Electronic Supplementary Information

Organoselenium-Catalyzed N^1- and N^2-selective aza-Wacker reaction of alkenes with benzotriazoles

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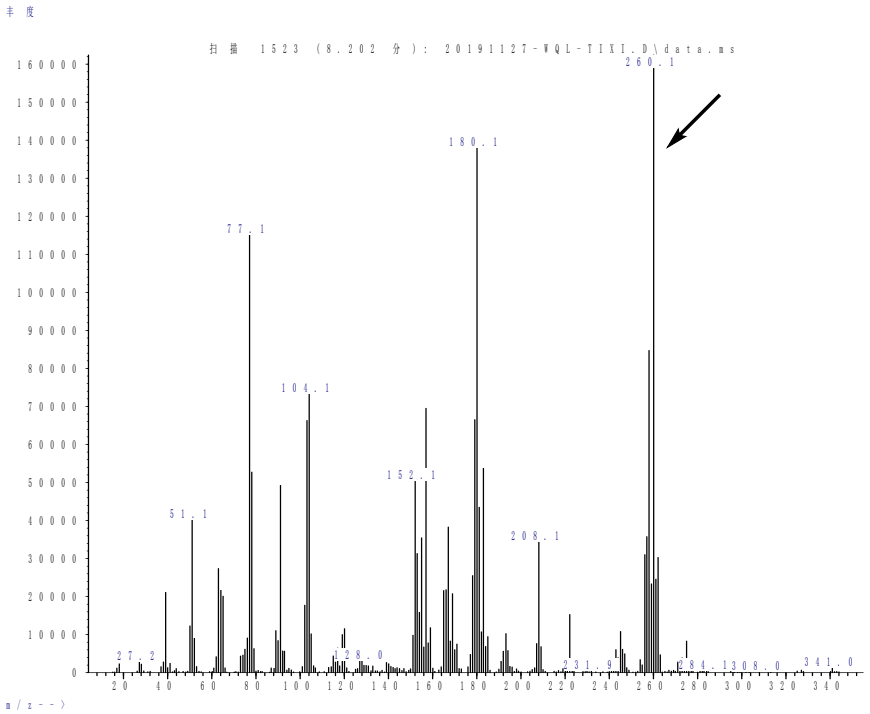
I. General remarks.

All reagents were purchased from commercial sources and used without further purification. ^{1}H NMR and ^{13}C NMR spectra were recorded on a Bruker Ascend™ 400 spectrometer in deuterated solvents containing TMS as an internal reference standard. High-resolution mass spectrometry (HRMS) analyses were conducted on a Waters LCT Premier/XE. Melting points were measured on a melting point apparatus equipped with a thermometer and were uncorrected. All the reactions were conducted in oil bath and monitored by thin-layer chromatography (TLC) using GF254 silica gel-coated TLC plates. Purification by flash column chromatography was performed over SiO_2 (silica gel 200−300 mesh).

II. GC-MS study

To a reaction tube equipped with a stir bar, styrene **1a** (0.5 mmol, 52.0 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg) and selectfluor (0.6 mmol, 212.4 mg) were addes. The reaction mixture was stirred in DME (2.0 mL) at 120 °C for 1.5 h. And then take 2 μL reaction liquid for GC-MS analysis. After scanned for 8.202 min, the signal 260.1, which is more like a mass fragment from intermediate **6**.



III. General procedure:

General procedure for compounds 3:

To a reaction tube equipped with a stir bar, alkenes **1** (0.5 mmol), benzotriazoles **2** (0.5 mmol), $(PhSe)_2$ (5% mol), and selectfluor (0.6 mmol) were added sequentially. Then the reaction mixture was stirred in DME (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **3**.

General procedure for compounds 4:

To a reaction tube equipped with a stir bar, alkenes **1** (0.5 mmol), benzotriazoles **2** (0.5 mmol), $(PhSe)_2$ (5% mol), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol) were added sequentially. Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **4**.

General procedure for compounds 5, 6, 7 and 8, please see references 1-4.

IV. Analytical data of products obtained in this study

1-(1-phenylvinyl)-1*H*-benzo[*d*][1,2,3]triazole (3a).

styrene **1a** (0.5 mmol, 52.0 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg) and selectfluor (0.6 mmol, 212.4 mg). Then the reaction mixture was stirred in DME (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were

dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **3a** as pale yellow liquid (79%, 87.4 mg).

^{1}H NMR (400 MHz; $CDCl_3$): δ = 5.79 (d, J = 0.8, 1H), 5.81 (s, 1H), 7.07 (d, J = 6.0, 1H), 7.30 (d, J = 7.2, 2H), 7.37-7.44 (m, 5H), 8.12 (t, J = 2.0, 1H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 111.1, 111.2, 120.1, 124.2, 126.9, 127.8, 128.8, 129.8, 132.9, 134.6, 142.6, 146.1. HRMS (ESI-TOF) Calcd for $C_{14}H_{12}N_3$, $[M+H]^+$ 222.1031; Found 222.1038.

1-(1-(2-fluorophenyl)vinyl)-1*H*-benzo[*d*][1,2,3]triazole (3b).

1-fluoro-2-vinylbenzene **1b** (0.5 mmol, 61.0 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg) and selectfluor (0.6 mmol, 212.4 mg). Then the reaction mixture was stirred in DME (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **3b** as as pale yellow liquid (73%, 87.3 mg).

^{1}H NMR (400 MHz; $CDCl_3$): δ = 5.82 (s, 1H), 6.01 (s, 1H), 7.12-7.20 (m, 3H), 7.25 (d, J = 7.2, 1H), 7.37-7.43 (m, 3H), 8.10 (s, 1H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 110.6, 113.6 (d, J = 4.3 Hz), 116.5 (d, J = 21.6 Hz), 120.2, 124.2, 124.5, 127.9, 130.1 (d, J = 2.2 Hz), 131.4, 132.5, 137.4, 146.1, 158.9, 161.4 (d, J = 252.3 Hz). HRMS (ESI-TOF) Calcd for $C_{14}H_{11}FN_3$, $[M+H]^+$ 240.0937; Found 240.0940.

1-(1-(4-fluorophenyl)vinyl)-1*H*-benzo[*d*][1,2,3]triazole (3c).

1-fluoro-4-vinylbenzene **1c** (0.5 mmol, 61.0 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg) and selectfluor (0.6 mmol, 212.4 mg). Then the reaction mixture was stirred in DME (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and

quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **3c** as pale yellow liquid (75%, 89.7 mg).

^{1}H NMR (400 MHz; $CDCl_3$): δ = 5.76 (s, 2H), 7.07-7.13 (m, 3H), 7.30 (q, J = 5.2, 2H), 7.39-7.42 (m, 2H), 8.12 (d, J = 6.8, 1H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 110.8, 111.0, 115.8, 116.0, 120.4, 124.3, 127.9, 128.9 (d, J = 8.3 Hz), 130.8 (d, J = 3.3 Hz), 132.8, 141.7, 146.1, 162.3 (d, J = 250.3 Hz), 164.8. HRMS (ESI-TOF) Calcd for $C_{14}H_{11}FN_3$, $[M+H]^+$ 240.0937; Found 240.0933.

1-(1-(2-chlorophenyl)vinyl)-1*H*-benzo[*d*][1,2,3]triazole (3d).

1-chloro-2-vinylbenzene **1d** (0.5 mmol, 69.3 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg) and selectfluor (0.6 mmol, 212.4 mg). Then the reaction mixture was stirred in DME (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **3d** as white solid (76%, 97.1 mg), melting point: 68-69 ^{o}C.

^{1}H NMR (400 MHz; $CDCl_3$): δ = 5.59 (s, 1H), 6.08 (s, 1H), 7.08 (d, J = 6.8, 1H), 7.37-7.41 (m, 5H), 7.55 (dd, J_1 = 1.2, J_2 = 6.0, 1H), 8.09 (d, J = 2.0, 1H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 110.7, 111.7, 120.2, 124.2, 127.2, 128.0, 130.3, 130.9, 131.6, 132.2, 133.4, 134.1, 140.7, 146.2. HRMS (ESI-TOF) Calcd for $C_{14}H_{11}ClN_3$, $[M+H]^+$ 256.0642; Found 256.0638.

1-(1-(3-chlorophenyl)vinyl)-1*H*-benzo[*d*][1,2,3]triazole (3e).

1-chloro-3-vinylbenzene **1e** (0.5 mmol, 69.3 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg) and selectfluor (0.6 mmol, 212.4 mg). Then the reaction mixture was stirred in DME (2.0 mL) at 120 °C. Upon completion of the

reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **3e** as pale yellow liquid (74%, 94.6 mg).

^{1}H NMR (400 MHz; $CDCl_3$): δ = 5.81 (s, 1H), 5.84 (s, 1H), 7.15 (d, J = 8.0, 2H), 7.32-7.43 (m, 5H), 8.13 (t, J = 1.2, 1H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 110.9, 112.1, 120.2, 124.3, 125.1, 127.0, 128.1, 129.8, 130.1, 132.8, 134.9, 136.5, 141.4, 146.1. HRMS (ESI-TOF) Calcd for $C_{14}H_{11}ClN_3$, $[M+H]^+$ 256.0642; Found 256.0647.

1-(1-(4-chlorophenyl)vinyl)-1*H*-benzo[*d*][1,2,3]triazole (3f).

1-chloro-4-vinylbenzene **1f** (0.5 mmol, 69.3 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg) and selectfluor (0.6 mmol, 212.4 mg). Then the reaction mixture was stirred in DME (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **3f** as white solid (78%, 99.7 mg), melting point: 57-58 ^{o}C.

^{1}H NMR (400 MHz; $CDCl_3$): δ = 5.80 (s, 1H), 5.81 (s, 1H), 7.13 (d, J = 6.8, 1H), 7.24 (d, J = 8.4, 2H), 7.33-7.42 (m, 4H), 8.13 (d, J = 2.0, 1H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 111.0, 111.4, 120.2, 124.3, 128.0, 128.2, 129.1, 132.7, 133.1, 135.8, 141.6, 146.1. HRMS (ESI-TOF) Calcd for $C_{14}H_{11}ClN_3$, $[M+H]^+$ 256.0642; Found 256.0639.

1-(1-(2-bromophenyl)vinyl)-1*H*-benzo[*d*][1,2,3]triazole (3g).

1-bromo-2-vinylbenzene **1g** (0.5 mmol, 91.5 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg) and selectfluor (0.6 mmol, 212.4 mg). Then the reaction mixture was stirred in DME (2.0 mL) at 120 °C. Upon completion of the

reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **3g** as white solid (75%, 112.6 mg), melting point: 67-68 ^oC.

^1H NMR (400 MHz; $CDCl_3$): δ = 5.55 (d, J = 0.8, 1H), 6.08 (d, J = 0.8, 1H), 7.05 (d, J = 6.8, 1H), 7.34-7.38 (m, 3H), 7.46 (q, J = 6.4, 1H), 7.57-7.62 (m, 2H), 8.09 (dd, J_1 = 2.8, J_2 = 6.8, 1H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 110.8, 111.2, 120.2, 122.9, 124.2, 127.8, 128.0, 131.1, 131.9, 132.2, 133.5, 136.0, 142.0, 146.3. HRMS (ESI-TOF) Calcd for $C_{14}H_{11}BrN_3$, $[M+H]^+$ 300.0137; Found 300.0142.

1-(1-(3-bromophenyl)vinyl)-1*H*-benzo[*d*][1,2,3]triazole (3h).

1-bromo-3-vinylbenzene **1h** (0.5 mmol, 91.5 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg) and selectfluor (0.6 mmol, 212.4 mg). Then the reaction mixture was stirred in DME (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **3h** as pale yellow liquid (72%, 108.1 mg). ^1H NMR (400 MHz; $CDCl_3$): δ = 5.82 (s, 1H), 5.84 (s, 1H), 7.14 (d, J = 8.0, 2H), 7.19 (d, J = 8.4, 1H), 7.24-7.28 (m, 2H), 7.39-7.46 (m, 2H), 7.56 (d, J = 8.0, 1H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 110.9, 112.1, 120.3, 124.4, 125.5, 128.1, 129.9, 130.3, 132.8, 136.7, 141.3, 146.1. HRMS (ESI-TOF) Calcd for $C_{14}H_{11}BrN_3$, $[M+H]^+$ 300.0137; Found 300.0148.

1-(1-(4-bromophenyl)vinyl)-1*H*-benzo[*d*][1,2,3]triazole (3i).

1-bromo-4-vinylbenzene **1i** (0.5 mmol, 91.5 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg) and selectfluor (0.6 mmol, 212.4 mg). Then the

reaction mixture was stirred in DME (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **3i** as white solid (80%, 120.1 mg), melting point: 57-58 ^oC.

^1H NMR (400 MHz; $CDCl_3$): δ = 5.80 (d, J = 1.2, 1H), 5.82 (d, J = 0.8, 1H), 7.11-7.13 (m, 1H), 7.17 (dd, J_1 = 1.6, J_2 = 6.8, 2H), 7.40 (dd, J_1 = 1.6, J_2 = 4.8, 2H), 7.43 (d, J = 1.6, 2H), 7.53 (t, J = 6.4, 1H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 110.9, 111.4, 120.2, 124.1, 124.3, 128.0, 128.4, 132.0, 132.8, 133.6, 141.7, 146.1. HRMS (ESI-TOF) Calcd for $C_{14}H_{11}BrN_3$, $[M+H]^+$ 300.0137; Found 300.0141.

1-(1-(4-(trifluoromethyl)phenyl)vinyl)-1*H*-benzo[*d*][1,2,3]triazole (3j).

1-(trifluoromethyl)-4-vinylbenzene **1j** (0.5 mmol, 86.0 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg) and selectfluor (0.6 mmol, 212.4 mg). Then the reaction mixture was stirred in DME (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **3j** as white solid (77%, 111.4 mg), melting point: 83-84 ^oC.

^1H NMR (400 MHz; $CDCl_3$): δ = 5.89 (s, 1H), 5.92 (s, 1H), 7.13 (d, J = 7.6, 1H), 7.42-7.44 (m, 4H), 7.64 (d, J = 8.4, 2H), 8.13 (d, J = 7.2, 1H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 110.8, 112.9 (J_{C-F} = 209 Hz), 120.3, 123.8 (d, J = 272.9 Hz), 124.4, 125.8 (q, J = 3.7 Hz), 126.7, 128.2, 131.6 (q, J = 32.7 Hz), 132.7, 138.1, 141.4, 146.1. HRMS (ESI-TOF) Calcd for $C_{15}H_{11}F_3N_3$, $[M+H]^+$ 290.0905; Found 290.0909.

1-(1-(2,6-dichlorophenyl)vinyl)-1*H*-benzo[*d*][1,2,3]triazole (3k).

1,3-dichloro-2-vinylbenzene **1k** (0.5 mmol, 86.5 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg) and selectfluor (0.6 mmol, 212.4 mg). Then the reaction mixture was stirred in DME (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **3k** as white solid (73%, 105.9 mg), melting point: 91-92 ^oC.

^1H NMR (400 MHz; $CDCl_3$): δ = 5.50 (s, 1H), 6.26 (s, 1H), 7.24 (d, J = 8.4, 1H), 7.30-7.42 (m, 5H), 8.06 (dd, J_1 = 0.8, J_2 = 8.4, 1H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 110.7, 111.9, 120.3, 124.3, 128.4, 131.0, 131.7, 133.2, 135.8, 136.9, 146.2. HRMS (ESI-TOF) Calcd for $C_{14}H_{10}Cl_2N_3$, $[M+H]^+$ 290.0252; Found 290.0258.

1-(1-(*m*-tolyl)vinyl)-1*H*-benzo[*d*][1,2,3]triazole (3l).

1-methyl-3-vinylbenzene **1l** (0.5 mmol, 59.1 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg) and selectfluor (0.6 mmol, 212.4 mg). Then the reaction mixture was stirred in DME (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **3l** as pale yellow liquid (85%, 100.0 mg).

^1H NMR (400 MHz; $CDCl_3$): δ = 2.33 (s, 3H), 5.75 (s, 1H), 5.78 (s, 1H), 7.07-7.11 (m, 3H), 7.25 (d, J = 3.6, 2H), 7.37 (dd, J_1 = 3.2, J_2 = 6.4, 2H), 8.11 (dd, J_1 = 1.2, J_2 = 4.0, 1H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 21.4, 110.9, 111.3, 120.0, 124.1, 127.5, 127.7, 128.7, 130.6, 132.9, 134.6, 138.6, 142.7, 146.1. HRMS (ESI-TOF) Calcd for $C_{15}H_{14}N_3$, $[M+H]^+$ 236.1188; Found 236.1184.

1-(1-(*p*-tolyl)vinyl)-1*H*-benzo[*d*][1,2,3]triazole (3m).

1-methyl-4-vinylbenzene **1m** (0.5 mmol, 59.1 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg) and selectfluor (0.6 mmol, 212.4 mg). Then the reaction mixture was stirred in DME (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **3m** as pale yellow liquid (83%, 97.6 mg). ^{1}H NMR (400 MHz; $CDCl_3$): δ = 2.40 (s, 3H), 5.73 (s, 1H), 5.76 (s, 1H), 7.08 (d, J = 6.4, 1H), 7.20 (s, 4H), 7.37 (dd, J_1 = 3.2, J_2 = 6.4, 2H), 8.11-8.14 (m, 1H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 21.3, 110.2, 111.3, 120.1, 124.1, 126.8, 127.6, 129.5, 131.8, 132.9, 139.9, 142.6, 146.1. HRMS (ESI-TOF) Calcd for $C_{15}H_{14}N_3$, $[M+H]^+$ 236.1188; Found 236.1191.

1-(1-(4-(*tert*-butyl)phenyl)vinyl)-1*H*-benzo[*d*][1,2,3]triazole (3n).

1-(*tert*-butyl)-4-vinylbenzene **1n** (0.5 mmol, 80.1 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg) and selectfluor (0.6 mmol, 212.4 mg). Then the reaction mixture was stirred in DME (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **3n** as pale yellow liquid (79%, 109.6 mg). ^{1}H NMR (400 MHz; $CDCl_3$): δ = 1.34 (s, 9H), 5.71 (s, 1H), 5.80 (s, 1H), 7.14 (d, J = 6.4, 1H), 7.22 (d, J = 8.4, 2H), 7.37-7.41 (m, 4H), 8.12 (d, J = 2.0, 1H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 31.2, 34.8, 110.4, 111.2, 120.0, 124.1, 125.7, 126.5, 127.7, 131.7, 133.0, 142.5, 146.0, 153.1. HRMS (ESI-TOF) Calcd for $C_{18}H_{20}N_3$, $[M+H]^+$ 278.1657; Found 278.1652.

1-(1-(4-(chloromethyl)phenyl)vinyl)-1*H*-benzo[*d*][1,2,3]triazole (3o).

1-(chloromethyl)-4-vinylbenzene **1o** (0.5 mmol, 76.3 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg) and selectfluor (0.6 mmol, 212.4 mg). Then the reaction mixture was stirred in DME (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **3o** as pale yellow liquid (76%, 102.5 mg). ^{1}H NMR (400 MHz; $CDCl_3$): δ = 4.60 (s, 2H), 5.78 (s, 1H), 5.83 (d, J = 0.8, 1H), 7.11-7.13 (m, 1H), 7.28 (d, J = 8.0, 2H), 7.38-7.41 (m, 4H), 8.11 (t, J = 2.0, 1H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 31.2, 34.8, 110.4, 111.2, 120.0, 124.1, 125.7, 126.5, 127.7, 131.7, 133.0, 142.5, 146.0, 153.1. HRMS (ESI-TOF) Calcd for $C_{15}H_{13}ClN_3$, $[M+H]^+$ 270.0798; Found 270.0792.

4-(1-(1*H*-benzo[*d*][1,2,3]triazol-1-yl)vinyl)phenyl acetate (3p).

4-vinylphenyl acetate **1p** (0.5 mmol, 81.1 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg) and selectfluor (0.6 mmol, 212.4 mg). Then the reaction mixture was stirred in DME (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **3p** as white solid (69%, 96.4 mg), melting point: 95-96 ^{o}C.

^{1}H NMR (400 MHz; $CDCl_3$): δ = 2.30 (s, 3H), 5.75 (s, 1H), 5.79 (s, 1H), 7.11 (d, J = 6.8, 3H), 7.30 (d, J = 8.4, 2H), 7.37-7.39 (m, 2H), 8.09 (t, J = 2.4, 1H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 21.1, 111.1, 111.3, 120.1, 122.1, 124.3, 128.0, 132.2, 132.8, 141.7, 146.0, 151.7, 169.1. HRMS (ESI-TOF) Calcd for $C_{16}H_{14}N_3O_2$, $[M+H]^+$ 280.1086; Found 280.1082.

1-(1-(cyclohex-1-en-1-yl)vinyl)-1*H*-benzo[*d*][1,2,3]triazole (3q).

cyclohexene **1q** (0.5 mmol, 41.1 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg) and selectfluor (0.6 mmol, 212.4 mg). Then the reaction mixture was stirred in DME (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **3q** as pale yellow liquid (72%, 81.1 mg).

^{1}H NMR (400 MHz; $CDCl_3$): δ = 1.79-1.82 (m, 2H), 1.94-1.97 (m, 2H), 2.36-2.38 (m, 2H), 2.78-2.80 (m, 2H), 6.19-6.21 (m, 1H), 7.40 (m, 1H), 7.47 (t, J = 7.6, 1H), 7.66 (d, J = 8.4, 1H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 21.6, 22.4, 24.4, 27.6, 111.0, 120.0, 121.3, 124.0, 127.5, 131.9, 135.2, 146.0. HRMS (ESI-TOF) Calcd for $C_{14}H_{16}N_3$, $[M+H]^+$ 226.1344; Found 226.1347.

(*E*)-1-(1-(cyclooct-1-en-1-yl)vinyl)-1*H*-benzo[*d*][1,2,3]triazole (3r).

(*Z*)-cyclooctene **1r** (0.5 mmol, 55.1 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg) and selectfluor (0.6 mmol, 212.4 mg). Then the reaction mixture was stirred in DME (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **3r** as pale yellow liquid (70%, 88.7 mg).

^{1}H NMR (400 MHz; $CDCl_3$): δ = 1.68-1.75 (m, 8H), 2.41-2.46 (m, 2H), 2.93-2.93 (m, 2H), 6.11 (t, J = 8.4, 1H), 7.38 (t, J = 7.2, 1H), 7.47-7.51 (m, 1H), 7.65 (d, J = 8.4, 1H), 8.07 (d, J = 8.4, 1H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 26.0, 26.1, 26.5, 28.5, 29.1, 29.9, 111.0, 120.0, 123.9, 124.2, 127.5, 132.4, 137.4, 145.9. HRMS (ESI-TOF) Calcd for $C_{16}H_{20}N_3$, $[M+H]^+$ 254.1657; Found 254.1656.

5,6-dimethyl-1-(1-phenylvinyl)-1*H*-benzo[*d*][1,2,3]triazole (3s).

styrene **1a** (0.5 mmol, 54.0 mg), 5,6-dimethyl-2*H*-benzo[*d*][1,2,3]triazole (0.5 mmol, 73.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg) and selectfluor (0.6 mmol, 212.4 mg). Then the reaction mixture was stirred in DME (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **3s** as white solid (79%, 98.5 mg), melting point: 81-82 °C.

^{1}H NMR (400 MHz; $CDCl_3$): δ = 2.30 (s, 3H), 2.40 (s, 3H), 5.73 (s, 1H), 5.78 (s, 1H), 6.86 (s, 1H), 7.29 (d, J = 7.6, 2H), 7.36-7.42 (m, 3H), 7.85 (s, 1H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 20.3, 20.9, 110.5, 110.7, 119.1, 126.8, 128.7, 129.6, 132.0, 134.0, 138.2, 142.7, 145.3. HRMS (ESI-TOF) Calcd for $C_{16}H_{16}N_3$, $[M+H]^+$ 250.1344; Found 250.1340.

2-(1-phenylvinyl)-2*H*-benzo[*d*][1,2,3]triazole (4a).

styrene **1a** (0.5 mmol, 52.0 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **4a** as pale yellow liquid (79%, 87.3 mg).

^{1}H NMR (400 MHz; $CDCl_3$): δ = 5.67 (s, 1H), 6.21 (s, 1H), 7.42-7.45 (m, 7H), 7.92 (dd, J_1 = 2.8, J_2 = 6.8, 2H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 111.0, 118.5, 127.2, 128.4, 129.6, 134.6, 144.7, 147.1. HRMS (ESI-TOF) Calcd for $C_{14}H_{12}N_3$, $[M+H]^+$ 222.1031; Found 222.1037.

2-(1-(2-fluorophenyl)vinyl)-2*H*-benzo[*d*][1,2,3]triazole (4b).

1-fluoro-2-vinylbenzene **1b** (0.5 mmol, 61.0 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **4b** as white solid (74%, 88.5 mg), melting point:67-68 ^oC.

^1H NMR (400 MHz; $CDCl_3$): δ = 5.63 (s, 1H), 6.50 (s, 1H), 7.14 (t, J = 8.4, 1H), 7.27 (d, J = 7.2, 1H), 7.40 (dd, J_1 = 3.2, J_2 = 6.8, 2H), 7.47 (t, J = 7.2, 2H), 7.88 (d, J = 6.4, 2H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 112.6, 115.8, 116.1, 118.5, 124.2, 127.2, 131.1, 131.2 (d, J = 2.5 Hz), 131.4 (d, J = 8.3 Hz), 131.5, 141.9, 144.7, 159.0, 160.2 (d, J = 251.4 Hz), 161.5 . HRMS (ESI-TOF) Calcd for $C_{14}H_{11}FN_3$, $[M+H]^+$ 240.0937; Found 240.0942.

