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13aWT-1

水中気泡内交流放電による有機フッ素化合物 PFOS の分解

○鈴木大輔＊，竹内希＊＊，＊

東工大工＊，産総研＊＊

Abstract:

Perfluorooctanesulfonic acid (PFOS) was used for various industrial products due to its chemical stability and physical characteristics. However, recent studies indicate that PFOS is environmentally persistent and cannot be decomposed by conventional water treatment. In this paper, we conducted decomposition of PFOS using AC discharge within Bubble in Water. As the frequency increases, the generation amount of F- also increases. Although it increases proportionally up to a certain value, the trend of increase from a certain value is not proportional.

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水処理用パルス放電プラズマリアクタへの Coanda 効果の適用

○林田智仁，花畑良輔，古木貴志，赤峰修一，立花孝介，市來龍大，金澤誠司

大分大学

Abstract:

It is difficult to decompose organic compounds in liquid with conventional water treatment. In order to solve this problem, we have focused on atmospheric pressure plasma and have studying for water treatment. In the previous study, we found the effectiveness of the Coandă effect. We also adopted Coandă effect to a reactor used in this experiment and attempted to improve the decolorization rate. An indigo carmine solution with a concentration of 10 mg/L and a volume of 300 mL was decolorized by a plasma driven by a pulsed high voltage (15 kV, 100 pps) and influences in decolorization rate with and without Coandă effect were measured. The decolorization rate with Coandă effect was better than that without Coandă effect and showed the effectiviness of Coandă effect.

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13aWT-3

教師リカレント用教材としての オゾンによる汚損水浄化装置

山野芳昭

千葉大学教育学部

Abstract:

An equipment of water purification by Ozone bubbling was designed and constructed in order to apply to a teaching material in a recurrent program for teachers. The ozone was produced by the barrier dis-charges. The electrode for the discharge was equipped in a cylindrical insulating pipe. The applied high voltage to the electrode was 10 – 14 kVpp of ac 20 kHz. The air with ozone gas was introduced to methylene blue water solution with a rate of 5 L/min through the porous ceramic stone to produce small bubbles in a PET bottle of 400 ml. The concentration of the solution was 1 mg/100 cc. The generation characteristics of the barrier discharges were almost unchanged during the voltage application of 120 min. It was confirmed that the effect of the ozone gas was clearly demonstrated using the equipment. However, the time required for the experience using the equipment was about 100 min, which is rela-tively long for the demonstration in one lecture period. Accordingly, further improvement is required to shorten the time of the experimental observation to know the effect of ozone gas.

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13aWT-4

パルス放電プラズマ-超音波複合処理によるフェノールの分解

○大瀧悠裕，熊澤祐哉，黒木智之，大久保雅章

大阪府立大学大学院・工学研究科・機械系専攻

Abstract:

We investigated phenol decomposition in water using pulsed discharge plasma combined with ultrasound. The discharge plasma of spark and streamer modes is used, and the initial concentration of phenol is also changed. As a result, the effect of ultrasound on discharge plasma depends on the shape of the ground electrode and the strength of ultrasound. Ultrasound does not affect discharge plasma directly, but bubbles generated by discharge plasma are moved by ultrasound and have an effect on discharge plasma. Removal efficiency depends on the initial concentration of phenol, but plasma discharge does not occur in the highest concentration.

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13aWT-5

ICCD カメラを用いた水中気泡内パルス放電の進展観測

○高橋克幸＊，＊＊，小林昌太＊，永田湧成＊＊＊，
武田尚大＊，高木浩一＊，＊＊，浪平隆男＊＊＊，＊＊＊＊

岩手大学理工＊，岩手大学次世代アグリイノベーション研究センター＊＊，
熊本大学自然科学研究科＊＊＊，熊本大学パルスパワー科学研究所＊＊＊＊

Abstract:

Development of discharge inside bubble in water is observed using two high speed gated ICCD cameras. A tungsten wire is inserted into a glass tube, which is immersed in water. The pulsed high voltage is generated using an inductive energy storage system pulsed power generator driven by SI-Thyristor. Two ICCD cameras with their optical axes perpendicular to each other are used to take two orthogonal images. The discharge propagates into the bubble from tip of the wire in the glass tube. Then, the discharge propagates along the bubble surface. The maximum length of discharge propagation decreases with increasing water conductivity. Indigo carmine, a common used organic dye, was used as chemical probe of active species produced by discharge inside bubble. The energy efficiency for indigo carmine decomposition in the water decreases with increasing water conductivity. These results show that the amount of active species consumed in loss reactions such as their recombination increases with decreasing the length of discharge propagation.

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13aWT-6

プラズマジェット照射が誘起する液体流に雰囲気ガスが与える影響

○川崎敏之＊, 川口諒＊＊, 西田佳祐＊＊,間結夏＊＊, 内田儀一郎＊＊＊,竹中弘祐＊＊＊, 古閑一憲＊＊＊＊,節原裕一＊＊＊, 白谷正治＊＊＊

西日本工大 工＊, 日本文理大 工＊＊, 阪大 接合研＊＊＊, 九大 院シス情＊＊＊＊

Abstract:

Several recent reports have highlighted the importance of plasma-induced liquid flows and mixing effects in various plasma-liquid systems. The plasma-induced liquid flows can enhance the specific plasma effects in applications involving liquids. Up to the present, two types of flows have been observed in a liquid target of a plasma jet. We used a PIV method to study the effects of surrounding gases of a plasma jet on plasma-induced liquid flows. Nitrogen, nitrogen and oxygen mixture, and oxygen gases were supplied to the surrounding of a plasma jet generated in helium gas. The results clearly indicated that oxygen in the surrounding gas is a key factor for the flows. An increase of oxygen concentration enhanced the flows linearly extending in the depth direction. We have to study the relationship between oxygen addition and the plasma-induced flows.

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オゾン気泡を含む流水中でのパルス放電の発生とインジゴカルミン分解への効果

○山口宗一郎＊，尾山太一＊＊，中野良祐＊＊，大澤直樹＊＊

金沢工大院工＊，金沢工大工＊＊

Abstract:

In this research, we investigated the effect of pulsed discharge application on an indigo carmine solution with ozone gas bubbles. The result showed that (1) the straight pulsed discharge was generated between pin electrodes and it was not influenced by the water stream and bubbles, (2) the decomposition time of pulsed discharge inside indigo carmine solution with ozone bubbles became shorter than that of only ozone bubbles treatment, (3) emission spectra of OH radical (309 nm) and Hα (656 nm) were observed when pulsed discharges are generated inside water with air bubbles, on the other hand, emission spectra of OH radical (309 nm), Hα (656 nm), and O radical (777 nm) were observed when pulsed discharges were generated inside water with ozone bubbles, and (4) O radicals produced by reacting ozone molecules with high energy electrons contribute to generating OH radicals.

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13aWT-8

水上コロナ放電処理における溶液循環の影響

○久保基
見市知昭

大阪工業大学

Abstract:

The influence of solution circulation on water treatment using DC corona discharge over water was investigated. The water treatment was performed by the batch reactor or the reactor of the solution circulation type. It was found that acetic acid was decomposed most in the case of the batch reactor. Furthermore, the concentrations of dissolved ozone and dissolved hydrogen peroxide did not depend on the amount of decomposition of acetic acid.

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13aWT-9

誘電体バリア放電を用いた水処理リアクタのエネルギー効率の向上への検討

○花畑良輔,古木貴志,立花孝介,赤峰修一,市來龍大,金澤誠司

大分大　理工

Abstract:

In the current water treatment methods, it is difficult to completely decolorize colored water, such as dye solution. Therefore a new treatment technology which can decolorize the colored water completely are required. In the water treatment using discharge plasma, high treatment ability can be obtained by generating active species such as OH radicals. Since they have a very short lifetime, it is important to make a structure where the treatment solution can react with the active species efficiently in order to improve energy efficiency G50 [g/kWh]. We introduced the Coandă effect, which is a tendency of a jet flow being attached to a surface of a nearby object, into a new plasma reactor, and the treatment solution was swirled efficiently. In addition, we introduced the Postdischarge reactions, which are chemical reactions occurring in the treatment solution after the discharge is turned off. We have shown that the plasma reactor with Coandă effect improved the treatment speed and the energy efficiency G50 of the decolorization, and Postdischarge reactions increased the energy efficiency G50.

