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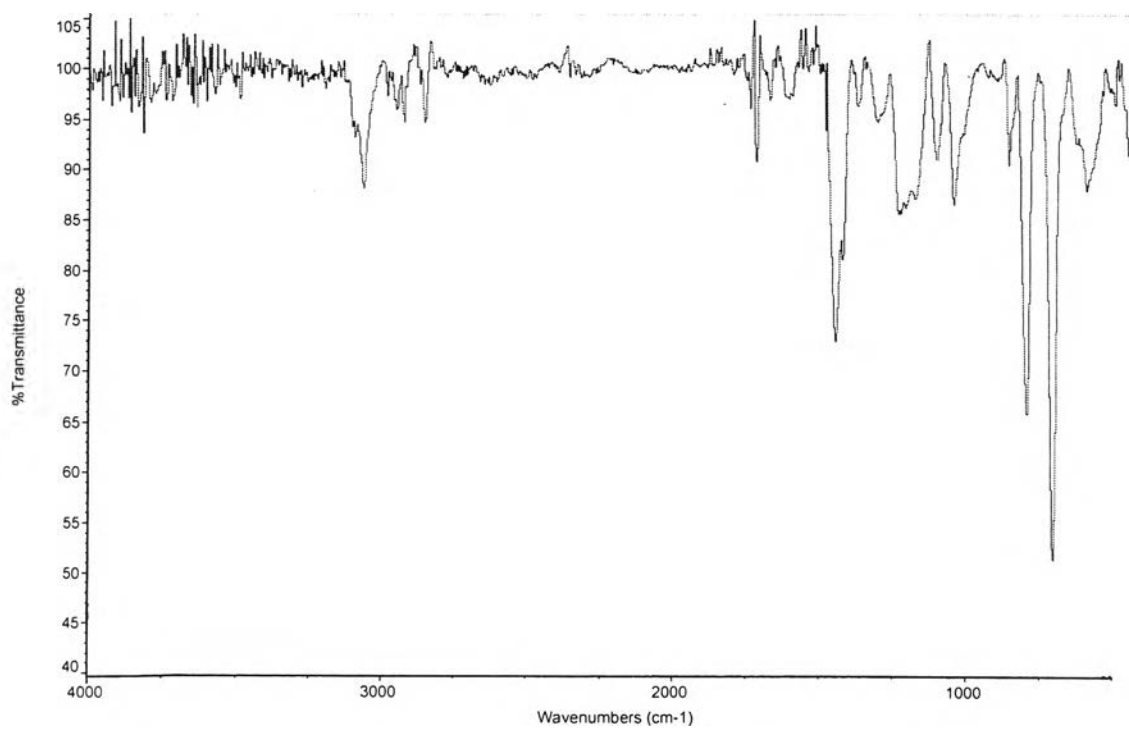
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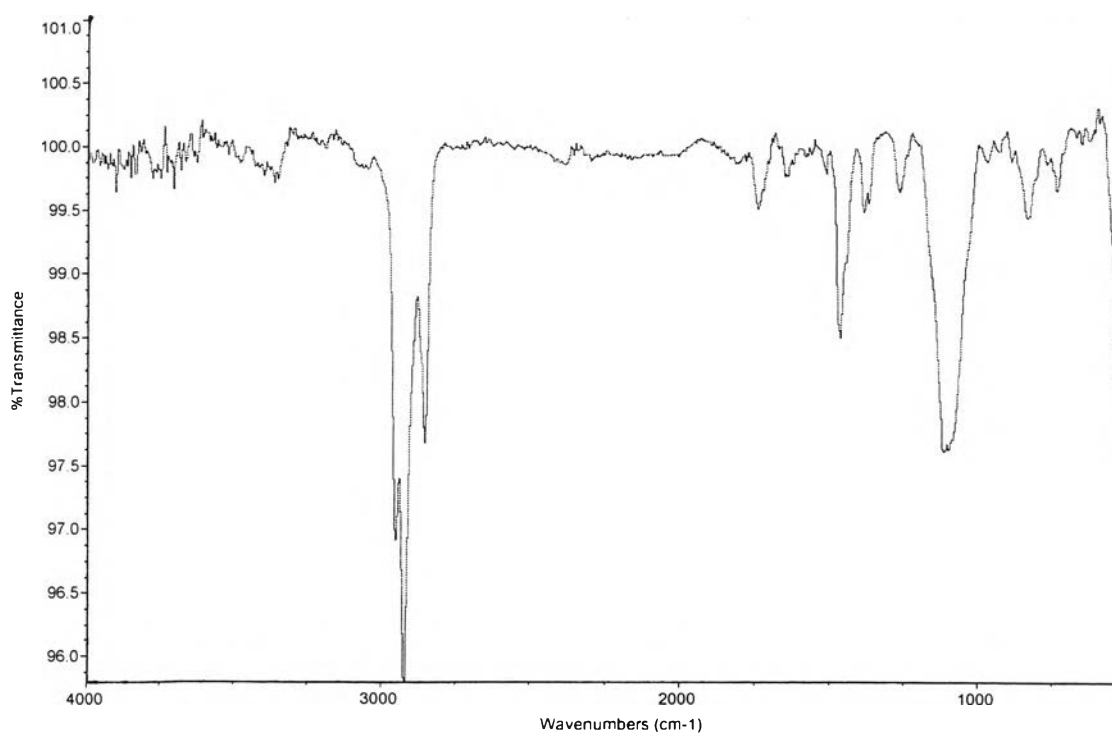
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## **APPENDICES**

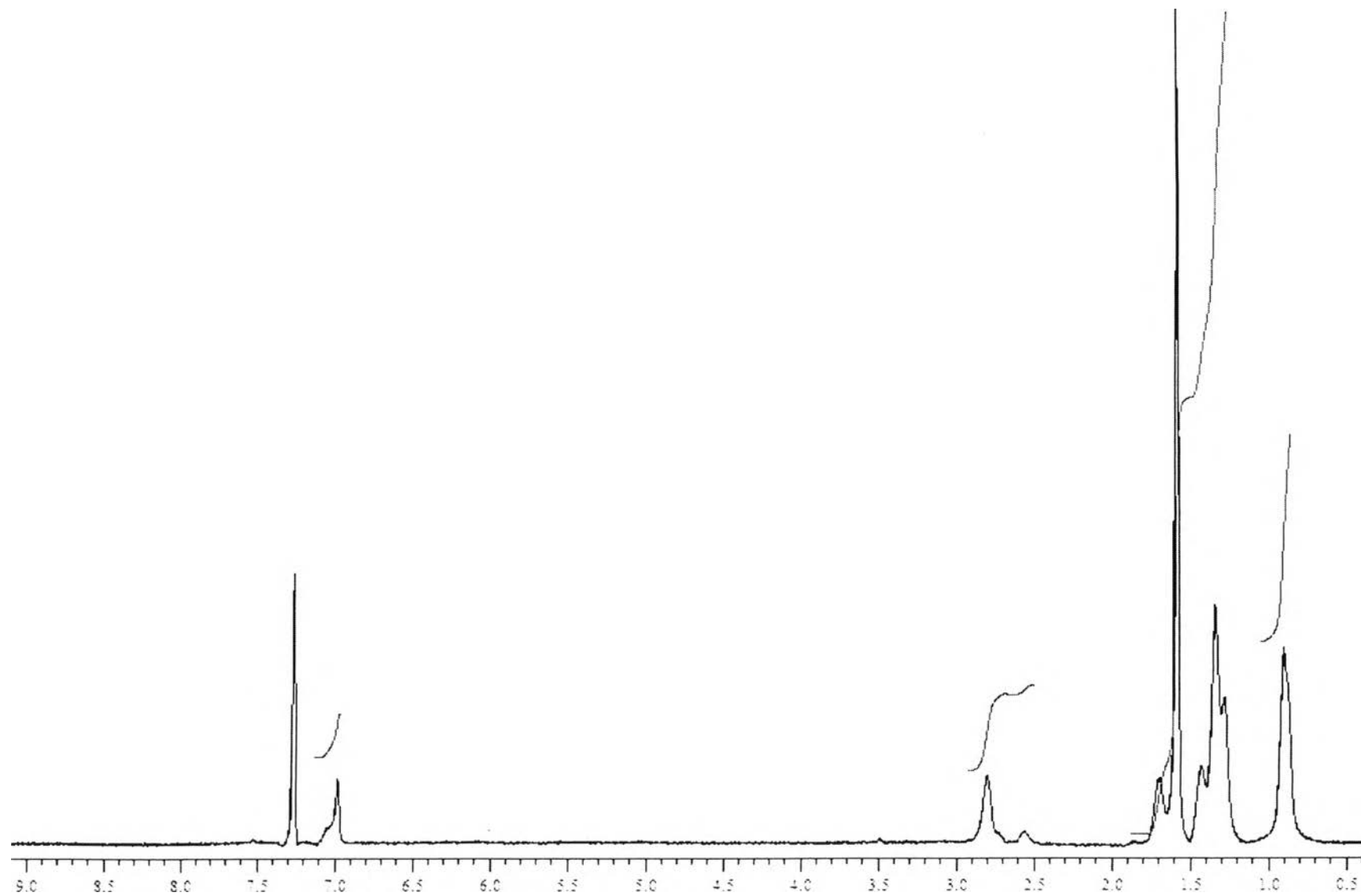
## **APPENDIX A**



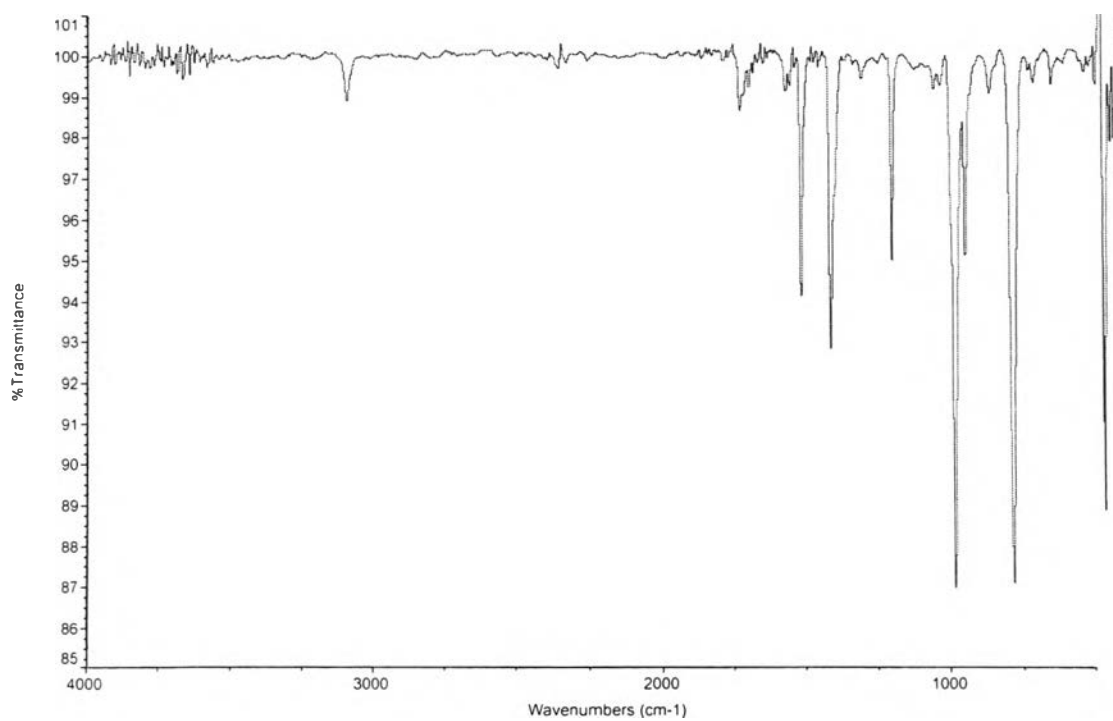
**Figure A-1** FT-IR (KBr) spectrum of polythiophene.



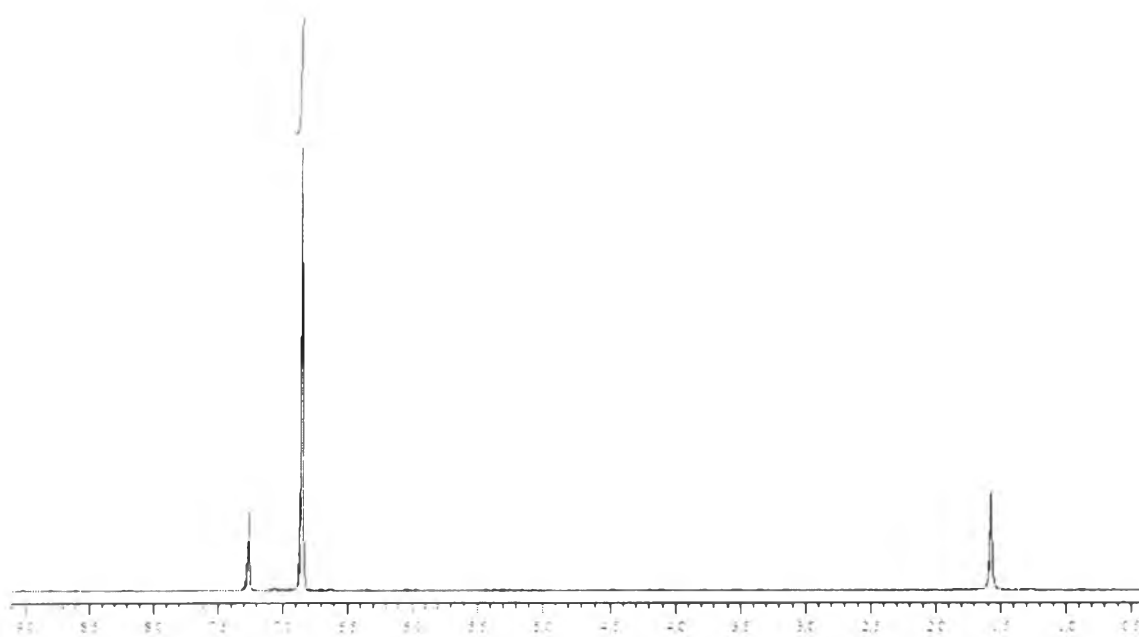
**Figure A-2** FT-IR (KBr) spectrum of poly(3-hexylthiophene) (P3HT).



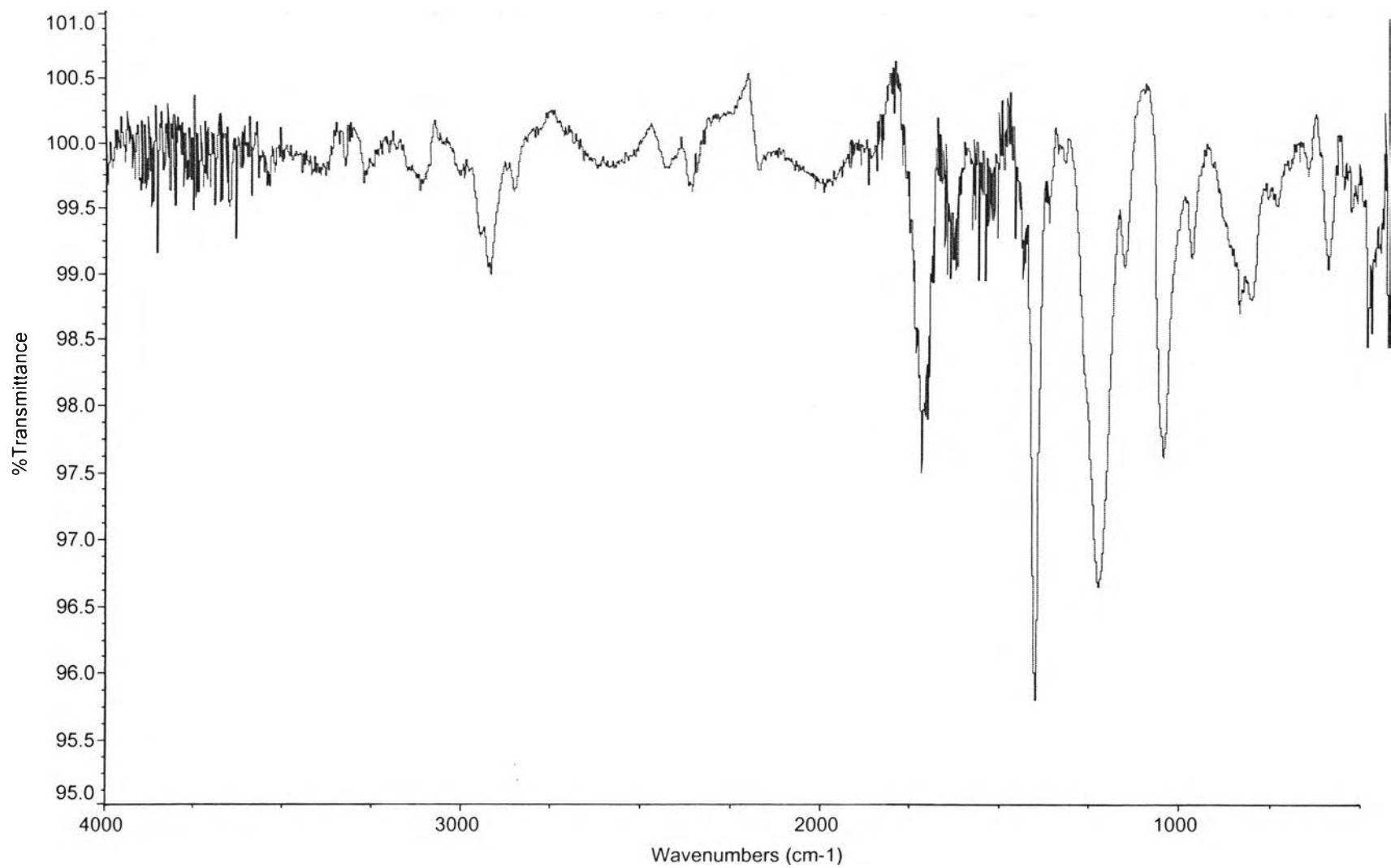
**Figure A-3**  $^1\text{H-NMR}$  (400 MHz,  $\text{CDCl}_3$ ) spectrum of P3HT.



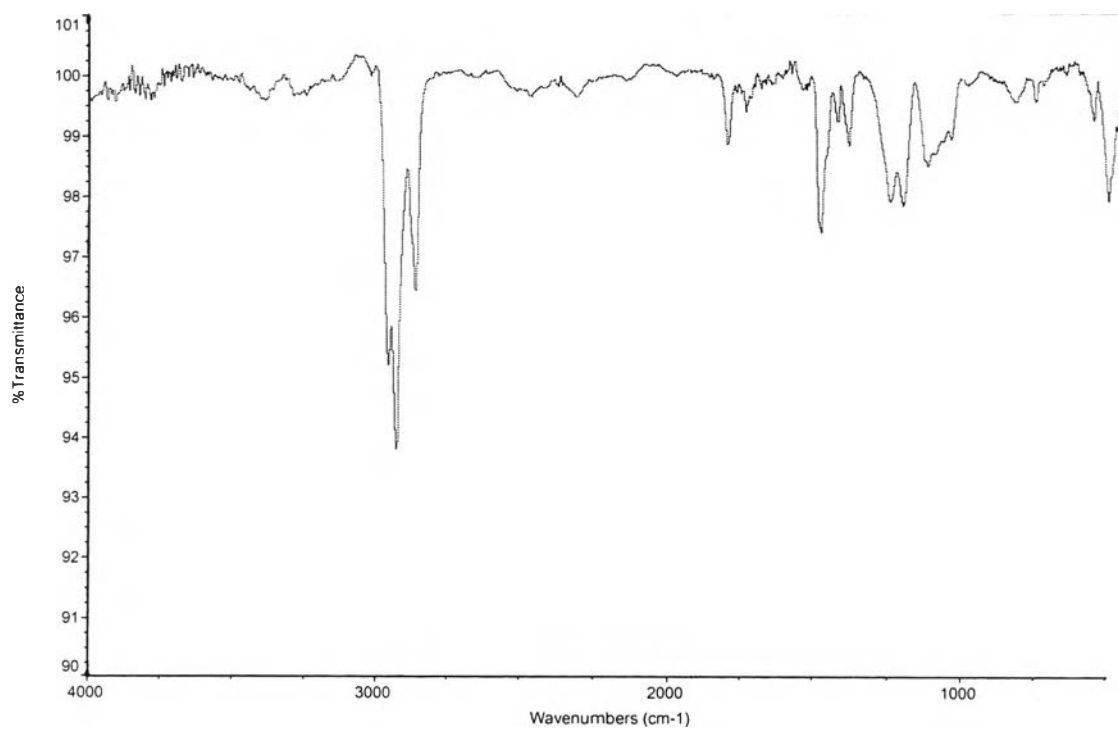
**Figure A-4** FT-IR (KBr) spectrum of 2, 5-dibromothiophene.



