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Supporting Information

Convenient Synthesis of Organic-Electronics-Oriented Building Blocks via On-Water and Under-Air Homocoupling of (Hetero)aryl Iodides

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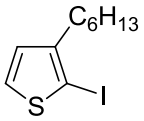
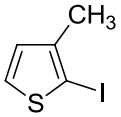
General procedure for the synthesis of heteroaryl iodides (1a, 1c-1s):

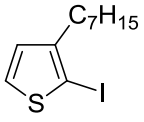
To a solution of the alkylated thiophene derivatives (or other heteroarenes) (2.00 mmol) in a mixture of chloroform (6 mL) and acetic acid (6 mL) at 0 ^{o}C was added *N*-iodosuccinimide (2.02 mmol) portionwise. The reaction mixture was then stirred at 0 ℃ for 1-6 h. After the iodination was complete, the mixture was neutralized with NaOH (10 mL, 1 N in water) followed by the extraction using dichloromethane (2 × 30 mL). The combined organic layers were washed with $NaHSO_3$ (50 mL), brine (50 mL), and dried over Na_2SO_4 before concentrated in *vacuo*. Purification by flash chromatography yielded the desired products **1a**, **1c-1s**.



3-Hexyl-2-iodothiophene[1] **(1a)** was prepared from 3-hexylthiophene (336 mg, 2.00 mmol), *N*-iodosuccinimide (455 mg, 2.02 mmol), chloroform (6 mL), and acetic acid (6 mL) according to the general procedure and yielding after column chromatography (hexanes) the pure product **1a** (500 mg, 85 %). A pale yellow liquid. ^{1}H NMR ($CDCl_3$, 300 MHz, ppm): δ 7.39 (d, *J* = 5.4 Hz, 1 H), 6.77 (d, *J* = 5.4 Hz, 1 H), 2.58 (t, *J* = 7.7 Hz, 2 H), 1.52-1.73 (comp, 2 H), 1.23-1.49 (comp, 6 H), 0.93 (t, *J* = 6.5 Hz, 3 H); ^{13}C NMR ($CDCl_3$, 75 MHz, ppm): δ 147.1, 130.2, 127.9, 74.0, 32.1, 31.6, 30.0, 28.9, 22.6, 14.1.

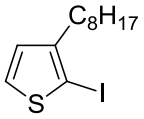


2-Iodo-3-methylthiophene[2] **(1c)** was prepared from 3-methylthiophene (196 mg, 2.00 mmol), *N*-iodosuccinimide (455 mg, 2.02 mmol), chloroform (6 mL), and acetic acid (6 mL) according to the general procedure and yielding after column chromatography (hexanes) the pure product **1c** (403 mg, 90 %). A pale yellow liquid. ^{1}H NMR ($CDCl_3$, 300 MHz, ppm): δ 7.37 (d, *J* = 5.4 Hz, 1 H), 6.77 (d, *J* = 5.4 Hz, 1 H), 2.25 (s, 3 H); ^{13}C NMR ($CDCl_3$, 75 MHz, ppm): δ 142.5, 130.1, 128.9, 74.4, 18.0.

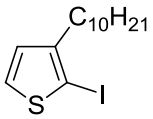


3-Heptyl-2-iodothiophene (1d) was prepared from 3-heptylthiophene (364 mg, 2.00 mmol), *N*-iodosuccinimide (455 mg, 2.02 mmol), chloroform (6 mL), and acetic acid (6 mL) according to the general procedure and yielding after column chromatography

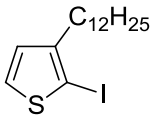
(hexanes) the pure product **1d** (493 mg, 80 %). A pale yellow liquid. ^{1}H NMR ($CDCl_3$, 300 MHz, ppm): δ 7.38 (d, J = 5.4 Hz, 1 H), 6.76 (d, J = 5.4 Hz, 1 H), 2.56 (t, J = 7.7 Hz, 2 H), 1.49-1.67 (comp, 2 H), 1.19-1.42 (comp, 8 H), 0.89 (t, J = 6.8 Hz, 3 H); ^{13}C NMR ($CDCl_3$, 75 MHz, ppm): δ 147.1, 130.2, 127.9, 74.0, 32.1, 31.8, 30.0, 29.2, 29.1, 22.7, 14.1; MS (EI, 70 ev): 308 (M^+, 7 %), 223 (29 %), 97 (100 %); HRMS (EI): calcd. for $C_{11}H_{17}IS$: 308.0096, found: 308.0099.



2-Iodo-3-octylthiophene[3] **(1e)** was prepared from 3-octylthiophene (392 mg, 2.00 mmol), *N*-iodosuccinimide (455 mg, 2.02 mmol), chloroform (6 mL), and acetic acid (6 mL) according to the general procedure and yielding after column chromatography (hexanes) the pure product **1e** (464 mg, 72 %). A pale yellow liquid. ^{1}H NMR ($CDCl_3$, 300 MHz, ppm): δ 7.38 (d, J = 5.4 Hz, 1 H), 6.75 (d, J = 5.4 Hz, 1 H), 2.55 (t, J = 7.7 Hz, 2 H), 1.46-1.66 (comp, 2 H), 1.21-1.42 (comp, 10 H), 0.88 (t, J = 6.5 Hz, 3 H); ^{13}C NMR ($CDCl_3$, 75 MHz, ppm): δ 147.1, 130.2, 127.9, 74.0, 32.1, 31.9, 30.0, 29.4, 29.23, 29.21, 22.7, 14.1.

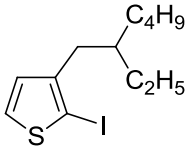


3-Decyl-2-iodothiophene (1f) was prepared from 3-decylthiophene (448 mg, 2.00 mmol), *N*-iodosuccinimide (455 mg, 2.02 mmol), chloroform (6 mL), and acetic acid (6 mL) according to the general procedure and yielding after column chromatography (hexanes) the pure product **1f** (490 mg, 70 %). A pale yellow liquid. ^{1}H NMR ($CDCl_3$, 300 MHz, ppm): δ 7.38 (d, J = 5.4 Hz, 1 H), 6.76 (d, J = 5.4 Hz, 1 H), 2.56 (t, J = 7.8 Hz, 2 H), 1.49-1.69 (comp, 2 H), 1.18-1.44 (comp, 14 H), 0.90 (t, J = 6.6 Hz, 3 H); ^{13}C NMR ($CDCl_3$, 75 MHz, ppm): δ 147.2, 130.3, 127.9, 73.9, 32.1, 31.9, 30.0, 29.60, 29.57, 29.4, 29.3, 29.2, 22.7, 14.1; MS (EI, 70 ev): 350 (M^+, 9 %), 223 (45 %), 97 (100 %); HRMS (EI): calcd. for $C_{14}H_{23}IS$: 350.0565, found: 350.0566.

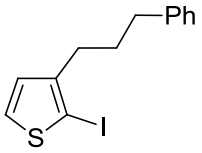


3-Dodecyl-2-iodothiophene[4] **(1g)** was prepared from 3-dodecylthiophene (504 mg, 2.00 mmol), *N*-iodosuccinimide (455 mg, 2.02 mmol), chloroform (6 mL), and acetic acid (6 mL) according to the general procedure and yielding after column

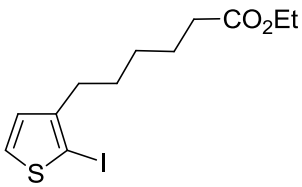
chromatography (hexanes) the pure product **1g** (507 mg, 67 %). A pale yellow liquid. ^{1}H NMR ($CDCl_3$, 300 MHz, ppm): δ 7.38 (d, J = 5.4 Hz, 1 H), 6.75 (d, J = 5.4 Hz, 1 H), 2.56 (t, J = 7.7 Hz, 2 H), 1.48-1.66 (comp, 2 H), 1.19-1.40 (comp, 18 H), 0.89 (t, J = 6.8 Hz, 3 H); ^{13}C NMR ($CDCl_3$, 75 MHz, ppm): δ 152.2, 136.5, 125.8, 69.3, 31.9, 31.5, 30.2, 29.64, 29.62, 29.5, 29.34, 29.30, 29.0, 22.7, 14.1.



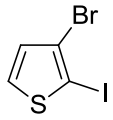
3-(2-Ethylhexyl)-2-iodothiophene (1h) was prepared from 3-(2-ethylhexyl)thiophene (392 mg, 2.00 mmol), *N*-iodosuccinimide (455 mg, 2.02 mmol), chloroform (6 mL), and acetic acid (6 mL) according to the general procedure and yielding after column chromatography (hexanes) the pure product **1h** (560 mg, 87 %). A pale yellow liquid. ^{1}H NMR ($CDCl_3$, 300 MHz, ppm): δ 7.38 (d, J = 5.4 Hz, 1 H), 6.73 (d, J = 5.4 Hz, 1 H), 2.50 (d, J = 7.2 Hz, 2 H), 1.55-1.78 (m, 1 H), 1.20-1.39 (comp, 8 H), 0.82-0.98 (comp, 6 H); ^{13}C NMR ($CDCl_3$, 75 MHz, ppm): δ 146.3, 130.1, 128.5, 74.8, 40.2, 36.2, 32.4, 28.8, 25.6, 23.0, 14.1, 10.9; MS (EI, 70 ev): 322 (M^+, 9 %), 223 (38 %), 97 (100 %), 57 (50 %); HRMS (EI): calcd. for $C_{12}H_{19}IS$: 322.0252, found: 322.0257.



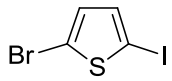
2-Iodo-3-(3-phenylpropyl)thiophene (1i) was prepared from 3-(3-phenylpropyl)thiophene (404 mg, 2.00 mmol), *N*-iodosuccinimide (455 mg, 2.02 mmol), chloroform (6 mL), and acetic acid (6 mL) according to the general procedure and yielding after column chromatography (hexanes) the pure product **1i** (517 mg, 79 %). A pale yellow liquid. ^{1}H NMR ($CDCl_3$, 300 MHz, ppm): δ 7.17-7.45 (comp, 6 H), 6.78 (d, J = 5.5 Hz, 1 H), 2.57-2.78 (comp, 4 H), 1.87-2.05 (comp, 2 H); ^{13}C NMR ($CDCl_3$, 75 MHz, ppm): δ 146.5, 141.9, 130.4, 128.4, 128.3, 127.9, 125.8, 74.3, 35.4, 31.7, 31.6; MS (EI, 70 ev): 328 (M^+, 2 %), 223 (11 %), 201 (13 %), 97 (100 %); HRMS (EI): calcd. for $C_{13}H_{13}IS$: 327.9783, found: 327.9779.



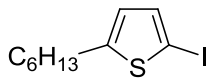
Ethyl 6-(2-iodothiophen-3-yl)hexanoate (1j) was prepared from ethyl 6-(thiophen-3-yl)hexanoate (452 mg, 2.00 mmol), *N*-iodosuccinimide (455 mg, 2.02 mmol), chloroform (6 mL), and acetic acid (6 mL) according to the general procedure and yielding after column chromatography (ethyl acetate : hexanes = 20 : 80) the pure product **1j** (597 mg, 85 %). A pale yellow liquid. ^{1}H NMR ($CDCl_3$, 300 MHz, ppm): δ 7.37 (d, J = 5.4 Hz, 1 H), 6.74 (d, J = 5.4 Hz, 1 H), 4.12 (q, J = 7.1 Hz, 2 H), 2.55 (t, J = 7.7 Hz, 2 H), 2.30 (t, J = 7.5 Hz, 2 H), 1.53-1.72 (comp, 4 H), 1.32-1.43 (comp, 2 H), 1.25 (t, J = 7.1 Hz, 3 H); ^{13}C NMR ($CDCl_3$, 75 MHz, ppm): δ 173.6, 146.7, 130.3, 127.8, 74.1, 60.1, 34.2, 31.8, 29.6, 28.6, 24.7, 14.2; MS (EI, 70 ev): 352 (M^+, 1 %), 223 (58 %), 179 (51 %), 151 (22 %), 97 (100 %); HRMS (EI): calcd. for $C_{12}H_{17}IO_2S$: 351.9994, found: 351.9988.



3-Bromo-2-iodothiophene[5] **(1k)** was prepared from 3-bromothiophene (326 mg, 2.00 mmol), *N*-iodosuccinimide (455 mg, 2.02 mmol), chloroform (6 mL), and acetic acid (6 mL) according to the general procedure and yielding after column chromatography (hexanes) the pure product **1k** (306 mg, 53 %). An orange liquid. ^{1}H NMR ($CDCl_3$, 300 MHz, ppm): δ 7.41 (d, J = 5.6 Hz, 1 H), 6.90 (d, J = 5.6 Hz, 1 H); ^{13}C NMR ($CDCl_3$, 75 MHz, ppm): δ 132.1, 130.3, 120.5, 76.8.

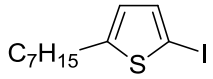


2-Bromo-5-iodothiophene[6] **(1l)** was prepared from 2-bromothiophene (326 mg, 2.00 mmol), *N*-iodosuccinimide (455 mg, 2.02 mmol), chloroform (6 mL), and acetic acid (6 mL) according to the general procedure and yielding after column chromatography (hexanes) the pure product **1l** (514 mg, 89 %). A pale yellow liquid. ^{1}H NMR ($CDCl_3$, 300 MHz, ppm): δ 7.03 (d, J = 3.8 Hz, 1 H), 6.75 (d, J = 3.8 Hz, 1 H); ^{13}C NMR ($CDCl_3$, 75 MHz, ppm): δ 137.4, 131.6, 115.1, 72.4.

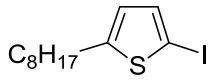


2-Hexyl-5-iodothiophene[7] **(1m)** was prepared from 2-hexylthiophene (336 mg, 2.00 mmol), *N*-iodosuccinimide (455 mg, 2.02 mmol), chloroform (6 mL), and acetic acid (6 mL) according to the general procedure and yielding after column chromatography (hexanes) the pure product **1m** (512 mg, 87 %). A pale yellow liquid. ^{1}H NMR ($CDCl_3$, 300 MHz, ppm): δ 7.04 (d, J = 3.6 Hz, 1 H), 6.47 (d, J = 3.6 Hz, 1 H), 2.79 (t, J = 7.7

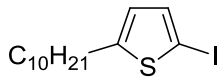
Hz, 2 H), 1.57-1.71 (comp, 2 H), 1.19-1.42 (comp, 6 H), 0.89 (t, J = 6.8 Hz, 3 H); ^{13}C NMR ($CDCl_3$, 75 MHz, ppm): δ 152.0, 136.4, 125.7, 69.4, 31.5, 31.4, 30.2, 28.6, 22.5, 14.1.



2-Heptyl-5-iodothiophene (1n) was prepared from 2-heptylthiophene (364 mg, 2.00 mmol), *N*-iodosuccinimide (455 mg, 2.02 mmol), chloroform (6 mL), and acetic acid (6 mL) according to the general procedure and yielding after column chromatography (hexanes) the pure product **1n** (524 mg, 85 %). A pale yellow liquid. ^{1}H NMR ($CDCl_3$, 300 MHz, ppm): δ 7.04 (d, J = 3.6 Hz, 1 H), 6.48 (dt, J = 3.5, 0.9 Hz, 1 H), 2.80 (t, J = 7.6 Hz, 2 H), 1.58-1.70 (comp, 2 H), 1.17-1.41 (comp, 8 H), 0.90 (t, J = 6.8 Hz, 3 H); ^{13}C NMR ($CDCl_3$, 75 MHz, ppm): δ 152.1, 136.5, 125.7, 69.3, 31.7, 31.5, 30.2, 28.97, 28.95, 22.6, 14.1; MS (EI, 70 ev): 308 (M^+, 23 %), 223 (100 %), 97(28 %); HRMS (EI): calcd. for $C_{11}H_{17}IS$: 308.0096, found: 308.0100.

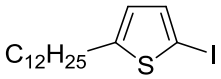


2-Iodo-5-octylthiophene (1o) was prepared from 2-octylthiophene (392 mg, 2.00 mmol), *N*-iodosuccinimide (455 mg, 2.02 mmol), chloroform (6 mL), and acetic acid (6 mL) according to the general procedure and yielding after column chromatography (hexanes) the pure product **1o** (528 mg, 82 %). A pale yellow liquid. ^{1}H NMR ($CDCl_3$, 300 MHz, ppm): δ 7.04 (d, J = 3.6 Hz, 1 H), 6.47 (d, J = 3.6 Hz, 1 H), 2.79 (t, J = 7.7 Hz, 2 H), 1.57-1.71 (comp, 2 H), 1.19-1.42 (comp, 10 H), 0.89 (t, J = 6.8 Hz, 3 H); ^{13}C NMR ($CDCl_3$, 75 MHz, ppm): δ 152.1, 136.5, 125.7, 69.3, 31.8, 31.5, 30.2, 29.3, 29.2, 29.0, 22.6, 14.1; MS (EI, 70 ev): 322 (M^+, 22 %), 223 (100 %), 97(20 %); HRMS (EI): calcd. for $C_{12}H_{19}IS$: 322.0252, found: 322.0248.

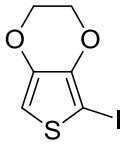


2-Decyl-5-iodothiophene (1p) was prepared from 2-decylthiophene (448 mg, 2.00 mmol), *N*-iodosuccinimide (455 mg, 2.02 mmol), chloroform (6 mL), and acetic acid (6 mL) according to the general procedure and yielding after column chromatography (hexanes) the pure product **1p** (546 mg, 78 %). A pale yellow liquid. ^{1}H NMR ($CDCl_3$, 300 MHz, ppm): δ 7.04 (d, J = 3.5 Hz, 1 H), 6.48 (dt, J = 3.5, 0.9 Hz, 1 H), 2.80 (t, J = 7.9 Hz, 2 H), 1.58-1.73 (comp, 2 H), 1.15-1.44 (comp, 14 H), 0.90 (t, J = 6.7 Hz, 3 H); ^{13}C NMR ($CDCl_3$, 75 MHz, ppm): δ 152.1, 136.5, 125.7, 69.3, 31.9, 31.5, 30.2, 29.6, 29.5, 29.3, 29.0, 22.7, 14.1; MS (EI, 70 ev): 350 (M^+, 42 %), 223 (100 %), 97(46 %);

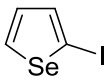
HRMS (EI): calcd. for $C_{14}H_{23}IS$: 350.0565, found: 350.0571.



2-Dodecyl-5-iodothiophene[8] **(1q)** was prepared from 2-dodecylthiophene (504 mg, 2.00 mmol), *N*-iodosuccinimide (455 mg, 2.02 mmol), chloroform (6 mL), and acetic acid (6 mL) according to the general procedure and yielding after column chromatography (hexanes) the pure product **1q** (575 mg, 76 %). A pale yellow liquid. ^{1}H NMR ($CDCl_3$, 300 MHz, ppm): δ 7.04 (d, J = 3.6 Hz, 1 H), 6.48 (d, J = 3.6 Hz, 1 H), 2.80 (t, J = 7.7 Hz, 2 H), 1.58-1.74 (comp, 2 H), 1.20-1.47 (comp, 18 H), 0.90 (t, J = 6.7 Hz, 3 H); ^{13}C NMR ($CDCl_3$, 75 MHz, ppm): δ 152.2, 136.5, 125.8, 69.3, 31.9, 31.5, 30.2, 29.7, 29.6, 29.5, 29.4, 29.3, 29.0, 22.7, 14.1.



2-Iodo-3,4-ethylenedioxythiophene[9] **(1r)** was prepared from 3,4-ethylenedioxythiophene (284 mg, 2.00 mmol), *N*-iodosuccinimide (455 mg, 2.02 mmol), chloroform (6 mL), and acetic acid (6 mL) according to the general procedure (0 ^{o}C, 1 h) and yielding after column chromatography (ethyl acetate : hexanes = 20 : 80) the pure product **1r** (418 mg, 78 %). A greenish yellow liquid. ^{1}H NMR ($CDCl_3$, 300 MHz, ppm): δ 6.54 (s, 1 H), 4.22-4.28 (comp, 2 H), 4.07-4.20 (comp, 2 H); ^{13}C NMR ($CDCl_3$, 75 MHz, ppm): δ 144.0, 140.80, 104.83, 65.0, 64.4, 49.1.



2-Iodoselenophene[10] **(1s)** was prepared from selenophene (262 mg, 2.00 mmol), *N*-iodosuccinimide (455 mg, 2.02 mmol), chloroform (6 mL), and acetic acid (6 mL) according to the general procedure (0 ^{o}C, 1 h) and yielding after column chromatography (hexanes) the pure product **1s** (334 mg, 65 %). A yellow liquid. ^{1}H NMR ($CDCl_3$, 300 MHz, ppm): δ 8.09 (dd, J = 5.9, 1.1 Hz, 1 H), 7.53 (dd, J = 3.8, 1.1 Hz, 1 H), 6.97 (dd, J = 5.9, 3.8 Hz, 1 H); ^{13}C NMR ($CDCl_3$, 75 MHz, ppm): δ 140.0, 137.1, 131.3, 75.3.

References:

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Figure S1. ^{1}H NMR Spectrum of **1a** (300 MHz, $CDCl_3$)

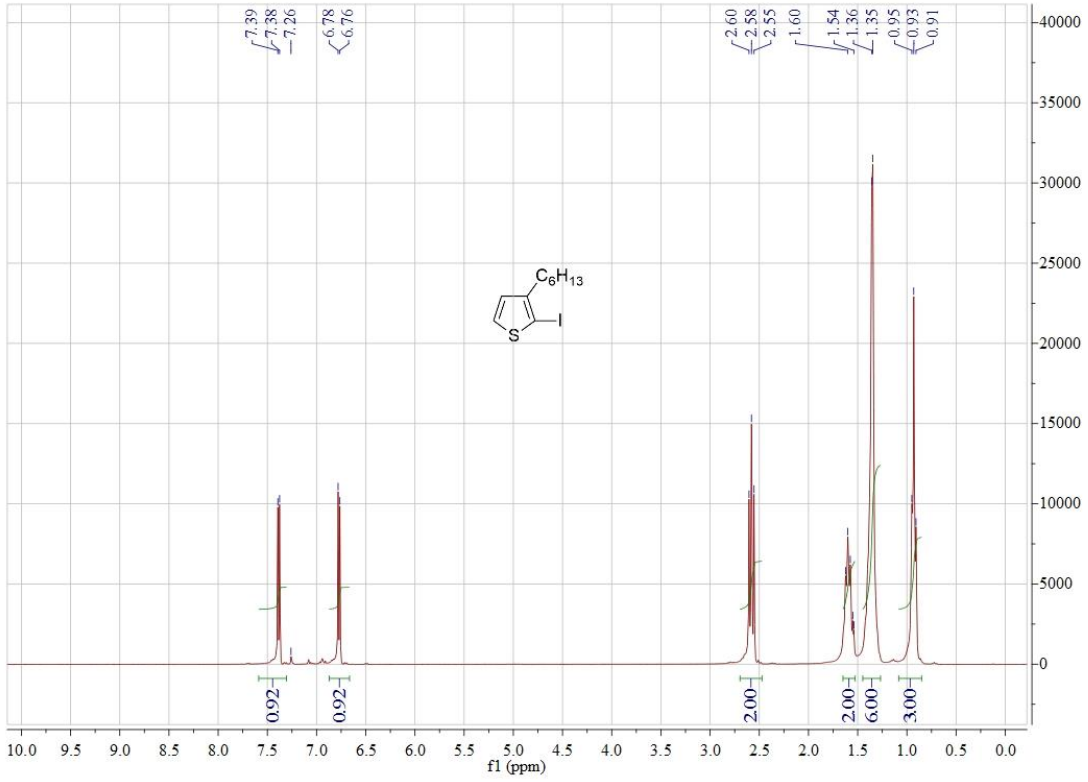

Figure S2. ^{13}C NMR Spectrum of **1a** (75 MHz, $CDCl_3$)

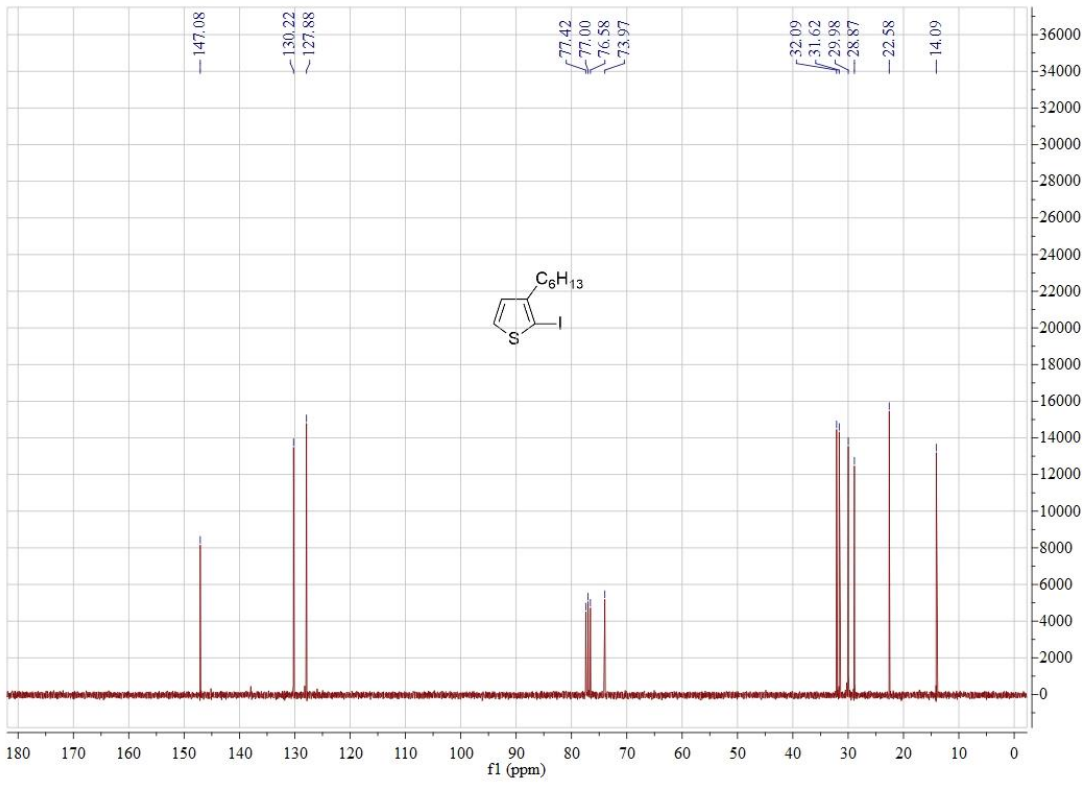

Figure S3. ^{1}H NMR Spectrum of **1c** (300 MHz, $CDCl_3$)

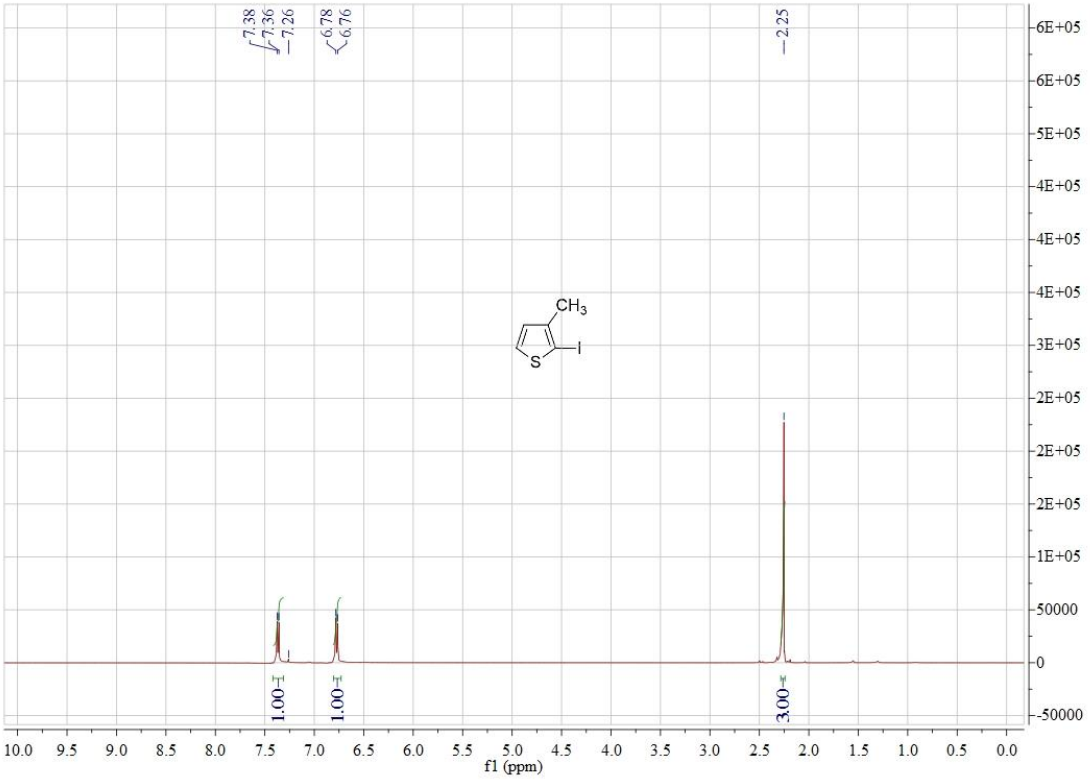

Figure S4. ^{13}C NMR Spectrum of **1c** (75 MHz, $CDCl_3$)

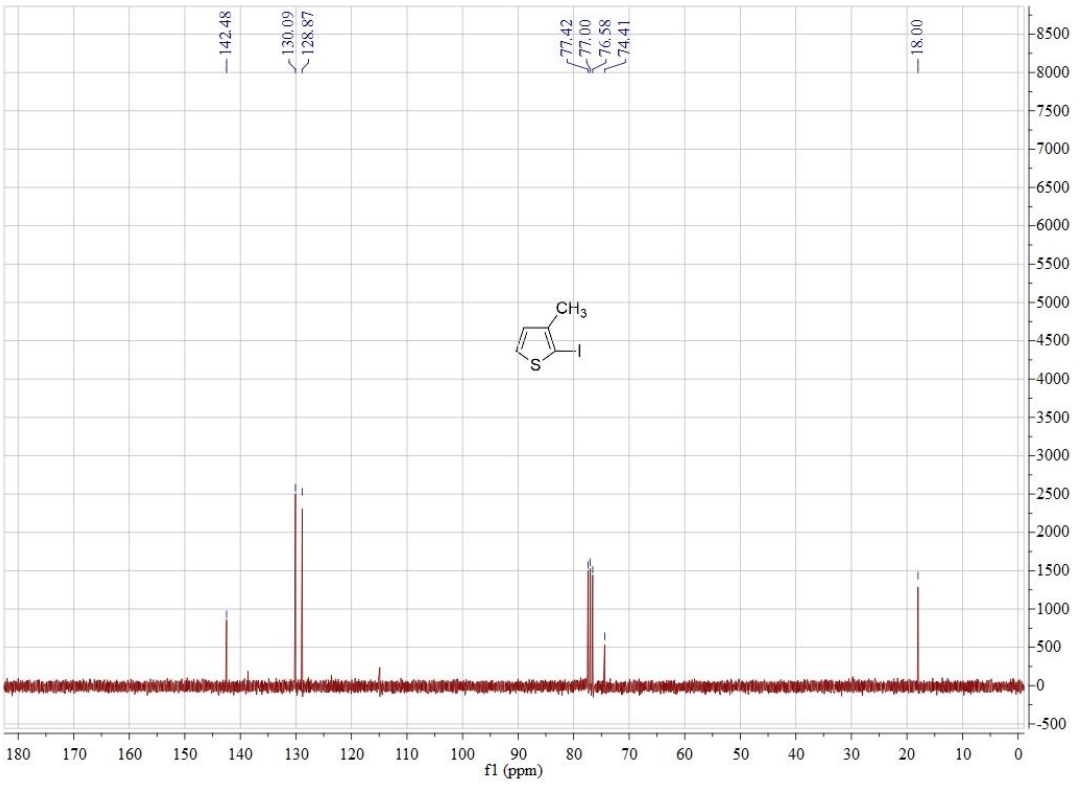

Figure S5. ^{1}H NMR Spectrum of **1d** (300 MHz, $CDCl_3$)

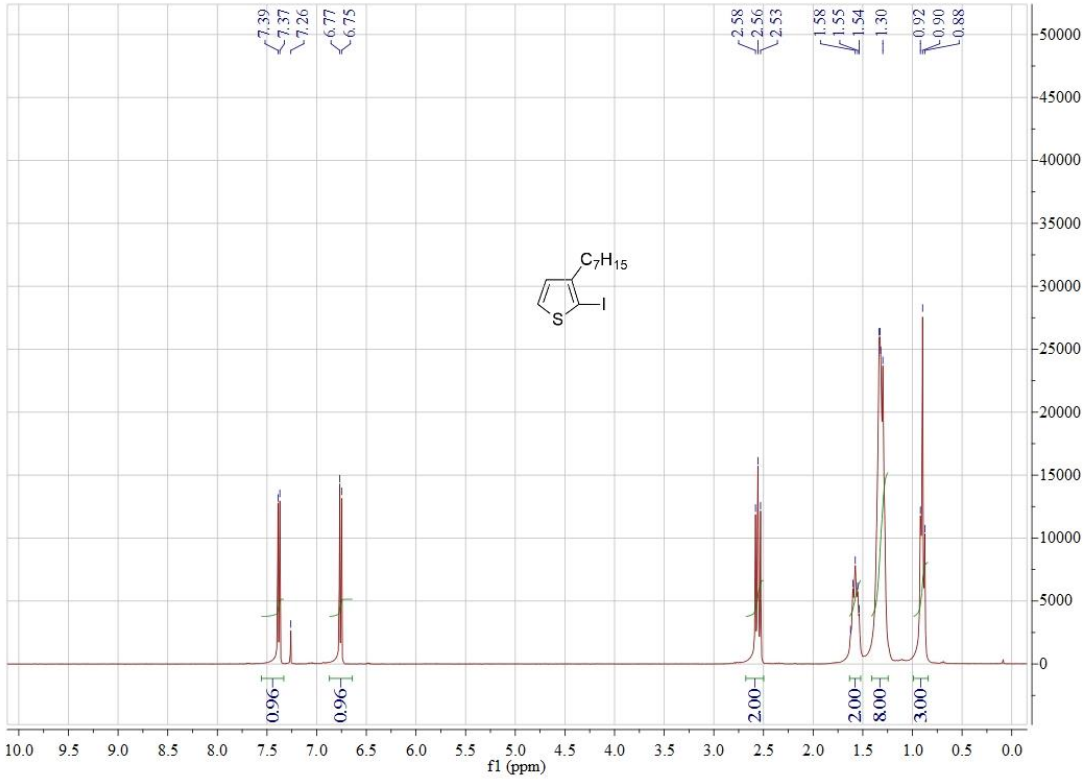

Figure S6. ^{13}C NMR Spectrum of **1d** (75 MHz, $CDCl_3$)

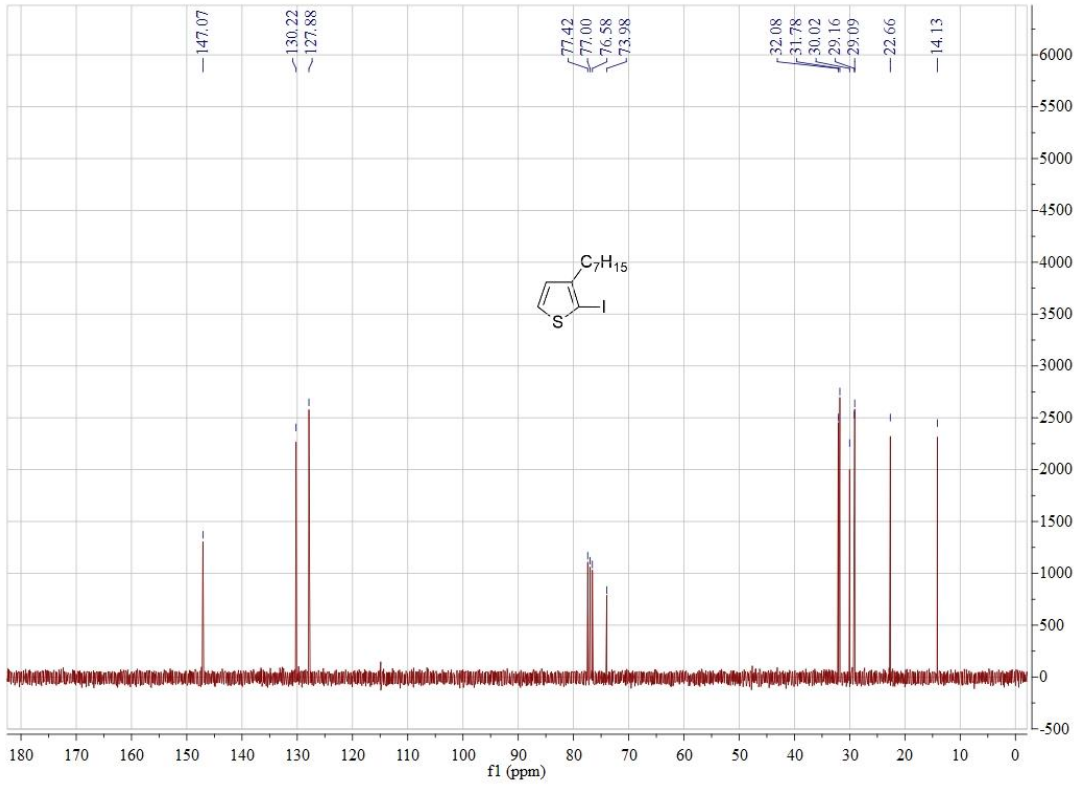

Figure S7. ^{1}H NMR Spectrum of **1e** (300 MHz, $CDCl_3$)

