What are the light-absorbing materials used in optical path modules

Article Overview

Optical path modules commonly use black coatings, light-absorbing panels, and specialized semiconductors to suppress stray light and enhance system performance.

Black Coatings

Black coatings are widely used to minimize stray light in optical systems. They can be applied to metals, polymers, glasses, semiconductors, and ceramics. Common types include:

o Polymer-based paints and dyes: Provide strong visible light absorption and are easy to apply .
o Carbon nanotube coatings: Offer extremely low reflectance, often referred to as "super black" .
o Inorganic coatings: Such as anodized aluminum or nickel-phosphorus, which provide higher thermal stability and durability . These coatings are used in optical housings, beam dumps, thermal detectors, and monochromators to prevent scattered light from degrading system performance .

Light-Absorbing Panels

Specialized panels, such as those from Acktar, are designed for optical modules:

o Hexa Black(TM): Wide-band absorption at grazing angles up to 88?, suitable for stray light suppression .
o Metal Velvet(TM) and Spectral Black(TM): Thin coatings with extremely low hemispherical reflectance and high emissivity, ideal for low-power laser beam dumps and optical mounts .
o Panels can be flexible or mounted on aluminum plates, and some feature low outgassing adhesives for vacuum applications . These panels are particularly useful in space applications and high-precision optical instruments, including telescopes and laser systems .

Semiconductor and Solar-Absorbing Materials

For applications requiring high-efficiency light absorption, such as photodetectors or solar energy capture, semiconductors are used:

o Thin-film absorbers: Materials like complex phosphides, chalcogenides, oxides, and nitrides are engineered for strong optical absorption and long carrier lifetimes .
o Conventional PV absorbers: Silicon, copper indium gallium selenide (CIGS), and cadmium telluride (CdTe) are used in modules where light-to-energy conversion is needed .
o These materials are optimized for specific wavelength ranges and can be integrated into optical path modules for energy harvesting or photodetection .

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Key Considerations

When selecting light-absorbing materials for optical path modules, important properties include:

o Spectral absorption range: UV, visible, SWIR, or MWIR depending on the application .
o Thermal and mechanical stability: To withstand high optical intensities and environmental conditions .
o Low reflectance and high emissivity: To maximize absorption and minimize stray light .
o Vacuum compatibility: Low outgassing for space or high-vacuum systems .
o Adhesion and durability: Ensures long-term performance in optical assemblies . By combining black coatings, light-absorbing panels, and semiconductor absorbers, optical path modules can achieve precise beam control, minimize stray light, and maintain high system efficiency across a wide range of applications.

Applications of Optical Filters Optical filters have a wide range of applications in various fields, including

Optical coatings are used to enhance the transmission, reflection, or polarization properties of an optical component. For example,

However, current absorbers show detrimental insufficient absorption spectral range, or light angle and polarization

An optical isolator, or optical diode, is an optical component which allows the transmission of light in only

1.1 Introduction Materials used to manipulate the flow of light are considered as optical materials. Upon interaction of light within

Acktar Light Absorbing Panels are used in optical systems as light absorbing black out material, stray light absorber or

The path light follows as it travels through a substance depends on the substance"s index of refraction. This path is

Optical materials are defined as substances that alter or control electromagnetic radiation in the ultraviolet, visible, or

The performance of these solar cells relies considerably on the light-absorbing material that generates electron-hole

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This is the case for which the term "absorbance" was first used. A common expression of the Beer"s law relates the attenuation of

Explore the ultimate guide to optical modules. Learn types, functions, performance metrics

The optical path length (OPL) is an essential property of optical systems since it determines the phase of the light and

Optical modules are electronic devices used in communication systems to transmit optical signals. These modules

The study of manipulation of light in the presence of matter is important to understand the optical properties of

Optical path (OP) is the trajectory that a light ray follows as it propagates through an optical medium. The geometrical optical-path

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