Supporting Information

For

Copper-Catalyzed 1,1-Alkynylalkylation of Alkynes: Access toward Conjugated Enynes

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Ⅰ. General Considerations

All reagents were purchased from commercial sources and used without further treatment, unless otherwise indicated. The following starting materials were prepared according to the procedures described previously in the literature: **5**,[1] **6**,[2] **7**,[3] **8**.[3] All reactions were run under air with no precautions taken to exclude moisture. ^{1}H NMR and ^{13}C NMR spectra were recorded at 25 ºC on a Varian (400 MHz and 100 MHz). Melting points were obtained with a micro melting point XT4A Beijing Keyi electrooptic apparatus and are uncorrected. High-resolution mass data were recorded on a Waters LCT PremierxeTM (USA). Single-crystal X-ray crystallography was carried out on a Bruker Smart Apex II diffractometer system. All reactions were monitored by TLC with Taizhou GF254 silica gel coated plates. Flash column chromatography was carried out using 200-300 mesh silica gel at increased pressure.

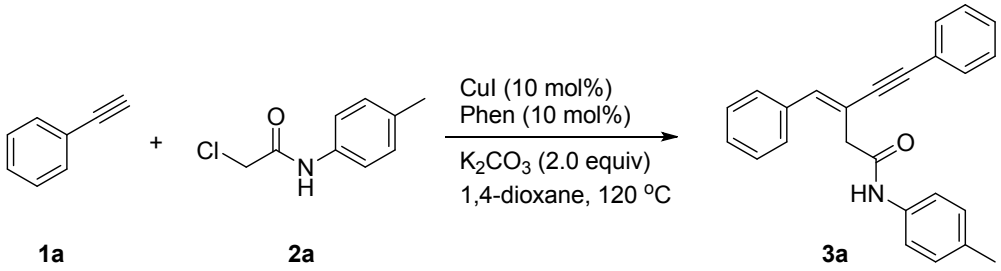
Ⅱ. General Procedure for the Preparation of 2, 3 and 4

1. General Procedure for the Preparation of 2

Substrates **2** were prepared by the reaction of corresponding anilines (1 equiv) and acyl chlorides (1.2 equiv) in CH_2Cl_2 at room temperature according to procedures described in the literature reported before.[4]

2. General Procedure for the Preparation of 3 and 4

3a as an example

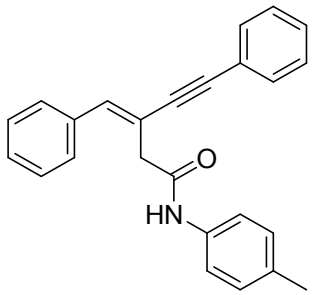


1a **2a** **3a**

To a solution of the 2-chloro-*N*-(*p*-tolyl)acetamide **2a** (73.2 mg, 0.4 mmol) in 1,4-dioxane (0.8 ml) was added the ethynylbenzene **1a** (110 μL, 0.96 mmol), Phen (7.9 mg, 0.04 mmol), CuI (7.6 mg, 0.04 mmol), and K_2CO_3 (110.6 mg, 0.8 mmol) under air in a Schlenck tube. The reaction mixture was stirred at 120 °C for 1.0 h. After the reaction finished, the reaction mixture was

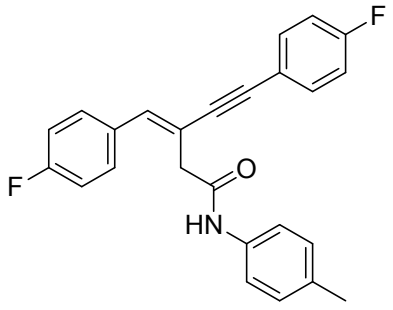
cooled to room temperature and quenched by water. The mixture was extracted with EtOAc (3.0 mL×3), the combined organic phases were dried over anhydrous Na_2SO_4 and the solvent was evaporated under vacuum. The residue was purified by column chromatography to give the corresponding products **3a** (112.0 mg, 80%).

Ⅲ. Analytical Data of Compounds 3 and 4



(*E*)-3-benzylidene-5-phenyl-*N*-(p-tolyl)pent-4-ynamide 3a

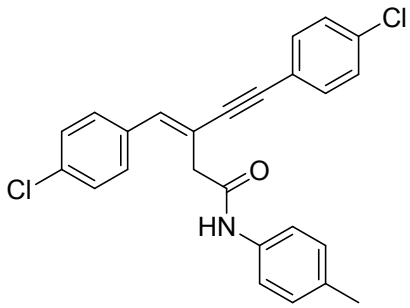
White solid. mp: 140 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.30 (s, 3H), 3.55 (s, 2H), 7.10 (d, J = 8.0 Hz, 2H), 7.23 (s, 1H), 7.29-7.34 (m, 4H), 7.37-7.40 (m, 6H), 7.47 (t, J = 3.6 Hz, 2H), 7.79 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.8, 41.3, 90.8, 91.1, 116.8, 120.1, 122.5, 128.3, 128.4, 128.6, 128.7, 128.9, 129.5, 131.6, 134.1, 135.2, 135.3, 140.1, 167.5. HRMS (ESI-TOF). Calcd for $C_{25}H_{22}NO$, $[M+H]^+$ *m/z* 352.1701, Found 352.1710.



(*E*)-3-(4-fluorobenzylidene)-5-(4-fluorophenyl)-*N*-(*p*-tolyl)pent-4-ynamide 3b

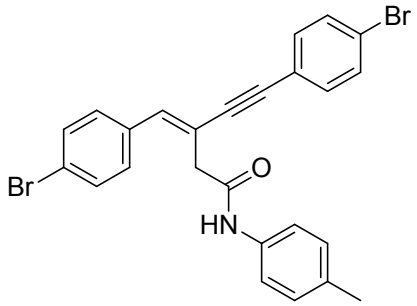
White solid. mp: 156 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.30 (s, 3H), 3.50 (s, 2H), 7.00-7.15 (m, 7H), 7.38-7.45 (m, 6H), 7.78 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.8, 41.2, 89.7, 90.6, 115.7 (d, J_{C-F} = 6.0 Hz), 115.9 (d, J_{C-F} = 6.0 Hz), 116.5, 118.6 (d, J_{C-F} = 4.0 Hz), 120.1, 129.5, 130.7 (d, J_{C-F} = 8.0 Hz), 131.3 (d, J_{C-F} = 3.0 Hz), 133.5 (d, J_{C-F} = 8.0 Hz), 134.3, 135.1, 138.9, 162.5 (d, J_{C-F} = 248.0 Hz), 162.7 (d, J_{C-F} = 249.0 Hz), 167.4. HRMS (ESI-TOF). Calcd for

$C_{25}H_{20}F_2NO$, $[M+H]^+$ *m/z* 388.1513, Found 388.1516.



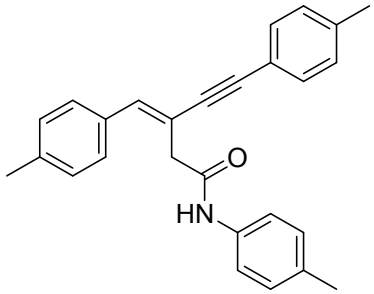
(*E*)-3-(4-chlorobenzylidene)-5-(4-chlorophenyl)-*N*-(*p*-tolyl)pent-4-ynamide 3c

White solid. mp: 180 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.31 (s, 3H), 3.50 (s, 2H), 7.11 (d, *J* = 8.4 Hz, 2H), 7.15 (s, 1H), 7.30 (d, *J* = 8.8 Hz, 2H), 7.35-7.39 (m, 8H), 7.70 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.8, 41.2, 90.0, 91.7, 117.2, 120.1, 120.9, 128.8, 128.9, 129.5, 130.2, 132.8, 133.6, 134.3, 134.4, 134.8, 135.0, 139.0, 167.2. HRMS (ESI-TOF). Calcd for $C_{25}H_{20}Cl_2NO$, $[M+H]^+$ *m/z* 420.0922, Found 420.0918.



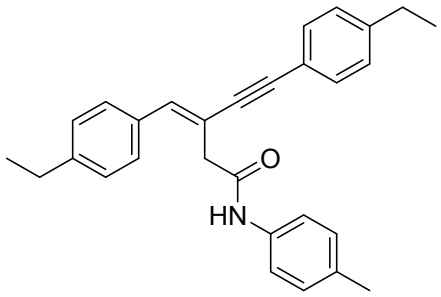
(*E*)-3-(4-bromobenzylidene)-5-(4-bromophenyl)-*N*-(*p*-tolyl)pent-4-ynamide 3d

White solid. mp: 174 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.31 (s, 3H), 3.49 (s, 2H), 7.12 (d, *J* = 9.2 Hz, 3H), 7.29-7.32 (m, 4H), 7.38 (d, *J* = 8.0 Hz, 2H), 7.46 (d, *J* = 8.0 Hz, 2H), 7.51 (d, *J* = 8.0 Hz, 2H), 7.68 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.9, 41.2, 90.1, 91.9, 117.3, 120.1, 121.4, 122.7, 123.1, 129.5, 130.4, 131.8, 131.9, 133.0, 134.0, 134.4, 135.0, 139.1, 167.1. HRMS (ESI-TOF). Calcd for $C_{25}H_{20}Br_2NO$, $[M+H]^+$ *m/z* 509.9891, Found 509.9896.



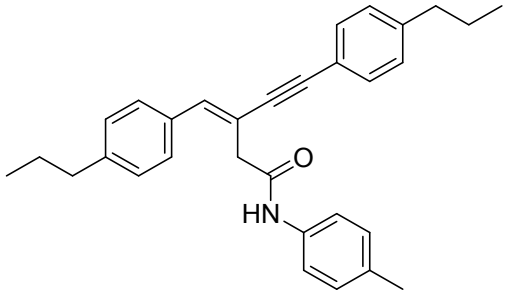
(*E*)-3-(4-methylbenzylidene)-*N*,5-di-*p*-tolylpent-4-ynamide 3e

White solid. mp: 169-170 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.30 (s, 3H), 2.36 (s, 3H), 2.36 (s, 3H), 3.56 (s, 2H), 7.11 (d, J = 8.0 Hz, 2H), 7.14 (d, J = 7.6 Hz, 2H), 7.19 (d, J = 9.2 Hz, 3H), 7.30 (d, J = 8.0 Hz, 2H), 7.38 (t, J = 8.4 Hz, 4H), 7.81 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.8, 21.3, 21.5, 41.5, 90.8, 90.9, 115.9, 119.5, 120.1, 128.9, 129.2, 129.4, 129.5, 131.5, 132.5, 134.1, 135.2, 138.4, 138.8, 139.9, 167.6. HRMS (ESI-TOF). Calcd for $C_{27}H_{26}NO$, $[M+H]^+$ *m/z* 380.2014, Found 380.2014.



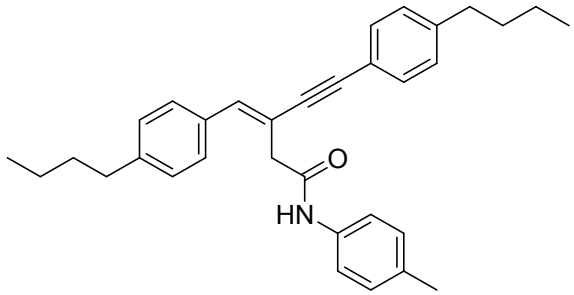
(*E*)-3-(4-ethylbenzylidene)-5-(4-ethylphenyl)-*N*-(*p*-tolyl)pent-4-ynamide 3f

White solid. mp: 138-139 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.24 (t, J = 7.6 Hz, 6H), 2.30 (s, 3H), 2.65 (q, J = 7.6 Hz, 4H), 3.56 (s, 2H), 7.10 (d, J = 8.0 Hz, 2H), 7.17 (d, J = 8.0 Hz, 2H), 7.19 (s, 1H), 7.22 (d, J = 8.0 Hz, 2H), 7.32 (d, J = 7.6 Hz, 2H), 7.39 (d, J = 8.0 Hz, 4H), 7.83 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 15.3, 15.4, 20.8, 28.6, 28.8, 41.5, 90.8, 90.9, 116.0, 119.8, 120.1, 128.0, 128.2, 128.9, 129.4, 131.6, 132.8, 134.0, 135.2, 139.9, 144.7, 145.1, 167.7. HRMS (ESI-TOF). Calcd for $C_{29}H_{30}NO$, $[M+H]^+$ *m/z* 408.2327, Found 408.2327.



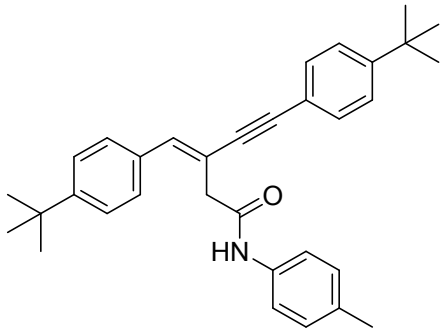
(*E*)-3-(4-propylbenzylidene)-5-(4-propylphenyl)-*N*-(*p*-tolyl)pent-4-ynamide 3g

White solid. mp: 126-128 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.94 (t, J = 7.2 Hz, 6H), 1.59-1.68 (m, 4H), 2.30 (s, 3H), 2.58 (t, J = 7.6 Hz, 4H), 3.56 (s, 2H), 7.10 (d, J = 8.0 Hz, 2H), 7.14 (d, J = 8.0 Hz, 2H), 7.19 (d, J = 8.0 Hz, 3H), 7.31 (d, J = 8.0 Hz, 2H), 7.38 (d, J = 4.4 Hz, 2H), 7.40 (d, J = 4.4 Hz, 2H), 7.85 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 13.7, 13.8, 20.8, 24.3, 24.3, 37.8, 37.9, 41.5, 90.8, 90.9, 115.9, 119.8, 120.1, 128.6, 128.8, 128.8, 129.4, 131.5, 132.8, 134.0, 135.2, 139.9, 143.1, 143.6, 167.7. HRMS (ESI-TOF). Calcd for $C_{31}H_{34}NO$, $[M+H]^+$ *m/z* 436.2640, Found 436.2647.



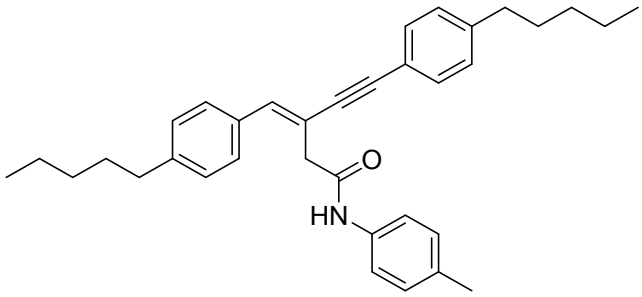
(*E*)-3-(4-butylbenzylidene)-5-(4-butylphenyl)-*N*-(*p*-tolyl)pent-4-ynamide 3h

White solid. mp: 128-129 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.92 (t, J = 7.6 Hz, 6H), 1.30-1.39 (m, 4H), 1.55-1.63 (m, 4H), 2.29 (s, 3H), 2.60 (t, J = 7.6 Hz, 4H), 3.56 (s, 2H), 7.10 (d, J = 8.0 Hz, 2H), 7.14 (d, J = 7.6 Hz, 2H), 7.19 (d, J = 8.4 Hz, 3H), 7.31 (d, J = 8.0 Hz, 2H), 7.38 (d, J = 6.0 Hz, 2H), 7.40 (d, J = 6.4 Hz, 2H), 7.86 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 13.9, 20.8, 22.3, 22.3, 33.3, 33.4, 35.4, 35.6, 41.5, 90.8, 90.9, 115.9, 119.7, 120.1, 128.5, 128.7, 128.8, 129.4, 131.5, 132.7, 134.0, 135.2, 139.8, 143.3, 143.8, 167.7. HRMS (ESI-TOF). Calcd for $C_{33}H_{38}NO$, $[M+H]^+$ *m/z* 464.2953, Found 464.2948.



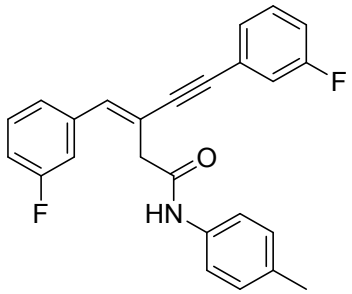
(*E*)-3-(4-(*tert*-butyl)benzylidene)-5-(4-(*tert*-butyl)phenyl)-*N*-(*p*-tolyl)pent-4-ynamide 3i

White solid. mp: 172-174 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.31 (s, 18H), 2.29 (s, 3H), 3.57 (s, 2H), 7.09 (d, J = 8.0 Hz, 2H), 7.19 (s, 1H), 7.34 (d, J = 8.4 Hz, 4H), 7.40 (d, J = 8.0 Hz, 6H), 7.91 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.8, 31.1, 31.2, 34.6, 34.8, 41.5, 90.8, 90.8, 116.1, 119.6, 120.1, 125.4, 125.6, 128.7, 129.4, 131.3, 132.5, 134.0, 135.2, 139.7, 151.4, 151.9, 167.7. HRMS (ESI-TOF). Calcd for $C_{33}H_{38}NO$, $[M+H]^+$ *m/z* 464.2953, Found 464.2963.



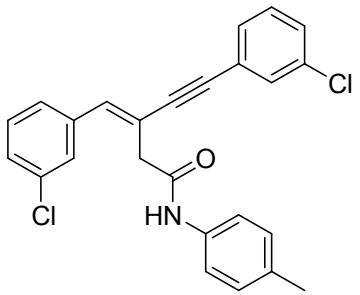
(*E*)-3-(4-pentylbenzylidene)-5-(4-pentylphenyl)-*N*-(*p*-tolyl)pent-4-ynamide 3j

White solid. mp: 129-130 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.89 (t, J = 6.8 Hz, 6H), 1.31-1.32 (m, 8H), 1.57-1.64 (m, 4H), 2.30 (s, 3H), 2.60 (t, J = 7.6 Hz, 4H), 3.56 (s, 2H), 7.10 (d, J = 8.0 Hz, 2H), 7.14 (d, J = 8.0 Hz, 2H), 7.19 (d, J = 8.4 Hz, 3H), 7.31 (d, J = 8.0 Hz, 2H), 7.38 (d, J = 5.2 Hz, 2H), 7.40 (d, J = 5.6 Hz, 2H), 7.84 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 14.0, 20.8, 22.5, 30.9, 30.9, 31.4, 31.4, 35.7, 35.9, 41.5, 90.8, 90.9, 115.9, 119.7, 120.1, 128.6, 128.7, 128.9, 129.4, 131.5, 132.7, 134.0, 135.2, 139.9, 143.4, 143.8, 167.7. HRMS (ESI-TOF). Calcd for $C_{35}H_{42}NO$, $[M+H]^+$ *m/z* 492.3266, Found 492.3268.



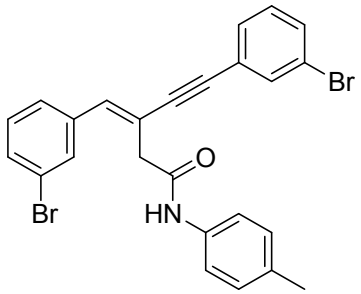
(*E*)-3-(3-fluorobenzylidene)-5-(3-fluorophenyl)-*N*-(*p*-tolyl)pent-4-ynamide 3k

White solid. mp: 141-142 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.30 (s, 3H), 3.52 (s, 2H), 7.00-7.07 (m, 2H), 7.10-7.36 (m, 9H), 7.40 (d, J = 8.4 Hz, 2H), 7.68 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.8, 41.1, 89.9 (d, J_{C-F} = 4.0 Hz), 91.4, 115.3 (d, J_{C-F} = 21.0 Hz), 115.7 (d, J_{C-F} = 22.0 Hz), 116.1 (d, J_{C-F} = 21.0 Hz), 117.8, 118.4 (d, J_{C-F} = 22.0 Hz), 120.1, 124.2 (d, J_{C-F} = 9.0 Hz), 124.6 (d, J_{C-F} = 3.0 Hz), 127.5 (d, J_{C-F} = 3.0 Hz), 129.5, 130.1 (d, J_{C-F} = 8.0 Hz), 130.3 (d, J_{C-F} = 8.0 Hz), 134.3, 135.0, 137.2 (d, J_{C-F} = 8.0 Hz), 139.2 (d, J_{C-F} = 2.0 Hz), 162.4 (d, J_{C-F} = 246.0 Hz), 162.8 (d, J_{C-F} = 245.0 Hz), 167.1. HRMS (ESI-TOF). Calcd for $C_{25}H_{20}F_2NO$, $[M+H]^+$ *m/z* 388.1513, Found 388.1517.



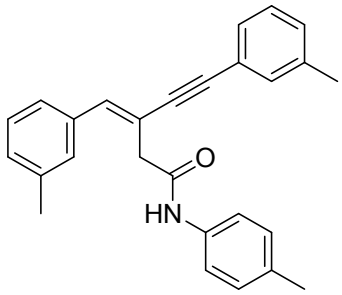
(*E*)-3-(3-chlorobenzylidene)-5-(3-chlorophenyl)-*N*-(*p*-tolyl)pent-4-ynamide 3l

White solid. mp: 130 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.30 (s, 3H), 3.50 (s, 2H), 7.09 (s, 1H), 7.12 (d, J = 6.0 Hz, 2H), 7.22-7.34 (m, 6H), 7.38 (d, J = 4.4 Hz, 2H), 7.41 (d, J = 4.4 Hz, 2H), 7.76 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.8, 41.0, 89.7, 91.6, 118.1, 120.2, 124.1, 126.8, 128.4, 128.8, 128.9, 129.5, 129.6, 129.7, 129.9, 131.4, 134.3, 134.3, 134.6, 135.0, 136.9, 138.9, 167.1. HRMS (ESI-TOF). Calcd for $C_{25}H_{20}Cl_2NO$, $[M+H]^+$ *m/z* 420.0922, Found 420.0918.



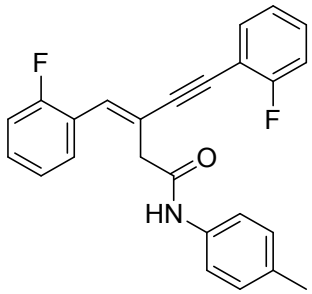
(*E*)-3-(3-bromobenzylidene)-5-(3-bromophenyl)-*N*-(p-tolyl)pent-4-ynamide 3m

White solid. mp: 112 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.29 (s, 3H), 3.49 (s, 2H), 7.09-7.23 (m, 5H), 7.34-7.46 (m, 6H), 7.52 (m, 1H), 7.57 (m, 1H), 7.76 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.8, 41.0, 89.6, 91.7, 118.1, 120.2, 122.2, 122.7, 124.4, 127.3, 129.5, 129.8, 130.1, 131.3, 131.7, 131.8, 134.3, 135.0, 137.2, 138.8, 167.1. HRMS (ESI-TOF). Calcd for $C_{25}H_{20}Br_2NO$, $[M+H]^+$ *m/z* 509.9891, Found 509.9896.



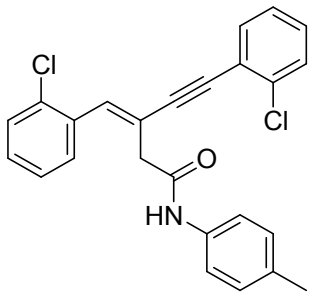
(*E*)-3-(3-methylbenzylidene)-5-(m-tolyl)-*N*-(*p*-tolyl)pent-4-ynamide 3n

White solid. mp: 128-129 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.30 (s, 3H), 2.32 (s, 3H), 2.36 (s, 3H), 3.56 (s, 2H), 7.09-7.15 (m, 4H), 7.19-7.24 (m, 4H), 7.26-7.29 (m, 3H), 7.40 (d, J = 8.4 Hz, 2H), 7.80 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.8, 21.2, 21.4, 41.4, 90.8, 91.0, 116.6, 120.1, 122.4, 125.9, 128.3, 128.6, 128.7, 129.1, 129.4, 129.5, 129.6, 132.2, 134.1, 135.2, 135.3, 138.1, 138.3, 140.1, 167.6. HRMS (ESI-TOF). Calcd for $C_{27}H_{26}NO$, $[M+H]^+$ *m/z* 380.2014, Found 380.2022.



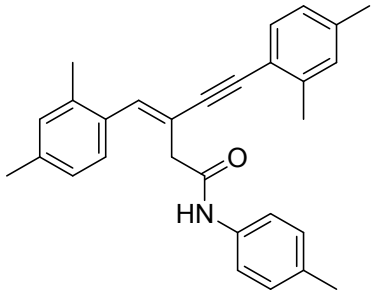
(*E*)-3-(2-fluorobenzylidene)-5-(2-fluorophenyl)-*N*-(*p*-tolyl)pent-4-ynamide 3o

White solid. mp: 120-122 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.30 (s, 3H), 3.49 (s, 2H), 7.07-7.14 (m, 5H), 7.19 (t, J = 7.6 Hz, 1H), 7.27 (s, 1H), 7.29-7.35 (m, 2H), 7.42-7.48 (m, 3H), 7.63 (t, J = 7.6 Hz, 1H), 7.84 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.8, 41.5, 84.5, 95.6 (d, J_{C-F} = 3.0 Hz), 111.1 (d, J_{C-F} = 16.0 Hz), 115.5 (d, J_{C-F} = 22.0 Hz), 118.6, 120.2, 123.0 (d, J_{C-F} = 14.0 Hz), 124.2 (d, J_{C-F} = 4.0 Hz), 124.3 (d, J_{C-F} = 3.0 Hz), 129.4, 130.3 (d, J_{C-F} = 9.0 Hz), 130.5 (d, J_{C-F} = 3.0 Hz), 130.5 (d, J_{C-F} = 2.0 Hz), 133.0 (d, J_{C-F} = 3.0 Hz), 133.3, 134.1, 135.2, 160.1 (d, J_{C-F} = 247.0 Hz), 162.7 (d, J_{C-F} = 250.0 Hz), 167.2. HRMS (ESI-TOF). Calcd for $C_{25}H_{20}F_2NO$, $[M+H]^+$ *m/z* 388.1513, Found 388.1515.



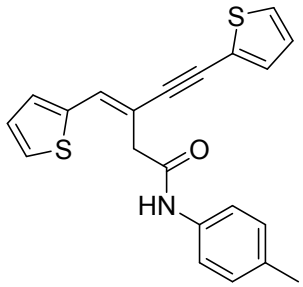
(*E*)-3-(2-chlorobenzylidene)-5-(2-chlorophenyl)-*N*-(*p*-tolyl)pent-4-ynamide 3p

White solid. mp: 122 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.30 (s, 3H), 3.46 (s, 2H), 7.11 (d, J = 8.0 Hz, 2H), 7.22-7.32 (m, 4H), 7.35 (s, 1H), 7.42 (d, J = 8.0 Hz, 4H), 7.53 (d, J = 6.4 Hz, 1H), 7.64 (d, J = 6.8 Hz, 1H), 7.85 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.8, 41.2, 88.2, 95.4, 118.4, 120.3, 122.4, 126.7, 127.0, 129.3, 129.4, 129.6, 129.7, 129.8, 130.8, 133.3, 133.4, 133.8, 134.2, 135.1, 135.9, 137.6, 167.1. HRMS (ESI-TOF). Calcd for $C_{25}H_{20}Cl_2NO$, $[M+H]^+$ *m/z* 420.0922, Found 420.0922.



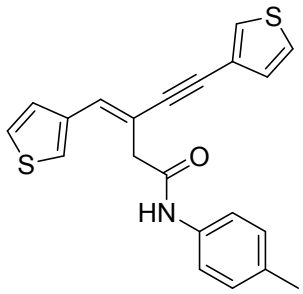
(*E*)-3-(2,4-dimethylbenzylidene)-5-(2,4-dimethylphenyl)-*N*-(*p*-tolyl)pent-4-ynamide 3q

White solid. mp: 142-144 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.30 (s, 6H), 2.32 (s, 6H), 2.40 (s, 3H), 3.45 (s, 2H), 6.97 (d, J = 7.6 Hz, 1H), 7.03 (d, J = 6.0 Hz, 3H), 7.10 (d, J = 8.0 Hz, 2H), 7.20 (d, J = 8.4 Hz, 2H), 7.34 (d, J = 8.0 Hz, 1H), 7.38 (d, J = 8.4 Hz, 2H), 7.72 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.0, 20.7, 20.8, 21.2, 21.4, 41.3, 89.9, 93.9, 117.1, 119.3, 120.0, 126.5, 126.7, 128.7, 129.5, 130.4, 131.1, 131.6, 131.8, 134.0, 135.3, 136.5, 138.3, 138.6, 138.8, 140.1, 167.7. HRMS (ESI-TOF). Calcd for $C_{29}H_{30}NO$, $[M+H]^+$ *m/z* 408.2327, Found 408.2326.



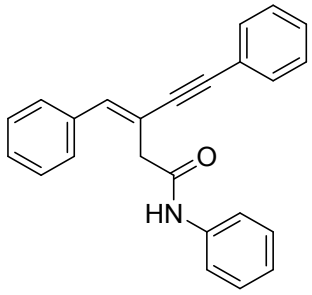
(*E*)-5-(thiophen-2-yl)-3-(thiophen-2-ylmethylene)-*N*-(*p*-tolyl)pent-4-ynamide 3r

White solid. mp: 139-140 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.28 (s, 3H), 3.70 (s, 2H), 6.98 (dd, J_1 = 4.0 Hz, J_2 = 4.8 Hz, 1H), 7.05-7.09 (m, 3H), 7.22 (d, J = 3.2 Hz, 2H), 7.28 (d, J = 4.4 Hz, 2H), 7.37 (d, J = 7.6 Hz, 3H), 7.69 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.8, 41.8, 84.6, 95.2, 113.7, 120.3, 122.7, 127.2, 127.7, 127.8, 128.0, 129.4, 130.0, 132.3, 134.1, 135.1, 138.4, 166.6. HRMS (ESI-TOF). Calcd for $C_{21}H_{18}NOS_2$, $[M+H]^+$ *m/z* 364.0830, Found 364.0839.



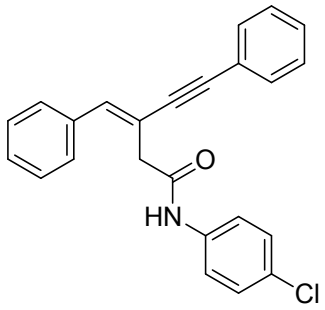
(*E*)-5-(thiophen-3-yl)-3-(thiophen-3-ylmethylene)-*N*-(*p*-tolyl)pent-4-ynamide 3s

White solid. mp: 146-148 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.29 (s, 3H), 3.58 (s, 2H), 7.05-7.13 (m, 4H), 7.18 (d, J = 4.4 Hz, 1H), 7.28 (dd, J_1 = 3.2 Hz, J_2 = 4.8 Hz, 1H), 7.32 (dd, J_1 = 3.2 Hz, J_2 = 4.8 Hz, 1H), 7.38 (d, J = 8.0 Hz, 2H), 7.47 (d, J = 2.4 Hz, 1H), 7.50 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 20.8, 41.8, 85.9, 90.9, 115.2, 120.1, 121.6, 125.6, 125.7, 126.1, 128.3, 129.0, 129.4, 129.7, 133.8, 134.1, 135.1, 136.5, 167.4. HRMS (ESI-TOF). Calcd for $C_{21}H_{18}NOS_2$, $[M+H]^+$ *m/z* 364.0830, Found 364.0837.



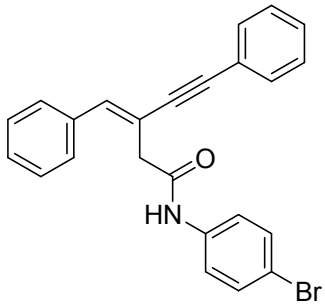
(*E*)-3-benzylidene-*N*,5-diphenylpent-4-ynamide 4b

White solid. mp: 146-148 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 3.57 (s, 2H), 7.11 (t, J = 7.2 Hz, 1H), 7.24 (s, 1H), 7.29-7.35 (m, 6H), 7.38-7.41 (m, 4H), 7.48 (t, J = 3.2 Hz, 2H), 7.52 (d, J = 8.0 Hz, 2H), 7.86 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 41.4, 90.9, 91.0, 116.6, 120.0, 122.5, 124.5, 128.3, 128.5, 128.7, 128.9, 129.0, 131.6, 135.2, 137.7, 140.2, 167.6. HRMS (ESI-TOF). Calcd for $C_{24}H_{20}NO$, $[M+H]^+$ *m/z* 338.1545, Found 338.1541.



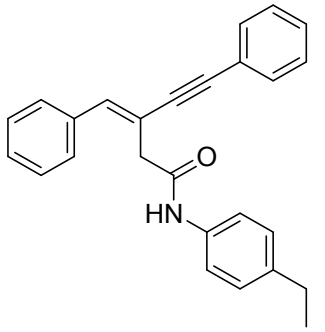
(*E*)-3-benzylidene-*N*-(4-chlorophenyl)-5-phenylpent-4-ynamide 4c

White solid. mp: 170 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 3.56 (s, 2H), 7.24 (d, J = 8.8 Hz, 3H), 7.33-7.39 (m, 8H), 7.45-7.47 (m, 4H), 7.93 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 41.3, 90.9, 91.0, 116.4, 121.2, 122.4, 128.4, 128.5, 128.7, 128.7, 128.8, 129.0, 129.4, 131.6, 135.2, 136.3, 140.3, 167.7. HRMS (ESI-TOF). Calcd for $C_{24}H_{19}ClNO$, $[M+H]^+$ *m/z* 372.1155, Found 372.1157.



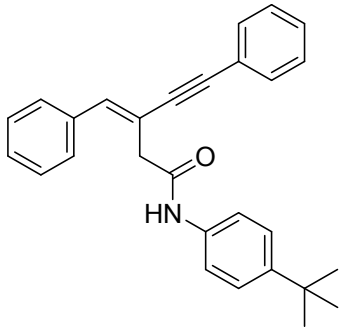
(*E*)-3-benzylidene-*N*-(4-bromophenyl)-5-phenylpent-4-ynamide 4d

White solid. mp: 1704-175 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 3.57 (s, 2H), 7.24 (s, 1H), 7.32-7.36 (m, 4H), 7.39-7.42 (m, 8H), 7.46-7.48 (m, 2H), 7.84 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 41.4, 90.9, 91.0, 116.3, 117.1, 121.5, 122.4, 128.4, 128.5, 128.8, 128.8, 128.9, 131.6, 132.0, 135.2, 136.8, 140.4, 167.7. HRMS (ESI-TOF). Calcd for $C_{24}H_{19}BrNO$, $[M+H]^+$ *m/z* 416.0650, Found 416.0647.



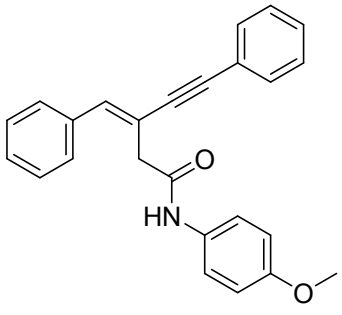
(*E*)-3-benzylidene-*N*-(4-ethylphenyl)-5-phenylpent-4-ynamide 4e

White solid. mp: 132-133 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.20 (t, J = 7.6 Hz, 3H), 2.60 (q, J = 7.6 Hz, 1H), 3.56 (s, 2H), 7.13 (d, J = 8.0 Hz, 2H), 7.23 (s, 1H), 7.29-7.34 (m, 4H), 7.36-7.44 (m, 6H), 7.46-7.48 (m, 2H), 7.83 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 15.6, 28.3, 41.3, 90.8, 91.1, 116.7, 120.2, 122.5, 128.3, 128.4, 128.6, 128.7, 128.9, 131.6, 135.3, 135.3, 140.1, 140.6, 167.5. HRMS (ESI-TOF). Calcd for $C_{26}H_{24}NO$, $[M+H]^+$ *m/z* 366.1858, Found 366.1861.



(*E*)-3-benzylidene-*N*-(4-(*tert*-butyl)phenyl)-5-phenylpent-4-ynamide 4f

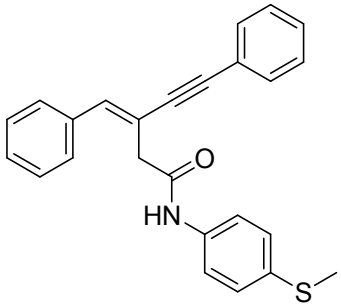
White solid. mp: 140 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.29 (s, 9H), 3.56 (s, 2H), 7.23 (s, 1H), 7.29-7.34 (m, 6H), 7.36-7.49 (m, 8H), 7.83 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 31.3, 34.3, 41.4, 90.8, 91.1, 116.8, 119.9, 122.5, 125.8, 128.3, 128.4, 128.6, 128.7, 128.9, 131.6, 135.1, 135.3, 140.1, 147.5, 167.5. HRMS (ESI-TOF). Calcd for $C_{28}H_{28}NO$, $[M+H]^+$ *m/z* 394.2171, Found 394.2176.



(*E*)-3-benzylidene-*N*-(4-methoxyphenyl)-5-phenylpent-4-ynamide 4g

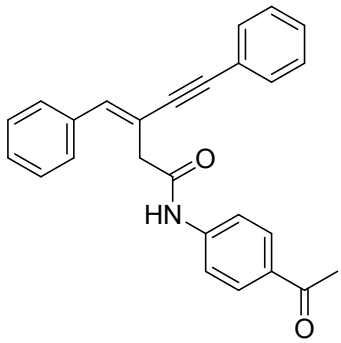
White solid. mp: 160-161 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 3.57 (s, 2H), 3.78 (s, 3H), 6.85 (d, J = 8.4 Hz, 2H), 7.24 (s, 1H), 7.34-7.49 (m, 12H), 7.71 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 41.3, 55.5, 90.9, 91.1, 114.2, 116.8, 122.0, 122.6, 128.4, 128.5, 128.7, 128.7, 128.9, 130.8, 131.6,

135.3, 140.2, 156.6, 167.5. HRMS (ESI-TOF). Calcd for $C_{25}H_{22}NO_2$, $[M+H]^+$ *m/z* 368.1651, Found 368.1653.



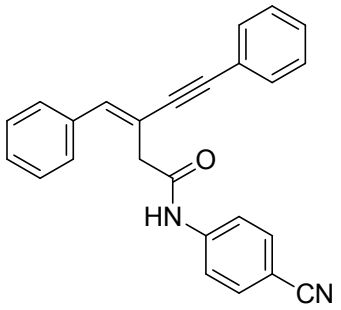
(*E*)-3-benzylidene-*N*-(4-(methylthio)phenyl)-5-phenylpent-4-ynamide 4h

White solid. mp: 162-163 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.45 (s, 3H), 3.56 (s, 2H), 7.21-7.25 (m, 3H), 7.32-7.48 (m, 12H), 7.80 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 16.7, 41.4, 91.0, 91.0, 116.5, 120.6, 122.5, 128.0, 128.4, 128.5, 128.7, 128.9, 131.6, 133.9, 135.2, 135.4, 140.3, 167.6. HRMS (ESI-TOF). Calcd for $C_{25}H_{22}NOS$, $[M+H]^+$ *m/z* 384.1422, Found 384.1425.



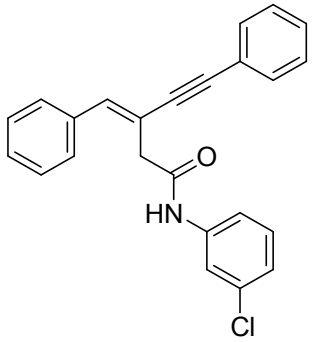
(*E*)-*N*-(4-acetylphenyl)-3-benzylidene-5-phenylpent-4-ynamide 4i

White solid. mp: 182-183 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.57 (s, 3H), 3.60 (s, 2H), 7.26 (s, 1H), 7.34-7.49 (m, 10H), 7.62 (d, *J* = 8.0 Hz, 2H), 7.93 (d, *J* = 7.6 Hz, 2H), 8.02 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 26.4, 41.5, 90.9, 91.2, 116.2, 119.0, 122.3, 128.5, 128.6, 128.8, 128.9, 129.8, 131.6, 133.1, 135.1, 140.5, 142.0, 167.9, 196.8. HRMS (ESI-TOF). Calcd for $C_{26}H_{22}NO_2$, $[M+H]^+$ *m/z* 380.1651, Found 380.1655.



