 MeV to 5.54 MeV by integrating the induced waveform with a fast component time window set at 26 ns. Additionally, the obtained recoil proton pulse height energy spectrum as a function of light output was compared with MCNP simulation results, showing good agreement between the experimental data and simulations.

Keywords: Neutron/γ-ray pulse shape discrimination, EJ-301 liquid scintillator, TRIM Code, Fast Neutron Laboratory, Monte Carlo N-particle (MCNP) Code

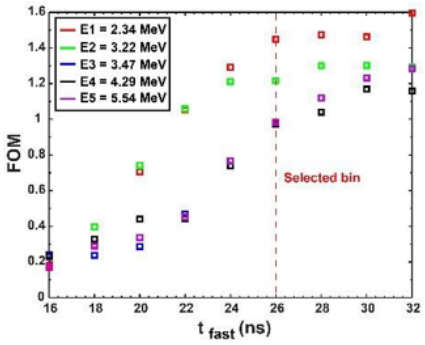

Figure 1: Variations in the FOM value as t_{fast} varies between 16 ns and 32 ns for experiments with neutron energies ranging from 2.34 MeV to 5.54 MeV.

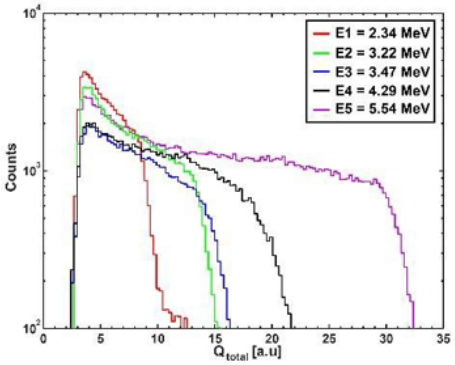

Figure 2: Histogram of recoil proton as a function of total charge.

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O22_NPR

Sensor-Driven Machine Learning Approaches for Identifying Plasma Position in Thailand Tokamak-1

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Abstract:
Accurate localization of plasma is essential for stability and operation control in fusion reactors. This work aims to overcome the constraints associated with traditional imaging methods in Thailand Tokamak-1 (TT-1). Specifically, it elevates our capability to identify plasma location in the millisecond scale beyond the limitations imposed by the 2000-fps frame rate of the Charged-coupled Device (CCD) camera. We have introduced an innovative machine learning method to improve precision and faster identifying plasma position and its radius.

Our approach combines a big data set from magnetic, inductive sensors and the CCD camera of the TT-1 plasma diagnostics with annotations produced by the YOLO [3] (You Only Look Once). The set of sensors in this study are 4-ch. flux loop voltage sensors, 4-ch. integration of flux loop voltage sensors, 24-ch. magnetic coil sensors and 1-ch. Rogowski coil. Data preparation required a crucial chronological alignment between sensor measurements and YOLO [3] annotations, accomplished using convert frame to time equations to provide synchronization across different data sources.

Our implementation of a multiple output regression model utilized CatBoost [1], a well-known gradient boosting method known for its effectiveness with categorical data and strong default settings. The hyperparameter tuning was performed using Optuna [2], a cutting-edge framework, in order to optimize the performance of the model.

It has been shown that Root Mean Squared Error (RMSE) are: 3.349 for center_x, 1.154 for center_y, and 1.322 for radius. These results signify a substantial improvement to the conventional approaches and set the CCD camera to the higher level.

The machine learning algorithms in this study has enabled us to visualize and widen the sensor capability. Using rigorous data preprocessing and Optuna-driven hyperparameter optimization [2], the CatBoost [1] model allows us to identify plasma location better. This methodology helps us to improve the plasma control system of TT-1.

Keywords: Machine learning, Thailand tokamak - 1, Plasma, Sensor driven, Fusion energy

References:
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O23_RAB

Optimization of Anthocyanin Induction in Butterfly Pea Using Full Factorial Design and Plasma Techniques

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Abstract:
This research aims to optimize the incorporation of anthocyanin into butterfly pea flowers using a chemical accumulation technique involving polymers. A full factorial experimental design was employed, consisting of 21 experiments with two replications and five center points, to investigate the effects of process duration, electrical power, and argon gas flow rate on anthocyanin incorporation. UV spectrophotometry was utilized to measure the anthocyanin content in butterfly pea flowers before and after plasticization. Optimal conditions were determined using a response optimizer and found to be a treatment time of 15 minutes, electrical power of 80 watts, and an argon gas flow rate of 1.1×10^{-1} Pa. Under these conditions, the predicted anthocyanin concentration was 209.9 mg/L.

Keywords: Full factorial design, Anthocyanin incorporation, Response optimizer, Butterfly pea flowers

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O24_FLI

Review of NO_3 UV Absorption Spectroscopy and Simulation of Reactive Species Diffusion in Atmospheric Pressure Plasma

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Abstract:
This work reviews the application of UV absorption spectroscopy for detecting nitrate radicals (NO_3) in atmospheric pressure plasma systems and develop a computational model to simulate NO_3 diffusion in the gas phase generated from atmospheric pressure plasma. NO_3, a reactive species with distinct UV absorption characteristics, is reliably quantified via spectroscopy for monitoring its concentration in plasma. The computational model combines fluid flow and species transport dynamics, accounting for diffusion and convection-reaction mechanisms, and captures essential parameters such as concentration gradients and diffusion rates. Integrating spectroscopy with simulation provides a comprehensive understanding of NO_3 behavior under plasma conditions, offering insights for optimizing plasma processes in its applications.

Keywords: Nitrate radicals (NO_3), UV absorption spectroscopy, Fluid flow model

O25_RAB

Evaluation in Phenotype and Genotype of Gamma Radiated Chili Pepper Using Molecular Techniques

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Abstract:
Evaluation in the phenotype and the genotype of gamma radiated chili pepper using molecular techniques was analyzed at Faculty of Agricultural Production and Faculty of Science, Maejo University, Chiangmai, Thailand. The experimental design was in the completely randomized design (CRD) in 7 treatments and each treatment contained with 3 replications/treatment, each replication contained with 10 plants/replication. In the results of the gamma radiation at 0, 100, 200, 300, 400, 500 and 600 gray were showed that doses of gamma radiation affected to the phenotype and genotype of chili pepper. There showed a significant statistical difference in the phenotype such as plant height, stem diameter, canopy diameter, number of fruits per plant, fresh weight per fruit and fruit width. Chili pepper radiated at 100 gray showed the highest of plant height, stem diameter, and canopy diameter in 73.3 cm, 6.8 mm., and 56.9 cm., respectively. At gamma 600 gray, there showed the highest of the number of fruits per plant in 4.0 fruits. For each fruit, the highest of the fresh weight was 1.5 g. at gamma 500 gray and the fruit width was 7.0 mm. in control. For the weight per plant and the fruit length, there were not differences. In addition, the chili pepper genotype detected by RAPD technique also show the difference in the genetic patterns too. Of 30 RAPD primers screening, 2 primers were showed in the polymorphism and the rest was in the monomorphism or no amplification. The total data of this study will be useful to radiation of chili pepper for breeding program in the future.

Keywords: gamma radiation, phenotype, genotype, chili pepper, molecular techniques

Poster

P01_FM

Adhesion properties of diamond-like carbon film and silicon interlayer deposited on DC53 cold wok tool steels

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Abstract:
The aim of this work is to investigate the adhesion properties of diamond-like carbon (DLC) [1] film deposited on cold work tool steels (DC53) using silicon layers as an interlayer. The silicon interlayer was fabricated using the pulsed DC magnetron sputtering technique with a pulse frequency of 50 kHz and a power of 150 W, 200 W and 250 W, while the diamond-like carbon film was prepared by the RF-PECVD method [2]. The deposition time for the silicon and diamond-like carbon films was 30 minutes each. The adhesion of the DLC coatings to the DC53 tool steels was examined using the scratch test. The result shows that the use of the silicon intermediate layer can significantly improve the adhesion properties.

Keywords: Diamond-like carbon film, Silicon interlayer, Cold wok tool steels, Adhesion properties, Scratch test

References :
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P02_FM

Preparation of potassium tungsten bronze particles by ball milling process for infrared and thermal shielding applications

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Abstract:
The increasing consumption of energy is a critical problem due to the impact of Near-infrared (NIR), also known as heat wave, on the economy and the environment. Potassium tungsten bronze, composed of metals like Li, Na, Cs, and K is a promising material for addressing this issue due to its optical properties, which enable the absorption of NIR radiation and transmission in the visible region. This research aims to synthesize potassium tungsten bronze particles using a simple high-energy ball milling method. The crystal structure of the particles (K_xWO_3) is examined using X-ray diffraction (XRD). The results, depicted in Fig. 1, show phase changes from the raw materials to the $K_{0.3}WO_3$ phase after milled at certain time of 5 hours. In addition, scanning electron microscopy and UV-Vis spectroscopy are used to study the surface morphology and optical properties in the visible light and NIR regions, respectively. The study will also explore the effects of high-energy ball milling under different milling times on the relevant properties of the prepared samples.

