SAPP XXIII

23rd Symposium on Application of Plasma Processes

Book of Contributed Papers

Virtual Meeting
4th and 5th February, 2021

Edited by V. Medvecká, P. Papp, J. Országh, Š. Matejčík

Book of Contributed Papers: 23rd Symposium on Application of Plasma Processes, 4th and 5th February 2021.

Virtual meeting for PhD. and Master Students organised by Department of Experimental Physics, Faculty of Mathematics, Physics and Informatics, Comenius University in Bratislava and Society for Plasma Research and Applications.

Editors: V. Medvecká, P. Papp, J. Országh, Š. Matejčík

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Foreword

Dear SAPP participants, colleagues, friends,

For the first time in its 46-year long history the Symposium on Applications of Plasma Processes was held online without the possibility to meet personally. For the SAPP community it is a major setback since the spirit of SAPP is not only in excellent science but also in personal contact and in friendship spiced with leisure activities in beautiful nature. Thanks to SAPP many of us has built strong international network of colleagues supporting our scientific results and careers. Since we would like to broaden the community and offer similar experience to younger colleagues, we decided to assign all oral presentation slots to young scientists. Another reason was their need to present the work in situation when due to the world-wide COVID-19 pandemic many conferences and meetings are postponed or cancelled. On the other hand, this crisis pushed us in exploring new possibilities. Thanks to modern technology and internet accessibility around the world it was possible to organize such a nice event even though travelling is very limited. It also made SAPP accessible to participants who would not be able to attend even if there were no travel restrictions. We believe this experience will guide us to organizing partially hybrid meetings in the future which will join the good of both worlds. They will provide the personal contact that we miss so much to majority and allow somewhat limited participation to those who are unable to travel due to various reasons.

With such a positive outlook we would like to express our gratitude to all of you for the participation and we are looking forward to meeting you in the future.

SAPP XXIII LOC

Local Organizers

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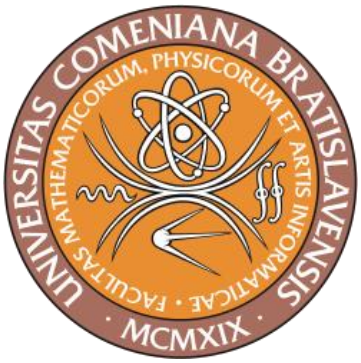

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SPVAP

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23rd Symposium on Application of Plasma Processes

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Content

INFLUENCE OF PLASMA PROPERTIES ON REACTIVE SPECIES IN PAW

Olivera Jovanović[1], Nevena Puač[1], Radmila Sandić[1], Nikola Škoro[1]

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We have used a pin-type of atmospheric pressure plasma jet (APPJ) for treatment of distilled water samples and production of plasma activated water (PAW). Electrical characterization of the APPJ and plasma power measurements were performed in order to obtain information about stability of the treatment conditions, the plasma properties, and the influence of plasma parameters on PAW. In order to investigate the influence of working gas on the PAW chemistry, we have performed treatments with helium or argon streamer discharges. Diagnostics of treated liquid samples were carried out to evaluate the effectiveness of plasma treatment. Results show that chemically reactive gaseous environment of helium discharge favours the production of nitrates and nitrites. At the same time, the argon discharge produces an order of magnitude higher values of hydrogen peroxide and nitrates, but the amount of nitrites is quite low.

1. Introduction

Cold atmospheric pressure plasmas have been intensively investigated over the past decade due to their great potential for various applications. In the area of plasma agriculture, gaseous plasma treatment of aqueous solutions has multiple advantages such as reduction or elimination of organic contaminants and antimicrobial effects [1, 2]. The exposure of water to plasma induces a number of reactions occurred in the gaseous phase and introduces reactive oxygen and nitrogen species (RONS) species in aqueous phases. The resulting "plasma-activated water" was shown to remain active long after the plasma is turned off [3]. Among the most commonly detected chemical species in PAW are hydrogen peroxide, nitrite and nitrate due to their relative stability. These reactive species play a key role in the reactions involving dissolved organic species in water and can effectively inactivate bacteria or microorganisms [4]. Proper and detailed diagnostics of plasma sources will help to achieve better understanding and establish the correlation between the plasma processes and the treatment effects which is of crucial importance for further applications. From the point of view of plasma physics, the central issue is to standardize the performance in RONS production. Here we will present the results of the influence of the type of the working gas used (He or Ar) on the production of RONS in PAW.

