Supporting Information

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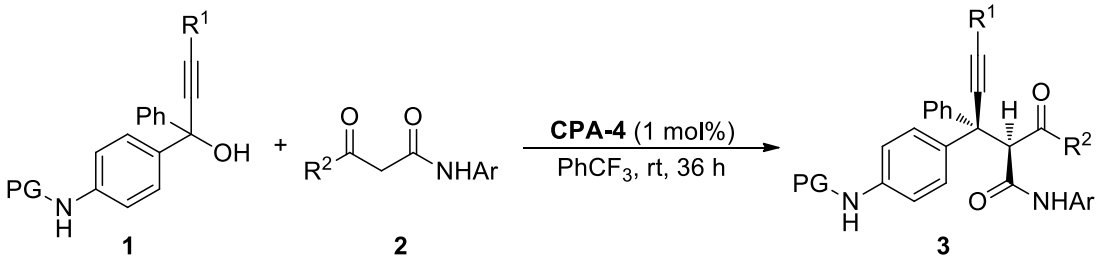
A: General Information and Starting Materials

General Information. Proton nuclear magnetic resonance (^{1}H NMR) spectra and carbon nuclear magnetic resonance (^{13}C NMR) spectra were recorded on a Bruker ACF300 spectrometer (500 MHz and 125 MHz). Chemical shifts for protons are reported in parts per million downfield from tetramethylsilane and are referenced to residual protium in the NMR solvent ($(CD_3)_2SO$: δ 2.50). Chemical shifts for carbon are reported in parts per million downfield from tetramethylsilane and are referenced to the carbon resonances of the solvent ($(CD_3)_2SO$: δ 39.50). Data are represented as follows: chemical shift, integration, multiplicity (br = broad, s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet), coupling constants in Hertz (Hz). All high resolution mass spectra were obtained on a Finnigan/MAT 95XL-T mass spectrometer. Optical Rotation was measured on a Rudolph Autopol I polarimeter. For thin layer chromatography (TLC), Merck pre-coated TLC plates (Merck 60 F254) were used, and compounds were visualized with a UV light at 254 nm. Flash chromatography separations were performed on Merck 60 (0.040-0.063 mm) mesh silica gel.

Starting Materials. All solvents, inorganic reagents and 3-oxo-*N*-phenylbutanamide were from commercial sources and used without purification unless otherwise noted. The propargylic alcohols were prepared following the literature procedures.[1]

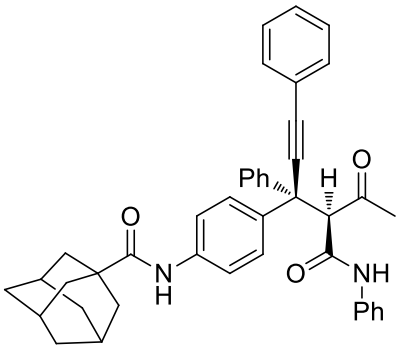
B: General Procedure



To a solution of $PhCF_3$ (0.3 mL) was added propargylic alcohol **1** (0.06 mmol), 3-oxo-*N*-phenylbutanamide **2** (0.05 mmol) and **CPA-4** (0.0005 mmol). The reaction mixture was stirred at room temperature for 36 h and then the solvent was removed under vacuum. The residue was purified by silica gel chromatography to yield the desired product **3**.

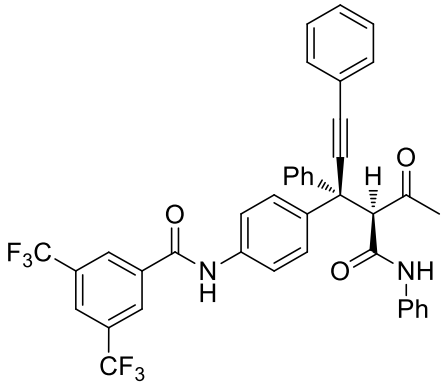
C: Characterization Data

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-5-oxo-1,3-diphenyl-4-(phenylcarbamoyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3aa)



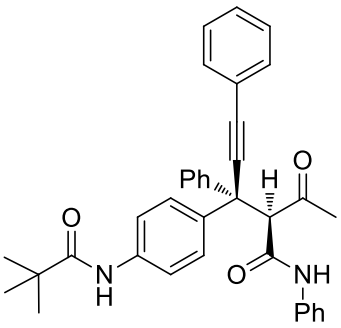
Eluent for flash column chromatography: petroleum ether/ethyl acetate = 6:1. Yellow solid, 29.1 mg, 94% yield. mp 107.3-110.7 ^{o}C. ^{1}H NMR ($(CD_3)_2SO$, 500 MHz): δ (ppm) 9.96 (s, 1H), 9.03 (s, 1H), 7.59-7.56 (m, 4H), 7.51 (s, 4H), 7.43-7.42 (m, 3H), 7.37-7.33 (m, 4H), 7.25-7.20 (m, 3H), 7.03-7.00 (m, 1H), 5.07 (s, 1H), 2.15 (s, 3H), 1.96 (s, 3H), 1.82 (s, 6H), 1.65 (s, 6H). ^{13}C NMR ($(CD_3)_2SO$, 125 MHz): δ (ppm) 202.0, 176.3, 165.1, 144.0, 138.8, 138.4, 138.1, 131.7, 129.2, 129.1, 128.9, 127.3, 127.2, 127.1, 124.2, 123.5, 120.2, 120.1, 119.8, 92.4, 87.9, 68.0, 50.4, 41.3, 38.7, 36.4, 30.4, 28.1. HRMS (ESI): exact mass calculated for $[M+Na]^+$ ($C_{42}H_{40}O_3N_2Na$) requires m/z 643.2931, found m/z 643.2938. The enantiomeric excess was determined to be 95% by HPLC. [ID column, 254 nm, *n*-hexane:EtOH = 80:20, 1.0 mL/min]: 7.9 min (minor), 13.6 min (major). $[\alpha]^{22}_D$ = 69.00 (c = 1.00, CH_2Cl_2).

N-(4-((3*R*,4*S*)-5-oxo-1,3-diphenyl-4-(phenylcarbamoyl)hex-1-yn-3-yl)phenyl)-3,5-bis(trifluoromethyl)benzamide (3ba)



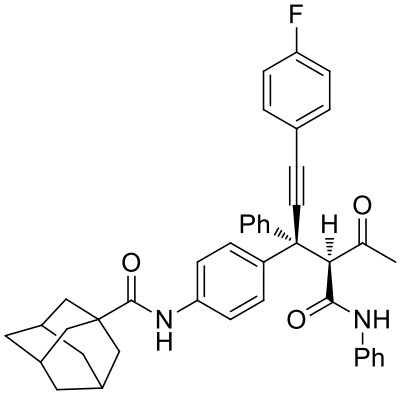
Eluent for flash column chromatography: petroleum ether/ethyl acetate = 8:1. Yellow solid, 33.1 mg, 95% yield. mp 113.3-116.0 ^{o}C. ^{1}H NMR ($(CD_3)_2SO$, 500 MHz): δ (ppm) 10.61 (s, 1H), 9.99 (s, 1H), 8.53 (s, 2H), 8.31 (s, 1H), 7.66-7.64 (m, 6H), 7.61-7.60 (m, 2H), 7.45-7.37 (m, 7H), 7.26-7.23 (m, 3H), 7.03-7.00 (m, 1H), 5.12 (s, 1H), 2.20 (s, 3H). ^{13}C NMR ($(CD_3)_2SO$, 125 MHz): δ (ppm) 201.9, 165.1, 162.9, 143.8, 139.5, 138.8, 137.5, 137.4, 131.8, 131.0, 130.8, 129.2, 129.1 (2), 128.9, 128.8, 127.7, 127.3, 127.2, 124.6, 124.2, 123.5, 122.4, 120.7, 119.9, 92.3, 88.0, 68.0, 50.5, 30.4. ^{19}F NMR ($(CD_3)_2SO$, 470 MHz): δ (ppm) -61.34. HRMS (ESI): exact mass calculated for $[M+Na]^+$ ($C_{40}H_{28}O_3N_2F_6Na$) requires m/z 721.1896, found m/z 721.1900. The enantiomeric excess was determined to be 94% by HPLC. [IA column, 254 nm, *n*-hexane:IPA = 90:10, 1.0 mL/min]: 8.9 min (minor), 11.3 min (major). $[\alpha]^{22}_D$ = 47.90 (c = 1.00, CH_2Cl_2).

(2*S*,3*R*)-2-acetyl-*N*,3,5-triphenyl-3-(4-pivalamidophenyl)pent-4-ynamide (3ca)



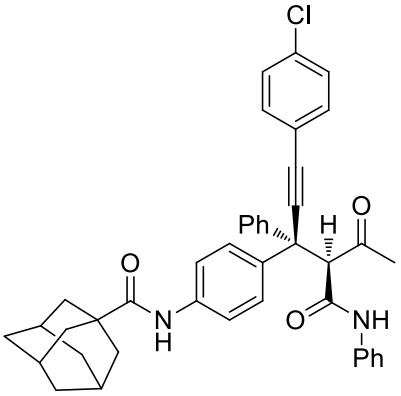
Eluent for flash column chromatography: petroleum ether/ethyl acetate = 6:1. Yellow solid, 23.5 mg, 87% yield. mp 149.8-152.4 ^{o}C. ^{1}H NMR ($(CD_3)_2SO$, 500 MHz): δ (ppm) 9.94 (s, 1H), 9.11 (s, 1H), 7.59-7.56 (m, 4H), 7.51 (s, 4H), 7.43-7.42 (m, 3H), 7.37-7.33 (m, 4H), 7.25-7.20 (m, 3H), 7.03-7.00 (m, 1H), 5.06 (s, 1H), 2.16 (s, 3H), 1.14 (s, 9H). ^{13}C NMR ($(CD_3)_2SO$, 125 MHz): δ (ppm) 202.0, 176.8, 165.1, 144.0, 138.8, 138.4, 138.2, 131.7, 129.2, 129.1, 128.9, 127.4, 127.3, 127.2, 124.2, 123.5, 120.2, 119.8, 110.0, 92.4, 87.9, 68.0, 50.4, 30.4, 29.5, 27.6. HRMS (ESI): exact mass calculated for $[M+Na]^+$ ($C_{36}H_{34}O_3N_2Na$) requires m/z 565.2462, found m/z 565.2466. The enantiomeric excess was determined to be 84% by HPLC. [ID column, 254 nm, *n*-hexane: EtOH = 70:30, 1.0 mL/min]: 4.9 min (minor), 6.3 min (major). $[\alpha]^{22}_D$ = 78.00 (c = 1.00, CH_2Cl_2).

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(4-fluorophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ea)



Eluent for flash column chromatography: petroleum ether/ethyl acetate = 6:1. Yellow solid, 24.3 mg, 76% yield. mp 119.6-120.3 ^{o}C. ^{1}H NMR ($(CD_3)_2SO$, 500 MHz): δ (ppm) 9.94 (s, 1H), 9.02 (s, 1H), 7.63-7.56 (m, 4H), 7.52-7.48 (m, 4H), 7.36-7.33 (m, 4H), 7.29-7.22 (m, 5H), 7.03-7.00 (m, 1H), 5.06 (s, 1H), 2.14 (s, 3H), 1.95 (s, 3H), 1.82 (s, 6H), 1.65 (s, 6H). ^{13}C NMR ($(CD_3)_2SO$, 125 MHz): δ (ppm) 201.9, 176.3, 165.0, 162.3 (d, *J* = 985.0 Hz), 143.9, 138.8, 138.2 (d, *J* = 140.0 Hz), 134.0, 133.9, 129.2, 128.9, 127.3, 127.2, 127.1, 124.2, 120.2, 120.0, 119.8, 116.3 (d, *J* = 85.0 Hz), 92.1, 86.8, 67.9, 50.4, 41.3, 38.7, 36.4, 30.4, 28.1. ^{19}F NMR ($(CD_3)_2SO$, 470 MHz): δ (ppm) -111.15. HRMS (ESI): exact mass calculated for $[M+Na]^+$ ($C_{42}H_{39}O_3N_2FNa$) requires m/z 661.2837, found m/z 661.2839. The enantiomeric excess was determined to be 88% by HPLC. [ID column, 254 nm, *n*-hexane: EtOH = 70:30, 1.0 mL/min]: 5.5 min (minor), 9.0 min (major). $[\alpha]^{22}_D$ = 51.00 (c = 1.00, CH_2Cl_2).

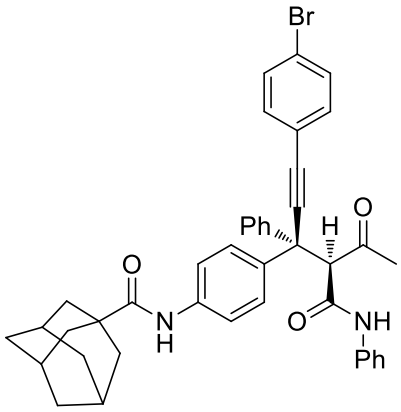
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(4-chlorophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3fa)



Eluent for flash column chromatography: petroleum ether/ethyl acetate = 6:1. Yellow solid, 26.9 mg, 82% yield. mp 110.4-112.4 ^{o}C. ^{1}H NMR ($(CD_3)_2SO$, 500 MHz): δ (ppm) 9.95 (s, 1H), 9.03 (s, 1H), 7.59-7.55 (m, 4H), 7.52-7.47 (m, 6H), 7.36-7.33 (m, 4H), 7.25-7.20 (m, 3H), 7.03-7.00 (m, 1H)), 5.07 (s, 1H), 2.14 (s, 3H), 1.95 (s, 3H), 1.81 (s, 6H), 1.64 (s, 6H).

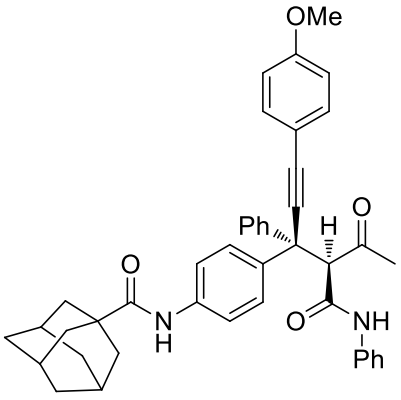
^{13}C NMR ((CD$_3$)$_2$SO, 125 MHz): δ (ppm) 201.8, 176.3, 165.0, 143.8, 138.8, 138.4, 138.0, 133.5, 130.1, 129.3 (2), 129.2, 128. 9, 127.3, 127.1, 124.2, 122.4, 120.2, 119.9, 93.7, 86.7, 67.9, 50.4, 41.3, 38.7, 36.4, 30.4, 28.1. HRMS (ESI): exact mass calculated for [M+Na]$^+$ ($C_{42}H_{39}O_3N_2ClNa$) requires m/z 677.2541, found m/z 677.2543. The enantiomeric excess was determined to be 82% by HPLC. [ID column, 254 nm, *n*-hexane:EtOH = 70:30, 1.0 mL/min]: 5.6 min (minor), 9.0 min (major). $[\alpha]^{22}_D$ = 40.00 (c = 1.00, CH_2Cl_2).

(1*r*,3*R*,5S)-*N*-(4-((3*R*,4*S*)-1-(4-bromophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ga)



Eluent for flash column chromatography: petroleum ether/ethyl acetate = 6:1. Yellow solid, 26.7 mg, 76% yield. mp 119.2-121.0 ^{o}C. ^{1}H NMR ((CD$_3$)$_2$SO, 500 MHz): δ (ppm) 9.95 (s, 1H), 9.02 (s, 1H), 7.64-7.62 (m, 2H), 7.56-7.55 (m, 2H), 7.52-7.47 (m, 6H), 7.36-7.33 (m, 4H), 7.25-7.20 (m, 3H), 7.03-7.00 (m, 1H), 5.07 (s, 1H), 2.14 (s, 3H), 1.95 (s, 3H), 1.82 (s, 6H), 1.64 (s, 6H). ^{13}C NMR ((CD$_3$)$_2$SO, 125 MHz): δ (ppm) 201.7, 176.3, 165.0, 143.8, 138.8, 138.4, 137.9, 133.7, 132.2 (2), 129.2, 128.9, 127.3, 127.1, 124.2, 122.8, 122.1, 120.2, 119.9, 93.9, 86.7, 67.9, 50.4, 41.3, 38.7, 36.4, 30.4, 28.1. HRMS (ESI): exact mass calculated for [M+Na]$^+$ ($C_{42}H_{39}O_3N_2BrNa$) requires m/z 721.2036, found m/z 721.2039. The enantiomeric excess was determined to be 87% by HPLC. [ID column, 254 nm, *n*-hexane: EtOH = 70:30, 1.0 mL/min]: 5.9 min (minor), 9.4 min (major). $[\alpha]^{22}_D$ = 39.60 (c = 1.00, CH_2Cl_2).

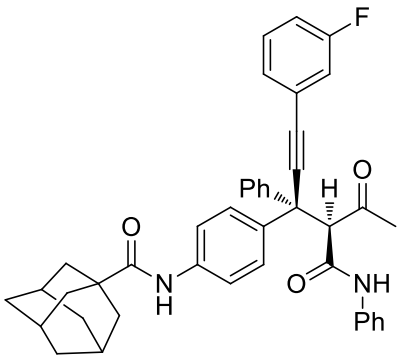
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(4-methoxyphenyl)-5-oxo-3-phenyl-4-(phenylcarbamo yl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ha)



Eluent for flash column chromatography: petroleum ether/ethyl acetate = 5:1. Yellow solid, 22.5 mg, 69% yield. mp 126.0-127.1 ^{o}C. ^{1}H NMR ((CD$_3$)$_2$SO, 500 MHz): δ (ppm) 9.91 (s, 1H), 9.03 (s, 1H), 7.59 (d, *J* = 5.0 Hz, 2H), 7.51-7.49 (m, 5H), 7.37-7.35 (m, 2H), 7.34-7.32 (m, 2H), 7.25-7.19 (m, 4H), 7.03-7.01 (m, 1H), 7.00-6.98 (m, 2H), 5.04 (s, 1H), 3.78 (s, 3H), 2.14 (s, 3H), 1.96 (s, 3H), 1.82 (s, 6H), 1.65 (s, 6H). ^{13}C NMR ((CD$_3$)$_2$SO, 125 MHz): δ (ppm) 202.2, 176.3, 165.1, 159.7, 144.1, 138.8, 138.7, 138.3, 133.2, 129.2, 128.8, 127.3, 127.2, 124.1, 120.2, 119.8, 115.4, 114.7, 114.6, 90.6, 87.9, 68.1, 55.7, 50.5, 41.3, 38.7, 36.4, 30.5, 28.1. HRMS (ESI): exact mass calculated for [M+Na]$^+$ ($C_{43}H_{42}O_4N_2Na$) requires m/z 673.3042, found m/z 673.3023. The enantiomeric excess was determined to be 70% by HPLC. [ID column,

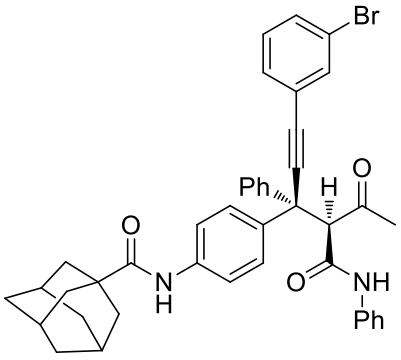
254 nm, *n*-hexane: EtOH = 70:30, 1.0 mL/min]: 9.1 min (minor), 14.5 min (major). $[\alpha]^{22}_{D}$ = 59.00 (c = 1.00, CH_2Cl_2).

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(3-fluorophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ia)



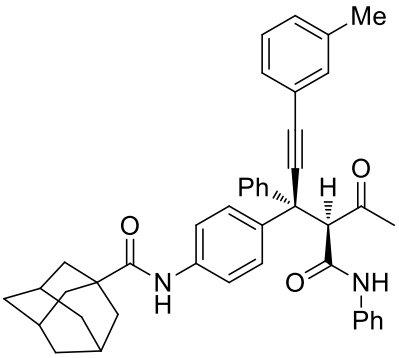
Eluent for flash column chromatography: petroleum ether/ethyl acetate = 6:1. Yellow solid, 24.9 mg, 78% yield. mp 113.7-116.4 °C. ^{1}H NMR ($(CD_3)_2SO$, 500 MHz): δ (ppm) 9.97 (s, 1H), 9.03 (s, 1H), 7.57-7.56 (m, 2H), 7.53-7.47 (m, 5H), 7.41-7.33 (m, 6H), 7.28-7.22 (m, 4H), 7.03-7.00 (m, 1H), 5.08 (s, 1H), 2.15 (s, 3H), 1.95 (s, 3H), 1.82 (s, 6H), 1.64 (s, 6H). ^{13}C NMR ($(CD_3)_2SO$, 125 MHz): δ (ppm) 201.7, 176.3, 165.0, 162.4 (d, *J* = 970.0 Hz), 143.8, 138.8, 138.4, 137.9, 131.3 (d, *J* = 35.0 Hz), 129.2, 128.9, 128.1 (d, *J* = 10.0 Hz), 127.3, 127.1, 125.5 (d, *J* = 40.0 Hz), 124.2, 120.2, 119.9, 118.3 (d, *J* = 90.0 Hz), 116.1 (d, *J* = 85.0 Hz), 110.0, 93.8, 86.6, 67.9, 50.4, 41.3, 38.7, 36.4, 30.4, 28.1. ^{19}F NMR ($(CD_3)_2SO$, 470 MHz): δ (ppm) -112.74. HRMS (ESI): exact mass calculated for $[M+Na]^+$ ($C_{42}H_{39}O_3N_2FNa$) requires m/z 661.2837, found m/z 661.2836. The enantiomeric excess was determined to be 90% by HPLC. [ID column, 254 nm, *n*-hexane: EtOH = 70:30, 1.0 mL/min]: 5.1 min (minor), 8.1 min (major). $[\alpha]^{22}_{D}$ = 53.60 (c = 1.00, CH_2Cl_2).

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(3-bromophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ja)



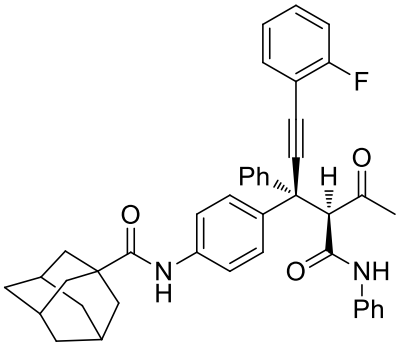
Eluent for flash column chromatography: petroleum ether/ethyl acetate = 6:1. Yellow solid, 29.1 mg, 83% yield. mp 142.9-143.9 °C. ^{1}H NMR ($(CD_3)_2SO$, 500 MHz): δ (ppm) 9.97 (s, 1H), 9.03 (s, 1H), 7.74 (s, 1H), 7.62 (d, *J* = 10.0 Hz, 1H), 7.57-7.55 (m, 3H), 7.53-7.47 (m, 4H), 7.40-7.33 (m, 5H), 7.25-7.20 (m, 3H), 7.03-7.00 (m, 1H), 5.09 (s, 1H), 2.14 (s, 3H), 1.95 (s, 3H), 1.82 (s, 6H), 1.64 (s, 6H). ^{13}C NMR ($(CD_3)_2SO$, 125 MHz): δ (ppm) 201.7, 176.3, 164.9, 143.7, 138.8, 138.4, 137.9, 133.9, 131.8, 131.2, 130.8, 129.2, 128.9, 127.3, 127.1, 125.8, 124.2, 122.1, 120.2, 119.9, 110.0, 94.2, 86.2, 67.9, 50.4, 41.3, 38.7, 36.4, 30.4, 28.1. HRMS (ESI): exact mass calculated for $[M+Na]^+$ ($C_{42}H_{39}O_3N_2BrNa$) requires m/z 721.2036, found m/z 721.2041. The enantiomeric excess was determined to be 81% by HPLC. [ID column, 254 nm, *n*-hexane: EtOH = 70:30, 1.0 mL/min]: 5.3 min (minor), 9.3 min (major). $[\alpha]^{22}_{D}$ = 44.00 (c = 1.00, CH_2Cl_2).

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-5-oxo-3-phenyl-4-(phenylcarbamoyl)-1-(*m*-tolyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ka)



Eluent for flash column chromatography: petroleum ether/ethyl acetate = 6:1. Yellow solid, 30.2 mg, 95% yield. mp 117.9-120.1 ^{o}C. ^{1}H NMR ((CD$_3$)$_2$SO, 500 MHz): δ (ppm) 9.93 (s, 1H), 9.03 (s, 1H), 7.58 (d, *J* = 10.0 Hz, 2H), 7.53-7.49 (m, 4H), 7.38-7.29 (m, 7H), 7.25-7.20 (m, 4H), 7.03-7.00 (m, 1H), 5.05 (s, 1H), 2.32 (s, 3H), 2.15 (s, 3H), 1.96 (s, 3H), 1.82 (s, 6H), 1.65 (s, 6H). ^{13}C NMR ((CD$_3$)$_2$SO, 125 MHz): δ (ppm) 202.0, 176.3, 165.1, 144.0, 138.8, 138.4, 138.3, 138.2, 132.1, 129.6, 129.2, 129.0, 128.9, 128.8, 127.3, 127.2, 127.1, 124.2, 123.3, 120.2, 119.8, 92.0, 88.0, 68.0, 50.4, 41.3, 38.7, 36.4, 30.4, 28.1, 21.2. HRMS (ESI): exact mass calculated for [M+Na]$^+$ ($C_{43}H_{42}O_3N_2Na$) requires m/z 657.3088, found m/z 657.3089. The enantiomeric excess was determined to be 85% by HPLC. [ID column, 254 nm, *n*-hexane: EtOH = 70:30, 1.0 mL/min]: 5.6 min (minor), 9.5 min (major). $[\alpha]^{22}_D$ = 58.70 (c = 1.00, CH_2Cl_2).

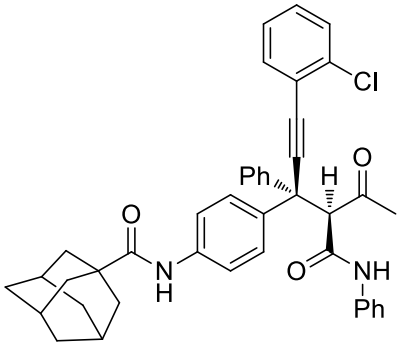
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(2-fluorophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3la)



Eluent for flash column chromatography: petroleum ether/ethyl acetate = 6:1. Yellow solid, 31.9 mg, 99% yield. mp 147.1-149.6 ^{o}C. ^{1}H NMR ((CD$_3$)$_2$SO, 500 MHz): δ (ppm) 9.97 (s, 1H), 9.03 (s, 1H), 7.63-7.60 (m, 1H), 7.58 (d, *J* = 5.0 Hz, 1H), 7.51 (s, 4H), 7.47-7.44 (m, 1H), 7.36-7.31 (m, 5H), 7.28-7.20 (m, 5H), 7.03-7.00 (m, 1H), 5.07 (s, 1H), 2.16 (s, 3H), 1.95 (s, 3H), 1.82 (s, 6H), 1.64 (s, 6H). ^{13}C NMR ((CD$_3$)$_2$SO, 125 MHz): δ (ppm) 201.8, 176.4, 165.0, 162.6 (d, *J* = 990.0 Hz), 143.7, 138.8, 138.4, 137.9, 133.9, 131.0 (d, *J* = 30.0 Hz), 129.2, 128.9, 127.3, 127.2, 127.1, 125.2 (d, *J* = 15.0 Hz), 124.2, 120.2, 119.9, 116.2 (d, *J* = 80.0 Hz), 111.7 (d, *J* = 65.0 Hz), 97.7, 81.4, 67.9, 50.6, 41.3, 38.7, 36.4, 30.3, 28.1. ^{19}F NMR ((CD$_3$)$_2$SO, 470 MHz): δ (ppm) -110.65. HRMS (ESI): exact mass calculated for [M+Na]$^+$ ($C_{42}H_{39}O_3N_2FNa$) requires m/z 661.2837, found m/z 661.2836. The enantiomeric excess was determined to be 90% by HPLC. [ID column, 254 nm, *n*-hexane: EtOH = 70:30, 1.0 mL/min]: 6.3 min (minor), 8.7 min (major). $[\alpha]^{22}_D$ = 48.00 (c = 1.00, CH_2Cl_2).

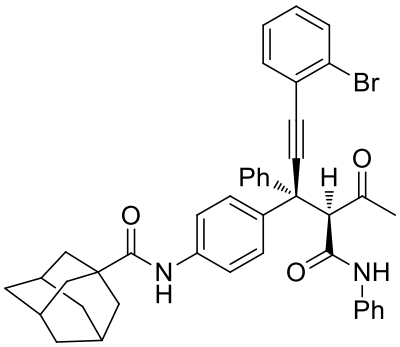
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(2-chlorophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ma)

Eluent for flash column chromatography: petroleum ether/ethyl acetate = 6:1. Yellow solid, 24.1 mg, 74% yield. mp 141.5-145.4 ^{o}C. ^{1}H NMR ((CD$_3$)$_2$SO, 500 MHz): δ (ppm) 9.97 (s, 1H), 9.03 (s, 1H), 7.64-7.60 (m, 4H), 7.58-7.55 (m, 2H), 7.53-7.51 (m, 2H), 7.44-7.40 (m, 2H), 7.38-7.33 (m, 4H), 7.25-7.22 (m, 3H), 7.03-7.00 (m, 1H), 5.09 (s, 1H), 2.16 (s, 3H), 1.95 (s, 3H), 1.82 (s, 6H), 1.64 (s, 6H). ^{13}C NMR



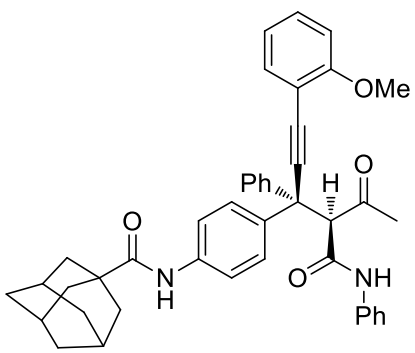
($(CD_3)_2SO$, 125 MHz): δ (ppm) 201.8, 176.3, 165.0, 143.8, 138.8, 138.4, 137.9, 134.9, 134.1, 130.4, 129.8, 129.2, 128.9, 127.8, 127.3, 127.2, 124.2, 123.2, 120.2, 119.9, 110.0, 97.8, 84.7, 67.9, 50.7, 41.3, 38.7, 36.4, 30.5, 28.1. HRMS (ESI): exact mass calculated for $[M+Na]^+$ ($C_{42}H_{39}O_3N_2ClNa$) requires m/z 677.2541, found m/z 677.2545. The enantiomeric excess was determined to be 84% by HPLC. [ID column, 254 nm, *n*-hexane: EtOH = 70:30, 1.0 mL/min]: 5.8 min (minor), 8.7 min (major). $[\alpha]^{22}_D$ = 42.70 (c = 1.00, CH_2Cl_2).

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(2-bromophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3na)



Eluent for flash column chromatography: petroleum ether/ethyl acetate = 6:1. Yellow solid, 24.3 mg, 70% yield. mp 143.0-146.8 °C. ^{1}H NMR ($(CD_3)_2SO$, 500 MHz): δ (ppm) 9.96 (s, 1H), 9.03 (s, 1H), 7.74 (d, *J* = 10.0 Hz, 1H), 7.64-7.61 (m, 3H), 7.58-7.56 (m, 2H), 7.52-7.51 (m, 1H), 7.46-7.43 (m, 1H), 7.37-7.33 (m, 5H), 7.25-7.20 (m, 4H), 7.03-7.00 (m, 1H), 5.09 (s, 1H), 2.16 (s, 3H), 1.95 (s, 3H), 1.82 (s, 6H), 1.64 (s, 6H). ^{13}C NMR ($(CD_3)_2SO$, 125 MHz): δ (ppm) 201.8, 176.3, 165.0, 143.7, 138.8, 138.4, 137.9, 134.3, 132.9, 130.6, 129.2, 128.9, 128.3, 127.4, 127.3, 127.2, 125.5, 124.7, 124.2, 120.2, 119.9, 97.1, 86.4, 67.9, 50.7, 41.3, 38.7, 36.4, 30.5, 28.1. HRMS (ESI): exact mass calculated for $[M+Na]^+$ ($C_{42}H_{39}O_3N_2BrNa$) requires m/z 721.2036, found m/z 721.2038. The enantiomeric excess was determined to be 72% by HPLC. [ID column, 254 nm, *n*-hexane: EtOH = 70:30, 1.0 mL/min]: 5.8 min (minor), 9.1 min (major). $[\alpha]^{22}_D$ = 43.00 (c = 1.00, CH_2Cl_2).

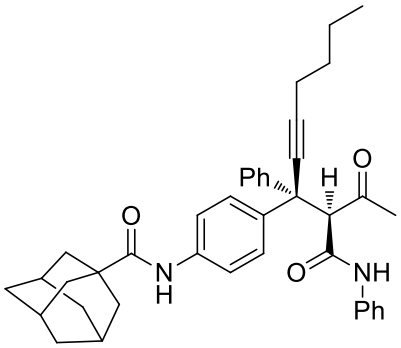
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(2-methoxyphenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3oa)



Eluent for flash column chromatography: petroleum ether/ethyl acetate = 5:1. Yellow solid, 28.7 mg, 88% yield. mp 192.6-193.5 °C. ^{1}H NMR ($(CD_3)_2SO$, 500 MHz): δ (ppm) 9.90 (s, 1H), 9.03 (s, 1H), 7.65 (d, *J* = 10.0 Hz, 2H), 7.62-7.60 (m, 2H), 7.53-7.51 (m, 2H), 7.47 (d, *J* = 10.0 Hz, 1H), 7.40-7.37 (m, 2H), 7.35-7.32 (m, 3H), 7.25-7.23 (m, 1H), 7.21-7.19 (m, 2H), 7.10 (d, *J* = 10.0 Hz, 1H), 7.02-7.01 (m, 1H), 7.00-6.97 (m, 1H), 5.04 (s, 1H), 3.87 (s, 3H), 2.19 (s, 3H), 1.96 (s, 3H), 1.82 (s, 6H), 1.65 (s, 6H). ^{13}C NMR

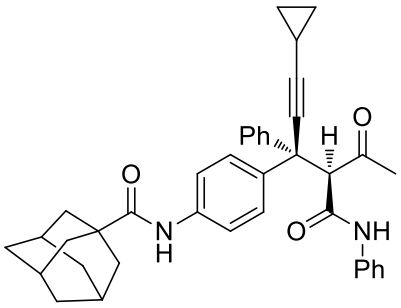
($(CD_3)_2SO$, 125 MHz): δ (ppm) 202.5, 176.3, 165.1, 160.5, 144.1, 138.8, 138.3, 138.2, 133.2, 130.4, 129.2, 128.8, 127.4, 127.3, 127.2, 124.2, 120.9, 120.1, 119.8, 112.5, 111.8, 95.9, 85.1, 68.3, 56.2, 50.8, 41.3, 38.7, 36.4, 30.5, 28.1. HRMS (ESI): exact mass calculated for $[M+Na]^+$ ($C_{43}H_{42}O_4N_2Na$) requires m/z 673.3042, found m/z 673.3023. The enantiomeric excess was determined to be 89% by HPLC. [ID column, 254 nm, *n*-hexane: EtOH = 70:30, 1.0 mL/min]: 9.5 min (minor), 12.8 min (major). $[\alpha]^{22}_D$ = 49.00 (c = 1.00, CH_2Cl_2).

(1*r*,3*R*,5*S*)-*N*-(4-((3*S*,4*R*)-2-oxo-4-phenyl-3-(phenylcarbamoyl)dec-5-yn-4-yl)phenyl)adamantane-1-carboxamide (3pa)



Eluent for flash column chromatography: petroleum ether/ethyl acetate = 7:1. White solid, 25.8 mg, 86% yield. mp 164.1-166.3 °C. ^{1}H NMR ($(CD_3)_2SO$, 500 MHz): δ (ppm) 9.79 (s, 1H), 9.02 (s, 1H), 7.58 (d, *J* = 5.0 Hz, 2H), 7.50 (s, 4H), 7.38 (d, *J* = 10.0 Hz, 2H), 7.34-7.30 (m, 2H), 7.28-7.24 (m, 2H), 7.22-7.18 (m, 1H), 7.05-7.01 (m, 1H), 4.96 (s, 1H), 2.46-2.42 (m, 2H), 2.10 (s, 3H), 1.97 (s, 3H), 1.85 (s, 6H), 1.66 (s, 6H), 1.60-1.57 (m, 2H), 1.53-1.47 (m, 2H), 0.94-0.90 (m, 3H). ^{13}C NMR ($(CD_3)_2SO$, 125 MHz): δ (ppm) 202.6, 176.3, 165.3, 144.6, 138.9, 138.8, 138.2, 129.2, 128.6, 127.3, 127.3, 127.1, 124.1, 120.0, 119.8, 88.9, 82.1, 68.1, 50.1, 41.3, 38.7, 36.5, 30.9, 30.6, 28.1, 21.9, 18.6, 14.0. HRMS (ESI): exact mass calculated for $[M+H]^+$ ($C_{40}H_{45}O_3N_2$) requires m/z 601.3425, found m/z 601.3422. The enantiomeric excess was determined to be 83% by HPLC. [ID column, 254 nm, *n*-hexane:IPA = 70:30, 1.0 mL/min]: 12.6 min (minor), 16.2 min (major). $[\alpha]^{22}_D$ = 142.70 (c = 1.00, CH_2Cl_2).

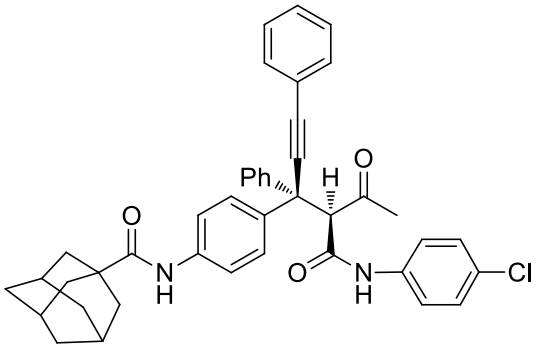
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-cyclopropyl-5-oxo-3-phenyl-4-(phenylcarbamoyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3qa)



Eluent for flash column chromatography: petroleum ether/ethyl acetate = 6:1. White solid, 20.4 mg, 70% yield. mp 232.2-225.0 °C. ^{1}H NMR ($(CD_3)_2SO$, 500 MHz): δ (ppm) 9.80 (s, 1H), 9.03 (s, 1H), 7.54-7.49 (m, 4H), 7.46-7.44 (m, 2H), 7.39-7.37 (m, 2H), 7.34-7.30 (m, 2H), 7.28-7.24 (m, 2H), 7.21-7.18 (m, 1H), 7.05-7.01 (m, 1H), 4.94 (s, 1H), 2.08 (s, 3H), 1.98 (s, 3H), 1.84 (s, 6H), 1.67 (s, 6H), 1.56-1.52 (m, 1H), 0.89-0.85 (m, 2H), 0.76-0.73 (m, 2H). ^{13}C NMR ($(CD_3)_2SO$, 125 MHz): δ (ppm) 202.1, 175. 9, 164.8, 144.0, 138.4, 138.3, 137.8, 128.8, 128.2, 126.8, 126.8, 126.6, 123.7, 119.6, 119.3, 91.4, 76.5, 67.7, 49.6, 40.9, 38.3, 36.0, 30.1, 27.7, 8.0, -0.3. HRMS (ESI): exact mass calculated for $[M+H]^+$ ($C_{39}H_{41}O_3N_2$) requires m/z 585.3112, found m/z 585.3109. The enantiomeric excess was determined to be 83% by HPLC. [ID column, 254 nm, *n*-hexane:EtOH = 70:30, 1.0 mL/min]: 7.1 min (minor), 11.2

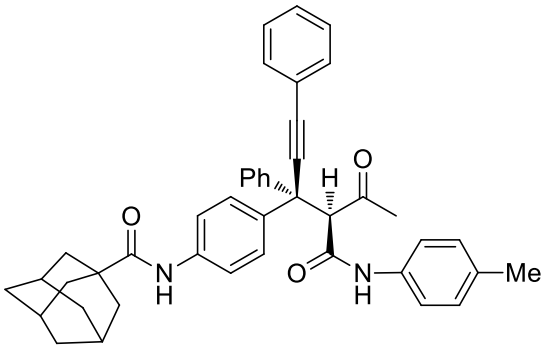
min (major). $[\alpha]^{22}_D$ = 129.40 (c = 1.00, CH_2Cl_2).

