

Magnetic Ring Fiber Optic Sensor



Article Overview

A magnetic ring fiber optic sensor detects magnetic fields by combining a ring-shaped optical fiber with a magnetic fluid, where changes in the magnetic field alter the optical properties of the fiber, enabling high-sensitivity measurement.

Structure and Working Mechanism

The sensor consists of a ring-shaped optical fiber, typically fabricated by bending a single-mode fiber (SMF) into a loop. This ring shape induces stress-optic effects, which modify the refractive index distribution across the fiber cross-section. The inner part of the bent fiber experiences a decrease in refractive index, while the outer part increases, affecting the propagation of guided light modes along the fiber. The fiber is coated with a nanostructured magnetic fluid (MF). The magnetic fluid exhibits magneto-optical properties, meaning its optical characteristics, such as refractive index and light absorption, change in response to an external magnetic field. When a magnetic field is applied, the nanostructure of the fluid aligns or reorients, producing magneto-tropic anisotropy, which modulates the intensity and orientation of light traveling through the fiber.

Sensing Principle

The sensor operates on intensity demodulation. As the magnetic field varies, the interaction between the guided light in the ring fiber and the magnetic fluid causes measurable changes in light intensity. These changes are detected and correlated with the magnitude and direction of the magnetic field, allowing the sensor to perform 2D vector magnetic sensing. The ring-shaped fiber enhances the evanesce...

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Fiber-optic sensor

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In this paper, two optical fiber magnetic field sensors based on iron-based amorphous

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FIBER OPTIC MAGNETIC SENSORS

This chapter discusses the theory and operation of fiber optic magnetic sensors, including magnetostriction-based

Contact Us

For more information, pricing, or custom solutions, please contact us:

Website: <https://www.chromadecksigns-eastrand.co.za>

Email: sales@chromadecksigns-eastrand.co.za

Phone: +32 2 318 5792

Address: Avenue Louise 500, 1050 Brussels, Belgium

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