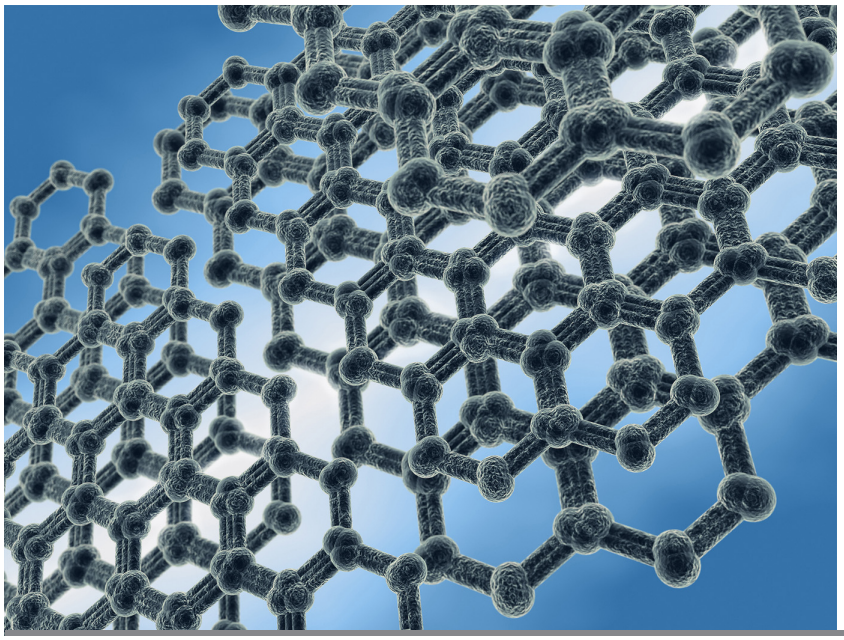


National Aeronautics and Space Administration

TECHNOLOGY SOLUTION

Sensors

Electrical Response Using Nanotubes on a Fibrous Substrate

Gas and vapor sensors on paper

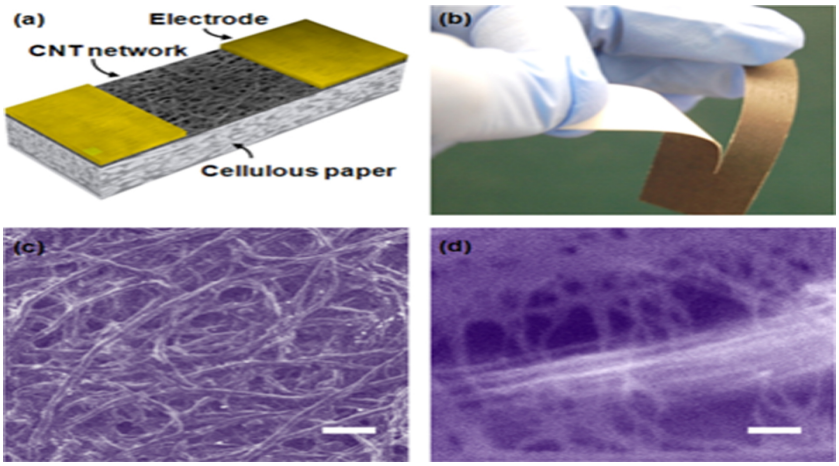
This NASA technology is a a unique resistor-type gas/vapor sensor on cellulose paper employing carboxylic acid functionalized, single-walled carbon nanotubes as the sensing material. Electronic devices built on cellulose paper substrates can be cheaper than equivalent class of solid-state devices while providing excellent performance. Furthermore, the paper-based devices can be used for flexible, foldable, biodegradable, disposable applications, such as biosensors and intelligent packaging. Single-walled carbon nanotubes (SWCNTs) are used to construct the sensor on paper. Gas sensors are typically classified according to transduction methods and each class has its own strengths and weaknesses. These sensors are characterized by their simple structure, low fabrication cost, and simple read-out circuitry.

BENEFITS

- Simple structure, low fabrication cost and simple read-out circuitry
- No heating or vacuum treatment needed
- Simple solution processing
- Cheaper than equivalent class of solid-state devices
- Foldable, flexible, biodegradable and disposable
- Green Technology
- Robust in cryo-temperatures
- Wide range of applications

THE TECHNOLOGY

A resistor-type sensor was fabricated which has a network of cross-linked SWCNTs with purity over 99%. An ordinary cellulose paper used for filtration was employed as the substrate. The filter paper exhibits medium porosity with a flow rate of 60 mL/min and particle retention of 5-10m. The roughness and porosity of the papers are attractive because they increase the contact area with the ambient air and promote the adhesion to carbon nanotubes. The SWCNTs were functionalized with carboxylic acid (COOH) to render them hydrophilic, thus increasing the adhesion with the substrate. The functionalized SWCNTs were dispersed in dimethylformamide solution. The film composed of networks of cross-linked CNTs was formed using drop-cast coating followed by evaporation of the solvent. Adhesive copper foil tape was used for contact electrodes. Our sensors outperformed the oxide nanowire-based humidity sensors in terms of sensitivity and response/recovery times.



Humidity sensor built on a cellulose paper substrate

APPLICATIONS

The technology has several potential applications:

- Biosensor technology
- Industrial mining
- Intelligence / Security
- Biomedical

PUBLICATIONS

Patent No: 10,031,097

technology.nasa.gov

NASA's Technology Transfer Program pursues the widest possible applications of agency technology to benefit US citizens. Through partnerships and licensing agreements with industry, the program ensures that NASA's investments in pioneering research find secondary uses that benefit the economy, create jobs, and improve quality of life.

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More Information

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