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## Sensors for Pointing Moving Instruments Toward Each Other

*NASA's Jet Propulsion Laboratory, Pasadena, California*

Optoelectronic sensor systems are being developed for use in maintaining fixed relative orientations of two scientific-instrument platforms that are in relative motion. In the original intended application, the platforms would be two spacecraft flying in formation and separated by a long baseline. In principle, sensor systems of this type could also be used in terrestrial applications for maintaining alignments between moving instrument platforms. The sensor system

would utilize beacon laser beams that would be transmitted by the platforms in the normal course of scientific measurements. The frequency of the returned laser beam would differ by about 5 MHz. On each platform, the transmitted laser beam and the laser beam bounced off the other platform would be focused onto a quadrant photodetector, where the interference between the laser beams would give rise to sinusoidal (beat-frequency) signals on all four quadrants. The differ-

ences among the phases of the beat-frequency signals in the quadrants would depend on, and would be used to determine the angle between, the wave fronts of the outgoing and incoming laser beams.

*This work was done by Carl Liebe, Alexander Abramovici, Jacob Chapsky, Daniel Shaddock, Charles Harb, and Frank Dekens of Caltech for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-40610*

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## Pd/CeO<sub>2</sub>/SiC Chemical Sensors

**Nanostructured interfacial CeO<sub>2</sub> layers contribute to thermal stability and transfer of electrons.**

*John H. Glenn Research Center, Cleveland, Ohio*

The incorporation of nanostructured interfacial layers of CeO<sub>2</sub> has been proposed to enhance the performances of Pd/SiC Schottky diodes used to sense hydrogen and hydrocarbons at high temperatures. If successful, this development could prove beneficial in numerous applications in which there are requirements to sense hydrogen and hydrocarbons at high temperatures: examples include monitoring of exhaust gases from engines and detecting fires.

Sensitivity and thermal stability are major considerations affecting the development of high-temperature chemical sensors. In the case of a metal/SiC Schottky diode for a number of metals, the SiC becomes more chemically active in the presence of the thin metal film on the SiC surface at high temperature. This increase in chemical reactivity causes changes in chemical composition and structure of the metal/SiC inter-

face. The practical effect of the changes is to alter the electronic and other properties of the device in such a manner as to degrade its performance as a chemical sensor. To delay or prevent these changes, it is necessary to limit operation to a temperature <450 °C for these sensor structures.

The present proposal to incorporate interfacial CeO<sub>2</sub> films is based partly on the observation that nanostructured materials in general have potentially useful electrical properties, including an ability to enhance the transfer of electrons. In particular, nanostructured CeO<sub>2</sub>, that is CeO<sub>2</sub> with nanosized grains, has shown promise for incorporation into high-temperature electronic devices. Nanostructured CeO<sub>2</sub> films can be formed on SiC and have been shown to exhibit high thermal stability on SiC, characterized by the ability to withstand temperatures somewhat greater than 700 °C for lim-

ited times. The exchanges of oxygen between CeO<sub>2</sub> and SiC prevent the formation of carbon and other chemical species that are unfavorable for operation of a SiC-based Schottky diode as a chemical sensor. Consequently, it is anticipated that in a Pd/CeO<sub>2</sub>/SiC Schottky diode, the nanostructured interfacial CeO<sub>2</sub> layer would contribute to thermal stability and, by contributing to transfer of electrons, would also contribute to sensitivity.

*This work was done by Weijie Lu and W. Eugene Collins of Fisk University for Glenn Research Center. Further information is contained in a TSP (see page 1).*

*Inquiries concerning rights for the commercial use of this invention should be addressed to NASA Glenn Research Center, Commercial Technology Office, Attn: Steve Fedor, Mail Stop 4-8, 21000 Brookpark Road, Cleveland, Ohio 44135. Refer to LEW-17332.*

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## Microparticle Flow Sensor

**As many as 1,000 microparticles can be identified, tracked, and counted.**

*Lyndon B. Johnson Space Center, Houston, Texas*

The microparticle flow sensor (MFS) is a system for identifying and counting microscopic particles entrained in a flowing liquid. The MFS includes a transparent, optoelectronically instrumented laminar-flow chamber (see fig-

ure) and a computer for processing instrument-readout data. The MFS could be used to count microparticles (including micro-organisms) in diverse applications — for example, production of microcapsules, treatment of wastewater,

pumping of industrial chemicals, and identification of ownership of liquid products.

In addition to the instrumented chamber and the computer, the system includes a process controller and pumps.