5TH ASIAN WORKSHOP ON APPLIED PLASMA AND ENGINEERING

JANUARY 28-29, 2019

UNIVERSITY OF MALAYA, KUALA LUMPUR, MALAYSIA

PROGRAMME BOOK

ABEX

UNIVERSITY OF MALAYA

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DESSERTS DELICACIES

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ROYALE™ PHARMA

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INTRODUCTION

The 5th Asian Workshop on Applied Plasma Science and Engineering 2019 (APSE2019) will be held at University of Malaya, Kuala Lumpur, Malaysia on January 28-29, 2019.

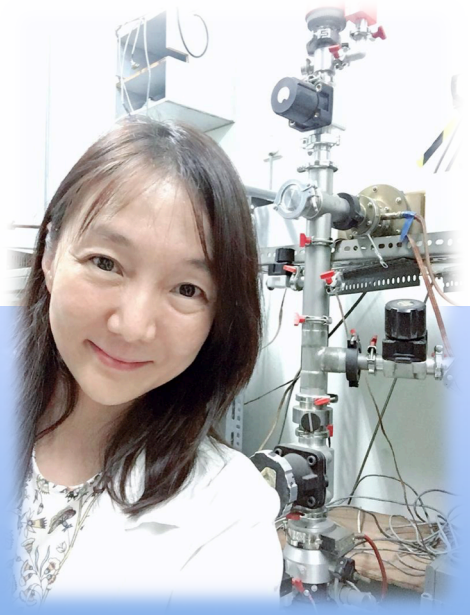
The Asian Workshops on Applied Plasma Science and Engineering organized by Asian Joint Committee for Applied Plasma Science and Engineering (AJC-APSE) have traditionally held open forums for discussions and collaboration of ideas among the industry and scientific communities within these fields. Leading industries (which include semiconductors, digital devices comprising of display and touch panels, automobiles, etc.) from East Asia, together with those engaged with initiatives in plasma agriculture and plasma medicine from almost every part of Asia, set a new paradigm for innovation in plasma technologies. Scientists within the region are cordially invited to participate in open discussions, networking and collaboration to advance the quality and creativity of plasma science and surface engineering. AJC-APSE welcome researchers in all disciplines to join us! We believe that collaborating with complementary expertise is the perfect way to innovate plasma technologies, as we declare, “Today's challenges, tomorrow's solutions”.

Foreword

Prof. Dr. Hasan Abu Kassim
(International Advisory APSE2019)
Head, Department of Physics, UM

Firstly, my warmest welcome to all the participants of the 5th Asian Workshop on Applied Plasma Science and Engineering (APSE) whose presence and contribution will add to another chapter of science and engineering activities in Asia. The main goal of APSE is to provide open forums for discussions and collaborations among the students, scientists and industry within the fields. I am certain that you will find this workshop within the Asian community a step forward in building our networks within the region. The theme for this workshop of 'Today's Challenges, Tomorrow's Solutions' is believed to give huge impact on new exploration of plasma technologies innovation. I hope all participants will actively participate in the workshop and share their constructive ideas within the applied plasma fields. My heartiest Congratulations to the Secretariat in organizing the APSE 2019 and have made this workshop a success.

Welcoming Message



Assoc. Prof. Dr. Seong Ling Yap
Chair, APSE 2019

On behalf of the organizing committee, I am honored to welcome you to the 5th Asian Workshop on Applied Plasma Science and Engineering (APSE 2019). This is the first time the workshop is held in Malaysia, thanks to the trust of the committee members of the Asian Joint Committee for Applied Plasma. Science and Engineering (AJC-APSE). The continuously growing interdisciplinary nature of applied plasma science and engineering with a broad range of applications making it challenging and exciting ! Researchers will be constantly rewarded with new challenges, observations or discoveries, that we do not have time to get bored but simply not enough time to work. In this two days workshop, we have a total of 41 presentations in the forms of talks, tutorials and posters. 22 papers are from researchers from the 6 Asian countries : Singapore, Thailand, Taiwan, Korea, Japan and India, while from Malaysia, we have participants from 12 institutions/universities, including University of Malaya, University Kebangsaan Malaysia, Universiti Malaysia Terengganu, Malaysian Nuclear Agency, Universiti Malaysia Perlis, Universiti Tun Hussein Onn Malaysia, Universiti Teknologi Malaysia, Heriot-Watt University Malaysia, INTI International College Subang, Sunway University, Multimedia University and Malaysia Innovation Hub.

I wish to express my sincere appreciation to all that have collaborated to make this workshop possible, including the Head of Physics Department that have make the workshop a department event and the local organizing committees that are from different research centers (Center for Ionics University of Malaya (CIUM), Low Dimensional Materials Research Centre (LDMRC), Radiaiton Research Group and Plasma Technology Research Centre (PTRC). Thank you to all the participants, and speakers that have travelled from different regions to present at this meeting. Together we are stronger, for the goal of sustainable development.

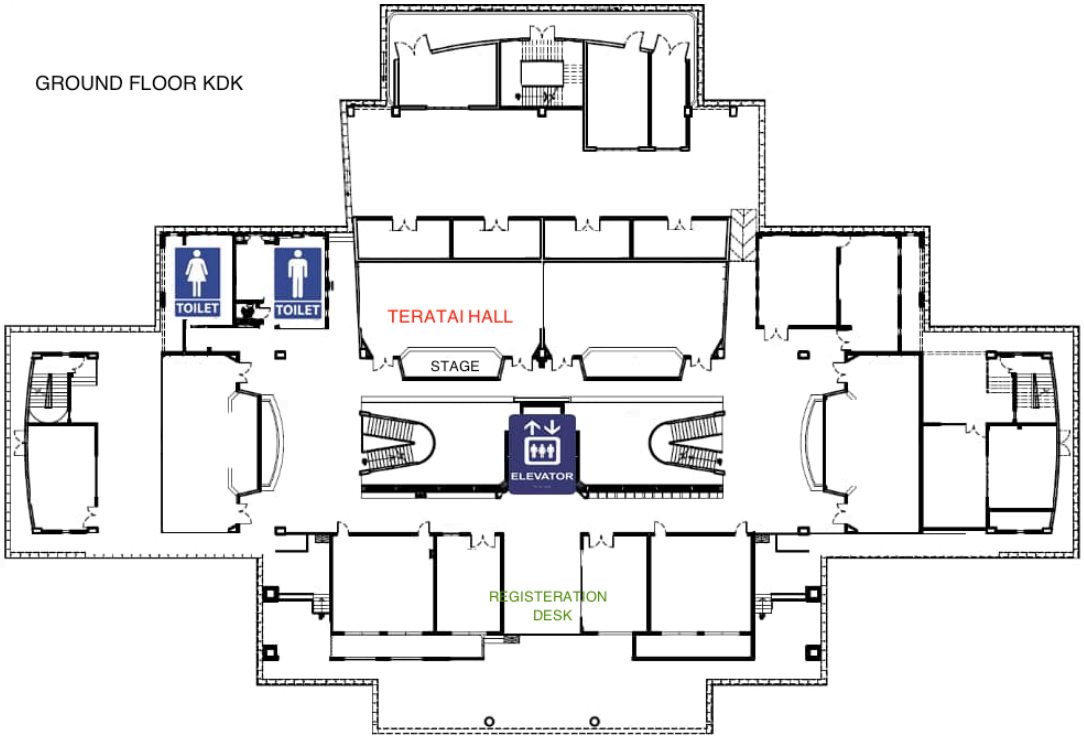
PROGRAM at-a GLANCE

TIME	January 28th, 2019 (Monday)
07:30	Hotel Transfer (Hotel Sentral KL to University of Malaya)
08:30	Registration (Foyer of KDK)
09:00	Opening Session
09:25	Session 1 : Plenary Talks
10:55	Coffee Break
11:10	Session 2 : Special Invited Talks
12:30	Lunch Break
13:30	Session 3 : Tutorial Part 1
14:45	Session 4
16:15	Coffee Break
16:30	Session 5
17:45	End

