Mobility of negative ions in H_2O-He mixtures

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We report the measurement of the drift velocity of negative ions in gaseous H_2O-He mixtures over a wide range of total mixture pressure and H_2O concentrations over the range 2-70%. A pulsed Townsend apparatus was used for the measurements. The present mobility data, measured at values of E/N low enough so that the mobility is essentially constant, depend, as expected, on the amount of H_2O in the mixture; additionally, for a fixed H_2O concentration in the mixture, the mobility depends on the total pressure. Because of the relatively high pressures used in this experiment (4-450 Torr), no mass spectrometry of the negative ions was possible. Current work is in progress to identify the ionic species from other means.

1. Introduction

The field of bioplasmas has been growing at a fast rate in view of the many applications in medicine, engineering and basic science. For instance, He-H_2O mixtures are used in atmospheric pressure plasmas to treat wounds in human tissue. While water may be present due to normal ambient humidity, He, a non-reactive rare gas under the present conditions, and with an excellent thermal conductivity, is a preferred carrier gas. Recent studies on the abundance of negative ions in an atmospheric discharge plasma report the formation of OH^- as the dominant species follow by the clusters $OH^-(H_2O)_n$, with n=1-5 [1]. It has been recently found from a study on pure H_2O, performed in a pulsed Townsend apparatus that the same kind of cluster ions are formed (n=1-3) over the pressure range 4-16 Torr [2].

2. Experimental

A pulsed Townsend apparatus was used for these measurements. Details of the experiment and analytical techniques are given in [2]. The measurements were limited to regions of E/N where no ionisation processes take place. Mixture gas pressures between 4-450 Torr were used.

3. Measurements

The variation of the low-field mobility of negative ions in H_2O-He mixtures is shown in Fig. 1 as a function of pressure and H_2O concentration in the mixture. It is interesting to note that apart from the variation of the mobility, K_{00}, with the H_2O content in the mixture, there is also a well-defined dependence with gas pressure. The lines joining the points correspond to a linear dependence between K_{00} and pressure (the pressure scale is logarithmic).

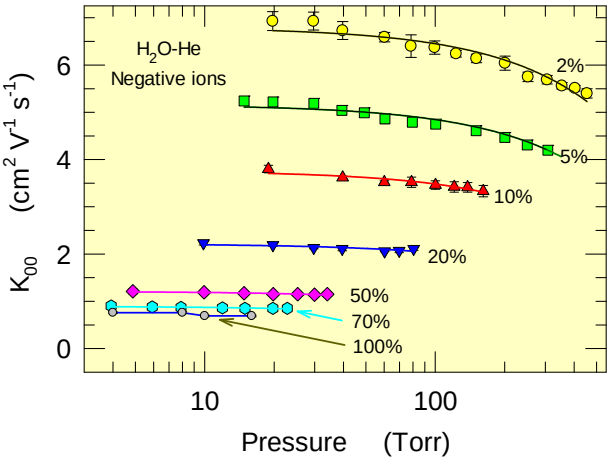

Figure 1. The low-field mobility of negative ions in H_2O-He mixtures. Uncertainties in the mobility values range from 1-3%

Due to the very high pressures used, no mass spectrometric means were used. Current work is underway to determine the ionic species from indirect means [2].

References

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