Modeling of DC Discharges in Argon at Low Pressures

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Abstract

The glow discharges are modeling in argon at gas pressure ranging from 0.5 to 50 mtor. The discharge tube size is large with 0.5m diameter and the length ranging from 0.3 to 0.6 m. The discharge current ranges from 100 mA to 100A and the power supply voltage ranges from 100V to 300V with low external resistance of 0.5Ohm. The model is based on Plasma Module recently introduced by COMSOL[1].Two mechanisms of electron emission are considered: one is self-sustained glow discharge based on secondary electron emission and another is low pressure arc in which electrons are emitting by thermionic cathode. In this model we are comparing 3 different conditions on discharge wall; first, a charge balance conditions associated with dielectric discharge tube, and two boundary conditions associated with metal discharge tube: one is a floating potential tube and another one is a tube serving as an anode in a discharge circuit. The results show that the I-V characteristics of thermionic discharge have a negative differential resistance (the voltage decreases when the current increases) typical to arc discharges while in self-sustained discharges the I-V characteristics have a positive differential resistance (the voltage increases when the current increases) typical for glow discharges with secondary electron emission [2]. Other plasma characteristic vs. discharge parameters are discussing.

Reference

1. COMSOL Plasma Module reference guide.
2. Raizer, Y.P., Gas Discharge Physics, Springer (1991).

Figures used in the abstract

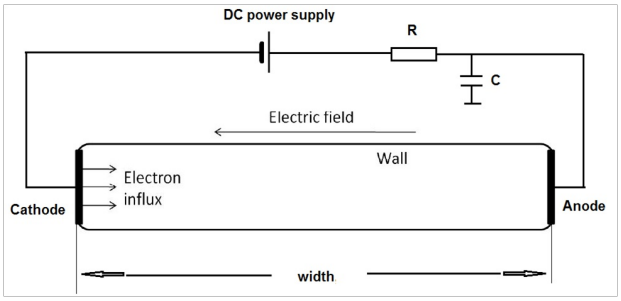

Figure 1: Axisymmetric DC plasma discharge scheme.

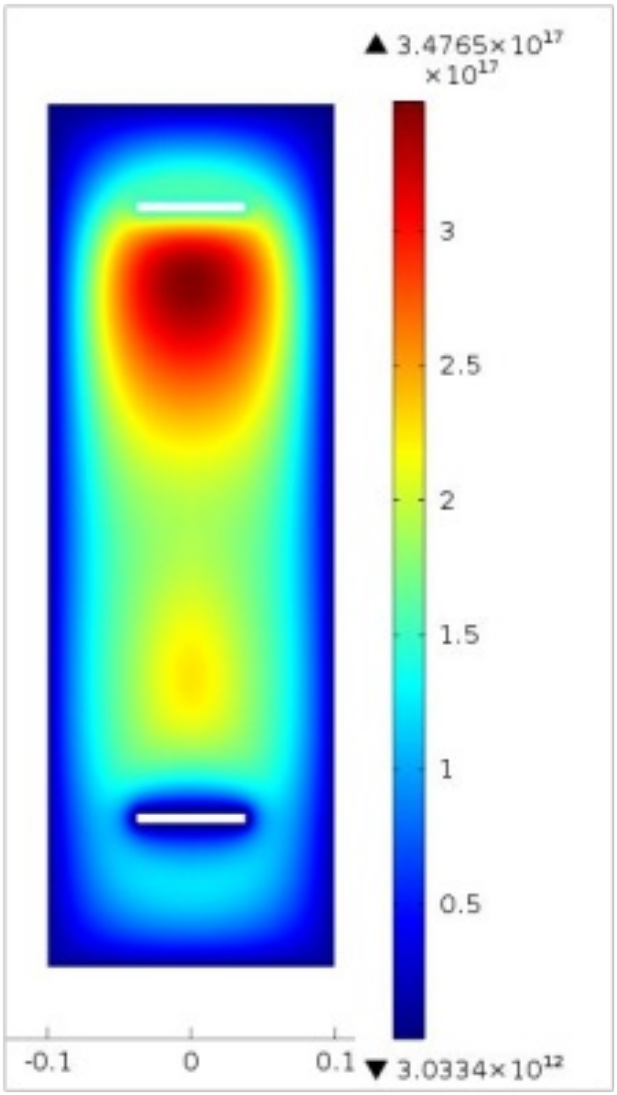

Figure 2: Plasma distribution in the floating metal discharge tube.

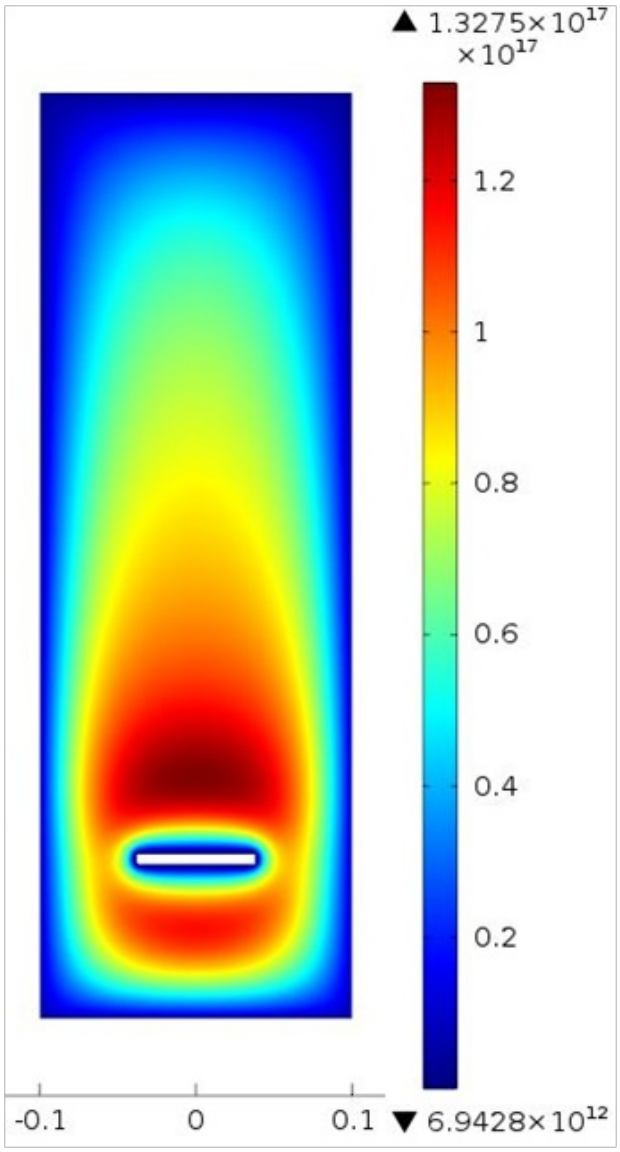

Figure 3: Plasma distribution in the metal discharge tube-anode.