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13pS-1

微細毛構造を用いた静電チャック

齊藤滋規

東京工業大学環境・社会理工学院教授
> 教授

Abstract:

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13pC-1

気流剥離様相とナノ秒パルス駆動型 DBD プラズマアクチュエータによる気流制御効果の関係

○菅野将輝，小室淳史，鈴木健人，野々村拓，浅井圭介，安藤晃

東北大学工学研究科電気エネルギーシステム専攻

Abstract:

A nanosecond pulsed-driven dielectric-barrier-discharge plasma actuator (ns-DBDPA) was applied to the flow separation control on the three different shapes of airfoils, that is NACA 0015, NASA-CRM and Gottingen 387. The force and pressure measurements showed that these three airfoils exhibit different characteristics of the flow separation mode such as the leading-edge separation and the trailing-edge separation. The effects of the ns-DBDPA are different depending on these flow-separation modes. In this experimental conditions, the ns-DBDPA attached at the leading edge of the airfoil was effective for the leading-edge separation control regardless of the airfoil shape.

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13pC-2

液体を用いた新しい姿勢検出システム開発の一考察

益子康太朗○，八塚京子

山形大院理工

Abstract:

Many types of gyro sensors are utilized for detecting the position and the orientation of an object, like as a smartphone. Such gyro sensors detect the force generated by the motion. In this report, we have proposed another kind of gyro sensor system with a fluid to detect the orientation of the object as a result of the gravitational force. In this system, even though a vessel is rotating, the liquid surface in it will be retained still. We examined two methods to detect; the change of the resistance between a pair of electrodes, and the change of the capacitance with the rotating angle. For the measuring the current between the pair of electrodes, the electrodes contact with the liquid and then the Electrochemical reaction often occurs. Detecting the change of the capacitance makes the measuring circuit complex and the shape of the detecting system limited. The advantage and disadvantage aspects in those two systems have been discussed.

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13pC-3

DBD-PA 用磁気圧縮パルス電源の開発と動的失速流れ制御への応用

○鈴木健人＊, 小室淳史＊, 菅野将輝＊, 小池一未＊,南海昂輝＊, 高島圭介＊, 安田英将＊＊, 越智章生＊＊, 葉山賢司＊＊,辻内智郁＊＊, 中北和之＊＊＊, 満尾和徳＊＊＊, 野々村拓＊, 金子俊郎＊, 安藤晃＊ ,浅井圭介＊

東北大院工＊, 川崎重工＊＊, JAXA＊＊＊

Abstract:

A nanosecond pulse-power spply has been developed for the nanosecond-pulsed-driven plasma actuator (ns-DBDPA) whose length is 1 m long and it was applied to the flow separation control on periodically oscillated NACA 0012 airfoil. The pulse-power supply is consisted of one saturable transformer and two saturable magnetic core for the pulse compression and the special attention were paid for the output cable and plasma actuator's electrode to reduce the electromagnetic noise. In the wind-tunnel experiment, the airfoil was driven in 4 Hz of periodic cycle and the ns-DBDPA was operated in 100 Hz of the discharge frequency. The lift increase is mainly observed when the angle of attack decreases, which is possibly synchronized with the vortex shedding induced by ns-DBDPA actuation. The voltage amplitude applied to ns-DBDPA does not affect the flow control effectiveness. It might be because the plasma actuator effect is already saturated in the range we investigated. Therefore, it is possible to optimize the pulse power supply more which results in reducing its size and weight.

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13pC-4

住宅床面における埃の静電特性のフラクタル的考察（Ⅰ）

○大谷昌生＊，宮内佑輔＊＊，早坂亮＊＊，川島健弥＊＊，金井徳兼＊

神奈川工科大学大学院 工学研究科 電気電子工学専攻＊，
神奈川工科大学 創造工学部 ホームエレクトロニクス開発学科＊＊

Abstract:

Electrostatic properties of dust have not been thoroughly investigated and studied. We think can measure the amount of dust on floor can be measured by considering the electrostatic properties of dust. Figure made by dust on the floor in as summed fractal shapes. In this report, we demonstrate the relationship between capacitance of dust condenser and figure made by dust experimentally.

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13pC-5

大気圧低温プラズマ照射処理を行った生理食塩水が低酸素脳症モデルラットに与える影響の考察

○松田清香，細井戸健人，小林千尋，森晃

東京都市大学

Abstract:

In recent years, atmospheric-pressure plasmas are applied in the medical applications. Although the mechanism of action remains unclear, new biomedical applications of plasma have been found. Experiments using atmospheric pressure plasmas confirmed several effects such as burn healing with angiogenesis. We believe that plasma properties are involved in plasma healing effects. However, there are still many unclear points about the healing mechanism of living bodies by plasma, and it is the present situation that clear evidence has not been obtained. We have been focusing treatment of Hypoxic Ischemic Encephalopathy (HIE). HIE caused by the discontinuation of blood supplied means that a part of the brain is necrotized and a brain function is impaired. There is no fundamental therapy for HIE except for symptomatic therapy as of now. In this paper, plasma irradiated physiological saline was used as a method of using plasma for HIE. Through influence on HIE due to administration of plasma irradiated physiological saline and examination on physiological saline solution by plasma irradiation, we estimate influence factors of plasma on living body, especially HIE.

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13pC-6

高電界パルス印加による 大腸菌の漏出した核酸の大きさと印加波形の関係

山下遼　佐藤拓直　村上祐一　村本裕二

名城大学

Abstract:

High electric field pulse has been used the sterilization of cell. In this paper, we report the relationship between size of leaked nucleic acid of Escherichia coli (JM103) and the voltage waveform by high electric field pulse application. The sample is 1.0×10-3 mol/L NaCl aqueous solution contained E. coli. High voltage pulse (－10 kV) is applied once to the sample at room temperature. As results, in pulse waveforms with fast rise time we could not detect DNA and RNA. In pulse waveforms with slow rise time we could detect DNA and RNA.

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13pC-7

炭素電極を用いた流通式 PEF 殺菌装置の開発と日本酒殺菌への応用

○谷野孝徳＊、＊＊, 松井雅義＊, 廣澤充＊, 茂木玲央＊, 大嶋孝之＊、＊＊

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＊＊

Abstract:

Pulsed electric field (PEF) flow reactors using carbon material as the electrodes were developed. Carbon cloth was employed as an electrode material and two types of reactors with parallel- and cross-flow to the electrode surfaces were constructed. PEF treatment using carbon electrodes was successfully achieved inactivation of E. coli, and the cross-flow type reactor showed higher inactivation efficiency than that of the parallel-flow type reactor. Inactivation of microbes in sake was carried out with the cross-flow type of PEF flow reactor. In the inactivation of the sake yeast, decrease in living cell number in suspension of four orders was achieved after 3 passes of PEF treatment. In the inactivation of Lactobacillus homohiochi, which causes spoilage of fermentation mash, this microbe was also inactivated by PEF treatment using carbon electrodes but was not completely inactivated even after 5 passes of PEF treatment.

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13pC-8

減圧下誘電体バリア放電による球状固体表面の殺菌

○須田健太*、上原建佑*、谷野孝徳*、**、松井雅義*、大嶋孝之*、**

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

Abstract:

Heat sterilization has been used as a major method for the inactivation of bacteria in the food industry. However, there are some disadvantages of this method such as the long-term processing time to inactivate bacterial spores and the decomposition of nutrients, the deterioration of flavor and the discoloration of the food. Therefore, we focused on the application of dielectric barrier discharge (DBD) to the effective non-heat sterilization of various particulate foods such as beans and spices. We developed a device capable of generating DBD under reduced pressure and evaluate its performance of the sterilization of bacterial spores on the surface of glass beads as a model of particulate foods. As a result, bacterial spores were completely inactivated within 240 seconds of DBD treatment at a discharge distance of 6 mm. The effects of ozone, hydroxy radical and heat on the inactivation of bacterial spores by DBD treatment were also investigated.

