Yotsarayuth Seekaew 2014: Development of Flexible Gas Sensors Based on Ink-jet Printing Method. Master of Science (Physics), Major Field: Physics, Department of Physics. Thesis Advisor: Mr. Chatchawal Wongchoosuk, Ph.D. 60 pages.

This work presents a simple, low-cost and practical inkjet-printing technique for fabricating innovative flexible gas sensors made of Poly(3,4-ethylenedioxythiophene): Polystyrene sulfonate (PEDOT:PSS) conducting polymer and graphene material composite film with high uniformity over a large area. The fabricated flexible gas sensors have been investigated for ammonia (NH_3) detection at room temperature. Transmission electron microscopy (TEM), Atomic force microscopy (AFM), Fourier transform infrared spectroscopy (FTIR), UV-visible spectrometer and Raman spectroscopy were used to characterize the morphology and formation mechanism of printed sensing films. The results show that the electrical resistance of the films decreases with increasing film thickness. The based line resistance of sensing film can change on time due to humidity effect. The heating temperature of 90 ^{0}c for 20 min can correct the drift effect and recover the based line resistance to the original sensor. AFM results show an increase of surface roughness after adding of graphene into PEDOT:PSS. It suggests a significant enhancement of the active surface-area for gas adsorption by graphene. TEM, FTIR and Raman characterizations confirm the presence of few-layer graphene in PEDOT:PSS polymer matrix and the present of $\pi - \pi$ interactions between graphene and PEDOT: PSS. The ink-jet printed graphene-PEDOT:PSS gas sensor exhibits high response and high selectivity to NH_3 in a low concentration range of 25-1000 ppm at room temperature. The sensing mechanism of graphene-PEDOT:PSS sensor has been discussed in term of three possible mechanisms; (I) reducing reaction, (II) direct charge transfer process, and (III) swelling process.

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