Keywords: Potassium tungsten bronze, Ball milling process, Near infrared shielding

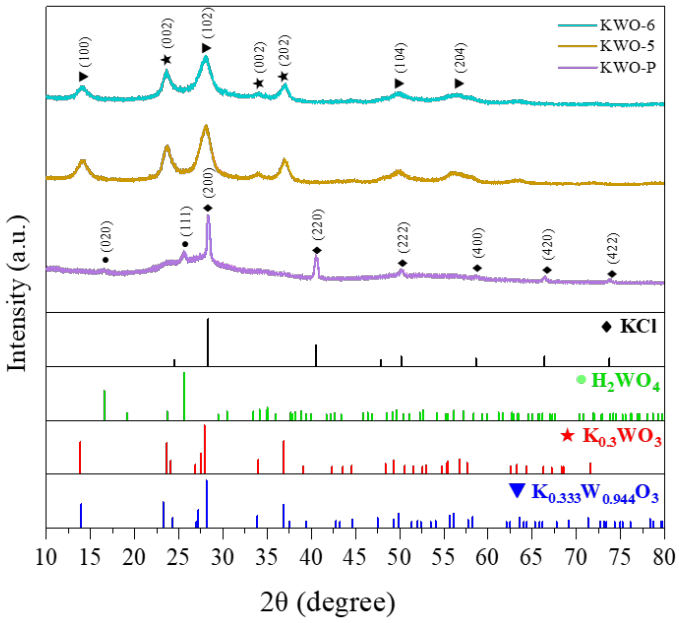

Figure 1. XRD patterns of potassium tungsten bronze prepared by ball milling process at different milling time of 5 hr and 6 hr.

P03_FM

Fabrication of composite carbon nanofibers with silver particles for high-quality membranes for antimicrobial water filtration

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Abstract:
In this study, carbon nanofiber (CNF) composites containing silver particles at varying silver-to-carbon ratios of 0%, 10%, 20%, and 40% (denoted as CNF, CNF@Ag-10, CNF@Ag- 20, and CNF@Ag-40, respectively) were fabricated using the electrospinning technique. Polyacrylonitrile (PAN) solutions, with silver nitrate ($AgNO_3$) as a precursor at concentrations of 10%, 20%, and 40%, were dissolved in dimethylformamide (DMF) to produce the fibers. These fibers were subsequently calcined to form carbon nanocomposites embedded with silver nanoparticles. The resulting fibers had average diameters ranging from 527 to 750 nm, with the silver nanoparticles measuring between 6 and 21 nm. The membranes derived from these fibers exhibited filtration rates of 7.9 to 14.3 cm^3/min and effectively inhibited Escherichia coli, Salmonella, and Enterobacter, achieving microbial reductions of 59.46% to 98.23%. The antimicrobial performance of the CNF@Ag composites was found to increase with higher silver doping concentrations.

Keywords: Carbon nanocomposite fibers, Membrane filtration, Electrospinning, Microbial inhibition

P04_MC

Impact of Gd_2O_3 addition on the radiation shielding properties of zinc barium borate glasses and the absorbed dose in the MRCP-AM phantom by Monte Carlo simulation

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Abstract:
Developing materials for use as shielding windows in diagnostic and therapeutic radiology rooms is crucial for protecting humans. The purpose of this research is not only to study the radiation shielding property of the glass but also to estimate the absorbed dose on the human body after using the glass. The Gd_2O_3 added with zinc barium borate glass samples were prepared by the melt-quenching method. The produced glass samples are ZBaBGd0.0, ZBaBGd2.5, ZBaBGd5.0, ZBaBGd7.5, and ZBaBGd10.0, respectively. The glass samples have been examined for their X/Gamma-rays shielding properties by PHITS Monte Carlo simulation. The radiation hazards to the human body before and after using shielding glass were also estimated by PHITS. The adult male mesh-type reference computational phantoms (MRCP-AM) were employed to represent the entire human body, including each organ's geometry, chemical composition, and densities. The absorbed dose of the MRCP-AM in diagnostic and therapeutic radiology rooms, which are the various tube voltages of the x-ray generator, was computed. The X-ray spectrum was generated by the SpekPy program with an anterior-posterior (AP) direction. The results found that the ZBaBGd10.0 sample exhibits superior shielding performance against x-rays and gamma rays compared to other standard shielding materials. The absorbed dose and the effective dose rate in MRCP-AM with shielding glass revealed significantly less harm than that without shielding glass. This work will improve realistic simulation in diagnostic and therapeutic radiology rooms.

Keywords: Shielding glass, Monte Carlo simulation, Gd_2O_3, MRCP-AM, X/Gamma-rays.

P05_MC

Investigation of the Structural, Thermal, Dielectric, and Physical Properties of Li_2O-B_2O_3-TeO_2 Oxide Glass was added with transition metals for Thermoelectric Applications

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Abstract:
In this research, Li_2O-B_2O_3-TeO_2 oxide glasses were synthesized, incorporating transition metals such as Bi_2O_3, MoO_3, and CuO in molar percentages calculated for all components. The melt quenching technique was used to synthesize this material at a temperature of 1200°C. This study aims to investigate the properties of these oxide glasses to assess their suitability for thermoelectric applications preliminarily. To achieve this, various properties were examined. The physical properties were characterized by determining the density and molar volume using Archimedes principles, with values of 4.63 g/cm³ and 48.28 cm³/mol, respectively. The structural properties were investigated using X-ray diffraction, which is indicative of an amorphous structure. Thermal properties were analyzed through thermal analysis techniques, examining the synthesized materials from room temperature up to 650 °C. This analysis revealed the thermal reactions occurring within this temperature range, which indicates the material's appropriate operational thermal range. Lastly, the dielectric properties were assessed using an LCR meter, with AC stimulation applied across the material at frequencies ranging from 100 Hz to 1 MHz. The results from this technique demonstrated that electron transfer occurs within the material, with comparisons made to previous studies. The data from these analyses help conclude whether the synthesized material is suitable for thermoelectric applications within specific temperature ranges.

Keywords: Amorphous Structure, Thermoelectric Materials, Dielectric Properties, Thermal Analysis

P06_MC

Enhanced Luminescence and Scintillation Properties of Tb^{3+}ion - Doped Tellurite Glasses for Potential X-Ray Screen Applications

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Abstract:
Glass compositions of (35-x)TeO_2: 40ZnO: 25B_2O_3: xTb_2O_3, with x values of 0.00, 0.50, 1.00, 2.00, 3.00, 4.00, and 5.00 mol%, were synthesized using the microwave melt-quenching technique. These glasses were analyzed for physical, structural, optical, and luminescent properties such as density measurement, molar volume, refractive index, absorption spectra, Fourier transform infrared (FTIR), X-ray diffraction (XRD), and photoluminescence. XRD analysis confirmed the amorphous nature of the glasses, using a Shimadzu XRD-6100 diffractometer. The absorption spectra showed three distinct peaks corresponding to Tb^{3+} ion energy transitions: $^7F_6 \rightarrow {}^5D_4$, $^7F_1$, and $^7F_3$ at 487, 1956, and 2221 nm, respectively. Photoluminescence spectra revealed that the glass exhibited its strongest luminescence at 543 nm ($^7F_5$) under 377 nm excitation, resulting in a green emission in the CIE 1931 chromaticity diagram. Under X-ray excitation, the glass containing 4.00 mol% Tb_2O_3 displayed the highest intensity of 543 nm emission among the Tb^{3+} ion-doped tellurite glasses, surpassing commercial $Bi_4Ge_3O_{12}$ (BGO) crystals. The integral scintillation efficiency of the glass was approximately 22.26% of that of BGO crystals. In addition, glass has been imaged for its emission under X-ray excitation as a potential application for an X-ray screen.

Keywords: Glass, Microwave melt-quenching technique, Terbium, Luminescence, X-ray Screen.

P07_MC

Analysis of Ce^{3+} obtained borophosphate glasses with different alkali oxide additives for scintillation applications

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Abstract:
A simple method for the manufacture of a clear and colorless CeF_3 contained alkali borophosphate glasses using the usual melt-quenching technique. Ce L_{III}-edge X-ray absorption near edge structure (XANES) spectra were acquired at the 8 beamline of the Thai Synchrotron National Lab, the 3+ oxidation state of cerium (Ce^{3+}) in CeF_3 at 5728.9 eV constituting to 5d→4f emission. The results obtained from the XANES measurements using Ce L_{III}-edge confirms the coexistence of the two valences Ce3+ and Ce4+ in the glass and revealing the predominant oxidation state of Ce in all glasses is 3+ ion. Various physical parameter such as density, molar volume, inter-ionic distance, field strength, etc., have been computed. Their optical properties were investigated by refractive index and optical transmittance. The characteristics Ce^{3+} emission and excitation were observed at 341 and 305 nm, respectively. From X-ray luminescence spectra, the integral scintillation efficiency was calculated and observed to be 41%, 50% and 54% for LiCe, NaCe and KCe glasses, respectively compared with the commercial bismuth germanate ($Bi_4Ge_3O_{12}$; BGO) scintillation. The decay times of these glass shows fast decay component was also observed as nanosecond (ns). The scintillation property of the CeF_3 containing different alkali oxide glasses was studied from total energy peak in the pulse height spectra of a ^{241}Am α-ray and the calculated alpha light yields of LiCe, NaCe and KCe glasses 15, 140 and 135 Ph/MeV under α-ray, respectively. Based on the result, these glasses may be used as scintillation materials in radiation detectors.