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13aD-1

コロナ放電を用いた除電における印加電圧の影響

○久保勝也*，高橋克幸*，**，高木浩一*，**，竹内希***，****，山口晋一*，*****，永田秀海*****

岩手大学理工*，岩手大学次世代アグリイノベーション研究センター**，産総研環境管理***，東工大工学院****，シシド静電気*****

Abstract:

Influence of frequency of applied voltage on electrostatic elimination using corona discharge is investigated. The corona discharge is generated using a needle to ring electrodes with high voltage AC. The compressed air is supplied to an air nozzle to generate the air flows from the electrodes to the ion trapping metal plate. The amount of charge per half cycle decreases and the discharge current increases with increasing the frequency of the applied voltage. The static elimination time increases with increasing the frequency of the applied voltage and it's suppressed by increasing the air velocity. The plate voltage (ion balance) increases with increasing the frequency when the frequency is lower than 250 Hz. On the other hands, that decreases with increasing the frequency when the frequency is higher than 250 Hz. Positive and negative ions coexist in the static elimination space with increasing the frequency, and its density increases. Then, recombination of generated ions and reduction of Coulomb force from the plate occur. Negative ions with higher mobility than positive ions are easy to flow into the plate. Therefore, the static elimination time increases and the ion balance decreases with increasing the frequency of the applied voltage.

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13aD-2

マイクロ波プラズマ源を用いた 真空用除電器の開発

○最上智史＊,峯村和樹＊, 野村信雄＊,細田聡史＊＊,神田大樹＊＊,森下貴都＊＊＊

春日電機＊, JAXA＊＊, 東京大学＊＊＊

Abstract:

The number of production processes in vacuum is increasing. Along with this, the demand for neutralization in the vacuum is increasing as well. Therefore, a neutralizer using a microwave plasma source which can be used in a vacuum was developed in this study. A vacuum neutralizer was placed in the upper part of the experimental chamber (vacuum degree 3×10 −3 Pa), and an electrode was placed in the lower part of the chamber. The neutralization current was measured at this electrode, and the neutralization ability of the neutralizer for vacuum was examined. Compared to a much higher neutralization current was measured.As a result vacuum neutralizer with a sufficiently high neutralization capacity in a vacuum was developed.

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13aD-3

高速バルブを用いた プラズマ放電式除電器の開発

○峯村和樹＊,最上智史＊,野村信雄＊,池畑隆＊＊

春日電機＊, 茨城大学＊＊

Abstract:

In recent years, processing steps under high vacuum such as LSI manufacturing process have been increasing.Along with this, the demand for neutralization in a vacuum is increasing.

Therefore, in this study, a neutralizer was developed using plasma neutralization in vacuum using a high-speed valve.A plasma discharge type neutralizer was placed in the upper part of a large experimental chamber, and an electrode connected to an atmospheric ion monitor was placed in the lower part of the chamber.The neutralization rate of the plasma discharge type neutralizer was measured using this electrode.

It was possible to develop a vacuum neutralizer which can be neutralized at a higher speed than that of a general neutralizer and can be sufficiently used even in a vacuum.

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13aD-4

真空中のプラズマ除電のモデル

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茨城大学大学院理工学研究科

Abstract:

Static elimination of charged objects in vacuum by irradiation of plasma flow has been investigated theoretically based on the double probe model as a method to mitigate electrostatic hazards in vacuum processes of electronic devices. Analytical solutions have suggested specific features of the method such as linear potential decay as a function of time, very short elimination time and unbalance between positive and negative neutralizing currents, as a result, static elimination times. These results support that the plasma works as a conductor to short-circuit between the charged object and the grounded chamber. A concern to be further investigated such that impact of high-energy ions on the object may cause damage to it has been pointed out as well.

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13aD-5

アルゴン中でのマイクロギャップ放電による摩擦帯電緩和の効率

○三浦崇

○労働安全衛生総合研究所

Abstract:

Triboelectrification by sliding friction between a stainless steel pin and a fused quartz disk was measured in a vacuμm, argon-nitrogen mixtures, and neon. The initial charge separation by friction was determined by the measurement in a vacuμm. In ambient gases, the charge separation process and intermittent micro-gap gas discharge were repeated during friction. The rates of residual charge was calculated as the net value of electrification in the ambient gas divided by amount of the initial charge. The rate in pure argon at 1 atm was about 1% which was much smaller than the rate of about 25% in pure nitrogen and the rate decreased with increase of partial pressure of argon in the mixture. The neon gas indicated highly reduction effect that is similar with argon.

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13aD-6

グリシン粉体とL-イソロイシン粉体の静電気特性の比較

○加藤智規*,崔光石**,金佑勁***

○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***

Abstract:

Electrostatic characteristic, in particular, the volume resistivity, charge-to-mass ratio, and minimum ignition energy (MIE) of Glycine and L-isoleucine powder were experimentally investigated. The results show that the volume resistivity, charge-to-mass ratio, and MIE of glycine were 2.7 × 10 9 Ωm, 62 nC/g and 540 mJ, respectively. These values indicate that Glycine powder is classified as low electrostatic risk. In the other hand, L-isoleucine powder had 1.2 × 1013 Ωm, 6.4 nC/g, and 4 mJ, respectively. These results demonstrate that L-isoleucine powder is a material very sensitive to electrostatic charges and/or discharges to require the prevention of dust explosions in the process industries.

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13aD-7

粉体投入時におけるサイロ内の突起物からの静電気放電

崔光石、長田裕生、遠藤雄大、鈴木輝夫

独立行政法人労働者健康安全機構労働安全衛生総合研究所

Abstract:

This paper has experimentally introduced the electrostatic discharges occurred from protrusions inside a conical-cylindrical silo during the loading of powders. A full-sized pneumatic powder transport facility polypropylene (PP, 2-3 mm in size) were used for this test. The loading PP powders was 0.38 kg/s.The five different dimeters of metal protrusions, may affect the electrostatic discharging of granules. This needs to be examined in the future. As the results, the electrostatic discharges (brush discharges) from protrusions during the loading of PP pellet in were clearly observed. The discharges during time was increased with the increase of dimeter of protrusions. In additions, the charge amount and maximum current of brush discharges with several different test conditions was measured and discussed.

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13aD-8

粉体の投入・排出中におけるフレキシブルコンテナの表面電位

長田裕生、崔光石、遠藤雄大、鈴木輝夫

春日電機株式会社

Abstract:

Powder handling operations are conducted to support our daily life and industrial society. However, industrial accidents caused by electrostatic charges or/and discharges on powders are sometimes happened with an insulating flexible container. This paper reports surface voltages on a flexible container bag during power loading and unloading. Polypropylene pellets (PP, 2-3 mm, about 150 kg) was used as power sample. As a result, the maximum surface voltage exceed the 120 kV. And surface voltage decreased by increasing relative humidity.

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13aD-9

ブラシ放電防止の液体充てん流速

大澤敦

労働安全衛生総合研究所

Abstract:

This paper discusses the maximum filling velocity to prevent brush discharges on liquid surface employed in the latest international standard, IEC 60079-32-1, while it requires specified conditions for tank diameter, the ratio of height/diameter of tanks and the charge relaxation time of liquids to obtain the maximum filling velocity as an equation. The model to obtain the maximum velocity, however, does not require such conditions. We show then the model here again and implement some examples of inquiries except for the specified conditions.

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13pD-1

静電気放電によりウェアラブル機器が受ける電気的ストレスの回路インピーダンス依存性の検討

○田中武蔵，吉田孝博

東京理科大学
工学部電気工学科

Abstract:

In actual situation that wearable devices are used, there is a situation that the device is charged to high voltage and potential of the human body and the device rapidly drops when electrostatic discharge (ESD) is occurred. Therefore, in our previous study, we have measured ESD stress induced on portable oscilloscope that was worn by charged human when ESD from charged human body to the surrounding object occurred.

However, we have measured only three ways of impedance conditions of an input circuit of the portable oscilloscope in the previous study. Therefore, in this study, in order to consider circuit impedance dependency of the ESD stress induced on a wearable device by ESD, we measured and analyzed induced voltages on the portable oscilloscope for ten kinds of resistance value connected to input terminal of the portable oscilloscope. From the result, it is found that the amplitude of long duration induced voltage and its time constant are affected by the resistance value of the input circuit.

