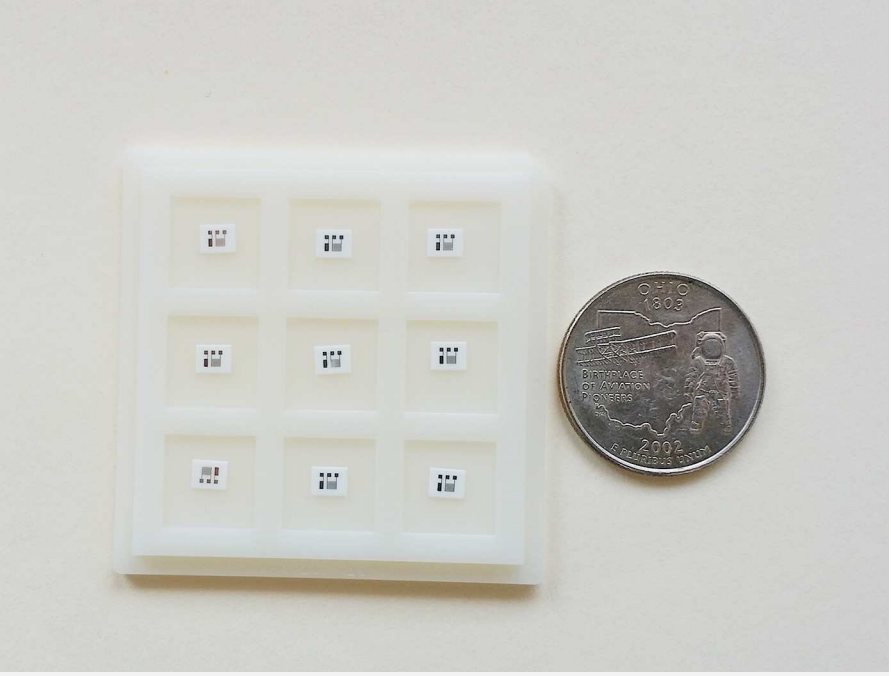



National Aeronautics and Space Administration

Sensors

# Polymer Electrolyte-Based Ambient Temperature Oxygen Microsensor

## Allows fire, fuel-leak, and personal-protection monitoring in a variety of environments

Innovators at NASA's Glenn Research Center have developed an ambient temperature oxygen microsensor that can be used in fuel-leak and fire-detection applications. Because the technology detects oxygen levels from 7-21% in nitrogen, it also enables environmental and personal health monitoring. Many existing ambient temperature oxygen sensors are optically based, hard to miniaturize, and involve large, complicated, and costly instrumentation. By contrast, the Glenn microsensor is small, simple to batch-fabricate, consumes little power, and operates in a wide humidity range. Originally developed for extravehicular activity for monitoring oxygen in spacesuits, Glenn's novel design is based on a Nafion$^{tm}$ polymer electrolyte and manufactured using state-of-the-art thin-film technologies. It combines an innovative use of metal oxide as a reference electrode with a unique sensor design that enables miniaturization and flexibility, for a multitude of personal health monitoring and environmental applications.

## BENEFITS

- Flexible: Employs water-retaining agents to prevent the sensor from losing conductivity in dry environments
- Low-cost: Does not require expensive and complicated instrumentation
- Miniaturized: Uses batch fabrication processes to fabricate sensor electrodes, enabling small sensor size
- Versatile: Enables use of the sensor in potentiometric operation mode to save power
- Efficient: Uses little power and has relatively high sensor yield

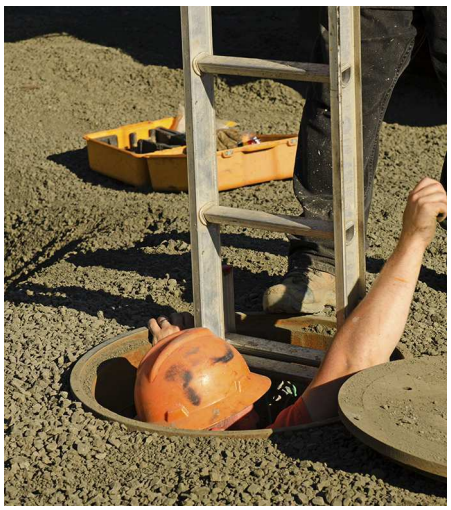
technology solution

## THE TECHNOLOGY

Conventional ambient-temperature oxygen sensors are limited in various ways: optically based sensors can be expensive and challenging to manufacture; electrochemical cells with liquid electrolytes can have limited lifetimes and become leak sources; and both types of sensors are difficult to miniaturize. These problems are addressed with Glenn's novel ambient temperature oxygen microsensor, which is based on a Nafion$^{tm}$ polymer electrolyte, microfabricated using thin-film technologies. In the past, one drawback of Nafion$^{tm}$ film has been that it can lose conductivity when the moisture content in the film is too low, potentially affecting sensor operation. Glenn researchers devised a method to use certain salts to hold water molecules in the Nafion$^{tm}$ film structure at room temperature. The presence of these salts provides extra sites in the film to promote proton (H+) mobility, thus improving film conductivity and overall sensor performance, particularly in arid and high-temperature environments.

The innovative use of metal/metal oxide as the reference electrode enables miniaturization by eliminating the reference gas and sealing the reference electrode. The combination of interdigitized electrodes with the unique metal/metal oxide reference electrode permits sensor operation in either potentiometric or amperometric mode, as appropriate. In potentiometric mode, which measures voltage differences between working and reference electrodes in different gases, the voltage differences can be monitored with a voltmeter; however, the sensor itself does not need a power source. In room-temperature testing, the sensor achieved repeatable responses to 21 percent oxygen in nitrogen (using nitrogen as a baseline gas), and also detected oxygen from 7 to 21 percent, making Glenn's breakthrough technology usable for personal health monitoring as well as fire detection, fuel-leak detection, and environmental monitoring.

Glenn's microsensor can be used in conjunction with hyperbaric oxygen therapy, used to treat decompression sickness, serious infections, and wounds



Glenn's technology can improve safety for those who work in confined spaces where oxygen loss, fire, or fuel leaks are concerns

## APPLICATIONS

The technology has several potential applications:

- Personal health monitoring
- Environmental monitoring
- Hyperbaric chambers
- Submarines
- Mines
- Aerospace
- Monitoring oxygen in spacesuits
- Any confined space where oxygen loss, fire, or fuel leaks are concerns

## PUBLICATIONS

Patent Pending

More Information

National Aeronautics and Space Administration

**Technology Transfer Office**

**Glenn Research Center**

21000 Brookpark Road
Cleveland, OH 44135
216-433-3484
grc-techtransfer@mail.nasa.gov

http://technology.nasa.gov/

**www.nasa.gov**

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