

## Ambient Temperature Gas Sensors

OTT ID# 1164

### TECHNOLOGY

Gas sensors are used in a variety of applications that include continuous measurement of emissions, confined space monitoring and ambient air quality monitoring. This gas sensor technology offers the ability to sense a wide range of gases, at low concentrations and at room temperature. These sensors are made possible by a unique method of assembling nanoparticles and carbon nanotubes.

There are a variety of techniques used to sense gases. Unfortunately, many of the techniques that are appropriate for analytical instruments are simply not practical and too expensive for low cost monitoring devices. Photoelectric devices that employ light sources and diodes are costly and complex. Applications for these devices are also limited by the need to match sources and detectors with absorption spectra of the species of interest.

Oxide semiconductor devices overcome some of the limitations of photo electric devices, but they must be operated at high temperature (as high as 200C to 500C) in order to achieve sensitivities needed for practical devices. This drives the complexity and operating cost of these devices due to the current draw required to heat the sensor. In addition, the high temperature constraint precludes use of these devices in applications where the elevated temperatures might pose a risk for explosion. Other sensors rely on catalysts such as palladium which drives the material costs as well as the manufacturing costs.

This unique device offers a low cost gas sensor capable of detecting a variety of gases at room temperature. Sensors for detection of CO, NO<sub>2</sub>, NH<sub>3</sub>, and H<sub>2</sub> have already been demonstrated with high sensitivity at room temperature. These sensors use low cost tin oxide. An innovative manufacturing technique (see related technology OTT 1085) is used to assemble nanoparticles onto carbon nanotubes. These assemblies are integrated into a sensing device which measures changes in electrical properties of the carbon nanotube assemblies when they are exposed to specific gases. The sensor configuration is conducive to producing a matrix of sensors, potentially employing a variety of sensing elements. This matrix configuration makes it possible to apply statistical and pattern recognition techniques which may help address specificity problems with existing sensors.

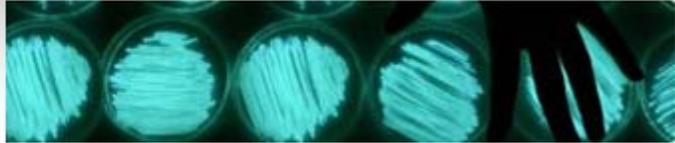
### FEATURES/BENEFITS

- Room temperature operation (versus existing oxide semiconductor sensors that typically operate between 200C and 500C)
- Eliminates cost and complexity associated with heating elements and high temperature operation
- Low cost materials such as tin oxide
- Low operating costs due to low power requirements
- Less expensive materials and ambient pressure production lead to significantly lower manufacturing costs
- Suitable for sensing a wide variety of gases
- Sensor conducive to matrix configuration allowing application of statistical and pattern recognition techniques

### INTELLECTUAL PROPERTY

US Patent Application No. 12/199,891, "Ambient-Temperature Gas Sensor"

**This technology is available for commercialization and licensing.**



## MARKETS

Miniaturized gas sensors that rapidly and accurately detect and differentiate trace amounts of chemical species are extremely attractive for environmental monitoring (e.g., monitoring indoor and outdoor air quality, such as residential toxic gases and exhaust emission control for combustion processes; detection of H<sub>2</sub> leakage for clean energy applications; detection of explosives and chemicals for national security; and CO<sub>2</sub> monitoring for CO<sub>2</sub> sequestration), medical diagnosis, food processing, and lab-on-a-chip analytical devices.

## INVENTOR(S)

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Dr. Junhong Chen is Associate Professor in Mechanical Engineering at the University of Wisconsin-Milwaukee. His research areas include nanoparticle synthesis, assembly and nanofabrication as well as application of these structures to gas sensors, biosensors and advanced energy conversion devices.

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