Formaldehyde Sensing Properties of Conducting Polymer-Functionalized Carbon Nanocomposites

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Abstract

There is a growing demand for room temperature chemical sensor detecting volatile organic compounds (VOCs), specifically formaldehyde, with a high sensitivity and selectivity. Polyethyleneimine (PEI) was reported to be effective in sensing formaldehyde due to the interactive affinity between formaldehyde molecules and amine groups of PEI [1]. Multi-walled carbon nanotube (MWNT) and graphene oxide (GO) were chosen as a carbonaceous platform nanomaterial for detecting formaldehyde in this work. PEI was attached to acyl chloride group-modified MWNTs and GOs, respectively. Then the prepared MWNT-PEI and GO-PEI were respectively surrounded with conducting polymer by carrying out an in-situ chemical oxidative polymerization. Intrinsically conducting polymers (ICPs) such as polypyrrole (PPy), poly(3,4-ethylenedioxy thiophene) (PEDOT) and polyaniline (PANI) were used for the conducting polymer non-covalent functionalization of MWNT-PEI and GO-PEI. Then the obtained ICP-functionalized carbon nanocomposites were used as a chemiresistor for the detection of formaldehyde in the closed gas sensing system. Both MWNT-PEI/PEDOT and GO-PEI/PEDOT showed the most excellent sensitivity and selectivity to formaldehyde among the ICP-functionalized carbon nanocomposites. The reason for the enhanced formaldehyde sensing response of them was addressed based on the characterization results. A characterization of ICP-functionalized carbon nanocomposites was made by using Fourier transform infrared spectroscopy, Raman spectroscopy, X-ray diffractometer, theromogravimetric analysis, transmission electron microscopy and X-ray photoelectron spectroscopy.

References

[1] X. Wang, B. Ding, M. Sun, J. Yu, and G. Sun, Sensors & Actuators B: Chemical, **144** (2010) 11-17.

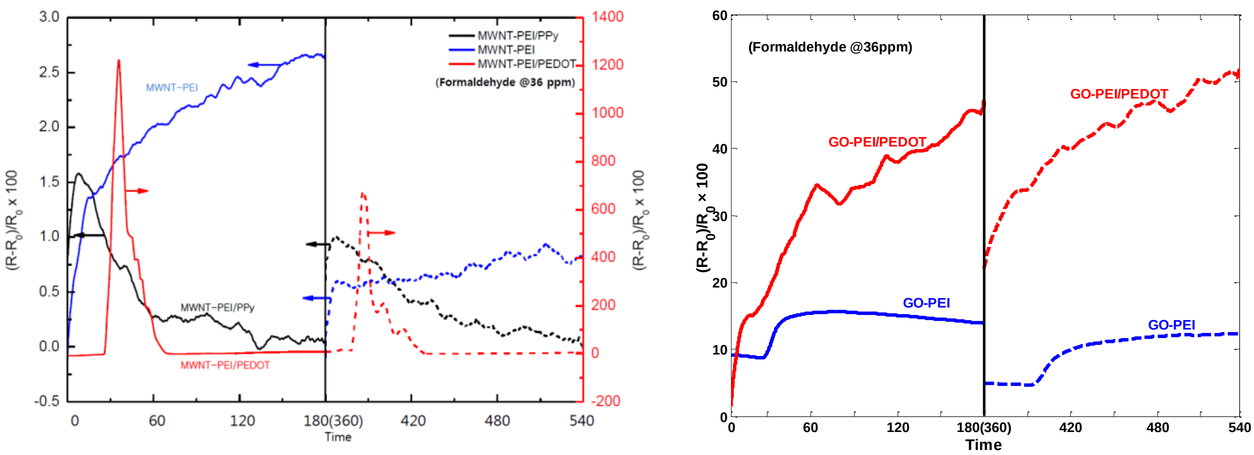


Figure 1. Relative resistance increase of ICP-functionalized MWNT**(Left)** and GO**(Right)** nanocomposites when exposed to 36 ppm of formaldehyde.

