Measurment of plasma parameters in gdc stis-1s

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At present, works on modernization of T-15MD tokamak are carried out. The additional plasma heating in the tokamak with use of three neutral beam injectors is planned. Each of them is equipped with two ion sources STIS-1S, generated the hydrogen ion beam with a power of 2 MW each at an energy up to 50 кэВ and a pulse duration of more than 5 s.

One of the main units of the source is a stationary gas discharge chamber (GDC) [1], which generates the hydrogen plasma whith the required ion current density at the emission boundary – surface of the electrode of the ion-optical system, which extracts and accelerates the ion beam. The basic characteristics of GRC STIS-1S: operation mode - stationary (up to 30 s); type of discharge in the GRK - arc; discharge power - up to 70 kW; the area of the uniform plasma emission surface is about 450 cm2; the hydrogen ions current density is up to 0,3 A/cm2 at discharge current of about 1,3 kA which is provided by a set of tungsten wire thermo-cathodes with a total emission area of up to 100 cm2.

To ensure a high energy efficiency of the discharge, a near-wall peripheral magnetic field (“cusp”) is used, created by a series of permanent magnets made of Nd-Fe alloy mounted on the camera body with alternating poles. The magnetic field value in the central part of the chamber volume is quite small and has a near exponential increase to ~ 1000 G in the walls vicinity.

This paper presents the results of the magnetic field configuration measurements in the near wall region of the GDС and in the emission electrode area and, using Langmuir probes, the distribution of plasma parameters (ion current density, electron temperature and plasma potential) in these regions at different discharge currents, working gas pressures in GRС and power system configuration. On the basis of the data obtained, the total current of the ions generated in the volume of the GDK and the current of the ions coming onto the emission electrode under different discharge conditions is estimated and its energy efficiency is determined.

References

1. V.A. Nikulin, V.F. Korolev, A.A. Panasenkov e.a. Gas discharge chamber of steady state ion source STIS-1S for T-15 injection system. XLIII International (Zvenigorod) Conf. on Plasma Physics and Controlled Fusion, 2016., Book of abstracts,p.88.