CHAPTER 4

CONCLUSION

Fabrication of P2ABA/SWNTs composites thin film by electrochemical-surface plasmon resonance (EC-SPR) spectroscopy technique was successfully prepared. Characterization and property study of P2ABA/SWNTs composite thin films were investigated using EC-SPR spectroscopy, UV-vis absorption spectroscopy, FT-IR/ATR and QCM-D techniques**.** Fabrication of the electrochemical sensor based P2ABA/ZnO nanoparticles composite thin films were also performed with the intention to improve the sensitivity of P2ABA thin films. Detection of some biomolecules such as adrenaline, UA and AA, using P2ABA /SWNTs composite thin films and P2ABA/ZnO nanoparticles composite thin films were investigated.

The P2ABA thin film was grown on the gold surface by electropolymerization of 2ABA monomer. During cyclic voltammetry scan, the first oxidation peak which was about 0.85 V corresponds to the oxidation of 2ABA monomer in order to form P2ABA film. The dedoping peak at about 0.4 V in the cathodic scan and doping peak at about 0.5 V in the anodic scan of the second cycle correspond to the electron transfer to formation of redox couple during the oxidation of P2ABA. The SPR curve was shifted to the higher dip angle after electropolymerization indicating that the P2ABA was deposited on the gold electrode. The thickness of the film was calculated by Fresnel calculation (Winspall software version 3.02) by fitting data from the obtained SPR curves. The thickness of deposited P2ABA film was estimated to be 10 nm.

For the detection of adrenaline on the P2ABA thin film, electroactivity of P2ABA was studied in PBS supporting electrolyte solution (pH 7.4) by cyclic voltammetry, which indicated that the electrochemical signal can be enhanced in the event of specific reaction with adrenaline. The SPR reflectivity change was observed after injection of 1 mM adrenaline at an applied potential of 0.5 V. SPR reflectivity increased rapidly and gradually increased due to the specific adsorption and physical adsorption between adrenaline with benzylamine in P2ABA structure. The detection limit of SPR reflectivity response upon injection of adrenaline into P2ABA thin film was determined to be 10 pM at an open circuit potential. EC-SPR responses of adrenaline in the presence of UA and AA was also studied, the current and reflectivity changes in the UA and AA were observed to be smaller than that of adrenaline because UA and AA did not has a catechol group in the structure react with benzylamine to form fluorescence derivative structure. Furthermore, the experiment at –0.2 V and open circuit (dedoped and neutral state of P2ABA in PBS solution) were found that P2ABA increasing the selectivity of adrenaline detection over UA and AA. Since adrenaline easily oxidizes to react with benzylamine site and offers the electron to P2ABA, the P2ABA becomes the dedoped state. Moreover, the P2ABA film has an amino-functionalized group, which can attract the negative ion from adrenaline. Therefore, EC-SPR response of adrenaline in the presence of UA and AA at –0.2 V and an open circuit was observed in terms of selectivity than that of 0.5 V. UV-vis absorption spectra properties at applied constant potential of 0.5 V indicated that the specific reaction of adrenaline with benzylamine in P2ABA structure. The selectivity of adrenaline at a constant applied potential of –0.2 V and an open circuit, showed improvement of the selectivity because SPR reflectivity response of adrenaline separating from the SPR reflectivity responses detect of UA and AA. Furthermore, QCM-D results at an open circuit indicated that adrenaline reacted with benzylamine site in the P2ABA films and confirmed the result from EC-SPR spectroscopy.

The cyclic voltammetry measurement results, the redox current of P2ABA/SWNTs composites thin film higher than P2ABA thin film because P2ABA/SWNTs composites thin film has more charge capacitance. The cyclic voltammetry at the second scan decrease because electroactivity of P2ABA can be shifted to neutral pH by doping P2ABA with anion. Then UA was detected using P2ABA/SWNTs composites thin film at a constant applied potential of 0.5 V, which showed the SPR reflectivity response of UA separate from the SPR reflectivity response of AA. P2ABA/SWNTs composite thin films based electrochemical sensor showed a possibility to develop high sensitive EC-SPR UA sensor using electropolymerized P2ABA film and suspension of carboxylated SWNTs were assembled on the P2ABA film, which can be applied for rapid measurement of UA in urine.

It was found that electrochemical sensor based P2ABA/ZnO nanoparticles composites thin film provided no improvement in the sensitivity of P2ABA thin film for the detection of adrenaline, UA and AA. When P2ABA/ZnO nanoparticles composites thin film was employed to detect UA in the presence of AA, it was found that P2ABA/ZnO nanoparticles composites thin film showed higher sensitivity towards UA than that of AA. When P2ABA/ZnO nanoparticles composite and P2ABA/SWNTs composite thin films were employed for the detection of UA, P2ABA/SWNTs composites thin film gave higher SPR and current response than P2ABA/ZnO nanoparticles composites thin film, therefore it can be concluded that P2ABA/SWNTs composites thin film was found to be a better biosensor for the detection of UA.