

Supporting Information

Modular synthesis of sulfilimines via NFSI-mediated S-arylation of sulfenamides with naphthols, phenols and indoles

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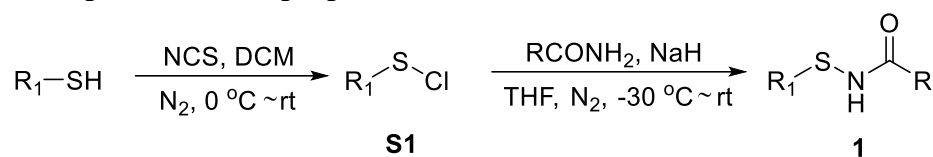
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(A) General information

Commercially available reagents were used directly without further purification. For others, we prepared them in suitable reaction conditions. NMR spectra were recorded on a Bruker ADVANCE III 400MHz spectrometer (^1H NMR: 400 MHz, ^{13}C NMR: 100 MHz). Chemical shifts (δ) were reported in ppm relative to CDCl_3 (δ 7.26) for the ^1H NMR and to CDCl_3 (δ 77.16) for the ^{13}C NMR measurements. High-resolution mass spectral (HRMS) analysis data was measured on a Bruker impact II (Q-TOF) mass spectrum by means of the ESI technique and a Fourier Transform Ion Cyclotron (SolariX 7.0T). Melting points were tested in an X-4A apparatus without correcting temperature. Flash column chromatography was performed on 300-400 mesh silica gel from Qingdao Haiyang Chemical Co., Ltd. Reactions were monitored by thin-layer chromatography (TLC) using 254 nm UV light to visualize the progress of the reactions. The single crystal X-ray diffraction study was performed on Bruker D8 Venture. Melting points were tested in an X-4A apparatus without correcting temperature.

(B) General procedure for preparation of sulfenamides **1**^[1]

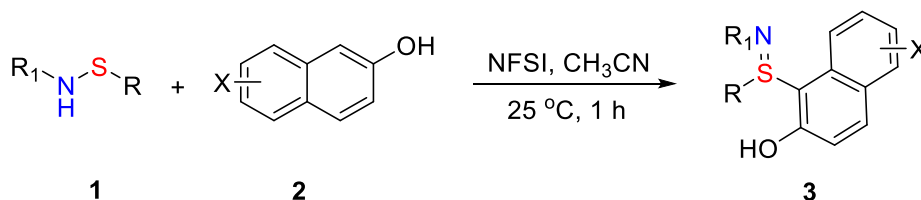


Step **a**: In a 50 mL reaction flask, N-chlorosuccinimide (1.5 equiv.) was dissolved in dichloromethane (0.3 M) under a nitrogen atmosphere. Then thiol (1.5 equiv.) was slowly added and the reaction mixture was stirred at 0 °C. Then the resulting mixture was stirred room temperature for 3 h. The reaction solution was concentrated under reduced pressure. The concentrated mixture was washed with *n*-hexane (10 mL), filtered, and concentrated to afford the crude sulfenyl chloride **S1**, which was used directly in the next step.

Step **b**: NaH (3 equiv., 60% in mineral oil) was added to the solution of amide (1 equiv.) in dry THF (0.3 M) and stirred at room temperature for 1 hour to afford the corresponding sodium salt. Then the crude sulfenyl chloride **S1** was added dropwise to the sodium salt mixture at -30 °C under nitrogen. Upon completion of the addition, the reaction mixture was stirred at room temperature for 12 hours, then quenched by adding water (15 mL). The reaction mixture was extracted with ethyl acetate (3 × 10 mL), and the organic phase was washed successively with water, brine, dried over anhydrous sodium sulfate, and concentrated in vacuo. The crude residue was purified by flash column chromatography on a silica gel to give the desired sulfenamide **1**.

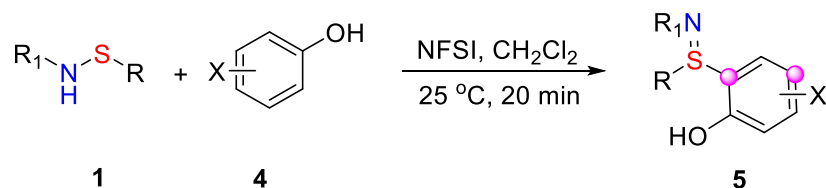
Some sulfenamides **1** have previously been reported in literatures.^[1]

(C) General procedure for preparation of sulfilimine **3**



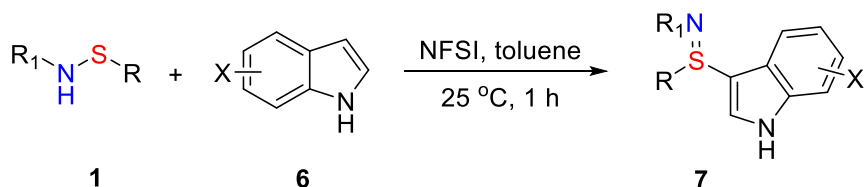
To a stirred solution of sulfenamide **1** (0.1 mmol, 1.0 equiv.) and naphthol **2** (0.12 mmol, 1.2 equiv.) in dry CH₃CN (1 mL) was added NFSI (0.15 mmol, 1.5 equiv.). The reaction mixture was stirred at room temperature until completion (judged by TLC, 1 h). Upon completion, the reaction was quenched with saturated aqueous Na₂SO₃ (5 mL). The organic layer was separated, and the aqueous layer was extracted with CH₂Cl₂ (10 mL×3). The combined organic layers were dried over anhydrous Na₂SO₄, filtered, and concentrated under reduced pressure. The residue was purified by silica gel column chromatography (DCM/PE/MeOH= 20:20:1) to yield **3**.

(D) General procedure for preparation of sulfilimine 5



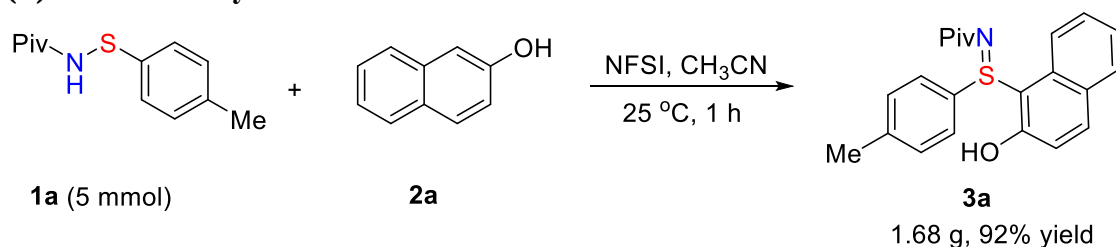
To a stirred solution of sulfenamide **1** (0.1 mmol, 1.0 equiv.) and phenol **4** (0.12 mmol, 1.2 equiv.) in dry CH_2Cl_2 (1 mL) was added NFSI (0.12 mmol, 1.2 equiv.). The reaction mixture was stirred at room temperature until completion (judged by TLC, 20 min). Upon completion, the reaction was quenched with saturated aqueous Na_2SO_3 (5 mL). The organic layer was separated, and the aqueous layer was extracted with CH_2Cl_2 (10 mL $\times$ 3). The combined organic layers were dried over anhydrous Na_2SO_4 , filtered, and concentrated under reduced pressure. The residue was purified by silica gel column chromatography (DCM/PE/MeOH= 20:20:1) to yield **5**.

(E) General procedure for preparation of sulfilimine 7



To a stirred solution of sulfenamide **1** (0.1 mmol, 1.0 equiv.) and indole **6** (0.12 mmol, 1.2 equiv.) in dry toluene (1 mL) was added NFSI (0.12 mmol, 1.2 equiv.). The reaction mixture was stirred at room temperature until completion (judged by TLC, 1 h). Upon completion, the reaction was quenched with saturated aqueous Na_2SO_3 (5 mL). The organic layer was separated, and the aqueous layer was extracted with CH_2Cl_2 (10 mL $\times$ 3). The combined organic layers were dried over anhydrous Na_2SO_4 , filtered, and concentrated under reduced pressure. The residue was purified by silica gel column chromatography (DCM/MeOH= 30:1) to yield **7**.

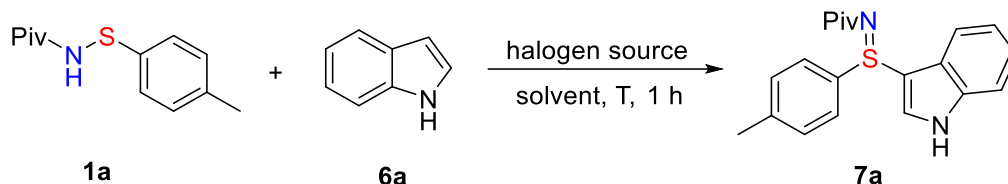
(F) Gram-scale synthesis of sulfilimine 3a



To a stirred solution of sulfenamide **1a** (5 mmol, 1.0 equiv.) and naphthol **2a** (5.5 mmol, 1.1 equiv.) in dry CH_3CN (35 mL) was added NFSI (6.0 mmol, 1.2 equiv.). The reaction mixture was stirred at room temperature until completion (judged by TLC, 1 h). Upon completion, the reaction was quenched with saturated aqueous Na_2SO_3 (15 mL). The organic layer was separated, and the aqueous layer was extracted with CH_2Cl_2 (20 mL $\times$ 3). The combined organic layers were dried over

anhydrous Na₂SO₄, filtered, and concentrated under reduced pressure. The residue was purified by silica gel column chromatography (DCM/PE/MeOH= 20:20:1) to provide **3a** (1.68 g, 92% yield).

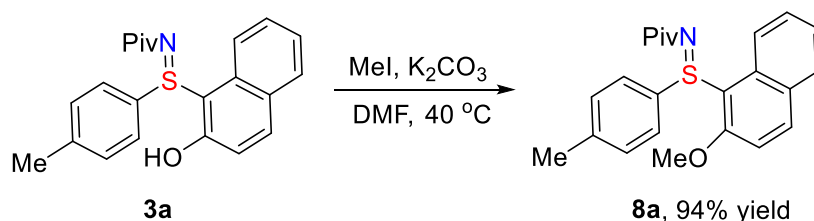
(G) Table S1 Reaction optimization for synthesis of sulfilimine 7a^a



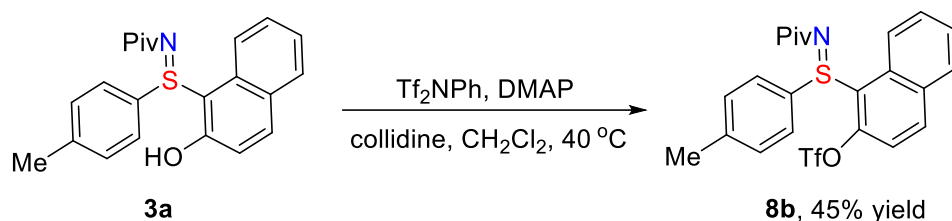
entry	halogen source	solvent	T. (°C)	yield (%) ^b
1	NFSI	CH ₃ CN	25	35
2	NFSI	acetone	25	83
3	NFSI	EA	25	64
4	NFSI	CH ₂ Cl ₂	25	85
5	NFSI	toluene	25	97(95) ^c
6	NFSI	THF	25	29
7	Selectfluor	toluene	25	-
8	NBS	toluene	25	-
9	NCS	toluene	25	20
10	NFSI	toluene	50	73
11	NFSI	toluene	0	85

^aReaction conditions: the reaction of **1a** (0.1 mmol), halogen source (0.12 mmol) and indole **6a** (0.12 mmol) in the indicated solvent (1.0 mL) was carried out at indicated temperature for 1 h. ^bNMR yield using 1,3,5-trimethoxybenzene as an internal standard. ^cIsolated yield. NFSI = *N*-Fluorobenzenesulfonimide.

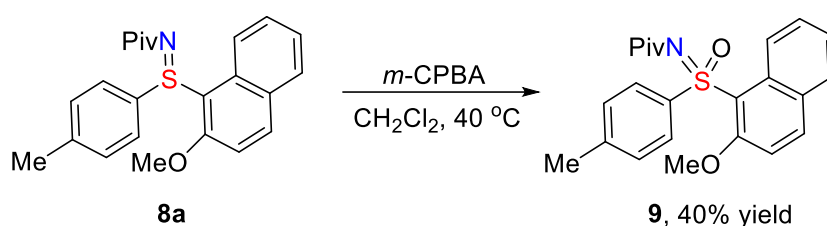
(H) Synthetic transformations



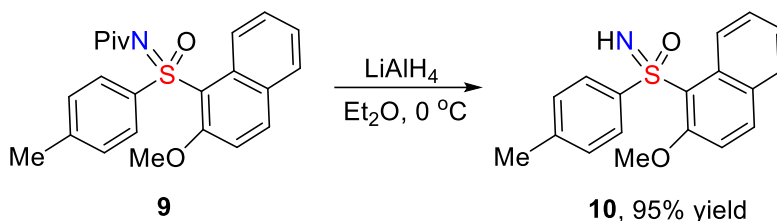
To a solution of **3a** (351 mg, 1 mmol, 1.0 equiv.) and K₂CO₃ (207 mg, 1.5 mmol, 1.5 equiv.) in dry DMF (5 mL) was added MeI (213 mg, 1.5 mmol, 1.5 equiv.) under nitrogen. The reaction mixture was heated to 40 °C in a preheated oil bath for 12 h. After cooling to room temperature, the reaction mixture was quenched with saturated NH₄Cl solution and extracted with CH₂Cl₂ (10 mL × 3). The combined organic layers were washed with brine, dried over sodium sulfate, and concentrated. Purification by silica gel chromatography (PE/EtOAc = 2:1) afforded the product **8a** (356.3 mg, 94% yield).



To a solution of **3a** (35.1 mg, 0.1 mmol, 1.0 equiv.), DMAP (0.012 mmol, 0.12 equiv.) and 2,4,6-collidine (14.5 mg, 0.12 mmol, 1.2 equiv.) in dry CH_2Cl_2 (5 mL) was added Tf_2NPh (39.5 mg, 0.11 mmol, 1.1 equiv.) at room temperature. The reaction mixture was heated to 40 °C in a preheated oil bath for 24 h. The solvent was removed under reduced pressure, and the residue was purified by silica gel chromatography (DCM/EA = 5:1) afforded the product **8b** (19.8 mg, 45% yield).



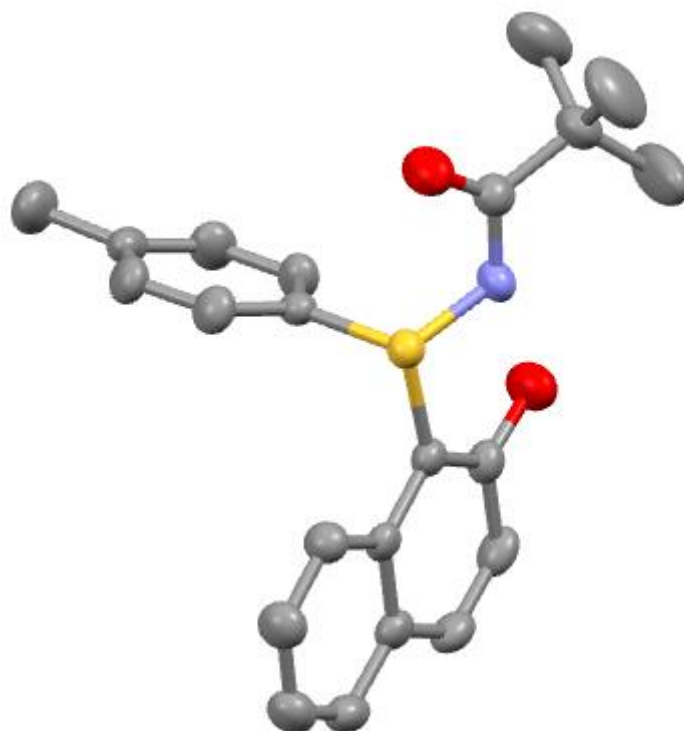
To a solution of **8a** (75.8 mg, 0.2 mmol, 1.0 equiv.) in dry CH_2Cl_2 (5 mL) was added *m*-CPBA (103.5 mg, 0.6 mmol, 3.0 equiv.) at room temperature. The reaction mixture was heated to 40 °C in a preheated oil bath for 24 h. The solvent was removed under reduced pressure, and the residue was purified by silica gel chromatography (PE/EtOAc = 3:1) afforded the product **9** (31.6 mg, 40% yield).



To a solution of **9** (39.5 mg, 0.1 mmol, 1.0 equiv.) in dry Et_2O (5 mL) was added LiAlH_4 (45.6 mg, 1.2 mmol, 12 equiv.) slowly at 0 °C. The reaction mixture was stirred at 0 °C for 30 min. The reaction mixture was quenched with saturated NH_4Cl solution and extracted with CH_2Cl_2 (10 mL $\times$ 3). The combined organic layers were washed with brine, dried over sodium sulfate, and concentrated. Purification by silica gel chromatography (PE/EtOAc = 1:1) afforded the product **10** (29.5 mg, 95% yield).

(I) X-ray diffraction data of **3a** (CCDC 2494482)

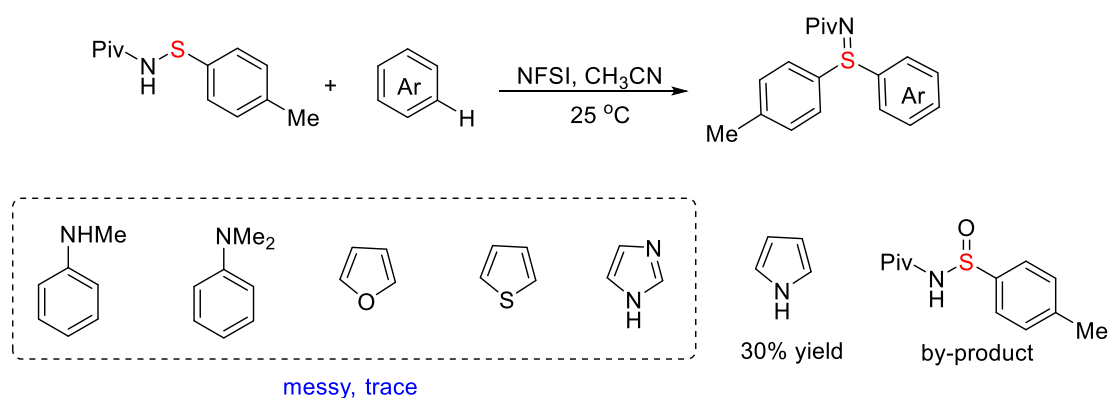
The structure of product **3a** was determined by X-ray diffraction. The X-ray crystallography data have been deposited at the Cambridge Crystallographic Data Center (CCDC 2494482).



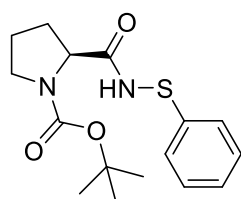
Displacement ellipsoids are drawn at the 50% probability level.

Sample preparation: Compound **3a** was dissolved in petroleum ether and ethyl acetate. The single crystal **3a** was obtained by slow evaporating mixed solvent at room temperature under the air conditions. A suitable crystal was selected and collected on a Xcalibur, Sapphire3, Gemini ultra diffractometer.

Unsuccessful nucleophilic arenes

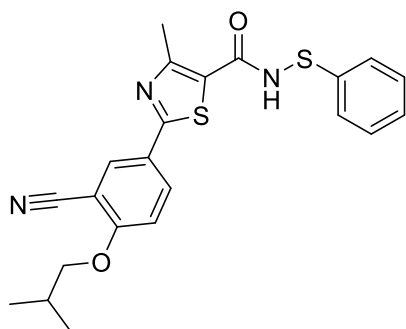


(J) Analytical Data



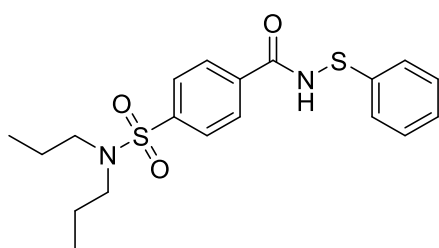
tert-butyl (S)-2-((phenylthio)carbamoyl)pyrrolidine-1-carboxylate (1ah)

White solid ($R_f = 0.3$, PE/EA = 8:1); mp 131-133 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.44 (s, 1H), 7.29-7.13 (m, 5H), 4.42-4.37 (m, 1H), 3.49-3.33 (m, 2H), 2.21-1.73 (m, 4H), 1.47 (s, 9H). ^{13}C NMR (100 MHz, CDCl_3) δ 174.2, 156.3, 138.9, 129.1, 126.4, 124.6, 81.1, 60.4, 47.3, 31.4, 28.5, 24.8; HRMS (ESI) calcd for $\text{C}_{16}\text{H}_{22}\text{N}_2\text{O}_3\text{SNa}$ m/z $[\text{M}+\text{Na}]^+$: 345.1243, found: 345.1242.



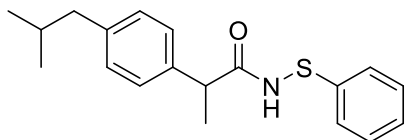
2-(3-cyano-4-isobutoxyphenyl)-4-methyl-N-(phenylthio)thiazole-5-carboxamide (1ai)

White solid ($R_f = 0.3$, PE/EA = 8:1); mp 150-152 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.11 (d, $J = 2.3$ Hz, 1H), 8.04 (dd, $J = 8.9, 2.3$ Hz, 1H), 7.37-7.29 (m, 4H), 7.26-7.20 (m, 1H), 7.18 (s, 1H), 7.00 (d, $J = 8.9$ Hz, 1H), 3.88 (d, $J = 6.4$ Hz, 2H), 2.75 (s, 3H), 2.24-2.14 (m, 1H), 1.08 (d, $J = 6.7$ Hz, 6H); ^{13}C NMR (100 MHz, CDCl_3) δ 165.7, 163.4, 162.7, 159.5, 138.2, 132.7, 132.2, 129.3, 127.5, 126.2, 125.7, 115.5, 112.8, 103.0, 75.8, 28.2, 19.2, 17.9; HRMS (ESI) calcd for $\text{C}_{22}\text{H}_{22}\text{N}_3\text{O}_2\text{S}_2$ m/z $[\text{M}+\text{H}]^+$: 424.1148, found: 424.1152.



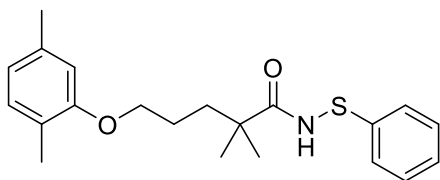
4-(N,N-dipropylsulfamoyl)-N-(phenylthio)benzamide (1aj)

White solid ($R_f = 0.3$, PE/EA = 8:1); mp 155-157 °C; ^1H NMR (400 MHz, CDCl_3) δ 8.19 (s, 1H), 7.91 (d, $J = 7.8$ Hz, 2H), 7.72 (d, $J = 8.0$ Hz, 2H), 7.28-7.23 (m, 4H), 7.16 (d, $J = 6.4$ Hz, 1H), 3.02 (t, $J = 7.7$ Hz, 4H), 1.53-1.44 (m, 4H), 0.82 (t, $J = 7.4$ Hz, 6H); ^{13}C NMR (100 MHz, CDCl_3) δ 168.4, 143.5, 138.1, 136.7, 129.2, 128.6, 127.3, 125.9, 50.0, 22.0, 11.2; HRMS (ESI) calcd for $\text{C}_{19}\text{H}_{25}\text{N}_2\text{O}_3\text{S}_2$ m/z $[\text{M}+\text{H}]^+$: 393.1301, found: 393.1302.



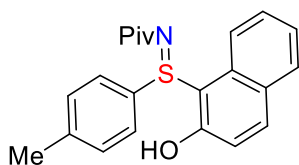
2-(4-isobutylphenyl)-N-(phenylthio)propenamide (1ak)

White solid ($R_f = 0.3$, PE/EA = 8:1); mp 114-116 °C; ^1H NMR (400 MHz, CDCl_3) δ 7.22-7.18 (m, 4H), 7.15-7.10 (m, 3H), 7.02 (d, $J = 7.5$ Hz, 2H), 6.85 (s, 1H), 3.76-3.71 (m, 1H), 2.47 (d, $J = 7.2$ Hz, 2H), 1.91-1.81 (m, 1H), 1.54 (d, $J = 7.1$ Hz, 3H), 0.91 (d, $J = 6.7$ Hz, 6H); ^{13}C NMR (100 MHz, CDCl_3) δ 176.3, 141.3, 138.9, 137.7, 129.9, 129.0, 127.5, 126.5, 124.7, 47.2, 45.1, 30.3, 22.5, 18.6; HRMS (ESI) calcd for $\text{C}_{19}\text{H}_{24}\text{NOS}$ m/z $[\text{M}+\text{H}]^+$: 314.1573, found: 314.1571.



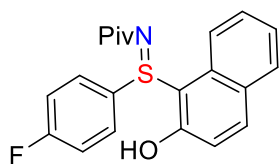
5-(2,5-dimethylphenoxy)-2,2-dimethyl-N-(phenylthio)pentanamide (1al)^[2]

White solid ($R_f = 0.3$, PE/EA = 8:1); ^1H NMR (400 MHz, CDCl_3) δ 7.31-7.26 (m, 4H), 7.18-7.21 (m, 1H), 7.02-6.98 (m, 2H), 6.67 (d, $J = 7.6$ Hz, 1H), 6.60 (s, 1H), 3.91-3.89 (m, 2H), 2.31 (s, 3H), 2.17 (s, 3H), 1.80-1.78 (m, 4H), 1.30 (s, 6H); ^{13}C NMR (100 MHz, CDCl_3) δ 179.1, 157.0, 139.0, 136.7, 130.5, 129.1, 127.0, 125.8, 123.6, 120.9, 112.1, 67.8, 43.4, 37.8, 25.9, 25.2, 21.5, 16.0; HRMS (ESI) calcd for $\text{C}_{21}\text{H}_{28}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 358.1835, found: 358.1842.



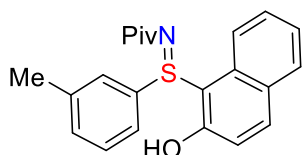
(Z)-N-((2-hydroxynaphthalen-1-yl)(p-tolyl)- λ^4 -sulfaneylidene)pivalamide (3a)

White solid ($R_f = 0.5$, DCM/PE/MeOH = 10:10:1); mp 159-160 °C; 34.3 mg, 94% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.11 (d, $J = 8.5$ Hz, 1H), 7.88 (d, $J = 9.0$ Hz, 1H), 7.76 (d, $J = 8.1$ Hz, 1H), 7.65 (d, $J = 7.9$ Hz, 2H), 7.52 (t, $J = 7.8$ Hz, 1H), 7.35 (t, $J = 7.6$ Hz, 1H), 7.18 (d, $J = 6.2$ Hz, 3H), 2.30 (s, 3H), 1.28 (s, 9H). ^{13}C NMR (101 MHz, CDCl_3) δ 188.1, 162.4, 143.1, 135.0, 133.9, 131.7, 130.7, 129.1, 128.6, 128.2, 127.6, 124.2, 122.0, 120.8, 103.6, 40.4, 28.4, 21.5; HRMS (ESI) calcd for $\text{C}_{22}\text{H}_{24}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 366.1522, found: 366.1519.



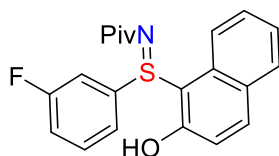
(Z)-N-((4-fluorophenyl)(2-hydroxynaphthalen-1-yl)-λ⁴-sulfaneylidene)pivalamide (3b)

Brown solid (R_f = 0.5, DCM/PE/MeOH= 10:10:1); mp 156-157 °C; 33.1 mg, 90% yield; ¹H NMR (400 MHz, CDCl₃) δ 8.07 (d, J = 8.5 Hz, 1H), 7.91 (d, J = 8.7 Hz, 1H), 7.80-7.76 (m, 3H), 7.53 (t, J = 7.8 Hz, 1H), 7.36 (t, J = 7.6 Hz, 1H), 7.20 (d, J = 9.0 Hz, 1H), 7.08 (t, J = 8.4 Hz, 2H), 1.28 (s, 9H); ¹³C NMR (100 MHz, CDCl₃) δ 188.2, 164.8 (d, J = 253 Hz), 162.6, 135.3, 132.5 (d, J = 3.3 Hz), 131.5, 130.3, 130.2, 129.2, 128.8, 128.3, 124.3, 122.0, 120.5, 117.4 (d, J = 22.7 Hz), 103.2, 40.4, 28.3. ¹⁹F NMR (376 MHz, CDCl₃) δ -105.56 (s, 1F); HRMS (ESI) calcd for C₂₁H₂₁FNO₂S m/z [M+H]⁺: 370.1272, found: 307.1276.



(Z)-N-((2-hydroxynaphthalen-1-yl)(*m*-tolyl)-λ⁴-sulfaneylidene)pivalamide (3c)

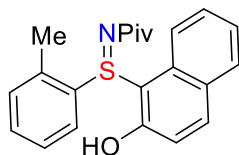
White solid (R_f = 0.5, DCM/PE/MeOH= 10:10:1); mp 155-156 °C; 34.2 mg, 94% yield; ¹H NMR (400 MHz, CDCl₃) δ 8.14 (d, J = 8.5 Hz, 1H), 7.90 (d, J = 8.8 Hz, 1H), 7.77 (d, J = 8.1 Hz, 1H), 7.55 (d, J = 7.5 Hz, 3H), 7.36 (t, J = 7.6 Hz, 1H), 7.29-7.25 (m, 1H), 7.23-7.19 (m, 2H), 2.31 (s, 3H), 1.29 (s, 9H); ¹³C NMR (100 MHz, CDCl₃) δ 187.9, 162.5, 140.2, 136.6, 135.1, 133.2, 131.8, 129.9, 129.1, 128.6, 128.3, 127.7, 124.6, 124.2, 122.0, 120.8, 103.6, 40.5, 28.3, 21.6; HRMS (ESI) calcd for C₂₂H₂₄NO₂S m/z [M+H]⁺: 366.1522, found: 366.1519.