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-4-((4-chlorophenyl)carbamoyl)-5-oxo-1,3-diphenylhex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ab)



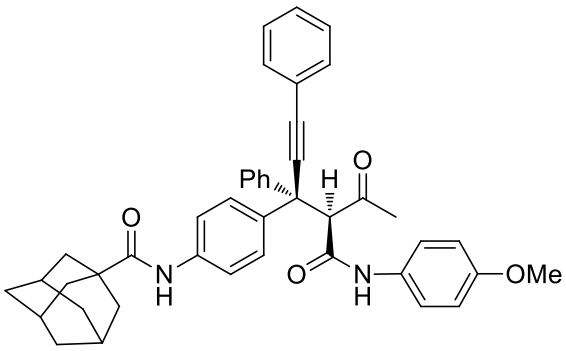
Eluent for flash column chromatography: petroleum ether/ethyl acetate = 6:1. Yellow solid, 25.6 mg, 78% yield. mp 181.5-184.1 °C. ^{1}H NMR ($(CD_3)_2SO$, 500 MHz): δ (ppm) 10.12 (s, 1H), 9.03 (s, 1H), 7.59-7.56 (m, 4H), 7.52-7.48 (m, 4H), 7.43-7.39 (m, 5H), 7.36-7.33 (m, 2H), 7.30-7.28 (m, 2H), 7.23-7.20 (m, 1H), 5.04 (s, 1H), 2.14 (s, 3H), 1.96 (s, 3H), 1.82 (s, 6H), 1.65 (s, 6H). ^{13}C NMR ($(CD_3)_2SO$, 125 MHz): δ (ppm) 201.8, 176.3, 165.2 143.9, 138.4, 138.1, 137.8, 131.7 (2), 129.1 (2), 129.0, 128.9, 127.7, 127.3, 127.2, 123.5, 121.3, 120.2, 92.3, 87.9, 68.1, 50.4, 41.3, 38.7, 36.4, 30.4, 28.1. HRMS (ESI): exact mass calculated for $[M+Na]^+$ ($C_{42}H_{39}O_3N_2ClNa$) requires m/z 677.2541, found m/z 677.2544. The enantiomeric excess was determined to be 76% by HPLC. [ID column, 254 nm, *n*-hexane: EtOH = 70:30, 1.0 mL/min]: 5.0 min (minor), 7.6 min (major). $[\alpha]^{22}_D$ = 75.00 (c = 1.00, CH_2Cl_2).

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-5-oxo-1,3-diphenyl-4-(*p*-tolylcarbamoyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ac)



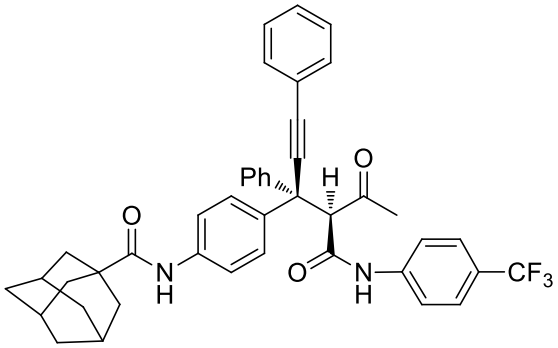
Eluent for flash column chromatography: petroleum ether/ethyl acetate = 6:1. Yellow solid, 27.7 mg, 87% yield. mp 195.6-198.4 °C. ^{1}H NMR ($(CD_3)_2SO$, 500 MHz): δ (ppm) 9.83 (s, 1H), 9.03 (s, 1H), 7.58-7.56 (m, 4H), 7.51-7.48 (m, 4H), 7.43-7.41 (m, 3H), 7.36-7.33 (m, 2H), 7.25-7.21 (m, 3H), 7.04-7.02 (m, 2H), 5.03 (s, 1H), 2.20 (s, 3H), 2.16 (s, 3H), 1.96 (s, 3H), 1.82 (s, 6H), 1.65 (s, 6H). ^{13}C NMR ($(CD_3)_2SO$, 125 MHz): δ (ppm) 202.1, 176.3, 164.8, 144.0, 138.4, 138.1, 136.3, 133.2, 131.7, 129.5, 129.1, 128.8, 127.3, 127.2, 127.1, 123.5, 120.1, 119.8, 110.0, 92.5, 87.9, 68.0, 50.4, 41.3, 38.7, 36.4, 30.4, 28.1, 20.9. HRMS (ESI): exact mass calculated for $[M+Na]^+$ ($C_{43}H_{42}O_3N_2Na$) requires m/z 657.3088, found m/z 657.3088. The enantiomeric excess was determined to be 92% by HPLC. [ID column, 254 nm, *n*-hexane: EtOH = 70:30, 1.0 mL/min]: 6.1 min (minor), 9.9 min (major). $[\alpha]^{22}_D$ = 61.30 (c = 1.00, CH_2Cl_2).

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-4-((4-methoxyphenyl)carbamoyl)-5-oxo-1,3-diphenylhex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ad)



Eluent for flash column chromatography: petroleum ether/ethyl acetate = 5:1. Yellow solid, 29.1 mg, 89% yield. mp 111.7-114.1 ^{o}C. ^{1}H NMR ($(CD_3)_2SO$, 500 MHz): δ (ppm) 9.78 (s, 1H), 9.04 (s, 1H), 7.57-7.56 (m, 4H), 7.53-7.48 (m, 5H), 7.42-7.41 (m, 2H), 7.36-7.33 (m, 2H), 7.25 (d, *J* = 10.0 Hz, 2H), 7.23-7.20 (m, 1H), 6.80 (d, *J* = 10.0 Hz, 2H), 4.99 (s, 1H), 3.67 (s, 3H), 2.16 (s, 3H), 1.96 (s, 3H), 1.83 (s, 6H), 1.65 (s, 6H). ^{13}C NMR ($(CD_3)_2SO$, 125 MHz): δ (ppm) 202.1, 176.3, 164.6, 156.0, 144.0, 138.4, 138.1, 131.9, 131.7, 129.1, 128.8, 127.4, 127.3, 127.2, 123.5, 121.6, 121.5, 120.1, 114.3, 92.5, 87.8, 67.9, 55.6, 50.4, 41.3, 38.7, 36.4, 30.4, 28.1. HRMS (ESI): exact mass calculated for $[M+Na]^+$ ($C_{43}H_{42}O_4N_2Na$) requires m/z 673.3037, found m/z 673.3039. The enantiomeric excess was determined to be 81% by HPLC. [ID column, 254 nm, *n*-hexane: EtOH = 70:30, 1.0mL/min]: 7.5 min (minor), 12.2 min (major). $[\alpha]^{22}_D$ = 47.00 (c = 1.00, CH_2Cl_2).

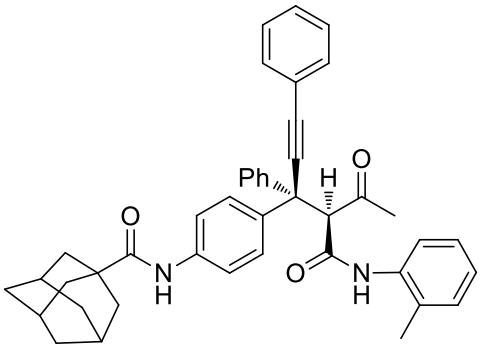
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-5-oxo-1,3-diphenyl-4-((4-(trifluoromethyl)phenyl)carbamoyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ae)



Eluent for flash column chromatography: petroleum ether/ethyl acetate = 7:1. Yellow solid, 28.8 mg, 84% yield. mp 211.0-213.2 ^{o}C. ^{1}H NMR ($(CD_3)_2SO$, 500 MHz): δ (ppm) 10.37 (s, 1H), 9.05 (s, 1H), 7.66-7.65 (m, 7H), 7.63-7.61 (m, 2H), 7.57-7.56 (m, 3H), 7.46-7.43 (m, 3H), 7.41-7.38 (m, 2H), 7.27-7.24 (m, 1H), 5.14 (s, 1H), 2.19 (s, 3H), 1.97 (s, 3H), 1.86 (s, 6H), 1.66 (s, 6H). ^{13}C NMR ($(CD_3)_2SO$, 125 MHz): δ (ppm) 201.8, 176.4, 165.8, 143.8, 142.4, 138.5, 138.1, 131.8, 129.1, 128.9, 127.4, 127.3, 127.2, 126.5 (q, *J* = 20.0 Hz), 124.4, 124.0, 123.5, 123.4, 120.3, 119.7, 92.2, 88.1, 68.2, 50.6, 41.3, 38.7, 36.5, 30.5, 28.1. ^{19}F NMR ($(CD_3)_2SO$, 470 MHz): δ (ppm) -60.48. HRMS (ESI): exact mass calculated for $[M+H]^+$ ($C_{43}H_{40}O_3N_2F_3$) requires m/z 689.3251, found m/z 689.3250. The enantiomeric excess was determined to be 94% by HPLC. [ID column, 254 nm, *n*-hexane: EtOH = 70:30, 1.0 mL/min]: 4.7 min (minor), 7.2 min (major). $[\alpha]^{22}_D$ = 198.80 (c = 1.00, CH_2Cl_2).

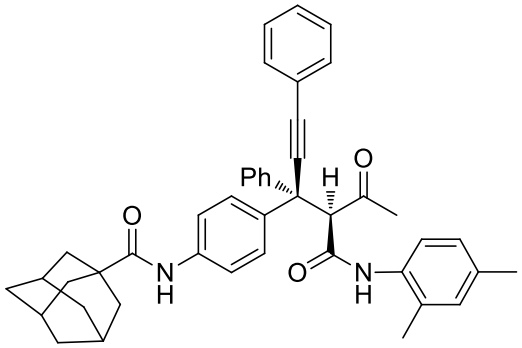
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-5-oxo-1,3-diphenyl-4-(*o*-tolylcarbamoyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3af)

Eluent for flash column chromatography: petroleum ether/ethyl acetate = 6:1. Yellow solid, 20.8 mg, 66% yield. mp 105.3-109.9 ^{o}C. ^{1}H NMR ($(CD_3)_2SO$, 500 MHz): δ (ppm) 9.36 (s, 1H), 9.09 (s, 1H), 7.61 (d, *J* = 5.0 Hz, 2H), 7.57 (s, 4H), 7.54-7.53 (m,



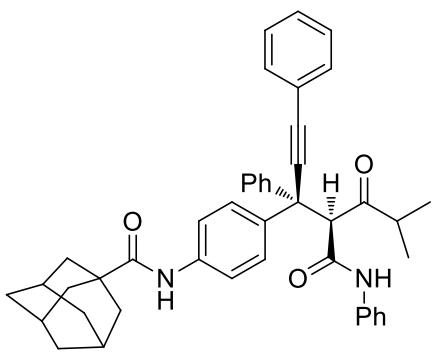
2H), 7.40-7.39 (m, 2H), 7.35-7.32 (m, 2H), 7.22-7.19 (m, 1H), 7.16-7.11 (m, 2H), 7.07-7.00 (m, 3H), 5.31 (s, 1H), 2.20 (s, 3H), 1.96 (s, 6H), 1.85 (s, 6H), 1.66 (s, 6H). ^{13}C NMR ($(CD_3)_2SO$, 125 MHz): δ (ppm) 201.9, 176.4, 165.2, 144.3, 138.5, 138.0, 136.1, 131.8, 131.7, 130.7, 130.1, 129.1 (2), 128.8, 127.6, 127.1, 126.3, 125.7, 125.0, 123.6, 120.2, 92.6, 87.7, 67.3, 50.3, 41.3, 38.7, 36.4, 30.5, 28.1, 17.9. HRMS (ESI): exact mass calculated for $[M+Na]^+$ ($C_{43}H_{42}O_3N_2Na$) requires m/z 657.3088, found m/z 657.3089. The enantiomeric excess was determined to be 70% by HPLC. [ID column, 254 nm, *n*-hexane:EtOH = 70:30, 1.0 mL/min]: 7.3 min (minor), 9.5 min (major). $[\alpha]^{22}_D$ = 45.80 (c = 1.00, CH_2Cl_2).

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-4-((2,4-dimethylphenyl)carbamoyl)-5-oxo-1,3-diphenylhex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ag)



Eluent for flash column chromatography: petroleum ether/ethyl acetate = 6:1. Yellow solid, 26.8 mg, 83% yield. mp 105.1-108.1 ^{o}C. ^{1}H NMR ($(CD_3)_2SO$, 500 MHz): δ (ppm) 9.14 (s, 1H), 9.08 (s, 1H), 7.58-7.56 (m, 4H), 7.54-7.52 (m, 4H), 7.40-7.39 (m, 3H), 7.35-7.32 (m, 2H), 7.22-7.20 (m, 1H), 7.01 (d, *J* = 5.0 Hz, 1H), 6.93 (s, 1H), 6.86 (d, *J* = 10.0 Hz, 1H), 5.18 (s, 1H), 2.20 (s, 3H), 2.18 (s, 3H), 1.98 (s, 3H), 1.90 (s, 3H), 1.85 (s, 6H), 1.67 (s, 6H). ^{13}C NMR ($(CD_3)_2SO$, 125 MHz): δ (ppm) 202.0, 176.4, 165.1, 144.2, 143.4, 138.5, 138.0, 134.9, 133.5, 131.7, 131.6, 131.2, 131.1, 129.1, 128.8, 127.6, 127.2, 126.8, 124.9, 123.5, 120.1, 92.6, 87.8, 67.4, 50.3, 41.3, 38.7, 36.4, 30.4, 28.1, 20.9, 17.8. HRMS (ESI): exact mass calculated for $[M+Na]^+$ ($C_{44}H_{44}O_3N_2Na$) requires m/z 671.3244, found m/z 671.3246. The enantiomeric excess was determined to be 93% by HPLC. [ID column, 254 nm, *n*-hexane: EtOH = 70:30, 1.0 mL/min]: 7.0 min (minor), 10.7 min (major). $[\alpha]^{22}_D$ = 64.00 (c = 1.00, CH_2Cl_2).

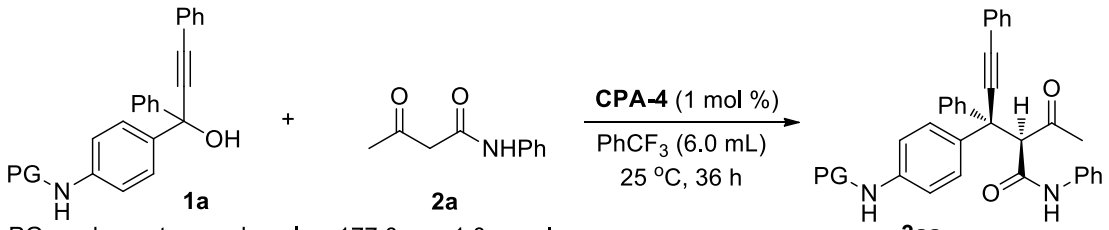
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-6-methyl-5-oxo-1,3-diphenyl-4-(phenylcarbamoyl)hept-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ah)



Eluent for flash column chromatography: petroleum ether/ethyl acetate = 8:1. Yellow solid, 26.4 mg, 81% yield. mp 101.5-104.2 ^{o}C. ^{1}H NMR ($(CD_3)_2SO$, 500 MHz): δ (ppm) 9.90 (s, 1H), 9.04 (s, 1H), 7.57-7.55 (m, 8H), 7.44-7.40 (m, 3H), 7.36-7.32 (m, 4H), 7.25-7.20 (m, 3H), 7.03-7.00 (m, 1H), 5.19 (s, 1H), 2.94-2.87 (m,

1H), 1.95 (s, 3H), 1.83 (s, 6H), 1.64 (s, 6H), 0.90 (d, *J* = 5.0 Hz, 3H), 0.86 (d, *J* = 5.0 Hz, 3H). ^{13}C NMR ($(CD_3)_2SO$, 125 MHz): δ (ppm) 207.6, 176.3, 164.8, 143.9, 138.7, 138.4, 138.0, 131.7, 129.2, 129.1, 128.8, 128.7, 127.5, 127.2, 127.1, 124.2, 123.6, 120.1, 119.8, 92.5, 87.9, 66.5, 50.7, 41.3, 38.7, 36.4, 28.1, 19.0, 18.8. HRMS (ESI): exact mass calculated for $[M+Na]^+$ ($C_{44}H_{44}O_3N_2Na$) requires m/z 671.3244, found m/z 671.3246. The enantiomeric excess was determined to be 86% by HPLC. [IA column, 254 nm, *n*-hexane: IPA = 70:30, 1.0 mL/min]: 5.6 min (minor), 9.8 min (major). $[\alpha]^{22}_D$ = 92.30 (c = 1.00, CH_2Cl_2).

D: Large Scale Reaction



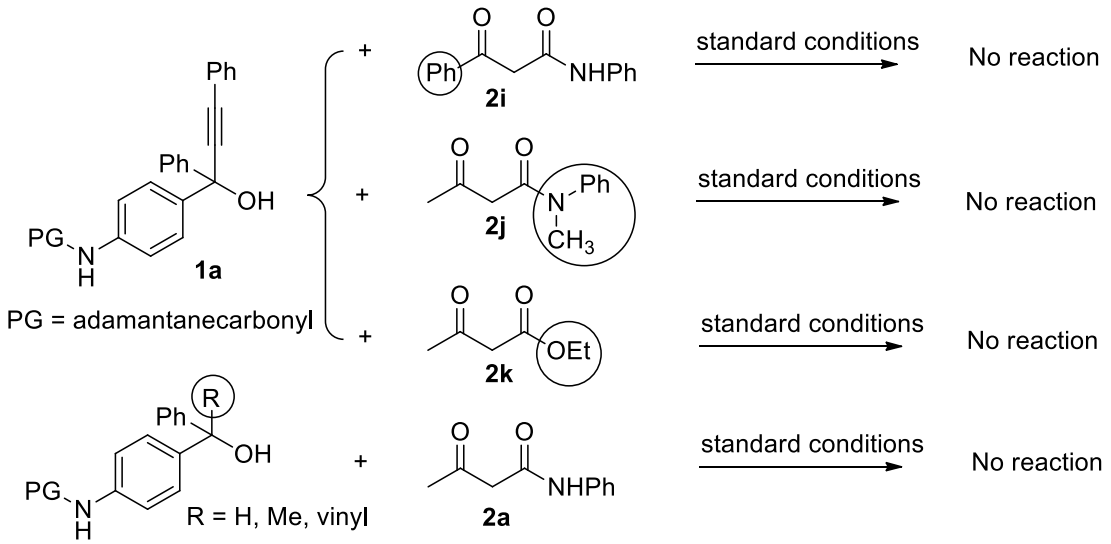
PG = adamantanecarbonyl
554.4 mg, 1.2 mmol

177.0 mg, 1.0 mmol

610.0 mg, 98% yield, 95% ee, >20:1 dr

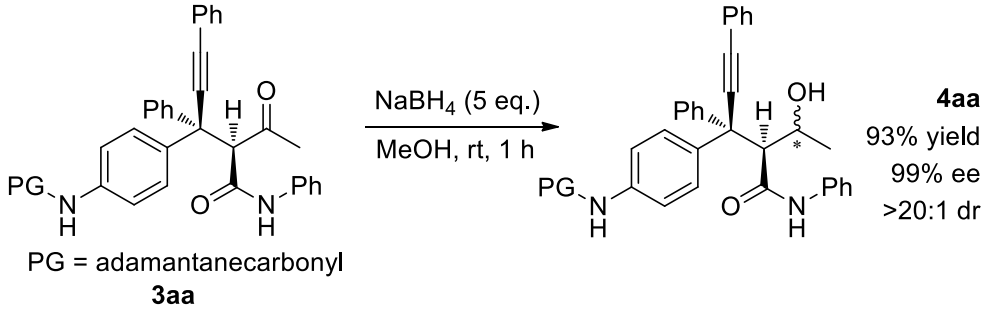
To a solution of $PhCF_3$ (6.0 mL) were added propargylic alcohol **1a** (554.4 mg, 1.2 mmol), 3-oxo-*N*-phenylbutanamide **2a** (177.0 mg, 1.0 mmol) and **CPA-4** (7.0 mg, 0.01 mmol). The reaction mixture was stirred at room temperature for 36 h and then the solvent was removed under vacuum. The residue was purified by silica gel chromatography to yield the desired product **3aa** as a yellow solid (610.0 mg, 98% yield, 95% ee, >20:1 dr).

E: Control Experiment



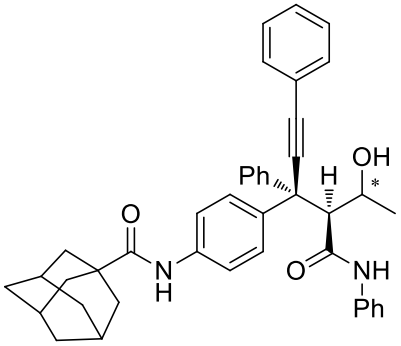
To a solution of $PhCF_3$ (0.3 mL) were added substrate **1a** (27.72 mg, 0.06 mmol), nucleophiles **2i-k** and **CPA-4** (0.35 mg, 0.0005 mmol). The reaction mixture was stirred at room temperature for 36 h. No desired product was observed under the optimized conditions.

F: Synthetic Transformations.



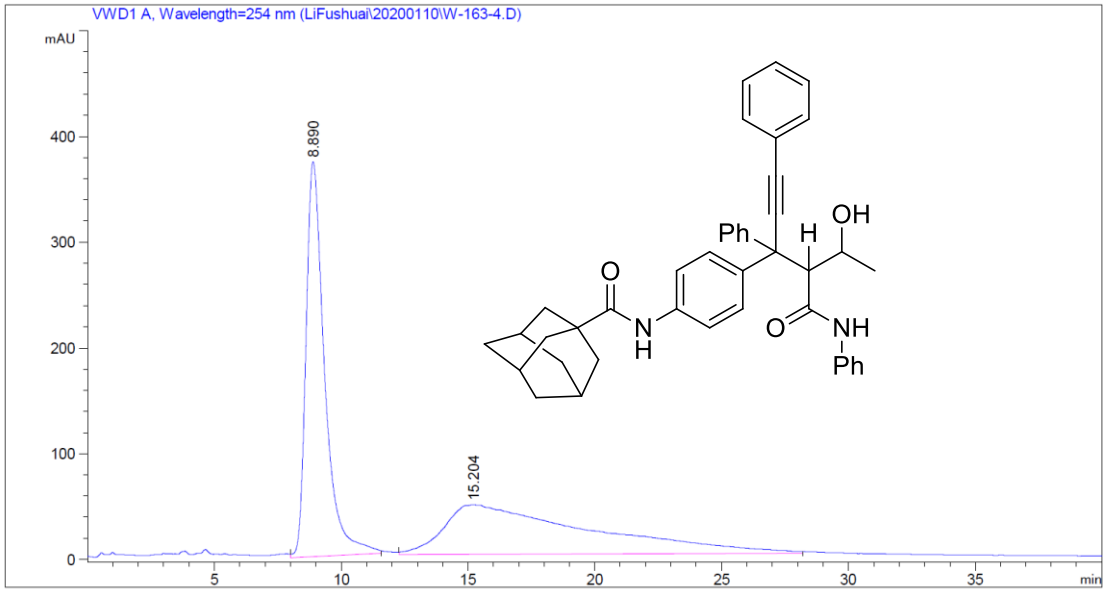
To a solution of **3aa** (31.1 mg, 0.05 mmol) in MeOH (2.5 mL) was added $NaBH_4$ (9.5 mg, 0.25 mmol) in one portion at 0 ^oC. It was stirred at room termperature for 1 h. Then a saturated aqueous NH_4Cl solution (2.5 mL) was added to quench the reaction. The aqueous layer was extracted with ethyl acetate (3×5 mL). The combined organic layers were washed with brine (5 mL), dried over anhydrous Na_2SO_4, filtered, and concentrated. The residue was purified by silica gel chromatography (eluent: hexanes/ethyl acetate = 3:1) to afford compound **4aa** (29.0 mg, 93% yield, 99% ee, >20:1 dr).

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-5-hydroxy-1,3-diphenyl-4-(phenylcarbamoyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (4aa)

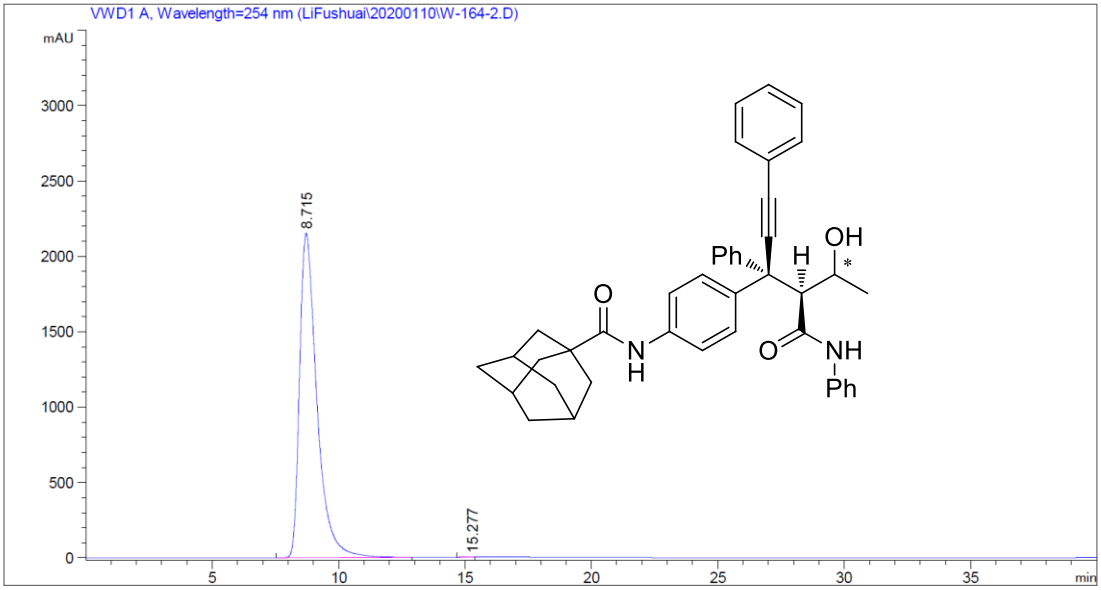


Eluent for flash column chromatography: petroleum ether/ethyl acetate =3:1. White solid, 29.0 mg, 93% yield. mp 165.5-167.1 ^oC. ^1H NMR ($CDCl_3$, 500 MHz): δ (ppm) 8.59 (s, 1H), 7.67-7.65 (m, 3H), 7.63-7.61 (m, 3H), 7.49 (d, *J* = 10.0 Hz, 2H), 7.43-7.43 (m, 2H), 7.42-7.41 (m, 1H), 7.32-7.26 (m, 5H), 7.22-7.21 (m, 1H), 7.20-7.18 (m, 2H), 7.05-7.01 (m, 1H), 4.23-4.18 (m, 1H), 3.97 (d, *J* = 10.0 Hz, 1H), 2.56 (d, *J* = 5.0 Hz, 1H), 2.05 (s, 3H), 1.89 (s, 6H), 1.75-1.66 (m, 6H), 1.48 (d, *J* = 10.0 Hz, 3H). ^{13}C NMR ($CDCl_3$, 125 MHz): δ (ppm) 176.2, 169.4, 143.1, 139.3, 137.3, 137.1, 131.7, 129.3, 129.0, 128.9, 128.8, 127.4, 126.7, 124.6, 121.8, 120.3, 120.0, 91.0, 90.9, 68.2, 62.4, 50.4, 41.5, 39.2, 36.4, 28.1, 21.1. HRMS (ESI): exact mass calculated for $[M+H]^+$ ($C_{42}H_{43}O_3N_2$) requires m/z 623.3268, found m/z 623.3270. The enantiomeric excess was determined to be 99% by HPLC. [IA column, 254 nm, *n*-hexane:EtOH = 75:25, 1.0 mL/min]: 8.7 min (major), 15.3 min (minor). $[\alpha]^{22}_D$ = 13.88 (c = 1.00, CH_2Cl_2).

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-5-hydroxy-1,3-diphenyl-4-(phenylcarbamoyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (4aa)

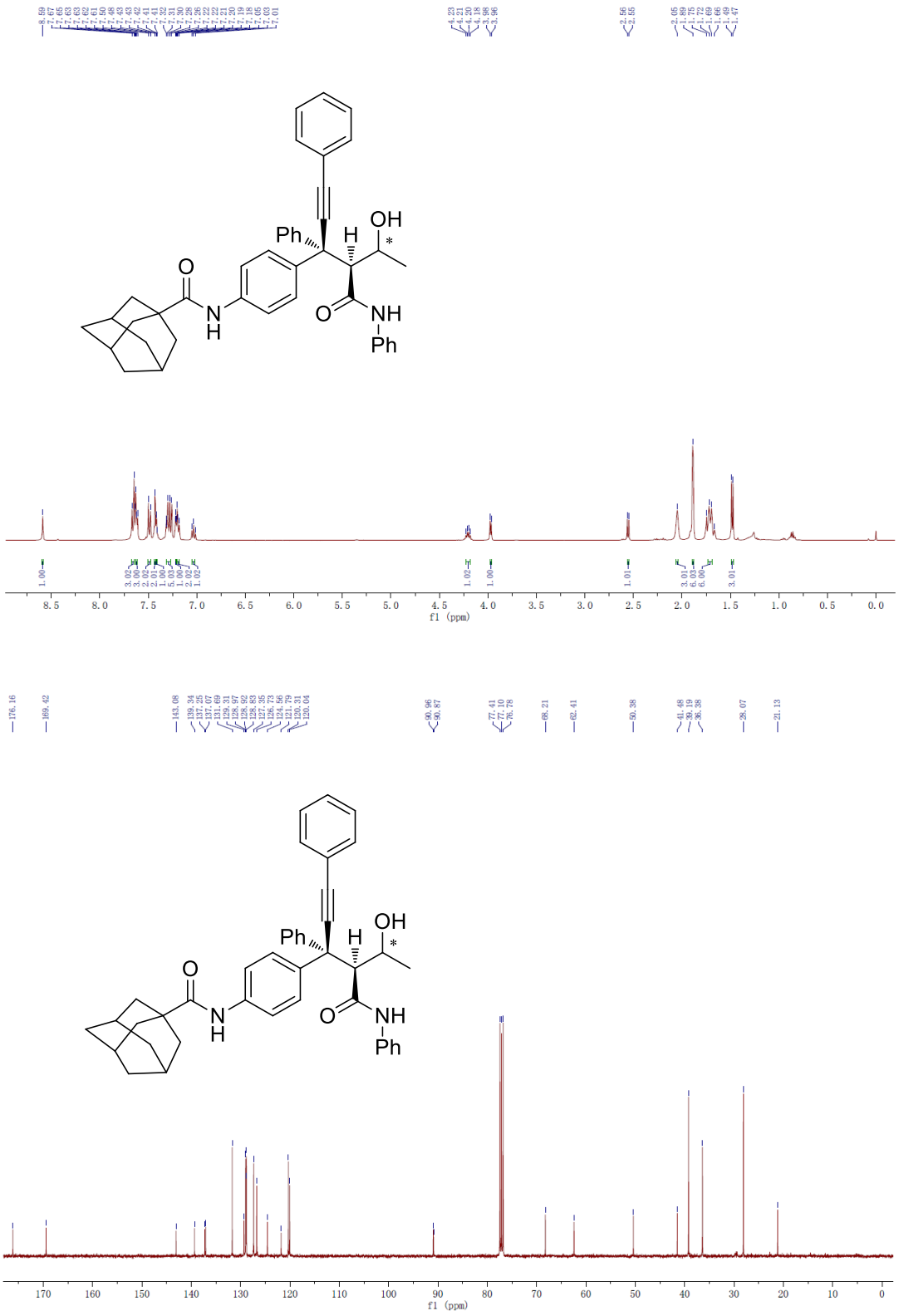


#	Time	Area	Height	Width	Symmetry	Area %
1	8.89	19005.3	373.2	0.8487	0.588	50.488
2	15.204	18638	47	6.6052	0.257	49.512



#	Time	Area	Height	Width	Symmetry	Area %
1	8.715	102784.8	2153	0.737	0.557	99.982
2	15.277	18.8	3.3E-1	0.7199	0	0.018

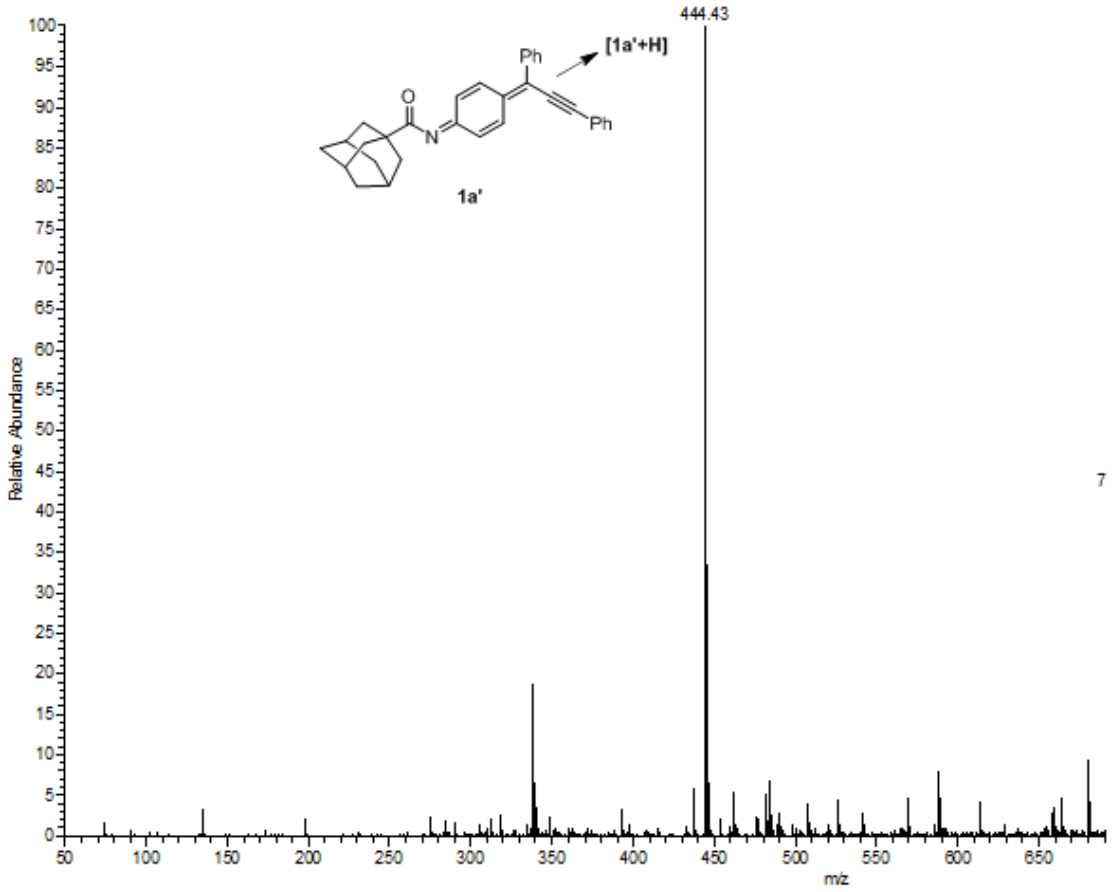
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-5-hydroxy-1,3-diphenyl-4-(phenylcarbamoyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (4aa)



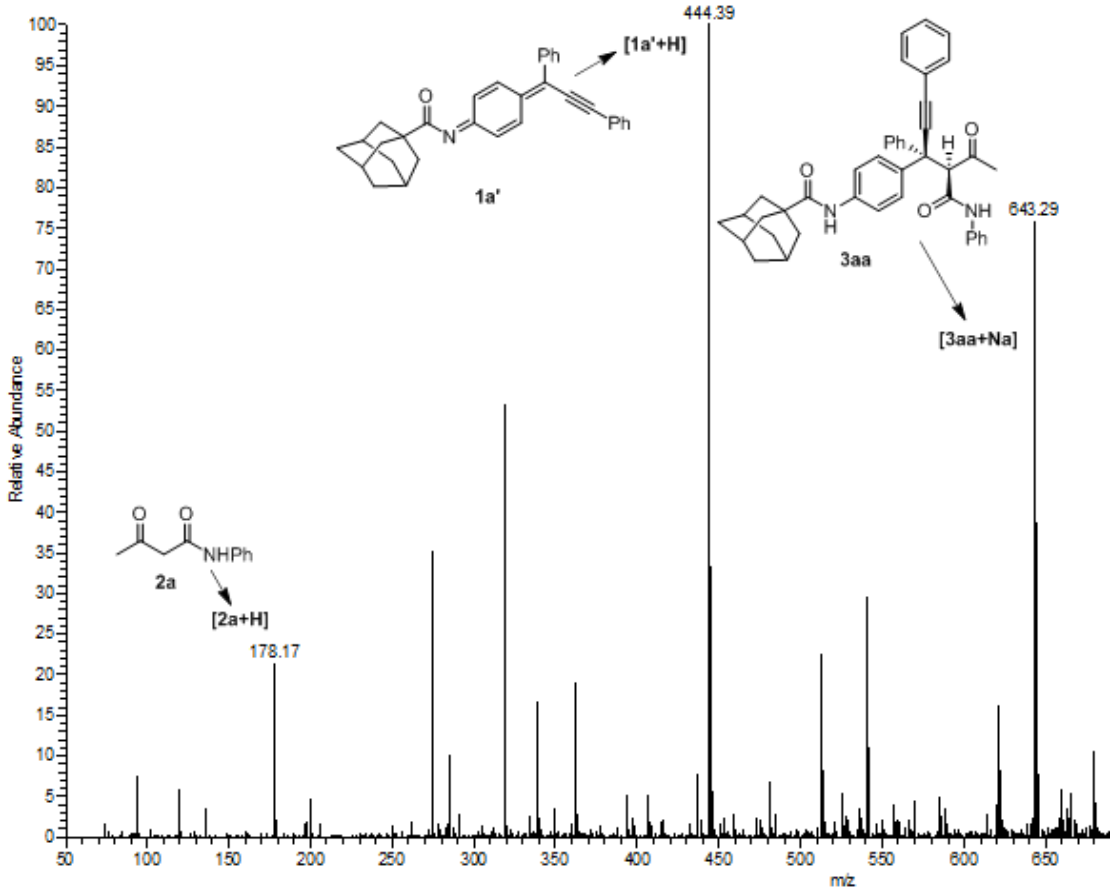
G: ESI-MS Studies

a) ESI(+)-MS spectra for the reaction of catalyst **CPA-4** and propargylic alcohol **1a** for 2 h; b) ESI(+)-MS spectra for the 1,6-conjugate addition of propargylic alcohol **1a** and 3-oxo-*N*-phenylbutanamide **2a** catalyzed by catalyst **CPA-4** for 12 h. Other unidentified ions are likely to correspond to either impurities or side-reaction products.

