

Function of Monochromator in Spectrophotometer



Overview

Monochromators are used in many optical measuring instruments and in other applications where tunable monochromatic light is wanted. Sometimes the monochromatic light is directed at a sample and the reflected or transmitted light is measured. Sometimes white light is directed at a sample and the monochromator is used to analyze the reflected or transmitted light.

Key Takeaways

The monochromator in a spectrophotometer isolates a narrow band of light wavelengths from a broad-spectrum source, enabling precise measurement of a sample's absorbance at specific wavelengths.

A monochromator is an optical device that selects a specific wavelength of light from a polychromatic (broad-spectrum) source, converting it into a nearly monochromatic beam. This is crucial in spectrophotometry because the absorbance of a sample depends on the wavelength of light, and accurate measurements require light of a single wavelength to interact with the sample .

Components and Operation

The main components of a monochromator include:

- Entrance slit: Controls the size and intensity of the incoming light beam. Narrower slits improve spectral resolution but reduce light intensity .

- Collimating optics (mirrors or lenses): Transform diverging light into a parallel beam, which is necessary for precise wavelength separation .
- Dispersive element (prism or diffraction grating): Separates light into its constituent wavelengths. Prisms use differences in refractive index, while diffraction gratings exploit interference patterns to bend different wavelengths at unique angles .
- Focusing optics: Direct the dispersed light toward the exit slit or detector .
- Exit slit: Allows only the selected wavelength to pass through to the sample, blocking all other wavelengths . In modern spectrophotometers, the diffraction grating is commonly used due to its high efficiency and ability to cover a wide spectral range .

Role in Spectrophotometry

By isolating a single wavelength, the monochromator ensures that the absorbance measurement corresponds to a specific interaction between light and the sample, eliminating interference from other wavelengths. This allows for:

- Accurate determination of concentration using Beer-Lambert law.
- High spectral resolution, enabling detection of subtle differences in absorbance.
- Flexibility to scan across a range of wavelengths by mechanically adjusting the dispersive element, such as rotating a diffraction grating .

Summary

In essence, the monochromator is the key component that transforms broad-spectrum light into a controlled, single-wavelength beam, making precise spectrophotometric analysis possible. Its design and operation directly affect the accuracy, resolution, and sensitivity of the spectrophotometer .

Article Content

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A monochromator is incorporated into fluorescence spectrophotometers and emission spectrometers to determine the wavelength of

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Monochromator: Fundamental Principle and Methods

The monochromator supplies light of a certain wavelength that is specifically absorbed by a substance, and its concentration can

Monochromator

Monochromator in an x-ray beamline at the Advanced Photon Source, Argonne National Laboratory. A monochromator is an optical

13.4: Instrumentation

Single-Beam Spectrophotometer An instrument that uses a monochromator for wavelength selection is called a spectrophotometer.

Monochromator

Monochromator A monochromator provides a wavelength selection option in microplate readers, spectrophotometers and other

Monochromator M

Overview The main function of a monochromator is to separate the color components of a light. It can use either the optical

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