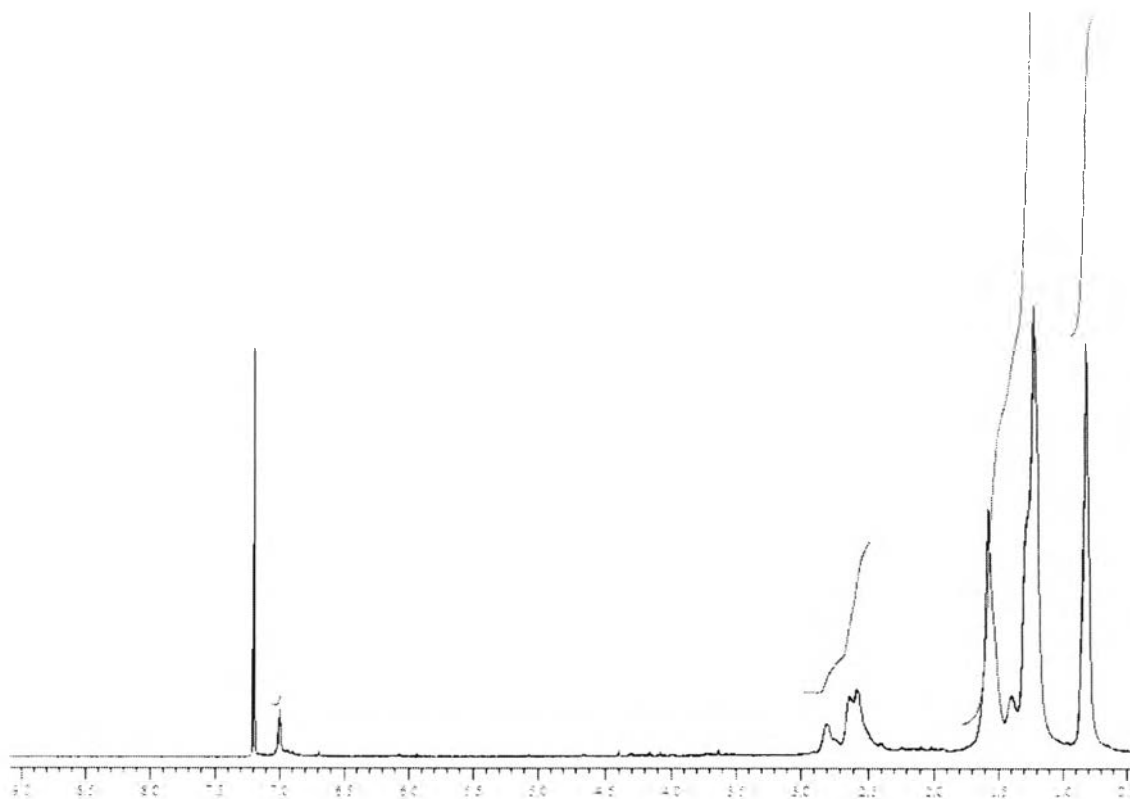
**Figure A-5**  $^1\text{H-NMR}$  (400 MHz,  $\text{CDCl}_3$ ) spectrum of 2, 5-dibromothiophene.



**Figure A-6** FT-IR (KBr) spectrum of brominated polythiophene.

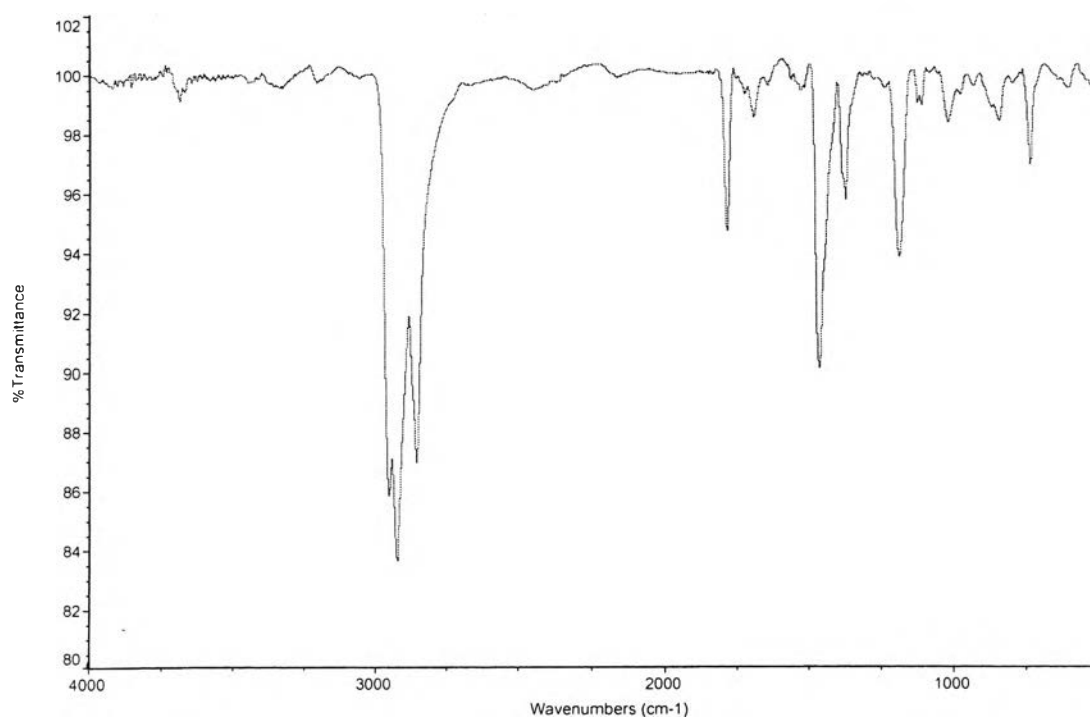


**Figure A-7** FT-IR (KBr) spectrum of brominated P3HT (Entry 1, Table 3.3).

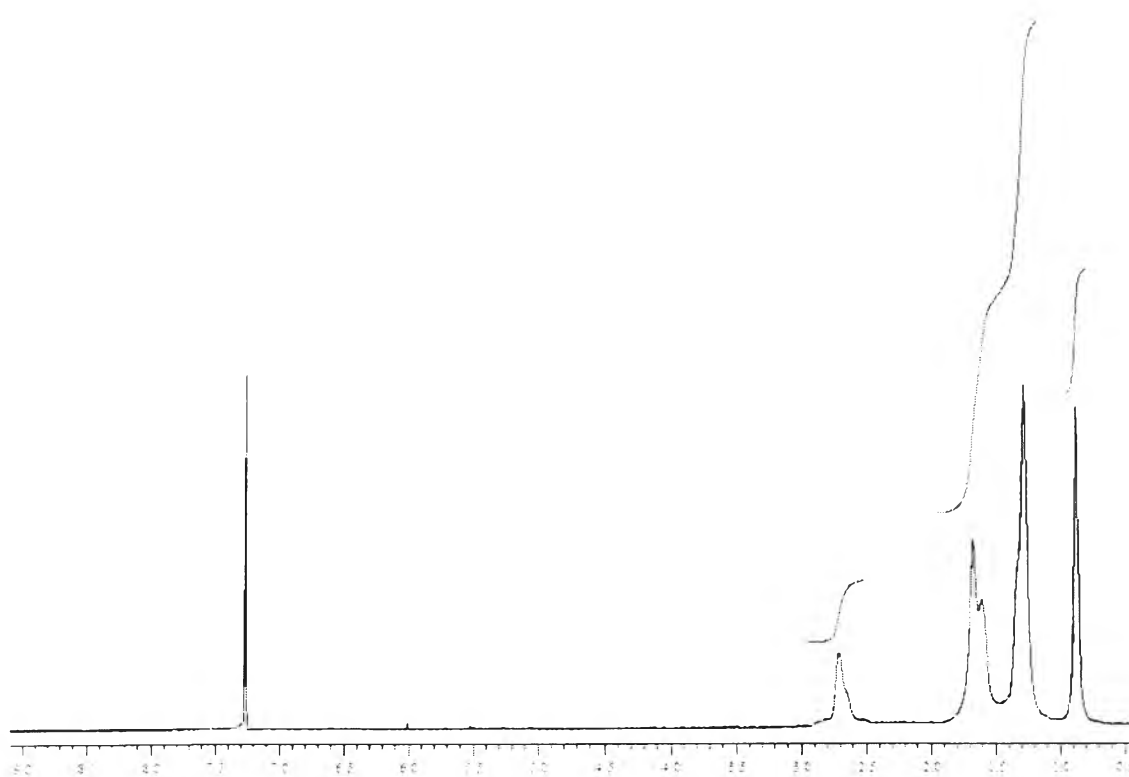


**Figure A-8** <sup>1</sup>H-NMR (400 MHz, CDCl<sub>3</sub>) spectrum of brominated P3HT (Entry 1, Table 3.3).

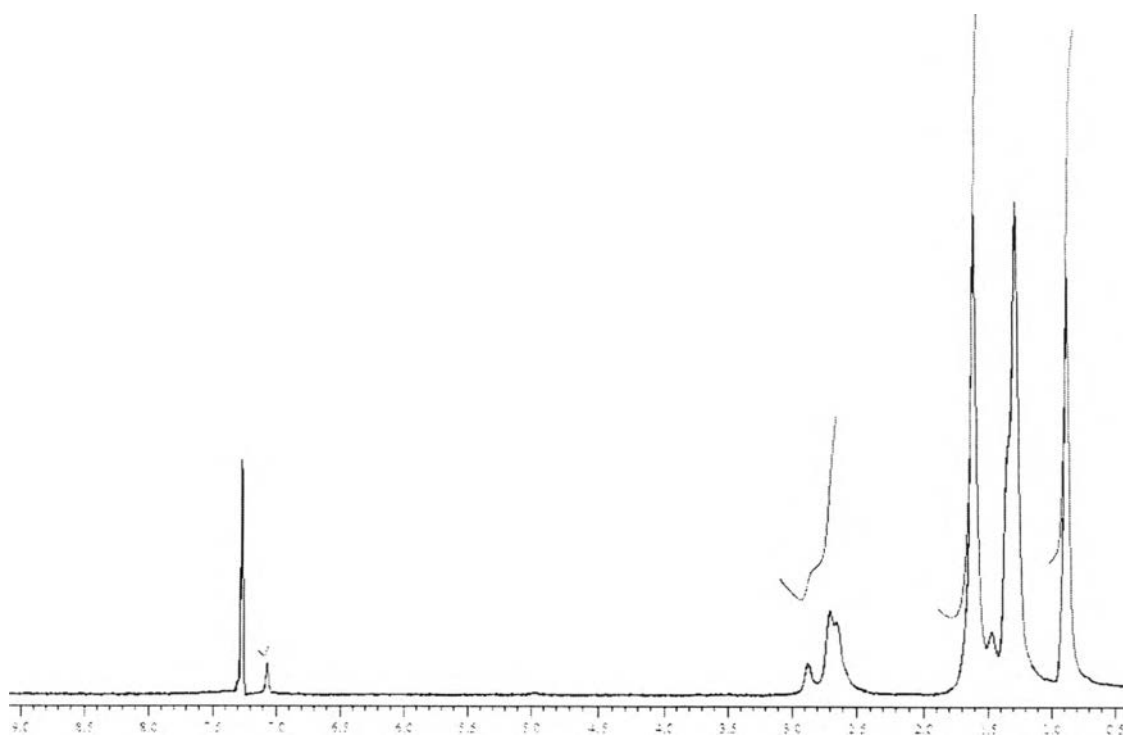




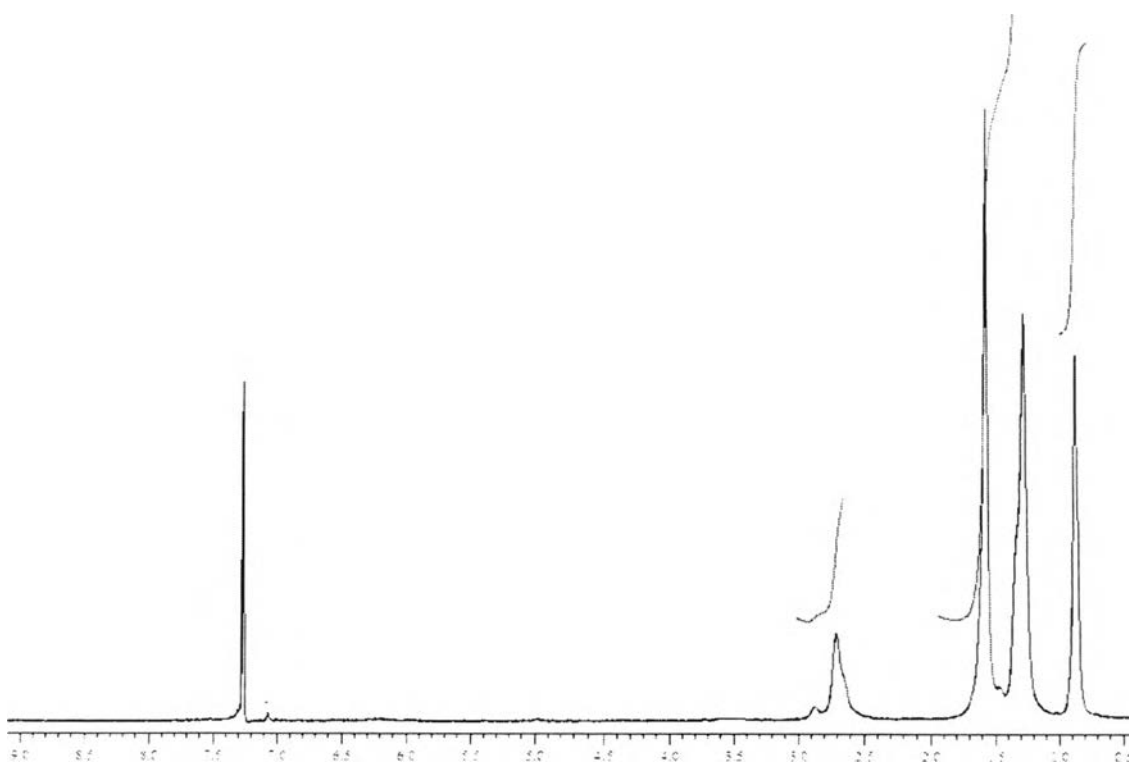
**Figure A-9** FT-IR (KBr) spectrum of brominated P3HT (Entry 2, **Table 3.3**).



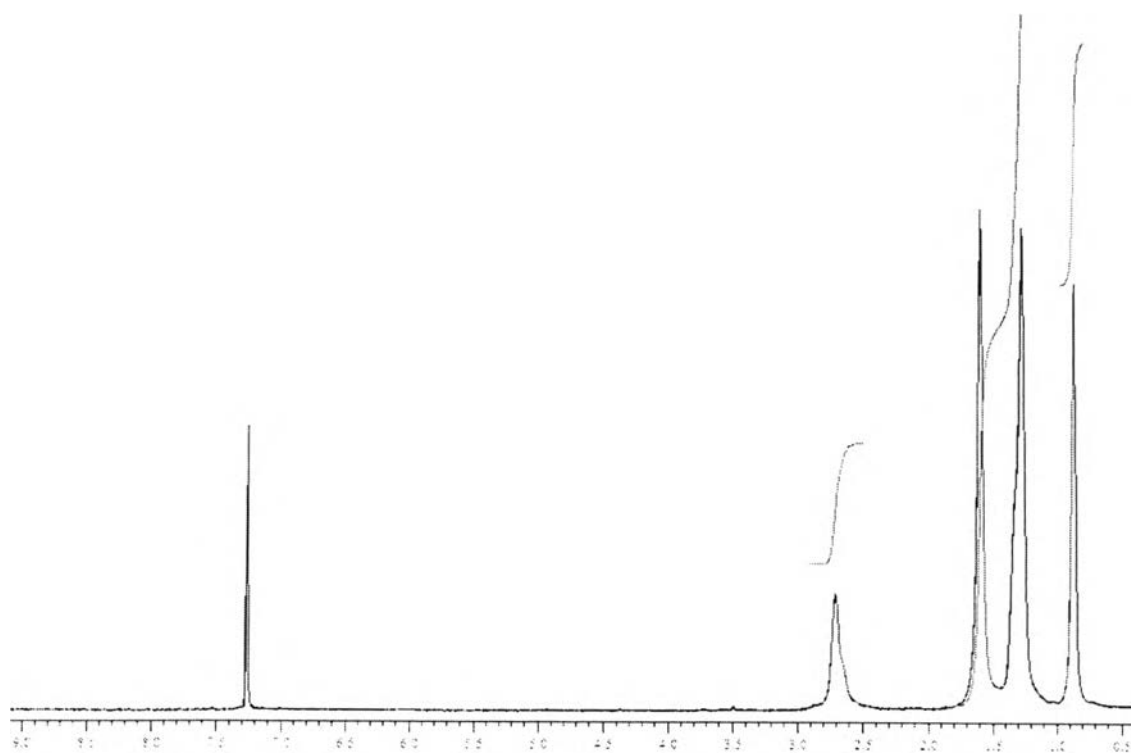
**Figure A-10** <sup>1</sup>H-NMR (400 MHz, CDCl<sub>3</sub>) spectrum of brominated P3HT (Entry 2, **Table 3.3**).



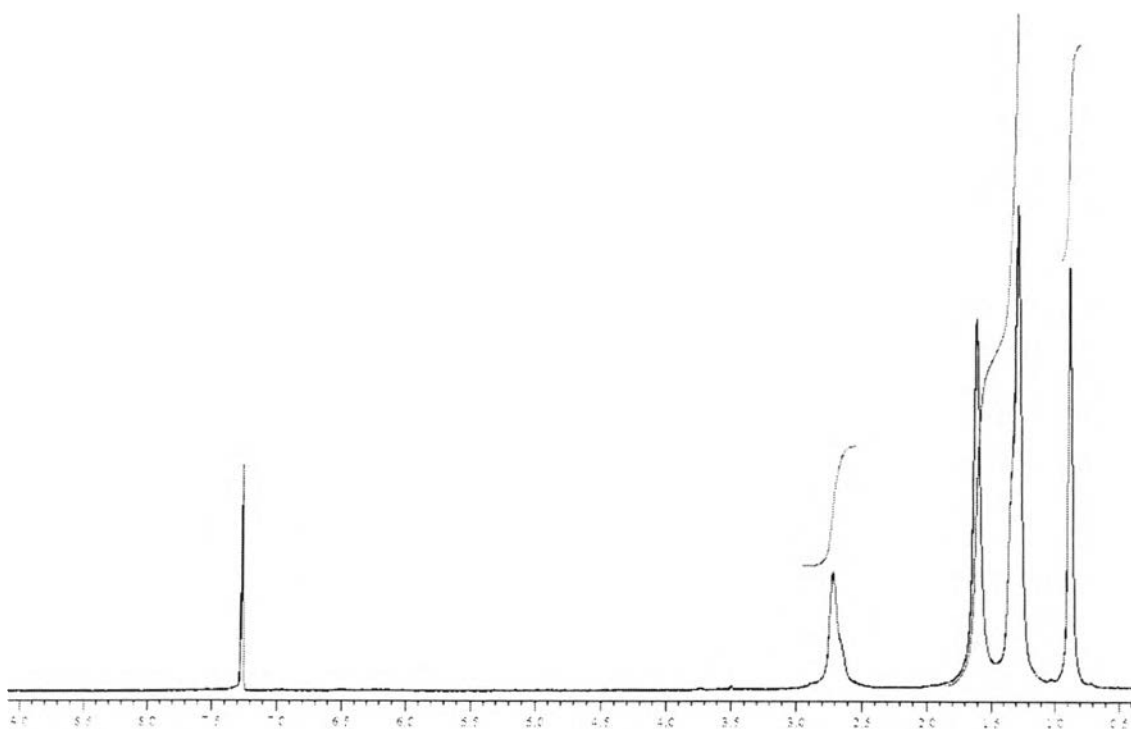
**Figure A-11** <sup>1</sup>H-NMR (400 MHz, CDCl<sub>3</sub>) spectrum of brominated P3HT  
(Entry 3, Table 3.3).



