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Electron Shock Waves with Current behind the Shock Front[1]
MOSTAFA HEMMATI, W.C. CHILDS, H. MORRIS, P. PINKSTON, Arkansas Tech University — Electrical breakdown of a gas in a strong electric field is carried out by a wave with a strong discontinuity at the wave front, and traveling with speed comparable to speed of light. For theoretical investigation of electrical breakdown of a gas, we apply a one-dimensional, steady state, constant velocity, three component fluid model, and assume the electrons to be the main element in propagation of the wave. Our set of electron fluid-dynamical equations consists of the equations of conservation of mass, momentum, and energy plus the Poisson's equation. For breakdown waves with a significant current behind the shock front, in addition to the set of electron fluid dynamical equations, the shock condition on electron temperature need to be modified as well. Considering existence of current behind the shock front, we have derived the shock condition on electron temperature, and for a set of experimentally measured current values, we have been able to integrated the set of electron fluid dynamical equations through the dynamical transition region of the wave. Our results meet the expected conditions at the trailing edge of the wave.

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