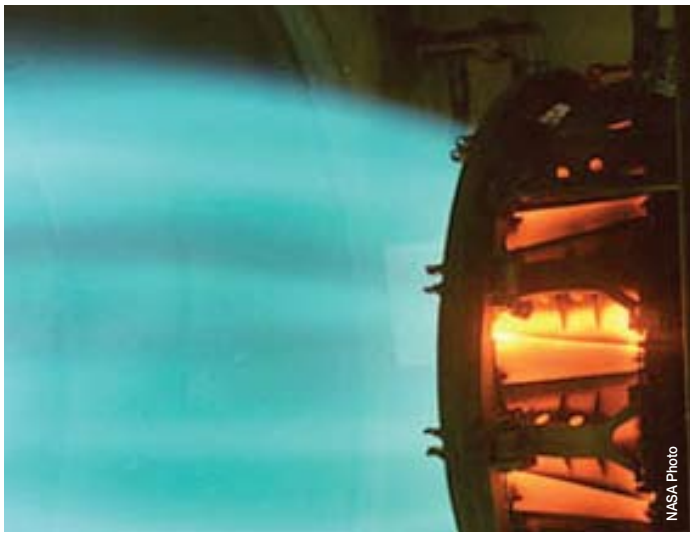
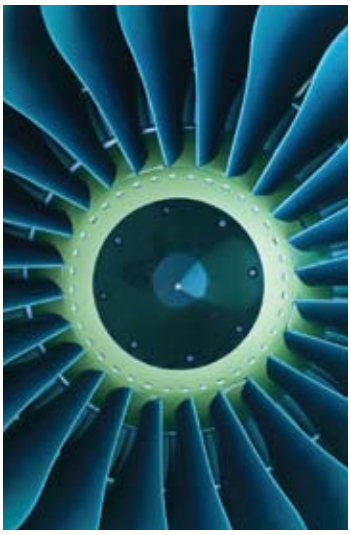
National Aeronautics and Space Administration

technology opportunity

Temperature Probe for Measuring Up to 2400°C

Using multiwavelength pyrometry to gauge temperature in aerospace and commercial applications





Temperature probe assembly showing the high-temperature ceramic sheath inserted into the metal support section

Innovators at NASA's Glenn Research Center have developed a temperature probe that uses multiwavelength pyrometry to measure very high temperatures, from approximately 800°C up to 2400°C. The probe consists of a high-temperature ceramic sheath partially inserted into a high-temperature metal support section and an optical fiber inside the sheath/support assembly. The fiber is located at the cool end of the probe, so a high-temperature fiber is not necessary. Glenn's innovation can be used to measure gas temperatures inside jet engine combustors, gas turbine engines, and industrial furnaces and offers many advantages over conventional thermocouple-based designs.

Benefits

- **Robust:** Operates at high temperatures and in oxidizing environments
- **Durable:** Offers extended lifetime over thermocouple-based designs
- **Reliable:** Functions even in the presence of electromagnetic interference

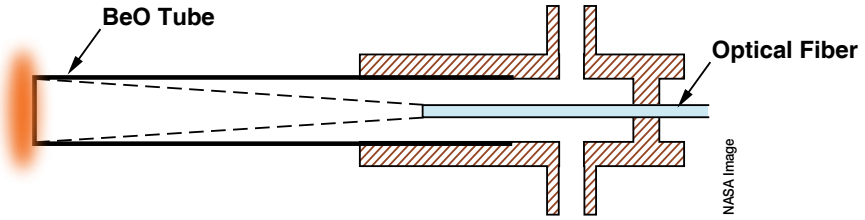
Applications

- Jet engine combustors
- Gas turbine engines
- Industrial vacuum furnaces
- Gas-fired furnaces

Technology Details

How It Works

Innovators at Glenn designed a beryllia (BeO) sheath inserted into an Inconel® support section. BeO was chosen as the sheath material because of its excellent high-temperature properties and resistance to thermal shock; however, depending on the application, other high-temperature materials could be used. The length of the ceramic sheath and metal support for a specific probe also could be modified to fit the dimensions of an intended application.



The above schematic shows the configuration of the probe technology, which features a ceramic temperature probe sheath and support assembly.

To obtain a temperature measurement, the ceramic portion of the probe is inserted into the hot area of interest. The sheath acts as a black body, and because of the high thermal conductivity of BeO, the inside and outside sheath temperatures are nearly the same. Multiwavelength pyrometry is an effective way to capture the temperature of interest because the emissivity is measured as well as the temperature. The black body signal is then transmitted from the probe to a spectrometer via the optical fiber, which is focused on the end of the sheath.

Why It Is Better

Conventional thermocouple-based designs cannot survive in high temperatures and oxidizing environments without an auxiliary cooling system and inert gas protection. The upper limit of this instrument is the same as the upper limit of the BeO sheath, which is about 2400°C in oxidizing environments. This ability to withstand high temperatures and oxidizing atmospheres translates into extended instrument lifetime even when operating in less severe conditions. Glenn's probe also has an advantage over thermocouple-based designs in that it is not affected by electromagnetic interference, which makes it more accurate and easy to use.

Patents

Glenn has secured patent protection for its Emissivity Independent and Calibration Free Multiwavelength Pyrometer technology: U.S. Patent No. 5,690,429.

Licensing and Partnering Opportunities

This technology is part of NASA's Innovative Partnerships Program, which seeks to transfer technology into and out of NASA to benefit the space program and U.S. industry. NASA invites companies to inquire about the licensing possibilities for this high-temperature probe (LEW-15793-1) for commercial applications.

For More Information

For information about this and other technology licensing opportunities, please visit:

Technology Transfer and Partnership Office
NASA's Glenn Research Center
E-mail: ttp@grc.nasa.gov
Phone: 216-433-3484
http://technology.grc.nasa.gov

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