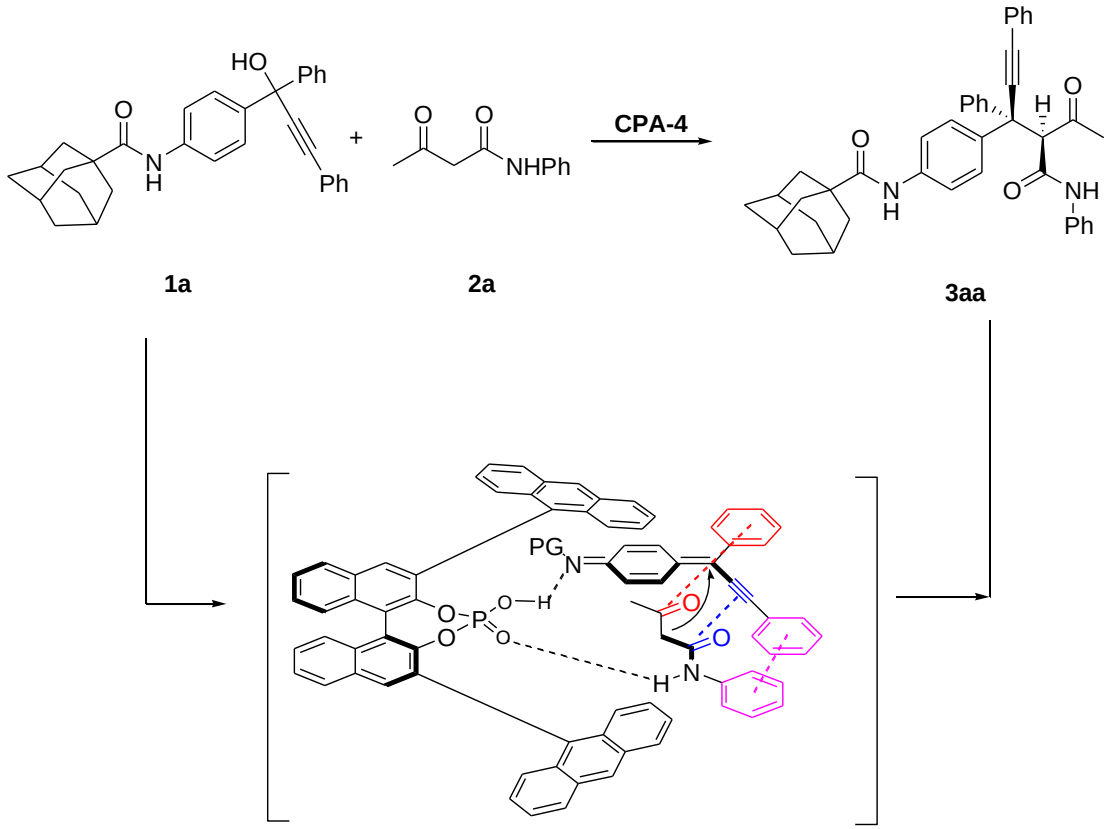
a)



b)

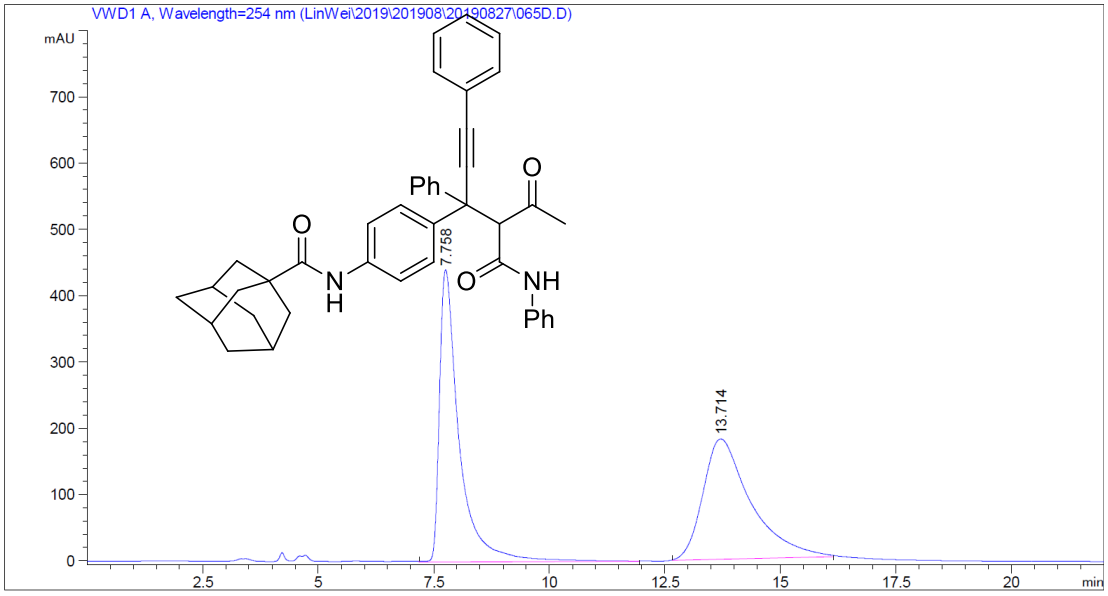

444.39
[1a'+H]
1a'
3aa
643.29
[3aa+Na]
2a
[2a+H]
178.17
Relative Abundance
m/z

H: Possible Transition State

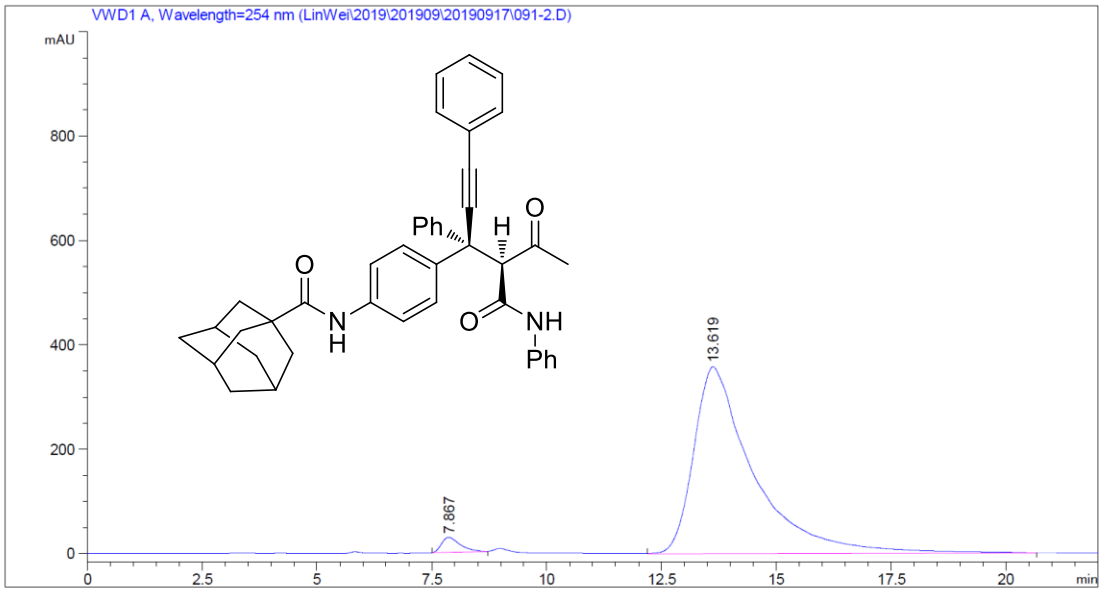


I: HPLC Analysis

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-5-oxo-1,3-diphenyl-4-(phenylcarbamoyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3aa)

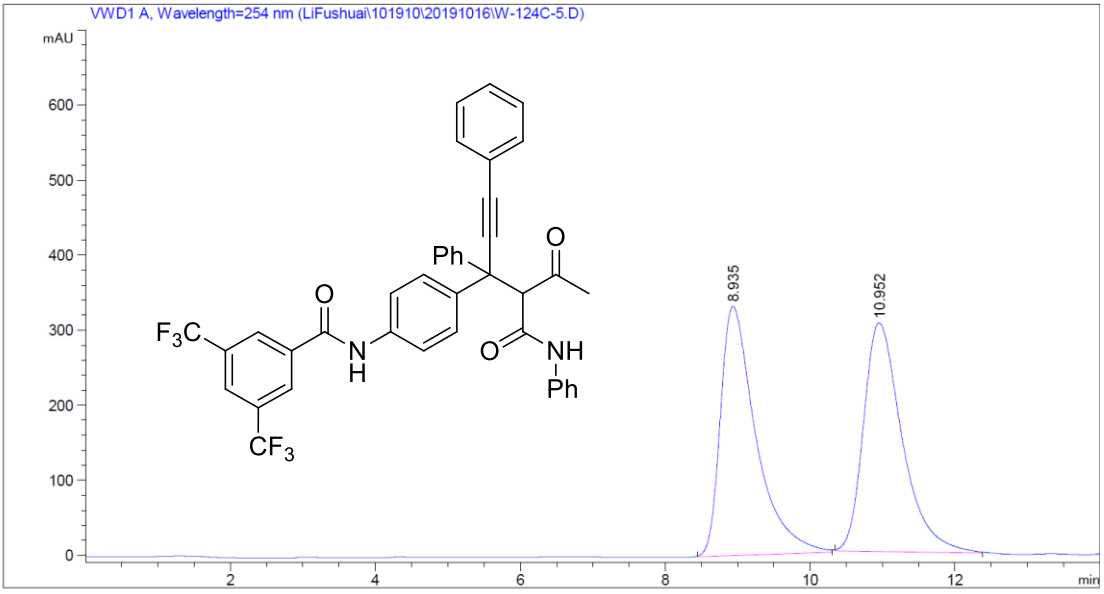


#	Time	Area	Height	Width	Symmetry	Area %
1	7.758	13076.3	440.3	0.495	0.424	50.007
2	13.714	13072.5	181.4	1.2011	0.584	49.993

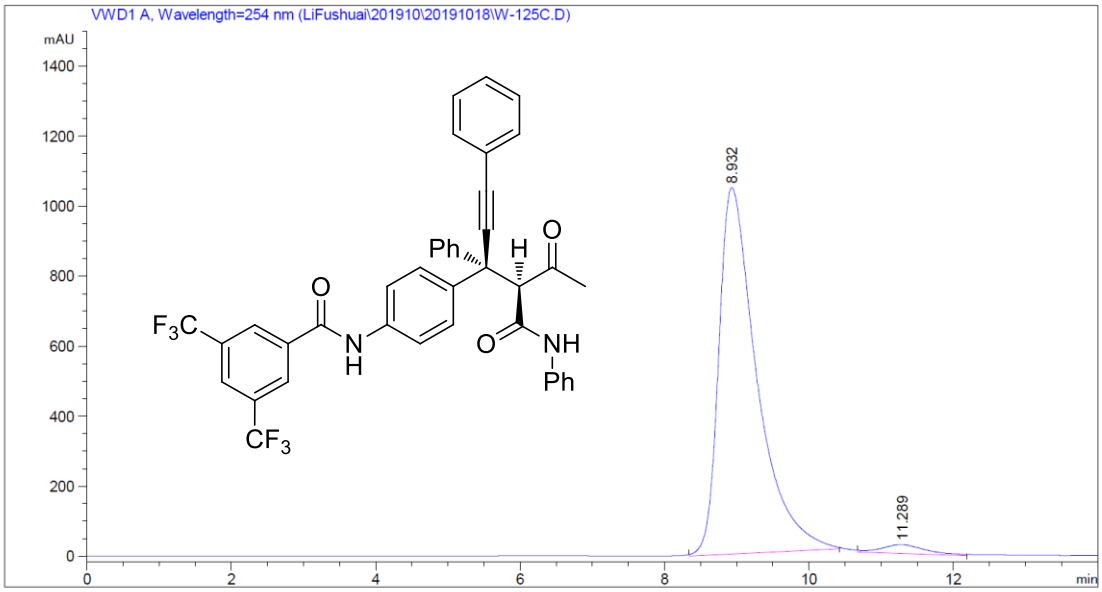


#	Time	Area	Height	Width	Symmetry	Area %
1	7.867	821.9	28.9	0.4734	0.589	2.457
2	13.619	32626.3	358.3	1.5175	0.454	97.543

***N*-(4-((3*R*,4*S*)-5-oxo-1,3-diphenyl-4-(phenylcarbamoyl)hex-1-yn-3-yl)phenyl)-3,5-bis(trifluoromethyl)benzamide (3ba)**

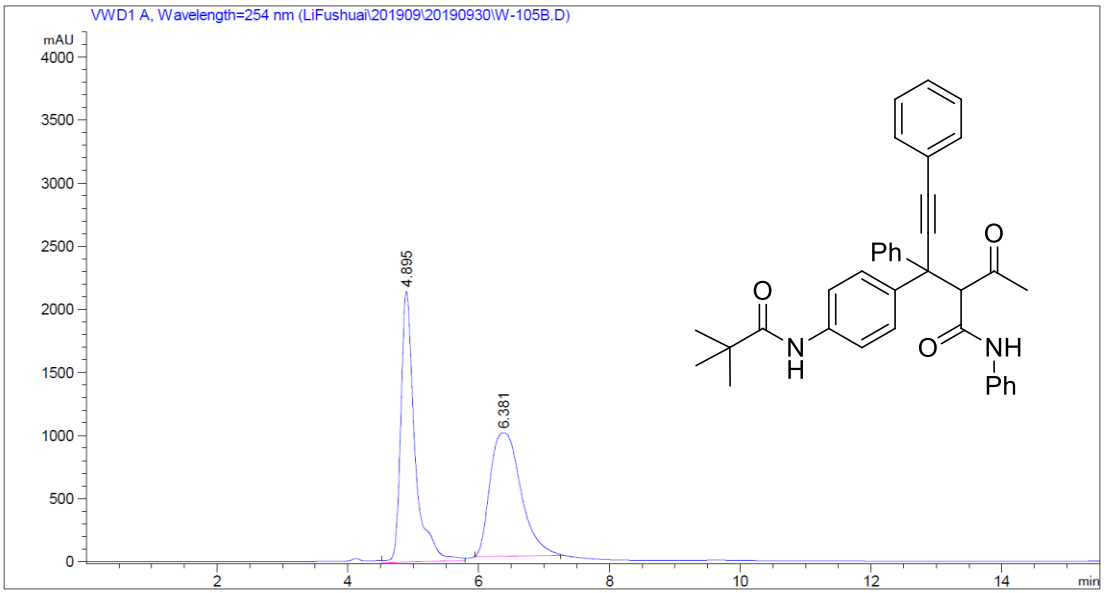


#	Time	Area	Height	Width	Symmetry	Area %
1	8.935	11296	332.3	0.5666	0.526	50.022
2	10.952	11286	304.6	0.6175	0.647	49.978

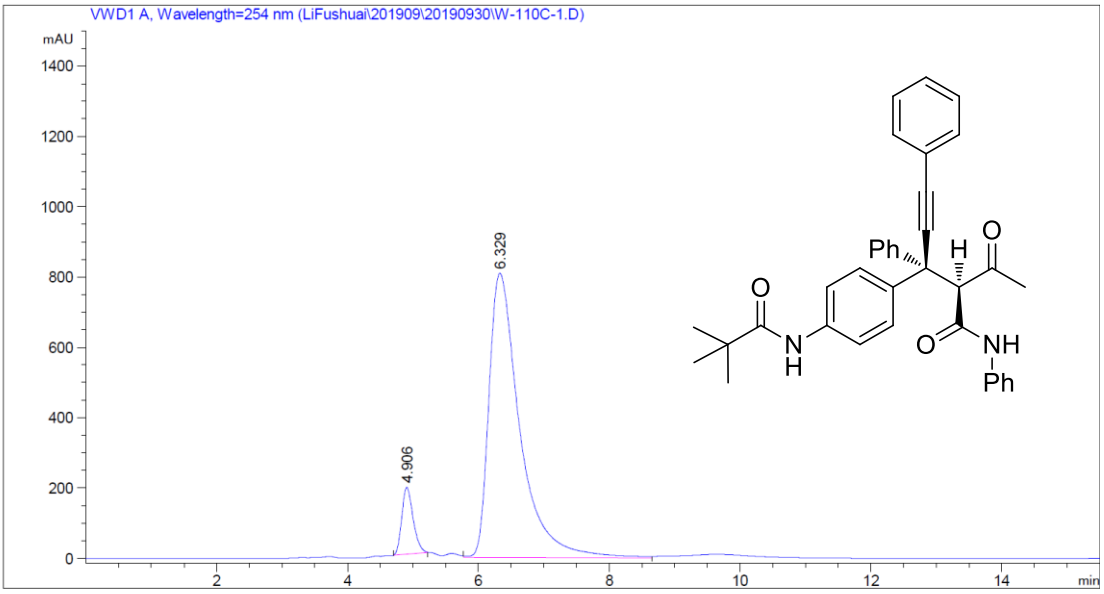


#	Time	Area	Height	Width	Symmetry	Area %
1	8.932	38265.6	1046.6	0.6094	0.506	97.177
2	11.289	1111.8	25.4	0.7305	0.736	2.823

(2*S*,3*R*)-2-acetyl-*N*,3,5-triphenyl-3-(4-pivalamidophenyl)pent-4-ynamide (3ca)

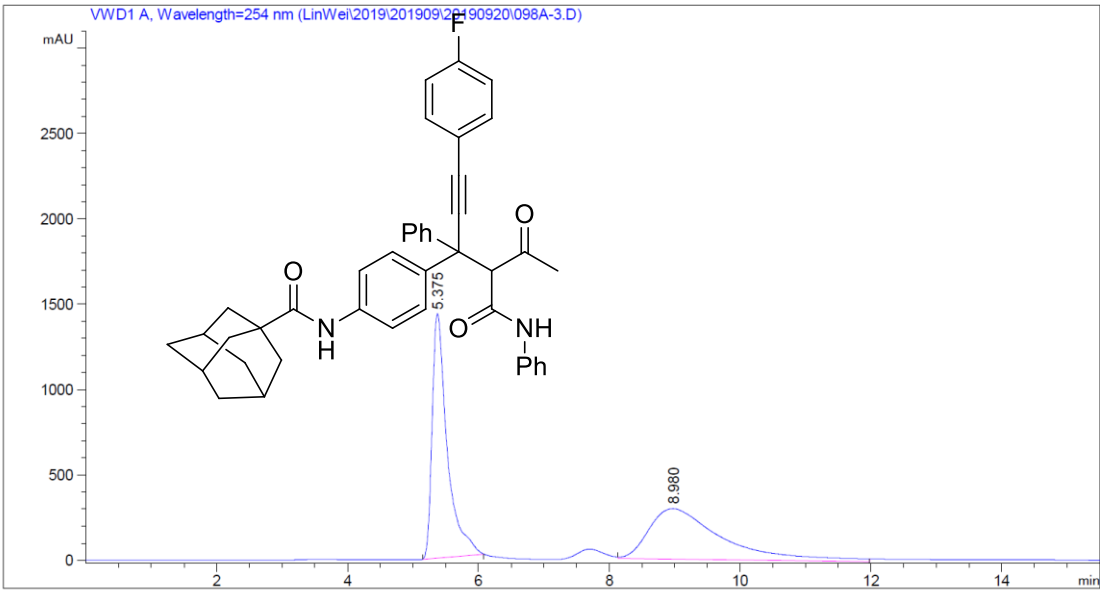


#	Time	Area	Height	Width	Symmetry	Area %
1	4.895	32075.7	2145.1	0.2492	0.619	49.984
2	6.381	32096.3	978.6	0.5466	0.745	50.016

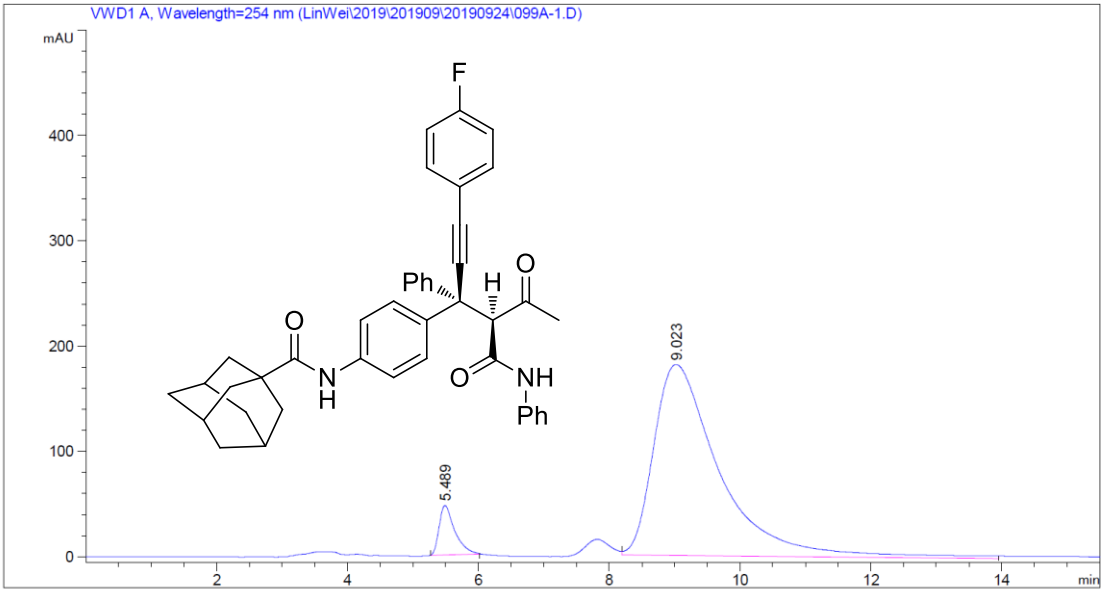


#	Time	Area	Height	Width	Symmetry	Area %
1	4.906	2297.8	190.4	0.2011	0.758	7.973
2	6.329	26521.6	808.3	0.5469	0.52	92.027

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(4-fluorophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ea)

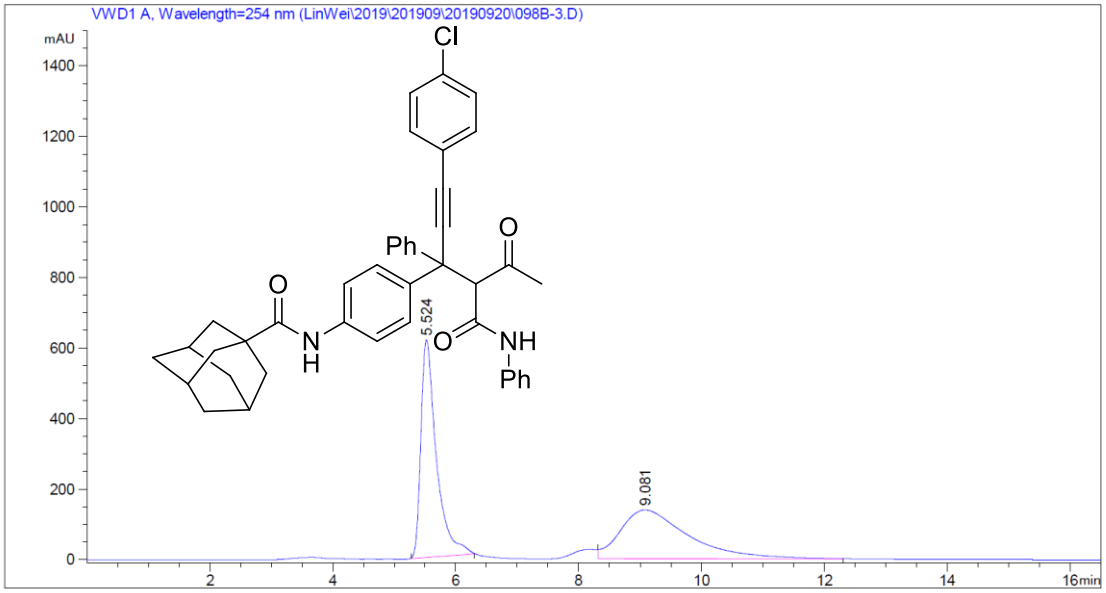


#	Time	Area	Height	Width	Symmetry	Area %
1	5.375	22908.5	1431.4	0.2667	0.511	49.913
2	8.98	22987.9	296.2	1.2935	0.477	50.087

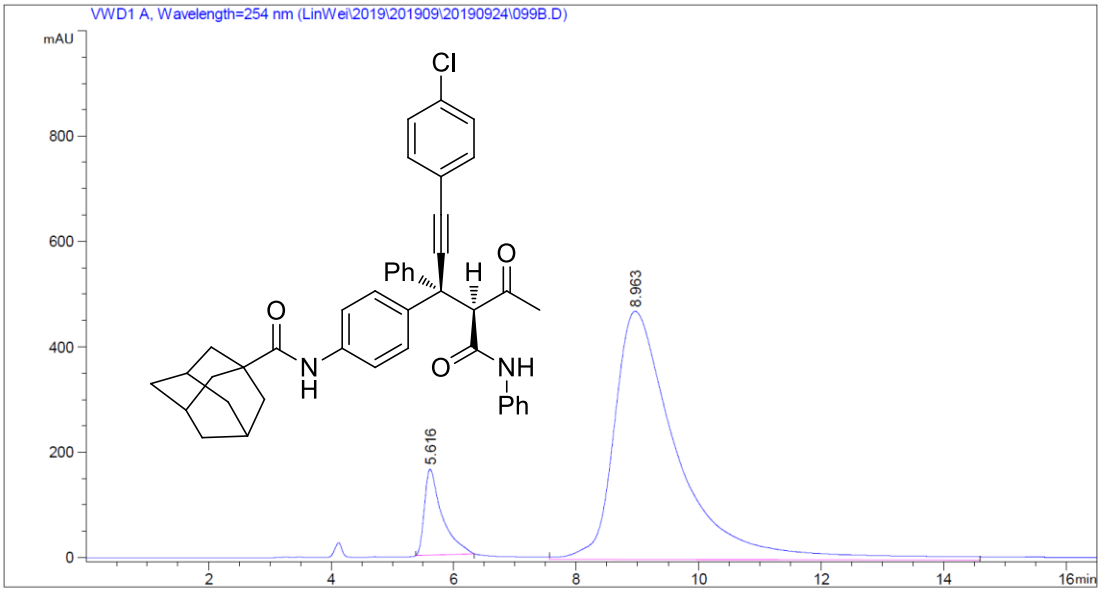


#	Time	Area	Height	Width	Symmetry	Area %
1	5.489	784.9	47.2	0.2774	0.58	5.801
2	9.023	12744.1	181.3	1.1715	0.489	94.199

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(4-chlorophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3fa)

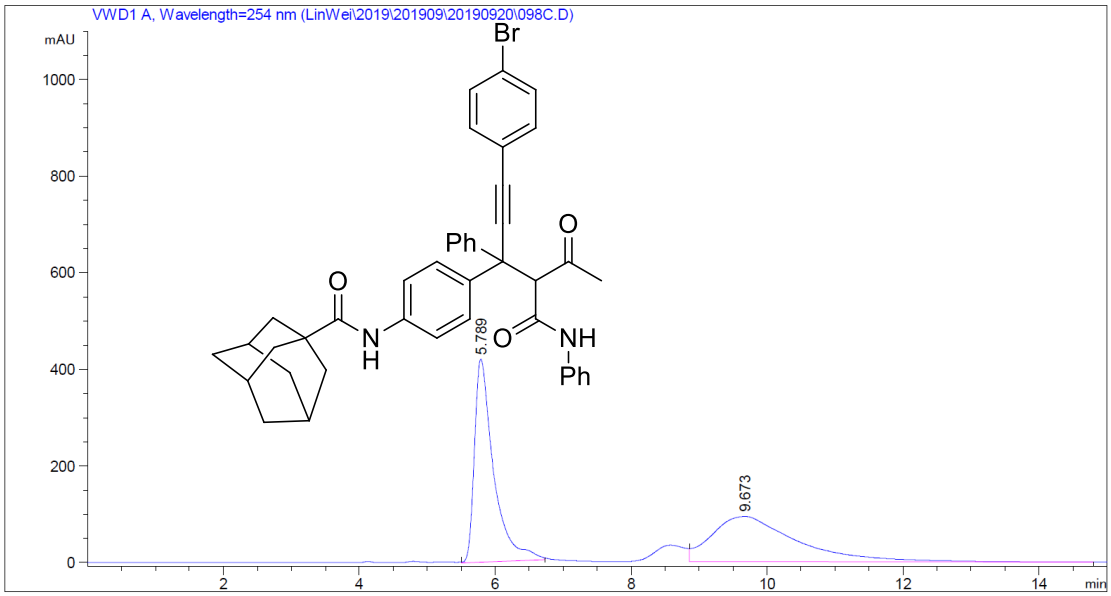


#	Time	Area	Height	Width	Symmetry	Area %
1	5.524	10763	616.2	0.2911	0.533	50.153
2	9.081	10697.3	137.9	1.2933	0.545	49.847

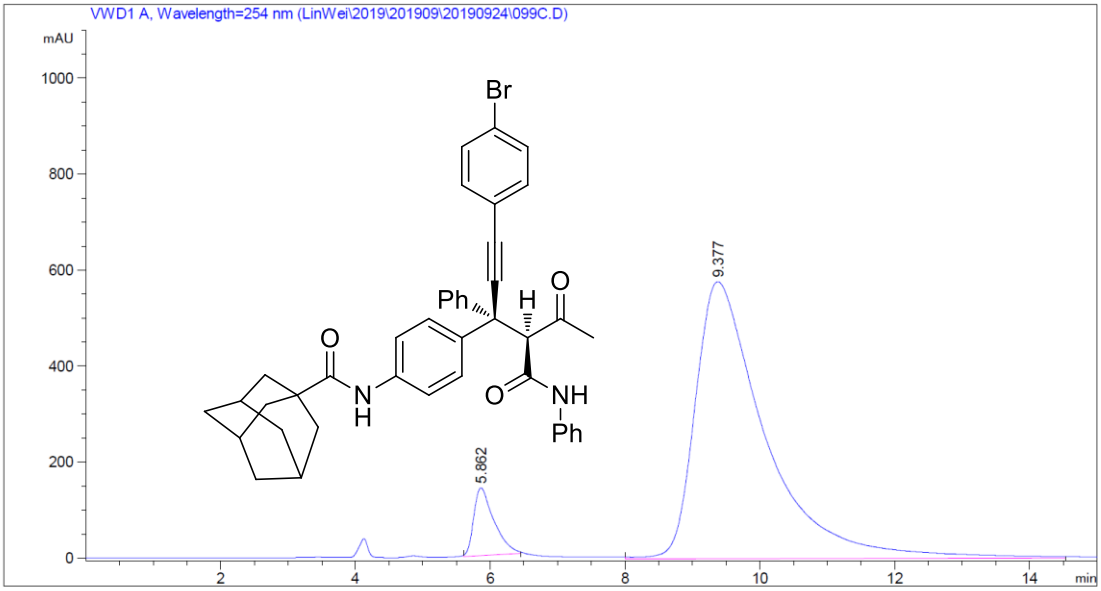


#	Time	Area	Height	Width	Symmetry	Area %
1	5.616	3289.8	163.1	0.3362	0.457	8.846
2	8.963	33901.5	470.5	1.2009	0.475	91.154

(1*r*,3*R*,5S)-*N*-(4-((3*R*,4*S*)-1-(4-bromophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ga)

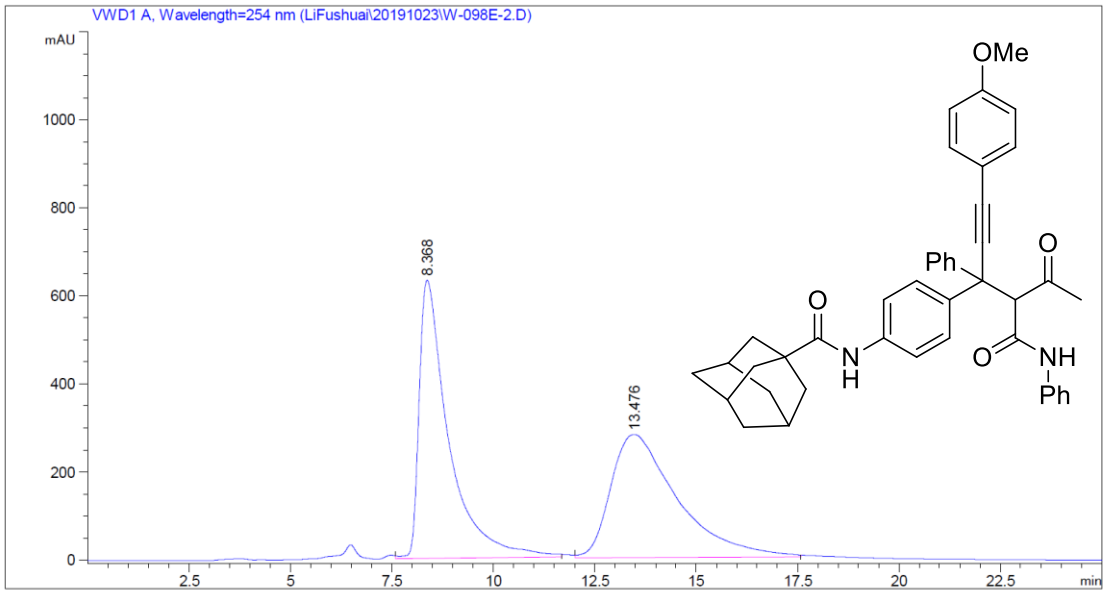


#	Time	Area	Height	Width	Symmetry	Area %
1	5.789	8246.4	420.3	0.327	0.484	50.017
2	9.673	8240.8	93.8	1.2473	0.573	49.983

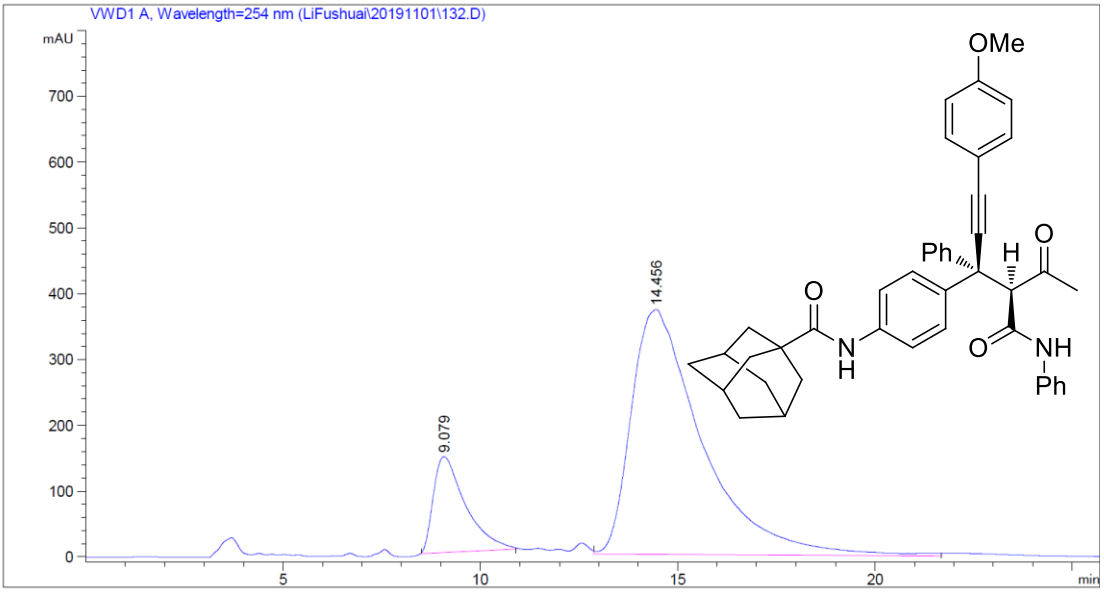


#	Time	Area	Height	Width	Symmetry	Area %
1	5.862	2944.8	141.3	0.3472	0.534	6.612
2	9.377	41589.7	577	1.2013	0.462	93.388

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(4-methoxyphenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ha)

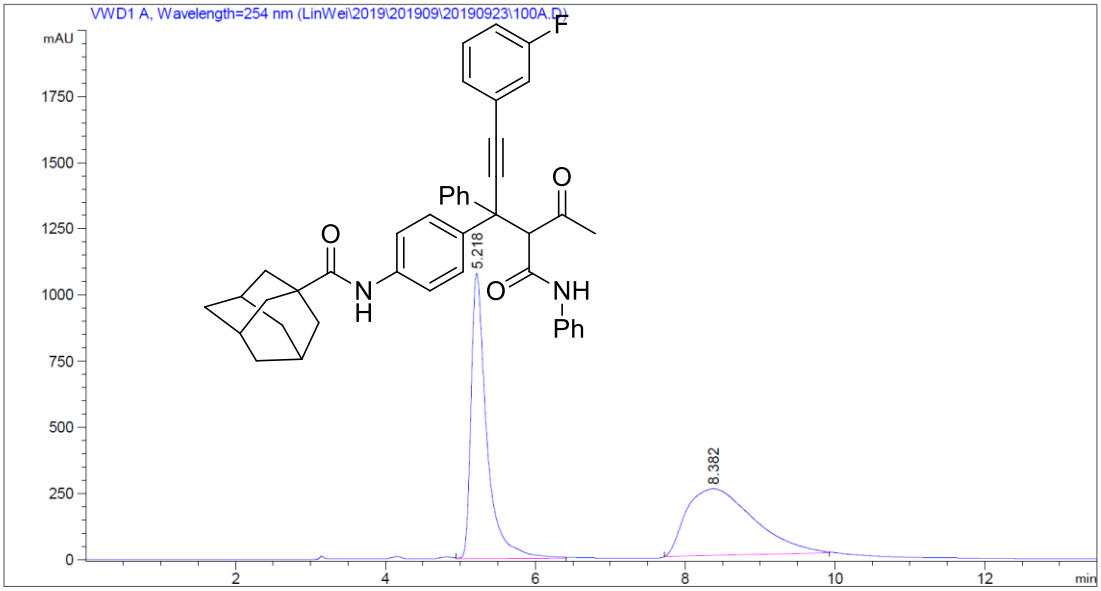


#	Time	Area	Height	Width	Symmetry	Area %
1	8.368	31941.8	631.9	0.8425	0.358	50.100
2	13.476	31814.8	279.6	1.8962	0.531	49.900

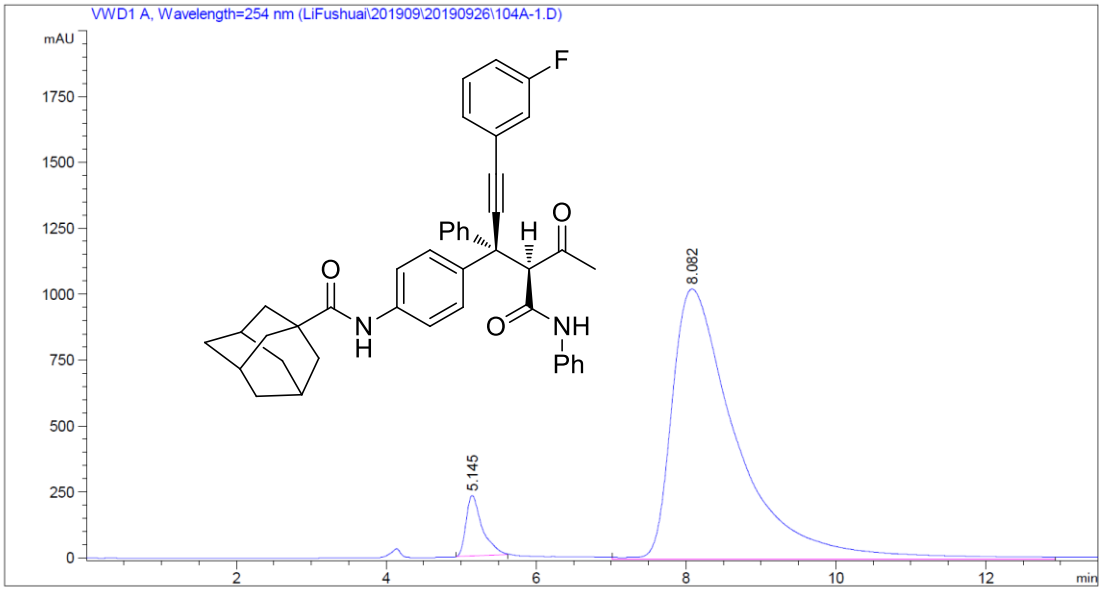


#	Time	Area	Height	Width	Symmetry	Area %
1	9.079	8249.8	145.6	0.9443	0.479	15.045
2	14.456	46584.5	372	2.087	0.515	84.955

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(3-fluorophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ia)

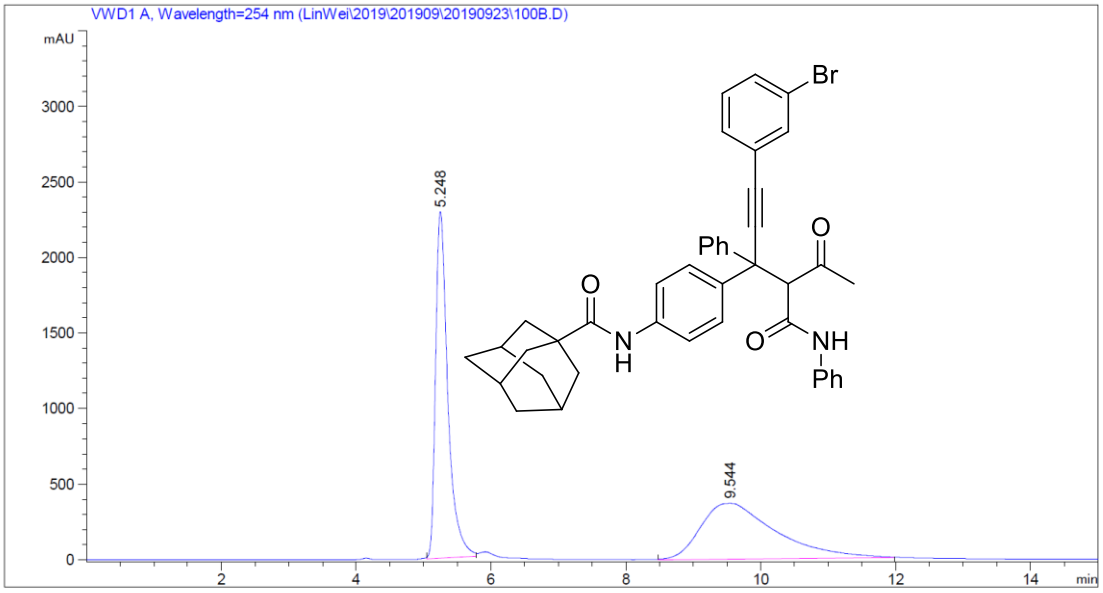


#	Time	Area	Height	Width	Symmetry	Area %
1	5.218	15711.8	1079.3	0.2426	0.525	49.968
2	8.382	15731.7	251.2	1.0438	0.649	50.032

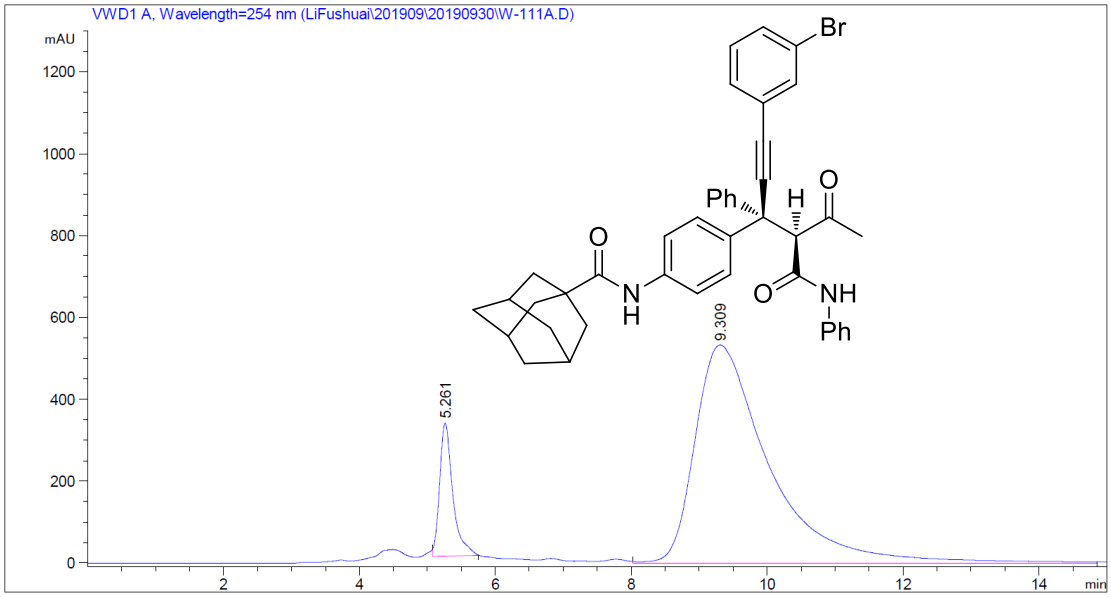


#	Time	Area	Height	Width	Symmetry	Area %
1	5.145	3435.5	229	0.2501	0.579	5.199
2	8.082	62641.4	1026.4	1.0172	0.424	94.801

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(3-bromophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ja)