Keywords: XANES, Optical, Luminescence, Glasses

P08_MC

Characterization of $Ni_{0.475}Zn_{0.475}Li_{0.025}Al_{0.025}Fe_2O_4$ doped ($Ba_{0.91}Ca_{0.09}Ti_{0.916}Sn_{0.084}O_3$-0.1wt% ZnO-0.1wt% MnO_2) multiferroic composites ceramics prepared via the solid-state combustion technique

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Abstract:
The multiferroic composite ceramics of (1-x)[$Ba_{0.91}Ca_{0.09}Ti_{0.916}Sn_{0.084}O_3$-0.1wt%ZnO-0.1wt%$MnO_2$]-x[$Ni_{0.475}Zn_{0.475}Li_{0.025}Al_{0.025}Fe_2O_4$] [(1-x)BCTZMS-xNZLAF]; x = 0, 0.05, 0.10, 0.15 and 0.20 were prepared by the solid-state combustion technique. The effect of increasing x content on the phase formation, microstructure, dielectric, ferroelectric, ferromagnetic and magnetoelectric properties of (1-x)BCTZMS-xNZLAF were reported. X-ray diffraction patterns of BCTZMS showed a pure perovskite phase with orthorhombic (O) and tetragonal (T) phases. When NZLAF was added, the ceramics exhibited coexistence of phases between orthorhombic (O), tetragonal (T) perovskite, and cubic (C) spinel. The composite ceramics showed clearly separated large and small grains. The average grain size of the larger grains increased, while that of the smaller grains decreased as x increased. As x increased, the density decreased from 5.32 to 4.59 g/cm^3. The addition of NZLAF resulted in a decrease in the dielectric constant (ε), remnant polarization (P_r) and leakage current in the sample at x ≥ 15. The sample at x = 0.10 give the optimal electrical, magnetic and magnetoelectric properties (ε = 3852, P_r = 1.77 μC/cm^2, M_s= 3.66 emu/g and α_E = 7.01 mV/cm-Oe).

Keywords: Multiferroic, Ferroelectric, Solid-state combustion, Ferromagnetic, Magnetoelectric

P09_MC

A Novel Tb^{3+}/Dy^{3+} codoped fluoro-silicophosphate scintillating glass with energy transfer mechanism for solid state lighting and X-ray detecting materials

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Abstract:
Tb^{3+}/Dy^{3+} codoped oxyfluoro-silicophosphate scintillating glasses have been synthesized by melt-quenching process. The optical absorption spectra have shown mixing spectra between Tb^{3+} and Dy^{3+}. With increasing of Dy_2O_3 concentrations, the absorbance was enhanced as per Beer-Lamber law. The emission spectra have been measured under excitation at 214 nm for investigating the energy transfer mechanism. The $^5D_4 \rightarrow {}^7F_5$ transition has appeared due to direct emission of Tb^{3+} whereas the $^4F_{9/2} \rightarrow {}^6H_{15/2}$ transition has occurred due to the energy transfer from Tb^{3+} to Dy^{3+}. The prediction Tb^{3+} to Dy^{3+} energy transfer probability values and the energy transfer coefficient have shown an increment as a function of Dy_2O_3 concentrations.

The CIE chromaticity color coordinates were used to confirm the yellowish-green emission color of Tb^{3+}/Dy^{3+} codoped scintillating glasses in this work which has been pointed out for its potential application as a solid-state lighting material. Besides, the integral scintillation efficiencies of glasses have been evaluated and compared in the similar wavelength region with commercial $Bi_4Ge_3O_{12}$ scintillation crystal by X-ray induced luminescence measurement. It was indicated the appropriate potential to be X-ray detecting material.

Keywords: Energy transfer, Fluoro-silicophosphate scintillating glass, $Tb^{3+/}Dy^{3+}$, X-ray induced luminescence, Yellowish-green emission

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P10_MC

Preparation and Photocatalytic Activity of ZnO Nanoparticles

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Abstract:
The ZnO nanoparticles were synthesized by the co-precipitation method for use as photocatalytic materials. X-ray diffraction (XRD) analysis revealed that the sample had a particle size in the nanometer range. The synthesized nanoparticles, which were calcined at 350°C, exhibit a crystallite size of 52.5±27.21 nm and have a hexagonal wurtzite crystal structure. Transmission electron microscopy (TEM) and energy dispersive spectroscopy (EDS) were used to determine the morphology of the particles and the chemical composition of the sample. The results clearly show the accumulation of uniformly rectangular ZnO nanoparticles. The EDS analysis confirms the presence of the main elements zinc (Zn) and oxygen (O) without impurity elements. To determine the specific surface area and pore volume of the ZnO nanoparticles, the isothermal nitrogen adsorption-desorption measurement was performed. The BET technique revealed that the ZnO nanoparticles have a specific surface area of 13.40 ± 0.04 m^2/g with an average pore diameter of 37.10 nm. The photoluminescence properties of the ZnO nanoparticles were investigated by photoluminescence (PL) spectroscopy, which was performed in the wavelength range of 200-800 nm with an excitation energy at a wavelength of 345 nm. The result showed that the PL peak in the UV region was caused by the aggregation of excitons, which is due to the high exciton binding band (60 meV) of ZnO and leads to the emission of UV light.

Keywords: Photocatalytic, ZnO Nanoparticles, Co-precipitation, Photoluminescence

P11_MC

Effect of Diatomite on Porous Structure and Plant Growth-Promoting Fungi Immobilization in Calcined Clay Pellets

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Abstract:
Calcined clay pellets have gained popularity as a versatile planting material, particularly favored by pot gardening enthusiasts due to their excellent water retention, aeration properties, and ability to support healthy root development in various plant species. In this study, calcined clay pellets were composed of clay (C), phosphate rock (PR), rice husk ash (RHA), and diatomite (D). The formulation used was [(17.5C–17.5PR–0.65RHA)–xD], where x(D) represented diatomite contents of 0, 5, 10, 15, and 20 wt%. The effect of x contents on phase formation, microstructure, porosity, water absorption and density of samples were studied. X-ray diffraction analysis revealed the presence of typical mineral phases, including quartz, illite, and kaolinite, in all samples. SEM images showed irregular packing and a highly porous microstructure across the samples. As the diatomite content (x) increased, the porosity of the microstructure became more pronounced. Consequently, the surface area increased from 9.91 $m^2 \cdot g^{-1}$ to 23.78 $m^2 \cdot g^{-1}$, and the pore volume rose from 0.023 $cm^3 \cdot g^{-1}$ to 0.026 $cm^3 \cdot g^{-1}$. At the same time, the sample density slightly decreased as the diatomite content increased. The potential of calcined clay pellets to support plant growth-promoting fungi was investigated. The findings revealed that orchid endophytes, which are known to promote plant growth, thrived on the calcined clay pellets saturated with potato dextrose broth (PDB). Furthermore, all tested fungi remained viable on the pellets after inoculation. These results indicate that calcined clay pellets can effectively serve as a planting medium that simultaneously supports plant growth through its nutrients and growth-promoting fungi.

Keywords: Calcined Clay Pellets, Plant Growth-Promoting Fungi, Diatomite, Porosity, Water Retention

P12_MC

Enhanced dielectric, ferroelectric, and ferromagnetic properties of $Ba_{0.97}Ca_{0.03}Ti_{0.94}Sn_{0.06}O_3$-$Mn_{0.85}Zn_{0.15}Ni_{0.15}Fe_2O_4$ multiferroic ceramic composite

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Abstract

Multiferroic composites with general formular (1-x)($Ba_{0.97}Ca_{0.03}Ti_{0.94}Sn_{0.06}O_3$)-x($Mn_{0.85}Zn_{0.15}Ni_{0.15}Fe_2O_4$) (x=0, 0.1, 0.2, 0.3, 0.4 and 0.5) were prepared using a solid-state combustion method, and their structure, morphology, electrical (dielectric and ferroelectric), magnetic, and magnetoelectric properties were investigated. The samples were sintered at 1300 ºC for 2 h. The X-ray Diffraction (XRD) patterns have predicted the tetragonal perovskite, orthorhombic perovskite and cubic spinel structures of BCTS and MZNF. When x > 0.2, the second phase appeared in the sintered samples. The grain growth up phenomena was seen with increasing MZNF content in composites. The dielectric constant of the samples showed an overall decreasing trend with the amount of substitution after a sharp drop in the low frequency band and trended to be stable in the high frequency band. The density, saturated magnetization (M_s) and magnetoelectric coupling increased with increased MZNF content.

