



**8th International Symposium on Plasmas & Fine Bubbles
(8th ISPFB 2024)**

**Hosted by Donghua University, China
24th – 26th May, 2024**

**Information Center of Donghua University, Songjiang Campus,
Donghua University, Shanghai**

<https://ispfb2024.scimeeting.cn/>

CONFERENCE SCOPE

The 8th International Symposium on Plasmas & Fine Bubbles (8th ISPFB 2024) will be held at Donghua University, Shanghai, China, May 24-26, 2024.

This symposium aims to provide an open forum for researchers to share and discuss the current status of innovative scientific and technological achievements in the interdisciplinary versatile fields of high pressure, plasma and fine bubbles, along with their potential applications in environmental remediation, biomedical applications, agriculture, aquaculture, food safety and industrial cleaning, etc. Since 2017, the symposium has been successfully held seven times in Chiang Mai (twice, Thailand), Iwate (twice, Japan), Ayutthay (Thailand) and online (twice).

This 8th ISPFB 2024 will bring together leading researchers and industry experts worldwide to share the latest research progress in their respective fields and explore future development trends in related fields. Through in-depth discussions and cooperation, the symposium will promote a deeper intersection and integration of plasma and fine bubble technologies, thereby fostering the shared advancement of these two advanced technologies.

HOST ORGANIZATION

Donghua University

COMMITTEE

- **Honorary Chair**

- *Kiyoshi Yoshikawa*, Kyoto University, RMUTT, Japan
- *Jun Ma*, Harbin Institute of Technology, China

- **Chair**

- *Yanan Liu*, Donghua University, China
- *Pan Li*, Tongji University, China

- **Vice-chairs**

- *Koichi Takaki*, Iwate University, Japan
- *Yoshikatsu Ueda*, Kyoto University, Japan
- *Chiti Sritontip*, Rajamangala University of Technology Lanna

- **Program Committee**

- *Yanan Liu*, Donghua University, China
- *Pan Li*, Tongji University, China
- *Yoshikatsu Ueda*, Kyoto University, Japan
- *Katsuyuki Takahashi*, Iwate University, Japan
- *Krischonme Bhumkittipich*, Rajamangala University of Technology Thanyaburi,
Thailand
- *Luhai Chen*, Shanghai Jinxiang Environment Technology Co., Ltd.

- ***Qingquan Lan***, Nanjing TianQi Advanced Oxidation Technology Co., Ltd.
- ***Jinglin Wan***, Nanjing Suman Plasma Technology Co., Ltd.
- **Academic Committee**
 - ***Jun Hu***, Shanghai University, China
 - ***Lijuan Zhang***, Shanghai Advanced Research Institute, CAS, China
 - ***Douyan Wang***, Kumamoto University, Japan
 - ***Dongping Liu***, Dalian University of Technology, China
 - ***Dingxin Liu***, Xi'an Jiaotong University, China
 - ***Tiecheng Wang***, Northwest A&F University, China
 - ***Banjerd Saengchandr***, Rajamangala University of Technology Lanna
 - ***Boonyang Plangklang***, Rajamangala University of Technology Thanyabur
 - ***Chanchai Dechthummarong***, Rajamangala University of Technology Lanna
 - ***Vishnu Thonglek***, Rajamangala University of Technology Lanna, Thailand
 - ***Fenghua Zhang***, Beijing University of Chemical Technology, China
 - ***Krischonme Bhumkittipich***, Rajamangala University of Technology Thanyaburi
 - ***Masafumi Ito***, Meijo University, Japan
 - ***Shoichiro Hamamoto***, The University of Tokyo, Japan
 - ***Sorapong Pavasupree***, Rajamangala University of Technology Thanyaburi
 - ***Sumonman Niamlang***, Rajamangala University of Technology Thanyaburi
 - ***Takashi Hata***, Kochi Institute of Technology, Japan
 - ***Takayuki Ohshima***, Gunma University, Japan
 - ***Takehiko Sato***, Tohoku University, Japan

- **Uthen Kamnarn**, Rajamangala University of Technology Lanna
- **Wen Zhang**, New Jersey Institute of Technology, USA
- **Xianren Zhang**, Beijing University of Chemical Technology, China
- **Xuehua Zhang**, University of Alberta, Canada
- **Yomei Tokuda**, Shiga University, Japan
- **Zhaojun Li**, The Institute of Process Engineering, CAS, China
- **Jinglin Wan**, Nanjing Suman Plasma Technology Co., Ltd.

CO-ORGANIZER

Tongji University

Chinese Society of Particuology

Shanghai Jinxiang Environment Technology Co., Ltd.

Nanjing TianQi Advanced Oxidation Technology Co., Ltd.

Nanjing Suman Plasma Technology Co., Ltd.

Zhejiang Jubei Group.



SESSION TOPICS

- (1) Innovative integrated micro/nano bubble (fine bubble) and high voltage, plasma technologies for advanced application to environmental field.
- (2) Plasma and micro/nano bubble (fine bubble) technologies for application to agriculture, aquaculture and food safety.
- (3) Plasma and micro/nano bubble (fine bubble) technologies for biomedical applications
- (4) Micro/nano bubble (fine bubble)/high voltage, plasma technologies for application to industrial cleaning.

GENERAL CONFERENCE INFORMATION

- Plenary presentation: 25 minutes for presentation, and 5 minutes for discussion.
- Invited presentation: 17 minutes for presentation, and 3 minutes for discussion.
- Presentation: 12 minutes for presentation, and 3 minutes for discussion.

DAILY OVERVIEW

May 24th	08:30-20:00	Registration
May 25th	08:30-08:40	Opening & Welcome
	08:40-11:55	Session
	11:55-13:10	Lunch Break
	13:10-13:50	Science and Technology Museum Tour
	13:50-17:00	Session
May 26th	08:30-12:05	Session
	12:05-13:20	Lunch Break
	13:20-16:00	Session
	16:00-16:20	General Discussion
	16:20-16:40	Closing & Award Ceremony

SYMPOSIUM CONTACT CENTER

➤ **Secretary:**

Zhang Yinyin: Donghua University, China

Email: zhangyinyin11@163.com

Tel: 18616585358

Luo Pengcheng: Donghua University, China

Email: pc.luo@qq.com

Tel: 18756957846

➤ **Organizing team:**

Zhang Han: Donghua University, China

Email: 1199121@mail.dhu.edu.cn

Tel: 18502582658

Zhao Jingyi: Donghua University, China

Email: 553713211@qq.com

Tel: 18601650873

➤ **Travel and vehicle team:**

He Jinling: Donghua University, China

Email: 15702439814@163.com

Tel: 15702439814

Lu Jizhe: Donghua University, China

Email: 1191016444@qq.com

Tel: 15589751321

Wei Huiru: Donghua University, China

Email: 2584956807@qq.com

Tel: 15517865206

➤ **Accommodation team:**

Zhang Yinyin: Donghua University, China

Email: zhangyinyin11@163.com

Tel: 18616585358

Liu Xing: Donghua University, China

Email: liuxinghandler@163.com

Tel: 13785407171

➤ **Registration team:**

Gu Xia: Donghua University, China

Email: 2191603@mail.dhu.edu.cn

Tel: 15026583975

Wei Qianting: Donghua University, China

Email: 15962890019@163.com

Tel: 15962890019

2024 & 8th ISFPB Program and Schedule

CST Beijing	Friday, 24th, May	Saturday, 25th, May	Sunday, 26th, May
		Lecture Hall 2	Lecture Hall 2
08:30-08:40	Registration	Opening & Welcome	Speaker:Kazuyuki KUCHITSU
08:40-08:50		Speaker: Kiyoshi Yoshikawa	Speaker:Yanan Liu
08:50-09:00		Speaker: Koichi Takaki	
09:00-09:10		Speaker: Koichi Terasaka	Speaker:Jun Hu
09:10-09:20			
09:20-09:30		Coffee & Photo	Coffee
09:30-09:40			
09:40-09:50		Speaker: Dongping Liu	Speaker:Pan Li
09:50-10:00			
10:00-10:10		Speaker: Dingxin Liu	Speaker: Minoru Tanigaki
10:10-10:20			
10:20-10:30		Speaker:Lijuan Zhang	Speaker:Shaofeng Xu
10:30-10:40			
10:40-10:50		Speaker: Douyan Wang	Speaker: Nopporn Patchararpakit
10:50-11:00			
11:00-11:10		Lunch & Meeting	Speaker: Rattanaporn Norarat
11:10-11:20			
11:20-11:30		Science and Technology Museum Tour	Speaker: Chanchai Dechthummarong
11:30-11:40			
11:40-11:50		Speaker: Masayoshi Takahashi	Speaker: Ai Zhang
11:50-12:00			
12:00-12:10		Speaker: Qiang Chen	Speaker:Jinglin Wan
12:10-12:20			
12:20-12:30		Speaker:Yoshikatsu Ueda	Speaker: Xubo Lin
12:30-12:40			
12:40-12:50		Speaker: Qing Zhang	Speaker: Hangbo Xu
12:50-13:00			
13:00-13:10		Coffee	Speaker: Chirwa William
13:10-13:20			
13:20-13:30		Speaker: Jixiang Li	Speaker: Zhongxian Wu
13:30-13:40			
13:40-13:50		Speaker: Chiti Sritontip	Coffee
13:50-14:00			
14:00-14:10		Speaker: Anto Tri sugiarto	Presentation: Mengying Zhu
14:10-14:20			
14:20-14:30		Speaker: Katsuyuki Takahashi	Presentation: Bo Qiao
14:30-14:40			
14:40-14:50		Speaker: Yuwei Huang	Presentation: Nachael Mwanga
14:50-15:00			
15:00-15:10		Dinner	General Discussion
15:10-15:20			
15:20-15:30		Closing & Award Ceremony	
15:30-15:40			
15:40-15:50			
15:50-16:00			
16:00-16:10			
16:10-16:20			
16:20-16:30			
16:30-16:40			
16:40-16:50			
16:50-17:00			
17:00-17:10			
17:10-17:20			
17:20-20:20			

➤ Programme

Saturday, May 25 (Lecture Hall 2)				
CST Beijing	Session Chair	Presenter	Title	Affiliation
08:30-08:40	Opening Ceremony Prof. Yanan Liu (Chair, Donghua University, China) Prof. Ge Chen (Vice President, Donghua University, China)			
08:40-08:55	Yanan Liu	Kiyoshi Yoshikawa	Opening address	Kyoto University, Japan
08:55-09:25		Koichi Takaki	Function control of plant and marine products by pulsed power technologies	Iwate University, Japan
09:25-09:55		Koichi Terasaka	Generation mechanism of ultrafine bubbles in water, and the development of transport, concentration and removal technologies	Keio University, Japan
09:55-10:15	Coffee & Photo			
10:15-10:45	Koichi Takaki	Dongping Liu	Peroxynitrous acid (HO-ONO) in plasma activated medium: from its generation and stability to its chemical reactivity	Dalian University of Technology, China
10:45-11:15		Dingxin Liu	Dynamic Processes in Microbubble Production by Spark Discharges in Water	Xi'an Jiaotong University, China
11:15-11:35		Lijuan Zhang	Hydrogen Nanobubbles Generated in Situ from Nanoscale Zerovalent Iron with Water to Further Enhance the Removal of Quasi-heavy Metal	Shanghai Synchrotron Radiation Facility, Shanghai Advanced Research Institute, Chinese Academy of Sciences, China
11:35-11:55		Douyan Wang	Removing damped oscillation from nanosecond pulse voltage for ideal nonthermal plasma processing	Kumamoto University, Japan
11:55- 13:10	Lunch			
13:10-13:50	Science and Technology Museum Tour			
13:50-14:10		Masayoshi Takahashi	Dynamics at the Gas-Water Interface of Collapsing Microbubbles - An Exciting Reaction Field -	Tohoku University, Japan

14:10-14:30	Lijuan Zhang	Qiang Chen	Formation Of Hydrogen Peroxide And Nitrate Through A DC Discharge Plasma Generated Inside An Aqueous Solution	Xiamen University, China.
14:30-14:50		Yoshikatsu Ueda	Properties Correlation between Ultra Fine Bubbles and Water Characteristics	Kyoto University, Japan
14:50-15:05		Qing Zhang	Cancer-Targeting Carbon Quantum Dots Synthesized by Plasma Electrochemical Method for Red Light Activated Photodynamic Therapy	Shanghai Jiao Tong University, China
15:05-15:25	Coffee			
15:25-15:45	Qiang Chen	Jixiang Li	Magnetic activated sludge & nanobubbles to improve the bioreactor performance and its scale-up: biodegradation and sludge dewatering	Shanghai Advanced Research Institute, Chinese Academy of Sciences, China.
15:45-16:05		Chiti Sritontip	Utilizing Fine Bubbles Technology for Crop Production and Aquaculture in Thailand	Rajamangala University of Technology Lanna, Thailand
16:05-16:25		Anto Tri sugiarto	Characteristics of Plasma Activated Fine Bubble Water Using Dielectric Barrier Discharge Reactor for Agriculture	Research Center for Smart Mechatronics, National Research and Innovation Agency, Bandung, Indonesia
16:25-16:45		Katsuyuki Takahashi	Generation of pulsed discharges contacted into water and their environmental and agricultural applications	Iwate University, Japan
16:45-17:00		Yuwei Huang	Portable System of Microbubble Water for Biomedical Treatment	National Yang Ming Chiao Tung University, China
Dinner				

