

## CHAPTER IV

### CONCLUSION

Poly(3-hexylthiophene) (P3HT) has been successfully prepared by polymerization of 3-hexylthiophene with anhydrous ferric chloride. Extracted P3HT had been extracted into 5 fractions by consecutive solvent extraction with acetone, hexane,  $\text{CH}_2\text{Cl}_2$ , 10% $\text{CHCl}_3$  in  $\text{CH}_2\text{Cl}_2$ , and  $\text{CHCl}_3$  in which the P3HT fractions with increasing average molecular weight were obtained with respect to the order of extractions. From the result of UV-visible spectra and  $^1\text{H-NMR}$  spectra, the values of  $\lambda_{\text{max}}$ , %HT and AC-index were approximately and comparably correlated with the average molecular weight, and hence the effective conjugation length of the polymer. Upon doping with TFA, the change in AC-index values of each fraction showed similar trend of doping level and behavior.

When P3HT was doped by TFA, a significant change was observed in the UV-visible spectra at 3 wavelengths (440, 541, and 824 nm). The change of AC-index values was quite similar to that of the absorbance at 824 nm which was assumed to be the absorbance of polaron, induced by the different doping levels of acid, emphasizing the applicability of AC-index for the determination the doping level of polymer. Furthermore, the AC-index values of P3HT doped by TCA, DCA, and CA were found to be linearly correlated to the acidity of acid dopants.

The best condition for the oxidation of P3HT in the study so far was the premixed of UHP/TFA before adding to P3HT solution followed by gentle heating. The UV-visible spectra of oxidized mixture showed a slight shift of  $\lambda_{\text{max}}$  and no new peak detected. But from this experiment, the oxidation progress could be alternatively monitored by calculating the AC-index values from the spectra.

From the solvato-controlled doping, MSA and thiophene were found to be the optimized pair of strong dopants and good coordinating ligand. The result showed homogeneity throughout the whole process of turning the solution into films.

From the conductometric method, the conductivity curve was quite similar to the AC-index curve when plotted against number of equivalence of added TFA. This

further emphasized a relationship between these two parameters, and eventually, with the effective conjugation length of the polymer. The conductivity of the polymer solution was also found to increase with the concentration of the polymer. From the 4-point probe method, the P3HT film doped with TCA was found to be more stable than P3HT film doped with I<sub>2</sub>. The measured conductivity was also higher and increased with more amount of TCA dopant.