

# Homoallyl Alcohol as Allylation Reagent for Termination of Catellani-Lautens Reaction via Retro-Allylation

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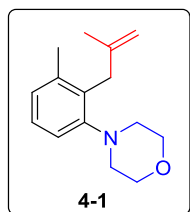
## 1. General remarks

The desired product was purified by flash column chromatography, silica gel (200~300 mesh).  $^1\text{H}$  NMR spectra and  $^{13}\text{C}$  NMR spectra were recorded on 400 MHz in  $\text{CDCl}_3$  and TMS as internal standard. All products were further characterized by HRMS (high resolution mass spectra). Copies of their  $^1\text{H}$  NMR and  $^{13}\text{C}$  NMR spectra are provided. For *N*-benzoyloxyamines **2**<sup>1</sup> and homoallyl alcohol **3**<sup>2</sup> was prepared based on reported procedures and NMR data have matched to literatures. All reactions were heated by oil bath. HRMS analysis of compounds was performed with a time-of-flight mass spectrometer (microTOF-Q, Bruker Daltonik, Germany).

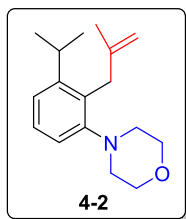
## 2. General procedure for the preparation of the products 4

An oven-dried Schlenk tube under a nitrogen atmosphere was charged aryl iodide **1** (0.3 mmol, 1.0 equiv), *N*-benzoyloxyamine **2** (0.6 mmol, 2.0 equiv), homoallyl alcohol **3** (1.2 mmol, 4.0 equiv),  $\text{PdCl}_2$  (10 mol %),  $\text{P}(p\text{-Me-C}_6\text{H}_4)_3$  (20 mol%),  $\text{N}^1$  (0.60 mmol, 2.0 equiv),  $\text{Cs}_2\text{CO}_3$  (1.20 mmol, 4.0 equiv), solvent (2.0 mL). The mixture was stirred at 35 °C for 30 mins and then stirred at 110 °C for 24 h. The resulting mixture was cooled to room temperature and filtered through Celite eluting with EtOAc. The volatiles were evaporated under reduced pressure and the residue was purified by silica gel flash chromatography to afford the desired products **4**.

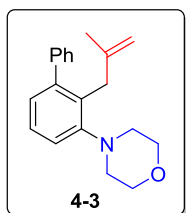
## 3. Spectral data of compound 4



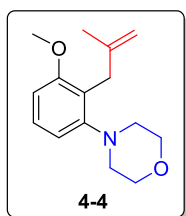
**4-(3-methyl-2-(2-methylallyl)phenyl)morpholine**;  $R_f=0.31$ (petroleum ether/ethyl acetate, 20:1); Column chromatography(silica gel; petroleum ether/ethyl acetate, 40:1); 54mg, 78%; colourless oil;  $^1\text{H}$  NMR(400MHz,  $\text{CDCl}_3$ )  $\delta$ : 7.09-7.05(m, 1H), 6.92-6.87(m, 2H), 4.62(s, 1H), 4.20(s, 1H), 3.73(t,  $J=4.4\text{Hz}$ , 4H), 3.39(s, 2H), 2.80-2.78(m, 4H), 2.17(s, 3H), 1.75(s, 3H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 151.8, 144.2, 138.8, 133.8, 126.7, 126.1, 117.8, 109.6, 67.6, 53.3, 35.6, 23.7, 19.6; HRMS(ESI)  $m/z$ : $[\text{M}+\text{H}]^+$  calcd for  $\text{C}_{15}\text{H}_{22}\text{NO}$  232.1696; found 232.1698.



**4-(3-isopropyl-2-(2-methylallyl)phenyl)morpholine**; Rf=0.32(petroleum ether/ ethyl acetate, 20:1); Column chromatography(silica gel; petroleum ether/ethyl acetate, 40:1); 53mg, 68%; colourless oil; <sup>1</sup>H NMR(400MHz, CDCl<sub>3</sub>) δ: 7.18-7.14(m, 1H), 7.03-7.01(m, 1H), 6.90(dd, J=1.2Hz, 8.0Hz, 1H), 4.64(t, J=1.6Hz, 1H), 4.19(d, J=1.2Hz, 1H), 3.73(t, J=4.4Hz, 4H), 3.44(s, 2H), 2.98-2.91(m, 1H), 2.80-2.77(m, 4H), 1.78(s, 3H), 1.11(s, 3H), 1.09(s, 3H); <sup>13</sup>C NMR(100MHz, CDCl<sub>3</sub>) δ: 151.6, 149.4, 145.7, 132.2, 127.1, 121.4, 117.7, 109.9, 67.7, 53.4, 34.7, 29.2, 24.1, 23.9; HRMS(ESI) m/z: [M+H]<sup>+</sup> calcd for C<sub>17</sub>H<sub>26</sub>NO 260.2009; found 260.2006.

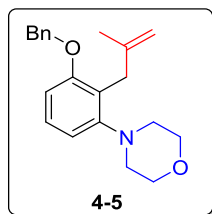


**4-(2-(2-methylallyl)-[1,1'-biphenyl]-3-yl)morpholine**; Rf=0.30(petroleum ether/ ethyl acetate, 20:1); Column chromatography(silica gel; petroleum ether/ethyl acetate, 40:1); 55mg, 63%; colourless oil; <sup>1</sup>H NMR(400MHz, CDCl<sub>3</sub>) δ: 7.34-7.25(m, 6H), 7.20(dd, J=1.2Hz, 8.0Hz, 1H), 7.03(dd, J=1.2Hz, 7.2Hz, 1H), 4.63(s, 1H), 4.15(s, 1H), 3.80(t, J=4.4Hz, 4H), 3.36(s, 2H), 2.90(t, J=4.4Hz, 4H), 1.61(s, 3H); <sup>13</sup>C NMR(100MHz, CDCl<sub>3</sub>) δ: 152.0, 146.1, 144.1, 142.2, 134.2, 129.0, 127.7, 126.7, 126.6, 120.6, 110.3, 67.7, 53.5, 35.9, 23.6; HRMS(ESI) m/z: [M+H]<sup>+</sup> calcd for C<sub>20</sub>H<sub>24</sub>NO 294.1852; found 294.1847.

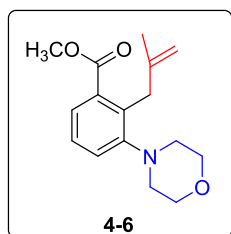


**4-(3-methoxy-2-(2-methylallyl)phenyl)morpholine**; Rf=0.27(petroleum ether/ ethyl acetate, 20:1); Column chromatography(silica gel; petroleum ether/ethyl acetate, 40:1); 57mg, 77%; white solid; <sup>1</sup>H NMR(400MHz, CDCl<sub>3</sub>) δ: 7.14-7.10(m, 1H), 6.69-6.68(m, 1H), 6.61(d, J=8.0Hz, 1H), 4.58-4.57(m, 1H), 4.29(s, 1H), 3.73(t, J=4.4Hz, 4H), 3.71(s, 3H), 3.35(s, 2H), 2.80-2.78(m,

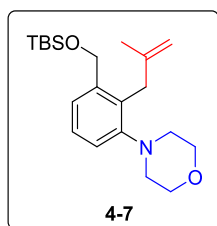
4H), 1.73(s, 3H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 158.7, 152.7, 145.1, 127.3, 123.8, 112.7, 109.0, 106.7, 67.5, 55.7, 53.1, 32.8, 23.6; HRMS(ESI) m/z:  $[\text{M}+\text{H}]^+$  calcd for  $\text{C}_{15}\text{H}_{22}\text{NO}_2$  248.1645; found 248.1651.



**4-(3-(benzyloxy)-2-(2-methylallyl)phenyl)morpholine**; Rf=0.28(peterolium ether/ ethyl acetate, 20:1); Column chromatography(silica gel; peterolium ether/ethyl acetate, 40:1); 74mg, 76%; white solid;  $^1\text{H}$  NMR(400MHz,  $\text{CDCl}_3$ )  $\delta$ : 7.32(d,  $J=7.2\text{Hz}$ , 2H), 7.28-7.25(m, 2H), 7.22-7.18(m, 1H), 7.10-7.06(m, 1H), 6.68(d,  $J=7.6\text{Hz}$ , 1H), 6.63(d,  $J=8.4\text{Hz}$ , 1H), 4.95(s, 2H), 4.61(s, 1H), 4.35(s, 1H), 3.73-3.71(m, 4H), 3.41(s, 2H), 2.80(t,  $J=4.4\text{Hz}$ , 4H), 1.73(s, 3H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 157.7, 152.8, 145.0, 137.6, 128.3, 127.5, 127.3, 126.9, 124.1, 112.9, 109.2, 107.9, 69.9, 67.5, 53.1, 33.0, 23.6; HRMS(ESI) m/z:  $[\text{M}+\text{Na}]^+$  calcd for  $\text{C}_{21}\text{H}_{25}\text{NO}_2\text{Na}$  346.1778; found 346.1783

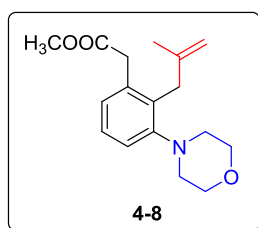


**Methyl 2-(2-methylallyl)-3-morpholinobenzoate**; Rf=0.32(peterolium ether/ ethyl acetate, 10:1); Column chromatography(silica gel; peterolium ether/ethyl acetate, 20:1); 40mg, 48%; yellow solid;  $^1\text{H}$  NMR(400MHz,  $\text{CDCl}_3$ )  $\delta$ : 7.56-7.54(m, 1H), 7.29-7.26(m, 2H), 4.66(s, 1H), 4.21(s, 1H), 3.86(s, 2H), 3.84-3.81(m, 7H), 2.88-2.86(m, 4H), 1.79(s, 3H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 168.7, 152.4, 146.2, 136.3, 132.7, 126.8, 125.9, 124.0, 109.5, 67.4, 53.2, 51.9, 34.7, 23.7; HRMS(ESI) m/z:  $[\text{M}+\text{Na}]^+$  calcd for  $\text{C}_{16}\text{H}_{21}\text{NO}_3\text{Na}$  298.1414; found 298.1424.

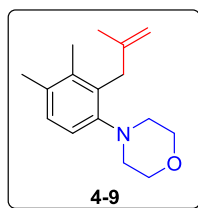


**4-(3-(((tert-butyl)dimethylsilyl)oxy)methyl)-2-(2-methylallyl)phenyl)morpholine**

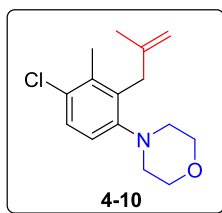
Rf=0.28(petroleum ether/ ethyl acetate, 20:1); Column chromatography(silica gel; petroleum ether/ethyl acetate, 40:1); 69mg, 64%; colourless oil;  $^1\text{H}$  NMR(400MHz,  $\text{CDCl}_3$ )  $\delta$ : 7.25(d,  $J=7.2\text{Hz}$ , 1H), 7.19(t,  $J=7.6\text{Hz}$ , 1H), 6.99(d,  $J=8.0\text{Hz}$ , 1H), 4.62-4.61(m, 3H), 4.20(s, 1H), 3.73(t,  $J=4.4\text{Hz}$ , 4H), 3.39(s, 2H), 2.80-2.77(m, 4H), 1.74(s, 3H), 0.87(s, 9H), 0.01(s, 6H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 151.4, 144.5, 141.4, 131.8, 126.9, 122.5, 119.1, 109.8, 67.6, 62.5, 53.3, 34.3, 25.9, 23.6, 18.4, -5.3; HRMS(ESI)  $m/z$ :  $[\text{M}+\text{Na}]^+$  calcd for  $\text{C}_{21}\text{H}_{35}\text{NO}_2\text{SiNa}$  384.2329; found 384.2336.



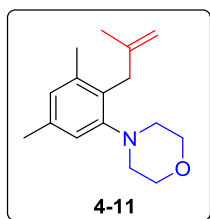
**2-(2-methylallyl)-3-morpholinobenzyl acetate**; Rf=0.31(petroleum ether/ ethyl acetate, 8:1); Column chromatography(silica gel; petroleum ether/ethyl acetate, 15:1); 50mg, 58%; colourless oil;  $^1\text{H}$  NMR(400MHz,  $\text{CDCl}_3$ )  $\delta$ : 7.16-7.12(m, 1H), 6.99(d,  $J=8.0\text{Hz}$ , 1H), 6.95(d,  $J=7.6\text{Hz}$ , 1H), 4.63(d,  $J=1.2\text{Hz}$ , 1H), 4.18(s, 1H), 3.73(t,  $J=4.4\text{Hz}$ , 4H), 3.58(s, 3H), 3.53(s, 2H), 3.44(s, 2H), 2.79(t,  $J=4.4\text{Hz}$ , 4H), 1.75(s, 3H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 172.3, 152.1, 144.6, 134.9, 134.1, 127.1, 126.4, 119.5, 110.1, 67.5, 53.2, 51.9, 38.6, 35.2, 23.6; HRMS(ESI)  $m/z$ :  $[\text{M}+\text{Na}]^+$  calcd for  $\text{C}_{17}\text{H}_{23}\text{NO}_3\text{Na}$  312.1570; found 312.1579



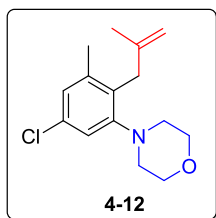
**4-(3,4-dimethyl-2-(2-methylallyl)phenyl)morpholine**; Rf=0.32(petroleum ether/ ethyl acetate, 20:1); Column chromatography(silica gel; petroleum ether/ethyl acetate, 40:1); 60mg, 82%; white solid;  $^1\text{H}$  NMR(400MHz,  $\text{CDCl}_3$ )  $\delta$ : 6.95(d,  $J=5.2\text{Hz}$ , 1H), 6.83(d,  $J=5.6\text{Hz}$ , 1H), 4.62(s, 1H), 4.18(s, 1H), 3.72-3.70(m, 4H), 3.43(s, 2H), 2.75-2.74(m, 4H), 2.16(s, 3H), 2.04(s, 3H), 1.75(s, 3H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 149.9, 144.6, 137.1, 133.8, 132.6, 128.2, 117.4, 109.8, 67.7, 53.4, 35.8, 23.7, 20.4, 15.9; HRMS(ESI)  $m/z$ :  $[\text{M}+\text{H}]^+$  calcd for  $\text{C}_{16}\text{H}_{24}\text{NO}$  246.1852; found 246.1858



**4-(4-chloro-3-methyl-2-(2-methylallyl)phenyl)morpholine**; Rf=0.30(petroleum ether/ ethyl acetate, 20:1); Column chromatography(silica gel; petroleum ether/ethyl acetate, 40:1); 56mg, 70%; colourless oil;  $^1\text{H}$  NMR(400MHz,  $\text{CDCl}_3$ )  $\delta$ : 7.18-7.15(m, 1H), 6.85(d,  $J=8.4\text{Hz}$ , 1H), 4.65-4.64(m, 1H), 4.17(d,  $J=0.8\text{Hz}$ , 1H), 3.73-3.71(m, 4H), 3.42(s, 2H), 2.76-2.74(m, 4H), 2.19(s, 3H), 1.76(s, 3H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 150.5, 143.9, 136.4, 135.9, 130.5, 127.5, 118.9, 110.1, 67.5, 53.2, 36.3, 23.7, 16.8; HRMS(ESI)  $m/z$ : $[\text{M}+\text{H}]^+$  calcd for  $\text{C}_{15}\text{H}_{21}\text{ClNO}$  266.1306; found 266.1314.

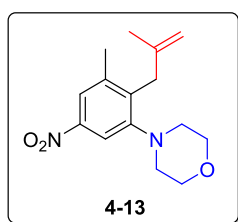


**4-(3,5-dimethyl-2-(2-methylallyl)phenyl)morpholine**; Rf=0.31(petroleum ether/ ethyl acetate, 20:1); Column chromatography(silica gel; petroleum ether/ethyl acetate, 40:1); 59mg, 80%; colourless oil;  $^1\text{H}$  NMR(400MHz,  $\text{CDCl}_3$ )  $\delta$ : 6.71(s, 2H), 4.61(s, 1H), 4.22(s, 1H), 3.72(t,  $J=4.4\text{Hz}$ , 4H), 3.33(s, 2H), 2.78-2.76(m, 4H), 2.22(s, 3H), 2.12(s, 3H), 1.74(s, 3H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 151.7, 144.4, 138.6, 136.1, 130.5, 126.9, 118.4, 109.5, 67.6, 53.3, 35.4, 23.6, 21.1, 19.5; HRMS(ESI)  $m/z$ : $[\text{M}+\text{H}]^+$  calcd for  $\text{C}_{16}\text{H}_{24}\text{NO}$  246.1852; found 246.1854.

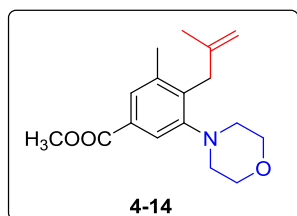


**4-(5-chloro-3-methyl-2-(2-methylallyl)phenyl)morpholine**; Rf=0.30(petroleum ether/ ethyl acetate, 20:1); Column chromatography(silica gel; petroleum ether/ethyl acetate, 40:1); 41mg, 52%; yellow oil;  $^1\text{H}$  NMR(400MHz,  $\text{CDCl}_3$ )  $\delta$ : 6.86(d,  $J=2.4\text{Hz}$ , 2H), 4.63-4.62(m, 1H), 4.18(s, 1H), 3.73-3.71(m, 4H), 3.31(s, 2H), 2.76(t,  $J=4.4\text{Hz}$ , 4H), 2.13(s, 3H), 1.74(s, 3H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 152.9, 143.7, 140.4, 132.1, 131.8, 125.8, 118.3, 109.8, 67.4, 53.1, 35.4,

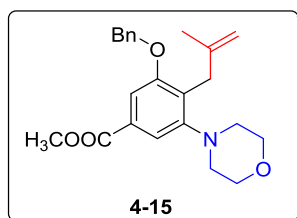
23.6, 19.5; HRMS(ESI)  $m/z$ :  $[M+H]^+$  calcd for  $C_{15}H_{21}ClNO$  266.1306; found 266.1310.



**4-(3-methyl-2-(2-methylallyl)-5-nitrophenyl)morpholine**  $R_f=0.31$ (petroleum ether/ ethyl acetate, 10:1); Column chromatography(silica gel; petroleum ether/ethyl acetate, 20:1); 48mg, 58%; yellow oil;  $^1H$  NMR(400MHz,  $CDCl_3$ )  $\delta$ : 7.75-7.74(m, 2H), 4.67(d,  $J=1.2$ Hz, 1H), 4.14(s, 1H), 3.78-3.75(m, 4H), 3.42(s, 2H), 2.84(t,  $J=4.4$ Hz, 4H), 2.27(s, 3H), 1.79(s, 3H);  $^{13}C$  NMR(100MHz,  $CDCl_3$ )  $\delta$ : 152.7, 146.7, 142.8, 141.6, 140.4, 120.5, 113.0, 110.4, 67.3, 53.0, 36.1, 23.8, 19.9; HRMS(ESI)  $m/z$ :  $[M+Na]^+$  calcd for  $C_{15}H_{20}N_2O_3Na$  299.1366; found 299.1362.

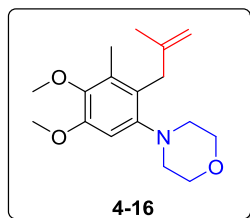


**methyl 3-methyl-4-(2-methylallyl)-5-morpholinobenzoate**  $R_f=0.30$ (petroleum ether/ ethyl acetate, 10:1); Column chromatography(silica gel; petroleum ether/ethyl acetate, 20:1); 61mg, 70%; colourless oil;  $^1H$  NMR(400MHz,  $CDCl_3$ )  $\delta$ : 7.57(d,  $J=2.4$ Hz, 2H), 4.63-4.62(m, 1H), 4.14(s, 1H), 3.82(s, 3H), 3.74(t,  $J=4.4$ Hz, 4H), 3.40(s, 2H), 2.82-2.80(m, 4H), 2.20(s, 3H), 1.76(s, 3H);  $^{13}C$  NMR(100MHz,  $CDCl_3$ )  $\delta$ : 167.2, 151.9, 143.4, 139.4, 139.1, 128.4, 127.1, 119.0, 109.9, 67.4, 53.2, 51.9, 35.8, 23.7, 19.6; HRMS(ESI)  $m/z$ :  $[M+Na]^+$  calcd for  $C_{17}H_{23}NO_3Na$  312.1570; found 312.1576.

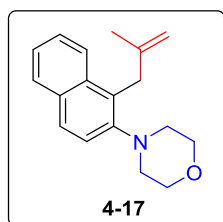


**methyl 3-(benzyloxy)-4-(2-methylallyl)-5-morpholinobenzoate**  $R_f=0.27$ (petroleum ether/ ethyl acetate, 10:1); Column chromatography(silica gel; petroleum ether/ethyl acetate, 20:1); 86mg, 75%; yellow oil;  $^1H$  NMR(400MHz,  $CDCl_3$ )  $\delta$ : 7.39(d,  $J=1.2$ Hz, 1H), 7.35-7.33(m, 3H), 7.29(t,  $J=6.8$ Hz, 2H), 7.24-7.21(m, 1H), 5.01(s, 2H), 4.61(s, 1H), 4.29(s, 1H), 3.83(s, 3H), 3.75-3.73(m,

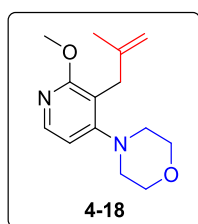
4H), 3.42(s, 2H), 2.83(t,  $J=4.4\text{Hz}$ , 4H), 1.73(s, 3H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 167.0, 157.6, 152.7, 144.2, 137.0, 129.7, 129.2, 128.4, 127.7, 127.0, 114.4, 109.6, 108.5, 70.1, 67.4, 53.0, 52.1, 33.3, 23.6; HRMS(ESI)  $m/z$ :  $[\text{M}+\text{Na}]^+$  calcd for  $\text{C}_{23}\text{H}_{27}\text{NO}_4\text{Na}$  404.1832; found 404.1836



**4-(4,5-dimethoxy-3-methyl-2-(2-methylallyl)phenyl)morpholine**;  $R_f=0.31$ (petroleum ether/ethyl acetate, 15:1); Column chromatography(silica gel; petroleum ether/ethyl acetate, 30:1); 56mg, 64%; yellow oil;  $^1\text{H}$  NMR(400MHz,  $\text{CDCl}_3$ )  $\delta$ : 6.53(s, 1H), 4.60(s, 1H), 4.19(s, 1H), 3.78(s, 3H), 3.73-3.72(d,  $J=4.4\text{Hz}$ , 4H), 3.67(s, 3H), 3.33(s, 2H), 2.77-2.75(m, 4H), 2.01(s, 3H), 1.73(s, 3H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 151.0, 147.5, 144.6, 144.0, 132.3, 127.0, 109.5, 102.5, 67.6, 60.2, 55.6, 53.4, 35.4, 23.5, 12.1; HRMS(ESI)  $m/z$ :  $[\text{M}+\text{H}]^+$  calcd for  $\text{C}_{17}\text{H}_{26}\text{NO}_3$  292.1907; found 292.1914



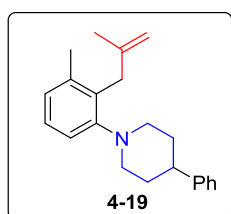
**4-(1-(2-methylallyl)naphthalen-2-yl)morpholine**  $R_f=0.30$ (petroleum ether/ethyl acetate, 20:1); Column chromatography(silica gel; petroleum ether/ethyl acetate, 40:1); 69mg, 86%; white solid;  $^1\text{H}$  NMR(400MHz,  $\text{CDCl}_3$ )  $\delta$ : 7.78(d,  $J=8.4\text{Hz}$ , 1H), 7.71-7.66(m, 2H), 7.38-7.27(m, 3H), 4.66-4.65(m, 1H), 4.15(d,  $J=0.8\text{Hz}$ , 1H), 3.84(s, 2H), 3.79-3.77(m, 4H), 2.90-2.88(m, 4H), 1.83(s, 3H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 148.4, 145.0, 133.5, 131.0, 129.6, 128.1, 127.8, 125.8, 125.2, 124.4, 119.8, 111.1, 67.6, 53.0, 34.9, 23.8; HRMS(ESI)  $m/z$ :  $[\text{M}+\text{H}]^+$  calcd for  $\text{C}_{18}\text{H}_{22}\text{NO}$  268.1696; found 268.1695



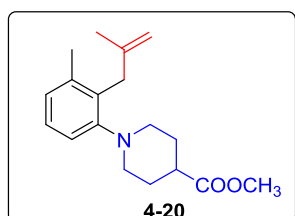
**4-(2-methoxy-3-(2-methylallyl)pyridin-4-yl)morpholine**  $R_f=0.27$ (petroleum ether/ethyl acetate,



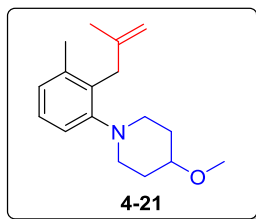
10:1); Column chromatography(silica gel; petroleum ether/ethyl acetate, 20:1); 51mg, 68%; colourless oil;  $^1\text{H}$  NMR(400MHz,  $\text{CDCl}_3$ )  $\delta$ : 7.92(d,  $J=5.6\text{Hz}$ , 1H), 6.50(d,  $J=5.6\text{Hz}$ , 1H), 4.63(s, 1H), 4.32(s, 1H), 3.83(s, 3H), 3.75-3.72(m, 4H), 3.20(s, 2H), 2.90-2.87(m, 4H), 1.74(s, 3H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 163.8, 159.7, 145.2, 143.8, 114.2, 109.6, 108.2, 67.1, 53.6, 51.8, 33.2, 23.6; HRMS(ESI)  $m/z$ :  $[\text{M}+\text{H}]^+$  calcd for  $\text{C}_{14}\text{H}_{21}\text{N}_2\text{O}_2$  249.1598; found 249.1593



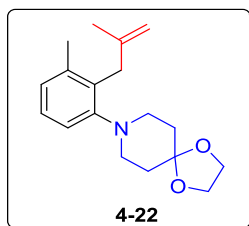
**1-(3-methyl-2-(2-methylallyl)phenyl)-4-phenylpiperidine**  $R_f=0.27$ (petroleum ether /ethyl acetate, 30:1); Column chromatography(silica gel; petroleum ether/ethyl acetate, 60:1); 52mg, 57%; colourless oil;  $^1\text{H}$  NMR(400MHz,  $\text{CDCl}_3$ )  $\delta$ : 7.26-7.19(m, 4H), 7.15-7.11(m, 1H), 7.07-7.03(m, 1H), 6.94(d,  $J=7.6\text{Hz}$ , 1H), 6.85(d,  $J=7.2\text{Hz}$ , 1H), 4.63(s, 1H), 4.26(s, 1H), 3.41(s, 2H), 3.08(d,  $J=12.0\text{Hz}$ , 2H), 2.71-2.63(m, 2H), 2.57-2.49(m, 1H), 2.17(s, 3H), 1.83-1.78(m, 4H), 1.76(s, 3H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 153.0, 146.5, 144.3, 138.7, 133.8, 128.4, 126.9, 126.5, 126.1, 125.6, 117.7, 109.4, 54.1, 42.5, 35.8, 34.3, 23.6, 19.7; HRMS(ESI)  $m/z$ :  $[\text{M}+\text{H}]^+$  calcd for  $\text{C}_{22}\text{H}_{28}\text{N}$  306.2216; found 306.2220.



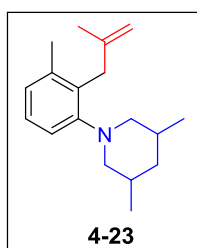
**methyl 1-(3-methyl-2-(2-methylallyl)phenyl)piperidine-4-carboxylate**;  $R_f=0.30$  (petroleum ether/ ethyl acetate, 6:1); Column chromatography(silica gel; petroleum ether/ethyl acetate, 12:1); 43mg, 50%; colourless oil;  $^1\text{H}$  NMR(400MHz,  $\text{CDCl}_3$ )  $\delta$ : 7.05-7.01(m, 1H), 6.88-6.83(m, 2H), 4.61(d,  $J=1.6\text{Hz}$ , 1H), 4.21(d,  $J=1.2\text{Hz}$ , 1H), 3.62(d,  $J=2.8\text{Hz}$ , 3H), 3.35(s, 2H), 3.01-2.98(m, 2H), 2.58-2.52(m, 2H), 2.36-2.28(m, 1H), 2.16(s, 3H), 1.90-1.86(m, 2H), 1.83-1.76(m, 2H), 1.74(s, 3H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 175.8, 152.6, 144.3, 138.7, 133.8, 126.5, 125.7, 117.7, 109.4, 52.8, 51.6, 41.0, 35.6, 29.1, 23.6, 19.7; HRMS(ESI)  $m/z$ :  $[\text{M}+\text{H}]^+$  calcd for  $\text{C}_{18}\text{H}_{26}\text{NO}_2$  288.1958; found 288.1966



**4-methoxy-1-(3-methyl-2-(2-methylallyl)phenyl)piperidine;** Rf=0.30(peterolium ether/ ethyl acetate, 20:1); Column chromatography(silica gel; peterolium ether/ethyl acetate, 40:1); 42mg, 54%; colourless oil;  $^1\text{H}$  NMR(400MHz,  $\text{CDCl}_3$ )  $\delta$ : 7.04(t,  $J=7.6\text{Hz}$ , 1H), 6.90(d,  $J=7.6\text{Hz}$ , 1H), 6.84(d,  $J=7.2\text{Hz}$ , 1H), 4.62(d,  $J=1.2\text{Hz}$ , 1H), 4.22(s, 1H), 3.37(s, 2H), 3.31(s, 3H), 3.27-3.21(m, 1H), 2.99-2.94(m, 2H), 2.62-2.56(m, 2H), 2.17(s, 3H), 1.94-1.91(m, 2H), 1.75(s, 3H), 1.65-1.57(m, 2H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 152.6, 144.3, 138.7, 133.9, 126.4, 125.7, 117.8, 109.3, 55.5, 51.0, 35.7, 31.9, 23.6, 19.7; HRMS(ESI) m/z:  $[\text{M}+\text{H}]^+$  calcd for  $\text{C}_{17}\text{H}_{26}\text{NO}$  260.2009; found 260.2013.