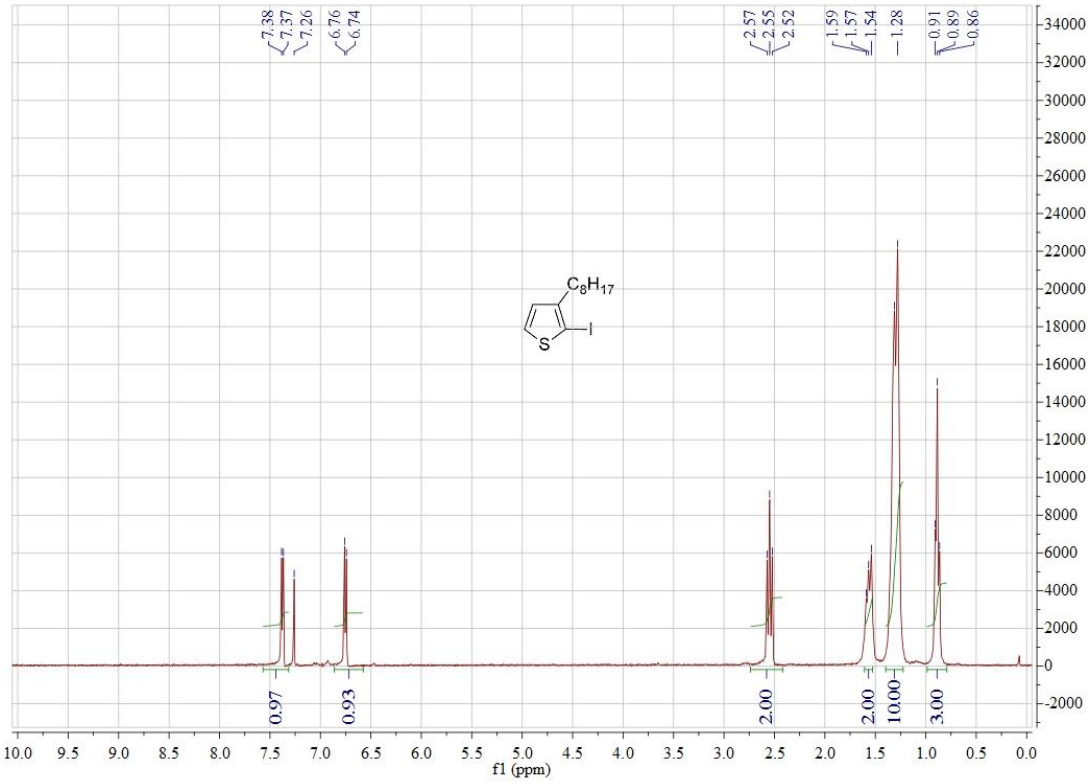

Figure S6. ^{13}C NMR Spectrum of **1e** (75 MHz, $CDCl_3$)

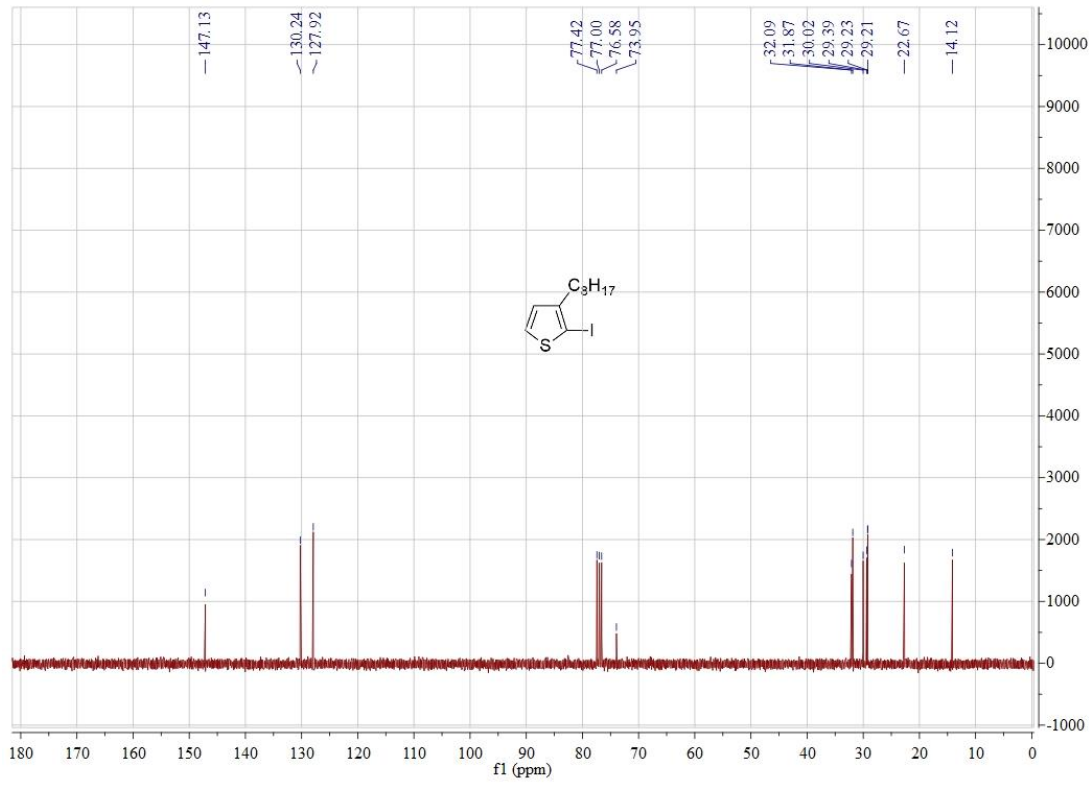

Figure S9. ^{1}H NMR Spectrum of **1f** (300 MHz, $CDCl_3$)

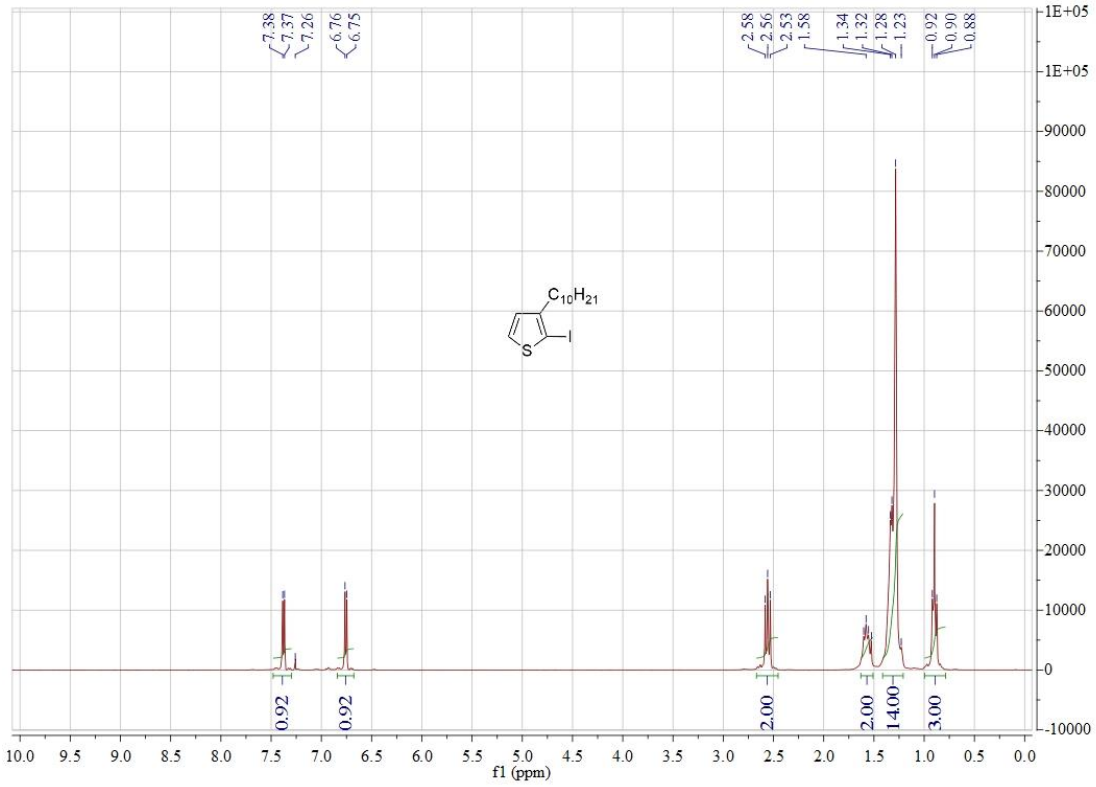

Figure S10. ^{13}C NMR Spectrum of **1f** (75 MHz, $CDCl_3$)

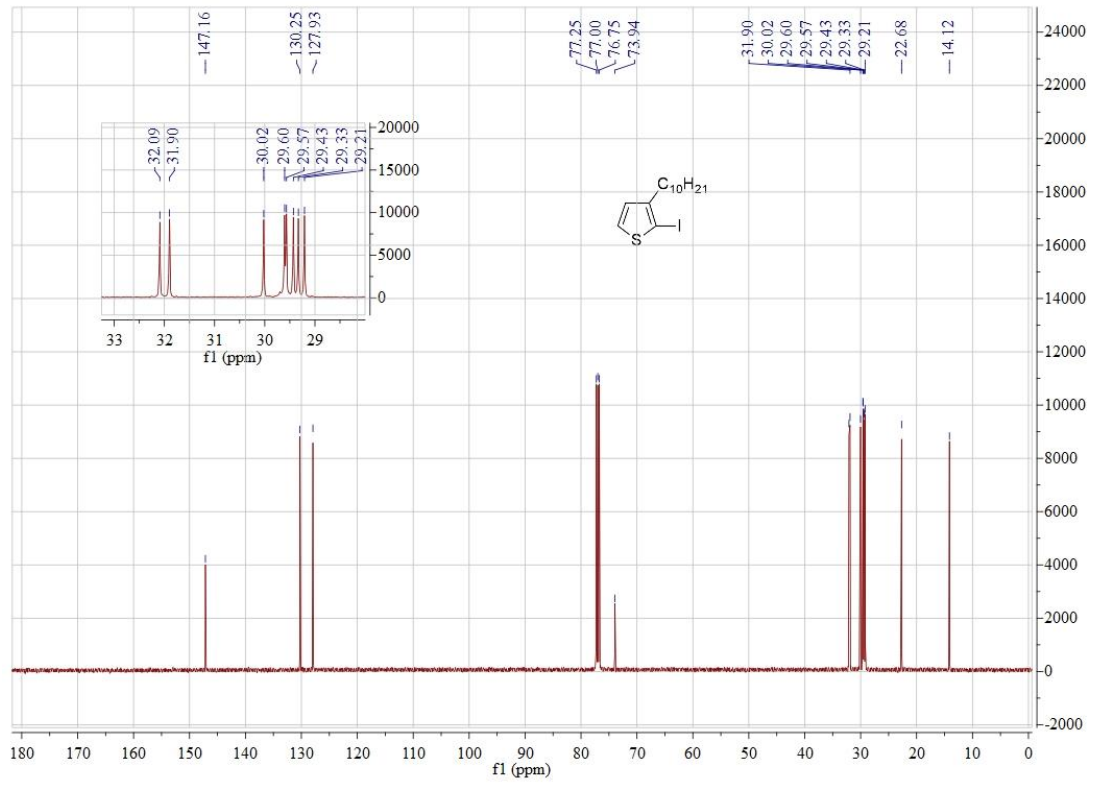

Figure S11. ^{1}H NMR Spectrum of **1g** (300 MHz, $CDCl_3$)

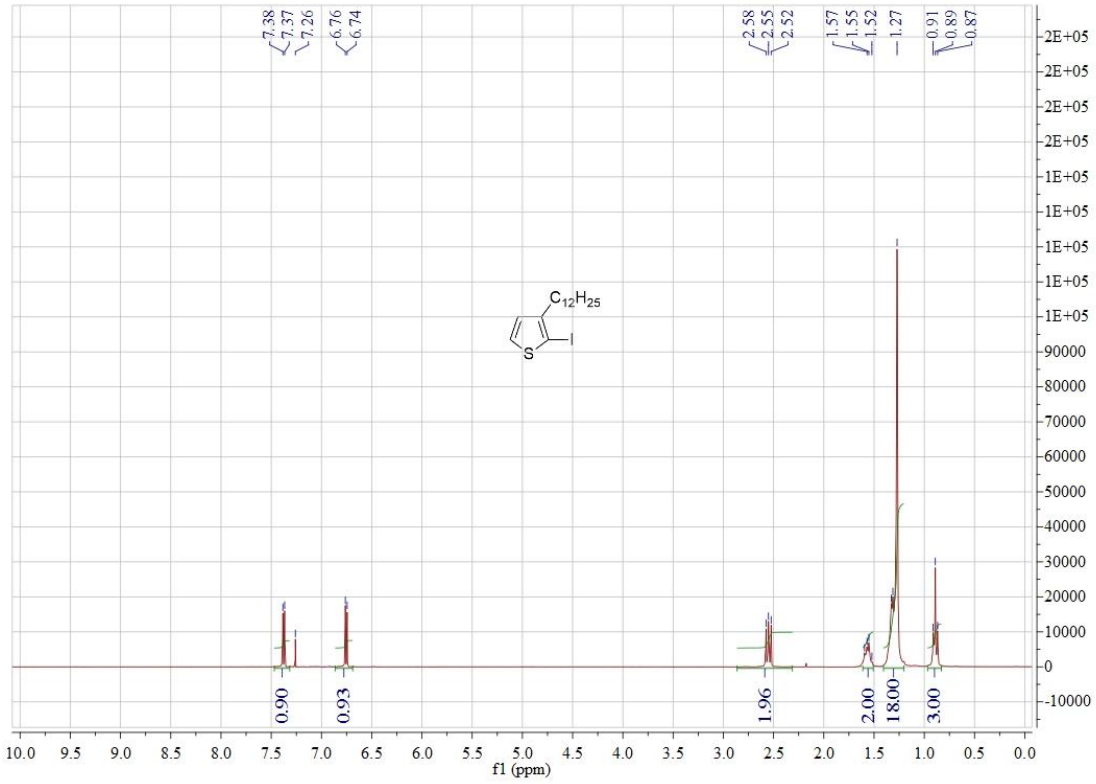

Figure S12. ^{13}C NMR Spectrum of **1g** (75 MHz, $CDCl_3$)

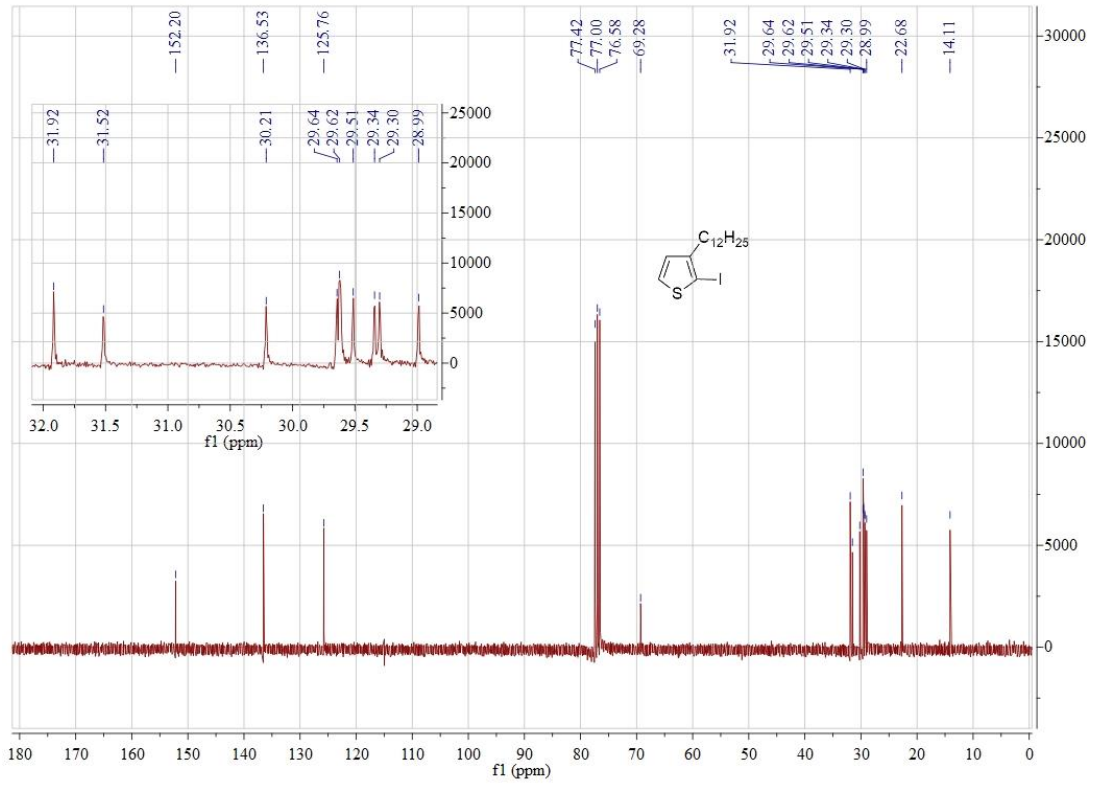

Figure S13. ^{1}H NMR Spectrum of **1h** (300 MHz, $CDCl_3$)

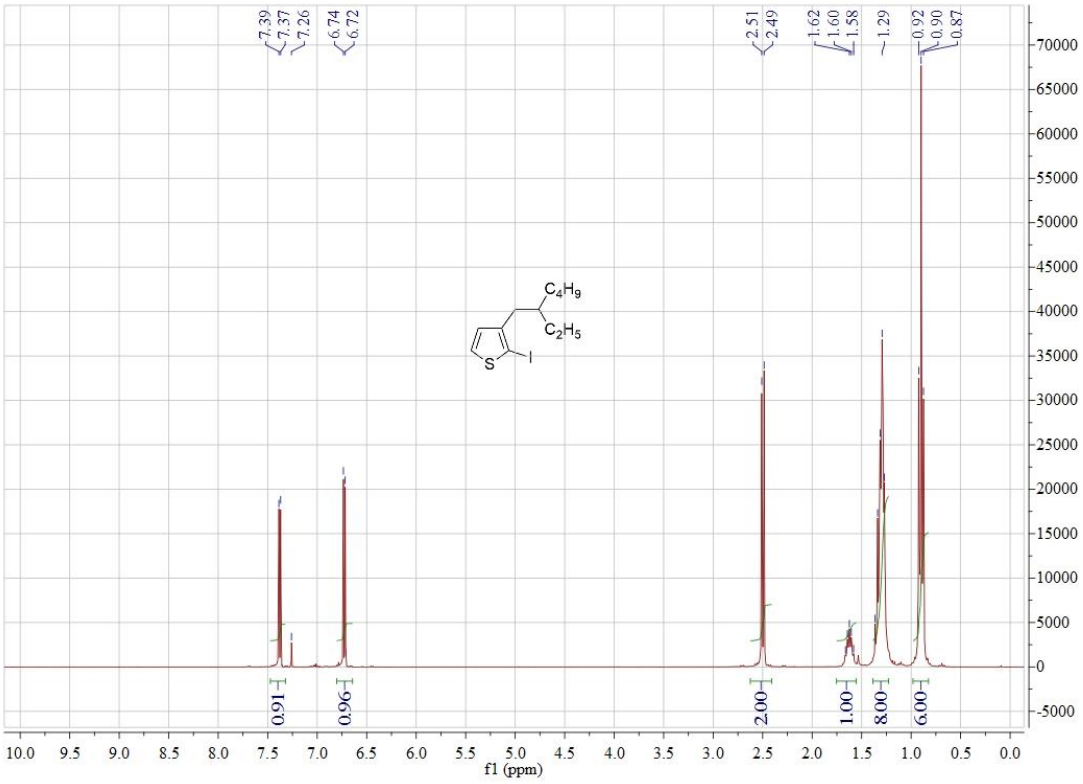

Figure S14. ^{13}C NMR Spectrum of **1h** (75 MHz, $CDCl_3$)

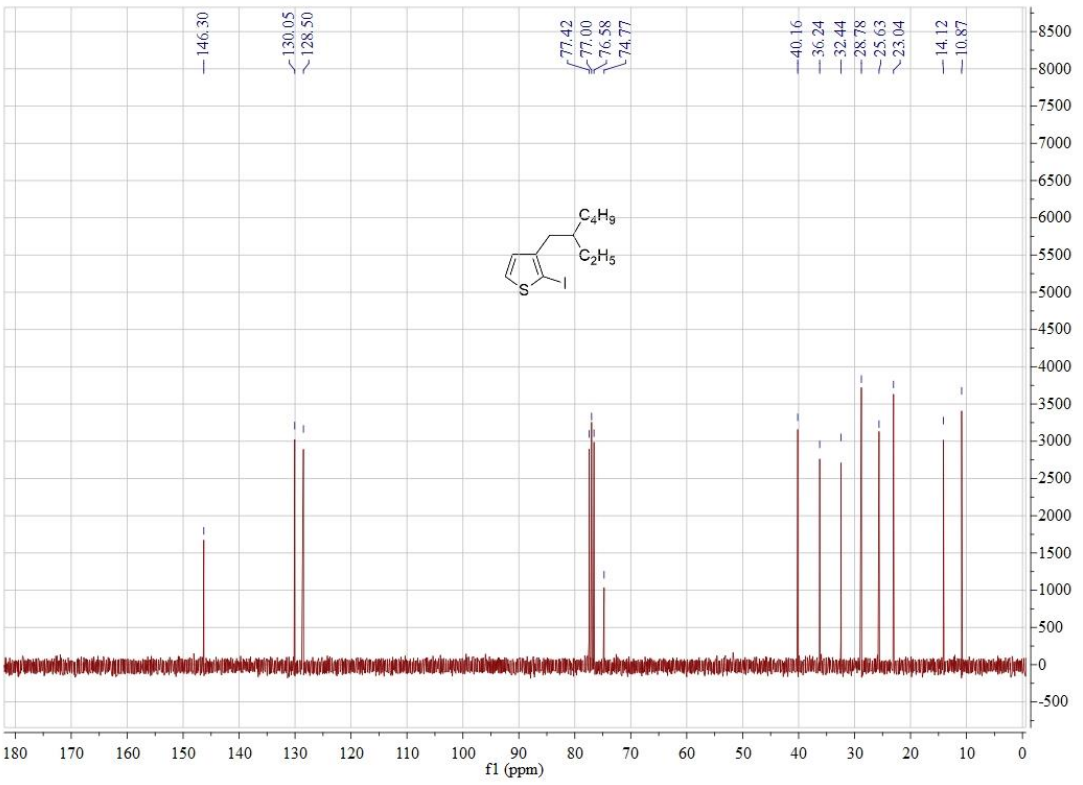

Figure S15. ^{1}H NMR Spectrum of **1i** (300 MHz, $CDCl_3$)

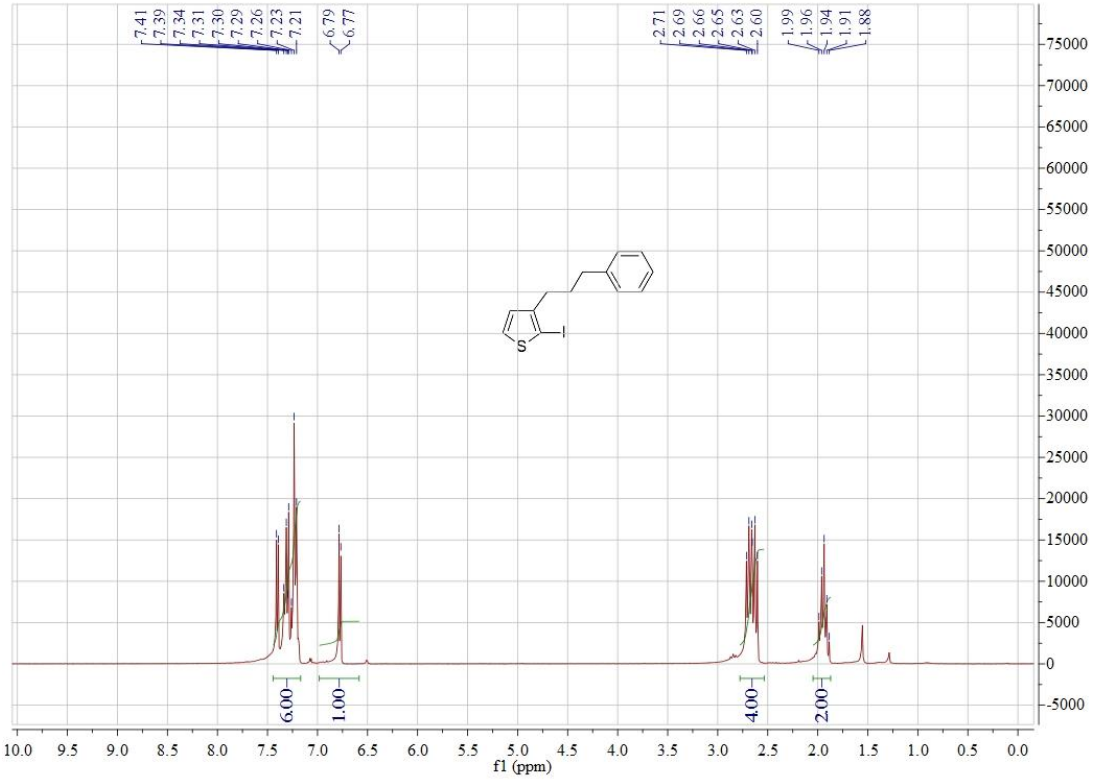

Figure S16. ^{13}C NMR Spectrum of **1i** (75 MHz, $CDCl_3$)

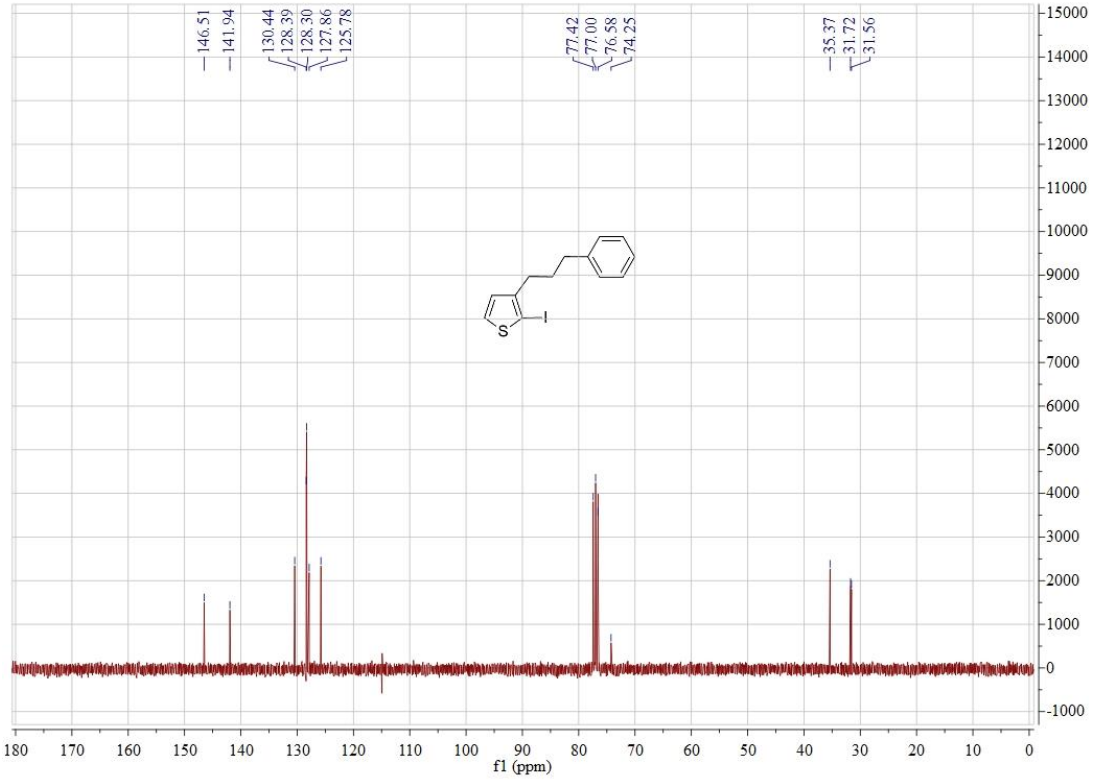

Figure S17. ^{1}H NMR Spectrum of **1j** (300 MHz, $CDCl_3$)

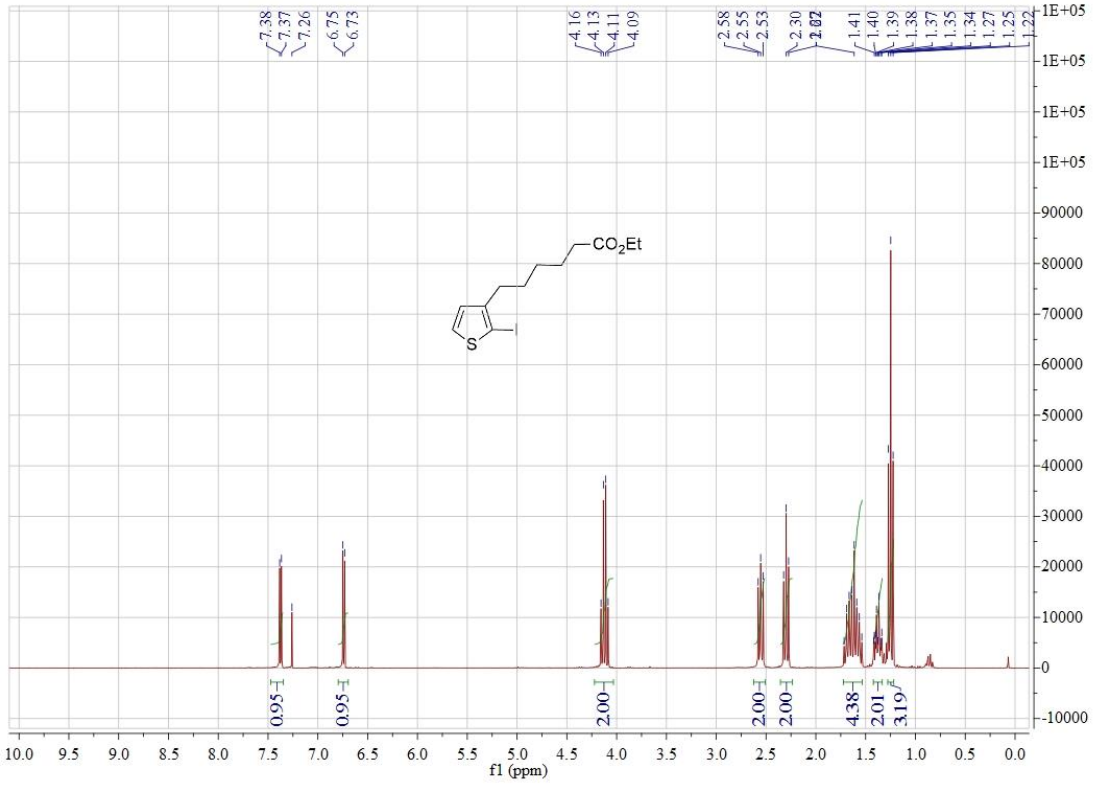

Figure S18. ^{13}C NMR Spectrum of **1j** (75 MHz, $CDCl_3$)

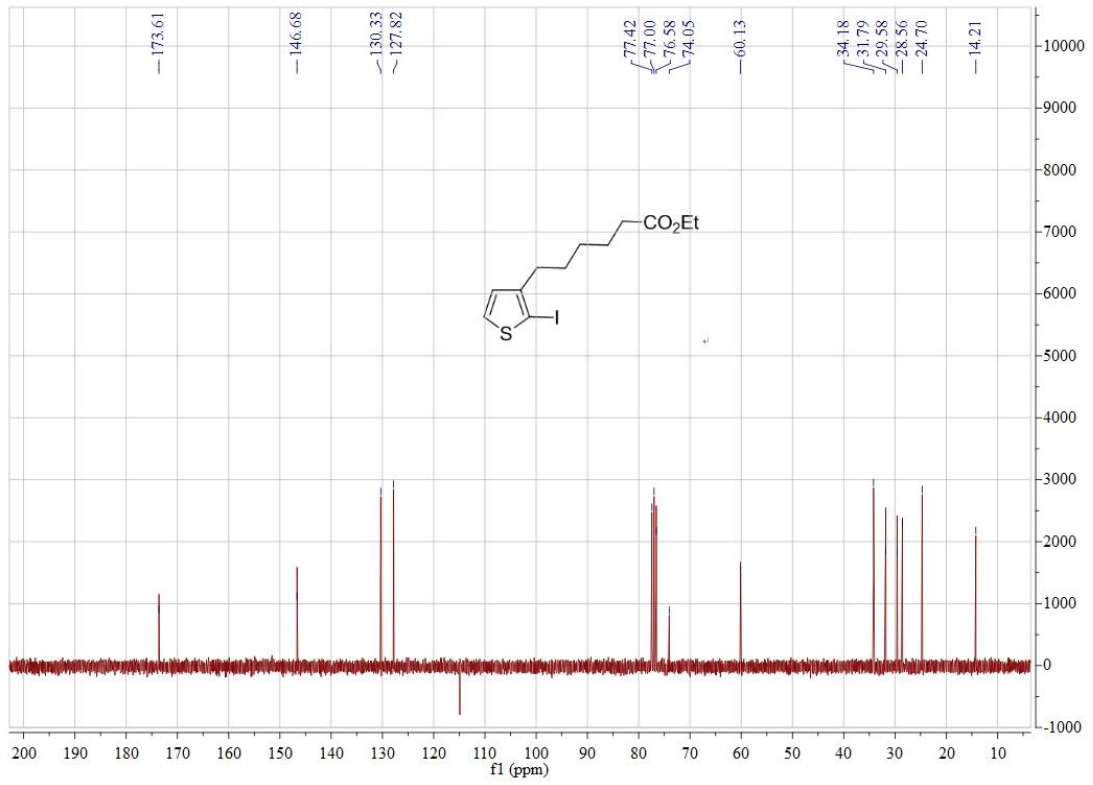

Figure S19. ^{1}H NMR Spectrum of **1k** (300 MHz, $CDCl_3$)

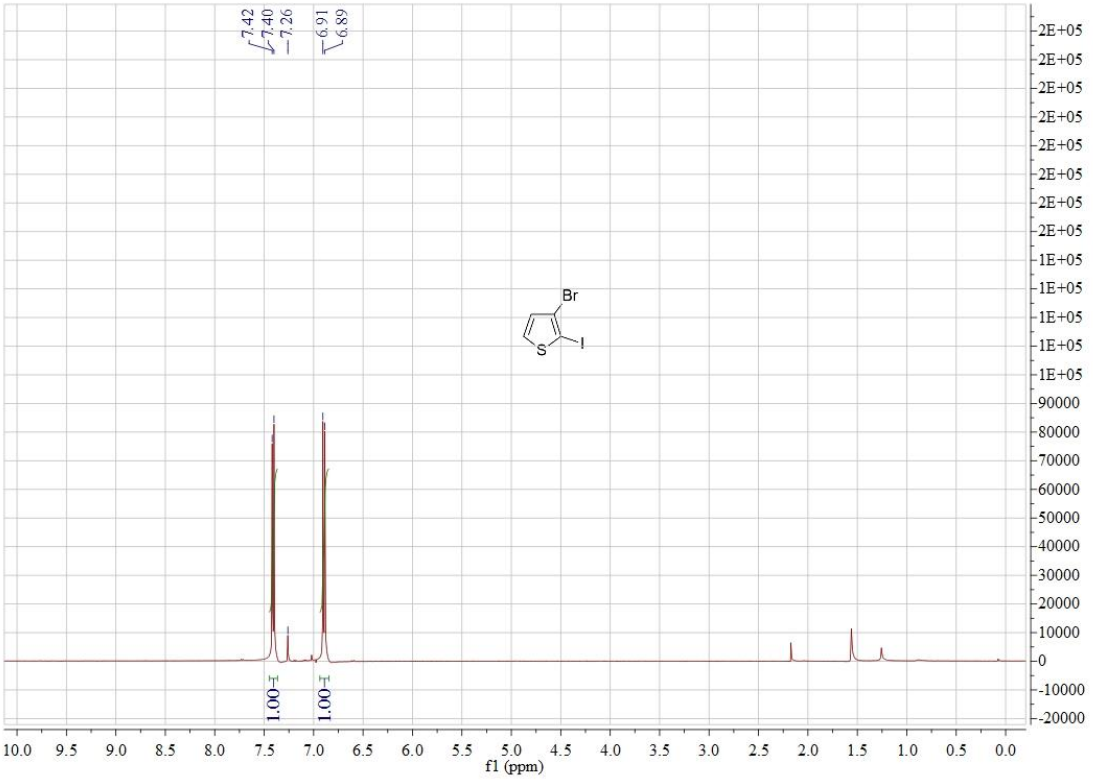

Figure S20. ^{13}C NMR Spectrum of **1k** (75 MHz, $CDCl_3$)

