

**Abstracts of
International Young Electrostatic
Scholar Symposium for Convergence
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The influence of ozonation of methane fermentation digested slurry on the moisture content of dewatered sludge

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Abstract

The influence of ozonation of methane fermentation digested slurry on the moisture content of dewatered sludge was investigated. A cylindrical dielectric barrier discharge reactor was used for the ozone generation with oxygen gas. Methane fermentation digested slurry collected from a methane fermentation plant was used as a sample. The moisture content of dewatered sludge of methane fermentation digestate was evaluated after ozone bubbling treatment. The initial moisture content was 89.4%. The moisture content decreased by approximately 0.8% pt after 15 minutes of treatment with 1760 ppm ozone, while the moisture content decreased by about 8% pt after 60 minutes of treatment with 6000 ppm ozone. A defoamer was added to eliminate forms produced by ozone bubbling. The moisture content was reduced by about 1.6% pt after 60 minutes of treatment at 1760 ppm, and the reduction in moisture content was approximately 3% pt less than that without defoamer. To improve the efficiency, increased sample volume and longer contact time between bubbles and digested slurry. The reduction in moisture content was at least 1.5% pt greater than that of half the liquid surface height.

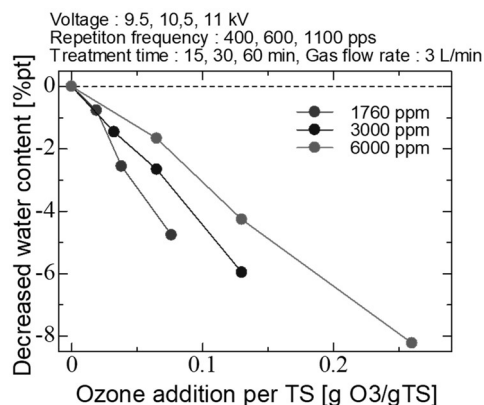


Fig.1 Decreased sludge moisture content as a function of amount of input ozone addition per TS for three ozone concentrations.

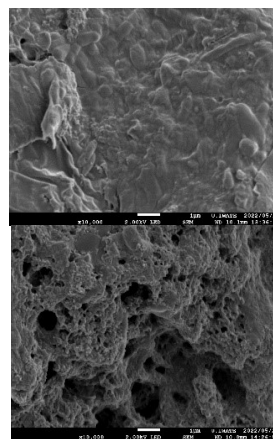


Fig.2 SEM images of digestate (a) before ozone bubbling treatment, and (b) after ozone bubbling treatment

Curriculum Vitae



Tatsuya Yamamoto

My hobby : video game, ski, motorcycle

Influence of the pulsed electric fields (PEF) on crop yield of *Lentinula edodes*

Shuta Onodera^{a*}, Aoi Sato^a, Katsuyuki Takahashi^{a, b}, Koichi Takaki^{a, b},
Yuichi Sakamoto^c, Hiroyuki Yoshida^d

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^b Agri-Innovation Center, Iwate University

^c Iwate Biology Research Center

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Abstract:

The application of pulsed electric fields (PEF) to improvement of mushroom production has been investigated. 5 pulses with a voltage of 50 kV, generated by a Marx generator, are applied to wooden logs inoculated with *L. edodes* (Mori Sangyo, mori No. 290 and No. 908). The cultivation period after inoculation is 1 years. The pulses are applied spring and autumn seasons before harvesting. Fig (a) shows the yield of fruit body cropped from the logs inoculated with strain mori290. In the autumn, the total yield cropped from pulse- treated logs was more than double of that of untreated logs. Fig (b) shows the yield of fruit body cropped from the logs inoculated with strain mori908. The fruit body is only expressed with pulse applications in the autumn season. This result suggests that stable harvesting is possible throughout the year.

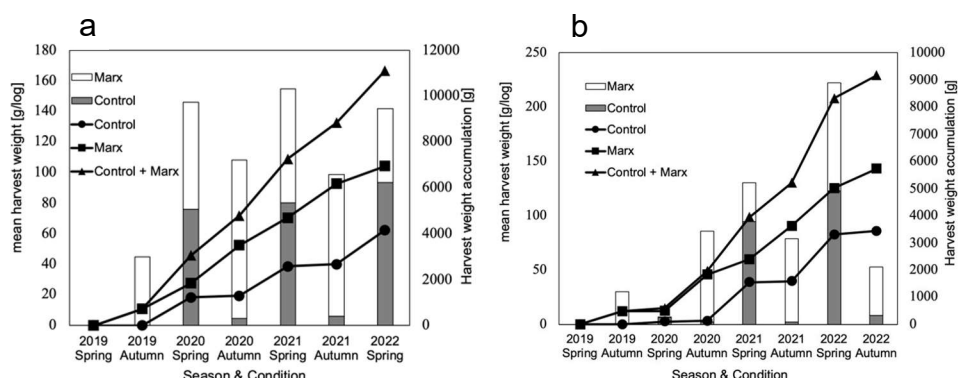


Fig. Mean weight of fruit bodies harvested per log (bar graph) and total harvest weight (line graph) (a No.290, b No.908)

Curriculum Vitae



Shuta Onodera

I am currently studying the effects of applying voltage to mushrooms, with a particular focus on shiitake mushrooms. My favorite mushroom dish is shiitake takikomi gohan (shiitake mushroom rice).

Plasma-Enhanced Germination: A Novel Approach to Boost Plant Growth

Siraporn Chuea-uan ^{a*}, Dheerawan Boonyawan ^b, Choncharoen Sawangrat ^c,
Chanchai Dechthummarong ^d, Natchaya Saikamwong ^a, Nattaya Hompian ^a,
and Sa-nguansak Thanapornpoonpong ^a

^a Department of Plant and Soil Sciences, Faculty of Agriculture, Chiang Mai University, Chiang Mai 50200, Thailand

^b Department of Physics and Materials Science, Faculty of Science, Chiang Mai University, Chiang Mai 50200, Thailand

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^d Department of Electrical Engineering, Faculty of Engineering, Rajamangala University of Technology Lanna,
Chiang Mai 50300, Thailand

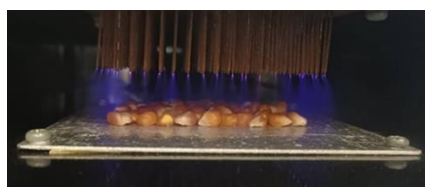
*siraporn_chueauan@cmu.ac.th, siraporn.ripon@gmail.com

Abstract:

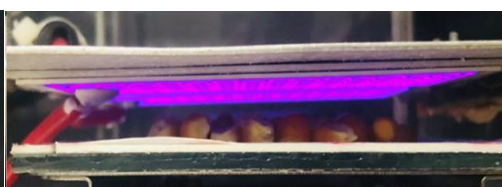
Plasma technology is becoming a highly effective approach to improve seed quality and promote plant growth, marking a promising advancement in agriculture. The use of low-temperature atmospheric pressure plasma utilizes reactive oxygen and nitrogen species (RONS), which are introduced into the physiological components of seed through various mechanisms to promote germination and growth.

The research investigates the effects of air plasma and plasma-activated water (PAW) treatments on seed quality, focusing on the optimal conditions for each technique. For maize seeds, it was found that using air corona plasma at a voltage of 150 volts for 75 seconds significantly enhanced germination quality. Similarly, applying air surface dielectric barrier discharge plasma to maize seeds for 60 seconds was found to be the most suitable for increasing germination, growth parameters, and reducing pathogens on the seed surface. Additionally, using air gliding arc plasma to generate PAW for rice seed treatment significantly increased germination, early growth stages, and total nitrogen content in rice seedlings.

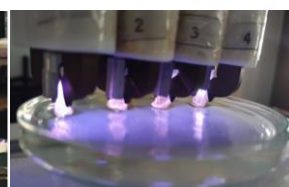
Plasma treatment effectively enhances seed quality and stimulates plant growth by introducing RONS. Research indicates that air plasma and PAW treatments significantly enhance germination and boost early growth in maize and rice seeds, providing an eco-friendly alternative to traditional methods.



Corona



Surface Dielectric Barrier Discharge



Gliding Arc

Curriculum Vitae



Name: Siraporn Chuea-uan

Education: Ph.D. of Major of Agronomy, Faculty of Agriculture, Chiang Mai University, Thailand

Research topics: Enhancement of Seed Quality, Growth, and Yield in Rice (*Oryza sativa* L.)
by Using Plasma Activated Water

Hobbies: Listening to podcasts, traveling, and cooking

Motto: Today is hard but tomorrow will be sunshine

Work: Government employee, Rice Department, Thailand

Numerical Analysis of Collection Characteristics of Microplastics by Dielectrophoresis

Saya Fukui,^{a,*} Ippei Yagi^a and Satoshi Uchida^a

^a Graduate School of Systems Design, Tokyo Metropolitan University

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Abstract:

In recent years, the increase in plastic waste emissions and its flow into the oceans have become significant issues. Microplastics (MP), which are broken down by ultraviolet rays and waves, are easily ingested by marine organisms, posing potential impacts on humans and the environment. Therefore, monitoring technologies to understand environmental impacts are essential. As a solution, we focus on dielectrophoresis. In this report, we constructed a two-dimensional model using COMSOL Multiphysics to investigate the electrophoretic properties and particle behavior of MPs. We analyzed the dependence on key factors such as conductivity, frequency, and particle size. As a result, we found that the electric field becomes stronger at high frequencies or low solvent conductivities. Additionally, positive dielectrophoresis was observed at low frequencies or low solvent conductivities, and it was confirmed that larger particle sizes tend to exhibit negative dielectrophoresis.