2-(1-(4-fluorophenyl)vinyl)-2*H*-benzo[*d*][1,2,3]triazole (4c).

1-fluoro-4-vinylbenzene **1c** (0.5 mmol, 61.0 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **4c** as pale yellow liquid (70%, 83.7 mg).

^1H NMR (400 MHz; $CDCl_3$): δ = 5.61 (s, 1H), 6.22 (s, 1H), 7.15 (t, J = 8.4, 2H), 7.41-7.45 (m, 4H), 7.91 (dd, J_1 = 2.8, J_2 = 6.8, 2H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 110.8, 115.4 (d, J = 21.9 Hz), 115.6, 118.4, 127.4, 130.3 (d, J = 8.5 Hz), 130.7 (d, J = 3.4 Hz), 144.7, 146.1, 162.2, 163.4 (d, J = 249.8 Hz), 164.7. HRMS (ESI-TOF) Calcd

for $C_{14}H_{11}FN_3$, $[M+H]^+$ 240.0937; Found 240.0941.

2-(1-(2-chlorophenyl)vinyl)-2*H*-benzo[*d*][1,2,3]triazole (4d).

1-chloro-2-vinylbenzene **1d** (0.5 mmol, 69.3 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **4d** as pale yellow liquid (71%, 90.8 mg).

^{1}H NMR (400 MHz; $CDCl_3$): δ = 5.52 (s, 1H), 6.56 (s, 1H), 7.38-7.46 (m, 5H), 7.56 (dd, J_1 = 2.0, J_2 = 6.8, 1H), 7.87 (d, J = 3.2, 2H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 111.9, 118.5, 126.9, 127.2, 129.8, 130.8, 131.8, 134.0, 134.1, 144.6, 144.8. HRMS (ESI-TOF) Calcd for $C_{14}H_{11}ClN_3$, $[M+H]^+$ 256.0642; Found 256.0640.

2-(1-(3-chlorophenyl)vinyl)-2*H*-benzo[*d*][1,2,3]triazole (4e).

1-chloro-3-vinylbenzene **1e** (0.5 mmol, 69.3 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **4e** as pale yellow liquid (73%, 93.3 mg).

^{1}H NMR (400 MHz; $CDCl_3$): δ = 5.67 (s, 1H), 6.26 (s, 1H), 7.34 (q, J = 7.6, 2H), 7.43-7.47 (m, 4H), 7.91 (dd, J_1 = 2.8, J_2 = 6.4, 2H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 111.8, 118.5, 124.6, 126.5, 127.4, 128.4, 129.7, 134.4, 136.3, 144.7, 145.8. HRMS

(ESI-TOF) Calcd for $C_{14}H_{11}ClN_3$, $[M+H]^+$ 256.0642; Found 256.0649.

2-(1-(4-chlorophenyl)vinyl)-2*H*-benzo[*d*][1,2,3]triazole (4f).

1-chloro-4-vinylbenzene **1f** (0.5 mmol, 69.3 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **4f** as white solid (75%, 95.9 mg), melting point: 156-157 ^oC.

^1H NMR (400 MHz; $CDCl_3$): δ = 5.65 (s, 1H), 6.24 (s, 1H), 7.39-7.44 (m, 6H), 7.90 (dd, J_1 = 3.2, J_2 = 6.8, 2H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 111.2, 118.4, 127.4, 128.7, 129.6, 133.0, 135.6, 144.7, 146.0. HRMS (ESI-TOF) Calcd for $C_{14}H_{11}ClN_3$, $[M+H]^+$ 256.0642; Found 256.0648.

2-(1-(2-bromophenyl)vinyl)-2*H*-benzo[*d*][1,2,3]triazole (4g).

1-bromo-2-vinylbenzene **1g** (0.5 mmol, 91.5 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **4g** as pale yellow liquid (68%, 102.1 mg).

^1H NMR (400 MHz; $CDCl_3$): δ = 5.50 (s, 1H), 5.67 (s, 1H), 7.36-7.41 (m, 3H), 7.56-7.58 (m, 2H), 7.65 (d, J = 8.0, 1H), 7.89 (t, J = 3.6, 2H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 111.7, 118.5, 123.8, 127.3, 127.6, 130.9, 132.1, 133.0, 136.0, 144.8, 145.8.

HRMS (ESI-TOF) Calcd for $C_{14}H_{11}BrN_3$, $[M+H]^+$ 300.0136; Found 300.0144.

2-(1-(3-bromophenyl)vinyl)-2*H*-benzo[*d*][1,2,3]triazole (4h).

1-bromo-3-vinylbenzene **1h** (0.5 mmol, 91.5 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **4h** as white solid (62%, 93.0 mg), melting point: 125-126 °C.

^{1}H NMR (400 MHz; $CDCl_3$): δ = 5.66 (s, 1H), 6.26 (s, 1H), 7.29-7.44 (m, 4H), 7.60 (d, J = 7.6, 2H), 7.90 (s, 2H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 111.8, 118.5, 122.5, 127.0, 127.4, 129.9, 131.3, 132.5, 136.7, 144.7, 145.7. HRMS (ESI-TOF) Calcd for $C_{14}H_{11}BrN_3$, $[M+H]^+$ 300.0136; Found 300.0141.

2-(1-(4-bromophenyl)vinyl)-2*H*-benzo[*d*][1,2,3]triazole (4i).

1-bromo-4-vinylbenzene **1i** (0.5 mmol, 91.5 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **4i** as pale yellow liquid (70%, 105.1 mg).

^{1}H NMR (400 MHz; $CDCl_3$): δ = 5.65 (s, 1H), 6.24 (d, J = 0.8, 1H), 7.33 (d, J = 8.4, 2H), 7.43 (dd, J_1 = 2.8, J_2 = 6.4, 2H), 7.57 (d, J = 8.8, 2H), 7.89 (dd, J_1 = 3.2, J_2 = 6.8, 2H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 111.2, 118.4, 123.9, 127.4, 129.9, 131.6,

133.5, 144.7, 146.1. HRMS (ESI-TOF) Calcd for $C_{14}H_{11}BrN_3$, $[M+H]^+$ 300.0136; Found 300.0139.

2-(1-(4-(trifluoromethyl)phenyl)vinyl)-2*H*-benzo[*d*][1,2,3]triazole (4j).

1-(trifluoromethyl)-4-vinylbenzene **1j** (0.5 mmol, 86.0 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **4j** as white solid (72%, 104.1 mg), melting point: 89-90 ^oC.

^1H NMR (400 MHz; $CDCl_3$): δ = 5.72 (s, 1H), 6.35 (s, 1H), 7.44 (dd, J_1 = 3.2, J_2 = 6.8, 2H), 7.59 (d, J = 4.4, 2H), 7.70 (d, J = 8.0, 2H), 7.91 (dd, J_1 = 3.2, J_2 = 6.8, 2H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 111.2, 118.1, 118.4, 123.8 (d, J = 272.9 Hz), 125.4 (q, J = 3.7 Hz), 127.5, 127.6, 128.8, 131.4 (q, J = 32.5 Hz), 138.0, 144.8, 145.8. HRMS (ESI-TOF) Calcd for $C_{15}H_{11}F_3N_3$, $[M+H]^+$ 290.0905; Found 290.0911.

2-(1-(4-nitrophenyl)vinyl)-2*H*-benzo[*d*][1,2,3]triazole (4k).

1-nitro-4-vinylbenzene **1k** (0.5 mmol, 74.5 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **4k** as white solid (65%, 86.5 mg), melting point: 110-111 ^oC.

^1H NMR (400 MHz; $CDCl_3$): δ = 5.78 (s, 1H), 6.43 (s, 1H), 7.45 (dd, J_1 = 3.2, J_2 = 6.8,

2H), 7.65 (d, J = 8.8, 2H), 7.89 (dd, J_1 = 3.2, J_2 = 6.8, 2H), 8.30 (d, J = 8.8, 2H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 113.2, 118.4, 123.7, 127.7, 129.4, 140.6, 144.8, 145.1, 148.3. HRMS (ESI-TOF) Calcd for $C_{14}H_{11}O_2N_4$, $[M+H]^+$ 267.0882; Found 267.0887.

2-(1-(2,6-dichlorophenyl)vinyl)-2*H*-benzo[*d*][1,2,3]triazole (4l).

1,3-dichloro-2-vinylbenzene **1l** (0.5 mmol, 86.5 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg), NIS (0.5 mmol, 112.5 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **4l** as white solid (80%, 116.1 mg), melting point: 150-151 ^{o}C.

^{1}H NMR (400 MHz; $CDCl_3$): δ = 5.51 (d, J = 0.8, 1H), 6.85 (s, 1H), 7.36-7.40 (m, 3H), 7.47 (d, J = 7.6, 2H), 7.85-7.88 (m, 2H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 112.5, 118.5, 127.3, 128.1, 130.8, 133.0, 136.0, 140.6, 144.8. HRMS (ESI-TOF) Calcd for $C_{14}H_{10}Cl_2N_3$, $[M+H]^+$ 290.0252; Found 290.0257.

2-(1-(naphthalen-2-yl)vinyl)-2*H*-benzo[*d*][1,2,3]triazole (4m).

2-vinylnaphthalene **1m** (0.5 mmol, 72.1 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **4m** as pale yellow liquid (76%, 102.7 mg).

^{1}H NMR (400 MHz; $CDCl_3$): δ = 5.80 (s, 1H), 6.31 (s, 1H), 7.44 (dd, J_1 = 3.2, J_2 = 6.4,

2H), 7.53 (dd, J_1 = 3.6, J_2 = 7.2, 2H), 7.89-7.99 (m, 7H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 111.4, 118.5, 125.4, 126.5, 127.0, 127.3, 127.7, 128.0, 128.1, 128.5, 132.0, 133.0, 133.7, 144.7, 147.2. HRMS (ESI-TOF) Calcd for $C_{18}H_{14}N_3$, $[M+H]^+$ 272.1188; Found 272.1182.

2-(1-(*m*-tolyl)vinyl)-2*H*-benzo[*d*][1,2,3]triazole (4n).

1-methyl-3-vinylbenzene **1n** (0.5 mmol, 59.7 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **4n** as pale yellow liquid (75%, 88.2 mg).

^{1}H NMR (400 MHz; $CDCl_3$): δ = 2.39 (s, 3H), 5.65 (s, 1H), 6.18 (s, 1H), 7.24 (t, J = 8.0, 3H), 7.32 (d, J = 7.6, 1H), 7.42 (dd, J_1 = 3.2, J_2 = 6.4, 2H), 7.92 (dd, J_1 = 3.2, J_2 = 6.8, 2H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 21.4, 110.9, 118.5, 125.4, 127.2, 128.3, 128.8, 130.4, 134.6, 138.1, 144.7, 147.3. HRMS (ESI-TOF) Calcd for $C_{15}H_{14}N_3$, $[M+H]^+$ 236.1188; Found 236.1192.

2-(1-(*p*-tolyl)vinyl)-2*H*-benzo[*d*][1,2,3]triazole (4o).

1-methyl-4-vinylbenzene **1o** (0.5 mmol, 59.7 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **4o** as pale yellow liquid (79%,

92.9 mg).

^{1}H NMR (400 MHz; $CDCl_3$): δ = 2.42 (s, 3H), 5.63 (s, 1H), 6.16 (s, 1H), 7.24 (d, J = 8.0, 2H), 7.34 (d, J = 8.4, 2H), 7.42 (dd, J_1 = 2.8, J_2 = 6.8, 2H), 7.92 (dd, J_1 = 3.2, J_2 = 6.8, 2H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 21.3, 110.3, 118.5, 127.1, 128.2, 129.1, 131.8, 139.7, 144.6, 147.1. HRMS (ESI-TOF) Calcd for $C_{15}H_{14}N_3$, $[M+H]^+$ 236.1188; Found 236.1195.

2-(1-(4-(*tert*-butyl)phenyl)vinyl)-2*H*-benzo[*d*][1,2,3]triazole (4p).

1-(*tert*-butyl)-4-vinylbenzene **1p** (0.5 mmol, 80.1 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **4p** as pale yellow liquid (74%, 102.6 mg).

^{1}H NMR (400 MHz; $CDCl_3$): δ = 1.36 (s, 9H), 5.65 (s, 1H), 6.15 (s, 1H), 7.38-7.47 (m, 6H), 7.91 (dd, J_1 = 3.2, J_2 = 6.4, 2H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 31.2, 34.7, 110.5, 118.5, 125.4, 127.1, 127.9, 131.6, 144.6, 147.1, 152.7. HRMS (ESI-TOF) Calcd for $C_{18}H_{20}N_3$, $[M+H]^+$ 278.1657; Found 278.1651.

2-(1-(4-(chloromethyl)phenyl)vinyl)-2*H*-benzo[*d*][1,2,3]triazole (4q).

1-(chloromethyl)-4-vinylbenzene **1q** (0.5 mmol, 76.3 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was

purified by flash column chromatography to give the desired product **4q** as pale yellow liquid (70%, 94.4 mg).

^{1}H NMR (400 MHz; $CDCl_3$): δ = 4.64 (s, 2H), 5.67 (s, 1H), 6.24 (s, 1H), 7.42-7.46 (m, 6H), 7.90 (dd, J_1 = 3.2, J_2 = 6.4, 2H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 45.6, 111.3, 118.4, 127.3, 128.6, 128.7, 134.6, 138.7, 144.7, 146.5. HRMS (ESI-TOF) Calcd for $C_{15}H_{13}ClN_3$, $[M+H]^+$ 270.0798; Found 270.0793.

4-(1-(2*H*-benzo[*d*][1,2,3]triazol-2-yl)vinyl)phenyl acetate (4r).

4-vinylphenyl acetate **1r** (0.5 mmol, 81.1 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **4r** as white solid (67%, 93.6 mg), melting point: 90-91 ^{o}C.

^{1}H NMR (400 MHz; $CDCl_3$): δ = 2.33 (s, 3H), 6.56 (s, 1H), 6.22 (s, 1H), 7.17 (d, J = 8.4, 2H), 7.42-7.49 (m, 4H), 7.90 (dd, J_1 = 3.2, J_2 = 6.8, 2H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 21.2, 111.2, 18.4, 121.7, 127.3, 129.5, 132.2, 144.7, 146.2, 151.1, 169.2. HRMS (ESI-TOF) Calcd for $C_{16}H_{14}N_3O_2$, $[M+H]^+$ 280.1086; Found 280.1092.

2-(cyclopent-1-en-1-yl)-2*H*-benzo[*d*][1,2,3]triazole (4s).

cyclopentene **1s** (0.5 mmol, 34.0 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash

column chromatography to give the desired product **4s** as white solid (78%, 72.2 mg), melting point: 91-92 °C.

^{1}H NMR (400 MHz; $CDCl_3$): δ = 2.16-2.23 (m, 2H), 2.65-2.69 (m, 2H), 3.16-3.20 (m, 2H), 6.63 (s, 1H), 7.37 (dd, J_1 = 3.2, J_2 = 6.8, 2H), 7.86 (dd, J_1 = 2.8, J_2 = 6.4, 2H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 22.1, 31.2, 31.4, 118.0, 121.2, 126.9, 141.8, 144.5. HRMS (ESI-TOF) Calcd for $C_{11}H_{12}N_3$, $[M+H]^+$ 186.1031; Found 186.1037.

2-(cyclohex-1-en-1-yl)-2*H*-benzo[*d*][1,2,3]triazole (4t).

cyclohexene **1t** (0.5 mmol, 41.0 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **4t** as white solid (73%, 72.7 mg), melting point: 65-66 °C.

^{1}H NMR (400 MHz; $CDCl_3$): δ = 1.72-1.76 (m, 2H), 1.90-1.93 (m, 2H), 2.35-2.37 (m, 2H), 2.90-2.92 (m, 2H), 6.98 (s, 1H), 7.35 (dd, J_1 = 2.8, J_2 = 6.4, 2H), 7.86 (dd, J_1 = 3.2, J_2 = 6.4, 2H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 21.6, 22.3, 24.4, 25.6, 118.0, 120.7, 126.5, 138.2, 144.1. HRMS (ESI-TOF) Calcd for $C_{12}H_{14}N_3$, $[M+H]^+$ 200.1188; Found 200.1195.

(*E*)-2-(cyclooct-1-en-1-yl)-2*H*-benzo[*d*][1,2,3]triazole (4u).

(*Z*)-cyclooctene **1u** (0.5 mmol, 55.1 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and

concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **4u** as white solid (82%, 93.2 mg), melting point: 64-65 ^{o}C.

^{1}H NMR (400 MHz; $CDCl_3$): δ = 1.59-1.84 (m, 8H), 2.38-2.43 (m, 2H), 3.11-3.14 (m, 2H), 6.96 (s, 1H), 7.35 (dd, J_1 = 2.8, J_2 = 6.4, 2H), 7.86 (dd, J_1 = 3.2, J_2 = 6.4, 2H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 25.9, 26.3, 26.4, 26.7, 28.5, 29.9, 118.0, 123.1, 126.5, 140.5, 144.2. HRMS (ESI-TOF) Calcd for $C_{14}H_{18}N_3$, $[M+H]^+$ 228.1501; Found 228.1509.

2-(2,5-dihydrofuran-3-yl)-2*H*-benzo[*d*][1,2,3]triazole (4v).

2,5-dihydrofuran **1v** (0.5 mmol, 35.0 mg), benzotriazole **2a** (0.5 mmol, 59.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **4v** as white solid (69%, 64.6 mg), melting point: 116-117 ^{o}C.

^{1}H NMR (400 MHz; $CDCl_3$): δ = 4.99-5.02 (m, 2H), 5.30-5.33 (m, 2H), 6.69 (t, J = 2.0, 1H), 7.42 (dd, J_1 = 3.2, J_2 = 7.2, 2H), 7.86 (d, J = 2.8, 2H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 72.2, 75.5, 115.2, 118.1, 127.6, 144.7. HRMS (ESI-TOF) Calcd for $C_{10}H_{10}ON_3$, $[M+H]^+$ 188.0824; Found 188.0827.

5-methyl-2-(1-phenylvinyl)-2*H*-benzo[*d*][1,2,3]triazole (4w).

styrene **1a** (0.5 mmol, 54.0 mg), 5-methyl-2*H*-benzo[*d*][1,2,3]triazole (0.5 mmol, 66.5 mg), $(PhSe)_2$ (5% mol, 7.8 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5

× 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **4w** as pale yellow liquid (70%, 82.4 mg).

^{1}H NMR (400 MHz; $CDCl_3$): δ = 2.51 (s, 3H), 5.64 (d, J = 0.8, 1H), 6.18 (d, J = 0.8, 1H), 7.25 (d, J = 1.2, 1H), 7.44-7.46 (m, 5H), 7.66 (d, J = 1.2, 1H), 7.79 (d, J = 8.8, 1H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 22.2, 110.5, 116.5, 117.9, 128.2, 128.4, 129.5, 130.2, 134.7, 143.4, 145.2, 147.1. HRMS (ESI-TOF) Calcd for $C_{15}H_{14}N_3$, $[M+H]^+$ 236.1188; Found 236.1194.

5-chloro-2-(1-phenylvinyl)-2*H*-benzo[*d*][1,2,3]triazole (4x).

styrene **1a** (0.5 mmol, 54.0 mg), 5-chloro-2*H*-benzo[*d*][1,2,3]triazole (0.5 mmol, 76.7 mg), $(PhSe)_2$ (5% mol, 7.8 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **4x** as white solid (74%, 94.6 mg), melting point: 65-66 ^{o}C.

^{1}H NMR (400 MHz; $CDCl_3$): δ = 5.68 (s, 1H), 6.24 (s, 1H), 7.35-7.46 (m, 6H), 7.84-7.92 (m, 2H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 111.4, 117.4, 119.7, 128.3, 128.5, 128.8, 129.6, 133.1, 134.3, 143.2, 145.0, 147.0. HRMS (ESI-TOF) Calcd for $C_{14}H_{11}ClN_3$, $[M+H]^+$ 256.0642; Found 256.0647.

5,6-dimethyl-2-(1-phenylvinyl)-2*H*-benzo[*d*][1,2,3]triazole (4y).

styrene **1a** (0.5 mmol, 54.0 mg), 5,6-dimethyl-2*H*-benzo[*d*][1,2,3]triazole (0.5 mmol, 73.6 mg), $(PhSe)_2$ (5% mol, 7.8 mg), Me_3SiH (0.5 mmol, 37.1 mg) and $K_2S_2O_8$ (0.6 mmol, 162.0 mg). Then the reaction mixture was stirred in dioxane (2.0 mL) at 120 °C. Upon completion of the reaction (as monitored by TLC), the mixture was cooled

to room temperature and quenched with water before being extracted with dichloromethane (5 × 3 mL). The combined organic layers were dried over anhydrous Na_2SO_4 and concentrated under reduced pressure to give a residue, which was purified by flash column chromatography to give the desired product **4y** as pale yellow liquid (75%, 93.5 mg).

^{1}H NMR (400 MHz; $CDCl_3$): δ = 2.42 (s, 6H), 5.61 (s, 1H), 6.16 (s, 1H), 7.44-7.45 (m, 5H), 7.65 (s, 2H). ^{13}C NMR (100 MHz; $CDCl_3$): δ = 20.9, 110.2, 116.7, 128.2, 128.4, 129.4, 134.8, 137.9, 144.2, 147.1. HRMS (ESI-TOF) Calcd for $C_{16}H_{16}N_3$, $[M+H]^+$ 250.1344; Found 250.1339.

References:

1. E. Tang, W.-L. Wang, Y.-J. Zhao, M. Zhang, X. Dai, *Org. Lett*., 2016, **18**, 176.

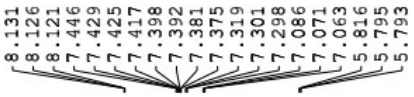
2. K. Sun, X. Wang, Y.-H. Lv, G. Li, H.-Z. Jiao, C.-W. Dai, Y.-Y. Li, C. Zhang, L. Liu, *Chem. Commun*., 2016, **52**, 8471.

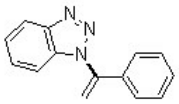
3. L. Sun, Y. Yuan, M. Yao, H. Wang, D.-X. Wang, M. Gao, Y.-H. Chen, A.-W. Lei, *Org. Lett*., 2019, **21**, 1297.

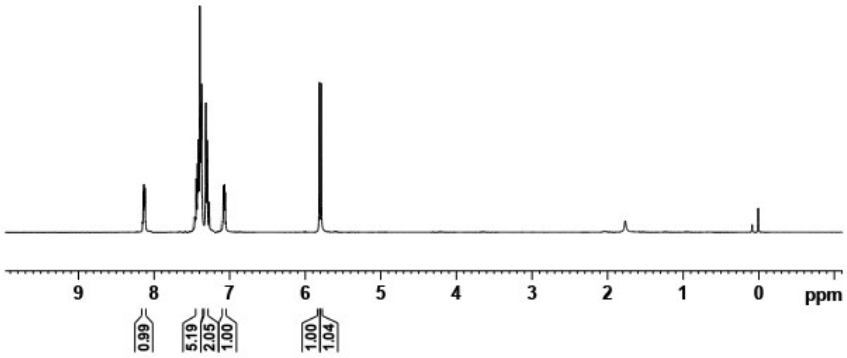
4. 1-(Trimethylsilyl)-1H-benzotriazole **8** (CAS: 43183-36-4) is purchased directly from Sigma-Aldrich or TCI.

