Fiber Optic Taper Force Sensing

AI Overview

A fiber optic taper (TOF) force sensor is a high-sensitivity device that measures mechanical forces using tapered optical fibers, achieving enhanced precision through structural design and the vernier effect.

Overview and Working Principle

Fiber optic taper (TOF) force sensors utilize tapered optical fibers, where the fiber diameter gradually decreases along a specific length, allowing strong interaction between the guided light and the external environment. This structure enables high sensitivity to mechanical forces, as small deformations in the fiber alter the light propagation characteristics, such as intensity, phase, or wavelength. The vernier effect can be applied by cascading multiple tapered fibers, significantly amplifying the sensor's response to applied forces, achieving sensitivities up to 10.11 nm/N .

Fabrication and Structure

TOF sensors are typically fabricated by heating and stretching optical fibers to form a tapered region, with lengths ranging from tens to hundreds of millimeters depending on the application. The tapering process can be combined with metal coatings or fiber gratings to further enhance sensitivity and selectivity. Common structures include Fiber Bragg Gratings (FBG), long-period fiber gratings (LPFGs), and photonic crystal fibers (PCFs), each offering unique advantages for force, pressure, or displacement measurements .

Performance Characteristics

• High Sensitivity: Cascaded TOF sensors can achieve sensitivities exceeding 10 nm/N, suitable for detecting minute forces.

Article Content

Fiber-based sensors

This is an active field of research Fiber taper sensors Fiber taper pulling setup Transmission oscillation observed

Optical fibre taper-enabled waveguide photoactuators

To overcome these challenges, authors propose an optical fibre taper-enabled waveguide photoactuator and show

Comprehensive Review Tapered Optical Fiber Configurations for

We evaluated many issues to make an informed judgement about the viability of employing the best of these methods

Optical fiber membrane-based Fabry–Perot tactile force sensing

This study introduces an optical fiber tactile force sensing platform powered by ambient LED lighting. Based on the

Application of fused tapering optical fiber coupler in mode selective ...

Silica-based optical fibers are primarily used for fabricating fused tapering fiber couplers, while novel materials like

Fiber Optic Sensors in Tactile Sensing: A Review

This article reviews the progress of research on fiber optic tactile sensing technology in recent years, including those based on fiber

The Structure and Applications of Fused Tapered Fiber Optic

This paper provides a comprehensive review of tapered optical fiber sensing technology, starting from the principles

Transmission properties of tapered optical fibres: Simulations and ...

We simulated the transmission of the tapered fibres and found reasonable agreement with the measured graded-index

Ultra-compact fiber tapering: plasmonics and structural ...

The evanescent field geometry of these micro- and nano-tapered fibers, together with their straightforward coupling to

The Structure and Applications of Fused Tapered Fiber Optic Sensing

The structure and performance of tapered optical fiber sensors are closely related, with subtle changes in structure having a

High-Sensitivity Fiber-Optic Tactile Force Sensor Based on Tapered ...

To address the environmental disturbance susceptibility of traditional optical fiber force sensors, we propose a cascaded sensitivity

The Structure and Applications of Fused Tapered Fiber Optic Sensing

Tapered optical fibers have continuously evolved in areas such as distributed sensing and laser generation in recent

Recent Applications of Tapered Multicore Fiber in Optical Sensing: A ...

This review presents the current applications of tapered multicore fiber (TMCF)-based optical sensors in single- and multiparameter

Tapered optical fiber geometries and sensing applications based on

Abstract In this review paper, we systematically summarize the various tapered optical fiber geometries and their

An optical fiber strain sensor by using of taper based TCF structure ...

We propose an optical fiber strain sensor consisting of a spliced twin-core fiber (TCF). The sensor structure has two

High-sensitivity force measurement using optical tapered fiber with ...

Abstract Optical fiber taper is proposed to be a high-sensitivity force sensor by using high-resolution, high-sensitivity

A nanonewton force sensor using a U-shape tapered microfiber ...

The U-shape tapered microfiber interferometer can detect contact force as low as ~5.4 nN, which is one of the lowest

Taper Fiber-Based SPR Sensor | Springer Nature Link

Taper fiber sensors can be fabricated by gradually tapering the waist from its maximum diameter to a minimum

Tapered optical fiber for Micro-Newton force sensor

Fiber Bragg gratings inscribed in the waist of tapered photosensitive fibers offer specific attractive properties for

Fiber-Optic Inclinometer Based on Taper Michelson Interferometer

Abstract: A compact fiber-optic inclinometer based on a fiber-taper Michelson interferometric sensor is constructed and

Thermal and mechanical properties of tapered single mode fiber

In this report, we represent our study on fiber taper''s thermal and mechanical properties by using an OFDR scheme, and a highly

Fiber-Optic Force Sensor based on Cascaded Fiber Tapers and

Abstract: This study presents an enhanced fiber-optic force sensor based on optical Vernier effect (OVE) via two cascaded tapers

Taper Fiber-Based SPR Sensor | Springer Nature Link

In this chapter, the taper fiber optic sensor is discussed in terms of geometrical optics theory. Simulation results must

In-Line Gas Sensor Based on the Optical Fiber Taper Technology

This article investigates the possibilities of gas detection using a tapered optical fiber coated with a graphene oxide

Highly sensitive fiber force sensor based on cascaded Fabry-Perot ...

In this article, we introduce a new concept for an in-line optical fiber force sensor probe, which is based on two

(PDF) Tapered optical fibres for sensing

Recently, optical fibre tapers have intensively been investigated for many applications e.g. in telecommunications,

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