Application Of Bi-Modal Electron Energy Distribution To Discharges In E × B Fields

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ABSTRACT

Electron energy distribution in gas discharges is the central concept that links theory, measurements, simulation and computational aspects. Boltzmann equation is the foundation of theoretical developments and application of the equation to various gases has shown that the theory has been remarkably successful. The measurement aspects encompass the swarm parameters which are the drift and diffusion coefficients, ionization coefficients, and attachment coefficients where applicable. The measurement aspects also comprise various collision cross sections for electron energy in the range from a few milli-Volts to about 1000 Volts. Theoretical aspects aim to correlate the measured cross sections with the measured swarm parameters through the electron energy distribution function. With the expansion of gas discharge applications into new areas such as plasma medical application there is a need to obtain simpler analytical expressions for the energy distribution that satisfy the integral equations relating the cross sections to swarm coefficients. The simpler method saves considerable computational time and assists specialists in other areas to adopt the energy distribution as a tool. Towards this end the author has previously shown that a bimodal distribution satisfies these requirements in argon. A simplified method of evaluating the approximations to the energy distribution function and the resulting swarm coefficients are shown to yield very good agreement with measured coefficients. The method does not make use of adjustments to experimentally measured cross sections. Further only the momentum transfer and ionization cross sections are employed, representing the effects of remaining cross sections by field dependent constants. In this contribution the results for neon are presented to show that very good results are obtained in this gas. Further extension of the theory to crossed electric and magnetic fields are explored as there are no theoretical or experimental results in the gas. The effects of a magnetic field are included in accordance with the theory of effective reduced electric field [1].

[1] G. Govinda-Raju, "Gaseous Electronics: Theory and Practice," Taylor and Francis LLC, Boca Raton, USA, 2006. ●