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静電選別におけるポリスチレンの高精度選別技術の開発
Development of High Precision Sorting Technology of Polystyrene in Electrostatic Separation

〇黒田真司*, 西川祐介*, 三木伸介*, 平田靖典**〇黒田真司*, 西川祐介*, 三木伸介*, 平田靖典**
〇Shinji KURODA*, Yusuke, NISHIKAWA*, Shinsuke MIKI*, Yasunori HIRATA**

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Abstract:

Electrostatic separation, which is one of the plastic sorting steps, is a sorting method using the difference in charge polarity generated when different types of plastic are rubbed. In electrostatic separation, fluctuation in the mixing ratio of plastic affects the charge amount, which influences the efficiency of separating. In this investigation, we tested the electrostatic sorting in changing the PS (polystyrene) : PP (polypropylene) ratio in the plastics mixtures and evaluated the weight distributions of each of the sorted PS and PP by fitting with Gaussian function. We clarified the relationship between the PS : PP ratio in the plastics mixtures and the fall distribution of each sorted plastic. From this result, we made it possible to predict the fall distribution of each plastic in changing the mixing ratio. By manipulating the position of the partition plate of the collection box according to the mixing ratio, it is possible to raise the recovery rate.

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江戸時代における静電気の考え方
Concept of Electrostatics in Edo Period

西村　亮西村　亮
Ryo NISHIMURA

鳥取大学工学部
Faculty of Engineering, Tottori University

Abstract:

It is described in this paper that how electrostatic and its phenomena are explained in Edo period. Friction generators (Erekiteru) are introduced to Japan in late 18th century, ten several years after Benjamin Franklin discovered that the thunder is electrostatic phenomenon, from Europe. Japanese intellect of that time heard of that thunder and the essence of phenomena occurring when operating friction generators are same. Of course they did not know the “Modern electrostatic concept” such as frictional charging phenomena explained by work function. Some of them called “essence of electricity” chi and tried to explain the electrostatic phenomena by using Yin-Yang theory. A Japanese word “denki” began to be used by 1854 at the latest.

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有機溶剤噴霧による 2 流体ノズルの帯電
Electrification of two-fluid nozzle by spraying organic solvent

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労働安全衛生総合研究所
National Institute of Occupational Safety and Health, Japan (JNIOSH)

Abstract:

The spray electrification of liquid sprayed from a two-fluid nozzle (SUS303) were experimentally investigated. The effects of conductivity were examined with the low conductivity liquid (mineral spirit) by adding the conductivity improving additive (Statsafe 3000) and it varied from 10-11 to 10-6 S/m. The specific charge (charge per mass of splayed liquid) of the nozzle depended strongly on the conductivity and became maximum around 10-7 S/m. In terms of the splaying method, the specific charge of the two-fluid nozzle became larger by about two figures as compared with that of the one-fluid nozzle (SUS303) in all the conductivities.

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アミノ酸粉体の静電気放電による着火性評価
Experimental study on electrostatic spark ignitability of amino acid powders

○加藤智規*,土屋仁志*,崔光石**,金佑勁***○加藤智規*,土屋仁志*,崔光石**,金佑勁***
○Tomonori KATO*, Hitoshi TSUCHIYA*, Kwangseok CHOI** and Wookyung KIM***

○味の素（株）バイオファイン研究所*,労働安全衛生総合研究所**,広島大学大学院工学研究科***
○*Ajinomoto Co., Inc., **JNIOSH, ***Hiroshima Univ.

Abstract:

This paper reports the experimental results dealing with minimum ignition energies (MIE) of five kinds of amino acids (Glycine, L-Alanine, L-Valine, L-Leucine and L-Isoleucine). The MIE of Glycine which was over 300 mJ, was the highest out of the powders used in this study. This value obtained is relatively safe for electrostatic risk assessments in the industry. On the other hand, L-Alanine, L-Valine, L-Leucine and L-Isoleucine were sensitive that even a spark with very low energy, such as about 4 mJ, could ignite them. Therefore, these powders must be carefully handled in the industrial process.

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静電気力を用いた顆粒剤の吸着特性
Adsorption Characteristics of Granules using an Electrostatic Force

○田中　醇＊, 杉本　俊之＊○田中　醇＊, 杉本　俊之＊
Jun TANAKA＊, Toshiyuki SUGIMOTO＊

山形大学大学院＊
Yamagata University

Abstract:

A capsule medicine includes particular amount of granular medicine. If the number of filling granules can be controlled, custom-made capsule medicine can be prepared for patients with ordered ingredients and ordered number of granules. The purpose of this research is to pick-up granules with controlled number by a principle of electrostatic chucking. The prototype electrostatic adsorption device called U-type electrode was prepared for picking up granules ranging from 710 mm to 850 mm. The electrode is composed of a high voltage electrode with by providing an insulating coating layer partly covered with grounded conductive layer. The granules are adsorbed on the insulating layer by the electrostatic force acting between the high voltage electrode and the granules. The adsorped number of granules were counted with changing width and length of the insulating layer, di　and dU. The number of granules was found be a function of di and dU

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大気圧誘電体バリア放電を用いたアンモニア貯蔵物質の合成及び試料分析

Synthesis and sample analysis of ammonia storage materials using atmospheric pressure dielectric barrier discharge

〇全俊豪，阿部哲也〇全俊豪，阿部哲也
Shungo ZEN and Tetsuya ABE

東京工業大学　工学院電気電子系
Tokyo Institute of Technology

Abstract:

As global warming issues continue to intensify and traditional fossil fuels continue to be consumed, there is increasing demand for new energy sources. Hydrogen plays an important role in energy storage systems which are supposed to substitute for traditional fossil fuels, and NH3 is promising hydrogen storage material due to its high hydrogen density. In our previous research, Mg3N2 has been proposed as an NH3 storage material. In this paper, we focused on the direct synthesis of Mg3N2 by nitridation of MgO via atmospheric-pressure dielectric barrier discharge (DBD) plasma in which mix of nitrogen and hydrogen was used as reaction gas at room temperature. This method only requires simple apparatus and does not cause decomposition of NH3.

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広帯域能動型平衡不平衡変換器の設計開発(1)
Design and development of broadband active-balun Part 1

○石上 忍, 鈴木滉太, 川又 憲○石上 忍, 鈴木滉太, 川又 憲
○Shinobu ISHIGAMI, Kota SUZUKI and Ken KAWAMATA

東北学院大学
Tohoku Gakuin University

Abstract:

Many of the antennas for measuring electromagnetic fields, especially the broadband antennas for EMI measurements, are balanced feed type such as dipole antennas. However, since the input port of instruments such as spectrum analyzers and oscilloscopes are unbalanced, a balanced-unbalance transformer (balun) is required to connect the antenna and the instrument. In the EMI measurements at frequency range below 30 MHz, it is usually difficult to measure electric field strength with high sensitivity, so magnetic field strength is usually measured. In this study, we design and develop a broadband balun used for an antenna to measure electric field strength below 30 MHz in high sensitivity and broadband. Furthermore, prototypes are fabricated, and their characteristics are evaluated.

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球電極 ESD に伴う近傍過渡磁界の測定と磁界ピーク値の距離特性に関する考察

Measurement of Transient Magnetic Field and Consideration on Distance Characteristics of Magnetic Field Peak Value Caused by ESD in Sphere Gap

加藤健人＊,○川又憲＊,石上忍＊,藤原修＊＊加藤健人＊,○川又憲＊,石上忍＊,藤原修＊＊
Kent KATO*, ○Ken KAWAMATA*, Shinobu ISHIGAMI and Osamu FUJIWARA**

東北学院大学＊,名古屋工業大学＊＊
*Graduate School of Engineering, Tohoku Gakuin University
**Nagoya Institute of Technology

Abstract:

Distance characteristics of transient magnetic field caused by a micro gap ESD in sphere gap was studied experimentally to discuss the EM radiation mechanism due to ESDs. Firstly, a measurement system of wideband transient magnetic field was set up using a shielded loop probe. For the probe with a nominal bandwidth of 6 GHz, the probe correction factors up to a frequency bandwidth of 20 GHz were obtained from the three-antenna method. Next, the correction factor was applied to the measured output voltage waveforms to determine the peak value of the transient magnetic field. As a result, the peak value of magnetic field strength was about 700 A/m in the spherical electrodes in diameter of 70 mm, and the magnetic field strength varied depending on the size of the spherical electrode.

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窒素プラズマ照射による Fe-Co 箔の窒化
Nitriding of Fe-Co foil Irradiated with Nitrogen plasma

〇矢澤翔大*, 中野裕悟*, 萩原涼*, 片桐正人*, 江頭雅之*, 工藤祐輔*, 黒岩孝*, 新妻清純*〇
矢澤翔大*, 中野裕悟*, 萩原涼*, 片桐正人*, 江頭雅之*, 工藤祐輔*, 黒岩孝*, 新妻清純*
〇Shota YAZAWA* 1, Yugo NAKANO*, Ryo HAGIWARA*, Masato KATAGIRI*,
Masayuki EGASHIRA*, Yusuke KUDO*, Takashi KUROIWA*, Kiyozumi NIIZUMA*

日本大学生産工学部電気電子工学科
Department of Electrical and Electronic Engineering, College of Industrial Techology, Nihon University

Abstract:

This paper tried nitriding of Fe-Co foil plasma irradiation method, and examined from the view of the process to preparation and the crystal structure and magnetic property of the prepared sample. In this study, we first tried the plasma nitriding treatment in the N2+30%H2 mixed gas atmosphere which was the conventional condition which was done in the previous research, but from the measurement result of the XRD and the VSM, the preparation of the Fe-Co alloy didn't confirmed. Based on this result, we proposed to irradiate Fe-Co foil with nitrogen plasma in N2+30%H2 mixed gas atmosphere after plasma irradiation in Ar gas atmosphere different from the conventional method. The results were summarized as follows. After the Ar plasma irradiation which was the proposed nitriding treatment method, nitriding treatment was successfully performed by plasma irradiation with N2+30%H2 gas, and formation of γ-austenite was observed in addition to the Fe-Co peak.

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発酵廃液蒸留水中の有機酸除去を目指したDBDによる水蒸気中の有機酸分解

Degradation of organic acids in steam by DBD for elimination of organic acids in the water distilled from the fermentation waste water

○谷野孝徳＊、＊＊，松井雅義＊，渋木一晃＊＊＊，大嶋孝之＊、＊＊○谷野孝徳＊、＊＊，松井雅義＊，渋木一晃＊＊＊，大嶋孝之＊、＊＊

○Takanori TANINO＊，＊＊, Masayoshi MATSUI＊, Kazuaki SHIBUK＊＊＊,Takayuki OHSHIMA＊ ，＊＊

群馬大学大学院理工学府＊，群馬大学食健康科学教育研究センター＊＊,味の素株式会社＊＊＊

＊Graduate School of Science and Technology, Gunma University, ＊＊Gunma University Center for Food Science and Wellness (GUCFW), ＊＊＊Ajinomoto Co., Inc.

