

The Supporting Information for

Synthesis of Azacyclic Nucleoside Analogues via Asymmetric [3+2] Cycloaddition of 9-(2-tosylvinyl)-9*H*-purines

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1. General information

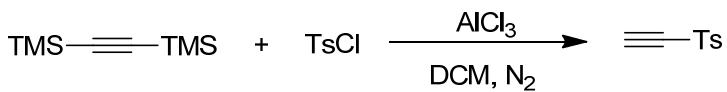
¹H NMR spectra were recorded on commercial instruments (400 MHz). Chemical shifts are recorded in ppm relative to tetramethylsilane and with the solvent resonance as the internal standard. Data are reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, m = multiplet, br = broad), coupling constants (Hz), integration. ¹³C NMR data were collected on commercial instruments (100 MHz) with complete proton decoupling. Chemical shifts are reported in ppm from the tetramethylsilane with the solvent resonance as internal standard. Enantiomer excesses were determined by chiral HPLC analysis on Chiralcel IA/ASH/ODH/ADH in comparison with the authentic racemates. Optical rotations were reported as follows: $[\alpha]_D^T$ (c: g/100 mL, in solvent). HRMS was recorded on a commercial apparatus (ESI Source). All the solvents were purified by usual methods before use. The chiral phosferrox ligands **L1-L3**, **L8-L9** were synthesized according to the reported literature.¹

2. Synthesis methods of starting materials

2.1 General procedure for the synthesis of α -iminoesters

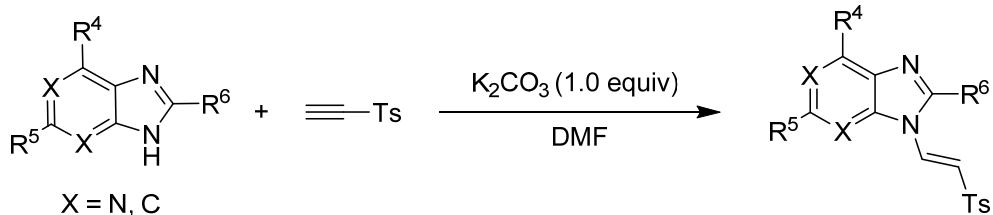
All the α -iminoesters mentioned in the paper were synthesized according to the known procedure.² To a suspension of glycine methyl ester hydrochloride (1.1 equiv) and MgSO₄ (2.0 equiv) in CH₂Cl₂ was added Et₃N (1.1 equiv). Then, this solution was stirred at room temperature for 1 h. Subsequently, the aldehyde (1.0 equiv) was added and the reaction was stirred at room temperature overnight. Work up: MgSO₄ was removed by filtration and the filtrate was washed once with H₂O. The aqueous phase was extracted once with CH₂Cl₂ and the combined organic layers were washed with brine. The organic phase was dried over Na₂SO₄, filtered and concentrated. Due to their instability, most of the α -iminoesters, once isolated, were immediately used in the 1,3-dipolar cycloaddition reactions. But if necessary, further purification can be obtained via recrystallization from ethanol.

2.2 General procedure for the synthesis of ethynyl *p*-tolyl sulfone



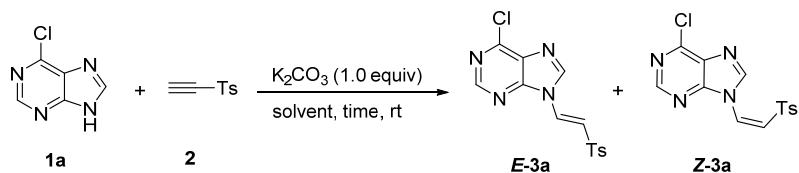
The ethynyl *p*-tolyl sulfone was synthesized according to the known procedure.³ In a 100 mL round bottom flask equipped with a magnetic stir bar, fresh anhydrous aluminum chloride (1.5 g, 11 mmol) and *p*-toluenesulfonyl choride (2.1 g, 11 mmol) were dissolved in dry DCM (30 mL) at room temperature under argon atmosphere. The mixture was stirred for 30 min to form an orange solution and then bis(trimethylsilyl)acetylene (2.0 mL, 10 mmol) was added. Thereafter, the reaction was complete as monitored by TLC, and then the reagent was concentrated to dryness. The crude adducts were then purified by flash column chromatography (eluent: ethyl acetate/petroleum ether = 1:20) to afford the product in 82% yield (1.46 g).

2.3 General procedure for the synthesis of dipolarophiles.



Purine or benzimidazole (10.0 mmol), K_2CO_3 (10.0 mmol, 1.38 g) and DMF (30.0 mL) were mixed in a 100 mL flask. The mixture was stirred for 30 min at ambient temperature and then ethynyl *p*-tolyl sulfone (12.0 mmol, 2.16 g) was added. After the reaction was complete as monitored by TLC, the resulting mixture was partitioned between water and ethyl acetate, and the separated aqueous layer extracted with ethyl acetate. The combined organic layers were washed with brine (100 mL×3), dried over anhydrous MgSO_4 , filtered, and evaporated under reduced pressure. The residue was purified by flash column chromatography with EtOAc/petroleum (1:3) as the eluant.

Table S1. Synthesis of 9-(2-tosylvinyl)-9*H*-purine.^a

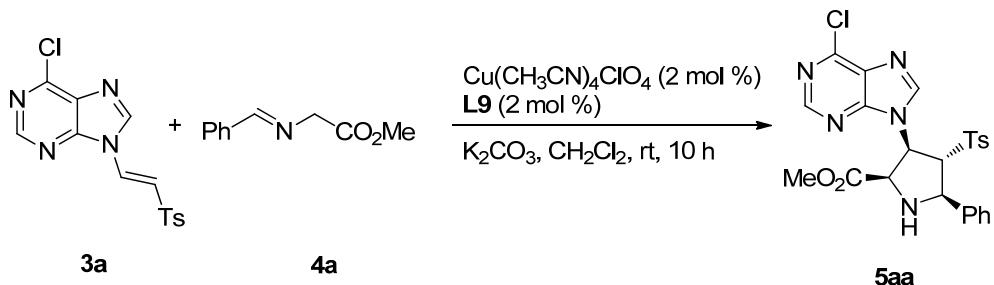


entry	solvent	time (h)	yield (%) ^b	E/Z ^c
1	CH_3CN	4	90	1:1
2	CH_3CN	30	90	1:0
3	DMF	5	95	1:0
4	CH_2Cl_2	6	42	1:11
5	CH_2Cl_2	30	83	1:4

^aReaction conditions: **1a** (10.0 mmol), K_2CO_3 (1.0 equiv) and solvent (30.0 mL) were stirred for 30 min at room temperature and then ethynyl *p*-tolyl sulfone **2** (1.2 equiv) was added. ^bIsolated yield. ^cDetermined by the ¹H NMR spectra of the crude products.

3. Typical procedure for the asymmetric [3+2] cycloaddition

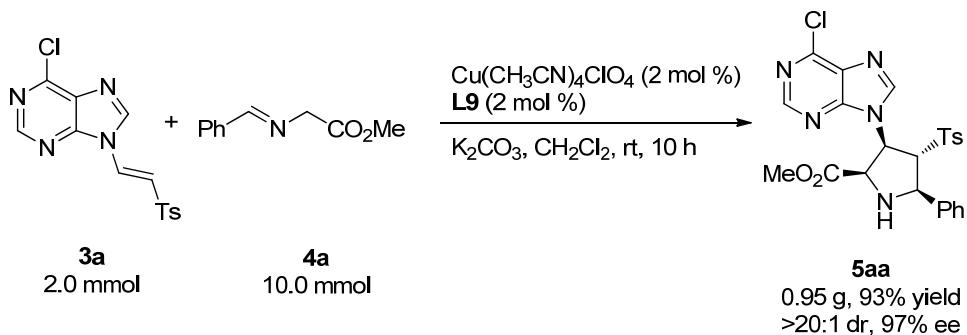
3.1 General procedure for the asymmetric [3+2] cycloaddition



- 1) The preparation of the catalyst solution. **L9** (3.0 mg, 0.005 mmol) and $\text{Cu}(\text{CH}_3\text{CN})_4\text{ClO}_4$ (1.6 mg, 0.005 mmol) were dissolved in CH_2Cl_2 (1.0 mL) and stirred for 30 min at ambient temperature.
- 2) In a test tube, 200 μL (2 mol %) of the catalyst solution was added, and CH_2Cl_2 (0.5 mL) was added subsequently under N_2 . Then, *N*-benzylidene glycine methyl ester **4a** (0.25 mmol), dipolarophile **3a** (0.05 mmol) and K_2CO_3 (20 mol %) were added. The reaction mixture was stirred at ambient temperature for 10 h.

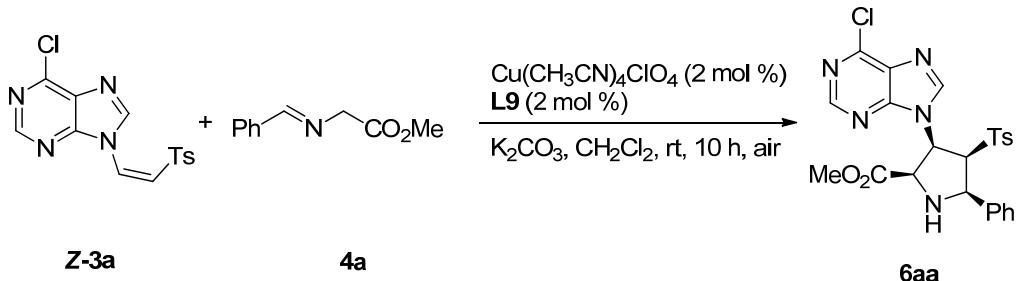
3) Work up procedure: Upon consumption of dipolarophile **3a**, the mixture was filtered through Celite and the filtrate was concentrated to dryness. The drvalue was determined by the ¹H-NMR spectroscopic analysis of crude product. The crude adducts were then purified by flash column chromatography (eluent: ethyl acetate/petroleum ether = 1:2) to afford the cycloadduct **5aa** in 90% yield (23.0 mg).

3.2 Gram-scaled synthesis of **5aa**



In a 100 mL round bottom flask equipped with a magnetic stir bar, **L9** (26.4 mg, 0.04 mmol) and $\text{Cu}(\text{CH}_3\text{CN})_4\text{ClO}_4$ (14.4 mg, 0.04 mmol) were dissolved in CH_2Cl_2 (30 mL) at room temperature under argon atmosphere. The mixture was stirred for 30 min and then dipolarophile **3a** (668.0 mg, 2.0 mmol), *N*-benzylidene glycine methyl ester **4a** (1.4 g, 10.0 mmol) and K_2CO_3 (55.2 mg, 0.4 mmol) were added. The reaction mixture was stirred until dipolarophile **3a** was consumed (determined by TLC). Subsequently, upon consumption of the dipolarophile **3a**, the mixture was filtered through Celite and the filtrate was concentrated to dryness. The drvalue was determined by the ¹H-NMR spectroscopic analysis of crude product. The crude adducts were then purified by flash column chromatography (eluent: ethyl acetate/petroleum ether = 1:2) to afford the cycloadduct **5aa** (952.5 mg, 93% yield).

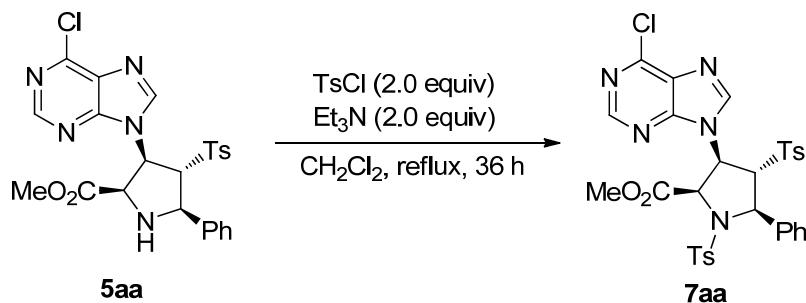
3.3 The synthetic procedure of **6aa**



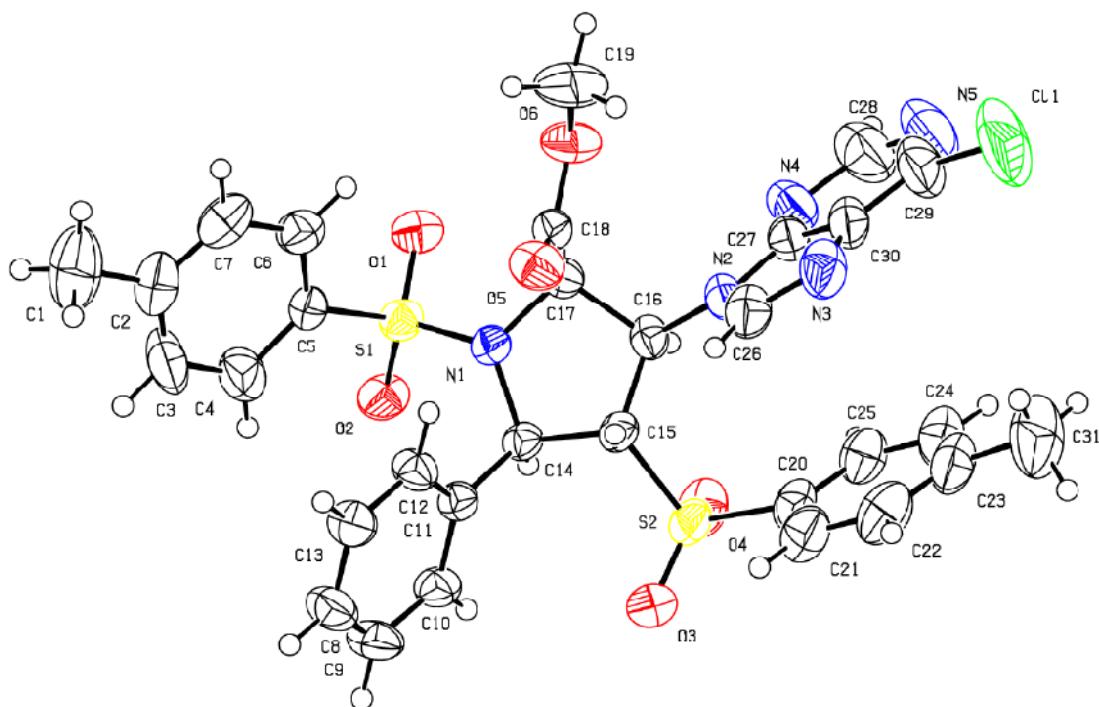
In a test tube, **L9** (0.003 mmol) and $\text{Cu}(\text{CH}_3\text{CN})_4\text{ClO}_4$ (0.003 mmol) were

dissolved in CH₂Cl₂ (2 mL) at room temperature. The mixture was stirred for 30 min and then dipolarophile **Z-3a** (0.15 mmol), *N*-benzylidene glycine methyl ester **4a** (0.75 mmol) and K₂CO₃ (20 mol %) were added under air atmosphere. The reaction mixture was stirred until dipolarophile **Z-3a** was consumed (determined by TLC). Subsequently, upon consumption of the dipolarophile **Z-3a**, the mixture was filtered through Celite and the filtrate was concentrated to dryness. The drvalue was determined by the ¹H-NMR spectroscopic analysis of crude product. The crude adducts were then purified by flash column chromatography (eluent: ethyl acetate/petroleum ether = 1:2) to afford the cycloadduct **6aa** in 86% yield (65.8 mg).

3.4 The synthetic procedure of **7aa**

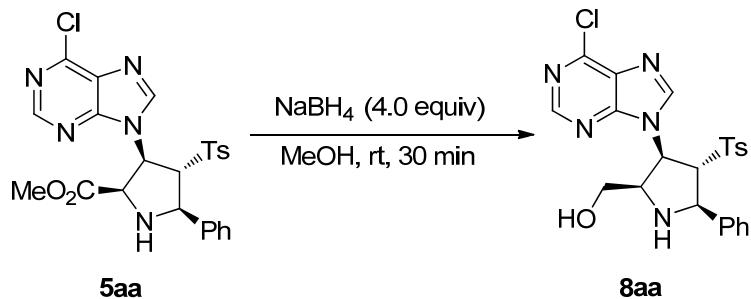


Azacyclic nucleoside analogue **5aa** (204 mg, 0.4 mmol) and *p*-toluenesulfonyl chloride (153 mg, 0.8 mmol) were dissolved in CH₂Cl₂ (5.0 mL). Then, Et₃N (0.11 mL, 0.8 mmol) was added and the mixture was refluxed for 36 h. The solvent was evaporated and the crude product was purified by column chromatography. The excess *p*-toluenesulfonyl chloride was eluted with CH₂Cl₂ and then the product was eluted with Et₂O to give **7aa** in 75% yield (200.0 mg). Recrystallisation in a mixture of DCM and pentane afforded crystal suitable for X-ray analysis.



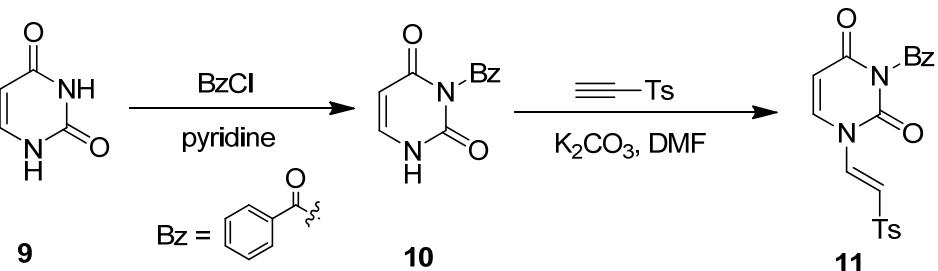
X-ray of **7aa**

3.5 The synthetic procedure of **8aa**



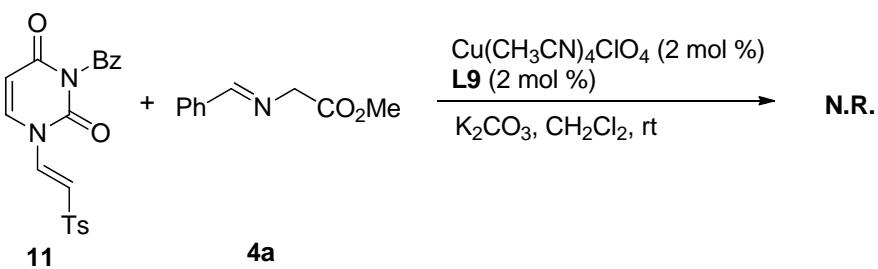
To a solution of azacyclic nucleoside analogue **5aa** (76.6 mg, 0.15 mmol) in MeOH (5.0 mL) at room temperature, NaBH₄ (22.7 mg, 0.6 mmol) was added. After **5aa** was consumed (determined by TLC), saturated NH₄Cl aqueous solution (5.0 mL) was added. The aqueous phase was extracted with CH₂Cl₂ (5.0 mL×3) and the combined organic phases were dried and concentrated. The residue was purified by silica gel flash chromatography (ethyl acetate/petroleum ether = 1:1) to afford product **8aa** in 95% yield (68.5 mg).

4. General procedure for the synthesis of uracil dipolarophile



Following the procedure of Zhou and co-workers⁴, benzoyl chloride (1.01 mL, 8.72 mmol, 2.2 equiv) and uracil **9** (0.45 g, 4.0 mmol, 1.0 equiv) were suspended in a mixture of acetonitrile (4 mL) and pyridine (1.6 mL, 4.0 mmol, 1.0 equiv) in a flame-dried flask under nitrogen. The reaction was stirred under nitrogen atmosphere at room temperature for 12 h. Then, the reaction was partitioned between DCM and water. The aqueous layer was extracted three times with DCM and the combined organic layers were dried over anhydrous NaSO₄. The solvent was removed under reduced pressure. The residue was purified by flash column chromatography with EtOAc/petroleum (1:5) as the eluant to give the pure product **10** in 65% yield (560.0 mg).

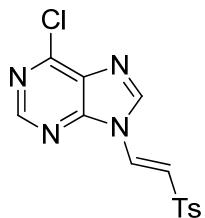
The N-3-Bz-protected uracil **10** (2.0 mmol, 435 mg), potassium carbonate (2.0 mmol, 275 mg) and DMF (15.0 mL) were mixed in a 50 mL flask. The mixture was stirred for 30 min at ambient temperature and then ethynyl *p*-tolyl sulfone (2.4 mmol, 432 mg) was added. After the reaction was complete as monitored by TLC, the resulting mixture was partitioned between water and ethyl acetate, and the separated aqueous layer extracted with ethyl acetate. The combined organic layers were washed with brine (30 mL×3), dried over anhydrous MgSO₄, filtered, and evaporated under reduced pressure. The residue was purified by flash column chromatography with EtOAc/petroleum (1:3) as the eluant to give the pure product **11** as a white solid.



Unfortunately, in the presence of optimized reaction conditions, the asymmetric [3+2] cycloaddition of uracil dipolarophile **11** to azomethine ylide **4a** did not occur.

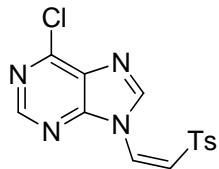
5. Characterization of compounds

(E)-6-Chloro-9-(2-tosylvinyl)-9*H*-purine (**3a**)



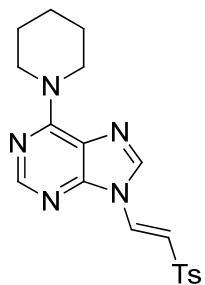
White solid. **¹H NMR** (400 MHz, CDCl₃): δ 8.84 (s, 1H), 8.26 (s, 1H), 8.16 (d, *J* = 13.8 Hz, 1H), 7.94-7.83 (m, 3H), 7.39 (d, *J* = 8.2 Hz, 2H), 2.46 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 153.3, 152.3, 151.2, 145.3, 144.0, 137.0, 132.9, 130.9, 130.3, 127.8, 122.2, 21.7.

(Z)-6-Chloro-9-(2-tosylvinyl)-9*H*-purine (**3a**)



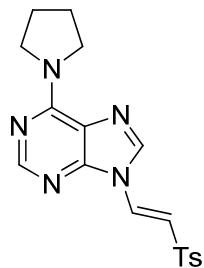
White solid. **¹H NMR** (400 MHz, CDCl₃): δ 9.24 (s, 1H), 8.78 (s, 1H), 7.80 (d, *J* = 8.3 Hz, 2H), 7.53 (d, *J* = 10.2 Hz, 1H), 7.35 (d, *J* = 8.1 Hz, 2H), 6.43 (d, *J* = 10.2 Hz, 1H), 2.44 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 153.0, 151.9, 151.6, 145.9, 136.6, 131.0, 130.3, 127.6, 124.6, 122.2, 21.7.

(E)-6-(Piperidin-1-yl)-9-(2-tosylvinyl)-9*H*-purine (**3b**)



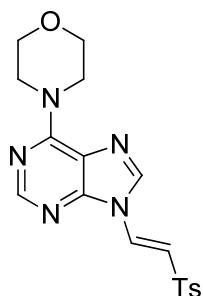
White solid. **¹H NMR** (400 MHz, CDCl₃): δ 8.32 (s, 1H), 8.08 (d, *J* = 13.7 Hz, 1H), 7.88-7.78 (m, 4H), 7.36 (d, *J* = 8.1 Hz, 2H), 4.20 (br, 4H), 2.44 (s, 3H), 1.79-1.64 (m, 6H). **¹³C NMR** (100 MHz, CDCl₃): δ 153.6, 150.9, 144.7, 137.8, 136.8, 132.1, 130.1, 127.7, 120.6, 119.6, 26.1, 24.7, 21.7.

(E)-6-(Pyrrolidin-1-yl)-9-(2-tosylvinyl)-9*H*-purine (3c)



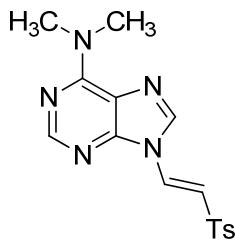
White solid. **¹H NMR** (400 MHz, CDCl₃): δ 8.35 (s, 1H), 8.09 (d, *J* = 13.7 Hz, 1H), 7.86-7.80 (m, 4H), 7.35 (d, *J* = 8.1 Hz, 2H), 4.10 (br, 2H), 3.74 (br, 2H), 2.43 (s, 3H), 2.13-1.94 (br, 4H). **¹³C NMR** (100 MHz, CDCl₃): δ 153.9, 152.9, 150.2, 144.7, 137.7, 132.2, 130.1, 127.7, 121.0, 119.6, 49.0, 47.6, 26.2, 24.3, 21.7.

(E)-4-(9-(2-Tosylvinyl)-9*H*-purin-6-yl)morpholine (3d)



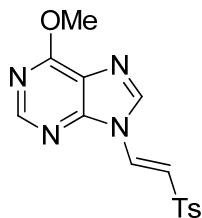
White solid. **¹H NMR** (400 MHz, CDCl₃): δ 8.36 (s, 1H), 8.09 (d, *J* = 13.7 Hz, 1H), 7.87-7.82 (m, 4H), 7.36 (d, *J* = 8.2 Hz, 2H), 4.28 (br, 4H), 3.27-3.99 (m, 4H), 2.44 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 153.8, 153.5, 151.0, 144.7, 137.7, 137.4, 131.9, 130.1, 127.7, 120.8, 120.0, 66.9, 21.7.

(E)-N,N-Dimethyl-9-(2-tosylvinyl)-9H-purin-6-amine (3e)



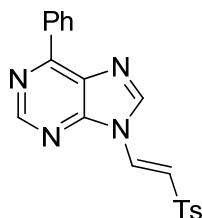
White solid. **¹H NMR** (400 MHz, CDCl₃): δ 8.36 (s, 1H), 8.10 (d, *J* = 13.7 Hz, 1H), 7.86-7.81 (m, 4H), 7.37 (d, *J* = 8.2 Hz, 2H), 3.49 (br, 6H), 2.45 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 154.8, 153.5, 150.6, 144.7, 137.8, 137.1, 132.1, 130.1, 127.7, 120.9, 119.7, 21.7.

(E)-6-Methoxy-9-(2-tosylvinyl)-9H-purine (3f)



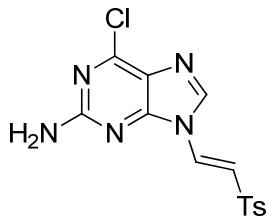
White solid. **¹H NMR** (400 MHz, CDCl₃): δ 8.59 (s, 1H), 8.13 (d, *J* = 13.7 Hz, 1H), 8.05 (s, 1H), 7.90-7.84 (m, 3H), 7.37 (d, *J* = 8.0 Hz, 2H), 4.20 (s, 3H), 2.45 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 161.4, 153.5, 151.5, 144.9, 141.3, 137.4, 131.7, 130.2, 127.8, 122.7, 120.8, 54.6, 21.7.

(E)-6-Phenyl-9-(2-tosylvinyl)-9H-purine (3g)



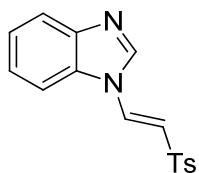
White solid. **¹H NMR** (400 MHz, CDCl₃): δ 9.07 (s, 1H), 8.76-8.73 (m, 2H), 8.25 (s, 1H), 8.20 (d, *J* = 13.7 Hz, 1H), 7.96 (d, *J* = 13.7 Hz, 1H), 7.89 (d, *J* = 8.3 Hz, 2H), 7.60-7.53 (m, 3H), 7.39 (d, *J* = 8.1 Hz, 2H), 2.45 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 156.0, 153.6, 152.1, 145.0, 143.1, 137.4, 134.8, 132.0, 131.7, 131.4, 130.2, 130.0, 128.8, 127.8, 121.0, 21.7.

(E)-6-Chloro-9-(2-tosylvinyl)-9*H*-purin-2-amine (3h)



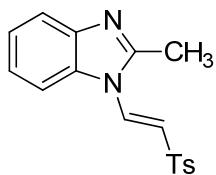
Red solid. **¹H NMR** (400 MHz, DMSO): δ 8.50 (s, 1H), 8.22 (d, J = 13.8 Hz, 1H), 7.81 (d, J = 8.3 Hz, 2H), 7.73 (d, J = 13.8 Hz, 1H), 7.48 (d, J = 8.2 Hz, 2H), 7.34 (s, 2H), 2.41 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 155.6, 155.1, 154.7, 153.2, 152.3, 145.6, 144.9, 136.6, 131.6, 130.4, 127.9, 124.6, 123.1, 21.7.

(E)-1-(2-Tosylvinyl)-1*H*-benzo[d]imidazole (3i)



White solid. **¹H NMR** (400 MHz, CDCl₃): δ 8.17 (d, J = 13.9 Hz, 1H), 8.11 (s, 1H), 7.90-7.79 (m, 3H), 7.59 (dd, J = 6.7, 2.0 Hz, 1H), 7.46-7.33 (m, 4H), 6.76 (d, J = 13.9 Hz, 1H), 2.45 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 144.8, 144.6, 141.8, 137.8, 133.4, 131.8, 130.2, 127.6, 125.3, 124.8, 121.4, 115.5, 111.1, 21.7.

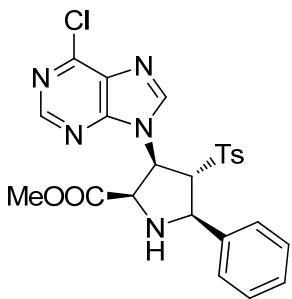
(E)-2-Methyl-1-(2-tosylvinyl)-1*H*-benzo[d]imidazole (3j)



White solid. **¹H NMR** (400 MHz, CDCl₃): δ 8.10 (d, J = 13.9 Hz, 1H), 7.85 (d, J = 8.3 Hz, 2H), 7.71-7.64 (m, 1H), 7.46 (dd, J = 6.4, 2.5 Hz, 1H), 7.35 (d, J = 8.2 Hz, 2H), 7.33-7.23 (m, 2H), 6.79 (d, J = 13.9 Hz, 1H), 2.73 (s, 3H), 2.43 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 152.3, 144.7, 143.5, 137.9, 133.8, 132.7, 130.2, 127.5, 124.6, 124.4, 120.3, 115.6, 111.7, 21.7, 14.8.

(2*R*,3*R*,4*R*,5*R*)-Methyl

3-(6-chloro-9*H*-purin-9-yl)-5-phenyl-4-tosylpyrrolidine-2-carboxylate (5aa)



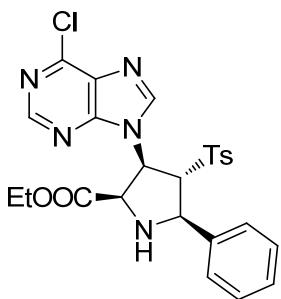
Colorless oil; 23.0 mg, 90% yield, >20:1 dr, 98% ee. $[\alpha]_D^{25.5} = -123.7$ (c 0.97, DCM).

HPLC CHIRALCEL IA, n-hexane/2-propanol = 50/50, flow rate = 0.5 mL/min, $\lambda = 254$ nm, retention time: 31.642 min, 42.565 min.

¹H NMR (400 MHz, CDCl₃): δ 8.61 (s, 1H), 8.34 (s, 1H), 7.60 (d, *J* = 8.1 Hz, 2H), 7.54-7.48 (m, 2H), 7.29-7.27 (m, 3H), 7.13 (d, *J* = 8.1 Hz, 2H), 5.88 (dd, *J* = 6.6, 3.8 Hz, 1H), 4.81 (d, *J* = 7.9 Hz, 1H), 4.55 (d, *J* = 6.7 Hz, 1H), 4.18 (dd, *J* = 7.8, 3.7 Hz, 1H), 3.35 (s, 3H), 2.33 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 167.7, 151.7, 151.6, 151.0, 145.8, 144.9, 137.6, 134.0, 131.4, 130.0, 128.9, 128.5, 127.4, 74.4, 64.3, 62.1, 58.7, 52.6, 21.6. **HRMS:** exact mass calcd for C₂₄H₂₂ClN₅O₄S (M+Na)⁺ 534.0973, found 534.0970.

(2*R*,3*R*,4*R*,5*R*)-Ethyl

3-(6-chloro-9*H*-purin-9-yl)-5-phenyl-4-tosylpyrrolidine-2-carboxylate (5ab)



Colorless oil; 25.0 mg, 98% yield, >20:1 dr, 99% ee. $[\alpha]_D^{25.5} = -51.5$ (c 3.70, DCM).

HPLC CHIRALCEL IA, n-hexane/2-propanol = 50/50, flow rate = 0.5 mL/min, $\lambda = 254$ nm, retention time: 28.679 min, 33.667 min.

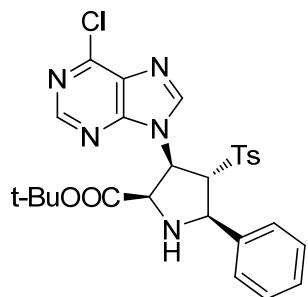
¹H NMR (400 MHz, CDCl₃): δ 8.62 (s, 1H), 8.36 (s, 1H), 7.59 (d, *J* = 8.3 Hz, 2H),

7.50 (dd, *J* = 6.4, 2.9 Hz, 2H), 7.30-7.26 (m, 3H), 7.13 (d, *J* = 8.1 Hz, 2H), 5.90 (dd, *J*

= 6.8, 3.9 Hz, 1H), 4.79 (d, *J* = 8.0 Hz, 1H), 4.52 (d, *J* = 6.8 Hz, 1H), 4.18 (dd, *J* = 8.0, 3.8 Hz, 1H), 3.79 (dd, *J* = 12.4, 7.1 Hz, 2H), 3.33(s, 1H), 2.33(s, 3H), 0.77 (t, *J* = 7.1 Hz, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 167.3, 151.7, 151.5, 151.1, 145.7, 144.9, 138.0, 134.1, 130.0, 128.8, 128.5, 127.3, 74.8, 64.6, 62.1, 61.7, 58.7, 21.6, 13.6. **HRMS:** exact mass calcd for C₂₅H₂₄ClN₅O₄S (M+H)⁺ 526.1310, found 526.1301.

(2*R*,3*R*,4*R*,5*R*)-Tert-butyl

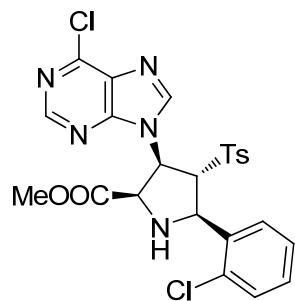
3-(6-chloro-9*H*-purin-9-yl)-5-phenyl-4-tosylpyrrolidine-2-carboxylate (5ac)



Colorless oil; 25.5 mg, 93% yield, >20:1 dr, 97% ee. [α]_D^{25.5} = -123.0 (c 0.67, DCM). HPLC CHIRALCEL ODH, n-hexane/2-propanol = 60/40, flow rate = 0.5 mL/min, λ = 254 nm, retention time: 16.069 min, 24.214 min.

¹H NMR (400 MHz, CDCl₃): δ 8.66 (s, 1H), 8.40 (s, 1H), 7.58(d, *J* = 8.3 Hz, 2H), 7.46 (dd, *J* = 6.6, 2.9 Hz, 2H), 7.26 (t, *J* = 3.2 Hz, 3H), 7.11 (d, *J* = 8.1 Hz, 2H), 5.89 (dd, *J* = 6.9, 3.9 Hz, 1H), 4.72 (d, *J* = 8.1 Hz, 1H), 4.44 (d, *J* = 6.7 Hz, 1H), 4.16 (dd, *J* = 8.1, 3.8 Hz, 1H), 3.30 (s, 1H), 2.32 (s, 3H), 0.97 (s, 9H). **¹³C NMR** (100 MHz, CDCl₃): δ 166.2, 151.7, 151.5, 151.2, 145.6, 145.0, 138.0, 134.2, 131.4, 130.0, 128.8, 128.5, 128.4, 127.4, 83.2, 75.1, 65.3, 62.3, 58.7, 27.4, 21.6. **HRMS:** exact mass calcd for C₂₇H₂₈ClN₅O₄S (M+Na)⁺ 576.1443, found 576.1437.

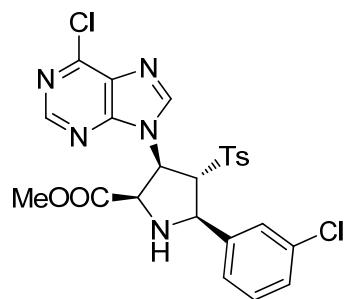
**(2*R*,3*R*,4*R*,5*R*)-Methyl
3-(6-chloro-9*H*-purin-9-yl)-5-(2-chlorophenyl)-4-tosylpyrrolidine-2-carboxylate
(5ad)**



Colorless oil; 26.5mg, 98% yield, >20:1 dr, 99% ee. $[\alpha]_D^{25.5} = -82.3$ (c 3.10, DCM).
HPLC CHIRALCEL ODH, n-hexane/2-propanol = 60/40, flow rate = 0.5 mL/min, $\lambda = 254$ nm, retention time: 30.779 min, 58.954 min.

¹H NMR (400 MHz, CDCl₃): δ 8.73 (s, 1H), 8.28 (s, 1H), 7.61-7.48 (m, 3H), 7.30-7.21 (m, 1H), 7.15 (dd, *J* = 6.4, 2.9 Hz, 2H), 7.01 (d, *J* = 8.1 Hz, 2H), 6.00 (dd, *J* = 7.5, 5.3 Hz, 1H), 5.10 (t, *J* = 9.3 Hz, 1H), 4.67 (dd, *J* = 9.5, 5.2 Hz, 1H), 4.49 (t, *J* = 8.3 Hz, 1H), 3.42(s, 1H), 3.30(s, 3H), 2.24(s,3H). **¹³C NMR** (100 MHz, CDCl₃): δ 167.7, 151.8, 151.0, 145.6, 145.5, 134.8, 134.2, 133.6, 131.9, 130.0, 129.7, 129.6, 128.2, 127.7, 127.3, 72.6, 65.0, 60.0, 59.8, 52.5, 29.7, 21.5. **HRMS:** exact mass calcd for C₂₄H₂₁Cl₂N₅O₄S (M+Na)⁺ 568.0584, found 568.0577.

**(2*R*,3*R*,4*R*,5*R*)-Methyl
3-(6-chloro-9*H*-purin-9-yl)-5-(3-chlorophenyl)-4-tosylpyrrolidine-2-carboxylate
(5ae)**

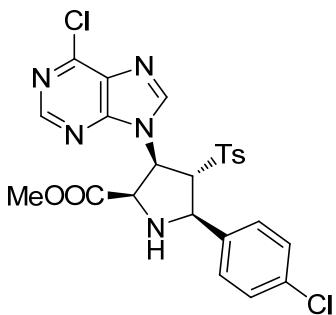


Colorless oil; 25.8 mg, 95% yield, >20:1 dr, 98% ee. $[\alpha]_D^{25.5} = -34.9$ (c 7.53, DCM).
HPLC CHIRALCEL ODH, n-hexane/2-propanol = 60/40, flow rate = 0.5 mL/min, $\lambda =$

254 nm, retention time: 31.651min, 45.603 min.

¹H NMR (400 MHz, CDCl₃): δ 8.65 (s, 1H), 8.29 (s, 1H), 7.59 (d, *J* = 8.2 Hz, 2H), 7.49-7.42 (m, 1H), 7.38 (s, 1H), 7.21 (dd, *J* = 4.8, 1.0 Hz, 2H), 7.15 (d, *J* = 8.1 Hz, 2H), 5.90 (dd, *J* = 6.8, 4.0 Hz, 1H), 4.68 (d, *J* = 7.6 Hz, 1H), 4.52 (d, *J* = 7.2 Hz, 1H), 4.23 (dd, *J* = 8.0, 4.0 Hz, 1H), 3.38(s, 1H), 3.35(s, 3H), 2.35 (s,3H). **¹³C NMR** (100 MHz, CDCl₃): δ 167.7, 151.8, 151.7, 151.0, 146.1, 144.9, 140.0, 134.6, 133.8, 131.5, 130.1, 128.5, 127.7, 125.5, 74.4, 64.5, 62.0, 59.0, 52.6, 21.6. **HRMS:** exact mass calcd for C₂₄H₂₁Cl₂N₅O₄S (M+Na)⁺ 568.0584, found 568.0580.

**(2*R*,3*R*,4*R*,5*R*)-Methyl
3-(6-chloro-9*H*-purin-9-yl)-5-(4-chlorophenyl)-4-tosylpyrrolidine-2-carboxylate
(5af)**

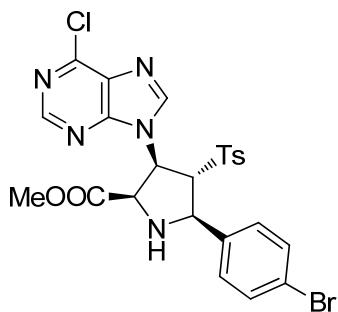


Colorless oil; 24.5 mg, 90% yield, >20:1 dr, >99% ee. [α]_D^{25.5} = -27.47 (c 2.77, DCM).

HPLC CHIRALCEL IA, n-hexane/2-propanol = 50/50, flow rate = 0.5 mL/min, λ= 254 nm, retention time: 29.577 min, 54.932 min.

¹H NMR (400 MHz, CDCl₃): δ 8.60 (s, 1H), 8.27 (s, 1H), 7.59 (d, *J* = 8.3 Hz, 2H), 7.48 (d, *J* = 8.5 Hz, 2H), 7.28-7.26 (m, 2H), 7.16 (d, *J* = 8.0 Hz, 2H), 5.84(dd, *J* = 6.8, 4.1 Hz, 1H), 4.79 (d, *J* = 7.8 Hz, 1H), 4.53 (d, *J* = 6.7 Hz, 1H), 4.15 (dd, *J* = 8.0, 4.0 Hz, 1H), 3.35(s, 3H), 3.33(s, 1H), 2.36 (s,3H). **¹³C NMR** (100 MHz, CDCl₃): δ 167.8, 151.7, 151.0, 146.0, 144.7, 136.6, 134.4, 134.0, 131.4, 130.1, 129.0, 128.8, 128.4, 74.4, 64.3, 61.4, 58.8, 52.5, 21.6. **HRMS:** exact mass calcd for C₂₄H₂₁Cl₂N₅O₄S (M+Na)⁺ 568.0584, found 568.0582.

**(2*R*,3*R*,4*R*,5*R*)-Methyl
5-(4-bromophenyl)-3-(6-chloro-9*H*-purin-9-yl)-4-tosylpyrrolidine-2-carboxylate
(5ag)**

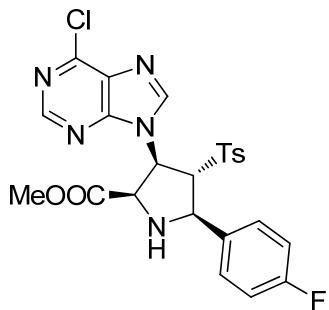


Colorless oil; 28.9 mg, 99% yield, >20:1 dr, >99% ee. $[\alpha]_D^{25.5} = -106.3$ (c 1.90, DCM).

HPLC CHIRALCEL IA, n-hexane/2-propanol = 50/50, flow rate = 0.5 mL/min, $\lambda = 254$ nm, retention time: 30.407 min, 53.696 min.

¹H NMR (400 MHz, CDCl₃): δ 8.60 (s, 1H), 8.27 (s, 1H), 7.58 (d, *J* = 8.2 Hz, 2H), 7.42 (s, 4H), 7.16 (d, *J* = 8.1 Hz, 2H), 5.84 (dd, *J* = 6.8, 4.1 Hz, 1H), 4.77 (t, *J* = 7.3 Hz, 1H), 4.53 (t, *J* = 6.3 Hz, 1H), 4.16 (dd, *J* = 8.0, 4.0 Hz, 1H), 3.35 (s, 3H), 3.30 (s, 1H), 2.37 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 167.8, 151.7, 151.0, 146.1, 144.7, 137.1, 133.9, 131.9, 131.4, 130.1, 129.1, 128.4, 122.5, 74.3, 64.3, 61.5, 58.8, 52.6, 21.6. **HRMS:** exact mass calcd for C₂₄H₂₁BrClN₅O₄S (M+Na)⁺ 612.0078, found 612.0073.

**(2*R*,3*R*,4*R*,5*R*)-Methyl
3-(6-chloro-9*H*-purin-9-yl)-5-(4-fluorophenyl)-4-tosylpyrrolidine-2-carboxylate
(5ah)**

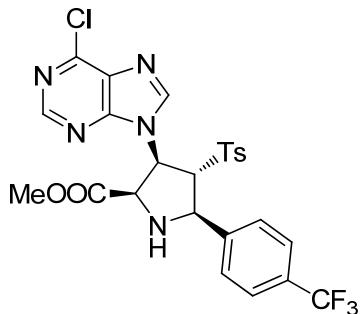


Colorless oil; 25.8 mg, 98% yield, >20:1 dr, >99% ee. $[\alpha]_D^{25.5} = -73.4$ (c 4.33, DCM).

HPLC CHIRALCEL IA, n-hexane/2-propanol = 50/50, flow rate = 0.5 mL/min, λ = 254 nm, retention time: 26.119 min, 44.094 min.

¹H NMR (400 MHz, CDCl₃): δ 8.61 (s, 1H), 8.28 (s, 1H), 7.59 (d, J = 8.2 Hz, 2H), 7.52 (dd, J = 8.6, 5.3 Hz, 2H), 7.15 (d, J = 8.1 Hz, 2H), 6.98 (t, J = 8.6 Hz, 2H), 5.85 (dd, J = 6.8, 4.0 Hz, 1H), 4.80 (d, J = 6.1 Hz, 1H), 4.53 (d, J = 5.0 Hz, 1H), 4.16 (dd, J = 8.0, 4.0 Hz, 1H), 3.35 (s, 3H), 3.31 (s, 1H), 2.35 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 167.9, 151.7, 151.6, 145.9, 144.7, 130.0, 129.1, 128.5, 115.8, 115.6, 74.5, 64.3, 61.5, 58.9, 52.5, 21.6. **HRMS:** exact mass calcd for C₂₄H₂₁ClFN₅O₄S (M+Na)⁺ 552.0879, found 552.0871.

**(2*R*,3*R*,4*R*,5*R*)-Methyl
3-(6-chloro-9*H*-purin-9-yl)-4-tosyl-5-(4-(trifluoromethyl)phenyl)pyrrolidine-2-carboxylate (5ai)**

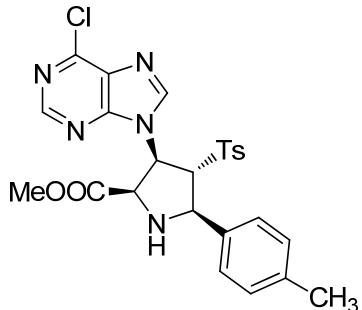


Colorless oil; 28.5 mg, 99% yield, >20:1 dr, 99% ee. $[\alpha]_D^{25.5} = -58.3$ (c 6.00, DCM).

HPLC CHIRALCEL IA, n-hexane/2-propanol = 50/50, flow rate = 0.5 mL/min, λ = 254 nm, retention time: 20.897 min, 26.945 min.

¹H NMR (400 MHz, CDCl₃): δ 8.61 (s, 1H), 8.27 (s, 1H), 7.68 (d, J = 8.2 Hz, 2H), 7.56 (dd, J = 11.8, 8.3 Hz, 4H), 7.13 (d, J = 8.1 Hz, 2H), 5.87 (dd, J = 6.9, 4.2 Hz, 1H), 4.85 (t, J = 7.9 Hz, 1H), 4.56 (t, J = 7.2 Hz, 1H), 4.25 (dd, J = 8.1, 4.1 Hz, 1H), 3.39 (s, 1H), 3.35 (s, 3H), 2.33 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 168.7, 151.7, 151.0, 146.1, 144.8, 142.0, 133.8, 131.4, 130.1, 128.4, 127.9, 125.7, 125.2, 74.2, 64.4, 61.7, 59.0, 52.6, 21.5. **HRMS:** exact mass calcd for C₂₅H₂₁ClF₃N₅O₄S (M+Na)⁺ 602.0847, found 602.0839.

**(2*R*,3*R*,4*R*,5*R*)-Methyl
3-(6-chloro-9*H*-purin-9-yl)-5-(p-tolyl)-4-tosylpyrrolidine-2-carboxylate (5aj)**

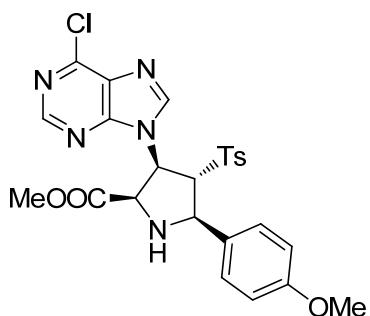


Colorless oil; 25.0 mg, 95% yield, >20:1 dr, 98% ee. $[\alpha]_D^{25.5} = -97.57$ (c 1.53, DCM).

HPLC CHIRALCEL IA, n-hexane/2-propanol = 50/50, flow rate = 0.5 mL/min, $\lambda = 254$ nm, retention time: 28.931 min, 35.204 min.

¹H NMR (400 MHz, CDCl₃): δ 8.60 (s, 1H), 8.33 (s, 1H), 7.60 (d, *J* = 8.3 Hz, 2H), 7.39 (d, *J* = 8.1 Hz, 2H), 7.11 (dd, *J* = 18.2, 8.0 Hz, 4H), 5.85 (dd, *J* = 6.7, 3.9 Hz, 1H), 4.79 (t, *J* = 5.8 Hz, 1H), 4.53 (t, *J* = 5.1 Hz, 1H), 4.14 (dd, *J* = 7.9, 3.9 Hz, 1H), 3.34 (s, 3H), 3.28 (s, 1H), 2.33 (d, *J* = 7.1 Hz, 6H). **¹³C NMR** (100 MHz, CDCl₃): δ 167.9, 151.7, 151.5, 151.1, 145.7, 144.8, 138.3, 135.0, 134.2, 131.3, 130.0, 129.5, 128.5, 127.2, 74.7, 64.3, 61.8, 58.8, 52.4, 21.6, 21.1. **HRMS:** exact mass calcd for C₂₅H₂₄ClN₅O₄S (M+Na)⁺ 548.1130, found 548.1129.

**(2*R*,3*R*,4*R*,5*R*)-Methyl
3-(6-chloro-9*H*-purin-9-yl)-5-(4-methoxyphenyl)-4-tosylpyrrolidine-2-carboxylat
e (5ak)**

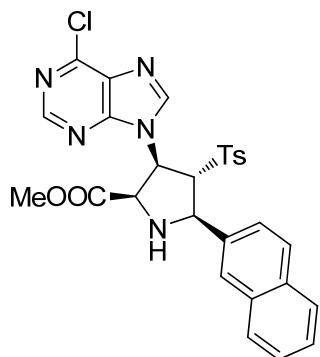


Colorless oil; 24.0 mg, 90% yield, >20:1 dr, 99% ee. $[\alpha]_D^{25.5} = -15.2$ (c 6.97, DCM).

HPLC CHIRALCEL OD-H, n-hexane/2-propanol = 50/50, flow rate = 0.5 mL/min, $\lambda = 254$ nm, retention time: 28.722 min, 46.967 min.

¹H NMR (400 MHz, CDCl₃): δ 8.62 (s, 1H), 8.32 (s, 1H), 7.59 (d, *J* = 8.2 Hz, 2H), 7.42 (d, *J* = 8.7 Hz, 2H), 7.14 (d, *J* = 8.1 Hz, 2H), 6.81 (d, *J* = 8.7 Hz, 2H), 5.85(dd, *J* = 6.7, 4.1 Hz, 1H), 4.76 (d, *J* = 7.8 Hz, 1H), 4.51 (d, *J* = 6.7 Hz, 1H), 4.15 (dd, *J* = 8.0, 4.0 Hz, 1H), 3.79 (s, 3H), 3.34 (s, 3H), 3.25 (s, 1H), 2.34 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 167.9, 159.6, 151.7, 151.5, 151.0, 145.7, 144.8, 134.2, 131.3, 130.0, 128.5, 114.1, 74.6, 64.3, 61.7, 58.9, 55.3, 52.5, 21.6. **HRMS:** exact mass calcd for C₂₅H₂₄ClN₅O₅S (M+Na)⁺ 564.1079, found 564.1076.

