The Atom

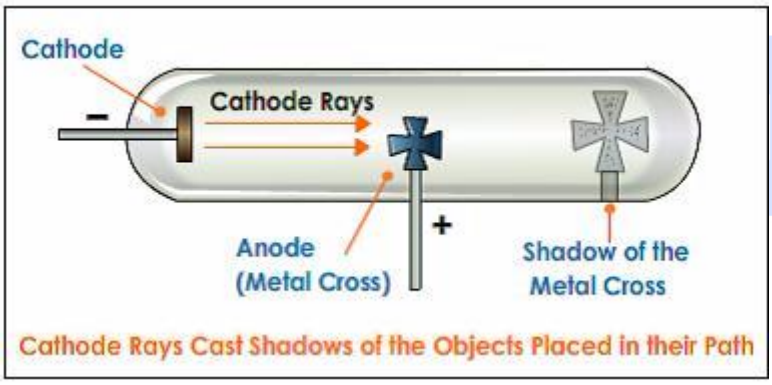
Atoms are the tiny building blocks that make up all materials. In Chemistry, materials are referred to as matter. The particulate nature of matter is the term given to materials being made up of small particles.

History and Structure of the Atom

- 4oo BC: Greek philosopher, Democritus, theorised that the tiny particles, of which all matter was composed, were so small that they could not be broken down into even smaller particles.

- 1808: John Dalton, an English Chemist, wrote a book in which he put forward an atomic theory to explain the results of a number of experiments he had performed with gases. Dalton's atomic theory is as follows:
1. All matter is made up of very small particles called atoms
2. All atoms are indivisible. They cannot be broken down into simpler particles

- 1875: An English Chemist, William Crookes, experimented to find out what happens when an electric current is passed through a glass tube containing air at low pressure



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1. Crookes found that a shadow of the Maltese cross is formed on the tube when the cathode rays are obstructed by the cross.
2. His paddle wheel experiment demonstrated that Cathode Rays travel in straight lines, cause glass to fluoresce when they strike it and, cathode rays possess enough energy to move a paddle wheel.

Definition: Cathode rays are streams of negatively charged particles called electrons. They travel in straight lines from the cathode to the anode, are deflected by electric and magnetic fields, and have sufficient energy to move a small object such as a paddle wheel.

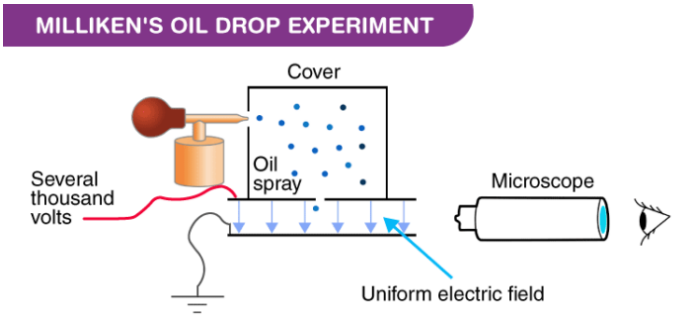
- 1897: J.J. Thomson, an English Scientist, carried out an experiment with a cathode ray tube containing a pair of oppositely charged, parallel plates.
1. He found that the rays were attracted to the positive plate. This meant the cathode rays were negatively charged.
2. He called the negatively charged particles Electrons, a name suggested by

Irish Physicist, George Stoney.

3. Further experimentation by Thomson found that he could cancel out the attractive forces between the electron and the positive plate using a magnetic field.

4. He was able to calculate the ratio of the charge on an electron to its mass using the formula $\frac{charge\ of\ electron}{mass\ of\ electron}$ = 1.76 x 10^{11} coulombs per kg

- 1909: An American Physicist, Robert Millikan, carried out the oil drop experiment to determine the charge on an electron.



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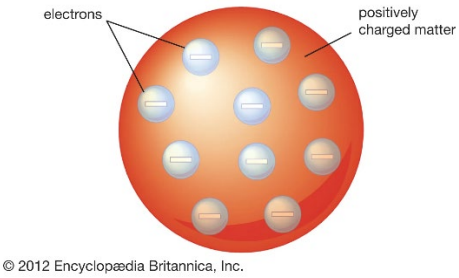
1. Oil was sprayed in a fine mist between two charged metal plates. X-rays were used to ionise the air between the plates. As the oil droplets fell through the air, they picked up these electrons and became negatively charged.

2. The charge on two plates were changed until the droplets floated in mid-air. This meant the force of the charge was equal to the force of gravity.

3. He was able to calculate the charge on the electron as 1.6 x 10^{19} coulomb.

4. Using Thomson's formula, Millikan was also able to calculate the mass of the electron.

- 1898: J.J. Thomson proposed the 'Plum Pudding' model of the atom. This was later found to be incorrect.



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- 1909: New Zealand scientist, Ernest Rutherford, discovered the nucleus by bombarding gold foil with positively charged alpha particles and looking at what happened to them.

Observation	Conclusion
Most + particles pass straight through the foil	Most of the atom is empty space
Some + particles deflected at large angles	+ particles are repelled when they pass through the small + nucleus
Small number of + particles are deflected back along their own path	Small number of + particles collided head on with the nucleus

Rutherford went on to discover the proton by bombarding elements lighter than gold with alpha particles. These elements would break and release small, positively charged particles. He called these small positively charged particles the proton.

- 1932: James Chadwick discovered the Neutron. He bombarded a sample of beryllium with alpha particles and found that small neutral particles were being knocked out of the nucleus of the beryllium atom. He found that these particles had about the same mass as the proton and, because they were neutral, he called them neutrons.

Properties of the sub-atomic particles

	Relative Charge	Relative Mass	Location
Proton	+1	1	Nucleus
Neutron	0	1	Nucleus
Electron	-1	$\frac{1}{1838}$	Outside Nucleus

References

1. Sutori.com
2. BYJUS.com
3. EncyclopaediaBritannica.co.uk