Acetone vapor-sensing properties of chitosan-polyethylene glycol using surface plasmon resonance technique

ABSTRACT

To non-invasively monitor and screen for diabetes in patients, there is need to detect low concentration of acetone vapor in the range from 1.8 ppm to 5 ppm, which is the concentration range of acetone vapor in diabetic patients. This work presents an investigation for the utilization of chitosan-polyethylene glycol (PEG)-based surface plasmon resonance (SPR) sensor in the detection of trace concentration acetone vapor in the range of breath acetone in diabetic subjects. The structure, morphology, and elemental composition of the chitosan-PEG sensing layer were characterized using FTIR, UV-VIS, FESEM, EDX, AFM, and XPS methods. Response testing was conducted using low concentration of acetone vapor in the range of 0.5 ppm to 5 ppm using SPR technique. All the measurements were conducted at room temperature and 50 mL/min gas flow rate. The sensor showed good sensitivity, linearity, repeatability, reversibility, stability, and high affinity toward acetone vapor. The sensor also showed better selectivity to acetone compared to methanol, ethanol, and propanol vapors. More importantly, the lowest detection limit (LOD) of about 0.96 ppb confirmed the applicability of the sensor for the non-invasive monitoring and screening of diabetes.

Keyword: Surface plasmon resonance sensor; Acetone vapor detection; Diabetes; Chitosan-polyethylene glycol film; Non-invasive