E1-06: Performance of the newly constructed linear time-of-flight plasm desorption mass spectrometer

C K G Piyadasa, U K Abeywarna, T R Ariyaratna, R V Coorey,
D D N B Daya, W M K P Wijayaratna
(Dept. of Physics, Univ. of Colombo, Colombo 3)

A new linear time-of-flight mass spectrometer was designed and construct at the Department of Physics, University of Colombo. The development

this application rapidly increased after the introduction of the concept of "Desorption of molecular ions upon fast heavy ion bombardment" after about 1981. The growing interest in this technique is mainly due to its relative simplicity and ability to investigate a rather broad mass range. For example from unit mass to masses of bio-molecules (thermally fragile and non-volatile) with many thousands amu can be analysed.

This mass spectrometer consists of a stainless steel main vacuum chamber fixed to an oil diffusion vacuum pump system, a flight tube,a ^{252}Cf ion source and 2 ion detectors. Self-aligned co-axial type trouble free internal elements were designed and constructed for the mass spectrometer in order to achieve an improved performance in the molecular yield and the mass resolution. Locally available PVC materials were used in the construction in order to test their suitability in a high vacuum environment. Conventional NIM electronics and a PC based data acquisition system were used for the collection of ions and for the analysis of data. Spin coated sample of CsBr dissolved in TFA and an electrosprayed sample of Valine (amino acid) was used to evaluate the performance of the mass spectrometer. The study was performed for different secondary ion energies ranging from 2kV to 14kV and using 4 different molecular masses ranging from 1 amu to 436.5 amu (H^+, Cs^+ and cluster ions of Caesium halides).

Mass spectra recorded, showed detectable peaks for several molecular ions including cluster ions of CsBr up to a mass of 1500 amu. Molecular ion yield was found to increase rapidly with the secondary ion energies (i.e. acceleration voltage) and a significant percentage increase was observed with increasing mass numbers. The mass resolution (M/▲ M) reached the maximum value around 10keV of secondary ion energy for all masses except hydrogen which gave a fairly constant value over the range of energies used. The highest mass resolution of 1140 was achieved for all molecular ions studied except for hydrogen. It was found that both the mass resolution and the molecular ion yield of the spectra obtained with this mass spectrometer were approximately 60% higher than the corresponding values obtained with the existing mass spectrometer at the Department of Physics. Similar results were obtained with the Valine sample.

Increasing acceleration voltage increases the axial velocity of secondary ions which in turn reduces dispersion giving rise to a better mass resoluton. A mass resolution of 1140 obtained for molecular ions in the range of 100-450 amu reveals that this mass spectrometer is a promising tool for research in the field of natural products in addition to its use in the detection of heavy bio-molecules. This investigation also reveals that some of the locally available PVC materials are suitable for high vacuum work.

Financial assistance by International Science Program in Physical Sciences, (Project SRI 01/2), Uppsala University, Sweden, NARESA, (Research grant RG/92/P/02, University of Colombo and technical assistance from Colombo Dockyard are acknowledged.