EXPERIMENTS OF VACUUM UV ABSORPTION DURING LOW-TEMPERATURE PLASMA FORMATION AT ATMOSPHERIC PRESSURE

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There has been a continued interest in utilizing streamer and spark discharges for new technologies which require low temperature plasma generation at atmospheric pressure. One key area of study is the role of photon dominated processes, such as ionization and dissociation, as a result of emission and re-absorption of vacuum UV radiation (e.g. photons with energies greater than 8 eV). This experiment consists of a triggered surface flashover event along a dielectric surface between two point-point electrodes, where spectral measurements are performed in the vacuum UV regime (i.e. 115 - 175 nm). Previous studies of air breakdown alluded to a cross-species photon absorption process between N₂ and O₂ molecules, and a later study revealed an impurity in the form of HI Lyman-α radiation in spark discharges in air. In an effort to understand the self-absorption of this radiation at atmospheric pressure, a basic study was performed in various N₂/H₂ mixtures in a controlled environment. Spectral measurements were taken via intensified CCD devices in the VUV range, photomultiplier electronics with accompanying electrical diagnostics, and external imaging with nano-second resolution. It was concluded from the experiments that significant self-absorption of HI radiation is occurring during plasma formation at electron temperatures of ~10 eV, and detailed spectral line-fitting showed that the parameters which define absorption vary as a function of distance from the anode (i.e. where the streamers originate due to the geometry in this experiment). Therefore, rough estimates can be made of parameters such as H₂ dissociation percentage (as much as 10⁻³ in the plasma channel) and electron density (upwards of 10¹⁹ cm⁻³ in the spark phase) as a function of position between the electrodes. These studies elucidate the plasma kinetics (specifically absorption) which occurs during the transition from streamer to spark discharge at atmospheric pressure.

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