E1-07: Performance of an electrostatic lens (Einzel lens) as an ion manoeuvering device in a time-of flight mass spectrometer

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Employment of ion optics to the newly built plasma desorption time-of-flight mass spectrometer has been tried out as a means to improve its collection efficiency at the end of long flights. The mass resolution of the time-of-flight mass spectrometer can be enhanced by increasing the time-of-flight of molecular ions. However when long flight lengths are used, the efficiency of the mass spectrometer becomes low mainly due to the deviation of the ions from the expected flight path. Such deviations are caused by the presence of velocity components perpendicular to the flight path and it is supposed to be a direct consequence of the initial velocity distribution of molecular ions, inhomogeneity of acceleration fields and other stray electric fields.

The mass spectrometer has a 108 cm flight path for secondary ions and these ions enter the flight path *via* a 12 mm diameter aperture. A 3 element unipotential lens(Einzel lens) was constructed and mounted at the beginning of the flight path to produce necessary focusing for molecular ions on the ion detector which is situated at the end of the flight path. This Einzel lens provides a focused secondary ion beam without an overall change in the

kinetic energy. The other major advantage being simplicity of its construction. Acceleration mode (V2/V1 > 0) of focusing was used for the operation. In this mode the centre element was kept at the positive potential (V2) while the other 2 electrodes were kept at the ground potential (V1 and V3). Investigations have been done to determine its optimum voltage configuration for secondary ions with different energies and masses. Spin coated sample of CsBr dissolved in TFA was used for the investigation.

Spectra obtained for a series of lens potentials showed a gradual increase of the secondary ion yield with lens potential followed by similar drop indicating the lens action. The lens potential required to focus the secondary ions on to the ion detector was found to increase with the ion energy. With proper focusing of the lens nearly 70% increase of molecular ion yield was observed for all masses and secondary ion energies analysed. No noticeable change in the mass resolution had been observed when the mass spectrometer was operated with the lens voltage on. Calculations showed that the total time-of-flight had been linearly increased with the focusing voltage. It means that the effect of introduction of the Einzel lens is only to increase the flight without changing the energy of the molecular ions. After optimising the mass spectrometer with the Einzel lens it was possible to obtain some high mass cluster peaks of CsBr which were not visible in spectra taken without the lens.

The introduction of the unipotential (Einzel) lens clearly shows that there is an increase in efficiency of the mass spectrometer without changing its other characteristics and this will be a distinct advantage in the field of natural product research and the analysis of heavy bio-molecules.

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