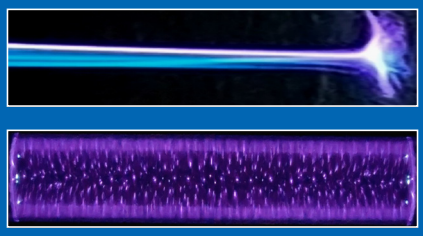
10th Central European Symposium on Plasma Chemistry
21st International Conference on Plasma Physics and Applications

Bucharest, Romania, 1-5 September 2025

Book of Abstracts

Edited by: Daniela Dobrin, Monica Magureanu, Bogdana Mitu, Veronica Satulu

CEI
CENTRAL EUROPEAN INITIATIVE



21st CONFERENCE
3 - 5 September 2025
Bucharest - Romania
PLASMA PHYSICS & APPLICATIONS

https://cespc.inflpr.ro/

10th Central – European Symposium on Plasma Chemistry

1-5 September 2025, Bucharest, Romania

Book of Abstracts

Edited by:

Daniela Dobrin
Monica Magureanu
Bogdana Mitu
Veronica Satulu

21st International Conference on Plasma Physics and Applications

3-5 September 2025, Bucharest, Romania

Plasma under liquid via microbubble discharge: enhanced formation of reactive oxygen and nitrogen species

K. Ahlawat, A. Chithran, M. Janda, Z. Machala

Division of Environmental Physics, Faculty of Mathematics, Physics and Informatics, Comenius University, 842 48 Bratislava, Slovakia
ahlawat.kiran@fmph.uniba.sk

Plasma-activated water (PAW) has gained increasing attention for its potential applications in environmental remediation, agriculture, and biomedicine, primarily due to the generation of reactive oxygen and nitrogen species (RONS). In this study, we explore a plasma under liquid configuration utilizing a microbubble discharge system to promote the formation of RONS in aqueous environments. Microbubbles, owing to their high surface-to-volume ratio and prolonged residence time, offer an efficient interface for plasma-liquid interactions, facilitating more effective energy transfer and chemical activation [1].

A dielectric barrier discharge (DBD) based microbubble plasma reactor was designed to treat up to 1000 mL of tap water in batch/recirculation and operate under optimized discharge conditions. The evolution of key RONS including hydrogen peroxide (H_2O_2~108 µM), nitrite (NO_2^- ~ 155 µM), and nitrate (NO_3^- ~ 4455 µM) was quantitatively analyzed over a 20-minute treatment period. To demonstrate the potential for large-scale application, a comparison was made between reactor configurations using 1, 2, and 3 plasma devices while treating the same volume of tap water. With an increasing number of devices, the concentration of RONS in the treated water also increased, confirming that the designed system is scalable and suitable for environmental applications such as wastewater treatment. Standard colorimetric and spectrophotometric techniques were employed for species detection. The temporal profile of RONS generation in liquid phase and gas phase were examined to understand the underlying physicochemical mechanisms and synergistic effects unique to the microbubble interface. The results demonstrate that microbubble discharge significantly enhances the accumulation of long-lived reactive species into the liquid. This work provides mechanistic insights into RONS formation under plasma-liquid conditions and underscores the potential of microbubble-assisted plasma systems for scalable water activation and wastewater treatment applications [2].

Acknowledgements: This work was funded by the EU NextGenerationEU through the Recovery and Resilience Plan for Slovakia under the project No. 09I03-03-V03-00033 EnvAdwice.

[1] Y. Gao, M. Li, C. Sun, X. Zhang, Chem. Eng. J., **446** (2022), 137318
[2] S. Meropoulis, C.A. Aggelopoulos, Chem. Eng. J., Processes, **11** (2023), 109855