Applications and Importance of Spectrofluorometry in Analysis

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Commentary

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DESCRIPTION

An electromagnetic spectroscopy technique called fluorescence spectroscopy examines fluorescence from a sample. It is often referred to as fluorimetry or spectrofluorometry. It entails the use of a beam of light, often ultraviolet light, to excite the electrons in the molecules of particular compounds and cause them to release light, usually visible light but not always. Absorption spectroscopy is a complementary method. Single fluorophores or pairs of fluorophores are used to detect intensity variations in the particular situation of single molecule fluorescence spectroscopy. Energy levels are the different states that exist for molecules. Electronic and vibrational states are largely studied in fluorescence spectroscopy. Typically, the species under investigation has a ground electronic state of interest (a low energy state) and an excited electronic state of interest (a higher energy state). There are different vibrational states inside each of these electrical states. In order to produce fluorescence, a species must first be excited from its ground electronic state to one of the many vibrational modes in the excited electronic state by absorbing a photon. The excited molecule loses vibrational energy as a result of collisions with other molecules and eventually achieves the lowest vibrational state from the excited electronic state.

There are two main categories of instruments: spectrofluorometers, which employ diffraction grating monochromators to isolate incident light and fluorescent light, and filter fluorometers, which utilize filters to isolate incident light and fluorescent light.

The employment of lasers, LEDs, and lamps, specifically xenon arcs and mercury-vapor lamps, as excitation sources is possible. An excitation monochromatic or filter is not essential because a laser only generates light with strong irradiance across a very small wavelength range, often around 0.01 nm. The limitation of this technique's ability to significantly alter a laser's wavelength is a drawback. A line lamp, such as a mercury vapour lamp, emits light at or near peak wavelengths.

Fluor meters may employ filters or monochromators. A monochromator transmits light with a wavelength and tolerance that are both adjustable. The most popular kind of monochromator uses a diffraction grating, which means that depending on the wavelength, collimated light illuminates the grating and leaves at a variable angle. Either a single channel or multiple channels can be used in the detector. The multichanneled detector can detect the intensity of all wavelengths concurrently while the single-channeled one can only detect the intensity of one wavelength at a time. This eliminates the need for an emission monochromator or filter.

Applications

- For the analysis of organic substances, fluorescence spectroscopy is employed in the disciplines of biochemical, medicinal, and chemical research, among others. It has also been mentioned that it can be used to distinguish between benign and malignant skin cancers.
- AFS techniques, such as CVAFS, which is used to identify heavy metals like mercury, are helpful for different types of analysis or measurement of a component present in air, water, or other media.
- See fluorescent solar collector for more information on using fluorescent materials to reroute light.
- Microfluorimetry is another tool that can be used to adapt fluorescence spectroscopy to the microscopic level.
- Fluorescence detectors are employed with HPLC in analytical chemistry.
- Fluorescence spectroscopy can be used to assess water quality in the study of water by looking for organic contaminants.