SIMULATION OF A HELIUM/OXYGEN ATMOSPHERIC PRESSURE PLASMA JET*

P. -W. Yu, F. -W. Gu, , K. -C. Leou
Engineering and System Science, National Tsing Hua University, Hsinchu, Taiwan

M. -W. Wu, C. -F. Ai
Physics Division, Institute of Nuclear Energy Research, Tauyuan, Taiwan

Atmospheric pressure plasma jet (APPJ) has attracted a great deal of attention recently because its atmospheric pressure operation minimize the need for high cost vacuum system and thus allows a wide range of applications, e.g., surface modification, thin film synthesis, and bio-medical treatments, etc., at low cost. Although experimental works have been demonstrated extensively, along with numerical simulation using global model or one-dimensional fluid model, simulate on using two dimensional model that examines the discharge not only in the discharge gap region, but also the effluent of the APPJ, is highly desirable so that a complete picture of APPJ can be obtained. In this study, we investigated a slot type He/O_2 APPJ by employing a 2D fluid model (CFD-ACE +, ESI Corp.) running at time-dependent transient mode. The fluid model solve the standard fluid equations, such as continuity, momentum and energy equations, for electrons while for ions and neutrals, continuity and momentum equations, in conjunction with the drift-diffusion approximation for all charged particles. Simulation was performed for APPJ operated under radio frequency (27.12 MHz) power and a gas mixture of He and O_2 (0 – 1 %). Simulation results show that O_2 is the major species that are ionized, i.e., becoming O_2^+ or O^+, instead of He, due to the much lower ionization thresholds of O_2 or O. Compared to pure He discharge, the plasma density decreases as O2 fraction increases, due to the formation of negative ions (O_2^- and O^-). In the effluent region, the oxygen radicals, such as O, O_2^* and O^3 increase significantly as the fraction of O_2 increases, as expected. The detailed simulation results of the parametric analysis by varying , e.g., rf power, gas flow rates, or gas mixtures, will be presented.

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