Abstract:

In water recycle of fermentation industry, contamination of distilled water from fermentation waste water by volatile organic acids, that produced as the by-product of fermentation, makes it difficult to reuse distilled water because organic acids inhibit the fermentation of microorganisms. In this study, degradation of organic acids in distilled steam by dielectric barrier discharge (DBD) was investigated. DBD treatment of steam, in other words, generation of DBD under steam atmosphere successfully degraded organic acids and degradation efficiency depended on retention time of steam in DBD reactor. In the experiment using propionic acid, almost all of total organic carbon was removed from the distilled water within 60 msec retention time. The chromatogram of HPLC analysis using DBD treated distilled solution with t = 15 msec showed the production of organic acids possessing shorter carbon chain as the intermediate of degradation.

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大気圧プラズマ照射による絶縁物表面の帯電
Charging on dielectric surface by atmospheric plasma treatment

○清水鉄司＊,菊永和也＊＊, 榊田創＊○清水鉄司＊,菊永和也＊＊, 榊田創＊
○Tetsuji SHIMIZU*, Kazuya KIKUNAGA* and Hajime SAKAKITA**

産総研電子光 RI＊, 産総研製造技術 RI＊＊
*Electronics and Photonics Research Institute, AIST, **Advanced Manufacturing Research Institute, AIST

Abstract:

Low temperature atmospheric plasmas have been widely used in many application areas including medicine and agriculture. Plasma jet is one of the low temperature atmospheric plasma sources. In this abstract, we treated dielectric surface by helium plasma jet and a potential distribution on the dielectric surface was measured using an array of capacitance type sensors. The helium flow rate for plasma production was 2.0 l/min and the power consumption was about 1.4 W. We found that the surface was charged-up positively in average and the potential distribution has a donut shape. We will discuss the charging mechanism with distribution of charged particles above the surface.

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帯電した絶縁膜表面の水分層が沿面放電の進展に及ぼす効果
Effect of Water Layer on the Propagatinon of Brush Discharge Occurring at the Surface of a Charged Film

○二階堂慎一＊，杉本俊之＊，佐藤岳彦＊＊○二階堂慎一＊，杉本俊之＊，佐藤岳彦＊＊
○Shinichi NIKAIDO*, Toshiyuki SUGIMOTO*, Takehiko SATO**

山形大学大学院＊，東北大学＊＊
*Graduated School of Science and Engineering, yamagata University, **Insitute of Fluid Science, Tohoku University

Abstract:

A propagating brush discharge (PBD) is one of the electrostatic discharge phenomena occurring at the surface of strongly charged insulator film with backing ground. This paper describes the measurement of induction current to detect the flow of static charge in developing PBD. The experiments were performed using strongly charged hydrophobic and hydrophilic film to clarify the effect of water layer on the films. The hydrophilic film includes thin water layer on its surface. Experimental results show that there is a significant difference in the induction current of PBD between hydrophobic and hydrophilic films. The induction current of the hydrophilic film might be affected by the low resistance of the streamer due to the presence of water layer in the streamer channel.

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静電気火花放電の電位差・距離・分光の同時測定
Simultaneous measurements of potential difference, breakdown distance, and spectrum of electrostatic spark discharge

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Takashi MIURA

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National Institute of Occupational Safety and Health

Abstract:

For the development of a practical method to estimate the energy of electrostatic air discharge without electrical measurements, the dependence of spectral characteristics of light emission from the spark discharge on electrostatic energy has been investigated. It was found from the experimental measurements that the relative light intensity emitted from a monovalent positive ion of nitrogen (N II) to a nitrogen atom (N I) increased with the electrostatic energy from 0.02 mJ to 30 mJ. Furthermore, simultaneous measurements of the potential difference (voltage), the gap length of the spark, and the spectrum revealed that the intensity ratio, N II/N I, becomes large when increasing the electrostatic energy divided by the breakdown gap length ,i.e., spatial energy density.

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アーク加熱式過熱水蒸気生成に適した コロナ放電電極の形状と配置の検討

Investigation of shape and arrangement of Corona Electrode applying for Generating Superheated Steam using Arc Heating

姉崎直人，杉本俊之姉崎直人，杉本俊之
Naoto ANEZAKI and Toshiyuki SUGIMOTO

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Graduated School of Science and Engineering, Yamagata University

Abstract:

Conventional superheated steam generating apparatus can be divided into steam generation unit and steam heating unit. The apparatus intrinsically becomes large setup, and there are disadvantage in terms of efficiency and cost. The final goal of this research is to develop a compact and highly efficient superheated steam generator using arc heating with corona charging system. An outlet of a cylindrical copper electrode is heated by arc discharge to heat up saturated steam transported by corona ion. The temperature of the target heated by the superheated steam was measured by changing the shape and installation position of the corona charging electrode. It was found that pattern of corona ion flow significantly affect the heating temperature.

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静電吸着式ロールクリーナーのホコリ吸着等価回路モデル

An equivalent circuit model of dust removal for an electrostatic roll cleaner

○古屋佑樹，杉本俊之○古屋佑樹，杉本俊之
○Yuki FURUYA and Toshiyuki SUGIMOTO

山形大学大学院 理工学研究科
Yamagata University

Abstract:

In house cleaning, dust is generally removed by a vacuum cleaner which may cause allergic symptoms due to the disturbance of air including tiny dust or pollen. The purpose of this research is to develop a roll type cleaner that can easily remove dust using electrostatic force without an air flow. In this paper, we proposed an equivalent circuit model and its theoretical electrostatic absorption force. The adsorption characteristic were obtained experimentally by the collection rate of cotton threads chosen as dust. The collection rate for different base materials on which the dust was prepared showed good agreement with the theoretically predicted force. The surface resistance of the base material was found to be significantly important to obtain high collection rate.

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非接触型体積抵抗測定法による 塗装鋼板上の樹脂膜劣化度評価

Evaluating a degree of deterioration for coated steel panel by non-contact type volume resistance measurement

〇大友涼*，杉本俊之*，野村信雄**〇大友涼*，杉本俊之*，野村信雄**
〇Ryo OTOMO* and Toshiyuki SUGIMOTO*，Nobuo NOMURA**

山形大学大学院　理工学研究科*，春日電機(株)**
Yamagata University*, KASUGA DENKI.INC**

Abstract:

It is well known that the deteriorated polymer materials become wettable, resulting in poor insulating performance. In this work, we tried to evaluate the degree of deterioration of the polymer by evaluating the insulating performance. A needle to cylinder corona charger and surface voltmeter were located on the target polymer sample with back grounding metal coated steel panel. The surface potential made by the charger were measured during and after the charging process. It was confirmed that the surface potential of the deteriorated sample was lower than new sample, because of its rich water content. Due to the optimum electrode setup, the potential difference between the new and the deterioreted sample becomes significant.

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誘電体バリア放電式オゾン発生器における放電の円相当直径分布とオゾン生成特性の関係

Relation between equivalent area circle diameter distribution of discharge and ozone yield by dielectric barrier discharge type ozone generator

○鈴木涼平＊, 西脇昂平＊＊, 小林敬季＊＊, 大澤直樹＊＊, 吉岡芳夫＊＊,
田口正樹＊＊＊, 河井茂充＊＊＊, 青木未知子＊＊＊, 大戸時喜雄＊＊＊○鈴木涼平＊, 西脇昂平＊＊, 小林敬季＊＊, 大澤直樹＊＊, 吉岡芳夫＊＊,
田口正樹＊＊＊, 河井茂充＊＊＊, 青木未知子＊＊＊, 大戸時喜雄＊＊＊
○Ryohei SUZUKI＊, Kohei NISHIWAKI＊＊, Hiroki KOBAYASHI＊＊, Naoki OSAWA＊＊, Yoshio Yoshioka＊＊, Masaki TAGUCHI＊＊＊, Shigemitsu KAWAI＊＊＊, Michiko AOKI＊＊＊,
Tokio OHTO＊＊＊

金沢工大院工＊, 金沢工大工＊＊, メタウォーター＊＊＊
＊Graduate Program in Electrical Engineering and Electronics, Kanazawa Institute of Technology,
＊＊Department of Electrical and Electronic Engineering, Kanazawa Institute of Technology,
＊＊＊METAWATER Co., Ltd.

Abstract:

In this study, the relation between ozone yield and discharge appearance was investigated by a dielectric barrier discharge type ozone generator and an image processing software. As a result, ozone yield increased with decreasing cooling water temperature of the SUS electrode, however, ozone yield did not change by changing gas pressure. From the analysis of discharge photographs, we confirmed that the size of the equivalent area circle diameter of the discharge decreased with decreasing cooling water temperature and the frequency of small discharge occurrence increased with decreasing cooling water temperature.

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直流コロナ放電を用いた難分解性有機化合物の分解における液相化学反応過程の数値解析

Numerical Analysis for Decomposition of Persistent Organic Compounds in Water Using DC Corona Discharge

〇川端唯斗，眞銅雅子，見市知昭〇川端唯斗，眞銅雅子，見市知昭
〇Yuito Kawabata, Masako Shindo, Tomoaki Miichi

大阪工業大学
Osaka Institute of Technology

Abstract:

The characteristics of acetic acid decomposition upon a negative DC corona discharge over water are investigated. The corona discharge is 4 mm away from the water surface. Further, we explore the mechanisms involved in the chemical reactions of active species during water treatment using discharged plasma. During processing, oxygen or ozone were supplied to the reactor. The experiment and the simulation show the acetic acid concentration phenomenon of the same tendency. Therefore it is thought that the simulation model considering only the reaction of ozone and hydrogen peroxide can confirm the acetic acid concentration change.

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成形炭素電極を用いた正コロナ放電によるにおい物質低減に関する研究

Odor Reduction with Positive Corona Discharge using Formed Carbon Electrode

○川田吉弘、大川翔太郎、清水洋隆○川田吉弘、大川翔太郎、清水洋隆
Yoshihiro KAWADA, Syoutarou OKAWA and Hirotaka SHIMIZU

職業能力開発総合大学校
Polytechnic University of Japan

Abstract:

The odor compounds are evaporated to form a gaseous or fine particles state when the odor compounds are diffused in the room air. Therefore, a positive corona discharge with a wire-to-plate electrode structure like an electrostatic precipitator are considered that an effective for the odor removal. In this study, the grounded electrodes in the positive corona discharge were used two material, a stainless-steel and a woodceramics. The woodceramics has electric conductivity and porous structure. The target for removal was β-phenylethyl alcohol in a closed space. The β-phenylethyl alcohol were measured with a gas chromatography with FID and splitless injection method. In addition, the thermal desorption type absorb was used with the gas sampling. As results, the β-phenylethyl alcohol were removed from the air with the positive corona discharge. In addition, the reduction rate was increased, and the by-products were decreased with using the woodceramics electrode compared with stainless-steel electrode.

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絶縁材料の表面抵抗測定のための新電極構成
New Designed Electrode Arrangement for a Measurement of Surface Resistance of Insulating Material

前田孝夫*，○山野芳昭**前田孝夫*，○山野芳昭**
Takao Maeda* and ○Yoshiaki YAMANO**

絶縁テクノ工房*，千葉大学**
*Techno-lab on Electrical Insulation
**Chiba University

Abstract:

The new electrode arrangement for the measurement of resistance along the surface of insulating material is presented. The new electrode arrangement was originally designed by the authors of this report. The normal components of the current to the surface are reduced by the new arrangement in order to diminish the current flowing to the backside electrode in the conventional electrode arrangement used in IEC standard. The measurements of surface current using the new electrode arrangement were carried out to confirm the effectiveness of the measured values to the evaluation of surface resistivity of insulating materials. The consideration on the measured results using computer analysis reveals that the surface resistance obtained by the new electrode arrangement can reflect to the evaluation of surface resistance with higher reliably than the conventional arrangements. The new electrode arrangement can also be applied to the surface treated to avoid the electrostatic charge accumulation.

