Supporting information

Domino condensation/Heterocyclisation reactions: Iodine catalyzed four component synthesis of 1, 3-thiazine

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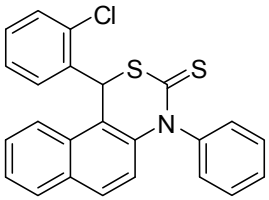
General procedure

All reactions were carried out in oven-dried glassware. Analytical grade solvents and commercially available reagents were purchased from commercial sources and used directly without further purification unless otherwise stated. Thin-layer chromatography (TLC) was carried out on glass silica gel plates which were iodinated by Iodine chamber. ^{1}H-NMR and ^{13}C-NMR spectra were recorded at room temperature using Bruker (^{1}H-NMR at 400MHz and ^{13}C-NMR at 100 MHz). Chemical shifts are reported in ppm with reference to solvent signals [^{1}H-NMR: $CDCl_3$ (7.26ppm); ^{13}C-NMR: $CDCl_3$ (77.16ppm)]. Signal patterns are indicated as s, singlet; d, doublet; t, triplet; q, quartet and m, multiplet. High Resolution Mass (HRMS) analysis was obtained using JEOL GCMATE II GC-MASS SPECTROMETER (Electron impact ionization) and reported as m/z (relative intensity) for the molecular ion [M]. HPLC analysis was carried out with Waters manual injector HPLC system.

Experimental

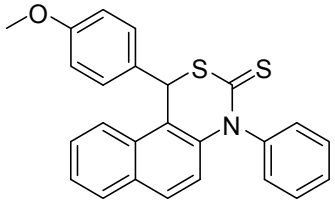
A mixture of 2-chlorobenzadehyde (4mmol) and β-naphthol (4mmol) were mixed in a 50ml two necked round bottom flask containing acetonitrile (7ml) solvent. To this reaction mixture 20mol% Iodine and four granules of 4 A° molecular sieve were added and refluxed. After 10minutes a mixture of CS_2 (4mmol) and aniline (4mmol) in 3ml ethanol and KOH (8mmol) was added in RB flask. The reaction mixture was allowed to reflux for 4h. The completion of the reaction was monitored with TLC. After the completion of the reaction the reaction mixture was quenched with 20% solution of sodium thiosulfate and extracted with ethyl acetate. The combined organic layer was dried over sodium sulfate and concentrated by evaporation and settled white product was dried. Some of the derivatives which are obtained like gels were purified by column chromatography on silica gel (60-120mesh, ethyl acetate/n-hexane).

Characterization data and HPLC data conditions of compounds 4.

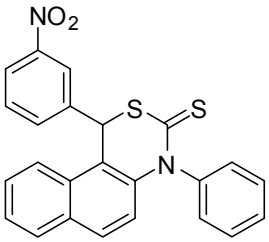


1-(2-chlorophenyl)-4-phenyl-1H-naphtho [2, 1-d][1,3]thiazine-3(4H)-thione (4a). White color powder; Melting point**:** 210-212 ^{0}C; The purity was determined by HPLC analysis using a Symmetry C18 5µ 4.6 x 100mm HPLC column (50/50 Acetonitrile/ water; flow rate: 0.5ml/min; λ = 254nm; tR = 2.5min); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.97-7.95 (d, J= 8Hz, 1H), 7.82-7.77 (t, J= 10 Hz,1H), 7.75-7.73 (d, J=7.2 Hz, 1H), 7.56-7.54 (d, J= 8Hz, 1H), 7.41(m, 2H), 7.41(m, 2H), 7.332 (bs, 3H), 7.295-7.258(t, J= 6.4Hz,1H), 7.122-7.084(t, J=7.6Hz, 1H), 7.050-7.016(t, J= 6.4Hz, 1H), 6.10(s, 1H) 6.05(s, 1H) ^{13}C NMR (100 MHz, $CDCl_3$) δ 160.5, 153.1, 139.6, 137.3, 136.2, 134.3, 133.0, 131.8, 131.4, 130.3, 129.9, 129.6, 129.2, 128.7, 127.6, 127.1, 126.4, 123.6,

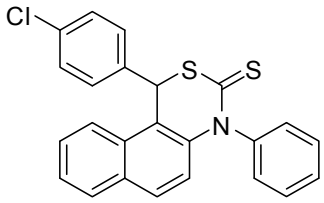
122.9, 121.6, 120.2, 119.1, 113.5, 52.4; EI- MS m/z 417 (M^+); HRMS (EI) calcd for $C_{24}H_{16}ClNS_2$ (M^+) 417.0413, found 417.0415.



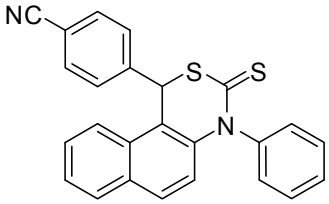
1-(4-methoxyphenyl)-4-phenyl-1H-naphtho [2, 1-d][1,3]thiazine-3(4H)-thione (4b).). White color powder; Melting point**:** 202-204 ^{0}C; The purity was determined by HPLC analysis using a Symmetry C18 5µ 4.6 x 100mm HPLC column (50/50 Acetonitrile/ water; flow rate: 0.5ml/min; λ = 254nm; tR = 7.5min); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.88-7.76 (m, 3H), 7.71-7.69(d, J=8Hz, 1H),7.46 – 7.32(m, 8H),7.189(S, 1H) 7.14-7.12(d, J=8Hz, 2H), 5.36(s, 1H), 1.67(S, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 153.5, 137.1, 134.7, 129.9, 129.7, 129.3, 129.2, 129.0, 127.8, 127.3, 126.6, 126.4, 125.4, 123.6, 117.9, 117.6, 114.4, 109.6, 55.7, 31. EI- MS m/z 413 (M^+); HRMS (EI) calcd for $C_{25}H_{19}NOS_2$ (M^+) 413.0908, found 413.0911.



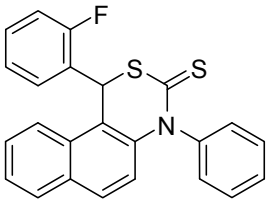
1-(3-nitrophenyl)-4-phenyl-1H-naphtho [2, 1-d][1,3]thiazine-3(4H)-thione (4c). White color powder; Melting point**:** 196-198 ^{0}C; The purity was determined by HPLC analysis using a Symmetry C18 5µ 4.6 x 100mm HPLC column (50/50 Acetonitrile/ water; flow rate: 0.5ml/min; λ = 254nm; tR = 5.0min); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.50 (s, 1H), 8.33 (s, 1H), 8.23- 8.21 (d, J= 8Hz, 1H), 8.18-8.16 (d, J=8Hz, 1H),7.94-7.92(d, J=8Hz, 1H) 7.87- 7.83(t, J= 9.2Hz, 2H), 7.67- 7.66(d, J= 6.4Hz, 1H), 7.60- 7.56(t, J= 7.6Hz, 1H), 7.52- 7.48(t, J= 7.6Hz, 1H), 7.36- 7.35 (d, J= 5.6Hz , 2H), 7.31- 7.29 (d, J= 8Hz, 1H), 7.26 (s,1H), 5.75(s, 1H), 5.66-5.63(d, J=8Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 152.2, 148.7, 148.4, 144.6, 140.6, 135.6, 132.7, 131.3, 130.4, 129.5, 129.3, 129.0, 127.3, 124.3, 124.1, 123.7, 123.0, 122.4, 121.5, 119.3, 112.9, 81.0, 53.5; EI- MS m/z 428 (M^+); HRMS (EI) calcd for $C_{24}H_{16}N_2O_2S_2$ (M^+) 428.0653, found 428.0650.



1-(4-chlorophenyl)-4-phenyl-1H-naphtho [2, 1-d][1,3]thiazine-3(4H)-thione (4d). White color powder; Melting point**:** 215-217 ^{0}C; The purity was determined by HPLC analysis using a Symmetry C18 5µ 4.6 x 100mm HPLC column (50/50 Acetonitrile/ water; flow rate: 0.5ml/min; λ = 254nm; tR = 4.0min); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.81-7.78(m, 2H), 7.78(s, 1H), 7.52-7.50(d, J=8Hz, 2H) 7.36(bs, 1H), 7.34-7.34(d, J= 2Hz, 2H), 7.29(bs, 3H), 7.27(s,1H)7.23-7.21(d,J=8Hz, 2H), 5.61(s, 1H), 5.59(s, 1H) ^{13}C NMR (100 MHz, CDCl3) δ 152.4, 141.2, 137.5, 134.5, 133.4, 131.6, 130.8, 130.1, 129.7, 129.2, 129.0, 128.9, 128.7, 128.6, 127.7, 126.9, 123.7, 122.8, 119.3, 114.0, 81.8, 53.5; EI- MS m/z 417 (M^+); HRMS (EI) calcd for $C_{24}H_{16}ClNS_2$ (M^+) 417.0413, found 417.0416.

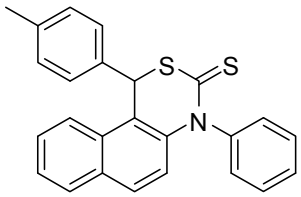


1-(4-cyanophenyl)-4-phenyl-1H-naphtho [2, 1-d][1,3]thiazine-3(4H)-thione (4e). White color powder; Melting point**:** 212-214 ^{0}C; The purity was determined by HPLC analysis using a Symmetry C18 5µ 4.6 x 100mm HPLC column (50/50 Acetonitrile/ water; flow rate: 0.5ml/min; 254nm; tR =7.5 min); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.86-7.84(d, J= 8Hz,2H), 7.74-7.71(m,3H), 7.65-7.63(d, 2H), 7.52-7.50(d, J= 8Hz, 1H), 7.39-7.36(m, 4H), 7.28-7.27(d, J= 2Hz, 2H), 5.70(s, 1H), 5.58 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 152.0, 147.5, 143.4, 132.9, 132.8, 132.3, 132.2, 131.3, 130.1, 129.1, 129.0, 128.8, 127.2, 127.0, 123.9, 122.4, 119.1, 118.6, 112.9, 112.5, 111.6, 81.4, 53.6 ; EI- MS m/z 408 (M^+); HRMS (EI) calcd for $C_{25}H_{16}N_2S_2$ (M^+) 408.0755, found 408.0757.

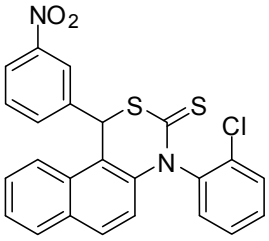


1-(2-fluorophenyl)-4-phenyl-1H-naphtho [2, 1-d][1,3]thiazine-3(4H)-thione (4f). White color powder; Melting point**:** 206-208 ^{0}C; The purity was determined by HPLC analysis using a Symmetry C18 5µ 4.6 x 100mm HPLC column (50/50 Acetonitrile/ water; flow rate: 0.5ml/min;

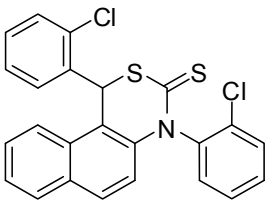
λ = 254nm; tR = 3.9 min); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.93-7.91(d, J=5.6Hz,1H), 7.81(bs, 2H), 7.60-7.59(d, J=5.6Hz, 1H), 7.36-7.35(d, J=4.8Hz, 4H), 7.26-7.22(t, J=5.6Hz, 3H) 7.0(bs, 2H), 6.92-6.91(d, J=4.4Hz, 1H), 6.09-6.03(dd, J=4.8Hz, J=16.8Hz,1H) ^{13}C NMR (100 MHz, $CDCl_3$) δ 157.3, 153.1, 131.3, 130.6, 130.0, 129.9, 129.6, 129.2, 128.9, 128.7, 128.1, 127.0, 126.9, 124.4, 123.6, 122.7, 119.2, 116.1, 115.9, 115.8, 112.8, 78.9, 48.7; EI- MS m/z 401 (M^+); HRMS (EI) calcd for $C_{24}H_{16}FNS_2$ (M^+) 401.0708, found 401.0706.



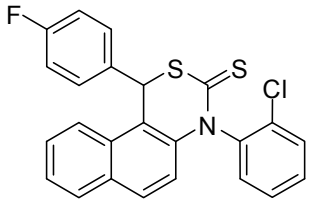
1-(4-methylphenyl)-4-phenyl-1H-naphtho [2, 1-d][1,3]thiazine-3(4H)-thione (4g). White color powder; Melting point**:** 192-194 ^{0}C; The purity was determined by HPLC analysis using a Symmetry C18 5µ 4.6 x 100mm HPLC column (50/50 Acetonitrile/ water; flow rate: 0.5ml/min; λ = 254nm; tR = 3.9min); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.88-7.87(d, J=6Hz, 1H), 7.81-7.79(d, J=8.8Hz, 2H), 7.70(s, 1H), 7.46(s, 2H), 7.33-7.23(m, 5H), 7.13(bs, 2H), 6.43(s, 1H), 5.71(s,1H), 5.66(s, 1H) 2.42-2.31(bs,3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.7, 155.5, 152.6, 142.7, 140.0, 138.5, 137.5, 137.0, 136.4, 132.0, 131.8, 129.9, 129.2, 128.9, 127.8, 126.7, 123.7, 122.9, 122.7, 120.4, 119.5,116.5, 116.4, 114.7, 54.0, 21.3. EI- MS m/z 397 (M^+); HRMS (EI) calcd for $C_{25}H_{19}NS_2$ (M^+) 397.0959, found 397.0956.



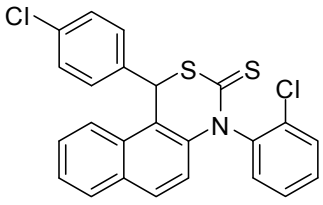
4-(2-chlorophenyl)-1-(3-nitrophenyl)-1H-naphtho[2, 1-d][1,3]thiazine-3(4H)-thione (4h). White color powder; Melting point**:** 223-225 ^{0}C; The purity was determined by HPLC analysis using a Symmetry C18 5µ 4.6 x 100mm HPLC column (50/50 Acetonitrile/ water; flow rate: 0.5ml/min; λ = 254nm; tR = 5.9min); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.50 (bs, 1H), 8.33(bs, 1H), 8.22-8.17(m, 1H), 7.93-7.85(m, 3H), 7.66 -7.50(m,3H), 7.36-7.29(m, 4H), 5.75(s, 1H), 5.64(s,1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 152.1, 148.6, 148.3, 144.5, 140.5, 135.4, 132.6, 131.2, 130.3, 129.4, 129.2, 128.9, 127.2, 124.2, 123.6, 123.4, 122.8, 122.3, 121.4, 119.2, 112.8, 80.9, 53.4. EI- MS m/z 462 (M^+); HRMS (EI) calcd for $C_{24}H_{15}ClNO_2S_2$ (M^+) 462.0263, found 462.0263.



4-(2-chlorophenyl)-1-(2-chlorophenyl)-1H-naphtho[2, 1-d][1,3]thiazine-3(4H)-thione(4i). White color powder; Melting point**:** 220-222 ^{0}C; The purity was determined by HPLC analysis using a Symmetry C18 5µ 4.6 x 100mm HPLC column (50/50 Acetonitrile/ water; flow rate: 0.5ml/min; λ = 254nm; tR = 2.6min); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.93(bs, 1H), 7.78(m, 4H), 7.53(s, 1H), 7.40-7.31(m, 5H), 7.08(bs, 1H), 7.01(bs, 1H), 6.08(s, 1H), 6.03(s,1H) ^{13}C NMR (100 MHz, $CDCl_3$) δ 153.1, 139.5, 136.2, 132.9, 131.3, 130.3, 130.1, 129.9, 129.6, 129.2, 129.1, 128.7, 127.6, 127.1, 126.9, 126.4, 123.6, 122.9, 119.1, 113.5 EI- MS m/z 451 (M^+); HRMS (EI) calcd for $C_{24}H_{15}Cl_2NS_2$ (M^+) 451. 0023, found 451.0026.

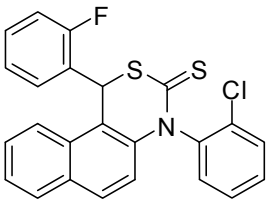


4-(2-chlorophenyl)-1-(4-fluorophenyl)-1H-naphtho[2, 1-d][1,3]thiazine-3(4H)-thione (4j). White color powder; Melting point**:** 215-217 ^{0}C; The purity was determined by HPLC analysis using a Symmetry C18 5µ 4.6 x 100mm HPLC column (50/50 Acetonitrile/ water; flow rate: 0.5ml/min; λ = 254nm; tR = 3.9min); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.88(bs, 1H), 7.78-7.77(d, J= 4Hz, 2H), 7.56(bs, 1H), 7.31-7.19(m,5H), 7.12-7.10(d, J= 7.6Hz, 1H), 7.07-7.02(t, J= 10.8, 1H), 6.96(s, 1H), 6.87(s, 1H), 6.04(s, 1H), 5.99(s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 153.1, 133.9, 131.6, 130.6, 129.6, 129.7, 128.9, 128.1, 127.0, 126.4, 125.9, 124.9, 124.4, 123.7, 122.7, 121.3, 120.3, 119.2, 116.4, 115.9, 114.7, 112.8, 78.9, 48.7; EI- MS m/z 435 (M^+); HRMS (EI) calcd for $C_{24}H_{15}ClFNS_2$ (M^+) 435.0318, found 435.0319.

