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Polymer/Metal Nanoparticle/Nanocarbon Hybrid Materials for Highly Sensitive and Selective Volatile Organic compound Detection

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Recently, gas sensor based on the simple change in its resistance in response to the analytes, has been focused as a promising candidate for practical sensing devices. Several nanostructured materials such as carbon nanotube (CNT) and graphene, have attracted considerable attention as alternative sensing materials because of their distinctive characteristics in structural, electrical and mechanical properties. In this study, we studied on hybrid materials based on metal nanoparticle (NP) and polymer-functionalized nanocarbon materials for highly sensitive and selective volatile organic compound (VOC) detection. By taking dichloromethane (DCM) sensing as an example, we successfully demonstrated a highly sensitive detection of DCM vapor at room-temperature operation by means of functionalization of CNT with PMMA and Pt NPs. The response of hybrid sensor to DCM was 69-fold higher than that of pristine SWNT and linearly increased with increasing DCM concentration. The sensing mechanism was elucidated by polymer swelling and catalytic oxidation on the Pt NPs catalyst surface. Besides Pt/PMMA/CNT system, the sensing performance of the sensor based on polymer-coated graphene was also investigated. With the selection of coating polymer, the sensivity and selectivity of the sensor were successlly improved. These results suggest that the integration of nanocarbon materials with polymer and nanoparticle is a promising approach for highly sensitive and selective volatile organic compound detection.

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