Carbon Nanotube Infrared Detector

Tech ID: 32704 / UC Case 2006-367-0

PATENT STATUS

Country	Type	Number	Dated	Case
United States Of America	Issued Patent	7,723,684	05/25/2010	2006-367

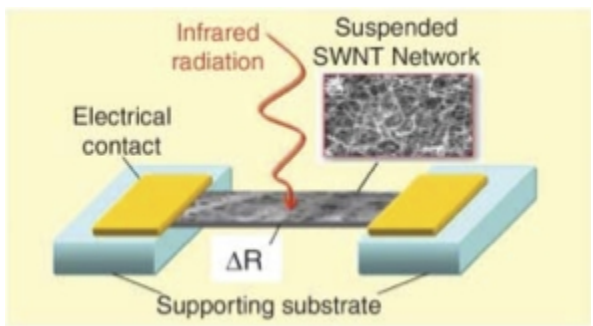
FULL DESCRIPTION

Background

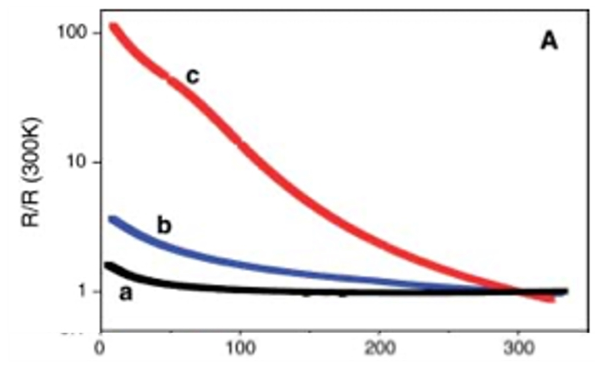
Prominent adsorption features and photoconductivity of single-walled carbon nanotubes (SWNTs) suggest an outstanding potential for application in nanoscale sized optoelectronic applications. The extremely large photo response that is observed for suspended SWNT films also makes them attractive candidates for sensitive element of an infrared bolometer. A high negative value of temperature coefficient of resistance (TCR) of the bolometer sensitive element is required to efficiently transfer temperature modulation into an electrical signal.

Current Invention

Researchers led by Prof. Robert Haddon at UCR have developed a patented, novel infrared bolometer derived from their research on the photoconductivity of semi-transparent SWNTs. In their invention, the SWNT film was suspended between two blocks that also served as electrical contacts. In suspending the SWNT film in vacuum they show that they can increase the photoconductivity response by at least 5 orders of magnitude.



Schematic diagram of SWNT network suspended between electrical contacts.



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OTHER INFORMATION

KEYWORDS

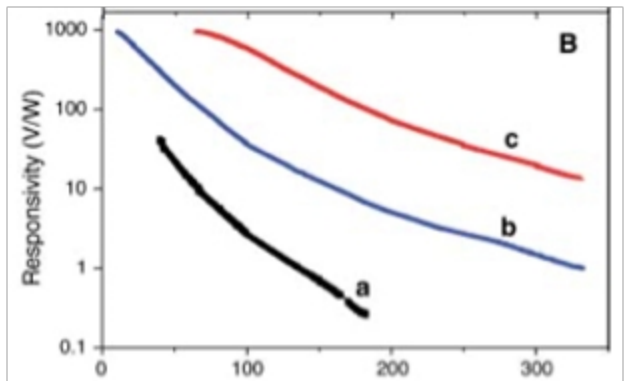
Bolometer, Infrared detector, Carbon nanotubes, Sensors and detectors

CATEGORIZED AS

- **Engineering**
  - Engineering
- **Materials & Chemicals**
  - Nanomaterials
  - Thin Films
- **Nanotechnology**
  - Materials
- **Sensors & Instrumentation**
  - Environmental Sensors
  - Other

RELATED CASES

2006-367-0



Temperature dependence of (A) resistance and (B) voltage responsivity – of 3 SWNT films (a) 1 micron thick purified SWNTs, (b) 100 nm thick purified SWNTs annealed in vacuum and (c) 40 nm thick purified SWNTs annealed in vacuum.

ADVANTAGES

The significance and benefits of their invention are:

- The absorption coefficient of SWNTs is extremely high (10^4 to 10^5 cm^{-1}) which is at least an order of magnitude greater than that of mercury-cadmium-telluride the popular photoconductor for IR photodetectors.
- The strong absorption of coefficient of SWNTs ranges from the ultraviolet to the far-infrared region.
- Low mass of the SWNT film also results in low heat capacity for the bolometer sensing element.
- The SWNT sensing element is thermally insulated from the supporting substrate.
- Amenable to further increase of TCR via chemical functionalization of the SWNT films.
- Provides a cost-efficient alternative to pyroelectric detectors, vanadium dioxide and silicon based bolometer arrays.

SUGGESTED USES

Suitable applications for this innovation include:

- Thermal imaging
- Microbolometers for thermal cameras
- Spectroscopy
- Infrared astronomy

RELATED MATERIALS

- Bolometric infrared photoresponse of suspended single-walled carbon nanotube films

INVENTIONS BY PROF. ROBERT HADDON

Please see all inventions by Prof. Robert Haddon and his team at UCR

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