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ナノ秒パルス放電方式オゾナイザにおける余剰エネルギーの低減化
Excess energy reduction on nanosecond pulsed discharge based ozonizer

〇佐々木　貫至*, 日高　寛貴*, 森　皓亮**, 王　斗艶***, 浪平　隆男***〇佐々木　貫至*, 日高　寛貴*, 森　皓亮**, 王　斗艶***, 浪平　隆男***
〇Kanji SASAKI*, Hiroki HIDAKA*, Teruaki MORI**, Douyan WANG***, and Takao NAMIHIRA***

熊本大学大学院自然科学教育部*, 熊本大学工学部情報電気電子工学科**, 熊本大学パルスパワー科学研究所***
*Graduate School of Science and Technology, Kumamoto University, **Department of Computer Science and Electrical Engineering, and ***Institute of Pulsed Power Science, Kumamoto University

Abstract:

Ozone has very strong oxidizability far better than chlorine, and it has no residual toxicity due to natural decomposition into oxygen. Therefore, ozone finds a wide variety of applications such as sterilization, deodorization, decoloration, bleach, and so on. In our earlier research, nanosecond (ns) pulsed discharge based ozonizer which has been developed in recent years has achieved the higher ozone generation yield than the other discharge methods. However, the ozone concentration formed by the ns pulsed discharge saturates at approximately 40 g/m3. It is assumed that the main cause of the saturation of ozone is a thermal decomposition of ozone due to a transition of the discharge mode to an arc discharge. The result shows that the oscillation of the pulse wave due to an imperfect matching between the generator and a discharge reactor was suspected as the cause of the arc discharge. Therefore, a resistor for absorbing excess energy was connected to the end of the reactor in order to prevent the oscillation. In this study, the effect of the transition of the discharge mode and ozone concentration were investigated.

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リチウムイオン電池正極材リサイクルを目的とした電気パルスによる選択的解体

Selective dismantlement by electrical discharge for recycling of lithium-ion battery positive electrode material

〇丸山修平＊, 澤村幸宏＊, 近藤正隆＊,林秀原＊, 浪平隆男＊＊, 大和田秀二＊, 所千晴＊〇丸山修平＊, 澤村幸宏＊, 近藤正隆＊,林秀原＊, 浪平隆男＊＊, 大和田秀二＊, 所千晴＊

〇Shuhei MARUYAMA*, Yukihiro SAWAMURA*, Masataka KONDO*,Soowon LIM*, Takao NAMIHIRA**, Shuji Owada*, Chiharu TOKORO*

早稲田大学＊, 熊本大学＊＊

* Faculty of Science and Engineering, Waseda University,** Institute of Pulsed Power Science, Kumamoto University

Abstract:

It is expected that a large amount of Lithium-Ion Battery (LIB) is disposed in the foreseeable future. A novel recycling method is needed to realize material reuse/recycling of LIB. The positive electrode of the LIB contains cobalt-based compound called the active material and has three-layer structure consist of two positive electrode active material layers and an aluminum base layer. The objective of this study is to selectively recovery the positive electrode active material from the LIB positive electrode by an electrical disintegration method. Discharge electrodes were set on the active material. A capacitor bank of 2.4μF was charged up to 45 kV. After discharge experiment, particle size distribution and element ratio were evaluated. It was confirmed that the active material layers and aluminum layer were successfully separated enough to recycle cobalt/nickel and aluminum.

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プラズマキャンドル：大気圧ヘリウム プラズマジェットのスケーリングアップ

Plasma Candle: Scaling-up of Atmospheric Pressure Helium Plasma Jet

金賢夏,寺本慶之，竹内希，尾形敦金賢夏,寺本慶之，竹内希，尾形敦
Hyun-Ha KIM, Yoshiyuki TERAMOTO, Nozomi TAKEUCHI, and Atsushi OGATA

国立研究開発法人産業技術総合研究所
National Institute of Advanced Industrial Science and Technology
Tokyo Institute ofTechnology

Abstract:

Plasma het has been intensively studied in the last decade, and A new type of atmospheric-pressure plasma jet, referred to as plasma candle hereafter, has been developed. By using a multi-hole tube (honeycomb type) or a porous ceramic plate, we demonstrated that plasma jet can be established with the diameter larger than 20 mm. Preliminary results on the effect of tube geometry, gas flow rate, applied voltage and their effect on plume shape and temperature will be discussed.

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Quantitative analysis of the influences of gas temperature on nitrogen fixation in nano-pulsed DBD

Quantitative analysis of the influences of gas temperature on nitrogen fixation in nano-pulsed DBD

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Ayman A. ABDELAZIZ , Hyun-Ha KIM

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Tokyo Institute ofTechnology

Abstract:

In this work, the effect of the gas temperature (in range of 300 – 600 K) on the nitrogen fixation in a DBD operated by a pulsed high-voltage was studied at different humidity levels and oxygen contents. To fully understand the effect of the temperature on the nitrogen fixation, its effect on the characterization of the DBD, including the current-voltage waveforms and optical emission spectroscopy, was investigated.

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パルス電圧の立ち上がり速度とストリーマ放電特性の関係

Effect of the pulse voltage rise rate on the characteristics of the streamer discharge

〇小室淳史＊, 安藤晃＊〇小室淳史＊, 安藤晃＊
〇Atsushi KOMURO＊, Akira ANDO＊

東北大学工＊
＊Department of electrical engineering, Tohoku University

Abstract:

Effect of pulse rise rate on a streamer discharge is investigated through simulations. Pulsed voltages with various pulse rise rate are applied to point-to-plane electrode configurations, and the propagation velocity, the diameter and the production amount of O(3P) radical are calculated. The results show that as the pulse rise rate increases, there is an increase in the discharge current, velocity of the primary streamer, and diameter of the streamer channel. Additionally, the curvature of the point anode affects these parameters, indicating that the applied voltage potential during the streamer propagation is important to determine the streamer characteristics.

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誘電泳動インピーダンス計測におけるマイクロ櫛型平面電極の等価回路モデル

Equivalent Circuit Model of Micro Interdigitated Planar Electrodes in Dielectrophoretic Impedance Measurenent System

〇堀貴嗣，内田諭，朽久保文嘉〇堀貴嗣，内田諭，朽久保文嘉
〇Takashi HORI, Satoshi UCHIDA, Fumiyoshi TOCHIKUBO

首都大システムデザイン
Faculty of Systems Design, Tokyo Metropolitan University

Abstract:

In this study, we examined an equivalent circuit model for accurate analysis of dielectrophoretic impedance measurement (DEPIM), which is expected as a rapid and simple bacterial detection technology. In addition, we considered the more accurate equivalent circuit model including the double layer capacity, the resistance and the capacitance derived from the solvent and the electrode. In the theoretical value of the impedance frequency characteristics, three areas could be confirmed as in the previous research. Furthermore, we compared the theoretical values of the equivalent circuit with the capacitance component derived from the SiO2 cover and the glass substrate in consideration of actual use. The comparison results suggest that the SiO2 and the glass have some influence on the impedance frequency characteristics. This result suggests that we could obtain the significant result for future DEPIM experiment and analysis. In addition, we constructed and evaluated a quadruple-layer ellipsoid model for E.coli, which is a more accurate model than the convention one.

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絶縁被覆接地電極の放電特性と荷電性能
Discharge Characteristics and Electric Charge Performance of Insulation coating GND-electrodes

〇永吉健太郎*,野﨑優介*,栗田加奈絵*,中村陽平*,江原由泰**〇永吉健太郎*,野﨑優介*,栗田加奈絵*,中村陽平*,江原由泰**
〇Kentaro NAGAYOSHI*, Yusuke NOZAKI*, Kanae KURITA*, Yohei NAKAMURA*, Yoshiyasu EHARA**

富士通ゼネラル研究所*,東京都市大学**
Fujitsu General Laboratories Limited*,　Tokyo City University**

Abstract:

An ionizer with insulation coating GND-electrodes was measured about a discharge current characteristic, the electric charge performance and the ozone generation. For collecting efficiency pulse electric charge was different from DC corona discharge and ozone reduction was observed.

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異なる電極径を用いた放電によって生成された衝撃波の違い
Difference of shock waves generated by discharges with different electrode diameters

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〇Mitsuhiko Sato*、 Hiroki Takaura*、 Hamid Hosano*,**、 Takashi Sakugawa*,**

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*Graduate School of Science and Technology, Kumamoto University、**Institute of Pulsed Power Science, Kumamoto University

Abstract:

In this study, we measured the pressure of shock waves generated by the discharge with two different electrode diameters. We discharged by using a magnetic pulse compression (MPC) circuit and a point-to-point electrode in the water of conductivity 50 mS / cm. The shock waves were measured through an elastic membrane using a fiber optic probe hydrophone (FOPH) pressure transducer. we analyzed the shock wave waveform. The pressure value was averaged at every 100 points on the waveform, and curve fitting was applied. As a result, the fall time of shock waves generated using discharges with different electrode diameters are different.

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線対平板型電気集塵装置における粒子の帯電及び軌道解析
Simulation of particle charge and trajectory in a wire-to-plate type electrostatic precipitator

○伊藤航平＊, 田村亮太＊, 瑞慶覧章朝＊,川田吉弘＊＊,田岡智浩＊＊＊
○伊藤航平＊, 田村亮太＊, 瑞慶覧章朝＊,川田吉弘＊＊,田岡智浩＊＊＊

○Kohei ITO*, Ryota TAMURA*, Akinori ZUKERAN*, Yoshihiro KAWADA** and Tomohiro TAOKA***

神奈川工科大学＊,職業能力開発総合大学校＊＊,住重プラントエンジニアリング株式会社＊＊＊
* Kanagawa Institute of Technology
** Polytechnic University of Japan
*** Sumiju Plant Engineering Co.,Ltd.

Abstract:

The purpose of this study is to analyze particle charge and trajectory in a wire-to-plate type electrostatic precipitator. The particle charge and trajectory in the gas flow considered the ionic flow were calculated using the simulation software COMSOL Multiphysics®(Ver.5.4). The gas flow distribution and particle trajectory were measured using particle tracking velocimetry (PTV). As a result, it was succeeded in analyzing particle charge considering the spatial electric field and ionic density. The analysis result of the particle trajectory near the grounded plate electrode was almost the same as experimental result. However, the analysis result near the wire electrode did not agree with the experimental result.

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水滴滴下時の微小水滴の発生
Ejection of tiny water droplets when water droplets are dripped on an insulator

○堀江史人，下川博文○堀江史人，下川博文
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神奈川工科大学
Kanagawa Institute of Technology

Abstract:

In this study, the behavior of water droplets was photographed using a high-speed camera. The water droplets bounce completely on the superhydrophobic surface and tiny water droplets may be ejected. The formation of tiny droplets are known to be related to Coulomb repulsion and surface tension of water, but the details of the formation mechanism is unknown. It has been found that tiny water droplets are released from droplets reaching the Rayleigh limit by increasing the charge amount of the droplets as one of the ejection mechanisms. However, in the case of a drop distance of 2 cm, when the water droplet is not charged, a tiny water droplet is ejected with a probability of 100%. This paper mainly describes the ejection mechanism of tiny water droplets under the conditions.

