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Fluid Modelling of Plasma Sheaths with Thermionically Emitted Electrons[1] RUPALI SAHU, ALBINA TROPINA, RICHARD MILES, Texas AM University — Leading edges of hypersonic vehicles are exposed to excessive thermal fluxes and need management of surface heating rates. Electron transpiration cooling (ETC) is a prospective and effective concept of thermal control of the leading edge temperature. The surface is covered by a low work-function material that emits electrons thermionically when heated. The emitted electrons take away some part of the energy that leads to a transpiration cooling of the surface of the hypersonic vehicle. Instead of thermionic emission to vacuum, the ambient air is partially ionized and a plasma sheath forms near the surface, which affects the emission of electrons through various phenomena like the space charge limited emission and the Schottky effect. Numerical studies are performed using a full fluid moment model of plasma to study plasma sheath behavior near such surfaces. The presence of counter-propagating streams of charged particles in the sheaths near emissive surfaces in addition to high wall biases tends to make the sheath simulation very sensitive to various physical and numerical instabilities. In this study, we analyzed the effect of the flux functions, boundary conditions, and Bohm criterion on the stability of plasma sheaths in the presence of the thermionic emission.

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