P 2: Atmospheric Plasmas and their Applications I

Time: Monday 13:45–15:45 Location: ZHG006

Invited Talk P 2.1 Mon 13:45 ZHG006
Nanosecond pulse generators for gas discharges — •Tom Huiskamp, Jeroen Van Oorschot, Chiel Ton, and Guus Pemen — Eindhoven University of Technology, Eindhoven, The Netherlands

Gas discharges generated by nanosecond high-voltage pulses have gained attraction for a number of reasons, but mainly because they are very efficient for a variety of (environmental) plasma applications such as air pollution control, nitrogen fixation, synthesis of chemicals, materials processing, plasma medicine and others. Specifically, researchers have noted that the pulse duration and the rise time of the applied high-voltage pulse have a significant influence on the radical yield of the transient plasmas generated with nanosecond pulses; shorter pulses result in higher yields. With the need to study gas discharges generated by these short pulses comes the need to understand how to generate those pulses and to understand the interaction between the pulse source and the discharge. In this contribution, we will explore the different methods with which to generate nanosecond high-voltage pulses, how the interaction between the pulse source and the discharge may influence the source and the discharge and how to optimize the energy transfer from the pulse source to the discharge.

P 2.2 Mon 14:15 ZHG006
Properties of microarcs in atmospheric pressure air in a presence of metal vapour — •Margarita Baeva[1] and Dirk Uhrlandt[2] — [1]Leibniz Institute for Plasma Science and Technology (INP), Greifswald, Germany — [2]Institute of Electrical Power Engineering, University of Rostock, Rostock, Germany

Electric discharges in presence of metal vapours can be found in various applications, e.g. in switching devices and welding arcs. In low-voltage, low-current switching devices, an electric arc in metal vapours occurs during the early contact opening. A bridge of molten metal can be built and it can break at temperatures close to the boiling temperature of the material so that the gap between the electrodes is filled with metal vapour. The metal atoms are easily ionized due to their low ionization potential and a discharge ignites.
In this contribution, we report results from modelling studies of microarcs in atmospheric pressure air-copper vapour mixtures. The effects of copper metal vapour on the microarc properties and plasma chemistry are studied. Findings demonstrate the spatial structure of the microarc and the behaviour of the plasma parameters for various ratios of the air and metal vapour concentrations, and the length of the inter-electrode gap.
The work is funded by the German Research Foundation (DFG) Project number 524731006.

P 2.3 Mon 14:30 ZHG006
modeling of the ion wind for a surface barrier discharge used for gas conversion — •soad mohsenimehr[1], sebastian wilczek[2], thomas mussenbrock[3], and achim von keudell[1] — [1]Experimental Physics II, Reactive Plasmas, Ruhr University Bochum, D*44780 Bochum, Germany — [2]Technische Hochschule Georg Agricola, Bochum, Germany — [3]Chair of Applied Electrodynamics and Plasma Technology, Ruhr University Bochum, D-44780 Bochum, Germany

The ion wind in a surface dielectric barrier discharge (SDBD) plays a crucial role in generating and manipulating the flow field through its electrohydrodynamic force (EHD). This work employs a twin SDBD consisting of an aluminium oxide plate (190*88*0.63 mm) covered by a nickel grid printed on both sides in a comb-like pattern and generated at atmospheric pressure using damped sinusoidal voltage waveforms at kHz frequency. A Schlieren diagnostic was performed and compared with computational fluid dynamic simulation to investigate the flow pattern. This work presents how the EHD force was calculated from a direct time-dependent plasma simulation by the nonPDPSIM platform and incorporated, after proper scaling, into the steady-state flow simulation by COMSOL. Finally, the comparison between numerical simulation and experimental results is reported. It is shown that the origin of the EHD force is not only given by the streamer propagation dynamics but more importantly by the relaxation phase of the boundary region above the dielectric during the decay of the plasma channel.

