

# Modeling the dependence of the electron density on the gas flow rate in the induction plasma of argon

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The dependence of the parameters of an inductive-coupled radio-frequency discharge at low pressure (113-165 Pa) with the gas flow is investigated by numerical simulation. The calculation is performed in the COMSOL Multiphysics 5.6 software package (modules: plasma, magnetic fields, heat transfer and laminar flow in conjunction with plasma conductivity coupling, electron heat source. License No. 9602172).

The mathematical model consists of the Navier-Stokes, Maxwell equations and the continuity equation for electrons. The applicability of the Navier-Stokes equations with the no slip boundary condition is limited by the Knudsen number  $K_n \geq 0.1$  [1]. For the model under consideration  $K_n \approx 0.01 - 0.1$ , which satisfies the condition of applicability. The distributions of the discharge parameters in the center of the tube are obtained, and dependencies on the gas flow rate in the range of 10-2000 sccm and on frequencies in the range of 1.76-13.56 MHz are investigated. The model was verified by comparing the model results with the experiment [2].

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- [1] Kara V, Yakhot V and Ekinici K L 2017 *Physical review letters* **118** 074505
- [2] Abdullin I, Zheltukhin V and Kashapov N 2000 *Radio-Frequency Plasma Treatment of Materials at Low Pressures. Theory and Practice of Application* (Kazan Publishing House University)