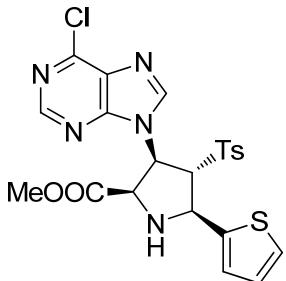
**(2*R*,3*R*,4*R*,5*R*)-Methyl
3-(6-chloro-9*H*-purin-9-yl)-5-(naphthalen-2-yl)-4-tosylpyrrolidine-2-carboxylate
(5al)**



Colorless oil; 24.5 mg, 89% yield, >20:1 dr, 99% ee. [α]_D^{25.5} = -84.5 (c 3.47, DCM). HPLC CHIRALCEL IA, n-hexane/2-propanol = 50/50, flow rate = 0.5 mL/min, λ= 254 nm, retention time: 40.687 min, 79.443 min.

¹H NMR (400 MHz, CDCl₃): δ 8.67 (s, 1H), 8.41 (s, 1H), 7.86-7.75 (m, 3H), 7.75-7.65 (m, 2H), 7.56 (d, *J* = 8.3 Hz, 2H), 7.49 (dt, *J* = 5.4, 3.3 Hz, 2H), 6.99 (d, *J* = 8.0 Hz, 2H), 5.96 (dd, *J* = 6.9, 4.0 Hz, 1H), 4.90 (d, *J* = 8.1 Hz, 1H), 4.60 (d, *J* = 6.9 Hz, 1H), 4.32 (dd, *J* = 8.1, 4.0 Hz, 1H), 3.36 (s, 3H), 2.11 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 167.9, 151.8, 151.6, 151.1, 145.8, 145.0, 135.0, 133.9, 133.1, 133.0, 131.4, 129.9, 128.9, 128.0, 127.7, 127.1, 126.5, 124.2, 74.4, 64.5, 62.6, 58.8, 52.5, 29.7, 21.3. **HRMS:** exact mass calcd for C₂₈H₂₄ClN₅O₄S (M+Na)⁺ 584.1130, found 584.1127.

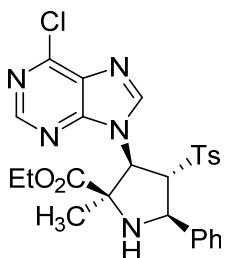
**(2*R*,3*R*,4*R*,5*S*)-Methyl
3-(6-chloro-9*H*-purin-9-yl)-5-(thiophen-2-yl)-4-tosylpyrrolidine-2-carboxylate
(5am)**



Colorless oil; 23.0 mg, 90% yield, >20:1 dr, 97% ee. $[\alpha]_D^{25.5} = -111.2$ (c 1.13, DCM).
HPLC CHIRALCEL IA, n-hexane/2-propanol = 50/50, flow rate = 0.5 mL/min, $\lambda = 254$ nm, retention time: 33.299 min, 55.483 min.

¹H NMR (400 MHz, CDCl₃): δ 8.60 (s, 1H), 8.48 (s, 1H), 7.69 (d, *J* = 8.2 Hz, 2H), 7.25-7.19 (m, 3H), 6.96 (d, *J* = 3.3 Hz, 1H), 6.88 (dd, *J* = 5.0, 3.6 Hz, 1H), 5.90 (dd, *J* = 6.3, 3.0 Hz, 1H), 5.16 (s, 1H), 4.54 (s, 1H), 4.01 (dd, *J* = 7.3, 3.0 Hz, 1H), 3.47 (s, 1H), 3.37 (s, 3H), 2.38 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 167.5, 151.8, 151.4, 151.1, 146.0, 144.7, 142.1, 134.0, 131.1, 130.1, 128.7, 127.2, 126.5, 125.5, 75.9, 64.4, 57.8, 57.5, 52.5, 21.7. **HRMS:** exact mass calcd for C₂₂H₂₀ClN₅O₄S₂ (M+Na)⁺ 540.0537, found 540.0529.

**(2*R*,3*R*,4*R*,5*R*)-Ethyl
3-(6-chloro-9*H*-purin-9-yl)-2-methyl-5-phenyl-4-tosylpyrrolidine-2-carboxylate
(5ap)**

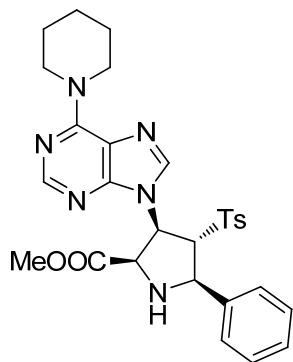


Colorless oil; 23.0 mg, 87% yield, >20:1 dr, 97% ee. $[\alpha]_D^{25.5} = -156.0$ (c 0.33, DCM).
HPLC CHIRALCEL IA, n-hexane/2-propanol = 70/30, flow rate = 0.5 mL/min, $\lambda = 254$ nm, retention time: 32.291 min, 69.952 min.

¹H NMR (400 MHz, CDCl₃): δ 8.72 (s, 1H), 8.14 (s, 1H), 7.58-7.50 (m, 2H), 7.39 (d, J = 8.2 Hz, 2H), 7.33-7.24 (m, 3H), 6.94 (d, J = 8.1 Hz, 2H), 5.48 (d, J = 7.0 Hz, 1H), 4.84 (s, 2H), 3.76-3.71 (m, 1H), 3.63-3.51 (m, 1H), 2.24 (s, 3H), 1.78 (s, 3H), 0.76 (t, J = 7.1 Hz, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 171.0, 151.5, 151.3, 151.0, 145.3, 134.0, 129.4, 128.5, 128.2, 127.7, 127.3, 69.4, 61.9, 29.5, 21.3, 13.2. **HRMS:** exact mass calcd for C₂₆H₂₆ClN₅O₄S (M+Na)⁺ 540.1467, found 540.1464.

(2*R*,3*R*,4*R*,5*R*)-Methyl

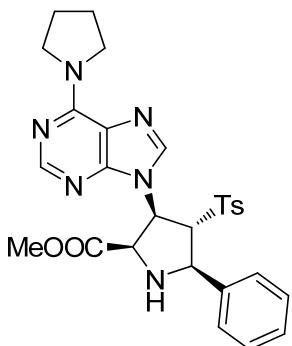
**5-phenyl-3-(6-(piperidin-1-yl)-9*H*-purin-9-yl)-4-tosylpyrrolidine-2-carboxylate
(5ba)**



Colorless oil; 26.0 mg, 93% yield, >20:1 dr, >99% ee. [α]_D^{25.5} = -75.5 (c 2.00, DCM). HPLC CHIRALCEL IA, n-hexane/2-propanol = 50/50, flow rate = 0.5 mL/min, λ= 254 nm, retention time: 24.555 min, 42.088 min.

¹H NMR (400 MHz, CDCl₃): δ 8.20 (s, 1H), 7.75 (s, 1H), 7.52 (dd, J = 9.2, 5.9 Hz, 4H), 7.24-7.18 (m, 3H), 7.07 (d, J = 8.1 Hz, 2H), 5.78 (dd, J = 7.2, 4.3 Hz, 1H), 4.61 (d, J = 8.6 Hz, 1H), 4.45-4.37 (m, 2H), 4.19 (br, 3H), 3.35 (s, 3H), 2.30 (s, 3H), 1.70 (dd, J = 11.4, 5.8 Hz, 7H). **¹³C NMR** (100 MHz, CDCl₃): δ 168.0, 153.8, 152.0, 149.9, 145.3, 138.1, 137.9, 134.3, 129.8, 128.5, 128.3, 128.1, 127.7, 119.7, 74.5, 65.1, 63.6, 59.7, 52.2, 26.1, 24.7, 21.6. **HRMS:** exact mass calcd for C₂₉H₃₂N₆O₄S (M+H)⁺ 561.2279, found 561.2286.

**(2*R*,3*R*,4*R*,5*R*)-Methyl
5-phenyl-3-(6-(pyrrolidin-1-yl)-9*H*-purin-9-yl)-4-tosylpyrrolidine-2-carboxylate
(5ca)**

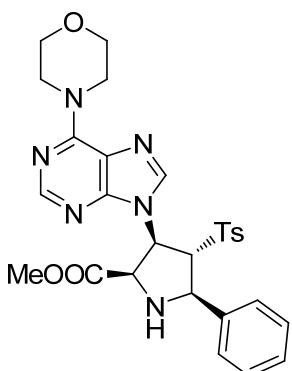


Colorless oil; 25.5 mg, 95% yield, >20:1 dr, >99% ee. $[\alpha]_D^{25.5} = -137.9$ (c 3.80, DCM).

HPLC CHIRALCEL IA, n-hexane/2-propanol = 50/50, flow rate = 0.5 mL/min, $\lambda = 254$ nm, retention time: 29.846 min, 44.969 min.

¹H NMR (400 MHz, CDCl₃): δ 8.23 (s, 1H), 7.73 (s, 1H), 7.57-7.50 (m, 4H), 7.24-7.18 (m, 3H), 7.07 (d, *J* = 8.0 Hz, 2H), 5.77 (dd, *J* = 7.2, 4.3 Hz, 1H), 4.62 (d, *J* = 8.6 Hz, 1H), 4.42 (dd, *J* = 8.5, 4.2 Hz, 2H), 4.11 (d, *J* = 7.1 Hz, 2H), 3.76 – 3.68 (m, 2H), 3.35 (s, 3H), 2.29 (s, 3H), 2.03 (br, 4H). **¹³C NMR** (100 MHz, CDCl₃): δ 168.0, 153.0, 152.4, 149.3, 145.3, 138.9, 137.9, 134.4, 129.8, 128.6, 128.3, 128.1, 127.7, 120.1, 74.5, 65.1, 63.7, 59.8, 52.2, 29.7, 21.5. **HRMS:** exact mass calcd for C₂₈H₃₀N₆O₄S (M+Na)⁺ 569.1941, found 569.1950.

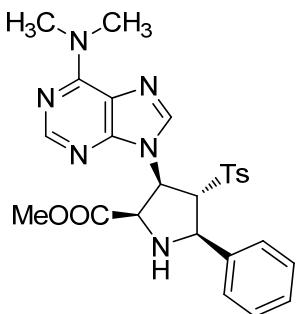
**(2*R*,3*R*,4*R*,5*R*)-Methyl
3-(6-morpholino-9*H*-purin-9-yl)-5-phenyl-4-tosylpyrrolidine-2-carboxylate (5da)**



Colorless oil; 26.0 mg, 93% yield, >20:1 dr, 99% ee. $[\alpha]_D^{25.5} = -55.1$ (c 4.10, DCM).
 HPLC CHIRALCEL IA, n-hexane/2-propanol = 50/50, flow rate = 0.5 mL/min, $\lambda = 254$ nm, retention time: 45.010 min, 60.022 min.

¹H NMR (400 MHz, CDCl₃): δ 8.22 (s, 1H), 7.81 (s, 1H), 7.56-7.46 (m, 4H), 7.23-7.16 (m, 3H), 7.07 (d, *J* = 8.1 Hz, 2H), 5.80 (dd, *J* = 7.1, 4.2 Hz, 1H), 4.62 (d, *J* = 8.6 Hz, 1H), 4.44 (d, *J* = 7.2 Hz, 1H), 4.37 (dd, *J* = 8.5, 4.2 Hz, 1H), 4.26 (br, 4H), 3.85-3.77 (m, 4H), 3.35 (s, 3H), 2.30 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 167.9, 153.8, 151.9, 150.1, 145.3, 138.7, 137.8, 134.3, 129.8, 128.6, 128.4, 128.1, 127.7, 119.8, 74.5, 67.0, 65.0, 63.5, 59.5, 52.3, 21.6. **HRMS:** exact mass calcd for C₂₈H₃₀N₆O₅S (M+H)⁺ 563.2071, found 563.2072.

**(2*R*,3*R*,4*R*,5*R*)-Methyl
 3-(6-(dimethylamino)-9*H*-purin-9-yl)-5-phenyl-4-tosylpyrrolidine-2-carboxylate
 (5ea)**

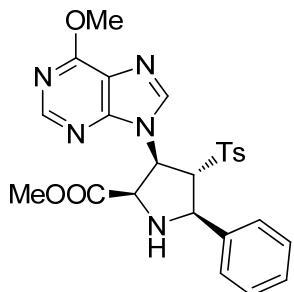


Colorless oil; 24.3 mg, 96% yield, >20:1 dr, >99% ee. $[\alpha]_D^{25.5} = -53.0$ (c 6.40, DCM).

HPLC CHIRALCEL IA, n-hexane/2-propanol = 50/50, flow rate = 0.5 mL/min, $\lambda = 254$ nm, retention time: 28.193 min, 77.964 min.

¹H NMR (400 MHz, CDCl₃): δ 8.21 (s, 1H), 7.75 (s, 1H), 7.53 (d, *J* = 8.2 Hz, 4H), 7.24-7.19 (m, 3H), 7.07 (d, *J* = 8.1 Hz, 2H), 5.77 (dd, *J* = 7.2, 4.4 Hz, 1H), 4.61 (d, *J* = 6.9 Hz, 1H), 4.41 (dd, *J* = 8.5, 4.3 Hz, 2H), 3.83 (s, 1H), 3.50(br, 5H), 3.34 (s, 3H), 2.29 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 168.0, 154.9, 152.0, 149.7, 145.3, 138.3, 137.9, 134.3, 129.8, 128.6, 128.3, 128.1, 127.7, 120.0, 74.5, 65.1, 63.6, 59.7, 52.2, 21.5. **HRMS:** exact mass calcd for C₂₆H₂₈N₆O₄S (M+Na)⁺ 543.1785, found 543.1782.

**(2*R*,3*R*,4*R*,5*R*)-Methyl
3-(6-methoxy-9*H*-purin-9-yl)-5-phenyl-4-tosylpyrrolidine-2-carboxylate (5fa)**

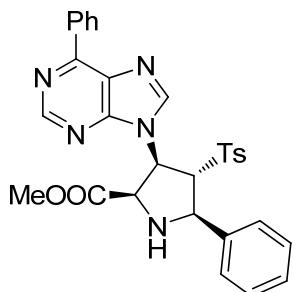


Colorless oil; 23.5 mg, 93% yield, >20:1 dr, 95% ee. $[\alpha]_D^{25.5} = -126.6$ (c 2.87, DCM).

HPLC CHIRALCEL ODH, n-hexane/2-propanol = 60/40, flow rate = 0.5 mL/min, $\lambda = 254$ nm, retention time: 29.198 min, 40.576 min.

¹H NMR (400 MHz, CDCl₃): δ 8.43 (s, 1H), 7.95 (s, 1H), 7.54 (dd, *J* = 9.5, 5.1 Hz, 4H), 7.32-7.22 (m, 3H), 7.09 (d, *J* = 8.1 Hz, 2H), 5.82 (dd, *J* = 7.1, 4.3 Hz, 1H), 4.70 (d, *J* = 8.3 Hz, 1H), 4.47 (d, *J* = 6.9 Hz, 1H), 4.37 (dd, *J* = 8.5, 4.3 Hz, 1H), 4.16 (s, 3H), 3.30 (s, 3H), 2.30 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 167.9, 161.2, 151.9, 151.1, 145.5, 142.1, 137.8, 134.3, 129.9, 128.7, 128.3, 127.6, 121.5, 74.4, 64.9, 63.2, 59.7, 54.4, 52.3, 21.5. **HRMS:** exact mass calcd for C₂₅H₂₅N₅O₅S (M+Na)⁺ 530.1469, found 530.1480.

**(2*R*,3*R*,4*R*,5*R*)-Methyl
5-phenyl-3-(6-phenyl-9*H*-purin-9-yl)-4-tosylpyrrolidine-2-carboxylate (5ga)**



Colorless oil; 26.0 mg, 95% yield, >20:1 dr, 99% ee. $[\alpha]_D^{25.5} = -106.4$ (c 2.50, DCM).

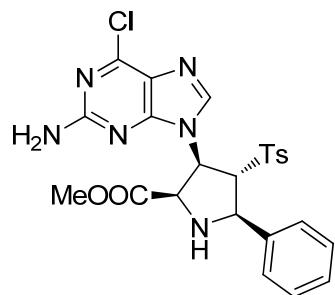
HPLC CHIRALCEL IA, n-hexane/2-propanol = 50/50, flow rate = 0.5 mL/min, $\lambda = 254$ nm, retention time: 31.553 min, 44.134 min.

¹H NMR (400 MHz, CDCl₃): δ 8.88 (s, 1H), 8.73 (dd, *J* = 7.7, 1.9 Hz, 2H), 8.28 (s,

1H), 7.65-7.50 (m, 7H), 7.34-7.22 (m, 3H), 7.11 (d, J = 8.1 Hz, 2H), 5.92 (dd, J = 6.9, 4.1 Hz, 1H), 4.80 (d, J = 8.2 Hz, 1H), 4.55 (d, J = 7.0 Hz, 1H), 4.34 (dd, J = 8.2, 4.1 Hz, 1H), 3.30 (s, 3H), 2.30 (s, 3H). ^{13}C NMR (100 MHz, CDCl_3): δ 168.0, 155.3, 152.0, 151.7, 145.6, 144.1, 138.1, 135.2, 134.2, 131.3, 130.8, 130.0, 129.8, 128.8, 128.4, 128.3, 127.5, 74.5, 64.6, 62.5, 59.0, 52.3, 21.6. HRMS: exact mass calcd for $\text{C}_{30}\text{H}_{27}\text{N}_5\text{O}_4\text{S} (\text{M}+\text{Na})^+$ 576.1676, found 576.1675.

(2*R*,3*R*,4*R*,5*R*)-Methyl

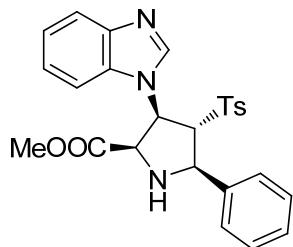
**3-(2-amino-6-chloro-9*H*-purin-9-yl)-5-phenyl-4-tosylpyrrolidine-2-carboxylate
(5ha)**



Colorless oil; 23.2 mg, 90% yield, >20:1 dr, 99% ee. $[\alpha]_D^{25.5} = -102.9$ (c 3.50, DCM). HPLC CHIRALCEL ODH, n-hexane/2-propanol = 50/50, flow rate = 0.5 mL/min, λ = 254 nm, retention time: 15.843 min, 25.663 min.

^1H NMR (400 MHz, CDCl_3): δ 7.83 (s, 1H), 7.63 (d, J = 8.3 Hz, 2H), 7.49 (dd, J = 7.3, 2.1 Hz, 2H), 7.32-7.26 (m, 3H), 7.17 (d, J = 8.0 Hz, 2H), 5.62 (dd, J = 6.7, 3.7 Hz, 1H), 4.93 (s, 2H), 4.80 (d, J = 8.0 Hz, 1H), 4.46 (d, J = 6.7 Hz, 1H), 4.24 (dd, J = 7.9, 3.6 Hz, 1H), 3.43 (s, 3H), 2.34 (s, 3H). ^{13}C NMR (100 MHz, CDCl_3): δ 168.0, 158.6, 152.8, 151.8, 145.7, 141.7, 138.3, 134.3, 130.0, 128.7, 128.5, 128.2, 127.3, 124.9, 74.2, 64.8, 62.5, 59.3, 52.5, 29.7, 21.6. HRMS: exact mass calcd for $\text{C}_{24}\text{H}_{23}\text{ClN}_6\text{O}_4\text{S} (\text{M}+\text{Na})^+$ 549.1082, found 549.1077.

**(2*R*,3*R*,4*R*,5*R*)-Methyl
3-(1*H*-benzo[d]imidazol-1-yl)-5-phenyl-4-tosylpyrrolidine-2-carboxylate (5ia)**

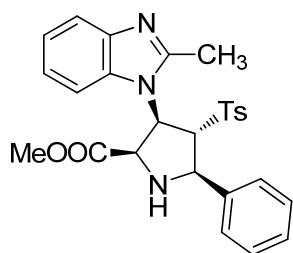


Colorless oil; 23.0 mg, 98% yield, >20:1 dr, >99% ee. $[\alpha]_D^{25.5} = -18.6$ (c 7.67, DCM).

HPLC CHIRALCEL ODH, n-hexane/2-propanol = 50/50, flow rate = 0.5 mL/min, $\lambda = 254$ nm, retention time: 14.683 min, 30.872 min.

¹H NMR (400 MHz, CDCl₃): δ 8.40 (s, 1H), 7.71 (d, *J* = 7.9 Hz, 1H), 7.64 (d, *J* = 7.8 Hz, 2H), 7.31 (dd, *J* = 6.3, 2.9 Hz, 2H), 7.25-7.13 (m, 8H), 5.52 (dd, *J* = 6.1, 2.2 Hz, 1H), 4.84 (s, 1H), 4.62 (d, *J* = 5.1 Hz, 1H), 3.79 (d, *J* = 5.6 Hz, 1H), 3.32 (s, 3H), 2.90 (s, 1H), 2.37 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 168.3, 145.9, 138.9, 134.1, 130.2, 128.7, 128.5, 128.3, 127.2, 123.2, 122.6, 120.3, 109.8, 64.1, 60.7, 56.7, 53.5, 52.2, 21.6. **HRMS:** exact mass calcd for C₂₆H₂₅N₃O₄S (M+H)⁺ 476.1639, found 476.1649.

**(2*R*,3*R*,4*R*,5*R*)-Methyl
3-(2-methyl-1*H*-benzo[d]imidazol-1-yl)-5-phenyl-4-tosylpyrrolidine-2-carboxylate (5ja)**



Colorless oil; 22.3 mg, 94% yield, >20:1 dr, 97% ee. $[\alpha]_D^{25.5} = -78.2$ (c 4.83, DCM).

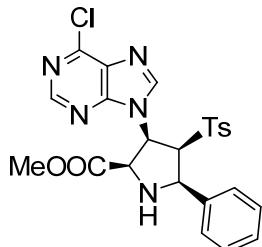
HPLC CHIRALCEL ODH, n-hexane/2-propanol = 60/40, flow rate = 0.5 mL/min, $\lambda = 254$ nm, retention time: 15.248 min, 21.406 min.

¹H NMR (400 MHz, CDCl₃): δ 8.20-8.13 (m, 1H), 7.69-7.62 (m, 1H), 7.29 (dd, *J* = 5.8, 4.2 Hz, 3H), 7.25-7.10 (m, 6H), 6.88 (d, *J* = 8.1 Hz, 2H), 5.90 (dd, *J* = 8.8, 6.3 Hz,

1H), 4.56-4.40 (m, 3H), 3.14 (s, 3H), 2.76 (s, 3H), 2.21 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 168.6, 153.3, 145.1, 143.1, 137.0, 134.3, 132.1, 129.5, 128.6, 128.4, 127.9, 127.8, 127.1, 122.4, 122.1, 119.4, 112.4, 70.4, 63.4, 62.1, 56.9, 52.2, 29.7, 21.4, 14.4. **HRMS:** exact mass calcd for C₂₇H₂₇N₃O₄S (M+H)⁺ 490.1795, found 490.1801.

(2*R*,3*R*,4*S*,5*R*)-methyl

3-(6-chloro-9*H*-purin-9-yl)-5-phenyl-4-tosylpyrrolidine-2-carboxylate (6aa)



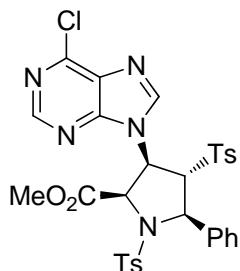
Colorless oil; 65.8 mg, 86% yield, >20:1 dr, 94% ee.

HPLC CHIRALCEL IA, n-hexane/2-propanol = 50/50, flow rate = 0.5 mL/min, λ= 254 nm, retention time: 20.390 min, 26.206 min.

¹H NMR (400 MHz, CDCl₃): δ 8.46 (s, 1H), 8.40 (s, 1H), 7.51 (d, *J* = 7.2 Hz, 2H), 7.41-7.32 (m, 3H), 7.16 (d, *J* = 8.2 Hz, 2H), 6.86 (d, *J* = 8.1 Hz, 2H), 5.52-5.44 (m, 1H), 5.38 (d, *J* = 3.8 Hz, 1H), 5.07 (d, *J* = 9.3 Hz, 1H), 4.34 (dd, *J* = 7.8, 5.0 Hz, 1H), 3.74 (s, 3H), 2.90 (s, 1H), 2.22 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 170.5, 151.7, 151.6, 150.8, 145.0, 144.4, 140.8, 134.0, 130.8, 129.1, 129.0, 128.4, 126.9, 126.7, 69.7, 61.0, 60.6, 57.4, 53.1, 21.3. **HRMS:** exact mass calcd for C₂₄H₂₂ClN₅O₄S (M+Na)⁺ 534.0973, found 534.0976.

(2*R*,3*R*,4*S*,5*R*)-Methyl

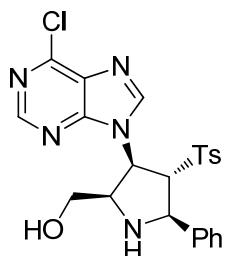
3-(6-chloro-9*H*-purin-9-yl)-5-phenyl-1,4-ditosylpyrrolidine-2-carboxylate (7aa)



White solid; 200.0 mg, 75% yield, $[\alpha]_D^{25.5} = -81.8$ (c 0.73, DCM).

¹H NMR (400 MHz, CDCl₃): δ 8.64 (s, 1H), 8.00 (s, 1H), 7.59-7.48 (m, 2H), 7.26-7.14 (m, 7H), 7.08 (d, *J* = 8.1 Hz, 2H), 6.85 (d, *J* = 8.1 Hz, 2H), 5.73 (dd, *J* = 11.0, 9.3 Hz, 1H), 5.49-5.23 (m, 3H), 3.22 (s, 3H), 2.36 (s, 3H), 2.23 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 168.9, 151.9, 151.4, 145.9, 144.1, 136.8, 135.4, 133.8, 131.3, 129.4, 129.3, 129.0, 128.6, 128.4, 127.7, 127.6, 62.9, 61.7, 55.5, 52.9, 21.6, 21.4.

((2*R*,3*R*,4*R*,5*R*)-3-(6-chloro-9*H*-purin-9-yl)-5-phenyl-4-tosylpyrrolidin-2-yl)methanol (8aa)



Colorless oil; 68.5 mg, 95% yield, >20:1 dr, >99% ee. $[\alpha]_D^{25.5} = -49.3$ (c 1.12, DCM). HPLC CHIRALCEL AS, n-hexane/2-propanol = 50/50, flow rate = 0.5 mL/min, λ = 254 nm, retention time: 84.709 min, 123.198 min.

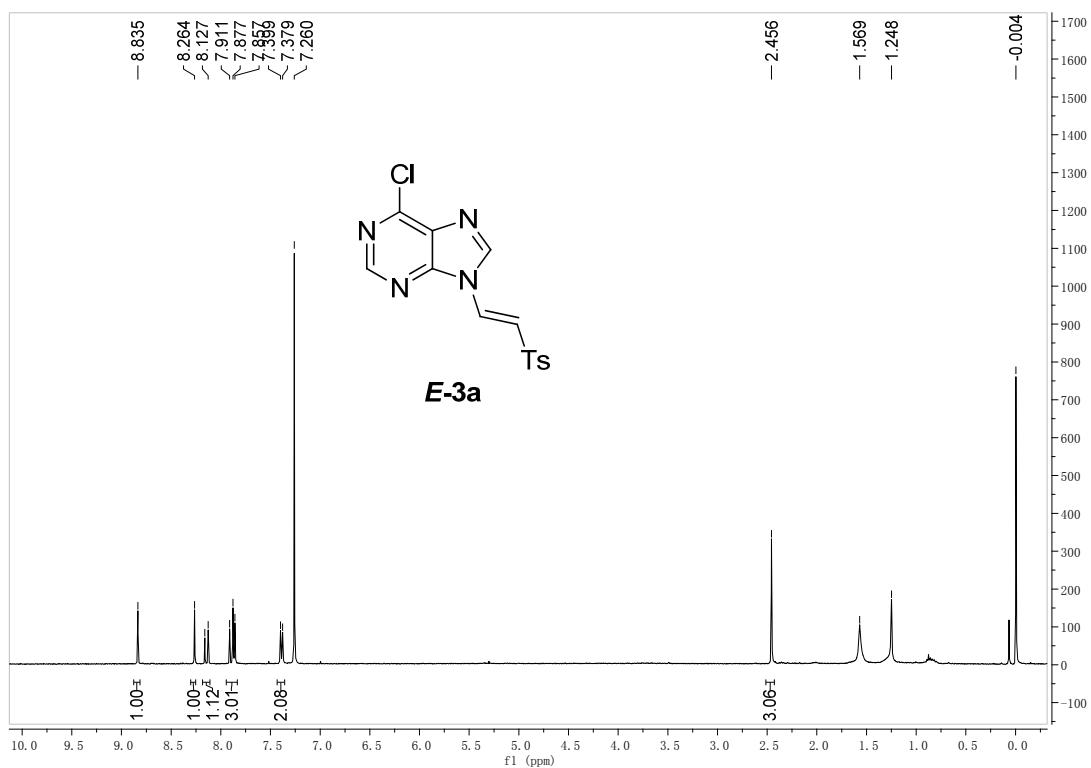
¹H NMR (400 MHz, CDCl₃): δ 8.65 (s, 1H), 8.22 (s, 1H), 7.49-7.47 (m, 4H), 7.34-7.24 (m, 3H), 7.08 (d, *J* = 8.1 Hz, 2H), 5.74 (dd, *J* = 6.5, 4.5 Hz, 1H), 4.81 (d, *J* = 8.0 Hz, 1H), 4.22 (dd, *J* = 7.8, 4.3 Hz, 1H), 3.89 (q, *J* = 6.3 Hz, 1H), 3.47 (dd, *J* = 11.2, 5.6 Hz, 1H), 3.29 (dd, *J* = 11.2, 6.5 Hz, 1H), 2.29 (s, 3H). **¹³C NMR** (100 MHz, CDCl₃): δ 151.7, 151.4, 145.7, 145.6, 138.6, 134.2, 131.3, 129.9, 128.8, 128.3, 127.2, 74.8, 62.8, 62.1, 60.6, 58.6, 21.5. **HRMS:** exact mass calcd for C₂₃H₂₂ClN₅O₃S (M+Na)⁺ 506.1024, found 506.1031.

6. References

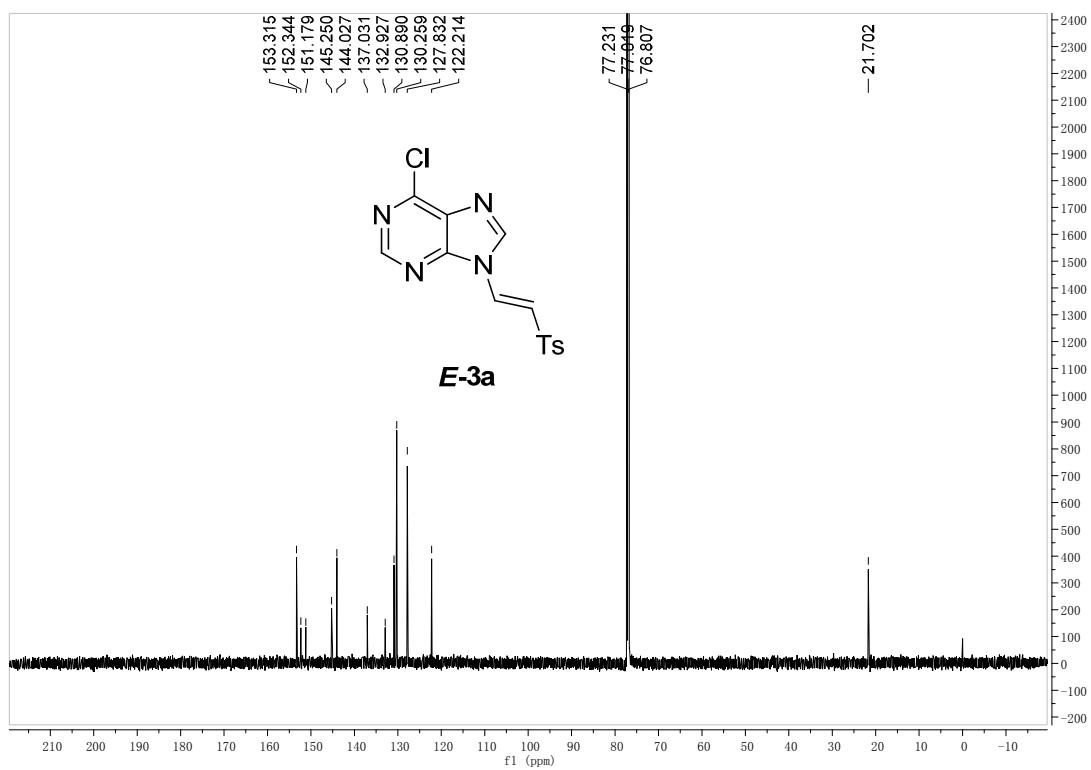
- (1) (a) Nishibayashi, Y.; Segawa, K.; Ohe, K.; Uemura, S. *Organometallics* **1995**, *14*, 5486–5487. (b) Nishibayashi, Y.; Segawa, K.; Takada, H.; Ohe, K.; Uemura, S. *Chem. Commun.* **1996**, 847–848. (c) Herbert, S. A.; Castell, D. C.; Clayden, J.; Arnott, G. E. *Org. Lett* **2013**, *15*, 3334–3337.
- (2) (a) Grigg, R.; Guaratne, H. Q. N.; Kemp, J. *J. Chem. Soc., Perkin Trans. 1*, **1984**, 41–46. (b) Longmire, J. M.; Wang, B.; Zhang, X. *J. Am. Chem. Soc.* **2002**, *124*, 13400–13401.
- (3) Eisch, J. J.; Shafii, B.; Odom, J. D.; Rheingo, A. L. *J. Am. Chem. Soc.* **1990**, *112*, 1847–1853.
- (4) Zhou, J.; Shevlin, P. B. *Synth. Commun.* **1997**, *27*, 3591–3597.