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電気穿孔後の生体膜を介したイオン輸送の特性
Ca ion transport through plasma membrane after electroporation

○緒方拓海,卜部玄,島田雅治,勝木淳○緒方拓海,卜部玄,島田雅治,勝木淳
Ogata Takumi

熊本大学
Kumamoto University

Abstract:

Pulsed electric field (PEF) produces small pores on the cell membrane, so called “electroporation”, and the trans-membrane molecules transport occurs through the pores. In this study, in order to clarify the environmental factors related to the trans-membrane ion transport, the Ca ion influx was observed by using artificial cells (giant unilamellar vesicles), which enable to adjust the osmotic pressure and the Ca ion concentration independently. The experiment shows that the osmotic pressure and Ca concentration influences the Ca influx after the electroporation.

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表面電位分布を用いた複合材料の評価方法
Evaluation Method of Composite Materials using Surface Potential Distribution

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〇Kazuya KIKUNAGA and Nao TERASAKI

産総研
National Institute of Advanced Industrial Science and Technology

Abstract:

Composite materials can have excellent functions or performances that could not be obtained alone by combining two or more materials with different physical properties, and they are adapted to aircraft and automotive applications. A composite material composed of polyvinyl chloride film and conductive carbon coating were charged using directly applied voltage of -100 ~ +100 V or corona discharge of 5kV, and the surface potential distribution of 30 mm × 30 mm was measured. We found that a high potential was able to be given to the conductive part by applying voltage and corona discharge, and the position information of the conductive part was able to be visualized using it.

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マイクロ波水プラズマの OH-LIF 計測
Measurement of OH Radical Density in Water Vapor Microwave Excited Plasma Using Laser-Induced Fluorescence

○井上樹＊, 小野亮＊, 相澤洸＊＊, 石島達夫＊＊＊○井上樹＊, 小野亮＊, 相澤洸＊＊, 石島達夫＊＊＊
○Itsuki INOUE＊, Ryo ONO＊, Takeshi AIZAWA＊＊, and Tatsuo ISHIJIMA＊＊＊

東京大学＊, 米倉製作所＊＊, 金沢大学＊＊＊
＊The university of Tokyo, ＊＊Yonekura MFG, ＊＊＊Kanazawa University

Abstract:

The OH density is measured in microwave water vapor plasma developed for ashing process in minimal fabrication system. Laser-induced fluorescence is used for the measurement of OH density. When the microwave (2.45 GHz) is 100 Hz pulsed mode with a duty cycle of 30% and 60 W average power (3 ms repetitive pulse), the OH density is saturated at approximately 1.5 × 1015 cm-3 at the center of the plasma at t = 1 ms, where t = 0 ms is the microwave pulse ignition time. The temporal evolution and the spatial distribution of OH are measured, and the generation and decay mechanisms of OH radicals are discussed.

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バリア放電における放電本数計算手法
Calculation method of discharge number in DBD

〇竹本翔一＊, 松井良彦＊＊, 飯盛遊＊＊,西島義明＊＊＊,松本修一＊＊＊ ,榎本啓士＊＊＊〇竹本翔一＊, 松井良彦＊＊, 飯盛遊＊＊,西島義明＊＊＊,松本修一＊＊＊ ,榎本啓士＊＊＊

〇Shoichi TAKAMOTO＊, Yoshihiko MATSUI＊＊, Yu ISAKARI＊＊, Yoshiaki NISHIJIMA＊＊＊, Shuichi MATSUMOTO＊＊＊, Hiroshi ENOMOTO＊＊＊

〇株式会社 SOKEN＊, 株式会社デンソー＊＊,金沢大学＊＊＊
＊SOKEN CORP. ＊＊DENSO CORP. ＊＊＊Kanazawa University

Abstract:

There is dielectric barrier discharge (DBD) as a means to generate ozone efficiently. In order to improve the generation efficiency of ozone, it is necessary to increase the electric charge amount of single discharge and the number of discharges. In other words, it is necessary to grasp the relationship between the discharge characteristics and the amount of generated ozone. However, to date, there has been no methods by which measurement of single discharge characteristics and measurement of ozone production can be evaluated in the same experimental system. In this study, we constructed the method to calculate the number of single discharges by repeatedly subtracting the reference current waveform of a single discharge from the macro discharge current waveform.

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バリア放電の周波数特性を考慮した放電特性数式モデルの開発
The mathematical model of discharge characteristics of DBD considering applied voltage frequency

〇竹本翔一＊, 松井良彦＊＊, 飯盛遊＊＊, 服部健二＊＊, 西島義明＊＊＊, 松本修一＊＊＊, 榎本啓士＊＊＊〇竹本翔一＊, 松井良彦＊＊, 飯盛遊＊＊, 服部健二＊＊, 西島義明＊＊＊, 松本修一＊＊＊, 榎本啓士＊＊＊

〇Shoichi TAKAMOTO＊, Yoshihiko MATSUI＊＊, Yu ISAKARI＊＊,Yoshiaki NISHIJIMA＊＊＊, Shuichi MATSUMOTO＊＊＊, Hiroshi ENOMOTO＊＊＊

〇株式会社 SOKEN＊, 株式会社デンソー＊＊,金沢大学＊＊＊
＊SOKEN CORP. ＊＊DENSO CORP. ＊＊＊Kanazawa University

Abstract:

Dielectric Barrier Discharge (DBD) is expected to be applied in various fields such as automobiles, surface treatment and medical treatment. In the design of an electrical circuit using a DBD as a load, it is essential to clarify its discharge characteristics. However, to date, no mathematical model has been available that can handle changes in discharge characteristics due to applied voltage frequency in an electric circuit. In this study, we found that the discharge resistance changes when the applied voltage frequency changes, through single discharge observation and measurement. Furthermore, the phenomenon was expected to space-time and theorized to construct the mathematical model that can handle frequency change of discharge resistance value of macro-scale DBD.

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エステル交換反応を用いた低動粘度植物系電気絶縁油の作製
Production of Vegetable Oil based Insulating Oil with Low Kinematic Viscosity using Ester Exchange Reaction

〇長井宏樹，山田卓哉，石黒泰誠，村上祐一，村本裕二〇長井宏樹，山田卓哉，石黒泰誠，村上祐一，村本裕二
Hiroki NAGAI

名城大学
〇Hiroki NAGAI, Takuya YAMADA, Taisei ISHIGURO, Yuichi MURAKAMI, Yuji MURAMOTO

Abstract:

Our paper reports AC breakdown properties of vegetable oil by ester exchange reaction. Experimental oil was a soybean oil treated ester exchange reaction. We observed AC breakdown strength of the ester soybean oil. These results were shown as the following: (i) Kinematic viscosity of the soybean ester oil was lower than that of soybean oil before ester exchange reaction. (ii) Kinematic viscosity of the soybean ester oil decreases with increase of NaOH. (iii) AC breakdown strength of the soybean ester was as big as that of natural oil.

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高周波バーストパルスが
がん細胞へ与える影響における低周波重畳の効果

Influence of Superimposing Low Frequency on Effect on Cancer cell of High Frequency Burst Pulse

〇佐藤浩美＊, 南谷靖史＊, 卜部玄＊＊, 亀崎太一＊＊, 岡本修治＊＊, 勝木淳＊＊〇佐藤浩美＊, 南谷靖史＊, 卜部玄＊＊, 亀崎太一＊＊, 岡本修治＊＊, 勝木淳＊＊
Hiromi SATO＊, Yasushi MINAMITANI＊, Gen URABE＊＊, Taichi KAMEZAKI＊＊, Shuji OKAMOTO＊＊, Sunao KATSUKI＊＊

山形大院＊, 熊本大院＊
＊Graduate school of Science and Engineering, Yamagata University, ＊＊Graduate school of Science and Technology, Kumamoto University

Abstract:

The cancer treatment by an ultra-short pulse high electric field is one of new biological applications. It is shown that cancer is able to be treated by nanosecond pulsed high electric field. In this study, we have investigated effect on a cancer cell by a high frequency and high intensity burst pulse for cancer treatment. And, it is more effective to add a burst pulse that can be continuously supplied, rather than a single pulse and repeated supply to cells. However, unipolar burst pulses also contain low frequency components due to their own burst pulse width. Here, we investigated the influence of low frequency components contained in unipolar burst pulses on cell death. As a result, cell death could be caused more effectively by applying a burst pulse in which high frequency and low frequency were superimposed.

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細胞膜穿孔のためのパルス波形に関する解析的考察

Analytical consideration of pulse waveform for electroporation

〇豊満陽希，主計俊哉，勝木淳〇豊満陽希，主計俊哉，勝木淳
〇Haruki Toyomitsu, Shunya KAZUE and Sunao KATSUKI

熊本大学
Kumamoto University

Abstract:

Pulsed electric fields produce pores in the cell membrane, which is called electroporation. This paper discusses the pore expansion process under a high electric field on the basis of the electrical energy dissipation in the pore. The waveform of the external electric field determines the history of the energy dissipation into the pore, and then contributes to the determination of the size and the number density of the pore.

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電気パルスによる金属細線爆発を用いた廃太陽光パネルからの選択的金属回収の検討

Examination of selective metal recovery from PV panel using wire explosion by electrical disintegration

〇澤村幸宏＊, 西麻依子＊, 丸山修平＊, 近藤正隆＊, 林秀原＊, 浪平隆男＊＊, 所千晴＊
〇澤村幸宏＊, 西麻依子＊, 丸山修平＊, 近藤正隆＊, 林秀原＊, 浪平隆男＊＊, 所千晴＊
〇Yukihiro SAWAMURA*, Maiko NISHI*, Shuhei MARUYAMA*, Masataka KONDO*, Soowon LIM*, Takao NAMIHIRA**, Chiharu TOKORO*

早稲田大学＊, 熊本大学＊＊
* Faculty of Science and Engineering, Waseda University
** Institute of Pulsed Power Science, Kumamoto University

Abstract:

Photovoltaic (PV) panels are widely used recently and has been exponentially increasing. However, the recycling system of PV panels has not been established. In this paper, we introduce a novel electrical disintegration (ED) method to separate copper in the PV panels. Samples were prepared by removing the glass with the hot knife method from the PV panels before applying the ED method. The pulsed power source was connected to a thin Cu wire of the sample. A large current flowed through the wire then it caused a wire explosion. Precipitates were collected by wet sieving method and followed by elemental analysis. Experimental results indicate that the Cu wire was successfully separated from the PV panels with high selectivity and enough for Cu recycling.

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強電界パルスが多量体タンパク質に及ぼす影響
Influence of intense electrical pulses on multimer protein

○中村剛丸，卜部玄，大石諒，勝木淳○中村剛丸，卜部玄，大石諒，勝木淳
〇Gomaru NAKAMURA，Gen URABE，Ryo OISHI，Sunao KATSUKI

熊本大学
Kumamoto University

Abstract:

This paper discusses the influence of intense nanosecond pulsed electric field (nsPEF) up to 300 kV/cm on the structure of urease proteins (hexamer). Quaternary structure of urease was investigated by means of the modified SDS-PAGE. Our experiment indicates the intense electric fields more than 200 kV/cm directly influence the quaternary structure of some kinds of multimer proteins including urease.

