Supporting Information

Asymmetric [4+3] Cycloaddition of Hydroxyphenyl Indolinones to Synthesize Novel Spirooxindoles

Shuhui Huang,[a] Yongquan Xu,[a] Mohan Li,[a] Lihuan Liao,[a] and Weiwu Ren*[,a,b]

[a] Molecular Synthesis Center & Key Laboratory of Marine Drugs, Chinese Ministry of Education, School of Medicine and Pharmacy, Ocean University of China, 5 Yushan Road, Qingdao 266003, China.

[b] Laboratory for Marine Drugs and Bioproducts, Qingdao Marine Science and Technology Center, Qingdao 266237, China.

Email: renweiwu@ouc.edu.cn

Table of Content:

1. General methods

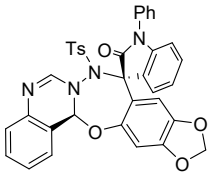
Unless otherwise mentioned, all reagents were purchased from commercial suppliers without further purification. Solvent purification was conducted according to Purification of Laboratory Chemicals (Peerrin, D. D.; Armarego, W. L. and Perrins, D. R., Pergamon Press: Oxford, 1980). Reactions were monitored using Merck Kieselgel $60F_{254}$ aluminium plates. TLC was visualized by UV fluorescence (254 nm) then one of the following: $KMnO_4$, phosphomolybdic acid, ninhydrin. If not specially mentioned, flash column chromatography was performed using Yantai xinnuo Chemicals (China) (particle size 0.040-0.063 mm). NMR spectra were recorded on JEOL 400 instruments and calibrated by using residual undeuterated chloroform-*d* (δ ^{1}H = 7.26 ppm, δ ^{13}C = 77.0 ppm). The following abbreviations were used to explain the multiplicities: s = singlet, d = doublet, t = triplet, q = quartet, dd = double doublet, dq = double quartet, m = multiplet. Infrared (IR) spectra were recorded on an iCAN 9-T FT-IR spectrometer. High-resolution mass spectra (HRMS) were recorded on a Thermo Fisher Q Exactive Orbitrap mass spectrometer using ESI (electrosprayionization) as ionization method. X-Ray data were taken on an Agilent Supernova X-Ray diffractometer equipped with a large area CCD detector. 3-(2-Hydroxyphenyl)indolin-2-ones **1a**[2], **1l-1q**[2] and azomethine imines **2**[3] are known compounds. Compounds **1b-1k** are unknown compounds which were synthesized according to the literature methods.[1,2] ^{1}H and ^{13}C-NMR spectra for compounds **1b-1k** cannot be obtained due to sample decomposition.

2. Experimental procedures and characterization data

Procedure for synthesis of 3

To a solution of 3-(2-hydroxyphenyl)indolin-2-one **1** (0.10 mmol, 1.0 equiv) in diethyl ether (1.5 mL) was added Ag_2O (0.15 mmol, 1.5 equiv). The reaction was stirred at 40 ℃ in an oil bath for 3 h. Then, the solvent was removed under reduced pressure. Next, azomethine imine **2** (0.30 mmol, 3.0 equiv) and **C4** (0.01 mmol, 10 mol%) in 2-MeTHF (2.0 mL) were added and this reaction was stirred at 25 ℃ for 72-96 h. The reaction mixture was directly concentrated under vacuum and charged to column chromatography on aluminium oxide eluting with dichloride/ethyl acetate = 200/1 to give product **3**.

(*3R*,*15a'S*)-1-phenyl-8'-tosyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3aa)



White solid, isolated yield 65% (42 mg);

m.p.: 207.7-208.1 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.36 (d, J = 7.5 Hz, 1H), 7.79 (d, J = 8.0 Hz, 2H), 7.64-7.58 (m, 4H), 7.53-7.49 (m, 2H), 7.42 (t, J = 7.3 Hz, 1H), 7.35 (t, J = 7.3 Hz, 1H), 7.26-7.22 (m, 3H), 7.14 (q, J = 7.5 Hz, 2H), 6.98 (d, J = 8.3 Hz, 2H), 6.75 (d, J = 7.7 Hz, 2H), 5.89 (d, J = 4.5 Hz, 2H), 5.84 (s, 1H), 2.39 (s, 3H);

^{13}C NMR (101 MHz, $CDCl_3$): δ 174.8, 150.2, 148.9, 146.6, 145.5, 145.2, 142.6, 139.3, 134.4, 131.0, 130.9, 130.0, 129.9, 129.7, 128.83, 128.77 (2C), 128.3, 127.2, 126.6, 125.9, 124.3, 123.9, 121.7, 120.4, 110.2, 107.1, 105.9, 102.1, 87.4, 76.0, 21.7;

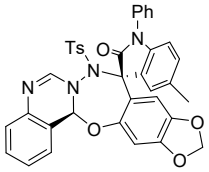
IR (neat): ν 3459, 2929, 2859, 1729, 1626, 1482, 1372, 1263, 1169, 1030 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{36}H_{26}N_4O_6S$: 643.1646; found: 643.1639；

$[\alpha]_D^{20}$ = -109.0 (c = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 13.63 min, 0.6%; t_{R2} = 28.35 min, 99.4%).

(*3R*,*15a'S*)-5-methyl-1-phenyl-8'-tosyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3ba)



White solid, isolated yield 71% (46 mg);

m.p.: 218.2-218.5 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.12 (s, 1H), 7.78 (d, J = 8.3 Hz, 2H), 7.63-7.57 (m, 4H), 7.54-7.50 (m, 2H), 7.42 (td, J = 7.5, 1.5 Hz, 1H), 7.35 (td, J = 7.5, 1.2 Hz, 1H), 7.26 (s, 1H), 7.24 (s, 1H), 7.10 (d, J = 7.7 Hz, 1H), 7.05 (d, J = 7.9 Hz, 1H), 7.00 (s, 1H), 6.96 (s, 1H), 6.72 (s, 1H), 6.65 (d, J = 8.0 Hz, 1H), 5.89 (s, 1H), 5.88 (d, J = 1.4 Hz, 1H), 5.84 (d, J = 1.4 Hz, 1H), 2.40 (s, 3H), 2.37 (s, 3H);

^{13}C NMR (101 MHz, $CDCl_3$): δ 174.7, 150.3, 148.8, 146.5, 145.5, 145.1, 140.2, 139.3, 134.60, 134.55, 133.5, 130.92, 130.88, 130.1, 129.9, 129.8, 128.8, 128.7, 128.3, 127.1, 126.6, 125.9, 124.9, 121.9, 120.4, 109.9, 107.1, 105.9, 102.0, 87.4, 76.2, 21.7, 21.4;

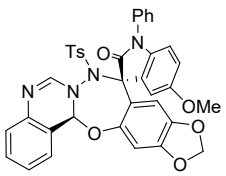
IR (neat): ν 3454, 2931, 2862, 1607, 1350, 1267, 1175, 1097, 1023, 806 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{37}H_{28}N_4O_6S$: 657.1802; found: 657.1795；

$[\alpha]_D^{20}$ = -145.6 (c = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 11.20 min, 0.7%; t_{R2} = 23.95 min, 99.3%).

(*3R*,*15a'S*)-5-methoxy-1-phenyl-8'-tosyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3ca)



White solid, isolated yield 73% (49 mg);

m.p.: 165.4-165.8 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 7.99 (d, J = 2.56 Hz, 1H), 7.80 (d, J = 8.4 Hz, 2H), 7.63-7.58 (m, 4H), 7.52-7.48 (m, 2H), 7.41 (td, J = 7.5, 1.6 Hz, 1H), 7.34 (td, J = 7.5, 1.2 Hz, 1H), 7.27 (s, 1H), 7.25 (s, 1H), 7.10 (d, J = 7.8 Hz, 1H), 6.99 (s, 1H), 6.94 (s, 1H), 6.77 (dd, J = 8.6, 2.6 Hz, 1H), 6.73 (s, 1H), 6.67 (d, J = 8.6 Hz, 1H), 5.88 (s, 1H), 5.87 (d, J = 1.4 Hz, 1H), 5.84 (d, J = 1.4 Hz, 1H), 3.81 (s, 3H), 2.39 (s, 3H);

^{13}C NMR (101 MHz, $CDCl_3$): δ 174.4, 156.6, 150.2, 148.9, 146.5, 145.5, 145.2, 139.2, 136.0, 134.6, 134.4, 132.1, 130.9, 129.9, 129.8, 128.8, 128.6, 128.3, 127.0, 126.6, 125.8, 121.7, 120.3, 113.8, 111.6, 110.5, 107.1, 105.9, 102.0, 87.4, 76.2, 55.8, 21.7;

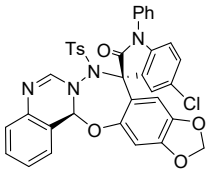
IR (neat): v 3460, 2930, 2660, 1628, 1486, 1355, 1170, 1036, 904, 807 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{37}H_{28}N_4O_7S$: 673.1751; found: 673.1757;

$[\alpha]_D^{20}$ = -132.0 (c = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 13.57 min, 1.0%; t_{R2} = 36.18 min, 99.0%).

(*3R,15a'S*)-5-chloro-1-phenyl-8'-tosyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3da)



White solid, isolated yield 69% (46 mg);

m.p.: 216.2-216.5 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.31 (d, J = 2.1 Hz, 1H), 7.77 (d, J = 8.4 Hz, 2H), 7.64-7.60 (m, 2H), 7.57-7.51 (m, 4H), 7.43 (td, J = 7.5, 1.6 Hz, 1H), 7.36 (td, J = 7.5, 1.3 Hz, 1H), 7.28 (s, 1H), 7.26 (s, 1H), 7.22 (dd, J = 8.4, 2.2 Hz, 1H), 7.10 (d, J = 7.8 Hz, 1H), 6.96 (s, 1H), 6.92 (s, 1H), 6.70 (s, 1H), 6.68 (d, J = 8.4 Hz, 1H), 5.90-5.89 (m, 2H), 5.86 (d, J = 1.4 Hz, 1H), 2.41 (s, 3H);

^{13}C NMR (101 MHz, $CDCl_3$): δ 174.4, 150.0, 149.1, 146.6, 145.6, 145.4, 141.2, 139.2, 134.3, 134.1, 132.3, 131.0, 130.1, 129.9, 129.6, 129.2, 129.1, 128.7, 128.4, 127.1, 126.7, 125.9, 124.7, 121.0, 120.2, 111.2, 107.0, 106.1, 102.1, 87.5, 75.7, 21.7;

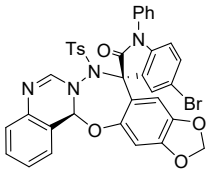
IR (neat): v 3452, 2930, 1960, 1733, 1668, 1606, 1532, 1350, 1271, 1175 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{36}H_{25}ClN_4O_6S$: 677.1256; found: 677.1252;

$[\alpha]_D^{20}$ = -65.0 (c = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 16.51 min, 2.1%; t_{R2} = 22.81 min, 97.9%).

(*3R,15a'S*)-5-bromo-1-phenyl-8'-tosyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3ea)



White solid, isolated yield 60% (43 mg);

m.p.: 220.9-221.2 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.42 (d, J = 1.9 Hz, 1H), 7.76 (d, J = 8.8 Hz, 2H), 7.64-7.60 (m, 2H), 7.56-7.52 (m, 4H), 7.43 (td, J = 7.5, 1.4 Hz, 1H), 7.37-7.32 (m, 2H), 7.29 (s, 1H), 7.26 (s, 1H), 7.10 (d, J = 7.6 Hz, 1H), 6.98 (s, 1H), 6.89 (s, 1H), 6.69 (s, 1H), 6.63 (d, J = 8 Hz, 1H), 5.90-5.89 (m, 2H), 5.86 (d, J = 1.2 Hz, 1H), 2.41 (s, 3H);

^{13}C NMR (101 MHz, $CDCl_3$): δ 174.3, 150.0, 149.1, 146.6, 145.6, 145.4, 141.7, 139.2, 134.4, 134.1, 132.6 (2C), 131.0, 130.1, 130.0, 129.1, 128.7, 128.4, 127.4, 127.1, 126.7, 125.9, 121.0, 120.2, 116.5, 111.7, 107.0, 106.1, 102.2, 87.4, 75.6, 21.7;

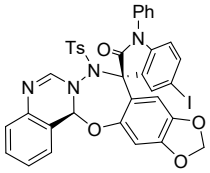
IR (neat): ν 3467, 2967, 2929, 1626, 1407, 1264, 1095, 1021, 802, 754 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{36}H_{25}BrN_4O_6S$: 721.0751; found: 721.0749;

$[\alpha]_D^{20}$ = -128.6 (c = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 16.49 min, 8.7%; t_{R2} = 22.33 min, 91.3%).

(*3R,15a'S*)-5-iodo-1-phenyl-8'-tosyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3fa)



White solid, isolated yield 65% (50 mg);

m.p.: 224.7-225.1 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.53 (s, 1H), 7.74 (d, J = 8.1 Hz, 2H), 7.64-7.60 (m, 2H), 7.56-7.52 (m, 4H), 7.43 (t, J = 7.5 Hz, 1H), 7.36 (t, J = 7.5 Hz, 1H), 7.29-7.26 (m, 3H), 7.12 (d, J = 7.6 Hz, 1H), 7.03 (s, 1H), 6.84 (s, 1H), 6.68 (s, 1H), 6.53 (d, J = 8.2 Hz, 1H), 5.90-5.89 (m, 2H), 5.86 (s, 1H), 2.42 (s, 3H);

^{13}C NMR (101 MHz, $CDCl_3$) δ 174.1, 150.1, 149.1, 146.5, 145.6, 145.4, 142.5, 139.2, 138.5, 134.4, 134.0, 132.9, 132.8, 131.0, 130.1, 130.0, 129.1, 128.6, 128.4, 127.1, 126.7, 125.9, 121.1, 120.2, 112.2, 106.9, 106.1, 102.1, 87.4, 86.7, 75.4, 21.8;

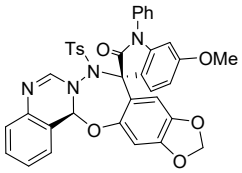
IR (neat): *v* 3453, 2930, 1610, 1534, 1350, 1263, 1176, 1095, 1022, 753 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{36}H_{25}IN_4O_6S$: 769.0612; found: 769.0605;

$[\alpha]_D^{20}$ = -64.0 (*c* = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 17.18 min, 2.6%; t_{R2} = 22.72 min, 97.4%).

(*3R,15a'S*)-6-methoxy-1-phenyl-8'-tosyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3ga)



White solid, isolated yield 75% (50 mg);

m.p.: 213.5-213.8 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.27 (d, *J* = 8.5 Hz, 1H), 7.80 (d, *J* = 8.2 Hz, 2H), 7.63-7.57 (m, 4H), 7.53-7.49 (m, 2H), 7.41 (t, *J* = 7.4 Hz, 1H), 7.34 (t, *J* = 7.4 Hz, 1H), 7.26 (s, 1H), 7.24 (s, 1H), 7.09 (d, *J* = 7.7 Hz, 1H), 6.96 (d, *J* = 11.2 Hz, 2H), 6.71 (s, 1H), 6.62 (dd, *J* = 8.5, 2.2 Hz, 1H), 6.29 (d, *J* = 2.2 Hz, 1H), 5.88-5.87 (m, 2H), 5.84 (s, 1H), 3.73 (s, 3H), 2.39 (s, 3H);

^{13}C NMR (101 MHz, $CDCl_3$): δ 175.2, 161.0, 150.2, 148.7, 146.4, 145.4, 145.1, 144.1, 139.3, 134.5, 134.3, 130.9, 130.0, 129.9, 128.9, 128.7, 128.3, 127.2, 126.6, 125.8, 125.3, 123.0, 122.1, 120.4, 108.0, 107.0, 105.8, 102.0, 97.7, 87.4, 75.7, 55.4, 21.7;

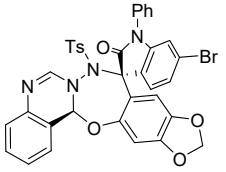
IR (neat): *v* 3466, 2968, 2928, 1626, 1533, 1351, 1262, 1095, 1022, 801 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{37}H_{28}N_4O_7S$: 673.1751; found: 673.1757;

$[\alpha]_D^{20}$ = -165.0 (*c* = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 22.22 min, 0.5%; t_{R2} = 38.84 min, 99.5%).

(*3R,15a'S*)-6-bromo-1-phenyl-8'-tosyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3ha)



White solid, isolated yield 62% (44 mg);

m.p.: 202.5-202.9 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.25 (d, J = 8.2 Hz, 1H), 7.80 (d, J = 8.2 Hz, 2H), 7.66-7.62 (m, 2H), 7.57-7.49 (m, 4H), 7.42 (t, J = 7.1 Hz, 1H), 7.35 (t, J = 7.4 Hz, 1H), 7.28-7.26 (m, 1H), 7.26-7.24 (m, 2H), 7.09 (d, J = 7.7 Hz, 1H), 6.96 (s, 1H), 6.91 (s, 1H), 6.86 (s, 1H), 6.69 (s, 1H), 5.88 (s, 2H), 5.85 (s, 1H), 2.40 (s, 3H);

^{13}C NMR (101 MHz, $CDCl_3$) δ 174.6, 149.9, 149.1, 146.5, 145.6, 145.4, 143.8, 139.2, 134.1, 133.9, 131.0, 130.2, 129.93, 129.91, 129.2, 128.8, 128.3, 127.2, 126.8, 126.7, 125.9, 125.6, 123.4, 121.0, 120.2, 113.6, 107.0, 105.9, 102.1, 87.5, 75.5, 21.7;

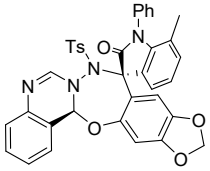
IR (neat): v 3642, 2901, 2856, 1856, 1658, 1521, 1284, 1010, 874, 812 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{36}H_{25}BrN_4O_6S$: 721.0751; found: 721.0749;

$[\alpha]_D^{20}$ = -50.3 (c = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 24.96 min, 1.4%; t_{R2} = 28.10 min, 98.6%).

***(3R,15a'S)*-4-methyl-1-phenyl-8'-tosyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3ia)**



White solid, isolated yield 71% (46 mg);

m.p.: 157.5-157.8 °C;

^{1}H NMR (400 MHz, $CDCl_3$) δ 8.27 (d, J = 6.9 Hz, 1H), 7.77 (d, J = 8.2 Hz, 2H), 7.63-7.49 (m, 6H), 7.41 (t, J = 7.4 Hz, 1H), 7.34 (m, 1H), 7.24 (d, J = 8.2 Hz, 2H), 7.10-7.05 (m, 1H), 7.03-7.00 (m, 2H), 6.97 (d, J = 6.0 Hz, 2H), 6.75 (s, 1H), 5.88-5.84 (m, 3H), 2.38 (s, 3H), 1.69 (s, 3H);

^{13}C NMR (101 MHz, $CDCl_3$): δ 176.4, 150.2, 148.8, 146.4, 145.4, 145.1, 139.6, 139.3, 137.2, 134.4, 133.5, 132.1, 130.8, 129.8, 129.4, 129.1, 129.0, 128.8, 128.5, 128.3, 126.6, 125.8, 123.7, 121.9, 121.2, 120.4, 107.0, 105.9, 102.0, 87.5, 76.0, 21.7, 18.8;

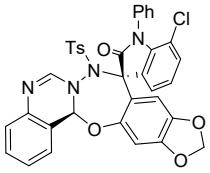
IR (neat): v 3641, 2930, 1741, 1704, 1625, 1544, 1458, 1347, 1174, 993 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{37}H_{28}N_4O_6S$: 657.1802; found: 657.1795;

$[\alpha]_D^{20}$ = -46.0 (c = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 10.82 min, 5.6%; t_{R2} = 52.36 min, 94.4%).

(*3S,15a'S*)-4-chloro-1-phenyl-8'-tosyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3ja)



White solid, isolated yield 73% (49 mg);

m.p.: 205.9-206.3 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.31 (d, J = 8.2 Hz, 1H), 7.80 (d, J = 8.3 Hz, 2H), 7.66-7.62 (m, 2H), 7.57-7.49 (m, 4H), 7.42 (t, J = 7.5 Hz, 1H), 7.35-7.32 (m, 1H), 7.28 (s, 1H), 7.26 (s, 1H), 7.10-7.08 (m, 2H), 6.97 (s, 1H), 6.91 (s, 1H), 6.72 (d, J = 1.8 Hz, 1H), 6.69 (s, 1H), 5.89 (s, 2H), 5.85 (s, 1H), 2.40 (s, 3H);

^{13}C NMR (101 MHz, $CDCl_3$) δ 174.7, 149.9, 149.1, 146.5, 145.6, 145.4, 143.8, 139.2, 135.4, 134.1, 133.9, 131.0, 130.2, 129.9, 129.4, 129.2, 128.8, 128.3, 127.2, 126.7, 125.9, 125.3, 123.9, 121.1, 120.2, 110.8, 107.0, 105.9, 102.1, 87.5, 75.4, 21.7;

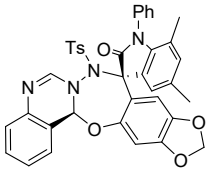
IR (neat): v 3579, 2930, 2860, 1458, 1348, 1263, 1176, 1017, 857, 803 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{36}H_{25}ClN_4O_6S$: 677.1256; found: 677.1252;

$[\alpha]_D^{20}$ = -146.0 (c = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 30/70; flow rate = 1.0 mL/min; t_{R1} = 39.70 min, 0.2%; t_{R2} = 43.93 min, 99.8%).

(*3R,15a'S*)-5,7-dimethyl-1-phenyl-8'-tosyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3ka)



White solid, isolated yield 75% (50 mg);

m.p.: 195.4-195.9 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.03 (s, 1H), 7.76 (d, J = 8.4 Hz, 2H), 7.62-7.50 (m, 6H), 7.41 (td, J = 7.5, 1.4 Hz, 1H), 7.34 (td, J = 7.4, 1.2 Hz, 1H), 7.24 (d, J = 8.2 Hz, 2H), 7.09 (d, J = 7.6 Hz, 1H), 6.99 (d, J = 13.2 Hz, 2H), 6.82 (s, 1H), 6.75 (s, 1H), 5.89 (s, 1H), 5.88 (d, J = 1.4 Hz, 1H), 5.84 (d, J = 1.4 Hz, 1H), 2.38 (s, 3H), 2.33 (s, 3H), 1.65 (s, 3H);

^{13}C NMR (101 MHz, $CDCl_3$): δ 176.3, 150.3, 148.7, 146.3, 145.4, 145.0, 139.3, 137.3, 134.5, 134.1, 133.2, 132.1, 130.8, 129.8, 129.7, 129.4, 129.0, 128.8, 128.4, 128.3, 126.5, 125.8, 122.5, 122.2, 120.8, 120.4, 107.0, 105.9, 102.0, 87.5, 76.2, 21.7, 21.1, 18.6;

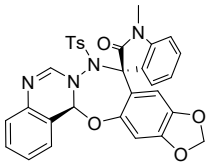
IR (neat): v 3469, 2912, 2854, 1562, 1318, 1263, 1107, 1017, 956, 823 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{38}H_{30}N_4O_6S$: 671.1959; found: 677.1961;

$[\alpha]_D^{20}$ = -78.1 (*c* = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 8.58 min, 2.4%; t_{R2} = 44.90 min, 97.6%).

(*3R,15a'S*)-1-methyl-8'-tosyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3la)



White solid, isolated yield 77% (44 mg);

m.p.: 187.7-187.9 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.27 (d, *J* = 7.6 Hz, 1H), 7.77 (d, *J* = 8.3 Hz, 2H), 7.49 (dd, *J* = 7.6, 1.3 Hz, 1H), 7.41-7.26 (m, 5H), 7.12-7.08 (m, 2H), 6.98 (s, 1H), 6.90 (d, *J* = 8.3 Hz, 2H), 6.55 (s, 1H), 5.85 (s, 2H), 5.80 (d, *J* = 1.4 Hz, 1H), 3.44 (s, 3H), 2.40 (s, 3H);

^{13}C NMR (101 MHz, $CDCl_3$) δ 174.9, 150.2, 148.7, 146.5, 145.3, 145.1, 142.0, 139.2, 134.5, 131.3, 130.8, 129.8, 129.7, 128.7, 128.2, 126.6, 125.8, 124.0, 123.5, 121.5, 120.4, 108.9, 107.1, 105.7, 102.0, 87.4, 75.9, 27.1, 21.7.;

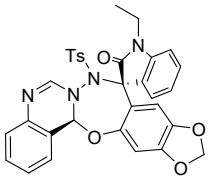
IR (neat): *v* 3521, 2864, 2791, 1554, 1385, 1172, 1075, 1042, 908, 707 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{31}H_{24}N_4O_6S$: 581.1489; found: 581.1484;

$[\alpha]_D^{20}$ = -168.0 (*c* = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 18.57 min, 4.6%; t_{R2} = 29.39 min, 95.4%).

(*3R,15a'S*)-1-ethyl-8'-tosyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3ma)



White solid, isolated yield 73% (43 mg);

m.p.: 186.4-186.7 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.30 (d, *J* = 7.6 Hz, 1H), 7.79 (d, *J* = 8.2 Hz, 2H), 7.49 (d, *J* = 7.2 Hz, 1H), 7.41-7.37 (m, 1H), 7.33-7.28 (m, 4H), 7.10-7.07 (m, 2H), 6.96 (s, 1H), 6.92-6.89 (m, 2H), 6.54 (s, 1H), 5.85 (s, 2H), 5.80 (s, 1H), 4.10-4.02 (m, 1H), 3.96-3.87 (m, 1H), 2.40 (s, 3H), 1.45 (t, *J* = 7.2 Hz, 3H);

^{13}C NMR (101 MHz, $CDCl_3$) δ 174.5, 150.2, 148.7, 146.6, 145.3, 145.1, 141.0, 139.3, 134.5, 131.6, 130.8, 129.8, 129.7, 128.7, 128.3, 126.6, 125.8, 124.2, 123.4, 121.7, 120.4, 109.0, 107.0, 105.8, 102.0, 87.4, 75.9, 35.6, 21.7, 12.3;

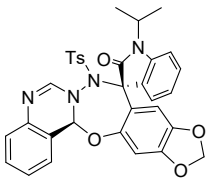
IR (neat): ν 3457, 2930, 2861, 1454, 1401, 1270, 1175, 1022, 808, 757 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{32}H_{26}N_4O_6S$: 595.1646; found: 595.1645;

$[\alpha]_D^{20}$ = -125.1 (c = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 13.22 min, 4.6%; t_{R2} = 46.42 min, 95.4%).

(*3R,15a'S*)-1-isopropyl-8'-tosyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3na)



White solid, isolated yield 73% (44 mg);

m.p.: 203.5-203.8 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.31 (d, J = 7.6 Hz, 1H), 7.78 (d, J = 8.3 Hz, 2H), 7.48 (dd, J = 7.5, 1.2 Hz, 1H), 7.41 (td, J = 7.5, 1.5 Hz, 1H), 7.33-7.28 (m, 4H), 7.10-6.99 (m, 4H), 6.88 (s, 1H), 6.55 (s, 1H), 5.85-5.84 (m, 2H), 5.80 (d, J = 1.3 Hz, 1H), 4.77-4.70 (m, 1H), 2.40 (s, 3H), 1.70 (dd, J = 16.0, 7.0 Hz, 6H);

^{13}C NMR (101 MHz, $CDCl_3$) δ 174.6, 150.3, 148.7, 146.6, 145.4, 145.1, 140.9, 139.4, 134.6, 131.8, 130.9, 129.8, 129.5, 128.8, 128.3, 126.6, 125.9, 124.3, 123.1, 122.0, 120.4, 110.2, 106.9, 105.8, 102.0, 87.5, 75.7, 45.2, 21.8, 19.6, 19.0;

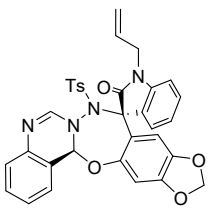
IR (neat): ν 3457, 2929, 2859, 1609, 1483, 1467, 1408, 1354, 1264, 753 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{33}H_{28}N_4O_6S$: 609.1802; found: 609.1789;

$[\alpha]_D^{20}$ = -96.7 (c = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 8.64 min, 4.4%; t_{R2} = 18.48 min, 95.6%).

(*3R,15a'S*)-1-allyl-8'-tosyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3oa)



White solid, isolated yield 71% (43 mg);

m.p.: 185.2-185.6 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.30 (d, J = 7.6 Hz, 1H), 7.78 (d, J = 8.2 Hz, 2H), 7.49 (d, J = 7.4 Hz, 1H), 7.41 (t, J = 7.4 Hz, 1H), 7.34-7.28 (m, 4H), 7.11-7.08 (m, 2H), 6.94 (s, 2H), 6.89 (d, J = 7.8 Hz, 1H), 6.55 (s, 1H), 6.03-5.94 (m, 1H), 5.85 (s, 2H), 5.81 (s, 1H), 5.46 (d, J = 17.2 Hz, 1H), 5.33 (d, J = 10.4 Hz, 1H), 4.63-4.52 (m, 2H), 2.40 (s, 3H);

^{13}C NMR (101 MHz, $CDCl_3$) δ 174.6, 150.1, 148.8, 146.6, 145.4, 145.1, 141.1, 139.3, 134.5, 131.4, 131.1, 130.9, 129.8, 129.6, 128.7, 128.3, 126.6, 125.8, 124.0, 123.6, 121.6, 120.4, 118.1, 109.8, 107.0, 105.8, 102.0, 87.5, 76.0, 43.2, 21.7;

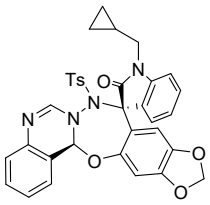
IR (neat): v 3450, 2929, 2861, 1635, 1537, 1460, 1352, 1270, 1174, 756 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{33}H_{26}N_4O_6S$: 607.1646; found: 607.1634;

$[\alpha]_D^{20}$ = -96.0 (c = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 15.39 min, 4.1%; t_{R2} = 43.28 min, 95.9%).

(*3R,15a'S*)-1-(cyclopropylmethyl)-8'-tosyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3pa)



White solid, isolated yield 71% (44 mg);

m.p.: 213.4-213.6 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.31 (d, J = 7.6 Hz, 1H), 7.80 (d, J = 8.3 Hz, 2H), 7.50 (dd, J = 7.5, 1.1 Hz, 1H), 7.41 (td, J = 7.5, 1.4 Hz, 1H), 7.33-7.28 (m, 4H), 7.11-7.08 (m, 2H), 6.98-6.95 (m, 3H), 6.60 (s, 1H), 5.86 (s, 1H), 5.84 (d, J = 1.3 Hz, 1H), 5.79 (d, J = 1.3 Hz, 1H), 3.84 (d, J = 7.3 Hz, 2H), 2.40 (s, 3H), 1.35-1.2 (m, 1H), 0.70-0.62 (m, 2H), 0.58-0.56 (m, 2H);

^{13}C NMR (101 MHz, $CDCl_3$) δ 174.8, 150.1, 148.7, 146.5, 145.3, 145.0, 141.4, 139.3, 134.5, 131.5, 130.8, 129.7, 129.6, 128.7, 128.3, 126.5, 125.8, 124.0, 123.4, 121.7, 120.4, 109.1, 107.0, 105.7, 101.9, 87.4, 76.0, 45.3, 29.6, 21.7, 9.6, 4.1;

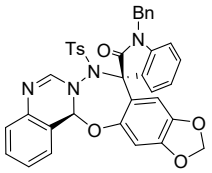
IR (neat): v 3449, 2930, 1625, 1532, 1351, 1264, 1176, 1019, 855, 753 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{34}H_{28}N_4O_6S$: 621.1802; found: 621.1810;

$[\alpha]_D^{20}$ = -88.0 (c = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 13.09 min, 6.3%; t_{R2} = 25.31 min, 93.7%).

(*3R,15a'S*)-1-benzyl-8'-tosyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3qa)



White solid, isolated yield 72% (47 mg);

m.p.: 165.1-165.4 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.33 (d, J = 7.6 Hz, 1H), 7.79 (d, J = 8.3 Hz, 2H), 7.50-7.47 (m, 3H), 7.41-7.26 (m, 7H), 7.23 (td, J = 7.7, 1.1 Hz, 1H), 7.10-7.06 (m, 2H), 6.98 (d, J = 11.2 Hz, 2H), 6.77 (d, J = 7.7 Hz, 1H), 6.56 (s, 1H), 5.86-5.84 (m, 2H), 5.81 (d, J = 1.4 Hz, 1H), 5.26 (d, J = 15.9 Hz, 1H), 5.12 (d, J = 15.9 Hz, 1H), 2.40 (s, 3H);

^{13}C NMR (101 MHz, $CDCl_3$) δ 175.0, 150.1, 148.8, 146.5, 145.4, 145.1, 141.2, 139.3, 135.3, 134.4, 131.4, 130.8, 129.8, 129.6, 128.9, 128.7, 128.3, 127.7, 127.3, 126.6, 125.8, 124.0, 123.6, 121.7, 120.4, 109.9, 107.0, 105.8, 102.0, 87.5, 76.0, 44.8, 21.7;

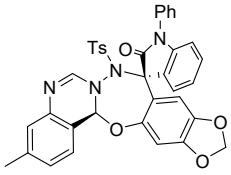
IR (neat): ν 3461, 2928, 2859, 1662, 1626, 1607, 1408, 1382, 1264, 857 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{37}H_{28}N_4O_6S$: 657.1802; found: 657.1798;

$[\alpha]_D^{20}$ = -108.0 (c = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 23.14 min, 4.6%; t_{R2} = 36.25 min, 95.4%).

(*3R,15a'S*)-3'-methyl-1-phenyl-8'-tosyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3ab)



White solid, isolated yield 74% (48 mg);

m.p.: 188.6-188.9 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.37 (d, J = 7.0 Hz, 1H), 7.79 (d, J = 8.3 Hz, 2H), 7.64-7.57 (m, 4H), 7.53-7.49 (m, 1H), 7.39 (d, J = 7.8 Hz, 1H), 7.24-7.22 (m, 3H), 7.15-7.10 (m, 2H), 6.95 (s, 1H), 6.93 (s, 1H), 6.89 (s, 1H), 6.75 (d, J = 7.2 Hz, 2H), 5.92 (s, 1H), 5.88 (d, J = 1.4 Hz, 1H), 5.84 (d, J = 1.4 Hz, 1H), 2.39 (s, 3H), 2.36 (s, 3H);

^{13}C NMR (101 MHz, $CDCl_3$) δ 174.8, 150.2, 148.8, 146.6, 145.4, 145.1, 142.6, 141.1, 139.1, 134.4, 131.0, 129.9 (2C), 129.8, 129.6, 128.81, 128.75, 128.1, 127.6, 127.2, 126.2, 124.3, 123.9, 121.7, 117.5, 110.2, 107.1, 106.0, 102.0, 87.5, 76.0, 21.7, 21.3;

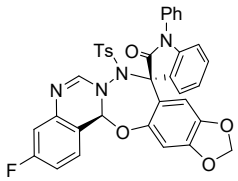
IR (neat): *v* 3449, 2932, 2863, 1637, 1477, 1448, 1377, 1270, 756, 656 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{37}H_{28}N_4O_6S$: 657.1802; found: 657.1795;

$[\alpha]_D^{20}$ = -181.7 (*c* = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 8.10 min, 92.3%; t_{R2} = 10.30 min, 7.7%).

(*3R,15a'S*)-3'-fluoro-1-phenyl-8'-tosyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3ac)



White solid, isolated yield 74% (48 mg);

m.p.: 217.9-217.3 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.33 (d, *J* = 7.6 Hz, 1H), 7.79 (d, *J* = 8.0 Hz, 2H), 7.64-7.57 (m, 4H), 7.54-7.45 (m, 2H), 7.27 (s, 1H), 7.26-7.22 (m, 2H), 7.14 (t, *J* = 7.6 Hz, 1H), 7.06-7.00 (m, 2H), 6.92 (s, 1H), 6.80-6.73 (m, 3H), 5.90-5.89 (m, 2H), 5.85 (s, 1H), 2.40 (s, 3H);

^{13}C NMR (101 MHz, $CDCl_3$) δ 174.7, 165.1 (d, *J* = 250.0 Hz), 151.1, 149.0, 146.3, 145.6, 145.3, 142.6, 141.3 (d, *J* = 11.6 Hz), 134.4, 134.3, 130.8, 130.0, 129.9, 129.8, 129.7, 128.9, 128.7, 127.2, 124.3, 124.0, 121.6, 116.5 (d, *J* = 2.8 Hz), 114.2 (d, *J* = 22.7 Hz), 112.4 (d, *J* = 22.4 Hz), 110.2, 107.2, 105.8, 102.1, 87.0, 76.0, 21.7;

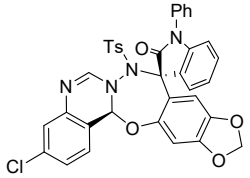
IR (neat): *v* 3447, 2928, 2859, 1728, 1664, 1602, 1382, 1264, 857, 753 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{36}H_{25}FN_4O_6S$: 661.1552; found: 661.1554;

$[\alpha]_D^{20}$ = -163.0 (*c* = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel AD; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 26.03 min, 99.9%; t_{R2} = 37.46 min, 0.1%).

(*3R,15a'S*)-3'-chloro-1-phenyl-8'-tosyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3ad)



White solid, isolated yield 75% (50 mg);

m.p.: 156.9-156.4 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.32 (d, J = 7.6 Hz, 1H), 7.78 (d, J = 8.2 Hz, 2H), 7.64-7.57 (m, 4H), 7.53-7.50 (m, 1H), 7.44 (d, J = 8.2 Hz, 1H), 7.31-7.27 (m, 2H), 7.26-7.22 (m, 2H), 7.14-7.08 (m, 2H), 6.99 (s, 1H), 6.91 (s, 1H), 6.75-6.73 (m, 2H), 5.92 (s, 1H), 5.89 (s, 1H), 5.86 (s, 1H), 2.40 (s, 3H);

^{13}C NMR (101 MHz, $CDCl_3$) δ 174.6, 151.1, 149.0, 146.3, 145.6, 145.3, 142.6, 140.5, 136.5, 134.4, 134.3, 130.80, 129.98, 129.9, 129.8, 129.4, 128.9, 128.7, 127.2, 126.8, 125.8, 124.2, 124.0, 121.6, 118.8, 110.2, 107.2, 105.8, 102.1, 86.9, 76.0, 21.7;

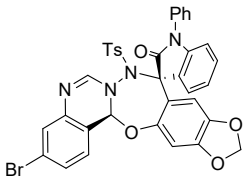
IR (neat): v 3451, 2930, 2860, 1732, 1606, 1350, 1270, 1174, 858, 756 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{36}H_{25}ClN_4O_6S$: 677.1256; found: 677.1252;

$[\alpha]_D^{20}$ = -102.3 (c = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 9.30 min, 95.6%; t_{R2} = 12.84 min, 4.4%).

(*3R,15a'S*)-3'-bromo-1-phenyl-8'-tosyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3ae)



White solid, isolated yield 74% (53 mg);

m.p.: 144.5-144.8 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.32 (d, J = 7.4 Hz, 1H), 7.78 (d, J = 8.3 Hz, 2H), 7.64-7.57 (m, 4H), 7.53-7.50 (m, 1H), 7.46 (dd, J = 8.2, 1.8 Hz, 1H), 7.37 (d, J = 8.2 Hz, 1H), 7.27 (s, 1H), 7.26-7.22 (m, 3H), 7.13 (t, J = 7.3 Hz, 1H), 6.98 (s, 1H), 6.90 (s, 1H), 6.75-6.73 (m, 2H), 5.93 (s, 1H), 5.89 (s, 1H), 5.86 (s, 1H), 2.40 (s, 3H) ;

^{13}C NMR (101 MHz, $CDCl_3$) δ 174.6, 151.1, 149.0, 146.3, 145.6, 145.3, 142.6, 140.6, 134.3, 134.2, 130.8, 130.0, 129.9, 129.8, 129.63, 129.58, 128.9, 128.8, 128.7, 127.2, 124.5, 124.2, 124.0, 121.5, 119.3, 110.2, 107.2, 105.8, 102.1, 86.9, 75.9, 21.7;

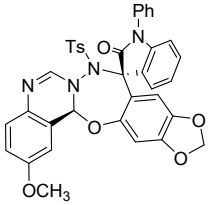
IR (neat): v 3453, 2928, 2859, 1609, 1409, 1383, 1351, 1264, 1176, 752 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{36}H_{25}BrN_4O_6S$: 721.0751; found: 721.0749;

$[\alpha]_D^{20}$ = -146.7 (c = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 8.61 min, 98.8%; t_{R2} = 11.48 min, 1.2%).

(*3R,15a'S*)-2'-methoxy-1-phenyl-8'-tosyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3af)



White solid, isolated yield 72% (48 mg);

m.p.: 184.1-184.7 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.37 (d, J = 7.2 Hz, 1H), 7.79 (d, J = 8.3 Hz, 2H), 7.64-7.57 (m, 4H), 7.53-7.50 (m, 1H), 7.26-7.22 (m, 3H), 7.13 (t, J = 7.0 Hz, 1H), 7.04-6.93 (m, 4H), 6.88 (s, 1H), 6.75-6.73 (m, 2H), 5.96 (s, 1H), 5.88 (d, J = 1.2 Hz, 1H), 5.84 (d, J = 1.2 Hz, 1H), 3.90 (s, 3H), 2.39 (s, 3H);

^{13}C NMR (101 MHz, $CDCl_3$) δ 174.8, 158.0, 148.9, 148.2, 146.5, 145.5, 145.1, 142.6, 134.45, 134.43, 133.0, 131.0, 129.9, 129.8, 129.6, 128.8, 128.7, 127.2 (2C), 124.3, 123.9, 121.7, 121.3, 117.4, 111.9, 110.2, 107.0, 105.8, 102.0, 87.6, 76.0, 55.6, 21.7;

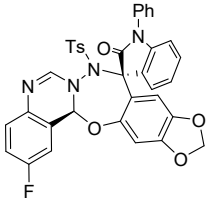
IR (neat): v 3432, 2935, 2817, 1884, 1721, 1484, 1261, 1194, 1036, 834 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{37}H_{28}N_4O_7S$: 673.1751; found: 673.1757;

$[\alpha]_D^{20}$ = -158.0 (c = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 13.78 min, 11.8%; t_{R2} = 24.04 min, 88.2%).

