Yong Zhang et al., Res. Rev. J Mat. Sci. 2018, Volume 6
DOI: 10.4172/2321-6212-C2-017

Properties of a weakly ionized NO gas sensor based on multi-walled carbon nanotubes

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Nitric oxide NO is one of the major targets for environmental monitoring and causes environmental and human health problems. Hence, it is of significant importance to measure NO concentrations in the air. However, the existing NO sensors are limited by their low sensitivity and narrow test range. Here, a weakly ionized NO gas sensor employing multiwalled carbon nanotubes (MWCNTs) was fabricated, and its properties in NO-N_2 mixture were investigated from both emission and ionization. The current Ie passing through the nanotubes cathode was found to decrease with increasing NO concentration and increase linearly in different slopes with the extracting voltage Ue. It is shown that the Schottky barrier of the MWCNTs calculated by Ie increased with NO concentration due to the adsorption of NO gas, which restrained the electron emission and consequently weakened the ionization. The positive ion currents Ic passing through the collecting electrode at different voltages of Ue were found to be monotonically decrease with increasing NO concentration which was induced by both of the reduced electron emission and the consumption of the two excited metastable states $N_2(A_3\Sigma u+)$ and $N_2(a'1\Sigma u-)$ by NO. The sensor exhibited high sensitivity at the low temperature of 30°C. The calculated conductivity was found to be able to take place of Ic for NO detection in a wide voltage range of 80-150V Ue.

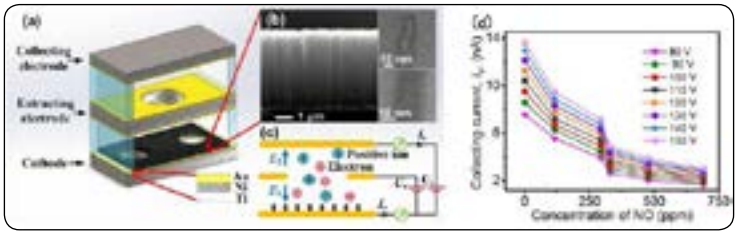

Figure 1: (a) The stucture of the sensor, (b) SEM and TEM of MWCNTs, (c) Schematic diagram of the test system, (d) Ic vs. NO concentrations at different Ue.

Recent Publications:

1. Zhang J Y et al. (2015) Properties of a weakly ionized NO gas sensor based on multi-walled carbon nanotubes. Applied Physics Letters. 107(9):093104-1-4.
2. Pan Z G et al. (2017) A high-integration sensor array sensitive to oxynitride mixture. Sensors and Actuators B Chemical. 245:183-188.
3. Pan Z G et al. (2017) Sensing properties of a novel temperature sensor based on field assisted thermal emission. Sensors. 17(3):473.
4. Zhang Y et al. (2013) High - performance gas sensors with temperature measurement. Scientific Reports. 3:1267-1-7.
5. Zhang Y, Liu J H and Zhu C C (2010) Novel gas ionization sensors using carbon nanotubes. Sensor Letters. 8(2):219-227.

Biography

Yong Zhang obtained his Bachelor's in Department of Electron, Master's in Department of Electron and Doctor Degree in Department of Measurement and Control Technology and Instrument from Xi'an Jiaotong University, respectively. She is a Professor in the School of Electrical Engineering of Xi'an Jiaotong University, a fixed Member of the State Key Lab of Electrical Institute and Power Equipment, a Senior Member of IEEE, and an expert Committee Member of Energy Equipment of China Energy Society. She has published 43 papers in international well-known publications (*Sensors and Actuators B: Chemical* of the Nature Publishing Group, *Sensors and Actuators B: Chemical* and so on). Twenty six of her patents have been authorized and 7 patents have been accepted by the Patent Office of China.

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