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Editorial

Note on Nuclear Magnetic Resonance

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INTRODUCTION

Nuclear Magnetic Resonance is a research method that uses the magnetic properties of specific nuclei. NMR spectroscopy determines the physical and chemical properties of an atom or molecule. It is based on the phenomenon of nuclear magnetic resonance and provides information on molecular structure, dynamics, reaction states and chemical environment.

METHODOLOGY

Principles of NMR spectroscopy

Many nuclei have spins, and all nuclei are charged according to the principles of NMR. When an external magnetic field is applied, energy transfer from basic energy to higher energy levels can be achieved.

• All nuclei are charged and many have spin.

• Energy transfer from basic energy to higher energy levels is possible only when an external magnetic field is applied.

• Energy is transmitted at the wavelength corresponding to the radio frequency.

• When the spin returns to the base level, energy is released at the same frequency.

• Therefore, by measuring the signal corresponding to this transmission, the processing of the NMR spectrum is sufficient for the nucleus in question.

NMR spectroscopy working

• Place the sample in a magnetic field.

• Excite the nuclei sample into nuclear magnetic resonance with the help of radio waves to produce NMR signals.

• These NMR signals are detected with sensitive radio receivers.

• The resonance frequency of an atom in a molecule is changed by the intra-molecular magnetic field surrounding it.

• This will give details of a molecule`s individual functional groups and its electronic structure.

• Nuclear magnetic resonance spectroscopy is a conclusive method of identifying monomolecular organic compounds.

• This method provides details of the reaction state, structure, chemical environment and dynamics of a molecule.

NMR spectroscopy instrumentation

This instrument consists of nine major parts:

• Sample holder – It is a glass tube which is 8.5 cm long and 0.3 cm in diameter.

• Magnetic coils – Magnetic coil generates magnetic field whenever current flows through it

• Permanent magnet – It helps in providing a homogenous magnetic field at 60 – 100 MHZ

• Sweep generator – It modifies the strength of the magnetic field which is already applied.

• Radio Frequency Transmitter – Generates powerful but short radio pulses.

• Radio Frequency – Aids in detecting the radio frequency of the receiver.

• RF detector –It helps to determine the unabsorbed radio frequencies.

• Recorder – Records the NMR signal received by the RF detector.

• Read system – A computer that records data.

Techniques

Resonant frequency:

It refers to the energy of the absorption, and the intensity of the signal that is directly proportional to the strength of the magnetic field. NMR active nuclei absorb electromagnetic radiation at a frequency characteristic of the isotope when placed in a magnetic field.

Acquisition of spectra:

Upon excitation of the sample with a radiofrequency pulse, a nuclear magnetic resonance response is obtained. It is a very weak signal and requires a sensitive wireless receiver to receive it.

Application

• NMR spectroscopy is a spectroscopic technique widely used by chemists and biochemists to study the properties of organic molecules, but it can be applied to all types of samples, including nuclei with spins.

• For example, NMR can quantitatively analyse mixtures containing known compounds. NMR can either be used to match against spectral libraries or to deduce the basic structure directly for unknown compounds.

• Once the basic structure is known, NMR can be used to determine molecular conformation in solutions also in studying physical properties at the molecular level such as conformational exchange, phase changes, solubility, and diffusion.

CONCLUSION

Nuclear Magnetic Resonance spectroscopy is undoubtedly, the most powerful analytical technique in terms of the range of systems that can be studied and the nature or type of information that can be obtained regarding the system of interest. we can measure the energy that is required to change the alignment of magnetic nuclei in a magnetic field. NMR spectroscopies can provide us complementary chemical information about a certain given molecule.