

Article Overview

Fiber Bragg Grating (FBG) sensors are optical devices that measure strain, temperature, and other physical parameters by reflecting specific wavelengths of light, offering high sensitivity and immunity to electromagnetic interference.

Operating Principle

FBG sensors are created by inscribing periodic variations in the refractive index along the core of an optical fiber using ultraviolet laser irradiation. This structure acts as a wavelength-specific mirror, reflecting a particular wavelength known as the Bragg wavelength while transmitting other wavelengths. When the fiber experiences strain or temperature changes, the Bragg wavelength shifts proportionally, allowing precise measurement of these parameters. The relationship between the Bragg wavelength, effective refractive index, and grating period enables accurate sensing.

Advantages of FBG Sensors

- o High Sensitivity and Precision: Direct wavelength encoding allows accurate detection of small changes in strain or temperature.
- o Immunity to Electromagnetic Interference: Unlike traditional electrical sensors, FBGs are unaffected by high-voltage or high-frequency environments.
- o Multiplexing Capability: Multiple FBGs can be inscribed along a single fiber using Wavelength Division Multiplexing (WDM) or Time Division Multiplexing (TDM), enabling distributed sensing over long distances.
- o Compact and Lightweight: Ideal for aerospace, robotics, and embedded applications.
- o Durability: Silica-based fibers and protective coatings (acrylate, polyimide, or metallic) allow operation in harsh environments, including extreme temperatures and corrosive conditions.

Applications

FBG sensors are widely used across industries:

- o Structural Health Monitoring (SHM): Bridges, dams, and buildings are monitored for strain and deformation under load.
- o Aerospace and Aviation: Embedded in aircraft components to track stress, vibration, and temperature changes.
- o Industrial and Harsh Environments: Monitoring pipelines, machinery, and chemical processes where electromagnetic interference is significant.
- o Medical Devices: Tactile sensors and smart instruments benefit from compact, precise FBG arrays.

o Environmental Monitoring: Detecting temperature variations, pressure changes, or chemical parameters in remote or challenging locations .

Sensor Design and Implementation

FBG sensors can be single or arrayed, with customizable parameters such as length, bandwidth, and reflectivity . Packaging options include flexible or rigid metallic tubes, enabling integration into composite materials or other complex structures. Advanced FBG systems use fiber-integrated spectrometers for high-performance interrogation, ensuring reliable signal detection even in harsh conditions .

Future Directions

Research continues to improve temperature-strain decoupling, reduce interrogation system costs, and enhance long-term reliability and scalability of FBG-based sensing systems . Innovations in grating inscription, packaging, and multiplexing are expanding the applications of FBG sensors in smart infrastructure, aerospace, and industrial automation.

Abstract: The authors review their recent advances in the development of optical fiber Bragg grating (FBG) sensor technologies.

Additionally, this review compares FBG sensors with other sensing technologies and

FiSens develops, manufactures, and markets accurate fiberoptic sensor solutions based on fiber Bragg

FBG sensors have been explored for a wide variety of applications and in particular they have found important applications in strain

Fiber Bragg grating (FBG) array is a powerful technique for quasi-distributed sensing along the entire length of

A fiber-optic sensor is a sensor that uses optical fiber either as the sensing element ("intrinsic sensors"), or as a means of relaying

Violakis et al. (contribution 2) explored the use of optical-fiber-based acoustic emission (AE) detection sensors,

This paper presents a review of the recent trends and the current state of the art in the application of fiber optic fiber

This review paper aims to give a general understanding of the basic principles of FBG sensors, advances in sensing

What is a FBG sensor? A Fiber Bragg Grating (FBG) sensor is an optical device inscribed in a fiber using a

Similarly, for FBG-based strain sensors, both uniform and non-uniform strain are considered and discussed in brief.

2. Theory and models of FBG Fiber Bragg Grating (FBG) technology is one of the most popular choices for optical fiber sensors for

Fiber Bragg gratings are reflective structures in the core of an optical fiber with a periodic or aperiodic perturbation of the effective

FBG sensors are defined as optical sensors that utilize Fibre Bragg gratings to measure various physical parameters, offering

Evaluation of compatibility and co-operation on fiber-optic FBG sensor and single channel 10 Gbit/s NRZ-OOK

The inscription of gratings in optical fibres to form a Fiber Bragg grating (FBG) creates a characteristic reflection

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