# Helica™ Sensors

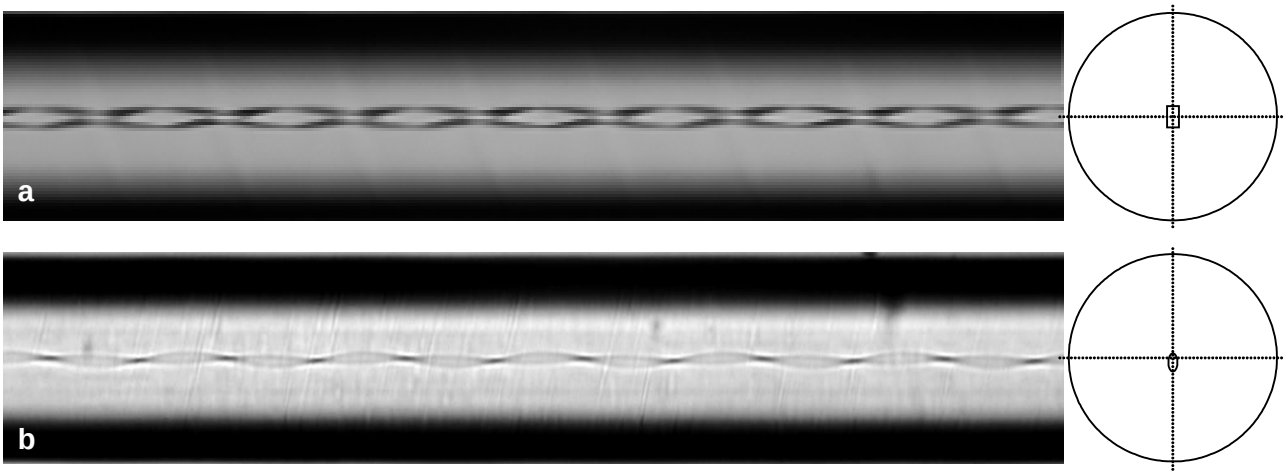
Helica™ Sensors, fabricated from chiral long period gratings, can be used to optically sense environmental factors, such as chemical composition, temperature, and pressure.

Chiral gratings are structurally formed into fiber. As such, Helica™ Sensors do not require the use of photosensitive fibers or rely on applying or relieving stress in the fiber. As a result, they are highly stable at high temperature and in other environmental conditions that can cause conventional long period gratings to degrade. Since photosensitive fibers are not needed, Helica™ Sensors can also be fabricated from refractory or radiation resistive glasses, according to the application. Such sensors can be used to *probe harsh environments* with high levels of radiation, high temperature, or corrosive chemicals such as might exist in nuclear power plants or in bore holes in oil fields and in deep mines.

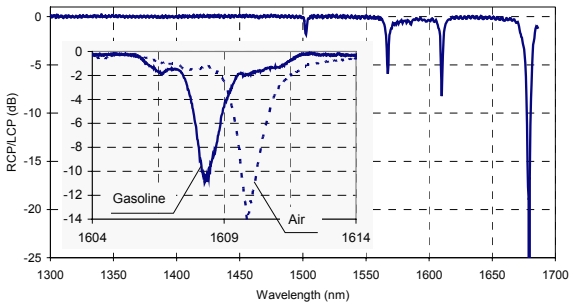
Helica™ Sensors come in two varieties: single helix or double helix, as shown below. In both, the optical fiber's refractive index is modulated by twisting a fiber with noncircular or nonconcentric cross section as it is passed through a miniature oven to produce the highly stable grating. A concentric core is used to produce a double helix structure and a non-concentric core is used to produce a single helix structure. While the double helix structures are polarization sensitive, single helix structures are polarization insensitive. The second polarization in double helix Helica™ Sensors can be used for added sensing channels, or as a reference channel. Both Helica™ Sensor types can be used for a myriad of sensor applications.