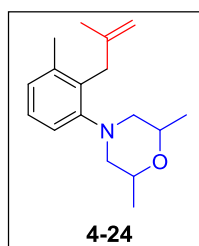


**8-(3-methyl-2-(2-methylallyl)phenyl)-1,4-dioxaspiro[4.5]decane;** Rf=0.32(peterolium ether/ethyl acetate, 15:1); Column chromatography(silica gel; peterolium ether/ethyl acetate, 30:1); 55mg, 64%; colourless oil;  $^1\text{H}$  NMR(400MHz,  $\text{CDCl}_3$ )  $\delta$ : 7.02(t,  $J=7.6\text{Hz}$ , 1H), 6.93(d,  $J=8.0\text{Hz}$ , 1H), 6.84(d,  $J=7.2\text{Hz}$ , 1H), 4.62-4.61(m, 1H), 4.22(d,  $J=1.2\text{Hz}$ , 1H), 3.91(s, 4H), 3.38(s, 2H), 2.85(t,  $J=5.6\text{Hz}$ , 4H), 2.16(s, 3H), 1.76(d,  $J=5.6\text{Hz}$ , 4H), 1.74(s, 3H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 152.4, 144.2, 138.6, 133.8, 126.5, 125.7, 118.0, 109.4, 107.1, 64.2, 51.2, 35.8, 35.7, 23.5, 19.7; HRMS(ESI) m/z:  $[\text{M}+\text{H}]^+$  calcd for  $\text{C}_{18}\text{H}_{26}\text{NO}_2$  288.1958; found 288.1963.

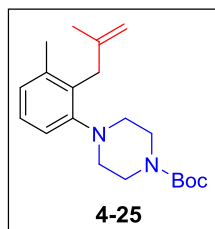


**3,5-dimethyl-1-(3-methyl-2-(2-methylallyl)phenyl)piperidine;** Rf=0.4(peterolium ether); Column chromatography(silica gel; peterolium ether); 45mg, 58%; colourless oil;  $^1\text{H}$

NMR(400MHz, CDCl<sub>3</sub>)  $\delta$ : 7.02(t,  $J=7.6$ Hz, 1H), 6.86(d,  $J=8.0$ Hz, 1H), 6.81(d,  $J=7.6$ Hz, 1H), 4.63(s, 1H), 4.25(s, 1H), 3.35(s, 2H), 2.90(d,  $J=10.8$ Hz, 2H), 2.16(s, 3H), 2.03(t,  $J=10.8$ Hz, 2H), 1.72-1.68(m, 6H), 0.79(s, 3H), 0.77(s, 3H), 0.60-0.50(m, 1H); <sup>13</sup>C NMR(100MHz, CDCl<sub>3</sub>)  $\delta$ : 153.0, 144.4, 138.6, 133.7, 126.4, 125.3, 117.7, 109.4, 61.2, 42.3, 35.7, 32.1, 23.5, 19.7, 19.4; HRMS(ESI) m/z:[M+H]<sup>+</sup> calcd for C<sub>18</sub>H<sub>28</sub>N 258.2216; found 258.2215.

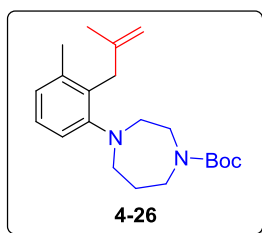


**2,6-dimethyl-4-(3-methyl-2-(2-methylallyl)phenyl)morpholine**; R<sub>f</sub>=0.34(petroleum ether/ ethyl acetate, 20:1); Column chromatography(silica gel; petroleum ether/ethyl acetate, 50:1); 64mg, 82%; colourless oil; <sup>1</sup>H NMR(400MHz, CDCl<sub>3</sub>)  $\delta$ : 7.06-7.02(m, 1H), 6.87-6.84(m, 2H), 4.63(s, 1H), 4.21(s, 1H), 3.75-3.69(m, 2H), 3.36(s, 2H), 2.88(d,  $J=11.2$ Hz, 2H), 2.33(t,  $J=10.8$ Hz, 2H), 2.16(s, 3H), 1.73(s, 3H), 1.10(s, 3H), 1.08(s, 3H); <sup>13</sup>C NMR(100MHz, CDCl<sub>3</sub>)  $\delta$ : 151.5, 144.2, 138.7, 133.8, 126.6, 125.9, 117.8, 109.6, 72.3, 59.0, 35.6, 23.6, 19.6, 19.0; HRMS(ESI) m/z:[M+H]<sup>+</sup> calcd for C<sub>17</sub>H<sub>26</sub>NO 260.2009; found 260.2010.



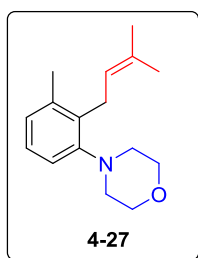
**tert-butyl 4-(3-methyl-2-(2-methylallyl)phenyl)piperazine-1-carboxylate**;

R<sub>f</sub>=0.30(petroleum ether/ ethyl acetate, 20:1); Column chromatography(silica gel; petroleum ether/ethyl acetate, 40:1); 74mg, 75%; colourless oil; <sup>1</sup>H NMR(400MHz, CDCl<sub>3</sub>)  $\delta$ : 7.06-7.02(m, 1H), 6.86(d,  $J=7.6$ Hz, 2H), 4.62(s, 1H), 4.19(s, 1H), 3.41(m, 6H), 2.72(s, 4H), 2.16(s, 3H), 1.74(s, 3H), 1.40(s, 9H); <sup>13</sup>C NMR(100MHz, CDCl<sub>3</sub>)  $\delta$ : 154.9, 151.8, 144.1, 138.7, 133.8, 126.6, 126.1, 117.9, 109.6, 79.5, 52.7, 35.6, 28.4, 23.6, 19.6; HRMS(ESI) m/z:[M+H]<sup>+</sup> calcd for C<sub>20</sub>H<sub>31</sub>N<sub>2</sub>O<sub>2</sub> 331.2380; found 331.2378.

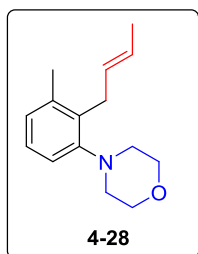


**tert-butyl 4-(3-methyl-2-(2-methylallyl)phenyl)-1,4-diazepane-1-carboxylate;**

R<sub>f</sub>=0.31(petroleum ether/ ethyl acetate, 8:1); Column chromatography(silica gel; petroleum ether/ethyl acetate, 15:1); 74mg, 72%; yellow oil; <sup>1</sup>H NMR(400MHz, CDCl<sub>3</sub>) δ: 7.05-7.00(m, 1H), 6.92-6.89(m, 1H), 6.86-6.83(m, 1H), 4.61(s, 1H), 4.13(s, 1H), 3.52-3.39(m, 6H), 2.97-2.87(m, 4H), 2.16(s, 3H), 1.80-1.73(m, 5H), 1.41(s, 9H); <sup>13</sup>C NMR(100MHz, CDCl<sub>3</sub>) δ: 155.5, 154.7, 144.0, 138.6, 134.1, 126.6, 125.9, 119.7, 109.4, 79.2, 57.6, 56.8, 48.5, 46.1, 35.8, 29.0, 28.5, 23.6, 19.7; HRMS(ESI) m/z: [M+H]<sup>+</sup> calcd for C<sub>21</sub>H<sub>33</sub>N<sub>2</sub>O<sub>2</sub> 345.2537; found 345.2551.

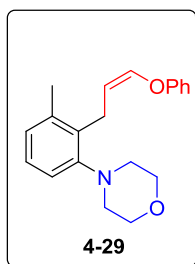


**4-(3-methyl-2-(3-methylbut-2-en-1-yl)phenyl)morpholine;** R<sub>f</sub>=0.33(petroleum ether/ ethyl acetate, 20:1); Column chromatography(silica gel; petroleum ether/ethyl acetate, 40:1); 60mg, 82%; colourless oil; <sup>1</sup>H NMR(400MHz,CDCl<sub>3</sub>) δ: 7.03(t, *J*=7.6Hz, 1H), 6.91-6.86(m, 2H), 4.98-4.95(m, 1H), 3.75(t, *J*=4.4Hz, 4H), 3.42(d, *J*=6.0Hz, 2H), 2.80-2.78(m, 4H), 2.21(s, 3H), 1.70(s, 3H), 1.61(s, 3H); <sup>13</sup>C NMR(100MHz, CDCl<sub>3</sub>) δ: 151.4, 138.2, 135.9, 131.7, 126.4, 123.3, 117.9, 67.5, 53.4, 26.8, 25.6, 20.0, 18.1; HRMS(ESI) m/z: [M+H]<sup>+</sup> calcd for C<sub>16</sub>H<sub>24</sub>NO 246.1852; found 246.1859

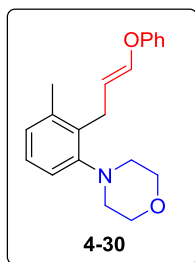


**(E)-4-(2-(but-2-en-1-yl)-3-methylphenyl)morpholine;** R<sub>f</sub>=0.31(petroleum ether/ ethyl acetate, 20:1); Column chromatography(silica gel; petroleum ether/ethyl acetate, 40:1); 41mg, 59%;

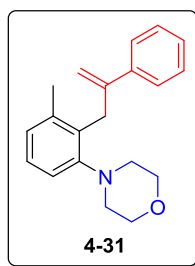
colourless oil;  $^1\text{H}$  NMR(400MHz,  $\text{CDCl}_3$ )  $\delta$ : 7.04(t,  $J=7.6\text{Hz}$ , 1H), 6.92(d,  $J=7.6\text{Hz}$ , 1H), 6.87(d,  $J=7.2\text{Hz}$ , 1H), 5.47-5.41(m, 1H), 5.30-5.24(m, 1H), 3.76-3.74(m, 4H), 3.43-3.41(m, 2H), 2.81-2.78(m, 4H), 2.22(s, 3H), 1.56-1.53(m, 3H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 151.6, 138.3, 134.7, 129.2, 126.5, 126.4, 125.1, 118.2, 67.5, 53.4, 30.7, 19.9, 17.9; HRMS(ESI)  $m/z$ :  $[\text{M}+\text{H}]^+$  calcd for  $\text{C}_{15}\text{H}_{22}\text{NO}$  232.1696; found 232.1699



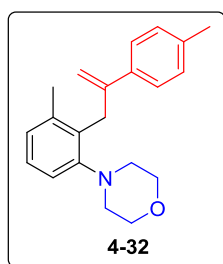
**(E)-4-(3-methyl-2-(3-phenoxyallyl)phenyl)morpholine**; Rf=0.29(peterolium ether/ ethyl acetate, 20:1); Column chromatography(silica gel; peterolium ether/ethyl acetate, 40:1); 50mg, 54%; colourless oil;  $^1\text{H}$  NMR(400MHz,  $\text{CDCl}_3$ )  $\delta$ : 7.28-7.24(m, 2H), 7.08-7.04(m, 1H), 7.01-6.88(m, 5H), 6.37-6.34(m, 1H), 4.78-4.73(m, 1H), 3.73(t,  $J=4.4\text{Hz}$ , 4H), 3.70-3.68(m, 2H), 2.83-2.80(m, 4H), 2.29(s, 3H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 157.4, 151.6, 140.2, 138.3, 134.8, 129.7, 126.6, 126.4, 122.6, 118.0, 116.2, 111.2, 67.5, 53.4, 22.9, 19.9; HRMS(ESI)  $m/z$ :  $[\text{M}+\text{H}]^+$  calcd for  $\text{C}_{20}\text{H}_{24}\text{NO}_2$  310.1802; found 310.1809



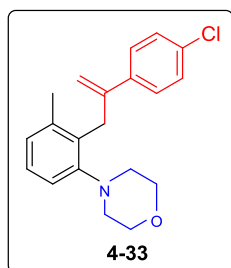
**(E)-4-(3-methyl-2-(3-phenoxyallyl)phenyl)morpholine** Rf=0.29(peterolium ether/ ethyl acetate, 20:1); Column chromatography(silica gel; peterolium ether/ethyl acetate, 40:1); 57mg, 62%; colourless oil;  $^1\text{H}$  NMR(400MHz,  $\text{CDCl}_3$ )  $\delta$ : 7.23-7.18(m, 2H), 7.09-7.05(m, 1H), 6.96-6.93(m, 2H), 6.91-6.89(d,  $J=7.6\text{Hz}$ , 1H), 6.83-6.81(m, 2H), 6.27(dt,  $J=1.6\text{Hz}$ , 12.0Hz, 1H), 5.47-5.41(m, 1H), 3.79-3.77(m, 4H), 3.48(dd,  $J=1.2\text{Hz}$ , 6.4Hz, 2H), 2.85-2.83(m, 4H), 2.31(s, 3H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 157.3, 151.6, 142.2, 138.0, 134.1, 129.5, 126.9, 126.7, 122.5, 118.6, 116.2, 112.1, 67.6, 53.6, 25.6, 19.9; HRMS(ESI)  $m/z$ :  $[\text{M}+\text{H}]^+$  calcd for  $\text{C}_{20}\text{H}_{24}\text{NO}_2$  310.1802; found 310.1799



**4-(3-methyl-2-(2-phenylallyl)phenyl)morpholine:** Rf=0.31(peterolium ether/ ethyl acetate, 20:1); Column chromatography(silica gel; peterolium ether/ethyl acetate, 40:1); 65mg, 74%; colourless oil;  $^1\text{H}$  NMR(400MHz,  $\text{CDCl}_3$ )  $\delta$ : 7.48-7.46(m, 2H), 7.32-7.28(m, 2H), 7.25-7.22(m, 1H), 7.11(t,  $J=7.6\text{Hz}$ , 1H), 6.96-6.91(m, 2H), 5.18(d,  $J=1.6\text{Hz}$ , 1H), 4.45(d,  $J=1.2\text{Hz}$ , 1H), 3.88(s, 2H), 3.68(t,  $J=4.4\text{Hz}$ , 4H), 2.82-2.80(m, 4H), 2.20(s, 3H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 152.0, 146.7, 142.2, 139.0, 133.5, 128.3, 127.5, 127.0, 126.2, 125.8, 118.0, 111.8, 67.6, 53.3, 33.3, 19.7; HRMS(ESI) m/z:  $[\text{M}+\text{H}]^+$  calcd for  $\text{C}_{20}\text{H}_{24}\text{NO}$  294.1853; found 294.1851.

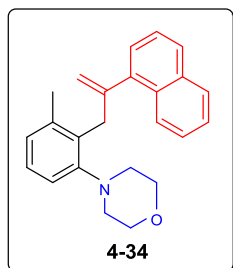


**4-(3-methyl-2-(2-(p-tolyl)allyl)phenyl)morpholine:** Rf=0.32(peterolium ether/ ethyl acetate, 20:1); Column chromatography(silica gel; peterolium ether/ethyl acetate, 40:1); 51mg, 55%; colourless oil;  $^1\text{H}$  NMR(400MHz,  $\text{CDCl}_3$ )  $\delta$ : 7.37(d,  $J=8.4\text{Hz}$ , 2H), 7.11(t,  $J=7.6\text{Hz}$ , 3H), 6.96-6.91(m, 2H), 5.17(d,  $J=1.6\text{Hz}$ , 1H), 4.41(d,  $J=1.2\text{Hz}$ , 1H), 3.86(s, 2H), 3.69(t,  $J=4.4\text{Hz}$ , 4H), 2.83-2.81(m, 4H), 2.30(s, 3H), 2.19(s, 3H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 152.0, 146.4, 139.2, 139.0, 137.3, 133.6, 129.0, 126.9, 126.2, 125.6, 117.9, 111.0, 67.6, 53.3, 33.2, 21.1, 19.7; HRMS(ESI) m/z:  $[\text{M}+\text{H}]^+$  calcd for  $\text{C}_{21}\text{H}_{26}\text{NO}$  308.2009; found 308.2003.

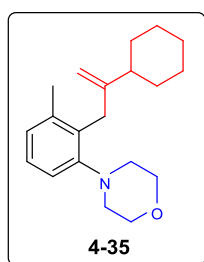


**4-(2-(2-(4-chlorophenyl)allyl)-3-methylphenyl)morpholine:** Rf=0.34(peterolium ether/ ethyl acetate, 20:1); Column chromatography(silica gel; peterolium ether/ethyl acetate, 40:1); 65mg,

66%; colourless oil;  $^1\text{H}$  NMR(400MHz,  $\text{CDCl}_3$ )  $\delta$ : 7.41-7.38(m, 2H), 7.27-7.25(m, 2H), 7.12(t,  $J=7.6\text{Hz}$ , 1H), 6.97-6.91(m, 2H), 5.18(d,  $J=1.2\text{Hz}$ , 1H), 4.49(d,  $J=1.2\text{Hz}$ , 1H), 3.84(s, 2H), 3.69-3.67(m, 4H), 2.81-2.79(m, 4H), 2.19(s, 3H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 152.0, 145.7, 140.5, 138.9, 133.3, 133.2, 128.4, 127.2, 127.1, 126.4, 118.2, 112.4, 67.6, 53.4, 33.1, 19.8; HRMS(ESI) m/z:  $[\text{M}+\text{H}]^+$  calcd for  $\text{C}_{20}\text{H}_{23}\text{ClNO}$  328.1463; found 328.1462.



**4-(3-methyl-2-(2-(naphthalen-1-yl)allyl)phenyl)morpholine:**  $R_f=0.32$ (petroleum ether/ ethyl acetate, 20:1); Column chromatography(silica gel; petroleum ether/ethyl acetate, 40:1); 52mg, 51%; colourless oil;  $^1\text{H}$  NMR(400MHz,  $\text{CDCl}_3$ )  $\delta$ : 7.91(s, 1H), 7.81-7.75(m, 3H), 7.64-7.61(m, 1H), 7.45-7.37(m, 2H), 7.15-7.11(m, 1H), 6.98-6.93(m, 2H), 5.36(d,  $J=1.2\text{Hz}$ , 1H), 4.57(d,  $J=1.2\text{Hz}$ , 1H), 4.01(s, 2H), 3.69(t,  $J=4.4\text{Hz}$ , 4H), 2.85-2.83(m, 4H), 2.24(s, 3H);  $^{13}\text{C}$  NMR(100MHz,  $\text{CDCl}_3$ )  $\delta$ : 152.0, 146.4, 139.2, 139.0, 133.6, 133.3, 132.8, 128.2, 127.8, 127.5, 127.0, 126.3, 126.2, 125.9, 124.4, 124.3, 118.0, 112.4, 67.6, 53.4, 33.2, 19.8; HRMS(ESI) m/z:  $[\text{M}+\text{H}]^+$  calcd for  $\text{C}_{24}\text{H}_{26}\text{NO}$  344.2009; found 344.2007.

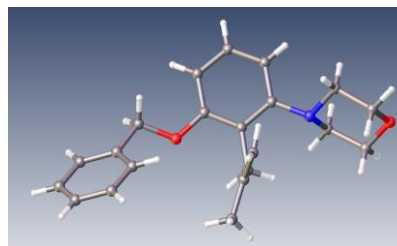
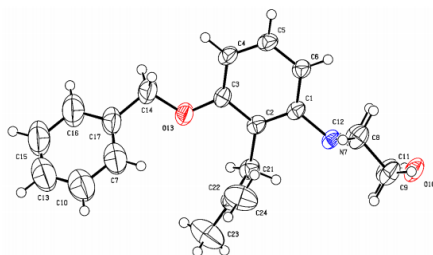
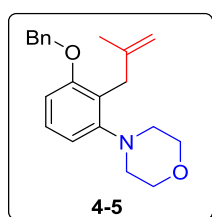


**4-(2-(2-cyclohexylallyl)-3-methylphenyl)morpholine:**  $R_f=0.33$ (petroleum ether/ ethyl acetate, 20:1); NMR yield, HRMS(ESI) m/z:  $[\text{M}+\text{H}]^+$  calcd for  $\text{C}_{20}\text{H}_{30}\text{NO}$  300.2322; found 300.2323.

#### 4. References

1. (a) Dong, Z.; Dong, G. Ortho vs Ipso: Site-Selective Pd and Norbornene-Catalyzed Arene C-H Amination Using Aryl Halides. *J. Am. Chem. Soc.* **2013**, *135*, 18350; (b) Fan, L.; Liu, J.; Bai, Lu.; Wang, Y.; Luan, X. Rapid Assembly of Diversely Functionalized Spiroindenes by a Three-Component Palladium-Catalyzed C-H Amination/Phenol Dearomatization Domino Reaction, *Angew. Chem. Int. Ed.* **2017**, *56*, 14257.
2. (a) Bunnelle, W. H.; Rafferty, M. A.; Hodges, S. L. Aldol-equivalent elaboration of sterically hindered ketones: methallylmagnesium chloride as a synthon for acetone enolate, *J. Org. Chem.* **1987**, *52*, 1603; (b) Iwasaki, M.; Hayashi, S.; Hirano, K.; Yorimitsu, H.; Oshima, K. Pd(OAc)<sub>2</sub>/P(C<sub>6</sub>H<sub>11</sub>)<sub>3</sub>-Catalyzed Allylation of Aryl Halides with Homoallyl Alcohols via Retro-Allylation, *J. Am. Chem. Soc.* **2007**, *129*, 4463.

#### 5. The crystal structure of product 4-5





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Bond precision: C-C = 0.0059 A

Wavelength=1.54184

Cell: a=12.4334(3)

b=7.2808(2)

c=40.6710(13)

alpha=90

beta=90

gamma=90

Temperature: 293 K

	Calculated	Reported
Volume	3681.75(18)	3681.75(18)
Space group	P b c a	P b c a
Hall group	-P 2ac 2ab	-P 2ac 2ab
Moiety formula	C21 H25 N O2	C21 H25 N O2
Sum formula	C21 H25 N O2	C21 H25 N O2
Mr	323.42	323.42
Dx, g cm-3	1.167	1.167
Z	8	8
Mu (mm-1)	0.583	0.583
F000	1392.0	1392.0
F000'	1395.88	
h,k,lmax	15,8,50	15,8,50
Nref	3584	3520
Tmin,Tmax	0.993,0.994	0.567,1.000
Tmin'	0.988	

Correction method= # Reported T Limits: Tmin=0.567 Tmax=1.000

AbsCorr = MULTI-SCAN

Data completeness= 0.982

Theta(max)= 71.490

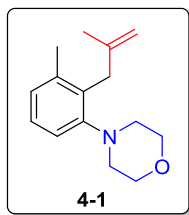
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wR2(reflections)=  
0.1971( 3520)

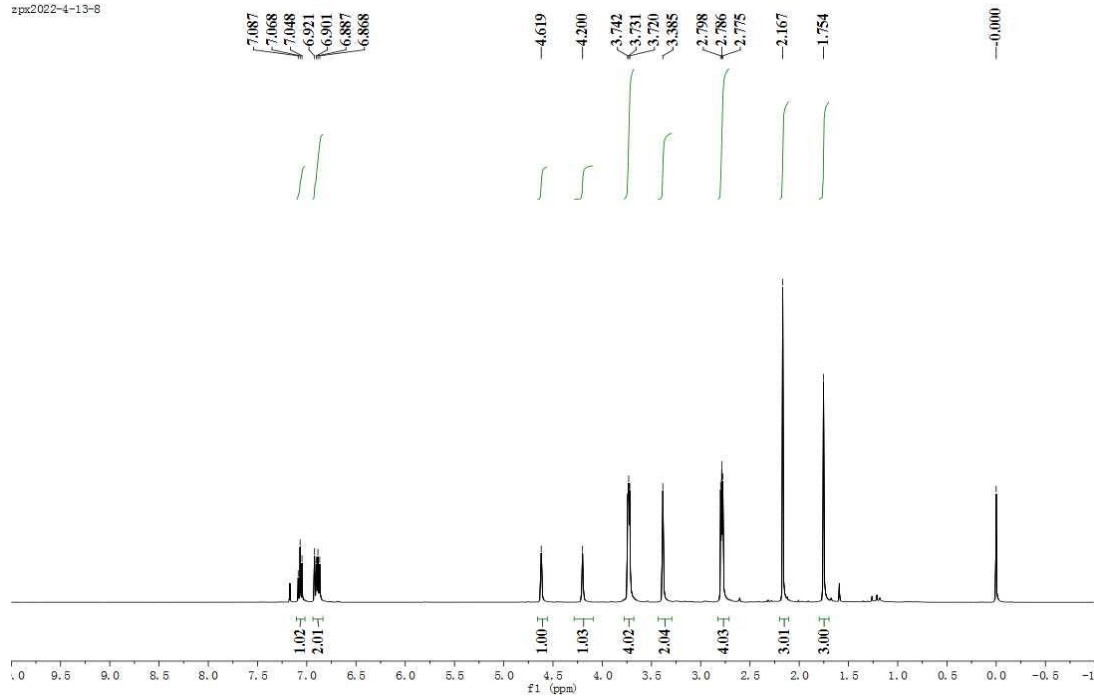
S = 1.110

Npar= 234

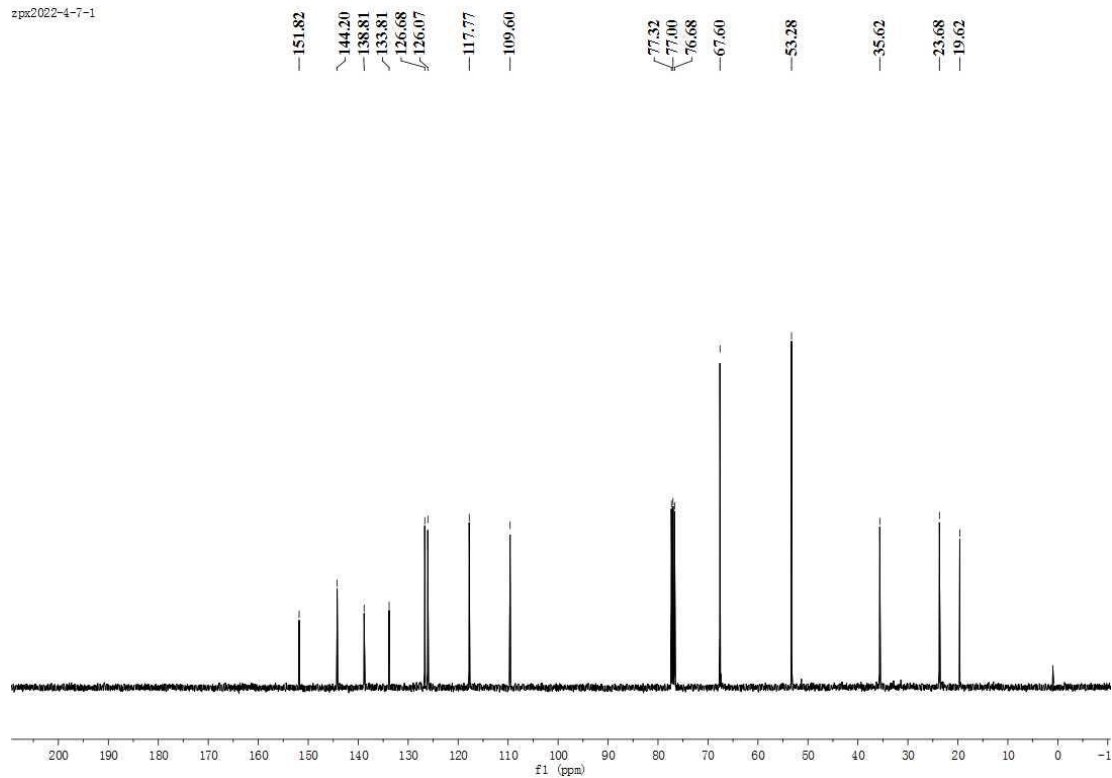
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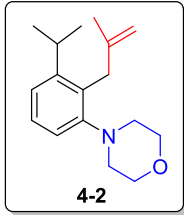


