From Pore Structure of Single-Walled Carbon Nanotube to Gas Sensing Application

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Single-walled carbon nanotube (SWCNT) has been used as a sensing material in an interdigitated electrode platform for gas sensing. Due to extremely high surface-to-volume ratio, efficient gas adsorption occurs on the surface of the carbon nanotubes. Gas adsorption causes the SWCNT to change its conductivity. The one-dimensional quantum wire nature makes its electronic properties very sensitive to gas adsorption. SWCNT based chemiresistors have demonstrated high sensitivity to gases and vapors such as nitrogen dioxide (NO_2), benzene, nitromethane and nitrotoluene.
A high pressure CO disproportionation (HiPco) process produced SWCNTs are used in this study. Very high purity single-walled carbon nanotubes (SWCNTs) were obtained from this HiPco SWCNT samples containing Fe particles by a two-step purification process. The raw and purified samples were characterized using high-resolution transmission electron microscopy, Raman spectroscopy and thermogravimetric analysis. The purified sample consists of ~ 0.4% Fe and the process does not seem to introduce any additional defects. The N_2 adsorption isotherm studies at 77K reveal that the total surface area of the purified sample increases to 1587 m^2/g that is the highest value reported for SWCNTs.
The adsorption properties to different analytes and pore structures of this purified SWCNT have been investigated. The polarity, electronegatitivty and vapor pressure of the analytes will be correlated to the sensor performance, such as response amplitude, response curve shape, response time and sensitivity, of SWCNT based chemiresistors.

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