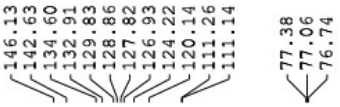
V. ^{1}H NMR, and ^{13}C NMR Spectra of Compounds **3 and 4**

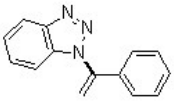
Compound 3a

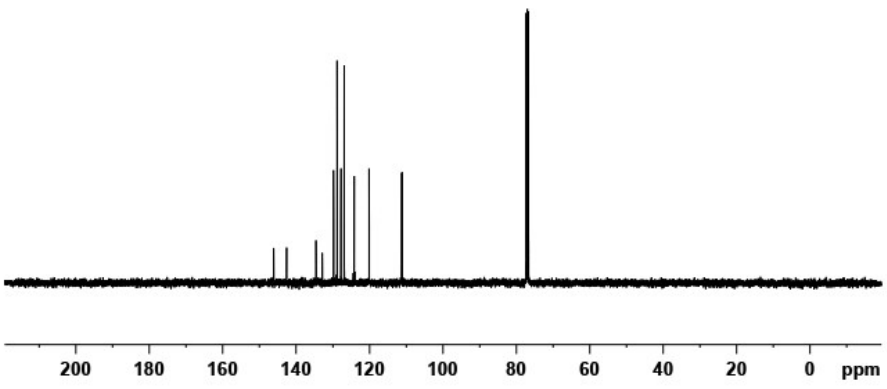




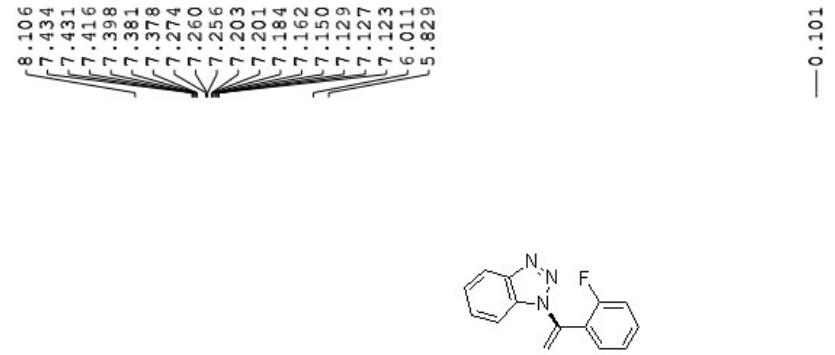








Compound 3b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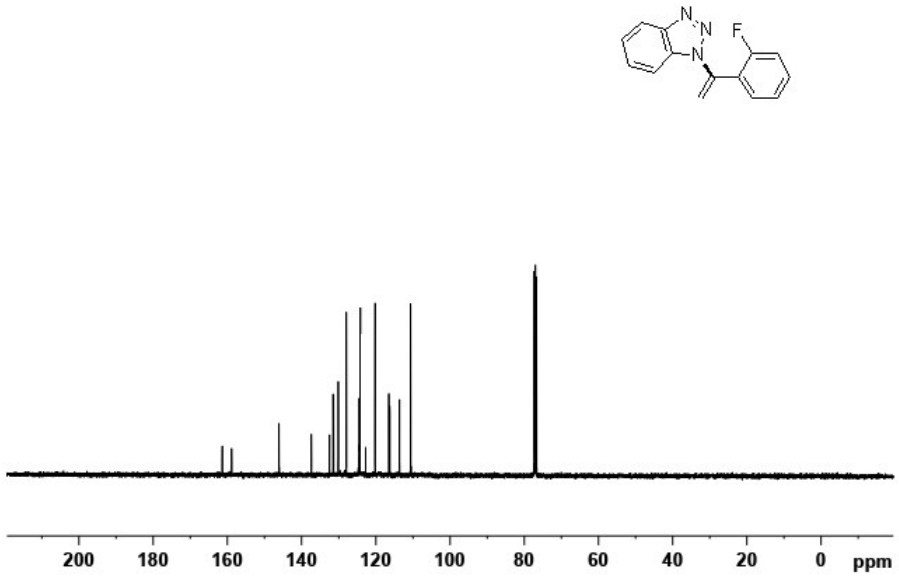
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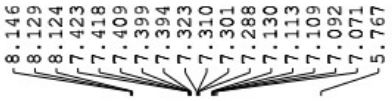
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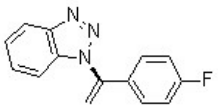
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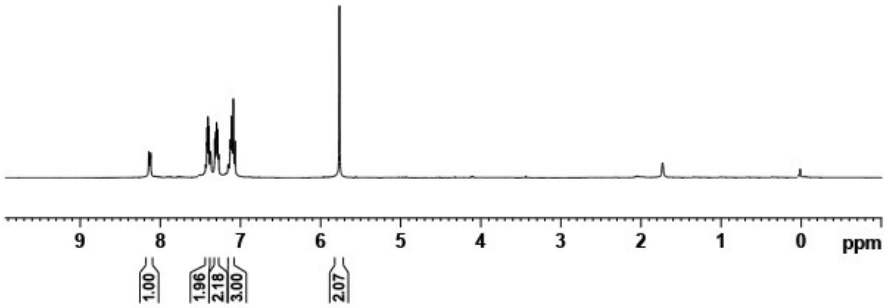
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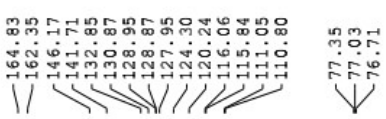
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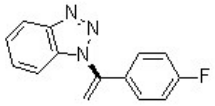
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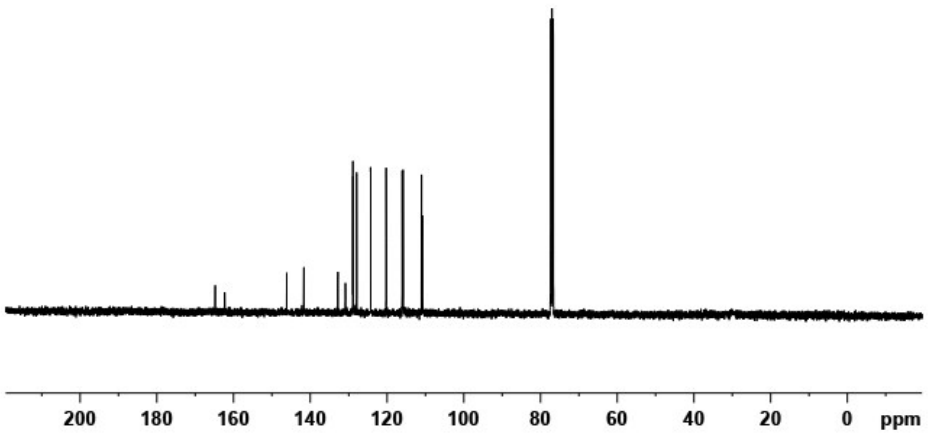
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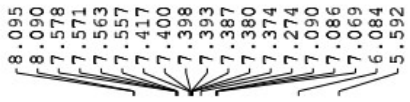
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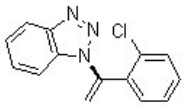
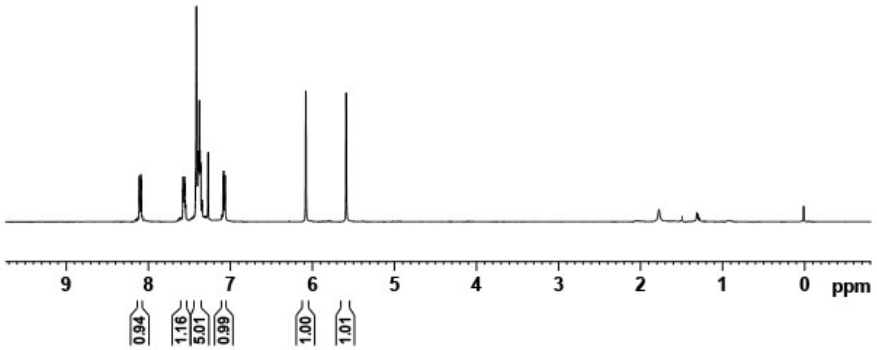
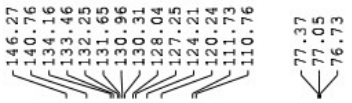
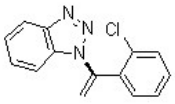
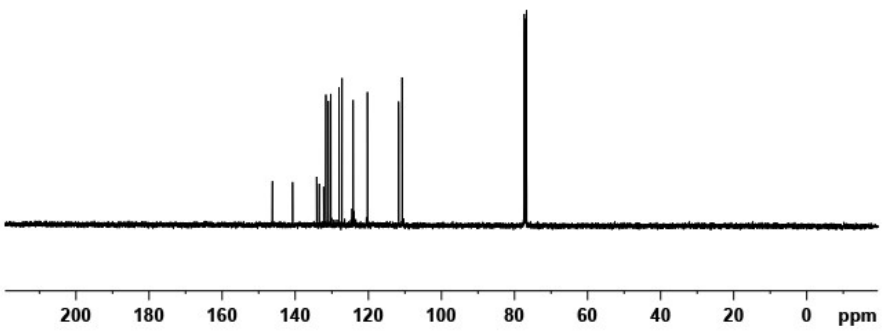
7.069
6.084
5.592


N
N
N
Cl

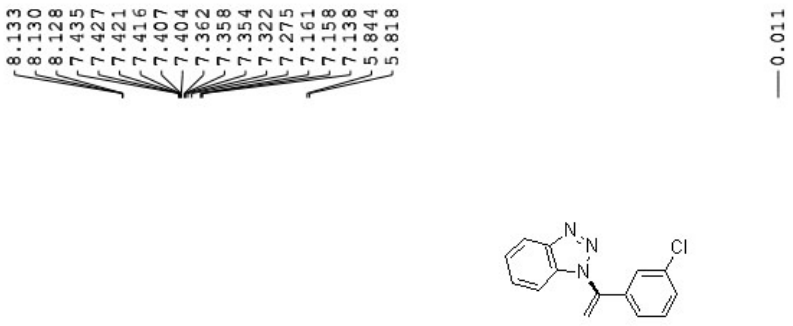

9
8
7
6
5
4
3
2
1
0
ppm
0.94
1.16
5.01
0.99
1.00
1.01

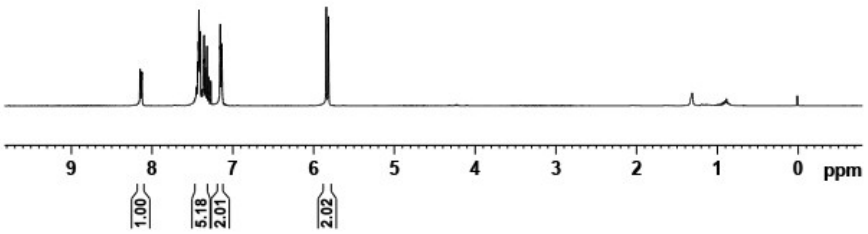

146.27
140.76
134.16
133.46
132.25
131.65
130.96
130.31
128.04
127.25
124.21
120.24
111.73
110.76
77.37
77.05
76.73

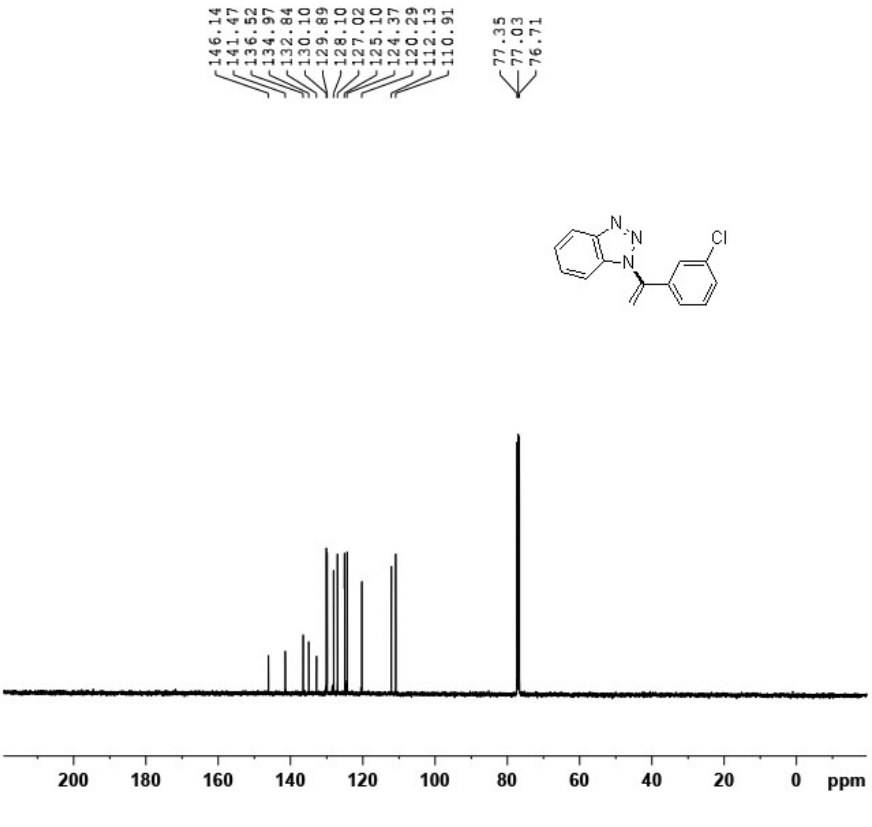

N
N
N
Cl


200
180
160
140
120
100
80
60
40
20
0
ppm

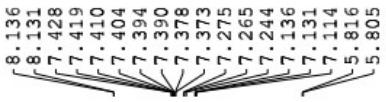
Compound 3e

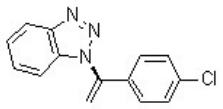

8.133
8.130
8.128
7.435
7.427
7.421
7.416
7.407
7.404
7.362
7.358
7.354
7.322
7.275
7.161
7.158
7.138
5.844
5.818
0.011
N
N
N
Cl

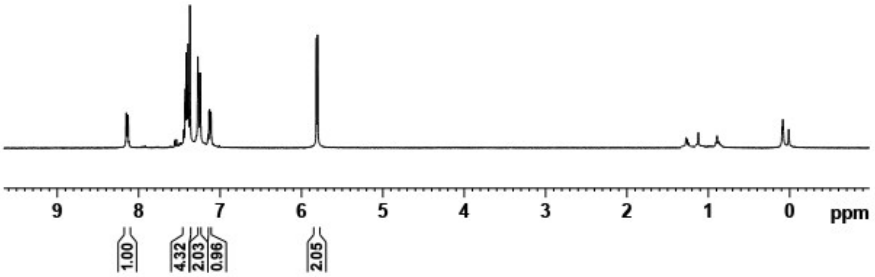

9
8
7
6
5
4
3
2
1
0
ppm
1.00
5.18
2.01
2.02

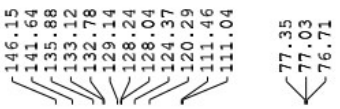

146.14
141.47
136.52
134.97
132.84
130.10
129.89
128.10
127.02
125.10
124.37
120.29
112.13
110.91
77.35
77.03
76.71
N
N
N
Cl
200
180
160
140
120
100
80
60
40
20
0
ppm

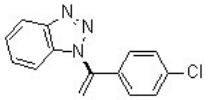
Compound 3f


8.136
8.131
7.428
7.419
7.410
7.404
7.394
7.390
7.378
7.373
7.275
7.265
7.244
7.136
7.131
7.114
5.816
5.805


N
N
N
Cl


9
8
7
6
5
4
3
2
1
0
ppm
1.00
4.32
2.03
0.96
2.05

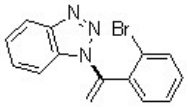

146.15
141.64
135.88
133.12
132.78
129.14
128.24
128.04
124.37
120.29
111.46
111.04
77.35
77.03
76.71

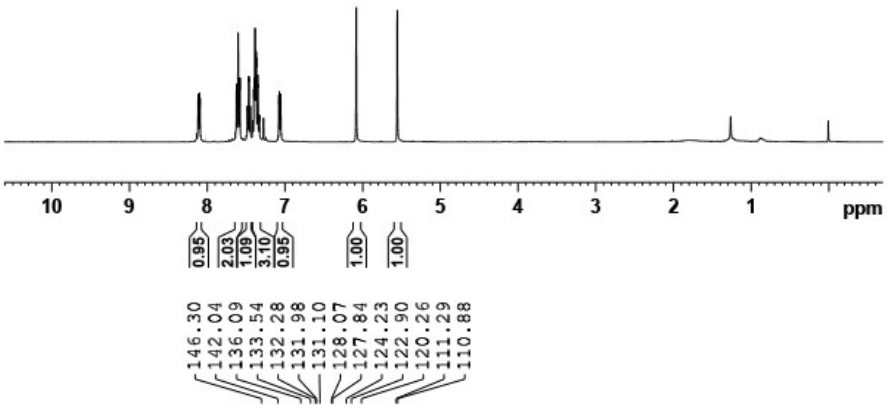

N
N
N
Cl

200
180
160
140
120
100
80
60
40
20
0
ppm

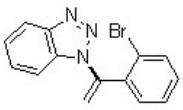
Compound 3g

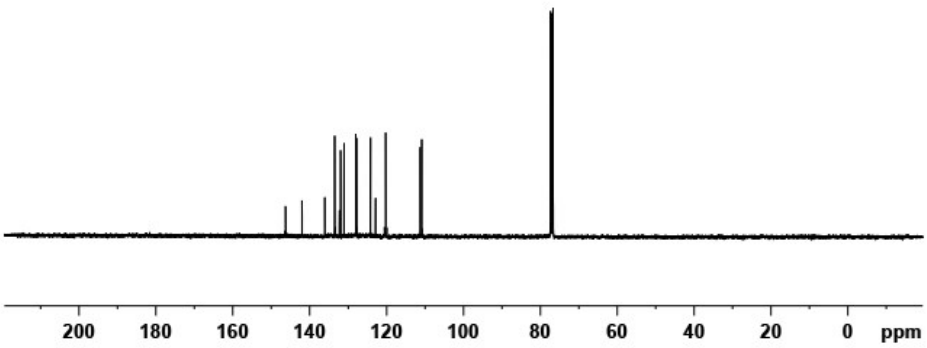

8.114
8.107
8.097
8.092
7.621
7.619
7.600
7.581
7.577
7.479
7.463
7.460
7.444
7.389
7.382
7.375
7.369
7.365
7.349
7.274
7.074
7.070
7.053
6.082
6.080
5.556
5.554


N
N
N
Br

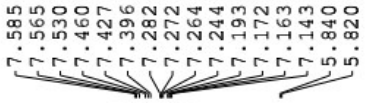

10
9
8
7
6
5
4
3
2
1
ppm
0.95
2.03
1.09
3.10
0.95
1.00
1.00

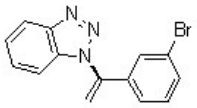
146.30
142.04
136.09
133.54
132.28
131.98
131.10
128.07
127.84
124.23
122.90
120.26
111.29
110.88

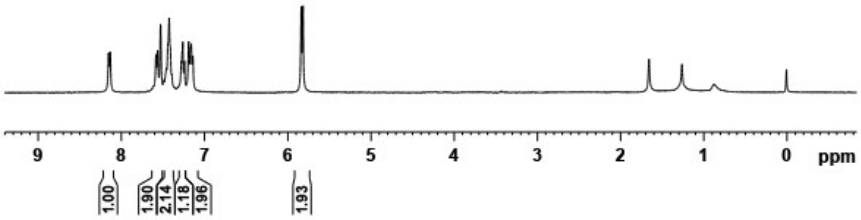

N
N
N
Br

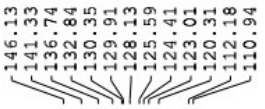

200
180
160
140
120
100
80
60
40
20
0
ppm

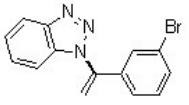
Compound 3h

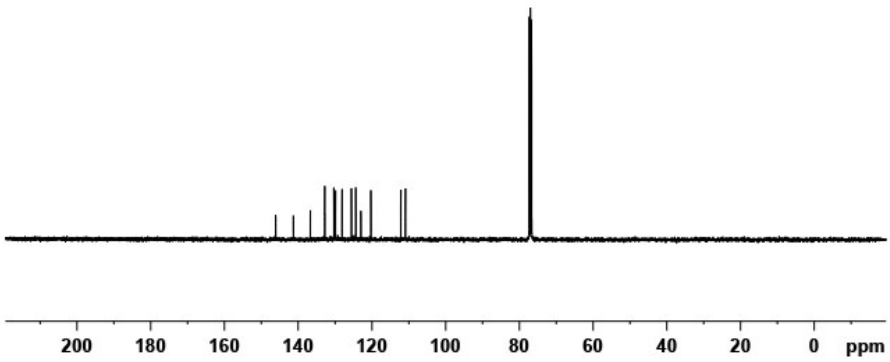

7.585
7.565
7.530
7.460
7.427
7.396
7.282
7.272
7.264
7.244
7.193
7.172
7.163
7.143
5.840
5.820


N
N
N
Br

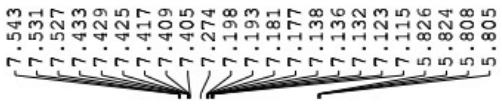

9
8
7
6
5
4
3
2
1
0
ppm
1.00
1.90
2.14
1.18
1.96
1.93

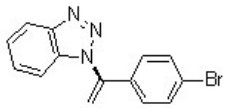

146.13
141.33
136.74
132.84
130.35
129.91
128.13
125.59
124.41
123.01
120.31
112.18
110.94

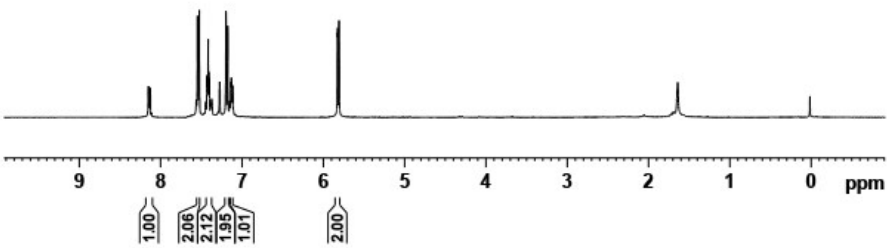

N
N
N
Br

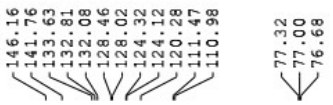

200
180
160
140
120
100
80
60
40
20
0
ppm

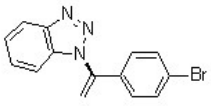
Compound 3i

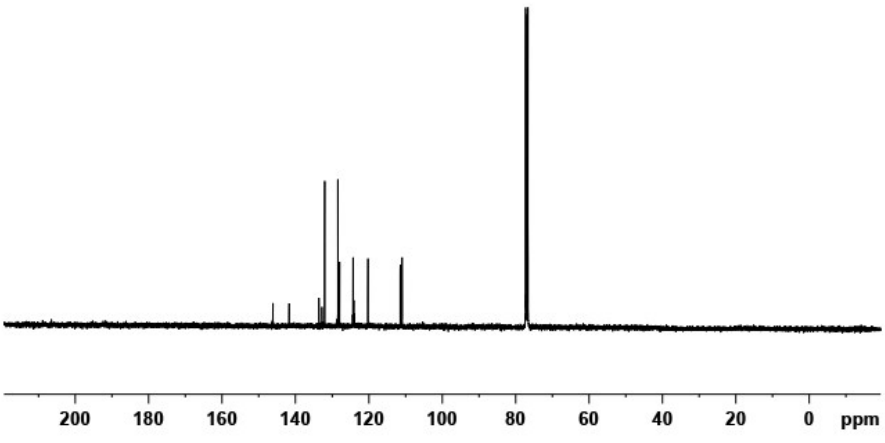

7.543
7.531
7.527
7.433
7.429
7.425
7.417
7.409
7.405
7.274
7.198
7.193
7.181
7.177
7.138
7.136
7.132
7.123
7.115
5.826
5.824
5.808
5.805


N
N
N
Br

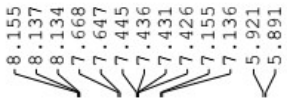

9
8
7
6
5
4
3
2
1
0
ppm
1.00
2.06
2.12
1.95
1.01
2.00

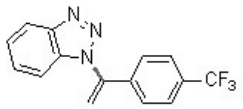

146.16
141.76
133.63
132.81
132.08
128.46
128.02
124.32
124.12
120.28
111.47
110.98
77.32
77.00
76.68

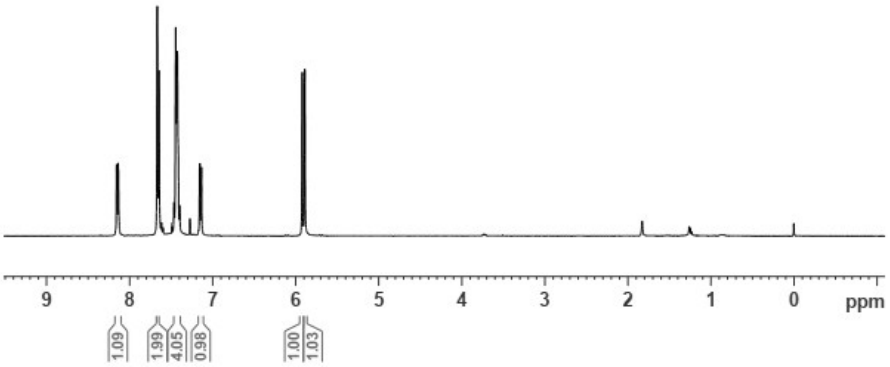

N
N
N
Br

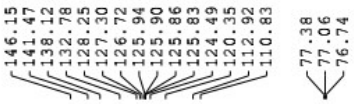

200
180
160
140
120
100
80
60
40
20
0
ppm

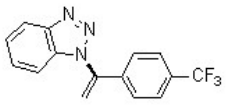
Compound 3j

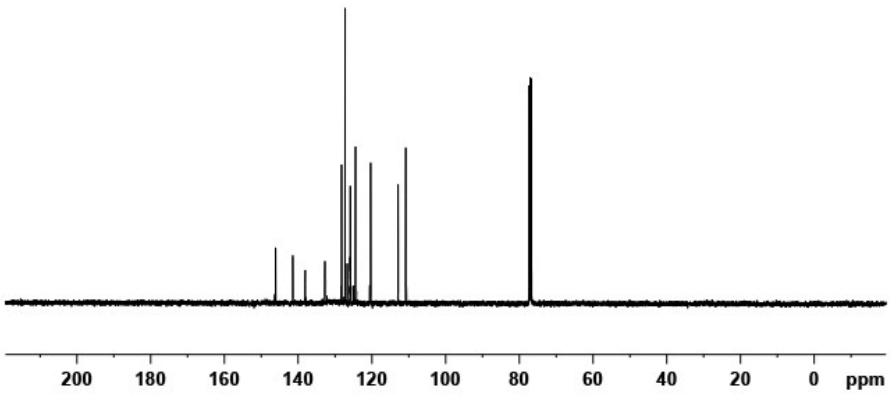

8.155
8.137
8.134
7.668
7.647
7.445
7.436
7.431
7.426
7.155
7.136
5.921
5.891


N
N
N
CF3

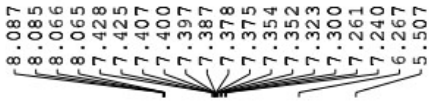

9
8
7
6
5
4
3
2
1
0
ppm
1.09
1.99
4.05
0.98
1.00
1.03

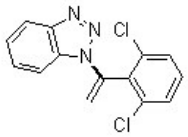

146.15
141.47
138.12
132.78
128.25
127.30
126.72
125.94
125.90
125.86
125.83
124.49
120.35
112.92
110.83
77.38
77.06
76.74