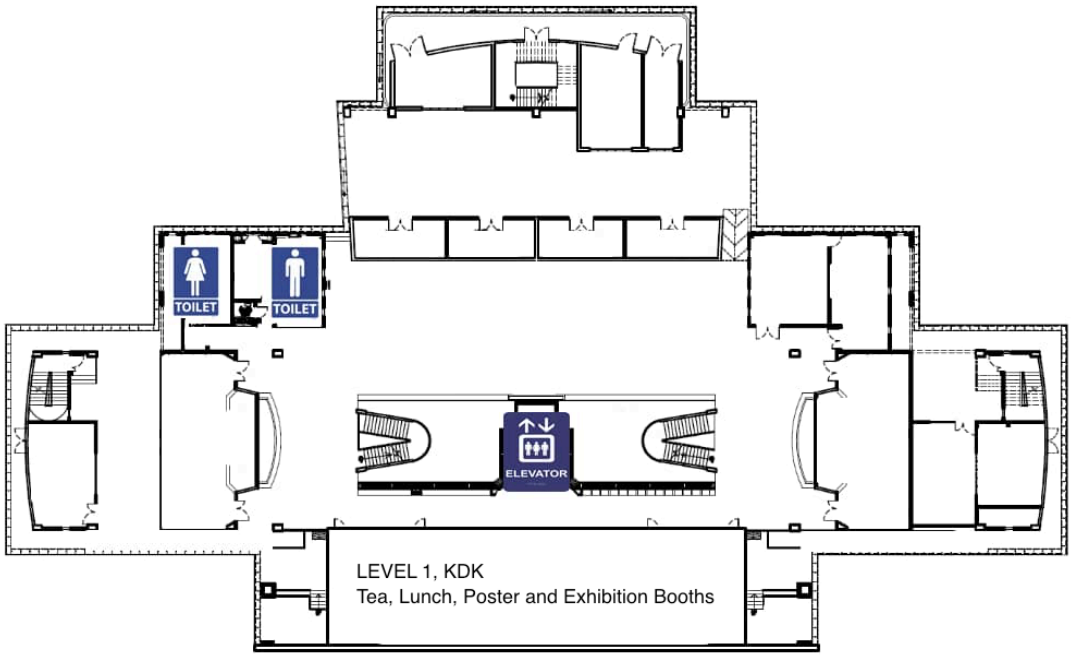
TIME	January 29th, 2019 (Tuesday)
07:30	Hotel Transfer (Hotel Sentral KL to University of Malaya)
08:00	AJC Meeting (iCube, Faculty of Science, UM) Poster Session (Level 1, KDK, UM)
09:00	Session 6 : Plenery Talks
11:00	Coffee Break
11:15	Session 7 : Tutorial Part 2
13:00	Lunch Break
14:00	Session 8
15:30	Coffee Break
15:45	Session 9
16:45	Session 10
18:30	Closing Speech by Chair of APSE2019
18:35	End

KOMPLEK DEWAN KULIAH (KDK)

GROUND LEVEL



LEVEL 1



THE 5th WORKSHOP ON APSE 2019 - PROGRAM DAY 1 28 Jan 2019				Abstract code
7:30	8:00		Hotel Transfer (Hotel Sentral KL to University of Malaya)	
8:30	9:00		Registration (Foyer of KDK)	
			Opening Session (Dr. Siti Fairus Binti Abdul Sani)	
9:05	9:15	Opening Remark	Chairman of Asian Joint Committee - Applied Plasma Science and Engineering (AJC-APSE) Prof. Dr. Masaharu Shiratani	
9:15	9:25	Opening Speech	Offical Opening by Dean of Science, Faculty of Science, University of Malaya Prof. Dr. Norzulaani Binti Khalid	
			Session 1 : Plenary Talks (Chair : Jeng Gong Duh)	
9:25	10:10	Plenary Talk	Masaharu Shiratani Kyusyu University, Japan *Plasma-Bio Consortium: Opportunities and Challenges.*	P01
10:10	10:55	Plenary Talk	Eun Han Choi Plasma Bioscience Research Cente & Applied Plasma Medicine Center, Kwangwoon University, Korea *Nonthermal Biocompatible Plasma (NBP) Sources and their Applications to Plasma Medicine and Agricultures.*	P02
10:55	11:10		Tea Break (Level 1, KDK, UM)	
			Session 2 : Special Invited Talks (Chair : Seong Ling Yap)	
11:10	11:40	Plenary Talk	Duh Jeng Gong Department of Material Science and Engineering, National Tsing Hua University, Taiwan *Atmosphere pressure plasma treatment of anode materials for advanced lithium-ion batteries*	P03
11:40	11:55	Special Invited Talk	Vincent Wong Wai Sang Malaysian Innovation Hub, Malaysia *International collaboration on innovation : modern technology for sustainability*	SV01
11:55	12:25	Special Invited Talk	Harith Ahmad Photonic Research Center University of Malaya, Malaysia *Application of nanotechnology in photonics*	SV02
12:25	12:30		Group Photo Session	
12:30	13:30		Lunch (Level 1, KDK, UM)	

			Session 3 : Tutorial Part 1 (Chair : Yuichi Setsuhara)	
13:30	14:45	Tutorial	Subrahmanyam Aryasomayajula Indian Institute of Technology Madras, India *Fundamental of Plasma*	T01
			Session 4: Chair (Masuharu Shiratani)	
14:45	15:15	Plenary Talk	Dheerawan Boonyawan Chiang Mai University, Thailand *Plasma medicine in Thailand: CAPs recent clinical practice*	P04
15:15	15:45	Invited Talk	Masafumi Ito Meijo University, Japan *Bactericidal effects and reactive species in oxygen-radical-activated water*	V01
15:45	16:15	Invited Talk	Yuichi Setsuhara Osaka University, Japan ICP-Enhanced Reactive Plasma Processes for Low Temperature Formation of High-Mobility Oxide Semiconductor TFT Low-Temperature Formation of High-Mobility Oxide Semiconductor TFT	V02
16:15	16:30		Tea Break (Level 1, KDK, UM)	
			Session 5: Chair (Dheerawan Boonyawan)	
16:30	16:45	Invited Talk	Mudtorlep Nisoa Walailak University, Thailand *Large volume activated water produced by moderated pressure RF cold plasmas*	V03
16:45	17:00	Invited Talk	Siow Kim Shyong IMEN Universiti Kebangsaan Malaysia, Malaysia *Sulfur and Nitrogen Containing Plasma Polymers as Anti-Bacterial Coatings*	V04
17:00	17:15	Invited Talk	Ahmad Nazri Dagang Universiti Malaysia Terengganu, Malaysia *Effect of Types of Gases and Their Pressure on Plasma Antenna Performance*	V05
17:15	17:30	Contributed Talk	Choncharoen Sawangrat Science and Technology Park, Chiang Mai University, Thailand *Plasma Applications to Agriculture and Food in Thailand*	C01
17:30	17:45	Contributed Talk	Partha Saikia University of Malaya, Malaysia *Frequency Coupling and the Secondary Electron Effects in Geometrically Asymmetric Dual Frequency Capacitively Coupled Plasmas*	O02

THE 5th WORKSHOP ON APSE 2019 - PROGRAM DAY 2 (29 Jan 2019)				Abstract code
7:30	8:00		Hotel Transfer (Hotel Sentral KL to University of Malaya)	
8:00	9:00	AJC Meeting	iCube, Faculty of Science, UM	
		Poster Session	Level 1, KDK, UM	
			Session 6 : Plenery Talks (Chair : Eu Han Choi)	
9:00	09:45	Plenary Talk	Kenji Ishikawa Nagoya University, Japan *Low temperature plasma surface interactions among multiple phases*	P05
09:45	10:30	Plenary Talk	Seong Bong Kim National Fusion Research Institute, Korea *2018 status and future prospects of Plasma Farming R&D activities at Plasma Technology Research Center, NFRI*	P06
10:30	11:00	Invited Talk	Subrahmanyam Aryasomayajula Indian Institute of Technology Madras, India *Surface Work function measurements by Non-contact and Non-destructive Kelvin Probe technique: Fundamentals to recent advances*	V06
11:00	11:15		Tea Break (Level 1, KDK, UM)	
			Session 7 : Tutorial Part 2 (Chair : Seong Shan Yap)	
11:15	12:15	Tutorial	Eu Han Choi Plasma Bioscience Research Cente & Applied Plasma Medicine Center, Kwangwoon University, Korea *Nonthermal Biocompatible Plasma (NBP) Sources and Their Characteristics for Plasma Medicines*	T02
12:15	13:00	Tutorial	Rajdeep Singh Rawat National Institute of Education, Nanyang Technological University, Singapore *Dense Plasma Focus Device: Designing and Applications for Material Synthesis and Processing*	T03
13:00	14:00		Lunch (Level 1, KDK, UM)	