**Figure A-12** <sup>1</sup>H-NMR (400 MHz, CDCl<sub>3</sub>) spectrum of brominated P3HT  
(Entry 4, Table 3.3).



**Figure A-13** <sup>1</sup>H-NMR (400 MHz, CDCl<sub>3</sub>) spectrum of brominated P3HT  
(Entry 5, Table 3.3).



**Figure A-14** <sup>1</sup>H-NMR (400 MHz, CDCl<sub>3</sub>) spectrum of brominated P3HT  
(Entry 6, Table 3.3).

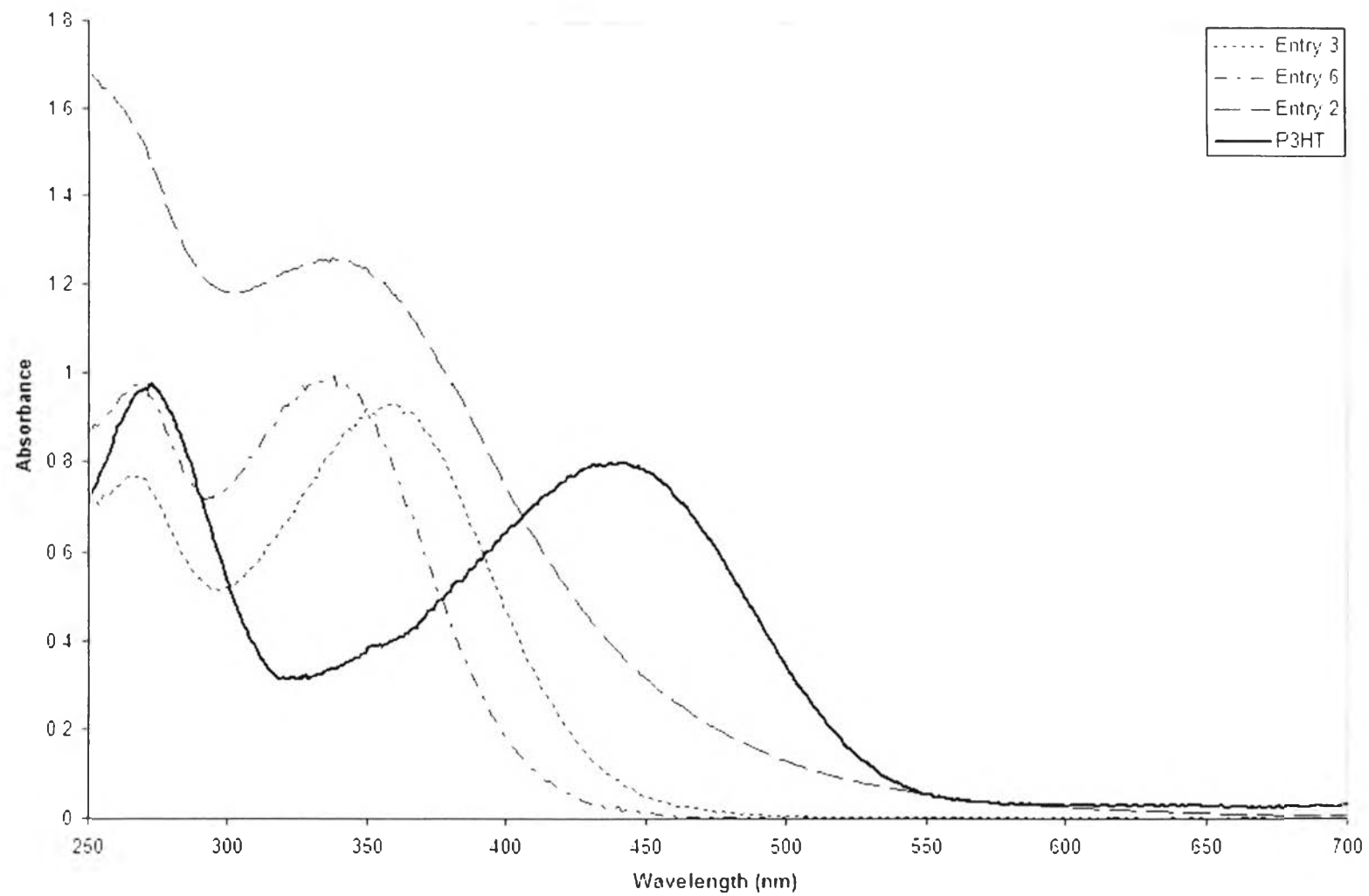
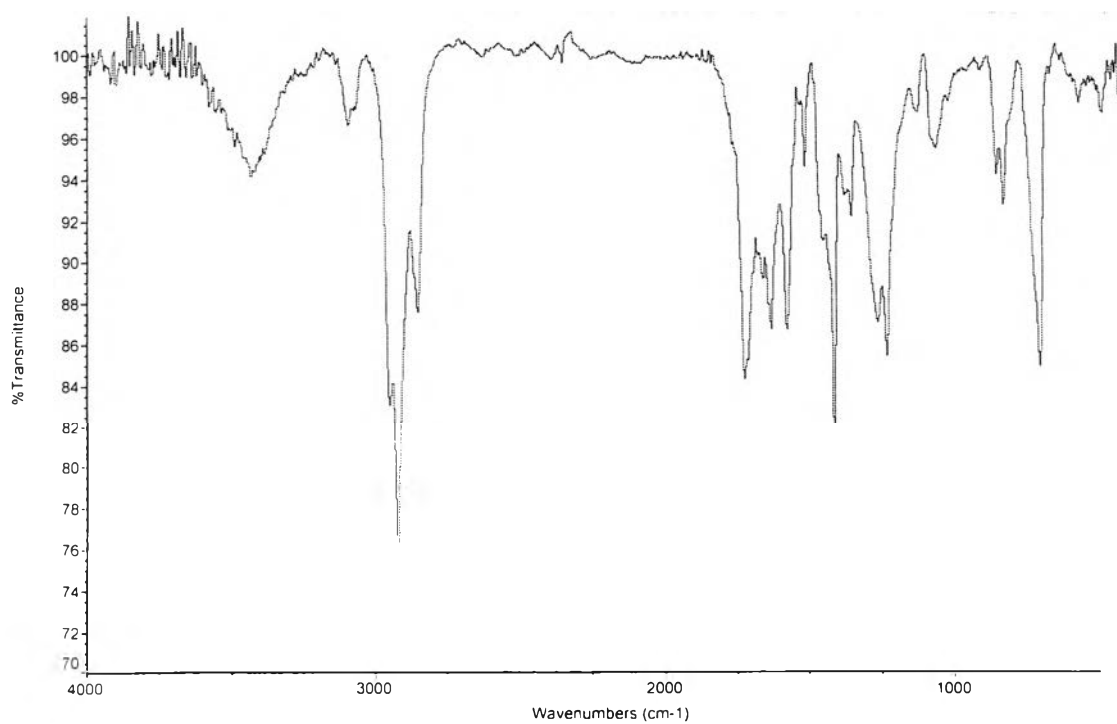
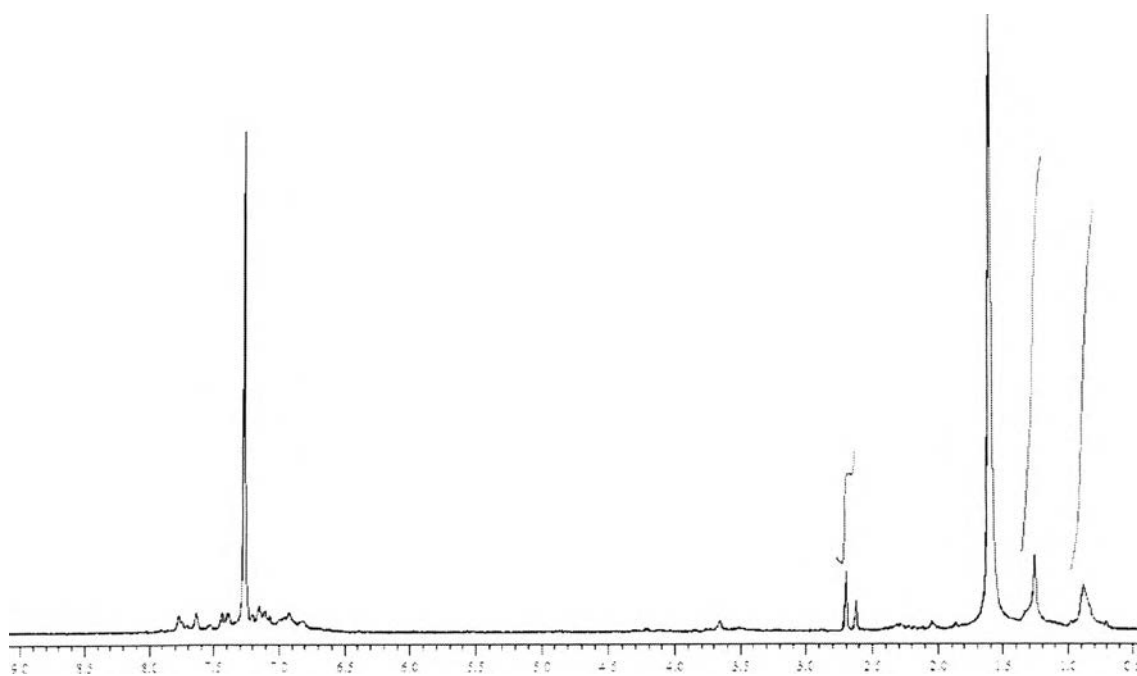


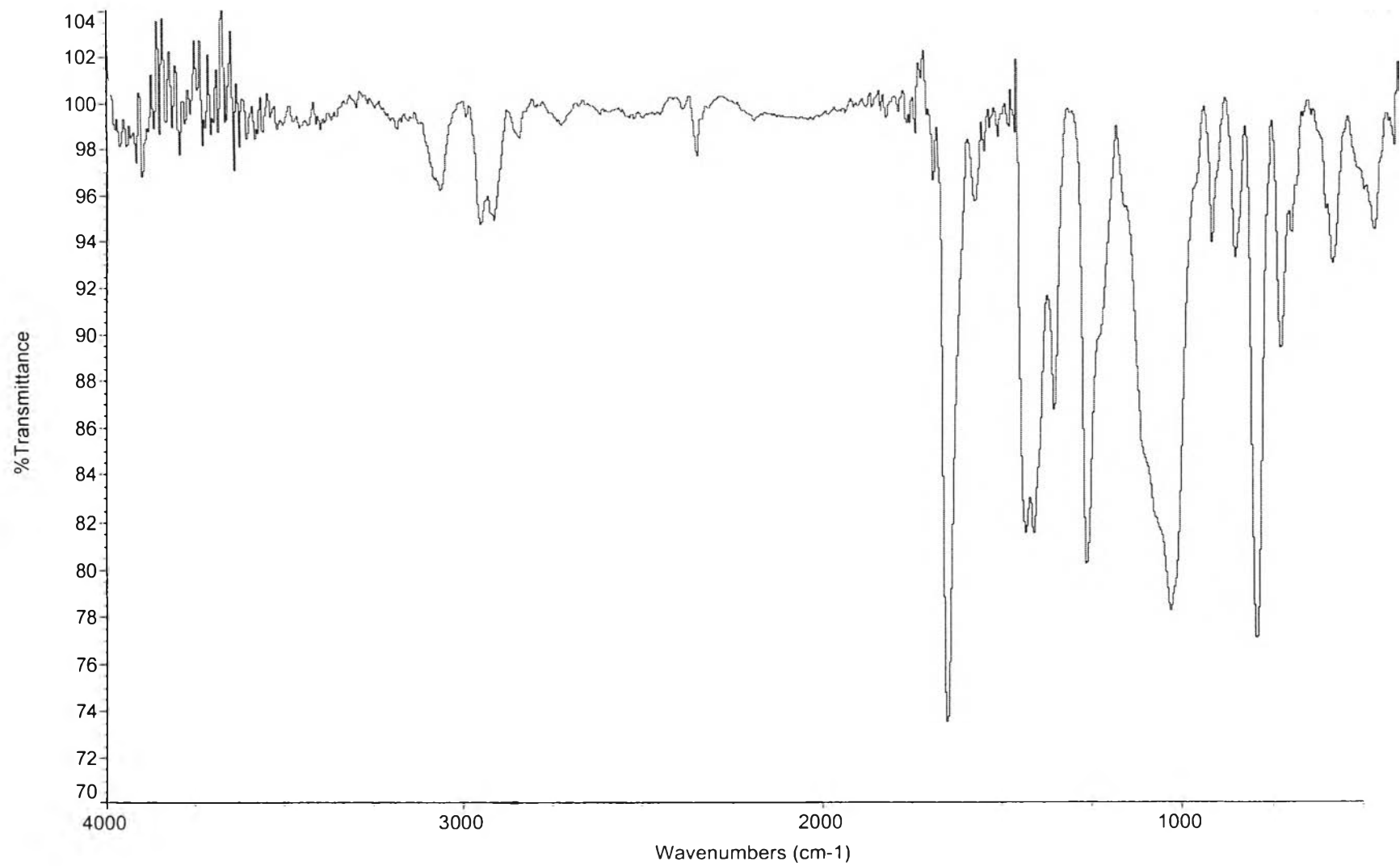
Figure A-15 UV-Vis spectra of brominated P3HTs from Table 3.3.



**Figure A-16** FT-IR (KBr) spectrum of acetylated thiophene.



**Figure A-17**  $^1\text{H-NMR}$  (400 MHz,  $\text{CDCl}_3$ ) spectrum of acetylated thiophene.



**Figure A-18** FT-IR (KBr) spectrum of acetylated polythiophene.

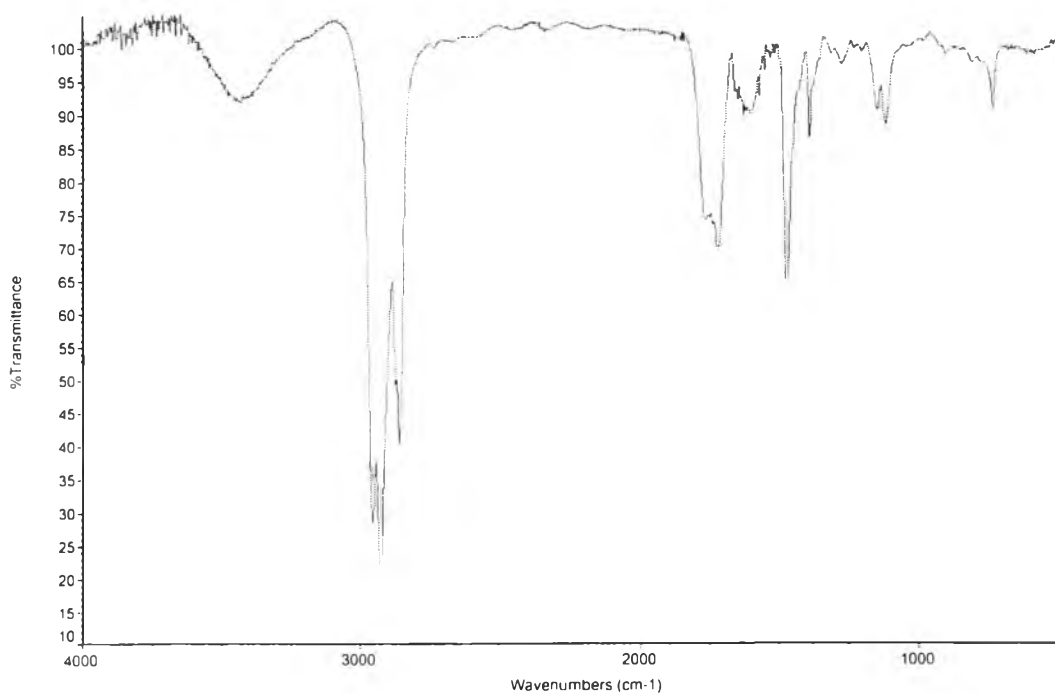


Figure A-19 FT-IR (KBr) spectrum of octanoylated polythiophene.

