2D KINETIC MODELING OF PLASMA JET IN EXTERNAL MAGNETIC FIELD

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Numerical particle-in-cell and Monte Carla simulations were carried out to study the effect of an external axial magnetic field on a plasma jet flowing from a cathode spot of a vacuum arc. A plasma jet carrying a current of 1 A from a cathode spot with a radius of 5 μm was studied. The calculated domain had a size of 22X60 μm. The range of variation of the external axial magnetic field was 1–2.5 T. An increase in the magnetic field predictably leads to compression of the plasma jet (Fig.1). The difference from previous calculations using various quasi-neutral approximations (for example, [1]) is that, in kinetic simulation, a positive space charge is accumulated in the outer layers of the plasma jet.

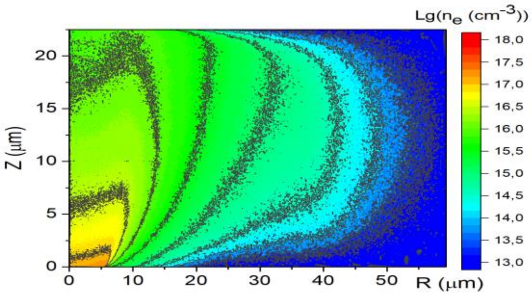

Fig.1. Electron density. External axial magnetic field – 2 T.

Fig. 2 shows the distributions of the electron and ion current densities from the plasma to the cathode. It can be seen that the electron current dominates near the cathode spot, while the ion current dominates in the outer regions. With an increase in the external magnetic field, the area dominated by the electron current shrinks, and the ion current density increases. In the region where the ion current predominates, the mechanism of charging and subsequent breakdown of dielectric films, leading to the ignition of a new cathode spot [2], is possible. If this mechanism works, then it is obvious that the probability of the appearance of a new cathode spot should increase with increasing magnetic field.

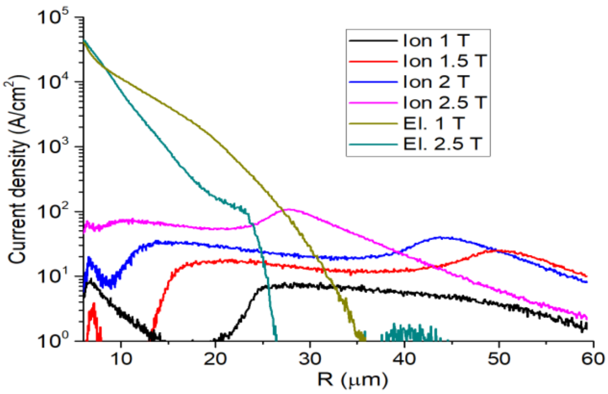

Fig.2. Distributions of electron and ion current to cathode at different magnetic field.

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