National Aeronautics and Space Administration

Nanosensor/Cell Phone Hybrid Instrument for Detecting Chemicals and Concentrations

This invention is available for licensing from NASA's space program to benefit U.S. industry. This cutting edge invention is an electronic nose sensor, about the size of a postage stamp, comprised of an array of nanosensors and an associated signal processor. The sensor detects which chemicals are present and in what the concentrations and then transmits this information using the cell phone, to a network that delivers it to a chemical reporting module. The chemicals that can be sensed by the sensor array include H_2, H_2O_2, NO_2, NH_3, Cl_2, HCN, N_2H_4, CH_4, benzene, acetone, formaldehyde, dinitrotoluene, and some chemical warfare agents (down to about 10 parts per billion concentrations) . The electronic nose was developed for the analysis of liquids and gases. Chemical detection and identification of molecules of interest is accomplished by selecting multiple combinations of coating and doped metal and employing pattern recognition software.

Technology Details

A combined cell phone and nanosensor array instrument detects the presence of selected chemicals and their concentrations and transmits such information over a cell phone network. Unlike other chemical sensors, this solid-state approach requires no reagents and can be refreshed with a solid-state Ultra-violet diode.

Patent

This technology is protected by a pending U.S. Provisional Patent Application (Reference No. ARC- 16292-1)

Benefits

- Improved mechanical properties
- Detect fuel leaks, industrial toxins, chemical warfare agents, and hazardous chemicals
- Fast response, high selectivity
- Monitor vapor concentration
- Handheld device
- Detect chemicals and radiation simultaneously
- High sensitivity, low false alarm rate
- Integration with wireless networks

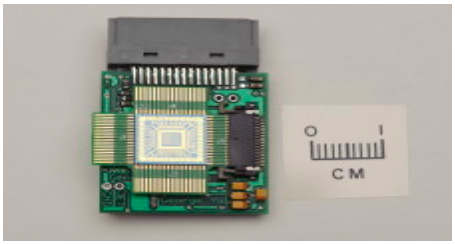
The sensors possess high sensitivity (parts per billion by volume), fast response (<2seconds), high selectivity, low power micro Watt (μW), and very small size (1 cm^2 or less based on advanced miniaturization). The device has shown reliable and fast operation for more than 15 hazardous gases and vapors, with detection limits between parts per billion (ppb) to parts per million (ppm) levels. For example for NO_2 the detection limit is 4.6 parts per billion in air at 25° C.

Selectivity is provided by integrating multiple sensors on a single chip, and modifying carbon nanotubes (CNT) or nanowires on each sensor with different functional groups, polymer coatings, and/or dopants of metal catalytic nanoparticles. All sensors use simple absorbate-modulated-resistance (current/voltage) measurements combined with pattern-recognition software for identifying gases and their concentrations and is ideal for easy integration.

The sensors work well as radiation detectors for protons and gamma rays. They have demonstrated constant in-line and in-situ, and real time detection without moving the sample offline to distinguish hazardous materials and explosives from innocuous items (e.g., water, wine, suntan lotion). This nanosensor/cell phone hybrid instrument can provide swappable sensor chips for various target applications.

Commercial Applications

- Oil and Gas industry
- Medical diagnostics tool
- Automotive industry
- Fuel leak detection
- Food and Agriculture
- Homeland Security and Defense
- Air quality monitoring



The sensing chip integrated into a chemical detector board, about the size of a postage stamp, sensing chip facing up.

Contact the Ames Technology Partnerships Office at 1-855-627-2249 or ARC-TechTransfer@mail.nasa.gov