

# TECHNOLOGY OPPORTUNITY

## OPTICAL SENSING MATERIALS COMPRISING METAL OXIDE NANOWIRES

### OPPORTUNITY:

The invention consists of the application of metal oxide nanowire-based sensor layers to optical sensing platforms such as optical fiber-based sensor devices. This technology is available for licensing and/or further collaborative research from the U.S. Department of Energy's National Energy Technology Laboratory.

### CHALLENGE:

Thin film and thick film metal oxide based materials are typically employed as the active layer in harsh environment chemical sensing. However, these sensing layers do not have sufficient sensitivity and chemical selectivity in many applications because of their microstructure and the lack of a sufficiently large surface area.

### OVERVIEW:

Metal oxide nanowire based materials have been employed to address these weaknesses. However, nanowire-based metal oxides have only been applied previously to resistive-based and electrical-based sensing platforms that have inherent weaknesses when used in harsh environment and high-temperature sensing applications. These limitations include (1) prohibitive costs of electrical wiring composed of high-temperature metals like platinum, (2) the lack of adequate and cost-effective electrical insulation for temperatures above ~700 °C, (3) high failure rates of electrical contacts in high-temperature environments, and (4) safety concerns associated with electrical wiring and components in flammable gas environments.

NETL researchers have developed methods and systems for applying metal oxide nanowire-based sensor layers to optical sensing platforms such as optical fiber-based sensor devices. By using this approach, many of the stated limitations can be overcome.

### ADVANTAGES:

Metal oxide based nanowire materials have several unique advantages for sensor materials in chemi-resistive sensing applications:

- Large surface area
- Small nanowire diameter
- A variety of functional nanoparticles can be incorporated into the nanowire surface
- Engineering of the microstructure possible

(continued)



**FOR MORE INFORMATION:**

Customer Service:  
**1.800.553.7681**

626 Cochran's Mill Road  
P.O. Box 10940  
Pittsburgh, PA 15236-0940  
412.386.4687

3610 Collins Ferry Road  
P.O. Box 880  
Morgantown, WV 26507-0880  
304.285.4764

1450 Queen Avenue SW  
Albany, OR 97321-2198  
541.967.5892

**APPLICATIONS:**

- Process monitoring and control in power generation systems
- Process and emissions monitoring in automotive, oil and gas, aerospace, aviation and industrial manufacturing applications
- Optical sensor materials

**PATENT STATUS:**

- U.S. Non-Provisional Patent Application No. 16/043,129  
Filed 7/23/2018  
*"Optical Sensing Materials Comprising Metal Oxide Nanowires"*  
Inventors: Paul Ohodnicki (NETL) and Pu-Xian Gao (UCONN)  
Ref No. 15N-21