High-Temperature Optical Sensor

The technology significantly extends applicability of optical sensors to high-temperature environments.

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A high-temperature optical sensor (see Figure 1) has been developed that can operate at temperatures up to 1,000 °C. The sensor development process consists of two parts: packaging of a fiber Bragg grating into a housing that allows a more sturdy thermally stable device, and a technological process to which the device is subjected to in order to meet environmental requirements of several hundred °C.

This technology uses a newly discovered phenomenon of the formation of thermally stable secondary Bragg gratings in communication-grade fibers at high temperatures to construct robust, optical, high-temperature sensors. Testing and performance evaluation (see Figure 2) of packaged sensors demonstrated operability of the devices at 1,000 °C for several hundred hours, and during numerous thermal cycling from 400 to 800 °C with different heating rates.

The technology significantly extends applicability of optical sensors to high-temperature environments including ground testing of engines, flight propulsion control, thermal protection monitoring of launch vehicles, etc. It may also find applications in such non-aerospace arenas as monitoring of nuclear reactors, furnaces, chemical processes, and other high-temperature environments where other measurement techniques are either unreliable, dangerous, undesirable, or unavailable.

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Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Innovative Partnerships Office, Attn: Steve Fedor, Mail Stop 4–8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-18373-1.

Figure 1. A Probe packaged and connectorized with a fiber Bragg grating (FBG) inside. The FBG is located at the end of the probe inside a smaller-diameter ceramic tube.

Figure 2. Performance Characteristics: (a) Wavelength stability of a sensor exposed to 1,000 °C for 500 hours and (b) wavelength readings as a function of temperature during thermal cycling from 400 to 800 °C.