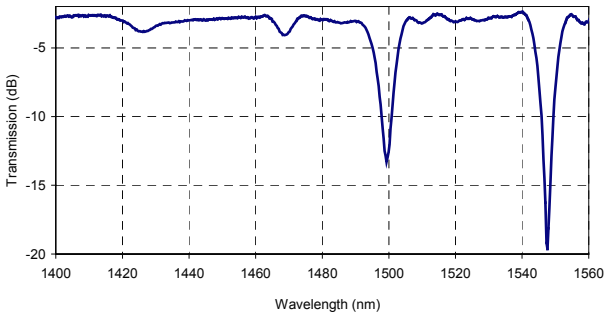
## Applications:

- Environmental sensing
- Strain / pressure sensing
- Temperature sensing
- Liquid level sensing
- Axial twist / torque sensing
- R&D




Side and face images of double (a) and single (b) helix gratings.




Above, left, is an exemplary double helix Helica™ Sensor spectrum which illustrates the sensitivity to the handedness of light. In this example, the Helica™ Sensor is right handed and interacts only with right circularly polarized light. The inset shows the shift of a transmission dip when the fiber is surrounded by gasoline.

Single helix Helica™ Sensors are polarization insensitive, as shown above on the right, and their spectra are similar to conventional long period gratings. The primary differences between single and double helix CLPGs are given in the table below.

| | Polarization insensitivity | Multiplexing using orthogonal polarizations | Fabricated in low NA fibers | Easily coupled to standard fiber | Ultra-narrow transmission dips (< 2 nm) | Sensitivity to temperature, strain, and twist |
|---|---|---|---|---|---|---|
| **Single Helix** | Yes | No | Yes | Yes | No | Yes |
| **Double Helix** | No | Yes | No | No | Yes | Yes |

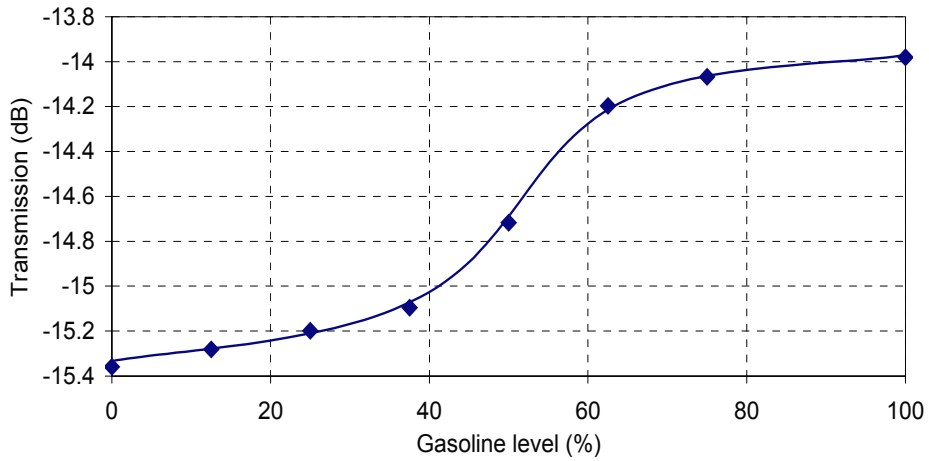
## Unique Helica™ Sensor features:

- Flexible, continuous manufacturing process
- UV irradiation of photosensitive glass not required
- Suitable for harsh environments
- Second polarization may be used for normalization or second channel
- Narrow dip enables high sensitivity

A wide variety of sensors as well as input and output fibers are available to meet your needs. The wavelength of the dips can be tailored to suit the application. Please call Chiral Photonics, Inc. to discuss your specific requirements and receive a prompt quotation.

# Exemplary Helica™ Sensor Data

Performance of a fuel level sensor based on a double helix Helica™ Sensor is shown below.




The dip wavelength in transmission of a single helix Helica™ Sensor is shown below left as a function of temperature. On the right is the dip position of a single helix CLPG as it was cycled continuously for 24 hours around 400 °C after being annealed at 800 °C for 2 hours.