7. Copies of ^1H and ^{13}C NMR spectra.

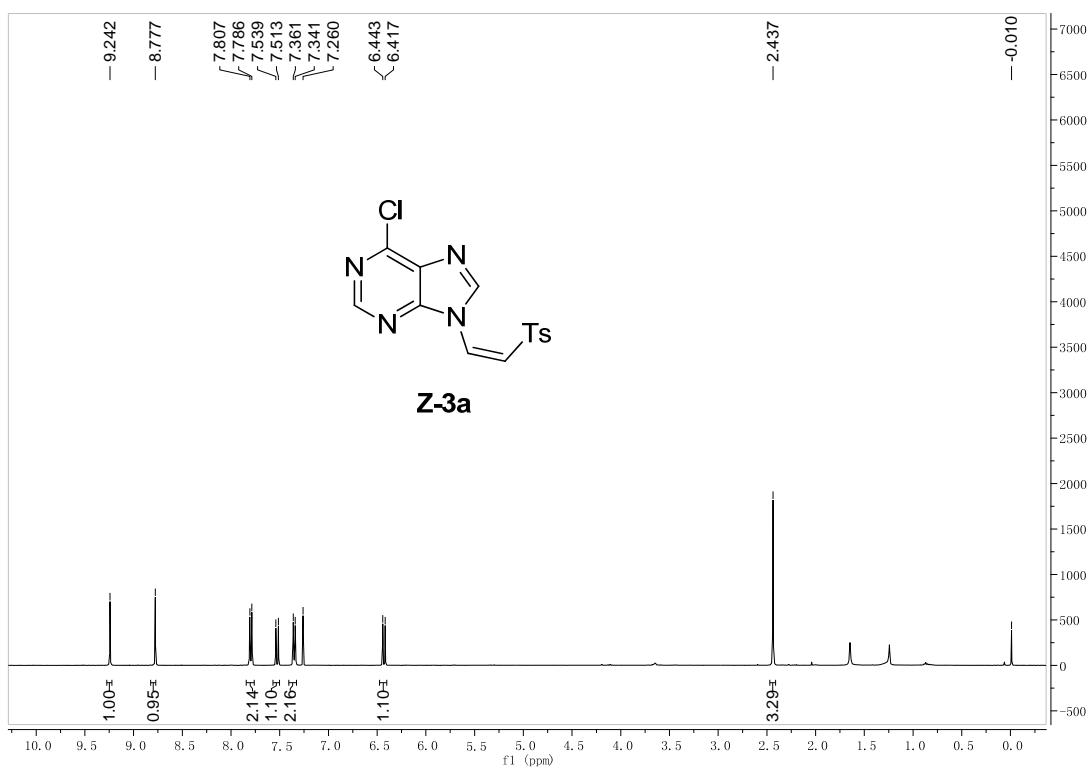
^1H NMR of 3a



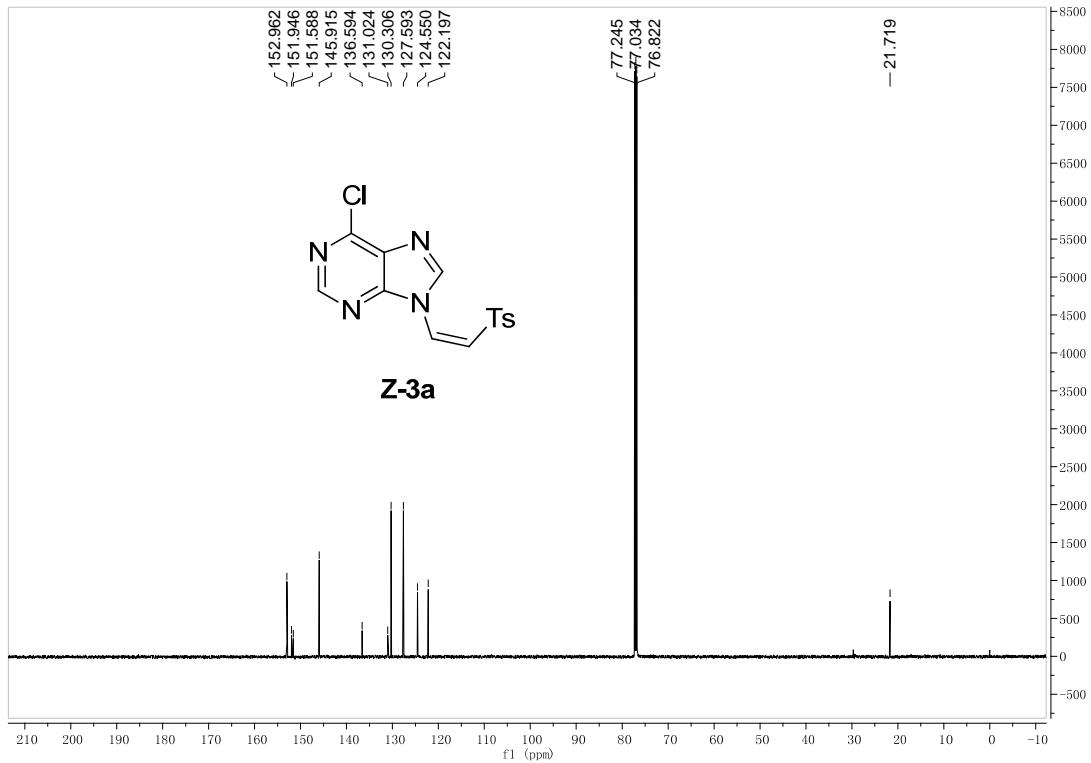
^{13}C -NMR for 3a



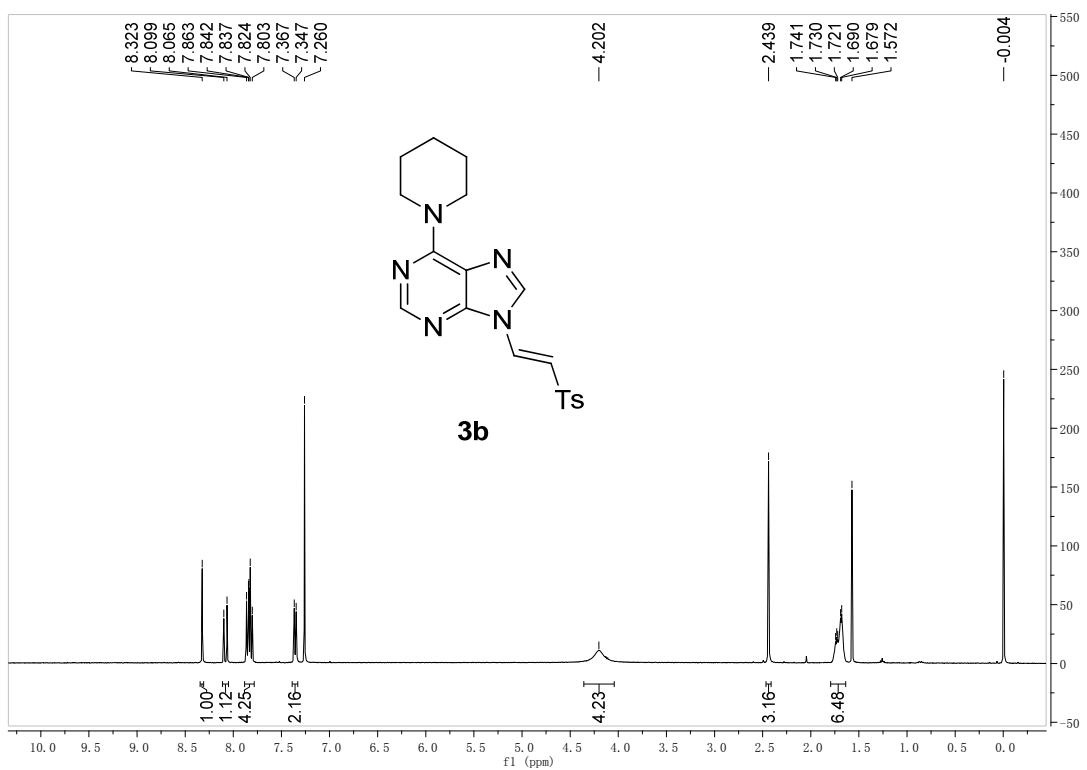
¹H NMR of 3a



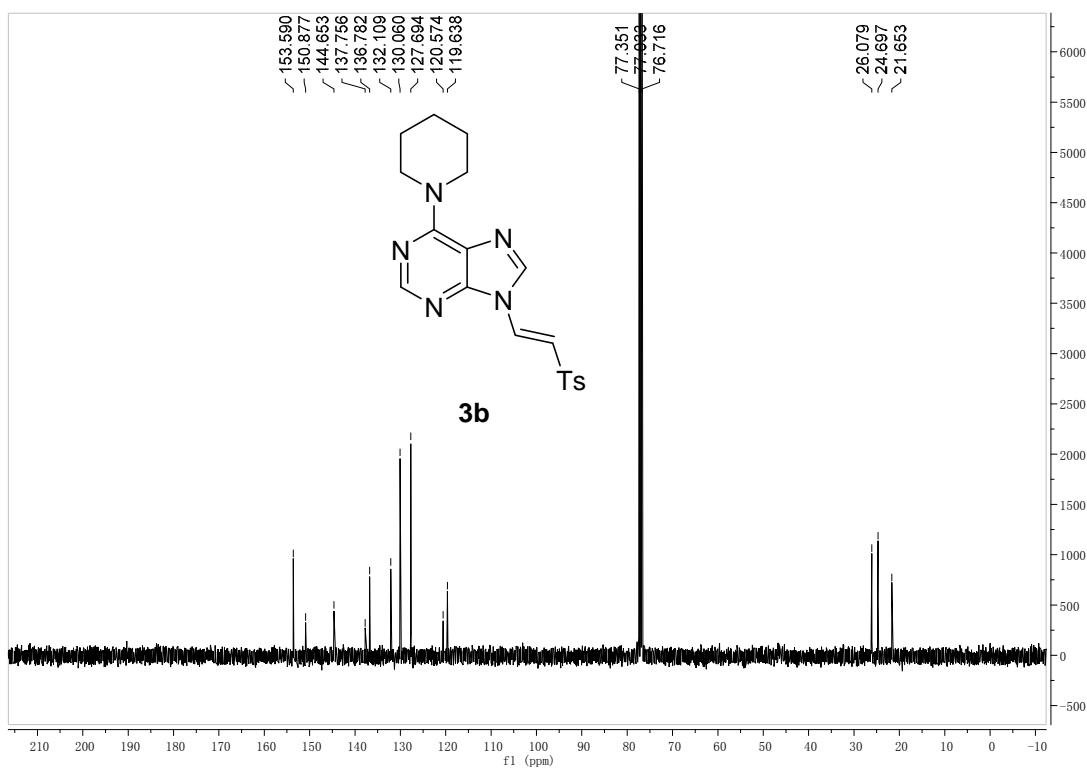
¹³C-NMR for 3a



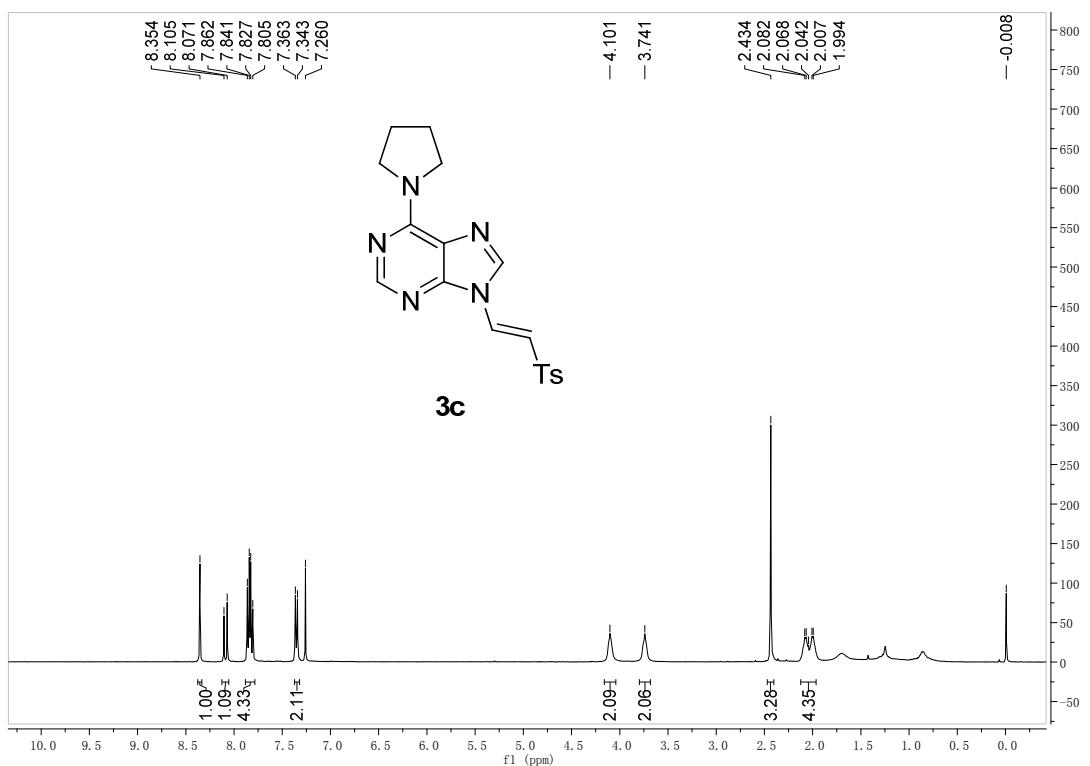
¹H NMR of 3b



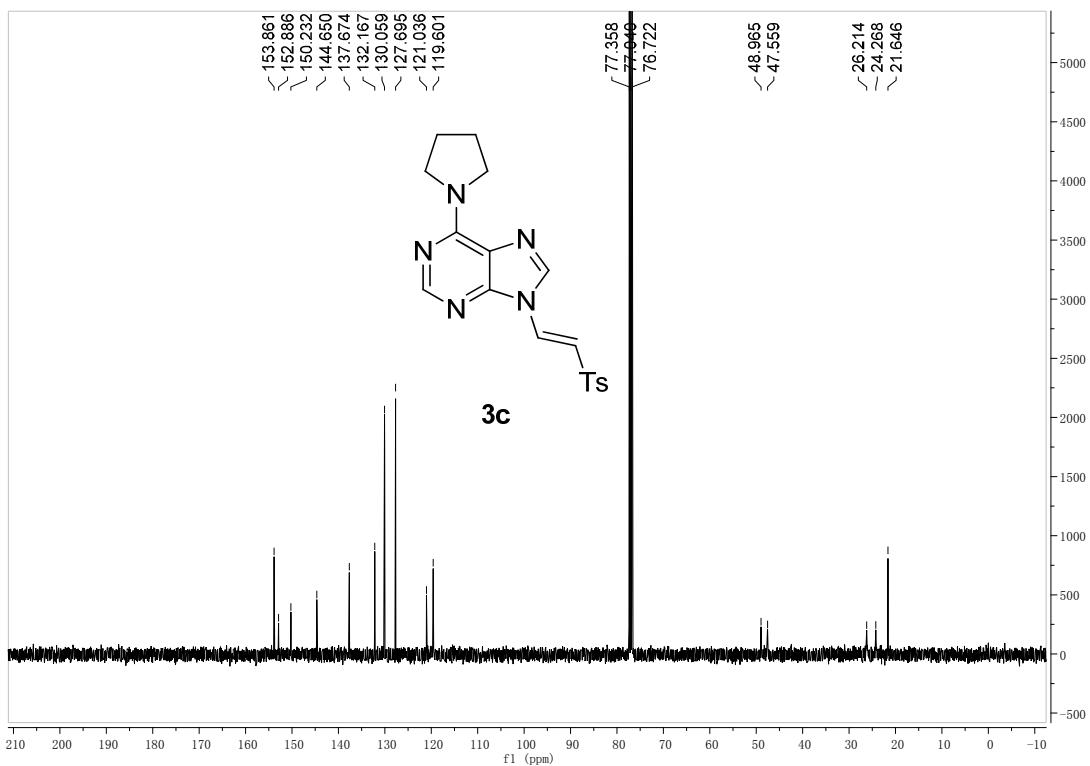
¹³C-NMR for 3b



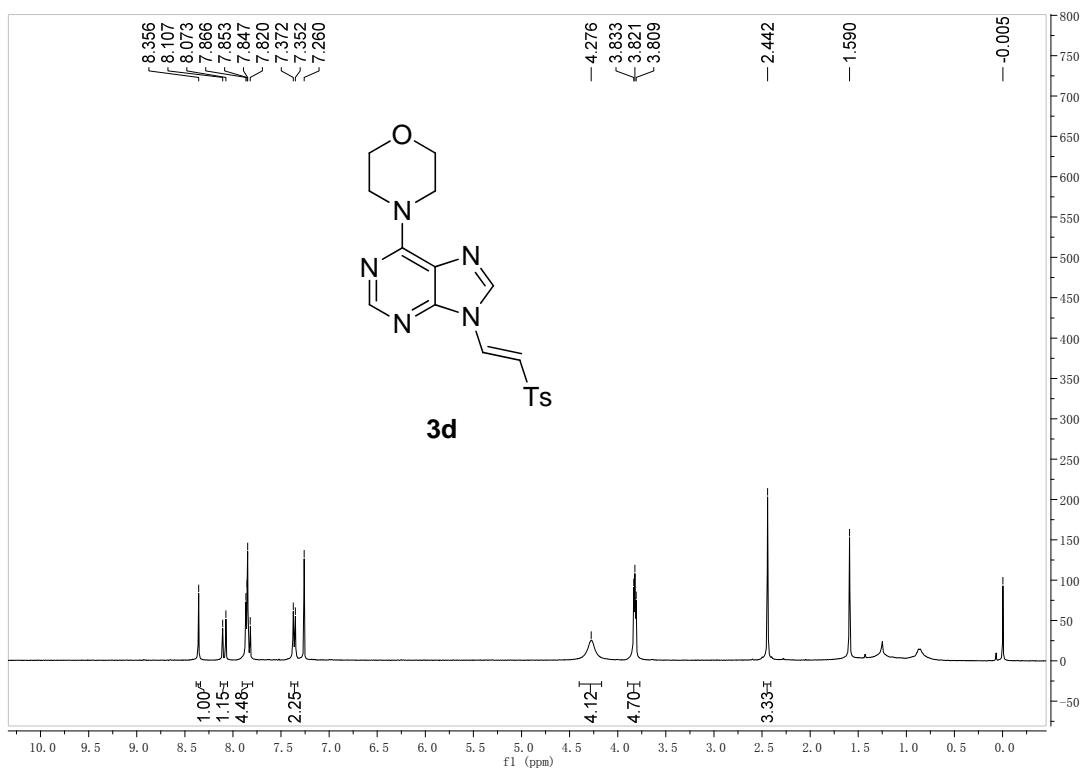
¹H NMR of 3c



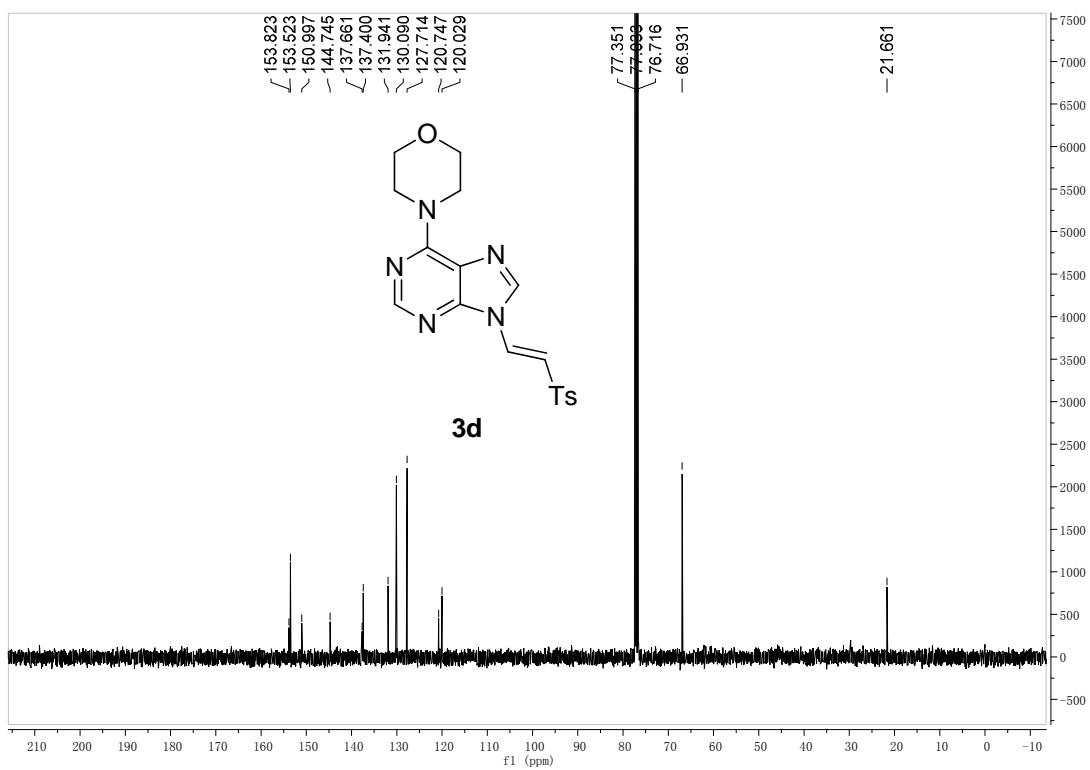
¹³C-NMR for 3c



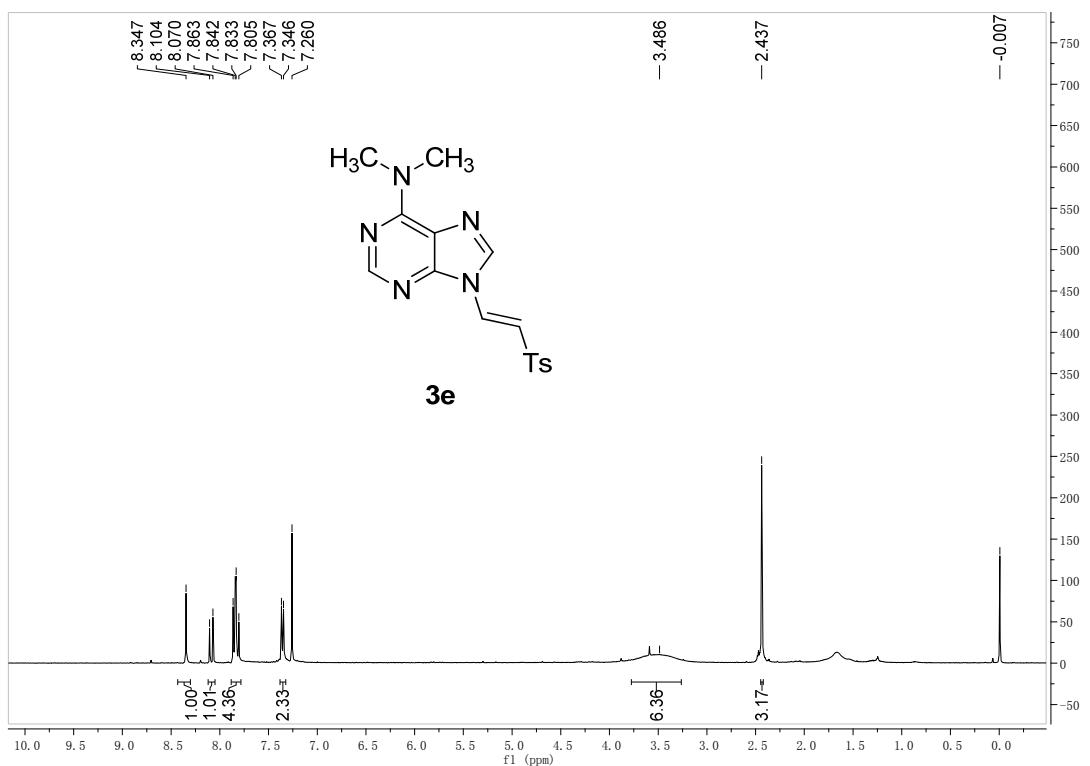
¹H NMR of 3d



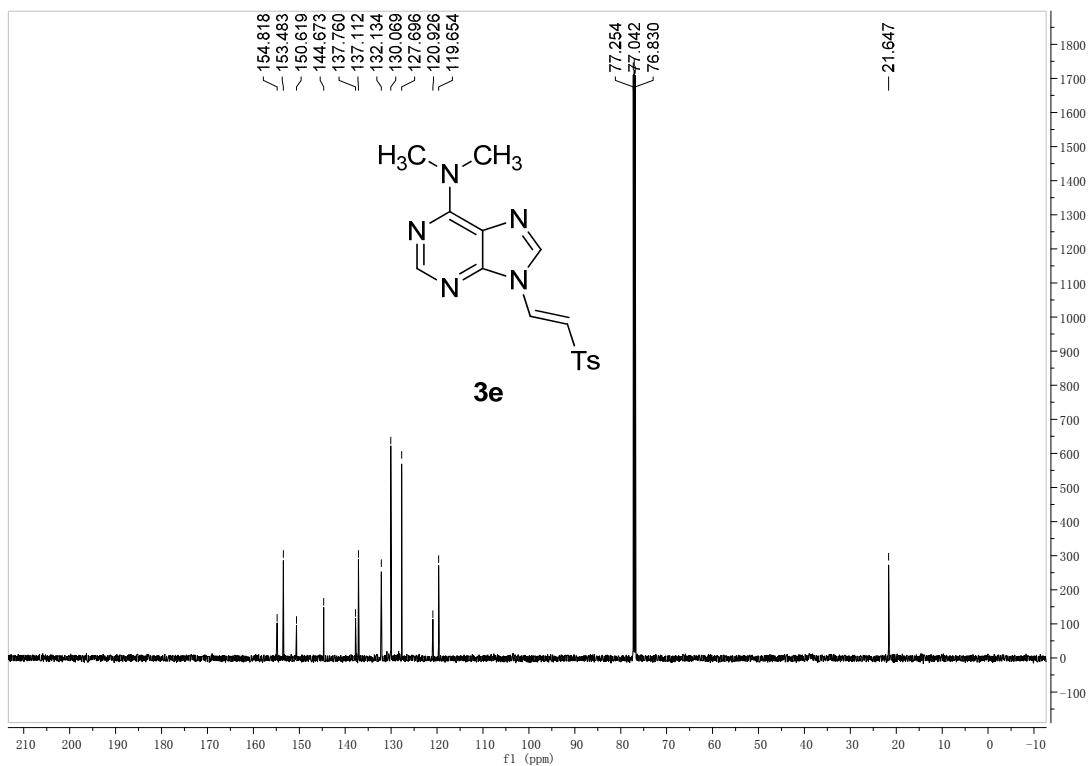
¹³C-NMR for 3d



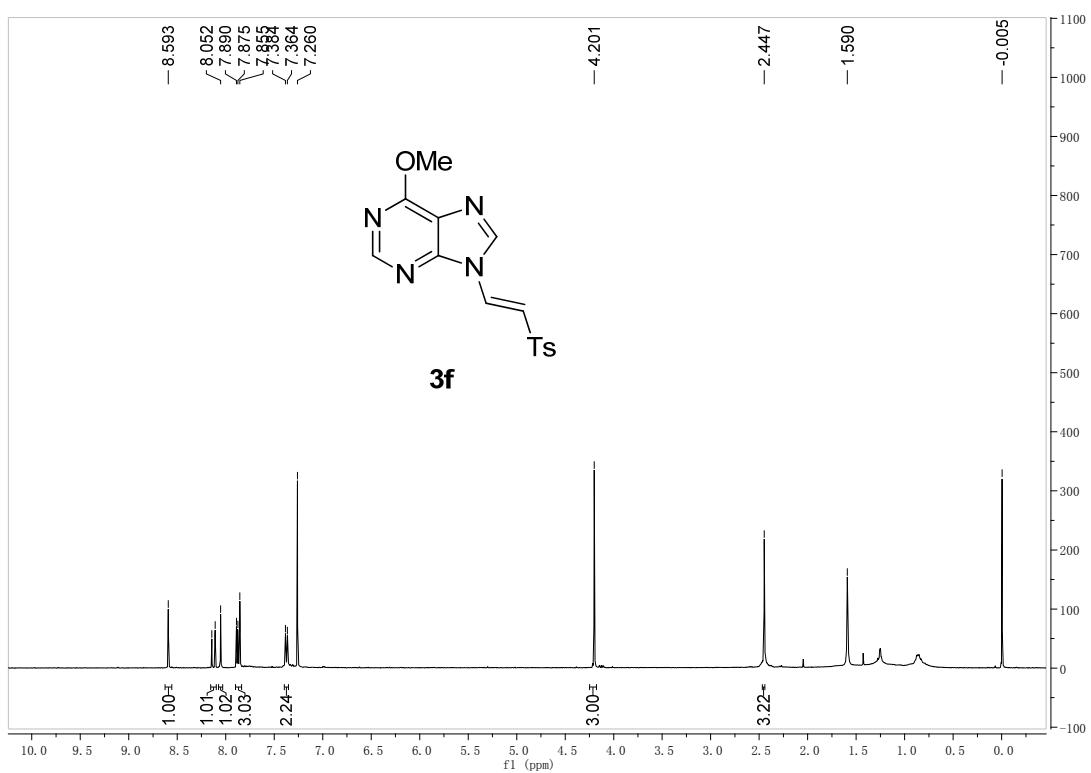
¹H NMR of 3e



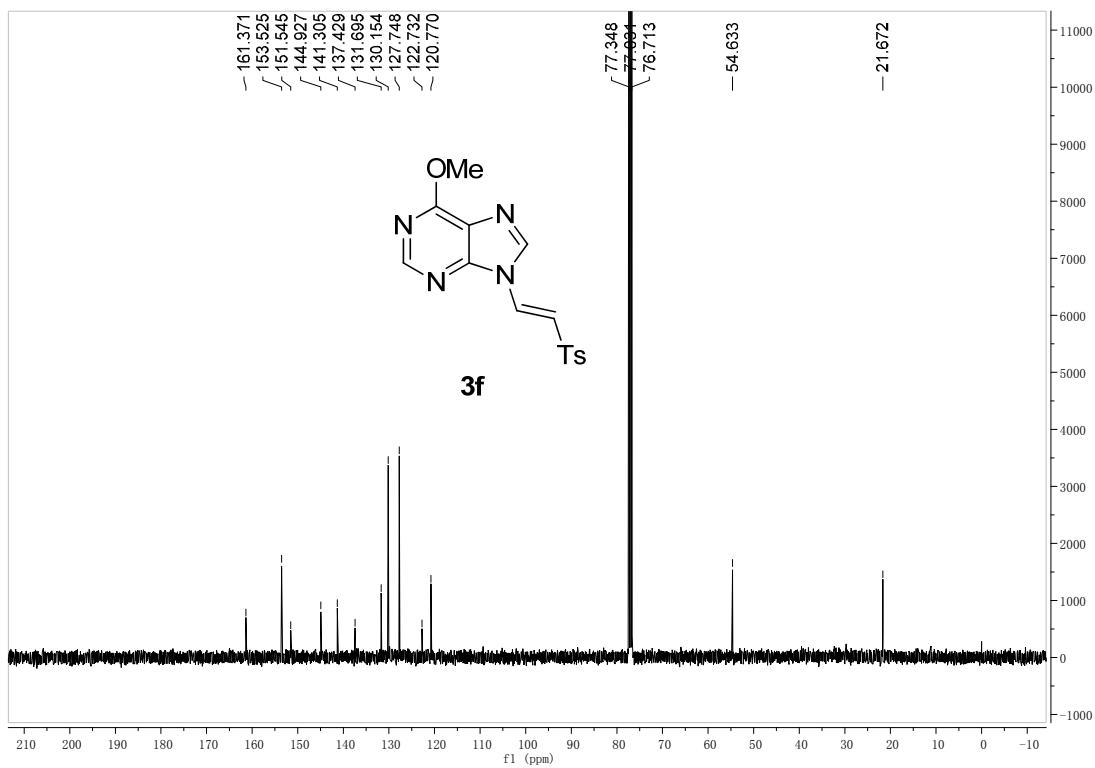
¹³C-NMR for 3e



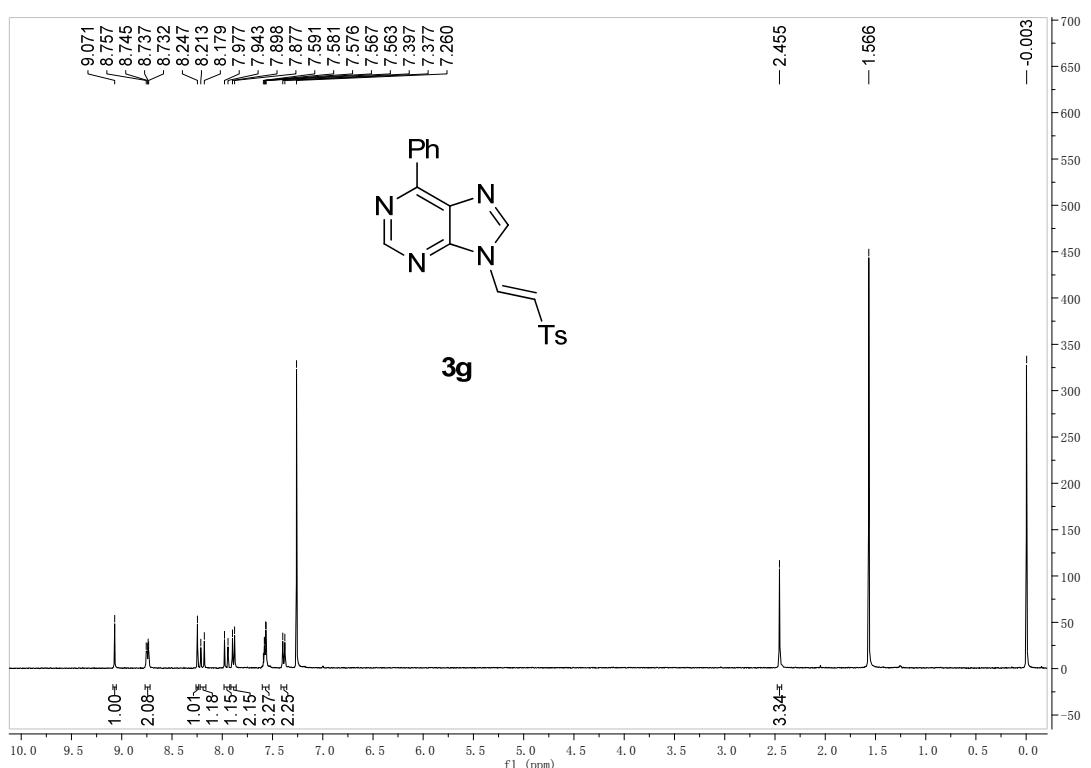
¹H NMR of 3f



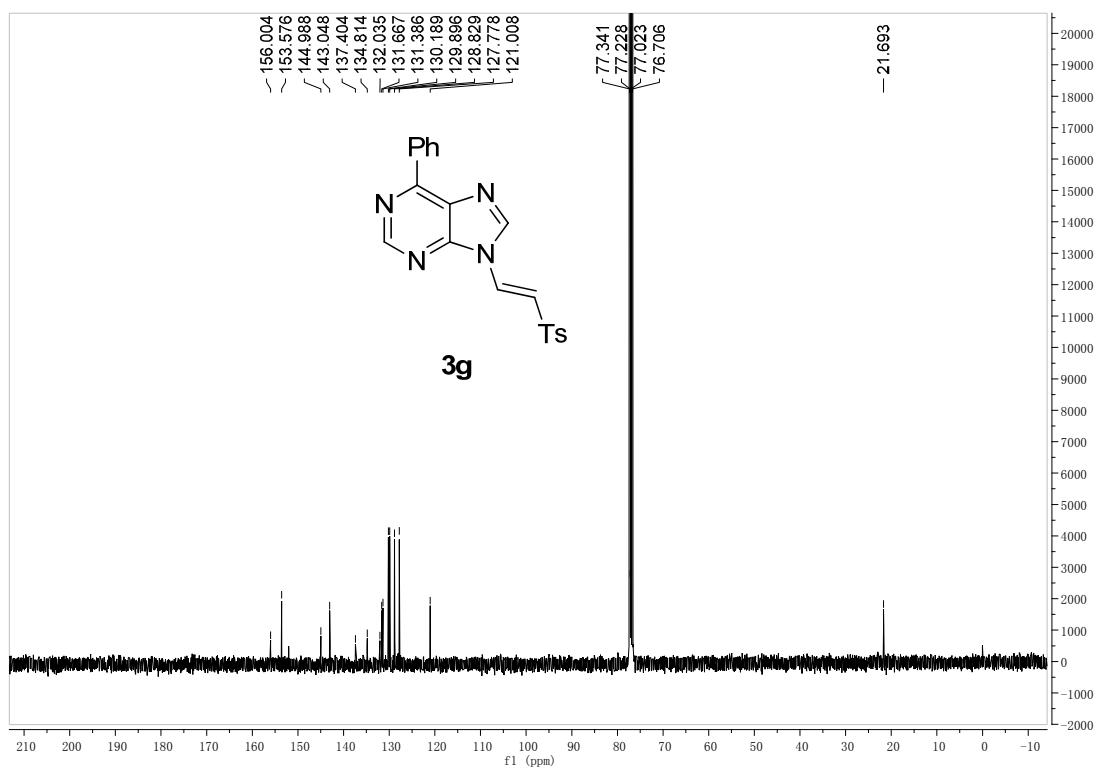
¹³C-NMR for 3f



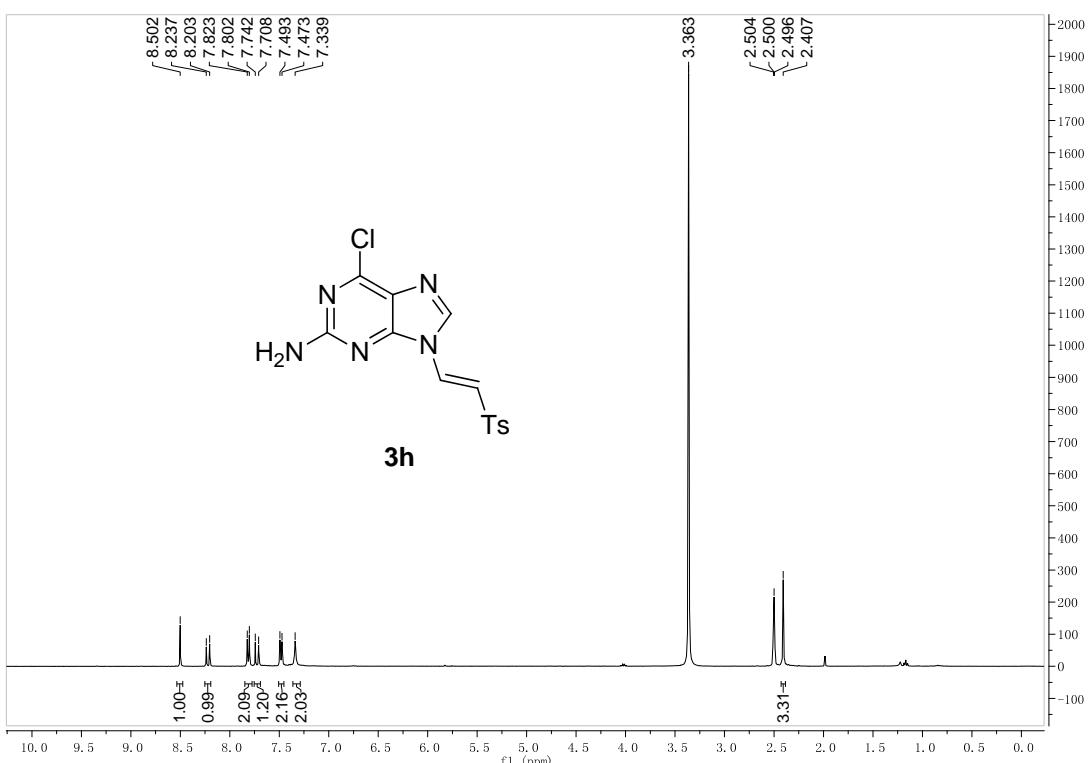
¹H NMR of 3g



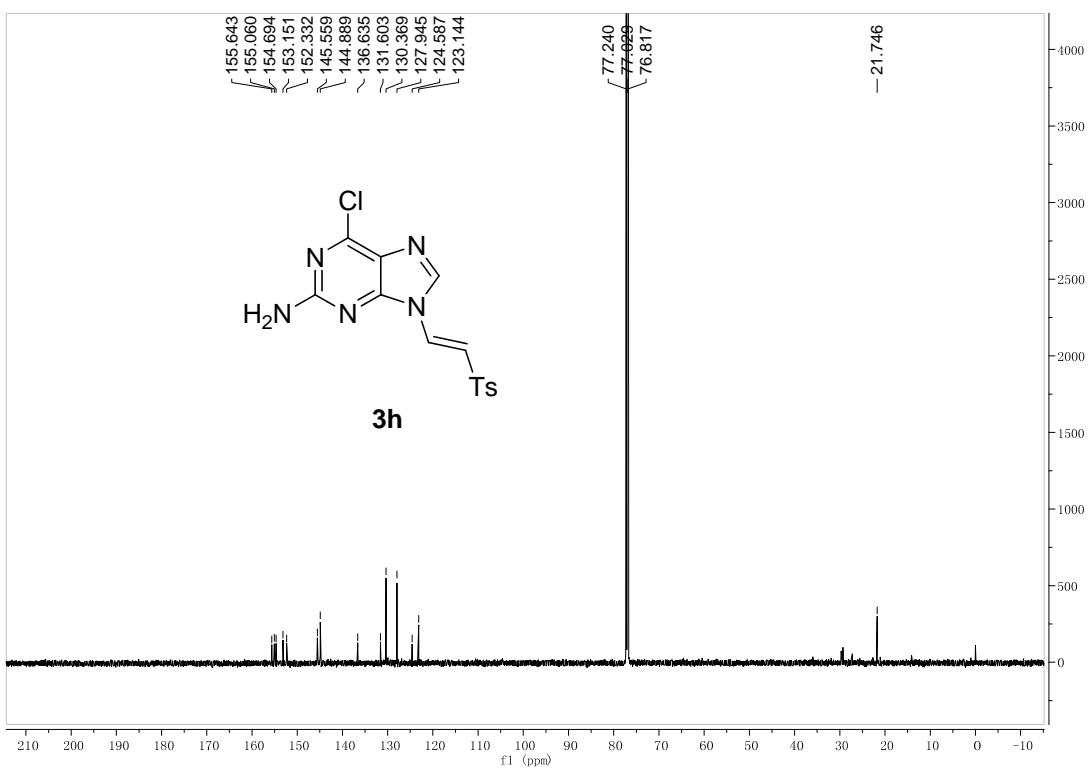
¹³C-NMR for 3g



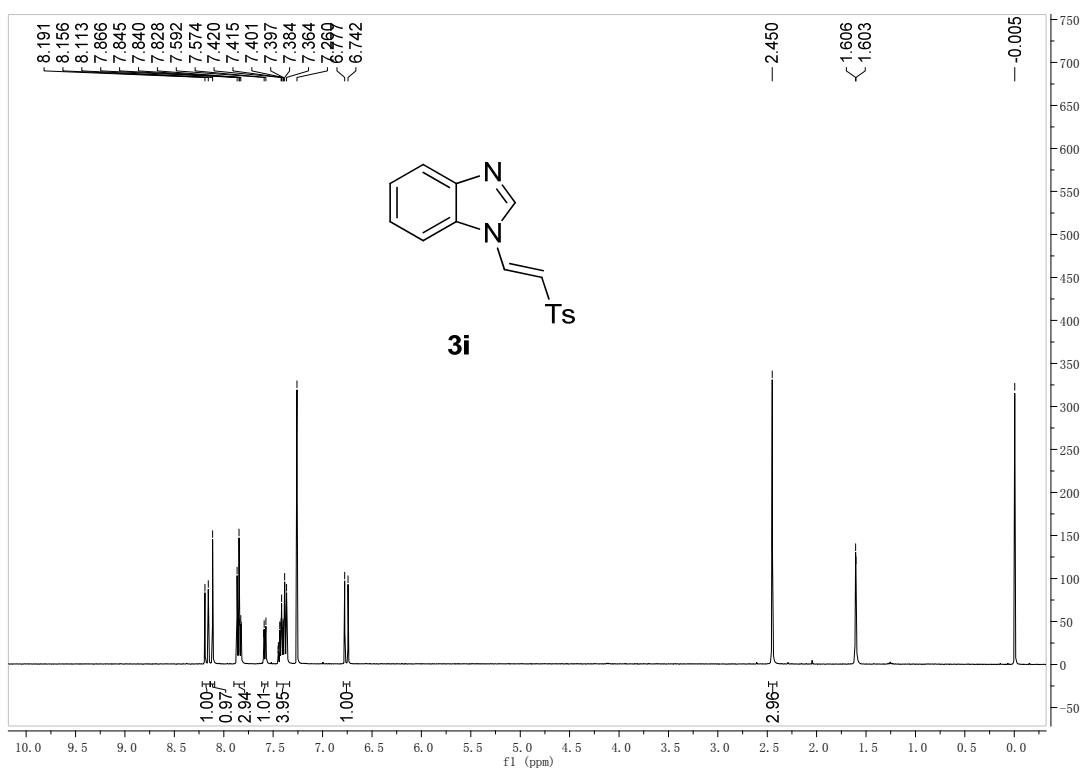
¹H NMR of 3h



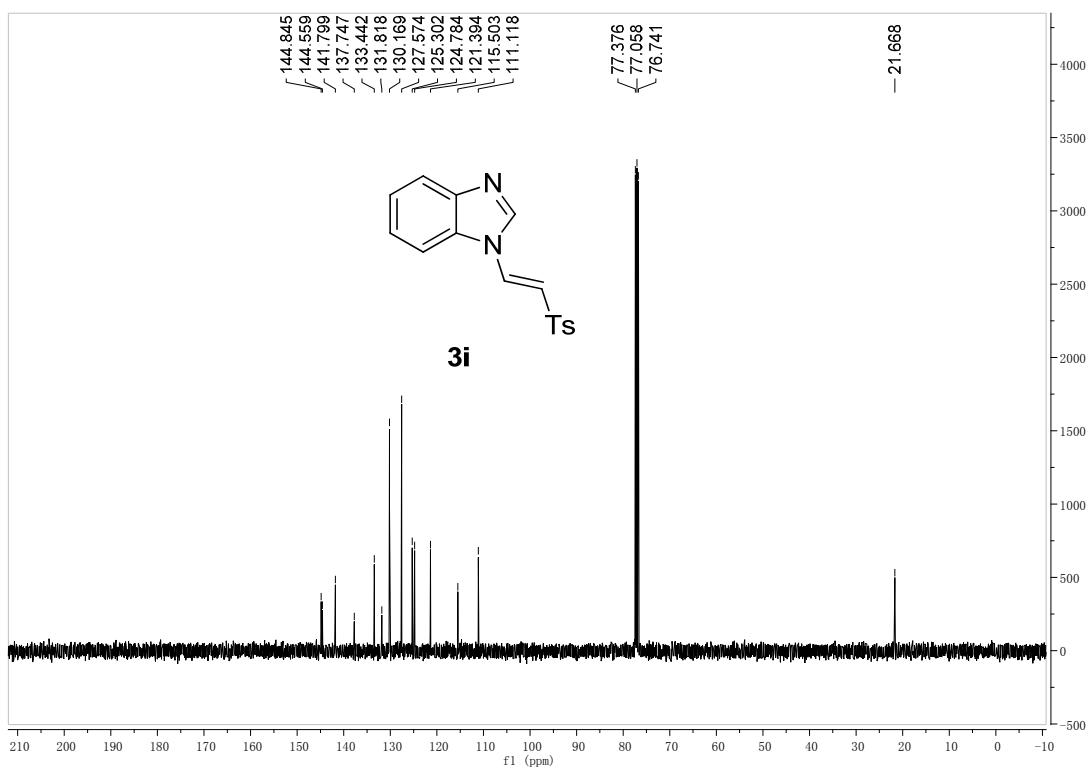
¹³C-NMR for 3h



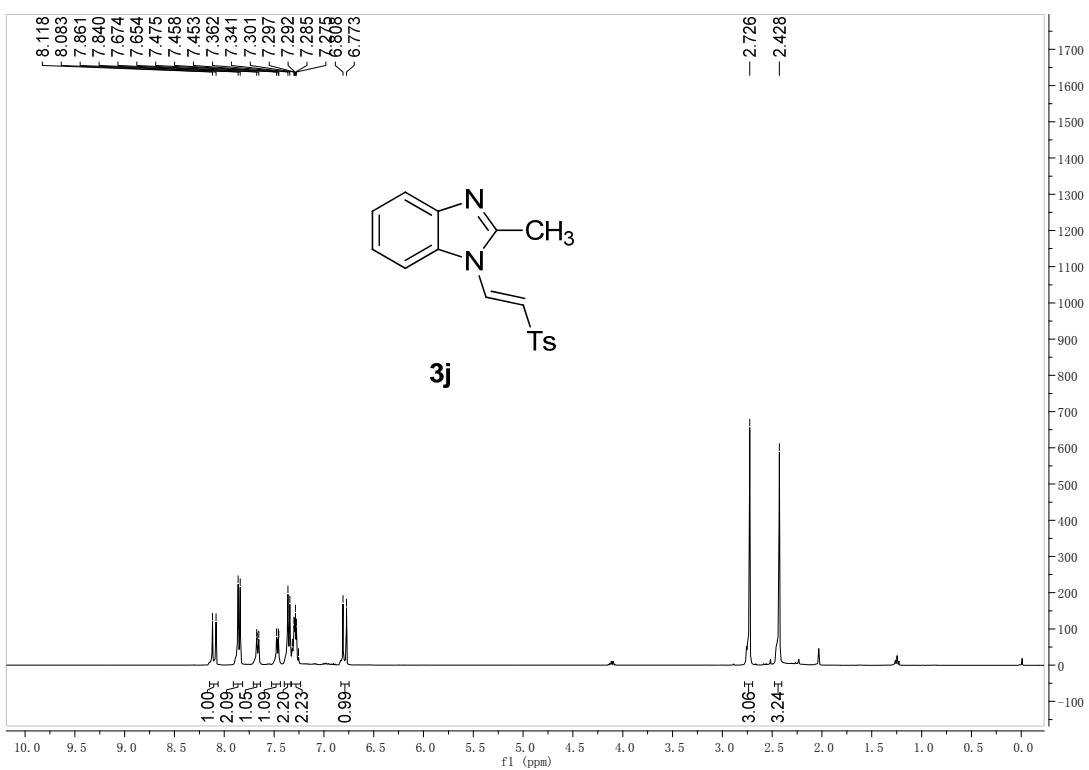
¹H NMR of 3i



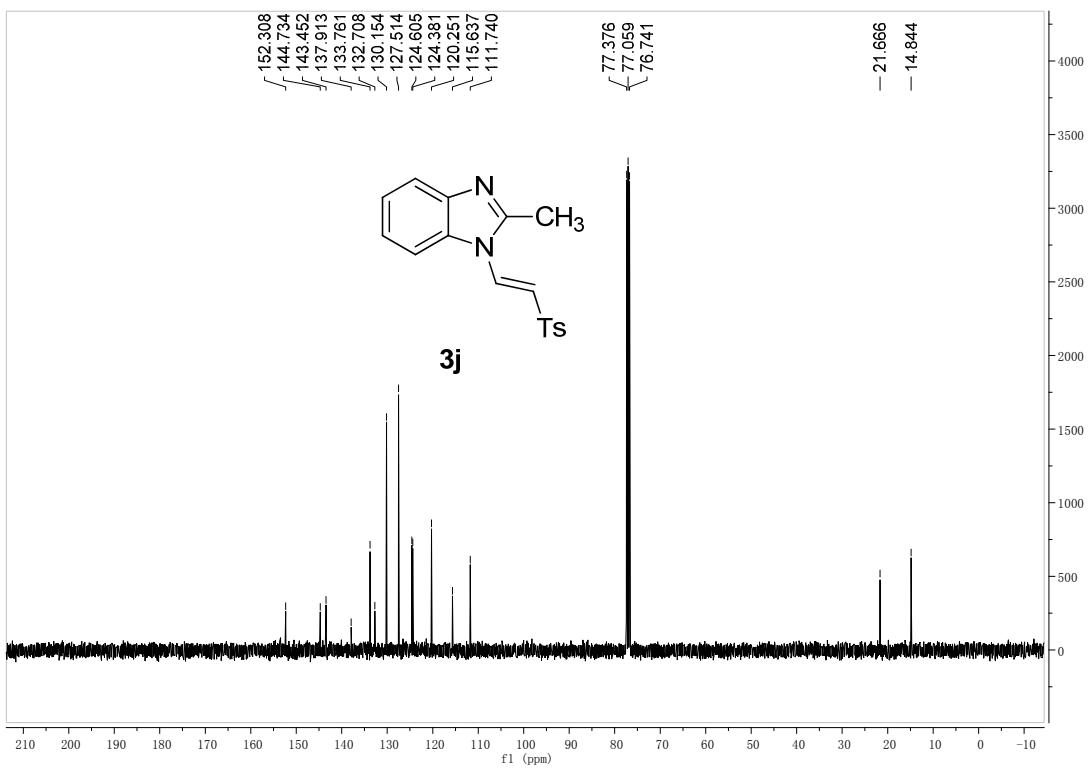
¹³C-NMR for 3i



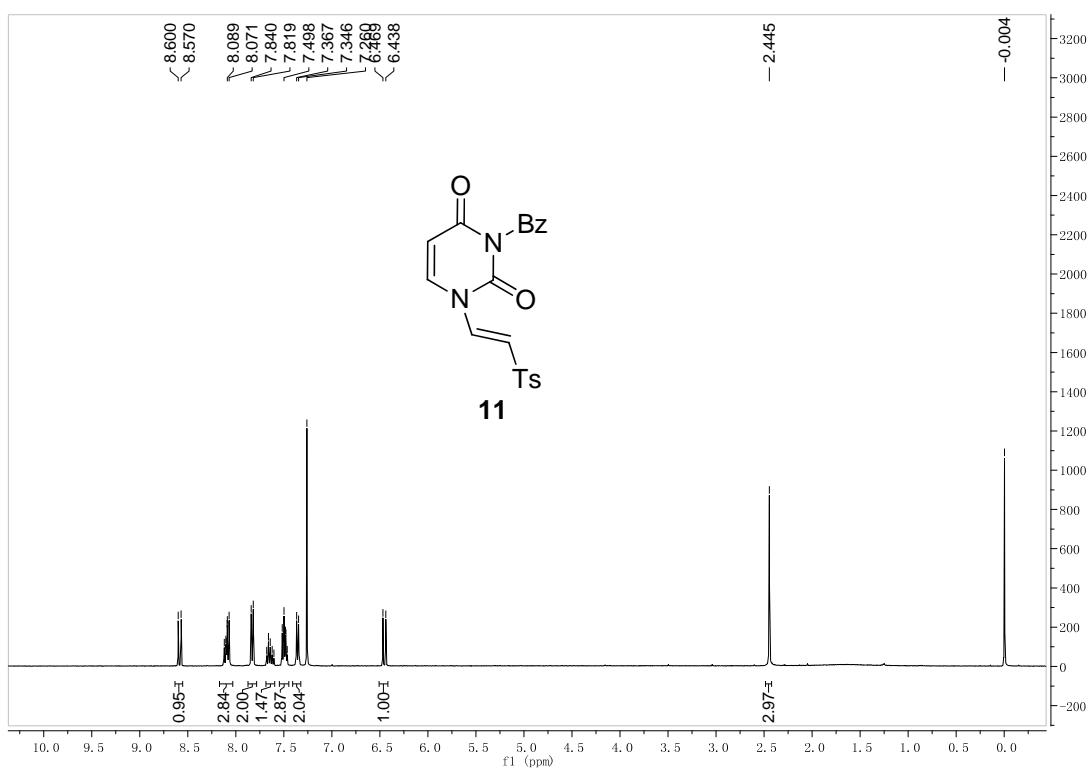
¹H NMR of 3j



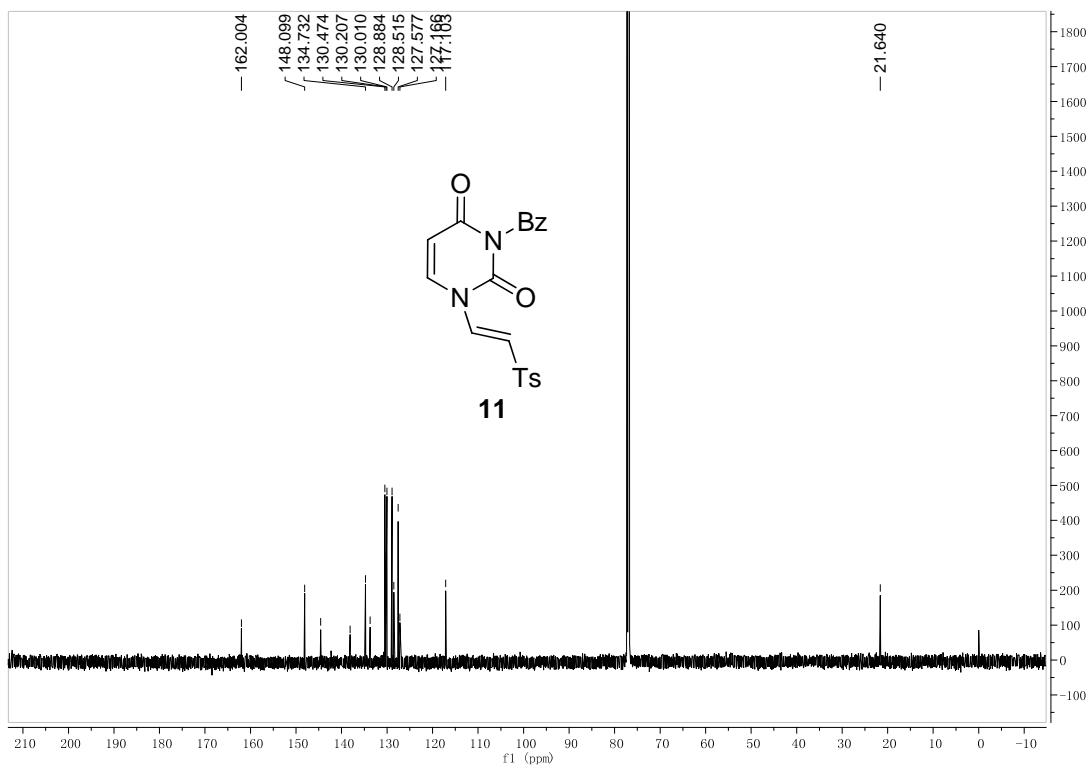
¹³C-NMR for 3j



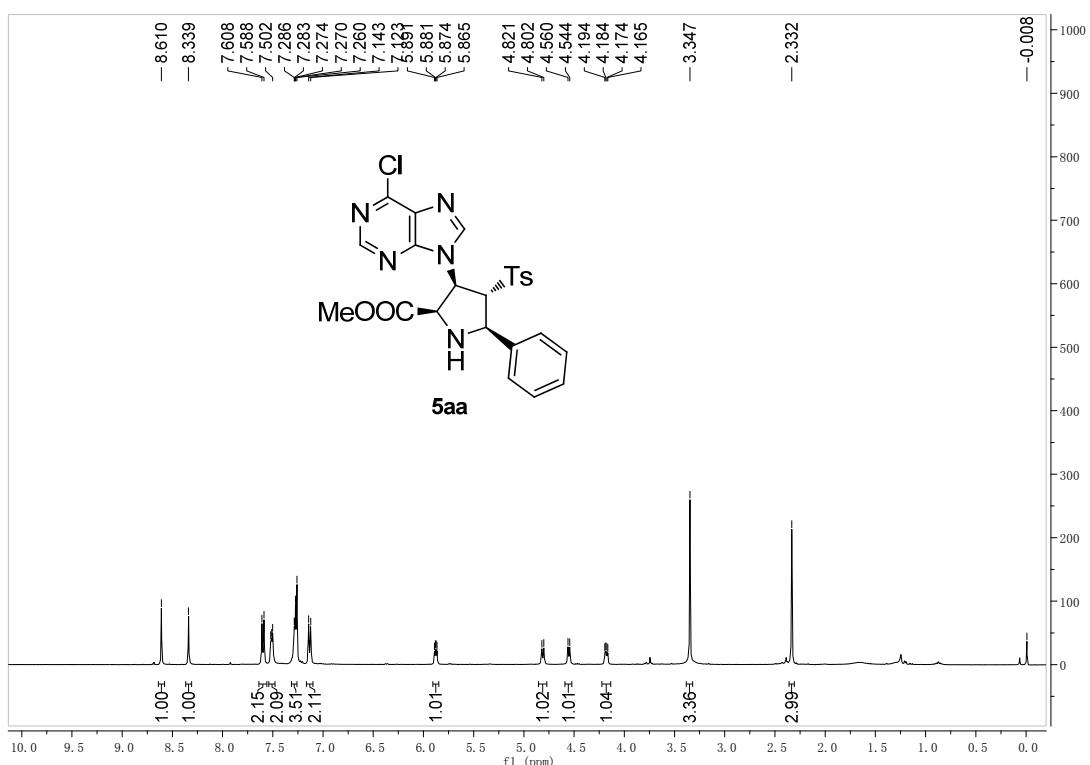
¹H NMR of 11



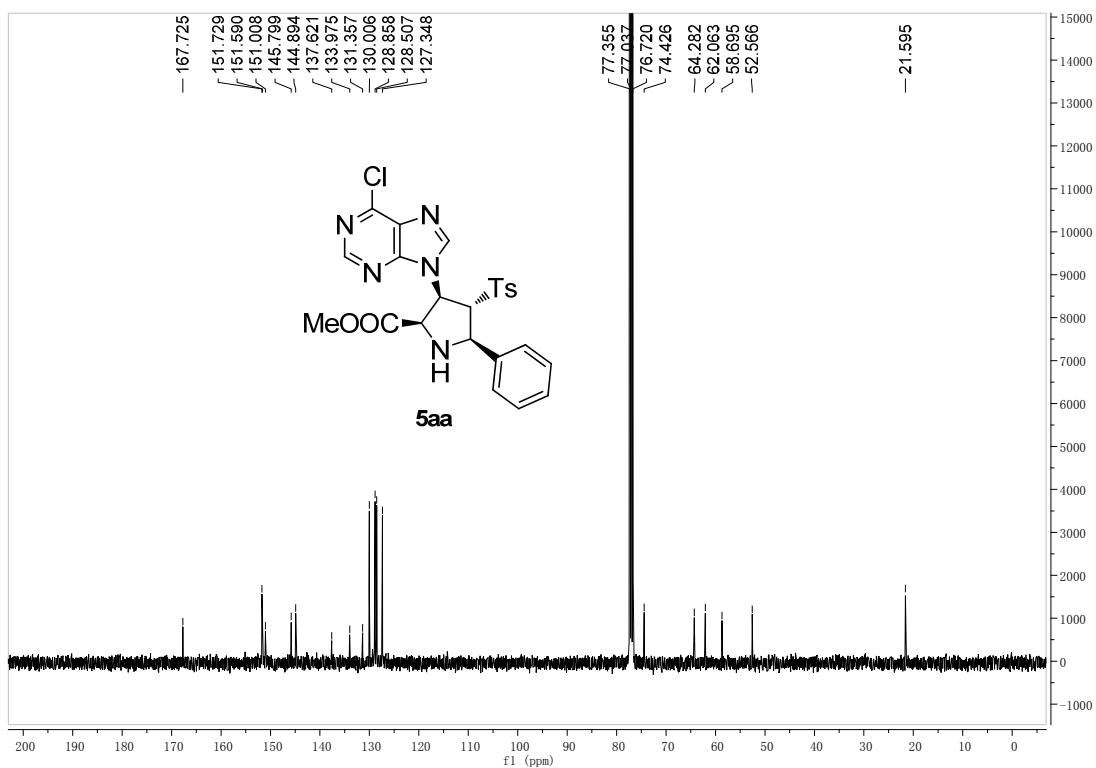