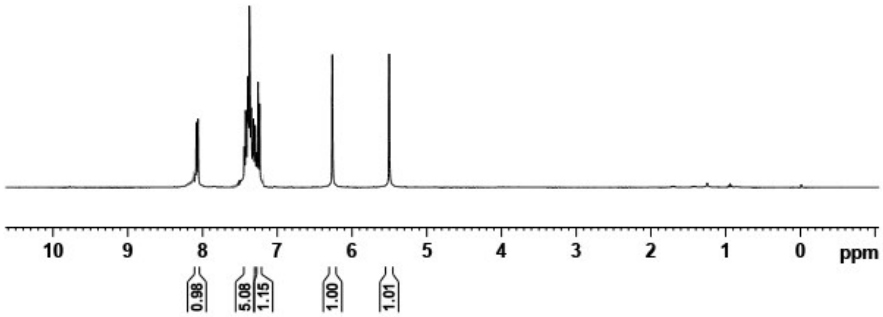

N
N
N
CF3

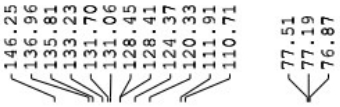

200
180
160
140
120
100
80
60
40
20
0
ppm

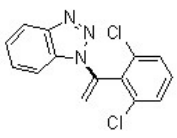
Compound 3k


8.087
8.085
8.066
8.065
7.428
7.425
7.407
7.400
7.397
7.387
7.378
7.375
7.354
7.352
7.323
7.300
7.261
7.240
6.267
5.507


N
N
N
Cl
Cl


10
9
8
7
6
5
4
3
2
1
0
ppm
0.98
5.08
1.15
1.00
1.01


146.25
136.96
135.81
133.23
131.70
131.06
128.45
128.41
124.37
120.33
111.91
110.71
77.51
77.19
76.87

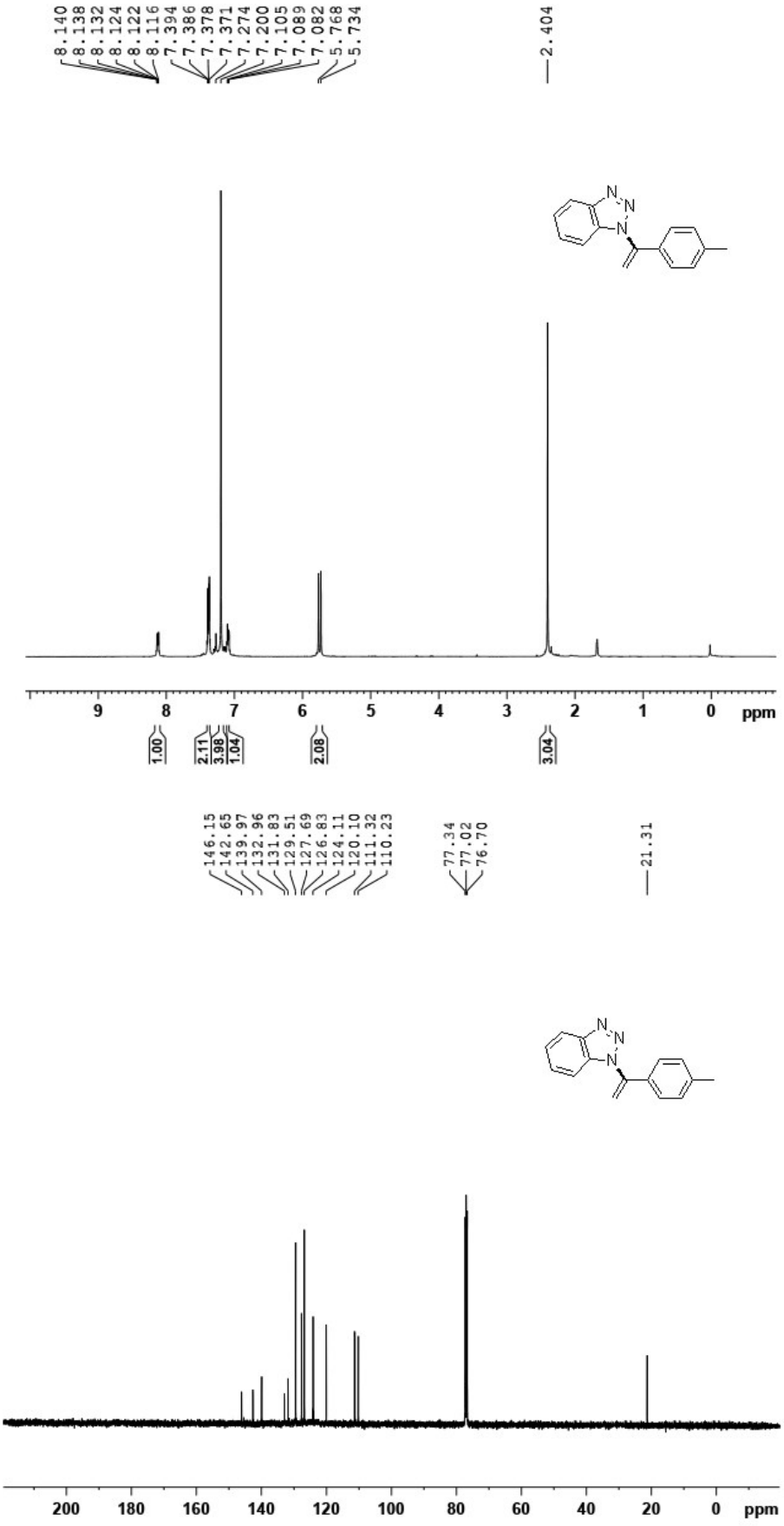

N
N
N
Cl
Cl

200
180
160
140
120
100
80
60
40
20
0
ppm

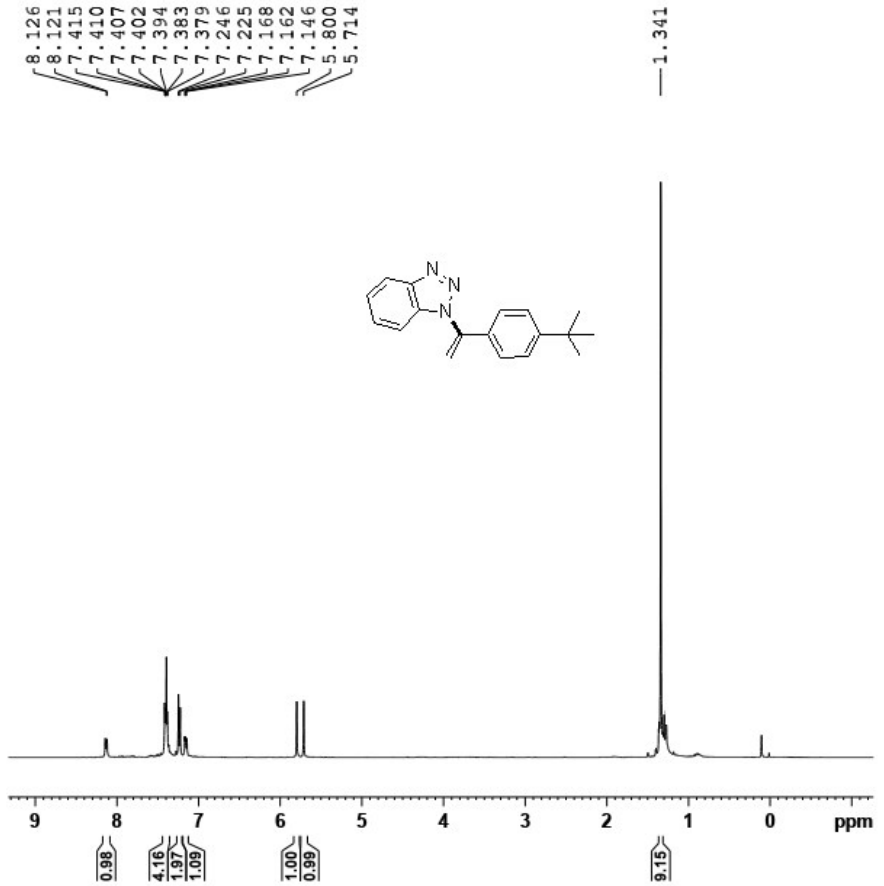
Compound 3l

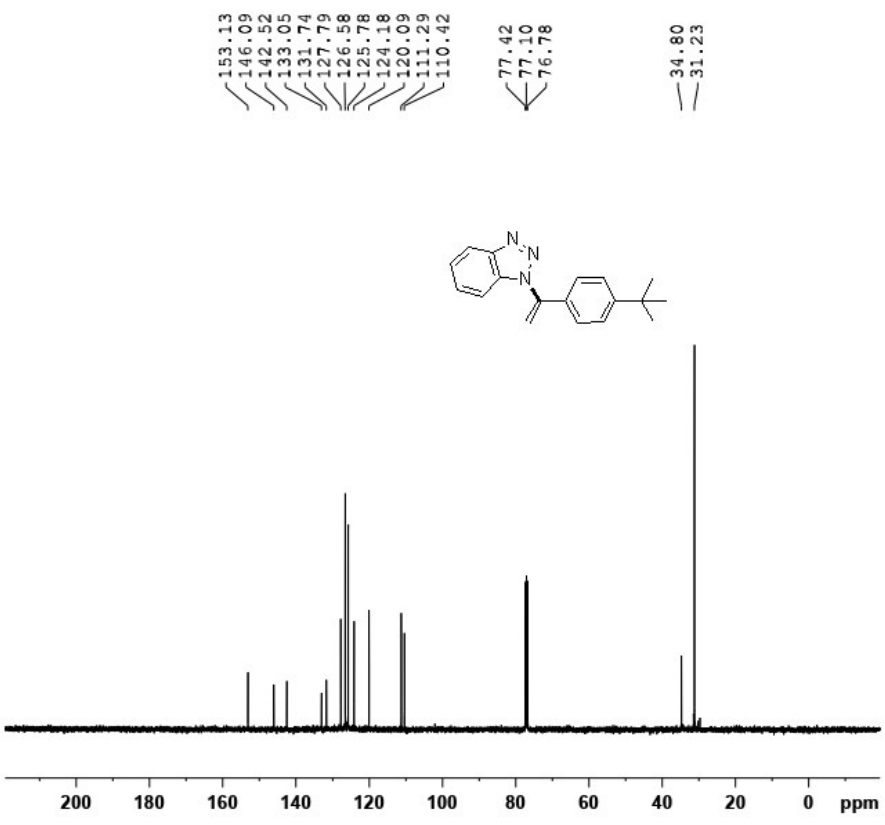

8.129
8.126
8.119
8.111
7.391
7.383
7.375
7.367
7.272
7.253
7.130
7.107
7.099
7.093
7.084
7.076
5.785
5.751
2.337
9
8
7
6
5
4
3
2
1
0
ppm
1.00
2.09
2.05
2.97
0.99
1.00
3.00
146.11
142.76
138.62
134.60
132.96
130.62
128.73
127.79
127.51
124.19
124.12
120.08
111.31
110.90
77.42
77.11
76.79
21.41
200
180
160
140
120
100
80
60
40
20
0
ppm

Compound 3m

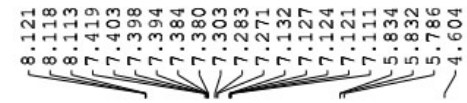

8.140
8.138
8.132
8.124
8.122
8.116
7.394
7.386
7.378
7.371
7.274
7.200
7.105
7.089
7.082
5.768
5.734
2.404
9
8
7
6
5
4
3
2
1
0
ppm
1.00
2.11
3.98
1.04
2.08
3.04
146.15
142.65
139.97
132.96
131.83
129.51
127.69
126.83
124.11
120.10
111.32
110.23
77.34
77.02
76.70
21.31
200
180
160
140
120
100
80
60
40
20
0
ppm

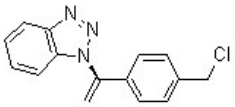
Compound 3n

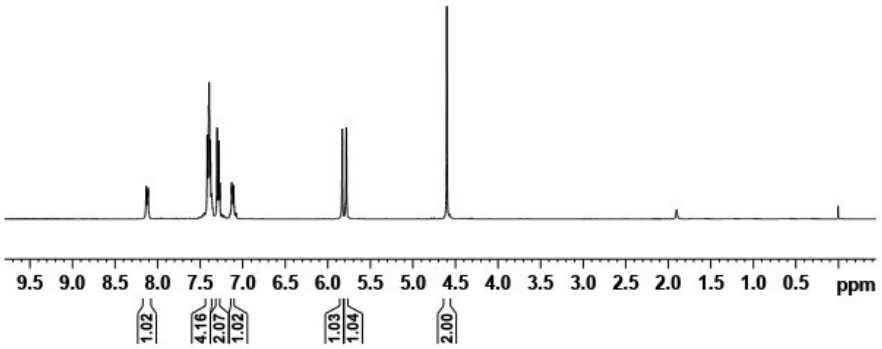

8.126
8.121
7.415
7.410
7.407
7.402
7.394
7.383
7.379
7.246
7.225
7.168
7.162
7.146
5.800
5.714
1.341
9 8 7 6 5 4 3 2 1 0 ppm
0.98
4.16
1.97
1.09
1.00
0.99
9.15

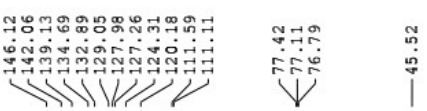

153.13
146.09
142.52
133.05
131.74
127.79
126.58
125.78
124.18
120.09
111.29
110.42
77.42
77.10
76.78
34.80
31.23
200 180 160 140 120 100 80 60 40 20 0 ppm

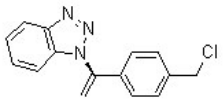
Compound 3o

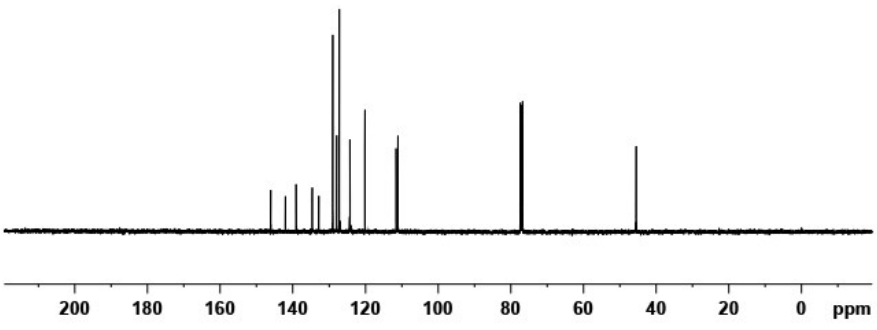

8.121
8.118
8.113
7.419
7.403
7.398
7.394
7.384
7.380
7.303
7.283
7.271
7.132
7.127
7.124
7.121
7.111
5.834
5.832
5.786
4.604


N
N
N
Cl

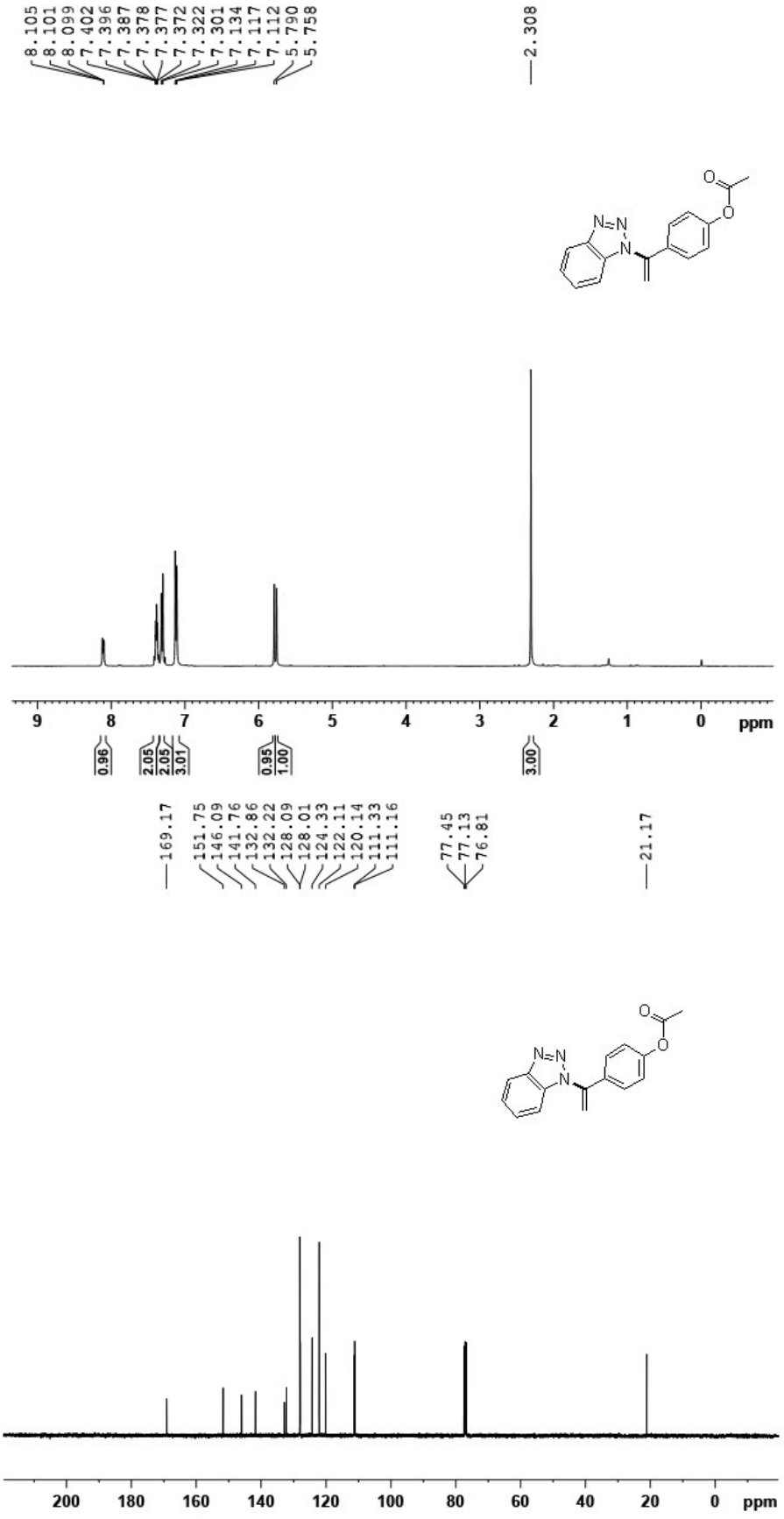

9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 ppm
1.02
4.16
2.07
1.02
1.03
1.04
2.00


146.12
142.06
139.13
134.69
132.89
129.05
127.98
127.26
124.31
120.18
111.59
111.11
77.42
77.11
76.79
45.52

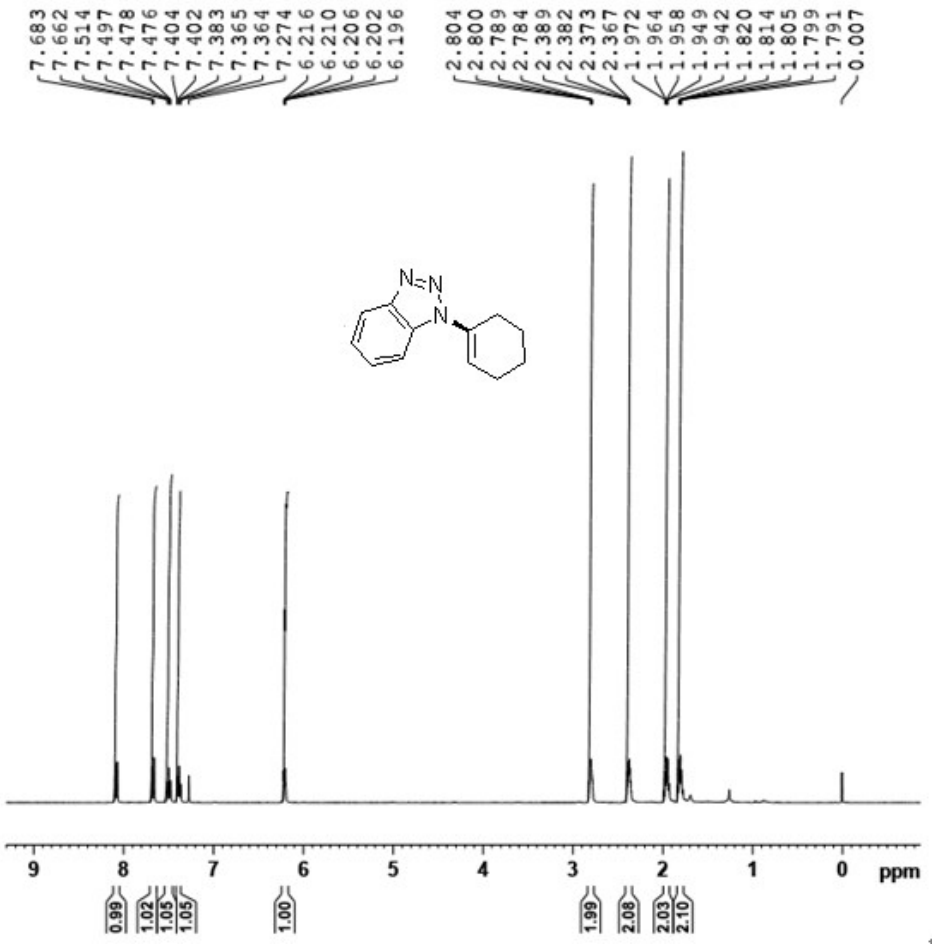

N
N
N
Cl

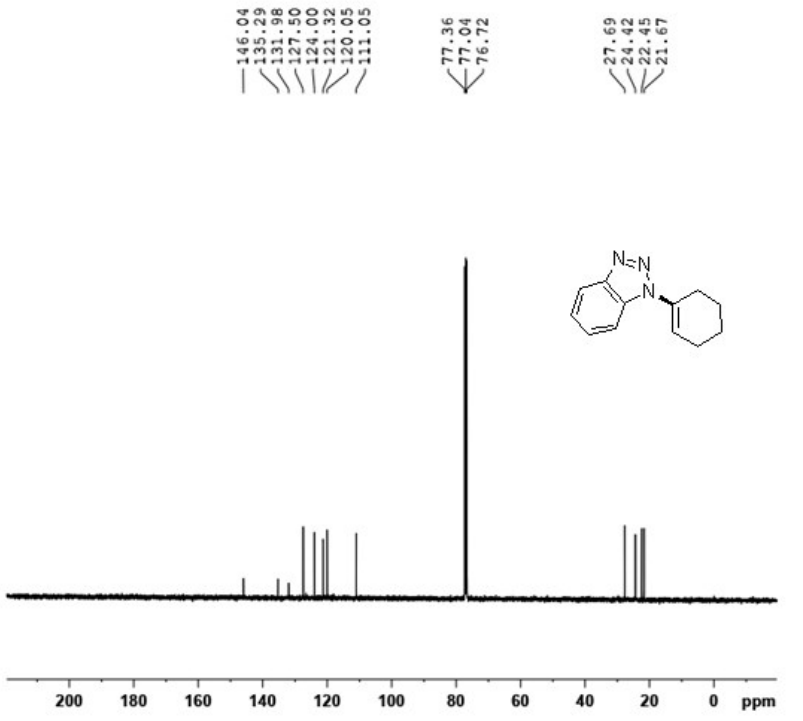

200 180 160 140 120 100 80 60 40 20 0 ppm

Compound 3p

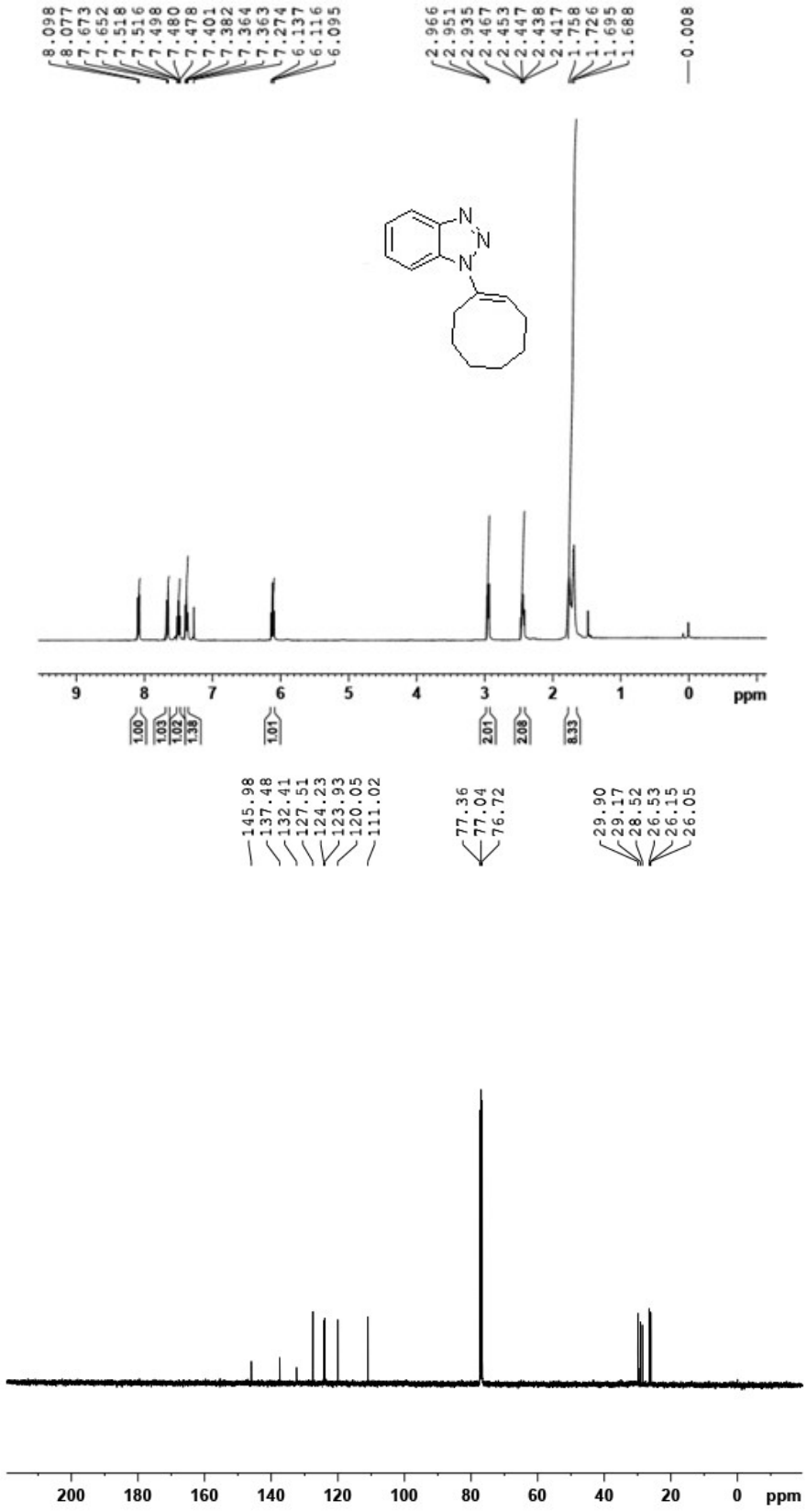

8.105
8.101
8.099
7.402
7.396
7.387
7.378
7.377
7.372
7.322
7.301
7.134
7.117
7.112
5.790
5.758
2.308
9
8
7
6
5
4
3
2
1
0
ppm
0.96
2.05
2.05
3.01
0.95
1.00
3.00
169.17
151.75
146.09
141.76
132.86
132.22
128.09
128.01
124.33
122.11
120.14
111.33
111.16
77.45
77.13
76.81
21.17
200
180
160
140
120
100
80
60
40
20
0
ppm

