

Principle of Gallium Arsenide Fiber Optic Temperature Sensor

Article Overview

Gallium Arsenide (GaAs) fiber optic temperature sensors provide precise, non-invasive temperature measurements in environments where traditional electrical sensors fail due to electromagnetic interference or extreme conditions.

Principle of Operation

GaAs fiber optic temperature sensors operate based on the temperature-dependent bandgap of the GaAs semiconductor crystal. The GaAs crystal, mounted at the tip of an optical fiber, is transparent to light above its bandgap wavelength and absorbs light below it. As temperature changes, the bandgap shifts, causing a wavelength shift of approximately 0.4 nm per Kelvin. Light injected into the fiber interacts with the GaAs crystal, and the reflected light is analyzed by a spectrometer to determine the precise temperature .

Advantages

- o Electromagnetic Immunity: Being fully non-metallic and dielectric, GaAs fiber optic sensors are immune to RF, EMI, NMR, and microwave radiation, making them ideal for high-voltage, MRI, or industrial environments .
- o High Temperature Capability: They can operate reliably in extreme temperatures where conventional sensors like thermocouples or RTDs may fail .
- o Non-Invasive and Safe: The sensors are intrinsically safe and non-conductive, suitable for explosive or sensitive environments .
- o Precision and Miniaturization: GaAs crystals can be very small (e.g., 300 um x 300 um), allowing direct contact measurement on small surfaces with fast response times .

Applications

- o Industrial: Monitoring temperatures in furnaces, high-voltage equipment, or areas with strong magnetic fields .
- o Medical: MRI-compatible temperature monitoring for patients or materials, where metallic sensors would interfere with imaging .
- o Harsh Environments: Power plants, microwave fields, or explosion-proof areas where traditional sensors are unsafe or inaccurate .

Measurement Process

- o Light Injection: White light is sent through the optical fiber to the GaAs crystal.
- o Interaction: The crystal absorbs light below the bandgap and reflects light above it.

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- o Spectral Analysis: A spectrometer measures the reflected light spectrum, identifying the absorption edge shift.
- o Temperature Calculation: The position of the absorption shift is correlated to temperature, independent of light intensity, ensuring high accuracy and repeatability .

Summary

GaAs fiber optic temperature sensors are critical in applications requiring high precision, electromagnetic immunity, and safety. By exploiting the optical properties of GaAs crystals, these sensors provide reliable temperature measurements in environments where conventional electrical sensors are impractical or unsafe, supporting both industrial and medical applications .

Bandgap-based sensors (also called semiconductor absorption sensors) employ a small semiconductor crystal (e.g., gallium

This paper proposed a solution about low cost multi-channels Gallium Arsenide (GaAs) absorption-based fiber optic

Multimodal scanning-probe quantum sensing of quantum materials Solid-state spin defects are a powerful and versatile

Our fiber optic sensors use a Gallium Arsenide (GaAs) crystal at the fiber tip, making them ideal for highly

Indium gallium arsenide single-photon avalanche diodes (InGaAs SPADs) are important ultra-sensitive photodetectors operating

As the industry-leading business directory for over 20 years, Manta has been connecting people to local and small businesses

The TS series fiber optic temperature probes are true absolute temperature sensors consisting of a gallium arsenide (GaAs) crystal

The Role of Gallium Arsenide Crystals The key to many fiber optic temperature sensors lies in the behavior of gallium

The document describes a fiber optic temperature measurement technology using gallium arsenide (GaAs) for accurate temperature

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The sensor which uses optical fiber as sensing device. Rugged Monitoring have top fiber optic temperature sensors team on

In summary, fiber optic temperature sensors function by exploiting the relationship between temperature and the light

The diagram above illustrates how the fiber optic temperature measurement system works. A broadband

Gallium arsenide (GaAs) is a III-V direct band gap semiconductor with a zinc blende crystal structure.

GaAs Wafers in Temperature Measurement Applications Gallium Arsenide (GaAs), as a III-V group direct bandgap

The TS series fiber optic temperature probes consist of a gallium arsenide (GaAs) semiconductor crystal that is mounted on the end

Fiber optic temperature sensors solve many environmental and packaging challenges in the unique operating conditions of many

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