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13pD-2

放電電流プローブを用いた人体からの放電電流の計測

早田裕

プローブテック

Abstract:

Discharge from the human-body after taking off the jacket was measured by the discharge-current probe. The current waveforms were measured five-times a day and almost everyday, and then continued more than year and a half. The maximum value of the current-waveforms reached 24A in 2017 January and 31.7A in 2018 February. The peak-values were plotted as functions of the temperature and the humidity, furthermore were correlated well with the absolute humidity. The waveforms were varied widely, therefore classified three types of impulse-, one-peak- and others-waveforms. It was recognized that the impulse-type waveforms were characterized to appear mostly more than 10A.

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13pD-3

ゴムパッキンの剥離帯電に起因する火災原因の検証

田村裕之

消防研究センター

Abstract:

An explosion occurred when a worker opened a manhole of a battery room containing lead-acid batteries, and several workers were killed or injured. It was thought that hydrogen gas was ignited by discharge caused by peeling electrostatic charge of a rubber packing used for the manhole. Measurement of resistivity of the rubber packing and charging experiments were carried out. The rubber packing used for 9 years, the resistivity increased greatly. The peeling electrostatic charge of a rubber packing was found to be -18 kV in some cases. It is necessary to perform the electrical bonding between conductors during the opening work of a manhole. Also, it is necessary to periodically replace a rubber packing.

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13pD-4

直流重畳型ナノ秒パルス高電圧発生装置の出力特性及びその応用

○鳥越泰明*、王斗艷**、浪平隆男**

○熊本大学大学院自然科学研究科*, 熊本大学パルスパワー科学研究所**

Abstract:

Non-thermal plasma generated by pulsed discharge is expected to treat combustion exhaust gases such as nitrogen oxide (NOx) and sulfur oxide (SOx) due to high chemical activity. Nanosecond pulsed discharge which has voltage rise time and fall time of 2ns, pulse width 5 ns and peak value of 60 kV, has been developed by our group. Nanosecond pulsed discharge mainly consists of streamer discharge phase, so that heat loss which caused by glow discharge is less, and plasma impedance is kept constant during the streamer discharge phase. Therefore, impedance matching between pulsed power supply and discharge load is possible. Applications on ozone generation and NO treatment using nanosecond pulsed discharge are reported with high energy efficiency compared to other discharge methods. However, the discharge mode transit to arc discharge phase sometimes. Also, for industrial applications, the plasma processing capacity leaves room to improve. In this study, DC superimposed nanosecond pulsed discharge is suggested in order to improve the better performance of nanosecond discharge plasma. Results of ozone generation and NO treatment using DC superimposed nanosecond pulsed discharge have also been introduced.

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13pD-5

絶縁被覆接地電極とワイヤ高圧電極の荷電性能に関する研究

○永吉健太郎、栗田加奈絵

株式会社富士通ゼネラル研究所

Abstract:

An ionizer of insulation coating GND-electrodes and wire HV-electrodes was measured about a discharge current characteristic, the electric charge and the ozone generation. Ion space of pulse electric charge different from DC corona discharge appeared and ozone reduction was observed.

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13pB-1

誘電体バリア放電による希薄メタン予混合燃焼安定化

○石川祐太、小野亮

東大新領域

Abstract:

Nonthermal plasma can assist combustion because it produces a lot of reactive species. In this paper, we aim to stabilize lean premixed methane combustion and reduce the emissions of NOx, CO, and HC by applying DBD plasma. The experiment is carried out to investigate emission component concentration with changing various parameters such as equivalent ratio and applied voltage. First, the combustion reactor is imploved to suppress heat loss. The result of experiment using plasma shows that production of CO is suppressed and the combustion continues in an ultra-lean condition that cannot be sustained without plasma. On the other hand, the plasma itself produces NO because of its reactivity. It is suggested that most of NO are produced in flame zone.

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13pB-2

プラズマ・触媒反応による CH4/CO2 改質の反応速度論的解析

○坂田謙太，亀島晟吾，Zunrong Sheng，渡邊善紀，野崎智洋

東京工業大学　工学院機械系

Abstract:

Pulsed dry methane reforming (DMR: CH4 + CO2 = 2H2 + 2CO) in a dielectric barrier discharge (DBD) and La:Ni/Al2O3 catalyst hybrid reaction was investigated with CH4/CO2 ratio of 0.5–1.5. DBD-catalyst hybrid reaction and thermal reaction without DBD were carried out at the same catalyst temperature of 600 °C. CH4, CO2 conversions and H2, CO yields were enhanced dramatically by applying DBD. CH4 conversion and H2 yield monotonically increased with increasing CH4 fraction in the feed gas. However, CO2 conversion and CO yield turned to decrease at CH4 fraction > 0.5 in which the carbon deposition occurred by CH4 decomposition reaction (CH4 = C + 2H2). The reaction enhancements would suggest the overall reaction order for both CH4 and CO2 increased in the presence of DBD.

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13pB-3

ホール型電気集塵装置におけるイオン風と粒子挙動の解析

○宮下 皓高 ＊,
江原 由泰 ＊,
乾 貴誌 ＊＊,
青木 幸男 ＊＊,
西田 英幸 ＊＊

東京都市大学＊,
富士電機株式会社＊＊

Abstract:

Due to the adverse effects of air pollutants on human bodies and the serious environmental pollution problems, even higher performance air purification techniques are required. Particularly, exhaust gas from diesel engines contains a large amount of PM, and these exhaust gas regulations annually have been strict. The electrostatic precipitator (ESP) are means to collect PM. The low resistive diesel engine particles are detached from the collection electrode, which causes the particle re-entrainment, resulting in poor collection efficiency. To address this problem, a new hole-type ESP was developed to overcome the re-entrainment in the ESP. The authors thought that the performance evaluation and design of Hall type ESP is important. Therefore, the electric field, fluid, particle behavior in Hall type ESP was analyzed. In the electric field analysis, the electric field is high at the edge of the hole. It was considered that the electric field is increased by the edge effect and the particles are likely to be induced into the hole.

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13pB-4

被選別原料中の樹脂混合比率に基づいた静電選別技術の開発

○西川　祐介*，梅村　園子*，三木　伸介*，井関 康人**

三菱電機株式会社 先端技術総合研究所*，リビングデジタルメディア事業本部**

Abstract:

This paper examined the influence of composition ratio of ABS (Acrironitrile-Butadien-Styrene) resin and PS (Polystyrene) resin in electrostatic separation for residual plastics from shredded household appliances. The composition of the plastic mixtures is not constant because it is affected by the type and number of consumer electronics being collected. In the electrostatic separation using the triboelectric charging between the plastics, there was a problem that the composition variation of the plastic mixtures influences the efficiency of separating1). In this investigation, we tested the electrostatic sorting by changing the ratio ABS to PS in the plastics mixtures and evaluated the weight distributions of each of the sorted ABS and PS by fitting with Gaussian function. From the result, we clarified the relationship between the ratio of ABS to PS in the plastics mixtures and the weight distributions of each sorted plastics. We made it possible to predict the weight distributions of sorted plastics from the composition ratio. By manipulating the position of the partition plate of the collection box according to the mixing ratio, it is possible to improve the collection rate of electrostatic sorting.

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14aA-1

摩擦帯電メカニズムの解明に向けたポリエチレンモデル化合物のギャップ内準位の観測

○山口雄生*、清水康平*、松崎厚志*、佐野大輔*、佐藤友哉*、石井久夫**,***

○千葉大学大学院融合理工学府*
千葉大分子キラリティー研究センター**
千葉大学先進科学センター***

Abstract:

The contact and triboelectric charging phenomenon of insulating polymer materials is familiar to our lives as static electricity. The charging mechanism, however, is not well clarified and various models have been proposed. Among them, we payed attention to models in which charging occurs due to electron transfer from/to gap states. In order to examine the impact of gap states on charging nature, the gap states of tetratetracontane (C44H90 ; TTC), which is a model oligomer of polyethylene, was examined by using hv-dependent high-sensitivity ultraviolet photoemission spectroscopy (HS-UPS). The high sensitivity enabled us to directly observe the weak gap states distributed in the HOMO-LUMO gap from the valence band top to 3.0 eV below the vacuum level. On the basis of the density-of-states derived from UPS results, the tribocharging nature and surface charge density of polyethylene were discussed in comparison with our previous result for nylon-6,6 film.