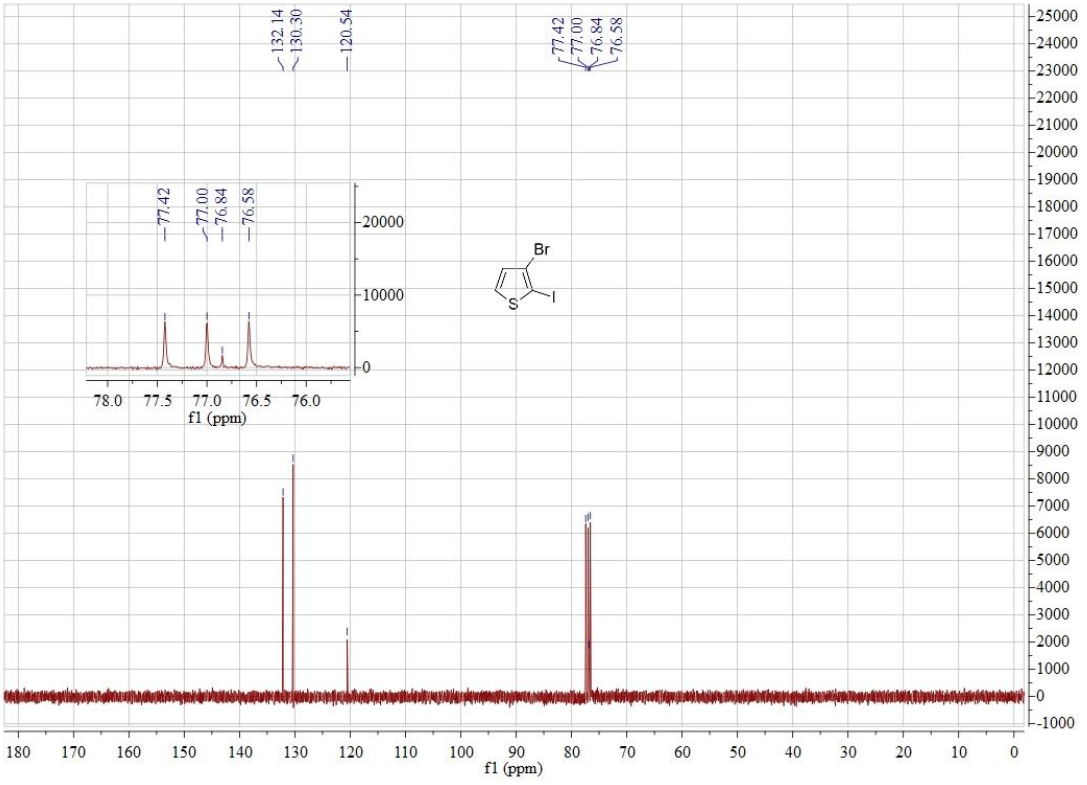

Figure S21. ^{1}H NMR Spectrum of **1l** (300 MHz, $CDCl_3$)

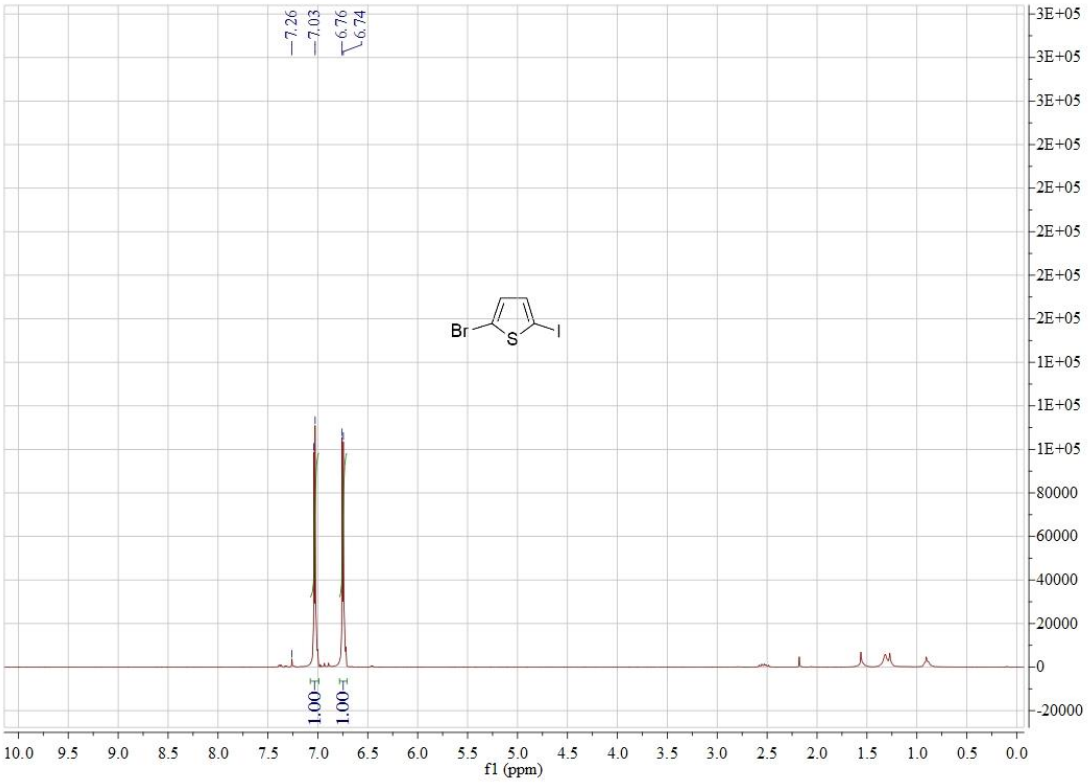

Figure S22. ^{13}C NMR Spectrum of **1l** (75 MHz, $CDCl_3$)

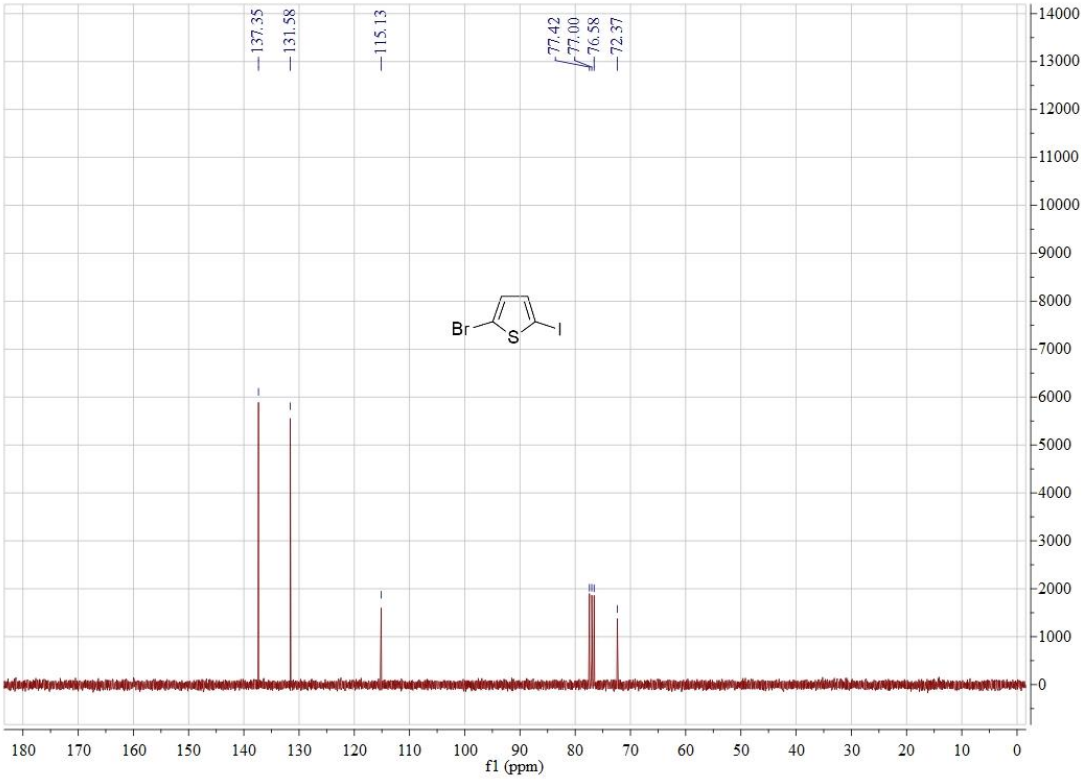

Figure S23. ^{1}H NMR Spectrum of **1m** (300 MHz, $CDCl_3$)

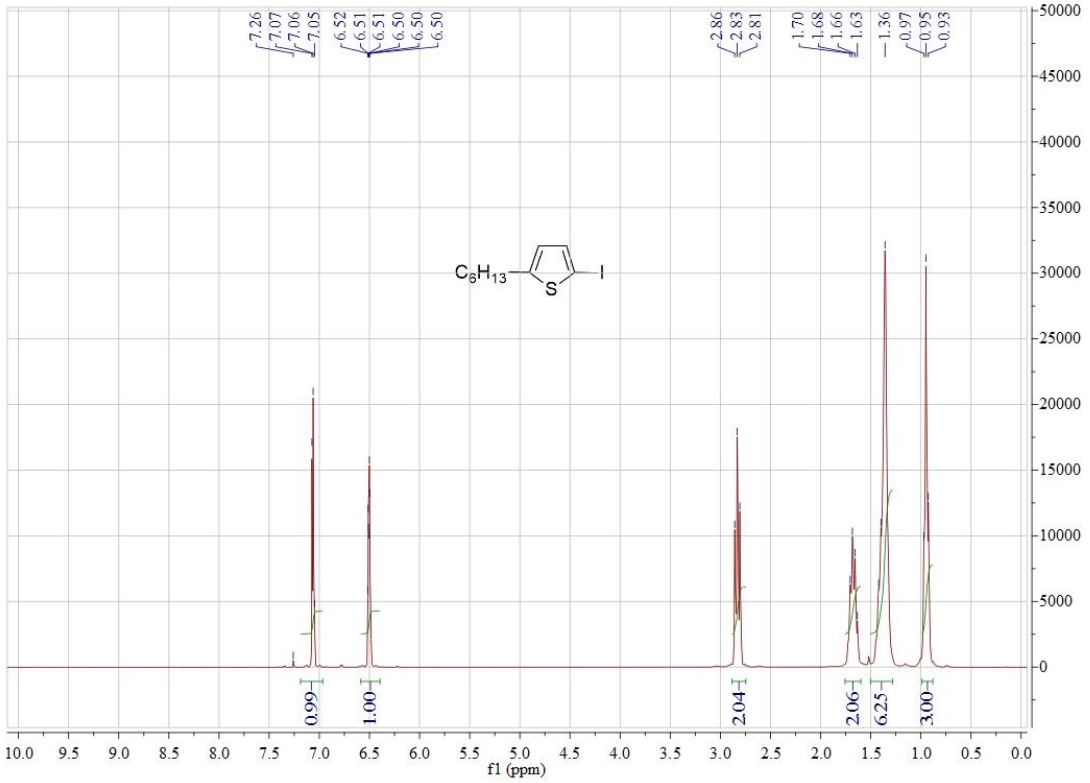

Figure S24. ^{13}C NMR Spectrum of **1m** (75 MHz, $CDCl_3$)

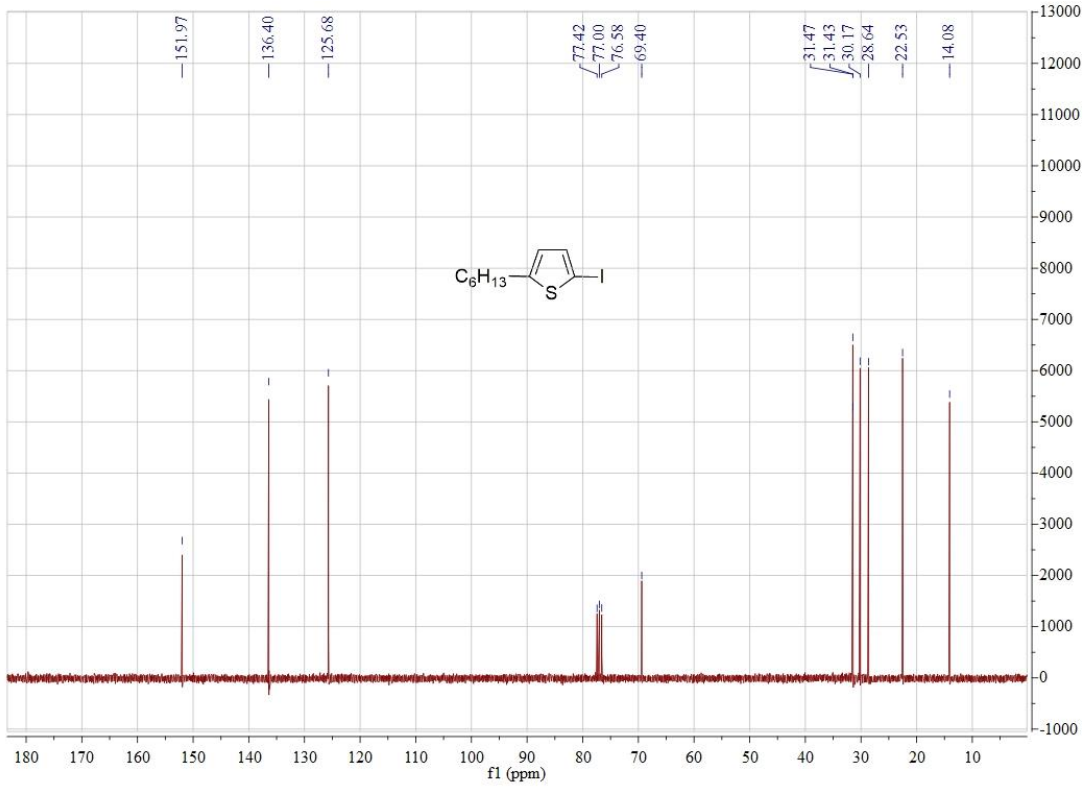

Figure S25. ^{1}H NMR Spectrum of **1n** (300 MHz, $CDCl_3$)

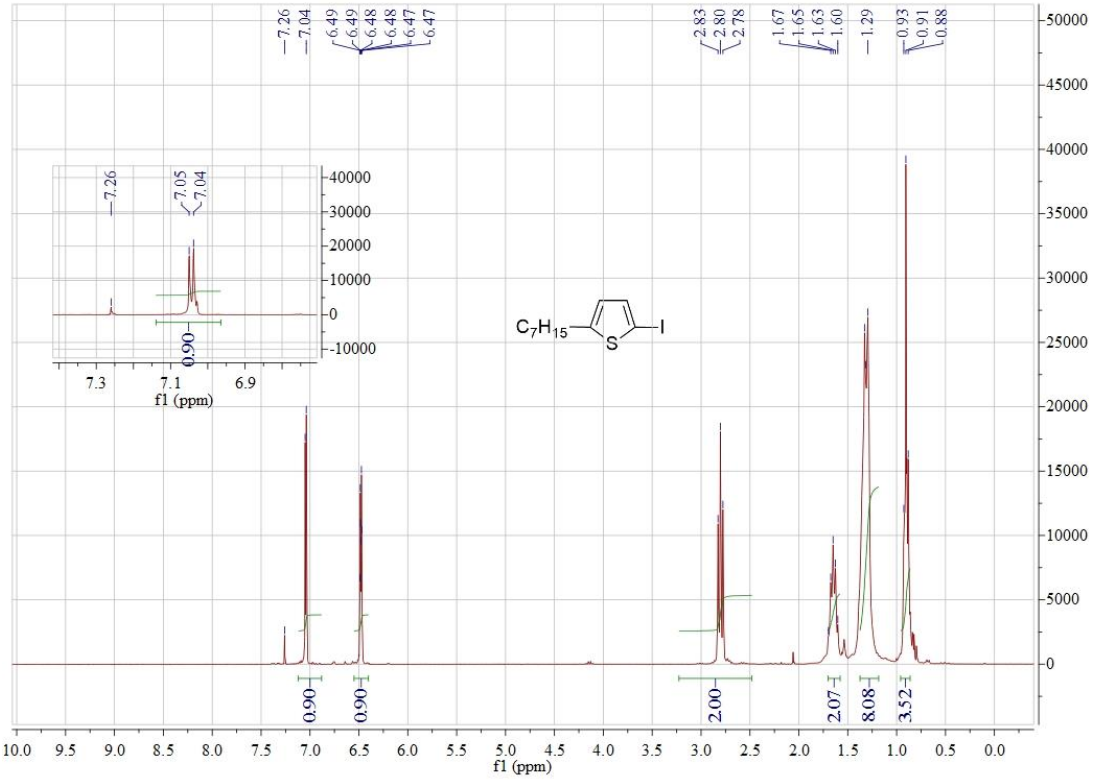

Figure S26. ^{13}C NMR Spectrum of **1n** (75 MHz, $CDCl_3$)

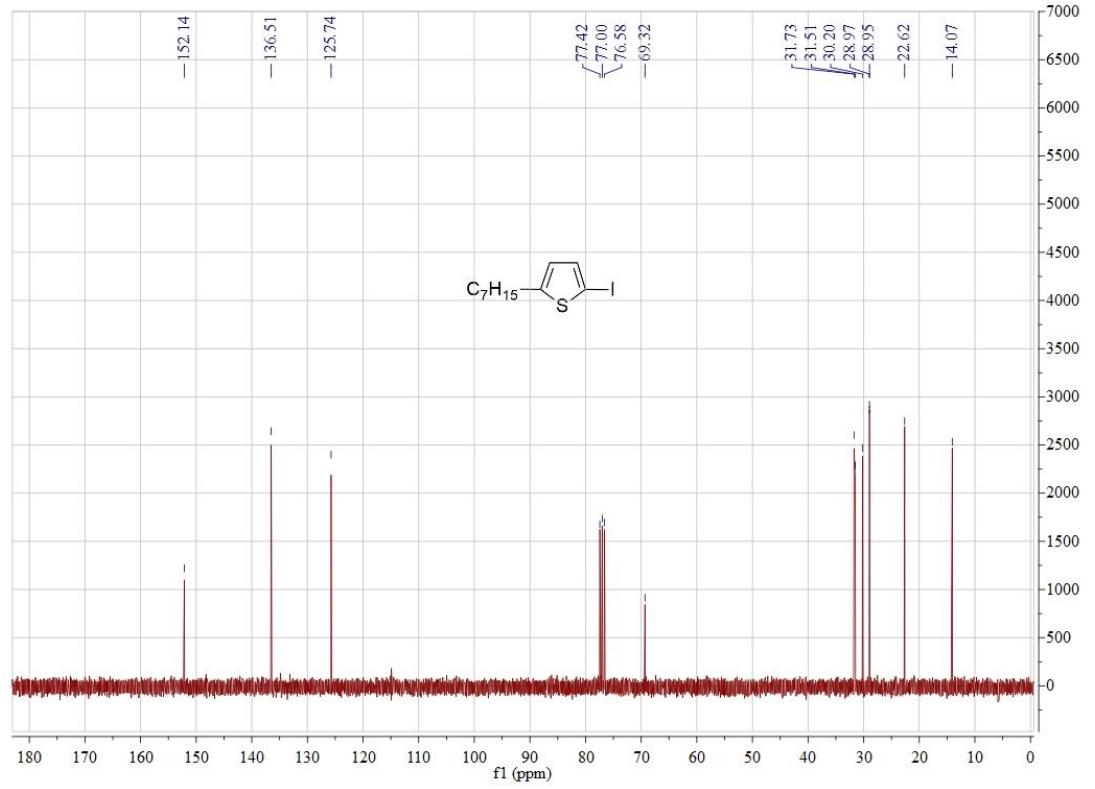

Figure S27. ^{1}H NMR Spectrum of **1o** (300 MHz, $CDCl_3$)

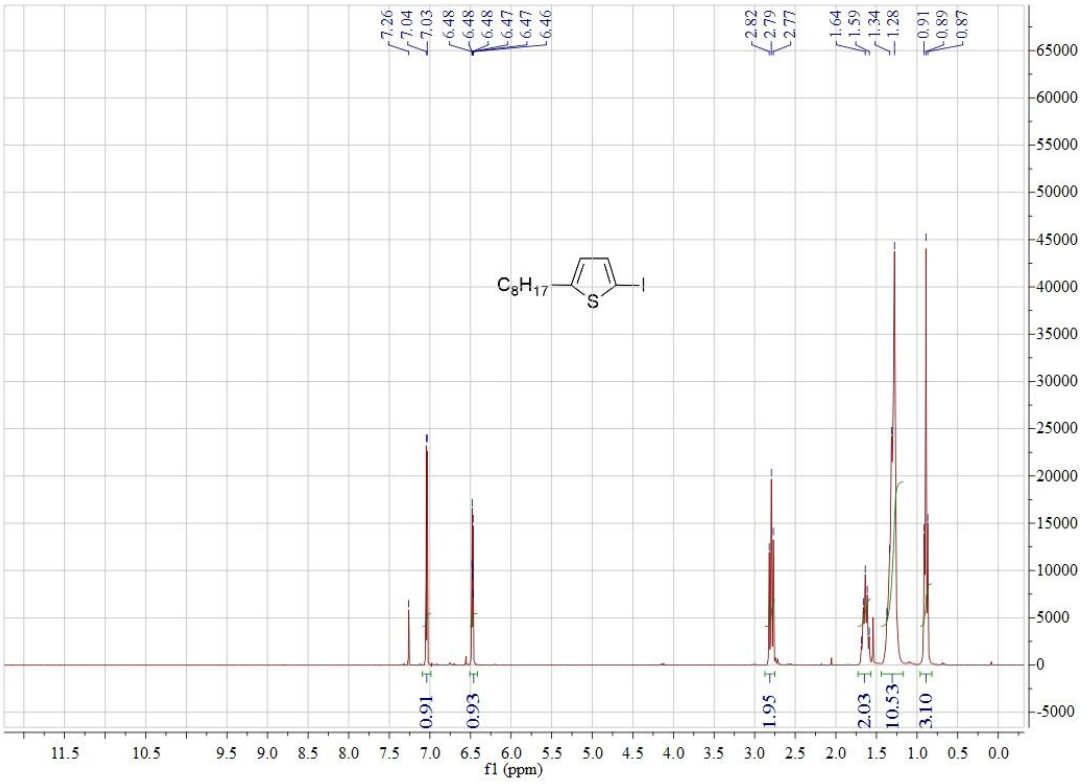

Figure S28. ^{13}C NMR Spectrum of **1o** (75 MHz, $CDCl_3$)

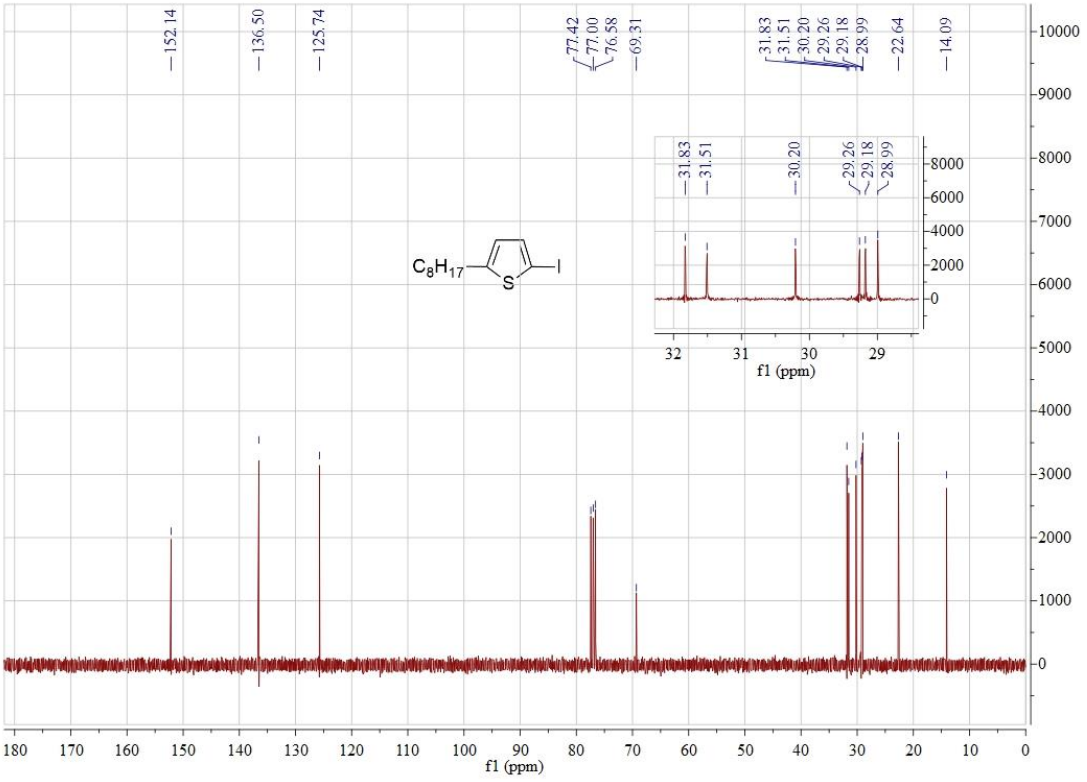

Figure S29. ^{1}H NMR Spectrum of **1p** (300 MHz, $CDCl_3$)

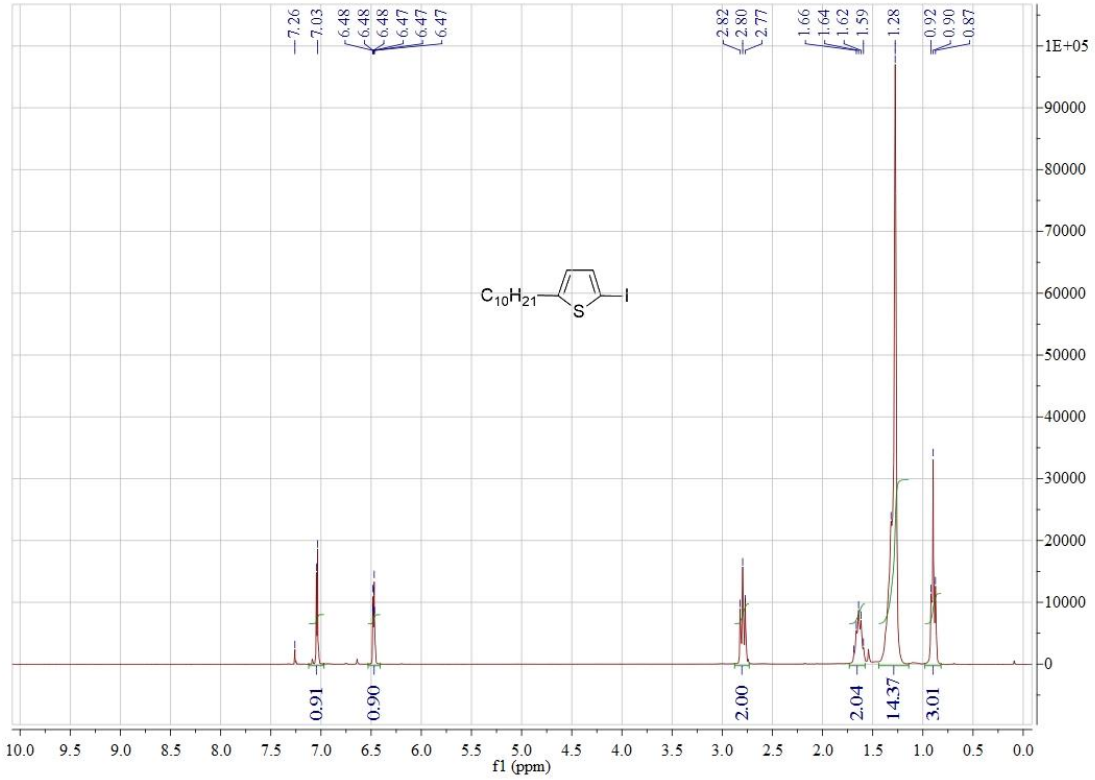

Figure S30. ^{13}C NMR Spectrum of **1p** (75 MHz, $CDCl_3$)

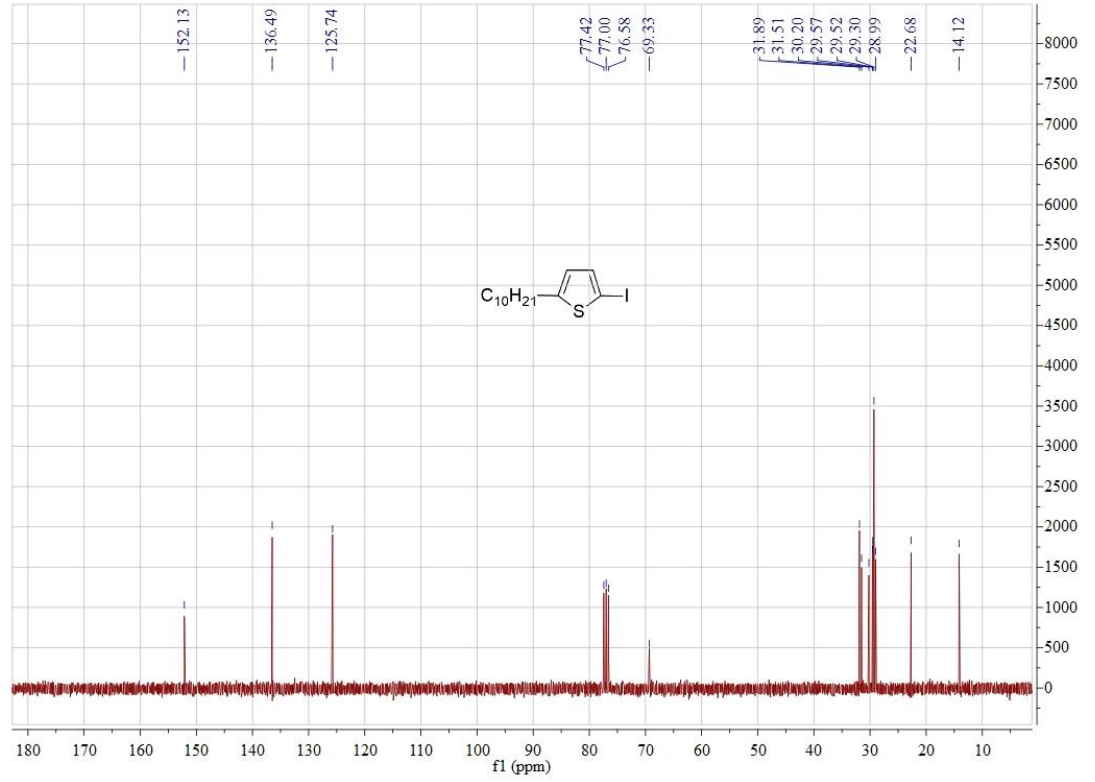

Figure S31. ^{1}H NMR Spectrum of **1q** (300 MHz, $CDCl_3$)

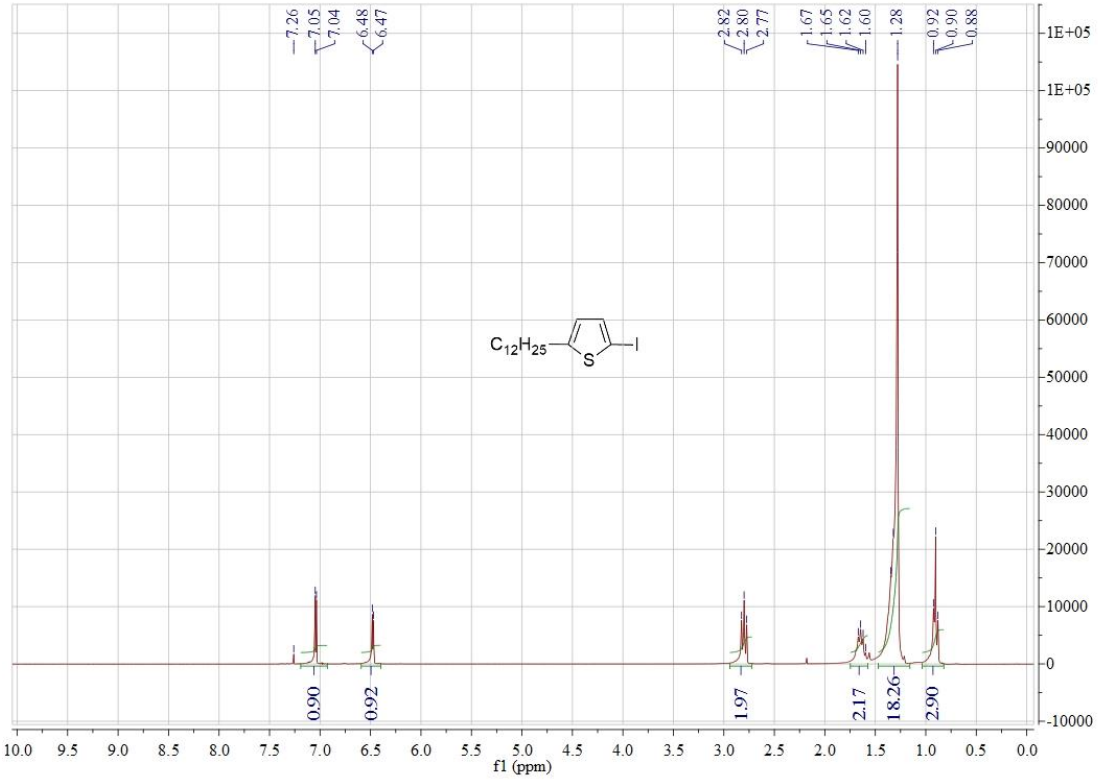

Figure S32. ^{13}C NMR Spectrum of **1q** (75 MHz, $CDCl_3$)

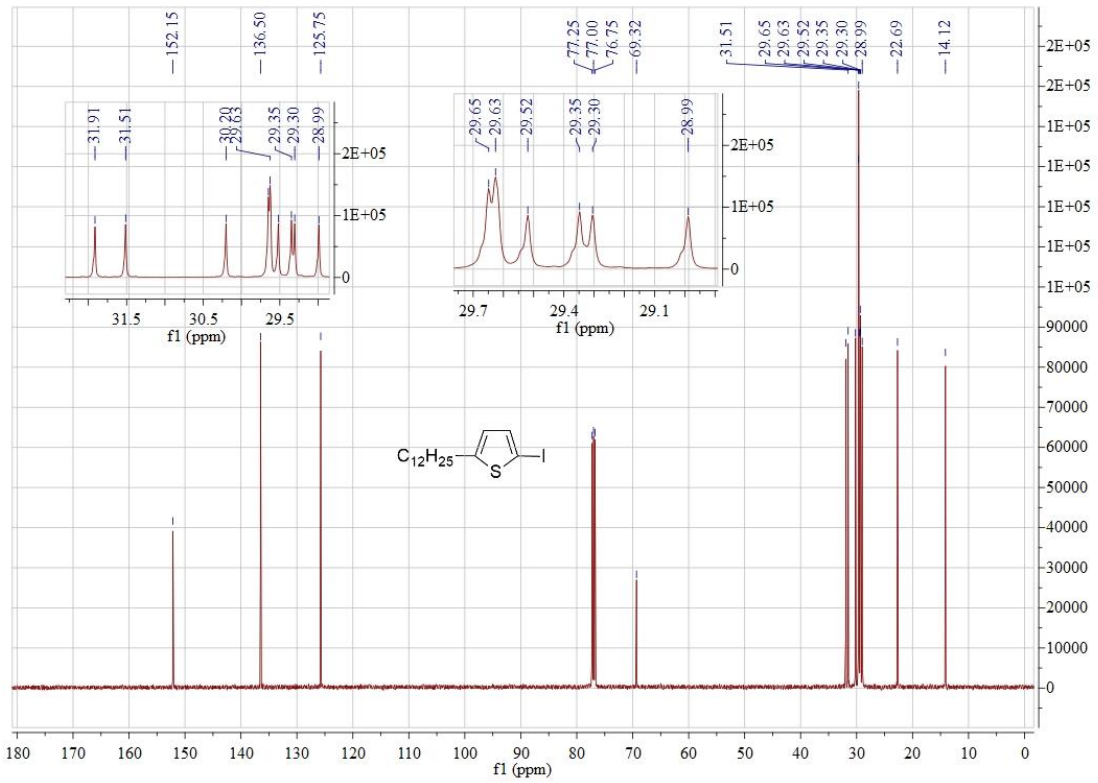

Figure S33. ^{1}H NMR Spectrum of **1r** (300 MHz, $CDCl_3$)