(Z)-N-((3-fluorophenyl)(2-hydroxynaphthalen-1-yl)-λ⁴-sulfaneylidene)pivalamide (3d)

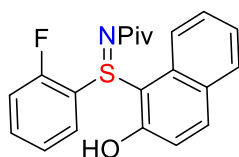
Brown solid (R_f = 0.5, DCM/PE/MeOH= 10:10:1); mp 134-135 °C; 32.3 mg, 89% yield; ¹H NMR (400 MHz, CDCl₃) δ 8.07 (d, J = 8.4 Hz, 1H), 7.91 (d, J = 8.8 Hz, 1H), 7.78 (t, J = 6.8 Hz, 3H), 7.53 (t, J = 7.8 Hz, 1H), 7.37 (t, J = 7.6 Hz, 1H), 7.20 (d, J = 8.8 Hz, 1H), 7.13 (t, J = 8.4 Hz, 2H), 1.28 (s, 9H); ¹³C NMR (100 MHz, CDCl₃) δ 188.2, 162.9 (d, J = 251.3 Hz), 139.0 (d, J = 6.3 Hz), 135.5, 131.8, 131.6, 131.5,

129.2, 128.9, 128.4, 124.5, 123.3 (d, $J = 3.4$ Hz), 122.0, 120.7, 119.6 (d, $J = 21.0$ Hz), 114.6 (d, $J = 24.5$ Hz), 40.4, 28.3; ^{19}F NMR (376 MHz, CDCl_3) δ -108.27(s, 1F); HRMS (ESI) calcd for $\text{C}_{21}\text{H}_{21}\text{FNO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 370.1272, found: 370.1275.



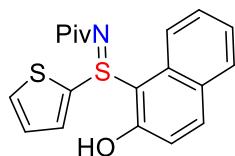
(Z)-N-((2-hydroxynaphthalen-1-yl)(o-tolyl)- λ^4 -sulfaneylidene)pivalamide (3e)

White solid ($R_f = 0.6$, DCM/PE/MeOH= 10:10:1); mp 136-138 °C; 32.7 mg, 90% yield; ^1H NMR (400 MHz, CDCl_3) δ 7.92-7.87 (m, 2H), 7.82 (d, $J = 8.0$ Hz, 1H), 7.73 (d, $J = 8.1$ Hz, 1H), 7.49 (t, $J = 7.8$ Hz, 1H), 7.35-7.29 (m, 2H), 7.24-7.18(m, 3H), 3.00 (s, 3H), 1.25 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 187.2, 162.7, 139.4, 136.8, 134.9, 132.6, 131.5, 131.3, 129.2, 128.6, 128.5, 128.4, 128.3, 124.1, 122.3, 120.4, 103.4, 40.2, 28.3, 19.9; HRMS (ESI) calcd for $\text{C}_{22}\text{H}_{24}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 366.1522, found: 366.1520.



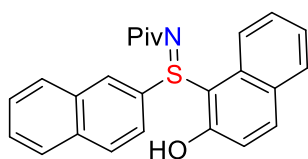
(E)-N-((2-fluorophenyl)(2-hydroxynaphthalen-1-yl)- λ^4 -sulfaneylidene)pivalamide (3f)

Brown solid ($R_f = 0.6$, DCM/PE/MeOH= 10:10:1); mp 116-118 °C; 32.1 mg, in 87% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.19 (d, $J = 8.6$ Hz, 1H), 7.87 (d, $J = 9.1$ Hz, 2H), 7.74 (d, $J = 8.1$ Hz, 1H), 7.56 (t, $J = 7.8$ Hz, 1H), 7.44-7.34 (m, 2H), 7.24-7.20 (m, 1H), 7.16 (d, $J = 9.0$ Hz, 1H), 7.08 (t, $J = 8.9$ Hz, 1H), 1.29 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.0, 162.3 (d, $J = 116.5$ Hz), 158.7, 135.3, 134.5 (d, $J = 8.2$ Hz), 131.4, 129.0, 128.6, 128.3, 128.1, 126.1 (d, $J = 3.5$ Hz), 125.9 (d, $J = 15.8$ Hz), 124.3, 121.8, 120.8 (d, $J = 3.7$ Hz), 116.9 (d, $J = 20.7$ Hz), 103.2, 40.4, 28.3; ^{19}F NMR (376 MHz, CDCl_3) δ -108.98 (s, 1F); HRMS (ESI) calcd for $\text{C}_{21}\text{H}_{21}\text{FNO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 370.1272, found: 370.1273.



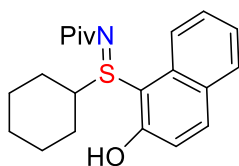
(E)-N-((2-hydroxynaphthalen-1-yl)(thiophen-2-yl)- λ^4 -sulfaneylidene)pivalamide (3g)

White solid (R_f = 0.6, DCM/PE/MeOH= 10:10:1); mp 146-148 °C; 28.6 mg, 81% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.08 (d, J = 8.4 Hz, 1H), 7.9 (d, J = 9.0 Hz, 1H), 7.78 (d, J = 8.1 Hz, 1H), 7.59 (d, J = 3.7 Hz, 1H), 7.52 (dd, J = 18.5, 6.4 Hz, 2H), 7.37 (t, J = 7.6 Hz, 1H), 7.21 (d, J = 9.1 Hz, 1H), 6.98 (t, J = 4.5 Hz, 1H), 1.27 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.5, 162.3, 136.2, 135.4, 133.3, 132.9, 131.4, 129.2, 128.7, 128.2, 127.8, 124.3, 121.9, 120.6, 103.9, 40.4, 28.3; HRMS (ESI) calcd for $\text{C}_{19}\text{H}_{20}\text{NO}_2\text{S}_2$ m/z $[\text{M}+\text{H}]^+$: 358.0930, found: 358.0938.



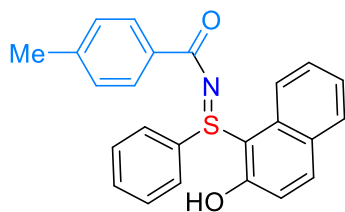
(Z)-N-((2-hydroxynaphthalen-1-yl)(naphthalen-2-yl)- λ^4 -sulfaneylidene)pivalamide (3h)

White solid (R_f = 0.5, DCM/PE/MeOH= 10:10:1); mp 142-143 °C; 36.1 mg, 90% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.33 (s, 1H), 8.20 (d, J = 8.5 Hz, 1H), 7.90 (d, J = 9.0 Hz, 1H), 7.87 (d, J = 6.0 Hz, 1H), 7.84 (d, J = 9.0 Hz, 1H), 7.77 (t, J = 8.6 Hz, 3H), 7.54 (t, J = 3.8 Hz, 3H), 7.35 (t, J = 7.6 Hz, 1H), 7.21 (d, J = 9.0 Hz, 1H), 1.3 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.3, 162.6, 135.2, 134.7, 133.8, 132.7, 131.8, 130.8, 129.2, 129.1, 129.1, 128.7, 128.7, 128.3, 128.0, 127.6, 124.2, 122.6, 122.0, 120.7, 103.3, 40.5, 28.4; HRMS (ESI) calcd for $\text{C}_{25}\text{H}_{24}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 402.1522, found: 402.1521.



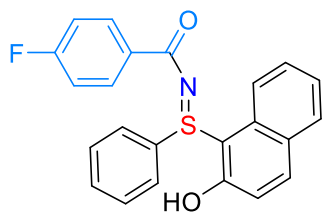
(Z)-N-(cyclohexyl(2-hydroxynaphthalen-1-yl)- λ^4 -sulfaneylidene)pivalamide (3i)

White solid (R_f = 0.5, DCM/PE/MeOH= 10:10:1); mp 123-124 °C; 8.7 mg, 25% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.05 (d, J = 9.1 Hz, 1H), 7.88 (d, J = 9.0 Hz, 1H), 7.76 (d, J = 8.1 Hz, 1H), 7.54-7.50 (m, 1H), 7.36 (t, J = 7.0 Hz, 1H), 7.14 (d, J = 9.0 Hz, 1H), 3.54-3.46 (m, 1H), 2.14-1.84 (m, 3H), 1.83-1.70 (m, 2H), 1.59 (d, J = 13.1 Hz, 1H), 1.52-1.37 (m, 3H), 1.27 (s, 9H), 1.19-1.08 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.3, 163.4, 134.8, 133.0, 128.9, 128.3, 128.0, 124.0, 121.8, 121.4, 101.3, 61.5, 40.8, 28.5, 27.4, 27.2, 25.6, 25.6, 25.2; HRMS (ESI) calcd for $\text{C}_{21}\text{H}_{28}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 358.1835, found: 358.1838.



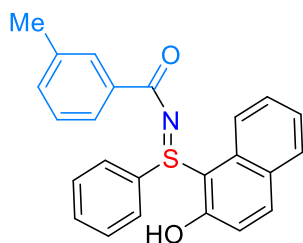
(Z)-N-((2-hydroxynaphthalen-1-yl)(phenyl)-λ⁴-sulfaneylidene)-4-methylbenzamide (3j)

White solid (R_f = 0.5, DCM/PE/MeOH= 10:10:1); mp 146-148 °C; 36.8 mg, 96% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.24 (d, J = 8.5 Hz, 1H), 8.04 (d, J = 8.0 Hz, 2H), 7.94 (d, J = 9.0 Hz, 1H), 7.81 (dd, J = 6.2, 2.2 Hz, 3H), 7.59 (t, J = 7.8 Hz, 1H), 7.45-7.38 (m, J = 7.7 Hz, 4H), 7.24-7.22 (m, 3H), 2.40 (s, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 175.1, 162.3, 142.2, 136.7, 135.3, 132.3, 132.2, 131.8, 130.0, 129.2, 129.0, 129.0, 128.8, 128.3, 127.5, 124.4, 121.8, 120.9, 104.1, 21.7; HRMS (ESI) calcd for $\text{C}_{24}\text{H}_{20}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 386.1209, found: 386.1210.



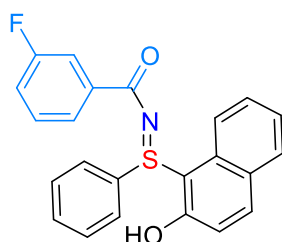
(Z)-4-fluoro-N-((2-hydroxynaphthalen-1-yl)(phenyl)-λ⁴-sulfaneylidene)benzamide (3k)

Brown oil (R_f = 0.4, DCM/PE/MeOH= 10:10:1); 34.6 mg, 89% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.22 (d, J = 8.4 Hz, 1H), 8.16-8.13 (m, 2H), 7.95 (d, J = 8.7 Hz, 1H), 7.80 (d, J = 7.7 Hz, 3H), 7.59 (t, J = 7.8 Hz, 1H), 7.47-7.38 (m, 4H), 7.24 (d, J = 8.9 Hz, 1H), 7.10 (t, J = 8.4 Hz, 2H); ^{13}C NMR (100 MHz, CDCl_3) δ 174.0, 165.2 (d, J = 250.1 Hz), 162.3, 136.4, 135.5, 132.4, 131.8, 131.4, 131.3 (d, J = 2.9 Hz), 131.2, 130.1, 129.2, 128.9, 128.4, 127.6, 124.5, 121.8, 120.9, 115.3 (d, J = 21.6 Hz); ^{19}F NMR (376 MHz, CDCl_3) δ -108.18 (s, 1F); HRMS (ESI) calcd for $\text{C}_{23}\text{H}_{17}\text{NO}_2\text{SF}$ m/z $[\text{M}+\text{H}]^+$: 390.0959, found: 390.0961.



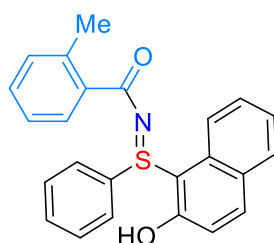
(Z)-N-((2-hydroxynaphthalen-1-yl)(phenyl)- λ^4 -sulfaneylidene)-3-methylbenzamide (3l)

Brown oil (R_f = 0.5, DCM/PE/MeOH= 10:10:1); 36.4 mg, 95% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.14 (d, J = 8.5 Hz, 1H), 7.85 (d, J = 8.3 Hz, 3H), 7.73-7.70 (m, 3H), 7.6 (t, J = 7.4 Hz, 1H), 7.37-7.29 (m, 4H), 7.23 (d, J = 5.2 Hz, 2H), 7.2 (s, 1H), 2.32 (s, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 175.2, 162.3, 138.0, 136.6, 135.4, 134.9, 132.6, 132.3, 131.8, 130.1, 129.5, 129.1, 128.8, 128.4, 128.2, 127.6, 126.1, 124.4, 121.9, 120.9, 21.5; HRMS (ESI) calcd for $\text{C}_{24}\text{H}_{20}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 386.1209, found: 386.1210.



(Z)-3-fluoro-N-((2-hydroxynaphthalen-1-yl)(phenyl)- λ^4 -sulfaneylidene)benzamide (3m)

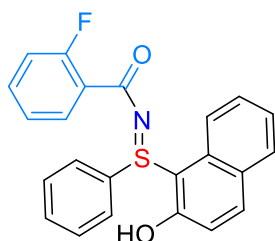
Brown oil (R_f = 0.4, DCM/PE/MeOH= 10:10:1); 36.5 mg, 94% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.21 (d, J = 8.5 Hz, 1H), 7.95 (d, J = 8.9 Hz, 1H), 7.90 (d, J = 7.8 Hz, 1H), 7.79 (t, J = 6.6 Hz, 4H), 7.59 (t, J = 7.7 Hz, 1H), 7.48-7.36 (m, 5H), 7.25 (d, J = 4.2 Hz, 1H), 7.18 (t, J = 8.4 Hz, 1H); ^{13}C NMR (100 MHz, CDCl_3) δ 173.8, 162.7 (d, J = 244.8 Hz), 162.1, 137.4 (d, J = 6.9 Hz), 136.1, 135.6, 132.5, 131.8, 130.2, 129.9 (d, J = 7.6 Hz), 129.2, 129.0, 128.4, 127.6, 124.6 (d, J = 3.0 Hz), 124.5, 121.8, 120.9, 118.8 (d, J = 21.2 Hz), 115.9 (d, J = 22.4 Hz), 103.8; ^{19}F NMR (376 MHz, CDCl_3) δ -112.82 (s, 1F); HRMS (ESI) calcd for $\text{C}_{23}\text{H}_{17}\text{FNO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 390.0958, found: 390.0958.



(Z)-N-((2-hydroxynaphthalen-1-yl)(phenyl)- λ^4 -sulfaneylidene)-2-methylbenzamide (3n)

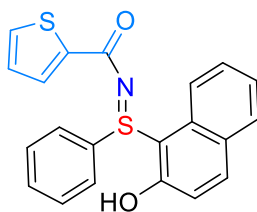
Brown oil (R_f = 0.5, DCM/PE/MeOH= 10:10:1); 34.4 mg, 90% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.25 (d, J = 8.5 Hz, 1H), 7.93 (d, J = 8.9 Hz, 1H), 7.85-7.80 (m, 4H), 7.60 (t, J = 7.8 Hz, 1H), 7.48-7.39 (m, 4H), 7.33 (t, J = 7.8 Hz, 1H), 7.25-7.21 (m,

3H), 2.58 (s, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 177.7, 162.3, 138.0, 136.6, 135.7, 135.4, 132.3, 131.9, 131.4, 130.4, 130.1, 129.5, 129.2, 128.8, 128.3, 127.5, 125.7, 124.4, 121.9, 120.9, 103.7, 21.3; HRMS (ESI) calcd for $\text{C}_{24}\text{H}_{20}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 386.1209, found: 386.1209.



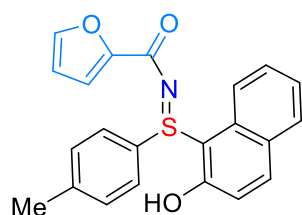
(Z)-3-fluoro-N-((2-hydroxynaphthalen-1-yl)(phenyl)- λ^4 -sulfaneylidene)benzamide (3o)

Brown oil (R_f = 0.4, DCM/PE/MeOH= 10:10:1); 36.6 mg, 94% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.21 (d, J = 8.5 Hz, 1H), 7.95 (d, J = 8.9 Hz, 1H), 7.90 (d, J = 7.8 Hz, 1H), 7.79 (t, J = 6.6 Hz, 4H), 7.59 (t, J = 7.7 Hz, 1H), 7.48-7.36 (m, 5H), 7.25 (d, J = 4.2 Hz, 1H), 7.18 (t, J = 8.4 Hz, 1H); ^{13}C NMR (100 MHz, CDCl_3) δ 172.2 (d, J = 5.0 Hz), 162.0, 161.7 (d, J = 252.8 Hz), 136.4, 135.4, 133.2 (d, J = 9.0 Hz), 132.4, 132.0 (d, J = 1.7 Hz), 131.7, 130.1, 129.2, 128.8, 128.3, 127.8, 124.3, 124.1 (d, J = 3.5 Hz), 123.3 (d, J = 10.9 Hz), 122.0, 120.7, 116.7 (d, J = 23.7 Hz), 103.3; ^{19}F NMR (376 MHz, CDCl_3) δ -112.82 (s, 1F); HRMS (ESI) calcd for $\text{C}_{23}\text{H}_{17}\text{NFO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 390.0959, found: 390.0958.



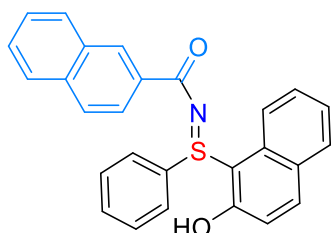
(Z)-N-((2-hydroxynaphthalen-1-yl)(phenyl)- λ^4 -sulfaneylidene)thiophene-2-carboxamide (3p)

Brown oil (R_f = 0.5, DCM/PE/MeOH= 10:10:1); 29.1 mg, 77% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.19 (d, J = 8.5 Hz, 1H), 7.93 (d, J = 9.0 Hz, 1H), 7.81-7.78 (m, 3H), 7.78 (t, J = 1.8 Hz, 1H), 7.59-7.55 (m, 1H), 7.47-7.38 (m, 5H), 7.23 (d, J = 9.0 Hz, 1H), 7.08 (dd, J = 5.0, 3.7 Hz, 1H); ^{13}C NMR (100 MHz, CDCl_3) δ 170.0, 162.1, 139.9, 136.3, 135.5, 132.4, 131.7, 131.1, 130.6, 130.1, 129.2, 128.9, 128.3, 127.8, 127.5, 124.5, 121.8, 120.8, 103.8; HRMS (ESI) calcd for $\text{C}_{21}\text{H}_{16}\text{NO}_2\text{S}_2$ m/z $[\text{M}+\text{H}]^+$: 378.0617, found: 378.0617.



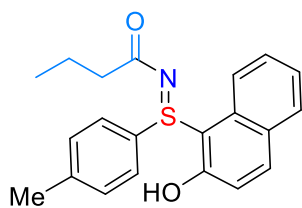
(Z)-N-((2-hydroxynaphthalen-1-yl)(p-tolyl)-λ⁴-sulfaneylidene)furan-2-carboxamide (3q)

Brown oil ($R_f = 0.6$, DCM/PE/MeOH= 10:10:1); 30.1 mg, 80% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.10 (d, $J = 8.5$ Hz, 1H), 7.92 (d, $J = 9.0$ Hz, 1H), 7.77 (d, $J = 8.1$ Hz, 1H), 7.69 (d, $J = 8.2$ Hz, 2H), 7.55-7.51 (m, 2H), 7.37 (t, $J = 7.5$ Hz, 1H), 7.24 (d, $J = 9.0$ Hz, 1H), 7.19 (d, $J = 8.1$ Hz, 2H), 7.14 (d, $J = 3.5$ Hz, 1H), 6.46-6.45 (m, 1H), 2.29 (s, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 166.1, 162.4, 149.7, 144.9, 143.4, 135.3, 133.1, 131.5, 130.8, 129.1, 128.7, 128.3, 127.8, 124.3, 122.0, 120.7, 115.1, 111.7, 103.0, 21.5; HRMS (ESI) calcd for $\text{C}_{22}\text{H}_{18}\text{NO}_3\text{S}$ m/z $[\text{M}+\text{H}]^+$: 376.1002, found: 376.1007.



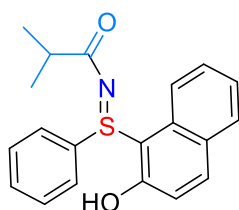
(Z)-N-((2-hydroxynaphthalen-1-yl)(phenyl)-λ⁴-sulfaneylidene)-2-naphthamide (3r)

White solid ($R_f = 0.5$, DCM/PE/MeOH= 10:10:1); mp 147-148 °C; 37.8 mg, 90% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.69 (s, 1H), 8.27 (d, $J = 8.6$ Hz, 1H), 8.21 (d, $J = 8.6$ Hz, 1H), 7.99-7.90 (m, 3H), 7.87 (t, $J = 6.8$ Hz, 3H), 7.81 (d, $J = 8.1$ Hz, 1H), 7.60 (t, $J = 7.9$ Hz, 1H), 7.58-7.47 (m, 2H), 7.47-7.39 (m, 4H), 7.27 (d, $J = 9.2$ Hz, 1H); ^{13}C NMR (100 MHz, CDCl_3) δ 175.2, 162.2, 136.6, 135.4, 135.1, 132.8, 132.4, 132.3, 131.9, 130.1, 129.8, 129.5, 129.2, 128.9, 128.4, 128.0, 127.8, 127.6, 127.6, 126.4, 125.5, 124.4, 121.8, 120.9, 104.1; HRMS (ESI) calcd for $\text{C}_{27}\text{H}_{20}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 422.1209, found: 422.1214.



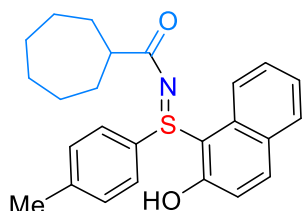
(Z)-N-((2-hydroxynaphthalen-1-yl)(p-tolyl)- λ^4 -sulfaneylidene)butyramide (3s)

Colorless oil (R_f = 0.5, DCM/PE/MeOH= 10:10:1); 30.5 mg, 87% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.10 (d, J = 8.5 Hz, 1H), 7.90 (d, J = 9.0 Hz, 1H), 7.77 (d, J = 8.1 Hz, 1H), 7.64 (d, J = 8.1 Hz, 2H), 7.52 (t, J = 7.7 Hz, 1H), 7.36 (t, J = 7.6 Hz, 1H), 7.19 (t, J = 5.6 Hz, 3H), 2.43 (t, J = 7.6 Hz, 2H), 2.31 (s, 3H), 1.77-1.68 (m, 2H), 0.95 (t, J = 7.4 Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 182.4, 162.5, 143.2, 135.2, 133.5, 131.7, 130.7, 129.1, 128.6, 128.3, 127.8, 124.2, 122.0, 120.8, 103.3, 39.9, 21.5, 19.9, 14.1; HRMS (ESI) calcd for $\text{C}_{21}\text{H}_{22}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 352.1366, found: 352.1362.



(Z)-N-((2-hydroxynaphthalen-1-yl)(p-tolyl)- λ^4 -sulfaneylidene)isobutyramide (3t)

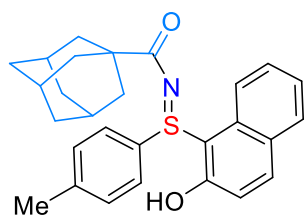
Colorless oil (R_f = 0.2, DCM/PE/MeOH= 10:10:1); 26.4 mg, 75% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.14 (d, J = 8.5 Hz, 1H), 7.91 (d, J = 8.9 Hz, 1H), 7.78 (d, J = 8.2 Hz, 1H), 7.73 (d, J = 7.1 Hz, 2H), 7.57-7.53 (m, 1H), 7.46-7.36 (m, 4H), 7.18 (d, J = 9.0 Hz, 1H), 2.77-2.67 (m, 1H), 1.23 (d, J = 7.1 Hz, 6H); ^{13}C NMR (100 MHz, CDCl_3) δ 186.5, 162.6, 136.9, 135.2, 132.2, 131.9, 130.0, 129.1, 128.7, 128.3, 127.5, 124.3, 122.0, 120.9, 36.9, 20.3, 20.2; HRMS (ESI) calcd for $\text{C}_{20}\text{H}_{20}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 338.1209, found: 338.1206.



(Z)-N-((2-hydroxynaphthalen-1-yl)(p-tolyl)- λ^4 -sulfaneylidene)cycloheptanecarboxamide (3u)

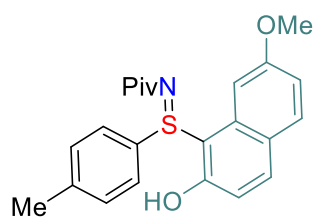
Brown oil (R_f = 0.6, DCM/PE/MeOH= 10:10:1); 28.8 mg, 71% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.10 (d, J = 8.5 Hz, 1H), 7.89 (d, J = 9.0 Hz, 1H), 7.76 (d, J = 8.1 Hz,

1H), 7.63 (d, $J = 7.9$ Hz, 2H), 7.52 (t, $J = 7.7$ Hz, 1H), 7.36 (t, $J = 7.6$ Hz, 1H), 7.18 (d, $J = 9.1$ Hz, 3H), 2.63-2.56 (m, 1H), 2.30 (s, 3H), 2.04-1.97 (m, 2H), 1.75-1.54 (m, 8H), 1.51-1.43 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3) δ 186.4, 162.5, 143.1, 135.1, 133.7, 131.8, 130.7, 129.1, 128.6, 128.2, 127.7, 124.2, 122.0, 120.8, 103.5, 48.4, 32.3, 32.2, 28.4, 28.4, 26.9, 26.8, 21.5; HRMS (ESI) calcd for $\text{C}_{25}\text{H}_{28}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 406.1835, found: 406.1826.



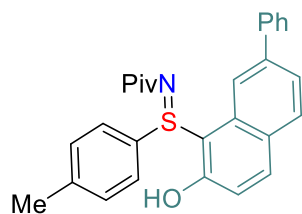
(3s)-N-((Z)-(2-hydroxynaphthalen-1-yl)(p-tolyl)- λ^4 -sulfaneylidene)adamantane-1-carboxamide (3v)

White solid ($R_f = 0.5$, DCM/PE/MeOH= 10:10:1); mp 168-169 °C; 38.4 mg, 87% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.15 (d, $J = 8.5$ Hz, 1H), 7.89 (d, $J = 9.0$ Hz, 1H), 7.76 (d, $J = 8.1$ Hz, 1H), 7.73 (dd, $J = 7.8, 1.8$ Hz, 2H), 7.54 (t, $J = 7.7$ Hz, 1H), 7.43-7.35 (m, 4H), 7.18 (d, $J = 9.0$ Hz, 1H), 2.03 (s, 3H), 1.99 (s, 6H), 1.72 (s, 6H); ^{13}C NMR (100 MHz, CDCl_3) δ 187.5, 162.5, 137.1, 135.1, 132.1, 131.9, 130.0, 129.1, 128.6, 128.2, 127.4, 124.2, 121.9, 120.8, 103.6, 42.5, 40.0, 36.8, 28.5; HRMS (ESI) calcd for $\text{C}_{28}\text{H}_{30}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 444.1922, found: 444.1928.



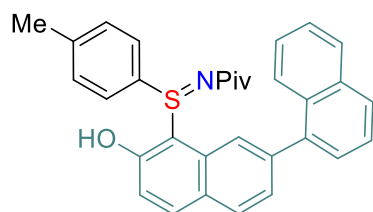
(Z)-N-((2-hydroxy-7-methoxynaphthalen-1-yl)(p-tolyl)- λ^4 -sulfaneylidene)pivalamide (3w)

White solid ($R_f = 0.6$, DCM/PE/MeOH= 10:10:1); mp 105-107 °C; 33.5 mg, 85% yield; ^1H NMR (400 MHz, CDCl_3) δ 7.79 (d, $J = 8.8$ Hz, 1H), 7.67-7.62 (m, 3H), 7.38 (s, 1H), 7.20 (d, $J = 7.9$ Hz, 2H), 7.03-6.97 (m, 2H), 3.89 (s, 3H), 2.31 (s, 3H), 1.28 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.2, 163.0, 159.8, 143.1, 134.7, 133.7, 133.4, 130.7, 130.7, 127.6, 123.4, 119.1, 116.1, 102.7, 100.3, 55.6, 40.4, 28.4, 21.5; HRMS (ESI) calcd for $\text{C}_{23}\text{H}_{26}\text{NO}_3\text{S}$ m/z $[\text{M}+\text{H}]^+$: 396.1628, found: 396.1631.



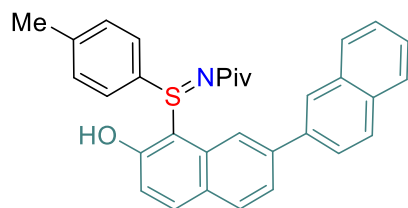
(Z)-N-((2-hydroxy-7-phenylnaphthalen-1-yl)(p-tolyl)- λ^4 -sulfaneylidene)pivalamide (3x)

Brown oil (R_f = 0.6, DCM/PE/MeOH= 10:10:1); 37.9 mg, 86% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.22 (s, 1H), 7.81 (d, J = 9.0 Hz, 1H), 7.72 (d, J = 8.4 Hz, 1H), 7.57 (dd, J = 7.8, 5.4 Hz, 4H), 7.51 (dd, J = 8.4, 1.6 Hz, 1H), 7.40 (t, J = 7.6 Hz, 2H), 7.31 (t, J = 7.4 Hz, 1H), 7.09 (dd, J = 8.6, 2.7 Hz, 3H), 2.19 (s, 3H), 1.20 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.2, 162.8, 143.1, 141.4, 140.5, 134.7, 133.8, 132.1, 130.8, 129.6, 129.1, 128.1, 127.7, 127.6, 127.4, 123.9, 121.9, 118.8, 103.9, 40.5, 28.4, 21.5; HRMS (ESI) calcd for $\text{C}_{28}\text{H}_{28}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 442.1835, found: 442.1831.



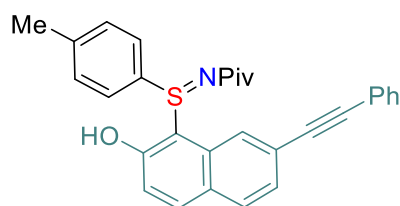
(Z)-N-((7'-hydroxy-[1,2'-binaphthalen]-8'-yl)(p-tolyl)- λ^4 -sulfaneylidene)pivalamide (3y)

Brown solid (R_f = 0.4, DCM/PE/MeOH= 10:10:1); mp 157-159 °C; 39.3 mg, 80% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.43 (s, 1H), 8.12 (s, 1H), 7.98-7.91 (m, 3H), 7.91-7.85 (m, 2H), 7.80 (d, J = 8.5 Hz, 1H), 7.74-7.70 (m, 3H), 7.58-7.51 (m, 2H), 7.21-7.18 (m, 3H), 2.29 (s, 3H), 1.32 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.3, 162.9, 143.1, 141.3, 137.9, 134.7, 133.8, 133.7, 133.0, 132.2, 130.8, 129.7, 128.9, 128.5, 127.8, 127.6, 127.4, 126.7, 126.6, 126.5, 125.7, 124.1, 122.0, 119.0, 103.9, 40.5, 28.4, 21.5; HRMS (ESI) calcd for $\text{C}_{32}\text{H}_{30}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 492.1992, found: 492.1993.