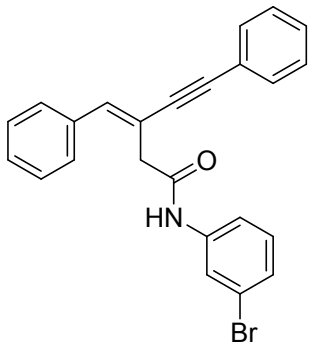
(*E*)-3-benzylidene-*N*-(4-cyanophenyl)-5-phenylpent-4-ynamide 4j

White solid. mp: 177-178 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 3.60 (s, 2H), 7.25 (s, 1H), 7.31-7.47 (m, 10H), 7.58 (d, J = 8.4 Hz, 2H), 7.65 (d, J = 8.0 Hz, 2H), 8.08 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 41.4, 90.7, 91.2, 107.3, 115.9, 118.7, 119.6, 122.2, 128.5, 128.6, 128.8, 128.8, 128.9, 131.6, 133.3, 135.1, 140.6, 141.7, 168.1. HRMS (ESI-TOF). Calcd for $C_{25}H_{19}N_2O$, $[M+H]^+$ *m/z* 363.1497, Found 363.1504.



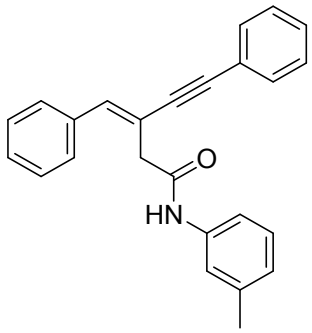
(*E*)-3-benzylidene-*N*-(3-chlorophenyl)-5-phenylpent-4-ynamide 4k

White solid. mp: 140 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 3.57 (s, 2H), 7.08 (d, J = 7.6 Hz, 1H), 7.19-7.24 (m, 2H), 7.32-7.39 (m, 9H), 7.47 (t, J = 3.6 Hz, 2H), 7.66 (s, 1H), 7.85 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 41.4, 90.9, 91.1, 116.4, 117.9, 120.1, 122.4, 124.5, 128.4, 128.5, 128.8, 128.8, 128.8, 130.0, 131.6, 134.7, 135.2, 138.9, 140.4, 167.7. HRMS (ESI-TOF). Calcd for $C_{24}H_{19}ClNO$, $[M+H]^+$ *m/z* 372.1155, Found 372.1145.



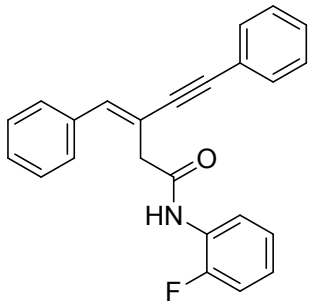
(*E*)-3-benzylidene-*N*-(3-bromophenyl)-5-phenylpent-4-ynamide 4l

White solid. mp: 110-112 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 3.55 (s, 2H), 7.11 (t, J = 8.0 Hz, 1H), 7.21 (d, J = 9.6 Hz, 2H), 7.29-7.40 (m, 9H), 7.44-7.46 (m, 2H), 7.80 (s, 1H), 7.98 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 41.1, 90.8, 90.9, 116.5, 118.4, 122.4, 122.5, 122.9, 127.3, 128.3, 128.4, 128.6, 128.7, 130.1, 131.5, 135.2, 139.0, 140.1, 168.0. HRMS (ESI-TOF). Calcd for $C_{24}H_{19}BrNO$, $[M+H]^+$ *m/z* 416.0650, Found 416.0646.



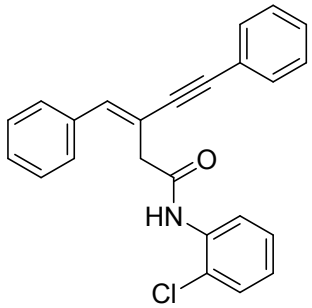
(*E*)-3-benzylidene-5-phenyl-*N*-(*m*-tolyl)pent-4-ynamide 4m

White solid. mp: 106-108 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.30 (s, 3H), 3.55 (s, 2H), 6.91 (d, J = 7.2 Hz, 1H), 7.18 (t, J = 8.0 Hz, 1H), 7.23 (s, 1H), 7.28-7.33 (m, 5H), 7.36-7.40 (m, 5H), 7.47 (d, J = 3.2 Hz, 2H), 7.83 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 21.4, 41.4, 90.9, 91.1, 116.7, 117.1, 120.7, 122.5, 125.3, 128.3, 128.4, 128.6, 128.7, 128.8, 128.9, 131.6, 135.3, 137.7, 138.9, 140.1, 167.6. HRMS (ESI-TOF). Calcd for $C_{25}H_{22}NO$, $[M+H]^+$ *m/z* 352.1701, Found 352.1710.



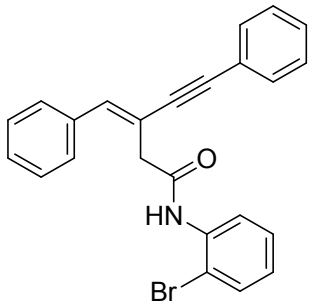
(*E*)-3-benzylidene-*N*-(2-fluorophenyl)-5-phenylpent-4-ynamide 4n

White solid. mp: 132-133 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 3.60 (s, 2H), 7.04-7.09 (m, 2H), 7.12-7.16 (m, 1H), 7.31-7.35 (m, 4H), 7.39-7.44 (m, 4H), 7.49-7.51 (m, 2H), 8.14 (s, 1H), 8.38 (t, J = 8.0 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 41.6, 90.7, 91.0, 114.8 (d, J_{C-F} = 19.0 Hz), 116.4, 121.8, 122.5, 124.4 (d, J_{C-F} = 8.0 Hz), 124.6 (d, J_{C-F} = 4.0 Hz), 126.4 (d, J_{C-F} = 10.0 Hz), 128.4, 128.5 (d, J_{C-F} = 31.0 Hz), 128.7, 128.9, 131.7, 135.3, 140.3, 152.5 (d, J_{C-F} = 242.0 Hz), 167.7. HRMS (ESI-TOF). Calcd for $C_{24}H_{19}FNO$, $[M+H]^+$ *m/z* 356.1451, Found 356.1461.



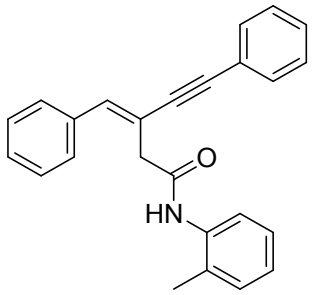
(*E*)-3-benzylidene-*N*-(2-chlorophenyl)-5-phenylpent-4-ynamide 4o

White solid. mp: 140-141 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 3.63 (s, 2H), 7.01-7.05 (m, 1H), 7.25-7.34 (m, 7H), 7.38-7.42 (m, 4H), 7.48-7.50 (m, 2H), 8.41 (s, 1H), 8.45 (d, J = 8.4 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 41.8, 91.0, 91.0, 116.4, 121.7, 122.7, 123.0, 124.8, 127.7, 128.4, 128.6, 128.7, 128.9, 129.0, 131.7, 134.7, 135.3, 140.4, 167.8. HRMS (ESI-TOF). Calcd for $C_{24}H_{19}ClNO$, $[M+H]^+$ *m/z* 372.1155, Found 372.1157.



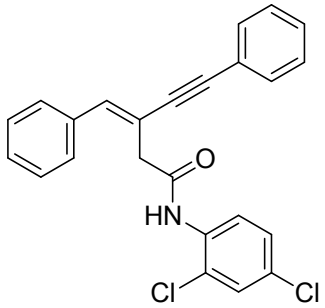
(*E*)-3-benzylidene-*N*-(2-bromophenyl)-5-phenylpent-4-ynamide 4p

White solid. mp: 140-141 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 3.63 (s, 2H), 6.95-6.99 (m, 1H), 7.29-7.34 (m, 6H), 7.38-7.42 (m, 4H), 7.48-7.51 (m, 3H), 8.36 (s, 1H), 8.43 (d, J = 8.0 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 41.9, 91.0, 91.1, 113.6, 116.4, 122.0, 122.7, 125.3, 128.3, 128.4, 128.6, 128.7, 128.9, 131.7, 132.3, 135.3, 135.8, 140.5, 167.8. HRMS (ESI-TOF). Calcd for $C_{24}H_{19}BrNO$, $[M+H]^+$ *m/z* 416.0650, Found 416.0644.



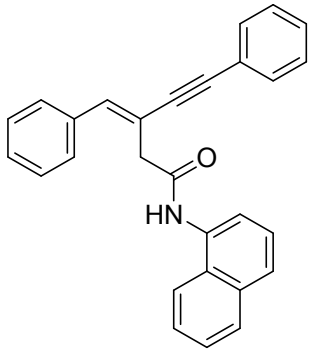
(*E*)-3-benzylidene-5-phenyl-*N*-(*o*-tolyl)pent-4-ynamide 4q

White solid. mp: 170-171 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.21 (s, 3H), 3.63 (s, 2H), 7.06 (t, J = 7.6 Hz, 1H), 7.14 (d, J = 7.2 Hz, 1H), 7.20-7.25 (m, 2H), 7.34-7.35 (m, 4H), 7.38-7.48 (m, 6H), 7.77 (s, 1H), 7.93 (d, J = 8.0 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 17.6, 41.5, 90.8, 91.3, 116.7, 122.5, 122.8, 125.2, 126.8, 128.4, 128.5, 128.7, 128.9, 128.9, 130.4, 131.6, 135.2, 135.7, 140.3, 167.6. HRMS (ESI-TOF). Calcd for $C_{25}H_{22}NO$, $[M+H]^+$ *m/z* 352.1701, Found 352.1698.



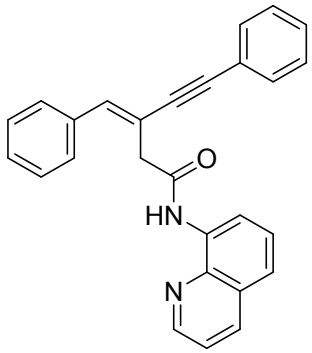
(*E*)-3-benzylidene-*N*-(2,4-dichlorophenyl)-5-phenylpent-4-ynamide 4r

White solid. mp: 130-131 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 3.62 (s, 2H), 7.25-7.41 (m, 11H), 7.48 (d, J = 3.6 Hz, 2H), 8.37 (s, 1H), 8.43 (d, J = 9.2 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 41.8, 90.9, 91.1, 116.2, 122.4, 122.6, 123.5, 127.8, 128.4, 128.4, 128.7, 128.8, 128.9, 129.2, 131.7, 132.5, 133.5, 135.2, 140.5, 167.8. HRMS (ESI-TOF). Calcd for $C_{24}H_{18}Cl_2NO$, $[M+H]^+$ *m/z* 406.0765, Found 406.0771.



(*E*)-3-benzylidene-*N*-(naphthalen-1-yl)-5-phenylpent-4-ynamide 4s

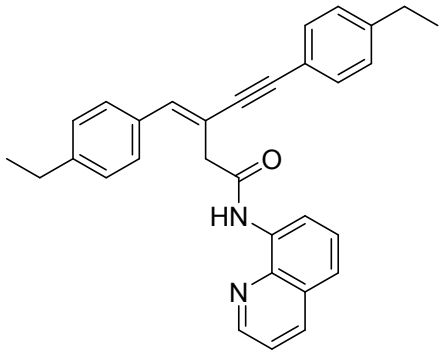
White solid. mp: 160 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 3.73 (s, 2H), 7.19 (t, J = 7.6 Hz, 1H), 7.33-7.49 (m, 11H), 7.50 (d, J = 3.6 Hz, 2H), 7.68 (d, J = 8.0 Hz, 1H), 7.83 (d, J = 8.4 Hz, 1H), 7.91 (d, J = 8.4 Hz, 1H), 8.06 (d, J = 7.2 Hz, 1H), 8.36 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 41.6, 91.2, 91.5, 116.6, 120.6, 122.5, 125.7, 125.9, 126.3, 127.0, 128.5, 128.5, 128.7, 128.8, 128.8, 129.0, 131.8, 132.2, 134.1, 135.2, 140.6, 168.1. HRMS (ESI-TOF). Calcd for $C_{28}H_{22}NO$, $[M+H]^+$ *m/z* 388.1701, Found 388.1693.



(*E*)-3-benzylidene-5-phenyl-*N*-(quinolin-8-yl)pent-4-ynamide 4t

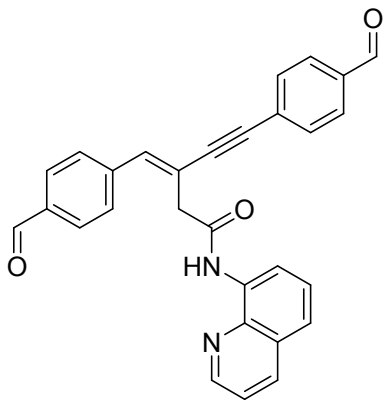
White solid. mp: 88-90 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 3.72 (s, 2H), 7.29-7.37 (m, 6H), 7.41 (t, J = 7.6 Hz, 2H), 7.49-7.56 (m, 6H), 8.10-8.12 (m, 1H), 8.46-8.47 (m, 1H), 8.86 (d, J = 7.2 Hz,

1H), 10.48 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 42.1, 90.7, 91.3, 116.6, 117.0, 121.4, 121.6, 123.0, 127.2, 127.8, 128.0, 128.2, 128.3, 128.5, 128.9, 131.7, 134.6, 135.5, 136.0, 138.5, 139.7, 148.1, 168.2. HRMS (ESI-TOF). Calcd for $C_{27}H_{21}N_2O$, $[M+H]^+$ *m/z* 389.1654, Found 389.1646.



(*E*)-3-(4-ethylbenzylidene)-5-(4-ethylphenyl)-*N*-(quinolin-8-yl)pent-4-ynamide 4u

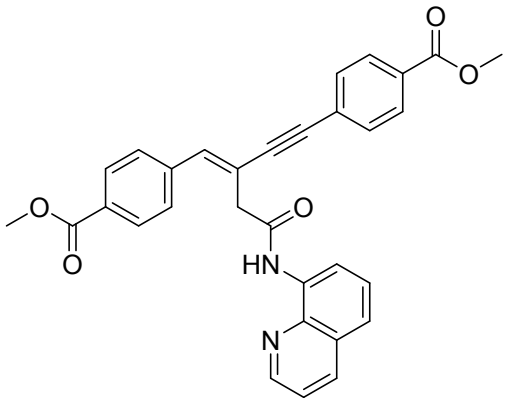
White solid. mp: 170-171 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 1.21-1.26 (m, 6H), 2.61-2.68 (m, 4H), 3.72 (s, 2H), 7.12 (d, J = 8.0 Hz, 2H), 7.22-7.25 (m, 3H), 7.34-7.37 (m, 1H), 7.41-7.45 (m, 4H), 7.48-7.56 (m, 2H), 8.10-8.12 (m, 1H), 8.47 (dd, J_1 = 1.2 Hz, J_2 = 4.4 Hz, 1H), 8.85 (d, J = 7.6 Hz, 1H), 10.49 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 15.4, 15.4, 28.7, 28.8, 42.2, 90.7, 90.9, 116.4, 116.7, 120.4, 121.5, 121.6, 127.3, 127.8, 127.9, 128.1, 129.0, 131.8, 133.2, 134.7, 136.1, 138.7, 139.5, 144.3, 144.7, 148.2, 168.5. HRMS (ESI-TOF). Calcd for $C_{31}H_{29}N_2O$, $[M+H]^+$ *m/z* 445.2280, Found 445.2283.



(*E*)-3-(4-formylbenzylidene)-5-(4-formylphenyl)-*N*-(quinolin-8-yl)pent-4-ynamide 4v

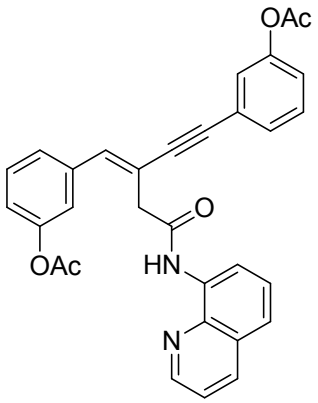
White solid. mp: 173-174 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 3.73 (s, 2H), 7.06 (s, 1H), 7.42 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 1H), 7.52-7.61 (m, 4H), 7.82 (d, J = 7.2 Hz, 2H), 7.93 (d, J = 7.6 Hz, 2H), 8.06 (d, J = 8.0 Hz, 2H), 8.17 (d, J = 8.0 Hz, 1H), 8.58 (d, J = 4.0 Hz, 1H), 8.81 (d, J = 7.2 Hz,

1H), 10.01 (s, 1H), 10.03 (s, 1H), 10.36 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 48.4, 91.9, 96.8, 116.9, 117.9, 121.6, 121.9, 127.5, 128.0, 128.6, 129.2, 129.5, 129.7, 132.3, 134.2, 135.8, 135.9, 136.6, 138.2, 138.3, 141.7, 148.0, 167.4, 191.2, 191.6. HRMS (ESI-TOF). Calcd for $C_{29}H_{21}N_2O_3$, $[M+H]^+$ *m/z* 445.1552, Found 445.1561.



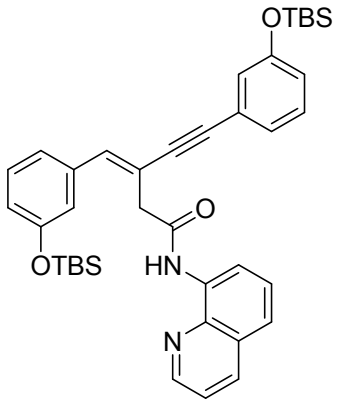
(*E*)-dimethyl 4,4'-(2-(2-oxo-2-(quinolin-8-ylamino)ethyl)but-1-en-3-yne-1,4-diyl)dibenzoate 4w

White solid. mp: 165-166 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 3.69 (s, 2H), 3.92 (s, 3H), 3.93 (s, 3H), 7.01 (s, 1H), 7.39 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 1H), 7.49-7.56 (m, 4H), 7.97 (d, J = 8.4 Hz, 4H), 8.07 (d, J = 8.0 Hz, 2H), 8.13 (d, J = 8.4 Hz, 1H), 8.54 (d, J = 4.0 Hz, 1H), 8.81 (d, J = 7.2 Hz, 1H), 10.37 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 48.4, 52.1, 52.2, 91.1, 96.7, 116.7, 117.1, 121.6, 121.8, 127.2, 127.4, 127.9, 128.6, 129.5, 129.5, 129.7, 130.0, 131.6, 134.3, 136.4, 138.1, 138.4, 140.3, 148.0, 166.3, 166.7, 167.6. HRMS (ESI-TOF). Calcd for $C_{31}H_{25}N_2O_5$, $[M+H]^+$ *m/z* 505.1763, Found 505.1764.



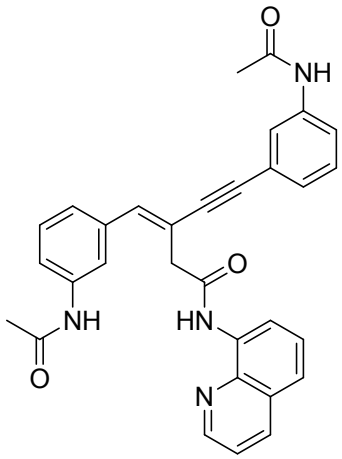
(*E*)-3-(3-acetoxybenzylidene)-5-(3-acetoxyphenyl)-*N*-(quinolin-8-yl)pent-4-ynamide 4x

Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.26 (s, 3H), 2.29 (s, 3H), 3.70 (s, 2H), 7.04 (d, J = 5.2 Hz, 2H), 7.22-7.55 (m, 10H), 8.11 (d, J = 8.4 Hz, 1H), 8.52 (d, J = 4.4 Hz, 1H), 8.83 (d, J = 7.2 Hz, 1H), 10.40 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 21.0, 21.1, 41.9, 90.0, 91.7, 116.7, 117.9, 121.4, 121.5, 121.7, 122.0, 122.0, 124.3, 124.8, 126.4, 127.3, 127.9, 129.2, 129.2, 129.5, 134.5, 136.2, 136.9, 138.4, 138.9, 148.2, 150.4, 150.7, 167.8, 169.0, 169.3. HRMS (ESI-TOF). Calcd for $C_{31}H_{25}N_2O_5$, $[M+H]^+$ *m/z* 505.1763, Found 505.1752.



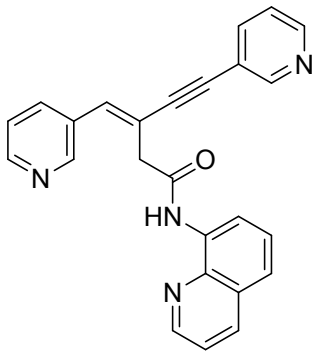
(*E*)-3-(3-((*tert*-butyldimethylsilyl)oxy)benzylidene)-5-(3-((*tert*-butyldimethylsilyl)oxy)phenyl)-*N*-(quinolin-8-yl)pent-4-ynamide 4y

Colorless oil. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 0.15 (s, 6H), 0.18 (s, 6H), 0.95 (s, 18H), 3.73 (s, 2H), 6.79 (d, J = 8.0 Hz, 2H), 6.97 (s, 2H), 7.08-7.15 (m, 3H), 7.24-7.28 (m, 2H), 7.35 (dd, J_1 = 4.0 Hz, J_2 = 8.0 Hz, 1H), 7.47-7.55 (m, 2H), 8.10 (d, J = 8.0 Hz, 1H), 8.54 (d, J = 4.0 Hz, 1H), 8.85 (d, J = 7.6 Hz, 1H), 10.43 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = -4.5, -4.5, 18.1, 18.1, 25.6, 42.0, 90.5, 91.0, 116.7, 117.2, 120.0, 120.5, 120.6, 121.5, 121.6, 122.1, 123.2, 124.1, 125.1, 127.3, 127.9, 129.2, 129.6, 134.6, 136.1, 136.9, 138.5, 139.7, 148.2, 155.4, 155.7, 168.1. HRMS (ESI-TOF). Calcd for $C_{39}H_{49}N_2O_3Si_2$, $[M+H]^+$ *m/z* 649.3282, Found 649.3276.



(*E*)-3-(3-acetamidobenzylidene)-5-(3-acetamidophenyl)-*N*-(quinolin-8-yl)pent-4-ynamide 4z

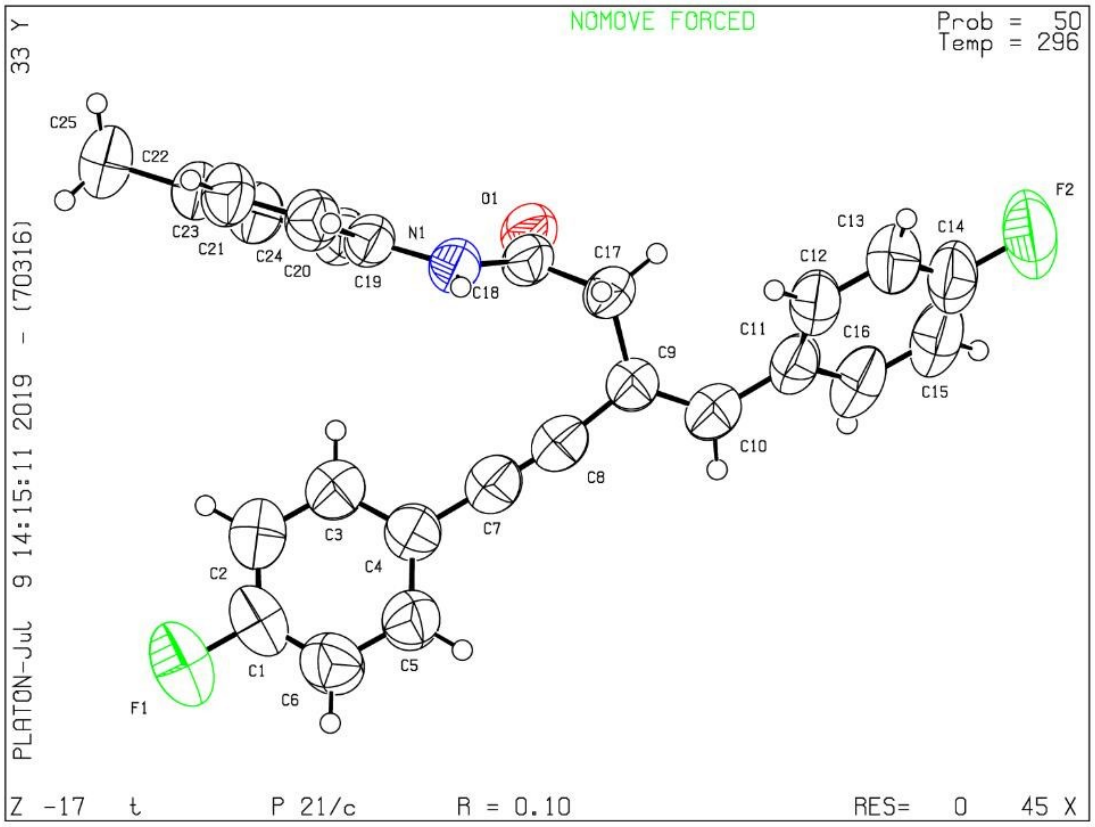
White solid. mp: 142-143 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 2.09 (s, 6H), 3.63 (s, 2H), 7.02 (s, 1H), 7.11-7.14 (m, 3H), 7.23-7.30 (m, 2H), 7.41-7.49 (m, 4H), 7.58 (d, J = 6.4 Hz, 1H), 7.65 (d, J = 7.6 Hz, 1H), 8.02 (d, J = 8.4 Hz, 1H), 8.25 (s, 1H), 8.42 (s, 1H), 8.46 (s, 1H), 8.72 (s, 1H), 10.34 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 24.4, 24.4, 41.8, 90.5, 91.2, 116.7, 117.2, 119.9, 120.0, 120.2, 121.6, 122.0, 122.8, 123.4, 124.6, 127.1, 127.4, 127.8, 128.8, 129.2, 134.2, 136.0, 136.2, 138.2, 138.3, 138.4, 139.4, 148.3, 168.5, 169.0, 169.1. HRMS (ESI-TOF). Calcd for $C_{31}H_{27}N_4O_3$, $[M+H]^+$ *m/z* 503.2083, Found 503.2094.



(*E*)-5-(pyridin-3-yl)-3-(pyridin-3-ylmethylene)-*N*-(quinolin-8-yl)pent-4-ynamide 4aa

White solid. mp: 172-173 ºC. ^{1}H NMR (400 MHz, $CDCl_3$): δ = 3.70 (s, 2H), 7.22-7.27 (m, 2H), 7.39-7.42 (m, 2H), 7.51-7.57 (m, 2H), 7.76 (d, J = 7.2 Hz, 1H), 8.08 (d, J = 8.0 Hz, 1H), 8.14 (d, J = 8.4 Hz, 1H), 8.55-8.84 (m, 6H), 10.36 (s, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ = 41.8, 88.0, 93.8, 116.7, 119.1, 119.9, 121.7, 121.9, 122.9, 123.6, 127.3, 127.9, 131.3, 134.3, 135.9, 136.3, 136.6, 138.4, 138.6, 148.2, 148.8, 149.0, 150.0, 152.4, 167.3. HRMS (ESI-TOF). Calcd for $C_{25}H_{19}N_4O$, $[M+H]^+$ *m/z* 391.1559, Found 391.1546.

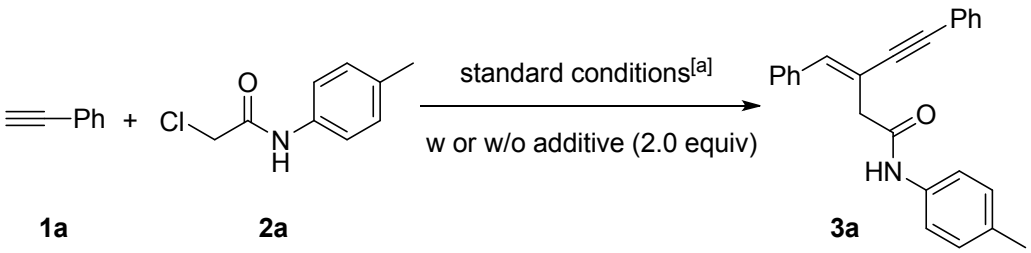
Ⅳ. Structure Analysis X-Ray Crystallography of 3b



Compound	**3b**
Empirical formula	$C_{25}H_{19}F_2NO$
Formula weight	387.41
Crystal system	Monoclinic
Space group	P 21/c
a (Å)	12.515(3)
b (Å)	8.4989(17)
c (Å)	19.132(4)
α (°)	90
β (°)	95.95(3)
γ (°)	90
V (Å3)	2024.1(7)
Z	4
D/g cm-3	1.271
μ/mm-1	0.090
F(000)	808.0
Parameters	263
R_{int}	0.0844
GOF	1.075
$wR_2{}^b$(all data)	0.3009

Ⅴ. Mechanistic Study

1. Radical Inhibition Experiments



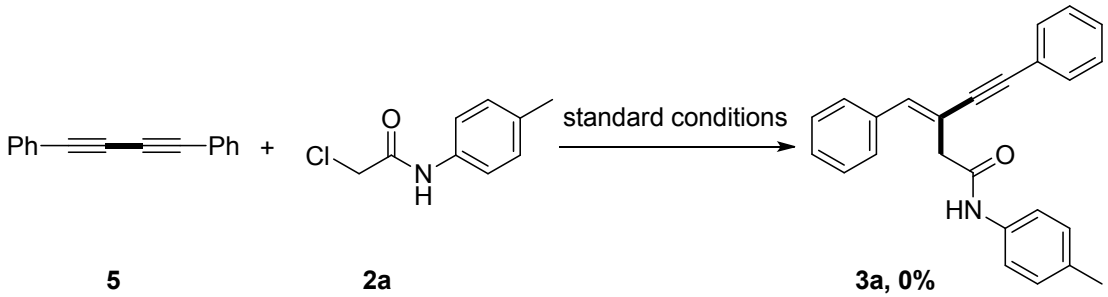
1a **2a** **3a**

Additive	Yield[b] (%)
none	80
TEMPO (2 equiv)	70
BHT (2 equiv)	68

[a] Standard conditions: **1a** (0.96 mmol), **2a** (0.4 mmol), CuI (10 mol %), Phen (10 mol %) and K_2CO_3 (2.0 equiv) in dioxane (0.8 mL) under air atmosphere at 120 °C for 1 h. [b] Yield of the isolated product.

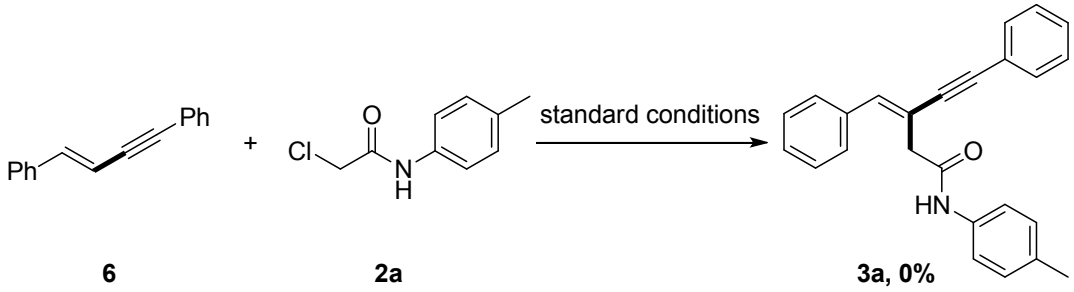
2. Control Experiment

To probe the reaction mechanism, compounds **5-8** were prepared as possible reaction intermediate that may be constructed from any two coupling partners, and reacted with another coupling partner under the standard reaction conditions. We conducted the following experiments.



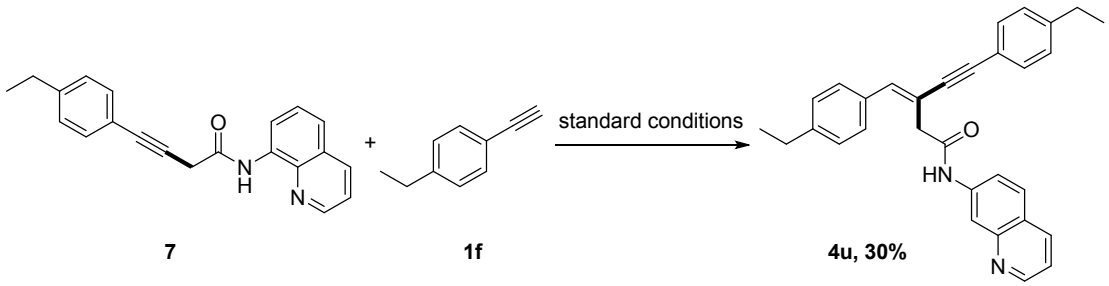
5 **2a** **3a, 0%**

Following the general procedure Ⅱ.2, to a solution of **5** (80.8 mg, 0.4 mmol) in 1,4-dioxane (0.8 mL) was added 2-chloro-*N*-(*p*-tolyl)acetamide **2a** (73.2 mg, 0.4 mmol), Phen (7.9 mg, 0.04 mmol), CuI (7.6 mg, 0.04 mmol), and K_2CO_3 (110.6 mg, 0.8 mmol) under air in screw-cap test tube. The reaction mixture was stirred at 120 °C for 1.0 h. After the reaction finished, **3a** was not detected in the reaction. This result suggested that **5** might not be the active intermediate.



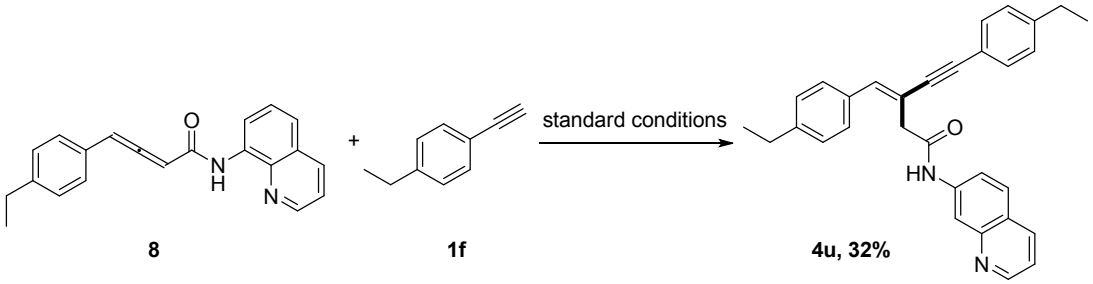
6 **2a** **3a, 0%**

Following the general procedure II.2, to a solution of **6** (81.6 mg, 0.4 mmol) in 1,4-dioxane (0.8 mL) was added 2-chloro-*N*-(*p*-tolyl)acetamide **2a** (73.2 mg, 0.4 mmol), Phen (7.9 mg, 0.04 mmol), CuI (7.6 mg, 0.04 mmol), and K_2CO_3 (110.6 mg, 0.8 mmol) under air in screw-cap test tube. The reaction mixture was stirred at 120 °C for 1.0 h. After the reaction finished, **3a** was not detected in the reaction. This result suggested that **6** might not be the active intermediate.



7 **1f** **4u, 30%**

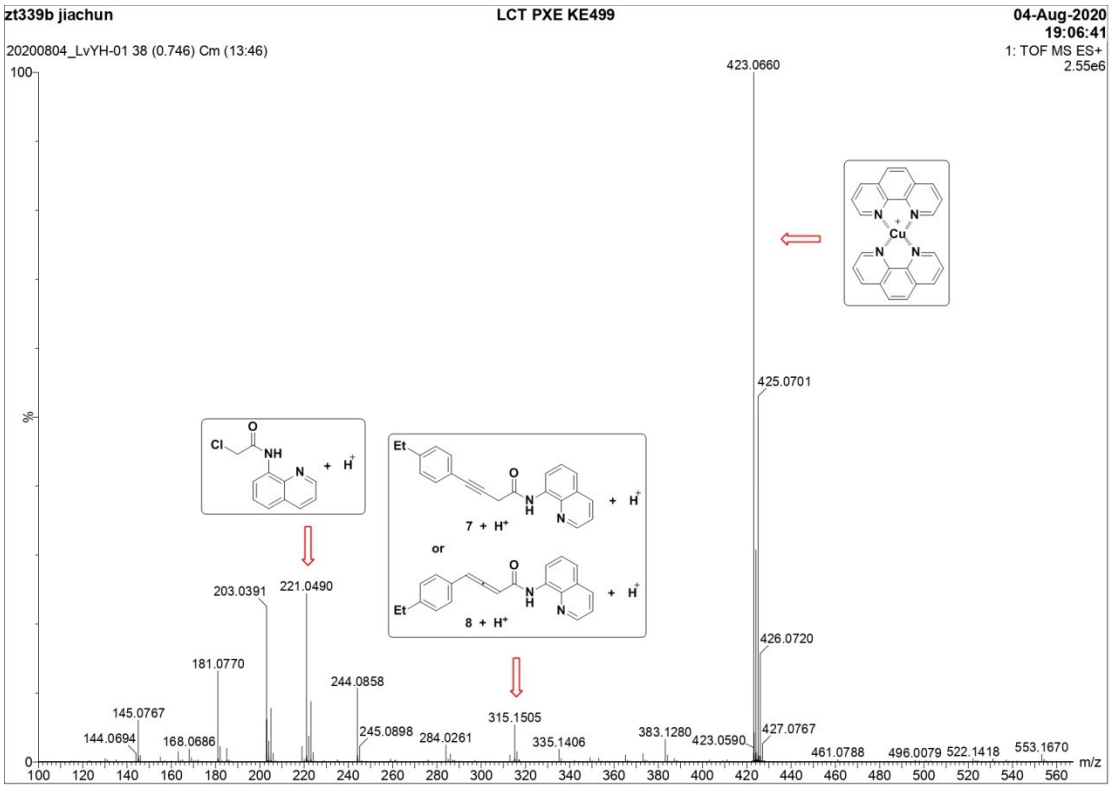
Following the general procedure II.2, to a solution of **7** (94.2 mg, 0.3 mmol) in 1,4-dioxane (0.6 mL) was added the 1-ethyl-4-ethynylbenzene **1f** (51 μL, 0.36 mmol), Phen (5.4 mg, 0.03 mmol), CuI (5.7 mg, 0.03 mmol), and K_2CO_3 (82.8 mg, 0.6 mmol) under air in screw-cap test tube. The reaction mixture was stirred at 120 °C for 1.0 h. After the reaction finished, the reaction mixture was cooled to room temperature and quenched by water. The mixture was extracted with EtOAc (3.0 mL×3), the combined organic phases were dried over anhydrous Na_2SO_4 and the solvent was evaporated under vacuum. The residue was purified by column chromatography to give the corresponding products **4u** (40.0 mg, 30%). This result also suggested that **7** might be the active intermediate.



Following the general procedure II.2, to a solution of **8** (94.2 mg, 0.3 mmol) in 1,4-dioxane (0.6 mL) was added the 1-ethyl-4-ethynylbenzene **1f** (51 μL, 0.36 mmol), Phen (5.4 mg, 0.03 mmol), CuI (5.7 mg, 0.03 mmol), and K_2CO_3 (82.8 mg, 0.6 mmol) under air in screw-cap test tube. The reaction mixture was stirred at 120 ^oC for 1.0 h. After the reaction finished, the reaction mixture was cooled to room temperature and quenched by water. The mixture was extracted with EtOAc (3.0 mL×3), the combined organic phases were dried over anhydrous Na_2SO_4 and the solvent was evaporated under vacuum. The residue was purified by column chromatography to give the corresponding products **4u** (42.5 mg, 32%). This result also suggested that **8** might be the active intermediate.