			Session 8 : (Chair : Seong Bong Kim)	
14:00	14:15	Invited Talk	Yap Seong Ling University of Malaya, Malaysia *Current Research Activities in the Plasma Technology Research Centre, University of Malaya*	V07
14:15	14:30	Invited Talk	Nafarizal Nayan Universiti Tun Hussein Onn Malaysia, Malaysia *Plasma-related research and facilities at Microelectronic and Nanotechnology - Shamsuddin Research Centre, UTHM.*	V08
14:30	14:45	Invited Talk	David Bradley University of Surrey/Sunway University, UK/Malaysia *Time-resolved Dose Measurements of Linear Accelerator Pulses using a Fibre Optic Sensor: Applications and Challenges*	V09
14:45	15:00	Contributed Talk	Kashif Tufail Chaudhary Universiti Teknologi Malaysia, Malaysia *Arc Discharge Plasma & Carbon Nano-Tubes*	O03
15:00	15:15	Contributed Talk	Syed Zuhaib Haider Rizvi Universiti Teknologi Malaysia, Malaysia *Spectral Response to Spatial Alignment of Optical Fiber, Gate Delay and Laser Energy in LIBS Experiments*	O04
15:15	15:30	Contributed Talk	Reeson Kek Multimedia University, Malaysia *Effects of background gas in pulsed laser deposition of Al-doped ZnO*	O05
15:30	15:45		Tea Break (Level 1, KDK, UM}	
			Session 9 : (Chair : Rajdeep Singh Rawat)	
15:45	16:00	Contributed Talk	Vas Joseph Vimal National Institute of Education, Singapore *Plasma Processing of Bare Tungsten substrates to improve its Surface Hardness for Plasma Facing Material Applications*	O06
16:00	16:15	Contributed Talk	Lim Lian Kuang INTI International College Subang, Malaysia *Ion beam and hard x-ray emission from a plasma focus device operated in non conventional pressure*	O07
16:15	16:30	Contributed Talk	Lim Ling Hong Universiti Malaya, Malaysia *Efficiency of Plasma Focus Machines Based on the Energy in the Pinch compare to Bank Energy*	O08
16:30	16:45	Contributed Talk	Ridhvee Taleh Walailak University, Thailand *Characteristics of high-temperature DC Plasma Torch*	O09

			Session 10 : (Chair : Nafarizal Nayan)	
16:45	17:00	Contributed Talk	Norhayati Binti Mohd Nasir University of Malaya, Malaysia *Effect of Cold Atmospheric Plasma on Bacteria and Fibroblasts cells*	O10
17:00	17:15	Contributed Talk	Nur Arina Hasmimi Ramli Universiti Malaysia Perlis, Malaysia *Study of adhesion of Staphylococus aerues bacteria on the plasma treated Contact Lens Surface*	O11
17:15	17:30	Contributed Talk	Kuntapas Kungsuwan Chiang Mai University, Thailand *Application of Plasma Activated Water on Pesticide and Microorganism Decontamination in Capsicum annuum L.: Preliminary Study*	O12
17:30	17:45	Contributed Talk	Patompong Khaw-on Chiang Mai University, Thailand *Effect of Non-thermal plasma-activated water on Pesticide degradation, Shelf Life Extension and Sensory Evaluation of Tangerine in Thailand*	O13
17:45	18:00	Contributed Talk	Pitchasak Chankuson Walailak University, Thailand *Influence of dielectric materials, gap distance and electrode geometries on electric field of surface discharges in ozonizer*	O14
18:00	18:15	Contributed Talk	Vahid Damideh University of Malaya, Malaysia *Study of Ozone Production from Dissociation of CO2 in a Water Cooled Cylindrical Dielectric Barrier Discharge*	O15
18:15	18:30	Contributed Talk	Pradoong Suanpoot Maejo University Phrae Campus, Thailand *Plasma Jet*	O16
18:15	18:20	Closing	**Closing Speech by Chair of APSE2019** Rajdeep Singh Rawat National Institute of Education, Nanyang Technological University, Singapore	

Tutorial 1 : Fundamental of Plasma Subrahmanyam Aryasomayajula Indian Institute of Technology Madras, India
Tutorial 2 : Nonthermal Biocompatible Plasma (NBP) Sources and Their Characteristics for Plasma Medicines Eun Ha Choi Plasma Bioscience Research Center & Applied Plasma Medicine Center, Kwangwoon University, Korea
Tutorial 3 : Dense Plasma Focus Device: Designing and Applications for Material Synthesis and Processing Rajdeep Singh Rawat National Institute of Education, Nanyang Technological University, Singapore

ABSTRACTS

Plenary Speaker PO1

Plasma-Bio Consortium: opportunities and challenges

Masaharu Shiratani, Kunihiro Kamataki, Naho Itagaki, and Kazunori Koga
Graduate School of Information Science and Electrical Engineering,
Kyushu University, Japan

Abstract

On June 1st in 2018, in collaboration with Nagoya University and the University Natural Science Research Organization, Kyushu University has launched "Plasma-Bio Consortium", Japan's first plasma biology research community. Kyushu University and Nagoya University employ "low temperature atmospheric pressure plasma" technology to lead the world with their outstanding results on selective death of cancer cells, regenerative medicine such as wound healing, promotion of plant growth, functional plant production, and so on. The consortium promotes collaborative research, pioneers "new plasma life science", and at the breakthrough structure to create new technologies of future medical care and agriculture from Japan. Attempts to apply low temperature plasmas to the fields of life sciences and medicine have been studied globally in recent years [1-10]. However, fundamental researches on the relationship between low temperature atmospheric pressure plasma and constituent elements of living organisms have not been conducted sufficiently, and it is the present situation that remarkable progress has not yet been made in applications.

Natural Sciences Research Organization, Nagoya University, and Kyushu University have established Plasma Biocon Consortium aiming at the development of integrated research between fundamental plasma science and life science and definite contribution to industry. In this consortium, we explore places for active applications and utilization of life science and medical care of "low temperature atmospheric pressure plasma" technology, which has been widely emplyed as surface treatment and processing technologies in innovative semiconductor manufacturing. We also aim to expand the base of various industries using low temperature plasmas.

[1] M. Ichinose, et al., Plasma Medical Science, (2019) 419.
[2] M. Gherardi, et al., Plasma Processes and Polymers, 15 (2018) 1877002.
[3] M. Gherardi, et al., Plasma Processes and Polymers, 15 (2018) 1700174.
[4] M. Ito, et al., Plasma Processes and Polymers, 15 (2018) 1700173.
[5] P. Attri, et al., Scientific Reports., 5 (2018) 2026.
[6] T. Kawasaki, et al., Jpn. J. Appl. Phys. 57 (2017) 01AG01.
[7] P. Attri, et al., Phys. Chem. Chem. Phys., 19 (2017) 25277.
[8] P. Attri, et al., Scientific Reports., 7 (2017) 8698.
[9] P. Attri, et al., Scientific Reports., 6 (2016) 34419.
[10] P. Attri, et al., Scientific Reports., 5 (2015) 17781.

Plenary Speaker PO2

Nonthermal biocompatible plasma (NBP) sources and their applications to plasma medicine and agricultures

Eun Ha Choi
Plasma Bioscience Research Cente & Applied Plasma Medicine Center,
Kwangwoon University, 20 Kwangwoon-ro, Nowon-gu, Seoul 01897, Korea
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Abstract

Nonthermal biocompatible plasma (NBP) sources and their characteristics operating at atmospheric pressure have been introduced for plasma medicine and agricultures, especially developed and used in Plasma Bioscience Research Center (PBRC). The electron temperatures and plasma densities are characterized to be 1.2 ~ 2.1 eV and 3×10^{14} ~ 5×10^{15} cm^{-3}, respectively, for the NBP soft jet and micro-DBD sources[1]. Here, the various applications of these NBP sources to plasma medicine including rescue vehicle sterilizer, plant growth, and agricultures will be discussed by RONS generation mechanism inside the liquid, so called synergistic action of plasma initiated UV photolysis [2] and molecular-transport diffusion processes.