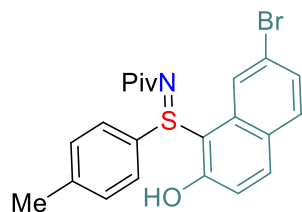
(Z)-N-((7-hydroxy-[2,2'-binaphthalen]-8-yl)(p-tolyl)- λ^4 -sulfaneylidene)pivalamide (3z)

Brown oil ($R_f = 0.6$, DCM/PE/MeOH= 10:10:1); 41.7 mg, 85% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.25 (s, 1H), 7.97 (d, $J = 9.0$ Hz, 1H), 7.95-7.91 (m, 2H), 7.87 (d, $J = 8.3$ Hz, 1H), 7.76 (d, $J = 8.5$ Hz, 1H), 7.66 (d, $J = 8.0$ Hz, 2H), 7.59-7.55 (m, 2H), 7.51 (d, $J = 7.7$ Hz, 1H), 7.46 (d, $J = 6.9$ Hz, 1H), 7.38 (t, $J = 7.7$ Hz, 1H), 7.26 (s, 1H), 7.23-7.19 (m, 2H), 2.32 (s, 3H), 1.26 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.0, 162.8, 143.2, 141.2, 139.5, 134.8, 134.0, 133.9, 131.8, 131.5, 130.8, 128.9, 128.6, 128.4, 127.8, 127.6, 127.3, 126.8, 126.4, 126.0, 125.8, 125.6, 122.1, 121.8, 103.8, 40.4, 28.3, 21.6; HRMS (ESI) calcd for $\text{C}_{32}\text{H}_{30}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 492.1992, found: 492.1989.



(Z)-N-((2-hydroxy-7-(phenylethynyl)naphthalen-1-yl)(p-tolyl)- λ^4 -sulfaneylidene)pivalamide (3aa)

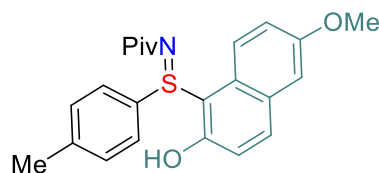
Brown solid ($R_f = 0.4$, DCM/PE/MeOH= 10:10:1); mp 152-154 °C; 23.7 mg, 51% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.37 (s, 1H), 7.86 (d, $J = 9.0$ Hz, 1H), 7.73 (d, $J = 8.3$ Hz, 1H), 7.65 (d, $J = 8.5$ Hz, 2H), 7.60-7.58 (m, 2H), 7.47 (d, $J = 8.3$ Hz, 1H), 7.40-7.36 (m, 3H), 7.22 (d, $J = 8.1$ Hz, 2H), 7.18 (d, $J = 8.9$ Hz, 1H), 2.32 (s, 3H), 1.29 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.3, 163.0, 143.1, 134.7, 133.5, 131.9, 131.7, 130.8, 129.1, 128.8, 128.6, 127.5, 127.4, 126.9, 124.1, 123.6, 122.9, 122.6, 103.6, 91.4, 89.3, 40.5, 28.4, 21.6; HRMS (ESI) calcd for $\text{C}_{30}\text{H}_{28}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 466.1835, found: 466.1830.



(Z)-N-((7-bromo-2-hydroxynaphthalen-1-yl)(p-tolyl)- λ^4 -sulfaneylidene)pivalamide (3ab)

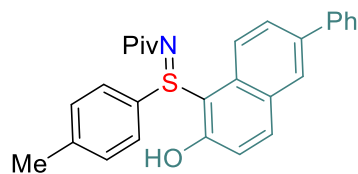
White solid ($R_f = 0.6$, DCM/PE/MeOH= 10:10:1); mp 155-156 °C; 34.9 mg, 79% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.29 (s, 1H), 7.83 (d, $J = 9.0$ Hz, 1H), 7.64 (d, $J = 8.0$ Hz, 2H), 7.60 (d, $J = 8.5$ Hz, 1H), 7.42 (d, $J = 8.2$ Hz, 1H), 7.21 (d, $J = 8.1$ Hz,

2H), 7.17 (d, $J = 9.0$ Hz, 1H), 2.31 (s, 3H), 1.27 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.1, 163.3, 143.3, 134.8, 133.4, 133.0, 130.9, 130.5, 127.6, 127.5, 126.6, 123.3, 123.1, 122.4, 102.9, 40.4, 28.3, 21.6; HRMS (ESI) calcd for $\text{C}_{22}\text{H}_{23}\text{NO}_2\text{SBr}$ m/z $[\text{M}+\text{H}]^+$: 444.0627, found: 444.0633.



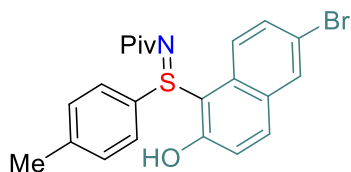
(Z)-N-((2-hydroxy-6-methoxynaphthalen-1-yl)(p-tolyl)- λ^4 -sulfaneylidene)pivalamide (3ac)

White solid ($R_f = 0.3$, DCM/PE/MeOH= 10:10:1); mp 110-111 °C; 27.6 mg, 70% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.03 (d, $J = 9.2$ Hz, 1H), 7.79 (d, $J = 9.0$ Hz, 1H), 7.63 (d, $J = 8.3$ Hz, 2H), 7.23-7.14 (m, 4H), 7.10 (d, $J = 2.7$ Hz, 1H), 3.87 (s, 3H), 2.30 (s, 3H), 1.27 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.2, 160.4, 156.4, 143.0, 133.9, 133.8, 130.7, 129.4, 127.6, 126.7, 122.3, 122.3, 120.6, 107.9, 104.0, 55.5, 40.5, 28.4, 21.6; HRMS (ESI) calcd for $\text{C}_{23}\text{H}_{26}\text{NO}_3\text{S}$ m/z $[\text{M}+\text{H}]^+$: 396.1628, found: 396.1628.



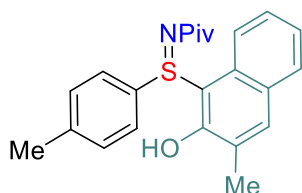
(Z)-N-((2-hydroxy-6-phenylnaphthalen-1-yl)(p-tolyl)- λ^4 -sulfaneylidene)pivalamide (3ad)

White solid ($R_f = 0.3$, DCM/PE/MeOH= 10:10:1); mp 158-159 °C; 34.8 mg, 79% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.18 (d, $J = 8.7$ Hz, 1H), 7.94 (d, $J = 9.0$ Hz, 2H), 7.80 (d, $J = 8.8$ Hz, 1H), 7.69 (d, $J = 8.1$ Hz, 2H), 7.65 (d, $J = 7.7$ Hz, 2H), 7.47 (t, $J = 7.5$ Hz, 2H), 7.37 (t, $J = 7.3$ Hz, 1H), 7.22 (dd, $J = 8.7, 3.2$ Hz, 3H), 2.31 (s, 3H), 1.30 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.1, 162.4, 143.1, 140.2, 137.0, 135.2, 133.8, 130.8, 130.8, 129.1, 128.6, 128.1, 127.7, 127.6, 127.2, 126.8, 122.4, 121.3, 103.6, 40.4, 28.4, 21.5; HRMS (ESI) calcd for $\text{C}_{28}\text{H}_{28}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 442.1835, found: 442.1838.



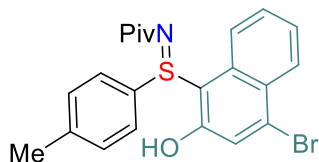
(Z)-N-((6-bromo-2-hydroxynaphthalen-1-yl)(p-tolyl)- λ^4 -sulfaneylidene)pivalamide (3ae)

White solid (R_f = 0.4, DCM/PE/MeOH= 10:10:1); mp 160-161 °C; 34.4 mg, 78% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.30 (s, 1H), 7.84 (d, J = 9.0 Hz, 1H), 7.62 (t, J = 8.9 Hz, 3H), 7.43 (d, J = 8.5 Hz, 1H), 7.22 (d, J = 8.0 Hz, 2H), 7.18 (d, J = 9.0 Hz, 1H), 2.33 (s, 3H), 1.27 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.1, 163.3, 143.4, 134.8, 133.4, 133.0, 130.9, 130.6, 127.6, 127.6, 126.7, 123.4, 123.2, 122.5, 102.9, 40.5, 28.3, 21.6; HRMS (ESI) calcd for $\text{C}_{22}\text{H}_{23}\text{NO}_2\text{SBr}$ m/z $[\text{M}+\text{H}]^+$: 444.0627, found: 444.0634.



(Z)-N-((2-hydroxy-3-methylnaphthalen-1-yl)(p-tolyl)- λ^4 -sulfaneylidene)pivalamide (3af)

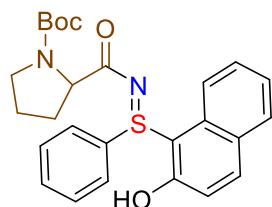
White solid (R_f = 0.5, DCM/PE/MeOH= 10:10:1); mp 156-158 °C; 34.1 mg, 90% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.11 (d, J = 8.5 Hz, 1H), 7.74 (s, 1H), 7.68 (d, J = 8.1 Hz, 1H), 7.63 (d, J = 8.1 Hz, 2H), 7.46 (t, J = 8.3 Hz, 1H), 7.32 (t, J = 7.5 Hz, 1H), 7.17 (d, J = 8.0 Hz, 2H), 2.42 (s, 3H), 2.29 (s, 3H), 1.29 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.1, 161.7, 142.8, 134.1, 133.9, 130.7, 130.7, 130.6, 128.2, 127.9, 127.5, 127.4, 124.0, 120.4, 103.1, 40.5, 28.4, 21.5, 17.0; HRMS (ESI) calcd for $\text{C}_{23}\text{H}_{26}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 380.1679, found: 380.1677.



(Z)-N-((4-bromo-2-hydroxynaphthalen-1-yl)(p-tolyl)- λ^4 -sulfaneylidene)pivalamide (3ag)

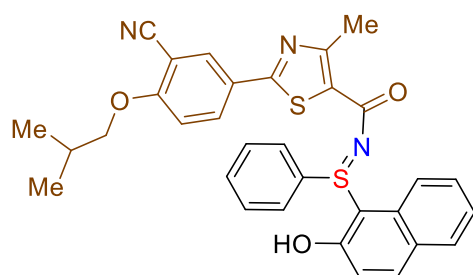
White solid (R_f = 0.5, DCM/PE/MeOH= 10:10:1); mp 151-152 °C; 36.7 mg, 83% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.18 (d, J = 8.4 Hz, 1H), 8.09 (d, J = 8.4 Hz, 1H), 7.64 (d, J = 8.0 Hz, 2H), 7.57 (t, J = 7.6 Hz, 2H), 7.44 (t, J = 7.7 Hz, 1H), 7.20 (d, J =

8.0 Hz, 2H), 2.31 (s, 3H), 1.27 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 187.9, 161.9, 143.4, 133.3, 132.1, 130.9, 130.0, 129.4, 128.6, 127.6, 127.0, 126.1, 125.3, 121.1, 103.4, 40.5, 28.3, 21.6; HRMS (ESI) calcd for $\text{C}_{22}\text{H}_{23}\text{NBrO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 444.0627, found: 444.0636.



tert-butyl(2S)-2-(((Z)-(2-hydroxynaphthalen-1-yl)(phenyl)- λ^4 -sulfaneylidene)carbamoyl)pyrrolidine-1-carboxylate (3ah)

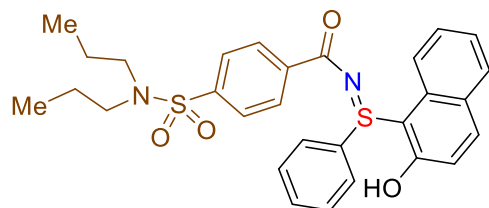
White solid (R_f = 0.25, DCM/PE/MeOH= 10:10:1); mp 124-126 °C; 41.4 mg, 90% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.07 (d, J = 8.4 Hz, 1H), 7.93 (d, J = 9.2 Hz, 1H), 7.69 – 7.79 (m, 3H), 7.50-7.60 (m, 1H), 7.34-7.40 (m, 4H), 7.21 (d, J = 9.2 Hz, 1H), 4.35-4.39 (m, 1H), 3.55-3.66 (m, 1H), 3.40-3.43 (m, 1H), 2.12-2.56 (m, 1H), 1.90-2.08 (m, 2H), 1.80-1.87 (m, 1H), 1.25 (s, 9H). ^{13}C NMR (100 MHz, CDCl_3) δ 182.6, 162.7, 154.2, 136.3, 135.5, 132.4, 131.8, 130.0, 129.2, 128.8, 128.0, 127.9, 124.3, 122.2, 120.7, 102.3, 79.5, 62.2, 46.8, 31.9, 28.6, 23.8; HRMS (ESI) calcd for $\text{C}_{26}\text{H}_{29}\text{N}_2\text{O}_4\text{S}$ m/z $[\text{M}+\text{H}]^+$: 465.1842, found: 465.1850.



(Z)-2-(3-cyano-4-isobutoxyphenyl)-N-((2-hydroxynaphthalen-1-yl)(phenyl)- λ^4 -sulfaneylidene)-4-methylthiazole-5-carboxamide (3ai)

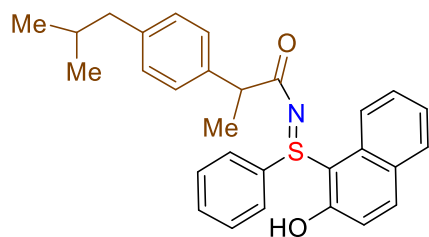
White solid (R_f = 0.25, DCM/PE/MeOH= 10:10:1); mp 161-163 °C; 36.7 mg, 65% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.23 (d, J = 8.5 Hz, 1H), 8.19 (d, J = 2.3 Hz, 1H), 8.10 (dd, J = 8.8, 2.4 Hz, 1H), 7.96 (d, J = 9.0 Hz, 1H), 7.82 (d, J = 8.1 Hz, 1H), 7.78 (d, J = 6.0 Hz, 2H), 7.60 (t, J = 7.7 Hz, 1H), 7.49-7.40 (m, 4H), 7.24 (d, J = 9.0 Hz, 1H), 6.98 (d, J = 8.9 Hz, 1H), 3.88 (d, J = 6.5 Hz, 2H), 2.81 (s, 3H), 2.24-2.14 (m, 1H), 1.08 (d, J = 6.7 Hz, 6H); ^{13}C NMR (100 MHz, CDCl_3) δ 170.2, 165.3, 162.3, 161.7, 158.5, 136.1, 135.7, 132.6, 132.5, 132.1, 131.8, 130.2, 129.2, 129.0, 128.5,

127.4, 127.3, 126.5, 124.6, 121.7, 120.9, 115.6, 112.6, 104.3, 102.9, 28.3, 19.2, 17.6; HRMS (ESI) calcd for C₃₂H₂₈N₃O₃S₂ m/z [M+H]⁺: 566.1567, found: 566.1573.



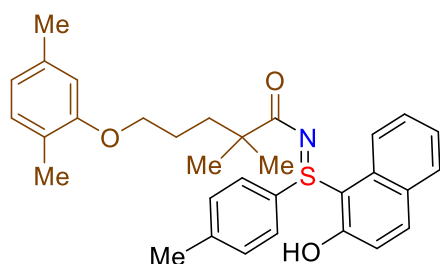
(Z)-4-(N,N-dipropylsulfamoyl)-N-((2-hydroxynaphthalen-1-yl)(phenyl)-λ⁴-sulfaneylidene)benzamide (3aj)

White solid (*R*_f = 0.25, DCM/PE/MeOH= 10:10:1); mp 158-159 °C; 39.5 mg, 74% yield; ¹H NMR (400 MHz, CDCl₃) δ 8.24-8.20 (m, 3H), 7.97 (d, *J* = 9.0 Hz, 1H), 7.86 (d, *J* = 8.2 Hz, 2H), 7.83-7.80 (m, 3H), 7.60 (t, *J* = 7.1 Hz, 1H), 7.50-7.40 (m, 4H), 7.25 (d, *J* = 9.3 Hz, 1H), 3.08 (t, *J* = 7.6 Hz, 4H), 1.59-1.50 (m, 4H), 0.86 (t, *J* = 7.4 Hz, 6H); ¹³C NMR (100 MHz, CDCl₃) δ 173.7, 162.1, 142.8, 138.6, 136.0, 135.7, 132.6, 131.8, 130.2, 129.5, 129.3, 129.0, 128.5, 127.7, 127.0, 124.6, 121.7, 120.8, 103.7, 50.1, 22.1, 11.3; HRMS (ESI) calcd for C₂₉H₃₁N₂O₄S₂ m/z [M+H]⁺: 535.1720, found: 535.1719.



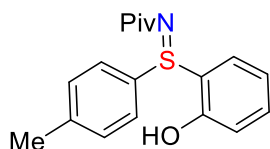
(Z)-N-((2-hydroxynaphthalen-1-yl)(phenyl)-λ⁴-sulfaneylidene)-2-(4-isobutylphenyl)propenamide (3ak)

Colorless oil (*R*_f = 0.3, DCM/PE/MeOH= 10:10:1); 27.8 mg, 61% yield; ¹H NMR (400 MHz, CDCl₃) δ 8.13 (dd, *J* = 35.4, 8.5 Hz, 1H), 7.85 (dd, *J* = 9.0, 3.1 Hz, 1H), 7.74 (t, *J* = 7.9 Hz, 1H), 7.67-7.60 (m, 1H), 7.58-7.50 (m, 1H), 7.48 (dd, *J* = 7.3, 1.5 Hz, 1H), 7.44-7.37 (m, 1H), 7.36-7.32 (m, 2H), 7.30-7.23 (m, 3H), 7.14-7.01 (m, 3H), 3.95-3.86 (m, 1H), 2.48-2.44 (m, 2H), 1.92-1.79 (m, 1H), 1.56 (t, *J* = 6.8 Hz, 3H), 0.89 (dd, *J* = 9.2, 6.6 Hz, 6H); ¹³C NMR (100 MHz, CDCl₃) δ 183.9, 183.6, 162.4, 162.3, 140.1, 140.0, 139.6, 136.7, 136.6, 135.2, 135.2, 132.2, 132.0, 131.9, 131.8, 130.0, 129.8, 129.3, 129.3, 129.1, 129.1, 128.7, 128.7, 128.3, 128.2, 127.4, 127.4, 127.3, 127.0, 124.3, 124.2, 121.9, 121.9, 120.9, 120.8, 104.0, 103.4, 48.1, 47.8, 45.2, 30.4, 30.3, 22.5, 19.0, 18.6; HRMS (ESI) calcd for C₂₉H₃₀NO₂S m/z [M+H]⁺: 456.1992, found: 456.1995.



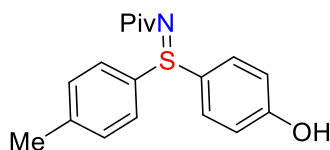
(Z)-5-(2,5-dimethylphenoxy)-N-((2-hydroxynaphthalen-1-yl)(phenyl)- λ^4 -sulfaneylidene)-2,2-dimethylpentanamide (3al)

White solid ($R_f = 0.5$, DCM/PE/MeOH= 10:10:1); mp 111-113 °C; 42.4 mg, 85% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.14 (d, $J = 8.5$ Hz, 1H), 7.91 (d, $J = 9.0$ Hz, 1H), 7.79 (d, $J = 4.8$ Hz, 3H), 7.55 (t, $J = 8.1$ Hz, 1H), 7.39 (d, $J = 8.3$ Hz, 4H), 7.19 (d, $J = 8.9$ Hz, 1H), 6.96 (d, $J = 7.4$ Hz, 1H), 6.62 (d, $J = 7.6$ Hz, 1H), 6.58 (s, 1H), 3.87 (s, 2H), 2.28 (s, 3H), 2.13 (s, 3H), 1.77 (s, 2H), 1.74 (s, 2H), 1.31 (s, 6H); ^{13}C NMR (100 MHz, CDCl_3) δ 187.3, 162.5, 157.1, 137.2, 136.5, 135.2, 132.3, 131.8, 130.3, 130.0, 129.1, 128.7, 128.3, 127.7, 124.3, 123.7, 122.0, 120.7, 120.6, 112.0, 103.3, 68.3, 43.6, 38.3, 26.3, 26.3, 25.3, 21.5, 15.9; HRMS (ESI) calcd for $\text{C}_{31}\text{H}_{34}\text{NO}_3\text{S}$ m/z $[\text{M}+\text{H}]^+$: 500.2254, found: 500.2263.



(Z)-N-((2-hydroxyphenyl)(p-tolyl)- λ^4 -sulfaneylidene)pivalamide (5a)

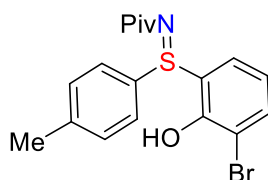
Brown solid ($R_f = 0.5$, PE/DCM/MeOH= 10:10:1); mp 140-142 °C; 14.5 mg, 46% yield; ^1H NMR (400 MHz, CDCl_3) δ 7.60 (d, $J = 8.0$ Hz, 2H), 7.33-7.38 (m, 1H), 7.22-7.26 (m, 3H), 6.97 (d, $J = 8.4$ Hz, 1H), 6.85 (t, $J = 7.2$ Hz, 1H), 2.33 (s, 3H), 1.25 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.5, 160.6, 143.1, 134.1, 134.0, 130.7, 129.5, 127.2, 120.4, 119.9, 114.3, 40.2, 28.4, 21.5; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{22}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 316.1372, found: 316.1366.



(Z)-N-((4-hydroxyphenyl)(p-tolyl)- λ^4 -sulfaneylidene)pivalamide (5a')

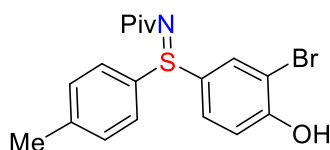
Brown solid ($R_f = 0.3$, PE/DCM/MeOH= 10:10:1); mp 181-183 °C; 11.2 mg, 35% yield; ^1H NMR (400 MHz, CDCl_3) δ 7.66 (d, $J = 8.0$ Hz, 2H), 7.34 (d, $J = 8.8$ Hz, 2H),

7.25 (d, $J = 8.0$ Hz, 2H), 6.55 (d, $J = 8.8$ Hz, 2H), 2.36 (s, 3H), 1.31 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 190.1, 161.5, 142.2, 132.2, 130.4, 129.4, 127.7, 125.0, 117.4, 40.5, 28.7, 21.5; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{22}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 316.1372, found: 316.1365.



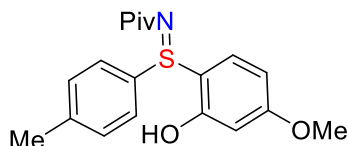
(Z)-N-((3-bromo-2-hydroxyphenyl)(p-tolyl)-l4-sulfaneylidene)pivalamide (5b)

Brown solid ($R_f = 0.6$, PE/DCM/MeOH= 10:10:1); mp 143-145 °C; 11.7 mg, 30% yield; ^1H NMR (400 MHz, CDCl_3) δ 7.66 (dd, $J = 1.6, 8.0$ Hz, 1H), 7.59-7.62 (m, 2H), 7.21-7.25 (m, 3H), 6.74 (t, $J = 8.0$ Hz, 1H), 2.35 (s, 3H), 1.25 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.6, 157.5, 143.7, 137.3, 133.9, 130.9, 128.8, 127.1, 120.4, 115.2, 114.1, 40.3, 28.4, 21.6; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{21}\text{BrNO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 394.0471, found: 394.0474.



(Z)-N-((3-bromo-4-hydroxyphenyl)(p-tolyl)-l4-sulfaneylidene)pivalamide (5b')

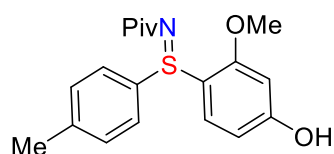
Brown solid ($R_f = 0.3$, PE/DCM/MeOH= 10:10:1); mp 194-195 °C; 9.8 mg, 25% yield; ^1H NMR (400 MHz, CDCl_3) δ 7.62-7.64 (m, 3H), 7.27-7.30 (m, 3H), 6.55 (t, $J = 8.8$ Hz, 1H), 2.38 (s, 3H), 1.29 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 190.3, 157.7, 142.7, 131.8, 131.2, 130.7, 129.1, 127.7, 127.1, 117.2, 112.2, 40.5, 27.7, 21.6; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{21}\text{BrNO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 394.0471, found: 394.0475.



(Z)-N-((2-hydroxy-4-methoxyphenyl)(p-tolyl)-l4-sulfaneylidene)pivalamide (5c)

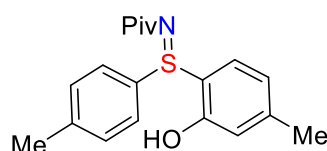
Brown solid ($R_f = 0.5$, PE/DCM/MeOH= 10:10:1); mp 154-155 °C; 19.6 mg, 57% yield; ^1H NMR (400 MHz, CDCl_3) δ 7.57 (d, $J = 8.4$ Hz, 2H), 7.24 (d, $J = 8.0$ Hz, 2H), 7.15 (d, $J = 8.8$ Hz, 1H), 6.50 (d, $J = 2.4$ Hz, 1H), 6.43 (dd, $J = 2.8, 8.8$ Hz, 1H), 3.78 (s, 3H), 2.35 (s, 3H), 1.25 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.2, 164.6, 162.8,

142.9, 134.6, 130.8, 130.7, 127.1, 107.7, 105.4, 104.4, 55.6, 40.3, 28.4, 21.5; HRMS (ESI) calcd for C₁₉H₂₄NO₃S m/z [M+H]⁺: 346.1471, found: 346.1477.



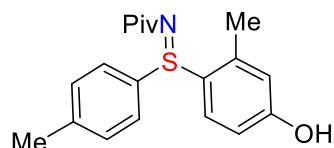
(Z)-N-((4-hydroxy-2-methoxyphenyl)(p-tolyl)-14-sulfaneylidene)pivalamide (5c')

Brown solid (R_f = 0.3, PE/DCM/MeOH= 10:10:1); mp 185-186 °C; 10.2 mg, 30% yield; ¹H NMR (400 MHz, CDCl₃) δ 7.60 (d, J = 8.0 Hz, 2H), 7.21-7.26 (m, 3H), 6.31 (dd, J = 2.0, 8.4 Hz, 1H), 6.14 (d, J = 2.0 Hz, 1H), 3.66 (s, 3H), 2.35 (s, 3H), 1.32 (s, 9H); ¹³C NMR (100 MHz, CDCl₃) δ 190.2, 163.0, 158.6, 142.0, 132.6, 130.2, 128.0, 126.9, 111.0, 110.1, 99.9, 55.7, 40.6, 28.8, 21.5; HRMS (ESI) calcd for C₁₉H₂₄NO₃S m/z [M+H]⁺: 346.1471, found: 346.1472.



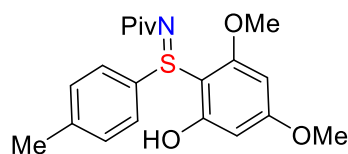
(Z)-N-((2-hydroxy-4-methylphenyl)(p-tolyl)-14-sulfaneylidene)pivalamide (5d)

White solid (R_f = 0.5, PE/DCM/MeOH= 10:10:1); mp 134-135 °C; 18.2 mg, 55% yield; ¹H NMR (400 MHz, CDCl₃) δ 7.59 (d, J = 8.4 Hz, 2H), 7.24 (d, J = 8.0 Hz, 2H), 7.14 (d, J = 8.0 Hz, 1H), 6.81 (d, J = 2.4 Hz, 1H), 6.69 (dd, J = 1.6, 8.0 Hz, 1H), 2.35 (s, 3H), 2.30 (s, 3H), 1.25 (s, 9H); ¹³C NMR (100 MHz, CDCl₃) δ 188.5, 160.6, 145.3, 142.9, 134.5, 130.7, 129.4, 127.2, 121.1, 120.8, 111.0, 40.3, 28.4, 21.7, 21.6; HRMS (ESI) calcd for C₁₉H₂₄NO₂S m/z [M+H]⁺: 330.1522, found: 330.1531.



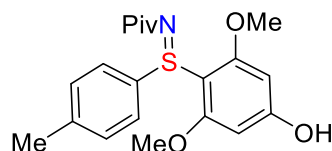
(Z)-N-((4-hydroxy-2-methylphenyl)(p-tolyl)-14-sulfaneylidene)pivalamide (5d')

White solid (R_f = 0.3, PE/DCM/MeOH= 10:10:1); mp 202-203 °C; 10.2 mg, 31% yield; ¹H NMR (400 MHz, CDCl₃) δ 7.51 (d, J = 8.0 Hz, 2H), 7.29 (d, J = 8.8 Hz, 1H), 7.24 (d, J = 8.0 Hz, 2H), 6.53 (dd, J = 2.4, 8.4 Hz, 1H), 6.23 (d, J = 1.2 Hz, 1H), 2.36 (s, 3H), 2.33 (s, 3H), 1.31 (s, 9H); ¹³C NMR (100 MHz, CDCl₃) δ 189.9, 161.0, 142.0, 140.6, 131.8, 130.4, 128.7, 127.9, 122.9, 118.3, 115.7, 40.5, 28.8, 21.5, 19.3; HRMS (ESI) calcd for C₁₉H₂₄NO₂S m/z [M+H]⁺: 330.1522, found: 330.1521.