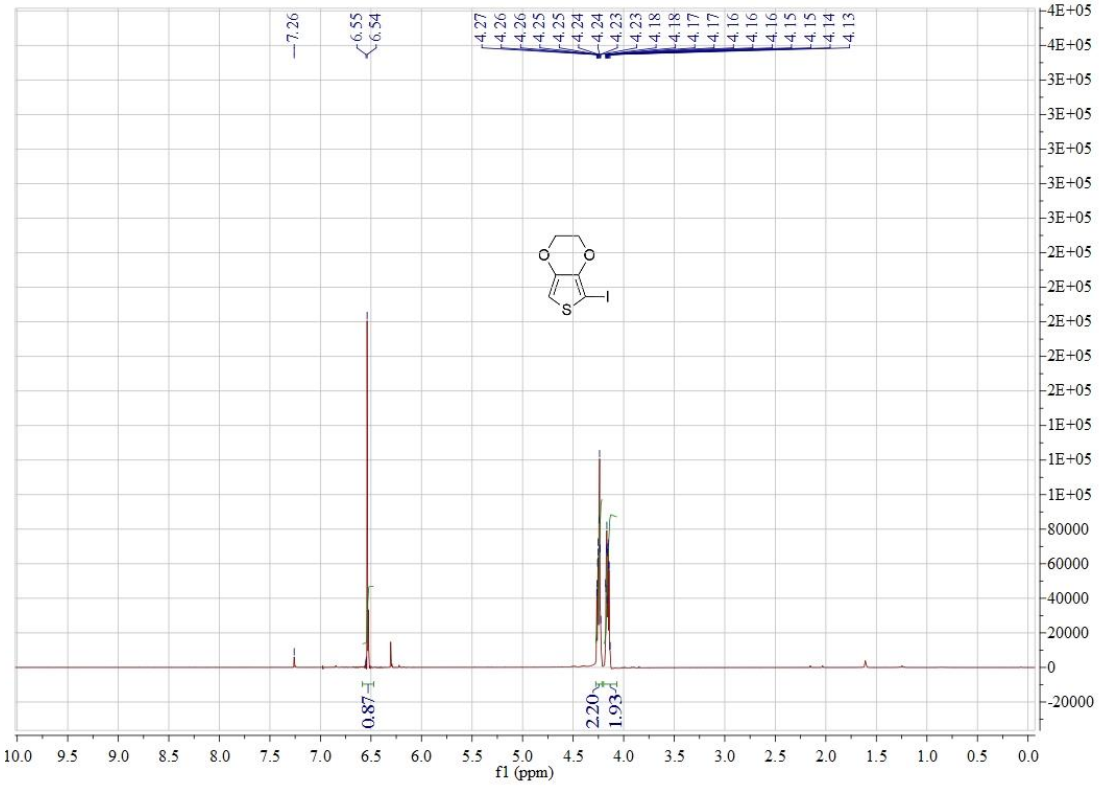

Figure S34. ^{13}C NMR Spectrum of **1r** (75 MHz, $CDCl_3$)

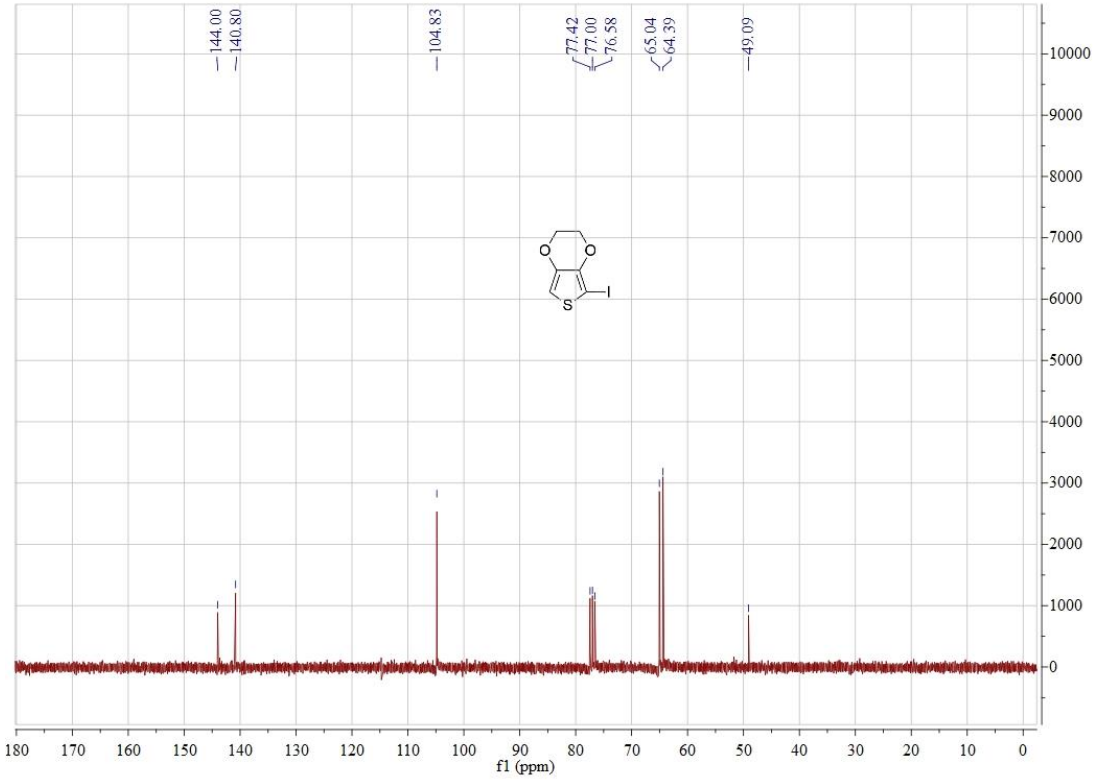

Figure S35. ^{1}H NMR Spectrum of **1s** (300 MHz, $CDCl_3$)

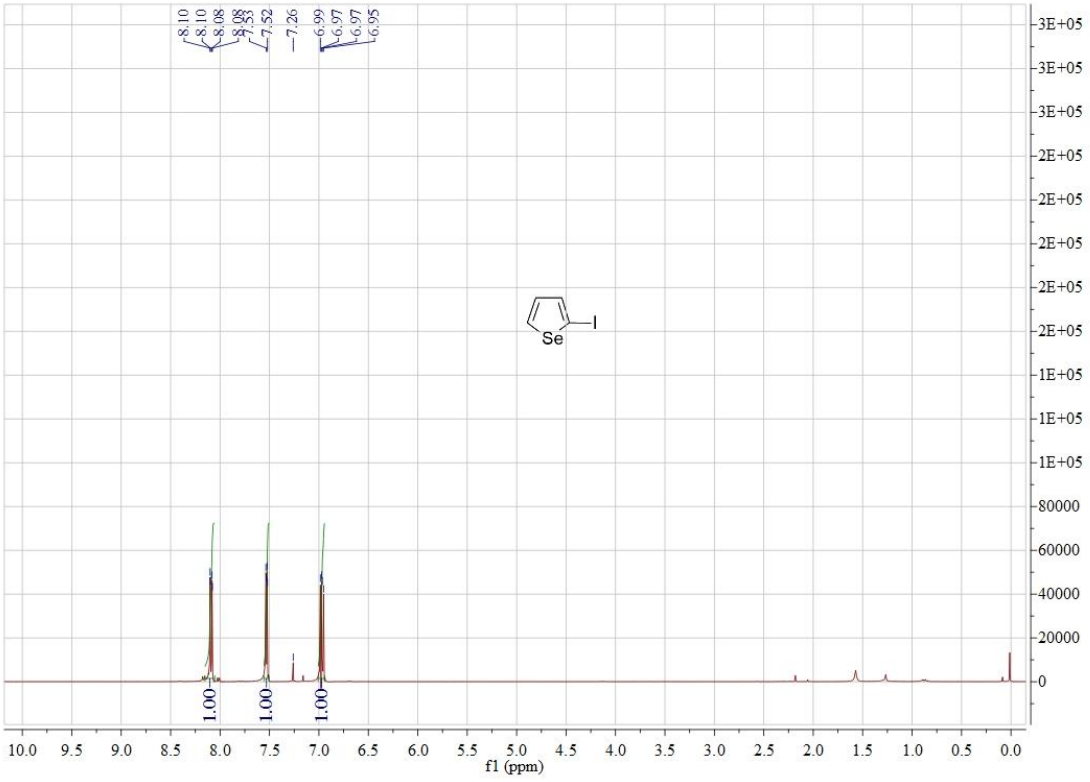

Figure S36. ^{13}C NMR Spectrum of **1s** (75 MHz, $CDCl_3$)

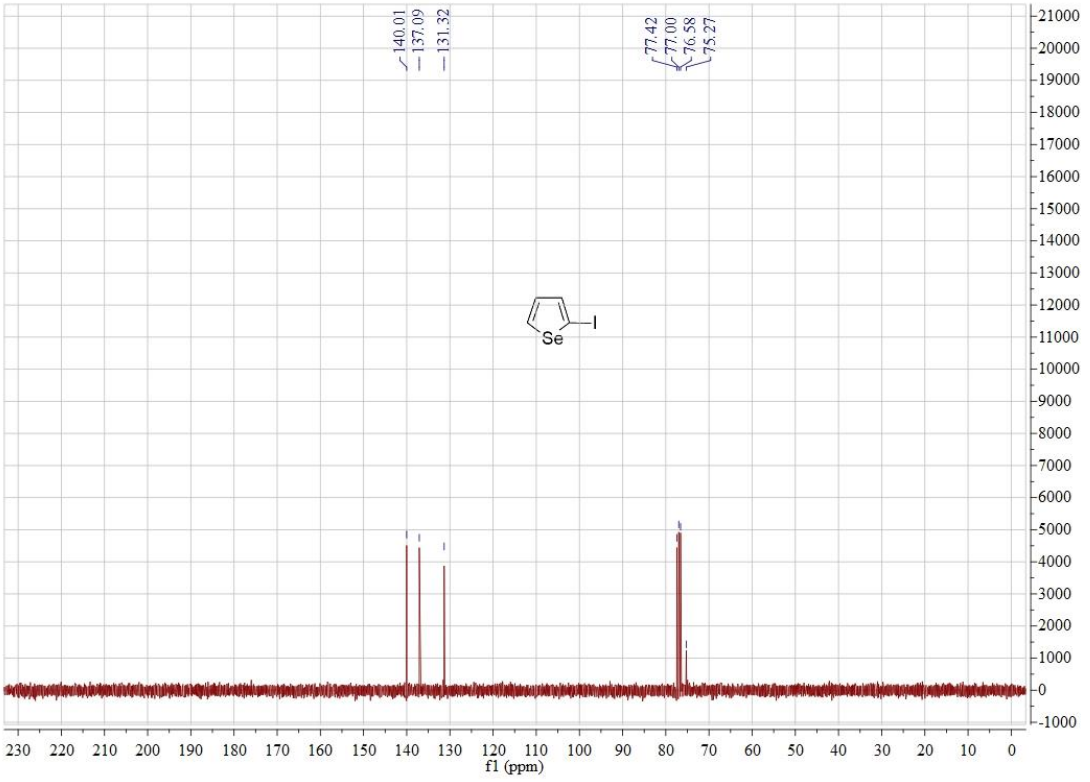

Figure S37. ^{1}H NMR Spectrum of **2a** (300 MHz, $CDCl_3$)

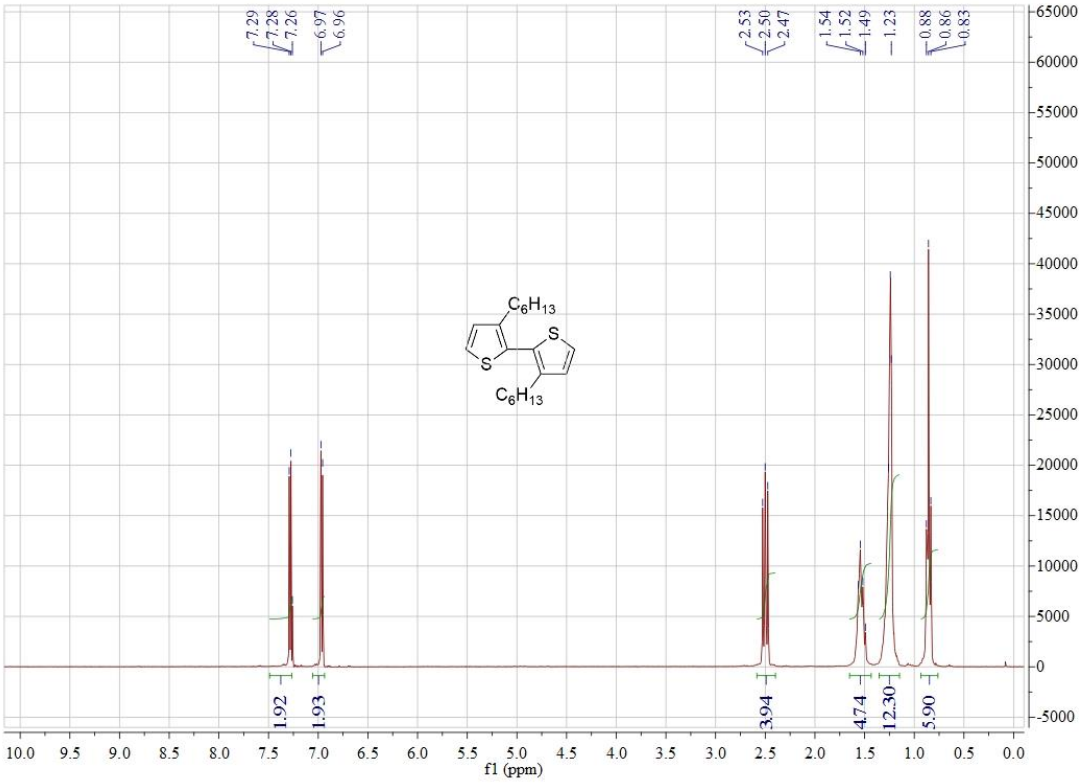

Figure S38. ^{13}C NMR Spectrum of **2a** (75 MHz, $CDCl_3$)

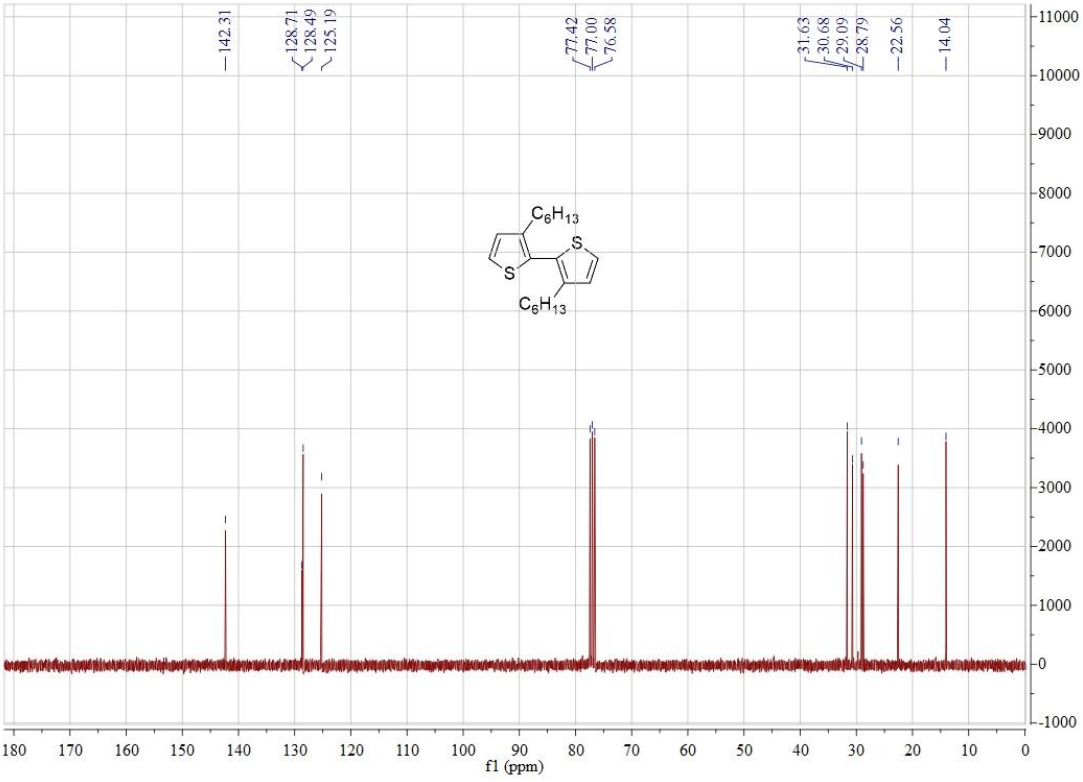

Figure S39. ^{1}H NMR Spectrum of **2b** (300 MHz, $CDCl_3$)

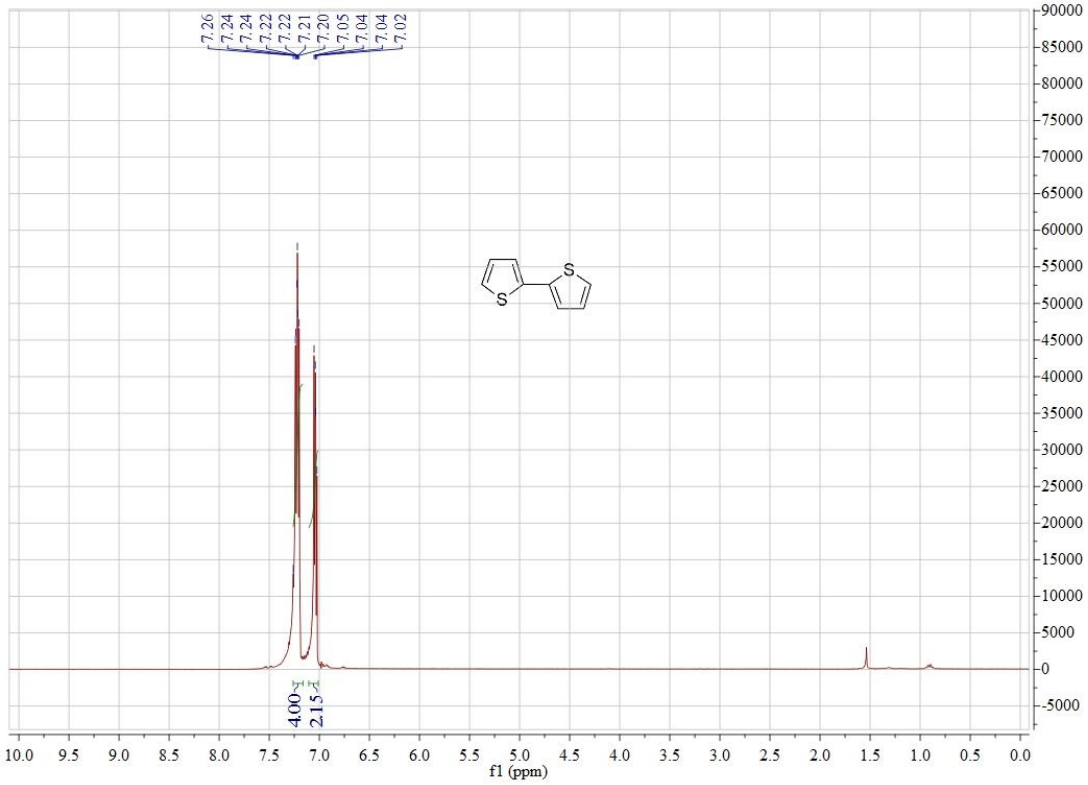

Figure S40. ^{13}C NMR Spectrum of **2b** (75 MHz, $CDCl_3$)

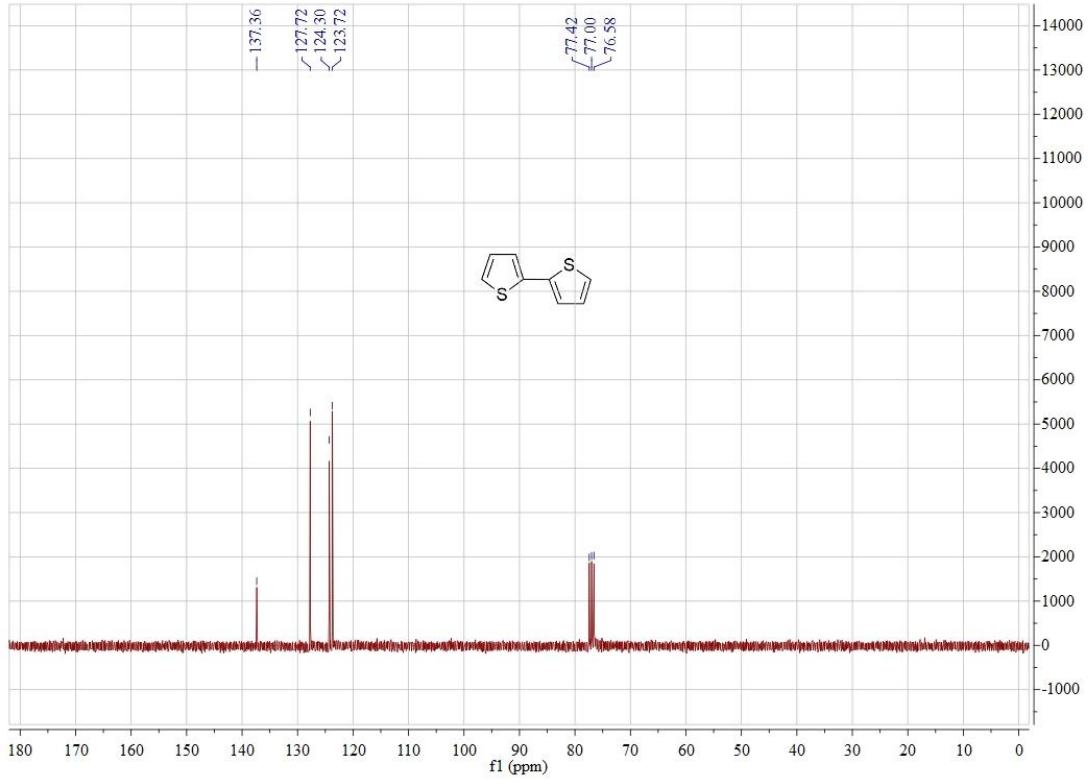

Figure S41. ^{1}H NMR Spectrum of **2c** (300 MHz, $CDCl_3$)

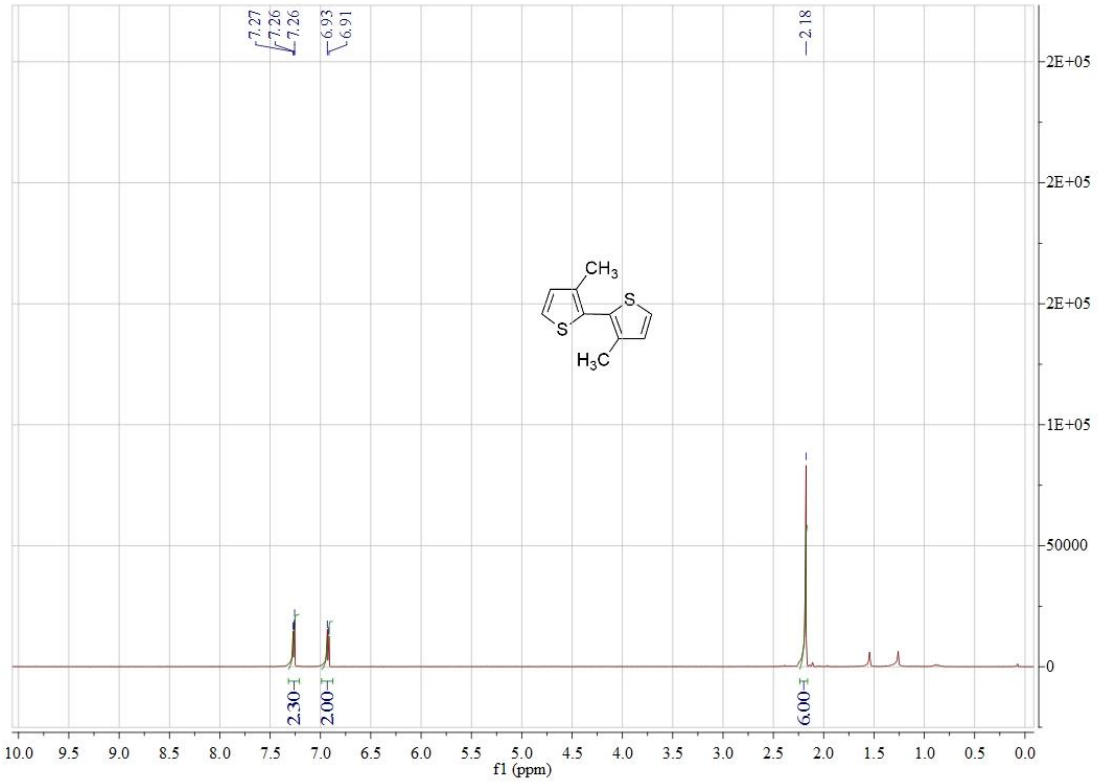

Figure S42. ^{13}C NMR Spectrum of **2c** (75 MHz, $CDCl_3$)

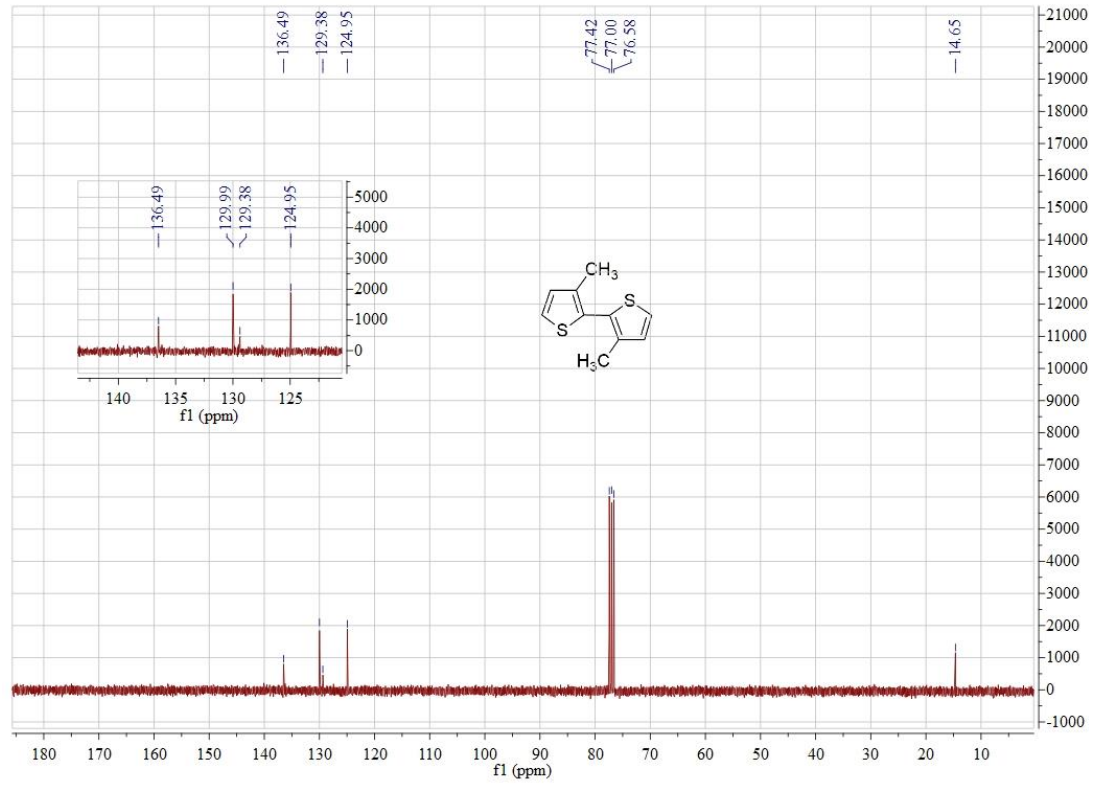

Figure S43. ^{1}H NMR Spectrum of **2d** (300 MHz, $CDCl_3$)

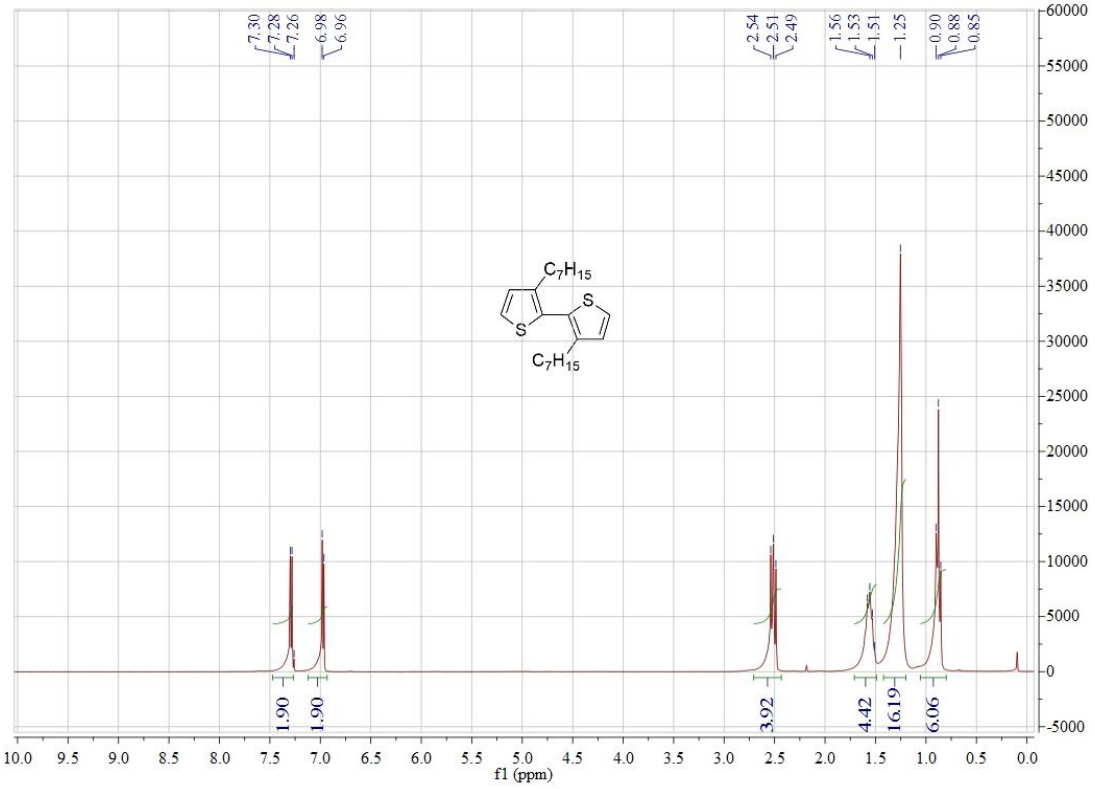

Figure S44. ^{13}C NMR Spectrum of **2d** (75 MHz, $CDCl_3$)

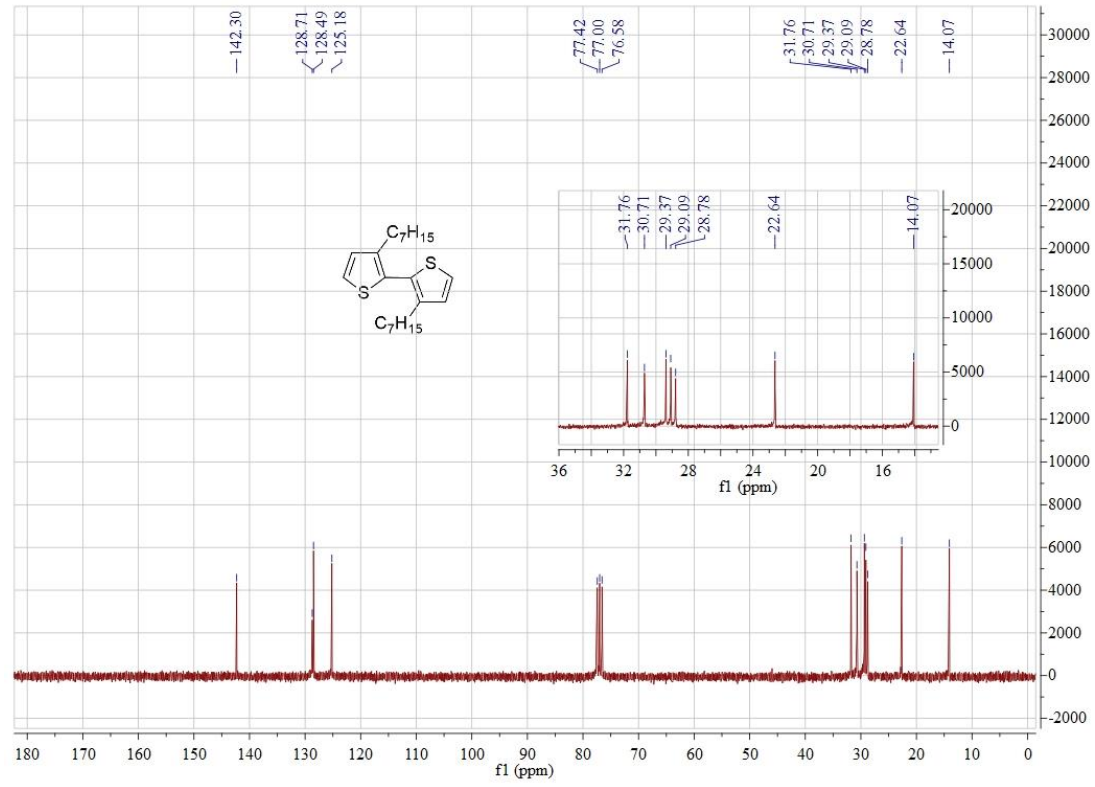

Figure S45. ^{1}H NMR Spectrum of **2e** (300 MHz, $CDCl_3$)

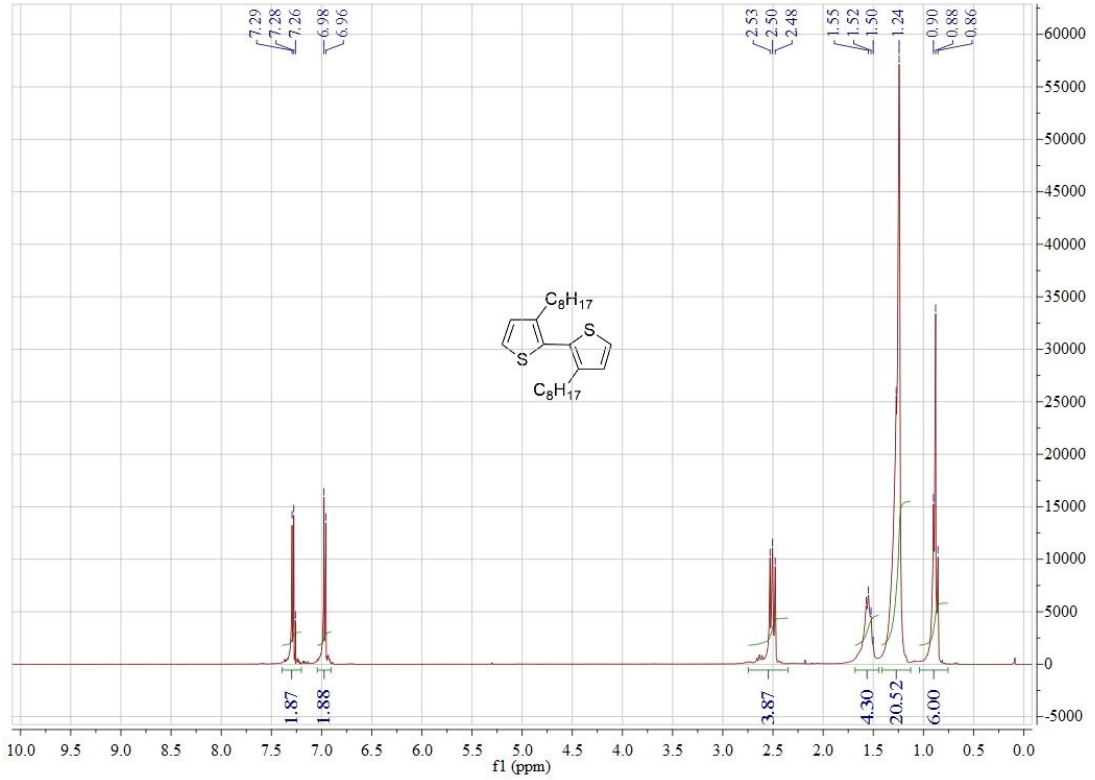

Figure S46. ^{13}C NMR Spectrum of **2e** (75 MHz, $CDCl_3$)

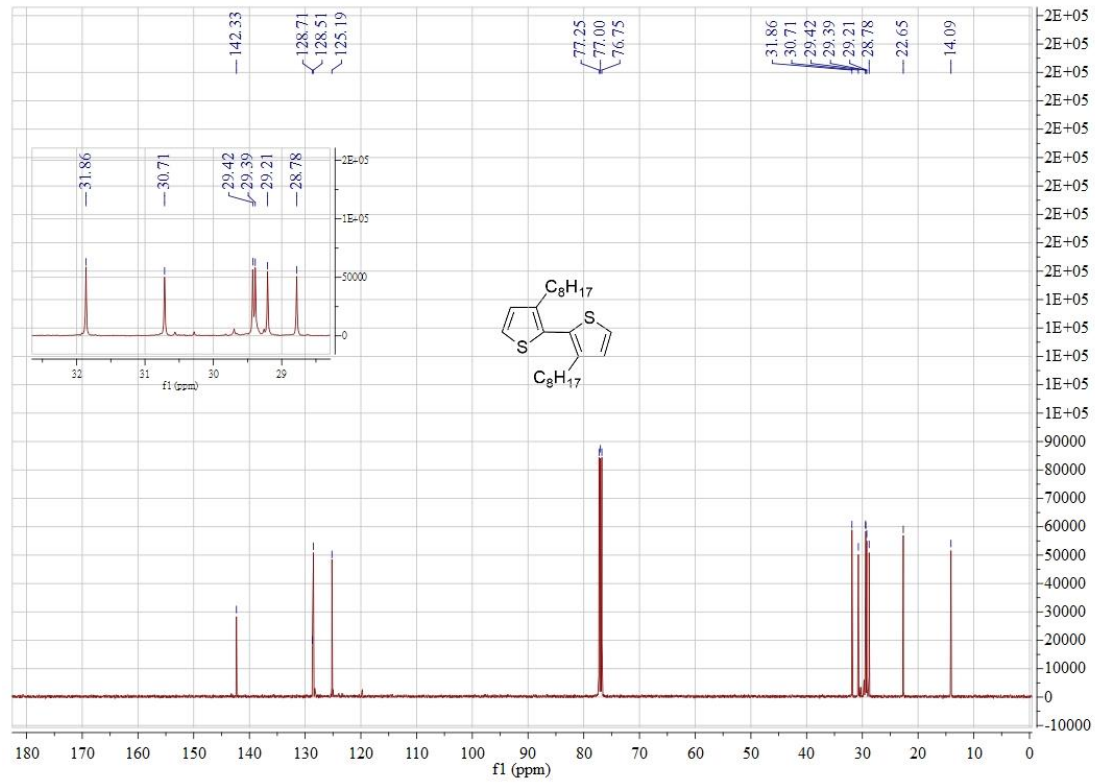

Figure S47. ^{1}H NMR Spectrum of **2f** (300 MHz, $CDCl_3$)