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14aA-2

針-水面放電に伴う水中電荷移動計測

○上原聡司*, 佐藤旭**,
清水鉄司***, 佐藤岳彦*

○東北大流体研*, 東北大院工**, 産総研電子光 RI***

Abstract:

A needle - water surface discharge has attracted much attention for developing various applications in the medical field. Understanding the charge transfer phenomena in water associated with the discharge is important to utilize the discharge technique as efficient tools. In this paper, surface potential of water irradiated by a needle-water discharge is demonstrated using an electrostatic voltmeter with a non-contacting manner. The distance between a stainless needle electrode and a water surface is 1mm. The applied voltage controlled by a function generator and a high voltage amplifier is a single pulsed voltage of 7.0 kV with 20 ・s. Considering the response time of the measurement system, it was possible to detect the change of the surface potential.

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14aA-3

水滴の帯電量と微小水滴の発生

○堀江史人，下川博文

神奈川工科大学

Abstract:

In this study, the behavior of water droplets was photographed using a high speed camera. Tiny water droplets may be generated when the water droplets completely bounces on the super water-repellent surface. Although it is known that the generation of tiny droplets is related to the Coulomb repulsion and the surface tension of water, the details of the mechanism of generation is unknown. It is found a mechanism of tiny droplets generation. It is found that related to the Rayleigh limit. Rayleigh limit is a maximum value in which the amount of charge that a water drop can have is determined by the balance between the surface tension and Coulomb repulsion. The liquids reached the Rayleigh limit, tiny water droplets are ejected from liquids.

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14aA-4

枚葉洗浄におけるシリコンウェハの帯電現象の観察 その２

○鈴木政典*1，川上雅之*2，矢野大作*2，荒木浩之*3，佐藤雅伸*3，川瀬信雄*4

㈱テクノ菱和*1，オルガノ㈱*2，㈱SCREEN セミコンダクターソリューションズ*3，ジョイ N テック㈱*4

Abstract:

In recent years, the charge-up of silicon wafer on single wafer wet processing in semiconductor manufacturing has caused the damage of LSI devices on a silicon wafer by electrostatic discharge. As a result, it has caused production yield loss. At this moment, we prevent the damage of LSI devices by the charge-up of silicon wafer to use conductive water dissolved carbon dioxide in ultra pure water. However, there are some cases that it is unusable. Therefore, we need new techniques. In our previous paper, we reported the result that we investigated the charge-up phenomena of silicon wafer with thermal oxide film on single wafer wet processing in order to prevent the charge-up of silicon wafer. In this paper, we will report the result we investigated the influence of some factors on the charge-up phenomena of silicon wafer with thermal oxide film.

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14aA-5

荷電粒子を用いた気中電界の新測定法Ⅱ

佐藤孝

花川フィールドラボラトリ

Abstract:

A quadrupole electrode which isconstituted with two pair of wireelectrode was used. Chargeddroplet is held in the central areaof quadrupole electrode by highfrequency electric field. Ifadditional electric field is appliedthis system charged droplet isaffected by it and will move orvibrate by external field. Wemade portable equipment formeasuring the electric fieldstrength in air and by using itmeasuring the electric field ofoutdoor was down. Some of theresults are shown here.

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14aA-6

車載電子機器における火花放電の発生メカニズムと解析技術の開発

○長谷川光洋＊, 泉地正人＊, 吉田孝博＊＊

株式会社デンソー＊, 東理大工＊＊

Abstract:

In the electrostatic discharge(ESD) immunity tests, the spark discharge can occur at the gaps between metallic parts inside of the automobile electronic products. The spark discharge generates the high current and induce malfunction and damage to ICs in the products. Therefore, the design method to avoid this damage is indispensable. In the past, the transient simulation method using 3D models which contains ESD generator and electronic devices has been developed. However, such transient simulation needs dozen hours for calculation. Then, the advanced method which can calculate faster is needed. In this paper, we clarified the spark discharge mechanism in automotive products and indicated the static simulation was useful for the spark discharge instead of the conventional transient simulation. In order to investigate the field strength which can occur spark discharge, first, we measured the correlation between the discharge voltage and the gap length by experiments using the electrode. And we calculated the breakdown electric field threshold value using the electrostatic field simulation.

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14aA-7

電子軌道における振動

○島元世秀＊、竹本義夫＊

日本文理大学＊

Abstract:

The oscillation with Planck constant is derived from the modified Maxwell equation. We study the oscillation model at atom by using of this equation. By using the modified Maxwell equation, vibration in arbitrary orbit was obtained. We consider frequency, it is expected that arbitrary frequency obtains surrounding velocity of an electron.

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14aA-8

大気圧プラズマジェットにおける OH 密度計測

○徳弘誠，小野亮

東京大学

Abstract:

Atmospheric pressure plasma jet (APPJ) is one of the non-equilibrium plasmas known as high chemical reactivity and easily generated in the open air at room temperature. APPJ has recently become an active area of research for their diverse applications in health care and medicine, materials processing, environmental treatment and so on. Hydroxyl radical (OH), which is reactive species produced in APPJ, is believed to play an important role in many plasma applications. Therefore, it is significant to know its concentration and how to generate it. Many researches about the OH density focused on the downstream of the plasma, but recent researches show the OH radical is mainly produced at the DBD in the glass tube. Therefore, in this work the OH density in the DBD is measured. The OH density versus the specific energy (SPE) in different operating parameters, including the amplitude of the applied voltage, frequency and flow rate of the working gas, is studied and discussed. Its density monotonically increases with the increase of SPE. The time variation of the OH concentration is also investigated. It indicates that the OH production and reproduction process is related with H2O concentration.

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14aA-9

放電プラズマで生成した準安定準位 N2 (A)の　　レーザ誘起蛍光法による観測

金澤誠司*○,大野章*，北野玄武*，立花孝介*,古木貴志*,市來龍大*,Marek Kocik**，鈴木あすみ***，黒井聖史***，鈴村啓***，田中利夫***，茂木完治***

大分大　理工*,　　ポーランド科学アカデミー**，ダイキン工業***

Abstract:

In the non-equilibrium plasma including nitrogen gas at atmospheric or low pressure, optical emissions from N2 (C) and N2 (B) (2nd and 1st positive system) are usually observed. However, N2 (A) metastable, which is located at the lower state compared to these excited states, is not observed by optical emission spectroscopy because it is a non-luminescent species. The N2 (A) plays an important role in many discharge-induced plasma chemical reactions. In this study, a laser-induced fluorescence technique was applied to investigate the N2 (A). We observed the spatial distribution of N2 metastable state N2 (A)　in the low-pressure pulsed discharge generated in needle-to-plate electrode system.

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14aA-10

表面電位減衰測定による樹脂膜の劣化検出法の開発

○磯恭平*
杉本俊之*
野村信雄**

山形大学大学院　理工学研究科*
春日電機（株）**

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 by measuring the insulating performance. A needle to cylinder corona charger and surface voltmeter were located on the target polymer sample with back grounding metal, the surface potential made by the charger during and after the charging process were measured. It was confirmed that the surface potential of the deteriorated sample was lower than that without deterioration. The difference in the surface potential between with and without deterioration depends on the position of the corona charger and the time from ending of the charging.

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14pS-1

自ら輝き、世界を輝かす 東工大リベラルアーツの挑戦

Abstract:

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14pA-1

テイラーコーンの挙動と液滴放出における印加電圧と極性の影響

○長尾圭祐，中川雄介，内田論，杤久保文嘉

首都大院

Abstract:

Plasma-liquid interaction is a key issue for plasma-induced liquid-phase reactions. The utilization of mist as liquid will enhance the plasma-liquid interaction because of the increase of contact area between plasma and liquid. Electrostatic spraying by Taylor cone is an effective way to generate fine droplets. Corona discharge is also generated at the tip of Taylor cone when negative high voltage is applied. However, the relationship between the behavior of generated droplets and the corona discharge is unclear. In this work, we investigated the effect of voltage polarity and applied voltage on the characteristics of Taylor cone, the corona discharge current and the mist emission. We found that droplets are emitted with rapid vibration of Taylor cone tip driven by negative corona discharge while droplets are emitted without vibration of Taylor cone with positive applied voltage.