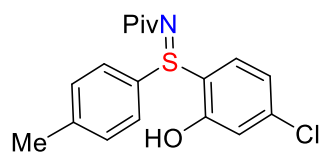
(Z)-N-((2-hydroxy-4,6-dimethoxyphenyl)(p-tolyl)-14-sulfaneylidene)pivalamide (5e)

Brown solid ($R_f = 0.5$, PE/DCM/MeOH= 10:10:1); mp 130-131 °C; 21.1 mg, 56% yield; ^1H NMR (400 MHz, CDCl_3) δ 7.62 (d, $J = 8.0$ Hz, 2H), 7.21 (d, $J = 8.0$ Hz, 2H), 6.10 (d, $J = 2.4$ Hz, 1H), 5.93 (d, $J = 2.4$ Hz, 1H), 3.76 (s, 3H), 3.75 (s, 3H), 2.34 (s, 3H), 1.21 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 187.6, 165.2, 164.1, 158.9, 142.5, 135.6, 130.4, 127.2, 96.4, 94.1, 91.0, 56.4, 55.6, 40.1, 28.3, 21.6; HRMS (ESI) calcd for $\text{C}_{20}\text{H}_{26}\text{NO}_4\text{S}$ m/z $[\text{M}+\text{H}]^+$: 376.1577, found: 376.1585.



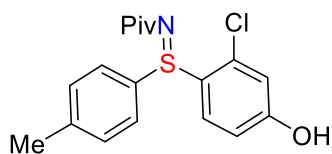
(Z)-N-((4-hydroxy-2,6-dimethoxyphenyl)(p-tolyl)-14-sulfaneylidene)pivalamide (5e')

White solid ($R_f = 0.3$, PE/DCM/MeOH= 10:10:1); mp 159-160 °C; 13.9 mg, 37% yield; ^1H NMR (400 MHz, CDCl_3) δ 7.59 (d, $J = 8.0$ Hz, 2H), 7.20 (d, $J = 8.0$ Hz, 2H), 5.77 (s, 2H), 3.58 (s, 6H), 2.36 (s, 3H), 1.29 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 189.1, 165.1, 161.7, 140.4, 131.7, 129.5, 127.2, 93.9, 55.9, 40.5, 28.9, 21.4; HRMS (ESI) calcd for $\text{C}_{20}\text{H}_{26}\text{NO}_4\text{S}$ m/z $[\text{M}+\text{H}]^+$: 376.1577, found: 376.1579.



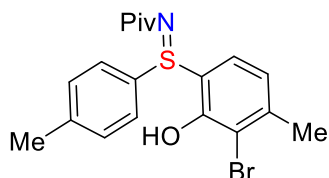
(Z)-N-((4-chloro-2-hydroxyphenyl)(p-tolyl)-14-sulfaneylidene)pivalamide (5f)

White solid ($R_f = 0.5$, PE/DCM/MeOH= 10:10:1); mp 198-200 °C; 10.8 mg, 31% yield; ^1H NMR (400 MHz, CDCl_3) δ 7.61 (d, $J = 8.4$ Hz, 2H), 7.27 (d, $J = 8.0$ Hz, 2H), 7.16 (d, $J = 8.4$ Hz, 1H), 6.99 (d, $J = 2.0$ Hz, 1H), 6.84 (dd, $J = 2.0, 8.4$ Hz, 1H), 2.37 (s, 3H), 1.25 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.6, 161.6, 143.6, 140.1, 133.8, 130.9, 130.3, 127.2, 120.7, 120.4, 112.9, 40.3, 28.4, 21.6; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{21}\text{ClNO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 350.0976, found: 350.0981.



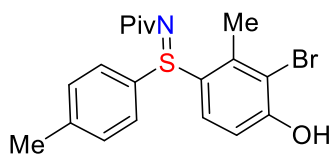
(Z)-N-((2-chloro-4-hydroxyphenyl)(p-tolyl)-14-sulfaneylidene)pivalamide (5f')

Brown solid ($R_f = 0.3$, PE/DCM/MeOH= 10:10:1); mp 178-179 °C; 7.7 mg, 22% yield; ^1H NMR (400 MHz, CDCl_3) δ 7.64 (d, $J = 8.4$ Hz, 2H), 7.35 (d, $J = 8.8$ Hz, 1H), 7.25 (d, $J = 7.6$ Hz, 2H), 6.66 (dd, $J = 2.4, 8.8$ Hz, 1H), 6.57 (d, $J = 2.4$ Hz, 1H), 2.36 (s, 3H), 1.32 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 190.7, 161.7, 142.8, 134.8, 131.2, 130.5, 128.4, 127.6, 122.2, 117.6, 116.7, 40.6, 28.7, 21.6; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{21}\text{ClNO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 350.0976, found: 350.0982.



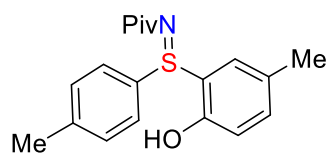
(Z)-N-((3-bromo-2-hydroxy-4-methylphenyl)(p-tolyl)-14-sulfaneylidene)pivalamide (5g)

Brown solid ($R_f = 0.5$, PE/DCM/MeOH= 10:10:1); mp 147-149 °C; 22.8 mg, 56% yield; ^1H NMR (400 MHz, CDCl_3) δ 7.60 (d, $J = 8.4$ Hz, 2H), 7.25 (d, $J = 8.0$ Hz, 2H), 7.13 (d, $J = 8.0$ Hz, 1H), 6.77 (d, $J = 8.4$ Hz, 1H), 2.41 (s, 3H), 2.35 (s, 3H), 1.26 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.3, 157.4, 145.0, 143.4, 134.2, 130.9, 127.8, 127.1, 121.6, 116.5, 112.0, 40.3, 28.4, 23.9, 21.6; HRMS (ESI) calcd for $\text{C}_{19}\text{H}_{23}\text{BrNO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 408.0627, found: 408.0628.



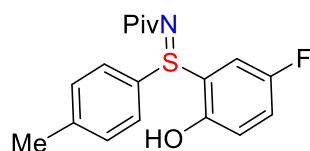
(Z)-N-((3-bromo-4-hydroxy-2-methylphenyl)(p-tolyl)-14-sulfaneylidene)pivalamide (5g')

Brown solid ($R_f = 0.3$, PE/DCM/MeOH= 10:10:1); mp 181-183 °C; 15.1 mg, 37% yield; ^1H NMR (400 MHz, CDCl_3) δ 7.48 (d, $J = 8.0$ Hz, 2H), 7.28 (d, $J = 8.8$ Hz, 1H), 7.23 (d, $J = 8.0$ Hz, 2H), 6.52 (d, $J = 8.8$ Hz, 1H), 2.59 (s, 3H), 2.36 (s, 3H), 1.30 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 190.2, 157.1, 142.4, 139.7, 132.0, 130.5, 128.0, 126.5, 125.2, 115.4, 115.2, 40.5, 28.8, 21.5, 20.2; HRMS (ESI) calcd for $\text{C}_{19}\text{H}_{23}\text{BrNO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 408.0627, found: 408.0630.



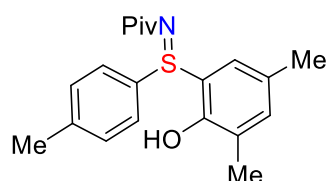
(Z)-N-((2-hydroxy-5-methylphenyl)(p-tolyl)-14-sulfaneylidene)pivalamide (5h)

Brown solid ($R_f = 0.5$, PE/DCM/MeOH= 10:10:1); mp 142-143 °C; 19.1 mg, 58% yield; ^1H NMR (400 MHz, CDCl_3) δ 7.65 (d, $J = 8.0$ Hz, 2H), 7.28 (d, $J = 8.4$ Hz, 2H), 7.06-7.11 (m, 1H), 6.92-6.96 (m, 2H), 2.37 (s, 3H), 1.25 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.9, 158.4, 143.1, 134.9, 134.4, 130.8, 129.5, 129.4, 127.3, 120.3, 113.6, 40.3, 28.4, 21.6, 20.4; HRMS (ESI) calcd for $\text{C}_{19}\text{H}_{24}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 330.1522, found: 330.1524.



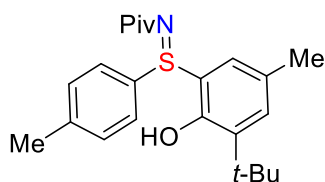
(Z)-N-((5-fluoro-2-hydroxyphenyl)(p-tolyl)-14-sulfaneylidene)pivalamide (5i)

Brown solid ($R_f = 0.5$, PE/DCM/MeOH= 10:10:1); mp 180-181 °C; 19.8 mg, 60% yield; ^1H NMR (400 MHz, CDCl_3) δ 7.62 (d, $J = 8.4$ Hz, 2H), 7.25 (d, $J = 7.2$ Hz, 2H), 7.19 (dd, $J = 2.4, 8.4$ Hz, 1H), 7.05 (d, $J = 2.0$ Hz, 1H), 6.90 (d, $J = 8.4$ Hz, 1H), 2.35 (s, 3H), 2.23 (s, 3H), 1.25 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.5, 156.7 (d, $J = 2.2$ Hz), 155.5 (d, $J = 240.3$ Hz), 143.6, 133.3, 130.9, 127.4, 121.5 (d, $J = 7.3$ Hz), 121.2 (d, $J = 22.7$ Hz), 115.1 (d, $J = 25.1$ Hz), 115.0 (d, $J = 6.7$ Hz), 40.3, 28.4, 21.6; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{21}\text{FNO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 334.1272, found: 334.1276.



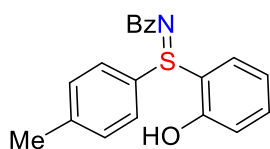
(Z)-N-((2-hydroxy-3,5-dimethylphenyl)(p-tolyl)-14-sulfaneylidene)pivalamide (5j)

White solid ($R_f = 0.5$, PE/DCM/MeOH= 10:10:1); mp 85-87 °C; 23.7 mg, 69% yield; ^1H NMR (400 MHz, CDCl_3) δ 7.60 (d, $J = 8.0$ Hz, 2H), 7.24 (d, $J = 8.0$ Hz, 2H), 7.07 (s, 1H), 6.92 (s, 1H), 2.35 (s, 3H), 2.23 (s, 3H), 2.20 (s, 3H), 1.26 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.4, 156.5, 142.9, 136.1, 134.4, 130.7, 129.4, 128.9, 127.2, 126.9, 112.9, 40.3, 28.4, 21.6, 20.4, 16.2; HRMS (ESI) calcd for $\text{C}_{20}\text{H}_{26}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 344.1679, found: 344.1685.



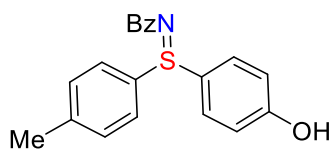
(Z)-N-((3-(tert-butyl)-2-hydroxy-5-methylphenyl)(p-tolyl)-14-sulfaneylidene)pivalamide (5k)

White solid ($R_f = 0.5$, PE/DCM/MeOH= 10:10:1); mp 93-95 °C; 31.6 mg, 82% yield; ^1H NMR (400 MHz, CDCl_3) δ 7.59 (d, $J = 8.4$ Hz, 2H), 7.23 (d, $J = 8.4$ Hz, 2H), 7.20 (d, $J = 2.0$ Hz, 1H), 6.97 (d, $J = 2.0$ Hz, 1H), 2.35 (s, 3H), 2.23 (s, 3H), 1.40 (s, 9H), 1.26 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.5, 157.8, 142.7, 140.7, 134.3, 132.3, 130.6, 128.4, 127.4, 127.3, 113.9, 40.4, 35.5, 29.4, 28.4, 21.5, 20.7; HRMS (ESI) calcd for $\text{C}_{23}\text{H}_{32}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 386.2148, found: 386.2149.



(Z)-N-((2-hydroxyphenyl)(p-tolyl)-14-sulfaneylidene)benzamide (5l)

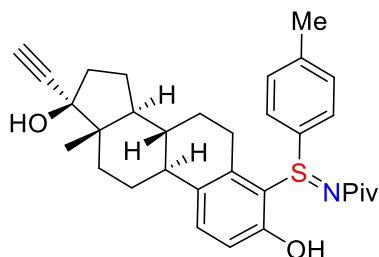
Brown solid ($R_f = 0.5$, PE/DCM/MeOH= 10:10:1); mp 151-153 °C; 13.6 mg, 40% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.13 (d, $J = 7.2$ Hz, 2H), 7.72 (d, $J = 8.0$ Hz, 2H), 7.47-7.51 (m, 1H), 7.38-7.44 (m, 3H), 7.33 (dd, $J = 1.6, 8.0$ Hz, 1H), 7.28 (d, $J = 8.0$ Hz, 2H), 7.04 (dd, $J = 1.2, 8.4$ Hz, 1H), 6.91 (t, $J = 7.6$ Hz, 1H), 2.37 (s, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 175.4, 160.3, 143.3, 135.2, 134.3, 132.9, 131.7, 130.8, 129.3, 128.9, 128.2, 127.6, 120.4, 120.3, 115.6, 21.6; HRMS (ESI) calcd for $\text{C}_{20}\text{H}_{18}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 336.1053, found: 336.1059.



(Z)-N-((4-hydroxyphenyl)(p-tolyl)-14-sulfaneylidene)benzamide (5l')

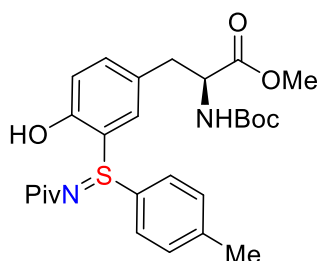
Brown solid ($R_f = 0.5$, PE/DCM/MeOH= 10:10:1); mp 176-178 °C; 10.4 mg, 31% yield; ^1H NMR (400 MHz, CDCl_3) δ 9.90 (s, 1H), 8.22-8.24 (m, 2H), 7.68-7.72 (m, 2H), 7.45-7.49 (m, 1H), 7.38-7.42 (m, 2H), 7.35-7.37 (m, 2H), 7.29 (d, $J = 8.0$ Hz, 2H), 6.52-6.56 (m, 2H), 2.39 (s, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 176.5, 161.4, 142.6, 131.4, 130.6, 129.8, 129.0, 128.9, 128.2, 127.9, 127.2, 117.5, 116.1, 21.6;

HRMS (ESI) calcd for $C_{20}H_{18}NO_2S$ m/z $[M+H]^+$: 336.1053, found: 336.1059.



N-((Z)-((8R,9S,13S,14S,17R)-17-ethynyl-3,17-dihydroxy-13-methyl-7,8,9,11,12,13,14,15,16,17-decahydro-6H-cyclopenta[a]phenanthren-4-yl)(p-tolyl)-14-sulfaneylidene)pivalamide (5m)

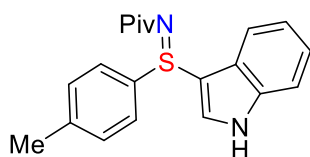
Brown solid ($R_f = 0.5$, DCM/MeOH= 30:1); mp 152-154 °C; 25.9 mg, 50% yield; 1H NMR (400 MHz, $CDCl_3$) δ 7.60 (dd, $J = 2.8, 8.4$ Hz, 2H), 7.21-7.25 (m, 2H), 7.18 (d, $J = 4.0$ Hz, 1H), 6.70 (d, $J = 8.8$ Hz, 1H), 2.74-2.86 (m, 2H), 2.55 (d, $J = 6.8$ Hz, 1H), 2.32 (d, $J = 3.6$ Hz, 3H), 1.61-2.29 (m, 9H), 1.25-1.47 (m, 4H), 1.23 (s, 9H), 0.84 (d, $J = 9.6$ Hz, 3H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 188.4, 157.8, 143.9, 142.7, 134.6, 132.8, 130.6, 127.1, 126.3, 119.9, 111.3, 87.7, 79.6, 77.5, 77.2, 76.8, 73.9, 49.4, 47.0, 43.2, 40.2, 39.0, 38.9, 32.6, 29.7, 28.4, 26.9, 26.3, 22.7, 21.5, 12.7; HRMS (ESI) calcd for $C_{32}H_{40}NO_3S$ m/z $[M+H]^+$: 518.2723, found: 518.2721.



methyl

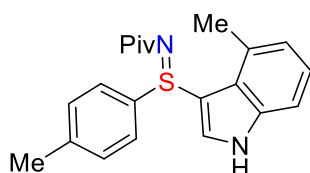
(2S)-2-((tert-butoxycarbonyl)amino)-3-(4-hydroxy-3-((Z)-N-pivaloyl-S-(p-tolyl)sulfanimidoyl)phenyl)propanoate (5n)

Pale-yellow oil ($R_f = 0.5$, DCM/MeOH= 30:1); 27.8 mg, 54% yield; 1H NMR (400 MHz, $CDCl_3$) δ 7.55-7.60 (m, 2H), 7.24 (d, $J = 8.0$ Hz, 2H), 7.13 (dt, $J = 2.0, 8.4$ Hz, 1H), 7.00-7.02 (m, 1H), 6.90 (dd, $J = 3.2, 8.4$ Hz, 1H), 5.00 (d, $J = 8.0$ Hz, 1H), 4.45-4.52 (m, 1H), 3.64 (s, 3H), 2.87-3.05 (m, 2H), 2.34 (s, 3H), 1.41 (s, 9H), 1.24 (s, 9H); ^{13}C NMR (100 MHz, $CDCl_3$) δ 188.5, 172.1, 159.8, 155.1, 143.1, 135.0, 134.2, 130.8, 130.0, 127.8, 127.2, 120.6, 113.9, 80.3, 54.4, 52.5, 40.3, 37.4, 28.4, 28.3, 21.5; HRMS (ESI) calcd for $C_{27}H_{37}N_2O_6S$ m/z $[M+H]^+$: 517.2367, found: 517.2365.



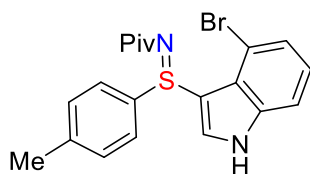
(Z)-N-((1H-indol-3-yl)(p-tolyl)-λ⁴-sulfaneylidene)pivalamide (7a)^[3]

White solid (R_f = 0.4, DCM/MeOH= 20:1); 32.2 mg, 95% yield; ^1H NMR (400 MHz, CDCl_3) δ 11.27 (s, 1H), 7.66 (d, J = 8.0 Hz, 2H), 7.59-7.56 (m, 1H), 7.25-7.20 (m, 3H), 7.13-7.11 (m, 1H), 7.01-6.96 (m, 2H), 2.33 (s, 3H), 1.33 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 190.3, 141.2, 137.4, 132.3, 131.6, 130.1, 127.2, 123.8, 123.3, 121.2, 119.6, 113.0, 104.6, 40.8, 29.0, 21.4. HRMS (ESI) calcd for $\text{C}_{20}\text{H}_{23}\text{N}_2\text{OS}$ m/z $[\text{M}+\text{H}]^+$: 339.1526, found: 339.1529.



(Z)-N-((4-methyl-1H-indol-3-yl)(p-tolyl)-λ⁴-sulfaneylidene)pivalamide (7b)

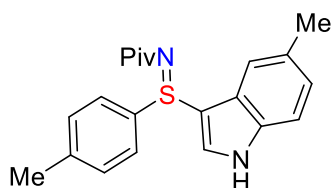
White solid (R_f = 0.4, DCM/MeOH= 20:1); mp 185-187 °C; 26.1 mg, 74% yield; ^1H NMR (400 MHz, CDCl_3) δ 11.20 (s, 1H), 7.50 (d, J = 8.0 Hz, 2H), 7.31 (d, J = 3.1 Hz, 1H), 7.20 (d, J = 8.0 Hz, 2H), 6.95 (d, J = 8.2 Hz, 1H), 6.87 (t, J = 7.7 Hz, 1H), 6.76 (d, J = 7.1 Hz, 1H), 2.43 (s, 3H), 2.34 (s, 3H), 1.33 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 188.8, 141.4, 137.7, 134.0, 132.0, 130.2, 129.9, 127.3, 123.8, 123.5, 123.0, 110.3, 104.7, 40.5, 28.9, 21.4, 21.2; HRMS (ESI) calcd for $\text{C}_{21}\text{H}_{25}\text{N}_2\text{OS}$ m/z $[\text{M}+\text{H}]^+$: 353.1682, found: 353.1683.



(Z)-N-((4-bromo-1H-indol-3-yl)(p-tolyl)-λ⁴-sulfaneylidene)pivalamide (7c)

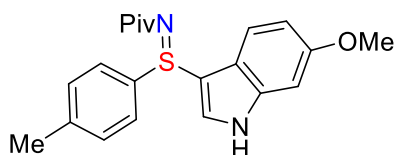
White solid (R_f = 0.5, DCM/MeOH= 20:1); mp 236-238 °C; 30.4 mg, 73% yield; ^1H NMR (400 MHz, $\text{DMSO}-d_6$) δ 12.42 (s, 1H), 7.99 (s, 1H), 7.63 (d, J = 8.0 Hz, 2H), 7.56 (d, J = 8.2 Hz, 1H), 7.34 (d, J = 7.4 Hz, 1H), 7.30 (d, J = 7.9 Hz, 2H), 7.14 (t, J = 7.8 Hz, 1H), 2.30 (s, 3H), 1.14 (s, 9H); ^{13}C NMR (100 MHz, $\text{DMSO}-d_6$) δ 187.0, 141.5, 137.9, 135.8, 131.2, 130.1, 127.7, 124.9, 124.1, 123.9, 112.6, 111.2, 106.4,

28.7, 20.9; HRMS (ESI) calcd for C₂₀H₂₂BrN₂OS m/z [M+H]⁺: 417.0631, found: 417.0634.



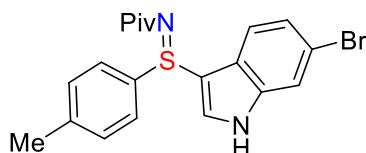
(Z)-N-((5-methyl-1H-indol-3-yl)(p-tolyl)-λ⁴-sulfaneylidene)pivalamide (7d)

White solid (R_f = 0.4, DCM/MeOH= 20:1); mp 132-133 °C; 27.5 mg, 78% yield; ¹H NMR (400 MHz, CDCl₃) δ 11.15 (s, 1H), 7.64 (d, *J* = 8.0 Hz, 2H), 7.37 (s, 1H), 7.21 (d, *J* = 8.0 Hz, 2H), 7.18 (s, 1H), 7.02 (d, *J* = 8.3 Hz, 1H), 6.81 (d, *J* = 8.3 Hz, 1H), 2.34 (s, 3H), 2.32 (s, 3H), 1.33 (s, 9H); ¹³C NMR (100 MHz, CDCl₃) δ 189.9, 141.7, 136.0, 132.9, 131.9, 131.1, 130.6, 127.7, 125.3, 124.7, 119.5, 113.1, 103.9, 41.2, 29.4, 22.1, 21.9; HRMS (ESI) calcd for C₂₁H₂₅N₂OS m/z [M+H]⁺: 353.1682, found: 353.1691.



(Z)-N-((6-methoxy-1H-indol-3-yl)(p-tolyl)-λ⁴-sulfaneylidene)pivalamide (7e)

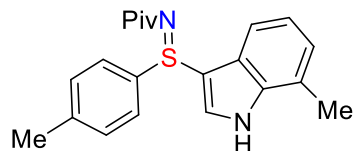
White solid (R_f = 0.4, DCM/MeOH= 20:1); mp 199-201 °C; 32.7 mg, 89% yield; ¹H NMR (400 MHz, CDCl₃) δ 11.01 (s, 1H), 7.68 (d, *J* = 8.1 Hz, 2H), 7.39 (d, *J* = 8.8 Hz, 1H), 7.31 (d, *J* = 2.9 Hz, 1H), 7.22 (d, *J* = 8.1 Hz, 2H), 6.59-6.56 (m, 1H), 6.30 (d, *J* = 2.2 Hz, 1H), 3.60 (s, 3H), 2.34 (s, 3H), 1.35 (s, 9H); ¹³C NMR (100 MHz, CDCl₃) δ 190.1, 156.9, 141.3, 138.4, 132.1, 130.8, 130.1, 127.3, 119.8, 117.3, 111.9, 104.3, 95.1, 55.2, 40.9, 28.9, 21.4; HRMS (ESI) calcd for C₂₁H₂₅N₂O₂S m/z [M+H]⁺: 369.1631, found: 369.1630.



(Z)-N-((6-bromo-1H-indol-3-yl)(p-tolyl)-λ⁴-sulfaneylidene)pivalamide (7f)

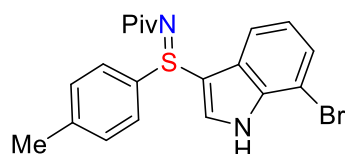
White solid (R_f = 0.5, DCM/MeOH= 20:1); mp 217-219 °C; 35.3 mg, 85% yield; ¹H NMR (400 MHz, DMSO-*d*₆) δ 12.16 (s, 1H), 8.23 (s, 1H), 7.69 (s, 1H), 7.63 (d, *J* = 8.7 Hz, 1H), 7.58 (d, *J* = 7.6 Hz, 2H), 7.31 (d, *J* = 7.9 Hz, 2H), 7.22 (d, *J* = 8.5 Hz,

1H), 2.29 (s, 3H), 1.17 (s, 9H); ¹³C NMR (100 MHz, DMSO-*d*₆) δ 187.6, 141.0, 137.9, 133.8, 132.2, 130.0, 126.1, 123.9, 123.2, 121.4, 115.8, 115.5, 105.3, 28.7, 20.8; HRMS (ESI) calcd for C₂₀H₂₂BrN₂OS m/z [M+H]⁺: 417.0631, found: 417.0630.



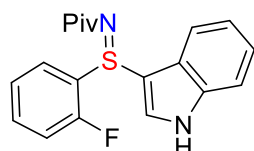
(Z)-N-((7-methyl-1H-indol-3-yl)(p-tolyl)-λ⁴-sulfaneylidene)pivalamide (7g)

White solid (R_f = 0.4, DCM/MeOH= 20:1); mp 214-216 °C; 30.6 mg, 88% yield; ¹H NMR (400 MHz, DMSO-*d*₆) δ 12.06 (s, 1H), 8.20 (s, 1H), 7.57 (d, *J* = 7.6 Hz, 2H), 7.49 (d, *J* = 6.9 Hz, 1H), 7.31 (d, *J* = 7.4 Hz, 2H), 6.96 (t, *J* = 7.2 Hz, 2H), 2.45 (s, 3H), 2.29 (s, 3H), 1.17 (s, 9H); ¹³C NMR (100 MHz, DMSO-*d*₆) δ 187.5, 140.7, 136.6, 134.1, 131.0, 129.9, 126.1, 124.0, 123.4, 122.3, 121.1, 117.3, 105.1, 28.8, 20.8, 16.7; HRMS (ESI) calcd for C₂₁H₂₅N₂OS m/z [M+H]⁺: 353.1682, found: 353.1682.



(Z)-N-((7-bromo-1H-indol-3-yl)(p-tolyl)-λ⁴-sulfaneylidene)pivalamide (7h)

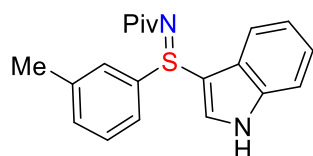
White solid (R_f = 0.4, DCM/MeOH= 20:1); mp 236-238 °C; 32.8 mg, 79% yield; ¹H NMR (400 MHz, DMSO-*d*₆) δ 12.33 (s, 1H), 8.27 (s, 1H), 7.72 (d, *J* = 7.9 Hz, 1H), 7.60 (d, *J* = 7.8 Hz, 2H), 7.42 (d, *J* = 7.5 Hz, 1H), 7.31 (d, *J* = 7.8 Hz, 2H), 7.02 (t, *J* = 7.7 Hz, 1H), 2.29 (s, 3H), 1.17 (s, 9H); ¹³C NMR (100 MHz, DMSO-*d*₆) δ 187.7, 141.0, 135.4, 133.8, 132.2, 130.0, 126.1, 125.8, 125.8, 122.4, 119.3, 106.5, 105.2, 28.7, 20.8; HRMS (ESI) calcd for C₂₀H₂₂BrN₂OS m/z [M+H]⁺: 417.0631, found: 417.0634.



(E)-N-((2-fluorophenyl)(1H-indol-3-yl)-λ⁴-sulfaneylidene)pivalamide (7i)

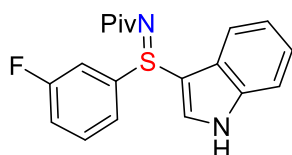
White solid (R_f = 0.5, DCM/MeOH= 20:1); mp 169-171 °C; 28.4 mg, 83% yield; ¹H NMR (400 MHz, CDCl₃) δ 11.06 (s, 1H), 8.27 (t, *J* = 7.7 Hz, 1H), 7.76-7.40 (m, 1H), 7.37-7.34 (m, 2H), 7.30 (t, *J* = 7.5 Hz, 1H), 7.16-7.14 (m, 1H), 7.08-7.02 (m, 2H), 6.99 (t, *J* = 9.0 Hz, 1H), 1.35 (s, 9H); ¹³C NMR (100 MHz, CDCl₃) δ 190.2, 161.1,

158.6, 137.1, 133.2, 133.1, 130.9, 128.0, 125.0, 125.0, 124.1, 123.4, 123.1, 121.3, 119.3, 116.8, 116.6, 113.0, 103.0, 40.8, 28.9; ^{19}F NMR (376 MHz, CDCl_3) δ -112.07 (s, 1F); HRMS (ESI) calcd for $\text{C}_{19}\text{H}_{20}\text{FN}_2\text{OS}$ m/z $[\text{M}+\text{H}]^+$: 343.1275, found: 343.1274.



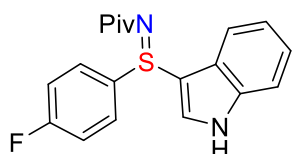
(Z)-N-((1H-indol-3-yl)(m-tolyl)- λ^4 -sulfaneylidene)pivalamide (7j)

White solid (R_f = 0.4, DCM/MeOH= 20:1); mp 189-191 °C; 31.4 mg, 93% yield; ^1H NMR (400 MHz, CDCl_3) δ 11.38 (s, 1H), 7.62-7.58 (m, 2H), 7.54 (s, 1H), 7.32-7.29 (m, 2H), 7.20 (d, J = 7.6 Hz, 1H), 7.15-7.12 (m, 1H), 7.02-6.99 (m, 2H), 2.33 (s, 3H), 1.35 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 190.2, 139.5, 137.4, 135.3, 131.7, 129.2, 127.6, 124.3, 123.9, 123.3, 121.2, 119.6, 113.0, 104.2, 40.8, 28.9, 21.6; HRMS (ESI) calcd for $\text{C}_{20}\text{H}_{23}\text{N}_2\text{OS}$ m/z $[\text{M}+\text{H}]^+$: 339.1526, found: 339.1529.