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気中水滴噴霧水処理においてパルスストリーマ放電で生成された活性種の反応観測

Reaction observation of Active Species Generated by Pulsed Streamer Discharge in the Air with Droplets for Water Treatment

齋藤崇＊, ○南谷靖史＊齋藤崇＊, ○南谷靖史＊
Takashi SAITO*, ○Yasushi MINAMITANI*

山形大院＊
＊Graduate school of Science and Engineering, Yamagata University

Abstract:

The image of hydroxyl radical reacting with the droplets in the area of pulsed streamer discharge has been observed. Luminol luminescence was used for detecting hydroxyl radical. The luminol luminescence was taken by using a high speed camera with an image intensifier. The discharge was generated at single shot in order to reduce the effect of the ozone generated by the discharge. We took a photograph that hydroxyl radical was just reacting to the luminol on the droplets.

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ハイパボリック電荷緩和則の適用条件
Proper conditions for the hyperbolic law of charge relaxation

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National Institute of Occupational Safety and Health, Japan

Abstract:

This paper discusses the hyperbolic law of the charge relaxation for low-conductivity liquids, which was proposed by Bustin et al. [Hydrocarbon Processing 43 (1964) 209–216] to describe the charge relaxation experimentally observed in low-conductivity liquids (≤ 1 pS/m), in which it is faster than that predicted with the exponential (ohmic) charge relaxation. In some literature, [R.J. Pazda et al. J. Electrostat. 28 (1992) 175–185] and [M. Fujii, Handbook of electrostatics, Ed. IEJ, Ohm-sha, Tokyo (1998) 1063–1064 in Japanese], however, the hyperbolic law was invalidly applied, resulting in the charge relaxation appearing slower than that with the exponential law. Therefore, we obtain conditions properly satisfying the requirement that the hyperbolic charge relaxation be faster than the exponential one for identification of electrostatic hazards in low-conductivity liquids.

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パルス放電によるアニサキスの殺虫
Killing of Anisakis　Larva Caused by Pulsed Discharge Treatment

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Abstract:

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超高感度紫外線カメラによる静電気放電現象の観察
～剥離帯電による放電現象の剥離速度依存性～

Observation of electrostatic discharge phenomenon by ultra high sensitivity ultra violet camera Peeling speed dependency of discharge phenomenon by peeling charge

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Abstract:

Observation of low energy discharge phenomena is important in identifying the cause and confirming the effect of the countermeasure technology as the electrostatic resistance of the electronic equipment decreases. As the low energy discharge, the discharge phenomenon due to peeling charge occurs in various processes such as the transfer of adhesive tape, protective film, and glass substrate for liquid crystal panel, so detailed elucidation of not only the charge phenomenon but the discharge phenomenon is desired. In this study, we observed the electrostatic discharge phenomenon using an ultra-high sensitivity ultraviolet camera and an optical electric field sensor. In particular, it reports about the peeling speed dependence of the micro gap discharge by the peeling charge of an adhesive tape.

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ナノ秒パルスプラズマと抗 PD-1 抗体の併用による抗腫瘍効果の検証
Antitumor Effects Induced by Nanosecond Pulsed Streamer Discharge in Combination with Anti-PD-1 Antibody

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○Yosuke KONDO＊, Sayo TAKEDA＊, Hideyuki YANAI＊＊, Ryo ONO＊

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Abstract:

Recently, cold atmospheric pressure plasma has been expected to be applied to cancer therapy. We have examined anti-tumor effects induced by pulsed streamer discharge against the tumors implanted in mice. In the present study, we investigated anti-tumor effect against B16F10 and Colon-26 tumor by using plasma in combination with checkpoint inhibitor, anti-PD-1 antibody, to get synergistic treatment effect. As a result, B16F10 tumor did not show any anti-tumor effect in all conditions. On the other hand, Colon-26 tumor showed clear suppression of its growth by the combination therapy, which suggested the possibility of new treatment method of plasma and checkpoint inhibitor.

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小型ナノ秒パルス電源の高出力化および高効率化
Higher output and Higher efficiency of a compact nanosecond pulse generator

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◯Ryuki MATSUKAWA＊, Tomohiro UEJI＊, Mikiya MATSUDA＊＊, Douyan WANG＊＊＊, Takao NAMIHIRA＊＊＊

熊本大学大学院自然科学教育部＊, 熊本大学工学部＊＊, 熊本大学パルスパワー科学研究所＊＊＊
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Abstract:

Pulses with extremely short FWHM allow for higher energy efficiency in plasma processing. The conventional nanosecond pulse generator developed by our research group can generate high voltage with rise time and fall time of 2ns each, and FWHM is 5ns. The nanosecond pulse generator (NS-PG) consists a microsecond pulse generator (MS-PG) and a nanosecond pulse forming line (NS-PFL). The MS-PG generates a 60 kV peak pulse, and the pulse is compressed to 5 ns by NS-PFL. The volume of NS-PG was 91 L, and miniaturization was necessary. So, we made a compact NS-PG. The volume was reduced to 12.1 liters. However, the output voltage and voltage efficiency of this new generator is very low. Therefore, three experiments were conducted to improve the output voltage and voltage efficiency. The three experiments were conducted focusing on the NS-PFL. The NS-PFL uses Blumlein line which consists coaxial cables and spark gap switch. The experiment contents are changing configuration of spark gap switch, applying ferrite cores to coaxial cables and changing filling gas in the gap switch. With three experiments, output voltage increases from 8.4 kV to 48.2 kV, and voltage efficiency increases from 42.8% to 83.1%.

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Measurement of temporal variation of OH density in wet nitrogen-oxygen pulsed streamer discharge with different amounts of oxygen

Measurement of temporal variation of OH density in wet nitrogen-oxygen pulsed streamer discharge with different amounts of oxygen

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〇Zhang Xiang*, Atsushi Komuro**, Ryo Ono*

東京大学*　東北大学**
The University of Tokyo*, Tohoku University**

Abstract:

The temporal variation of OH density in wet N2-O2 pulsed positive streamer discharge with different amounts of O2 is measured using laser-induced fluorescence. The result under trace amounts of O2 (< 20 ppm) show slow decays of OH density after discharge pulse. The decay time constant is 2.5 ms when O2 = 0 ppm. When O2 =1-40%, the recombination reaction of OH can explain the decay of OH density for t > 40 μs, where t is the postdischarge time, but not sufficient for 0 μs < t < 40 μs. Postdischarge simulations are used in both cases aiming at explaining the measured OH decay.

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自己放電式プラズマによる真空除電
Static Elimination in Vacuum by Using Self-Discharged Plasma

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〇Takashi IKEHATA*, Bao RUIDA*, Tomofumi MOGAMI**, Kazuki MINEMURA** and Nobuo NOMURA**

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Abstract:

Demand for static elimination in vacuum is expanding especially in display panels and functional films fabrication industries. One of on-site technologies is to trigger a self-discharge on the charged work surface by introducing a gas. However, academic research on the subject including discussion on the detailed characteristics and the physical mechanism is little reported. Therefore, the authors have conducted a model experiment on the static elimination by the self-discharged plasma. It is found that the potential of a few hundred volts remains on the work regardless of the initial charge polarity.

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高電界パルス殺菌におけるパルス波形に関する考察
Experimental and analytical considerations of waveform in pulsed electric field sterilization

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Abstract:

Pulsed electric field (PEF) is one of the non-thermal physical bactericidal agents that is unlikely to denature ingredients in liquid food. This paper discusses the optimum pulse waveform for the PEF sterilization experimentally and analytically. Enterobacter aerogenes in carboxymethyl cellulose solution (107 /ml) was continuously subjected to the PEF (Electric field : 30-50 kV/cm, pulse duration : 100-600 ns) and subsequently to the mild thermal energy with the temperature of 55℃. The minimum pulse durations for 6-log order bacterial reduction for the field strengths of 30 and 50 kV/cm were 300 and 600 ns, respectively. The longer PEF with the moderate field strength tends to be more efficient than the more intense field with the shorter pulse duration. An electromagnetic energy into a membrane pore due to the external electric field was calculated to discuss the pore expansion process based on the thermal energy. The waveform of the field determines the history of the energy dissipation into the pore, and then contributes to the determination of the diameter and the number density of the pore. The longer pulse enlarges the membrane pore, whereas the faster buildup field is likely to increase the number of pores.

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粉体連続投入におけるサイロ内の突起物からの静電気放電
Electrostatic Discharges from Metal Protrusion inside Silo during Powder loading

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〇長田裕生**、鈴木輝夫**崔光石*、
〇長田裕生**、鈴木輝夫**
Kwangseok CHOI*,
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*National Institute of Occupational Safety and Health, Japan
**Kasuga Denki Co., Ltd.

Abstract:

The electrostatic discharges that occurred from metal protrusion (D; 4 cm) inside a silo was investigated during the continuous loading of polypropylene powders (about 800 kg). The graphs of the experimental results can be divided into two main areas: area A representing when the powder approaches the protrusion, and area B when the powder levels completely overtook the protrusions. In area A, the amount of electrostatic discharges first gradually increased up to a maximum of -110 nC, then decreased. In area B, a part of the tested discharges amount surpassed the measurement range and therefore a specific numerical result could not be obtained. However, it could be seen that the obtained values were several times as large as the values in area A.

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印加電圧の極性が液面放電の進展とヒドロキシラジカルの生成に及ぼす影響

Influence of Voltage Polarity and on Development of Pulsed Discharge Over Water Surface and Hydroxyl Radical Production

○高橋克幸＊，＊＊，高山大聖＊，武田尚大＊，辛嶋一樹＊＊＊，高木浩一＊，＊＊，浪平隆男＊＊＊＊○高橋克幸＊，＊＊，高山大聖＊，武田尚大＊，辛嶋一樹＊＊＊，高木浩一＊，＊＊，浪平隆男＊＊＊＊

○Katsuyuki TAKAHASHI *, **, Hirotoshi TAKAYAMA *, Masahiro TAKEDA *, Kazuki KARASHIMA ***, Koichi TAKAKI *, **, and Takao NAMIHIRA ****

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**** Institute of Pulsed Power Science, Kumamoto University

Abstract:

The influence of the voltage polarity on the development of pulsed discharge over the water surface and the hydroxyl radical production is investigated. A tungsten wire is placed above the water and is used as high voltage electrode. A grounded stainless-steel disk is sunk to the bottom of the water. The positive and negative pulsed high voltages are generated using a capacitive energy storage pulsed power generator driven by a MOS-FET. An ICCD camera is used for observation of the development of discharges. An indigo carmine solution is used as a chemical probe of hydroxyl radical. The maximum discharge length, the propagation speed of discharges and the emission intensity at wavelength of 308 nm in the case of negative polarity are higher than them of positive polarity. The amount of hydroxyl radical dissolved into the solution in the case of positive polarity is higher than that of negative polarity. The results show that positive ions produced in the positive discharges could contribute to hydroxyl radical production in the solution by the sputtering effect.