(*3R,15a'S*)-2'-fluoro-1-phenyl-8'-tosyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3ag)



White solid, isolated yield 71% (46 mg);

m.p.: 209.1-209.5 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.32 (d, J = 7.5 Hz, 1H), 7.78 (d, J = 8.2 Hz, 2H), 7.64-7.57 (m, 4H), 7.53-7.50 (m, 1H), 7.27 (s, 1H), 7.26-7.18 (m, 3H), 7.14-7.08 (m, 3H), 6.96 (s, 1H), 6.88 (s, 1H), 6.75-6.73 (m, 2H), 5.94 (s, 1H), 5.89 (s, 1H), 5.85 (s, 1H), 2.40 (s, 3H);

^{13}C NMR (101 MHz, $CDCl_3$) δ 174.7, 161.8 (d, J = 248.1 Hz), 149.6, 149.0, 146.3, 145.6, 145.3, 142.6, 135.8 (d, J = 2.8 Hz), 134.42, 134.39, 130.8, 130.0, 129.9, 129.8, 128.9, 128.7, 127.9 (d, J = 8.3 Hz), 127.2, 124.3, 124.0, 121.8 (d, J = 8.0 Hz), 121.7, 118.4 (d, J = 22.7 Hz), 114.5 (d, J = 23.6 Hz), 110.2, 107.1, 105.8, 102.1, 86.9, 76.0, 21.7;

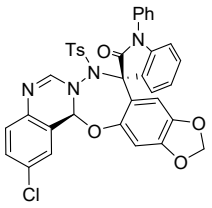
IR (neat): v 3457, 2930, 2862, 1448, 1377, 1348, 1270, 1175, 858, 757 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{36}H_{25}FN_4O_6S$: 661.1552; found: 661.1554;

$[\alpha]_D^{20}$ = -102.7 (*c* = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 15.61 min, 1.5%; t_{R2} = 29.44 min, 98.5%).

(*3R*,*15a'S*)-2'-chloro-1-phenyl-8'-tosyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3ah)



White solid, isolated yield 70% (47 mg);

m.p.: 227.1-227.3 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.30 (d, *J* = 7.5 Hz, 1H), 7.77 (d, *J* = 8.2 Hz, 2H), 7.64-7.57 (m, 4H), 7.53-7.48 (m, 2H), 7.36 (dd, *J* = 8.5, 2.3 Hz, 1H), 7.27 (s, 1H), 7.26-7.23 (m, 2H), 7.14 (t, *J* = 7.5 Hz, 1H), 7.04-7.01 (m, 2H), 6.85 (s, 1H), 6.75-6.73 (m, 2H), 5.96 (s, 1H), 5.89 (d, *J* = 1.0 Hz, 1H), 5.86 (d, *J* = 1.0 Hz, 1H), 2.40 (s, 3H);

^{13}C NMR (101 MHz, $CDCl_3$) δ 174.7, 150.5, 149.0, 146.3, 145.6, 145.3, 142.6, 138.0, 134.41, 134.38, 131.7, 131.1, 130.8, 130.0, 129.9, 129.8, 128.9, 128.7, 128.0, 127.4, 127.2, 124.3, 124.0, 121.8, 121.6, 110.3, 107.2, 105.8, 102.1, 86.7, 76.0, 21.7;

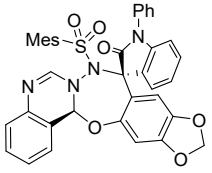
IR (neat): *v* 3451, 2930, 2860, 1667, 1606, 1350, 1270, 1174, 1020, 756 cm^{-1}

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{36}H_{25}ClN_4O_6S$: 677.1256; found: 677.1252;

$[\alpha]_D^{20}$ = -44.3 (*c* = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 14.19 min, 5.5%; t_{R2} = 17.20 min, 94.5%).

(*3R*,*15a'S*)-8'-(mesitylsulfonyl)-1-phenyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3ai)



White solid, isolated yield 75% (50 mg);

m.p.: 156.2-154.4 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.39 (d, *J* = 8.4 Hz, 1H), 7.62-7.56 (m, 4H), 7.51-7.38 (m, 3H), 7.33-7.29 (m, 2H), 7.26-7.21 (m, 1H), 7.15-7.08 (m, 2H), 6.88 (s, 3H), 6.76 (d, *J* = 7.2 Hz, 2H), 5.91 (s, 1H), 5.86 (s, 1H), 5.83 (s, 1H), 2.57-2.43 (m, 6H), 2.25 (s, 3H);

^{13}C NMR (101 MHz, $CDCl_3$) δ 173.9, 150.5, 148.8, 146.6, 145.5, 144.0, 142.7, 141.4, 139.3, 134.3, 132.5, 131.3, 130.9, 130.1, 129.83, 129.80, 128.7, 128.0, 127.2, 126.6, 125.9, 125.5, 123.6, 121.8, 120.2, 110.0, 107.6, 105.7, 102.0, 87.0, 76.0, 22.9, 21.0;

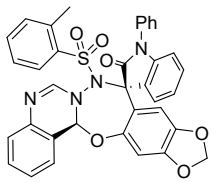
IR (neat): *v* 3460, 2929, 2859, 1353, 1244, 1172, 1093, 993, 804, 666 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{38}H_{30}N_4O_6S$: 671.1959; found: 671.1956;

$[\alpha]_D^{20}$ = -167.0 (*c* = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 9.84 min, 6.3%; t_{R2} = 23.44 min, 93.7%).

(*3R*,*15a'S*)-1-phenyl-8'-(o-tolylsulfonyl)-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3aj)



White solid, isolated yield 72% (46 mg);

m.p.: 209.8-210.2 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.36 (d, *J* = 7.6 Hz, 1H), 7.88 (d, *J* = 9.0 Hz, 1H), 7.64-7.58 (m, 4H), 7.52-7.41 (m, 4H), 7.35-7.30 (m, 2H), 7.25-7.22 (m, 2H), 7.14-7.10 (m, 2H), 7.00 (s, 1H), 6.95 (s, 1H), 6.76 (d, *J* = 7.8 Hz, 1H), 6.73 (s, 1H), 5.90 (s, 1H), 5.87 (d, *J* = 1.4 Hz, 1H), 5.84 (d, *J* = 1.4 Hz, 1H), 2.51 (s, 3H);

^{13}C NMR (101 MHz, $CDCl_3$): δ 174.3, 150.0, 148.9, 146.6, 145.5, 142.7, 139.3, 139.2, 135.8, 134.4, 134.1, 132.9, 131.0, 130.8, 130.4, 129.9, 129.8, 128.8, 128.2, 127.2, 126.9, 126.7, 126.0, 124.7, 123.8, 121.6, 120.2, 110.1, 107.3, 105.8, 102.0, 87.2, 76.0, 20.9;

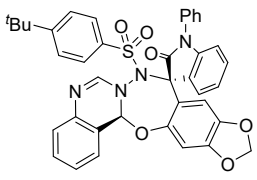
IR (neat): *v* 3529, 2939, 2819, 1829, 1636, 1382, 1312, 1153, 1067, 759 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{36}H_{26}N_4O_6S$: 643.1646; found: 643.1639;

$[\alpha]_D^{20}$ = -179.3 (*c* = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 11.24 min, 5.3%; t_{R2} = 28.22 min, 94.7%).

(*3R*,*15a'S*)-8'-((4-(tert-butyl)phenyl)sulfonyl)-1-phenyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3ak)



White solid, isolated yield 70% (47 mg);

m.p.: 192.8-193.2 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.36 (d, J = 7.5 Hz, 1H), 7.83 (d, J = 8.6 Hz, 2H), 7.64-7.58 (m, 4H), 7.53-7.46 (m, 4H), 7.42 (t, J = 7.5 Hz, 1H), 7.35 (t, J = 7.5 Hz, 1H), 7.24-7.22 (m, 1H), 7.14-7.09 (m, 2H), 7.04 (s, 1H), 6.93 (s, 1H), 6.75-6.73 (m, 2H), 5.88-5.87 (m, 2H), 5.84 (d, J = 1.4 Hz, 1H), 1.30 (s, 9H);

^{13}C NMR (101 MHz, $CDCl_3$) δ 174.7, 158.0, 150.2, 148.9, 146.6, 145.5, 142.6, 139.3, 134.4, 131.1, 130.9, 129.9, 129.7, 128.8, 128.6, 128.3, 127.2, 126.6, 126.2, 125.8, 124.3, 123.9, 121.7, 120.4, 110.2, 107.1, 105.9, 102.0, 87.5, 76.0, 35.3, 31.0;

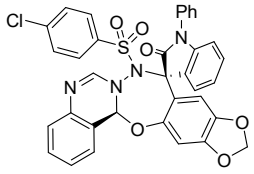
IR (neat): v 3450, 2930, 2861, 1668, 1606, 1353, 1268, 1174, 1021, 757 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{39}H_{32}N_4O_6S$: 685.2115; found: 685.2106;

$[\alpha]_D^{20}$ = -150.0 (c = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IDA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 6.17 min, 4.9%; t_{R2} = 11.81 min, 95.1%).

(*3R*,*15a'S*)-8'-((4-chlorophenyl)sulfonyl)-1-phenyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3al)



White solid, isolated yield 78% (51 mg);

m.p.: 220.8-221.4 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.36 (d, J = 7.2 Hz, 1H), 7.78 (d, J = 8.6 Hz, 2H), 7.64-7.52 (m, 8H), 7.44 (td, J = 7.5, 1.4 Hz, 1H), 7.37 (td, J = 7.5, 1.1 Hz, 1H), 7.26-7.23 (m, 1H), 7.15-7.10 (m, 2H), 6.98 (d, J = 13.4 Hz, 2H), 6.76-6.73 (m, 2H), 5.90 (s, 1H), 5.88 (d, J = 1.2 Hz, 1H), 5.84 (d, J = 1.2 Hz, 1H);

^{13}C NMR (101 MHz, $CDCl_3$) δ 174.7, 149.8, 149.0, 146.5, 145.6, 142.5, 139.1, 136.4, 134.3, 132.5, 131.0, 130.8, 130.2, 130.0, 129.8, 129.5, 128.9, 128.3, 127.1, 126.8, 125.9, 124.2, 124.0, 121.3, 120.2, 110.3, 107.0, 105.9, 102.1, 87.5, 76.2;

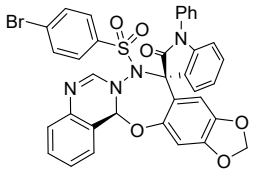
IR (neat): v 3460, 2918, 2867, 1583, 1462, 1225, 1074, 1041, 853, 725 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{35}H_{23}ClN_4O_6S$: 663.1100; found: 663.1110;

$[\alpha]_D^{20}$ = -158.7 (c = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 10.49 min, 2.4%; t_{R2} = 40.12 min, 97.6%)

(*3R,15a'S*)-8'-((4-bromophenyl)sulfonyl)-1-phenyl-8'*H*,15a'*H*-spiro[indoline-3,9'-[1,3]dioxolo[4'',5'':4',5']benzo[1',2':6,7][1,3,4]oxadiazepino[3,2-*c*]quinazolin]-2-one (3am)



White solid, isolated yield 62% (43 mg);

m.p.: 220.3-220.5 °C;

^{1}H NMR (400 MHz, $CDCl_3$): δ 8.36 (d, J = 7.2 Hz, 1H), 7.86 (d, J = 8.7 Hz, 2H), 7.64-7.50 (m, 6H), 7.45-7.40 (m, 3H), 7.37 (td, J = 7.4, 1.1 Hz, 1H), 7.27-7.23 (m, 1H), 7.15-7.10 (m, 2H), 6.96 (d, J = 5.3 Hz, 2H), 6.75-6.73 (m, 2H), 5.90-5.88 (m, 2H), 5.85 (d, J = 1.3 Hz, 1H);

^{13}C NMR (101 MHz, $CDCl_3$) δ 174.7, 149.8, 149.0, 146.6, 145.6, 142.5, 140.8, 139.1, 135.9, 134.3, 131.0, 130.8, 130.2, 130.0, 129.8, 129.6, 128.9, 128.3, 127.1, 126.8, 126.0, 124.2, 124.0, 121.4, 120.3, 110.3, 107.1, 105.9, 102.1, 87.5, 76.2;

IR (neat): v 3467, 2928, 2859, 1482, 1371, 1244, 1173, 851, 703, 673 cm^{-1};

HRMS (ESI): m/z $[M + H]^+$ calcd. for $C_{35}H_{23}BrN_4O_6S$: 707.0594; found: 707.0588;

$[\alpha]_D^{20}$ = -179.7 (c = 0.1, CH_2Cl_2);

The enantiomeric ratio of the product was determined by HPLC (Column Daicel Chiracel IA; ^{i}PrOH/Hexane = 50/50; flow rate = 1.0 mL/min; t_{R1} = 10.38 min, 0.2%; t_{R2} = 36.44 min, 99.8%).

3. Reference

[1] J. Yan, P. Retailleau, C. Tran, and A. Hamze, Leveraging *in situ N*-tosylhydrazones as diazo surrogates for efficient access to pyrazolo-[1,5-*c*]quinazolinone derivatives, *Org. Biomol. Chem.,* 2024, **22**, 5816−5821.

[2] H. Shi, L. Wang, S.-S., Li, Y. Liu, and L. Xu, Divergent syntheses of spirooxindoles from oxindole-embedded four-membered synthon *via* cycloaddition reactions, *Org. Chem. Front*., 2020, **7**, 747−755.

[3] T. Wang, A. Shao, H. Feng, S. Yang, M. Gao, J. Tian, and A. Lei, An efficient [3+2] cycloaddition for the synthesis of substituted pyrazolo[1,5-*c*]quinazolines, *Tetrahedron Lett*., 2015, **71**, 4473−4477.

.

4. Crystallographic data of 3am

Single crystal of **3am** suitable for X-ray analysis was grown in dichloromethane/hexane at room temperature. Crystallographic data have been deposited with the Cambridge Crystallographic Data Centre as supplementary publication nos. CCDC-2390408 (**3am**), Copies of these data can be obtained free of charge from the Cambridge Crystallographic Data Centre via www.ccdc.cam.ac.uk/data_request/cif.

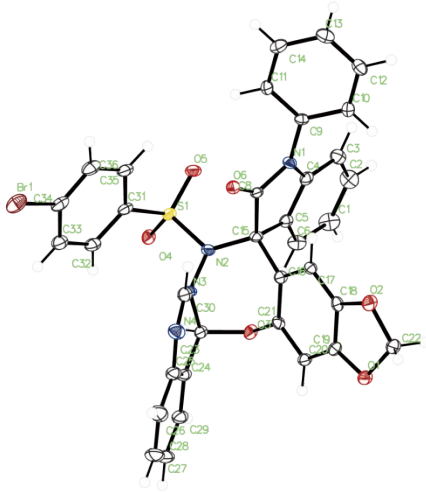


Figure S1. ORTEP drawing of **3am** with 30% thermal ellipsoids.

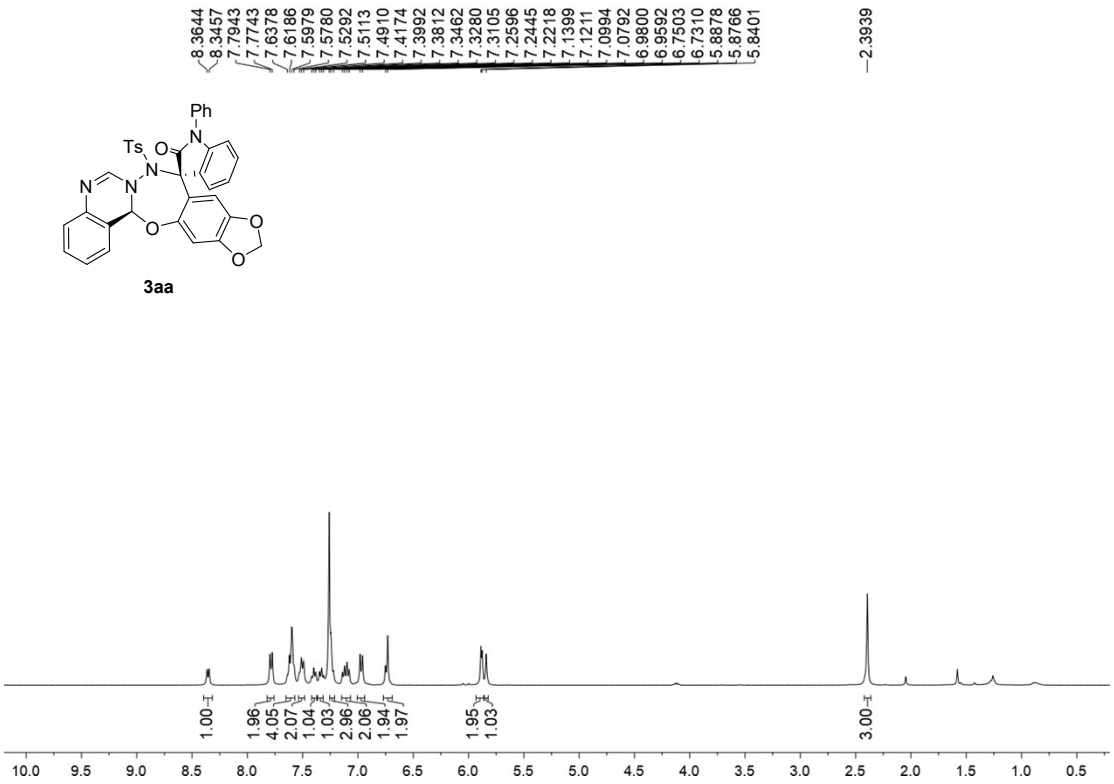
STable 1. Crystal data and structure refinement for **3am**.

Identification code	exp_4022
Empirical formula	$C_{93.33}H_{61.33}Br_{2.67}N_{10.67}O_{16}S_{2.67}$
Formula weight	1886.78
Temperature/K	100.01(10)
Crystal system	orthorhombic
Space group	$C222_1$
a/Å	11.76370(10)
b/Å	20.6560(2)
c/Å	26.7794(3)
α/°	90
β/°	90
γ/°	90
Volume/Å^3	6507.15(11)
Z	3
ρ_{calc}g/cm^3	1.444
μ/mm^{-1}	2.760
F(000)	2880.0
Crystal size/mm^3	0.2 × 0.2 × 0.05
Radiation	Cu Kα (λ = 1.54184)
2Θ range for data collection/°	6.602 to 144.09

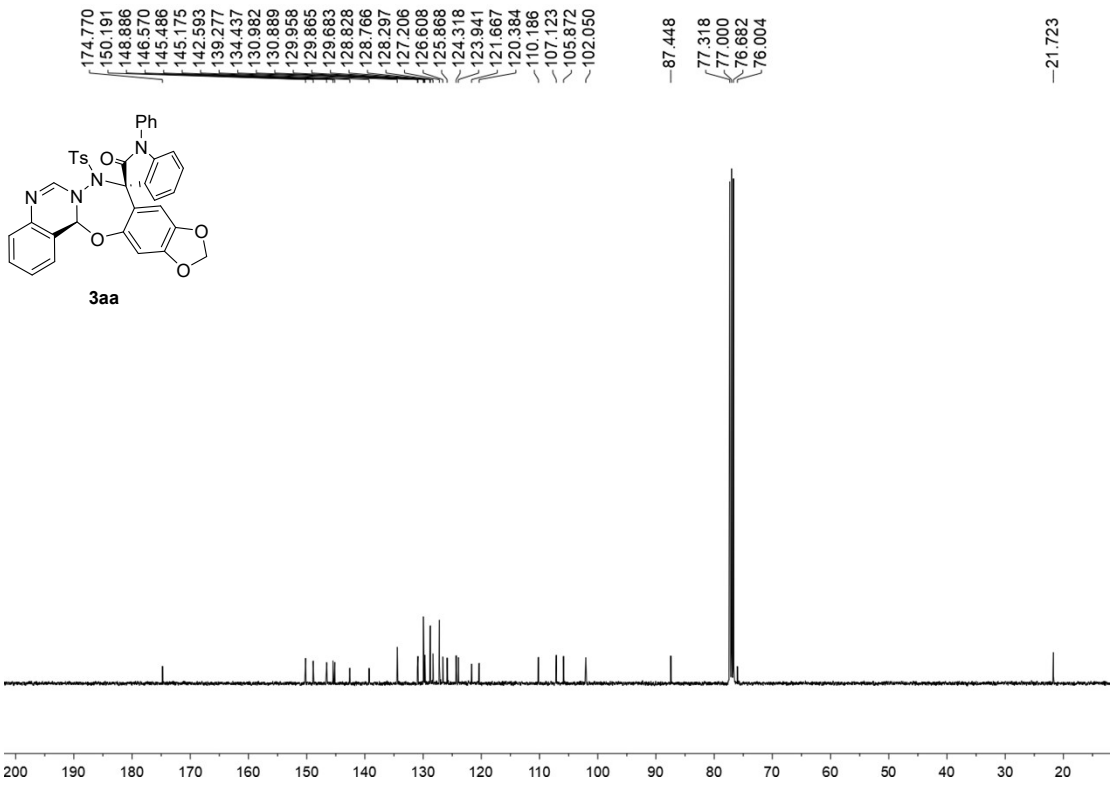
Index ranges	$-14 \leq h \leq 14$, $-25 \leq k \leq 25$, $-31 \leq l \leq 33$
Reflections collected	45604
Independent reflections	6390 [R_{int} = 0.0657, R_{sigma} = 0.0334]
Data/restraints/parameters	6390/0/189
Goodness-of-fit on F^2	2.666
Final R indexes [I>=2σ (I)]	R_1 = 0.0970, wR_2 = 0.2542
Final R indexes [all data]	R_1 = 0.0985, wR_2 = 0.2560
Largest diff. peak/hole / e $Å^{-3}$	2.72/-2.85

5. Copies of NMR spectra and HPLC chromatograms

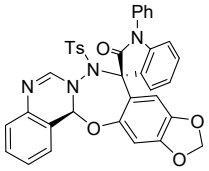
^{1}H NMR Spectrum of Compound **3aa** (400 MHz, $CDCl_3$)



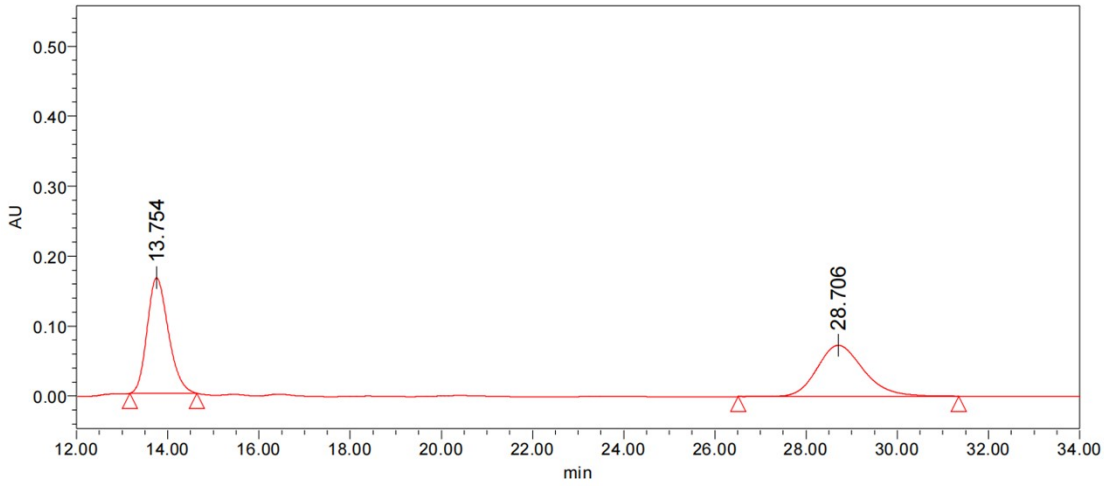
^{13}C{^{1}H} NMR Spectrum of Compound **3aa** (101 MHz, $CDCl_3$)



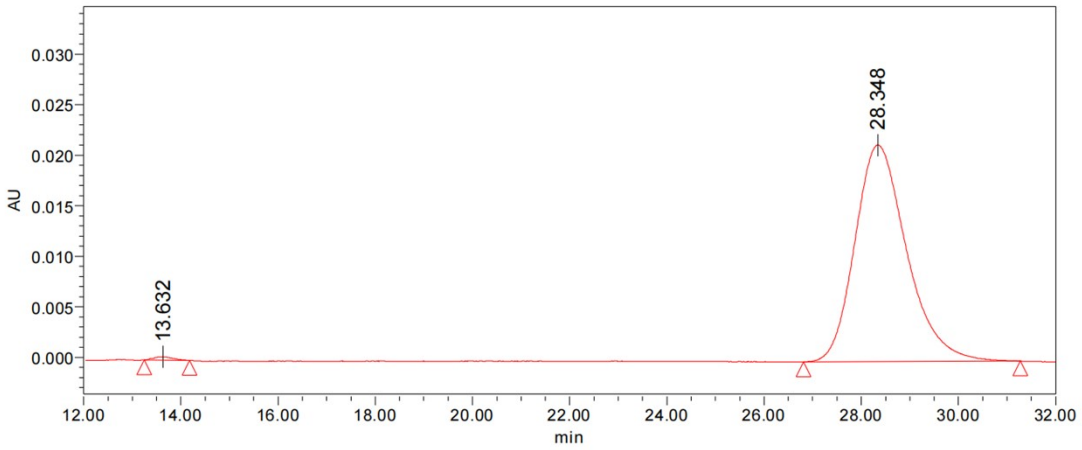
HPLC Spectra of Compound **3aa**



3aa

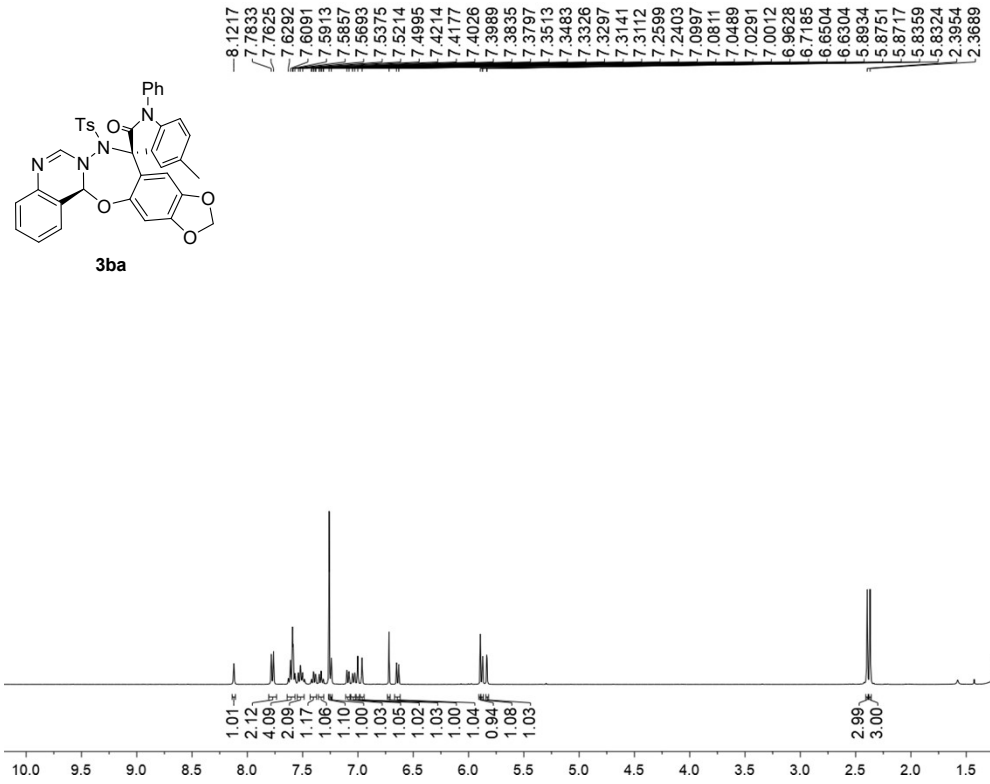


	RetTime [min]	Area [mAU*s]	Area%
1	13.754	5330454	50.75
2	28.706	5173736	49.25

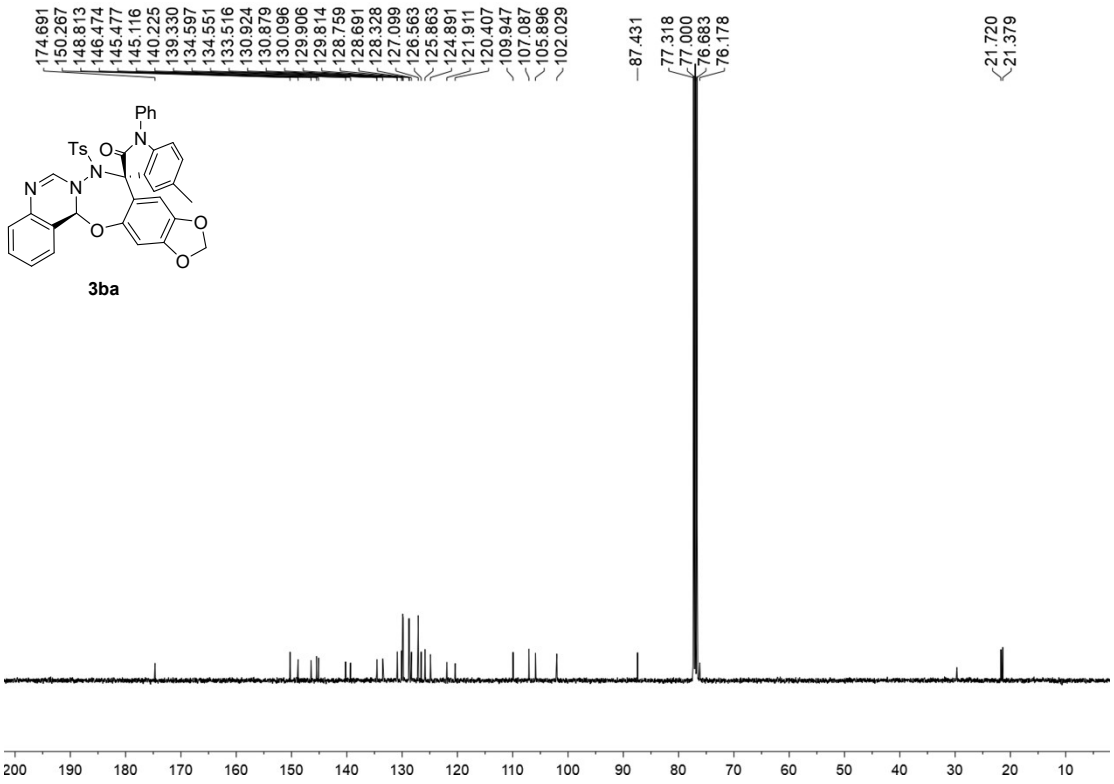


	RetTime [min]	Area [mAU*s]	Area%
1	13.632	9146	0.57
2	28.348	1585083	99.43

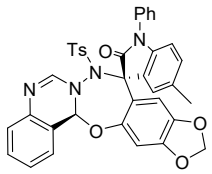
^{1}H NMR Spectrum of Compound **3ba** (400 MHz, $CDCl_3$)



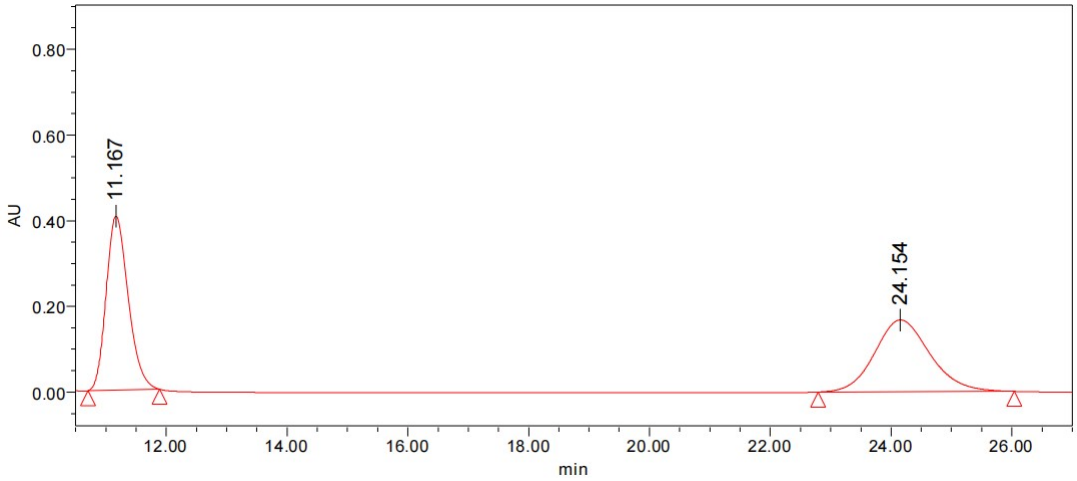
^{13}C{^{1}H} NMR Spectrum of Compound **3ba** (101 MHz, $CDCl_3$)



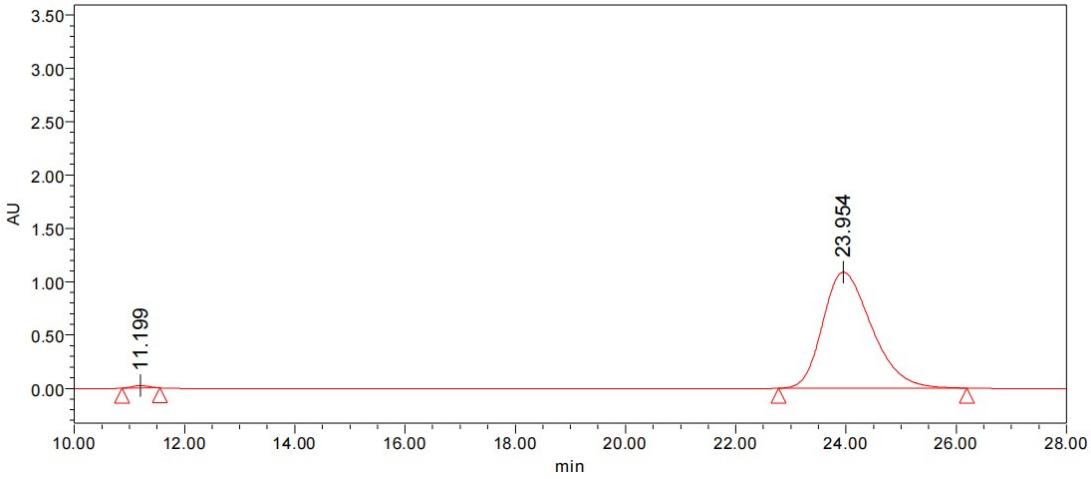
HPLC Spectra of Compound **3ba**



3ba

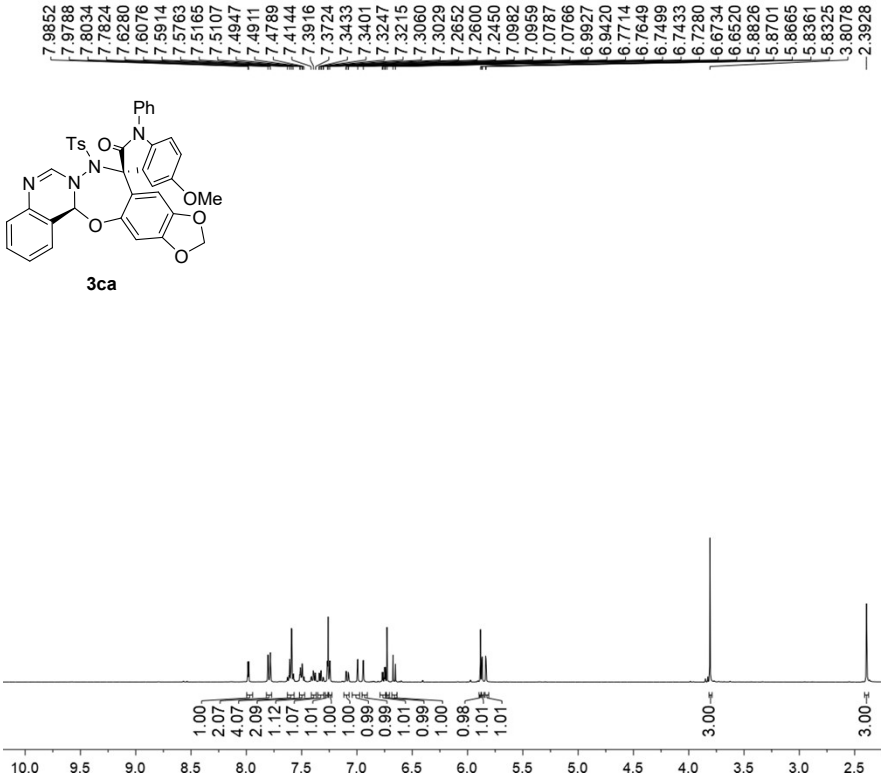


	RetTime [min]	Area [mAU*s]	Area%
1	11.167	10338491	49.23
2	24.154	10663374	50.77

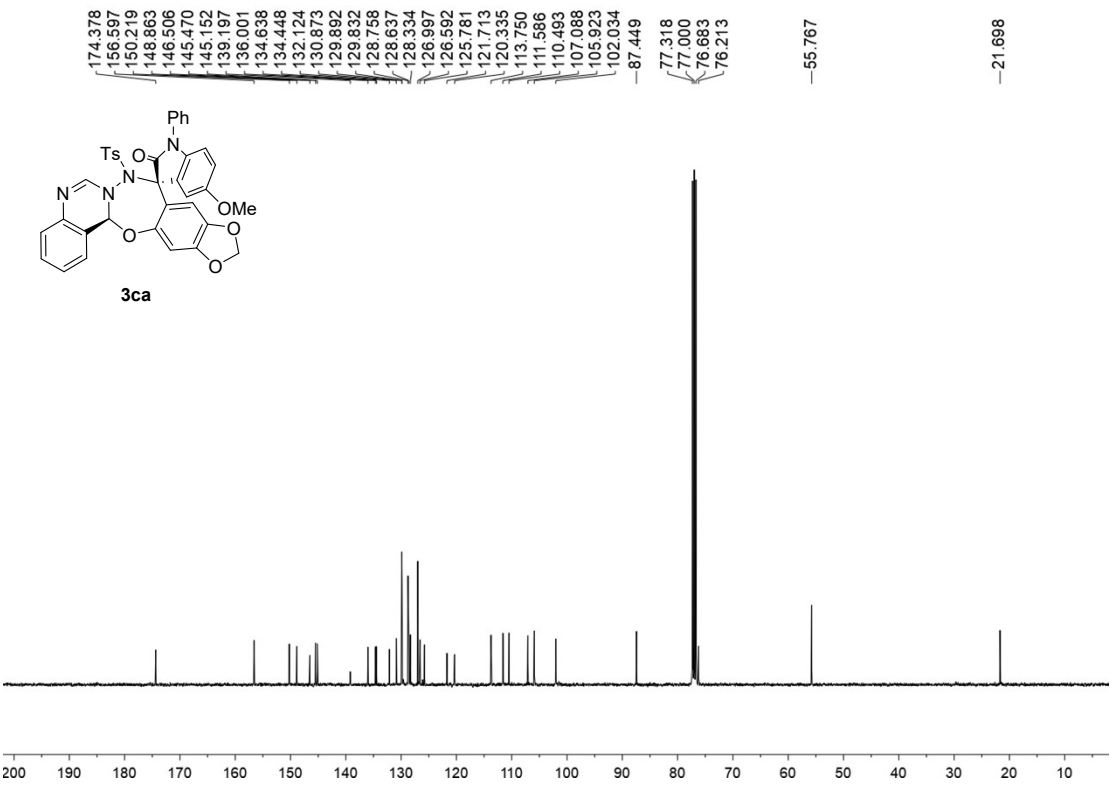


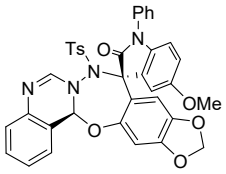
	RetTime [min]	Area [mAU*s]	Area%
1	11.199	476638	0.71
2	23.954	67032968	99.29

^{1}H NMR Spectrum of Compound **3ca** (400 MHz, $CDCl_3$)



