

Supporting Information

Copper-catalyzed divergent construction of naphthofurans and benzochromanes from 2-naphthols, 4-methylene-quinazolin(thi)ones, and *N,N*-dimethylethanolamine

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General information

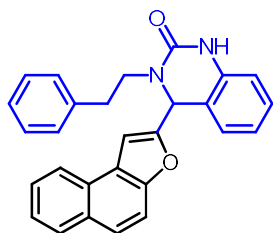
All commercially available reagents were used without further purification. Analytical TLC was performed on glass-backed plates pre-coated with silica gel, which were visualized by UV fluorescence ($\lambda_{\text{max}} = 254 \text{ nm}$). ^1H NMR and ^{13}C NMR spectra were measured on a Bruker 400 MHz spectrometer (^1H : 400 MHz; ^{13}C : 100 MHz), using CDCl_3 as the solvent with tetramethylsilane (TMS) as an internal standard at room temperature. All ^1H NMR spectra are reported in parts per million (ppm) downfield of TMS and were measured relative to the signals at 0 ppm (TMS). All ^{13}C NMR spectra were reported in ppm relative to residual CHCl_3 (77.0 ppm) and were obtained with ^1H -decoupling. Data for ^1H NMR are described as following: chemical shift (δ in ppm), multiplicity (s, singlet; d, doublet; t, triplet; q, quartet; quin, quintet; sep, septet; m, multiplet; br, broad signal), coupling constant (Hz), integration. Data for ^{13}C NMR are described in terms of chemical shift (δ in ppm). High resolution mass spectra were recorded on an ESI-Q-TOF mass spectrometer.

4-Methylene-3-substituted quinazolinones and quinazolinthiones are prepared according to the reported procedures.¹ 2-Naphthols used in this paper are commercially available.

General procedure for the synthesis of products 3 and 5

To an oven-dried 10-mL Schlenk tube were added β -naphthols **1** (0.50 mmol), quinazolinone **2** or quinazolinthione **4** (0.8 mmol, 1.6 equiv), $\text{Cu}(\text{OAc})_2$ (0.1 mmol, 20 mol%), 4,7-diphenyl-1,10-phenanthroline (0.12 mmol, 24 mol%) and *N,N*-dimethylethanolamine (DMEA) (2 mL) under air. The resulting mixture was then stirred at 120 °C (heating mantle) for 5 h and then cooled to room temperature. The reaction mixture was diluted with CH_2Cl_2 (30 mL) and washed with H_2O (10 mL \times 3). The organic fraction was then dried over anhydrous Na_2SO_4 . Filtration, concentration, and purification by flash chromatography on silica gel (eluent: PE & EA) afforded products **3** or **5**.

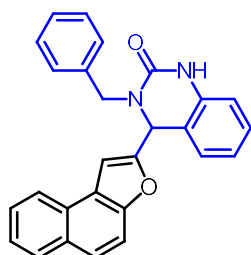
Synthesis and Characterization of compounds 3 and 5



4-(Naphtho[2,1-*b*]furan-2-yl)-3-phenethyl-3,4-dihydroquinazolin-2(1*H*)-one (3a)

The title compound was obtained as a white solid (152.6 mg, 73%). Mp: 171.4–172.7 °C.

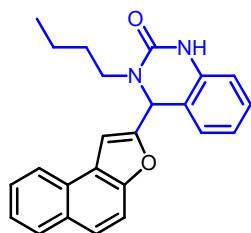
¹H NMR (400 MHz, DMSO-*d*₆) δ 9.66 (s, 1H), 8.28 (d, *J* = 8.0 Hz, 1H), 8.01 (d, *J* = 8.0 Hz, 1H), 7.80 (d, *J* = 9.2 Hz, 1H), 7.73 (d, *J* = 9.2 Hz, 1H), 7.62 (t, *J* = 7.6 Hz, 1H), 7.51 (t, *J* = 7.6 Hz, 1H), 7.46 (s, 1H), 7.31–7.14 (m, 7H), 6.99–6.88 (m, 2H), 6.07 (s, 1H), 4.13–3.98 (m, 1H), 3.34–3.20 (m, 1H), 3.05–2.89 (m, 1H), 2.80–2.67 (m, 1H). **¹³C NMR (100 MHz, DMSO-*d*₆)** δ 156.7, 153.2, 152.4, 139.5, 137.6, 130.3, 129.1, 129.1, 128.8, 127.6, 127.1, 127.0, 126.6, 125.8, 125.2, 124.1, 123.2, 121.7, 118.9, 114.3, 112.8, 103.5, 56.8, 47.5, 34.0. **HRMS (ESI-TOF) *m/z*** calcd. for C₂₈H₂₃N₂O₂⁺ [M+H]⁺: 419.1754; found: 419.1756.



