

TECHNOLOGY SOLUTION

Sensors

Inexpensive Microsensor Fabrication Process

[Sensors can be easily fabricated using nanostructures](#)

Innovators at NASA's Glenn Research Center have developed a simple method of fabricating novel microsensors in large quantities using nanostructures as templates. Existing nanostructures, such as carbon nanotubes or biological structures, have excellent potential for use in sensor systems but lack certain advantages, including the ability to operate at high temperatures. Glenn's novel technique enables the advantageous properties of nanostructures to be combined with more durable materials, such as metal or metal oxides. In this way, the sensor gets the best of both worlds - the nanostructure offers a larger surface area for sensing, and the metal oxide provides durability and high-temperature capability. By fabricating chemical sensors with nanostructured materials at their core, Glenn has made it possible to develop compact, uniquely tailored sensor systems with significantly improved capabilities. These advanced microsensors can be used in a wide variety of critical applications, including fire detection, gas detection, environmental monitoring, and health monitoring.

BENEFITS

- High-performance: Enables the simple fabrication of robust, highly reliable sensors that can be selectively tailored for specific uses
- Proven: Successfully demonstrated as a low-power, compact methane gas sensor (using tin oxide nanorods and carbon nanotubes as templates)
- Affordable: Permits batch fabrication, lowering costs
- Compact: Can be installed in a wide range of locations



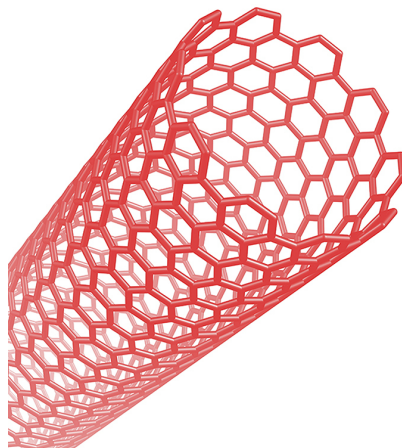
THE TECHNOLOGY

Because chemical sensors are used in many aspects of space missions, NASA researchers are continually developing ever smaller and more robust sensors that can be manufactured inexpensively and in high quantities; e.g., in batches. Glenn has developed a way to inexpensively fabricate microsensors using a sacrificial template approach. A nanostructure, such as a carbon nanotube, serves as a template, which can then be coated with a high-temperature oxide material. The carbon nanotube can be burned off, or sacrificed, leaving only the metal oxide. The resulting structure provides the unique morphology and properties of the carbon nanotube, which are advantageous for sensing, along with the material durability and high-temperature sensing capabilities of the metal oxide. This technique increases the surface area available for sensing because both the interior and exterior of the resulting microsensor can be used for gas detection, significantly increasing performance.

The fabrication of these microsensors includes three major steps: (1) synthesis of the porous metal or metal oxide nanostructures using a sacrificial template, (2) deposition of the electrodes onto alumina substrates, and (3) alignment of the nanostructures between the electrodes. The invention has been demonstrated for methane detection at room temperature (using tin oxide, with carbon nanotubes as the sacrificial template). The microsensor offers low power consumption (no heating required), compact size, extremely low cost, and simple batch-fabrication.



Oil and gas companies depend on accurate and affordable chemical microsensors with the ability to operate in harsh environments.



This innovative fabrication process uses carbon nanotubes to achieve a unique morphology and properties that are advantageous for sensing

APPLICATIONS

The technology has several potential applications:

- Environmental monitoring (fire detection, gas detection)
- System monitoring (leak detection)
- Health monitoring
- Oil and gas
- Remote sensing
- Fabrication
- Security
- Nanomaterials
- Composites

PUBLICATIONS

Patent No: 10,294,099; 11,192,780

technology.nasa.gov