PROJECT facts

U.S. Department of Energy
Office of Fossil Energy
National Energy Technology Laboratory

Advanced Research

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Ultra High Temperature Sensors Based on Optical Property Modulation

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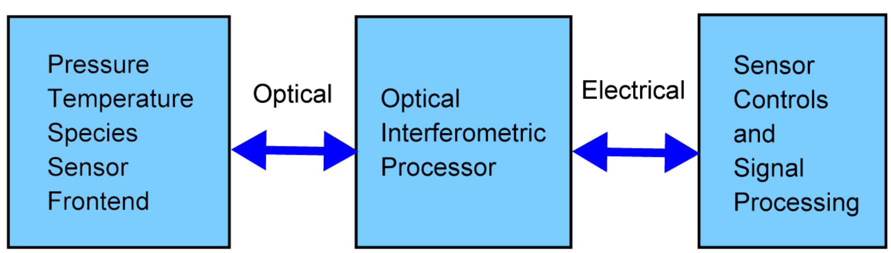
Description

Nuonics, Inc. is developing a new class of sensors in collaboration with the School of Optics at the University of Central Florida and AppliCote Associates, LLC, which will be capable of measuring ultra high temperatures (larger than 1000 degrees C), very high pressures (e.g., 70 atm) and combustion species concentrations in fossil fuel applications. The sensors are based on the principle of optical interferometric sensing in a medium. Due to the dependence of the optical property of a high temperature material on the temperature, pressure or species concentration, photonic and electrical signal processing can sense the given physical parameters. Since the optical changes can be very small, a high accuracy optical signal processing scheme will be implemented which will involve high sensitivity interferometry capable of measuring the changes in the light parameters with a subnanoscale accuracy and at a high speed. The sensor concept planned is depicted in the following figure.



Ultra High Temperature Sensor Concept

PARTICIPANT / PRINCIPAL INVESTIGATOR

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PROJECT COST

$950,000

PROJECT DURATION

3 Years

CUSTOMER SERVICE

1-800-553-7681

WEBSITES

www.netl.doe.gov/coal

www.sc.doe.gov

Benefits

Sensors are a critical element in controlling the operation of any engineering system accurately. They play an important role in the development of next generation technology, data acquisition and control systems. Today's sensor technology can be unreliable, inaccurate and costly (e.g., costlier than the controller), and lack fault tolerance or fault detection capabilities. These features lead to expensive system maintainance and repair costs. Various benefits of this project include:

(1) Development of a reliable sensor capable of responding to small changes in the measured variables accurately and rapidly.

(2) Measurement of temperature, pressure and species concentrations using an optical signal instead of an electrical signal. Rapid processing of optical signal will allow time-resolved measurements with nanosecond resolution. Conventional interferometric techniques, such as Fabry-Perot and Mach-Zehnder interferometers, are susceptible to errors because they are very sensitive to mechanical vibration. The sensor of this project will respond to very small (Angstrom level) changes in optical properties, without being sensitive to the vibration of the entire instrument.

(3) Laser-based remote interrogation of the detector will provide a non-intrusive means of measurement and simplify the instrument greatly because there will be no wires connecting the detector to any controller. This will facilitate the use of the proposed sensor in high temperature environments without being concerned about the high temperature integrity of any connecting wires or cooling needs for such wires.