(Z)-N-((3-fluorophenyl)(1H-indol-3-yl)- λ^4 -sulfaneylidene)pivalamide (7k)

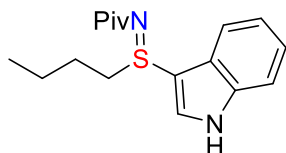
White solid (R_f = 0.4, DCM/MeOH= 20:1); mp 193-195 °C; 29.4 mg, 86% yield; ^1H NMR (400 MHz, CDCl_3) δ 11.41 (s, 1H), 7.66 (d, J = 8.7 Hz, 1H), 7.54 (d, J = 6.5 Hz, 1H), 7.47 (d, J = 7.9 Hz, 1H), 7.40-7.34 (m, 1H), 7.31 (d, J = 2.9 Hz, 1H), 7.17 (d, J = 7.1 Hz, 1H), 7.10 (t, J = 8.2 Hz, 1H), 7.05-6.99 (m, 2H), 1.35 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 190.6, 162.9 (d, J = 249.2 Hz), 137.8, 137.4, 132.2, 130.9 (d, J = 7.8 Hz), 123.6, 123.5, 123.2 (d, J = 3.3 Hz), 121.5, 119.4, 117.9 (d, J = 21.4 Hz), 114.7 (d, J = 25.3 Hz), 113.1, 103.8, 40.9, 28.9; ^{19}F NMR (376 MHz, CDCl_3) δ -109.55 (s, 1F); HRMS (ESI) calcd for $\text{C}_{19}\text{H}_{20}\text{FN}_2\text{OS}$ m/z $[\text{M}+\text{H}]^+$: 343.1275, found: 343.1275.



(Z)-N-((4-fluorophenyl)(1H-indol-3-yl)- λ^4 -sulfaneylidene)pivalamide (7l)^[3]

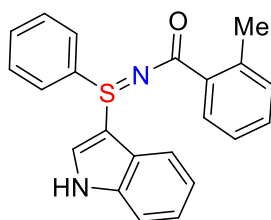
White solid (R_f = 0.4, DCM/MeOH= 20:1); 30.1 mg, 88% yield; ^1H NMR (400 MHz, CDCl_3) δ 11.37 (s, 1H), 7.80-7.77 (m, 2H), 7.52 (d, J = 8.8 Hz, 1H), 7.30 (d, J = 3.0

Hz, 1H), 7.17-7.09 (m, 3H), 7.04-6.98 (m, 2H), 1.33 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 190.4, 164.1 (d, $J = 250.5$ Hz), 137.4, 131.9, 130.8, 129.6 (d, $J = 8.7$ Hz), 123.6, 123.5, 121.4, 119.4, 116.7 (d, $J = 22.4$ Hz), 113.1, 104.1, 40.8, 28.9. ^{19}F NMR (376 MHz, CDCl_3) δ -109.02 (s, 1F).



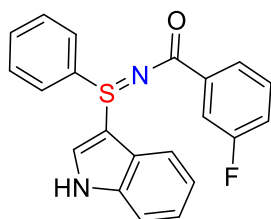
(Z)-N-(butyl(1H-indol-3-yl)- λ^4 -sulfaneylidene)pivalamide (7m)

Colorless oil ($R_f = 0.4$, DCM/MeOH= 20:1); 20.7 mg, 68% yield; ^1H NMR (400 MHz, CDCl_3) δ 11.24 (s, 1H), 7.94 (d, $J = 7.7$ Hz, 1H), 7.10-6.98 (m, 4H), 3.36 (d, $J = 48.5$ Hz, 2H), 1.64-1.45 (m, 2H), 1.44-1.37 (m, 2H), 1.27 (s, 9H), 0.87 (t, $J = 7.2$ Hz, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 189.7, 137.3, 131.0, 123.9, 123.3, 121.0, 119.4, 113.1, 101.8, 46.8, 40.4, 28.9, 26.0, 21.6, 13.7; HRMS (ESI) calcd for $\text{C}_{17}\text{H}_{25}\text{N}_2\text{OS}$ m/z $[\text{M}+\text{H}]^+$: 305.1682, found: 305.1682.



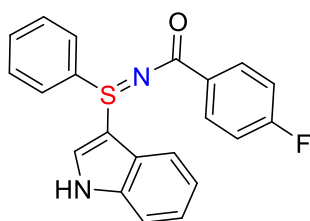
(Z)-N-((1H-indol-3-yl)(phenyl)- λ^4 -sulfaneylidene)-2-methylbenzamide (7n)

White solid ($R_f = 0.4$, DCM/MeOH= 20:1); mp 155-157 $^\circ\text{C}$; 32.2 mg, 90% yield; ^1H NMR (400 MHz, CDCl_3) δ 11.34 (s, 1H), 7.91 (d, $J = 6.9$ Hz, 1H), 7.83-7.81 (m, 2H), 7.53 (d, $J = 7.9$ Hz, 1H), 7.45-7.44 (m, 3H), 7.33 (d, $J = 3.0$ Hz, 1H), 7.27 (t, $J = 6.0$ Hz, 1H), 7.21-7.17 (m, $J = 6.4$ Hz, 3H), 7.07 (t, $J = 7.6$ Hz, 1H), 7.01 (t, $J = 7.5$ Hz, 1H), 2.61 (s, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 180.0, 137.8, 137.4, 137.3, 134.7, 132.2, 131.2, 131.1, 129.6, 129.6, 129.6, 127.5, 125.6, 123.9, 123.7, 121.8, 119.6, 113.1, 103.8, 21.7; HRMS (ESI) calcd for $\text{C}_{22}\text{H}_{19}\text{N}_2\text{OS}$ m/z $[\text{M}+\text{H}]^+$: 359.1213, found: 359.1220.



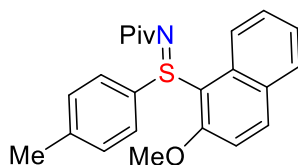
(Z)-N-((1H-indol-3-yl)(phenyl)- λ^4 -sulfaneylidene)-3-fluorobenzamide (7o)

White solid (R_f = 0.4, DCM/MeOH= 20:1); mp 175-177 °C; 30.4 mg, 84% yield; ^1H NMR (400 MHz, CDCl_3) δ 11.30 (s, 1H), 8.08 (d, J = 7.7 Hz, 1H), 7.99 (d, J = 7.4 Hz, 1H), 7.87-7.85 (m, 2H), 7.50-7.44 (m, 5H), 7.40-7.34 (m, 1H), 7.18-7.13 (m, 2H), 7.02-6.95 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3) δ 175.2, 162.7 (d, J = 243.6 Hz), 139.6, 137.4, 134.4, 132.6, 131.3, 129.7 (d, J = 2.8 Hz), 129.6, 127.4, 124.6 (d, J = 2.7 Hz), 123.8, 123.6, 121.8, 119.5, 118.0 (d, J = 21.3 Hz), 115.8 (d, J = 22.2 Hz), 113.2, 103.1; ^{19}F NMR (376 MHz, CDCl_3) δ -113.59 (s, 1F); HRMS (ESI) calcd for $\text{C}_{21}\text{H}_{16}\text{FN}_2\text{OS}$ m/z $[\text{M}+\text{H}]^+$: 363.0962, found: 363.0960.



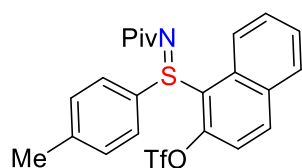
(Z)-N-((1H-indol-3-yl)(phenyl)- λ^4 -sulfaneylidene)-4-fluorobenzamide (7p)^[3]

White solid (R_f = 0.4, DCM/MeOH= 20:1); 31.9 mg, 88% yield; ^1H NMR (400 MHz, CDCl_3) δ 11.32 (s, 1H), 8.33-8.30 (m, 2H), 7.88-7.85 (m, 2H), 7.52-7.44 (m, 5H), 7.12 (d, J = 7.9 Hz, 1H), 7.08 (t, J = 8.5 Hz, 2H), 6.01-6.94 (m, 2H); ^{13}C NMR (100 MHz, CDCl_3) δ 175.9, 164.9 (d, J = 248.5 Hz), 137.4, 134.8, 133.3, 133.2, 132.3, 131.2 (d, J = 5.0 Hz), 131.1, 129.6, 127.4, 123.7 (d, J = 5.1 Hz), 121.8, 119.6, 114.9 (d, J = 21.4 Hz), 113.1, 104.1; ^{19}F NMR (376 MHz, CDCl_3) δ -109.87 (s, 1F). HRMS (ESI) calcd for $\text{C}_{21}\text{H}_{16}\text{N}_2\text{FOS}$ m/z $[\text{M}+\text{H}]^+$: 363.0962, found: 363.0968.



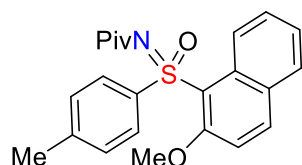
(Z)-N-((2-methoxynaphthalen-1-yl)(p-tolyl)- λ^4 -sulfaneylidene)pivalamide (8a)

White solid (R_f = 0.2, PE/EA= 2:1); mp 136-138 °C; 356 mg, 94% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.72 (d, J = 8.6 Hz, 1H), 7.96 (d, J = 9.1 Hz, 1H), 7.74 (d, J = 8.1 Hz, 1H), 7.61 (d, J = 8.2 Hz, 2H), 7.40 (t, J = 7.8 Hz, 1H), 7.32-7.28 (m, 2H), 7.18 (d, J = 8.1 Hz, 2H), 4.08 (s, 3H), 2.31 (s, 3H), 1.25 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 189.8, 159.3, 140.5, 135.5, 131.9, 131.9, 130.1, 129.9, 128.8, 127.9, 126.9, 124.7, 124.2, 116.0, 113.6, 57.7, 40.6, 28.9, 21.4; HRMS (ESI) calcd for $\text{C}_{23}\text{H}_{26}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 380.1679, found: 380.1686.



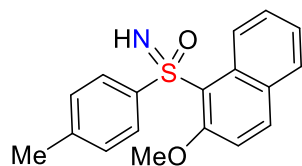
(Z) -1-(N-pivaloyl-S-(p-tolyl)sulfinimidoyl)naphthalen-2-yl trifluoromethanesulfonate (8b)

White solid ($R_f = 0.4$, DCM/EA = 5:1); mp 172-174 °C; 22.4 mg, 45% yield; ^1H NMR (400 MHz, CDCl_3) δ 8.80 – 8.73 (m, 1H), 8.09 (d, $J = 9.1$ Hz, 1H), 7.90-7.88 (m, 1H), 7.63 (d, $J = 8.3$ Hz, 2H), 7.59-7.52 (m, 2H), 7.47 (d, $J = 9.1$ Hz, 1H), 7.23 (d, $J = 8.2$ Hz, 2H), 2.35 (s, 3H), 1.24 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 190.5, 148.3, 141.5, 135.9, 133.4, 131.3, 130.3, 130.0, 129.1, 129.0, 127.9, 127.2, 125.4, 125.3, 119.5 (d, $J = 1.7$ Hz), 118.6 (q, $J = 318.7$ Hz), 40.7, 28.7, 21.4; ^{19}F NMR (376 MHz, CDCl_3) δ -73.12 (s, 3F); HRMS (ESI) calcd for $\text{C}_{23}\text{H}_{23}\text{NF}_3\text{O}_4\text{S}_2$ m/z $[\text{M}+\text{H}]^+$: 498.1015, found: 498.1023.



N-((2-methoxynaphthalen-1-yl)(oxo)(p-tolyl)- λ^6 -sulfaneylidene)pivalamide (9)

White solid ($R_f = 0.5$, PE/EA = 3:1); mp 151-153 °C; 31.8 mg, 40% yield; ^1H NMR (400 MHz, CDCl_3) δ 9.55 (d, $J = 9.1$ Hz, 1H), 7.98-1.95 (m, 3H), 7.77 (d, $J = 9.6$ Hz, 1H), 7.68-7.64 (m, 1H), 7.46-7.41 (m, 1H), 7.24 (d, $J = 8.2$ Hz, 2H), 7.06 (d, $J = 9.0$ Hz, 1H), 3.59 (s, 3H), 2.40 (s, 3H), 1.26 (s, 9H); ^{13}C NMR (100 MHz, CDCl_3) δ 187.4, 155.9, 143.5, 139.9, 136.7, 133.3, 129.6, 129.0, 129.0, 128.7, 127.9, 124.8, 124.7, 120.0, 112.8, 56.1, 41.7, 28.0, 21.7; HRMS (ESI) calcd for $\text{C}_{23}\text{H}_{26}\text{NO}_3\text{S}$ m/z $[\text{M}+\text{H}]^+$: 396.1628, found: 396.1637.



imino(2-methoxynaphthalen-1-yl)(p-tolyl)- λ^6 -sulfanone (10)

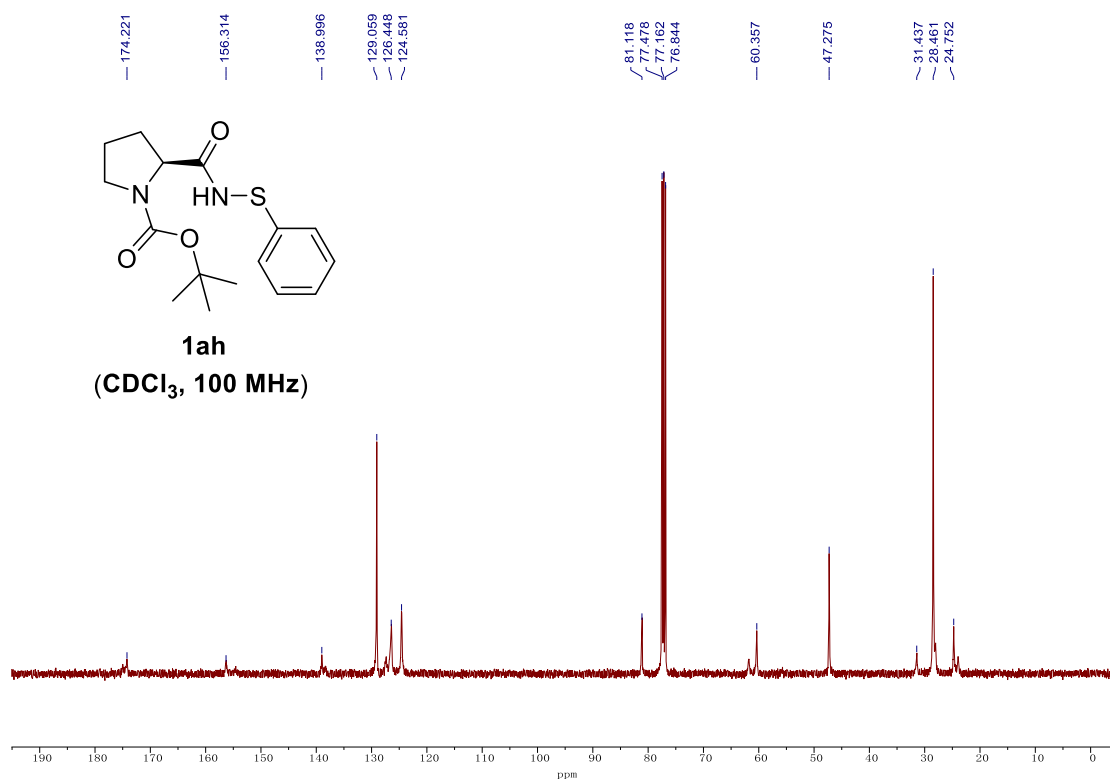
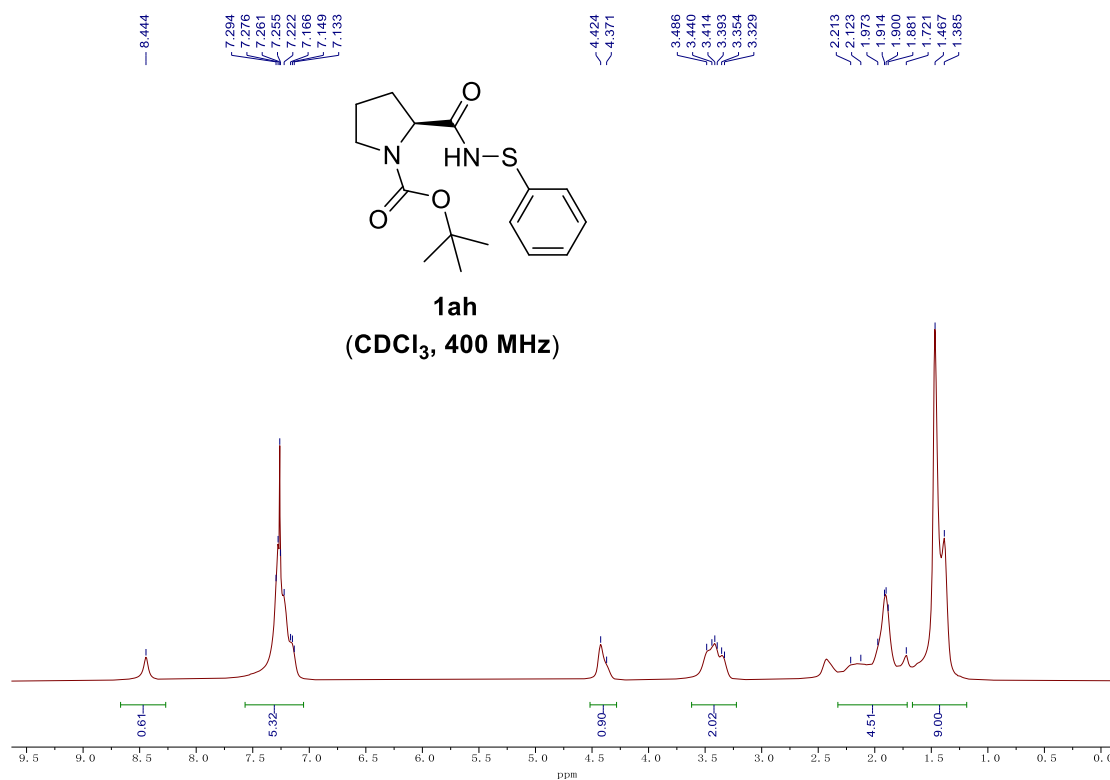
Colorless oil ($R_f = 0.3$, PE/EA = 1:1); 29.5 mg, 95% yield; ^1H NMR (400 MHz, CDCl_3) δ 9.37 (d, $J = 10.1$ Hz, 1H), 7.95 (d, $J = 9.1$ Hz, 1H), 7.87 (d, $J = 6.8$ Hz, 2H),

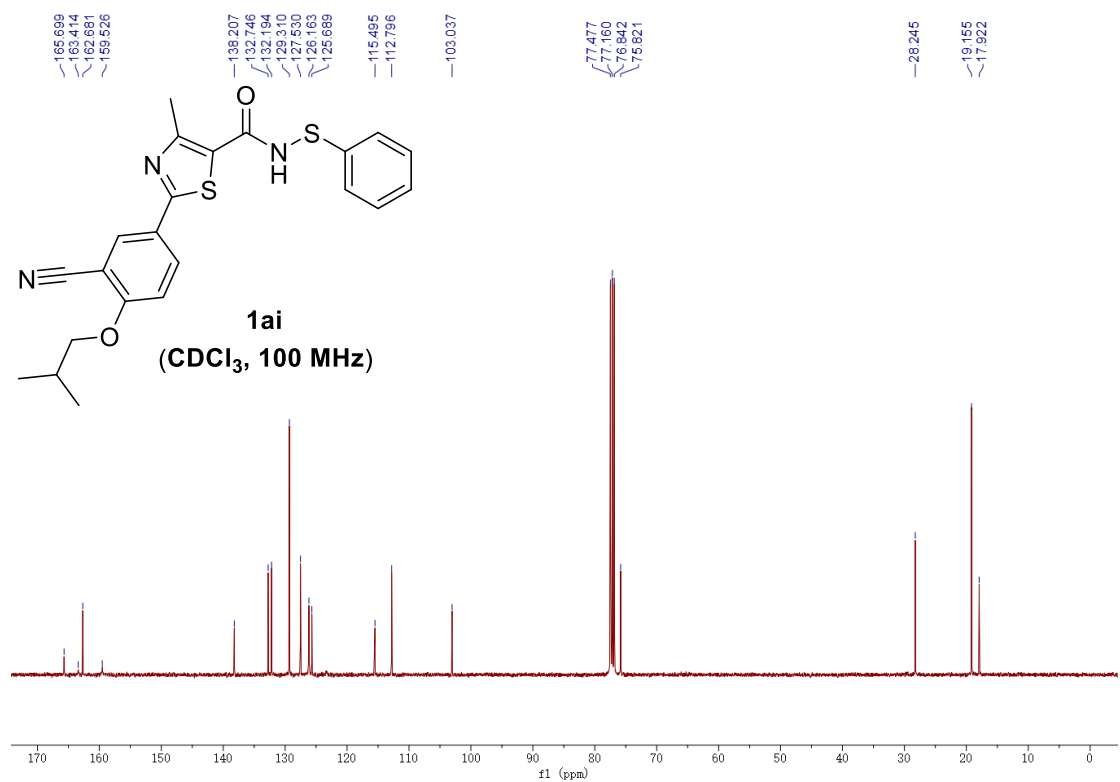
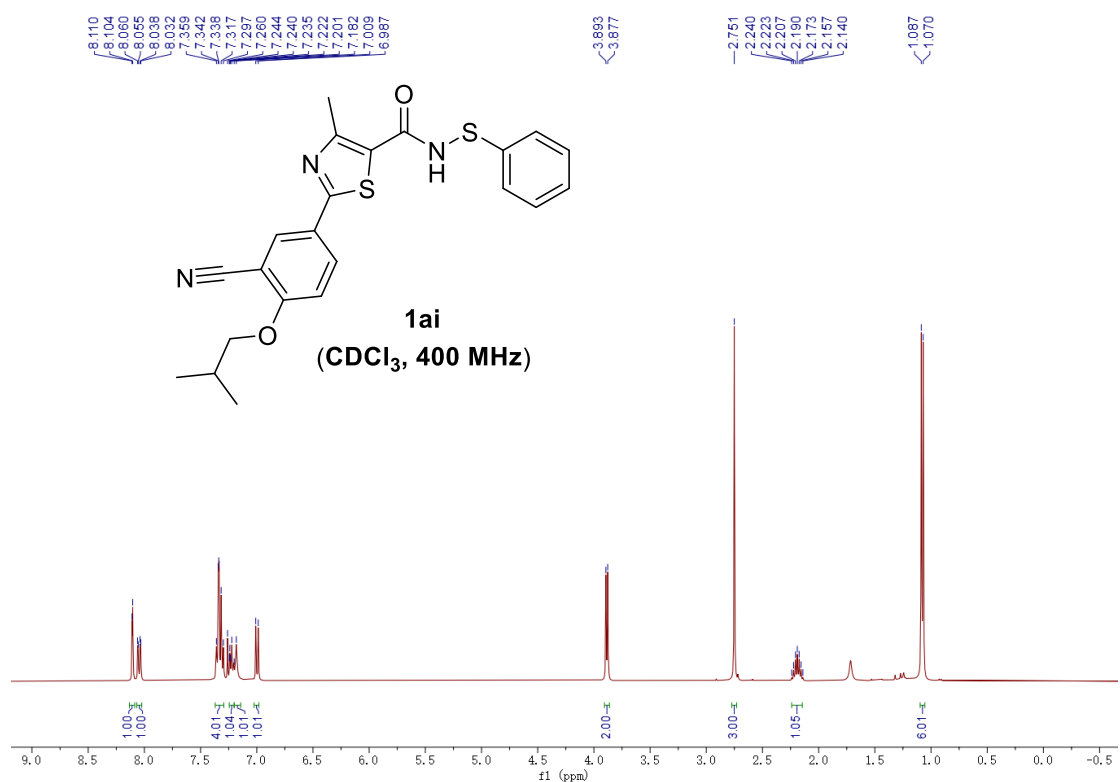
7.76 (d, $J = 9.7$ Hz, 1H), 7.57 (t, $J = 7.1$ Hz, 1H), 7.40 (t, 1H), 7.22 (d, $J = 8.1$ Hz, 2H), 7.16 (d, $J = 9.1$ Hz, 1H), 3.68 (s, 3H), 2.37 (s, 3H); ^{13}C NMR (100 MHz, CDCl_3) δ 156.1, 143.5, 142.6, 135.7, 131.2, 129.5, 128.9, 128.7, 128.5, 127.1, 124.6, 124.5, 124.5, 113.7, 56.6, 21.5; HRMS (ESI) calcd for $\text{C}_{18}\text{H}_{18}\text{NO}_2\text{S}$ m/z $[\text{M}+\text{H}]^+$: 312.1053, found: 312.1058.

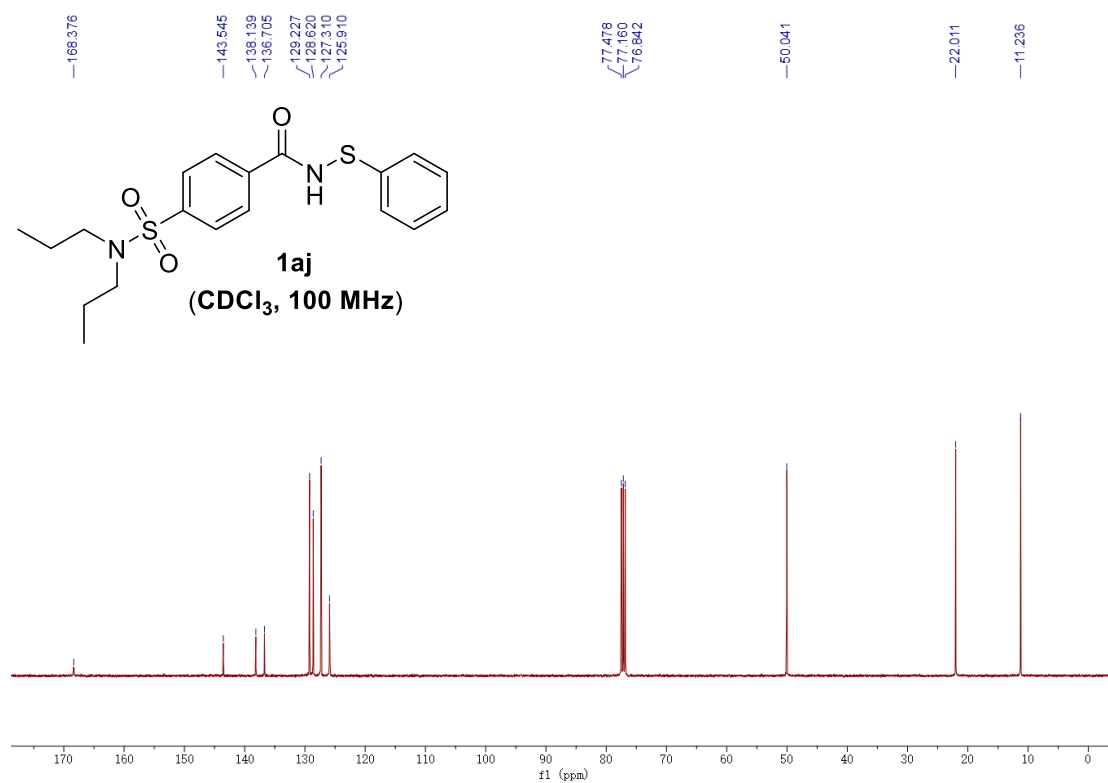
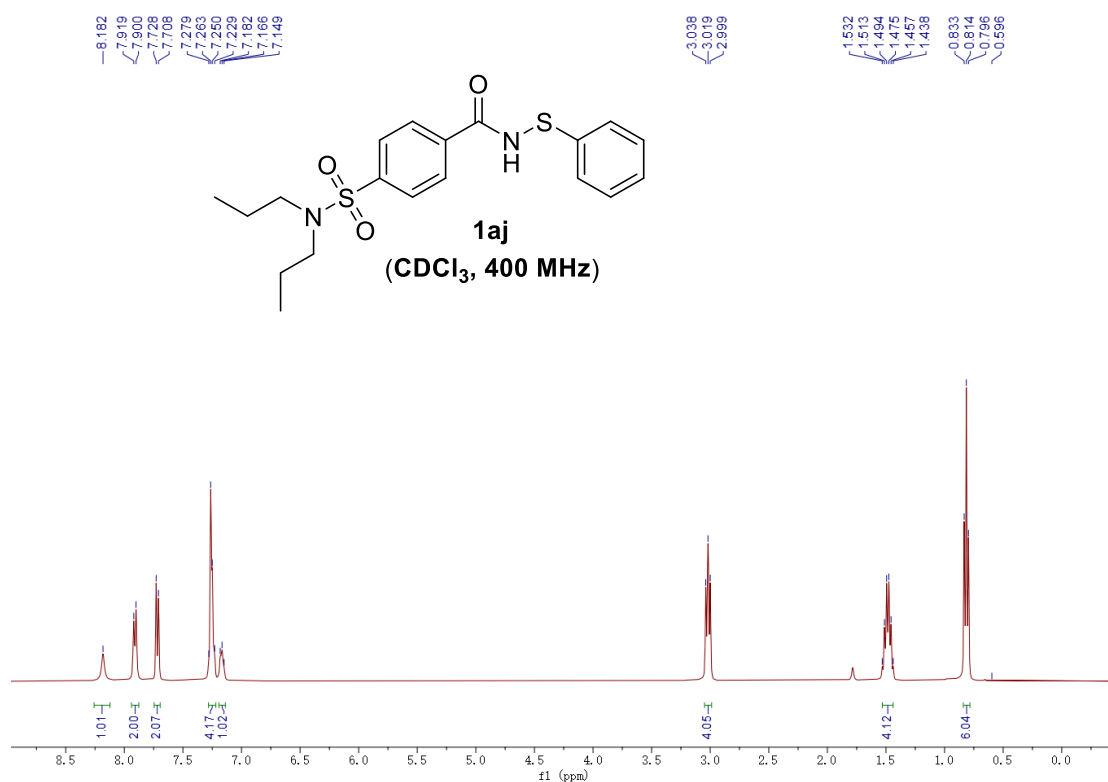
(K) References