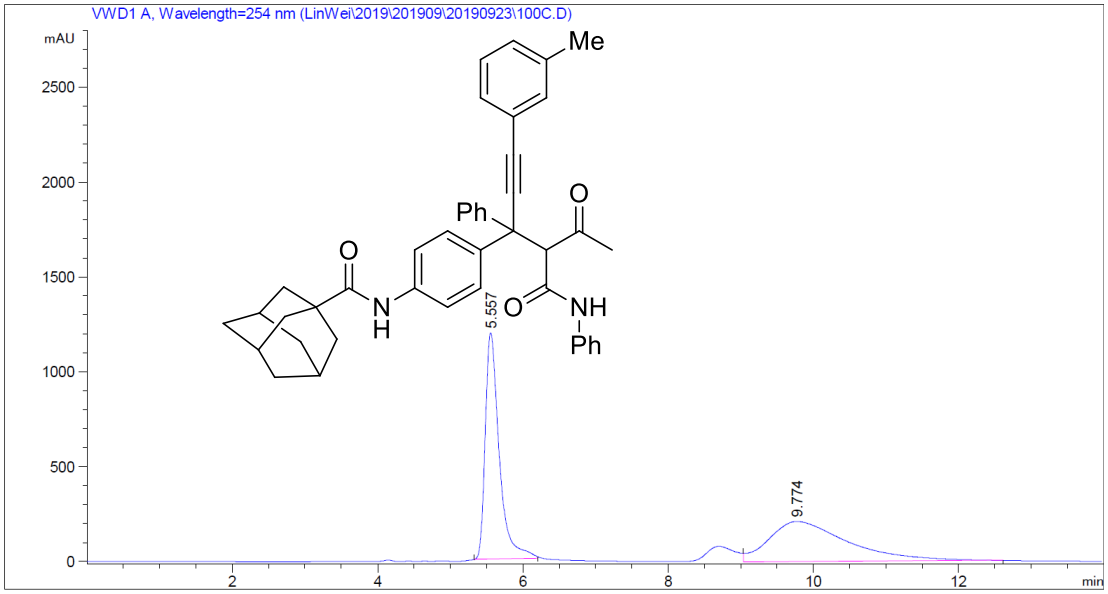


#	Time	Area	Height	Width	Symmetry	Area %
1	5.248	28732.2	2293.5	0.2088	0.599	49.956
2	9.544	28782.5	370.2	1.2959	0.619	50.044

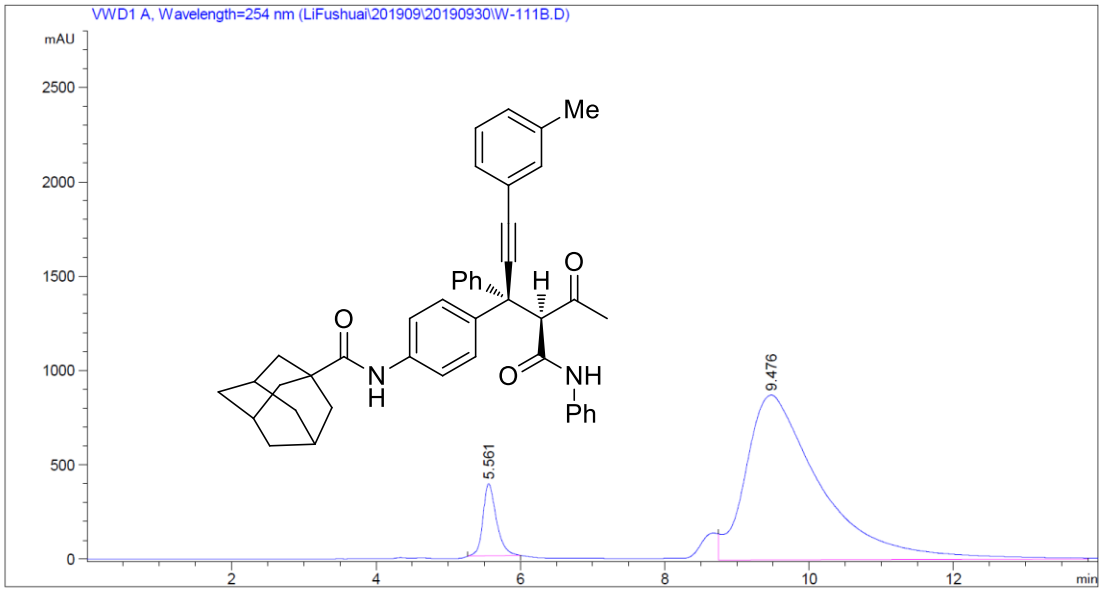


#	Time	Area	Height	Width	Symmetry	Area %
1	5.261	4382	324.7	0.2249	0.677	9.708
2	9.309	40757.1	533.4	1.2736	0.493	90.292

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-5-oxo-3-phenyl-4-(phenylcarbamoyl)-1-(*m*-tolyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ka)

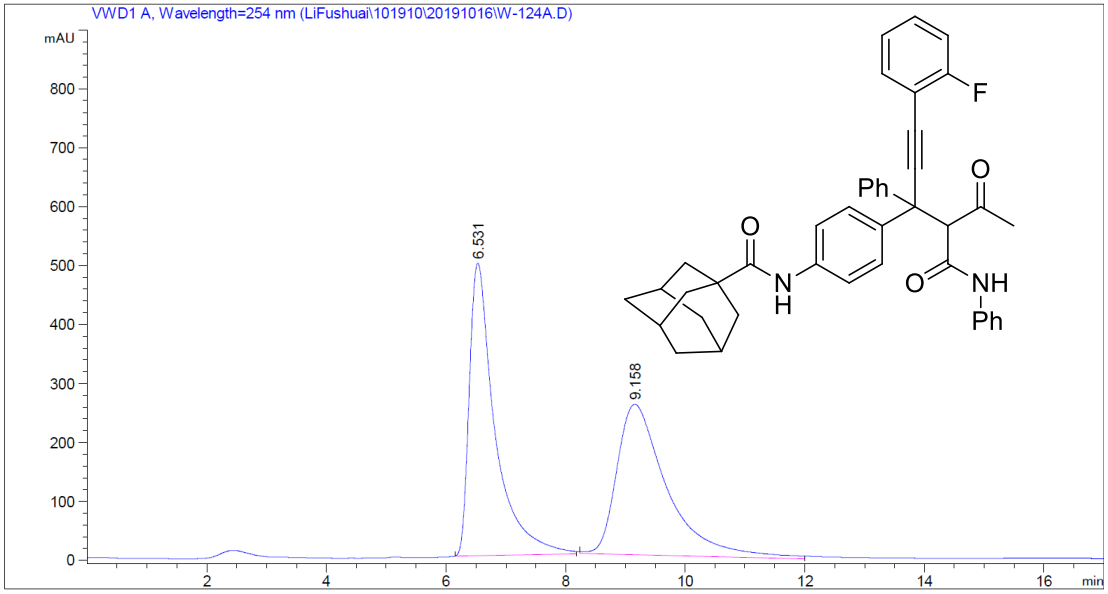


#	Time	Area	Height	Width	Symmetry	Area %
1	5.557	15949.6	1191.6	0.2231	0.598	50.061
2	9.774	15910.8	211.7	1.2528	0.543	49.939

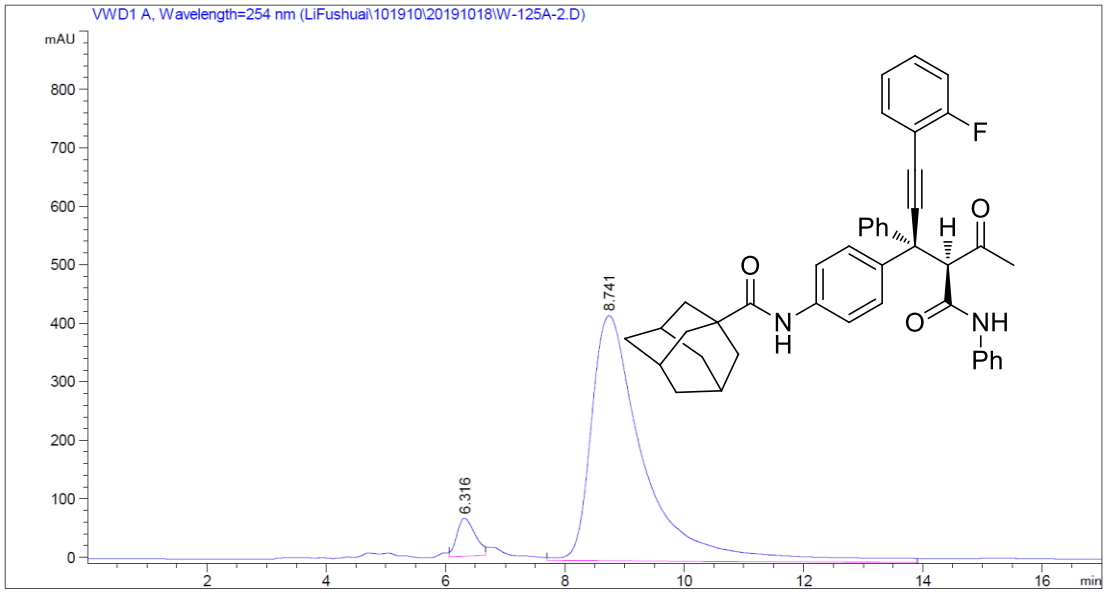


#	Time	Area	Height	Width	Symmetry	Area %
1	5.561	4996.6	382.2	0.2179	0.714	7.340
2	9.476	63074.5	874.6	1.202	0.493	92.660

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(2-fluorophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3la)

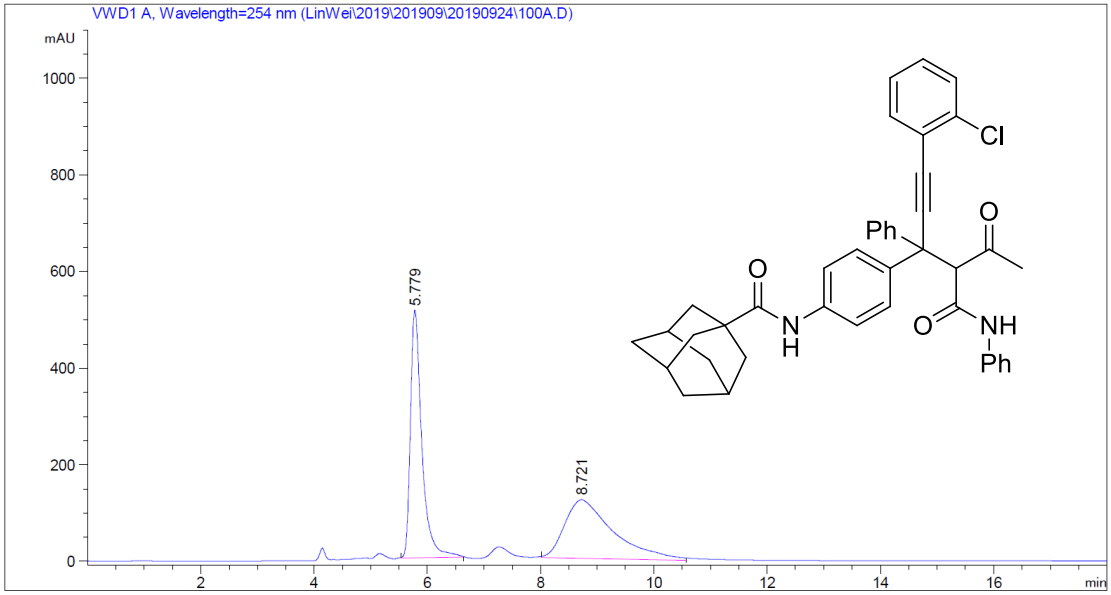


#	Time	Area	Height	Width	Symmetry	Area %
1	6.531	14786.9	496.6	0.4963	0.469	49.930
2	9.158	14828.5	255.1	0.969	0.54	50.070

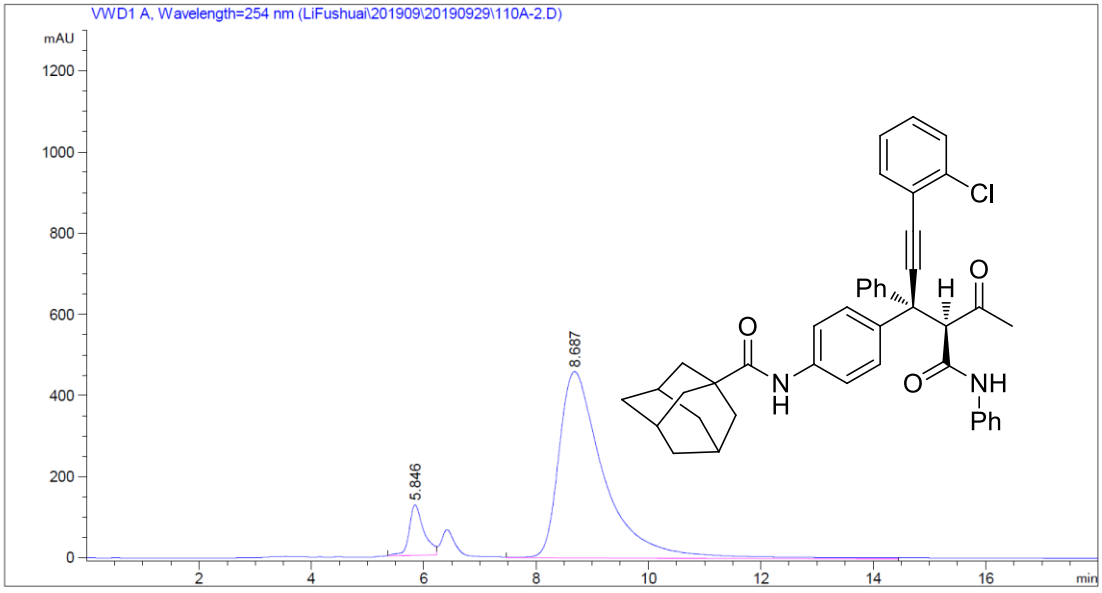


#	Time	Area	Height	Width	Symmetry	Area %
1	6.316	1388.5	64.9	0.3563	0.676	5.114
2	8.741	25761.5	419.2	1.0243	0.487	94.886

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(2-chlorophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ma)

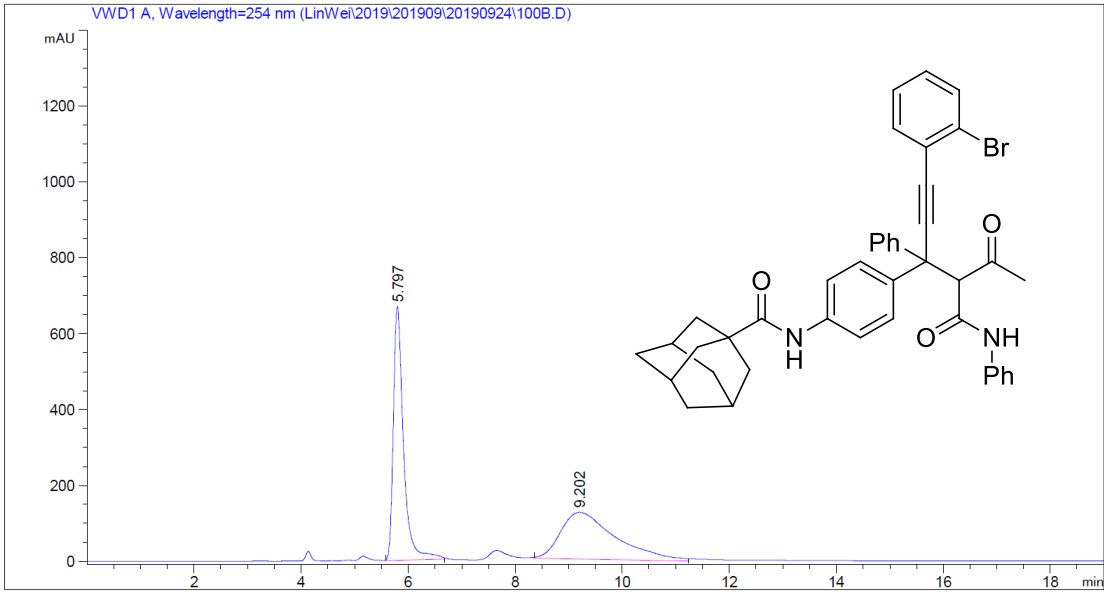


#	Time	Area	Height	Width	Symmetry	Area %
1	5.779	7181.3	512.9	0.2334	0.599	49.908
2	8.721	7207.9	121.2	0.9915	0.509	50.092

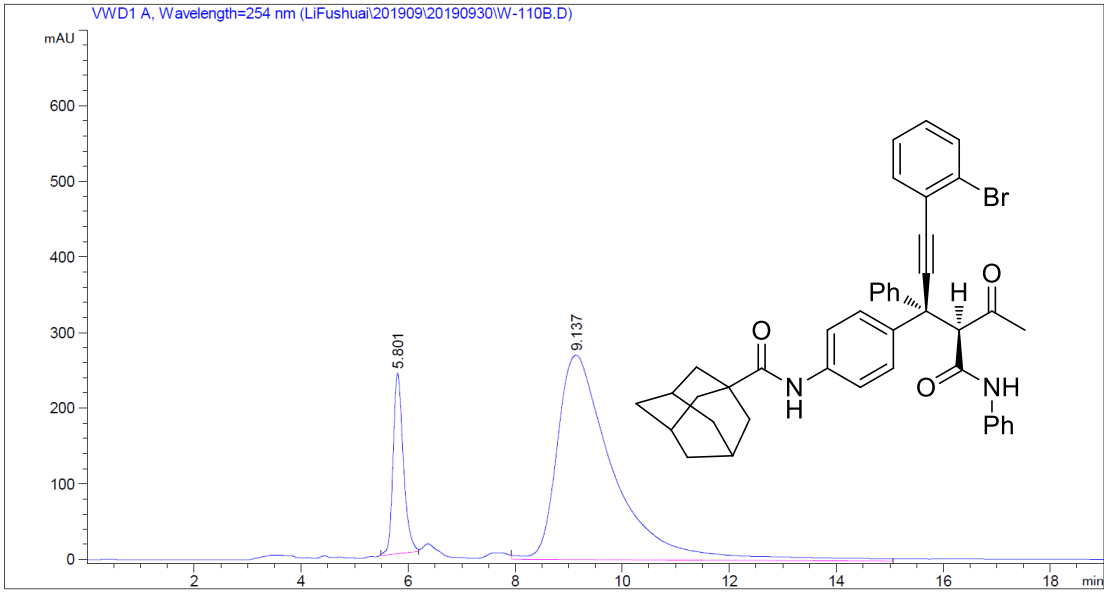


#	Time	Area	Height	Width	Symmetry	Area %
1	5.846	2258.5	124.5	0.3024	0.669	7.956
2	8.687	26128.8	459.7	0.9474	0.498	92.044

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(2-bromophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3na)

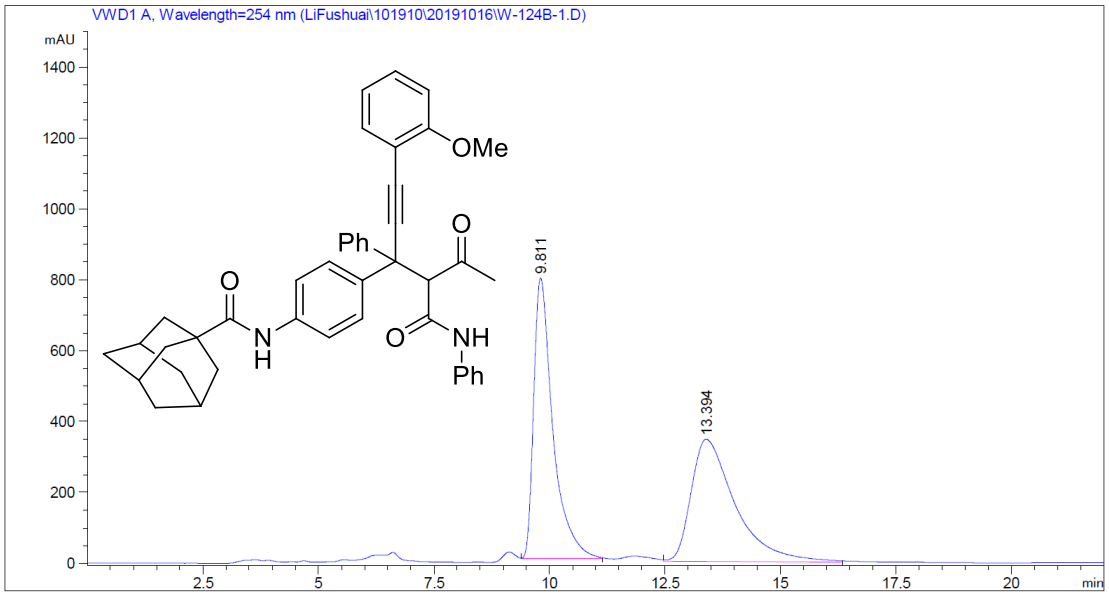


#	Time	Area	Height	Width	Symmetry	Area %
1	5.797	8815.5	669	0.2196	0.611	50.031
2	9.202	8804.6	123.1	1.1925	0.509	49.969

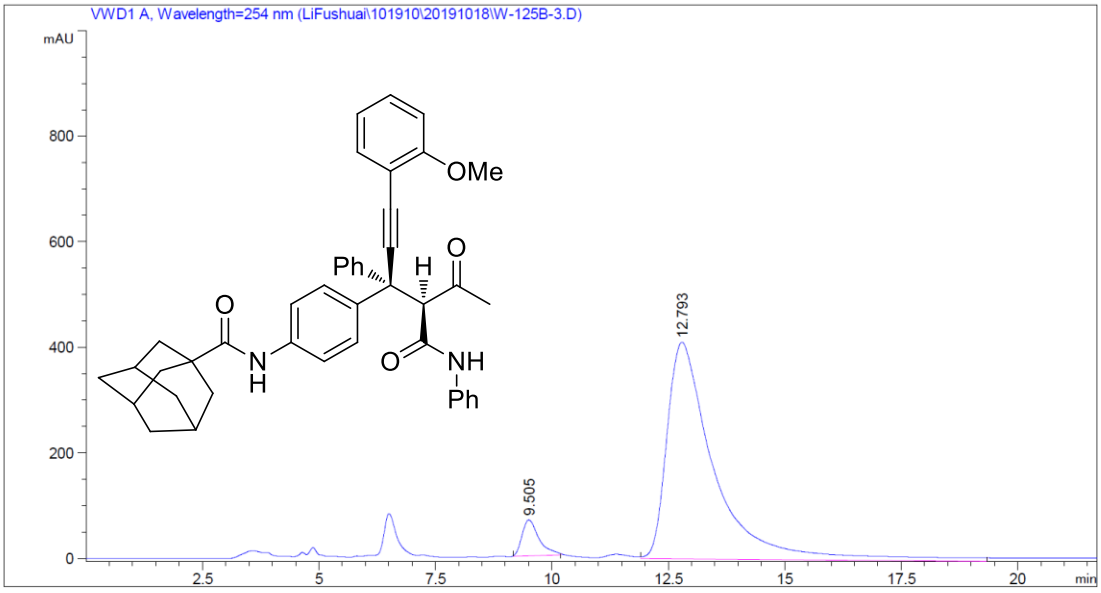


#	Time	Area	Height	Width	Symmetry	Area %
1	5.801	3166.1	238.9	0.2209	0.75	13.805
2	9.137	19767.6	270.5	1.2181	0.485	86.195

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(2-methoxyphenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3oa)

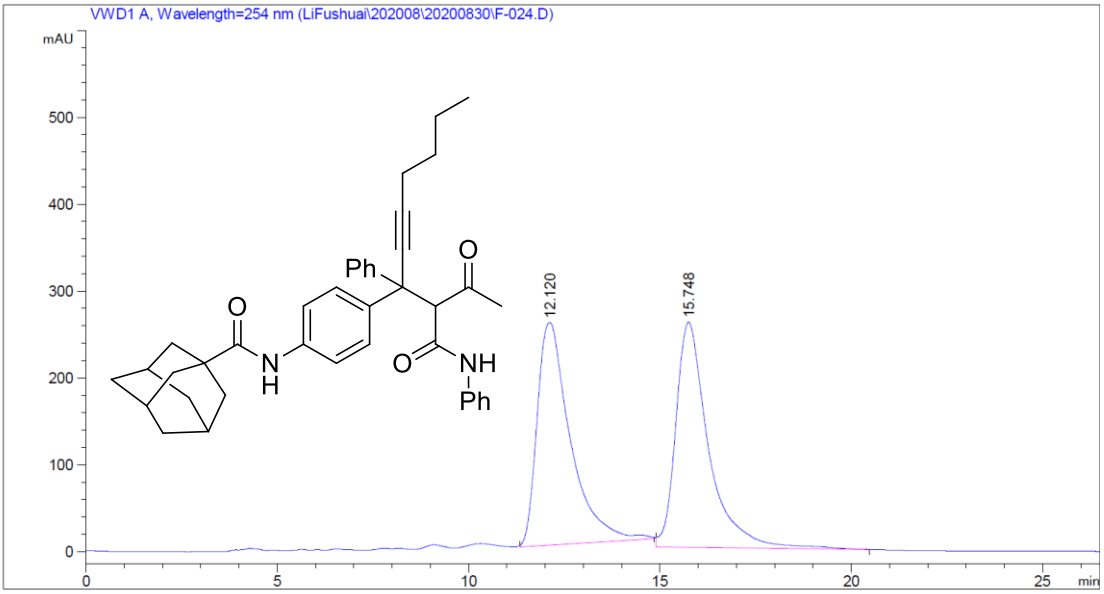


#	Time	Area	Height	Width	Symmetry	Area %
1	9.811	22812.3	791.2	0.4805	0.544	50.000
2	13.394	22812.1	344.6	1.1033	0.504	50.000

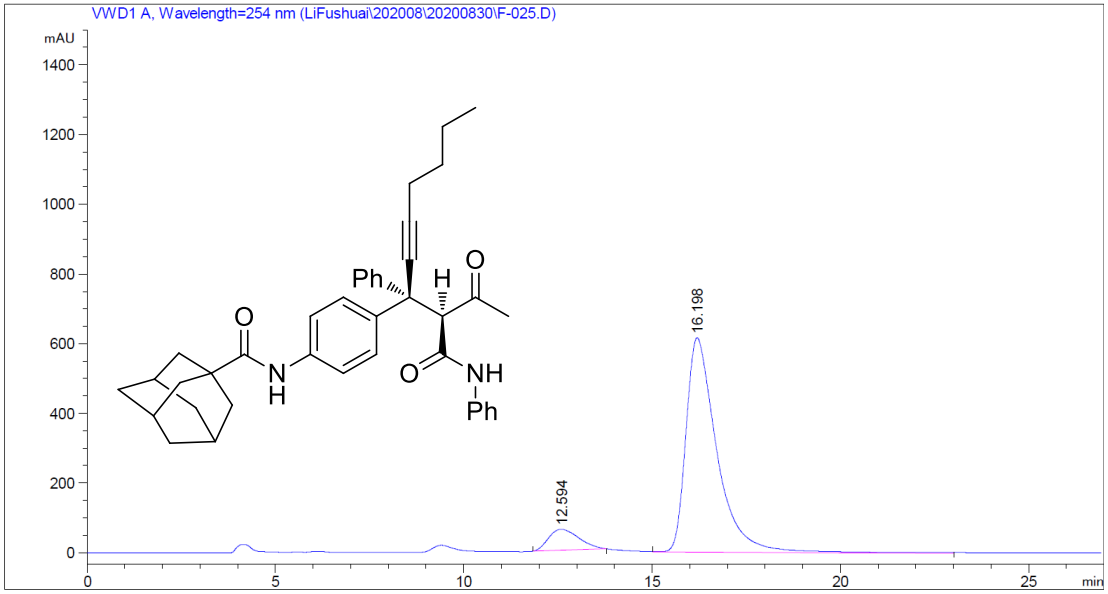


#	Time	Area	Height	Width	Symmetry	Area %
1	9.505	1728.1	68.2	0.4225	0.645	5.545
2	12.793	29439.5	410.9	1.194	0.437	94.455

(1*r*,3*R*,5*S*)-*N*-(4-((3*S*,4*R*)-2-oxo-4-phenyl-3-(phenylcarbamoyl)dec-5-yn-4-yl)phenyl)adamantane-1-carboxamide (3pa)

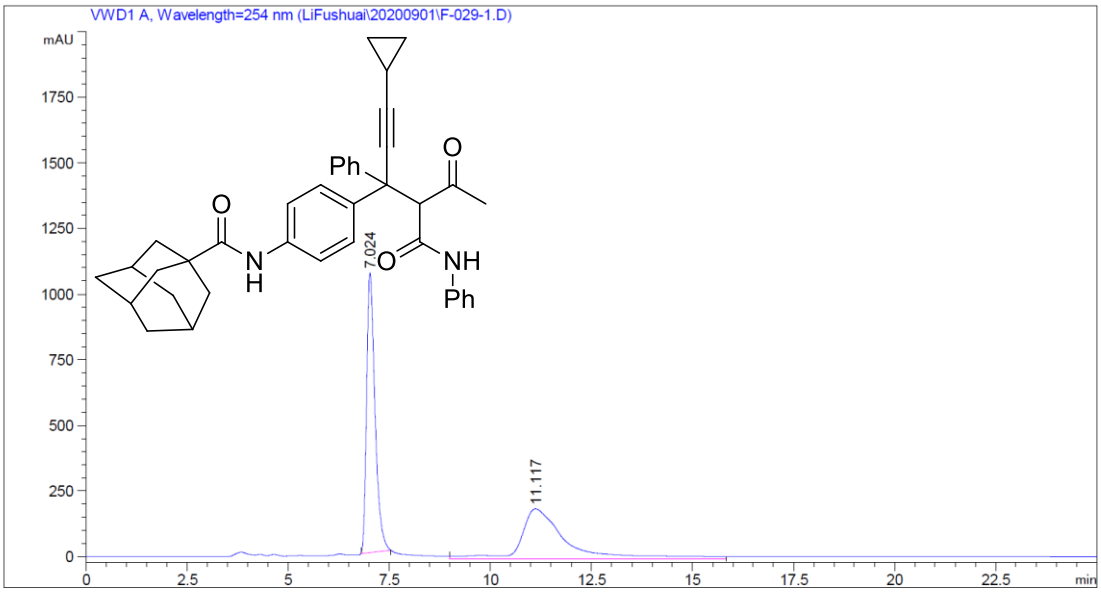


#	Time	Area	Height	Width	Symmetry	Area %
1	12.12	15543.2	256.6	1.0096	0.574	50.011
2	15.748	15536.2	259.6	0.9976	0.601	49.989

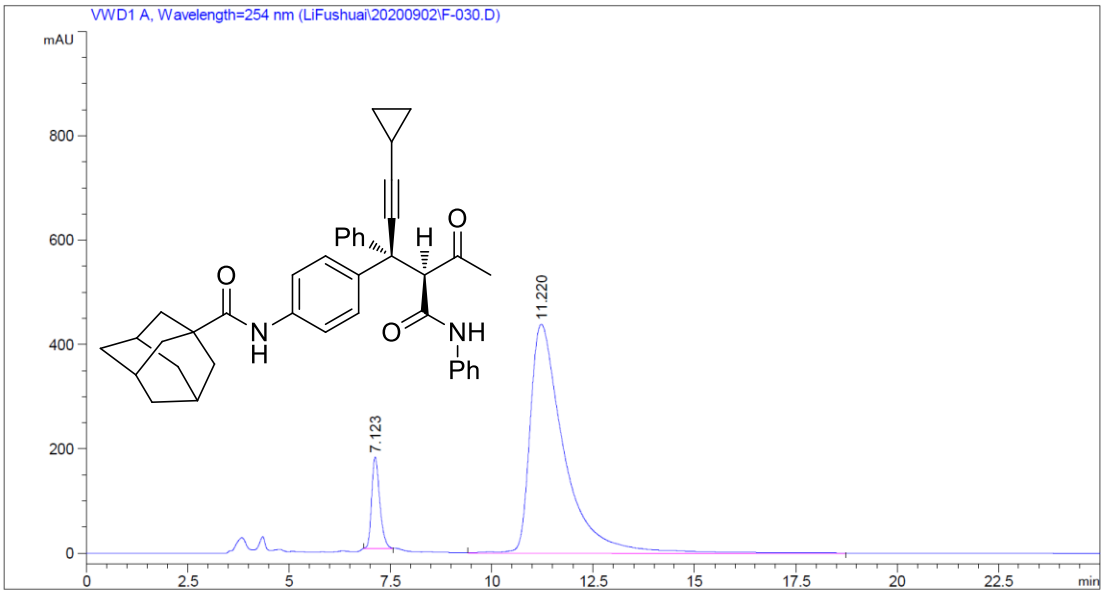


#	Time	Area	Height	Width	Symmetry	Area %
1	12.594	3397.3	60.4	0.9372	0.721	8.729
2	16.198	35522.8	615.8	0.9615	0.532	91.271

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-cyclopropyl-5-oxo-3-phenyl-4-(phenylcarbamoyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3qa)

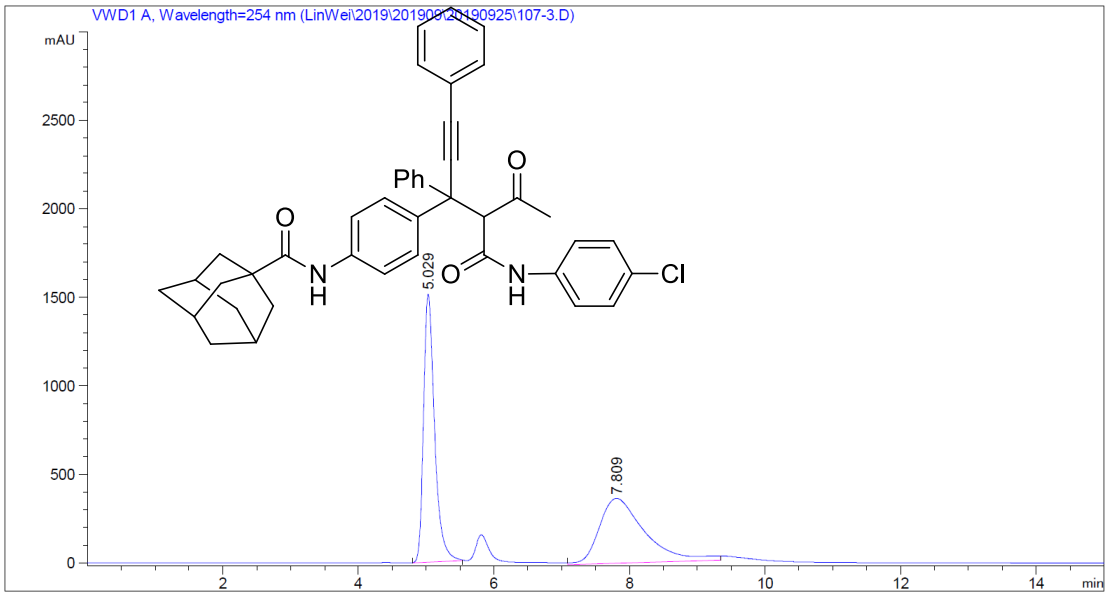


#	Time	Area	Height	Width	Symmetry	Area %
1	7.024	15344.5	1065	0.2401	0.651	50.056
2	11.117	15309.9	191.5	1.3321	0.483	49.944

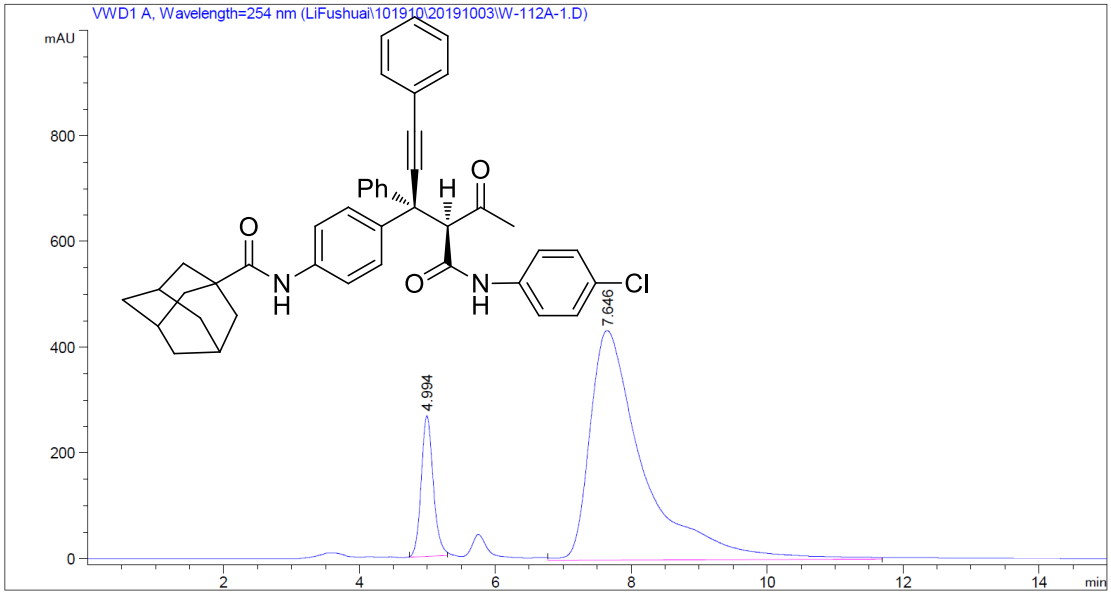


#	Time	Area	Height	Width	Symmetry	Area %
1	7.123	2431.4	175.5	0.2309	0.732	8.517
2	11.22	26114.7	439.6	0.9901	0.46	91.483

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-4-((4-chlorophenyl)carbamoyl)-5-oxo-1,3-diphenylhex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ab)

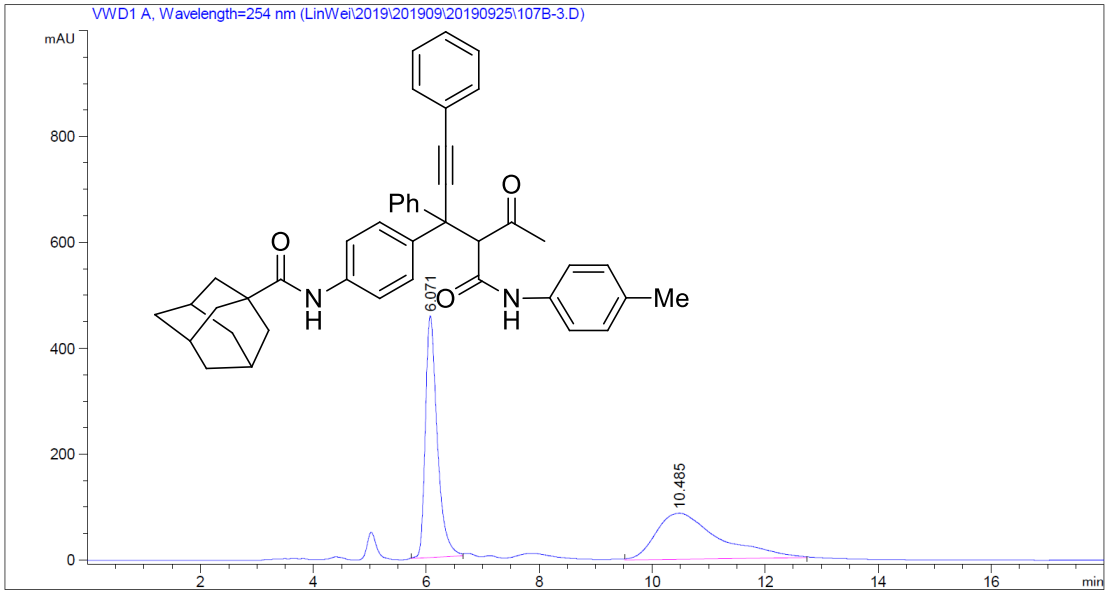


#	Time	Area	Height	Width	Symmetry	Area %
1	5.029	17104.5	1514	0.1883	0.685	49.984
2	7.809	17115.2	366.5	0.7783	0.59	50.016

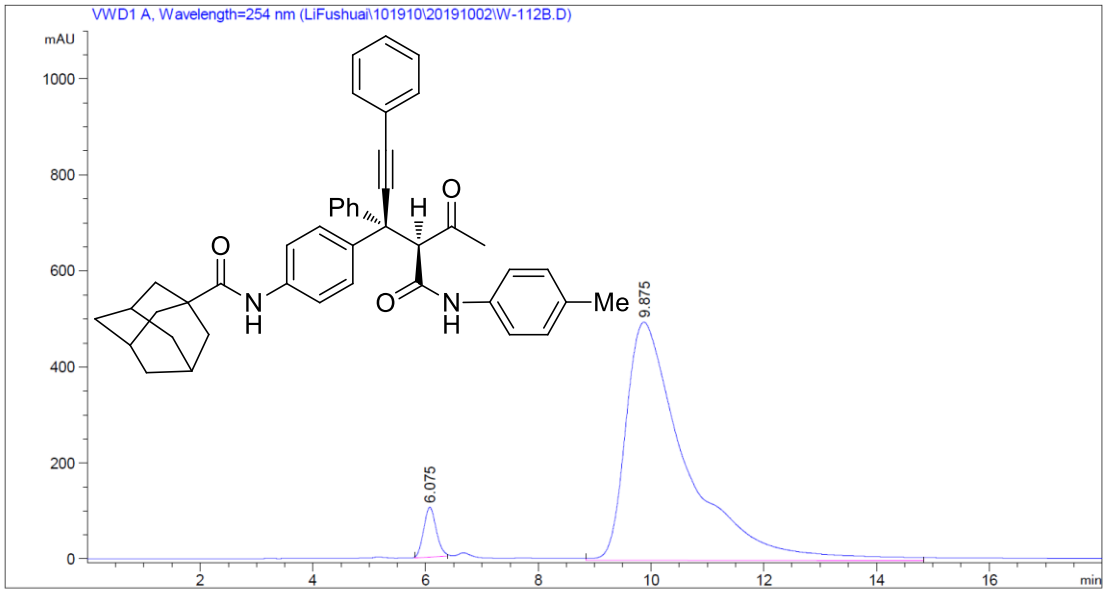


#	Time	Area	Height	Width	Symmetry	Area %
1	4.994	3259.1	266.1	0.2041	0.866	12.046
2	7.646	23796.3	434.5	0.9128	0.456	87.954