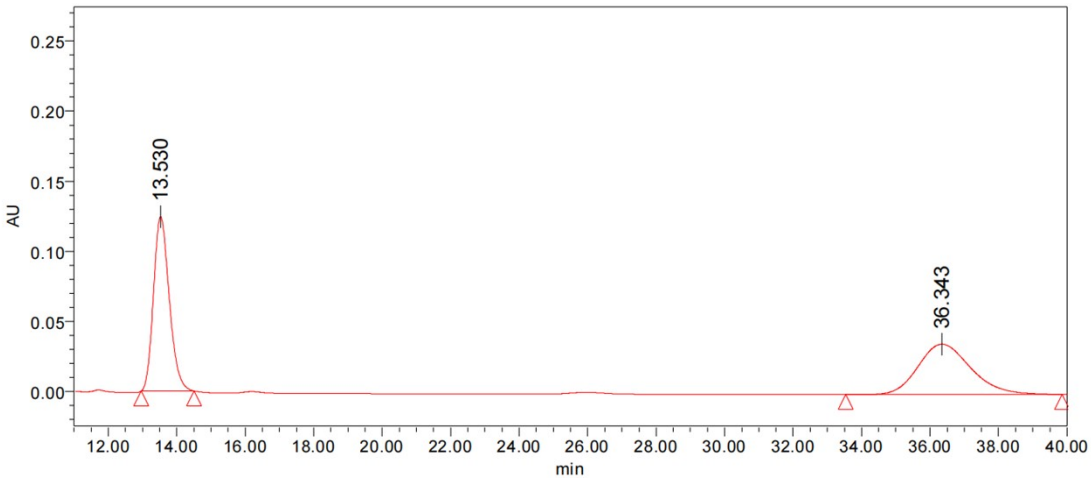
^{13}C{^{1}H} NMR Spectrum of Compound **3ca** (101 MHz, $CDCl_3$)



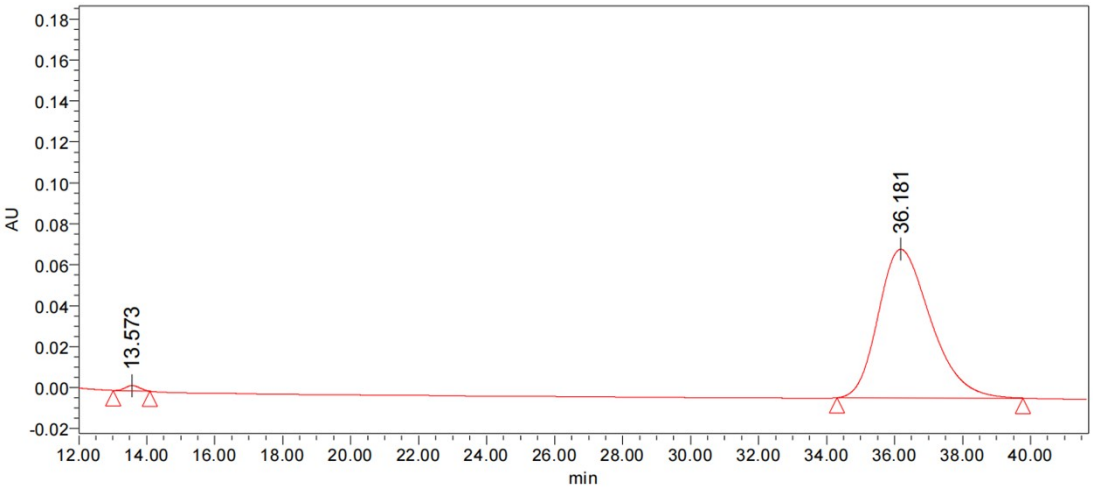


3ca

HPLC Spectra of Compound **3ca**

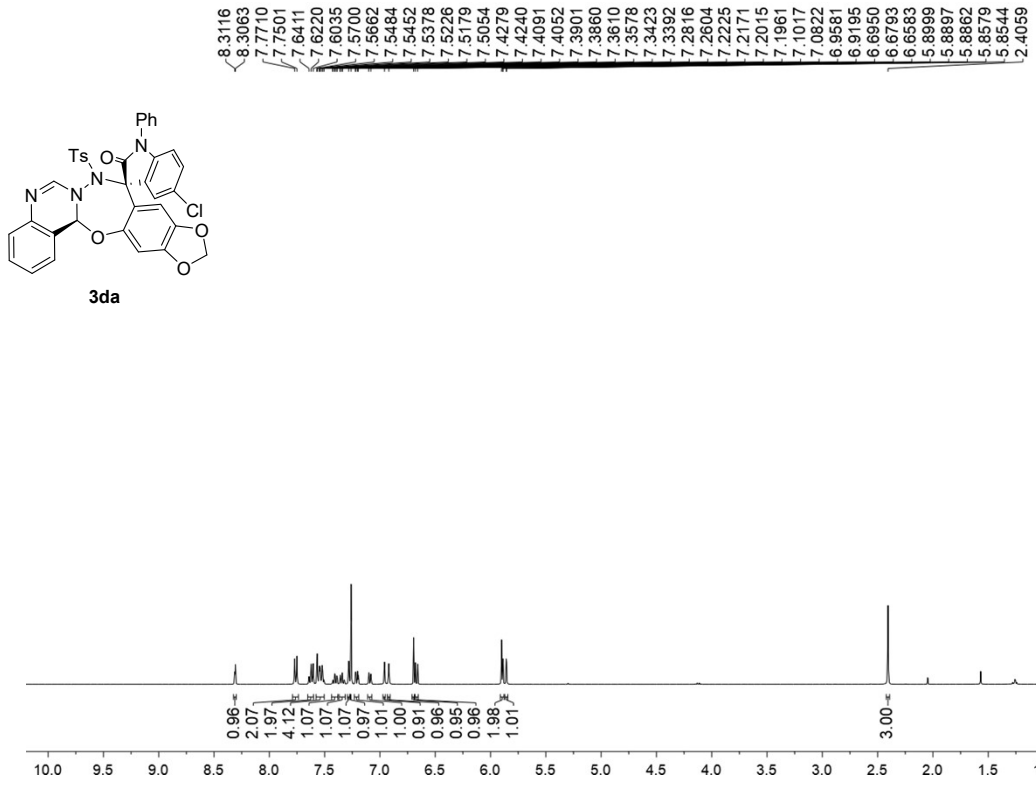


	RetTime [min]	Area [mAU*s]	Area%
1	13.530	3980312	50.97
2	36.343	3829580	49.03

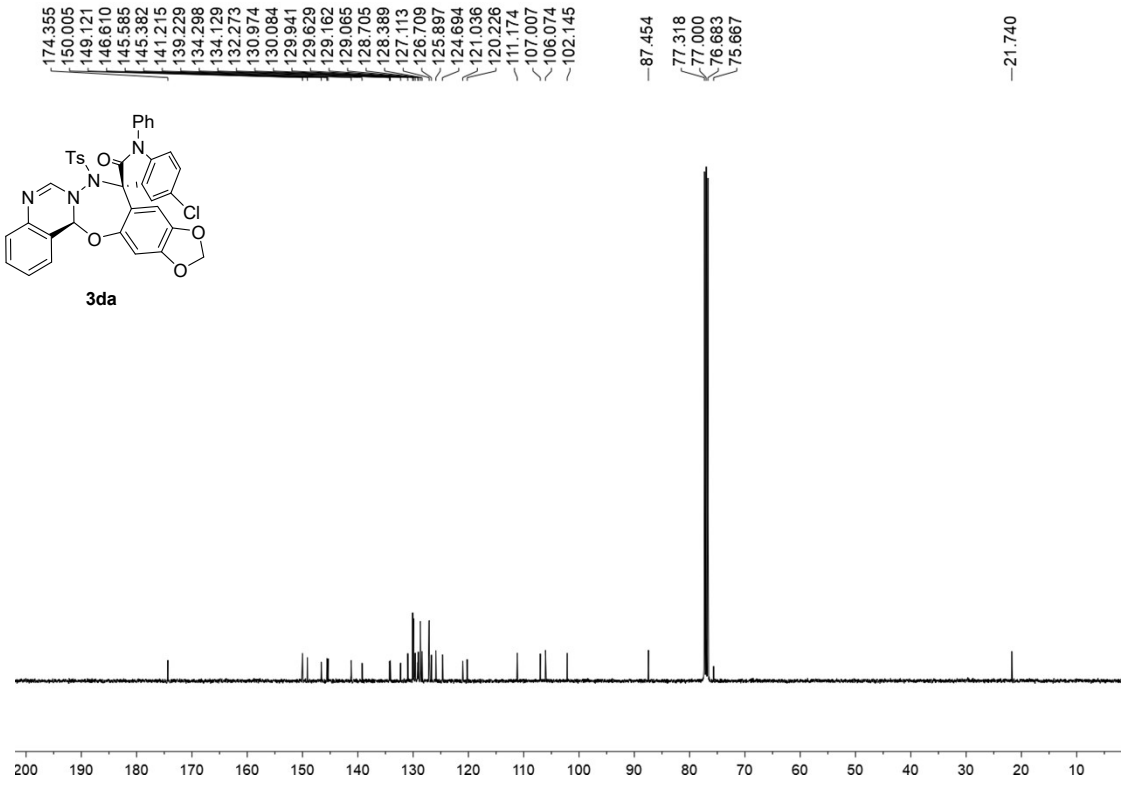


	RetTime [min]	Area [mAU*s]	Area%
1	13.573	75701	0.97
2	36.181	7748033	99.03

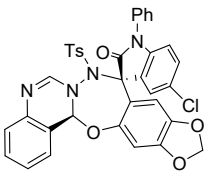
^{1}H NMR Spectrum of Compound **3da** (400 MHz, $CDCl_3$)



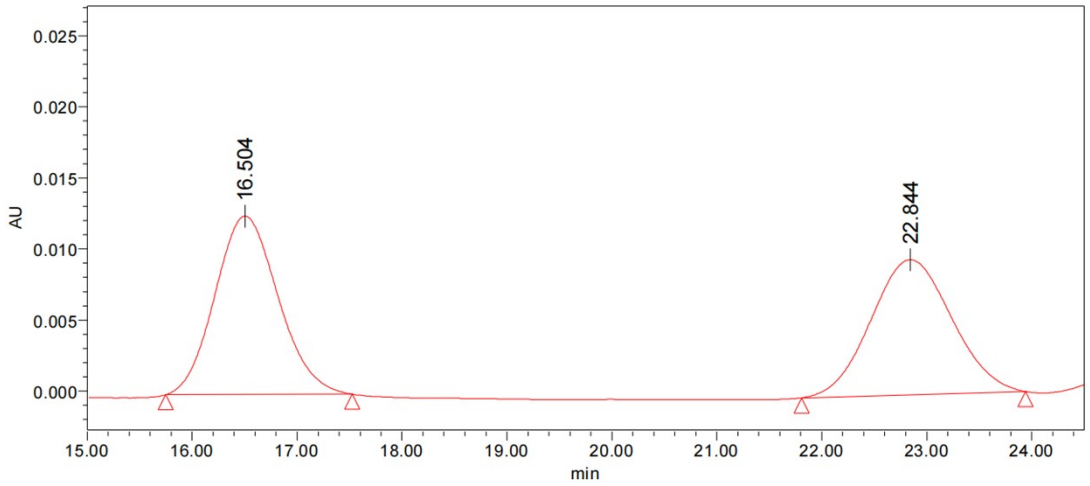
^{13}C{^{1}H} NMR Spectrum of Compound **3da** (101 MHz, $CDCl_3$)



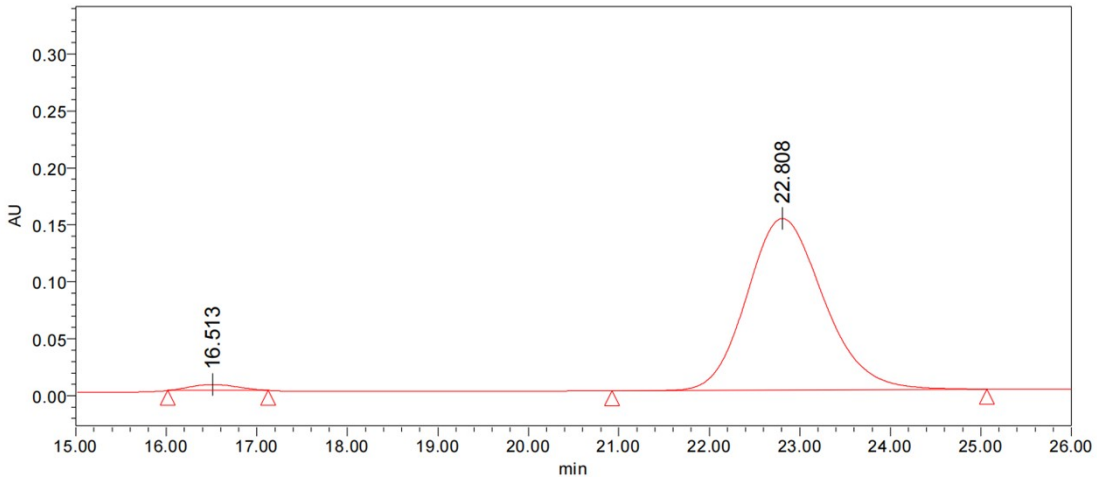
HPLC Spectra of Compound **3da**



3da

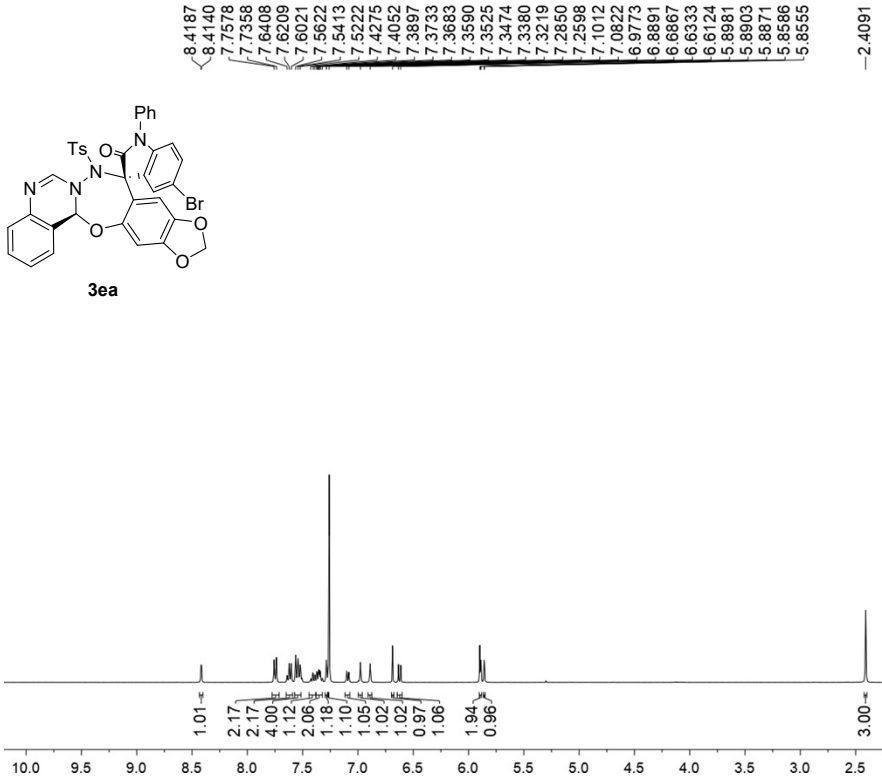


	RetTime [min]	Area [mAU*s]	Area%
1	16.504	525187	50.82
2	22.844	508286	49.18

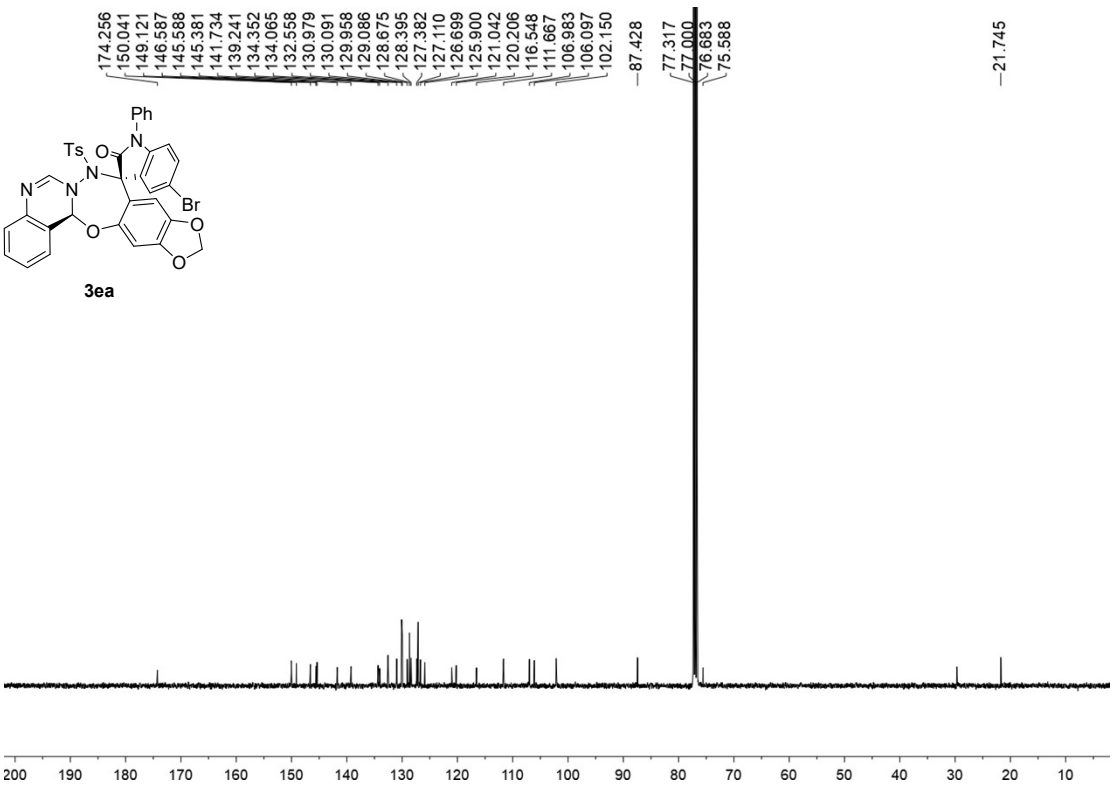


	RetTime [min]	Area [mAU*s]	Area%
1	16.513	187639	2.07
2	22.808	8885639	97.93

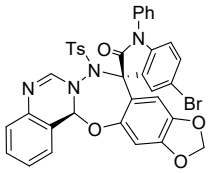
^{1}H NMR Spectrum of Compound **3ea** (400 MHz, $CDCl_3$)



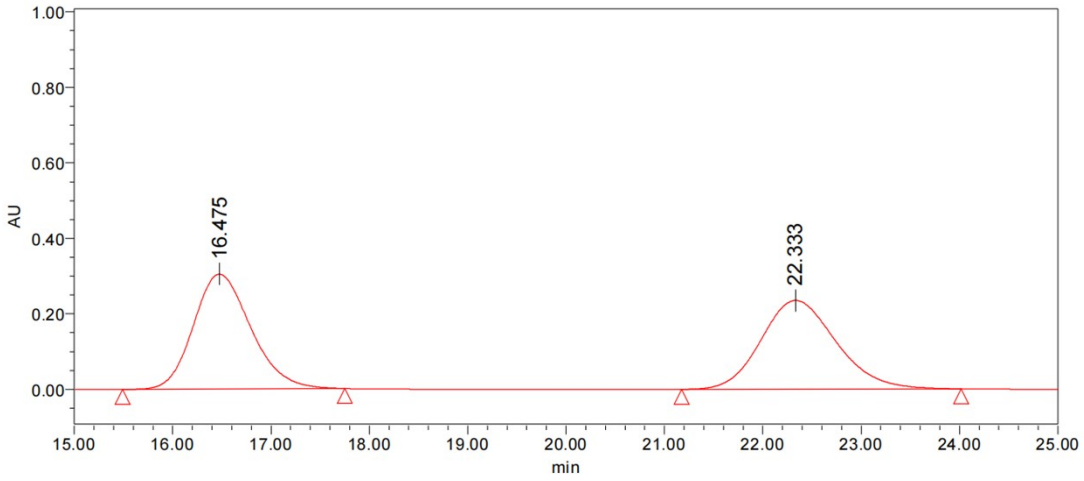
^{13}C{^{1}H} NMR Spectrum of Compound **3ea** (101 MHz, $CDCl_3$)



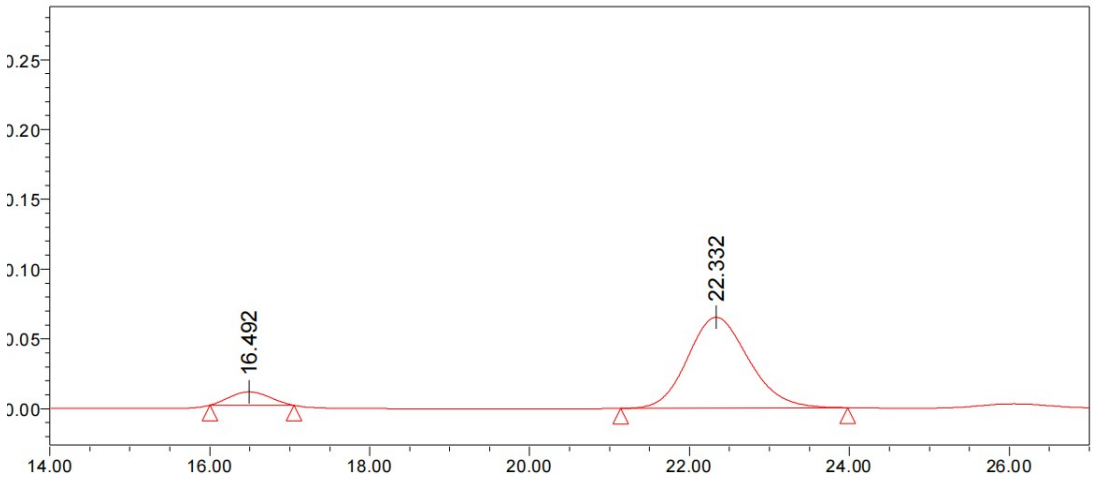
HPLC Spectra of Compound **3ea**



3ea

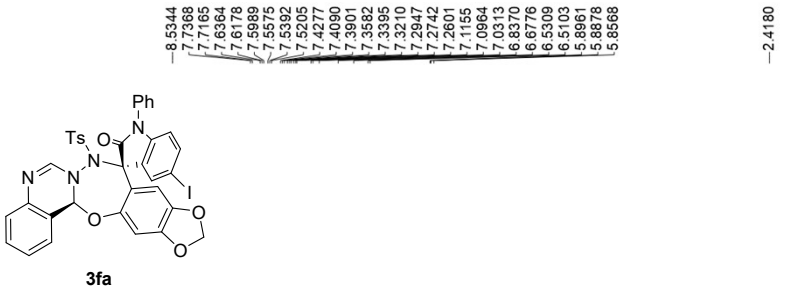


	RetTime [min]	Area [mAU*s]	Area%
1	16.475	12335663	49.71
2	22.333	12481146	50.29

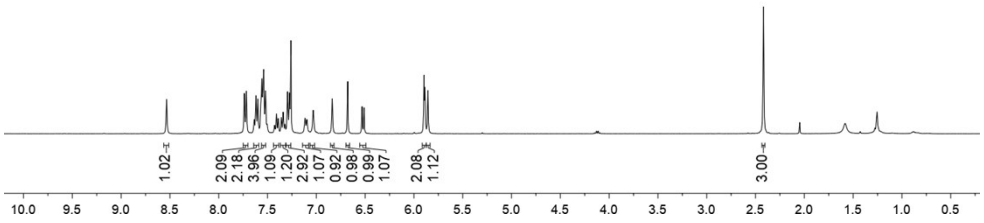


	RetTime [min]	Area [mAU*s]	Area%
1	16.492	329055	8.68
2	22.332	3460611	91.32

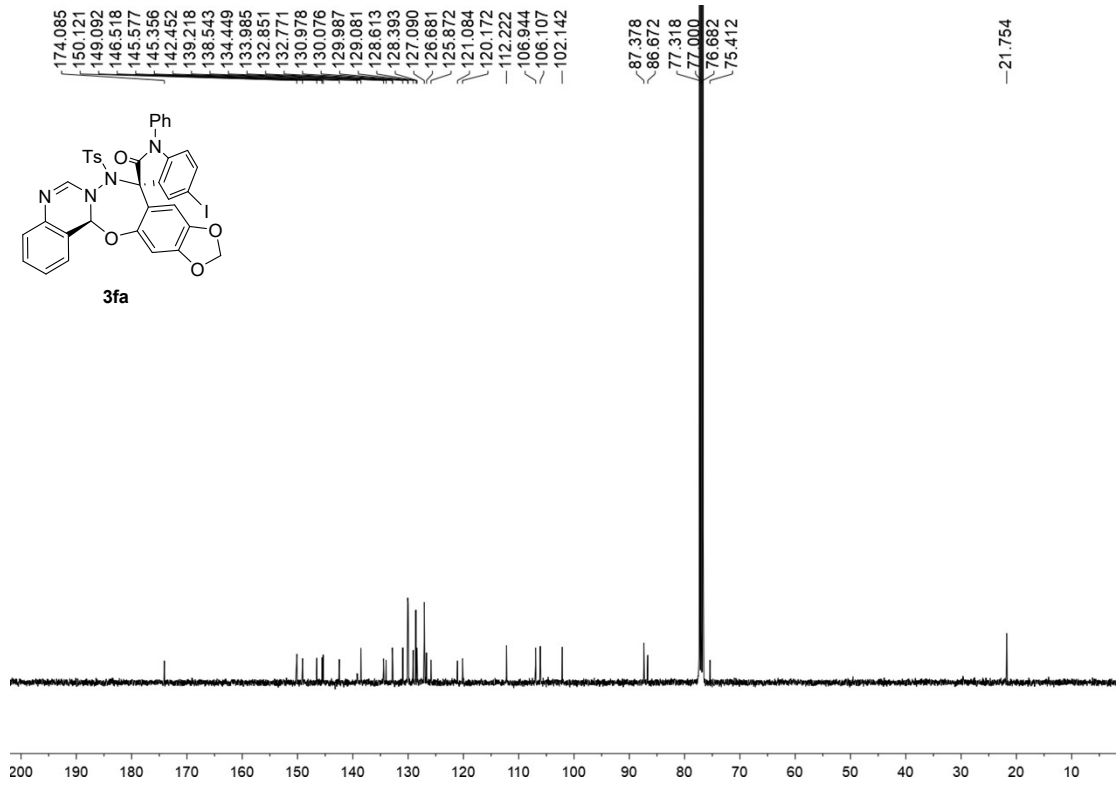
^{1}H NMR Spectrum of Compound **3fa** (400 MHz, $CDCl_3$)



3fa

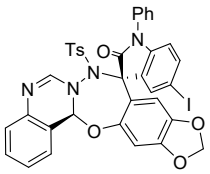


^{13}C{^{1}H} NMR Spectrum of Compound **3fa** (101 MHz, $CDCl_3$)

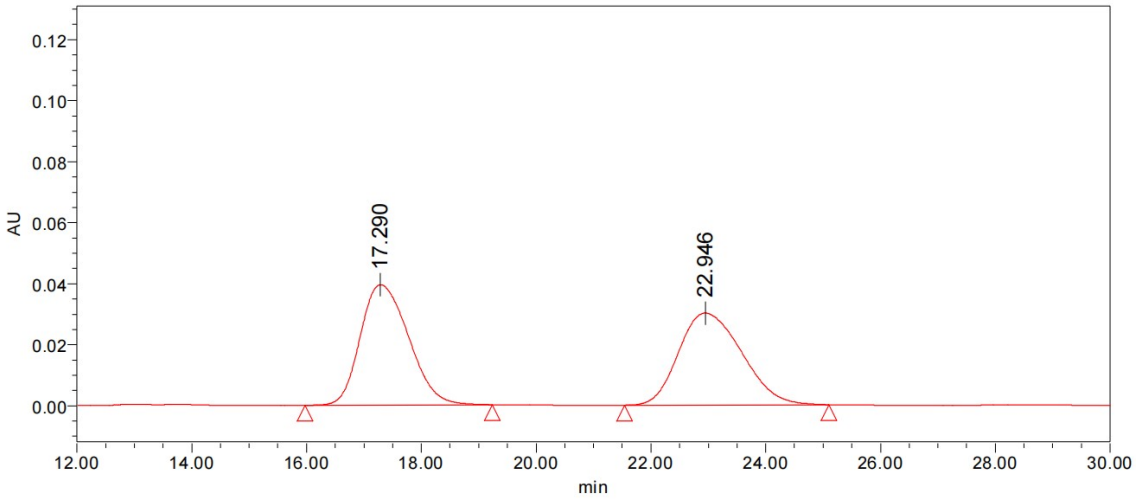


3fa

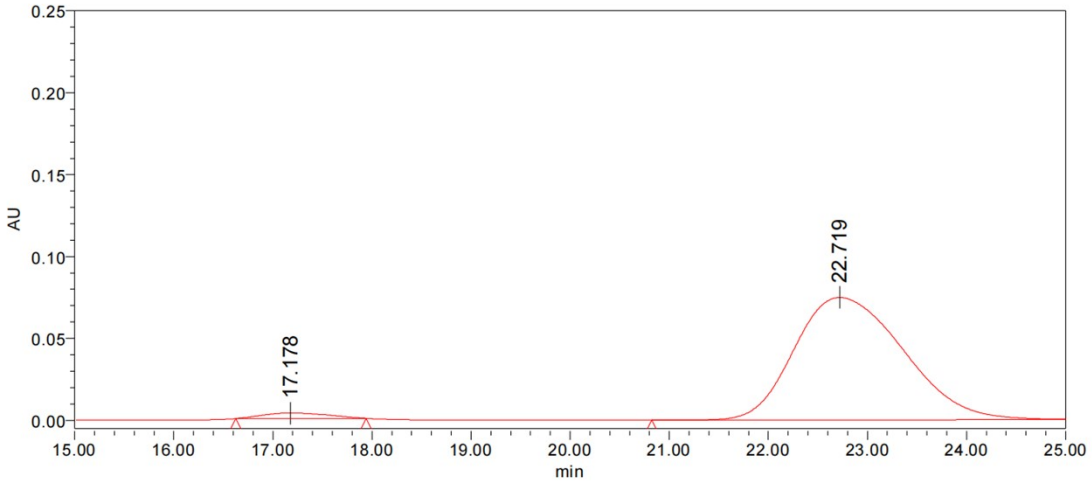
HPLC Spectra of Compound **3fa**



3fa

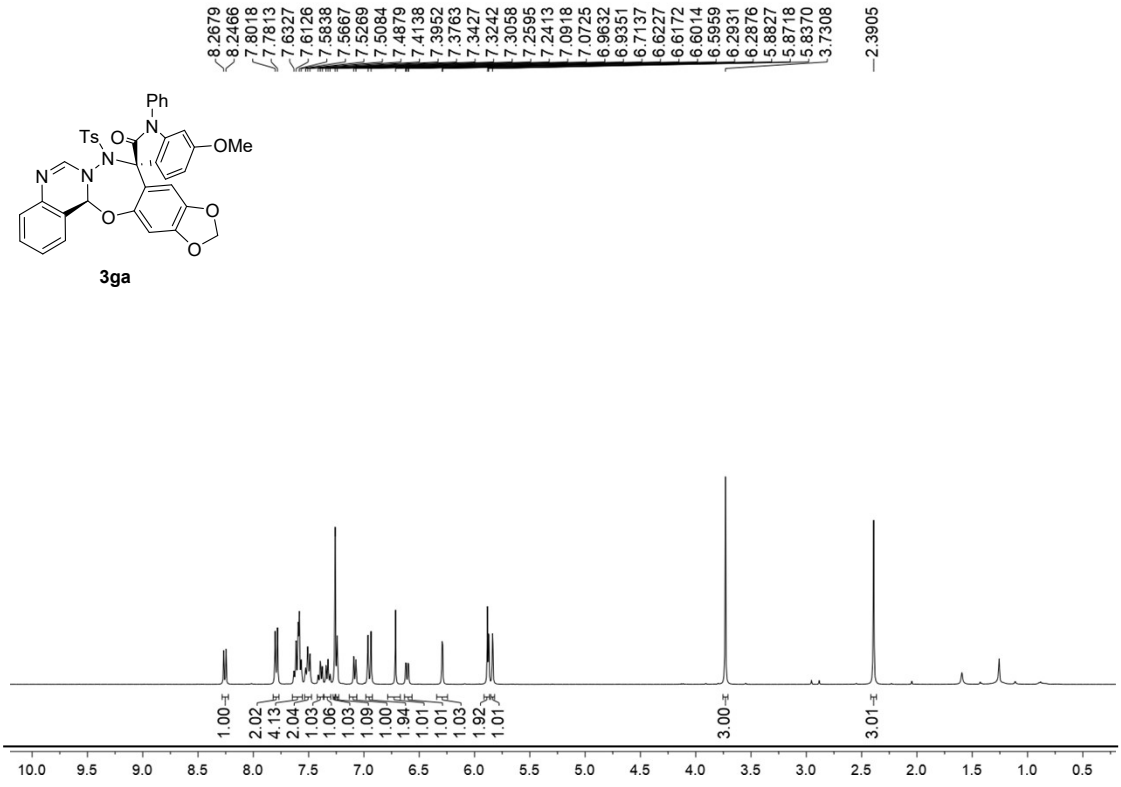


	RetTime [min]	Area [mAU*s]	Area%
1	17.290	2834394	49.86
2	22.948	2850633	50.14

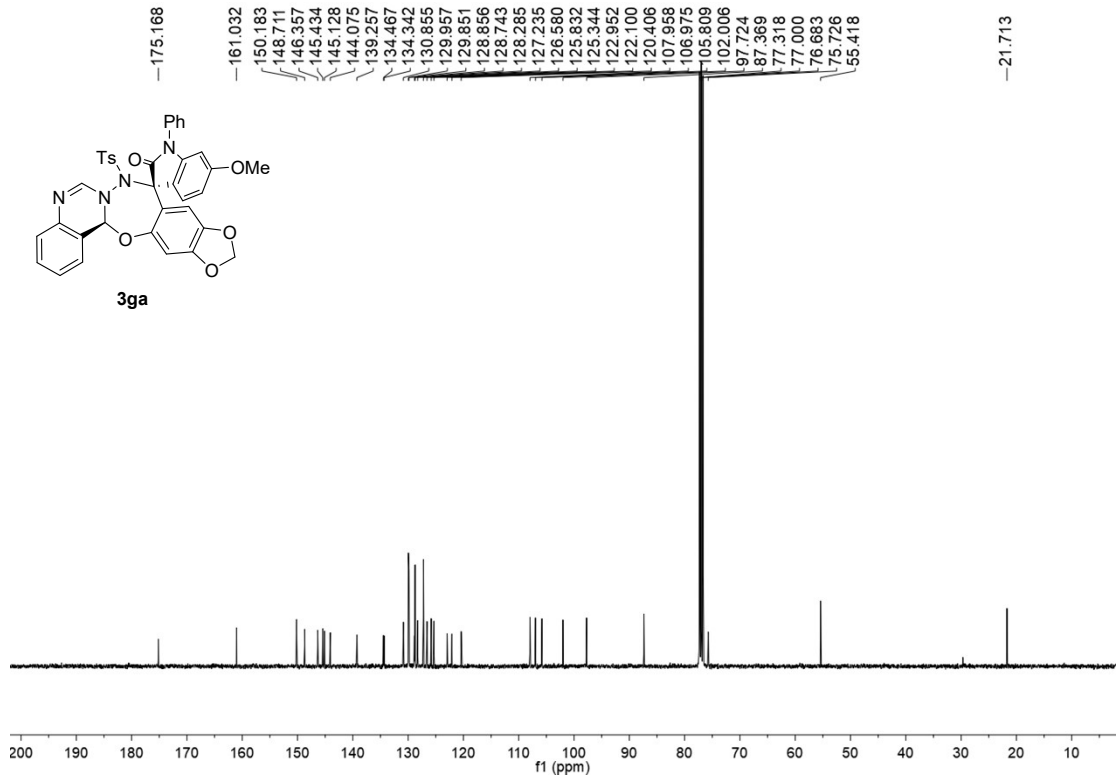


	RetTime [min]	Area [mAU*s]	Area%
1	17.178	152033	2.58
2	22.719	5735065	97.42

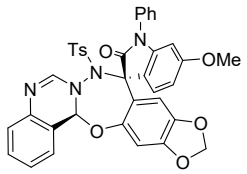
^{1}H NMR Spectrum of Compound **3ga** (400 MHz, $CDCl_3$)



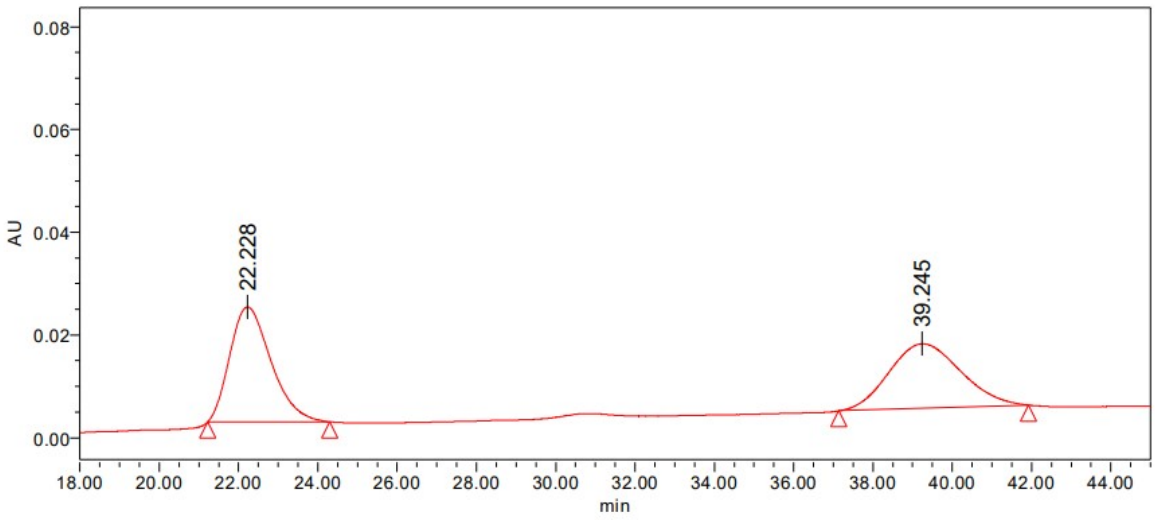
^{13}C{^{1}H} NMR Spectrum of Compound **3ga** (101 MHz, $CDCl_3$)