3-Benzyl-4-(naphtho[2,1-*b*]furan-2-yl)-3,4-dihydroquinazolin-2(1*H*)-one (3b)

The title compound was obtained as a white solid (131.3 mg, 65%). Mp: 198.8–200.4 °C.

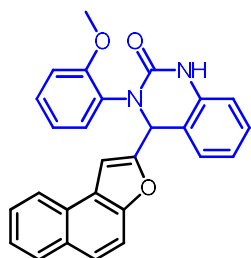
¹H NMR (400 MHz, DMSO-*d*₆) δ 9.79 (s, 1H), 8.25 (d, *J* = 8.0 Hz, 1H), 8.01 (d, *J* = 8.4 Hz, 1H), 7.80 (d, *J* = 8.8 Hz, 1H), 7.72 (d, *J* = 8.8 Hz, 1H), 7.61 (t, *J* = 7.6 Hz, 1H), 7.51 (t, *J* = 7.4 Hz, 1H), 7.44 (s, 1H), 7.35–7.29 (m, 4H), 7.27–7.23 (m, 1H), 7.23–7.16 (m, 2H), 6.96 (d, *J* = 8.0 Hz, 1H), 6.89 (t, *J* = 7.4 Hz, 1H), 5.89 (s, 1H), 5.25 (d, *J* = 15.6 Hz, 1H), 4.08 (d, *J* = 15.6 Hz, 1H). **¹³C NMR (100 MHz, DMSO-*d*₆)** δ 156.1, 153.5, 152.4, 138.1, 137.5, 130.3, 129.2, 129.1, 129.0, 128.8, 127.9, 127.63, 127.56, 127.2, 127.0, 125.8, 125.2, 124.1, 123.2, 121.9, 118.6, 114.5, 112.8, 103.9, 56.3, 48.1. **HRMS (ESI-TOF) *m/z*** calcd. for C₂₇H₂₁N₂O₂⁺ [M+H]⁺: 405.1598; found: 405.1595.



3-butyl-4-(Naphtho[2,1-*b*]furan-2-yl)-3,4-dihydroquinazolin-2(1*H*)-one (3c)

The title compound was obtained as a white solid (92.7 mg, 50%). Mp: 173.9–175.8 °C.

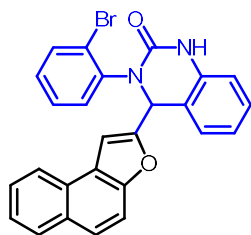
¹H NMR (400 MHz, DMSO-*d*₆) δ 9.55 (s, 1H), 8.26 (d, *J* = 8.4 Hz, 1H), 8.01 (d, *J* = 8.0 Hz, 1H), 7.79 (d, *J* = 9.2 Hz, 1H), 7.72 (d, *J* = 9.2 Hz, 1H), 7.61 (t, *J* = 7.6 Hz, 1H), 7.51 (t, *J* = 7.6 Hz, 1H), 7.41 (s, 1H), 7.26 (d, *J* = 7.6 Hz, 1H), 7.20 (t, *J* = 7.8 Hz, 1H), 6.99-6.80 (m, 2H), 6.05 (s, 1H), 3.97-3.70 (m, 1H), 3.09-2.86 (m, 1H), 1.68-1.36 (m, 2H), 1.32-1.18 (m, 2H), 0.84 (t, *J* = 7.4 Hz, 3H). **¹³C NMR (100 MHz, DMSO-*d*₆)** δ 156.8, 153.4, 152.3, 137.7, 130.3, 129.1, 127.5, 127.1, 127.0, 125.8, 125.2, 124.1, 123.2, 121.6, 119.0, 114.2, 112.8, 103.4, 56.4, 45.1, 29.8, 19.9, 14.2. **HRMS (ESI-TOF)** *m/z* calcd. for C₂₄H₂₃N₂O₂⁺ [M+H]⁺: 371.1754; found: 371.1750.



