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Sensor Gas Metilamina Berbasis Quartz Crystal Microbalance dengan Lapisan Aktif Nanofiber Polietilena dan Timah(IV) Oksida
Ghissani Mulan, Prof. Drs. Roto, M. Eng., Ph.D. ; Prof. Dr. Endang Tri Wahyuni, M.S.
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SENSOR GAS METILAMINA BERBASIS *QUARTZ CRYSTAL MICROBALANCE* DENGAN LAPISAN AKTIF NANOFIBER POLIETILENA OKSIDA DAN TIMAH(IV) OKSIDA

Ghissani Mulan
21/480761/PA/20903

INTISARI

Metilamina merupakan senyawa gas tidak berwarna dengan bau menyengat yang bersifat toksik dan berbahaya bagi sistem pernapasan manusia jika terhirup dalam konsentrasi tinggi. Penelitian ini mengembangkan sensor gas metilamina berbasis *Quartz Crystal Microbalance* (QCM) yang dimodifikasi dengan lapisan aktif nanofiber komposit polietilena oksida/timah(IV) oksida (PEO-SnO_2). Nanofiber PEO disintesis melalui metode *electrospinning* yang diberi doping SnO_2 0,1% untuk analisis performa sensor. Karakterisasi komposisi kimia dan morfologi permukaan dilakukan menggunakan *Fourier-transform infrared* (FTIR), *Scanning electron microscopy* (SEM), dan *Energy-dispersive X-Ray Fluorescence* (EDX).

Hasil analisis FTIR mengonfirmasi keberhasilan pembentukan nanofiber PEO melalui identifikasi gugus eter (C–O–C). Hasil SEM menunjukkan bahwa doping SnO_2 memengaruhi morfologi nanofiber dengan perubahan struktur permukaan. Sementara itu, hasil EDX mengidentifikasi keberadaan SnO_2 pada sampel. Sensor QCM termodifikasi nanofiber PEO-SnO_2 menunjukkan peningkatan sensitivitas terhadap gas metilamina dengan pergeseran frekuensi sebesar 20 ± 3 Hz dan sensitivitas 0,326 Hz/ppm. Sensor menghasilkan selektivitas tinggi terhadap metilamina dibandingkan senyawa lain yaitu BTX (benzena, toluena, xilena), alkohol (etanol, metanol, 1-propanol, 2-propanol), dan aseton. Mekanisme deteksi diduga melibatkan interaksi asam-basa Lewis dan interaksi dipol-dipol antara metilamina dengan permukaan PEO-SnO_2.

Kata kunci: metilamina, nanofiber, polietilena oksida, SnO_2, sensor QCM

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METHYLAMINE GAS SENSOR BASED ON QUARTZ CRYSTAL MICROBALANCE WITH NANOFIBER ACTIVE LAYER OF POLYETHYLENE OXIDE MODIFIED WITH TIN(IV)

Ghissani Mulan
21/480761/PA/20903

ABSTRACT

Methylamine is a colorless gas with a pungent odor, toxic, and hazardous to the human respiratory system when inhaled at high concentrations. This study developed a methylamine gas sensor based on a Quartz Crystal Microbalance (QCM) modified with an active composite nanofiber layer of polyethylene oxide/tin(IV) oxide (PEO-SnO_2). The PEO nanofibers were synthesized via the electrospinning method, with SnO_2 doping at a concentration of 0.1% for sensor performance analysis. The chemical composition and surface morphology were characterized using Fourier-transform infrared (FTIR) spectroscopy, Scanning electron microscopy (SEM), and Energy-dispersive X-Ray Fluorescence (EDX).

FTIR analysis confirmed the successful formation of PEO nanofibers, as indicated by the presence of ether (C–O–C) groups. SEM results revealed that SnO_2 doping influenced the nanofiber morphology, leading to morphological changes. In addition, the EDX identified the presence of SnO_2 in the sample. The QCM sensor modified with PEO-SnO_2 nanofibers exhibited enhanced sensitivity toward methylamine gas, with a frequency shift of 20 ± 3 Hz and a sensitivity of 0.326 Hz/ppm. The sensor also demonstrated high selectivity for methylamine compared to other compounds, including BTX compounds (benzene, toluene, xylene), alcohols (ethanol, methanol, 1-propanol, 2-propanol), and acetone. The sensing mechanism is attributed to Lewis acid-base and dipole-dipole interactions between methylamine and the PEO-SnO_2 composite.

Keywords: methylamine, nanofiber, polyethylene oxide, SnO_2, QCM sensor