Sunday, May 26 (Lecture Hall 2)				
CST Beijing	Session Chair	Presenter	Title	Affiliation
08:30-09:00	Pan Li	Kazuyuki KUCHITSU	Roles of reactive oxygen species in plant development: Growth control and immediate initial responses by nonthermal plasma irradiation	Tokyo University of Science
09:00-09:30		Yanan Liu	Non-thermal Plasma and Microbubbles for Environmental and Agricultural Application	Donghua University, China
09:30-09:50		Jun Hu	Gas-liquid interfaces of nanobubbles: properties & applications	Shanghai University, China.
09:50-10:10	Coffee			
10:10-10:40	Douyan Wang	Pan Li	Application of microbubbles in Cleaning: A Study on Controlling Venturi Tube Microbubble Generators for Efficient Aircraft Oil Removal	Tongji University, China
10:40-11:00		Minoru Tanigaki	Applications of Radioactive Nuclei to the Studies of Ultrafine Bubbles and Nano-Size Material Science	Kyoto University, Japan.
11:00-11:20		Shaofeng Xu	Reactive oxygen and nitrogen species produced by atmospheric pressure plasmas	Donghua University, China.
11:20-11:35	Chiti Sritontip	Nopporn Patchararpakiti	Total Dissolved Solid Reduction in Discharge from Mae Moh Coal Mine Using Electrocoagulation Process	Rajamangala University of Technology Lanna, Thailand
11:35-11:50		Rattanaporn Norarat	Effect of air-fine bubbles aeration on red tilapia cage culture in Thailand	Rajamangala University of Technology Lanna, Thailand
11:50-12:05		Chanchai Dechthummarong	Experiment and Investigation of Activated Spraying Water Fog Using Dielectric Barrier Discharge Plasma in Atmospheric Air	Rajamangala University of Technology Lanna, Thailand
12:05-13:20	Lunch			
13:20-13:40	Yoshikatsu Ueda	Ai Zhang	Synergistic coupling of plasma with microbubbles for enhancing short-chain fatty acids production during sludge anaerobic fermentation	Donghua University, China

13:40-13:55		Jinglin Wan	低温等离子体技术及应用	南京苏曼等离子科技有限公司
13:55-14:10		Xubo Lin	Molecular Dynamics Simulations of Lipid Nanobubbles	Beihang University, China.
14:10-14:25	Katsuyuki Takahashi	Hangbo Xu	Dual synergistic bactericidal mechanism of cold atmospheric plasma coupled with ZnO nanoparticles against Staphylococcus aureus	Zhengzhou University, China
14:25-14:40		Chirwa William	Aquaculture Effluent Treatment and Cabbage Growth Enhancement Using Plasma-Fine Bubbles	Tongji University, China
14:40-14:55		Zhongxian Wu	Study on the Mechanism of Pyrite Flotation Enhanced by Nanobubbles	China University of Mining and Technology, China.
14:55-15:15	Coffee			
15:15-15:30	Shaofeng Xu	Mengying Zhu	Efficient water activation by hybrid plasma microbubbles for bacterial inactivation	Xi'an Jiaotong University, China.
15:30-15:45		Bo Qiao	Enhancement mechanism of nanobubbles in coal flotation	Shandong University of Technology, China.
15:45-16:00		Nachael Mwanga	Unveiling the Preventive Potential: Micro and Nanobubbles Influence on Ceramic Membrane Fouling by Organic Foulants During Drinking Water Treatment	Tongji University, China
General Discussion				
Closing & Award Ceremony				

Speakers

Biography



Kiyoshi YOSHIKAWA (Professor Emeritus, Dr. Eng., nuclear engineering, Kyoto University, Japan, 1974) is currently a specially-appointed professor at Institute of Advanced Energy, Kyoto University and also a Counselor at Rajamangala University of Technology Thanyaburi, Thailand since February, 2022, after serving as a Research Advisor to the President of Rajamangala University of Technology Lanna, Chiangmai since June, 2015, Thailand. Before in Thailand, he served for 6 years as Executive Vice President for Research of Kyoto University, Japan. He held a visiting appointment at University of California, Lawrence Livermore Laboratory (now LLNL) in 1978 and at University of California, Lawrence Berkeley Laboratory (now LBNL) until March 1980. He served as the Chairperson of the Research Institute Directors' Committee of Ministry of Education, Culture, Sports, Science and Technology during 2003-2004, and also served as a director of Institute of Advanced Energy, Kyoto University during 2000-2007. His main interests are high voltage, plasma and Finebubble(Micro/nano bubble) applications to agriculture, aquaculture and industries, in addition to fusion direct energy conversion, reactor-relevant advanced technologies, super-compact DD fusion inertial-electrostatic confinement fusion, fusion reactor design, free electron laser, and humanitarian landmine detection.

Biography



Koichi TAKAKI, Professor of Iwate University, Japan. He has received the Dr. Eng. degrees for his study on high-voltage and electrical discharge characteristics in 1995 from Kumamoto University, Japan. He graduated at Kumamoto University in 1988, and joined Oita National College of Technology from 1989 to 1995. During this time, he clarified the characteristics of glow discharge in the gas flow such as rotational- and vibrational temperatures. He also developed a water jet machine to trigger the winter lightning and carried out the triggering lightning at Hokuriku Sea coast. He joined the Faculty of Engineering, Iwate University from 1996, and received a full professorship in 2011. During 2000-2001, he was a visiting researcher of McMaster University, Canada. His main research interests include pulsed power technologies such as plasma generation based on solid materials, environmental and agricultural applications. Typically, he has experienced studies of pulsed-ion technology such as high-power magnetron sputtering, exhaust gas processing in atmospheric pressure such as decomposition, water remediation by discharge under water, high-voltage stimulation on mushroom for improvement of harvest yield. He was the deputy director of Agri-Innovation Center from 2018 to 2021. He is authors of 36 books and 245 academic papers published on many journals. Prof. Takaki is a senior member of IEEE. He is also very active in reach out for energy, environment and STAEM education to contribute the SDGs. He received Prizes for Science and Technology in the Commendation for Science and Technology by the Minister of Education, Culture, Sports, Science and Technology in 2016. He appeared in more than thirty TV programs such as Asa-Ichi, NHK. His hobby is mountain climbing including top of Mt. Mont Blanc (4,807m) and trekking to the base-camp of Mt. Everest, Nepal.

Biography



Koichi TERASAKA was born in 1961 in Akashi, Japan. In 1991 he received his Doctor of Engineering degree from the Keio University Graduate School of Engineering. Since 2008, he has been a full Professor in the Chemical Engineering Laboratory, Department of Applied Chemistry, Faculty of Science and Technology, Keio University. He was a Visiting Professor at the Technical University of Braunschweig, Germany in 1995, the Hamburg University of Technology, Germany in 2016, and a Mercator Fellow of DFG since 2017. In 2017, he served as a Visiting Professor at Dalhousie University in Canada. His original professionality was bubble column design, but since 2001 he has been engaged in research on Fine Bubbles and Ultra-fine Bubbles, elucidating the principles of fine bubble generation, conducting practical research, and developing evaluation technology. He founded the Fine Bubble Industries Association (FBIA) in 2011 and the Union of Fine Bubble Scientists and Engineers (FBU) in 2015. He has been appointed as an ISO/TC281 (Fine Bubble Technology) committee member since 2013. In 2018, he established the International Fine Bubble Consortium with three universities in Japan, Germany, and Canada.

Biography



Dongping LIU born in 1971 received his master degree in 1998 and his doctorate degree in 2001, all from Dalian University of Technology, China. From November 2004 to May 2006, he worked at Colorado State University, USA as a postdoctoral research fellow. In 2006, he was appointed as Professor of Plasma Physics both at Xiamen University and at Dalian Nationalities University, China. Currently, he works in Dalian University of Technology, China as a full-time professor. His current research interests include plasma diagnosis and simulation, plasma agriculture, plasma bioscience and plasma medicine. Prof. Liu has authored/co-authored 200 international journal papers and published 2 books. He has presented 50 invited talks at domestic and international conferences. In 2006, He was conferred Deggendorfer Hochschule prize, Germany. He is the reviewer of more than 30 international journals. He closely collaborates with several companies in China to develop the plasma medicine and plasma agriculture. He has about 30 China invention patents, and many of them have been transferred to companies in China.

Biography



Dingxin LIU was born in 1982 in China. He received his Ph.D. in Electrical Engineering from Xi'an Jiaotong University in 2010 and has been working in the same university ever since. He used to study as a visiting student at Loughborough University in the UK from 2008 to 2009. He has been a full professor since 2017. He is an IOP fellow, and a vice director of the youth committee of China Electrotechnical Society.

Prof. Liu's expertise includes gas discharge plasma, plasma-liquid interaction and plasma biomedicine. The main focus of his research is on developing plasma technology for disinfection, wound care, dermatological treatment and cancer therapy, as well as elucidating the underlying mechanism of the biological effects of plasma-activated media.

Biography



Lijuan ZHANG was born in 1973 in China. She got her Ph.D. in Particle and Nuclear Physics from Shanghai Institute of Applied Physics, CAS in 2007. She has worked as a postdoctoral fellow in polymer research in Max Planck Institute for Polymer Research (Mainz, Germany) from 2007 to 2009, and joined to Shanghai Synchrotron Radiation Facility (SSRF) in 2009. She was been a full Professor of Synchrotron radiation techniques in Shanghai Institute of Applied Physics since 2016. She moved to Shanghai Advanced Research Institute in 2018. Currently, she is one of overall user responsible person of SSRF, Managing Director of the Chinese Particle Society, Secretary General of the Micro Nanobubble Professional Committee of the Chinese Particle Society, and Deputy Secretary General of the National Fine Bubble Technology Standardization Technical Committee.

Professor Zhang's expertise includes soft X-ray spectroscopy, nanomaterials, biomaterials and nano interfacial sciences, etc. She has already published more than 100 SCI papers including Nature, J. Am. Chem. Soc., Small, and Environmental Science & Technology. Her research mainly focus on the fundamental properties of nanobubbles and their important applications in biology and environment based on nanoimaging and spectroscopy techniques such as synchrotron radiation and atomic force microscopy, etc..

Biography



Douyan WANG was born in Beijing, China. She received the B.S., M.S. and Ph.D. degrees from Kumamoto University, Kumamoto, Japan. She was with Hitachi, Ltd., Ibaraki, Japan, from 2000 to 2002. From 2003 to 2004, she was on sabbatical leave with the Center for Pulsed Power and Power Electronics, Texas Tech University, Lubbock, TX, USA. She was a JSPS Research Fellow from 2003 to 2005. From 2005 to 2007, she was a Research Associate with the 21st Century Center of Excellence Program, Kumamoto University. Since 2007, she has held a tenure-track position as an Assistant Professor of Priority Organization for Innovation and Excellence, and since 2012, she has been a Tenure Associate Professor with Kumamoto University.

Her research interests include generation of nanoseconds pulsed discharge plasma, ozone generation, pollution control in gas phase and liquid phase, application of pulsed electric fields and plasmas on biological cells.

Biography



Masayoshi TAKAHASHI received the Ph.D. degree for his study on safety engineering in 2001 from Kyushu University, Japan.

During 1982-1985 he was a student of Master's course in Mining Engineering, Kyushu University and studied mineralization relating to granite activities in north Kyushu region, Japan. In 1985 he joined to National Institute for Pollution and Resources as a researcher and work there for 33 years. In 2018 he joined to Tohoku University as a full professor in New Industry Creation Hatchery Center.

His scientific approach was based on physiology and he also interested in breathing protection of divers. And he needed to find out the mechanism of Benz, decompression sickness. That is a problem arising from underwater diving decompression and relating to bubble generation in muscles and veins. And he wanted to know more about the mechanism of bubble generation in human body, especially the phenomenon of bubble nucleation. It was very fortunate for him, because it was the time when some prototypes of microbubble generator were developed in Japan.

He interested in the mechanism of the generation of tiny bubbles in aqueous solution. He started the research work of tiny bubbles around 2000 at National Institute of Advanced Industrial Science and Technology, as the result of reorganization. He discovered the phenomenon that microbubbles can produce free radicals in the shrinking and collapse process, and published this result in The Journal of Physical Chemistry B , and this article has been cited 427 times till March 2024.

Biography



Qiang CHEN received PhD in Engineering from Saitama University (Saitama, Japan) in March 2009. He was a JSPS and GCOE research Fellow in Tohoku University (Sendai, Japan) from 2009 to 2012, focusing on nanomaterials synthesis using the plasma electrochemical method. In April 2012, he joined the group of Prof. Ichiki Takanori in the University of Tokyo as a project researcher to develop ICP plasma based high-rate etching process. He was then appointed as an Associate Professor in the Department of Electronic Science at Xiamen University in April 2014 and was promoted to Professor in August 2022.

Prof. Chen has been working for many years on the plasma electrochemistry, and significant efforts are focused on the understanding of the chemical and physical processes taking place at the plasma-liquid interactions. The main objective of Chen's group is to apply plasma electrochemical processes on chemicals synthesis, waste treatment and surface modification etc.

Biography



Yoshikatsu UEDA was born in 1973 in Japan. He studied in the Department of Electrical Engineering and the Department of Electronic Engineering at Kyoto University's Faculty of Engineering, graduating in 1997. He then pursued his Master's and Doctoral degrees at Kyoto University, obtaining a Ph.D. in Information Science in 2004.

In his professional career, from 2002 to 2004, Dr. Ueda worked as an assistant at the Kyoto University Center for Radio Science in Space and Atmosphere. He then served as an assistant at the Kyoto University Research Institute for Sustainable Humanosphere from 2004 to 2007, where he was involved in developing wave-particle correlation measurement devices and conducting research related to the Mercury exploration mission. From 2007 to 2022, he was an assistant professor at the same institute, working on the development of fuel cells and research on organic-inorganic hybrid materials. Since 2022, he has been an assistant professor at the Future Development Research Center for the Humanosphere, focusing on technological development.

Dr. Ueda has also been active as a part-time lecturer at Kyoto University, contributing to the Center for Promotion of Interdisciplinary Education and Research and the Research Cooperation Foundation. Additionally, he is a council member of the Fine Bubble Society Federation.

His qualifications include being a Class 1 Occupational Safety and Health Manager, a handler of radioactive isotopes at Kyoto University, a fifth-degree black belt in Aikido, and a certified coaching assistant by the Japan Sports Association.