3-(2-Methoxyphenyl)-4-(naphtho[2,1-*b*]furan-2-yl)-3,4-dihydroquinazolin-2(1H)-one (3d)

The title compound was obtained as a white solid (176.6 mg, 84%). Mp: 245.0-246.9 °C.

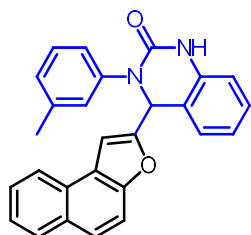
¹H NMR (400 MHz, DMSO-*d*₆) δ 9.81 (s, 1H), 8.19 (d, *J* = 8.4 Hz, 1H), 7.99 (d, *J* = 8.0 Hz, 1H), 7.79 (d, *J* = 8.8 Hz, 1H), 7.74 (d, *J* = 8.8 Hz, 1H), 7.57 (t, *J* = 7.6 Hz, 1H), 7.49 (t, *J* = 7.6 Hz, 1H), 7.33 (s, 1H), 7.28-7.16 (m, 3H), 7.15-6.94 (m, 3H), 6.91 (t, *J* = 7.6 Hz, 1H), 6.84-6.70 (m, 1H), 6.13 (s, 1H), 3.72 (s, 3H). **¹³C NMR (100 MHz, DMSO-*d*₆)** δ 156.7, 152.4, 152.2, 137.5, 131.2, 130.3, 129.5, 129.2, 129.1, 127.6, 127.2, 127.0, 125.8, 125.2, 124.1, 123.2, 121.9, 120.6, 119.2, 114.5, 112.8, 112.6, 103.9, 59.4, 56.0. **HRMS (ESI-TOF)** *m/z* calcd. for C₂₇H₂₁N₂O₃⁺ [M+H]⁺: 421.1547; found: 421.1544.



3-(2-Bromophenyl)-4-(naphtho[2,1-*b*]furan-2-yl)-3,4-dihydroquinazolin-2(1H)-one (3e)

The title compound was obtained as a white solid (177.8 mg, 76%). Mp: 153.4-155.2 °C.

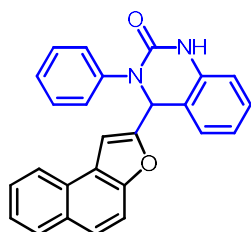
¹H NMR (400 MHz, DMSO-*d*₆) δ 10.04 (s, 1H), 8.20 (d, *J* = 8.4 Hz, 1H), 8.01 (d, *J* = 8.0 Hz, 1H), 7.84-7.74 (m, 3H), 7.59 (t, *J* = 7.0 Hz, 1H), 7.50 (t, *J* = 7.0 Hz, 1H), 7.42 (s, 1H), 7.34-7.19 (m, 4H), 7.02 (d, *J* = 6.8 Hz, 1H), 6.99-6.89 (m, 2H), 6.15 (s, 1H). **¹³C NMR (100 MHz, DMSO-*d*₆)** δ 156.1, 152.4, 152.0, 139.9, 137.2, 133.6, 132.5, 130.4, 130.1, 129.3, 129.1, 128.7, 127.6, 127.2, 127.1, 126.0, 125.3, 124.1, 123.2, 123.1, 122.2, 119.1, 114.8, 112.9, 104.3, 59.4. **HRMS (ESI-TOF)** *m/z* calcd. for C₂₆H₁₈BrN₂O₂⁺ [M+H]⁺: 469.0546; found: 469.0544.



4-(Naphtho[2,1-*b*]furan-2-yl)-3-(*m*-tolyl)-3,4-dihydroquinazolin-2(1*H*)-one (3f)

The title compound was obtained as a white solid (169.7 mg, 84%). Mp: 247.9-249.3 °C.

