

## CHAPTER IV

### CONCLUSION

Polythiophene (PT) and poly(3-hexylthiophene) (P3HT) have been successfully prepared by polymerization with ferric chloride. Synthesis of PT and P3HT containing thienyl *S,S*-dioxide groups by adding polymerizing agent and oxidizing agent (*m*CPBA) together in the reactor (one-pot method) yielded no product. Oxidation of PT by consecutive method degraded the polymer without the formation of sulfone group. The unsuccessful oxidation may arise from the problem that PT did not dissolve in any solvents and that made it difficult to initiate the reaction on the entangled, insoluble polymer chains. The soluble P3HT oxidized by *m*CPBA or H<sub>2</sub>O<sub>2</sub>/TFA yielded the end products with higher UV-Visible absorption in longer wavelength region. The films of P3HT oxidized by H<sub>2</sub>O<sub>2</sub>/TFA looked quite similar to the P3HT which, after being doped by iodine-vapor, showed the conductivity of 0.6 S.cm<sup>-1</sup>, higher than the non-oxidized P3HT (0.37 S.cm<sup>-1</sup>).

The P3HT solution was doped with aqueous HClO<sub>4</sub> in THF. By following the reaction by UV-Visible spectroscopy the intensity of the absorbance at  $\lambda_{\max}$  gradually reduced while the absorbance at higher wavelength increased. The AC-index method was proposed to follow the progress of the altered UV-Visible absorption spectra that corresponded to the partial oxidation of P3HT. High AC-index would reflect the high effective conjugation length within the polymer chain which, in turn, could correlate to high conductive properties. The AC-index of the oxidation of P3HT by *m*CPBA or H<sub>2</sub>O<sub>2</sub>/TFA generally increased at the beginning, decreased slightly, and finally rised up again. The downward curve was assumed to be due to the degradation of the polymer took place faster than the formation of the sulfone groups, where longer conjugations in the polymer chain were expected. From AC-index of P3HT solution doped by HClO<sub>4</sub>, the values increased continuously until the precipitation occurred. In contrast, doping by TFA gave AC-index values that were leveled off around 20-30 min of reaction time without precipitation. Furthermore, the AC-index could clearly indicate the different effect from the amount in doping agent. The polymer doped at higher doping agent concentration (TFA) showed higher AC-index values.