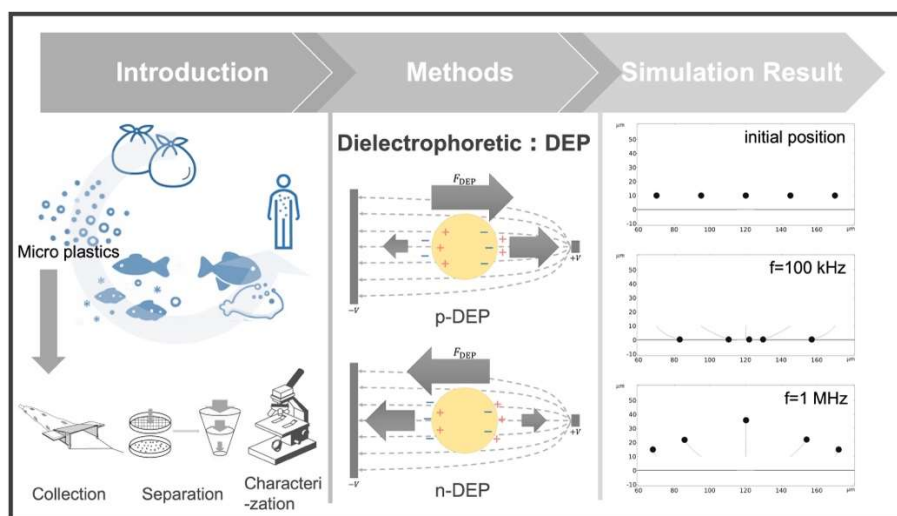


Fig. Introduction, method, and simulation results with frequency variation

Curriculum Vitae



Saya Fukui

Research topics

Separation of Microplastics and Nanoplastics Using Dielectrophoresis

Hobbies

Watching Musicals, Baseball Game Watching

Finite Element Modeling of Ring and Gaussian Dual Laser Heat Sources for Aluminum Butt Welding

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^a School of Material Science and Engineering, Pusan National Univ., Busan 1,46241, Korea

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Abstract:

Aluminum alloys have been widely used in various industries such as automotive and aerospace, due to their high specific strength and corrosion resistance. Laser welding using a dual laser allows welding thick products and reduces laser reflection effect of aluminum. The purpose of this study is to develop a numerical finite element simulation model that can predict melting and heat distribution behavior in dual laser beam welding of aluminum. The heat source used in the simulation model is a combination of an outer ring laser beam and a centrally focused Gaussian laser beam, for describing the dual laser heat source used in the experiments. In the simulations, centrally focused Gaussian laser was considered by two different heat distributions of 3D Gaussian distribution and cylindrical Gaussian distribution. Comparison of simulation and experimental results showed that the Gaussian cylinder heat input model reproduced the actual melting behavior better than the 3D Gaussian distribution.

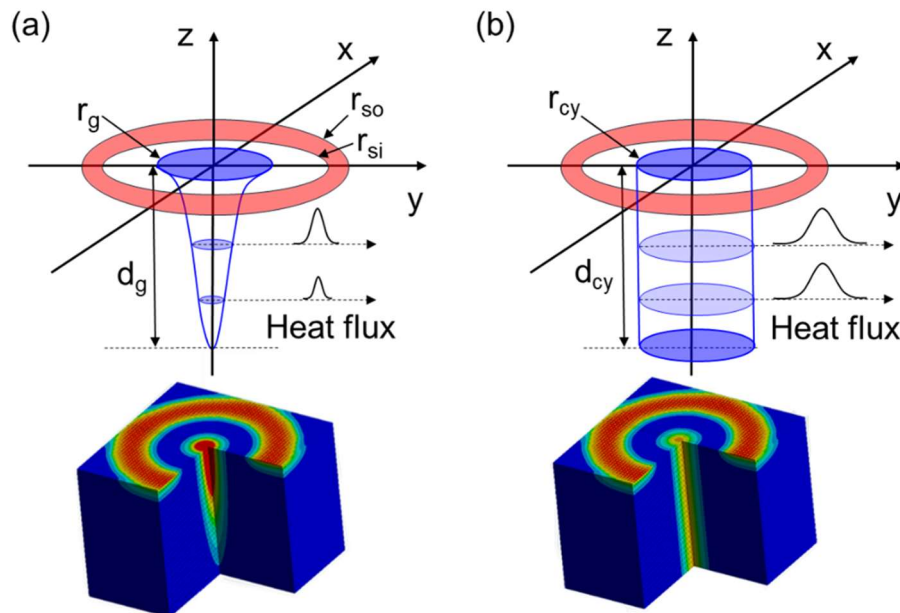


Fig. 1 Schematics of (a) ring and 3D gaussian beam and (b) ring and Gaussian cylinder beam shapes

Curriculum Vitae



Jongwook Jung

Ph.D. candidate at Pusan National University (PNU)

Research topic: Additive manufacturing (AM), Finite element analysis (FEA)

Hobbies: Game, Sports

Effect of spatial modulation amplitude on the mechanical properties of Al/Cu laser lap joints

Seong Min Yun,^{a,*} Je In Lee^a

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Abstract:

Electrical Vehicles (EV) using lithium ion batteries are one of the most promising replacement of the internal combustion engine cars. The EVs contain a battery pack, which includes thousands of battery cells connected by laser welding technique. Laser welding of Al and Cu tabs is difficult due to the low absorption rate of base metals and the generation of porosities and the formation of intermetallic compounds (IMCs). The formation of IMCs should be controlled because IMCs degrades the electrical and mechanical properties of the welds. In this research, laser beam was modulated in a circle with different amplitude (A) to control the formation of IMCs. At low amplitude range ($A \leq 0.1$ mm), the welds were fully penetrated and the upward flow of liquid copper was confirmed. When the amplitude was higher than 0.4 mm, the welds were partially penetrated and the upward flow of liquid copper was suppressed. When the welds were partially penetrated (with larger amplitude), tensile shear and fatigue properties of the welds were enhanced by changing the fracture site from Al fusion zone to Al/Cu heat affected zone.

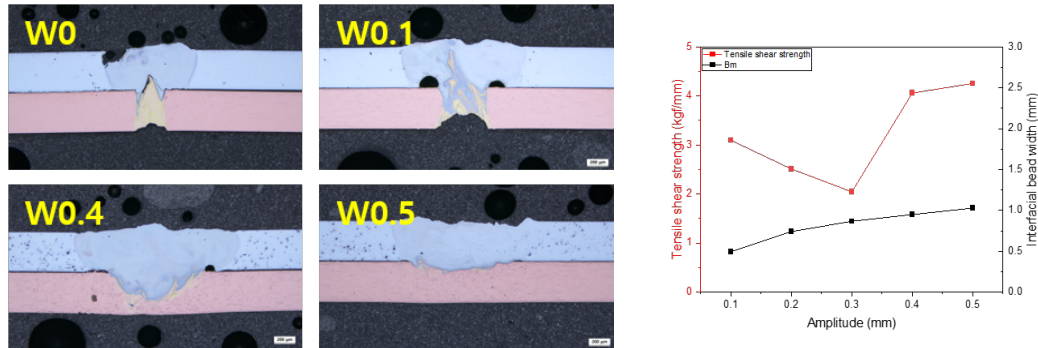


Fig. Cross-sections after welding (left), Tensile shear strength and interfacial bead width (right)

Curriculum Vitae



Seongmin Yun

School: Pusan National University

Position: M.S candidate

Topic: Al-Cu brazing for electric car

Study on Ozone Spatial Distribution and Generation Efficiency Using a Low-Concentration Ozone Generator

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Abstract:

Ozone has strong oxidation power and no secondary pollutions because of easily decompositions into oxygen molecules by reactions with other molecules. Therefore, ozone is used for widely applications such as air purifications, sterilization and water treatments.

In this study, we develop an ozone generator using small power generated by natural energy sources such as solar power, wind power and so on. However, it is considered that the efficiency of ozone generation and ozone production rate are not high in low power.

Therefore, the goal of this study is to development of the ozone generator that operates on the low power supply.

At first, a high voltage circuit for discharges as shown in fig. 1 was designed for the ozone generations with low electric power. Two ways of power supply was used for the circuit. One is a 12 V power supply, another one is boosted by a cold cathode tube inverter from a 12 V power supply. Then, the power supplies connected to a Cockcroft-Walton circuit (CW circuit) to discharge between a needle and plane electrode.

As the results, it was confirmed that the ozone was generated from the discharge between point and plane electrode. In the future, we investigate the amount of ozone generation and space distribution of the ozone density to keep fixed low ozone density for food sterilization.

Fig.

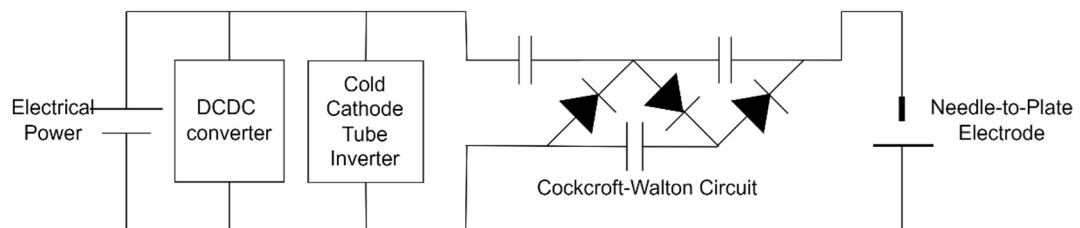


Fig1. Ozone generator circuit

Curriculum Vitae



Yano Takumi

Nice to meet you, I am Takumi Yano.

I am studying the development of ozone generators and techniques for ozone measurement.

My hobbies include camping, cooking, gaming, and various other activities. Camping is one of my favorite activities, and often take my motorcycle to go camping by myself.

Low Temperature Co-Fired Ceramics Device for Plasma Generation and Biomedical Applications

Abstract

This study investigates the advantages of Low Temperature Co-Fired Ceramics in the fabrication of a handheld plasma generating device for biomedical purposes and its effectiveness in suppressing arcing behaviors through electrode encapsulation and arrangement. Additionally, it also focuses on the robustness and sustainability of the plasma device. By employing micro holes into the plasma device, the gas flow can be made more uniform, enhancing the plasma discharge, and reducing the overall temperature of the device, thus preventing overheating. In addition, the electrodes are arranged in a staggered pattern to optimize the electric field distribution. To evaluate the device's robustness, a risk assessment criterion is established by measuring its durability over time, as well as monitoring its temperature, ozone concentration, UV concentrations, and current. This study employs optical measurements through Optical Emission spectroscopy (OES), along with assessments of power consumption, stability of voltage and current waveforms, temperature stability and Lissajous figures. Furthermore, SOLIDWORKS simulations are conducted for flow analysis, and 3-D printing will be used to create the device's outer structure, making it suitable for handheld use as well as ensuring portability and precision. Experimental results demonstrated that temperature measurements at three different points of the device: the inlet, outlet, and electrode remained stable over time. Additionally, the temperature decreased as the gas flow rate increased. Thus, showing the importance of gas flow within the device. Voltage stability was also maintained throughout the same period. LTCC has the potential to enhance the robustness of plasma-generating devices by ensuring proper sealing of electrodes, thereby preventing external contamination and contact with reactive species that can lead to corrosion phenomena and non-uniform discharge.

Keywords: Low Temperature Co-Fired Ceramics (LTCC), electrode configuration, arc discharge, plasma jet sustainability.

