

# MORRISON LECTURE

## ION CHEMISTRY: IN AIR AND SPACE.

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Ion-molecule reactions have a strategic role in the chemistry of the Universe. A brief but general outline will be given of some Selected Ion Flow Tube (SIFT) studies of extraterrestrial chemistry occurring in the atmosphere of Titan, Saturn's largest moon. These studies are relevant to the current Cassini mission to Saturn. The large nitrogen-based atmosphere of Titan and its major secondary component of methane (~2 %) make for some interesting comparisons with terrestrial ion chemistry.

The large reaction rate coefficients for many ion-molecule reactions make ion chemistry via chemical ionization a sensitive probe for monitoring volatile species in air. The SIFT-MS technique is designed specifically for this purpose and achieves quantitative results in real time. Five analytical applications of SIFT-MS will be briefly discussed. These applications include two from environmental chemistry. The problem of the increase in  $\text{NO}_3^-$  in ground water from the dairy industry and the problems arising from the presence of solvents in the work place and in the lungs and blood of workers. By monitoring solvents in single breath exhalations from individuals exposed to solvents, it is possible to readily appraise solvent exposure and examine the likely storage places of solvents within the body. The third application is in the area of medicine. Asthma and chronic obstructive pulmonary disease (COPD) are two of the major causes of hospitalization in New Zealand. We have found possible indicators of both respiratory problems from examining single breath exhalations. The fourth application deals with explosives and homeland security. The new peroxide based explosives used by some terrorists have proved to be difficult to detect by conventional means because of their notoriously unstable nature but they can be observed in real time using SIFT-MS technology. Finally an application from food chemistry will be outlined. Here, the application of SIFT-MS technology to olive oils has provided some quite unexpected results.