GEC18-2018-000324

Abstract for an Invited Paper
for the GEC18 Meeting of
the American Physical Society

Electron heating in electronegative capacitively coupled discharge of complex chemistry

JON TOMAS GUDMUNDSSON, University of Iceland

A brief overview is given on the development of a comprehensive reaction set for the oxygen discharge for particle-in-cell Monte Carlo collision (PIC/MCC) simulations. A particular attention is given to the creation and destruction of the negative ion O^-. Then the one-dimensional object-oriented PIC/MCC code `oopd1`, using this comprehensive reaction set, is applied to explore the charged particle density profiles, the electron heating mechanism and the electron energy probability function (EEPF) in a single frequency capacitively coupled oxygen discharge. We explore how including and excluding detachment by the singlet metastable molecules $O_2(a^1\Delta_g)$ and $O_2(b^1\Sigma_g)$ influences the electron heating mechanism and the discharge electronegativity. We demonstrate that the detachment processes have a significant influence on the discharge properties, in particular at the higher operating pressures ($>$ 30 mTorr) [1,2]. We show that for low driving frequency and low pressure (5 and 10 mTorr), a combination of stochastic (α-mode) and drift ambipolar (DA) heating in the bulk plasma (the electronegative core) is observed and the DA-mode dominates the time averaged electron heating [3]. As the driving frequency or pressure are increased, the heating mode transitions into a pure α-mode, where electron heating in the sheath region dominates [3]. This transition coincides with a sharp decrease in electronegativity. Furthermore, we demonstrate that the electrodes surface quenching coefficient has a significant influence on the density of the singlet metastable $O_2(a^1\Delta_g)$ and thus the discharge electronegativity and electron heating mechanisms [4]. [1] J. T. Gudmundsson and M. A. Lieberman, Plasma Sources Sci. Technol. **24**, 035016 (2015) [2] J. T. Gudmundsson and B. Ventéjou, J. Appl. Phys. **118**, 153302 (2015) [3] J. T. Gudmundsson, D. I. Snorrason and H. Hannesdottir, Plasma Sources Sci. Technol. **27**, 025009 (2018) [4] A. Proto and J. T. Gudmundsson, Plasma Sources Sci. Technol. accepted for publication 2018