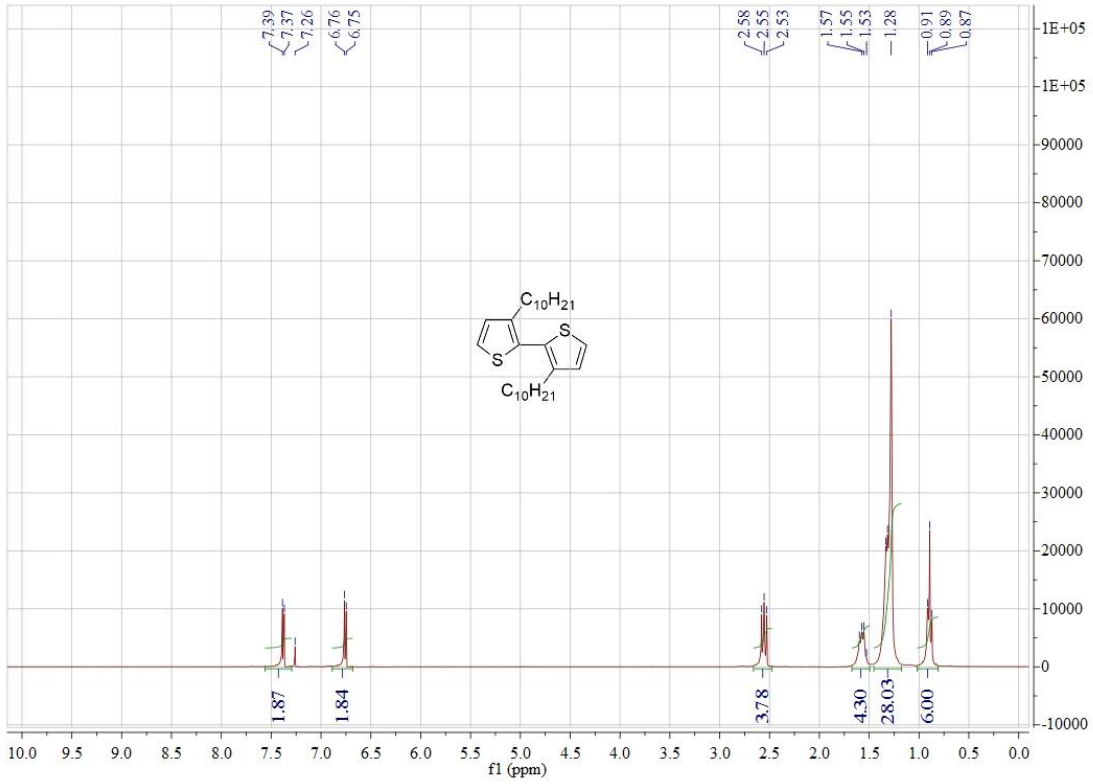

Figure S48. ^{13}C NMR Spectrum of **2f** (75 MHz, $CDCl_3$)

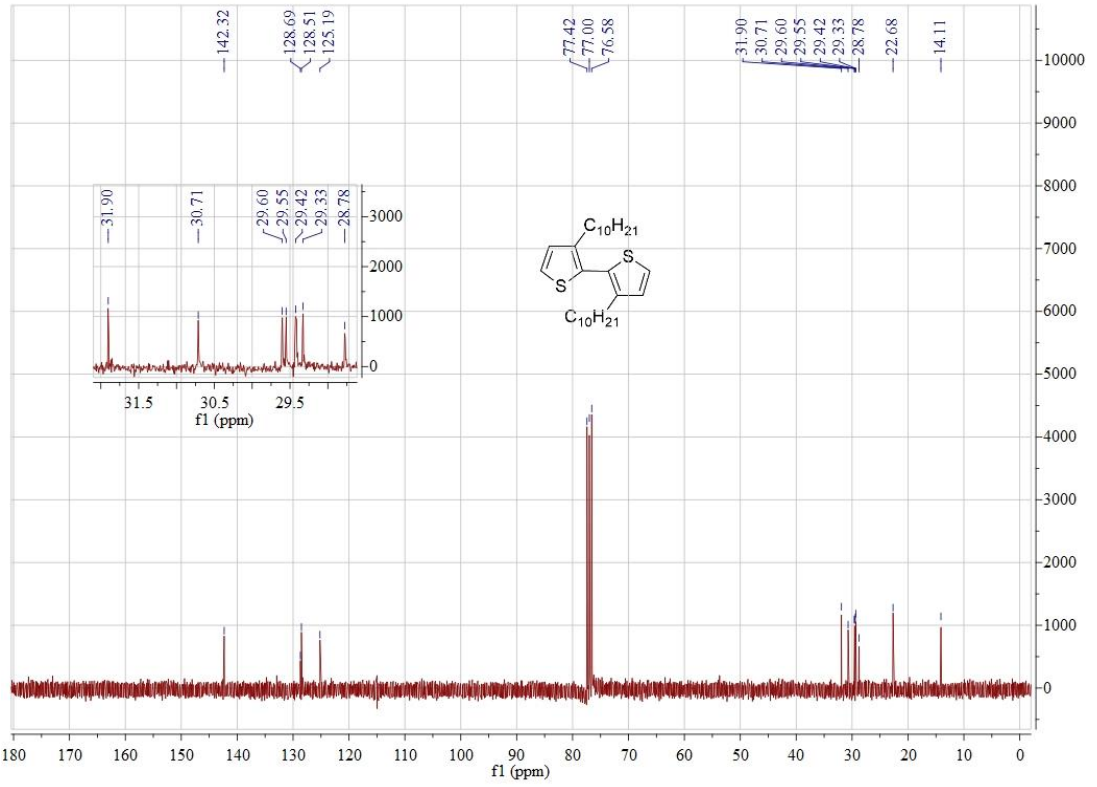

Figure S49. ^{1}H NMR Spectrum of **2g** (300 MHz, $CDCl_3$)

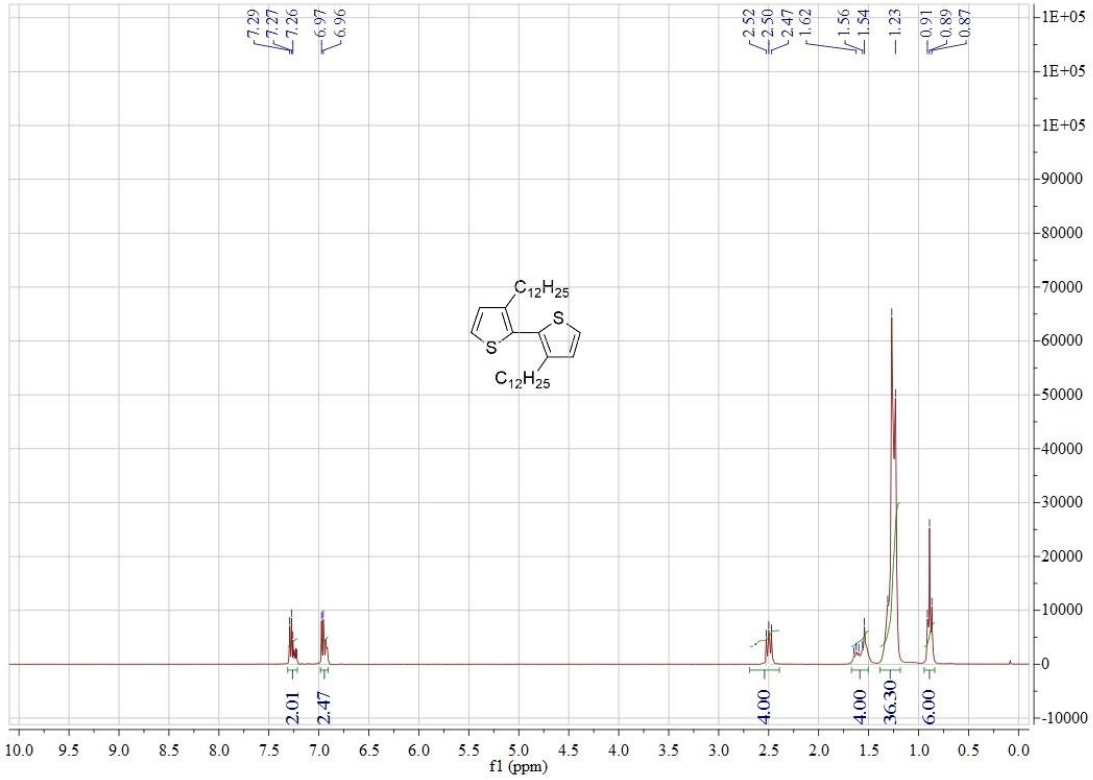

Figure S50. ^{13}C NMR Spectrum of **2g** (75 MHz, $CDCl_3$)

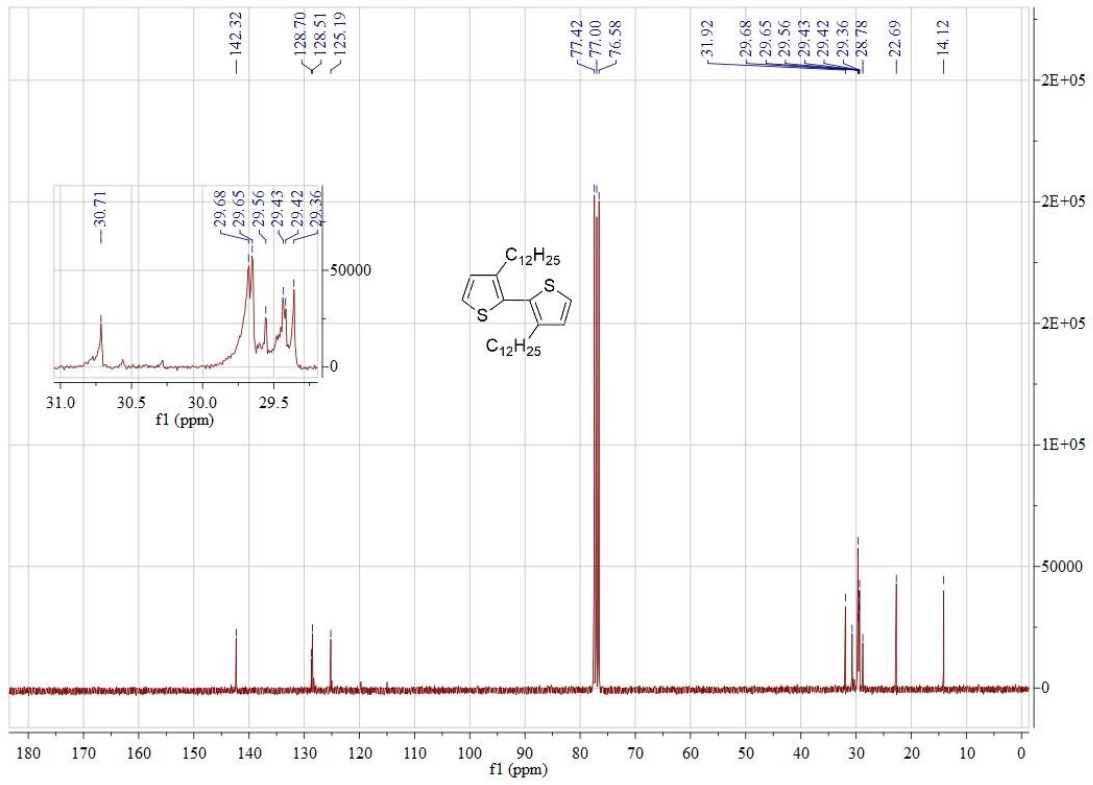

Figure S51. ^{1}H NMR Spectrum of **2h** (300 MHz, $CDCl_3$)

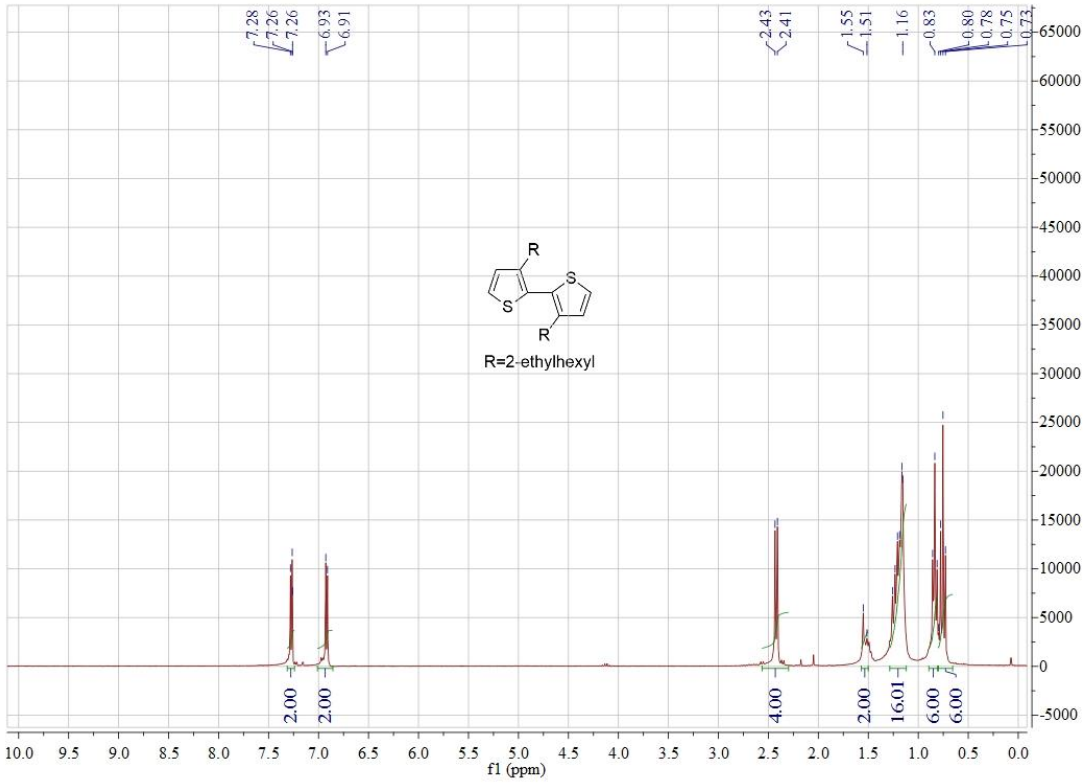

Figure S52. ^{13}C NMR Spectrum of **2h** (75 MHz, $CDCl_3$)

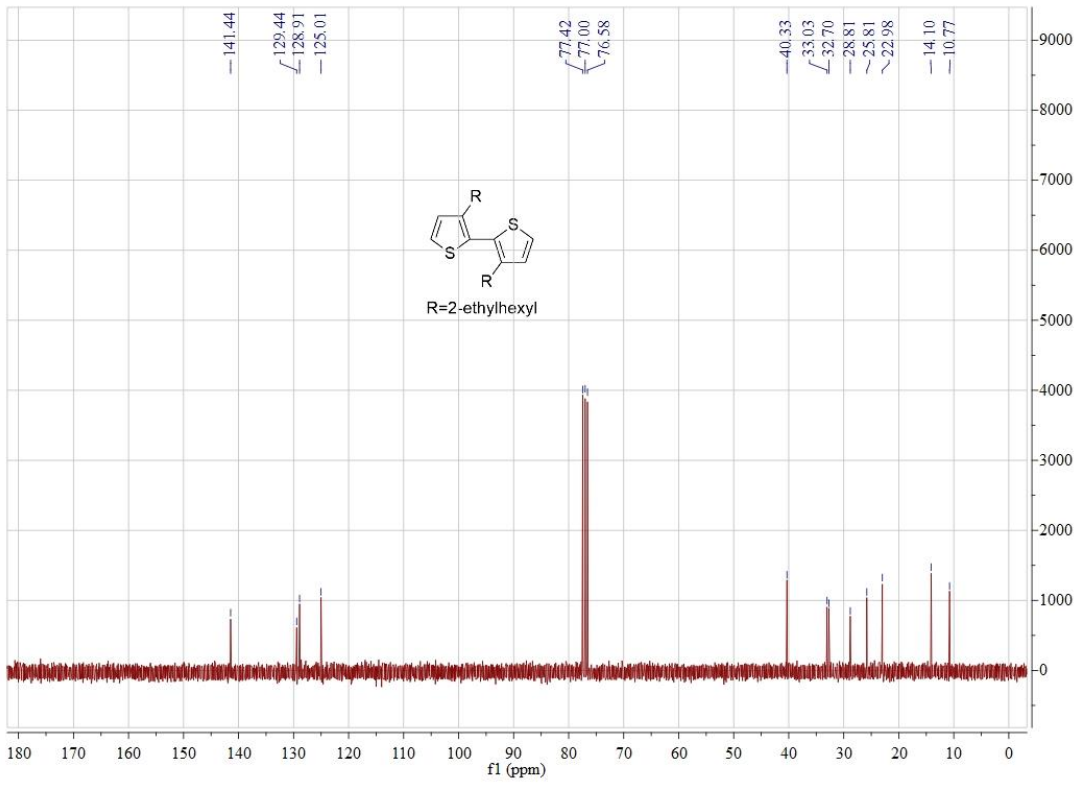

Figure S53. ^{1}H NMR Spectrum of **2i** (300 MHz, $CDCl_3$)

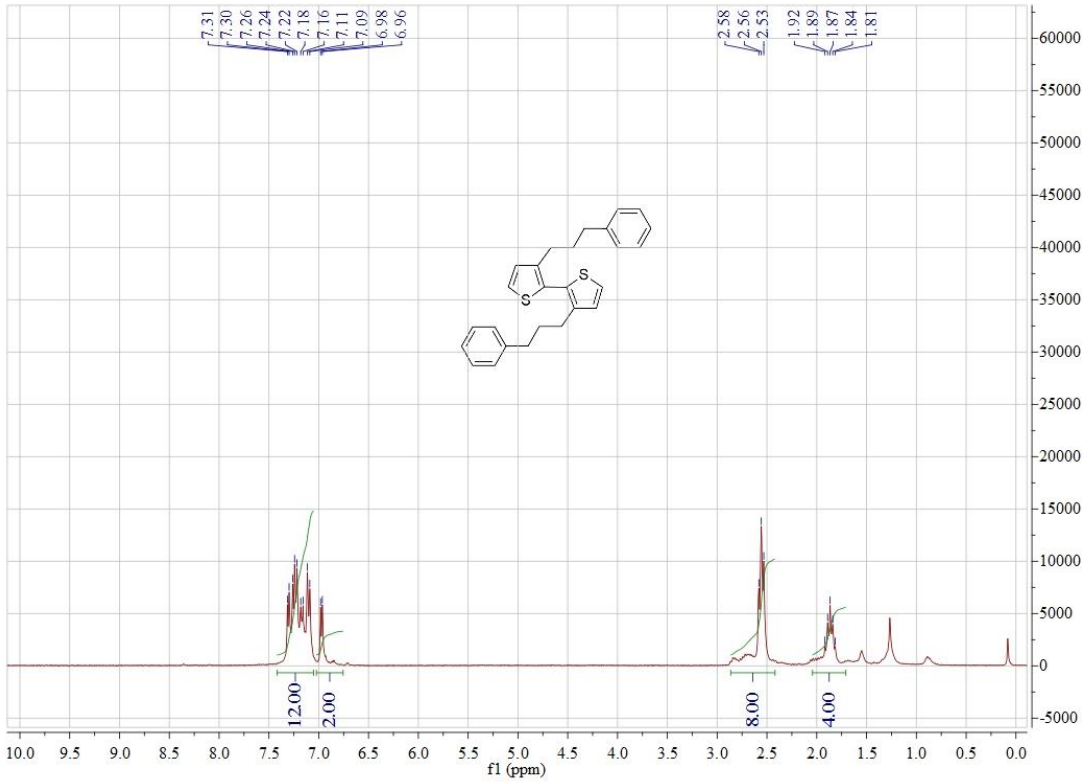

Figure S54. ^{13}C NMR Spectrum of **2i** (75 MHz, $CDCl_3$)

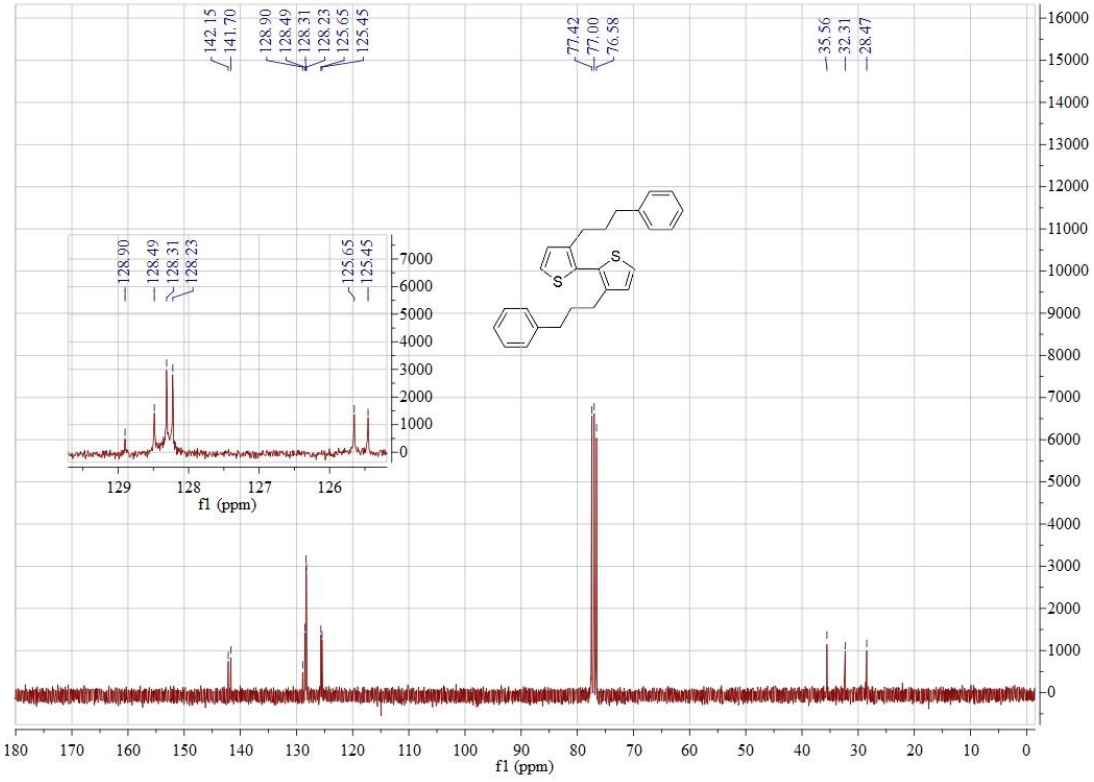

Figure S55. ^{1}H NMR Spectrum of **2j** (300 MHz, CD_2Cl_2)

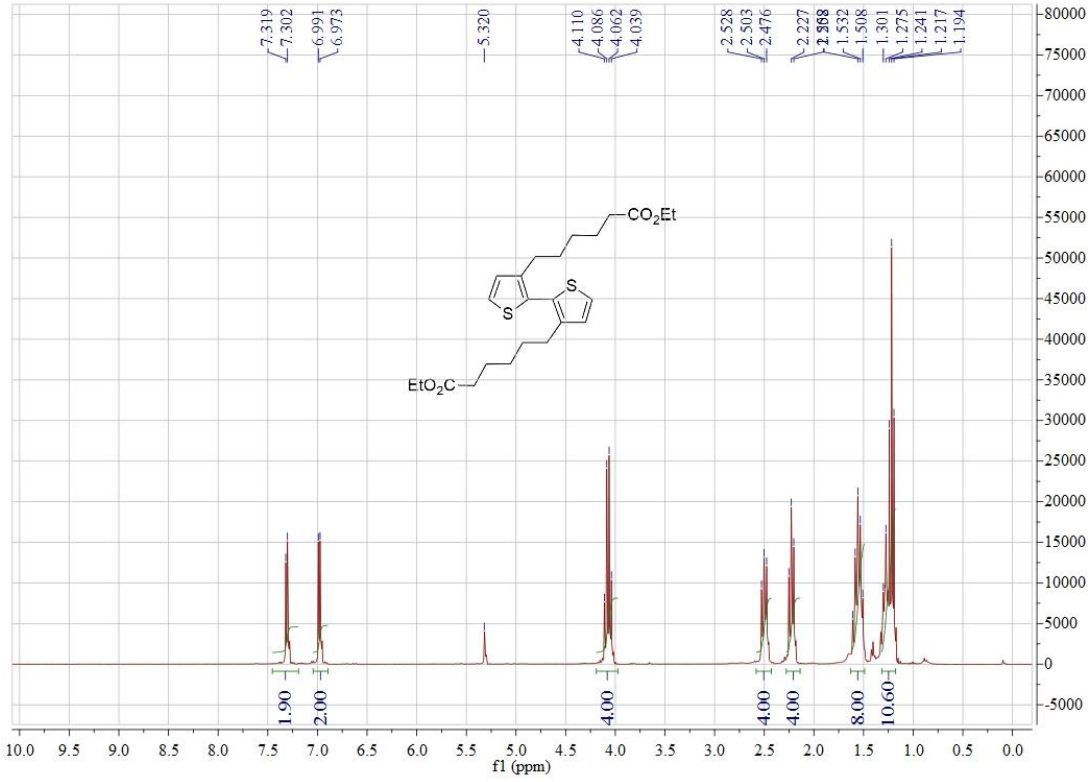

Figure S56. ^{13}C NMR Spectrum of **2j** (75 MHz, $CDCl_3$)

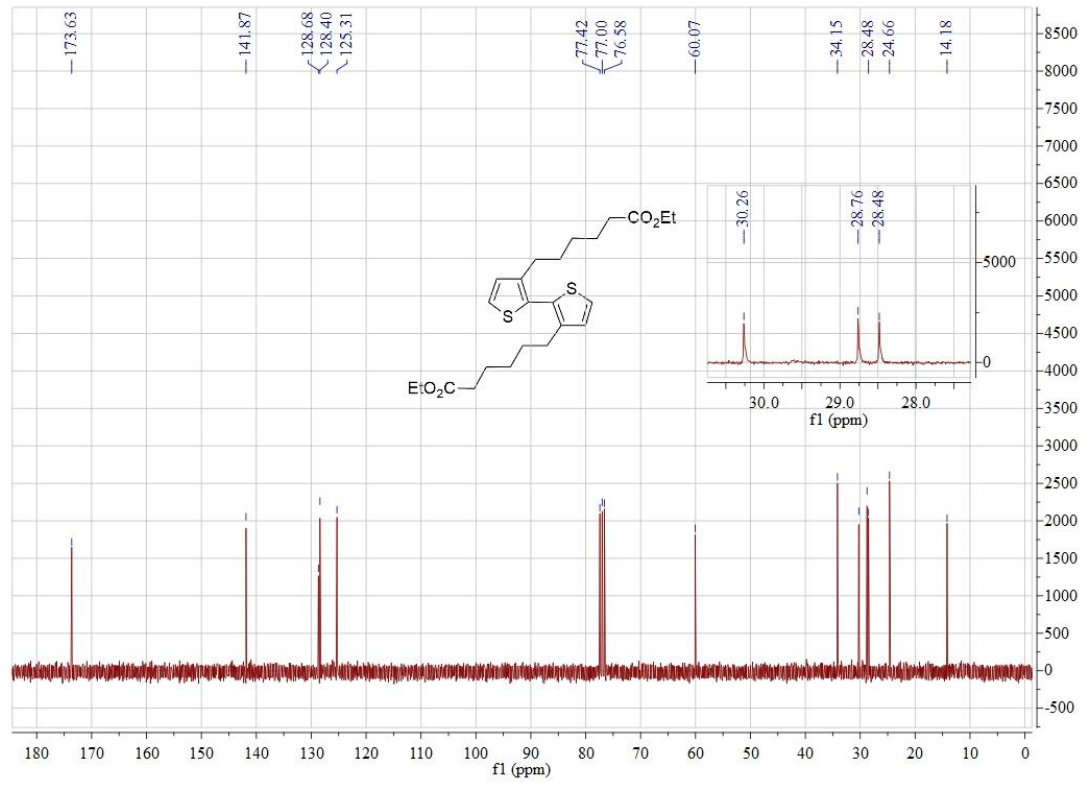

Figure S57. ^{1}H NMR Spectrum of **2k** (300 MHz, $CDCl_3$)

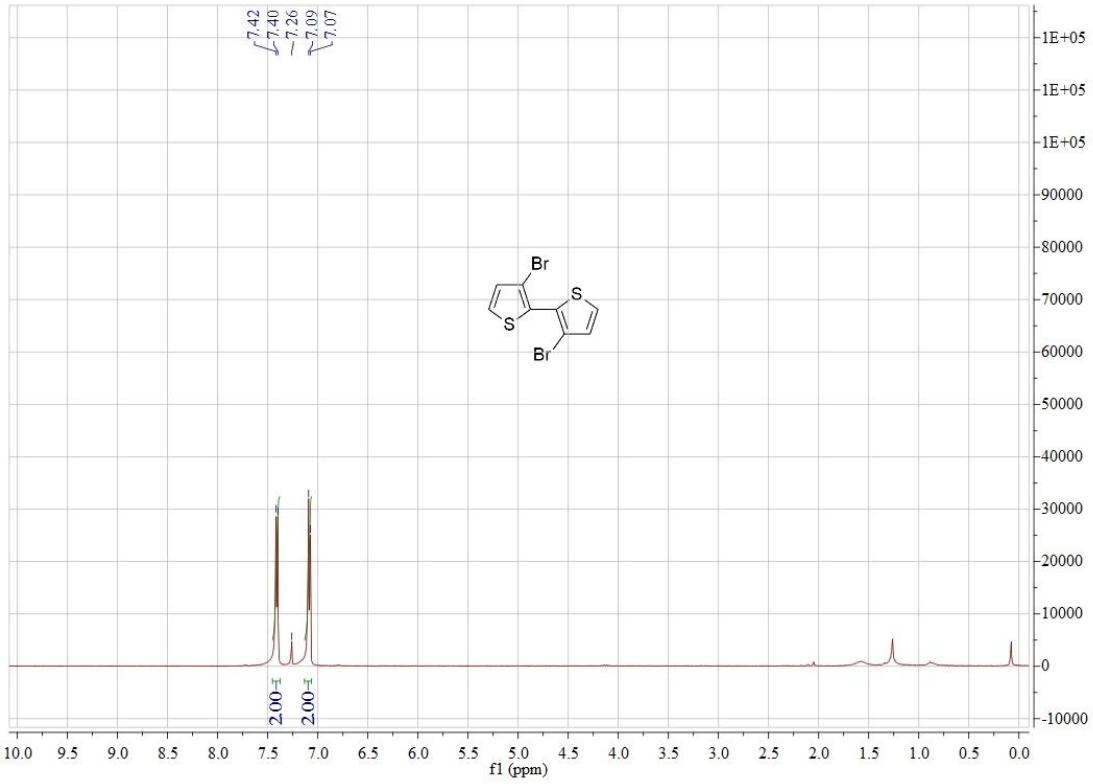

Figure S58. ^{13}C NMR Spectrum of **2k** (75 MHz, $CDCl_3$)

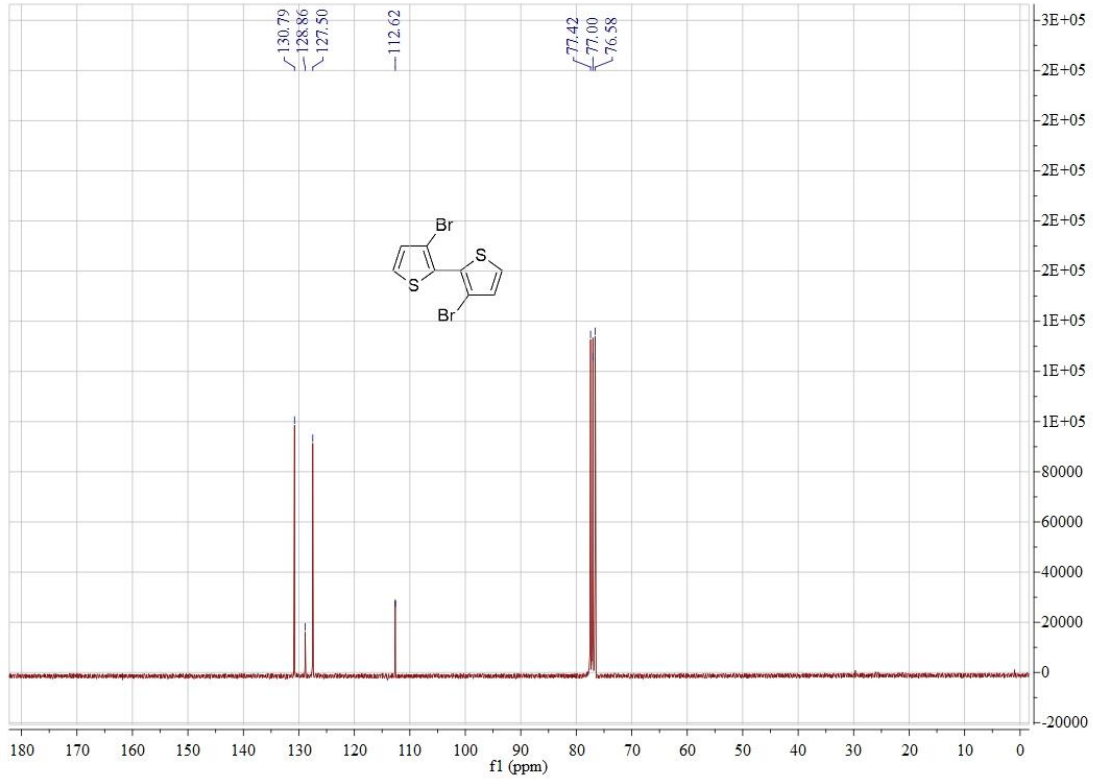

Figure S59. ^{1}H NMR Spectrum of **2l** (300 MHz, $CDCl_3$)

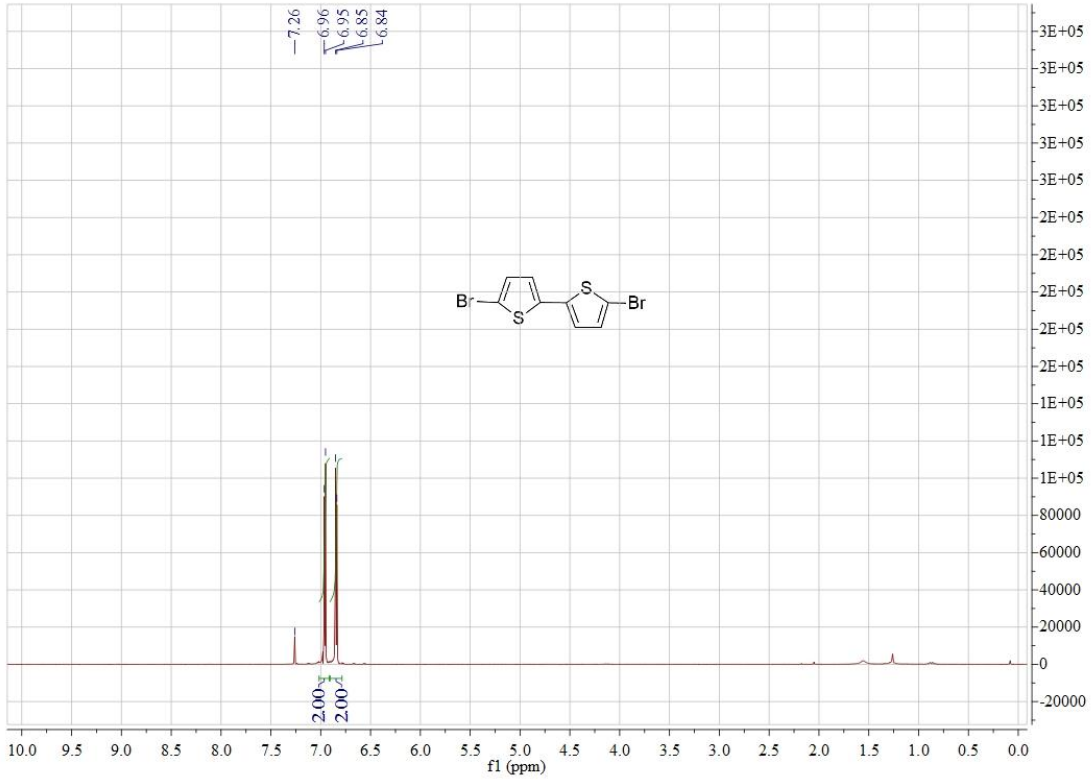

Figure S60. ^{13}C NMR Spectrum of **2l** (75 MHz, $CDCl_3$)

