Dual-core fiber optic sensor



Overview

Analysis and fabrication of dual-core tapered fiber for high. In this paper, we provide a theoretical analysis of dual-core fiber sensors for high-sensit.

Key Takeaways

Two-core fiber optic sensors are compact, high-sensitivity devices that use dual-core fibers to measure parameters such as refractive index, torsion angle, and torsion direction.

Overview and Design

A two-core fiber (TCF) consists of two optical cores within a single fiber structure, allowing light to propagate independently in each core while enabling controlled mode coupling between them when the cores are closely spaced. These fibers can be fabricated using all-glass preforms or photonic crystal fiber technology, and they can be twisted or tapered to enhance sensitivity for specific applications. Each core can act as a separate waveguide, and the interaction between cores can be exploited for sensing.

Working PrinciplesTwo-core fiber sensors often employ interferometric techniques, such as the Mach–Zehnder interferometer (MZI), where light from a source is split into the two cores and recombined to produce interference patterns. Changes in the environment, such as refractive index variations, torsion, or temperature, alter the phase difference between the cores, which shifts the interference fringes and allows precise measurement. Refractive Index SensingTwo-core fibers can be used to measure the refractive index (RI) of liquids with high sensitivity.

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Experiments have demonstrated sensitivities up to 3,119 nm per Refractive Index Unit (RIU), with potential enhancement to 3,485. 67 nm/RIU for RI ranges from 1. 3160 to 1.

3943. Such sensors are suitable for applications in food quality control, environmental monitoring, and chemical analysis. Torsion SensingTwo-core fibers can also function as torsion sensors.

By pre-twisting a short segment of TCF to form a helical structure, the sensor can measure both torsion angle and direction. Maximum sensitivity is achieved at a pre-twist angle of 180°, with wavelength sensitivities of 0. 242 nm/(rad/m) for torsion and 32 pm/°C for temperature.

These sensors are compact, low-cost, and immune to electromagnetic interference, making them suitable for aerospace, geological monitoring, and robotics.

Advantages

High sensitivity for refractive index and torsion measurementsCompact and simple architectureLow cost and easy fabricationImmunity to electromagnetic interferenceVersatility for chemical, biological, and industrial applications ApplicationsRefractive index measurement in liquids and mixturesSalinity detection in water solutionsQuality control in food and beverage industriesTorsion monitoring in mechanical and robotic systemsBiomedical and environmental sensing Two-core fiber optic sensors represent a versatile and high-performance sensing platform, combining the advantages of multi-core fiber technology with interferometric measurement techniques to achieve precise, real-time monitoring in diverse scientific and industrial fields.

Article Content

Analysis and fabrication of dual-core tapered fiber for high ...

In this paper, we provide a theoretical analysis of dual-core fiber sensors for high-sensitivity and high-accuracy measurement, which mainly focuses on the effects of the geometric

D-shaped dual-core photonic crystal fiber sensor: Enhanced sensitivity ...

In this paper, we design and simulate a RI sensor that includes a dual-core SPR-based PCF. The sensor structure is made of metal and graphene interfaces with dielectrics, including air,

An SPR-MZ Interference-Based Fiber-Optic Sensor for Dual

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This study introduces a novel single-hole, dual-core suspended fiber optic sensor that integrates the surface plasmon resonance (SPR) effect and the Mach-Zehnder interference (MZI)

Ultra-sensitive graphene–gold hybrid dual core photonic crystal fiber ...

The proposed design points out the excellent sensing feature for precise, immediate and reliable detection of disease diagnostics and other biomedical sensing applications.

Cascaded MZI and FPI Sensor for Simultaneous

In this paper, we propose and experimentally demonstrate a dual-parameter fiber optic sensor, which combines a Fabry–Perot interferometer (FPI)

Multi-core Fibers – dual core, twisted, space division

Beyond telecom, multi-core fibers are used in fiber-optic sensors, where coupling between cores is sensitive to strain or temperature. They are also used in high

Temperature self-compensated dual core fiber-optic sensor integrated ...

In this paper, a dual-core fiber optic sensor has been proposed for dynamic monitoring of temperature and humidity. The side core is polished into a D-type optical fiber, and a layer of nano-silver film and

Dual-Channel SPR Sensor Based on an Elliptical-Core

We first demonstrate a subwavelength SPR sensor employing single-mode fiber and photonic crystal fiber, each showing several-fold improvement in performance.

Refractive Index and Temperature Dual-Parameter Sensor with

To overcome the limitations in detection sensitivity associated with conventional single-layer membrane optical fiber sensors, we proposed a novel approach that integrates CeF 3 into a

Fiber optic temperature and salinity sensor with single hole twin ...

This paper introduces an innovative fiber optic sensor capable of simultaneously measuring seawater temperature and salinity using the dual surface plasmon resonance (SPR)

Dual-Aperture Dual-Core Photonic Crystal Fiber Sensor

Surface plasmon resonance sensing, which is based on photonic crystal fiber sensing technology, has a broad spectrum of applications in the

D-shaped dual-core photonic crystal fiber sensor: Enhanced sensitivity ...

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Abstract We present a novel real-time dual-core D-shaped photonic crystal fiber sensor. Our photonic crystal fiber is made of lossy media, including metal and graphene, interfaces with

Smart Sensor Optical Fiber Heat Stripping Tool Drop Resistant

Dual Modes: This ribbon fiber optic thermal stripper has dual modes, with normal mode and power saving mode, which can be selected for efficient and stable hot stripping without hurting the fiber.

A Single-Core Dual-Channel Optical Fiber Sensor Based on ...

Single-core dual-parameter sensors have wide applicability and importance in the fields of environmental monitoring, smart home, and medical health. In this paper, a single-core photonic

Compact omnidirectional multicore fiber-based vector bending sensor ...

The latter is a challenging feature as, usually, optical fiber-based bending sensors are only sensitive to few directions, which restricts their functionality.

Analysis and fabrication of dual-core tapered fiber for high ...

Among manifold multi-parameter fiber-optic sensors, dual-core fiber sensors cannot be ignored. By monitoring the wavelength shift of troughs in the transmission spectrum of each

A Dual-Core Two-Parameter of RI and Temperature Photonic Crystal Fiber ...

This paper presents a dual-core two-parameter optical fiber sensor based on the surface plasmonic resonance (SPR) effect. It is analyzed by the finite element method. The proposed sensor

Advances in Multicore Fiber Interferometric Sensors

In this paper, a review of multicore fiber interferometric sensors is given. Due to the specificity of fiber structure, i.e., multiple cores integrated into only one fiber cladding, multicore fiber

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