CONSTRUCTION OF A HIGH RESOLUTION MATRIX ASSISTED LASER DESORPTION/IONIZATION MASS SPECTROMETER AND ITS APPLICATIONS

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Abstract

The designing and construction of a new matrix assisted laser desorption/ionization (MALDI) mass spectrometer, its performance and applications are presented in this thesis. The main aim of this project is to provide a MALDI MS facility for sample analysis and research with bio molecular and natural products. The mass spectrometer is equipped with a laser ion source, time of flight mass analyzer, first order ion mirror, and microchannel plate ion detectors. The mass spectrometer has a flight length of approximately 1.6 m in the linear mode and 1.8 m in reflector mode. The cylindrical stainless steel main vacuum chamber is the central part of the mass spectrometer and stainless steel tubes provide the flight length for ions. Two diffusion pumps are used to obtain a high vacuum (10^{-6} mbar). A standard nitrogen pulsed laser (VSL-337ND-S) source is used for the production of molecular ions.

The performance of the MALDI-MS is evaluated both in linear and reflection modes. A peptide named Substance-P was used as the test sample. Preliminary features of the instrument such as the effect of the pressure within the instrument, the influence of laser intensity and acceleration voltage on the mass resolution of Substance-P were investigated. The optimum mass resolution (280) in the linear mode was obtained at a pressure of 8×10^{-6} mbar. The acceleration voltage around 12 kV was found to be most suitable for the linear mode spectra collected. It was possible to apply acceleration voltages up to about 15 kV across the acceleration gap. A 1st order electrostatic ion mirror has been installed in order to increase the mass resolution. Some preliminary characteristics of the mass spectrometer in the linear as well as in reflector modes are also discussed. It has been possible to observe the isotopic distribution of the MH^+ peak of Substance P in the mass spectra collected by using ion mirror showing an enhanced mass resolution of 3500. When operating at its optimum conditions, the ion mirror can improve the compensation of the energy distribution of ions by a factor of 35. Evan though MALDI – MS is well suited for heavy bio molecules some of the applications of MALDI mass spectrometry for low mass organic compounds such as organic metal complexes and rotaxanes have also been demonstrated.