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Commentary

Nuclear Magnetic Resonance and its Applications

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DESCRIPTION

Nuclear Magnetic Resonance (NMR) is a physical phenomenon in which nuclei in a strong constant magnetic field are irritated by a weak oscillating magnetic field (in the near field) and respond by creating an electromagnetic signal with a frequency characteristic of the magnetic field at the nucleus. This interaction happens near resonance, when the oscillation frequency matches the intrinsic frequency of the nuclei, which depends on the strength of the static magnetic field, the chemical environment, and the magnetic properties of the isotope involved; in practical applications with static magnetic fields up to ca. 20 tesla, the frequency is similar to Very High Frequency (VHF) and Ultra High Frequency (UHF) television broadcasts (60-1000 MHz). NMR results from specific magnetic properties of certain atomic nuclei. Nuclear magnetic resonance spectroscopy is widely used to determine the structure of organic molecules in solution and study molecular physics and crystals as well as non-crystalline materials. Nuclear magnetic resonance is also regularly utilized in advanced medical imaging techniques, such as in Magnetic Resonance Imaging (MRI).

The principle behind Nuclear Magnetic Resonance (NMR) is that many nuclei have spin and all nuclei are electrically charged. If an external magnetic field is applied, an energy transfer is possible between the base energy to a higher energy level (generally a single energy gap). The energy transfer takes place at a wavelength that corresponds to radio frequencies and when the spin returns to its base level, energy is emitted at the same frequency. The signal that matches this transfer is measured in many ways and processed in order to yield a nuclear magnetic resonance spectrum for the nucleus concerned.

Applications

- By studying the peaks of nuclear magnetic resonance spectra, we can determine the structure of many compounds.
- It is used to identify known and novel compounds.
- Used for identification of structural isomers.
- Used in detection of hydrogen bonding.
- Used in detection of electronegative atom or group.
- Nuclear magnetic resonance is primarily used for structural determination however it can be used for purity determination.
- It is useful for identifying drug leads and determining the confirmation of compounds bound to enzymes, receptors and other proteins.
- It is used for magnetic resonance imaging for medical diagnosis and magnetic resonance microscopy.
- Another use of nuclear magnetic resonance is used is data acquisition in the petroleum industry for petroleum and natural gas exploration and recovery.
- Nuclear magnetic resonance of boreholes is used to measure rock porosity.
- It is also used to study molecular structure and interactions.
- It is used for determining 3D structure of proteins and other macromolecules.
- It is also used in polymer production, cosmetics and food production.
- Nuclear magnetic resonance widely used in biochemical studies.
- It is useful for analysing samples non-destructively.
- Used in estimation of type and quantity of fluid hydrocarbons.
- Estimation of hydrocarbon producibility.
- Estimation of rock composition.

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