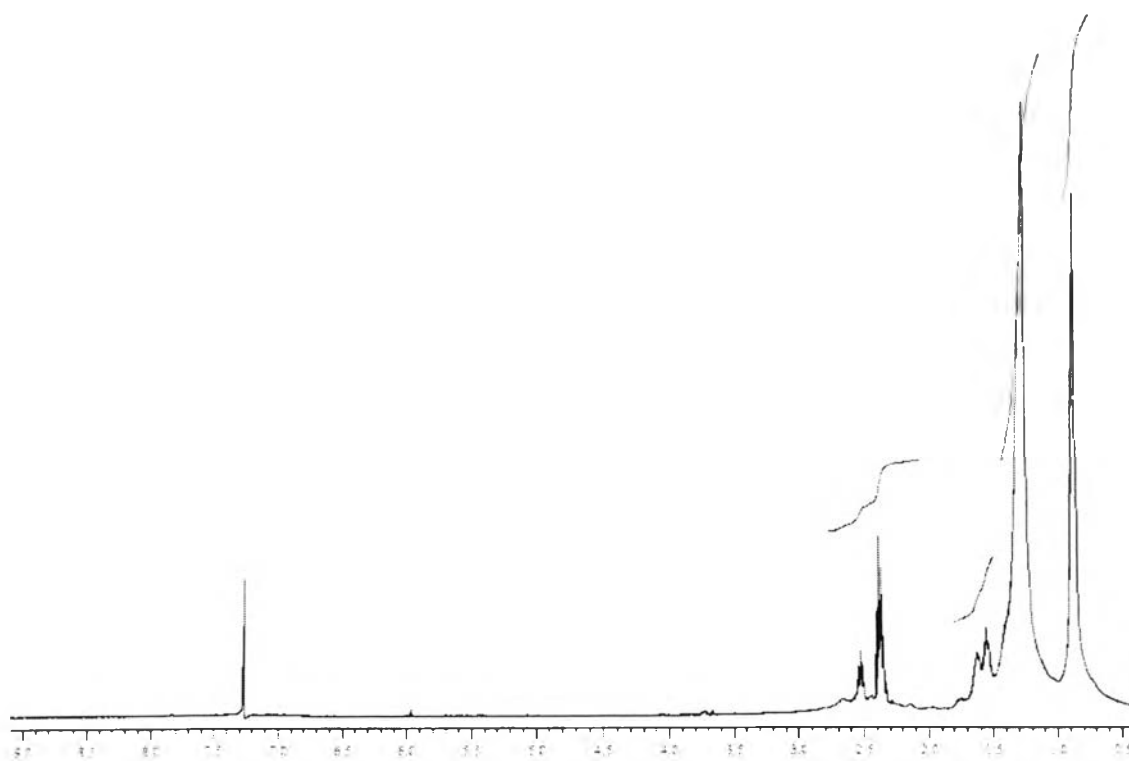
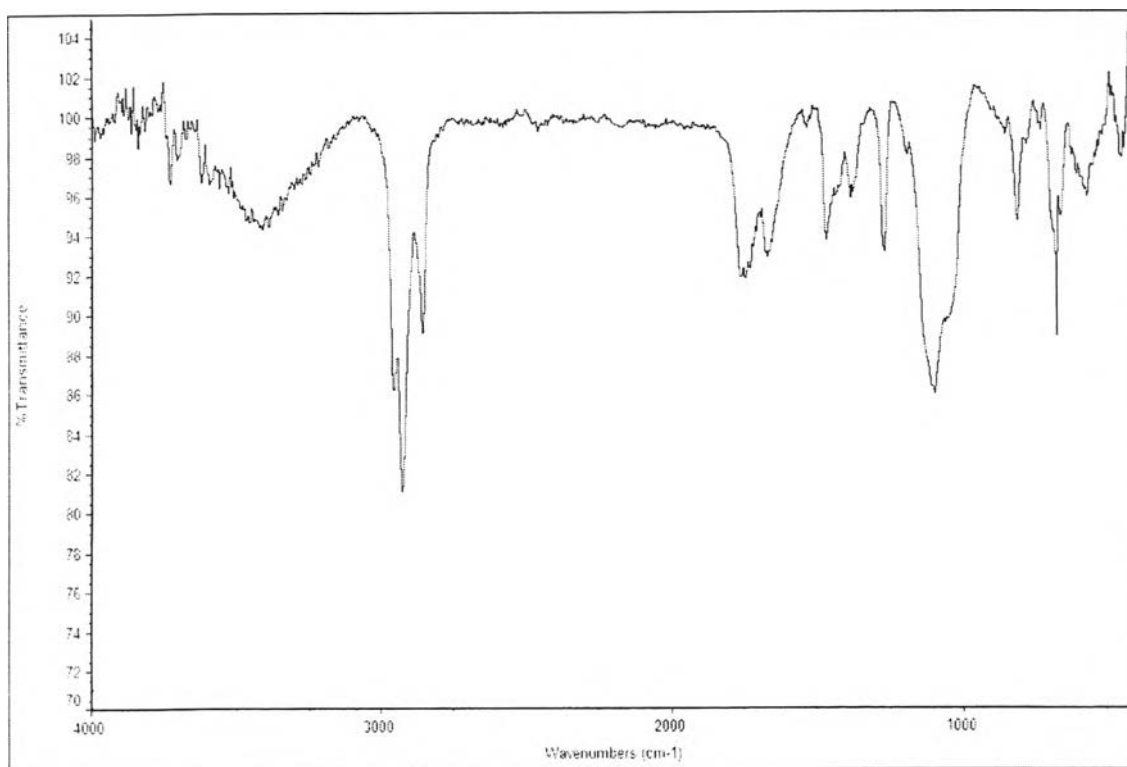
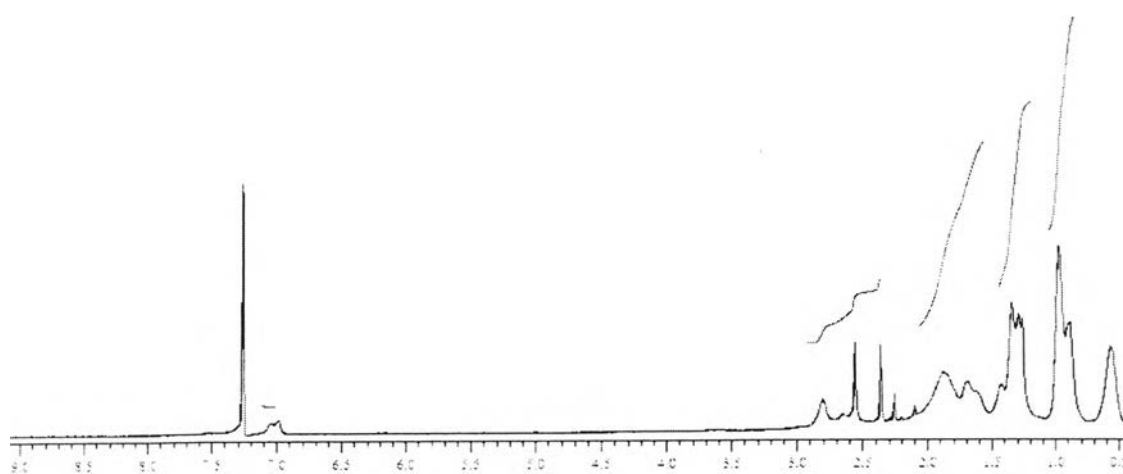


Figure A-20  $^1\text{H-NMR}$  (400 MHz,  $\text{CDCl}_3$ ) spectrum of octanoylated polythiophene.

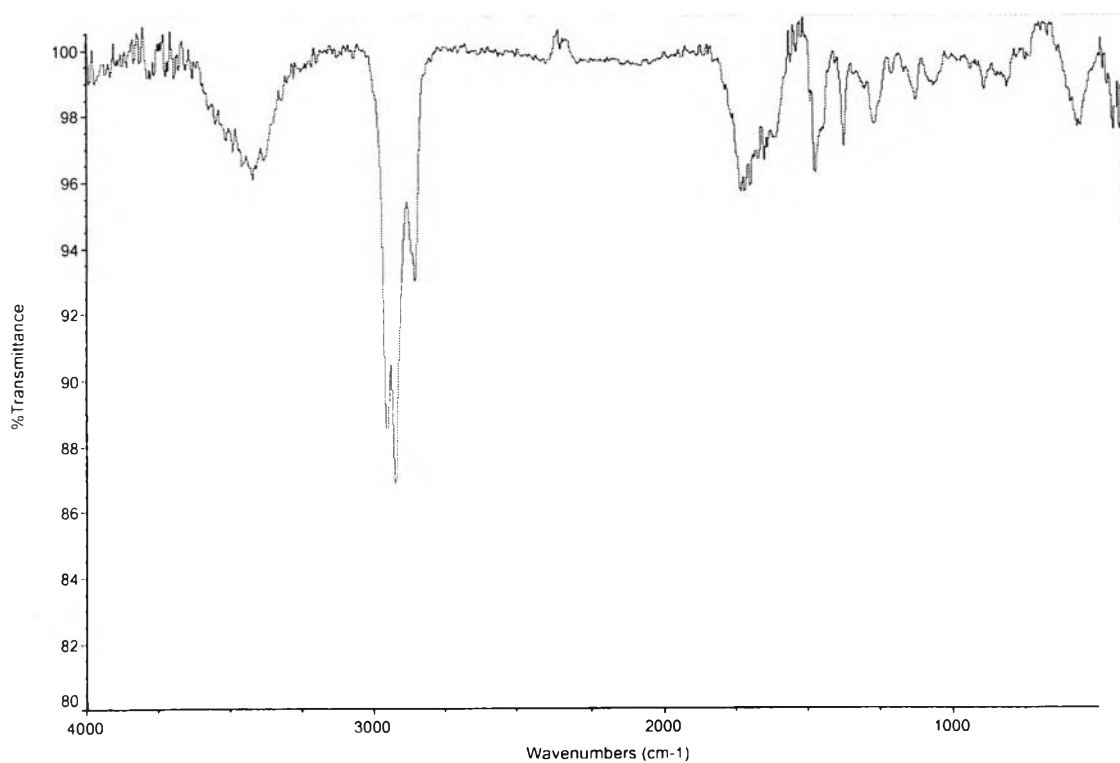


**Figure A-21** FT-IR (KBr) spectrum of acetylated P3HT (Entry 1, Table 3.4).

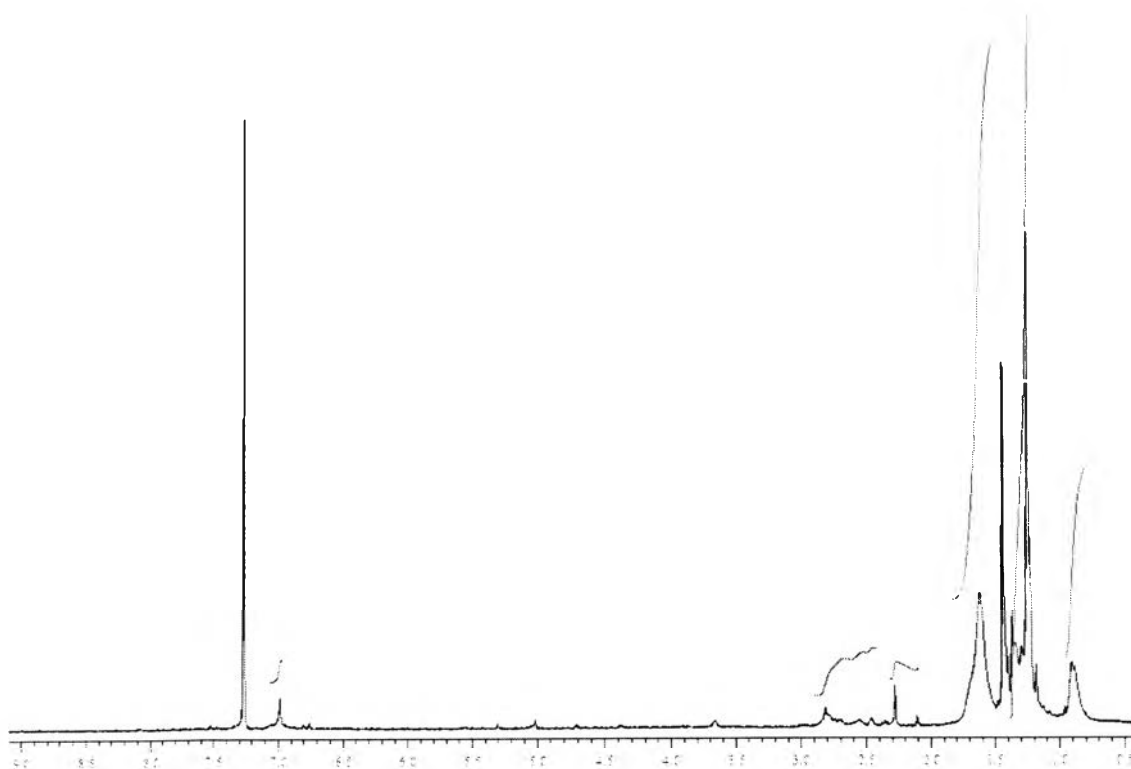


**Figure A-22**  $^1\text{H-NMR}$  (400 MHz,  $\text{CDCl}_3$ ) spectrum of acetylated P3HT (Entry 1, Table 3.4).

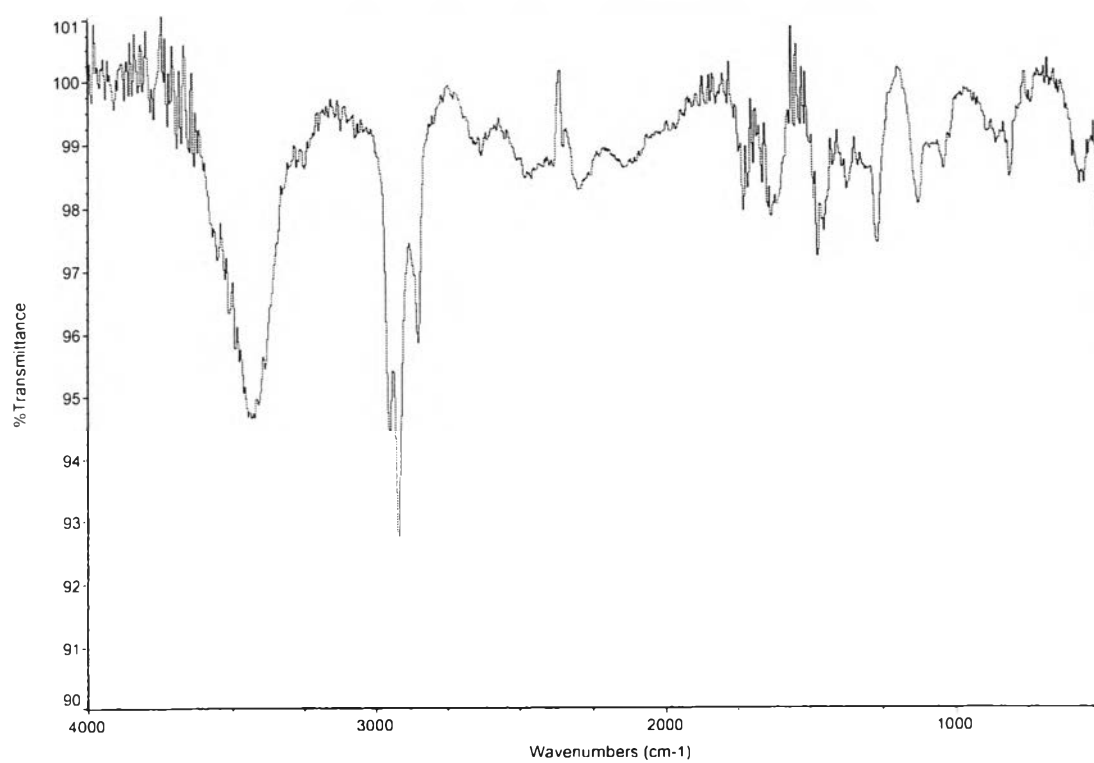




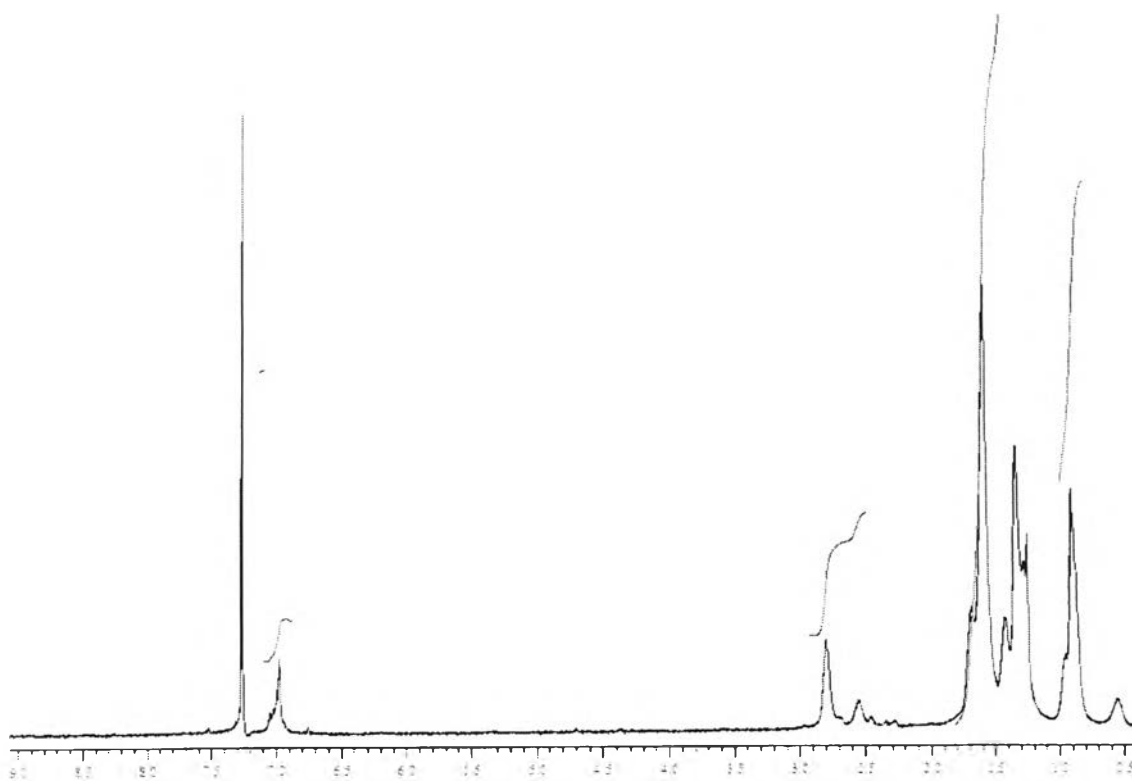
**Figure A-23** FT-IR (KBr) spectrum of acetylated P3HT (Entry 2, Table 3.4).



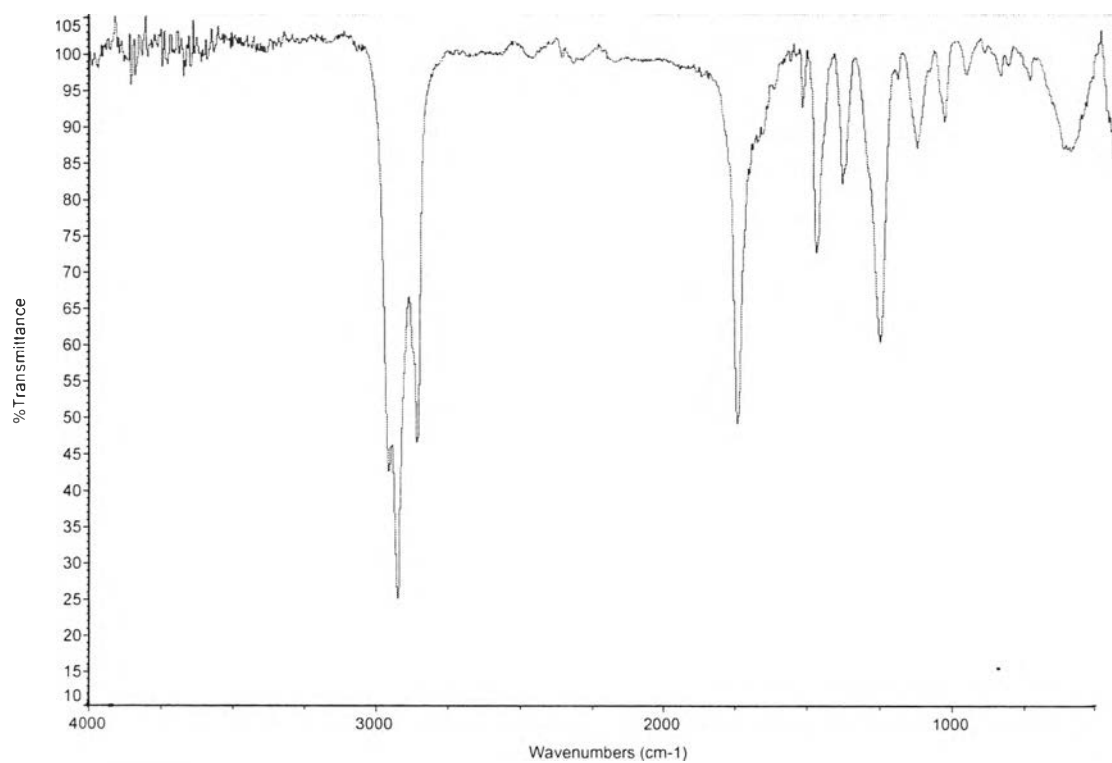
**Figure A-24**  $^1\text{H-NMR}$  (400 MHz,  $\text{CDCl}_3$ ) spectrum of acetylated poly(3-hexylthiophene) (Entry 2, Table 3.4).



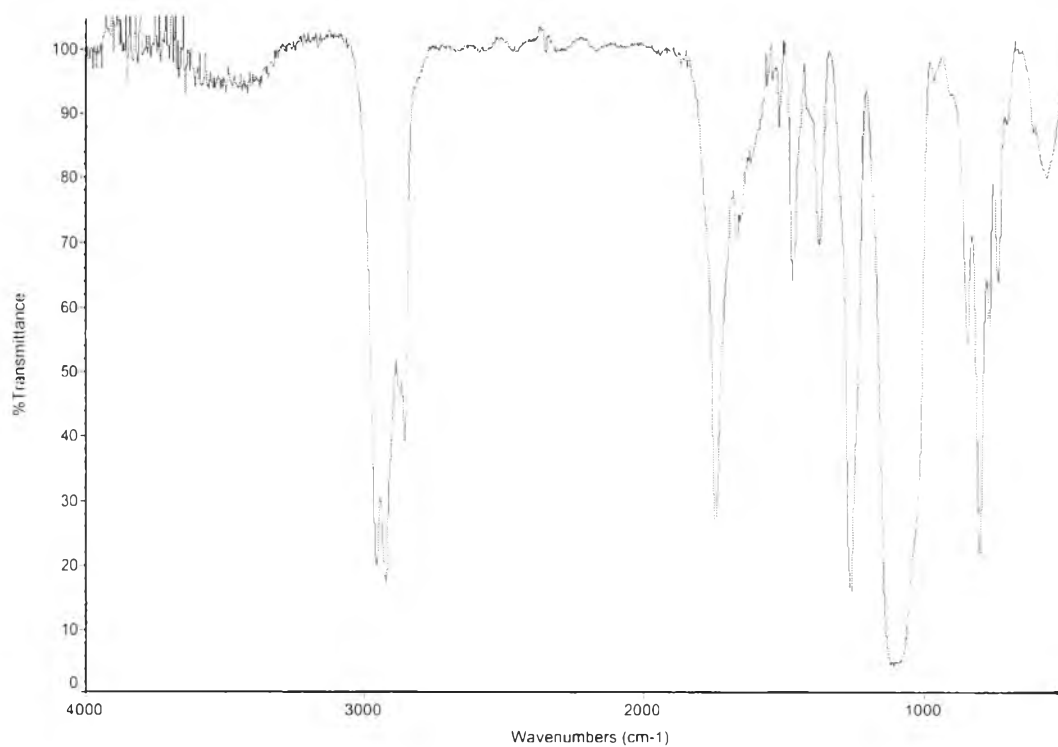
**Figure A-25** FT-IR (KBr) spectrum of acetylated P3HT (Entry 3, Table 3.4).