Keyword: BCTS-MZNF, Multiferroic, Solid-state combustion, Ferroelectric, Ferromagnetic

P13_MC

Physical and optical properties of tungsten doped ZnO particles prepared via co-precipitation method

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Abstract:
In this study, tungsten (W)-doped ZnO particles were synthesized with varying W dopant concentrations using the co-precipitation method. The crystallinity of the synthesized powders was characterized by X-ray diffraction (XRD), while the surface morphology was examined using field-emission scanning electron microscopy (FESEM) coupled with energy-dispersive X-ray spectroscopy (EDS) for elemental analysis. The optical properties of both the synthesized powders and the prepared thin films based on the synthesized particles were analyzed using a diffuse reflectance spectrophotometer. The results indicated that W doping significantly influences not only the physical but also the optical properties of the ZnO hexagonal structure. Additionally, optical shielding performance of the prepared thin films was evaluated using a custom-built device with a lamp simulating solar radiation and the corresponding performance was determined. Further details of results and discussion will be presented.

Keywords: W-doped ZnO, Co-precipitation, Optical property

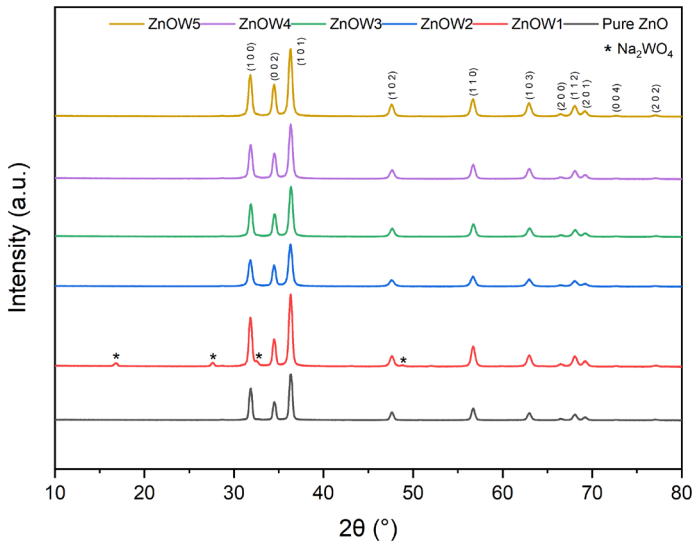

Fig 1. XRD patterns of ZnO doped with different W doping contents prepared by co-precipitation process.

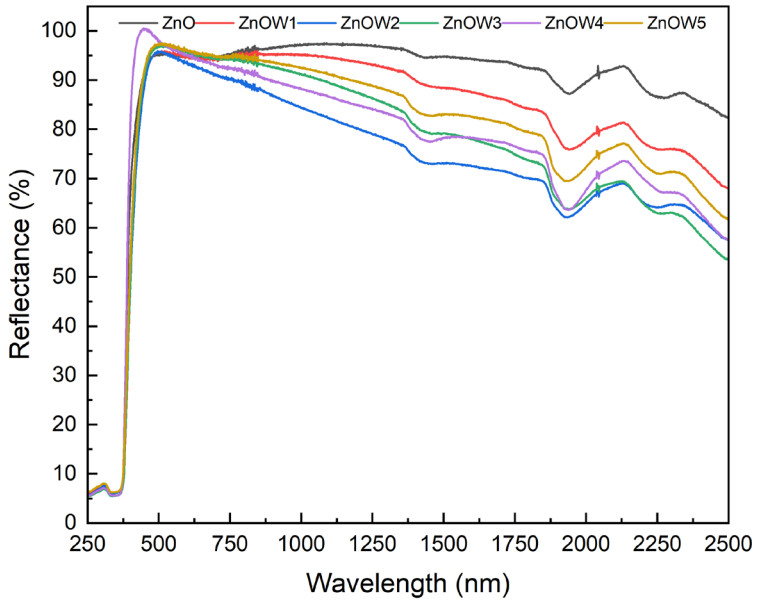

Fig 2. UV-Vis-NIR diffuse reflectance spectra of ZnO doped with different W doping contents

P14_MC

Polyvinylpyrrolidone/chitosan/nanocellulose Composite Films for Soluble Material Applications

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Abstract:
The suitable materials for transdermal drug delivery using microneedles were selected based on their soluble properties, including excellent degradability, biocompatibility, and ease of preparation. To study the performance of soluble and eco-friendly materials, a polymer composite consisting of polyvinylpyrrolidone, chitosan (CS), and nanocellulose was identified as a potential candidate. Polyvinylpyrrolidone (PVP) was chosen for a polymer matrix due to its excellent solubility, particularly in water, making it the core material for the structure of soluble microneedles. Chitosan (CS) and nanocellulose (NC) were incorporated into the PVP matrix as natural reinforcement phases owing to biocompatibility, antimicrobial properties, and excellent film-forming capability. The PVP/CS/NC composite films were synthesized by a solution casting method with varying ratios of CS to NC at 1:9, 3:7, 5:5, and 7:3. The structural and surface morphology of the PVP/CS/NC films were characterized using optical microscope, scanning electron microscope (SEM), and FTIR spectroscopy. The mechanical and thermal properties of the composite films were investigated by Vickers microhardness testing and thermogravimetric analysis (TGA). The preliminary results revealed a well-dispersed arrangement of natural fillers in the PVP matrix. The identical FTIR spectra across different CS:NC ratios in the PVP composite indicated a consistent phase alignment with the PVP matrix. Good thermal stability and high strength of the PVP/CS/NC composite were improved by comparing it to a bare PVP film. Furthermore, the solubility properties, swelling parameter, and encapsulation efficiency of the composite films exhibited were significantly enhanced by the influence of the CS and NC phases within the PVP structure.

Keywords: Polyvinylpyrrolidone, Chitosan, Nanocellulose, Nanocomposites, Soluble materials

P15_MC

Reflux-Hydrothermal Synthesis and Comprehensive Characterization of rGO-SnO_2/SnS_2 Nanohybrids

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Abstract:
In this study, reduced graphene oxide (rGO) decorated with SnO2/SnS2 nanohybrids was successfully synthesized using a reflux-hydrothermal method. The structure, morphology, elemental composition, and specific surface area of the resulting materials were comprehensively characterized through various X-ray and electron-based techniques, including X-ray diffraction (XRD), field emission scanning electron microscopy (FESEM), energy-dispersive X-ray spectroscopy (EDS), and Brunauer–Emmett–Teller (BET) analysis. XRD analysis confirmed the presence of composite phase structures corresponding to SnO2 (JCPDS no. 041-1445), SnS2 (JCPDS no. 023-0677), and rGO. BET analysis revealed a high specific surface area, while EDS confirmed the presence of all expected elements. FESEM images revealed well-defined spherical morphologies, with an average particle size of approximately 10 nm for the SnO2/SnS2 nanohybrids.

Keywords: Nanohybrids, Hydrothermal, SnO2/SnS2, High specific surface area

P16_MC

Hydrothermal Synthesis of Ultrafine n-n SnO_2/SnS_2 Structure: Effect of Reaction Time on Physical Properties

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Abstract:
In this research, pure tin oxide (SnO_2) and tin oxide/ sulfur oxide (SnO_2/SnS_2) n-n structure were successfully synthesized using a straightforward hydrothermal method. The structure, morphology, elemental composition, and particles size distribution of the resulting materials were thoroughly characterized through various X-ray and electron-based techniques, such as X-ray diffraction (XRD), field emission scanning electron microscopy (FESEM), energy-dispersive X-ray spectroscopy (EDS), and particles size analysis (PSA). XRD results confirmed the formation of composite phase structures corresponding to SnO_2 (JCPDS no. 041-1445) and SnS_2 (JCPDS no. 023-0677). FESEM images showed well-defined spherical morphologies with an average particle size of approximately 15–20 nm for the SnO_2/SnS_2 structure, and EDS analysis verified the presence of all expected elements.

Keywords: n-n structure, Hydrothermal, Physical properties, SnO_2/SnS_2

P17_MC

Influences of Gamma Radiation and Sputtering Power on the Optical and Electrical Properties of Indium Tin Oxide Films

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Abstract:
In this work, the effects of gamma radiation and sputtering power on the optical and electrical properties of indium tin oxide (ITO) films were investigated. The ITO films were deposited using direct current (DC) sputtering at power of 10 and 20 watts, with a thickness of 200 nm. These films were subsequently irradiated with varying doses of gamma radiation, ranging from 0 to 150 kGy. The results showed that intensity of the XRD peaks at the sputtering power of 10 watt increased after gamma radiation at 50 kGy and then continuously decreased at 100 and 150 kGy. However, at the sputtering power of 20 watt, the intensity of the XRD peaks decreased as the gamma radiation dose increase. Moreover, optical transmittance and energy bandgap of ITO films decreased as the gamma radiation dose increased. Additionally, the resistivity of the ITO films for sputtering power of 10 and 20 watts increased with gamma radiation doses These findings suggest that both the deposition power and the gamma radiation dose play significant roles in altering the properties of the ITO films.

Keyword: Gamma radiation, Indium tin oxide, Morphology, Optical and electrical properties.