Conclusions:

When **5** and **6** were used as starting material under the standard reaction conditions, **3a** was not detected in the reaction. By the treatment 1-ethyl-4-ethynylbenzene **1f** with **7** or **8** under the standard reaction conditions, the desired product **4u** was observed. These results suggested that **7** and **8** is a highly probable reaction intermediate that can be generated in situ from 1-ethyl-4-ethynylbenzene **1f** and 2-chloro-*N*-(quinolin-8-yl)acetamide **2t** via Sonogashira reactions. Furthermore, ESI/MS experiments were performed to gain evidence for the possible intermediates **7** and **8** in the proposed mechanism. A mixture of **1f** (0.96 mmol), **2t** (0.4 mmol), CuI (10 mol %), Phen (10 mol %) and K_2CO_3 (2.0 equiv) in dioxane (0.8 mL) was reacted at 90 °C for 10 minutes and 50 μL of the mixture was used for the ESI analysis in CH_3OH. The ESI/MS analyses showed a peak at m/z 315.1505, which was identified as intermediates **7** and **8**.



Ⅵ. References

[1] J.-H. Li, Y. Liang, Y.-X. Xie, *J. Org. Chem*. **2005**, *70*, 4393.

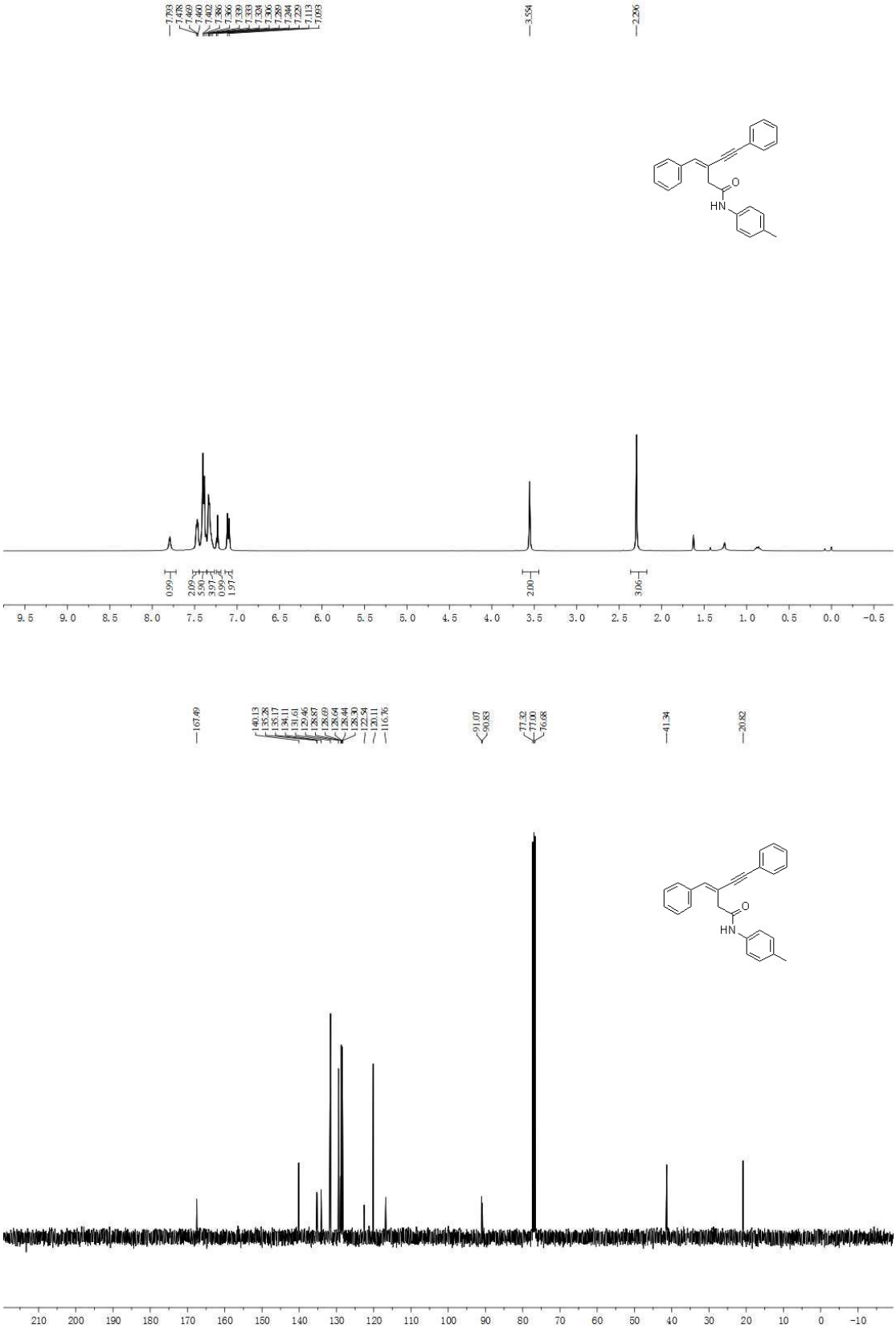
[2] Y. Liu, J. Yang, W. Bao, *Eur. J. Org. Chem.* **2009**, 5317.

[3] J. Li, D. Ding, L. Liu, J. Sun, *RSC Adv*. **2013**, *3*, 21260.

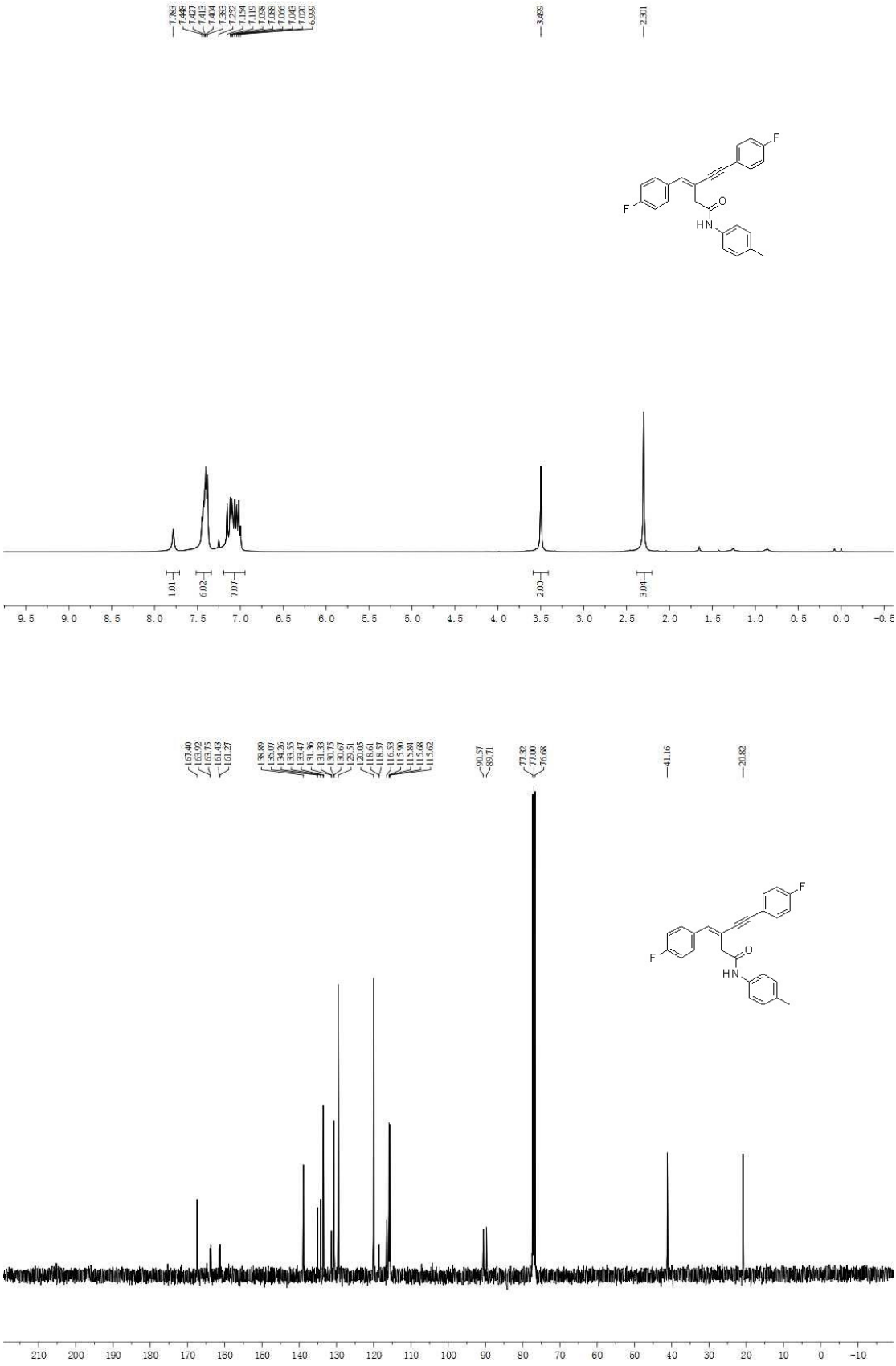
[4] Y. Lv, W. Pu, X. Zhu, T. Zhao, F. Lin, *Adv. Synth. Catal*. **2018**, *360*, 1397.

Ⅶ. ^{1}H and ^{13}C NMR Spectra of Compounds 3 and 4

Product 3a



Product 3b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7.020
6.999
3.499
2.301
F
F
O
HN
1.01
6.02
7.07
2.00
3.04
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 0.0
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161.43
161.27
138.89
135.07
134.26
133.55
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131.36
131.33
130.75
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129.51
120.05
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115.90
115.84
115.68
115.62
90.57
89.71
77.32
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O
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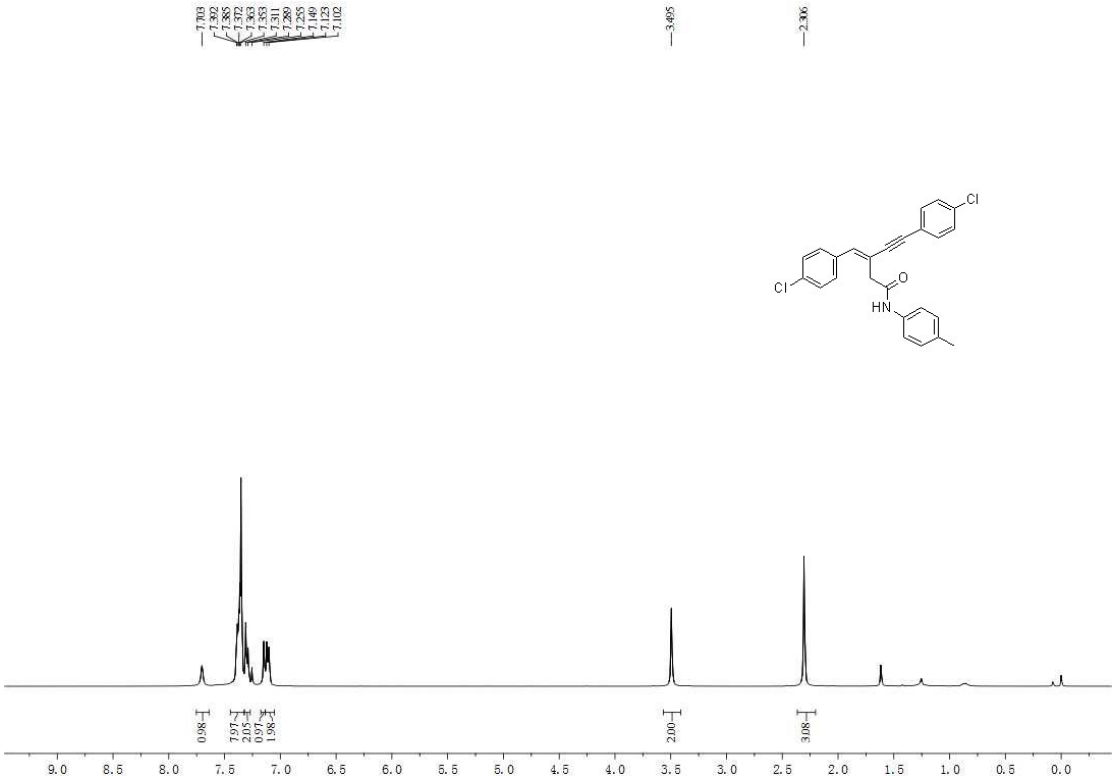
Product 3c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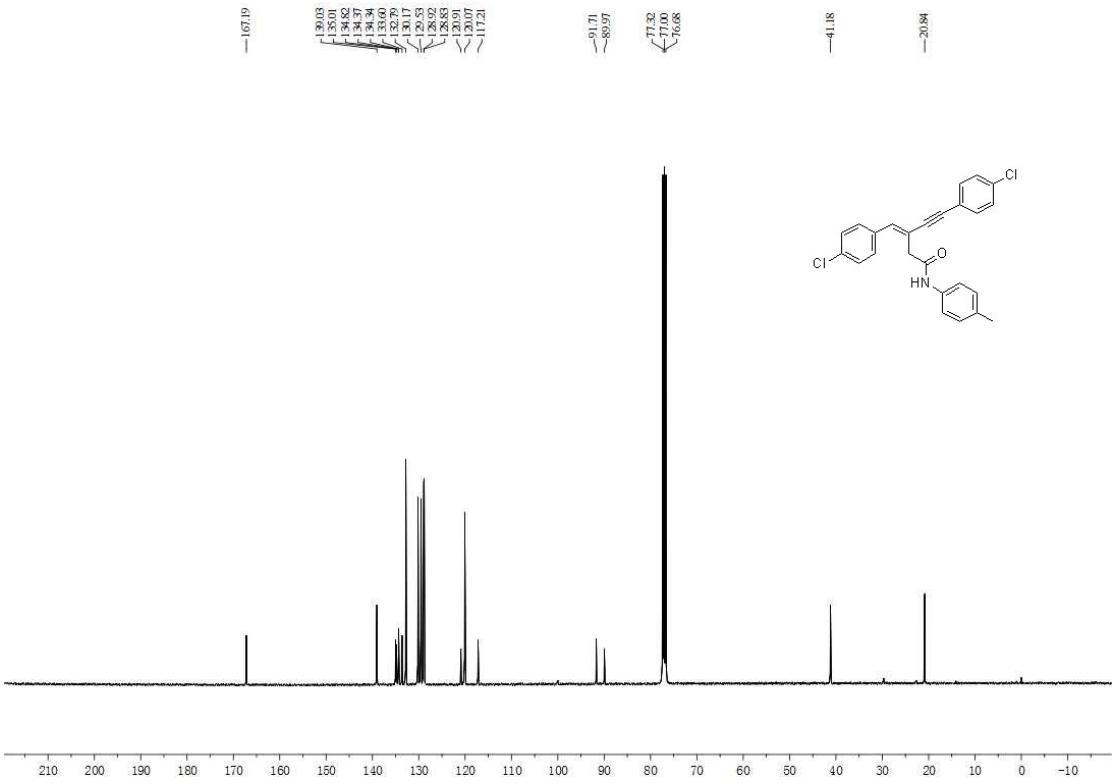
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Cl
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HN

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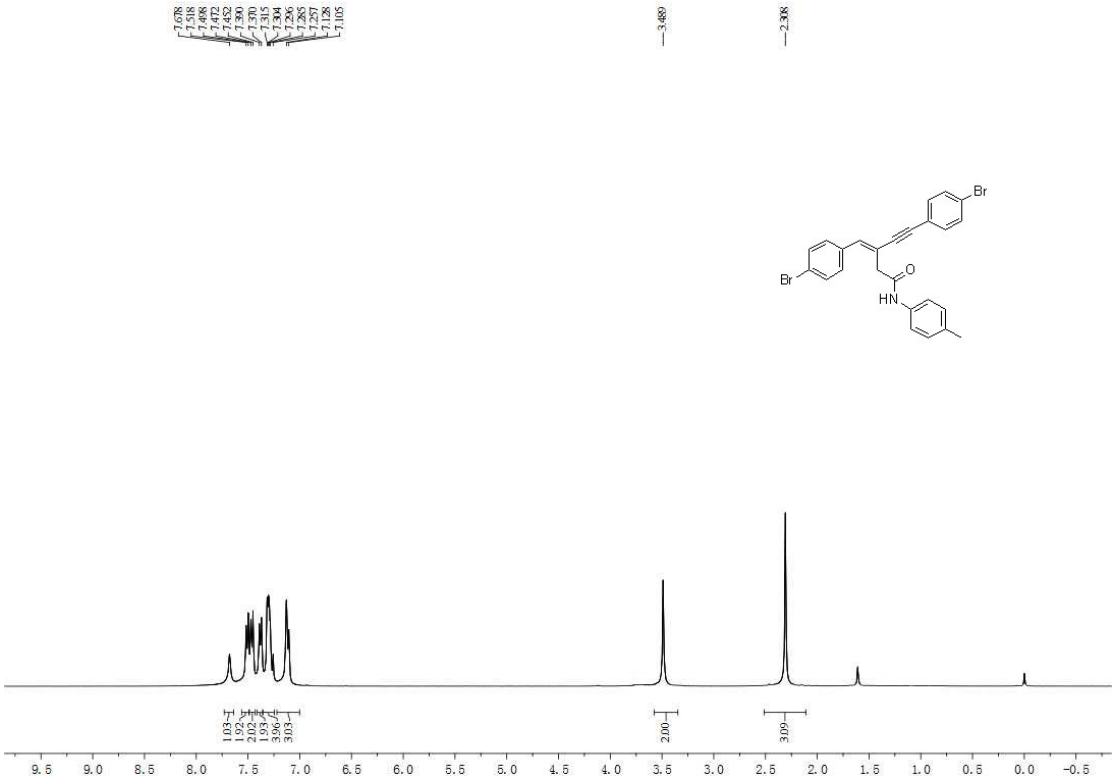
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7.105
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Br
O
HN
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1.02
2.02
1.93
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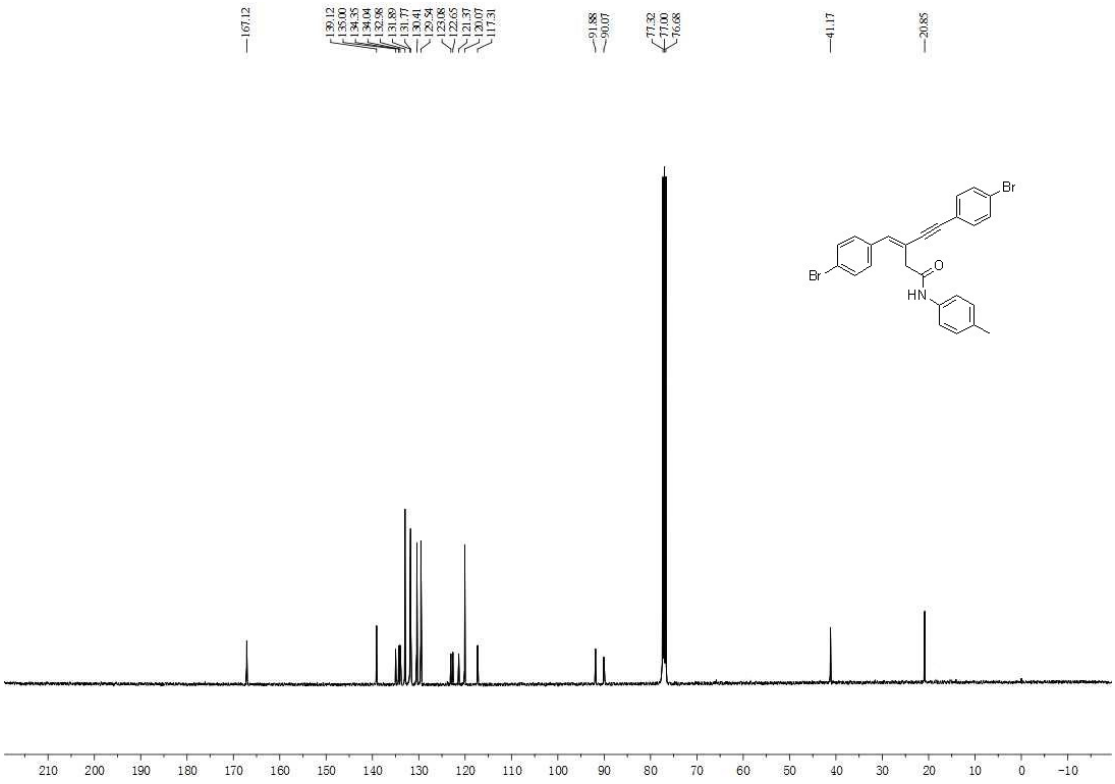
3.03
2.00
3.09
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5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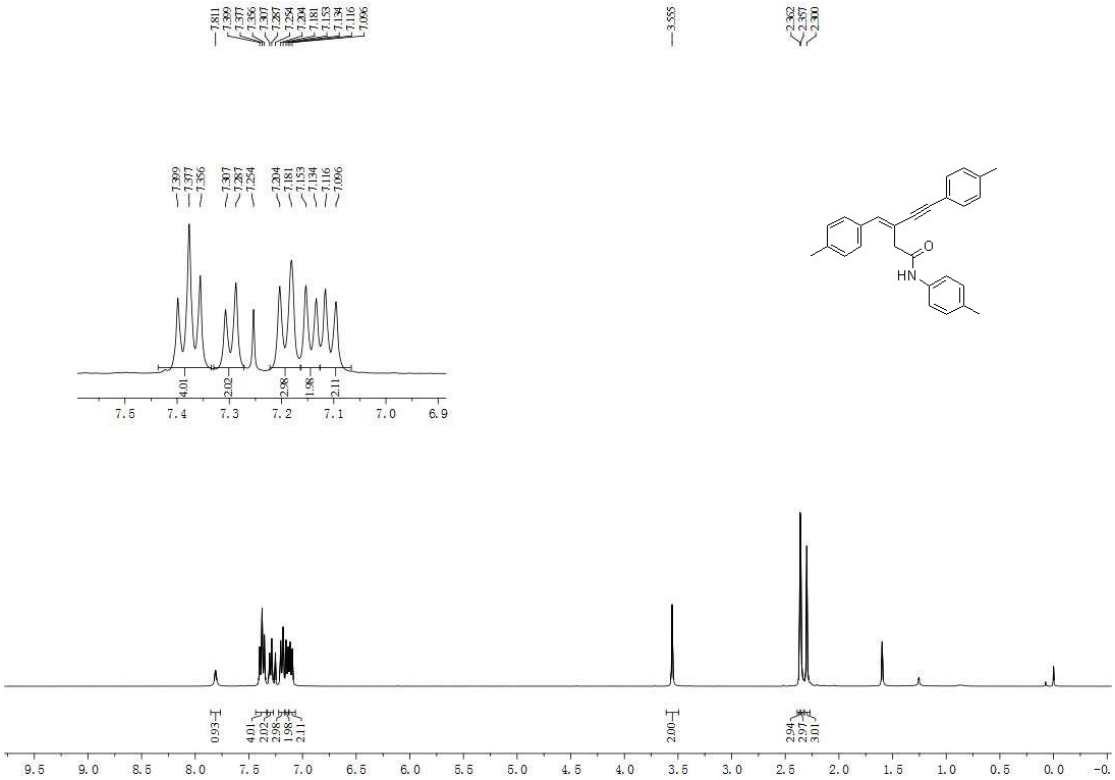
Product 3e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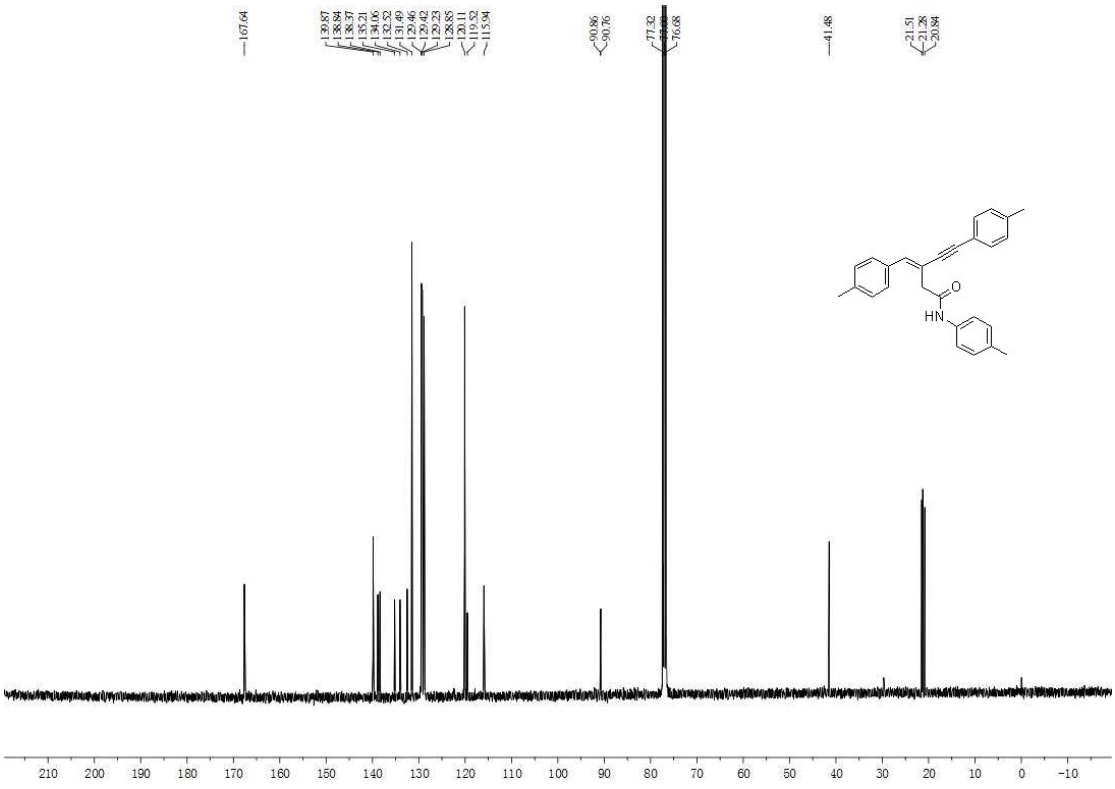
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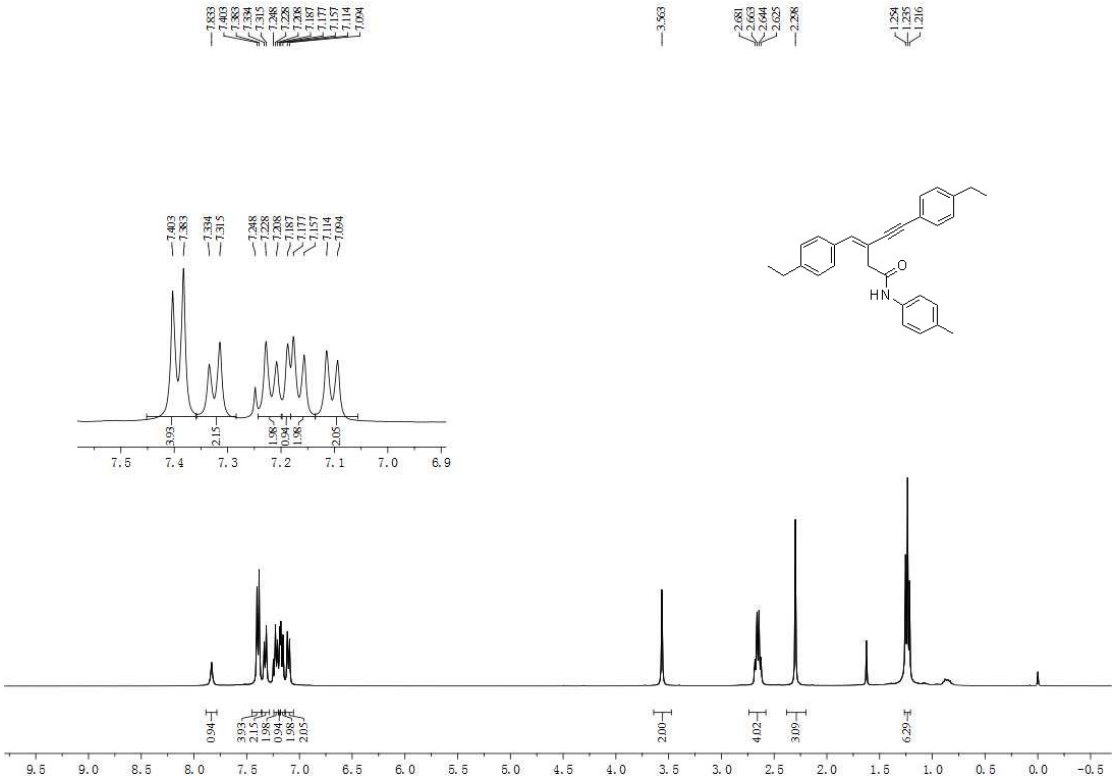
Product 3f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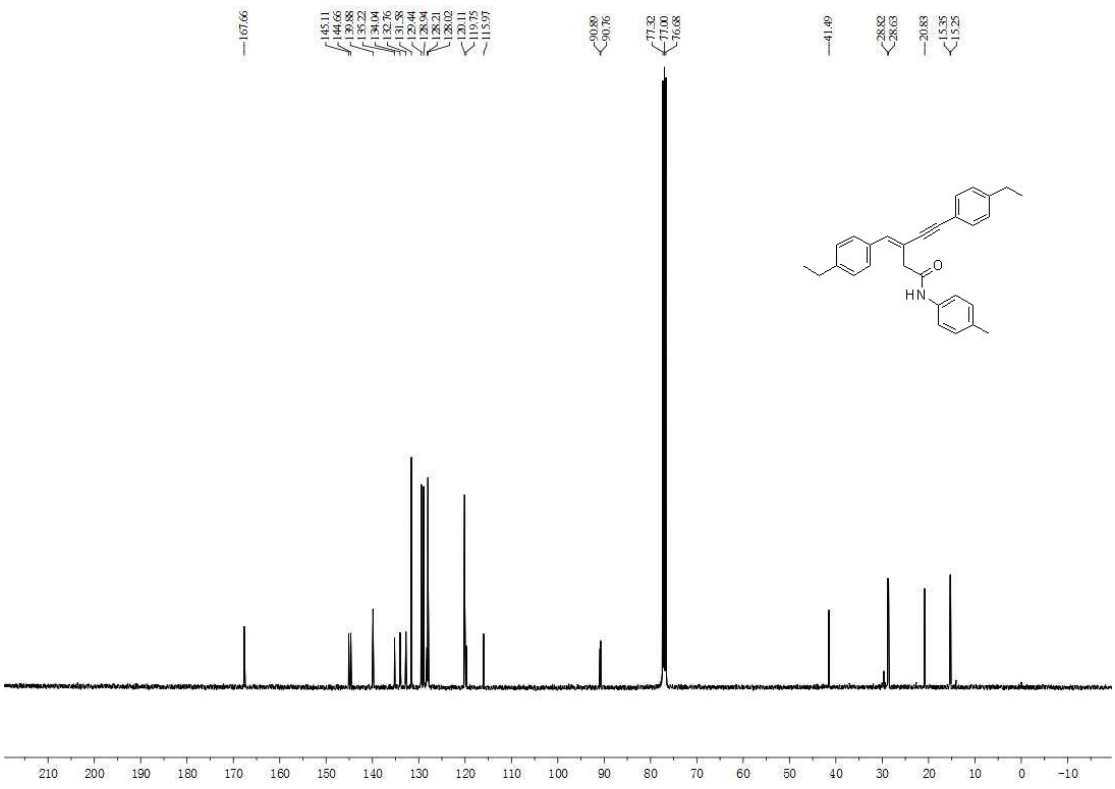
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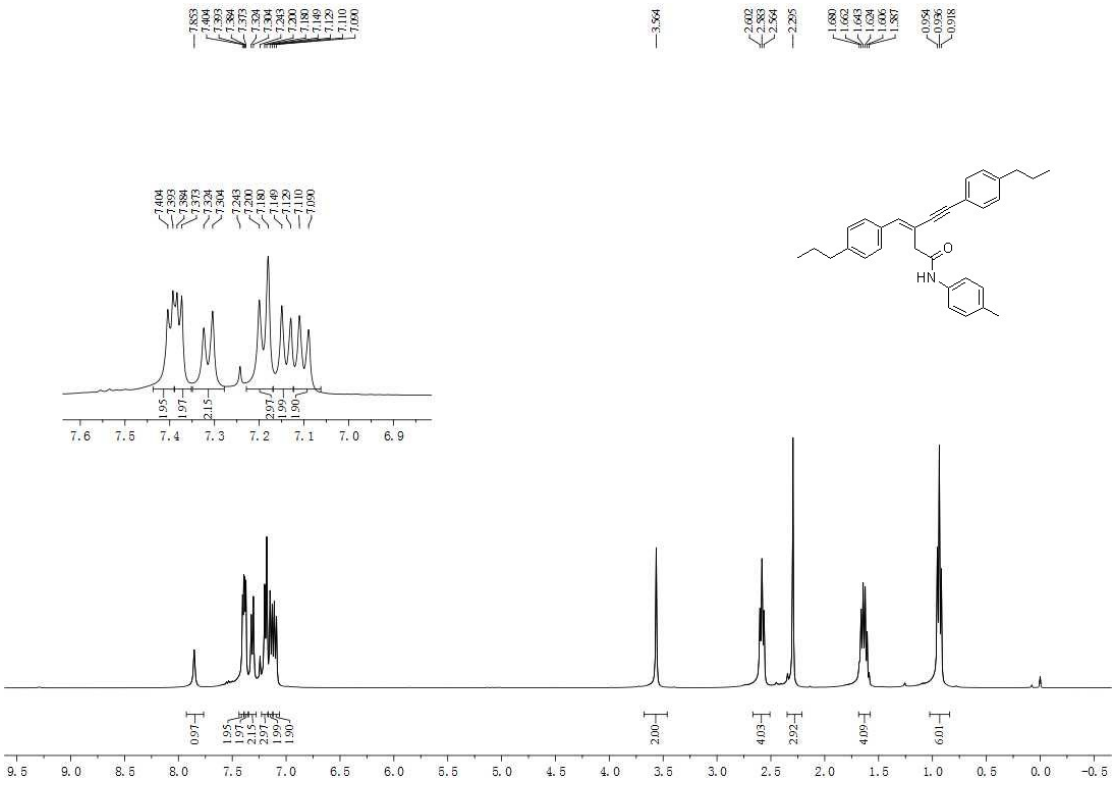
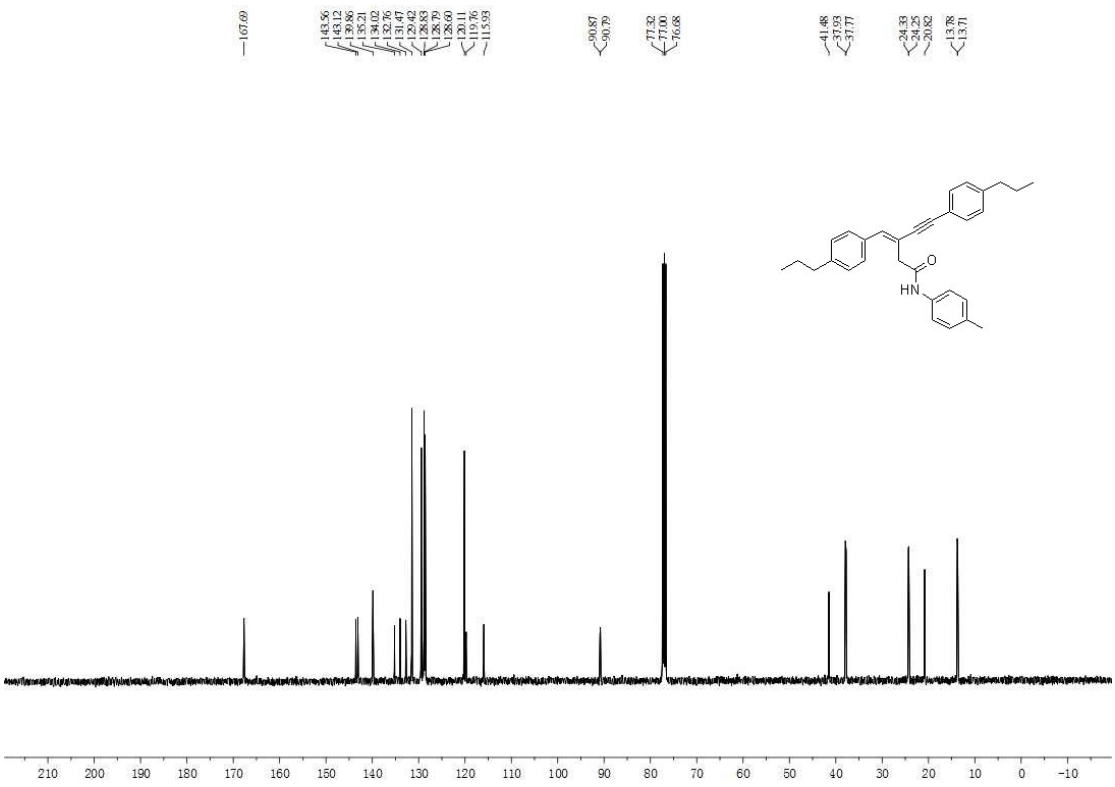
Product 3g





