ABSTRACT

Spectroscopic Investigation of a Repetitively-Pulsed Nanosecond Discharge

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Though the study of pulsed discharges can be traced back to the ancient Greek philosophers, there is still much that is not known about them. This work reports on a new investigation of a repetitively-pulsed nanosecond discharge (RPND) in helium over a range of 0.3-16.0 Torr. Several approaches were used in the study with the emphasis being on spectroscopic techniques complemented by a global model. Synthesis of the results provided new data and insights on the development of the RPND.

Among the results were direct measurements of the triplet metastable states during the excitation period. This period was found to be unexpectedly long at low pressures (less than 1.0 Torr), suggesting an excess in high-energy electrons as compared to an equilibrium distribution. Other phenomena such as a prominent return stroke and radiation trapping were also identified. Estimates of the electric field and electron temperatures were obtained for several conditions. Furthermore, several optical methods of electron temperature measurement were evaluated for application to the discharge. A ratio of the 3^3S-2^3P^o and 3^1S-2^1P^o transitions, based on the coronal model, was found to provide a promising approach.

Overall, these results provide new insight on the development of the repetitively-pulsed nanosecond discharge. Specifically, they reveal new information about the excited state dynamics within the discharge, the non-equilibrium nature of its electrons, and several new approaches for future studies. This improves the present understanding of repetitively-pulsed discharges, and advances the knowledge of energy coupling between electric fields and plasmas.