Biography



Jixiang LI was born in 1982 in China. He got his Ph.D. in Environmental Engineering from Tongji University in 2010. He is currently working as an Professor in Shanghai Advanced Research Institute, Chinese Academy of Sciences. He is also a PHD advisor at University of Chinese Academy of Sciences. His research focuses on the innovative water and wastewater treatment and reuse technologies. Her expertise and practical experience cover the areas of water and wastewater engineering such as micro-nano bubble technologies, membrane technologies, advance oxidation technologies, adsorption technologies. His current research is in the areas of membrane fouling alleviation technologies, environmental functional materials, environmental microorganisms, micro/nano bubbles, and etc. He has authored more than 70 journals. He has ever rewarded as Member of the Youth Innovation Promotion Association of the Chinese Academy of Sciences, Shanghai Youth Top Talent and etc. He is in charge of several key principle projects, more than 30 million RMB. Currently, he serves as Editorial Board Member of Journal of Water Sustainability, Member of China Technical Committee for the Standardization of Microbubble Technology, Member of Microbubble Committee of China particle Society and Core Member of International MBR Center.

Biography



Chiti SRITONTIP was born in 1971 in Thailand. He got his Ph.D. in Horticulture (Agriculture) from Chiang Mai University in 2015, and has worked at Rajamangala University of Technology Lanna since 1998. He has been an Associate Professor of Horticulture at Rajamangala University of Technology Lanna since 2014. Assoc. Prof. Chiti SRITONTIP is the Deputy Director of the Agricultural Technology Research Institute, Rajamangala University of Technology Lanna.

Associate Professor Sritontip's expertise includes the physiology of fruit crops (plant growth regulators or plant hormones and off-season flowering in fruit trees), soilless culture, plant nutrition, the application of high voltage plasma and fine bubbles in plant production, and extending the shelf life of vegetables and fruits.

Biography



Anto Tri Sugiarto was born in 1972 in Indonesia. He got B.Eng and M.Eng in Electrical Engineering from Nihon University, Japan in 1996 and 1998 respectively, and completed Ph.D in the field of plasma discharge in water at the Faculty of Industrial Engineering, Gunma University, Japan in 2002. He has worked as a Assistant Professor in Non-thermal Plasma Application in Department of Biological and Chemical Engineering, Gunma University from 2002 to 2003, and return to Indonesia as Researcher in Indonesian Institute of Sciences (2004-2021). Anto Tri Sugiarto, Ph.D is senior researcher in Research Centre for Smart Mechatronics, Indonesian Research and Innovation Agency (2021 – Now).

Anto Tri Sugiarto, Ph.D expertise includes non-thermal plasma in water, fine bubbles (micro/nano) and environmental engineering. The main focus of his research is on developing removal methods for water and wastewater treatment, soil remediation and recycling. He has about 12 Indonesian Invention Patents and has successfully applied more than 70 installations of water and wastewater treatment plant based on plasma ozone and fine bubbles for industrial and domestic sector. His recent research is development of urban aqua-agriculture technology based on non-thermal plasma and fine bubbles.

Biography



Katsuyuki TAKAHASHI was born in Miyagi, Japan. He received B.Eng. from Sendai national college of technology, and M. Eng. and Dr. Eng. degrees from Iwate University, all in electrical engineering. From 2009 to 2015, He was with Shishido Electrostatic LTD., as a researcher. From 2015, he has been in Faculty of Science and Engineering, Iwate University, now as an associate professor. His current research interests include electrostatic discharge, environmental and agricultural applications of plasma and high-voltage pulsed-power technology.

Biography



Kazuyuki KUCHITSU obtained Ph.D. in plant molecular physiology from the University of Tokyo. He worked at National Institute of Agrobiological Resources, Ministry of Agriculture, Forestry & Fisheries in Tsukuba, and University of California, San Diego, U.S.A. before joining the faculty at Tokyo University of Science (TUS) in 1999. He has been a Full Professor at Department of Applied Biological Science at TUS since 2007. He also founded and has been leading the Interdisciplinary Agricultural Science & Technology Course at TUS which combines biology with science and engineering. This innovative program integrates biology with science and engineering, aiming to devise groundbreaking solutions for agricultural and environmental challenges, including food security, environmental sustainability, and energy efficiency.

In addition to his academic endeavors, Professor Kuchitsu served as a Program Officer at the Ministry of Education, Culture, Sports, Science and Technology from 2007 to 2009. He has also shared his expertise as a visiting professor at numerous universities worldwide, spanning China, Korea, India, Finland, Poland, Germany, Mexico, among others. He was awarded prizes from the Japanese Society of Plant Physiologists as well as the Bioimaging Society. He also serves as editors for several scientific journals. Furthermore, he actively participates in various outreach programs targeting audiences ranging from students to the general public, including delivering annual lectures to commemorate the Fascination of Plants Day on May 18th.

Professor Kuchitsu's research covers how plants perceive infection of pathogens, herbivory, and environmental stresses, transmit signals, involving reactive oxygen species and various ions such as Ca^{2+} , throughout the body to enhance immunity and control development and morphogenesis. Furthermore, he actively explores interdisciplinary approaches, applying cutting-edge technologies such as cold atmospheric plasma and ultrafine/nano bubbles to advance plant biology and agricultural practices.

Biography



Yanan LIU was born in 1978 in China. She got her Ph.D. in Environmental Engineering from Harbin Institute of Technology in 2005 and has worked in Donghua University since then. She has worked as a postdoctoral fellow in Plasma Application in LGPPTS at ENSCP-UMPC (Paris, France) from 2009 to 2011, and been a full Professor of Environmental Engineering in Donghua University since 2014. Prof. Yanan LIU is the Deputy Director of the Science and Technology Research Institute and the Director of the Industrial Cooperation Department, Donghua University. She also serves as the Director of National Circular Economy Engineering Laboratory.

Professor Liu's expertise includes environmental engineering, plasma chemistry and environmental microbiology. The focus of her research is on developing removal methods for emerging pollutants, such as per- and polyfluoroalkyl substances (PFAS) and other recalcitrant chemicals or organisms, soil remediation and improvement, organic waste treatment and recycling, and development of physical agriculture technology based on non-thermal plasma and fine bubbles.

Biography



Pan LI is an Associate Professor of Civil Engineering at Tongji University. She earned her Ph.D. from the School of Science for Open and Environmental Systems at Keio University in 2006. Following her doctoral studies, she served as a postdoctoral researcher at the Research Institute for Environmental Management Technology, National Institute of Advanced Industrial Science and Technology (2006-2009) and later as a researcher at the R&D Center, Asahi Group Holdings LTD (2009-2011) before joining the College of Environmental Science and Engineering at Tongji University.

Her research interests center on the fundamental characteristics of micro/nano bubbles, exploring their interface physical and chemical properties, as well as delving into the phenomenon of free radical generation. Dr. Pan Li has also been actively involved in innovative applications of micro/nano bubbles, including pioneering research in their generation technology, advanced oxidation technology, ecological restoration technology, and green cleaning technology.

ResearchGate: <https://www.researchgate.net/profile/Pan-Li-28>

Institutional website (in Chinese): https://sese.tongji.edu.cn/szdw/zyjs/fjs_fyjj_/L/lp/jxky.htm

Biography



Minoru TANIGAKI was born in 1968 in Japan. He got his Ph.D. in Nuclear Physics from Osaka University in 1999. From 1996 to 1999, he worked on constructing a 100 MeV cyclotron accelerator as a postdoctoral fellow in the Accelerator Division in the Cyclotron and Radioisotope Center at Tohoku University. Since 1999, he has been an Assistant Professor at the Institute for Integrated Radiation and Nuclear Science, Kyoto University. His work has extended not only the studies on the structure of unstable nuclei but also the application of experimental techniques in nuclear physics. Based on his knowledge of radiation detection and control systems of experimental systems in nuclear physics, he developed KURAMA, an environmental radiation monitoring system for the Fukushima nuclear accident. He has been involved in recovery activities in Fukushima since 2011. He is also devoted to material science by using radioactive nuclei as probes to investigate the fundamental properties of materials. With his recent success in measuring the internal gas pressure of ultrafine bubbles by using radioactive nuclei produced inside the bubbles, he aims to expand his research on the basic properties of ultrafine bubbles by applying experimental techniques from nuclear physics.

Biography



Shaofeng XU was born in 1988, Henan, China. In 2016, He received Ph.D in Physics all from the Shanghai Jiao Tong University, Shanghai, China. In 2018, he joined the Institute of Plasma Physics of the Czech Academy of Sciences, Prague, Czech Republic, as a post-doctoral. In 2022, he joined the College of Science, Donghua University, Shanghai, China. He also serves as an academic editor of PLOS ONE and Young Editorial Board member of Fluid Dynamics & Materials Processing.

Dr Xu's main research field is plasma physics and fluid dynamics, which are widely used to water treatment, synthesis of materials and material surface modifications. His research focuses on Computational fluid dynamics, Quantum chemistry, Ab initio molecular dynamics simulations, Machine learning to understand the complex physical and chemical processes in the plasma-matter interactions.

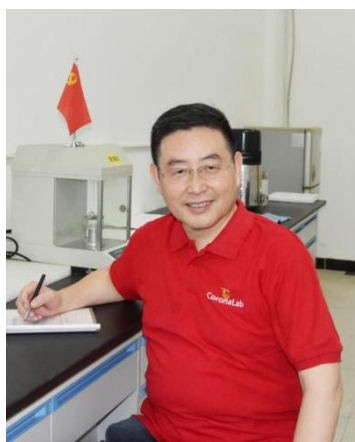
Biography



Ai ZHANG was born in 1989 in China. She got her Ph.D. in Environmental Engineering from Tongji University in 2016, and has worked in Donghua University since then. She has worked as a visiting scholar in University of Arizona (Tucson, USA) from 2014 to 2015, and been a full Associate Professor of Environmental Engineering in Donghua University since 2019.

Dr. Ai Zhang's research focuses on the removal of emerging organic contaminants by advanced oxidation processes (including plasma) and resource recovery by anaerobic treatment of biosolids. She found that plasma-based technologies exhibited great potential for controlling emerging contaminants in waste activated sludge, as well as promoting sludge reduction and resourcization. Currently, her h-index is 24 (1426 citations) as per Google Scholar.

Biography



万京林，男，获得部科技进步一等奖二项、二等奖三项、三等奖五项和江苏创新发明一等奖、三等奖、教育部技术发明二等奖和创业先锋奖各一项。为国家工作作出突出贡献被记授三等功、嘉奖和部“技术尖兵”荣誉称号。

现担任苏曼等离子工程研究院总经理，苏曼等离子科技有限公司董事长。被聘为江苏省教育厅产业教授、南京信息工程大学特聘教授。并是南京工业大学、南京林业大学、华南理工大学、上海东华大学、南京航空航天大学全日制硕士校外指导教师。是电工技术协会等离子体专委会委员、环境学会挥发性有机物防治专委会委员、西安交通大学高压放电与等离子体工程研究中心技术委员、机械协会表面技术装备专委会委员、科技出版社气体放电与等离子体应用著作丛书编委会委员、江苏真空学会常务理事、南京创新型企业家协会副会长。Email: coronalab@coronalab.net。

Presentation Abstracts

Function control of plant and marine products by pulsed power technologies

Koichi Takaki^{1,2*}, Katsuyuki Takahashi¹, Chunhong Yuan^{2,3}, Nobuya Hayashi⁴, Douyan Wang⁵,
and Takayuki Ohshima⁶

¹ Faculty of Science and Engineering, Iwate University, 4-3-5 Ueda, Morioka, Iwate 020-8551, Japan

² Agri-Innovation Center, Iwate University, 3-18-8 Ueda, Morioka, Iwate 020-8550, Japan

³ Faculty of Agriculture, Iwate University, 3-18-8 Ueda, Morioka, Iwate 020-8550, Japan

⁴ Department of Engineering Science, Kyusyu University, 6-1 Kasugakoen, Kasuga, Fukuoka 816-8580, Japan

⁵ Institute of Pulsed Power Science, Kumamoto University, 2-39-1 Kurokami, Chuo-ku, Kumamoto 860-8555, Japan

⁶ Faculty of Science and Technology, Gunma University, 1-5-1 Tengin, Kiryu, Gunma 376-8515, Japan

E-mail: takaki@iwate-u.ac.jp

Type of presentation: (Oral; Keynote Lecture)

Status of Presenter: (Regular)

Abstract

Intense pulse-electric field (PEF) and plasma have been tried to apply in agriculture and food processing such as seed germination promotion, seedling growth enhancement and inactivation of bacteria [1]. Objective of the study is the novel function control of plant and marine products based on pulsed power technologies and its scientifically deepening. Multi-reaction field of plasma and PEF were produced and controlled spatially and temporally using the pulsed power technologies. The key issue of the study is production of multi-reaction field of plasma and PEF with spatially and temporally control to adapt whole bio-scale as shown in **Fig. 1**. In the plant activity control, seed germination, effect of the multi-reaction on seedling growth enhancement, resistance for pathogenic bacteria and photosynthesis are evaluated through redox, metabolism, phytohormone and gene expression analysis. In the food safety issue, the effect on qualities (freshness) of agricultural and marine products are evaluated by k-value, bacteria number density, color index for ripening, enzyme activity and protein conformational change. This study focuses on pulsed power based multi-reaction field effect on plant activity and food function in science based on not only relaxation time of each bio-scale but also bio-activity of each growth phase as shown in **Fig. 2**. The research was supported by the Japan Society for financial support of a Grant-in-Aid for Scientific Research Foundations S (19H05611).

References

[1] K. Takaki, *et al.*: *Rev. Modern Plasma Physics* (2021) **5**, 12 (112pp).

