

tem provides nearly ideal conditions for strong Drude absorption of radiation by electrons. This allows for the very short momentum relaxation time (time between collisions) of electrons. Since this time is shorter than a period of the THz field oscillation, the electrons absorb

THz radiation well. In the GaAs structures, the momentum relaxation time is usually much longer, so the electrons move in the field without collisions for a long time. This reduces their ability to absorb radiation and makes the mixer device much less sensitive.

*This work was done by Boris S. Karasik, John J. Gill, Imran Mehdi, and Timothy J. Crawford of Caltech, and Andrei V. Sergeev and Vladimir V. Mitin of SUNY Buffalo for NASA's Jet Propulsion Laboratory. Further information is contained in a TSP (see page 1). NPO-47796*

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## Pattern Recognition Algorithm for High-Sensitivity Odorant Detection in Unknown Environments

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In a realistic odorant detection application environment, the collected sensory data is a mix of unknown chemicals with unknown concentrations and noise. The identification of the odorants among these mixtures is a challenge in data recognition. In addition, deriving their individual concentrations in the mix is also a challenge.

A deterministic analytical model was developed to accurately identify odorants and calculate their concentrations in a mixture with noisy data. This model is specially suited for hardware imple-

mentation with miniaturization. Hierarchical neural network architecture effectively deals with the induced odorants that can be formed from the combination of basic source odorants and their concentrations.

To search for an odorant in the mixture, where it exists in the operating environment, one of the most robust techniques is to recover the original odorant sources. When done, the detection can be an easy step by finding the minimum phase between the predicted original odorants and the target odorants. The

neural-network approach can be employed to capture the target odorants in various conditions through learning, i.e., concentration levels through the parameterized weight set, then the strongest correlation between parameterized weights and the predicted original can be used to identify the intended odorants.

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## Determining Performance Acceptability of Electrochemical Oxygen Sensors

**This screening method does not affect the operation life of the sensor.**

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A method has been developed to screen commercial electrochemical oxygen sensors to reduce the failure rate. There are three aspects to the method: First, the sensitivity over time (several days) can be measured and the rate of change of the sensitivity can be used to predict sensor failure. This method has been demonstrated in ongoing tests. Second, an improvement to this method would be to store the sensors in an oxygen-free (e.g., nitrogen) environment and intermittently measure the sensitivity over time (several days) to accomplish the same result while preserving the sensor lifetime by limiting consumption of the electrode. Third, the second time derivative of the sensor response over time can be used to determine the point in time at which the sensors are sufficiently stable for use.

Commercial electrochemical oxygen sensors are a limited-lifetime item because

the sensor electrode is consumed during normal operation. Basically, a given sensor at the time of manufacture has a finite lifetime, which can be quantified in terms of ppm-hours so that an exposure to a given concentration for a given time reduces the lifetime by the product of those two factors. Common practice is to simply replace a sensor that fails within the vendor-specified lifetime. In applications requiring long operational life with no replacement option, screening of the sensors is advantageous to reduce the sensor failure rate. Prior art for screening is unknown given the commercial nature and application of these sensors. The simple and obvious method for screening would be to measure the sensor response at a known oxygen concentration (i.e., initial sensitivity) and determine a statistical threshold for excluding a sensor from use. However, this does not guarantee acceptable lifetime performance.

The benefits of the invention are reduced failure rate, which is especially advantageous in applications with long operational life requirements and no replacement option. In addition, this provides a screening method that does not affect the operation life of the sensor to accomplish this screening. Finally, the method provides a criterion for determining sensor acceptability prior to system level integration. These benefits significantly improve on the common practice, which cannot predict failure at any point in time beyond the initial screening. The oxygen-free environment method would prevent unnecessary reduction in the available lifetime of the sensor.

*This work was done by Daniel Gonzales of Hamilton Sundstrand for Johnson Space Center. For further information, contact the JSC Innovation Partnerships Office at (281) 483-3809. MSC-24916-1*