

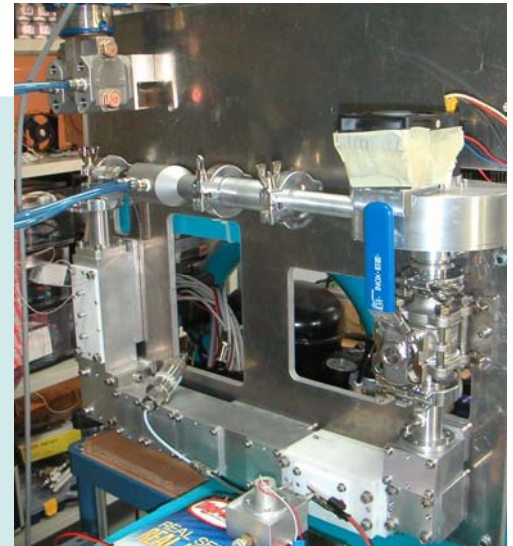
Effect of Humidity and Aging Time on the Mobility Distribution of Laboratory Air Ions Generated by ^{241}Am

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Introduction

We have designed and built an ion Differential Mobility Analyzer (IONER X1, commercially available) by up-scaling the sheath gas flow up to 1000 lpm in closed loop. In the classification region, sheath gas attains a speed of 0.9 Mach and a Reynolds number of 90,000, while keeping the turbulence below 0.1%. This device can be applied to a number of practical uses such as trace gas detection, industrial monitoring, atmospheric chemistry, health studies or aerosol charging studies. In this work, we have applied it to study the clustering of ions generated by a ^{241}Am source in synthetic air.



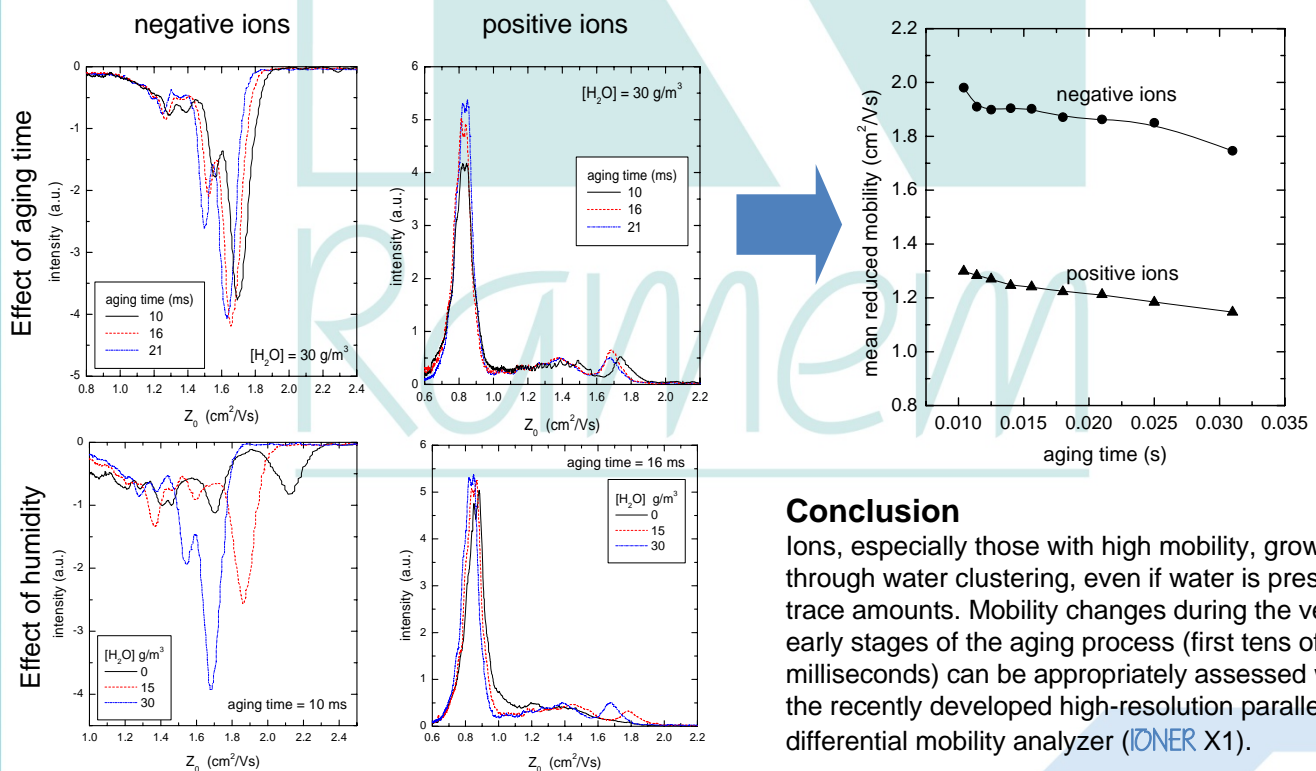
Experimental

Synthetic air was ionized with a ^{241}Am charger and the ions generated were classified in our ion-DMA system. The parameters that were tuned to change the ion chemistry were relative humidity and aging time

The sheath gas flow was kept around 300 l/min. The ions were detected with a compact, wireless femto-ammeter design on purpose for the application.

Results

Ion mobility spectra show clear differences mainly for negative ions when the relative humidity is changed. These changes can be explained on the basis of different hydration degrees, that enlarge the aerodynamic size of the cluster. In fact, the average ion mobility shifts to lower values when increasing relative humidity.



Conclusion

Ions, especially those with high mobility, grow fast through water clustering, even if water is present in trace amounts. Mobility changes during the very early stages of the aging process (first tens of milliseconds) can be appropriately assessed with the recently developed high-resolution parallel-plate differential mobility analyzer (IONER X1).