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ROLE OF ELECTRONS OF PLASMA AND ELECTRON BEAM IN GENERATION OF BEAM-PRODUCED PLASMA IN MEDIUM VACUUM*

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We discuss here the results of experimental studies aimed at revealing the role of low-energy electrons of plasma and high-energy electrons of energetic electron beam in the generation of beam-produced plasma in the fore-vacuum pressure range. Our main research instrument was RGA-300, the residual atmosphere quadrupole mass analyzer which ionizer was replaced by an ion-optical system described in details in [1].

The idea of the experiment was to inject different inert gases – argon and helium – in equal concentrations as a working mixture. During the process of generation of beam plasma, the mass spectrum of ions in such plasma was monitored, and the ratio of densities of argon to helium ions was recorded. This experimental ratio was compared with theoretical estimates of the ratio of the ionization probabilities P_{Ar}/P_{He} for the mentioned gases. The plasma electrons temperature was assumed to be 1.5 eV with the Maxwellian distribution function [2, 3]. For the beam electrons, it was assumed that their energy is completely dissipated during sequential acts of working and residual gas ionization.

According to theoretical estimations, the ratio P_{Ar}/P_{He} equals to 2058 in case of ionization by plasma electrons only, while for the ionization by energetic electron beam this ratio becomes equal to 5.54. Experimental ratio of densities of argon to helium ions was 5.8.

Therefore, we can conclude that the main contribution to plasma generation in medium vacuum make high-energy beam electrons not plasma electrons. However, the small contribution of plasma electrons can be significant during the ionization of alkali metal vapors with a low potential and a maximum ionization cross section.

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