P.G.SEMESTER-II
CC- V
Advances in Chemistry

Unit-I Nuclear Chemistry

Topic- Liquid Drop Model of Nucleus (PART - 2)

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LIQUID DROP MODEL (PART-2)

George Gamow suggested the liquid drop model, which was further developed by Niels Bohr and John Archibald Wheeler. It treats the nucleus as an incompressible fluid drop with a very high density that is kept together by the nuclear force (a residual effect of the strong force), with a structure that resembles that of a spherical liquid drop. The liquid drop model, though crude, accounts for most nuclei's spherical shape and allows a rough prediction of binding energy.

The mass formula is solely determined in terms of the number of protons and neutrons it includes. Five terms are described in the original Weizsäcker formula:

- Interior nucleon has a certain number of other nucleons in contact with it when an arrangement of nucleons of the same size is packed together into the smallest volume. As a result, the amount of nuclear energy emitted is proportional to the volume.
- The presumption that each nucleon interacts with the same number of other nucleons is corrected by surface energy. Since this definition is negative and proportional to the surface area, it is approximately equal to liquid surface tension.
- The potential energy of each pair of protons is known as Coulomb energy. The binding energy is diminished since this is a repulsive force.
- The Pauli exclusion theory is explained by asymmetry energy (also known as Pauli Energy). Uneven numbers of neutrons and protons mean that one form of the particle will fill higher energy levels while the other will leave lower energy levels empty.
- The propensity for proton and neutron pairs to form is explained by pairing energy. Due to spin coupling, an even number of particles is more stable than an odd number.

What are the major achievements of the liquid-drop model?

The liquid-drop model was an efficient model that helped scientists study atomic nuclei. The major achievements of the liquid-drop model are:

- It helps in predicting the atomic mass of the nuclei accurately.
- It helps in predicting the binding energies of various nuclei accurately.
- It helps scientists in predicting the emission of alpha particles and beta particles in radioactivity.
- It also efficiently explains the basic features of the process of fission.

What properties can be studied using a liquid-drop model?

The liquid-drop model can be efficiently used to study various properties of nuclear physics. This model considers the nucleus of an atom as a liquid. Nuclear properties, like binding energy, are studied through a liquid-drop model and are expressed in parameters that are associated with a liquid such as a volume energy, compressibility, and surface energy. The model was also used to explain how a nucleus performs when it undergoes fission.

What are the major advantages of the liquid-drop model?

The liquid-drop model has various advantages in the field of nuclear physics. The major advantages of the liquid-drop model are:

- The liquid-drop model explains the spherical shape and stability of nuclei very well.
- The model helps in predicting the binding energy of the nucleus and also helps us to know how much energy is available for consumption purposes.
- The model helps in explaining the radioactive phenomenon of artificial radioactivity and nuclear fission.

SOME TERMINOLOGIES USED IN NUCLEAR CHEMISTRY

- **Nucleon:** it refers to a proton or a neutron in the nucleus of an atom.
- **Atomic number:** it refers to the number of protons present in a nucleus and is denoted as Z.
- **Atomic mass number:** it refers to the number of nucleons present in a nucleus and is denoted as A =N+Z.
- **Nuclide:** it is the term given to a nucleus that contains a specific value of A and Z. the values of A and Z are written next to the chemical symbol in the form of subscript and superscript. The atomic mass number is written in the superscript and the atomic number is written in the subscript.
- **Isotope:** it refers to a nucleus that has the same atomic number but a different atomic mass number. The isotopes generally have similar chemical and atomic behavior but may possess different nuclear properties.
- **Isotone:** it refers to a nucleus that contains a different number of protons but the same number of neutrons.
- **Isobar:** these are just the opposite of isotopes and refer to a nucleus that has the same atomic mass number but a different atomic number.
- **Mirror nuclei:** these refer to a pair of unique nuclei wherein the number of protons in one nucleus, say A is equal to the number of neutrons in the other nuclei, say B, and the number of neutrons in A is equal to the number of protons in B.

Learn more about the liquid drop model of the atomic nucleus by Vedantu from the top subject matter experts and build a strong foundation of nuclear physics. Find out deeper insights into this topic and proceed with better concepts to study advanced subjects.

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