EXPERIMENTAL DETERMINATION OF ION ENERGY AT THE OUTLET OF SPT-ATON.

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Abstract

It was obtained the ions energy spectrum of plasma flow,which emerges from the thruster, with aid of multi-mesh probe. It was shown,that the ion flow, emerged from the thruster, contains the ions of the first ratio (their energy is approximately $\sim\frac{3}{4}U_d$) and ions of the second ratio with energy approximately $\sim\frac{5}{4}U_d$.

Investigation of ion energy spectrum was carried out by the method of cut-off potential with aid of multi-mesh probe. It is known, that the method of multi-mesh probe allows to obtain the energy spectrum of charged particles. However the aim of this work was not only to obtain the spectrum of charged particles - ions,but also to separate the ions of the first and second ratio. For this purpose the phenomenon of recharge can be used. Since the pressure in vacuum chamber is equal ~ 3E-4 mmHg, then, placing the probe sufficiently far from the thruster out-let, one can obtain not only the ion energy spectrum,but also to separate ions according to the charge value.

The probe contains two plane-parallel meshes and solid ion collector behind them (fig.1). The meshes were stainless-steel, with cells 0.4x0.4mm.The distance between meshes C_1 and C_2 was 2mm, the collector K was placed at 2mm from the mesh C_2, it had diameter ϕ = 6mm and corresponded to inner working diameter of the probe.

The constant voltage "$-V_2$" was applied between the meshes C_1 and C_2 (fig.2), which was enough to separate electron and ion current components on the collector K. The analyzing voltage "V" (fig.2) was applied between the mesh C_1 and the collector K. Ion current, coming to the collector, was registered with milliampermeter.

Investigation of ion energy spectrum was carried out for thruster operation mode $\dot{m}_A$ = 3.0 mg/s, U_d = 350 V.

The probe was placed at z= 0.75m from the thruster outlet.The collector ion current delay curves dependencies on voltage V between the mesh C_1 and the collector K allowed us to obtain ion energy spectrum of plasma flow from the thruster (fig.3).In this case V_2=-60V, and the ion current component was separated.

One may see, that the curve has two maxima on energy.The main maximum corresponds to ion energy $\mathcal{E}_{1max} \approx$ 280 eV .

The second maximum corresponds to ion energy $\mathcal{E}_{2max} \approx$ 420 eV, that is, higher, than discharge voltage.The area of the second maximum ($\mathcal{E}_{2max} \approx$ 420eV) is 12% of the main energy maximum ($\mathcal{E}_{1max} \approx$ 280eV) area.This fact says,that the ion flow, which emerges from the thruster, contains the ions of the first ratio (their energy is approximately $\sim\frac{3}{4}U_d$) and ions of the second ratio with energy approximately $\sim\frac{5}{4}U_d$.

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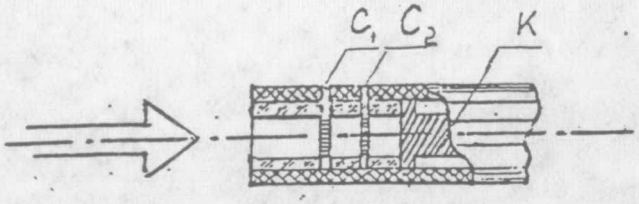

Fig.1.The design of three-electrode probe:
C_1 - the first mesh;
C_2 - the second mesh;
K - the collector.

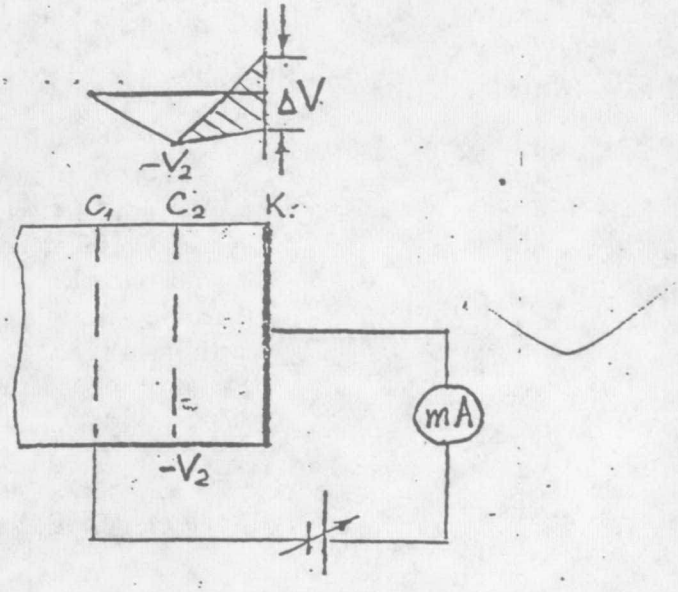

Fig.2.Electric circuit of three-electrode probe.

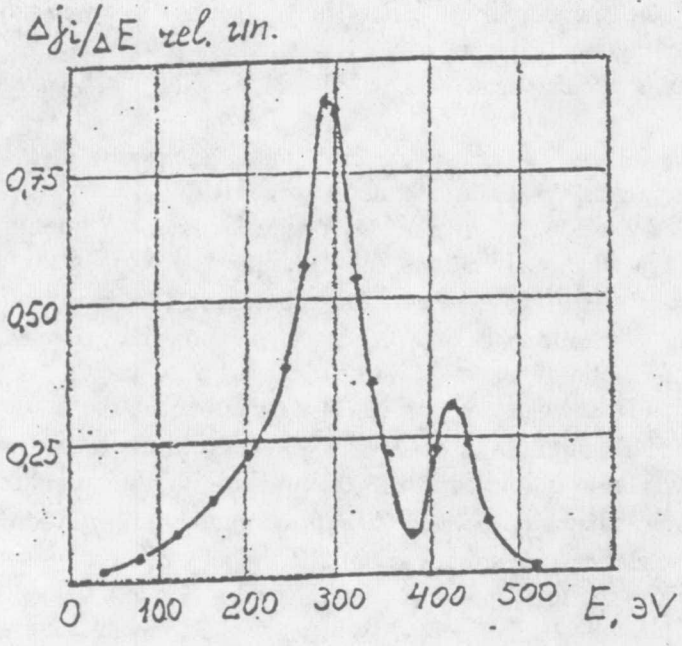

Fig.3.The ion flow energy spectrum.