INFLUENCE OF THE RADIAL COMPONENT OF THE DISCHARGE CURRENT ON THE ROTATION OF DUST STRUCTURES IN A GLOW DISCHARGE IN AN AXIAL MAGNETIC FIELD

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It is known that with an increase in the magnetic field, an inversion of the rotation of dust particles in a stratified DC glow discharge occurs. This is due to a change in the main rotation mechanism. At relatively low magnetic fields, the main mechanism is ion drag, and as the field increases, the neutral gas drag becomes predominant. The gas rotation is associated with eddy currents arising in the striation. At the striation head, where the dust structure is located, the radial component of the eddy current is directed towards the discharge axis. In this case, the two specified rotation mechanisms act in opposite directions. Therefore, when the neutral gas drag begins to predominate, a rotation inversion occurs. The contribution of each of these mechanisms to the dust structure rotation velocity at magnetic fields of 1.1−2.2 T has been considered in our communication at NPP−2022 and paper [1]. Now we will consider the rotation of the dust structure, which is not in the striation, but inside an insert that narrows the current channel and serves to stabilize the discharge. Here the dust structure hangs slightly below the narrowest part of the channel, where it expands somewhat. In this case, with a change in the magnetic field, some its displacement in height may occur. In this region, the current channel apparently begins to expand somewhat and a radial current component appears, directed from the axis of the discharge tube. With an increase in the magnetic field to 1 T and higher, the dust structure rotation velocity increases significantly without rotation inversion. We assume that the same mechanism works here as in the striation, i.e. the neutral gas drag. But since the radial component of the current is directed from the discharge axis, opposite to the direction of the eddy current in the striation, both mechanisms (ion and neutral gas drags) work in the same direction and rotation inversion does not occur. In this case, the rotation velocity is noticeably higher than in the striation and has the opposite direction.

1. Dyachkov L. G., Dzlieva E. S., Novikov L. A., Pavlov S. I., Karasev V. Yu. // High Temperature 2022. V. 60. No. 6. P. 870