Compound 3q

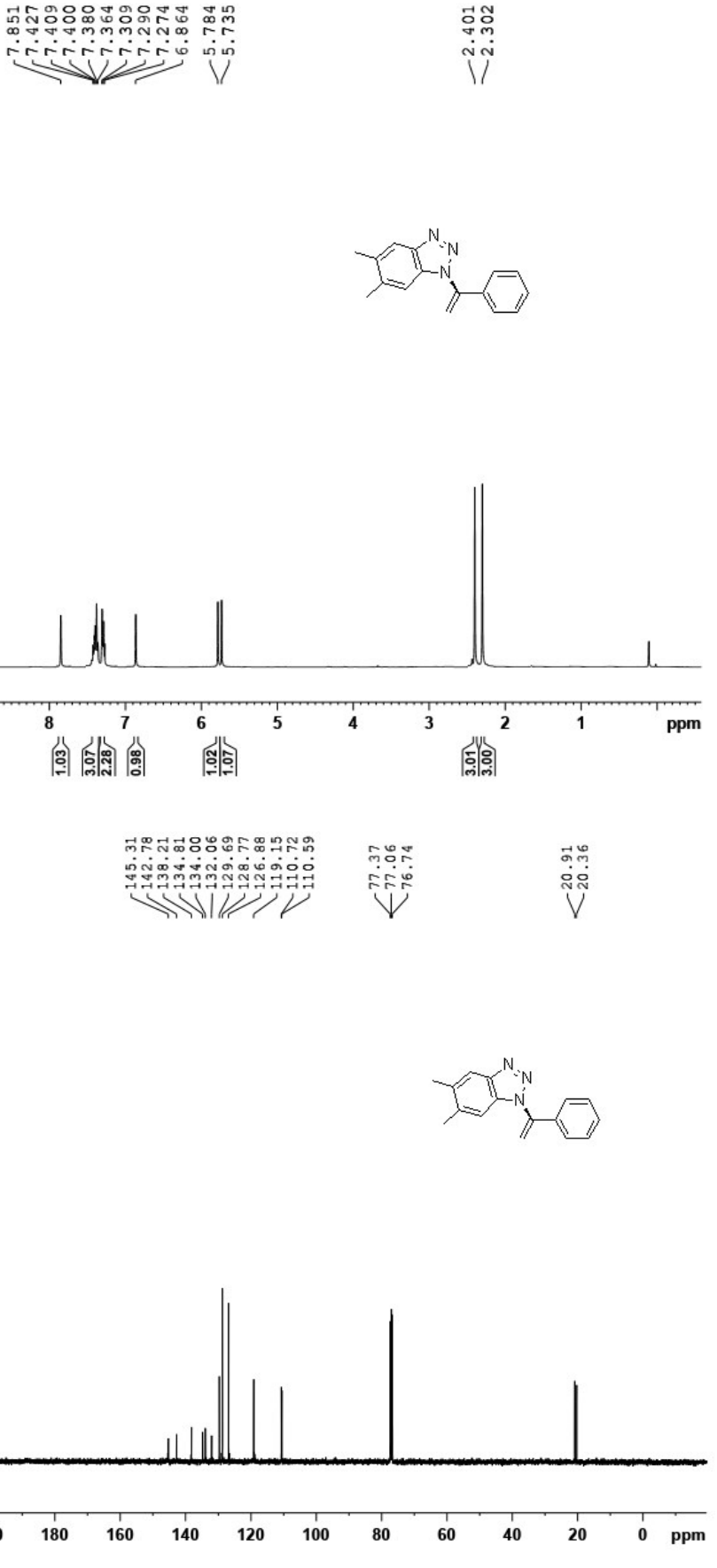

7.683
7.662
7.514
7.497
7.478
7.476
7.404
7.402
7.383
7.365
7.364
7.274
6.216
6.210
6.206
6.202
6.196
2.804
2.800
2.789
2.784
2.389
2.382
2.373
2.367
1.972
1.964
1.958
1.949
1.942
1.820
1.814
1.805
1.799
1.791
0.007
N=N
N
9
8
7
6
5
4
3
2
1
0
ppm
0.99
1.02
1.05
1.05
1.00
1.99
2.08
2.03
2.10


146.04
135.29
131.98
127.50
124.00
121.32
120.05
111.05
77.36
77.04
76.72
27.69
24.42
22.45
21.67
N=N
N
200
180
160
140
120
100
80
60
40
20
0
ppm

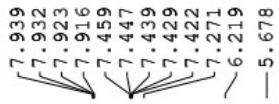
Compound 3r

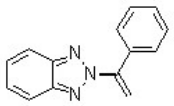

8.098
8.077
7.673
7.652
7.518
7.516
7.498
7.480
7.478
7.401
7.382
7.364
7.363
7.274
6.137
6.116
6.095
2.966
2.951
2.935
2.467
2.453
2.447
2.438
2.417
1.758
1.726
1.695
1.688
0.008
N
N
N
9
8
7
6
5
4
3
2
1
0
ppm
1.00
1.03
1.02
1.38
1.01
2.01
2.08
8.33
145.98
137.48
132.41
127.51
124.23
123.93
120.05
111.02
77.36
77.04
76.72
29.90
29.17
28.52
26.53
26.15
26.05
200
180
160
140
120
100
80
60
40
20
0
ppm

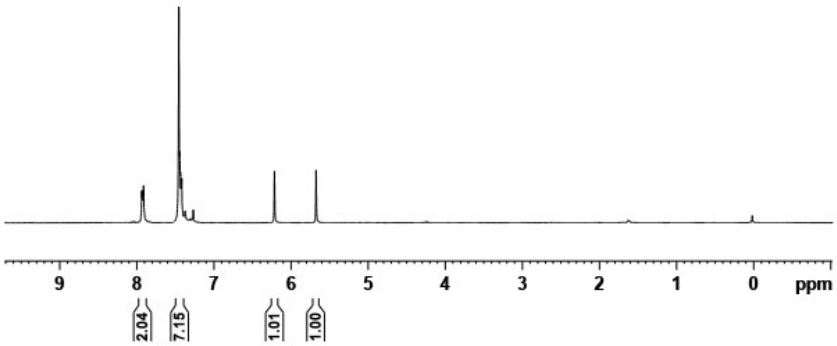
Compound 3s


7.851
7.427
7.409
7.400
7.380
7.364
7.309
7.290
7.274
6.864
5.784
5.735
2.401
2.302
9
8
7
6
5
4
3
2
1
ppm
1.03
3.07
2.28
0.98
1.02
1.07
3.01
3.00
145.31
142.78
138.21
134.81
134.00
132.06
129.69
128.77
126.88
119.15
110.72
110.59
77.37
77.06
76.74
20.91
20.36
200
180
160
140
120
100
80
60
40
20
0
ppm

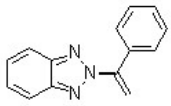
Compound 4a

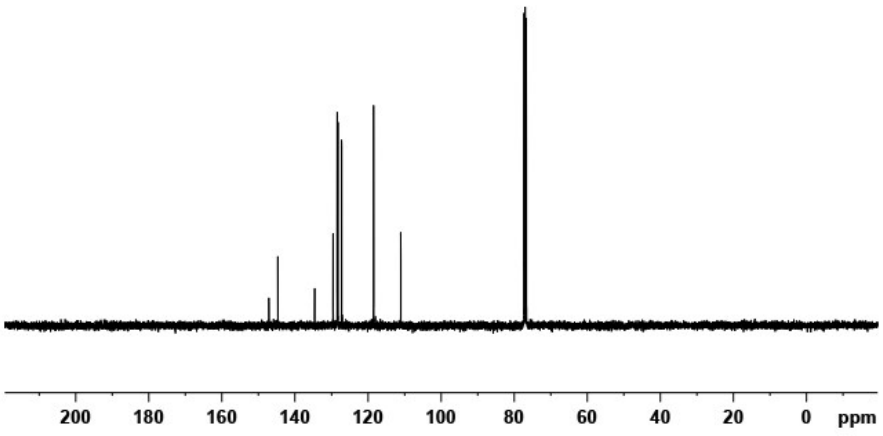

7.939
7.932
7.923
7.916
7.459
7.447
7.439
7.429
7.422
7.271
6.219
5.678



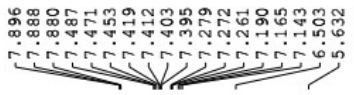

9
8
7
6
5
4
3
2
1
0
ppm
2.04
7.15
1.01
1.00

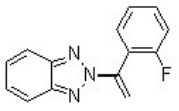

147.18
144.72
134.63
129.60
128.47
128.28
127.27
118.52
111.06
77.36
77.04
76.72

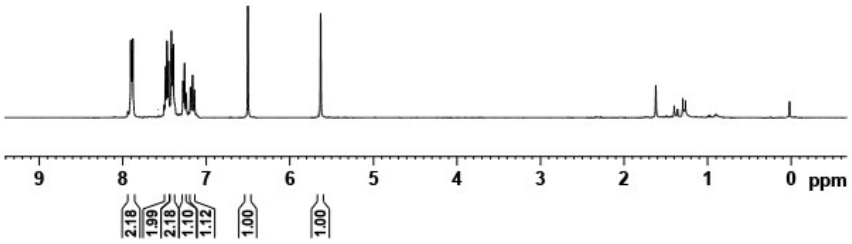


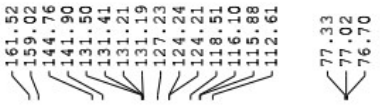

200
180
160
140
120
100
80
60
40
20
0
ppm

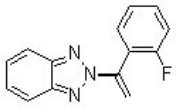
Compound 4b

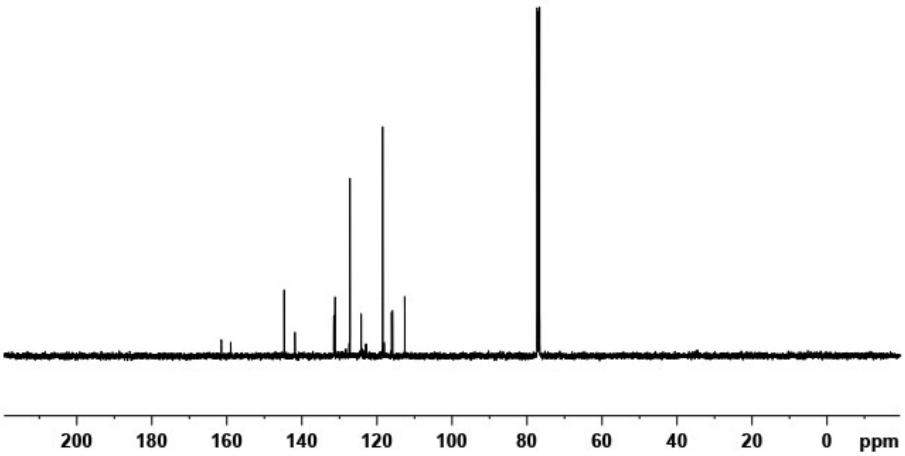

7.896
7.888
7.880
7.487
7.471
7.453
7.419
7.412
7.403
7.395
7.279
7.272
7.261
7.190
7.165
7.143
6.503
5.632

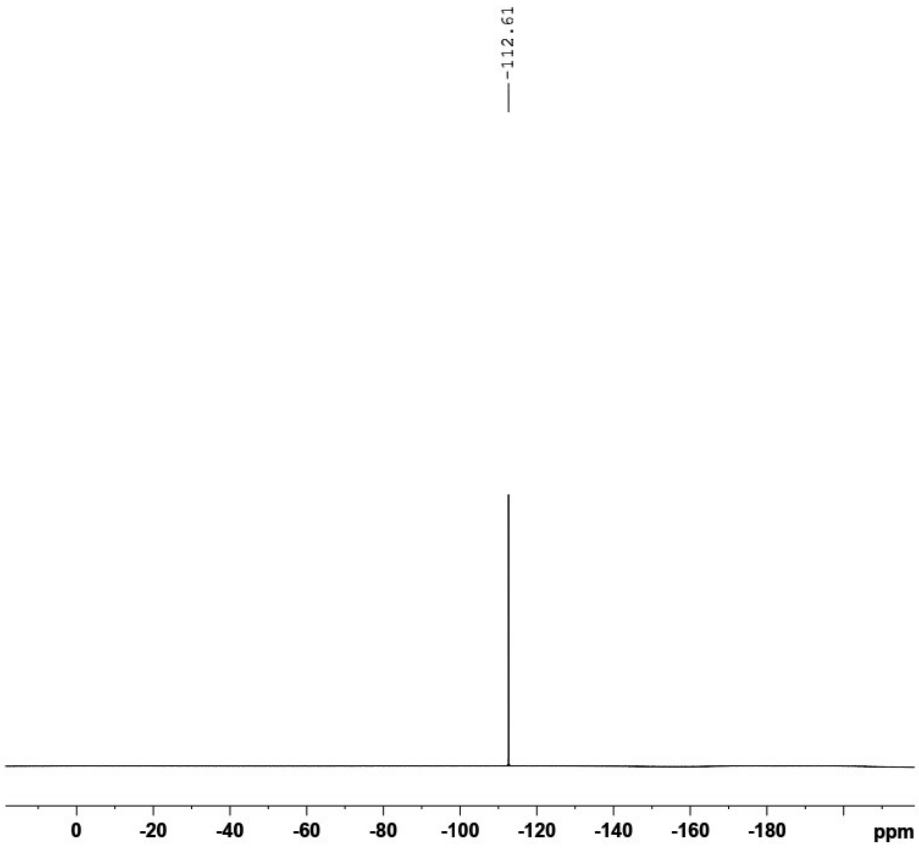

N
N
N
F


9
8
7
6
5
4
3
2
1
0 ppm
2.18
1.99
2.18
1.10
1.12
1.00
1.00

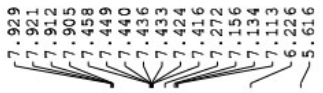

161.52
159.02
144.76
141.90
131.50
131.41
131.21
131.19
127.23
124.24
124.21
118.51
116.10
115.88
112.61
77.33
77.02
76.70

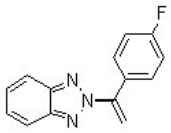

N
N
N
F

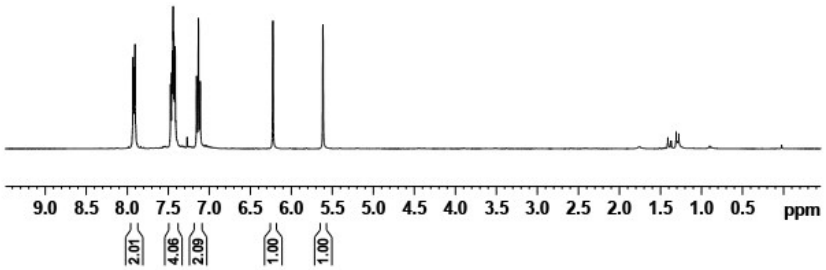

200
180
160
140
120
100
80
60
40
20
0 ppm

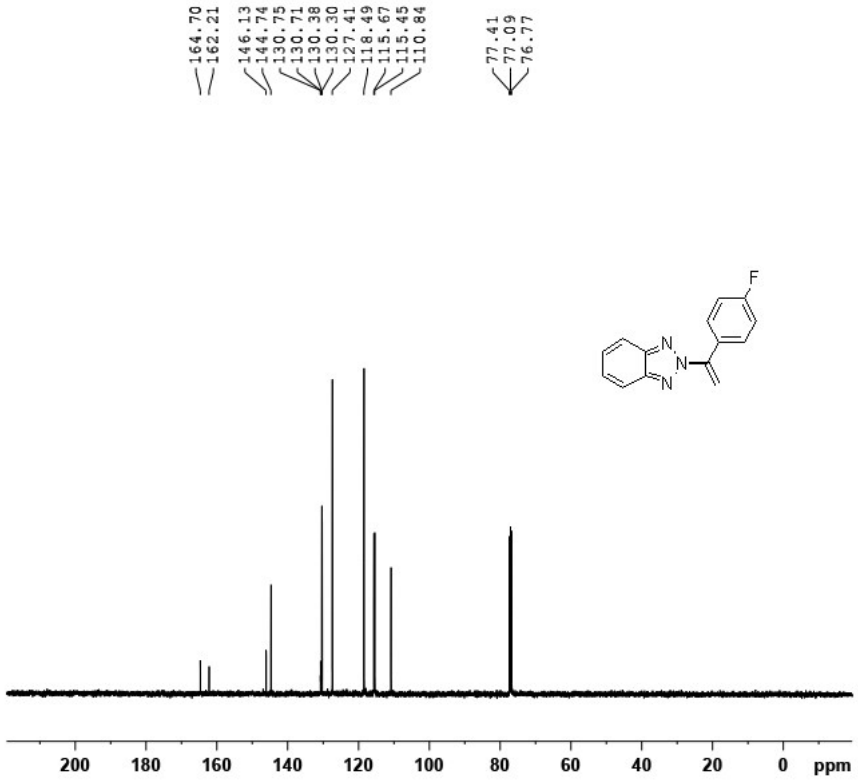

-112.61
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
ppm

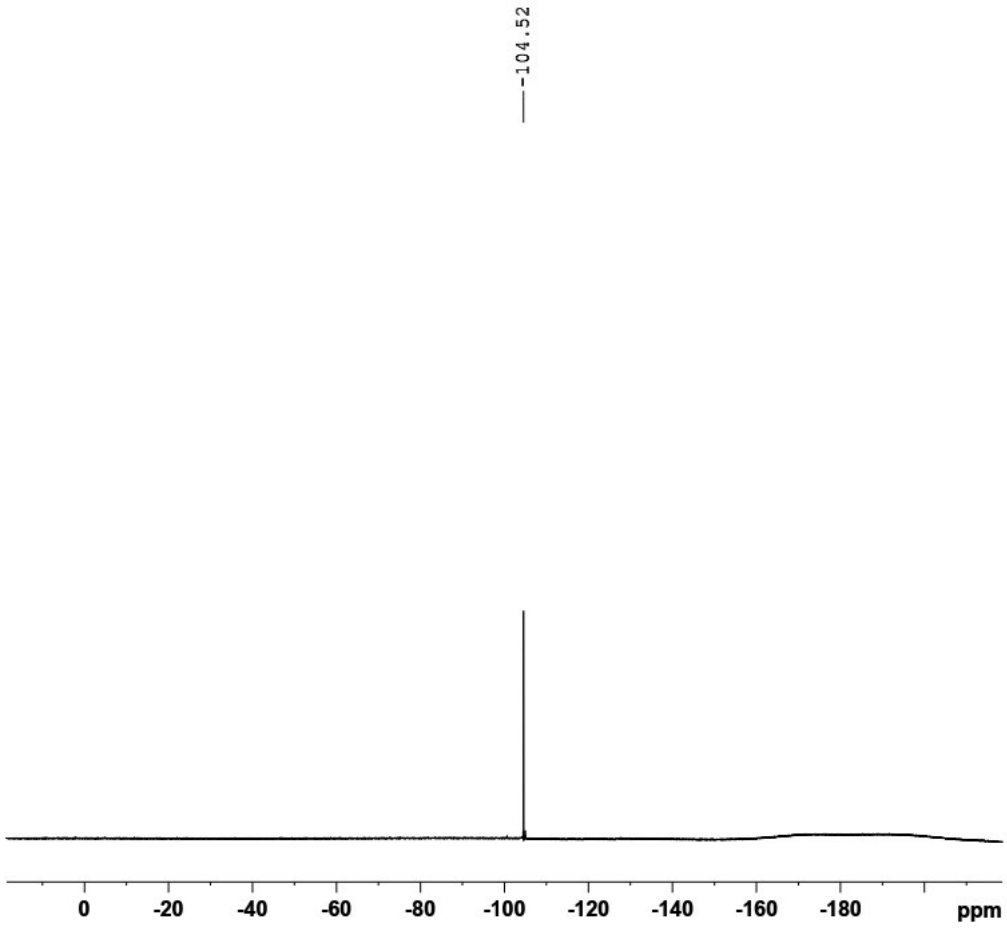
Compound 4c


7.929
7.921
7.912
7.905
7.458
7.449
7.440
7.436
7.433
7.424
7.416
7.272
7.156
7.134
7.113
6.226
5.616

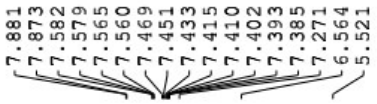

F
N
N
N

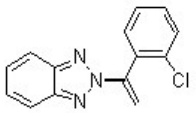

9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
ppm
2.01
4.06
2.09
1.00
1.00

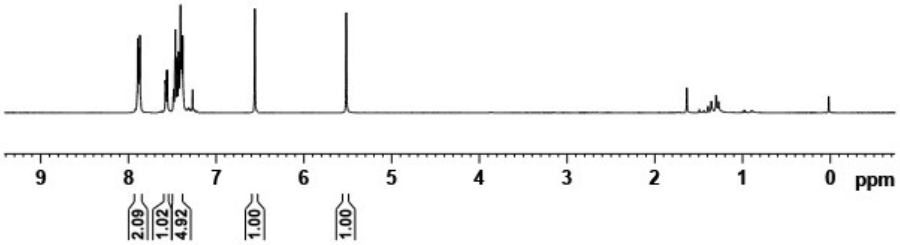

164.70
162.21
146.13
144.74
130.75
130.71
130.38
130.30
127.41
118.49
115.67
115.45
110.84
77.41
77.09
76.77
F
N
N
N
200
180
160
140
120
100
80
60
40
20
0
ppm

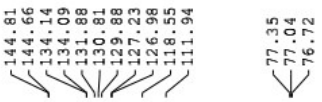

-104.52
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
ppm

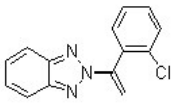
Compound 4d

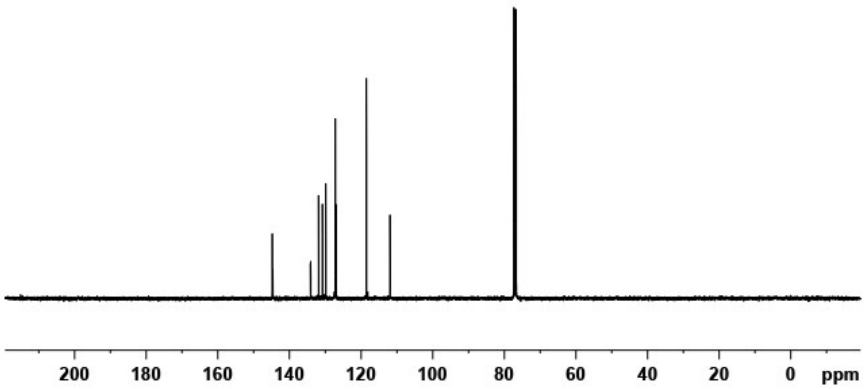

7.881
7.873
7.582
7.579
7.565
7.560
7.469
7.451
7.433
7.415
7.410
7.402
7.393
7.385
7.271
6.564
5.521


