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Double sheaths on cathodes emitting neutral atoms[1]

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— The model of a collisionless near-cathode space-charge sheath with ionization of atoms emitted by the cathode surface is considered. Apart from being of interest due to its potential application to vacuum arcs, the model is of interest due to its relation to the classic Tonks-Langmuir model of a plane glow discharge. Numerical calculations showed that the mathematical problem is solvable and its solution is unique. In the framework of this model, the sheath represents a double layer with a potential maximum, with the ions which are produced before the maximum returning to the cathode surface and those produced after the maximum escaping into the plasma. Numerical results are given in a form to be readily applicable in analysis of discharges burning in cathode vapor. It is found that the height of the potential hump is within the range $(0.85 \ldots 1.26)\mathrm{kT}_e/\mathrm{e}$. This value is insufficient to explain the observed velocities of ions in cathode jets of vacuum arcs, in agreement with the belief of many researchers that the main contribution to acceleration of ions is given by the plasma pressure gradient. The ion backflow coefficient is at least 53%, in agreement with the experiment.

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