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(G*) Spatial and Temporal Investigation of Equilibrium and Non-Equilibrium Regimes in the Gliding Arc Discharge

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Gliding arc discharges (GAD) provide an interesting discharge plasma platform where two regimes are theoretically possible –the thermal or equilibrium regime, where the plasma is in thermodynamic equilibrium, and the non-thermal or non-equilibrium regime, where a gradient is observed across different plasma temperatures The non-equilibrium state, characterized by high electron density plasma at atmospheric pressure, has propelled GAD into the forefront of plasma chemistry applications. However, a comprehensive understanding of temperatures, densities, and mechanisms in both regimes, as well as the conditions governing each, remains essential. In the following work, translational (TT), rotational (TR), vibrational (TV), and electron (TE) temperatures are investigated in the two regimes of the GAD plasma using optical emission spectroscopy of argon 2p—1s transitions (Paschen notation) along with collisional-radiative (CR) modeling of argon 2p states in an argon GAD plasma at atmospheric pressure in the presence of naturally occurring or admixtures of water vapor or N2. More specifically, TT is investigated from the line broadening of certain Ar emission lines using a hyperfine spectrometer, TR and TV are deduced from either the OH(A2Σ+ – X2Πi) or the N2+(B2Σu+ – X2Σg+) rovibrational systems, and TE is obtained from comparing measured and simulated Ar spectra via the CR model. Furthermore, electrical diagnostics are used to obtain TE , electron density (nE) and reduced electric field (E/n) in the two regimes of the GAD and compared with the results found from optical methods.

Keyword-1

Gliding Arc Discharge

Keyword-2

Optical Emission Spectroscopy

Keyword-3

Collisional-Radiative Modeling

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