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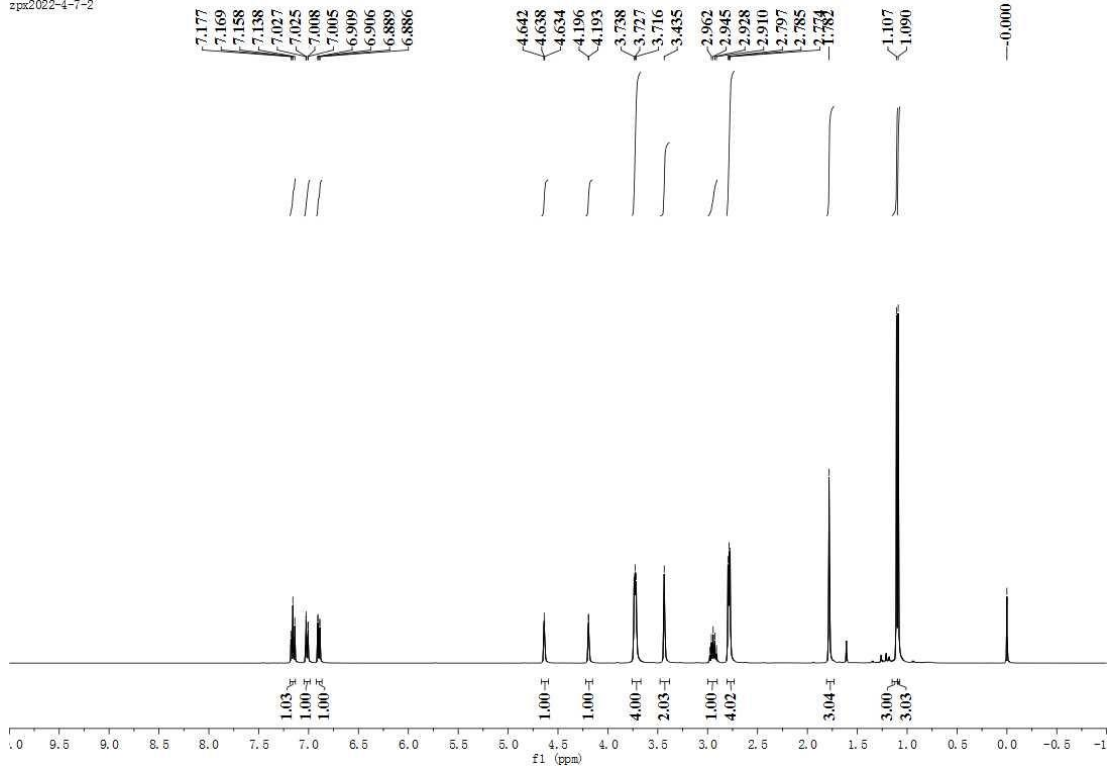


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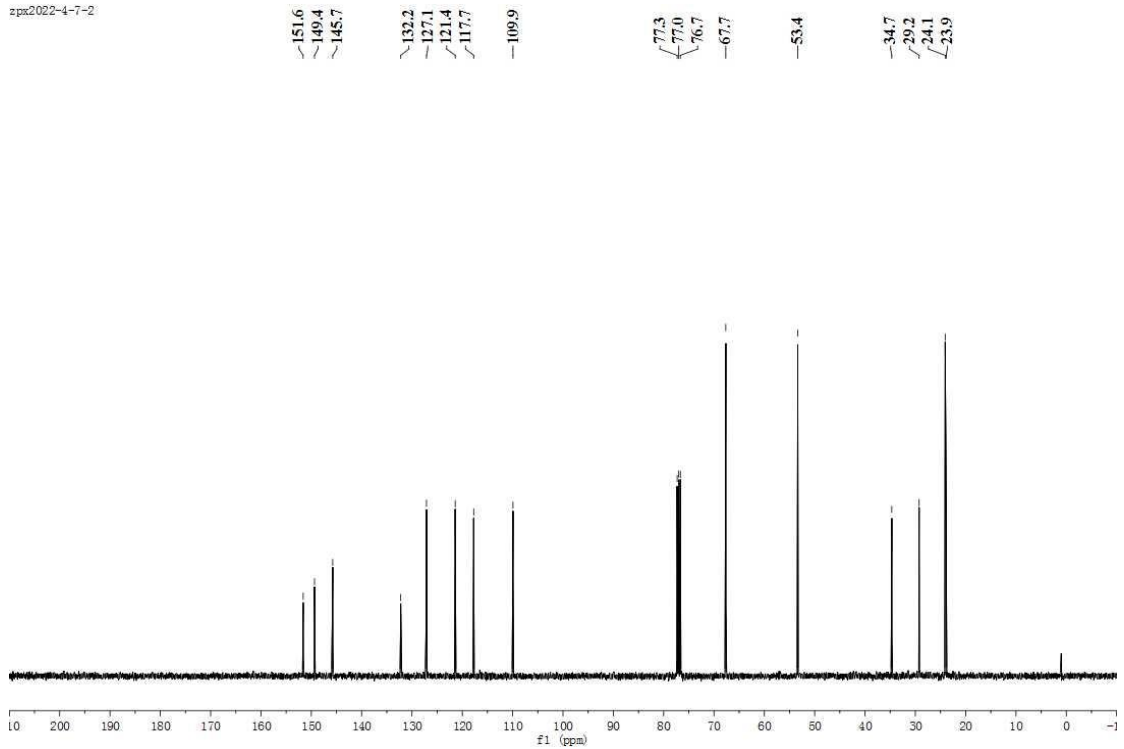


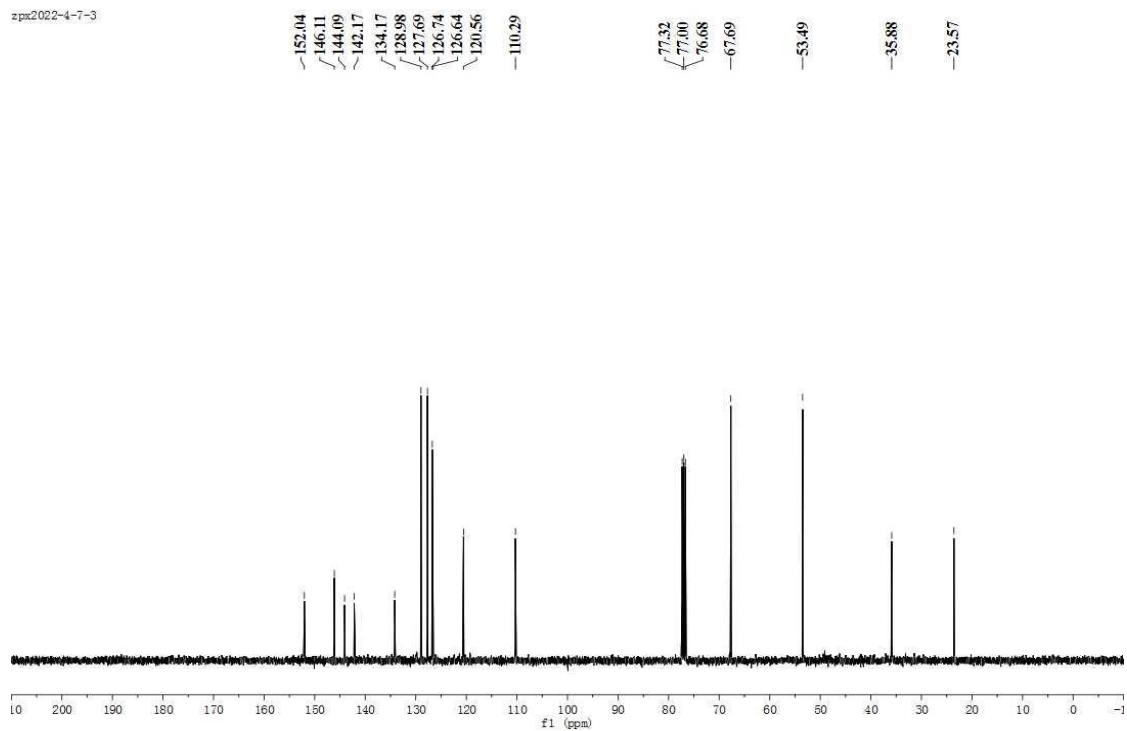
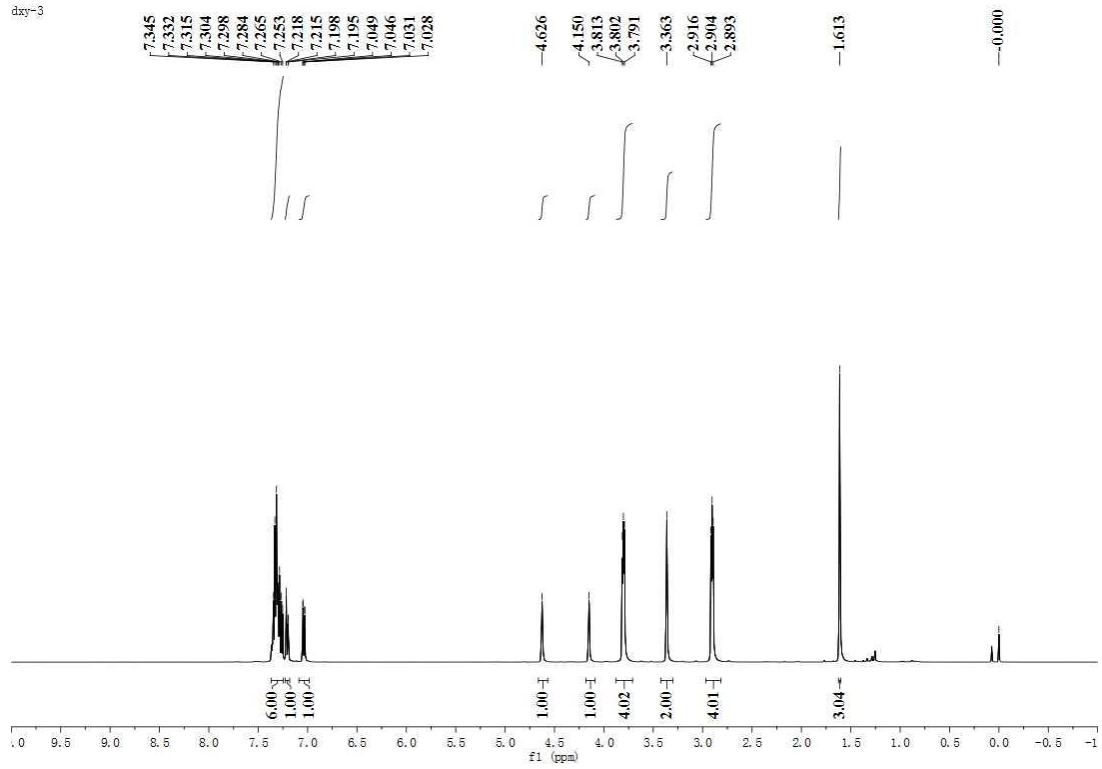
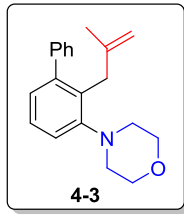


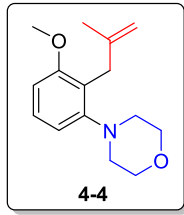
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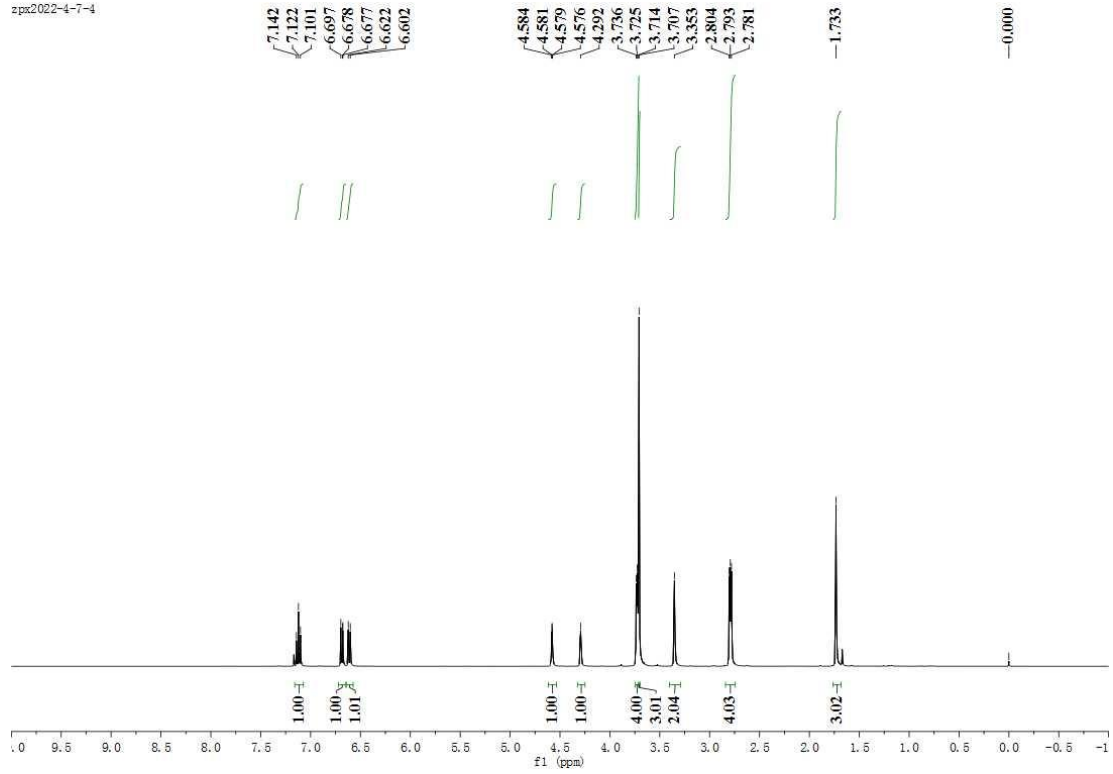
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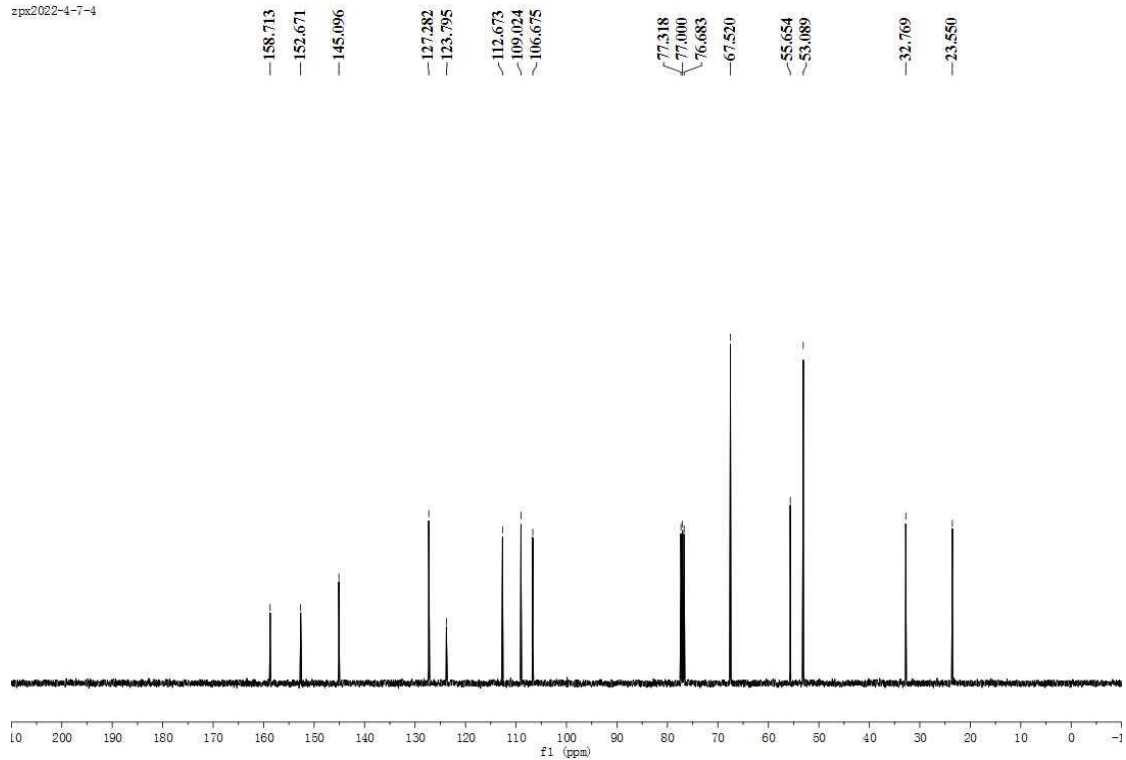


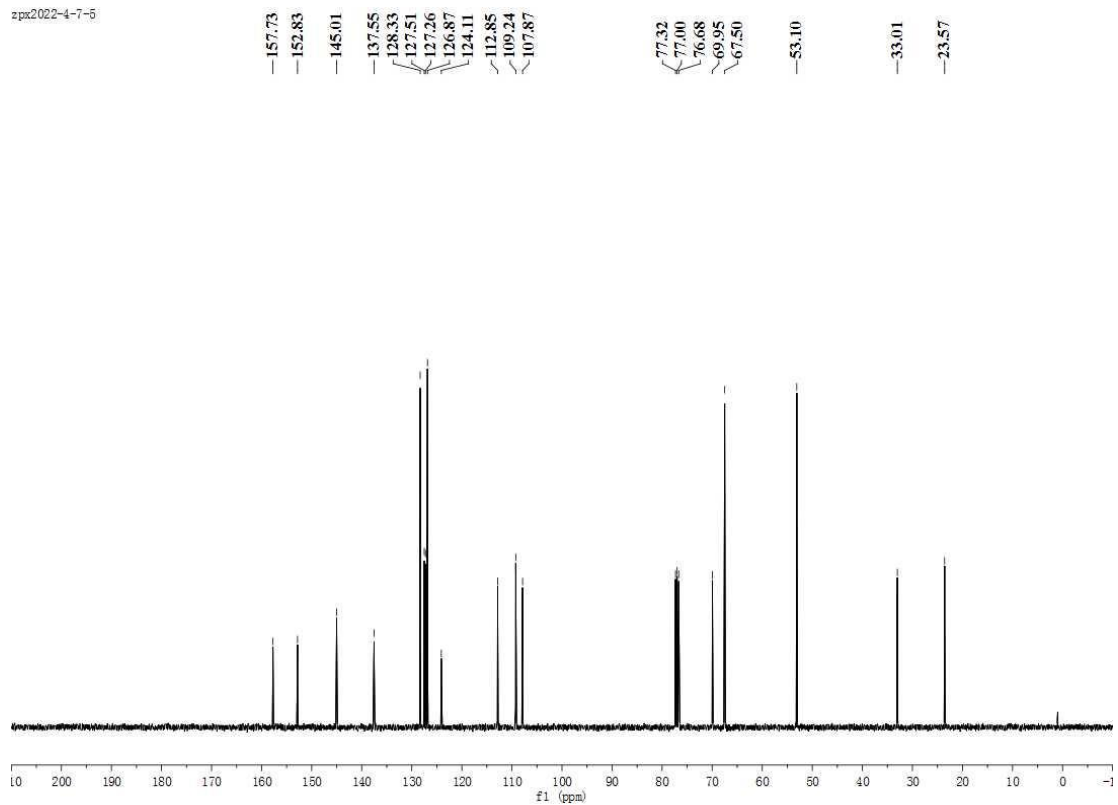
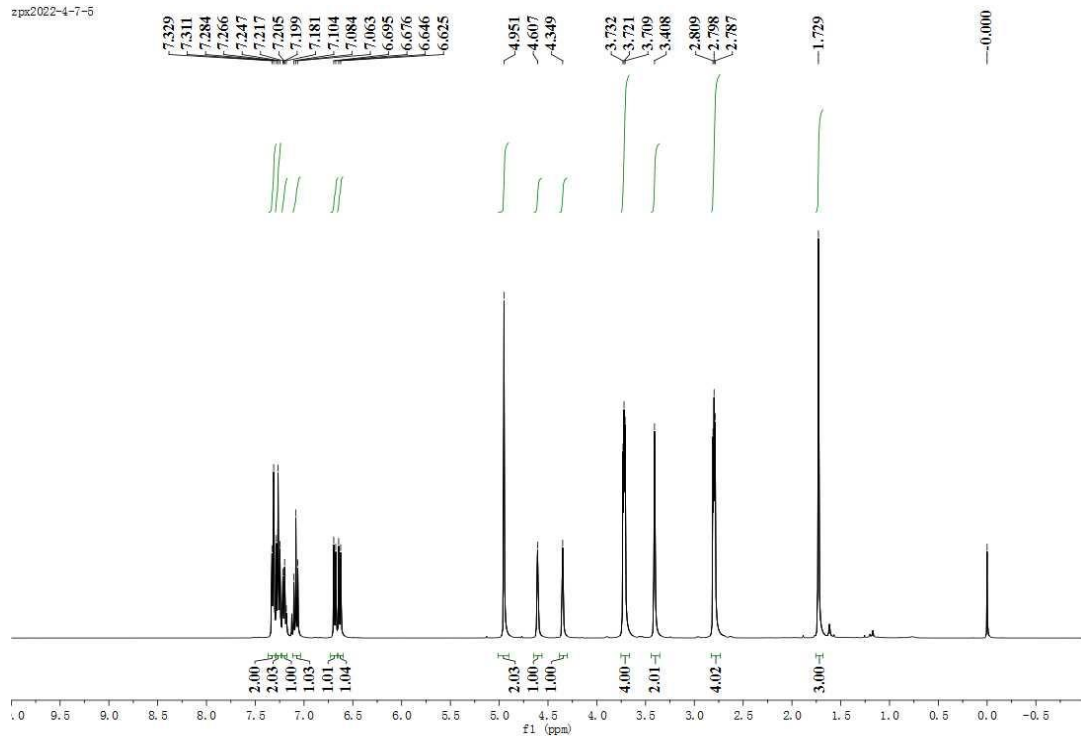
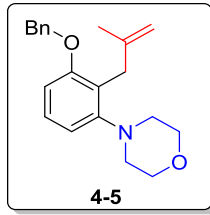


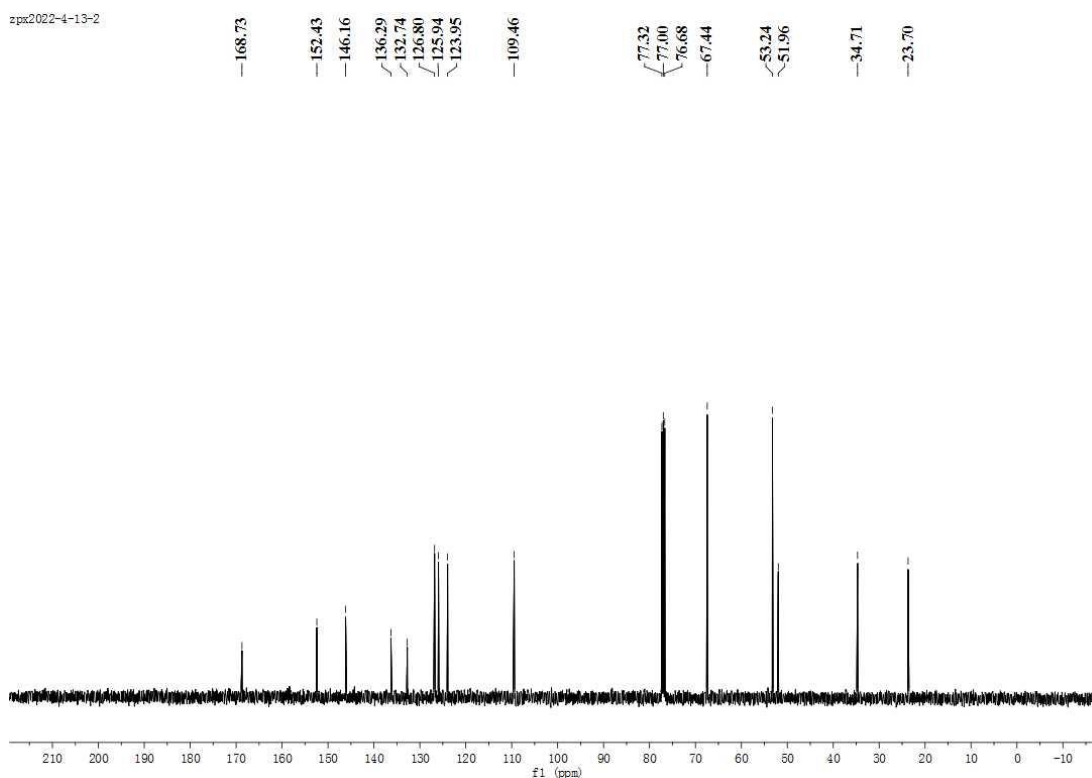
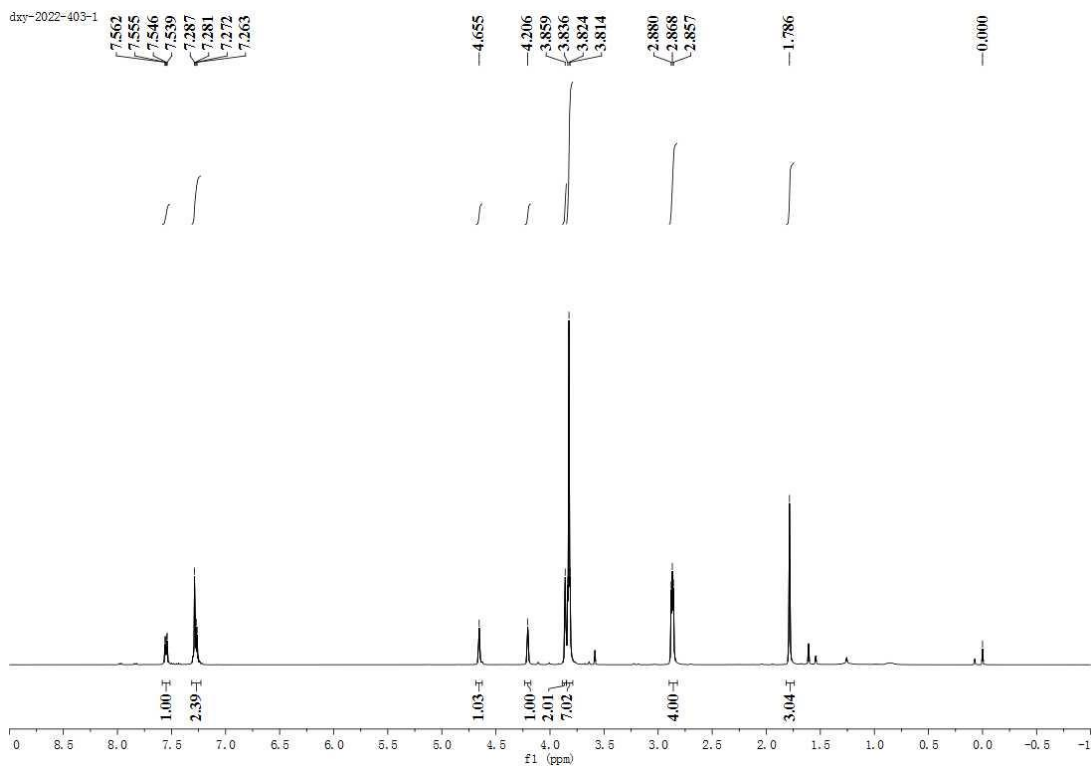
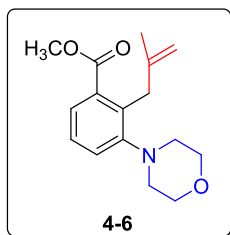
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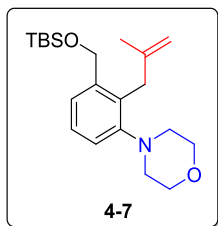


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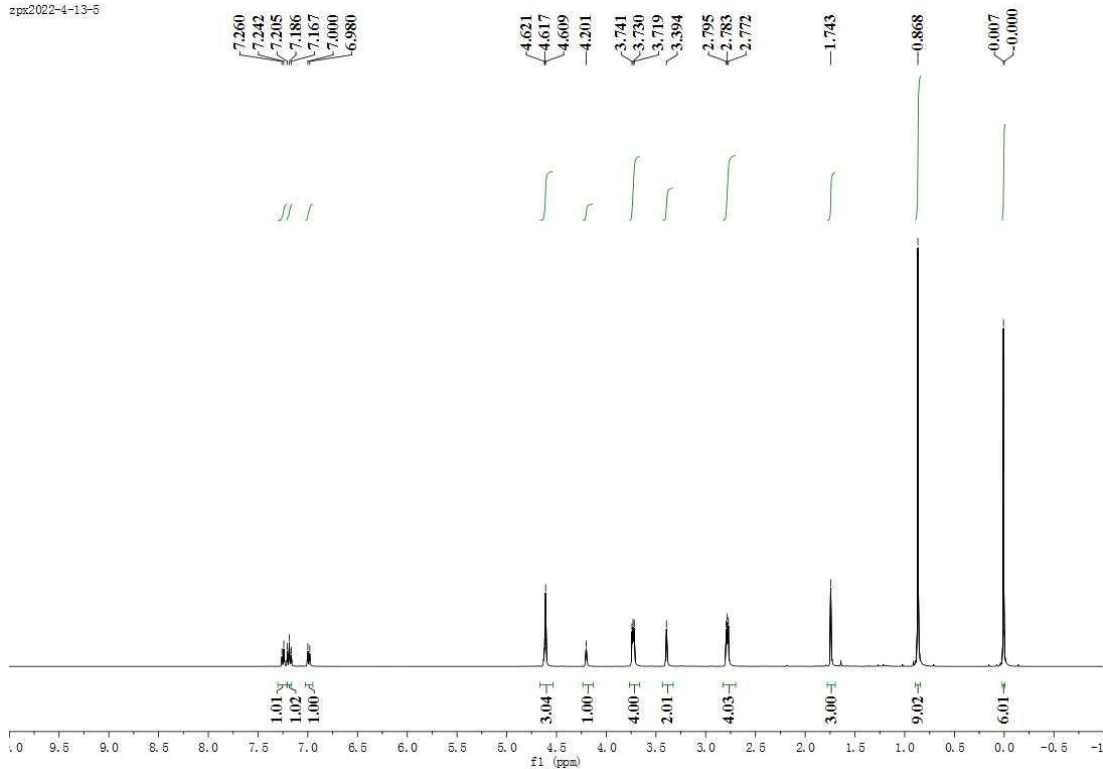