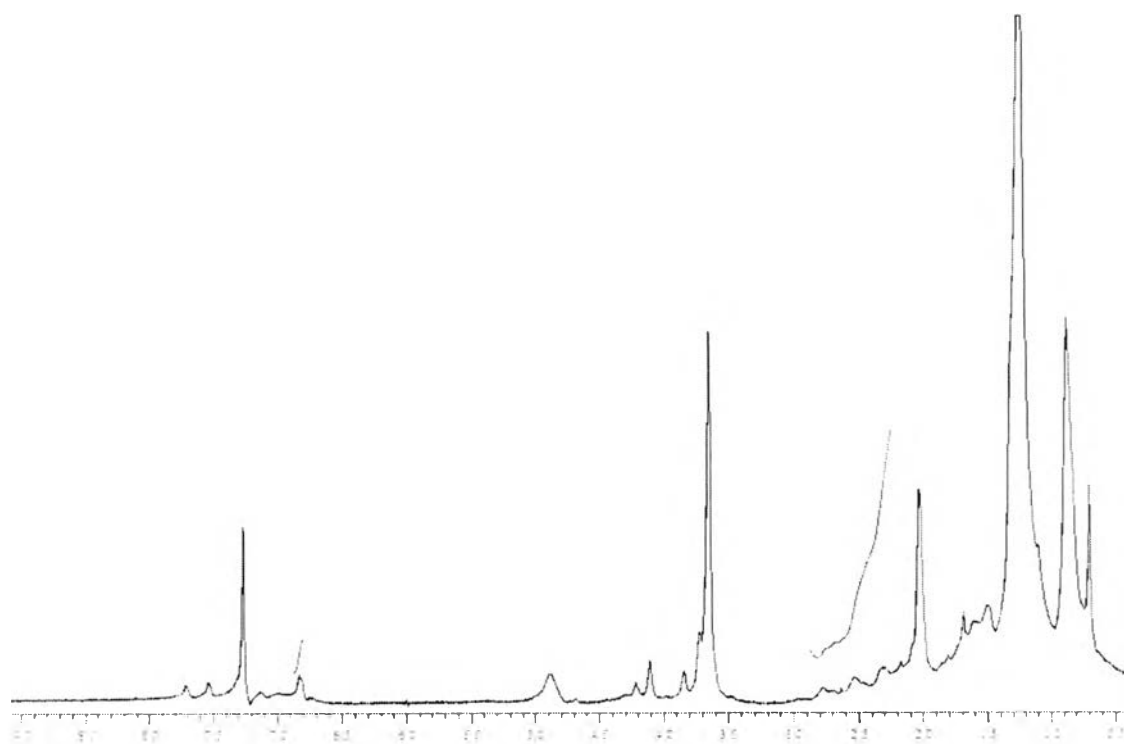
**Figure A-26** <sup>1</sup>H-NMR (400 MHz, CDCl<sub>3</sub>) spectrum of acetylated poly(3-hexylthiophene) (Entry 3, Table 3.4).



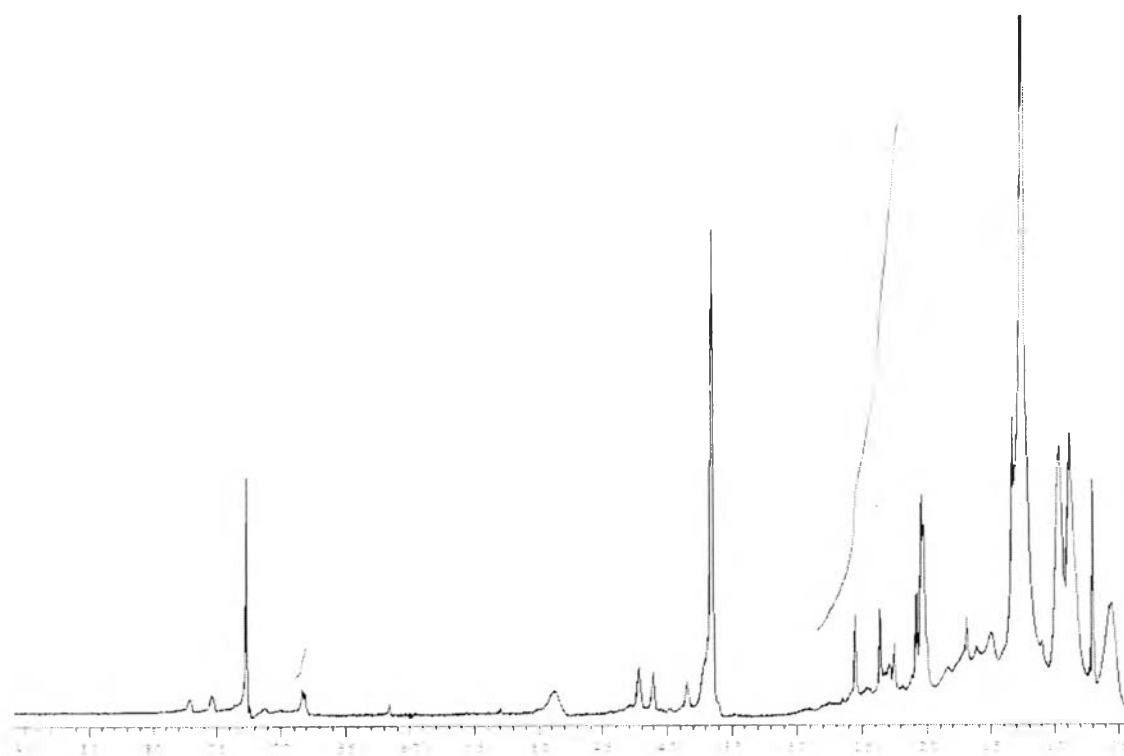
**Figure A-27** FT-IR (KBr) spectrum of the acetone-extracted fraction of P3HT [53].



**Figure A-28** FT-IR (KBr) spectrum of the acetone-extracted fraction of P3HT (entry 4, Table 3.4).



**Figure A-29** <sup>1</sup>H-NMR (400 MHz, CDCl<sub>3</sub>) spectrum of the acetone-extracted fraction P3HT.



**Figure A-30** <sup>1</sup>H-NMR (400 MHz, CDCl<sub>3</sub>) spectrum of the acetone-extracted fraction P3HT (Entry 4, Table 3.4).

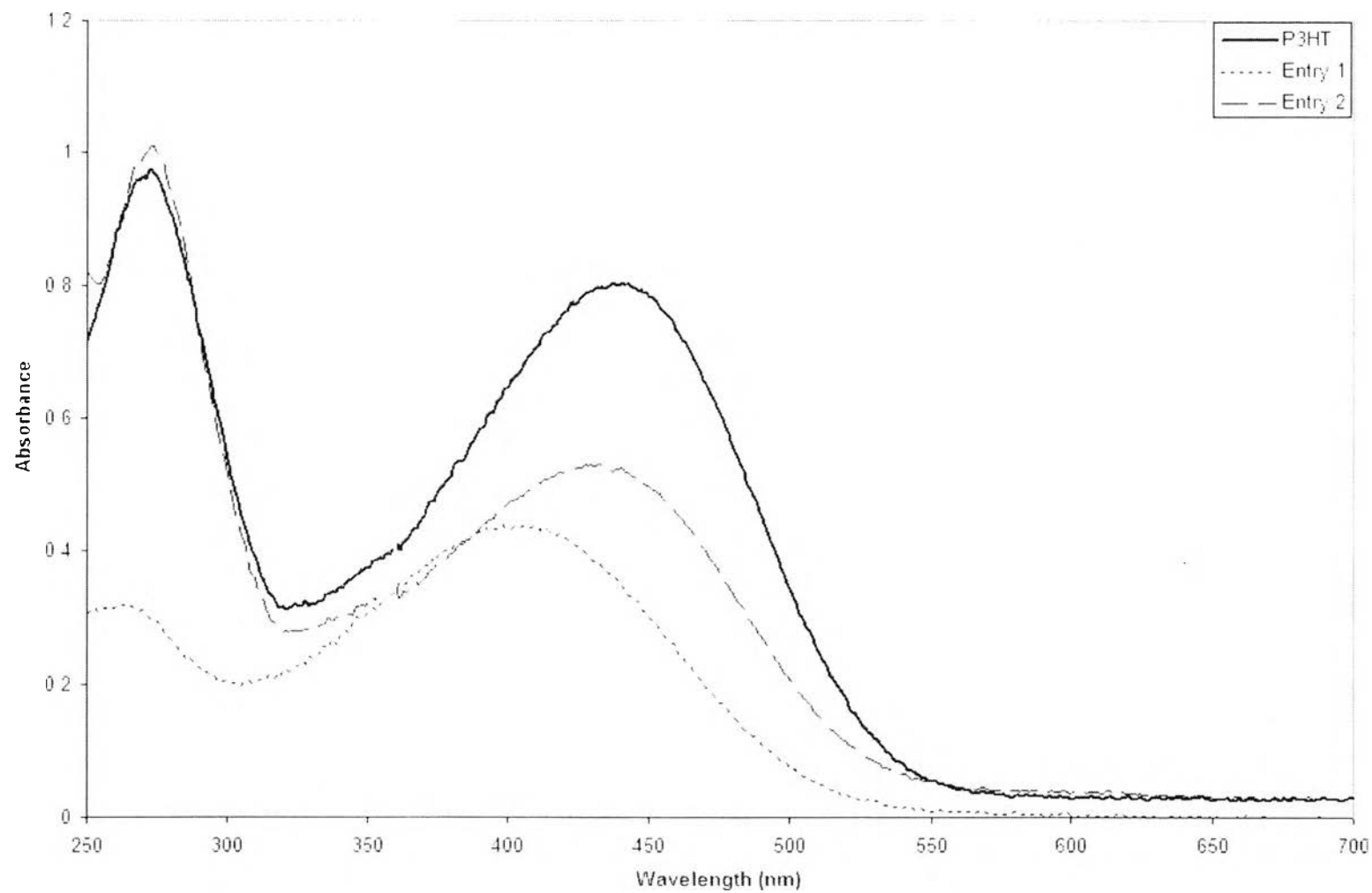
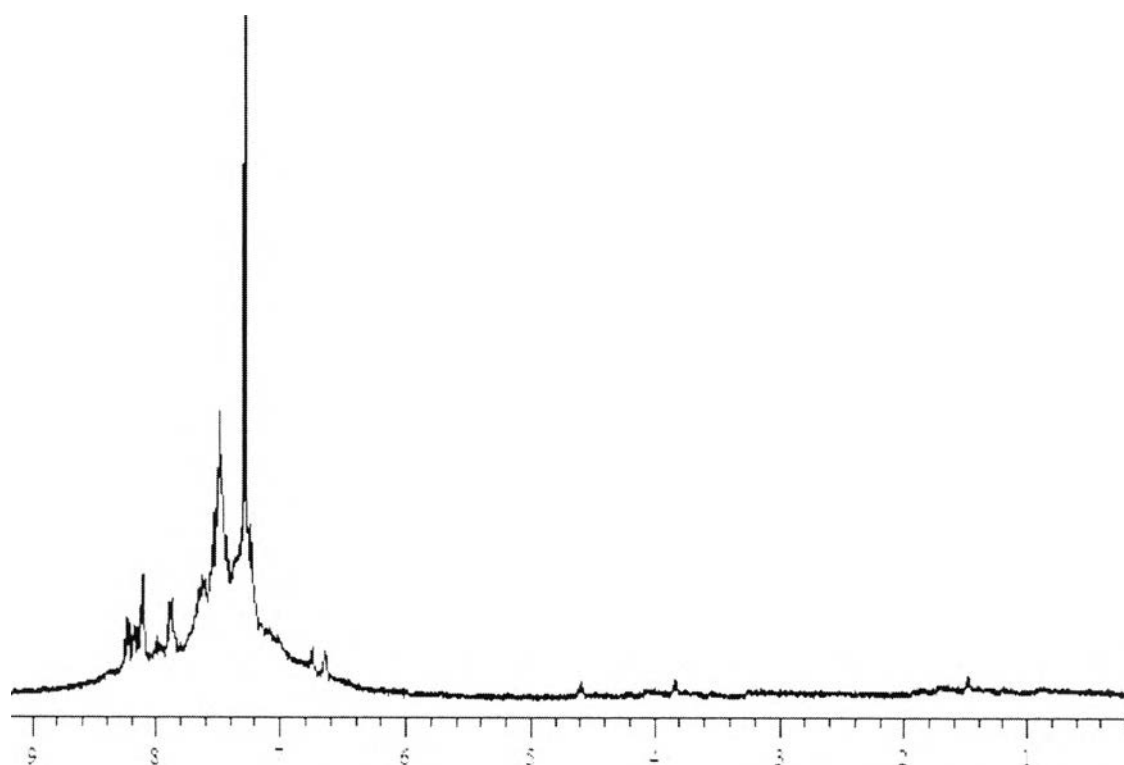
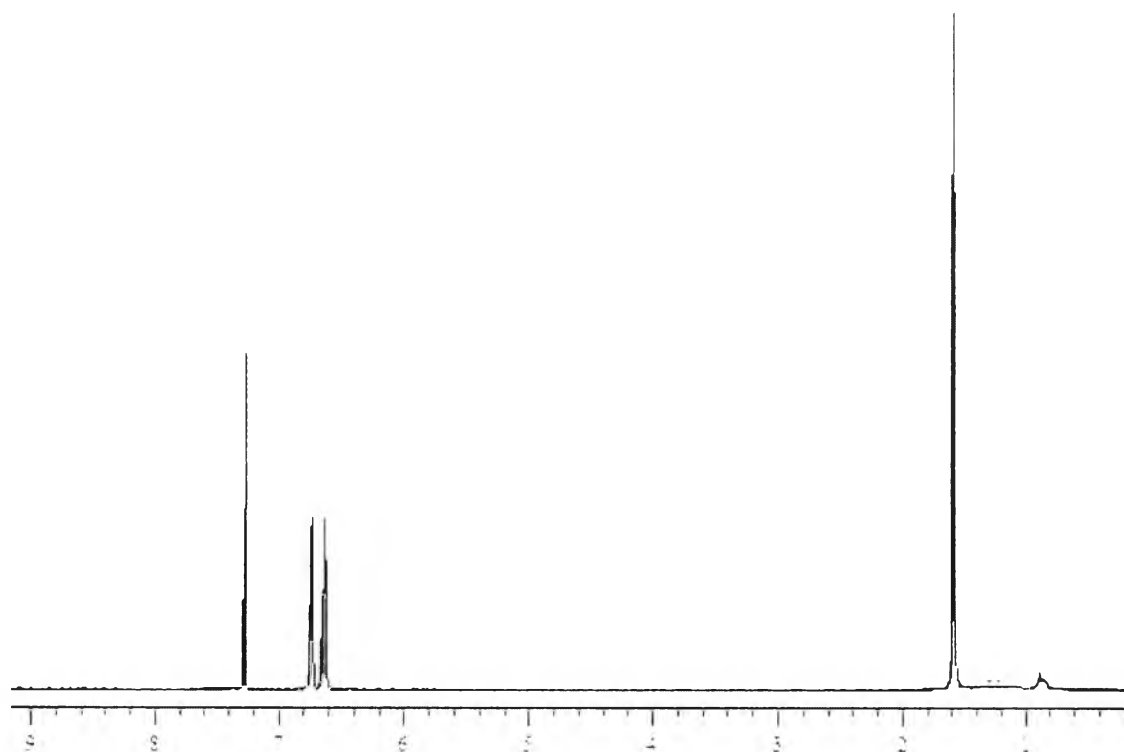


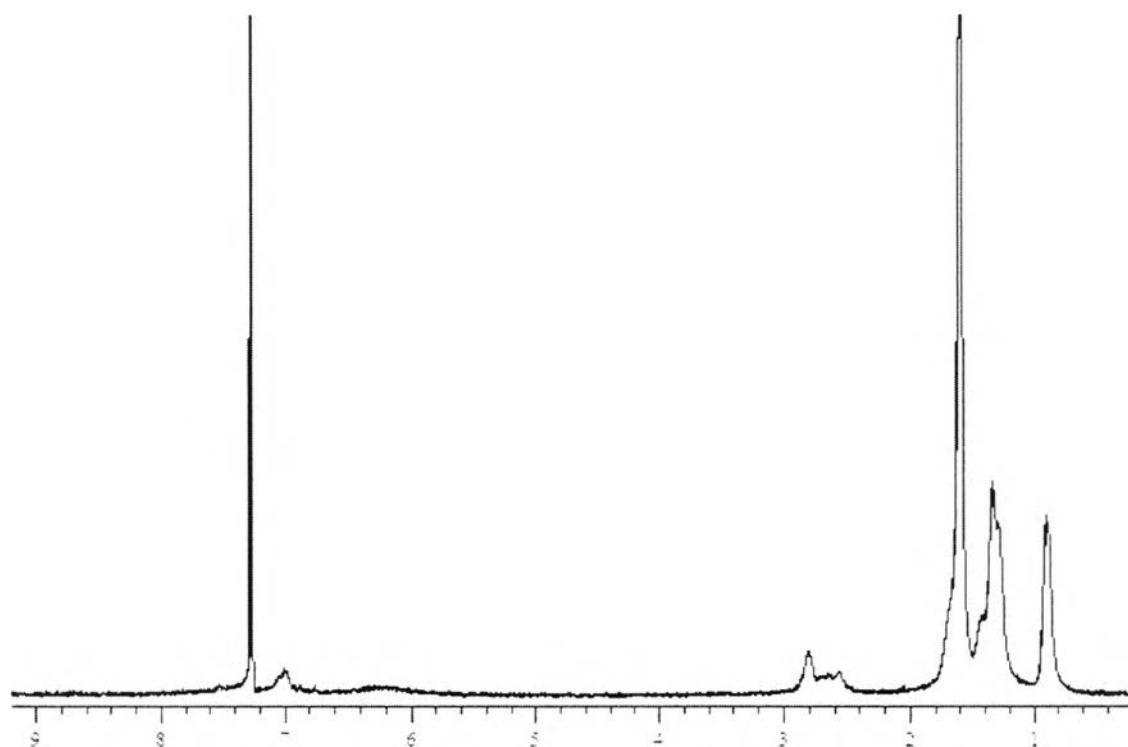
Figure A-31 UV-Vis spectra of acetylated P3HTs from Table 3.4.