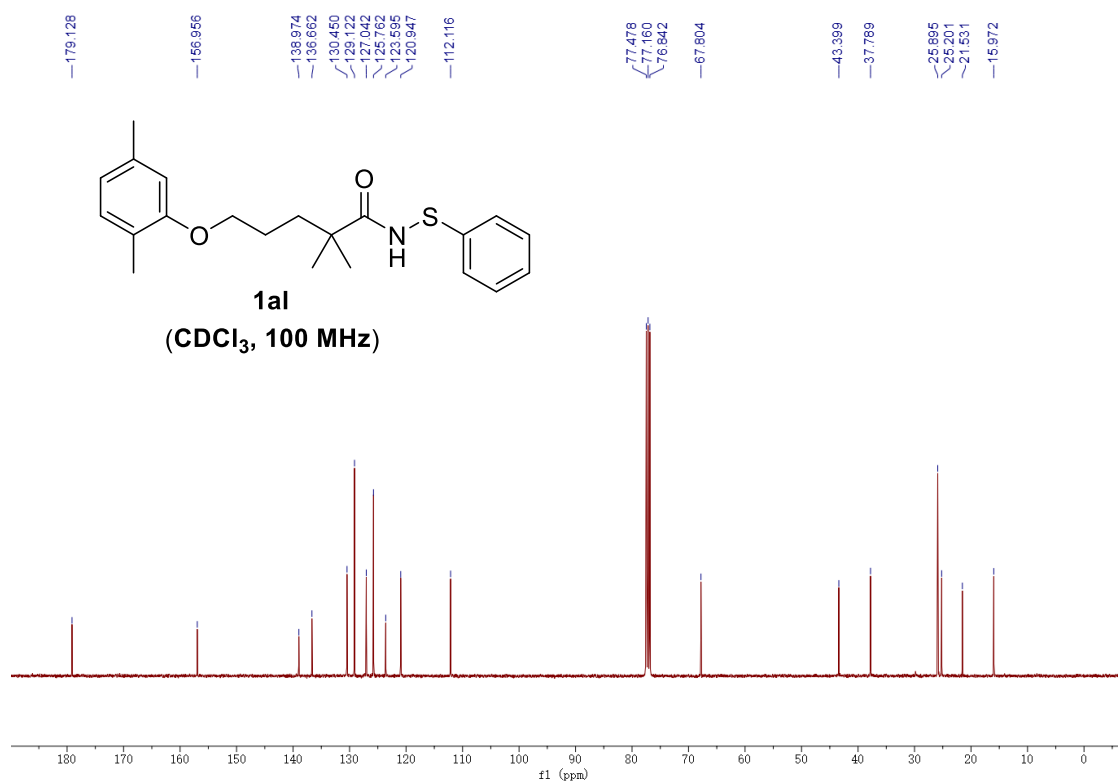
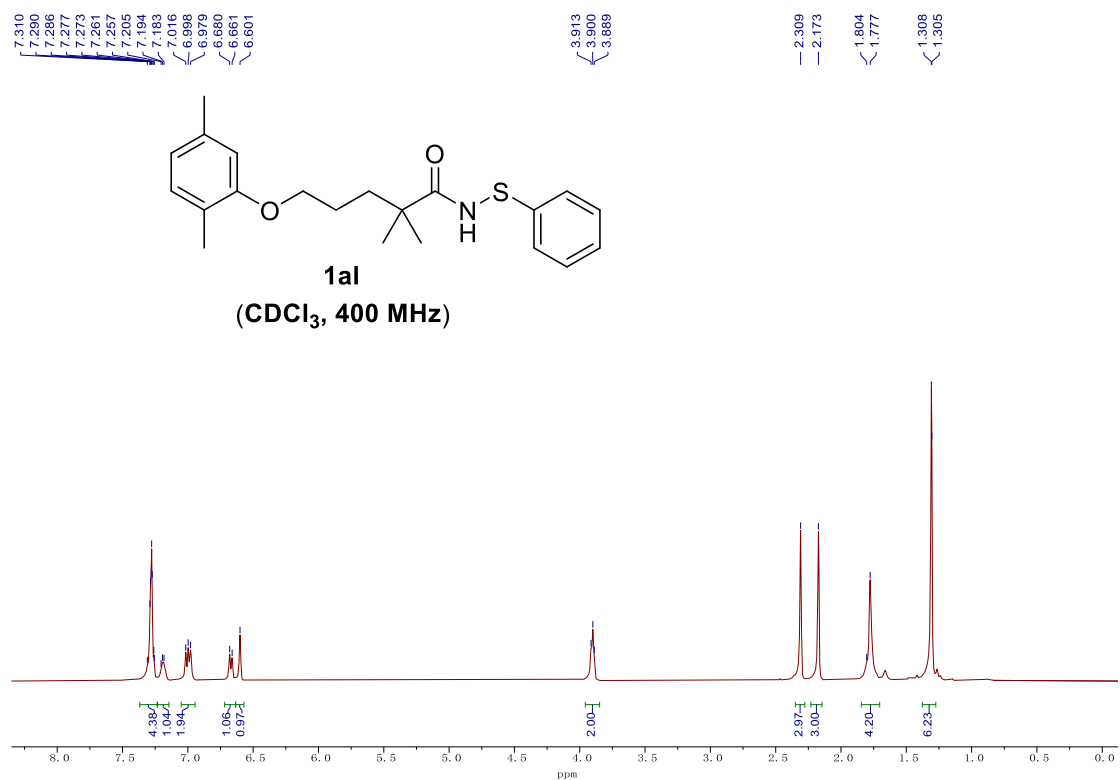
- [1] (a) Greenwood, N. S.; Champlin, A. T.; Ellman, J. A. Catalytic Enantioselective Sulfur Alkylation of Sulfenamides for the Asymmetric Synthesis of Sulfoximines. *J. Am. Chem. Soc.* **2022**, *144*, 17808–17814. (b) Huang, G.; Lu, X.; Yang, K.; Xu, X. Redox-Neutral Synthesis of Sulfilimines through the S-Alkylation of Sulfenamides. *Org. Lett.* **2023**, *25*, 3173–3178. (c) Greenwood, N. S.; Ellman, J. A. Sulfur-Arylation of Sulfenamides via Chan-Lam Coupling with Boronic Acids: Access to High Oxidation State Sulfur Pharmacophores. *Org. Lett.* **2023**, *25*, 2830–2834. (d) Liang, Q.; Wells, L. A.; Han, K.; Chen, S.; Kozlowski, M. C.; Jia, T. Synthesis of Sulfilimines Enabled by Copper-Catalyzed S-Arylation of Sulfenamides. *J. Am. Chem. Soc.* **2023**, *145*, 6310–6318. (e) Yang, G.-F.; Yuan, Y.; Tian Y.; Zhang S.-Q.; Cui, X.; Xia, B.; Li, G.-X.; Tang, Z. Synthesis of Chiral Sulfonimidoyl Chloride via Desymmetrizing Enantioselective Hydrolysis. *J. Am. Chem. Soc.* **2023**, *145*, 5439–5446. (f) Zhang, Mingjun.; Liu, L.; Tan, Y.; Jing, Y.; Liu, Y.; Wang, Z.; Wang, Q. Decarboxylative Radical Sulfilimination via Photoredox, Copper, and Brønsted Base Catalysis. *Angew. Chem. Int. Ed.* **2024**, *63*, e202318344.
- [2] Dong, F.; Shu, J.; Yang, J.; Xia, S.; Xiong, X. Modular Access to Sulfondiimidoyl Fluorides by NaH-Mediated Fluorination of Sulfenamides. *Org. Lett.* **2025**, *27*, 10908–10915.
- [3] Jian, C.; Huang, X.; Long, H.; Liao, M.; Wu, X. Heteroarylation of Sulfenamides for Modular Synthesis of Antimicrobial Sulfilimines via Sulfinimidoyl Fluoride Intermediates. *Org. Lett.* **2025**, *27*, 5464–5470.

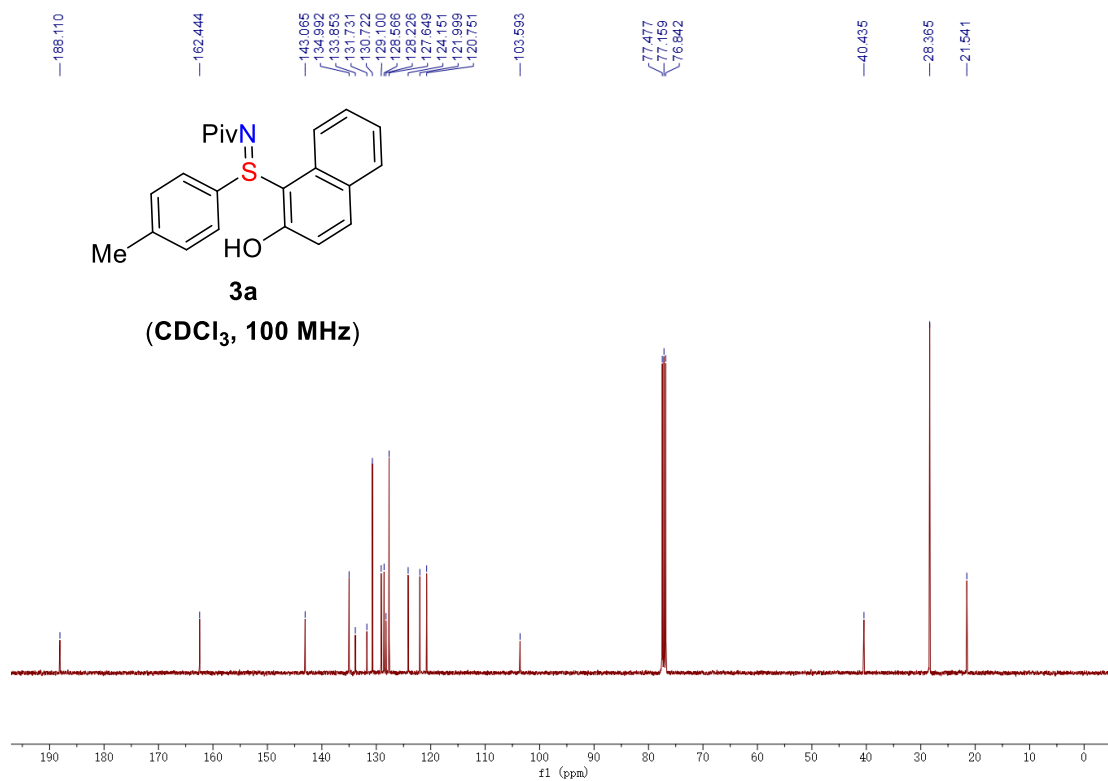
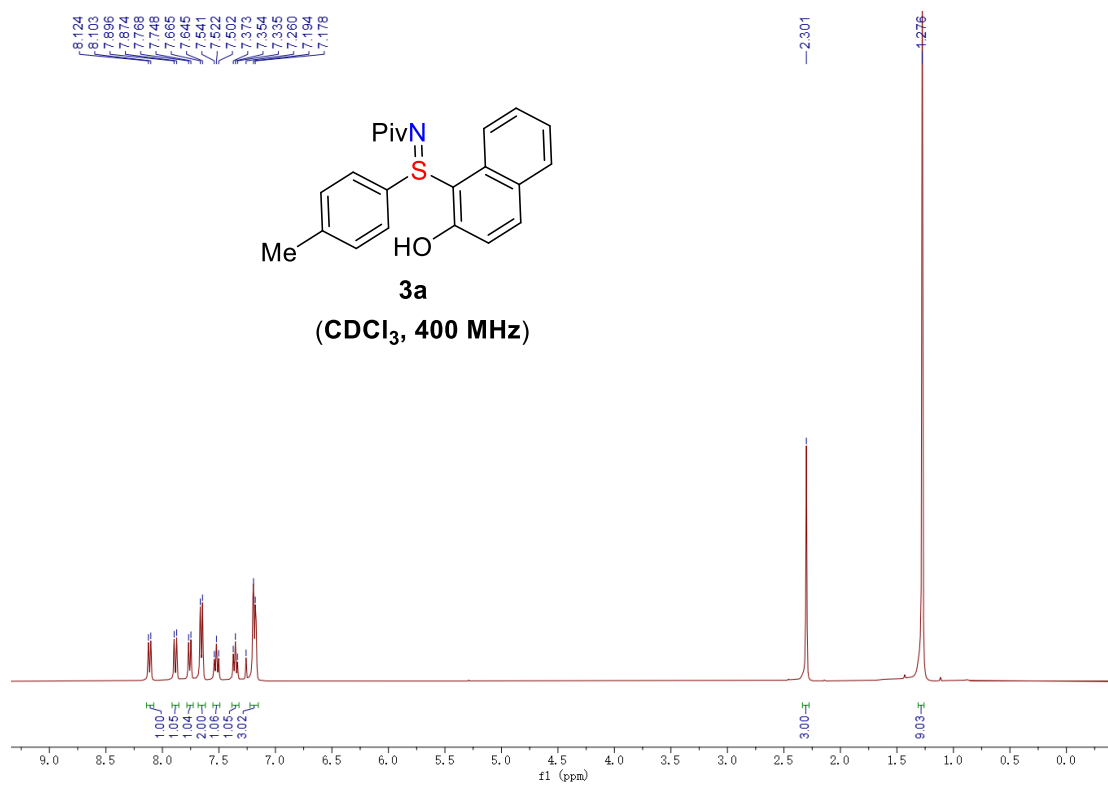
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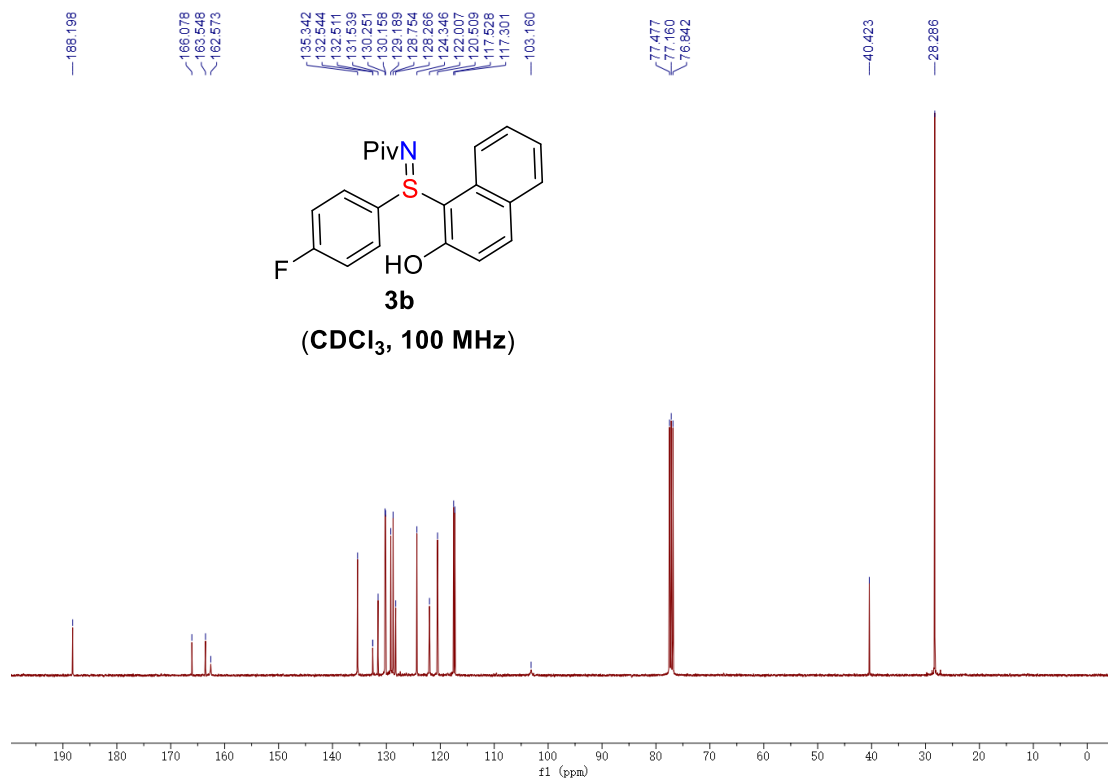
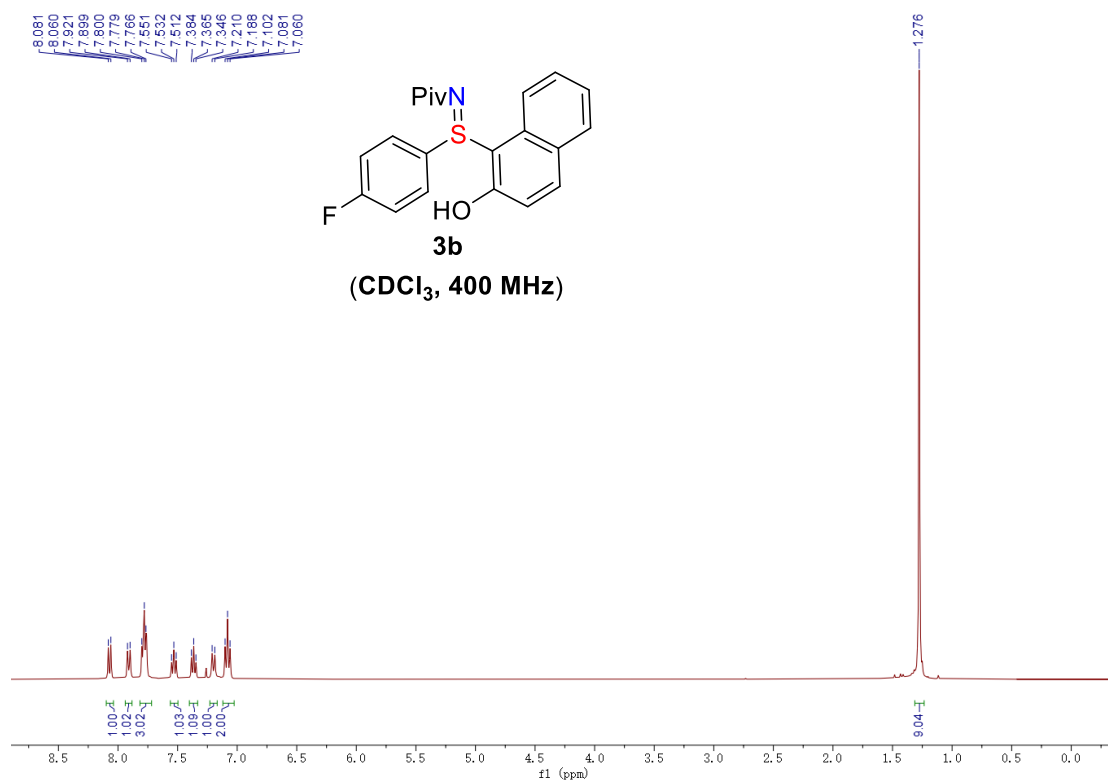


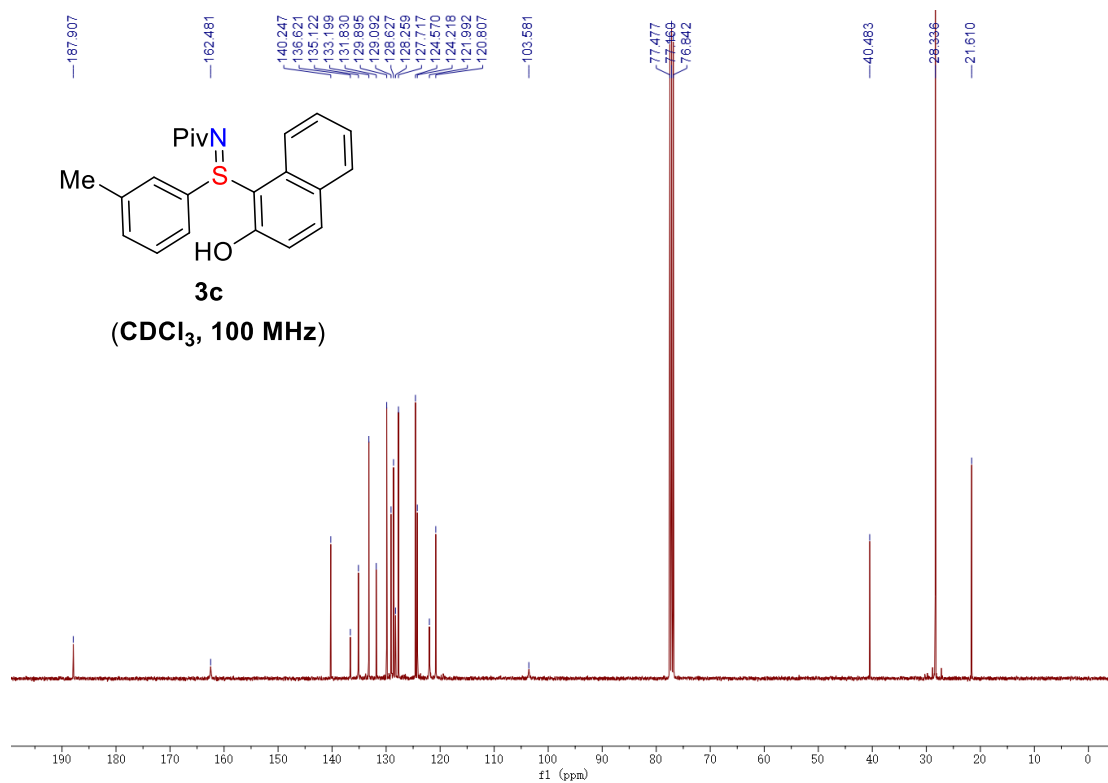
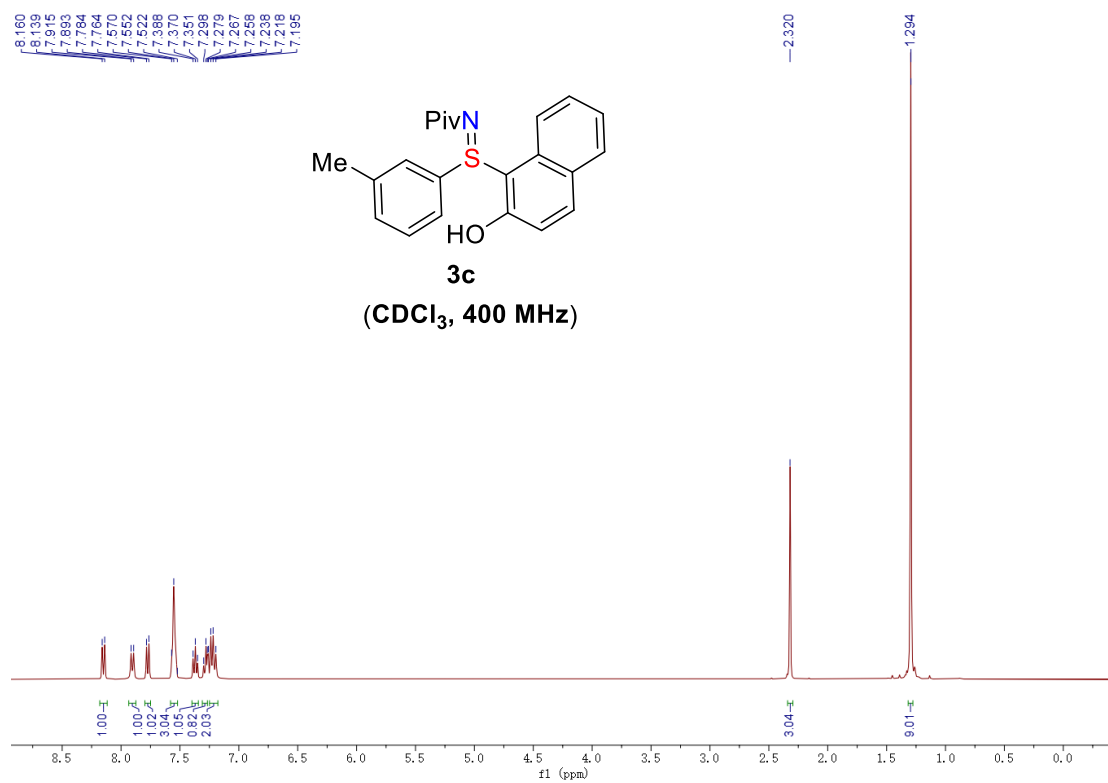


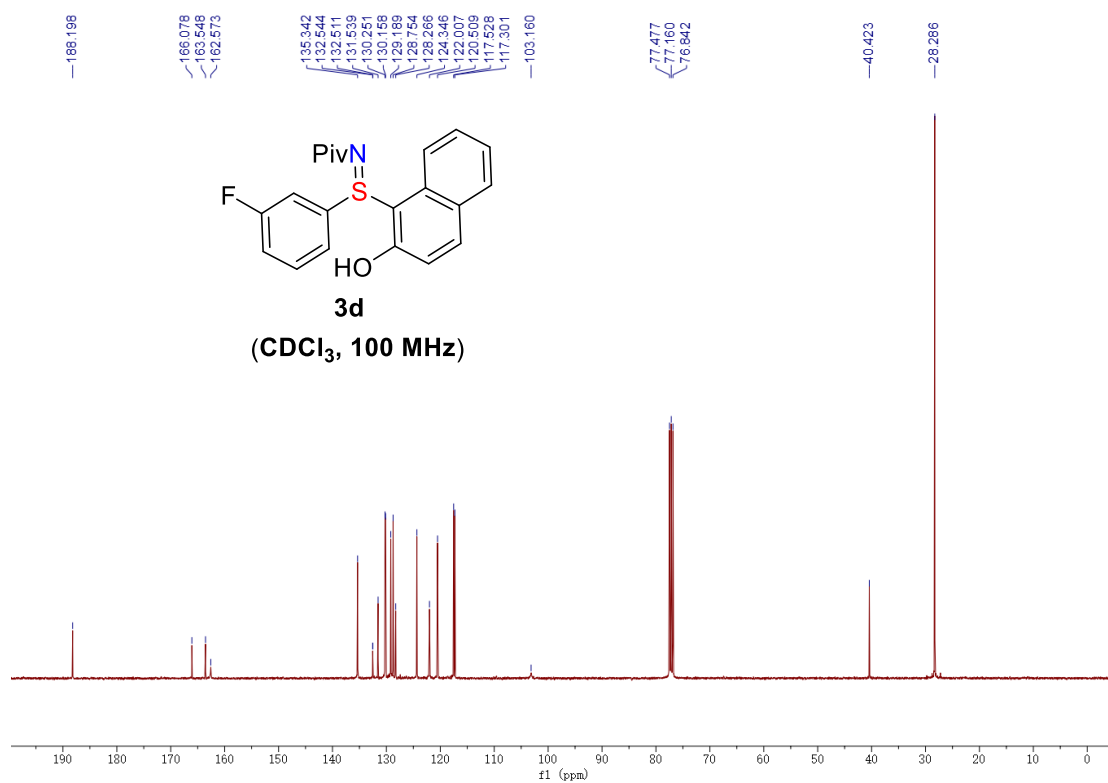
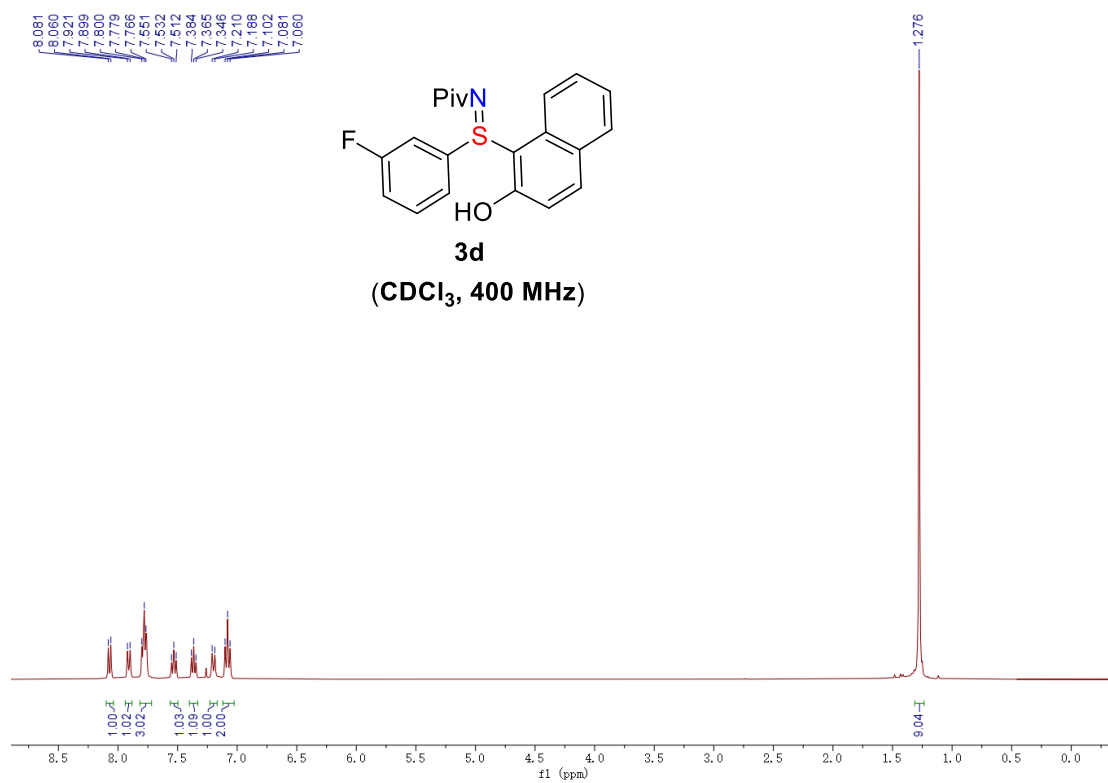