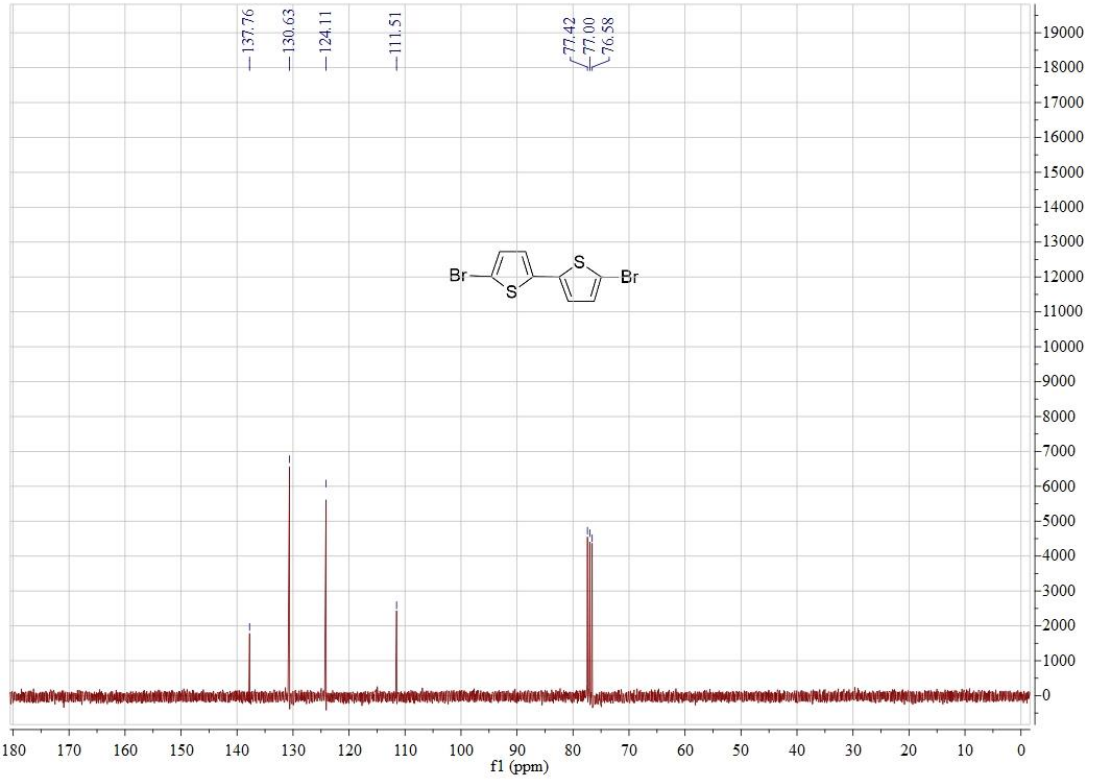

Figure S61. ^{1}H NMR Spectrum of **2m** (300 MHz, $CDCl_3$)

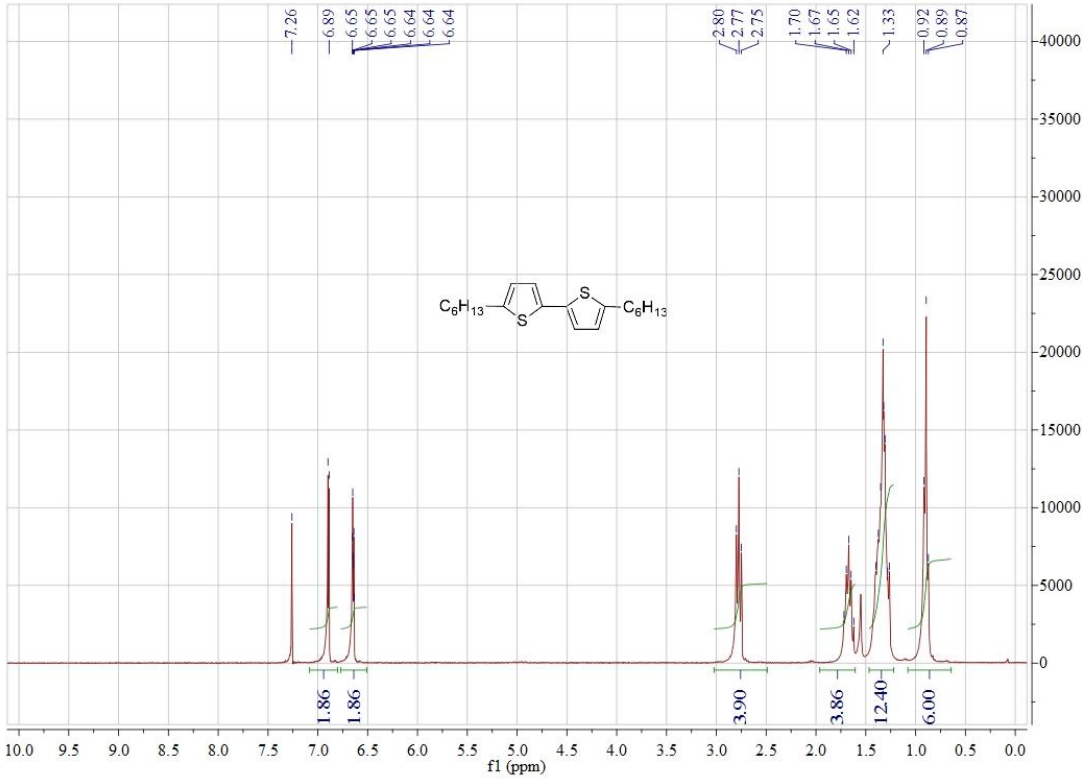

Figure S62. ^{13}C NMR Spectrum of **2m** (75 MHz, $CDCl_3$)

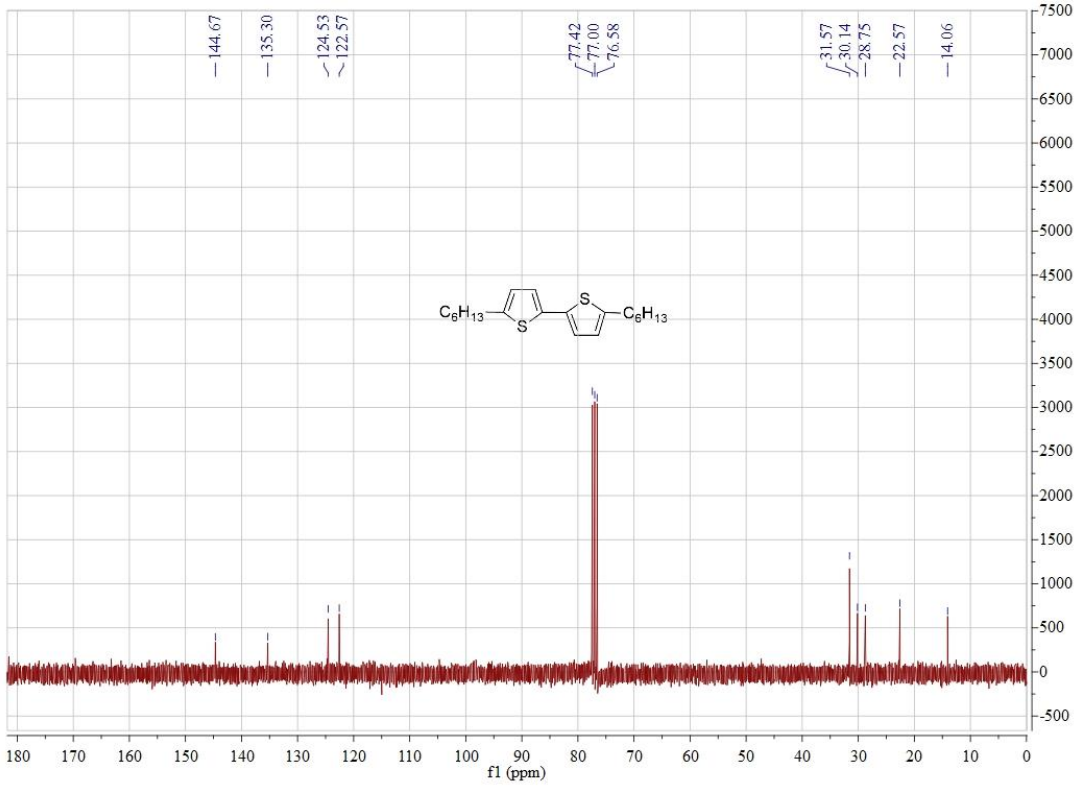

Figure S63. ^{1}H NMR Spectrum of **2n** (300 MHz, $CDCl_3$)

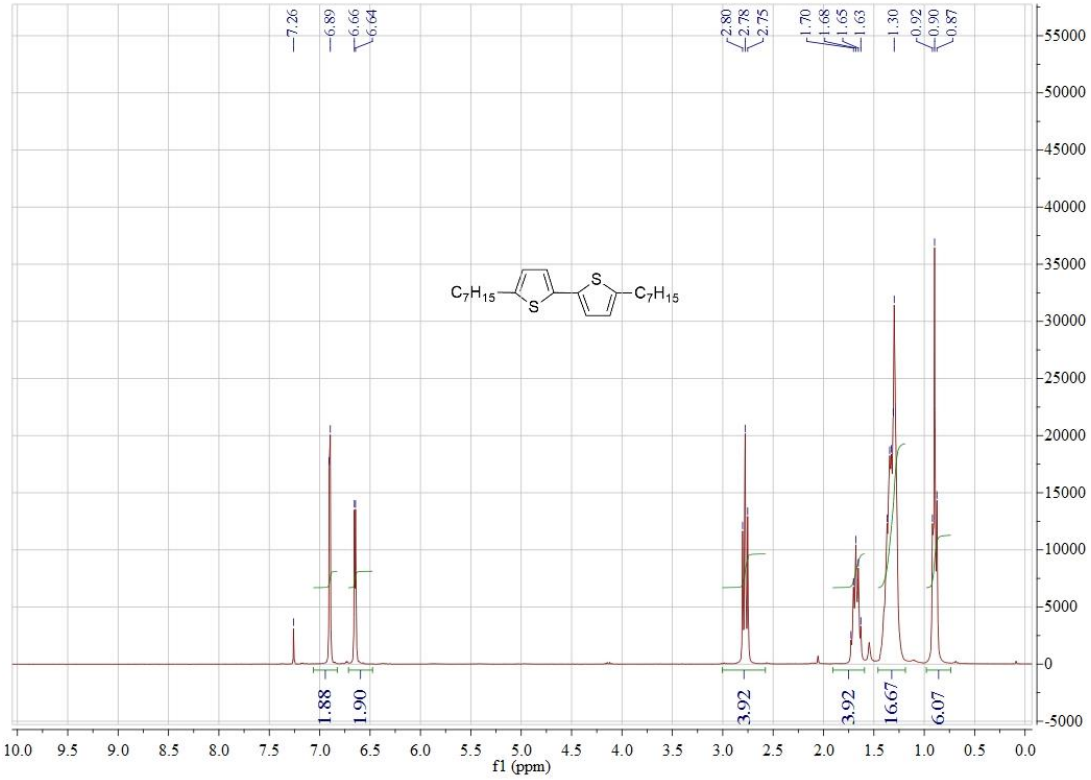

Figure S64. ^{13}C NMR Spectrum of **2n** (75 MHz, $CDCl_3$)

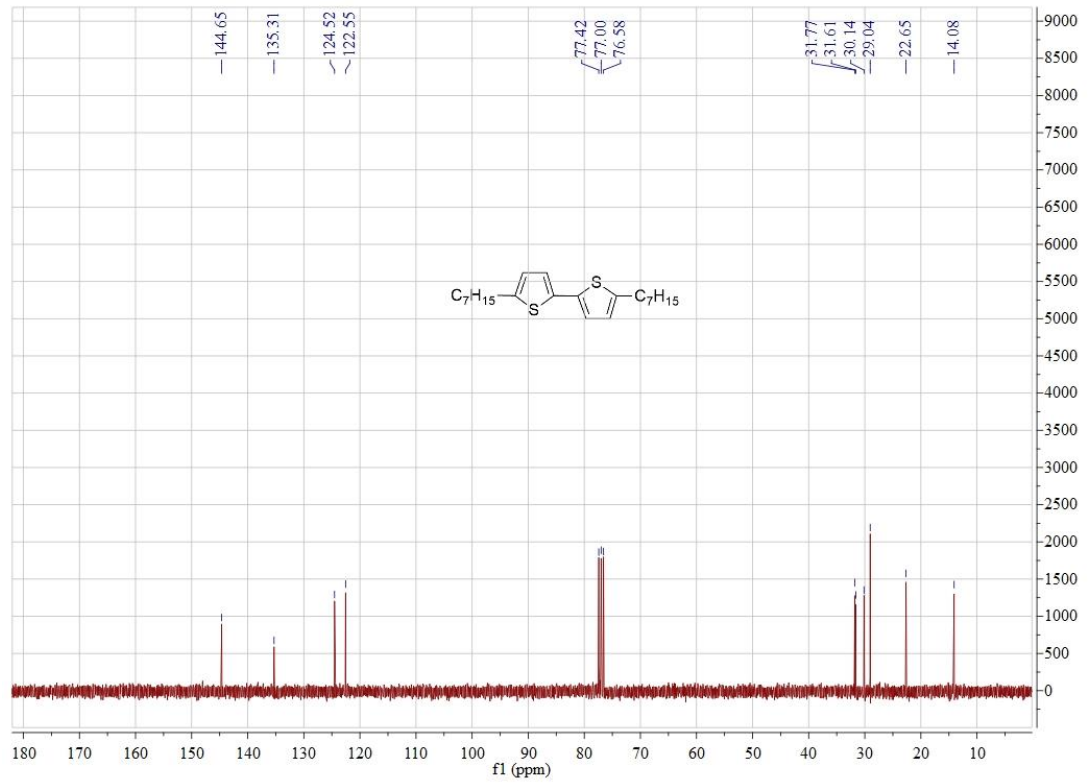

Figure S65. ^{1}H NMR Spectrum of **2o** (300 MHz, $CDCl_3$)

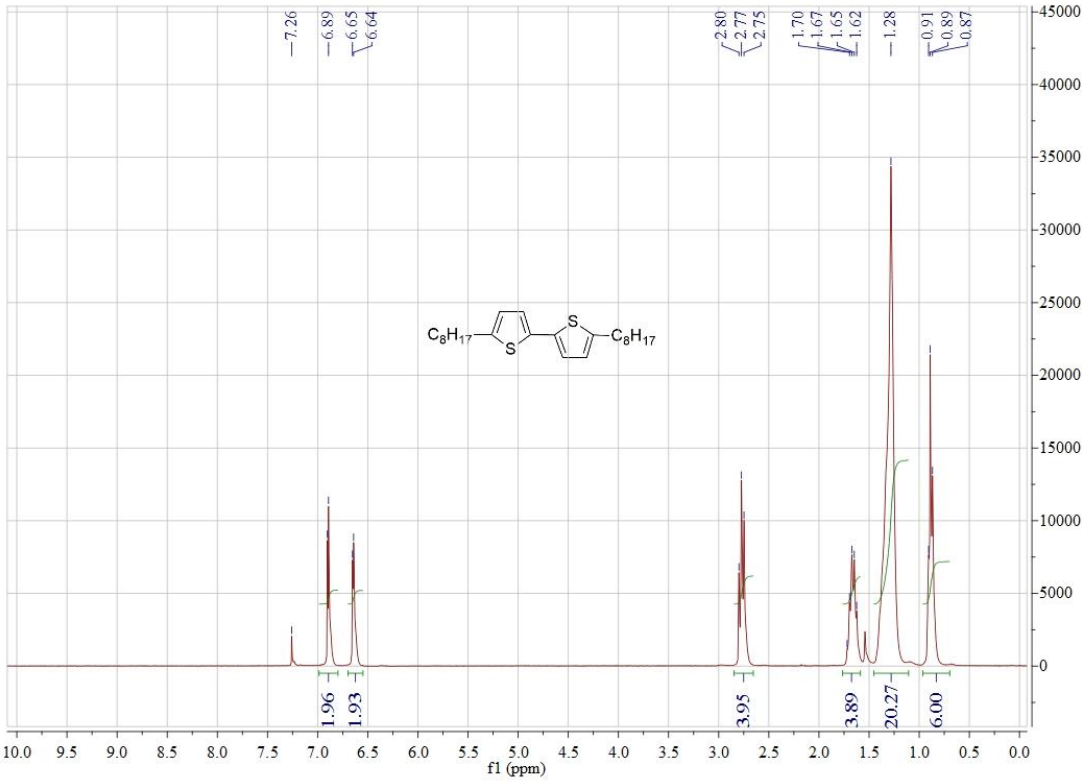

Figure S66. ^{13}C NMR Spectrum of **2o** (75 MHz, $CDCl_3$)

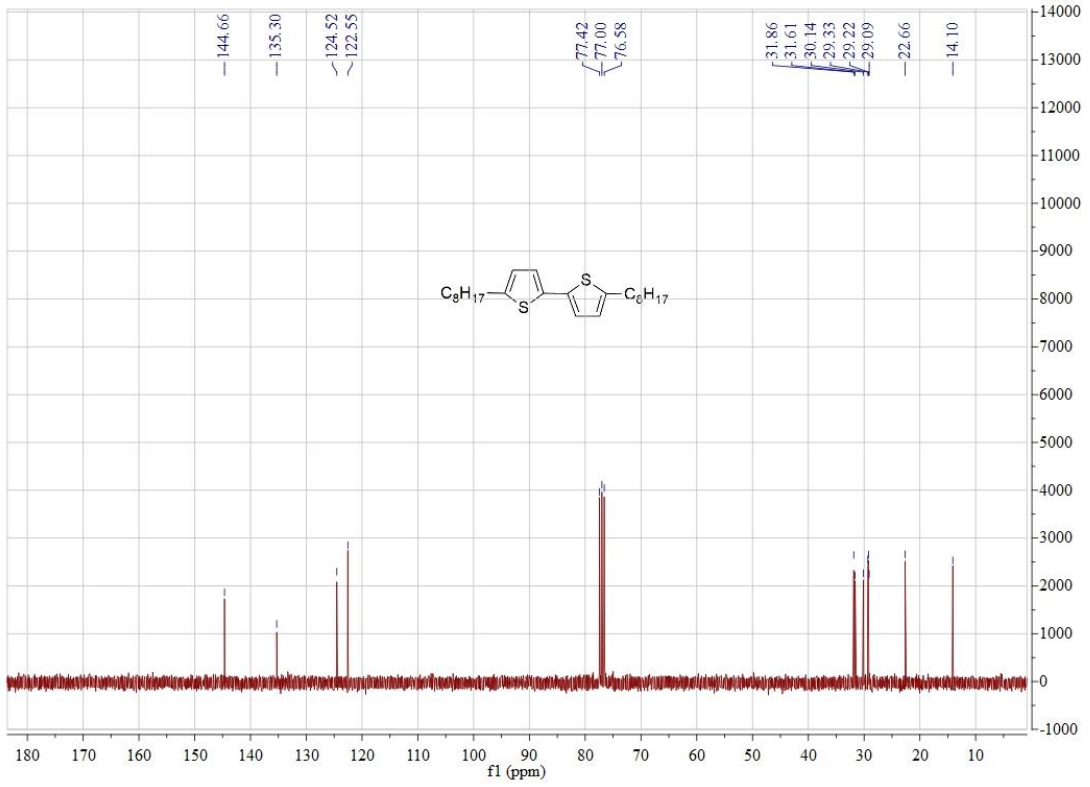

Figure S67. ^{1}H NMR Spectrum of **2p** (300 MHz, $CDCl_3$)

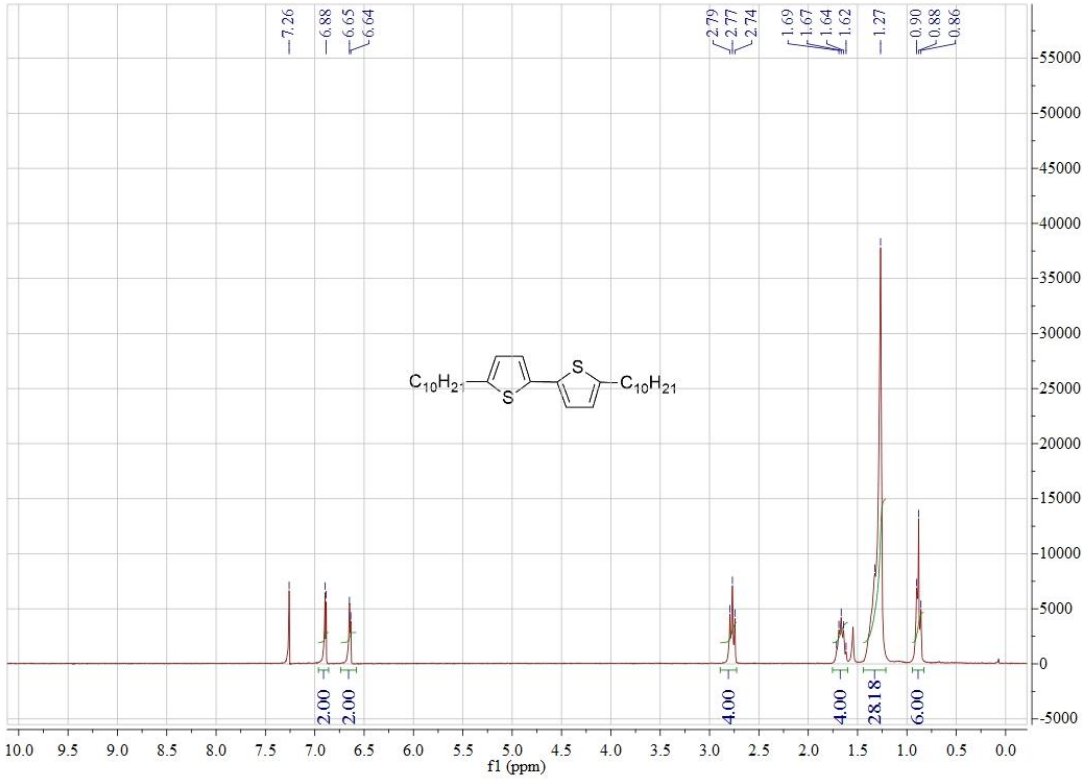

Figure S68. ^{13}C NMR Spectrum of **2p** (75 MHz, $CDCl_3$)

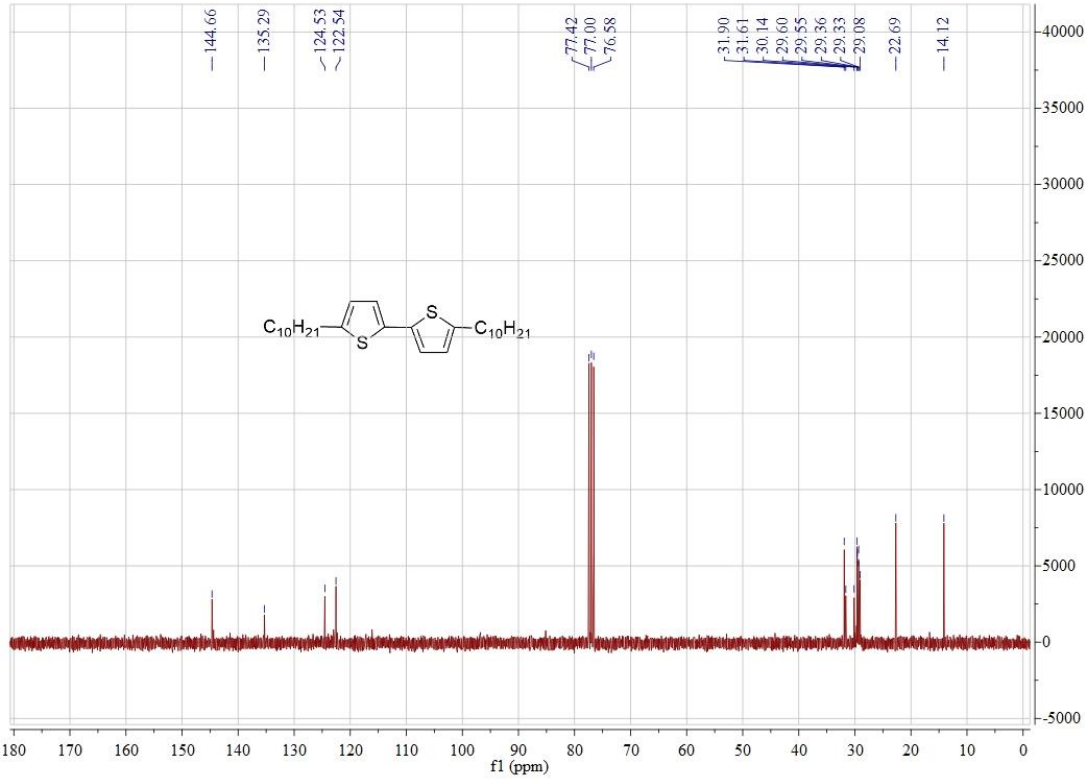

Figure S69. ^{1}H NMR Spectrum of **2q** (300 MHz, $CDCl_3$)

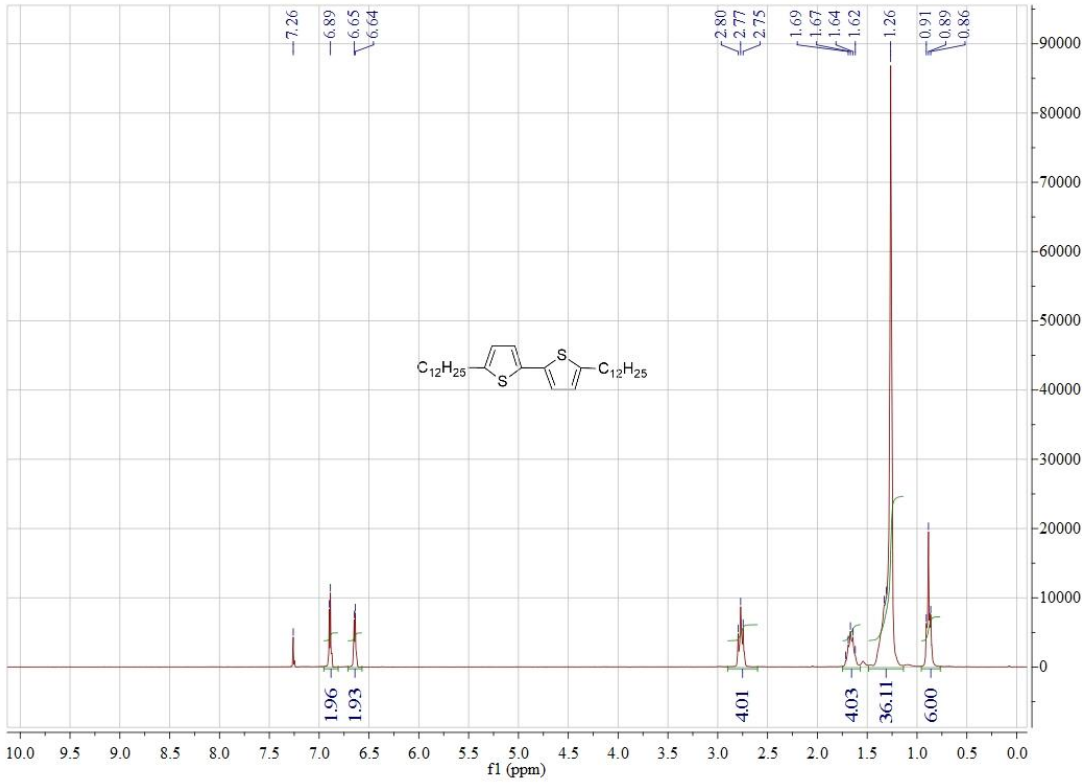

Figure S70. ^{13}C NMR Spectrum of **2q** (125 MHz, $CDCl_3$)

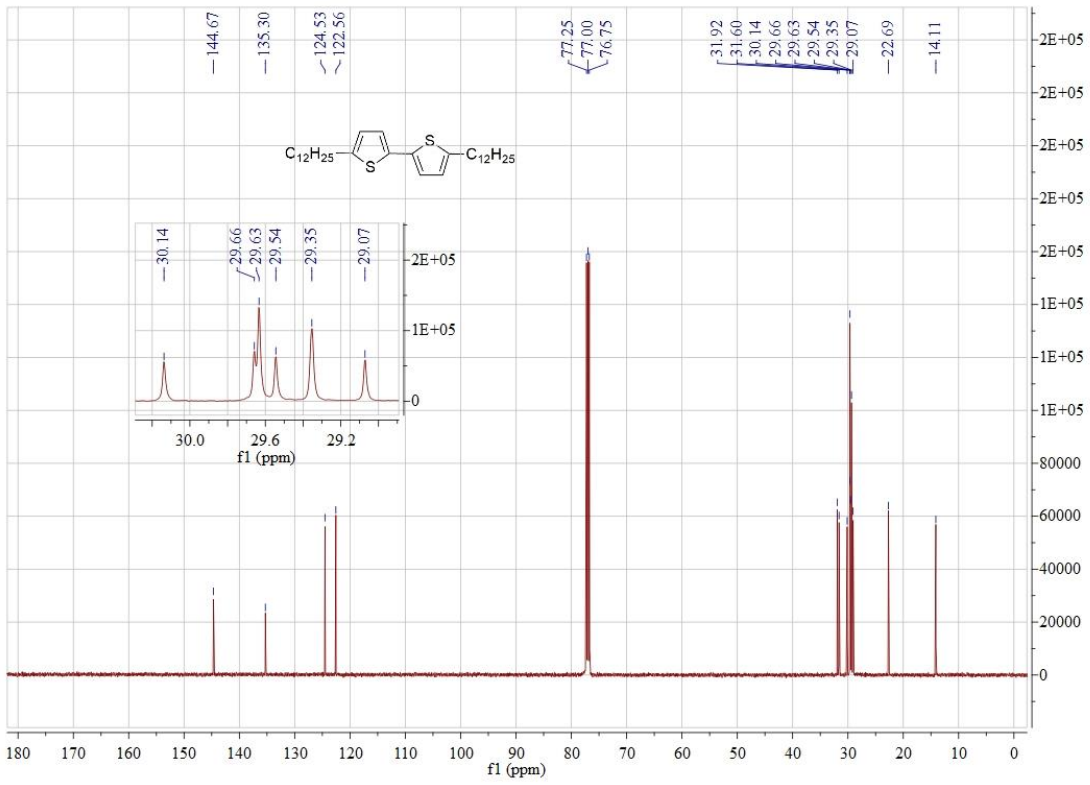

Figure S71. ^{1}H NMR Spectrum of **2r** (300 MHz, CD_2Cl_2)

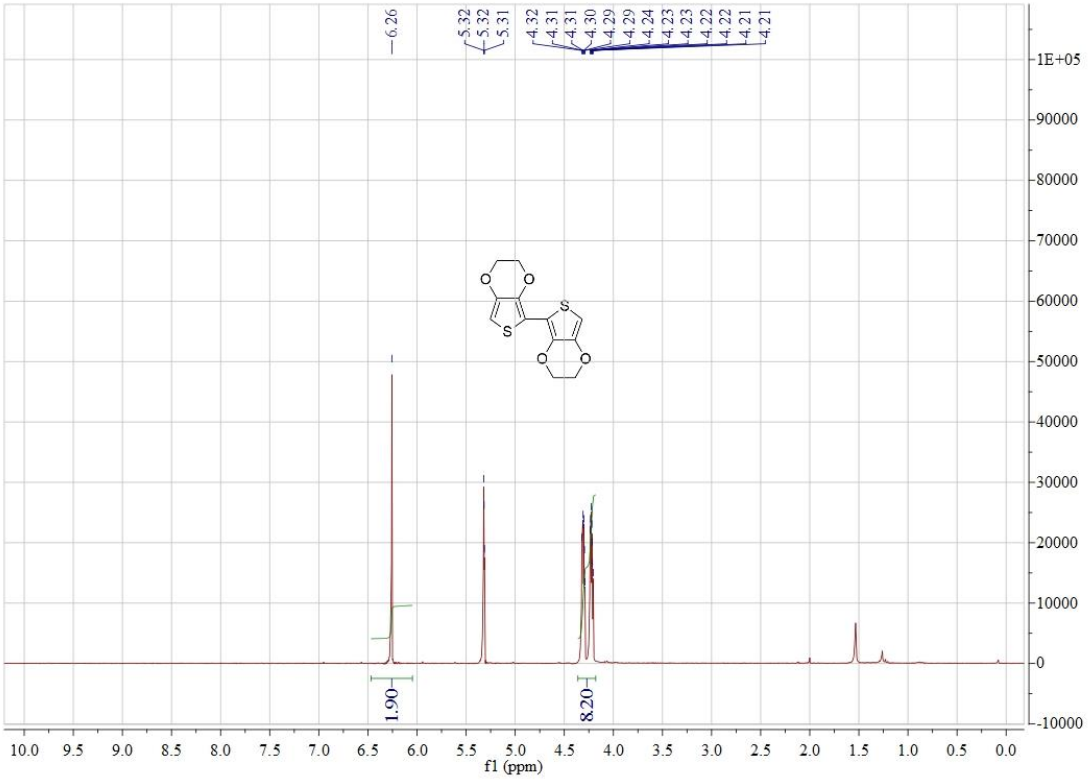

Figure S72. ^{13}C NMR Spectrum of **2r** (75 MHz, CD_2Cl_2)

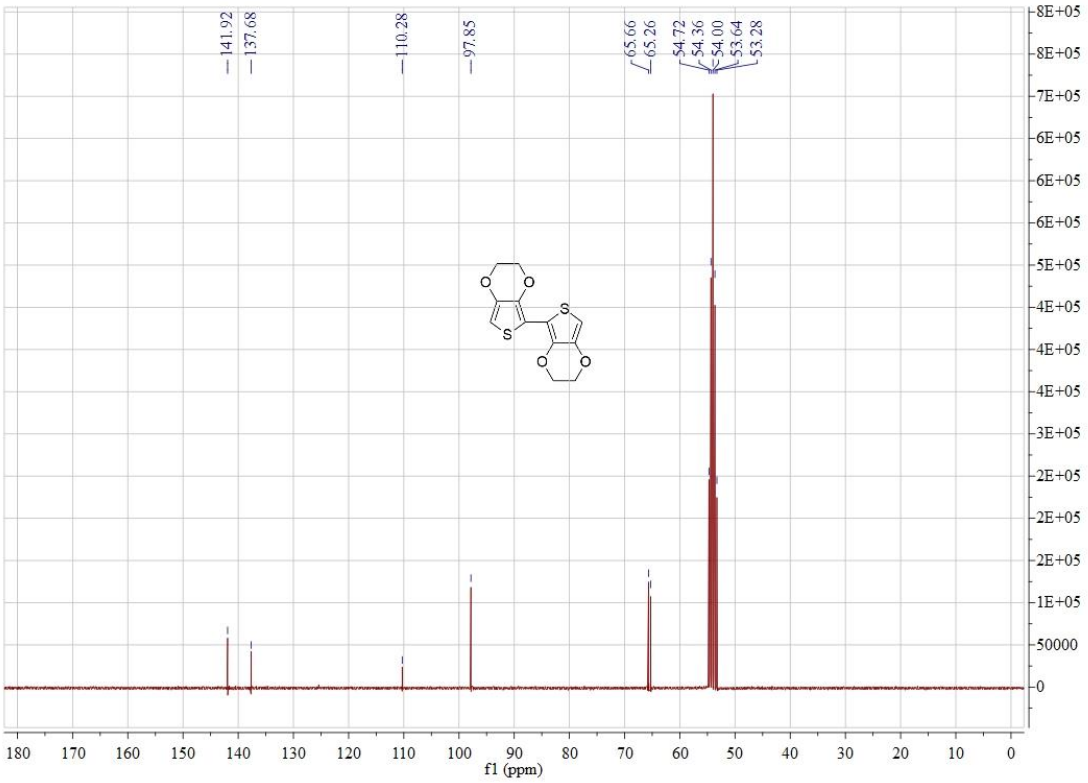

Figure S73. ^{1}H NMR Spectrum of **2s** (300 MHz, $CDCl_3$)