We have investigated neural differentiation [3] for degenerate neural diseases and enhanced anticancer effect of monocytes and macrophages activated by NBP which act as immune-modulator on these immune cells. Recently, we also apply DBD plasma and PEG-coated gold nano particles synergistically in-vivo on the solid cancer cells to enhance apoptosis of lung cancer efficiently. High voltage nanosecond pulsed arc-plasma and DBD plasma devices could be also applied to rice, spinach (*Spinacia oleracea*) and coriander (*Coriander sativum*) in both air and N_2 environments for inactivation of fungi, enhancement of germination and seeding growth rate along with enhancement of disease resistance and beneficial bacteria. The DBD plasma along with underwater micro/nano bubbler could also be used as an environmentally friendly agriculture disinfection device.

[1] J. Sornsakdanuphap et. al., J. Kor. Phys. Soc. 70, 979 (2017)
[2] P. Attri1et. al., Sci. Rep. 5, 9332 (2015)
[3] J. Jang, Biomaterials 156, 258 (2018).

Plenary Speaker PO3

Atmosphere pressure plasma treatment of anode materials for advanced lithium-ion batteries

Yuan-Tai Lai, Shang-I Chuang, Chun-Kai Lan, Bing-Hong Chen, and Jenq-Gong Duh*
Department of Material Science and Engineering, National Tsing Hua University
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Co-responding author email: jgd@mx.nthu.edu.tw

Abstract

Atmospheric pressure Ar/N_2 binary plasma irradiation has been introduced into the manufacturing process of lithium ions batteries as a facile, green and scalable post-fabrication treatment approach, which significantly enhance the electrochemical performance of Si and $Li_4Ti_5O_{12}$ energy materials. For titanium oxide-based anode materials ($Li_4Ti_5O_{12}$), sufficient oxygen vacancies have been evidenced by high resolution X-ray photoelectron spectroscopy analysis and Raman spectra after plasma treatment. Nitrogen doping has also been achieved simultaneously by the surface reaction between pristine $Li_4Ti_5O_{12}$ particles, owing to chemically reactive plasma species, such as N^* and N_2^+. Oxygen vacancies and nitrogen doping can lead to improved electronic conductivity, which is attributed to the reduction of partial Ti^{4+} to Ti^{3+}. In addition, the results of electrochemical impedance spectra (EIS) also confirm that the Ar/N_2 atmospheric plasma treatment facilitates Li^+ ions diffusion and reduces the internal charge-transfer resistance. Hence, $Li_4Ti_5O_{12}$-based electrodes deliver a stable cycling performance and excellent rate capability.

Applying surface modification to Si-based electrodes by using atmospheric pressure plasma jet treatment process is also conducted. Surface organic bonds are re-arranged, and N-doped compounds are formed on the electrodes through different plasma treatment durations. The qualitative examinations of before/after plasma treatment are identified by X-ray photoelectron spectroscopy (XPS) and electron probe microanalyzer (EPMA). The surface modification results in the enhancement of electrochemical performance with stable capacity retention and high columbic efficiency. In addition, depth profile and scanning electron microscope (SEM) images are executed to determine the existence of Li-N matrix and how the nitrogen compounds change the surface conditions of the electrodes. By integrating plasma diagnosis and surface characterization, dynamic plasma-surface interaction can thus be proposed to provide further guidelines for plasma surface modification for Li-ion battery (LIB) anodes.

Plenary Speaker PO4

Plasma medicine in Thailand: CAPs recent clinical practice

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Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand
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Abstract

Cold atmospheric plasma jets are at the focus of the attention due to onward applications such as plasma medicine. The potential of CAP in diverse bio-medical applications has been explored, including disinfection, wound treatments, control of inflammation, blood coagulation, cancer therapy, and regenerative medicine. Since CAP, is delivered essential radicals at room temperature, which results in less damaging effects on living tissue. Intensive studies proved that it is able to inactivate gram-negative and gram-positive bacteria, fungi, virus, spore, various parasites, and foreign organisms or pathogens without harming normal tissue.

Recently, RCT study *in vivo* using argon DBD type resulted outstanding clinical trial in 50 cases of grade 3/4 chronic pressure ulcer [1]. Also, air CAP jet has been demonstrated effectively in promoting typical wound healing and tissue regeneration in voluntary patients. The optimization condition for RONS production generates dose that is effective for bactericidal and non-toxic to living cells. Further *in vitro* air CAP studies is needed to support RONS dose will not far beyond the level outlined in the safety regulations of medical devices [2].

[1] A Chuangsuwanich, T Assadamongkol, D Boonyawan *The international journal of lower extremity wounds* 15 (4) 313-319 (2016)
[2] A Fridman, A Lin, V Miller, S Bekeschus, K Wende, K-D Weltmann *Plasma Medicine* 8(2) 195–201 (2018)

Keywords: Cold atmospheric plasma, RONS, Clinical trial.

Plenary Speaker PO5

Low Temperature Plasma Surface Interactions Among Multiple Phase

Kenji Ishikawa, Masaru Hori
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Abstract

Quantitative measurements of activated species generated in gaseous and liquid phases in the low temperature plasmas were conducted for understanding physicochemical mechanisms on interactions the plasmas in situ with polymer and biological surfaces, using plasma diagnosis with spectroscopic methods.

Keywords: Plasma enhanced chemical vapour deposition (CVD); In-liquid plasma; Polymer materials; Bioliquids; Graphene nanosheet; Amorphous carbon; Polymer-electrolyte fuel cell (PEFC).

Plenary Speaker PO6

2018 status and future prospects of Plasma Farming R&D activities at Plasma Technology Research Center, NFRI

Seong Bong Kim[1], Seungmin Ryu[1], Jaesung Oh[1]
[1] Plasma Technology Research Center, National Fusion Research Institute, Korea
Co-responding author email; sbkimr@nfri.re.kr

Abstract

Plasma technology has a great potential of an innovative technology to meet the requirements of future agriculture and food because it does not only inactivation of harmful microorganisms but also activation of seedling growth, functional metabolites, and useful microorganisms. Since the early 2000's the studies on plasma application for agriculture and food have been investigated by various research groups in Korea including universities, national institutes and companies. The R&D project of 'Plasma Farming' through the National Fusion Research Institute (NFRI) has been running since 2014 and given opportunities to many of plasma experts to involve the plasma farming and to collaborate with other experts in agriculture and food. 'Plasma Farming' is the comprehensive plasma application to the entire agricultural phases from farm to table, which includes whole animal processes for livestock and fishes as well as whole plant processes for crops, fruits and vegetables.

Here we would like to introduce a brief overview of plasma farming program and our R&D consortium in Korea. I will also show the R&D activities in 2018 in the fields of cultivation, postharvest, and food safety and finally discuss future plans.

ACKNOWLEDGEMENTS
This work was supported by R&D program of "Plasma Advanced Technology for Agriculture and Food (Plasma Farming)" through the National Fusion Research Institute of Korea (NFRI) funded by the government funds

Special Invited Talk SV01

Vincent Wong Wai Sang

MalayPhotonics Research

Malaysia Innovation Hub

Abstract

The Malaysia Innovation Hub (MIH) was set up in 2015 to create an innovation ecosystem to integrate the Academia, the Industries, the Government and the Community. It is a non-profit foundation and is affiliated to most of the Malaysian Universities, the various Malaysian Chambers of Commerce and Trade Associations, most of the Government agencies and related departments and civil societies. In the international front, it has network with the Big Innovation Hub of UK and their 10 top universities, Taiwan's ITRI and III, Hong Kong Science park and HK universities, Singapore CREATE, Korean, ASEAN and Middle East institutes. In China, MIH closely linked with China Academy of Sciences and their various institutes of research, Chinese Universities, Chinese State Owned Enterprises and Private Companies, Science Parks and Investors. The paper highlights MIH dedication to using Science and Technology to help mankind under the concept of Society 5.0, while working with all research institutes, universities, governments agencies and the industries to commercialize research outcomes and innovations.