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高電界パルスを用いた
酵母内成分の抽出特性

Extraction characteristics of yeast ingredients using Pulsed Electric Fields

〇岡本修治，亀崎太一，村上鷹児，中尾圭佑，勝木淳〇岡本修治，亀崎太一，村上鷹児，中尾圭佑，勝木淳
〇Shuji OKAMOTO, Taichi KAMEZAKI, Yoji MURAKAMI, Keisuke NAKAO, Sunao KATSUKI

熊本大学
Kumamoto University

Abstract:

This paper describes the extraction of intracellular contents of yeast (Saccharomyces cerevisiae) using 600 ns-long, 20 kV/cm pulsed electric fields (PEFs). Amounts of nucleic acids and amino acids included in supernatant from the yeast suspension were evaluated and compared to those by the conventional thermal method. Molecular size in the extract was investigated using SDS-PAGE. Also, the membrane damage and the cell wall morphology was observed using a fluorescent microscope.

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プラズマジェットによるカーボンクロスの親水処理がピロロキノリンキノンの吸着および酸化還元挙動に及ぼす影響

Effect of Hydrophilic Treatment of Carbon Cloth by Plasma Jet on the Adsorption and Redox Behavior of Pyrroloquinoline Quinone

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○Kenta SUDA*, Masayoshi MATSUI*, Takanori TANINO*,** and Takayuki OHSHIMA*,**

群馬大学大学院理工学府＊, 群馬大学食健康科学教育研究センター＊＊
*Division of Environmental Engineering Science, Gunma University, **Gunma University Center for Food Science and Wellness (GUCFW)

Abstract:

Enhancement of redox activity of pyrroloquinoline quinone (PQQ) on the electrode is very important to develop significant applications such as biofuel cell and biosensor. In this study, we evaluated the effect of plasma jet treatment of carbon cloth (CC) on the adsorption and redox activity of PQQ. CC was successfully hydrophilized by Ar, Ar + CO2 and Ar + N2 plasma jet. Adsorption amount of PQQ was increased on the moderately hydrophilized CC surface. The excess hydrophilic properties seemed to inhibit the adsorption of PQQ on CC. Cyclic voltammograms (CVs) of PQQ on hydrophilized CC electrodes showed well-defined redox peaks. Thus, increasing the amount of PQQ adsorption on CC is effective for the enhancement of redox activity. However the peak separation (ΔEp) of CVs was increased provably due to decrease in electrical conductivity of CC.

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Characteristic study of pulsed surface dielectric barrier discharge in atmospheric air
Characteristic study of pulsed surface dielectric barrier discharge in atmospheric air

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Bangfa PENG

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Abstract:

Streamer generation and propagation of positive pulsed surface dielectric barrier discharge (SDBD) has been investigated through the experiment. The results show that the single pulsed discharge consists of primary streamer and secondary streamer. Primary streamer is positive streamer characterized with streamer-like morphology and appears in the leading front of pulsed voltage. However, the secondary streamer is negative discharge, which has a relative diffuse morphology and emerges in the decaying region of pulsed voltage.

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Enrofloxacin Degradation in Water by Pulsed Discharge Plasma Combined With Graphene-WO3 Nanocomposites
Enrofloxacin Degradation in Water by Pulsed Discharge Plasma Combined With Graphene-WO3 Nanocomposites

OHe GUO**, Nan JIANG*,, Douyan WANG***, Takao Namihira**, Jie LI*, Yan WU*OHe GUO**, Nan JIANG*,, Douyan WANG***, Takao Namihira**, Jie LI*, Yan WU*
He GUO

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

Abstract:

Herein, pulsed discharge plasma (PDP) was combined with graphene-WO3 nanocomposites for enhancing enrofloxacin (EFA) degradation. The results showed that graphene could be hybridized with WO3 nanoparticles successfully. Addition of WO3 enhanced EFA removal efficiency in PDP system, which raised from 76.0% to 85.4% with 60 min treatment time. Compared to the pure WO3, rGO/WO3 could further improve the EFA removal efficiency in PDP system, which can reach 99.1 % with 60 min treatment.

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Study on Ion Flow Field of Corona Discharge in Bipolar HVDC Transmission Lines
Study on Ion Flow Field of Corona Discharge in Bipolar HVDC Transmission Lines

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Shiqiang LIU

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Abstract:

The ground ion flow field generated by corona discharge in HVDC transmission lines can reflect the operation status of the lines. In this paper, a reduced scale wire-plate experimental device that the Wilson plate is flush with the grounding plate was designed to study the ground composite field strength and ion current density distribution of bipolar HVDC transmission lines under different voltages. The results show that the ground composite field strength and ion current density are asymmetrically distributed with respect to the center of positive and negative conductors; With the increase of applied voltage, the ground composite field strength and ion current density will move to the direction of positive conductor; The ground ion current density at the center of the positive and negative conductors changes from positive to negative with the increase of voltage.

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直流電界および凍結を用いた氷中の大腸菌殺菌
Sterilization of Escherichia coli in Ice Using DC Electric Field and Freezing

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Hideki MATSUI

名城大学
Meijo University

Abstract:

This paper reports the effect of electric field (DC 100 V/mm) application and freezing (-20 ℃ or -80 ℃) on sterilization of Escherichia coli in ice. The sample was E. coli (JM103) in 5×10-3 mol/L NaCl aqueous solution. The experimental sample 120 μL placed in a cuvette with parallel electrode plates (the distance between the electrodes was 1 mm), cooled at -20 ℃ or -80 ℃ for 20 min. After freezing, DC voltage 100 V was applied to the sample at -20 ℃ or -80 ℃. These results were shown as the following: (i) The survival ratio of E. coli with no treatment was higher than that after any treatments. (ii) At -20 °C freezing, the survival ratio of E. coli after freezing only was higher than that after freezing and electric field application. However, (iii) At -80 °C freezing, the survival ratios of E. coli after freezing only and after freezing and electric field application were almost the same.

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導電性の異なるゴムからの放電エネルギーの比較
Comparison of Discharge Energy from Rubbers with Different Conductivity

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Abstract:

In the comparison with the rubber of the resistivity more than the resistivity of the antistatic, the discharge current from the charged rubber packing with different resistivity was observed.

・Discharge current is larger when resistivity is smaller.

・The length of discharge time is not much affected by the resistivity.

・Discharge energy depends on the magnitude of discharge current.

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パラレル電極型ストリーマ放電における準安定準位 N2(A3∑u+)の LIF 計測

Measurement of N2(A3∑u+) Metastable in Parallel type Streamer Discharge by Laser-Induced Fluorescence

○西本将基＊, 立花幸介＊, 古木貴志＊, 市來龍大＊, 金澤誠司＊鈴木あすみ＊＊, 黒井聖史＊＊, 鈴村啓＊＊, 田中利夫＊＊,茂木寛治＊＊, Marek Kocik＊＊＊, Jerzy Mizeraczyk＊＊＊＊
○西本将基＊, 立花幸介＊, 古木貴志＊, 市來龍大＊, 金澤誠司＊鈴木あすみ＊＊, 黒井聖史＊＊, 鈴村啓＊＊, 田中利夫＊＊,茂木寛治＊＊, Marek Kocik＊＊＊, Jerzy Mizeraczyk＊＊＊＊
○Masaki NISHIMTO＊, Kosuke TACHIBANA＊, Takashi FURUKI＊, Ryuta ICHIKI＊, Seiji KANAZAWA＊, Asumi SUZUKI＊＊, Kiyoshi KUROI＊＊, Kei SUZUMURA＊＊, Toshio TANAKA＊＊, Kanji MOTEGI＊＊, Marek KOCIK＊＊＊, Jerzy MIZERACZYK＊＊＊＊

○大分大学理工＊, ダイキン工業＊＊, ポーランド科学アカデミー＊＊＊, グディニァ海事大学＊＊＊＊

＊Faculty of Science and Technology, Oita University, ＊＊Daikin Industries, Ltd., ＊＊＊Polish Academy of Sciences, ＊＊＊＊Gdynia Maritime University

Abstract:

Reactive species generated by streamer discharge are very effective for air purification. N2(A3∑u+) metastable, which is one of reactive species generated by streamer discharge, has been studied by researchers. However, to the best of our knowledge, there have been no studies on measurement of N2(A3∑u+) using parallel electrodes. In this study, a laser-induced fluorescence (LIF) technique was applied to measure the N2(A3∑u+). As a result, we observed discharge structure and the spatial distribution of N2 metastable state N2(A3∑u+) at sub-atmospheric pressures in parallel type streamer discharge. Stronger discharges occurred from swaged portion of parallel electrode, but it was found that N2(A3∑u+) was distributed widely at both ends of the parallel electrode.

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大気圧マイクロプラズマ照射における角質層内薬剤浸透性の評価
Estimation of effect on transdermal absorption of drug by atmospheric microplasma irradiation in stratum corneum

○青島 知道＊, クリストフヤロスラブ＊＊, マリウスブラジャン＊＊＊, 清水 一男＊,＊＊,＊＊＊○青島 知道＊, クリストフヤロスラブ＊＊, マリウスブラジャン＊＊＊, 清水 一男＊,＊＊,＊＊＊

○Tomomichi AOSHIMA＊, Jaroslav KRISTOF＊＊, Marius Gabriel BLAJAN＊＊＊, Kazuo SHIMIZU＊, ＊＊, ＊＊＊

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Abstract:

The process of transdermal drug delivery of Adenosine (Molecular Weight=267.2 Da, Hydrophilic) by Microplasma Drug Delivery (MDD) method was investigated. Yucatan Micropig Skin was as target for drug delivery process. The absorbed quantity of drug in the skin was measured after the permeability of skin was modified by using tape stripping test and microplasma treatment. High-Performance Liquid Chromatography (HPLC) was used to measure absorbed quantity of target drug (Adenosine) in stratum corneum (SC) layer. Transdermal absorption of Adenosine was improved with atmospheric microplasma irradiation. This result shows that MDD method could have potential for the transdermal drug delivery.

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水処理用パルス放電プラズマリアクタによる酸素ガス雰囲気中のエネルギー効率向上への検討
Improvement of Energy Efficiency of Pulse Discharge Plasma Reactor

○林田智仁， 古木貴志，立花孝介，市來龍大，金澤誠司○林田智仁， 古木貴志，立花孝介，市來龍大，金澤誠司
○Tomohito HAYASHIDA, Takashi FURUKI,
Kosuke TACHIBANA, Ryuta ICHIKI, Seiji KANAZAWA

大分大学
Oita University

Abstract:

Persistent orgnic compounds in water are difficult to be decomposed with conventional water treatment , but we can degrade them by using a plasma. In the previous study, we found that using the Coandă effect improved an energy efficiency of the water treatment using plasma. In this study, in addition to the Coandă effect, we introduced oxygen instead of air to a plasma reactor for increasing the energy efficiency. A indigo carmine solution with a concentration of 10 mg/L and a volume of 300 mL was decolorized by an oxygen plasma driven by a pulsed high voltage (15 kV, 100 pps) and a decolorization rate of the solution was measured. As a result, the decolorization rate and energy efficiency were better than that in air. The energy efficiency of 187.5 g/kWh was obtained.

