The Role of Fiber Optic Temperature and Humidity Sensors



Overview

This chapter reviews optical fiber sensors designed for measuring temperature and humidity, covering their fundamental principles, advanced architectures, and functionalized designs.

Key Takeaways

Fiber optic sensors can simultaneously measure temperature and humidity with high sensitivity, fast response, and immunity to electromagnetic interference, using technologies like fiber Bragg gratings and Fabry–Perot interferometers.

Working Principles

Fiber optic temperature and humidity sensors operate by detecting changes in light properties—such as wavelength, intensity, or phase—caused by environmental variations. Fiber Bragg gratings (FBGs) are widely used for temperature sensing; they consist of periodic modulations in the fiber core's refractive index, reflecting a specific Bragg wavelength that shifts linearly with temperature changes. Humidity sensing typically involves a humidity-sensitive coating or film, such as porous anodic alumina or polymers, which absorbs water and alters the optical signal transmitted through the fiber.

Fabry–Perot interferometers (FPIs) are another common platform.

© 2026 CGWEB NETWORK INFRASTRUCTURE - All rights reserved

Intrinsic FP

Is have reflectors within the fiber, while extrinsic FPIs create an external cavity. Changes in temperature or humidity modify the optical path length, producing measurable interference shifts. Sensor ArchitecturesFBG-based sensors: Linear response to temperature, compatible with distributed sensing, and simple fabrication.

FPI-based sensors: High flexibility in design, suitable for compact or remote sensing applications. Multimode interference (MMI) and microstructured fibers: Enhance sensitivity and allow simultaneous multi-parameter detection. Hybrid sensors: Combine intrinsic and extrinsic elements for improved performance and robustness.

Materials and Sensitivity Enhancement

Coatings and infiltrations with graphene oxide, polymers, or porous anodic alumina improve sensitivity and selectivity. For example, a porous anodic alumina film can achieve temperature sensitivity of 10. 4 pm/°C and humidity sensitivity of 185 pm/%RH, providing precise dual-parameter monitoring.

Microstructural modifications in the fiber or coating materials can further enhance response speed and measurement accuracy.

Advantages

Electromagnetic immunity: Safe for high-voltage or explosive environments. Remote sensing capability: Can monitor hard-to-reach or hazardous areas. Compact and versatile: Suitable for industrial, environmental, and biomedical applications.

High sensitivity and fast response: Enables real-time monitoring of temperature and humidity changes.

Applications

Industrial process monitoring: Temperature and humidity control in manufacturing or storage. Environmental monitoring: Climate and atmospheric studies. Biomedical applications: Monitoring conditions in sensitive medical environments.

Structural health monitoring: Detecting environmental effects on buildings or infrastructure. Fiber optic temperature and humidity sensors represent a highly adaptable and precise solution for multi-parameter environmental monitoring, combining advanced optical technologies with functionalized materials to achieve reliable, real-time measurements.

© 2026 CGWEB NETWORK INFRASTRUCTURE - All rights reserved

Article Content

Fiber Optics Technology for Temperature and Humidity Sensor

This chapter reviews optical fiber sensors designed for measuring temperature and humidity, covering their fundamental principles, advanced architectures, and functionalized designs.

An optical fiber sensor for measuring temperature and humidity based

Table 1 systematically summarizes recent advancements in fiber optic temperature and humidity sensors, presenting key performance parameters essential for evaluating sensor efficacy.

Recent Developments in Fiber Optics Humidity Sensors

The present paper reports the current trends of optical fiber humidity sensors. The evolution of optical structures developed towards humidity sensing, as well as the novel materials

Optical Fiber Based Temperature Sensors: A Review

Recognizing the major developments in the field of optical fibers, this article provides recent progress in temperature sensors utilizing several sensing

Fiber-optic humidity sensor | How it works, Application

Fiber-optic humidity sensors have emerged as a groundbreaking technology in the field of environmental monitoring, offering numerous benefits

IMPROVEMENT OF FIBER OPTIC SENSOR MEASUREMENT

Fiber optic sensors are widely used in temperature and humidity monitoring studies due to their simple design, low cost, fast response time, high sensitivity, and unique intrinsic safety advantages.

(PDF) Optical fibre temperature and humidity sensor

Many optical fiber sensors designed to recover quasi-static strain fields in the presence of significant temperature changes have been reported in recent years.

High-Sensitivity Cellulose-Based Fiber-Optic SPR Humidity Sensor

We develop a fiber-optic surface plasmon resonance (SPR) sensor that integrates a cellulose-based humidity-sensing module and a polydimethylsiloxane (PDMS)-based temperature

An Optical Fiber Sensor Based on FeOOH Nanorod Arrays for

© 2026 CGWEB NETWORK INFRASTRUCTURE - All rights reserved

Abstract: It remains a major challenge to prepare a temperature or humidity optical fiber sensor with a simple structure, low cost, and high sensitivity. In this work, a Mach-Zehnder

Development of fabrication technique and sensing performance of optical ...

Several key principles are classified and introduced, as well as the sensing performance of different types of sensors are compared and discussed. By analyzing the main problems of

Review Fibre-optic sensor technologies for humidity and moisture ...

Abstract A review of the use of fibre-optic sensor technologies for humidity sensing is presented. The paper first provides a brief overview on the basic concept of what is meant by

Review of Optical Humidity Sensors

Optical humidity sensors have evolved through decades of research and development, constantly adapting to new demands and challenges. The continuous growth is supported by the

Optical Fiber Sensors and Sensing Networks: Overview of the Main

Optical fiber sensors present several advantages in relation to other types of sensors. These advantages are essentially related to the optical fiber properties, i.e., small, lightweight,

Optical Fiber Temperature Sensors and Their Biomedical Applications

The use of sensors in the real world is on the rise, providing information on medical diagnostics for healthcare and improving quality of life. Optical fiber sensors, as a result of their

A fully distributed fiber optic sensor for simultaneous relative ...

A distributed fiber-optic sensor for simultaneous relative humidity (RH) and temperature measurement is proposed and experimentally demonstrated by means of optical frequency domain

Fiber-optic humidity sensor

Fiber-Optic Humidity Sensors: A Revolution in Environmental Monitoring Introduction Humidity plays a crucial role in various industries,

Optical fiber based on humidity sensor with improved sensitivity for ...

An optical fiber humidity sensor combined with a new type of moisture-sensitive material is proposed and experimentally demonstrated. The structure of the sensor is based on two single-mode

© 2026 CGWEB NETWORK INFRASTRUCTURE - All rights reserved

Measurement of Temperature and Relative Humidity with Polymer Optical ...

This paper presents a system capable of measuring temperature and relative humidity with polymer optical fiber (POF) sensors. The sensors are based on variations of the Young''s and shear moduli of

Related Video Reference

This video was associated with the source search result. Verify technical details against current product documentation and project requirements.

Contact Us

Continue your research online:

Website: https://cgweb.co.za
Technical inquiry: https://cgweb.co.za/project-enquiry.html

This document is for preliminary research. Verify specifications against current standards, product documentation and project requirements.

© 2026 CGWEB NETWORK INFRASTRUCTURE - All rights reserved