Special Invited Talk SV02

Application of Nanotechnology in Photonics

Harith Ahmad and K. Thambiratnam

Photonics Research Centre, University of Malaya, 50603 Kuala Lumpur, Malaysia

Abstract

2-dimensional (2D) and 3-dimensional (3D) nano-materials have become the focus of numerous fast and ultrafast fiber laser designs and applications due to their inherent mechanical, electrical and optical properties. These materials are most commonly applied as saturable absorbers to passively induce Q-switching and mode-locking in fiber lasers, thus allowing for highly compact and rugged yet still powerful lasers to be built. The pulse lasers realized from these nanomaterials were initially focused towards the C-band region, and yielded impressive performance outputs with high repetition rates, narrow pulse widths and high pulse energies and average output powers. Since then, research efforts have expanded the study of nanomaterial to include other 2D and 3D nanomaterials such as topological insulators and transition metal dichalcogenides. Exotic materials such as Black Phosphorous have also been studied and demonstrate significant performance gains such as very high repetition rates and pulse energies. Research has also expanded to explore other wavelength regions including the 1950 to 2050 nm regions as well as Ytterbium the 1.0 micron region. These new works will see the expansion of these lasers to beyond the traditional field of communications, and realizing many new applications such as CO_2 and HBr trace-gas sensing platforms to precise and efficient optical scalpels that are used in surgery and dermatology as well as many other real-world applications that will solve key issues faced today.

Invited Talk V01

Bactericidal Effects And Reactive Species In Oxygen-Radical-Activated Water

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Abstract

Recently, plasma-activated water (PAW) has attracted much attention because of its huge potential for various application forms such as the disinfection of medical instruments. For a decade, many researchers have reported about the bactericidal mechanism of plasma-treated liquid (PTL) and revealed the key species in complicated composition of reactive oxygen and nitrogen species (RONS) in the PAW.[1] However, there have been few reports, performing a quantitative measurement of electrically-neutral radicals to prove that those radicals actually contribute to the generation of a bactericidal efficacy.

In this study, E. coli (108/mL) was prepared and suspended into deionized water (DI water). After that, the suspension was treated using the oxygen-radical source (Tough Plasma, Fuji Machine) operated with the mixture of Ar and O2, for several minutes.[2] Then, the number of survivors in RAW were immediately measured using a colony forming unit (CFU) of Escherichia coli (E. coli). Moreover, to identify the bactericidal factor in RAW, the UV absorption spectroscopy (UVAS) was performed using an UV-Vis-NIR spectrophotometer (SolidSpec-3700 DUV, Shimazu).

The E. coli in RAW was inactivated to be sterilization level at a radical irradiation time of 7 min. This result strongly suggests the contribution of radicals in plasma on the generation of a bactericidal effect in PTL. In the presentation, the generation path of RNS and killing mechanism in RAW will be discussed.

This work was supported by the MEXT-Supported Program for the Strategic Research Foundation at Private Universities (S1511021) and a JSPS KAKENHI Grant Number JP17K05099.

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Invited Talk V02

ICP-Enhanced Reactive Plasma Processes for Low-Temperature Formation of High-Mobility Oxide Semiconductor TFT

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Abstract

Reactive plasma processing systems have been developed via installation with inductively-coupled plasma (ICP) sustained with low-inductance antenna (LIA) for fabrication of next-generation devices including flexible electronics, which require large-area and low-damage processes with reactivity-control capabilities at low substrate temperature [1,2]. Major advantage of the ICP-enhanced reactive processing system is that the reactivity during film-deposition processes can be enhanced and controlled via low-damage and high-density plasma production for low-temperature processing of devices.

The reactive plasma processes have been applied to sputtering deposition of transparent amorphous oxide semiconductor a-InGaZnOx (a-IGZO) [3], which has attracted great attentions as key material for next-generation flexible electronics. So far post annealing at elevated temperature as high as 400 deg.C has been required because the electrical properties of the as-deposited IGZO TFTs are sensitive to oxidization process during the film deposition. Thus the conventional process for fabrication of the IGZO TFTs has been carried out on glass substrates. With the advanced reactivity-controlled plasma processes in this study, IGZO TFTs with mobility as high as or higher than 40 cm^2/Vs was successfully formed at substrate temperature less than 200 deg C.

In this presentation, ICP-enhanced reactive plasma processes are presented for low-temperature formation of IGZO TFTs.

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Invited Talk V03

Large Volume Activated Water Produced By Moderated Pressure RF Cold Plasmas

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Abstract

Recently, plasma activated waters (PAW) have been investigated intensively for sustainable agriculture and post-harvest technology. The waters can be used effectively as green fertilizers, decontamination agent and green pesticides, while no harmful by products left over[1-4]. The acidic characteristics of the PAW, resulted from nitrate and hydrogen peroxide, can produce high germination rate of various seeds[1,3,5]. The mechanism of synergic performance of nitrate and hydrogen peroxide, that release dormancy and increase germination rate, is also proposed. In this work, large volume PAW produced by RF cold atmospheric plasma in moderated pressure will be presented. The plasma is generated in closed chamber, whereas part of the chamber volume was filled with water. The air pressure was reduced by liquid ring vacuum pump, based pressure was about 50 torr. The floating electrode, made of tungsten rod and inserted in the Pyrex glass tube, is powered by RF power supply of 7 – 9 kV and 50 – 800 kHz. The plasmas, generated above the water surface, for production of PAW. Various characteristics of large volume PAW for the setup will be reported.

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Invited Talk V04

Sulfur and Nitrogen Containing Plasma Polymers as Anti-Bacterial Coatings

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Abstract

Role of sulfur (S) and nitrogen (N) groups in promoting cell adhesion or commonly known as biocompatibility, is well established, but their role in providing anti-bacterial properties is less explored or not known. Natural compounds use similar sulfur, i.e. sulfide, sulfoxide and sulfinic group to inhibit bacterial adhesion and biofilm formation. Hence, we mimicked this compound by plasma polymerizing thiophene (ppT) and air-plasma treating this ppT to achieve coatings with S of similar oxidation states as natural compounds (ppT-air). Similarly, the biocompatible amine-amide from n-heptylamine plasma polymer, instead of the toxic quaternary ammonium compounds, was investigated for their efficacy in anti-bacterial application. The ppT-air and ppHA were equally effective in reducing the bacteria E. coli and S. aureus during the shorter test of 24 h, while the ppT-air was more effective than ppHA for the more extended duration test of 72 h. Both coatings, ppT-air and ppHA, were effective than ppOD or glass substrates based on these anti-bacterial assays. Simultaneously, ppT-air and ppHA provided a conducive environment for the osteogenesis of Wharton's jelly mesenchymal stem cell based on alkaline phosphatase assays and scanning electron microscopy imaging. These results provided another avenue to produce anti-bacterial coatings which are scalable and biocompatible to combat hospital-acquired infections.

Keywords: anti-bacterial coating, sulfur, biofilm, plasma polymerization, thiophene, n-heptylamine.

Invited Talk V05

Effect of Types of Gases and Their Pressure on Plasma Antenna Performance

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Abstract

Plasma antenna is a type of antenna that uses ionized gases as a conductor to receive and transmit signal. Characteristically, plasma antennas have high frequency configurability, radiation pattern configurability and band with re-configurability compared to conventional metal antennas. This research provides an analysis to overcome the problem of lack of information on study of effect of type of gas and pressure on plasma antenna performance. Custom made discharge tube of neon and argon were used, glow discharges were produced at pressure range from 0.1 Torr to 15 Torr. The performance of each type of selected gases and their variants in terms of pressure to boost signals through the coupling sleeve was studied. The study was also aims to satisfy some hard-hitting points on the matter of plasma antenna. One of the focus was to investigate how the type of gas and pressure affect the plasma antenna performance in terms of its resonance frequency, return loss, gain and directivity. Next the investigation on the optimum pressure for the gases that can perform optimally as an antenna was done. Plasma is powered by two different frequencies simultaneously, i.e., an excitation frequency to drive the plasma discharge, and a working frequency to apply the signal to be used for either transmission or reception. The antenna performances were investigated using Computer Simulation Technology (CST) software by using the calculated plasma parameters values. From the results, it is found that the larger atoms with bigger atomic radius in lower pressures have better capabilities to transmit, receive and interference of radio signals. Thus conclusively it can be said that larger atomic with lower pressure is best used as plasma antenna (within above discharge condition) as it can be ionized easily. Argon 15 Torr discharge shows the best performance as plasma antenna in terms of better return loss and gain, with moderate directivity.