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-5-oxo-1,3-diphenyl-4-(*p*-tolylcarbamoyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ac)

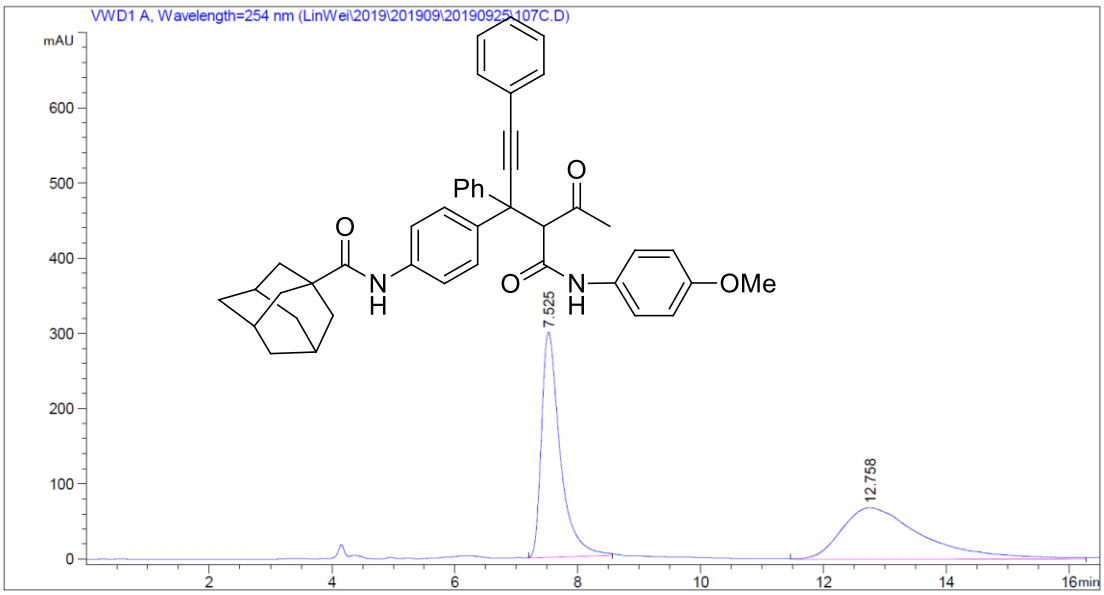


#	Time	Area	Height	Width	Symmetry	Area %
1	6.071	6707.9	456.7	0.2448	0.654	49.926
2	10.485	6727.9	86.6	1.295	0.573	50.074

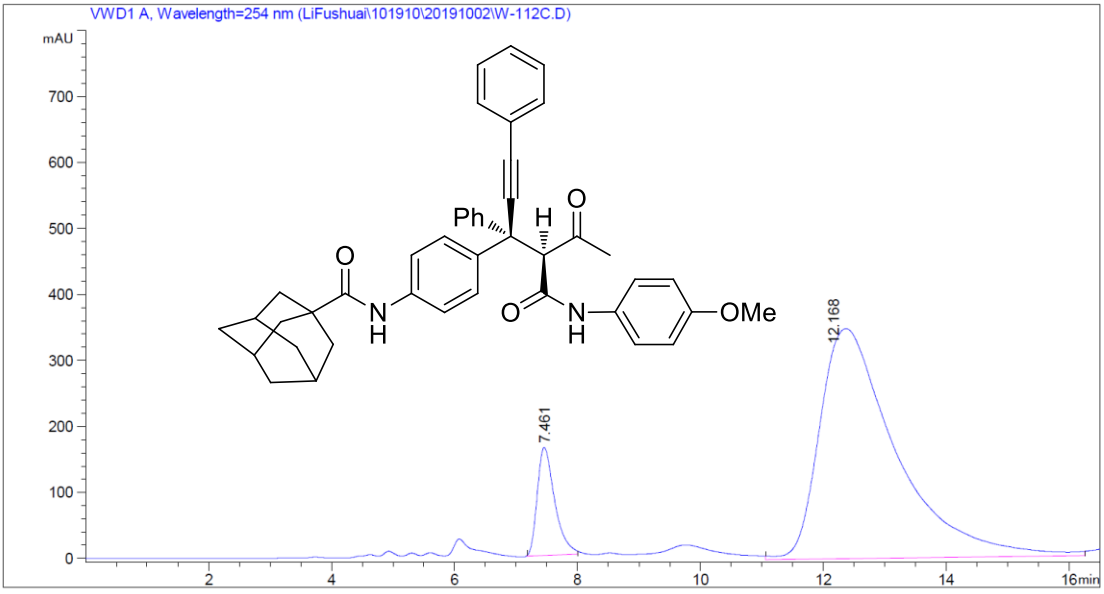


#	Time	Area	Height	Width	Symmetry	Area %
1	6.075	1630.7	104.4	0.2603	0.923	4.205
2	9.875	37145.1	496.5	1.2469	0.409	95.795

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-4-((4-methoxyphenyl)carbamoyl)-5-oxo-1,3-diphenylhex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ad)

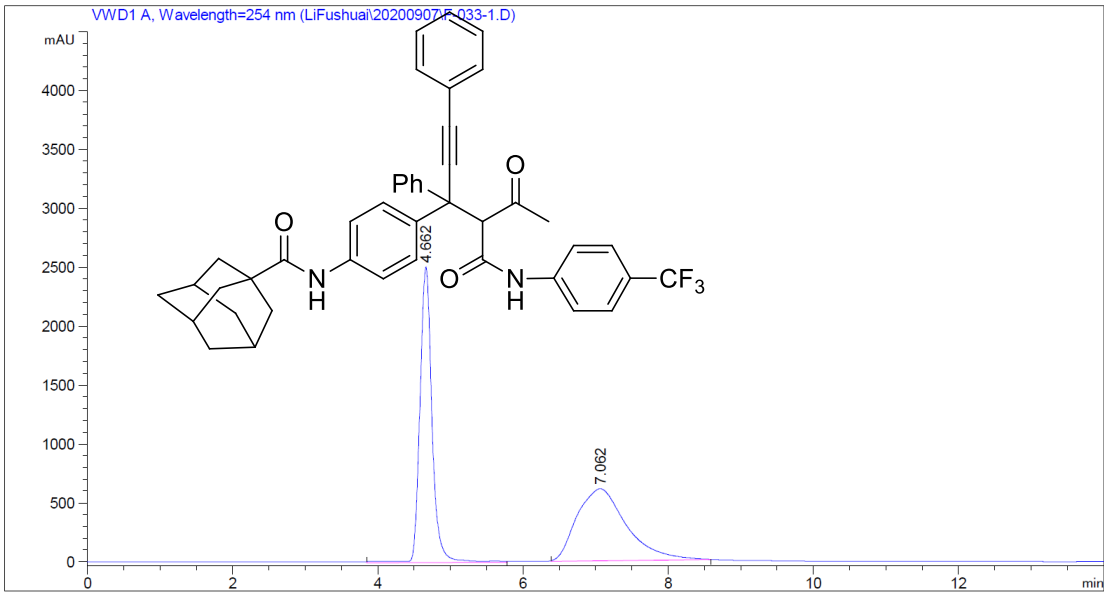


#	Time	Area	Height	Width	Symmetry	Area %
1	7.525	6304.8	299.3	0.351	0.573	49.902
2	12.758	6329.5	68.8	1.5342	0.528	50.098

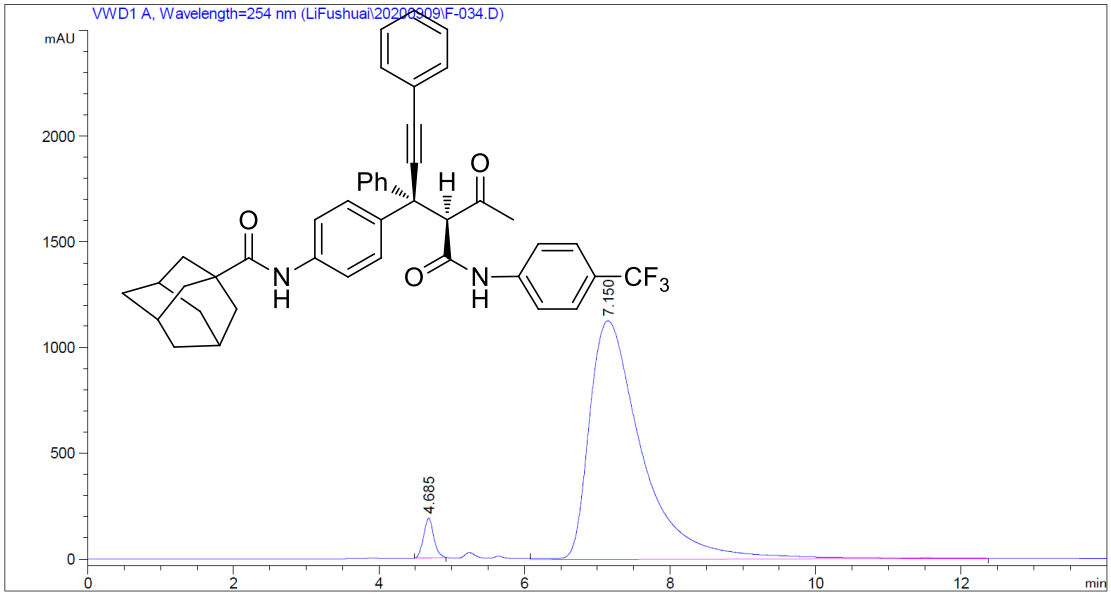


#	Time	Area	Height	Width	Symmetry	Area %
1	7.461	3219.3	163.4	0.3285	0.642	9.646
2	12.168	30156.7	296.6	1.6947	0	90.354

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-5-oxo-1,3-diphenyl-4-((4-(trifluoromethyl)phenyl)carbamoyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ae)

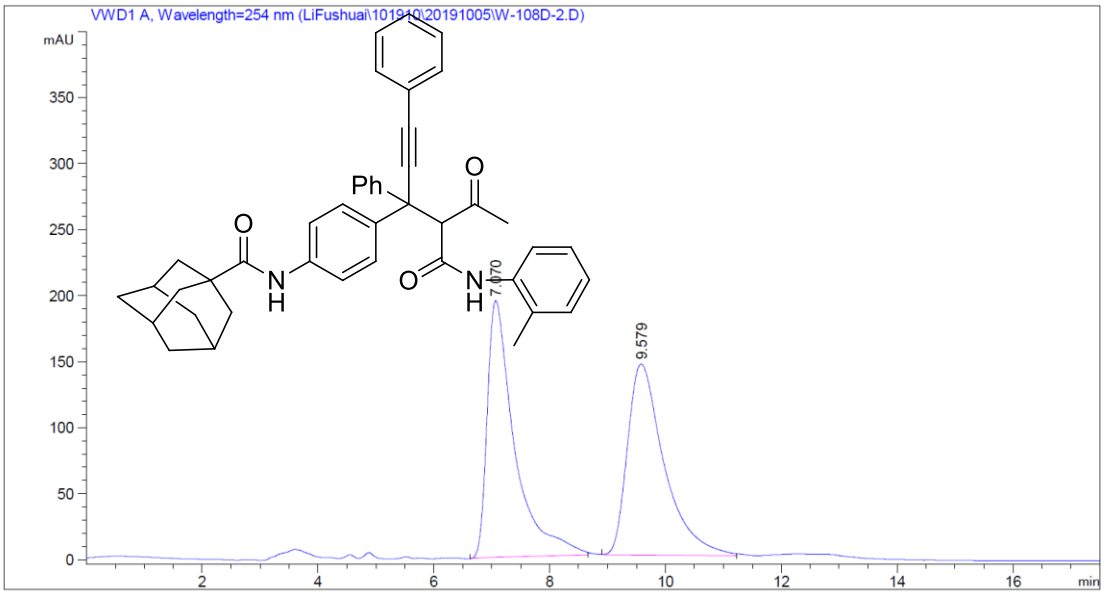


#	Time	Area	Height	Width	Symmetry	Area %
1	4.662	29075	2506.5	0.1933	0.922	49.990
2	7.062	29086.8	613.1	0.7908	0.841	50.010

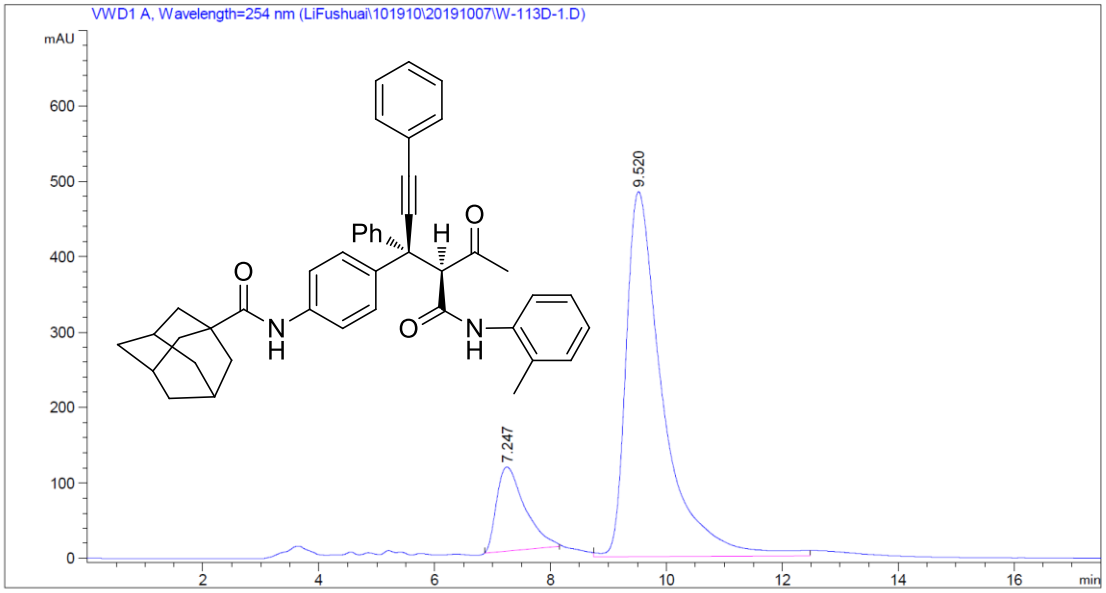


#	Time	Area	Height	Width	Symmetry	Area %
1	4.685	1829.9	188	0.1622	0.963	3.116
2	7.15	56902	1128.1	0.8406	0.522	96.884

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-5-oxo-1,3-diphenyl-4-(*o*-tolylcarbamoyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3af)

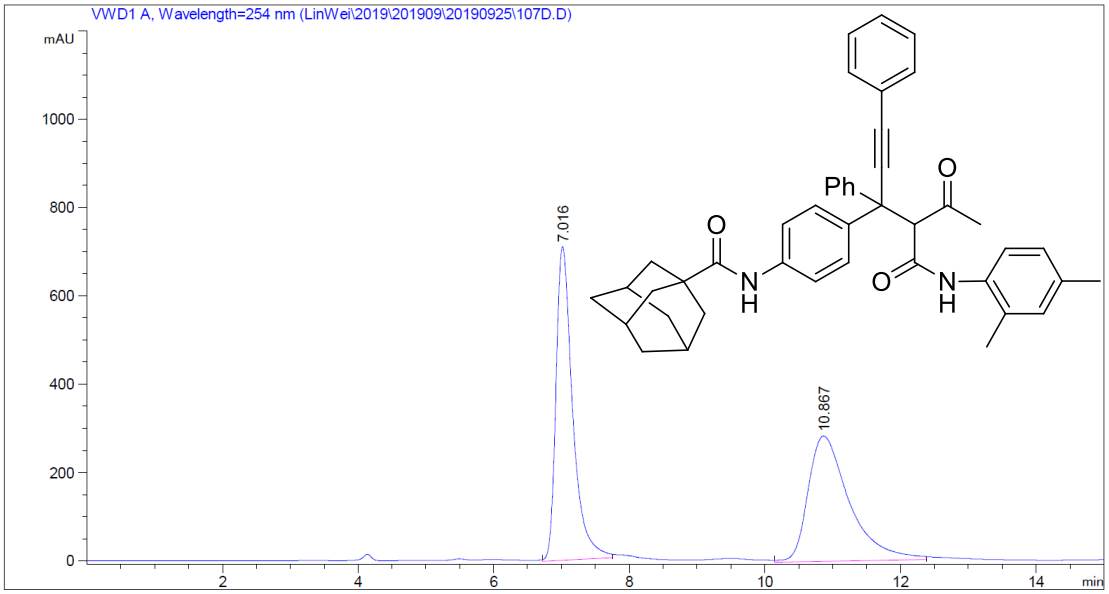


#	Time	Area	Height	Width	Symmetry	Area %
1	7.07	6364.2	194.3	0.546	0.433	49.931
2	9.579	6381.7	144.7	0.7353	0.569	50.069

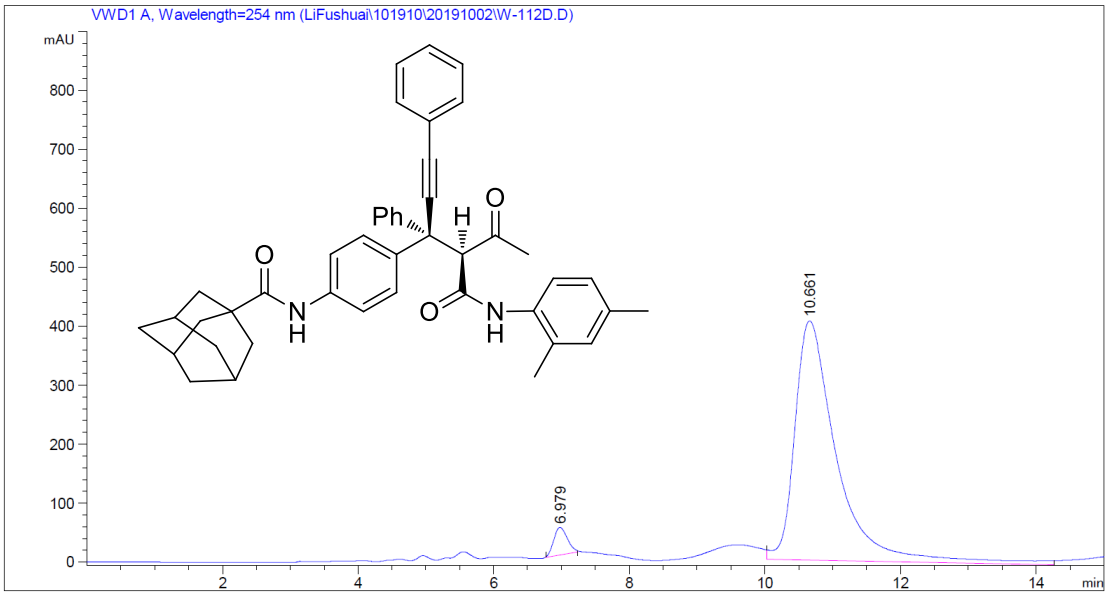


#	Time	Area	Height	Width	Symmetry	Area %
1	7.247	3772.8	111.5	0.564	0.556	15.022
2	9.52	21342	483.8	0.7353	0.493	84.978

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-4-((2,4-dimethylphenyl)carbamoyl)-5-oxo-1,3-diphenylhex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ag)

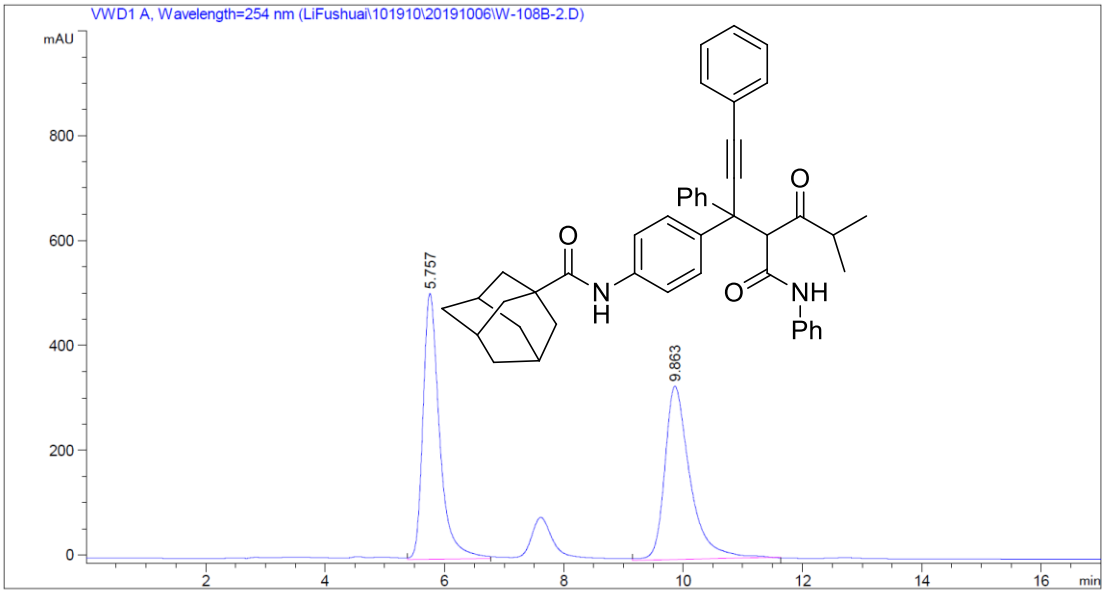


#	Time	Area	Height	Width	Symmetry	Area %
1	7.016	12130.5	710	0.2847	0.619	50.100
2	10.867	12081.9	284.2	0.7086	0.586	49.900

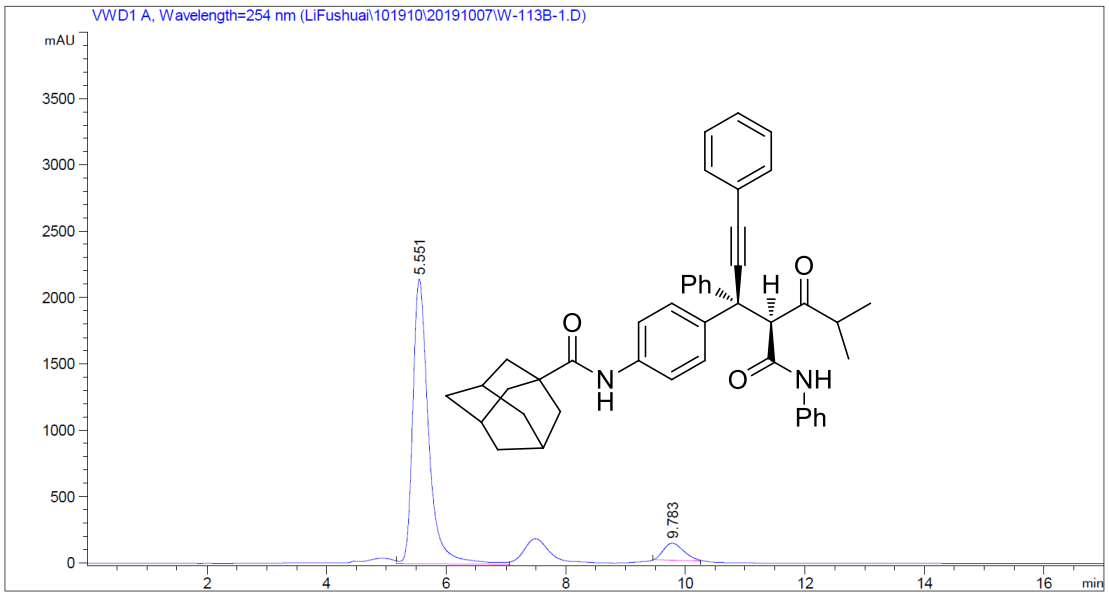


#	Time	Area	Height	Width	Symmetry	Area %
1	6.979	651.7	46.8	0.2319	0.864	3.574
2	10.661	17581.6	406.2	0.7214	0.522	96.426

(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-6-methyl-5-oxo-1,3-diphenyl-4-(phenylcarbamoyl)hept-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ah)



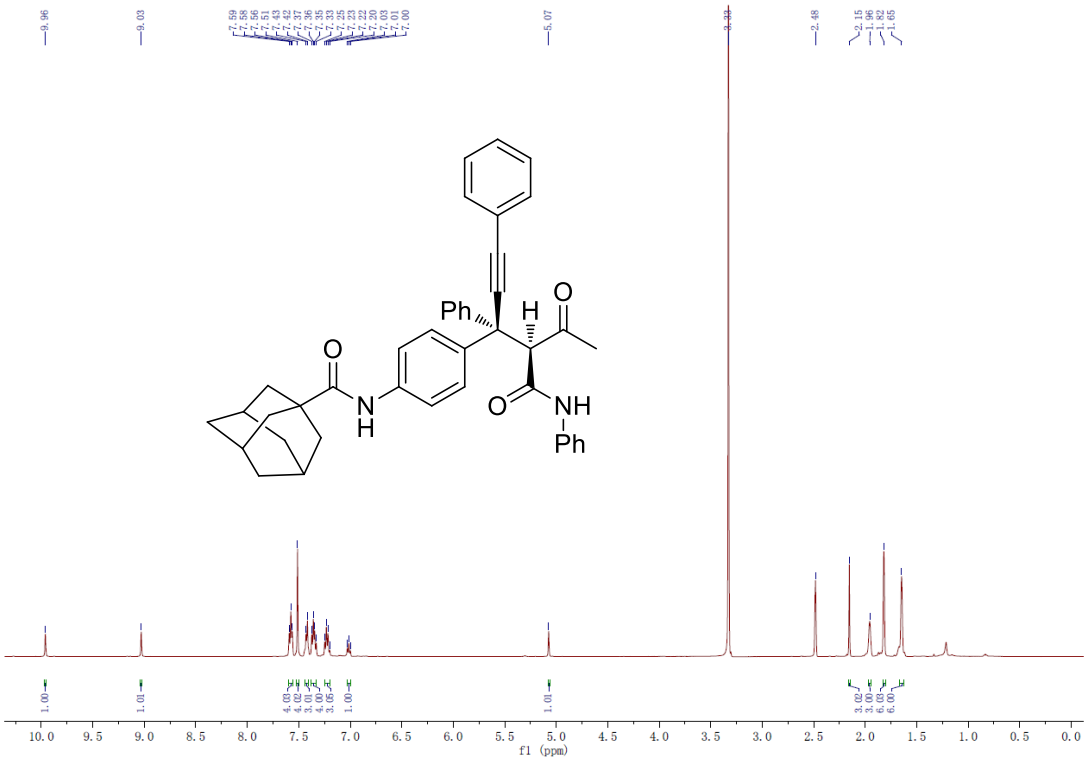
#	Time	Area	Height	Width	Symmetry	Area %
1	5.757	9782.9	506.6	0.3218	0.684	49.989
2	9.863	9787.2	330.8	0.4931	0.65	50.011

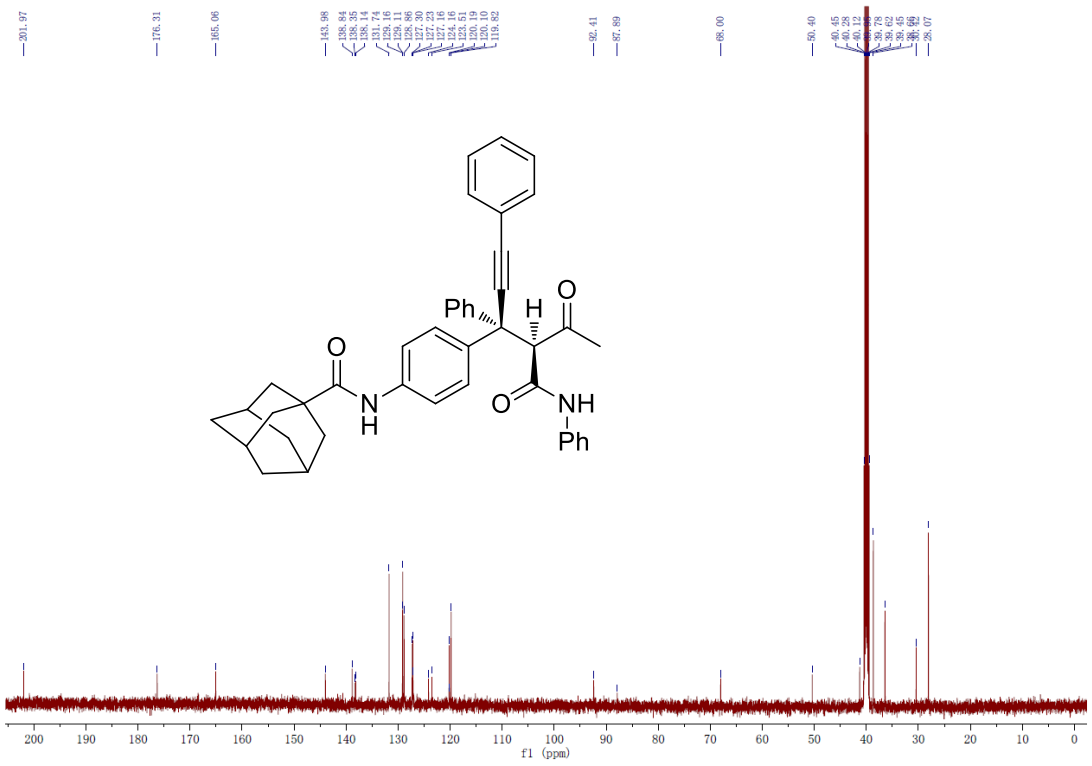


#	Time	Area	Height	Width	Symmetry	Area %
1	5.551	39375.3	2143.7	0.3061	0.652	92.870
2	9.783	3022.9	128.6	0.3918	0.732	7.130

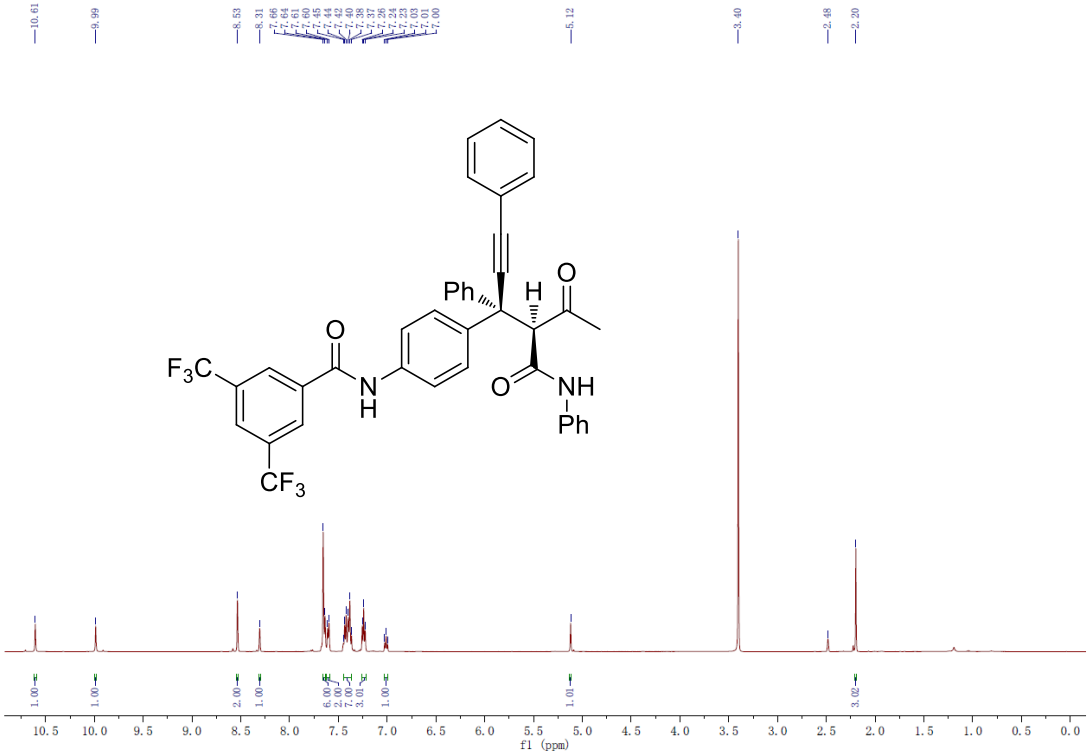
J: NMR Analysis

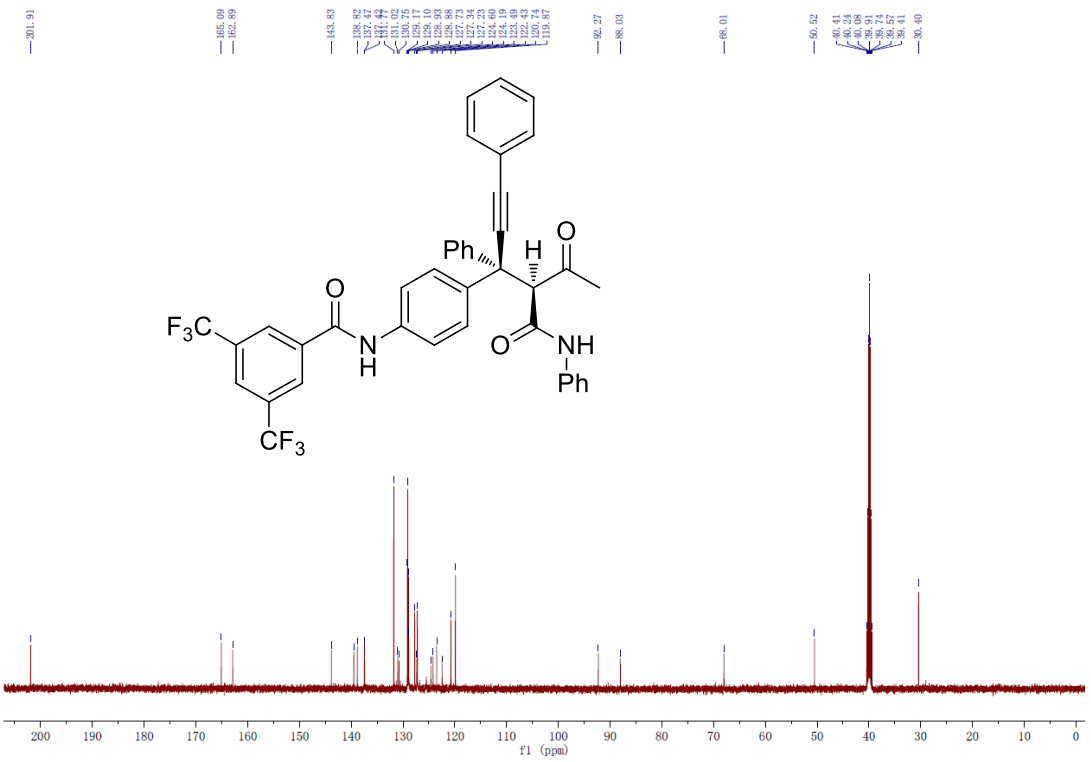
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-5-oxo-1,3-diphenyl-4-(phenylcarbamoyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3aa)



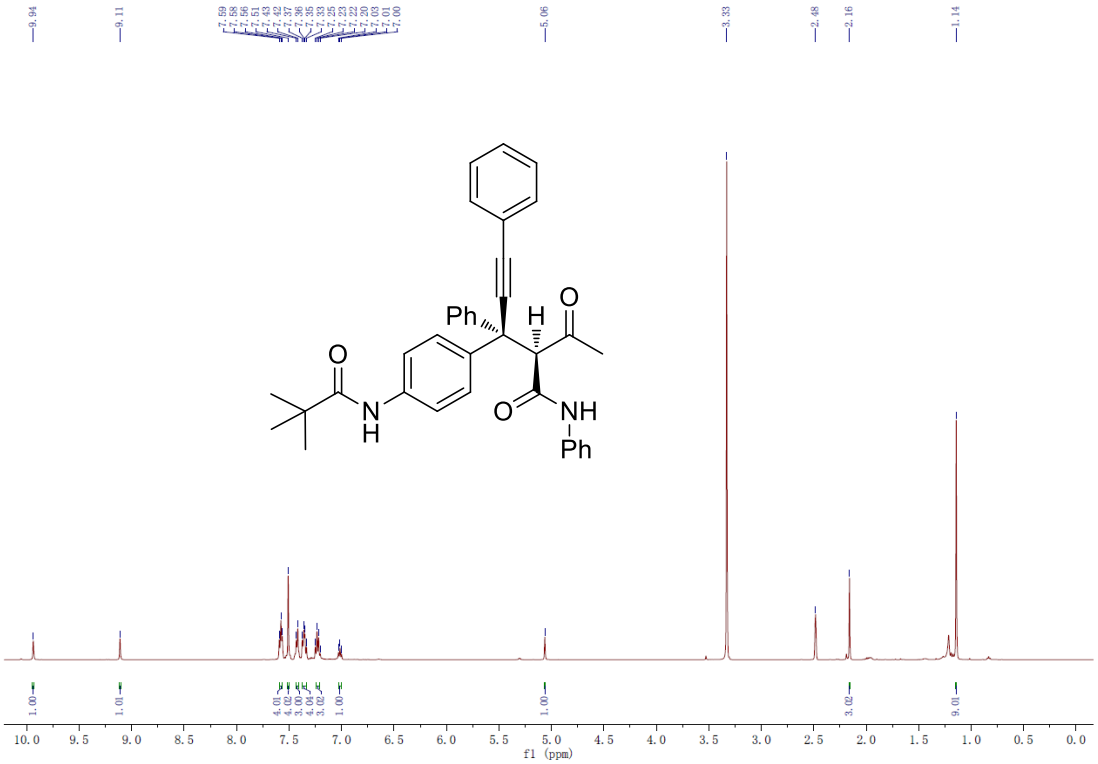


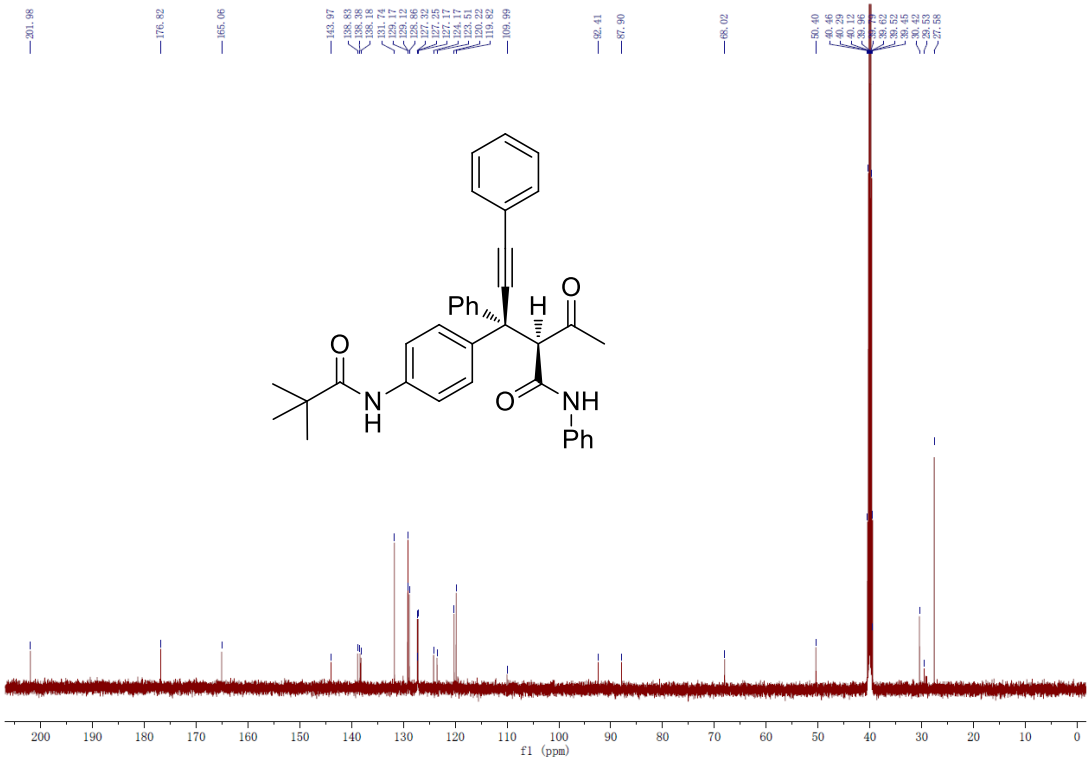
***N*-(4-((3*R*,4*S*)-5-oxo-1,3-diphenyl-4-(phenylcarbamoyl)hex-1-yn-3-yl)phenyl)-3,5-bis(trifluoromethyl)benzamide (3ba)**