Production of Sustainable Biodiesel by Utilizing Marine Waste Catalysts

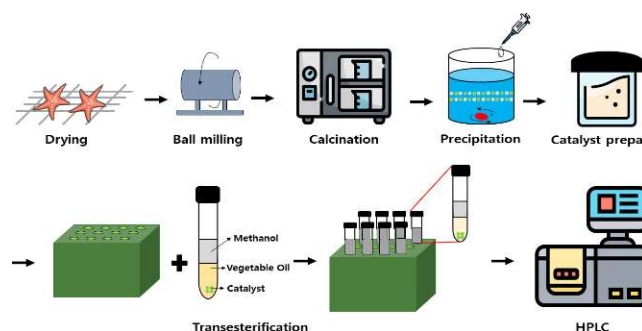
Jeyoung Ha,^{a,*} Oi Lun Helena Li^a

^a *Materials Science and Engineering, Pusan National University*

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Abstract:

The increasing demand of fossil fuels necessitates alternative energy sources. Biodiesel, a renewable fuel derived from non-edible oils, animal fats, vegetable oils, and waste cooking oil, offers advantages such as biodegradability, non-toxicity, and sustainability for waste management. This paper presents a method for biodiesel production utilizing starfish, a marine debris, as a transesterification catalyst. Starfish, harmful to marine ecosystems, are composed of magnesium carbonate (MgCaCO_3). This compound can be converted to calcium oxide (CaO) and magnesium oxide (MgO), where CaO is the major component and MgO is present in smaller amounts. While CaO is an effective catalyst, its performance is hindered by leaching during reactions. Doping CaO with transition metals, specifically zinc oxide (ZnO), improves stability and catalytic performance. Calcium oxide and magnesium oxide derived from calcined starfish at 1173 K (S900) and zinc nitrate hexahydrate were processed and used as catalyst (CMZ). Under optimal conditions, the CMZ catalyst achieved a methyl ester yield of 97.5 %, significantly outperforming the S900 catalyst's yield of 56.4 %. This study demonstrated the enhanced efficacy of ZnO -doped CaO in biodiesel production.



Graphical Abstract

Curriculum Vitae



Jeyoung Ha

Master Course in Pusan National University

Renewable Energy Lab

Hobbies: Game, travel

Research Topic: Biodiesel production, catalysts

Improving the performance of wide-bandgap CIGS solar cells via injection annealing system

Sanghun Lee· Yangdo Kim

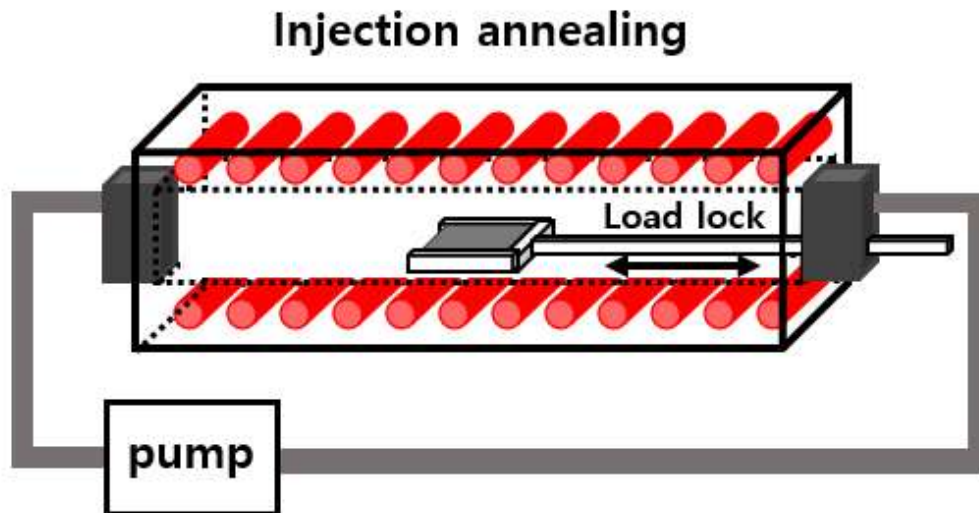
Department of Materials Science Engineering, Pusan National University

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Abstract:

In this study, we present an effective method of improving the performance of wide-bandgap Cu(InGa)S₂ (CIGS) solar cells via injection annealing. Via the injection annealing, secondary-phase InS_x was effectively removed from the surface of the CIGS thin films at temperatures over 550°C. This resulted in the formation of good-quality P–N junction CIGS devices, thereby improving significantly the performance of the CIGS solar cell. In addition, the open-circuit-voltage (V_{oc}) of the CIGS devices increased gradually with increasing annealing temperature in the range of 550°C–640°C. It is speculated that the bulk defects were decreased as the annealing temperature increased. Finally, via injection annealing, a wide-bandgap CIGS solar cell with an efficiency of 12.16% was achieved.

Fig.



Curriculum Vitae



Sanghun Lee

Department of Advanced Materials Science and Engineering, Kyungpook National University (2017~2023)

Department of Materials Science and Engineering, Pusan National University (2024~)

Evaluation of boron-doped diamond electrode prepared at various working pressures for electrochemical treatment

Tae Kyeong Lee^{a,*} Mi-Young You^b, Pung-Keun Song^a

^a Department of Materials Science and Engineering, Pusan National University, Korea

^b Institute of Materials Technology, Pusan National University, Korea

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Abstract:

Electro-chemical treatment processes are necessary, recently, in the field of various environmental treatments such as wastewater, oil bearing soil, plastic recycling, and so on, owing to the low physico-chemical treatment performance. To achieve high electro-chemical treatment efficiency, high-performance electrodes should be required. Hitherto, the electrode which has been used in electro-chemical treatment has low corrosion resistance and short life-time.

Here, the boron-doped diamond (BDD) has excellent mechanical properties based on their diamond structure and has excellent electro-chemical properties due to wide potential window ($\sim 3\text{eV}$), that enabling the efficient generation of the oxidants OH radical ($\text{OH}\cdot$) and ozone (O_3).

In this study, we have investigated the key parameters determining BDD properties, such as filament temperature, working pressure, CH_4 concentration, substrate temperature, and boron concentration. Among these factors, the microstructure of BDD heavily depends on the working pressure. Therefore, we employed the hot-filament chemical vapor deposition (HFCVD) method using tantalum filaments to deposit BDD electrodes at various working pressures. We evaluated BDD electrode characteristic using XRD, SEM, and Raman.

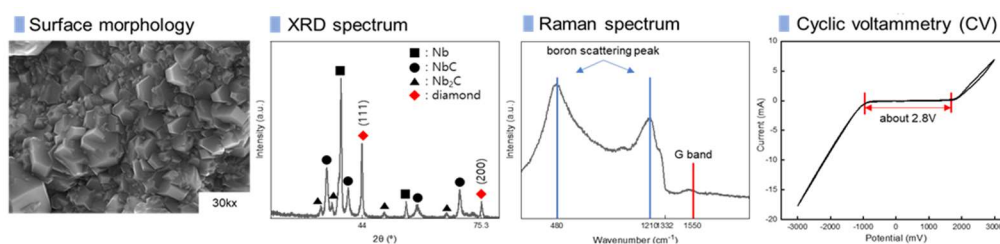


Fig. Characteristics of BDD thin films deposited

Curriculum Vitae



Taekyeong Lee

Boron-doped diamond (BDD), hiking

Nanolaminated structure film using Atomic Layer Deposition to enhance corrosion resistance on SUS304 steel

Jae-Hyun Kim,^{a,*} Se-Hun Kwon^a

^a School of Materials Science and Engineering, Pusan National University, Busan 46241, South Korea

*wogusmaple@pusan.ac.kr

Abstract:

Atomic Layer Deposition (ALD), which utilizes self-limiting surface reactions By alternately exposing precursors and reactants to the surface, has recently been investigated. As a way to form thin and defect-free thin films. This ALD method of thin film deposition has the advantages of precise thickness control on the nm scale, excellent step coverage on complex Surface geometries, and large-area deposition, which is required in industries that use large surface area materials. In this study, Al_2O_3 and ZrO_2 nanolaminated thin films were deposited on SUS 304 Substrates using ALD technology to improve corrosion resistance in high salt environments such as seawater. Using ALD technology, Al_2O_3 was deposited as an amorphous, grain-free thin film to effectively block the migration of salt water, a corrosive medium, into the bulk Stainless steel under the thin film, and ZrO_2 thin films with excellent dielectric properties were alternately deposited between the Al_2O_3 films to form a lamination structure. The repeat thickness of each Al_2O_3 and ZrO_2 thin film in the Al_2O_3 - ZrO_2 Nanolamination film was set to be 2 nm, 5 nm, and 9 nm, and finally, the deposition was carried out so that the total thickness was around 50 nm. And to evaluate the corrosion protection performance in high-salinity atmospheres such as seawater, which is one of the many corrosive media, a potentiostatic polarization test was conducted in 3.5 wt% NaCl electrolyte, and the corrosion properties were evaluated according to the film material, film Structure, and film thickness.

Curriculum Vitae



Jae Hyun Kim

Jae Hyun Kim received the B.S.degree in material science and engineering from the Pusan National University, Busan, South Korea, in 2024, where he is currently pursuing the master's degree with the Department of Material Science and Engineering. His research interests include semiconductor process. In particular interconnects technology using ALD process.

Effect of grain boundary serration on creep properties in Nimonic 80A alloy

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^a School of Materials Science and Engineering, Pusan National University, Busan, 46241, Republic of Korea

[*kkyeong13@pusan.ac.kr](mailto:kkyeong13@pusan.ac.kr)

Abstract:

For achievement of Net Zero in the power generation industry, most of thermal power plants has been replaced by combined cycle power plant (CCPP) using liquified natural gas, and its turbine inlet temperature (TIT) is increasing for the improvement of efficiency of plant. Currently, Ni-based superalloys have been used for steam turbine blades for CCPP. The turbine blades should have improved creep properties for the increased TIT. Here, to enhance the creep properties, we controlled the shape of grain boundary which is the site of crack initiation. In this study we used one of the forged precipitation hardening Ni-based superalloy, Nimonic 80A. Compared to the conventional heat treatment condition, new heat treatment is designed to slowly cool the alloy, which is effective to form the serrated grain boundary. we found that the movement of grain boundary was prevented by primary and precipitated carbides during the slow cooling. Creep test of the 80A alloy with serrated boundaries was conducted at 750 °C and 260 MPa. The creep life of 80A alloy increased by about 20 % due to the grain boundary serration. This result shows that the formation of serrated grain boundary with discontinuous precipitation improves the creep property of the 80A alloy.