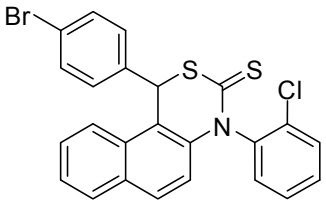


4-(2-chlorophenyl)-1-(4-chlorophenyl)-1H-naphtho[2, 1-d][1,3]thiazine-3(4H)-thione (4k). White color powder; Melting point**:** 225-227 ^{0}C; The purity was determined by HPLC analysis using a Symmetry C18 5µ 4.6 x 100mm HPLC column (50/50 Acetonitrile/ water; flow rate:

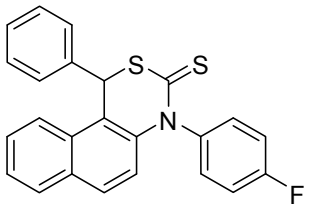
0.5ml/min; λ = 254nm; tR = 5.1min); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.88(bs, 1H), 7.78(bs, 1H), 7.56(bs, 1H), 7.46-7.40(m,1H) 7.32(bs, 2H), 7.26-7.20(m,4H), 7.05-7.0(t, J=10.8Hz, 1H), 6.96(bs, 1H), 6.88(bs, 1H), 6.04(s, 1H)-6.00(s 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.1, 159.5, 157.2, 156.0, 153.0, 131.5, 131.2, 130.5, 129.8, 129.7, 129.1, 128.8, 128.0, 127.9, 126.9, 125.8, 122.9, 121.2, 120.2, 119.4, 115.9, 112.7, 48.6; ; EI- MS m/z 417 (M^+); HRMS (EI) calcd for $C_{24}H_{15}Cl_2NS_2$ (M^+) 417.0413, found 417.0415.



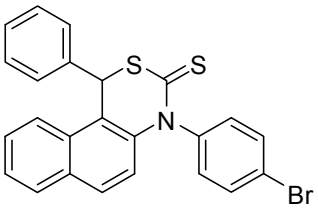
4-(2-chlorophenyl)-1-(4-chlorophenyl)-1H-naphtho[2, 1-d][1,3]thiazine-3(4H)-thione (4l). White color powder; Melting point**:** 206-208 ^{0}C; The purity was determined by HPLC analysis using a Symmetry C18 5µ 4.6 x 100mm HPLC column (50/50 Acetonitrile/ water; flow rate: 0.5ml/min; λ = 254nm; tR = 3.8min); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.90- 7.86(t, J= 7.6Hz, 1H), 7.79-7.78(d, J= 2.8Hz,1H), 7.77(bs, 1H), 7.58-7.54(t, J= 14.8Hz, 1H), 7.34-7.31(t, J= 6.8Hz, 5H), 7.21(s, 1H), 7.19(s, 1H), 7.17(s, 1H), 6.97-6.96(t, J= 2.4Hz, 1H), 6.05(s, 1H), 6.0(s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 153.2, 134.0, 133.9, 131.4, 130.6, 130.0, 129.9, 129.0, 128.7, 128.1, 127.5, 126.0, 125.1, 124.8, 123.8, 122.7, 121.4, 119.5, 116.3, 116.0, 114.8, 79.0, 48.8 EI- MS m/z 435 (M^+); HRMS (EI) calcd for $C_{24}H_{15}ClFNS_2$ (M^+) 435.0318, found 435.0317.



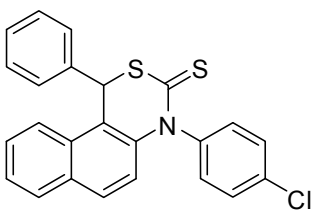
4-(2-chlorophenyl)-1-(4-bromophenyl)-1H-naphtho[2, 1-d][1,3]thiazine-3(4H)-thione (4m). White color powder; Melting point**:** 219-220 ^{0}C; The purity was determined by HPLC analysis using a Symmetry C18 5µ 4.6 x 100mm HPLC column (50/50 Acetonitrile/ water; flow rate: 0.5ml/min; λ = 254nm; tR = 3.8min); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.81-7.78(m, 2H), 7.52-7.51(d, J= 2.8Hz, 1H), 7.50(s, 1H), 7.45- 7.42(m, 3H), 7.33-7.32(m, 3H), 7.25- 7.21(m, 3H), 5.58(s, 1H), 5.57(s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 161.3, 152.2, 141.6, 137.9, 132.3, 132.0, 131.5, 131.4, 131.1, 130.2, 129.8, 129.6, 129.2, 128.9, 128.0, 127.9, 126.8, 123.6, 122.7, 122.6, 121.5, 119.2, 113.7, 81.7, 53.4; 5 EI- MS m/z 494 (M^+); HRMS (EI) calcd for $C_{24}H_{15}BrClNS_2$ (M^+) 494.9518, found 494.9517.



4-(4-flurophenyl)-1-phenyl-1H-naphtho[2, 1-d][1,3]thiazine-3(4H)-thione (4n). White color powder; Melting point**:** 202-205 ^{0}C; The purity was determined by HPLC analysis using a Symmetry C18 5µ 4.6 x 100mm HPLC column (50/50 Acetonitrile/ water; flow rate: 0.5ml/min; λ = 254nm; tR = 2.5min); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.80(s, 1H), 7.68(s, 1H), 7.64-7.62(d, J=8Hz, 1H), 7.64-7.62(d, J=8Hz, 2H), 7.58-7.56 (d, J=8Hz, 2H), 7.49-7.47 (d, J=8Hz, 2H), 7.35-7.33 (m, 3H), 7.23-(s, 1H), 7.10(bs, 1H), 5.66(s, 1H), 5.61(s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 153.4, 152.2, 146.3, 142.5, 131.4, 129.8, 129.7, 128.7, 127.7, 127.0, 126.6, 126.5, 126.3, 123.7, 122.6, 119.2, 117.7, 113.5, 109.4, 81.7, 53.6; EI- MS m/z 401 (M^+); HRMS (EI) calcd for $C_{24}H_{16}FNS_2$ (M^+) 401.0708, found 401.0711.

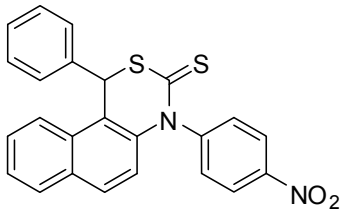


4-(4-bromophenyl)-1-phenyl-1H-naphtho[2, 1-d][1,3]thiazine-3(4H)-thione (4o). White color powder; Melting point**:** 214-216 ^{0}C; The purity was determined by HPLC analysis using a Symmetry C18 5µ 4.6 x 100mm HPLC column (50/50 Acetonitrile/ water; flow rate: 0.5ml/min; λ = 254nm; tR = 3.7min); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.84-7.82(d, J=8Hz, 2H), 7.72-7.66(q, J=8Hz, 4H), 7.62-7.60(d, J=8Hz, 2H), 7.50-7.48(d, J=8Hz, 2H), 7.36-7.35(m, 2H), 7.26-7.50(d, J=4Hz, 2H), 5.67(s, 1H), 5.56(s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 152.0, 147.5, 143.4, 132.3, 132.2, 131.3, 130.1, 129.1, 128.8, 127.2, 127.0, 123.9, 122.4, 119.1, 118.6, 118.5, 113.0, 112.5, 111.6, 81.4, 53.6; EI- MS m/z 460 (M^+); HRMS (EI) calcd for $C_{24}H_{16}BrNS_2$ (M^+) 460.9908, found 460.9904.



4-(4-chlorophenyl)-1-phenyl-1H-naphtho[2, 1-d][1,3]thiazine-3(4H)-thione (4p). White color powder; Melting point**:** 210-212 ^{0}C; The purity was determined by HPLC analysis using a Symmetry C18 5µ 4.6 x 100mm HPLC column (50/50 Acetonitrile/ water; flow rate: 0.5ml/min; λ = 254nm; tR = 5.1min); ^{1}H NMR (400 MHz, $CDCl_3$) δ 7.78-7.76(m, 3H), 7.56-7.55(d, J=4Hz,

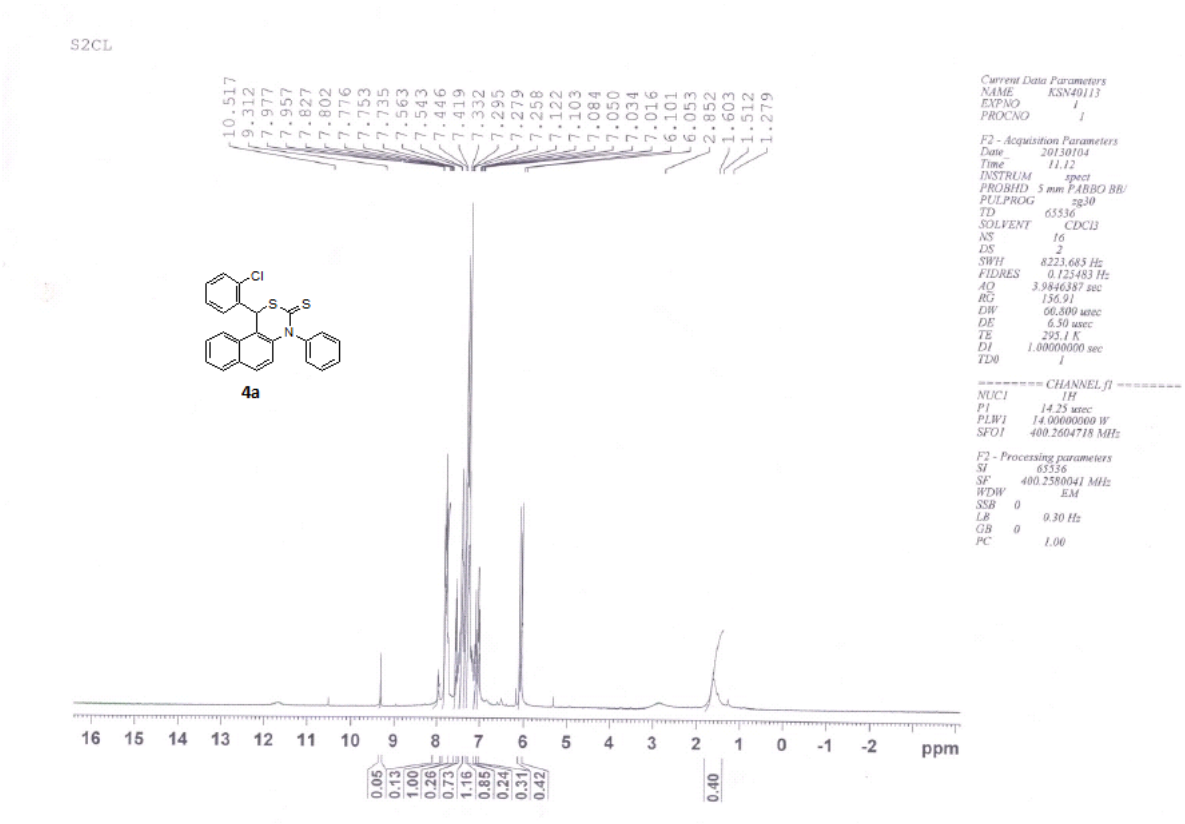
1H), 7.39-7.36 (m, 4H), 7.32- 7.28 (m, 4H), 7.26- 7.22 (q, J=8Hz, 2H), 5.69 (s, 1H), 5.66(s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 162.0, 152.5, 142.7, 139.1, 132.0, 131.7, 129.3, 129.2, 128.9, 128.5, 128.4, 128.3, 127.5, 127.3, 126.6, 126.3, 122.9, 121.5, 119.3, 114.4, 82.4, 54.1; EI- MS m/z 417 (M^+); HRMS (EI) calcd for $C_{24}H_{16}ClNS_2$ (M^+) 417.0413, found 417.0416.



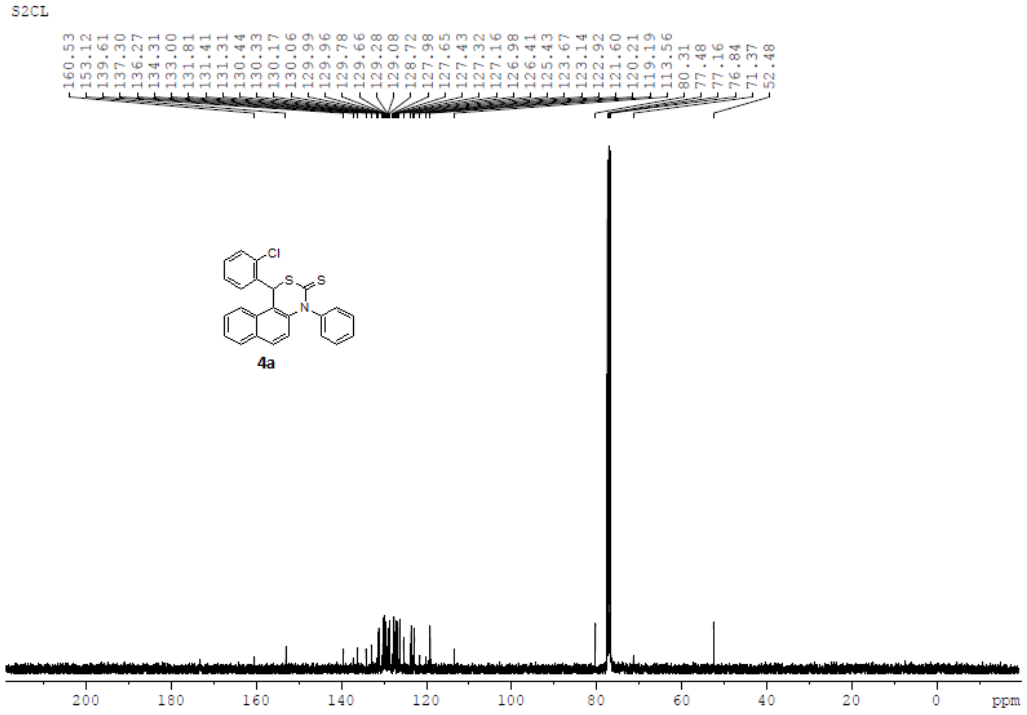
4-(4-chlorophenyl)-1-phenyl-1H-naphtho[2, 1-d][1,3]thiazine-3(4H)-thione (4q). White color powder; Melting point**:** 218-220 ^{0}C; The purity was determined by HPLC analysis using a Symmetry C18 5µ 4.6 x 100mm HPLC column (50/50 Acetonitrile/ water; flow rate: 0.5ml/min; λ = 254nm; tR = 9.1min); ^{1}H NMR (400 MHz, $CDCl_3$) δ 8.26-8.24(d, J=8Hz, 2H), 8.20-8.18(d, J=8Hz, 2H), 7.87-7.77(m, 2H), 7.80(s, 1H), 7.77(s, 1H), 7.58-7.56(d, J=8Hz, 2H), 7.38-7.36(d, J=8Hz, 2H), 7.29-7.27(d, J=8Hz, 2H), 5.74(s, 1H), 5.62(s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 159.8, 152.0, 149.3, 148.1, 147.4, 145.2, 131.2, 130.3, 130.2, 129.5, 129.1, 128.9, 127.3, 127.2, 124.0, 123.7, 123.5, 122.3, 119.1, 112.9, 81.3, 53.4; EI- MS m/z 428 (M^+); HRMS (EI) calcd for $C_{24}H_{16}N_2S_2O_2$ (M^+) 428.0653, found 428.0650.