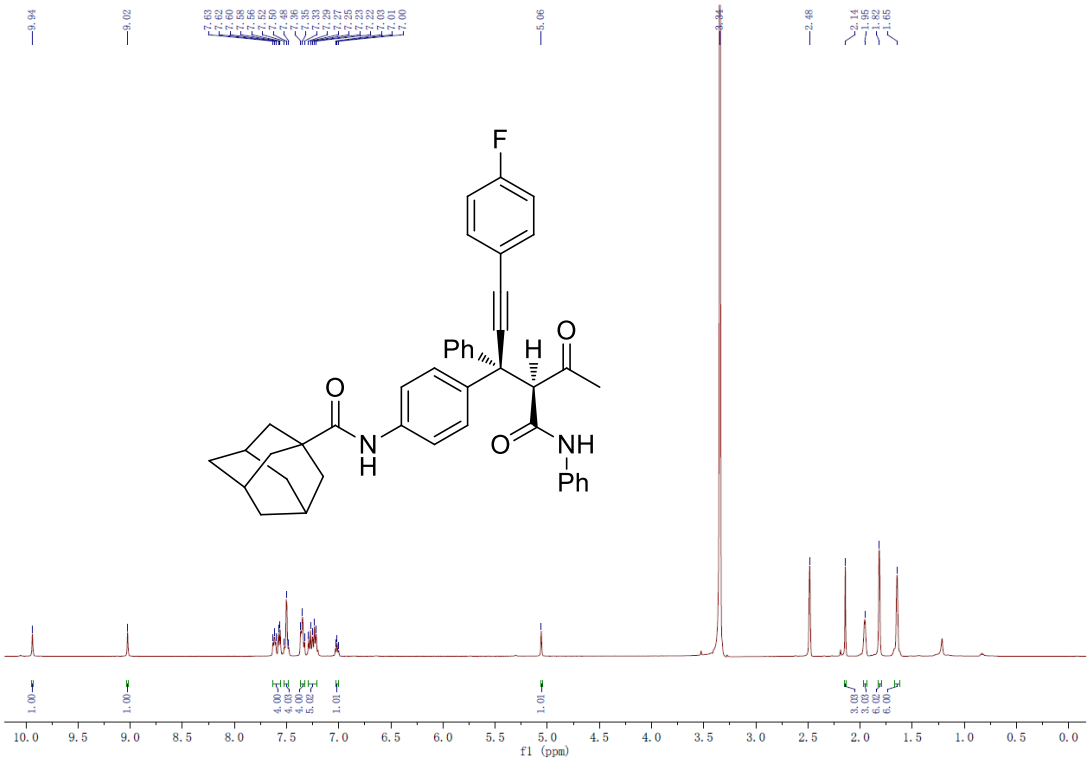


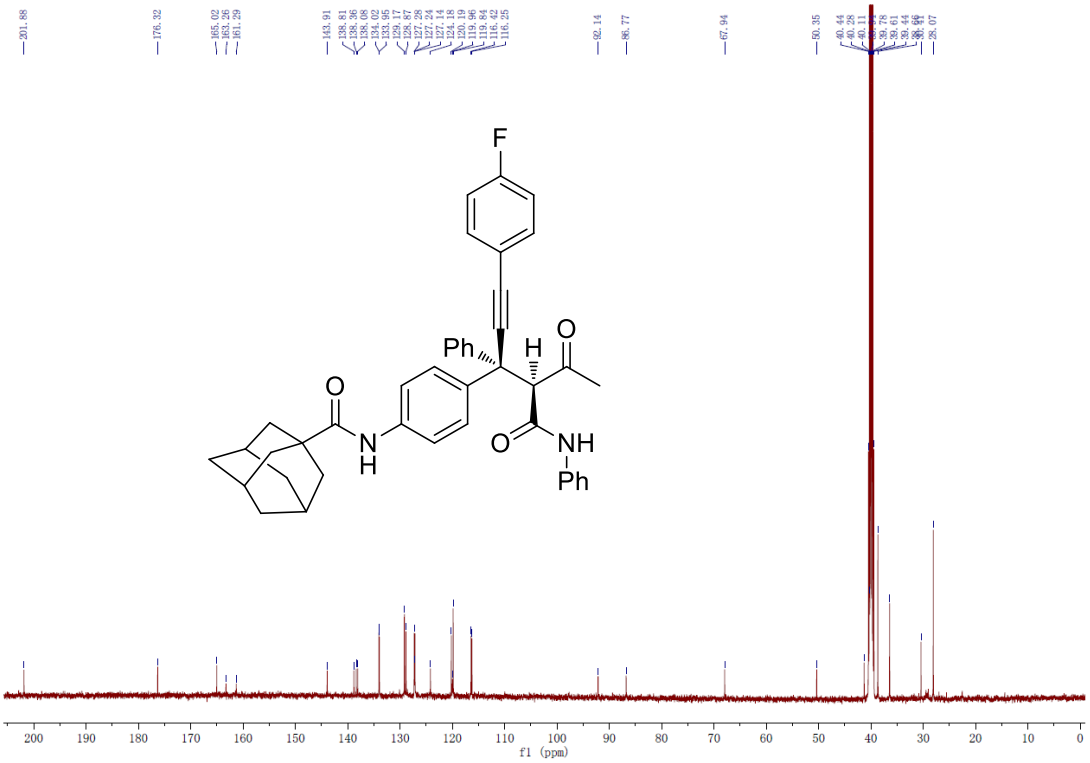
(2*S*,3*R*)-2-acetyl-*N*,3,5-triphenyl-3-(4-pivalamidophenyl)pent-4-ynamide (3ca)



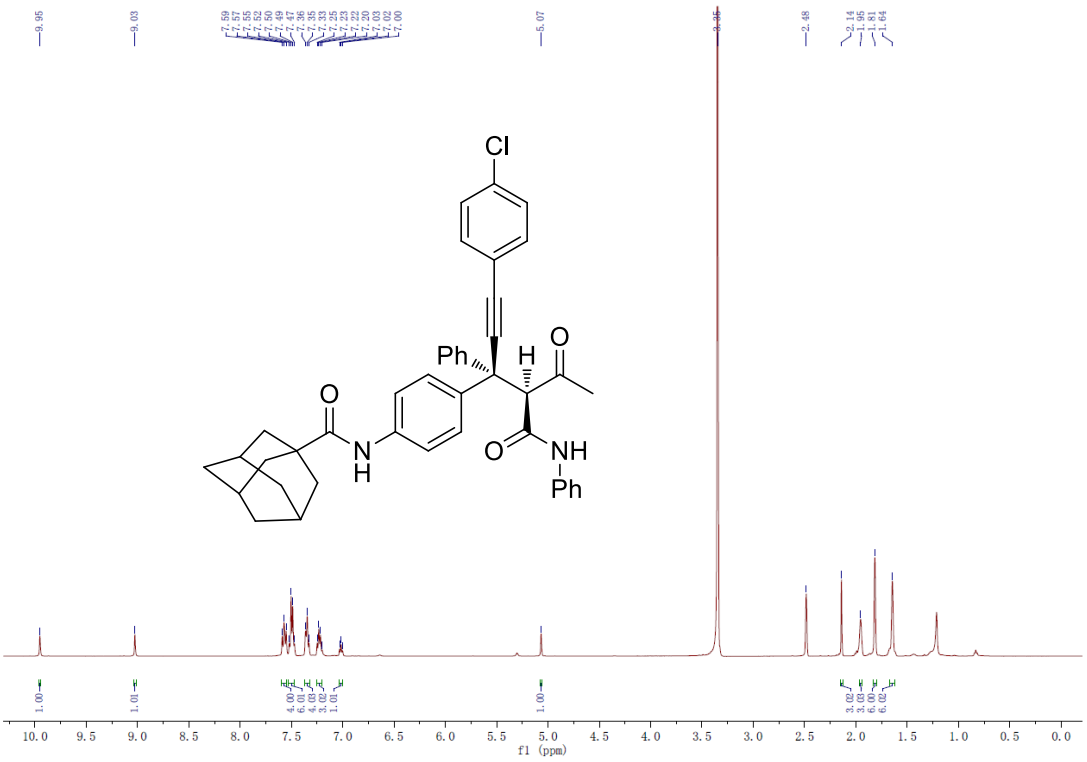


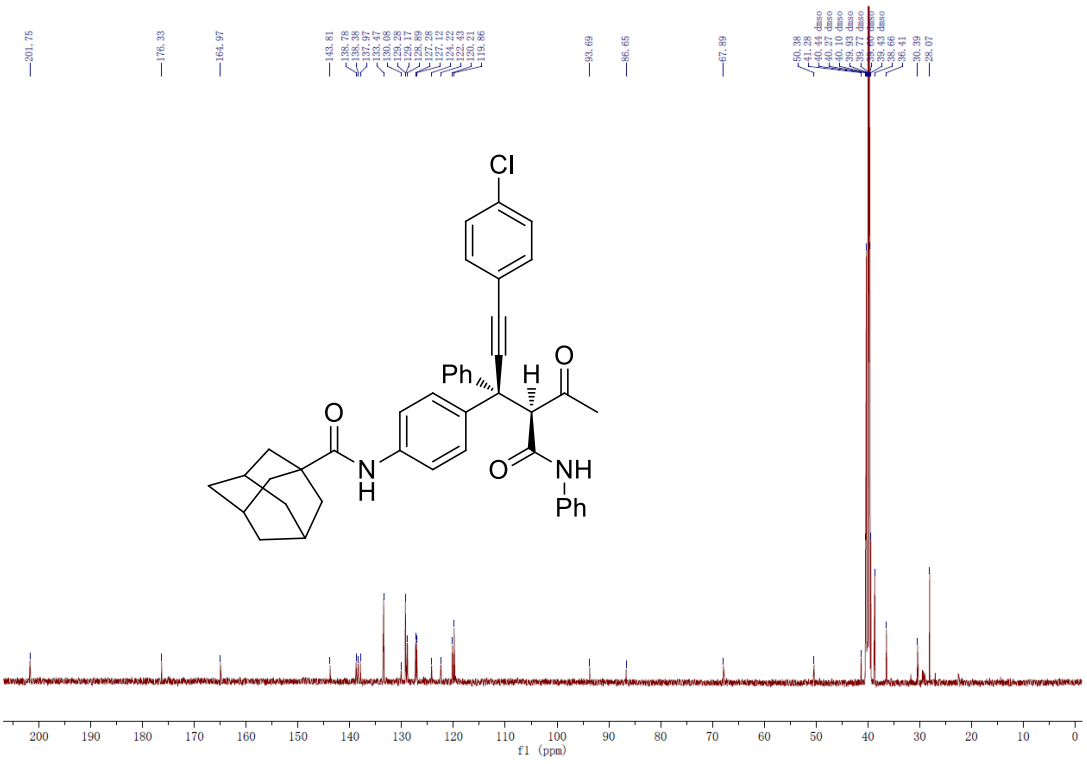
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(4-fluorophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ea)



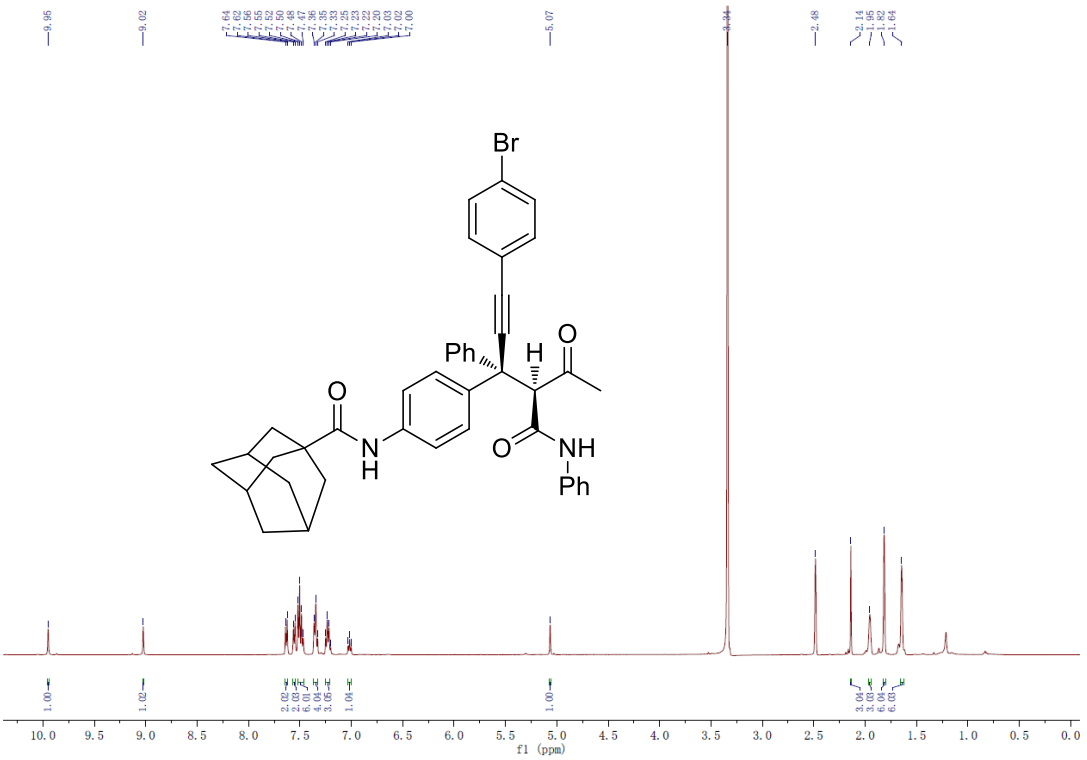


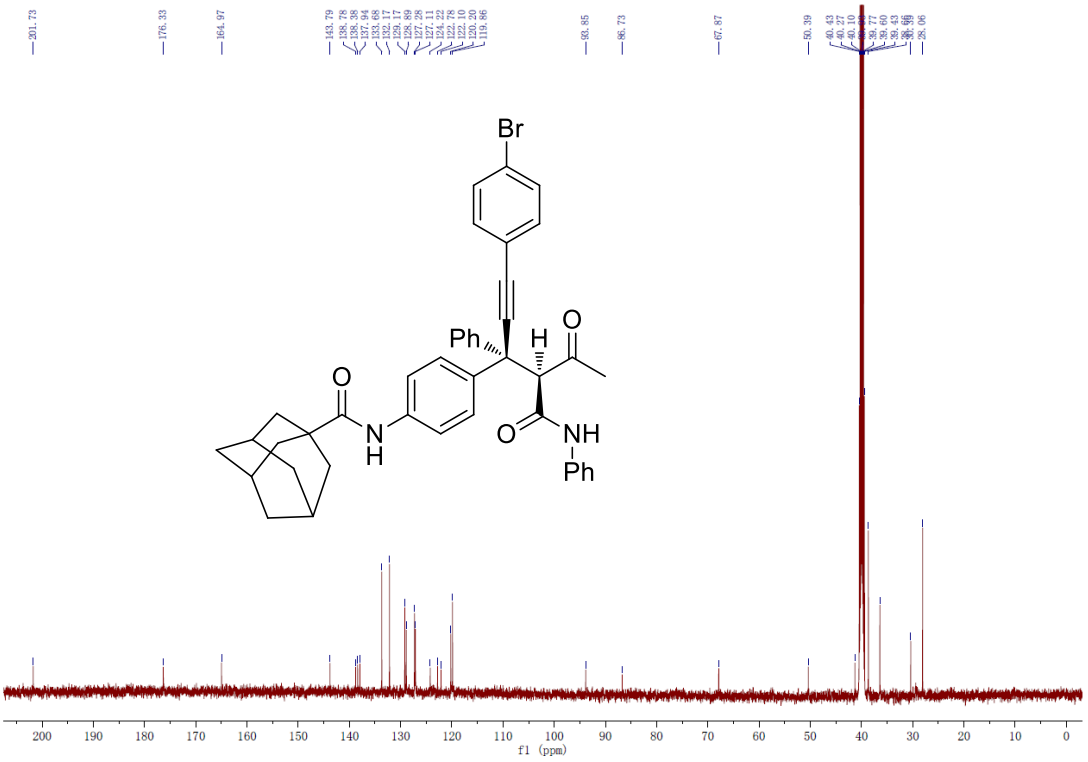
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(4-chlorophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3fa)



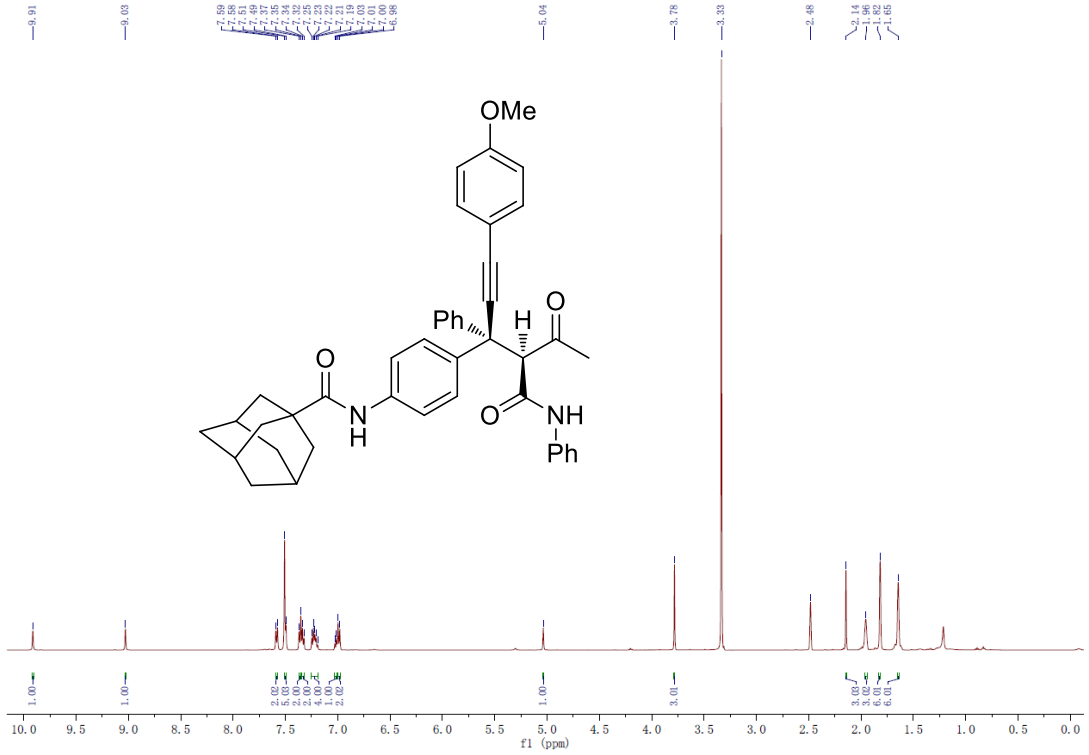


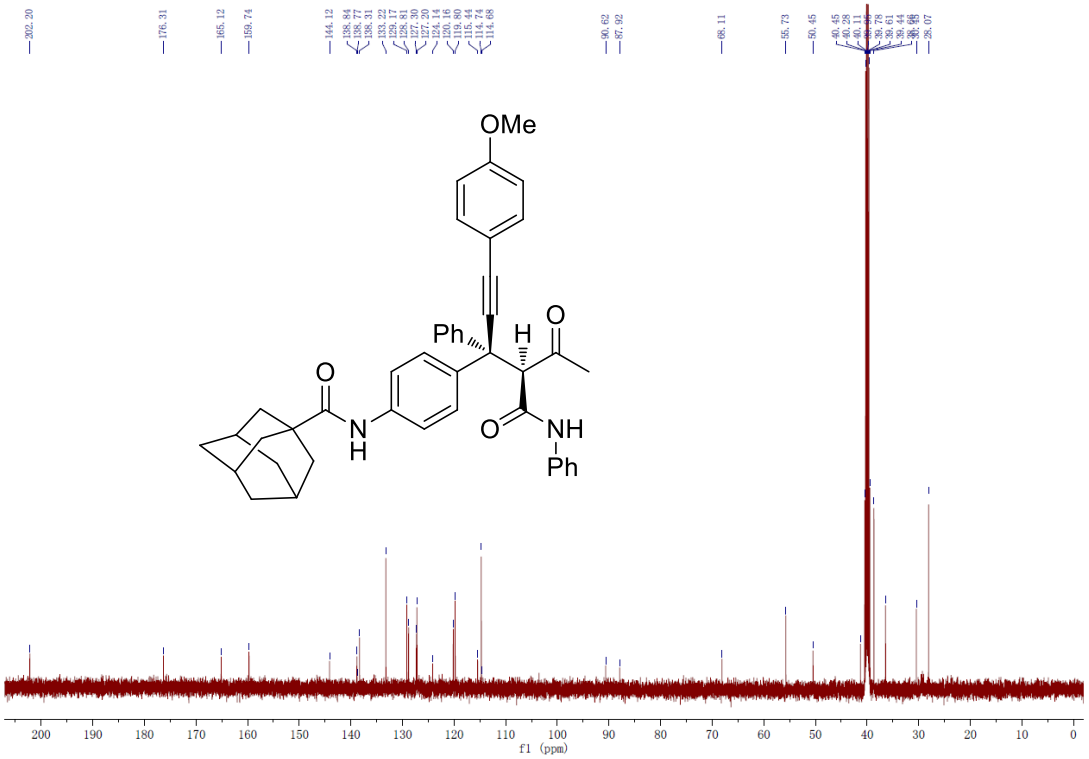
(1*r*,3*R*,5S)-*N*-(4-((3*R*,4*S*)-1-(4-bromophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ga)



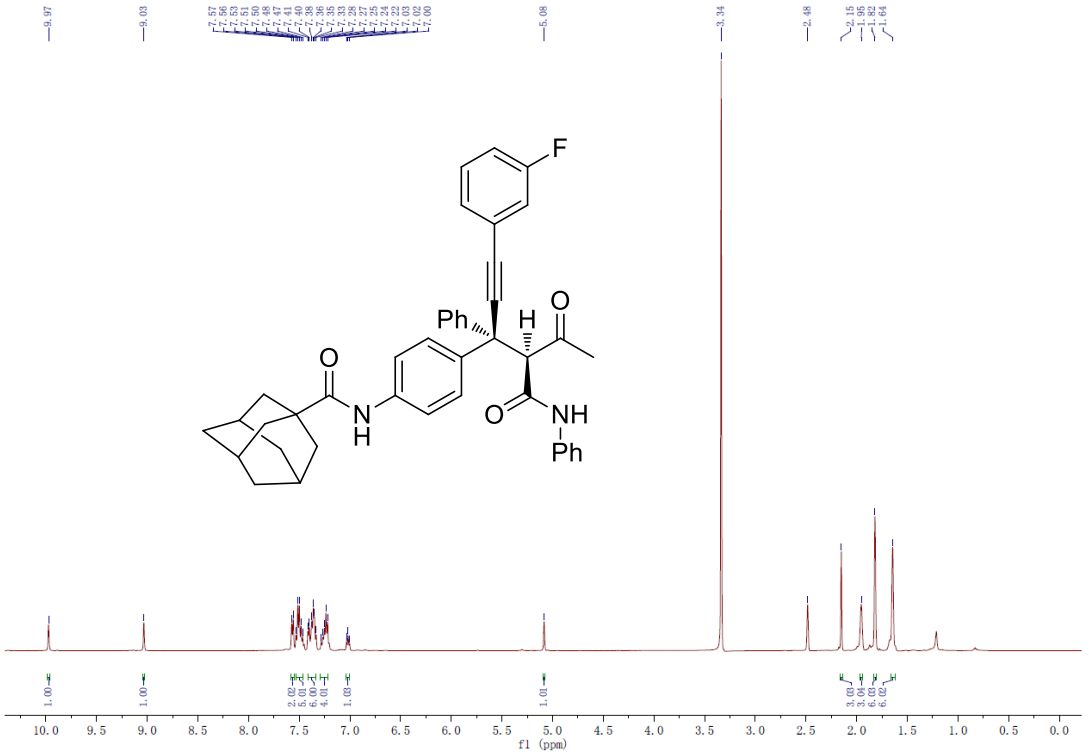


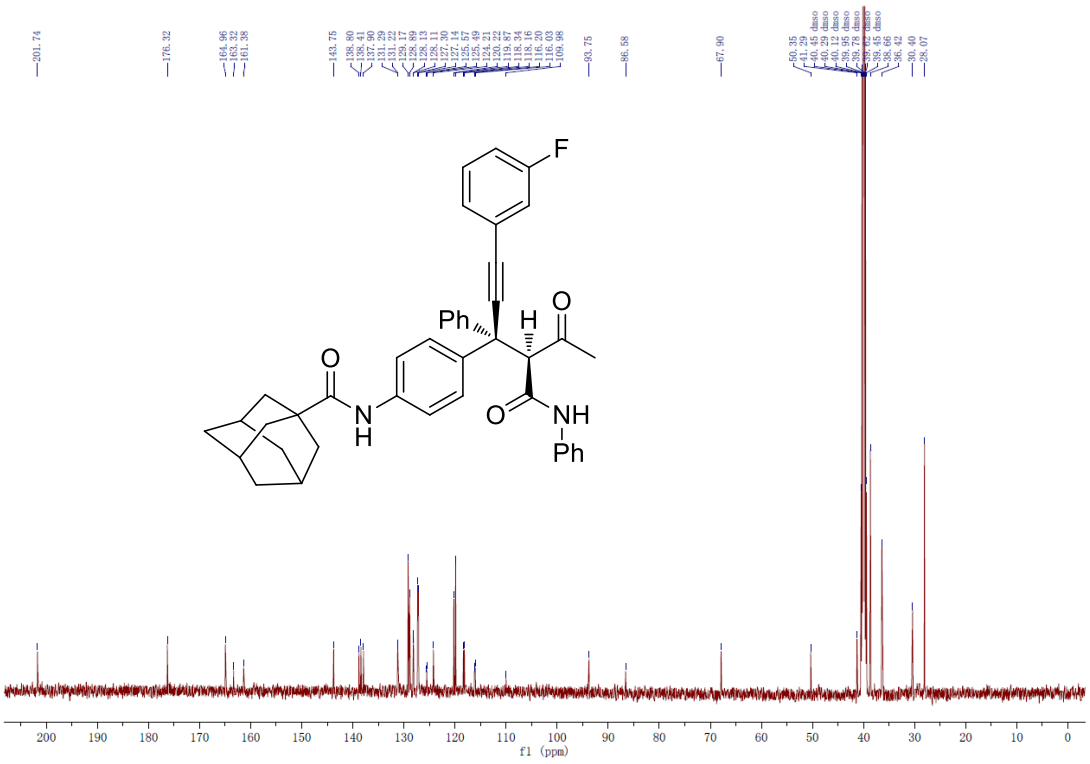
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(4-methoxyphenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ha)



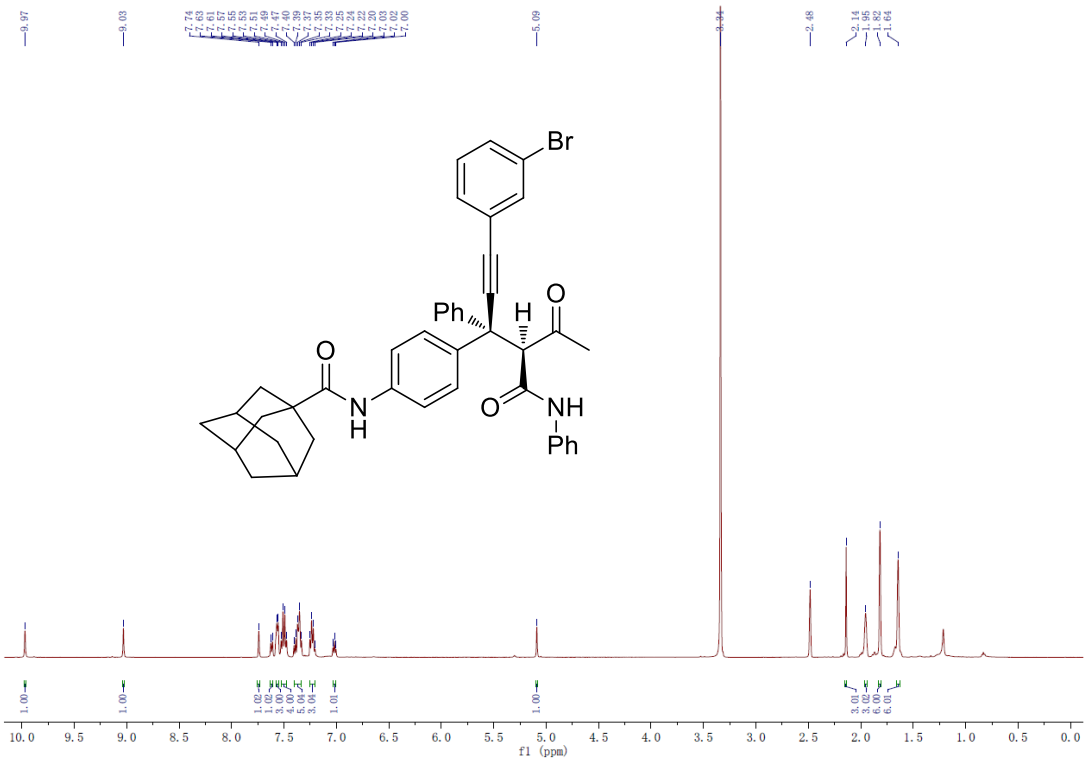


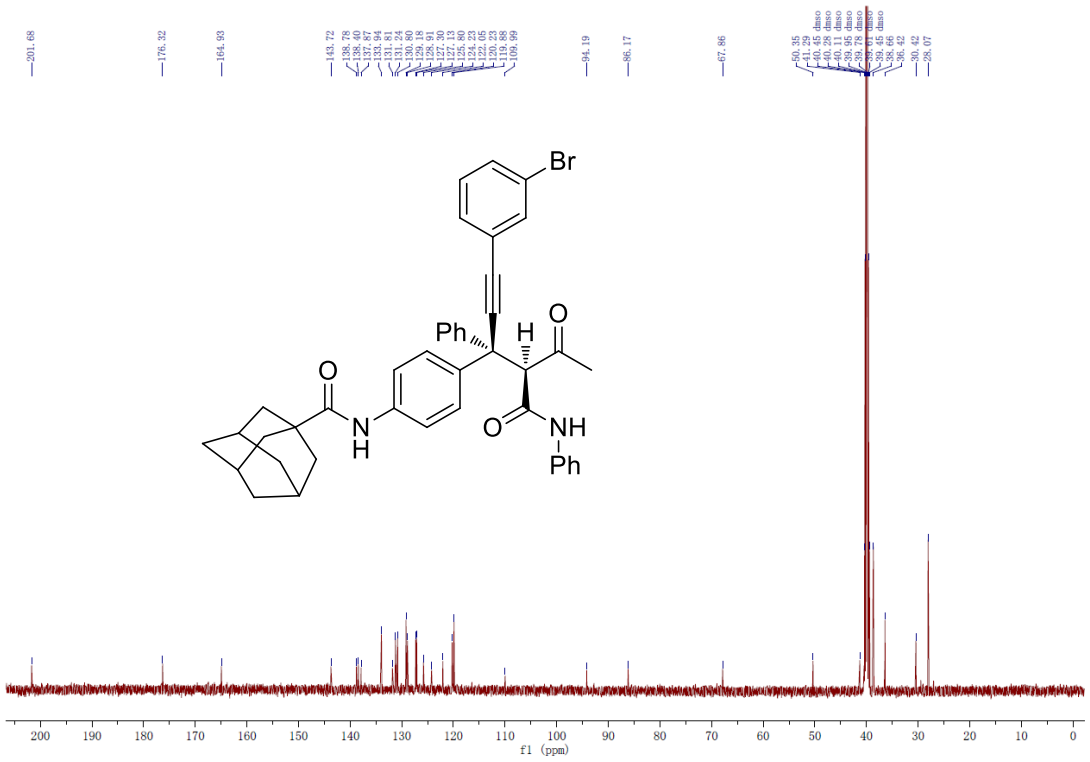
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(3-fluorophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ia)



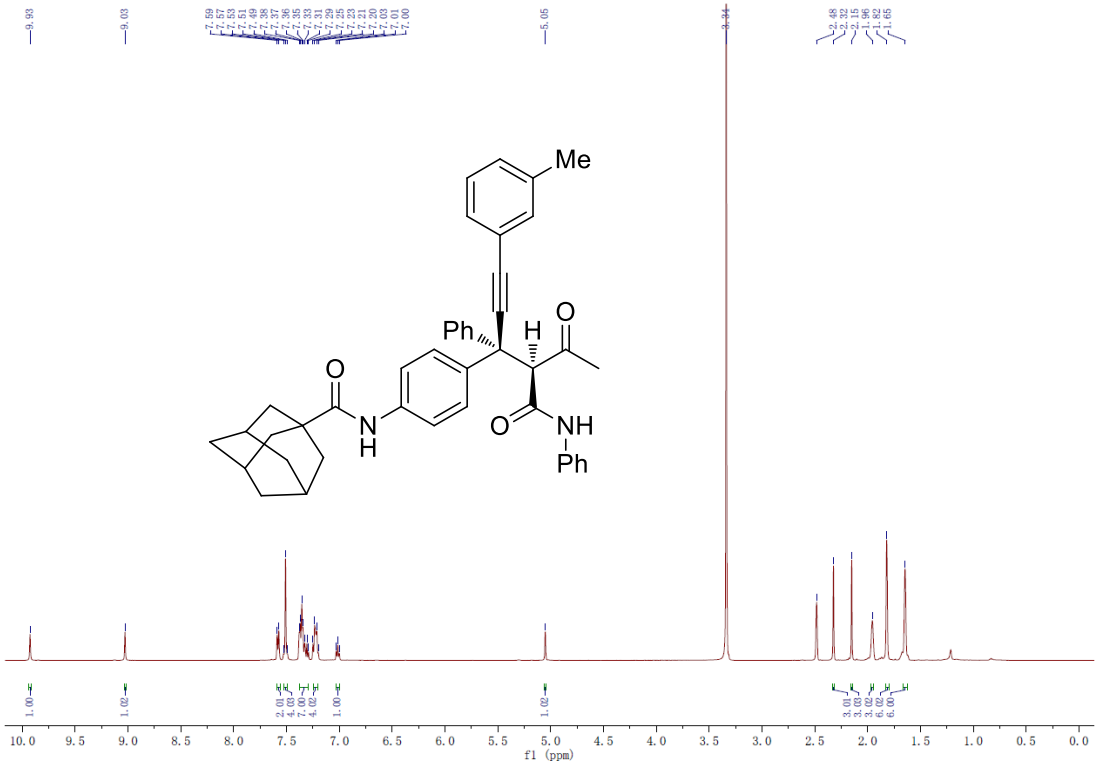


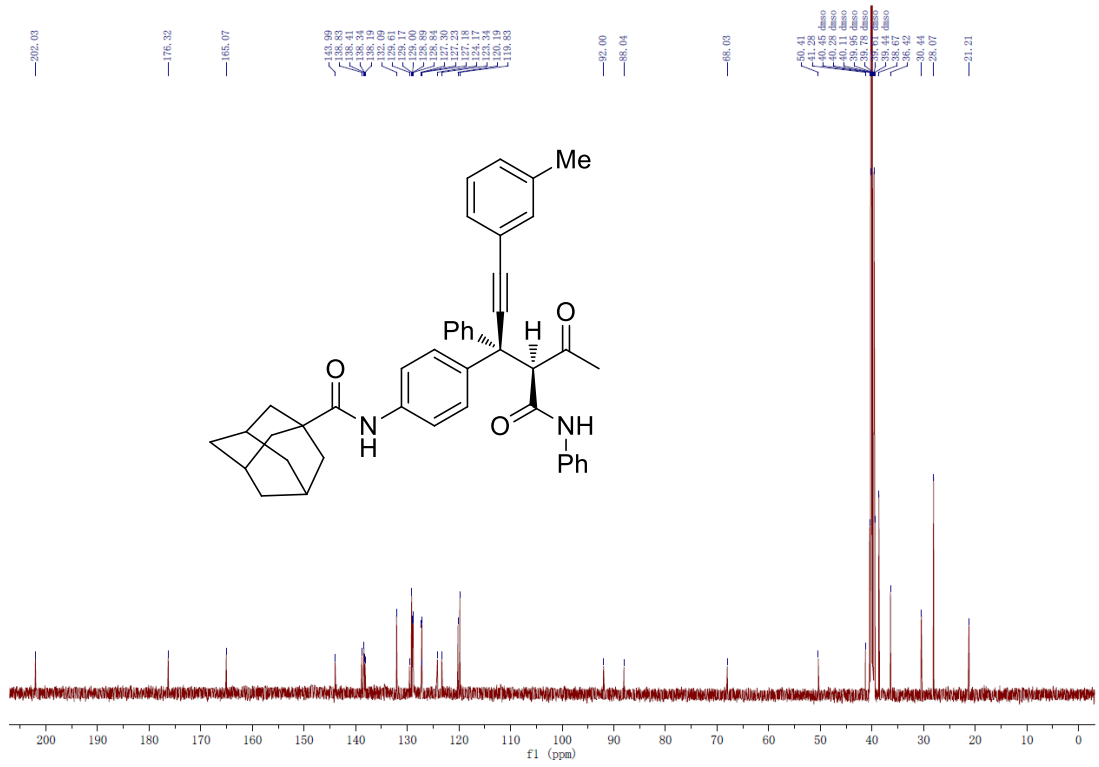
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(3-bromophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ja)



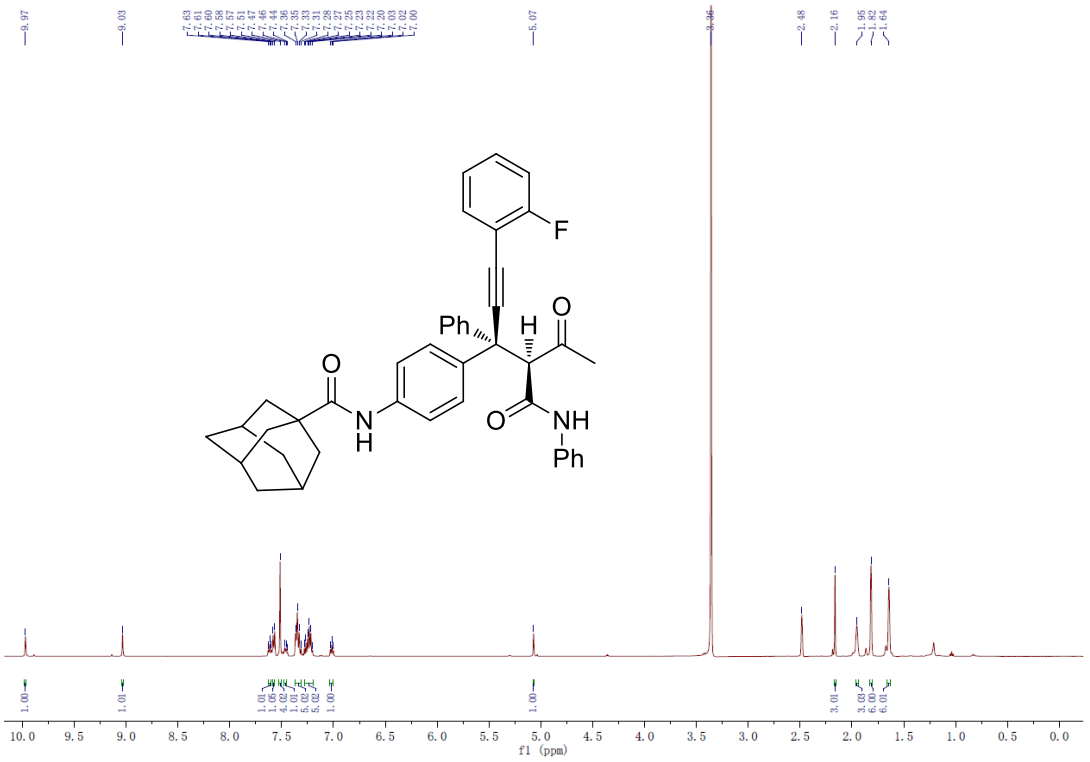


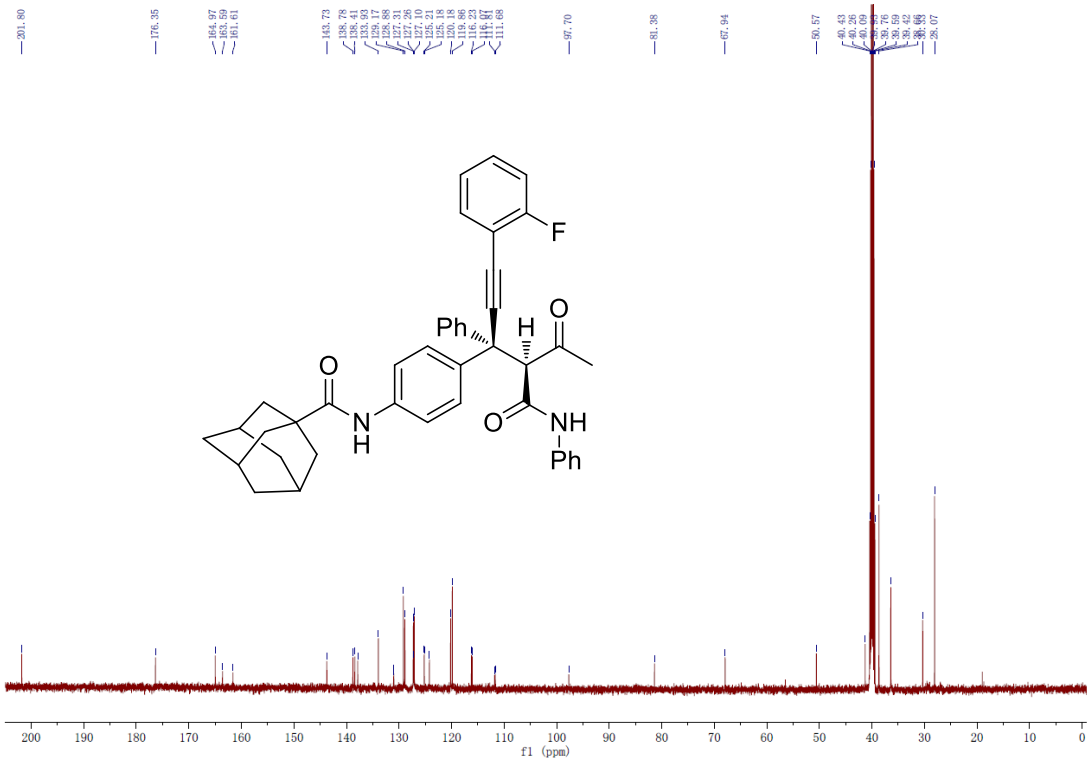
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-5-oxo-3-phenyl-4-(phenylcarbamoyl)-1-(*m*-tolyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ka)



