2015 Annual Meeting of The Institute of Electrostatics Japan
Tokyo Metropolitan University
September 24-25, 2015

24pB-1

September 24th (Thu.), <15:45-17:45>
Room 2

Importance of Liquid Flow Induced by Plasma on Water Treatment

○Nozomi TAKEUCHI

Tokyo Institute of Technology

Abstract:

The effect of liquid flow on water treatment using a plasma generated over a solution was investigated using a two-dimensional numerical simulation of pulsed argon plasma that was generated between a needle electrode and a solution surface. The behavior of the reactive species generated by the plasma was calculated by considering electron-impact reactions, gas- and liquid-phase reactions, liquid flow, and mass transfer, assuming a gas–liquid equilibrium on the interface and flux continuity through the interface. The numerical results indicated that even a weak liquid flow could drastically change the liquid-phase chemistry.

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24pB-2

September 24th (Thu.), <15:45-17:45>
Room 2

Pilot-scale Experiment of Semi-dry type Exhaust Gas Treatment for Glass Manufacturing System Using a Plasma-chemical Hybrid Process

○Hashira YAMAMOTO*,**, Tomoyuki KUROKI*, Hidekatsu FUJISHIMA* and Masaaki OKUBO*

*Department of Mechanical Engineering, Osaka Prefecture University, **Nihon Yamamura Glass Co., Ltd.

Abstract:

A pilot-scale experiment of semi-dry type simultaneous removal of NOx and SOx using a plasma-chemical hybrid process (PCHP) is carried out on an exhaust gas in a glass manufacturing system. The exhaust gas is produced by the combustion of fuel for raw glass materials and contains both NOx and SOx. NO is oxidized to water-soluble NO2 with the plasma induced ozone gas. Na2SO3 is produced as a by-product of the de-SOx process using NaOH solution at gas cooling area of 150°C or less. NO2 is reduced to N2 using Na2SO3. After the semi-dry state, the Na2SO3 is dried by the heat of exhaust gas, and produces Na2SO4. NO oxidation efficiency of more than 75% is achieved. NO and SOx removal efficiencies are 28% and 63%, respectively. Furthermore, de-NOx in bag filter is discussed for the injection of NaHCO3. Due to the synergistic effect of ozone and NaHCO3, and NOx removal efficiency of 45% is obtained. Through this experiment, it is confirmed that this simultaneous de-NOx and de-SOx technology using semi-dry type PCHP is highly effective and promising for exhaust gas treatment in glass manufacturing system.

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24pB-3

September 24th (Thu.), <15:45-17:45>
Room 2

Basic Treatment Property of Persistent Organic Pollutants in Wastewater Splay by Nanoseconds Pulsed Discharge in Air

○Shintaro KODAMA*, Satoru MATSUMOTO*, Douyan WANG**, Takao NAMIHIRA** and Hidenori AKIYAMA**

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

Abstract:

Persistent organic pollutants (POPs) are bioaccumulative and environmentally persistent substances. POPs cannot be decomposed by conventional water treatments. For this reason, a new treatment method is required. Nano-seconds (ns) pulsed discharges enable higher energy efficiencies of plasma processing. Its advantages have been already performed at gas phase treatment such as NOx treatment and ozone generation. On the other hand, there are few reports on the water treatment using ns discharge plasmas. In this study, we tried to decompose the organic pollutants using ns discharge method by spraying wastewater into gas phase plasma region. The discharge reactor was coaxial cylindrical geometry, and the treated wastewater was circulated and continuously treated in the reactor. The time course of pH and concentration of Non-Purgeable Organic Carbon (NPOC) in the wastewater were evaluated at several treatments.

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24pB-4

September 24th (Thu.), <15:45-17:45>
Room 2

Plasma assisted catalytic oxidation of low concentration carbon monoxide in air

・○Toyohashi University of Technology

Dept. of Environmental and Life Sciences, Toyohashi University of Technology

Abstract:

Oxidation of low concentration carbon monoxide (CO) using a plasma-catalyst hybrid reactor at low temperature was carried out. A packed bed discharge reactor was constructed with three types of dielectric pellets, γ-Al2O3 , Ru-Al2O3 and Ag-ZSM5. As a result, the reactor with γ-Al2O3 could not remove CO with or without using the discharge plasma. On the other hand, the reactor with Ru-Al2O3 showed 75% of CO removal at room temperature. In addition, 90% of CO was removed under the condition of 60ºC and 0% relative humidity with both of Ru-Al2O3 and Ag-ZSM5. Furthermore, in the case of Ag-ZSM5, NO2 production was smaller.

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24pB-5

September 24th (Thu.), <15:45-17:45>
Room 2

Development of Ultra High Density Ozone Generation Technology

○Yoko MATSUURA, Yusuke NAKAGAWA, Noboru WADA and Yasutaka INANAGA

Mitsubishi Electric Corporation, Advanced Technology R&D Center

Abstract:

The maximum ozone density of existing ozone generator is about 400 g/Nm3, while further improvement in the ozone generation density can develop various applications in the fields of semiconductor manufacturing and water treatment. Mitsubishi Electric has developed the highly-efficient ozone generator by producing precise narrow discharge gap. Applying the highly-efficient ozone generator to the pressure-swing ozone concentration system enables the large supply rate of the ultrahigh density concentrated ozone at low running cost.

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24pB-6

September 24th (Thu.), <15:45-17:45>
Room 2

Ammonia generation using discharge plasma and catalyst from diesel exhaust gas

○Ryo YOSHIDA, Hirofumi KURITA, Kazunori TAKASHIMA, and Akira MIZUNO

Department of Environmental and Life Sciences, Toyohashi University of Technology, Japan

Abstract:

Ammonia (NH3) generation from N2,H2O,CO,NO2 was experimentally studied using a simple plasma-catalyst hybrid reactor. This is intended to be an alternative to urea hydrolysis used in urea-SCR deNOx system for diesel engines. A packed bed type plasma reactor was used to generate intense discharge plasma on the catalyst pellet. Pellets of Pt, Rh, Pt-Rh, and Pd supported by Al2O3 were examined as catalyst for NH3 generation.

Effect of carbon monoxide (CO) addition was examined to improve energy efficiency. Ammonia was generated from NO2 and H2O by plasma-catalytic reaction with CO and NO2 addition. Pt-Rh resulted in very high NH3 generation compared with other catalysts. Maximum energy efficiency for NH3 generation in this method was 4.0 g/kWh.

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24pB-7

September 24th (Thu.), <15:45-17:45>
Room 2

Pulsed Dry Methane Reforming in DBD-Catalyst Hybrid reaction and Reaction Mechanisms

Keishiro TAMURA, Seigo KAMESHIMA, Yutaro ISHIBASHI, Ryo MIZUKAMI, Tomohiro NOZAKI

Department of Mechanical Sciences and Engineering, Tokyo Institute of Technology

Abstract:

Dry methane reforming in dielectric barrier discharge and catalyst hybrid reactor was investigated. Optical emission spectroscopy was employed for better understanding of reaction mechanism for enhanced CH4 and CO2 conversion as well as carbon removal reaction. Strong emission from C2 molecules, which is known as C2 high pressure Swan system, was observed when CO2 + “C(ad) or NiC” = CO + CO becomes dominant reaction. Excited C2 molecules were produced selectively via vibrationally excited CO. Because CO is produced from adsorbed carbon or nickel carbide, emission from C2 high pressure Swan system becomes a good indication of surface reaction enhancement by DBD. Time dependent change of gas composition and emission profiles of CO and C2 were correlated and detailed reaction pathways is discussed.