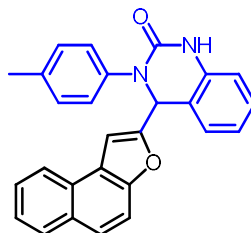
¹H NMR (400 MHz, DMSO-*d*₆) δ 9.93 (s, 1H), 8.22 (d, *J* = 8.0 Hz, 1H), 7.99 (d, *J* = 8.0 Hz, 1H), 7.78 (d, *J* = 9.2 Hz, 1H), 7.73 (d, *J* = 8.8 Hz, 1H), 7.57 (t, *J* = 7.6 Hz, 1H), 7.48 (t, *J* = 7.6 Hz, 1H), 7.42-7.31 (m, 2H), 7.29-7.15 (m, 3H), 7.08 (d, *J* = 8.0 Hz, 1H), 7.06-6.83 (m, 3H), 6.41 (s, 1H), 2.23 (s, 3H). **¹³C NMR (100 MHz, DMSO-*d*₆)** δ 156.6, 152.7, 152.3, 141.9, 138.5, 137.3, 130.3, 129.3, 129.1, 128.9, 128.0, 127.5, 127.4, 127.1, 127.0, 125.8, 125.2, 124.5, 124.1, 123.2, 122.0, 119.8, 114.5, 112.8, 103.4, 60.0, 21.4. **HRMS (ESI-TOF) *m/z*** calcd. for C₂₇H₂₁N₂O₂⁺ [M+H]⁺: 405.1598; found: 405.1598.



4-(Naphtho[2,1-*b*]furan-2-yl)-3-phenyl-3,4-dihydroquinazolin-2(1*H*)-one (3g)

The title compound was obtained as a white solid (146.3 mg, 75%). Mp: 265.7-266.9 °C

¹H NMR (400 MHz, DMSO-*d*₆) δ 9.92 (s, 1H), 8.23 (d, *J* = 8.0 Hz, 1H), 8.00 (d, *J* = 8.4 Hz, 1H), 7.80 (d, *J* = 8.8 Hz, 1H), 7.74 (d, *J* = 9.2 Hz, 1H), 7.58 (t, *J* = 7.6 Hz, 1H), 7.50 (t, *J* = 7.6 Hz, 1H), 7.42-7.28 (m, 6H), 7.28-7.16 (m, 2H), 7.02-6.90 (m, 2H), 6.44 (s, 1H). **¹³C NMR (100 MHz, CDCl₃)** δ 155.0, 153.5, 152.6, 141.2, 136.1, 130.2, 129.13, 129.10, 128.7, 127.5, 126.9, 126.8, 126.4, 126.3, 125.4, 124.6, 123.3, 123.1, 122.5, 119.4, 114.4, 112.4, 103.0, 61.0. **HRMS (ESI-TOF) *m/z*** calcd. for C₂₆H₁₉N₂O₂⁺ [M+H]⁺: 391.1441; found: 391.1442.

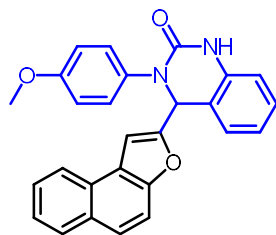


4-(Naphtho[2,1-*b*]furan-2-yl)-3-(*p*-tolyl)-3,4-dihydroquinazolin-2(1*H*)-one (3h)

The title compound was obtained as a white solid (177.8 mg, 88%). Mp: 153.0-154.5 °C.

¹H NMR (400 MHz, DMSO-*d*₆) δ 9.87 (s, 1H), 8.22 (d, *J* = 8.0 Hz, 1H), 8.00 (d, *J* = 8.0 Hz, 1H), 7.79 (d, *J* = 9.2 Hz, 1H), 7.74 (d, *J* = 8.8 Hz, 1H), 7.58 (t, *J* = 7.0 Hz, 1H), 7.53-7.45 (m, 1H), 7.34 (s, 1H), 7.30 (d, *J* = 7.6 Hz, 1H), 7.24 (t, *J* = 7.6 Hz, 1H), 7.18 (d, *J* = 8.4 Hz, 2H), 7.11 (d, *J* = 8.4 Hz, 2H), 6.99-6.90 (m, 2H), 6.37 (s, 1H), 2.24 (s, 3H). **¹³C NMR (100 MHz, DMSO-*d*₆)** δ 156.6, 152.7, 152.3, 139.4, 137.3, 136.0, 130.4, 129.6, 129.2, 129.1, 127.5,

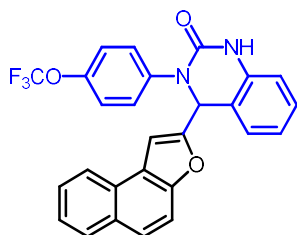
127.1, 127.0, 125.8, 125.2, 124.1, 123.2, 121.9, 119.6, 114.5, 112.8, 103.5, 60.2, 21.0. **HRMS** (ESI-TOF) m/z calcd. for $C_{27}H_{21}N_2O_2^+$ $[M+H]^+$: 405.1598; found: 405.1593.