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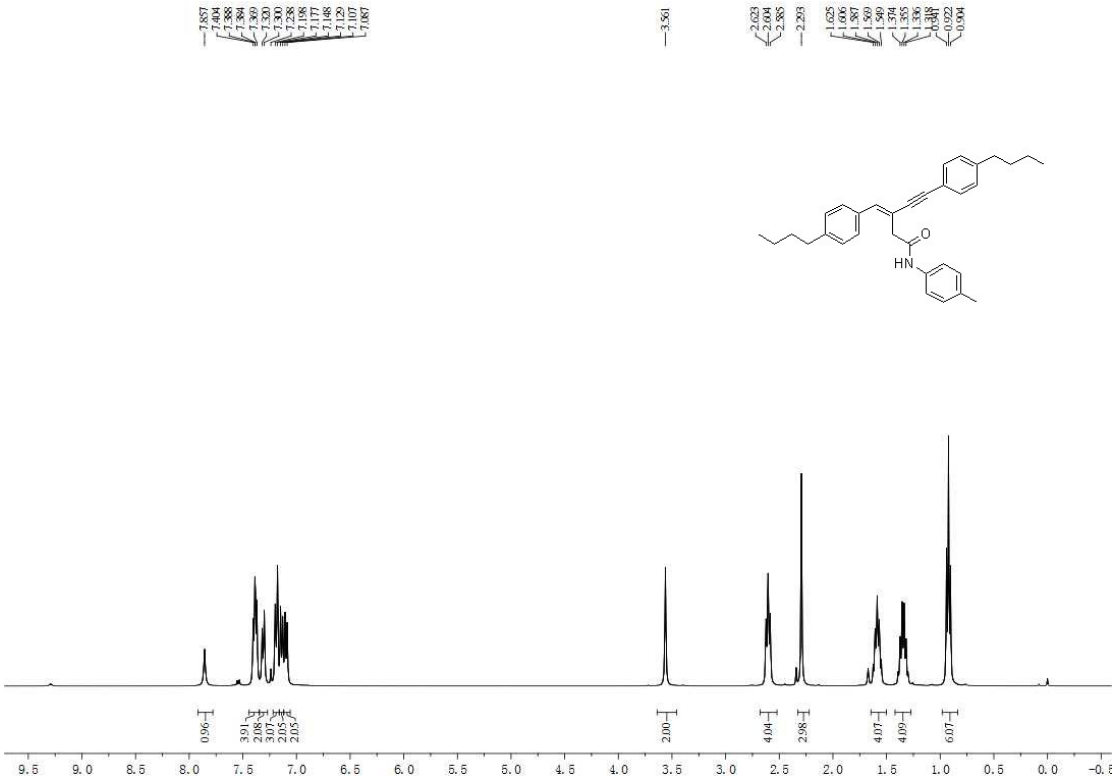
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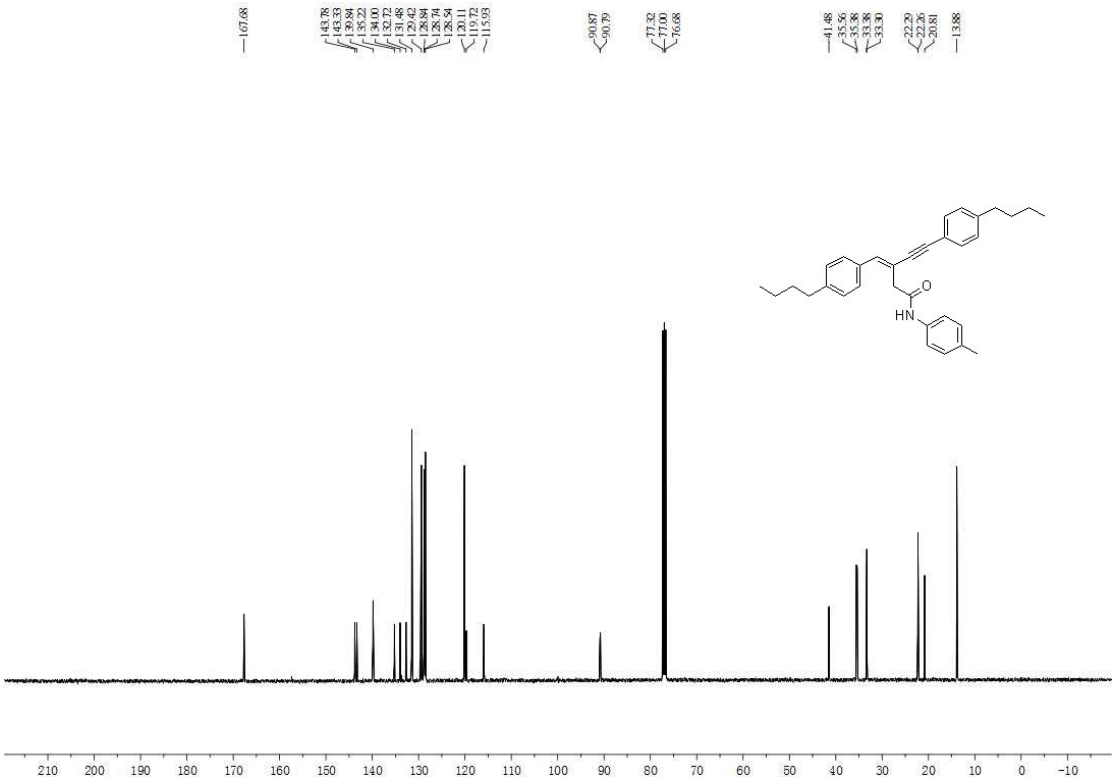
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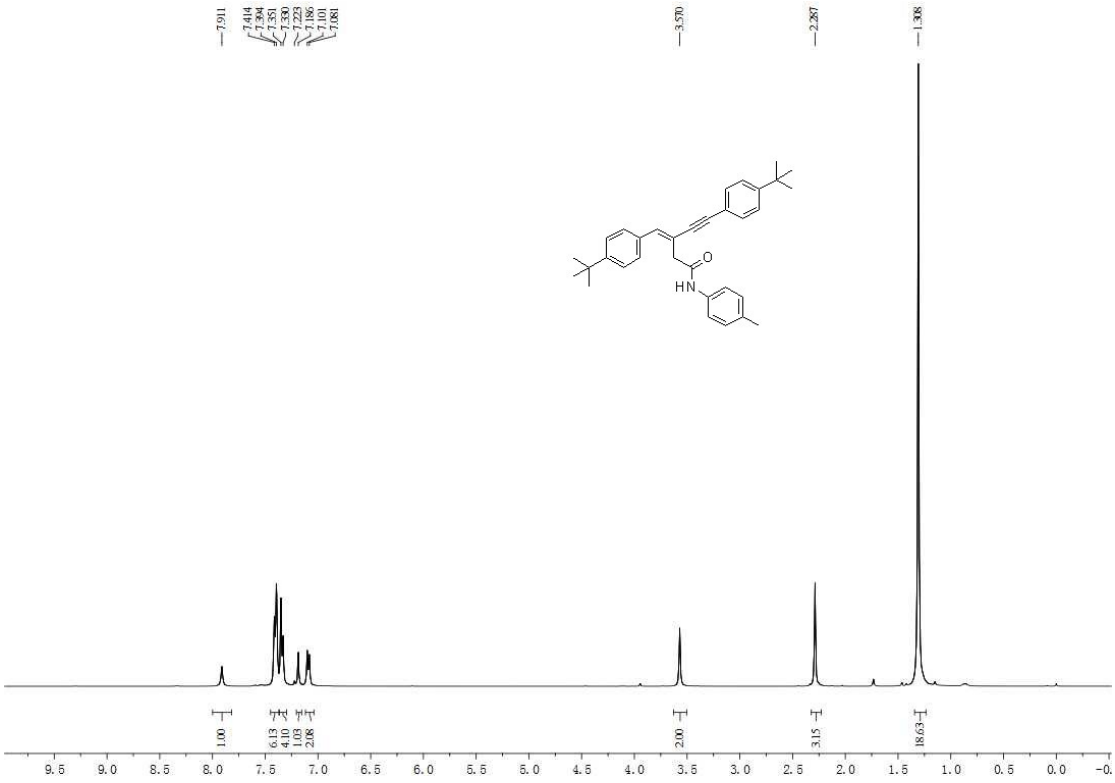
Product 3i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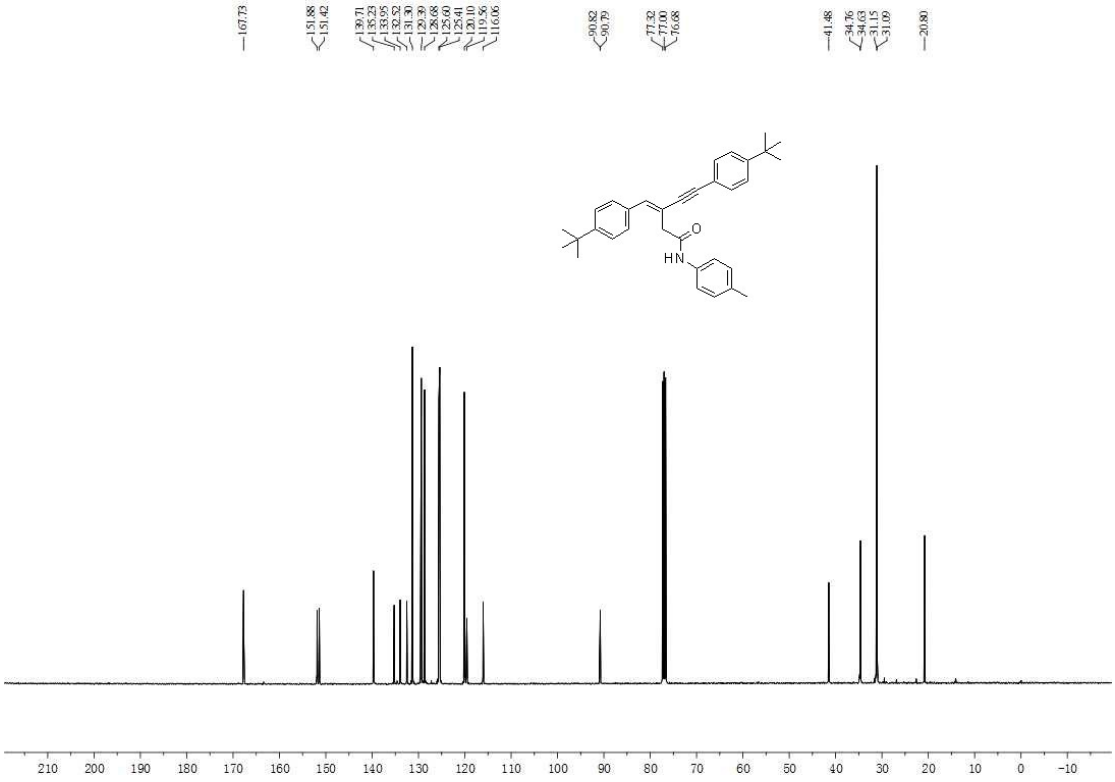
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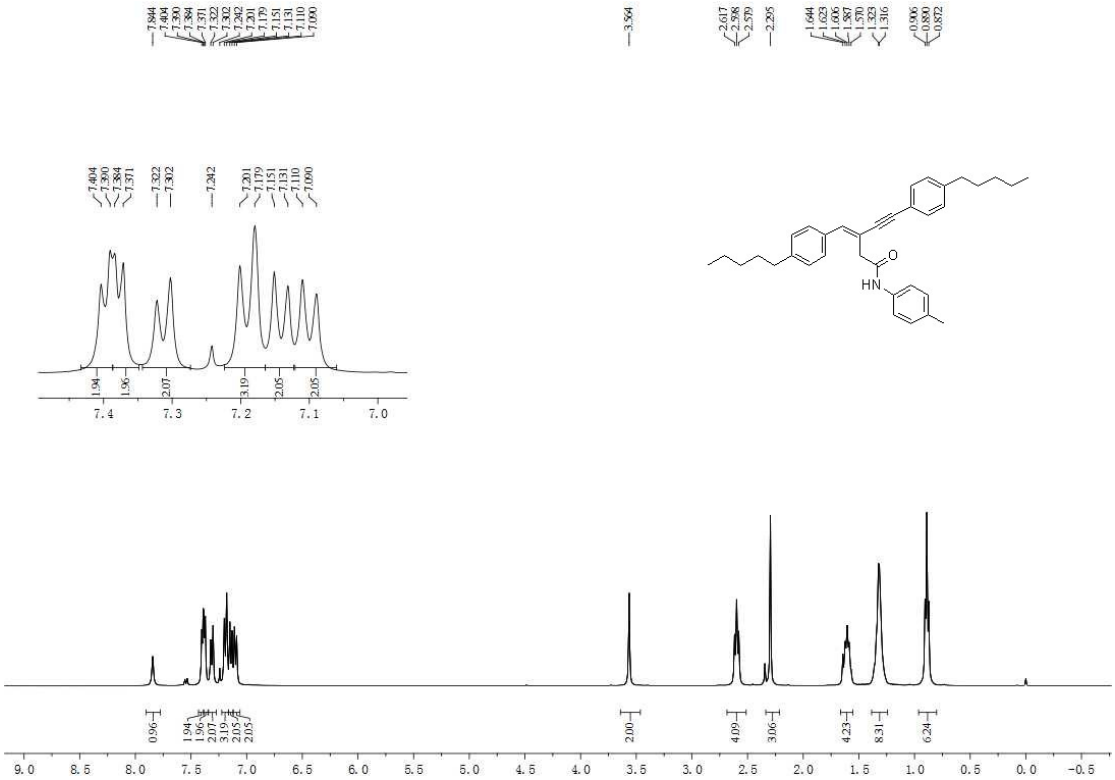
Product 3j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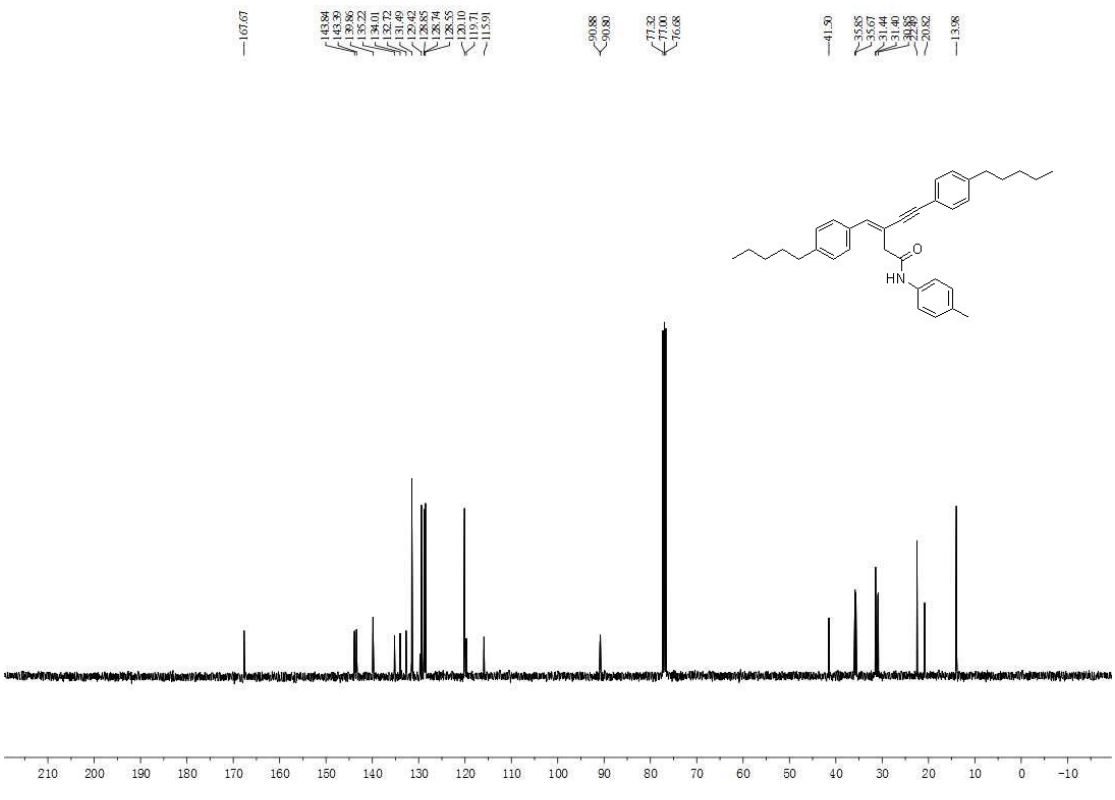
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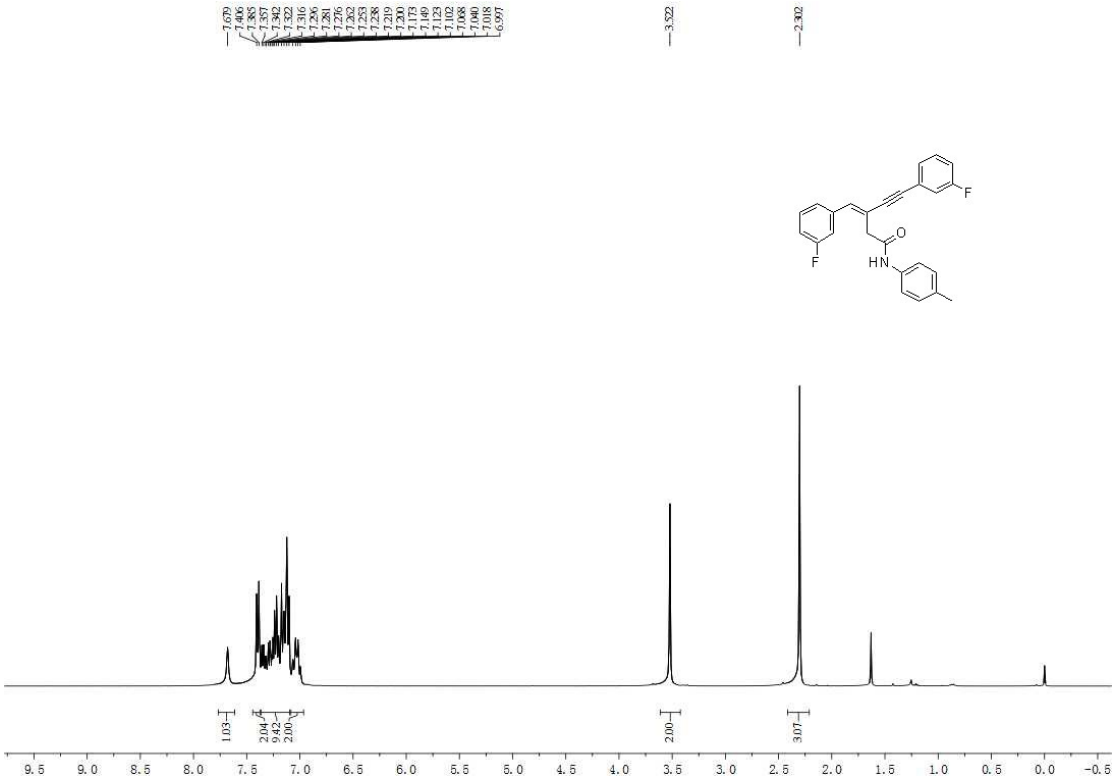
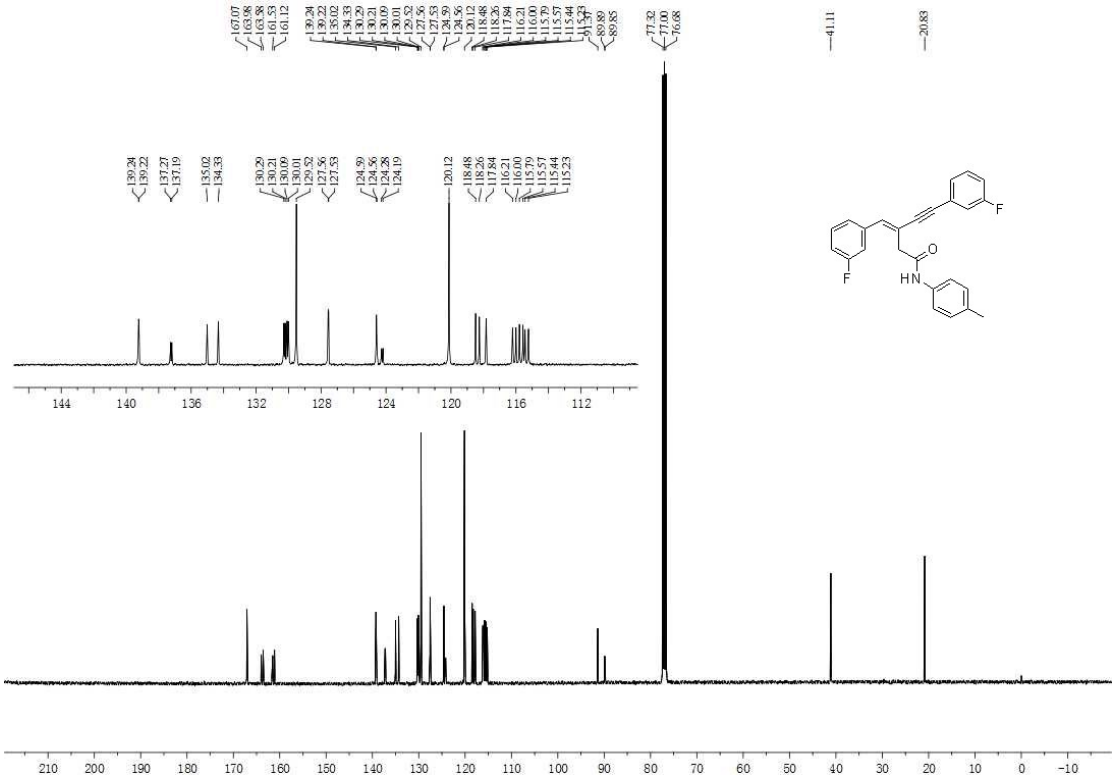
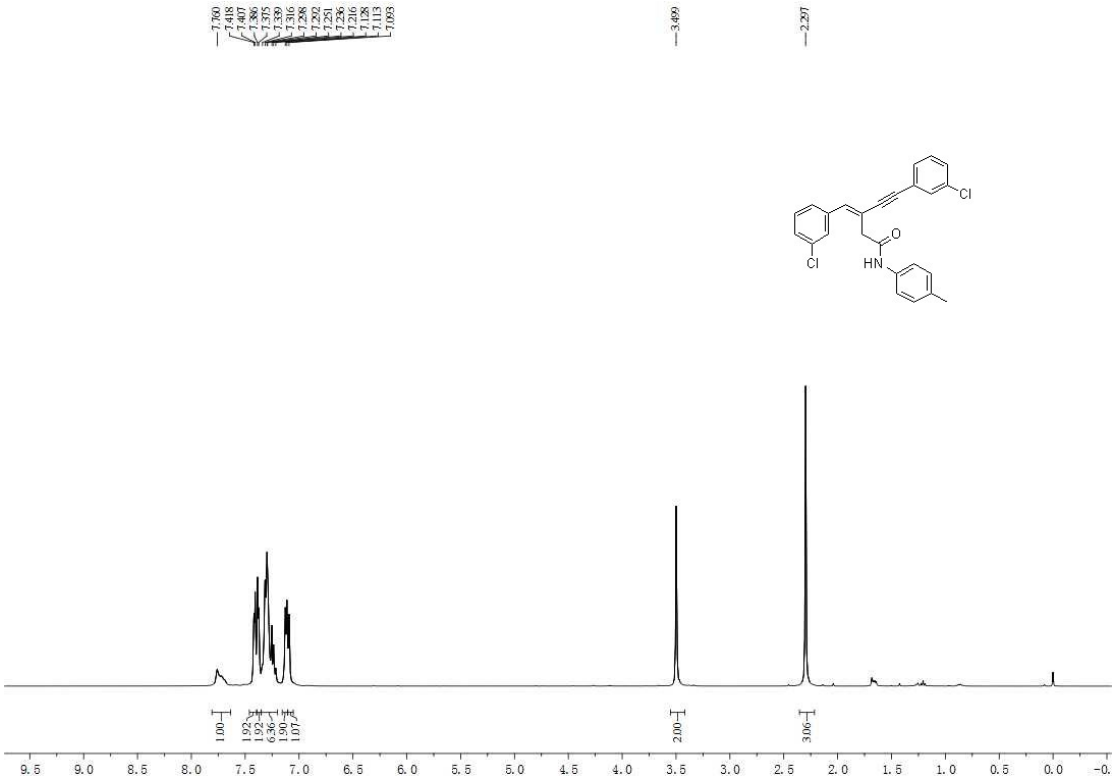
Product 3k





Product 3l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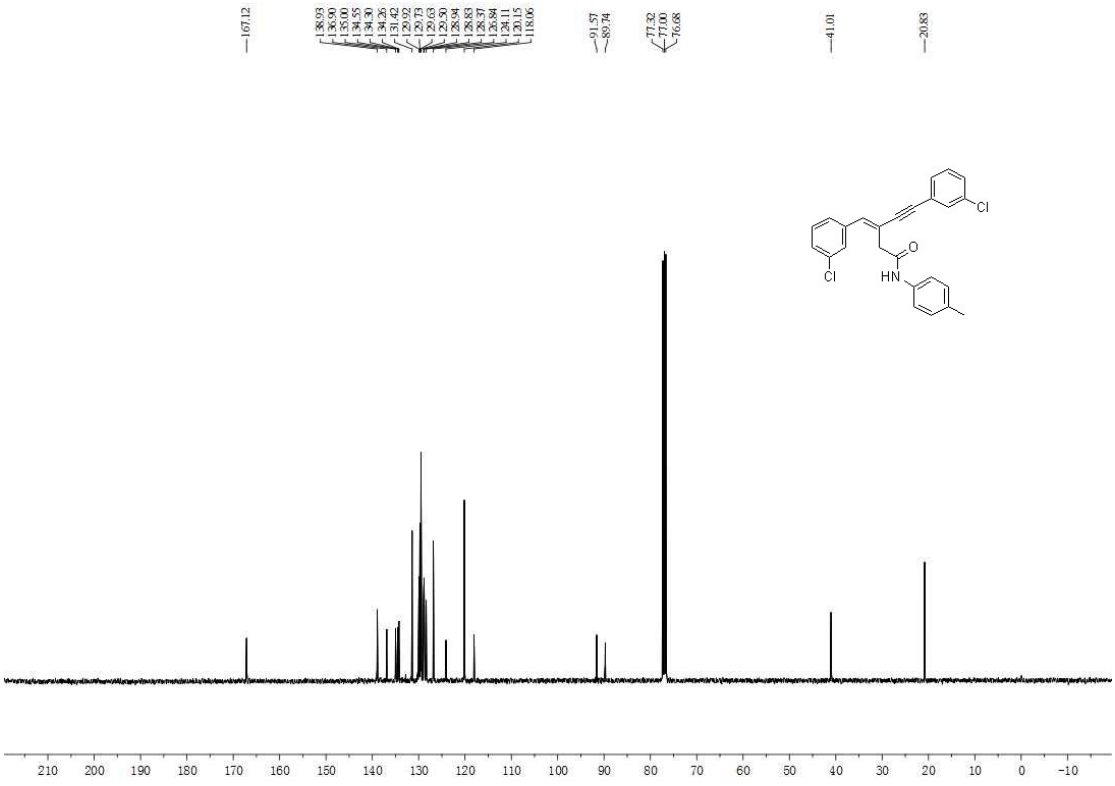
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.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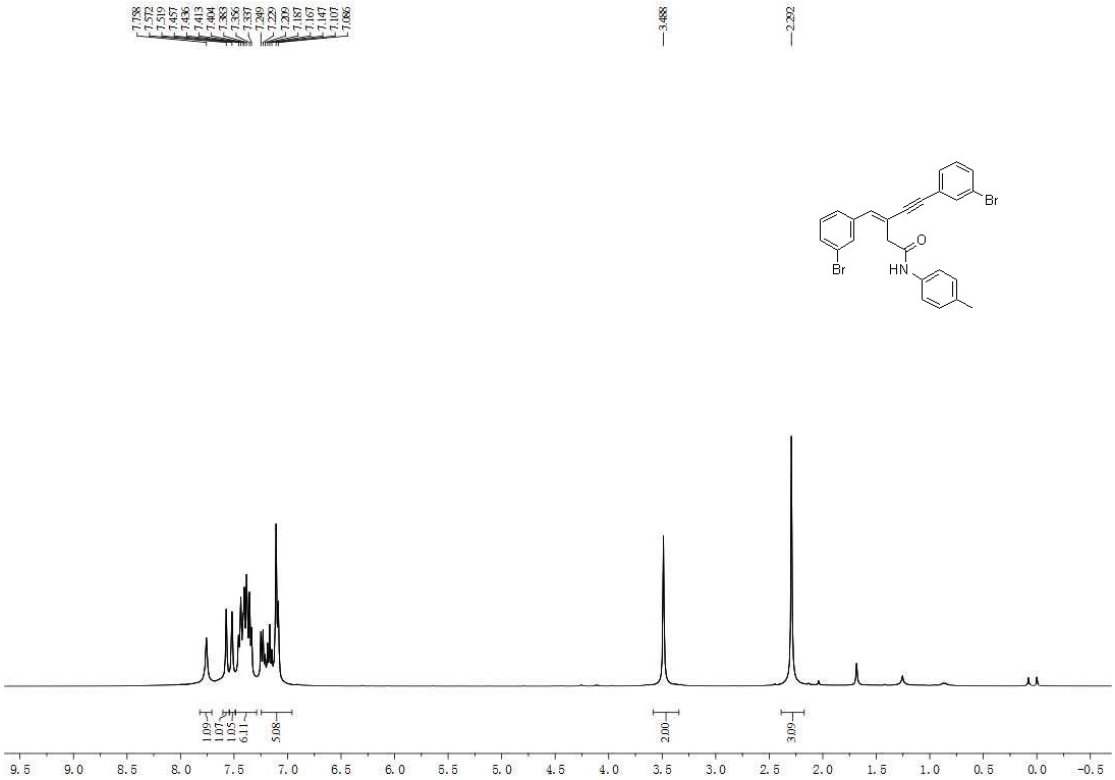
Product 3m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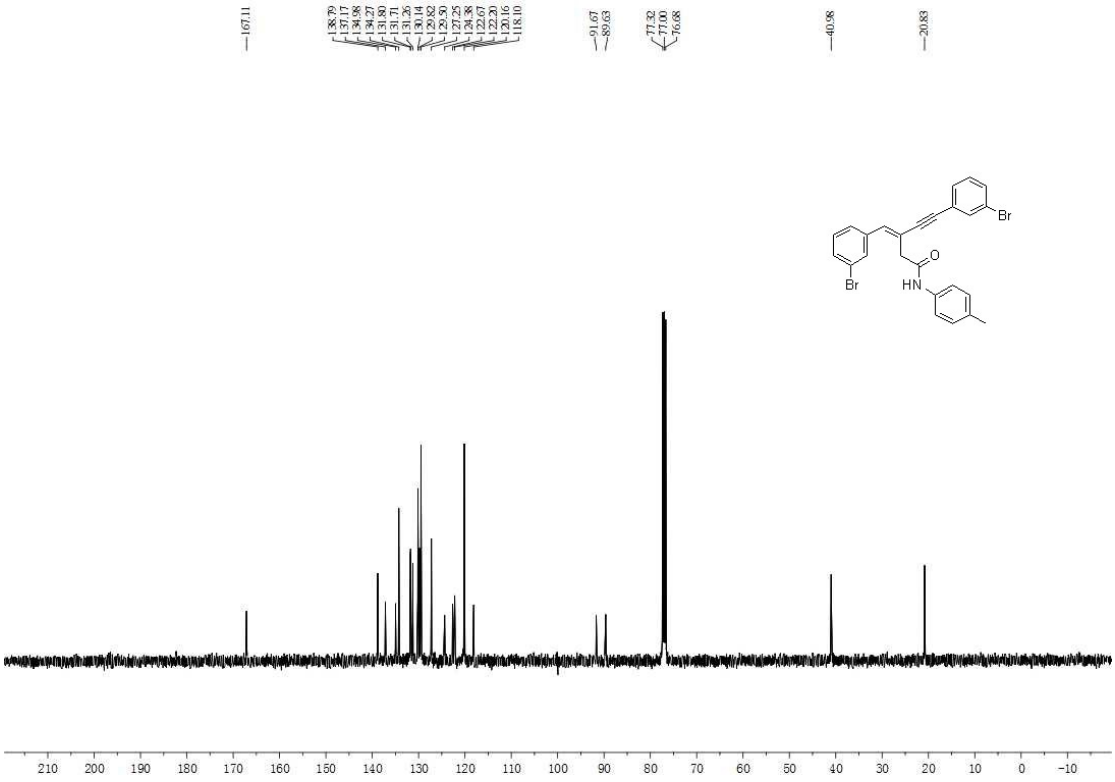
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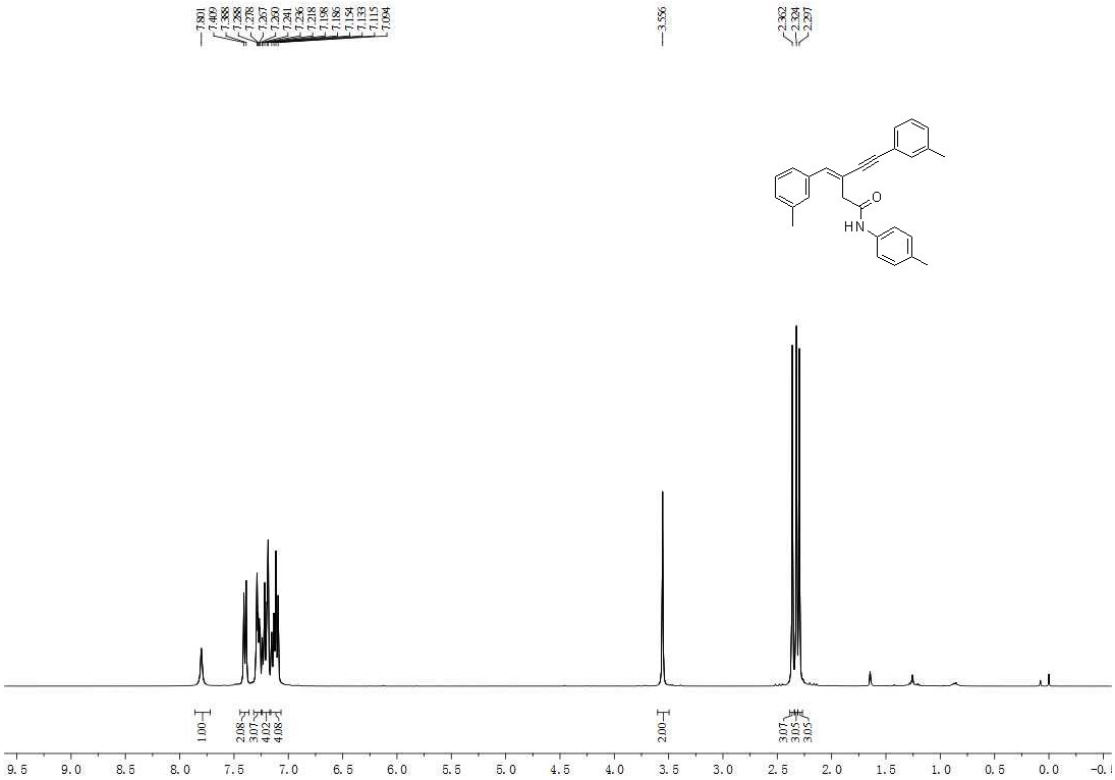
O
HN

Product 3n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7.115
7.094
3.556
2.362
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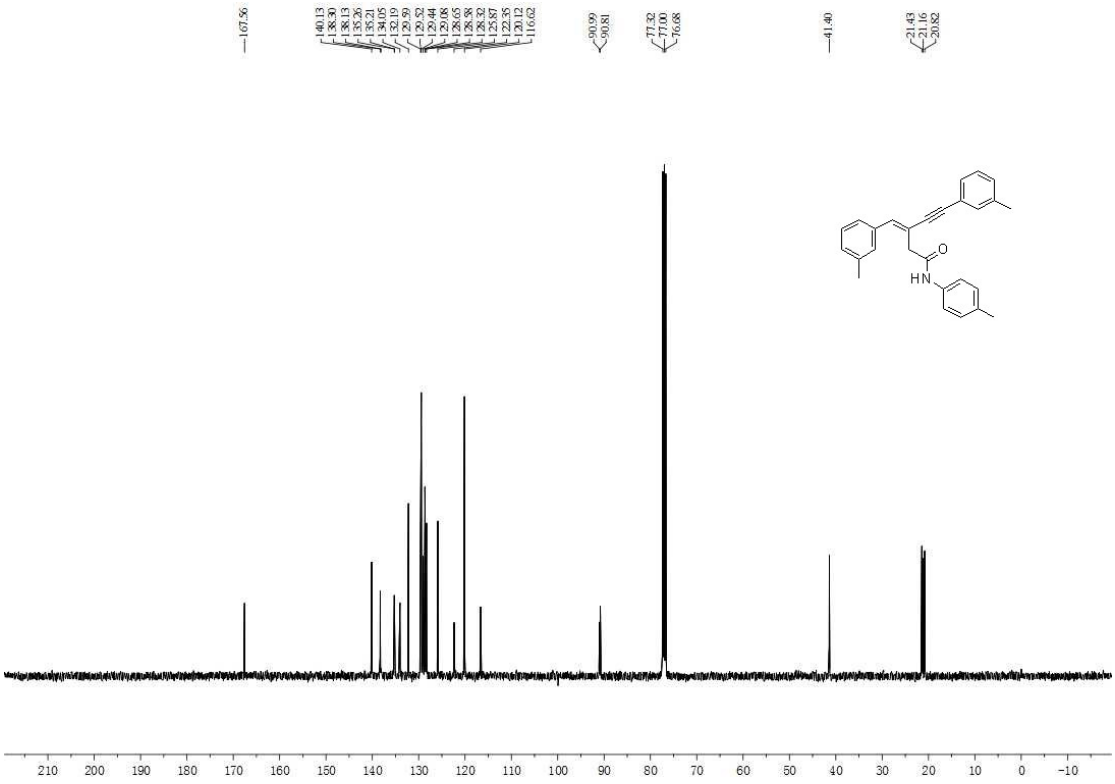
3.07
4.02
4.08
2.00
3.07
3.05
3.05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138.13
135.26
135.21
134.05
132.19
130.59
130.52
129.44
129.08
128.65
128.58
128.32
125.87
123.55
120.11
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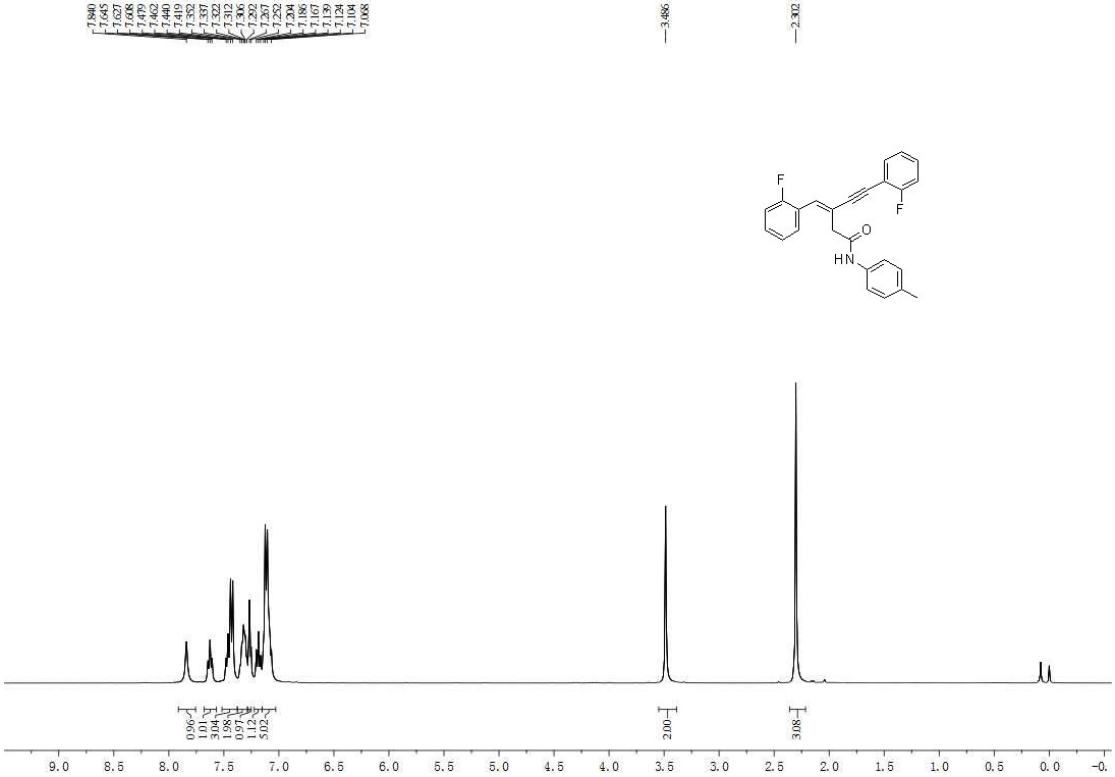
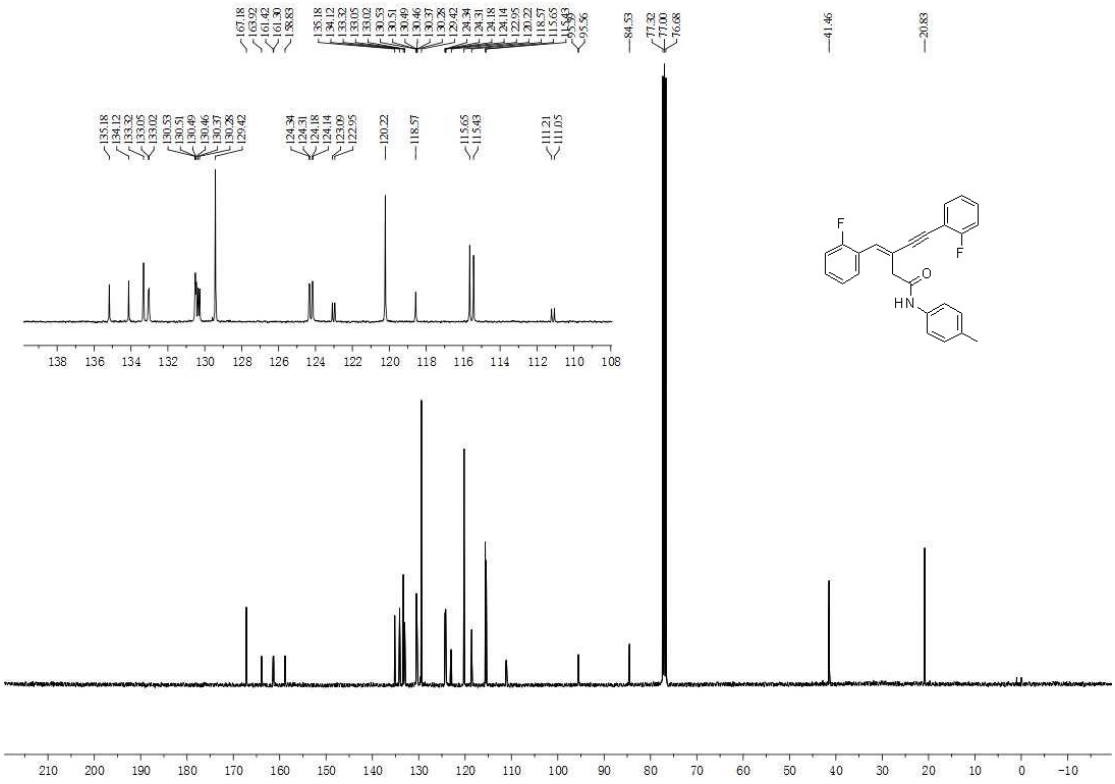
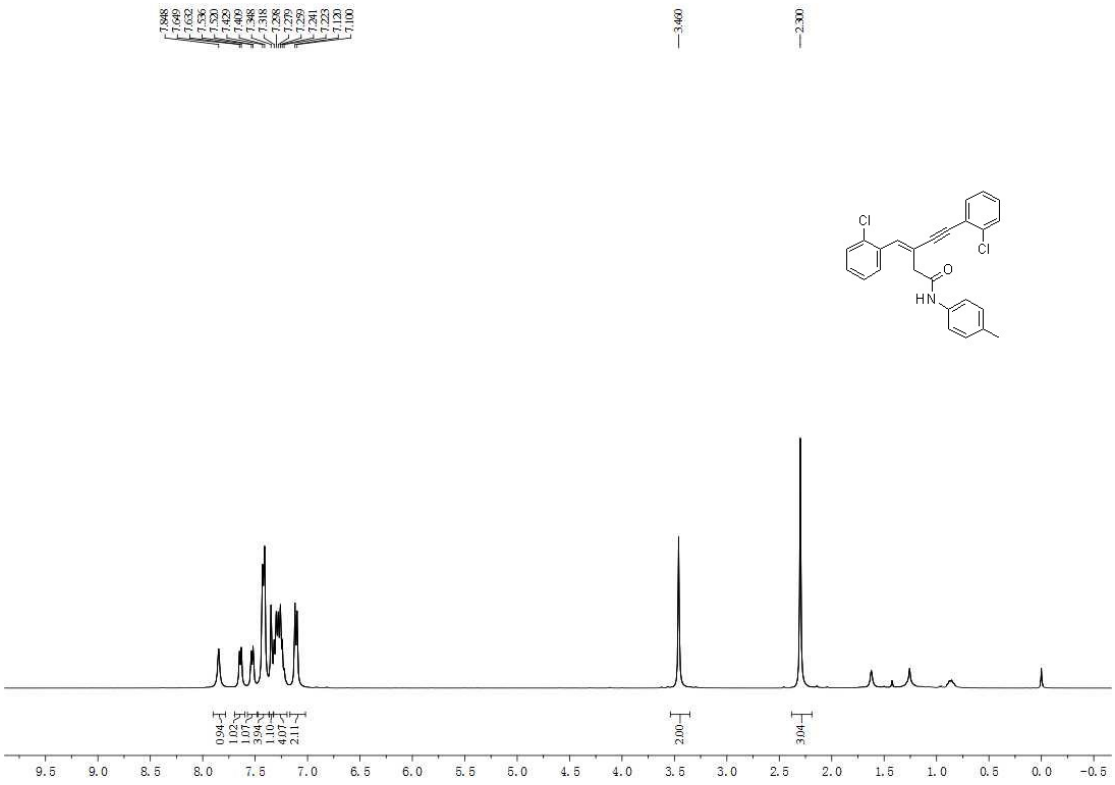
77.32
77.00
76.68
41.40
21.43
21.16
20.82
O
HN