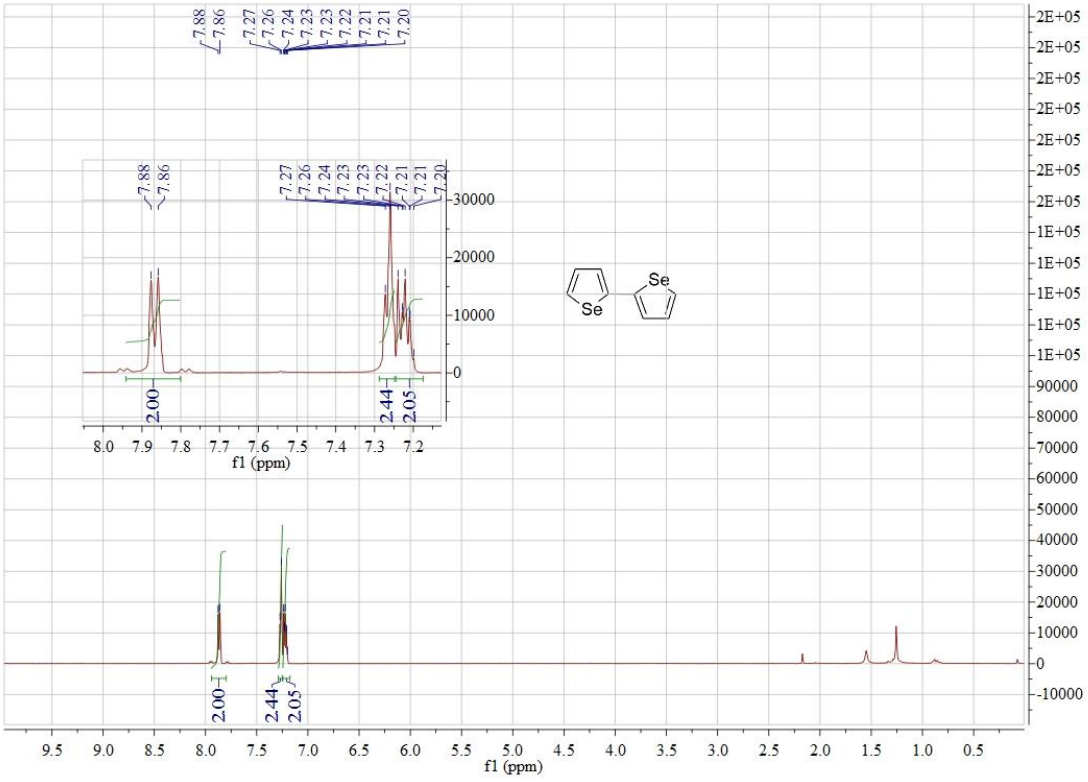

Figure S74. ^{13}C NMR Spectrum of **2s** (75 MHz, $CDCl_3$)

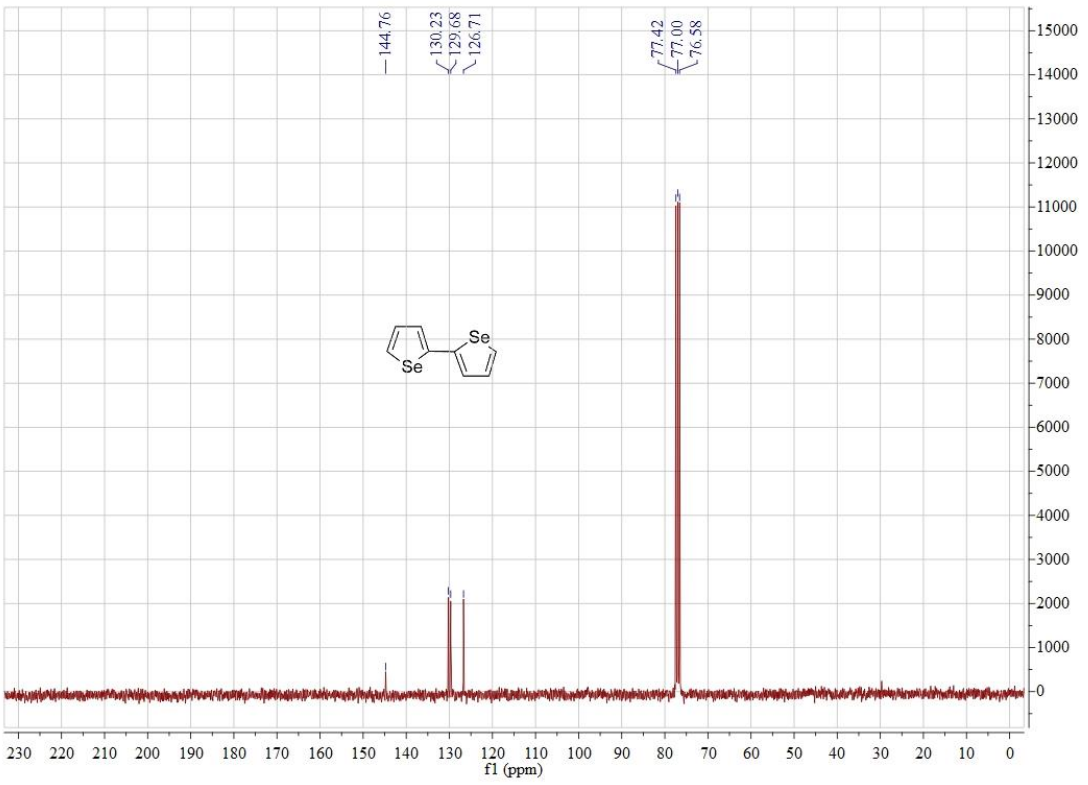

Figure S75. ^{1}H NMR Spectrum of **4a** (300 MHz, $CDCl_3$)

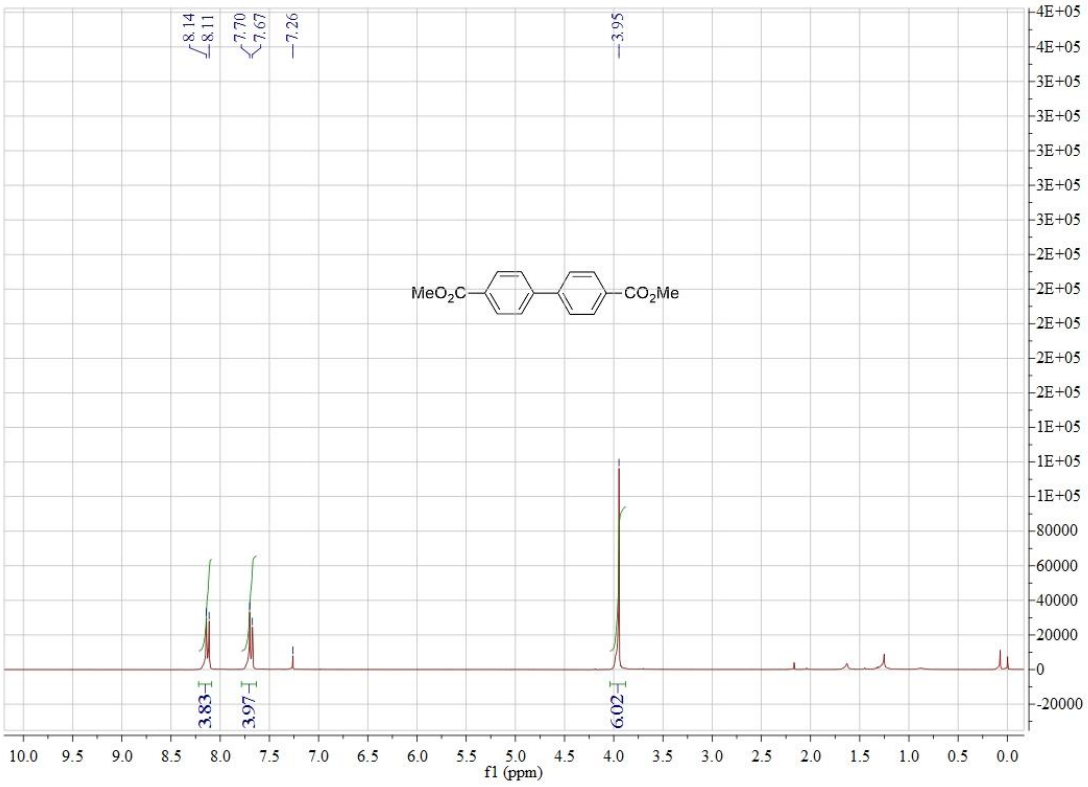

Figure S76. ^{13}C NMR Spectrum of **4a** (75 MHz, $CDCl_3$)

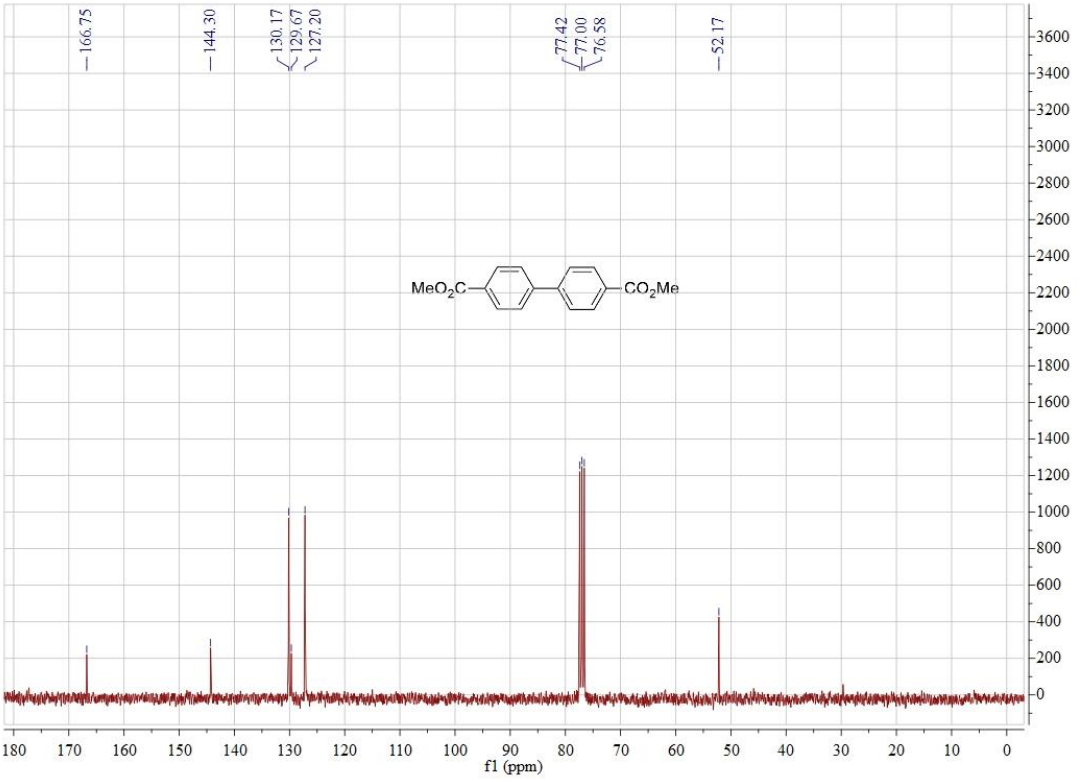

Figure S77. ^{1}H NMR Spectrum of **4b** (300 MHz, $CDCl_3$)

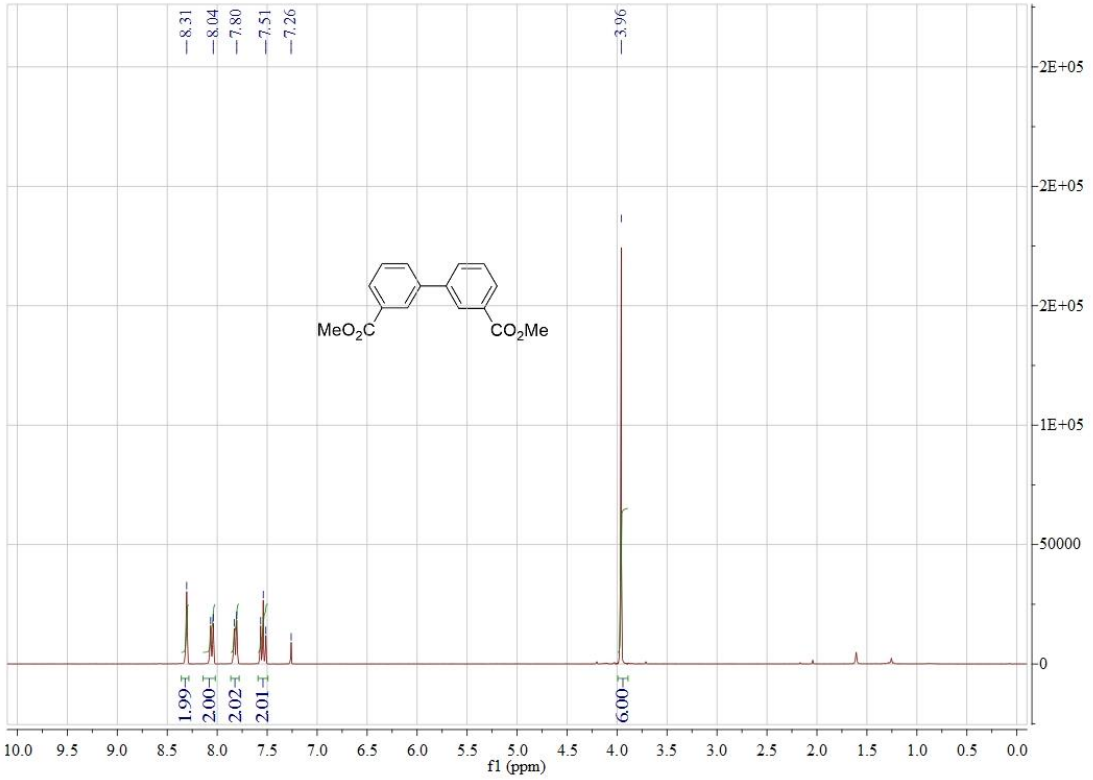

Figure S78. ^{13}C NMR Spectrum of **4b** (75 MHz, $CDCl_3$)

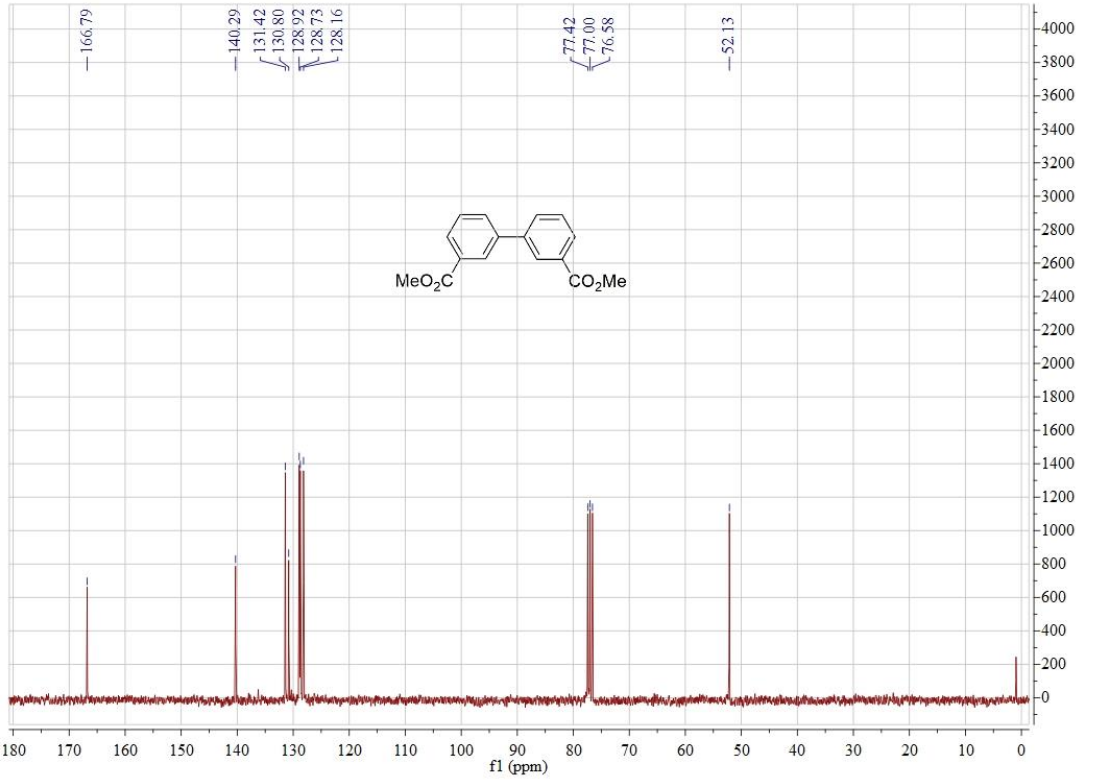

Figure S79. ^{1}H NMR Spectrum of **4c** (300 MHz, $CDCl_3$)

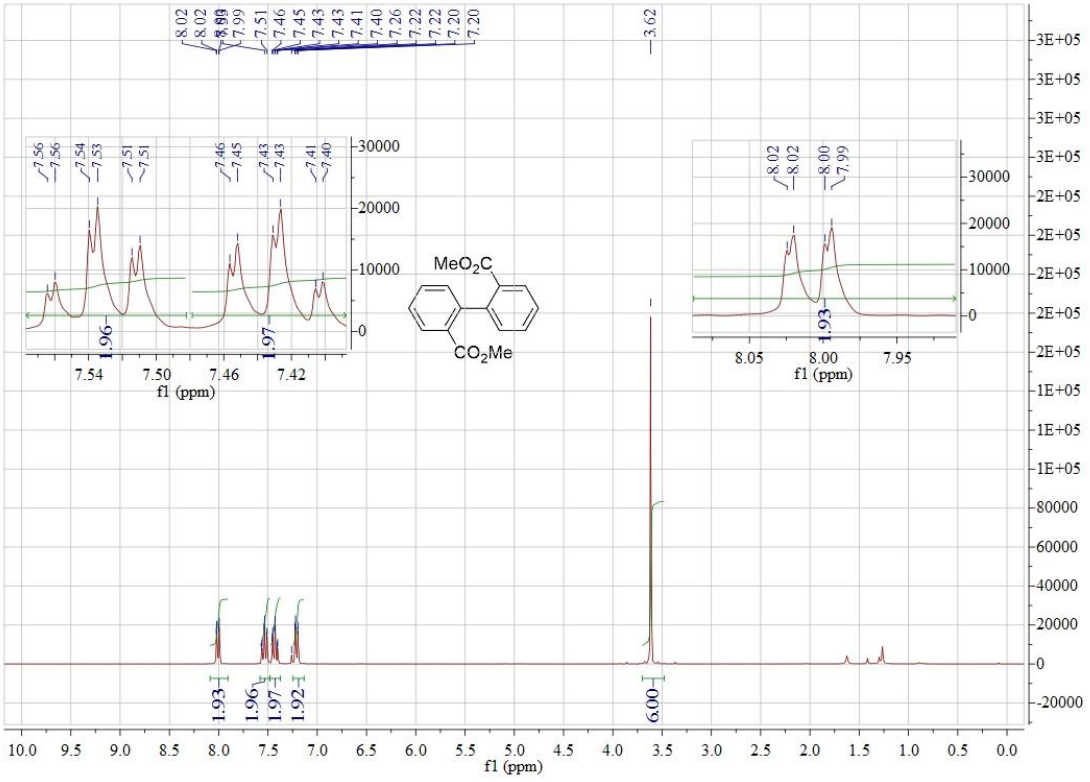

Figure S80. ^{13}C NMR Spectrum of **4c** (75 MHz, $CDCl_3$)

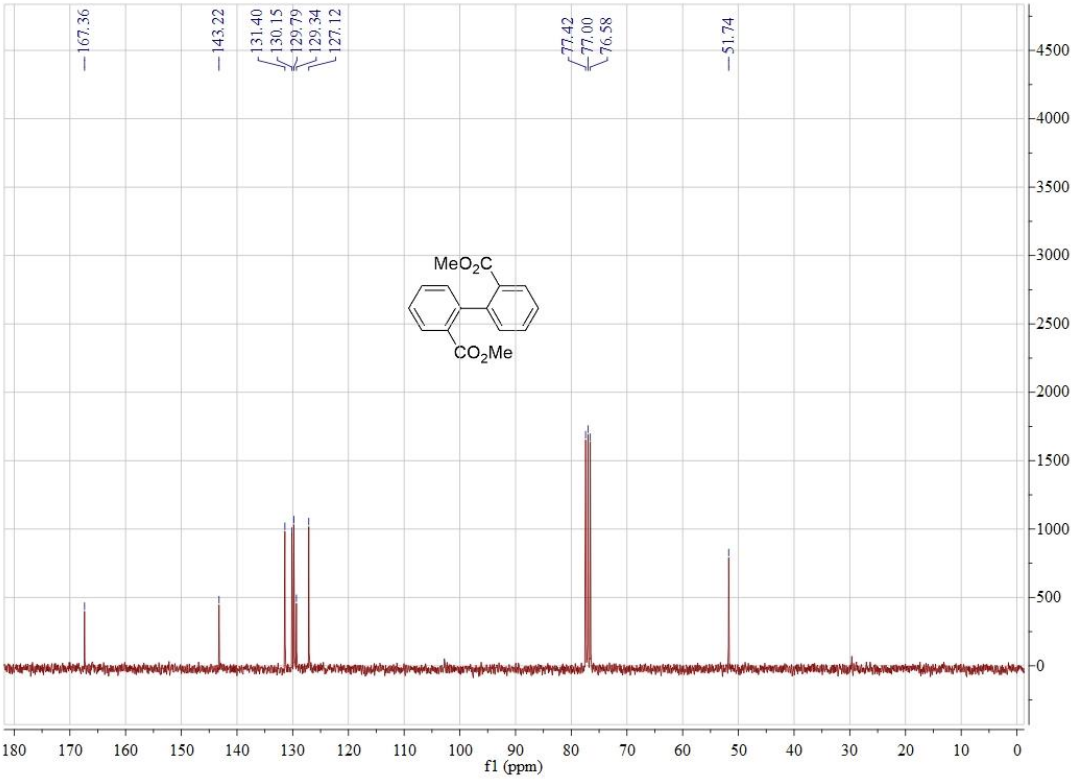

Figure S81. ^{1}H NMR Spectrum of **4d** (300 MHz, $CDCl_3$)

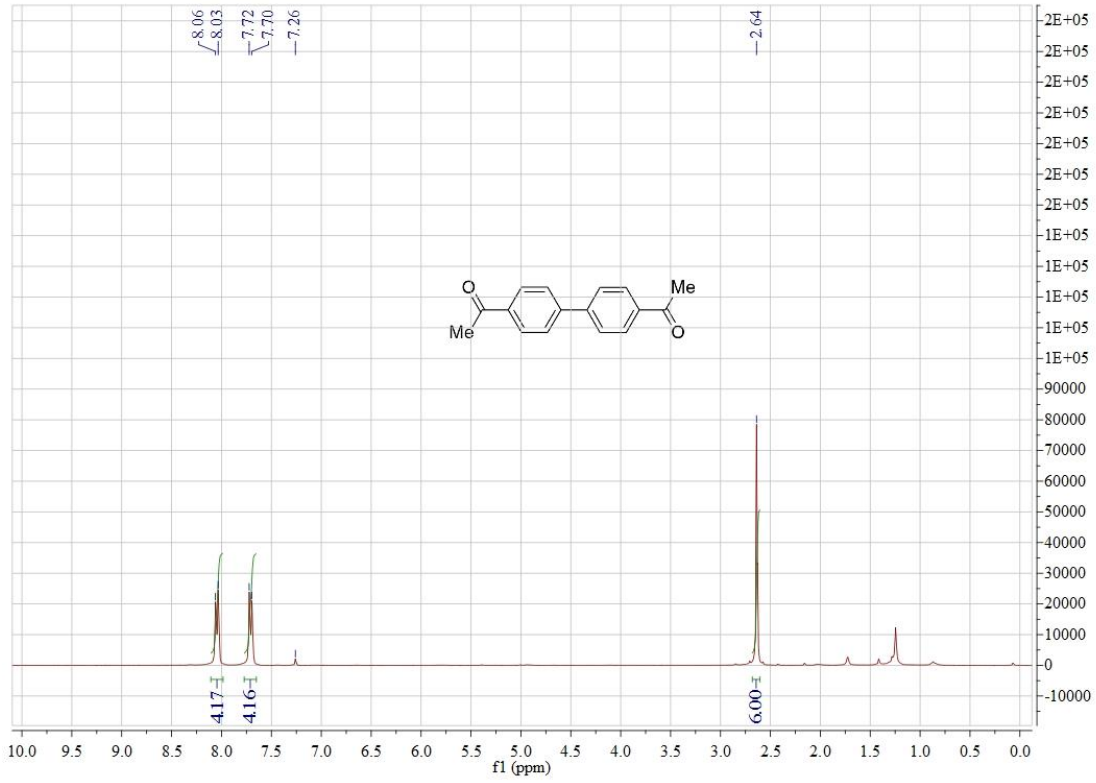

Figure S82. ^{13}C NMR Spectrum of **4d** (75 MHz, $CDCl_3$)

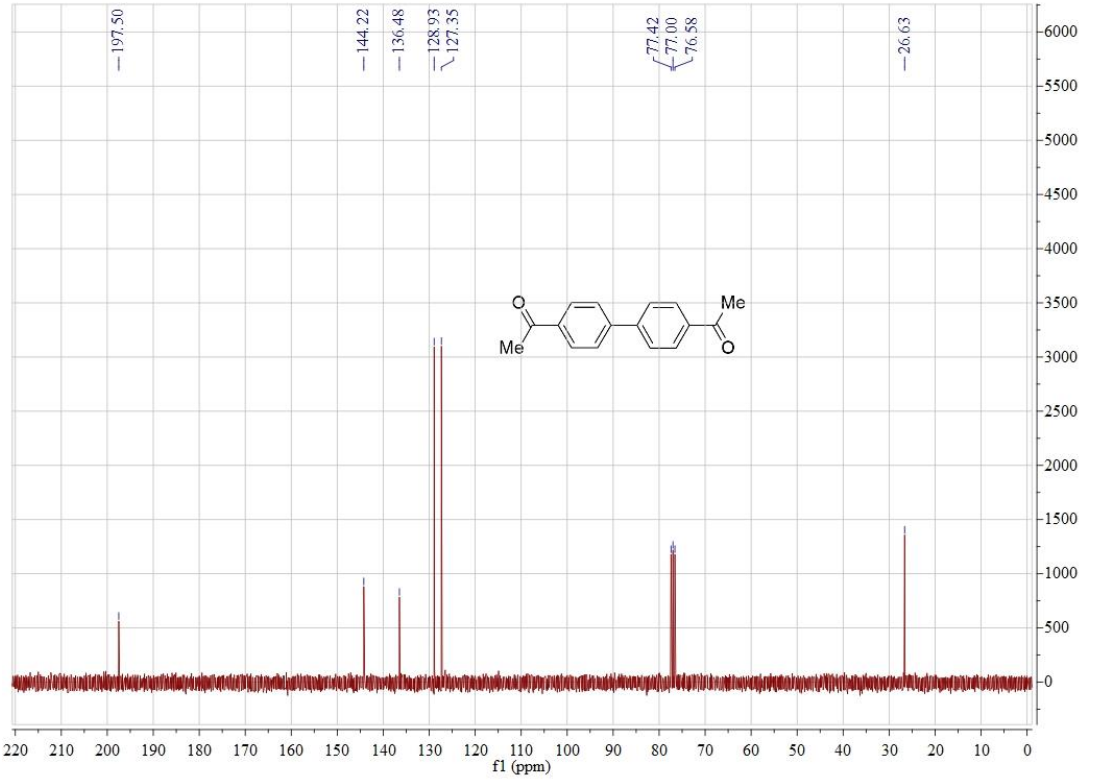

Figure S83. ^{1}H NMR Spectrum of **4e** (300 MHz, $CDCl_3$)

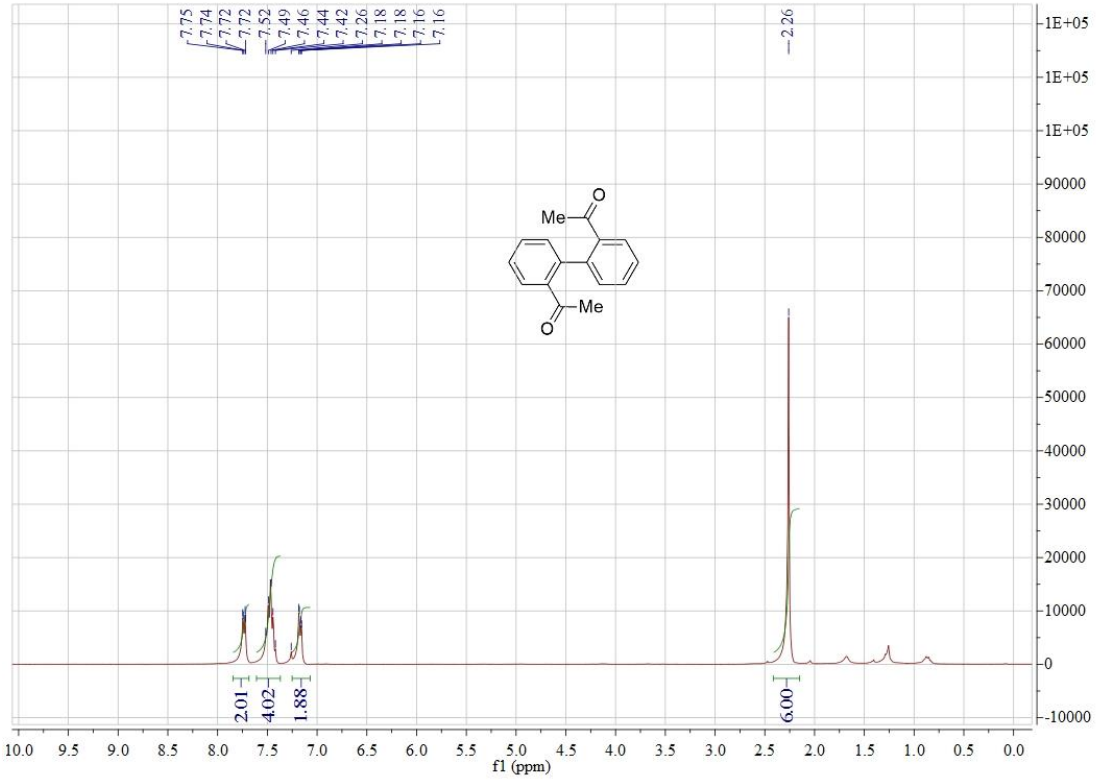

Figure S84. ^{13}C NMR Spectrum of **4e** (75 MHz, $CDCl_3$)

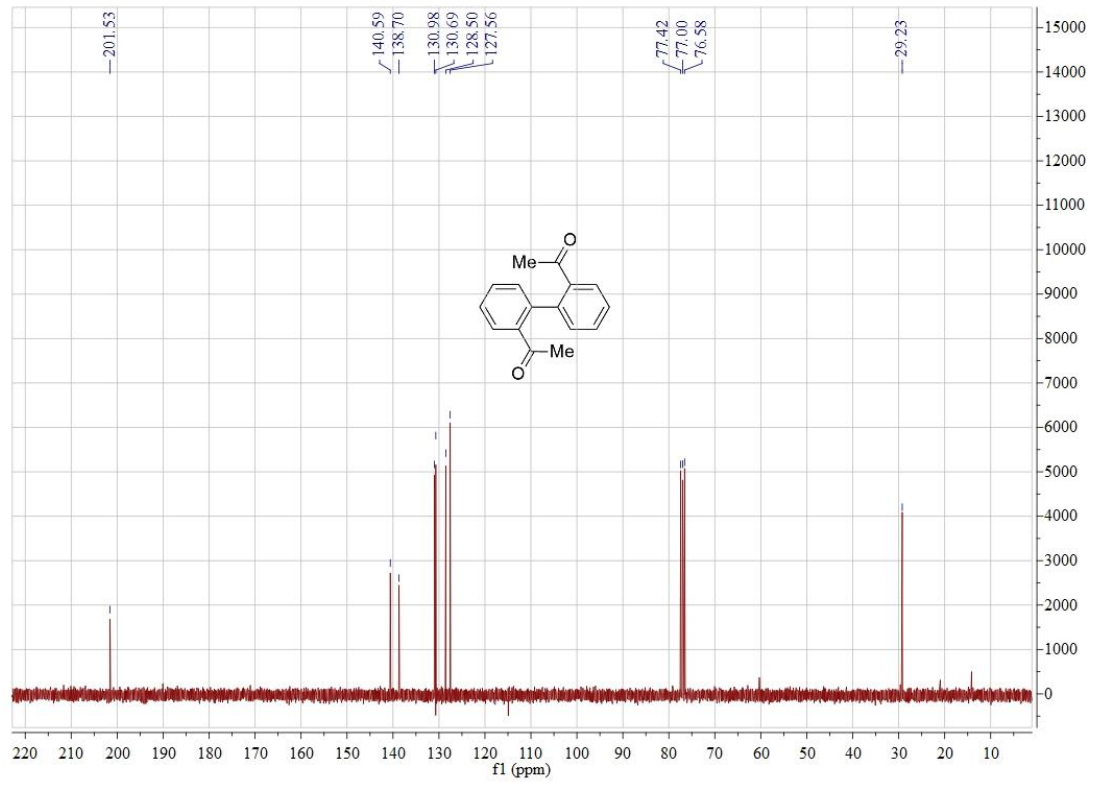

Figure S85. ^{1}H NMR Spectrum of **4f** (300 MHz, $CDCl_3$)

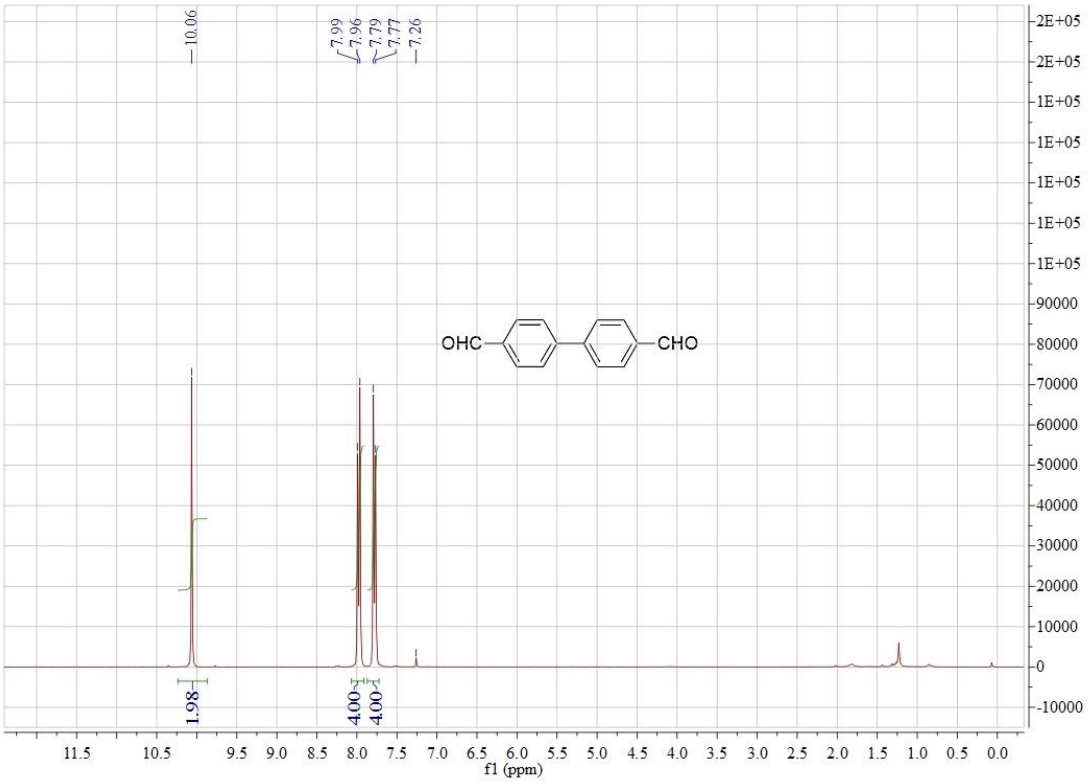

Figure S86. ^{13}C NMR Spectrum of **4f** (75 MHz, $CDCl_3$)

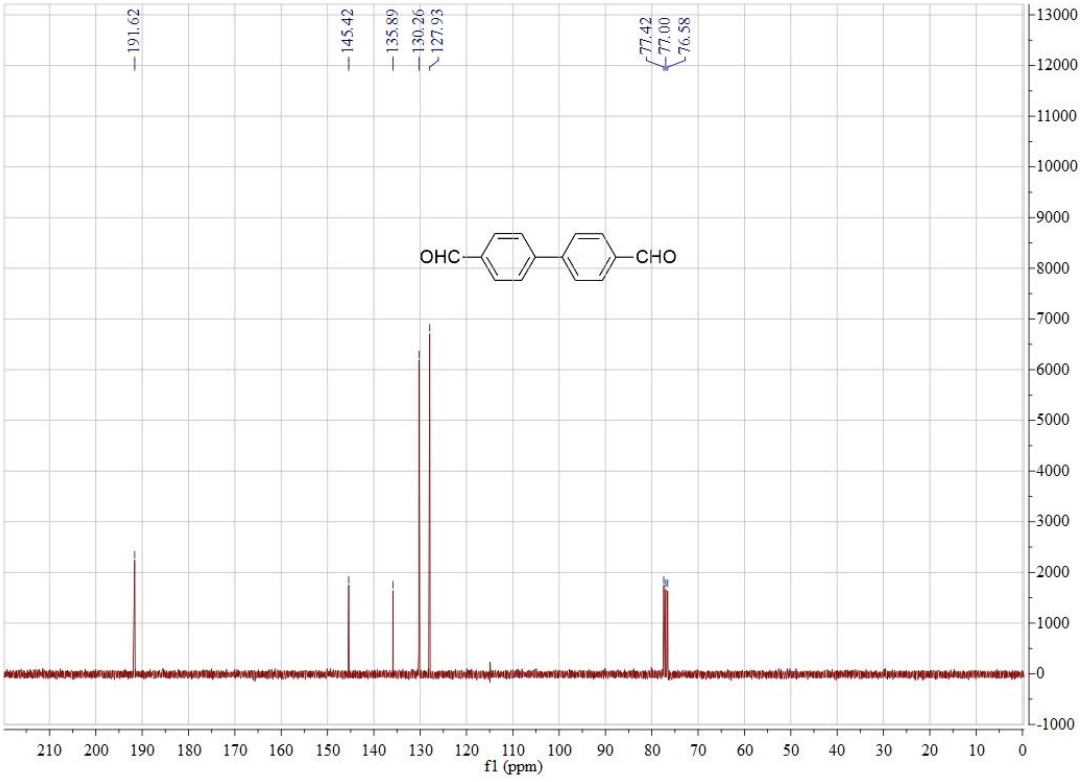

Figure S87. ^{1}H NMR Spectrum of **4g** (300 MHz, $CDCl_3$)