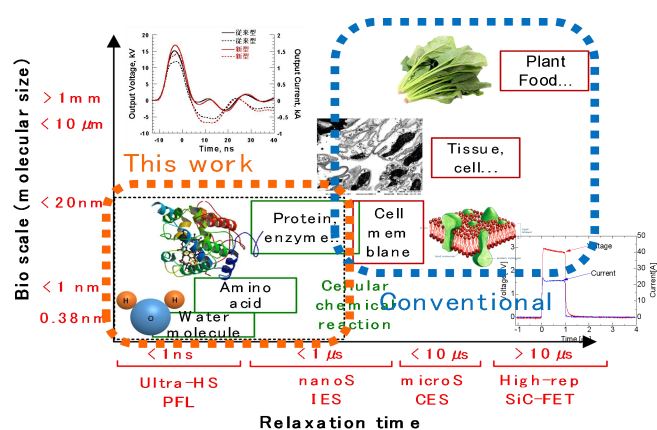


Fig. 1 Relation of bio-scale and relaxation time.

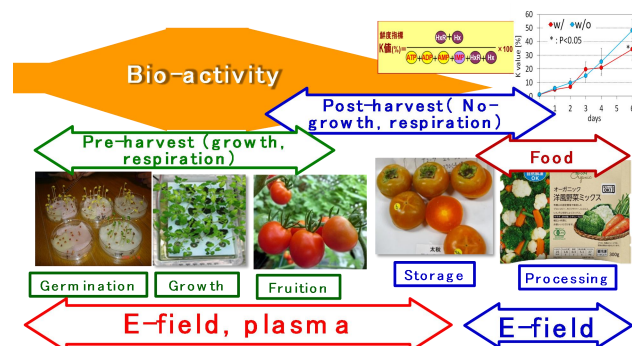


Fig. 2 Multi-reaction fields for each growth phase.

Generation mechanism of ultrafine bubbles in water, and the development of transport, concentration and removal technologies

Koichi Terasaka^{1*}

¹ Department of Applied Chemistry, Faculty of Science and Technology, Keio University

3-14-1 Hiyoshi, Kohoku-ku, Yokohama 223-8522, Japan.

E-mail: terasaka@aplc.keio.ac.jp

Type of presentation: Oral

Status of Presenter: Regular

Abstract

Ultra-fine bubbles (UFBs) are invisible bubbles with a diameter of less than 1 μm , which definition is determined by the consensus of representatives from all over the world at ISO, the terminology is promoted for the healthy development of the global economy [1].

The generation and stabilization mechanisms of UFBs in water have been much debated. In this lecture, I will introduce the UFB generation mechanism in water as well as the UFB stability and separation in water for practical use.

I proposed a hypothesis regarding the generation mechanism of UFBs in uncontaminated ultrapure water [2]. We conducted several different experiments and obtained sufficient experimental results to meet the hypothesis.

UFBs are practically used not only in agriculture but also in a wide range of fields such as fisheries, industry, and cleaning. Particularly for UFB water in agriculture, it is necessary to transport UFB water of sufficient quality using pipelines. Therefore, we experimentally measured the durability of the UFB water passing through a long tube at high velocity [3]. A loss of UFB was observed at large Re .

The number concentration of UFB may not be sufficient. Therefore, we demonstrated to concentrate the low number concentration of UFB water using a vacuum evaporation [4], and we developed a lab-scale UFB continuous concentration device.

On the other hand, continuous removal or continuous recovery of UFB from water may also be necessary. Therefore, we succeeded in separating UFBs from UFB water using a membrane and recovering the UFB trapped in the membrane by backwashing [5].

Acknowledgement

This research was partially supported by JSPS Kakenhi (No. 23H01749) and the Fine Bubble Industries Association (FBIA).

References

- [1] International Organization for Standardization, 2017, ISO 20480-1.
- [2] K. Terasaka, *et al.* Chem. Eng. Sci. 2022, 263 (14), 118070
- [3] K. Nakajima, *et al.* Proc. ICMF2022, 2022, P2.
- [4] S. Tanaka, *et al.* Colloids and Interfaces, 2020, 4(4), 50, doi: 10.3390/colloids4040050
- [5] E. Omata, *et al.*, Proc. ICSST23, 2023, DP-17.

Peroxynitrous acid (HO-ONO) in plasma activated medium: from its generation and stability to its chemical reactivity

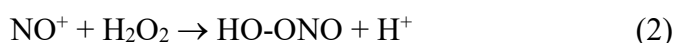
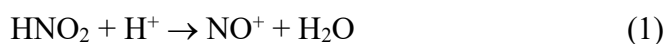
Di Dou, Jiaxin Li, Ruixuan Hui, and Dongping Liu*

School of Electrical Engineering, Dalian University of Technology, Dalian 116024, China

Email: dpliu@dlut.edu.cn

Type of presentation: Oral

Peroxynitrous acid (HO-ONO) is one of the most important nitrogen-containing reactive species in air or nitrogen plasma activated medium (PAM). HO-ONO can be generated during the direct plasma treatment of water via the reactions of the short-lived reactive species, such as OH, O₂H, and O₂⁻ with NO or NO₂ in water [1]. However, HO-ONO is also produced via the H₂O₂ reaction with HNO₂ in the acidic plasma activated medium, as shown below.



Both H₂O_{2(aq)} and HNO₂ are long-lived reactive species. HO-ONO in the aqueous solution can decompose into short-lived reactive species, such as OH and NO₂ since the HO-ONO bond is very weak. The geminate pair of OH and NO₂ in equilibrium with the reactant play a crucial role in controlling the chemical reactivity of PAW. Since the aqueous H₂O₂ and HNO₂ can penetrate into cells to generate geminate pair of OH and NO₂, HO-ONO can act as one of the most important intermediates reacting with biomolecules in cells. The stability and chemical reactivity of HO-ONO are strongly dependent on the temperature and pH value of PAM and the functional groups of amino acids and nucleobases from pathogens. Both the oxidation and nitration reactions occurring in the aqueous solution are responsible for the effective inactivation of pathogens by PAM. The oxidation reactions occurred both in the nucleobases of guanine and in the functional groups of methylthio, indolyl, and hydrosulphonyl in amino acids while the nitration reactions occurred in uracil and in the functional groups of hydroxybenzene in amino acids. The formation of HO-ONO is accompanied by the formation of HOONO₂ under acidic conditions. HOONO₂ in acidic solutions can decompose into HO_{2(aq)} and NO_{2(aq)}, which can also be helpful for improving PAM reactivity.

References

- [1] S. Goldstein, *et al.* Chem. Rev. 2005, 105, 2457.

Dynamic Processes in Microbubble Production by Spark Discharges in Water

Dingxin Liu^{1*}, Mengying Zhu¹, Mingyan Zhang¹, Renwu Zhou¹

¹ State Key Laboratory of Electrical Insulation and Power Equipment, Center for Plasma Biomedicine, Xi'an Jiaotong University, Xi'an City 710049, People's Republic of China

E-mail: liudingxin@mail.xjtu.edu.cn

Type of presentation: (Oral)

Status of Presenter: (Regular)

Abstract (less than 200 words)

Microbubbles have gained attention in water treatment owing to their substantial specific surface area, prolonged residence time, and elevated internal pressure [1]. When engaged in the interfacial interaction between plasma and water, microbubbles can enhance the concentration of reactive species in plasma-activated water (PAW) by minimizing losses during the gas-water mass transfer process [2]. In contrast to conventional microbubble generation methods [3], this study introduces a novel approach for direct microbubble generation through discharge in water, integrating in-situ plasma and microbubble generation. High-speed photography captures the formation of a spark discharge in bubbles, followed by its fragmentation after several discharge cycles. An LTE plasma model, developed using COMSOL, scrutinizes the bubble rupture process, highlighting the potential contribution of heightened heat-induced pressure within the bubble. Moreover, microbubbles exhibited a significant enhancement in the dissolution or generation of reactive species, including O_3 and H_2O_2 , in PAW, underscoring their potential for promising applications.

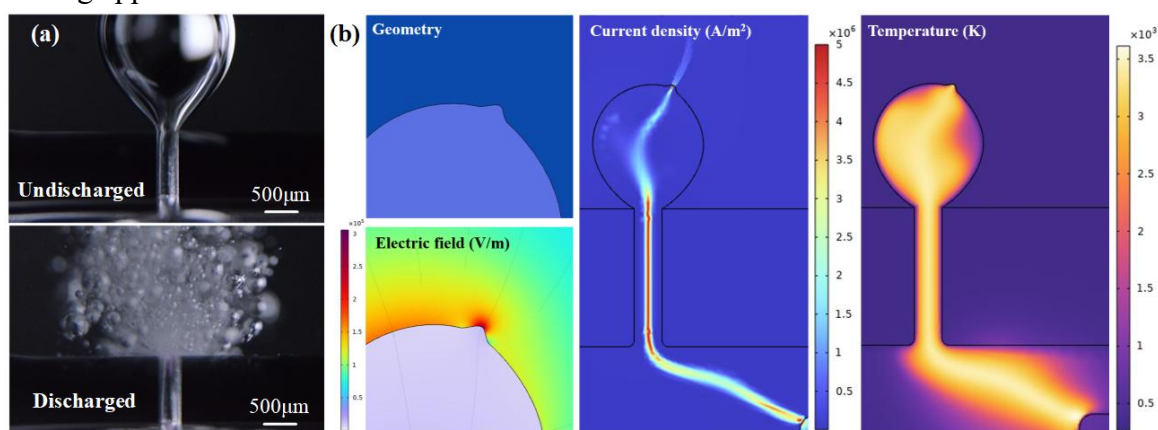


Fig 1. (a) Microbubbles formation (b) Electric, current and temperature fields in a bubble after perturbation

References

- [1] T. Temesgen, et al. *Adv. Colloid Interface Sci.*, 2017, 246, 40-51.
- [2] C. Man, et al. *Plasma Process Polym*, 2022, 19(6), 2200004.
- [3] J. Rodríguez-Rodríguez, et al. *Annu. Rev. Fluid Mech.*, 2015, 47, 405-429.

Hydrogen Nanobubbles Generated in Situ from Nanoscale Zerovalent Iron with Water to Further Enhance the Removal of Quasi-heavy Metal

Qing Huang,^{1,2} Weixian Zhang,² Jun Hu,^{1,3} Renzhong Tai,¹ Airong Liu,^{2*} and Lijuan Zhang^{*1,3}

1

¹ Shanghai Synchrotron Radiation Facility, Shanghai Advanced Research Institute, Chinese Academy of Sciences, Shanghai 201204, China

² State Key Laboratory for Pollution Control and Resource Reuse, College of Environmental Science and Engineering, Tongji University, Shanghai 200092, China.

³ Shanghai Institute of Applied Physics, Chinese Academy of Sciences, Shanghai 201800, China

E-mail: zhanglijuan@sari.ac.cn

Type of presentation: (Oral)

Status of Presenter: (Regular)

Abstract

Gas nanobubbles used for water treatment and recovery gives rise to great concern for their unique advantages of less byproducts, higher efficiency and environmentally friendly. Nanoscale zero-valent iron (nZVI), which has also been widely explored in the field of environmental remediation, can generate gas hydrogen by direct reaction with water. Whether nanoscale hydrogen bubbles can be produced to enhance the pollution removal of nZVI system is one significant concern involved. Herein, we report direct observations of in-situ generation of hydrogen nanobubbles (HNBs) from nZVI in water. More importantly, the formed HNBs can enhance indeed the reduction of Se(IV) beyond the chemical reduction ascribing to Fe(0), especially in the anaerobic environment. The possible mechanism is that HNBs enhances the reducibility of the system and promotes electron transport in the solution. This study demonstrates a unique function of HNBs combining with nZVI for the pollutant removal and a new approach for in-situ HNBs generation for potential applications in the fields of in-situ remediation agriculture, biotechnology, medical treatment and health, etc.

References

[1] Q. Huang, *et al.* Environmental Science & Technology, 2024, 58, 9, 4357.

Removing damped oscillation from nanosecond pulse voltage for ideal nonthermal plasma processing

Douyan Wang^{1*}, Hayato Koyanagi², Tsuyoshi Ogata², Takao Namihira¹

¹ Institute of Industrial Nanomaterials, Kumamoto University, 2-39-1 Kurokami, Chuo-ku, Kumamoto, 860-8555, Japan

² Graduate School of Science and Technology, Kumamoto University, 2-39-1 Kurokami, Chuo-ku, Kumamoto, 860-8555, Japan

E-mail: douyan@cs.kumamoto-u.ac.jp

Type of presentation: (Oral, Invite)

Status of Presenter: (Regular)

Abstract (less than 200 words)

A single pulse voltage without damped oscillation is the ideal result of nanosecond pulse generation because the oscillation causes impedance mismatching between pulse generator and load. The damped oscillation also induces an increase in gas temperature during plasma formation, reduces the energy efficiency of non-thermal plasma processing [1]. In our study, two methods were attempted to eliminate the damped oscillation after the first pulse of output voltage: one was to add a matched register between the generator and the load, the other was to introduce a peaking gap switch and a tail cut switch to the generator. The results showed that approximately 90% reduction of damped oscillation was achieved by both methods. In case of using peaking gap and tail cut switches, the pulse duration was reduced to about half.

References

[1] D. Wang, T. Namihira, Plasma Sources Sci. Technol, 2020, 29(2), 023001

Dynamics at the Gas-Water Interface of Collapsing Microbubbles - An Exciting Reaction Field -

Masayoshi Takahashi

New Industry Creation Hatchery Center, Tohoku University, Aoba 6-6-10, Aramaki, Aoba-ku, Sendai 980-8579,
Japan

E-mail: masayoshi.takahashi.c1@tohoku.ac.jp

Type of presentation: (Oral)

Status of Presenter: (Regular)

Abstract (less than 200 words)

The intriguing nature of microbubbles, particularly their dynamics at the gas-water interface during collapse, remains an unresolved challenge that has captivated our interest for over two decades. This presentation will concentrate on the gas-water interface, a crucial yet mysterious boundary where extraordinary reactions take place. We aim to elucidate how the distinctive shrinking behavior of microbubbles influences the observed physical and chemical phenomena. While the complete process is yet to be fully understood, the presentation will highlight findings from Tohoku University on chemical decomposition and nanobubble formation, offering valuable insights into the interfacial dynamics of microbubbles.

