DYNAMICS OF THE DELIVERY OF IMPURITIES TO THE GAS DISCHARGE PLASMA IN PLASMA FOCUS [[1]](#footnote-1)\*)

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An increased yield of X-ray and neutron radiation at high discharge currents in plasma focus installations is possible when the power source agrees with the mass characteristics of the current plasma sheath formed during the primary breakdown along the surface of the insulator between electrodes. One of the obstacles to the thermonuclear method of neutron generation (adiabatic compression) may be the presence of elements with a large charge number Z in the plasma compression zone. The question of the possible entry of impurities from the surface of the insulator and the surface of the electrodes during acceleration and cumulation of the current sheath into the deuterium plasma is of interest.

At the PF MOL installation ("SRC RF TRINITY"), the dynamics of impurities entering the gas discharge was studied at charging voltages up to 12 kV and discharge currents up to 700 kA [1].
In spectroscopic measurements, a spectrograph with a diffraction grating of 600 lines per mm and an electronic video camera SDU3-250S with a CCD matrix resolution of 2.0x2.4 thousand pixels and a minimum exposure of 1.5 μs were used.

The experiments used preliminary filling of the chamber with deuterium and the pulsed injection of deuterium with using a high-speed gas valve [2]. Spectra were recorded at the initial stage of the discharge (0-3 μs) when they were observed along the gap between electrodes through the diagnostic window in the end part of the chamber. The spectra of the pinch focusing area were photographed through a side diagnostic window. In this case, the optical axis was located perpendicular to the axis of the system at a distance of 1 cm from the end of the anode. The observation time was from -1 to +1 μs from the moment of pinching.

The experimental results revealed a small amount of impurities based on the intensity of the spectral lines relative to the lines of the deuterium working gas.The main ones in terms of ionization steps are C II – С IV, O II, N II, Al II, Cu I. When passing from the preliminary filling of the chamber to the pulsed injection of deuterium into the completely evacuated chamber, the elemental composition of impurities did not change.

When the region at the end of the anode was observed, the lines of copper and of other elements appeared in the plasma spectrum 1 μs after the electrical current peculiarity.

Therefore, it can be assumed that the impurities captured at the stage of plasma acceleration do not penetrate into the pinching zone due to the changing configuration of the SST at the stage of compression.

References

1. Krylov M.K., Grabovsky E.V., Gribov A.N., Efremov N.M., Lototsky A.P., et al. Magnetic probe measurements of the parameters of a moving current shell at the PF MOL installation XLVII International (Zvenigorod) Conference on Plasma Physics and Controlled Fusion, March 16 - 20, 2020 p. 128.
2. Lototsky A.P., Grabovsky E.V., Lukin V.V., et al. Dynamics of the current sheath in a self-contracting plasma discharge with additional gas injection. VANT (in the press).
1. \*) [abstracts of this report in Russian](http://www.fpl.gpi.ru/Zvenigorod/XLIX/It/ru/DK-Panfilov.docx) [↑](#footnote-ref-1)