N
N
N
Cl

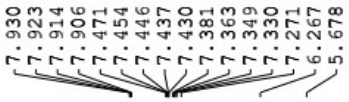

9
8
7
6
5
4
3
2
1
0
ppm
2.09
1.02
4.92
1.00
1.00

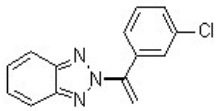

144.81
144.66
134.14
134.09
131.88
130.81
129.88
127.23
126.98
118.55
111.94
77.35
77.04
76.72

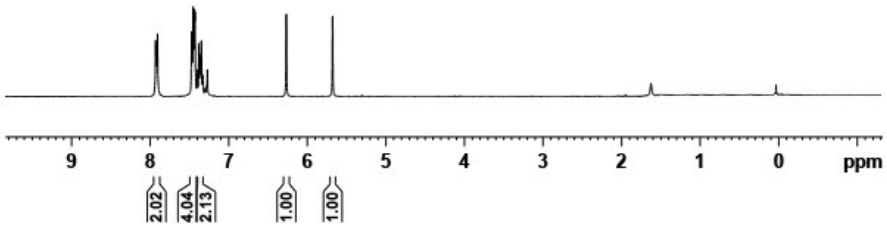

N
N
N
Cl

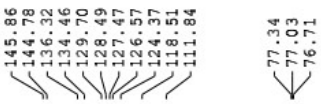

200
180
160
140
120
100
80
60
40
20
0
ppm

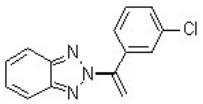
Compound 4e

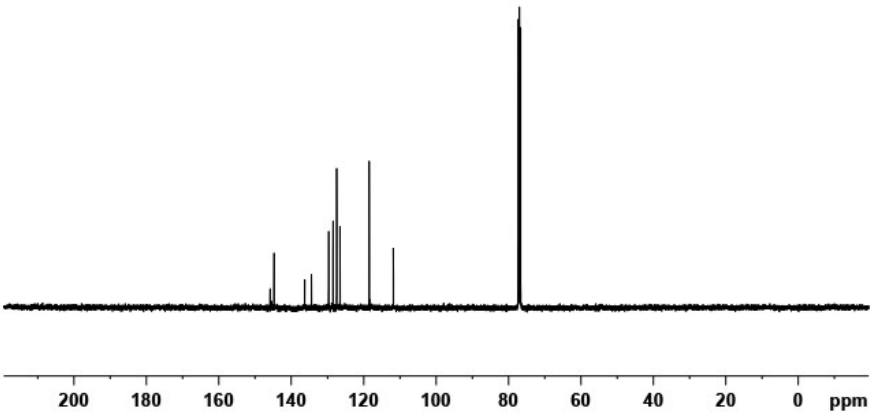

7.930
7.923
7.914
7.906
7.471
7.454
7.446
7.437
7.430
7.381
7.363
7.349
7.330
7.271
6.267
5.678


Cl
N
N
N

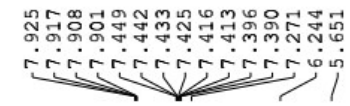

9
8
7
6
5
4
3
2
1
0
ppm
2.02
4.04
2.13
1.00
1.00

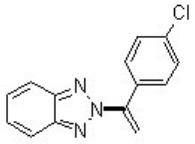

145.86
144.78
136.32
134.46
129.70
128.49
127.47
126.57
124.37
118.51
111.84
77.34
77.03
76.71

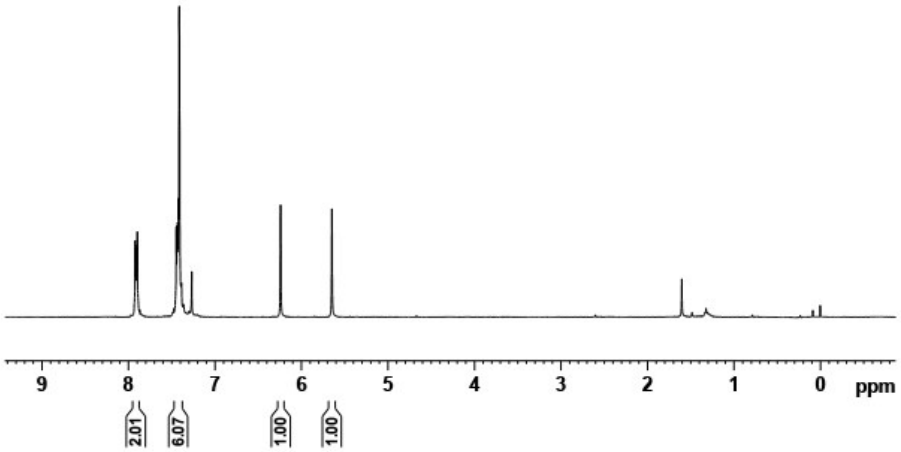

Cl
N
N
N

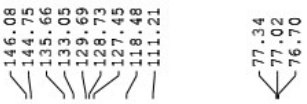

200
180
160
140
120
100
80
60
40
20
0
ppm

Compound 4f

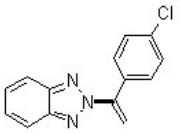

7.925
7.917
7.908
7.901
7.449
7.442
7.433
7.425
7.416
7.413
7.396
7.390
7.271
6.244
5.651

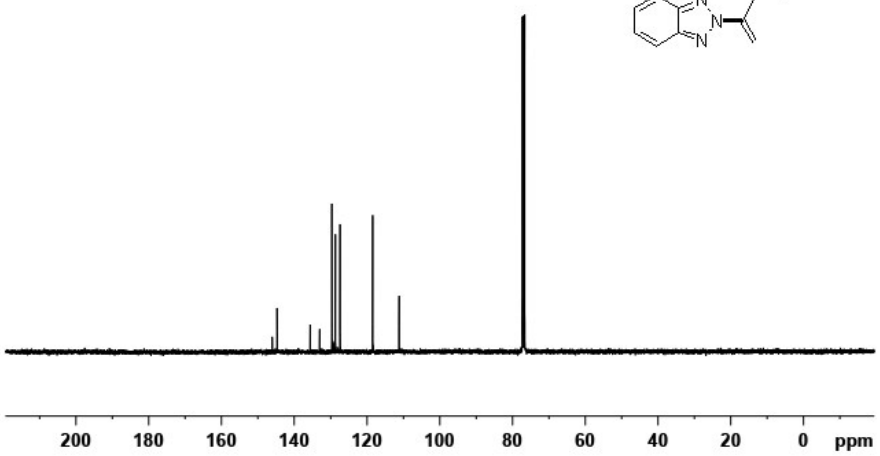

Cl
N
N
N


9
8
7
6
5
4
3
2
1
0
ppm
2.01
6.07
1.00
1.00

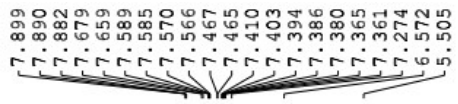

146.08
144.75
135.66
133.05
129.69
128.73
127.45
118.48
111.21

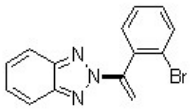
77.34
77.02
76.70

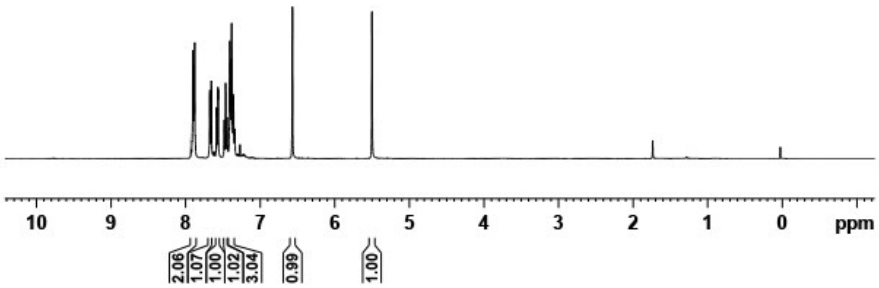

Cl
N
N
N

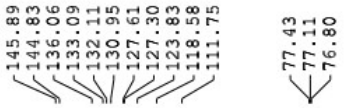

200
180
160
140
120
100
80
60
40
20
0
ppm

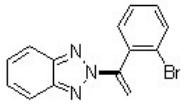
Compound 4g

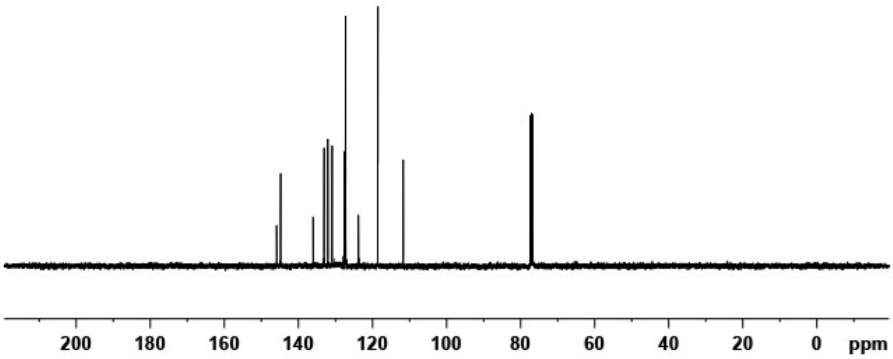

7.899
7.890
7.882
7.679
7.659
7.589
7.585
7.570
7.566
7.467
7.465
7.410
7.403
7.394
7.386
7.380
7.365
7.361
7.274
6.572
5.505


N
N
N
Br

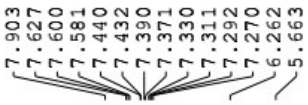

10
9
8
7
6
5
4
3
2
1
0
ppm
2.06
1.07
1.00
1.02
3.04
0.99
1.00

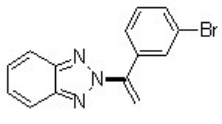

145.89
144.83
136.06
133.09
132.11
130.95
127.61
127.30
123.83
118.58
111.75
77.43
77.11
76.80

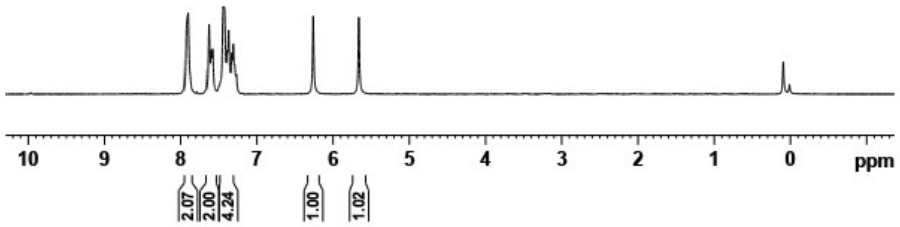

N
N
N
Br

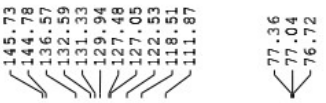

200
180
160
140
120
100
80
60
40
20
0
ppm

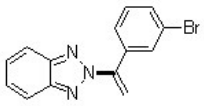
Compound 4h

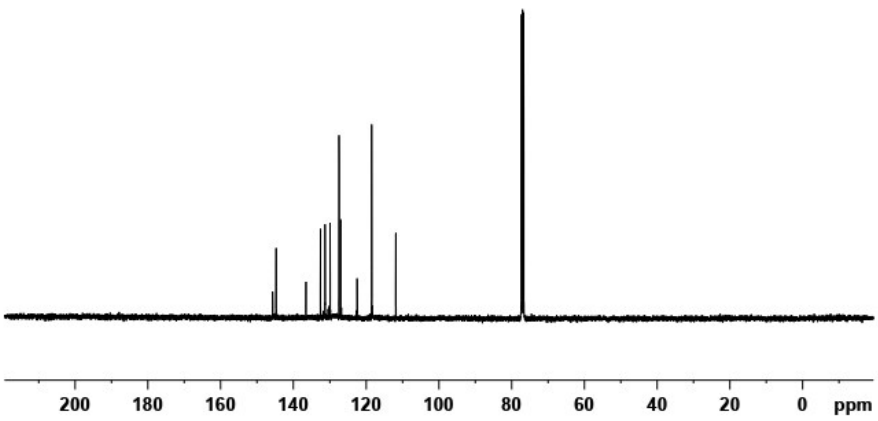

7.903
7.627
7.600
7.581
7.440
7.432
7.390
7.371
7.330
7.311
7.292
7.270
6.262
5.663


Br
N
N
N

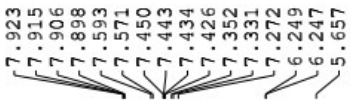

10
9
8
7
6
5
4
3
2
1
0
ppm
2.07
2.00
4.24
1.00
1.02

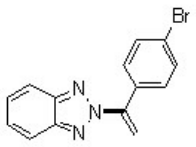

145.73
144.78
136.57
132.59
131.33
129.94
127.48
127.05
122.53
118.51
111.87
77.36
77.04
76.72

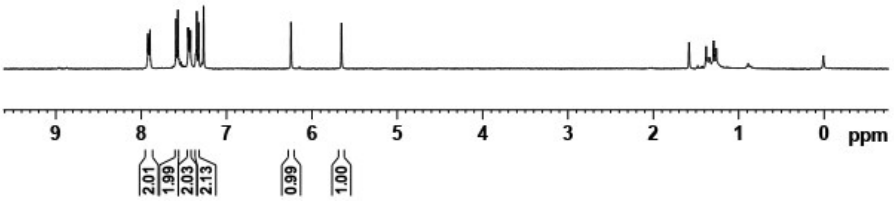

Br
N
N
N

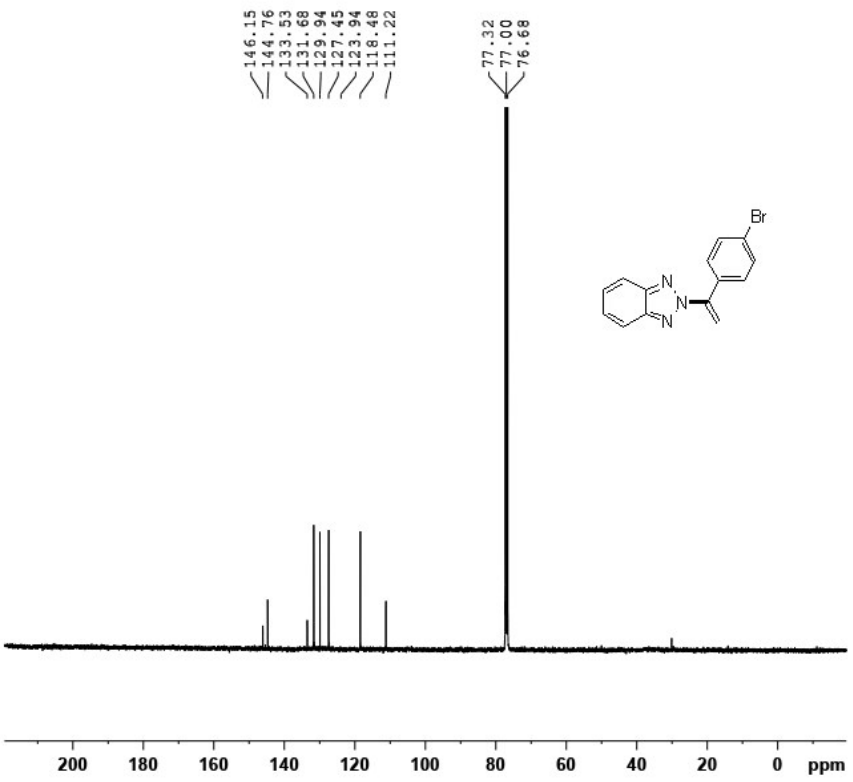

200
180
160
140
120
100
80
60
40
20
0
ppm

Compound 4i

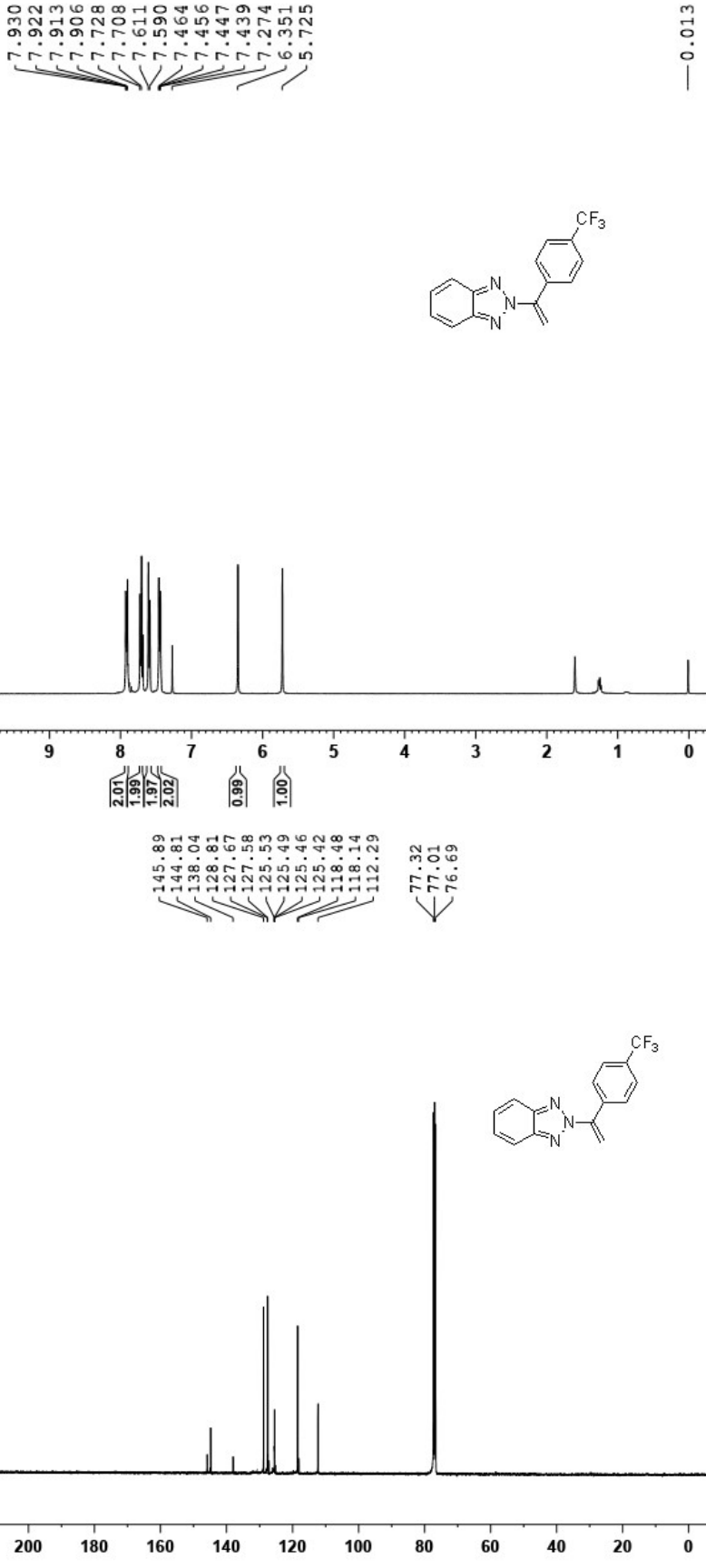

7.923
7.915
7.906
7.898
7.593
7.571
7.450
7.443
7.434
7.426
7.352
7.331
7.272
6.249
6.247
5.657

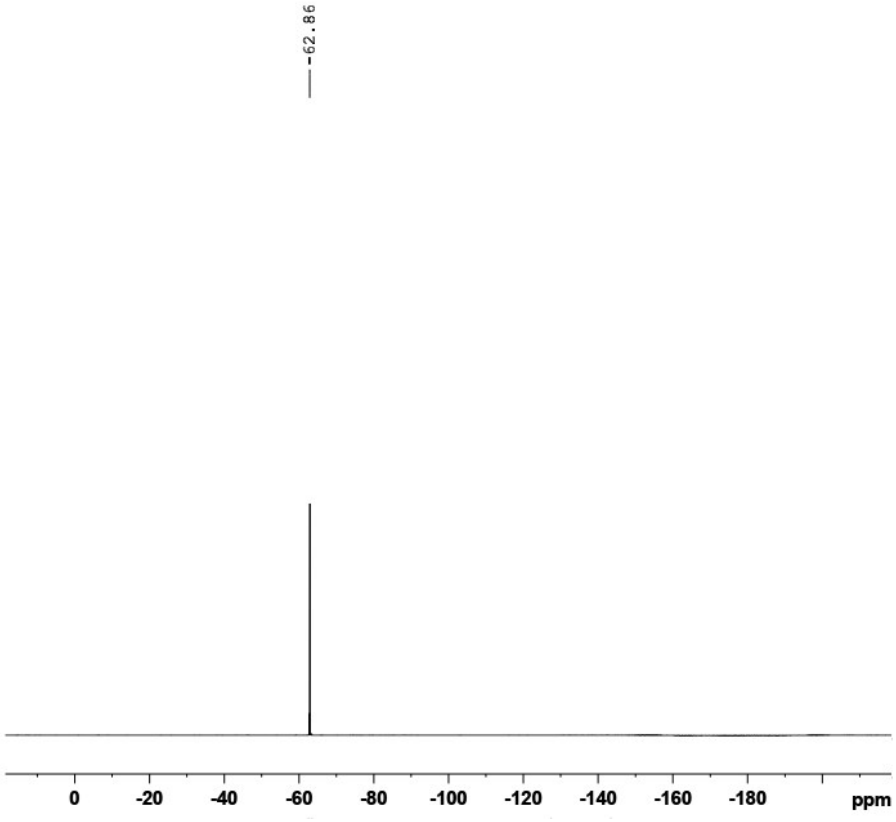

Br
N
N
N


9
8
7
6
5
4
3
2
1
0
ppm
2.01
1.99
2.03
2.13
0.99
1.00

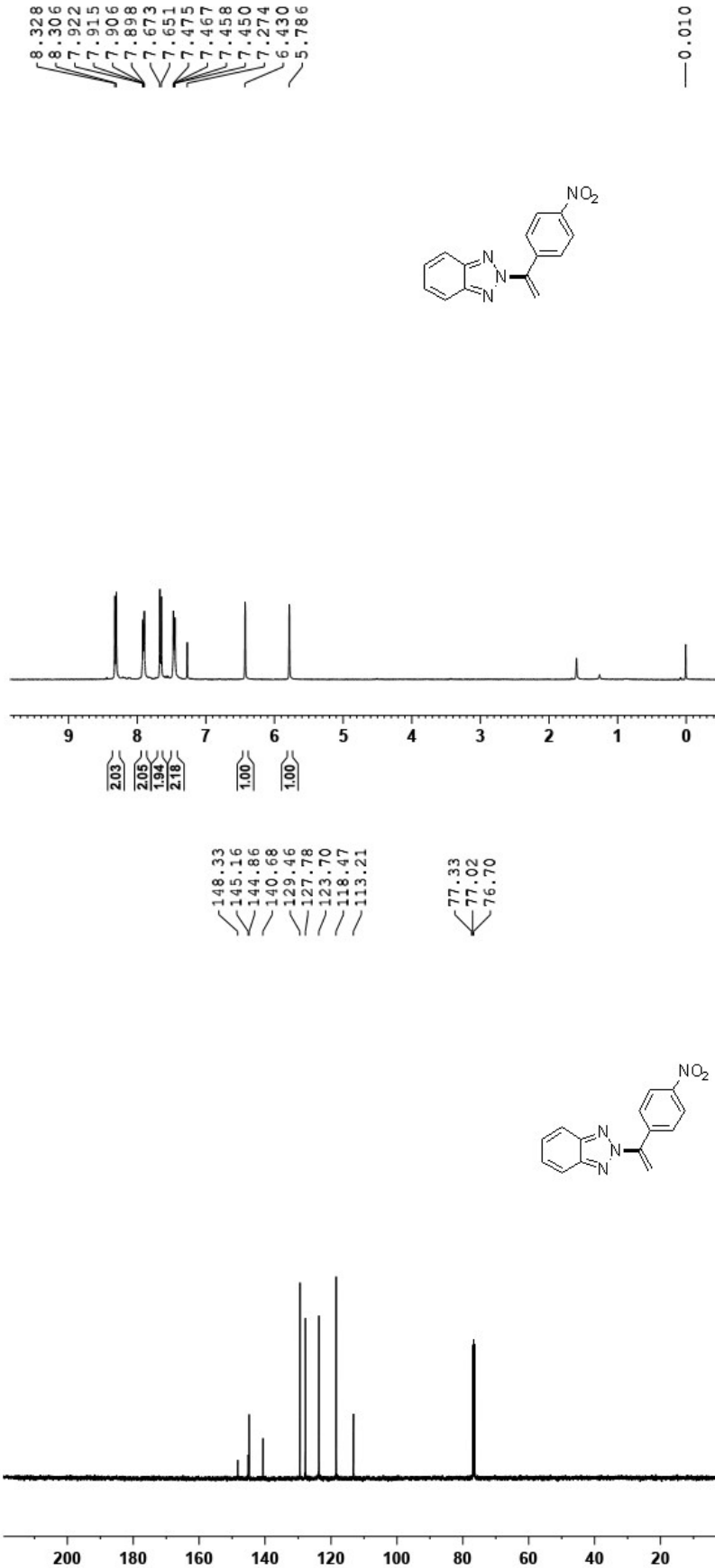

146.15
144.76
133.53
131.68
129.94
127.45
123.94
118.48
111.22
77.32
77.00
76.68
Br
N
N
N
200
180
160
140
120
100
80
60
40
20
0
ppm

