SAPP XXV

25th Symposium on Application of Plasma Processes
and
14th EU-Japan Joint Symposium on Plasma Processing

Book of Contributed Papers

Štrbské Pleso, Slovakia

31 Jan - 5 Feb, 2025

Edited by G. D. Megersa, E. Maťaš, J. Országh, P. Papp, Š. Matejčík

Book of Contributed Papers: 25th Symposium on Application of Plasma Processes and 14th EU-Japan Joint Symposium on Plasma Processing, Štrbské Pleso, Slovakia, 31 January – 5 February 2025.

Symposium organised by Department of Experimental Physics, Faculty of Mathematics, Physics and Informatics, Comenius University in Bratislava and Society for Plasma Research and Applications in hotel SOREA TRIGAN***.

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Publisher: Society for Plasma Research and Applications, Bratislava, Slovakia

Issued: January 2025, Bratislava, first issue

ISBN: 978-80-972179-5-2

URL: https://neon.dpp.fmph.uniba.sk/sapp/

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ELECTRICAL DISCHARGES IN CAPILLARY TUBES AND HONEYCOMB MONOLITHS

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Summary of our results on generation of discharges in glass capillary tube(s) and ceramic honeycomb monolith. Reactor and materials of various geometry, several power supplies of both polarities were tested. Electrical and optical diagnostic of the discharges was performed, and their chemical activity tested.

1. Summary

Atmospheric pressure plasmas generated by electrical discharges are often used for air pollution control. The common discharge types are corona and dielectric barrier discharges (DBD) generated in gases or on dielectric surfaces. They can be also generated inside cavities and pores of materials, such as foams, pellets, beads, or tubes [1]. It is very interesting from the point of view of plasma catalysis as the interaction of the plasma with (catalytic) materials can be utilized to enhance associated chemical processes.

This contribution summarizes the results on generation of discharges in a single capillary tube, a bundle of capillary tubes as well as ceramic honeycomb monolith. Electrical and optical measurements were performed in various geometry (diameter, length, cpi), feed gases (air, N2, O2, H2O) and power supplies (AC, DC, pulsed) of both polarities. Electrical diagnostics included oscilloscopic measurements and power consumption evaluation. The optical diagnostics included optical emission spectroscopy and measurements of discharge propagation velocity. Chemical activity was monitored by FTIR spectroscopy.

The discharge in a single capillary tube was investigated to understand a fundamental mechanism of its formation and propagation [2]. The propagation velocity increased with the decreasing tube diameter. It was found 4.3×10^7 and 9.9×10^7 cm/s for 1 and 0.2 mm diameter, respectively. Onset and breakdown voltages increased with the decreasing tube diameter, while stable discharge generation was improved by extending its length. Propagation velocity was higher for smaller tube diameters and higher O2 content. Tests with a bundle of capillary tubes were performed to assess the overall stability and spatial homogeneity of the discharge. The discharges were generated by a DC high voltage, eventually assisted by auxiliary AC driven discharges in a pellet bed [1] or in a multihollow DBD [3]. The homogeneity and the stability largely depended on the discharge polarity, ballasting resistor, and feed gas humidity. At last, the discharges generated directly in ceramic honeycombs of various geometry (length, cpi) were tested. They were also briefly subjected to the investigations of its plasma chemical activity (generation of O3 and NOx removal). Tentative results were quite promising and are expected to be further improved in systems with honeycombs supported by various catalysts.

The work was supported by Slovak Research and Development Agency grant APVV-20-0566 and Scientific Grant Agency VEGA grant 1/0822/21 and funded by the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I03-03-V04-00092.

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