2. Experimental setup

In the study, we assessed the performance characteristics of the pin-type configuration of an APPJ powered by a continuous high voltage signal at frequency 330 kHz and operated with He and Ar as working gases. Schematics of APPJ and experiment set up are provided in Fig.1. Determination of concentrations of three reactive species (H_2O_2, NO_2^-, NO_3^-) in liquid and pH of treated aquous solution was performed. Plasma source consists of a metal cylindrical case, a glass tube with concentrically placed powered sharpened electrode. The copper tape at the bottom of the microtiter plate was connected to the ground through a 1 kΩ resistance for monitoring the discharge current flowing through the plasma. The electrical volt–ampere characteristics as well as the power consumption were analysed with electrical probes.

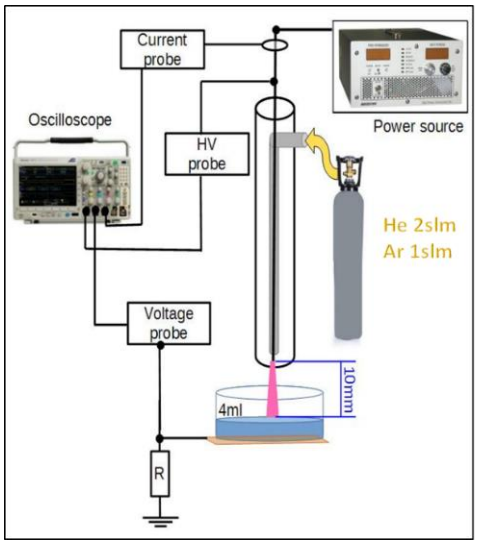

Fig. 1. Schematic overview of the experimental set up.

Two types of plasma treatments were done: with He as working gas with flow rate of 2 slm and Ar with flow rate of 1 slm. Treatment times were 5 and 10 minutes. The volume of treated samples placed in the wells of 6-well microtiter plate below the APPJ was 4ml. The distance between the water surface and wire was 10 mm in all treatments. In order to characterize PAW we used colorimetric methods for measuring the concentrations.

3. Results and Discussion

In Fig. 2. we show concentrations of long-lived reactive species obtained after 5 and 10 minutes treatment of water sample by a pin-electrode jet. We measured completely different concentrations of all reactive species depending on the working gas. By changing the working gas, concentrations of produced H_2O_2 and NO_3^- in PAW are measured to differ by an order of magnitude. For both gases the results show an increase in concentration of H_2O_2 and NO_3^- with treatment time. The amount of nitrite generated by He plasma is almost same after 5 and 10 min while in case of Ar plasma the concentrations of nitrite in liquid are negligible. This result may also reflect a significant difference in power dissipation under different feed gas composition.

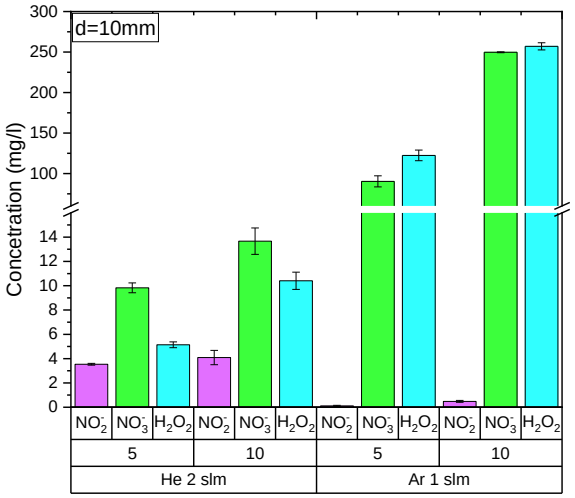

Fig. 2. Concentrations of nitrite, nitrate, and hydrogen peroxide in PAW samples after 5 and 10 minutes treatments using He and Ar as working gases.

4. Conclusions

Plasma treatments of distilled water were done using an APPJ in a pin-electrode configuration. These experiments demonstrated that changing the working gas produced different amounts of measured reactive species in PAW while in both cases filamentary type of plasma was established. Correlating measurement of plasma parameters with liquid sample properties will enable to investigate influence of different plasma parameters on changes in the properties of treated samples. Furthermore, it will be important to explore the potential use of these samples for the particular application in plasma agriculture field.

5. Acknowledgments

This research has been mainly supported by MESTD Republic of Serbia projects III41011 and ON171037. Part of the research was funded by IPB through grant by MESTD.

