

Indian U-shaped fiber optic sensor



Overview

Trends and Applications of U-Shaped Fiber Optic Sensors: A Review
Intrinsic U-shaped fiber optic sensors (FOSs) are well established in the field. With grea.

Key Takeaways

U-shaped fiber optic sensors (U-FOS) in India are being developed for high-sensitivity refractive index and chemical sensing, with research and commercial platforms available from institutions like IIT Madras and multiple Indian suppliers. Research and Development in India

Indian researchers, particularly at IIT Madras, have developed handheld refractometers using U-shaped optical fibers as sensing elements. These sensors operate on the principle of refractive losses, where the U-bent region of the fiber interacts with the surrounding medium to detect changes in refractive index (RI). The U-region can be chemically etched to create a tapered geometry, which doubles the sensitivity compared to unetched fibers. These sensors have been successfully tested for liquids such as glycerol, sulphuric acid, ethylene glycol, and ethanol, covering RI ranges from 1.333 to 1.40. The research also explores future enhancements using plasmonic nanoparticles or graphene coatings to further improve sensitivity .

Fabrication Techniques

Traditionally, U-FOS probes were fabricated manually using a butane flame to bend silica fibers, which often led to high variability and rejection rates. To address this, an automated fiber bending machine (FBM) has been developed, using a CO₂ laser to precisely heat the fiber and an articulating arm to bend it at the glass transition temperature (~1200°C). This method allows production of 60–80 probes per hour with minimal geometric deviations and bend diameters as small as 0.55 mm, improving reproducibility and performance .

Applications

U-shaped fiber optic sensors in India are applied in:

- Chemical and biosensing: Detecting concentrations of acids, solvents, and biological samples.
- Food and pharmaceutical testing: Measuring purity in honey, milk, fruit juices, and other liquids.
- Environmental monitoring: Detecting pollutants or changes in water quality.
- Compact refractometers: Pen-type or handheld devices for field measurements .

Commercial Availability

Several Indian suppliers provide fiber optic sensors, including U-shaped variants, for industrial and laboratory use. Notable suppliers include Close Contact, Navitek Automation, Krishna Machinery Tools, Binex Controls, and Electro Automation Industries, offering sensors with competitive pricing and bulk order support. These sensors are available in both plastic and glass fibers, with glass fibers preferred for high chemical and thermal stability, and plastic fibers for flexibility and small bending radii .

Advantages of U-Shaped Fiber Optic Sensors

- High sensitivity due to enhanced light interaction in the U-bent region.
- Compact and portable designs suitable for handheld devices.
- Versatility in detecting a wide range of liquids and chemicals.
- Scalability through automated fabrication methods, ensuring reproducibility and low rejection rates.
- Material flexibility: Silica fibers for stability and broad wavelength operation; plastic fibers for flexibility and dynamic applications . In summary, India has a growing ecosystem for U-shaped fiber optic sensor platforms, combining advanced research at institutions like IIT Madras with commercial suppliers capable of providing high-quality sensors for chemical, biological, and environmental applications.

Article Content

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