

CHEMICAL CHARACTERISTICS OF THE FILMS,  
APPEARED ON THE ANODE SURFACE OF SPT.

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Abstract

In order to understand the nature of film, appeared on the anode surface [1,2], the anode after operating in Kurchatov Institute and ring-shaped titanium insert after operating in MIREA were analysed to determine the composition of the appeared films. X-ray spectral analysis on the Camebax device has been carried out. According to this analysis, the oxidized film is formed on the anode surface. It contains elements of vacuum oil and of parts of thruster and vacuum chamber which are sputtered by plasma jet of thruster.

The nonconducting film appears on anode surface of thruster during SPT operation in vacuum chamber. It has been shown in experiments on Kurchatov Institute stands and, also, in experiments, when quartz or metal were sputtered [1,2]. In order to understand the film nature the anode after operating in Kurchatov Institute and ring-shaped titanium insert after operating in MIREA were analysed to determine the composition of the appeared films. X-ray spectral analysis on the Camebax device has been carried out.

For anode ring-shaped insert three anode sections have been analysed:

- a) section cleaned from dusting;
- b) section covered with light coating;
- c) section covered with dark coating.

It is seen from comparison of X-ray spectra of dusted surface and clean surface that the main chemical elements in near-surface layer of order 1  $\mu\text{m}$  of depth are Ti, Mo, Al, S. These elements are in all spectra. Oxygen and carbon have been registered only on coated sections. The main elements of coating are Si, O, C and, probably, Al. As it is followed from analysis the film of oxidized materials - Al, C, Si - grows on the surface (the last is followed from quantitative analysis). Aluminium appears in the channel as a result of sputtering of mounting hardware in vacuum chamber. Carbon appears in consequence of oil decomposition. The silicon line in material is weak. Its intensity in film increases at 5-7 times. As the used oil BM-5 does not contain silicon it is natural to assume that silicon is transported on the anode, when ceramics - and metal parts of vacuum chamber - sputtering take place.

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The results of film analysis, when the thruster operated on Kurchatov Institute stands show that intensities of Si, O, C lines on the coated section grow sufficiently, lines of Al grow weakly, and there are also small quantities of Zr and Sc. The silicon line is sufficiently more intensive than in MIREA experiments, which is in accordance with oil composition. Al-line and appearing Zr-line witness, that redusting of ceramics on the anode takes place.

Thus one can affirm, as a result of carried out analysis, the oxidized film is formed on the anode surface. It contains elements of vacuum oil and of parts of thruster and vacuum chamber which are sputtered by plasma jet of thruster.

#### References

1. A. I. Bugrova et al., "Influence of target sputtering on thruster parameters". In 24th IEPC, Moscow, Russia, 1995. IEPC-95-66.
2. A. I. Bugrova et al., "SPT-ATON tests at Kurchatov Institute stands". In 24th IEPC, Moscow, Russia, 1995. IEPC-95-67.