Product 3o





Product 3p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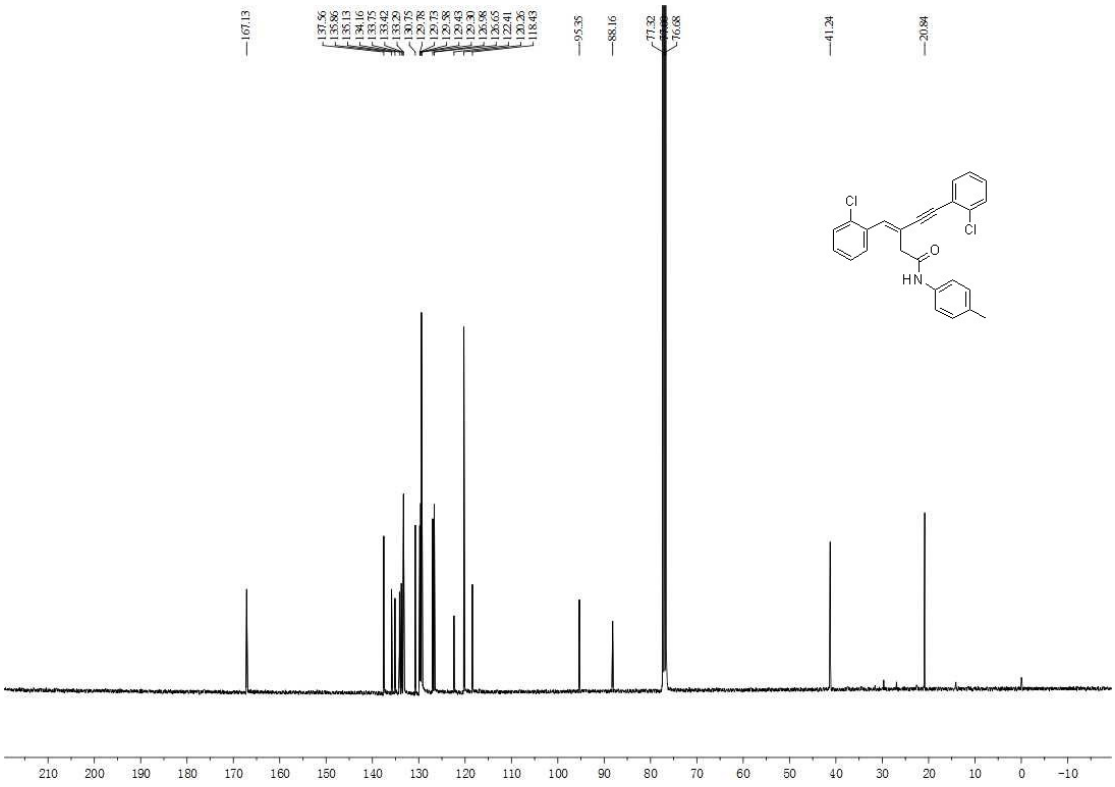
7.279
7.259
7.241
7.223
7.120
7.100
3.460
2.300
Cl
Cl
O
HN
0.94
1.02
1.07
3.94
1.10
4.07
2.11
2.00
3.04
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5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135.86
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134.16
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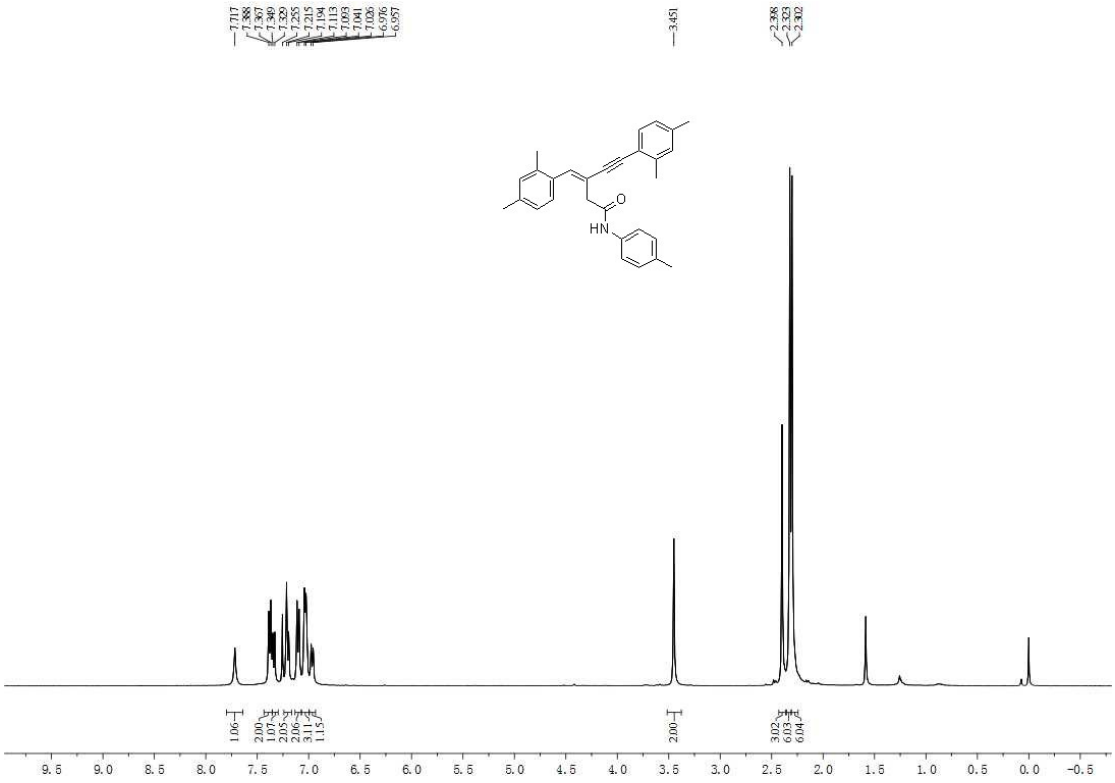
133.42
133.29
130.75
130.28
129.73
129.58
129.43
129.30
126.98
126.65
122.41
120.25
118.43
95.35
88.16
77.32
77.00
76.68
41.24
20.884
Cl
Cl
O
HN
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10

Product 3q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7.307
7.349
7.329
7.295
7.215
7.194
7.113
7.093
7.041
7.026
6.976
6.957
3.451
2.398
2.373
2.302
O
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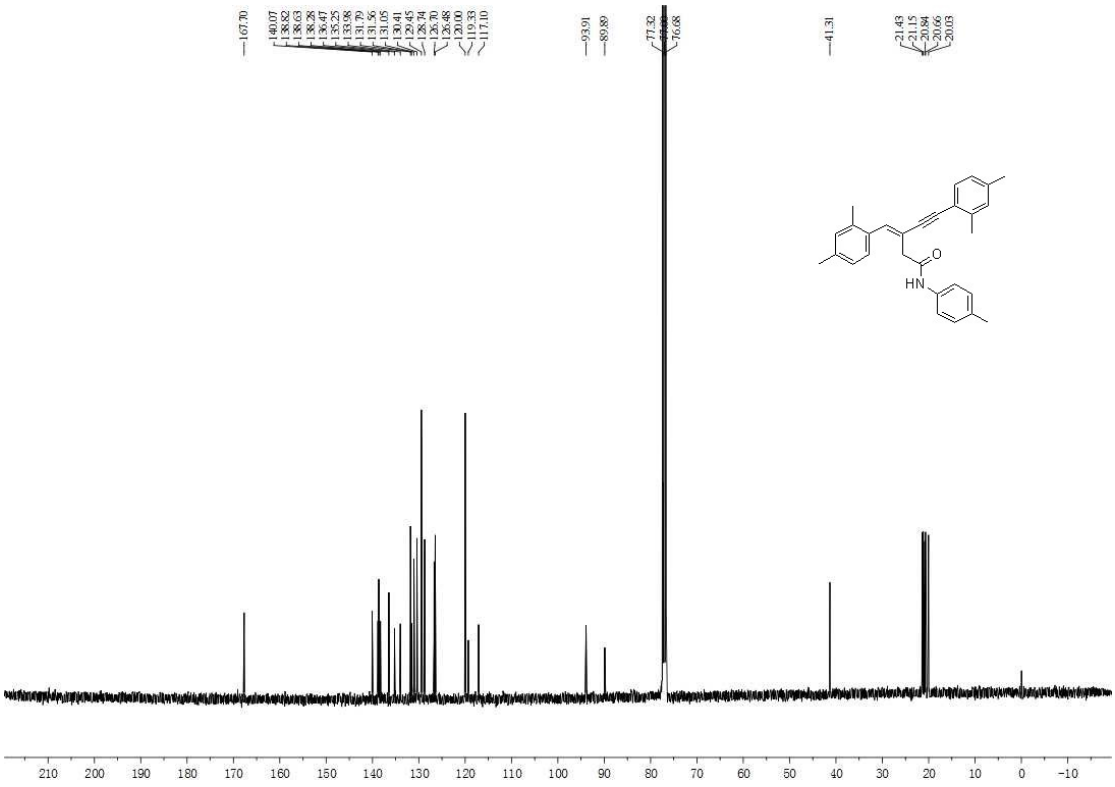
2.00
1.07
2.05
3.11
1.15
2.00
3.02
6.03
6.04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138.63
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136.47
135.25
133.98
131.79
131.56
131.05
130.41
129.45
128.74
126.70
126.48
120.00
119.33
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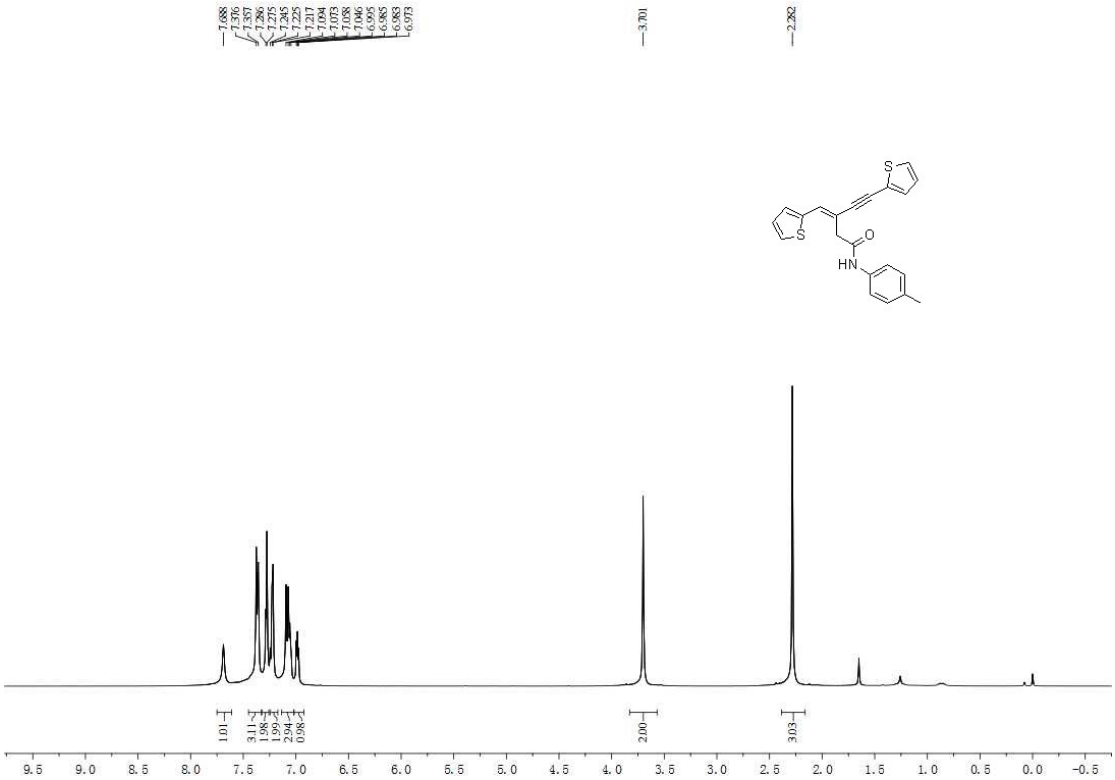
77.32
41.31
21.43
21.15
20.94
20.66
20.03
O
HN

Product 3r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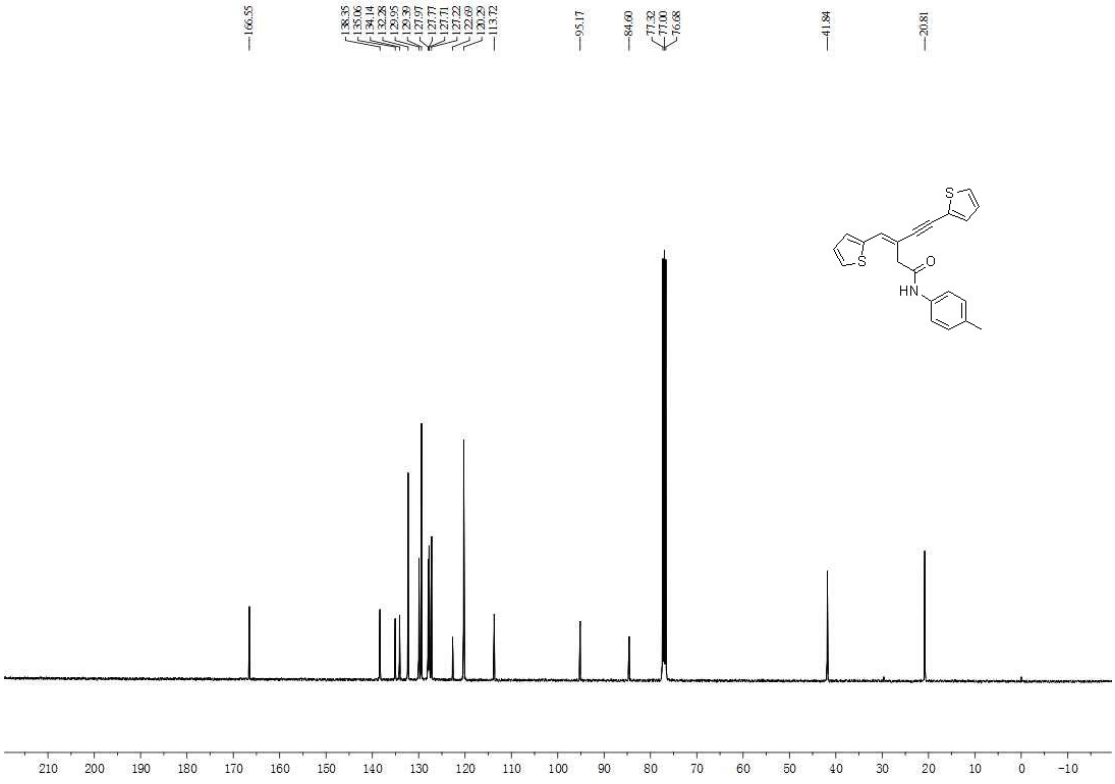
7.245
7.225
7.217
7.084
7.073
7.058
7.046
6.995
6.985
6.983
6.973
3.701
2.282
S
S
O
HN
1.01
3.11
1.98
1.99
2.94
0.98
2.00
3.03
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5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138.35
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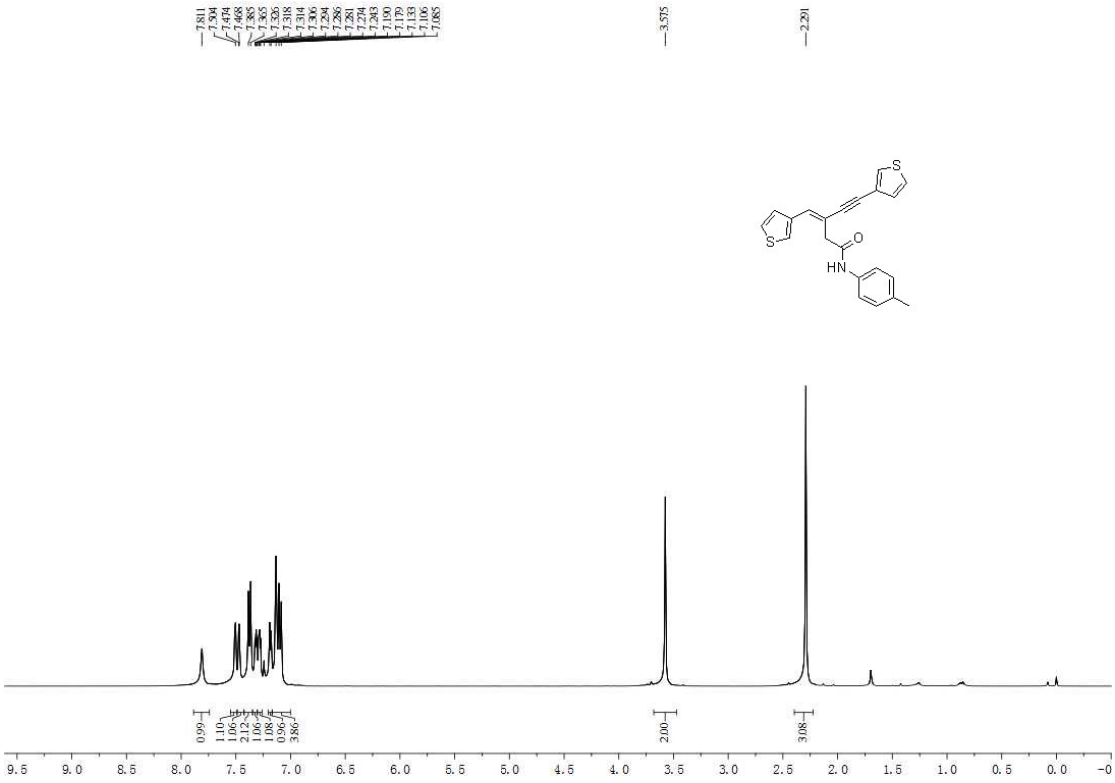
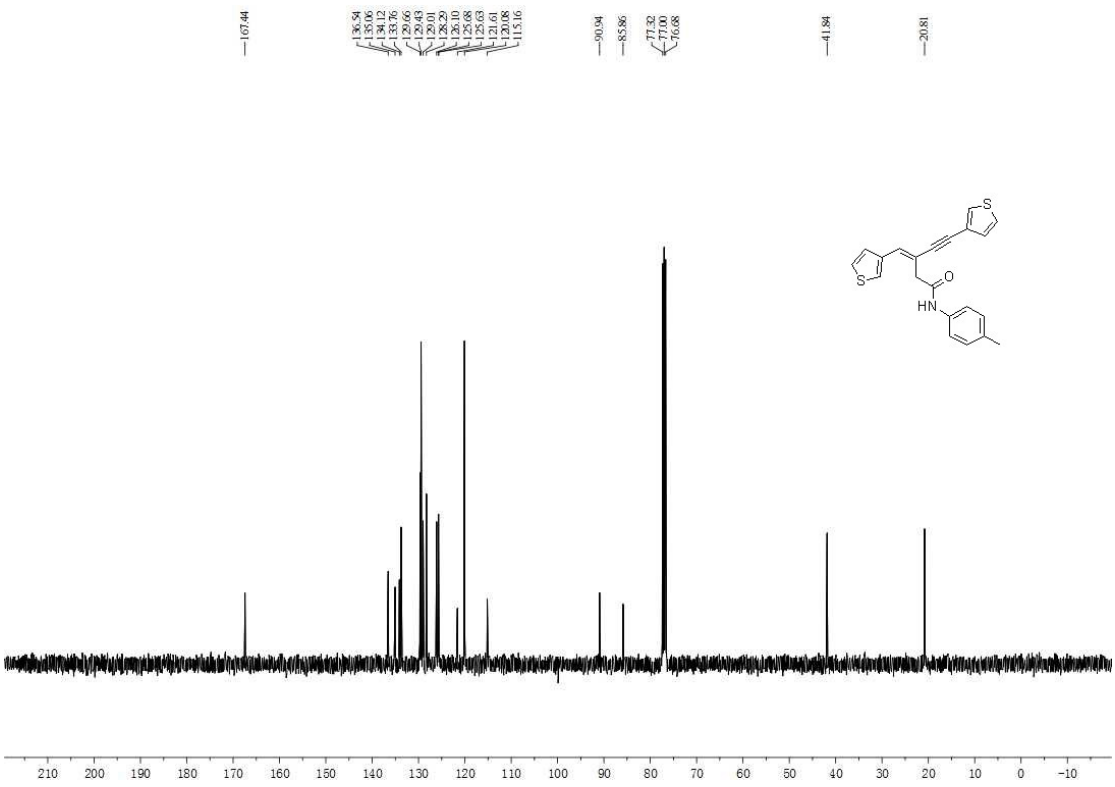
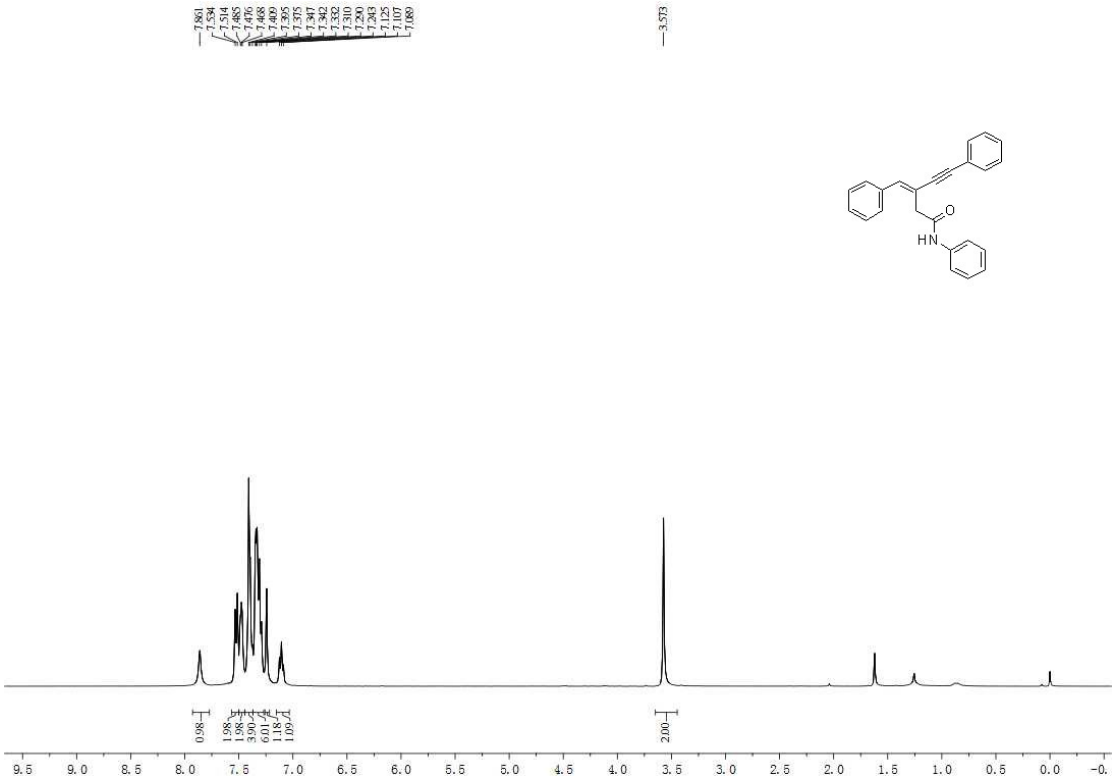
134.14
132.28
129.55
129.39
127.97
127.77
127.71
127.22
122.69
120.29
113.72
95.17
84.60
77.32
77.00
76.68
41.84
20.81
S
S
O
HN
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10

Product 3s





Product 4b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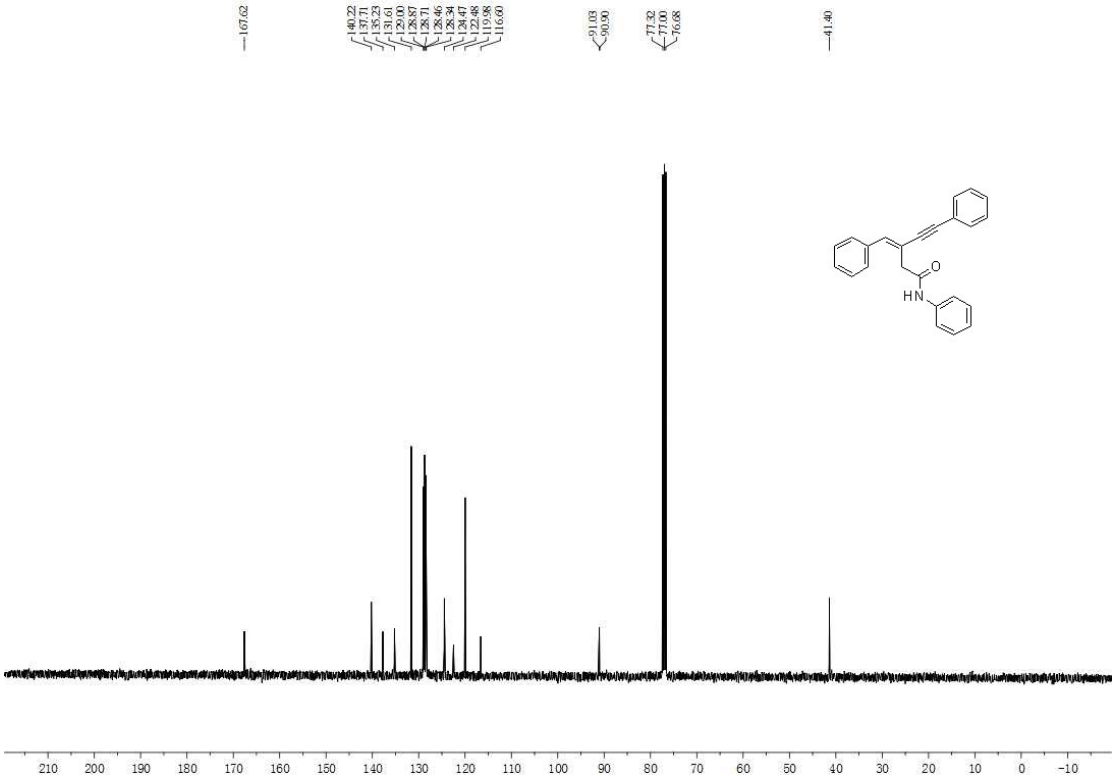
7.409
7.395
7.375
7.347
7.332
7.310
7.200
7.263
7.125
7.107
7.089
3.573
HN
O
0.98
1.98
1.98
3.90
6.01
1.18
1.09
2.00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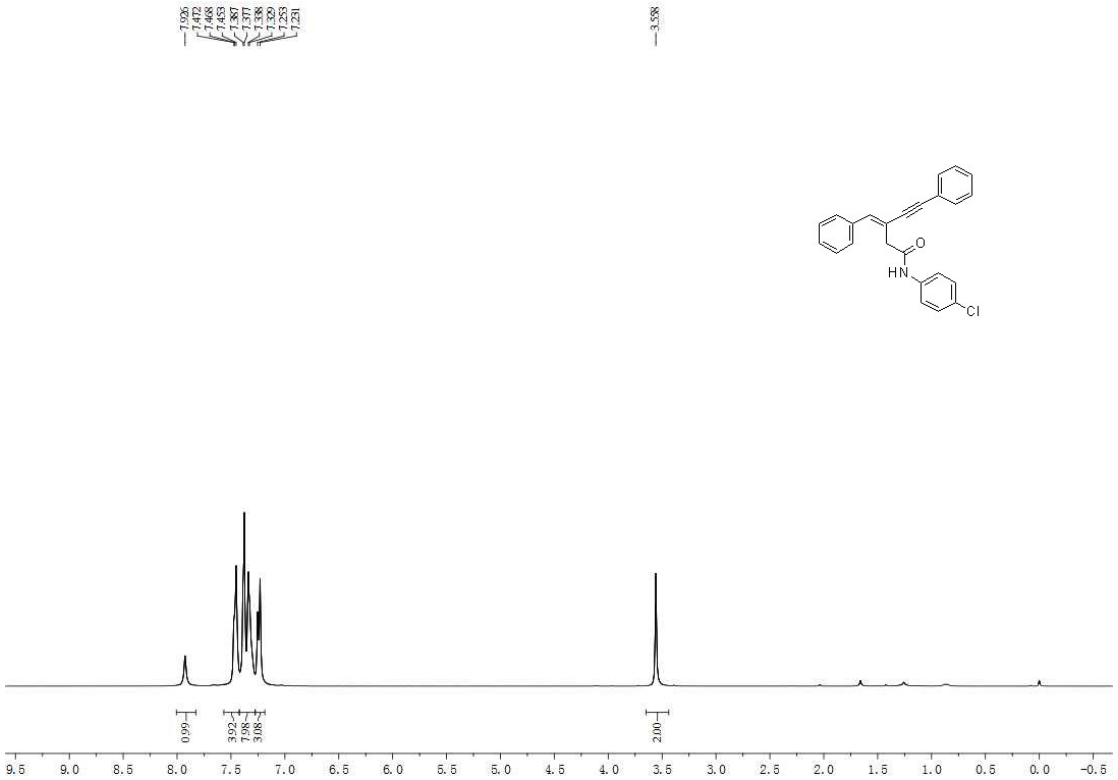
129.00
128.87
128.71
128.46
128.34
128.15
122.48
119.98
116.60
91.03
90.30
77.32
77.00
76.68
41.40
HN
O

Product 4c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7.468
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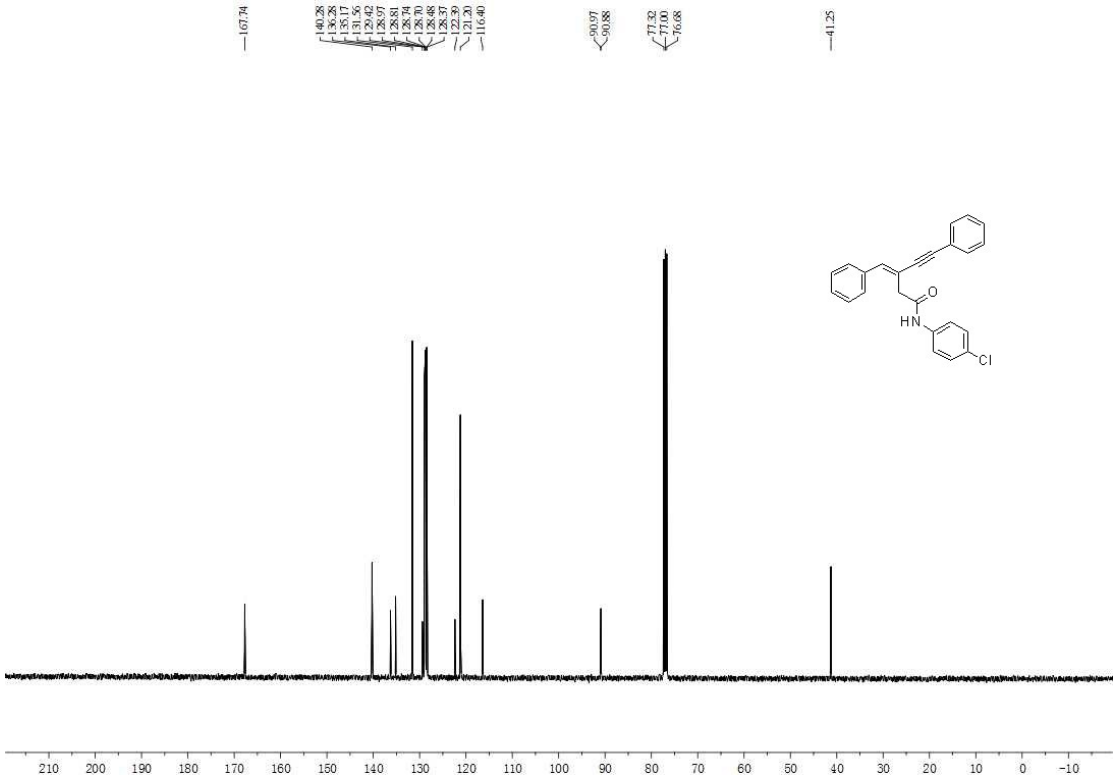
7.338
7.329
7.253
7.231
3.558
O
HN
Cl
0.99
3.92
7.98
3.08
2.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5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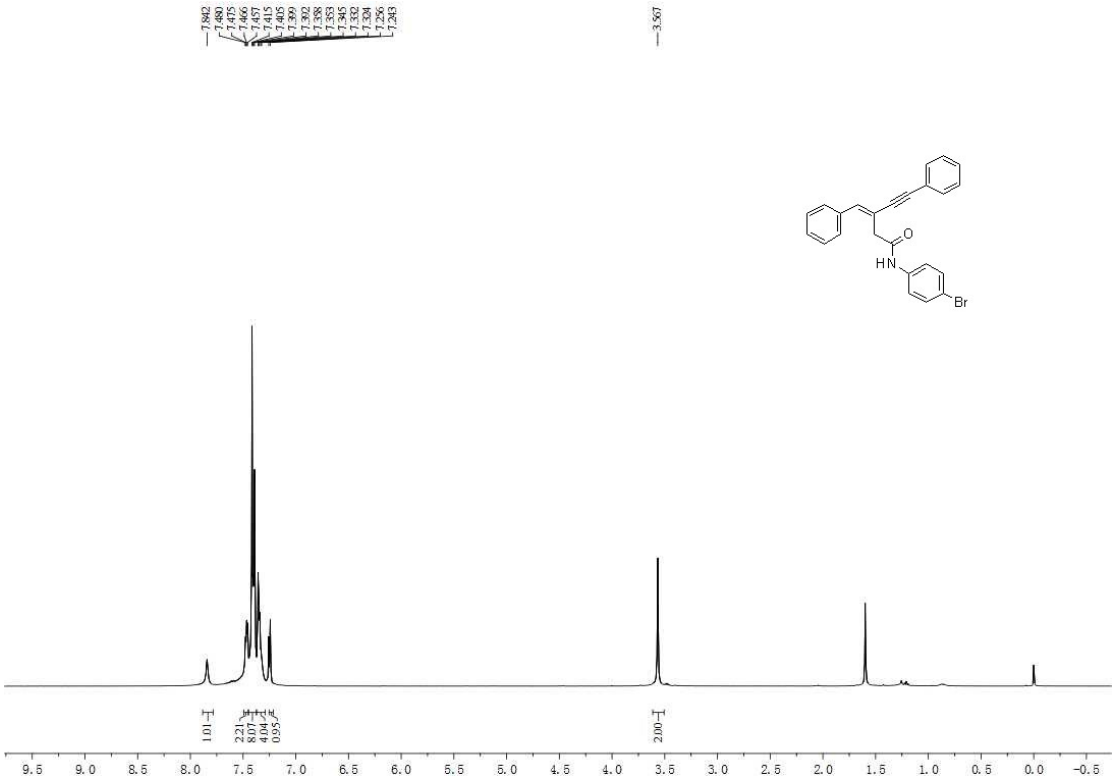
128.51
128.74
128.70
128.48
128.37
122.39
121.20
116.40
90.97
90.88
77.32
77.00
76.68
41.25
O
HN
Cl
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10