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直流アルゴンプラズマにより生成された短寿命活性種の気液界面における反応領域

Reaction region of short-lived active species generated by DC argon plasma at gas–liquid interface

○立花孝介＊, 古木貴志＊, 市來龍大＊, 金澤誠司＊, 内田諭＊＊○立花孝介＊, 古木貴志＊, 市來龍大＊, 金澤誠司＊, 内田諭＊＊
○Kosuke TACHIBANA*, Takashi FURUKI*, Ryuta ICHIKI*, Seiji KANAZAWA*, Satoshi UCHIDA**

＊大分大理工
＊＊首都大院システムデザイン
*Faculty of Science and Technology, Oita University
**Graduate School of Systems Design, Tokyo Metropolitan University

Abstract:

Plasma–liquid interactions are very important to understand mechanisms of plasma applications but have not been fully understood. To deepen understanding of the interactions, we have focused on where short-lived active species generated by plasma react with solutes at a plasma–liquid interface. We adopted sodium chloride (Cl−), bromide (Br−), and iodide (I−) ions as indicators of the reaction region of the short-lived active species. This is because it is known that these halide ions are located closer to the gas–liquid interface in an order of I−, Br−, and Cl−. We irradiated a DC argon plasma to 2.1 mol/L sodium chloride, bromide, and iodide solutions, and concentrations of chlorine, bromine and iodine were measured. Experimental results indicate a possibility that the short-lived active species generated by plasma could react with the solutes only at the topmost layer of the water surface.

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静電噴霧現象を用いた生理食塩水の微粒化
Atomization of physiological saline by Electrostatic spray phenomenon

〇江頭雅之，矢澤翔大，工藤祐輔，中西哲也〇江頭雅之，矢澤翔大，工藤祐輔，中西哲也
〇Masayuki EGSHIRA, Shota YAZAWA, Yusuke KUDO and Tetsuya NAKANISHI

日大生産工
College of Industrial Technology, Nihon Universty

Abstract:

Recently, asthmatic patients are increased. Nebulizer therapy is common treatment for asthmatic patients. Asthmatic patients inhale drug that is atomized by nebulizer. But, efficacy of drug is different each way of inhalation. It is thought that, drug was not reached to bronchial tube. There is a possibility that the charged particles are reach at a lung. The purpose of this study, proposal of novel drug delivery system for asthmatic patients that applied electrostatic spray phenomenon. In this paper, physiological saline was atomized by electrostatic spray phenomenon.

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DBD プラズマアクチュエータにおけるバースト比が気流中のガス密度場へ与える影響

Effests of the burst ratio in the DBD plasma actuator on the gas density in the flow field

〇鈴木健人，小室淳史，高島圭介，野々村拓，金子俊郎，浅井圭介，安藤晃〇鈴木健人，小室淳史，高島圭介，野々村拓，金子俊郎，浅井圭介，安藤晃
〇Kento SUZUKI, Atsushi KOMURO, Keisuke TAKASHIMA, Taku NONOMURA, Toshiro KANEKO,　Keisuke ASAI and Akira ANDO

東北大学院工
Graduate School of Engineering, Tohoku University

Abstract:

Effects of burst ratio of an applied high voltage on the density field in the flow were investigated in a dielectric-barrier-discharge plasma actuator (DBDPA). The experiment was conducted using a NACA 0015 airfoil model and a hand-made AC power supply for the DBDPA. The results show that the flow-control becomes less effective and vortices generated by the DBDPA become smaller as the burst ratio increases. This relation between the burst ratio and the vortices formation would affect the flow-control effect in the DBDPA.

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グリッド電極を用いたコロナ放電式除電装置における交流電界制御
Control of Electric Field Radiation from Corona Discharge Type Electrostatic Eliminator using Grounded Grid Electrodes

〇山口晋一＊，＊＊，久保勝也＊，高橋克幸＊，高木浩一＊，永田秀海＊＊〇山口晋一＊，＊＊，久保勝也＊，高橋克幸＊，高木浩一＊，永田秀海＊＊
〇Shinichi YAMAGUCHI*, **, Katsuyuki TAKAHASHI*, Koichi TAKAKI* Katsuya KUBO * and Hidemi NAGATA**

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シシド静電気＊＊

*Faculty of Science and Engineering, Iwate University, ** SHISHIDO ELECTROSTATIC, Ltd.

Abstract:

The corona discharge ionizer has been widely used to eliminate electrostatic charge on insulators in variety of manufacturing industries for the prevention of electrostatic discharge (ESD) problems. High speed electrostatic elimination is conventionally required for performance of ionizer. Since high sensitivity of recent electronic electrostatic eliminator. The most sensitive device such as magnetic head slider used in hard disc drives restricts the offset voltage to maximum several ~ 10 V in the manufacturing process. On the other hand, offset voltage is not only ion balance average voltage, but also peak offset voltage which including induction charge from electrostatic eliminator using corona discharge. Therefore, our team is confirmed that grounded conductive grid makes attenuate 1/10 of induction charge and also when high voltage input frequency will increased, electrostatic elimination time also will decreased.

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同軸円筒型電極内ナノ秒パルス放電の進展速度分布
Propagation velocity distribution on Nanosecond pulsed discharge in coaxial electrodes

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〇Terumasa RYU＊, Hitoshi YAMAGUCHI＊, Douyan WANG＊＊, Takao NAMIHIRA＊＊

○熊本大学大学院自然科学教育部＊, 熊本大学パルスパワー科学研究所＊＊
○＊Graduate School of Science and Technology, Kumamoto University, ＊＊Institute of Pulsed Power Science, Kumamoto University

Abstract:

The environmental improvements by non-thermal plasma have been actively studied for various applications. The observation of discharge plasmas is a beneficial for better understanding of the plasma physics of this growing field. Recently, nanosecond (ns) pulsed discharge with a short pulse duration of 5 ns achieved higher energy efficiency on ozone generation and NO removal. However, the underlying mechanisms of these high efficiencies remain unclear. In the present study, the newly developed high-speed imaging system combined with four emICCD cameras, which can observe the single ns pulsed discharge phenomenon at over time using a delay generator built-in each camera. Using this imaging system, the effects of inner electrode geometry on the propagation process (particularly propagation velocity distribution between electrodes) of ns pulsed discharge in coaxial electrodes were investigated. As the results, it was confirmed that the propagation velocity of streamer heads was significantly affected by inner electrode geometry and was changed depending on propagation position, not propagating constant propagation velocity.

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純酸素パルスバリア放電下における酸素原子及びオゾン密度の同時レーザー計測

Simultaneous Measurement of Atomic Oxygen and Ozone by Laser Spectroscopy under Pure Oxygen Pulsed Barrier Discharge

川北拓弥川北拓弥
Takuya Kawakita, Yusuke Nakagawa, Satoshi Uchida, Fumiyoshi Tochikubo

首都大院　システムデザイン
Department of System Design,
Tokyo Metropolitan University

Abstract:

Pure oxygen discharge is preferable for production of atomic oxygen and ozone, while there is the difficulty in measuring their local densities. The ozone density is usually measured by UV absorption, but its resolution is insufficient to measure the local ozone density in filamentary discharges. The atomic oxygen density can be measured by TALIF, but the ozone interference, which is the in-situ atomic oxygen production due to the ozone dissociation by incident UV light, disturbs the measurement. Therefore the compensation of ozone interference is important in atomic oxygen measurement. In this study, we achieved the separation of ozone interference from discharge-originated atomic oxygen, by focusing on the laser intensity dependence of TALIF signals on them. By varying the laser intensity in the TALIF measurement, the atomic oxygen density is separated from the ozone interference signals. Under short-gapped pulsed barrier discharge, the local ozone density in observed volume is estimated to be about 1 x 10^17 /cm3. The atomic oxygen density is also estimated to be 6.5 x 10^16 /cm3 using Xe compensation method, and it is consistent with the local ozone density. However, the estimated atomic oxygen density in the streamer filament does not agree with the experimental decay, which indicates either underestimation of the discharge volume or the influence of the reactions at the electrode surface.

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酸素放電中におけるガス加熱機構の詳細モデリング
Detailed modelling of gas heating process occurred in an oxygen discharge

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○Keigo YOSHIDA＊, Atsushi KOMURO＊, Akira ANDO＊

東北大学院工
Department of Electrical Engineering, Tohoku University

Abstract:

Thermal decomposition is one of the problems for ozone production and its applications. It is important to estimate the gas temperature variation occurred in oxygen discharge to optimize the ozone generator. In this study, gas temperature variation is estimated in detail from the reaction model including inelastic collision processes. The obtained results are compared with traditionally used gas heating model based on the consumed electrical power. The results indicate that the gas heating process through the inelastic collision process affect the temporal variations of the gas temperature after the discharge.

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針—水面放電に伴う水中電荷の挙動
Behavior of electric charge in water developed by needle-water discharge

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〇Akira SATO*,**, Satoshi UEHARA*, Tetsuji Shimizu*** and Takehiko SATO*

東北大学流体科学研究所*, 東北大学工学研究科**, 産業技術総合研究所
*Institute of Fluid Science, Tohoku University,**Graduate School of Engineering, Tohoku University , ***AIST

Abstract:

We clarified the factors relating to characteristics of a needle-water discharge. Among a position of an electrode on the water,an electrode under a container which was filled with a water, and an electrode in water to measure electric potential in water, the electrode on the water has the biggest influence on the behavior of the electric charge in water. On the other hand, the electrode in water to measure electric potential has the smallest influence on the behavior of the electric charge in water. The applied voltage and the container diameter change the behavior of the electric charge linearly.

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DC 放電と AC 放電を併用したプラズマアクチュエータの作動特性に関する実験的研究

Experimental Study on Working Characteristics of Plasma Actuator Utilizing Combination of DC and AC Discharges

〇畑本明彩未，中井公美，中野朝，西田浩之〇畑本明彩未，中井公美，中野朝，西田浩之
〇Asami HATAMOTO, Kumi NAKAI , Asa NAKANO, and Hiroyuki NISHIDA

東京農工大学
Tokyo University of Agriculture and Technology

Abstract:

Tri-electrode plasma actuator (TED-PA) induces jets from both the DC and AC electrode and it is stronger than that of conventional two-electrode plasma actuator. The jet from the DC electrode dominantly contributes to the stronger jet. In this report, we experimentally investigate the operation characteristics of discharge and jet generation at the DC electrode of TED-PA by taking discharge photographs and measuring flow velocity fields. And, those results are compared with those of two-electrode actuator which has only the AC and DC electrode. As a result, it is found that the DC discharge and jet generation is enhanced by the barrier discharge in TED-PA and the enhancement becomes more effective when the DC voltage is higher.

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ガソリンエンジン用点火プラグにおける流動により延伸した火花放電路の直径に関する考察

A Study on the Diameter of Elongated Spark Discharge Chanel in Flow Field in the Ignition Plug for Gasoline Engine

傅　建華傅　建華
Chien-hua FU

日本大学生産工学研究科
Graduate School of Industrial Technology, Nihon University

Abstract:

From the global CO2 reduction trend, improvement in thermal efficiency is required for the powertrain of automobiles. A promising direction for gasoline engine is lean burn. In the lean burn, since the laminar burning velocity is decrease, the turbulent flow is intensified to shorten the burning time. Stable ignition in the high velocity and turbulent flow is required in combination with the advance ignition timing. At this time, since the discharge path at the spark plug gap is elongated by the flow and it is assumed that the elongation of the discharge path affects the behavior of the ignition to flame propagation, it is important to understand the phenomena and to model the effect of such discharge path elongation on the ignition behavior. From this background, the discharge characteristics at spark plug gap in the flow were investigated using a small wind tunnel. The deformation of the discharge path in the flow was observed using a high-speed camera, and the current and voltage at the spark plug were measured. The relationship between them was investigated and compared with previous works. Especially in this report, the relations between the electric current and diameter of discharge path length are discussed analytically.