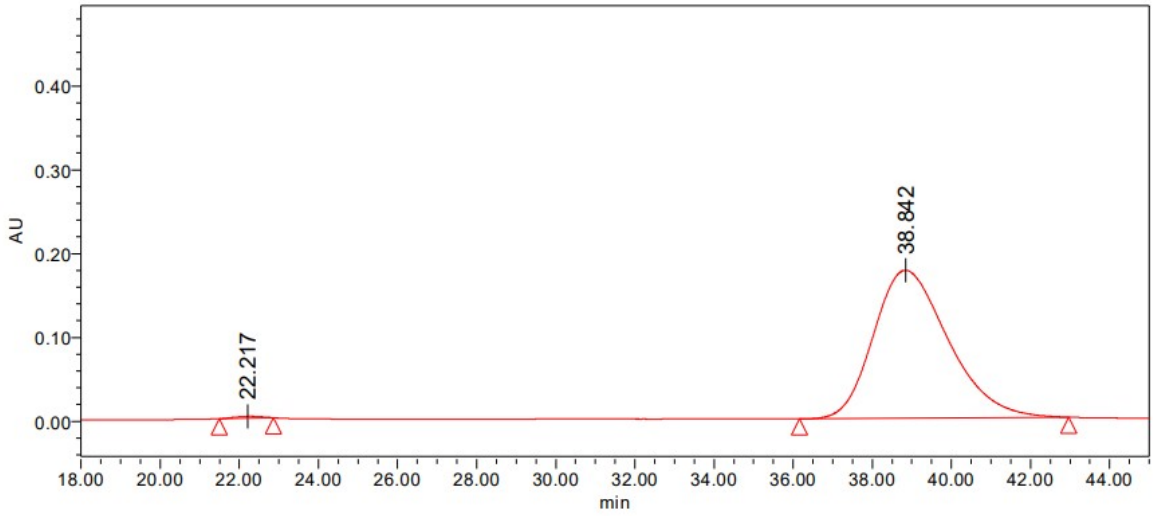
HPLC Spectra of Compound **3ga**



3ga

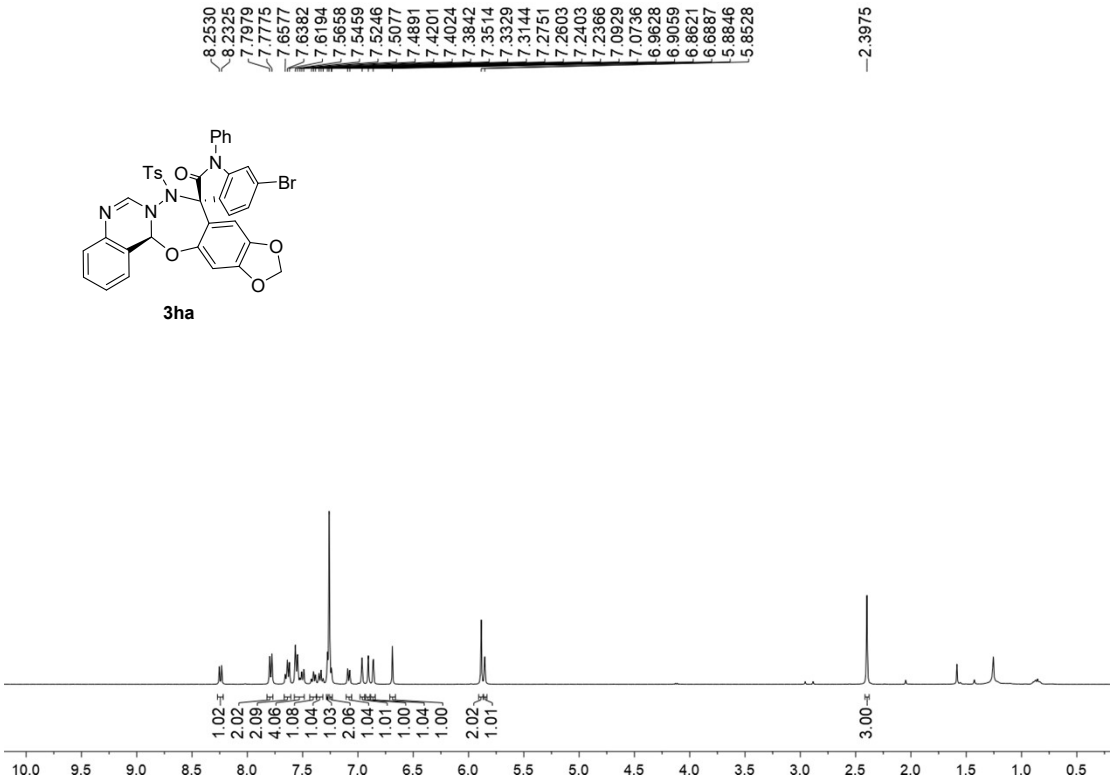


	RetTime [min]	Area [mAU*s]	Area%
1	22.228	1612989	50.54
2	39.245	1578614	49.46

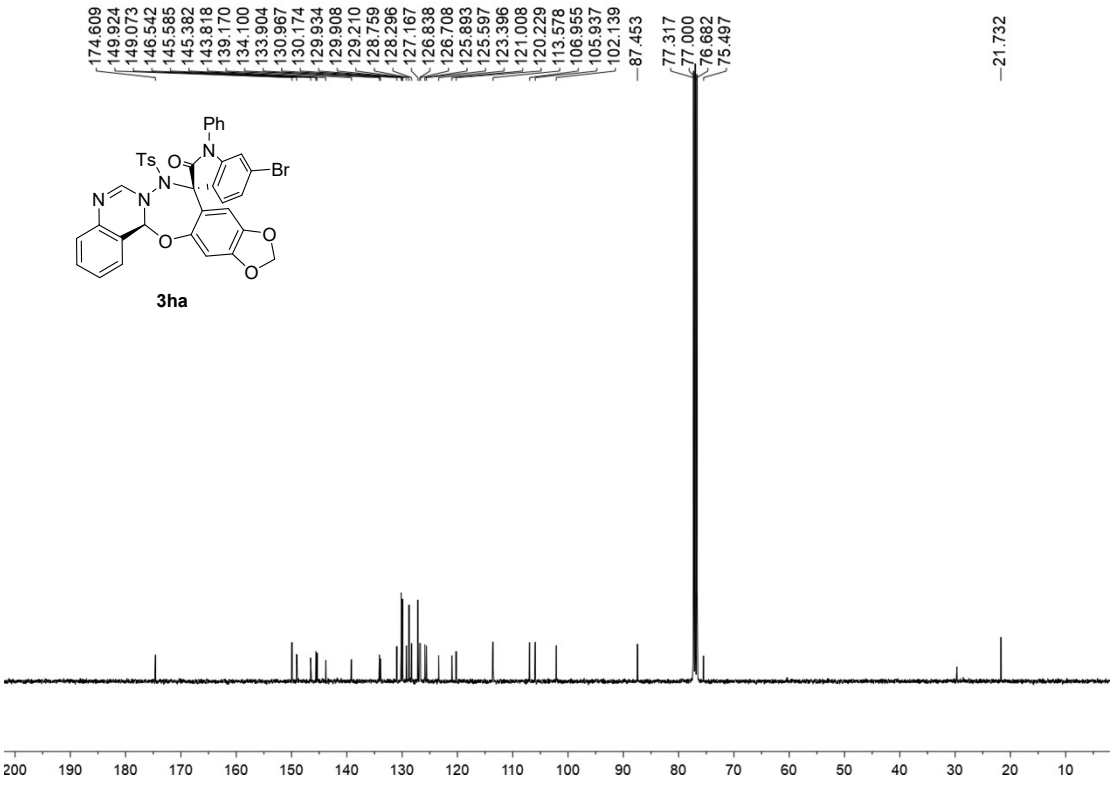


	RetTime [min]	Area [mAU*s]	Area%
1	22.217	106066	0.46
2	38.842	23146767	99.54

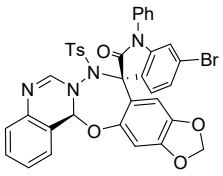
^{1}H NMR Spectrum of Compound **3ha** (400 MHz, $CDCl_3$)



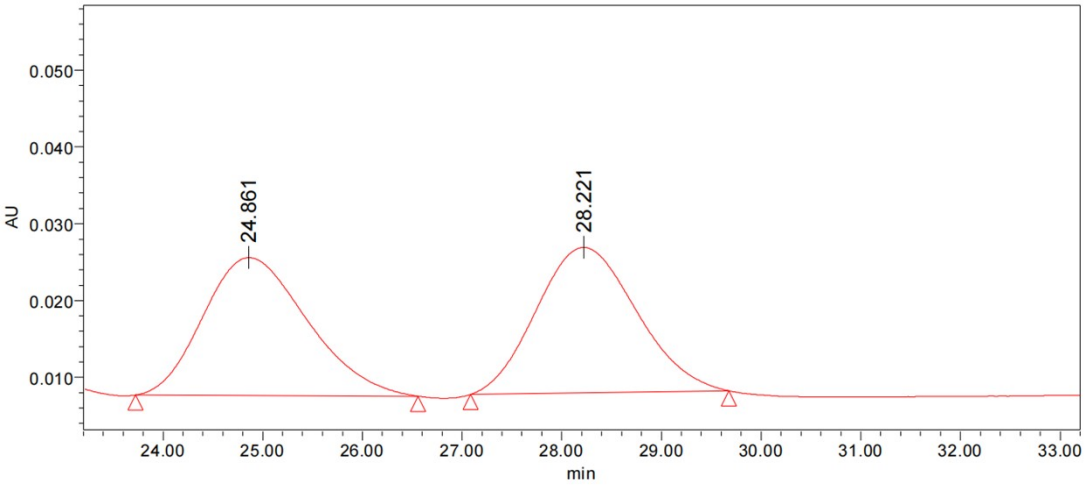
^{13}C{^{1}H} NMR Spectrum of Compound **3ha** (101 MHz, $CDCl_3$)



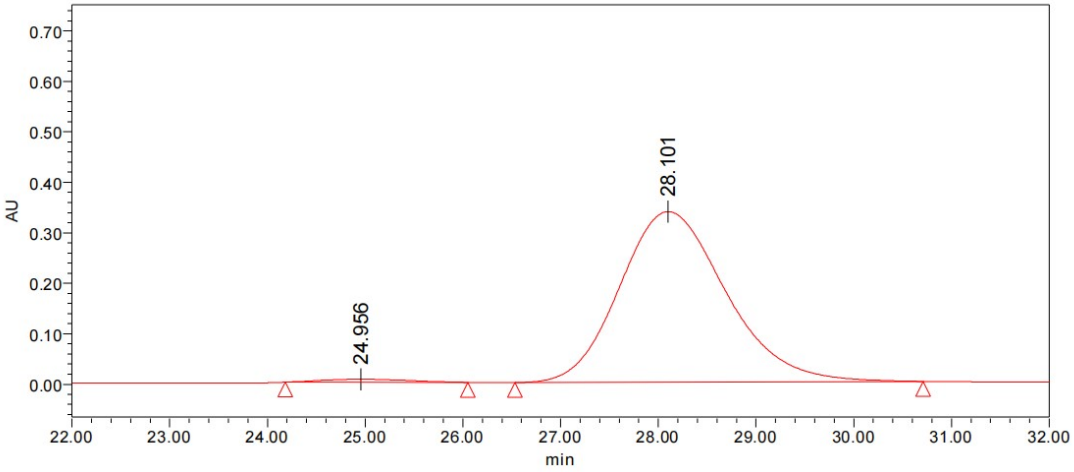
HPLC Spectra of Compound **3ha**



3ha

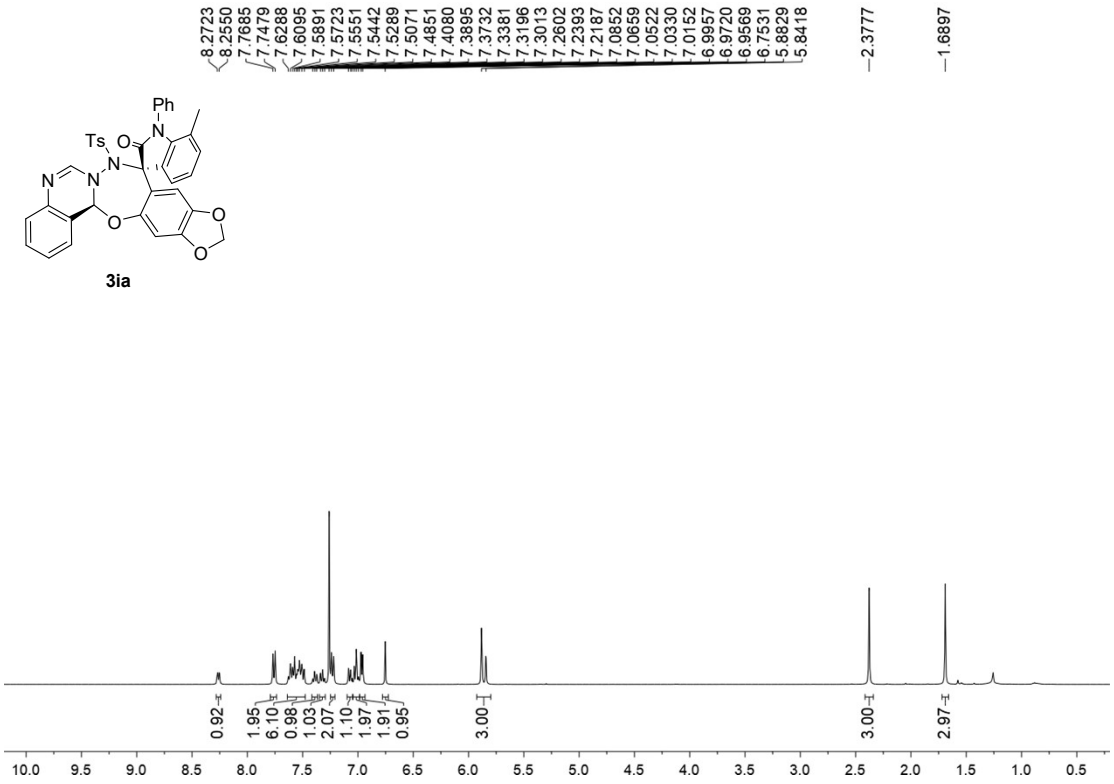


	RetTime [min]	Area [mAU*s]	Area%
1	24.861	1302098	49.65
2	28.221	1320507	50.35

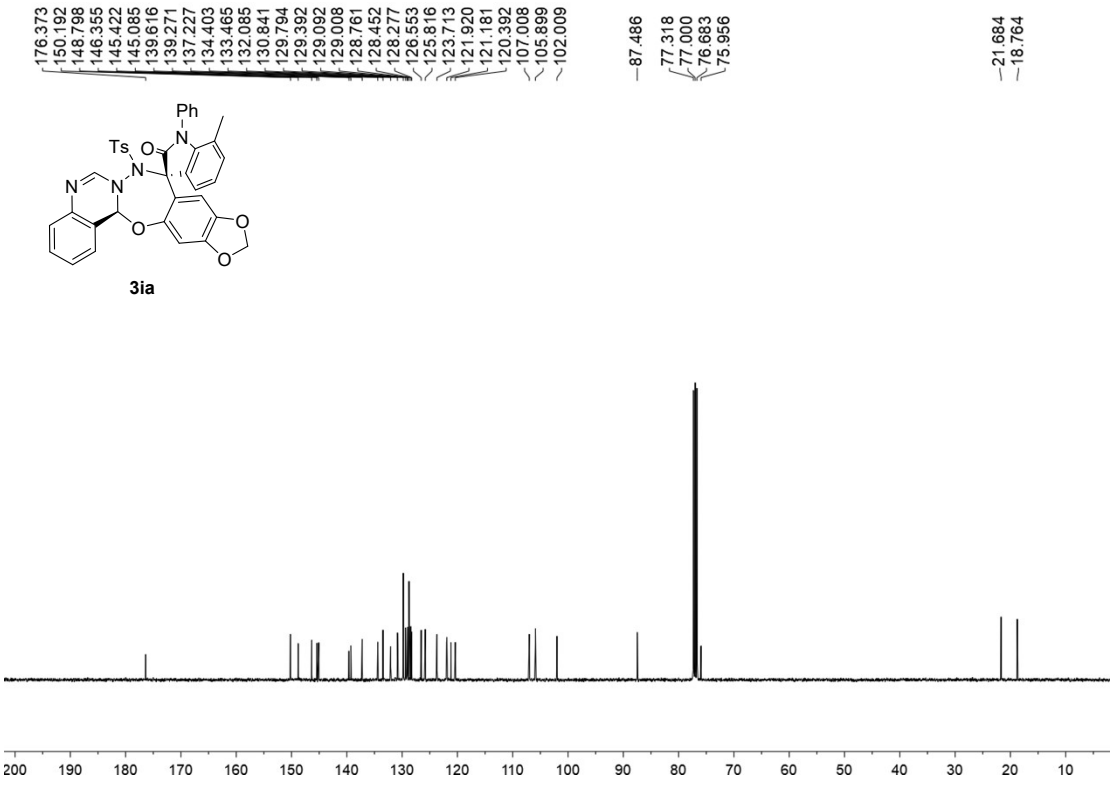


	RetTime [min]	Area [mAU*s]	Area%
1	24.956	373380	1.44
2	28.101	25537449	98.56

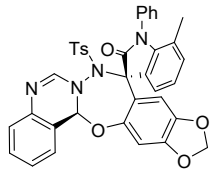
^{1}H NMR Spectrum of Compound **3ia** (400 MHz, $CDCl_3$)



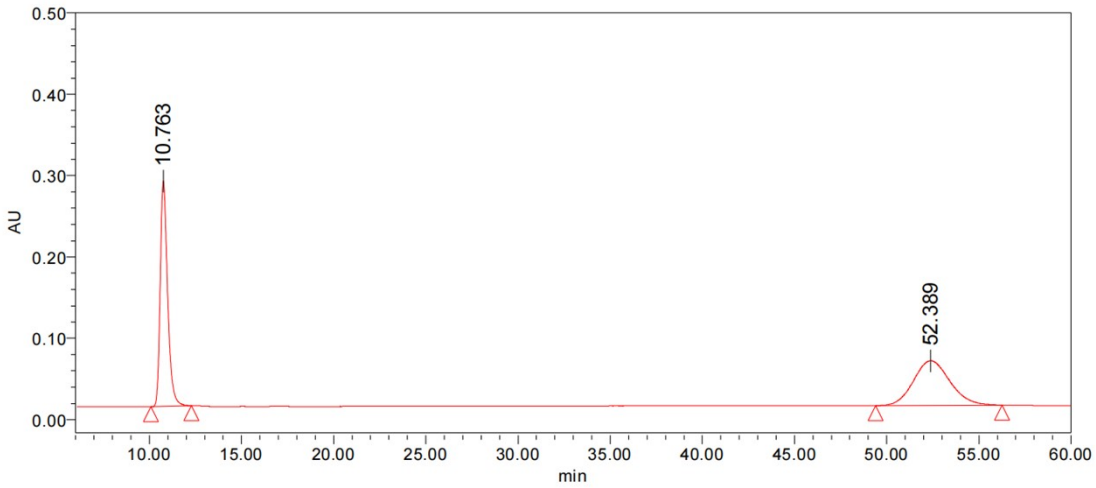
^{13}C{^{1}H} NMR Spectrum of Compound **3ia** (101 MHz, $CDCl_3$)



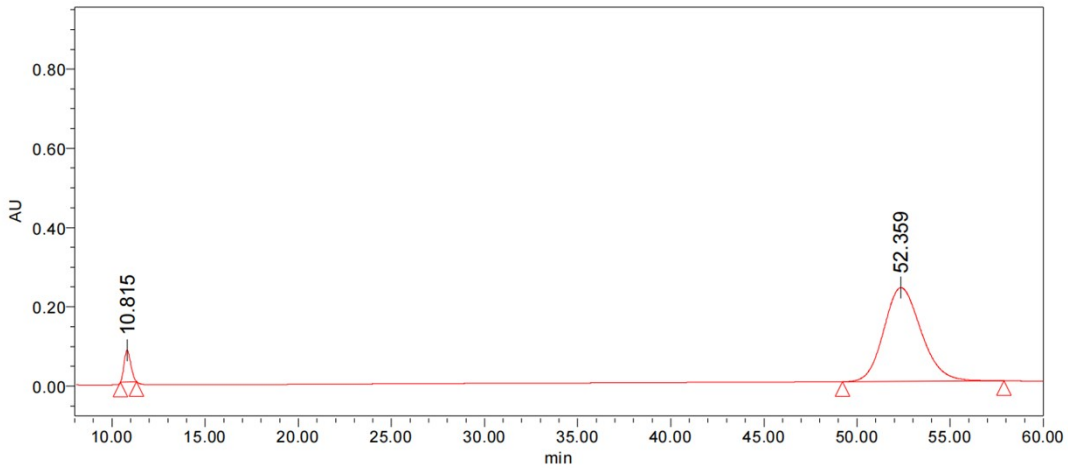
HPLC Spectra of Compound **3ia**



3ia

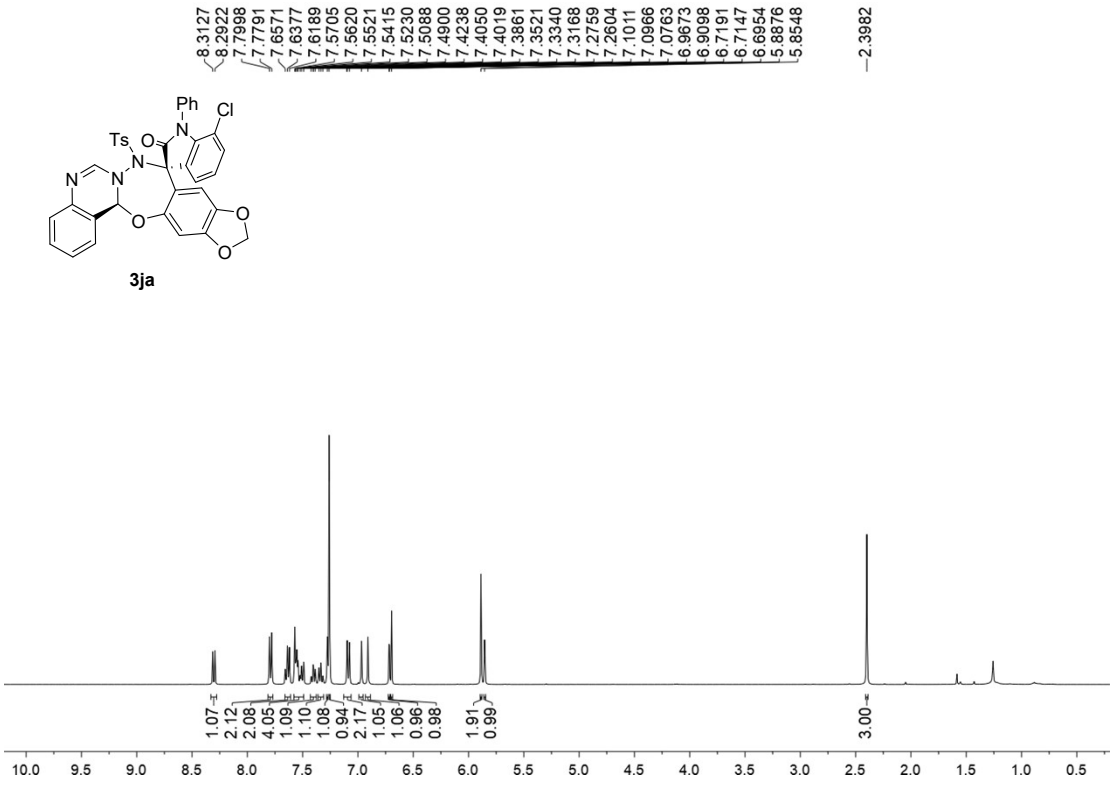


	RetTime [min]	Area [mAU*s]	Area%
1	10.763	7669336	50.34
2	52.389	7565453	49.66

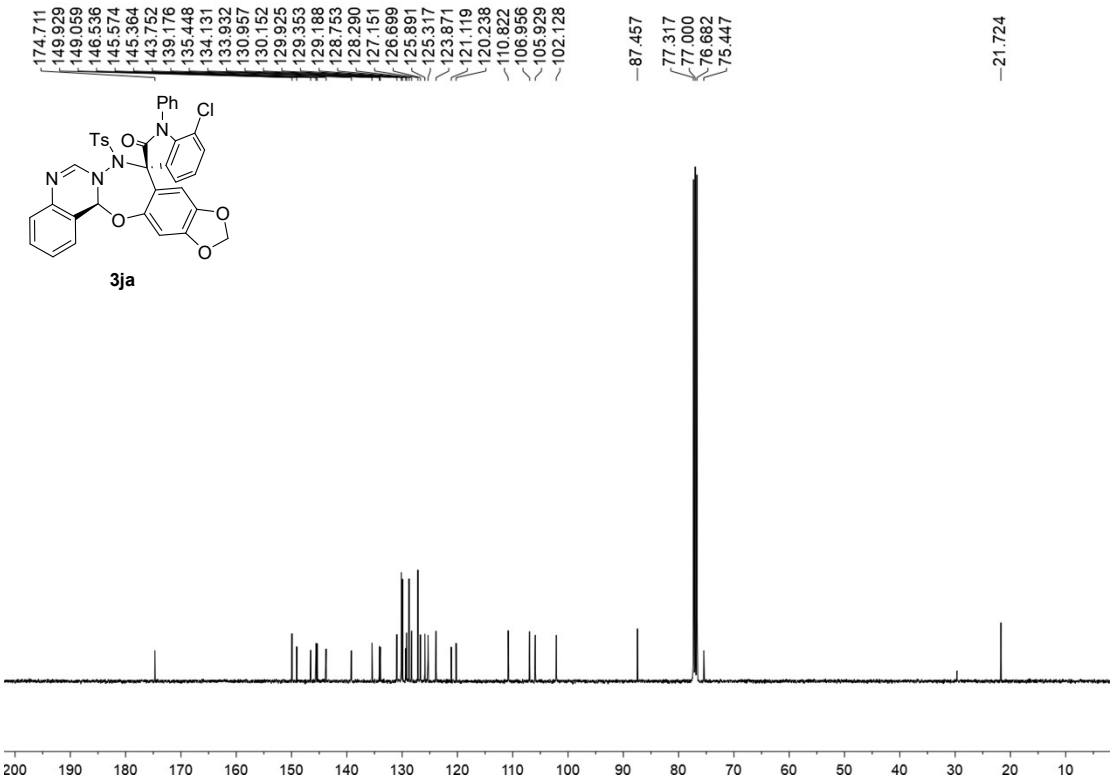


	RetTime [min]	Area [mAU*s]	Area%
1	10.815	1963878	5.60
2	52.359	33083179	94.40

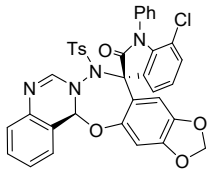
^{1}H NMR Spectrum of Compound **3ja** (400 MHz, $CDCl_3$)



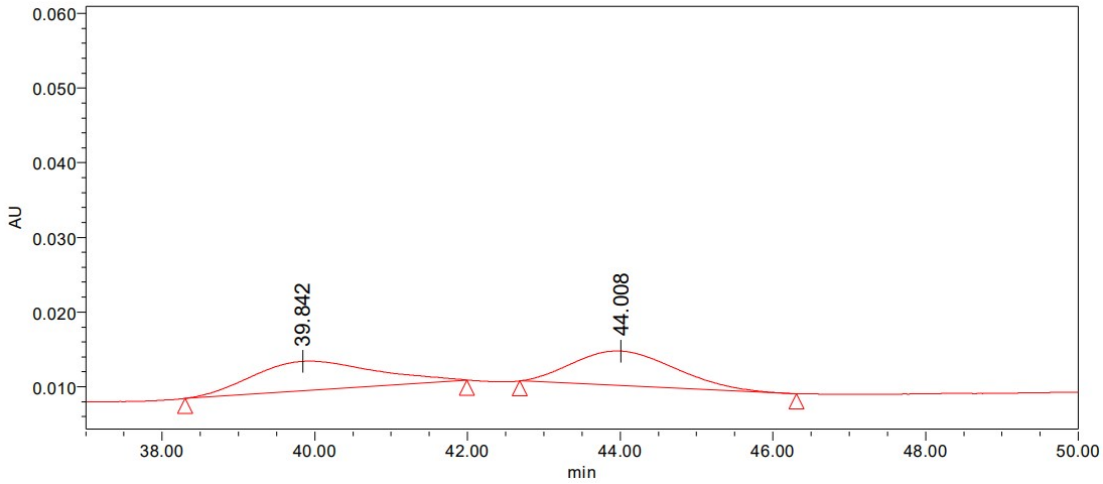
^{13}C{^{1}H} NMR Spectrum of Compound **3ja** (101 MHz, $CDCl_3$)



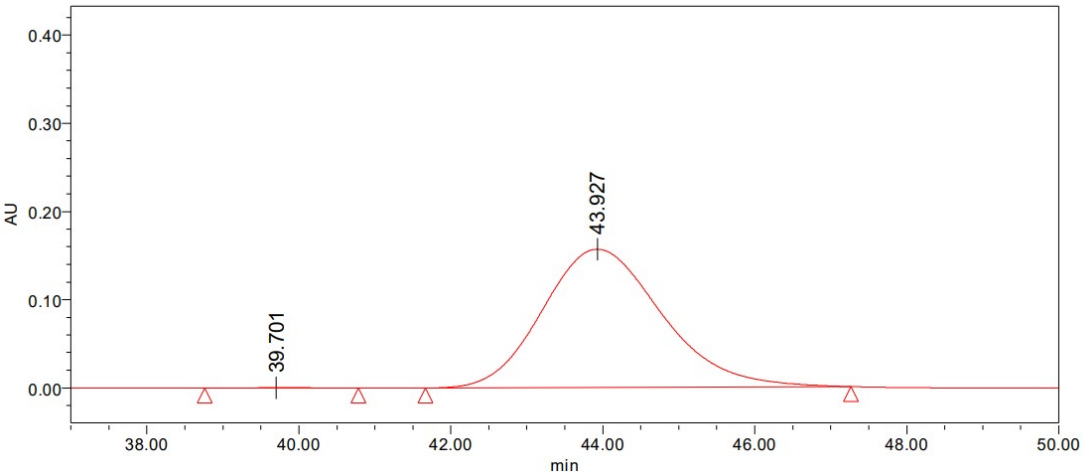
HPLC Spectra of Compound **3ja**



3ja

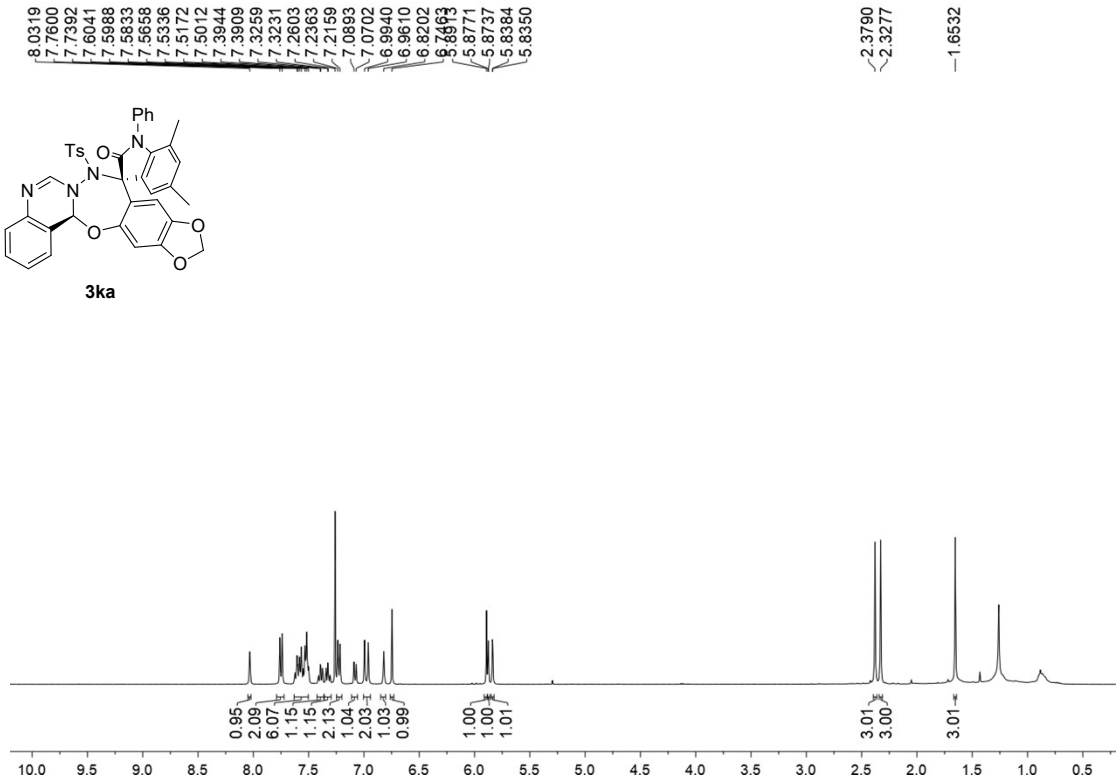


	RetTime [min]	Area [mAU*s]	Area%
1	39.842	432310	49.96
2	44.008	433059	50.04

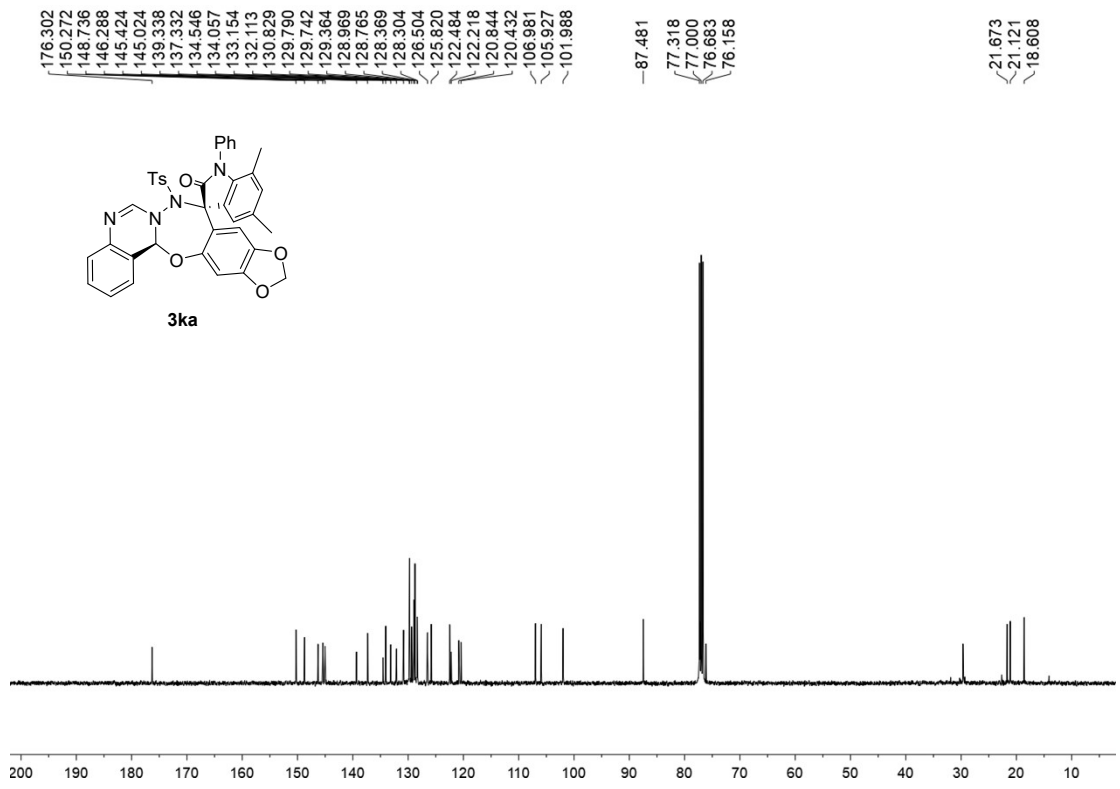


	RetTime [min]	Area [mAU*s]	Area%
1	39.701	32583	0.19
2	43.927	17138754	99.81

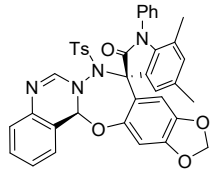
^{1}H NMR Spectrum of Compound **3ka** (400 MHz, $CDCl_3$)



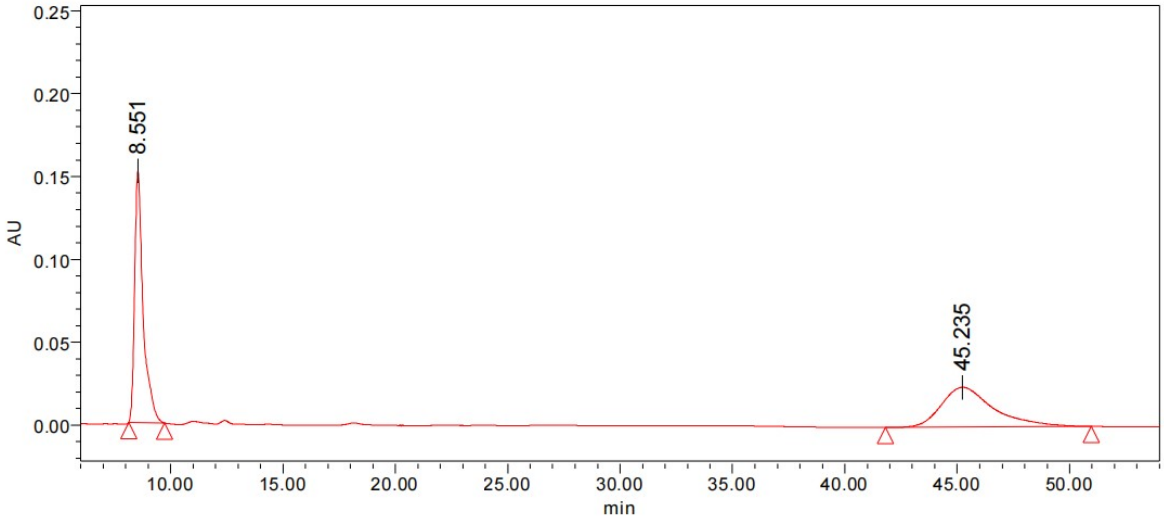
^{13}C{^{1}H} NMR Spectrum of Compound **3ka** (101 MHz, $CDCl_3$)



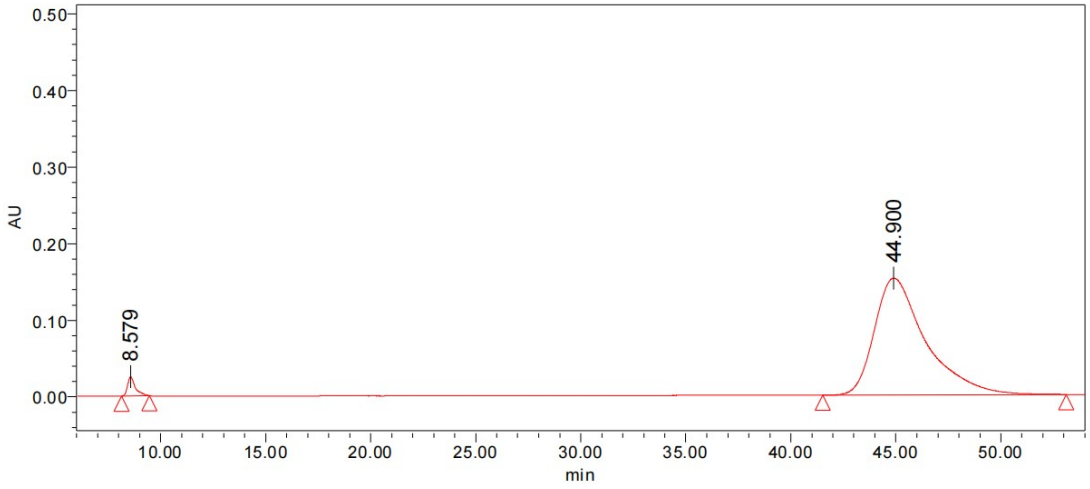
HPLC Spectra of Compound **3ka**



3ka

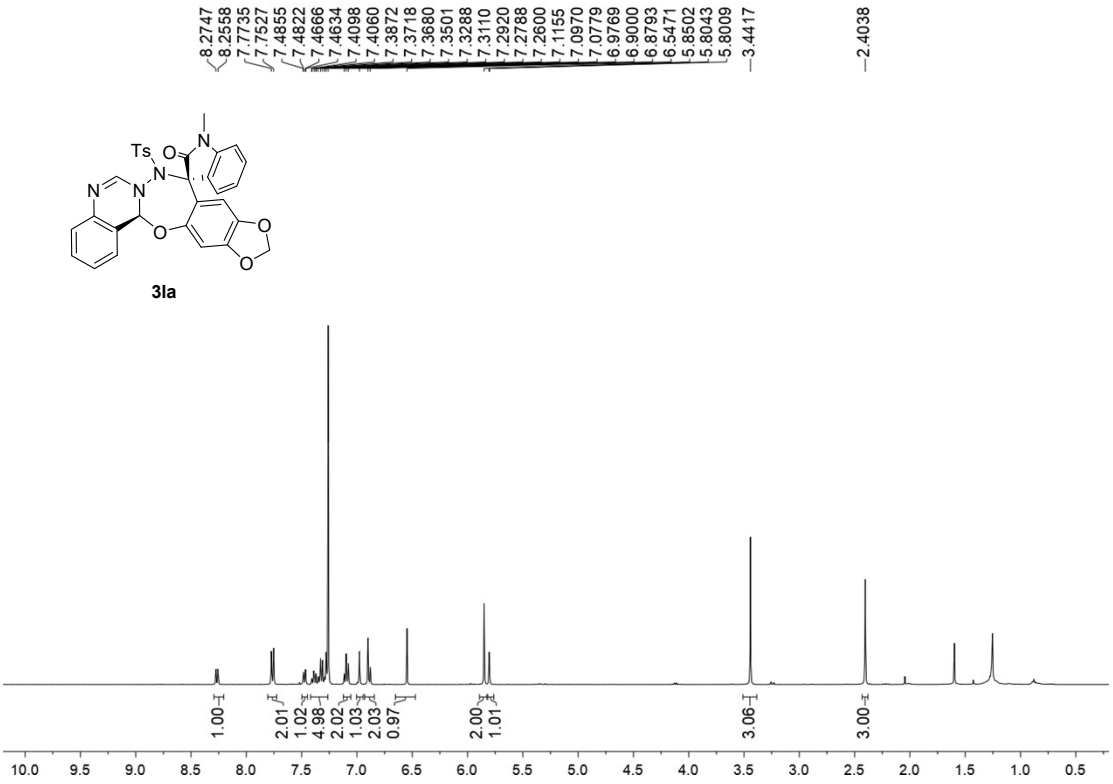


	RetTime [min]	Area [mAU*s]	Area%
1	8.551	4006122	50.74
2	45.235	3889507	49.26

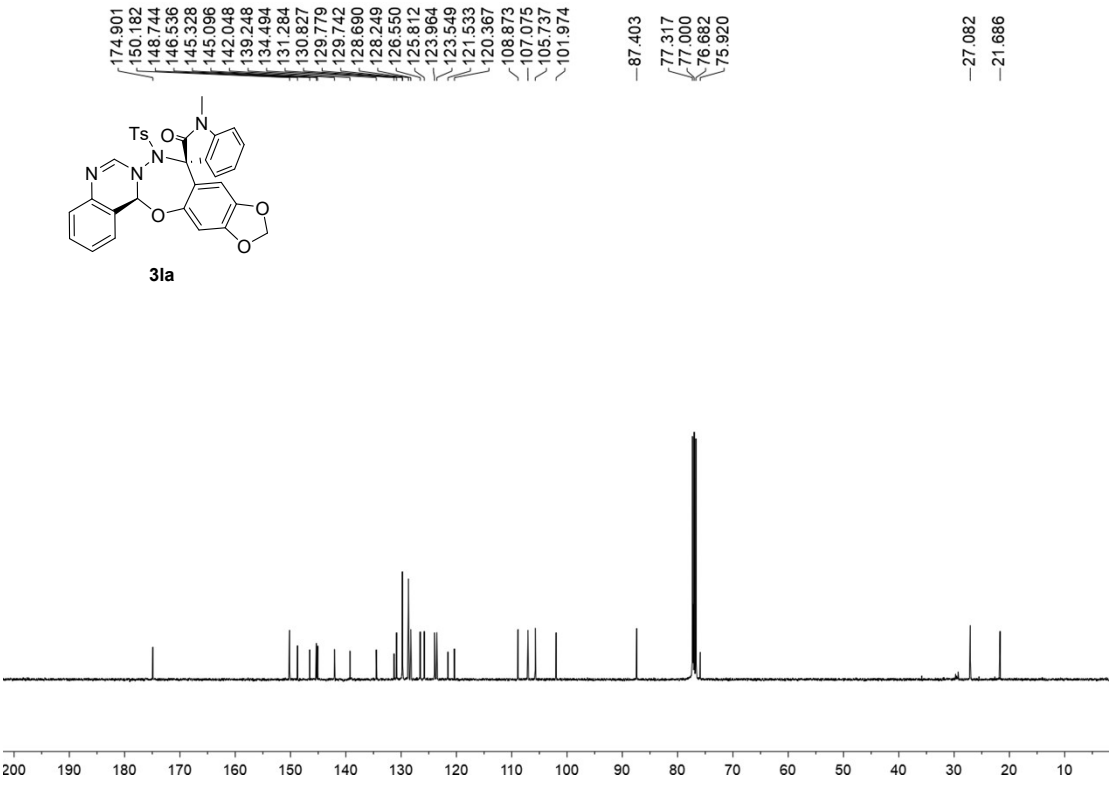


	RetTime [min]	Area [mAU*s]	Area%
1	8.579	648005	2.45
2	44.900	25822507	97.55

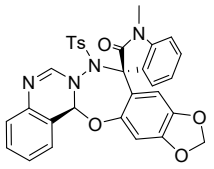
^{1}H NMR Spectrum of Compound **3la** (400 MHz, $CDCl_3$)