Product 4d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7.457
7.445
7.405
7.399
7.392
7.358
7.353
7.345
7.332
7.324
7.295
7.245
3.567
O
HN
Br
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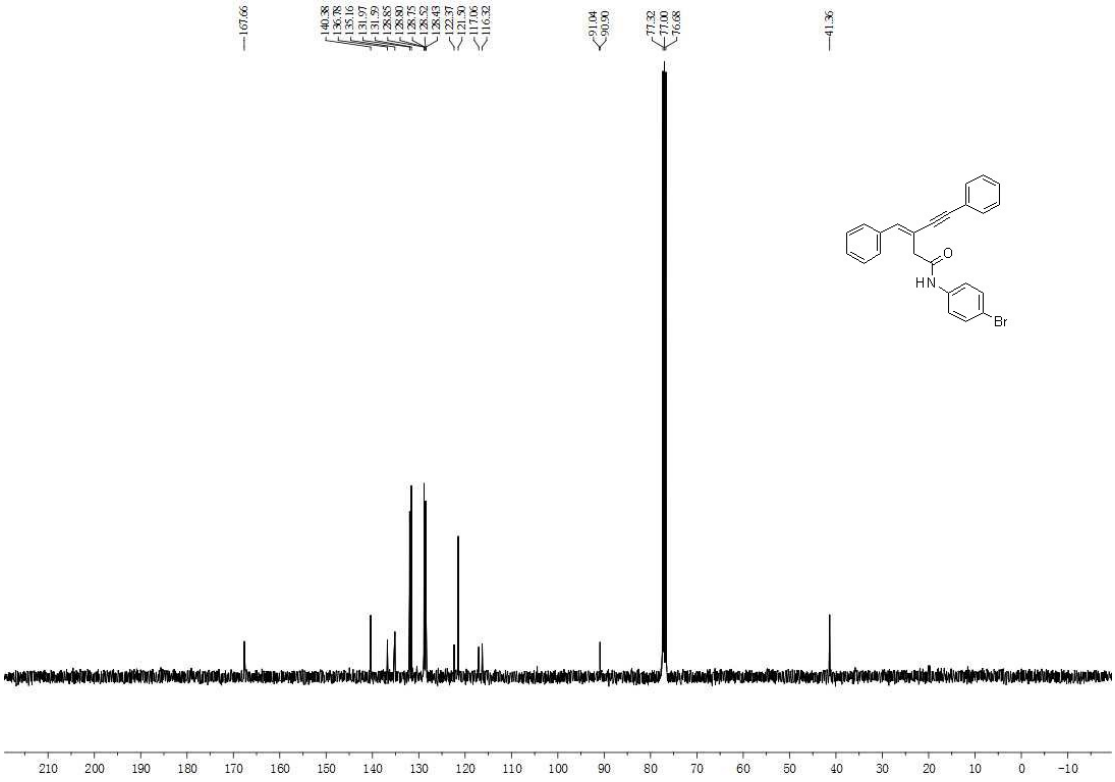
2.21
8.07
4.04
0.95
2.00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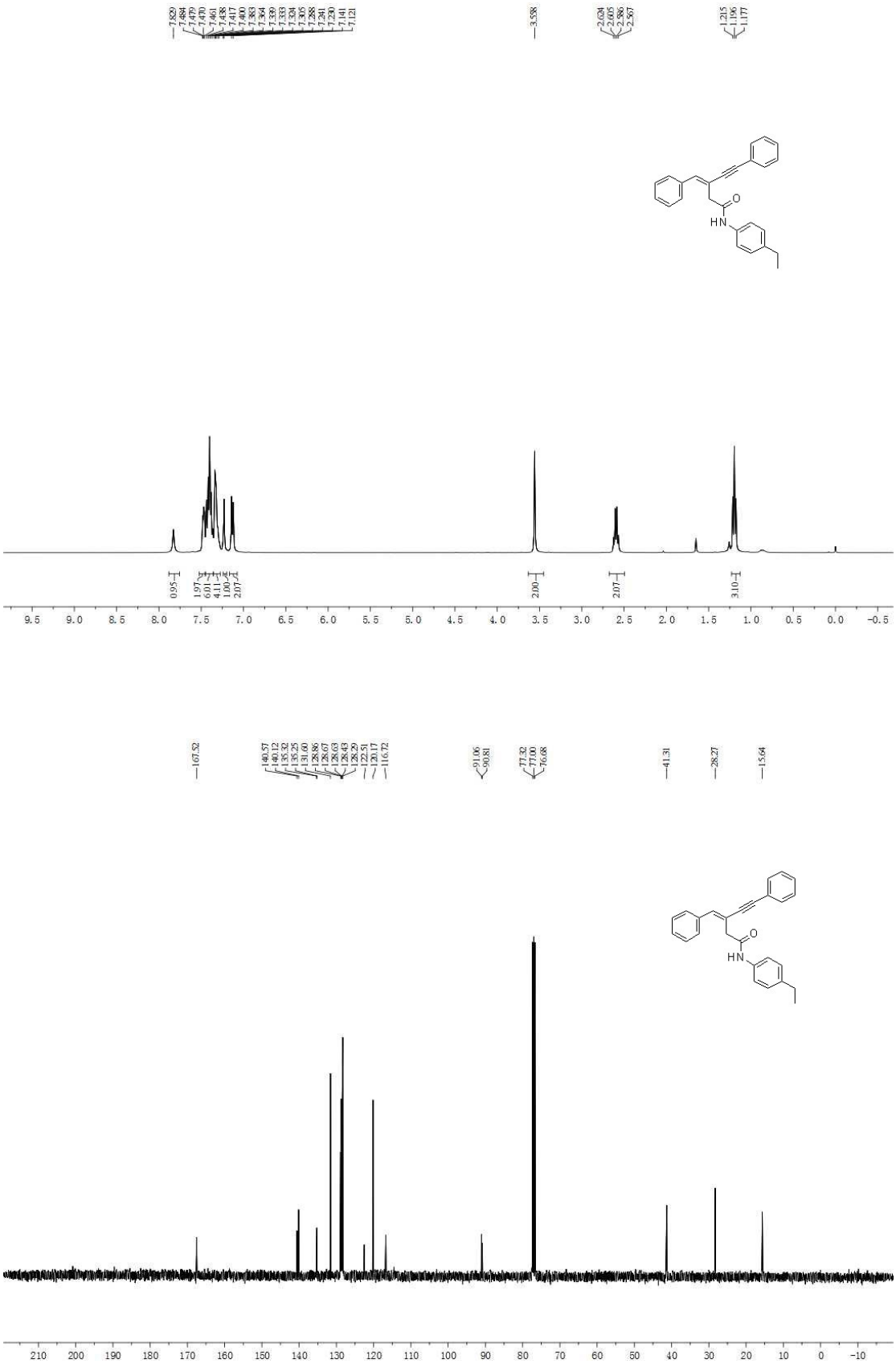
135.16
131.97
131.59
128.85
128.80
128.75
128.32
128.14
122.37
121.90
117.06
116.32
91.04
90.90
77.32
77.00
76.68
41.36
O
HN
Br

Product 4e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7.304
7.339
7.333
7.330
7.305
7.288
7.291
7.230
7.141
7.121
3.558
2.624
2.005
1.986
2.567
1.215
1.196
1.177
O
HN
0.95
1.97
6.01
4.11
1.00
2.07
2.00
2.07
3.10
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 0.0 -0.5
167.52
140.57
140.12
135.32
135.25
131.60
128.86
128.67
128.63
128.43
128.29
122.51
120.17
116.72
91.06
90.81
77.32
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76.68
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28.27
15.64
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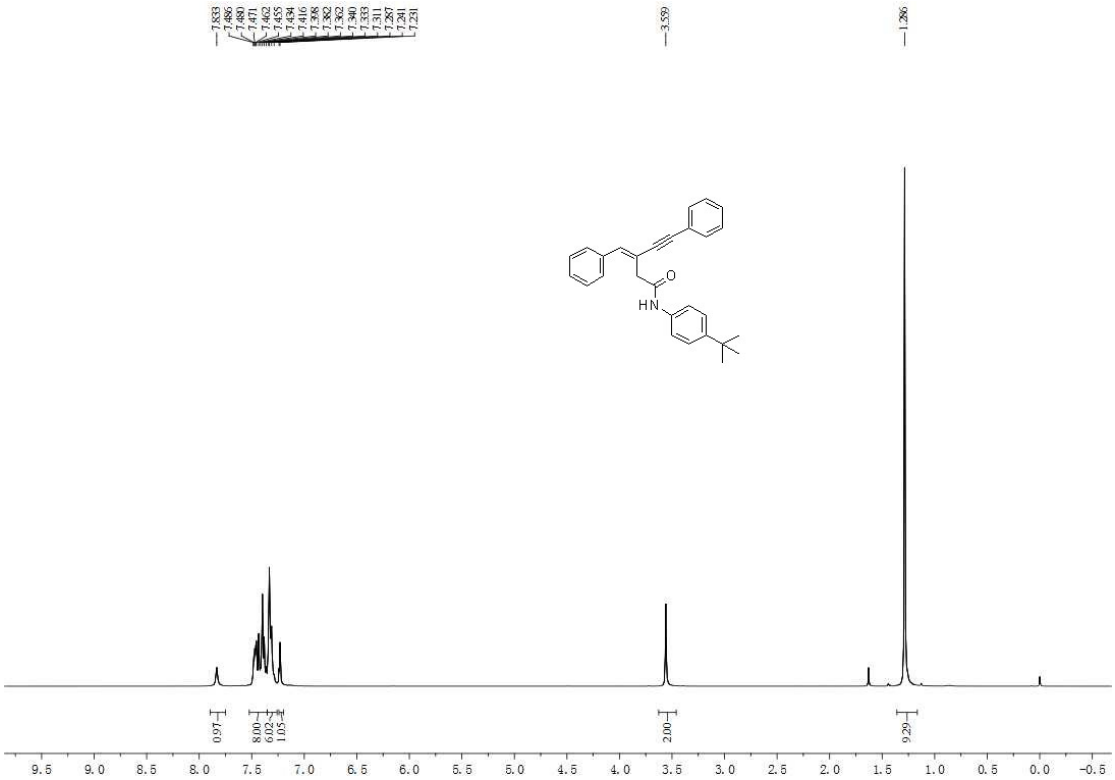
Product 4f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7.434
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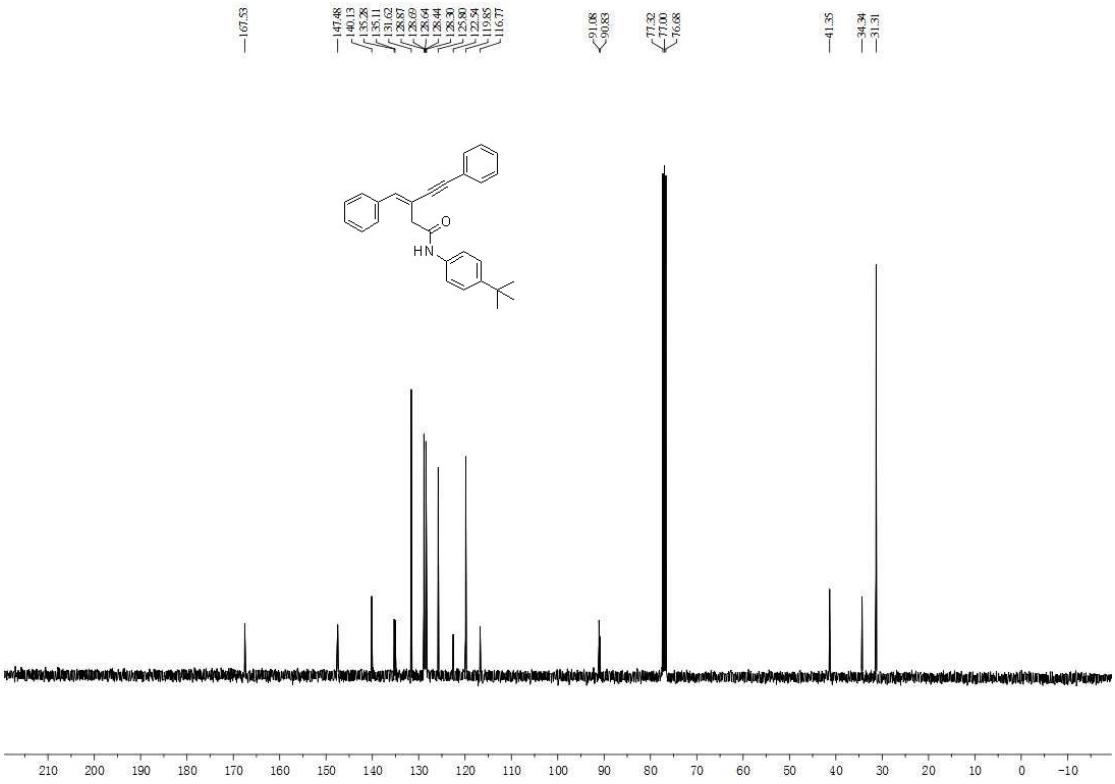
7.398
7.382
7.362
7.340
7.335
7.311
7.287
7.241
7.231
3.559
1.286
0.97
8.00
6.02
103.2
2.00
9.29
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5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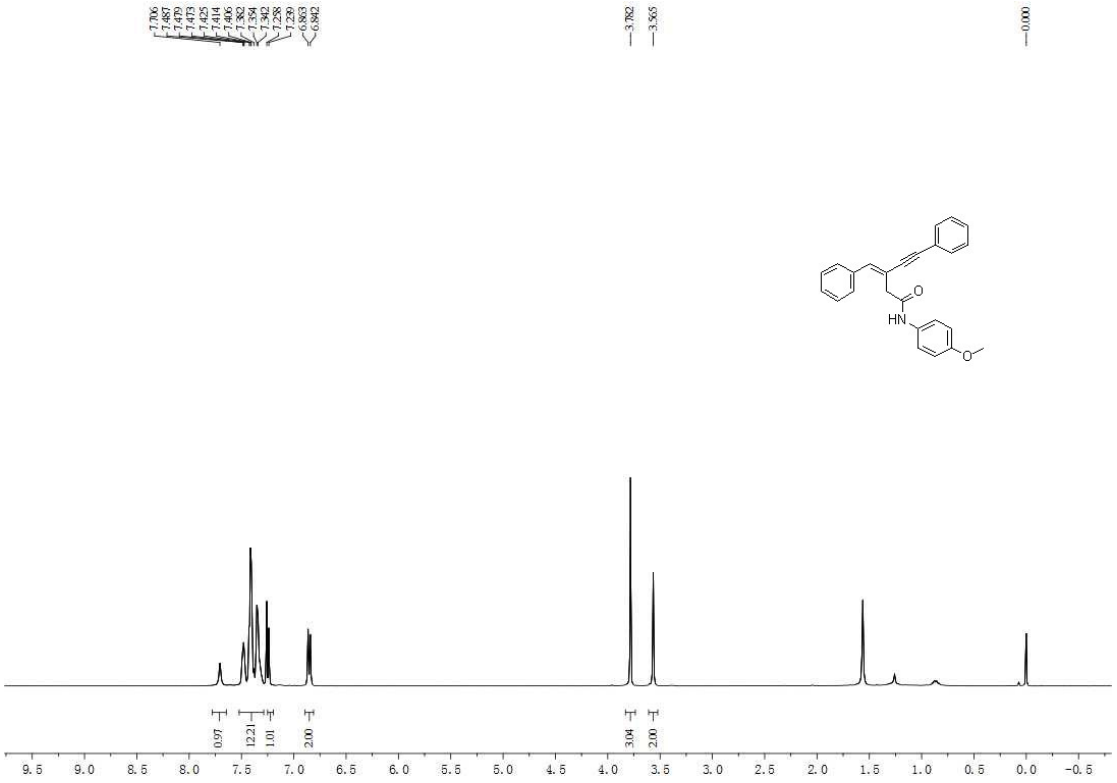
135.28
135.11
131.62
128.87
128.69
128.64
128.44
128.30
125.30
122.54
119.85
116.77
91.08
90.83
77.32
77.00
76.68
41.35
34.34
31.31
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10

Product 4g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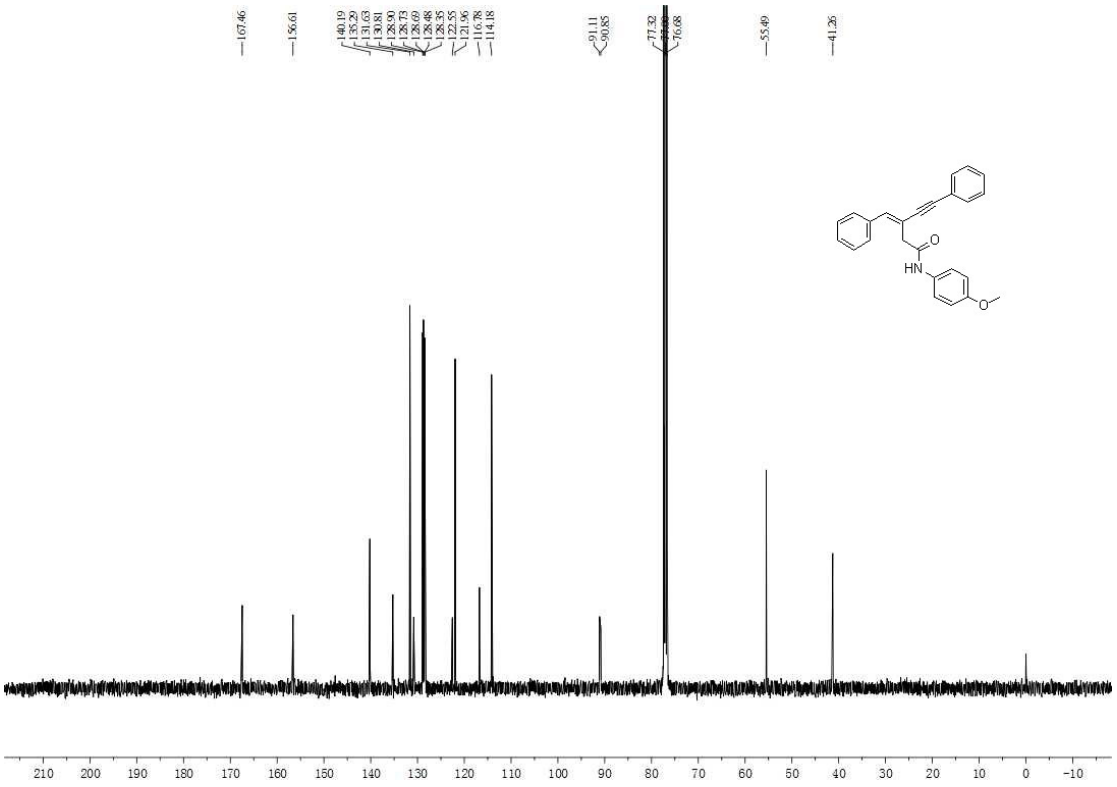
7.473
7.425
7.414
7.406
7.392
7.384
7.342
7.258
7.239
6.863
6.842
3.782
3.565
0.000
O
HN
O
0.97
12.21
1.01
2.00
3.04
2.00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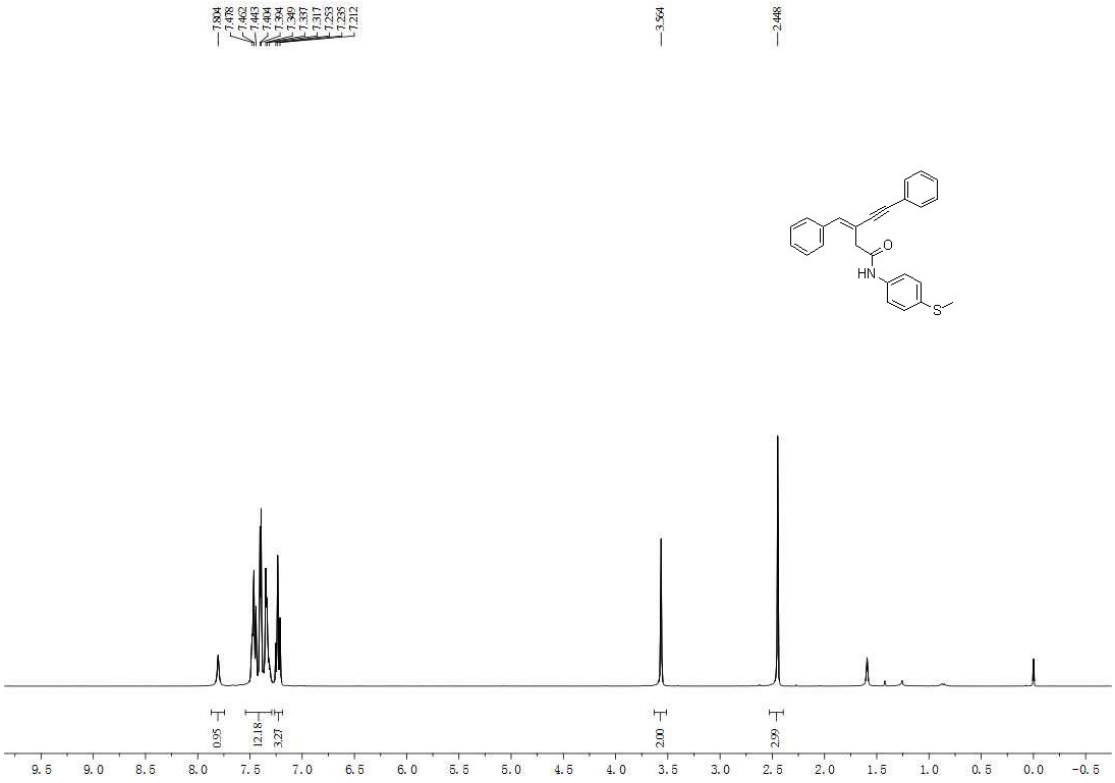
130.81
128.90
128.73
128.69
128.48
128.35
122.55
121.96
116.78
114.18
91.11
90.85
77.32
77.00
76.68
55.49
41.26
O
HN
O

Product 4h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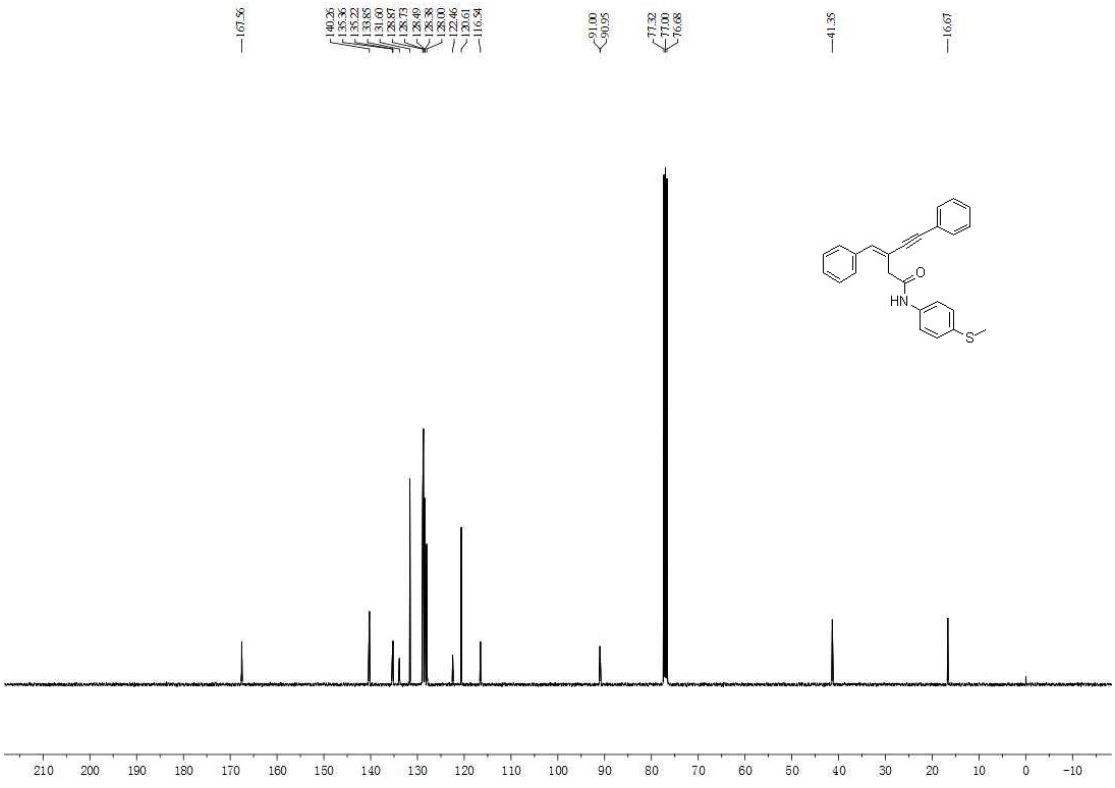
7.253
7.235
7.212
3.564
2.448
O
HN
S
0.95
12.18
3.27
2.00
2.99
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5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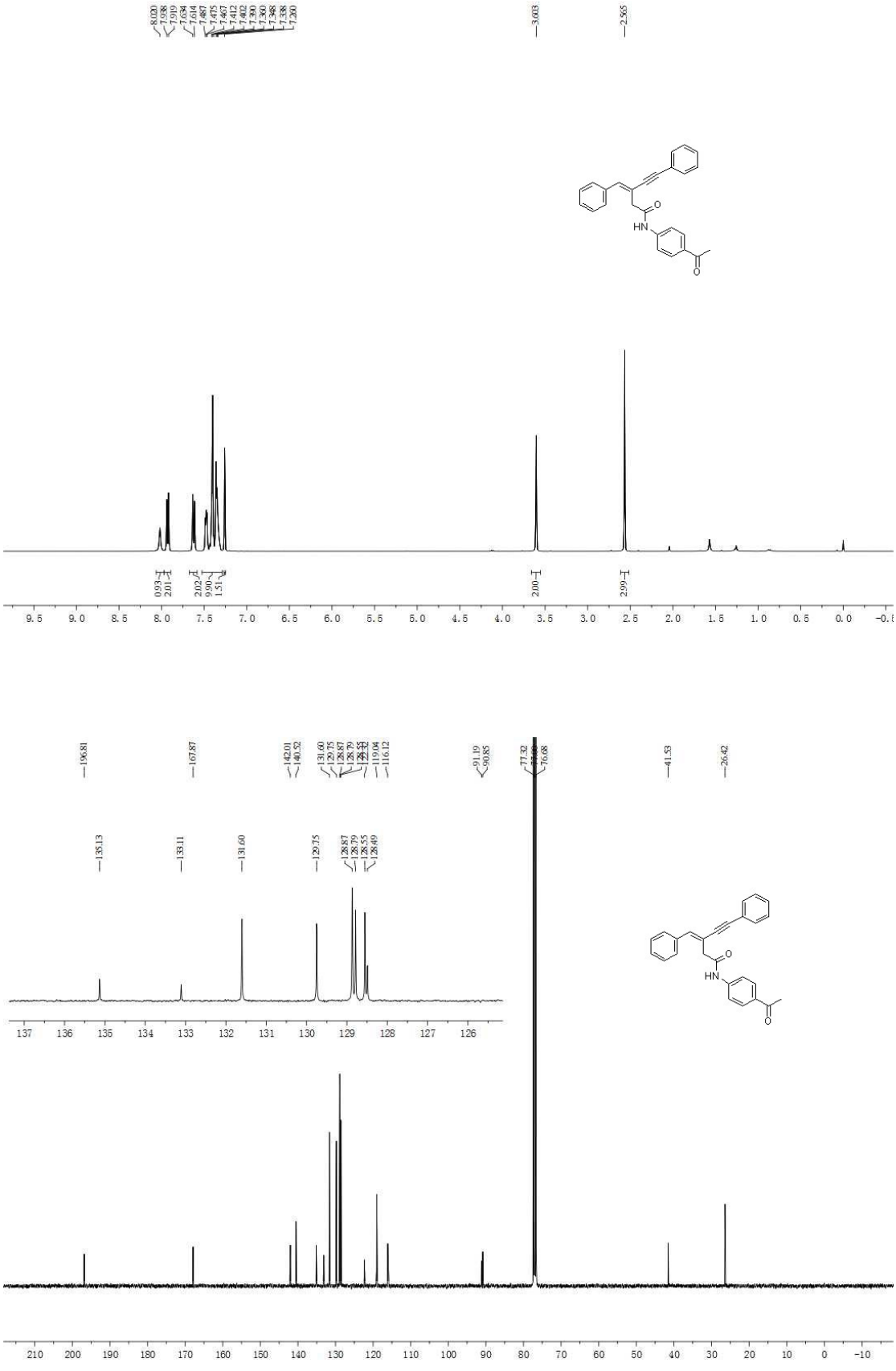
135.22
131.65
131.60
128.87
128.73
128.49
128.38
128.00
122.46
120.61
116.54
91.00
90.95
77.32
77.00
76.68
41.35
16.67
O
HN
S
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10

Product 4i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7.607
7.475
7.467
7.412
7.402
7.390
7.390
7.348
7.338
7.200
3.003
2.565
HN
O
O
0.93
2.01
2.02
9.90
1.51
2.00
2.99
196.81
167.87
142.01
140.52
131.60
129.75
128.87
128.79
128.55
128.49
119.04
116.12
91.19
90.85
77.32
76.68
41.53
26.42
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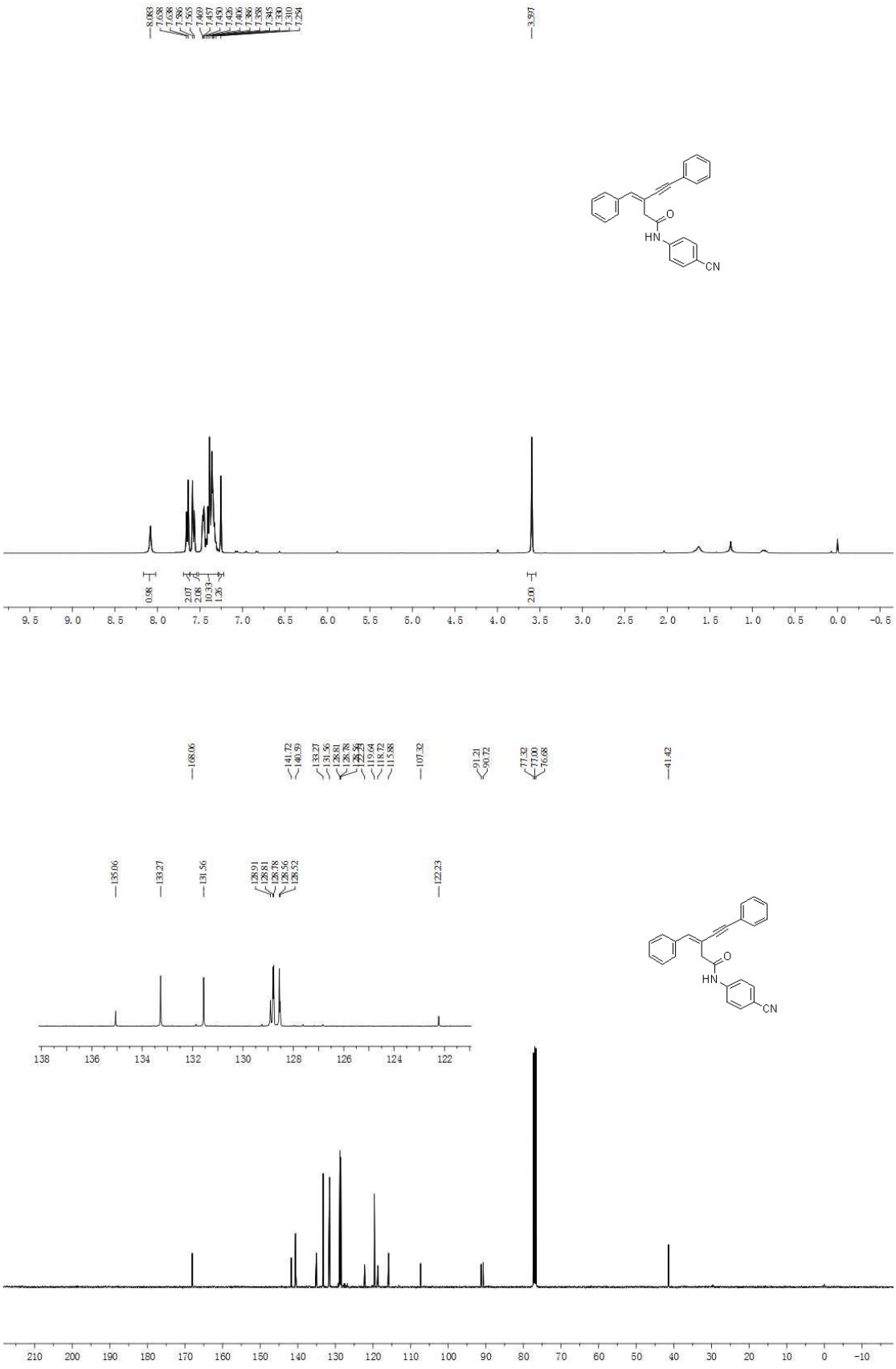
133.11
131.60
129.75
128.87
128.79
128.55
128.49
HN
O
O

Product 4j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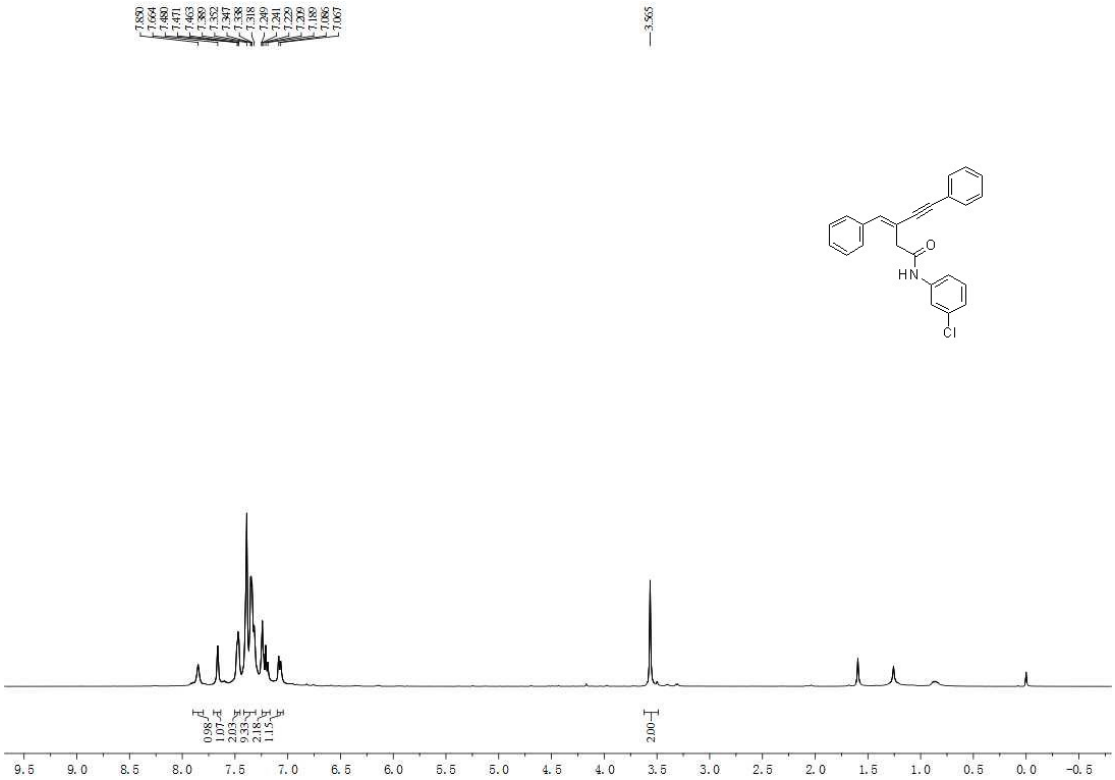
7.460
7.457
7.430
7.425
7.406
7.396
7.386
7.345
7.330
7.310
7.294
3.997
HN
O
CN
0.98
2.07
2.08
10.33
1.26
2.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
168.06
141.72
140.59
133.27
131.56
128.81
128.78
128.56
128.52
119.64
118.72
115.88
107.32
91.21
90.72
77.32
77.00
76.68
41.42
135.06
133.27
131.56
129.91
128.81
128.78
128.56
128.52
122.23
138 136 134 132 130 128 126 124 122
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10

Product 4k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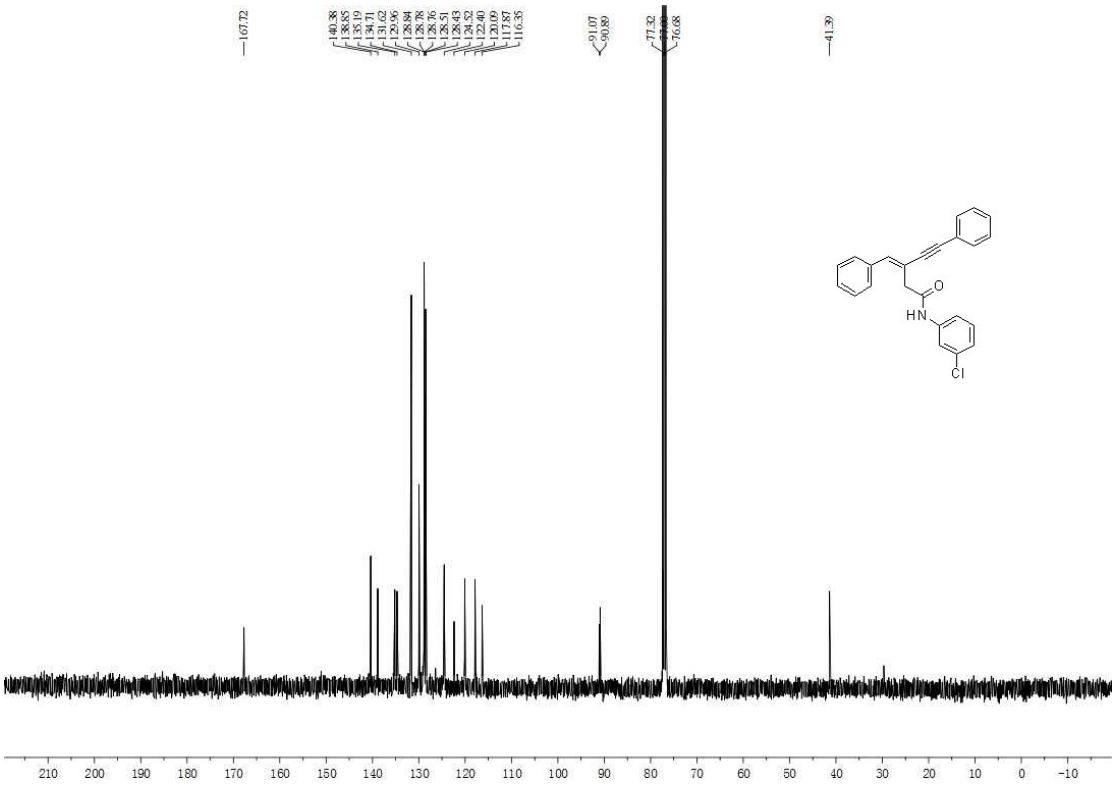
7.338
7.318
7.269
7.241
7.229
7.209
7.189
7.086
7.067
3.565
O
HN
Cl
0.98
1.07
2.03
9.33
2.18
1.15
2.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5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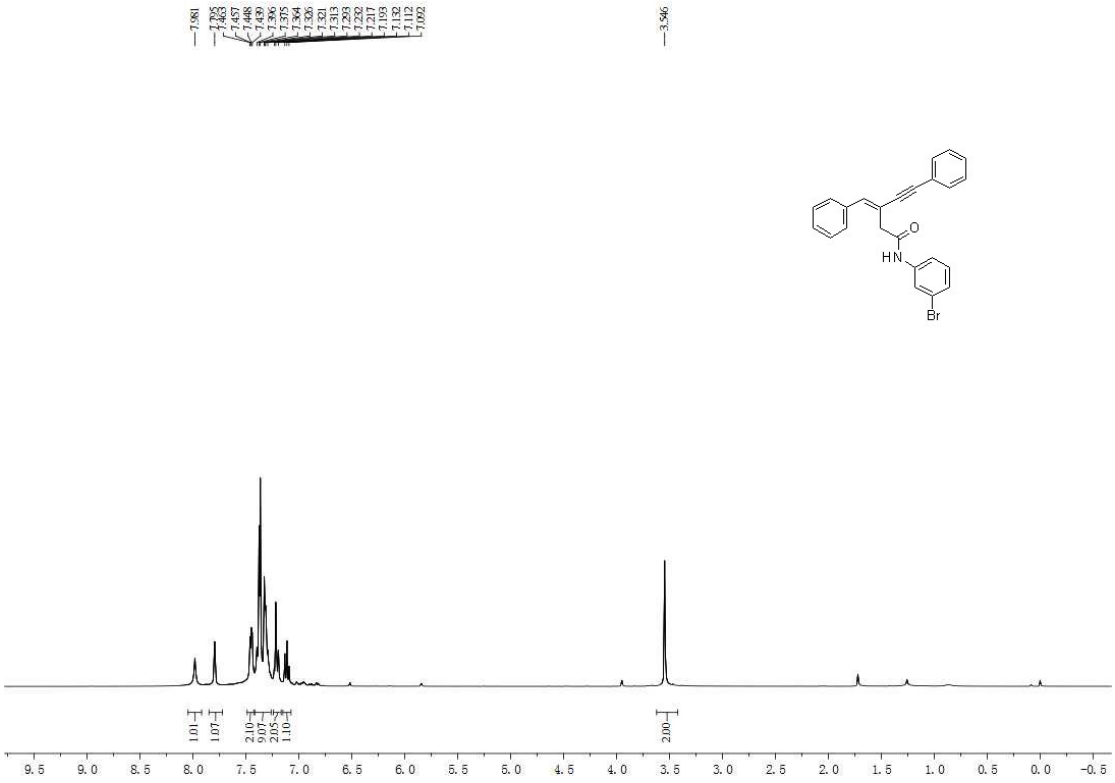
135.19
134.71
131.62
129.96
129.84
128.78
128.76
128.51
128.43
124.52
122.40
120.09
117.87
116.35
91.07
90.89
77.32
76.68
41.39
O
HN
Cl
210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10