¹³C-NMR for 11



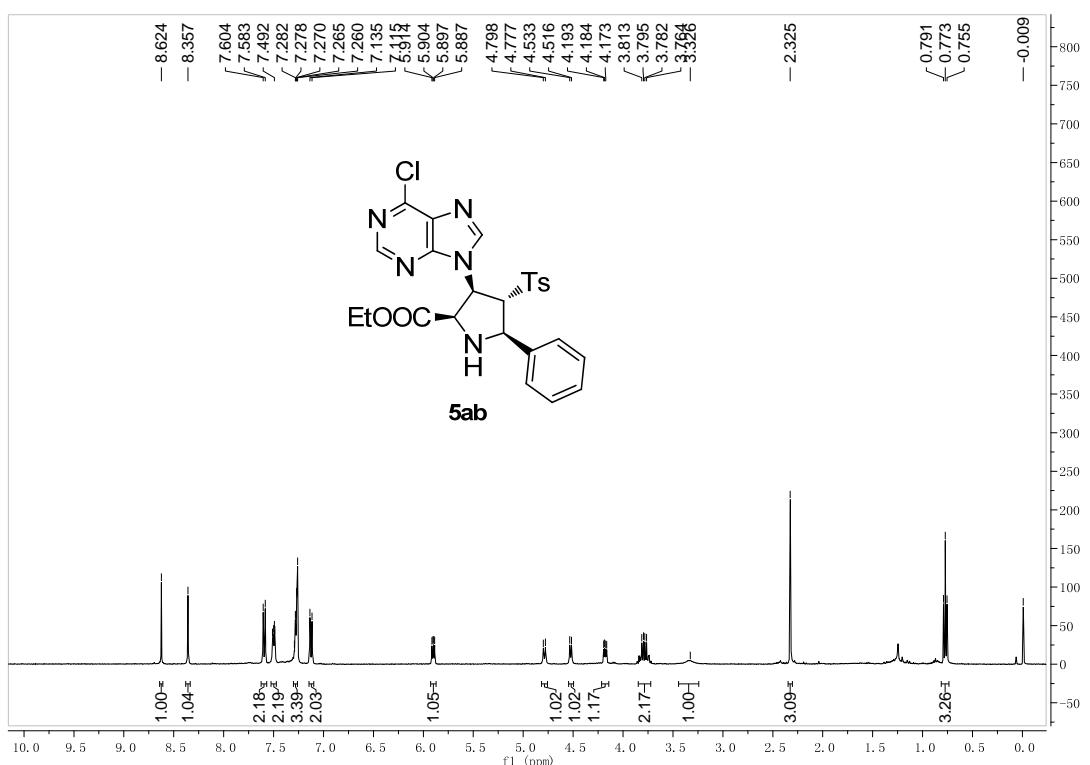
¹H NMR of 5aa



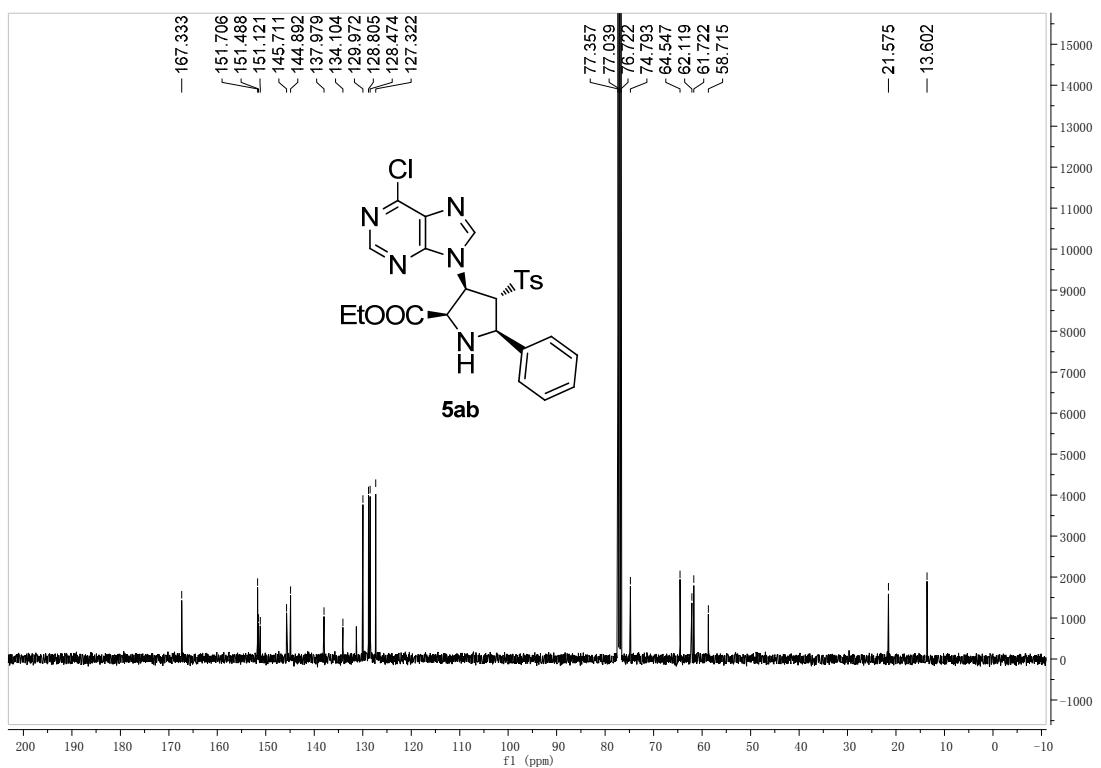
¹³C-NMR for 5aa



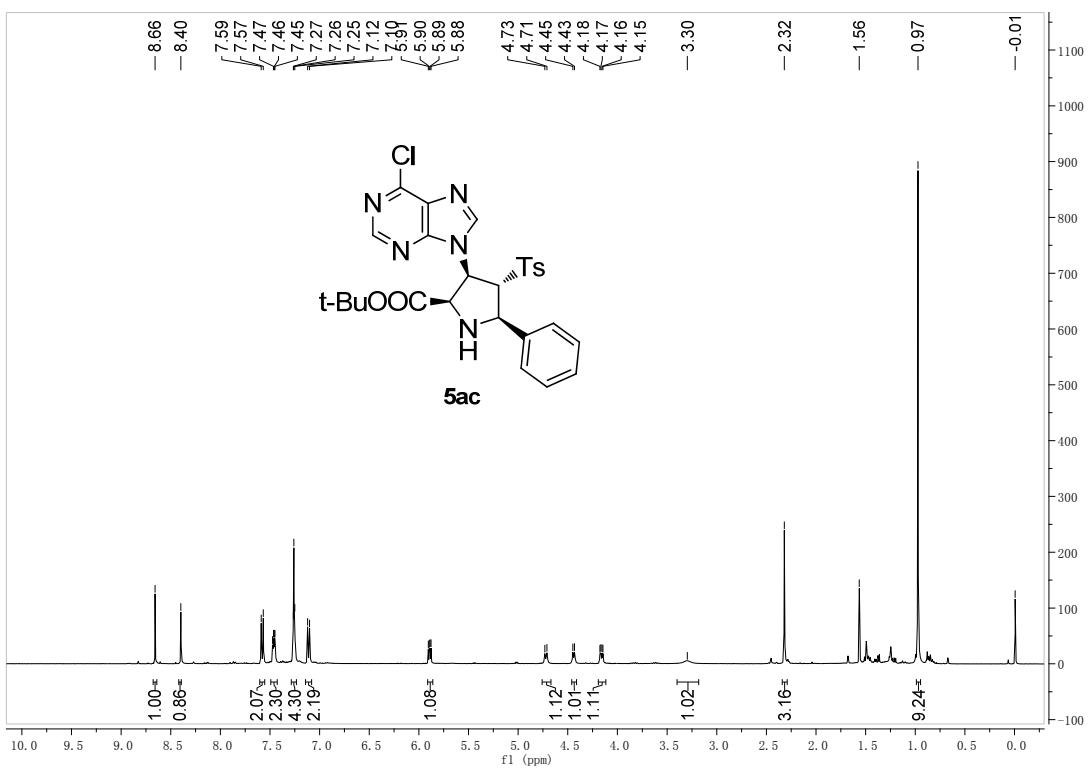
¹H NMR of 5ab



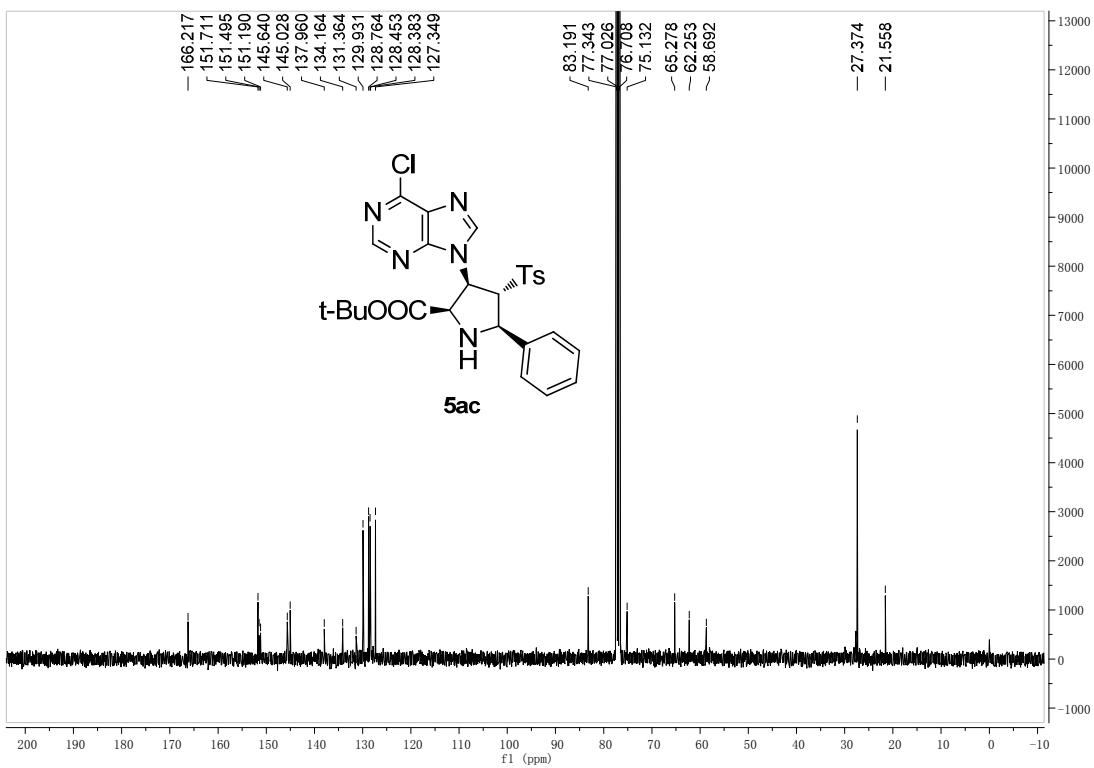
¹³C-NMR for 5ab



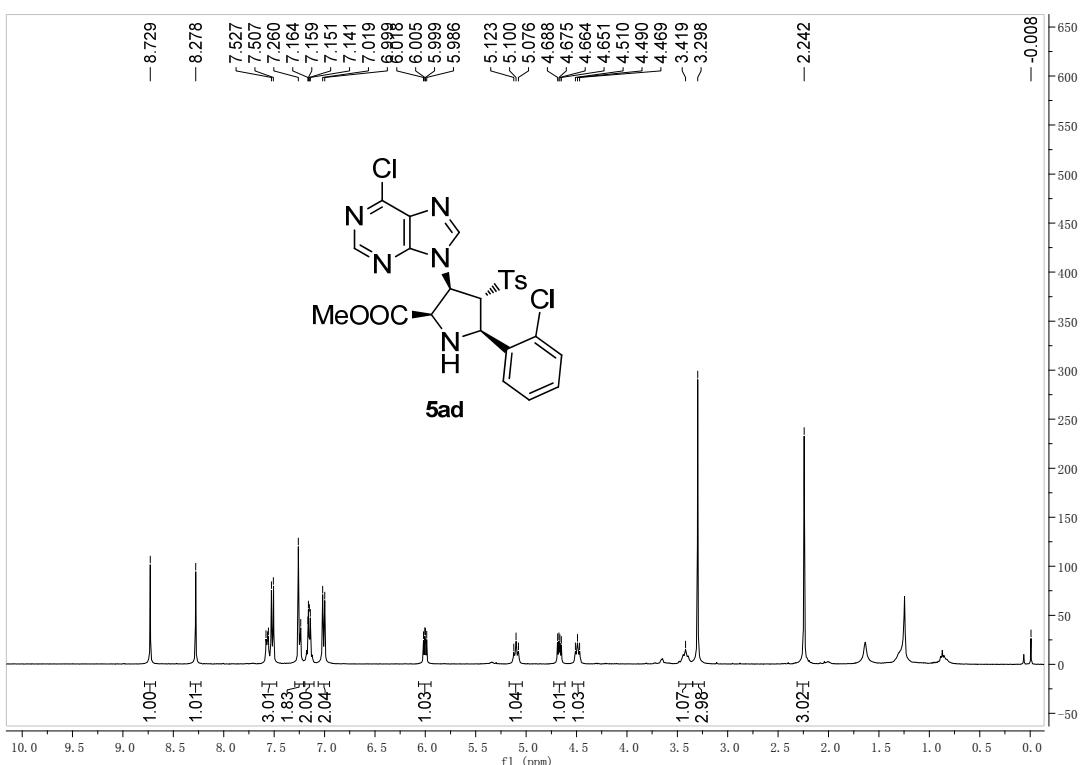
¹H NMR of 5ac



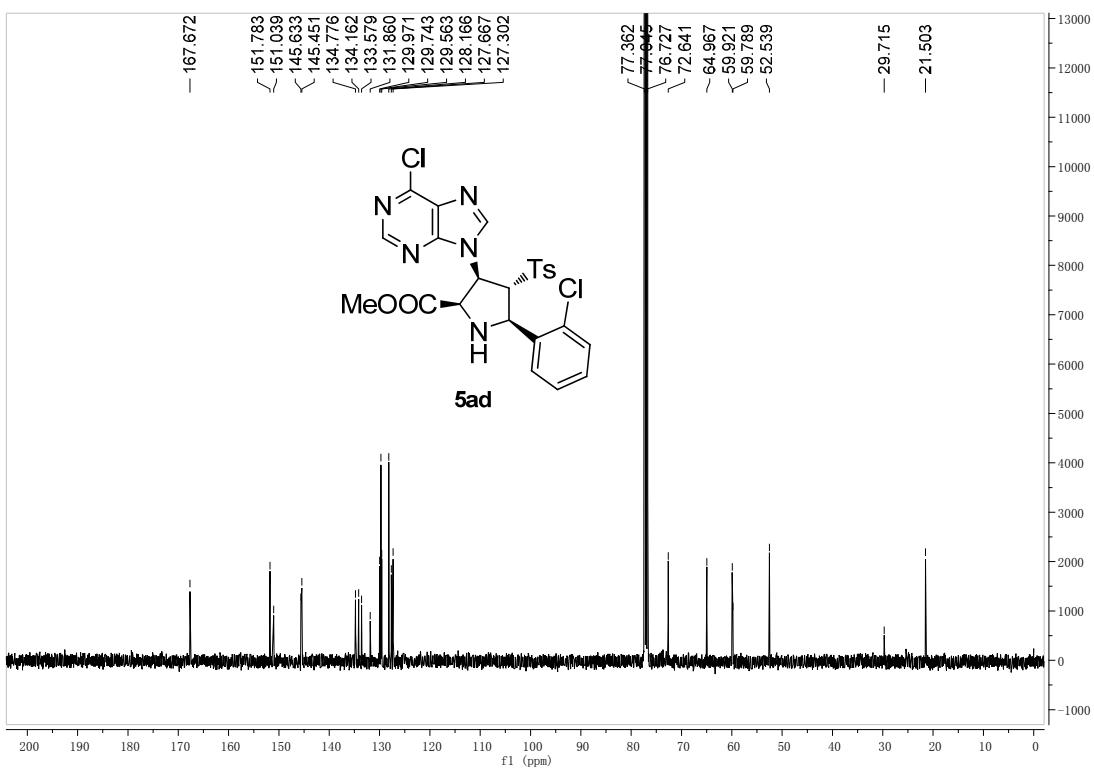
¹³C-NMR for 5ac



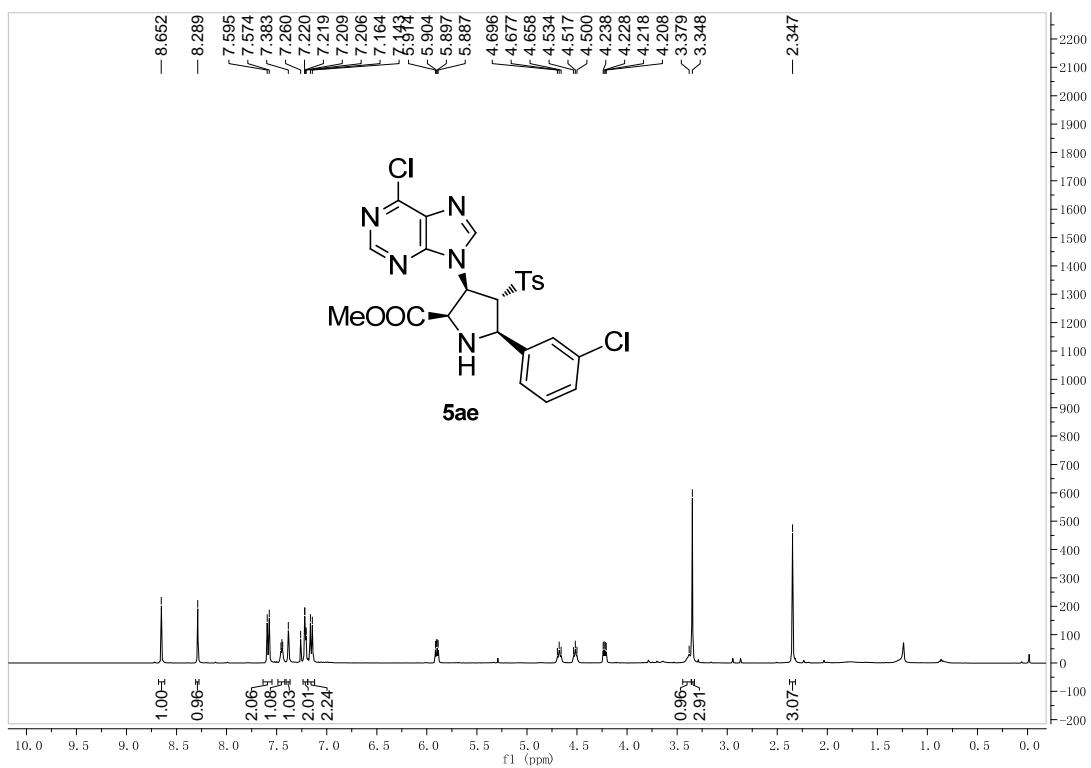
¹H NMR of 5ad



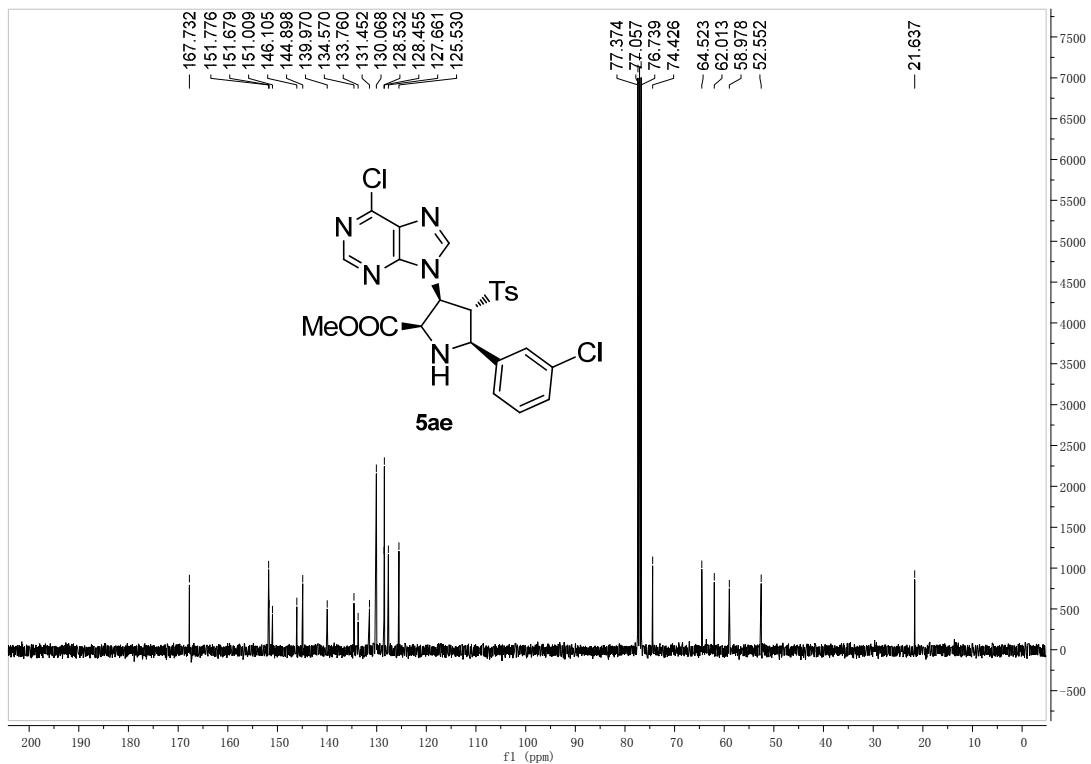
¹³C-NMR for 5ad



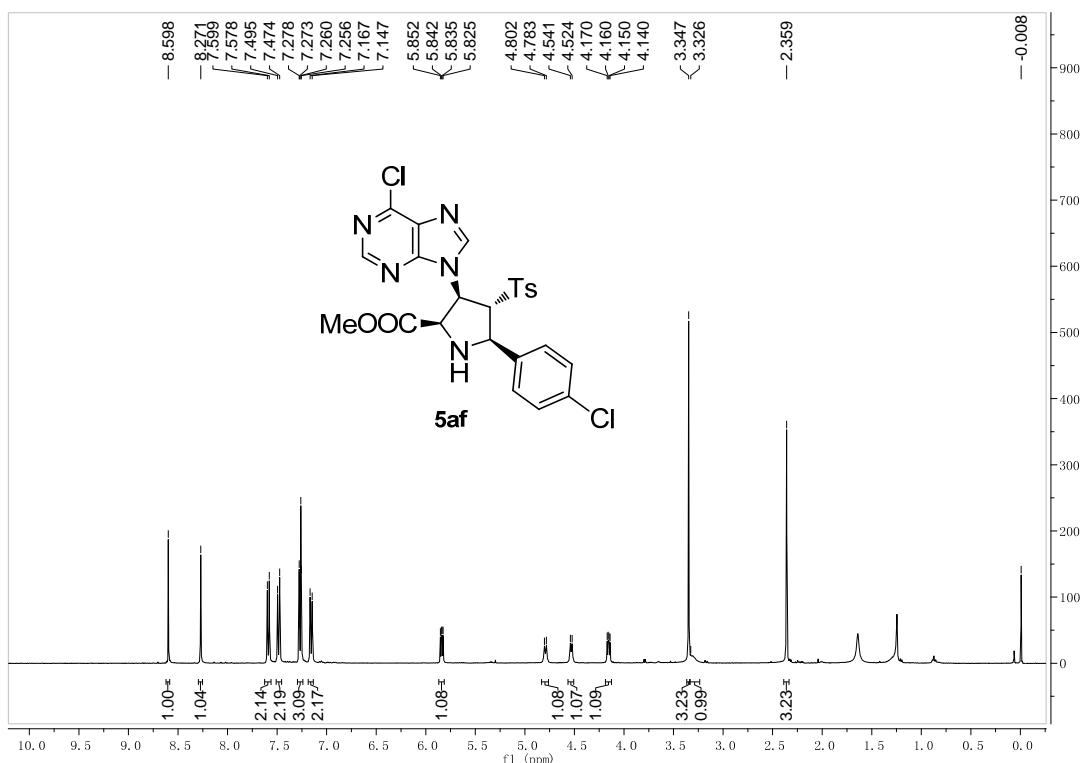
¹H NMR of 5ae



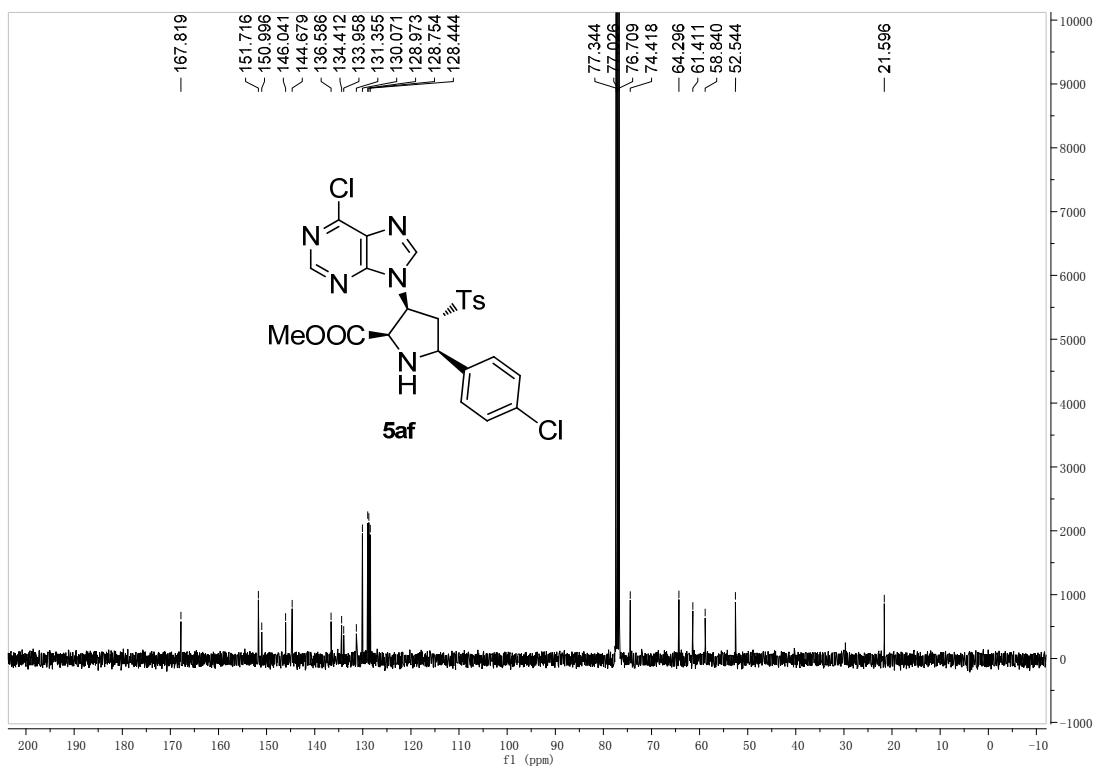
¹³C-NMR for 5ae



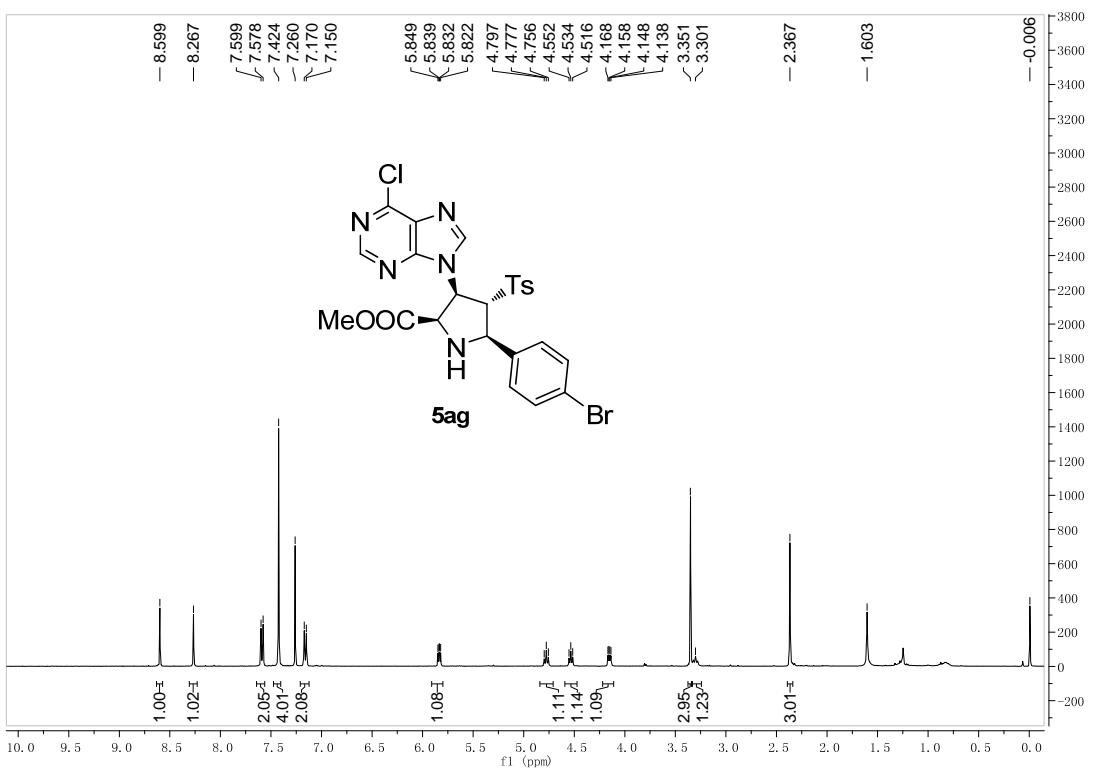
¹H NMR of 5af



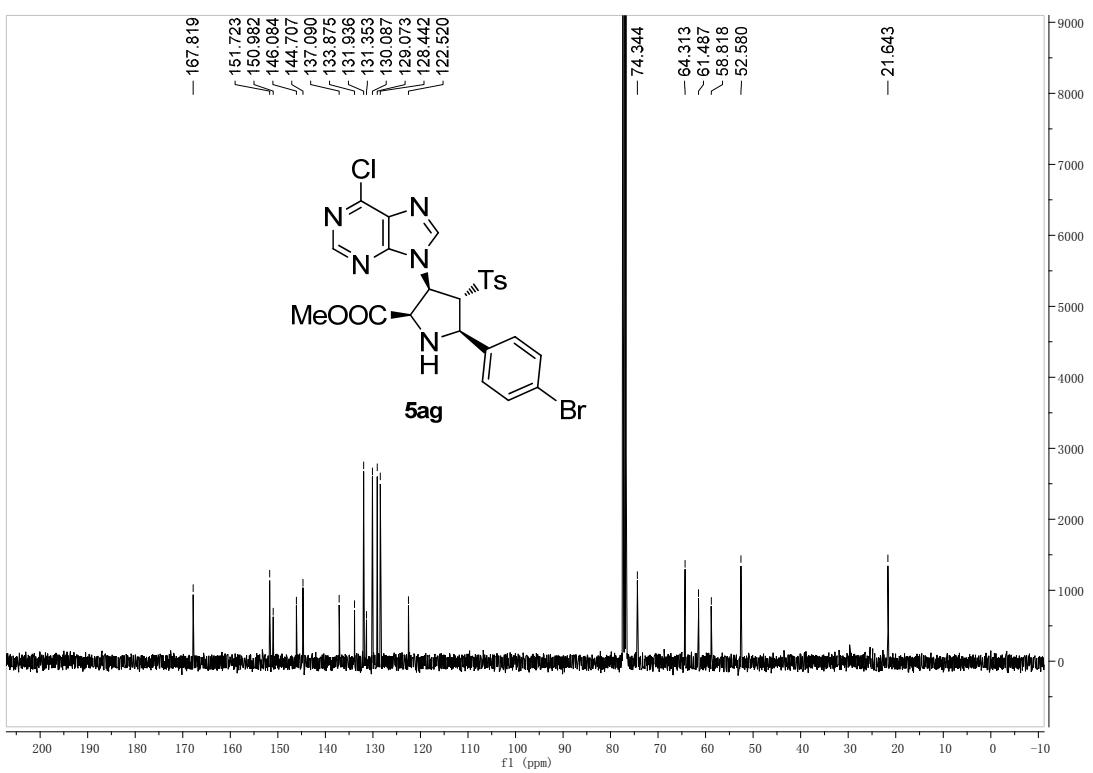
¹³C-NMR for 5af



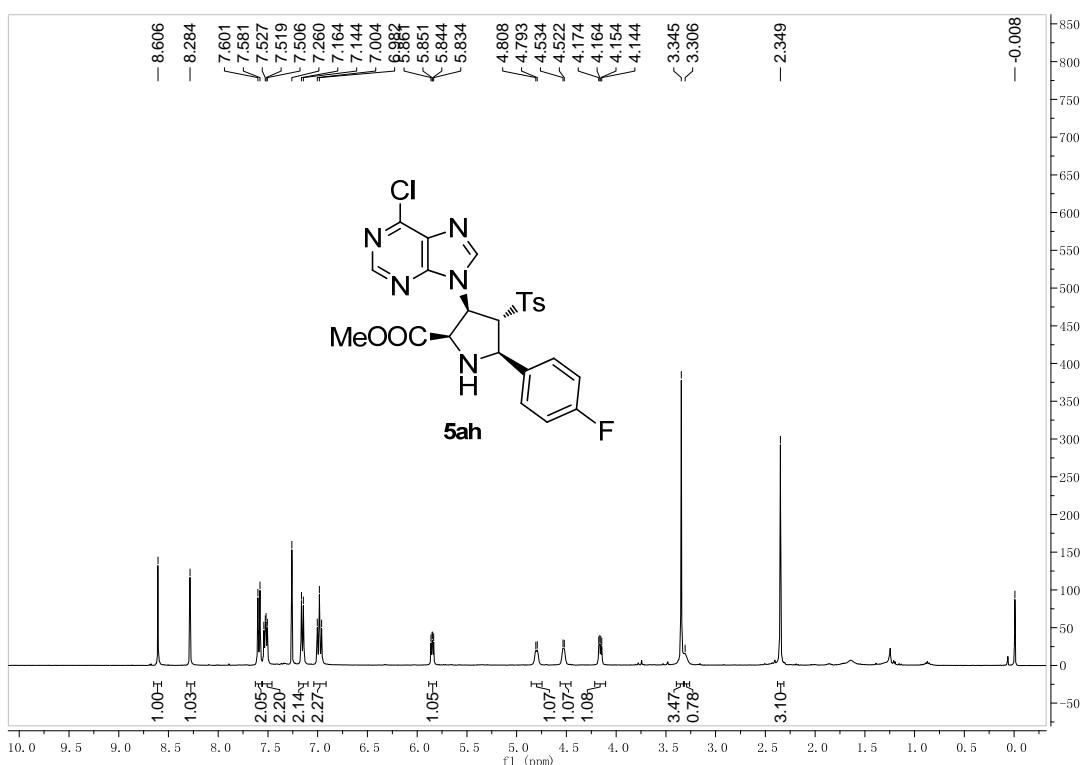
¹H NMR of 5ag



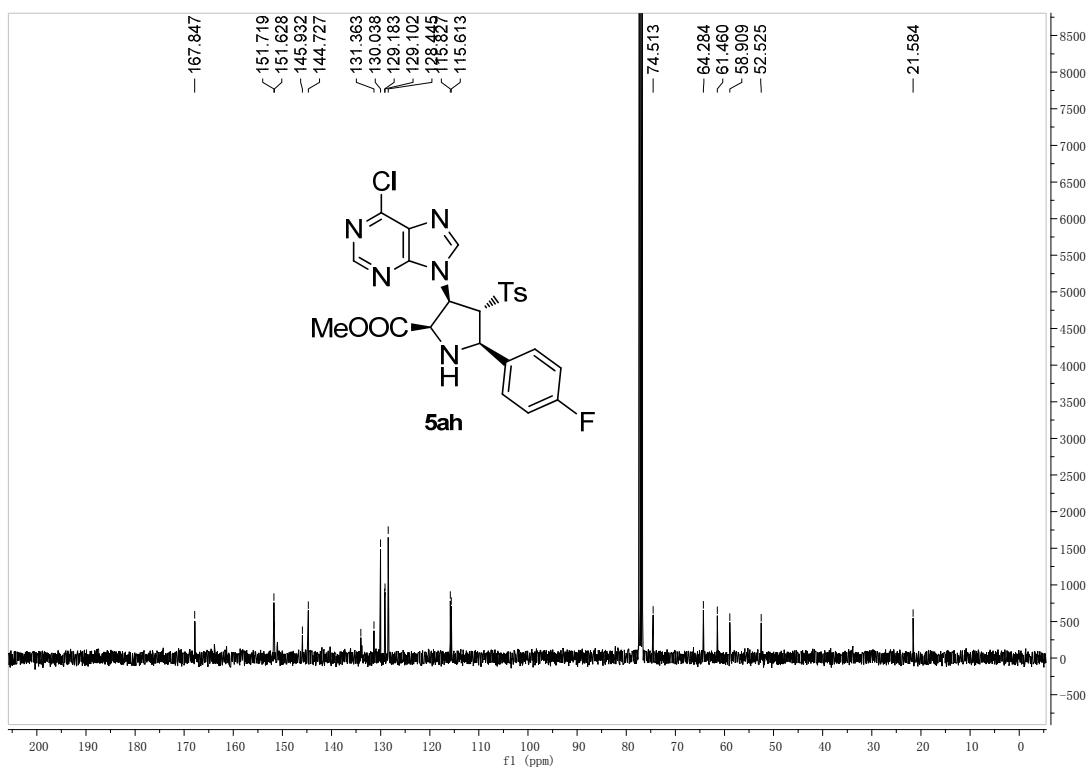
¹³C-NMR for 5ag



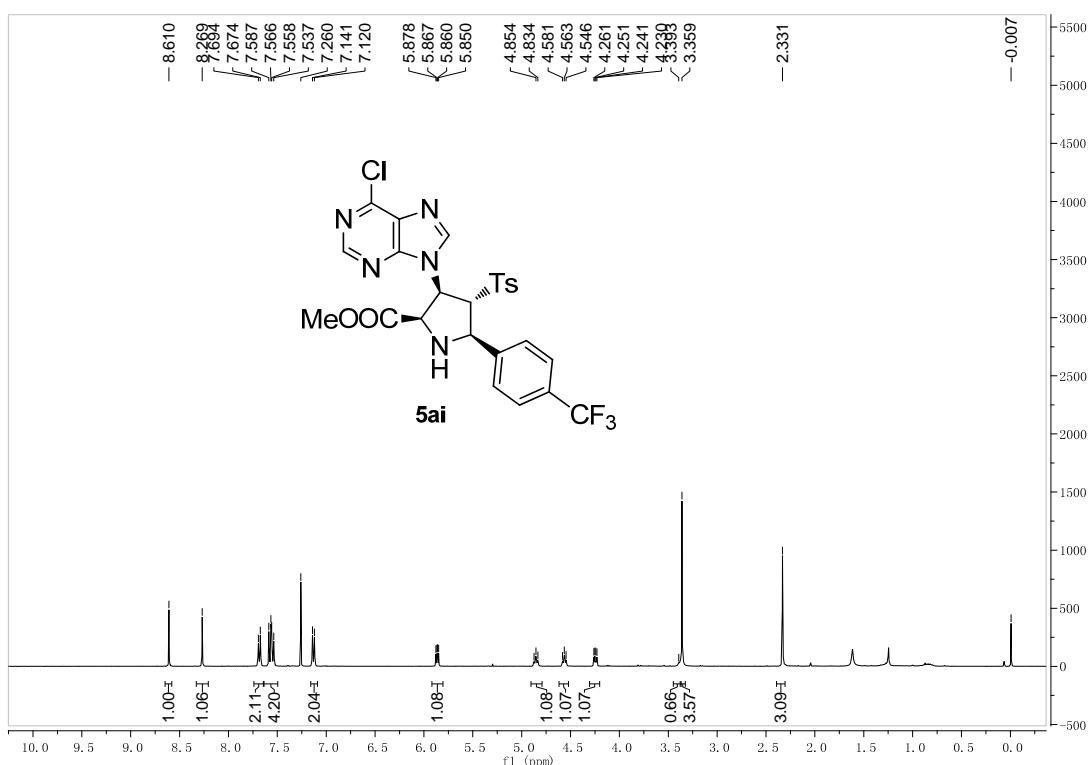
¹H NMR of 5ah



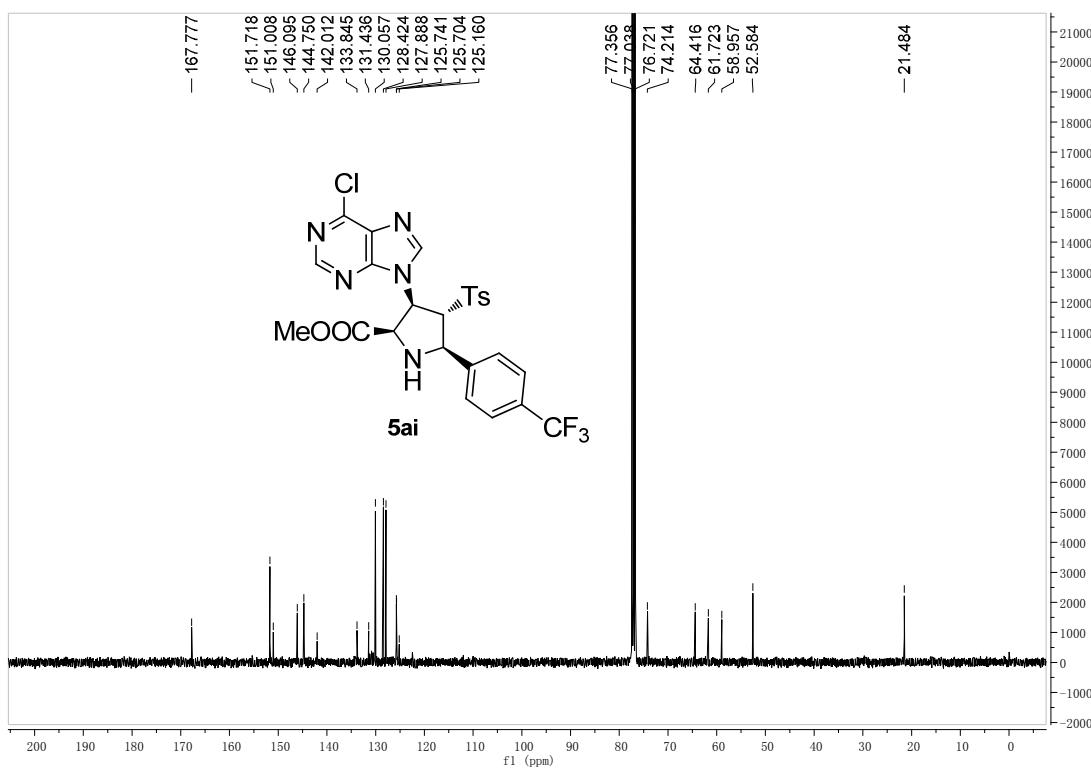
¹³C-NMR for 5ah



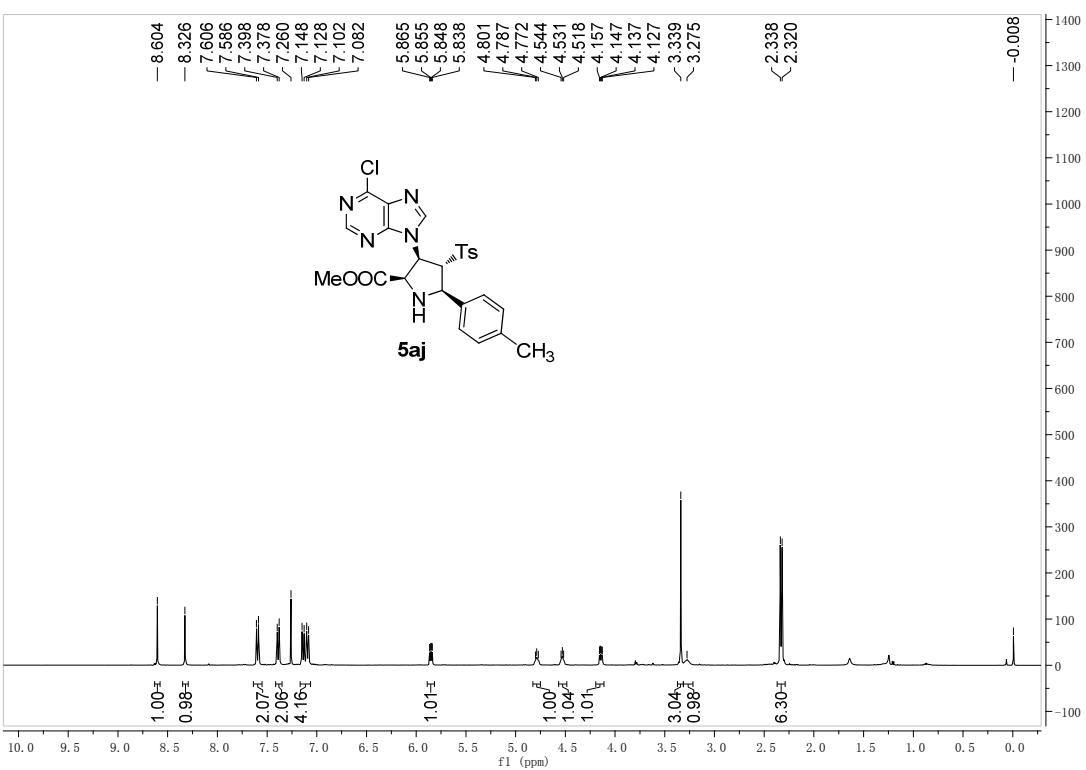
¹H NMR of 5ai



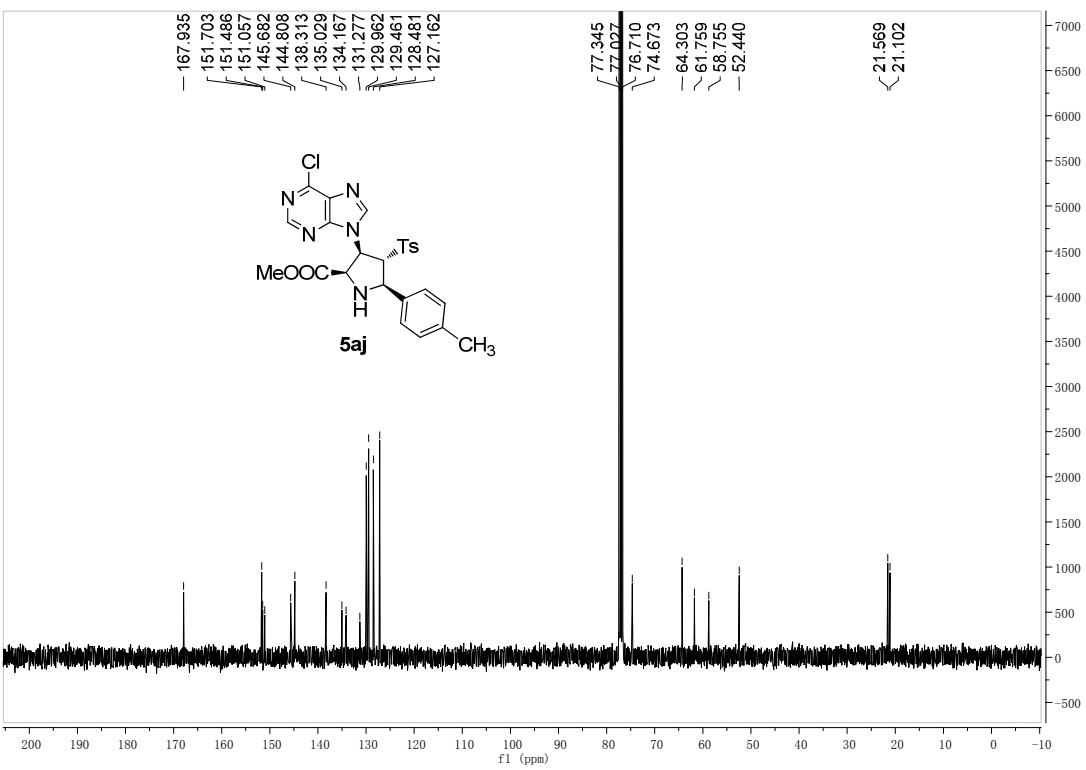
¹³C-NMR for 5ai



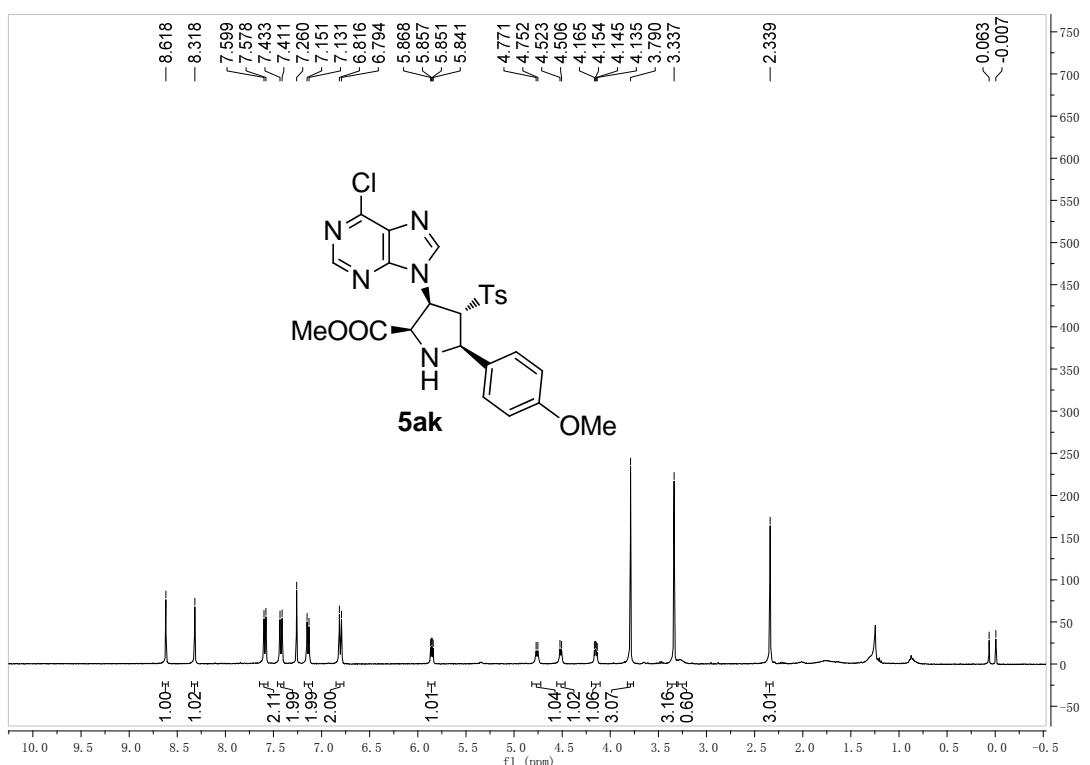
¹H NMR of 5aj



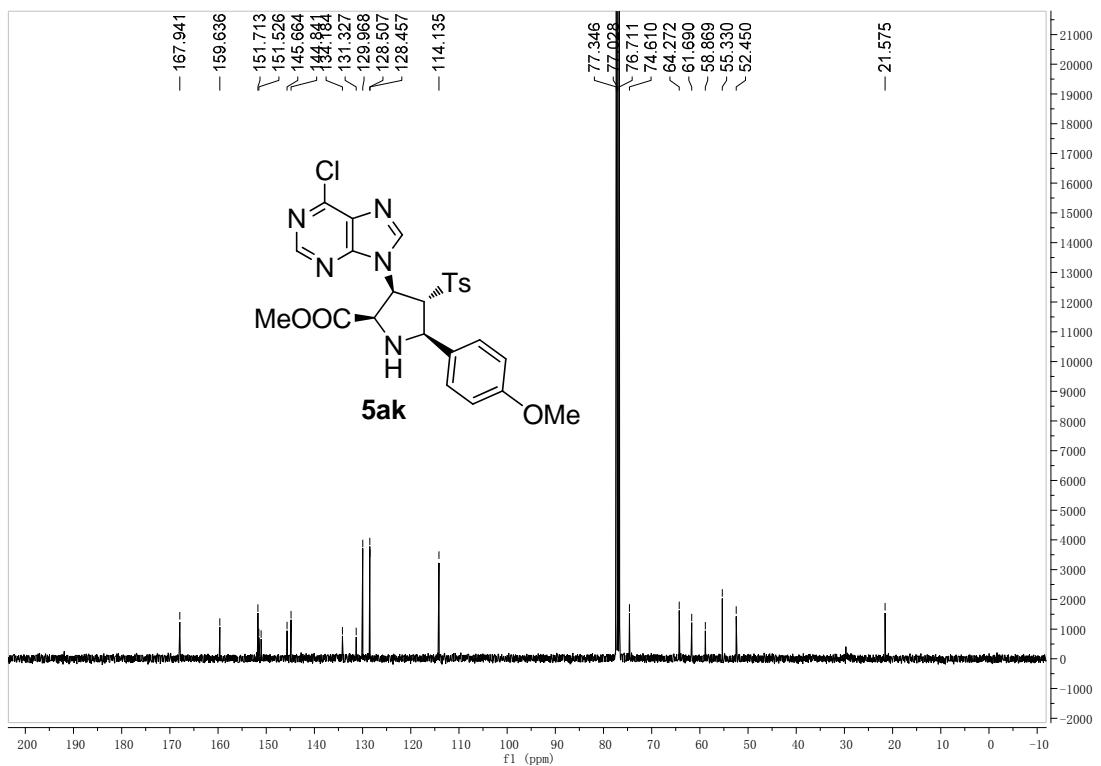
¹³C-NMR for 5aj



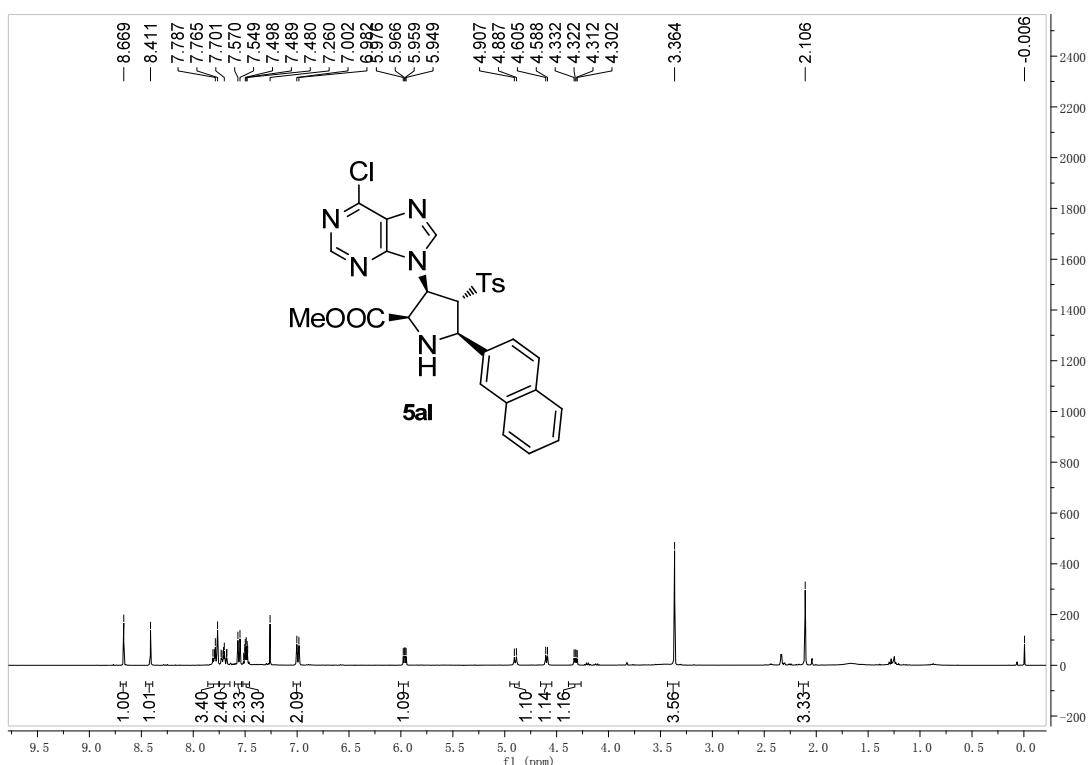
¹H NMR of 5ak



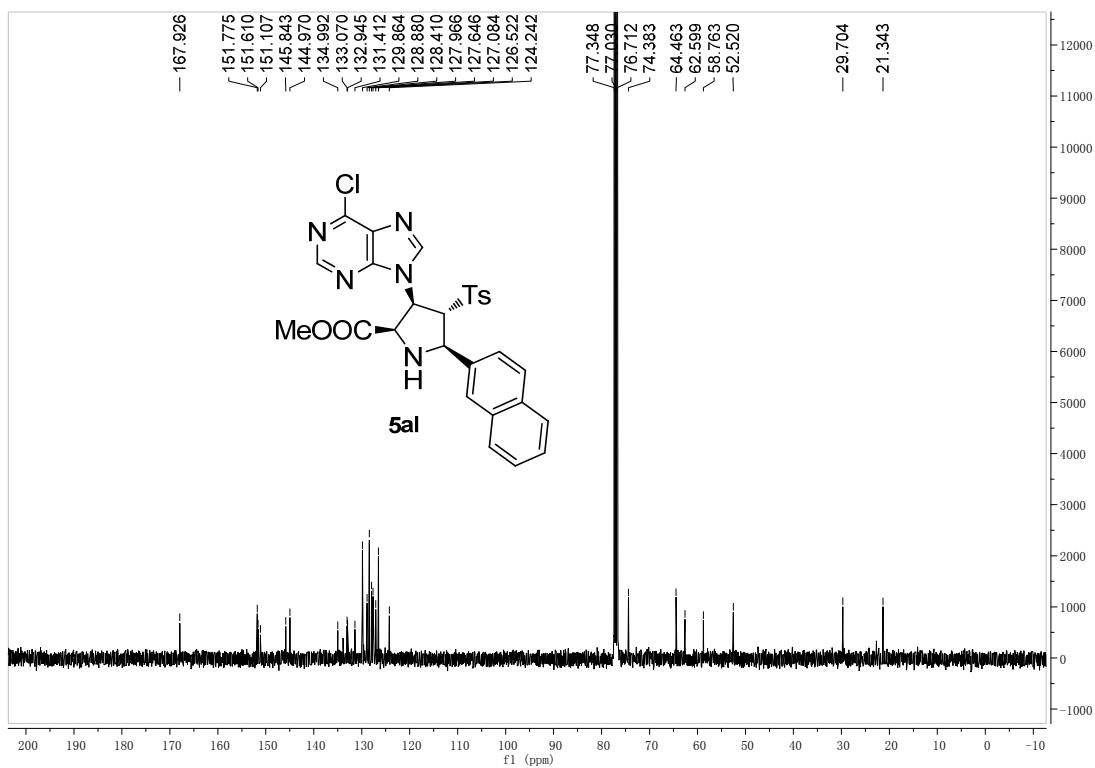
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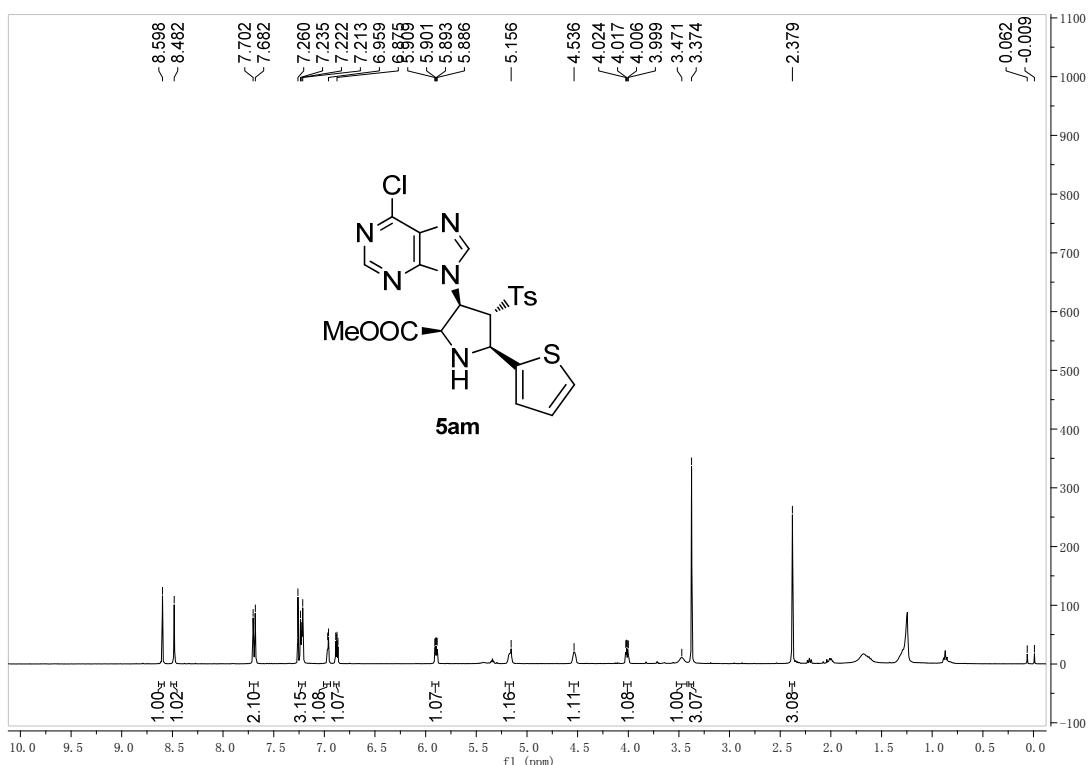
¹H NMR of 5al