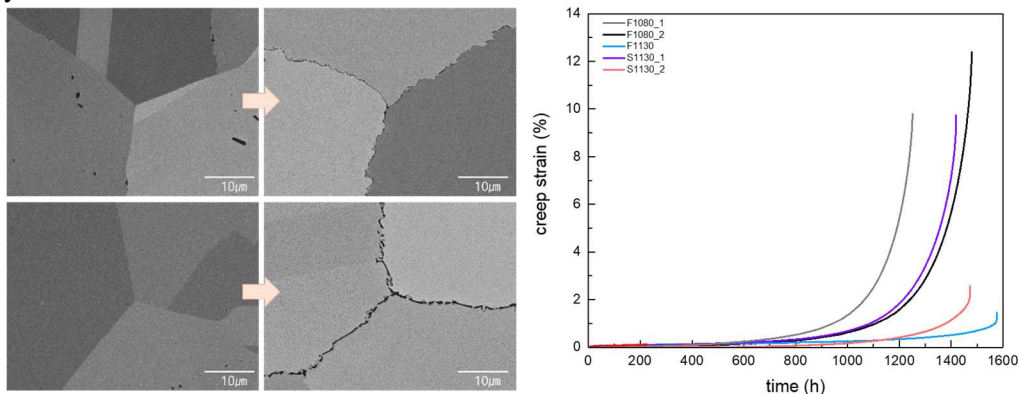


Fig. Microstructure of serrated grain boundary (left), Creep properties (right)

Curriculum Vitae



Kayeong Kim

School: Pusan National University

Position: M.S candidate

Topic: Nickel based superalloy

Development of inductive energy storage pulsed power supply using SiC semiconductor devices

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^a Iwate university, Morioka, Iwate 020-8551, Japan

^b Agri-Innovation Center, Iwate University, Morioka, Iwate 020-8550, Japan

* g0323160@iwate-u.ac.jp

Abstract:

Inductive energy storage (IES) pulsed power generator driven by the silicon carbide (SiC)-MOSFET with the blocking voltage of 1.2 kV was developed. Fig 1 shows the schematic diagram of inductive energy storage circuit using SiC-MOSFET. The IES pulsed power generator consists of a capacitor, a pulsed transformer and the SiC-MOSFET used as an opening switch. The influence of turn ratio of the pulsed transformer on the output voltage was evaluated. The amplitude of output voltage increased with increasing the secondary turn ratio. Fig 2 shows the waveforms of output voltage v_o , and inductor current i_{L1} with no load at 2:30 turns ratio. A peak voltage of 15 kV and a pulse width of 140 ns were obtained with a voltage across the drain-source terminals of the MOSFET of 1.2 kV. The peak voltage value increased, and the peak current and pulse width value decreased with increasing load resistance and decreased capacitance. The maximum energy transfer efficiency was obtained at 500 Ω and was approximately 50%.

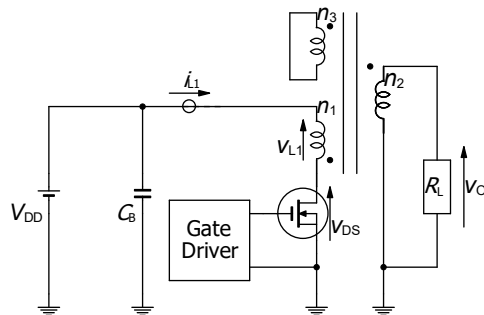


Fig 1. Schematic diagram of IES circuit using SiC-MOSFET

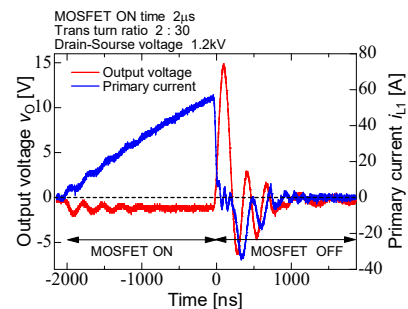


Fig 2. Waveforms of output voltage v_o , and inductor current i_{L1} with no load at 2:30 turns ratio

Curriculum Vitae



Sho Fujikura

My topic of study is development of pulse power supply.

Lately, I have been walking, taking cold showers and meditating as part of my morning routine. These motivate me from the morning.

New Commutation Path Design to Suppress Voltage across IGBT in Hybrid DCCB

Yuki Okegawa,^{a,*} Nozomi Takeuchi^a

^a Tokyo Institute of Technology
okegawa@hv.ee.e.titech.ac.jp

Abstract:

In recent years, the demands on DC power systems have increased because of their high transmission efficiency. On the other hand, DC circuit breakers (DCCBs) play a crucial role in ensuring the reliable operation of these systems. In our previous research, we developed a hybrid DCCB that combines a fuse as the main path and an IGBT and varistor as the commutation path, as shown on the left side of Figure 1. One problem with this DCCB is the voltage across the IGBT, particularly the transient recovery voltage (TRV) at the moment of interruption, and we have added a serial contactor and parallel RCD snubber circuit to the IGBT path, as shown on the right side of Figure 1. Owing to this new IGBT path design, the voltage across the IGBT can be suppressed throughout the entire current interruption process.

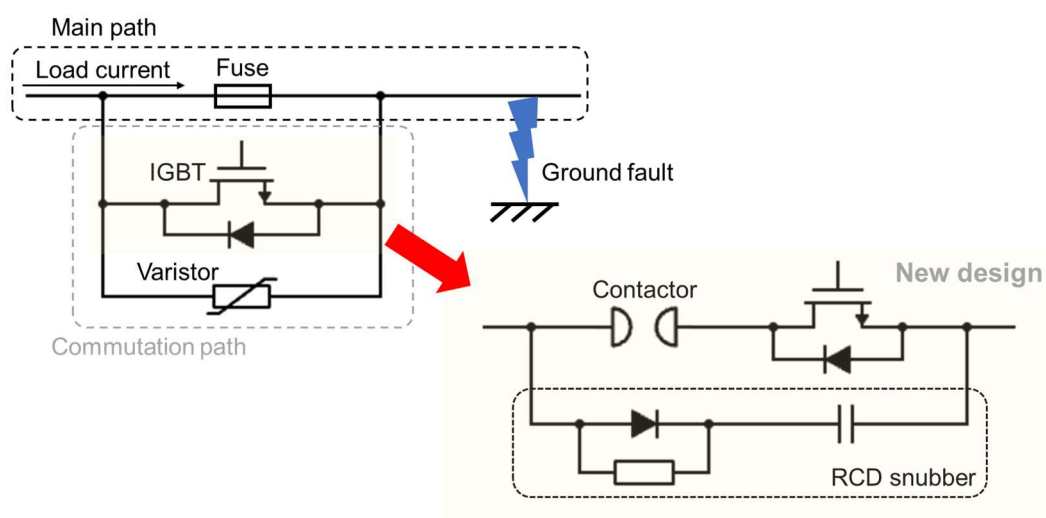


Fig. 1. Schematic diagram of our conventional hybrid DCCB and new design of IGBT path in commutation path

Curriculum Vitae



Yuki Okegawa

I was born in 1999 in Hokkaido, Japan. I received the B.E. degree in electrical and electronic engineering from Tokyo Institute of Technology, Tokyo, Japan, in 2023. My research interest includes dc hybrid switch technologies and lightning protection techniques of wind turbines.

Time-resolved observation of 150 kHz band high power pulse burst high-frequency discharge using a high speed video camera and an ICCD camera

Naohiro Takahashi ^a, Hikaru Suenaga ^a, Genta Ichii ^a, Katsuyuki Takahashi ^{a*},
Seiji Mukaigawa ^a, Koichi Takaki ^{a, b}

^a Iwate university, Morioka, Iwate 020-8551, Japan

^b Agri-Innovation Center, Iwate University, Morioka, Iwate 020-8550, Japan

*ktaka@iwate-u.ac.jp

Abstract:

The discharge phase and time evolution of a 150 kHz high-power pulse burst discharge was observed. A vacuum chamber constructed by connecting glass tubes on which a solenoid coil was wound. Burst pulses with the width of 1000 μs and the repetition rate of 10 Hz was applied to the solenoid coil. A high-speed video camera and an ICCD camera were used to record the photographs of discharges. Observation of the discharge phase using a high-speed camera showed that the discharge occurs at the time of 40 μs and propagates from the wall of the cylindrical reactor. As time, the discharge pattern evolves, and a blanch pattern appears. The number of the branch changes with the time. The discharge blinks synchronizing with the instantaneous power, which suggests that the discharge is generated and maintained by the electrostatic field generated by the sides of the coil. The propagation velocity calculated from the downstream decreased with increasing pressure and increased with increasing power.

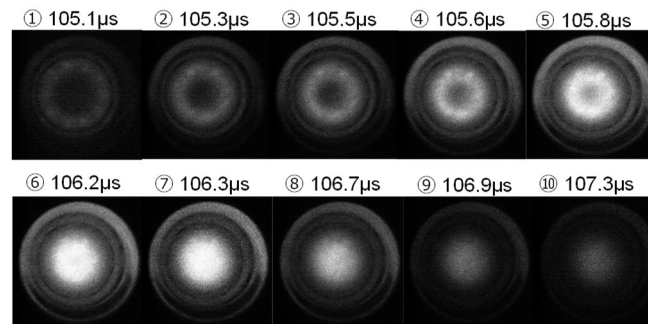


Fig. Example of framing photographs of discharges taken by a ICCD camera.

Curriculum Vitae



Naohiro Takahashi

My topic of study is basic research process plasma to make the semiconductor. Some of our lab members have motorcycles and often go touring to Tohoku area in Japan.

Fundamental Study on Waveform Characteristics Analysis of Partial Discharge in Artificial Defect at Cryogenic

Soshiro Murata,^{a*} Tomohiro Kawashima,^a Yoshinobu Murakami,^a Naohiro Hozumi,^a

^a Toyohashi University of Technology

* murata.soshiro.rs@tut.jp

Abstract:

The insulation system of a superconducting coil mainly consists of a superconducting conductor insulated with polyimide wound around it and then impregnated with epoxy resin. Generally, voids in solid insulation, such as epoxy resin, promote partial discharges (PD) and lead to dielectric breakdown. In this study, we prepared an artificial defect designed to mimic conditions in the insulation system of a superconducting coil and then estimated by analyzing the PD waveform features.

Fig. 1 shows a schematic diagram of the artificial defect. A hole with a diameter of 5 mm was introduced in an epoxy resin film (EP, average thickness 60 μm), which was sandwiched using polyimide films (PI, thickness 12.5 μm) attached to both sides of the EP. A high AC voltage (4 kVrms, 60 Hz) was applied to the sample at 298 K or 77 K, and 1,000 PD waveforms were recorded in time series.

