PECULIARITIES OF THE DUOPLASMATRON APPLICATION
IN THE COMPLEX FOR PRODUCTION OF
TRACK-ETCHED MEMBRANES

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The complex for production of track-etched membranes is being created on the basis of the MILAC heavy ion accelerator. The accelerator was put into operation in 1958 in KIPT. In the course of its commissioning, the construction of the accelerator has undergone a series of changes, presently, it is dedicated for accelerating ions with $A/q=14$ ($A$ - ion mass, $q$ - ion charge) and initial energy of 33 keV/u up to the energies of 0.975 MeV/u in the pre-stripping section and up to 8.5 MeV/u in the main section. For track-etched membrane production, an ion beam with the number of particles of $10^{12}$ $s^{-1}$, mass of no less than 40 a.m.u. and energy of about 1 MeV/u is required. Thus, the MILAC satisfies all demands on track-etched membrane production.

At the first stage, a duoplasmatron of the pulsed type with the hot or cold cathode is used as an ion source. The peculiarity of the application of the duoplasmatron on the MILAC lies in the fact that it is used as a source of heavy multicharged ions. Besides that, it is necessary to use the source together with the accelerating tube, and there is no chance to separate the ion beam at the input to the accelerating tube according to the charge state due to the source construction.

Analysis of the charge states of argon and krypton ions showed that when the source is adjusted for the maximum current, and the beam is focused at the output from the accelerating tube, the ions of the necessary charge multiplicity are either absent or their number is rather small and is far beyond the sensitivity of the analyzer.

The radial beam dimension, $r_0$, at the output of the accelerating tube and the focal length, $f$, depend on the initial beam parameters and on the parameters of the forming system of the accelerating tubes. With the fixed $r_0$ and $f$, this dependence defines the total current of the ion beam that is focused on the output of the accelerating tube. Therefore there is no possibility to increase the yield of multicharged ions through the straightforward increase of the power being supplied into discharge and spent for maintaining the high electron temperature. Besides that, each beam component has its own focal length, which hinders the adjustment of the focusing system of the complex for the required charge multiplicity.

To obtain an ion beam of necessary charge multiplicity, which is focused on the input of the accelerating structure, simultaneous matching the operational modes of the source and accelerating tube is necessary. These modes have individual values for the operating gas pressure, magnetic field strength, discharge current, source anode voltage and electric field distribution along the accelerating field for each component. With the optimum parameters, it was obtained 20% from the total amount of particles for the $\text{Ar}^{2+}$ beam and about 1.5% for $\text{Kr}^{6+}$ beam. The profiles of the beam current densities have been measured at the output of the accelerating tube, which define different operational modes of the source and adjustment of the optical system.

On the basis of the obtained data the sequence of adjusting the accelerator optical system for accelerating ions of different masses has been determined. The capabilities of duoplasmatron application for track-etched membrane production on the MILAC accelerator have been evaluated.