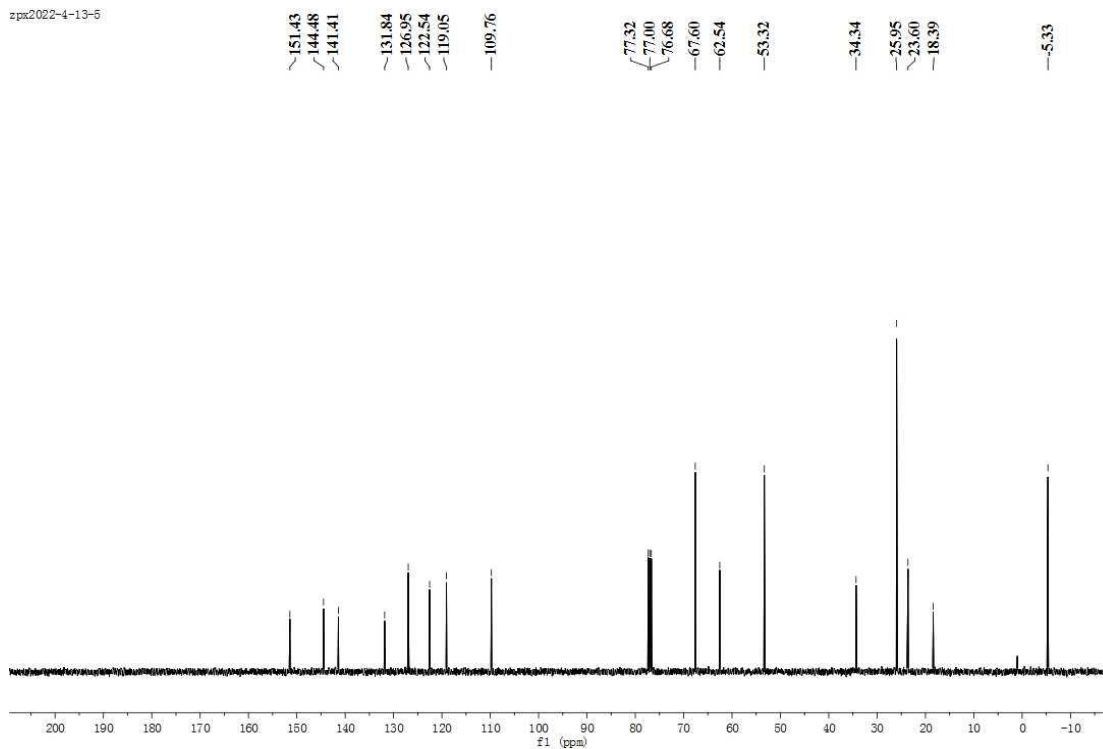




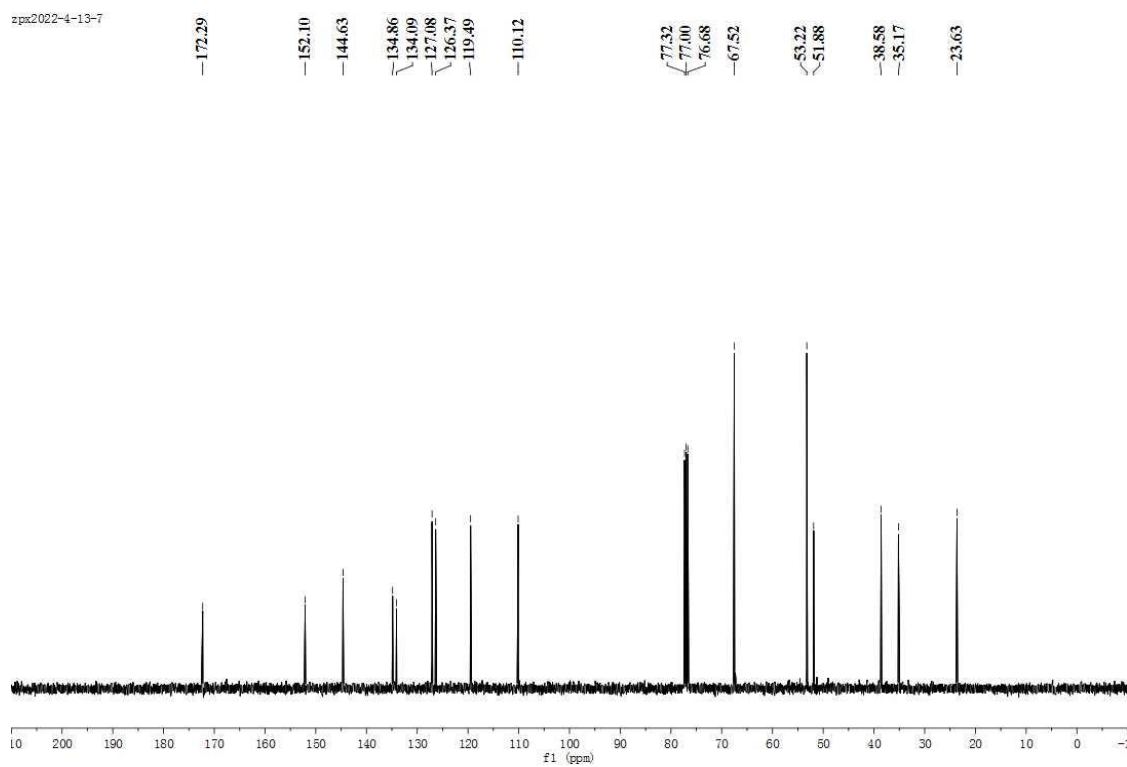
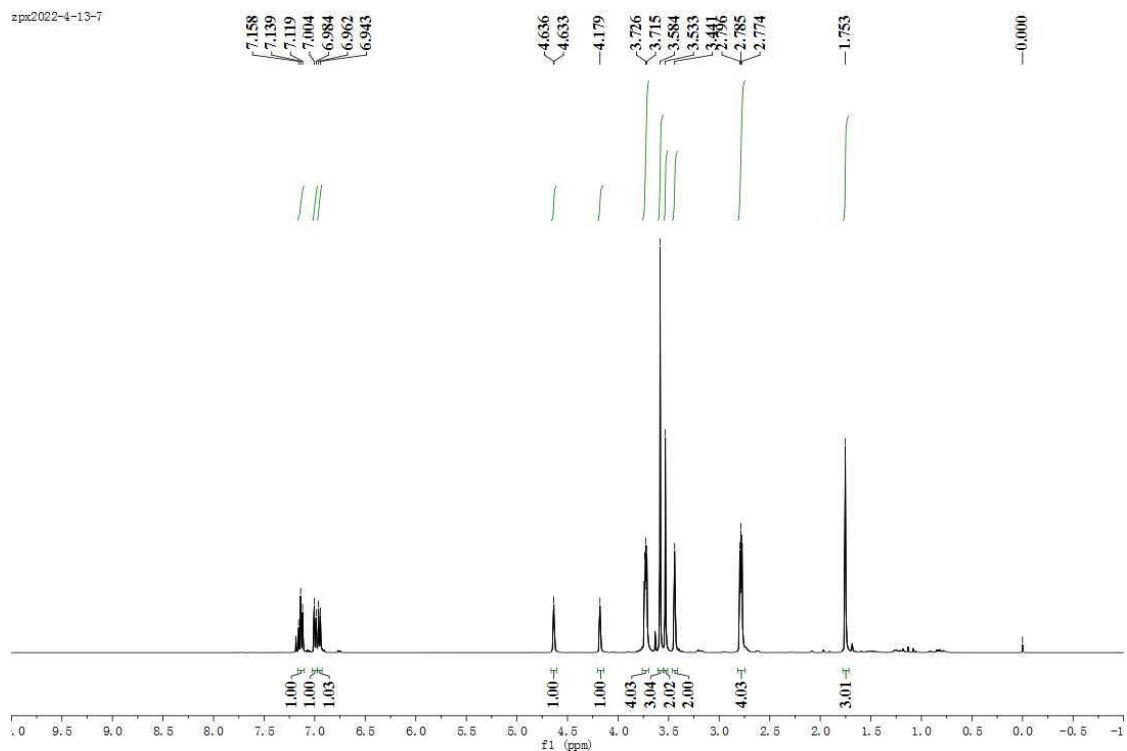
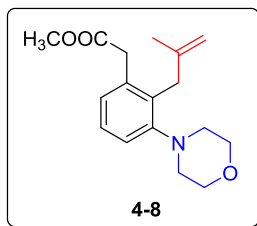
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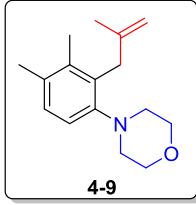


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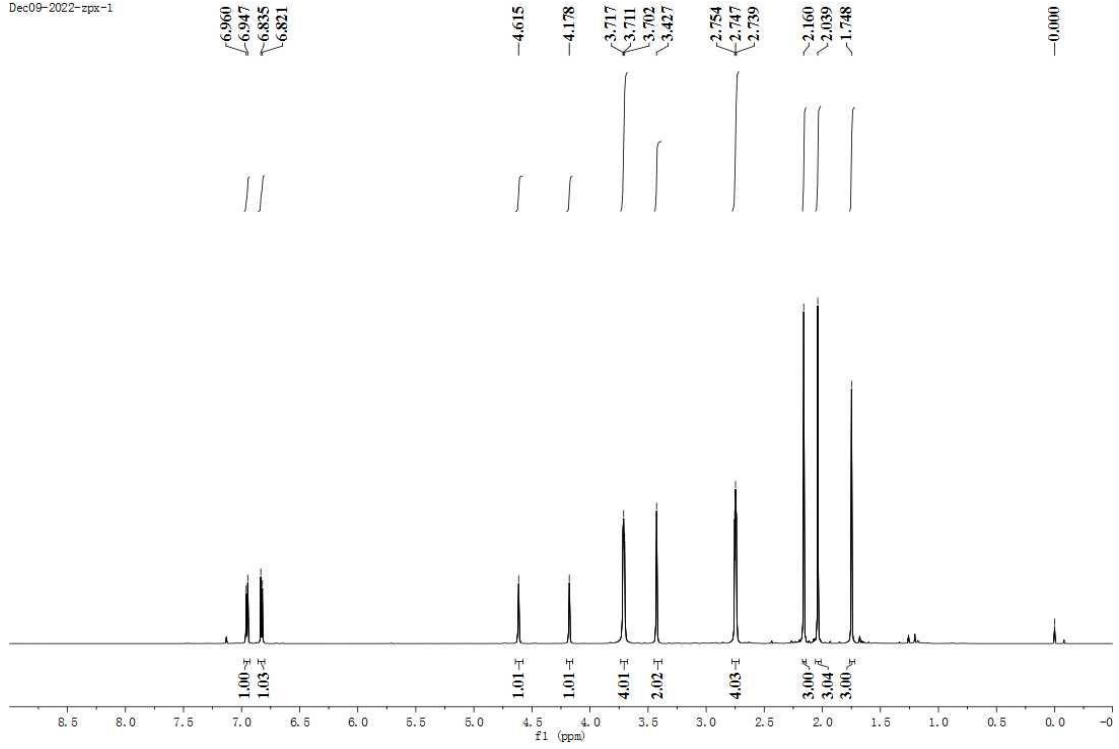




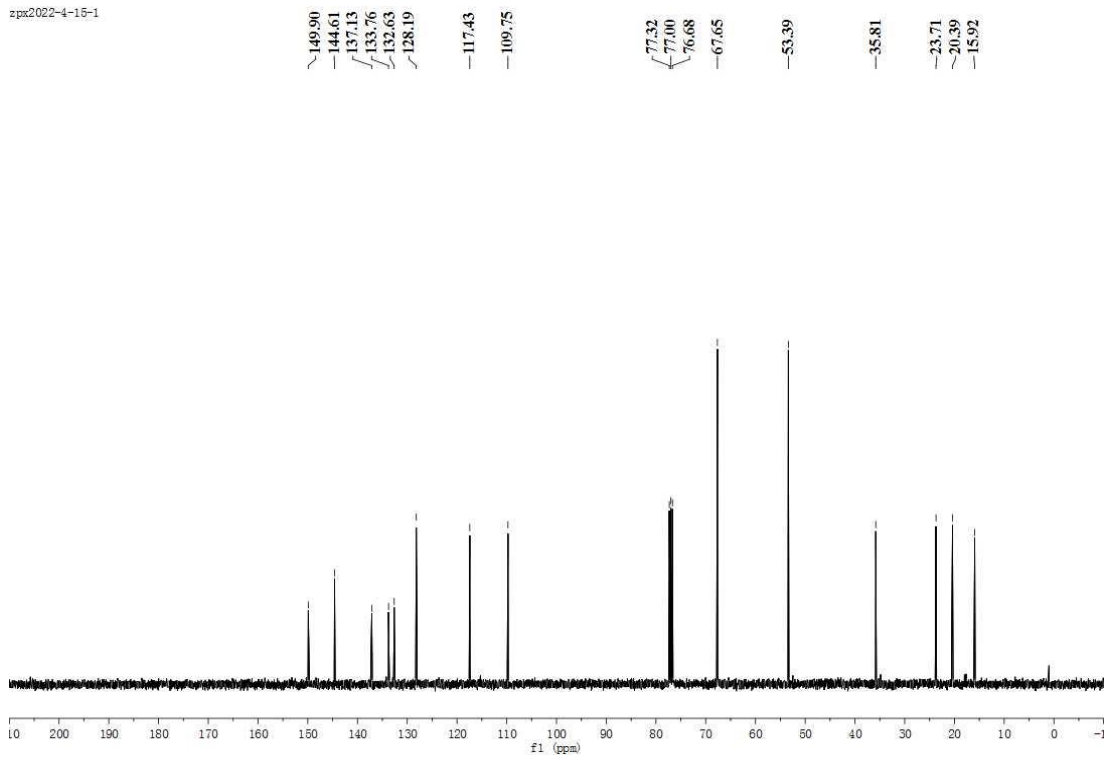


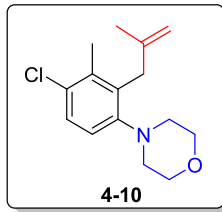


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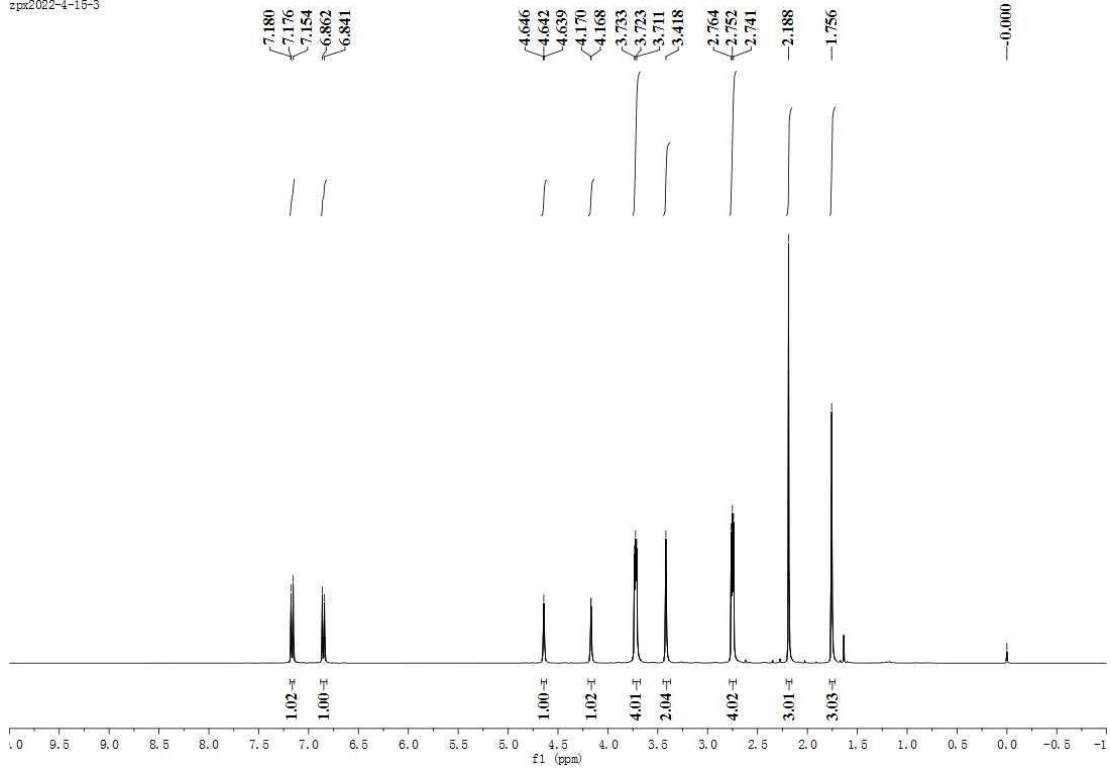


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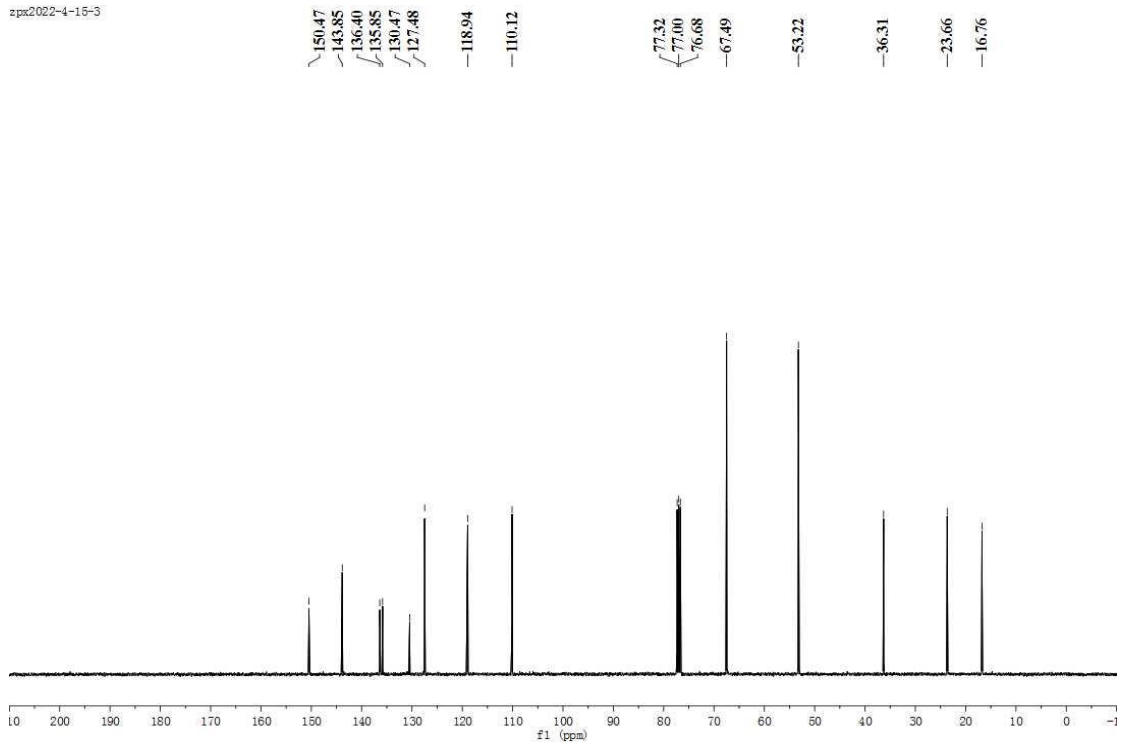


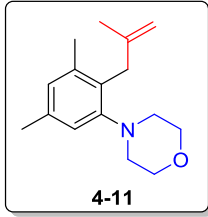


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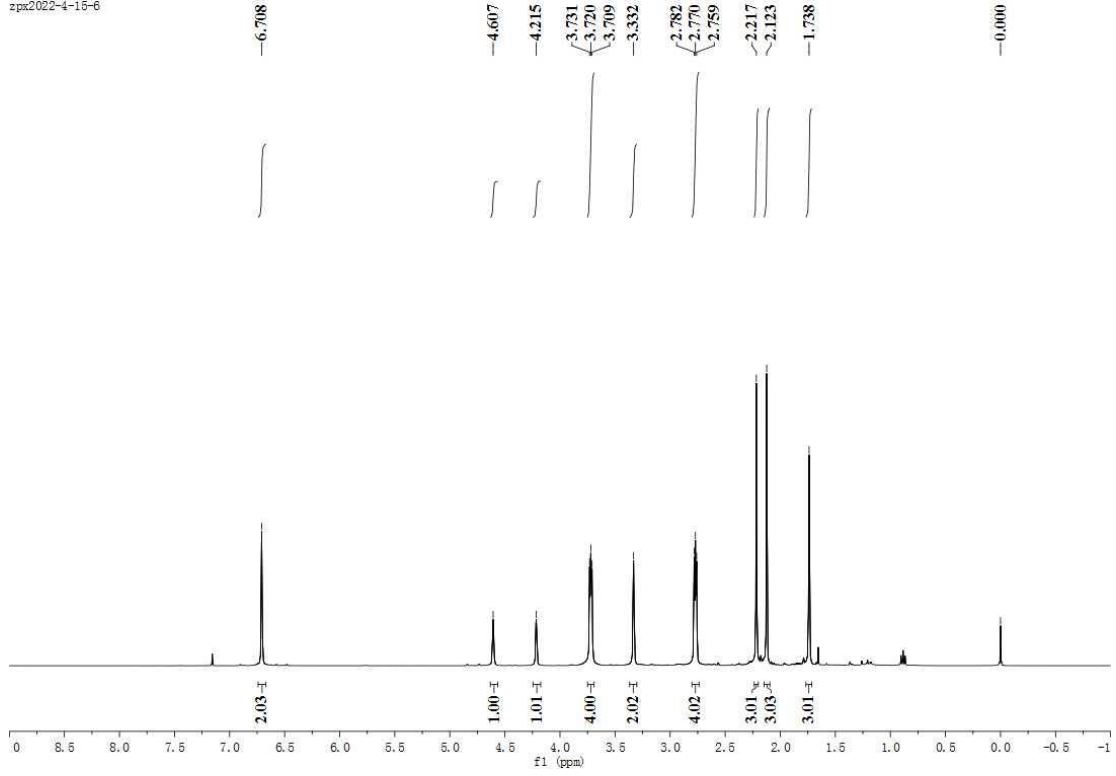


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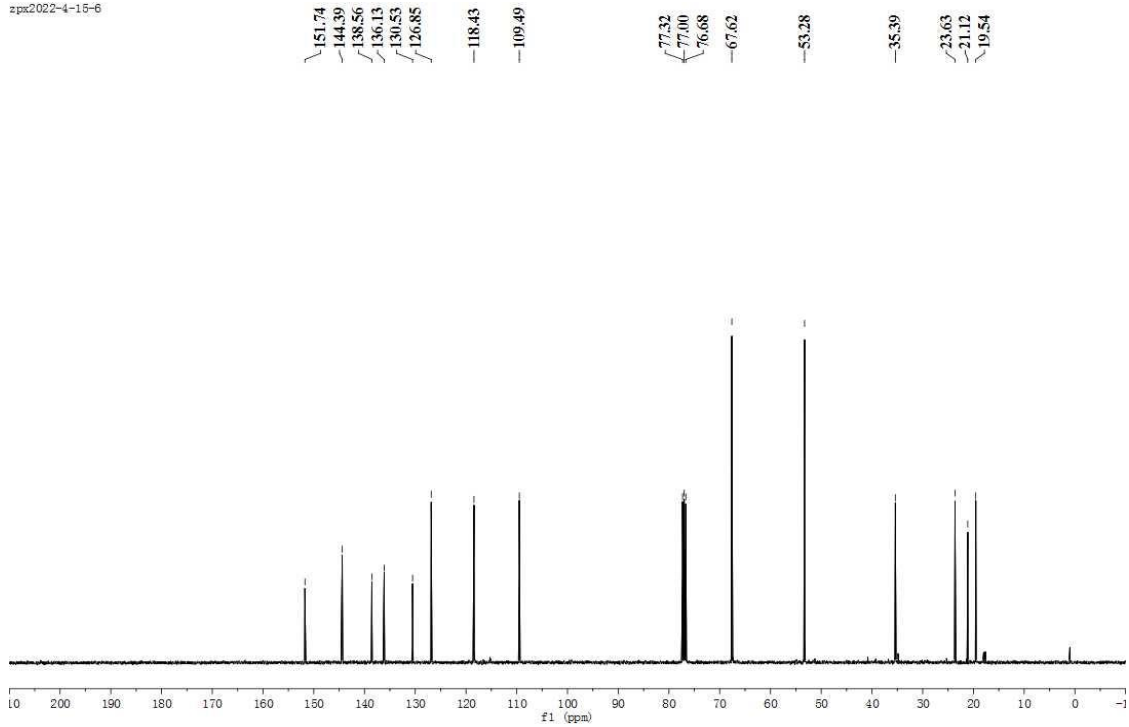


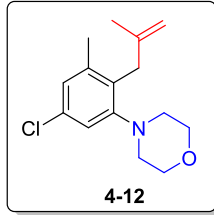


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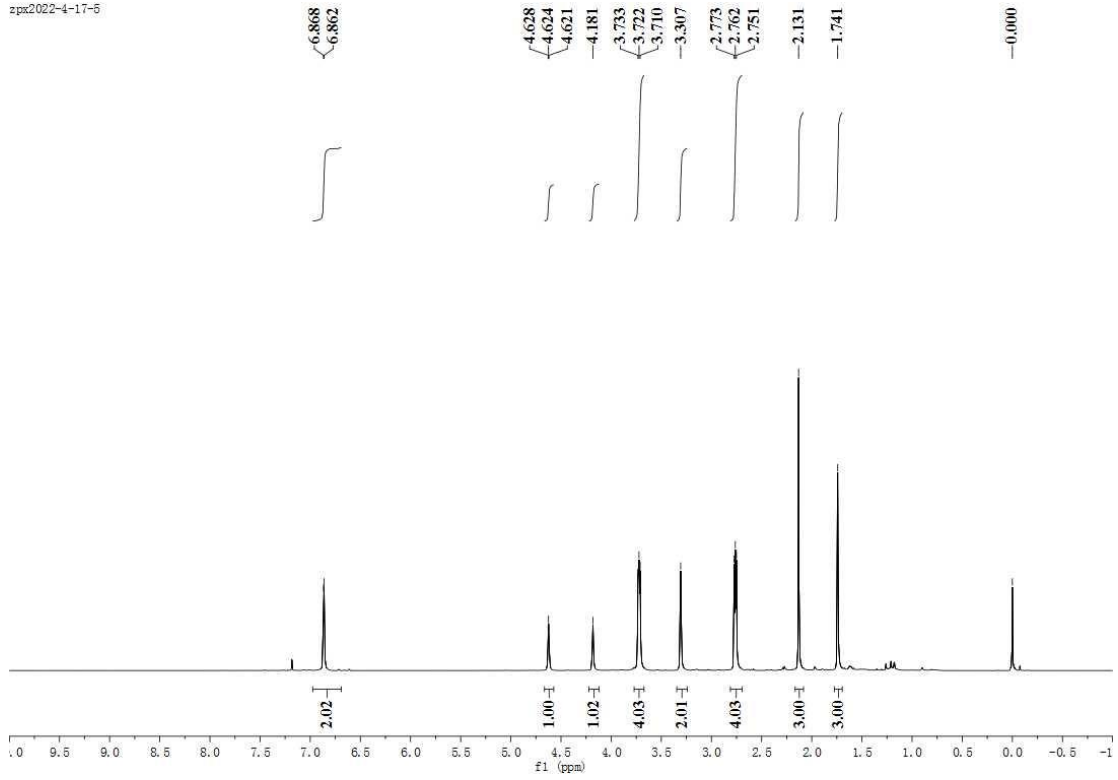