Keywords: CST, Plasma Antenna, Resonance Frequency, Plasma Frequency

Invited Talk V06

Surface Work function measurements by Non-contact and Non-destructive Kelvin Probe technique: Fundamentals to recent advances

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Abstract

Surfaces are an integral part of any solids. Surface modification and surface engineering span several applications and it is a multi-million Dollar Industry. Most of the commercially available analytical tools modify the surface under study; also, some of them need vacuum environment. Kelvin probe measures the Surface Work function. Surface work function is a fundamental electronic property; it provides an understanding of the relative position of the surface Fermi level. For example, plasma modification of surfaces, corrosion of metal surfaces (including bio-corrosion) can be studied by non-contact and non-destructive methods of measuring surface work function. Kelvin probe is the only analytical technique which leaves the surface virgin even after the measurement; and it is the only technique which can operate in several environments: vacuum, atmospheric pressure and in any reactive environment, temperatures ranging from liquid helium to 400 C. Kelvin machine is the most powerful tool for (i) bio-medical implants to study the rejected implants and for assessing bio-corrosion (bio-fluid and metal surface interactions), (ii) analyse dynamic changes of oxidation, (iii) charge transfer process in bio- molecule – surface interactions and (iv) studies on corrosion. Surface Photovoltage Spectroscopy (SPV) is based on Kelvin probe technique and it is used to probe and analyse interfaces. Present talk summarizes the basic principles of Kelvin probe technique and presents the status of surface work function measurements on several metals and semiconductor modified surfaces.

Invited Talk V07

Current Research Activities in the Plasma Technology Research Centre, University of Malaya

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Abstract

Pulsed discharge plasma devices like the dense plasma focus, with high density and high temperature exhibit many interesting phenomena. Diagnostics of the pinched plasma is challenging due to the highly transient event and the complicated dynamics. Efforts are made to enhance fundamental understanding of the phenomena, while diagnostics techniques are developed to refine the observation based on the X-ray emission, ion beams and neutrons emissions. Time resolved and time integrated techniques are combined to give better interpretation of the results. Other configuration of pulsed discharged device like vacuum spark and capillary discharge are developed as pulsed X-ray sources and EUV sources. Application based on the pulsed plasma radiations are explored and experimented. On the other hand, cold atmospheric plasma is studied with the aims at its potential application in plasma medicine. Plasma medicine has drawn different collaborations to this field. Exploratory work to generate cold atmospheric plasma by using dielectric barrier discharge shows that the configuration of electrodes and dielectric properties of the barrier materials play important roles. Effect of the cold plasma on microbes and cells are studied.

Invited Talk V08

Plasma-Related Research And Facilities At Microelectronic And Nanotechnology – Shamsuddin Research Centre, Uthm

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Abstract

Microelectronics & Nanotechnology - Shamsuddin Research Centre or MiNT-SRC is one of six Center of Excellence (CoE) at Universiti Tun Hussein Onn Malaysia (UTHM). It was established in November 27th, 2006. Formerly it was known as Microelectronic and Nanotechnology Centre of UTHM. In November 25th, 2007, the name of Microelectronic & Nanotechnology - Shamsuddin Research Center was effective as an acknowledgment to our university's former chairman Tan Sri Dato' Seri Ir Shamsuddin bin Abdul Kadir for his contribution to the university (2007-2009). Our objectives at MiNT-SRC are as follows: 1) To focus on researches that support microelectronic, semiconductor and nanotechnology industries. 2) To encourage research and development among students, researchers, and lecturers. 3) To become a training and consultant center in microelectronic, semiconductor and nanotechnology areas. Most of the facilities related to fabrication and characterization using nano-scale techniques are available at MiNT-SRC. Currently, there are three clusters at MiNT-SRC which are: 1) nanoelectronics, 2) nano heterogenous computing and 3) nano-bio sensor and instrumentations. Under nanoelectronics, we have plasma processing research laboratory where facilities such as magnetron sputtering plasma, plasma etching, Langmuir probe and optical emission spectrometer are available. With the help of these facilities, there are several research projects have been secured and there are funded by CREST Sdn Bhd, NanoMalaysia Sdn Bhd, and Malaysia Productivity Corporation. Details of the projects will be discussed during the workshop.

Invited Talk V09

Time-Resolved Dose Measurements Of Linear Accelerator Pulses Using A Fibre Optic Sensor: Applications And Challenges

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Abstract

We present time-resolved radioluminescence (RL) measurements from P-doped silica optical fibre, demonstrating potential utility in pulsed source dosimetry. When subjected to 140 MU/min from a 6 MV photon linac source, a 220 μm-core fibre has produced a RL response of 720 ± 20 photon counts/pulse from a saw-tooth ~ 40 μs duration return-to-baseline waveform. Conversely, the Cerenkov *stem signal* within the radiation insensitive carrier fibre is observed to offer an amplitude amounting to a little less than 3% of that of the P-doped fibre, the sharply spiked response being of ~ 2 μs duration. On the basis of these results, the practical applications and the challenges in the establishment of an effective dosimetry system are discussed.

Keywords: radioluminescence, dosimetry, fibre optic, time-resolved, pulse, linac

Contributed Talk C01

Plasma Applications to Agriculture and Food in Thailand.

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Abstract

Plasma Technology is a great innovation approach to accomplish not only food safety but also long shelf life in agriculture and food product. Recently, food safety becomes hot issues in Thailand due to conventional agriculture replaced by chemical agriculture. Non-Thermal Plasma is one of most effective technique to decontaminated pesticide residue and sterilized fungus at room temperature with reasonable cost. The project of plasma applications to agriculture and food has been conducted since 2014 by Thai-Korea Research Collaboration Center (TKRCC) under Science and Technology Park (STeP), Chiang Mai University in Thailand. There are almost 20 expertise from 4 key research areas consisted of engineering, science, agro-industry and agriculture areas. The business and research development (R&BD) of center will be discusses together with some case studies.

Contributed Talk C02

Frequency Coupling and the Secondary Electron Effects in Geometrically Asymmetric Dual Frequency Capacitively Coupled Plasmas

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Abstract

We investigate the effect of the neutral gas pressure on the discharge behavior of dual frequency capacitively coupled plasmas (2f CCP) driven at 2.26 and 13.56 MHz experimentally. In the experiment, the pressure is varied from 1 mtorr to 60 mtorr. In 2f CCP, the frequency coupling and the secondary electrons have profound effects on the discharge dynamics, thus limiting the separate control of the mean ion energy and the flux. In low pressure, due to the effect of frequency coupling the ion flux decreases as a function of the low frequency voltage amplitude. However, at an elevated pressure the opposite trend is usually expected due to enhanced ionization by secondary electrons. Until now, such phenomenon have mostly been studied computationally. In this letter, we reports the variation of the ion flux in 2f CCP driven by 2.26 and 13.56 MHz as a function of the low frequency voltage amplitude at different operating pressures experimentally. Finally by measuring the mean ion energy at different operating pressures, we clearly verify the effect of the secondary electrons and frequency coupling on the separate control of the ion flux and the mean ion energy in 2f CCP experiment.

Keywords: Radio frequency discharge; Capacitively coupled plasma; Discharge characteristics; Homogeneous discharge model.