Figs 2 and 3 show a typical PD waveform and the cumulative probability of rise/fall times, respectively. Fall time significantly changes depending on the temperature. Assuming that the temperature dependence of the ion mobility is an Arrhenius type, this tendency is agreed with qualitatively because it should decrease at 77 K.

From the above, the PD waveform characteristics reflect the difference in the formation process of the electron avalanche. Moreover, we can assess the insulation system using helpful information that is hard to obtain from the magnitude of the PD alone.

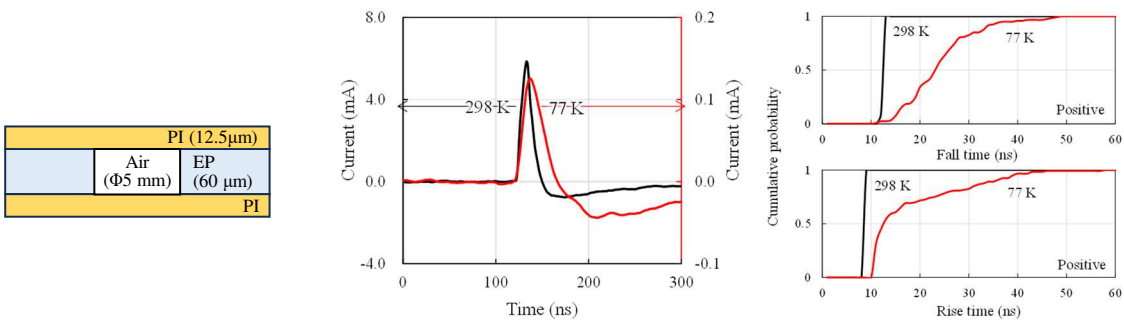


Fig.1 The sample

Fig.2 Typical PD waveform

Fig.3 Cumulative probability

Curriculum Vitae



Soshiro Murata

In 2022, he received an associate degree in National Institute of Technology Toyota College. He has been studying for a bachelor's degree in electrical and electronic information engineering at Toyohashi University of Technology and graduated in 2024. He is currently engaged in research on condition assessment of superconducting coil insulation systems.

Discussion on the Surface Reaction Area of Active Material in All-Solid-State Battery

So-Young Joo* and Heon-Cheol Shin

*School of Materials Science and Engineering, Pusan National University, Busan
46241, Republic of Korea*

**Presenting Author's email: soyoungjoo@pusan.ac.kr*

Abstract:

All-solid-state battery (ASSB) is one of the most promising secondary battery systems in recent years due to its high energy density and stability. Among various solid electrolytes for ASSBs, sulfide-based solid electrolytes are particularly noteworthy because of their high ionic conductivity as well as plasticity suitable for good interfacial formation with cathode active material particles. Despite many efforts to commercialize ASSBs, however, there are still many challenges to address. Poor interfacial contact between the active material and solid electrolyte is one of the major issues in ASSBs as it significantly reduces the electrochemically active surface area (ECSA) on which the Li^+ intercalation takes place. The nature of interfacial contact is known to be highly dependent on material properties and process conditions, such as solid electrolyte particle shape/size and external pressure.

In this work, we review the existing methods proposed to determine the ECSA of batteries and explore their application to ASSBs. In particular, we aim at suggesting a viable method to determine the ECSA of Ni-rich cathode in ASSB using sulfide-based solid electrolyte by electrochemical analyses. Among the possible methods, the combination of electrochemical impedance spectroscopy (EIS) and galvanostatic intermittent titration technique (GITT) deserves special attention for its consistency with existing literature and validity of results. By using this method, it can be seen that the ECSA decreases as the lithium content increases, indicating a reduction in intercalation sites on the surface of the active material. In addition, the ECSA difference can be effectively analyzed at different external pressures. In this presentation, the effective utilization of the EIS-GITT combination for ECSA estimation in ASSBs will be discussed.

Curriculum Vitae



So-Young Joo

I am a Ph.D candidate researching electrochemical analysis of ASSBs

Toward a Rational Surface Texture Design of FBR-ALD Pt/C Catalyst to enhance PEMFC performance

Seo-Jun Lee¹, and Se-Hun Kwon¹

¹*School of Materials Science and Engineering, Pusan National University, Busan 46241, South Korea*

E-mail address: sjlee1315@pusan.ac.kr

Abstract:

Proton exchange membrane fuel cell (PEMFC) is an efficient electrochemical energy conversion device that directly generates electricity from the chemical energy of fuels without the emission of greenhouse gases. The most reliable catalyst in PEMFC is Platinum (Pt) metal nanoparticles (NPs) that exhibit excellent electrochemical activity and stability compared to other catalysts. However, using of Pt catalyst is limited due to its very high cost and low abundance on Earth. Therefore, it is important to use Pt catalyst efficiently for making the PEMFC economically viable. In this regard, several synthesis techniques have been developed to reduce the loading and uniform distribution of Pt NPs on carbon support with high electrochemically active surface area (ECSA). One of the most efficient techniques to uniformly deposit Pt NPs with a controllable size on carbon support is to use a fluidized bed reactor (FBR) atomic layer deposition (ALD). Our group recently demonstrated that FBR-ALD Pt/C catalysts can exhibit high fuel cell performance and high endurance even with low Pt NPs loading by optimizing the surface of carbon supports combined with proper ALD process parameters. However, it is still challenging to further improve the fuel cell performance by rational designing the Pt NPs surfaces in order to make FBR-ALD into a viable commercial production.

In this study, a unique way to improve the fuel cell performance was suggested to design and optimize atomic scale surface textures of Pt NPs. During the FBR-ALD of Pt NPs, in-situ surface modulation of Pt NPs was applied via a proper protective oxide deposition and etching. A careful surface studies was performed to analyze the surface morphology, distribution and uniformity of Pt NPs. Electrochemical performances were evaluated and optimized by measuring cyclic voltammetry (CV) and oxygen reduction reaction (ORR). Finally, a fuel cell performance was studied through membrane electrode assembly (MEA) characteristics.

Curriculum Vitae

Seo Jun Lee



He graduated from Pusan National University in 2022 and is currently pursuing a master's program in the Surface Materials Laboratory at Pusan National University. He is conducting research on Pt/C catalysts to improve the performance of fuel cells.

Analysis of the Impact of Atmospheric Pressure DC Discharge Plasma on Graphene Nanoplatelet Treatment Outcomes

Kaixun Yao ^{a,*} Nozomi Takeuchi ^a

^a Tokyo Institute of Technology

* yao.k.af@m.titech.ac.jp

Abstract:

Sulfonated carbon catalysts are promising solid acid catalysts for cellulose hydrolysis, providing advantages over traditional catalysts due to their easy recovery and low corrosivity. This study investigates the relationship between acidic densities, sulfur content, physical structure changes, and catalytic performance of carbon materials treated using an atmospheric pressure gas–liquid interface plasma sulfonation system. Catalytic performance was assessed by glucose yield from hydrothermal reactions, correlating it with the total acid density and S content. Although a positive correlation between functional group density and catalytic performance was observed, further analysis indicated a complex relationship influenced by physical structure changes. These findings suggest that optimal performance of plasma-treated Graphene Nanoplatelet (GNP) may be achieved through balancing these factors.

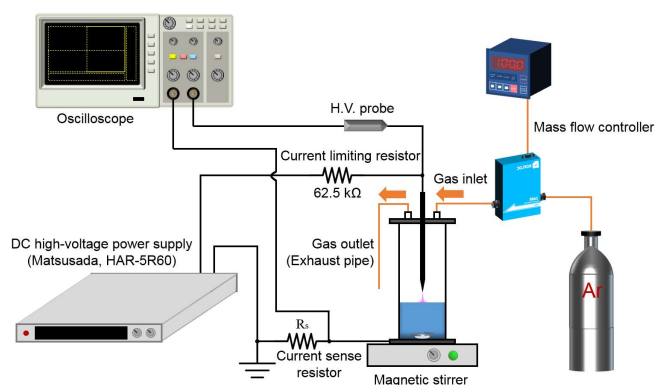
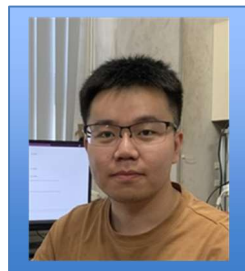


Fig. The scheme of plasma sulfonation system

Curriculum Vitae



Kaixun Yao

I am Kaixun Yao, born in Fujian, China, in 2000. Currently, I am a second-year master's student at Tokyo Institute of Technology, studying under Professor Takeuchi. My research focuses on atmospheric pressure plasma discharge, particularly in developing plasma-based processes for material treatment and synthesis. Outside of my studies, I enjoy watching anime and singing karaoke.

Basic Study of Fractional Laser Use in Fibrotic Tissue Flexibilization Therapy

Ren Sato,^{a,*} Eiko Kato,^{a,*} Ippei Yagi,^{a,*} Satodhi Uchida^a,

^a Faculty of System Design, Tokyo Metropolitan University

*sato-ren@ed.tmu.ac.jp

Abstract:

Fibrosis is a disease that causes stiffening of various organs and is associated with one-third of deaths worldwide. Fibrosis is defined as the result of excessive repair of damaged areas, so minimally invasive treatment is desirable. Fibrotic tissue deposits collagen during its progression. While collagen is a factor that makes tissues hard and has a triple-helix structure, it is thermally denatured into gelatin with a random structure when heated and softens. Fractional lasers are cosmetic lasers and can improve the appearance of skin through tissue hardening. We believe that with appropriate irradiation conditions, the collagen in fibrotic tissues can be thermally denatured to become a treatment for restoring flexibility. In this report, we irradiated collagen samples derived from bovine Achilles tendons with fractional laser, confirmed collagen thermal denaturation using CHP staining, and selected. The samples were then selected for the induction of thermal denaturation. Tensile tests were conducted to evaluate the elastic modulus of the tissue before and after irradiation. As a result, thermal denaturation of fibrotic tissue by fractional laser irradiation and the resulting tissue softening were confirmed.

