predictions can be verified through testing on Earth, and the results can be extrapolated to low-gravity liquid configurations using simulations of liquid configurations that would be likely to occur in low gravity. Such liquid configurations can also be solved using other computer software tools such as the Surface Evolver code. RF computer simulations are routinely used in the RF and communications industry to design or predict performance of RF devices. The same software tools can be used to calculate the electromagnetic eigenmodes of large tanks with a two-phase fluid distribution. By having a pre-built library of tank eigenmode simulations, the measured tank eigenmode spectra can be compared with the library of spectra to determine the unknown amount of propellant in the tank.

This work was led by Gregory A. Zimmerli, David A. Buchanan, Jeffrey C. Follo, Karl R. Vaden, and James D. Wagner of Glenn Research Center; Marius Asipauskas of National Center for Space Exploration Research; and Michael D. Herlacher of Analex Corp. Further information is contained in a TSP (see page 1).

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.

High-Temperature Optical Sensor

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

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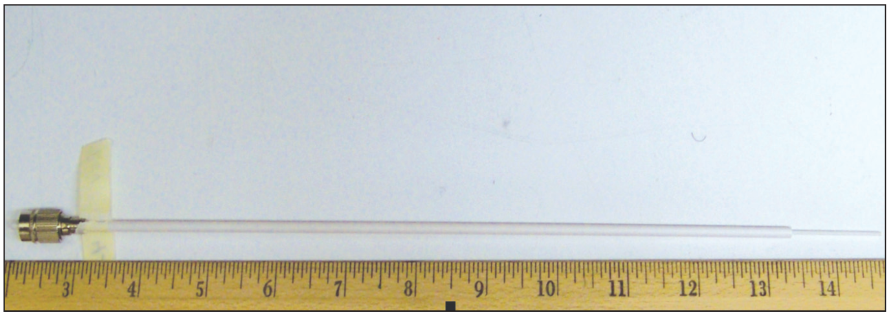

Figure 1. A **Probe** packaged and connectorized with a fiber Bragg grating (FBG) inside. The FBG is located at the end of the probe inside a smaller-diameter ceramic tube.

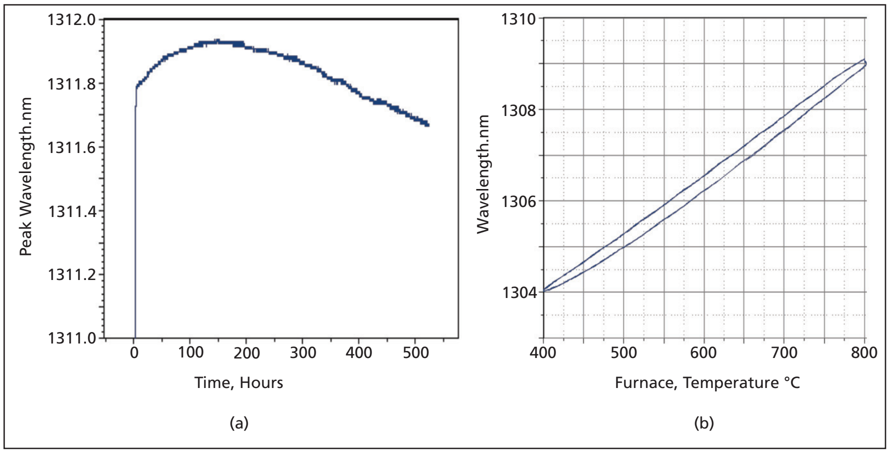

Figure 2. **Performance Characteristics**: (a) Wavelength stability of a sensor exposed to 1,000 °C for 500 hours and (b) wavelength readings as a function of temperature during thermal cycling from 400 to 800 °C.

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.

This work was done by Grigory Adamovsky, Jeffrey R. Juergens, and Donald J. Varga of Glenn Research Center and Bertram M. Floyd of Sierra Lobo, Inc. Further information is contained in a TSP (see page 1).

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-18381-1.