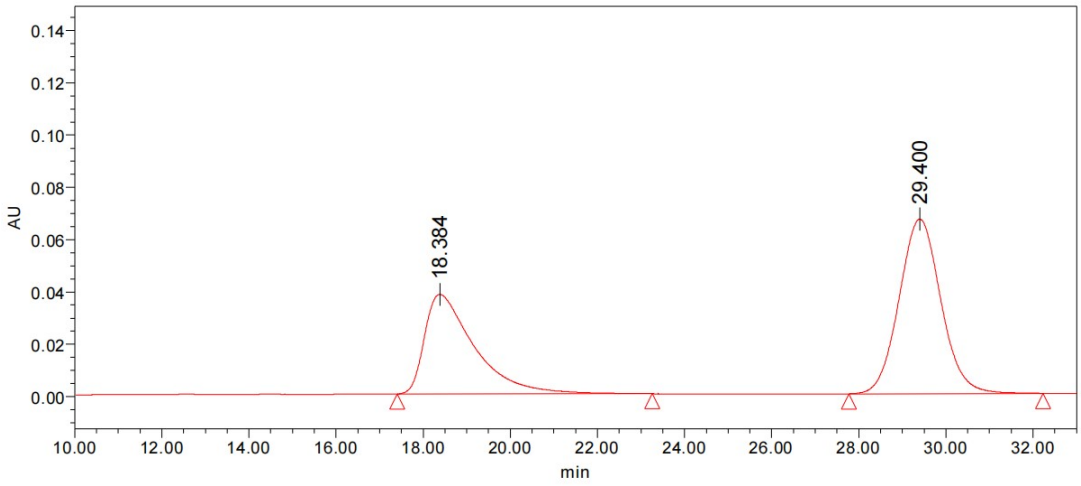
^{13}C{^{1}H} NMR Spectrum of Compound **3la** (101 MHz, $CDCl_3$)



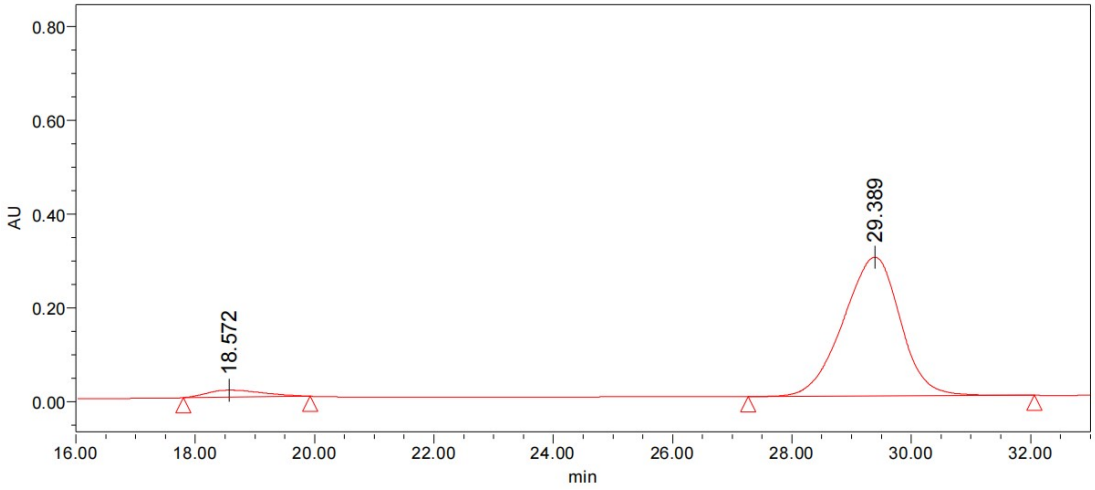
HPLC Spectra of Compound **3la**



3la

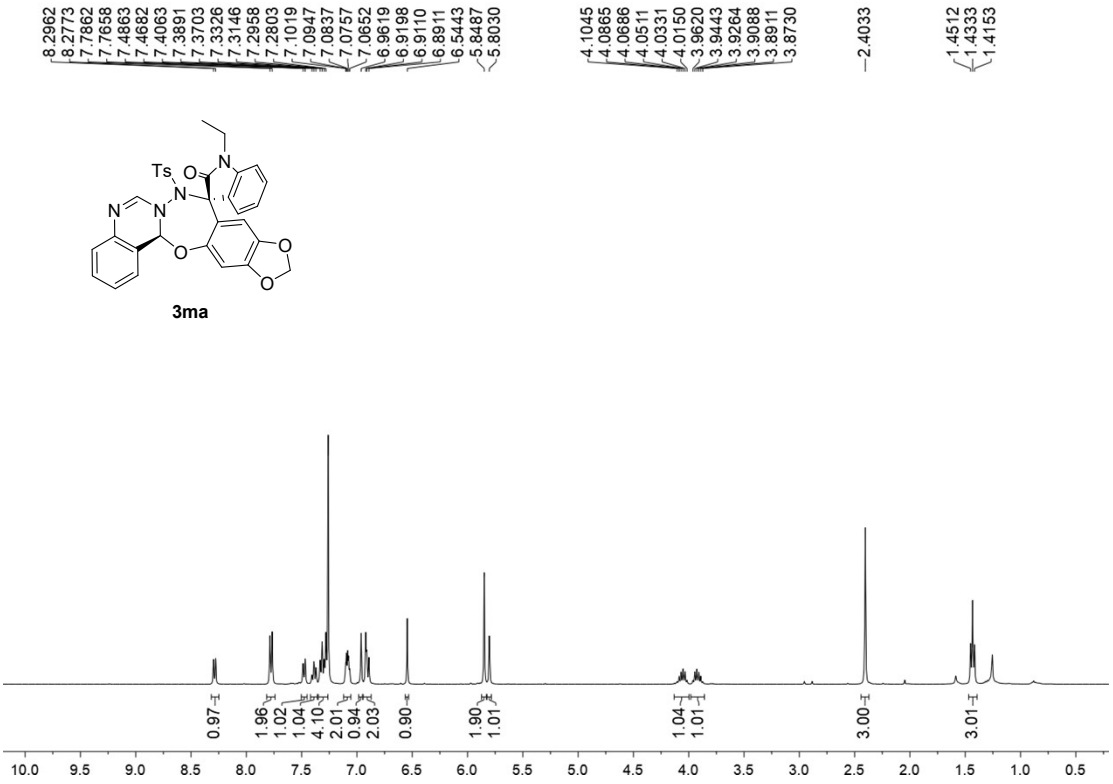


	RetTime [min]	Area [mAU*s]	Area%
1	18.384	3019859	40.49
2	29.400	4439106	59.51

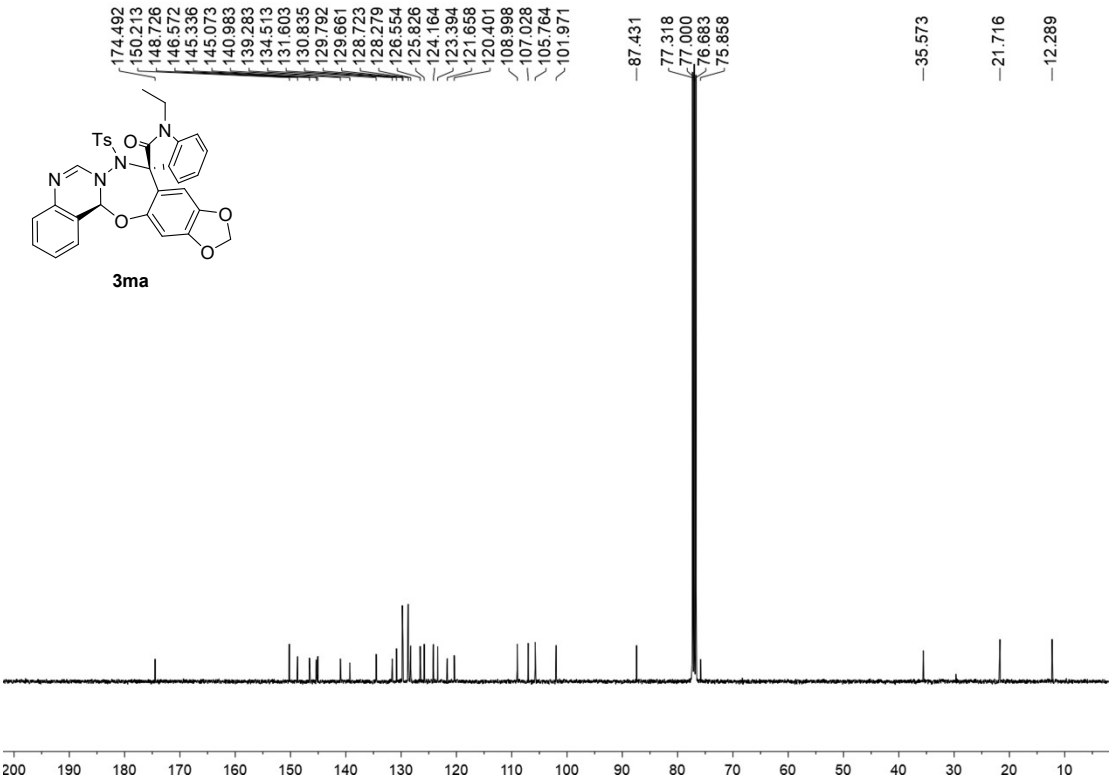


	RetTime [min]	Area [mAU*s]	Area%
1	18.572	961907	4.65
2	29.389	19744953	95.35

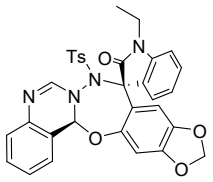
^{1}H NMR Spectrum of Compound **3ma** (400 MHz, $CDCl_3$)



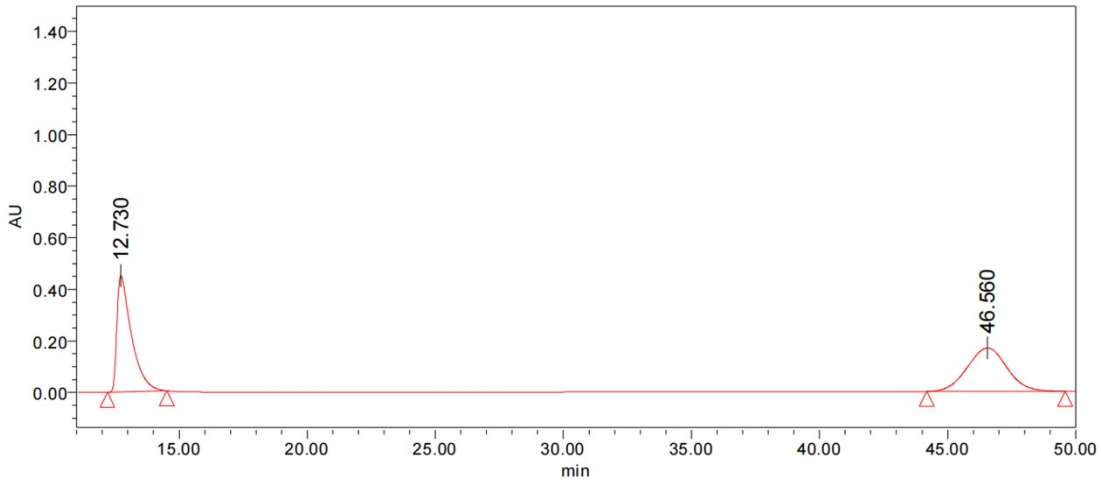
^{13}C{^{1}H} NMR Spectrum of Compound **3ma** (101 MHz, $CDCl_3$)



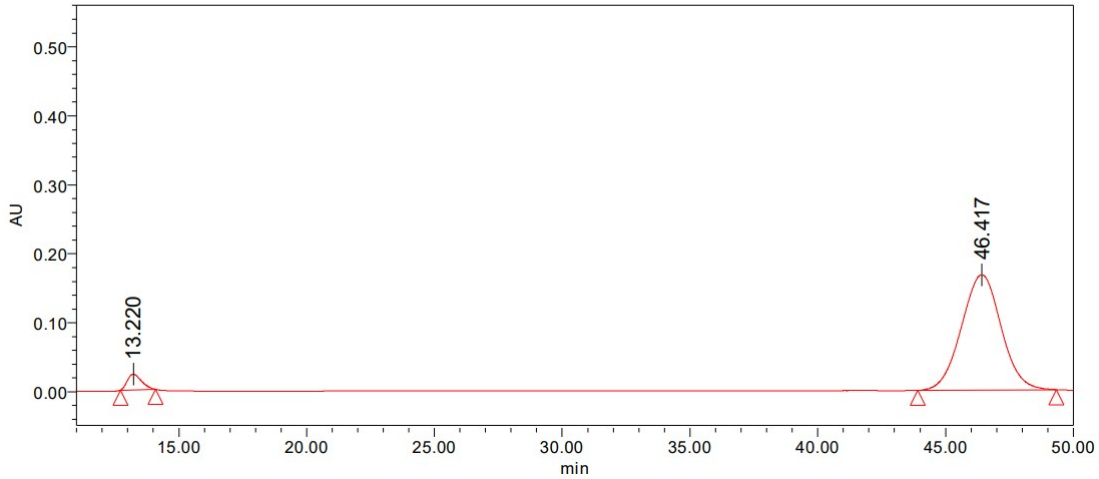
HPLC Spectra of Compound **3ma**



3ma

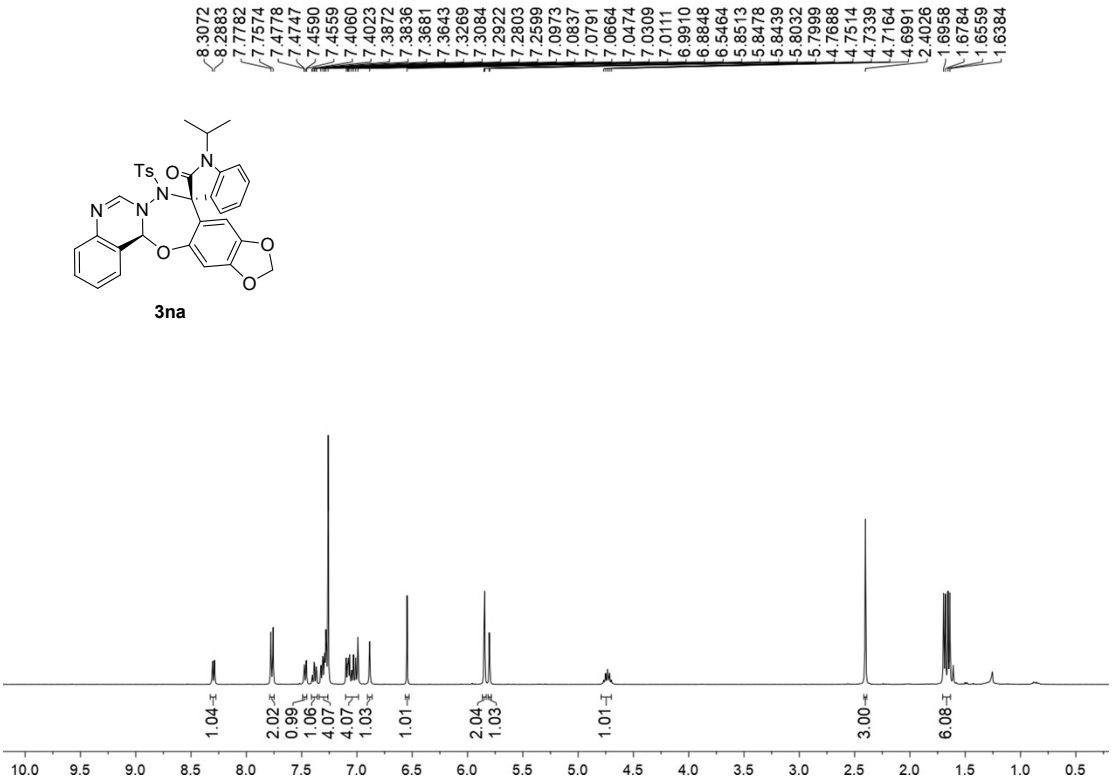


	RetTime [min]	Area [mAU*s]	Area%
1	12.730	17969735	49.70
2	46.560	18187957	50.30

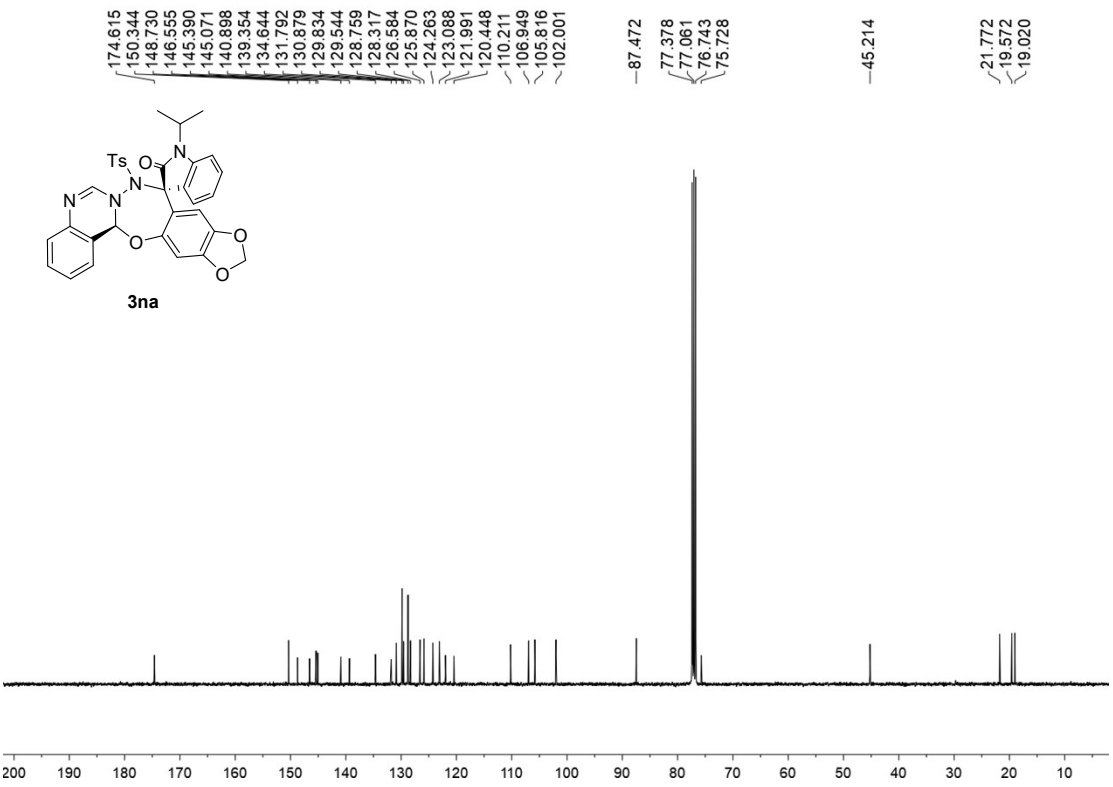


	RetTime [min]	Area [mAU*s]	Area%
1	13.220	866655	4.58
2	46.417	18041377	95.42

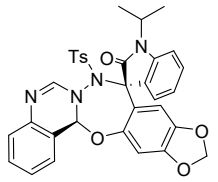
^{1}H NMR Spectrum of Compound **3na** (400 MHz, $CDCl_3$)



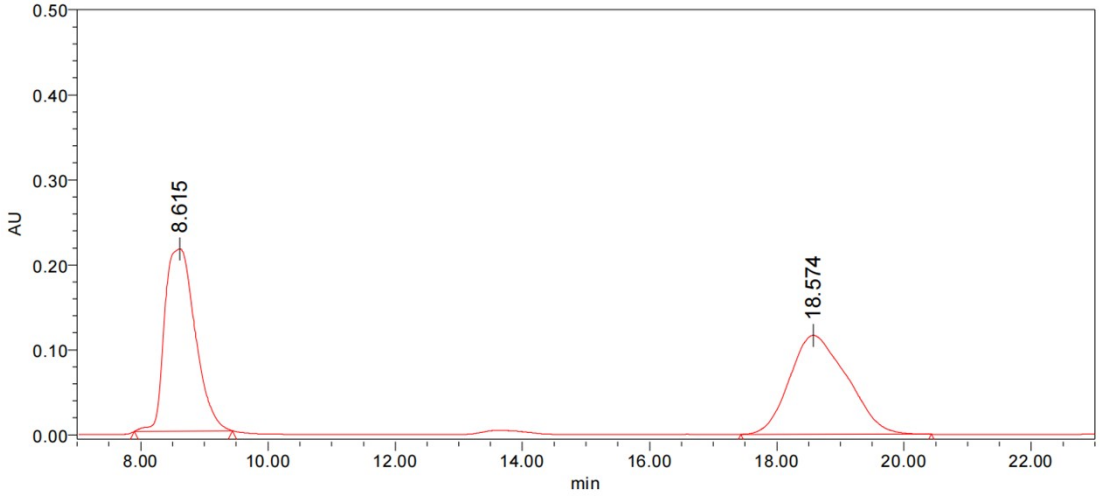
^{13}C{^{1}H} NMR Spectrum of Compound **3na** (101 MHz, $CDCl_3$)



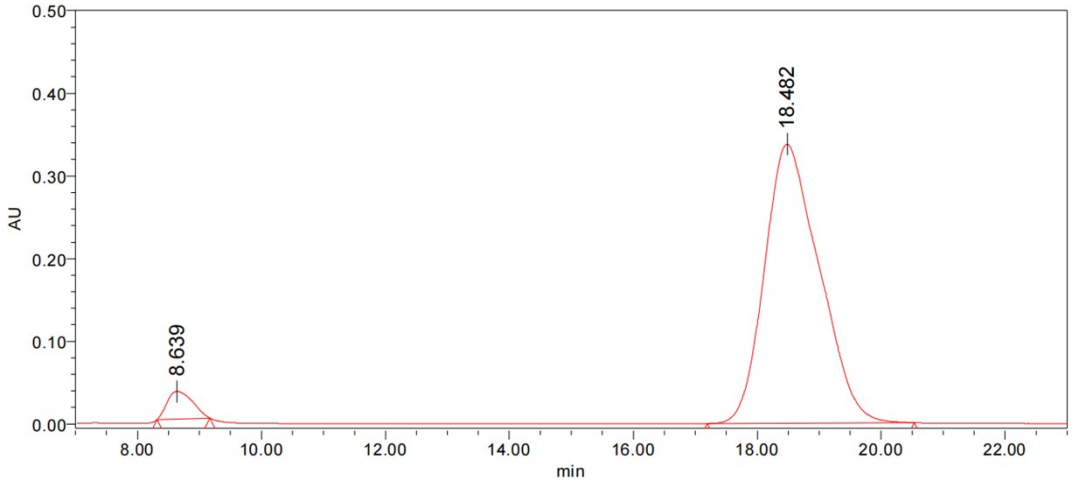
HPLC Spectra of Compound **3na**



3na

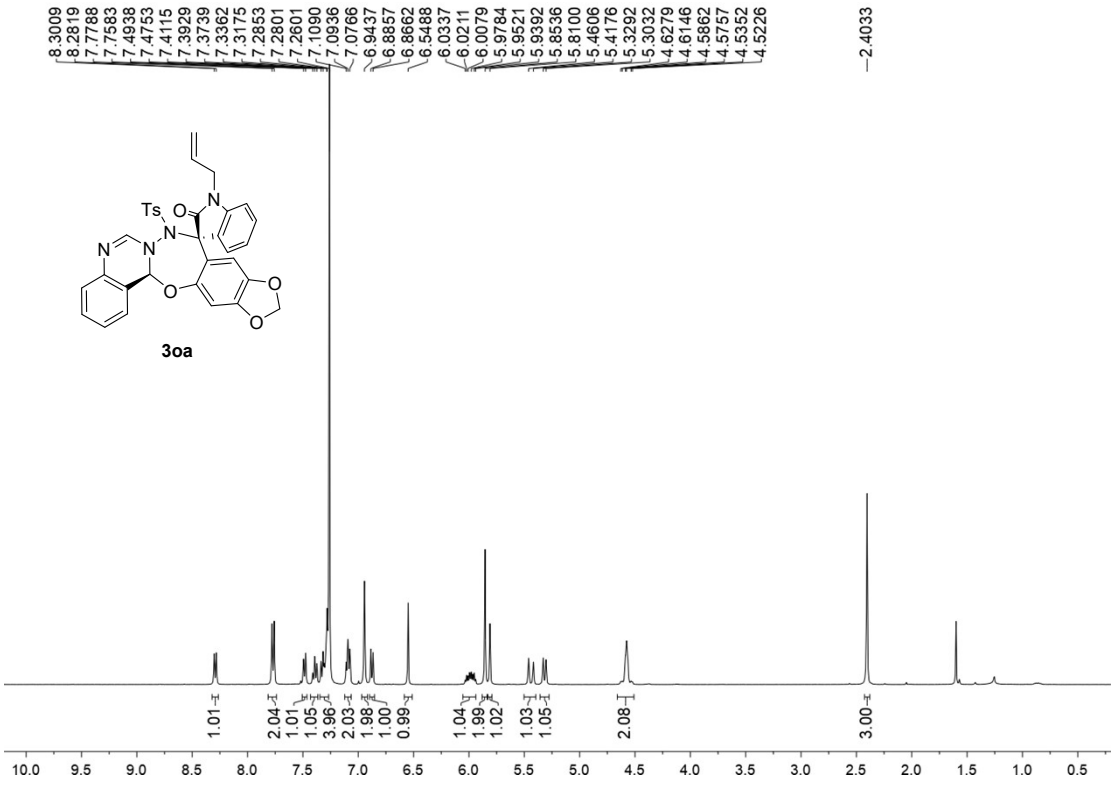


	RetTime [min]	Area [mAU*s]	Area%
1	8.615	7165680	49.47
2	18.574	7320235	50.53

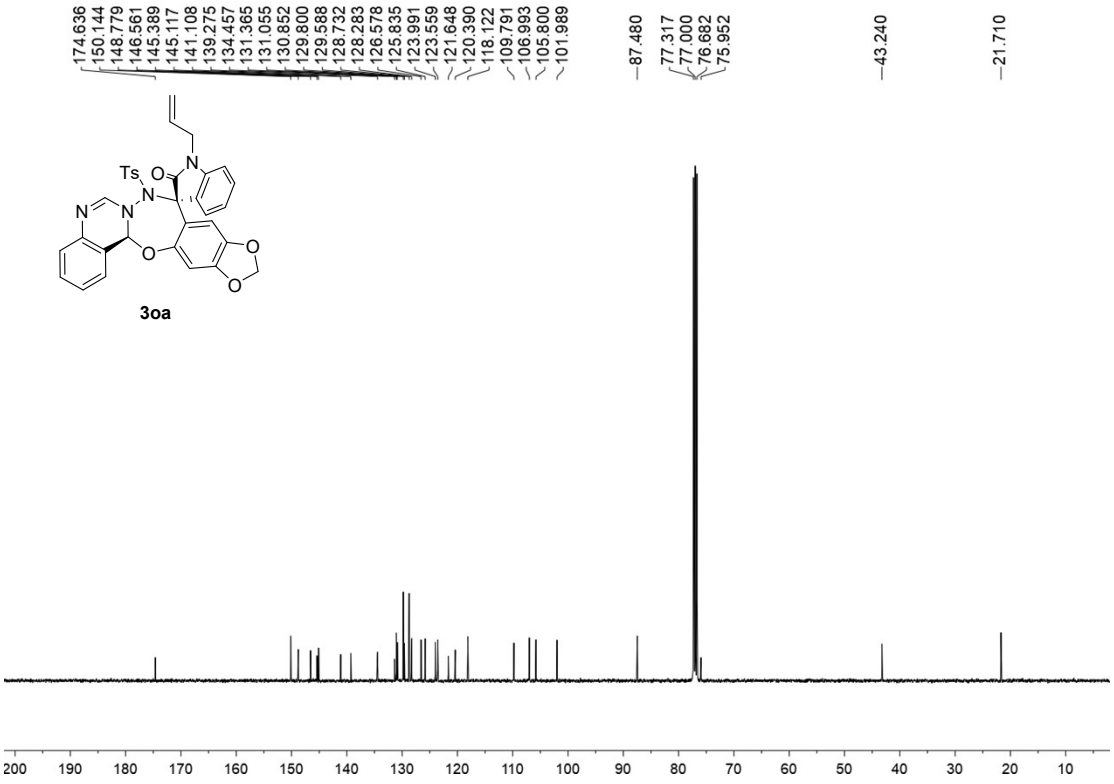


	RetTime [min]	Area [mAU*s]	Area%
1	8.639	947726	4.37
2	18.482	20721687	95.63

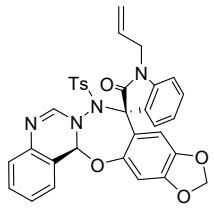
^{1}H NMR Spectrum of Compound **3oa** (400 MHz, $CDCl_3$)



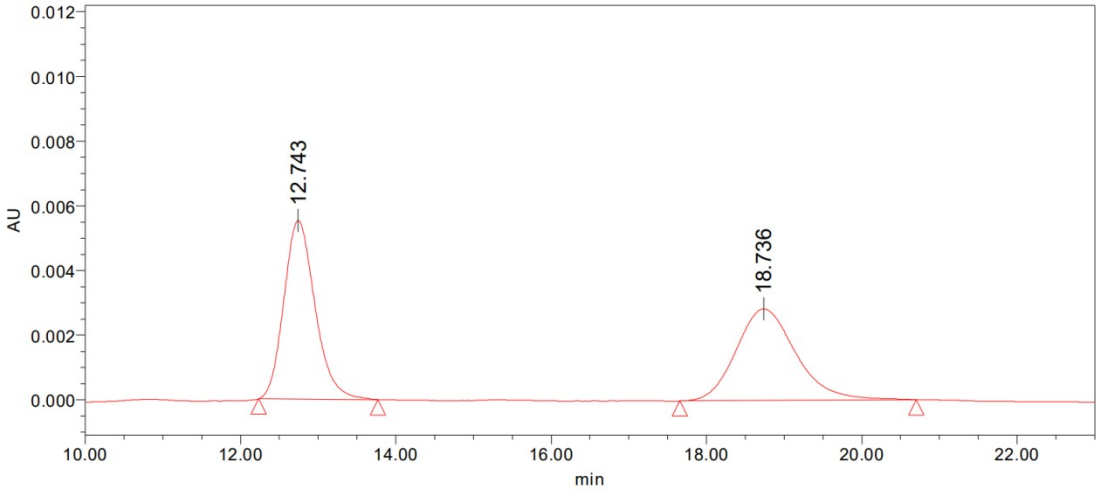
^{13}C{^{1}H} NMR Spectrum of Compound **3oa** (101 MHz, $CDCl_3$)



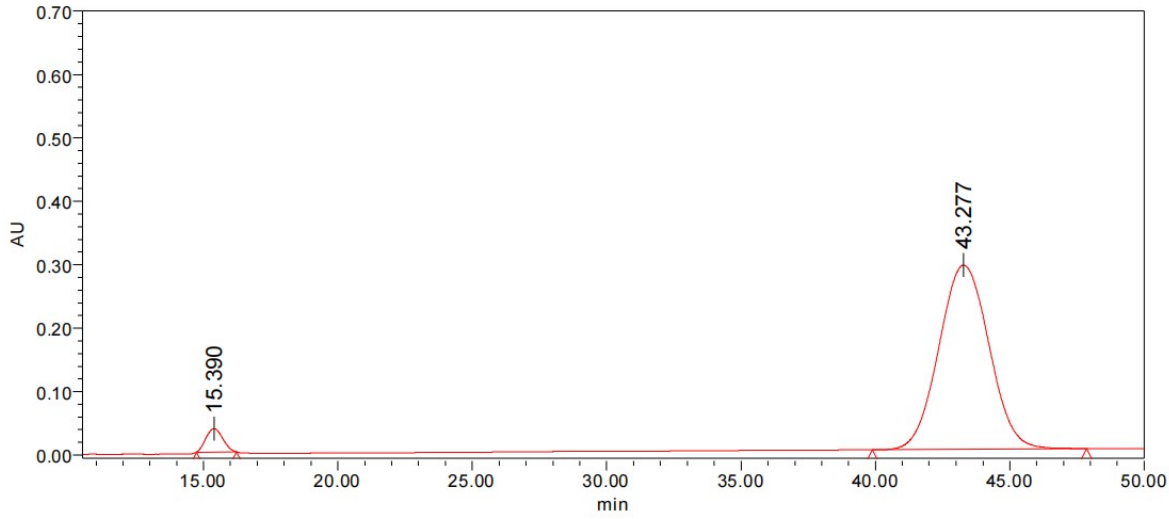
HPLC Spectra of Compound **3oa**



3oa

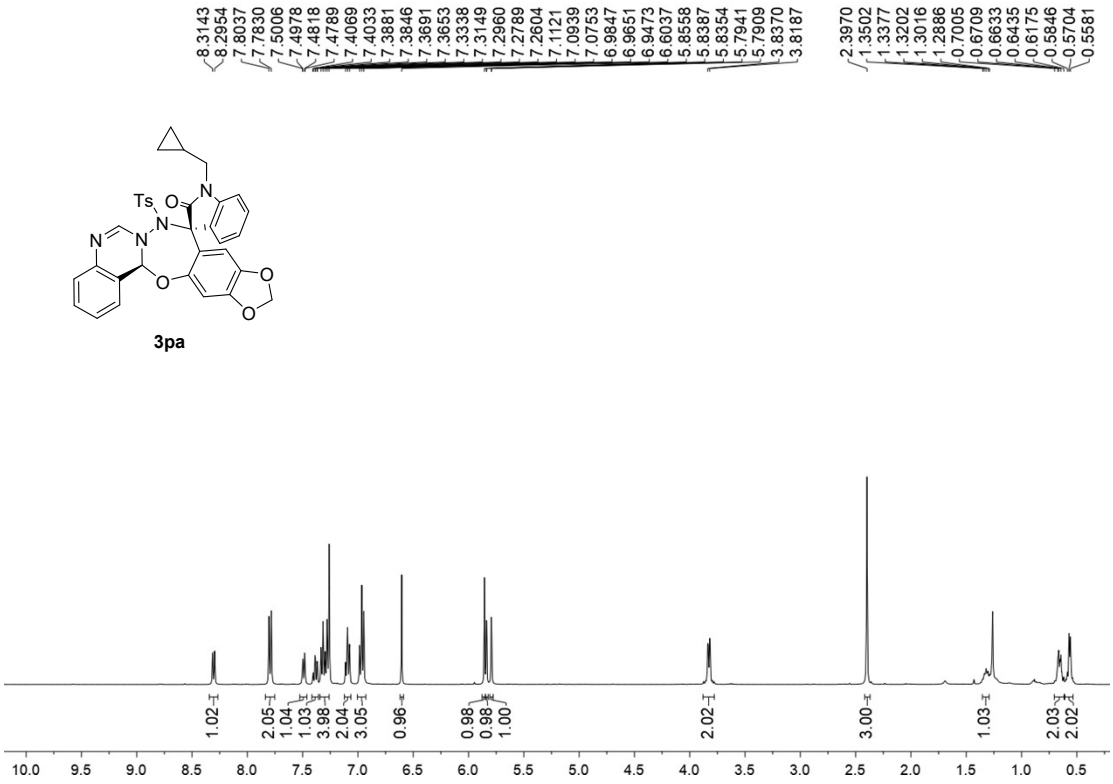


	RetTime [min]	Area [mAU*s]	Area%
1	15.552	20903811	50.29
2	44.772	20660125	49.71

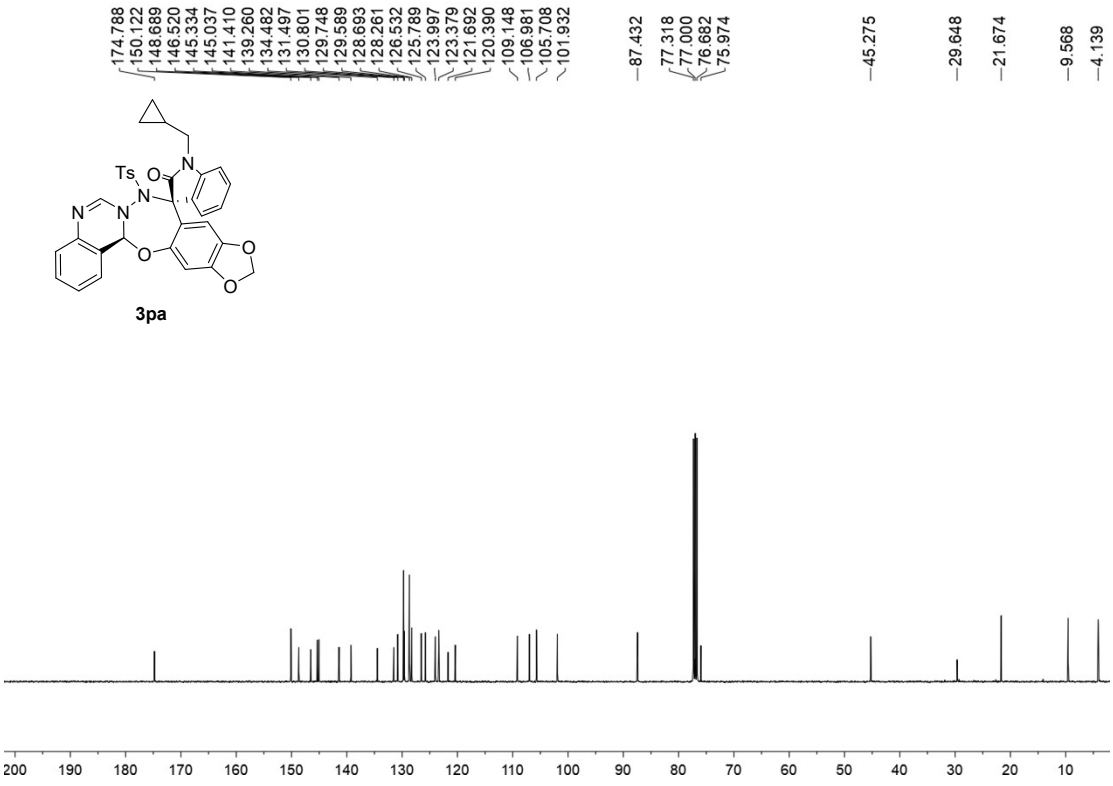


	RetTime [min]	Area [mAU*s]	Area%
1	15.390	1596010	4.06
2	43.277	37689300	95.94

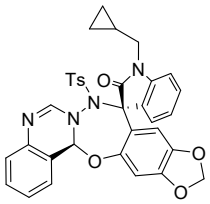
^{1}H NMR Spectrum of Compound **3pa** (400 MHz, $CDCl_3$)



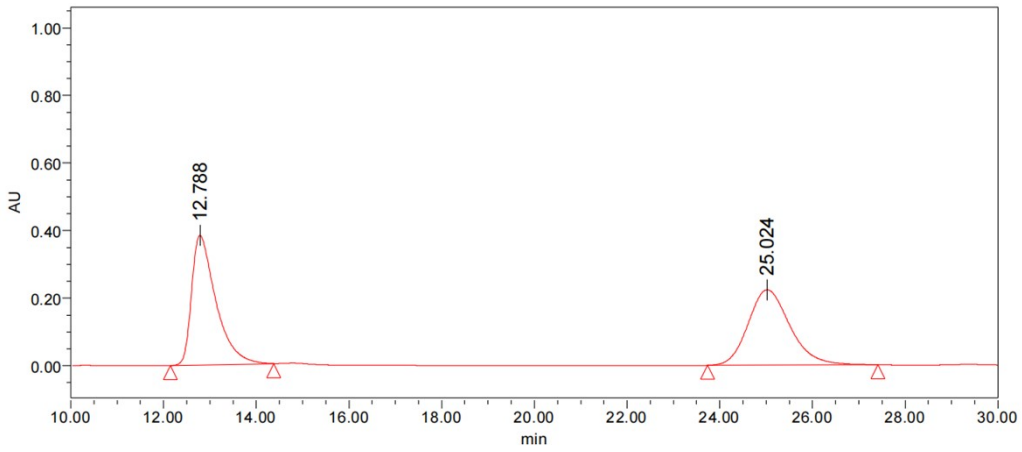
^{13}C{^{1}H} NMR Spectrum of Compound **3pa** (101 MHz, $CDCl_3$)