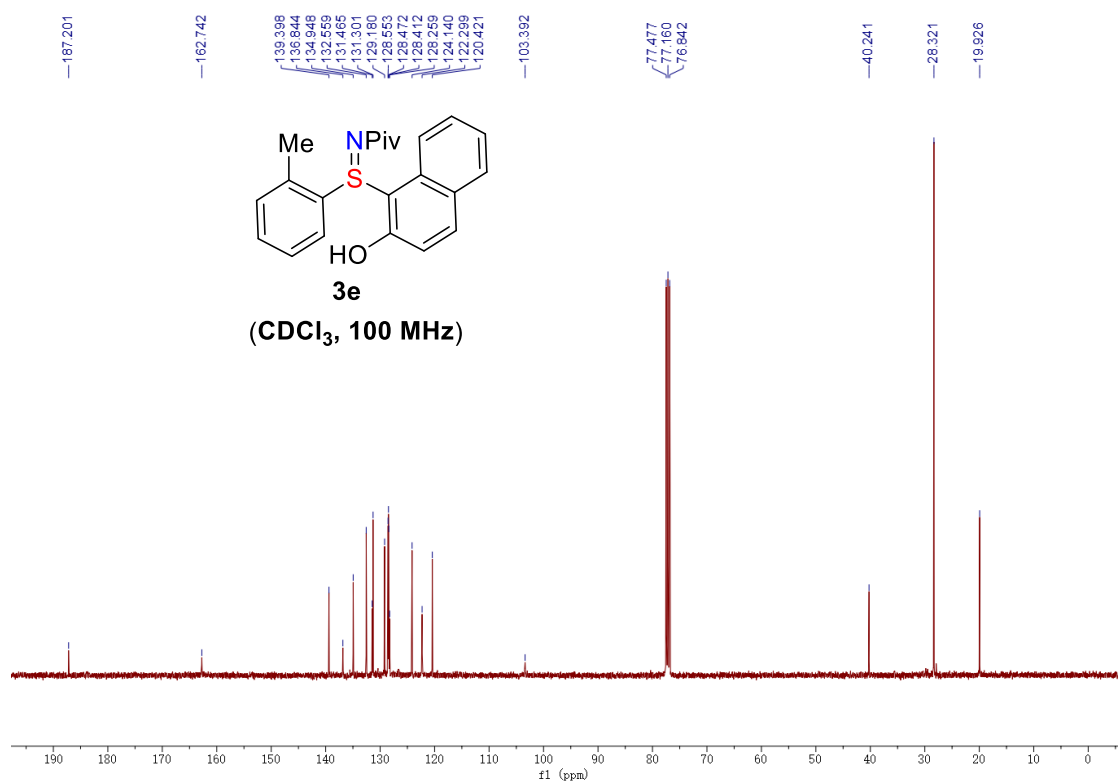
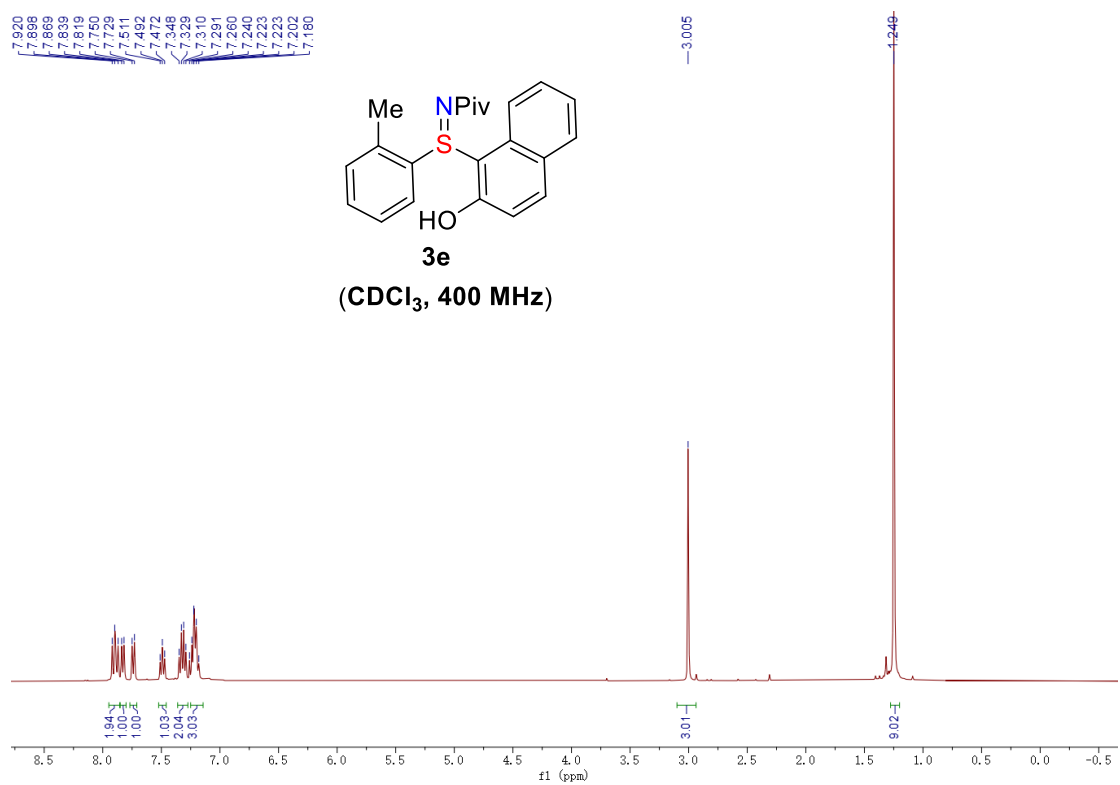


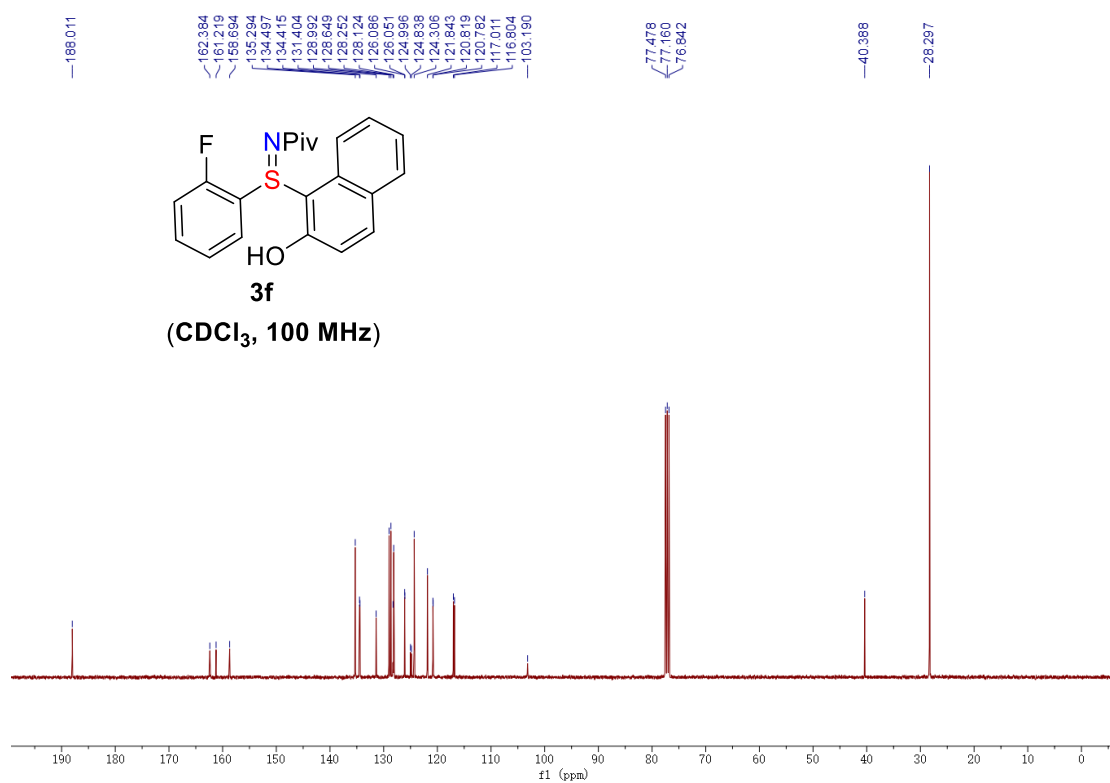
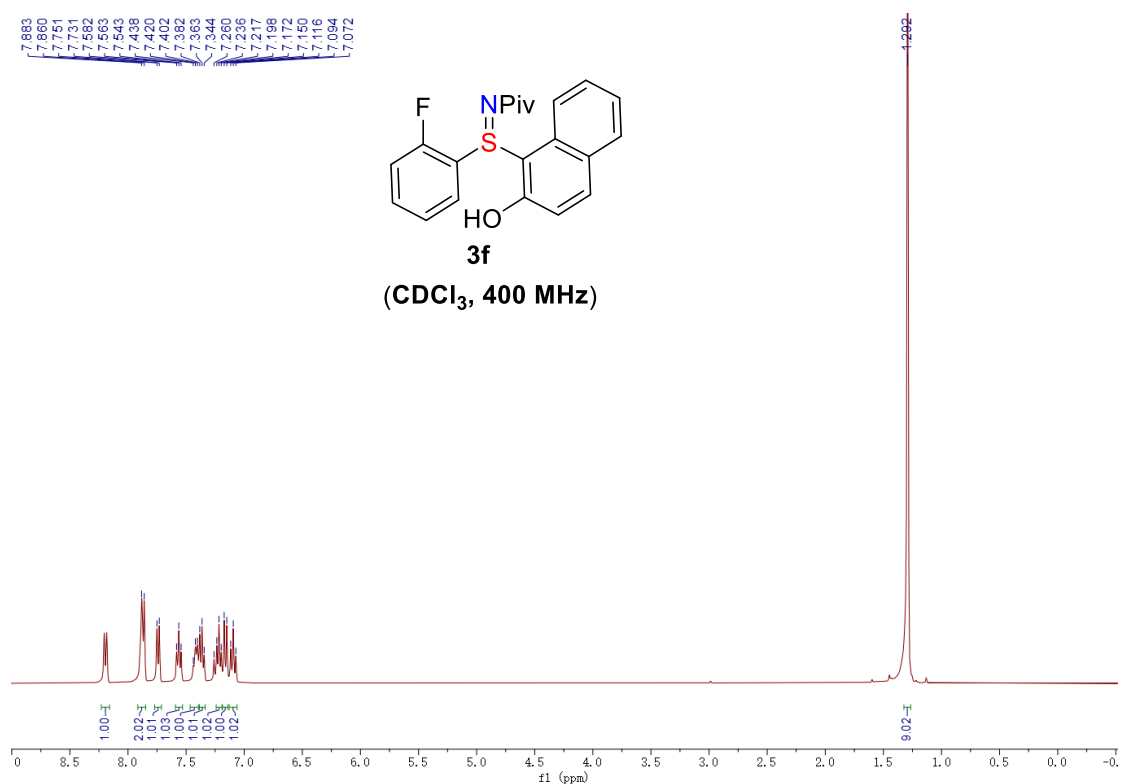


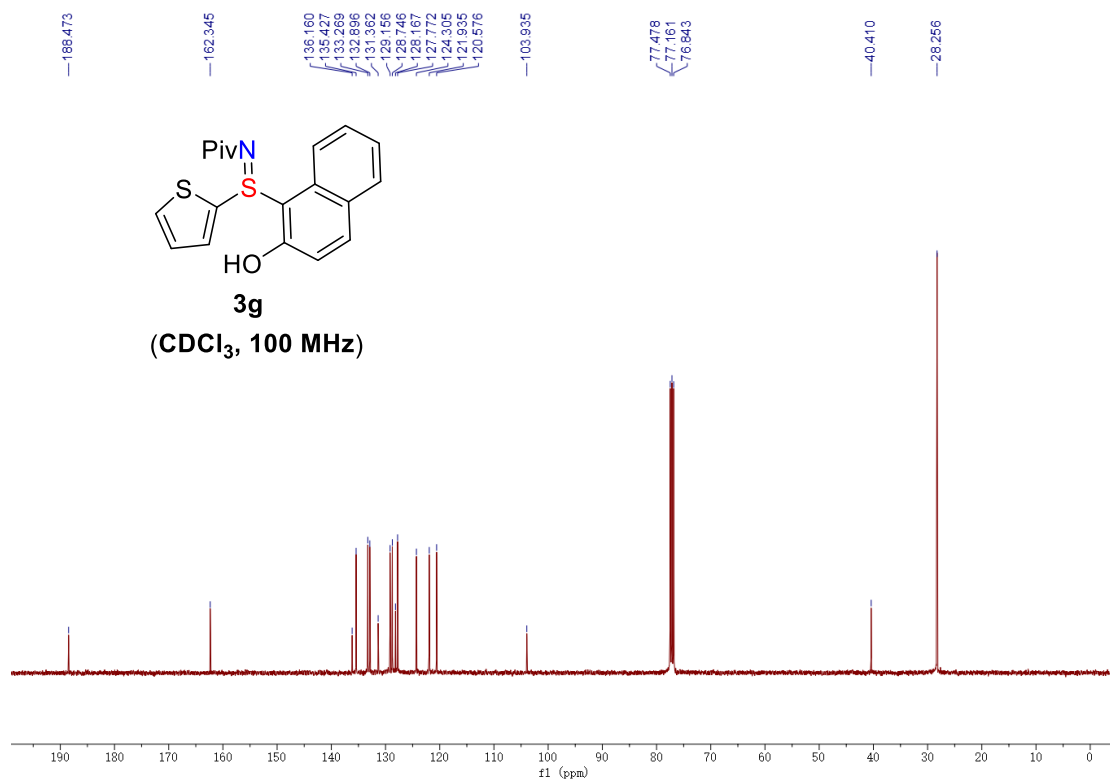
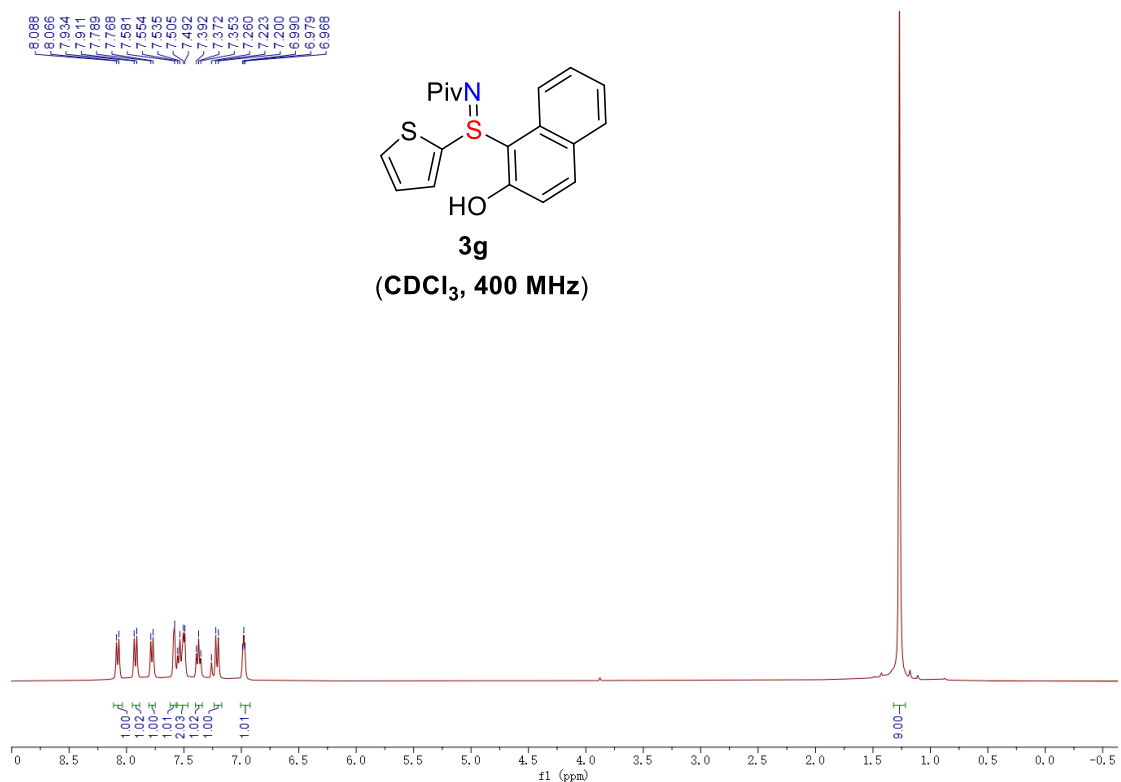


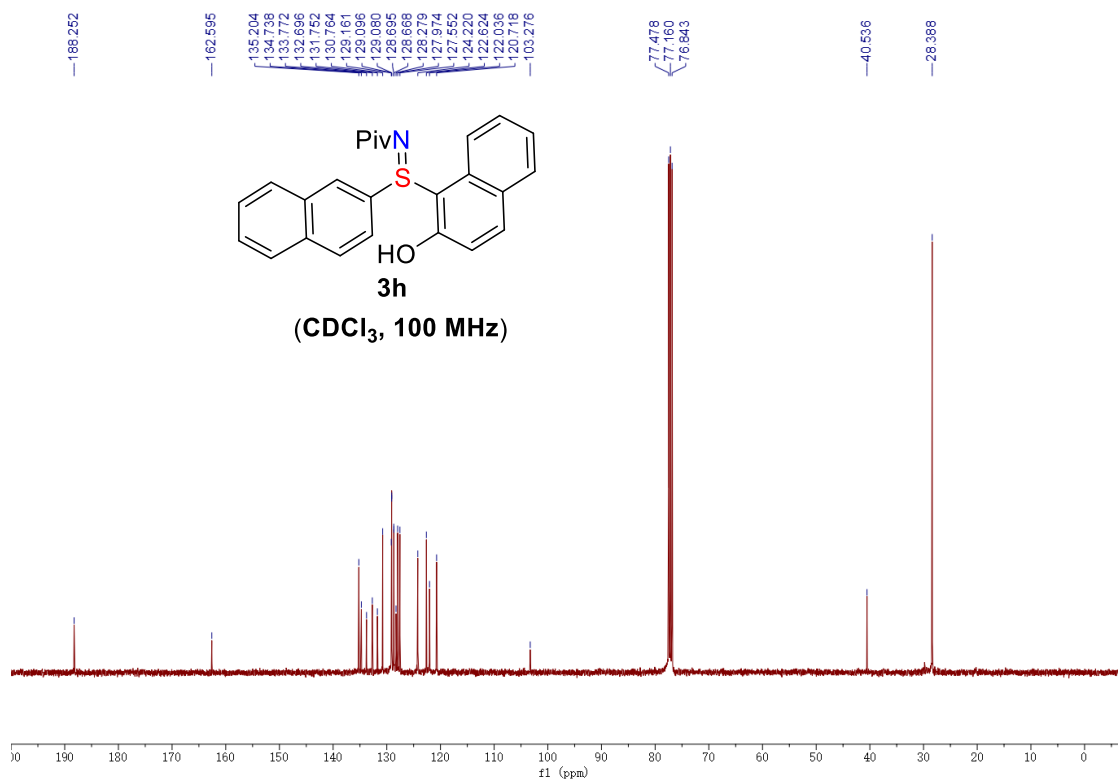
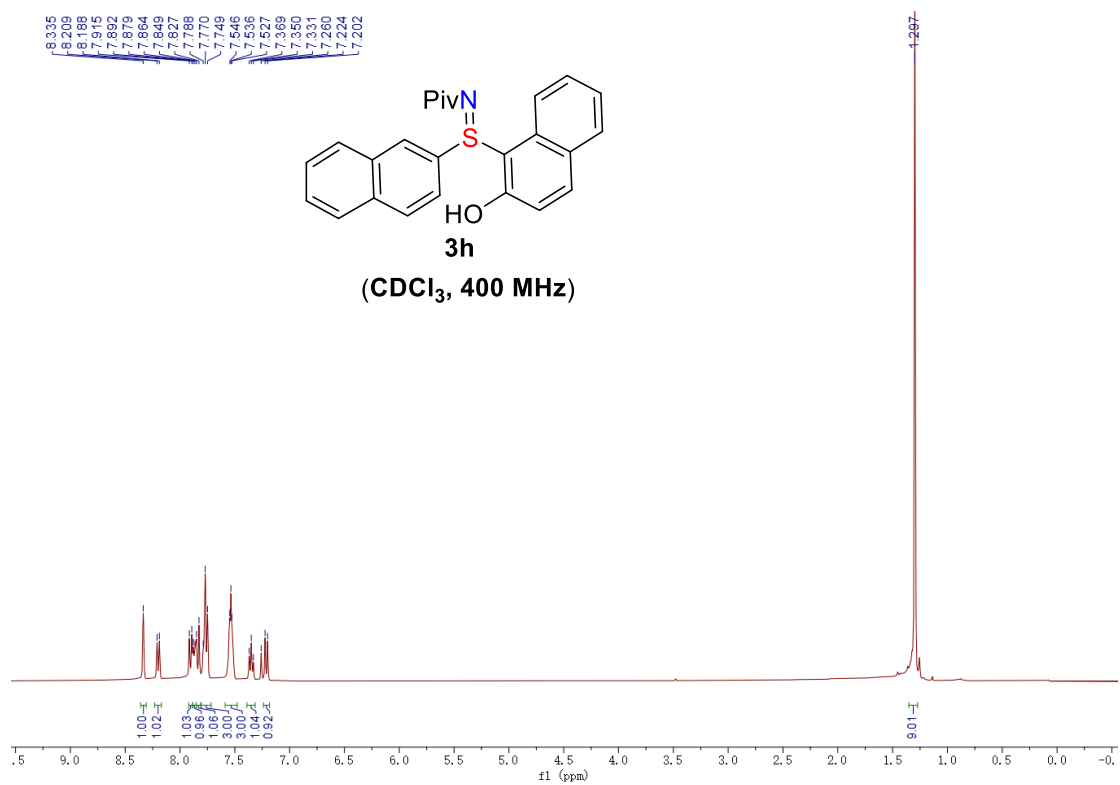


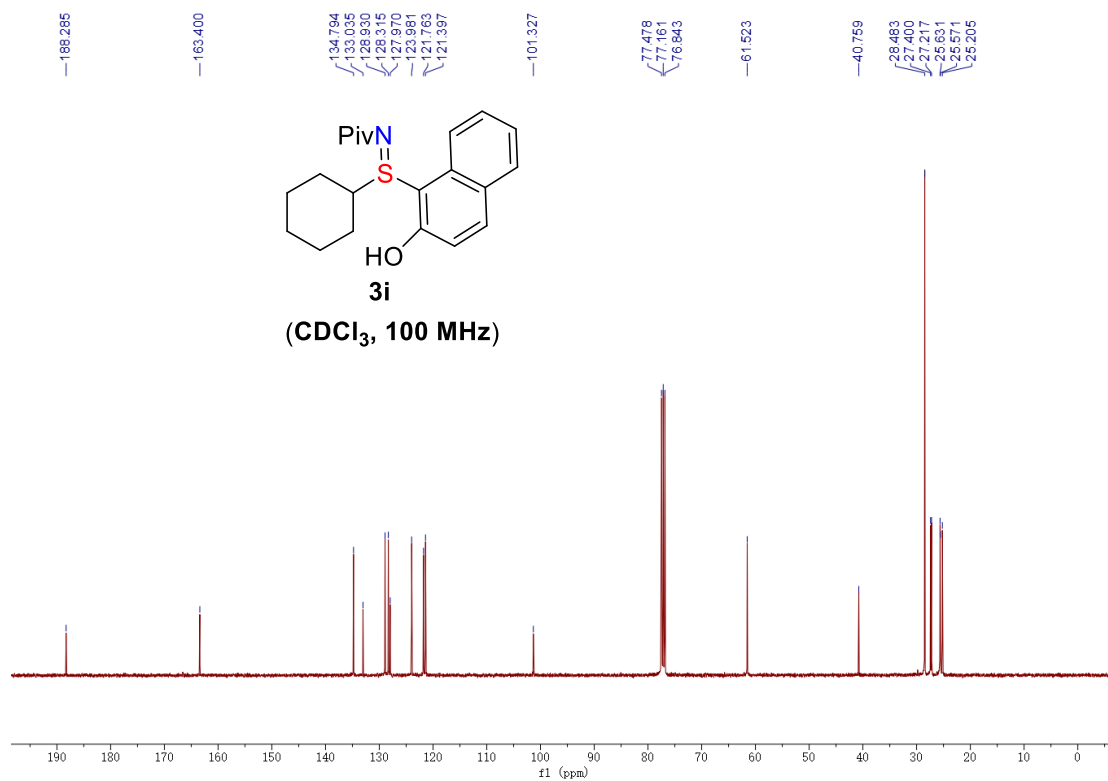
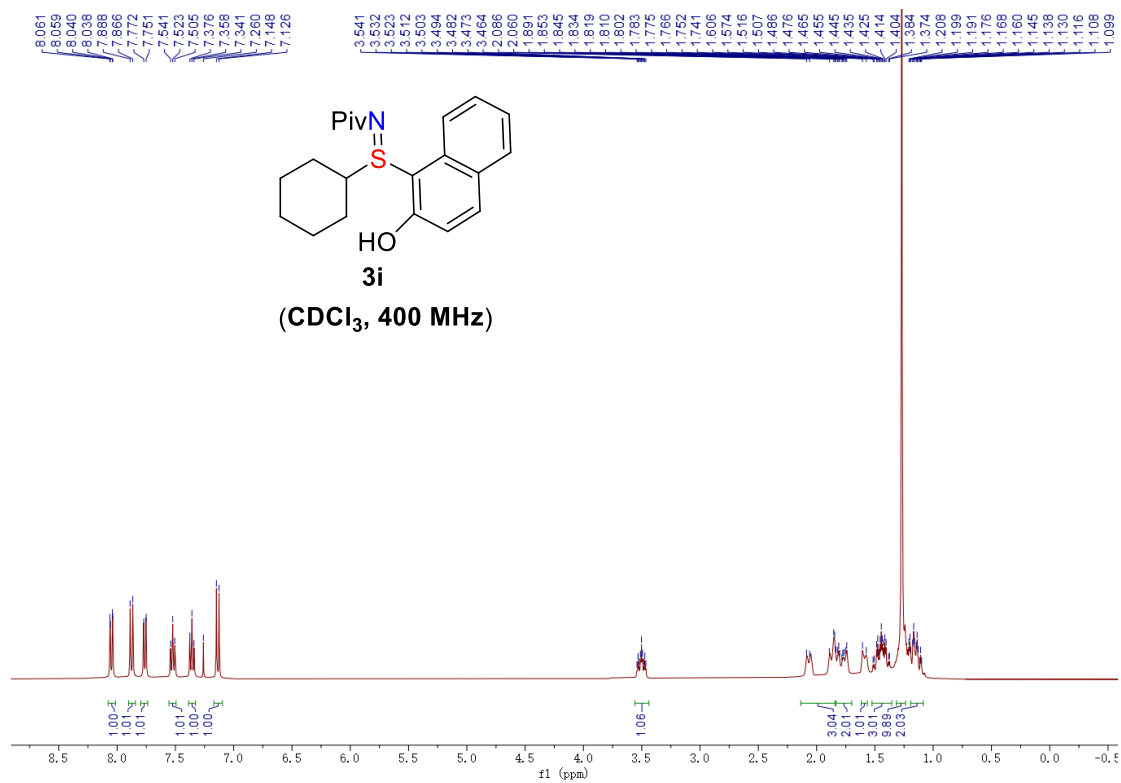


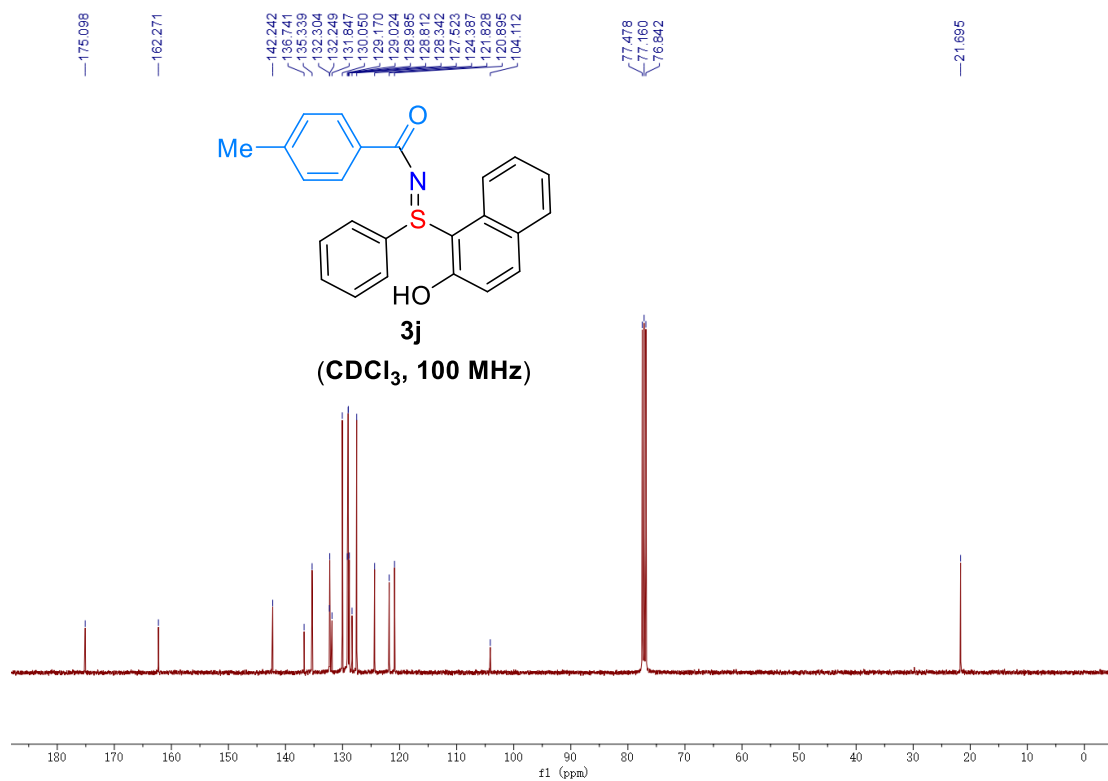
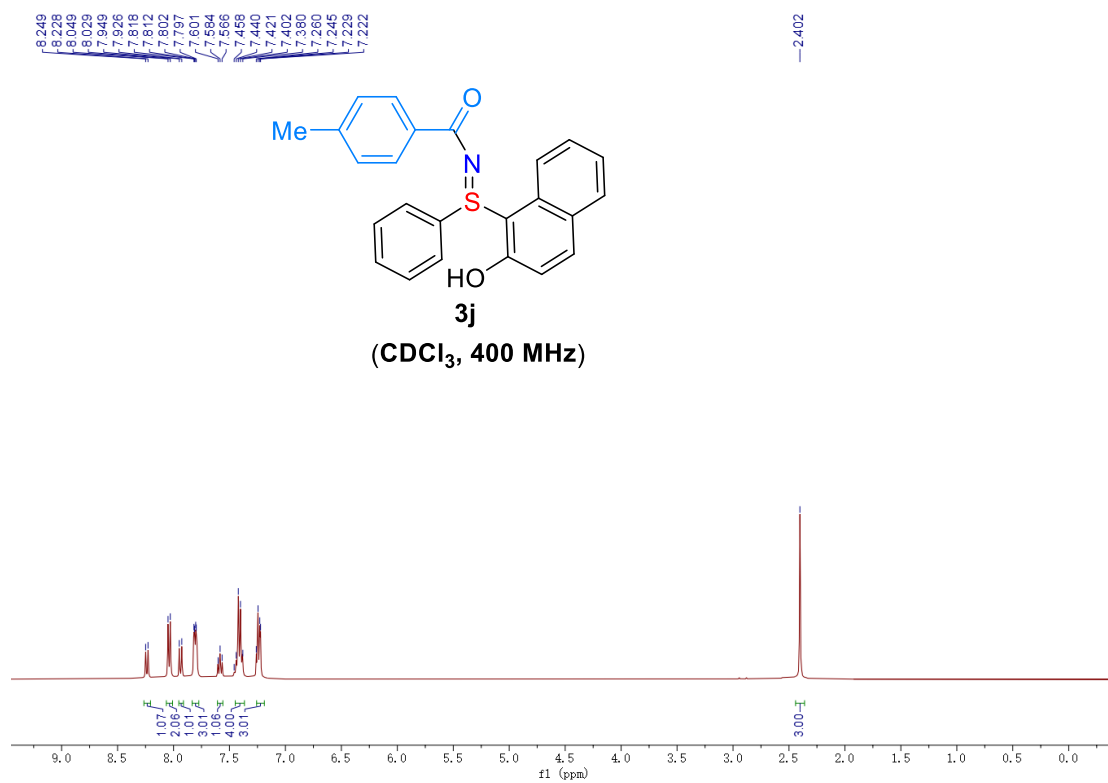