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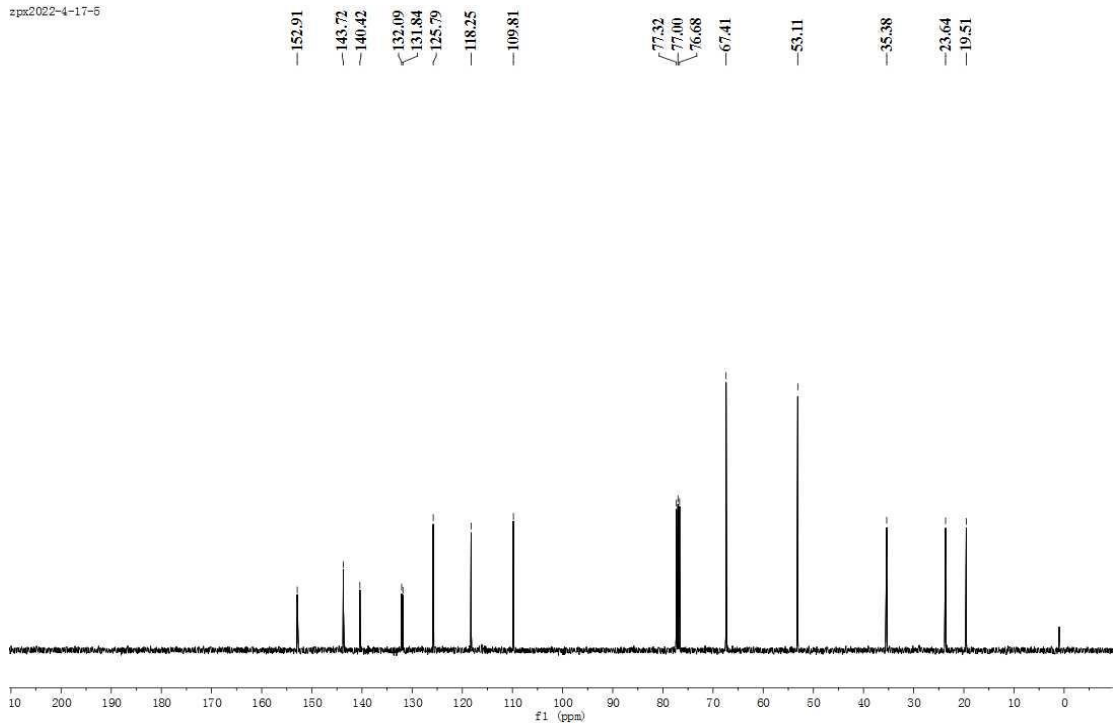


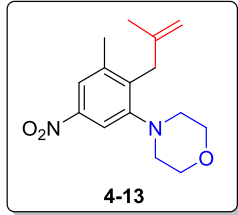


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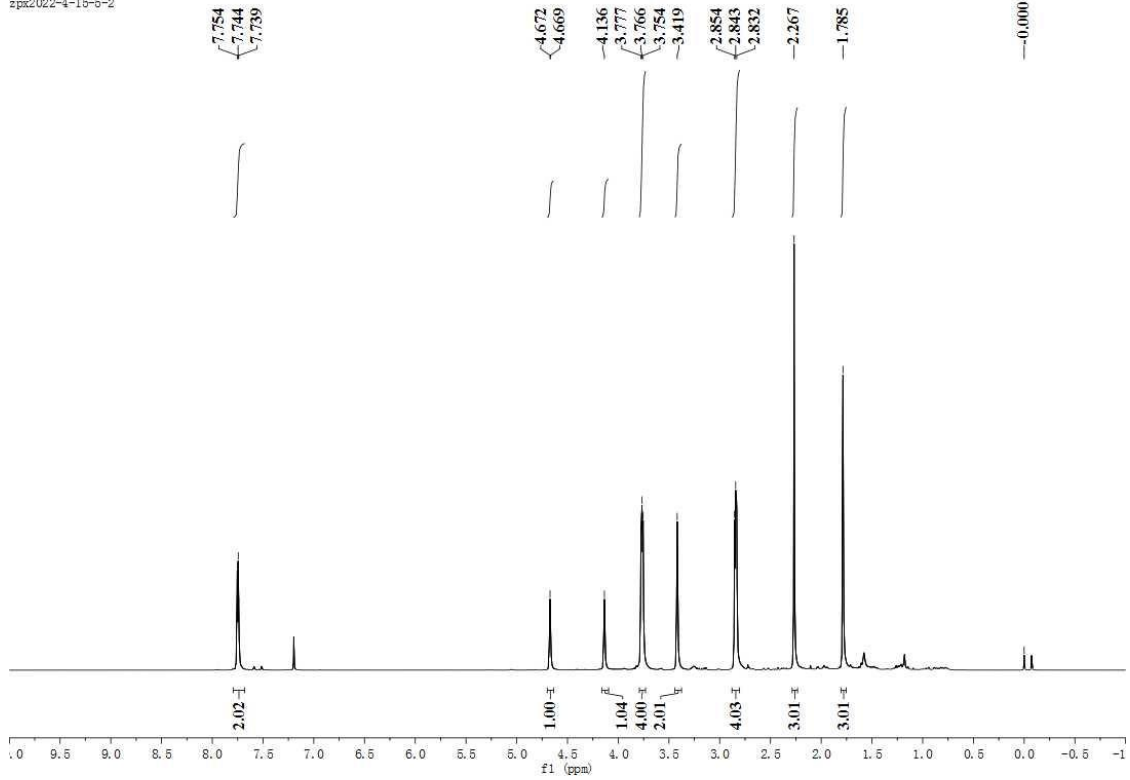


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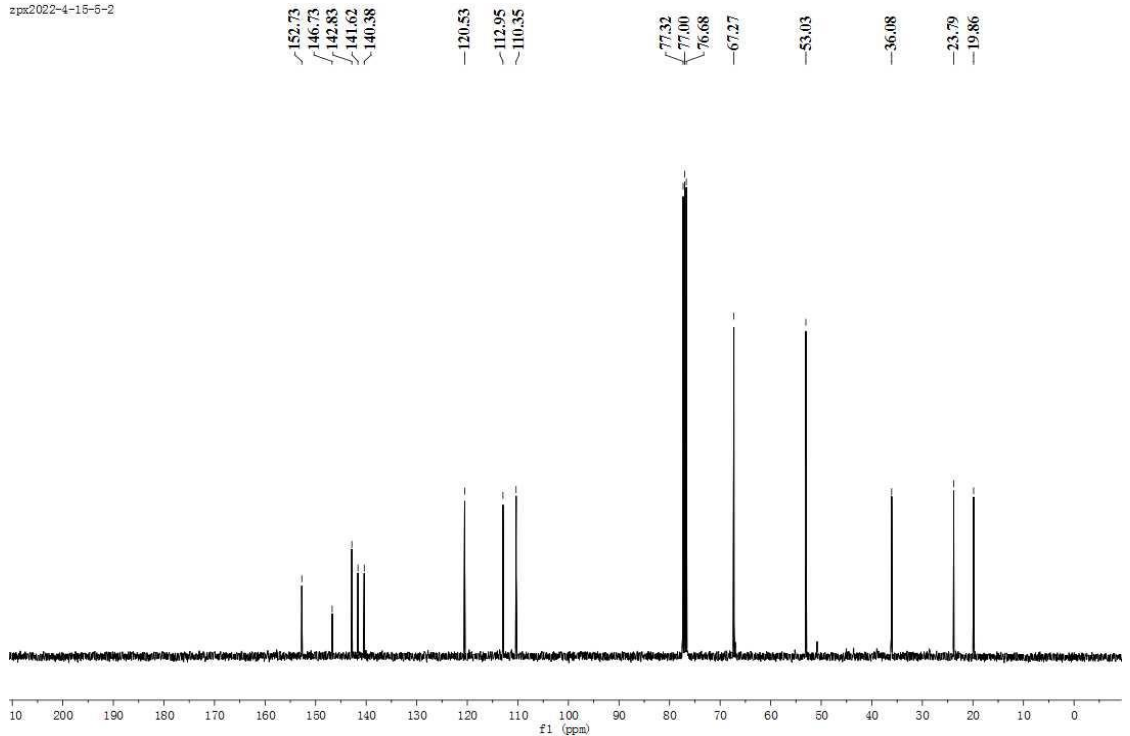


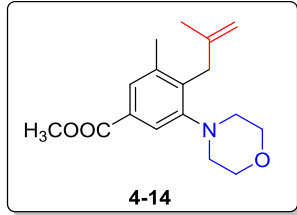


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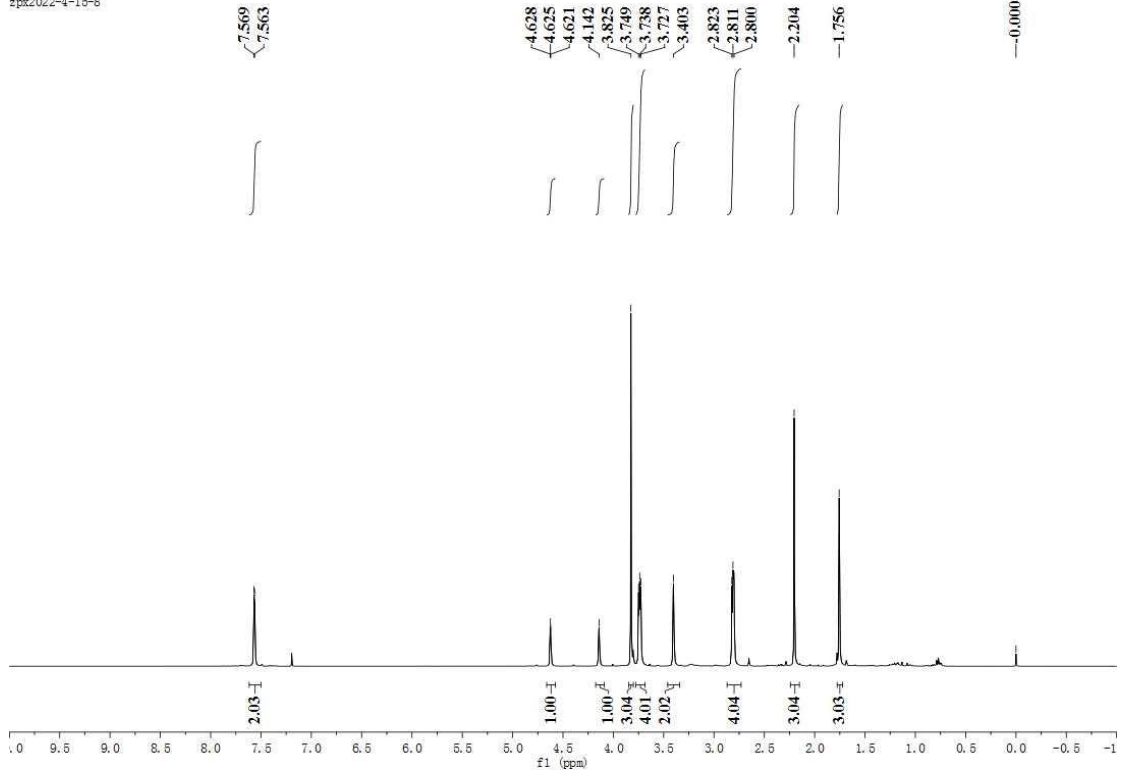


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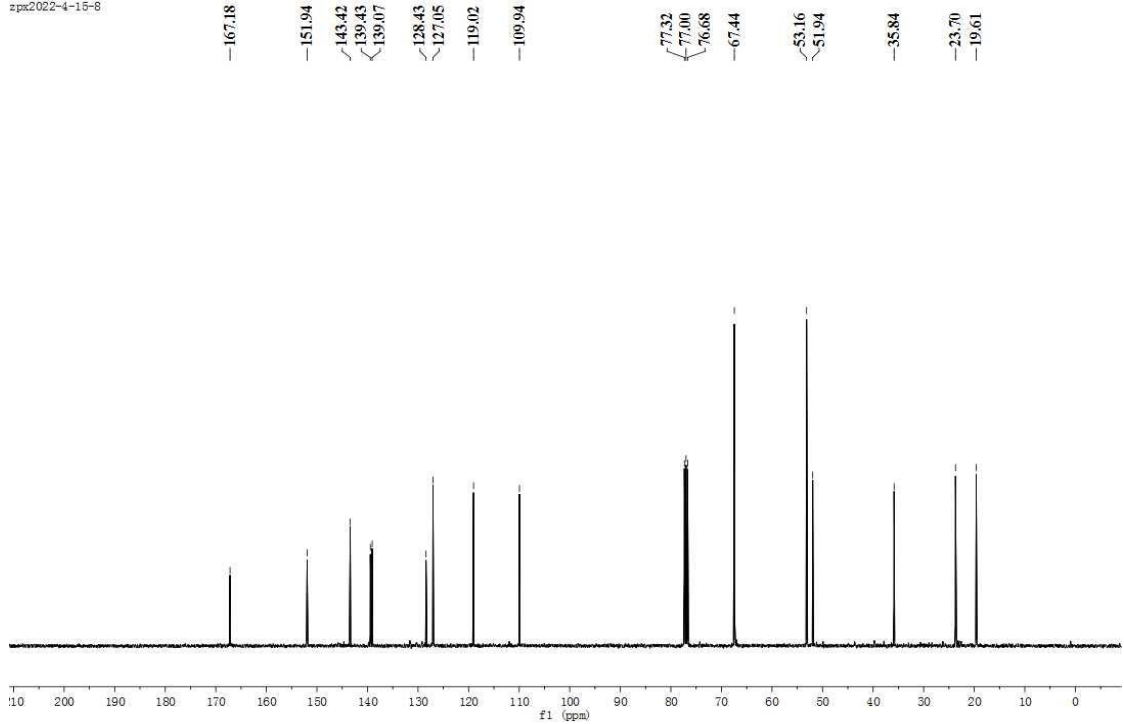


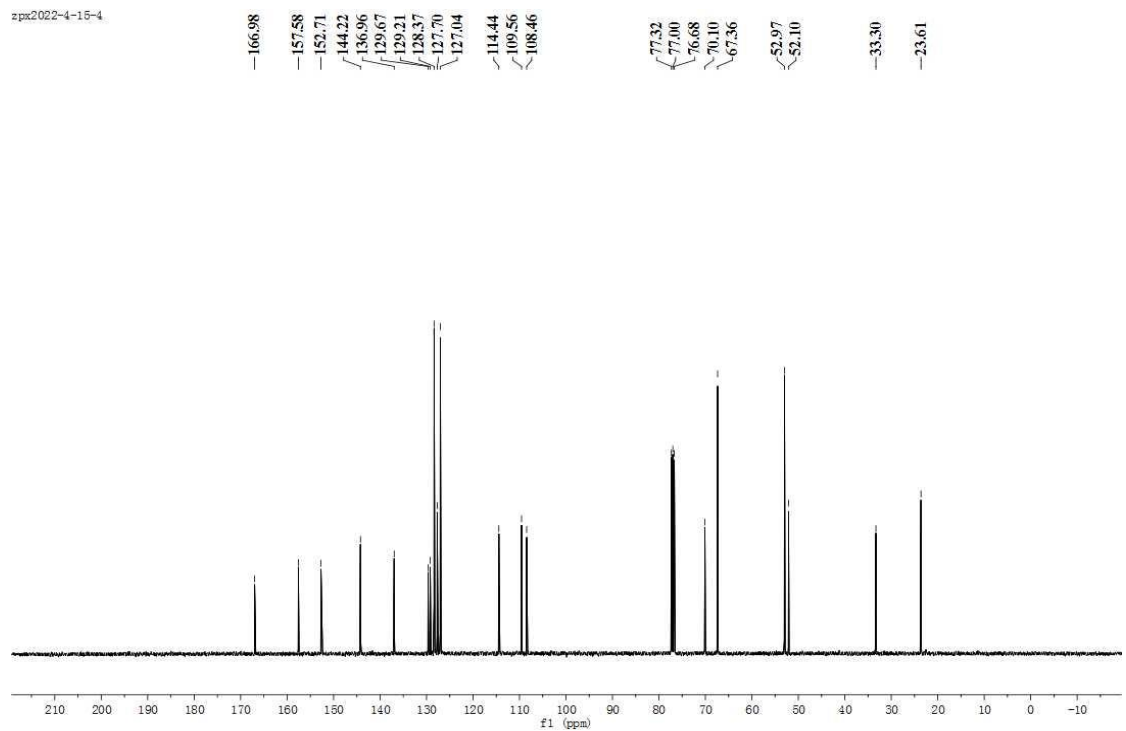
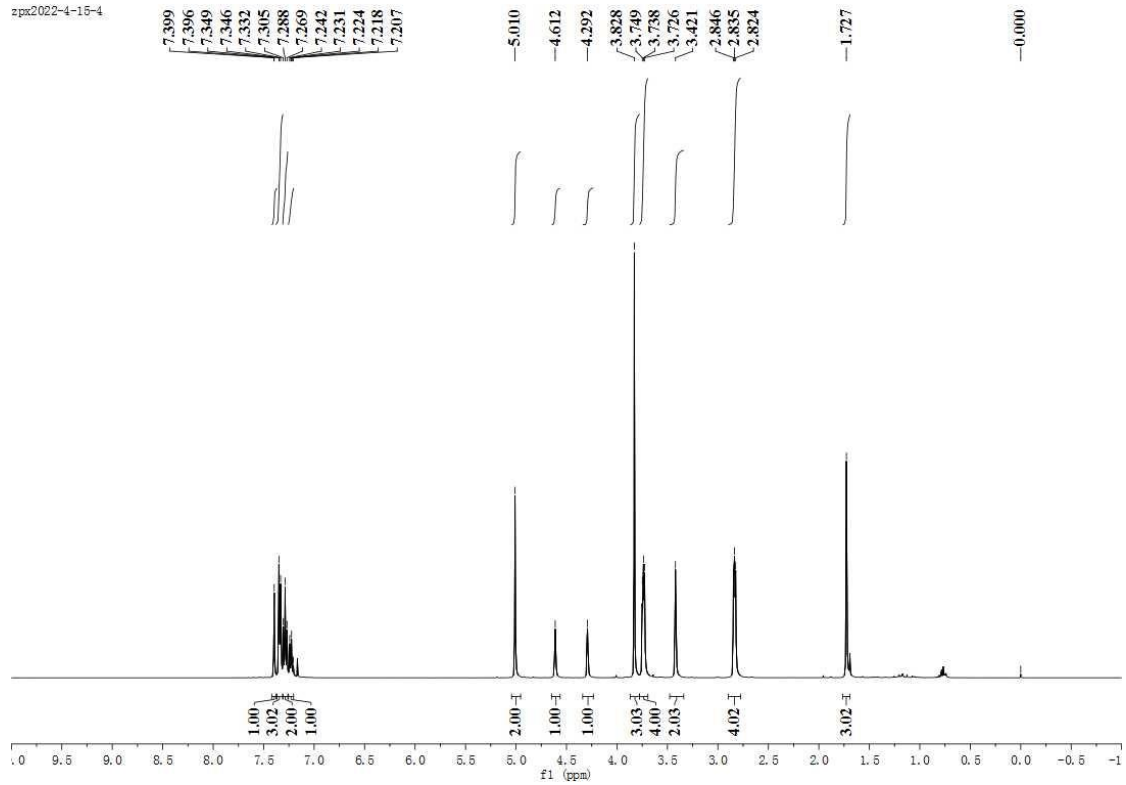
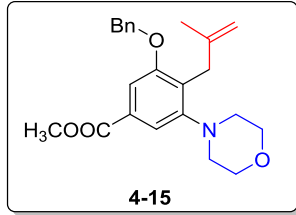


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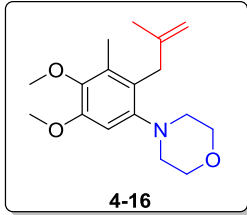


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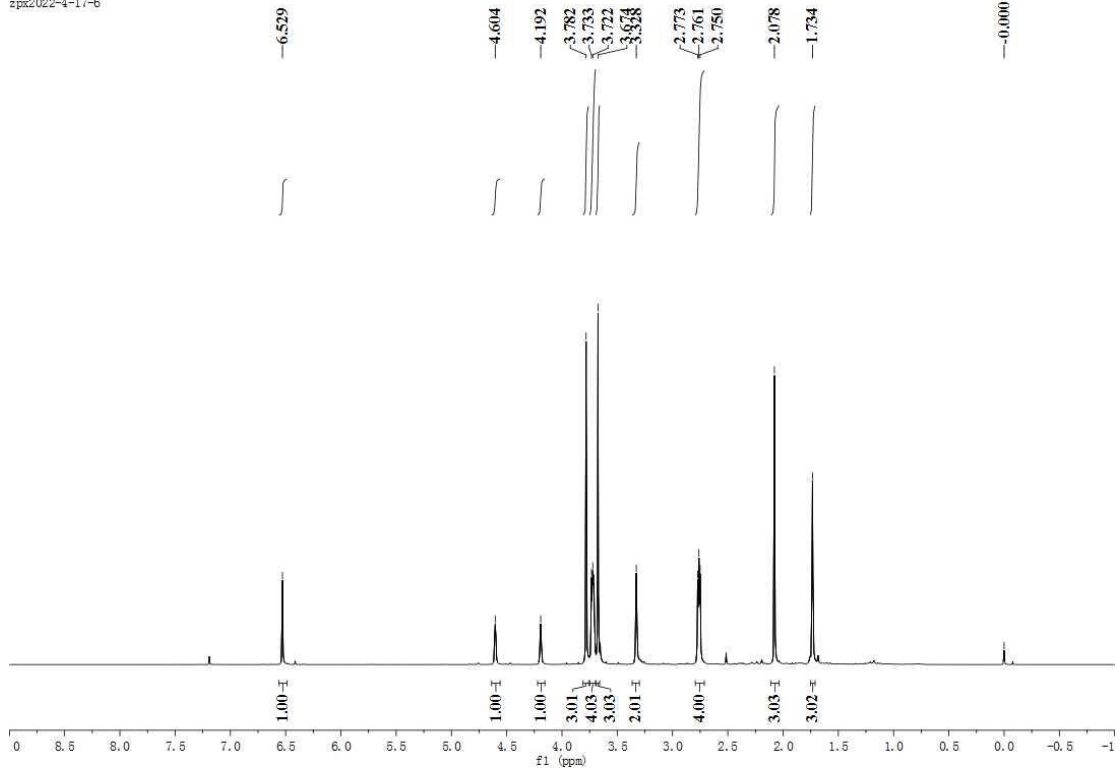




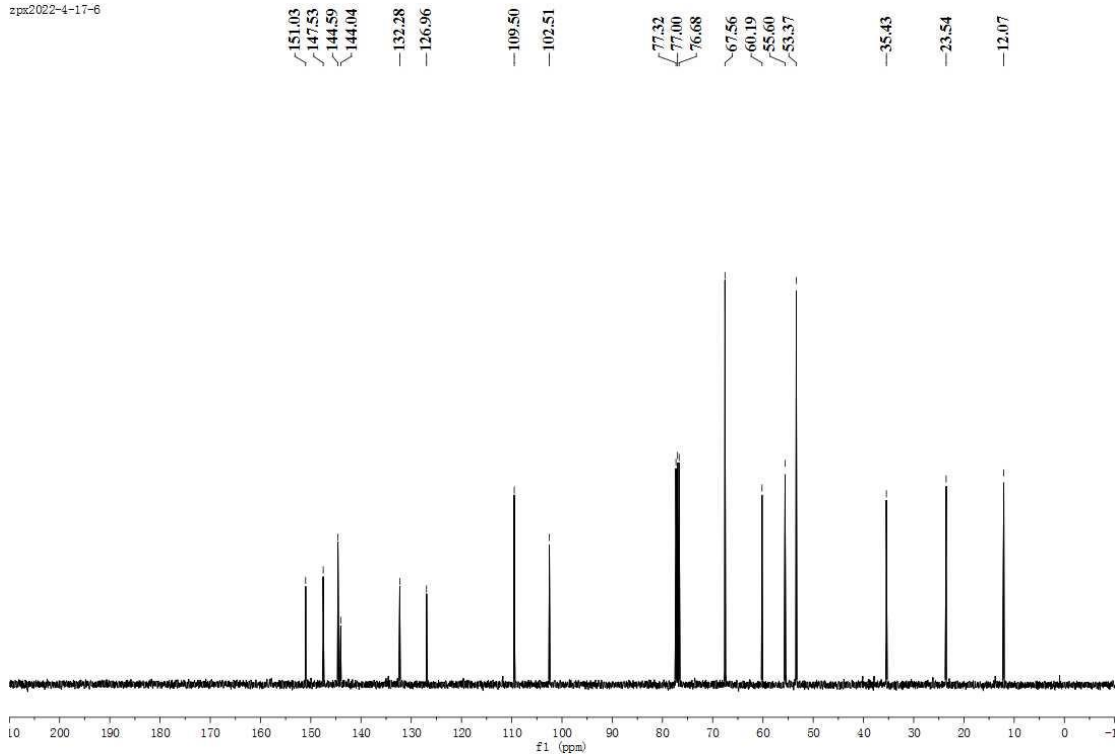


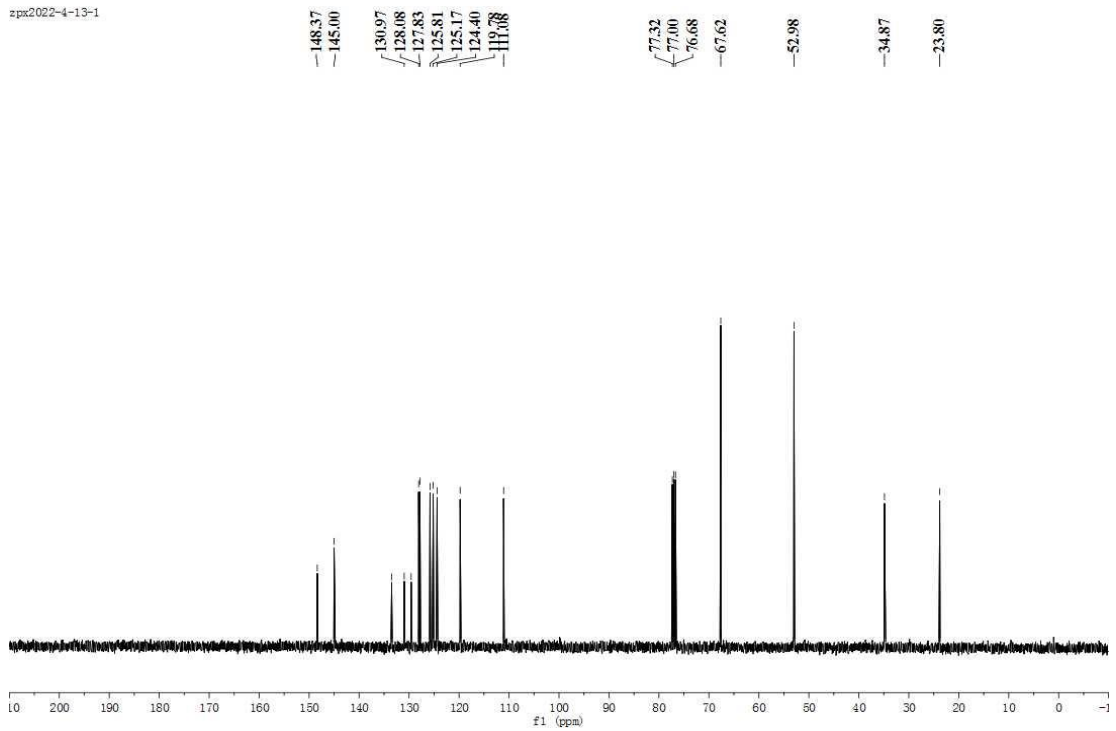
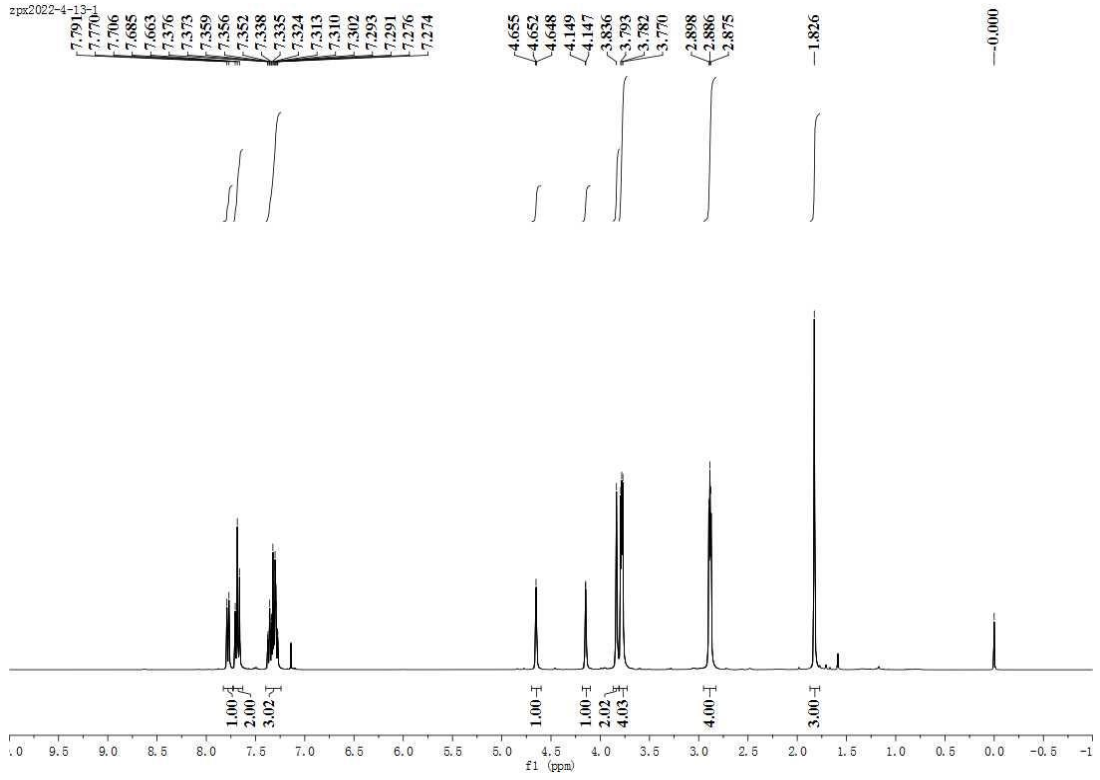
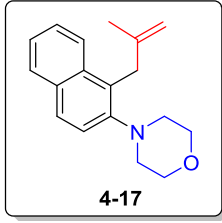