3-(4-Methoxyphenyl)-4-(naphtho[2,1-*b*]furan-2-yl)-3,4-dihydroquinazolin-2(1*H*)-one (3i)

The title compound was obtained as a white solid (172.4 mg, 82%). Mp: 167.3-168.6 °C.

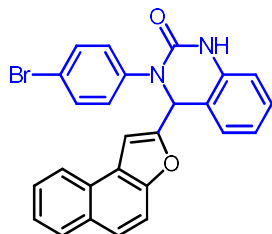
1H NMR (400 MHz, DMSO- d_6) δ 9.84 (s, 1H), 8.22 (d, J = 8.0 Hz, 1H), 8.00 (d, J = 8.0 Hz, 1H), 7.79 (d, J = 9.2 Hz, 1H), 7.74 (d, J = 9.2 Hz, 1H), 7.58 (t, J = 7.6 Hz, 1H), 7.49 (t, J = 7.4 Hz, 1H), 7.36 (s, 1H), 7.30-7.21 (m, 2H), 7.18 (d, J = 8.8 Hz, 2H), 7.01-6.90 (m, 2H), 6.86 (d, J = 8.8 Hz, 2H), 6.33 (s, 1H), 3.69 (s, 3H). **^{13}C NMR (100 MHz, DMSO- d_6)** δ 158.0, 156.7, 152.8, 152.3, 137.4, 134.6, 130.4, 129.2, 129.1, 127.5, 127.2, 127.0, 125.8, 125.2, 124.1, 123.2, 121.9, 119.6, 114.5, 114.4, 112.8, 103.6, 60.5, 55.6. **HRMS** (ESI-TOF) m/z calcd. for $C_{27}H_{21}N_2O_3^+$ $[M+H]^+$: 421.1547; found: 421.1545.



4-(Naphtho[2,1-*b*]furan-2-yl)-3-(4-(trifluoromethoxy)phenyl)-3,4-dihydroquinazolin-2(1*H*)-one (3j)

The title compound was obtained as a white solid (201.5 mg, 85%). Mp: 163.8-165.2 °C.

1H NMR (400 MHz, DMSO- d_6) δ 10.10 (s, 1H), 8.24 (d, J = 8.4 Hz, 1H), 8.00 (d, J = 8.0 Hz, 1H), 7.80 (d, J = 8.8 Hz, 1H), 7.75 (d, J = 9.2 Hz, 1H), 7.58 (t, J = 6.8 Hz, 1H), 7.54-7.43 (m, 3H), 7.43-7.32 (m, 4H), 7.28 (t, J = 7.6 Hz, 1H), 7.09-6.95 (m, 2H), 6.53 (s, 1H). **^{13}C NMR (100 MHz, DMSO- d_6)** δ 156.2, 152.6, 152.4, 146.4, 141.0, 137.1, 130.4, 129.4, 129.10, 129.05, 127.5, 127.2, 127.0, 125.9, 125.3, 124.1, 123.2, 122.2, 121.9, 120.5 (q, d = 253.7 Hz), 119.7, 114.6, 112.8, 103.6, 59.7. **^{19}F NMR (377 MHz, DMSO- d_6)** δ -56.95 (s, 3F). **HRMS** (ESI-TOF) m/z calcd. for $C_{27}H_{18}F_3N_2O_3^+$ $[M+H]^+$: 475.1264; found: 475.1260.

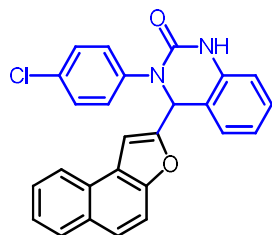


3-(4-Bromophenyl)-4-(naphtho[2,1-*b*]furan-2-yl)-3,4-dihydroquinazolin-2(1*H*)-one (3k)

The title compound was obtained as a white solid (172.6 mg, 75%). Mp: 160.9-162.8 °C.