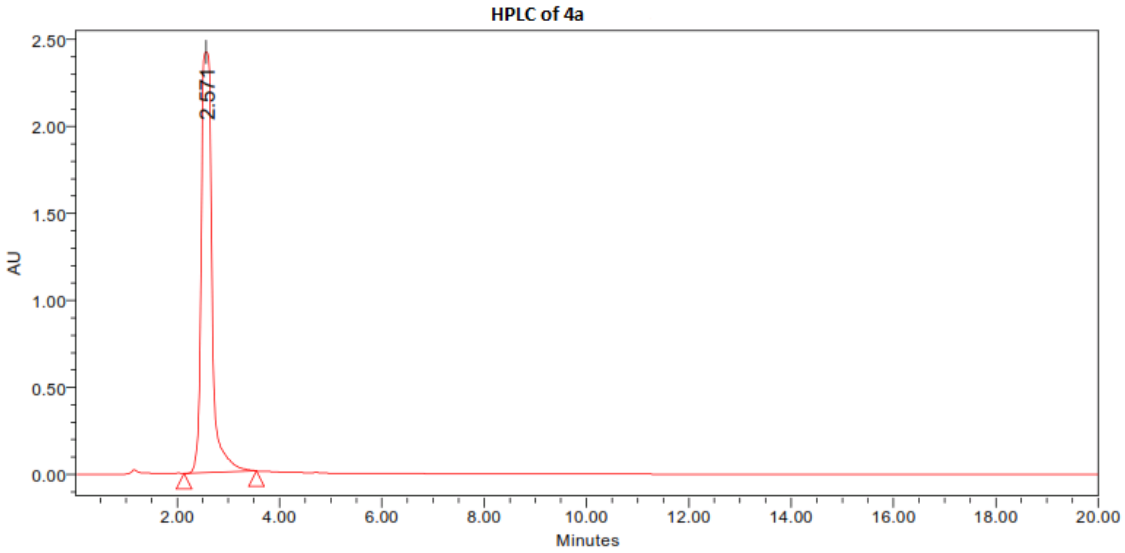
NMR spectra

^{1}HNMR of compound (4a):



^{13}C NMR of compound (4a):





Peak Results

	Name	RT	% Area	Area
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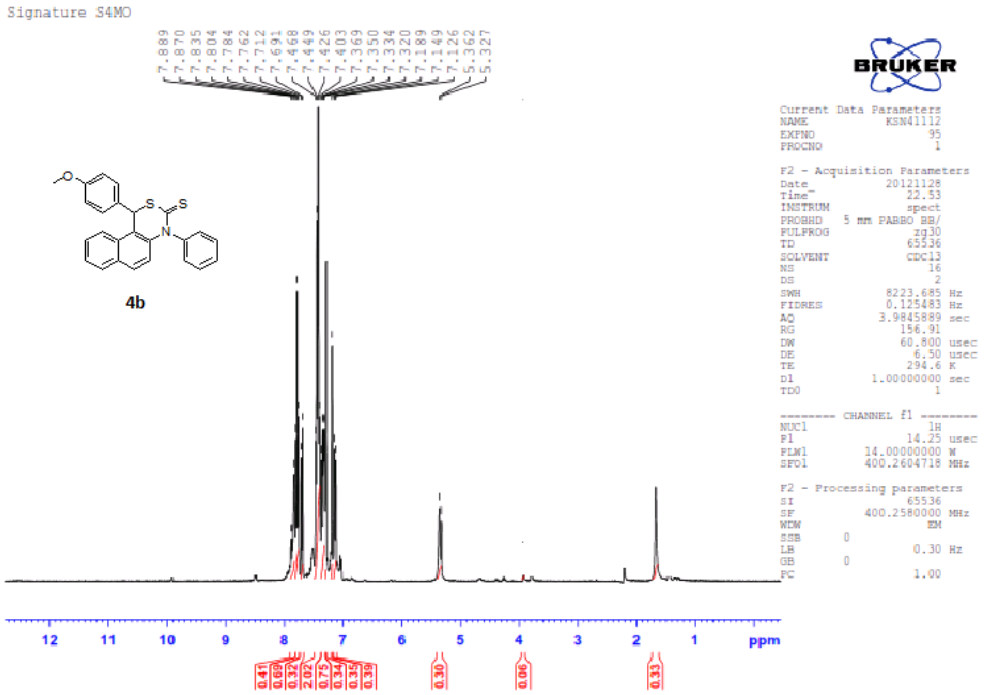
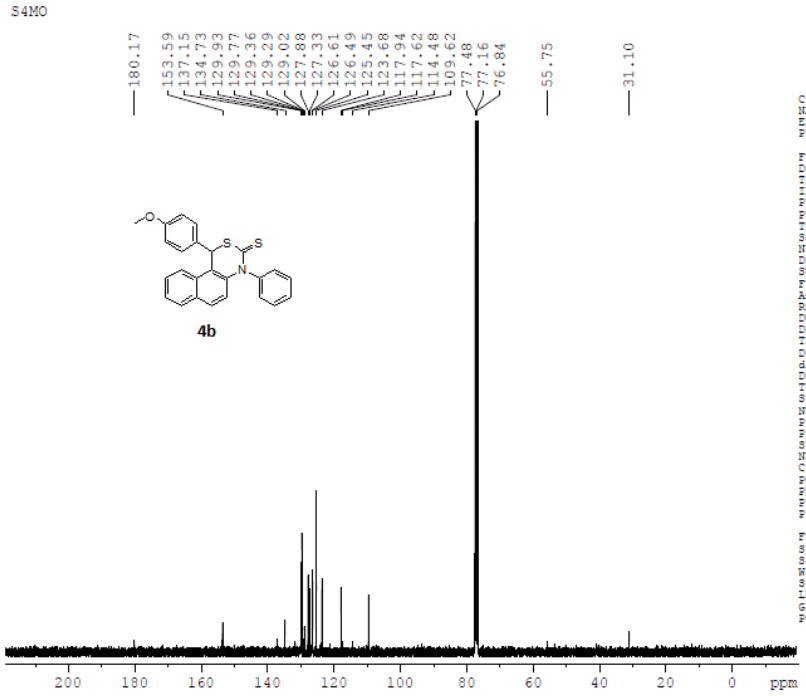
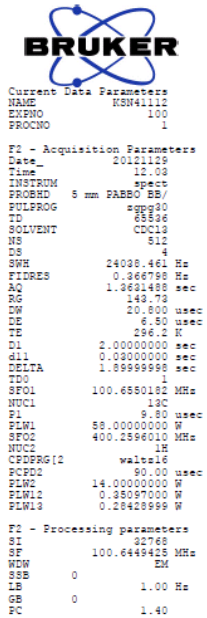
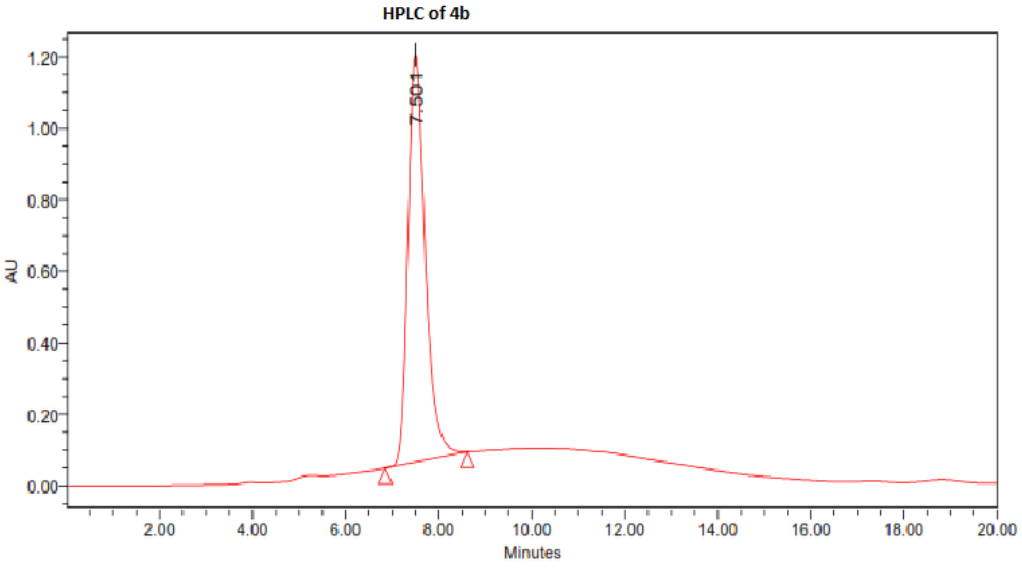
^{1}HNMR of compound (4b):



^{13}C NMR of compound (4b):



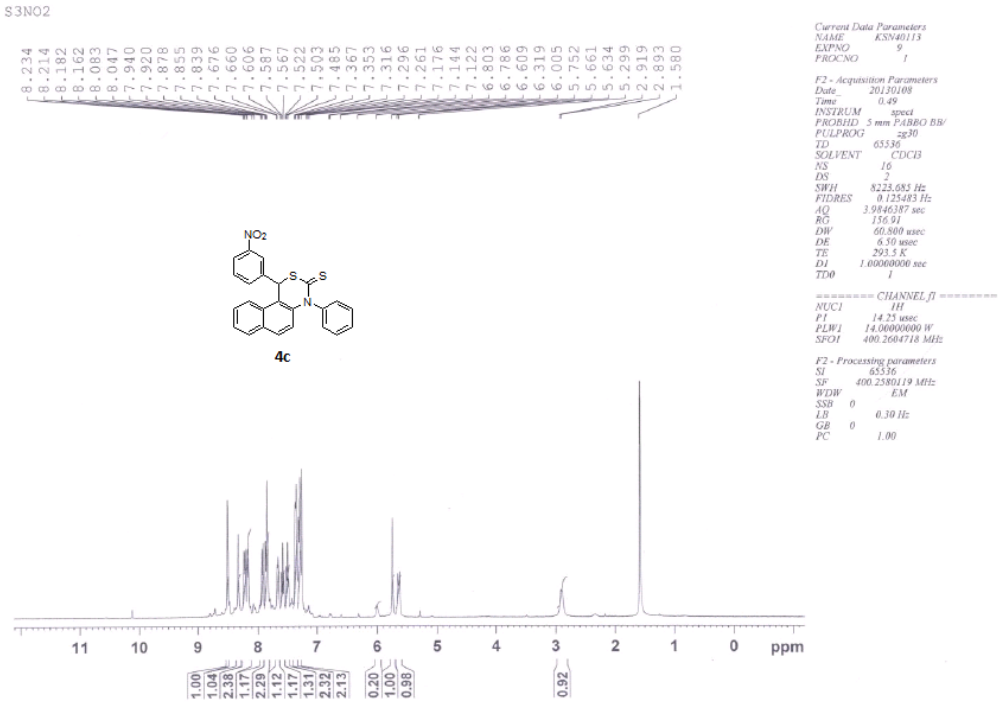




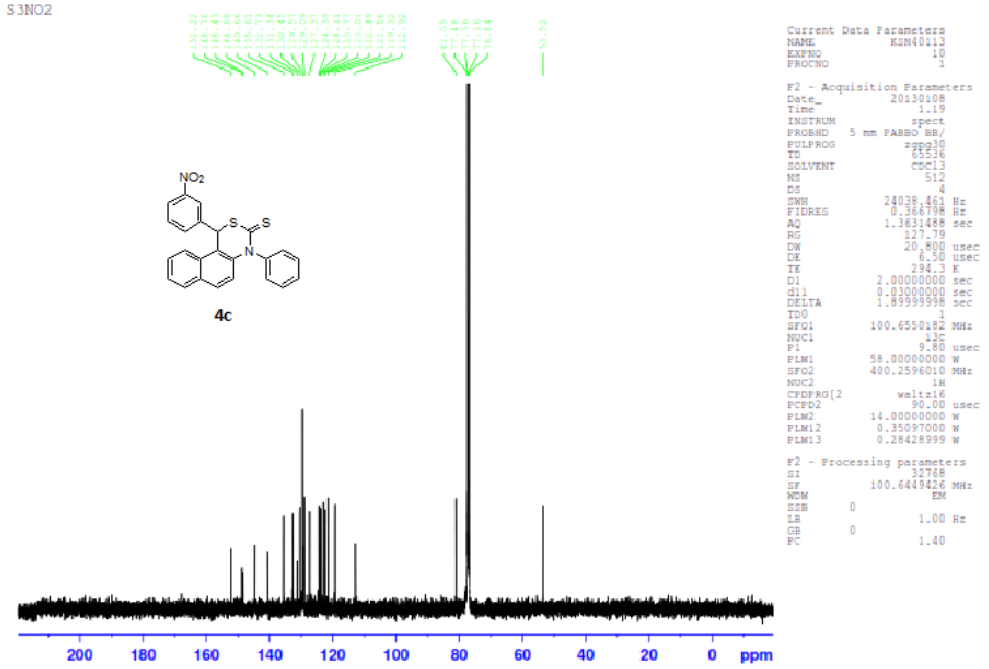
Peak Results

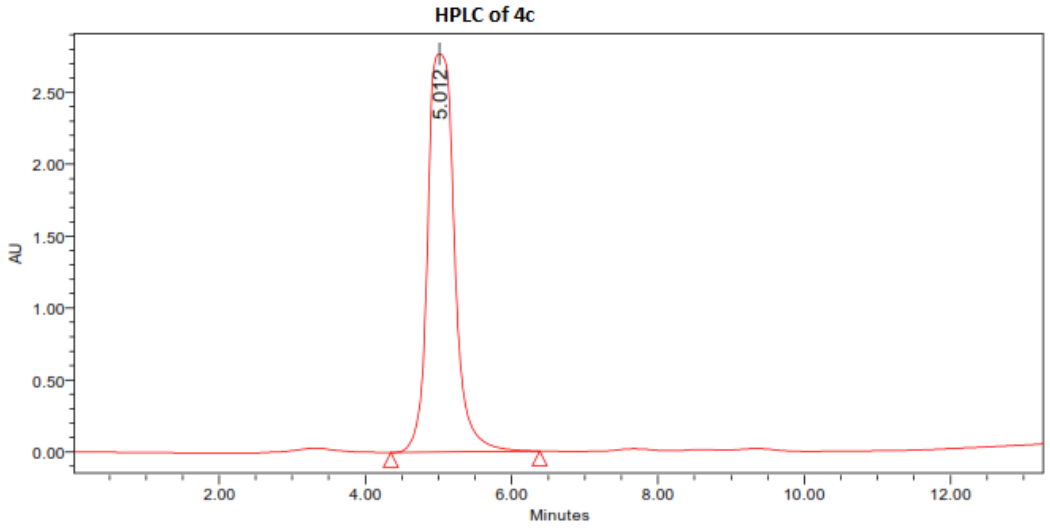
	Name	RT	% Area	Area
1		7.501	100.00	29134506

[1]HNMR of compound (4c):



^{13}C NMR of compound (4c):





Peak Results

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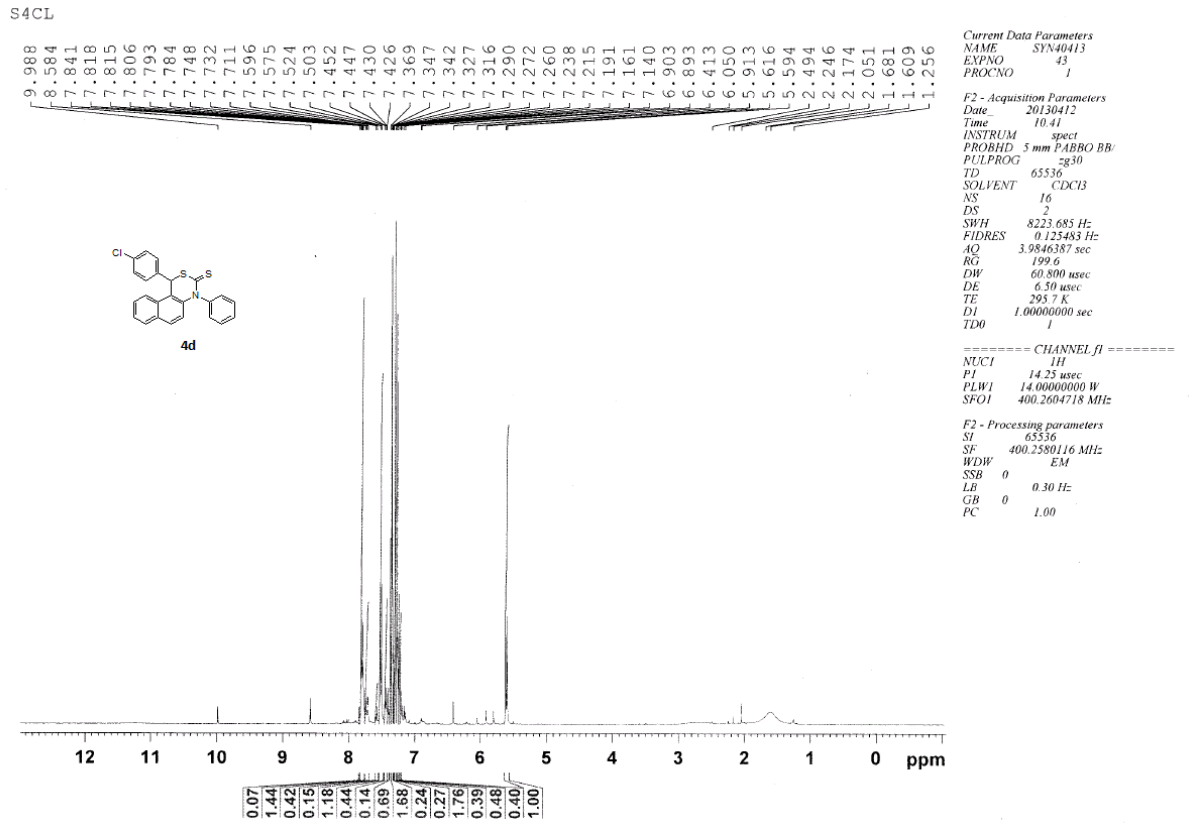
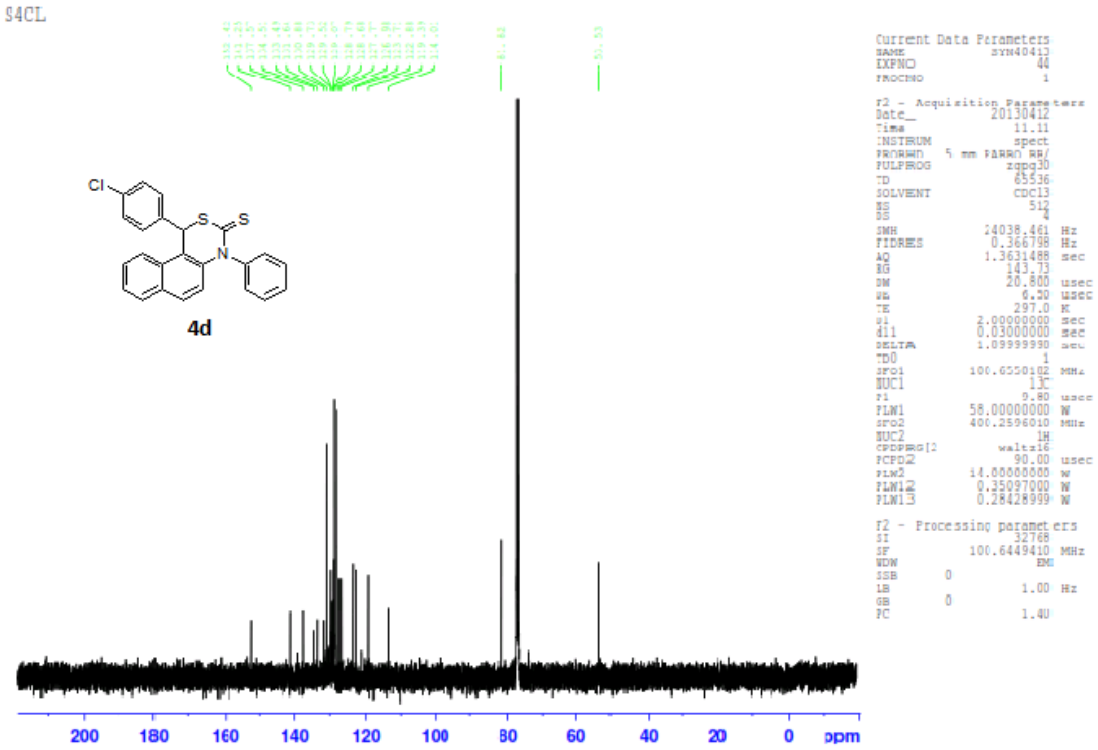
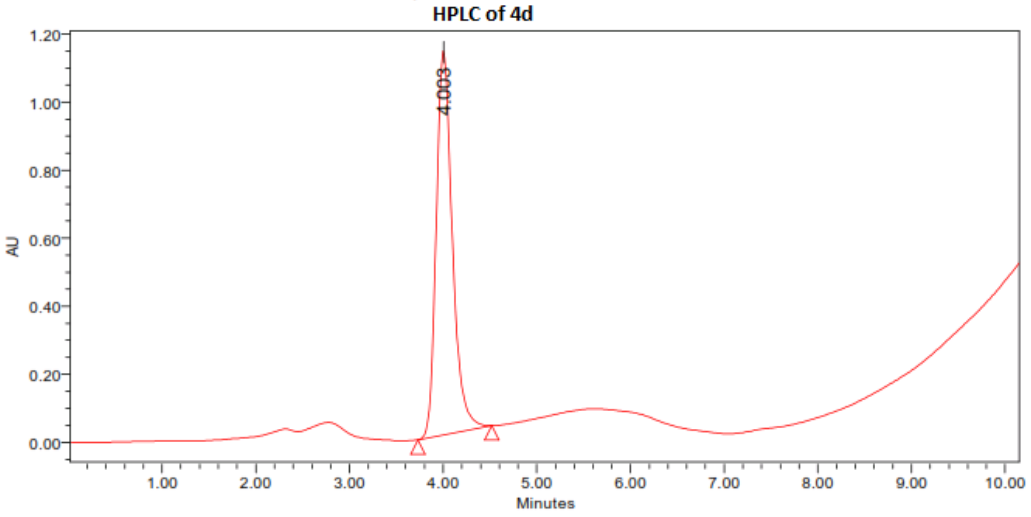
^{1}HNMR of compound (4d):



