

Mass Spectrometry

juliaabibe

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1 Definition

Mass Spectrometry is an analytical technique that helps identifying the amount of electrons present in a sample by measuring the mass-to-charge ratio.

2 Physical Principles

Before understanding how the concept of mass spectrometry works, there are essential principles that need to be defined. First, in a magnetic field, also known as "B field" the force generated by the field is calculated by the formula:

$$FB = q \times v \times B$$

Analysing this formula it is possible to see that the velocity of the electron interferes in the force of the field. Also, both the direction of the velocity and the B field determine the direction of the B field. When the velocity is perpendicular to the B field the sine of the angle between both is 1. Therefore, the formula does not include the sine of theta. Furthermore, another important principle to have knowledge is Newtons' second law. According to it, there is a formula to determine the net force. This formula is:

$$F_{net} = m \times a$$

In the case of magnetic fields the net force is the magnetic force. Therefore, it is possible to imply that:

$$q \times v \times B = \frac{m \times v^2}{R}$$

Then, by cross multiplying the formula it is possible to see that:

$$\frac{m}{q} = \frac{RB}{V}$$

By analysing this formula it is possible to state that the mass-to-charge ratio is determined in order to see how many electrons are present in the field. Depending on the ratio the electrons hit the detector at different points. Each point has a signal, therefore is used to identify the molecule.

3 Sample

The image below shows how the electron interacts in a magnetic field with the detector.

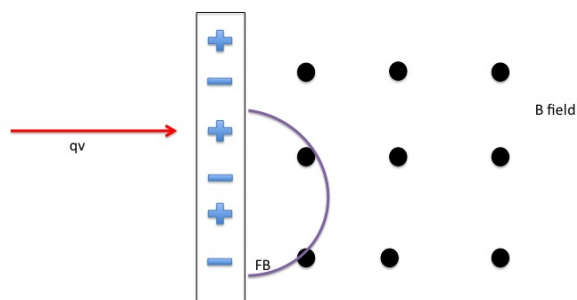


Figure 1: Mass Spectrometry Sample

4 Example: Unsaturated Ketone

In the graph below it is possible to observe that mass spectrometry helps determine a molecule.

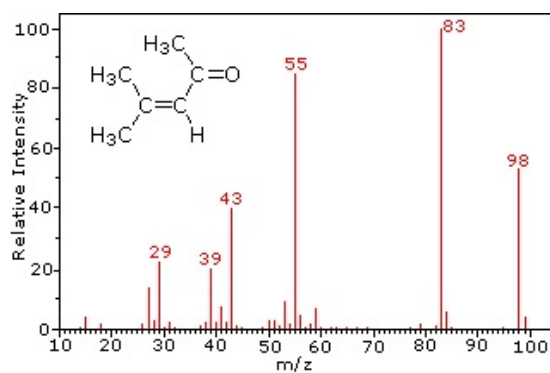


Figure 2: Unsaturated Ketone

5 Conclusion

After reading this text you, reader, is now able to understand what is mass spectrometry. Not only that, but also you know how to calculate the mass-to-charge ratio, which is the one that determines where the electron will hit the detector. Mass spectrometry is essential for determining which molecule is passing through the magnetic field. By detecting where each electron hits it is possible to determine the molecule as a whole. Now you reader have a better knowledge of this analytical technique chemicals and physicists use: mass spectrometry.

6 Bibliography

<https://www2.chemistry.msu.edu/faculty/reusch/VirtTxtJml/Spectrpy/MassSpec/masspec1.htm>