P18_PA

Strategic policies for advancing emerging low-carbon technologies: The case of plasma solutions for decarbonizing challenging sectors

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Abstract:
Recent academic interest in plasma technologies is driven by their significant potential to address the growing demand for energy with minimal carbon emissions. For example, plasma arc gasification can convert waste feedstock such as biomass, hazardous waste, or municipal solid waste into synthetic gas (syngas) for electricity generation or as a fuel. Similarly, plasma-assisted methane reforming can transform various feedstocks into valuable products like hydrogen, which serves as a sustainable energy carrier. Moreover, plasma technologies offer enhanced energy efficiency, high power densities, and the potential to create new markets for energy storage and distribution through manufacturing advanced materials for batteries and supercapacitors or hydrogen-ammonia and ammonia-hydrogen conversion.

Plasma technologies are well-established in industries like semiconductor manufacturing and surface treatment, while also showing significant potential in water purification and sterilization within the healthcare and food sectors. Their characteristics are especially valuable in decarbonization-challenged sectors like aviation and maritime, where high-temperature plasma processes can produce hydrogen or synthetic fuels for cleaner propulsion systems, significantly reducing global carbon emissions. Additionally, plasma-assisted combustion can enhance the efficiency and reduce emissions of internal combustion engines in these sectors.

However, a low-carbon transition involves more than just technological advancements; it requires significant shifts in labor markets, cost distribution, energy geopolitics, resource security, and supply chain structures. These broader implications are evident in the power sector and are increasingly important in other sectors as the transition progresses. Managing these multiple issues is critical, especially given that approximately 50% of the global emission reductions needed for net zero are expected to come from technologies that are not yet commercialized [1]. Thereby, recognizing their potential in strategic initiatives and addressing broader implications of this transition is essential for achieving significant progress in environmental sustainability and economic resilience.

When devising strategic initiatives for the advancement of novel technologies, it is crucial to consider the unique opportunities these technologies present. This involves prioritizing development in areas where existing low-carbon energy technologies are inadequate or less effective. For instance, plasma technologies offer high energy densities and may be used ‘on the fly’ by simply turning a plasma reactor on and off. Given that plasma-based solutions in many polluting industries are still in the development phase and not yet ready for commercialization, it is essential to focus on strategic policies that support early-stage research and development. To address this, the article aims to evaluate current strategic policies and explore new approaches to accelerate the market adoption of these promising technologies.

Keywords: Plasma technologies, Low-carbon transition, Challenging sectors, Strategic policy initiatives

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P19_PA

Effect of multiple cylinder-type DBD plasma gas on soil microorganisms and plant growth

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Abstract:
Microorganisms are major in soil [1]. They play a harmful role by acting as potential plant and animal pathogens, or a beneficial role by promoting plant growth and nutrient recycling [2]. Reducing soil-borne disease risks and preserving soil fertility can be accomplished by managing soil microorganisms. In our study, we examined the potential of gas generated from plasma devices with multiple cylinder-type DBD electrodes in controlling microorganisms and promoting soil fertility. Results demonstrated that composition of soil microorganisms in a community were not significantly changed after plasma gas treatment although there was a trivial change in the relative abundance of several bacterial and fungal species. The viability of total bacterial and mesophile bacteria on R2A and PCA media was significantly reduced by approximately 10 – 30 % after soil was treated with plasma-generated gas for at least 30 minutes. No significant change in fungal viability on PDA media was observed. Simultaneously, soil treated with plasma gas for 30 minutes could promote spinach growth. H_2O_2 and NO levels and electrical conductivity significantly increased in plasma gas-treated soil.

Keywords: Non-thermal plasma, Soil microorganisms, Soil fertility

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P20_PA

Electrical Property of Silk Sheet after Plasma Treatment

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Abstract:
This study investigates the effects of plasma treatment on the surface of silk proteins, particularly in terms of electrical properties such as electric induction and capacitance. Two types of silk fibers were analyzed: native silk and degummed silk. Plasma treatment was applied to modify the surface properties, enhancing electrical characteristics. The results show that plasma-treated silk demonstrated significantly improved electric induction compared to untreated silk. Specifically, plasma treatment increased surface charge density, contributing to higher electric induction and capacitance. For native silk, plasma treatment increased electric induction by approximately 40%, while degummed silk showed a 35% improvement. Removing sericin during degumming led to better electrical performance in both treated and untreated samples, as degummed silk exhibited lower resistivity and higher dielectric properties than native silk. In comparing treated and untreated samples, plasma-treated silk fibers, whether degummed or native, showed a marked increase in capacitor-like behavior due to enhanced surface polarization. These findings suggest that plasma surface treatment can effectively improve the electrical properties of silk proteins, making them more suitable for applications in bioelectronics and flexible electronic devices. The study highlights the importance of both degumming and plasma modification in optimizing silk's electrical performance, offering new opportunities for silk-based materials in emerging technologies.

Keywords: Silk sheet, Degumming, Plasma treatment, Conductivity, Electrical property

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P21_PA

Improvement of Antioxidant Activity of Sericin by Plasma Treatment

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Abstract:
Plasma treatment is an emerging technique for enhancing the extraction of sericin, a valuable protein found in silk cocoons, and for improving its antioxidant properties. This study investigates the effects of plasma treatment on silk cocoons, focusing on the extraction efficiency of sericin and its subsequent antioxidant activity. Plasma treatment, using a cold plasma system, alters the surface properties of the silk cocoon, resulting in improved penetration of solvents and increased yield of extracted sericin. The plasma-treated silk cocoon exhibits a significant increase in sericin content compared to untreated samples, as evidenced by biochemical analyses. Moreover, the extracted sericin demonstrates enhanced antioxidant activity, which is likely due to the plasma-induced modification of the silk cocoon structure, leading to exposure of more functional groups that can interact with free radicals. The increased antioxidant activity was confirmed through various assays, including DPPH and ABTS radical scavenging assays, which showed a higher percentage of radical inhibition in plasma-treated samples. These findings suggest that plasma treatment is an effective method for optimizing sericin extraction from silk cocoons and enhancing its bioactive properties, particularly antioxidant activity. The enhanced antioxidant potential of sericin extracted from plasma-treated silk cocoons may have significant implications for its use in biomedical, cosmetic, and food industries, where natural antioxidants are highly valued (Zhang et al., 2023). Further research could explore the underlying mechanisms of plasma-induced modifications and optimize treatment conditions to maximize both yield and functionality of sericin.

Keywords: Sericin, Antioxidant, Silk cocoon, Plasma treatment

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Zhang, Y., Li, X., Wang, J., & Chen, Z. (2023). Effects of plasma treatment on sericin extraction and antioxidant activity from silk cocoons. *Journal of Applied Polymer Science, 140*(3), 1-12. https://doi.org/10.1002/app.12345.

P22_APB

The effects of focused 1-MeV proton beam irradiation on linear low density polyethylene film

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Abstract:
Polyethylene (PE) is one of the most common polymers typically used in various industries such as packaging, construction industry, textile manufacturing, etc. [1] The underlying reasons behind its wide applications are not only the manufacturing process that allows chemically modify its bulk properties, but also its versatility, biocompatibility and cost-effectiveness. In light of the rapid development of micro/nano technologies, it has opened a broad spectrum of research fields to miniaturize the physical system down to micron or sub-micron regimes. Radiation by high-energy particles or photons has been well-studied to be the effective approach for this demand. It, however, wouldn't have been possible if the interactions between these radiations with materials hadn't been investigated for appropriate effects and applications. Some studies showed the irradiated-induced effects on PE characteristics such as mechanical changes by electrons and protons [2] or structural and optical properties by protons and heavy ions [3]. On the other hand, the locally microscopic modification by the focused radiation on this polymer could also lead to new applications. In this work, we applied the focused 1-MeV proton beam writing at Shibaura Institute of Technology to locally modify a thin film of linear low-density polyethylene (LLDPE). The LLDPE film was created by spin coating of 2.5%wt solution on a heated Silicon wafer with the size of 7.5 mm x 7.5 mm. The final polymer thickness was approximately ~8 μm. The ~1 μm x ~1 μm beam spot was used to micropattern 30-μm diameter circles with different fluences between 50-5000 nC/mm^2. The irradiation- induced effects on structural and chemical properties were subsequently investigated. The morphological changes were characterized by atomic force microscopy while degrees of chemical modification were analyzed by micro-Fourier transform infrared spectrometry. Results indicated that LLDPE films were both physically and chemically modified by the proton bombardment and these irradiation-induced changes will be discussed.

Keywords: Proton beam writing, Linear low density polyethylene, Ion modification

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P23_RD

Charged particles and scintillation properties in $CaF_2(Eu)$ scintillators using Compton coincidence technique

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Abstract:
The experimental Compton coincidence technique (CCT) was performed using a Cs-137 gamma source (662 keV) in a $CaF_2(Eu)$ scintillator, with the results compared to those obtained from a BGO scintillator. Measurements of electron energy resolution, light yield, and electron nonproportionality were conducted at seven scattering angles ranging from 30° to 120°. Additionally, the mass stopping power (MSP) and projected range (PR) were calculated using the SRIM program. The mass attenuation coefficient (MAC) and effective atomic number (Z_{eff}) were also investigated across the same gamma energy range using the WinXCom program. The results indicated that both the MAC and Z_{eff} were dependent on energy, decreasing as photon energy increased. The nonproportionality exhibited good proportionality across the entire electron energy range and demonstrated promising agreement with theoretical values.