6. References

[1] Graves D Bakken L Jensen M and Ingels R 2019 *Plasma Chemistry and Plasma Processing*. 39.
[2] Skoro N Puac N Zivkovic S Krstic-Milosevic D Cvelbar U Malovic G Petrovic Z Lj 2018 *Eur. Phys. J. D*, 72 2.
[3] Lukes P Dolezalova E Sisrova I and Clupek M 2014 *Plasma Sources Sci Technol* 23.
[4] Niquet R Boehm D Schnabel U Cullen P J Bourke P and Ehlbeck J 2017 *Plasma Processes and Polymers* 15 e1700127.

SAPP XXIII 23rd Symposium on Application of Plasma Processes

4th and 5th February 2021, Virtual Meeting

Thursday, 4th February 2021 (Central European Time)

The presenting authors will have 15 minutes for their presentations and 5 minutes for the discussion.

08:15 - 08:30 SAPP XXIII opening

08:30 - 10:10 **THEORY AND MODELLING** (*Zoltán Donkó*)

Ján Ďurian - ***AN EFFICIENT GPU IMPLEMENTATION OF A 1D PARTICLE-IN-CELL/MONTE CARLO COLLISIONS METHOD FOR MODELLING RADIO-FREQUENCY DISCHARGES***

Charisse Marie Cagomoc - ***MOLECULAR DYNAMICS STUDY OF ION SCATTERING ON SILICON AND SILICON DIOXIDE***

Kerstin Sgonina - ***EXPERIMENTAL AND MODELING STUDY OF SURFACE REACTIONS OF PLASMA GENERATED ATOMIC OXYGEN WITH PHENOL SOLUTIONS***

Benedek Horváth - ***THE ROLE OF ELECTRON-INDUCED SECONDARY ELECTRONS IN LOW-PRESSURE CAPACITIVELY COUPLED OXYGEN PLASMAS***

Sinéad Mannion - ***SIMULATION OF ATMOSPHERIC-PRESSURE PLASMA JETS USING FINITE ELEMENT METHOD***

10:10 - 10:30 break

10:30 - 12:10 **PLASMA BIO-APPLICATIONS AND LIQUID-APPLICATIONS** (*Marija Radmilović-Rađenović*)

Kateřina Smejkalová - ***CHARAKTERIZATION AND APPLICATION OF MICROWAVE PLASMA ON WOUND HEALING***

Amit Kumar - ***TREATMENT OF ACID BLUE 25 DYE BY USING PLASMA ACTIVATED WATER***

Fayza Hassan - ***PLASMA GENERATION IN NaCl AND KBr SOLUTIONS***

Andjelija Petrovic - ***TREATMENT OF DMEM AND RPMI 1640 CELL MEDIUM BY DBD TYPE ATMOSPHERIC PRESSURE PLASMA JET***

Aleksandra Lavrikova - ***METABOLIC ACTIVITY IN RELATION TO BACTERIAL VIABILITY INDUCED BY TRANSIENT SPARK DISCHARGE***

12:10 - 12:40 lunch

12:40 - 14:40 **ELEMENTARY PROCESSES AND PLASMA CHEMICAL REACTIONS** (*Tom Field*)

Stefan Bergmeister - ***INVESTIGATION OF MAGIC NUMBERS OF NEON CLUSTER IONS***

Ján Blaško - ***DISSOCIATION OF 2-METHYL-2-OXAZOLINE AND 2-ETHYL-2-OXAZOLINE MOLECULES INDUCED BY LOW-ENERGY ELECTRON IMPACT***

Natalia Tańska - ***DFT STUDY ON THE INTERACTIONS OF LOW ENERGY ELECTRONS WITH PYRIDINE, PYRAZINE, AND THEIR HALO DERIVATIVES***

Dušan Mészáros - ***LOW ENERGY ELECTRON ATTACHMENT TO COBALT TRICARBONYL NITROSYL MOLECULES AND CLUSTERS AND MIXED CLUSTERS WITH ACETIC ACID***

Izabela Wolańska - ***NEGATIVE ION MOBILITY SPECTROMETRY FOR MEASURING ELECTRON ATTACHMENT RATES***

Kateryna Trach - ***PRELIMINARY RESULTS ON QUANTITATIVE GC-IMS ANALYSIS OF ARABICA AND ROBUSTA COFFEES IN MIXES***

Friday, 5th February 2021 (Central European Time)

The presenting authors will have 15 minutes for their presentations and 5 minutes for the discussion.