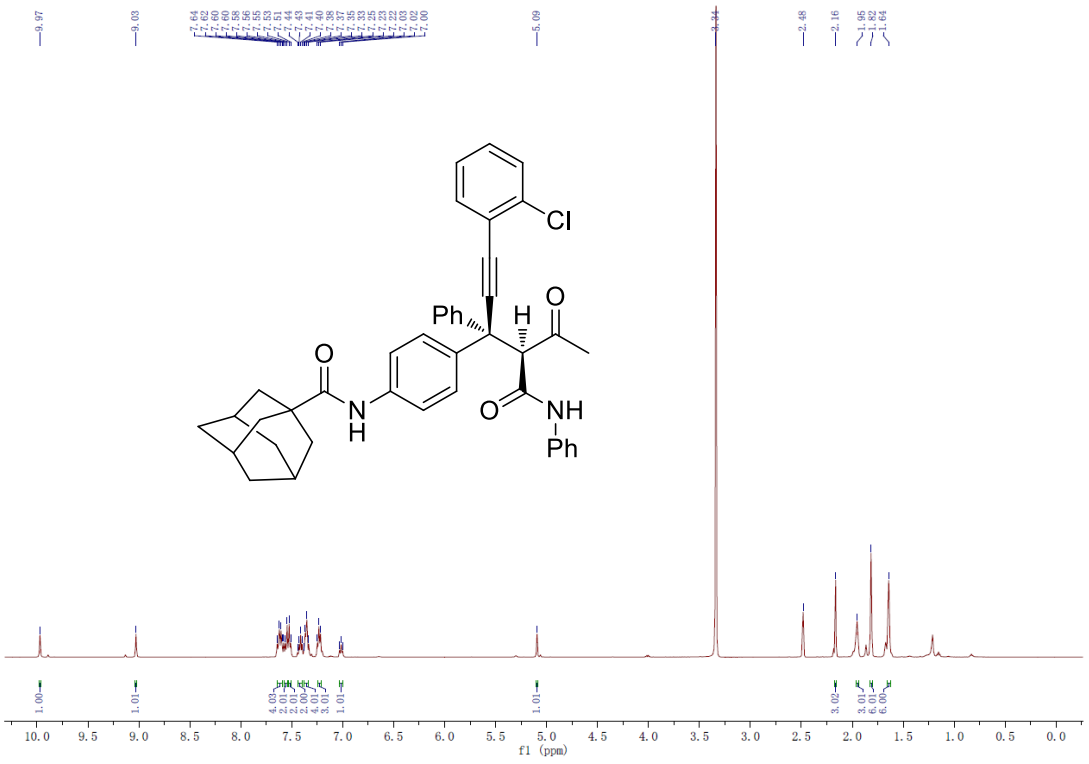


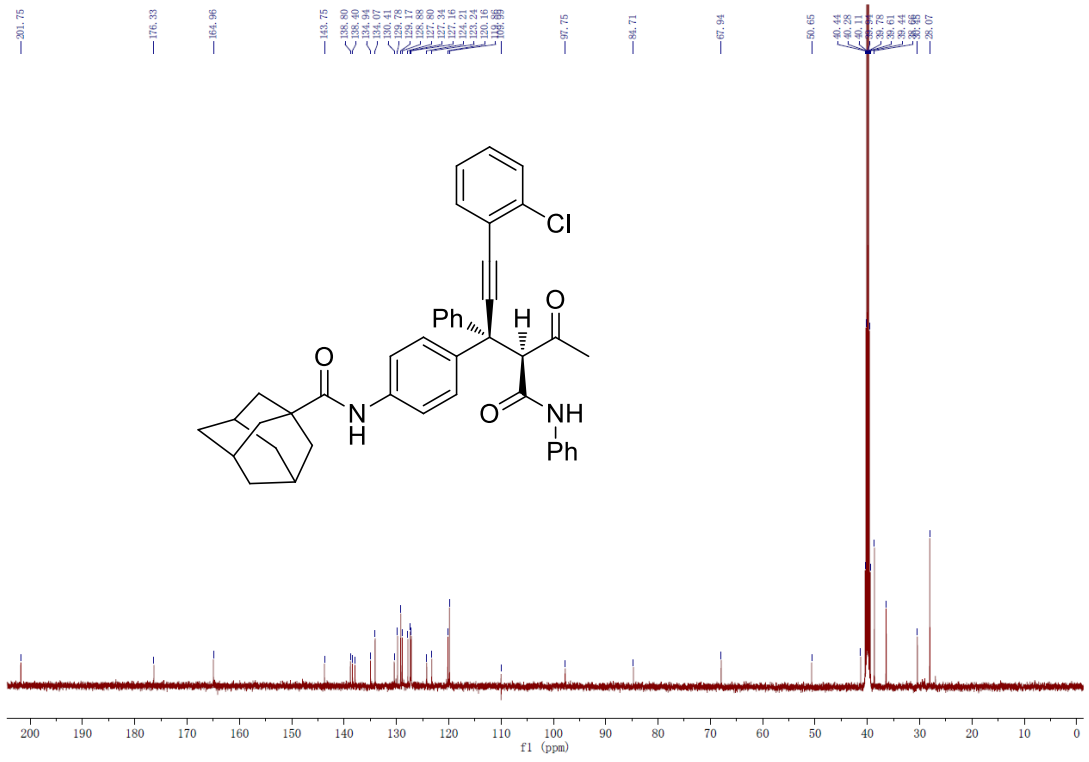
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(2-fluorophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3la)



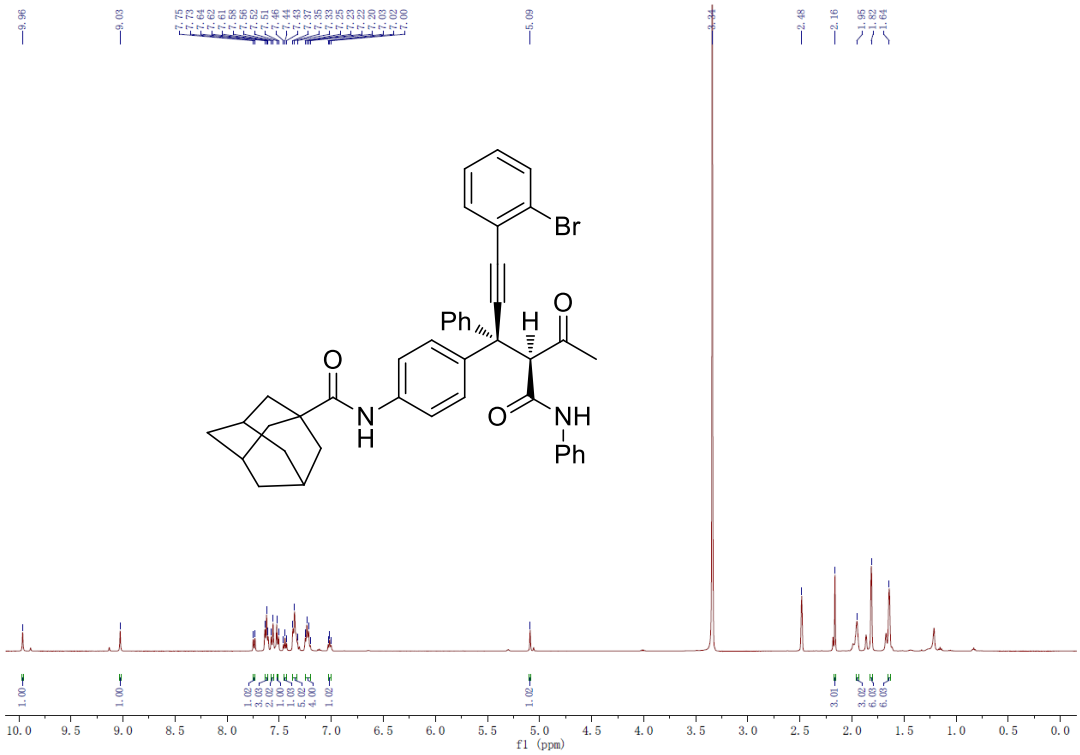


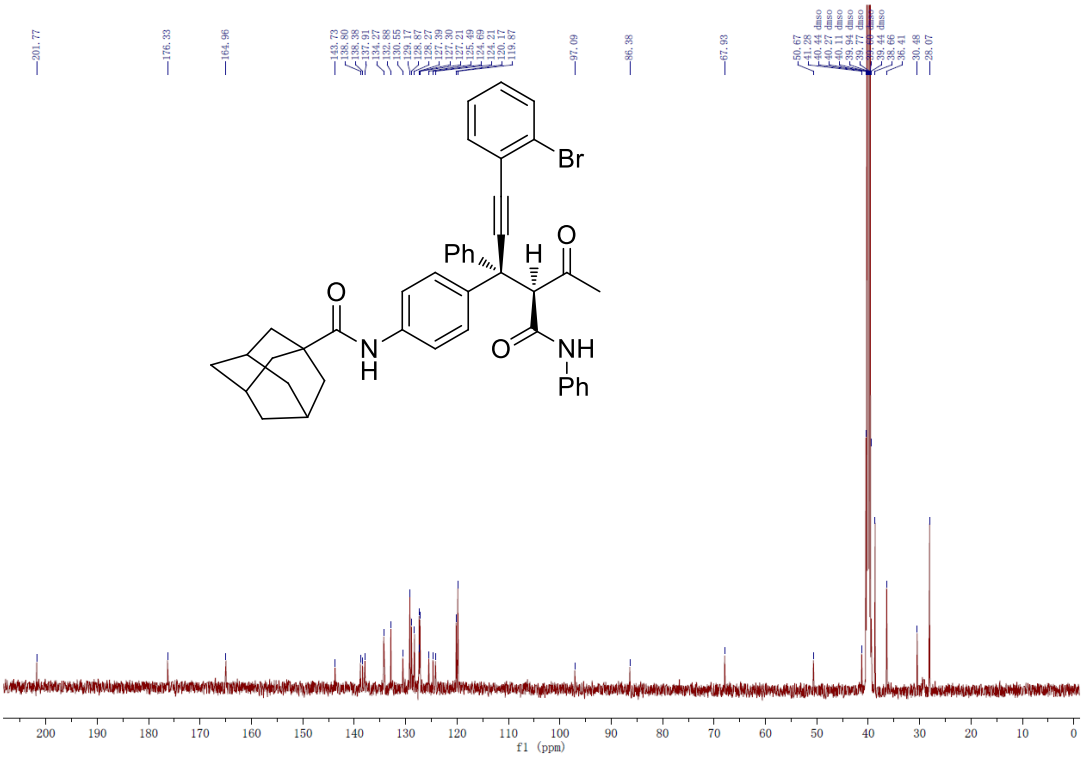
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(2-chlorophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ma)



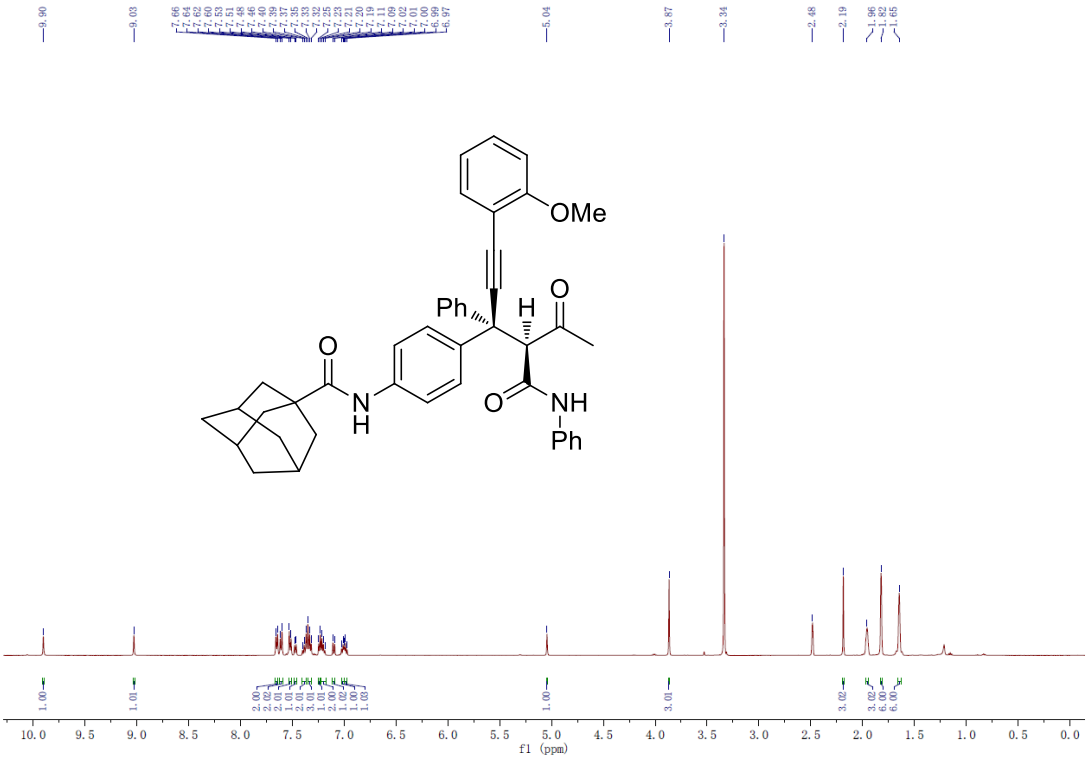


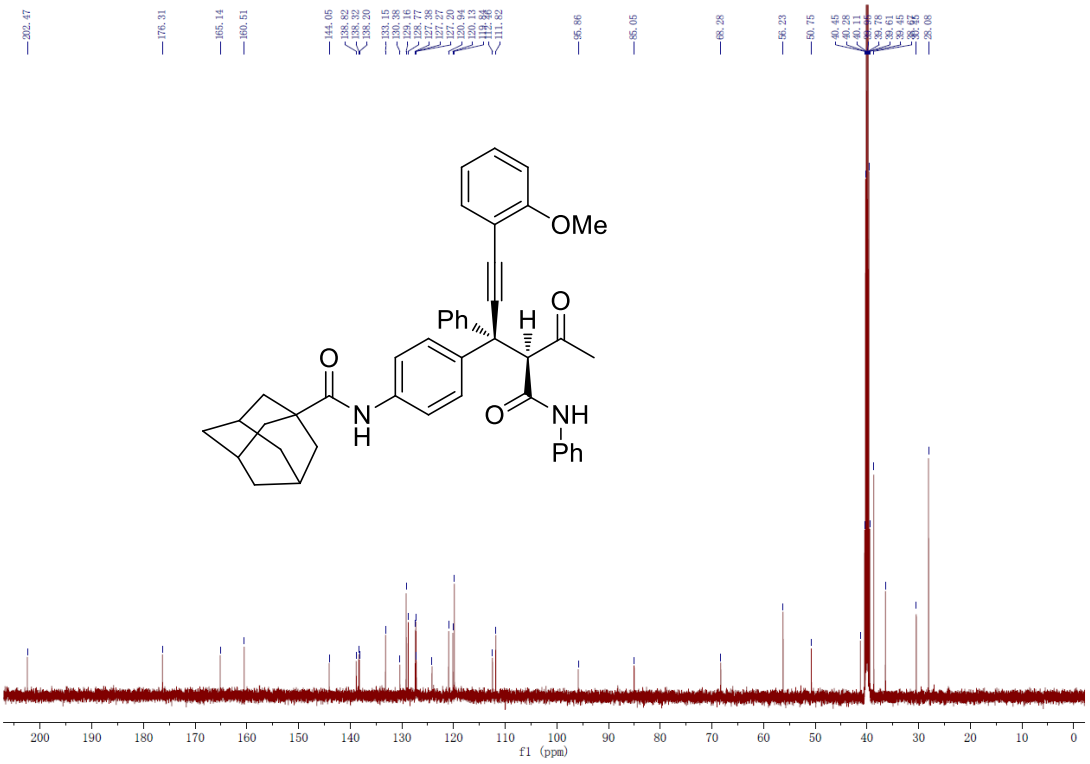
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(2-bromophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3na)



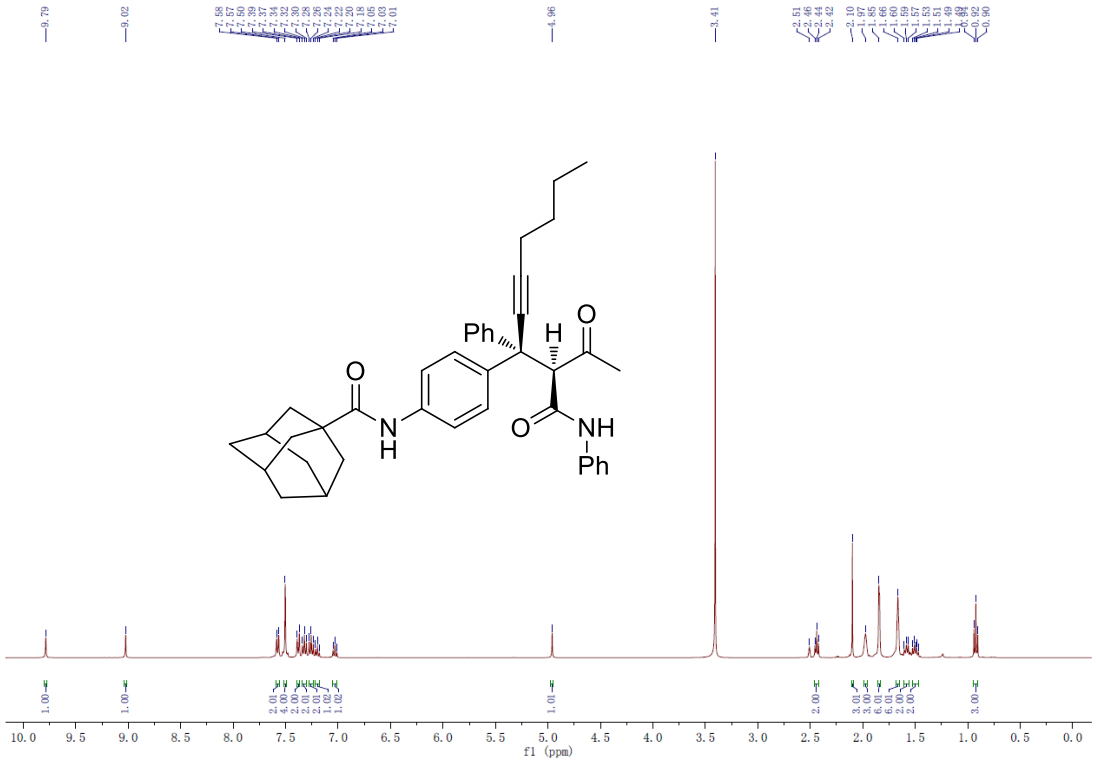


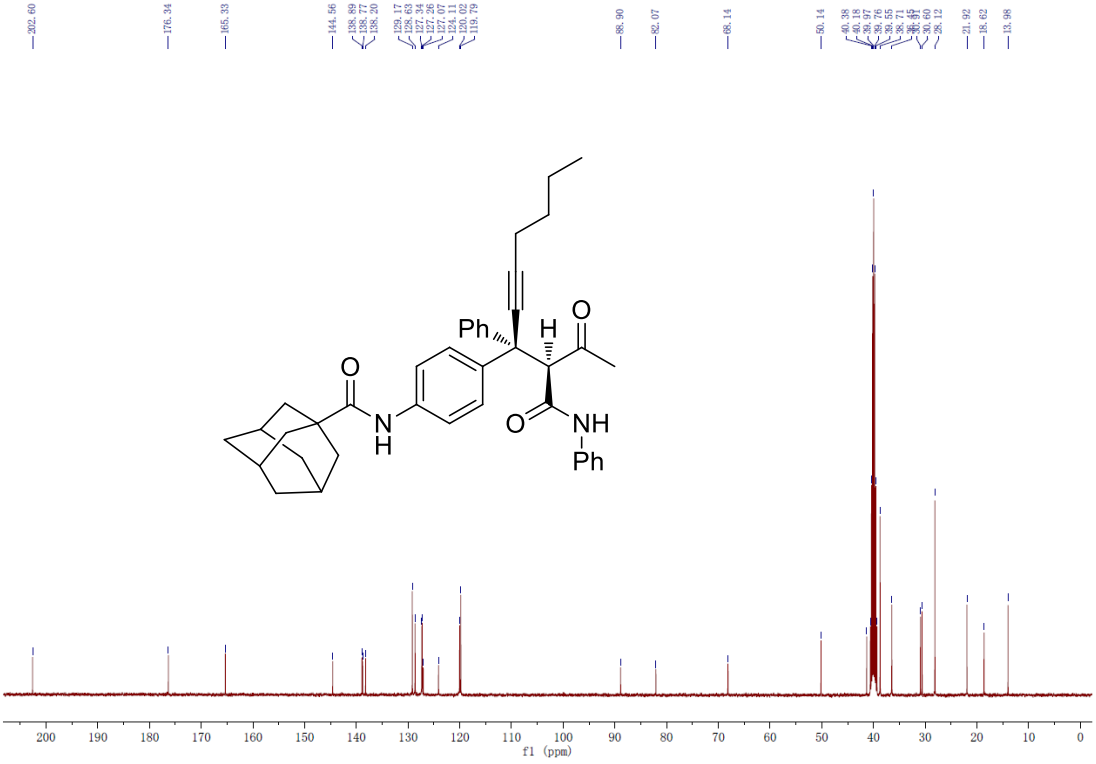
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(2-methoxyphenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3oa)



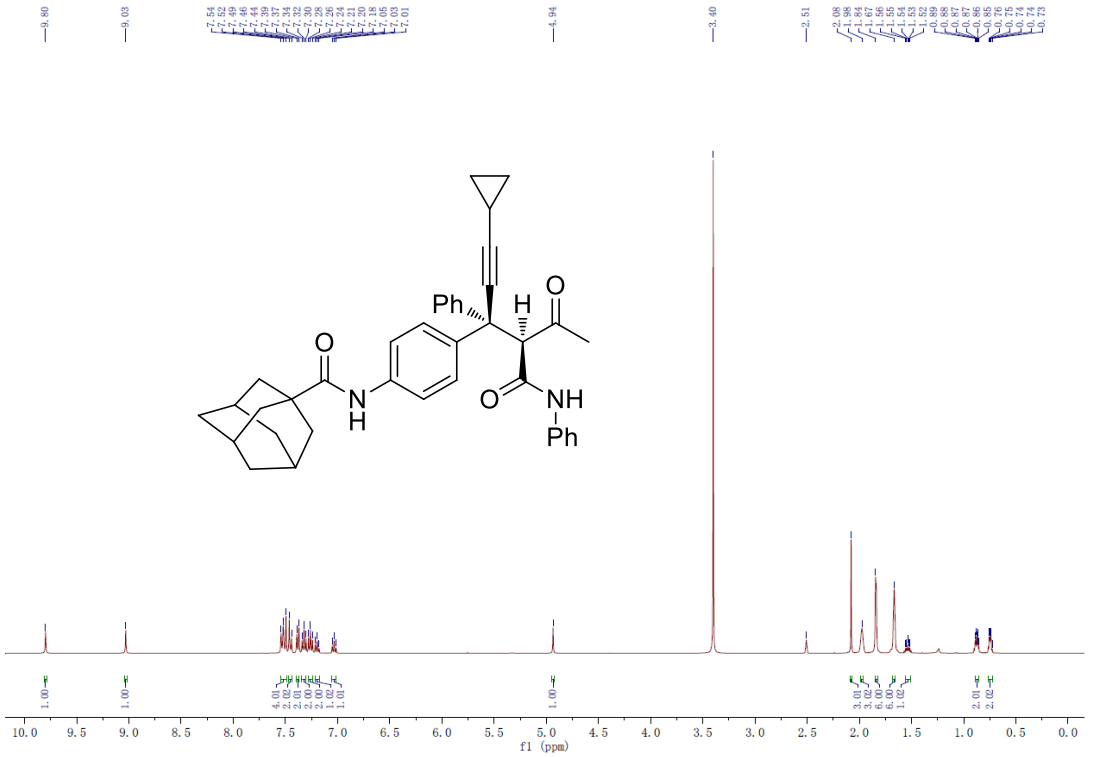


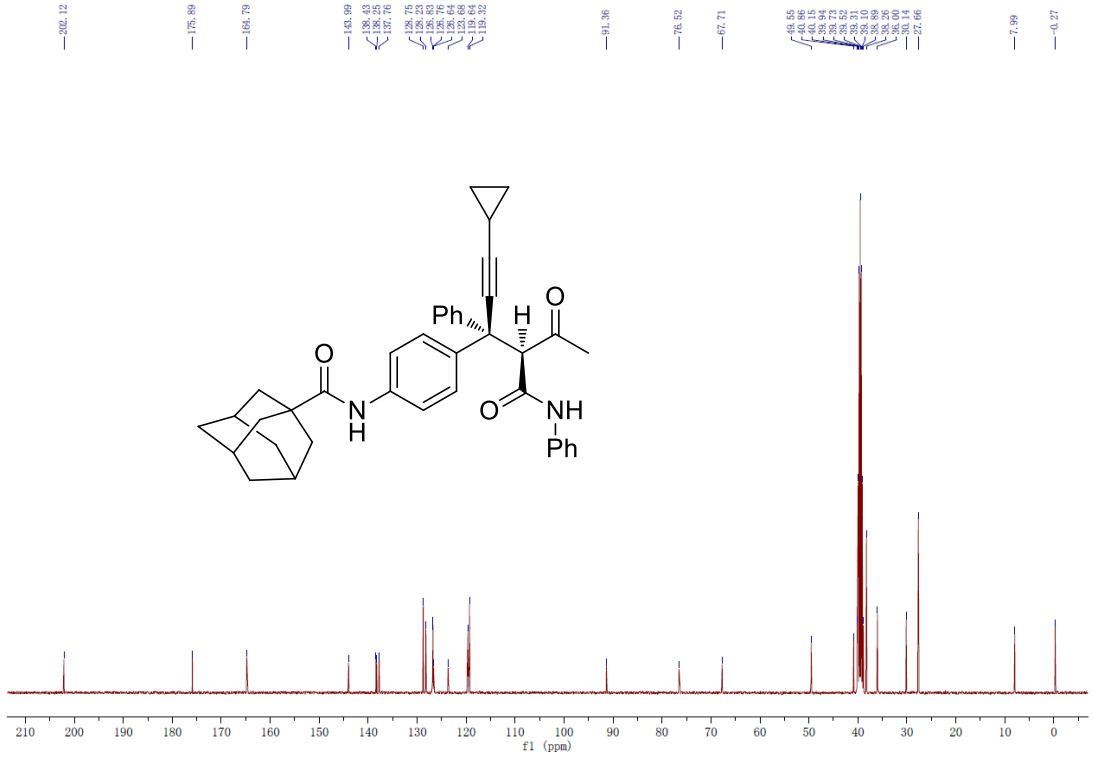
(1*r*,3*R*,5*S*)-*N*-(4-((3*S*,4*R*)-2-oxo-4-phenyl-3-(phenylcarbamoyl)dec-5-yn-4-yl)phenyl)adamantane-1-carboxamide (3pa)



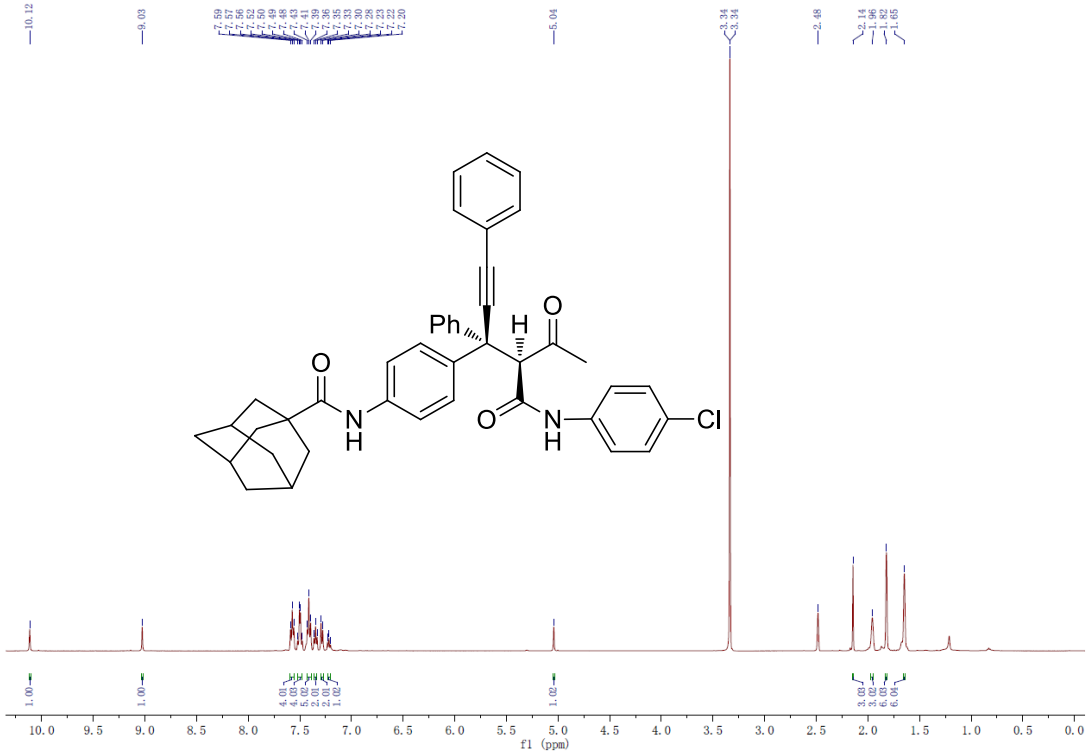


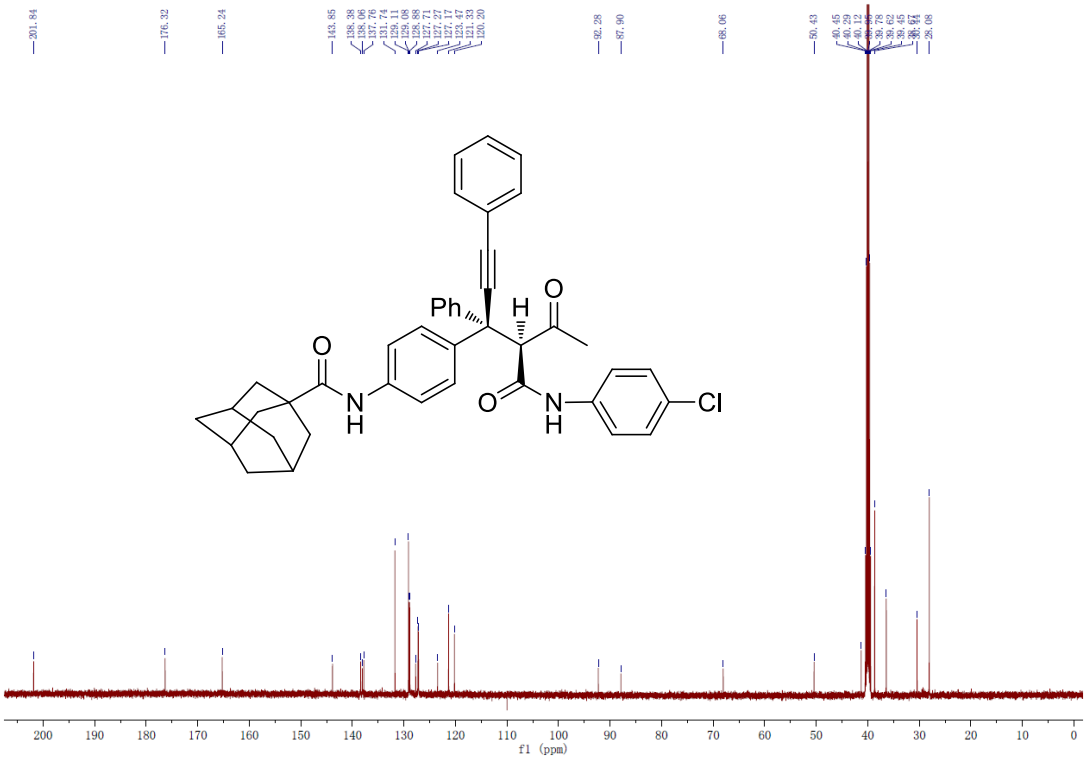
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-cyclopropyl-5-oxo-3-phenyl-4-(phenylcarbamoyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3qa)



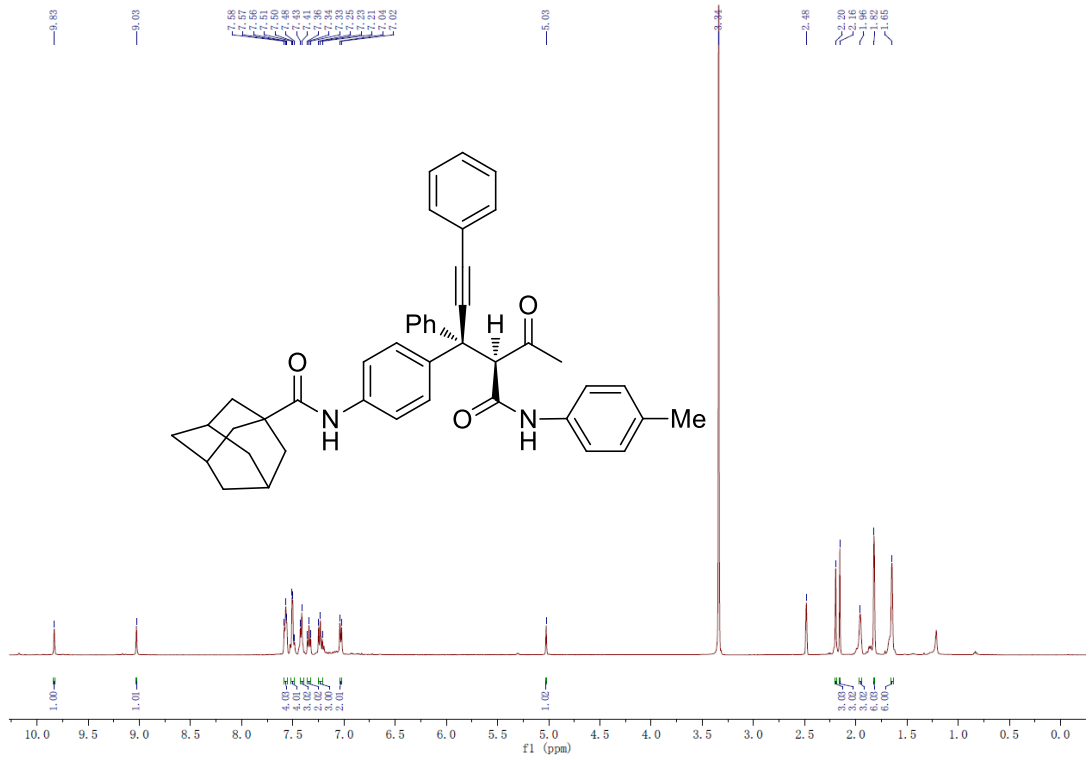


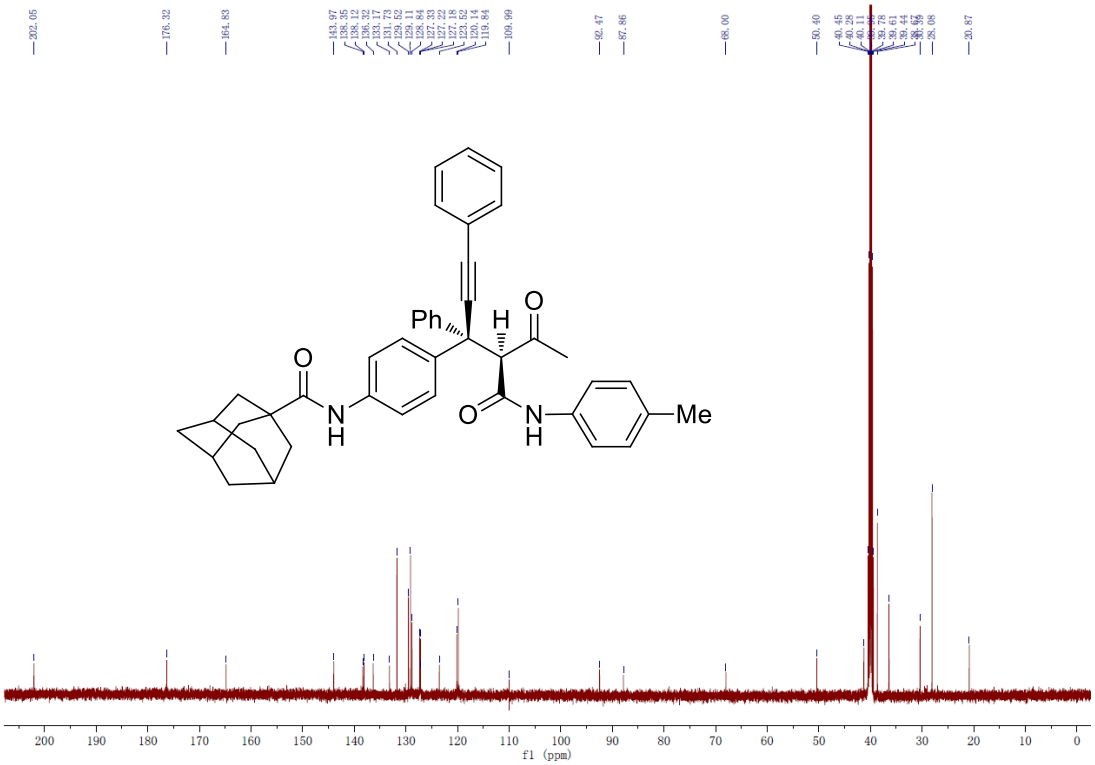
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-4-((4-chlorophenyl)carbamoyl)-5-oxo-1,3-diphenylhex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ab)



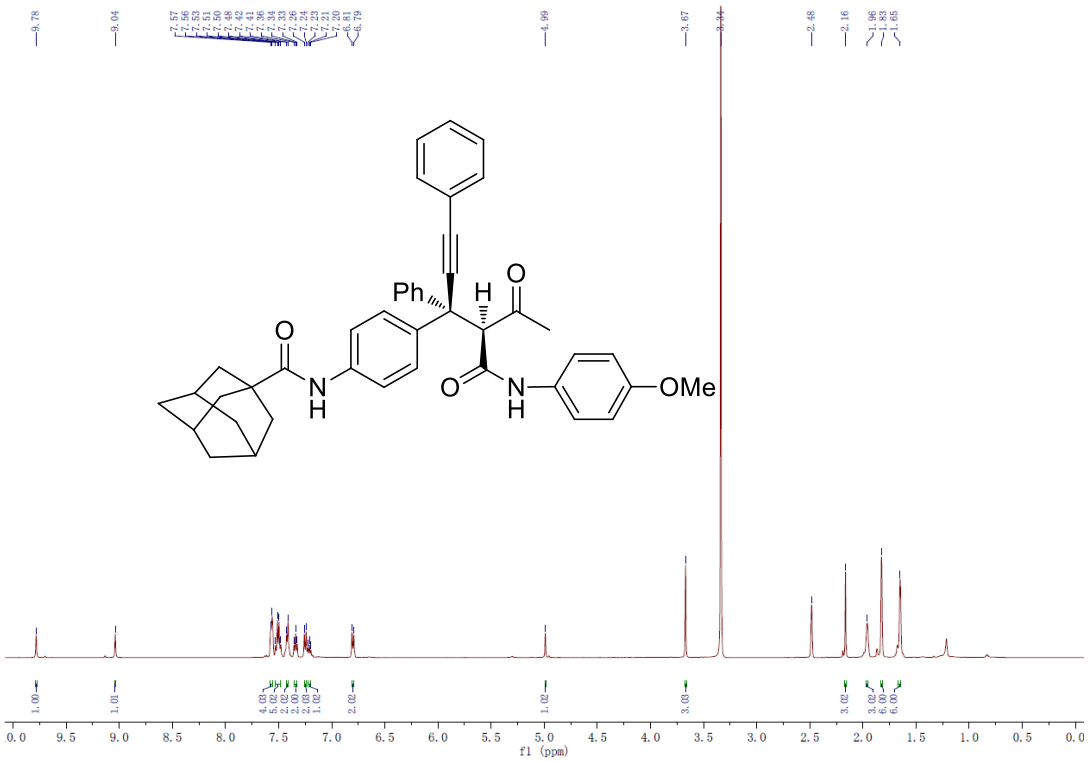


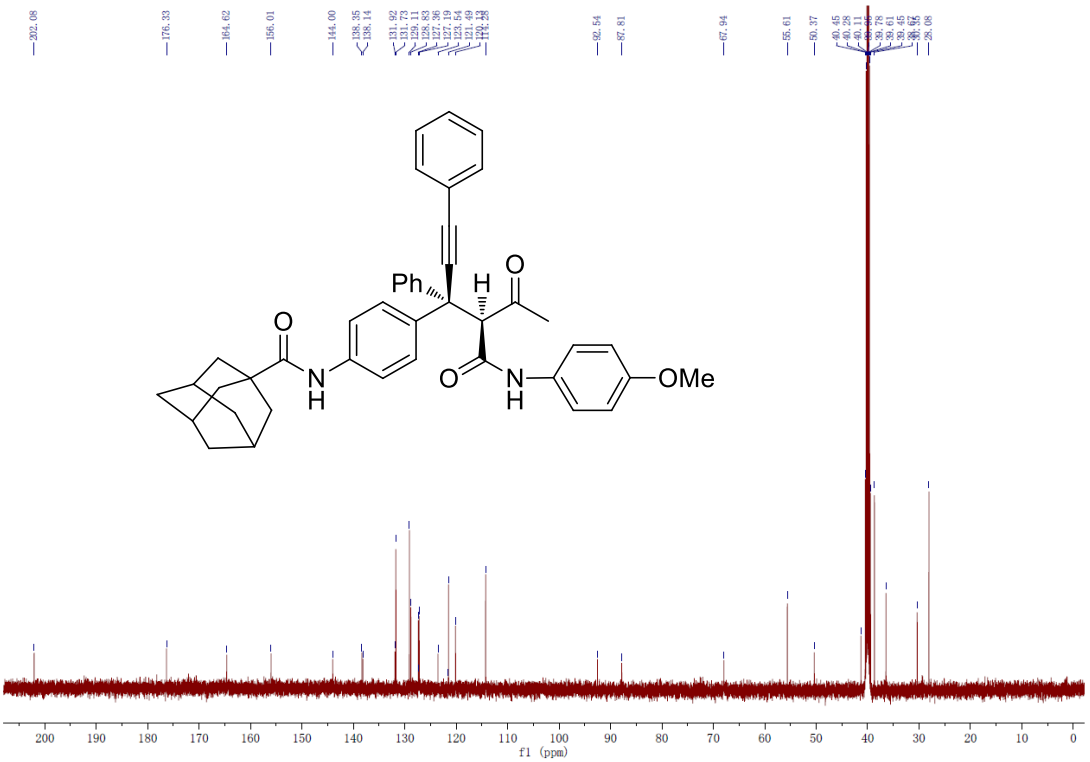
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-5-oxo-1,3-diphenyl-4-(*p*-tolylcarbamoyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ac)