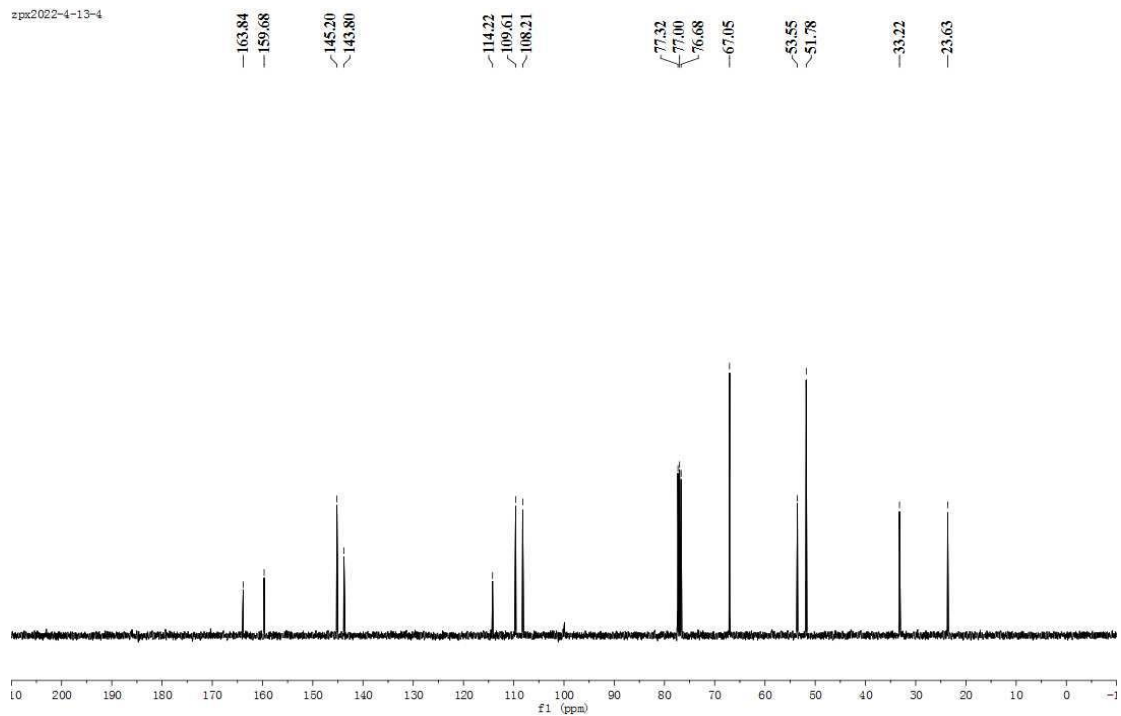
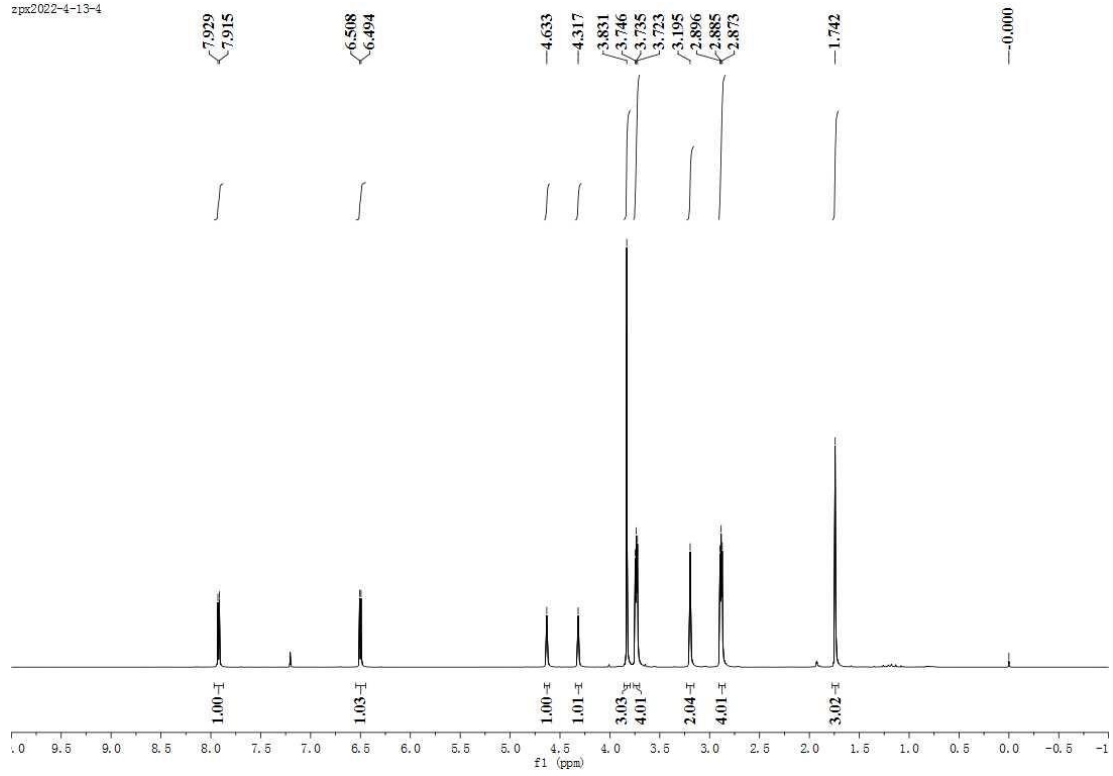
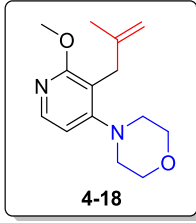
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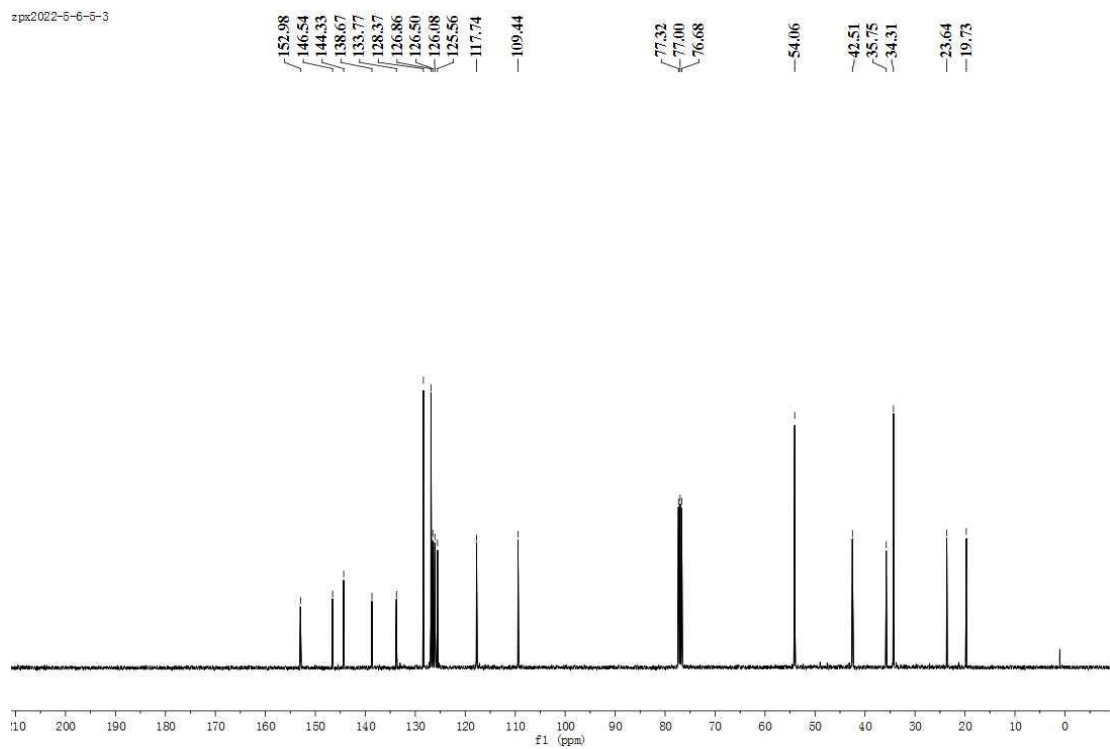
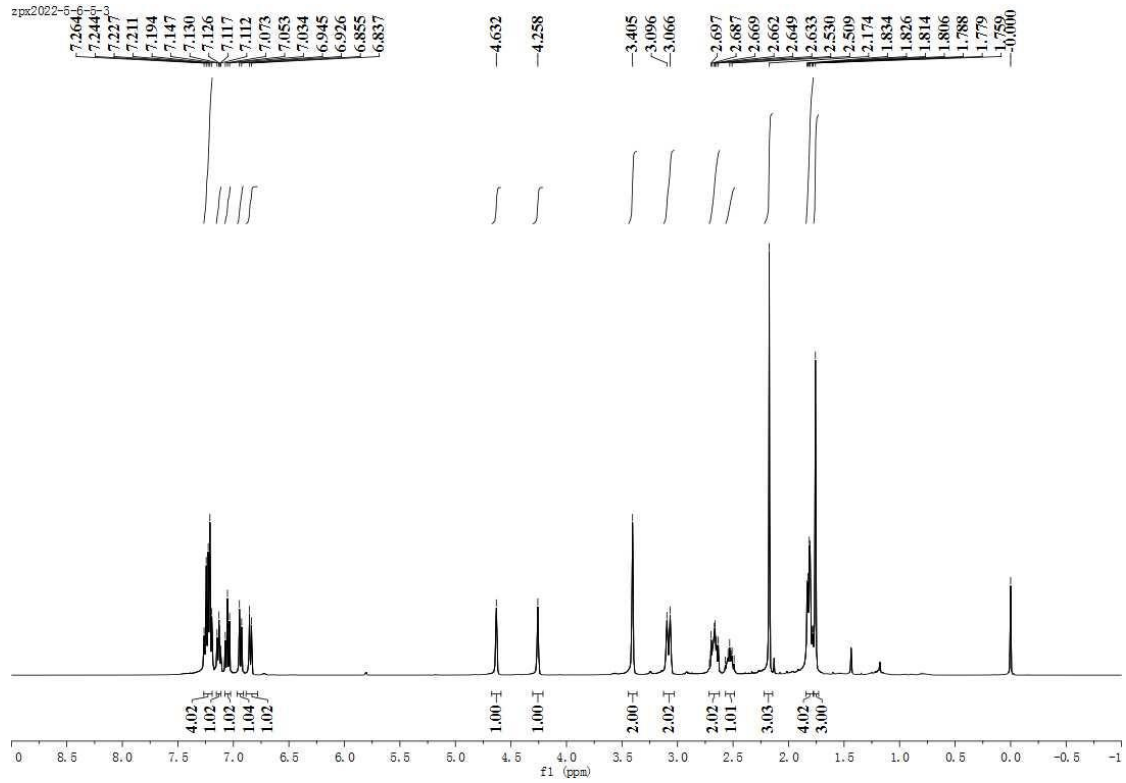
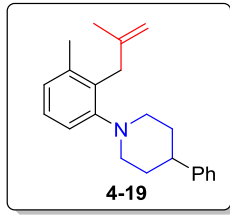


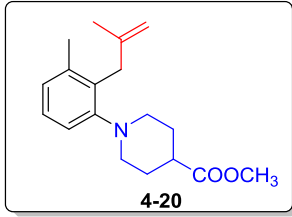
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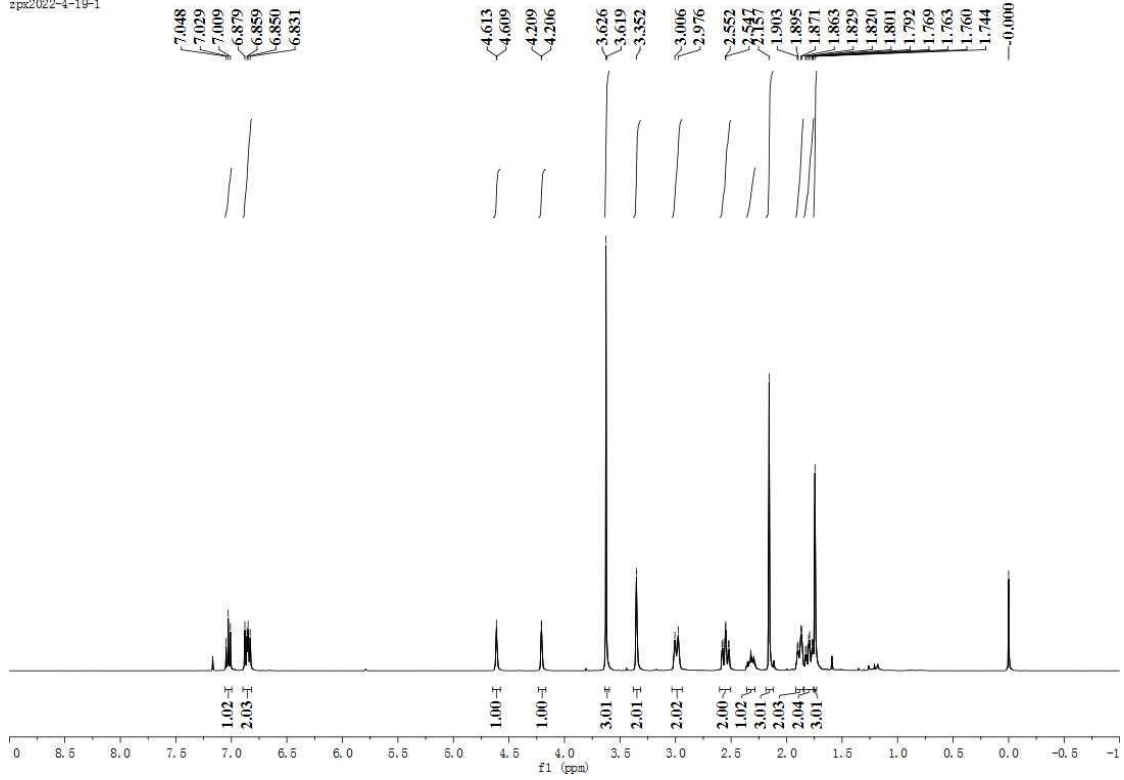




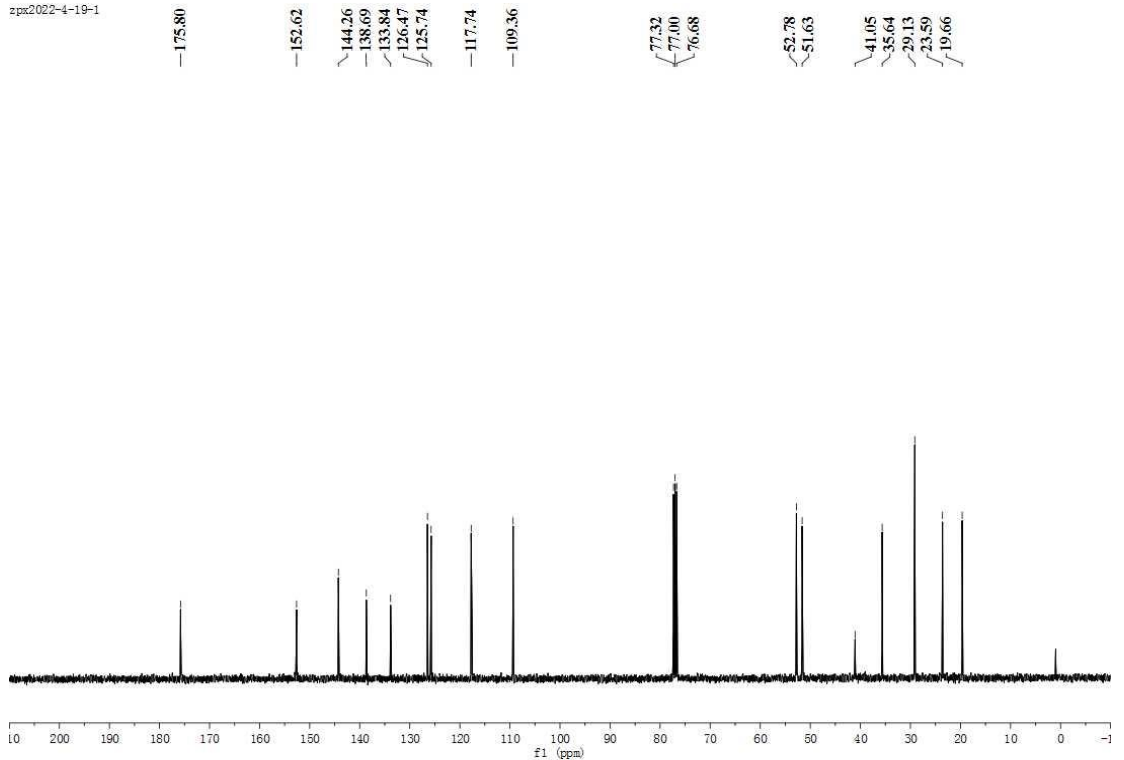


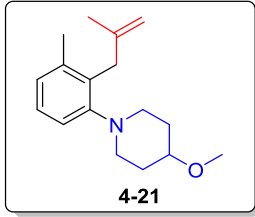


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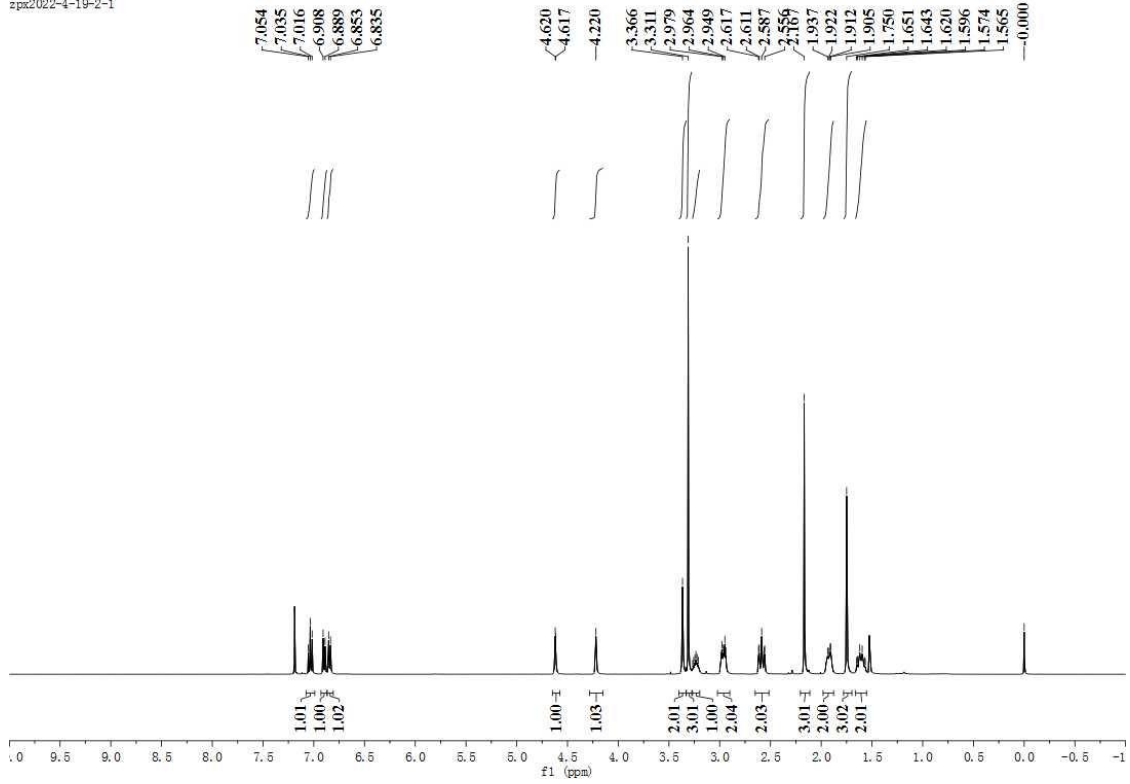


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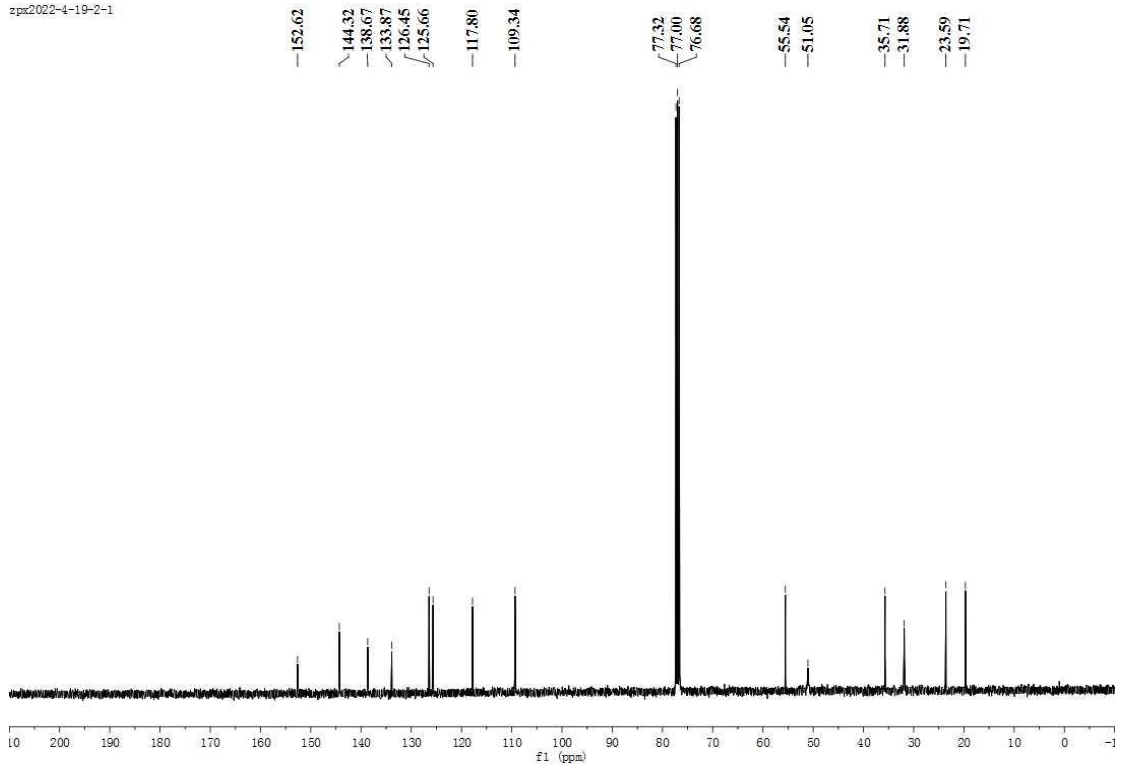


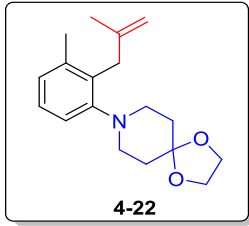


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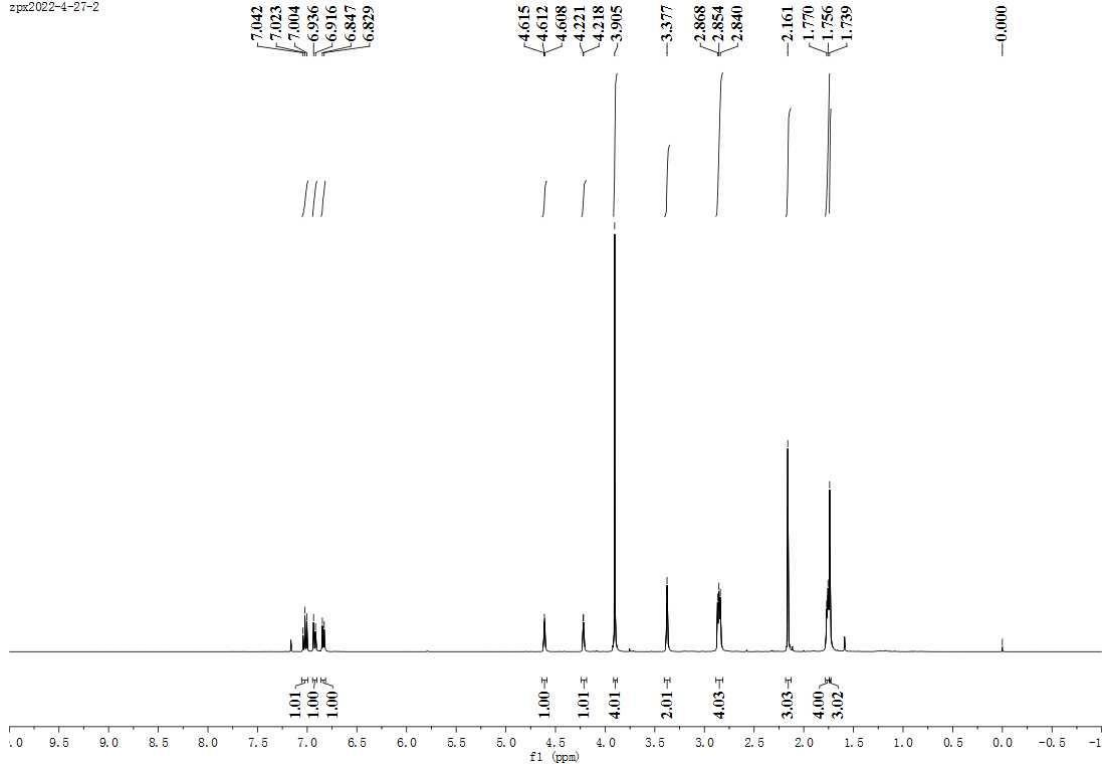


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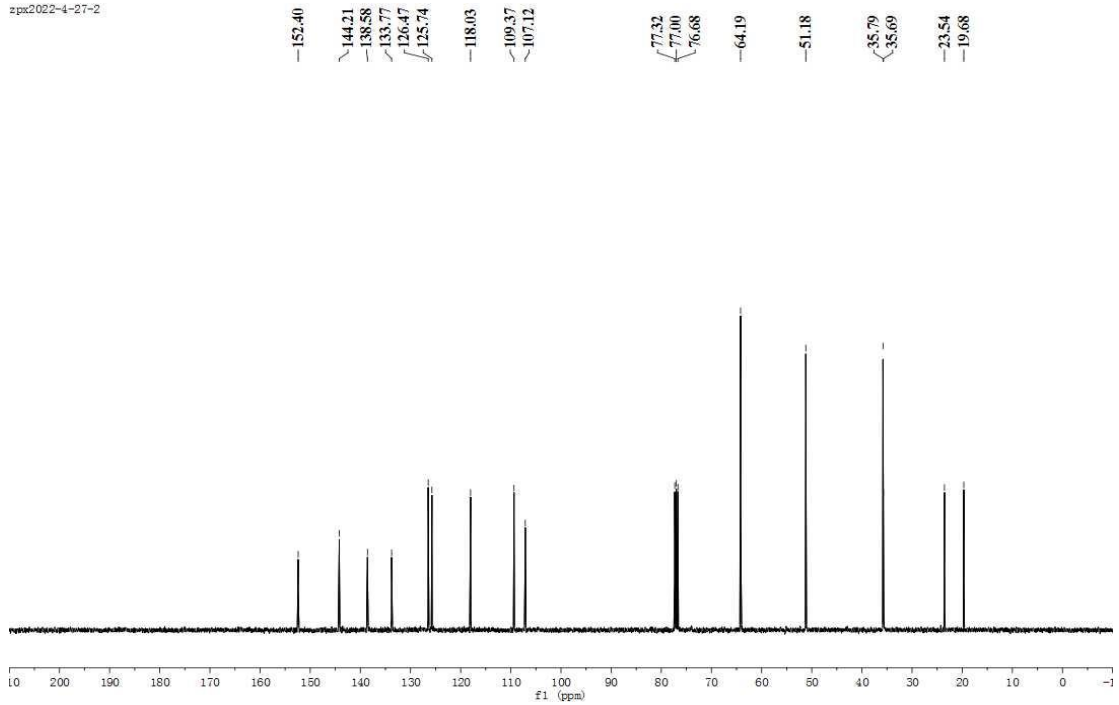