Product 4l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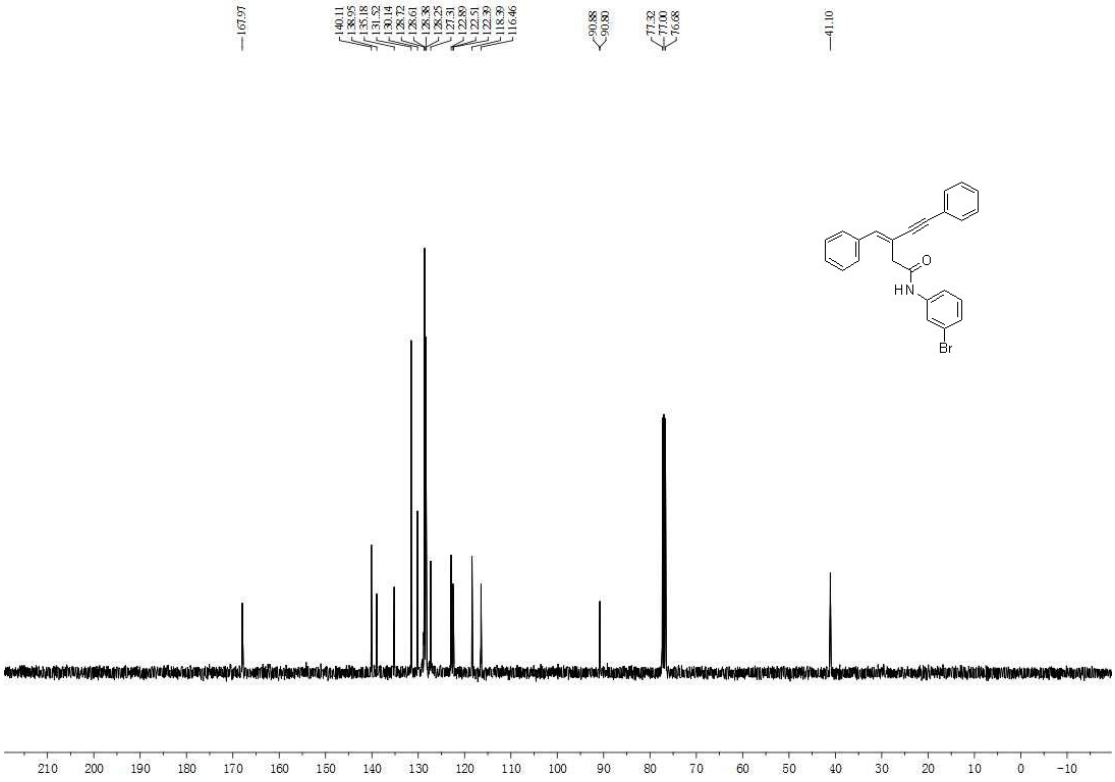
7.232
7.217
7.193
7.132
7.112
7.092
3.546
O
HN
Br
1.01
1.07
2.10
9.07
2.05
1.10
2.00
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5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122.51
122.39
118.39
116.46
90.88
90.80
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41.10
O
HN
Br
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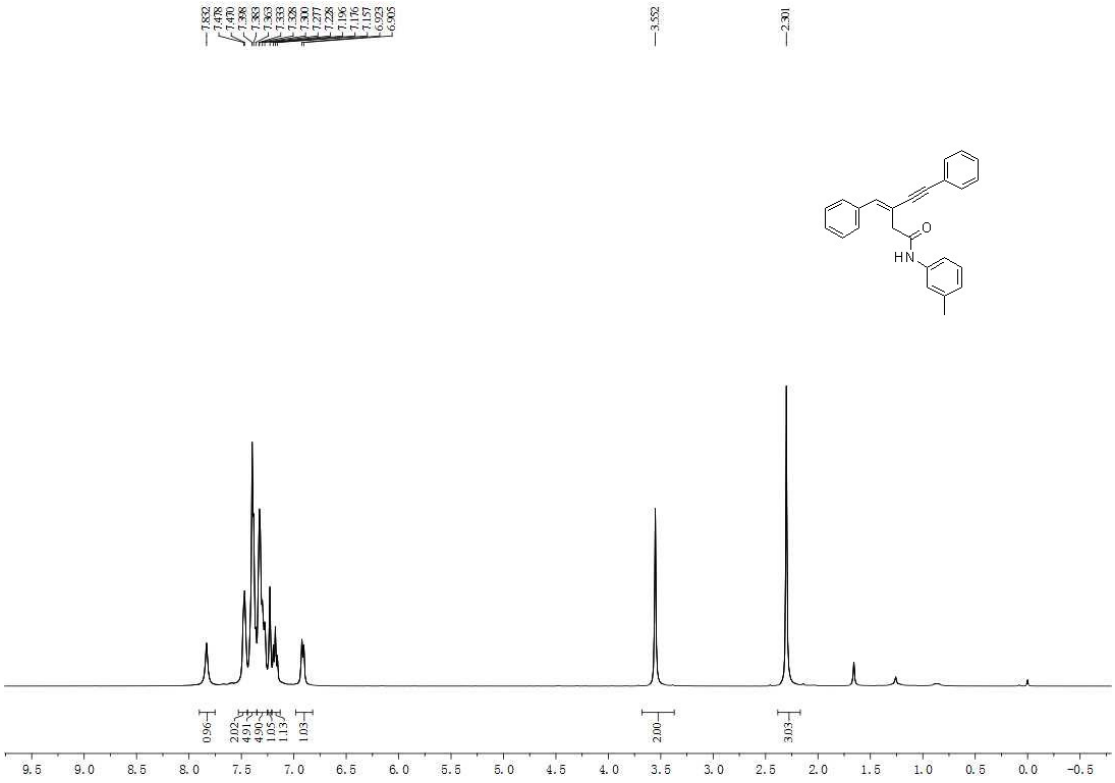
Product 4m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7.308
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7.277
7.228
7.196
7.176
7.157
7.078
6.905
3.552
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O
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1.05
1.13
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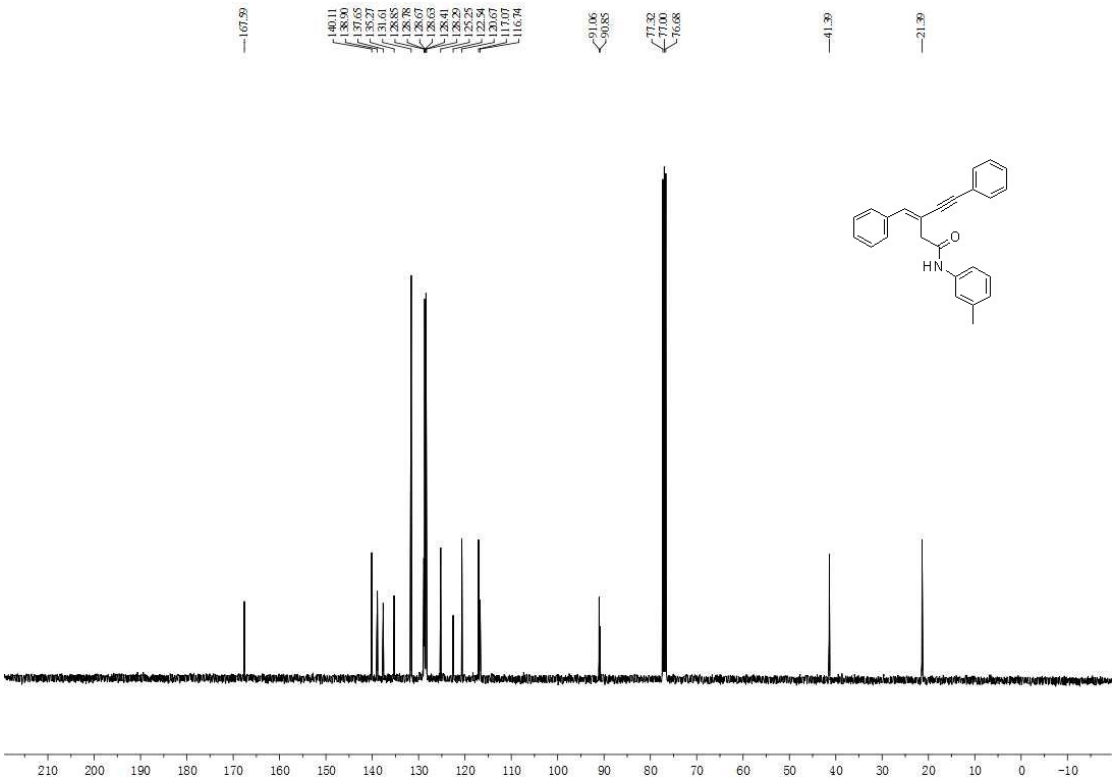
3.03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125.25
122.54
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76.68
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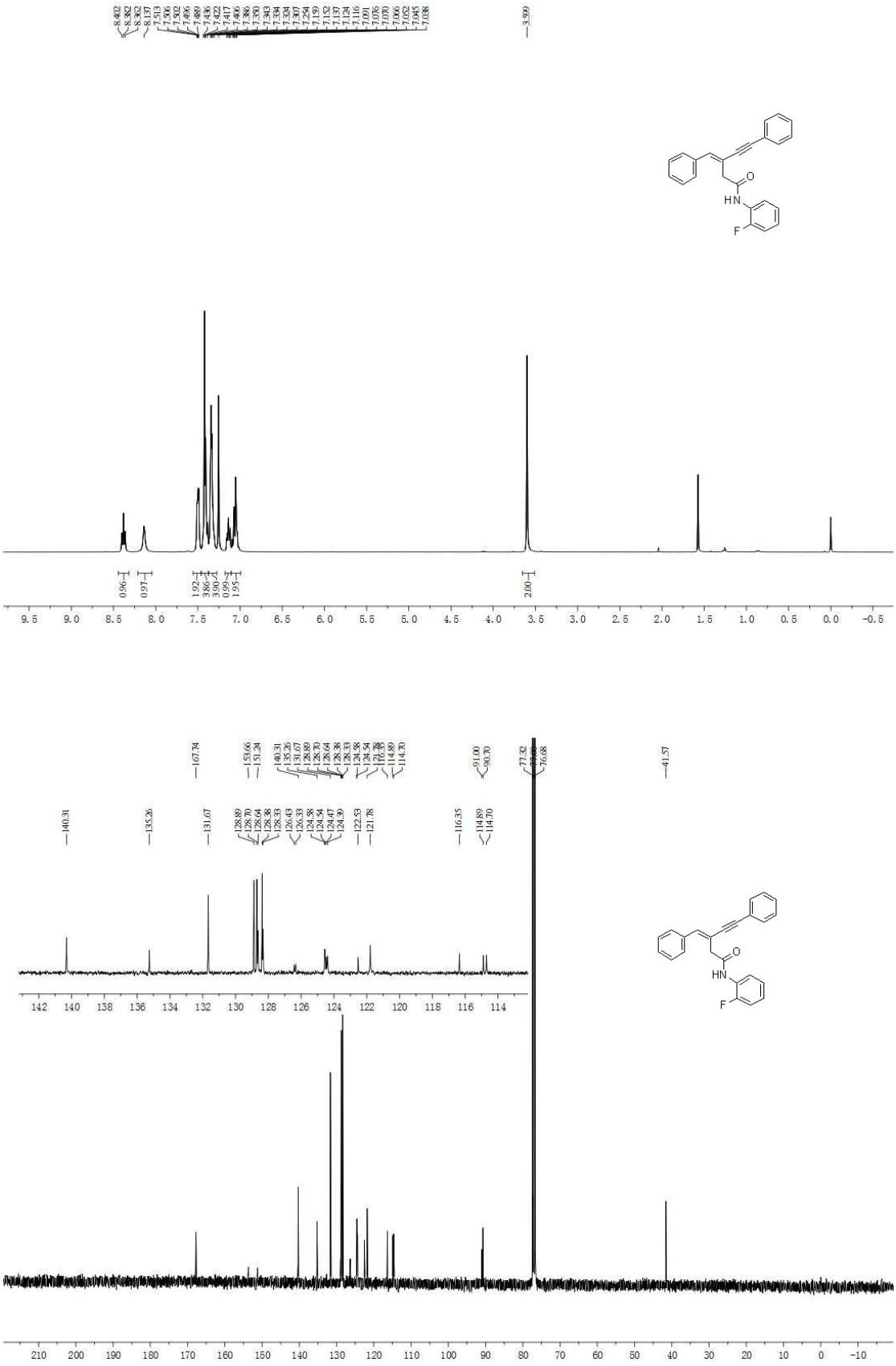
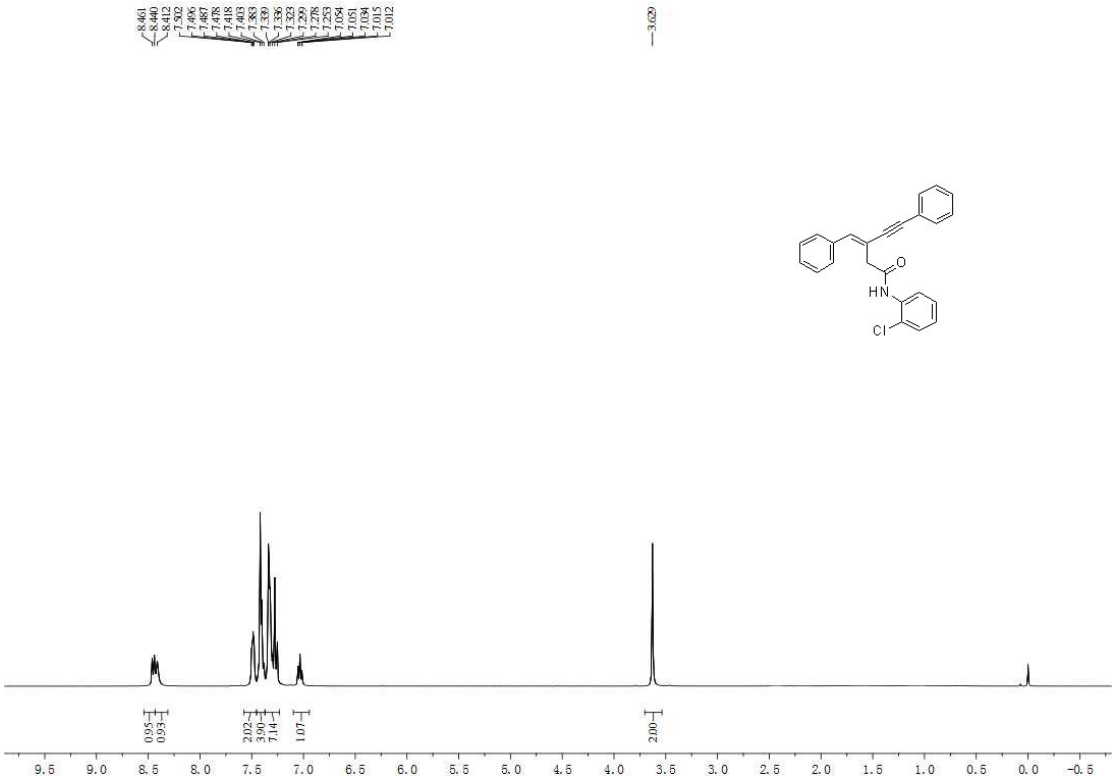
21.39
HN
O

Product 4n



Product 4o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7.418
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7.323
7.299
7.278
7.253
7.054
7.051
7.034
7.015
7.012
3.629
O
HN
Cl
0.95
0.93
2.02
3.90
7.14
1.07
2.00
9.5
9.0
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7.0
6.5
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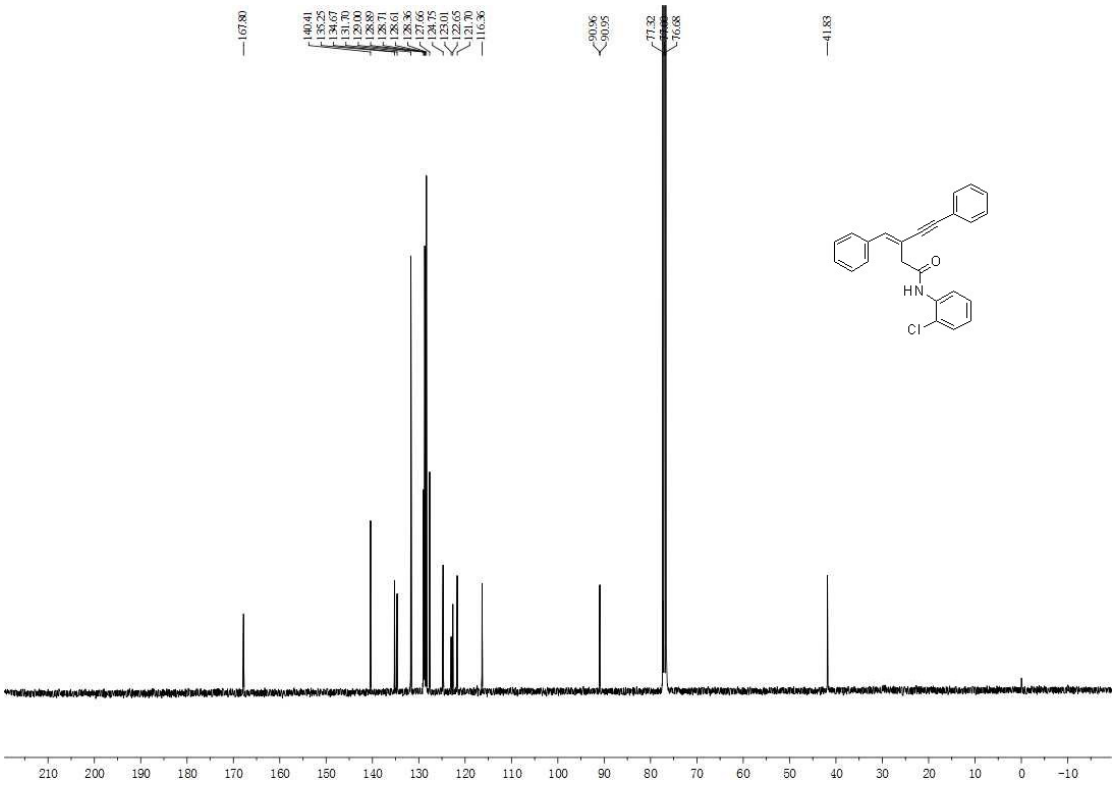
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77.32
77.00
76.68
41.83
O
HN
Cl
210
200
190
180
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80
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50
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30
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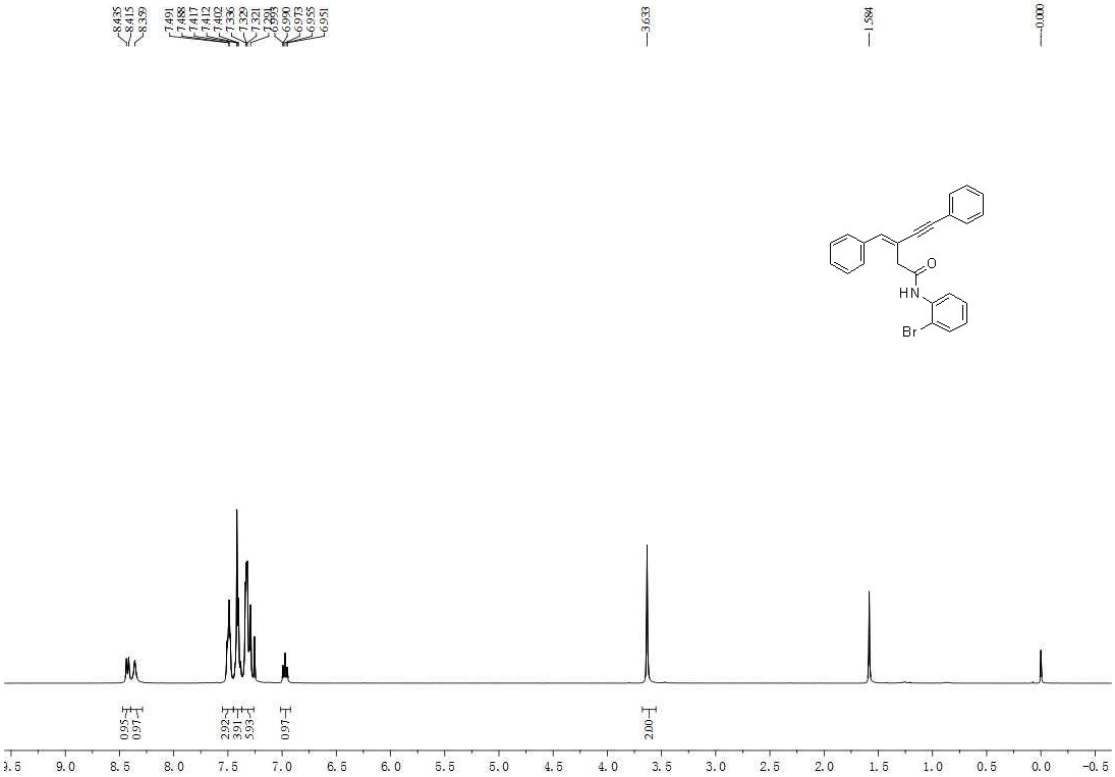
-10

Product 4p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7.402
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7.321
7.301
6.993
6.990
6.973
6.955
6.951
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HN
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Br
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2.92
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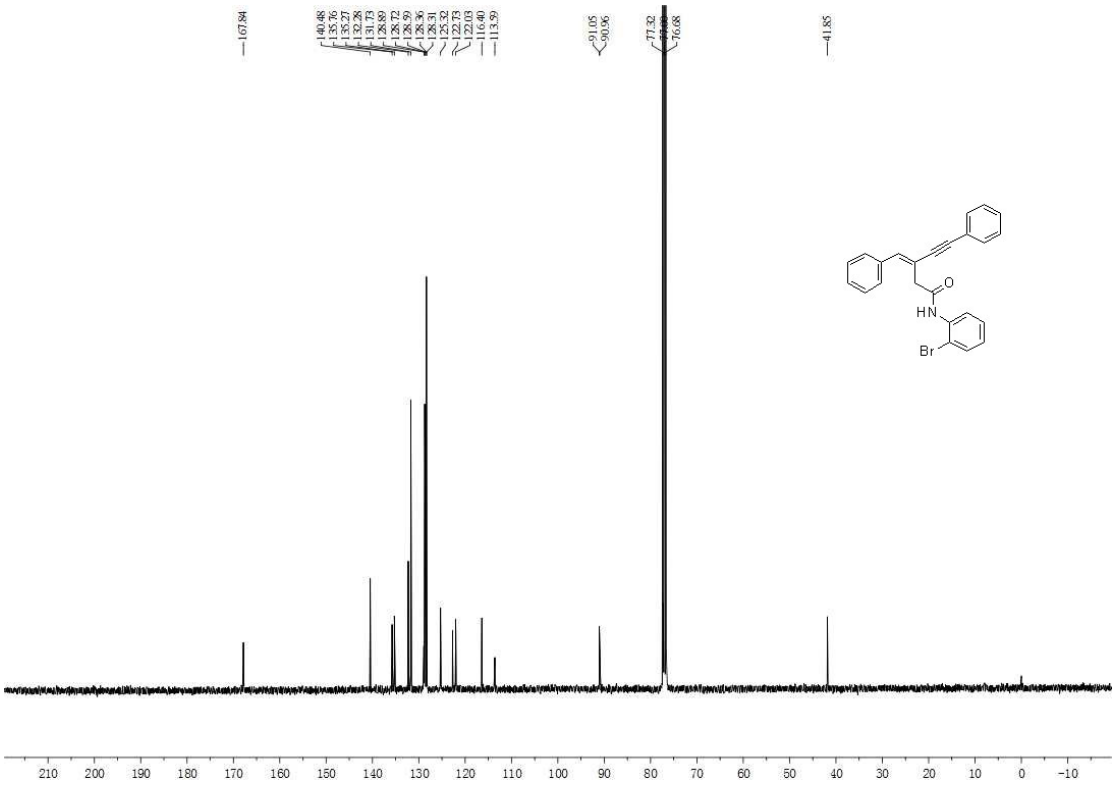
5.93
0.97
2.00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128.31
125.32
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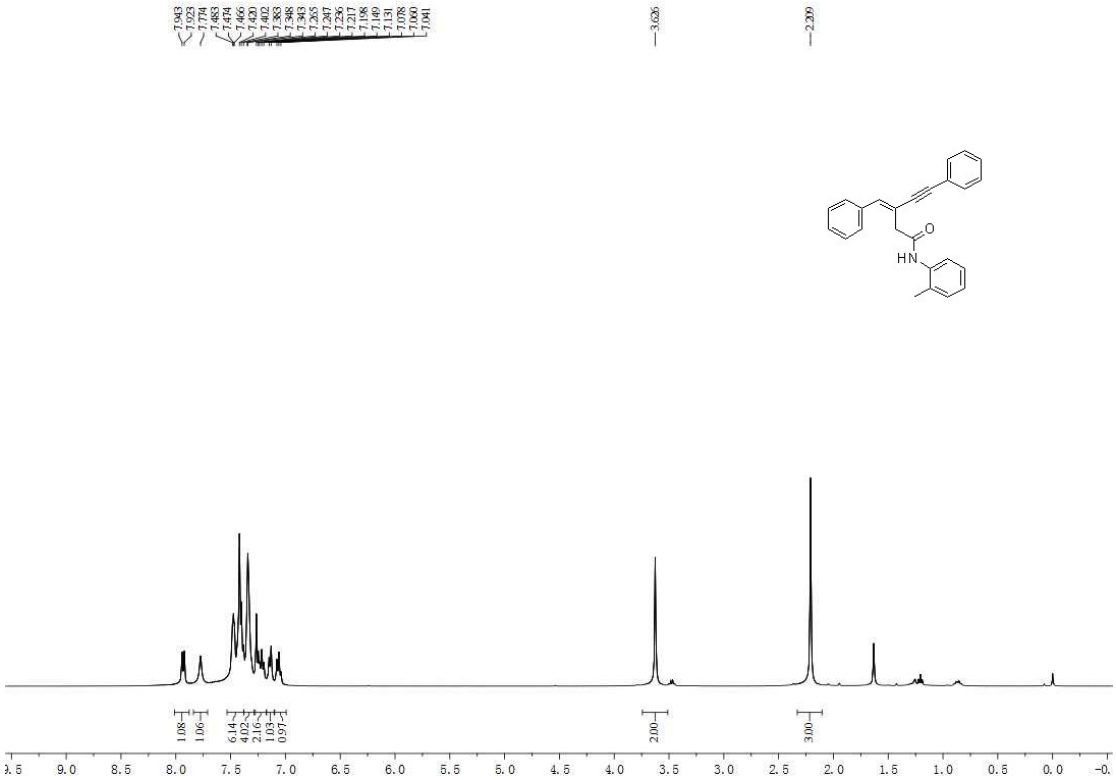
116.40
113.99
91.05
90.36
77.32
76.68
41.85
HN
O
Br

Product 4q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7.247
7.236
7.217
7.198
7.149
7.131
7.078
7.060
7.041
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2.16
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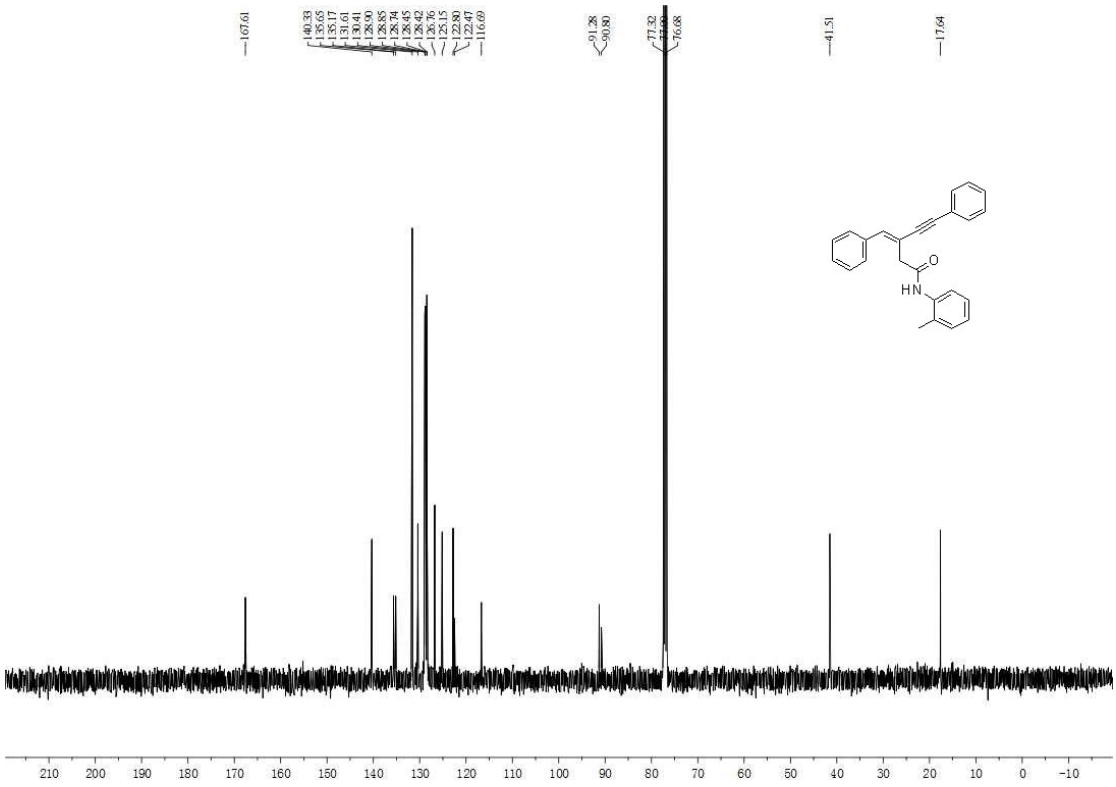
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128.85
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125.15
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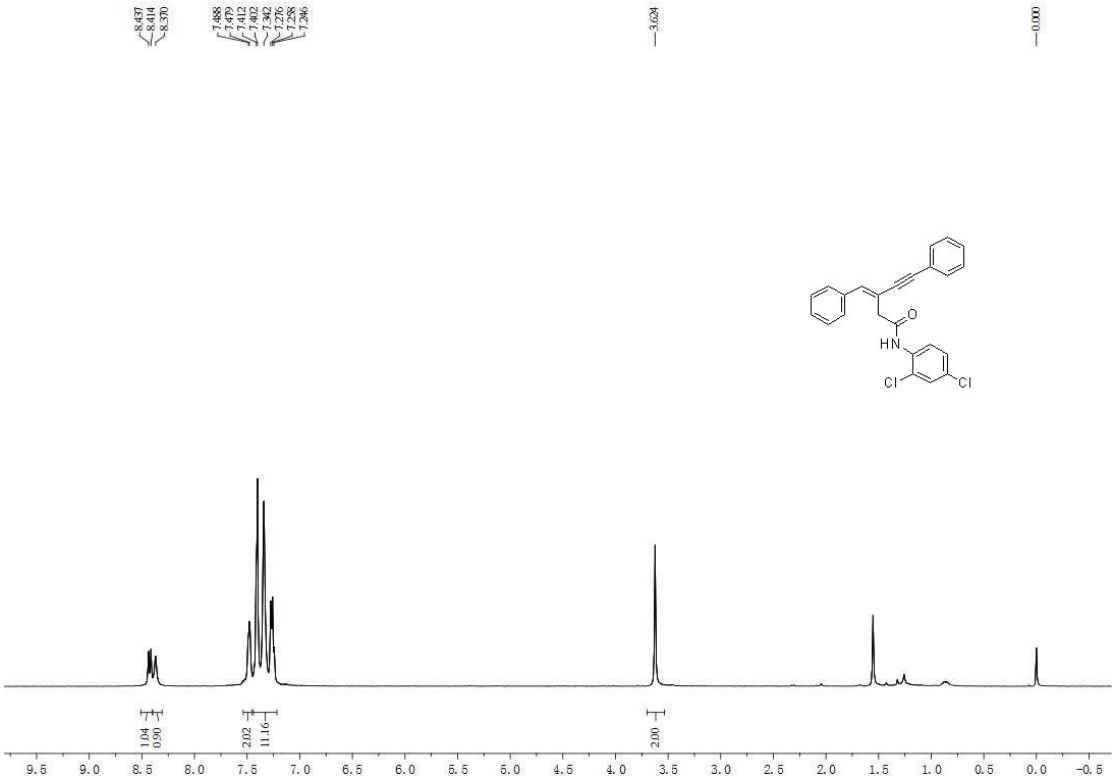
77.32
77.00
76.68
41.51
17.64
HN
O

Product 4r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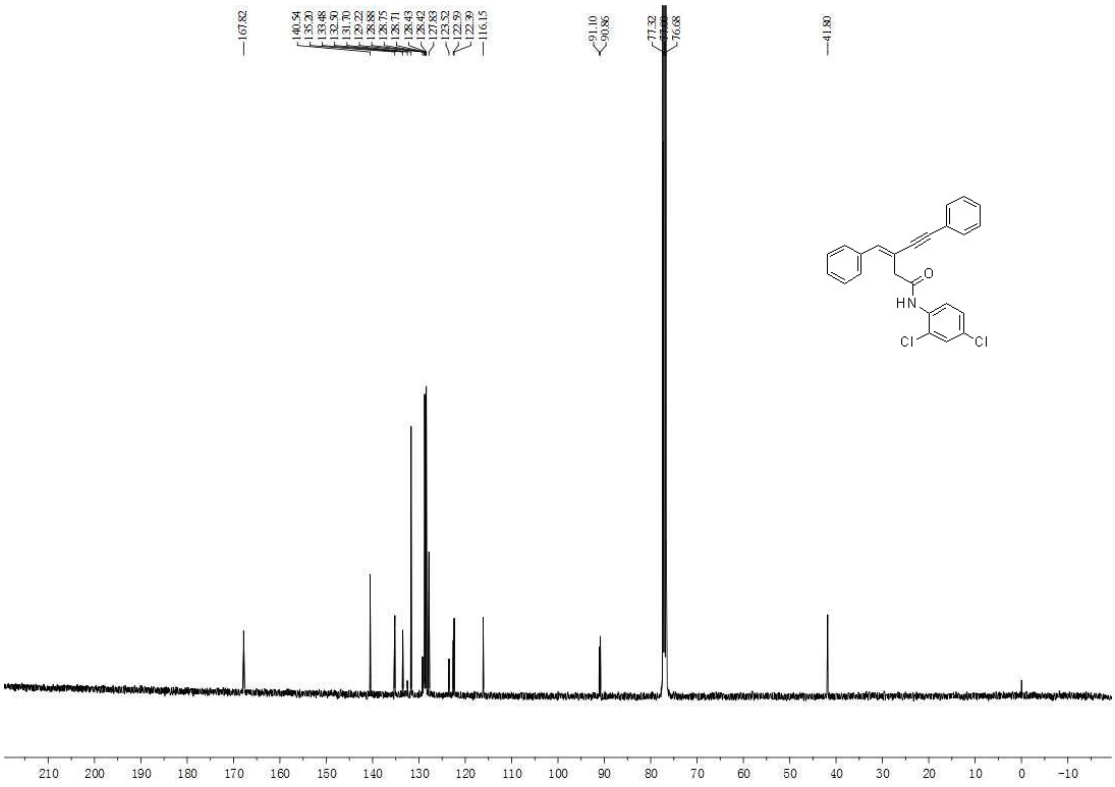
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127.83
123.52
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116.15
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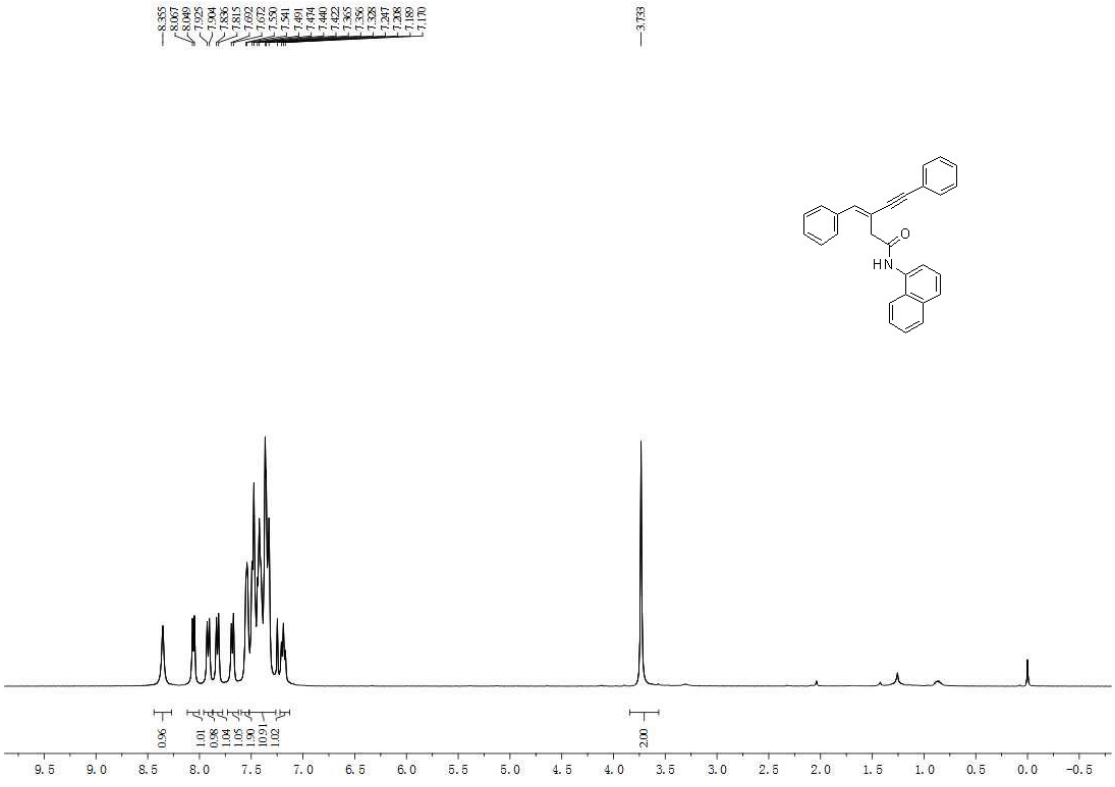
76.68
41.80
HN
Cl
Cl

