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Experimental Characterization of a Multi-Cusp Electron Source as Charge Neutralizer for Ion Implanter

In this study, we conducted experimental study on a hot-cathode, multi-cusp electron source as charge neutralizer device for ion implanters. This device is divided into a plasma source area using a hot-cathode and magnetic multi-cusp, and a transport area that transports extracted electrons through an axial magnetic field by the electromagnet. We utilized a biased mesh to measure the quantity of low-energy electrons, which significantly contribute to the neutralization of the ion beam charge, among the transported electrons. Also, we analyzed the effects of various variables through experiments, and the discharge voltage, gas pressure, and magnetic field strength were found to be variables that monotonically increase with the low-energy electrons measured at downstream. In contrast, the extraction energy of the electron beam and the voltage of the accelerating electrode showed a complex relation with them. In particular, we found the plasma potential which can be adjusted by controlling the voltage of the accelerating electrode plays a significant role for the transport of low-energy electron beam. We also observed that the change in plasma potential triggered instability propagating in the azimuthal direction, affecting the quantity and temperature of electrons at downstream.

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