08:30 - 10:10 **DISCHARGES AND OTHER PLASMA SOURCES** (*Satoshi Hamaguchi*)

Martina Ilčíková - ***SHAFTLESS SCREW DIELECTRIC BARRIER DISCHARGE CONVEYOR FOR TREATMENT OF RECYCLED PET FLAKES***

Juraj Surovčík - ***EFFECTS OF ATMOSPHERIC PRESSURE AIR PLASMA ON PHOTOCATALYTIC ACTIVITY OF TiO_2 NANOFIBERS***

Olivera Jovanović - ***INFLUENCE OF PLASMA PROPERTIES ON REACTIVE SPECIES IN PAW***

Arian Fateh Borkhari - ***INVESTIGATION OF STABILITY OF CORONA ION SOURCE AND ELECTRIC FIELD IN ION MOBILITY SPECTROMETRY***

Ludmila Čechová - ***PREPARATION OF SILVER AND GOLD NANOPARTICLES BY NOVEL PIN-HOLE DC PLASMA SOURCE***

10:10 - 10:30 break

10:30 - 12:30 **PLASMA DIAGNOSTICS** (*František Krčma*)

Tristan Winzer - ***MULTI-DIAGNOSTIC APPROACH TO ENERGY TRANSPORT IN AN ATMOSPHERIC PRESSURE PLASMA***

Marta Šlapanská - ***SPATIAL-RESOLVED OPTICAL EMISSION SPECTROSCOPY OF THE SPOKE IN NON-REACTIVE HiPIMS***

Miriam Meyer - ***SPECTROSCOPY OF ANTHRACENE IN HELIUM NANODROPLETS***

Carla McDonnell - ***ELECTRIC FIELD MEASUREMENTS OF A kHz DRIVEN ATMOSPHERIC PRESSURE PLASMA***

Oguz Han Asnaz - ***INFRARED-SPECTROMETRIC MONITORING OF THE GROWTH AND SURFACE TREATMENT OF NANOPARTICLES IN A LOW-PRESSURE PLASMA***

Shakti Prasad Sethi - *A MACHINE LEARNING APPROACH: TO STUDY ARC FLUCTUATION BEHAVIOR AND DETECTION OF CATHODE POSITION IN AN ARC PLASMA FURNACE*

12:30 SAPP XXIII closing

12:50 Meeting of the ISOC Members (Decision on the Ján D. Skalný's Prize for the best presentation)

Subject **SAPP XXIII - Programme**
From SAPP <sapp@neon.dpp.fmph.uniba.sk>
To <olivera@ipb.ac.rs>
Date 2021-01-28 18:06

Dear colleagues/SAPP participants,

Let us thank you again for your interest in the Symposium on Application of Plasma Processes. Due to higher number of participants requesting oral contribution the International Scientific Committee of the SAPP supported the idea of adding one more session to the conference programme.
The final conference programme can be found at the conference web page:
http://neon.dpp.fmph.uniba.sk/sapp/base.php?stranka=Programme

The meeting will be done as a webinar via Microsoft Teams. For each conference day you will receive a separate invitation by e-mail including the link to the MS Teams webinar.
Each oral presentation should last 15 minutes and additional 5 minutes will be reserved for discussion. Every session will be moderated by chairman. If you are one of the presenters connect at least several minutes bofore the start of your session, please. Each presenting author will share the slides from her/his computer. In case you would like to test presenting via MS Teams there will be a test session organized on Tuesday (Feb 2nd) at 9:00am (Central European Time). Every presenting participant will receive invitation by e-mail.
Please, feel free to share the MS Teams webinar link with your colleagues who are interested in participation but did not register to SAPP XXIII.

We are looking forward to meeting you online.

Kind regards,
SAPP LOC

Subject **SAPP test session**

From Országh Juraj <juraj.orszagh@fmph.uniba.sk>

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Date 2021-01-31 19:13

- Part 3.ics (~8 KB)

Dear SAPP presenters,

As promised this test session is for those of you who would like to test presenting from your computer using MS Teams. The session will be open for 1 hour from 9:00am CET to 10:00am CET. You can connect an try your microphone and presentation sharing. Once you connect, you will have an attendee status, your microphone and screen sharing ability will be disabled. Please wait until we change your status to presenter then you can test the presentation.

Please, keep in mind there will be not enough time to test your whole presentation. This session is meant as a short test only.

Kind regards,
SAPP LOC