^{13}C NMR of compound (4d):





Peak Results

	RT	% Area	Area
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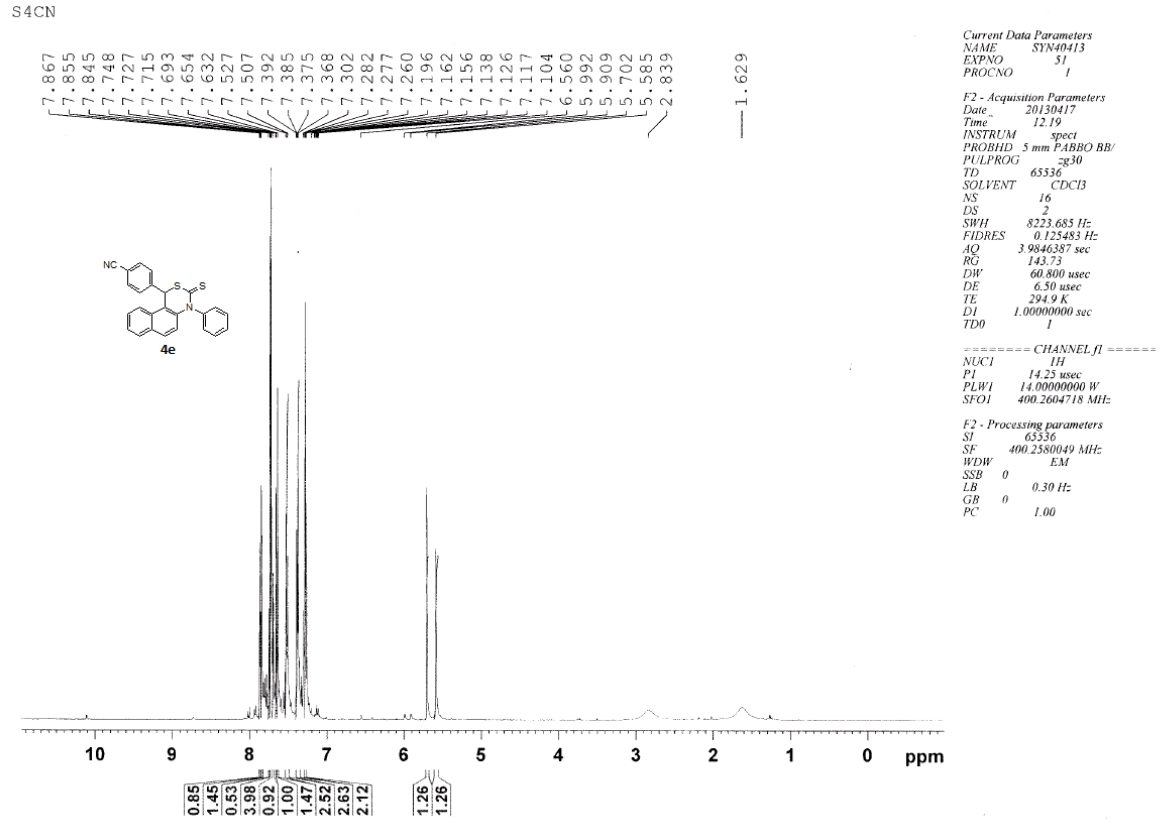
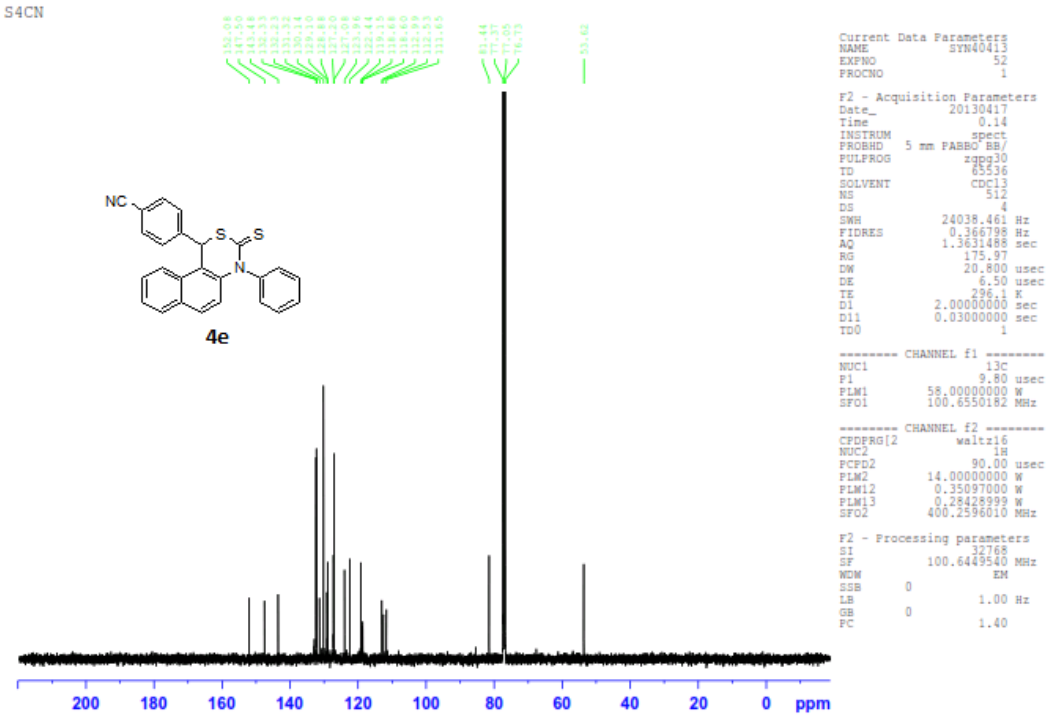
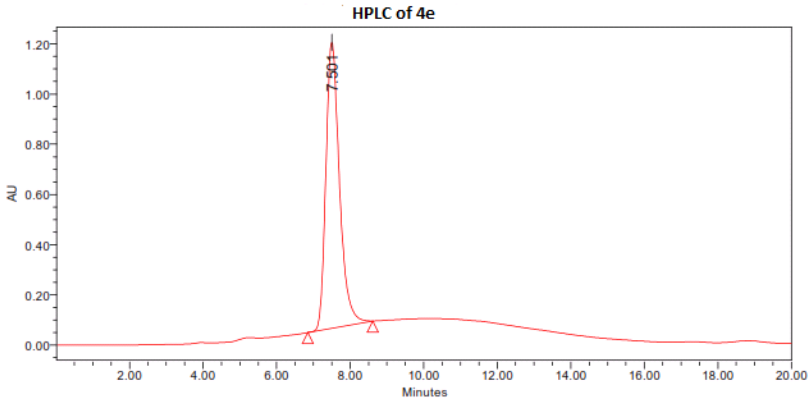
^{1}HNMR of compound (4e):



^{13}C NMR of compound (4e):

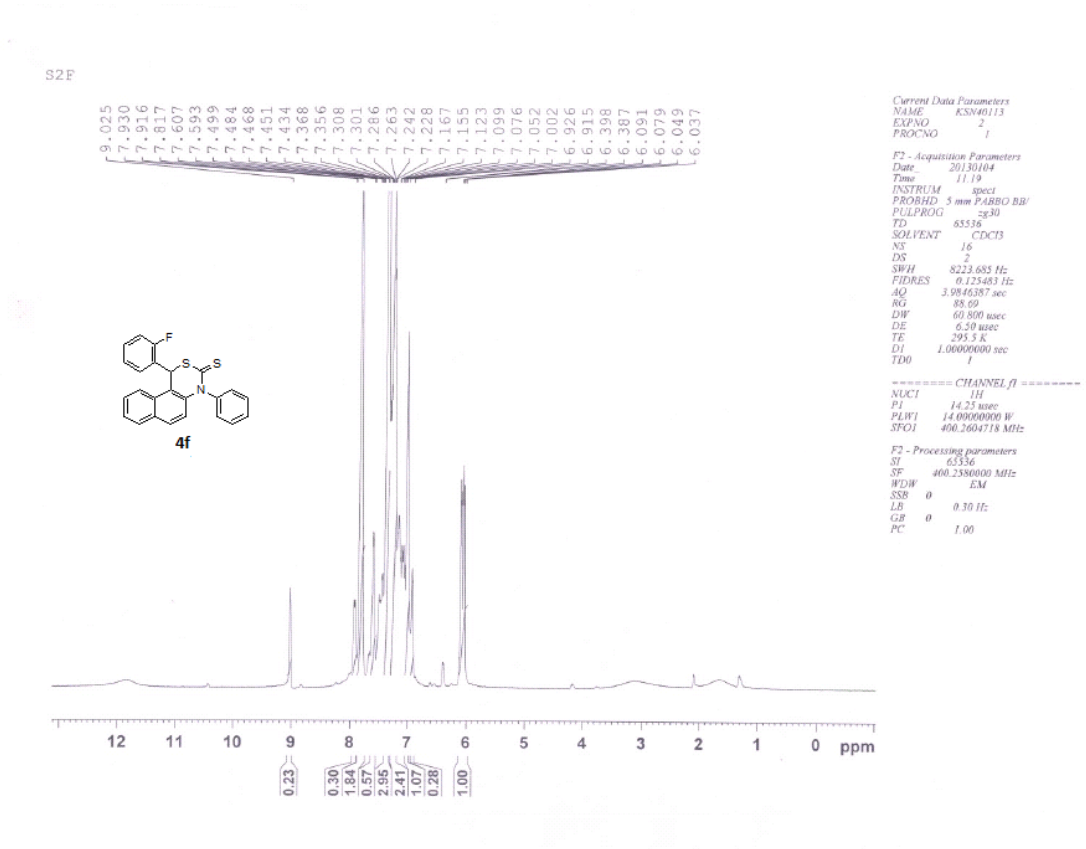




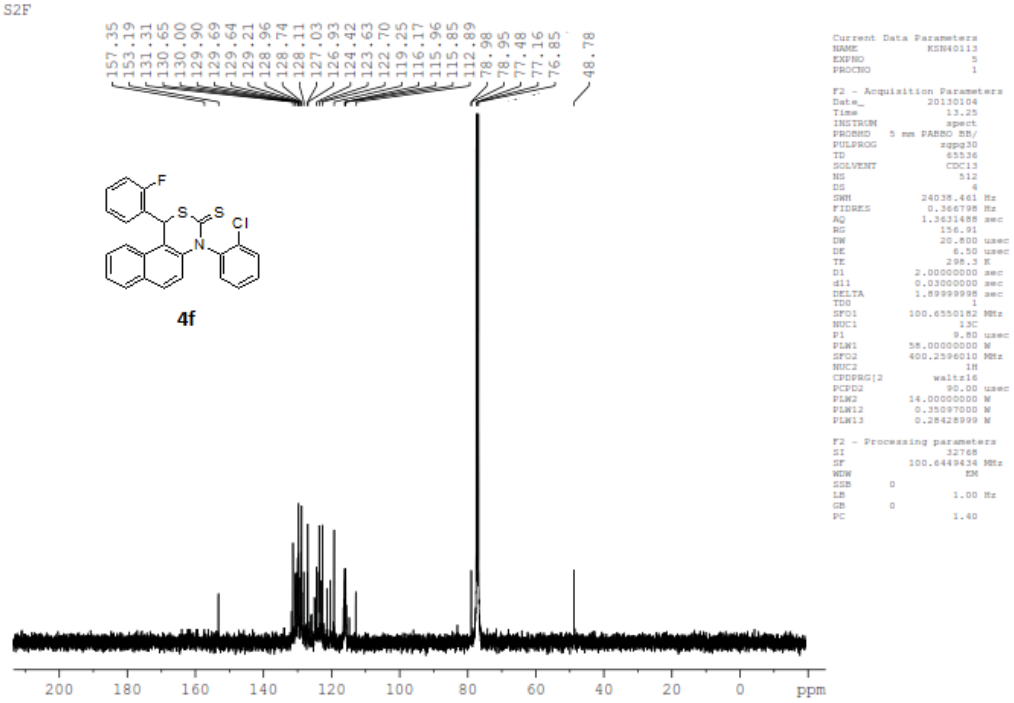
Peak Results

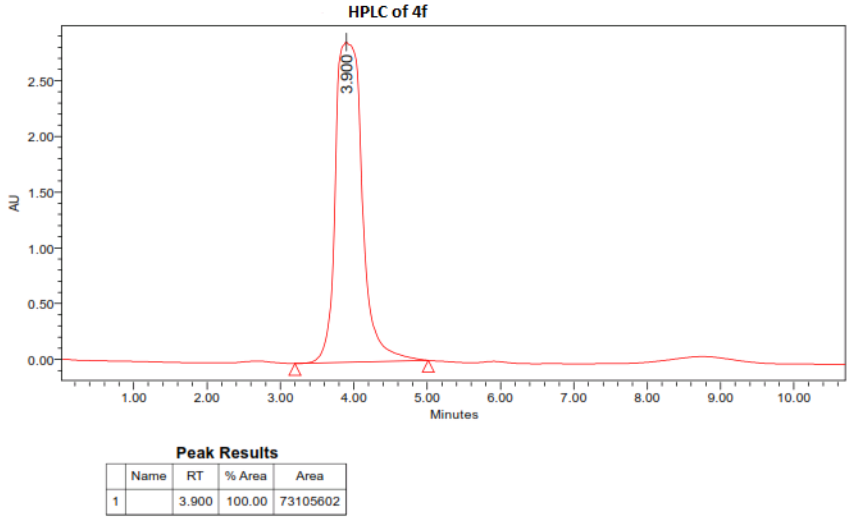
	Name	RT	% Area	Area
1		7.501	100.00	29134506

^{1}HNMR of compound (4f):



^{13}C NMR of compound (4f):