Keywords: Compton coincidence technique, Scintillator, Energy resolution, Nonproportionality

P24_RD

Impact of firing conditions on phase formation, microstructure, dielectric and ferroelectric characteristics of BCZT-$Li_{0.3}Y_{0.3}$ ceramics prepared using the solid-state combustion technique

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Abstract:
In this research, the effects of firing conditions on phase formation, microstructure, dielectric and ferroelectric characteristics of BCZT-$Li_{0.3}Y_{0.3}$ ceramics prepared using the solid-state combustion technique with glycine as fuel have been investigated. All samples were calcined at 1150°C to 1300°C for 2 h and sintered at 1350°C to 1450°C for 2 h. Pure BCZT-$Li_{0.3}Y_{0.3}$ powders were produced after calcination at 1300°C for 2 h. Particle agglomeration and average particle size in the BCZT-$Li_{0.3}Y_{0.3}$ powders increased as the calcination temperature rose. For the XRD result, all the ceramics exhibited a coexisting phase between tetragonal and orthorhombic. The ceramic grain size tended to increase with increase of the sintering temperature. The BCZT-$Li_{0.3}Y_{0.3}$ ceramic produced at the optimum sintering temperature (1400°C for 2 h) showed good crystalline morphology, the highest density, the highest dielectric constant and good ferroelectric behavior.

Keywords: Solid-state combustion technique, Perovskite, Dielectric, Piezoelectric

P25_RD

The Synthesis of Radiochromic Film using Polyvinyl Alcohol Solution Casting with Photosensitive Compounds

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Abstract:
Conventional radiation measurement methods, such as Geiger-Müller Counter, Ionization Chamber, Thermoluminescent Dosimeter, and others, reveals their effectiveness in measuring radiation at a specific point. In practical applications, a method that can measure radiation distributed across multiple points in a desired area is called Radiochromic Film. This type of film can identify areas and radiation doses received. The process of creating radiation measurement films using polyvinyl alcohol (PVA) involves utilizing the properties of PVA to form thin films capable of absorbing chemicals and responding to radiation efficiently. The process begins with preparing a PVA solution by dissolving PVA at a temperature of 90°C. Photosensitive compounds, such as Methylene Blue, Methyl Red, Crystal Violet, Congo Red, and Thymol Blue, are then added. Among these, Methylene Blue is the most suitable for gamma radiation measurement due to its high sensitivity and clear color change from blue to colorless. The solution is then heated at 50°C for 24 hours. This film changes color when exposed to gamma radiation, and the intensity of the color correlates with the amount of radiation absorbed. The created film is then analyzed for surface texture and thickness using an Optical Microscope. The size and shape of the particles are examined through Scanning Electron Microscope techniques, while the color change is analyzed using UV-Vis Spectroscopy. The film's optical density, in relation to the amount of radiation received, enables the assessment of radiation doses delivered to different areas.

Keywords: Radiation Measurement, Radiochromic Film, Polyvinyl Alcohol (PVA), Gamma Radiation, Methylene Blue

P26_RD

Graphene-wrapped iron/PVDF composites as X-ray radiation shield

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Abstract:
In general, the high-density materials such as lead, iron, or bismuth is utilized as X-ray radiation shield. However, heavyweight and inflexible properties of these materials make the various applications impractical. Polyvinylidene fluoride (PVDF) is a lightweight and flexible material. However, PVDF has poor X-ray radiation shielding properties. Although, some researchers can enhance the X-ray radiation shielding properties of PVDF by synthesis of graphene/ PVDF composite [1], its X-ray radiation shielding properties is still not good enough. In this study, we synthesized graphene-wrapped iron/ polyvinylidene fluoride composites and studied their X-ray shielding properties. For the synthesis of graphene-wrapped iron, the 9 g sugar, 9 g ferric chloride and 15 ml deionized water were mixed and dried in a hot air oven at 90 °C for 24 hours. After that, the sample was transferred into the quartz tube and heated at 700 °C for 6 hours under argon ambience. Thereafter, the sample was rapidly cooled down to room temperature. For the synthesis of graphene-wrapped iron/PVDF composites, the graphene-wrapped iron and PVDF powder were mixed and heated at 190 °C for 1 hour. The samples were pressed to various thickness. The structure of graphene, such as thickness and interlayer spacing, was revealed by X-ray diffraction. The grain size of graphene was measured using Raman spectroscopy and scanning electron microscope. The %weight of iron inside the sample was determined by energy dispersive X-ray analysis. For the characterization of the X-ray shielding properties, A copper tube in the X-ray diffractometer was used as an X-ray source with the wavelength of 1.54184 Å. The X-ray beam was diffracted on (002) plane of graphene foam (2θ ~25.6°) before passing through the sample and detector. Figure 1 displays the X-ray diffraction patterns with and without the graphene-wrapped iron/ polyvinylidene fluoride composite. The X-ray intensity decreased 98.15% after the X-ray beam passed through the graphene-wrapped iron/ polyvinylidene fluoride composite with the thickness of 1.110 mm.

Keywords: Graphene, Iron, Polyvinylidene fluoride, X-ray, Radiation shield

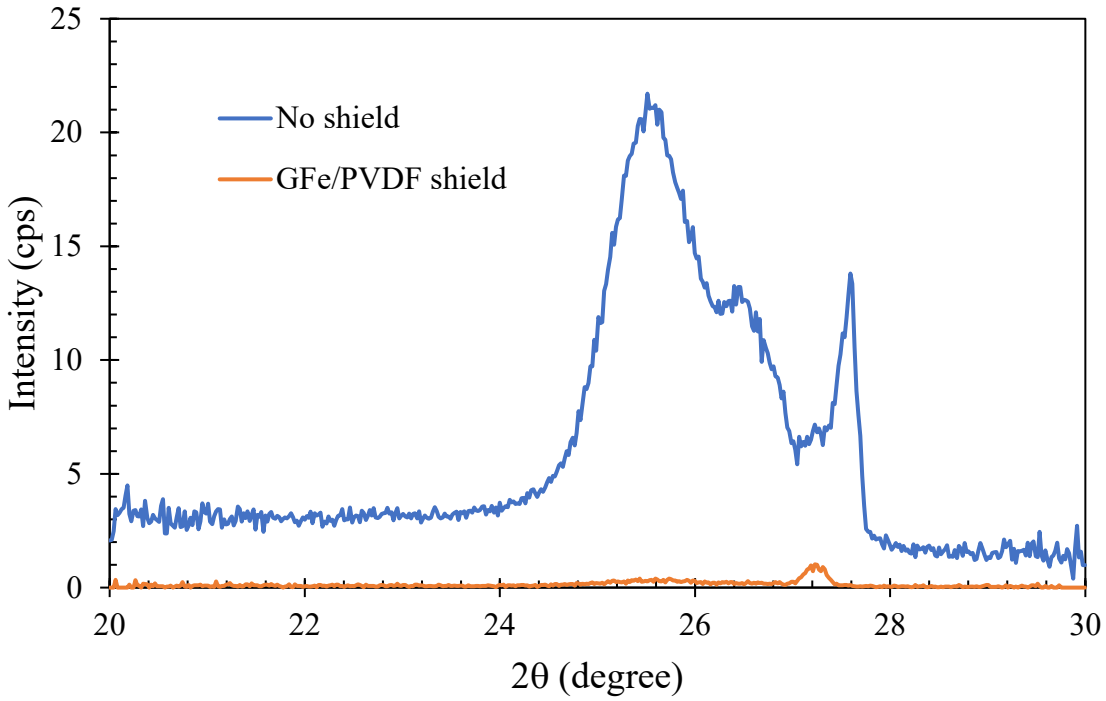

Figure 1. X-ray diffraction pattern with and without GFe/PVDF shield

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P27_RAB

The possibility study of ^{18}F-FAPI and ^{18}F-NOTA-Octreotide synthesis using a multipurpose synthesizer CFN-MPS100 for cancer diagnosis via molecular imaging

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Abstract:
The production of Fluorine-18 (^{18}F) radiopharmaceuticals, as a complex protein molecule for molecular cancer diagnosis, can utilize a new production method called Aluminum-[^{18}F] Fluoride (Al^{18}F). This method is convenient, involves simple chemical reactions, requires less synthesis time, and does not need high temperatures or highly acidic or basic chemicals. This research has developed a program and synthesis system for the semi-automatic radiopharmaceutical synthesizer CFN-MPS100 for the production of radiopharmaceutical using the new technique. The focus was on synthesizing new radiopharmaceuticals of interest, ^{18}F-FAPI [1] [2]. However, due to patent issues with the precursors, the system was extended to develop the synthesis of ^{18}F-NOTA-Octreotide, which also uses the AlF technique [3].

In non-radioactive (Cold) tests, the synthesis process was almost complete in all steps. Subsequently, radioactive (Hot) tests revealed that the highest activity loss occurred during the transfer of the radiopharmaceutical to the C18 cartridge (58.3% of the initial radioactivity in the reactor (n = 3)), potentially due to incomplete chemical reactions between Aluminum Fluoride (Al^{18}F) and the NOTA-Octreotide precursor, resulting in a significant amount of free Al^{18}F. Quality analysis of the radiopharmaceuticals produced showed 4-6 measurable substances with at least 2 identifiable radiopharmaceutical peaks (n=3), though it was unclear if the desired substance was produced. Residual solvent analysis indicated high levels of acetonitrile, while ethanol levels were within the acceptable range for a protein-type radiopharmaceutical (5.6 – 10.2 %V/V).