1H NMR (400 MHz, DMSO- d_6) δ 10.03 (s, 1H), 8.23 (d, J = 8.0 Hz, 1H), 8.00 (d, J = 8.0 Hz, 1H), 7.79 (d, J = 9.2 Hz, 1H), 7.74 (d, J = 8.8 Hz, 1H), 7.62-7.46 (m, 4H), 7.40-7.20 (m, 5H), 6.97 (t, J = 8.4 Hz, 2H), 6.48 (s, 1H). **^{13}C NMR (100 MHz, DMSO- d_6)** δ 156.1, 152.4, 141.2,

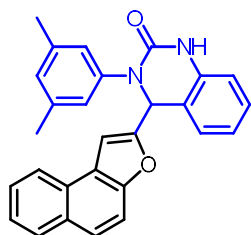
137.1, 132.1, 130.3, 129.5, 129.1, 127.5, 127.2, 127.0, 125.9, 125.3, 124.1, 123.2, 122.2, 119.6, 119.2, 114.6, 112.8, 103.7, 59.7. **HRMS** (ESI-TOF) m/z calcd. for $C_{26}H_{18}BrN_2O_2^+$ $[M+H]^+$: 469.0546; found: 469.0550.



3-(4-Chlorophenyl)-4-(naphtho[2,1-*b*]furan-2-yl)-3,4-dihydroquinazolin-2(1*H*)-one (3l)

The title compound was obtained as a white solid (184.4 mg, 87%). Mp: 197.2-198.8 °C.

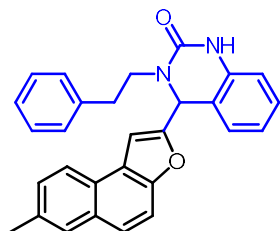
¹H NMR (400 MHz, DMSO-*d*₆) δ 10.01 (s, 1H), 8.23 (d, J = 8.0 Hz, 1H), 8.00 (d, J = 8.0 Hz, 1H), 7.79 (d, J = 9.2 Hz, 1H), 7.74 (d, J = 8.8 Hz, 1H), 7.58 (t, J = 8.2 Hz, 1H), 7.53-7.46 (m, 1H), 7.46-7.34 (m, 5H), 7.32 (d, J = 7.6 Hz, 1H), 7.26 (t, J = 7.8 Hz, 1H), 7.05-6.91 (m, 2H), 6.47 (s, 1H). **¹³C NMR** (100 MHz, DMSO-*d*₆) δ 156.1, 152.5, 152.3, 140.8, 137.1, 130.9, 130.4, 129.3, 129.2, 129.12, 129.07, 127.5, 127.2, 127.0, 125.9, 125.3, 124.1, 123.2, 122.1, 119.6, 114.6, 112.8, 103.7, 59.8. **HRMS** (ESI-TOF) m/z calcd. for $C_{26}H_{18}ClN_2O_2^+$ $[M+H]^+$: 425.1051; found: 425.1052.



3-(3,5-Dimethylphenyl)-4-(naphtho[2,1-*b*]furan-2-yl)-3,4-dihydroquinazolin-2(1*H*)-one (3m)

The title compound was obtained as a white solid (154.8 mg, 74%). Mp: 303.6-305.1 °C.

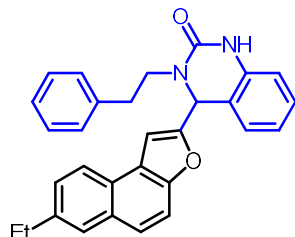
¹H NMR (400 MHz, DMSO-*d*₆) δ 9.90 (s, 1H), 8.23 (d, J = 8.0 Hz, 1H), 7.99 (d, J = 8.4 Hz, 1H), 7.79 (d, J = 9.2 Hz, 1H), 7.74 (d, J = 9.2 Hz, 1H), 7.58 (t, J = 7.6 Hz, 1H), 7.49 (t, J = 7.4 Hz, 1H), 7.42-7.31 (m, 2H), 7.25 (t, J = 7.6 Hz, 1H), 7.07-6.88 (m, 4H), 6.83 (s, 1H), 6.39 (s, 1H), 2.18 (s, 6H). **¹³C NMR** (100 MHz, DMSO-*d*₆) δ 156.6, 152.7, 152.3, 141.9, 138.1, 137.4, 130.3, 129.2, 129.1, 128.2, 127.5, 127.1, 127.0, 125.8, 125.2, 125.1, 124.1, 123.2, 122.0, 119.8, 114.5, 112.8, 103.3, 60.0, 21.3. **HRMS** (ESI-TOF) m/z calcd. for $C_{28}H_{23}N_2O_2^+$ $[M+H]^+$: 419.1754; found: 419.1758.