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電極材料の異なるスパーク放電装置を用いて生成したプラズマ栄養水の成分分析

Component Analysis of Plasma Nutrient Water Prepared by Spark Discharge System with Different Electrode Materials

○川野航平＊, 下村友人＊, 針谷 達＊, 滝川浩史＊, 井出健太郎＊, 日幷 勉＊, 爪光男＊＊
○川野航平＊, 下村友人＊, 針谷 達＊, 滝川浩史＊, 井出健太郎＊, 日幷 勉＊, 爪光男＊＊
○Kohei KAWANO＊, Yuto SHIMOMURA＊, Toru HARIGAI＊, Hirofumi TAKIKAWA＊, Kentaro IDE＊＊, Tsutomu HIBI＊＊, Mitsuo TSUME＊＊

豊橋技術科学大学＊, シンフォニアテクノロジー＊＊
＊Toyohashi University of Technology, ＊＊Sinfonia Technology Co., Ltd.

Abstract:

Plasma nutrient water which are prepared by spark discharge is able to improve the growth of plants. In a spark discharge system for the preparation of plasma nutrient water, high voltage electrodes are placed over water and a grounded electrode is submerged in the water. In this study, the components of plasma nutrient water prepared by spark discharge system with different electrode materials are investigated. High voltage electrodes were PtRh needle. Cu, SUS, Pt, and PtRh needles were used as a submerged electrode. The concentration of NO_3^- in plasma nutrient water was high when Pt and PtRh was used as the submerged electrode. The plasma nutrient water included metal elements being originate from the submerged electrode and high voltage electrodes. It was indicated that the metal component in the plasma nutrient water originating the submerged electrodes of Pt and PtRh was less compared with Cu and SUS submerged electrodes.

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水上パルス沿面放電の陰極降下電圧と電流密度
Cathode Fall Voltage and Current Density of Surface Discharge on Water

〇古里友宏＊, 坂本拓也＊, 山下敬彦＊〇古里友宏＊, 坂本拓也＊, 山下敬彦＊
〇Tomohiro FURUSATO*, Takuya SAKAMOTO* and Takahiko YAMASHITA*

長崎大学工＊
*Graduate School of Engineering, Nagasaki University

Abstract:

Elucidation of the interaction between liquid and plasma is an important theme in the field of plasma science. In this study, the time variation of the current density of the positive pulsed surface discharge on the water was investigated by taking into account the cathode fall voltage. The electric field in the creepage direction at the edge of discharge was calculated by a charge simulation method based on the similarity between current and electrostatic fields. In the field calculation, the contact area between discharge and water was assumed by a charged disk. The current density drastically decreases with time and converges to a few A/cm2. The fully converged value of the current density is the equivalent to the value of the direct current discharge on the water.

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ヒト由来培養細胞への大気圧低温プラズマ照射によって生じるゲノム DNA 損傷の解析

Analysis of genomic DNA damage in human cultured cells induced by low temperature plasma irradiation

〇春田 夏輝, 瀬戸 貴仁, 栗田 弘史, 高島 和則〇春田 夏輝, 瀬戸 貴仁, 栗田 弘史, 高島 和則
〇Natsuki HARUTA, Takahito SETO, Hirofumi KURITA, and Kazunori TAKASHIMA

豊橋技科大
Department of Applied Chemistry and Life Sciences, Toyohashi University of Technology

Abstract:

Chromosomal DNA damage in cold plasma-irradiated human lung cancer cell line was investigated. We confirmed cold atmospheric plasma produced reactive oxygen and nitrogen species (RONS) in a liquid, and the intracellular RONS level was increased in the plasma-irradiated cells. However, significant decrease in the cell viability was not observed 24 h after the plasma irradiation. Since RONS induce oxidative damage in biomacromolecules, strand breaks and chemical modification of genomic DNA was investigated by comet assay. As a result, not only DNA strand breaks which have been already investigated but also production of 7,8 dihydro-8-oxoguanine (8-oxoG) formation were induced by the plasma irradiation. In addition, expression of human OGG1, the major DNA glycosylase in human cells for removal of 8-OxoG, was also observed.

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自己放電型除電器具の性能比較方法
A method to compare the performance of induced field emission type electrostatic eliminator.

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Manabu HIRAI

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Osaka Research Institute of Industrial Science and Technology (ORIST)

Abstract:

Channel brushes which were induced-field-emission-type electrostatic eliminators were compared by using an apparatus specified in Japanese Industrial Standards. A grounded specimen was put between the wooden block and electrical potential detector of the apparatus. The initial electrical potential of nylon cloth was measured after ten frictions by the cotton cloth for each specimen. The values between +1.2 kV and 5.5 kV were obtained against the specimens. These values contained between 9.4 % and 43 % smaller than that of the blank sample.

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空間制御された大気圧空気中正極性ストリーマ放電の 2 次元電子密度分布測定

Two-Dimensional Electron Density Measurement of Spatially-Controlled Positive Streamer Discharge in Atmospheric-Pressure Air

○稲田優貴＊, 小野亮＊＊,
小室淳史＊＊＊, 熊田亜紀子＊＊, 日高邦彦＊＊, 前山光明＊
○稲田優貴＊, 小野亮＊＊,
小室淳史＊＊＊, 熊田亜紀子＊＊, 日高邦彦＊＊, 前山光明＊

○Yuki INADA*, Ryo ONO**, Atsushi Komuro***, Akiko KUMADA**, Kunihiko HIDAKA**, and Mitsuaki MAEYAMA*

埼玉大学＊, 東京大学＊＊, 東北大学＊＊＊
* Division of Mathematics, Electronics and Information Sciences, Saitama University
**Department of Electrical Engineering and Information Systems, The University of Tokyo
***Department of Electrical Engineering, Tohoku University

Abstract:

A Talbot type laser wavefront sensor with a temporal resolution of 2 ns was applied for single-shot two-dimensional electron density measurement of pulsed positive secondary streamer discharges generated in a form of a spatially-reproducible single filament. The electron density in the primary streamer was 1014-15 cm-3, which agreed well with previous simulation results. On the other hand, the experimentally observed electron density at the secondary streamer initiation was three times higher than that at the primary streamer arrival at the cathode, which has not been predicted in the previous simulation studies.

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ダイヤモンド電極を用いた
電解処理による下水臭の除去

Removal of a Sewage Odor by Electrolytic Process Using Boron-doped Diamond Electrode

〇水野良典＊, 村上栄造＊〇水野良典＊, 村上栄造＊
〇Yoshinori MIZUNO＊, Eizo MURAKAMI＊

株式会社朝日工業社＊
＊Asahikogyosha Co., Ltd.

Abstract:

Ozone water could be generated by electrolytic process using Boron-Doped Diamond (BDD) electrode. In this paper, deodorization of sewage odor gas (Hydrogen Sulfide; H2S, Methyl Mercaptan; CH3SH) by electrolytic process was investigated. Current efficiency of ozone generation and ozone energy yield were 2.0 %, and 0.5 g/kWh, respectively. Deodorization effect was experimented by odor gas bubbling to electrolytic cell. Without electrolysis, odor gas was emitted from absorbing solution due to the Henry's law. Sulfur odor gas could be eliminated by dissolved ozone generated by BDD electrolysis.

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エレクトレットフィルム発電デバイス
Application of piezoelectric electrets to energy-harvesting system

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平本 真輝＊, 中辻 貴大＊, 金子 侑生＊, 名切 卓男＊
井元 健二＊＊, 改森 信吾＊＊＊, 志方 良彰＊＊＊, ○田實 佳郎＊宝田 隼＊, 髙谷 航平＊, 田中 信悟＊, 柳本 光輝＊, 中西 陸＊
平本 真輝＊, 中辻 貴大＊, 金子 侑生＊, 名切 卓男＊
井元 健二＊＊, 改森 信吾＊＊＊, 志方 良彰＊＊＊, ○田實 佳郎＊
Jun Takarada*, Kohei Takatani*, Shingo Tanaka*, Hiroki Yanagimoto*, Riku Nakanishi*
Masaki Hiramoto*, Takahiro Nakatsuji*, Yuki Kaneko*, Takuo Nakiri*
Kenji Imoto**, Singo Kaimori***, Yoshiaki Shikata*** and ○Yoshiro Tajitsu*

関西大学大学院＊, 井元製作所＊＊, 住友電気工業＊＊＊
*Kansai University, **Imoto Mech. Eng, ***Sumitomo Electric Industries, Ltd.

Abstract:

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マイクロ波プラズマ源を用いた真空用除電器の開発Ⅱ
Development of a vacuum neutralizer using a microwave plasma sourceⅡ

〇最上智史＊,峯村和樹＊, 野村信雄＊,細田聡史＊＊,神田大樹＊＊,森下貴都＊＊＊〇最上智史＊,峯村和樹＊, 野村信雄＊,細田聡史＊＊,神田大樹＊＊,森下貴都＊＊＊
〇Tomofumi Mogami*,Kazuki Minemura*,Nobuo Nomura*,Satoshi Hosoda**, Daiki Koda** and Takato Morishita***

春日電機＊, JAXA＊＊, 東京大学＊＊＊
*Kasuga Denki INC, **Japan Aerospace Exploration Agency Institute of Space and Astronautical Science , ***The University of Tokyo

Abstract:

The number of production processes in vacuum is increasing. Along with this, the demand for neutralization in a vacuum is increasing. Therefore, in this study, a neutralizer using a microwave plasma source which can be used in a vacuum was developed. A vacuum neutralizer was placed in the upper part of the experimental chamber (vacuum degree 3×10−3Pa),and a film running apparatus was also installed. This apparatus was used to investigate the neutralizing ability of a vacuum neutralizer. The charge potential measurement of the film confirmed that the neutralizing ability of the vacuum neutralizer was sufficient.

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大気圧アルゴンプラズマ照射で生成する気相・液相活性種の関連性
Gas- and Liquid-phase Reactive Species Generated by Atmospheric Pressure Argon Plasma

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Takahito Seto*, Hirofumi Kurita*, Kenkichi Nagato**, and Kazunori Takashima*

豊技大*, 高知高専**
Toyohashi University of Technology*, National Institute of Technology, Kochi Collage**

Abstract:

Reactive oxygen and nitrogen species (RONS) produced by an atmospheric pressure plasma jet in both the gas phase and the liquid phase were measured to investigate the production characteristics. Both of the measurements have been already carried out; however, these results were not consistent with each other. The gas phase measurement was performed with an atmospheric pressure mass spectroscopy equipped with an orifice (0.25 mm diameter). It was considered that the reason was the difference of the target size; the liquid surface was sealed by a plastic film with a small hall (0.26 mm diameter) As a result, it was possible to measure RONS in the plasma irradiated liquid under this condition, and this experimental setup improved spatial resolution. Furthermore, the results showed better correlation with the results obtained by mass spectrometry than that obtained in the previous study.