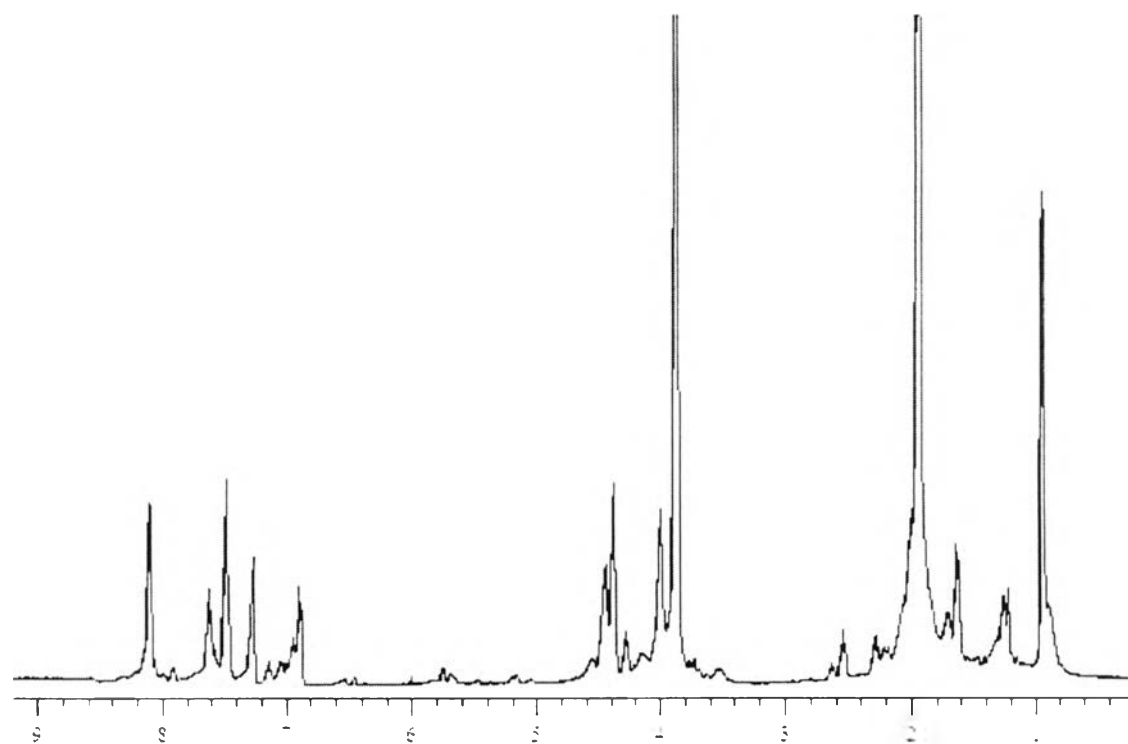
**Figure A-32** <sup>1</sup>H-NMR (400 MHz, CDCl<sub>3</sub>) spectrum of attempted trapping of benzyne by thiophene.



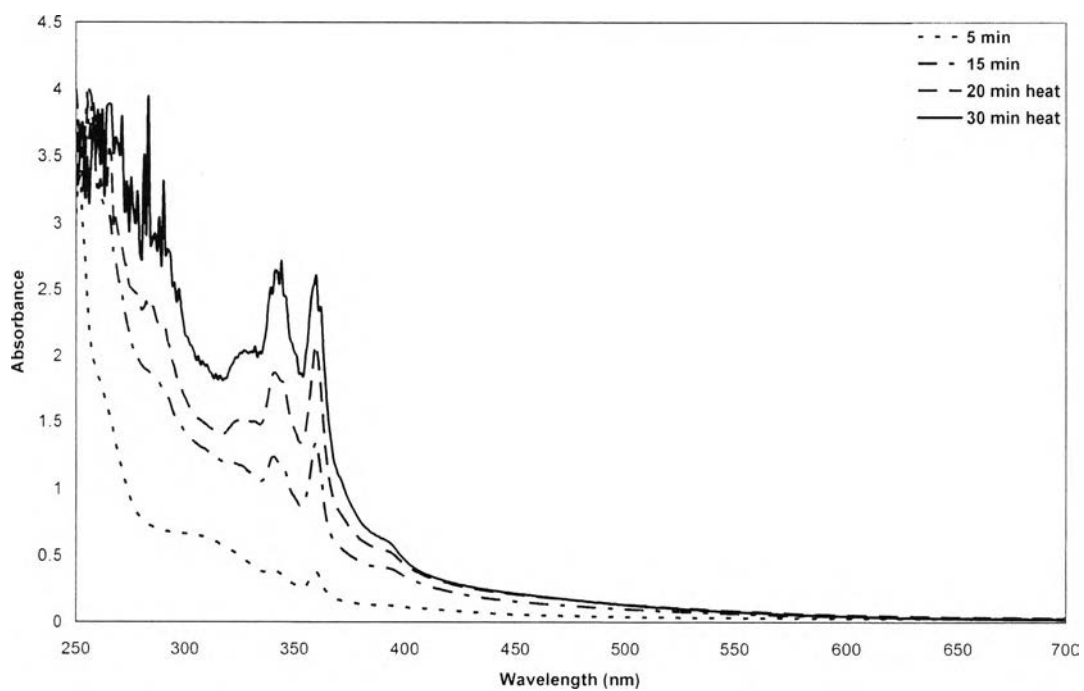
**Figure A-33** <sup>1</sup>H-NMR (400 MHz, CDCl<sub>3</sub>) spectrum of biphenylene.



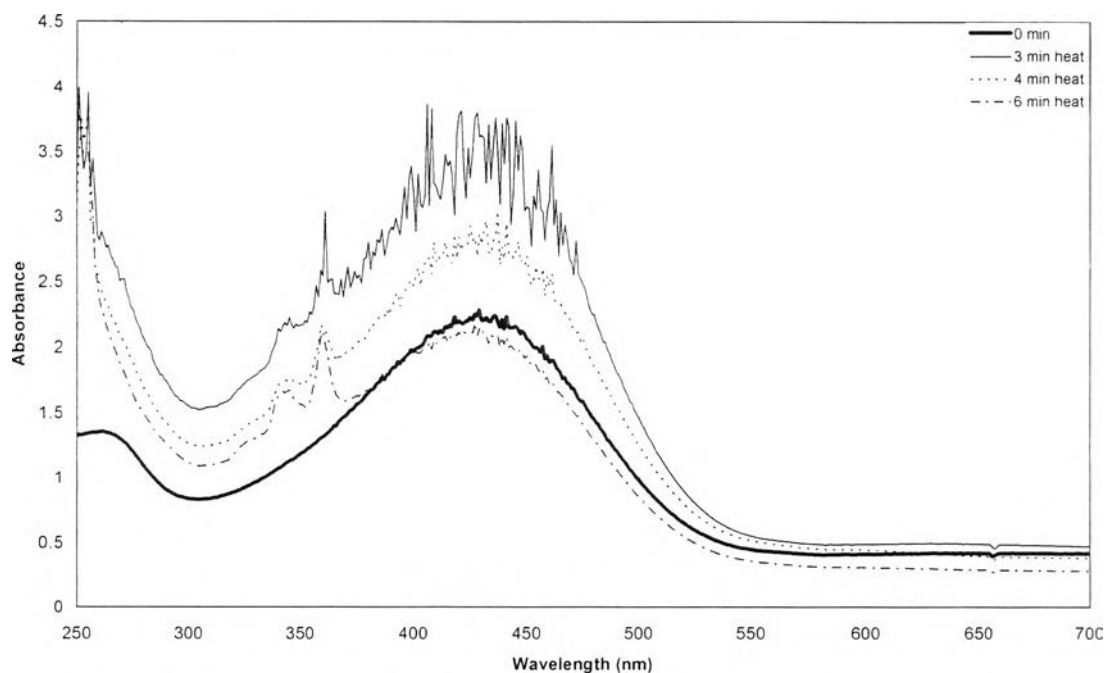
**Figure A-34**  $^1\text{H-NMR}$  (400 MHz,  $\text{CDCl}_3$ ) spectrum of attempted trapping of benzyne by P3HT.



**Figure A-35**  $^1\text{H-NMR}$  (400 MHz,  $\text{CDCl}_3$ ) spectrum of attempted in situ trapping of benzyne by P3HT.

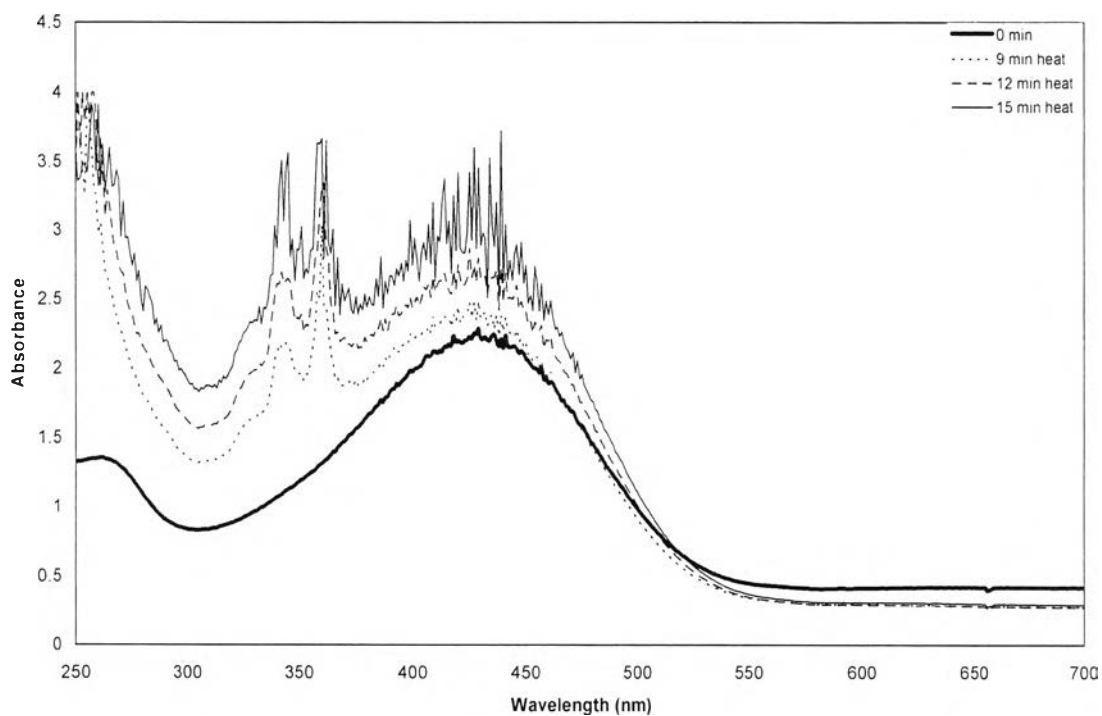


**Figure A-36** UV-Vis spectra of the decomposition of diazonium carboxylate into biphenylene during 15 min at RT and 15 more min heating at 50°C.

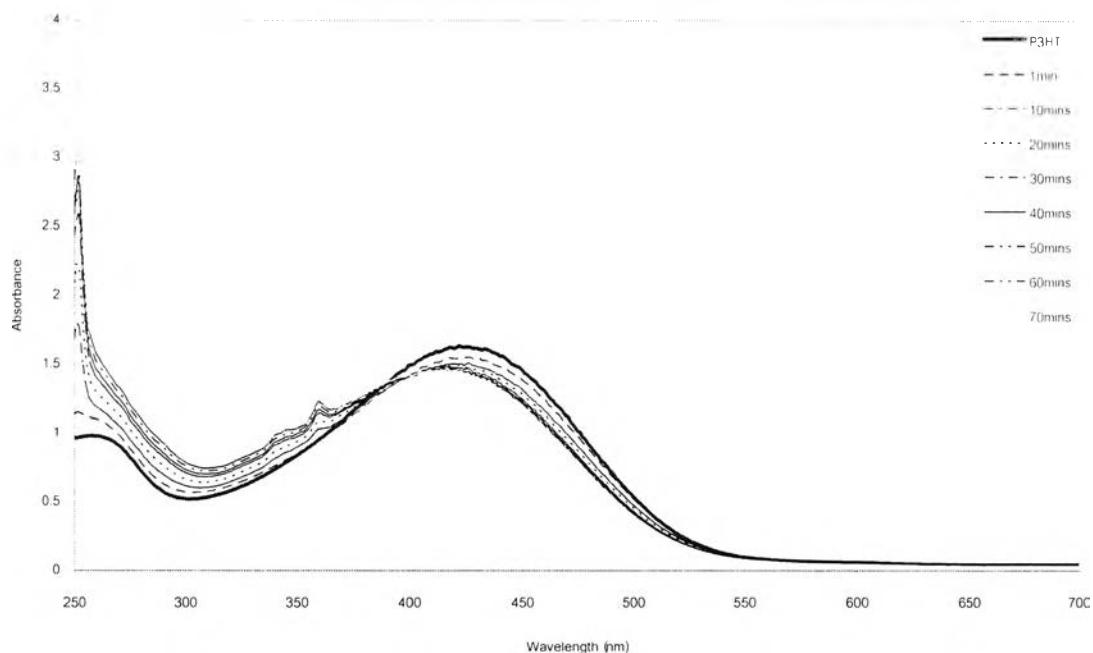


**Figure A-37** UV-Vis spectra of the attempted in situ trapping of benzyne by P3HT during 0–6 min heating.

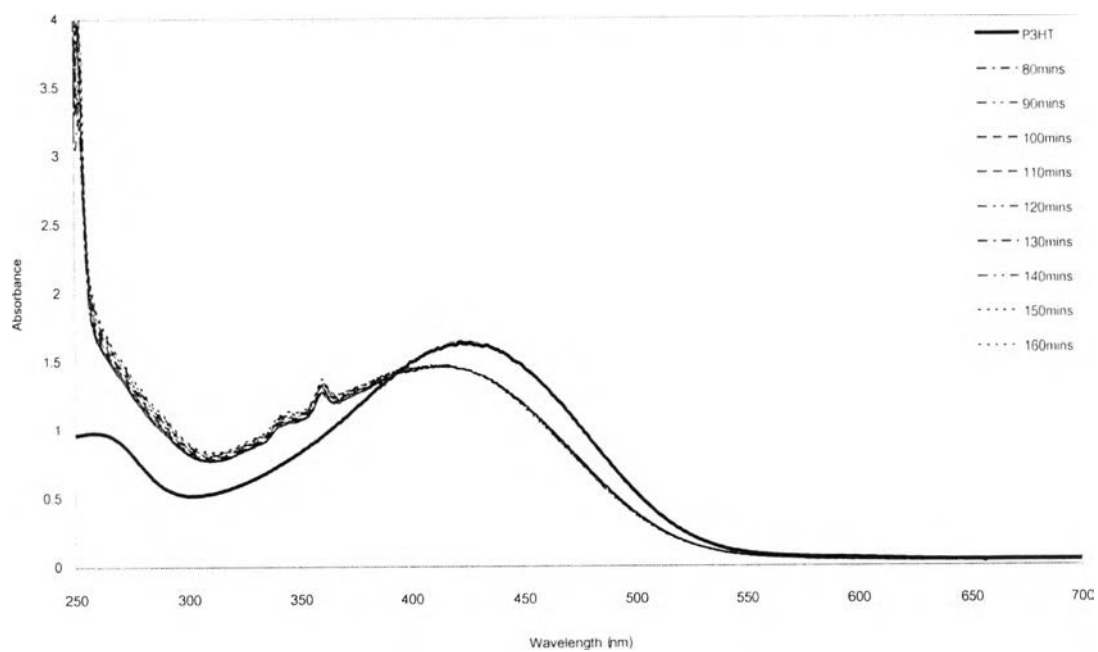




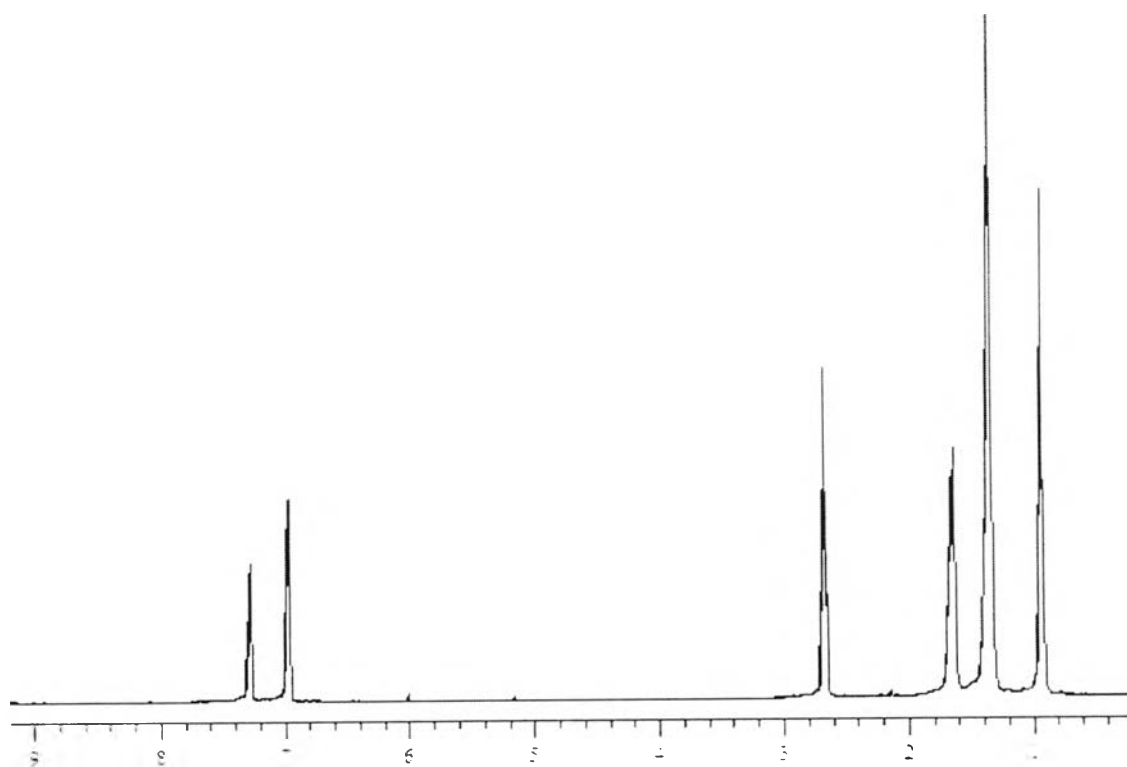
**Figure A-38** UV-Vis spectra of the attempted in situ trapping of benzyne with P3HT in 9–15 min heating.



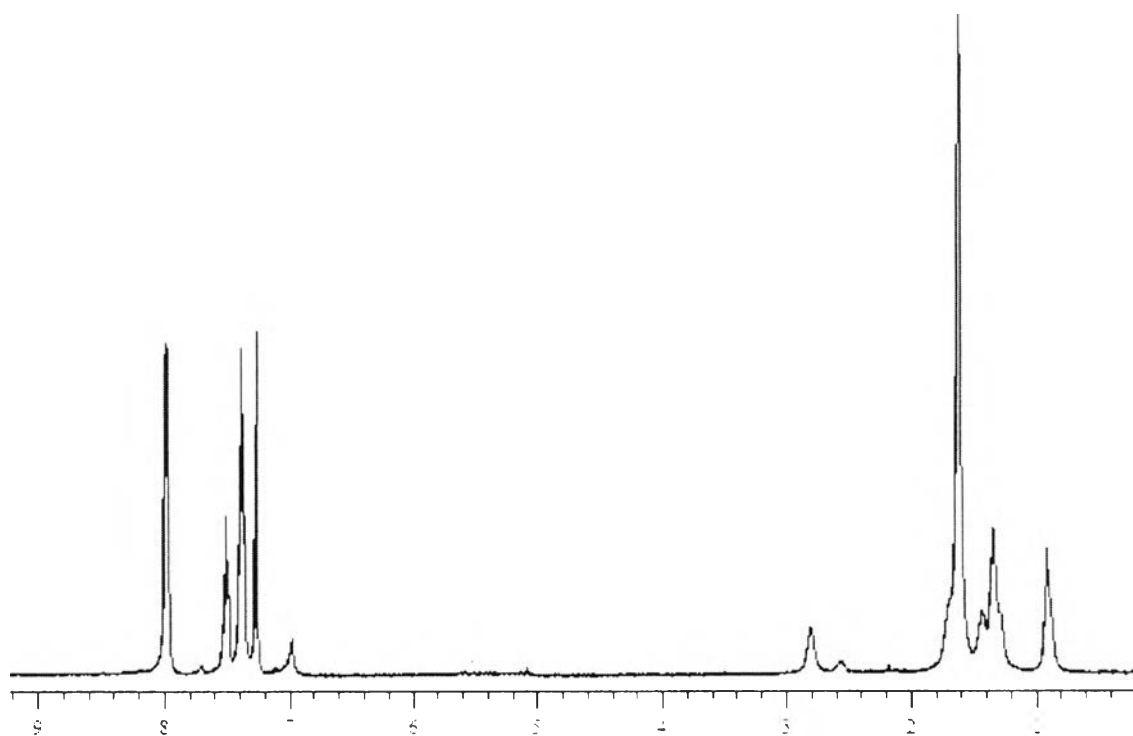
**Figure A-39** UV-Vis spectra of the attempted in situ trapping of benzyne with P3HT in 1–70 min at room temperature.



