

# NO<sub>x</sub>/O<sub>2</sub> Sensors for High Temperature Applications

In vehicle engines, monitoring NO<sub>x</sub> and O<sub>2</sub> simultaneously is necessary for emission control and air/fuel ratio measurement. A reliable and accurate sensor is needed to monitor NO<sub>x</sub> breakthrough and trigger the regeneration of adsorption catalysts, and for controlling the injection of reductants. However, current dual sensor fabrication is complex and compromises sensor durability.

## The Challenge

To create a new design for a dual NO<sub>x</sub>/O<sub>2</sub> high temperature sensor with an internal reference gas system.

## The Solution

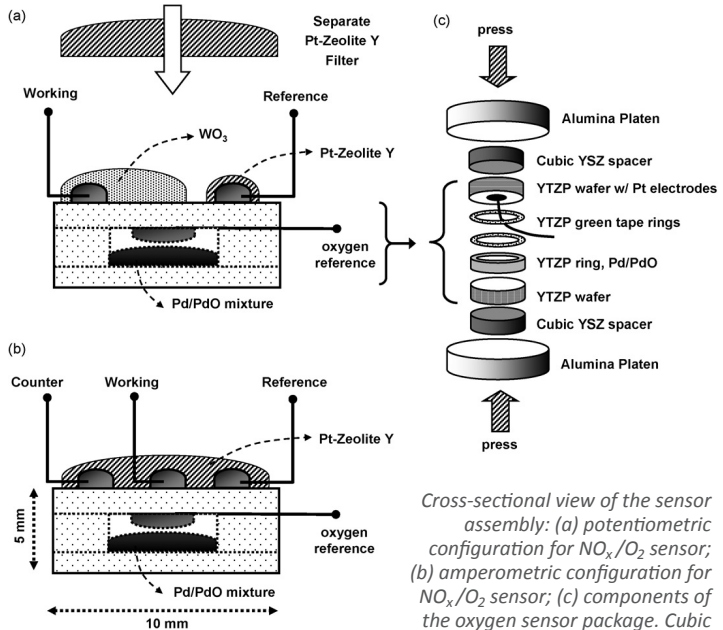
Using a unique deformation bonding method that joins the ceramic housing components without requiring the intermediate bonding materials that typically impede ionic oxygen conductivity, Argonne and Ohio State University created a novel, compact sensor with a self-contained reference gas system.

Two different electrochemical NO<sub>x</sub> measuring techniques, amperometric and potentiometric, were combined with an internal reference oxygen sensor. The sensor can measure O<sub>2</sub> and NO<sub>x</sub> simultaneously at high temperatures.

## The Results

Both amperometric and potentiometric type sensors showed excellent O<sub>2</sub> signal stability and total NO<sub>x</sub> response, though the potentiometric design provided more stable NO<sub>x</sub> detection.

This novel sensor is easy to manufacture, inexpensive, compact and has a self-contained reference gas system. It eliminates the need for costly and bulky high-temperature external plumbing for the reference gas. This allows placing multiple sensors much closer to where the combustion is occurring.



Cross-sectional view of the sensor assembly: (a) potentiometric configuration for NO<sub>x</sub>/O<sub>2</sub> sensor; (b) amperometric configuration for NO<sub>x</sub>/O<sub>2</sub> sensor; (c) components of the oxygen sensor package. Cubic YSZ spacers and alumina platens were removed following joining and not part of the package.

*"This sensor represents an important step in controlling combustion processes whether for large-scale production such as in the steel or glass industry, or for emission controls for transportation,"* said materials scientist Dileep Singh.