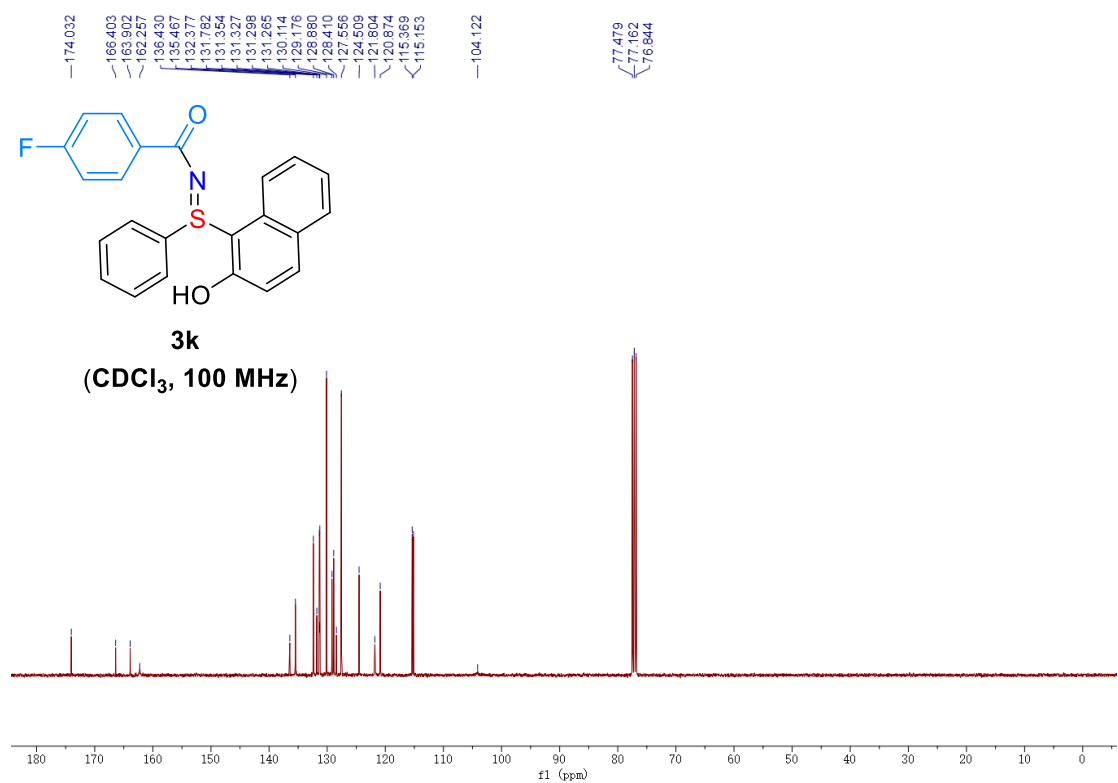
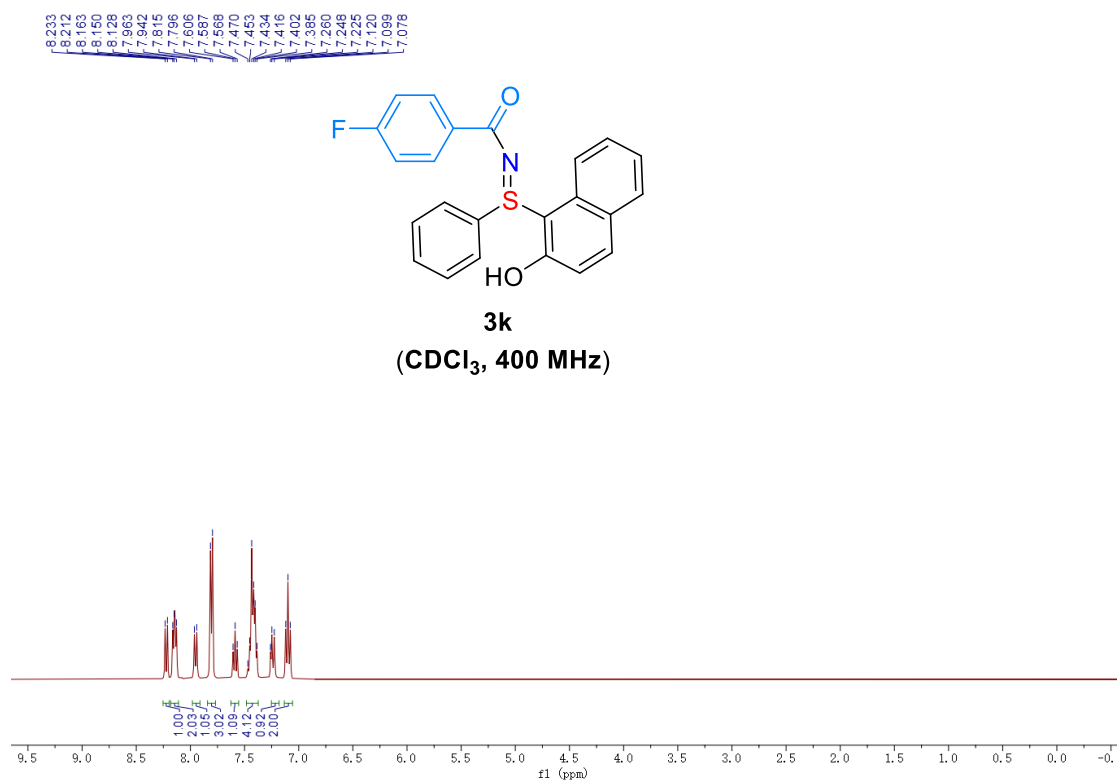


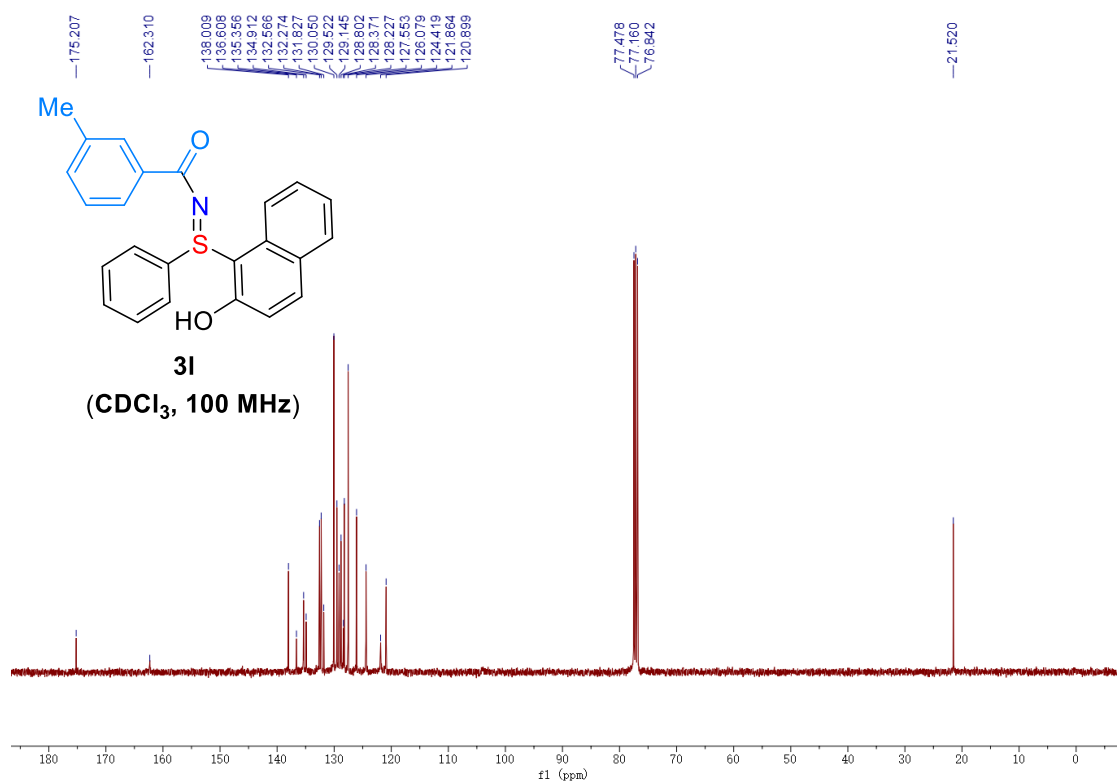
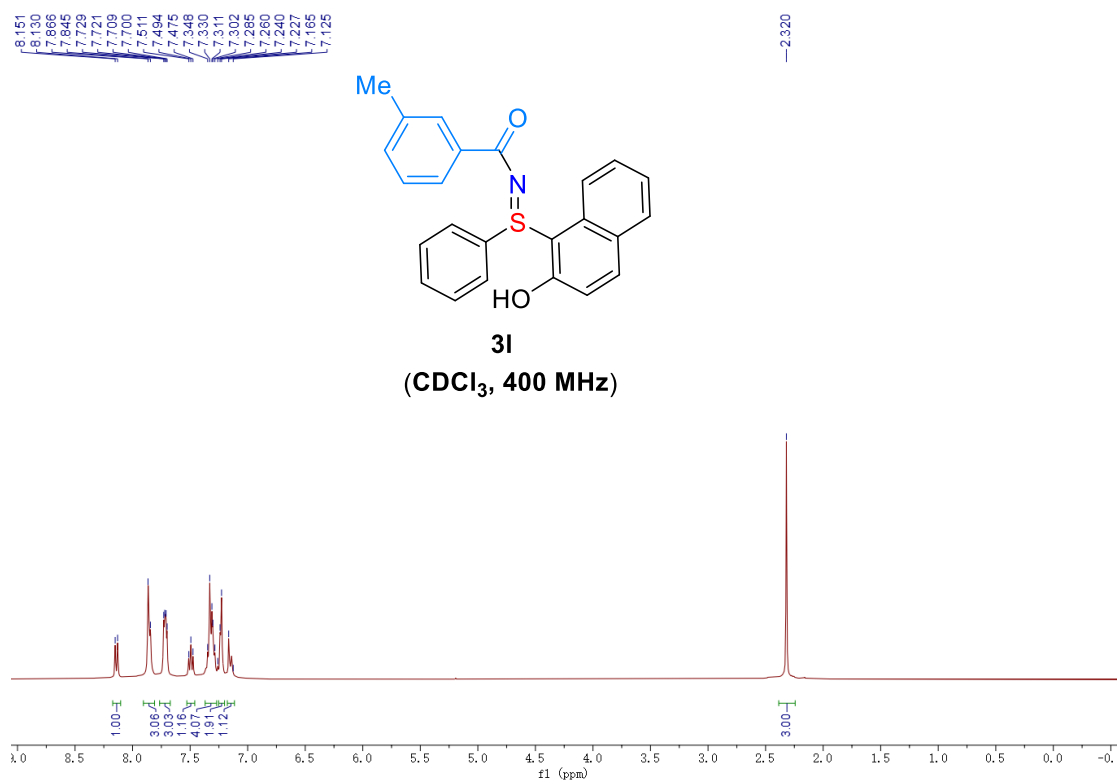


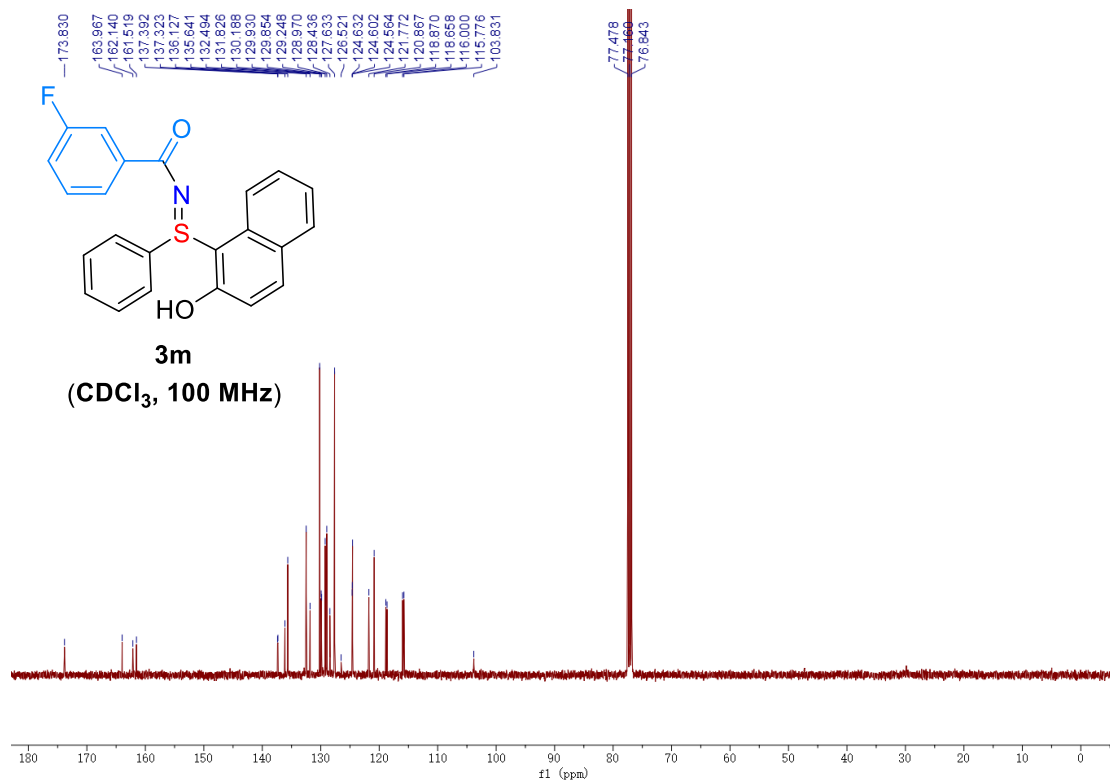
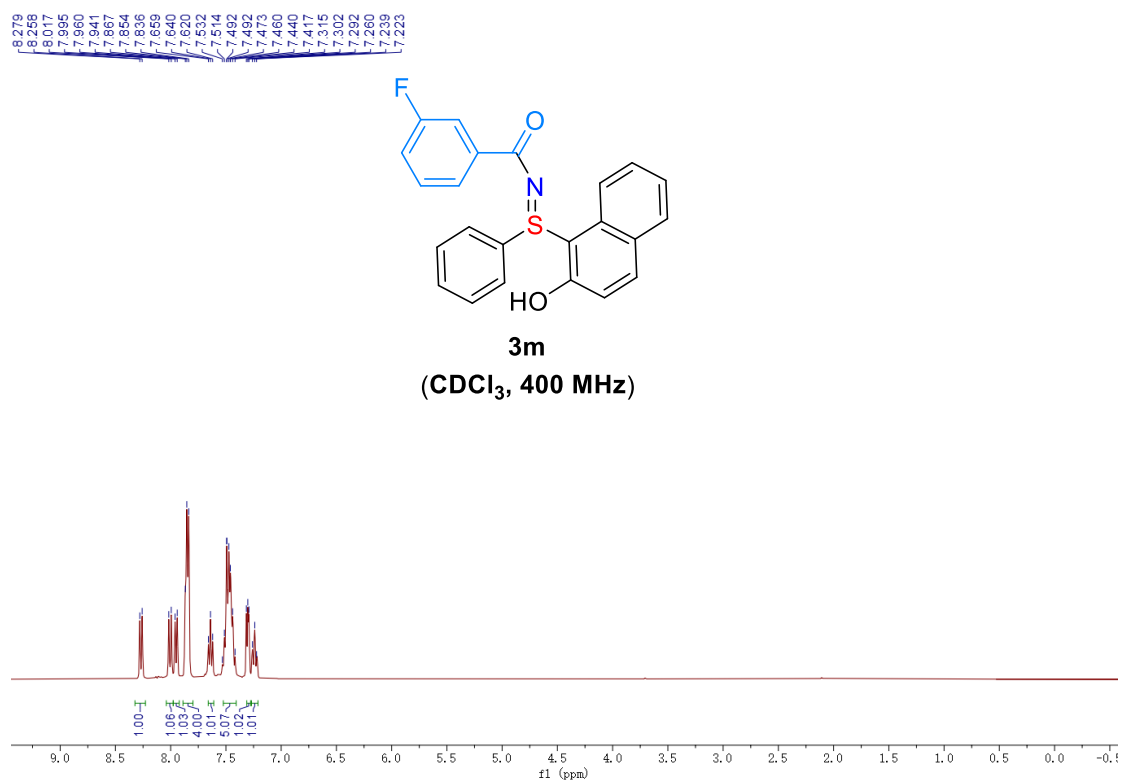


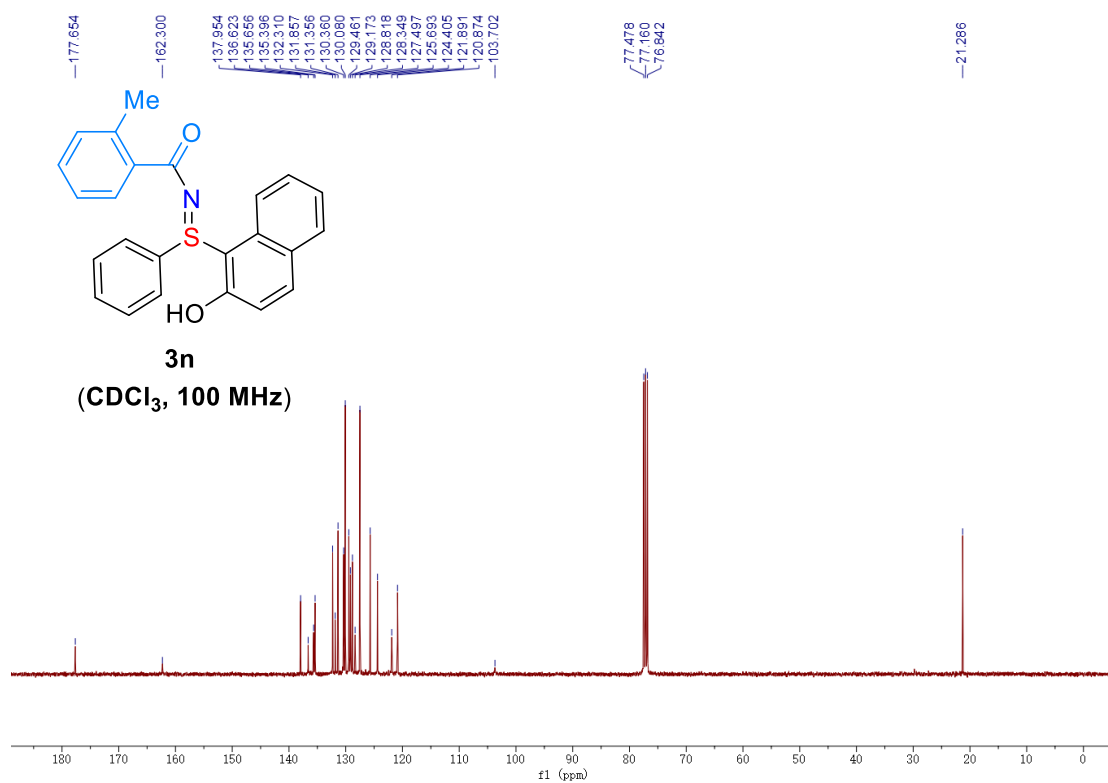
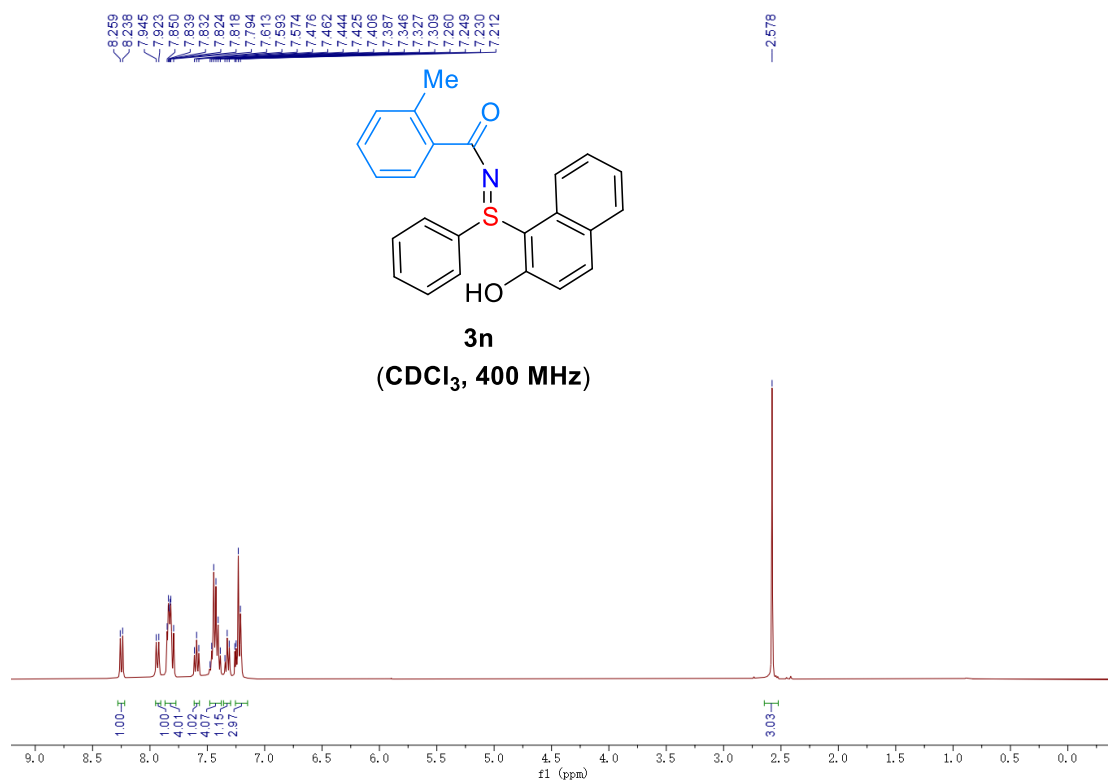


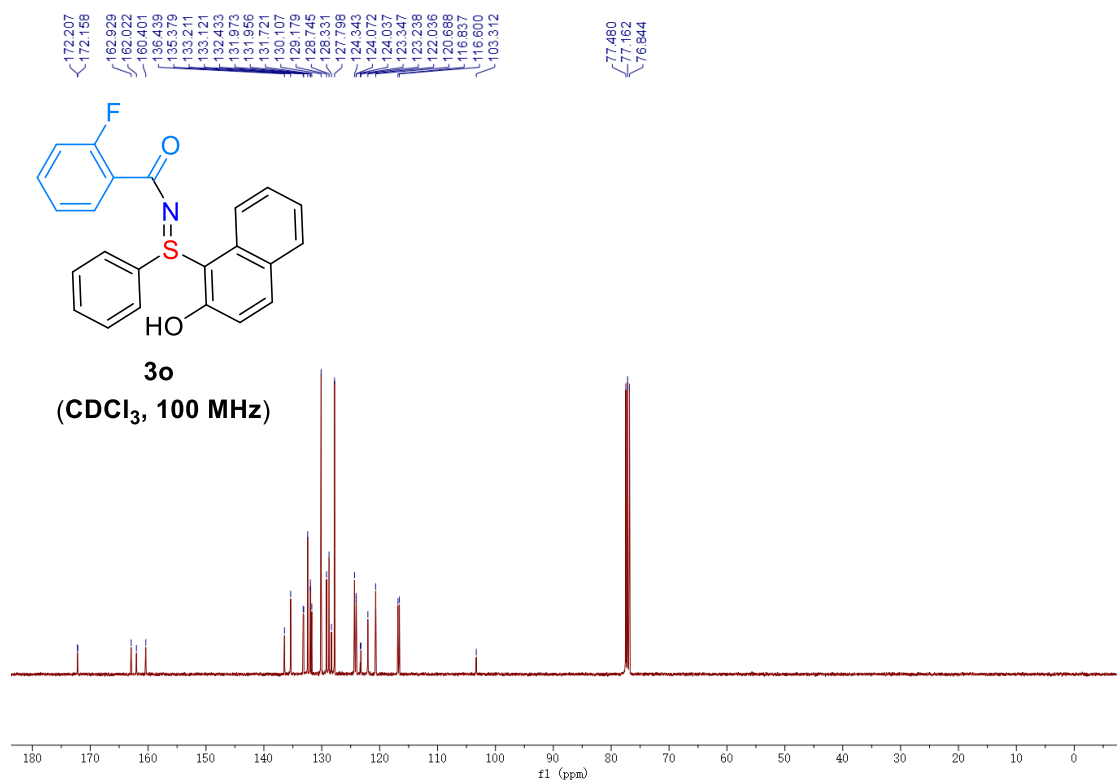
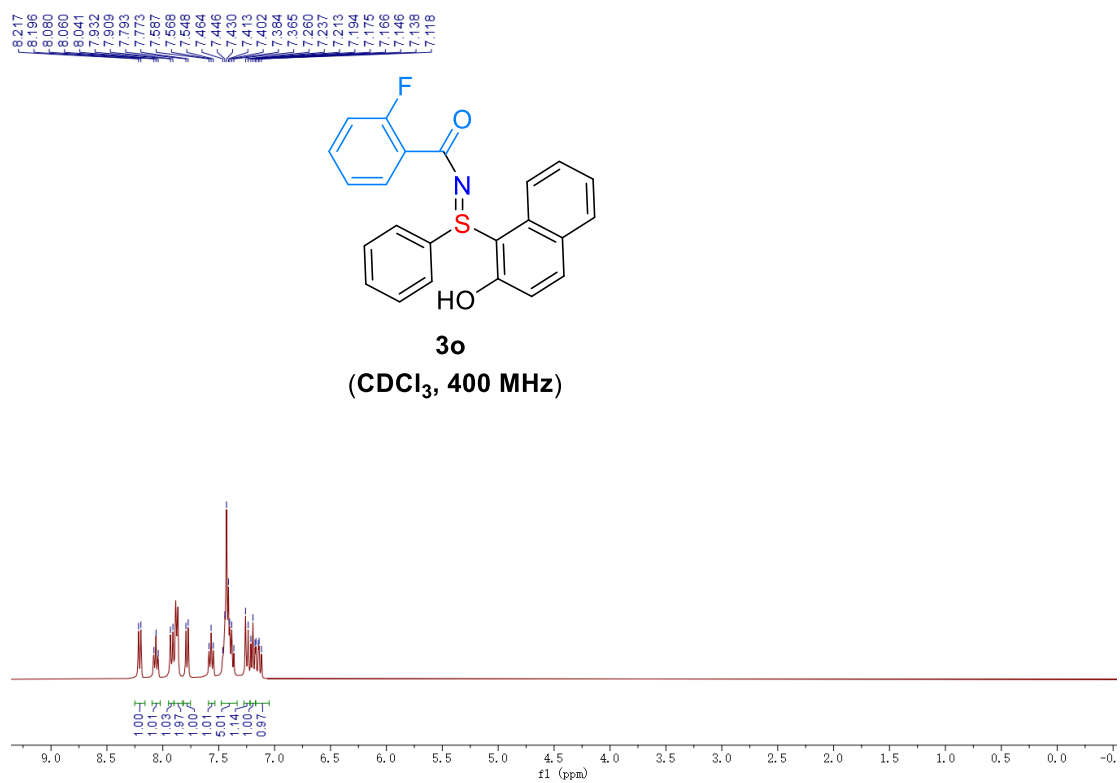




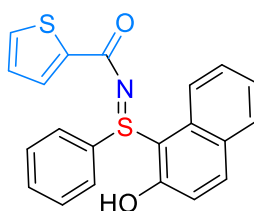




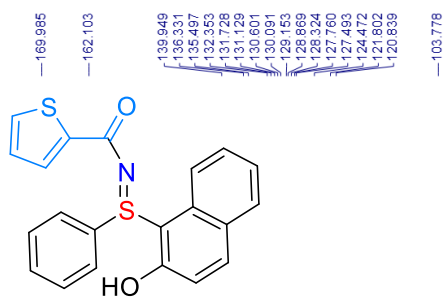
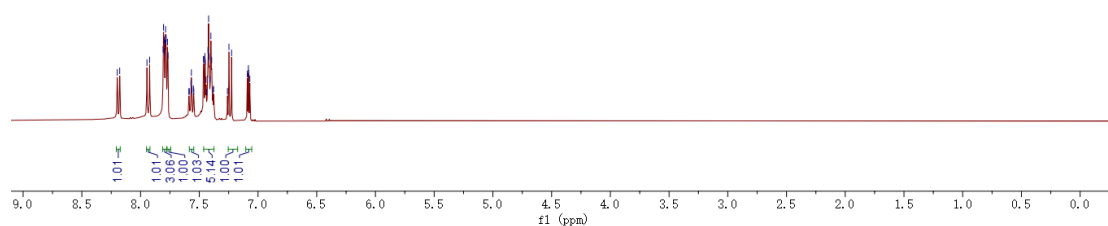




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3p
(CDCl₃, 400 MHz)



3p
(CDCl₃, 100 MHz)