Peak Results

	Name	RT	% Area	Area
1		3.900	100.00	73105602

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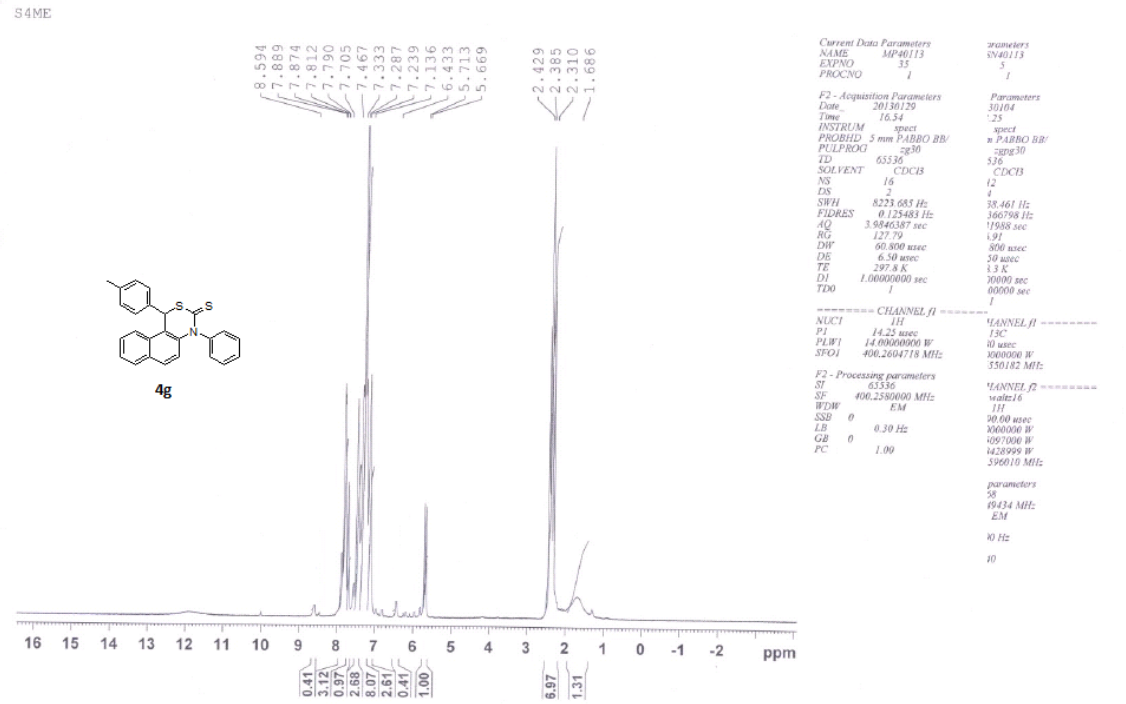
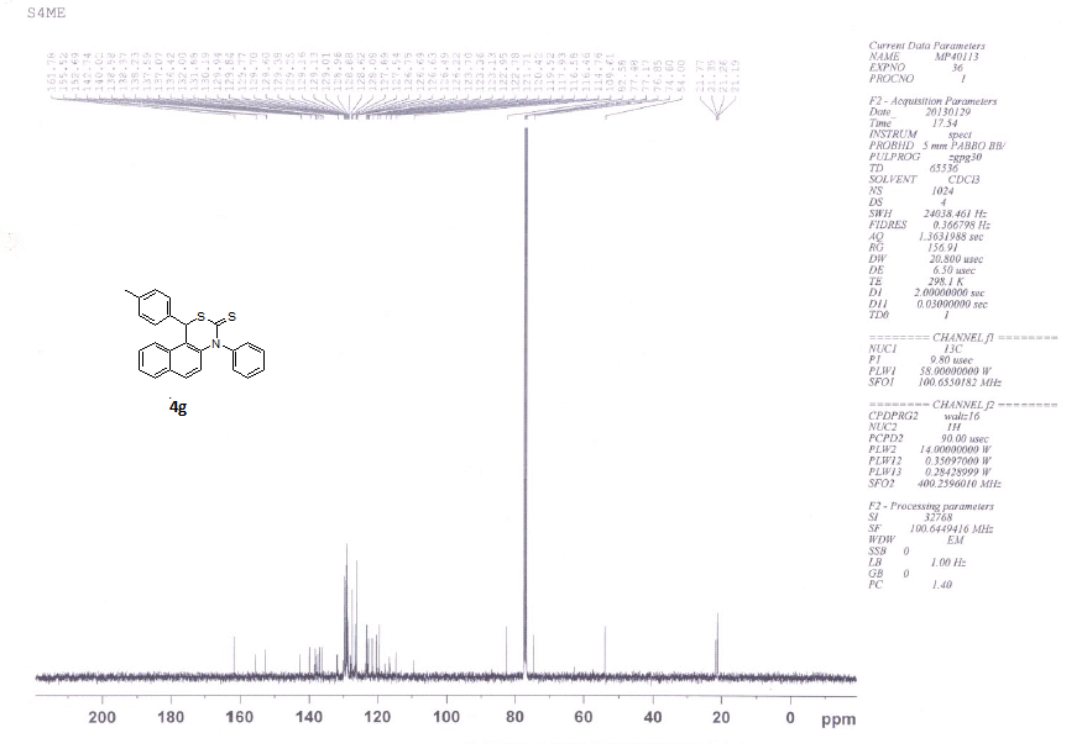
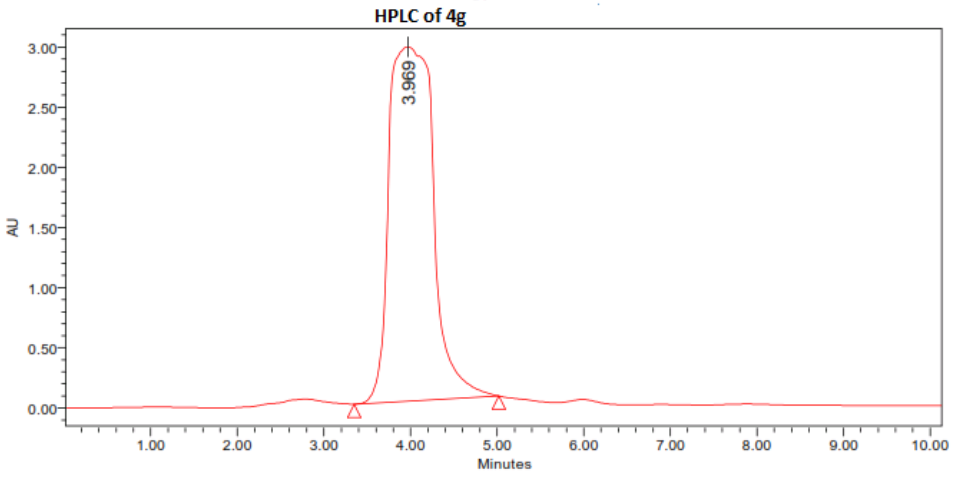


^{13}C NMR of compound (4g):

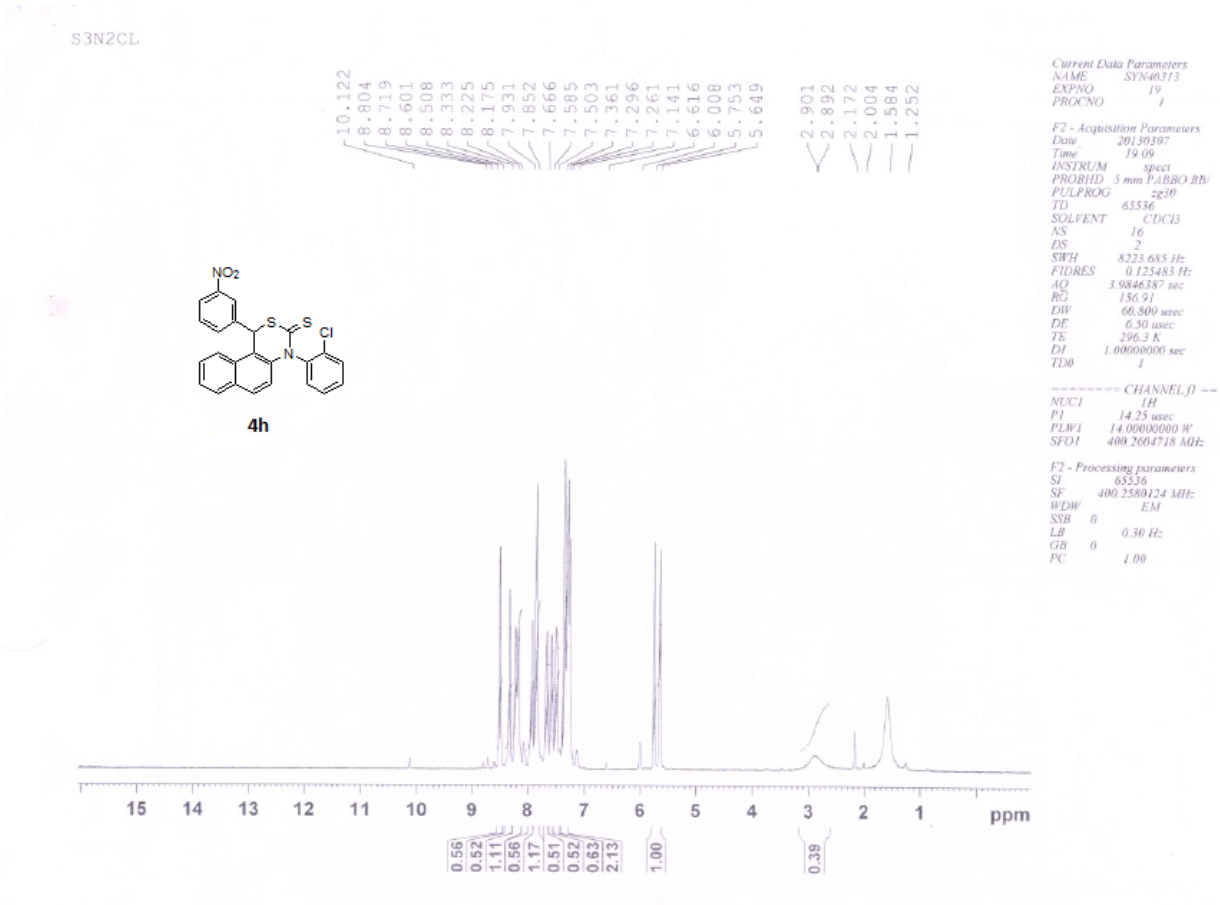




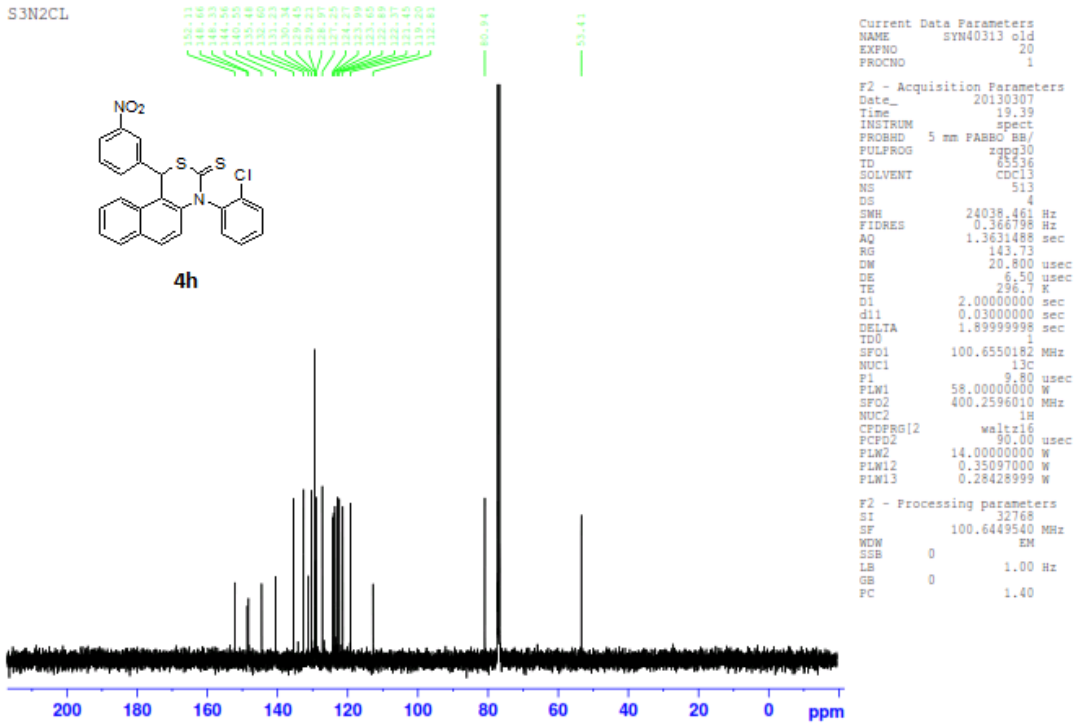
Peak Results

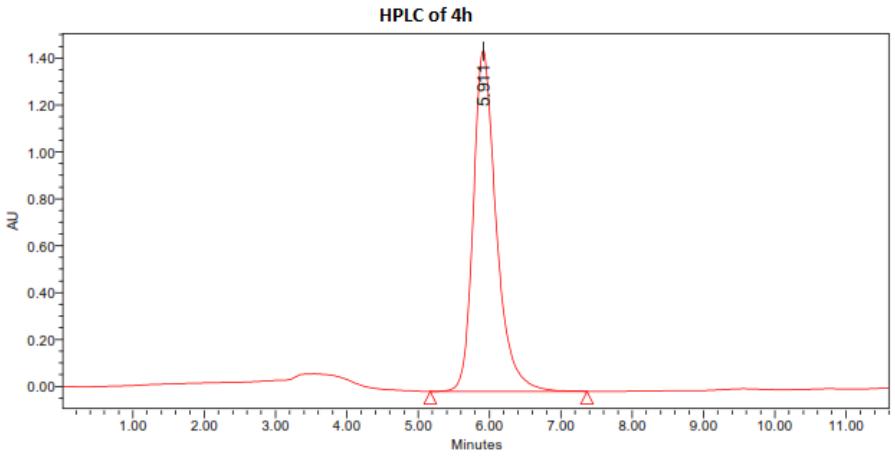
	Name	RT	% Area	Area
1		3.969	100.00	104777317

[1]HNMR of compound (4h):



^{13}C NMR of compound (4h):

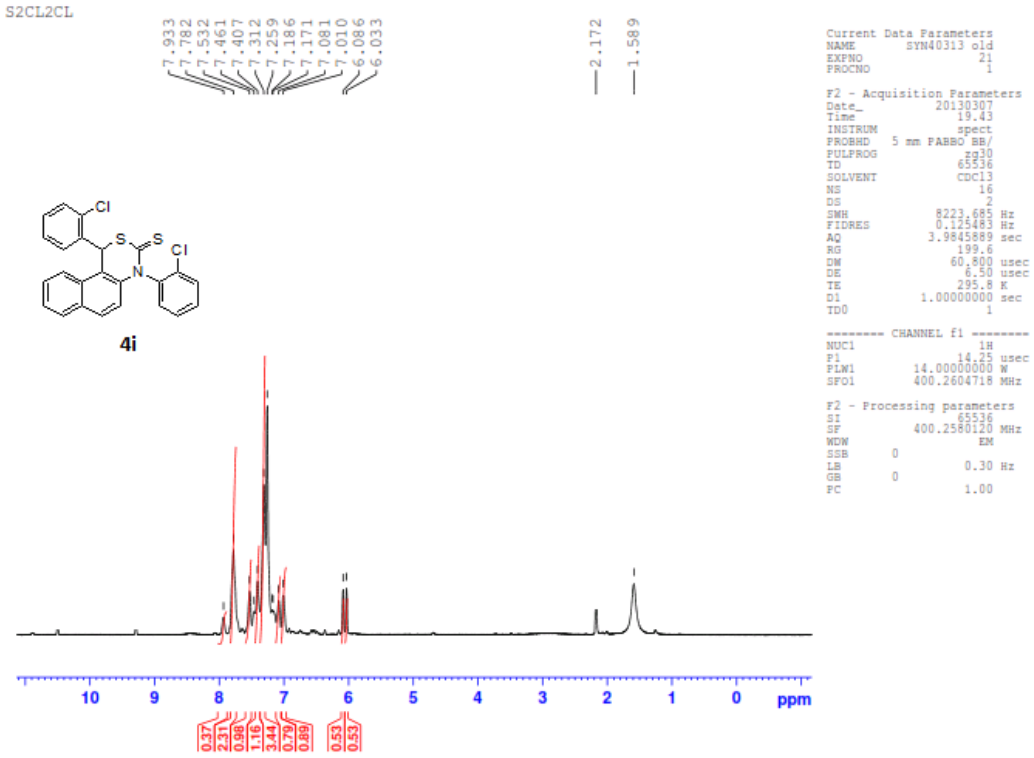




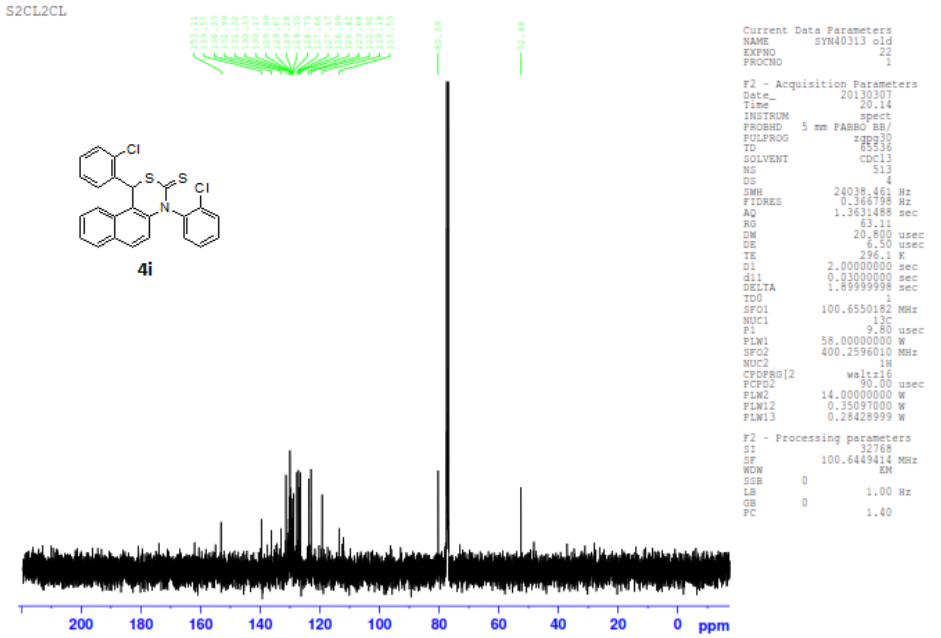
Peak Results

	RT	% Area	Area
1	5.911	100.00	32576688

[1]HNMR of compound (4i):



^{13}C NMR of compound (4i):