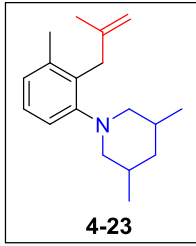


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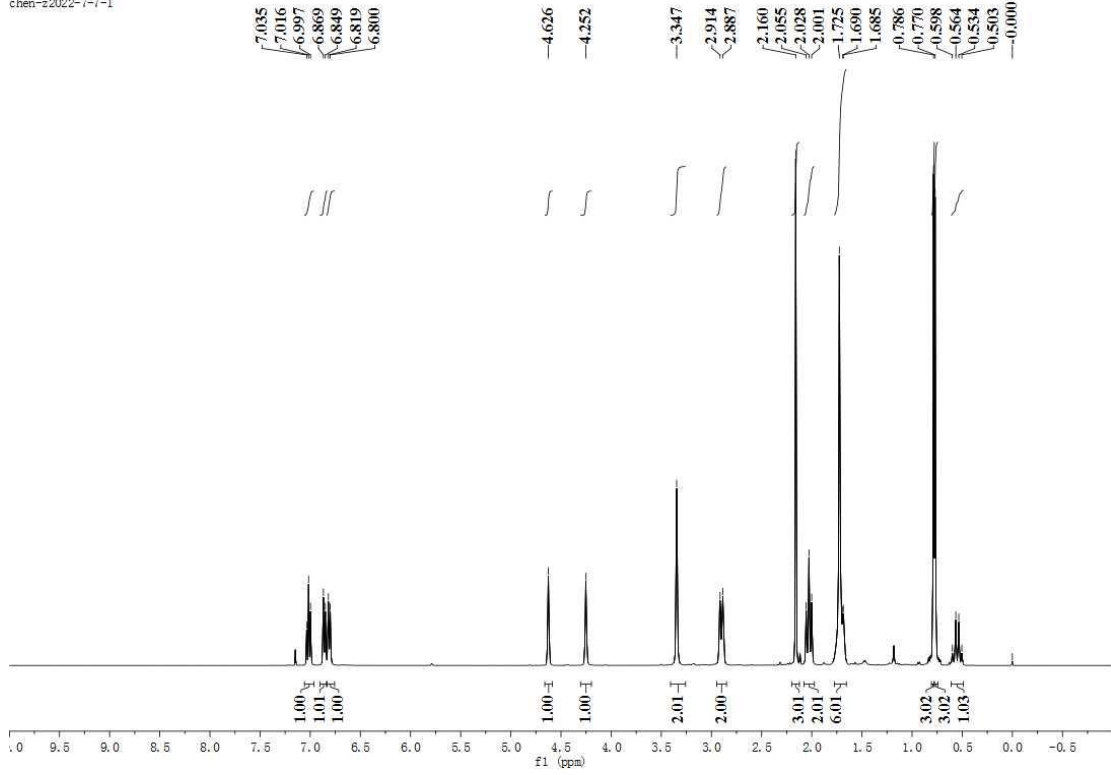


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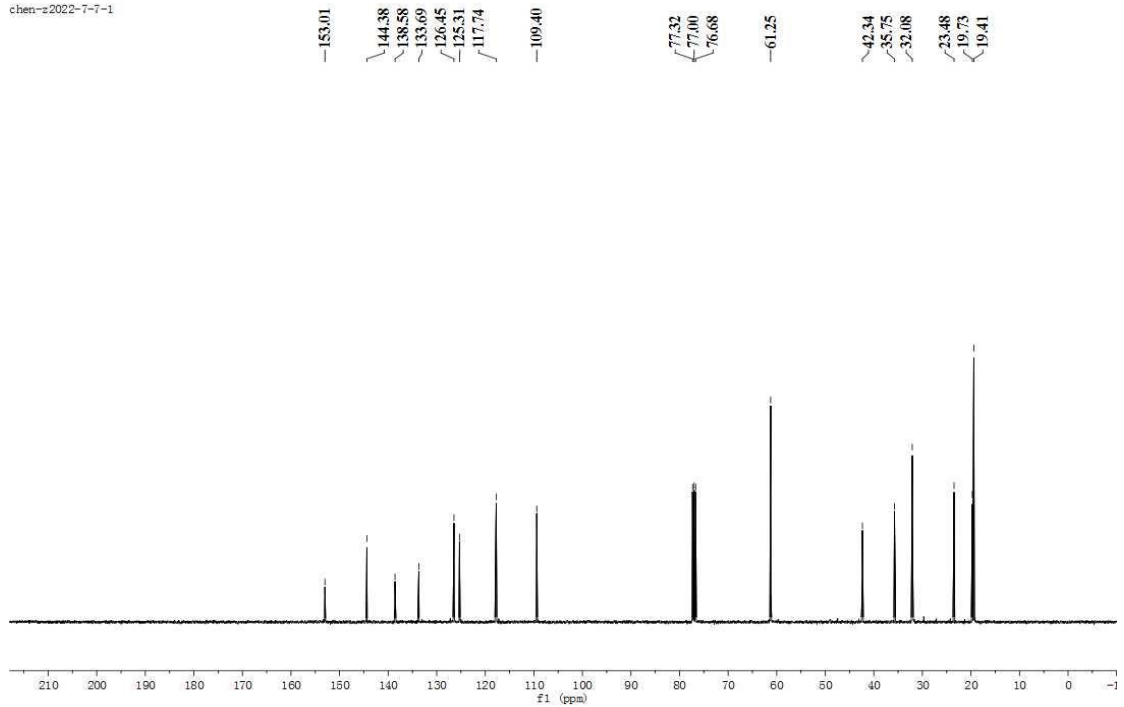




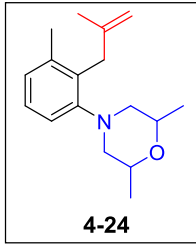
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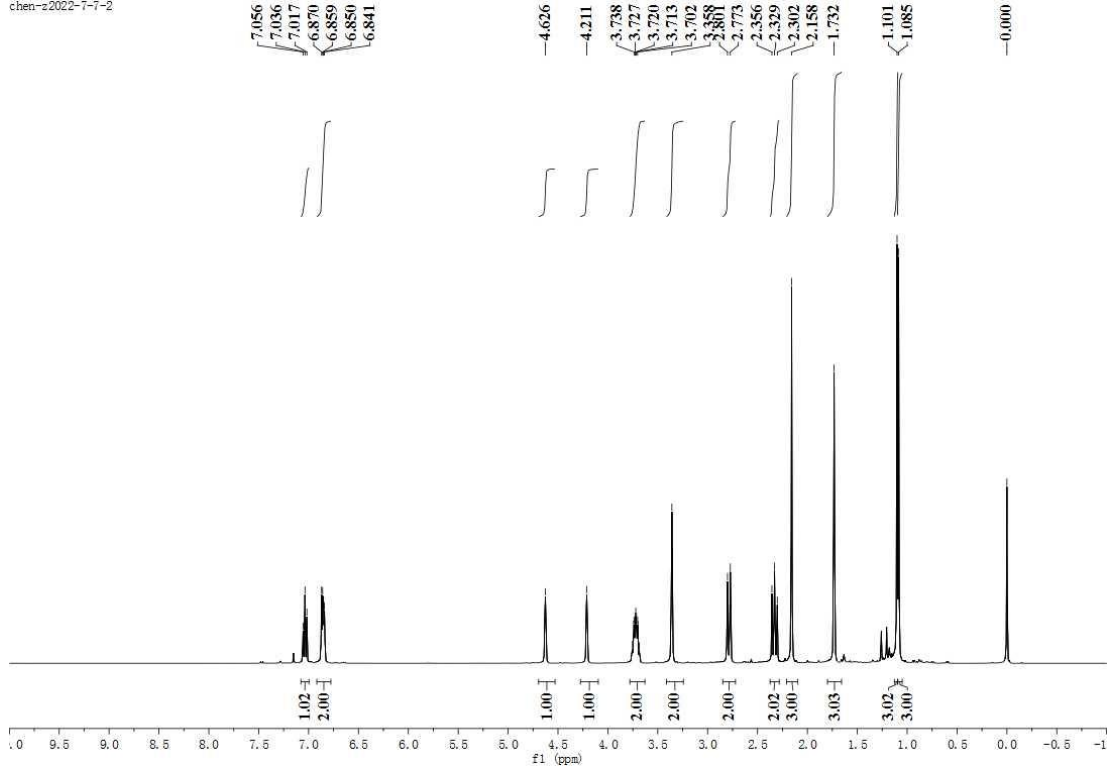
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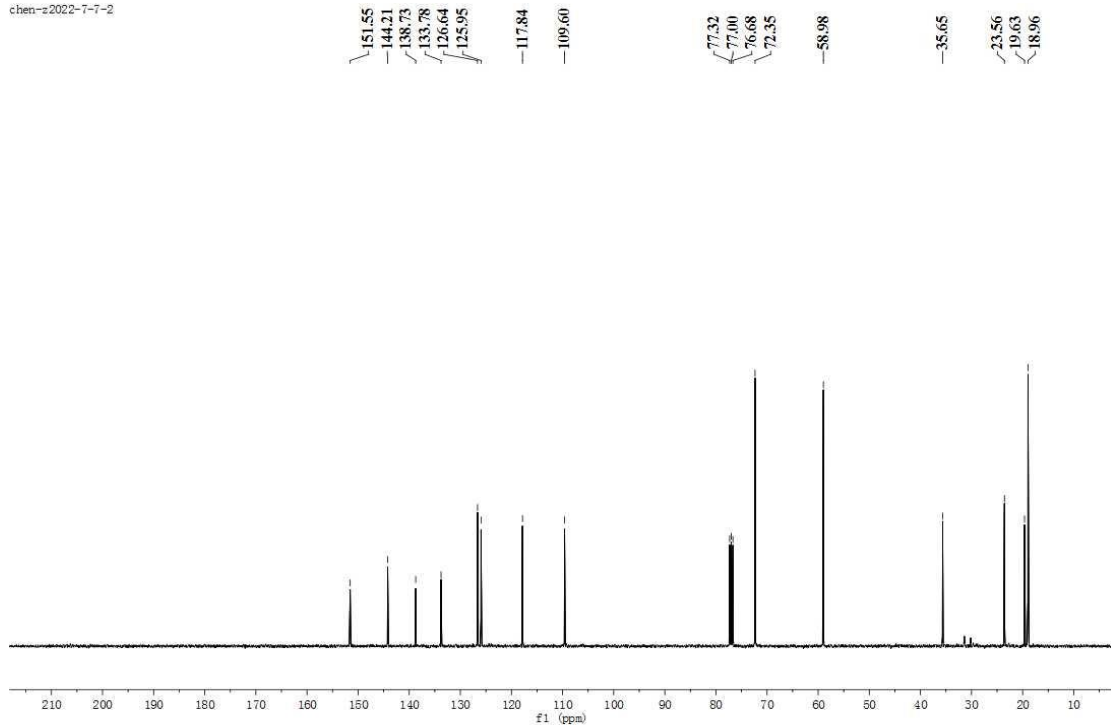


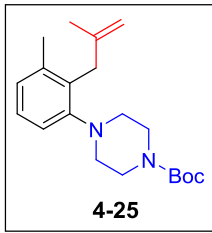


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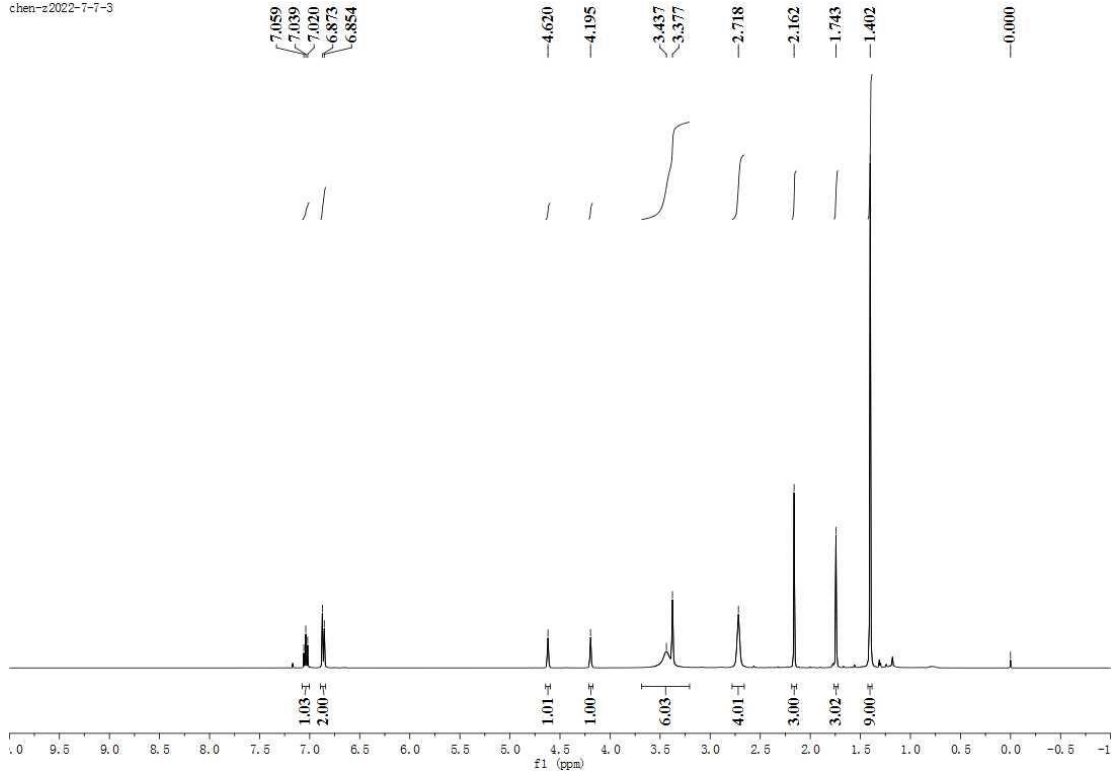


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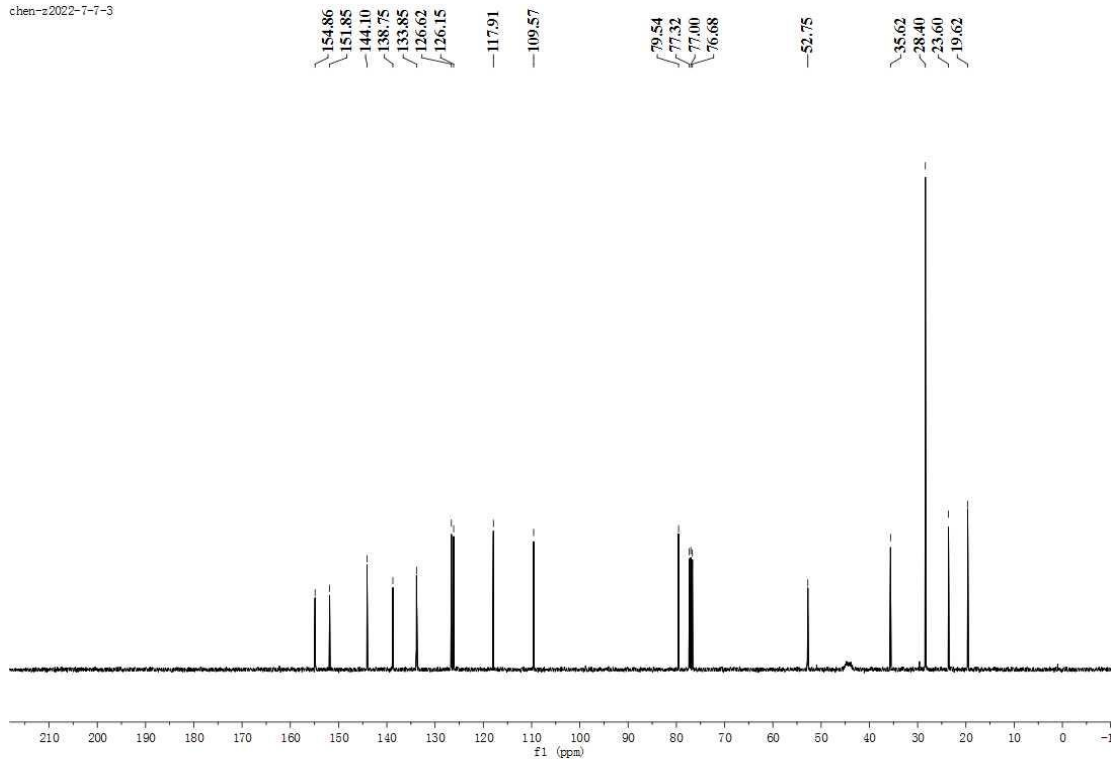


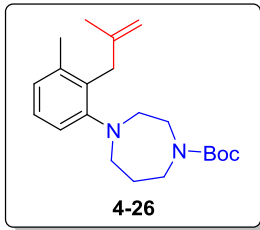


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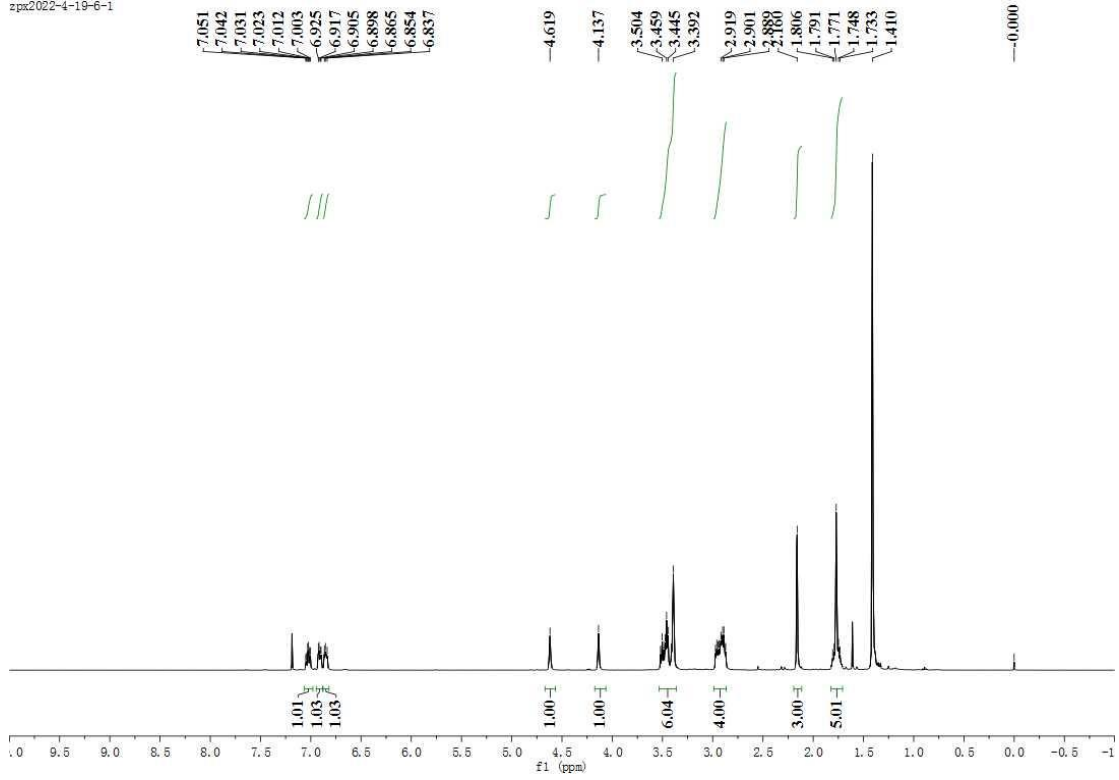


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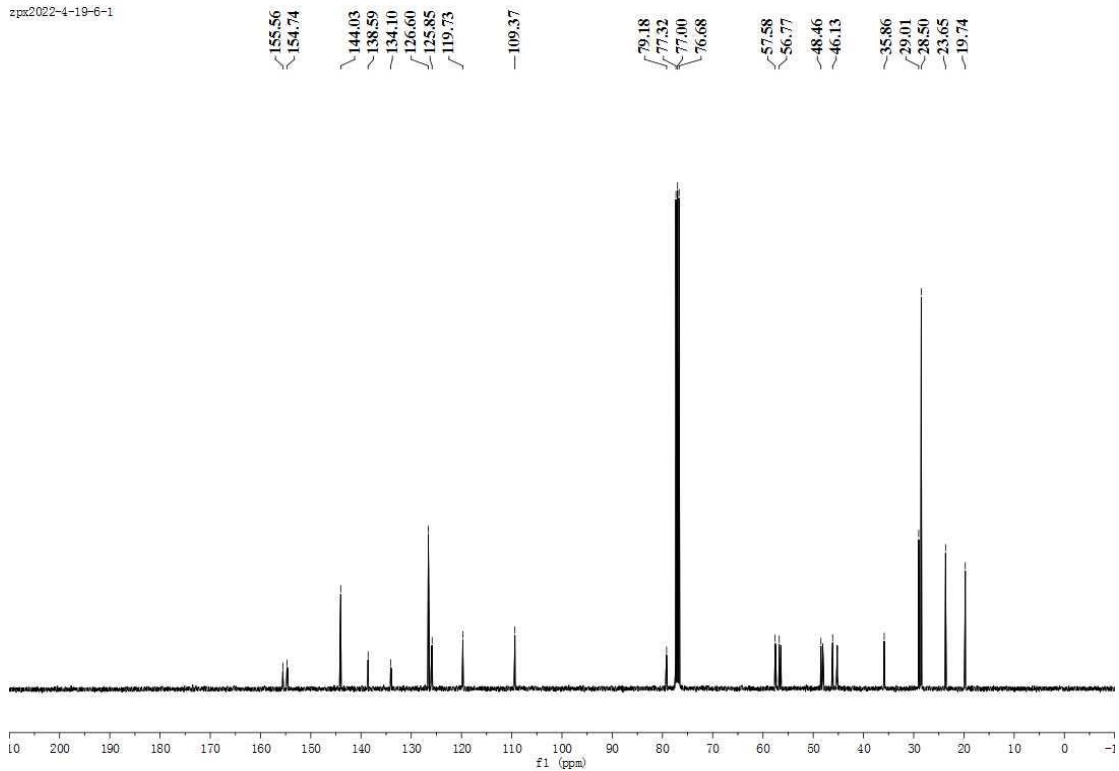


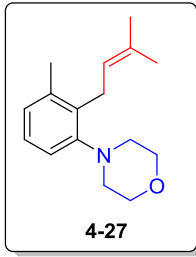


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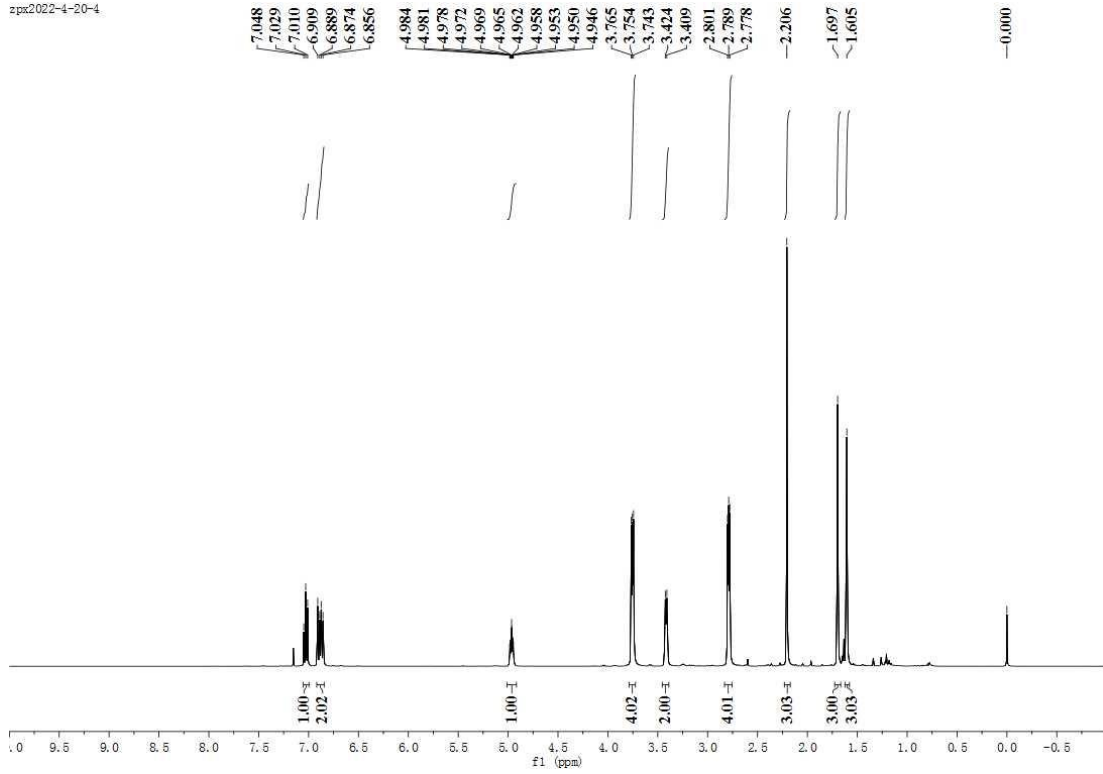


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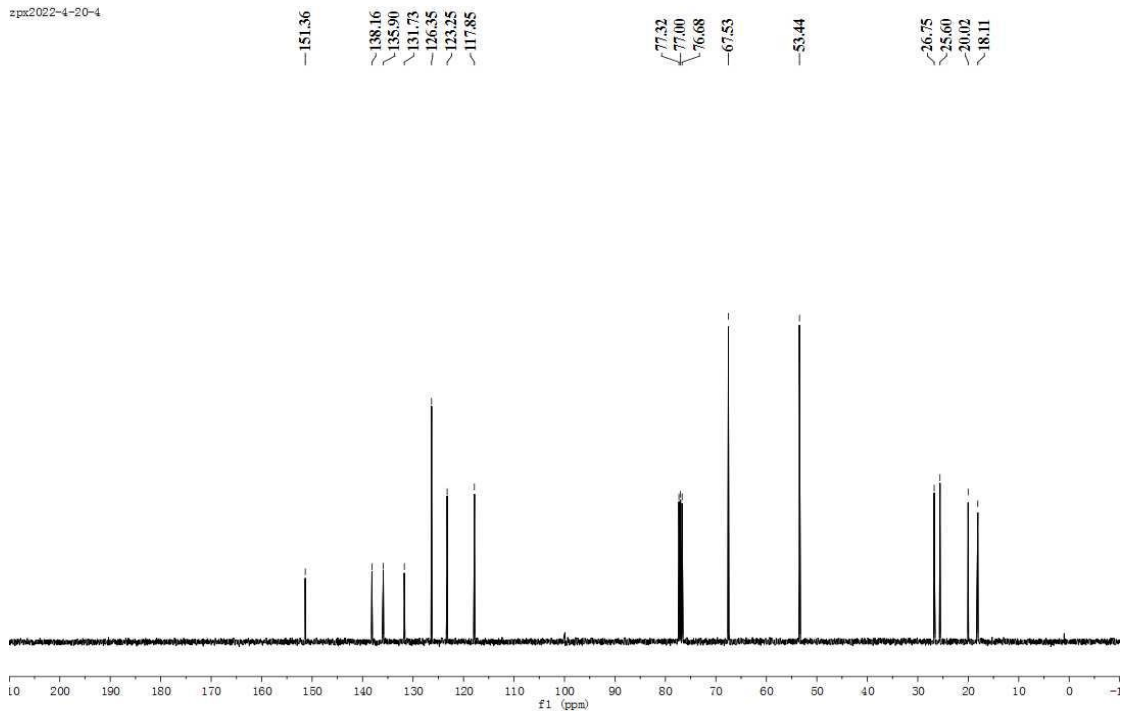