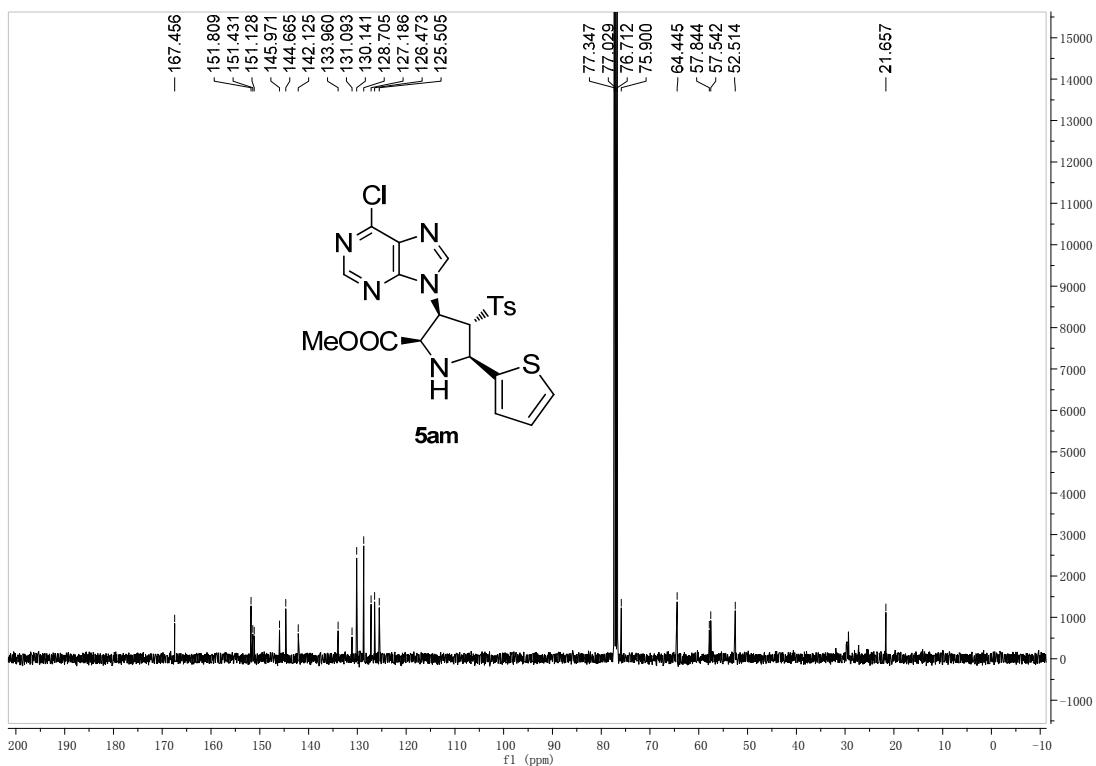
¹³C-NMR for 5al



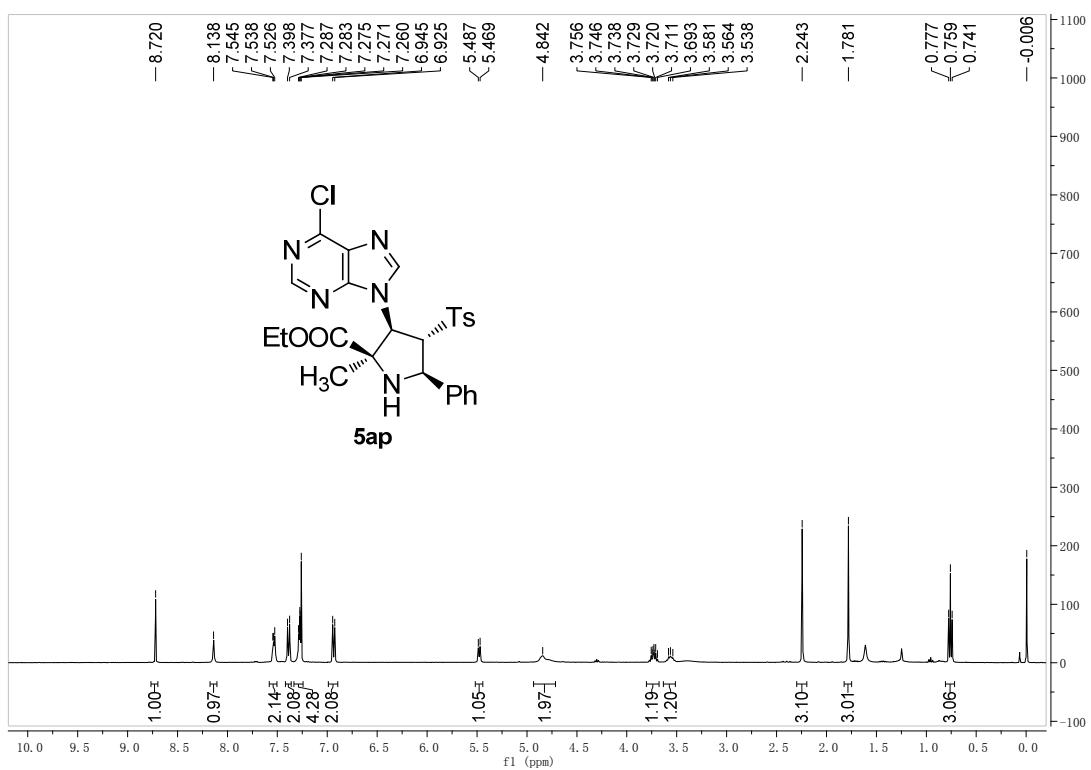
¹H NMR of 5am



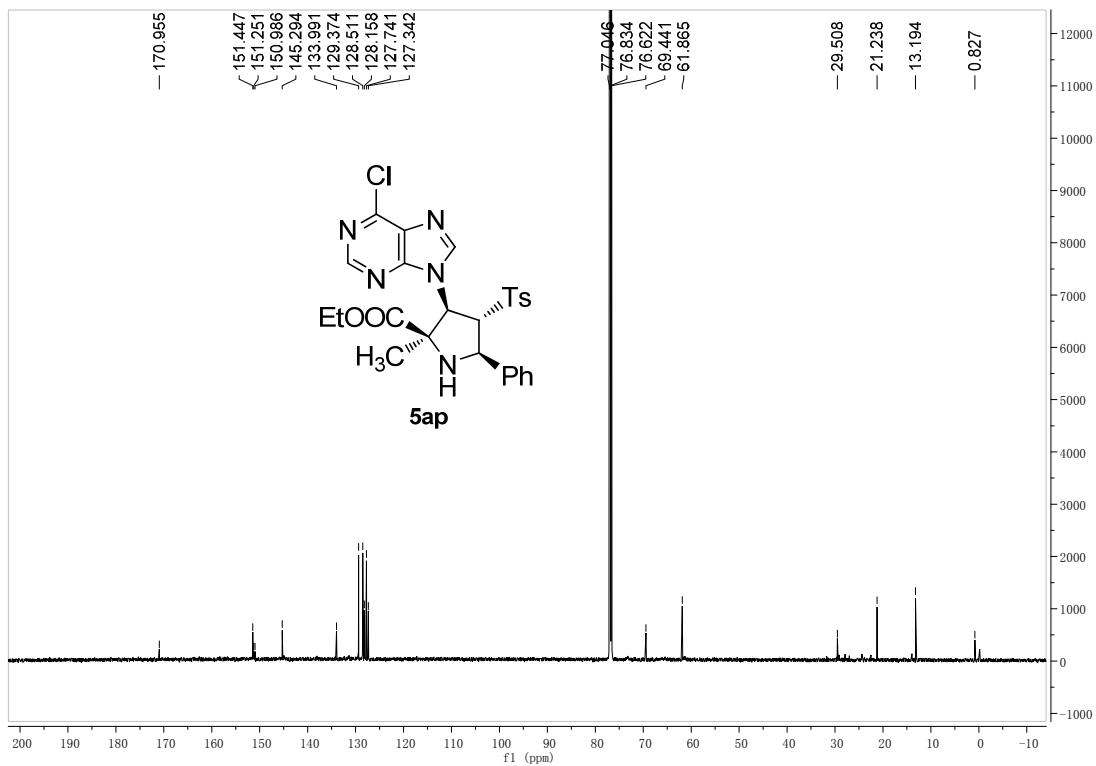
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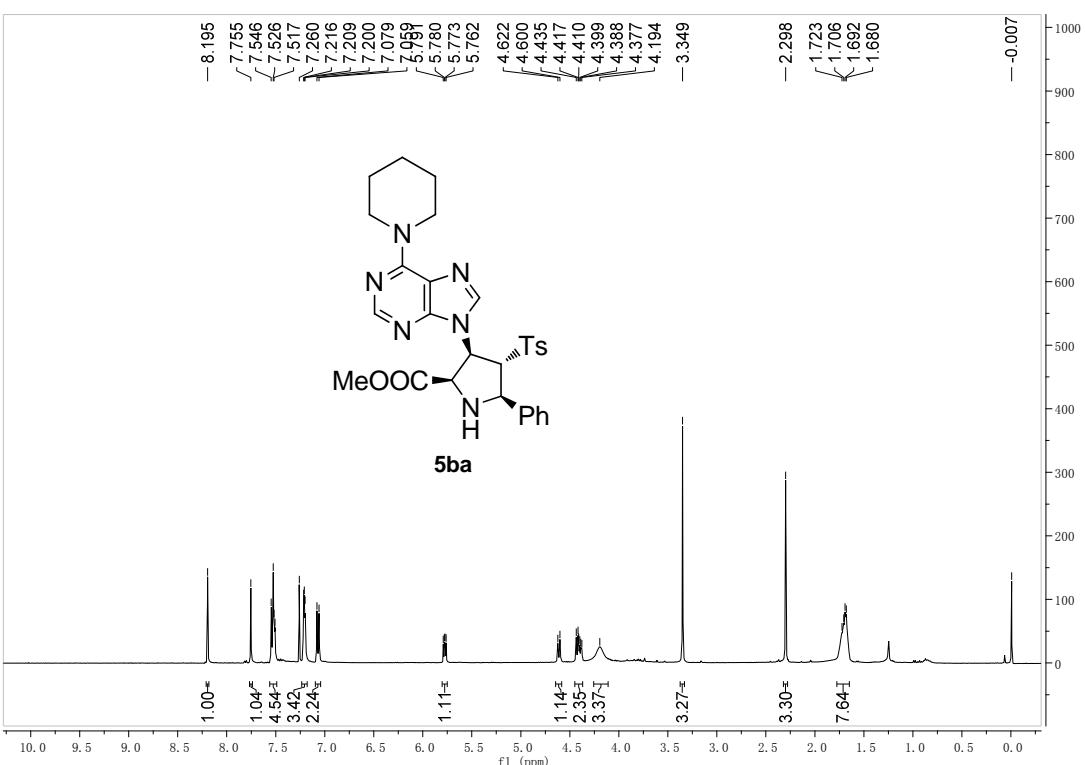
¹H NMR of 5ap



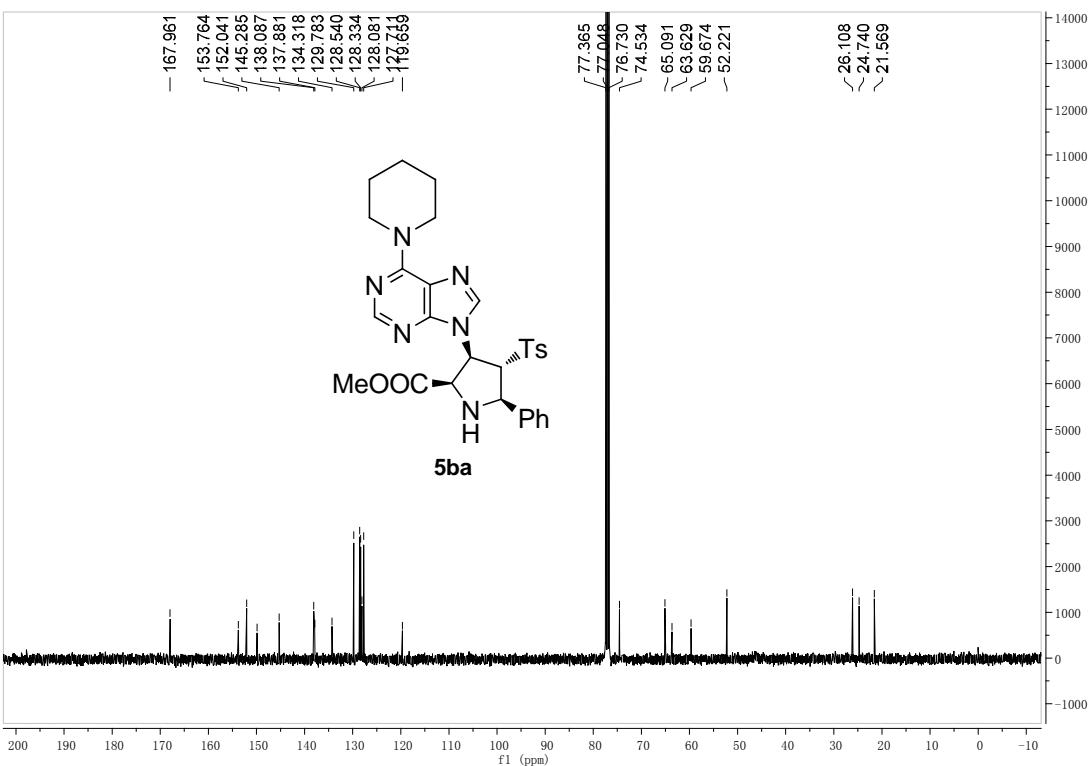
¹³C-NMR for 5ap



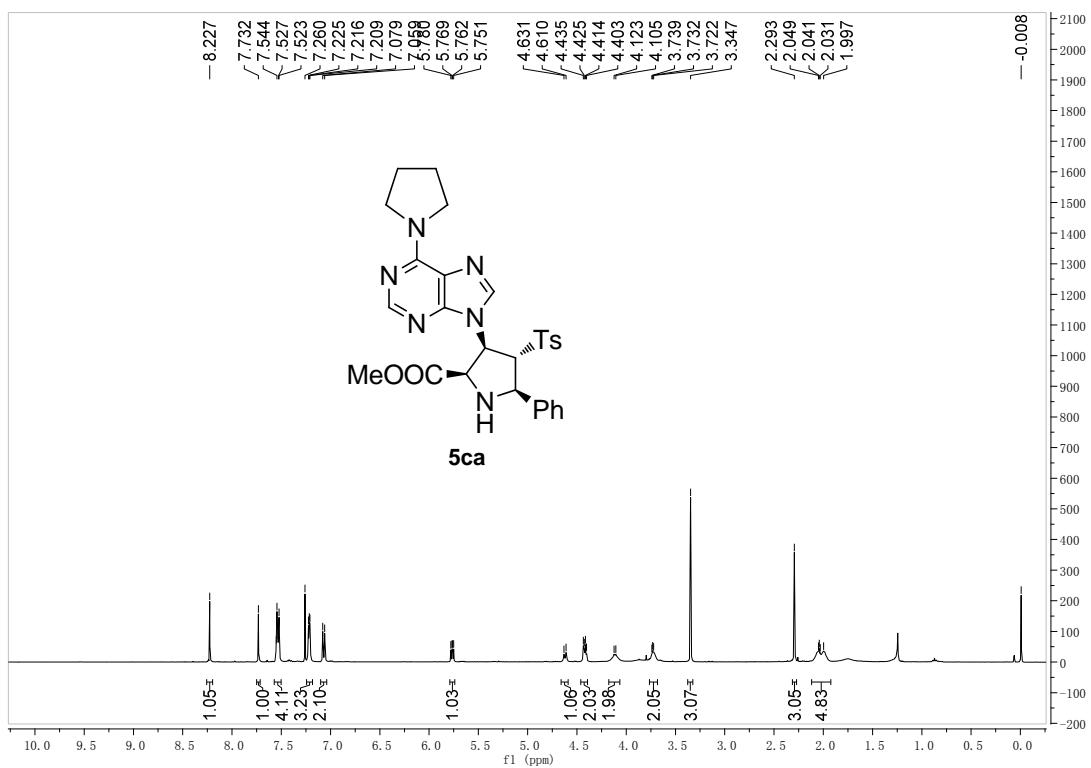
¹H NMR of 5ba



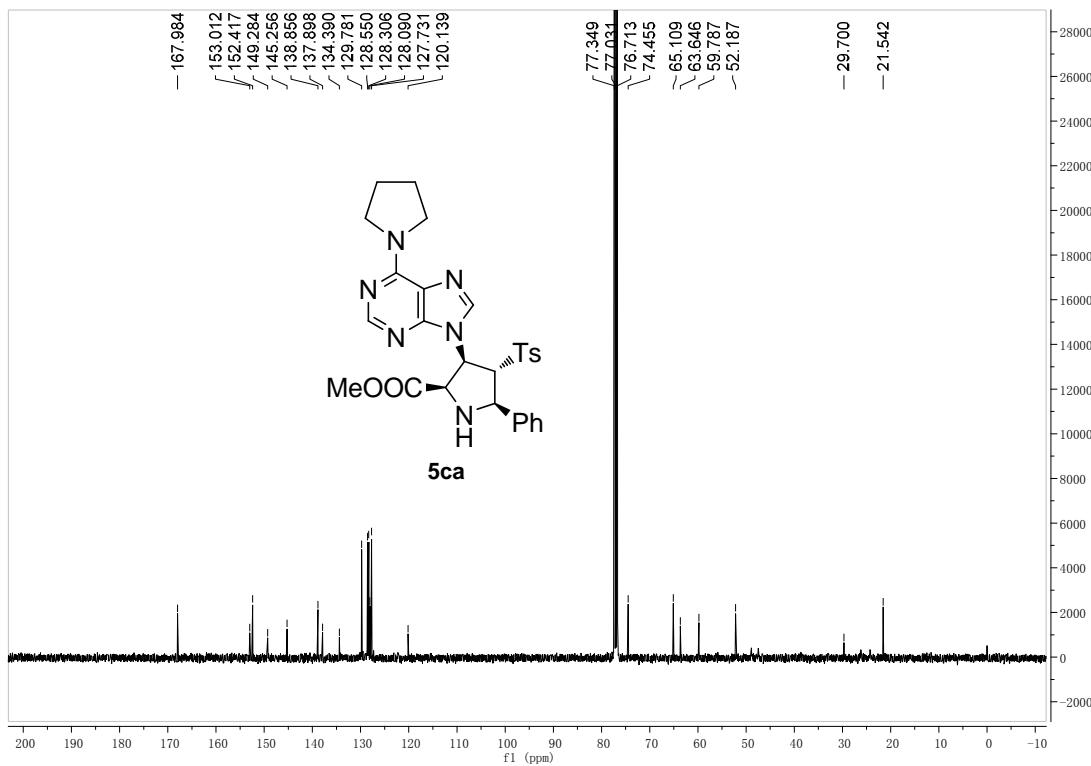
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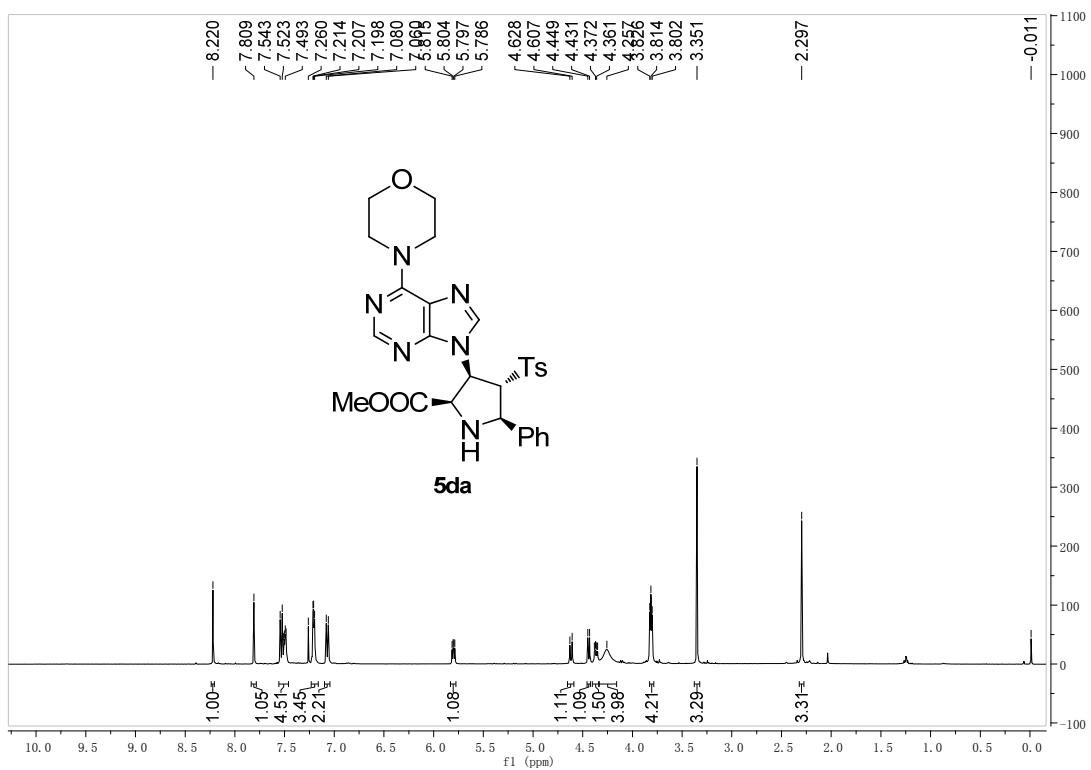
¹H NMR of 5ca



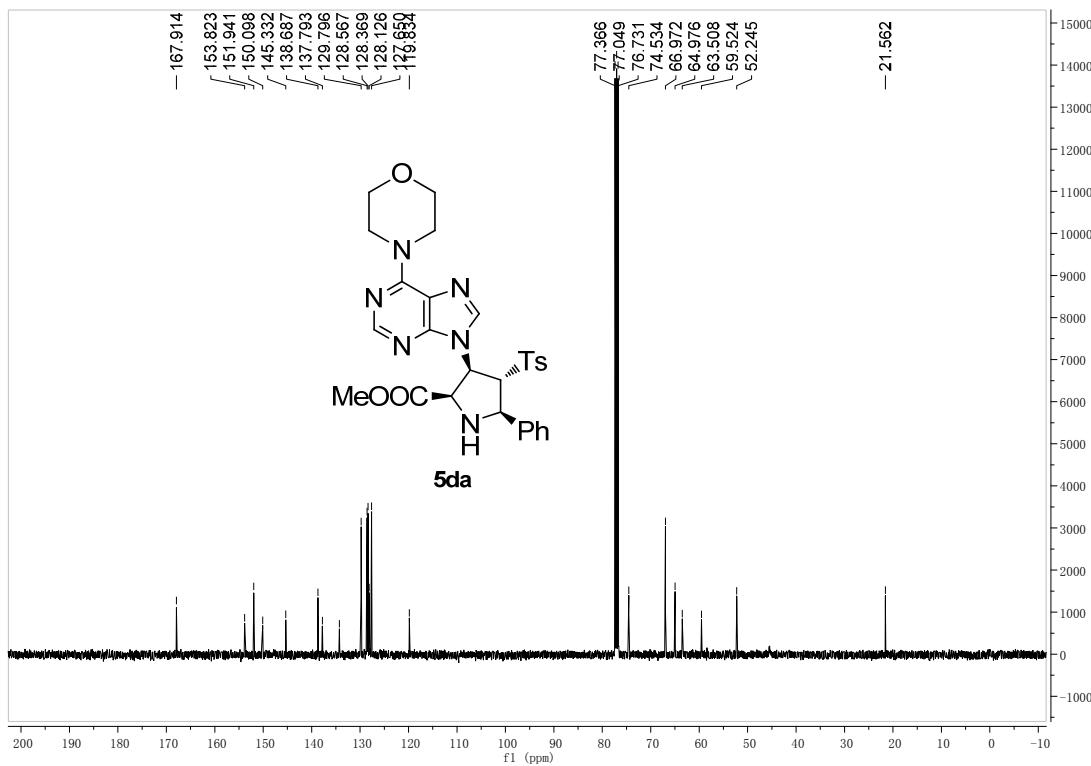
¹³C-NMR for 5ca



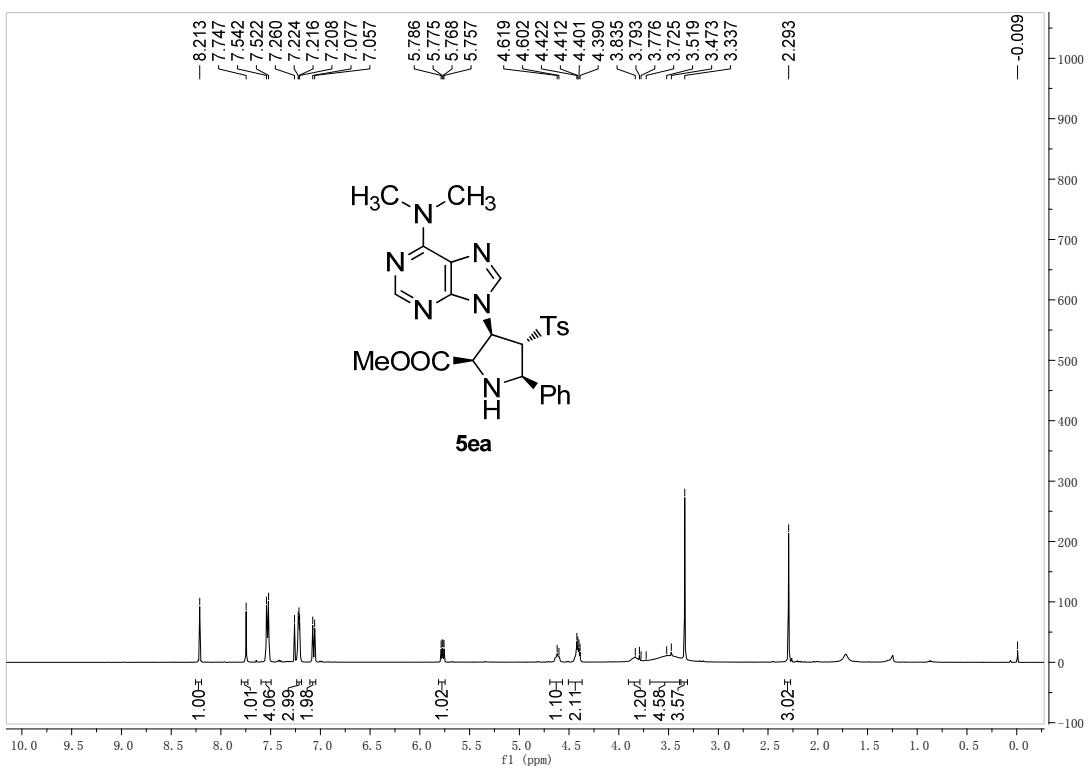
¹H NMR of 5da



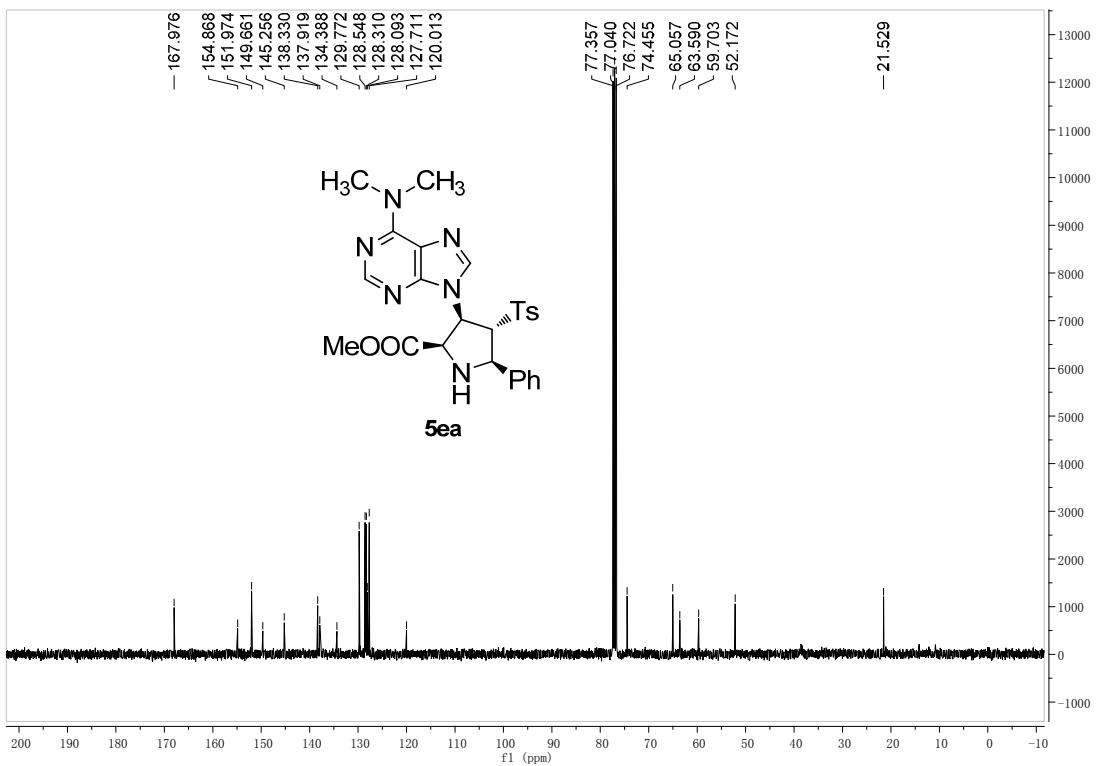
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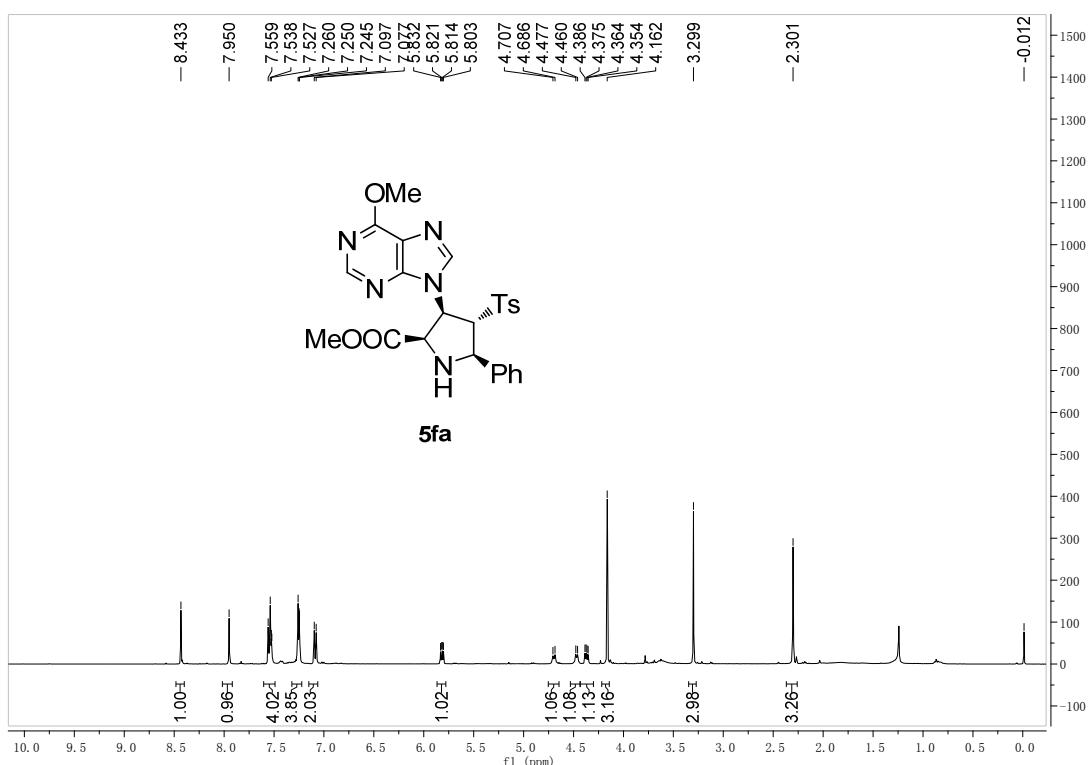
¹H NMR of 5ea



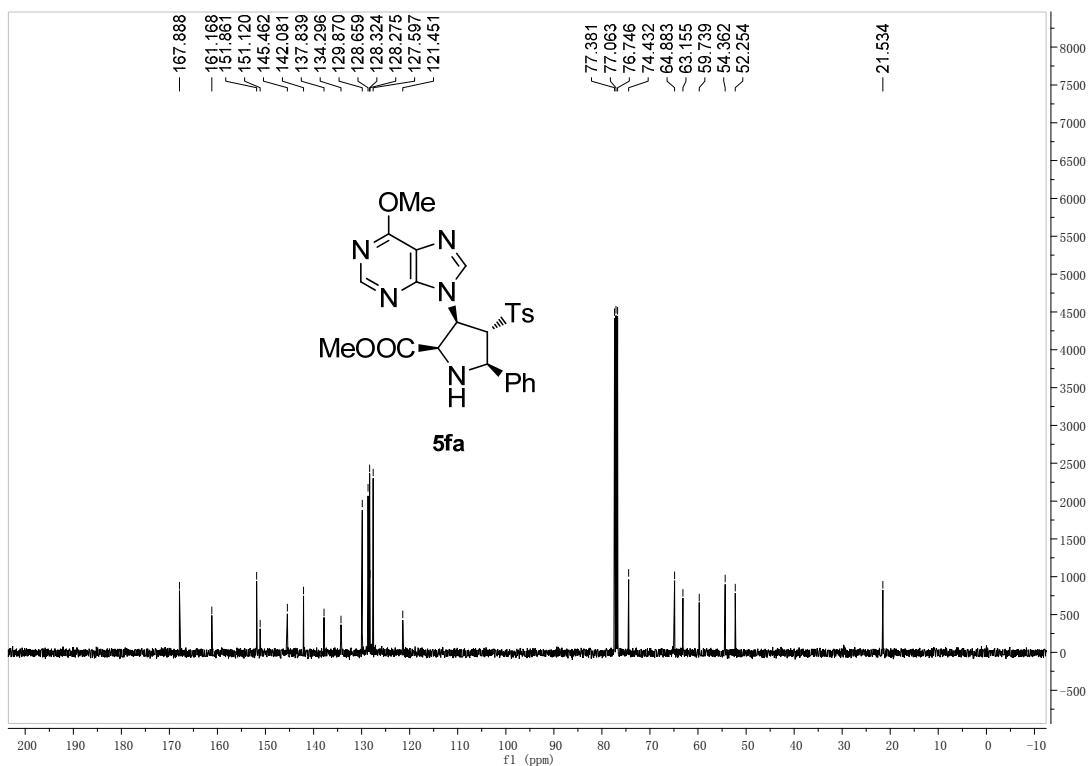
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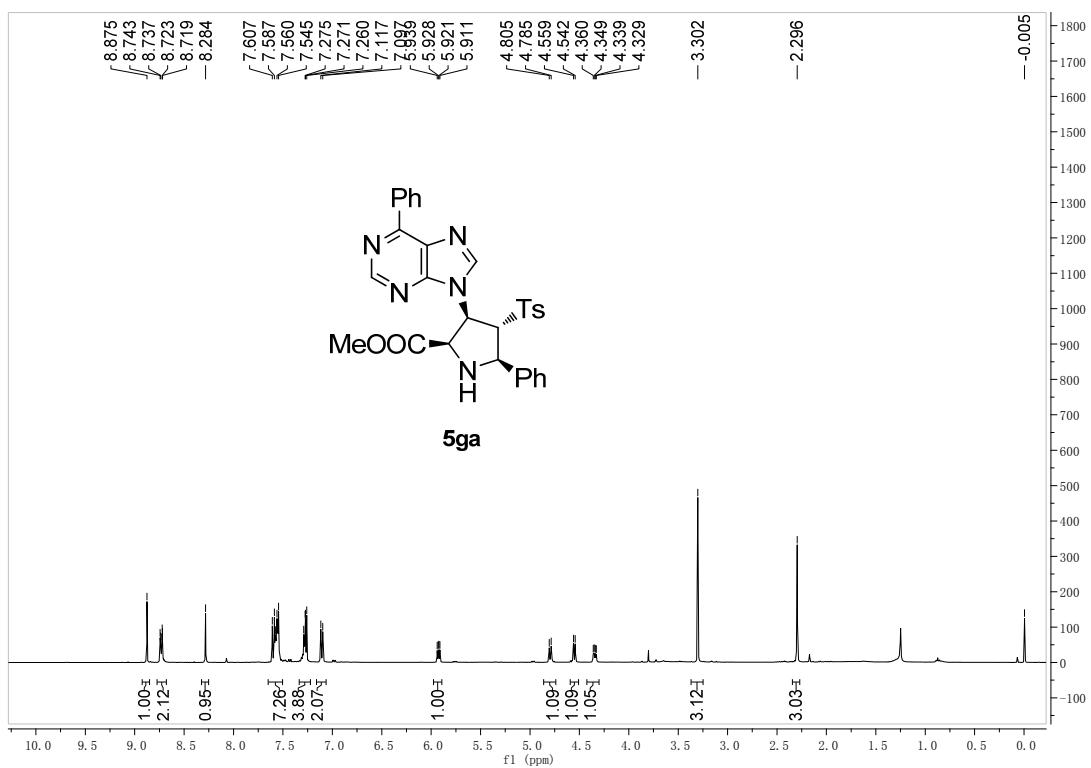
¹H NMR of 5fa