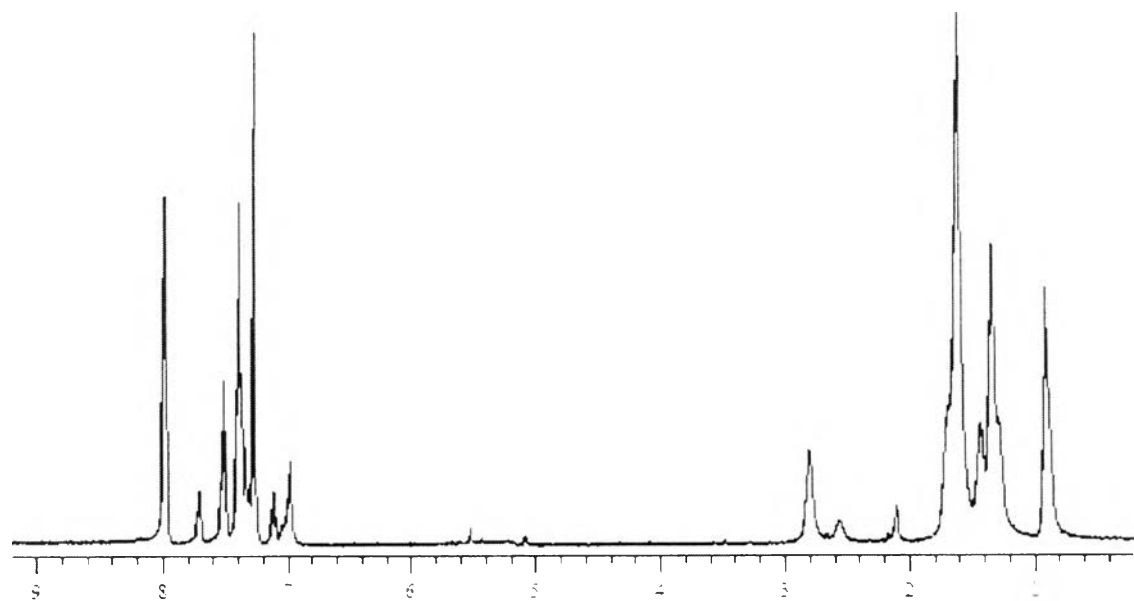
**Figure A-40** UV-Vis spectra of the trapping of benzyne with P3HT in 80–160 min at room temperature.



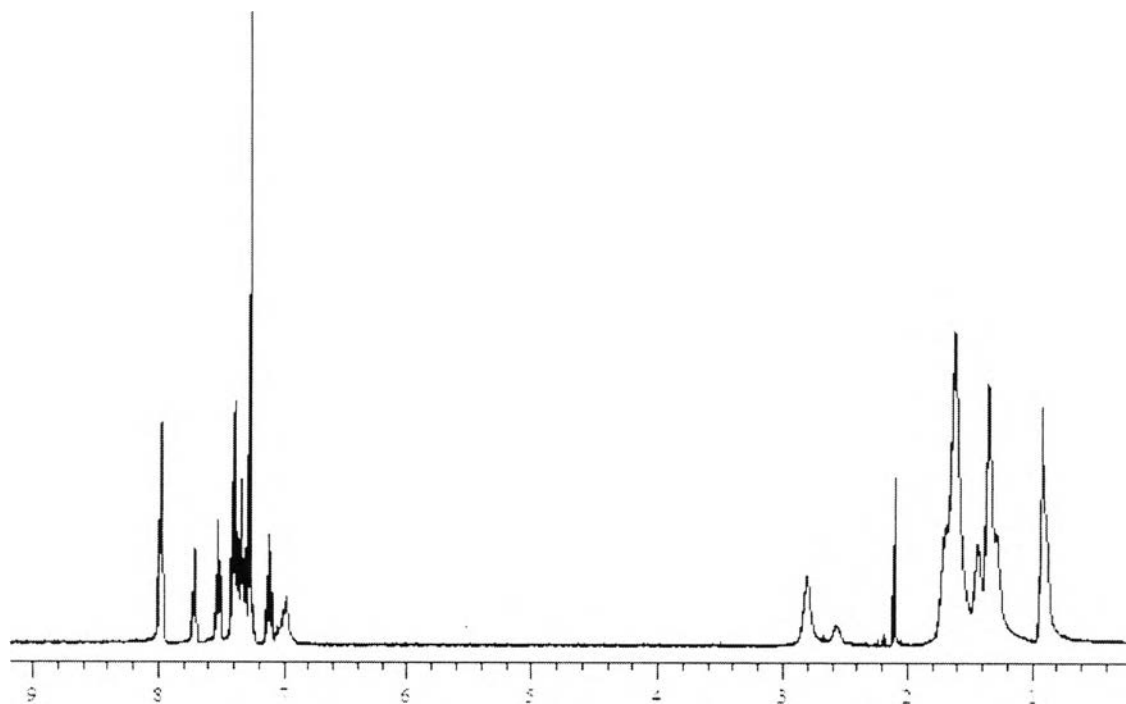
**Figure A-41** <sup>1</sup>H-NMR (400 MHz, CDCl<sub>3</sub>) spectrum of DPIC.



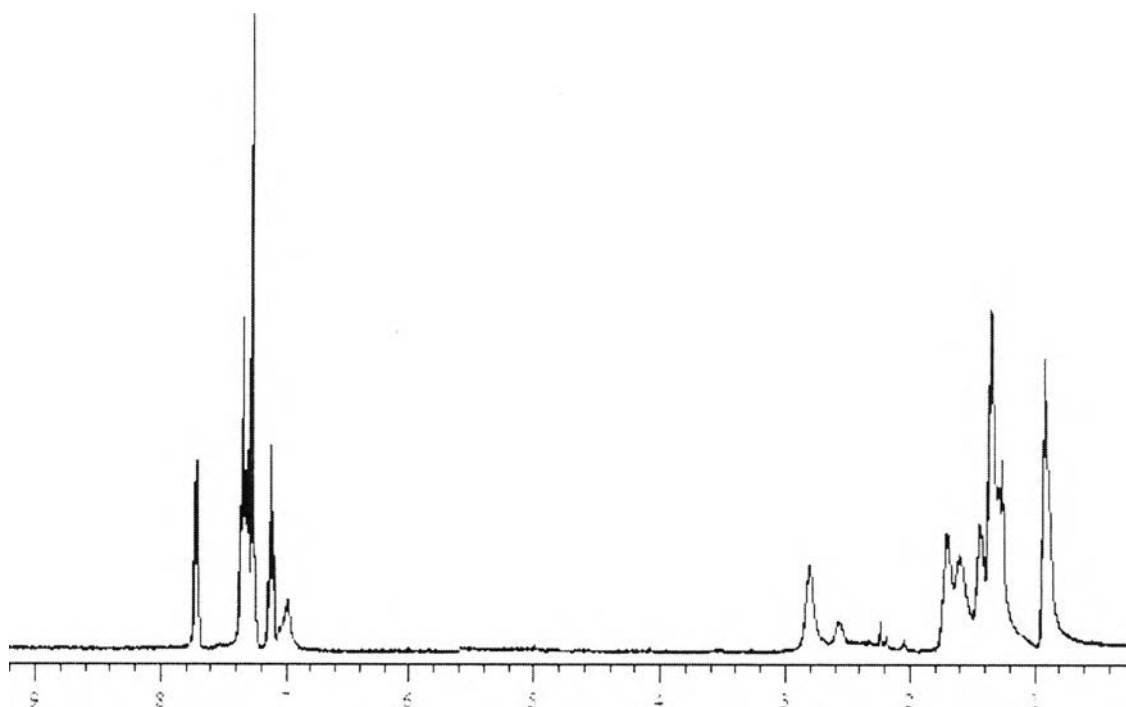
**Figure A-42** <sup>1</sup>H-NMR (400 MHz, CDCl<sub>3</sub>) spectrum of Arylation of P3HT using DPIC with Cu(OAc)<sub>2</sub> as catalyst in an NMR tube, RT, 0h.



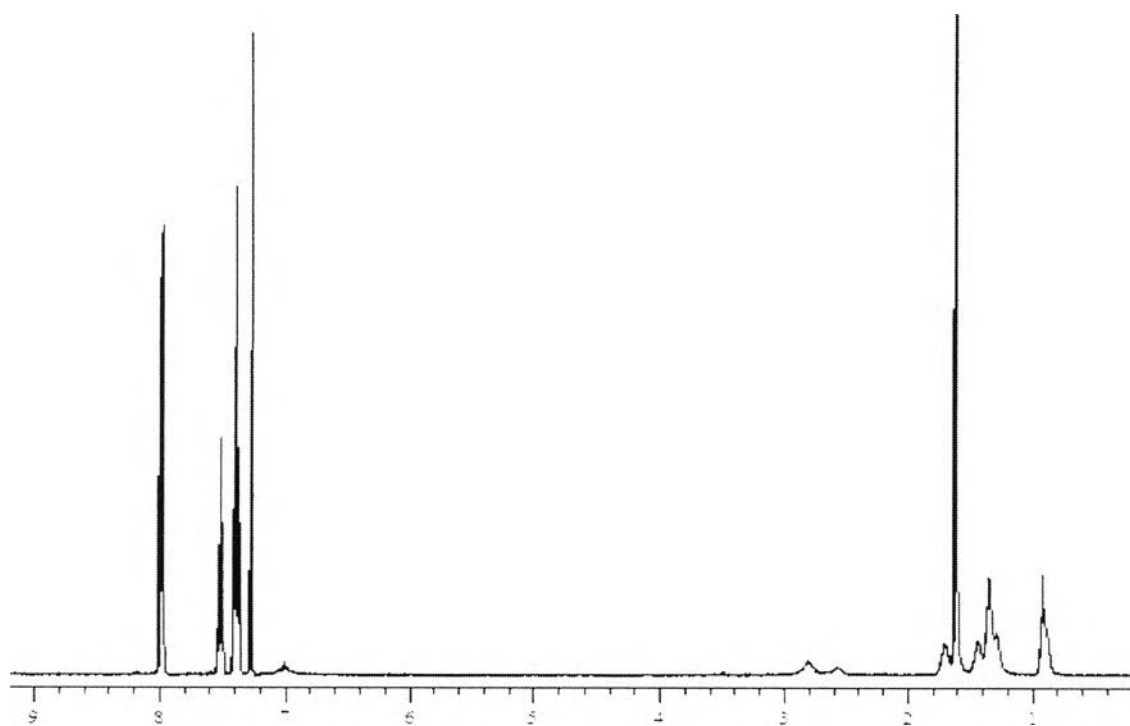
**Figure A-43** <sup>1</sup>H-NMR (400 MHz, CDCl<sub>3</sub>) spectrum of Arylation of P3HT using DPIC with Cu(OAc)<sub>2</sub> in an NMR tube, RT, 1.5h.



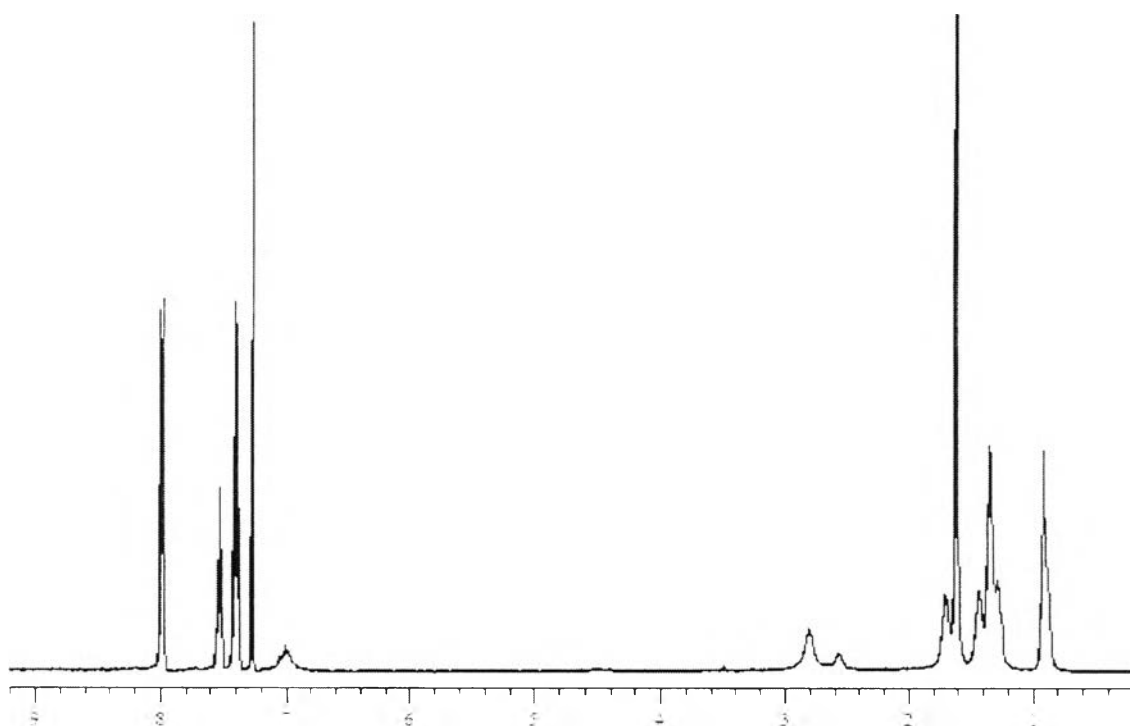
**Figure A-44** <sup>1</sup>H-NMR (400 MHz, CDCl<sub>3</sub>) spectrum of Arylation of P3HT using DPIC with Cu(OAc)<sub>2</sub> in an NMR tube, RT, 3h.



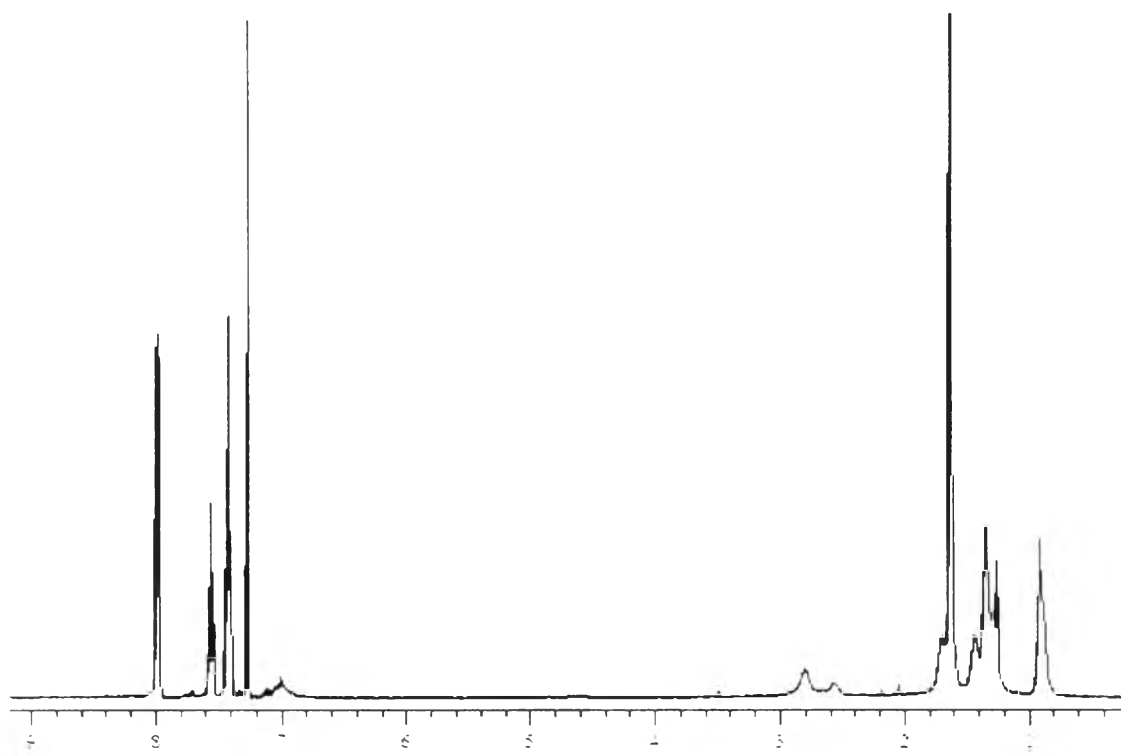
**Figure A-45** <sup>1</sup>H-NMR (400 MHz, CDCl<sub>3</sub>) spectrum of Arylation of P3HT using DPIC with Cu(OAc)<sub>2</sub> in an NMR tube, RT, 3h, 50 °C, 2h.



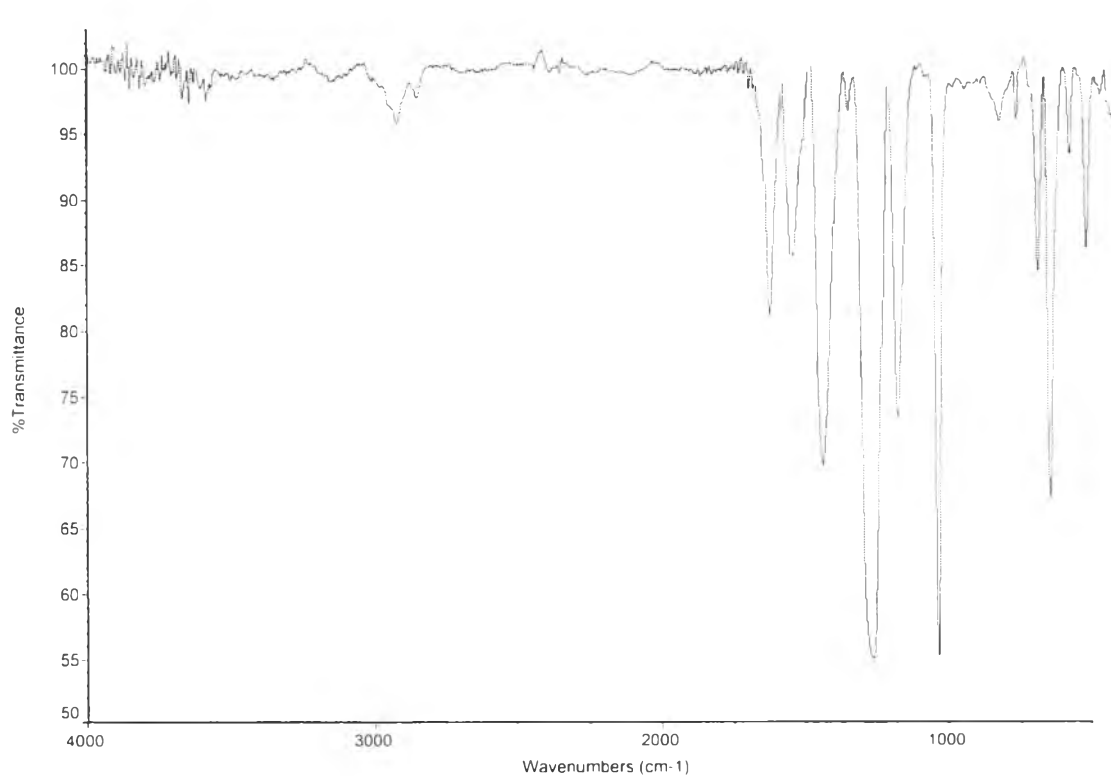
**Figure A-46** <sup>1</sup>H-NMR (400 MHz, CDCl<sub>3</sub>) spectrum of Arylation of P3HT using DPIC with AgOTf as catalyst in an NMR tube, RT, 0 h.