Formation Of Hydrogen Peroxide And Nitrate Through A DC Discharge Plasma Generated Inside An Aqueous Solution

Qiang Chen^{*}, Mingjia Zhang

Key Laboratory of Plasma and Magnetic Resonance, Key Laboratory of Electromagnetic Wave Science and Detection Technology, Xiamen University, Xiamen 361005, China.

E-mail: chenqiang@xmu.edu.cn

Type of presentation: (Oral)

Status of Presenter: (Regular)

Abstract

Usually, a DC glow discharge is difficult to be ignited in an aqueous solution because of the great heating effect in the solution. To overcome this problem, a special electrode configuration is used to replace the usually both immersed electrode configuration. Two wire discharge electrodes are covered inside two capillary quartz tubes, separately. Several mm of one wire electrode is left outside the quartz tube, while the other wire electrode is all covered by the quartz tube and its tip is several mm away from the end of the quartz tube. From this design, a small gas gap is usually present between the wire electrode tip and the solution, if the capillary quartz tubes are immersed in an aqueous solution. A DC glow discharge plasma can be ignited at the gas gap, as the applied DC voltage is greater than the gas breakdown voltage. Hydrogen peroxide and nitrate are formed by the DC glow discharge plasma operated in the aqueous solution of Na₂SO₄, which demonstrate the possibility of synthesizing useful chemicals and nitrogen fixation by this plasma reactor.

Properties Correlation between Ultra Fine Bubbles and Water Characteristics

Yoshikatsu Ueda^{1*}, Yomei Tokuda², Akifumi Sugiyama¹

¹ Research Institute for Sustainable Humanosphere, Kyoto University, Gokasho, Uji, Kyoto Japan, 611-0011

² Faculty of Education, Shiga University, 2-5-1, Hiratsu, Otsu, Shiga, Japan, 520-0862

E-mail: yueda@rsh.kyoto-u.ac.jp

Abstract (less than 200 words)

We conducted a statistical evaluation of the correlation between the characteristics of ultrafine bubbles (UFBs) and water. Our data indicated that the electrical conductivity of water tends to decrease when oxygen UFBs are generated. Moreover, when comparing data distributions of generated samples in room temperature, the decrease in electrical conductivity was especially large when the bubble concentration was low. However, due to significant measurement deviations and the presence of a threshold at the lower limit, we believe careful discussion is necessary going forward. In the presentation, we aim to introduce the differences in properties between oxygen and nitrogen and compare them with other gases, intending to further the discussion.

Keywords: Ultrafine bubble, electrical conductivity, nano bubble, data analyses

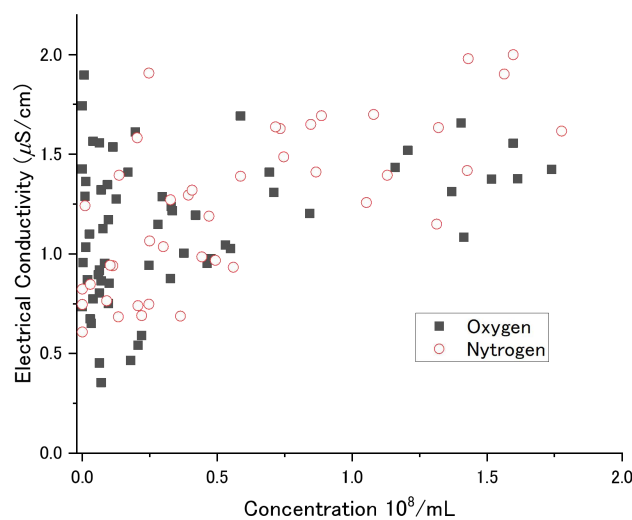


Figure. Correlation between electrical conductivity of water and bubble concentration

References

- [1] Ueda, Y., et. al., Water Supply, Vol. 22(11), 7972-7981 (2022)
- [2] Iijima, M., et., al., Plant Production Science, Vol. 25(2), 218-223 (2022)
- [3] Ueda, Y., et. al., ECS Transactions, Vol. 58(19), 11-19 (2014)

Cancer-Targeting Carbon Quantum Dots Synthesized by Plasma Electrochemical Method for Red Light Activated Photodynamic Therapy

Ruoyu Wang¹, Qing Zhang^{1*}, Xiaoxia Zhong^{1*}

¹ State Key Laboratory of Advanced Optical Communication Systems and Networks, Key Laboratory for Laser Plasmas (Ministry of Education), School of Physics and Astronomy, Shanghai Jiao Tong University, Shanghai 200240, China.

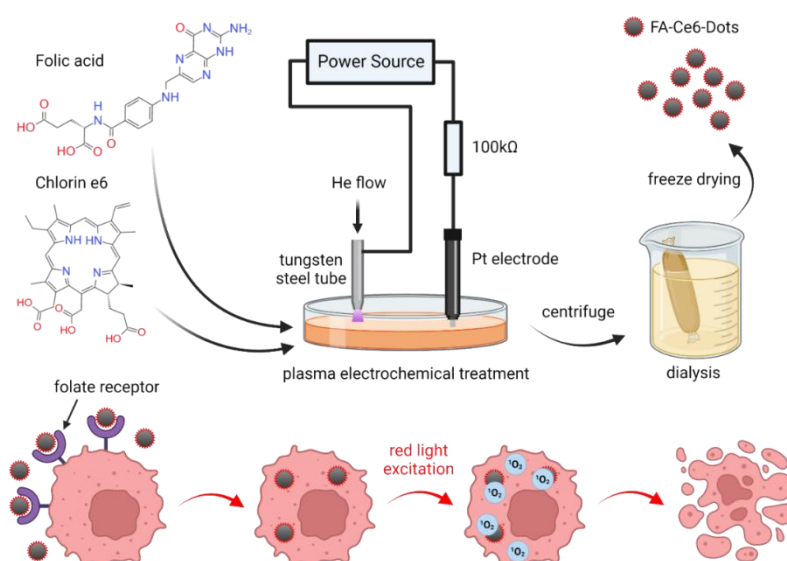
E-mail: qingzhang@sjtu.edu.cn

Type of presentation: (Oral)

Status of Presenter: (Regular)

Abstract (less than 200 words)

Cancer-targeting carbon quantum dots (CQDs) with red-light absorption/emission featuring inherent biological functionality and deep biological penetration depth are promising for biomedical applications. However, traditional high-temperature and high-pressure synthesis processes result in unpredictable functionalities and uncontrollable optical properties due to the functional group loss. Here, plasma electrochemical treatment is introduced to overcome this issue. The synthesized CQDs in this work have excellent folate receptor cancer-targeting ability, red-light absorption/emission, and pronounced photodynamic therapy effect. The CQDs produced by the plasma electrochemical method preserve most of the functional groups from precursors, thus making them to fully inherit the bio-functionality and photophysical properties of precursors. This work opens new opportunities for plasma-based processes to controllably synthesize functionalized CQDs for diverse biomedical and environmental applications.



Magnetic activated sludge & nanobubbles to improve the bioreactor performance and its scale-up: biodegradation and sludge dewatering

Qiming Zhang^{1,4}, Jiajun Hu², Nan Liu³, Jixiang Li^{1,4*}

¹ Shanghai Advanced Research Institute, Chinese Academy of Sciences, Shanghai 200120, China.

² Shanghai Key Laboratory of Bio-Energy Crops, School of Life Sciences, Shanghai University, Shanghai 200444, China.

³ Collaborative Innovation Center of Environmental Pollution Control and Ecological Restoration of Henan Province, Department of Material and Chemical Engineering, Zhengzhou University of Light Industry, Zhengzhou 450001, China.

⁴ University of Chinese Academy of Sciences, Beijing 100049, China.

Email : lijixiang@sari.ac.cn

Type of presentation: (Oral)

Status of Presenter: (Regular)

Abstract (less than 200 words)

In this work, magnetic activated sludge method coupled with nanobubbles (MAS&NBs) was used to improve the bioreactor performance on biodegradation and sludge dewatering. For biodegradation improvement, the MAS&MNBs promoted the COD and ammonia degradation efficiencies by 15.8% and 10.0%, respectively. The scale-up test also retained the COD and ammonia degradation efficiencies by 15.2 % and 9.2 %, respectively. For sludge properties improvement, the MAS enlarged the sludge particle size, the presence of NBs maintained a higher DO level, and the MAS&MNBs jointly depressed the production of soluble microbial product (SMP). For sludge dewatering improvement, the MAS&MNBs jointly shortened the capillary suction time (CST) by approximately 33%. The free radical scavenging and antioxidant capacity analyses showed that the MAS&NBs can significantly mitigate cellular damage and oxidative stress caused by environmental shocks, which may be responsible for the bioreactor performance improvement. Besides, microbial community and metabolic activity analyses suggested that the MAS&NBs altered the microbial community and dominant species in a short time, and increased the overall microbial activity by about 45.4 %. This study is expected to enrich and develop the application of MAS process and NBs technology in the field of wastewater treatment.

References

- [1] H. Guo, J. Hu, J. Li, M.-t. Gao, *et al.* Systematic insight into the short-term and long-term effects of magnetic microparticles and nanoparticles on critical flux in membrane bioreactors. *Journal of Membrane Science*, 2019, 582: 284-288.
- [2] J. Guo, X. Wang, T. Li, *et al.* Effect of micro-nanobubbles with different gas sources on the growth and metabolism of chemoautotrophic microorganisms, *Process Biochemistry*, 2023, 126 : 117-124.

Utilizing Fine Bubbles Technology for Crop Production and Aquaculture in Thailand

Chiti Sritontip^{1*}, Parinyawadee Sritontip¹, Rattanaporn Norara² and Vishnu Thonglek³

¹Agricultural Technology Research Institute, Rajamangala University of Technology Lanna, 202 Moo 17, Phichai, Muang, Lampang, 52000, Thailand

² Faculty of Science and Agricultural Technology, Rajamangala University of Technology Lanna, 99 Sai Khao, Phan, Chiang Rai, 57120, Thailand.

³ Faculty of Engineering, Rajamangala University of Technology Lanna, 128 Huay Kaew Road, Muang, Chiang Mai, 50300, Thailand.

* E-mail : Chiti@rmutl.ac.th

Abstract

Small gas bubbles known as fine bubbles (FBs) or ultra-fine bubbles (UFBs) have a diameter of less than 1 micrometer for UFBs and one to 1-100 micrometers for FBs. [1]. FBs are extension and utilization research of agriculture in Thailand. The application of FBs on plant production, food processing, food shelf-life extension and aquaculture are very importance technology in Thailand. The application of FBs and UFBs can promote vegetative growth in the melon substrate culture and cause earlier seed germination in the corps. [2] [3].

The application of FB water impacted the emergence and growth of microgreens in crops. The seed germination rate and total phenolic compounds in the spout were increased using FBs water when compared with tap water. Aeration in a nutrient solution is very important for plants grown in soilless cultures. FB water can induce growth and development in vegetables. Moreover, the growth and yield increased in lettuces, Chinese kale, Chinese cabbage, and Pak Choi grow in hydroponics. Melon and tomato production enhanced yield and fruit quality. The positive effect of FB water in hydroponics induced phenolic compounds in the leaf, stem, root, and sucker of *Houttuynia cordata* and tomato fruits. Because of FBs encourage plant growth and may aid in the root absorption of nutrient solution. The utilizing for shelf life and sterilization in extending the banana shelf life, FB's technology can lessen the quantity of fungus that causes banana crown rot. Additionally, ozone FBs effectively reduced fungal growth on fruits and vegetables. The development of aeration systems using FB-equipped machines to boost red tilapia fish revealed a higher specific survival rate and growth rate compared to control.

References

- [1] T. Kobayashi, A. Ushida. Experimental Thermal and Fluid Science, 2023. 145, 110899.
 - [2] S. Oshita, *et al.* Nanomaterials, 2023, 13, 1677.
 - [3] Sritontip *et al.* International Journal of Plasma Environmental Science & Technology, 2019. 12(2), 74-78.
- (Type of presentation: Oral Status of Presenter: Regular)

Characteristics of Plasma Activated Fine Bubble Water Using Dielectric Barrier Discharge Reactor for Agriculture

Anto Tri Sugiarto^{1*}, Hilman Syaeful Alam¹, Yohannes Aris Purwanto²

¹ Research Center for Smart Mechatronics, National Research and Innovation Agency, Bandung, Indonesia

² Faculty of Agricultural Technology, IPB University, Indonesia

E-mail: anto008@brin.go.id

Type of presentation: (Oral/ Poster)

Status of Presenter: (Regular/ Student)

Abstract

The plasma activated water (PAW), as a new environmentally nonthermal processing technology, has attracted wide attention for its applications in agriculture, food, and biomedical fields. On the other hand fine bubble technology (FBT) have been proven as a chemical-free solution to improve soil conditions for growers, from reducing soil compaction to increasing soil aeration, nutrient availability and uptake efficiency. We develop a plasma activated fine bubble water (PAFBW) generator using a dielectric barrier discharge reactor to activate fine bubble water. In the PAFBW system, the advantages of PAW are strengthened by the ability of fine bubble to dissolve reactive gas in water. Making activated water an effective post-harvest processing solution. To be able to apply activated water, it is necessary to have a device or generator that can produce activated water with ROS levels that can be varied according to the needs in processing post-harvest goods. It was found that the concentration of reactive oxygen species (ROS) and reactive nitrogen species (RNS) generated in the water was large and varied.

