Mechanisms of dust particle rotation in stratified dc discharges in inhomogeneous magnetic fields

Dyachkov L G

Joint Institute for High Temperatures of the Russian Academy of Sciences, Izhorskaya 13 Bldg 2, Moscow 125412, Russia

dyachk@mail.ru

We consider the rotation mechanisms in inhomogeneous magnetic fields for dust particles trapped in striations of dc discharges. In general, the mechanisms are the same as for homogeneous magnetic fields. However, in an inhomogeneous axial magnetic field its lines diverge (or converge), and a radial component B_r appears. So we have additional rotation mechanisms. There are two main mechanisms: rotation under action of ion drag and rotation with neutral gas. The ion rotation is due to the ion drift in the crossing electric and magnetic fields, as well as the gradient of ion number density (diamagnetic ion current). In the case of a homogeneous axial magnetic field B_z we have the ion drift in the crossing radial electric (ambipolar) E_r and B_z fields. In an inhomogeneous magnetic field, we get the additional contribution from the crossing longitudinal discharge electric field E_z and radial magnetic field B_r. The gas rotation occurs under the action of eddy currents appearing in striations due to noncollinearity n_e and T_e gradients. Eddy currents in an axial magnetic field cause the gas to rotate. The discharge current in a radial magnetic field can also cause the gas to rotate.