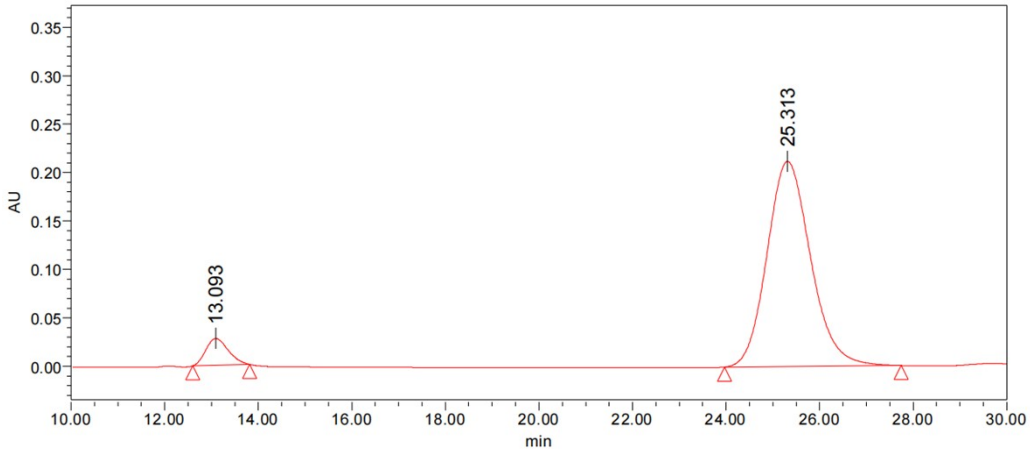
HPLC Spectra of Compound **3pa**



3pa

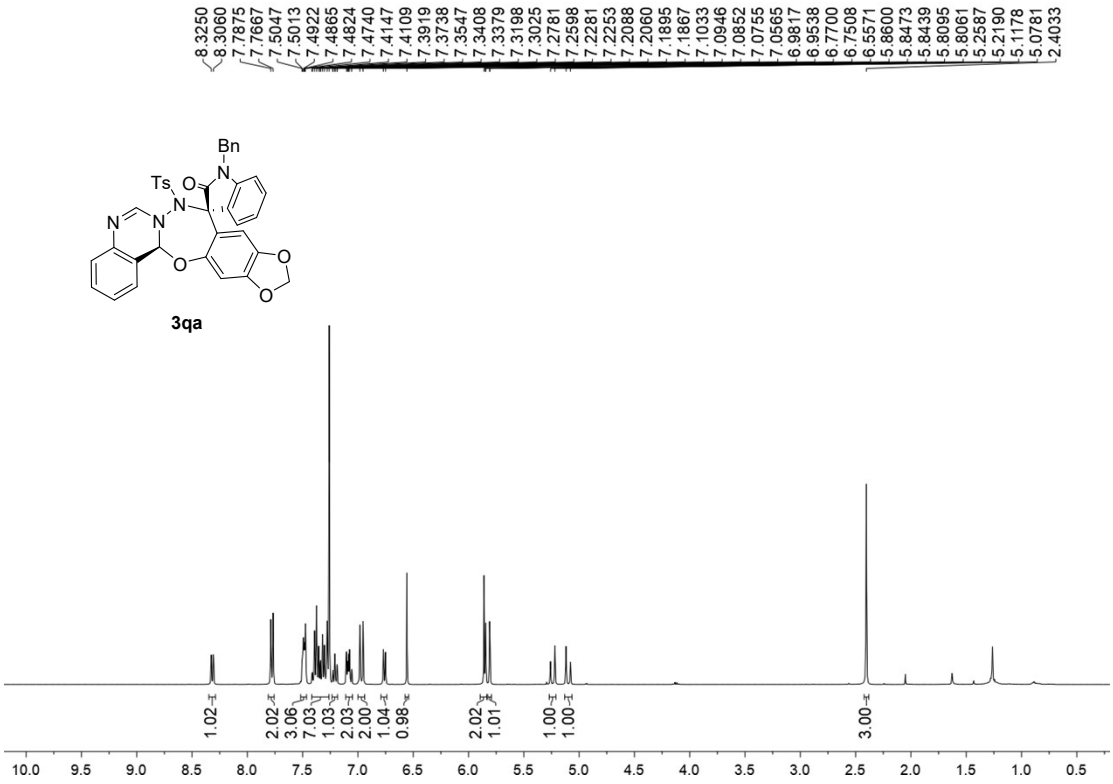


	RetTime [min]	Area [mAU*s]	Area%
1	12.788	13960894	49.93
2	25.024	13999808	50.07

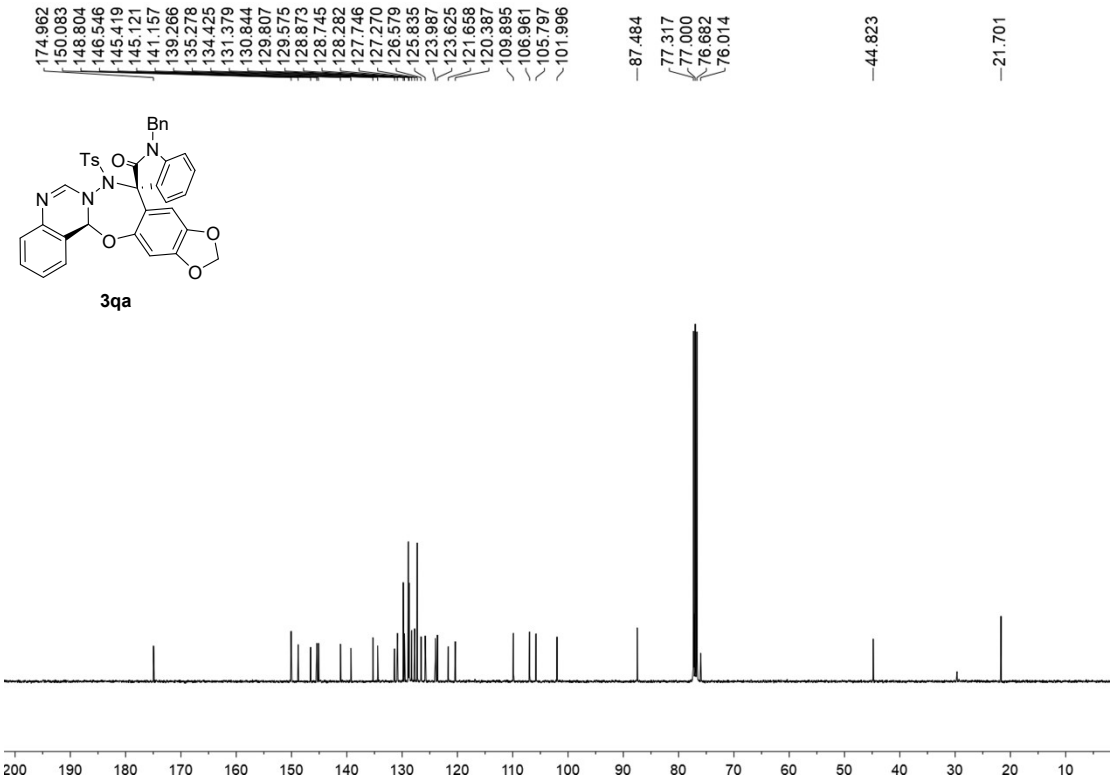


	RetTime [min]	Area [mAU*s]	Area%
1	13.093	920600	6.29
2	25.313	13722697	93.71

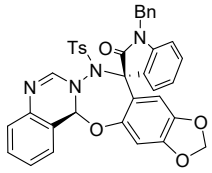
^{1}H NMR Spectrum of Compound **3qa** (400 MHz, $CDCl_3$)



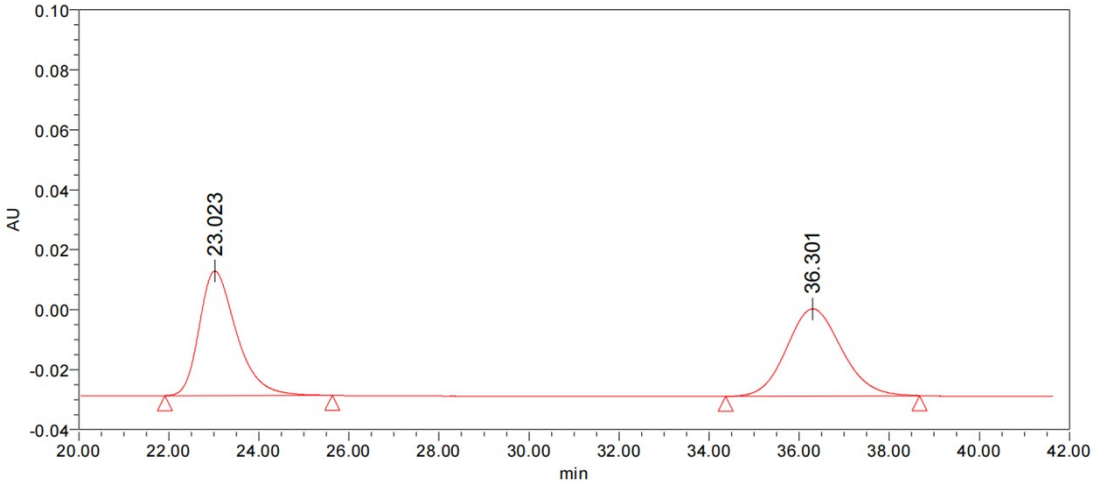
^{13}C{^{1}H} NMR Spectrum of Compound **3qa** (101 MHz, $CDCl_3$)



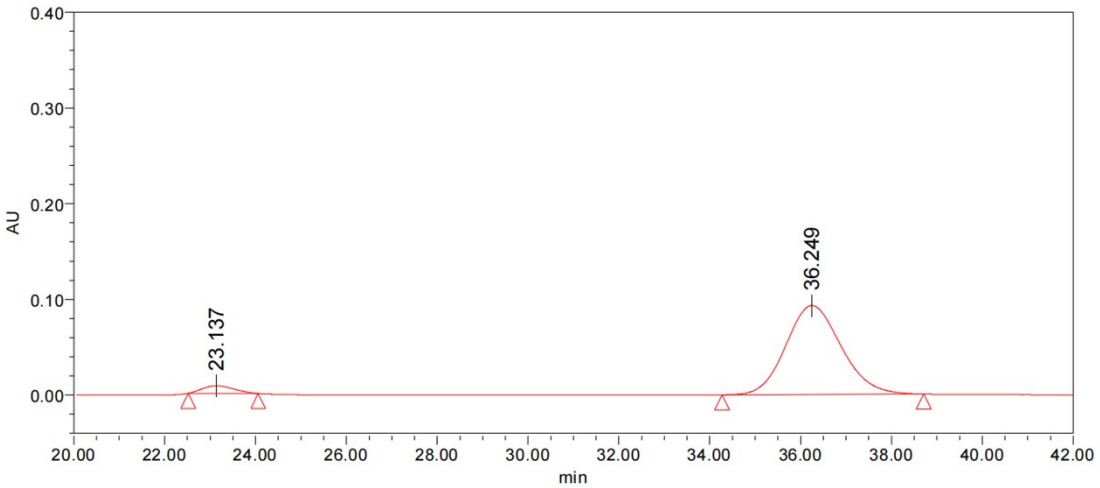
HPLC Spectra of Compound **3qa**



3qa

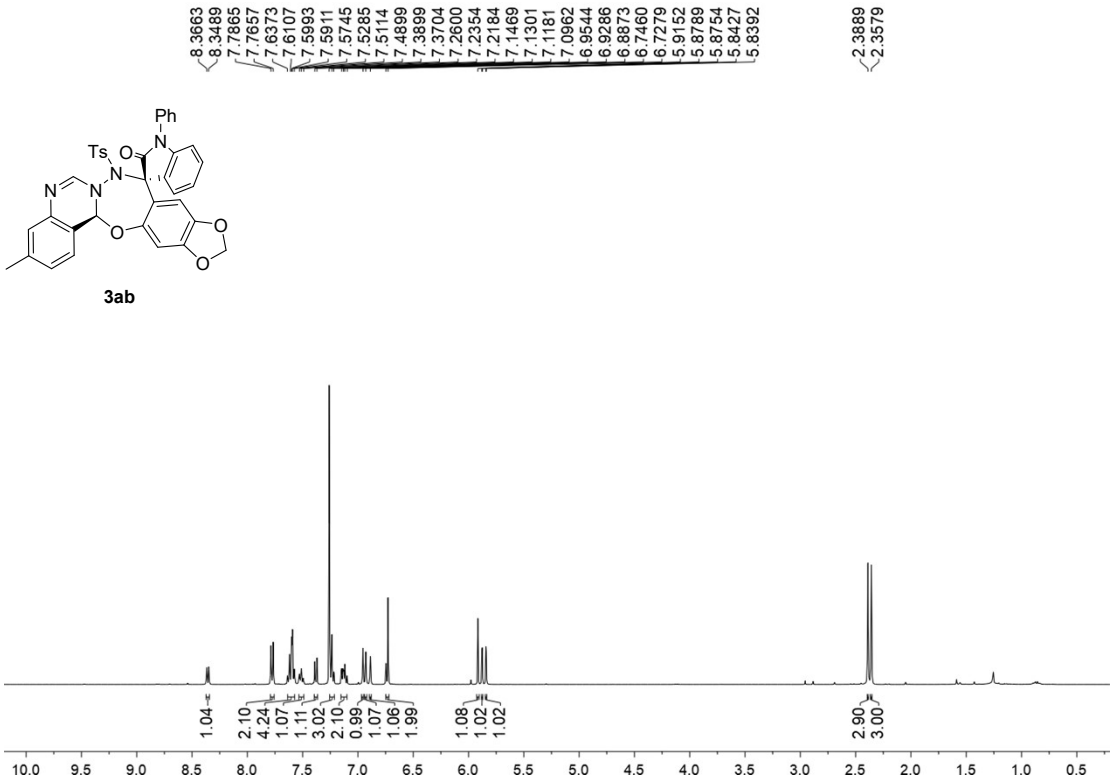


	RetTime [min]	Area [mAU*s]	Area%
1	23.023	2380150	49.19
2	36.301	2458453	50.81

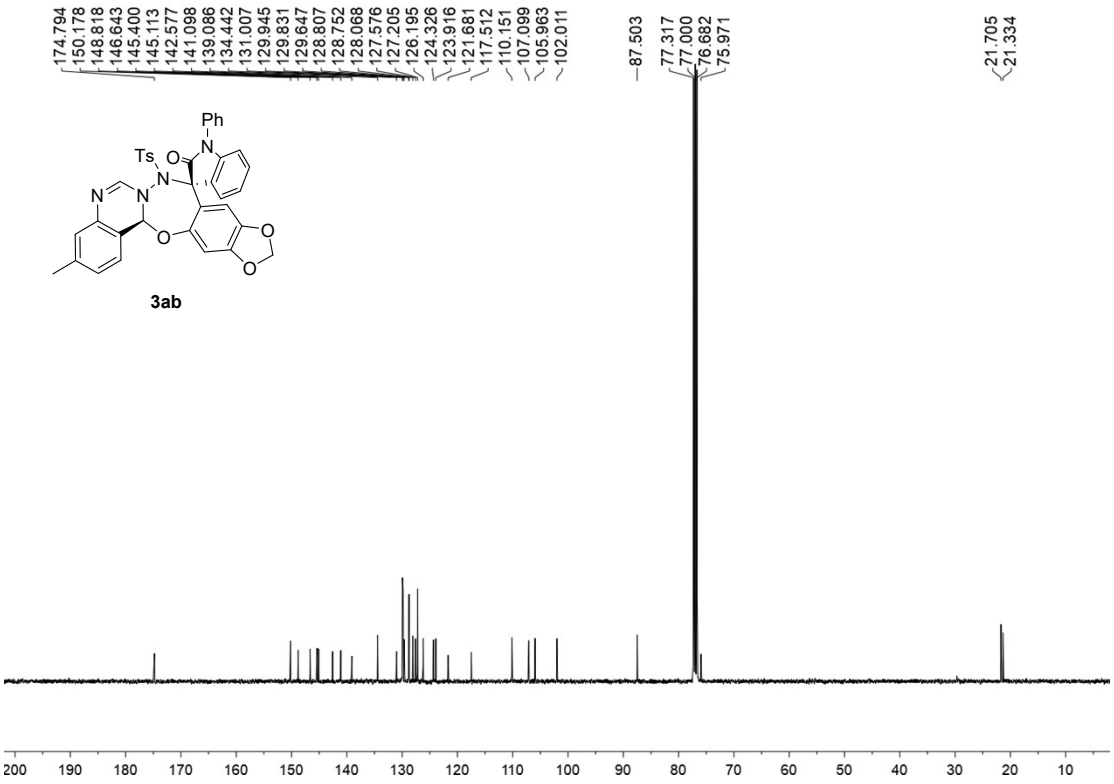


	RetTime [min]	Area [mAU*s]	Area%
1	23.137	381839	4.63
2	36.249	7865648	95.37

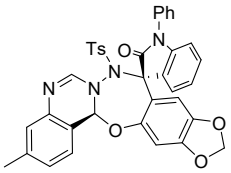
^{1}H NMR Spectrum of Compound **3ab** (400 MHz, $CDCl_3$)



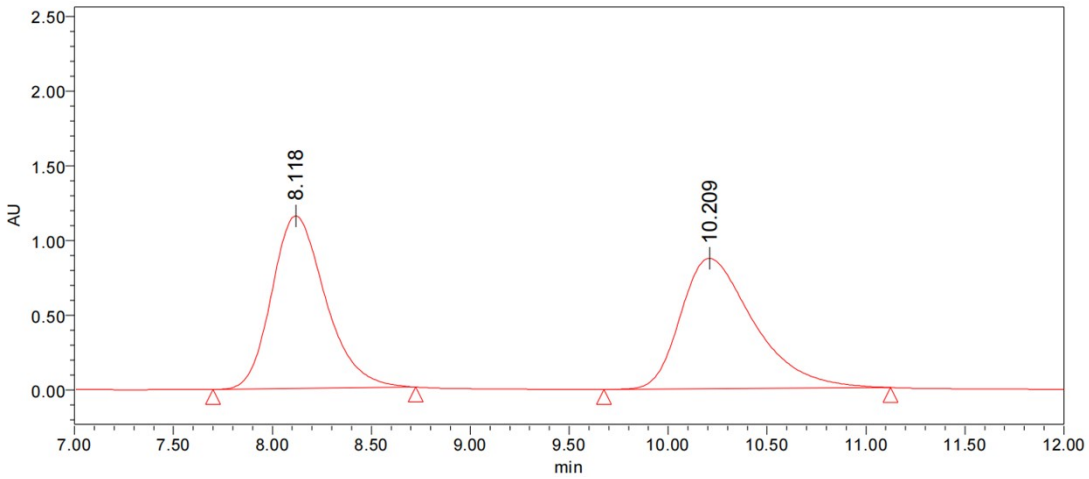
^{13}C{^{1}H} NMR Spectrum of Compound **3ab** (101 MHz, $CDCl_3$)



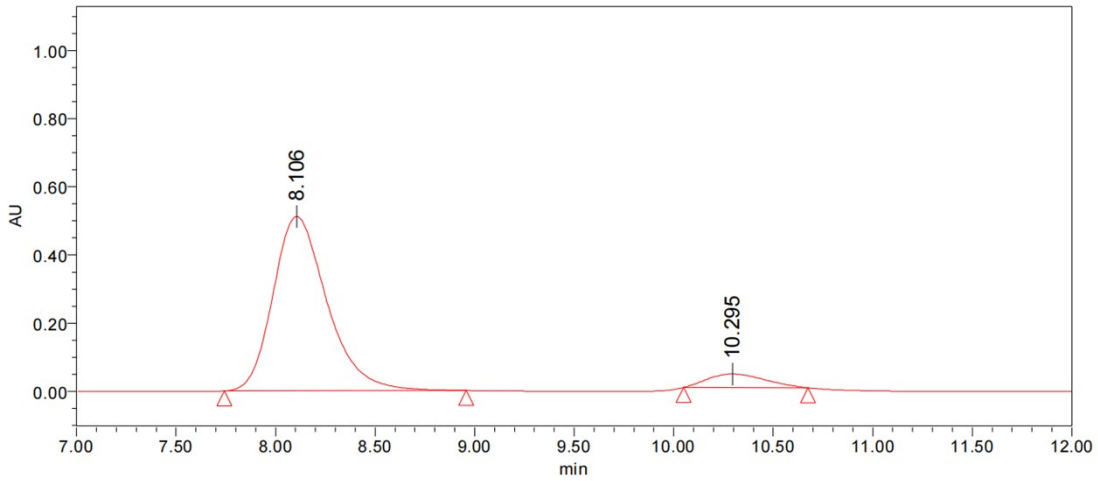
HPLC Spectra of Compound **3ab**



3ab

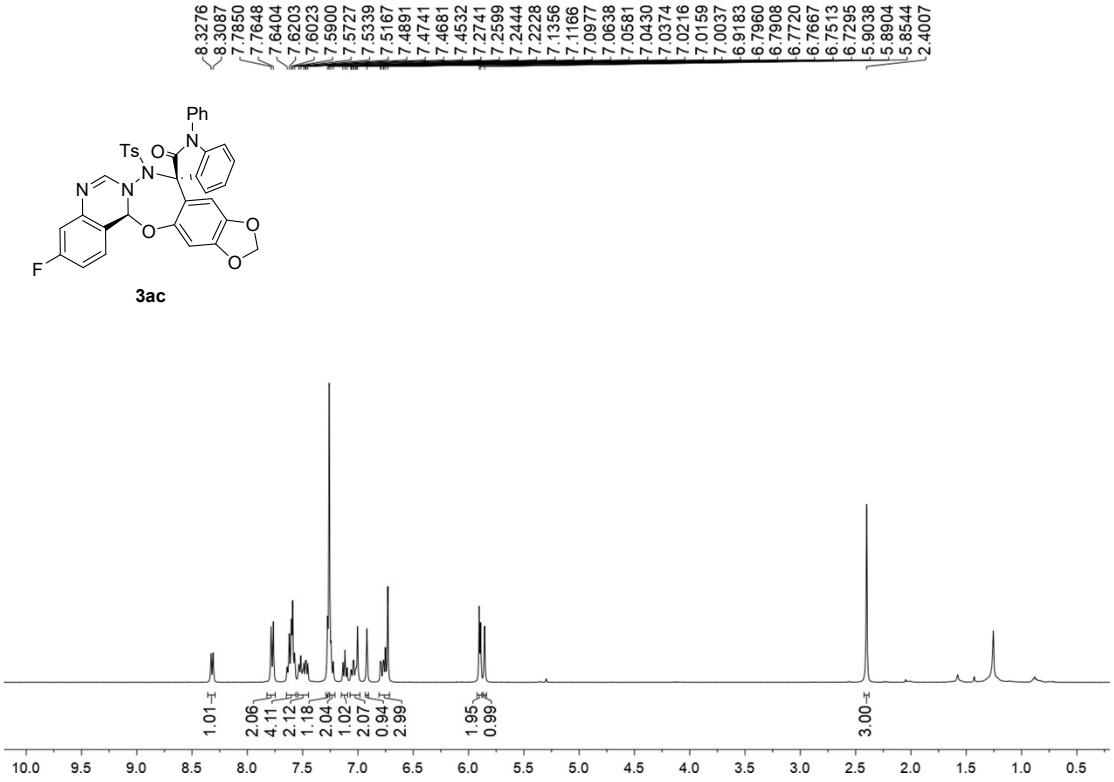


	RetTime [min]	Area [mAU*s]	Area%
1	8.118	21854668	49.32
2	10.209	22460085	50.68

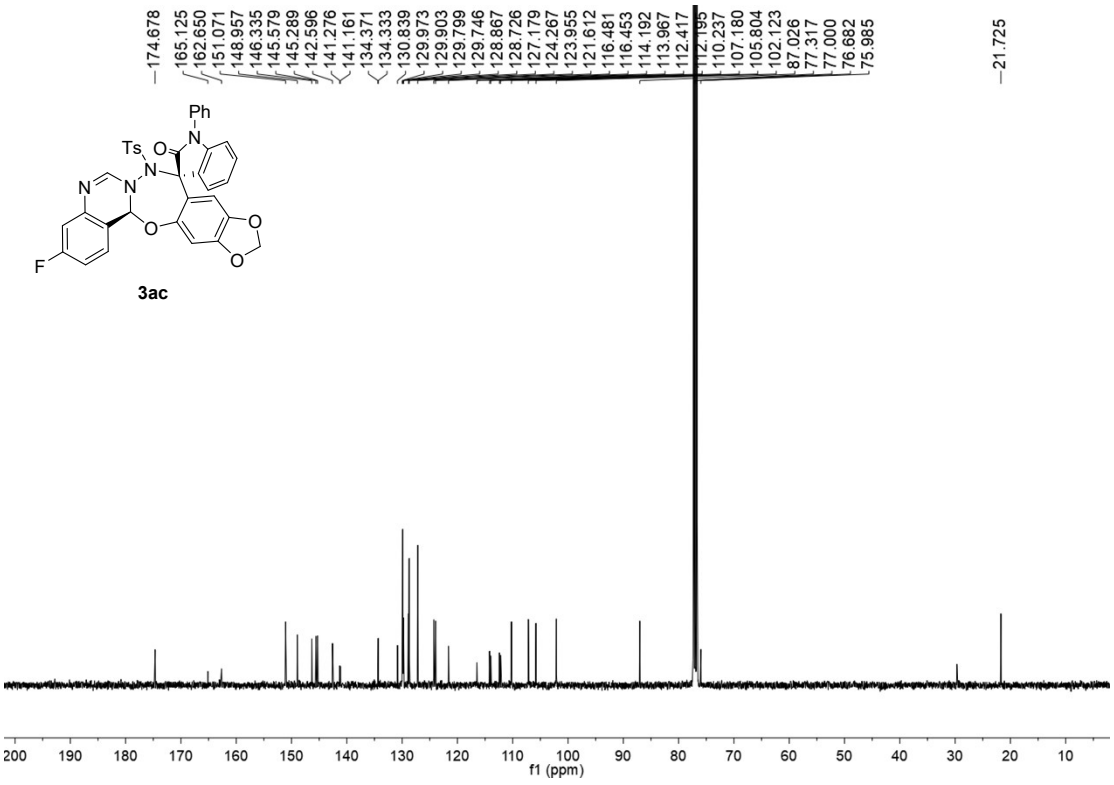


	RetTime [min]	Area [mAU*s]	Area%
1	8.106	9657589	92.29
2	10.295	806973	7.71

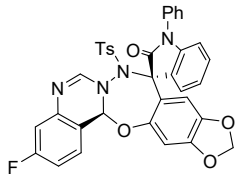
^{1}H NMR Spectrum of Compound **3ac** (400 MHz, $CDCl_3$)



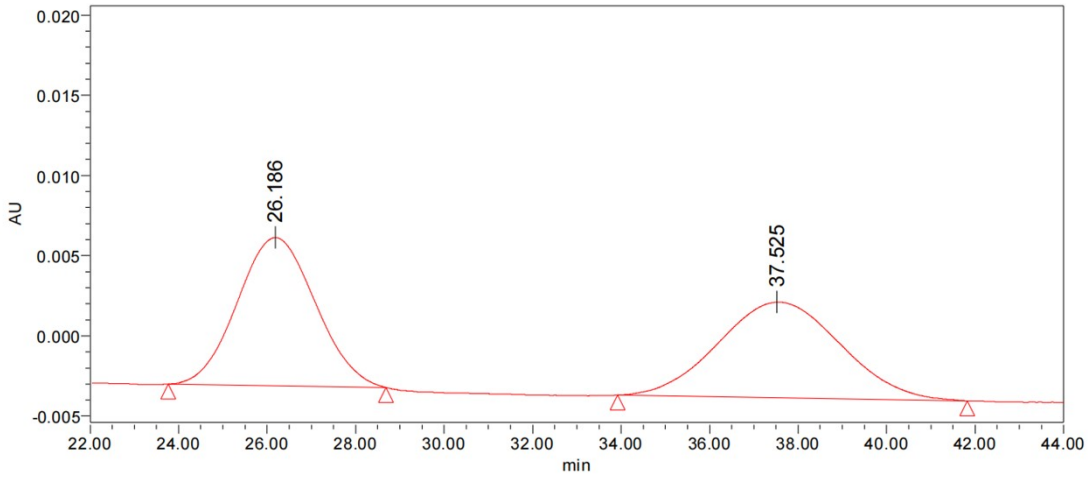
^{13}C{^{1}H} NMR Spectrum of Compound **3ac** (101 MHz, $CDCl_3$)



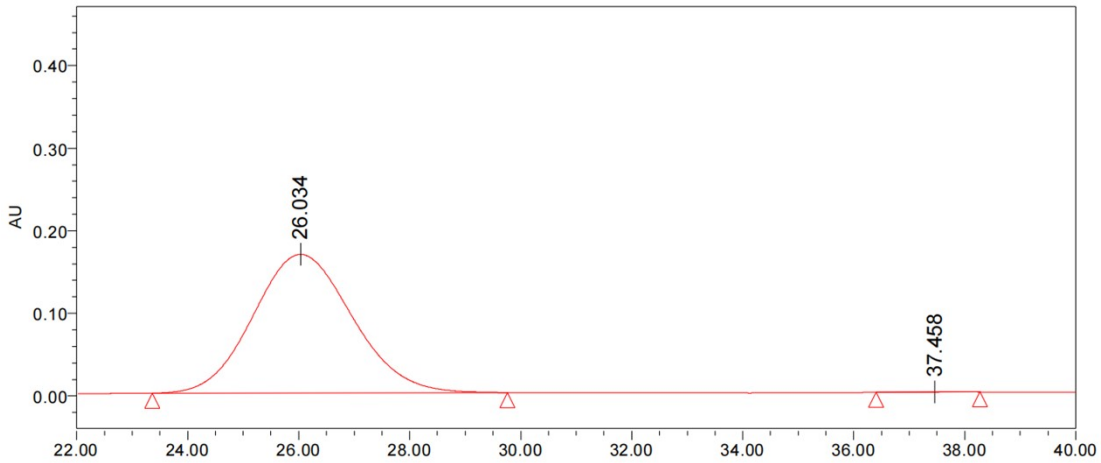
HPLC Spectra of Compound **3ac**



3ac

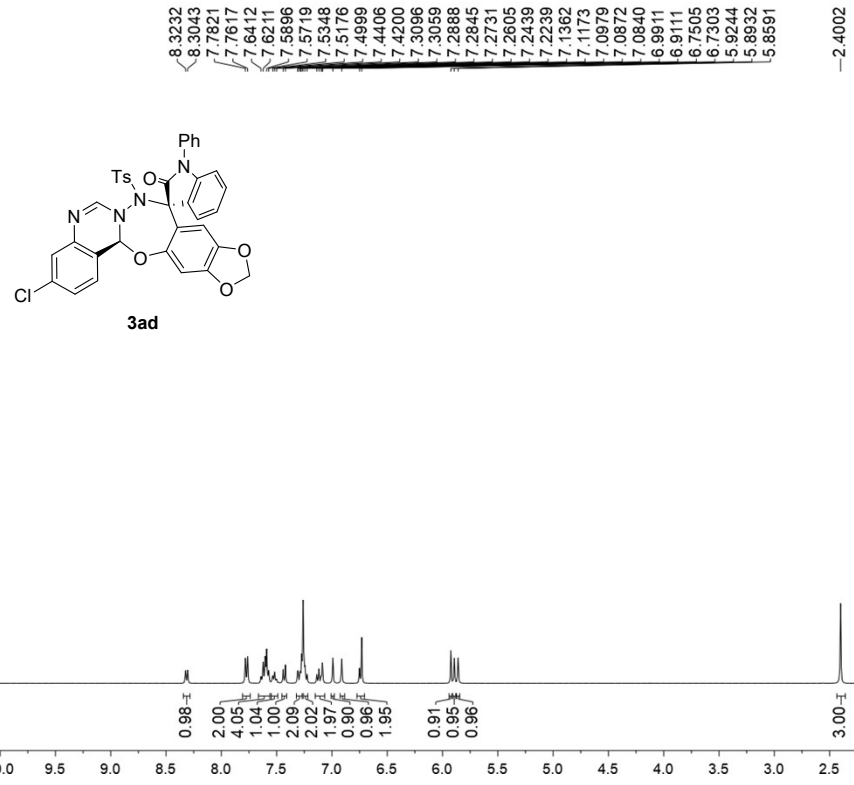


	RetTime [min]	Area [mAU*s]	Area%
1	26.186	1132048	49.72
2	37.525	1144905	50.28

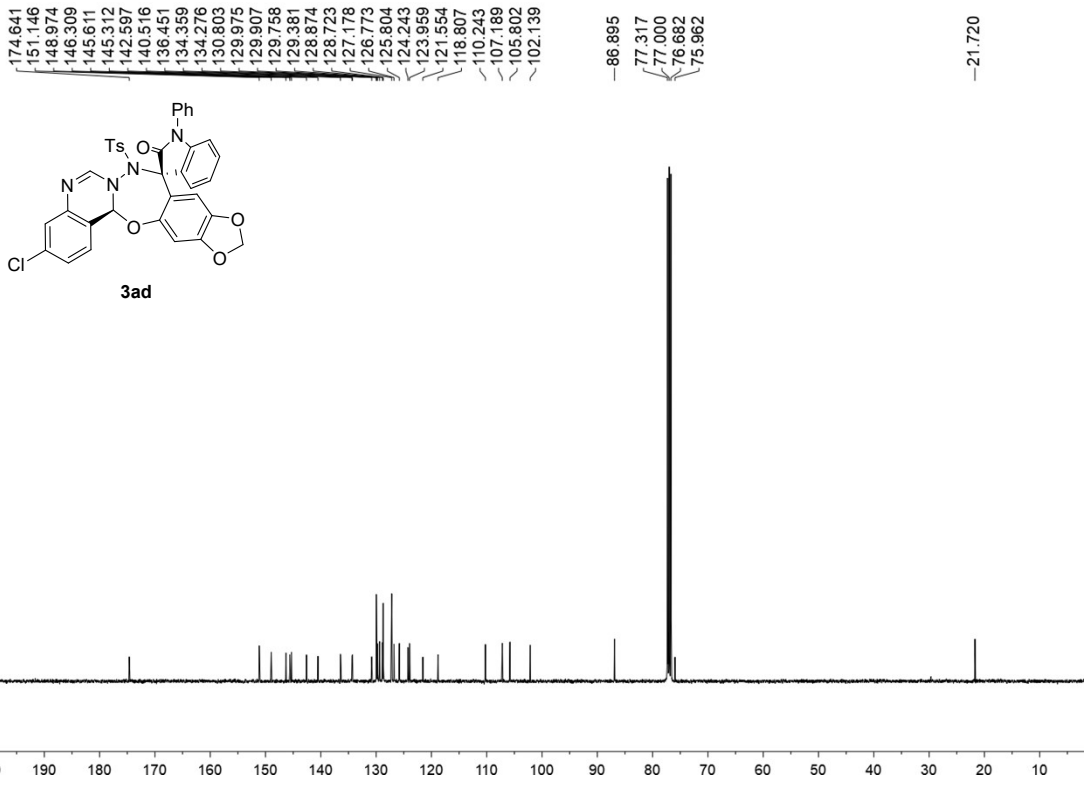


	RetTime [min]	**Area [mAU*s]**	**Area%**
1	26.034	20858561	99.94
2	37.458	12987	0.06

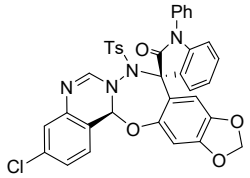
^{1}H NMR Spectrum of Compound **3ad** (400 MHz, $CDCl_3$)



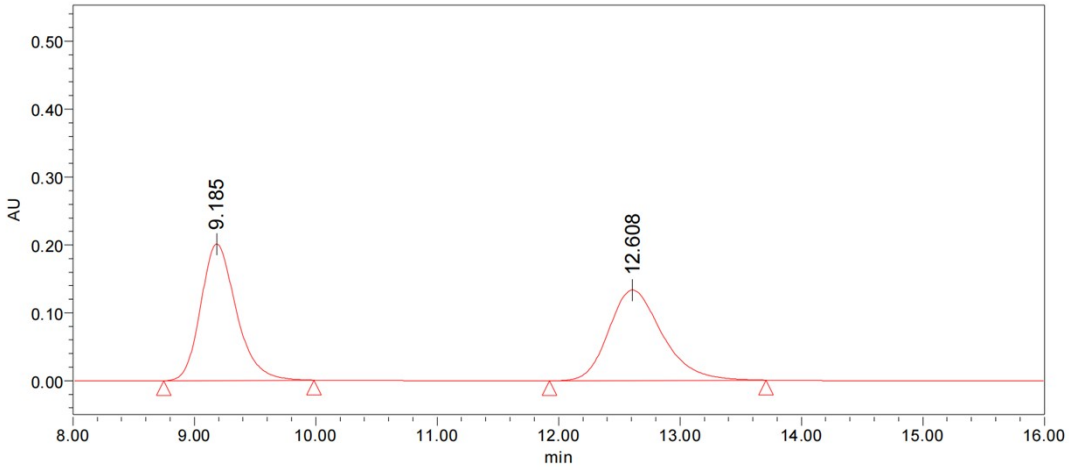
^{13}C{^{1}H} NMR Spectrum of Compound **3ad** (101 MHz, $CDCl_3$)



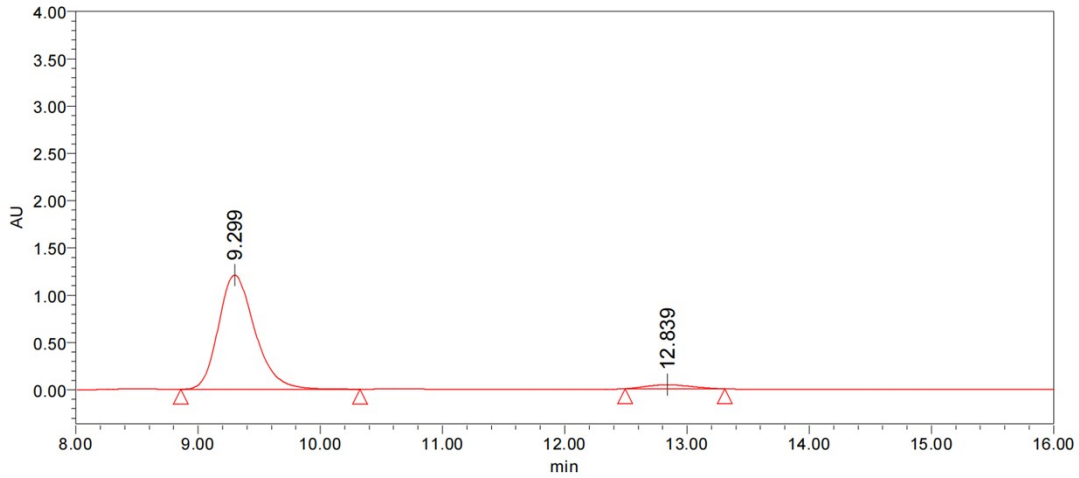
HPLC Spectra of Compound **3ad**



3ad

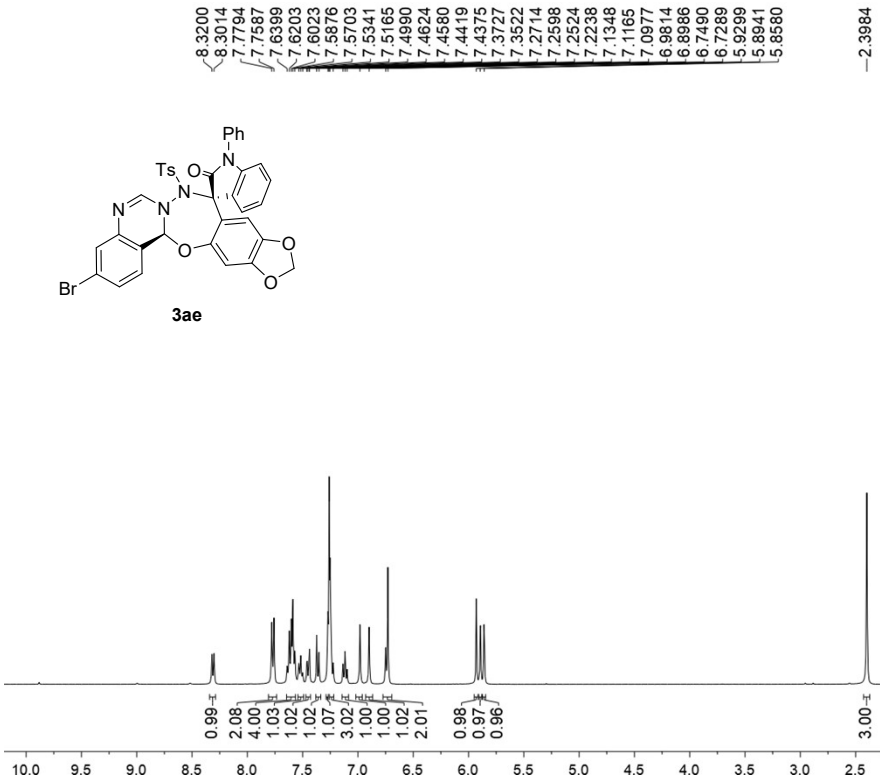


	RetTime [min]	Area [mAU*s]	Area%
1	9.185	4081746	50.07
2	12.608	4069646	49.93

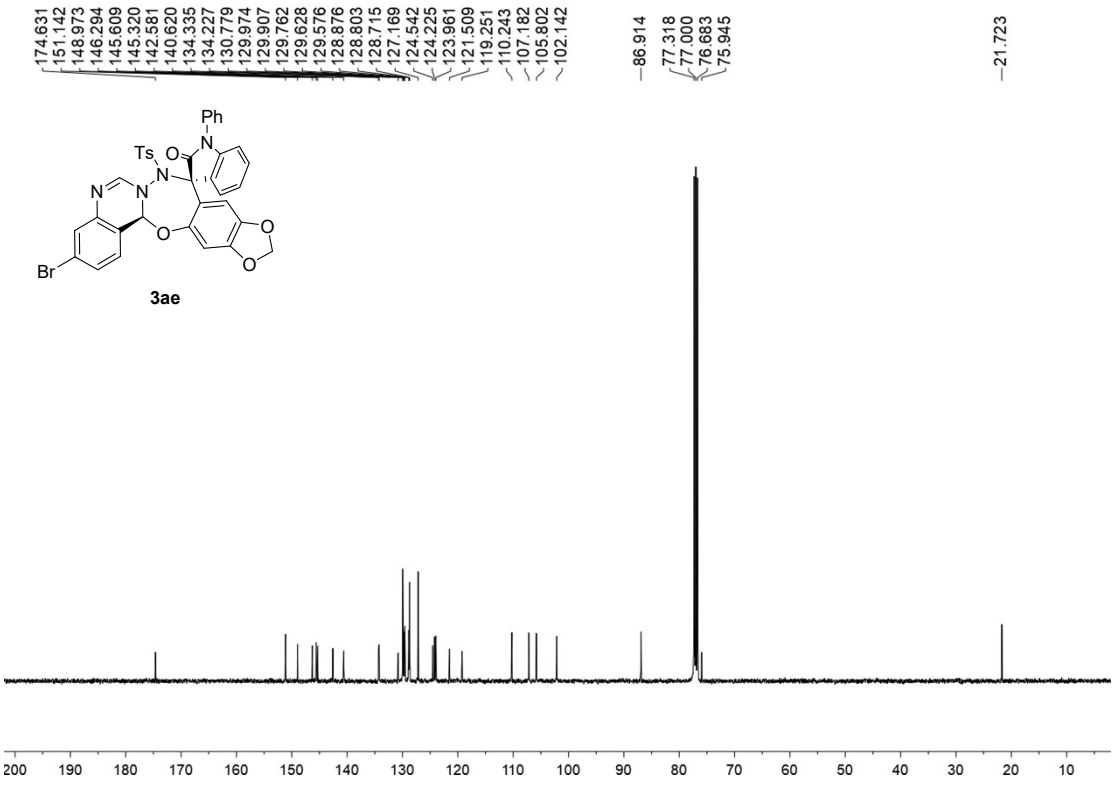


	RetTime [min]	Area [mAU*s]	Area%
1	9.299	25002255	95.86
2	12.839	1079133	4.14

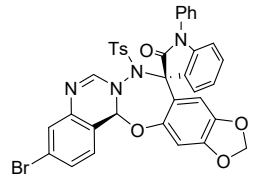
^{1}H NMR Spectrum of Compound **3ae** (400 MHz, $CDCl_3$)