References

- [1]. V. Luvita, S. Bismo, and A. T. Sugiarto “Characterization of Dielectric Barrier Discharge Reactor with Nanobubble Application for Industrial Water Treatment and Depolution“, South African Journal of Chemical Engineering, 40 (2022) 246–257
- [2]. H.S. Alam, P. Soetikno, T.A.F. Soelaiman, A.T. Sugiarto “Bulk Nanobubbles: Generation using a Two Chamber Swirling Flow Nozzle and Long-Term Stability in Water”, Journal Flow Chemistry
DOI: 10.1007/s41981-021-00208-8

Generation of pulsed discharges contacted into water and their environmental and agricultural applications

Katsuyuki Takahashi^{1*}, Koichi Takaki²

¹ Faculty of Science and Engineering, Iwate University, Ueda 4-3-5, Morioka, Iwate, 020-8551 Japan

² Agri-Innovation Center, Iwate University, Ueda 3-18-8 Morioka Iwate, 020-8550 Japan

E-mail: ktaka@iwate-u.ac.jp

Type of presentation: (Oral)

Status of Presenter: (Regular)

Abstract (less than 200 words)

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 [1,2]. In this study, the physical and chemical properties of the discharge plasma generated over a water surface are described. The decomposition of persistent organic compounds dissolved in wastewater, such as 1,4-dioxane and dichloromethane acid by 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. 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 [3,4].

References

- [1] K. Takahashi, *et al.* "Processing of food products and waste with high voltage electrical discharge; Chap. 3 Production of oxidants using pulsed high-voltage discharge plasma and degradation of organic compounds in liquid phase, pp. 65-91, Elsevier, Netherland, ISBN 978-0-323-95403-7 (2023)
- [2] K. Takahashi, *et al.* "Sewage - Recent Advances, New Perspectives and Applications; Chapt.1 A Novel Wastewater Treatment Method Using Electrical Pulsed Discharge Plasma over a Water Surface", IntechOpen Ltd., London, ISBN 978-1-83969-825-5 (2021)
- [3] K. Takahashi, *et al.* "Influence of a plasma-treated nutrient solution containing 2,4-dichlorobenzoic acid on the growth of cucumber in a hydroponic system", J. Appl. Phys., 2021, 129, 143301
- [4] K. Takahashi, *et al.* "Development of Automatically Controlled Corona Plasma System for Inactivation of Pathogen in Hydroponic Cultivation Medium of Tomato", J. Electrostat., 2018, 91, 61

Portable System of Microbubble Water for Biomedical Treatment

Yu-Wei Huang¹, An-Sheng Chen², Chun-Wei Feng³, Yun-Chien Cheng^{1*}

Department of Mechanical Engineering, College of Engineering, National Yang Ming Chiao Tung University,
Hsin-Chu, China

E-mail: jakey89728@gmail.com

Type of presentation: Oral

Status of Presenter: Student

Abstract

This study aims to optimize microbubble generation using water pump and combine it with plasma-generated reactive oxygen and nitrogen species (RONS) to produce RONS microbubble water, verifying the feasibility of RONS entering biological organisms through water. In current applications, some of the gases in RONS can be used to treat lung-related diseases. However, these medical devices are costly, less portable, and mostly rely on gas cylinders to store these gases, posing risks of gas leakage. This study utilizes high-speed cameras combined with dynamic image analysis methods to measure the size and concentration of microbubbles generated by the microbubble device. Gas analyzers measure the concentration of RONS generated by the plasma generator. Based on this data, optimal designs for the microbubble generation device (including Venturi tube angles, single or double-layer mesh) and optimal parameters for RONS generation are determined. RONS generated is then passed into the microbubble device to produce RONS microbubble water, verifying its feasibility for entering the biological body. This real-time RONS generation method is not only cost-effective and highly portable but also addresses the issue of gas leakage from gas cylinder storage, provides a new option for the application of RONS.

References

- [1] Wu, M.-C., Uehara, S., Wu, J.-S., Xiao, Y., Nakajima, T., and Sato, T. J. Phys. D: Appl. Phys. 2020, 53, 48, 485201.
- [2] Terasaka, K., Hirabayashi, A., Nishino, T., Fujioka, S., and Kobayashi, Chemical Engineering Science. 2011, 66, 14, 3172–3179.
- [3] Mário Janda¹, Zdenko Machala¹, Adriana Niklová¹ and Viktor Martišovits¹. Plasma Sources Sci. Technol. 2012, 21, 4.
- [4] A. Ozkan, T. Dufour, A. Bogaerts, and F. Reniers. Nature Medicine. 2002, 8, 711-717.

Roles of reactive oxygen species in plant development: Growth control and immediate initial responses by nonthermal plasma irradiation

Kazuyuki Kuchitsu^{1,2*}, Shoko Tsuboyama¹

¹Department of Applied Biological Science & ²Interdisciplinary Agricultural Science & Technology Course,
Tokyo University of Science, Noda, Japan

*E-mail: kuchitsu@rs.tus.ac.jp

Reactive oxygen species (ROS) are highly toxic molecules generated during photosynthesis and aerobic respiration. However, plants possess enzymes, such as NADPH oxidase, which regulate ROS production through Ca²⁺ binding and phosphorylation by protein kinases. The ROS-Ca²⁺ signaling network plays pivotal roles in governing growth, development, and defense responses against biotic and abiotic stresses [1-2].

Several studies have indicated that treatment with nonthermal plasma can promote seed germination and plant growth. However, the precise molecular mechanisms underlying plasma's effects on plants remain largely unknown, and its outcomes may vary depending on seed status, complicating detailed molecular analyses.

We recently demonstrated that plasma irradiation can exert both positive and negative effects on the growth of a model liverwort, *Marchantia polymorpha*, depending on irradiation intensity, providing an appropriate experimental system for unraveling plasma's molecular mechanisms in plants [3]. Additionally, we devised a novel plasma device and fluorescence imaging technique to monitor the dynamics of intracellular ROS and Ca²⁺ concentrations, serving as representative initial cellular responses. We will discuss the immediate cellular responses following plasma irradiation and propose potential molecular mechanisms underlying its action.

References

- [1] T. Hashimoto *et al.* *Physiol. Plant.* 2023, 175, e14101.
- [2] K. Watanabe *et al.* *Plant & Cell Physiol.* 2024, 65(4), 660-670.
- [3] S. Tsuboyama *et al.* *Sci. Rep.* 2024, 14, 3172.

Non-thermal Plasma and Microbubbles for Environmental and Agricultural Application

Yanan Liu¹, Han Zhang¹, Jingyi Zhao¹, Yinyin Zhang¹, Pan Li², Ai Zhang¹ and Xiang Li¹

¹ College of Environmental Science and Engineering, Donghua University, 2999 North Renmin Road, Shanghai 201620, China.

² School of Environmental Science and Engineering, State Key Laboratory of Control and Resource Reuse, Tongji University, 1239 Siping Road, Shanghai, PR China

Type of presentation: (Oral)

Status of Presenter: (Regular)

Abstract

Non-thermal plasma (NTP) has attracted extensive attention and is increasingly used in wastewater, contaminated gases and soil remediation due to its high removal efficiency and no demand for other chemical agents. Microbubbles (MBs), with diameters ranging between 1 and 100 μm , in theory, can be a much more effective approach to enhance the specific surface area of the gas-liquid interface because of the much larger specific surface area and high stability in solution. Moreover, it has the characteristics of shrinkage under water, high interfacial potential, strong interfacial effect and high mass transfer efficiency, which makes it a unique application potential in environmental remediation. Each of these two methods their combination could be applied for environmental pollution control or crop growth.

We have found that the combination of NTP and MB could enhance many organic pollutants (perfluorooctanoic acid (PFOA), dichloroacetic acid (DCAA), atrazine (ATZ), micro-organisms, different kinds of dyes and pharmaceuticals *etc.*) removal from water. It was proved that NTP is a rapid, effective and environmentally friendly technique to remediate soil pollution of organics, while at the same time increasing the fertility of soil. NTP can promote sludge disintegration, dewatering, sludge reduction, sludge solubilization, and acetate-enriched volatile fatty acid (VFA) production, simultaneously controlling antibiotic in sludge. Recently, we found that MB treatment enhances the nitrogen conversion ability of soil, and significantly enhances the nitrate reduction and nitrogen fixation effects of soil microorganisms in a shrimp-rice symbiotic system.

Application of microbubbles in Cleaning: A Study on Controlling Venturi Tube Microbubble Generators for Efficient Aircraft Oil Removal

Chao Huang, Pan Li*

College of Environmental Science and Engineering, Tongji University, Shanghai 200092, PR China

*Corresponding author: Pan Li^a

lipan@tongji.edu.cn

Abstract:

Microbubbles play a crucial role in cleaning applications due to their excellent interface cleaning abilities. However, optimizing the production of microbubbles with specific particle size distributions and number concentrations remains a challenging research problem. In this study, we investigate the regulation of microbubble generation using Venturi tube microbubble generators and explore their cleaning efficacy for removing aircraft oil contamination. Our research focuses on three main aspects: (1) understanding bubble behavior within the Venturi tube, (2) developing effective methods for bubble recognition and measurement, and (3) optimizing cleaning parameters for practical applications.

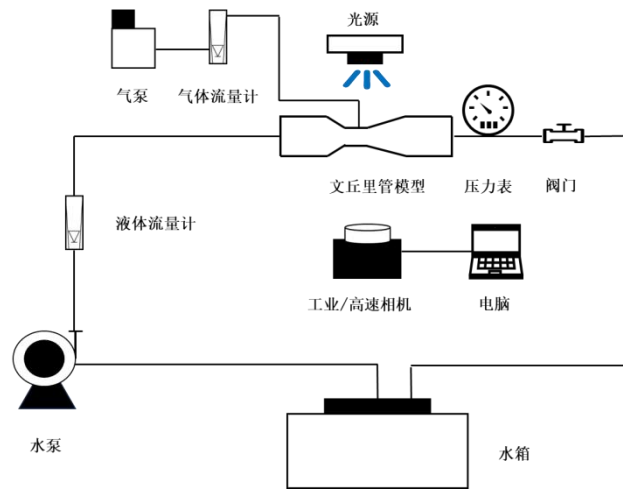


Figure 1 Bubble behavior observation and measurement system

Applications of Radioactive Nuclei to the Studies of Ultrafine Bubbles and Nano-Size Material Science

Minoru Tanigaki

Institute for Integrated Radiation and Nuclear Science, Kyoto University, 2-1010 Asashironishi, Kumatori, Osaka
590-0458, Japan.

E-mail: tanigaki@rri.kyoto-u.ac.jp

Type of presentation: (Oral)

Status of Presenter: (Regular)

The spin motion of a nucleus is affected by the electromagnetic interaction with its surrounding electrons, so-called hyperfine interactions. Therefore, the electromagnetic structure can be detected via the spin motions of nuclei as probes; a well-defined crystal structure gives a well-defined electromagnetic field, while dynamically changing electromagnetic fields are expected in fluids or gases. Nuclear magnetic resonance is a popular technique in material science using hyperfine interactions. However, for sufficient detection signals, probe nuclei must be introduced sufficiently (10^{16-20} /cc typ.) into the target substances by conventional chemical reactions or physicochemical methods.

Radiations from radioactive nuclei emit anisotropic radiation towards the spins of their originating nuclei and can be detected with very high efficiency. Perturbed Angular Correlation (PAC) [1] is a technique that observes spin motion via a cascade of gamma rays from radioactive nuclei as probes in materials (as low as 10^{10} /cc). By selecting the proper nuclear reaction, radioactive nuclei can be introduced even in nano-size materials without interfering with their structures.

In this presentation, we will discuss possible applications of radioactive nuclei and the hyperfine interactions to nano-size material science while introducing our current approach to the fundamental properties of ultrafine bubbles using radioactive nuclei and PAC [2].

References

- [1] H. H. Rinneberg, Atomic Energy Review **17** (1979) 477-595.
- [2] M. Tanigaki et al., Chem. Eng. Technol. **46** (2023) 1773-1781.

Reactive oxygen and nitrogen species produced by atmospheric pressure plasmas

Shaofeng Xu^{1*}, Ying Guo¹

¹ College of Physics, Donghua University, 2999 North Renmin Road, Shanghai 201620, China.

E-mail: xushaofeng@dhu.edu.cn

Type of presentation: Oral

Status of Presenter: Regular

Abstract

Reactive oxygen and nitrogen species produced by atmospheric plasmas play key roles in advanced oxidation processes. Here, we present experimental results of reactive oxygen and nitrogen species induced by atmospheric pressure Argon plasma jets contact with aqueous solution. Ab initio molecular dynamics based on DFT were used to study the physical-chemical processes of singlet and triplet oxygen atoms in bulk water and NaCl solutions. Calculations prove that triplet oxygen is stable, but triplet is chemical active. In bulk aqueous solutions, triplet oxygen reacted with water and NaCl, and produce H₂O₂, HOCl. However, quantum mechanics/molecular mechanics molecular dynamics simulations show different results at the gas-liquid interface. Singlet oxygen also reacted with water, produce OH radical, which is play a key role in advanced oxidation processes. Triplet oxygen become active at the gas-liquid interface. Some of triplet oxygens react with chloride anions and produce OCl⁻.

References

- [1] Ying Guo, Xuanying Guo, Shaofeng Xu*, Jianjun Shi, Estimation of total forces of jets on liquid interfaces using image processing methods. Journal of Physics D: Applied Physics, 2024. 57(24):245206..
- [2] Shaofeng Xu*, Xuanying Guo, Juan Wang, Ying Guo, and Jianjun. Shi, Chemical scanning of atomic oxygen at the gas-liquid interface of a NaCl solution via quantum mechanics/molecular mechanics molecular dynamics simulations. Science of The Total Environment, 2023, 165329

Total Dissolved Solid Reduction in Discharge from Mae Moh Coal Mine Using Electrocoagulation Process

Jeerawan Patcharapakit¹, Kssem Treepak², Rattanapol Panomwan Na Ayuttaya²,

Dhirasak Somsak², Worajak Muangjai², Nopporn Patcharapakiti^{2*}

¹ Department of Mathematics, Faculty of Science, Maejo University

² Department of Electrical Engineering, Rajamangala University of Technology Lanna

E-mail: pnopporn@rmutl.ac.th

Type of presentation: (Oral)

Status of Presenter: (Regular)

Abstract

This paper proposes a design and develop a prototype of the electrocoagulation wastewater treatment system for reducing total dissolved solid (TDS), analyze the parameters which affected the TDS removal efficiency of the electrocoagulation reactor; and conduct an economic assessment of TDS removal, all from the effluent or discharge from the sedimentation ponds of the Mae Moh Mine. The design of an electrocoagulation reactor, whose electrodes, electrode surface areas, current density, reverse polarity period and inter-plate distance could be modified; the collection and analysis of effluent samples from the sedimentation ponds after using electrocoagulation process; and an economic analysis of the electrocoagulation process, especially material and energy costs.

