

CHAPTER V

CONCLUSION

5.1 Conclusion

Polyaniline blended with polyvinyl alcohol (PAni-PVA blended film) was developed for ammonia sensing. Polyaniline base (PAni-EB) was synthesized by chemical oxidation polymerization in the acid condition. Synthesized PAni-EB was characterized by Fourier-Transform Infrared Spectrometer (FT-IR) and resulted similar spectrum to those reported earlier. PAni-PVA blended film was prepared and having citric acid to cross-link the PVA and doping the PAni-EB. All characteristic peaks of FT-IR spectrum of citric acid doped polyaniline was comparable to those of hydrochloric acid doped polyaniline indicating the conductive form of polyaniline. The morphology of polymer films was examined by Scanning Electron Microscope (SEM). Evenly distribution of PAni-ES (green color) in PVA was observed for PAni-PVA blended film. This indicated a uniform blending of PAni with PVA. When exposed to ammonia gas, the conductance of PAni-PVA blended film showed a remarkable change while the PVA, PVA-citric acid and PVA-PAni-EB films resulted a slightly change. Therefore, the sensing ability of the film was arising from the doping polyaniline with citric acid. The conductance of PAni-PVA blend film was increased when exposed to ammonia gas which is unusual for ammonia sensing by polyaniline. The proposed mechanism of this phenomenon was the competition of two available sites for ammonia attraction into PAni-PVA blended film, the proton at carboxylic group of citric acid and the proton at PAni chain. The former site led to a conductance increase and the latter site led to a conductance decrease. The predominant of the former result the overall conductance increase of the PAni-PVA blended film on the ammonia gas exposure.

The conductance of PANi-PVA blended films on exposure to 90 ppm ammonia gas were proportional to the quantities of the citric acid doped. The optimized citric acid doped was 4% w/v for fast and efficient sensing of ammonia gas. The conductance of the films also increased with increasing film thickness and required a longer time to reach their equilibrium. The optimized condition was using a 0.15 – 0.20 mm film thickness operating at room temperature (30°C) and 60%RH. This film showed a good repeatability and reversibility of ammonia gas sensing. The response and recovery time were 10 and 20 minutes, respectively. The responses of repeated exposure and removal of ammonia gas were reproducible up to 9 cycles. In the presence of 10 to 100 ppm of ammonia gas, the changes of conductivity were well related to the concentration of ammonia gas.

We have successfully developed ammonia sensing which is sensitive, stable, reversible, cheap, fast in response and easy to regenerate. The new sensor effectively eliminates the limitations associated with the current conducting polymer gas sensors, which are based on conductivity measurements.

5.2 Suggestion of future work

The limitation ammonia detection was digital multimeter conductance. The highest conductance that it can detect was not above 500 nS. In the experimental, this limitation allowed ammonia gas detection at only 100 ppm. The advancement of other multimeter should be performed for the future experimental. It is well known that interaction with water vapor also increases the conductivity of PANi and other conducting polymers. Thus, humidity surrounding a sensor will be influent the ammonia detection capability of PANi-PVA blended films. Consequently, humidity is a parameter that must be dealt within the process of sensor developing.