Characterization of a plasma system with microwave launcher used for treatment of liquids

N. Škoro[1], N. Babucić[1], K. Kutasi[2], K. Spasić[1] and N. Puač[1]

[1] *Institute of Physics, University of Belgrade, Belgrade, Serbia*
[2] *Wigner Research Centre for Physics, Budapest, Hungary*

In this work we present first steps in characterization of a MW plasma system used for water treatment and PAW creation. We performed spatially resolved optical emission measurements of a MW plasma operating with Ar as working gas and also determined properties of the treated water.

1 Introduciton

In the last decade a new research direction in the scientific field of non-thermal plasmas developed towards treatments of liquid targets. The motivation stems from the fact that plasma-activated liquid (PAL) has versatile applications in plasma medicine and agriculture. PAL contains reactive species with the pH of the solution reduced [1] and consequently have antimicrobial and antibacterial effect with an influence to the cells at different levels. Attaining positive effects in treatments of particular samples using PAL depend on properties which are directly connected to the conditions of the plasma treatment. Thus, for tuning of the PAL properties, among else, different plasma sources should be used [2].

In this regard, this work is a continuation of our plasma activated water (PAW) studies, now involving a microwave (MW) excited plasma. The setup will enable characterization of both the plasma and treated water thus enabling investigation of chemical reactivity properties of PAW.

2 Experimental setup

The plasma is created using an inductively coupled wave launcher and a microwave generator with precise control of an input power. The surface wave launcher is operated using Ar (with flow range 1-7 slm). Plasma is created inside the quartz tube with the plume formed at the tube ending. We analysed recordings of emission originating from different regions of plasma - images that show the spatial structure and optical emission spectra. For determination of reactive nitrogen and oxygen species in PAW colorimetric techniques were used.

3 Results and discussion

Optical measurements showed that the size of the plasma plume protruding depended on operating conditions. These measurements were conducted in order to establish distances from the source where role of reactive species is important which is important for water treatment. The optical spectrum recorded from the active volume of the plasma had lines of several excited species: Ar, O, N_2^+ and OH radical. In Fig. 1 we show change in the line intensity for argon 811 nm line depending on the position along the tube axis for 3 power values. The positions shown in the x-axis are with the respect to the tube ending (x=0) with positive values marking the outside zone.

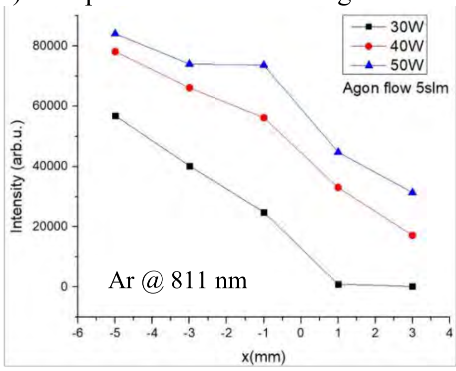

Fig. 1. Spatial change in the Ar 811 nm line intensities along the tube axis for 3 input powers. Ar flow 5 slm.

At a certain position, intensities increase with increasing power. Absence in intensities outside the tube at lower powers is due to reduced length of plasma plume. This type of measurements enables comparison of properties between existing surfatron and the new wave launcher.

Acknowledgment

This work was supported by the Sci. Fund of the RS, no. 7739780 - APPerTAin-BIOM and MSTDI Republic of Serbia grant number 451-03-68/2022-14/200024.

References

[1] Bradu C., Kutasi K., Magureanu M., Puač N., Živković S. Reactive nitrogen species in plasma-activated water: generation, chemistry and application in agriculture. J. Phys. D: Appl. Phys. **53(22)**, 223001 (2020)

[2] Kutasi K., Popović D., Krstulović N., Milošević S. Tuning the composition of plasma-activated water by a surface-wave microwave discharge and a kHz plasma jet. Plasma Sources Sci. Tech. **28(9)**, 095010 (2019)