The results showed that the reactor had 20 aluminum electrodes, 15x20 cm each, connected in parallel with a total anode area of 0.3 sq.mm., current of 30 A/m², alternating duration time of 10 seconds, inter-electrode distance of 0.5 mm, water pH of 3 and reaction time of about 60 minutes, and TDS removal efficiency of approximately 64.5%, the parameters which affected the treatment efficiency were electrode type, electrode area per water volume (m²/m³), current density (A/m²), alternating current time duration (second), inter-electrode distance (mm), and pH and reaction time (min) and the energy consumption of this TDS reduction process was about 3.26 kWh/m³ or 13 baht/m³ of discharge.

References

- [1] M. Murugananthan, G. Bhaskar Raju, S. Prabhakar, "Removal of sulfide, sulfate and sulfite ions by electro coagulation", *Journal of Hazardous Materials* B109 (2004) 37–44
- [2] K. I. Dermentzis, "Removal of Sulfide and COD from a Crude Oil Wastewater Model by Aluminum and Iron Electrocoagulation", *Journal of Engineering Science and Technology Review* 9 (1) (2016) 13-16
- [3] N. Drouiche, S. Aoudj, M. Hecini, N. Ghaffour, H. Lounici, N. Mameri (2009), "Study on the treatment of photovoltaic wastewater using electrocoagulation: Fluoride removal with aluminium electrodes —Characteristics of products", *Journal of Hazardous Materials*, Volume 169, Issues 1–3, 30 September,

Pages 65–69.

[4] P. K., Holt., Geoffrey W. Barton and Cynthia A. Mitchell (2004), “The future of electrocoagulation as a localized water treatment technology”, *Journal of Chemosphere*, 59 (3): April 2005, 355-367.

[5] R. Ramesh Babu, N.S. Bhadrinarayana, K.M.Meera Sheriffa Begum, Anantharaman 2007. “Treatment of tannery wastewater by electrocoagulation”, *Journal of University Chemical Technology Metallurgy*, 42 (2) (2007) 201-206.

[6] Ville Kuokkanen, Toivo Kuokkanen, Jaakko Rämö (2013). Ulla Lass, “Recent Applications of Electrocoagulation in Treatment of Water and Wastewater -- A Review”, *Green and Sustainable Chemistry*, Vol.3 No.2, Article ID:31993, pages 33.

[7] J. Nepo, Hakizimana and et.al (2017). “Electrocoagulation process in water treatment: A review of electrocoagulation modeling approaches”, *Desalination*, Volume 404, 17 February, Pages 1–2.

Effect of air-fine bubbles aeration on red tilapia cage culture in Thailand

Rattanaporn Norarat^{1*}, Karuna Jaitontee¹, Rungrawee Thongdon-a², Chiti Sritontip³
and Vishnu Thonglek⁴

¹ Faculty of Science and Agricultural Technology, Rajamangala University of Technology Lanna,
99 Sai Khao, Phan, Chiang Rai, Thailand, 57120.

² Faculty of Science and Agricultural Technology, Rajamangala University of Technology Lanna,
52 Moo 7, Ban Krang, Muang Phitsanulok District, Phitsanulok, Thailand, 65000.

³ Agricultural Technology Research Institute, Rajamangala University of Technology Lanna,
200 moo 17, Mueang Lampang, Lampang, Thailand, 52000.

⁴ Faculty of Engineering, Rajamangala University of Technology Lanna,
128 Huay Kaew Road, Muang, Chiang Mai, Thailand, 50300

E-mail: rattanaporn@rmutl.ac.th

Type of presentation: (Oral)

Status of Presenter: (Regular)

Abstract

Thailand is one of the leading producers of farmed tilapia in the world. The market for tilapia is valued at more than US\$1.4 billion in 2018 and is expected to reach US\$2.1 billion by 2025, with an expected compound annual growth rate of 5.5% [1]. Therefore, Thai government is interested to promote and support mass tilapia aquaculture. Fine bubbles (FB) technology is an innovative approach that has shown promise in aquaculture application. This technology can improve oxygen transfer efficiency in water due to the high surface area-to-volume ratio [2] and improve water quality by promoting gas exchange, reducing dissolved gases such as carbon dioxide and ammonia, and enhancing water circulation [3]. This research aims to investigate the effect of fine bubbles aeration on increasing dissolve oxygen, growth rate, feed conversion ratio (FCR) and survival rate of red tilapia reared in the fish cage. After 8 weeks, we found that the final weight of the red tilapia under air-fine bubbles treatment was significantly higher ($p < 0.05$) than without aeration treatment. Some of the important and interesting results appropriate to red tilapia farming with fine bubbles technology will be introduced in this talk.

Acknowledgement

This work was supported by Rajamangala University of Technology Lanna, Thailand Science Research and Innovation (TSRI) and National Science Research and Innovation Fund (NSRF) (NRIIS number 185796)

References

- [1] PMUC. <https://pmuc.or.th/en/a-look-at-thai-tilapia-market-and-new-technologies-to-help-enhance-the-ability-to-compete-for-entrepreneurs/>. 2023, January 30.
- [2] K. Jainontee, *et al.* IJPEST. 2019, Vol 12 (2), 84 – 88.
- [3] E. Heriyati, *et al.* Trends Sci. 2022, 19(20): 6251.

Experiment and Investigation of Activated Spraying Water Fog Using Dielectric Barrier Discharge Plasma in Atmospheric Air

Chanchai Dechthummarong^{1*}

¹ Department of Electrical Engineering Faculty of Engineering, Rajamangala University of Technology Lanna
Chiang Mai, Huay Kaew, Road, T. Changpuak, Muang, Chiangmai, 50300, Thailand.

E-mail: chancmth@rmutl.ac.th

Type of presentation: (Oral)

Status of Presenter: (Regular)

Abstract

Generating atmospheric pressure plasma with air and water by using a simple high voltage power supply has been widely receiving significant interest because the plasma can interact various chemical reactive species to produce the non-thermal plasma-activated water for applying in many industries and agriculture works. The objective of this paper was to experiment and investigate the electrical and optical characteristics including the effects of plasma-activated air-water fog in a concentric coaxial dielectric barrier discharge tube driven by commercial electronic neon transformer as shown in Fig. 1. Not only electrical parameters of voltage and current waveforms have measured but also Lissajous figure have been carried out. Furthermore, optical properties of the corona glow discharge plasma with air-water mist inside the quartz tube measured by using optical emission spectroscopy to correlate with the formation of reactive species in activated air-water mist such as H_2O_2 , NO_2 and NO_3 . The effects of air-fog flow and discharge power were also investigated. The obtained results suggest that at continuous applied voltage and air-water fog flow significantly related to the formation of reactive species with stabilized fog temperature as a non-thermal plasma source with increasing operating time.

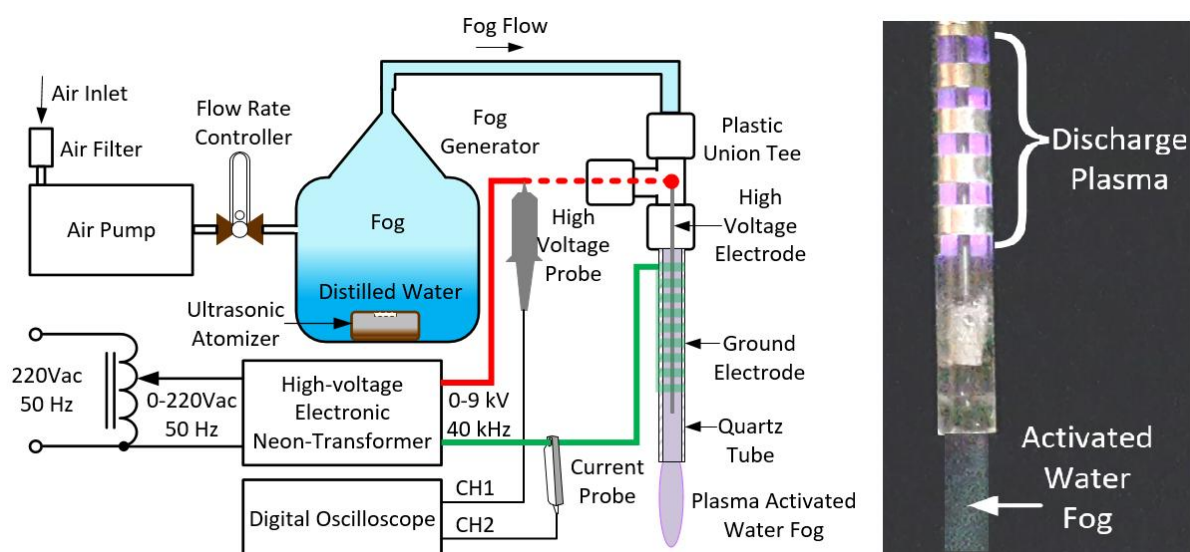


Fig. 1 Experimental setup diagram.

Synergistic coupling of plasma with microbubbles for enhancing short-chain fatty acids production during sludge anaerobic fermentation

Jinling He¹, Shuman Huang¹, Nan Jiang¹, Ai Zhang^{1,2,*}, Andere Clement Miruka^{1,3}, Yanan Liu^{1,2,4}

¹ College of Environmental Science and Engineering, Donghua University, 2999 North Renmin Road, Shanghai 201620, China.

² Shanghai institute of pollution control and ecological security, Shanghai 200092, China.

³ School of Chemistry and Material Science, Technical University of Kenya, Nairobi 52428-00200, Kenya.

⁴ National Circular Economy Engineering Laboratory, Shanghai 201620, China.

E-mail: aizhang@dhu.edu.cn

Type of presentation: (Oral/ Poster) Oral

Status of Presenter: (Regular/ Student) Regular

Abstract (less than 200 words)

The use of waste activated sludge (WAS) fermentative short-chain fatty acids (SCFAs) as the excellent carbon source of wastewater biological nutrient removal has drawn much attention recently as it can reuse WAS organics and reduce WAS production. This study developed a novel, efficient, and environmental-friendly approach combining atmospheric pressure plasma jet with microbubbles (plasma/MBs) for WAS pretreatment. Compared with the control, plasma/MBs pretreatment enhanced SCFA generation by 92% and acetic acid proportion by 21% with plasma discharge power at 500 W and MBs dosage at 7.9 mg/L dissolved oxygen. The plasma/MBs combination motivated the reaction of various reactive species (such as O_3 , NO_x , $ONOO^-$, $\bullet OH$, e^- , $^1O_2$, and $\bullet O_2^-$) and enhanced the activity of physical energies (such as light and heat). This synergy promoted sludge cell lysis and biodegradable substance release, significantly boosting acetic acid-enriched SCFA generation from fermentation. Moreover, plasma/MBs pretreatment increased the expression of key genes for SCFA production during fermentation, which also contributed to the production of SCFAs. Besides, plasma/MBs pretreatment favored WAS dewatering, heavy metal removal, and organic pollutant degradation, providing a new approach to advancing WAS resource recovery through innocuous management.



低温等离子体技术及应用

万京林¹, 万良溥², 戴阳

南京苏曼等离子科技有限公司

Email: coronalab@coronalab.net

摘要: 苏曼科技的低温等离子体技术是一种前沿的物理处理方法, 它利用高频高压电场作用于气体, 使得气体分子在电场的作用下电离, 生成高活性的等离子体。这种技术因其高效、环保以及广泛的应用前景, 在材料科学、环境工程和生物医学等领域受到了广泛关注。报告详细介绍了该技术在材料表面改性、环境污染控制、物理农业以及生物医学等方面的最新应用, 为读者提供一个全面的概览, 帮助大家理解苏曼科技低温等离子体技术的科学基础、技术优势以及其在现代工业和科技领域的潜在应用价值。通过这份报告, 读者将能够更好地认识这项技术的可能性及其对未来产业发展的贡献。

关键词: 等离子体; 等离子体材料处理; 等离子体环境工程; 等离子体物理农业; 等离子体生物医学

Molecular Dynamics Simulations of Lipid Nanobubbles

Xubo Lin^{1*}, Xiu Li², Xinyu Ren²

¹ Beijing Advanced Innovation Center for Biomedical Engineering, School of Engineering Medicine, Beihang University, Beijing 100191, China.

² Beijing Advanced Innovation Center for Biomedical Engineering, School of Biological Science and Medical Engineering, Beihang University, Beijing 100191, China.

E-mail: Linxbseu@buaa.edu.cn

Type of presentation: (Oral)

Status of Presenter: (Regular)

Abstract

Lipid nanobubbles have shown several promising biomedical applications including ultrasound molecular imaging and drug delivery. When the lipid nanobubble interact with the cell membrane, the shell lipid molecules can fuse into the cell membrane^[1] and the encapsulated gas molecules can penetrate into the hydrophobic region of the cell membrane^[2], which both may change the dynamics and thus the functions of membrane proteins. This indicates a new potential therapeutic way of lipid nanobubbles by targeting membrane proteins. In order to reveal the molecular-level interactions between the lipid nanobubble and the cell membrane, molecular dynamics simulation provides a powerful computational tool for the purpose. In order for the molecular dynamics simulations of lipid nanobubbles with realistic gas molecules, we focus on the optimization of the gas force field and the development of the toolkit for setting up and analyzing the corresponding simulation systems. In this talk, we will share our recent progress on molecular dynamics simulations of lipid nanobubbles, and hope to establish possible cooperations with our experimental experts.

References

- [1] D. Sun, X. Lin, Z. Zhang, N. Gu. J. Phys. Chem. C 2016, 120, 18803-18810.
- [2] J. Li, X. Zhang, D. Cao. J. Phys. D: Appl. Phys. 2018, 51, 184001.

