Abstract Submitted
for the GEC16 Meeting of
The American Physical Society

1D fluid model of the dielectric barrier discharge in chlorine

SVETLANA AVTAEVA, Novosibirsk State University — The 1D fluid model of the dielectric barrier discharge (DBD) in pure chlorine is developed. The discharge is excited in 8 mm gas gap between quartz dielectric layers of 2 mm thickness covered metallic electrodes. The source voltage $U_S = U_0 sin\omega t$ with a frequency 100 kHz and amplitude 8 kV is applied to the electrodes. Chlorine pressure is varied from 15 to 100 Torr. At pressure of 15 Torr a breakdown appears with voltage drop across the discharge gap about 1 kV whereas at 100 Torr it appears with voltage drop about 2 kV. After the first current spike some lower current spikes are observes with chlorine pressure of 100 Torr and large in number current spikes of about identical magnitude are observed with the pressure of 15 Torr. The maximal current density at all pressures reaches about 4 mA/cm^2. Total density of surface charge deposited on the electrodes during a half-cycle decreases with chlorine pressure because duration of the current spike discharge phase reduces with chlorine pressure. The average power density inputted in the discharge is 2.5-5.8 W/cm^3 per a cycle. The Cl_2 plasma is electronegative, the most abundant ions are Cl_2^+ and Cl^-. It is shown, that ions get about 95% of the discharge power as electrons get about 5% of the discharge power. 67-97% of the electron power is spending for dissociation and ionization of Cl_2 molecules. Emission of Cl^* atoms and Cl_2^* molecules is weak.

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Date submitted: 10 Jun 2016 Electronic form version 1.4