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Mass Spectrometry & Purification Techniques

Perspective

Various Models of Mass Analyzer

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DESCRIPTION

The ion source, mass analyzer, and detector are the three basic components of a mass spectrometer. A sample is ionized, usually to cations, in an ion source by the loss of an electron. The ions are then sorted and separated in the mass analyzer based on their mass and charge. The separated ions are detected and their relative abundance is recorded in the detector. In addition, the sample introduction system is required for the administration of samples into the ion source. To manage the instrument, obtain data, and compare spectra against the database, a computer and software are required. The mass analyzer, which takes ionized masses and separates them based on mass to charge ratios, is the heart of the mass spectrometer.

MODELS OF MASS ANALYZER

Magnetic sector mass analyzer

Ions are accelerated in the Magnetic Sector Mass Analyzer until they have the same kinetic energy. The ions are all accelerated into a narrow beam. The ions are then deflected by the magnetic field according to their masses. Ions that are lighter deflect more than those that are heavier. The amount of deflection is proportional to the quantity of positive charges present. When comparable ions move through a magnetic field, they are all deflected to the same degree and follow the same path. Ions that are not picked clash with the flight tube wall on either side or do not flow through the slit to the detector.

Time of Flight (TOF) mass analyzer

A pulsed ion source, an accelerating grid, a field-free flight tube, and a detector make up a time of flight analyzer. It is used to compute the time it takes for ions of a specific mass to charge, accelerated by a potential voltage, and reach a detector located at a distance. To avoid the arrival of ions of different m/z at the detector at the same time, the ion source must be pulsed.

Quadrupole mass analyzer

Each opposing rod pair is electrically coupled to the quadrupole,which is made up of four parallel metal rods. A Radio Frequency (RF) voltage is applied to one pair of raids, while a Direct Current (DC) voltage is delivered to the other. Only ions of a specific m/z demonstrate a stable trajectory and can be conveyed to the detector at a given DC and RF combination, while other ions with unstable trajectories do not pass the road because the amplitude of their oscillation becomes infinite. Ions with different m/z values can be transmitted to the detector one after the other by adjusting DC and RF in time, usually at a set ratio.

Electrostatic sector mass analyzer

It works in the same way as a time of flight analyzer in that it separates ions while they are in flight, but it does so using an electric field. Two curved plates with equal and opposite potential make up an electrostatic sector analyzer. The ion is deflected as it passes through the electric field, and the force exerted on it by the electric field equals the centripetal force. Ions with the same kinetic energy are concentrated here, while ions with differing kinetic energies are dispersed. Energy focusers, such as electrostatic sector analyzers, focus an ion beam for energy.

Quadrupole ion trap mass analyzers

This analyzer works on the same principles as the quadrupole analyzer in that it uses an electric field to separate the ions based on their mass to charge ratios. The analyzer is made up of grounded end cap electrodes and a ring electrode with a particular voltage. One of the end caps allows the ions to access the space between the electrodes. Following entry, the electric field created by the electrodes in the cavity causes ions with specific m/z values to orbit in space. The heavier mass ions' orbits get more stabilized as the radio frequency voltage increases, while the light mass ions' orbits become less stabilized, forcing them to smash with the wall and removing the chance of traveling to and being detected by the detector. The quadrupole ion trap usually performs mass selective ejection, which involves gradually increasing the applied radio frequency voltage to eject trapped ions in order of increasing mass.

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