Dependence of parameters of inductively coupled plasma on gas flow rate [[1]](#footnote-1)\*)

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The dependence of the electron and ion densities, as well as the electron and gas temperature on the gas flow rate is studied using a 2D axisymmetric mathematical model of a reduced pressure radiofrequency inductively coupled plasma with neutral argon gas flows through the tube. The simulation was carried out using the Comsol multiphysics software [1] including the «Plasma», «Magnetic fields», «Laminar flow», and «Heat transfer» modules. The simulation was carried out at pressures p=113-190 Pa, power W=1300 W, drive frequencies f=1.76, 13.56 MHz and gas flow rate range G=0-9000 SCCM.

Comparison of the existing model [2] with the experimental results of the electron density from the gas flow rate obtained by Abdullin et al. [3] shows that at high flow rates (G>6000 SCCM) there is a discrepancy between the model and the experimental data [2].

In this work, attempts have been made to explain such a discrepancy, as well as to make changes to the model that allow one to carry out calculations of radiofrequency inductively coupled plasma at high flow rates. It is expected that as a result of this work, distributions of the discharge parameters from the gas flow rate will be obtained, thanks to which it will be possible to establish the gas flow rate at which the maximum values ​​of the electron and ion densities, as well as the electron and gas temperature, are achieved.

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References

1. COMSOL AB, “Comsol multiphysics® license no 9602172.”, Stockholm, Sweden,, [www.comsol.com](http://www.comsol.com/).
2. Terentev T.N., Shemakhin A.Yu., Samsonova E.S., Zheltukhin V. S., Frequency dependencies of the characteristics of an inductively coupled radiofrequency discharge at reduced pressure, Plasma Sources Science and Technology, 2022, 31, 094005.
3. I.S. Abdullin, V.S. Zheltukhin, and N.F. Kashapov, Radio-frequency plasma jet treating of materials at low pressures: Theory and practice of application [vysokochastotnaya plazmenno-struynaya obrabotka materialov pri ponizhennykh davleniyakh. teoriya i praktika primeneniya – in russian], Kazan: Kazan Technol. Univ. Press [Kazan: Izdatel’stvo Kazanskogo gosudarstvennogo universiteta], 2000
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/L/Lt/ru/FD-Terent%27ev.docx) [↑](#footnote-ref-1)