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PROCNO                1

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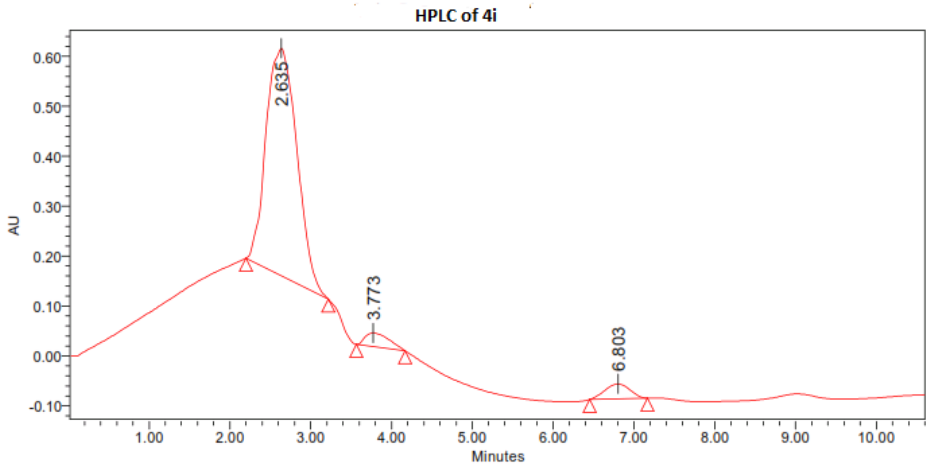

Peak Results

	Name	RT	% Area	Area
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2		3.773	4.32	574207
3		6.803	4.82	641312

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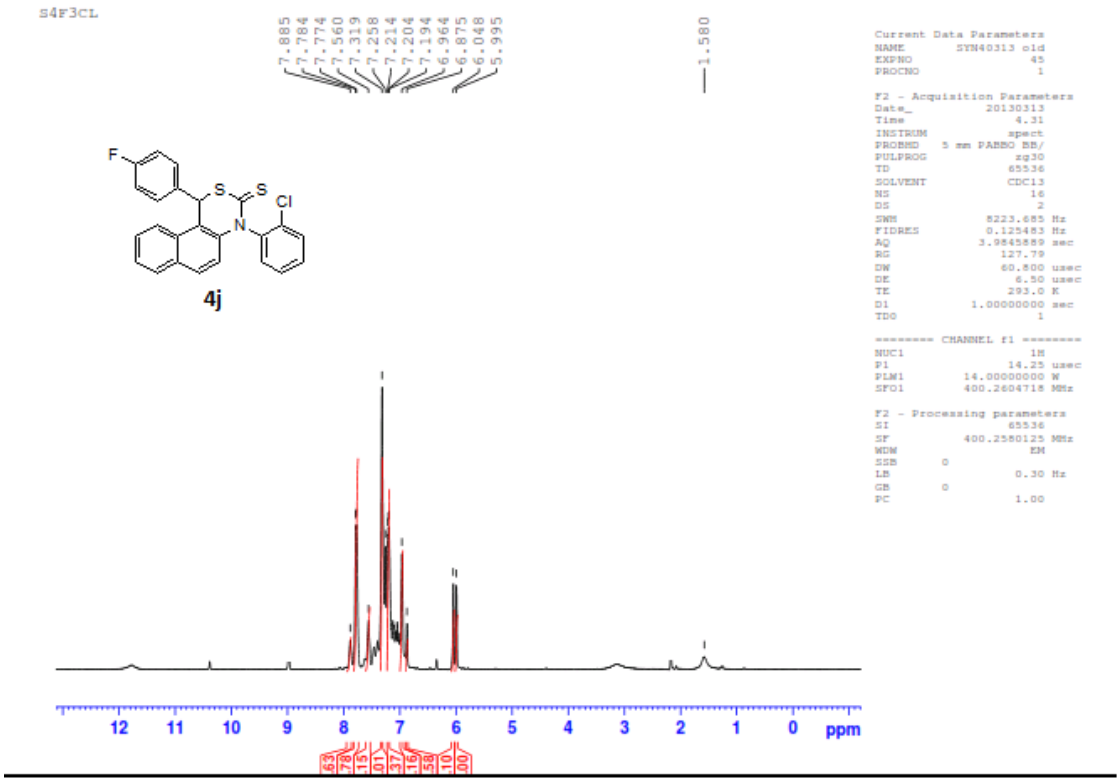
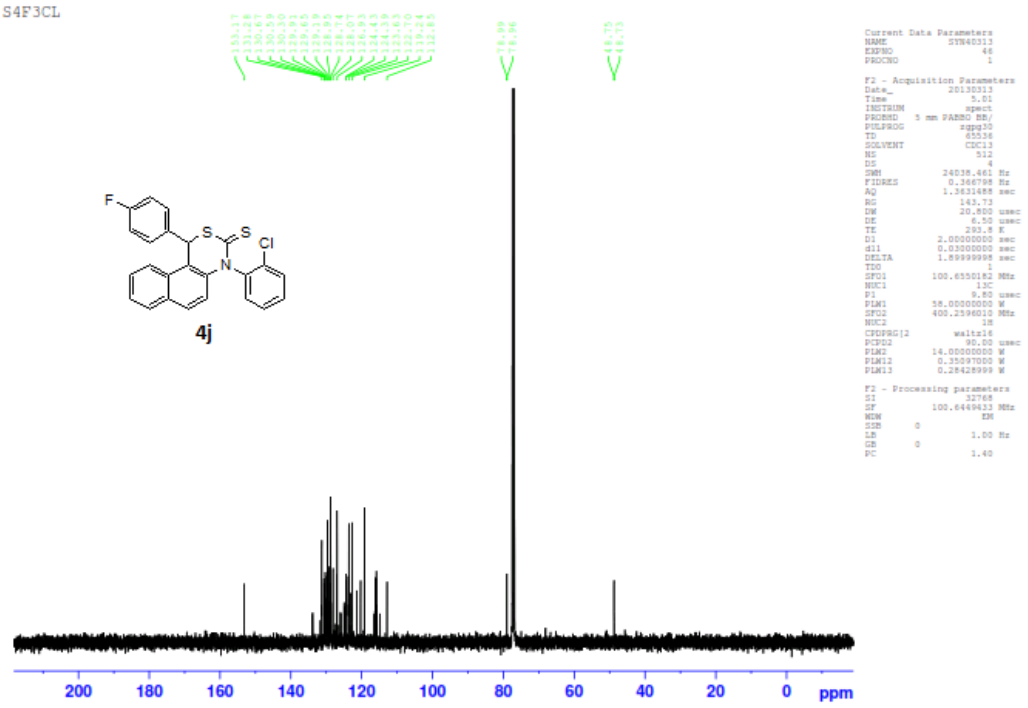
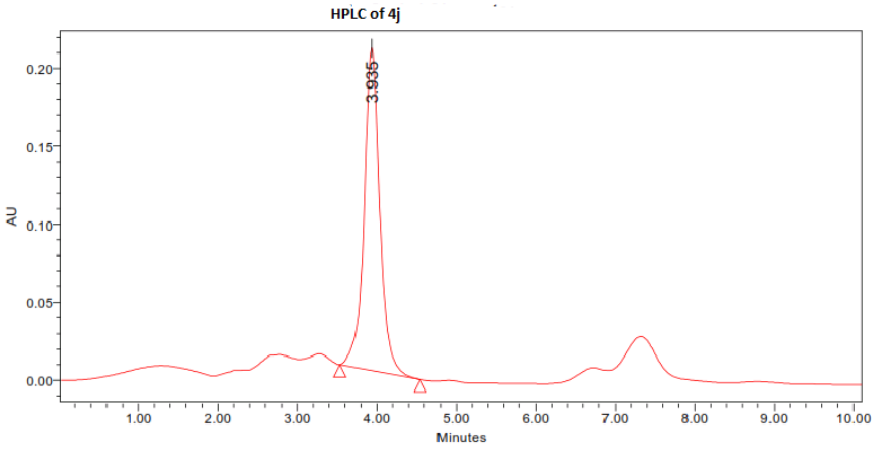


^{13}C NMR of compound (4j):



HPLC of 4j



Peak Results

	Name	RT	% Area	Area
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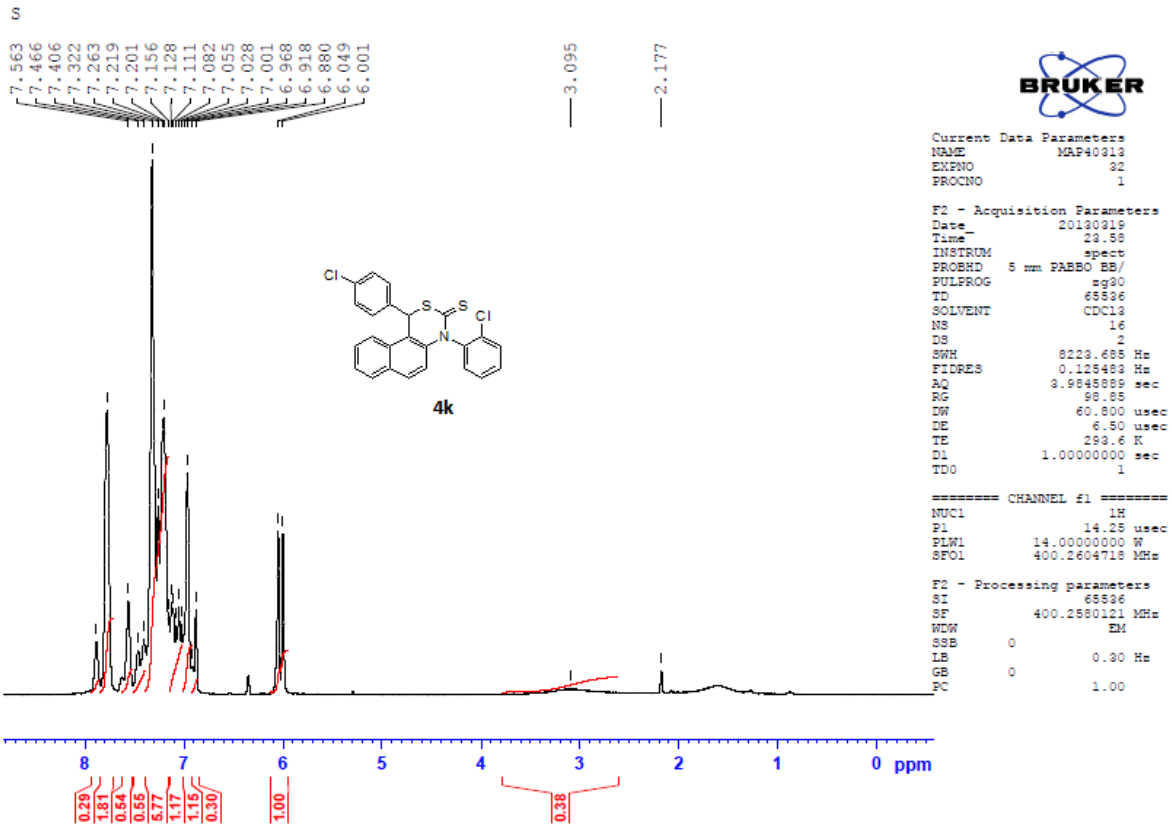
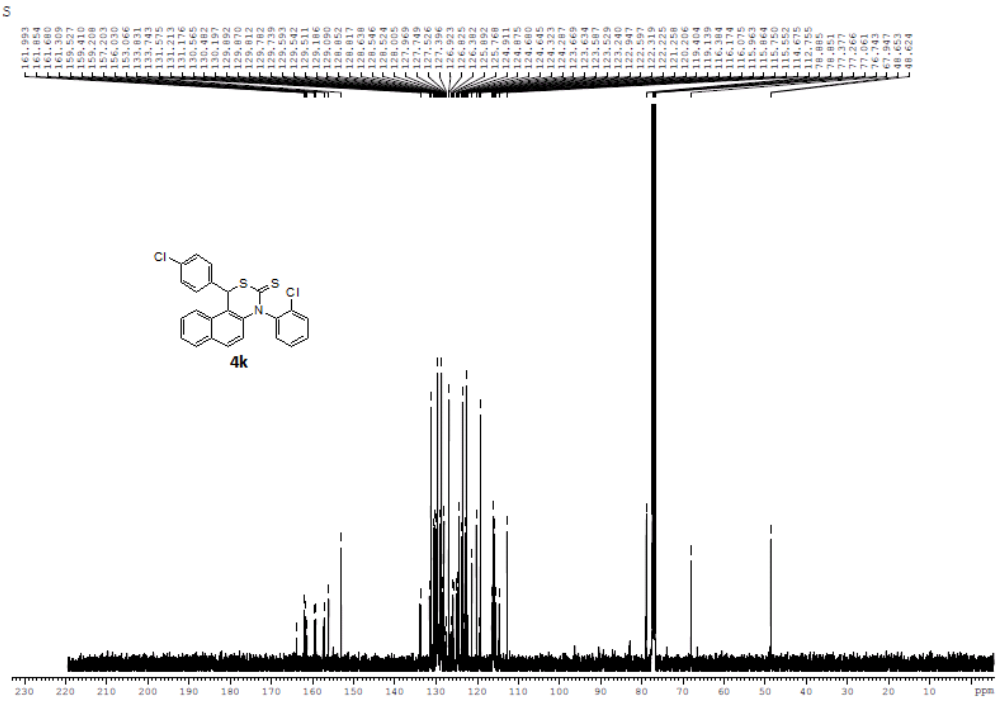
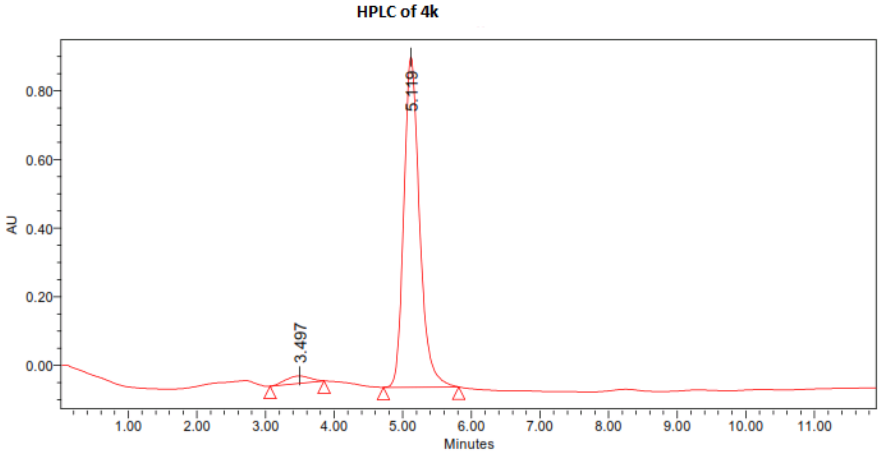
[1]HNMR of compound (4k):



^{13}C NMR of compound (4k):





Peak Results

	Name	RT	% Area	Area
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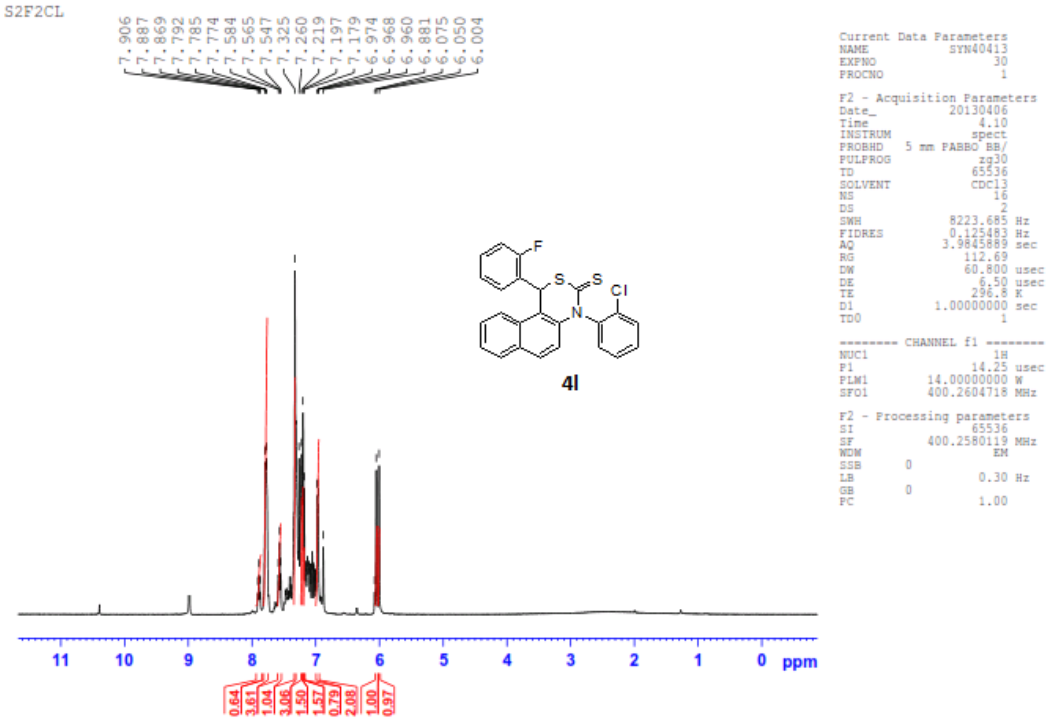