Dual synergistic bactericidal mechanism of cold atmospheric plasma coupled with ZnO nanoparticles against *Staphylococcus aureus*

Hang-Bo Xu¹, Meng-Ru Du¹, Ruo-Nan Ma¹

¹Henan Key Laboratory of Ion-beam Green Agriculture Bioengineering, School of Agricultural Sciences, Zhengzhou University, Zhengzhou, China, 450001

Email: xuhangbo@126.com

Type of presentation: (Oral)

Status of Presenter: (Regular)

Abstract

Cold atmospheric plasma (CAP) is a promising technique for microbial inactivation. Recently, the synergistic antimicrobial effect of CAP combined with photocatalyst have recieved much attention. Herein, CAP coupled with hydrophilic ZnO nanoparticles (H-ZnO NPs) was developed for the inactivation of *Staphylococcus aureus* (*S. aureus*) in this study. The result show that CAP coupled with 0.01 g/L H-ZnO NPs within 10 min had the best synergistic effect, which led to a higher inactivation of *S. aureus* (87.2%) than the individual H-ZnO NPs (0%) and CAP treatment (77.9%). H-ZnO NPs induced bacterial apoptosis due to attaching on *S. aureus* cell surface and causing membrane potential depolarization, while CAP disrupt the cell membrane integrity and result in bacterial necrosis. The combined treatment of CAP and H-ZnO NPs lead to the enhanced generation of RONS and Zn²⁺ release from H-ZnO NPs in the solution. Meanwhile, the released Zn²⁺ flow into the cell with the assistance of improved membrane permeability caused by CAP and increase the intracellular ROS level, consequently resulting in the improved bacterial inactivation. In addition, low concentration H-ZnO NPs solution (0.01g/L) could be effectively degraded by CAP. This study is helpful for understanding the synergistic bactericidal mechanism of CAP coupled with H-ZnO NPs, and demonstrates the potential of applying the combined treatment approach for water disinfection.

Keywords: Hydrophilic ZnO nanoparticles; cold atmospheric plasma; synergistic bactericidal effect; mechanisms; water disinfection

Aquaculture Effluent Treatment and Cabbage Growth Enhancement Using Plasma-Fine Bubbles

Chirwa William^{1,2}

¹ School of Environmental Science and Engineering, State Key Laboratory of Control and Resource Reuse, Tongji University, 1239 Siping Road, Shanghai, PR China

² Ministry of Natural Resources and Climate Change, Department of Fisheries, P.O. Box 593, Lilongwe, Malawi

E-mail: williamchirwa@live.com

Type of presentation: (Oral)

Status of Presenter: (Student)

Abstract

Aquaculture faces environmental challenges, including the generation of organic waste and chemical pollution from various additives. The lack of proper waste management infrastructure exacerbates these issues, leading to antibiotic pollution in the environment. This study explores the potential of Fine Bubble Plasma (FBP) treatment as a sustainable solution for aquaculture waste management. Experimental results indicate that FBP treatment significantly improves the removal of ammonia and phosphorus aquaculture wastewater, with Chemical Oxygen Demand removal ranging from 38-59%. However, there is an observed increase in total nitrogen and nitrate levels, posing challenges for comprehensive waste management strategies. Moreover, FBP treatment effectively removes micropollutants such as Tetracycline and 17 α -Methyltestosterone, with associated products exhibiting undetectable toxicity values, suggesting reduced toxicity compared to raw forms. In agricultural applications, FBP-treated water promotes higher germination rates for Chinese cabbage and bean seeds compared to other treatments. Additionally, FBP-treated plants exhibit larger leaf areas, indicative of improved growth conditions.

Despite its promising results, FBP implementation faces challenges, notably higher Life Cycle Costs (LCC) compared to plasma treatment alone. Addressing this issue is crucial for the widespread adoption and implementation of FBP as a sustainable solution for aquaculture effluent management.

Study on the Mechanism of Pyrite Flotation Enhanced by Nanobubbles

Zhongxian Wu¹, Dongping Tao^{2*}, Youjun Tao^{1*}

¹ School of Chemical Engineering and Technology, China University of Mining and Technology, 1 University Road, Xuzhou 221116, China.

² School of Resources and Environmental Engineering, Shandong University of Technology, 266 Western Xincun Road, Zibo 255049, China

E-mail: wuzhongxian567@163.com

Type of presentation: Oral

Status of Presenter: Student

Abstract

The flotation separation of pyrite is a key step to realize efficient gold enrichment in gold ore, while traditional flotation processes suffer from the problem of low separation efficiency of fine particles. It was innovatively proposed to employ cavitation nanobubble to enhance the flotation separation of pyrite from quartz, and the effects of nanobubble on the floatability of pyrite and quartz were explored through the micro flotation test, and the results showed that increasing the flow rate and time of cavitation significantly can improve pyrite floatability under any xanthate dosage, while quartz was not significantly floatable. A comparative laboratory test between nanobubble flotation and conventional flotation was carried out on the flotation feed from a gold beneficiation plant with different xanthate dosage. The results showed that the introduction of nanobubble increased the S grade and S recovery by about 7% and 8.7% in the pyrite concentrate, respectively, and reduced the xanthate consumption by nearly 75%. It is suggested that the preferential formation of nanobubbles on the surface of hydrophobic pyrite particles, the consequent hydrophobic agglomeration and the enhanced xanthate adsorption capacity on the pyrite surface are the primary means by which the separation performance of fine minerals is improved.

Efficient water activation by hybrid plasma microbubbles for bacterial inactivation

Mengying Zhu¹, Xiaoran Wang¹, Renwu Zhou^{1*}, Dingxin Liu¹

¹ State Key Laboratory of Electrical Insulation and Power Equipment, Center for Plasma Biomedicine, Xi'an Jiaotong University, Xi'an City 710049, China.

E-mail: renwu.zhou@xjtu.edu.cn

Type of presentation: (Oral)

Status of Presenter: (Student)

Abstract (less than 200 words)

Non-thermal plasma-liquid interactions have emerged as an emerging eco-friendly platform with promising applications in pollutant degradation, microbial sterilization, and food industry [1,2]. However, insufficient mass transfer and difficulties in liquid-phase discharge limit the efficiency of water activation[3]. This work proposes a novel microbubble plasma technique that utilizes the differential fluid pressure of a venturi to generate microbubbles and introduce plasma into the water flow. Experiments have confirmed that greater water pressure (4.0 Bar) at the inlet and smaller flow rates for air injection result in smaller size microbubbles (40-60 μm). Interestingly, increasing the air flowrate may result in more effective diffusion of reactive species produced by the coaxial dielectric barrier discharge into the water. With a 200 sccm air injection, the device can prepare 200 mL of plasma-activated water by air discharge for 10 min, inactivating 5.73 logs of *Staphylococcus aureus*. Furthermore, by setting the discharge device as a needle electrode, a needle-liquid spark discharge can be generated at the gas-liquid interface, and the combination of discharge modes can significantly optimize the activation efficiency.

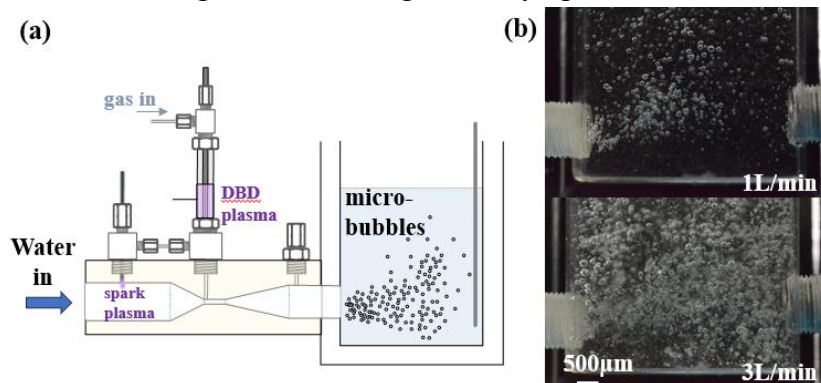


Figure 1. Schematic diagram of the device and bubble images under different water flow rates

References

- [1] H. Li, *et al.* Chem. Eng. J., 2020, 395, 125091.
- [2] S. Herianto, *et al.* Compr. Rev. Food Sci. Food Saf., 2021, 20, 583-626.
- [3] P. J. Bruggeman, *et al.* Plasma Sources Sci. Technol, 2016, 25(5), 053002.

Enhancement mechanism of nanobubbles in coal flotation

Qiao Bo^{1*}

¹ School of Resources and Environmental Engineering, Shandong University of Technology, Shandong 255000, China.

E-mail: 739428737@qq.com

Type of presentation: (Oral)

Status of Presenter: (Student)

Abstract (less than 200 words)

Most minerals are beneficiated with the process of froth flotation and efficient flotation performance is essential for achieving a high recovery of precious mineral resources. However, fine particles are known to be difficult to float due to its low probability of collision with conventional sized bubbles. Nanobubbles have very unique surface and physicochemical characteristics and have been successfully applied to enhancing the performance of fine particle flotation with a number of coal and minerals. This paper discusses the principal nanobubble enhancement mechanisms for fine coal particle flotation. Experimental flotation results with typical coal samples are presented to demonstrate the effect of nanobubbles on fine particle flotation behavior and the controlling process parameters.

Unveiling the Preventive Potential: Micro and Nanobubbles Influence on Ceramic Membrane Fouling by Organic Foulants During Drinking Water Treatment

Nachael Mwanga^{ab}, Xitong Wang^a, Pan Li^{b,c}, Yanling Liu^{b,c}, Shengji Xia^{b,c}, Daqiang Yin^{b,c}, Min Rui^d, Yubin Ye^d

^a College of Environmental Science and Engineering, Tongji University, Shanghai 200092, PR China

^b UNEP-Institute of Environment and Sustainable Development (IESD), Tongji University 1239 Siping Road, Shanghai 200092, PR China

^c State Key Laboratory of Pollution Control and Resource Reuse, Tongji University, Shanghai 200092, PR China

^d Shanghai Municipal Engineering Design Institute (Group) Co., Ltd, PR China

*Corresponding author: Nachael Mwanga^a

nachaelmwanga@gmail.com

Type of presentation: Oral

Status of Presenter: Student

Abstract

It is suggested that the advantages of micro-nanobubble technology in membrane fouling control are directly presented at the beginning. However, the present studies lack the effect relationship between bubble size, concentration and membrane fouling control. The considerable energy consumption involved in micro-nanobubble generation hinders the extensive implementation of this technology in drinking water plants. This study focuses on controlling the bubble size and concentration by controlling the release pressure and reducing the energy consumption of the process by optimizing the intermittent operation scheme. The study revealed that, incorporation of smaller and more concentrated bubbles had a substantial impact, leading to a 43.7% reduction in transmembrane pressure ratio, decreasing from 2.83 with larger and less concentrated bubbles to 1.59 with smaller and highly concentrated bubbles. The comparison between continuous release pattern and the optimal intermittent release pattern of 30-minutes interval revealed marginal differences in transmembrane pressure ratio (0.7%), Transmembrane pressure recovery after cleaning (8.71%) and rejection efficiency (2.4%), signifying the ability to optimize MNBs releasing time without compromising membrane performance while reducing the required energy to generated micro and nanobubbles.

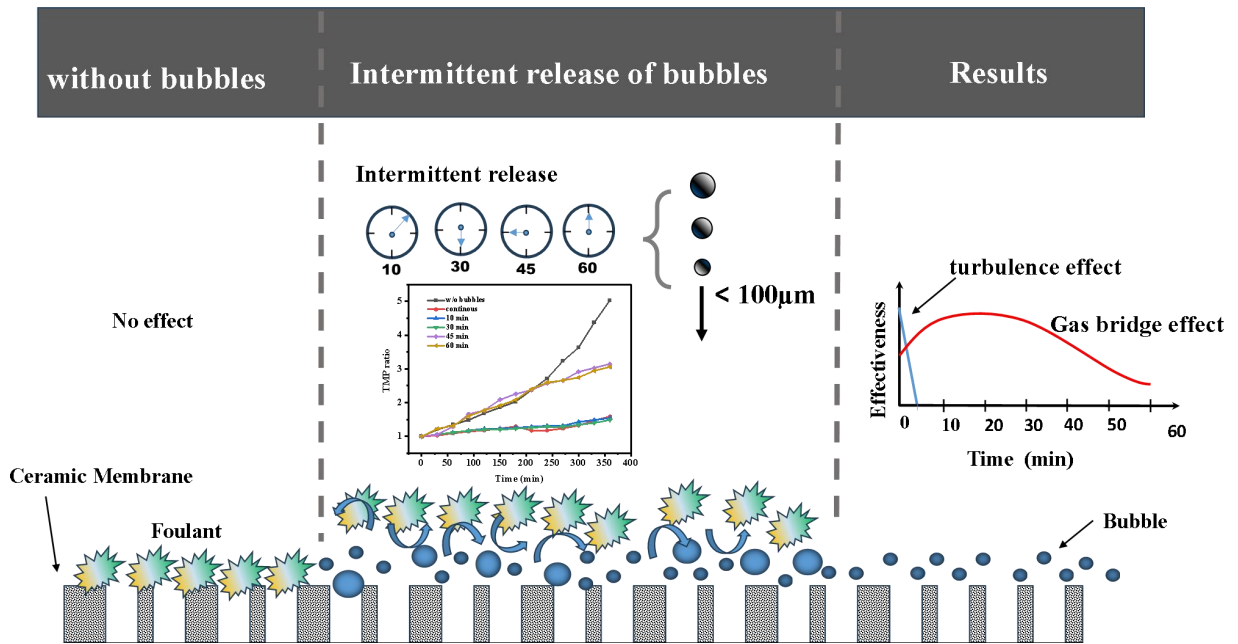


Figure 1. Demonstration on the effect of micro and nanobubbles on the membrane with respect to time.