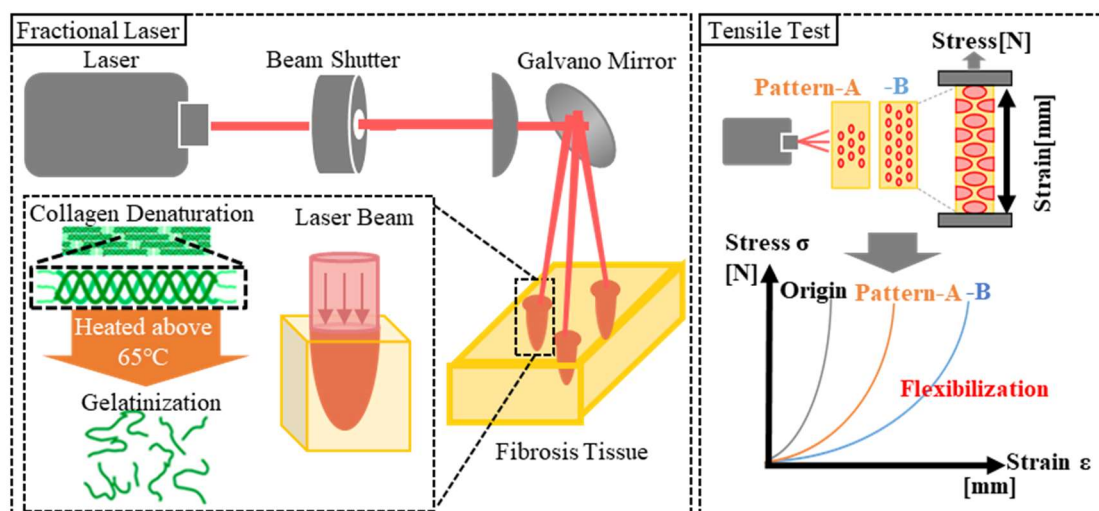


Fig. Mechanism of Softening treatment for fibrotic tissue by Fractional Laser
Curriculum Vitae



Sato Ren

Keyword's

Fibrosis, CHP Staining, Collagen, Fractional Laser, Young's Modules,

Hobbies, Likes

Bicycle, Guitar, Dog

Electric Current Induced by Impact of High-speed Nanodroplets on a Copper Plate

Jiun-Shian Lee^{a,*}, Yun-Chien Cheng^b, Takuro Okuma^a, Siwei Liu^a Tomoki Nakajima^a
and Takehiko Sato^a

^a *Institute of Fluid Science, Tohoku University, Japan*

^b *Department of Mechanical Engineering, National Yang Ming Chiao Tung University, Taiwan*

* *e-mail: lee.jiun.shian.t4@dc.tohoku.ac.jp*

Abstract:

Environment-friendly technology is receiving worldwide attention; plenty of experts are concentrating on limited water resource issues. Water is one of the principal human survival resources. Especially under strict and challenging circumstances where water is hard to supply, like deserts and outer space, water becomes extremely valuable. Nanodroplets can potentially revolutionize water conservation, offering a solution to the problem of saving water due to their several amazing functions. Nanodroplets are reported for their non-wetting cleaning and removal function of medical cleaning indicators with small amounts of water. Spraying small water droplets has also been proven to disinfect *E. coli* and *S. typhimurium*. The charged effect of aerosol and mist has been observed in past research. Protons and hydroxide ions are one probability of the charged droplets, which might have originated due to the water self-ionization during evaporation. Our experimental setup involved a high-speed nanodroplet device designed by Sato et al. It pressurizes a small amount of water with high-pressure air and simultaneously heats it with a water heater. The resulting mixing flow of air and water vapor is jetted into the ambient air through a nozzle, where the water vapor condenses into nanodroplets. We positioned a copper plate below the nozzle outlet and observed the induced current on the plate. We found that the maximum negative current value occurs near the nozzle exit. The current value decreases with the distance increase between the copper plate and the nozzle exit. We also have tested and confirmed that evaporation affects the phenomenon.

This work was supported by the Collaboration Research Project of the Institute of Fluid Science, Tohoku University, and JST SPRING, Grant Number JPMJSP2114.

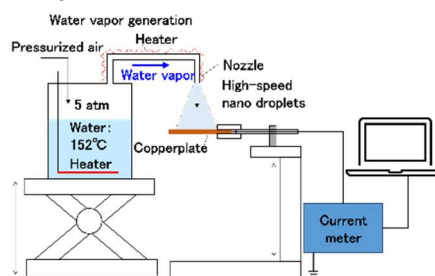


Fig. Schematic of the experiment

Curriculum Vitae



Jiun-Shian Lee

- BS. 2020 & MS. 2022, Department of Mechanical Eng., National Yang Ming Chao Tung University (Taiwan)
- Charged phenomenon and chemical characteristics of Nanodroplets
- Volleyball, movies, and comics

High-Durability Flexible Transparent Electrodes Using UV/O₃ Treated SWCNTs on Plasma-Etched PET Substrate

Sung-Yong Mun^{a,*}, Young-Rae Cho^a

^a. Division of Materials Science and Engineering, Pusan National University,
30 Jangjeon-dong, Geumjeong-gu, Busan 46241, Republic of Korea

*E-mail : symoon98@pusan.ac.kr

Abstract: Transparent conductive electrodes are extensively utilized in various applications such as solar cells, organic light-emitting diodes, and touch screens. Indium tin oxide (ITO), a material deposited on glass substrates, has been of considerable industrial interest over the past several decades. However, the use of ITO in flexible electrodes is limited due to its high cost, the scarcity of indium, and its brittleness. To address these limitations, flexible transparent conductive electrodes (FTCEs) can be developed by employing single-walled carbon nanotubes (SWCNTs) on flexible polymer substrates. Nevertheless, SWCNTs exhibit poor dispersibility in solvents and unstable adhesion properties on the substrate. To mitigate these issues, research has been conducted to improve the adhesion stability of SWCNTs using copper metal-organic decomposition (Cu MOD) ink. In this study, as shown in Fig. 1, plasma etching was applied to PET substrates, and UV/O₃ treatment (O_x) was used on SWCNTs. Subsequently, Ox-SWCNT and Cu MOD ink were deposited on PET substrates through a continuous spray process and heat treatment. Cu MOD ink acted as an adhesive, bonding Ox-SWCNT to PET substrates, resulting in the contribution of a robust, flexible, and transparent Ox-SWCNT/Cu@PET composite electrode. This electrode exhibited a sheet resistance of 720 Ω /sq and a transmittance of 84% at 550 nm. Even after undergoing 10,000 bending tests and 100 peel-off tests, the resistance increased by only 1.07 and 1.12 times, respectively, confirming its excellent mechanical durability.

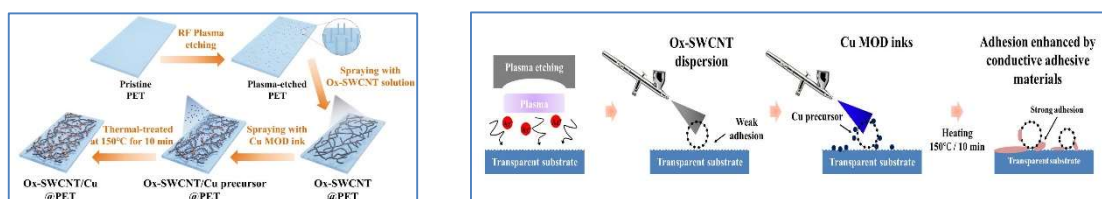


Fig. 1. Experimental procedure for flexible transparent electrodes using spray coating.

Curriculum Vitae



Sung-Yong Mun

He is a first-year master course student in the Interface Engineering Laboratory, Department of Materials Science and Engineering, Pusan National University. His major is researching in flexible transparent electrodes with Oxide/Metal/Oxide structures. He is particularly interested in the modification of thin film surfaces to change their properties. He is Korean, born and raised in Busan. His hobby is listening to music. He has been listening to the latest pop songs and K-pop recently. He is thrilled to be part of this community and look forward to collaborating and sharing ideas with all of you.

Layer Engineered MXene Empowered Wearable Pressure Sensors for Real-Time Motion Detection

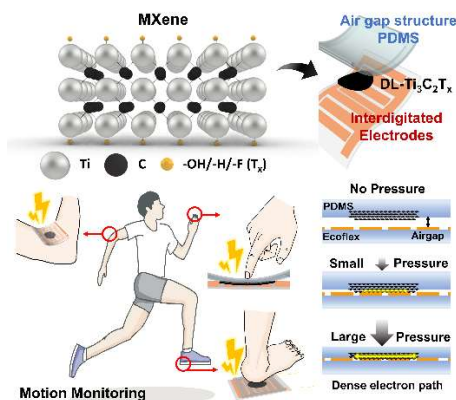
Jeong Eun Byun^{a,*}, Jung Woo Lee^a

^a Materials Science and Engineering, Pusan National University

*bje2535@naver.com

Abstract:

Flexible pressure sensors are attracting attention due to their wide range of applications, such as electronic skin, speech recognition, and healthcare monitoring. In this study, we introduce layer-engineered delaminated Ti-MXene (DL-Ti₃C₂T_x) with wider interlayer spacing and an accordion-like microstructure, compared to pristine Ti-MXene. Designed with an air gap structure, the DL-Ti₃C₂T_x sensor exhibits enhanced sensitivity due to its 3D conductive layer. This resistive pressure sensor induces various sensing mechanisms, especially, DL-Ti₃C₂T_x exhibit a piezo-resistance effect by a reduced lattice interlayer distance and increased surface contact area under applied pressure. A two-fold increase in sensitivity of DL-Ti₃C₂T_x MXene than that of Ti-MXene, reduced graphene oxide could be attributed to the wider interlayer distance among the delaminated MXene layers causing a facile interlayer atomic movements, contacts, and reversible compressibility. As a result, a rapid response time (< 500 ms) and excellent sensitivity of 242.3 kPa⁻¹ even under a high-pressure range (20.8 kPa), the airgap structured DL-Ti₃C₂T_x pressure sensor is suitable for detecting human vital signs and motion monitoring with real-time tracking ability.



Graphical Abstract

Curriculum Vitae



Jeong Eun Byun

M.S. Candidate Students

Energy Materials for Soft Electronics Lab.