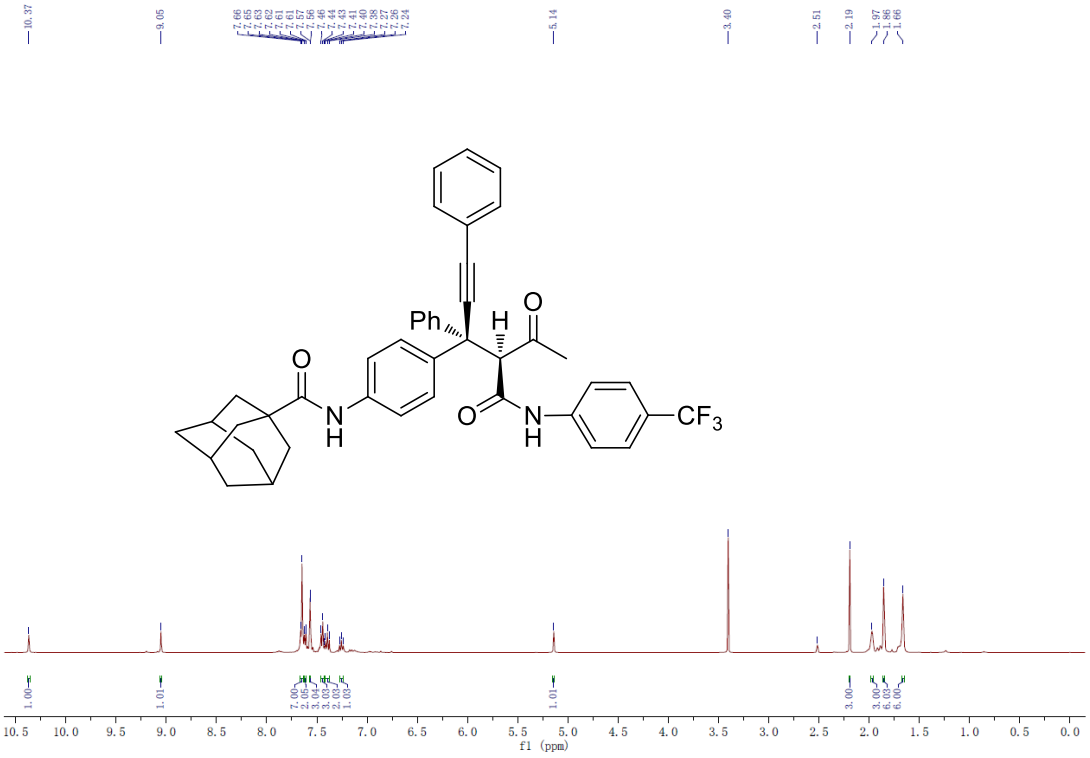


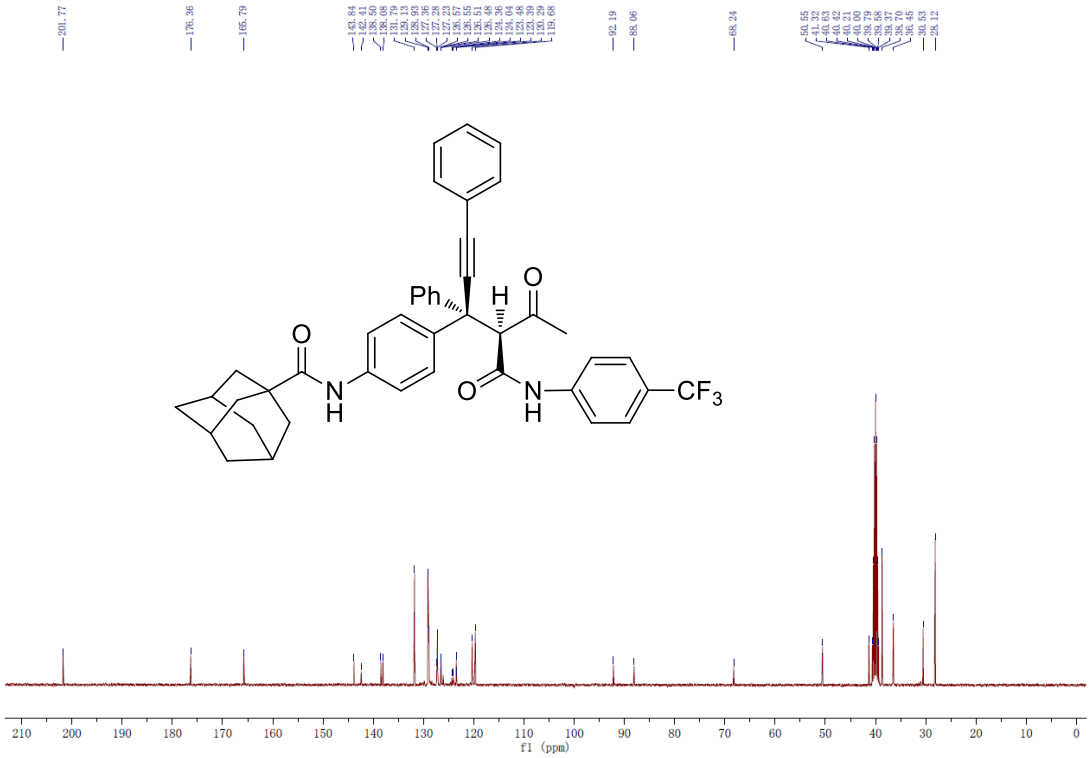
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-4-((4-methoxyphenyl)carbamoyl)-5-oxo-1,3-diphenylhex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ad)



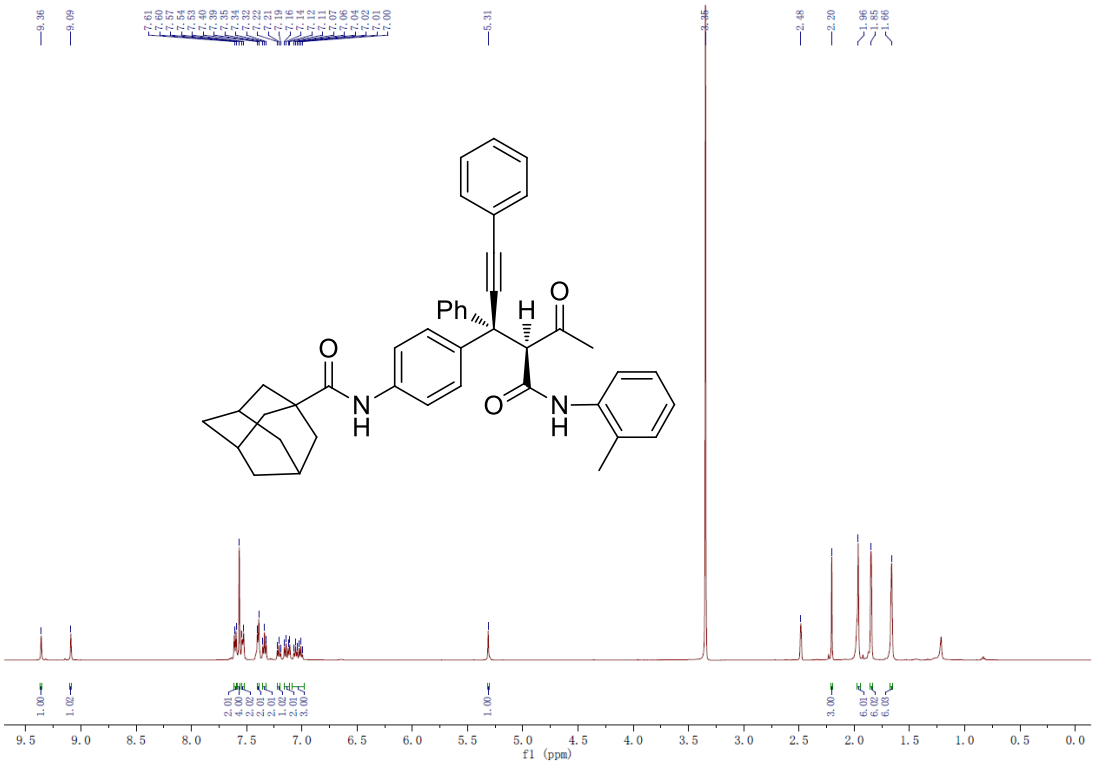


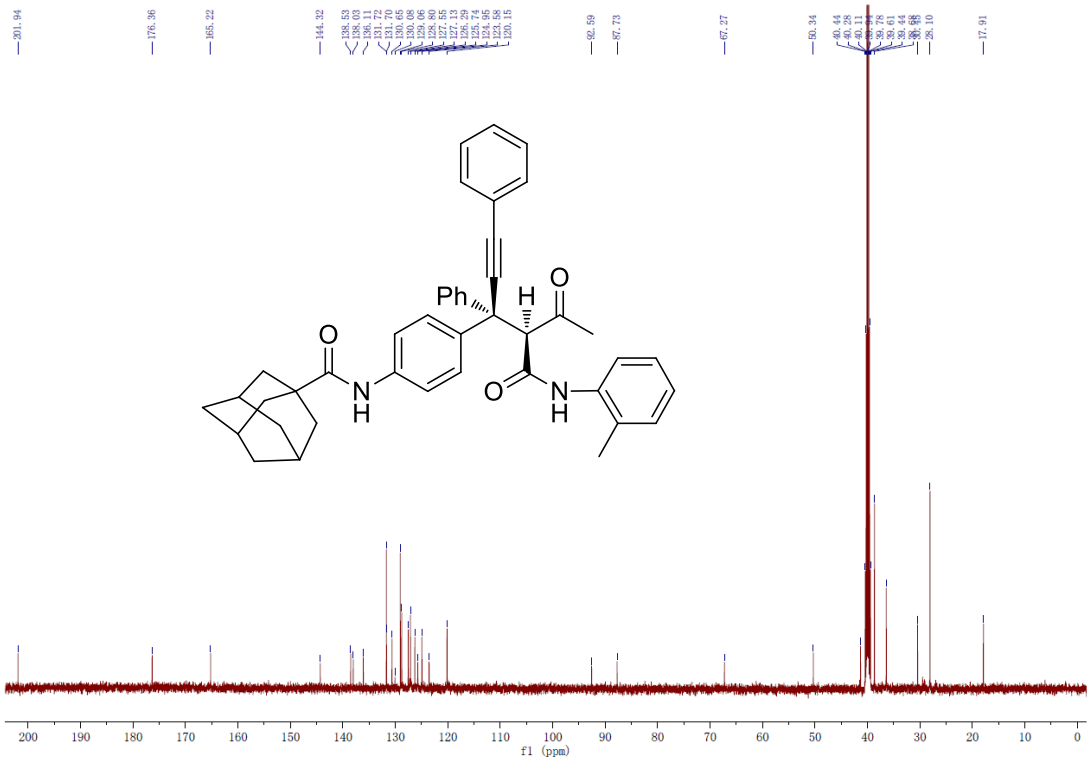
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-5-oxo-1,3-diphenyl-4-((4-(trifluoromethyl)phenyl)carbamoyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ae)



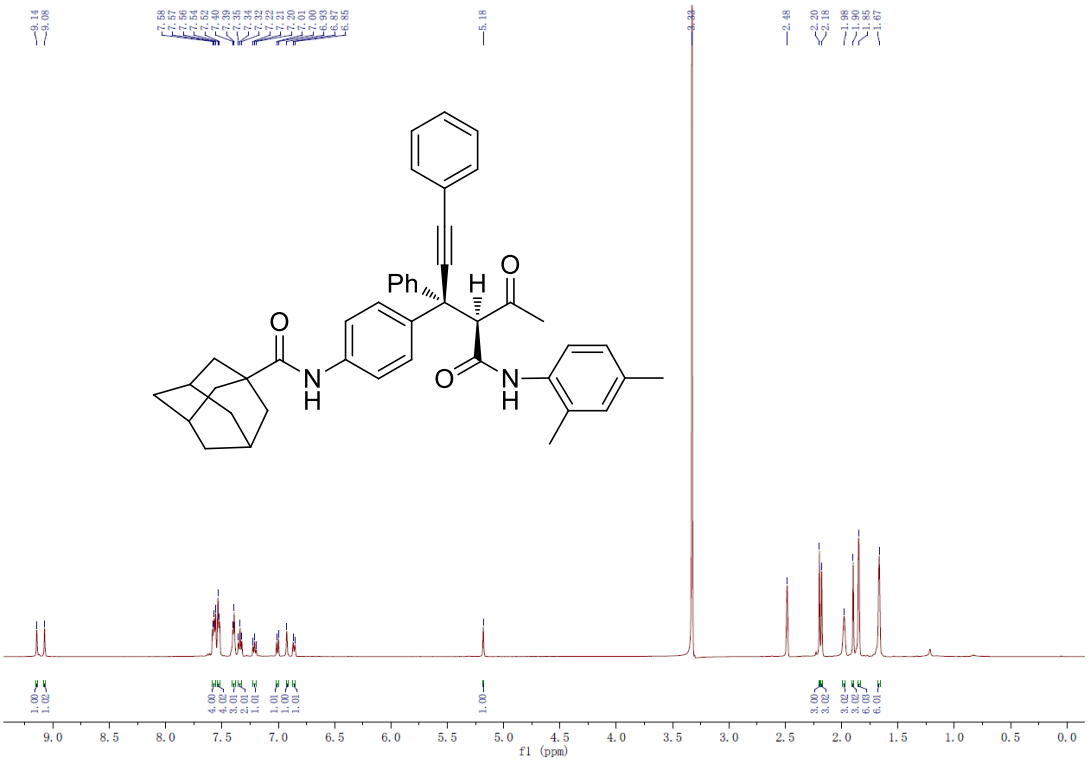


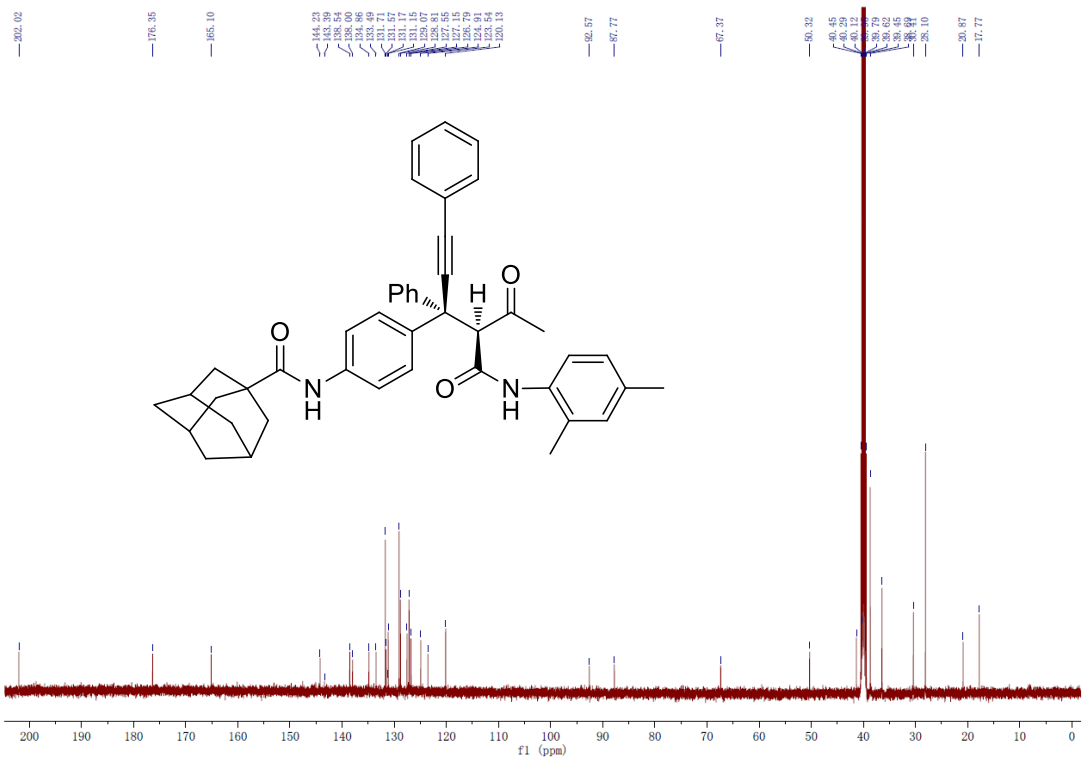
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-5-oxo-1,3-diphenyl-4-(*o*-tolylcarbamoyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3af)



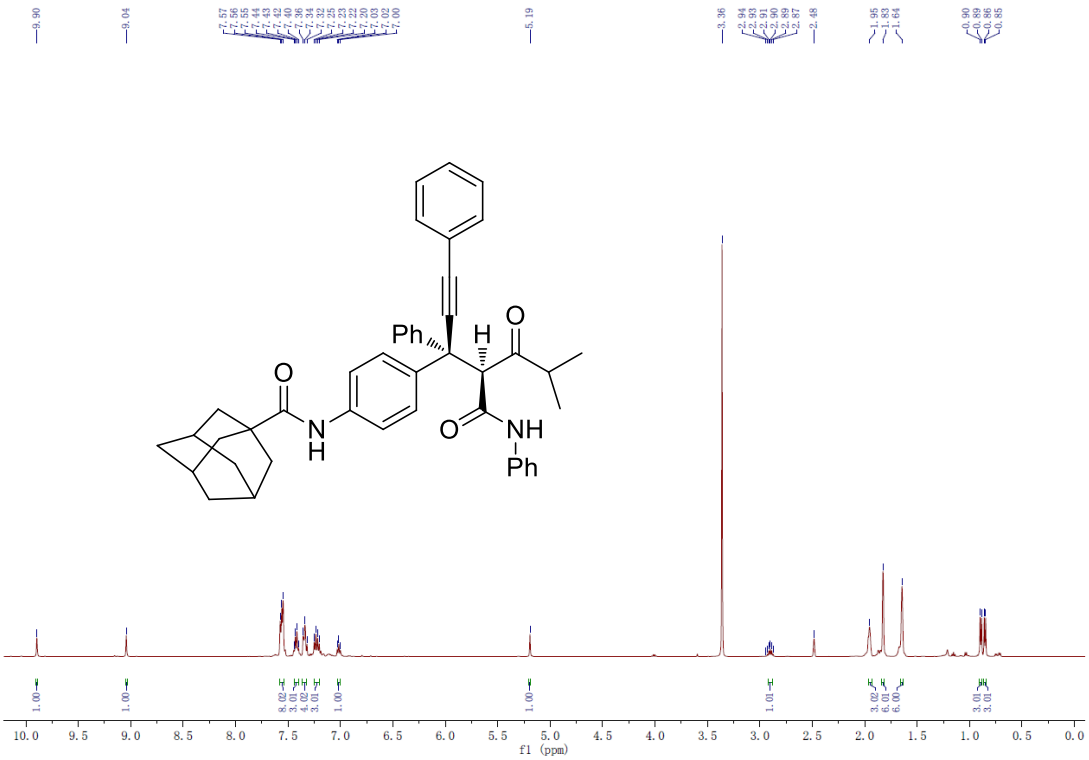


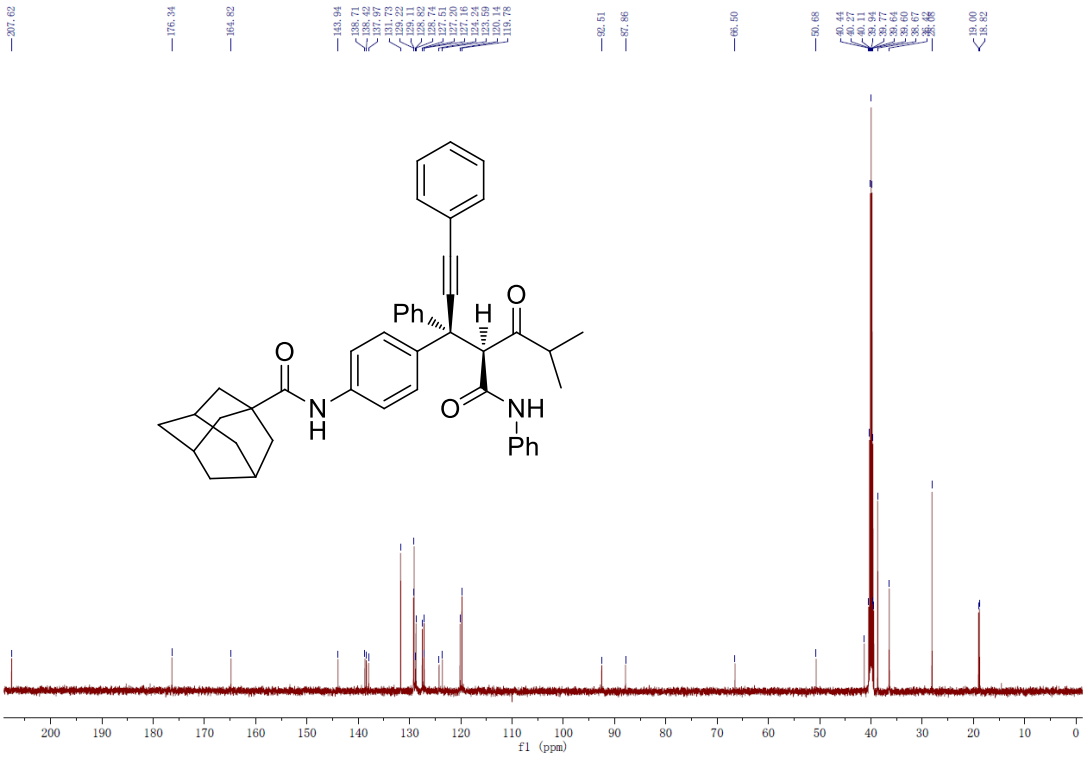
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-4-((2,4-dimethylphenyl)carbamoyl)-5-oxo-1,3-diphenylhex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ag)



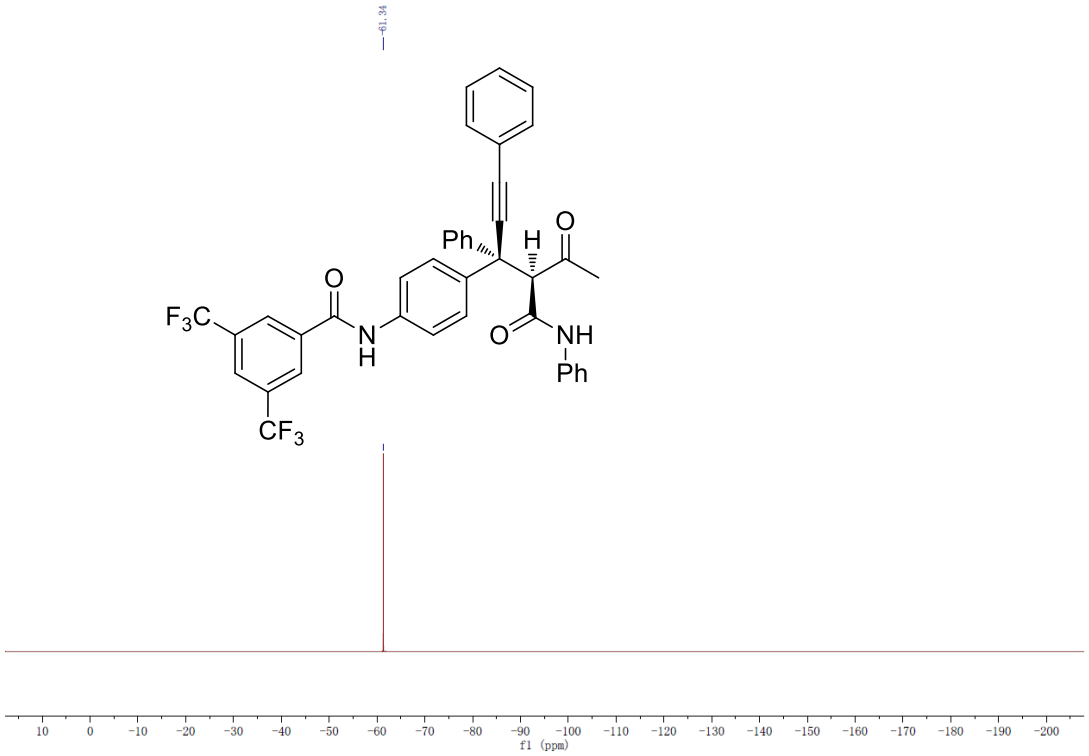


(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-6-methyl-5-oxo-1,3-diphenyl-4-(phenylcarbamoyl)hept-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ah)

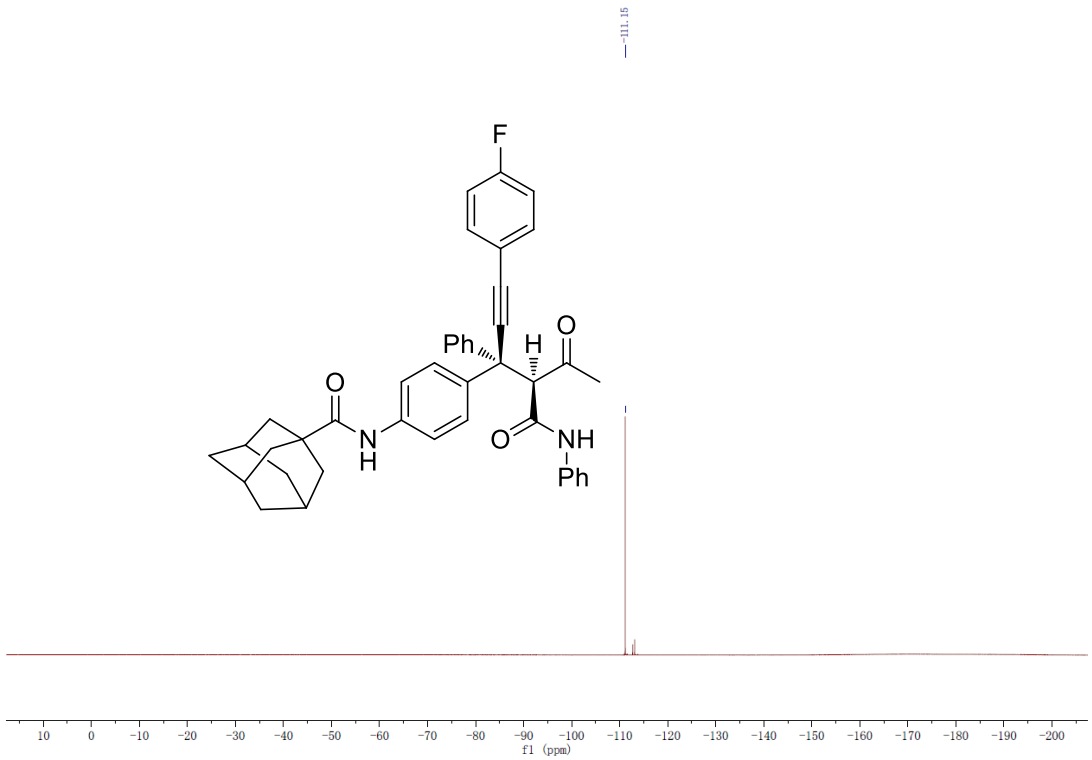




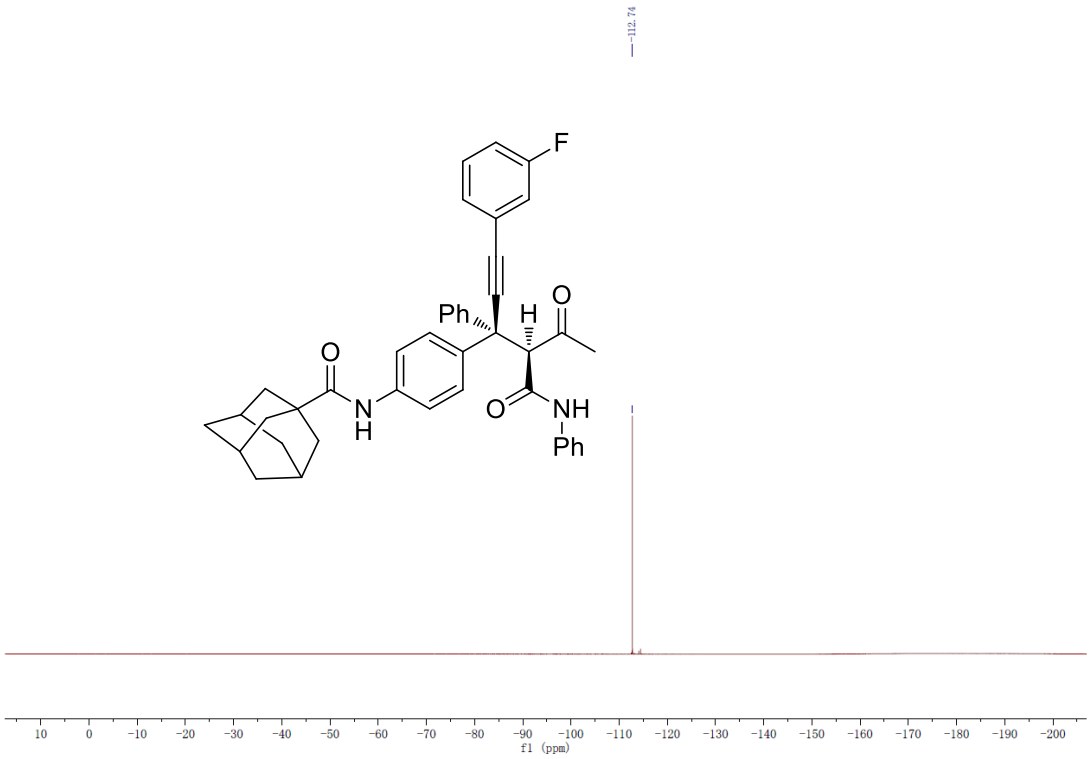
***N*-(4-((3*R*,4*S*)-5-oxo-1,3-diphenyl-4-(phenylcarbamoyl)hex-1-yn-3-yl)phenyl)-3,5-bis(trifluoromethyl)benzamide (3ba)**



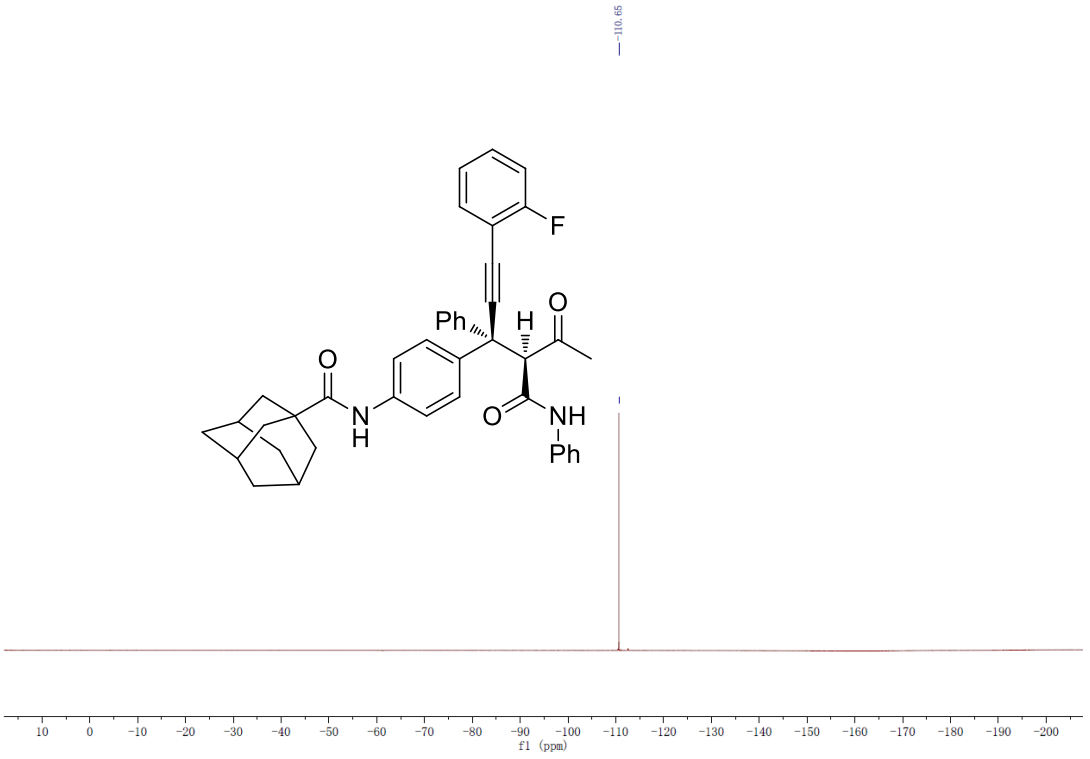
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(4-fluorophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ea)



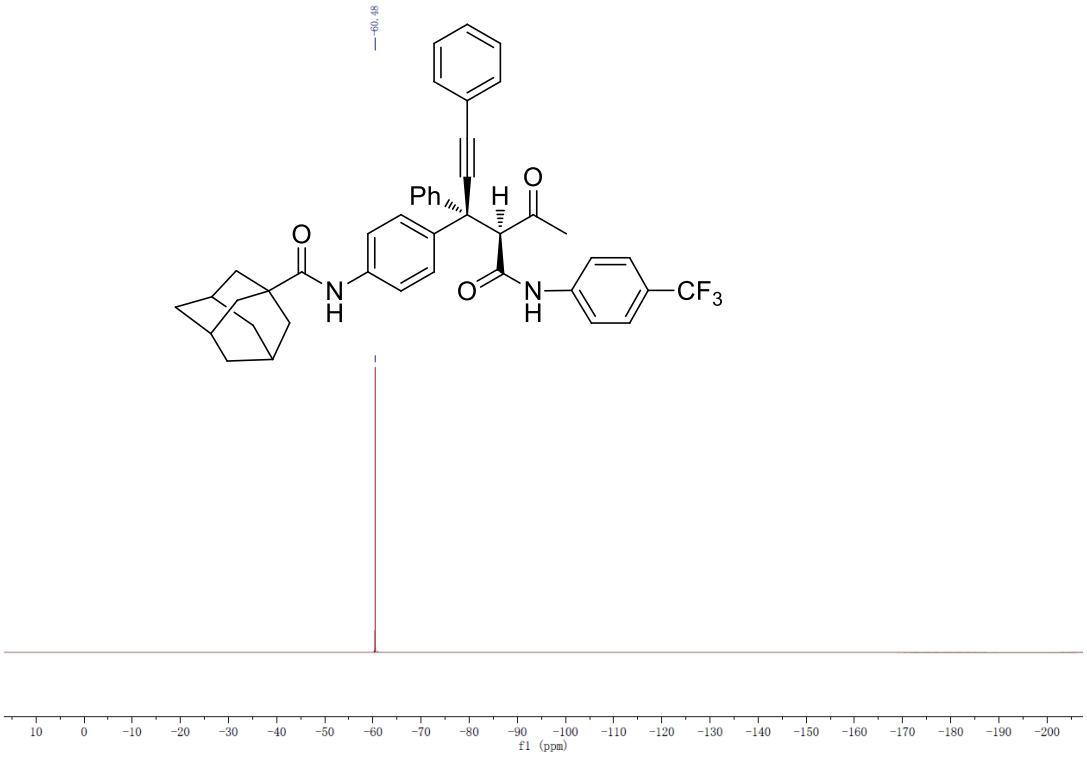
(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(3-fluorophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ia)



(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-1-(2-fluorophenyl)-5-oxo-3-phenyl-4-(phenylcarbamoyl) hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3la)



(1*r*,3*R*,5*S*)-*N*-(4-((3*R*,4*S*)-5-oxo-1,3-diphenyl-4-((4-(trifluoromethyl)phenyl)carbamoyl)hex-1-yn-3-yl)phenyl)adamantane-1-carboxamide (3ae)



K: X-Ray Analysis Data

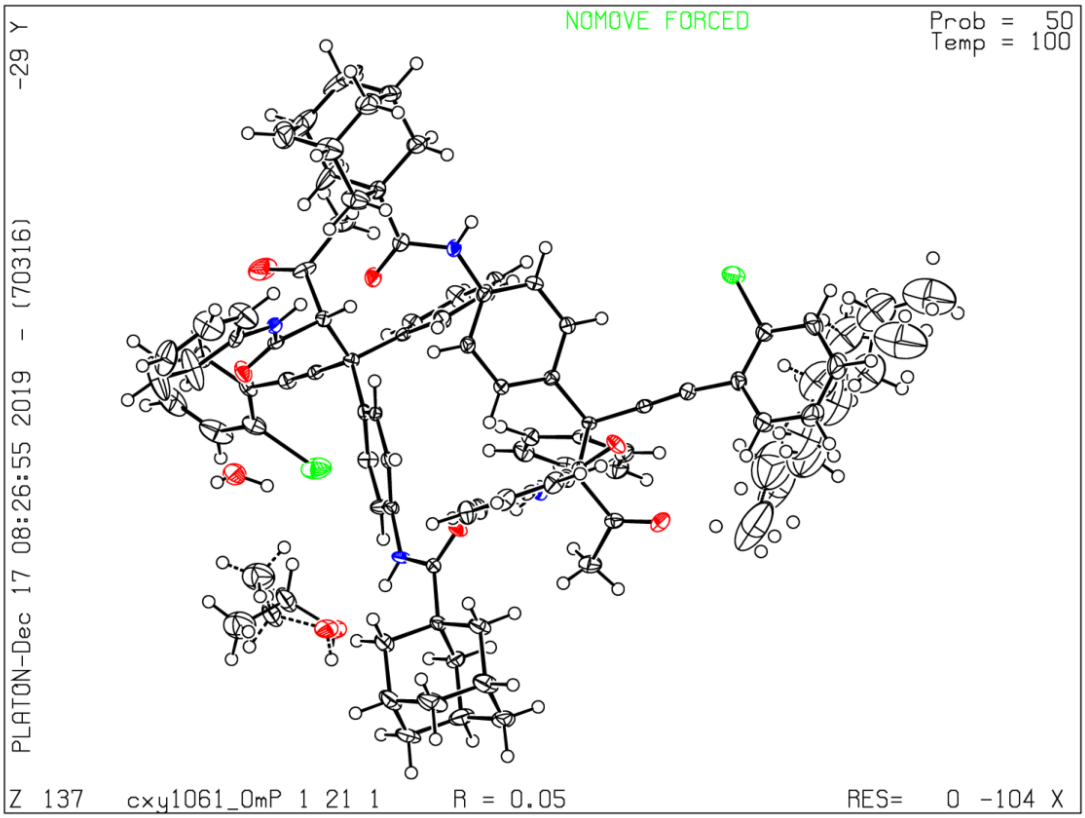


Table Crystal data and structure refinement for 3na.

Identification code	**3na**
Empirical formula	$C_{42}H_{39}BrN_2O_3$
Formula weight	698.21
Temperature/K	100
Crystal system	monoclinic
Space group	$P2_1$
a/Å	11.8175(4)
b/Å	22.6082(8)
c/Å	15.1003(6)
α/°	90
β/°	94.6410(10)
γ/°	90
Volume/Å^3	4021.2(3)
Z	2
ρ_{calc}g/cm^3	1.279
μ/mm^{-1}	1.067
F(000)	1626.0
Crystal size/mm^3	0.36 × 0.28 × 0.26
Radiation	MoKα (λ = 0.71073)
2Θ range for data collection/°	4.506 to 55.134
Index ranges	-15 ≤ h ≤ 15, -29 ≤ k ≤ 29, -19 ≤ l ≤ 19
Reflections collected	59272
Independent reflections	18547 [R_{int} = 0.0514, R_{sigma} = 0.0613]
Data/restraints/parameters	18547/96/994
Goodness-of-fit on F^2	1.033
Final R indexes [I>=2σ (I)]	R_1 = 0.0483, wR_2 = 0.1100
Final R indexes [all data]	R_1 = 0.0671, wR_2 = 0.1185
Largest diff. peak/hole / e Å^{-3}	0.56/-0.54
Flack parameter	-0.005(3)

L: Reference

1. a) M. Chen, J. Sun, *Angew. Chem. Int. Ed.* **2017**, *56*, 4583. b) D. Qian, L. Wu, Z. Lin, J. Sun, *Nat. Commun.* **2017**, *8*, 567.