4-(7-Methylnaphtho[2,1-*b*]furan-2-yl)-3-phenethyl-3,4-dihydroquinazolin-2(1*H*)-one (3n)

The title compound was obtained as a white solid (140.4 mg, 65%). Mp: 172.4-173.7 °C.

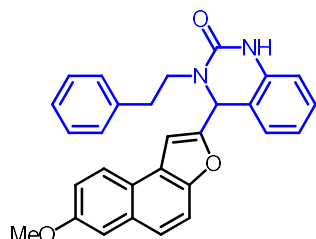
¹H NMR (400 MHz, DMSO-*d*₆) δ 9.61 (s, 1H), 8.17 (d, *J* = 8.0 Hz, 1H), 7.76 (s, 1H), 7.72-7.63 (m, 2H), 7.44 (d, *J* = 8.4 Hz, 1H), 7.39 (s, 1H), 7.28-7.15 (m, 7H), 6.96-6.88 (m, 2H), 6.03 (s, 1H), 4.11-3.96 (m, 1H), 3.33-3.16 (m, 1H), 3.03-2.91 (m, 1H), 2.79-2.67 (m, 1H), 2.47 (s, 3H). **¹³C NMR (100 MHz, DMSO-*d*₆)** δ 156.6, 153.2, 152.1, 139.6, 137.6, 134.3, 130.6, 129.1, 129.0, 128.8, 128.1, 127.0, 126.6, 125.6, 125.2, 124.0, 123.1, 121.7, 118.9, 114.3, 112.7, 103.5, 56.8, 47.5, 34.0, 21.6. **HRMS (ESI-TOF)** *m/z* calcd. for C₂₉H₂₅N₂O₂⁺ [M+H]⁺: 433.1911; found: 433.1916.



4-(7-Ethylnaphtho[2,1-*b*]furan-2-yl)-3-phenethyl-3,4-dihydroquinazolin-2(1*H*)-one (3o)

The title compound was obtained as a yellow solid (160.8 mg, 72%). Mp: 175.2-176.9 °C.

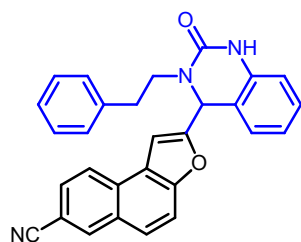
¹H NMR (400 MHz, DMSO-*d*₆) δ 9.64 (s, 1H), 8.19 (d, *J* = 8.4 Hz, 1H), 7.78 (s, 1H), 7.74-7.65 (m, 2H), 7.48 (d, *J* = 8.4 Hz, 1H), 7.41 (s, 1H), 7.30-7.14 (m, 7H), 6.97-6.88 (m, 2H), 6.05 (s, 1H), 4.12-3.96 (m, 1H), 3.35-3.19 (m, 1H), 3.04-2.90 (m, 1H), 2.79-2.69 (m, 3H), 1.27 (t, *J* = 7.6 Hz, 3H). **¹³C NMR (100 MHz, DMSO-*d*₆)** δ 156.5, 153.3, 152.1, 140.6, 139.6, 137.6, 130.6, 129.1, 128.8, 127.9, 127.0, 126.8, 126.6, 125.9, 125.4, 124.1, 123.1, 121.7, 118.9, 114.3, 112.7, 103.5, 56.8, 47.5, 34.0, 28.7, 16.0. **HRMS (ESI-TOF)** *m/z* calcd. for C₃₀H₂₇N₂O₂⁺ [M+H]⁺: 447.2067; found: 447.2063.



4-(7-Methoxynaphtho[2,1-*b*]furan-2-yl)-3-phenethyl-3,4-dihydroquinazolin-2(1*H*)-one (3p)

The title compound was obtained as a white solid (159.0 mg, 71%). Mp: 198.0-199.8 °C.