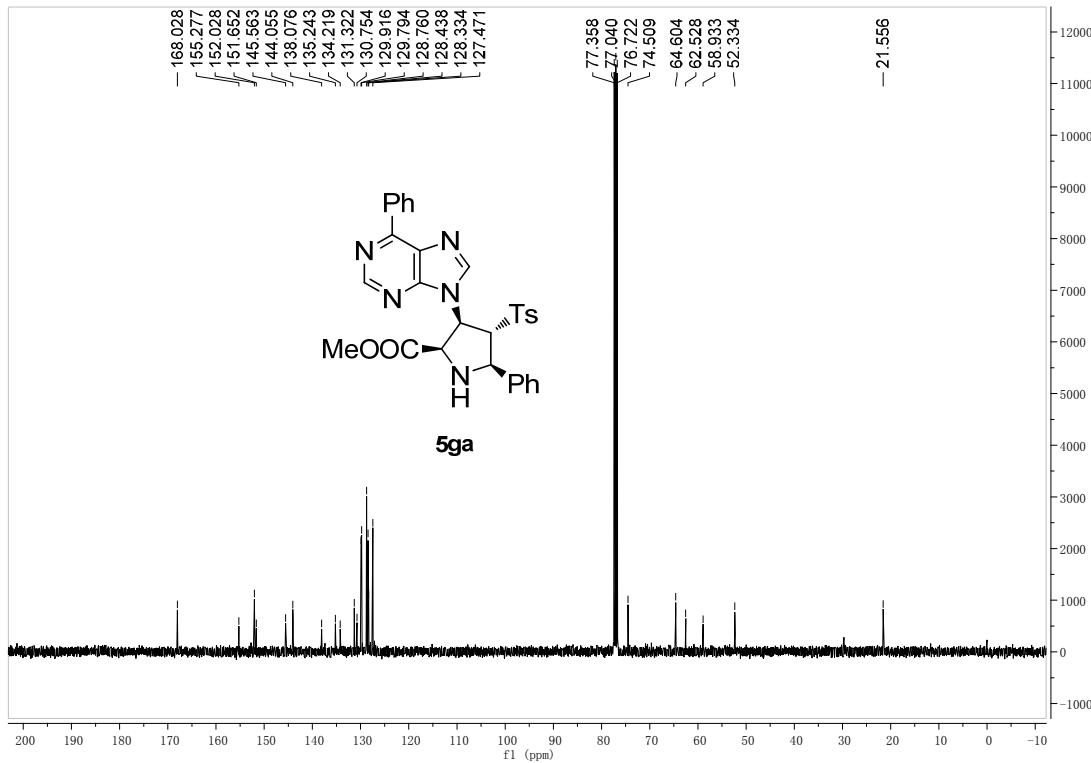
¹³C-NMR for 5fa



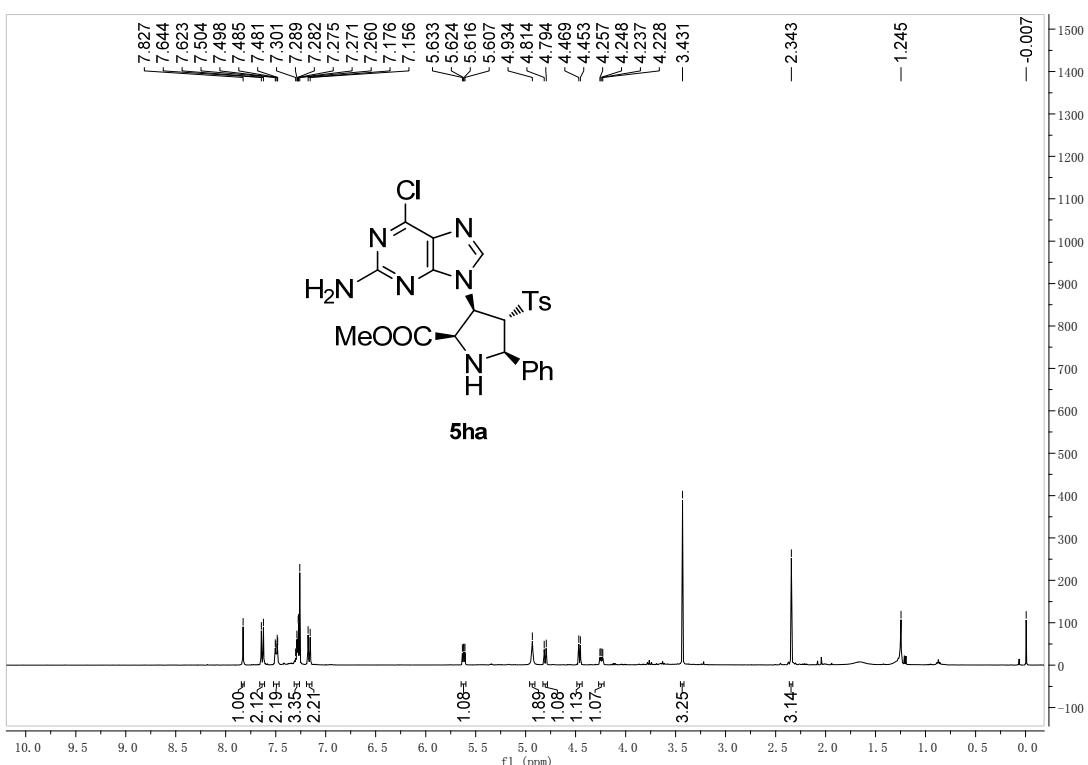
¹H NMR of 5ga



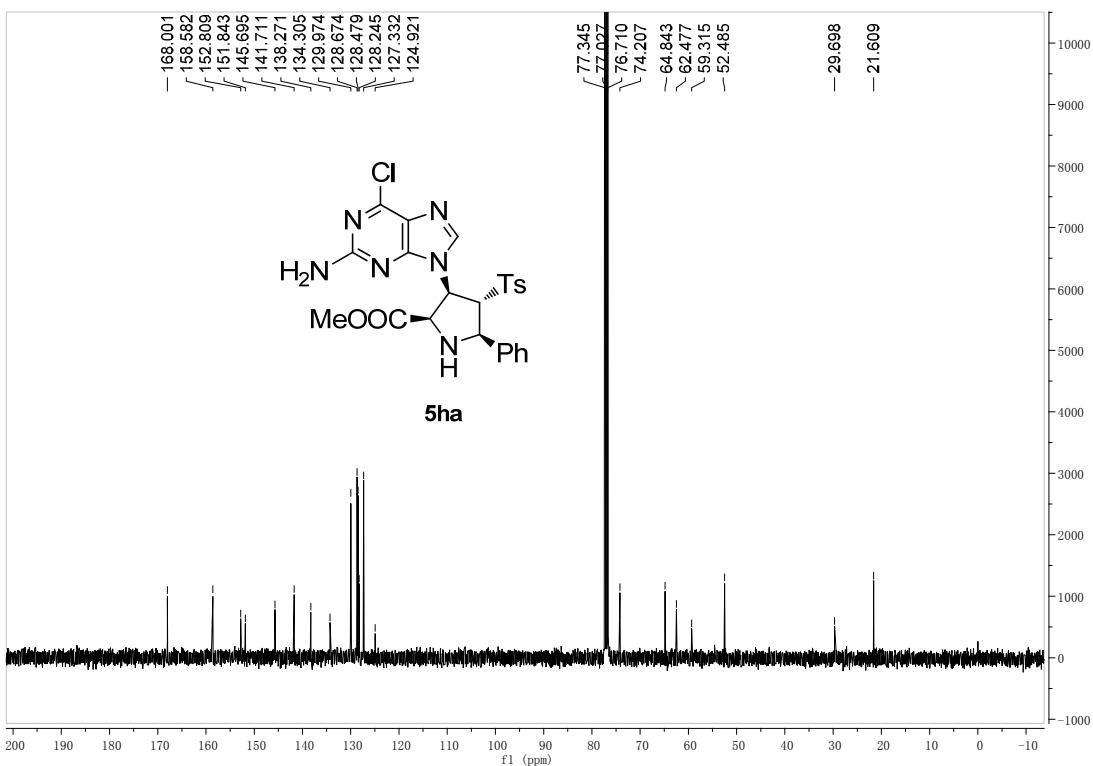
¹³C-NMR for 5ga



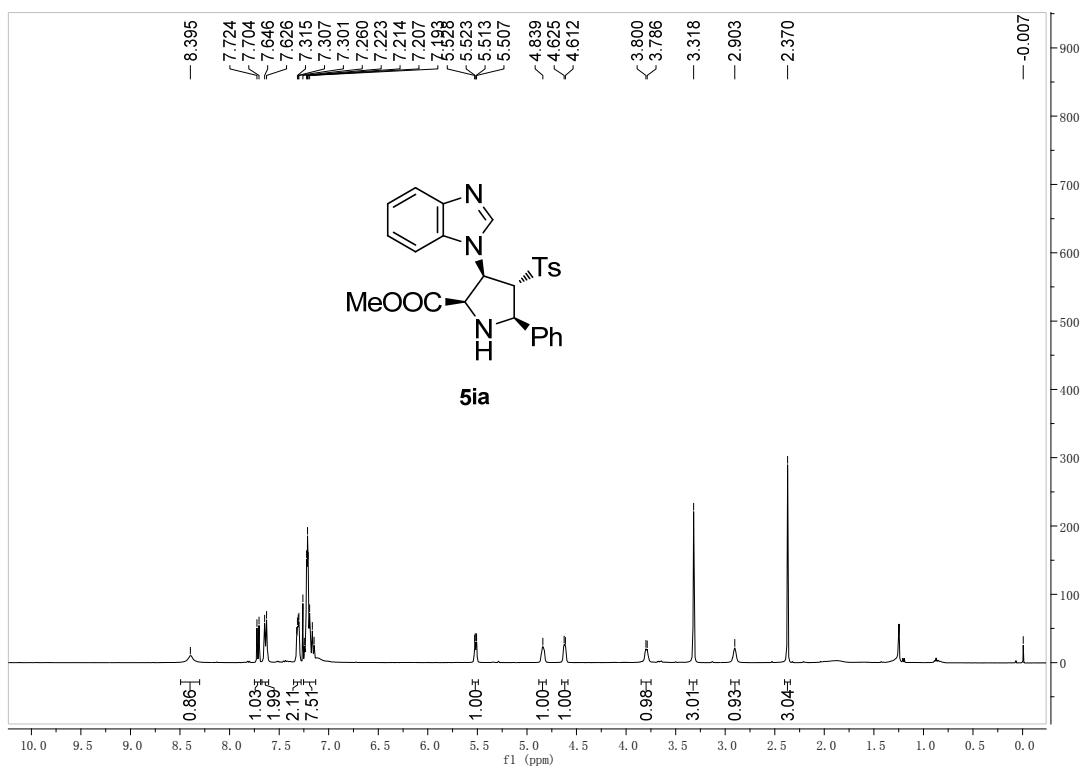
¹H NMR of 5ha



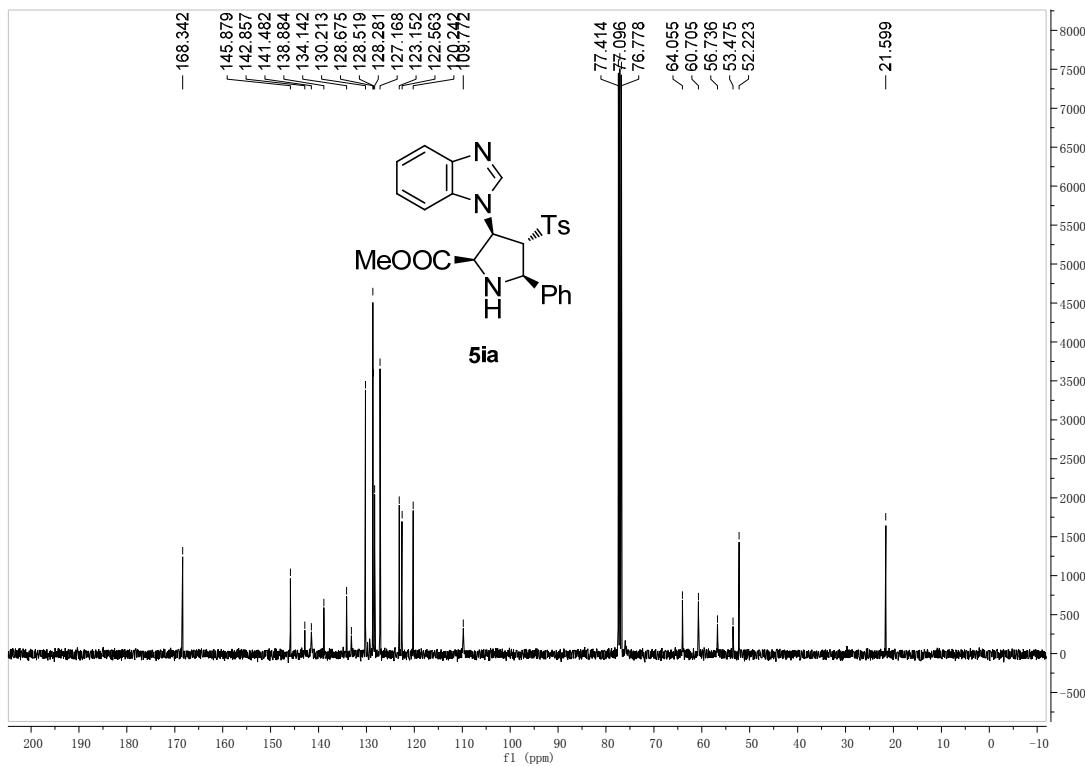
¹³C-NMR for 5ha



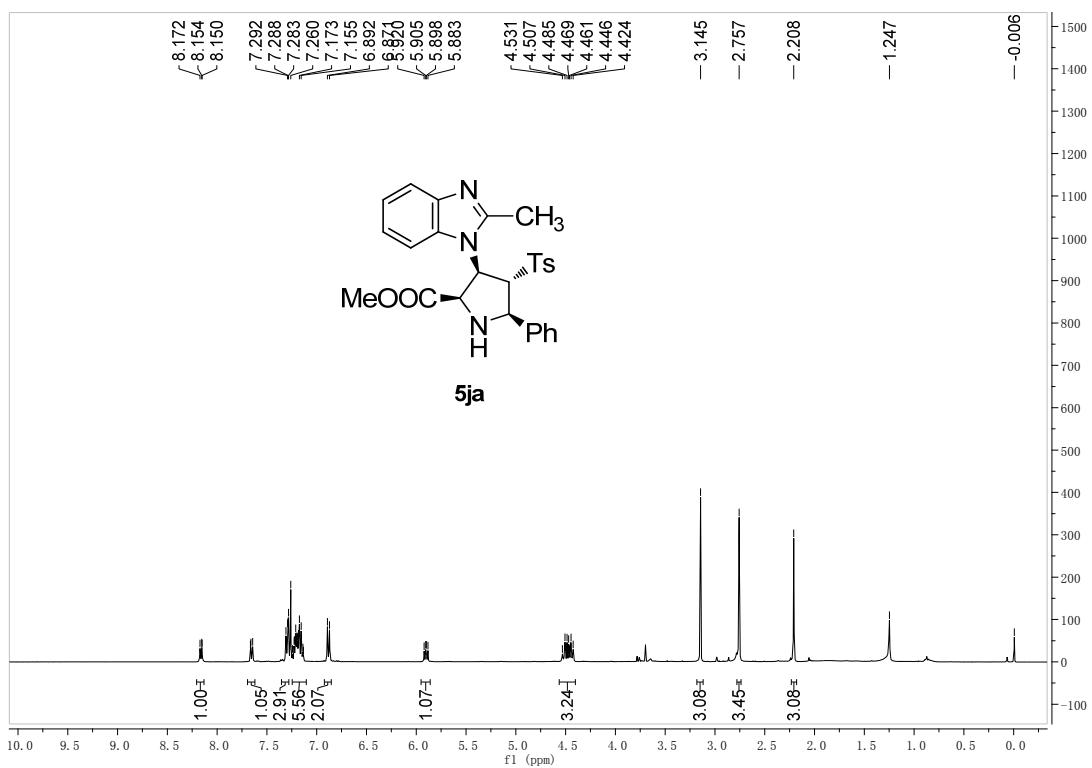
¹H NMR of 5ia



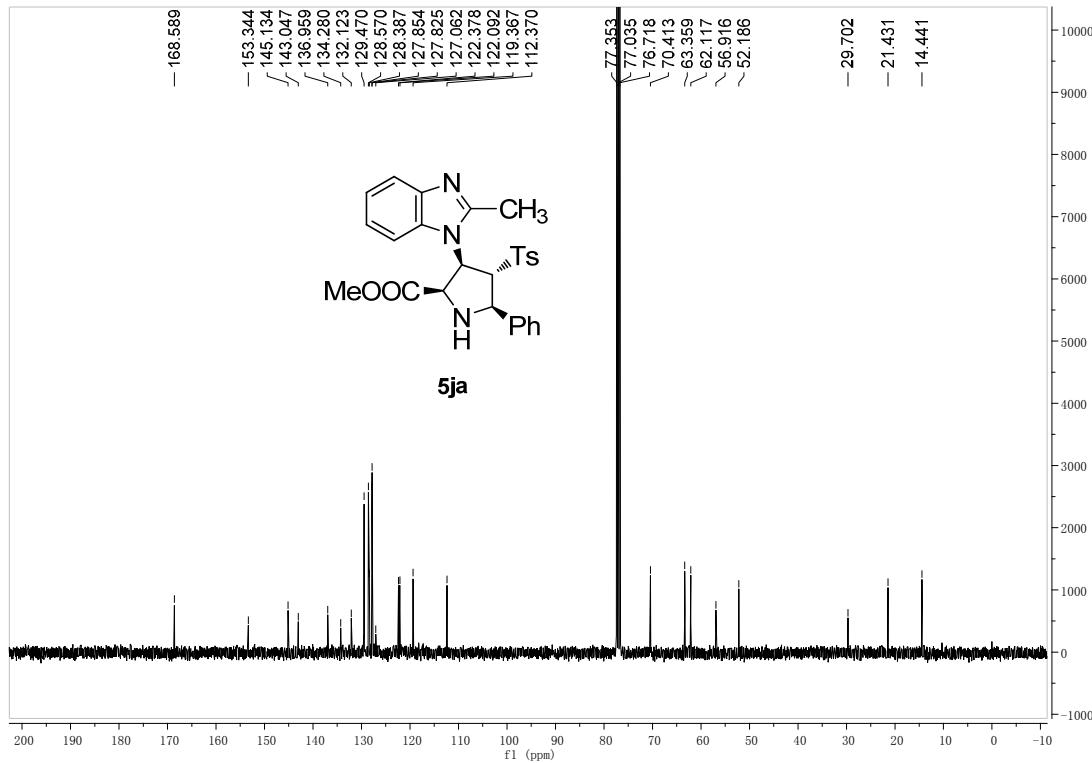
¹³C-NMR for 5ia



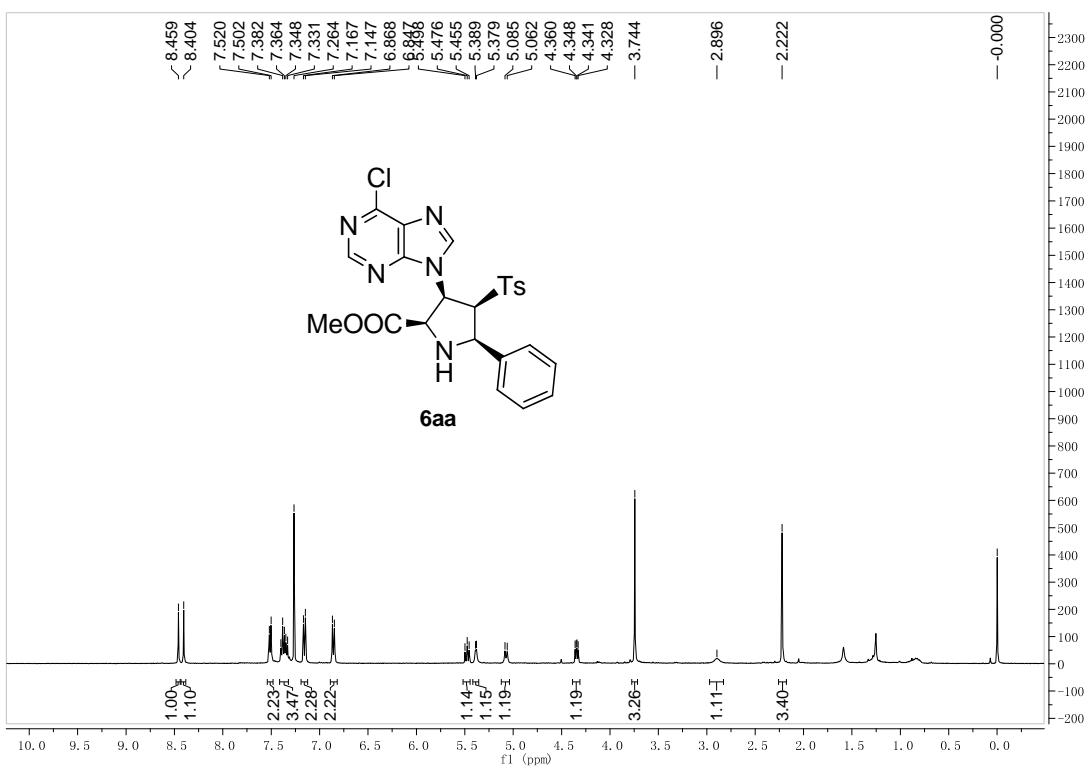
¹H NMR of 5ja



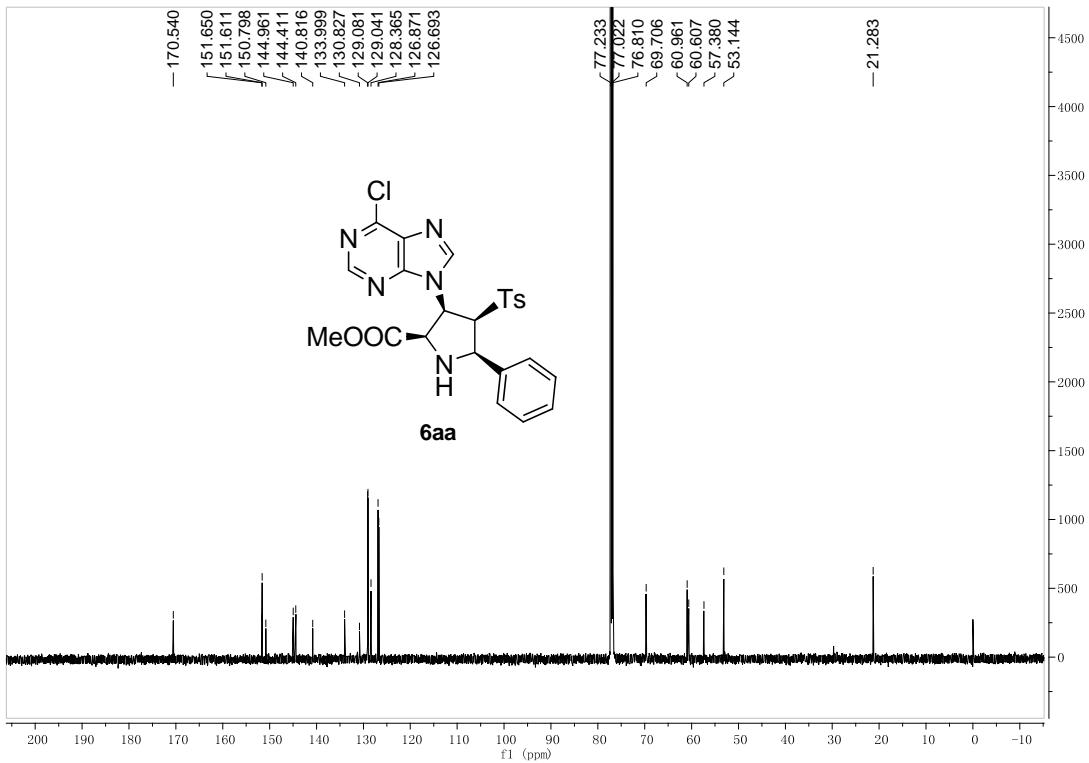
¹³C-NMR for 5ja



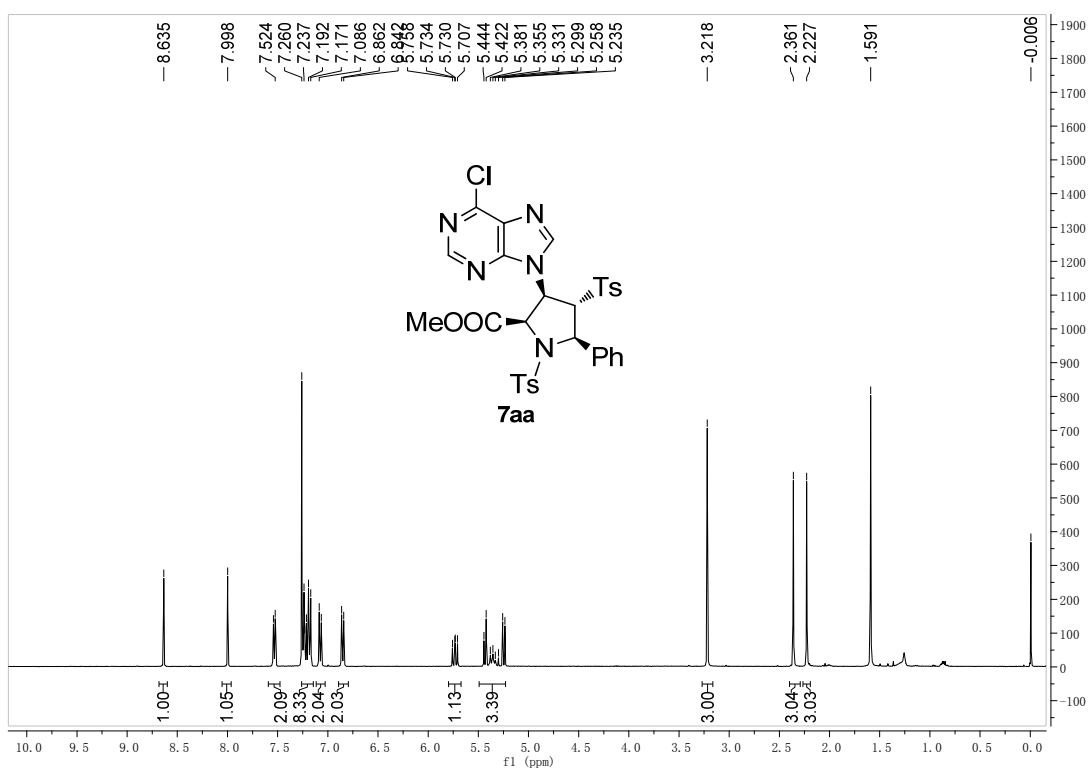
¹H NMR of 6aa



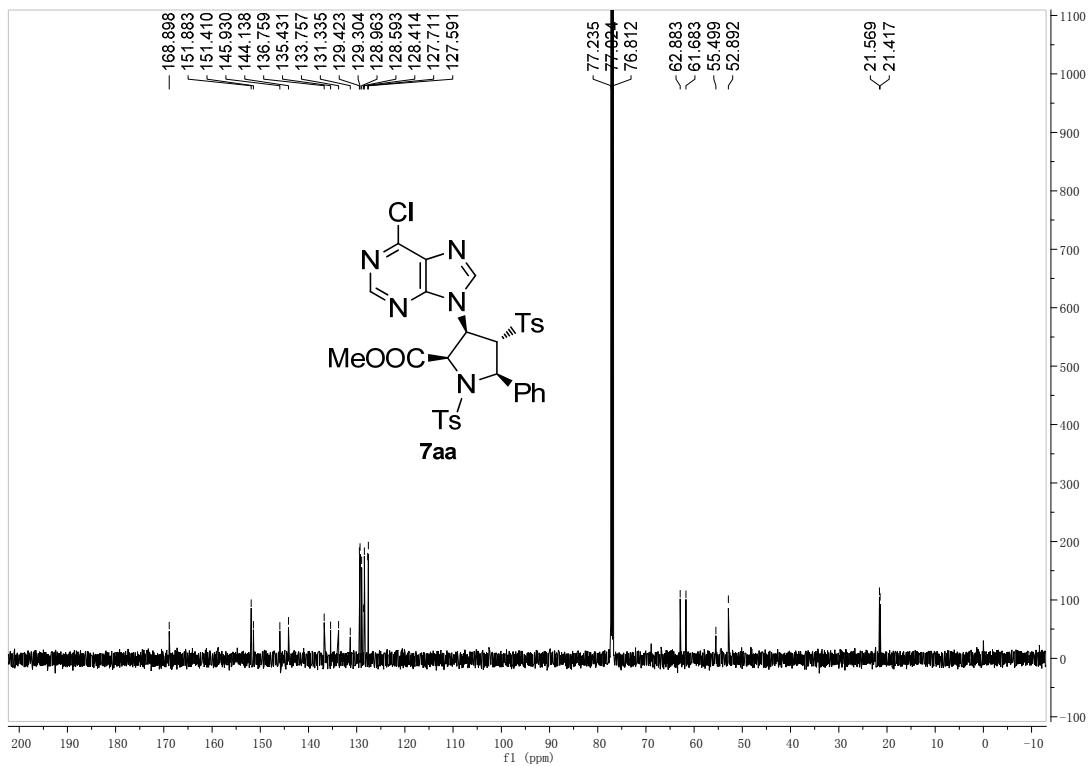
¹³C-NMR for 6aa



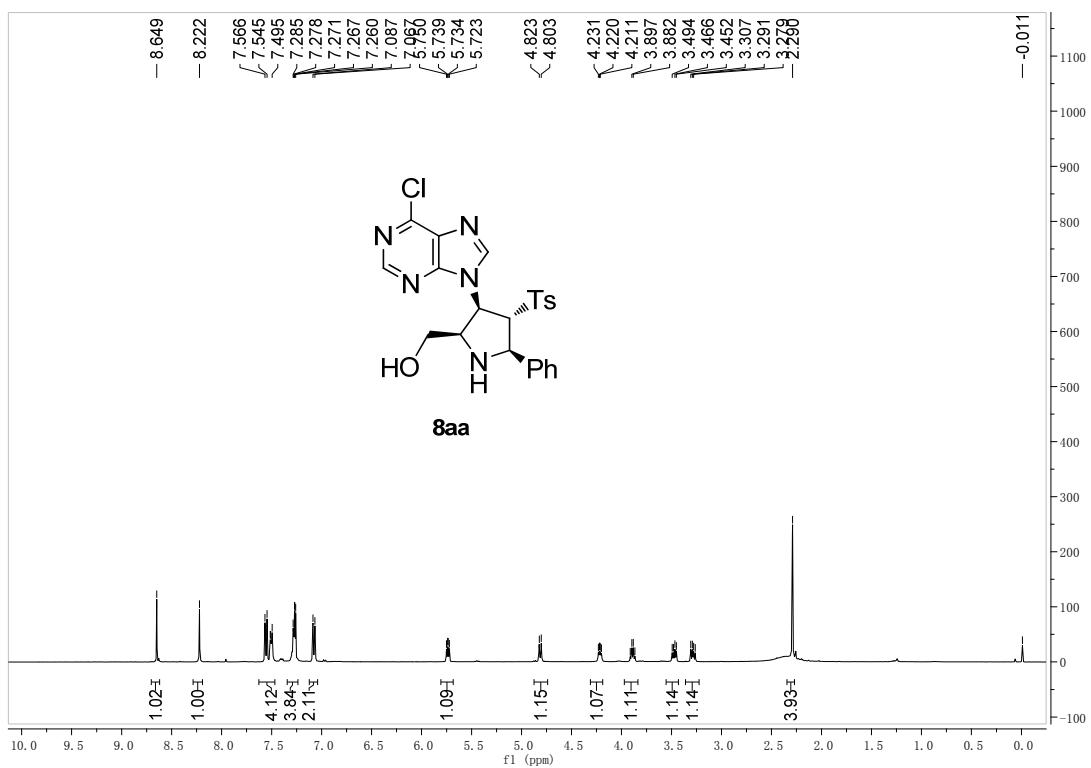
¹H NMR of 7aa



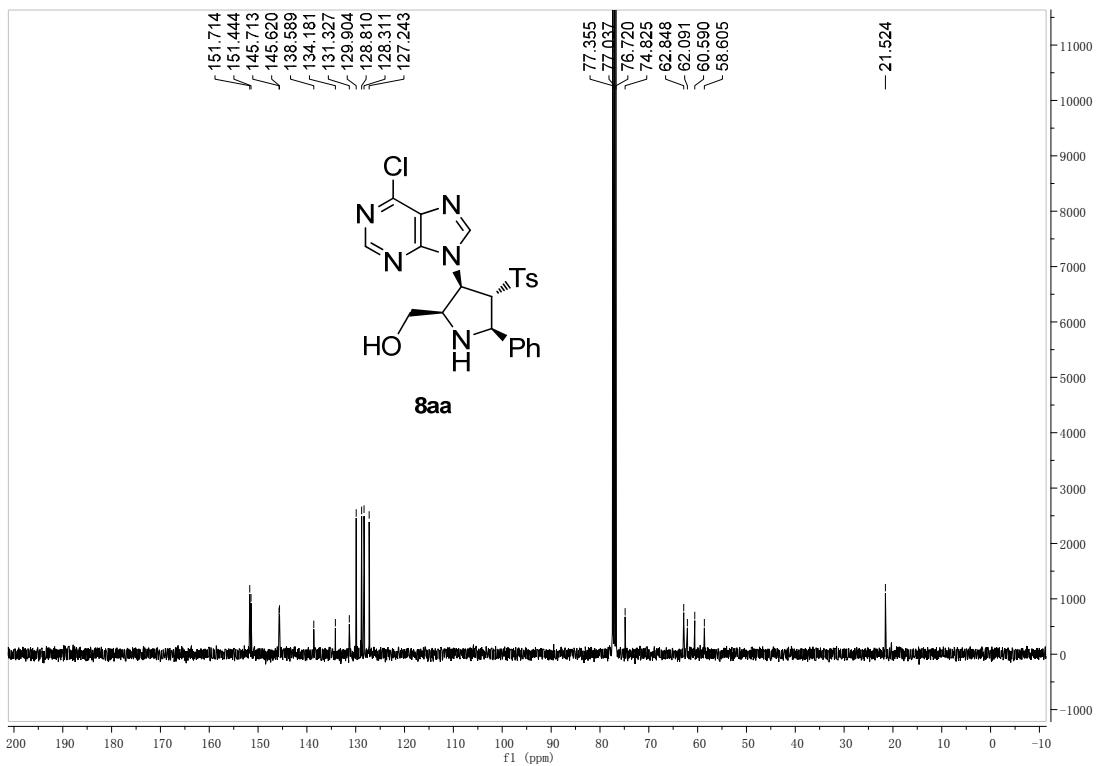
¹³C-NMR for 7aa



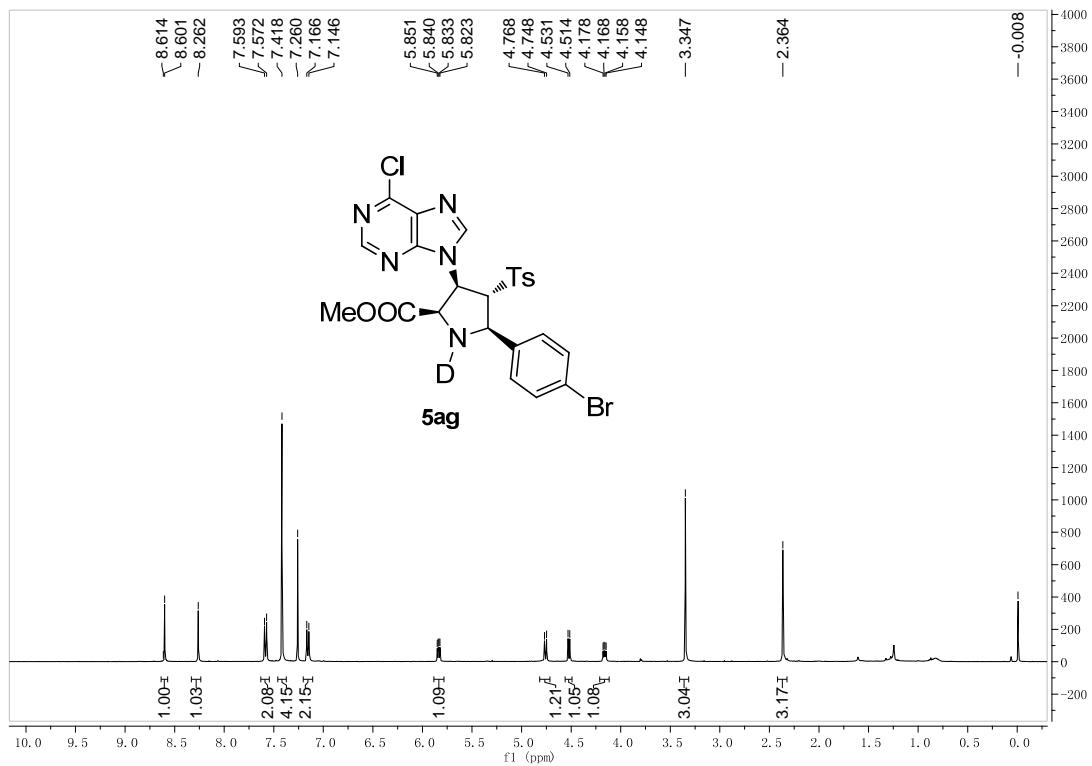
¹H NMR of 8aa



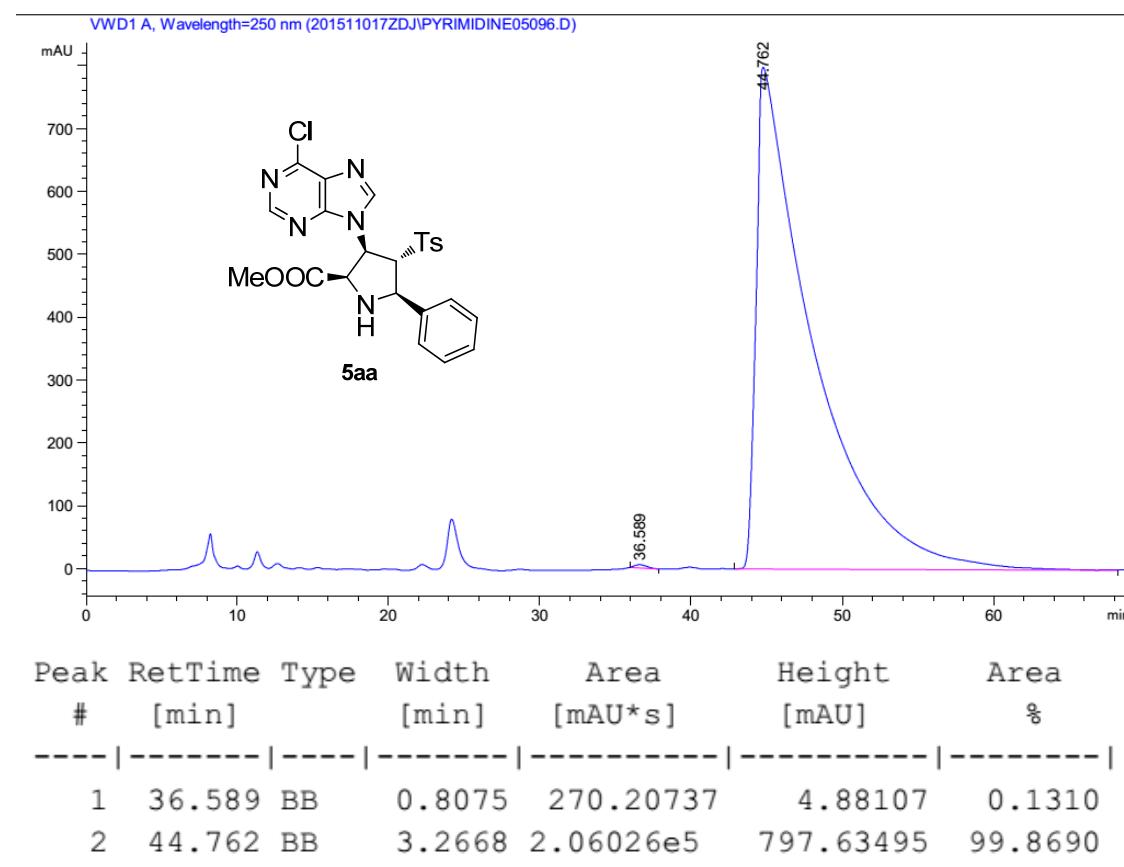
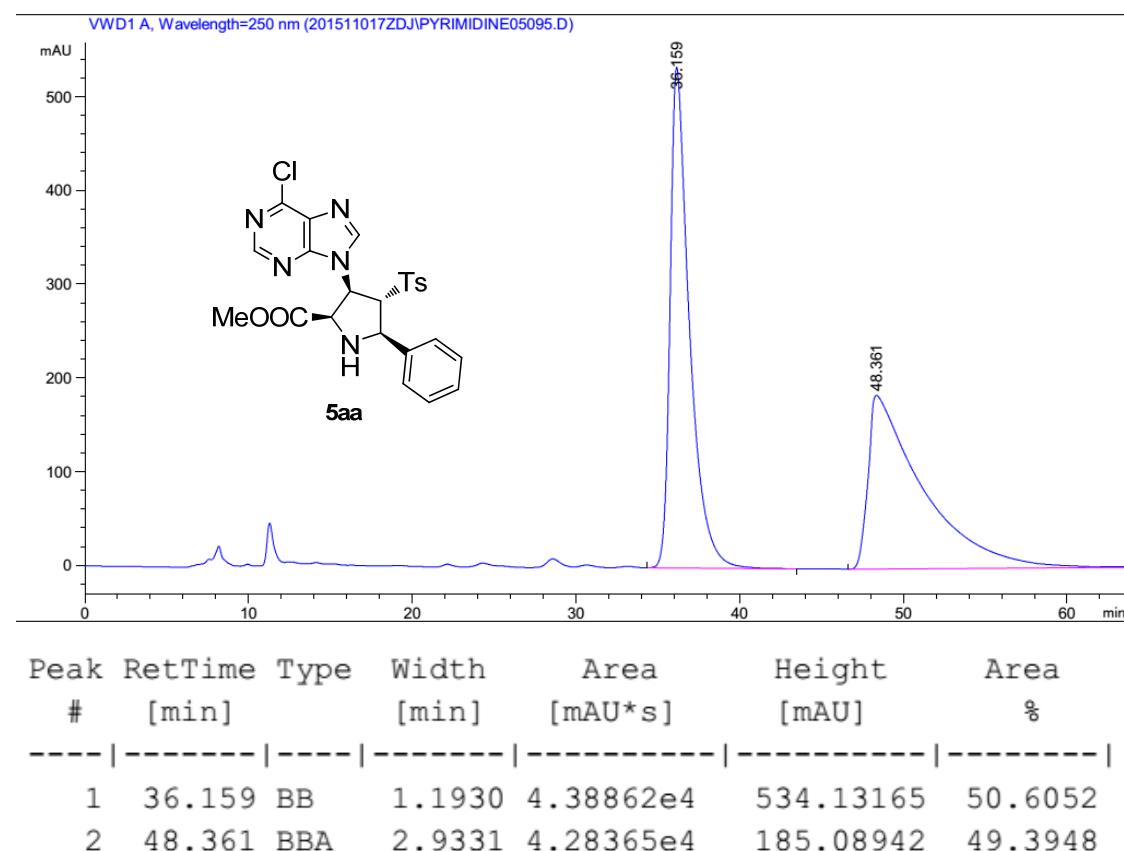
¹³C-NMR for 8aa



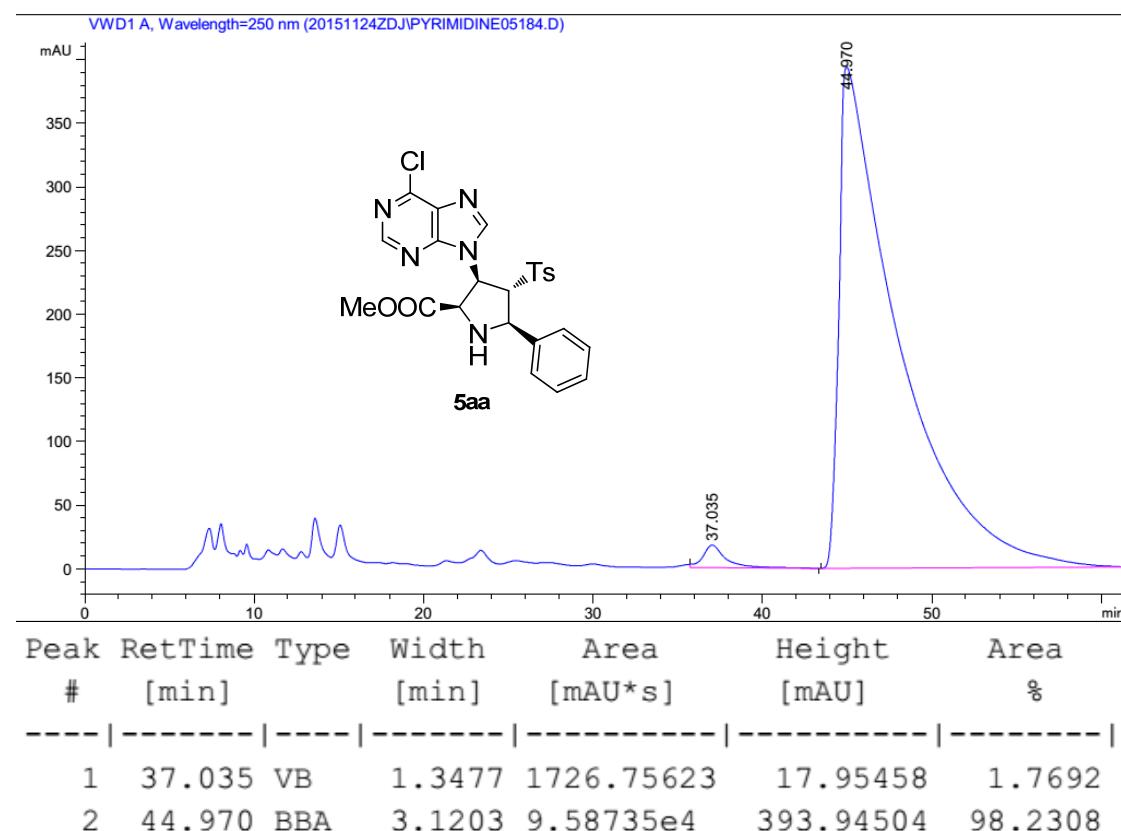
¹H NMR of D-5ag

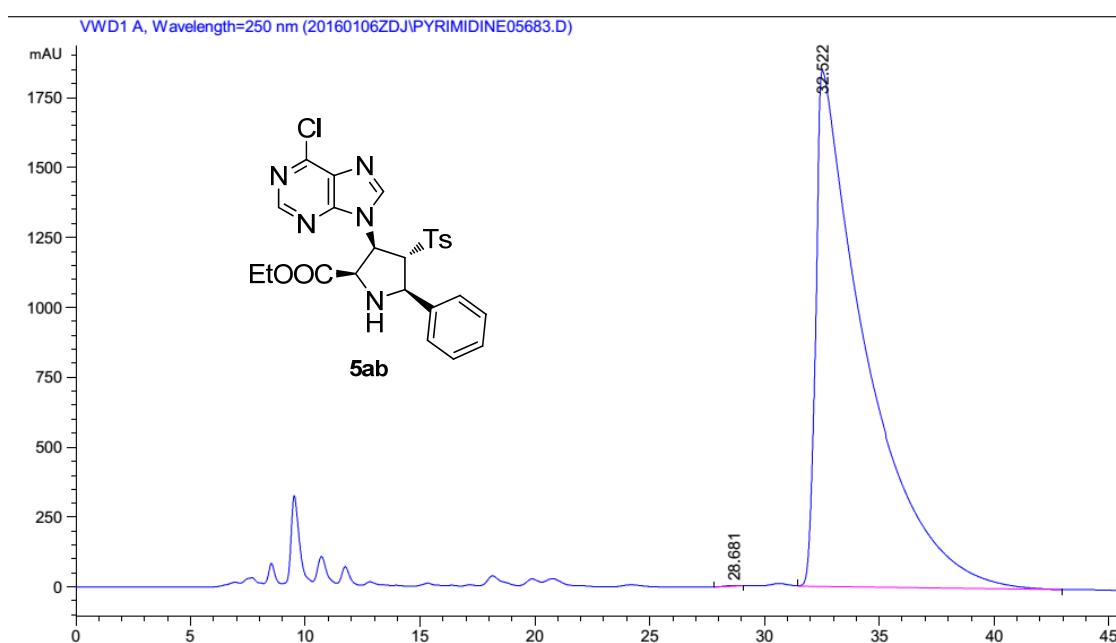
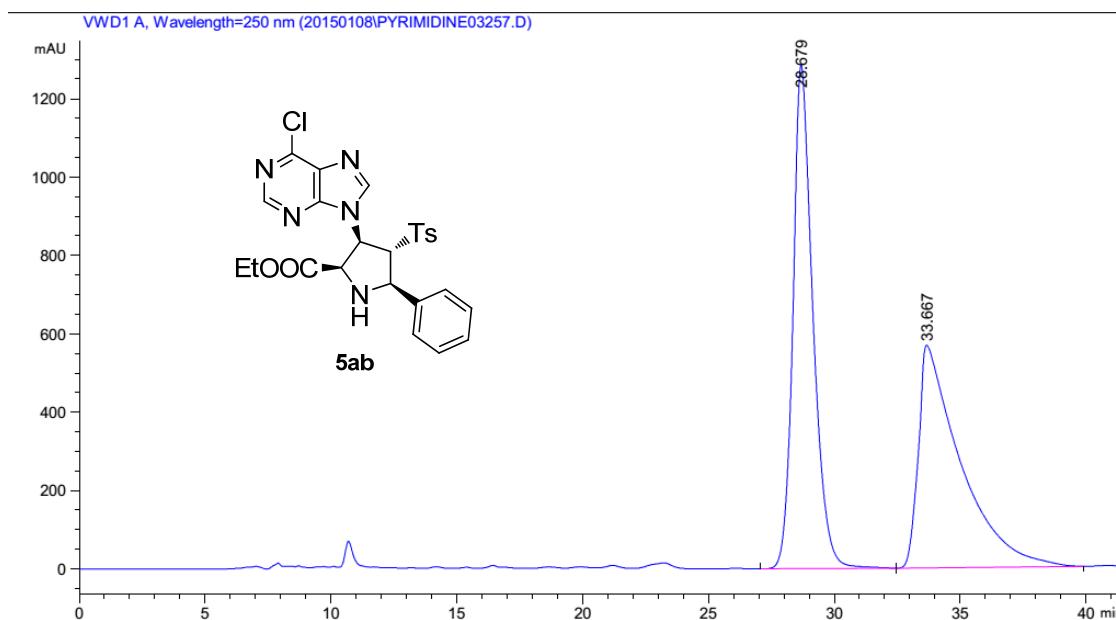


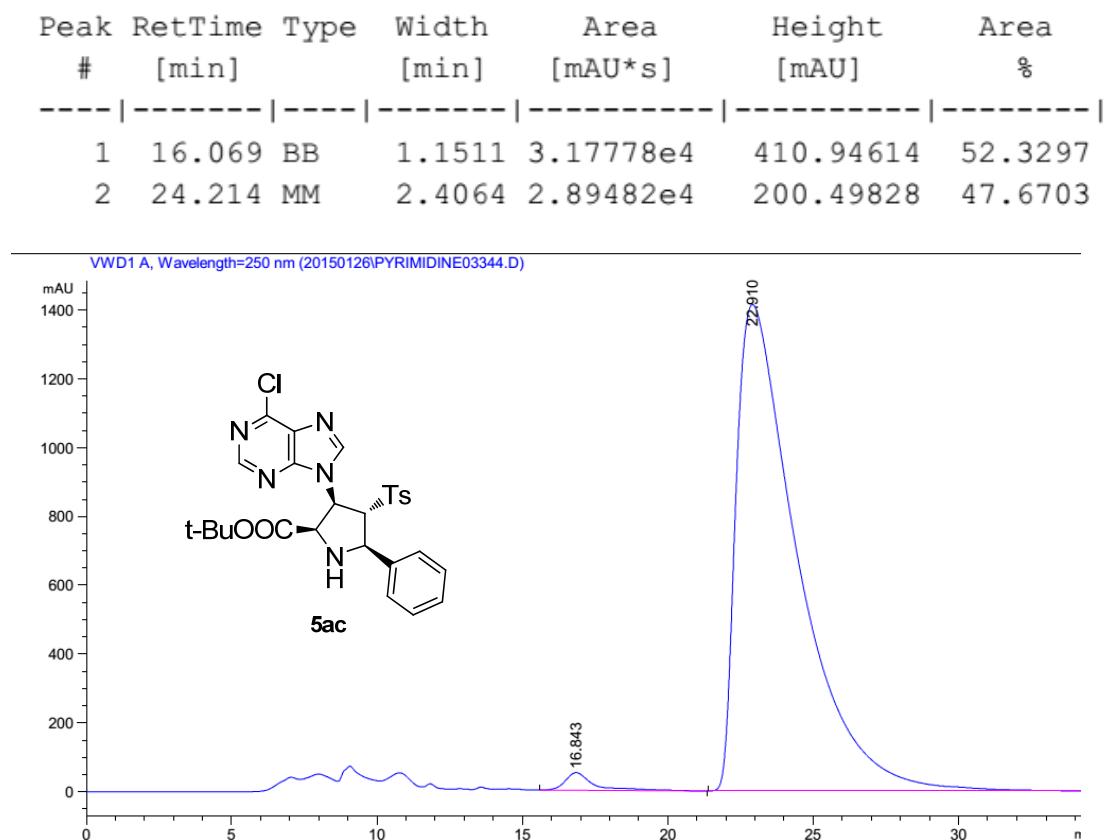
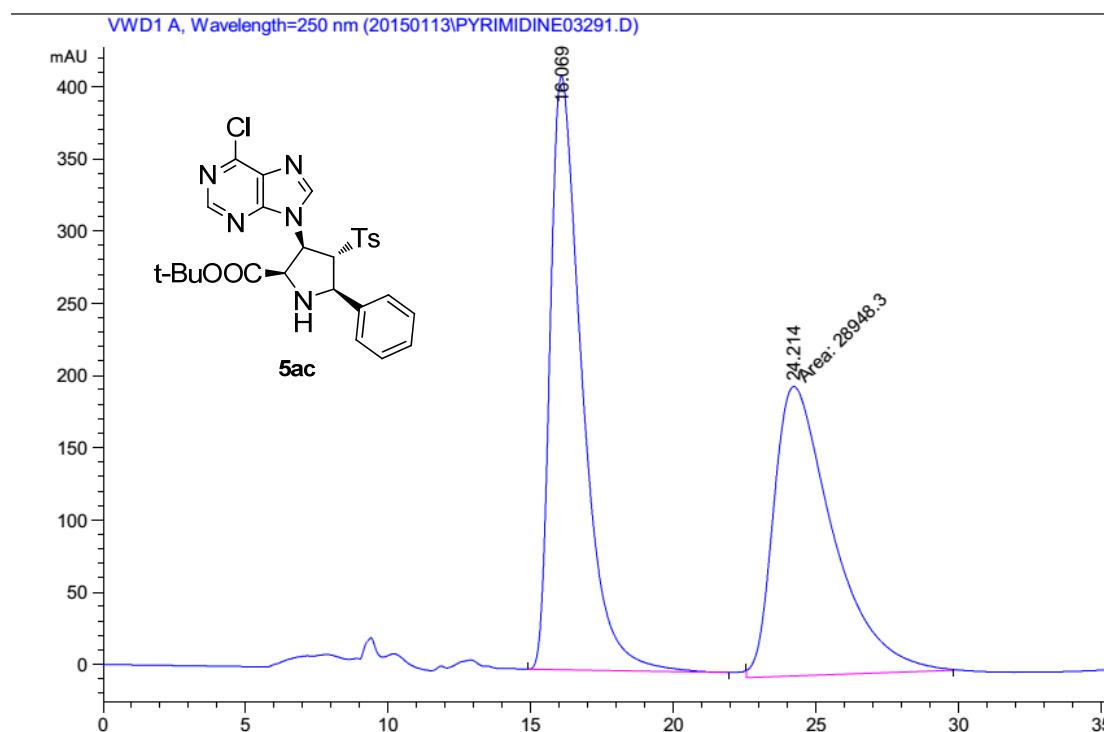
8. Copies of HPLC spectra for Racemic and Chiral Compounds



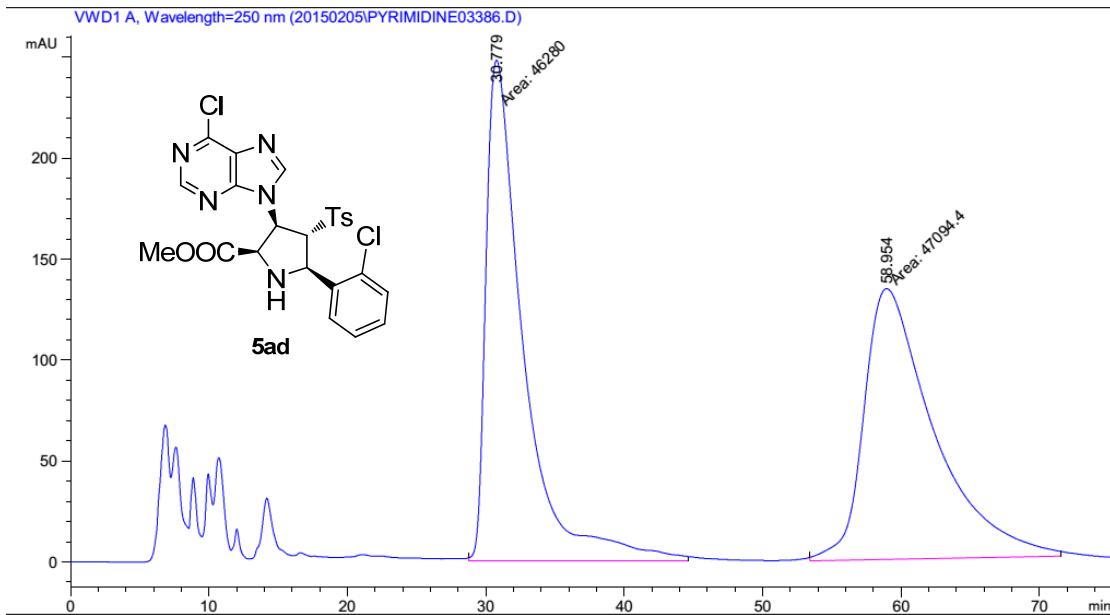
Scale up of cycloadduct 5aa



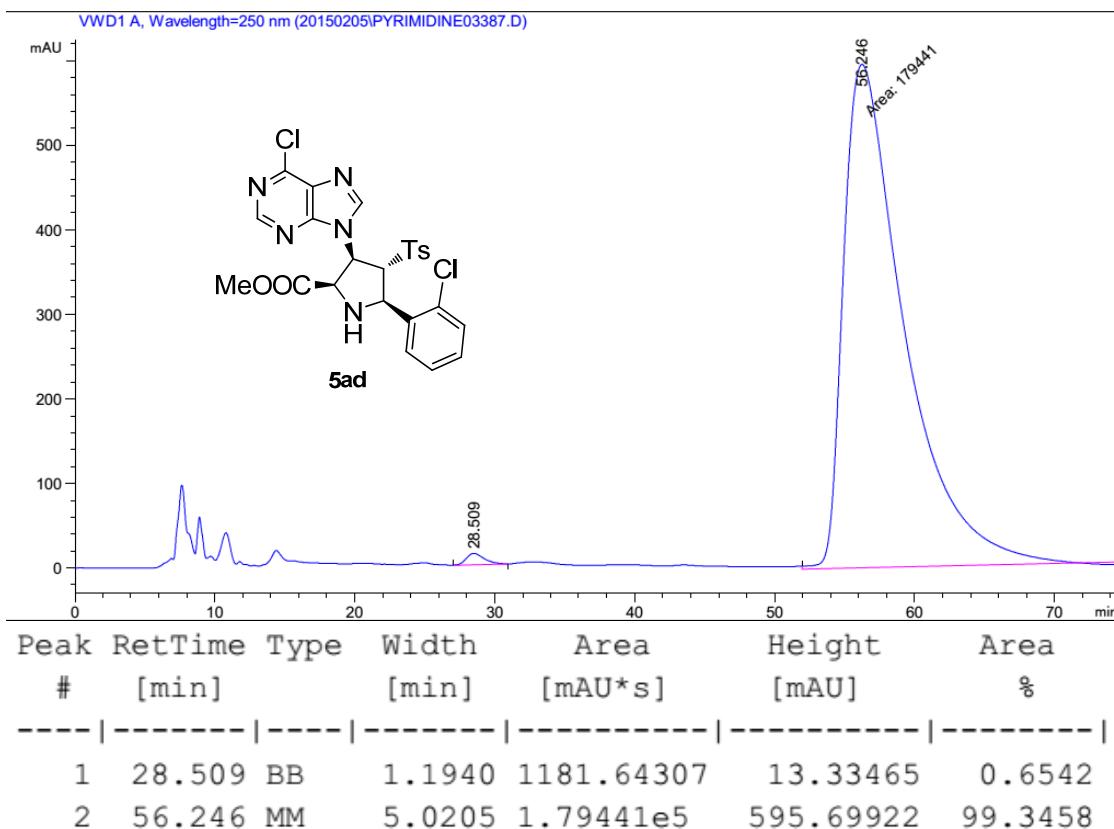


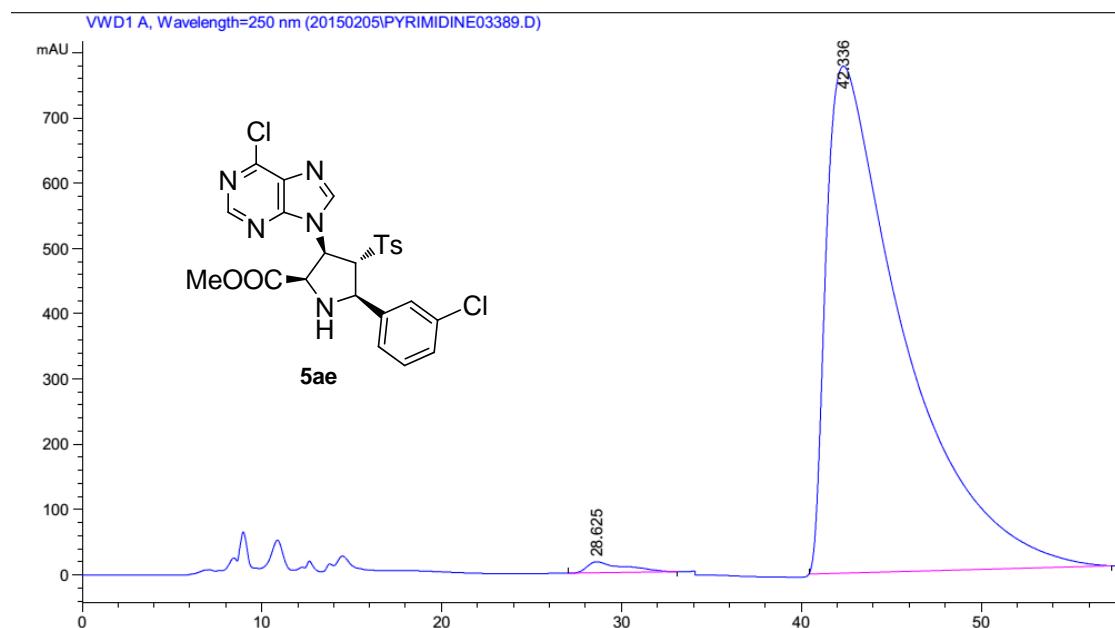
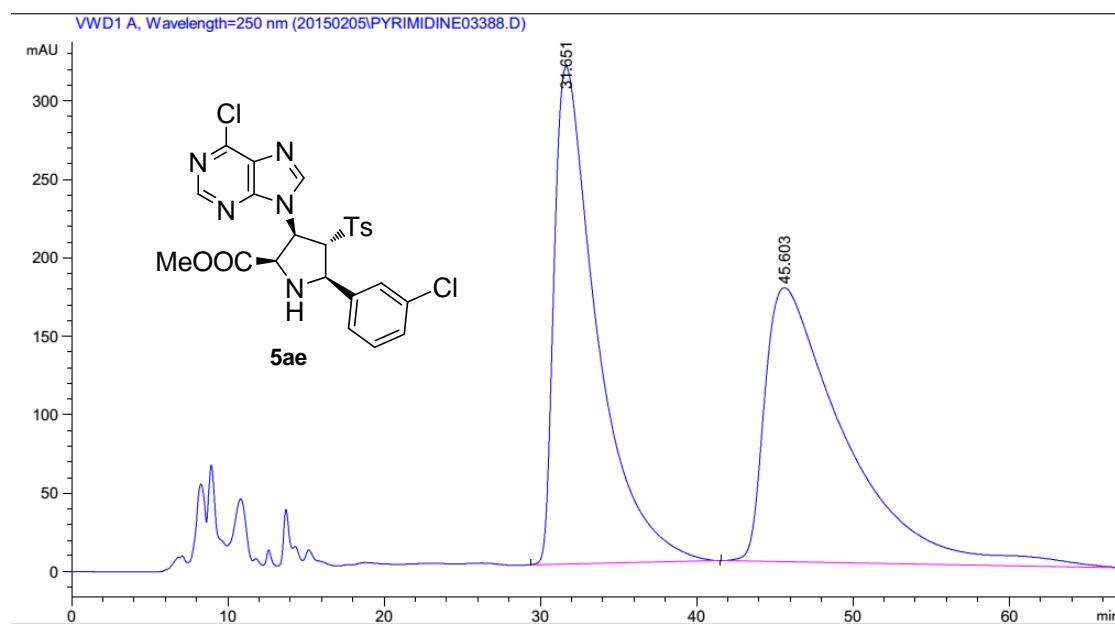


