J.j. thomson – discovery of the electron

CHE003 Chemistry Individual Assignment J. J. Thomson – Discovery of the electron Table of Contents Introduction2 Biographical information3 Background information4 Experimental information5 Impact6 Conclusion7 J. J. Thomson – Discovery of the electron Introduction The discovery of the electron is affirmative and justly credited to the English physicist Sir Joseph John Thomson (Weinberg, 2003). He had found and identified the electron in Cavendish Laboratory, Cambridge in 1897.

From many experiments, Thomson had certified that cathode rays carry negative charge and identified the cathode rays inside vacuum tubes as being electric currents composed of these tiny electrons (Hamblin, 2005). It was the crucial first step in the development of the twentieth-century concept of the atom (Simmons, 1996). In the following paragraphs, I will introduce the Thomson’s life and his important achievements. Biographical information J. J. Thomson was born at Cheetham Hill, a suburb of Manchester, England on December 18, 1856.

His father Joseph Thomson was a publisher and book dealer; his mother was Emma Swindles, a housewife. Thefamily’senvironmentwas not good for learned, but he was excellent in study and had an exceptional memory. When Thomson was fourteen in 1870, he enrolled in Owens College and had been taught by the physics professor, Balfour Stewart. Then he entered Trinity College in 1876, as a minor scholar. In 1880, Thomson became a Fellow of Trinity College, when he was Second Wrangler and Second Smith's Prizeman; he remained at Cambridge for the rest of his life, and becoming lecturer in 1883.

In 1884, Thomson was named Cavendish Professor of Experimental Physics at an exceptionally young age (Simmons, 1996). On April 30, 1897, was his first time announced preliminary discovery of electron during lecture in Royal Institute, England. In 1903, Thomson published a summary of his work; Conduction of electricity through gases, and he created the “ plum-pudding” model, which is the first model of atom. Thomson won the Nobel Prize for Physics in 1906, a knighthood in 1908, and the Presidency of the Royal Society in 1915. He was also a member of the Board of Investigation and Research, which served Britain in World War One (Weinberg, 2003).

After that, he resigned from the Cavendish Laboratory in 1919 to become Master of Trinity College, until died on August 30, 1940 (Hamblin, 2005). In addition, he married with Rose Elisabeth in 1980, they had one son; George Paget Thomson; also won the Nobel Prize for Physics in 1937, and one daughter. Background information In the end of nineteenth century and the beginning of the twentieth century were exciting and revolutionary time for physics (Franklin, 2004). They began to investigate the behavior of electricity in evacuated tubs.

The conduction of electricity through a near vacuum appeared to produce a kind of “ ray”, lighting up the inside of the tube. The cathode rays appeared to be like light, and thus some physicists concluded that they were wave but other evidence proofed that the rays were in fact material in nature. During 1894 to 1897, Thomson was investigated the phenomenon of cathode ray, which had been discovered in 1858 (Ne’eman& Kirsh, 1997). In 1897, he made a significant discovery that the “ rays” were indeed built up of particles and that they were the constituents of all atom.

Thomson believed that his experimental evidence, by electromagnetic deflection and measuring the kinetic energy of the ray, had proven it. In the first, he did not initially call it electron, but chose the word “ corpuscle” to emphasize the material nature of the particle. Thomson had found the new particle was very much matter, and he believed that it was the fundamental form of matter in atoms (Hamblin, 2005). Moreover, Albert Einstein introduced his special theory of relativity, which fundamentally changed our concepts of space and time in 1905.

Follow by this discovered, people also had changed the way to think about nature and formed an integral and important part of the physics of the time (Franklin, 2004). Experimental information The purpose of Thomson’s experiments in 1897 was to investigate the nature of the then recently discovered cathode rays. He was tried to decide between the view that rays were negatively charged, material particles and the view that they were disturbances in the “ Aether”, the medium through which physicists believed that light waves traveled at the time (Franklin, 2004).

In the first of several experiments, Thomson wanted to proof that the cathode rays carried negative charge. He placed two metal plates, connected to a battery, inside a cathode tube, creating a magnetic filed through which the rays would have to pass (Simmons, 1996). The rays were emitted from the negative electrode “ the cathode” and caused a glow when they impinged on the glass or a plate coated with Zinc Sulphide fixed inside the tube. There is another physicist, William Crookes, has been published that the cathode rays were a stream of particles carrying negative charges substances in 1897 (Ne’eman& Kirsh, 1997).

Thomson certified this by showing that the rays could be deflected from their straight path by a magnetic or an electric field, and that their behavior under the influence of these fields was exactly what would be expected of a stream of negatively charged particles. By measuring the deflection of the rays in combined electric and magnetic fields of different strengths he was able to calculate the speed of the particles and the ratio between the charges carried by each particle (e) and its mass (m), but no way could be found to calculating the charge and the mass separately.

The ratio e/m of the particle was found to be independent of the type of metal of which the cathode was made or residual gas in the tube. Thomson repeated these experiments and found that the particles, which the light knocked out of the metal surface, were identical to the particles constituting the cathode rays. Thus he got the conclusion that these particles were present in all matter, and that by means of an electric voltage or irradiation with light they could be extracted from certain substances (Ne’eman& Kirsh, 1997).

The particles were given the name “ electrons” (corpuscle). Impact Firstly, the electron was not only the first of the basic particles to be clearly identified but also by far the lightest of the elementary particles (Weinberg, 2003). Secondly, as a consequence of its lightness, charge and stability, the electron has a unique importance to physics, biology and chemistry. The heat of our sun is produce by the electrons participate in the nuclear reaction. In addition, every atom in the universe consists of a dense core, was surrounded by a cloud of electrons.

For chemistry, the chemical differences between one element and another one, depend almost entirely on the number of electrons in the atom, and the chemical forces that hold atoms together in all substances are due to the attraction of the electrons in each atom for the nuclei of the other atoms (Weinberg, 2003). Lastly, the cathode ray tube that we used in television screen and computer monitor today, was developed from experimental apparatus. It is basic from a glass tube plugged by metal electrodes, with the air evacuated and some specific gas pumped in.

When the electrodes are connected to a battery with enough voltage, the cathode rays strike the opposite end of the tube and glow or fluoresce. The rays are streams of electrons, not light rays (Simmons, 1996). Conclusion In conclusion, Thomson had constituted one of the important milestones in physics: Cathode rays consist of particles that are elementary and found in all matter. Because of his famous experiments, the Cavendish Laboratory was already became a paradise for physicists at that moment, and number of his students also won the Nobel Prize.

With change through time, there are nearly sixteen types of elementary particles have been known so far, but only one particle type has always remained on the list: the electron (Weinberg, 2003). Therefore, the achievements of J. J. Thomson were still having influence in the world.

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