Customization Process for Bestselling Fiber Bragg Gratings in Oil and Petrochemical Industries



Overview

Take advantages of Exail''s expertise in the manufacturing of speciality optical fibers and Fiber Bragg Gratings (FBG) to develop your customized solution.

Key Takeaways

Custom FBGs for oil and petrochemical applications are tailored through material selection, laser inscription techniques, polymer encapsulation, and integration with transducers to withstand extreme temperatures, pressures, and corrosive environments.

Key Customization Considerations

Environmental Resistance: FBGs used in oil and petrochemical industries must endure high temperatures (up to 400°C or more), high pressures (up to 100 MPa), and corrosive or flammable environments.

FB

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Gs are often inscribed using femtosecond laser side-illumination, which allows the gratings to withstand temperatures up to 1100°C and maintain stability under harsh conditions. Electromagnetic and Chemical Safety: Optical fiber sensors are intrinsically safe in explosive environments and immune to electromagnetic interference (EMI), making them ideal for offshore platforms, oilfields, and petrochemical plants. Encapsulation in polymers such as butyl synthetic rubber can enhance chemical resistance and enable oil spill detection by monitoring wavelength shifts caused by polymer expansion.

Mechanical Integration: FBGs are often combined with metal or mechanical transducers to enhance amplitude and frequency response for seismic or pressure measurements. This integration allows precise monitoring of temperature, pressure, strain, and acoustic waves in well-logging and pipeline applications.

Manufacturing and Inscription Techniques

Femtosecond Point-by-

Point Writing: This method focuses a laser into the fiber core to induce localized refractive index changes, creating type II gratings that are highly temperature-resistant and mechanically robust. It works through various fiber coatings without stripping or recoating, preserving tensile strength. Draw Tower Gratings: In this process, the fiber is drawn while a UV interference pattern writes the grating.

This allows precise positioning of gratings along the fiber and is suitable for large-scale production.

Direct-

Write Methods: Laboratory-scale direct-write techniques allow custom wavelength selection and small-batch fabrication, useful for research or specialized oilfield applications. Recoating Options: Custom FBGs can be recoated with low-index or high-index polymers, or specialized coatings for pump guidance and high-power handling, depending on the application requirements.

Application-

Specific Customization

Pipeline Monitoring: FBGs embedded in steel pipes or polymer coatings can detect temperature, strain, and leaks in real-time over long distances. Well Logging: FBGs integrated with transducers measure pressure, temperature, and acoustic signals in deep wells, providing high-resolution seismic data. Oil Spill Detection: Polymer-encapsulated FBGs expand in contact with petroleum, causing measurable wavelength shifts for early leak detection.

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Summary

The customization of FBGs for oil and petrochemical industries involves a multi-step process: selecting appropriate fiber and coating materials, choosing a laser inscription method (femtosecond, draw tower, or direct-write), integrating with mechanical or polymer transducers, and tailoring the grating for specific environmental and operational conditions. These steps ensure high sensitivity, durability, and safety in extreme industrial environments, making FBGs a reliable alternative to traditional electrical sensors.

Article Content

Custom FBG | Exail

Take advantages of Exail''s expertise in the manufacturing of speciality optical fibers and Fiber Bragg Gratings (FBG) to develop your customized solution. Exail offers custom FBGs on a complete range

FBG Manufacturing Process

This technology makes it possible to write Fiber Bragg Gratings in almost any type of optically transparent material and through a variety of fiber coatings such as acrylate, polyimide or carbon.

Fiber Bragg Gratings — Sol Photonics

Fiber Bragg manufacturing with the NORIA offers both speed and flexibility in writing a large variety of grating types. The fast writing process provides the ability to

Fiber Bragg Gratings Laser Workstation | SPD Laser

FemtoFBG is a laser micromachining workstation optimized for fiber Bragg gratings (FBG) writing. It is a perfect choice for scientific laboratories, R&D centers, and industrial clients working with fiber lasers,

Fiber Bragg Grating Sensors for the Oil Industry

In this paper we review our group''s research into fiber Bragg gratings (FBGs) and their applications in the oil industry, especially in the well-logging field.

Enhanced pressure sensitivity of side-hole fiber bragg grating sensor ...

The fiber Bragg grating is inscribed in the core of the side hole fiber to measure temperature and pressure. The sensitization structure is similar to the double-hole structure of the

Review of Femtosecond-Laser-Inscribed Fiber Bragg Gratings

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In this review, we present the historical developments and recent advances in the fabrication technologies and sensing applications of femtosecond-laser-inscribed FBGs. Firstly, the

Fully automatic fabrication of fibre Bragg gratings using an AI-powered ...

In this study, we present an AI- powered FLI system that enables automated, stable, and efficient FBG fabrication. By integrating a Multi-Layer Perceptron (MLP) model for real-time fabrication position

Fiber Bragg Gratings-Ideal-Photonics Inc

There are two main general manufacturing methods for FBG. We manufacture by our own optics. Phase Mask: In the phase mask method, the light incident on the phase mask is diffracted and the

Fiber Optic FBG Fiber Bragg Grating Sensing Solutions | AtGrating

AtGrating is a professional company for optical fiber sensing. AtGrating offers industrial solutions by providing customized sensors and sensing instruments that add value, reduce uncertainty, and

(PDF) Fiber Bragg Grating Sensors for the Oil Industry

Review Fiber Bragg Grating Sensors for the Oil Industry Xueguang Qiao *, Zhihua Shao, Weijia Bao and Qiangzhou Rong * School of Physics, Northwest University, No.229, T aibai Road,

Functional Coatings for Fiber Bragg Gratings: A Critical Review of ...

Fiber Bragg Grating (FBG) sensors facilitate compact, multiplexed, and electromagnetic interference-immune monitoring in embedded and harsh environments. The removal of the polymer

Fiber Bragg Gratings

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

Fiber Bragg Grating Sensors for the Oil Industry

With the oil and gas industry growing rapidly, increasing the yield and profit require advances in technology for cost-effective production in key areas of reservoir exploration and in oil

Fiber Bragg Gratings: Theory, Fabrication, and Applications

This paper discusses the evolution and significance of Fiber Bragg Gratings (FBGs) in optical fiber technology, detailing their theoretical foundations, fabrication techniques, and diverse applications. It

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Fiber Bragg Gratings: Fundamentals, Materials and Applications

Ever since their first observation, Fiber Bragg Gratings (FBG) have become a technically-mature technology in both optical communication and sensing. However, continuous research is ongoing to

Fabrication and Applications of Fiber Bragg Grating

Abstract: In this paper, the brief introduction of Fiber Bragg Grating, its significant applications, sensing principles, properties, fabrication and the basic designing of FBG have been discussed. FBG''s are

Fiber Bragg grating

A fiber Bragg grating (FBG) is a type of distributed Bragg reflector constructed in a short segment of optical fiber that reflects particular wavelengths of light and transmits all others.

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