**Ultrafast diagnostics of a pulsed barrier discharge in argon**

D. Prokop1, L. Kusýn1, Z. Navrátil1, T. Hoder1

*1 Department of Physical Electronics, Faculty of Science, Masaryk University, Kotlářská 2, 611 37 Brno, Czech Republic*

A time-correlated single photon counting (TCSPC) based optical emission spectroscopy and an electrical diagnostics utilizing an equivalent circuit theory [1] have been used for investigation of a volume barrier discharge in atmospheric pressure argon. Micro discharges were produced by applying high voltage nanosecond pulses to a pair of metallic electrodes, with one electrode covered in aluminum oxide. From the highly resolved TCSPC optical emission spectra, we have obtained a spatiotemporal evolution of different phases of argon discharge, namely the transition from rapid electron avalanching to streamer to transient glow discharge, which ended with surface discharge upon reaching the lower electrode. From the obtained data we have also determined the approximate velocity of propagating streamers. In this contribution, motivated by the detailed spectroscopic analysis of the nanosecond pulsed coplanar discharge in argon as done in [2], we present detailed spatiotemporally resolved measurements of light intensities originating from all ten Ar 2p1-10 radiative states. The quantified relative 2p1−10 densities for identified discharge phases enable a well-resolved insight into the ultra-fast discharge kinetics and open a possibility for the development of future detailed diagnostics of the rapidly ionized argon plasmas. These measurements are then crucial and serve as a cornerstone for further development of new optical emission spectroscopy methods for local and time resolved plasma diagnostics of highly transient plasmas.

**References:**

[1] A. V. Pipa et al. “*The simplest equivalent circuit of a pulsed dielectric barrier discharge and the determination of the gas gap charge transfer*.” The Review of scientific instruments 83 11 (2012): 115112.

[2] M. Šimek et al. “*Nanosecond imaging and emission spectroscopy of argon streamer micro-discharge developing in coplanar surface DBD*.” Plasma Sources Science and Technology 27 (2018): 055019.

**Acknowledgement:**This work is supported by the Czech Science Foundation project no. GACR 21-16391S and by the project LM2018097 funded by the Ministry of Education, Youth and Sports of the Czech Republic.