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TEMPERATURE DISTRIBUTION OF ARGON AND KRYPTON IONS ALONG THE SURFACE OF THE CURRENT SHEET *)

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A study of the two-dimensional distribution of electron concentrations in current sheets has shown that there are significant plasma density gradients in the direction perpendicular to the middle plane of the sheet, however, along the width of the sheet (the larger of the transverse dimensions of the sheet), the plasma density is distributed, as a rule, almost uniformly [1]. The purpose of this work was to study the temperature distribution of argon and krypton ions along the surface (width) of a current sheet formed in a two-dimensional (2D) or three-dimensional (3D) magnetic configuration.

The experiments were performed using the CS-3D installation (GPI RAS), experimental conditions: the initial pressure of the working gas p ≈ 30 mTorr, the gradient of the transverse magnetic field h = 0.57 kG/cm, the amplitude of the electric current in the plasma Jz = 45 kA, the induction of the longitudinal magnetic field Bz = 0/2.9 kG (2D/3D magnetic configurations). The measurements were carried out by spectral methods, the profiles of the spectral lines of argon ions Ar II 480.6 nm, krypton Kr II 473.9 nm and carbon C IV 580.1 nm (present in the plasma as an impurity) were recorded, the lines were broadened due to the Doppler effect. Plasma radiation was collected from a central quasi-cylindrical region elongated along the direction of the current, since all directed plasma movements in the current sheet occur mainly in a plane perpendicular to the current [1]. To study the temperature distributions of ions along the width of the current sheet, the receiving part of the measurement scheme was fixed on an optical table that moved along the width of the sheet. The measurements were carried out in the central region of the current sheet and two other areas shifted relative to the center by 3 and 6 cm. The spatial resolution of spectral measurements was 2.6 cm.

It was found that the temperature of argon ions Ar II (ionization potential E_i = 27.6 eV) is distributed along the width of the current sheet almost uniformly, changes slightly during the evolution of the sheet in both 2D and 3D magnetic configurations and is T_i ≈ 40-50 eV. This temperature characterizes the heating of the peripheral regions of the plasma sheet [2]. The heating of the hotter central region of the sheet is described by the temperature of carbon ions CIV 580.1 nm (E_i = 64.5 eV), which reaches a value of T_i^{max} ≈ 90 eV, that is ~ 2 times higher than the temperature of argon ions Ar II.

It is shown that the temperature distribution of krypton ions Kr II (E_i = 24.6 eV) along the sheet width at the beginning of the evolution of the current sheet is almost uniform, changes slightly with time, the characteristic ion temperature is T_i ≈ 50 eV. Then, in the 3D magnetic configuration, the temperature of krypton ions decreases along the entire width of the current sheet, and in the 2D magnetic configuration, on the contrary, increases along the width of the sheet, and a local temperature maximum is formed in the center of the sheet: T_i^{max} ≈ 80 eV.

Thus, it was found that in the central region of the current sheet formed in a 2D magnetic configuration during discharge in argon and krypton, a local region of hot plasma with an ion temperature of: T_i^{max} ≈ 80-90 eV is formed.

References

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*) abstracts of this report in Russian