Compound 4j

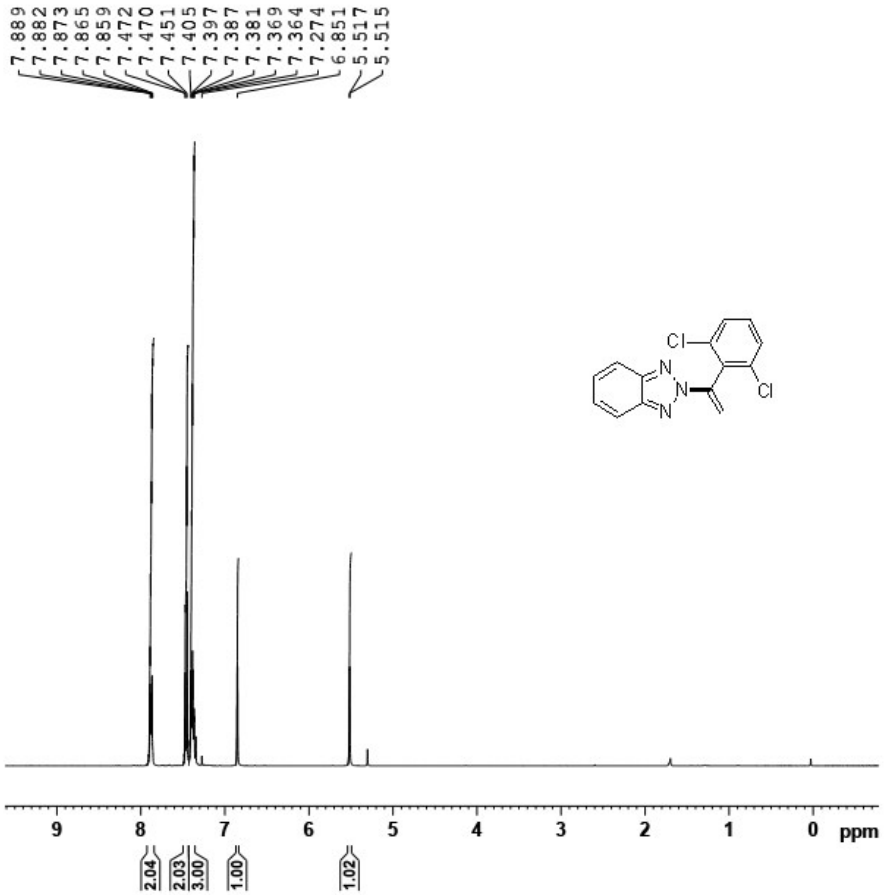

7.930
7.922
7.913
7.906
7.728
7.708
7.611
7.590
7.464
7.456
7.447
7.439
7.274
6.351
5.725
0.013
CF3
9
8
7
6
5
4
3
2
1
0
ppm
2.01
1.99
1.97
2.02
0.99
1.00
145.89
144.81
138.04
128.81
127.67
127.58
125.53
125.49
125.46
125.42
118.48
118.14
112.29
77.32
77.01
76.69
CF3
200
180
160
140
120
100
80
60
40
20
0
ppm

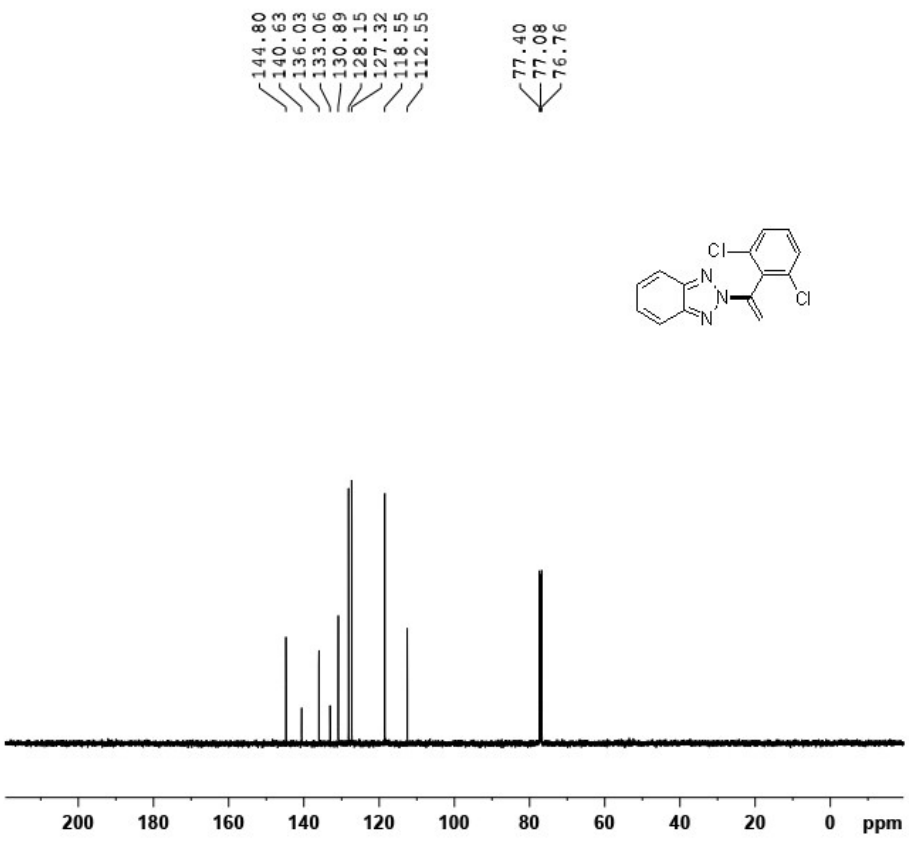

-62.86
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
ppm

Compound 4k

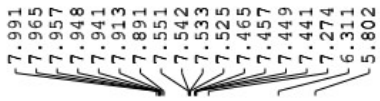

8.328
8.306
7.922
7.915
7.906
7.898
7.673
7.651
7.475
7.467
7.458
7.450
7.274
6.430
5.786
0.010
NO2
N
N
N
9
8
7
6
5
4
3
2
1
0
ppm
2.03
2.05
1.94
2.18
1.00
1.00
148.33
145.16
144.86
140.68
129.46
127.78
123.70
118.47
113.21
77.33
77.02
76.70
NO2
N
N
N
200
180
160
140
120
100
80
60
40
20
0
ppm

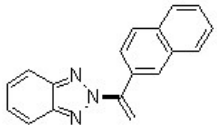
Compound 4l

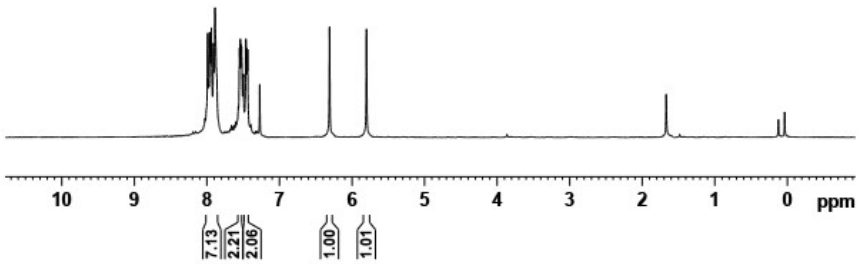

7.889
7.882
7.873
7.865
7.859
7.472
7.470
7.451
7.405
7.397
7.387
7.381
7.369
7.364
7.274
6.851
5.517
5.515
Cl
Cl
N
N
N
9
8
7
6
5
4
3
2
1
0
ppm
2.04
2.03
3.00
1.00
1.02

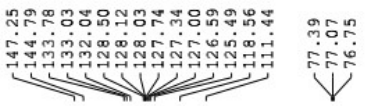

144.80
140.63
136.03
133.06
130.89
128.15
127.32
118.55
112.55
77.40
77.08
76.76
Cl
Cl
N
N
N
200
180
160
140
120
100
80
60
40
20
0
ppm

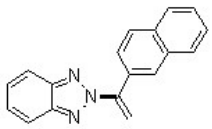
Compound 4m

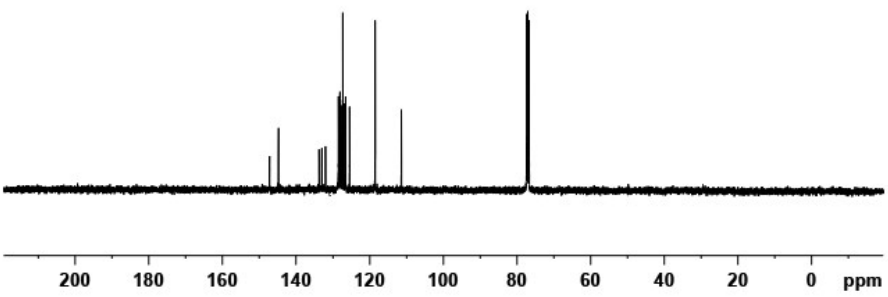




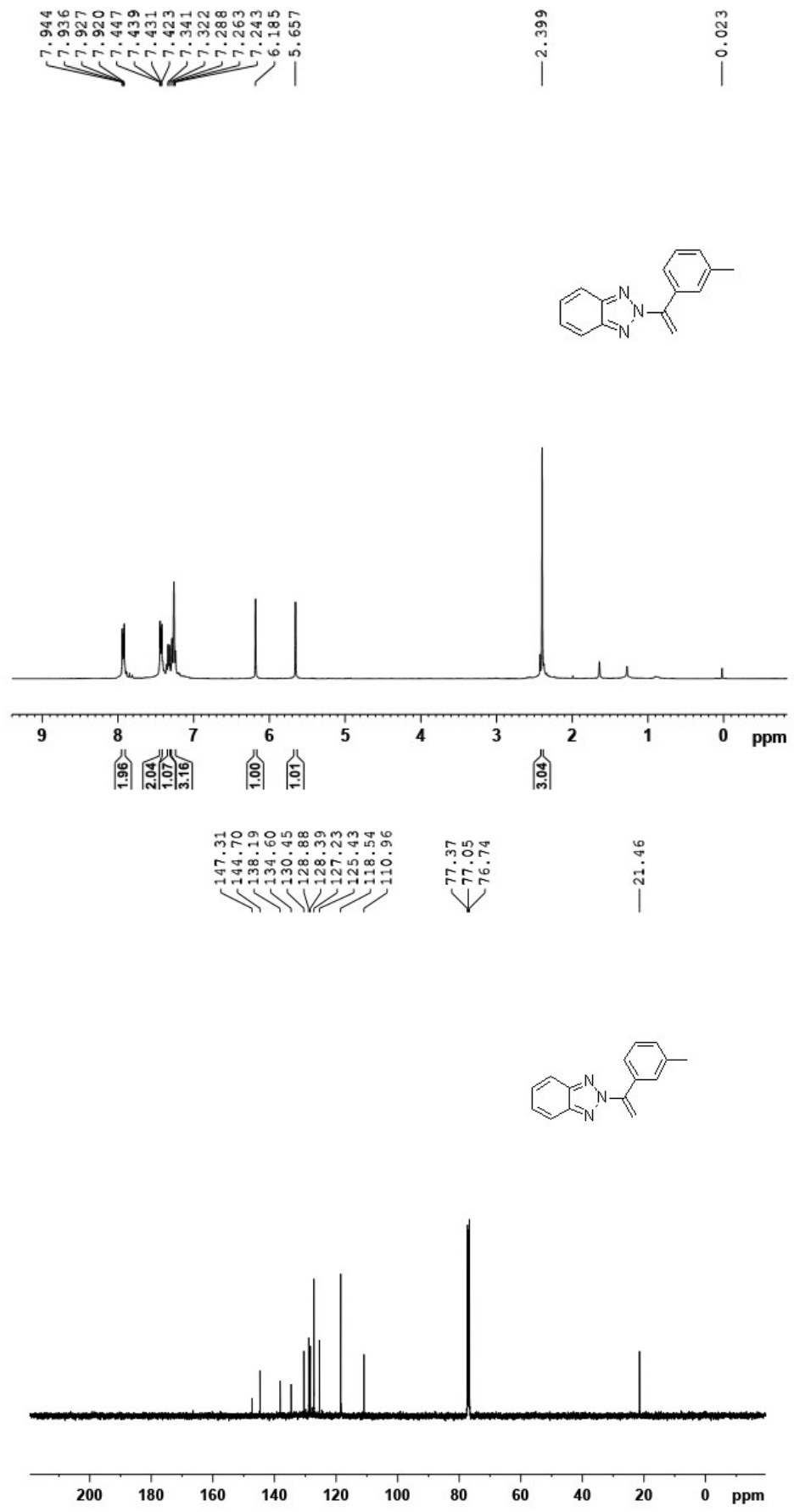




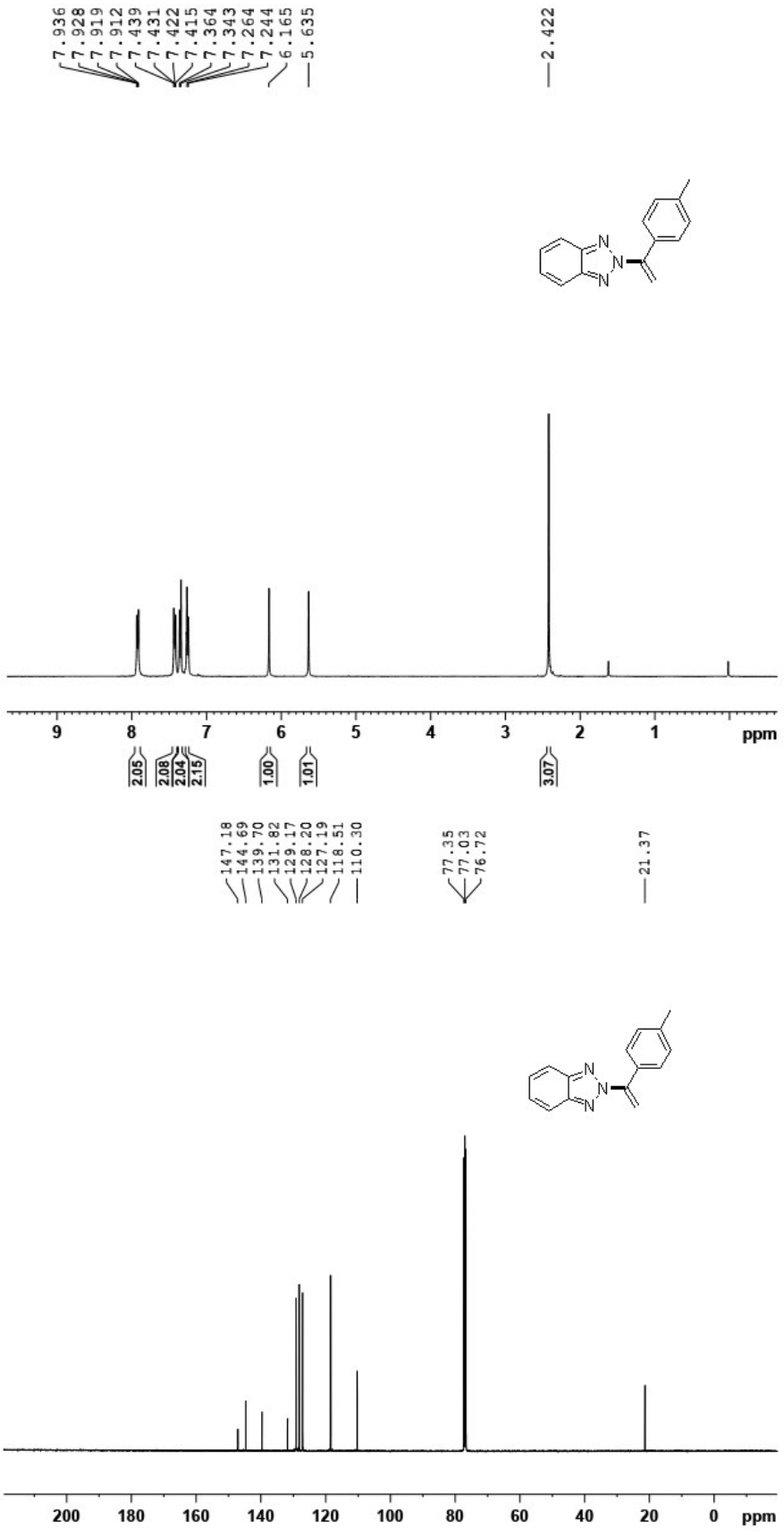




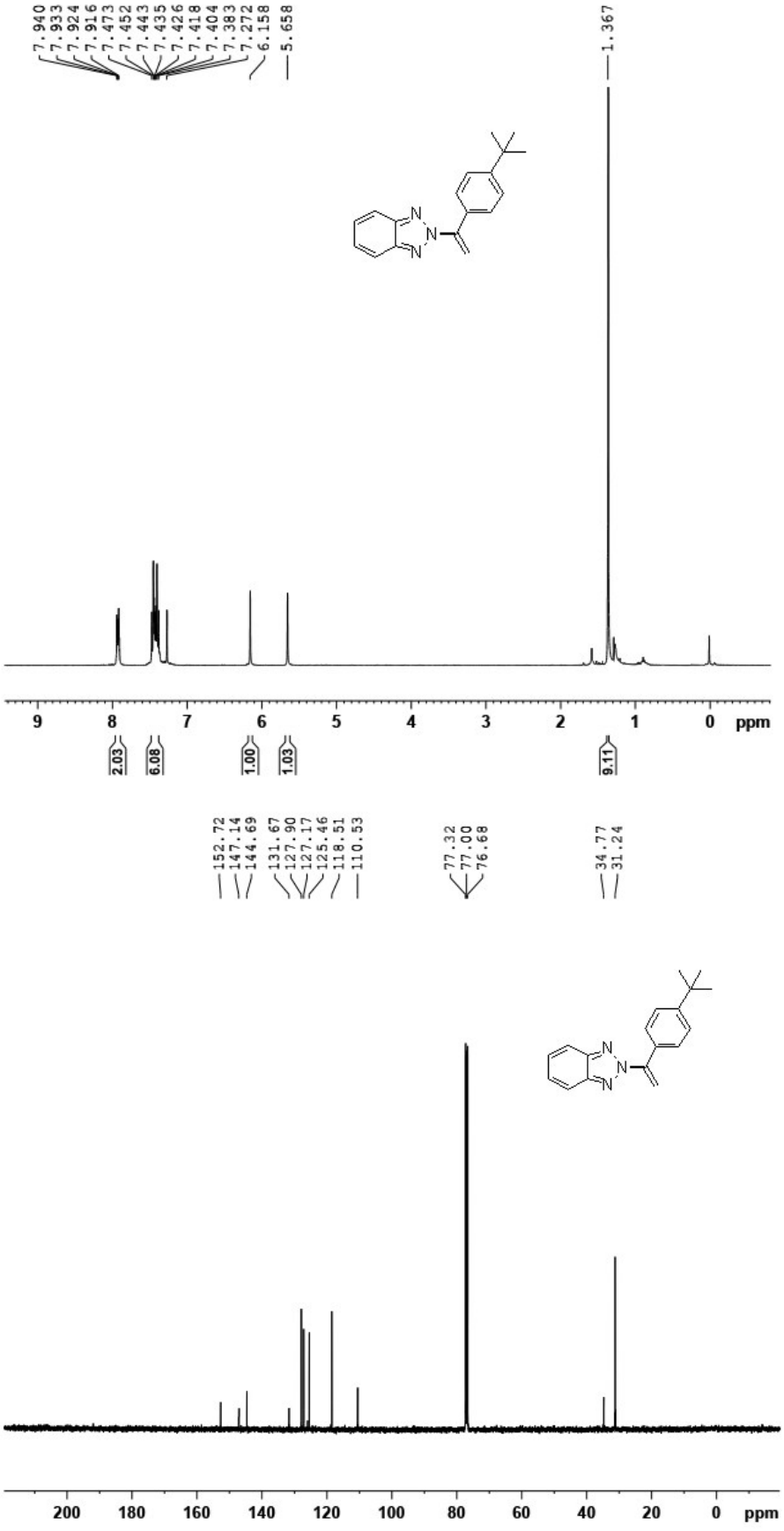
Compound 4n


7.944
7.936
7.927
7.920
7.447
7.439
7.431
7.423
7.341
7.322
7.288
7.263
7.243
6.185
5.657
2.399
0.023
9
8
7
6
5
4
3
2
1
0
ppm
1.96
2.04
1.07
3.16
1.00
1.01
3.04
147.31
144.70
138.19
134.60
130.45
128.88
128.39
127.23
125.43
118.54
110.96
77.37
77.05
76.74
21.46
200
180
160
140
120
100
80
60
40
20
0
ppm

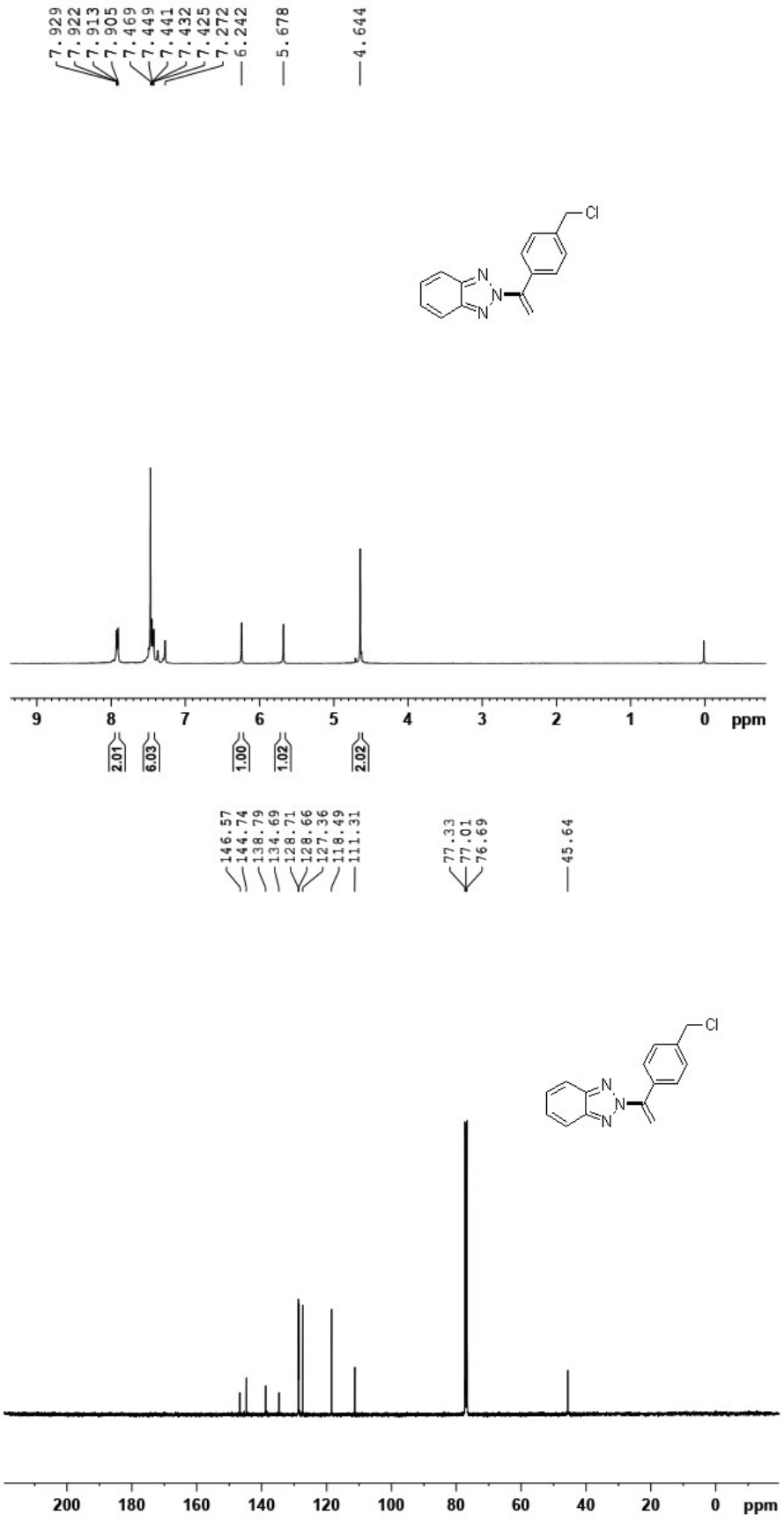
Compound 4o


7.936
7.928
7.919
7.912
7.439
7.431
7.422
7.415
7.364
7.343
7.264
7.244
6.165
5.635
2.422
9
8
7
6
5
4
3
2
1
ppm
2.05
2.08
2.04
2.15
1.00
1.01
3.07
147.18
144.69
139.70
131.82
129.17
128.20
127.19
118.51
110.30
77.35
77.03
76.72
21.37
200
180
160
140
120
100
80
60
40
20
0
ppm