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14pA-2

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検討

○姉崎直人,杉本俊之

山形大学大学院　理工学研究科

Abstract:

Conventional superheated steam generating apparatus is divided into steam generation and steam heating. 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 along with corona discharge. An outlet of a cylindrical copper electrode is heated by arc discharge to generate superheated from saturated steam. The corona discharge from the branched portion of the Y-shaped electrode is inserted in the center axis of the cylindrical electrode to transport steam to the hot cylinder wall. The temperature of the heat target was measured with changing the position and coverage of the corona electrode. We found that the installation position and the discharge mode of the Y- shaped discharge electrode influence the heating temperature.

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14pA-3

軽油中に浮遊するコーヒーパウダを用いた 進行波電界の EHD 基本特性

小田徹＊,
○橋本里奈＊, 小畑大地＊, 川崎敏之＊, 金澤誠司＊＊

西日本工大 工＊, 大分大 理工＊＊

Abstract:

In order to analyze various EHD phenomena using traveling wave electric field, it is very important to grasp fundamental characteristics such as shape, size and propagation velocity of the traveling wave electric field itself. Therefore, in this research, we made visualization of the traveling wave electric field itself by using coffee powders floating in light oil. As a result, it was found that the shape of the coffee powder moves is such that the length L of the three phase electrode moves as one block. It was found that the characteristic of the moving velocity V of the coffee powder is in good agreement with the propagation velocity of the traveling wave electric field.

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14pA-4

湿度がストリーマ放電中における荷電粒子の反応に与える影響について

○小室淳史＊, 安藤晃＊

東北大学工＊

Abstract:

Two-dimensional simulations of an atmospheric-pressure streamer discharge were performed to evaluate the effect of humidity on the chemical reaction pathways of the charged particles. The simulation results showed that the discharge current increases as the humidity increases. This results are not coincide with the previous report by Aleksandrov (Aleksandrov N L and Bazelyan E M 1999 Plasma Sources Sci. Technol. 8 285). Further analysis revealed that this inconsistence is due to the difference of the rate coefficient of recombination reaction of H3O+(H2O)3. To evaluate the effect of the humidity more precisely, it needs to determine the rate coefficient through the comparison with the experiment.

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14pA-5

窒素及び酸素ガス組成比がナノ秒パルス放電の挙動に与える影響

○龍輝優＊, 山口仁志＊, 王斗艶＊＊, 浪平隆男＊＊

○熊本大学大学院自然科学研究科＊, 熊本大学パルスパワー科学研究所＊＊

Abstract:

Non-thermal plasmas have been actively studied for various applications. The observation of a discharge plasma is an essential aspect for understanding the plasma physics of this growing field. Generally, a pulsed discharge having 100s ns pulse duration consists of streamer, glow, and arc discharge phases. It is well known that a streamer head always has the highest electric field in the entire discharge process. Furthermore, the streamer head produces a variety of radical species according to feeding gas composition. In the recent study, a nanosecond pulsed power generator having 5 ns pulse duration was developed and showed great advantages regarding energy efficiency for ozone generation and NO removal over conventional discharge methods. However, the underlying mechanisms of these high energy efficiencies are not well understood. Therefore, the present study focused on the effects of gas composition ratio of nitrogen and oxygen in a coaxial reactor on the phenomena of nanosecond pulsed discharge. In the experiment, the discharge propagation process was observed using a high-speed gated emICCD camera. As the result, the gas composition ratio significantly affected the discharge propagation process. This can be explained due to each characteristic of nitrogen and oxygen such as UV radiation, electron attachment, and photoionization.

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14pA-6

超臨界相を含む高圧二酸化炭素中におけるナノ秒パルスアーク放電の電子密度の解析

○芦塚直和＊
古里友宏＊
後藤宏輔＊
喜屋武毅＊＊
佐々木満＊＊＊
山下敬彦＊

○＊長崎大学
＊＊近畿大学
＊＊＊熊本大学

Abstract:

A state of matter such as solid, liquid and gas is determined by temperature and pressure. Supercritical fluids (SCFs) are in a state where temperature and pressure above those at the critical point. In recent years, plasma applications in SCFs have been actively researched, e.g. nanomaterial synthesis and high repetitive pulsed power switch. However, little is known about the basic property of plasma in SCFs. This study deals with electron density of nanosecond pulsed arc discharge in high pressure CO2 including supercritical phase. Spectroscopic measurement was performed to analyze the electron density. The emission spectrum was characterized by a black body radiation and emission line spectra of OI (wavelength 777 and 845 nm). Electron density was estimated by Stark broadening of the emission line spectrum of OI at 777 nm. As medium density of CO2 increased, electron density increased in gas phase. Meanwhile, irrespective of the medium density of CO2, electron density was approximately constant in the supercritical phase. These results were consistent with arc current as a function of medium density of CO2.

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14pA-7

真空紫外光を用いた選択的活性種生成法のシミュレーションの検証

○岩瀬篤郎, 小野亮

東京大学

Abstract:

To investigate the effect of reative specoes in plasma medicine, our group has developed a method for selectively producing reactive species by vacuum ultraviolet photodissociation and a simulation of the method. In the present study we verify the simulation by measuring the densities of O2, O3, H2O2 and OH in this method. The results show that the simulated densities of O3 and H2O2 are approximately agree with the measured results. But those of O2 and OH show some or large discrepancy. The reasons for the discrepancy are discussed.

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14pA-8

極短ギャップ放電における酸素原子密度の TALIF 計測と温度推定

○川北拓弥，中川雄介，内田諭，杤久保文嘉

首都大院　システムデザイン

Abstract:

Ozonizer is one of the most popular industrial applications of atmospheric pressure plasma. However, the gradual drop of the ozone production appears under long-term continuous operation in pure-oxygen-fed ozonizer, which is called 'ozone-zero' phenomenon. In order to elucidate this phenomenon, we measured the time evolution of atomic oxygen density in dielectric barrier discharge by TALIF.The results indicated that atomic oxygen density decays within 100 μs after discharge, when we compensate the ozone interference in TALIF measurement. By comparing the chemical reaction simulation with the experimental results, we estimated the atomic oxygen density and temperature in plasma region as 10000 ppm and 600 K, respectivly.

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14pA-9

大気圧空気中正極性 2 次ストリーマ放電内の 2 次元電子密度分布測定

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

埼玉大学＊, 東京大学＊＊, 東北大学＊＊＊

Abstract:

A Talbot type laser wavefront sensor with a temporal resolution of 5 ns was applied for single-shot two-dimensional electron density measurement of pulsed positive secondary streamer discharges generated in a 13-mm air gap between pin-to-plate electrodes. The single-shot visualisation demonstrated that the electron density over the secondary streamers was 1014-15 cm-3. During the secondary streamer propagation, the electron density around the plain cathode surface fluctuated with time. Such unstable dynamics could be explained by the attachment instability during the secondary streamer propagation. On the other hand, the electron density after the secondary streamer arrival decreased in a time constant of 10ns, which agreed well with that of two-body electron attachment with oxygen molecules.

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14aC-1

ポリマーフローアシストによる 1μm 流路での巨大 DNA1 分子の全長計測

○平野　研

国立研究開発法人産業技術総合研究所　健康工学研究部門

Abstract:

In this report, we describe a technique for full-length elongation and measurement of single molecules of DNA by using a 1 μm channel and a polymer solution. In this method, single molecules of T4 DNA, 166 kbp, can be elongated in a wider channel space, 1 μm deep and 1μm wide, without a conventional nano-sized geometry. Using hydroxyethyl cellulose (HEC) used as a polymer, it was confirmed that single molecules of DNA were sufficiently extended in its entirety within the channel within PDMS microfluidic chip. In this method, it was also effective that there was no clogging of DNA molecules at the entrance of the channel, and nonspecific adsorption in the channel could be prevented without using a reagent for preventing adsorption. Furthermore, single DNA molecules can be elongated in a μm-sized channel wider than a conventional nm-sized channel, and then it can also be labeled with a wide range of labeling substances (i.e., nanoparticles). This means that a brighter fluorescent labeling for full-stretched DNA molecules contributes to shortening detection time, so that a faster genome mapping currently required for next generation sequencing (NGS) techniques can be expected.

