GLOBAL MODEL OF RF-EXCITED ATMOSPHERIC PRESSURE HE/O_2 COLD PLASMAS

Dingxin Liu, Mingzhe Rong, and Xiaohua Wang
State Key Laboratory of Electrical Insulation and Power Equipment, Xi'an Jiaotong University, 710049, P. R. China

Peter Bruggeman
Department of Applied Physics, Eindhoven University of Technology, 5600 MB Eindhoven, PO Box 513, The Netherlands

Felipe Iza and Michael G Kong
Department of Electronic and Electrical Engineering, Loughborough University, LE11 3TU, UK

He/O_2 plasmas have received great attention in recent years for their potential application in the rapidly growing field of plasma medicine. In this contribution we present a comprehensive global model of RF-powered atmospheric pressure He/O_2 cold plasmas aimed at revealing the main species and chemical reactions involved in these discharges. Based on an extensive literature review, the model incorporates a total of 17 species and 211 reactions.

Simulation results indicate that He/O_2 plasmas undergo a mode transition as the oxygen concentration in the carrier gas increases. At low oxygen concentration, Penning processes are very important and ppm level admixtures of oxygen are sufficient for making O_2^+ the dominant ion species in the discharge.

As the oxygen concentration in the carrier gas increases, electron attachment becomes increasingly important and the discharge turns electronegative for oxygen concentrations above a few hundred ppm. Despite the larger presence of oxygen in the discharge, the reduction in electron density with increasing oxygen concentration at constant input power results in the reduction of the generation of excited atomic oxygen species (e.g. $O(^1D)$, $O(^1S)$,…). Maximum densities of excited atomic species are found when the oxygen concentration in the carrier gas is around 0.5%. The concentration of ground state atomic oxygen [O] is found to saturate when $[O_2]$~2% and further increase is limited by 1) the decrease in electron density and 2) the increase of O_3 formation via three-body reactions. These simulation results agree qualitatively with experimental results [1,2].

Ground state [O] and excited [O*] atomic oxygen concentrations display a different evolution with increasing oxygen concentration, suggesting that simple optical emission measurements of oxygen lines (e.g. 777nm and 845nm) are not accurate indicators of the actual atomic oxygen concentration generated in the plasma.

1. Knake N, et al. 2008 *Appl. Phys. Lett.* 93 131503
2. Wang B, Zhu W, Pu Y. 2005 *Plasma Sci. Technol.* 7 3045

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