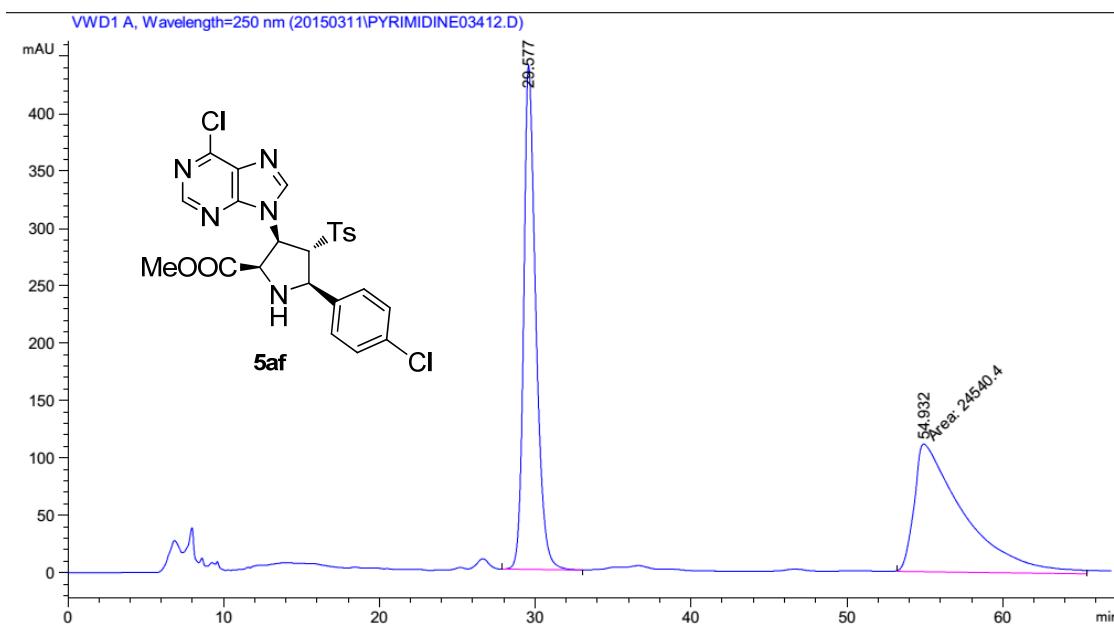
Peak	RetTime	Type	Width	Area	Height	Area %
#	[min]		[min]	[mAU*s]	[mAU]	%
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2	22.910	BBA	2.1115	2.07593e5	1414.18652	98.3058



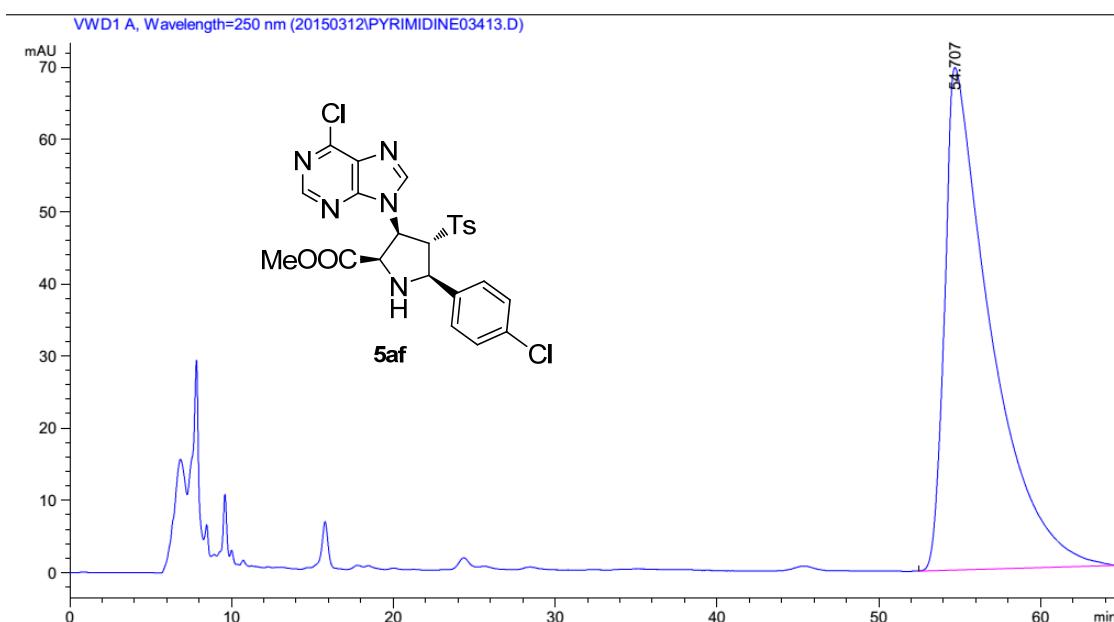
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	30.779	MM	3.1098	4.62800e4	248.03557	49.5639
2	58.954	MM	5.8528	4.70944e4	134.10724	50.4361





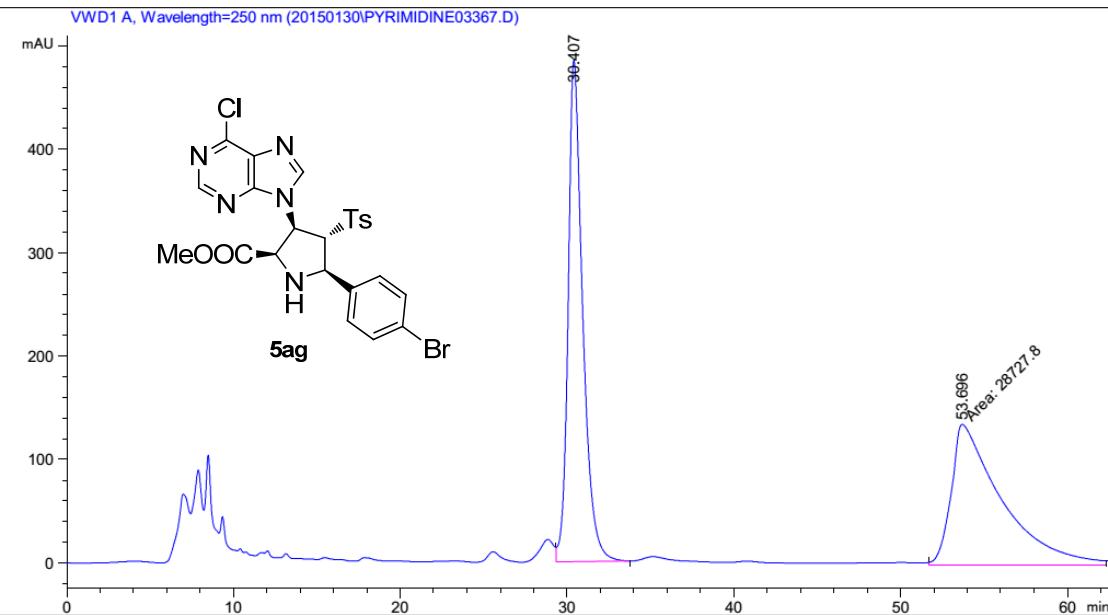


Peak	RetTime	Type	Width	Area	Height	Area
#	[min]		[min]	[mAU*s]	[mAU]	%
----- ----- ----- ----- ----- ----- -----						
1	29.577	BB	0.8030	2.38687e4	439.14648	49.3062
2	54.932	MM	3.6789	2.45404e4	111.17626	50.6938

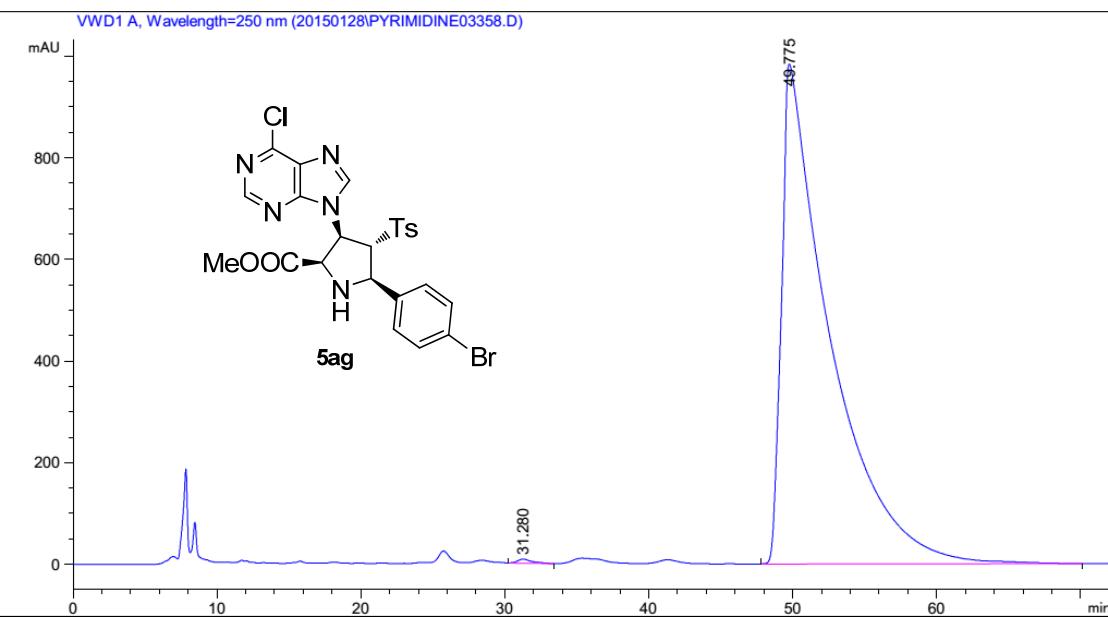


Peak	RetTime	Type	Width	Area	Height	Area
#	[min]		[min]	[mAU*s]	[mAU]	%
----- ----- ----- ----- ----- ----- -----						
1	54.707	BBA	2.5140	1.37233e4	69.61293	100.0000

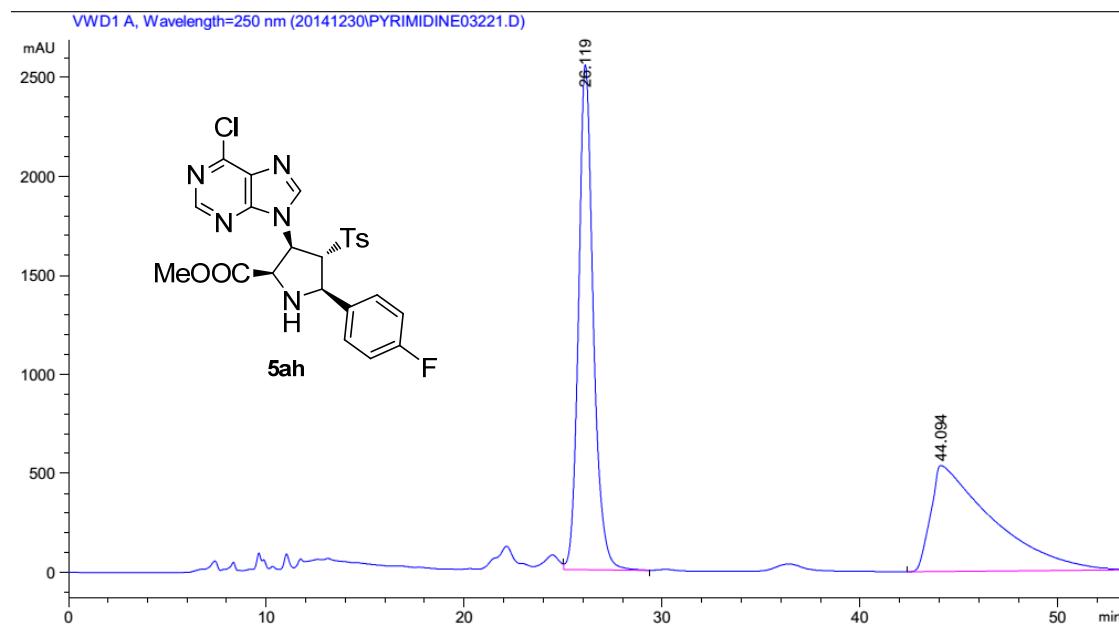
Totals : 1.37233e4 69.61293



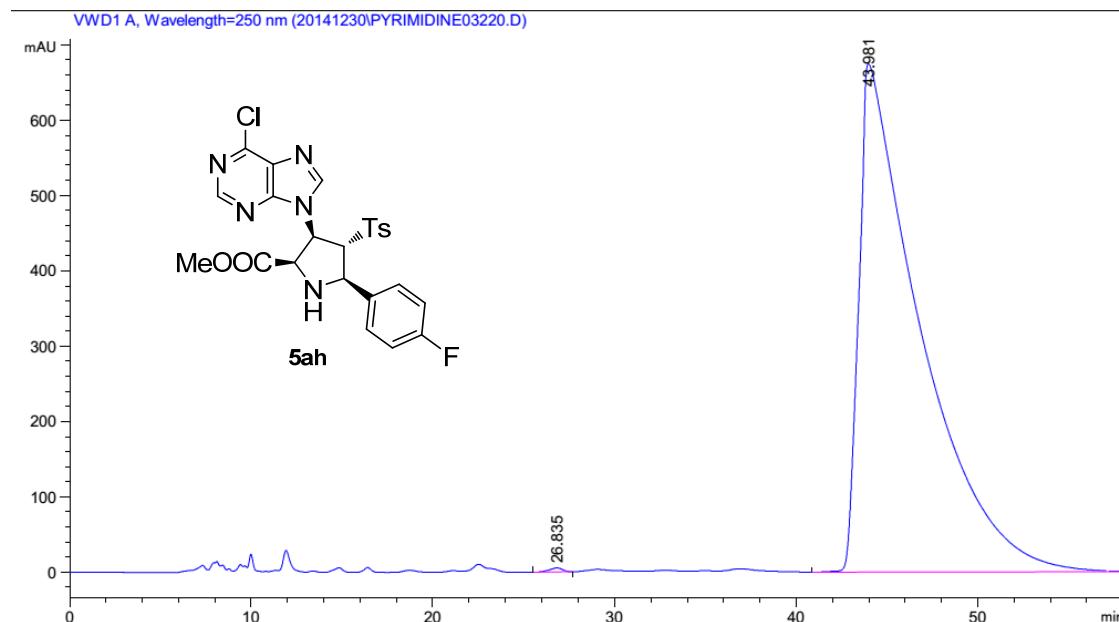
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1	30.407	VB	0.8836	2.94109e4	485.03812	50.5874
2	53.696	MM	3.5087	2.87278e4	136.46175	49.4126



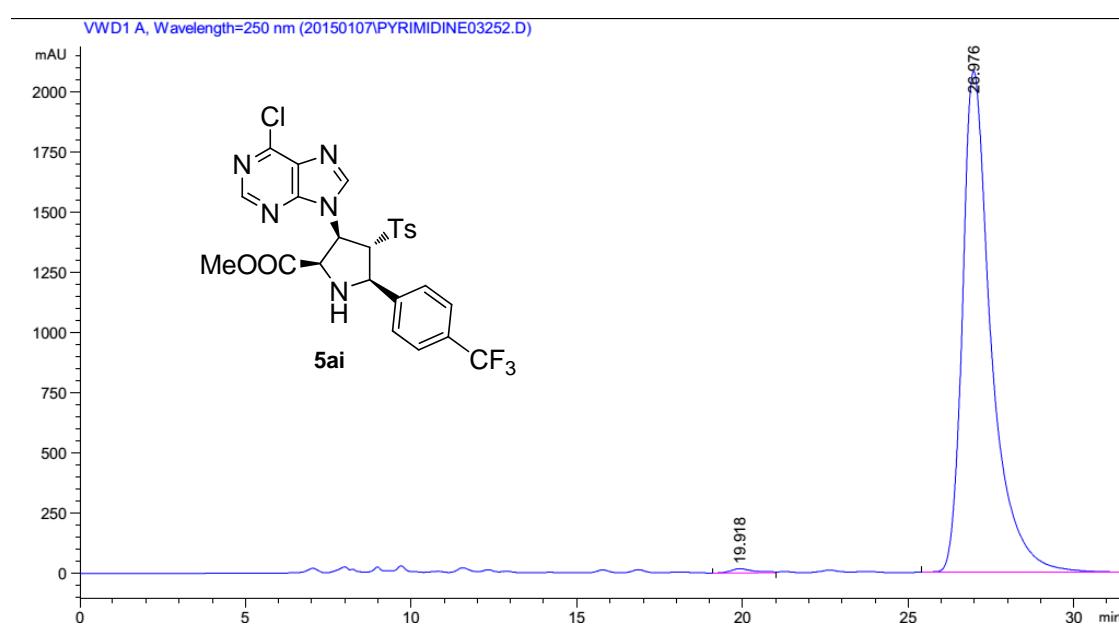
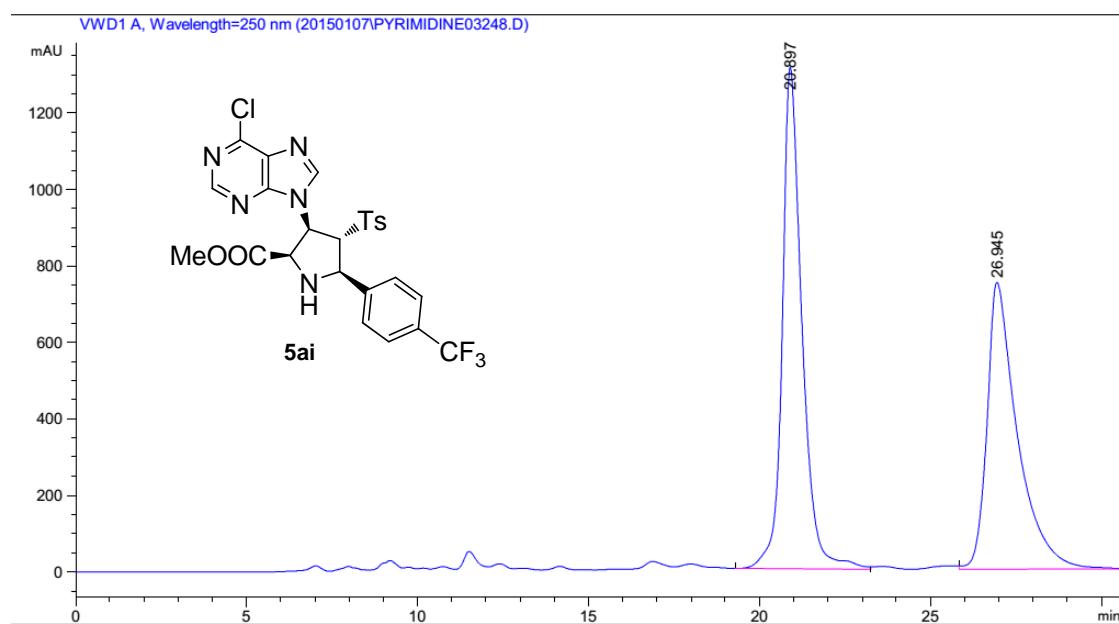
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	31.280	BB	0.9744	541.03845	7.85094	0.2364
2	49.775	BB	2.9349	2.28348e5	983.85114	99.7636

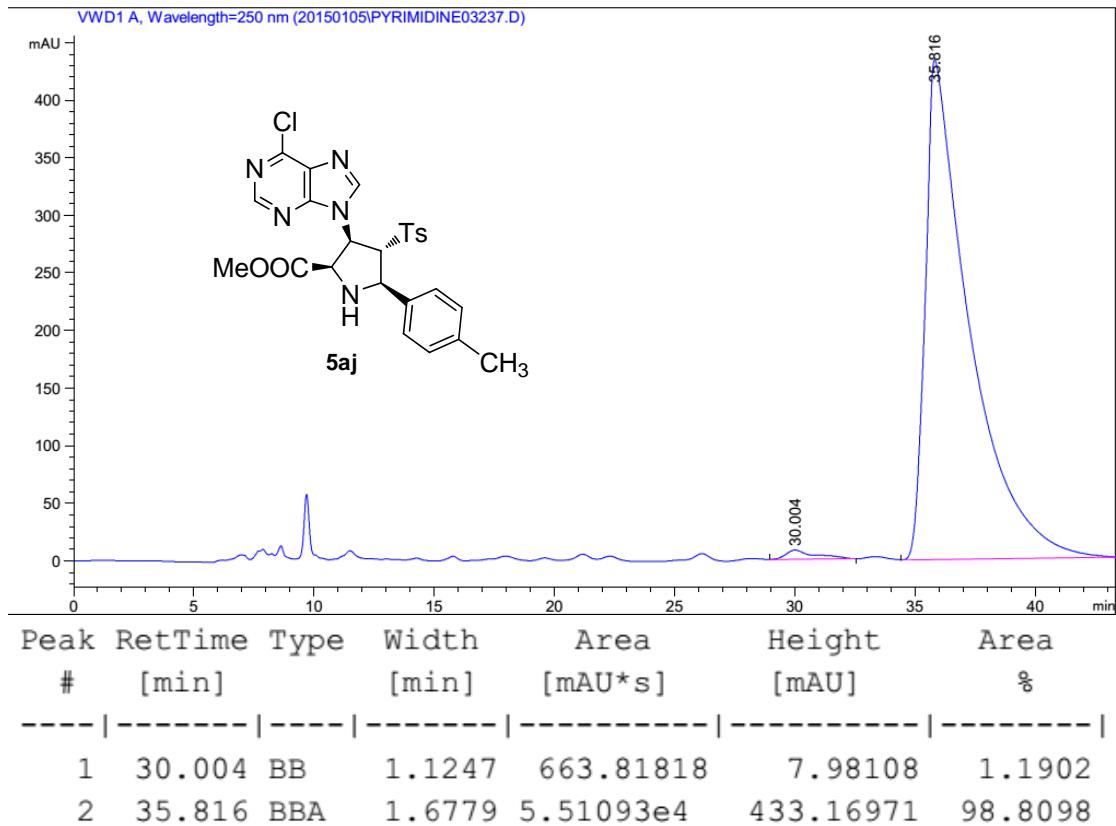
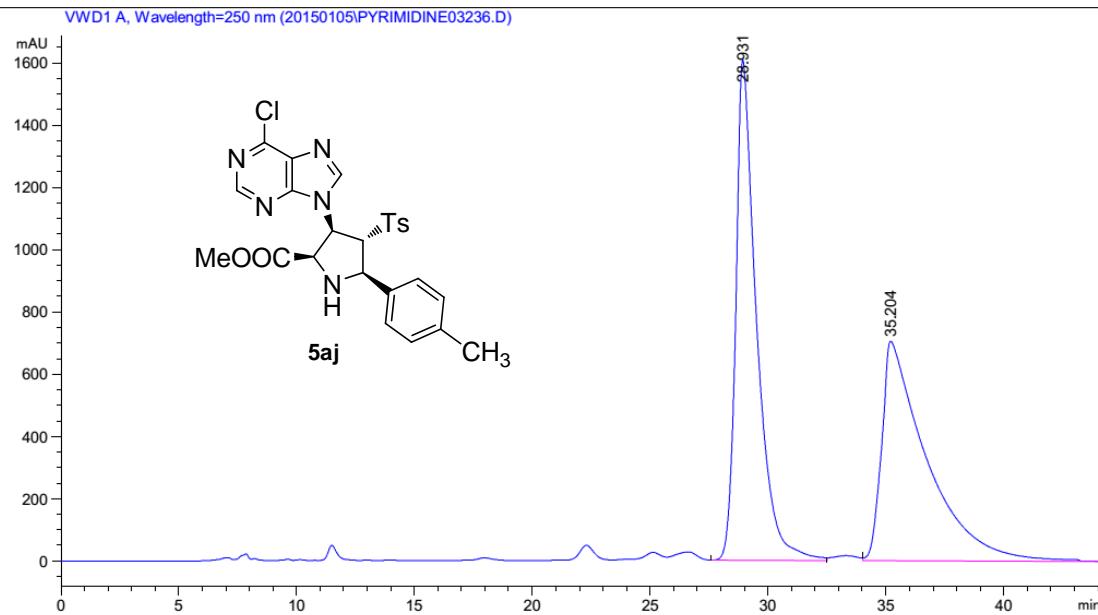


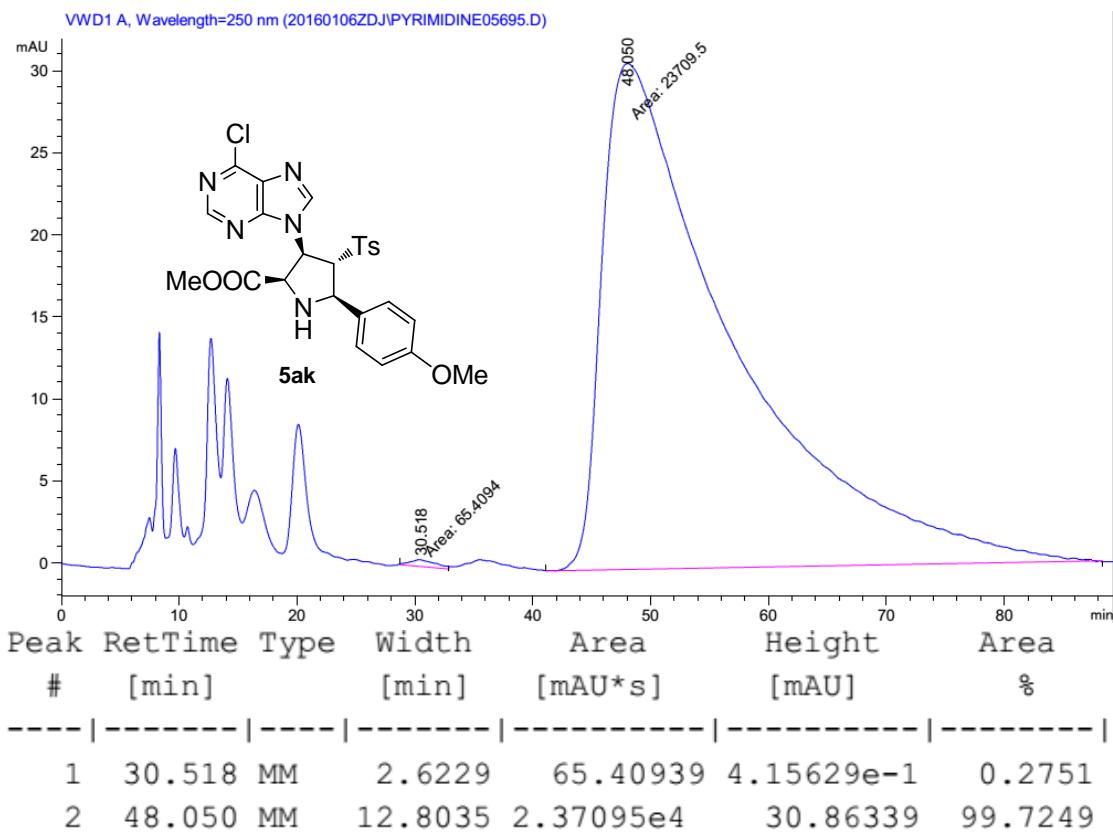
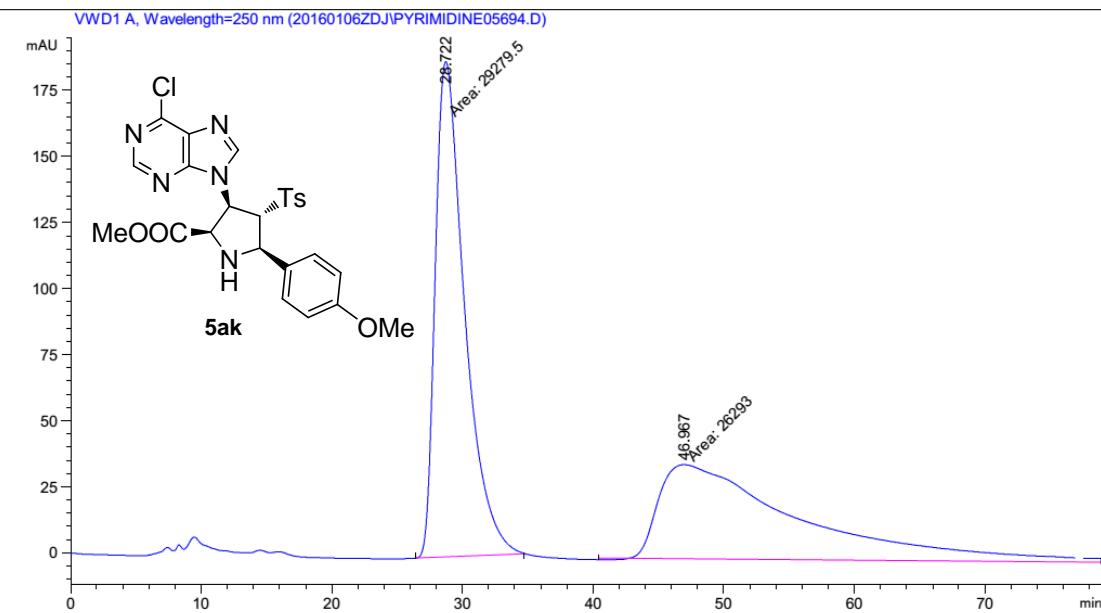
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	26.119	VB	0.7749	1.32179e5	2550.98853	53.3593
2	44.094	BBA	2.7120	1.15536e5	534.62323	46.6407

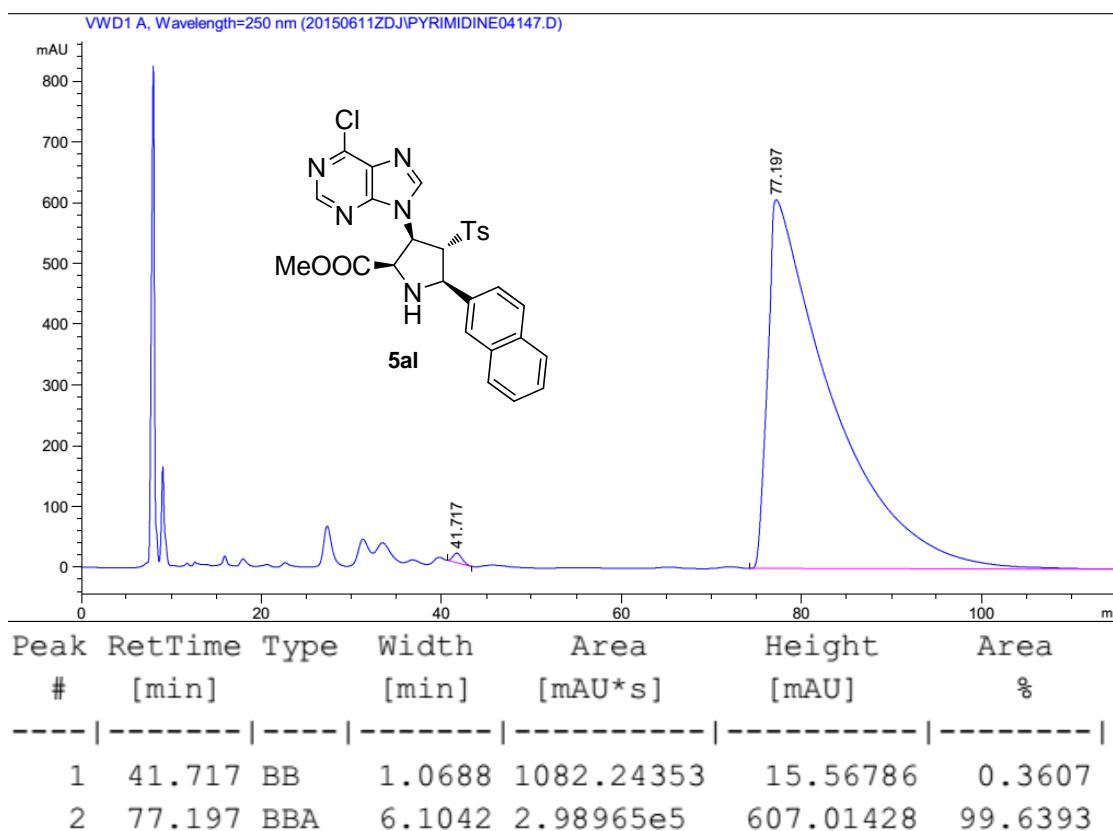
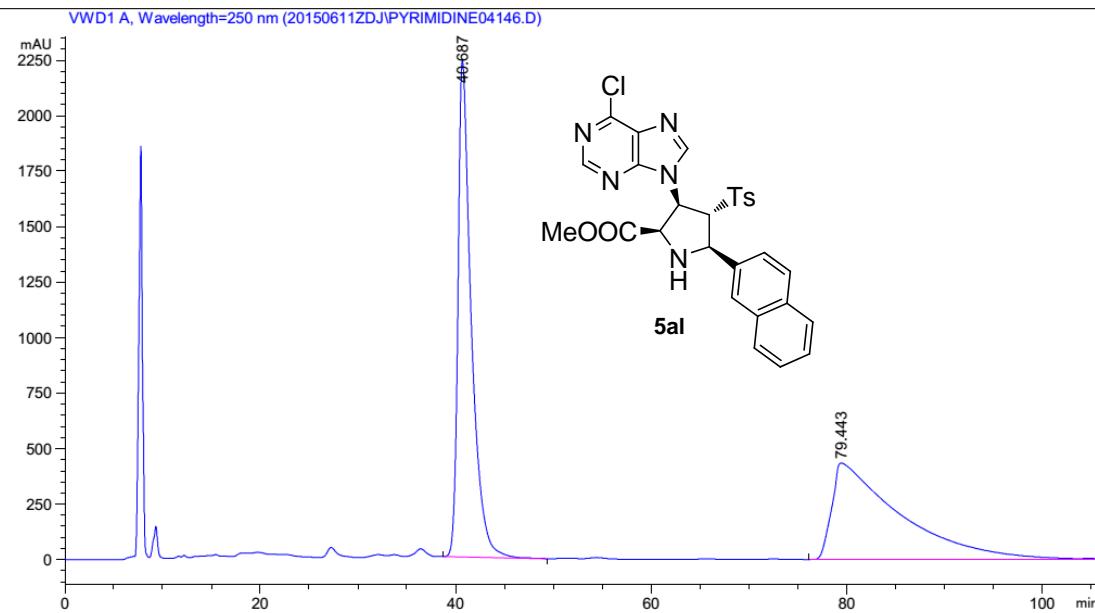


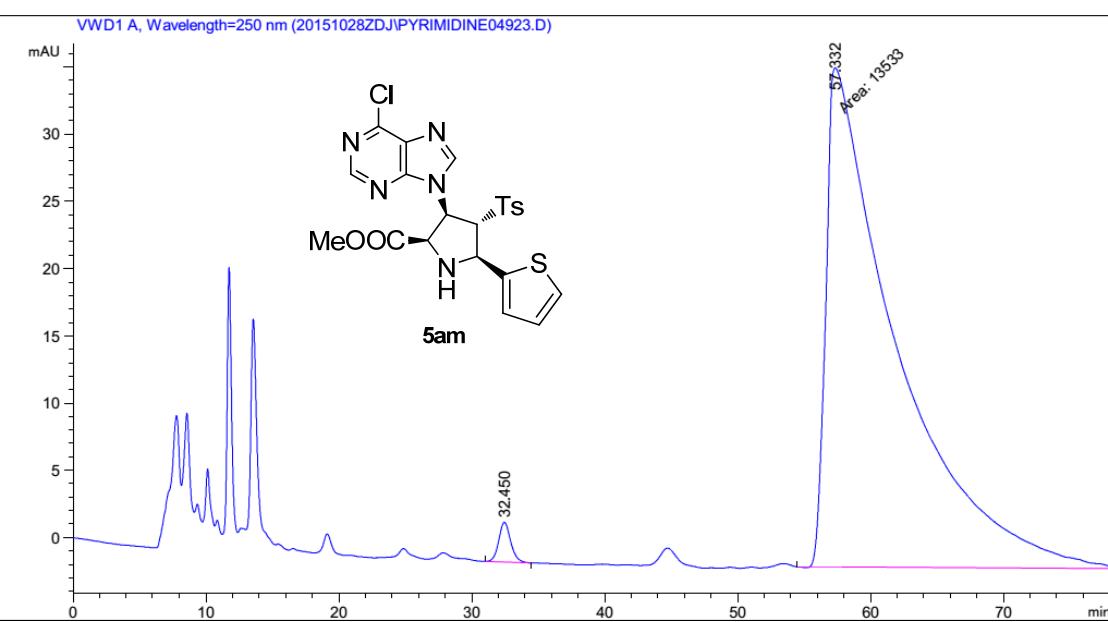
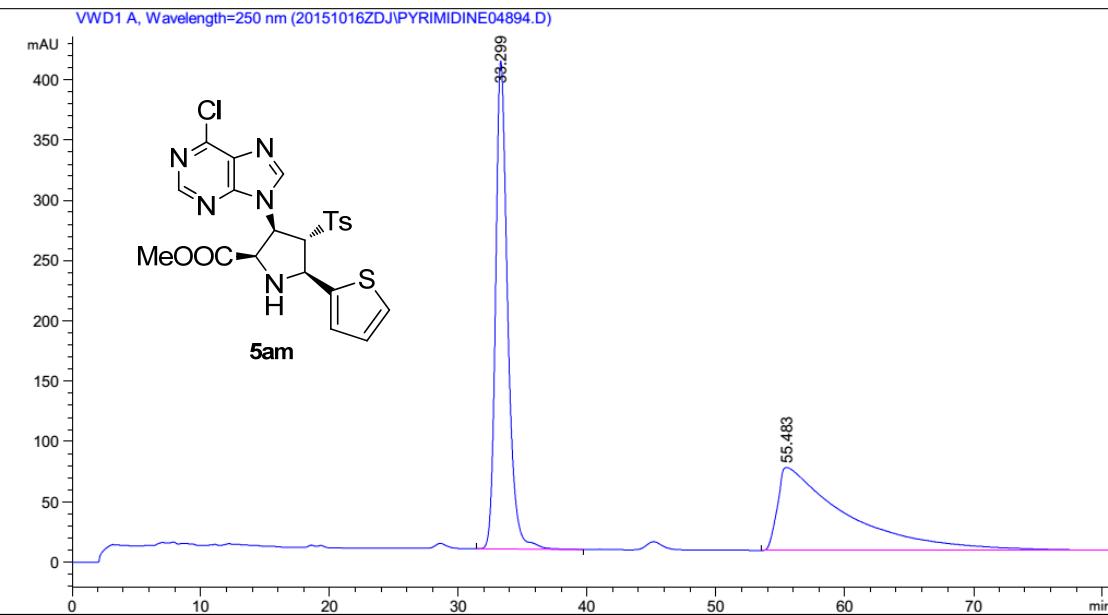
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	26.835	BB	0.7510	281.51147	5.45122	0.1783
2	43.981	BBA	2.9443	1.57604e5	674.53168	99.8217

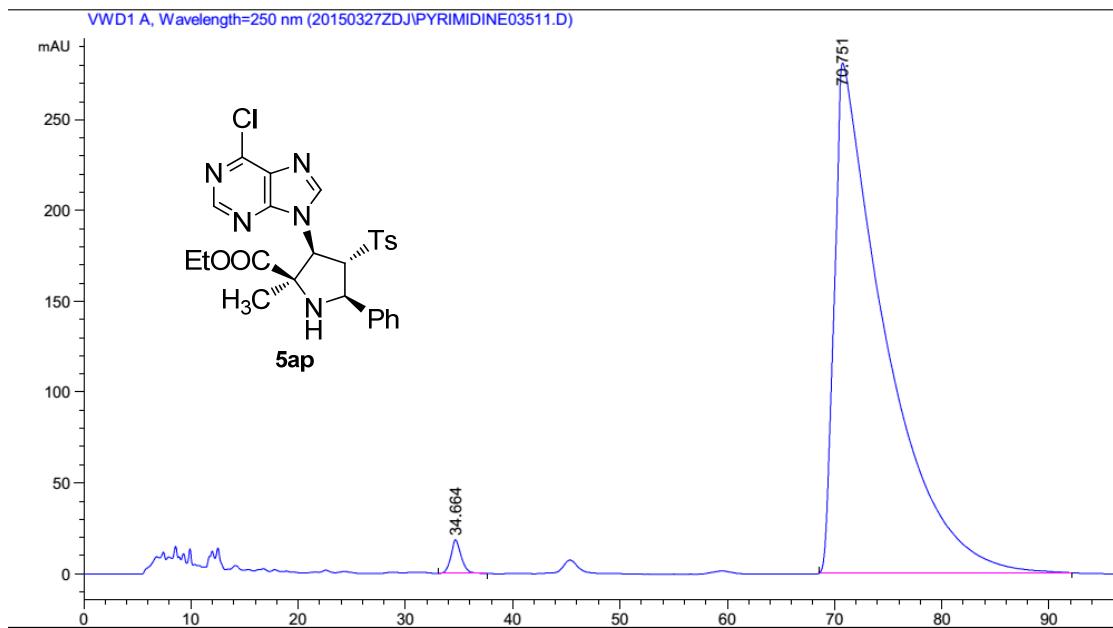
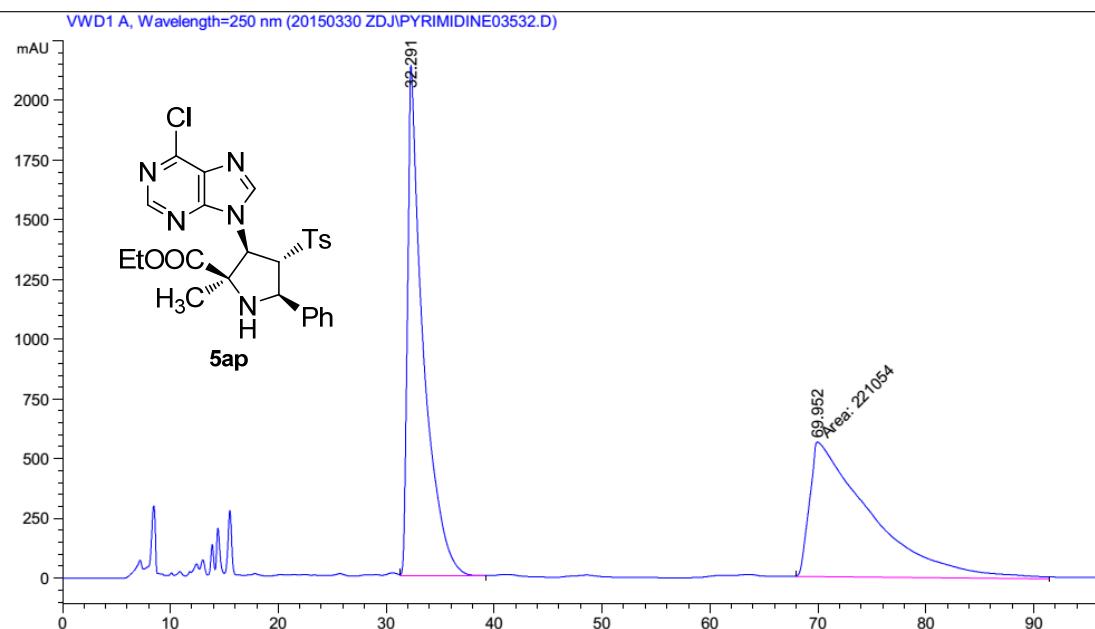


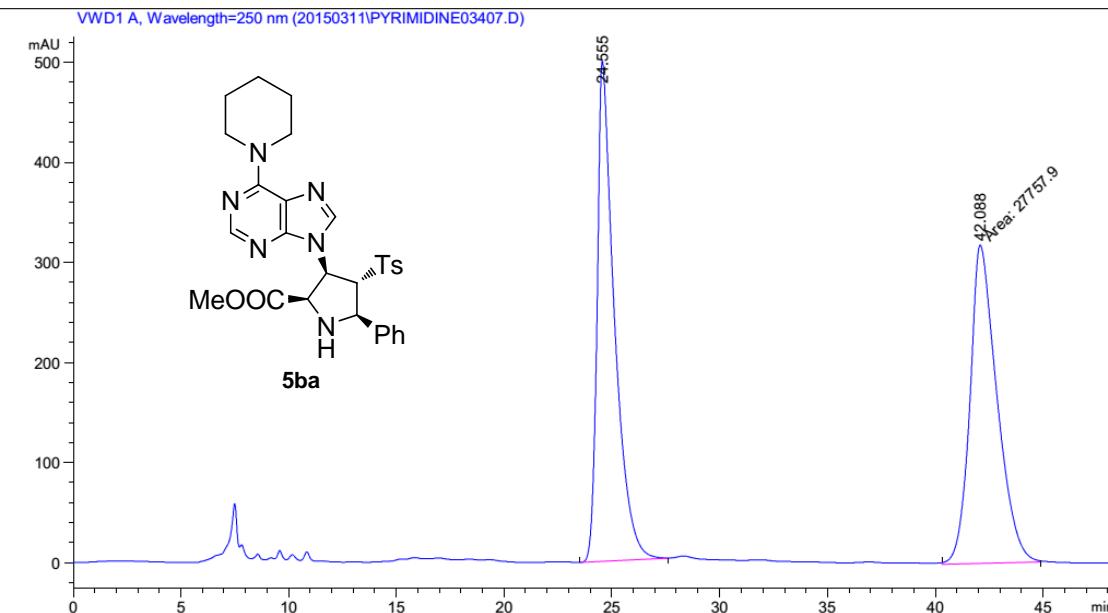




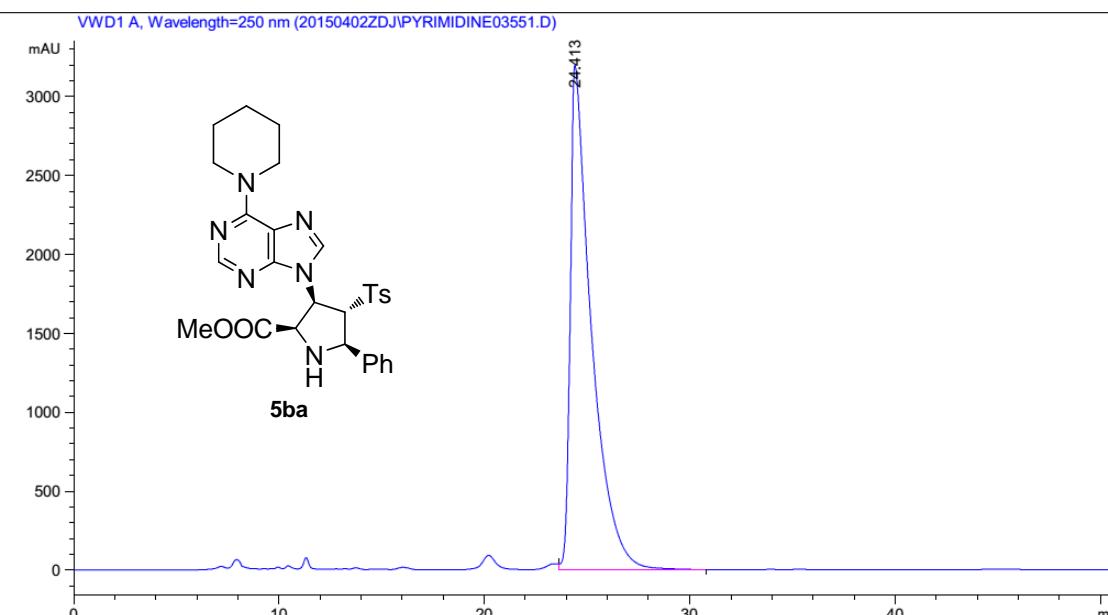






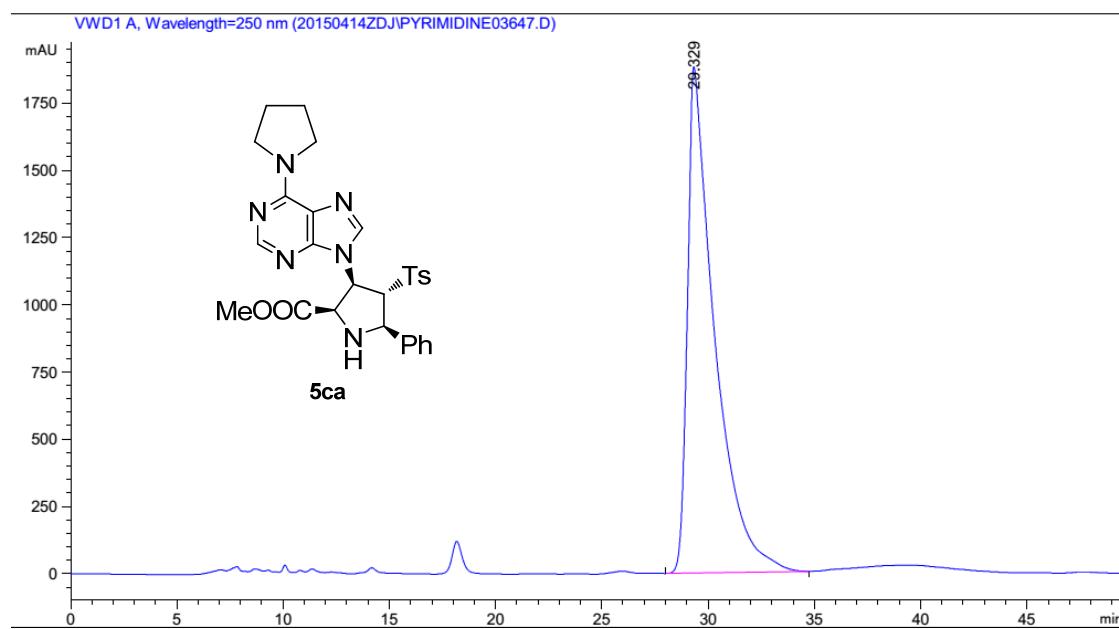
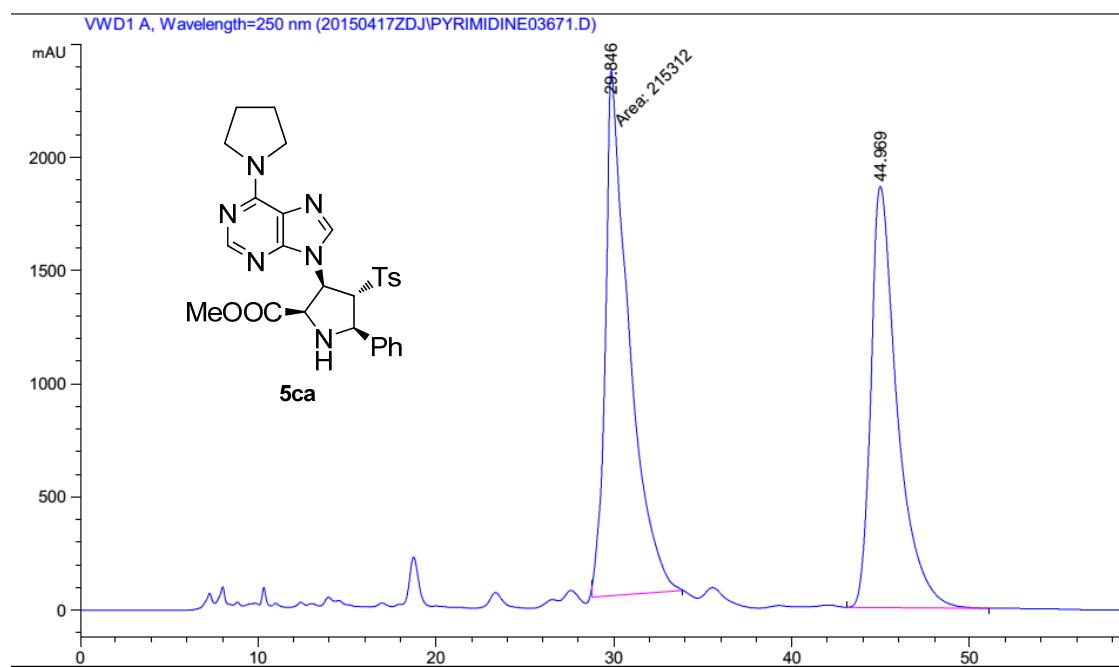


