Heating of a cathode with a conical tip by atmospheric-pressure arc

Tang Chen[1], Wei-zong Wang[1]

1.School of Astronautics, Beihang University, Beijing 100191, China

Abstract

In this study we performed a numerical investigation on the heating of a hot cathode with a conical tip by atmospheric arc, taking into account of the two temperature sheath effect for the first time. The Schottky effect at cathode surface is considered, which is based on the analytic solution of a one-dimensional sheath model. The arc-cathode interaction model is validated by comparison with available experimental data from literature and a reasonable agreement is obtained. We investigated the effects of several parameters (total current, cathode length and external axial magnetic field) on total heat transported to cathode body. The modeling results indicated that: The total heat flux to cathode surface is smaller than its components; heat flux due to electron back diffusion is as large as that due to ion flux.

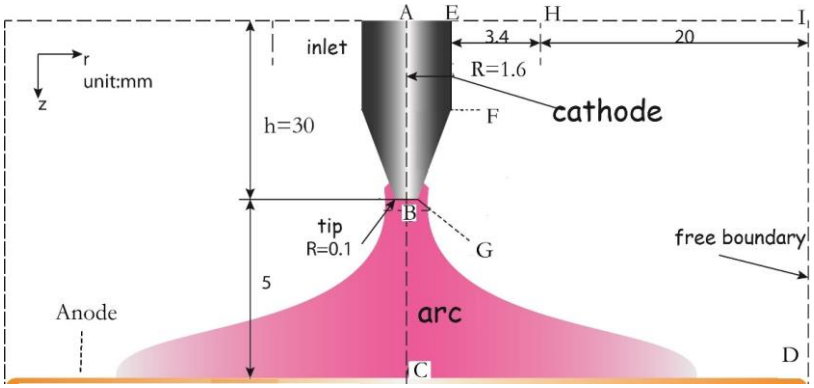

Figure 1. Geometry of the computation region.

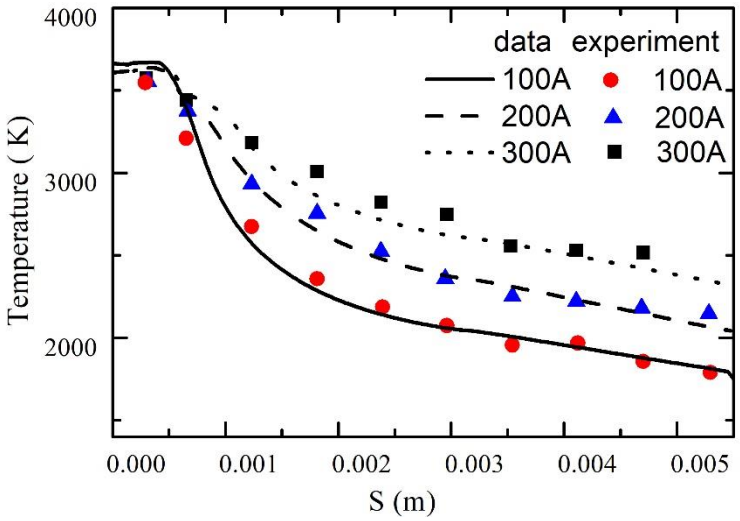

Figure 2. A comparison of the predicted temperatures of the cathode surface with the experimental measurement of Haidar and Farmer [47]: thoriated tungsten cathode with 60° conical tip, arc current $\mathrm{I} = 100\mathrm{A},\ 200\mathrm{A}, 300\mathrm{A}$. "z" represents the axial distance from the cathode tip.