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Electron Shock Waves Propagating into a Pre-ionized Medium

M. HEMMATI, N. RASUL, R. PEDEN, Arkansas Tech University — We employ a one dimensional, constant velocity, steady-state, three component fluid model to investigate breakdown waves propagating into an ionized medium. Assuming that electron gas partial pressure is much greater than that of the other species, we have been able to write down equations of conservation of the flux of mass, momentum and energy, plus the Poison's equation. The charge concentration ahead of the wave alters the set of fluid equations and also the boundary conditions at the shock front. The ionization rate is calculated by considering ionization from both random and directed electron motions. Integration of the set of electron-fluid dynamical equations for antiforce waves propagating into a pre-ionized medium through the dynamical transition region of the wave for two wave speeds and several current values ahead of the wave was successful. The results for both wave speed values and all current values ahead of the wave meet the expected physical conditions at the end of the sheath region. Calculation of the ionization rate through the sheath region shows that for high wave speeds and for all current values ahead of the shock front, as one approaches the trailing edge of the sheath, the ionization rate increases slightly. However, as the wave speed decreases, for all current values ahead of the shock front, the ionization rate essentially remains constant throughout the sheath region.

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