Contributed Talk C03

Arc Discharge Plasma & Carbon Nano-Tubes

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Abstract

Carbon nanotubes (CNTs) and nanostructures are of great importance due to their unique structural configurations which induce unique electronic, thermal and mechanical characteristics. In plasma based synthesis techniques, the carbon arc discharge is one of the effective technique to grow well-developed CNTs structures. The controlled growth of CNTs by arc discharge method has not been accomplished due to limited understanding of arc plasma dynamics, which play key role in the formation of CNTs. In this study, the growth of carbon nanotubes and the role of physical parameters such as arc current, and ambient pressure towards the dynamics of arc plasma and in turn towrds the growth of carbon nanotubes, is investigated. The fundamental properties of plasma dynamics such as plasma temperature and density are determined for different input arc currents from 50 A to 90 A, and ambient pressures from 100 torr to 500 torr using optical emission spectroscopy. The estimated plasma temperatures and densities are found in the range of 4780 K to 15200 K and 3.77×10^{3} m^{-3} to 5.61×10^{23} m^{-3} respectively under different applied experimental conditions. A linear increase in electron temperature and electron density is observed with increase in applied arc current, and ambient pressure. The well aligned and straight multi wall carbon nanotubes of diameter 7 nm to 200 nm along with other carbon nanostructures such as nano onions, capsules and graphene are observed in grown samples under different applied conditions. It is found that the increase in the ambient pressure enhances the growth of the CNTs and reduces the inner diameter while an increase in the arc current improves the structure quality of nanotubes. The multiwalled carbon nanotubes with small inner diameter less than 1 nm and well aligned walls are found at ambient pressure of 500 torr for arc current 90 A.

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Contributed Talk C04

Spectral Response to Spatial Alignment of Optical Fiber, Gate Delay and Laser Energy in LIBS Experiments

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Abstract

In LIBS experiment, optical alignments are carefully made and experimental parameters are cautiously selected to obtain as good spectra as possible. A good emission spectrum contains a number of isolated optically thin spectral lines with reasonable signal to noise and signal to background ratio. Optical alignments and experimental parameters have a significant influence on the quality of the recorded spectra. This study explores emission intensities and signal to background ratios of atomic and ionic lines of Calcium in LIBS spectrum obtained in response to variation in the alignment of fiber optic cable, gate delay and laser energy. These are few of the most important parameters in LIBS experiment. This study provides an insight into the choice of these parameters for optimal results.

Contributed Talk C05

Effects of background gas in pulsed laser deposition of Al-doped ZnO

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Abstract

In this work, background gases of O2, Ar and He are introduced into the process of pulsed laser deposition of Al-doped ZnO at room temperature by using a 355 nm laser. The velocity the ablated species for the gas at different pressure are measured by an ion probe. At pressure above 100 mTorr, the ion signal is low, thus the pressure for deposition of Al-doped is kept below 100 mTorr where the ions velocity is in the range of 104 m/s. Within the pressure range, when the deposition is performed in O2 background gas, transparent Al-doped ZnO films are obtained. However, when deposition is performed in Ar or He, nanostructures formation are observed in the absence of any catalyst. The effects of different background gas and the formation of structures are investigated and discussed.

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Contributed Talk C06

Plasma Processing of Bare Tungsten substrates to improve its Surface Hardness for Plasma Facing Material Applications

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Abstract

In thermonuclear fusion power research, plasma-facing component (PFC) materials are critical elements that have to withstand the high temperature plasmas generated during nuclear fusion reactions. These PFC materials have to fulfil complex requirements such as withstanding the extreme thermal load (~ 8MeV - 9MeV), radiation load (~ 14MeV) etc. As a result, the performance of PFC surface is a critical issue, as it may deteriorate the operational performance of the device. Some of the choices available include high Z metals like tungsten, zirconium, niobium, molybdenum, tantalum and hafnium as well as lighter materials like carbon and beryllium. Tungsten is the leading candidate for PFC materials because of its ablation resistance, hardness and radiation resistance. In this work, the mechanical properties of bare tungsten substrates were enhanced through different techniques such as nano-structurisation, thin-film deposition and nitriding using plasma treatment. Different types of plasma like RF plasma and high energy density pulsed plasma treatments are used to improve the surface hardness of the tungsten. The changes in the morphological and structural properties after plasma exposures are investigated using Scanning Electron Microscope (SEM), Atomic Force Microscopy (AFM) and X-ray Photoelectron Spectroscopy (XPS). Nanoindentation measurements shows the enhanced hardness of the RF and dense plasma treated tungsten as compare to unexposed tungsten. To prove its excellent performance in thermonuclear fusion reactor, the surface is then exposed to fusion conditions using the focused mode operation of the dense plasma focus (DPF) device in a deuterium environment to simulate the conditions in a thermonuclear fusion reactor, followed by the study of the changes morphology, chemical and crystallographic behavior using the same characterization techniques.

Contributed Talk C07

Ion Beam and Hard X-ray emission from a Plasma Focus Device Operated in Non-Conventional Pressure

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Abstract

The transient phenomena in the formation of pinched plasma in Plasma Focus (PF) device made it a versatile device for the studies of various radiation emission. With the use of deuterium as the working gas, the pinched plasma is hot and dense enough to cause nuclear fusion and emit neutrons along with ion beam and X-ray. In this work, the results of the ion beam and hard X-ray measurement from a 2.7 kJ plasma focus device charged at 13.5 kV were reported. The radiation emission is highly dependent on operating pressure where in current setup, operating pressure in non-conventional regime of less than 1 mbar was used. At this low pressure regime with deuterium filling, large current dip in the discharge current signal is significant. The current dip is correlated to the anomalous resistivity effect that is associated to the plasma instabilities which plays an important role to the radiation production. Towards lower pressure, larger current dip and hence higher ion beam energy as well as hard X-ray was obtained. Thus, the higher emission at lower pressure is strongly correlated to the effect of anomalous resistance.

Keywords: Ion beam, hard X-ray, plasma focus, current dip, anomalous resistivity

Contributed Talk C08

Efficiency of Plasma Focus Machines Based on the Energy in the Pinch compare to Bank Energy

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Abstract

The efficiency of the plasma focus machines will be discussed in this paper. The Lee model had been used to investigate the efficiency of the machines. The plasma focus machines used are PF1000, UNU and NX2. The efficiency is been investigated by comparing the energy used in the pinch phase with the bank energy.

Contributed Talk C09

Characteristics of high-temperature DC Plasma Torch

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Abstract

In this work, the 5 kW DC plasma torch system to generated thermal plasma has been developed which is composed of the DC power supply unit and plasma torch head. The power supply unit provides the DC current up to 50 A, 5 kW. The plasma torch head is concentric type, whose cathode electrode is in the center of hollow cylindrical anode electrode. The anode is 10 cm long and its inner diameter is 5 mm. The gap between both electrodes is 1.2 mm. When the 0.5 MPa compressed air has been applied to the head, air flow rate about 40 L/min and the 50 A, 90 V DC current has been supplied, the thermal plasma torch has been generated. The plasma length is 8 cm and its diameter is 1 cm wide. The knowledge of this work will be used for up scaling the system to be suitable for disposal of infectious wastes.

Contributed Talk C11

Study on the adhesion of *Staphylococcus aerues* bacteria on the plasma treated Contact Lens Surface

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Abstract

Eye infection is the most frequent cases that were reported by eye contact lens wearer [1]. Infections occurred from the infection of bacteria, yeast and fungi on the lens surface and also from the lens cases **[2][3]. Normally, for lens cases, the wearer uses multipurpose solution (MPS) to clean and disinfect contact lens before and after use [4]. However, previous research shows that, some of the multipurpose solutions were unable to disinfect lens surface [2][3].** Hence, this study was conducted in order to compare the adhesion of bacteria on the plasma treated contact lens to the current contact lens in the market (untreated contact lens). In this investigation hydrogel contact lens was used. New hydrogel lenses and plasma treated contact lens were incubated with *Staphylococcus aerues* bacteria for 10 minutes. After that, the infected contact lenses were insert inside the phosphate buffer saline (PBS) solution. The solution is shaken vigorously. After that, transfer 1 µl of PBS solution to agar plate. The bacteria growth was observed after 24 hours. Result shows, higher adhesion of bacteria is obtained on the untreated contact lens sample compare to the plasma treated contact lens. For *Staphylococcus aerues* bacteria, the highest bacteria reduction is recorded by plasma treated contact lens which is 64.31% when using 450 ml/min flow rate of gas and 5 minute time treatment compare to the untreated contact lens sample.

