High temperature of fiber optic sensor

Overview

Optical Fiber Sensors for High-Temperature Monitoring: This paper reviews the sensing principle, structural design, and temperature measurement performance.

Key Takeaways

Fiber optic sensors can reliably measure temperatures exceeding 1000 °C, with specialized crystal fibers and semiconductor materials enabling extreme high-temperature monitoring.

Temperature Range and Materials

Fiber optic sensors are increasingly used for high-temperature measurements above 1000 °C, particularly in aerospace, metallurgy, fossil fuel, and power production industries, where traditional electronic sensors struggle due to electromagnetic interference and harsh conditions. Standard glass optical fibers typically operate up to ~600–800 °C, while crystal fibers (e.g., sapphire) can withstand temperatures exceeding 1000 °C, making them suitable for extreme environments. Temperature-sensitive materials at the fiber tip, such as Gallium Arsenide (GaAs), Cadmium Telluride (CdTe), and Silicon (Si), are commonly used.

Ga

As is preferred for its superior wavelength variation with temperature, allowing precise detection of temperature-induced shifts in optical properties. These materials exploit the energy bandgap shrinkage phenomenon, where the absorption or transmission spectrum shifts with increasing temperature, enabling accurate high-temperature measurements.

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Sensor Types and Principles

Fiber optic temperature sensors can be intrinsic (the fiber itself acts as the sensor, often with Bragg gratings) or extrinsic (the fiber transmits light to a separate sensing element),. High-temperature sensors often use non-interferometric, interferometric (e.g., Mach-Zehnder), or luminescent-based designs. The working principle involves detecting changes in light intensity, wavelength, polarization, or phase as the temperature varies.

Some sensors, like GaAs-based fiber tips, provide fast response times (~0. 2 s) and high accuracy (±0. 2 °C), even under extreme conditions such as high electromagnetic fields, microwave radiation, or explosive environments.

Kevlar-reinforced fibers enhance durability and long-term stability. ApplicationsHigh-temperature fiber optic sensors are used in: Aerospace: Monitoring turbine and combustion chamber temperatures to extend engine life. Metallurgy: Real-time measurement inside high-temperature boilers for combustion efficiency and safety.

Power and energy sectors: Transformer and high-voltage equipment monitoring, including distributed sensing over long distances. Harsh industrial environments: Where electromagnetic interference or explosive conditions make traditional sensors unsafe.

Summary

Fiber optic sensors designed for high temperatures can measure beyond 1000 °C using crystal fibers and semiconductor sensing materials. They offer electromagnetic immunity, distributed sensing, and high accuracy, making them ideal for extreme industrial and aerospace applications. The choice of fiber type, sensing material, and sensor design determines the maximum operational temperature and measurement precision.

Article Content

Optical Fiber Sensors for High-Temperature Monitoring: A Review

This paper reviews the sensing principle, structural design, and temperature measurement performance of fiber-optic high-temperature sensors, as well as recent significant progress in the transition of

High temperature fiber sensor with improved sensitivity

We report a high sensitivity fiber optic temperature sensor. The sensor has two cascade FP cavities composed of ceramic core, fiber and quartz glass. When the two FP cavities are close in optical path

Fiber Optic Temperature Sensing and Measurement

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Measure temperature with fiber optic sensors for high-resolution distributed and multipoint monitoring in batteries, processes, and harsh environments.

High-Temperature Fibre Optical Sensor

Abstract: we report a sapphire Fabry-Perot cavity based fibre optical temperature sensor that is capable of operating at elevated temperatures > 1000°C for prolonged periods of time.

Fiber optic high temperature sensor with weak strain ...

We proposed a fiber optic high temperature sensor based on the Mach-Zehnder interference (MZI) structure, which is composed of two lengths of multi-mode fibers (MMFs), a length

FIBER OPTICAL SENSOR FOR HIGH TEMPERATURE

Fiber optical sensor for high temperature measurements. The fiber optical high temperature sensor is based on the fiber Bragg grating (FBG) technology and enables temperature monitoring up to

Fiber Optic Temperature Sensors for High-Voltage Monitoring

Our innovative, patented TSENS fiber optic temperature sensor is designed for durability and ease of installation. This is a standout choice for transformer manufacturers.

DTSX3000 Distributed Temperature Sensor

What Is Distributed Temperature Sensing? Distributed temperature sensing (DTS) measures temperature distribution over the length of an optical fiber cable using

Distributed Fiber Optic Temperature Sensor

Fiber optic sensing cable design offers high reliability, accuracy, and quick update times to ensure 24/7 monitoring of the fiber temperature sensor application with no downtime for maintenance.

DTSX1 Fiber Optic Heat Detector | Yokogawa Electric Corporation

DTSX1 fiber optic heat detector stores the functions required for heat detection in one box. DTSX1 analyzes the temperature data with high accuracy by measuring with fiber optic sensor cable and

OSENSA Innovations | Fiber Optic Temperature Sensing & Partial ...

Leading developer of fiber optic temperature sensing and partial discharge monitoring solutions for switchgear, data centers, energy, and life sciences, delivering critical insights for electrical

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Fiber Optic Sensors | KEYENCE America

Fiber optic sensors are compact because the detection circuit is located in the amplifier, allowing for detection even in narrow spaces. Installation and

DTSX200 Distributed Temperature Sensor

Cost When an application requires hundreds or thousands of sensors to be measured, it becomes very expensive to wire each individual sensor back to a data acquisition station. It is much more cost

Distributed Fiber Optic Sensing for Structural Health Monitoring

Enhance your Structural Health Monitoring using advanced Distributed Fiber Optic Sensing Interrogators. Get real-time, high-resolution strain and temperature data with reliable performance.

Fiber Bragg Grating Sensors: Design, Applications, and ...

Fiber Bragg grating (FBG) sensors have emerged as advanced tools for monitoring a wide range of physical parameters in various fields, including structural health, aerospace, biochemical,

Dual-Parameter Measurement of Temperature and Refractive Index

Temperature and refractive index (RI) are two core parameters in ocean hydrological monitoring. However, their inherent cross-sensitivity has long been a bottleneck restricting the measurement

Optical Switch Applications in Fiber Optic Sensing: FBG and DTS ...

Fiber optic sensors (FBG, Brillouin, Raman) can measure strain and temperature at hundreds of points along a single fiber. But most FBG interrogators have only 4–16 channels — while a large

IR Temperature Sensors | Process Sensors Corp

The high-performance Process Sensors Metis M3 Series pyrometers are available in one-color and two-color versions with adjustable focus, through lens, laser, or

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