PEN-BASED WRITING OF FUNCTIONALIZED MWCNT-PEDOT:PSS INK ON FLEXIBLE SUBSTRATE FOR APPLICATION IN AMMONIA GAS SENSOR

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Abstract

Functionalized multi-walled carbon nanotubes dispersed in a polymer mixture of poly (3,4-ethylenedioxythiophene): poly (styrenesulfonate) (*f*-MWCNT-PEDOT:PSS) have been presented as a functional ink for fabrication of room-temperature gas sensor. The ink was deposited onto the flexible substrates with silver interdigitated electrodes by a handwriting method. The sensor shows the sensitivity and selectivity to NH_3 at room-temperature. The high performance of sensor has attributed to the functionalized effect in the increment of extra active area for gas adsorption. The sensor can be worked without noticeable reduction in gas response although it is bent to the heavy disorder. The sensing mechanisms of sensor have proposed based on the reaction between NH_3 molecules and oxygen species on the surface of *f*-MWCNTs. The direct charge-transfers and the film swelling of polymer have been also proposed as possible NH_3-sensing mechanisms. From these findings, the direct ink writing is an effective method for preparing the sensing film of gas sensor. Furthermore, the *f*-MWCNT-PEDOT: PSS ink has the high potential to be selected as a good material for flexible NH_3-sensing applications.

Keywords: Ink, Carbon Nanotube, PEDOT: PSS, Gas Sensor, Pen-Based Writing

Introduction

Ammonia (NH_3) has been known as a technologically important gas for use in various industries associated with pharmaceutical production, medical treatment, environmental applications and food processing. However, NH_3 is toxic, harmful and flammable. Therefore, the gas sensing study has been focused on the NH_3 applications to monitor the leakage of NH_3. Poly (3, 4-ethylenedioxythiophene): poly (styrenesulfonate) (PEDOT:PSS), Multiwalled carbon nanotubes (MWCNTs) and their composites based gas sensors have attracted attention according to their performances in real-time monitoring, fast response and recovery for NH_3 and other hazardous gas detections (Isa *et al*., 2017; Chiou *et al*., 2019; Janudin *et al*., 2018; Lv *et al*., 2019; Fan *et al*., 2019). Many researchers have concentrated on the enhancement of NH_3 sensitivity at room-temperature by using the functionalization of some organic compounds and the decoration of metal nanoparticles on the MWCNT sidewalls (Wongchoosuk *et al*., 2010; Alvi *et al*., 2014; Han *et al*., 2014; Alshammari *et al*., 2017; Casanova-

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