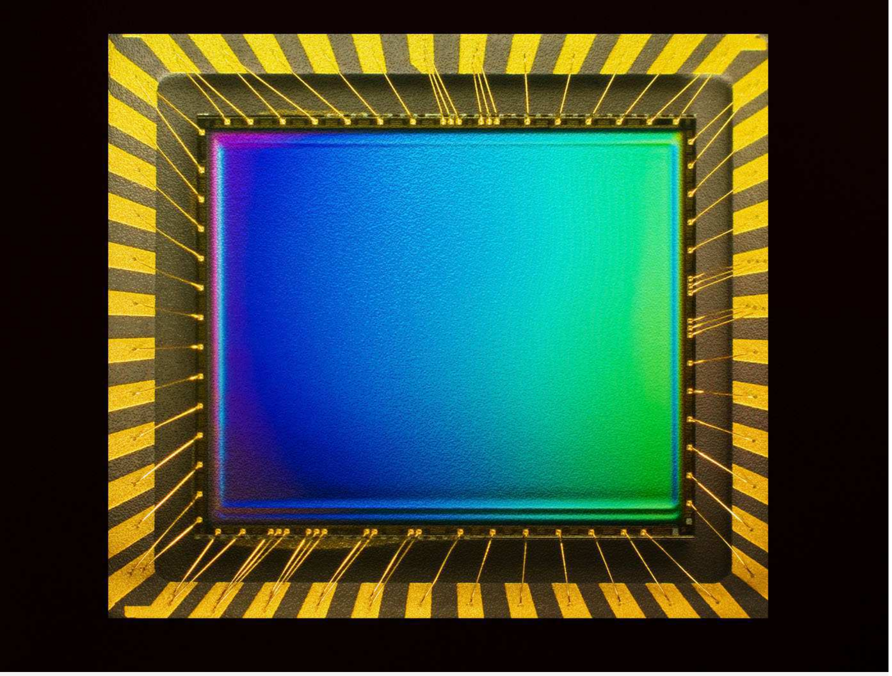


National Aeronautics and
Space Administration

Sensors

Gas Sensors Based on Coated and Doped Carbon Nanotubes

Novel nanotechnology for enabling high gas detection sensitivity

NASAs Ames Research Center offers the opportunity to license and codevelop electronic, inexpensive, low-power gas sensors based on single-walled carbon nanotubes (SWCNT). Traditional sensors, such as metal oxide devices, have been utilized for several decades for detection of combustible and toxic gases. However, they are power hungry, and their use is limited. There is a strong need for development of next-generation chemical sensors with higher sensitivity in the parts per million (ppm) to parts per billion (ppb) level and low power consumption. Sensors based on emerging nanotechnology, such as SWCNTs, promise to provide improved performance. NASA scientists came up with an innovative method for gas detection by coating or doping the SWCNTs with suitable materials. The purpose of the invention is to incorporate thus-treated SWCNTs into electronic devices that measure their electrical properties, such as resistance.

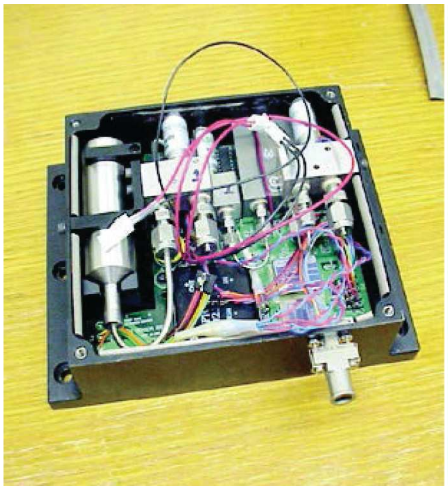
BENEFITS

- High sensitivity: ~4.6 ppb; can discriminate multiple gases at low concentration and room temperature
- Readily scaleable for mass production with high yield and good reproducibility
- Cheaper and easier to manufacture than SWCNT field transistors
- Fabricated using the conventional microfabrication process with a two-step metallization
- Large market size

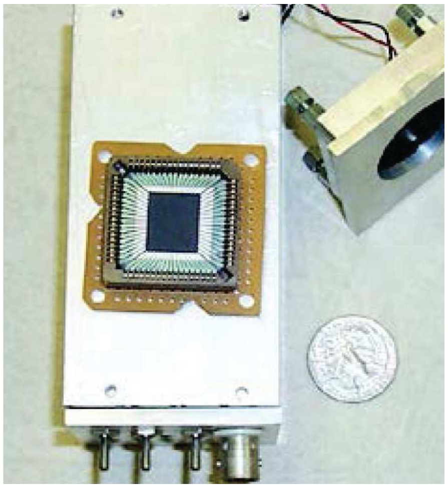
technology solution

THE TECHNOLOGY

A typical sensor device includes a set of interdigitated microelectrodes fabricated by photolithography on silicon wafer or an electrically insulating substrate. In preparation for fabricating the SWCNT portion of such a sensor, a batch of treated (coated or doped) SWCNTs is dispersed in a solvent. The resulting suspension of SWCNTs is drop-deposited or injected onto the area containing the interdigitated electrodes. As the solvent evaporates, the SWCNTs form a mesh that connects the electrodes. The density of the SWCNTs in the mesh can be changed by varying the concentration of SWCNTs in the suspension and/or the amount of suspension dropped on the electrode area. To enable acquisition of measurements for comparison and to gain orthogonality in the sensor array, undoped SWCNTs can be similarly formed on another, identical set of interdigitated electrodes. Coating materials tested so far include chlorosulfonated polyethylene. Dopants that have been tested include Pd, Pt, Au, Cu and Rh nanoparticle clusters. To date, the sensor has been tested for NO2, NH3, CH4, Cl2, HCl, toluene, benzene, acetone, formaldehyde and nitrotoulene.



Sensing module



Handheld sensing device

APPLICATIONS

The technology has several potential applications:

- Detection of flammable gases for the petrochemical industry
- Quality control by the chemical industry
- Methane detection for the mine safety industry
- Environmental monitoring of toxic industrial gases
- Biomedical - monitoring gases in a patients breath

PUBLICATIONS

Patent No: 7,801,687; 7,426,848; 8,000,903; 7,875,455; 7,623,972

More Information

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