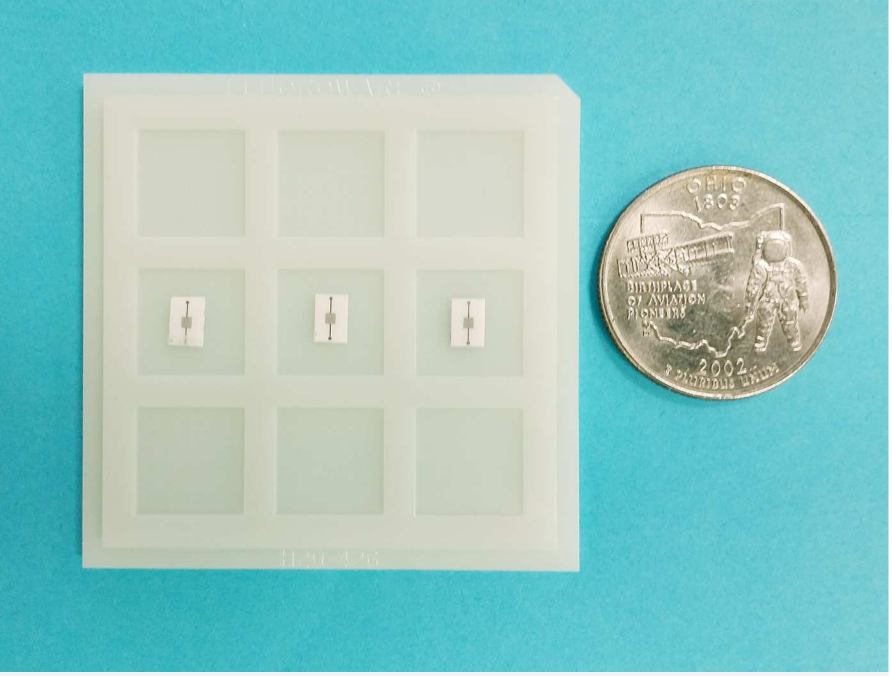

National Aeronautics and
Space Administration

technology solution

Sensors

Carbon Dioxide Gas Sensors and Method of Manufacturing

An enhanced CO_2 detecting microsensor with nanocrystalline tin oxide

Countless industries depend on chemical sensors for fast and accurate detection of carbon dioxide (CO_2) to protect their workers and those who rely on their products or services. Consequently, there is a strong push to continuously improve upon these chemical sensors. NASA's Glenn Research Center has developed a state-of-the-art, solid electrolyte-based microsensor for measuring concentrations of CO_2 from 0.5 to 4%. Whereas its predecessors typically operated only at high temperatures (600°C), this microsensor operates at temperatures as low as 375°C decreasing the power consumption needed to measure CO_2. This is accomplished through a simple modification to a preexisting NASA Glenn technology in which a coating of nanocrystalline tin oxide (SnO_2) is added on top of the sensor. It is low on power consumption, fast, easy to batch fabricate, easy to use, and therefore well-suited for use in a multitude of applications.

BENEFITS

- Power saving: Lower operating temperatures translate to lower power usage
- Compact: Has a detection area of .99 by 1.10 millimeters
- Robust: Resistant to humidity and vibration which can often damage or destroy microsensors
- Cost-effective: Can be easily batch fabricated using affordable photolithographic production processes
- Fast: Detects CO_2 concentrations from 0.5 to 4% in less than 30 seconds

THE TECHNOLOGY

Current bulk or thick film solid electrolyte CO_2 sensors are expensive, difficult to batch fabricate, and large in size. In contrast, this new amperometric, solid-state, oxide-based electrolyte CO_2 microsensor is affordable, easy to fabricate, and is so small that it could easily be integrated onto a substrate the size of a postage stamp.

The basic composition of the sensor is identical to a previously designed NASA Glenn technology in which a solid electrolyte of $Na_3Zr_2Si_2PO_{12}$ is deposited between interdigitated electrodes on an alumina substrate and is covered by $Na_2CO_3/BaCO_3$. Unlike its predecessor, however, this innovation includes an additional layer of nanocrystalline SnO_2 sol gel, an electron donor type (N-type) semiconductor, on top of the $Na_2CO_3/BaCO_3$. This new layer provides a greater number of electrons for reduction reaction at the working electrode to detect CO_2. As a result, overall performance is enhanced, and this new state-of-the-art sensor has the ability to operate at temperatures as low as 375°C. This low temperature capability significantly decreases the amount of power required to operate the sensor, opening the door to a multitude of new applications that were previously unattainable.

Monitoring the change of CO and CO_2 concentrations can help identify the chemical signature of a fire

This technology could be used to measure CO_2 levels in an engine's exhaust

APPLICATIONS

The technology has several potential applications:

- Fire detection
- Environmental monitoring
- Personal health monitoring
- Ventilation control
- Automotive engines
- Generators
- Power plants
- Space exploration

PUBLICATIONS

Patent No: 8,702,962

More Information

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NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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