Research Topic : 2D nanomaterials, Wearable sensor

Influence of fine bubble on generation efficiency of pulsed discharge underwater

Yuki Maeda¹, Ryosuke Takada¹, Katsuyuki Takahashi^{1,2}, Koichi Takaki^{1,2},
Yoshikatsu Ueda³, Takehiko Sato⁴

¹Faculty of Science and Technology, Iwate University, Japan

²Agri-innovation Center, Iwate University, Japan

³Research Institute for Sustainable Humanosphere, Kyoto University, Japan

⁴Institute of Fluid Science, Tohoku University, Japan

Abstract:

The influence of fine bubbles introduced into water on the dielectric breakdown characteristics of discharge probability, discharge delay time and arc probability was investigated. The fine bubbles were generated by the pressurized dissolution method. Figure 1 shows the schematic of the reactor. A needle-to-plate electrode was placed in the water where fine bubbles were introduced, and a pulsed voltage generated by a Blumlein line type pulsed forming network was applied to generate the underwater plasma. Figure 2 shows the discharge probability as a function of voltage with conductivities of 10 $\mu\text{S}/\text{cm}$. The discharge onset voltage, discharge delay time and arc voltage decreased, and the discharge probability increased by introducing fine bubbles. The decrease in the discharge onset voltage is more significant in the case of argon fine bubbles than for air fine bubbles. The influence of fine bubbles on the discharge onset voltage and the delay time is more significant the longer the gap length. On the other hand, that on the arc voltage is more significant the longer electrode gap. These results suggest that the bubble in the vicinity of the electrode introduced by fine bubbles enhances the breakdown; however, the fine bubbles in the water between the electrodes do not have much effect.

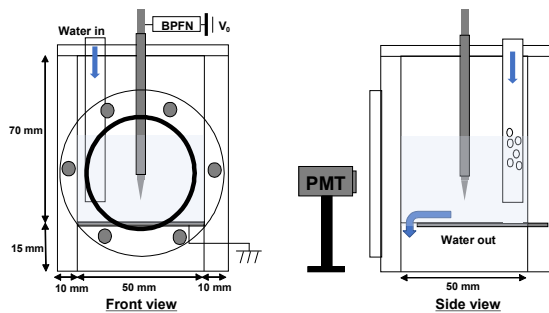


Fig.1. Schematic of the reactor

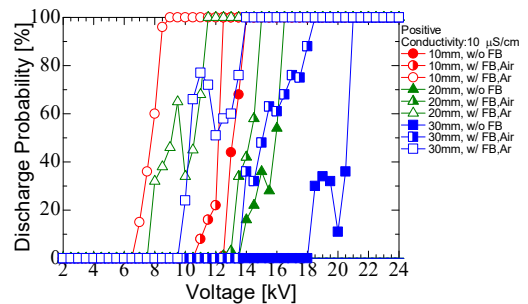


Fig. 2 Discharge Probability as a function of voltage with conductivities of 10 $\mu\text{S}/\text{cm}$

Curriculum Vitae



Yuki Maeda

My topic of study is Influence of fine bubble on generation efficiency of pulsed discharge underwater. My hobby is building scale plastic models(GANPURA).

Control of liquid flows induced by Ar plasma-jet irradiation

Kecheng Shen,^{a,*} Toshiyuki Kawasaki,^b Nozomi Takeuchi^a

^a Affiliation : Tokyo Institute of Technology

^b Affiliation : Nishinippon Institute of Technology

*Presenting Author's email: shen.k.aa@m.titech.ac.jp

Abstract:

Plasma-induced liquid flows play an indispensable role in recent plasma science and technology. Clarifying the mechanisms of plasma-induced liquid flows is necessary to understand the plasma-liquid interaction. In the present work, we investigated the effects of supply gas (helium and argon gases) on plasma-induced liquid flows using particle image velocimetry as shown in Figure 1. The results indicated that only the downward flow that extended to the liquid depth direction was generated when helium gas was supplied. However, the liquid flows switched with the increase in voltage when argon gas was supplied. We also discovered current waveforms and the optical emission spectroscopy results were greatly changed with the types of plasma-induced liquid flows. According to the experimental results for the argon gas, we successfully switched and controlled the plasma-induced liquid flow by varying the applied voltage or frequency only.

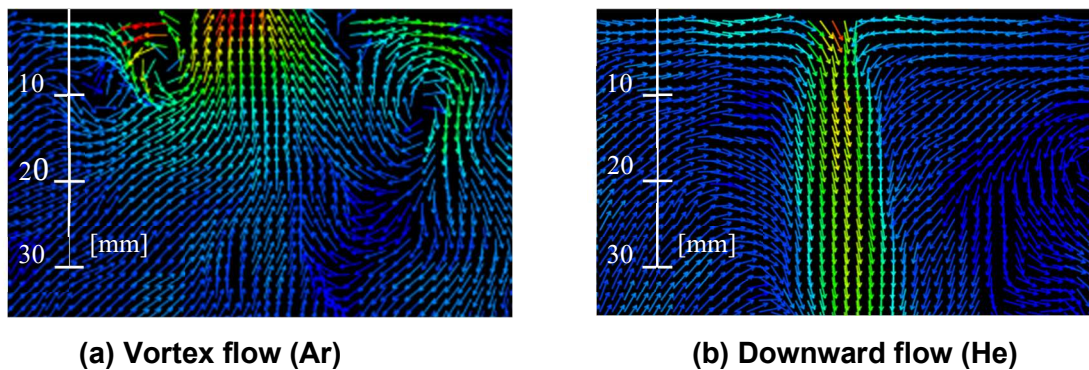


Fig.1 Two types of plasma-induced liquid flow patterns.

Curriculum Vitae



Kecheng Shen

Grade: 1st year of a Doctoral program.

Research topics: Two-dimensional visualization of ROS transported into a tissue model and plasma-induced liquid flow by nonthermal atmospheric plasma jets. I am very excited about the development of plasma in future mitral treatment.

Hobbies: Cooking, Hiking & Playing chess.

My most loved one is cooking. I started to cook for myself and my family when I was in middle school. There isn't anything more rewarding than cooking a meal that the whole family loves, seeing smiling faces and full bellies is what cooking is all about.

The optimization of PFOS decomposition using plasma

Shanshan Qing,^{a,*} Takao Namihira,^b Douyan Wang,^b Nozomi Takeuchi,^a

^a School of Engineering, Tokyo Institute of Technology, Japan

^b Institute of Industrial Nanomaterials, Kumamoto University, Japan

*qing.s.aa@m.titech.ac.jp

Abstract:

PFAS (Per- and Polyfluoroalkyl Substances) represent a significant concern due to their potential adverse health impacts and environmental persistence. These substances have been associated with a range of negative health effects. Conventional advanced oxidation processes are ineffective in breaking the C-F bond in PFAS. Water treatment using gas-liquid interface plasma, as developed in this study, has been explored for several environmental applications. When applied to water, plasma generates numerous reactive species, plasma water treatment enables water purification using only electricity, offering a potentially cleaner and more efficient method for contaminant degradation compared to traditional approaches. I have designed a reactor that has been proven to decompose PFOS (Perfluorooctanesulfonic acid) efficiently and quickly in water. The reactor, as shown in Fig.1, utilizes a microbubble generation device to facilitate the transport of PFOS molecules from the bulk solution to the gas-liquid interface, thereby enhancing the contact between PFOS molecules and the plasma. This design leverages the increased surface area and interaction opportunities provided by microbubbles, significantly improving the decomposition process. In the experiment, 90% of PFOS was decomposed within 15 minutes.

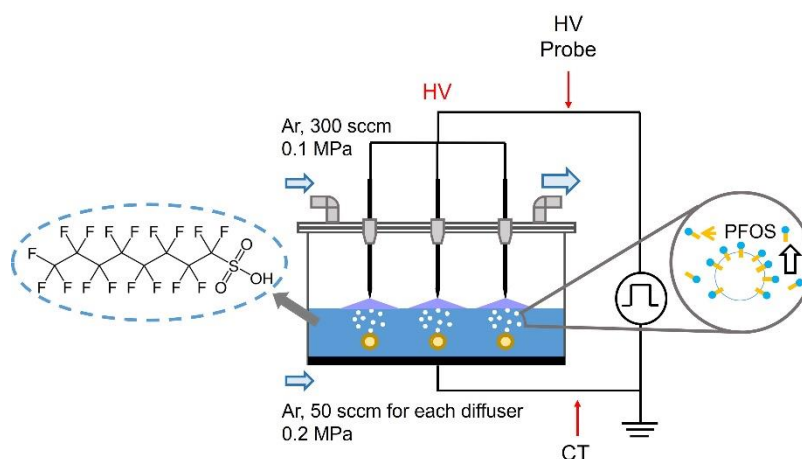


Fig.1

Curriculum Vitae



Shanshan Qing

Research topics: Plasma water treatment

Hobbies: Doing crafts, lego, video game...

Alcohol preference (for recent): Tequila and sour beer

Effect of microstructure on the shape memory effect in $\text{Cr}_{20}\text{Mn}_{20}\text{Fe}_{20}\text{Co}_{35}\text{Ni}_5$ high-entropy alloys

Hwi Yun Jeong^{a,*} Je In Lee^a

^a School of Materials Science and Engineering, Pusan National University, Busan, 46241, Republic of Korea

*hwiyun@pusan.ac.kr

Abstract:

High-entropy alloys, which consist of multi-principal elements with near equiatomic composition, have drawn significant attention to investigate the unexplored central region of phase diagram. Recently, $\text{Cr}_{20}\text{Mn}_{20}\text{Fe}_{20}\text{Co}_{35}\text{Ni}_5$ (Ni5) high-entropy shape memory alloys (SMAs) was found by controlling Co and Ni contents in the $\text{Cr}_{20}\text{Mn}_{20}\text{Fe}_{20}\text{Co}_{20}\text{Ni}_{20}$ high-entropy alloy, and the Ni5 alloy showed recovery strain about 2 % by bending test at room temperature. The recovery strain of 2 % should be increased above 4 to 5 % to satisfy the requirement for engineering applications. Here, we try to improve shape memory effect of high-entropy SMAs by designing microstructure. We reduce grain boundary and annealing twin boundary density by casting because these boundaries act as an obstacle for stress-induced martensitic transformation. As a result, after tensile deformation of about 10 %, the cast and annealed Ni5 alloy shows higher recovery strain (4.7 %) than conventional Fe-Mn-Si-based SMAs (0.0 %). This result suggests the potential of high-entropy SMAs for functional applications.

