Hydrogen Gas Sensors Based On Patterned Carbon Nanotube Ropes

Tech ID: 28781 / UC Case 2017-422-0

BRIEF DESCRIPTION

This is a fabrication method for hydrogen gas sensors; these sensors have more rapid response times and are more sensitive than current detection techniques.

FULL DESCRIPTION

The detection of leaked hydrogen gas (H2) in air has long been a challenge for sensing techniques. Due to its flammable nature at levels as low as 4% volume in air, as well as its colorless and odorless composition, reliable electronic methods for its rapid and sensitive detection are crucial. According to the US Department of Energy (DOE), H2 sensors should have a rapid response (detecting 1% volume of H2 within 1 minute) and a large dynamic range (able to detect between 0.1% - 4% volume H2).

However, most H2 sensors are chemiresistors, which display an increase in resistance upon exposure to gas. Though the specific architecture of these devices has evolved over the years, the most sensitive is single-wall carbon nanotubes functionalized with metal nanoparticle defects (SWCNT-NPs[KR1]). These platforms exhibit a dramatic response to H2, corresponding to a 1000-fold increase in resistance.

SWCNT-NP sensors, though significantly more sensitive than other chemiresistors, suffer from slow response. Most are functionalized with palladium (Pd) nanoparticles, though the specific means of Pd NP deposition have not been studied, nor have the NPs been optimized in terms of size, stability, etc.

Thus, there is a need to develop sensing devices which can rapidly detect H2 gas simultaneously over a large dynamic range of levels specified by the DOE. UCI researchers addressed these issues by fabricating sensors with a dynamic range and rapid response time meeting DOE standards with low power consumption at a comparable cost. This is done by using carbon nanotube ropes which are synthesized via dielectrophoresis, and then decorated with Pd nanoparticles via pulsed electrodeposition.

SUGGESTED USES

Sensors for H2 gas, especially at air levels ranging from 0.001 to 4% volume.

ADVANTAGES

· Wide dynamic range for H2 sensing (0.001% - 4% volume in air)

· Rapid response to all H2 exposure levels (62 sec)

· Rapid recovery time (72 sec, time for resistance to return to pre-hydrogen levels)

· Low power consumption (micro-Watt range)

· Requires only a small amount of precious materials (carbon, palladium)

· Flexible (carbon nanotubes are easily bent and stretched)

CONTACT

Ben Chu
ben.chu@uci.edu
tel: .

OTHER INFORMATION

CATEGORIZED AS

» **Environment**
» Sensing
» **Materials & Chemicals**
» Chemicals
» Nanomaterials
» **Sensors & Instrumentation**
» Analytical
» Other

RELATED CASES

2017-422-0

· Durable

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	11,231,381	01/25/2022	2017-422

STATE OF DEVELOPMENT

Working prototype

UCI Beall
Applied Innovation

5270 California Avenue / Irvine,CA
92697-7700 / Tel: 949.824.2683