



INVENTORS

SITI SALWA MAT ISA
MUHAMMAD MAHYIDDIN RAMLI
ASSOC. PROF. DR. JOHARI ADMAN

CONTACT DETAILS

SCHOOL OF MICROELECTRONIC ENG.,
UNIVERSITI MALAYSIA PERLIS,
KAMPUS PAUH PUTRA,
02609 ARAU, PERLIS,
MALAYSIA.
Tel: +6049805532/ +60194263805
E-mail: sitisalwa@unimap.edu.my

WEARABLE GAS SENSOR UTILISING DYE-FUNCTIONALISED SINGLE WALL CARBON NANOTUBES (SWCNT)

Patent Search No: PT/4752/UNIMAP/13



PRODUCT DESCRIPTION

Carbon nanotubes (CNTs) have attracted considerable interest due to their unique properties and vast potential in electronic applications. CNTs show sensitivity towards changes in local environment due to their large surface area and hollow geometry that make CNTs able to detect small concentrations of molecules, including industrial pollutant such as NO₂. The ability to monitor NO₂ in the air is important as this gas influences the growth of agriculture and causes respiratory problems. Recently, metal oxide semiconductor (MOS) and solid electrolyte (SE) sensors are used for gas detection; however these sensors operate at high operating temperatures. For this invention, direct golden orange dye was used as a dispersing agent for SWCNTs suspension in water. Uniform thin film was fabricated using vacuum filtration method with different concentrations of SWCNTs and transferred to glass substrate. This sensor operates at room temperature.

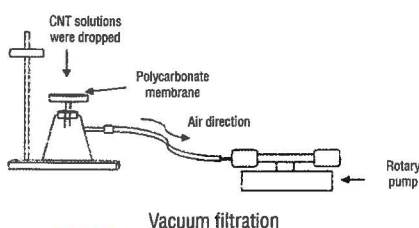
PRODUCT SIGNIFICANT

- NO₂ is a toxic gas, can lead to adverse respiratory symptoms in humans and detrimentally influences the growth of agriculture.
- Atmospheric concentrations of NO₂ lead to the formation of ground-level smog and acid rain.

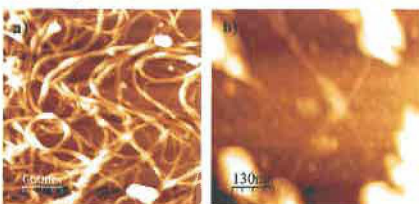
SAMPLE PREPARATION



SWCNTs suspensions



SWCNTs thin film on glass substrate



AFM of bundled SWCNTs and dye functionalised SWCNTs

NOVELTIES

- Low cost and simple device fabrication.
- Scalable and versatile solution production.
- High efficiency and fast response.

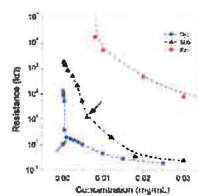
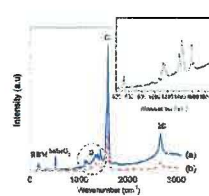
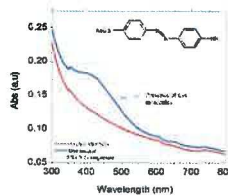
APPLICATIONS

- Agriculture sectors.
- Military purposes

INVENTION ADVANTAGES

- Operates at room temperature.
- Less sensitive to temperature fluctuation.
- Long lifetime.
- Good stability.
- High selectivity.
- Immediate operation after power loss.

RESULTS

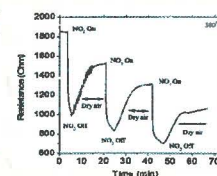
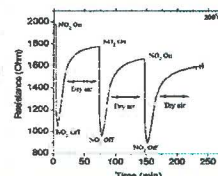
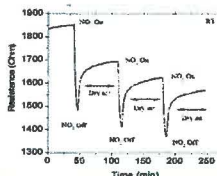


Optical absorption spectrum

Raman spectra

Electrical resistance

Resistance Changes



Room temperature

200°C

300°C

PUBLICATIONS

- M. M. Ramli, W. Zhang, S. R. P. Silva, and S. J. Henley, AIP Advances 2, 032165 (2012).
- M. M. Ramli, Siti S. Mat Isa, S. J. Henley, IEEE Regional Symposium on Micro and Nanoelectronics Conference (RSM 2013), Malaysia, 25-27 September, 2013.