Discharge formation in tokamak using injection of plasma jet of accelerator

V.Yu. Goryainov[1,2], A.V. Voronin[1], V.K. Gusev[1], V.B. Minaev[1], A.N. Novokhatskiy[1], Yu.V. Petrov[1], N.V. Sakharov[1]

[1] Ioffe Institute, St. Petersburg, Russia

[2] Peter the Great Polytechnic University SPbPU, St. Petersburg, Russia

e-mail: *vgoryainov@mail.ioffe.ru*

Technology of working gas breakdown, plasma fueling, and optimization of the discharge scenario are actual tasks that stand in the way of solving the effective management of tokamak parameters. At present, such methods of plasma production in tokamak as inductive gas breakdown, RF radiation, mercury ionization lamps, and others are being considered and applied. The paper presents a method of gas breakdown and plasma discharge generation by injection of plasma accelerator jet into tokamak chamber.

Previously, plasma accelerator was used on Globus-M tokamak with magnetic field ≤ 0.4 T for injection of plasma jet at the current plateau regime [1], as a result of which it was possible to increase the particle density by 30% in the central region of the plasma column without current disruption. In current experiments was used a modernized plasma accelerator, capable of generating plasma stream penetrating into the central region of Globus-M2 tokamak with increased magnetic field up to 0.7-0.8 T.

All experiments on gas breakdown and discharge formation were carried out on Globus-M2 spherical tokamak (major radius R = 0.36 m, minor radius a = 0.24 m, magnetic field B_T = 0.7 T, plasma current I_p = 115-250 kA). As a result, decrease in the breakdown voltage from 6 V during inductive breakdown to 3.1 V (-48%) during breakdown by plasma jet was obtained. The discharges created by the plasma jet showed their stability after driving through the formation stage.

The research results are supposed to be used to develop technology for gas breakdown and ionization, as well as to optimize the scenario of the initial phase of the discharge as applied to the parameters of Kazakhstan Tokamak of Materials Science (KTM).

The experimental work was performed on the Unique Scientific Facility ‘Spherical tokamak Globus-M’, which is incorporated in the Federal Joint Research Center ‘Material science and characterization in advanced technology’ within the framework of the State task of the Ioffe Institute. An experimental sample of a coaxial plasma jet accelerator was manufactured and tested under the agreement with the Ministry of Science and Higher Education (contract ID RFMEFI58519X0007). The work was supported by the Ministry of science and higher education of Russian Federation in the framework of the state contract in the field of science under project No. 0784-2020-0020.

References

[1] A. Voronin et al. 2005 *Nucl. Fusion* **45** 1039