Product 4s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7.422
7.365
7.356
7.328
7.247
7.208
7.189
7.170
3.733
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1.01
0.98
1.04
1.05
1.90
10.91
1.02
2.00
9.5
9.0
8.5
8.0
7.5
7.0
6.5
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5.0
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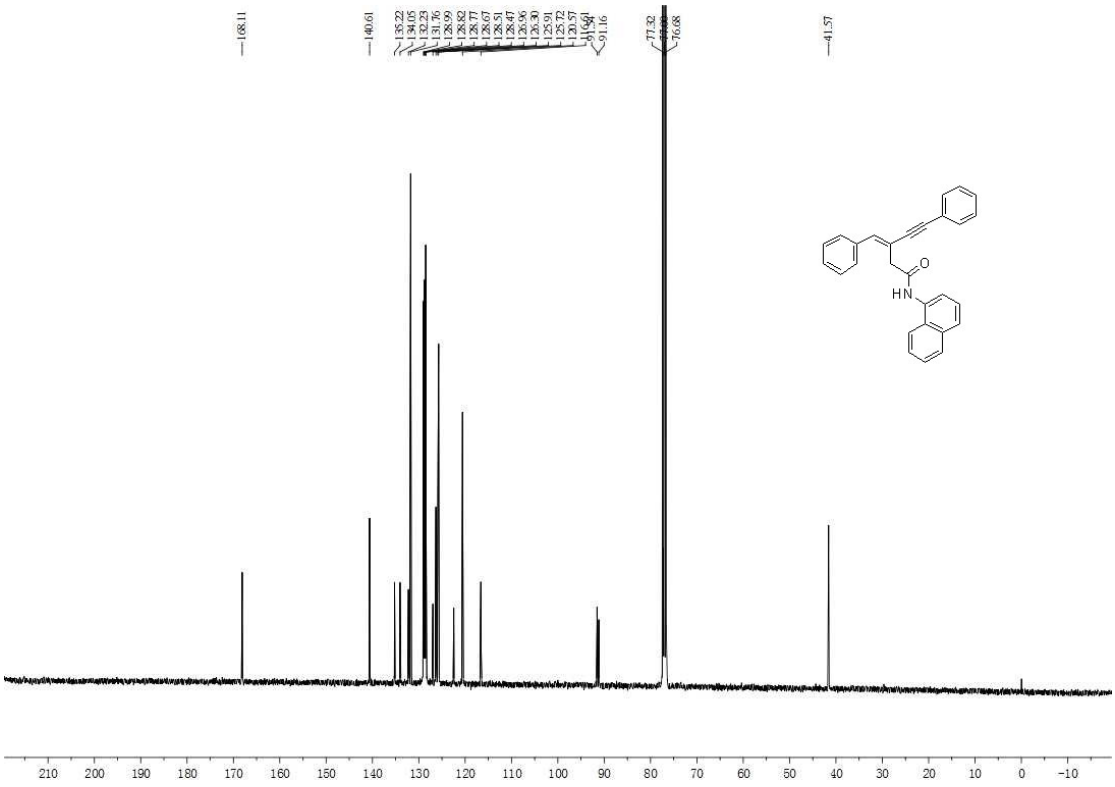
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126.96
126.30
125.91
125.72
120.57
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91.16
77.32
77.00
76.68
41.57
210
200
190
180
170
160
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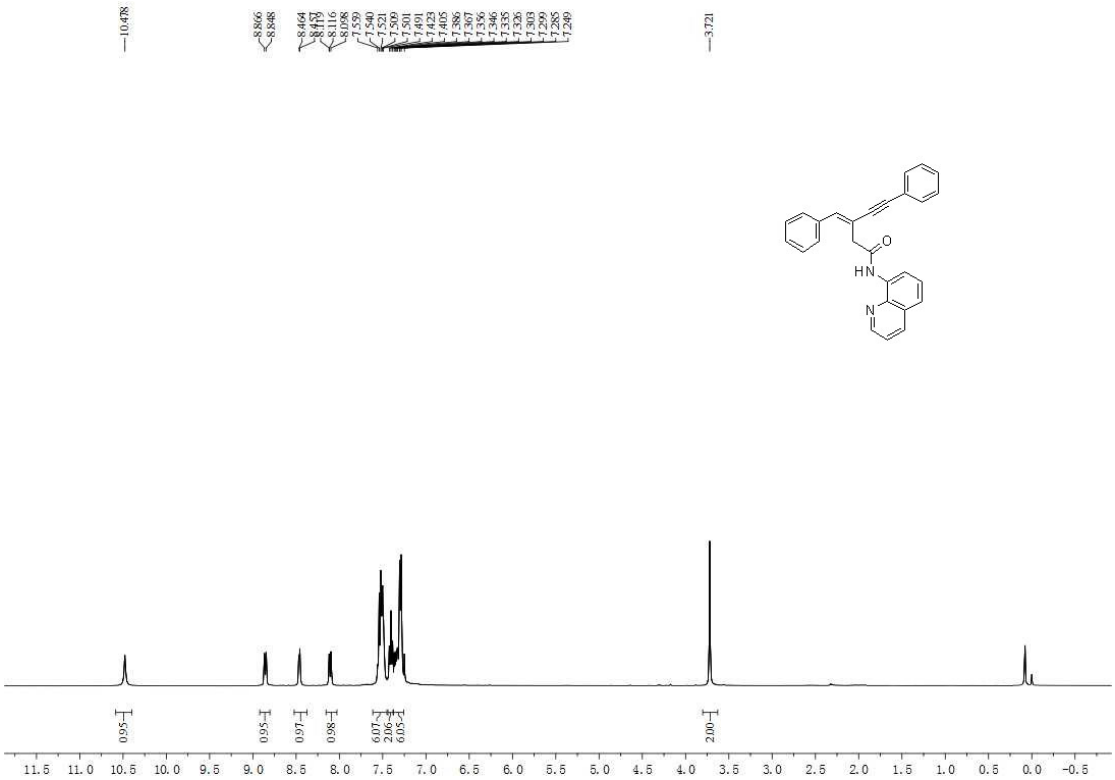
Product 4t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7.423
7.405
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7.303
7.299
7.285
7.249
3.721
O
HN
N
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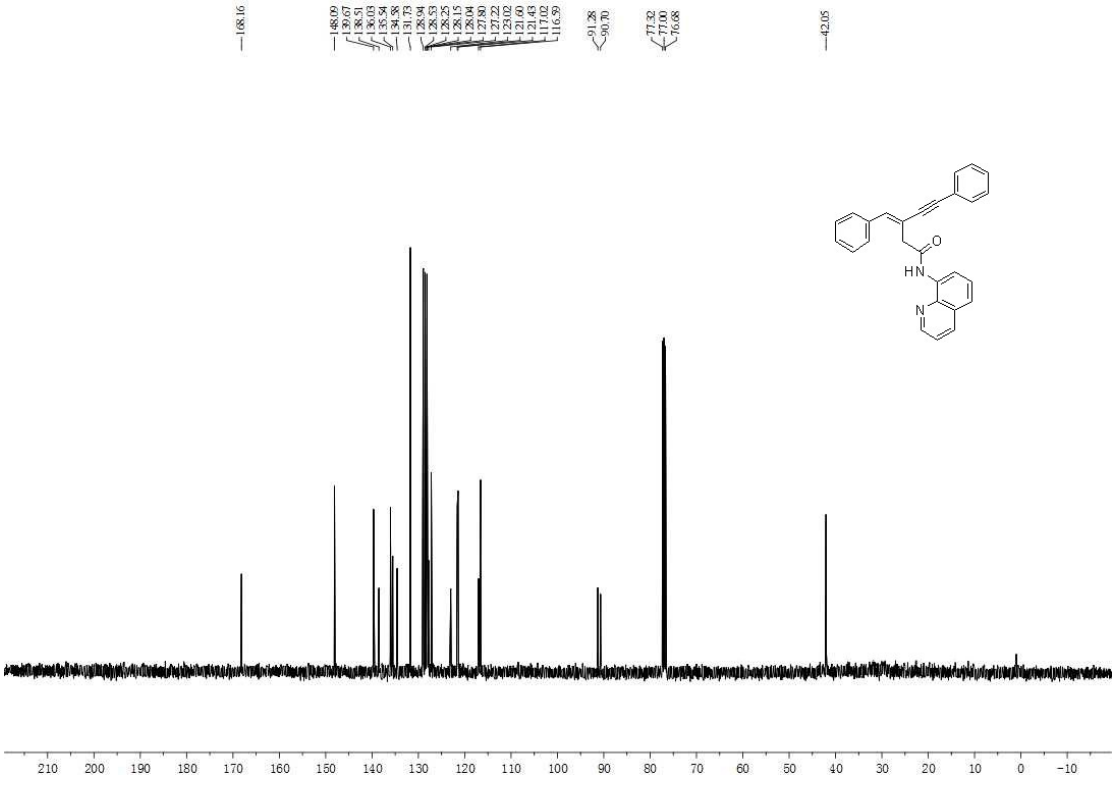
0.95
0.97
0.98
6.07
2.06
6.05
2.00
11.5 11.0 10.5 10.0 9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5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127.22
123.02
121.60
121.43
117.02
116.59
91.28
90.70
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76.68
42.05
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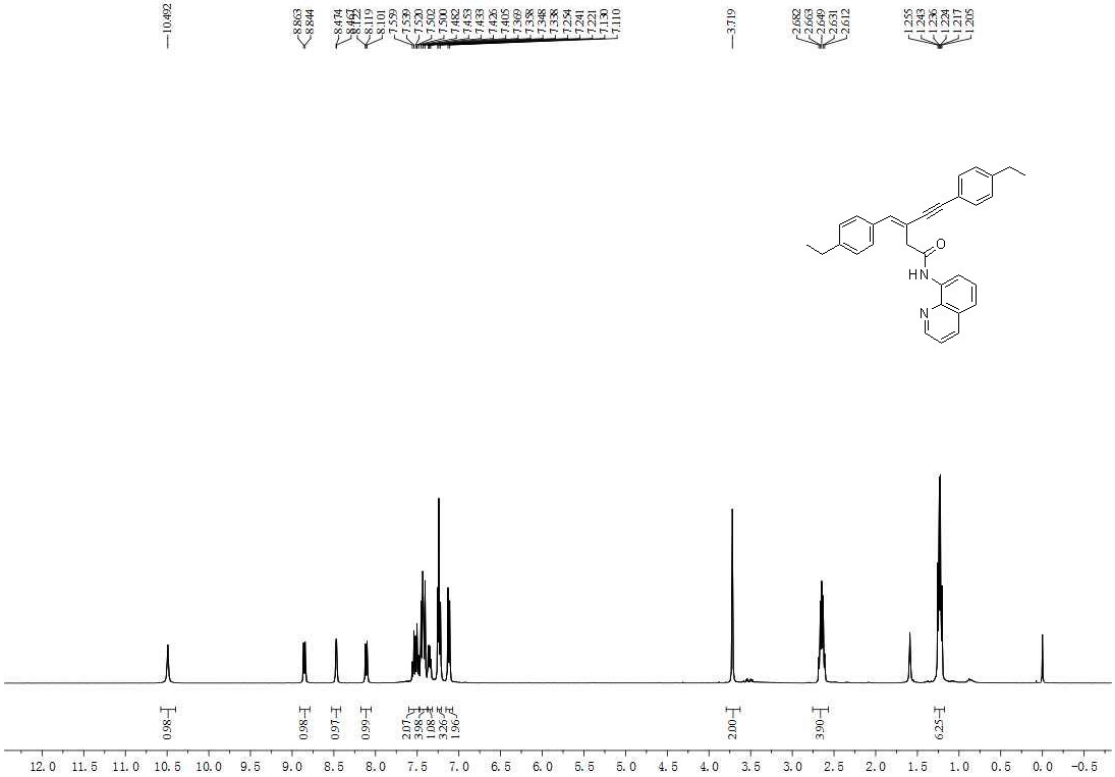
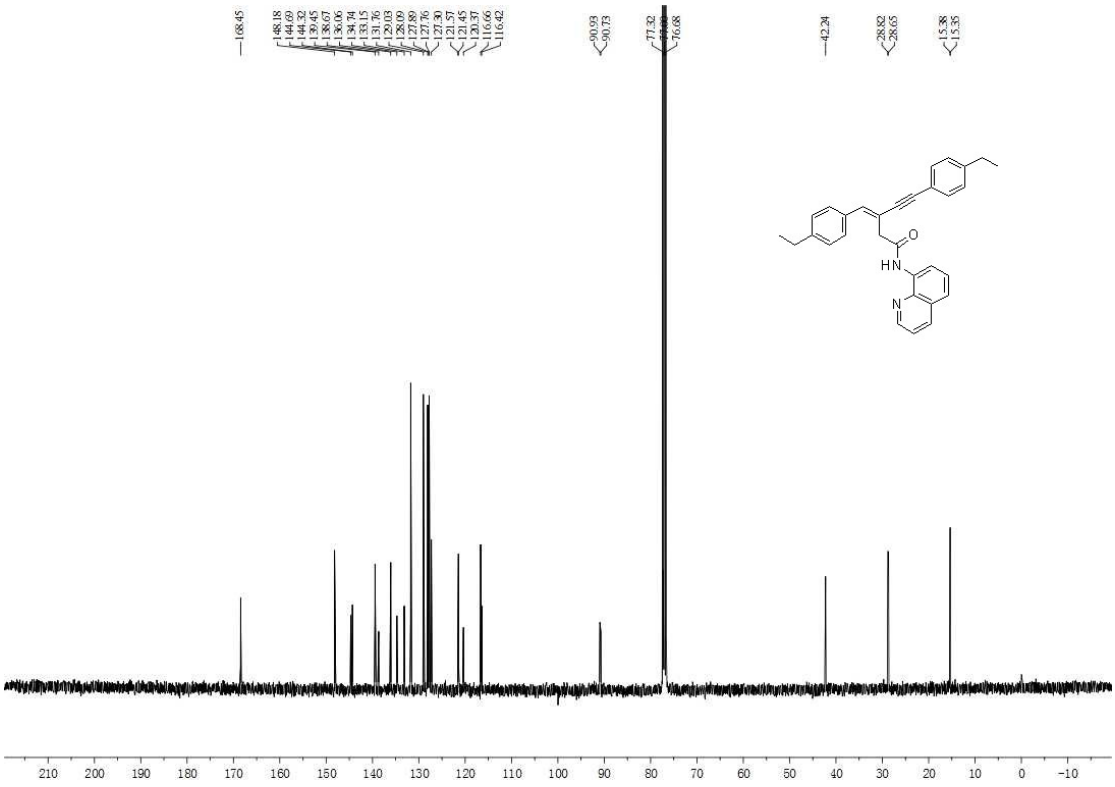
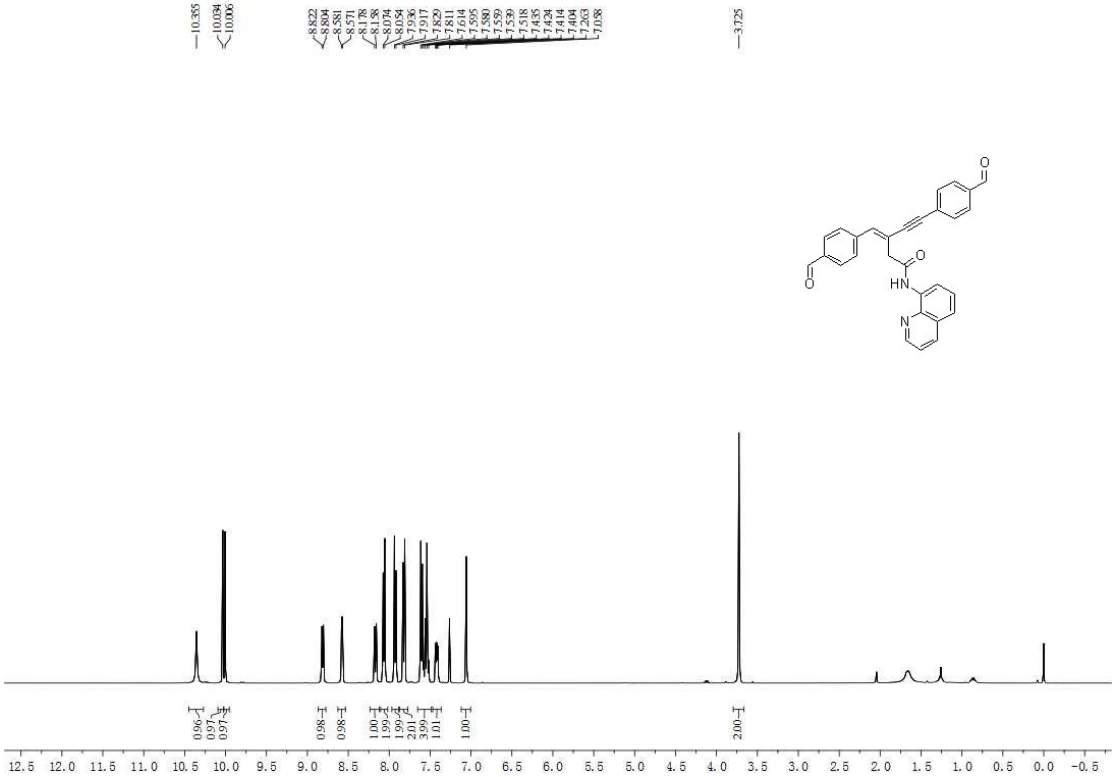
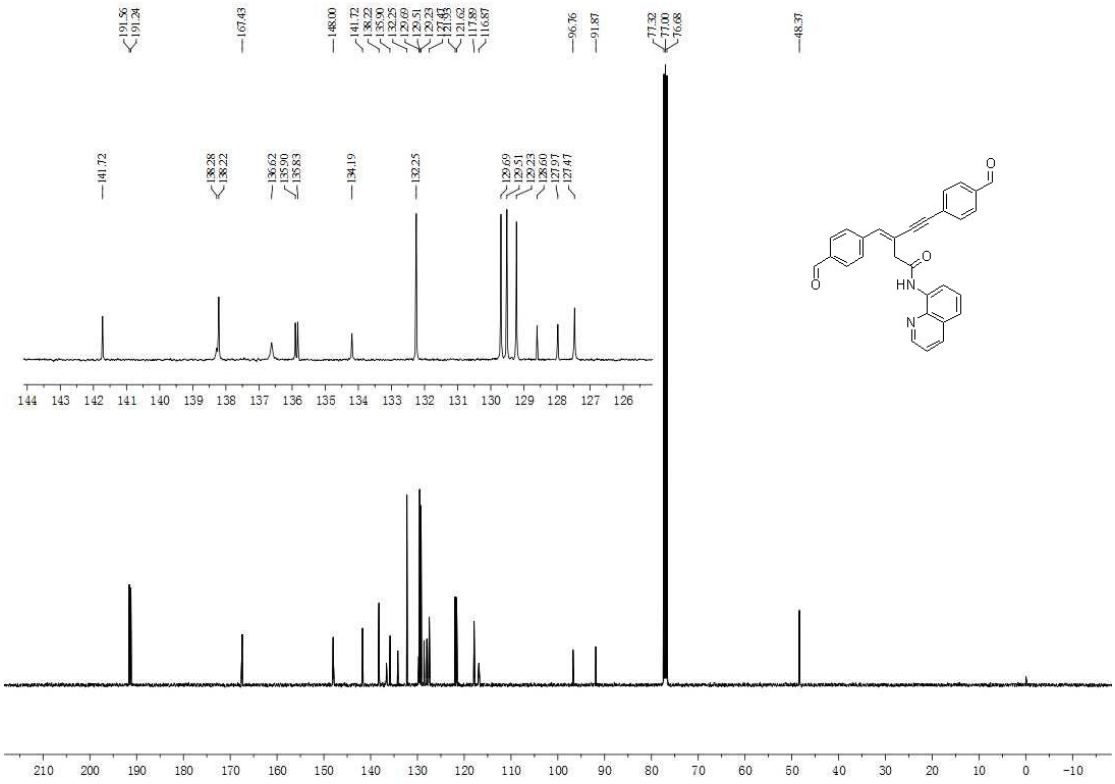
Product 4u



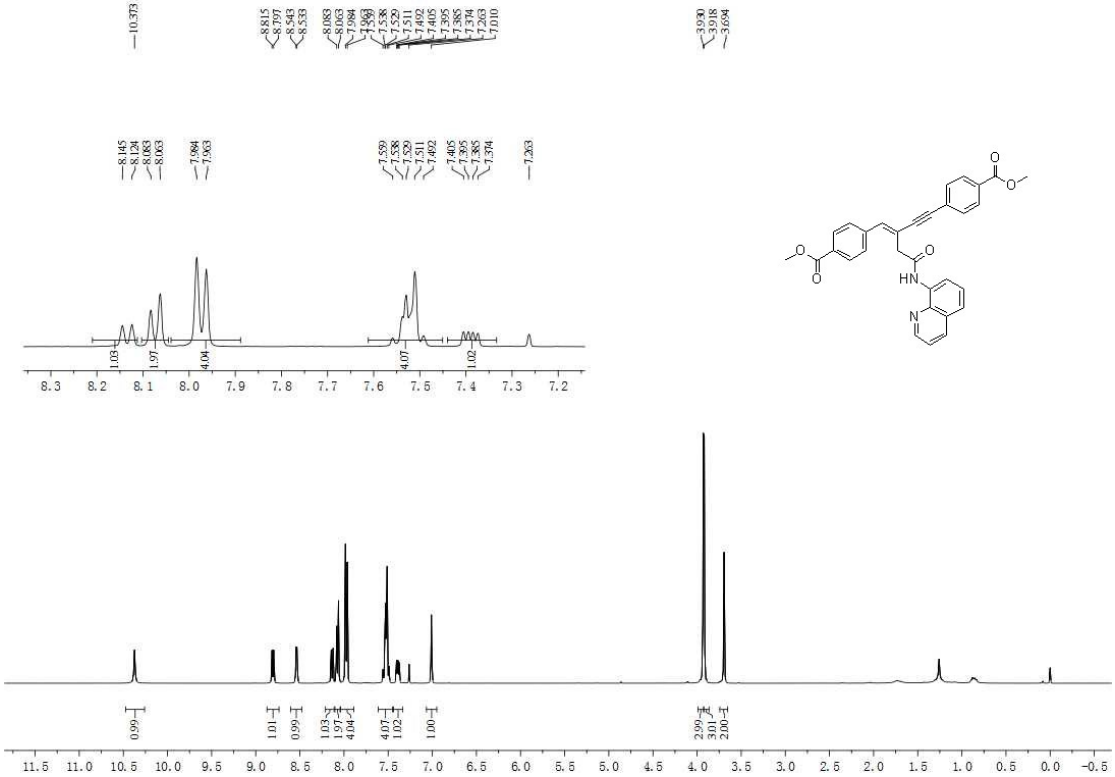


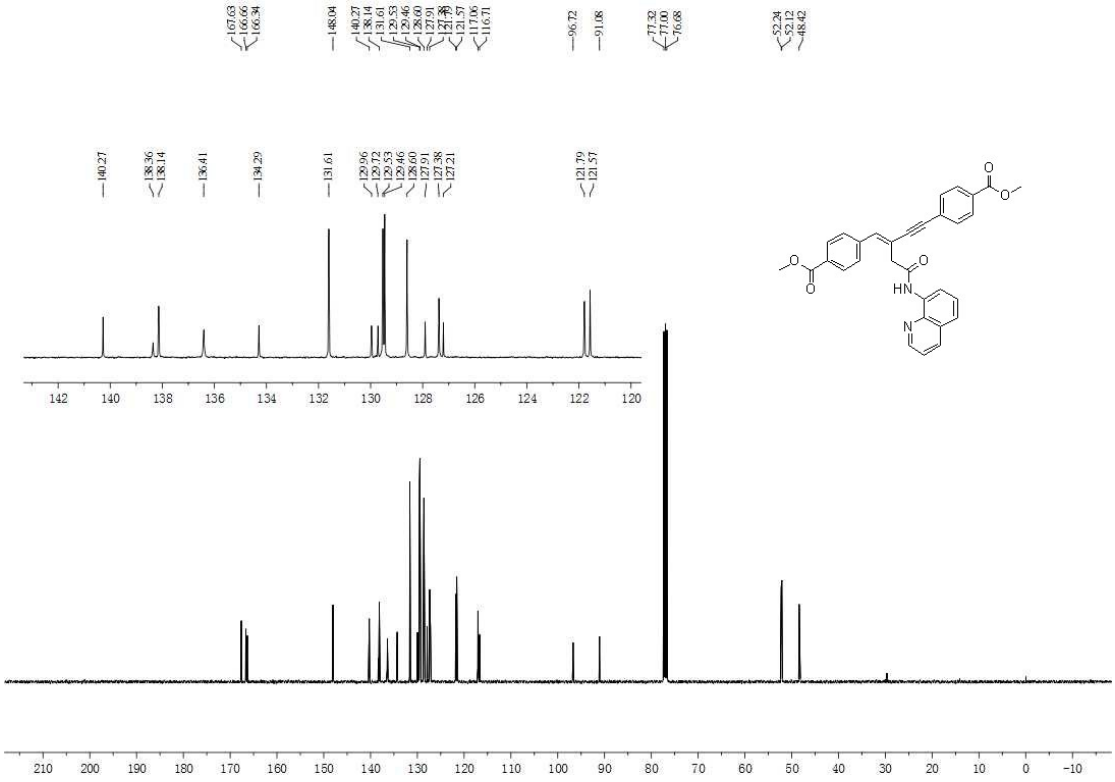
Product 4v



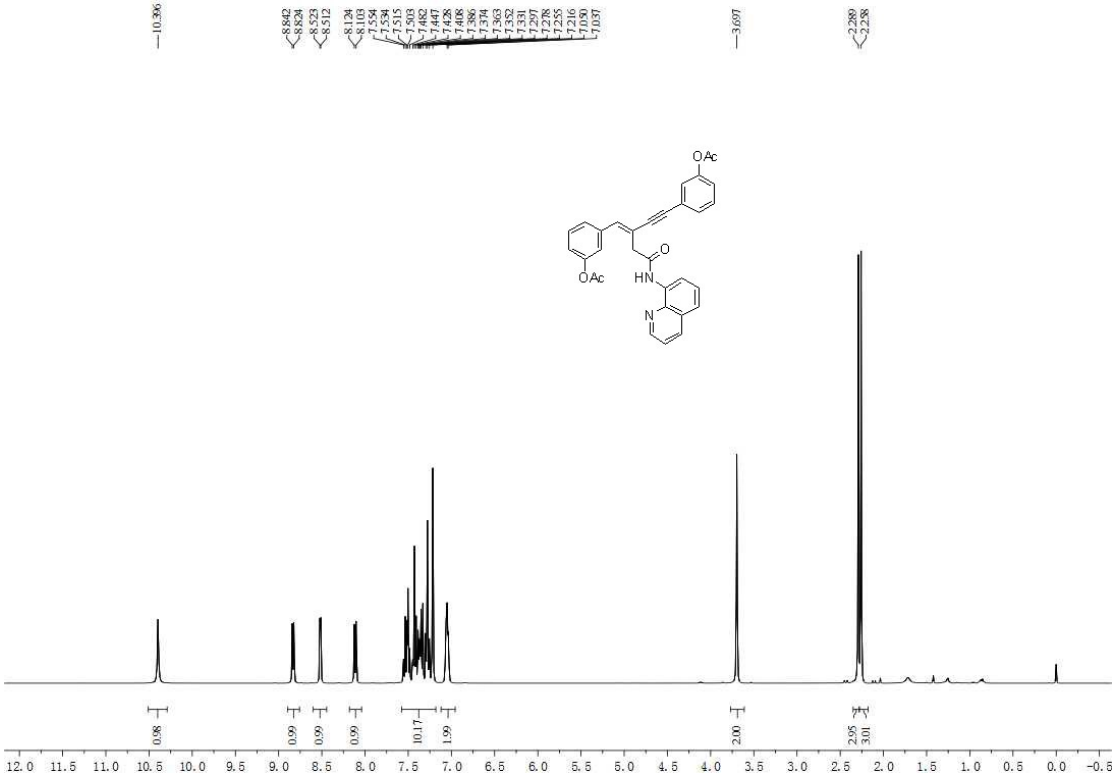


Product 4w





Product 4x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7.386
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7.255
7.216
7.050
7.037
3.697
2.289
2.238
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OAc
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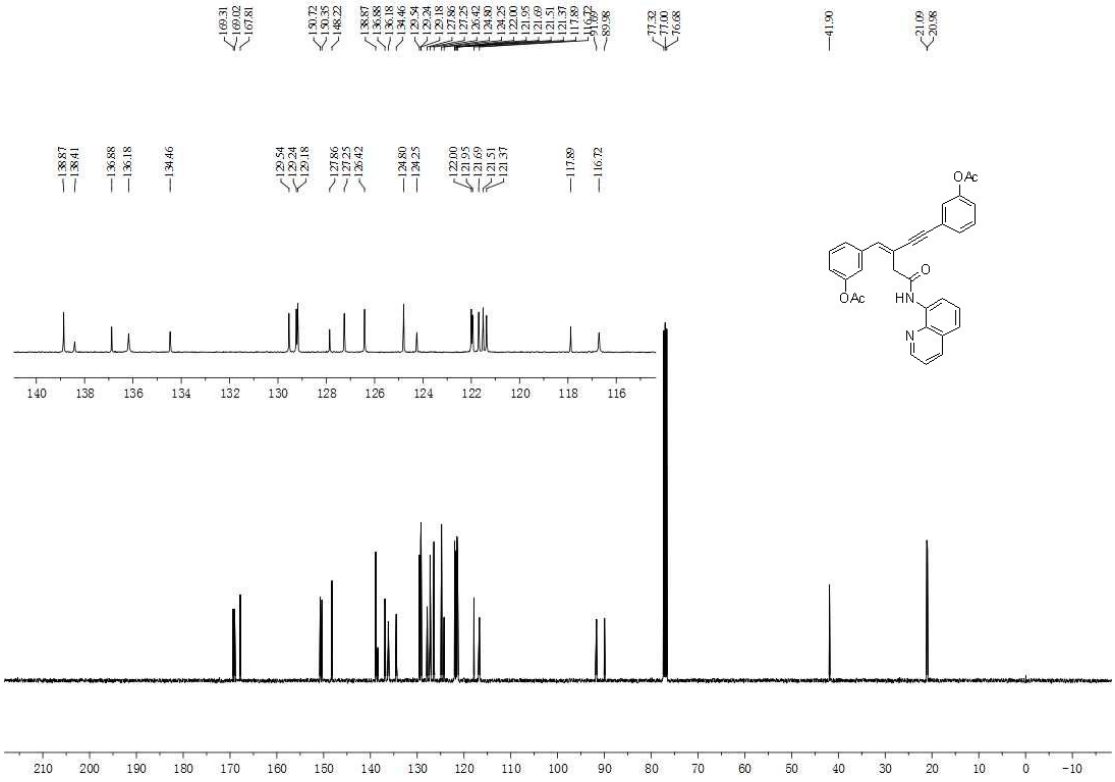
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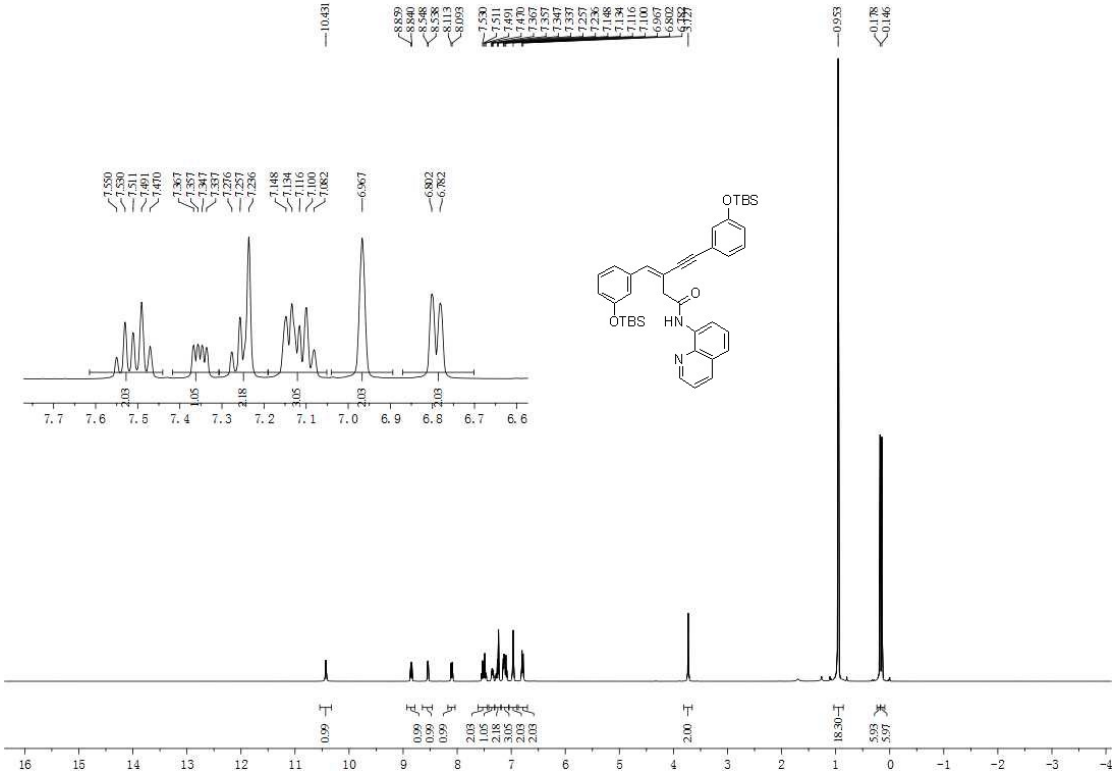
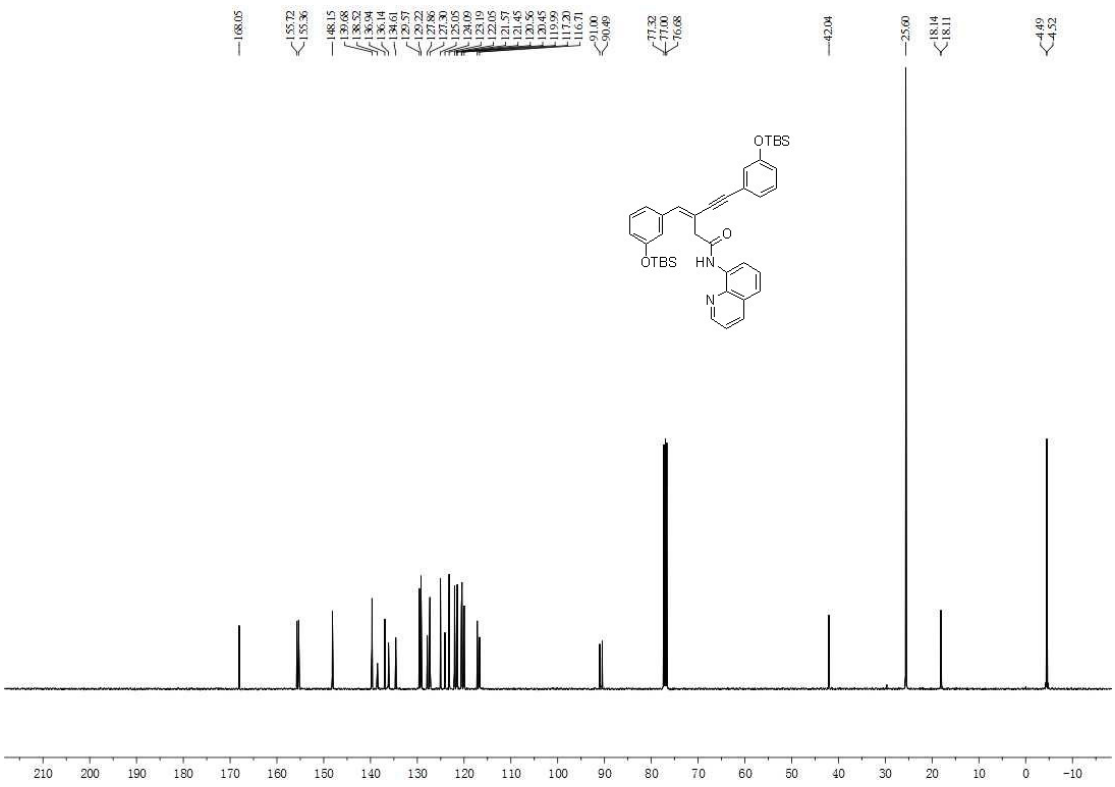
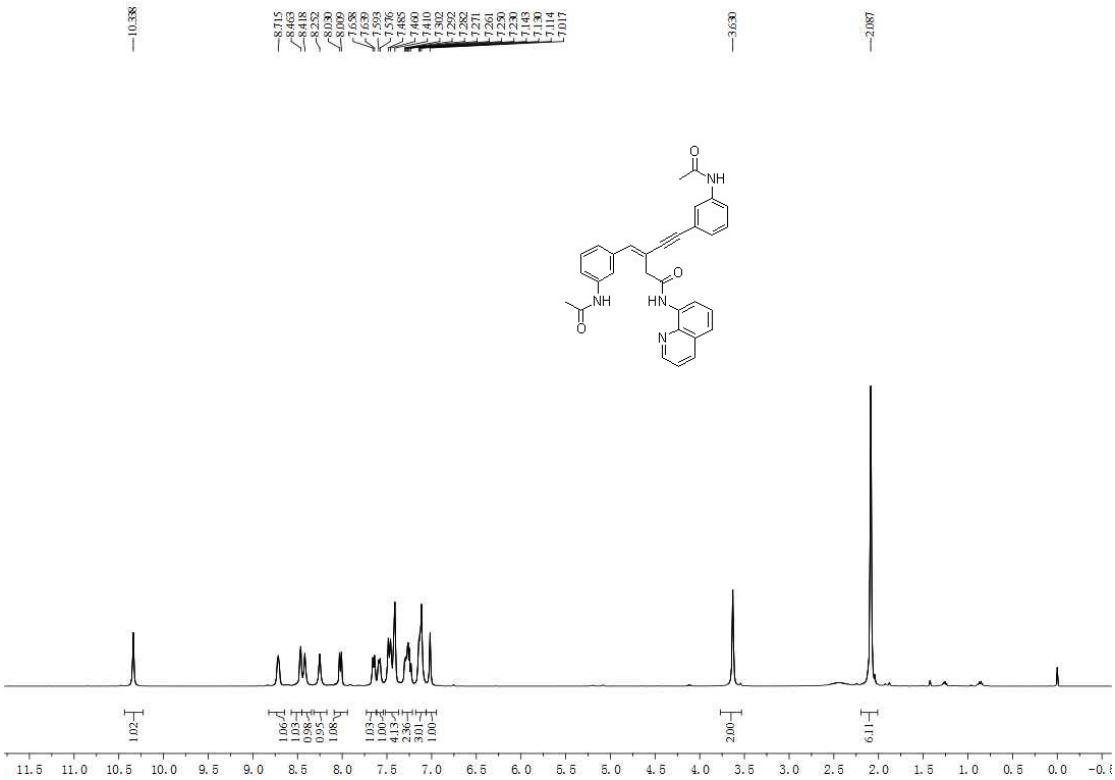
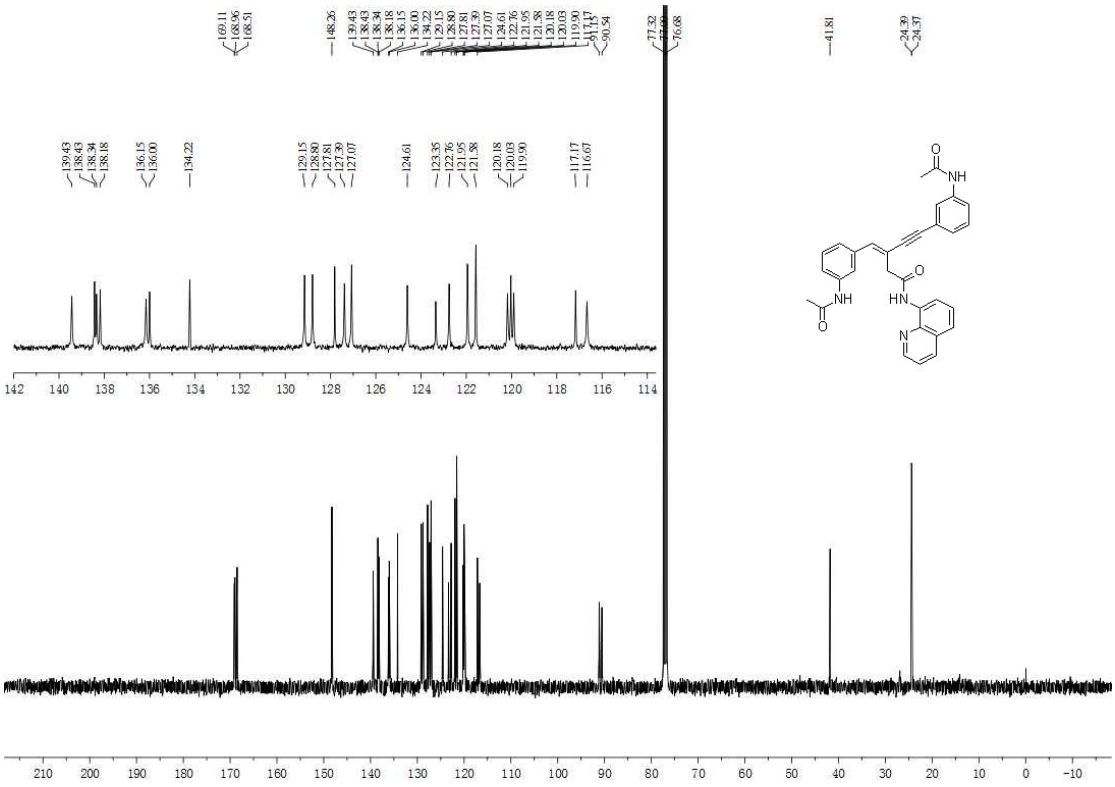
Product 4y





Product 4z





Product 4aa