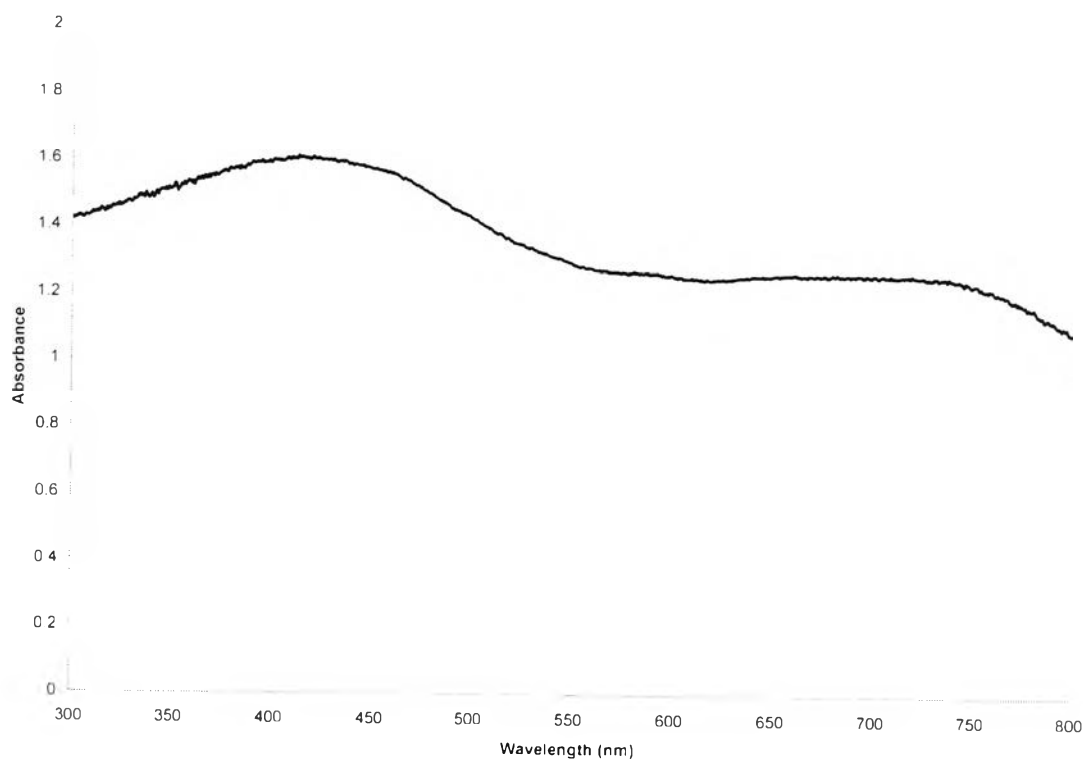
**Figure A-47** <sup>1</sup>H-NMR (400 MHz, CDCl<sub>3</sub>) spectrum of Arylation of P3HT using DPIC with AgOTf as catalyst in an NMR tube, RT, 1.5 h.



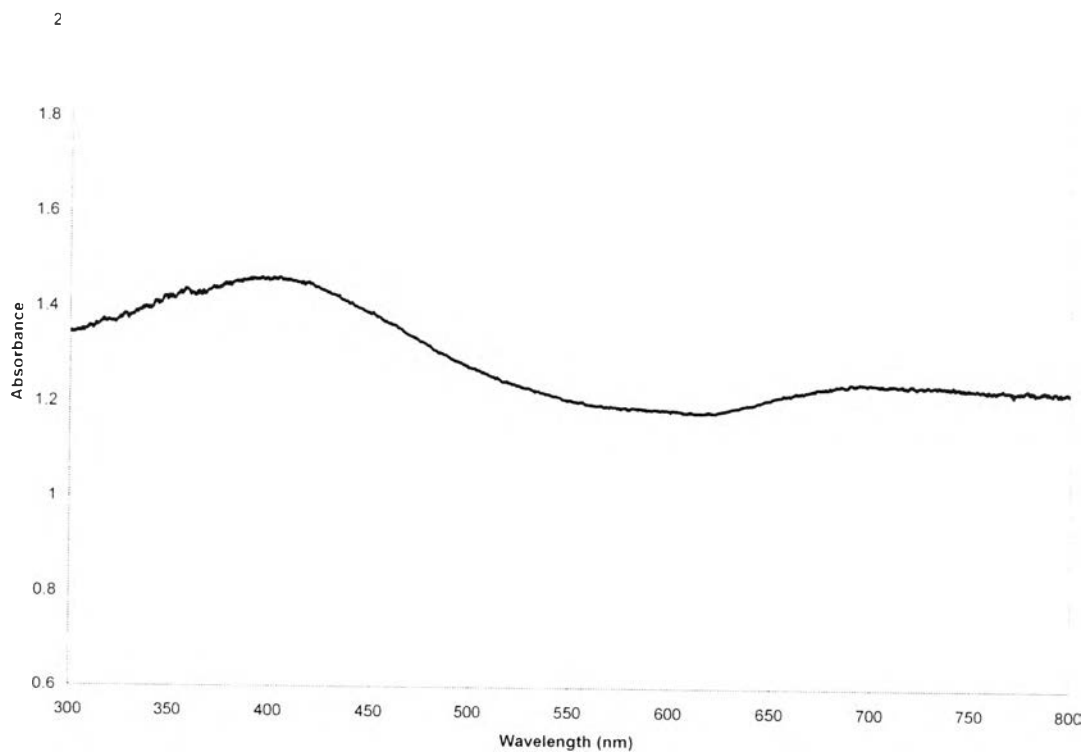
**Figure A-48** <sup>1</sup>H-NMR (400 MHz, CDCl<sub>3</sub>) spectrum of Arylation of P3HT using DPIC with AgOTf as catalyst in an NMR tube, RT, 3 h.



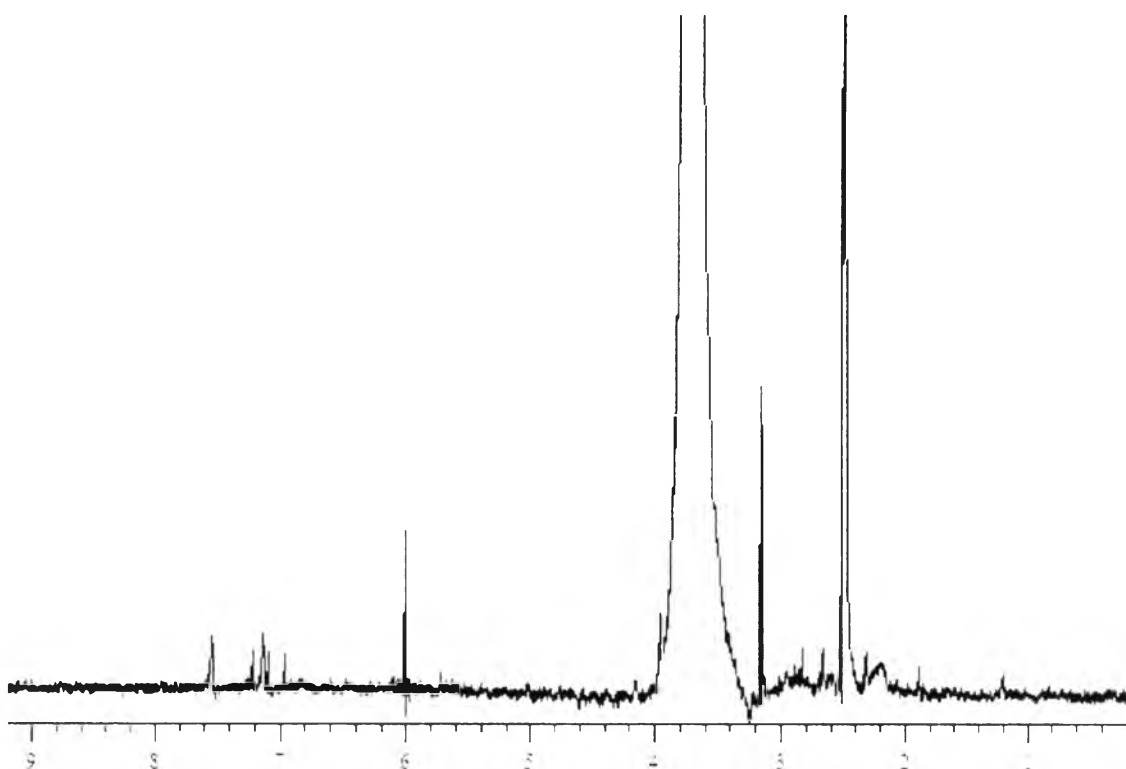
**Figure A-49** FT-IR (KBr) spectrum of arylated P3HT using DPIT.



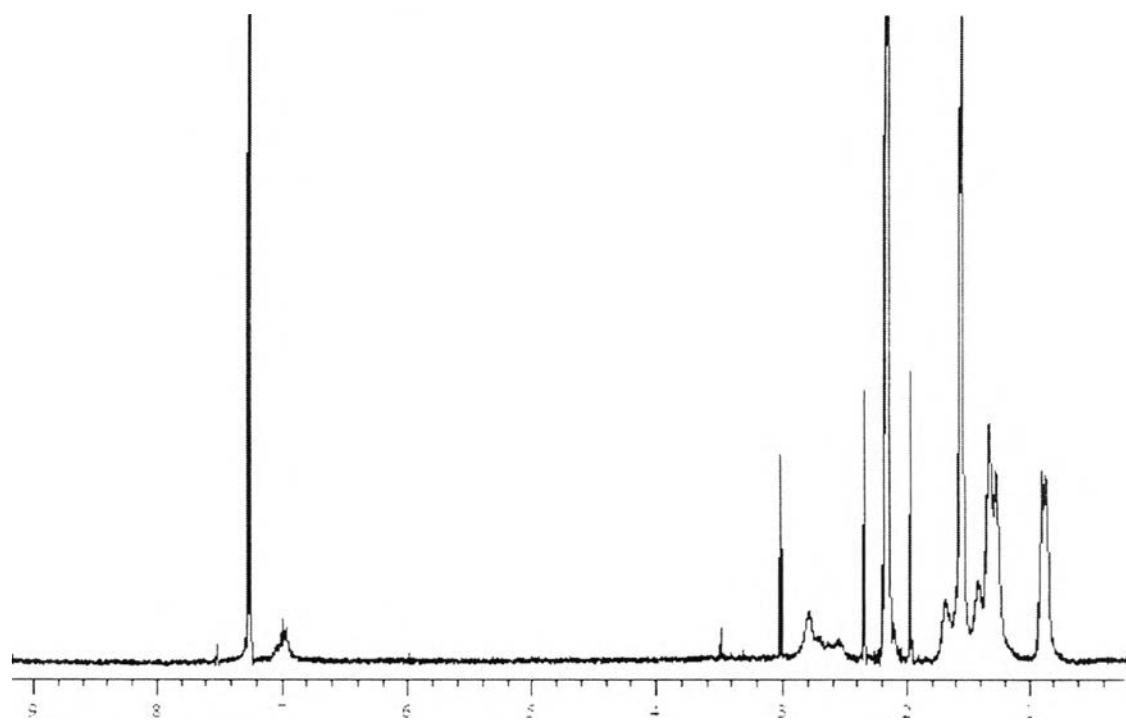
**Figure A-50** Solid state UV-Vis spectrum of P3HT.



**Figure A-51** Solid state UV-Vis spectrum of arylated P3HT using DPIT.

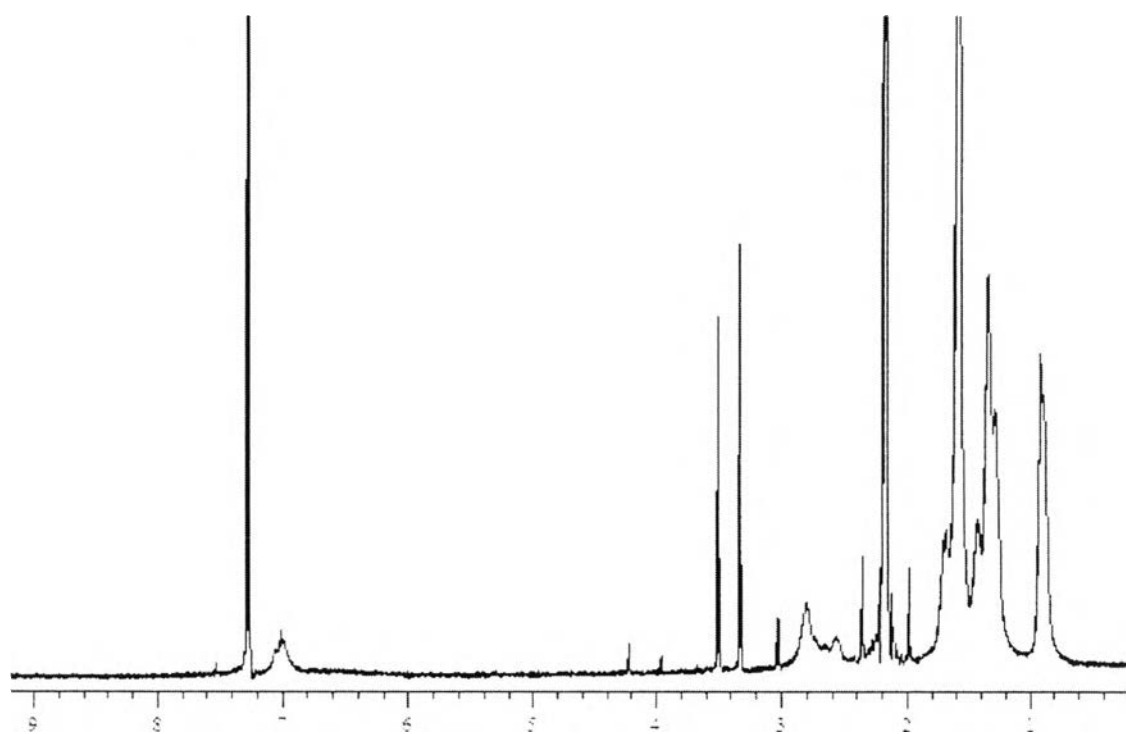


**Figure A-52** <sup>1</sup>H-NMR (DMSO-d<sub>6</sub>) spectrum of methylated thiophene.

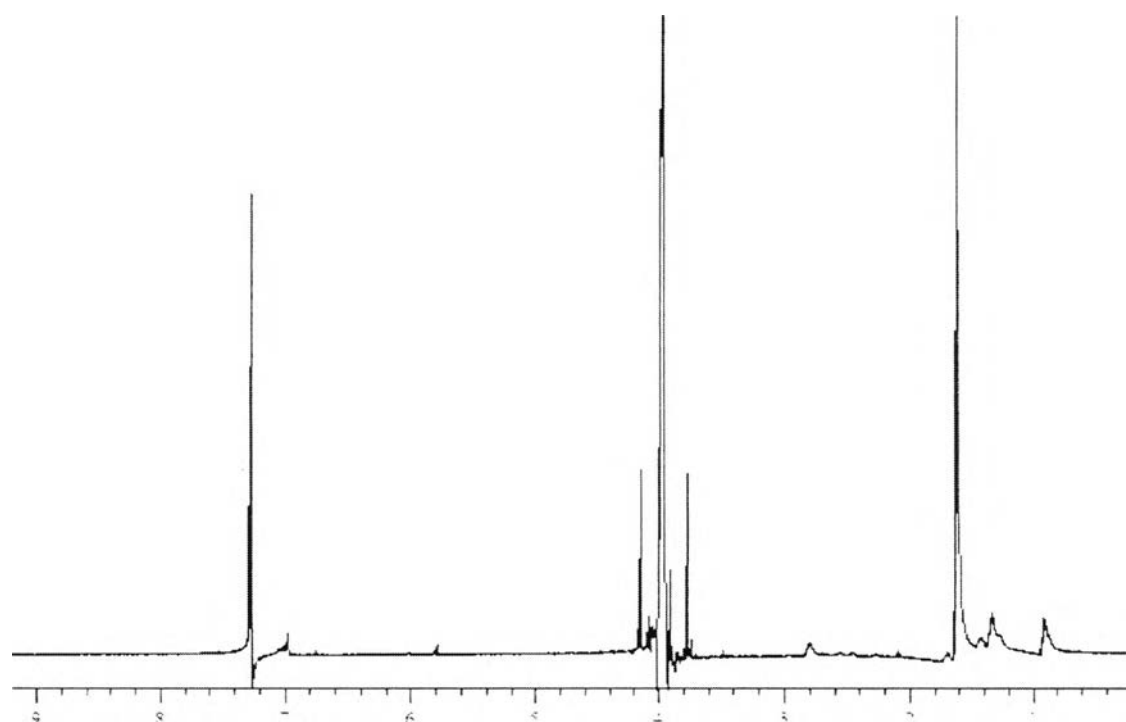


**Figure A-53** <sup>1</sup>H-NMR (400 MHz, CDCl<sub>3</sub>) spectrum of methylation of P3HT using MeI in an NMR tube, RT, 1h.

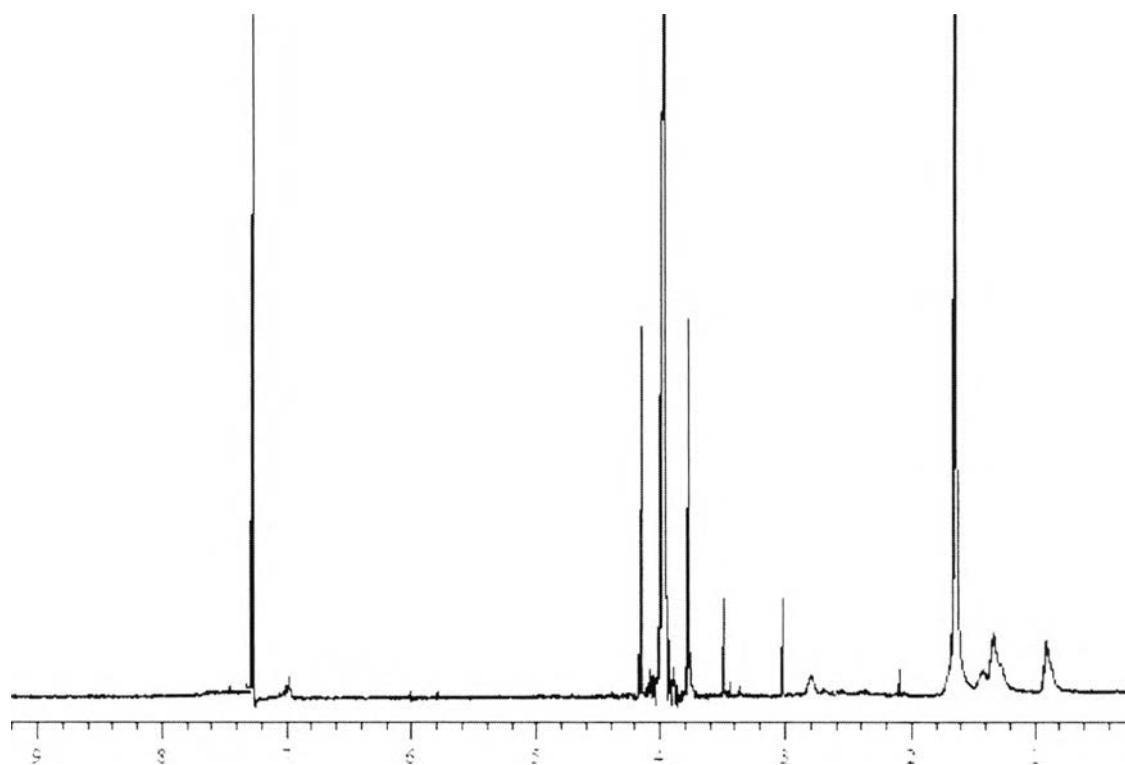




**Figure A-54** <sup>1</sup>H-NMR (400 MHz, CDCl<sub>3</sub>) spectrum of methylation of P3HT using MeI in an NMR tube, RT, 2 days.



**Figure A-55** <sup>1</sup>H-NMR (400 MHz, CDCl<sub>3</sub>) spectrum of methylation of P3HT using dimethylsulfate in an NMR tube, RT, 1h.



**Figure A-56**  $^1\text{H-NMR}$  (400 MHz,  $\text{CDCl}_3$ ) spectrum of methylation of P3HT using dimethylsulfate in an NMR tube. RT, 2days.

## **APPENDIX B**

ต้นฉบับ หน้าขาดหาย

ต้นฉบับ หน้าขาดหาย