

Mass Spectrometer

Trang Pham

October 28, 2015

1 HOW A MASS SPECTROMETER WORKS

Suppose you had a cannonball travelling past you and you wanted to deflect it as it went by you. All you've got is a jet of water from a hose-pipe that you can squirt at it. Frankly, its not going to make a lot of difference! Because the cannonball is so heavy, it will hardly be deflected at all from its original course.

But suppose instead, you tried to deflect a table tennis ball travelling at the same speed as the cannonball using the same jet of water. Because this ball is so light, you will get a huge deflection.

The amount of deflection you will get for a given sideways force depends on the mass of the ball. If you knew the speed of the ball and the size of the force, you could calculate the mass of the ball if you knew what sort of curved path it was deflected through. The less the deflection, the heavier the ball.

1.1 AN OUTLINE OF WHAT HAPPENS IN A MASS SPECTROMETER

Atoms and molecules can be deflected by magnetic fields - provided the atom or molecule is first turned into an ion. Electrically charged particles are affected by a magnetic field although electrically neutral ones aren't.

The sequence is :

The atom or molecule is ionised by knocking one or more electrons off to give a positive ion. This is true even for things which you would normally expect to form negative ions (chlorine, for example) or never form ions at all (argon, for example). Most mass spectrometers work with positive ions.

Stage 2: Acceleration

The ions are accelerated so that they all have the same kinetic energy.

Stage 3: Deflection

The ions are then deflected by a magnetic field according to their masses. The lighter they are, the more they are deflected.

The amount of deflection also depends on the number of positive charges on the ion - in other words, on how many electrons were knocked off in the first stage. The more the ion is charged, the more it gets deflected.

Stage 4: Detection

The beam of ions passing through the machine is detected electrically.

Bibliography:

"The Mass Spectrometer - How It Works." The Mass Spectrometer - How It Works. N.p., n.d. Web. 27 Oct. 2015.