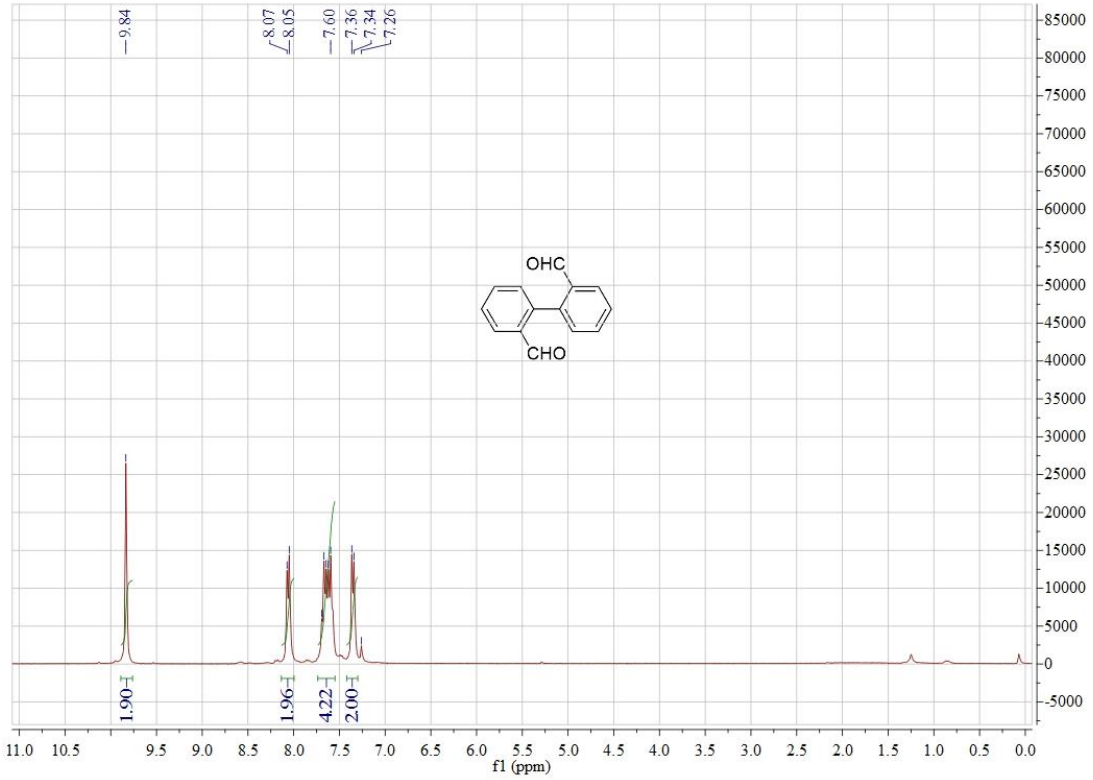

Figure S88. ^{13}C NMR Spectrum of **4g** (75 MHz, $CDCl_3$)

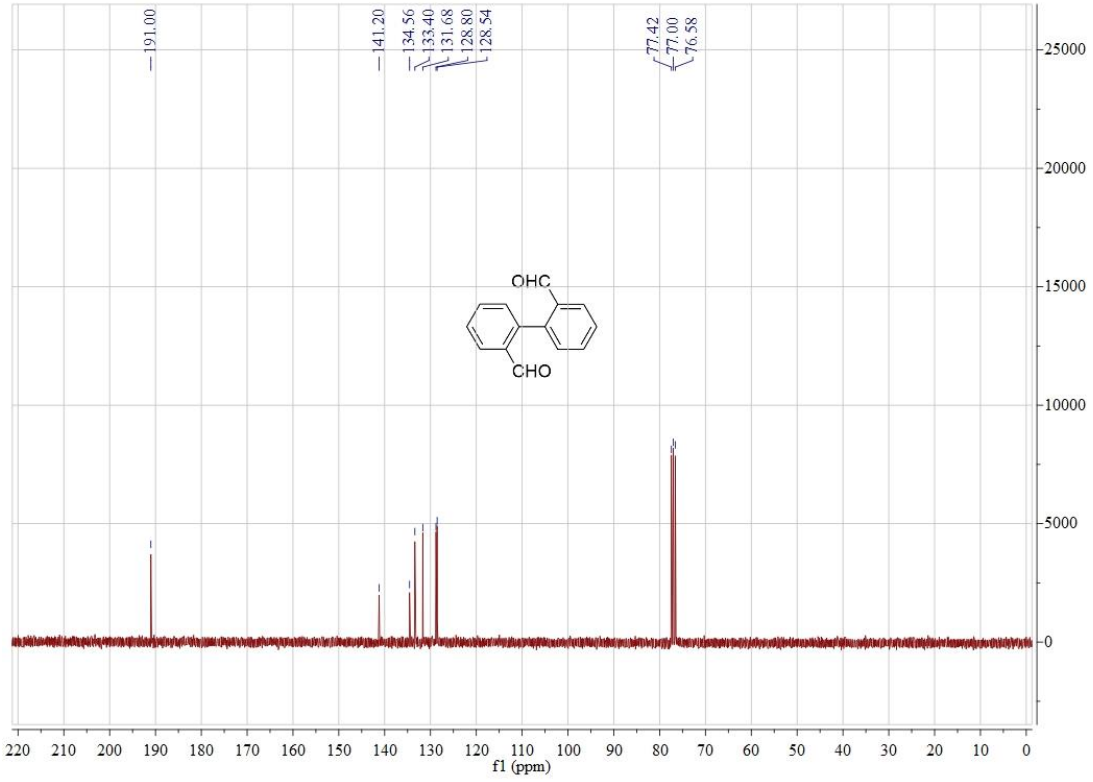

Figure S89. ^{1}H NMR Spectrum of **4h** (300 MHz, $CDCl_3$)

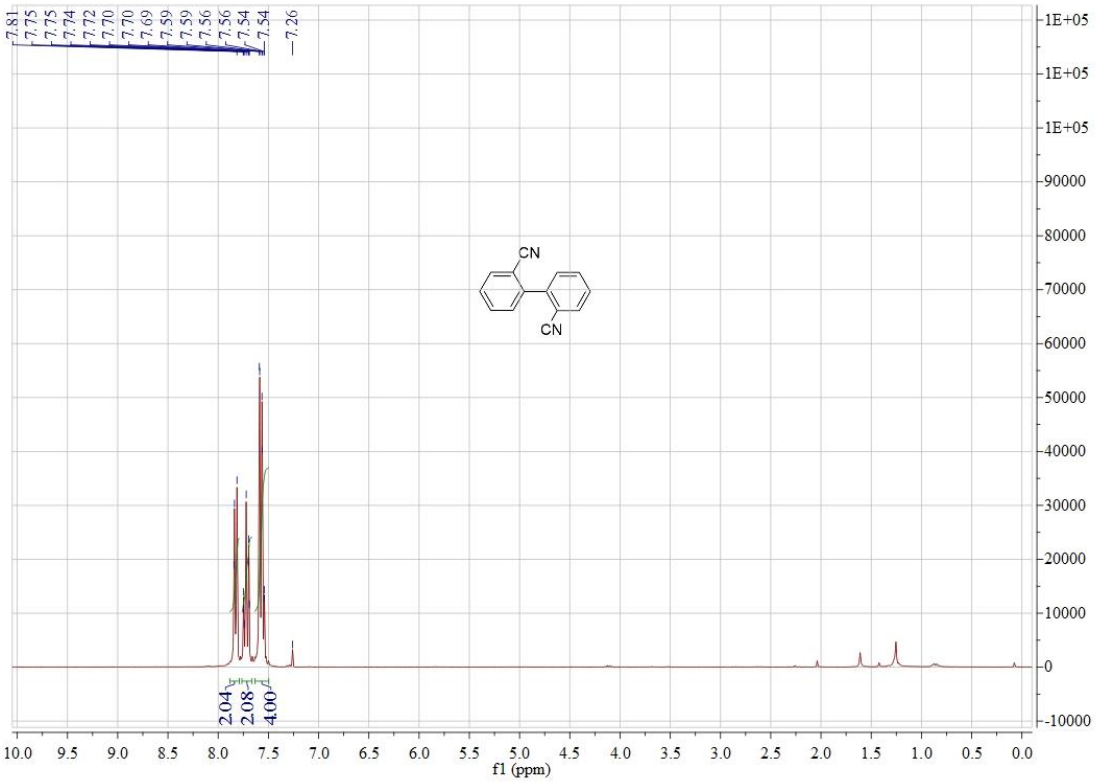

Figure S90. ^{13}C NMR Spectrum of **4h** (75 MHz, $CDCl_3$)

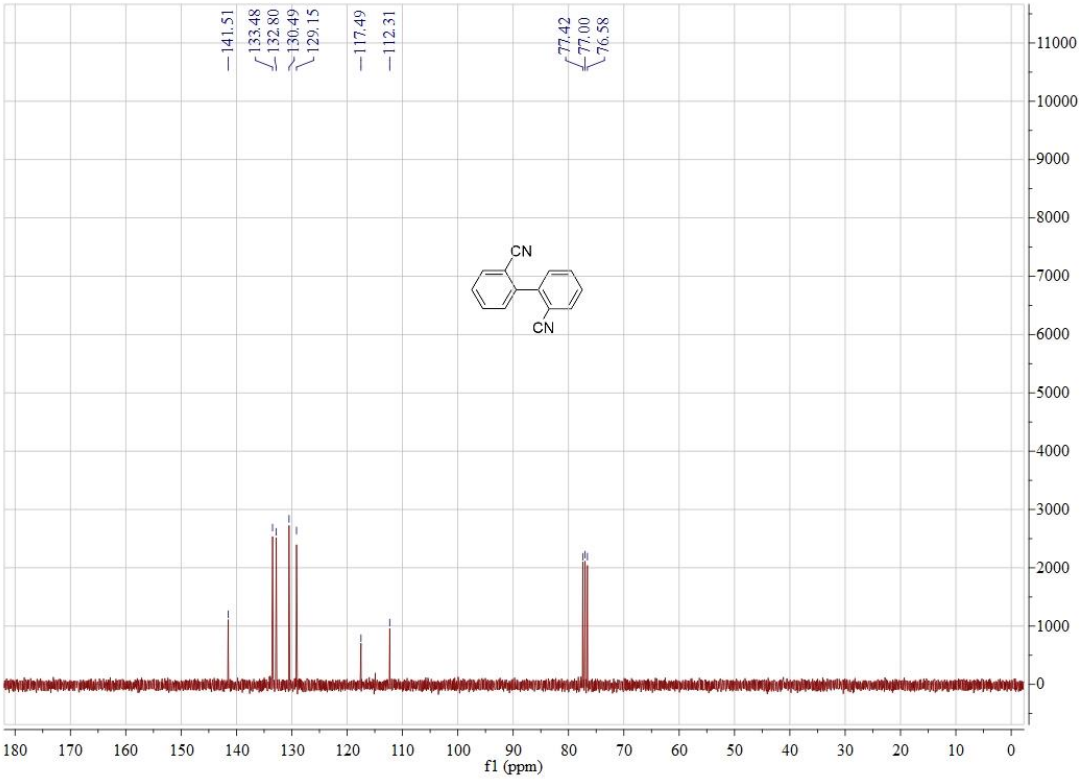

Figure S91. ^{1}H NMR Spectrum of **4i** (300 MHz, $CDCl_3$)

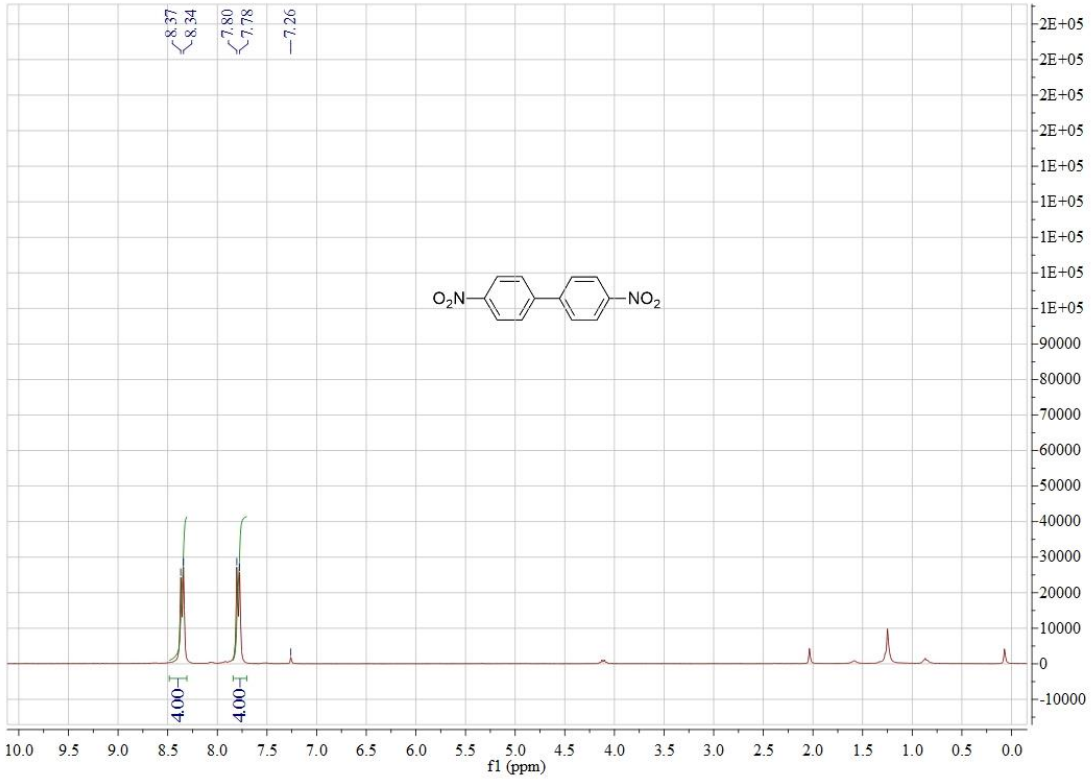

Figure S92. ^{13}C NMR Spectrum of **4i** (75 MHz, $CDCl_3$)

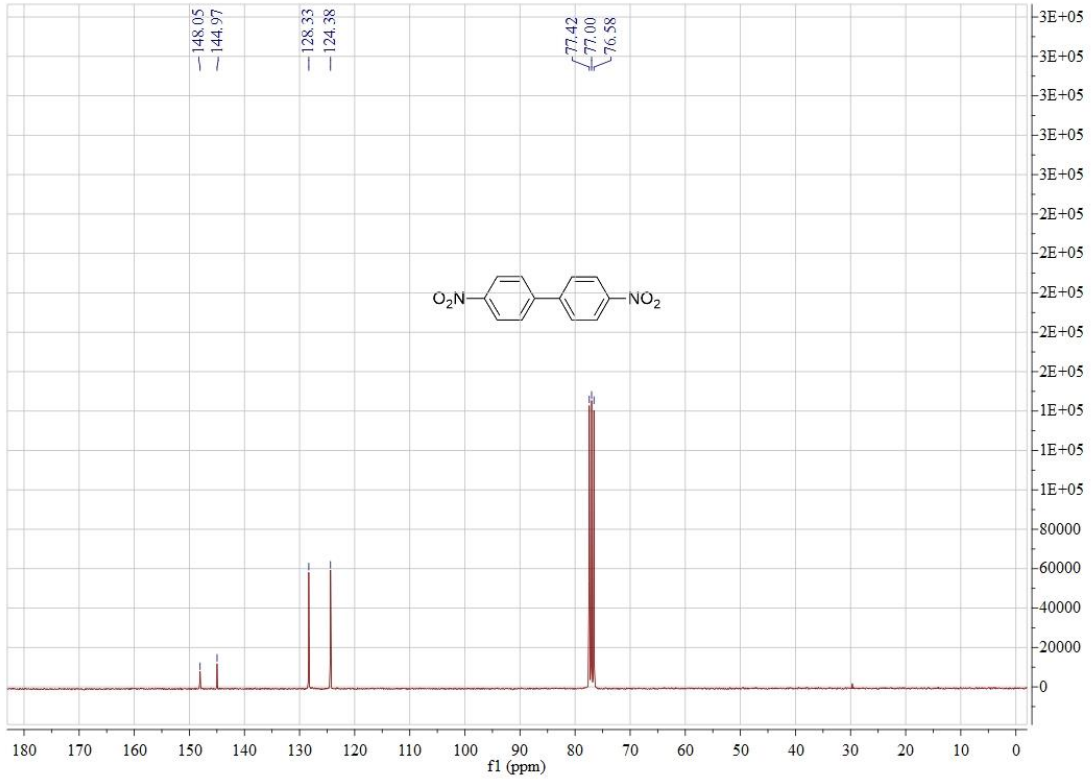

Figure S93. ^{1}H NMR Spectrum of **4j** (300 MHz, $CDCl_3$)

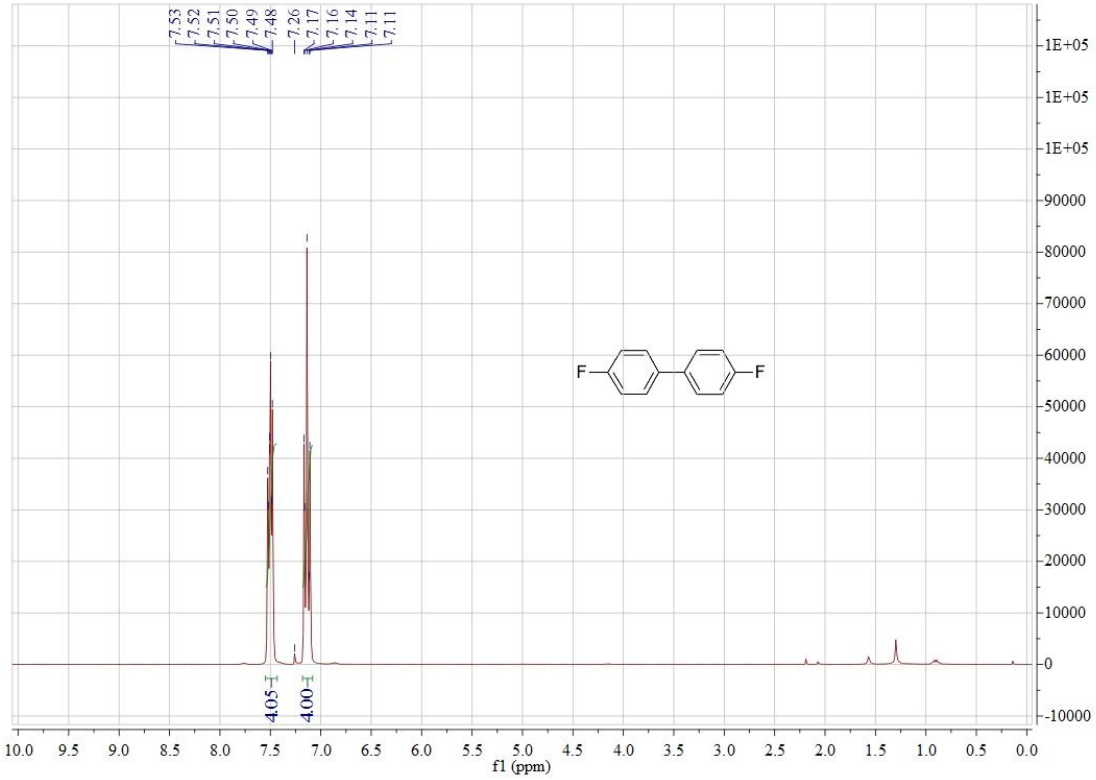

Figure S94. ^{13}C NMR Spectrum of **4j** (75 MHz, $CDCl_3$)

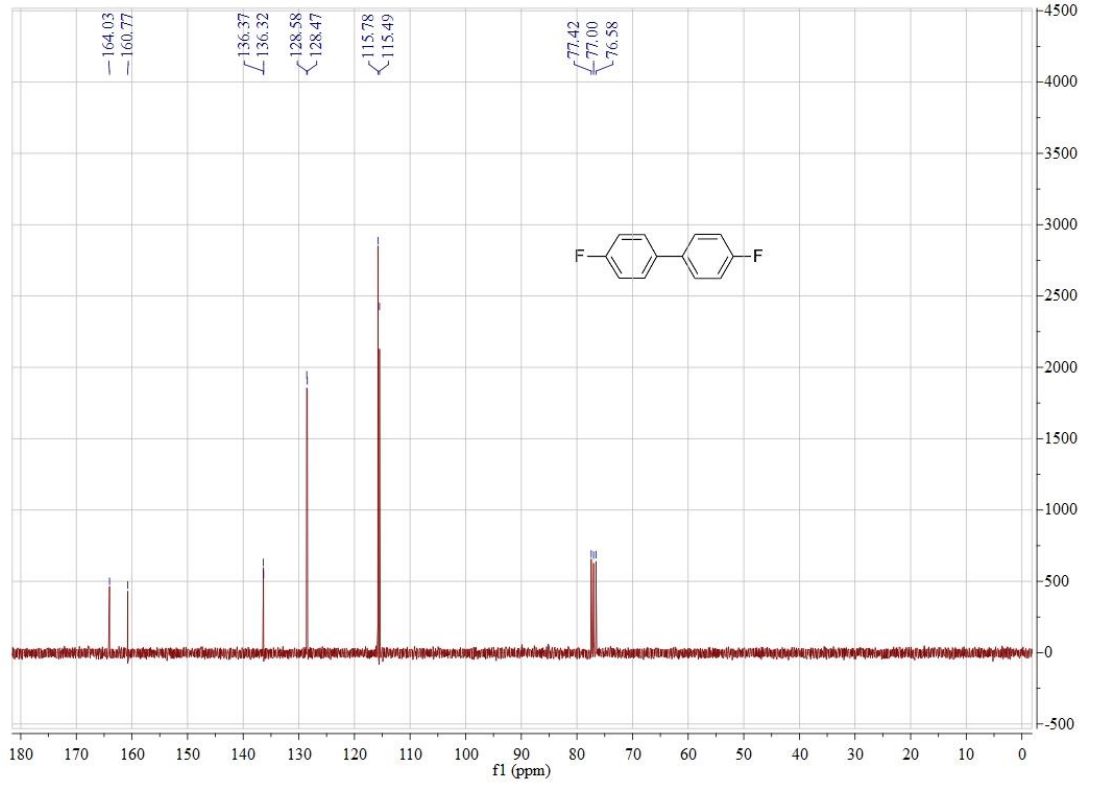

Figure S95. ^{1}H NMR Spectrum of **4k** (300 MHz, $CDCl_3$)

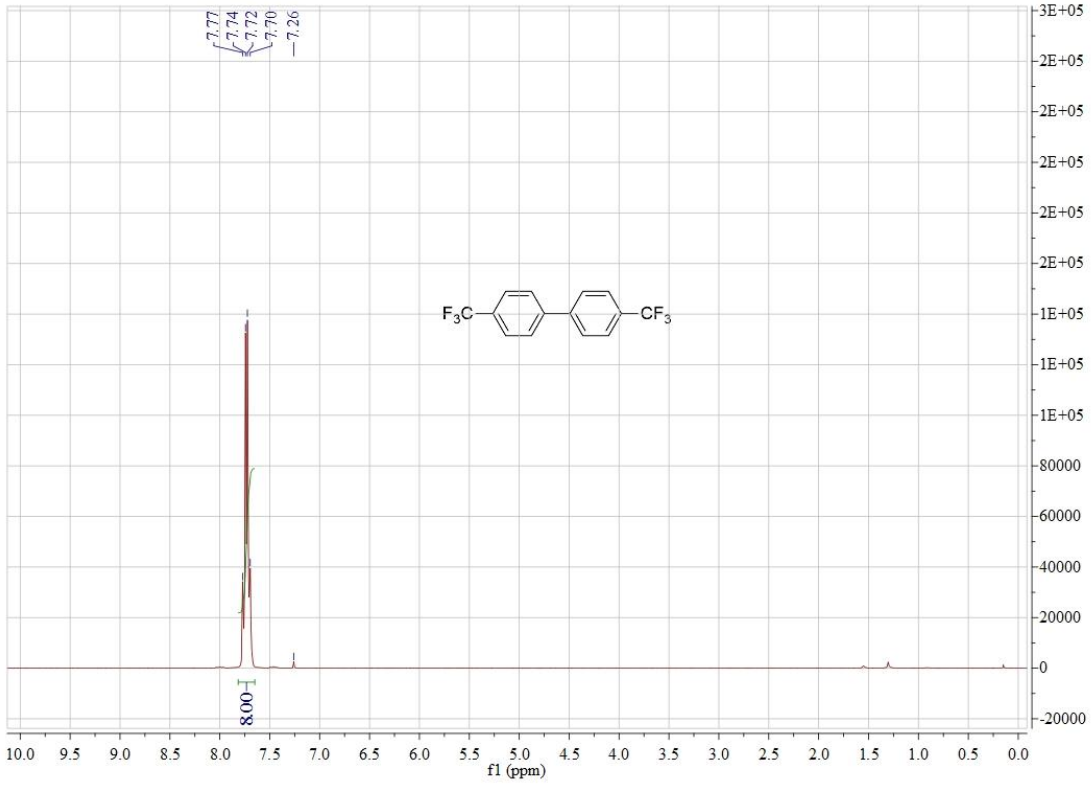

Figure S96. ^{13}C NMR Spectrum of **4k** (75 MHz, $CDCl_3$)

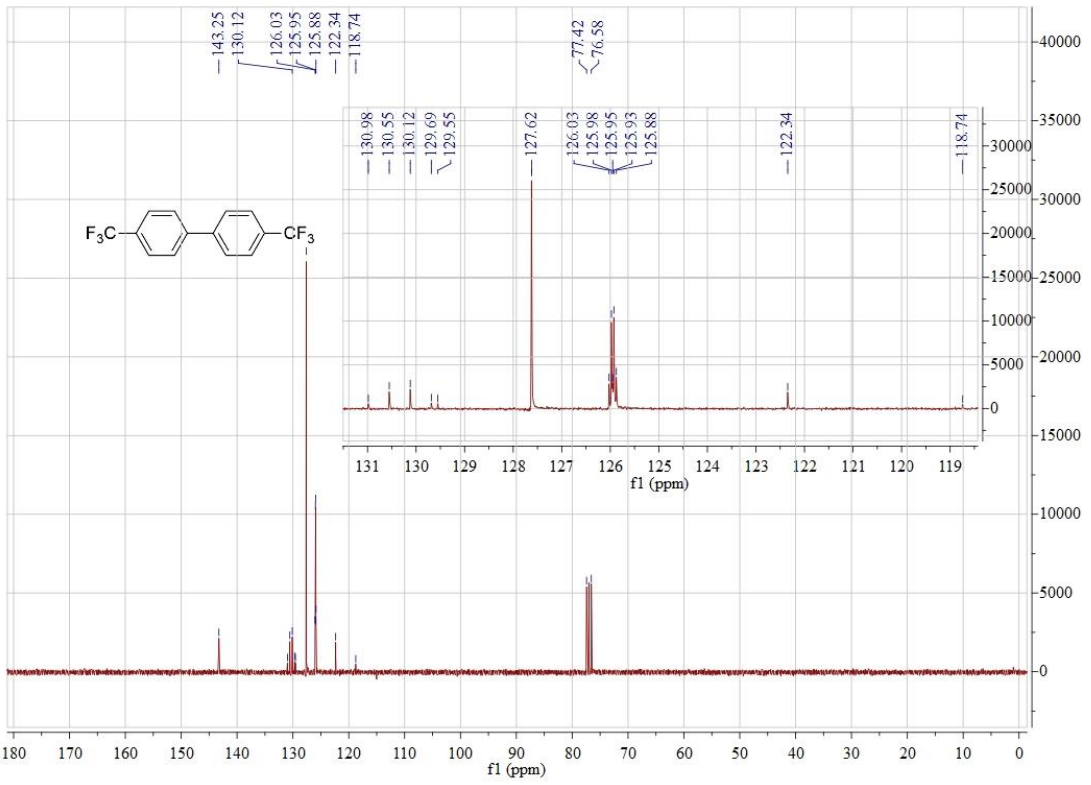

Figure S97. ^{1}H NMR Spectrum of **4l** (300 MHz, $CDCl_3$)

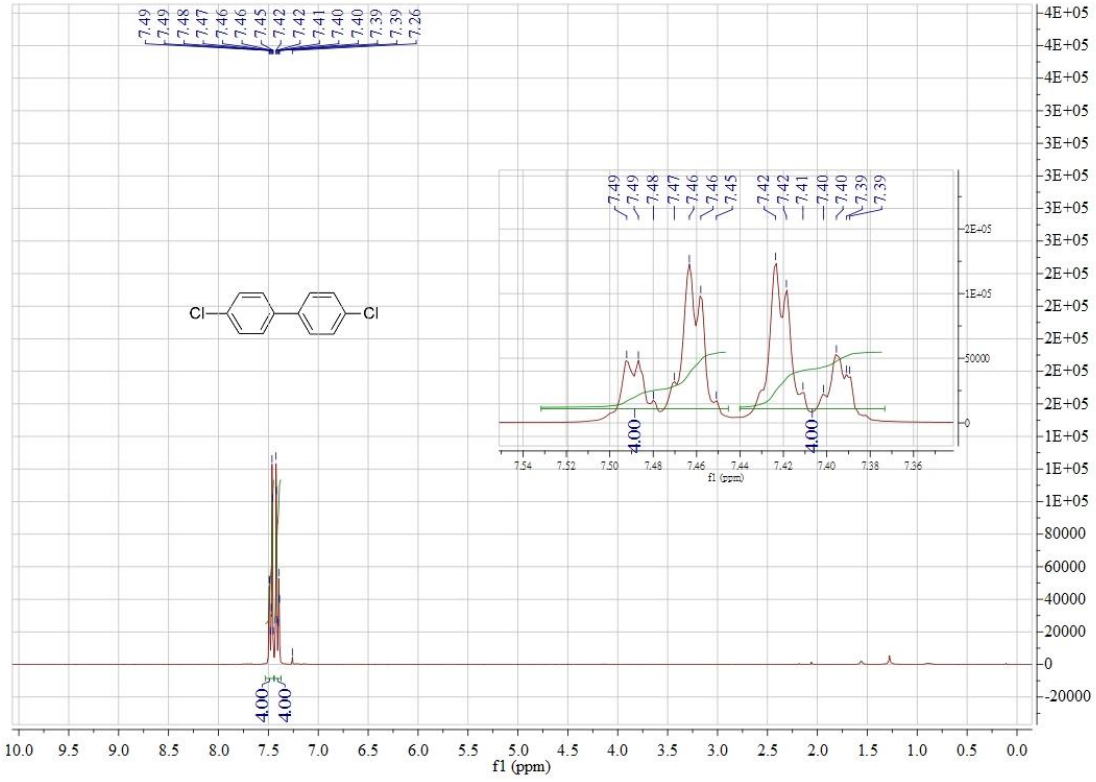

Figure S98. ^{13}C NMR Spectrum of **4l** (75 MHz, $CDCl_3$)

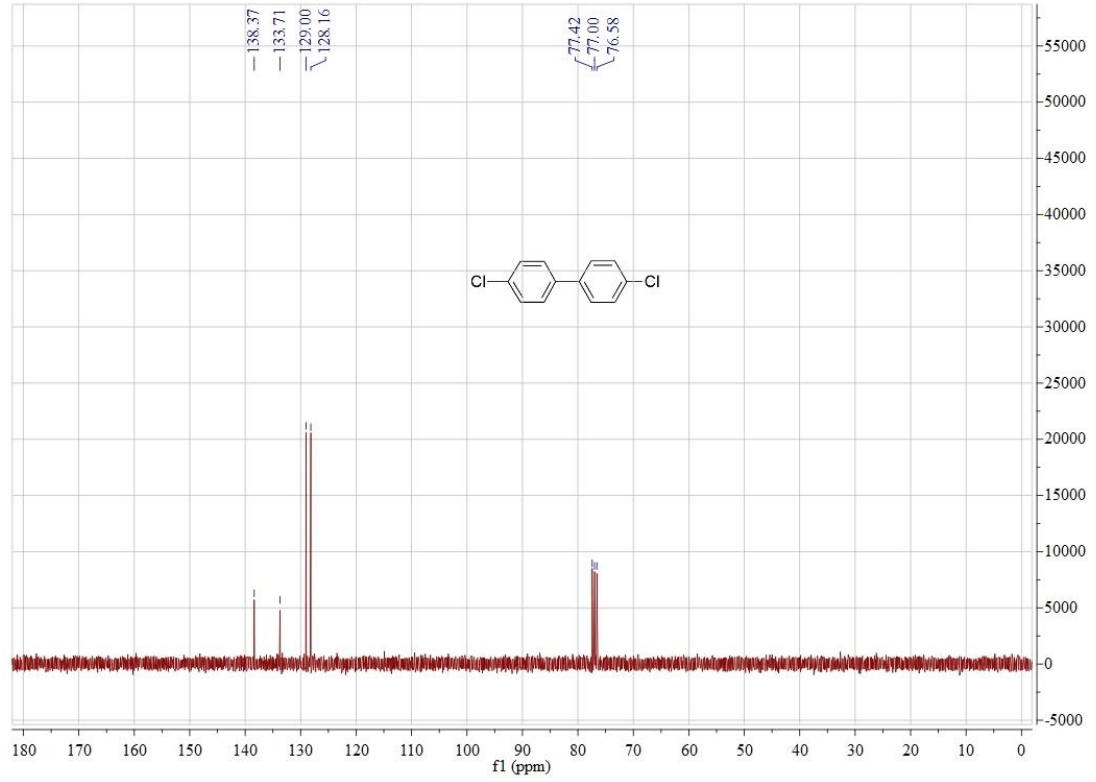

Figure S99. ^{1}H NMR Spectrum of **4m** (300 MHz, $CDCl_3$)

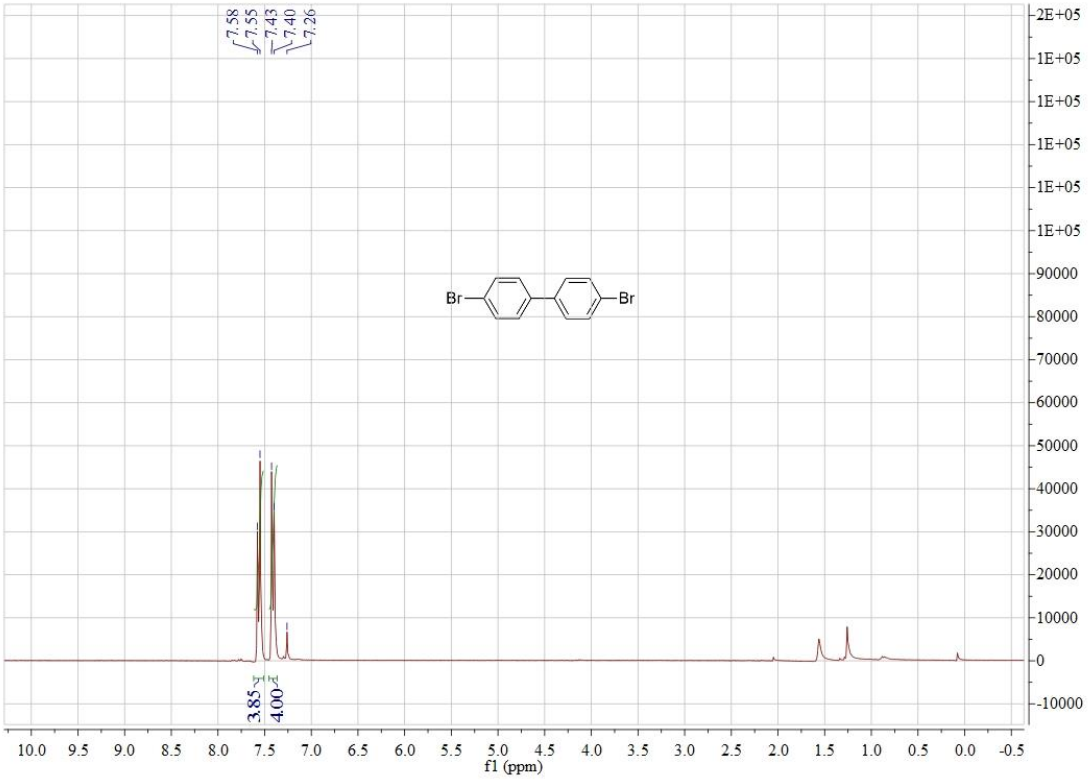

Figure S100. ^{13}C NMR Spectrum of **4m** (75 MHz, $CDCl_3$)