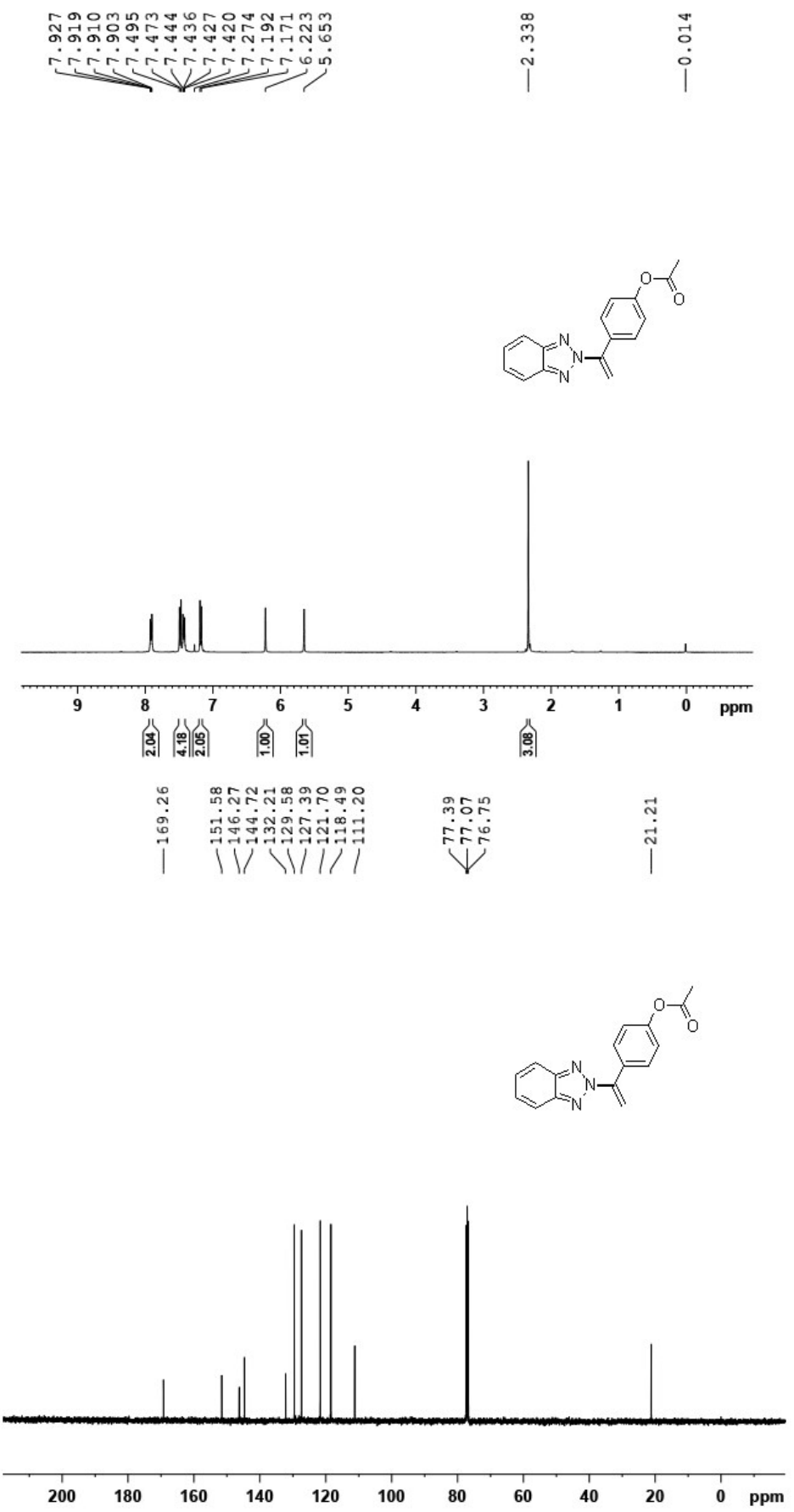
Compound 4p


7.940
7.933
7.924
7.916
7.473
7.452
7.443
7.435
7.426
7.418
7.404
7.383
7.272
6.158
5.658
1.367
9
8
7
6
5
4
3
2
1
0
ppm
2.03
6.08
1.00
1.03
9.11
152.72
147.14
144.69
131.67
127.90
127.17
125.46
118.51
110.53
77.32
77.00
76.68
34.77
31.24
200
180
160
140
120
100
80
60
40
20
0
ppm

Compound 4q

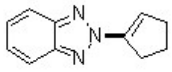

7.929
7.922
7.913
7.905
7.469
7.449
7.441
7.432
7.425
7.272
6.242
5.678
4.644
Cl
N
N
N
9
8
7
6
5
4
3
2
1
0
ppm
2.01
6.03
1.00
1.02
2.02
146.57
144.74
138.79
134.69
128.71
128.66
127.36
118.49
111.31
77.33
77.01
76.69
45.64
Cl
N
N
N
200
180
160
140
120
100
80
60
40
20
0
ppm

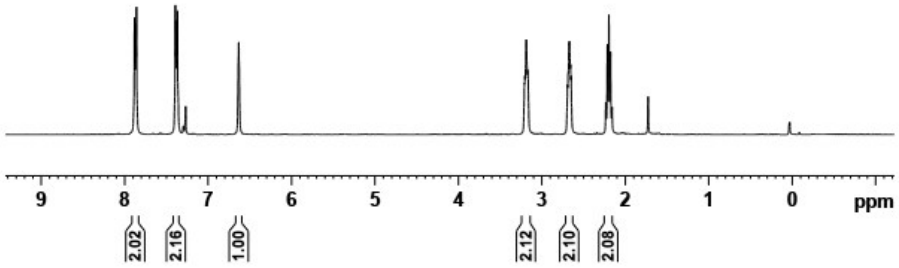
Compound 4r

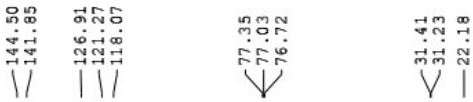

7.927
7.919
7.910
7.903
7.495
7.473
7.444
7.436
7.427
7.420
7.274
7.192
7.171
6.223
5.653
2.338
0.014
9
8
7
6
5
4
3
2
1
0
ppm
2.04
4.18
2.05
1.00
1.01
3.08
169.26
151.58
146.27
144.72
132.21
129.58
127.39
121.70
118.49
111.20
77.39
77.07
76.75
21.21
200
180
160
140
120
100
80
60
40
20
0
ppm

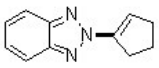
Compound 4s

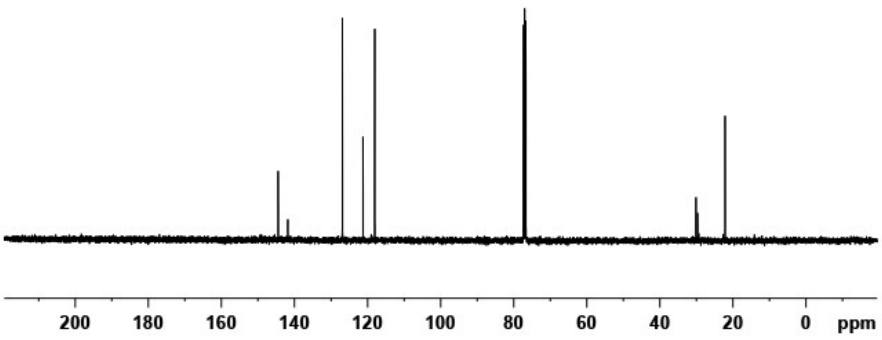

7.885
7.878
7.869
7.861
7.395
7.387
7.378
7.371
7.271
6.635
3.209
3.204
3.190
3.187
3.172
3.167
2.694
2.687
2.676
2.671
2.658
2.652
2.236
2.217
2.198
2.179
2.160




9
8
7
6
5
4
3
2
1
0
ppm
2.02
2.16
1.00
2.12
2.10
2.08

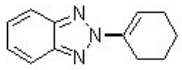

144.50
141.85
126.91
121.27
118.07
77.35
77.03
76.72
31.41
31.23
22.18

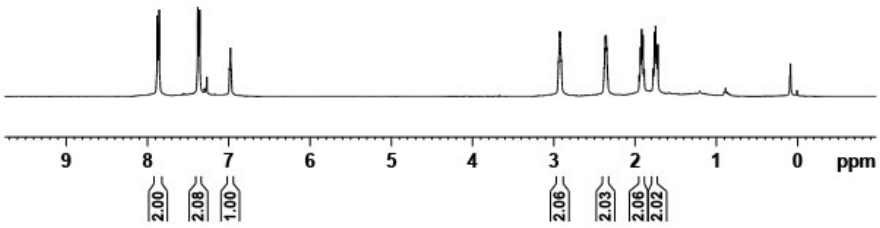


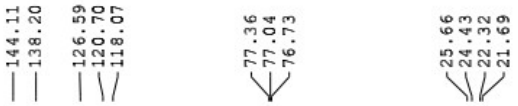

200
180
160
140
120
100
80
60
40
20
0
ppm

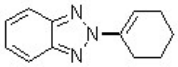
Compound 4t

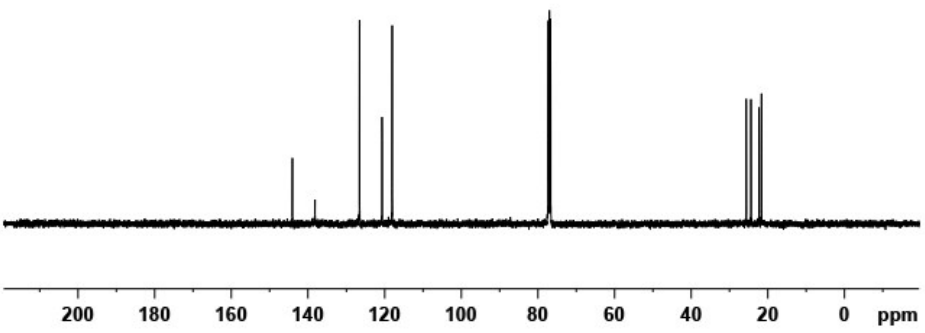

7.882
7.874
7.866
7.858
7.383
7.376
7.367
7.359
7.271
6.981
2.929
2.925
2.914
2.909
2.373
2.367
2.357
2.351
1.935
1.927
1.920
1.912
1.905
1.764
1.757
1.749
1.734
1.721



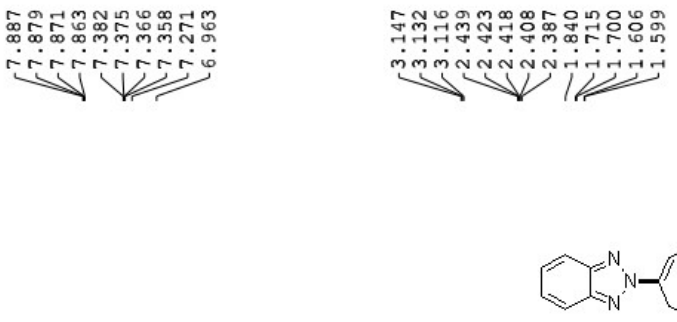

9
8
7
6
5
4
3
2
1
0
ppm
2.00
2.08
1.00
2.06
2.03
2.06
2.02


144.11
138.20
126.59
120.70
118.07
77.36
77.04
76.73
25.66
24.43
22.32
21.69

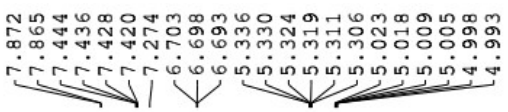


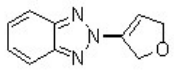

200
180
160
140
120
100
80
60
40
20
0
ppm

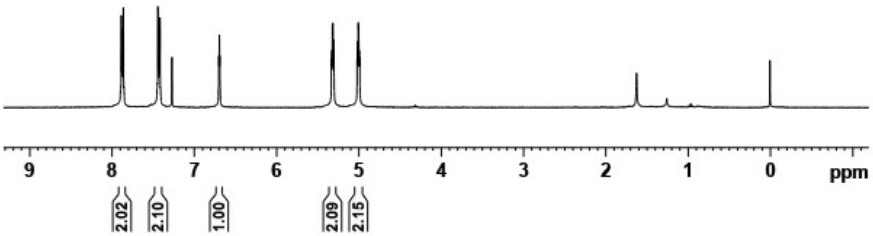
Compound 4u


7.887
7.879
7.871
7.863
7.382
7.375
7.366
7.358
7.271
6.963
3.147
3.132
3.116
2.439
2.423
2.418
2.408
2.387
1.840
1.715
1.700
1.606
1.599
N
N
N
9
8
7
6
5
4
3
2
1
0
ppm
2.18
2.12
1.00
2.02
2.02
2.00
2.12
4.15
144.27
140.57
126.55
123.16
118.08
29.99
28.51
26.77
26.44
26.33
25.97
N
N
N
200
180
160
140
120
100
80
60
40
20
0
ppm

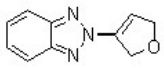
Compound 4v

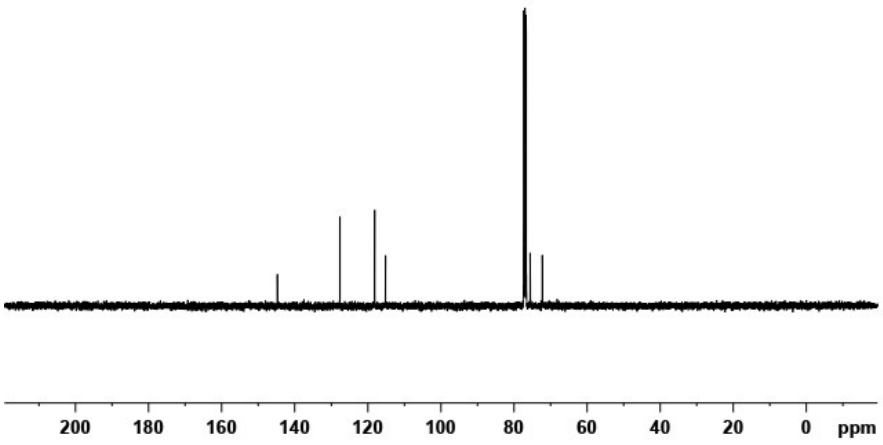

7.872
7.865
7.444
7.436
7.428
7.420
7.274
6.703
6.698
6.693
5.336
5.330
5.324
5.319
5.311
5.306
5.023
5.018
5.009
5.005
4.998
4.993




9
8
7
6
5
4
3
2
1
0
ppm
2.02
2.10
1.00
2.09
2.15


144.76
127.68
118.18
115.20
77.35
77.03
76.71
75.59
72.25

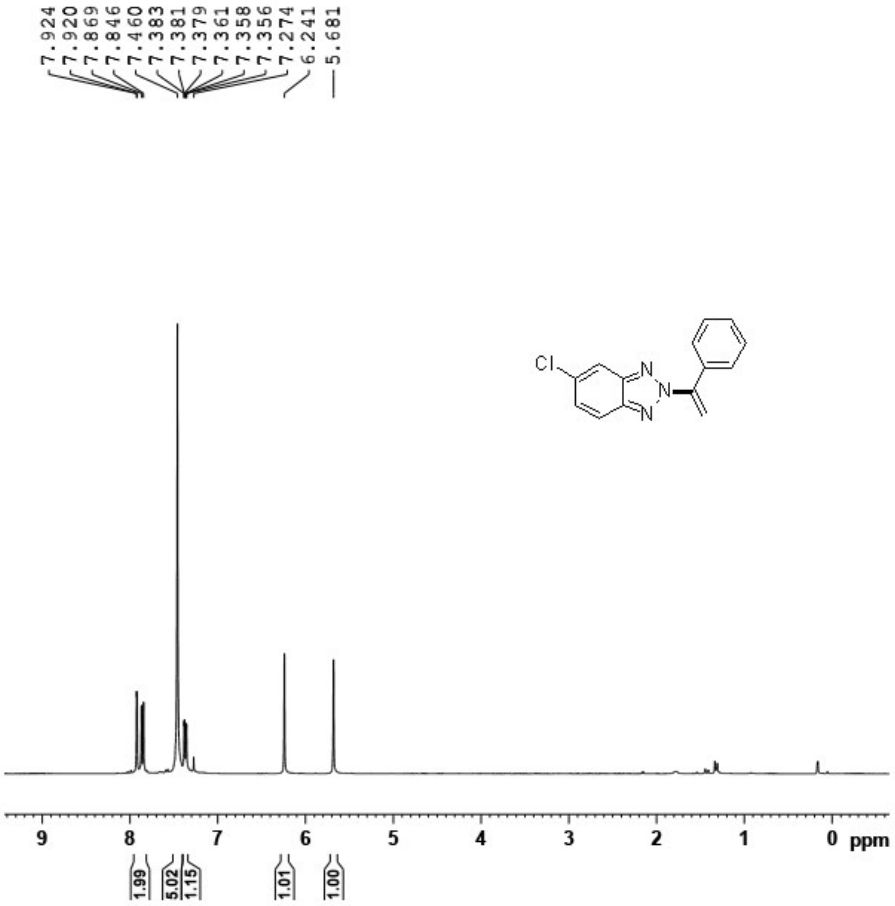


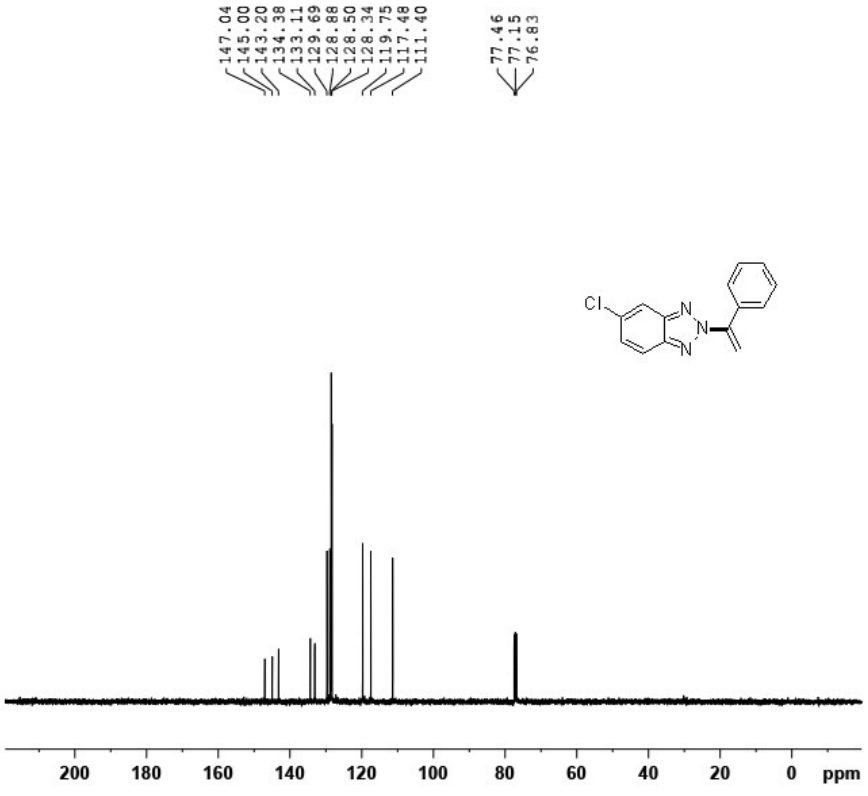

200
180
160
140
120
100
80
60
40
20
0
ppm

Compound 4w

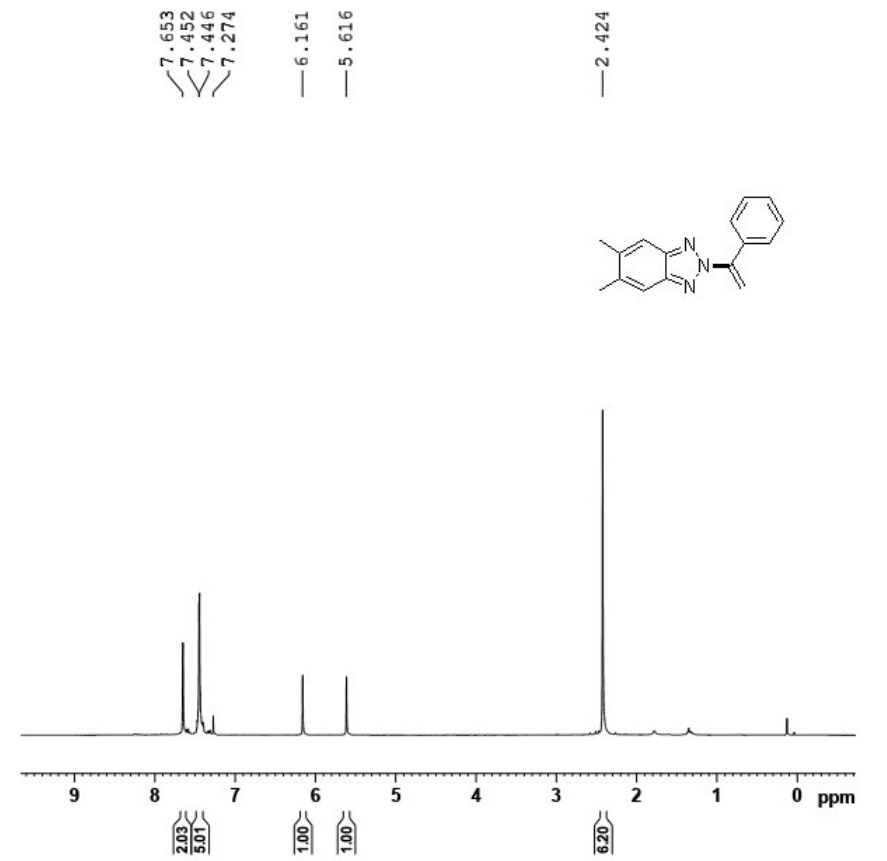

7.819
7.797
7.663
7.660
7.461
7.455
7.451
7.443
7.441
7.274
7.255
7.252
6.185
6.183
5.642
5.640
2.518
9
8
7
6
5
4
3
2
1
0
ppm
1.03
0.94
5.03
1.05
1.00
1.00
3.11
147.17
145.24
143.48
137.46
134.77
130.27
129.52
128.43
128.29
117.92
116.58
110.58
77.39
77.07
76.75
22.20
200
180
160
140
120
100
80
60
40
20
0
ppm

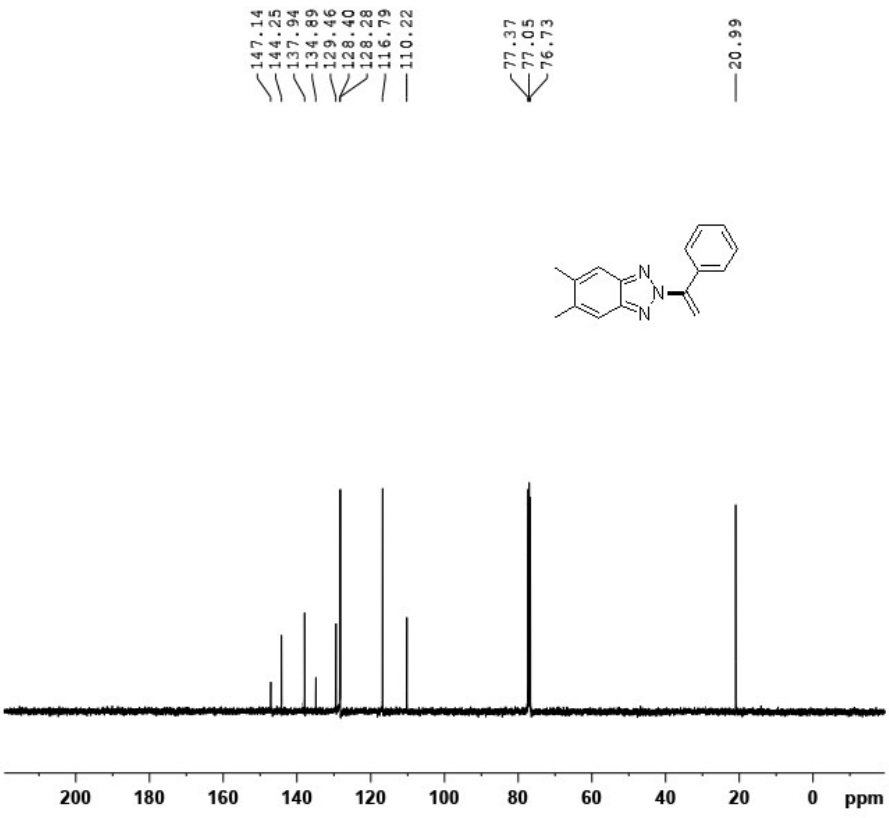
Compound 4x


7.924
7.920
7.869
7.846
7.460
7.383
7.381
7.379
7.361
7.358
7.356
7.274
6.241
5.681
Cl
N
N
N
9
8
7
6
5
4
3
2
1
0 ppm
1.99
5.02
1.15
1.01
1.00


147.04
145.00
143.20
134.38
133.11
129.69
128.88
128.50
128.34
119.75
117.48
111.40
77.46
77.15
76.83
Cl
N
N
N
200
180
160
140
120
100
80
60
40
20
0 ppm

Compound 4y


7.653
7.452
7.446
7.274
6.161
5.616
2.424
9
8
7
6
5
4
3
2
1
0
ppm
2.03
5.01
1.00
1.00
6.20


147.14
144.25
137.94
134.89
129.46
128.40
128.28
116.79
110.22
77.37
77.05
76.73
20.99
200
180
160
140
120
100
80
60
40
20
0
ppm