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14aC-2

温度変化処理を施した食材付着菌のインピーダンス計測

○堀貴嗣*，内田諭*，杤久保文嘉*，青木仁史**

○首都大システムデザイン*，㈱ニチレイフーズ**

Abstract:

Basic evaluation of bacteria attached with foods is essential for various processes in food industry. Dielectrophoretic detection related with the electrical characteristics of cells has attracted attention because of its rapidity, simplicity and low running cost. In the present work, we evaluated the effects of freezing, thawing and heating on some food adhering bacteria using dielectrophoretic impedance measurement. Pseudomonas fluorescens and Bacillus cereus were prepared as target bacteria. The bacterial suspension was injected into the microchannel and was applied by AC voltage under various frequencies on the interdigitated electrodes. There are significant differences in the conductance displacement at treatment temperatures. This result indicated that the characteristics depending on the membrane structure is available for simple classification and evaluation of bacteria.

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14aC-3

ナノ秒パルス電界がん治療法における単パルスと比較したバーストパルスの優位性の調査

○佐藤浩美＊, 安啓太＊, 南谷靖史＊

山形大大学院＊

Abstract:

A cancer treatment by ultra-short pulse high electric field is one of new biological applications. This work focuses on the design of a compact high power nanosecond pulsed electromagnetic wave generator for realizing cancer treatment by ultra-short pulsed electric field. Therefore, we have been developing a burst pulse generator. The burst pulse generator can output multiple pulse train. In this study, we have shown that applying the burst pulses to cancer cells is more effective than applying single pulses to the cancer cells under the same conditions by using yeast of model organism for apoptosis study.

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14aC-4

低周波交流電界印加によるタンパク質固定化法の最適化

侭田陽平*, 岸　一希*, 平賀　諒太*, 高橋　俊介*, 大重　真彦*,**, 桂　進司*,**

＊群馬大学理工学府環境創生部門
** 群馬大学食健康科学教育研究センター

Abstract:

A protein array, which immobilized many proteins on solid surface as ordered manner, is powerful tool for massive analysis of protein functions. Since higher immobilizing efficiency of proteins on protein arrays is required to improve sensitivities and specificities of the arrays, we developed a new immobilization method for proteins based on promoted molecular diffusions. Applying low frequency electric field generates steep gradients of proteins concentrations beside the electrode and the gradients promoted molecular diffusion toward the electrodes. In this research, we modified the buffer solution of acidic region and improved the reproduciblities of the amount of immobilized proteins. We also examined simultaneous immobilization for GFP(Green Fluorescence Protein) and DsRed (Discosoma sp. red Fluorescent Protein) as a model of protein array.

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14aC-5

大気圧マイクロプラズマを用いた植物ホルモン除去と鮮度保持の検討

清水　一男、木村　聡，ヤロスラヴ　クリストフ，マリウス　ブラジャン，大下　貴也

静岡大学

Abstract:

Decomposition of ethylene was investigated by the atmospheric pressure plasma. Ethylene is one of the plant hormone which is generated from various kinds of vegetables and fruits. It is involved in the growth of vegetables and fruits. During transportation and preservation of fruits and vegetables, it is necessary to control the amount of ethylene production as part of environmental condition in containers and warehouses. In this study, we have investigated the control of the amount of ethylene and the risk of generated by-products by using atmospheric pressure microplasma processed in a cubic box (1 m3) filled with ethylene. A decrease of ethylene was confirmed, and production of ozone and ethylene oxide were detected as by-products. The amount of generated ethylene oxide was small and does not present any danger for humans. To simulate the actual storage condition, avocados were used as test plants and were stored in a refrigerator for several weeks to confirm the effect with and without the atmospheric pressure microplasma. As a result, the decrease of ethylene by the plasma and the growth suppression of avocados were also confirmed.

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14aC-6

ナノ秒パルスプラズマによるマウス大腸がんの抗腫瘍効果の検証

○石崎啓＊，近藤陽介＊，水野和恵＊＊，小野亮＊

東大新領域＊，スタンフォード大医＊＊

Abstract:

Recently, a cold atmospheric-pressure plasma has been expected to be applied to the treatment of cancer. We have examined anti-tumor effects against mouse melanoma induced by a nanosecond pulsed streamer discharge and found that it might be possible to induce immune responses to the cancer using the streamer discharge. In the present study, we investigated an anti-tumor effect against mouse colon cancer by immune response induced by the nanosecond pulsed streamer discharge. The purposes of this study are to investigate the anti-tumor effect against different types of cancers, and to investigate the anti-tumor effect when the plasma is irradiated to a normal tissue, not to a tumor. The results suggest that the anti-tumor effect of plasma differs depending on the types of cancers.

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14aC-7

パルス高電界を用いたα-アミラーゼの不活化と立体構造への影響

○藤原隆寛＊, 高橋克幸＊, ＊＊, 高木浩一＊, ＊＊

岩手大学理工学部＊, 岩手大学次世代アグリイノベーションセンター＊＊

Abstract:

Inactivation of α-amylase using pulsed electric field (PEF) was investigated. Pulse forming network (PFN) circuit was used to generate PEF. The PEF strength, pulse width, treatment time, pulse repetition rate and total input energy into the solution were 2.5 ～ 12.5 kV/cm, 10 μs, 40 min, 30 ～ 1 pps, and 1440 J respectively. The residual activity of α-amylase was determined by α-amylase assay kit with N3-G5-β-CNP used as a substrate. The fluorescence spectra of the solution was observed to investigate the influence of PEF on the α-amylase conformation. Heat treatment was performed in 50 ～ 80℃ using water bath for comparison of PEF treatment. The α-amylase activity and fluorescence spectra decreased by the PEF application. The α-amylase activity decreased with increasing strength of the PEF for same input energy. The sample temperature increased to 56℃ by the PEF application. Also, activity was not affected by heat treatment under 60℃. The activity and fluorescence spectra decreased by heat treatment over 70℃ and the protein aggregation was observed with the heat treatment. These result shows that the mechanism of α-amylase inactivation by PEF treatment is different with heat treatment.

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14aC-8

がん治療を目的とした出芽酵母の細胞膜破壊による ROS の発生とアポトーシスの誘導

○佐藤鴻*,檜山純矢*,南谷靖史*

山形大学*

Abstract:

Apoptosis induction by ROS generating by breakdown of a cell membrane by applying pulsed high electric field was investigated for cancer treatment. Budding yeast was used in this experiment. In spite of inhibiting of Ca2+ and NADPH oxidase in the cell, ROS was generated at 3.5 MHz. In addition, in spite of inhibiting of Ca2+ and NADPH oxidase in the cell, at 3.5 MHz, apoptosis was induced some cells. It was shown that ROS generating by breakdown of the cell membrane was induced apoptosis.

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14aC-9

酵母の生育速度に影響を与える パルス電界印加条件の調査

○小林空*, 檜山純矢*, 南谷靖史*

山形大学*

Abstract:

Pulsed electric field is applied in various fields such as food processing and medical treatment. Among them, we focus on the growth of the fungus using the pulsed electric field. This study investigated what is condition that pulsed electric field can be controlled the growth rate of yeast. Saccharomyces cerevisiae was used for the target yeast. In this paper, the condition of the pulsed flectric field applying to Saccharomyces cerevisiae is 100 kV/cm with 100 MHz. When 1000 shots was applied to the yeasts, it was able to accelerate the growth between 12 hours and 36 hours.

