Available for Licensing

NATIONAL ENERGY TECHNOLOGY LABORATORY

EMBEDDED GAS AND TEMPERATURE SENSORS FOR EXTREME ENVIRONMENTS

OPPORTUNITY:

Research is active on optical sensors integrated with advanced sensing materials for high temperature embedded gas sensing applications. A portfolio of patented and patent pending technologies are available for licensing and/or further collaborative research from the U.S. Department of Energy's National Energy Technology Laboratory (NETL). Organizations or individuals with capabilities in optical sensor packaging for harsh environment and high temperature applications are encouraged to contact NETL to explore potential collaborative opportunities.

OVERVIEW:

Innovative process control systems for improved efficiency and lower emissions in current and future fossil fuel-based power systems and related applications requires the development of durable embedded sensor technology that can operate at higher temperatures and in harsh conditions. Currently available sensor technologies have limitations including functional temperature ranges, durability, and cost. There is a clear need for remote gas sensors that are capable of operating at temperatures approaching 1,000° C.

NETL has developed a portfolio of advanced optical sensor materials that address process monitoring in harsh environments and at temperatures approaching 1,000° C. These inventions integrate metal oxide-based functional sensor layers with optical waveguide-based platforms for gas composition analysis and other process variables. The novel materials and simplified fabrication processes are anticipated to provide for embedded sensors demonstrating long-term durability and functionality. processing, and industrial microwave processing.

SIGNIFICANCE:

- A broad portfolio of technologies for high temperature optical gas sensing involving metal oxide-based nanoparticles and films.
- Nanocomposite materials demonstrating stability and durability in corrosive environments at temperatures approaching 900-1,000 °C.
- Materials provide sensing responses across a broad range of wavelengths, which can potentially be used to construct multisensory arrays with enhanced sensing capabilities.
- Technologies allow for embedded optical sensors with remote monitoring capabilities.
- Novel materials that reduce fabrication complexity and cost of sensor devices.

SIGNIFICANCE:

- High temperature gas sensing for process monitoring and control in coal gasification, solid oxide fuel cells, gas turbines, boilers, and oxy-fuel combustion systems.
- Other areas where high temperature gas sensing is required, including nuclear power generation, aerospace, and industrial manufacturing process control.

RELATED PATENTS:

- U.S. Patent No. **8,411,275**, issued April 2, 2013, titled "Nanocomposite Thin Films for High Temperature Optical Gas Sensing of Hydrogen."

  Inventors: Paul R. Ohodnicki, Jr. and Thomas D. Brown.

- U.S. Patent No. **8,638,440**, issued January 24, 2014, titled "Plasmonic Transparent Conducting Metal Oxide Nanoparticles and Nanoparticle Films for Optical Sensing Applications."

  Inventors: Paul R. Ohodnicki, Jr., Congjun Wang, and Mark Andio.

- U.S. Patent No. **8,741,657**, issued June 3, 2014, titled "Nanocomposite Thin Films for Optical Gas Sensing."

  Inventors: Paul R. Ohodnicki, Jr. and Thomas D. Brown.

- U.S. Patent No. **8,836,945**, issued September 16, 2014, titled "Electrically Conducting Metal Oxide Nanoparticles and Films for Optical Sensing Applications."

  Inventors: Paul R. Ohodnicki, Jr., Congjun Wang, and Mark Andio.

- U.S. Patent No. **9,568,377**, issued February 14, 2017, titled "Nanocomposite Thin Films for Optical Temperature Sensing."

  Inventors: Paul R. Ohodnicki, Jr., Thomas D. Brown, Christopher Matranga, and Michael P. Buric.

- U.S. Patent No. **9,019,502**, issued April 28, 2015, titled "Electronically Conductive Perovskite-based Oxide Nanoparticles and Films for Optical Gas Sensing."

  Inventors: Paul R. Ohodnicki and Andrew Shultz.

- U.S. Patent No. **9,964,494** issued on May 8, 2018, titled "Thermally Emissive Materials for Chemical Spectroscopy Analysis."

  Inventors: Paul Ohodnicki, Jr. and Zsolt Poole.

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