National Aeronautics and Space Administration

Detection of Gases and Vapors Present at Low Concentrations

The timely collection, analysis, and optional reporting of the results of local gas sampling are essential for environmental monitoring and other related purposes. NASA has developed a novel technology whereby Nanostructure-based mechanisms are used for sensing the presence of, and estimating the concentration values of, specified chemical components in a sample gas to which the mechanism is exposed. The concentrations may range from parts per million (ppm) to as low as 5 parts per billion (ppb). This mechanism samples gases that are present locally and determines which, if any, of certain specified gas components of concern are present. It estimates a concentration for each specified gas that is present and compensates for the effects of variation of environmental parameters on gases found to be present. Finally, it distributes information wirelessly on the specified gases found to be present to one or more intended data recipients.

This invention is available for licensing from NASA's space program to benefit U.S. industry.

Patent

This technology is protected by a pending U.S. Patent Application.
(Reference No. ARC-17110-1)

Benefits

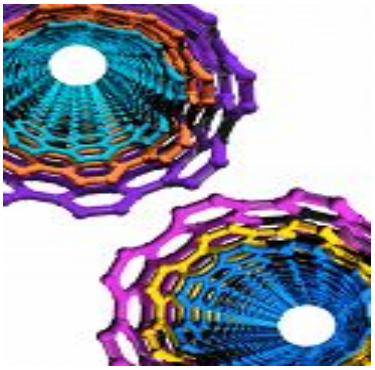
- Measures concentrations in gases below 1 ppm - 5 ppb
- Measures one or more gases of concern
- Wireless distribution of information
- Varying environmental conditions can be accommodated

Technology Details

This technology provides: (1) a mechanism that receives a sample gas, (2) converts the gas information received and changes it into an electrical parameter values (EPV) sensed at each of an array of separately functionalized carbon nanotubes (CNTs), (3) estimates which of a group of specified chemical components are present, and the associated chemical concentrations in the sample gas, (4) formats information concerning the chemical components sensed in the sample gas, and (5) transmits this information to selected recipients. The specified chemical components and the corresponding concentration values are displayed; e.g., on a cell phone screen. Optionally, the information is compensated by removing the effects of the presence of ambient gas components that are not of concern in the sample gas. The mechanism is based on functionalized carbon nanostructures (NSs), for sensing the presence of one or more specified chemical components in a sample gas and for estimating non-negligible concentration values for the sensed components. The mechanism compensates for the presence of baseline contributions to the concentration values from chemicals that are present where the sample gas is absent. Changes in electrical parameter values (EPVs), possibly time varying, are measured when the NSs are exposed to the sample gas. Constitutive equations using calibration coefficients relate concentration values to the EPV values for different specified components that may be in the sample gas. An error function provides a measure of a difference between a predicted constitutive model of EPVs and measured EPV values for the sample gas. Minimum-error concentration values are estimated. Where the error function numerical value is no greater than a threshold value, this condition is interpreted as indicating that at least one of the specified components is present and the corresponding concentration value estimate is reasonably accurate. Asymptotic limits for one or more concentration values are estimated and compared with alarm limits for one or more gases of concern.

Commercial Applications

- Medicine
- Aerospace
- Homeland security
- Research and chemistry laboratories
- Environmental monitoring
- Biomedicine
- Nanotechnology



Carbon Nanotube

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