97th IUVSTA Workshop on plasma-assisted conversion of gases for a sustainable future

17th to 21st December 2023, Cerklje, Slovenia

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Organizer

Slovenian Society for Vacuum Technique

Co-organizer

The International Union for Vacuum Science, Technique and Applications

PLASMADIS LTD.

Detailed program

Sunday, 17th December

16:00	**Registration**
18:00	**Grand opening and welcome cocktail**
18:30	**Dinner break**

Monday, 18th December

9:00	**Timo Gans (Ireland);** Self-limiting trade-off between CO yield and CO_2 conversion energy efficiency; **Invited**
9:25	**Holger Kersten (Germany)**; Combining a nanosecond-pulsed DBD with an electrolytic cell to reduce CO_2 and N_2; **Invited**
9:50	**Zdenko Machala (Slovakia)**; Plasma-liquid transport of reactive species for nitrogen fixation and biomedical/agri applications; **Invited**
10:15	**Susumu Toko (Japan)**; Experimental study on the effect of plasma-catalyst interaction on methanation reaction; **Invited**
10:40	**Coffee break**
11:10	**Peter Awakowicz (Germany)**; Gas treatment with catalytic enhanced surface–dielectric barrier discharges: diagnostics, simulation, applications for hydrogen cleaning + VOC removal, scale-up and optimisation; **Invited**
11:35	**Kinga Kutasi (Hungary)**; Plasma assisted nitrogen fixation; **Invited**
12:00	**Miran Mozetič (Slovenia)**; Scientific approach to plasma technologies; **Invited**
12:30	**Lunch break**
13:30	Round table on vibrational excitation and dissociation of gaseous molecules
15:45	**Break**
16:00	**Continuation of the round table**
18:30	**Dinner break**
19:30	**Poster session and networking**

Tuesday, 19th December

9:00	**Toshiro Kaneko (Japan);** Atmospheric pressure plasma with high-speed liquid flow: basic science and its application; **Invited**
9:25	**Deborah O'Connell (Ireland)**; Generating and transporting plasma reactive species into liquid environments; **Invited**

Invited

Plasma-liquid transport of reactive species for nitrogen fixation and biomedical/agri applications

Zdenko Machala

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Atmospheric air plasma produces a cocktail of reactive oxygen and nitrogen species (RONS) with multiple functions relevant to nitrogen fixation and applications in biomedicine, agriculture, air and water cleaning, etc. In plasmas interacting with liquids, the transport of RONS into the liquid through plasma–liquid interface can be significantly enhanced by converting bulk water to aerosol microdroplets [1]. The plasma discharge regime, deposited power, and gas flow conditions determine the plasma properties. Understanding physical, transport and chemical processes of the cold plasma-liquid interactions is crucial for the control of the chemical composition and biomedical effects of water and water solutions activated by air plasma for emerging applications in biomedicine and agriculture [2].

Atmospheric non-thermal plasma is maintained by elementary processes of ionization, excitation and dissociation of air components, the formation of radicals and other RONS, as well as their mutual reactions in the gas phase. Their transport into the liquid water is primarily driven by their solvation, characterized by the Henry's law coefficients. Finally, in the liquid, the plasma-formed, as well as the new ionic RONS, diffuse and undergo further reactions [2].

Transient spark discharge turns out to be very efficient for nitrogen fixation and its conversion to NO_x and transport of N-containing species into water [3]. Such plasma-activated water then serves as a green fertilizer and efficient plant growth stimulant [4].

In the end, examples of successful applications of such plasma-activated liquids for water or surface bacterial disinfection, biofilm treatment, dentistry, urinary tract infection treatment, cancer cell viability reduction and apoptosis induction will be shown. Besides the dominant effects of RONS, the synergy of peroxynitrites with pulsed electric field will be demonstrated [5].

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[2] Machala Z., Tarabová B., Sersenová D., Janda M., Hensel K. J. Phys. D Appl. Phys. 2019, 52, 340023.
[3] Janda M., Hensel K., Machala Z., Field T. A., J. Phys. D Appl. Phys. 56, 485202, (2023).
[4] Ndiffo Yemeli G.B., Janda M., Machala Z., Plasma Chemistry and Plasma Processing 42 (69), 1143–1168 (2022).

[5] Menthéour R., Machala Z., Frontiers in Physics 10 (895813), 1 (2022).

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