Marwari college Darbhanga

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By:-. Dr. Sony Kumari,

Assistant professor

Marwari college Darbhanga

Aston mass spectrometer

The first mass spectrograph was designed by Cambridge scientist F W Aston (1877-1945). It could separate isotopes, which are chemically identical atoms with different masses. The spectrograph’s globe contained a compound of the material to be tested and an electric current then knocked electrons from the material's atoms. Aston worked with J. J. Thomson (1856-1940) to show that over 50 elements were made up of atoms of different atomic masses but the same atomic numbers.

Basic Principle

A mass spectrometer generates multiple ions from the sample under investigation, it then separates them

according to their specific mass-to-charge ratio (m/z), and then records the relative abundance of each ion type.

The first step in the mass spectrometric analysis of compounds is the production of gas phase ions of the compound, basically by electron ionization. This molecular ion undergoes fragmentation. Each primary product ion derived from the molecular ion, in turn, undergoes fragmentation, and so on. The ions are separated in the mass spectrometer according to their mass-to-charge ratio, and are detected in proportion to their abundance. A mass spectrum of the molecule is thus produced. It displays the result in the form of a plot of ion abundance versus mass-to-charge ratio. Ions provide information concerning the nature and the structure of their precursor molecule. In the spectrum of a pure compound, the molecular ion, if present, appears at the highest value of m/z (followed by ions containing heavier isotopes) and gives the molecular mass of the compound.

Components

The instrument consists of three major components:

1. **Ion Source:** For producing gaseous ions from the substance being studied.
2. **Analyzer:** For resolving the ions into their characteristics mass components according to their mass-to-charge ratio.

3. **Detector System:** For detecting the ions and recording the relative abundance of each of the resolved ionic species.

In addition, a sample introduction system is necessary to admit the samples to be studied to the ion source while maintaining the high vacuum requirements (~10-6 to 10-8 mm of mercury) of the technique; and a computer is required to control the instrument, acquire and manipulate data, and compare spectra to reference libraries.

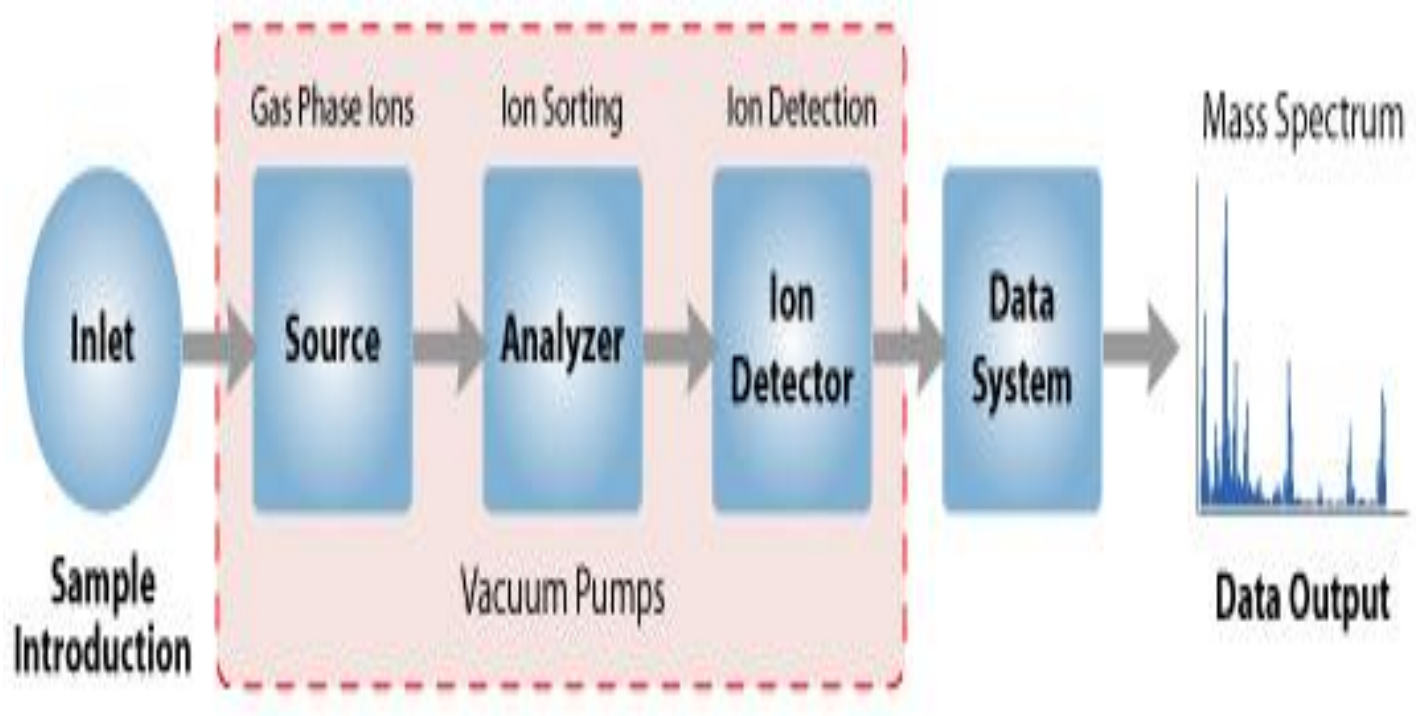

Figure: Components of a Mass Spectrometer

With all the above components, a mass spectrometer should always perform the following processes:

1. Produce ions from the sample in the ionization source.

2. Separate these ions according to their mass-to-charge ratio in the mass analyzer.
3. Eventually, fragment the selected ions and analyze the fragments in a second analyzer.
4. Detect the ions emerging from the last analyzer and measure their abundance with the detector that converts the ions into electrical signals.
5. Process the signals from the detector that are transmitted to the computer and control the instrument using feedback.