Electron Swarm and Photon Interactions with Biomolecules and Atmospheric Gases

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In this talk we present recent measurements and, in some cases, accompanying calculations on the interaction of electrons with molecules of biological interest such as THF (Tetrahydrofuran), THFA (Tetrahydrofurfuril Alcohol), and N_2O, the latter molecule of interest in atmospheric and industrial applications. In all cases the pulsed Townsend method has been used [1]. The measurement of the electron drift velocity, W, and the effective ionisation coefficient, α_{eff}, in THF has been used to improve/validate a previous set of electron collision cross sections [2,3]. Measurements on pure THFA have thus far been precluded because of its very low saturation vapour pressure (0.2 Torr at 20 ºC); however, measurements in mixtures of this gas with N_2 and Ar have been made, and a special setup is being built to perform measurements in pure THFA. Using a simulation code [4,5] which, apart from charge transport motion and electron attachment, collisional detachment from negative ions is considered, has led us to determine detachment coefficients at low E/N (up to 8 Td). It appears that electron detachment proceeds readily with fairly large values of the density-normalised ionisation coefficient, in the order of 10^{-15} cm^2.

The second part of the talk will be dedicated to present recent measurements on the photodetachment of negative ions in oxygen and N_2O. Briefly, we have used a standard technique for producing an electron avalanche followed by its slow ionic component. After some delay, a laser pulse (532 nm or 1,064 nm) is aimed at the avalanche at right angles. The photodetachment signals and results dealing with the photodetachment yield will be presented.

While performing the photodetachment measurements we observed that even in the absence of the UV laser light that produces the initial photoelectrons from the cathode, electron avalanches formed due to the ionisation of the gas from the strong photodetachment laser pulse (355 nm and 266 nm), which is an indication of multiphoton ionisation in the realm of the gas, even without focusing the 6 mm diameter laser beam. To substantiate these findings even further, measurements of W and α_{eff} in oxygen were found compatible with those published. Implications of this effect for laser assisted plasma diagnostics and special electron or ion sources will be discussed.

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