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14pC-1

大気圧アルゴンプラズマのイオン生成特性

○長門研吉＊，水田成海＊，瀬戸貴仁＊＊，栗田弘史＊＊，高島 和則＊＊

高知高専＊，豊橋技科大＊＊

Abstract:

Chemical compositions of the ions generated by atmospheric pressure argon plasma were investigated using an atmospheric pressure ionization mass spectrometry (API-MS). In the negative ion mass spectra with a distance between the glass tube tip of plasma generator and the sampling orifice being 15 mm, several ion species were observed. The major ions include CO3－, HCO3－, HCO4－. NO2－, NO3－ and NO3－·HNO3. Some of these ions were attached by H2O2 and HO2. The spectrum changed significantly by changing the flow rate of argon gas. With decreasing the flow rate, the relative abundances of NO3－ and NO3－·HNO3 increased. This indicates that the ions from NOx are generated mainly in the outside of the plasma jet, because the tips of the plasma jet were not contacted with the sampling orifice of the mass spectrometer at low flow rates of the argon gas.

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14pC-2

放電処理大気のバブリングおよび電気分解による水溶液の処理が植物に与える影響

○川田吉弘、掛橋海翔、清水洋隆

職業能力開発総合大学校

Abstract:

In hydroponic culture, an air is supplied to the solution by bubbling due to supplying sufficient oxygen to the roots. In this study, a room air treated with dielectric barrier discharge instead of the air was tested. The aim of this treatment is the effect of deodorizing and sterilizing solution. It has nitrogen compounds and ozone were generated from the room air with the dielectric barrier discharge. Watercress was used for this experiment. After the solution bubbling with the room air treated by the dielectric barrier discharge, the ozone attenuates while the nitrate ion increases over the time in the solution. Here, pH was decreased by this treatment, the pH was adjusted with the electrolysis or NaOH aqueous solution. The growth of plants was promoted with the solution adjusted with NaOH aq. On the other hand, growth of plants was not observed with the solution adjusted with the electrolysis.

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14pC-3

RF プラズマ処理による鉄箔の窒化

矢澤翔大，江頭雅之，工藤祐輔，黒岩孝，新妻清純

日本大学生産工学部電気電子工学科

Abstract:

In 1972, Kim and Minoru Takahashi reported that Fe-N films deposited in N2 gas atmosphere have a high saturation magnetization, and that the Fe-N films are polycrystalline and mixtures of a-Fe and α"-Fe16N2. Since then, extensive research on α"-Fe16N2 has been carried out. Komuro et al. used the molecular beam epitaxy method to make single crystal α"-Fe16N2 thin films, Nakajima and Okamoto formed α"-Fe16N2 in epitaxial iron thin films by nitrogen implantation, Shoji et al. used facing targets sputtering to make α"-Fe16N2 thin films, and Hattori et al. synthesized α"-Fe16N2 fine particles by heat treatment. All of these studies reported on thin films or fine particles. For characterization of α"-Fe16N2 and engineering applications, it is desirable to prepare a large amounts of bulk samples of α"-Fe16N2. The nitrogen plasma irradiation method has possibilities of preparing a large amounts of α"-Fe16N2. In this study, iron nitride foils were prepared by RF plasma irradiation method in the atmosphere of Ar2+15%N2 mixture gases using iron foils of 20 μm thickness as raw material.

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14pC-4

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生成濃度向上

○阿部哲也，全俊豪

東京工業大学

Abstract:

It is no doubt that we need an energy storage system for the road to a low-carbon society. We focused on Mg3N2 as an energy storage material and then we have challenged to produce Mg3N2 by nitridation of MgO via atmospheric dielectric barrier discharge (DBD) at room temperature. However, the degree of nitriding was very small. Therefore, in this study, the effect of nitridation of MgO was investigated by using mixed gases of nitrogen and hydrogen as the background gas. Under the condition that the ratio of hydrogen in the background gas is 35%, we achieved 17 times higher nitriding efficiency than when using pure nitrogen as the background gas.

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14pB-1

線対平板型電気集塵装置における電流密度分布及びイオン風の解析と実験結果の比較

○伊藤航平＊, 森悠真＊, 瑞慶覧章朝＊, 川田吉弘＊＊,
田岡智浩＊＊＊, 柴田憲司＊＊＊

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＊＊＊

Abstract:

The purpose of this study is to compare to simulation results and experimental results of the current density distribution and ion wind in a wire-to-plate type electrostatic precipitator. The current density on the surface of the grounded plate electrode was measured, and the gas flow distribution was also measured using particle image velocimetry (PIV). The gas flow distribution considered the ion wind in the ESP was calculated using the simulation software COMSOL Multiphysics®(Ver.5.3a). As a result, it was shown that the calculated value of the current density distribution on the surface of the grounded plate electrode agreed with the experimental value. The calculated gas flow velocity in the ESP increased and a spiral flow was generated between the wire electrode and the grounded plate electrode as the applied voltage increased. This result also agreed with the experimental result. Therefore, these results shown the validity of the simulation in this study.

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14pB-2

帯電誘電体表面へのディーゼル微粒子の集積と酸化分解
ディーゼル微粒子集積 と酸化分解 と酸化分解

吉田恵一郎

大阪工業大学

Abstract:

A novel type of electrostatic precipitator was proposed and its effect in controlling diesel particulate matters (PM) was discussed. Particulates charged negatively with corona discharge were collected on the surface of the glass that were charged positively. Positively offset AC high voltage was used to charge the glass surface. Results showed that PM density in diesel exhaust gas was reduced by around 40% by the effect of this precipitator for more than 800 minutes. Additional test about oxidative decomposition of carbon particle suggested that some fraction of the PM collected on the glass surface could be incinerated also during the collection process.

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14pB-3

静電噴霧法で作製したDMFC用触媒層の性能と電極間距離の関係

○江頭雅之，関口航，今関巧，山田淩誠，矢澤翔大，工藤祐輔，中西哲也

日大生産工

Abstract:

Improvement of power generation performance of DMFC is expected by increasing surface area of catalyst layer. We have been investigated electrostatic spray about as a method increasing surface area of catalyst layer. In this study, influence of the electrode distance on the performance of DMFC was investigated. From the result, it was found that the performance of DMFC was the highest when the electrode distance was 40 mm.

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14pB-4

球体への静電植毛加工における静電場解析の活用

○長谷川孝、小畑輝

地方独立行政法人東京都立産業技術研究センター

Abstract:

Flock finish is one of the electrostatic application techniques. In recent years, flock finish of exhibition display has increased and a hand-held portable flocking machine is used at work site. However, the know-how of a skilled worker is needed to master this machine. In the present study, in order to be able to carry out high quality flocking with a handheld portable machine even if the worker skill and know-how is poor, electrostatic field analysis software was introduced. And the optimum flocking distance for a sphere was determined by utilizing this software.

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14pB-5

ディーゼル微粒子捕集に使用する電気集塵機の放電電極の開発

○久保田斗馬，高島和則，栗田弘史

豊橋技術科学大学　環境・生命工学系

Abstract:

Diesel engine emits exhaust gas containing harmful substances such as soot and NOx. The soot is normally collected by DPF, but the DPF also has disadvantages such as high pressure drop and regeneration. We focused on ESP to overcome this problem, which has low pressure loss and can collect nanoparticles. However, the problem of ESP is re-entrainment of conductive particles. In this study, we newly developed discharge electrode having several advantages over conventional one. First, it was suggested that the new electrode is effective for suppressing the decrease in collection efficiency due to re-entrainment. Secondly, application of lower voltage generated more stable corona discharge compared with the conventional one.

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14pB-6

PM removal technologies using novel two-stage electrostatic precipitators developed by Korea Institute of Machinery and Materials

Korea Institute of Machinery and Materials (KIMM)

Abstract:

A novel two-stage electrostatic precipitator (ESP) with multiple ion injection type chargers and parallel collection plates was developed and shown to efficiently collect particles from the corrosive waste gas discharged from semiconductor and optoelectronic processes. Carbon brush ionizers for the generation of ions were located outside of the main gas flow, but the injection of clean air and induced voltage between the outer and inner plates of the charging stage carried ions into the main gas flow; thus, gases and particles in the main flow did not corrode or contaminate the charger. The particle collection performance of the ESP was evaluated experimentally for 0.3 μm particles, PM (Particular matter) 1, and PM 2.5 by varying main gas flow rate. The novel ESP achieved particle collection efficiencies of 89.5% and 99.5% at the best condition when the voltage was applied to only the charging stage and to both the charging and collection stages, respectively.