Abstract Submitted
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Hybrid Global Model Simulations of He/N_2 and He/H_2O Atmospheric Pressure Capacitive Discharges[1] M.A. LIEBERMAN, E. KAWAMURA, Univ of California - Berkeley, DING KE, Donghua Univ - China, A.J. LICHTENBERG, Univ of California - Berkeley, P. CHABERT, Ecole Polytechnique - France, C. LAZZARONI, Universite Paris 13 France — We used 1D particle-in-cell (PIC) simulations of an atmospheric He/0.1%N_2 discharge with simplified chemistry to guide the development of a hybrid analytical/numerical global model that includes electron multiplication and two classes of electrons: "hot" electrons associated with the sheaths, and "warm" electrons associated with the bulk. The model and PIC results show reasonable agreement and indicate a transition from a low power α-mode with a relatively high bulk electron temperature T_e to a high power γ-mode with a low T_e. The transition is accompanied by an increase in density and a decrease in sheath widths. Water is a trace gas of bio-medical interest since it may arise from contact with skin. We use the hybrid global model to simulate a chemically complex, bounded He/H_2O atmospheric pressure discharge, including 148 volume reactions among 43 species, and including clusters up to $H_{19}O_9^+$. For a planar discharge with a 1 cm electrode radius and a 0.5 mm gap driven at 13.56 MHz, we determine the depletion and diffusion effects and the α to γ transition for secondary emission γ_{se}=0.25 over a range of rf currents and external H_2O concentrations. Each simulation takes about 2 minutes on a moderate laptop.

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