In the future, the knowledge and experience gained from this research, along with an improved radiopharmaceutical synthesizer, will enhance the development of ^{18}F-FAPI and ^{18}F-NOTA-Octreotide production locally. This will provide patients and physicians in Northern Thailand with access to specific and sensitive molecular cancer diagnostics probes in which the ongoing production of other radiopharmaceuticals, such as ^{18}F-FDG, ^{18}F-PSMA1007, and ^{18}F-NaF, has done.

Keywords: Synthesis of ^{18}F-FAPI radiopharmaceuticals, Synthesis of ^{18}F-NOTA-Octreotide radiopharmaceuticals, Aluminum-[^{18}F] Fluoride method, Radiopharmaceuticals for molecular cancer diagnosis, Neuroendocrine tumor cancer diagnosis, Neuroendocrine tumors (NETs) cancer diagnosis.

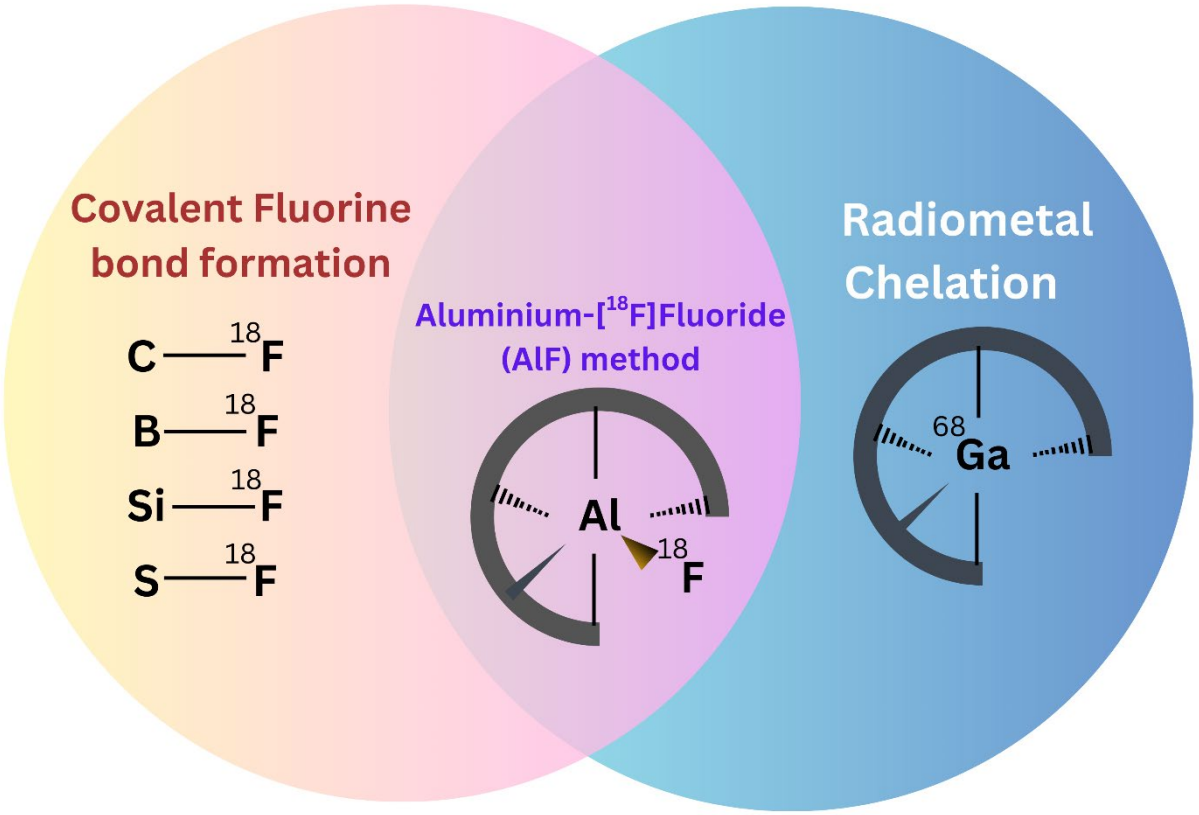

Figure 1. A schematic of Aluminum-[^{18}F]Fluoride method and traditional radiolabeling methods of PET (Positron Emission Tomography) radiopharmaceuticals molecules.

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P28_RAB

Effects of Gamma Radiation and Plasma Treatment on Growth, Morphological Characters, and Agronomic Traits of Jerusalem Artichoke at Seedling and Mature Stages

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Abstract:
This research examines the influence of gamma radiation and plasma treatment on the growth morphological characters and agronomic traits of Jerusalem artichoke at seedling and mature stages. Different parts of Jerusalem artichoke tubers were subjected to various gamma radiation doses (0, 10, 20, 30, 40, and 50 Gy) and plasma treatment durations (0, 30, 60, 90, and 120 seconds). The irradiated tubers were then planted in 2- and 12-inch plastic pots under a greenhouse condition to monitor their growth and development. Parameters evaluated included germination rate, plant growth and morphology (height, stem diameter, leaf area, leaf color, and flower number), photosynthetic efficiency (chlorophyll content), and agronomic traits (number of tubers, tuber weight, tuber size, tuber yield, Brix, and inulin content). Statistical analysis was conducted to determine significant differences between radiation treatments and control groups. The findings of this study provide valuable insights into the effects of radiation on Jerusalem artichoke and may inform future efforts to develop improved cultivars with enhanced productivity and nutritional value.

Keywords: *Helianthus tuberosus*, Gamma radiation, Plasma treatment, Morphological characteristics, Tuber yield

P29_RAB

Effectiveness of Microwave irradiation in Reducing Microbial Load on *Wolffia globosa*

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Abstract:
Wolffia (*Wolffia globosa*), a water meal, is a small flowering plant that thrives in natural wetlands, particularly in Thailand's northern and northeastern regions. Wolffia is in high demand, especially in the plant-based food and alternative protein trend, because it yields high plant-based protein, leading farmers to cultivate it in various natural water sources, such as earthen ponds, cement ponds, and plastic containers, including closed-system farms. Wolffia can be consumed fresh and dried, with the dried product commanding a significantly higher market price, making it a lucrative venture for farmers. Additionally, drying extends the product's shelf life and allows for broader distribution. Wolffia is commonly processed into dried products using hot air ovens, a simple and low-cost method. However, this technique can take more than 10 hours, resulting in a brown coloration due to excessive external heat applied to remove moisture. Furthermore, this method must adequately reduce microbial levels to meet safety standards, mainly since fresh Wolffia is sourced from diverse cultivation environments.

To address these issues, our team focused on developing microwave drying methods to reduce microbial levels and drying times. In our experiment, fresh Wolffia was sourced from farmers in Chiang Mai province, Thailand, then dried using a 40-liter microwave with a maximum power of 2 kilowatts and starting microwave energy levels of 1000, 1200, 1400, 1600, 1800, and 2000 watts. The drying times were 60, 90, 120, and 150 minutes.

The study's results indicated that the dried wolffia retained a vibrant green color, closely resembling fresh wolffia, despite slight color changes. This demonstrates the method's effectiveness in preserving the quality of fresh wolffia. The total microbial and Bacillus cereus levels were reduced to 99.27% and 87.14%, respectively. Notably, the number of microorganisms in dried wolffia was lower level than a safe level for consumers of dried vegetables and fruits according to the 'Microbiological Quality Criteria for Food and Food Contact Containers, 3rd Edition 2017' published by the Department of Medical Sciences, Ministry of Public Health, Thailand. These results underscore the microwave drying method as superior for processing Wolffia, offering enhanced safety and efficiency over conventional drying techniques, ensuring the highest quality for consumers.

Keywords: Drying, Microbial load, Microwave, Wolffia

P30_PS

The Potential of Plasma Activated Water for Sustainable Agriculture

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Abstract:
This study investigated the use of a multi-pin to plane DBD plasma generator, powered by a 6 kV 60W neon sign transformer, to enhance tap water for agricultural applications. Key plasma generation parameters were optimized to maximize the production of beneficial compounds in the plasma-activated water (PAW). Results showed that higher voltage and longer treatment times increased hydrogen peroxide, nitrate, and nitrite concentrations, while a shorter electrode-water distance decreased these levels. The PAW significantly improved seed germination and growth in curly kale. Additionally, 20-minute plasma treatment of 400 mL tap water resulted in up to 5-log reduction in *E. coli*, demonstrating potent antimicrobial activity. This research highlights the potential of plasma activation for enhancing water quality in agriculture by increasing beneficial compounds, promoting plant growth, and ensuring microbial safety, leading to more sustainable and efficient farming practices.