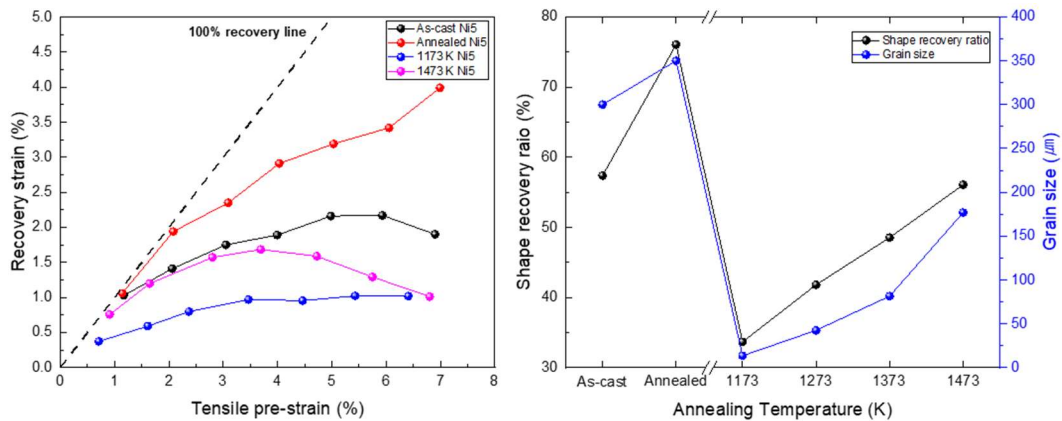


Fig. Shape memory effect of Ni5 alloys (left), Effect of grain size on the shape memory effect in Ni5 alloys (right)

Curriculum Vitae



Hwi Yun Jeong

School: Pusan National University

Position: M.S candidate

Topic: High-entropy alloy, Shape memory alloy

Microstructure of carbon-containing CoCrFeMn high entropy shape memory alloy produced by Laser direct energy deposition

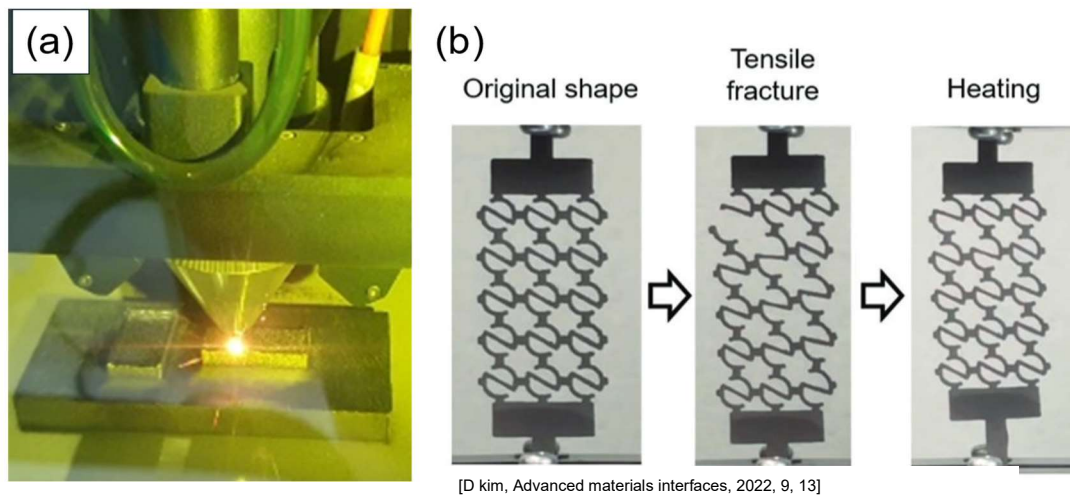
Minsu Park,^{a,*} Wooljin Lee^a

^a 1School of Materials Science and Engineering, Pusan National University, Busan 46241, Republic of Korea

*Presenting Author's email: wish7alstn@pusan.ac.kr

Abstract:

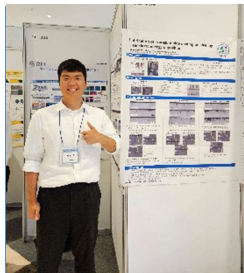
Laser direct energy deposition (L-DED) is a commonly used additive manufacturing process, also known as metal 3D printing. The L-DED process enables the rapid manufacturing of complex 3D parts with high resolution. On the other, CoCrFeMnNi high entropy alloy is the most widely studied high entropy alloy that consists of five or four principal elements. By replacing Ni with Co, the high entropy alloy exhibits a shape memory effect associated with stress-induced FCC to HCP martensitic transformation and its reverse while heating. In the authors' previous study, it was shown that the CoCrFeMn alloy can be 3D printed by the L-DED process. The L-DED processed CoCrFeMn alloy exhibited the shape memory effect. In this study, the effect of carbon addition on microstructure and properties of L-DED 3D printed Co-18Cr-20Fe-19Mn-0.6C (wt.%) alloy was investigated.



[D kim, Advanced materials interfaces, 2022, 9, 13]

Fig. 1. (a) Manufacturing of rectangular part by Laser direct energy deposition and (b) example of shape memory effect

Curriculum Vitae



Minsu park

M.S. candidate at Pusan National University

Advanced materials for additive manufacturing Lab.

Research topic: Additive manufacturing, shape memory alloy

Hobby: video game

Investigation of electrode structure for generating dielectric barrier discharge for large capacity treatment of highly conductive solutions

Shunsuke Kamata^{*a}, Tetsu Sakakibara^a, Katsuyuki Takahashi^a
Koichi Takaki^{a,b},

Kosuke Tachibana^c, Nozomi Takeuchi^d, Oi Lun Helene Li^e

^a Iwate University, ^b Agri Innovation Center, ^c Oita University,

^d Tokyo Institute of Technology, ^e Pusan National University

^{*}g0323048@iwate-u.ac.jp

Abstract:

A dielectric barrier discharge (DBD) was generated at the gas-liquid interface in a highly conductive solution using an inductive energy storage (IES) power supply, and its equivalent circuit model was constructed. The high voltage pulses generated by the IES power supply utilizing SiC MOS-FETs were applied to the DBD electrode consisted of glass disk and stainless-steel disk. Time-resolved images of the DBD per pulse were taken with an ICCD camera at 100 ns intervals. To analyze the equivalent circuit, the discharge current was derived by removing the displacement current by fitting, and the capacitance of the whole reactor was calculated using the discharge current. As a result, the capacitance of the electrode system was estimated as 42.5 pF in the case of H₂SO₄ solution with a conductivity of 100 mS/cm. Time-resolved images of discharges on the purified water and the H₂SO₄ solution show that discharge occurred across the electrodes uniformly at the time when the voltage rises and extinguished. When the voltage drops, the back discharge occurs. The discharge was uniform regardless of the conductivity. These results show that a stable and uniform plasma can be generated even in highly conductive solutions such as H₂SO₄.

Fig. Image of time-resolved DBD of H₂SO₄ (100 mS/cm) using an ICCD camera.

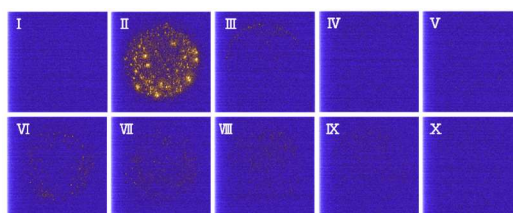


Fig. Image of time-resolved DBD of H₂SO₄ (100 mS/cm) using an ICCD camera.

Curriculum Vitae



Shunsuke Kamata

My topic of study is the generation of gas-liquid surface plasma (DBD) using IES power supply for high energy efficiency. I think Mountain DEW is the best drink in history.

Decomposition of Dibutyl Phosphate by Plasma Discharges over Highly Conductive Solution Surface

T. Sakakibara ^{a,*}, S. Onodera ^a, G. Ichii ^a, K. Takahashi ^{a, b}, K. Takaki ^{a, b}, Tetsuo Honma ^c, Mitsuru Sasaki ^d, T. Horimai ^e, K. Anzai ^e, and T. Tsukada ^e

^a Faculty of Science and Engineering, Iwate University

^b Agri-Innovation Center, Iwate University

^c Department of Industrial Systems Engineering, National Institute of Technology (KOSEN), Hachinohe College

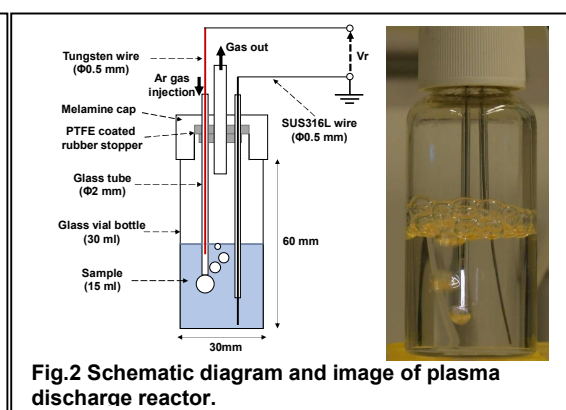
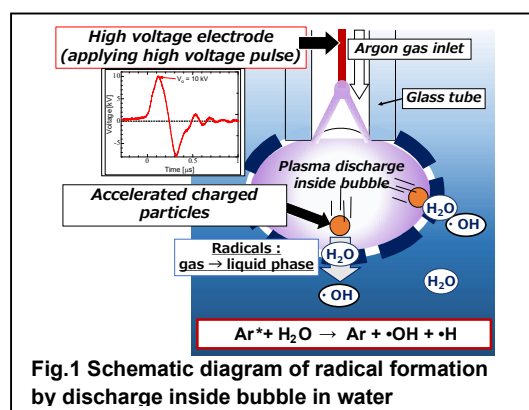
^d Institute of Industrial Nanomaterials, Kumamoto University

^e JAPAN NUCLEAR FUEL LIMITED

*s3223002@iwate-u.ac.jp

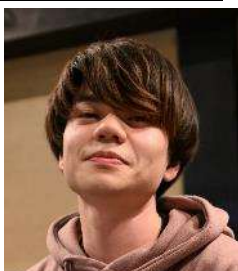
Abstract:

In this study, dibutyl phosphate (DBP) dissolved in alkaline solutions is decomposed by plasma discharges on the liquid surface. Since DBP causes unstable operation in the PUREX process, effective DBP decomposition methods are required. Atmospheric pulse discharge on liquid surface treatment has attracted attention as a promising method for water treatment (Figure.1). It can produce chemically active species such as hydroxyl radical ($\cdot\text{OH}$) at high density and active species contribute to the decomposition of organic solutes without selectivity in a short time. Figure. 2 shows a schematic diagram of the discharge reactor. Argon (Ar) gas is injected into the reactor and plasma is generated in the Ar gas phase by applying high voltage pulse. 15 mL of DBP solution is used as a sample and the Initial DBP concentration is 24 mM. 99% of DBP is decomposed with 9 hours treatment. The energy efficiency is 40 $\mu\text{mol/Wh}$. By assuming the reaction is a quasi-first order reaction, the rate constant is estimated $7.0 \times 10^{-5} \text{ s}^{-1}$.



Curriculum Vitae

Tetsu Sakakibara



Grade: 2nd year of a master's degree.

Research topics: Water treatment using plasma discharge. I study about water treatment using discharge generated by high voltage pulse power.

Hobbies: Playing the electric bass, playing video games, and watching movies. I like to watch Hollywood movies at home

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