Invited Talk P 2.4 Mon 14:45 ZHG006
Multimodal Diagnostic Approaches and Interactive Analysis of Mode Transitions in the kINPen Plasma Jet Interacting with Surfaces — •Torsten Gerling[1], Hans Höft[1], Sander Bekeschus[1,2], Markus M. Becker[1], Klaus-Dieter Weltmann[1], and Philipp Mattern[1] — [1]1Leibniz Institute for Plasma Science and Technology (INP), Greifswald, Germany — [2]Department of Dermatology and Venerology, Rostock University Medical Center, Rostock, Germany

The dynamic interactions of the effluent of the cold atmospheric pressure plasma jet kINPen and surfaces is investigated, focusing on the identification and characterization of distinct operational modes: conductive, transient, and free modes. By evaluating the influence of the surface distance on the plasma characteristics, the critical role of multimodal diagnostic techniques in monitoring mode shifts is explored including electrical measurements, high speed imaging, optical emission spectroscopy (OES), and acoustic analysis. Each diagnostic method revealed valuable insights into the discharge modes associated with a specific distance of the kINPen to the surface. The individual response of the detection methods to the mode shifts is compared and discussed. As data management emerges as a new challenge and burden in scientific research, this study highlights how leveraging these demands can inspire innovation and enhance scientific discovery. By providing the evaluated data in an interactive fashion, the results are prepared to support an individual exploration.

P 2.5 Mon 15:15 ZHG006
thermal characteristics of microarray DBD in helium — •Yue Cheng[1], Henrik van Impel[1], David Steuer[1], Judith Golda[1], and Marc Böke[2] — [1]Plasma Interface Physics, Ruhr-University Bochum, D-44801 Bochum, Germany — [2]Experimental Physics II: Physics of Reactive Plasmas, Ruhr-University Bochum, D-44801 Bochum, Germany

The urgent demand for efficient and sustainable chemical processes has driven interest in plasma-assisted catalytic methods, particularly for n-butane conversion, for their ability to promote energy-efficient reactions. Reaction kinetics and conversion rates are highly temperature-dependent, making it critical to investigate the effects of elevated temperatures on plasma chemistry. To address this, we optimized our reactor specifically for high-temperature applications. The reactor incorporates a neodymium magnet embedded in a MACOR carrier as the grounded electrode. A heating system positioned beneath the magnet, capable of reaching up to 350°C. A 40μm zirconium dioxide dielectric layer separates the magnet from a nickel grid, which is cut into two 1*1 cm squares with 1 mm gaps featuring substructures of 100 μm and 150 μm. The entire assembly is stabilized using a quartz frame and cover. Experimental results reveal a significant increase in rotational temperature with rising discharge surface temperature, with larger cavity structures exhibiting higher rotational temperatures. This temperature potentially reduces the activation energy for n-butane reactions, thereby enhancing reaction rates and promoting intermediate formation. This work is supported by DFG within SFB1316 (A6).

P 2.6 Mon 15:30 ZHG006
Tuning plasma chemistry by various excitation mechanisms for the H_2O_2 production of atmospheric pressure plasma jets — •Steffen Schüttler, Niklas Eichstaedt, and Judith Golda — Ruhr-University Bochum, Universitätsstraße 150, 44801 Bochum, Germany

Atmospheric pressure plasmas (APPJs) are widely used in various fields of research and applications. There are plenty of different APPJs designed with various geometries and excitation mechanisms ranging from μs and fast ns pulses pulsed at kHz frequencies to RF-driven waveforms. A direct comparison of these APPJs is challenging as the different excitation mechanisms at different geometries are barely comparable. In this work, a capillary plasma jet was used that is operable at kHz pulsing with a high voltage pulse with μs or ns rise time and a sinusoidal voltage pulse at 13.56 MHz (RF) at the same plasma jet geometry [1]. The effect of the excitation mechanisms on the production of H_2O_2 was investigated by treating liquids and measuring the H_2O_2 concentration in the treated liquid. The plasma jet is operable under all excitation mechanisms up to a plasma power of 1.5 W. An increased humidity admixture and higher plasma powers lead to enhanced H_2O_2 production under all excitation mechanisms. The fast ns pulses and the RF operation show similar results, while the μs operation is less effective.

This work is supported by the DFG within CRC 1316 (Subproject B11, project number 327886311).

[1] S. Schüttler et al 2025 J. Phys. D: Appl. Phys. 58 025203