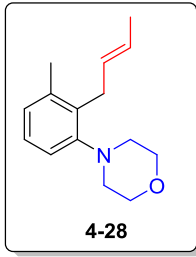


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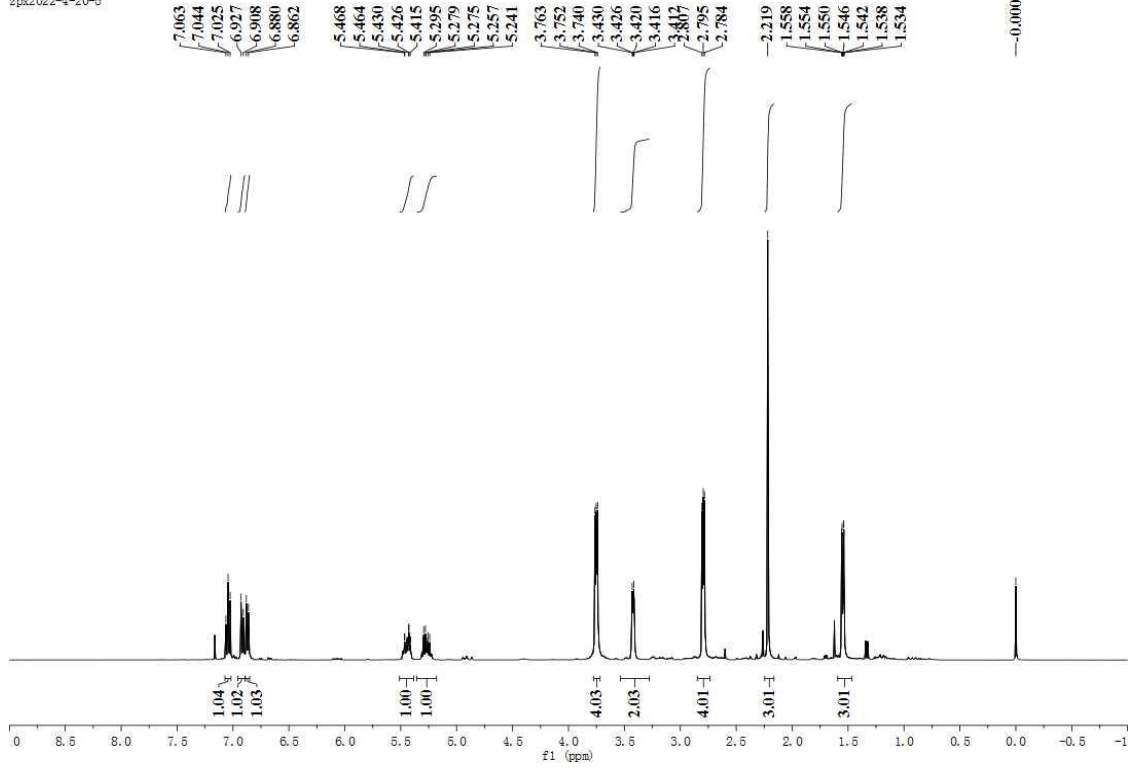


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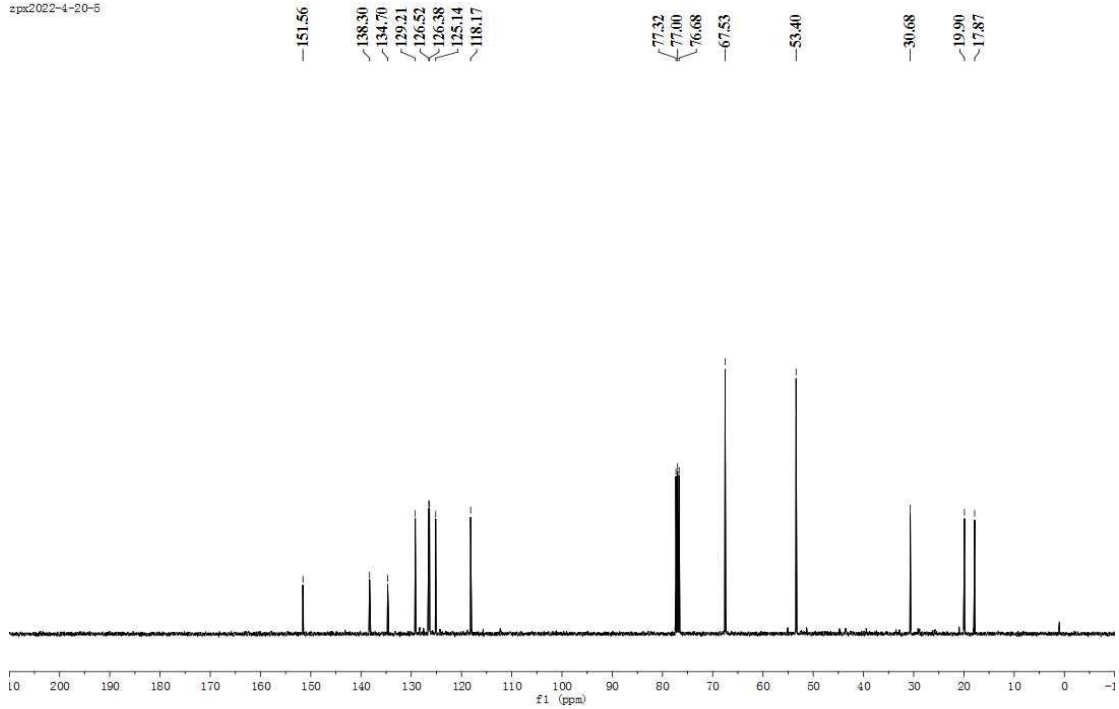


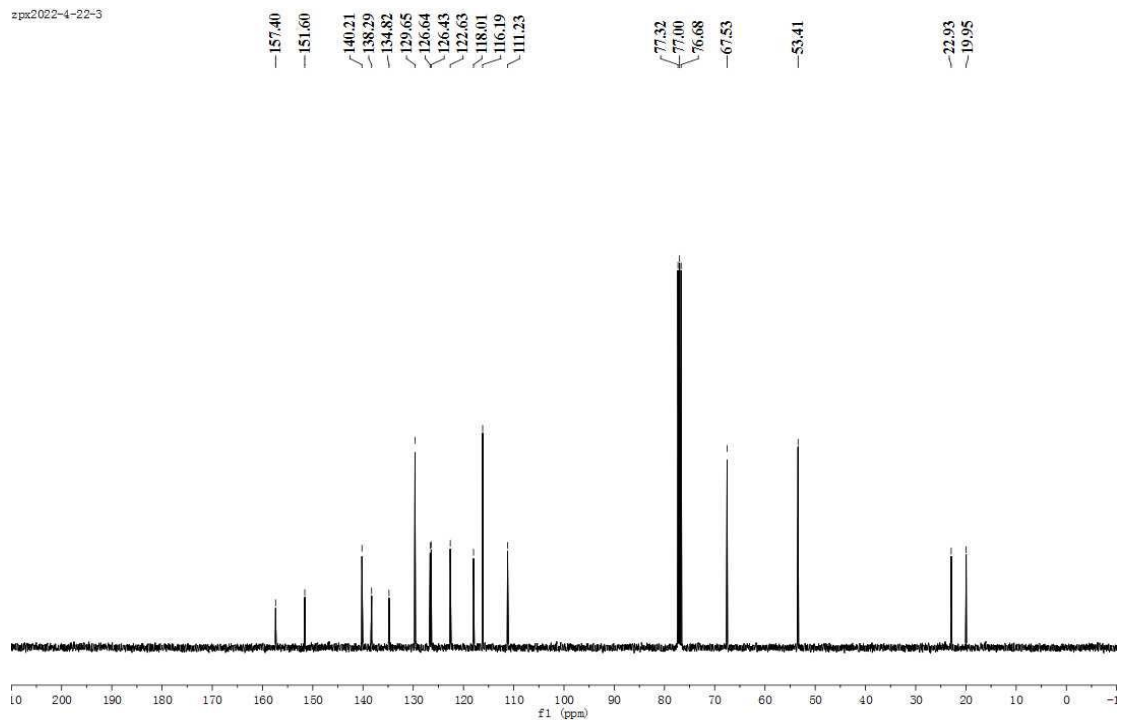
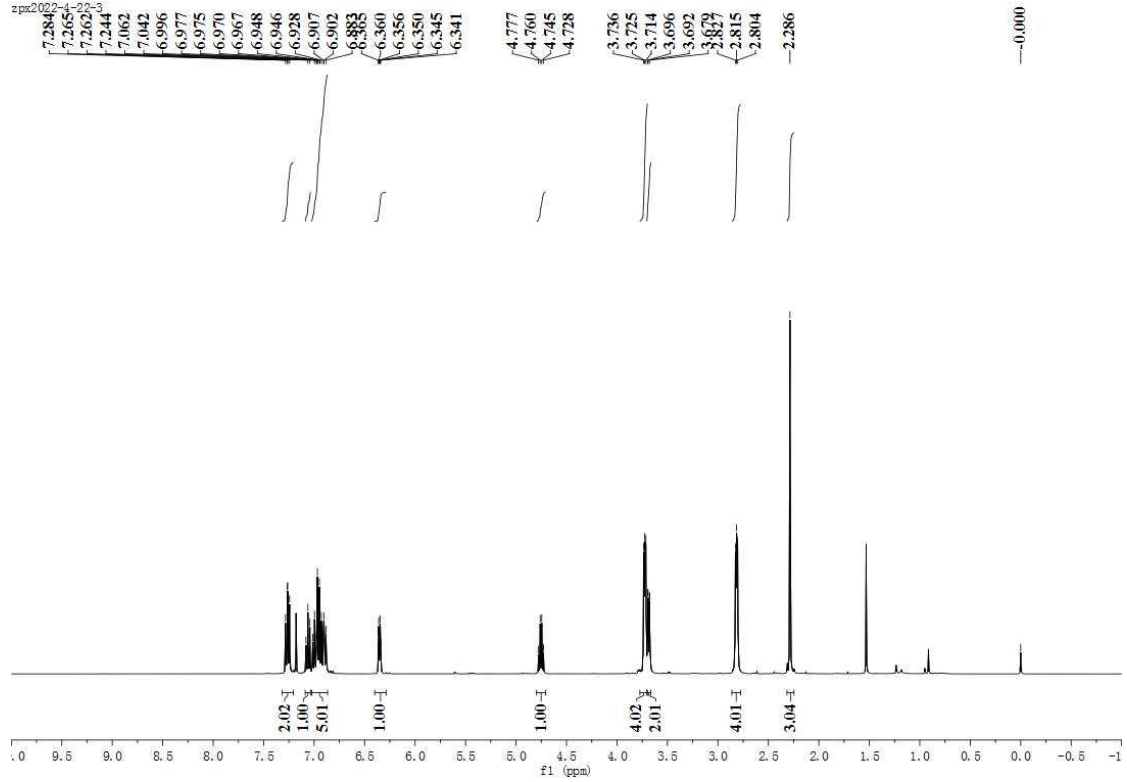
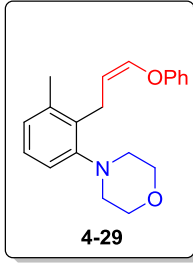


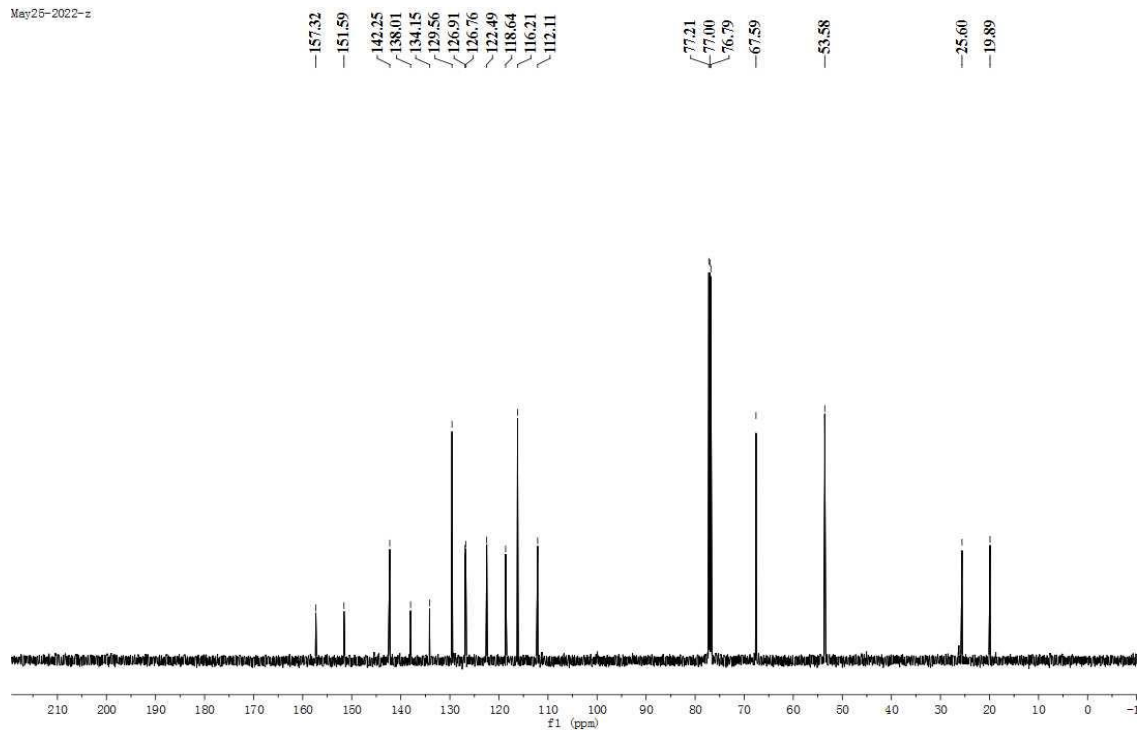
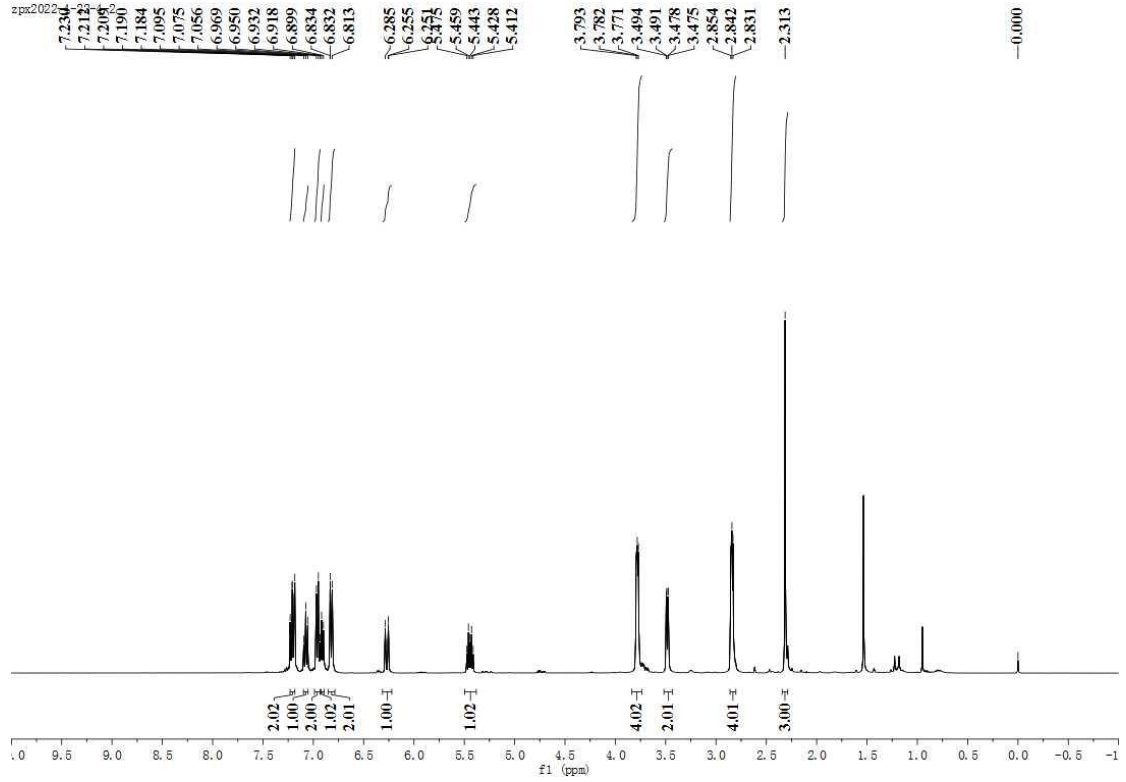
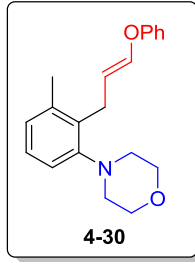
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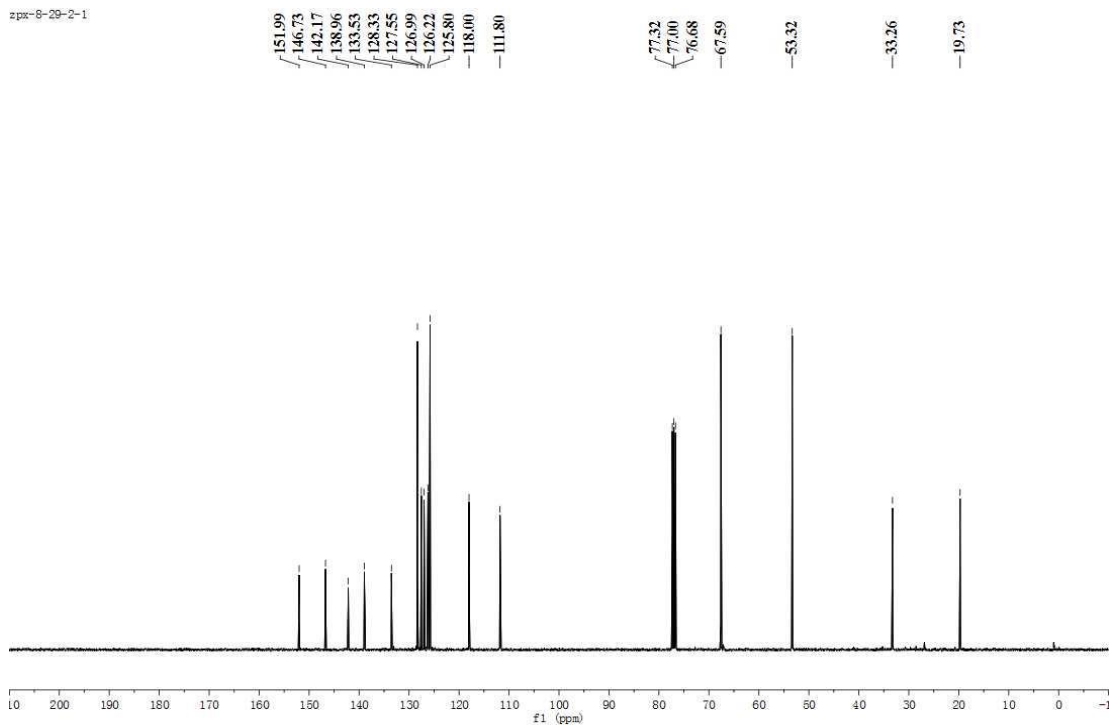
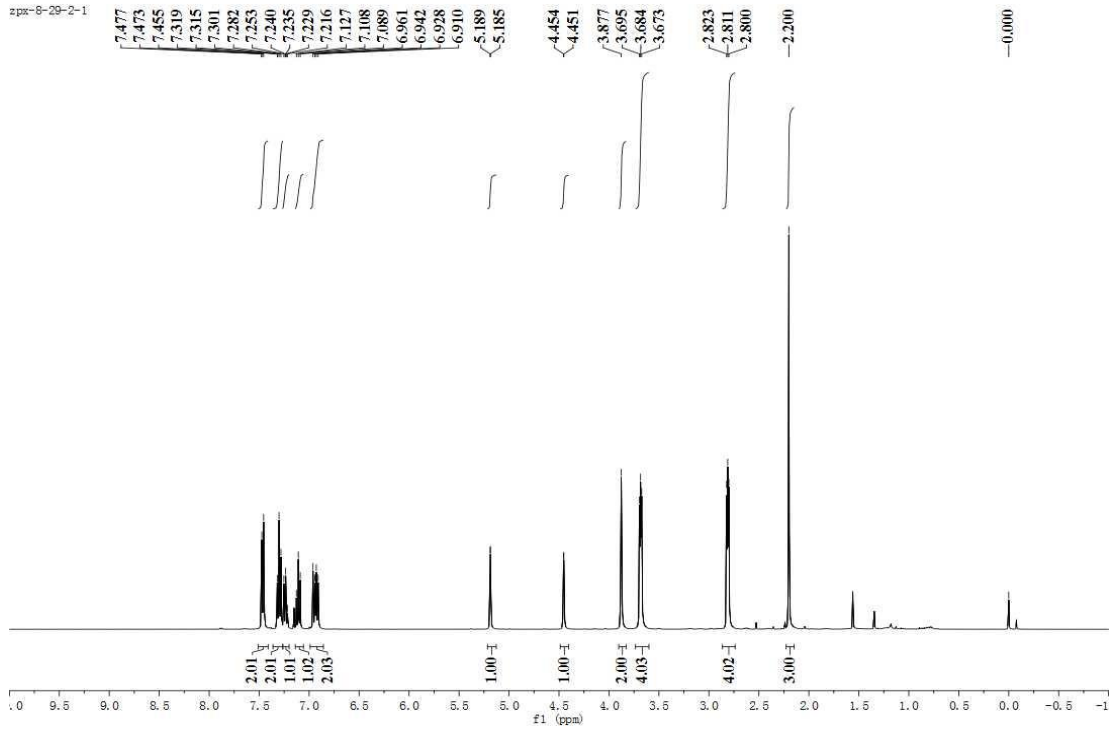
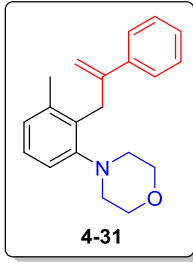


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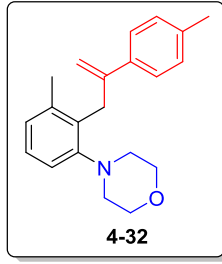




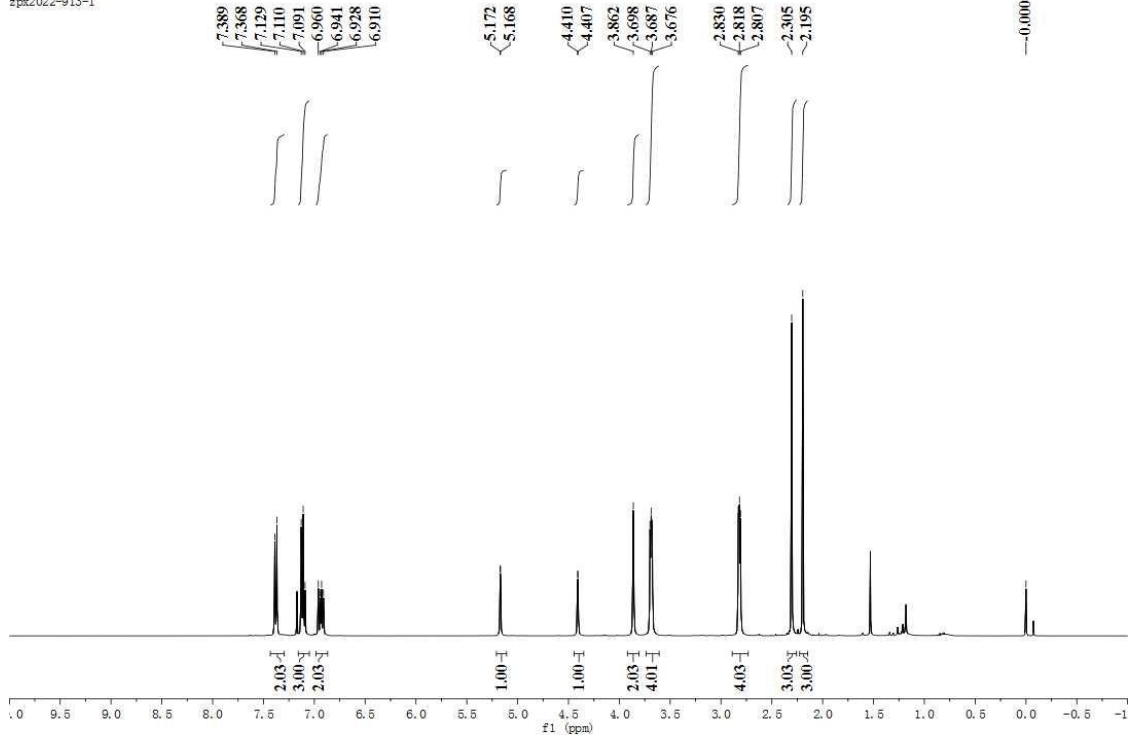




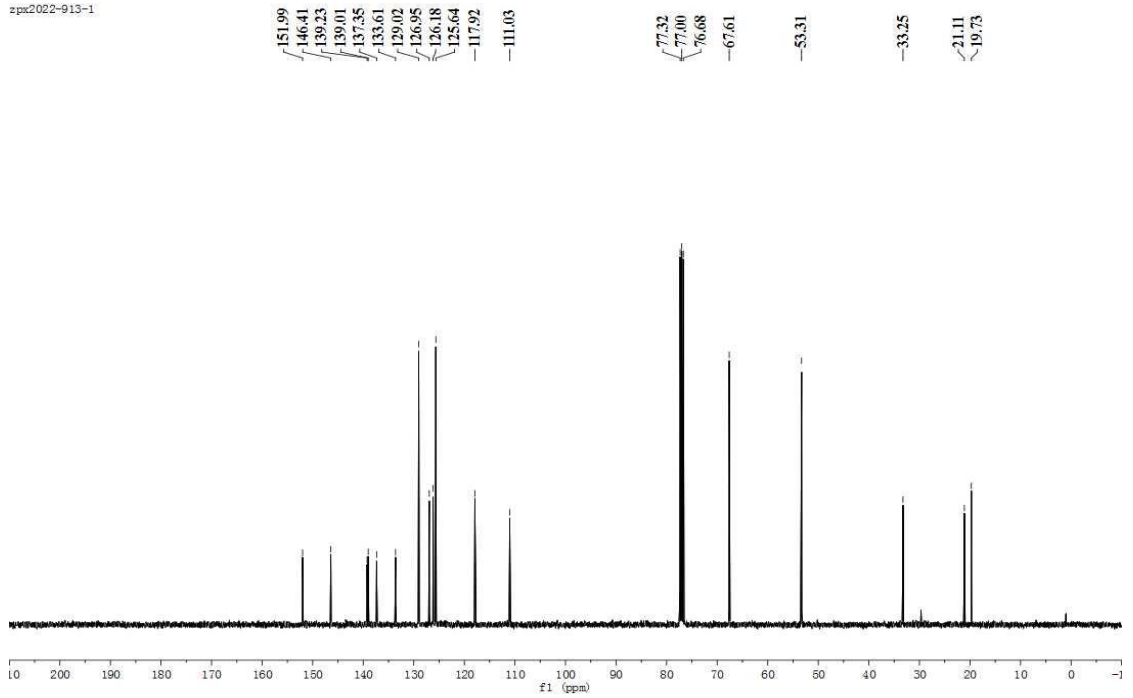


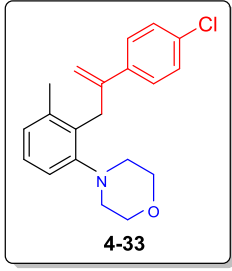


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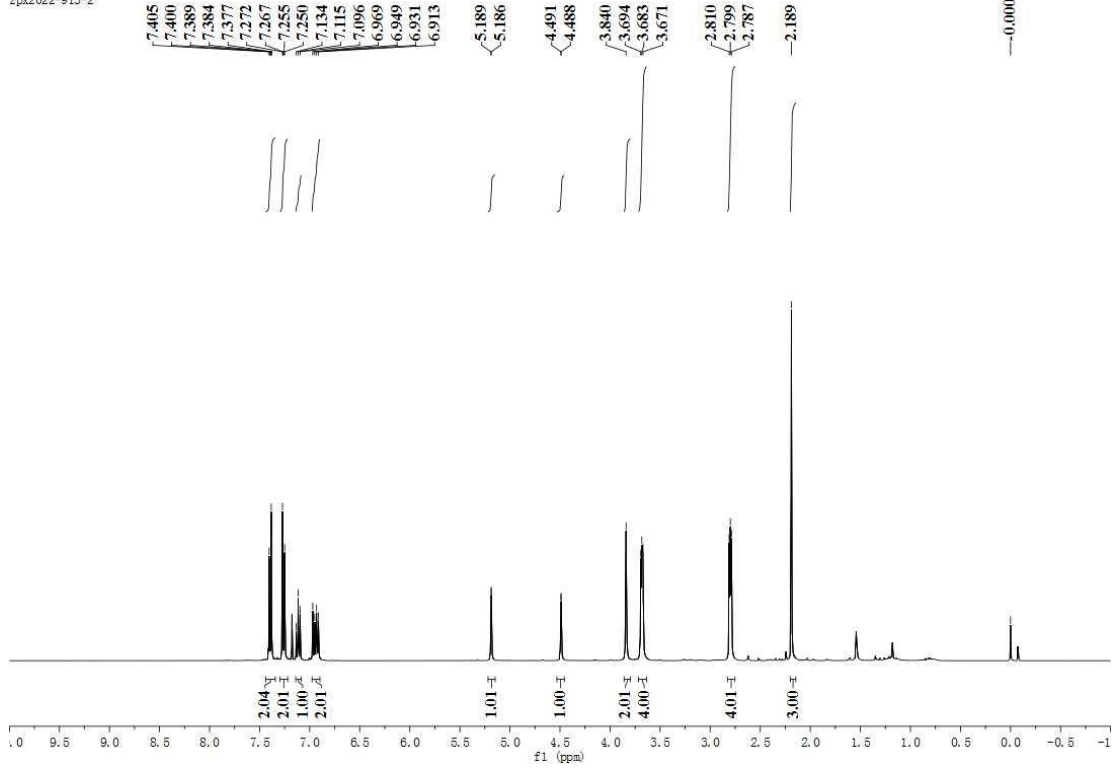


zpx2022-913-1





zpx2022-913-2



zpx2022-913-2