Acknowledgements

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Contributed Talk C12

Application of Plasma Activated Water on Pesticide and Microorganism Decontamination in *Capsicum annuum L.*: Preliminary Study

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Abstract

Capsicum annuum L. or Thai Hot Pepper is one of the most consumed pepper in Thailand. However, typical cultivation method of this pepper involves the use of pesticides, which results in high level of pesticide residue. To improve the safety for consumers, this research aimed to utilize plasma technology for decontamination of pesticide residue in Thai Hot Pepper. The effect of plasma is not limited to pesticide decontamination, but it can also improve shelf life of Thai Hot Pepper by microbial decontamination. The OH• radical generated from plasma plays a major role in the process because it has high Oxidation potential that can oxidize both pesticides and microorganisms. This study showed preliminary results of such application including suitable process parameters for plasma activated water generation (PAW), effect on microbial decontamination using *E. Coli* as a model and effect on quality parameters of Thai Hot Pepper. The result showed that Pinhole plasma jet with exposure time of 20 min, gas flow rate at 5 L/min and gas containing 2% Oxygen in Argon is the most suitable condition for producing PAW for Thai Hot Pepper decontamination. The resulting PAW contained the maximum number of Hydroxyl radical (OH•) at 33.38 ppm and could reduce 0.88 Log CFU/g of *E. Coli.*. Moreover, based on the color, weight and amount of capsaicin, it can be concluded that PAW treatment on the pepper did not significantly affect its quality. The future works includes a study on pesticide decontamination in Thai Hot Pepper and effect of PAW on its shelf life.

Contributed Talk C13

Effect of Non-thermal plasma-activated water on Pesticide degradation, Shelf Life Extension and Sensory Evaluation of Tangerine in Thailand

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Abstract

Development of alternative, chemical-free approaches for control of postharvest microbial has become a challenge in recent years. However, there are several established techniques for postharvest treatments, they often have disadvantages, including food quality variation due to physiological responses to the treatment. Plasma activated water (PAW), a product of cold atmospheric plasma reacting with water, is a broad-spectrum anti-microorganism and biochemical scavenging agent which recognized to the presence of an abundant mixture of highly reactive oxygen and nitrogen species. In this research, an air-supplied pinhole discharge in aqueous solution has been developed to investigate whether Non-thermal plasma-activated water (PAW) disintegrated insecticide residue; Cypermethrin and disinfected *Penicillium digitatum* in tangerine planted in northern Thailand. Air plasma was an efficiency to ionized reactive oxygen species and reactive nitrogen species which generated 30 ppm of peroxide level. A 125-Watt PAW removed 10 mg/L of cypermethrin solution by 82.45 percent at 60 minutes of discharge time. In addition, PAW degraded cypermethrin residue on tangerine to 0.008 ppm which met the maximum residue level, MRL (0.3 ppm). Also, 60 minutes of plasma washing process in tangerine increased shelf life up to 10 days compared with the control group which decomposed in 5 days of room temperature storage. Results from consumer testing indicated that the PAW did not change consumer acceptability of flavor, sweetness, sourness, bitterness or firmness and aroma of the samples. Taken together, PAW degenerated insecticide residue and extened shelf life of tangerine planted in northern Thailand. This technology may be a promising alternative to conventional sanitizers applied in the fresh food industry for safety and quality improvement.

Keywords: Plasma activated water, tangerine, Pesticide degradation, Shelf life extension, Food safety

Contributed Talk C14

Influence of dielectric materials, gap distance and electrode geometries on electric field of surface discharges in ozonizer

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Abstract

Dielectric barrier discharge (DBD) is a method of ozone production relies on applied energy to break the bonds holding the oxygen atoms in oxygen gas. After that molecule of ozone can be formed from oxygen atom. Electric field is a one of energy source for ozone production that it is produced by applying high voltage at the electrodes. The electrodes are separated by gap and a dielectric material. In this work to study influence of dielectric material, gap distance and electrode geometries on electric field. The work is focused primarily on time-independent studies of the discharge. COMSOL Multiphysics software used to make simulation and analysis. The dielectric materials were used quartz, mica, alumina and distilled water. The electrode geometries were plate-plate, pin-plate, line-plate and mesh-plate. As a results, pin-plate electrode has given high intensity and mesh-plate electrode has given uniform field. The highest electric field intensity on the surface occurs when small air gap and dielectric material as distilled water.

Contributed Talk C15

Study of Ozone Production from Dissociation of CO_2 in a Water Cooled Cylindrical Dielectric Barrier Discharge

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Abstract

This paper reports the characteristics of ozone production from a water cooled cylindrical dielectric barrier discharge at atmospheric pressure of CO_2. The discharge was powered by a variable high voltage generator (up to 20 kV, 300 W) operating at ≈20 kHz. The coaxial dielectric barrier discharge device consists of a stainless steel tube of outer diameter 6.5 mm as central electrode and an outer tinned annealed copper wire mesh of 13 mm diameter and 12 cm in length. The electrodes are separated by a 20 cm long quartz tube with 13 mm outer diameter and 1.5 mm wall thickness as the dielectric barrier. The discharge was in filamentary mode. Steady state ozone production during 6 l/min water cooling flow was observed for electrical input powers from 30 to 120 W. We observed that ozone concentration increases over a range of 700 ppm.

Key Words: Dielectric Barrier Discharge, filamentary mode, Ozone Generator, CO_2 Conversion

Contributed Talk C16

Electron Temperature and Plasma Density in Ar/N_2 Admixtured Non-thermal Atmospheric Pressure Plasma Jet

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Abstract

A model based on plasma propagation velocity has been recently developed to estimate the electron temperature (T_e) of non-thermal plasma jets. In this work, we have extended this model to calculate T_e for plasma generated with mixed gases (Ar/N_2) and the results are compared with pure Ar. Plasma has been generated by input discharge voltage of 3.0 kV at driving frequency of ≈ 40 kHz. A high-speed single-frame intensified charged coupled device (ICCD) has been used to observe the space and time-resolved discharge images and estimate the value of plasma propagation velocity (u_g). The value of u_g for Ar/N_2 admixtures (0-5%) has been obtained in the range of 10^4-10^5 m/s. The electron temperature has been calculated for these mixed gas plasmas. The average electron temperature has been found to be about 1.18 eV for Ar plasma and it increases up to 1.39 eV for plasma with Ar/N_2 admixture. Also, the average plasma density has been found to be about 6.61×10^{14} cm^{-3} for Ar plasma and it decreases down to 2.74×10^{14} cm^{-3} for plasma with Ar/N_2 admixture. Our results obtained with modified convective-wave packet model can be a new contribution to plasma medicine.

Keywords : Non-thermal atmospheric-pressure plasma, downstream-plasma jet, plasma jet, Ar/N_2 plasma, plasma propagation speed, electron temperature.

Poster L01

Selective removal of indium tin oxide film on glass and polyethylene terephthalate substrates by 266 nm laser

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Abstract

In this work, indium tin oxide (ITO) thin films on glass and polyethylene terephthalate (PET) substrates are ablated by using a 266 nm ns laser. The laser patterning/removal threshold of ITO on glass is found to be significantly higher compared to ITO on PET. Even at the highest laser energy in this study (6 mJ), ITO on glass substrate is not removed but appeared darken when the laser energy is above 3 mJ. The irradiated area is measured to be still conducting, indicating that only surface modification occurred. In addition, periodic lines with a spatial period of 2.5 mm and a depth of 36 are formed within the darkened region as observed by using AFM. For ITO on PET, the removal of ITO from PET substrate occurred at 0.7 mJ, well before the appearance of a darkened area at the laser energy of 2.2 mJ. Complete electrical isolation is achieved when the laser pulses overlapped and a line is formed. It is also found that upon repetitive laser pulses on the same area, the darkened area is removed.

Poster L02

The potential for radiotherapy of low energy X-ray using plasma focus device

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Abstract

Plasma Focus (PF) device developed since 60 s is well known for its rich sources of multi radiation such as X-rays, ion beam, electron beam. The production of low energy (few keV) X-rays shows the potential for radiotherapy in skin. Radiotherapy using plasma focus device can be a new technique for treatment of superficial skin cancer which plasma machine is versatile and safe.

Keywords: Plasma radiation, plasma focus, X-ray dose

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