FROM LOW-PRESSURE TO ATMOSPHERIC PLASMAS: PHYSICS, DIAGNOSTICS AND APPLICATIONS

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Abstract. Low-pressure low temperature discharges draw attention both from the side of basic-level investigations and from application motivated research. Advances in fundamental research lead to emergence of new applications but the vice versa approach is also present in many cases. In either way, due to the complexness of the discharges, full understanding of discharge processes is necessary for making efficient and reliable applications. In order to obtain results needed for different kind of applications, our investigation is performed following two different paths.

On one side, low-pressure dc breakdown and discharge regimes in standard (cm) size chamber with plane parallel electrodes were investigated. This research is continuation of previously well-established experimental method, now applied for the gases of interest for applications: fluorocarbons and water vapour. Breakdown properties for these gases were investigated in a wide interval of pressures. From recorded discharge emission profiles we were able to point out the most important processes governing the breakdown and low-current regimes and to extract the data of ionization coefficient and secondary electron yield. Apart from measurements of current-voltage characteristics in all gases, time resolved recordings provided information about particle kinetics during formation of different discharge regimes. Obtained data are useful for modeling of discharges used in various applications.

Another direction of investigation was aiming to explore properties of micro-discharges: the discharges with electrode gaps of several hundreds of μm that operate at pressures up to atmospheric. Diagnostics of these discharges is quite limited due to their very small size. Thus, it is important to find out how much of the existing knowledge about low-pressure discharges can be applied to their micro counterparts. Scaling laws can give that answer providing that they are valid for small gaps. Hence, results of breakdown and current-voltage characteristics obtained from parallel plate micro discharge chamber are interpreted in the sense of investigation of validity of scaling laws. Special attention was given to precise determination of scaling parameters from obtained experimental results.