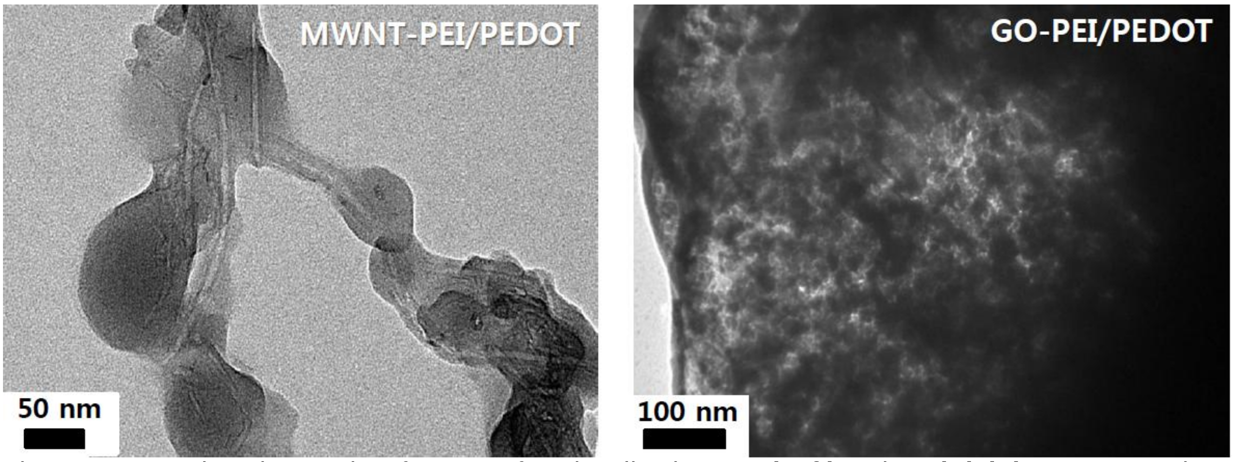
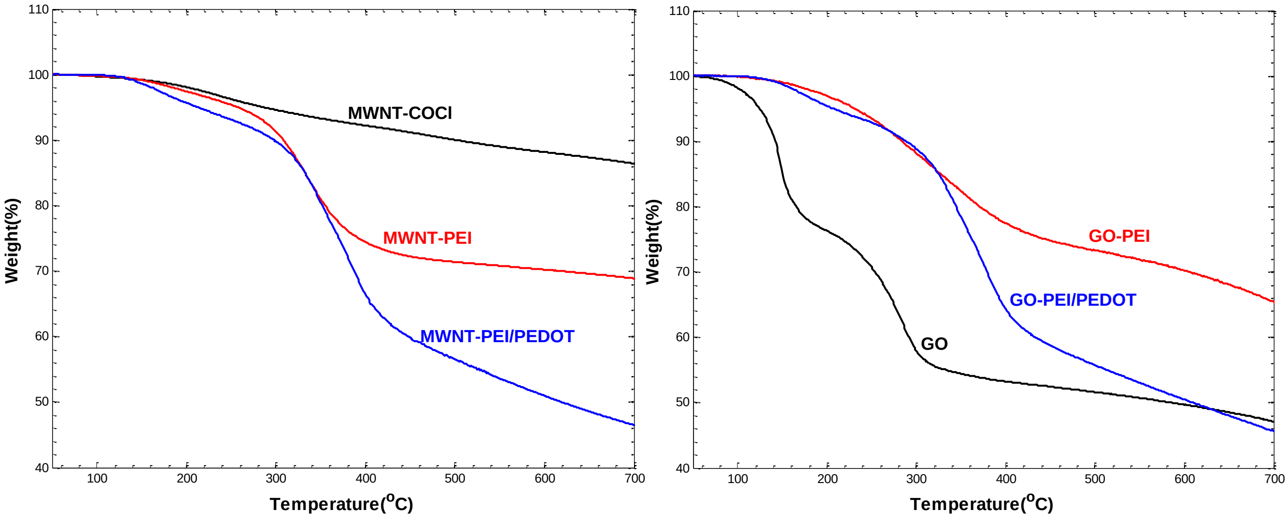
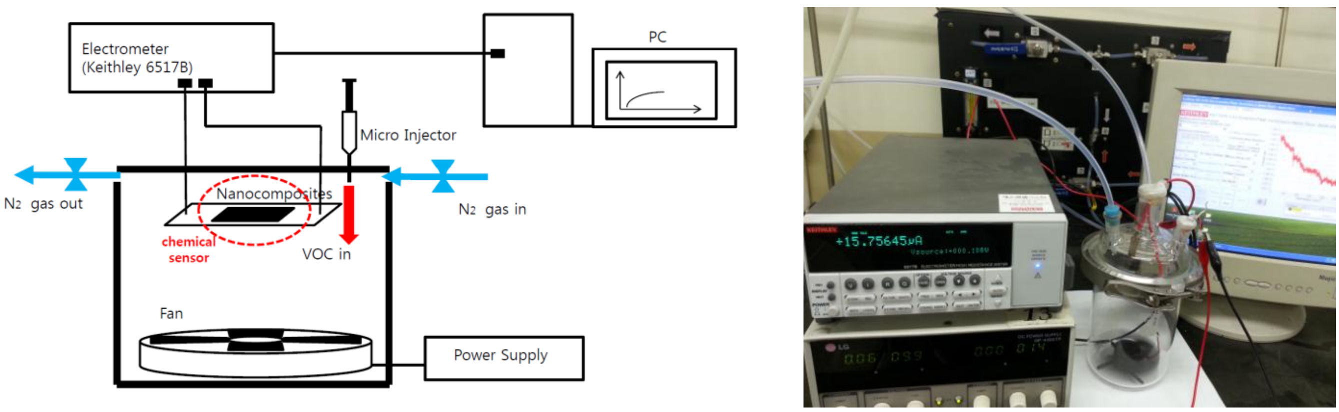


Figure 2. TEM microphtographs of PEDOT-functionalized MWNT**(Left)** and GO**(Right)** nanocomposites.



. Figure 3. TGA thermograms of PEDOT-functionalized MWNT **(Left)** and GO **(Right)** nanocomposites.



. Figure 4. Experimental setup for formaldehyde sensing.