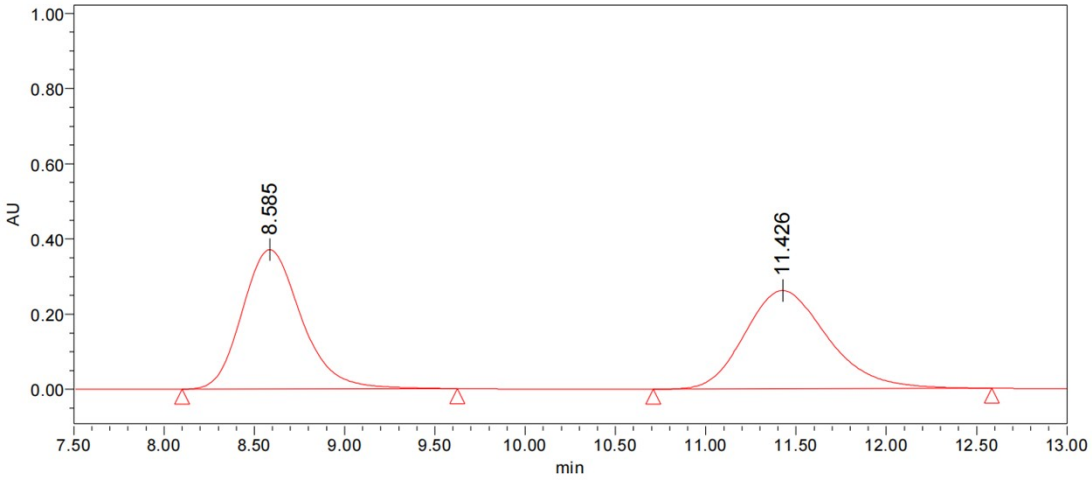
^{13}C{^{1}H} NMR Spectrum of Compound **3ae** (101 MHz, $CDCl_3$)



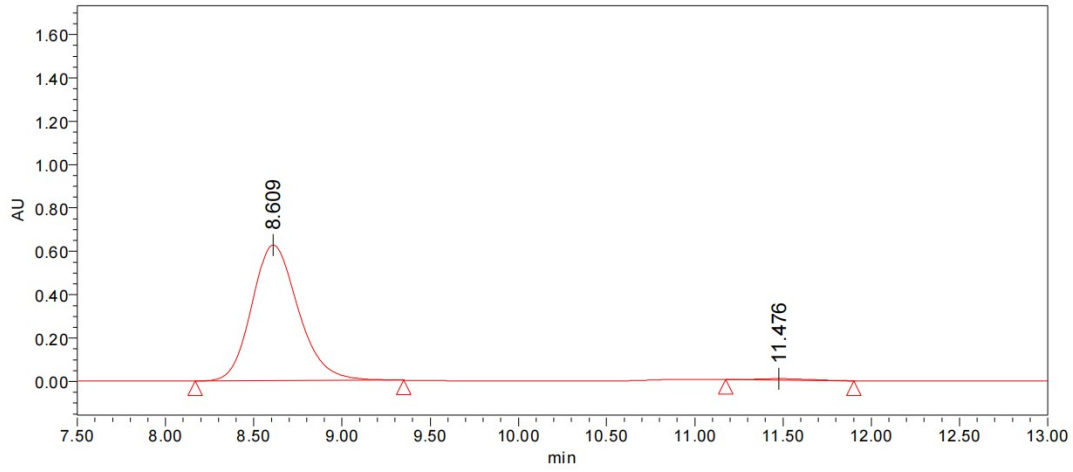
HPLC Spectra of Compound **3ae**



3ae

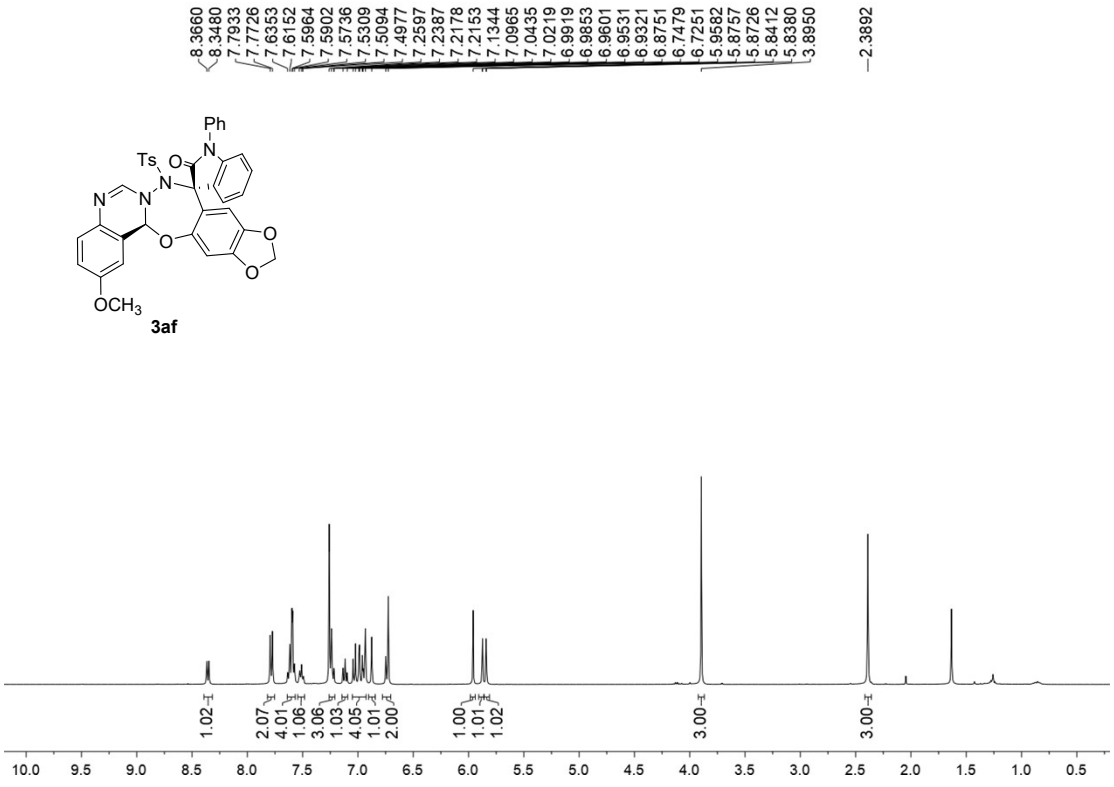


	RetTime [min]	Area [mAU*s]	Area%
1	8.585	8432968	50.29
2	11.426	8334585	49.71

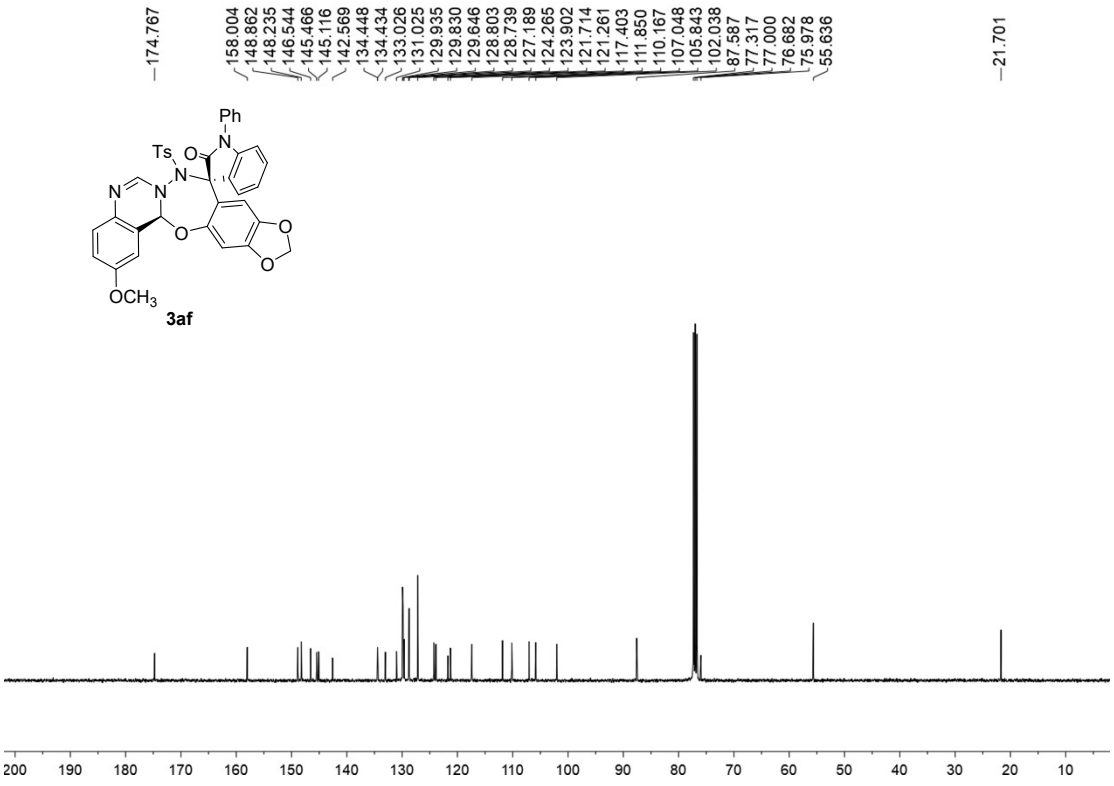


	RetTime [min]	Area [mAU*s]	Area%
1	8.609	11501124	98.77
2	11.476	143803	1.23

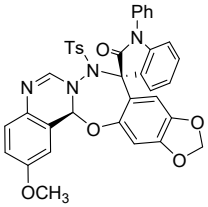
^{1}H NMR Spectrum of Compound **3af** (400 MHz, $CDCl_3$)



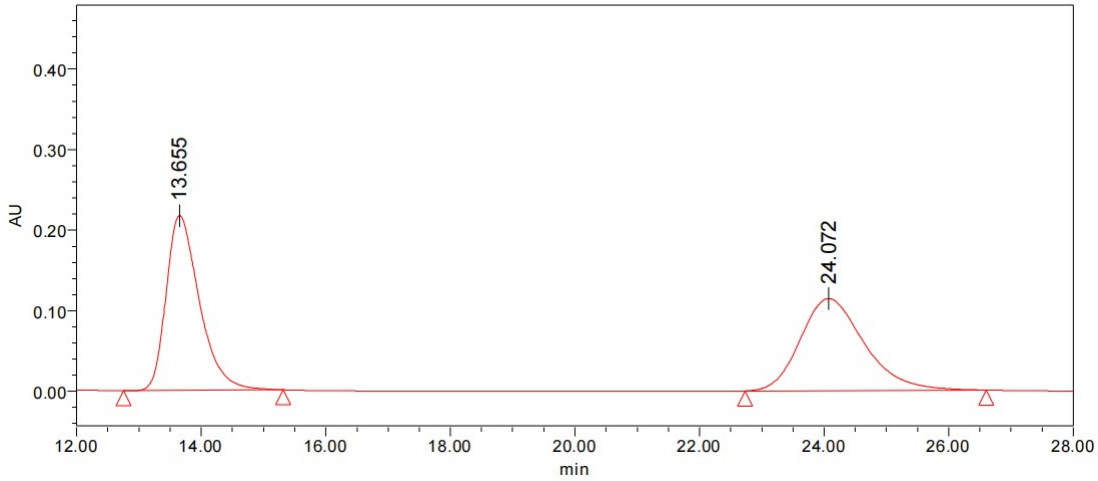
^{13}C{^{1}H} NMR Spectrum of Compound **3af** (101 MHz, $CDCl_3$)



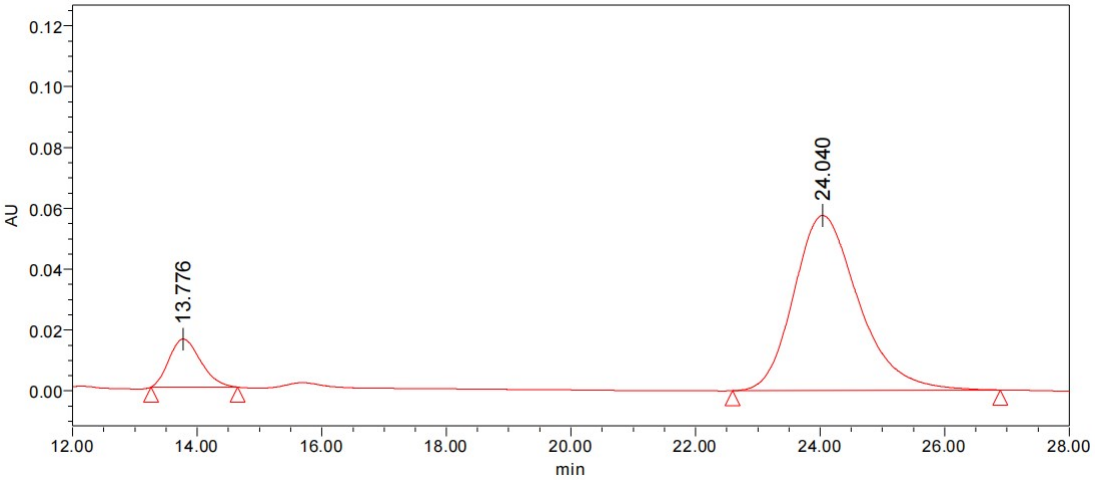
HPLC Spectra of Compound **3af**



3af

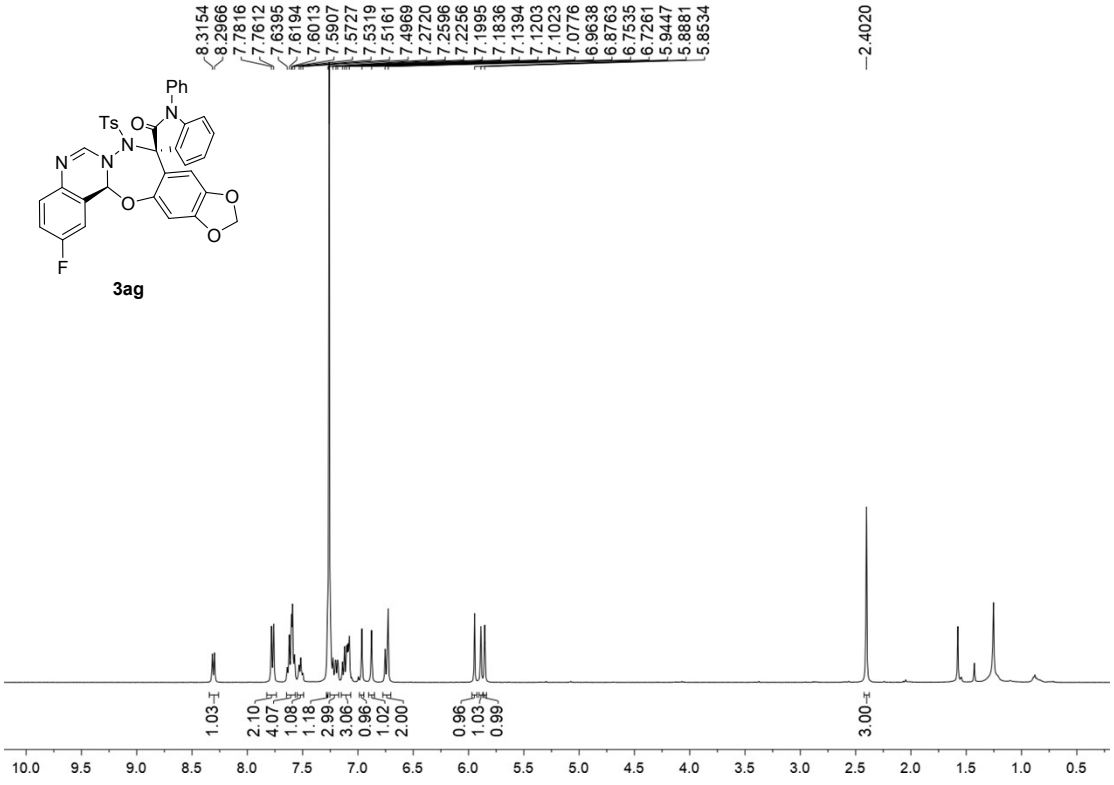


	RetTime [min]	Area [mAU*s]	Area%
1	13.655	8059090	49.71
2	24.072	8151870	50.29



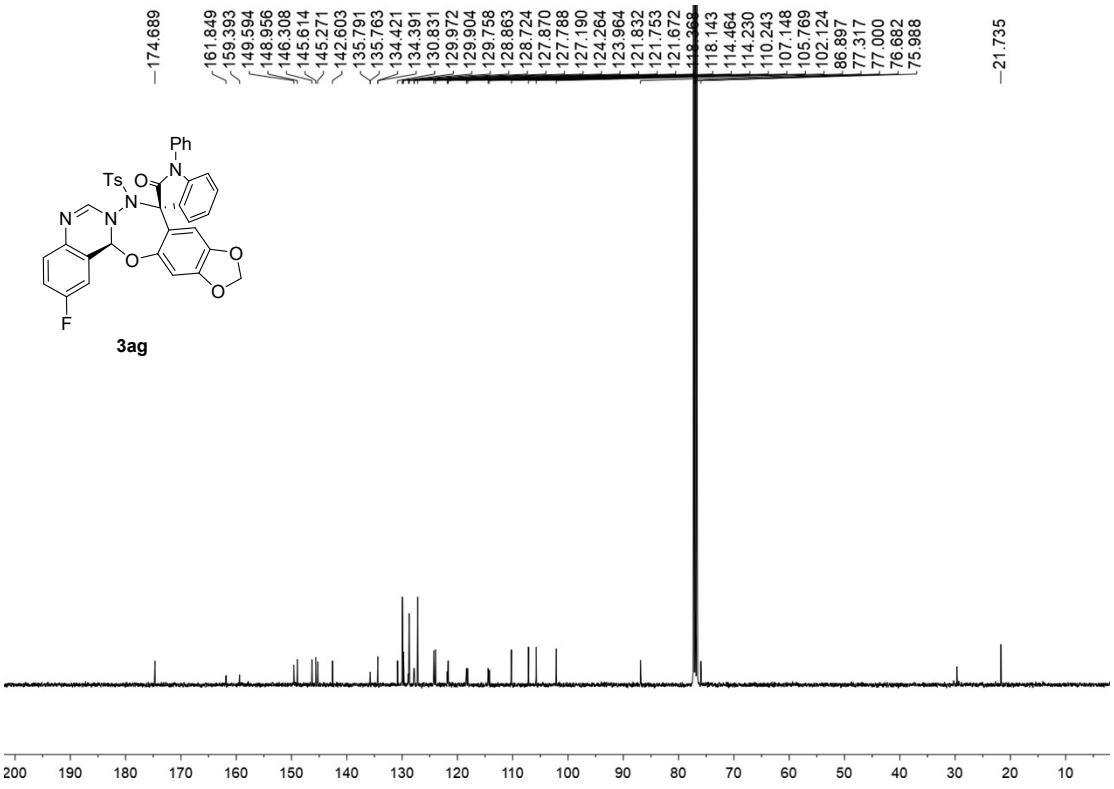
	RetTime [min]	Area [mAU*s]	Area%
1	13.776	555223	11.78
2	24.040	4158865	88.22

^{1}H NMR Spectrum of Compound **3ag** (400 MHz, $CDCl_3$)



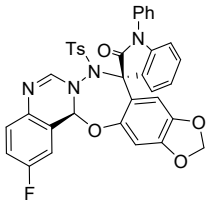
3ag

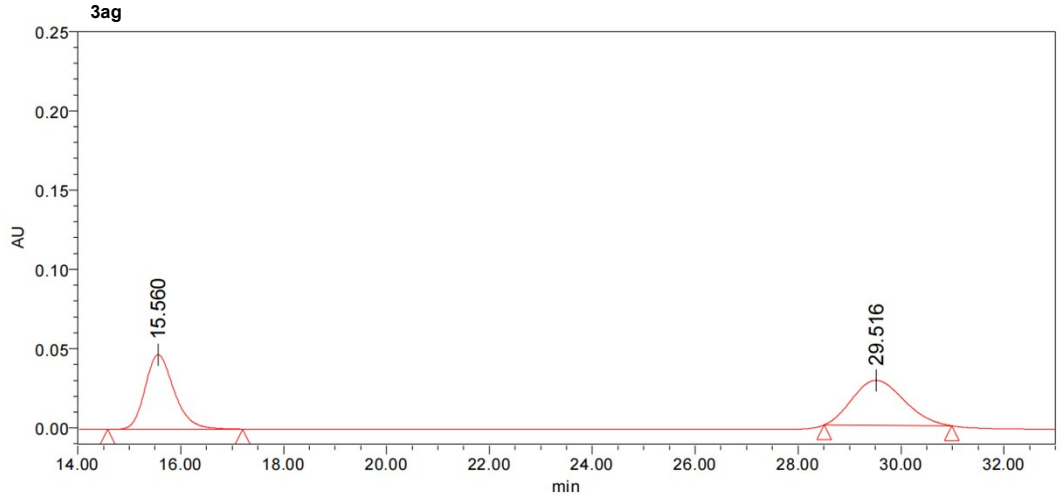
^{13}C{^{1}H} NMR Spectrum of Compound **3ag** (101 MHz, $CDCl_3$)



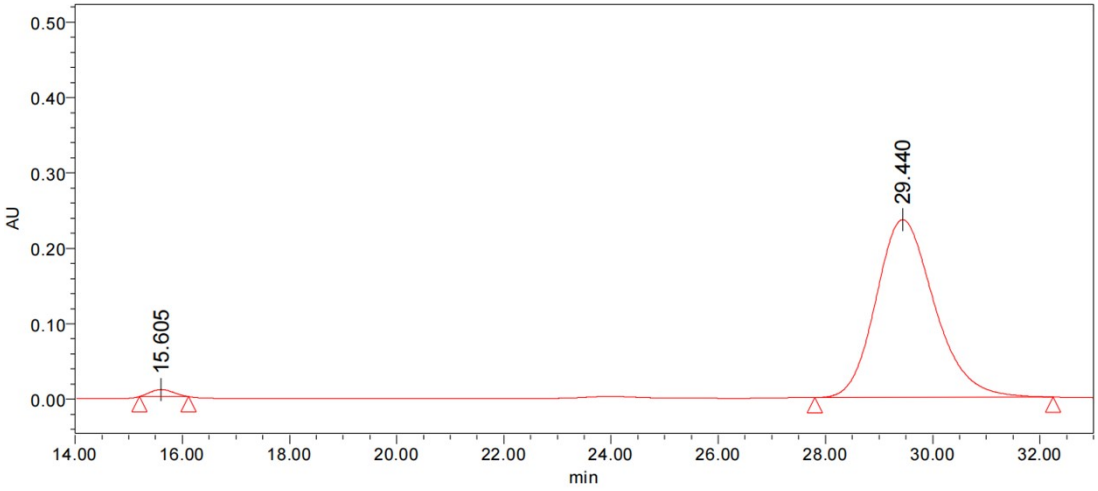
3ag

HPLC Spectra of Compound **3ag**





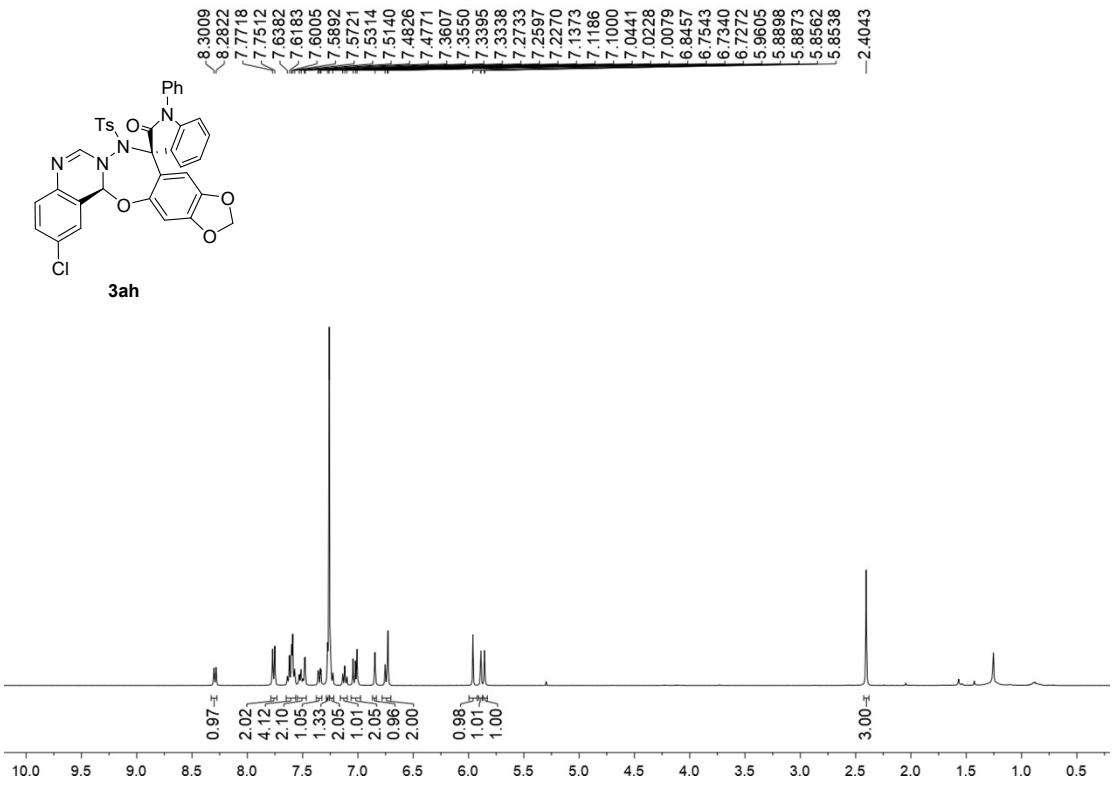
	RetTime [min]	Area [mAU*s]	Area%
1	15.560	1841510	48.21
2	29.516	1978420	51.79



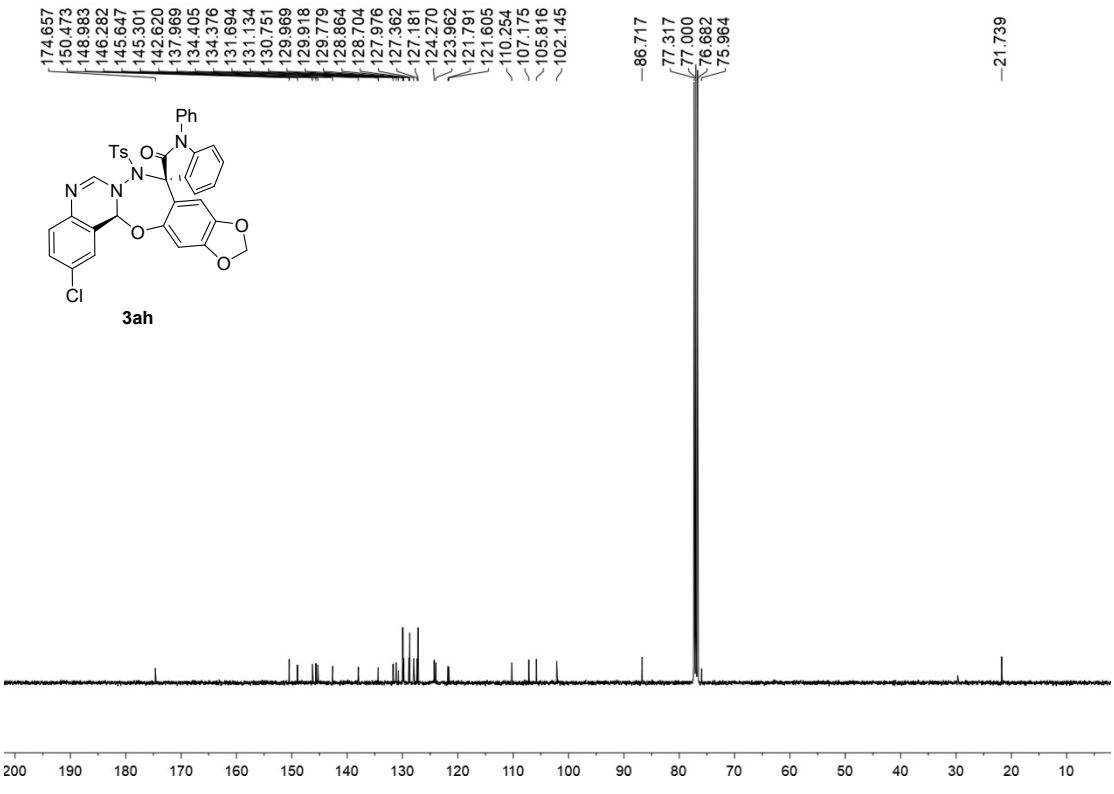
	RetTime [min]	Area [mAU*s]	Area%
1	15.605	282224	1.55
2	29.440	17869788	98.45

^{1}H NMR Spectrum of Compound **3ah** (400 MHz, $CDCl_3$)

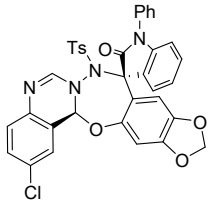
,

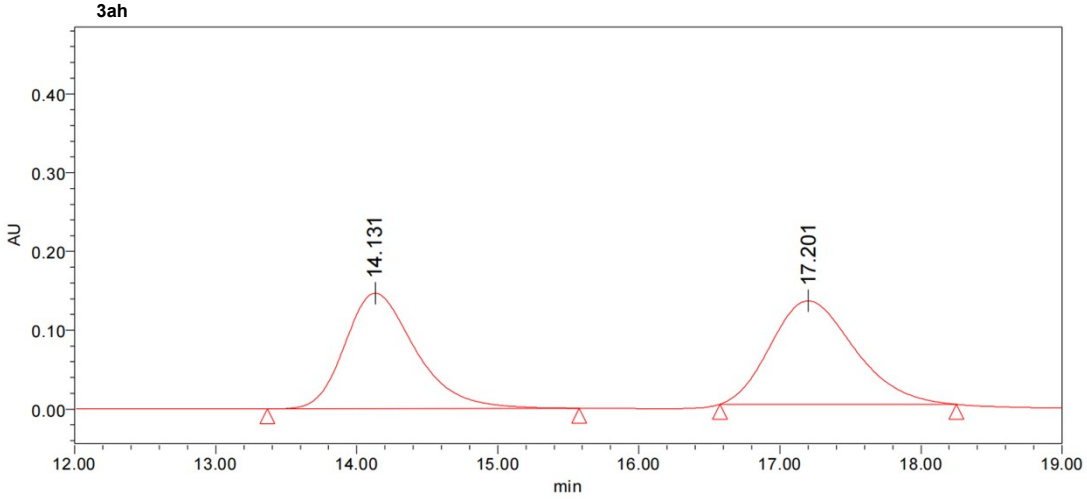


^{13}C{^{1}H} NMR Spectrum of Compound **3ah** (101 MHz, $CDCl_3$)

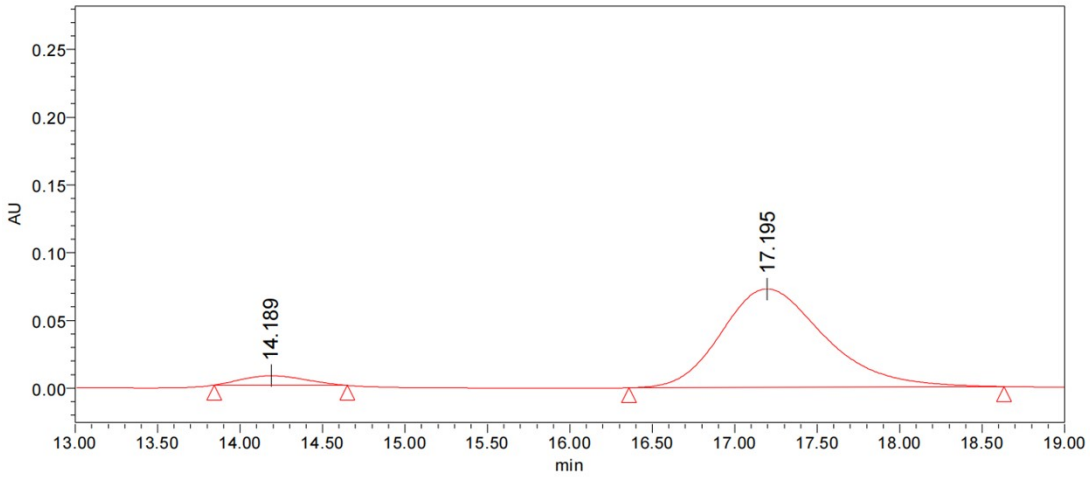


HPLC Spectra of Compound **3ah**



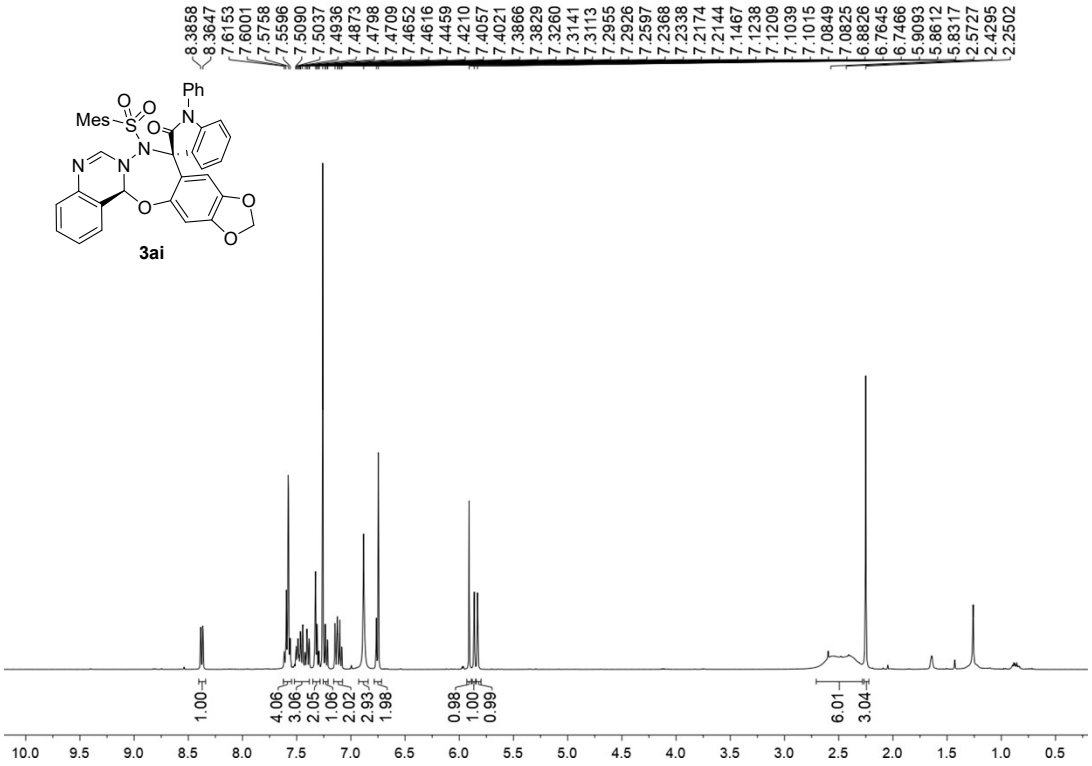


	RetTime [min]	Area [mAU*s]	Area%
1	14.131	5106431	48.47
2	17.201	5429092	51.53

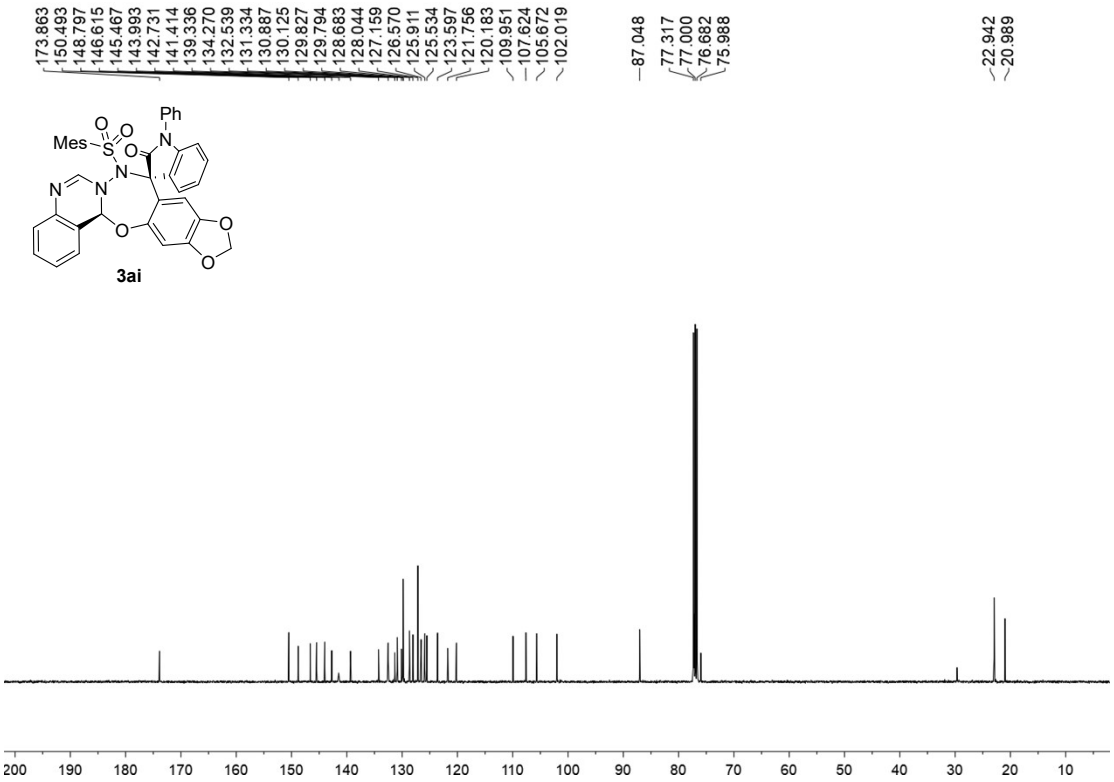


	RetTime [min]	Area [mAU*s]	Area%
1	14.189	185896	5.54
2	17.195	3166749	94.46

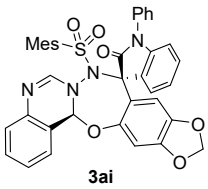
^{1}H NMR Spectrum of Compound **3ai** (400 MHz, $CDCl_3$)