Keywords: Non-thermal atmospheric plasma, Plasma-activated water, Agriculture

P31_TF

Influence of DLC film thickness in gas barrier performance deposited on polyethylene terephthalate sheets using PECVD method

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Abstract:
In this work, diamond-like carbon (DLC) films deposited on polyethylene terephthalate (PET) sheets using the bipolar pulsed-plasma enhanced chemical vapor deposition (bipolar pulsed-PECVD) method are studied. The mixed C_2H_2:Ar ration was utilized as a precursor. The influence of various deposition times on the microstructural properties was investigated using Raman spectroscopy, X-ray reflectivity (XRR), and near-edge X-ray absorption fine structure (NEXAFS) spectroscopy. The gas performance barrier property was characterized by the oxygen transmission rate (OTR) technique. The deposition rate is approximately 0.8±0.25 nm/s. It was found that a higher film thickness reveals a significantly gradual reduction of ID/IG ratio and sp^2 content in the films while the density remains constant. For this reason, there are not consider the existent hydrogen content in the DLC film but the C—H bond plays an essential role in determining the carbon sp^2 and sp^3 structures. In addition, the OTR value reduces from 102 to 2.9 cc/m^2/day, demonstrating the barrier improvement factors (BIF) is ~30 times. These studies led to improvement in the gas barrier performance of the DLC film deposited on polymer substrates.

Keywords: DLC, Polyethylene terephthalate, NEXAFS, Gas Barrier, Bipolar Pulsed-PECVD

P32_TF

Discharge Current Behavior in Reactive High Power Impulse Magnetron Sputtering during Acetylene Flow Ramping

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Abstract:
This study investigates the discharge characteristics of a reactive high power impulse magnetron sputtering (R-HiPIMS) discharge during the ramping of acetylene flow. A 2-inch titanium was used as the magnetron target. Argon was employed as the primary sputtering gas at a constant flow rate of 20 sccm, resulting in an initial pressure of approximately 6 mTorr. The HiPIMS power supply operated at a pulse repetition rate of 100 Hz with a pulse width of 20 microseconds. The average discharge current was recorded as the acetylene flow was incrementally increased from 0 to 6 sccm at a ramping rate of 0.1 sccm/second. The experimental results revealed that at lower discharge power, the average discharge current monotonically decreased from its initial value to nearly zero as the acetylene flow was increased. At higher discharge powers, a notable hump in the discharge current observed before the overall decline. This hump feature became more pronounced as the discharge power was increased. The observed discharge behavior is hypothesized to be associated with changes in the surface composition of the titanium target. Initially free of compounds, the target surface gradually becomes covered by a carbon-based compound layer as acetylene is introduced. At low power, the compound layer appears to have a lower secondary electron emission yield than the titanium surface, resulting in a steady decrease in discharge current. However, at higher power, the formation of an additional titanium carbide layer is postulated, which increases the secondary electron emission yield and leads to the observed hump in the discharge current. These findings provide new insights into the dynamics of target surface evolution and its impact on discharge characteristics in R-HiPIMS processes.

Keywords: Reactive DC magnetron sputtering, Electron emission yield, Target poisoning, Carbon layer

P33_TF

The Effect of Electrolyte Temperature on the Optimization of Optical and Electrochromic Properties of WO_3 Films Prepared by Sputtering and Anodization

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Abstract:
In this study, tungsten trioxide (WO_3) films were fabricated on fluorine-doped tin oxide (FTO) glass by using anodization and annealing at 450°C for 1 hour from the sputtered W films. The anodization process was carried out in ethylene glycol (EG) electrolyte at temperatures of 5, 25, and 45°C, under an applied voltage of 10 volts. The structural properties of the WO_3 films were characterized using X-ray diffraction (XRD) and field emission scanning electron microscopy (FE-SEM). It was found that increasing the electrolyte temperature resulted in more well-ordered crystal structures compared to lower temperatures. Anodization temperatures at 45°C showed that the WO_3 films exhibited a faster anodizing rate compared to those anodized at 25°C and 5°C. The temperature influences the mechanism involved during the anodizing process which promotes the formation of oxides of the film layer. As the electrolyte temperature rises, the viscosity of the electrolyte decreases, allowing ions to move more easily and quickly under the electric field, resulting in more efficient reactions. Additionally, optical and electrochromic properties were evaluated, and it was found that at a wavelength of 700 nm, the WO_3 films anodized at 45°C demonstrated the highest optical transmittance, reaching 51.64%. This makes them suitable for applications in electrochromic films or smart windows.

Keywords: WO_3 thin films, Anodization, Sputtering, Electrochromic properties

P34_TF

Effect of Sputtering Power and Film Thickness on the Electrochromic Properties of WO_3 and $TiWO_3$ Films

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Abstract:
The effects of sputtering power and film thickness on the electrochromic properties of WO_3 and $TiWO_3$ films were studied. The WO_3 and $TiWO_3$ films were prepared by using thermal oxidation at temperature of 500°C for 1 hour from W and TiW films, respectively. The W and TiW films were deposited on FTO glass by magnetron sputtering technique and oblique angle deposition (OAD) with thicknesses of 100, 300, and 500 nm. The WO_3 films exhibited optical properties with a lower energy gap compared to $TiWO_3$, highlighting the distinct differences between the two films. Additionally, the electrochromic properties of WO_3 is exhibited performance more than $TiWO_3$, particularly in the case of the 300 nm thick WO_3 film, which showed the highest optical contrast at a wavelength of 700 nm. In the study of the coloration and bleaching states, it was observed that WO_3 films exhibited near-zero transmittance in the near-infrared wavelength range. Furthermore, the WO_3 films had lower transmittance values compared to $TiWO_3$ films across all thicknesses. In terms of morphology, both the W and TiW films, deposited using the OAD technique, displayed a nanorod structure. Additionally, crystallographic planes of WO_3 and TiO_2 mixed with WO_3 were identified. As the height of the X-ray diffraction (XRD) peaks increased, the intensity of the XRD peaks also increased proportionally with the film thickness. These findings offer critical insights into optimizing film thickness for improved electrochromic performance, paving the way for advancements in the development of high-performance electrochromic materials. The results hold significant potential for future innovations in various technological applications requiring precise control of optical properties.

Keywords: Oblique angle deposition, Electrochromic properties, Sputtering power, WO_3, $TiWO_3$

P35_TF

Development of High-Precision Multilayer Coating System for Synchrotron Beamline Optics

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Abstract:
The high-precision multilayer coating system has been commissioned by the Synchrotron Light Research Institute (SLRI) in Thailand. The principal impetus for developing this apparatus is to satisfy the demands of synchrotron beamline optics, particularly for future flagship initiatives such as SPS-II. SLRI intends to establish a new 3 GeV synchrotron light source (SPS-II), comprising seven operational beamlines in its initial phase. Each beamline will transmit synchrotron radiation from its insertion device, focus the radiation with specialized optics, and select energy via a monochromator. Certain specialized optical components, such as single-coat or multilayer mirrors, may potentially be fabricated in-house utilizing the high-precision multilayer coating system. In this work, we will provide updates on the development of the high-precision multilayer coating system, which is expected to be completed by March 2025.

Keywords: X-ray optics, Multilayer mirror, Hard X-ray, Synchrotron

P36_TF

Fabrication of Polyvinylidene Fluoride/Silver Nanowire Composites for Triboelectric Nanogenerator Application

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Abstract:
The advancement of communication technology and data transmission in the Internet of Things (IoT) era, relying on numerous network of sensors and electronic components. These devices require a reliable power source, making the development of alternative, clean, and sustainable energy solution crucial. Triboelectric nanogenerators (TENGs) are among the most promising options, as they convert ubiquitous mechanical energy into electrical power. In this research, a TENG was developed using polyvinylidene fluoride (PVDF) filled with silver nanowires (AgNWs) to enhance its energy conversion performance. The role of AgNW filler and its effect on the TENG's electrical outputs were investigated. It was found that AgNWs significantly improved energy conversion efficiency due to their high electrical conductivity resulting in the enhanced charge capacitance properties. The generated electrical energy can be used as a power source and sensors for wearable electronics devices.

Keywords: Triboelectric nanogenerator, Polyvinylidene fluoride, Silver nanowires, Energy harvesting.

P37_TF

Power Output Enhancement of Triboelectric Nanogenerator by TiO_2-Ag Nanoparticles

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Abstract:
The rapid growth of the Internet of Things (IoT) and artificial intelligence (AI) is driving a surge in energy demand, raising concerns about a potential energy crisis. This highlights the urgent need for the development of sustainable and clean renewable energy technologies. Here, we have fabricated a triboelectric nanogenerator (TENG) using natural rubber (NR) filled with TiO_2-Ag nanoparticles. The power output NR TENG is enhanced by 13 folds with TiO_2-Ag nanoparticles. This enhancement is attributed to the synergistic effect of the photoelectric properties of TiO_2 and the dielectric polarization of the conductive Ag nanoparticles, which contribute to the increased triboelectric charge density. The findings of our work has proposed a new approach to enhancing the output performance of TENG leading to developing natural materials and increasing the value of products in the future.

Keywords: Triboelectric nanogenerator, Photoelectric properties, Titanium dioxide nanoparticles, Silver nanoparticles, Natural rubber

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