A Review On Near Infrared Spectroscopy – Introduction and Importance

Reena Rani[a],Sunil Kumar[b], Neha Munjal[c], Uma Kamboj[c]

a Physics Department Government College Jind(126102), Haryana
b PGT Physics GSSS Lajwana Kalan, Jind(126102), Haryana
c Department of Physics, School of Chemical Engineering and Physical Sciences, Lovely professional University, Jalandhar, Punjab, India

Abstract-
NIR (Near Infrared Spectroscopy) Is Important Technology. It Is Used In The Field Of Material Science, Food Analysis, Medicine, Environment, Agriculture And Pharmaceuticals. NIR Used In Food Analysis, Which Is Important Application Of NIR. There Is No Need Of Sample Preparation In This Technique, So It Is Very Simple And Fast Technique. It Is Based Upon Absorption Of Radiation In Range Of 700 To 2500nm. It Allow To Measure Several Constituent Concurrently. Present Paper Gives Information About The Basics Of NIR And Theory Of NIR And NIR Instrumentation And Its Importance In Field Of Food Analysis. NIR Used In Food Analysis, Which Is Important Application Of NIR.
Keywords: *Near Infrared Spectroscopy, Food Analysis*

I.   Introduction

NIR (Near Infrared Spectroscopy)

NIR use electromagnetic spectrum range 780-2500nm. For this method no sample preparation required. So it is easy and fast technique. It can be used for several constituents in one time. For each fundamental vibration, there is a series of overtones. Bond between atoms in molecules vibrate and this vibration behave as simple harmonic motion. This vibrational frequency is function of masses M1 and M2 and strength of bond K. [1,2] Between potential energy and intermolecular distance there is parabolic relation. When frequency of vibration match with frequency of radiation then there occur transfer of energy from radiation. Energy is transferred in term of packet known as quanta. Transition from 0-1 known as fundamental and transition from 0 to 2, 0-3 etc. are also possible and known as first overtones, second overtone etc. with frequency twice and thrice of fundamental. [3, 4]
NIR can be used for solid liquid or powdered sample

What is Spectroscopy Used For?

Spectroscopy is used in physical and analytical chemistry to detect, determine, or quantify the molecular and/or structural composition of a sample. Each type of molecule and atom will reflect, absorb, or emit electromagnetic radiation in its own characteristic way. Spectroscopy uses these characteristics to deduce and analyze the composition of a sample. [5,6]

Spectroscopy

Spectroscopy is the investigation and measurement of spectra produced by matter interacting with or emitting electromagnetic radiation. Originally, spectroscopy was defined as the study of the interaction between radiation and matter as a function of wavelength. Now, spectroscopy is defined as any measurement of a quantity as a function of wavelength or frequency. During a spectroscopy experiment, electromagnetic radiation of a specified wavelength range passes from a source through a sample containing compounds of interest, resulting in absorption or emission. During absorption, the sample absorbs energy from the light source. During emission, the sample emits light of a different wavelength than the source's wavelength. [7, 8]

Uses of spectroscopy

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Applications of NIR

Typical applications of NIR spectroscopy include the analysis of food products, pharmaceuticals, combustion products, and a major branch of astronomical spectroscopy.

Astronomical spectroscopy

Near-infrared spectroscopy is used in astronomy for studying the atmospheres of cool stars where molecules can form. The vibrational and rotational signatures of molecules such as titanium oxide, cyanide, and carbon monoxide can be seen in this wavelength range and can give a clue towards the star's spectral type. It is also used for studying molecules in other astronomical contexts, such as in molecular clouds where new stars are formed. [10]

Agriculture

Near-infrared spectroscopy is widely applied in agriculture for determining the quality of forages, grains, and grain products, oilseeds, coffee, tea, spices, fruits, vegetables, sugarcane, beverages, fats, and oils, dairy products, eggs, meat, and other agricultural products. It is widely used to quantify the composition of agricultural products because it meets the criteria of being accurate, reliable, rapid, non-destructive, and inexpensive.

Remote monitoring

Techniques have been developed for NIR spectroscopic imaging. Hyper spectral imaging has been applied for a wide range of uses, including the remote investigation of plants and soils. Data can be collected from instruments on airplanes or satellites to assess ground cover and soil chemistry.Remote monitoring or remote sensing from the NIR spectroscopic region can also be used to study the atmosphere. [11]

Materials science

Techniques have been developed for NIR spectroscopy of microscopic sample areas for film thickness measurements, research into the optical characteristics of nanoparticles and optical coatings for the telecommunications industry.

Medical uses

The application of NIRS in medicine centers on its ability to provide information about the oxygen saturation of hemoglobin within the microcirculation. Broadly speaking, it can be used to assess oxygenation and micro vascular function in the brain (cerebral NIRS) or in the peripheral tissues.

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