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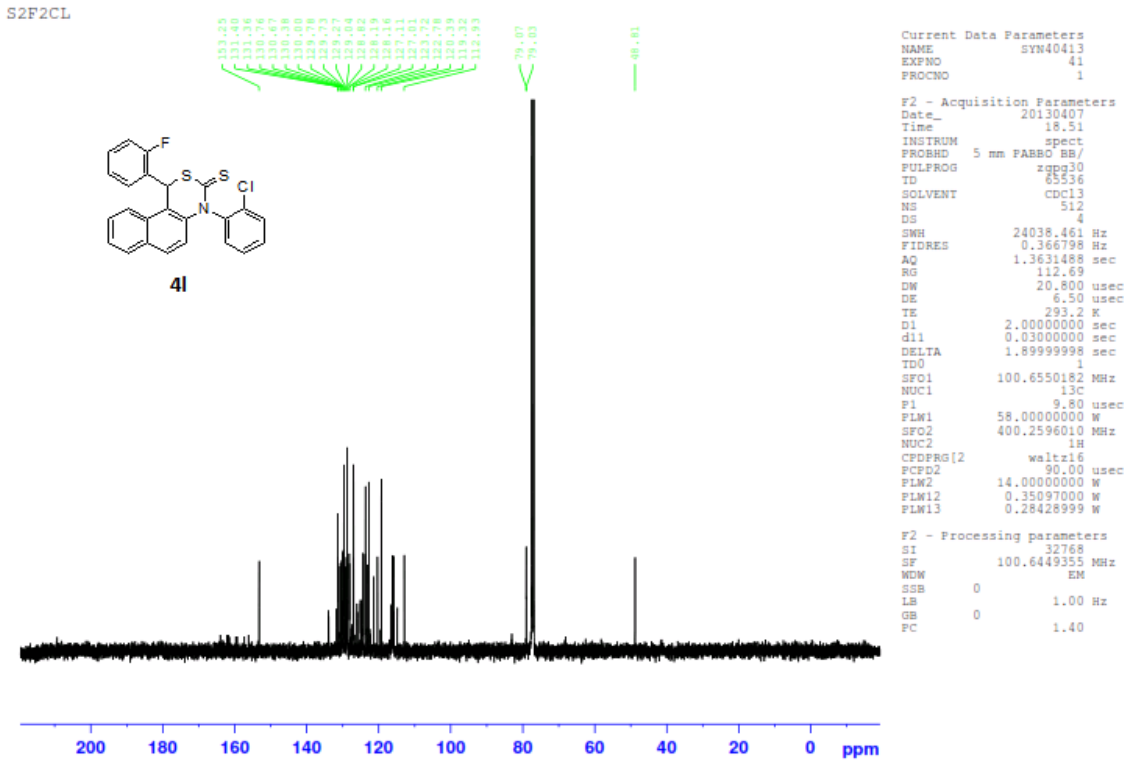
Current Data Parameters
NAME                  SYN40413
EXPNO                       30
PROCNO                       1

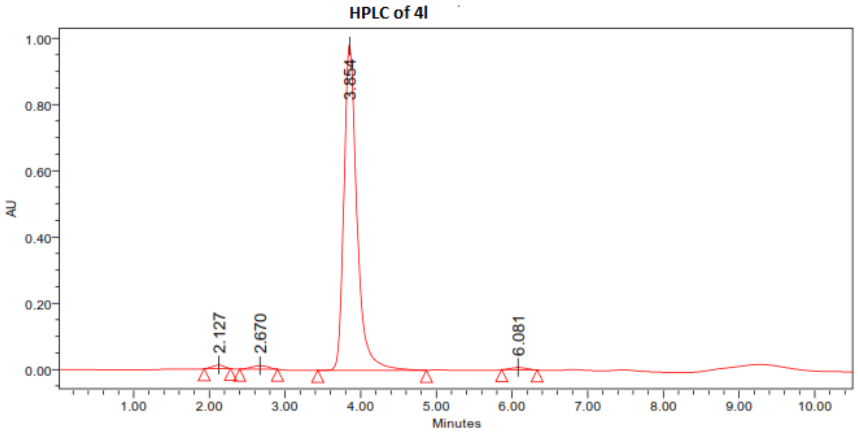
F2 - Acquisition Parameters
Date_                 20130406
Time                      4.10
INSTRUM                  spect
PROBHD     5 mm PABBO BB/
PULPROG                  zg30
TD                      65536
SOLVENT                 CDCl3
NS                         16
DS                          2
SWH                  8223.685 Hz
FIDRES               0.125483 Hz
AQ                   3.9845889 sec
RG                      112.69
DW                      60.800 usec
DE                       6.50 usec
TE                      296.8 K
D1                   1.00000000 sec
TD0                         1

======== CHANNEL f1 ========
NUC1                       1H
P1                      14.25 usec
PLW1            14.00000000 W
SFO1            400.2604718 MHz