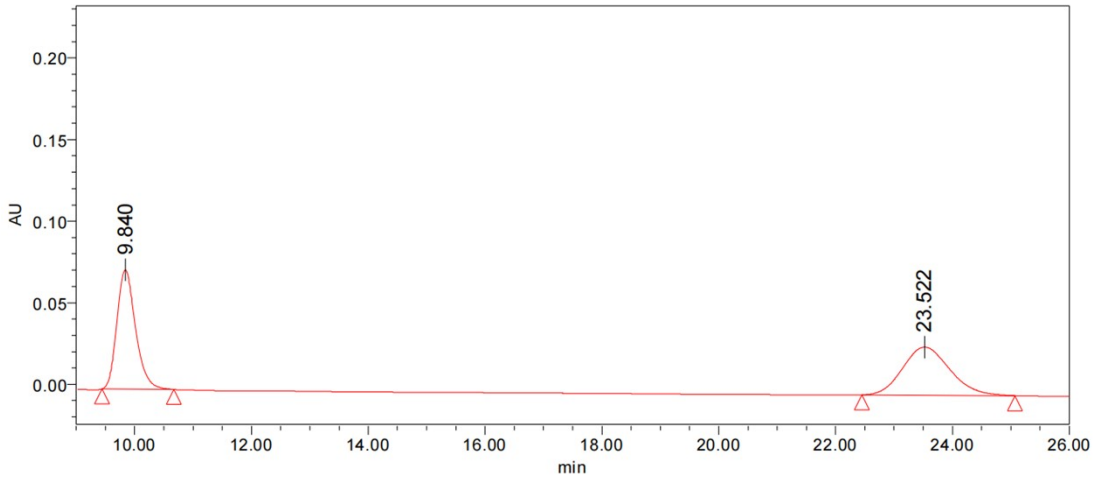


^{13}C{^{1}H} NMR Spectrum of Compound **3ai** (101 MHz, $CDCl_3$)

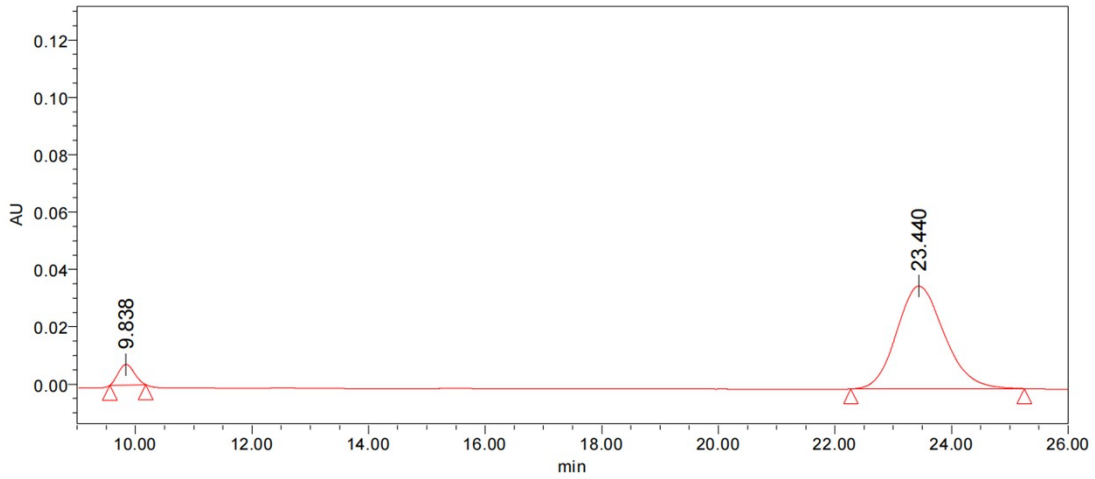


HPLC Spectra of Compound **3ai**



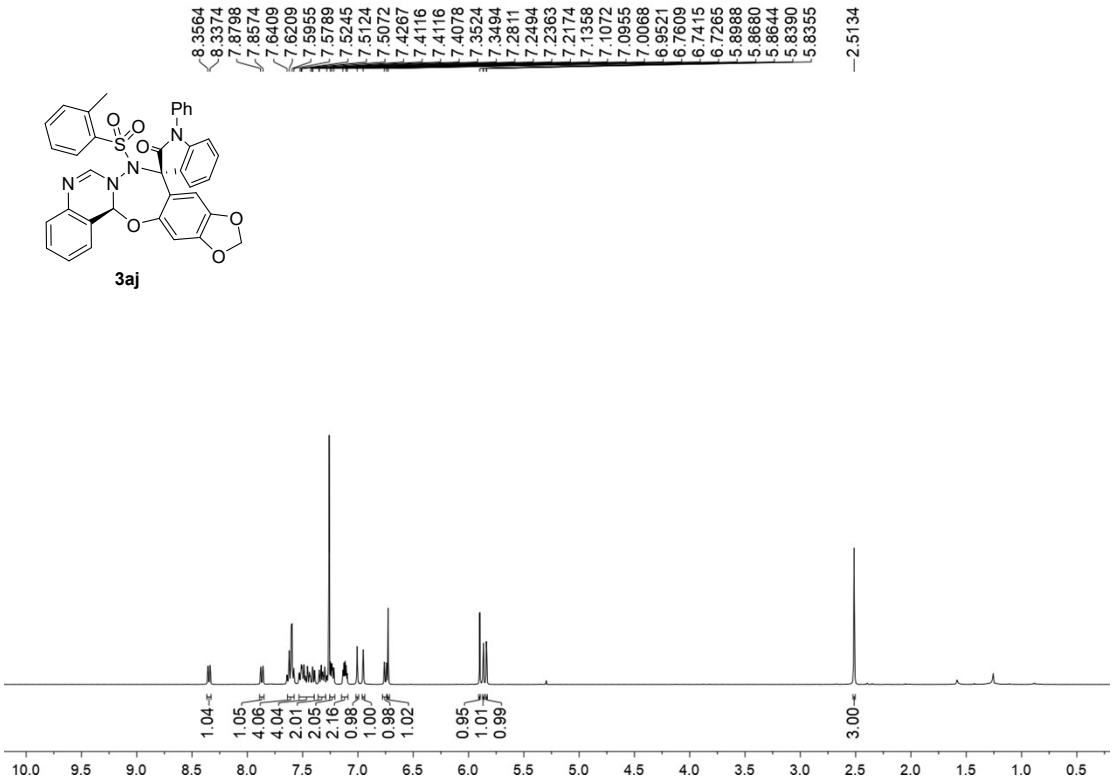


	RetTime [min]	Area [mAU*s]	Area%
1	9.840	1623388	49.54
2	23.522	1653754	50.46

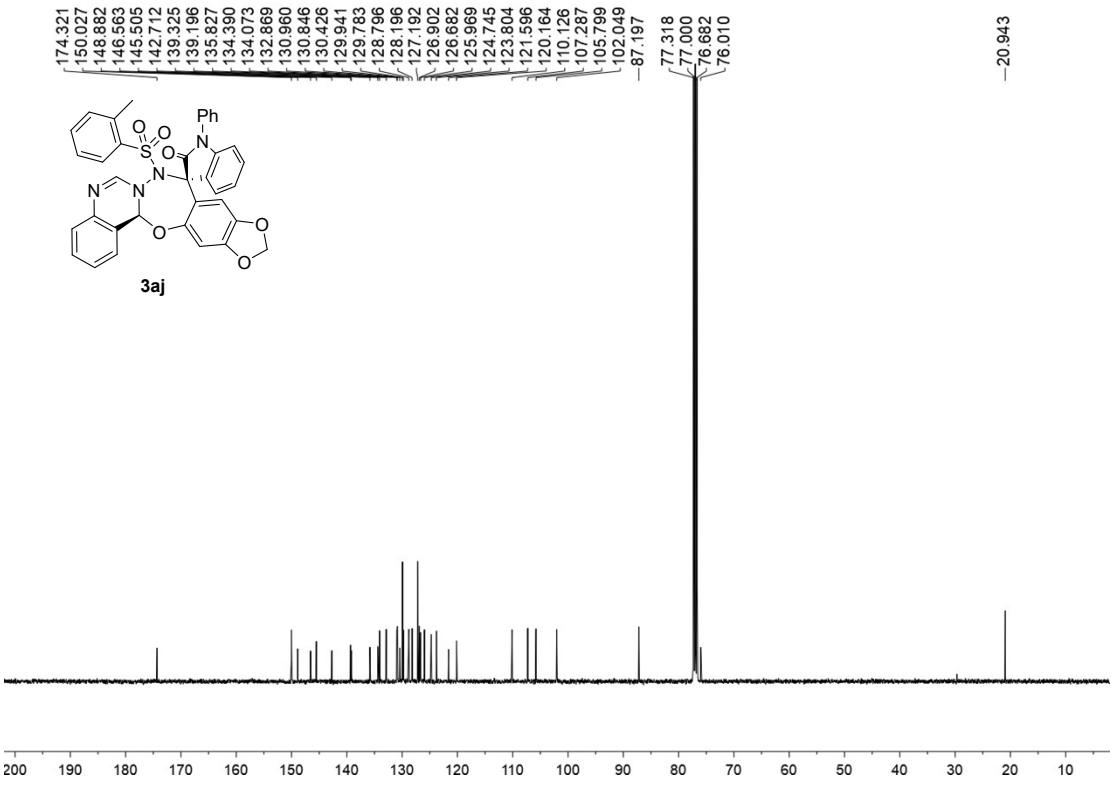


	RetTime [min]	Area [mAU*s]	Area%
1	9.838	136139	6.29
2	23.440	2028099	93.71

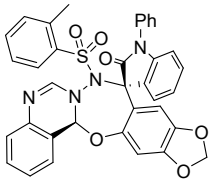
^{1}H NMR Spectrum of Compound **3aj** (400 MHz, $CDCl_3$)



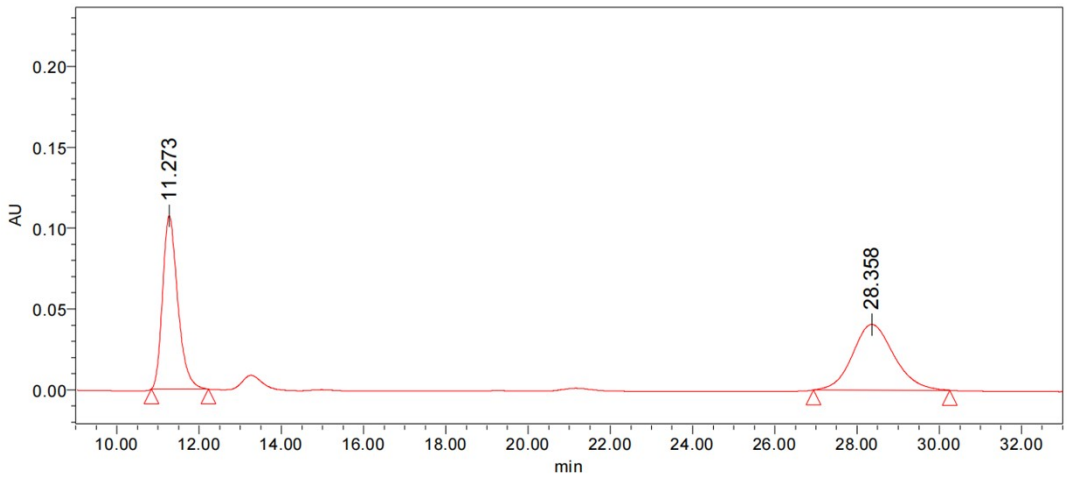
^{13}C{^{1}H} NMR Spectrum of Compound **3aj** (101 MHz, $CDCl_3$)



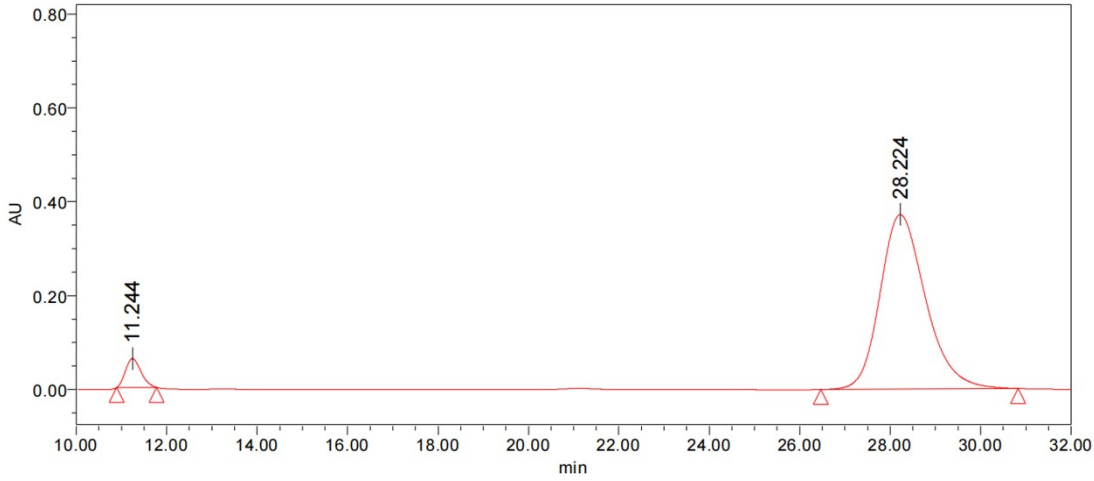
HPLC Spectra of Compound **3aj**



3aj

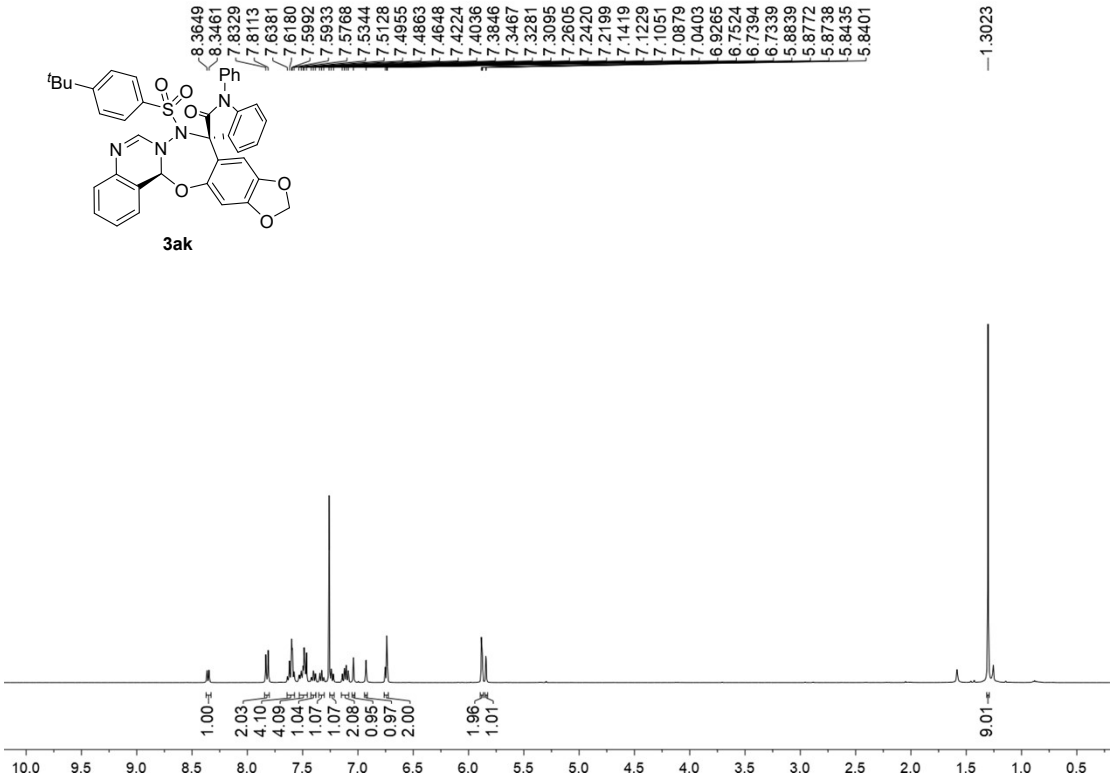


	RetTime [min]	Area [mAU*s]	Area%
1	11.273	2750344	49.16
2	28.358	2843834	50.84

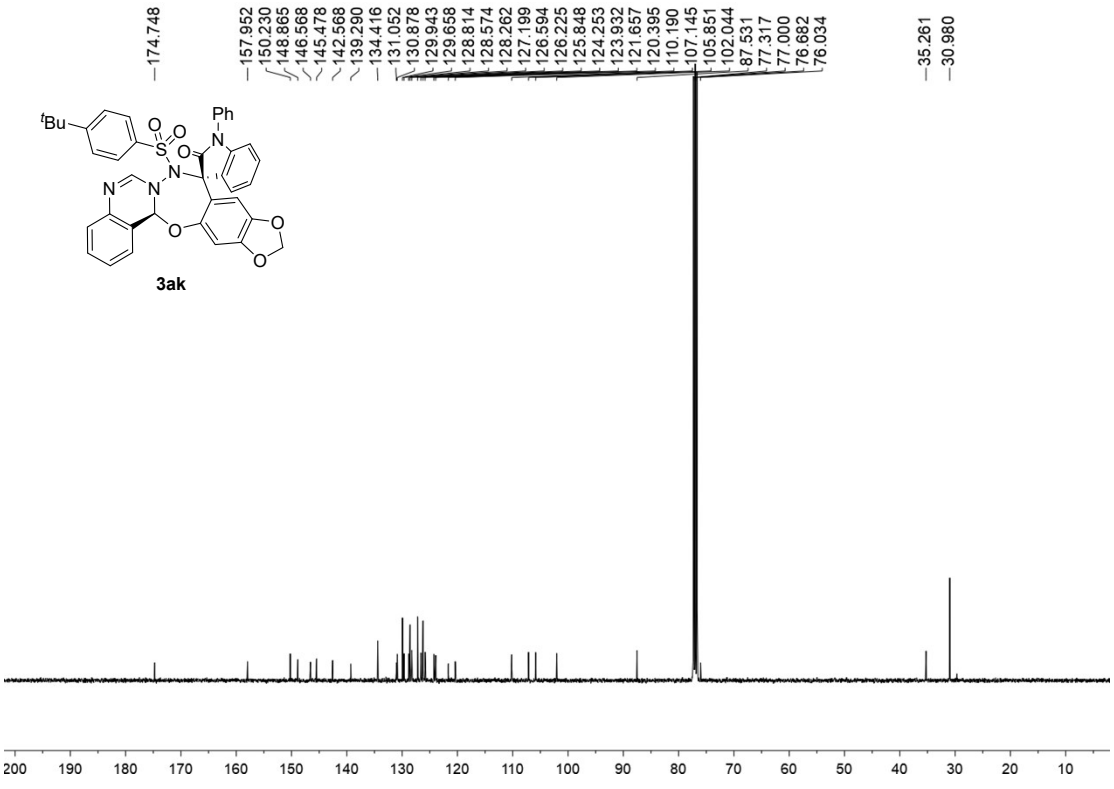


	RetTime [min]	Area [mAU*s]	Area%
1	11.244	1460567	5.32
2	28.224	25994948	94.68

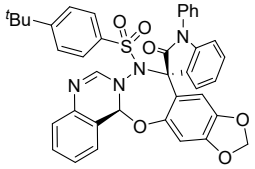
^{1}H NMR Spectrum of Compound **3ak** (400 MHz, $CDCl_3$)



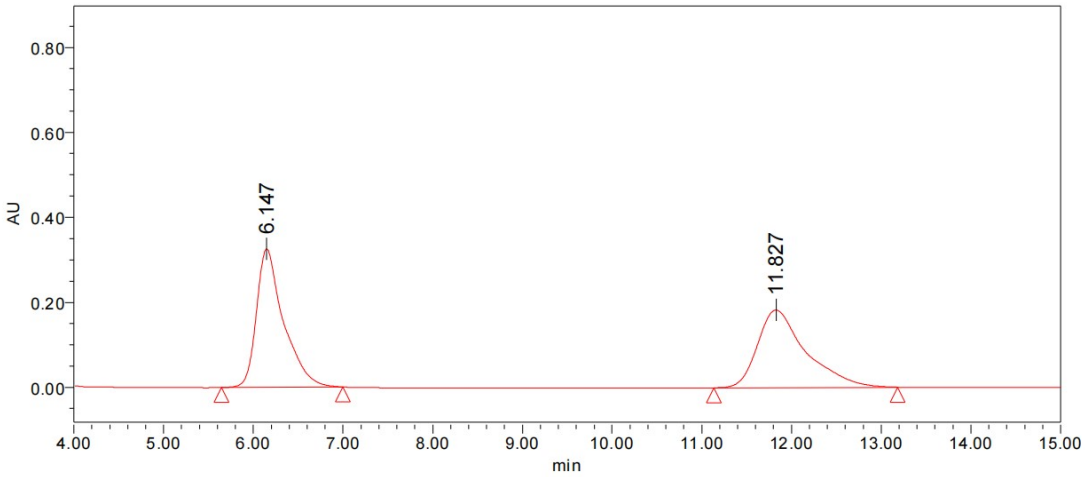
^{13}C{^{1}H} NMR Spectrum of Compound **3ak** (101 MHz, $CDCl_3$)



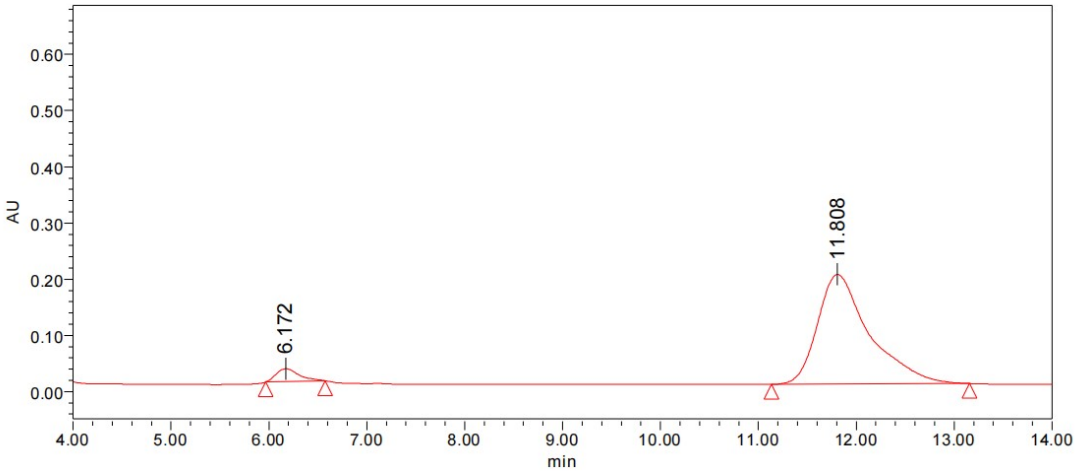
HPLC Spectra of Compound **3ak**



3ak

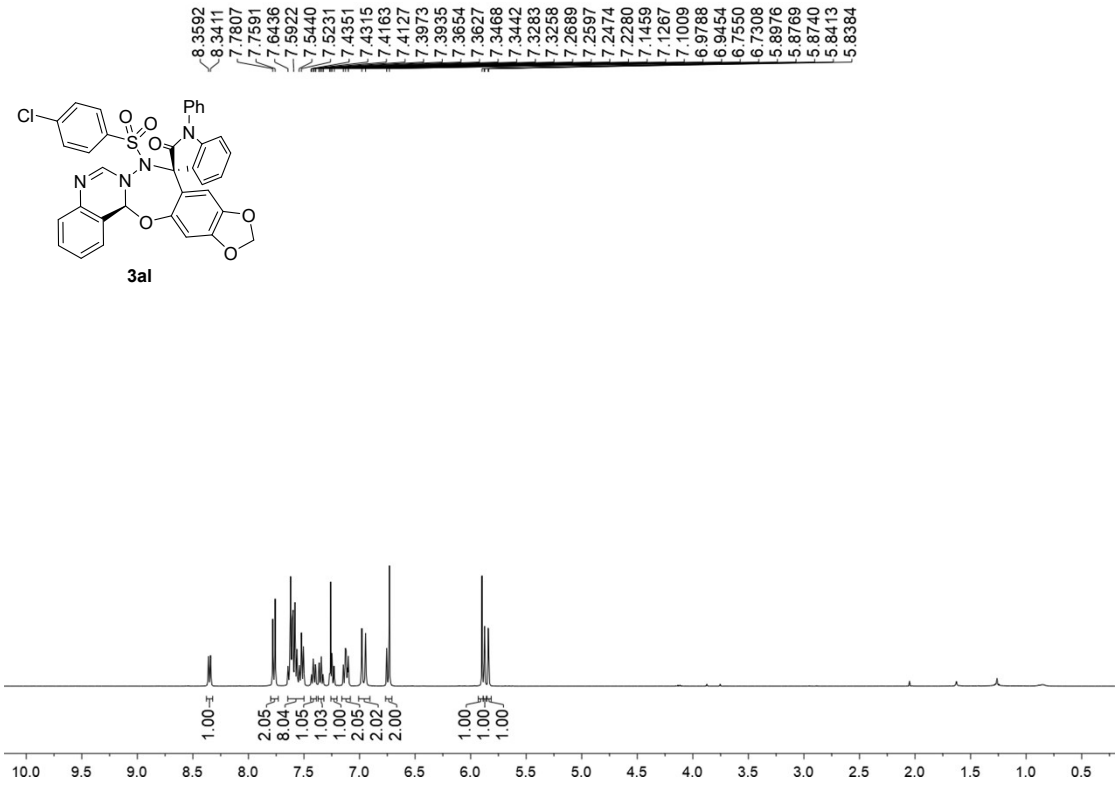


	RetTime [min]	Area [mAU*s]	Area%
1	6.147	6820793	50.07
2	11.827	6801762	49.93

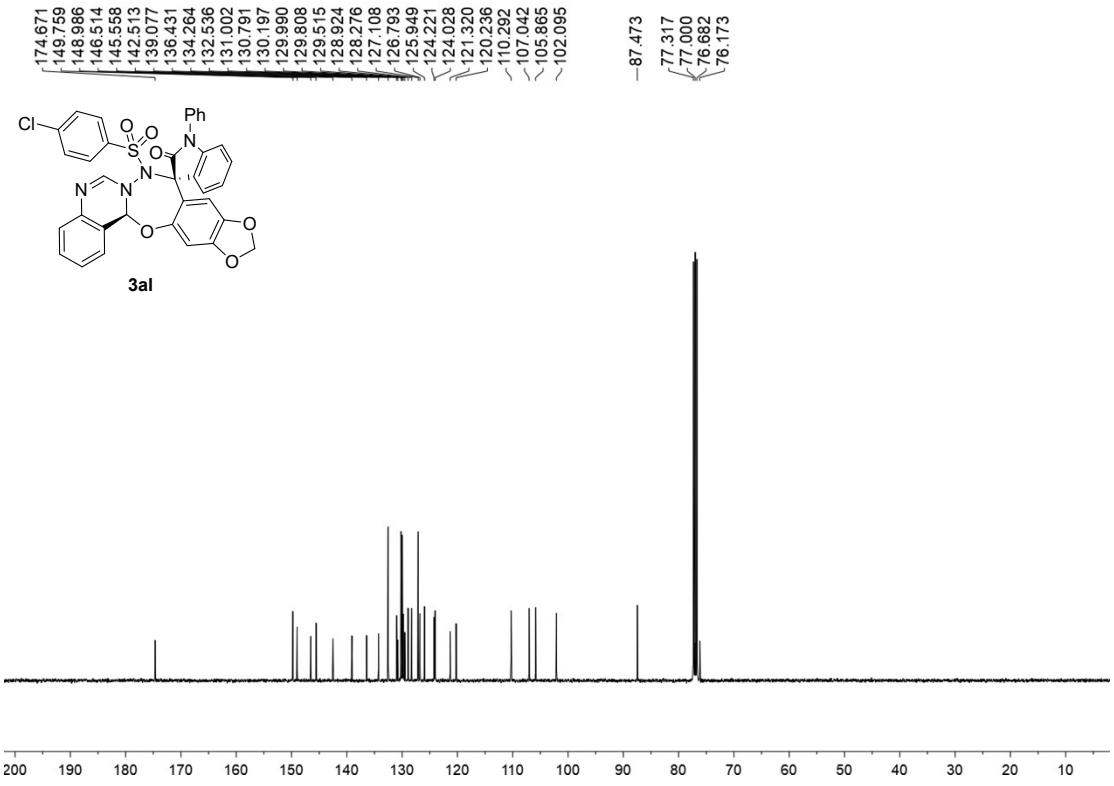


	RetTime [min]	Area [mAU*s]	Area%
1	6.172	368811	4.89
2	11.808	7177264	95.11

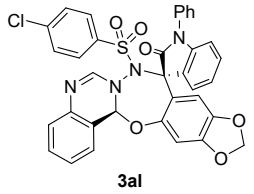
^{1}H NMR Spectrum of Compound **3al** (400 MHz, $CDCl_3$)



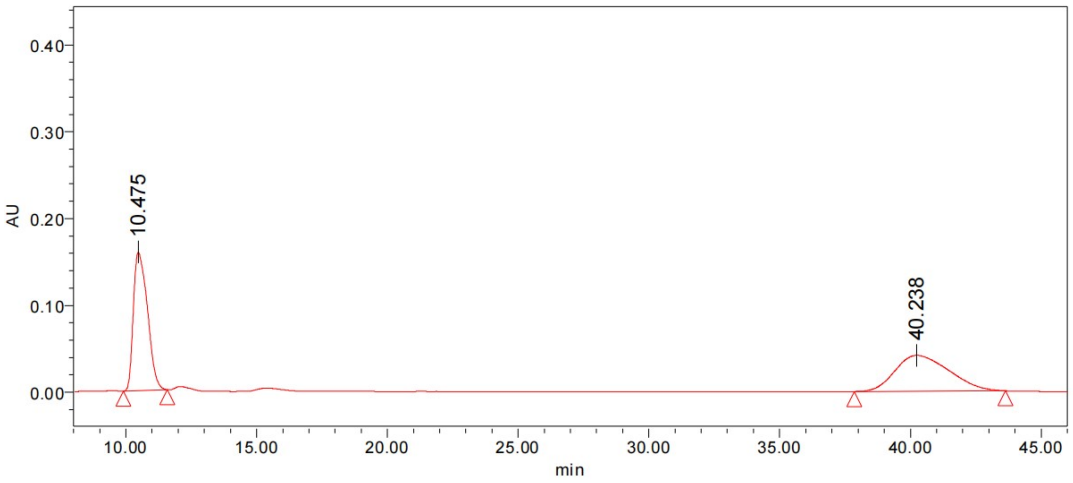
^{13}C{^{1}H} NMR Spectrum of Compound **3al** (101 MHz, $CDCl_3$)



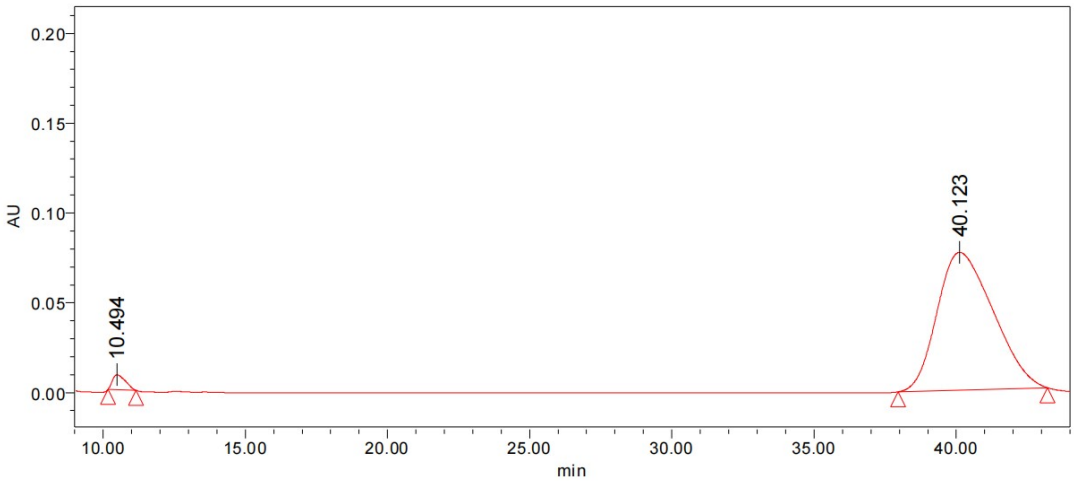
HPLC Spectra of Compound **3al**



3al

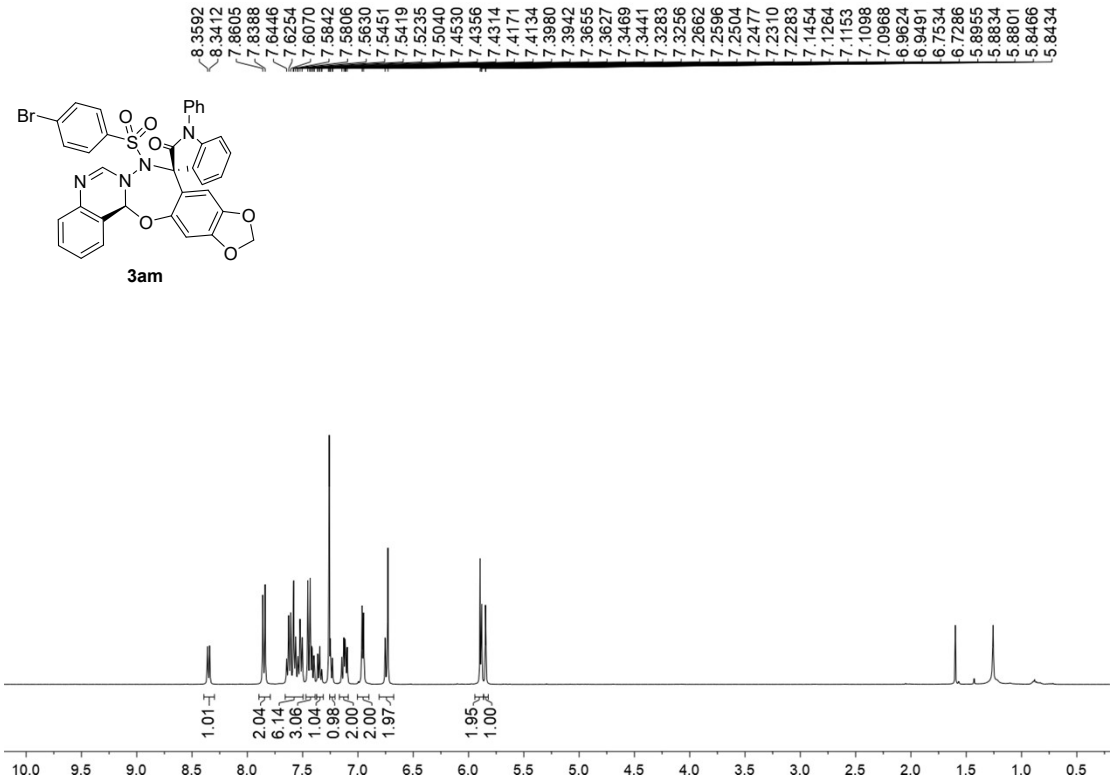


	RetTime [min]	Area [mAU*s]	Area%
1	10.475	5967069	50.20
2	40.238	5918655	49.80

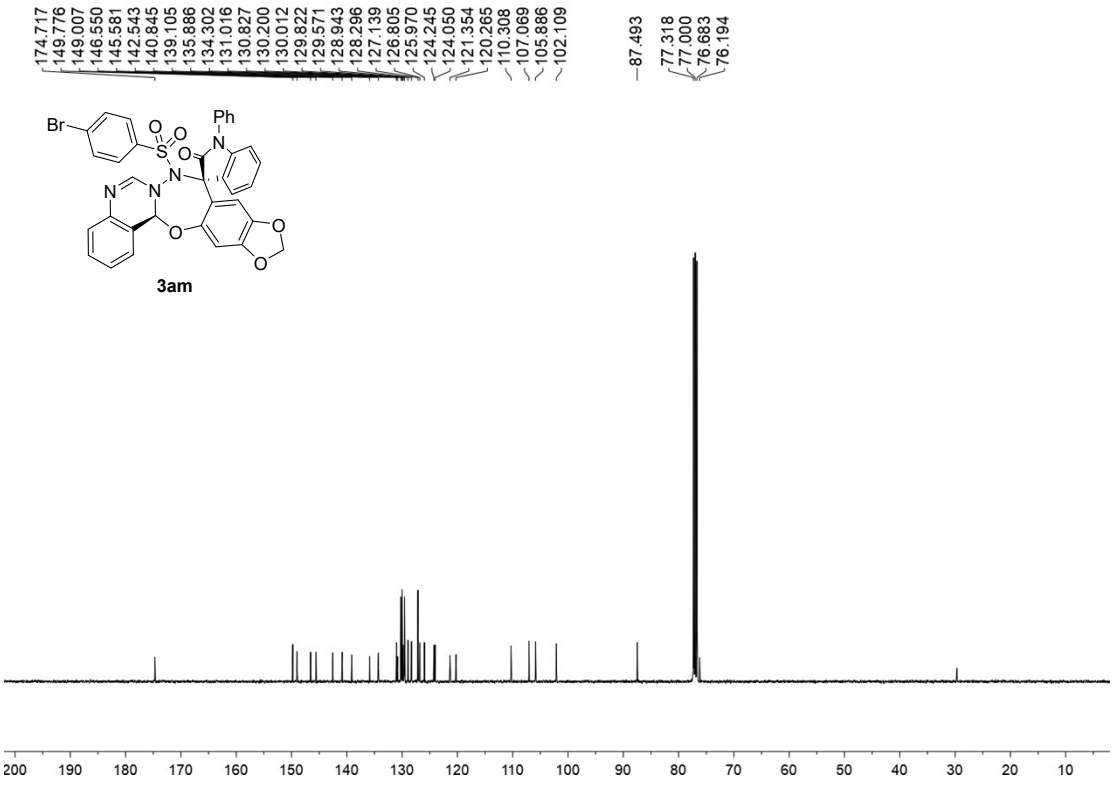


	RetTime [min]	Area [mAU*s]	Area%
1	10.494	262889	2.44
2	40.123	10497424	97.56

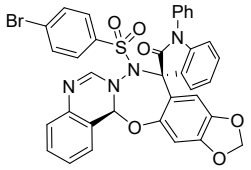
^{1}H NMR Spectrum of Compound **3am** (400 MHz, $CDCl_3$)



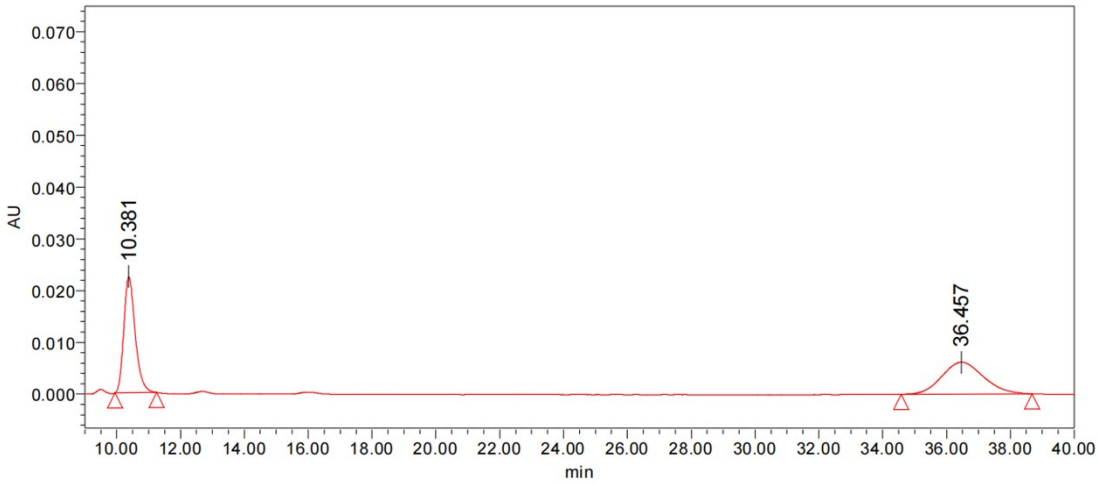
^{13}C{^{1}H} NMR Spectrum of Compound **3am** (101 MHz, $CDCl_3$)



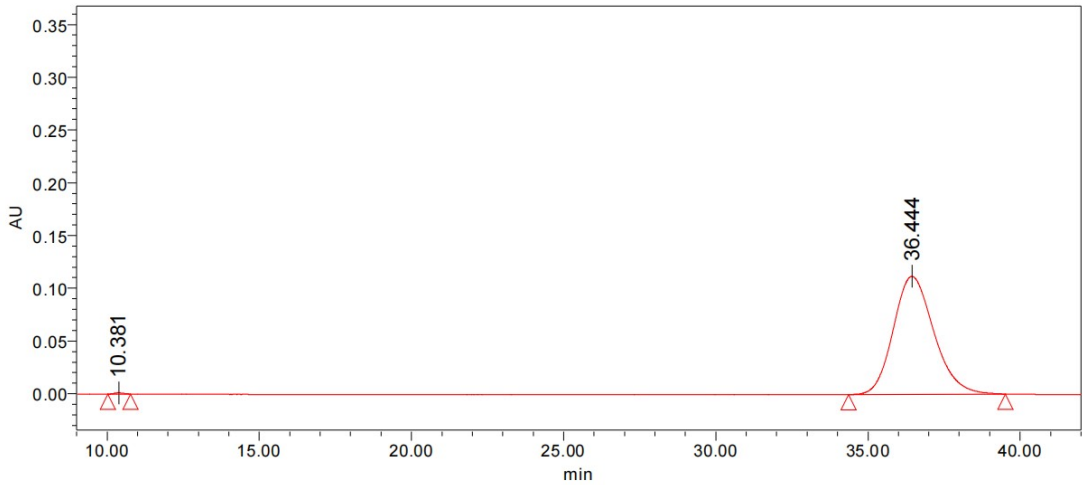
HPLC Spectra of Compound **3am**



3am



	RetTime [min]	Area [mAU*s]	Area%
1	10.381	556640	49.79
2	36.457	561280	50.21



	RetTime [min]	Area [mAU*s]	Area%
1	10.381	22424	0.22
2	36.444	10356364	99.78