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Simulation of microdischarge gas heating in electrothermal class of small satellite propulsion devices PRASHANTH KOTHNUR, LAXMINARAYAN RAJA, University of Texas at Austin — Microdischarges have unique features such as high power density (kW/cm^3) and high gas temperatures (1000-2000K) that enable use in electrothermal plasma devices with highly controllable thrust levels in the mN range. Two-dimensional modelling is used to simulate a flow-through microhollow electrode geometry with helium as the operating gas. Bulk fluid conservation equations are solved using the semi-implicit pressure linked equations (SIMPLE) approach and coupled to a nonequilibrium self-consistent plasma model [1]. Results indicate that plasma parameters are relatively insensitive to the flow rate. Electron temperatures as high as 20eV near the cathode fall and gas temperatures of 1000-2000K depending on the pressure and current are observed. Low Reynolds numbers and large surface-to-volume ratios result in strong sensitivity of gas temperatures to wall conditions. It is shown that wall losses must be minimized for any significant heating of the flow downstream of the electrodes, emphasizing the need for new refractory and insulating materials.
[1] P.S. Kothnur, and L.L. Raja, J. App. Phys. 97(2005), 043305.

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