National Aeronautics and Space Administration

Application of Carbon Nanotube Hold-off Voltage for Determining Gas Composition

NASA has developed a lightweight, small sensor that detects one or more inert gas components and measures gas concentration with accuracy comparable to conventional sensors. Few sensors are available to detect inert gases. Conventional inert gas analysis tools primarily rely upon infrared (IR) spectroscopy, mass spectroscopy (MS) and/or thermal conductivity measurements. Thermal conductivity sensors are available for fixed and portable instruments, but this conventional technique is not suitable for measuring extremely low levels of a gas (e.g., less than 1 percent by volume resolution), and the technique has difficulties when the target gas has a thermal conductivity close to that of a background gas.

The new technology uses variable voltages, applied to an exposed end of a carbon nanotube immersed in a gas mixture for a variable time interval, to estimate gas composition. It distinguishes between a gas component discharge that occurs substantially instantaneously and a discharge in the same gas component that occurs after a substantial time delay. The sensor is able to detect and identify the presence of one, two or more gas components, some or all of which may be relatively inert (e.g., Ne, Ar, Xe, Kr, CO, etc.). It also provides an estimate of the concentration of at least one gas component. Use of one or more carbon nanotube contacts may allow a more precise determination of discharge voltage holdoff than would be available where a larger diameter electrical contact is used.

Patent

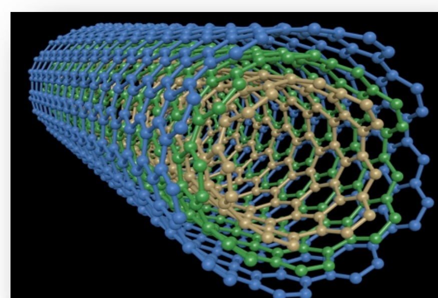
This technology has been patented.
U.S. Patent No. 7,529,633
(Reference No. ARC-15506-1)

Benefits

- Use constant non-pulse hold-off voltages
- Can be combined with other gas discharge methods
- Measures extremely low levels of gases
- Accurate
- Low cost
- Light weight
- Consumes small amounts of power
- Can be automated

Technology Details

This technology is a method and system for identifying chemical composition of a single-component or multiple-component gas, using a discharge holdoff mechanism. A voltage difference, V, between two spaced-apart electrodes is brought to a selected value and held, the holdoff time interval, $\Delta t(V;ho)$, required before gas discharge is measured, and the associated electrical current or cumulative electrical charge is measured. As the voltage difference V increases, the time interval length $\Delta t(V;ho)$ decreases monotonically. Particular voltage values, V_∞ and V_o, correspond to initial appearance of discharge ($\Delta t \approx \infty$) and prompt discharge ($\Delta t \approx 0$). The values V_∞ and V_o and the rate of decrease of $\Delta t(V;ho)$ and/or the rate of increase of current or cumulative charge with increasing V are characteristic of one or more gas components present.



Commercial Applications

- Space exploration
- Public safety
- Healthcare
- Oil and Gas industry
- Fire detection
- Leak detection
- Terrestrial environment
- Automobile industry
- Air monitoring in buildings, tunnels, and mines

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