F2 - Processing parameters
SI                      65536
SF              400.2580119 MHz
WDW                        EM
SSB                 0
LB                      0.30 Hz
GB                  0
PC                      1.00
```

^{13}C NMR of compound (4l):

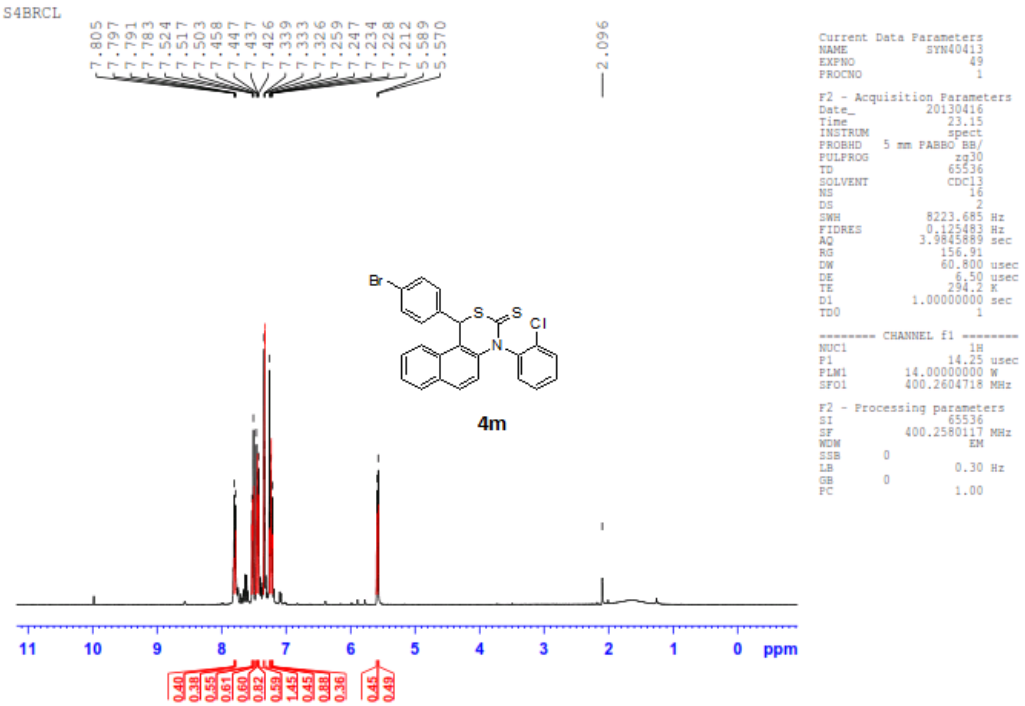




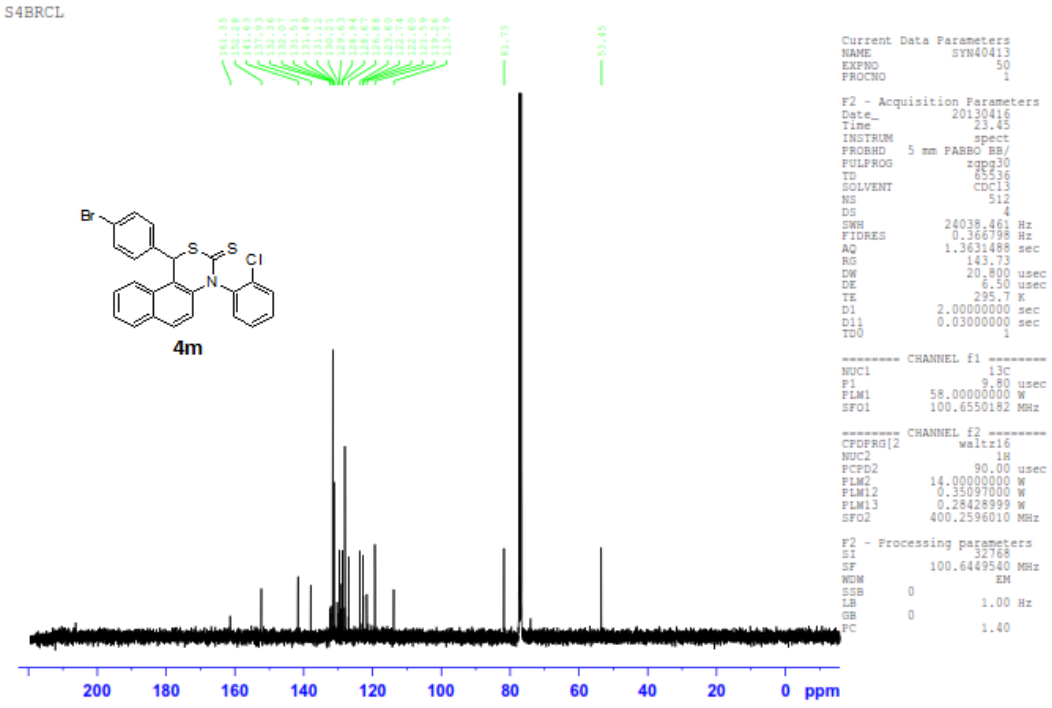
Peak Results

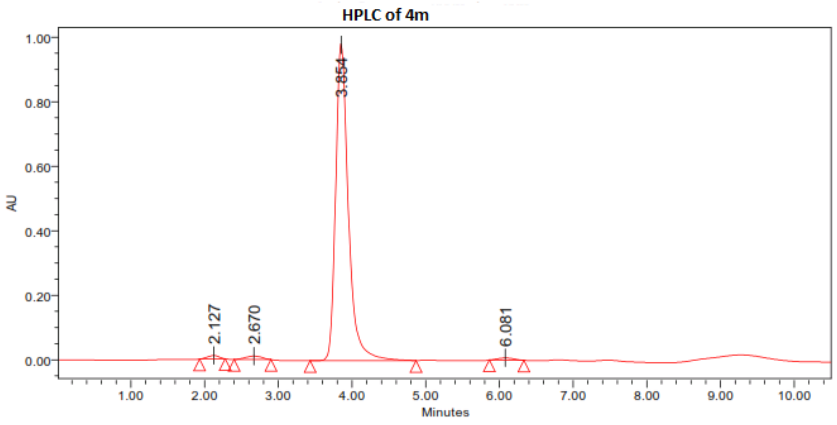
	Name	RT	% Area	Area
1		2.127	0.97	118300
2		2.670	1.39	168529
3		3.854	96.76	11751360
4		6.081	0.88	106507

[1]HNMR of compound (4m):



^{13}C NMR of compound (4m):





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	Name	RT	% Area	Area
1		2.127	0.97	118300
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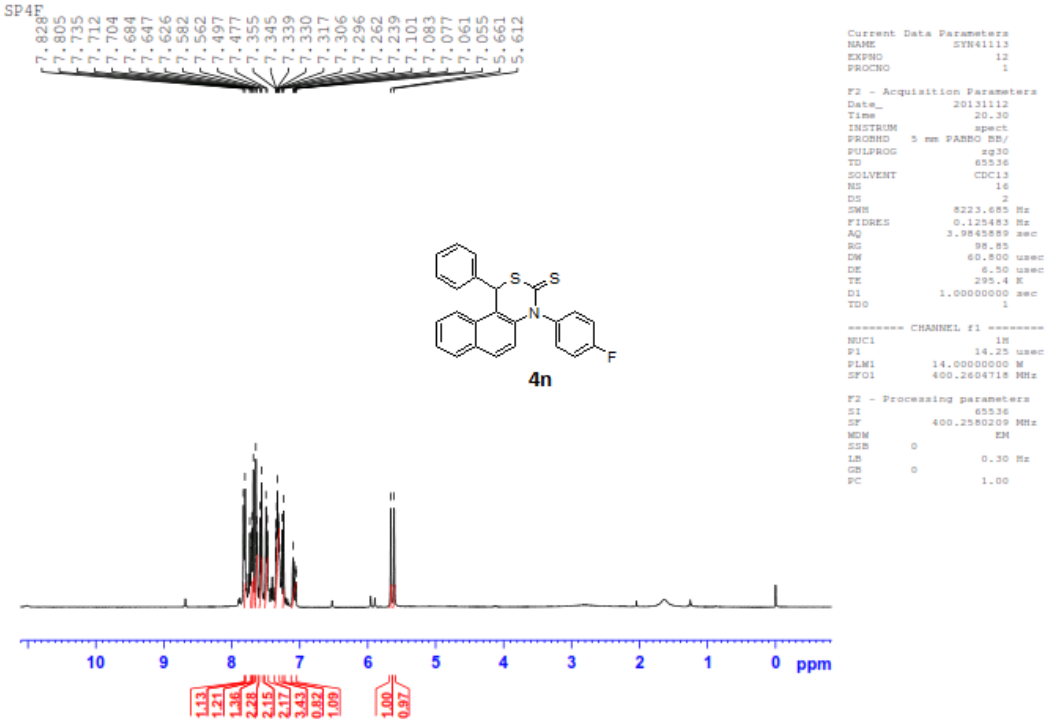
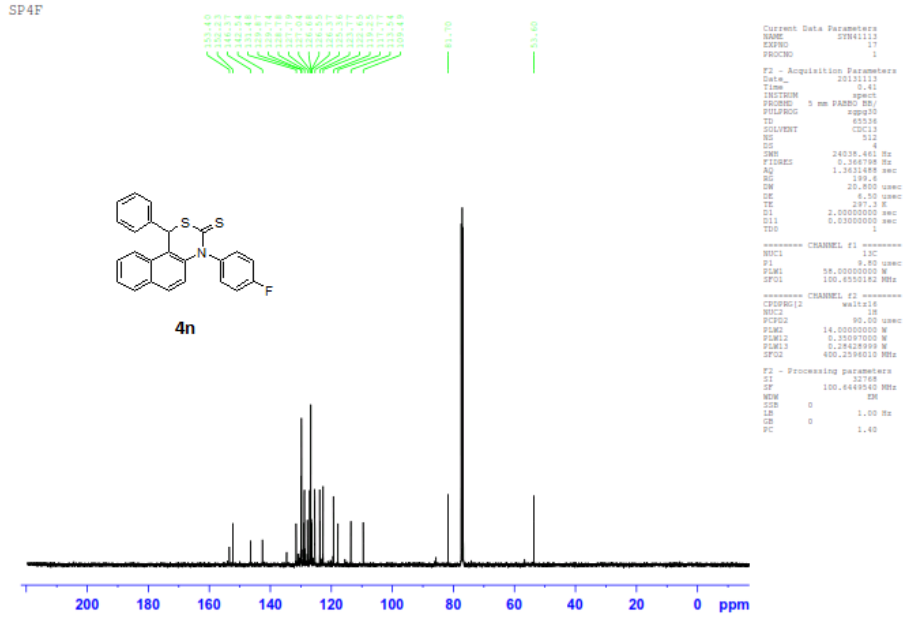
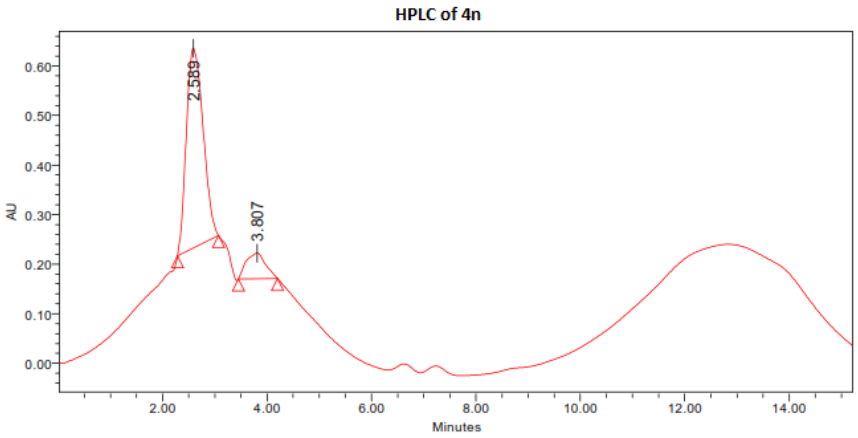
3		3.854	96.76	11751360
4		6.081	0.88	106507

^{1}HNMR of compound (4n):



^{13}C NMR of compound (4n):

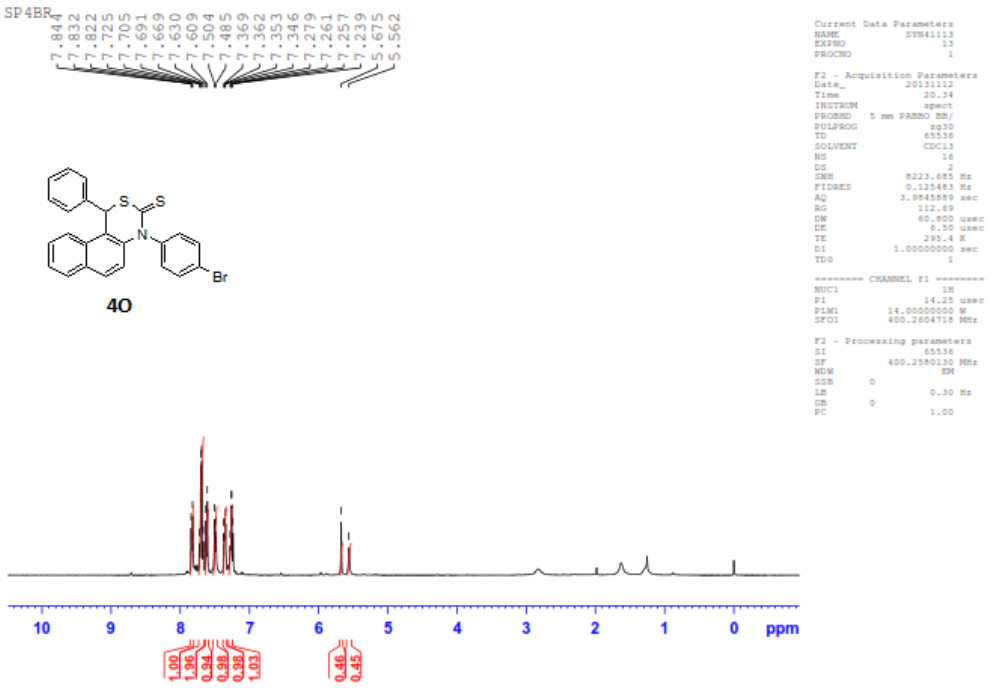




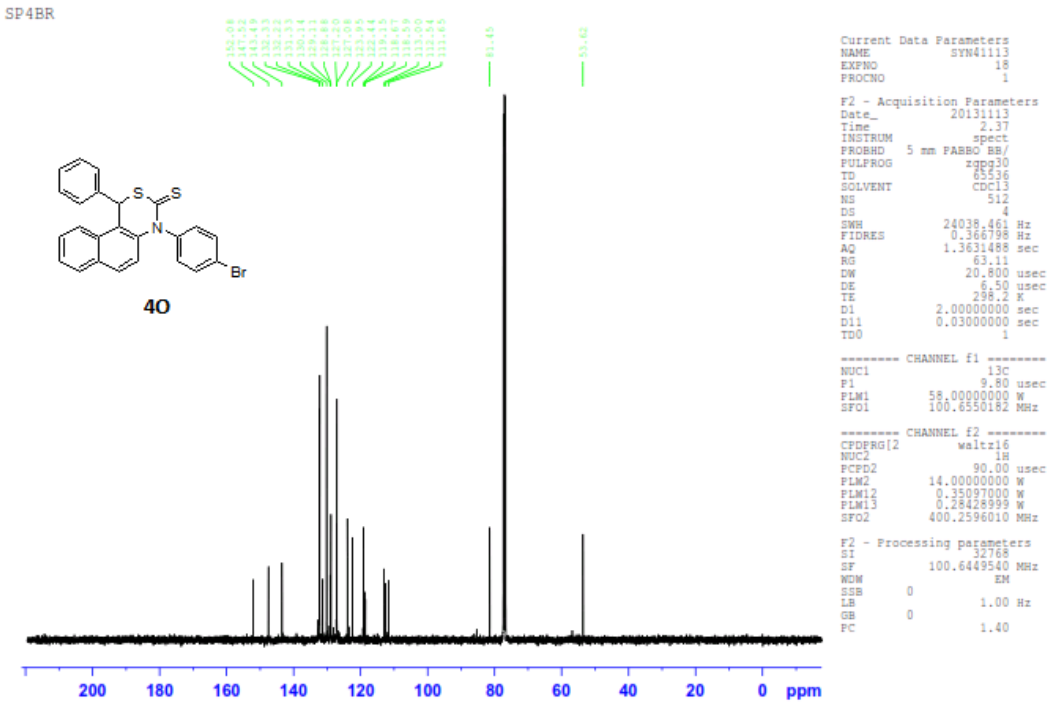
Peak Results

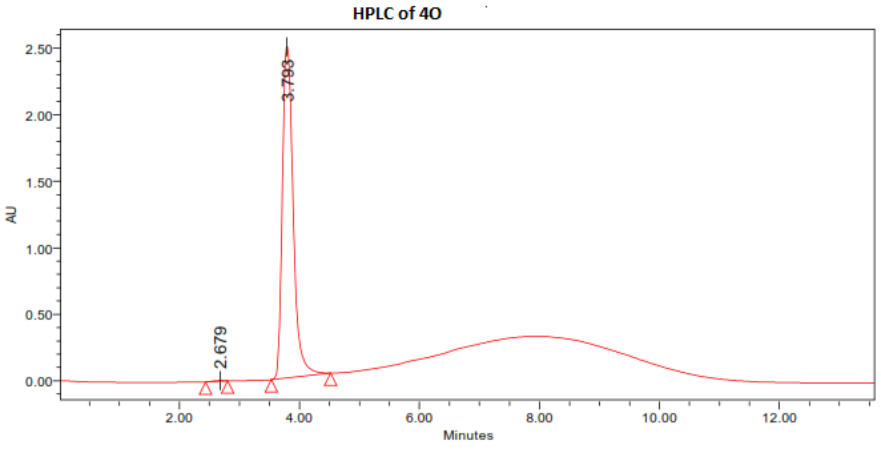
	Name	RT	% Area	Area
1		2.589	87.02	8952465
2		3.807	12.98	1335038

[1]HNMR of compound (4o):



^{13}C NMR of compound (4o):

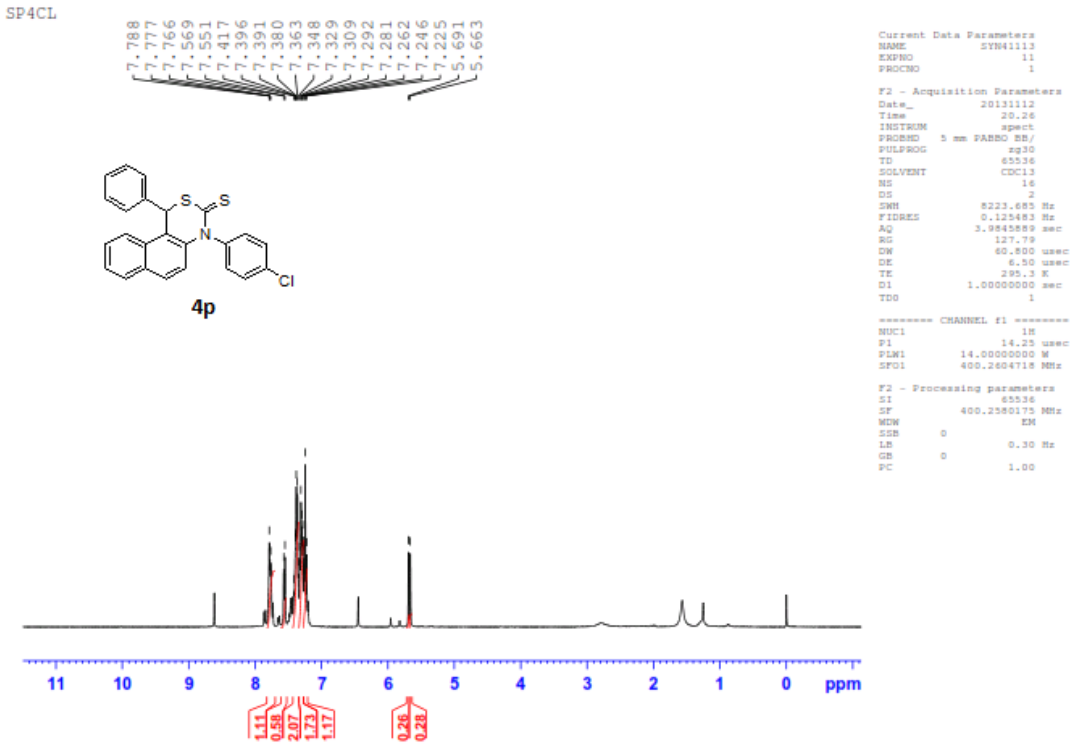




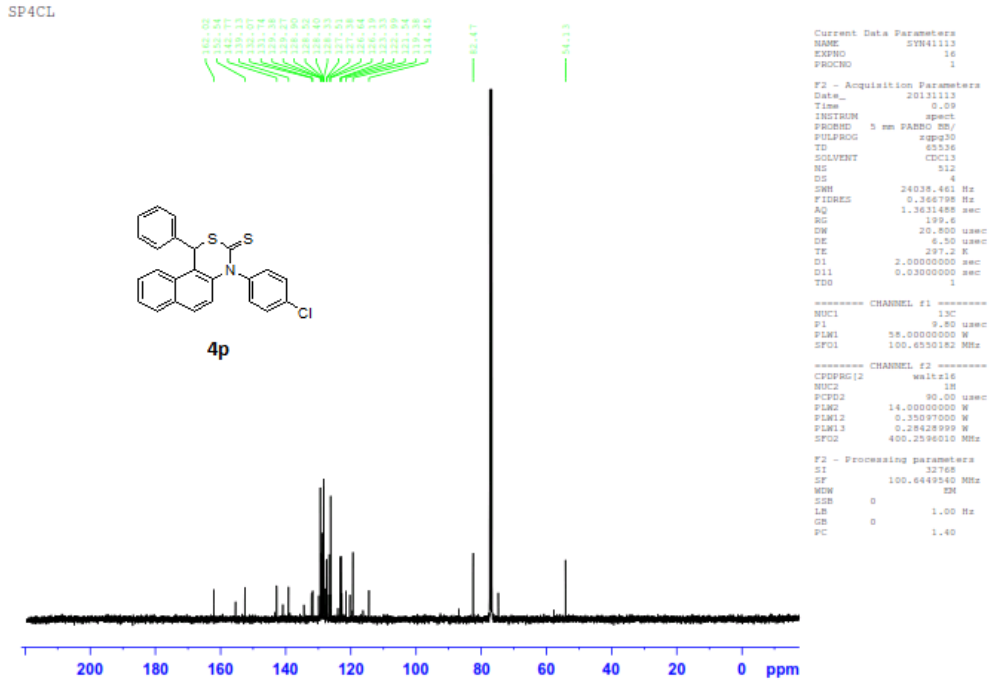
Peak Results

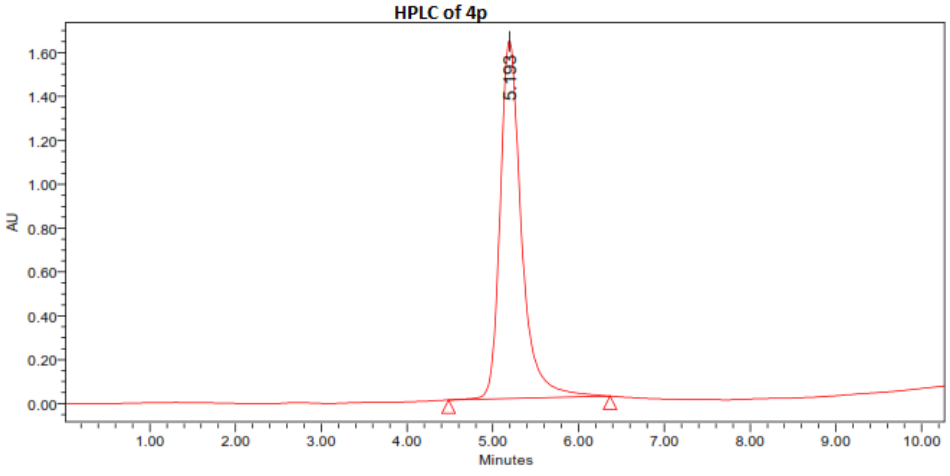
	Name	RT	% Area	Area
1		2.679	0.18	57796
2		3.793	99.82	31366749

[1]HNMR of compound (4p):



^{13}C NMR of compound (4p):

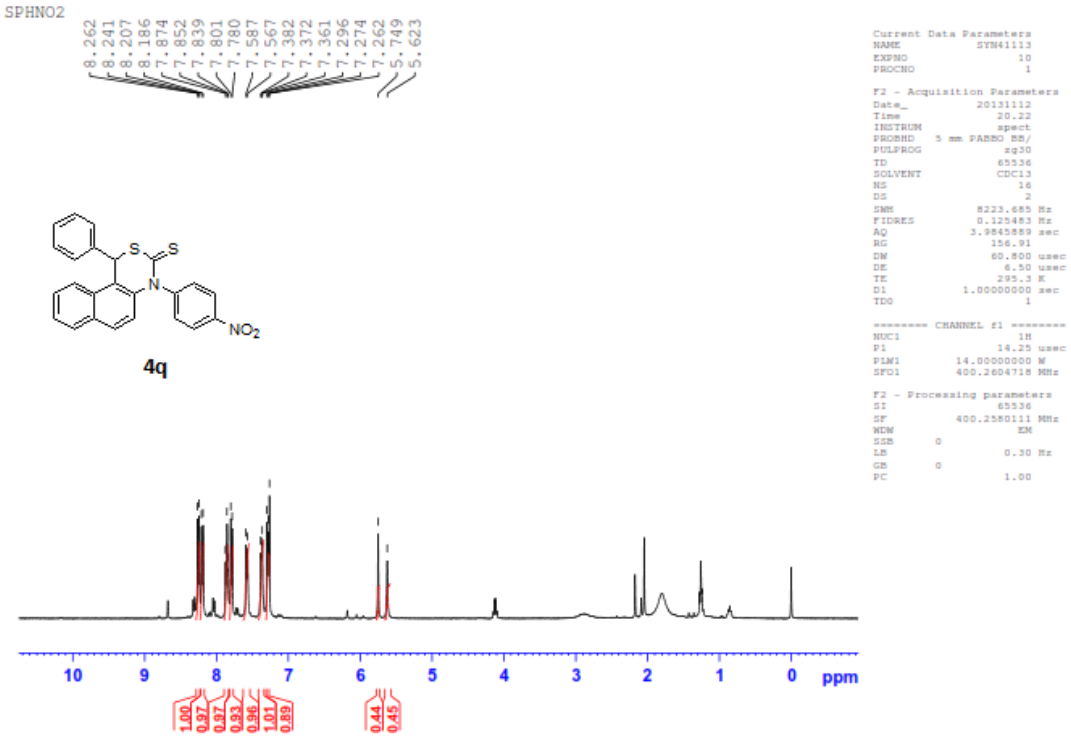




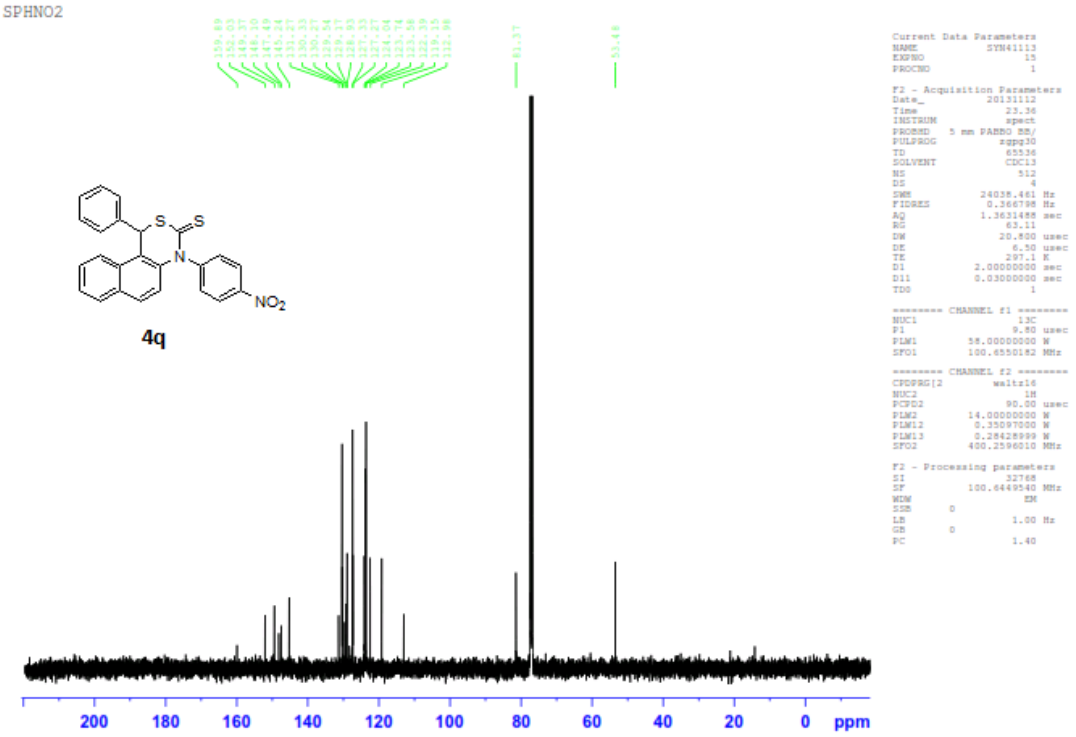
Peak Results

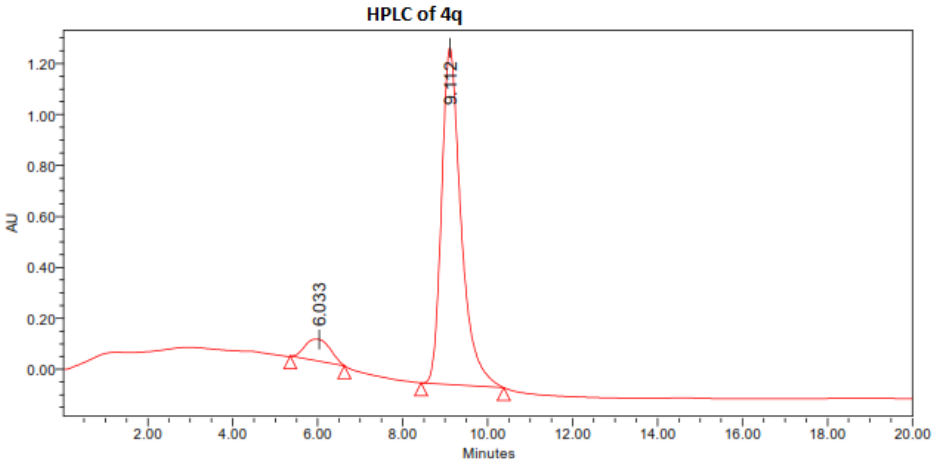
	Name	RT	% Area	Area
1		5.193	100.00	28247471

[1]HNMR of compound (4q):



^{13}C NMR of compound (4p):





Peak Results

	Name	RT	% Area	Area
1		6.033	7.77	3554983
2		9.112	92.23	42168441