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	24.555	BB	0.7774	2.77021e4	500.03015	49.9497
2	42.088	MM	1.4536	2.77579e4	318.26947	50.0503

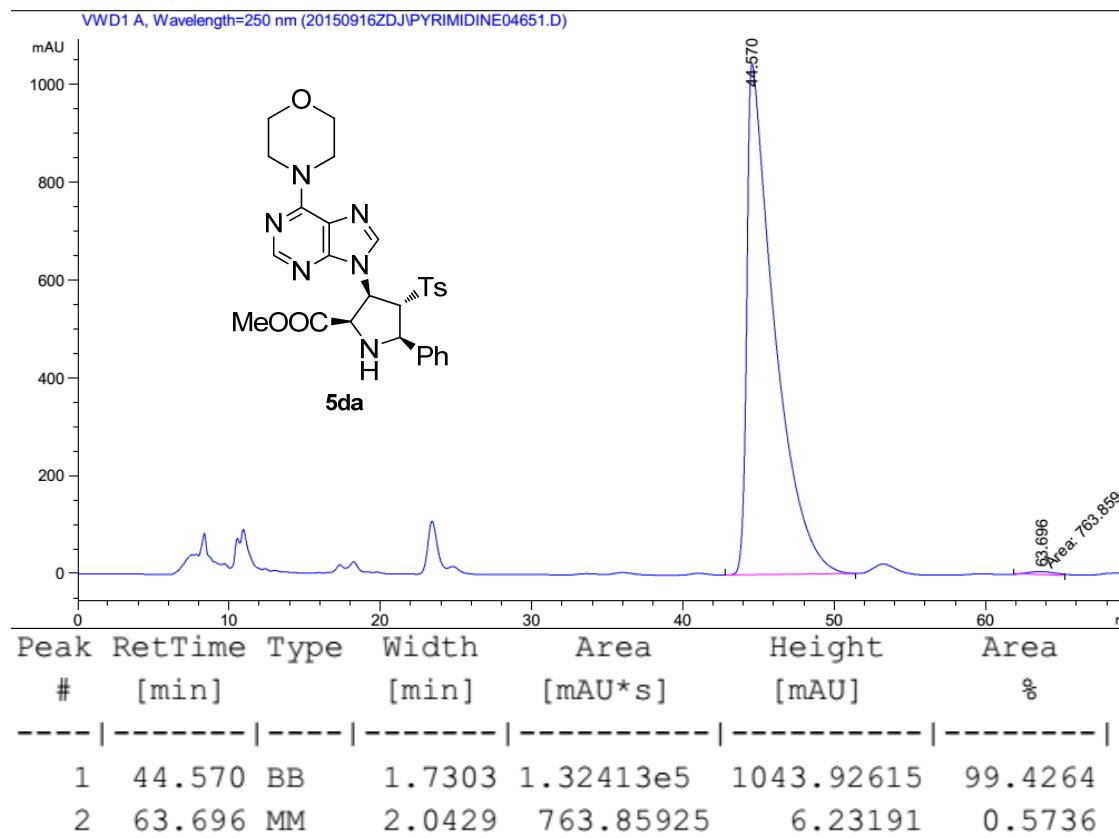
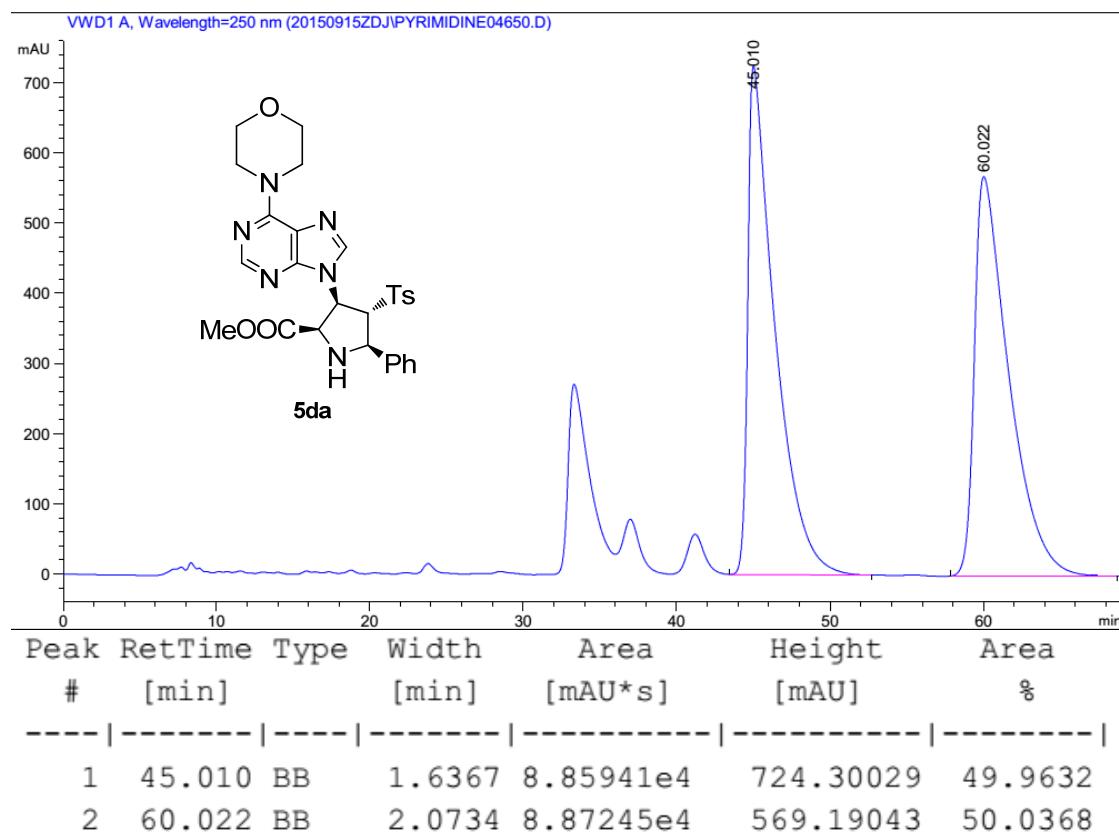


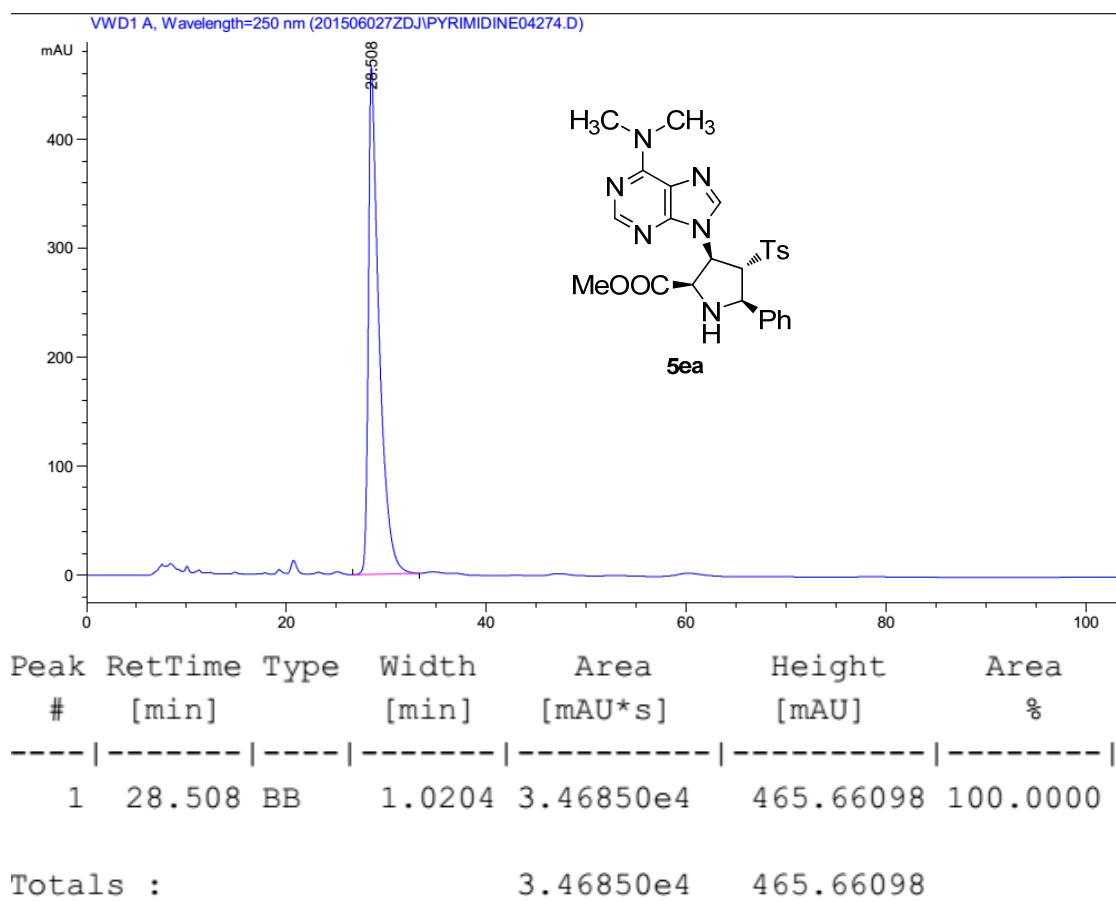
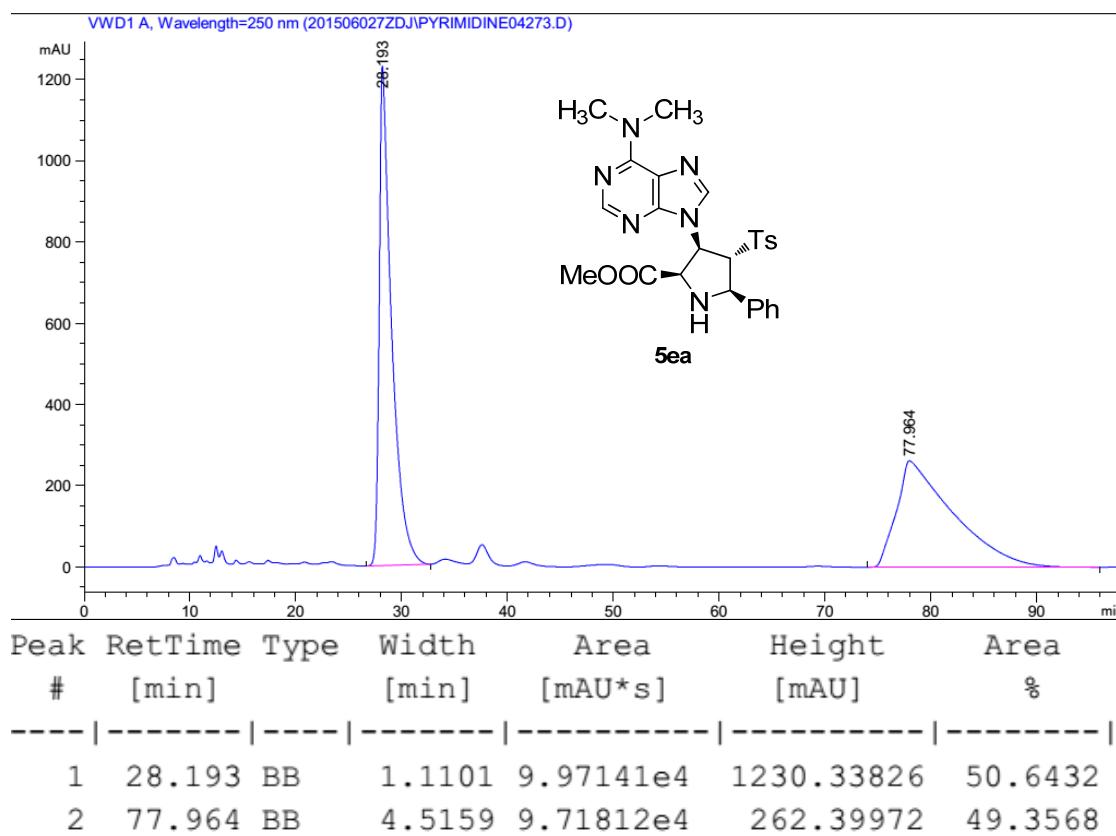
Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	24.413	VB	0.9728	2.27938e5	3197.83081	100.0000

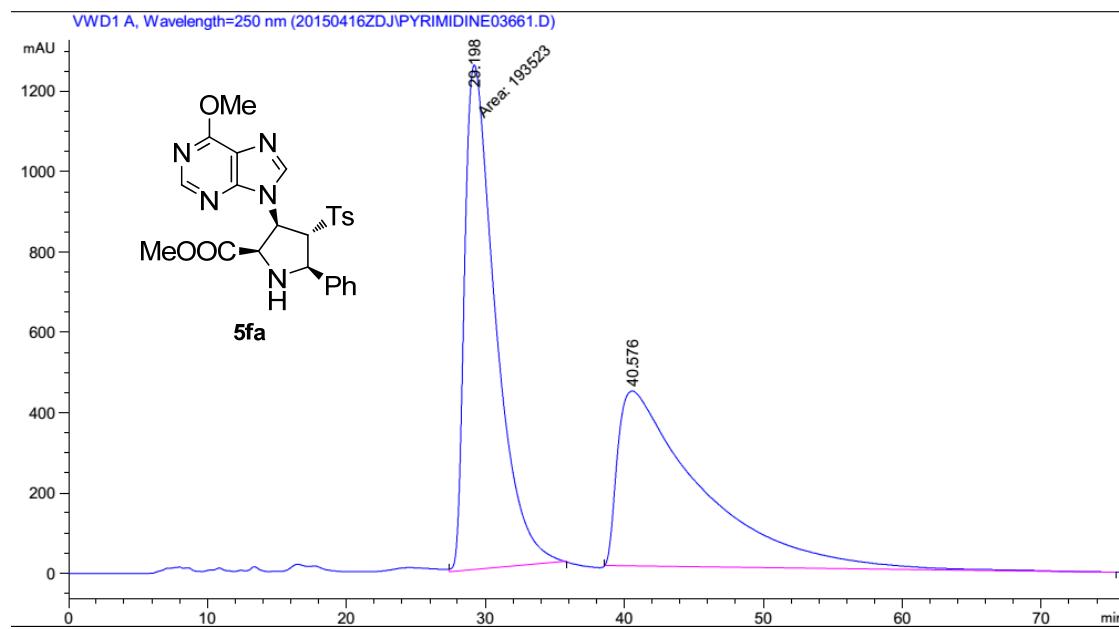
Totals : 2.27938e5 3197.83081



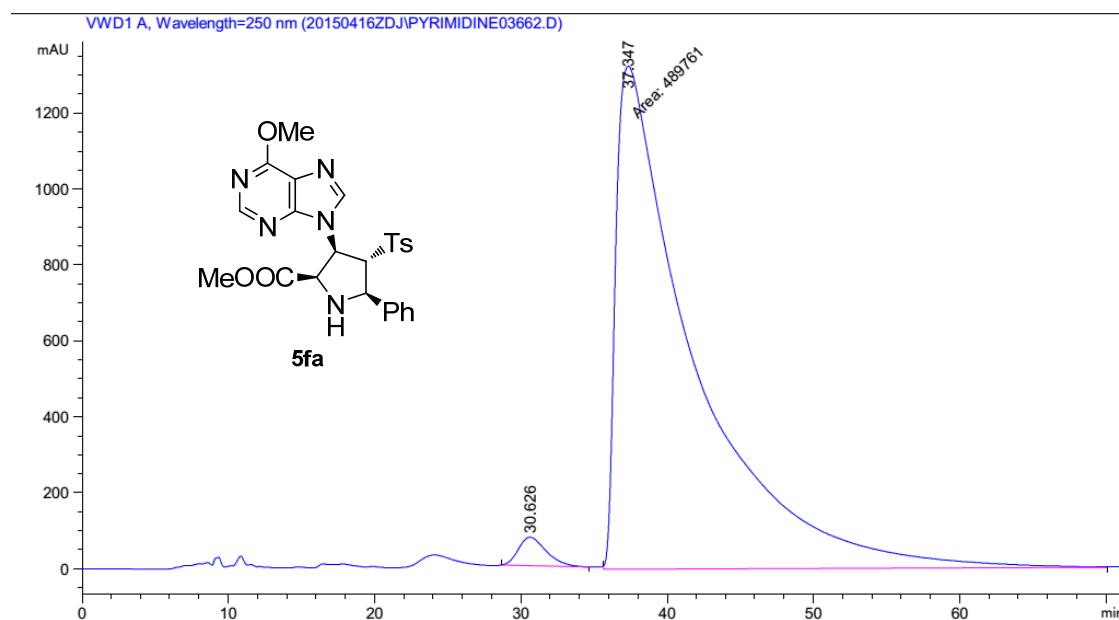
Totals : 1.67035e5 1881.28284



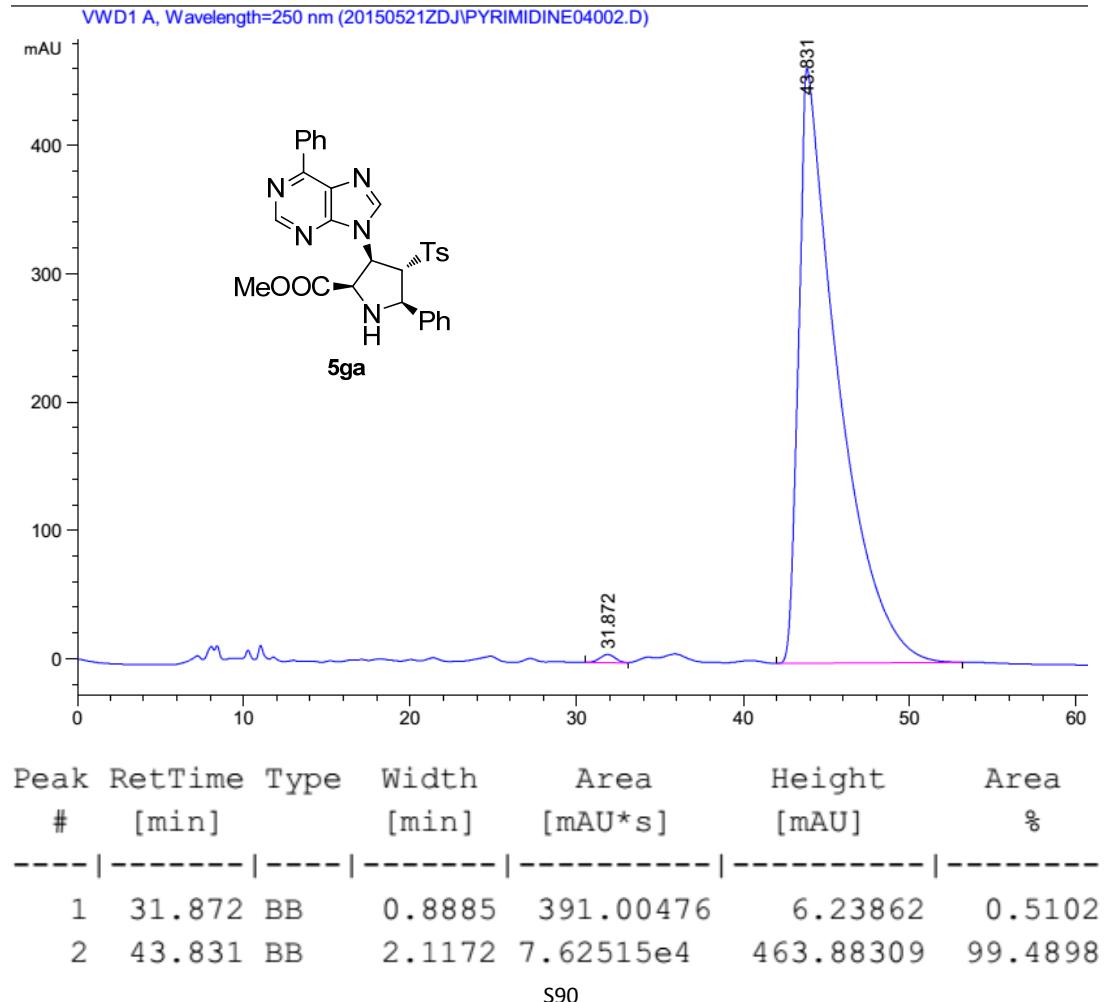
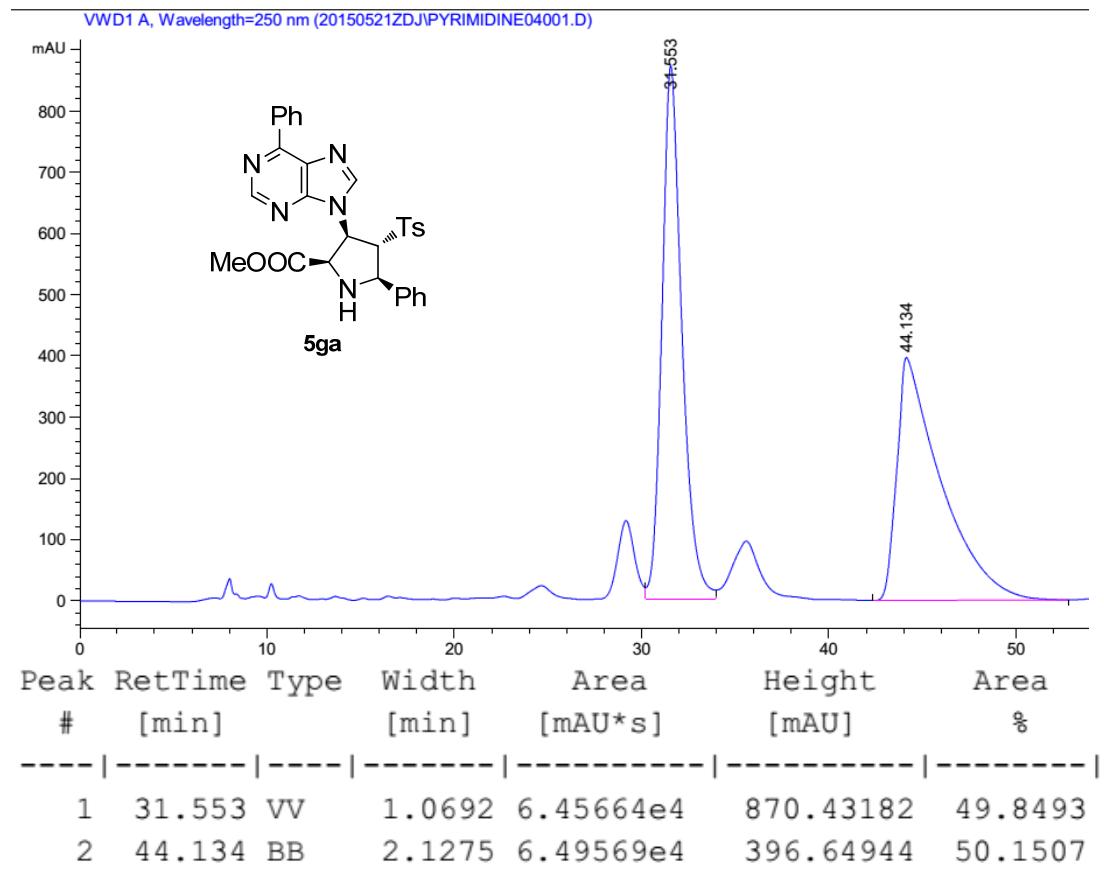


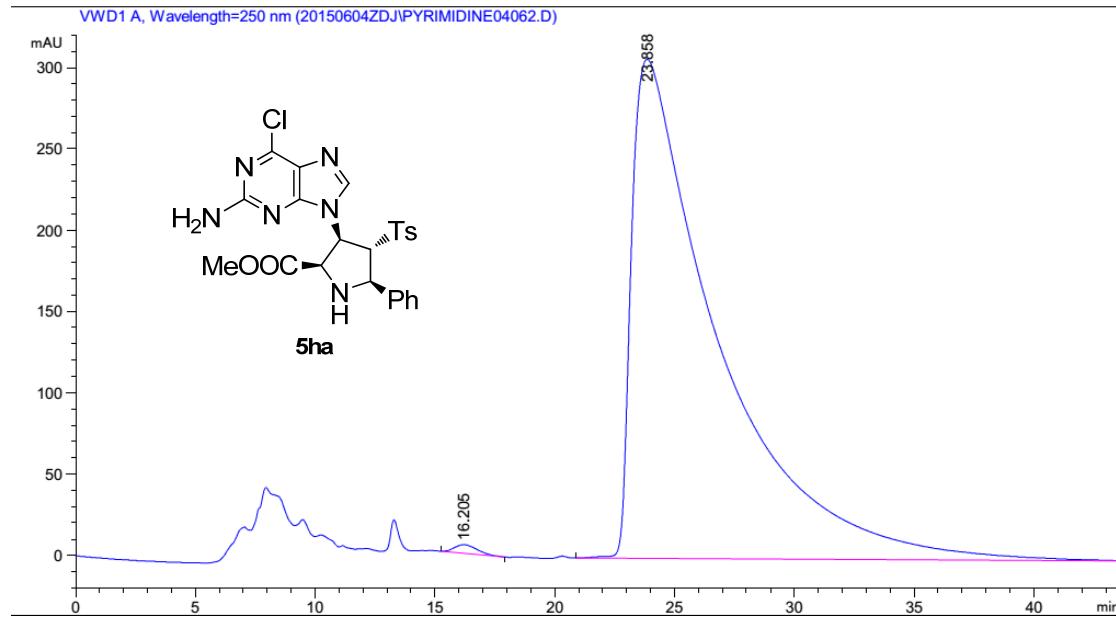
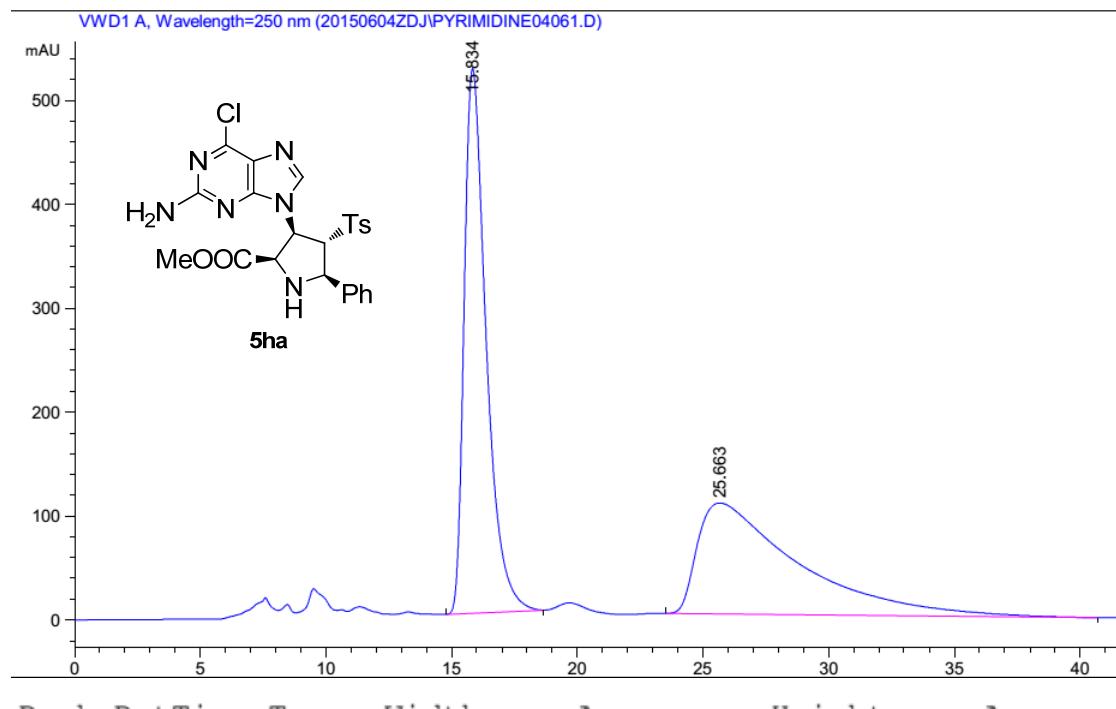


Peak	RetTime	Type	Width	Area	Height	Area
#	[min]		[min]	[mAU*s]	[mAU]	%
----- ----- ----- ----- ----- ----- -----						
1	29.198	MM	2.5678	1.93522e5	1256.07385	51.5227
2	40.576	BBA	5.1675	1.82084e5	435.38025	48.4773

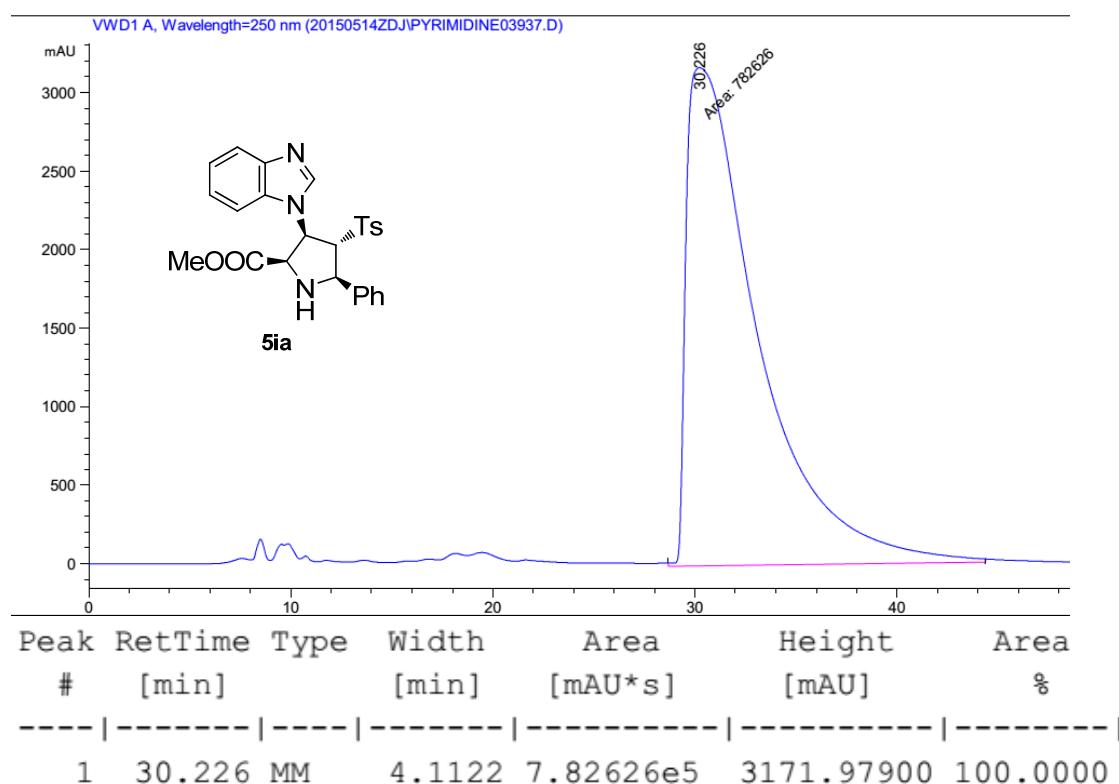
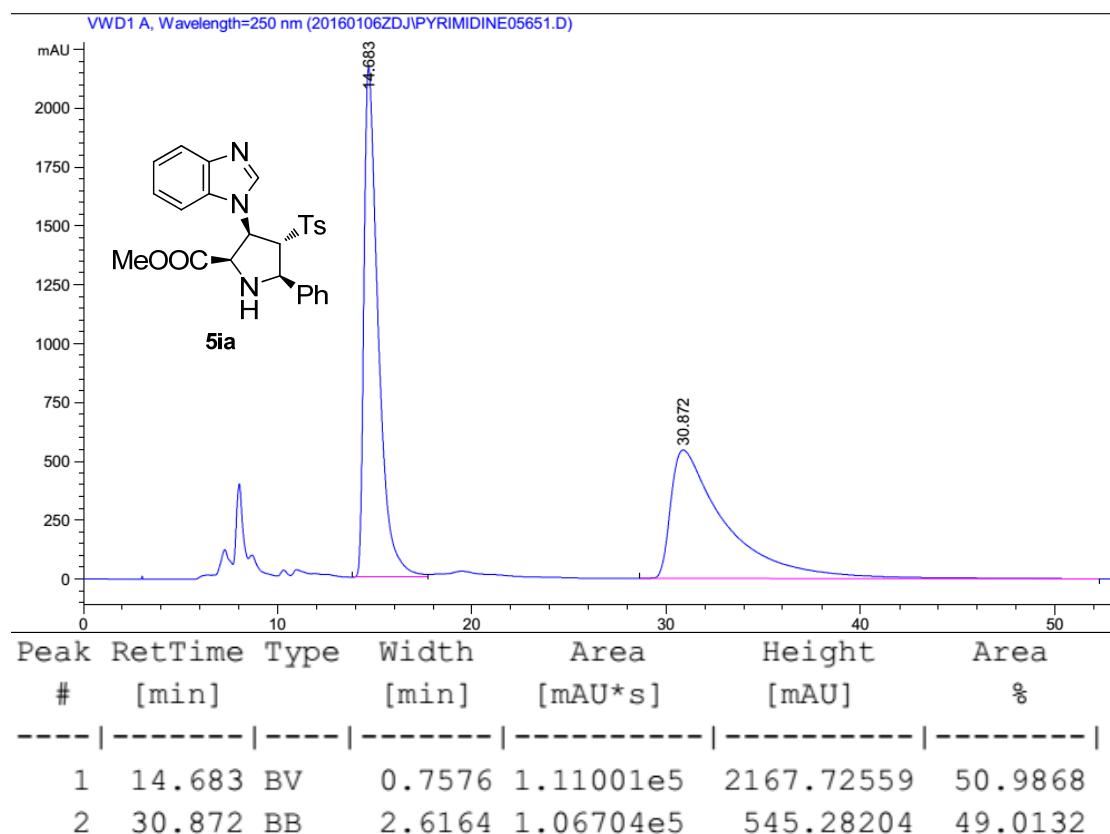


Peak	RetTime	Type	Width	Area	Height	Area
#	[min]		[min]	[mAU*s]	[mAU]	%
----- ----- ----- ----- ----- ----- -----						
1	30.626	BB	1.7961	9816.48926	74.65852	1.9650
2	37.347	MM	6.1619	4.89761e5	1324.71216	98.0350

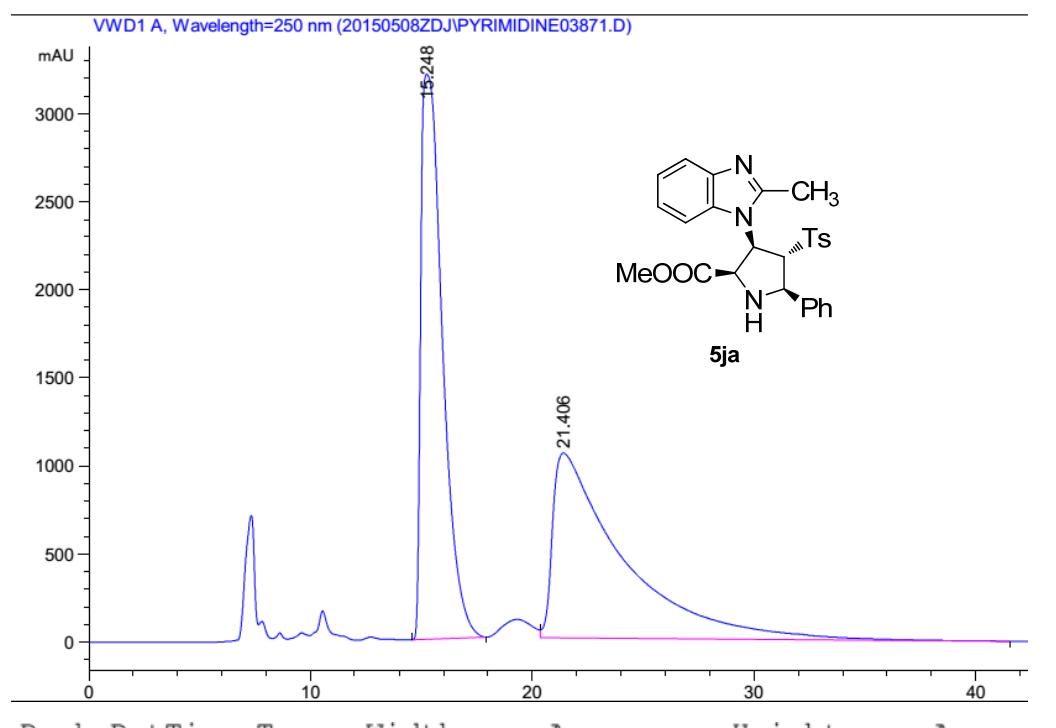




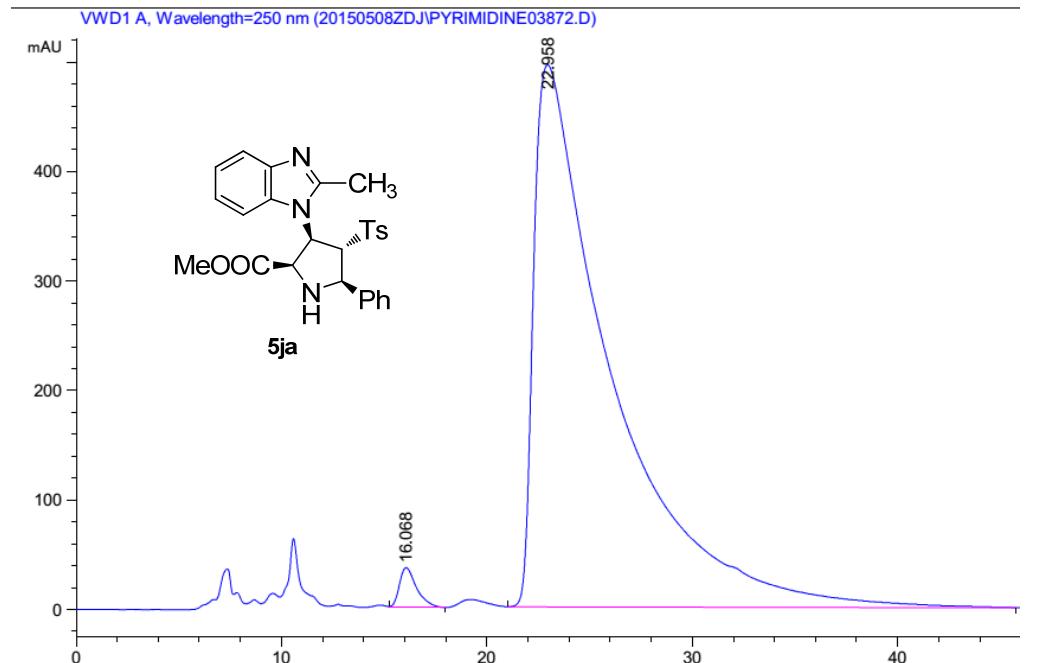
Peak	RetTime	Type	Width	Area	Height	Area
#	[min]		[min]	[mAU*s]	[mAU]	%
----- ----- ----- ----- ----- -----						
1	16.205	BB	0.9459	345.38071	5.26505	0.4472
2	23.858	BBA	3.3192	7.68822e4	306.99438	99.5528



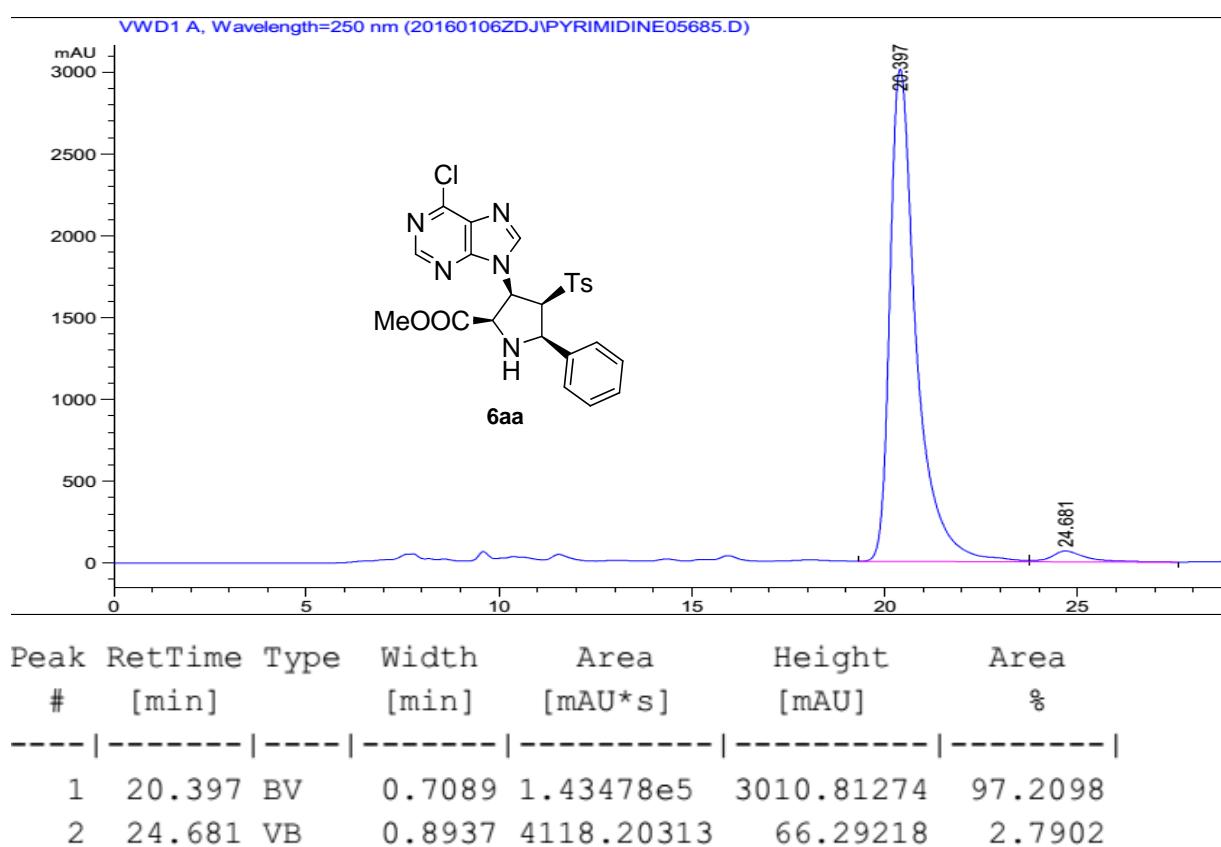
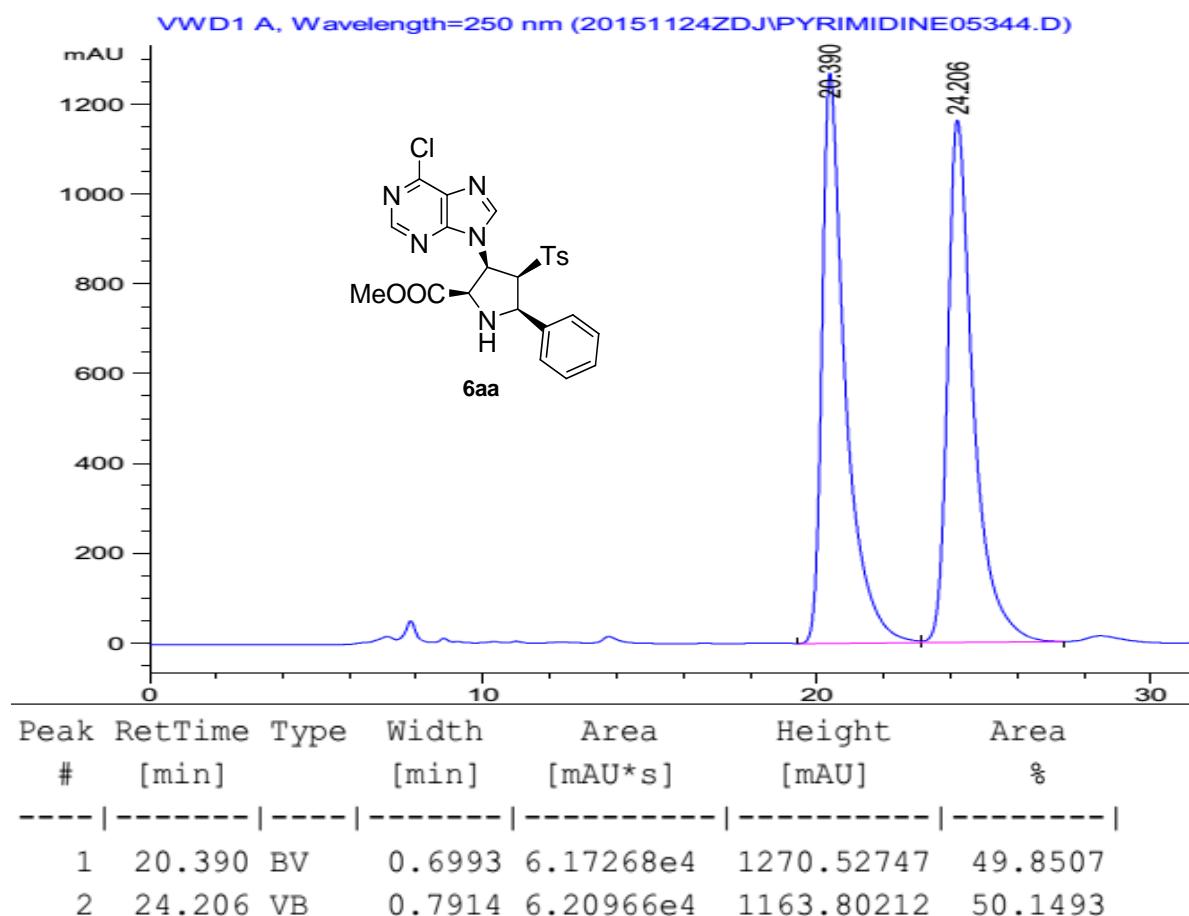
Totals : 7.82626e5 3171.97900

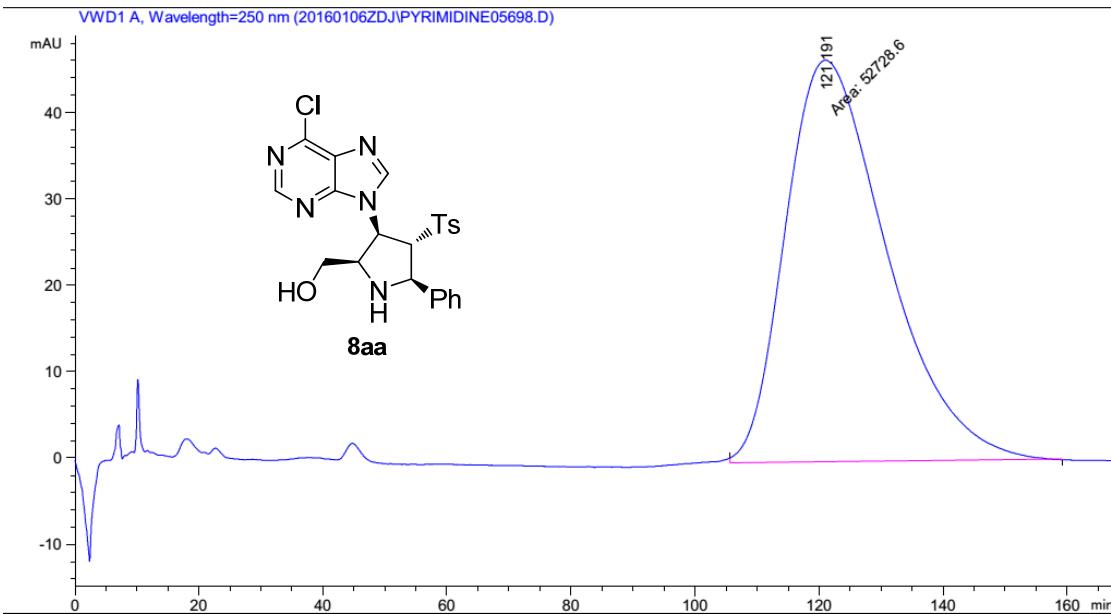
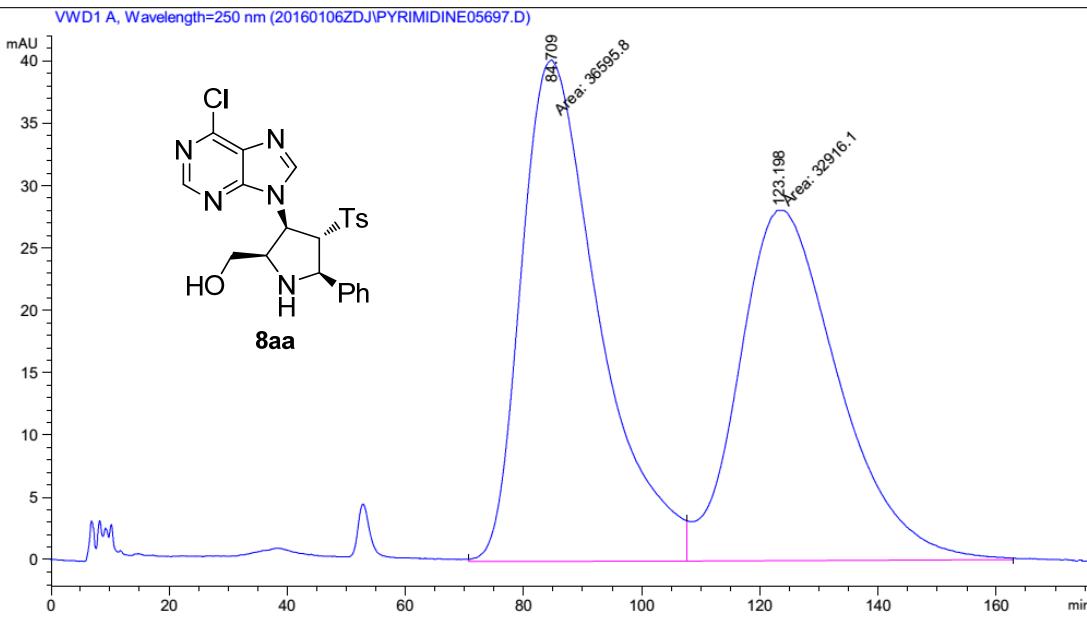


Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	15.248	BB	0.8025	2.17431e5	3207.59717	48.5039
2	21.406	VB	2.8710	2.30844e5	1048.68042	51.4961



Peak #	RetTime [min]	Type	Width [min]	Area [mAU*s]	Height [mAU]	Area %
1	16.068	VB	0.8680	2125.13843	36.45349	1.6179
2	22.958	BB	3.4438	1.29228e5	495.15305	98.3821





Totals : 5.27286e4 46.46641