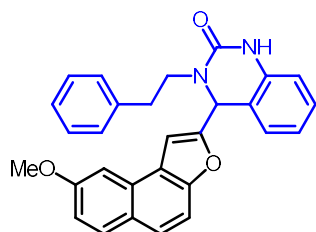
¹H NMR (400 MHz, DMSO-*d*₆) δ 9.62 (s, 1H), 8.19 (d, *J* = 8.8 Hz, 1H), 7.75-7.64 (m, 2H), 7.49-7.43 (m, 1H), 7.39 (s, 1H), 7.35-7.13 (m, 8H), 6.97-6.87 (m, 2H), 6.03 (s, 1H), 4.09-3.97 (m, 1H), 3.88 (s, 3H), 3.30-3.19 (m, 1H), 3.02-2.91 (m, 1H), 2.79-2.67 (m, 1H). **¹³C NMR (100 MHz, DMSO-*d*₆)** δ 156.9, 156.6, 153.2, 151.3, 139.6, 137.6, 131.7, 129.1, 128.8, 127.1, 126.6, 125.6, 124.8, 123.4, 122.4, 121.7, 118.9, 118.8, 114.3, 113.0, 108.1, 103.4, 56.8, 55.6, 47.4, 34.0. **HRMS (ESI-TOF)** *m/z* calcd. for C₂₉H₂₅N₂O₃⁺ [M+H]⁺: 449.1860; found: 449.1854.



2-(2-Oxo-3-phenethyl-1,2,3,4-tetrahydroquinazolin-4-yl)naphtho[2,1-*b*]furan-7-carbonitrile (3q)

The title compound was obtained as a yellow solid (155.1 mg, 70%). Mp: 126.2-127.9 °C.

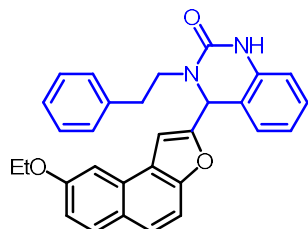
¹H NMR (400 MHz, DMSO-*d*₆) δ 9.61 (s, 1H), 8.66 (s, 1H), 8.49 (d, *J* = 8.4 Hz, 1H), 7.98-7.86 (m, 3H), 7.55 (s, 1H), 7.32-7.10 (m, 7H), 6.96-6.88 (m, 2H), 6.09 (s, 1H), 4.10-3.98 (m, 1H), 3.30-3.19 (m, 1H), 3.02-2.91 (m, 1H), 2.80-2.68 (m, 1H). **¹³C NMR (100 MHz, DMSO-*d*₆)** δ 157.7, 153.8, 153.2, 139.5, 137.6, 135.3, 129.5, 129.4, 129.2, 129.1, 128.8, 127.6, 127.1, 126.6, 126.3, 125.8, 123.5, 121.8, 119.7, 118.6, 114.7, 114.3, 107.6, 103.7, 56.8, 47.5, 34.1. **HRMS (ESI-TOF)** *m/z* calcd. for C₂₉H₂₂N₃O₂⁺ [M+H]⁺: 444.1707; found: 444.1710.



4-(8-Methoxynaphtho[2,1-*b*]furan-2-yl)-3-phenethyl-3,4-dihydroquinazolin-2(1H)-one (3r)

The title compound was obtained as a yellow solid (179.4 mg, 80%). Mp: 204.1-205.2 °C.

¹H NMR (400 MHz, DMSO-*d*₆) δ 9.60 (s, 1H), 7.89 (d, *J* = 9.2 Hz, 1H), 7.76-7.65 (m, 2H), 7.54 (d, *J* = 8.8 Hz, 1H), 7.45 (s, 1H), 7.31-7.15 (m, 7H), 7.13 (dd, *J* = 8.8, 2.4 Hz, 1H), 6.96-6.88 (m, 2H), 6.02 (s, 1H), 4.12-4.01 (m, 1H), 3.95 (s, 3H), 3.33-3.20 (m, 1H), 3.03-2.90 (m, 1H), 2.82-2.69 (m, 1H). **¹³C NMR (100 MHz, DMSO-*d*₆)** δ 158.5, 156.1, 153.3, 152.9, 139.6, 137.6, 130.6, 129.10, 129.08, 128.8, 127.0, 126.6, 125.6, 125.3, 122.7, 121.7, 119.0, 117.2, 114.3, 110.1, 103.6, 103.5, 56.9, 55.9, 47.6, 34.1. **HRMS (ESI-TOF)** *m/z* calcd. for C₂₉H₂₅N₂O₃⁺ [M+H]⁺: 449.1860; found: 449.1864.

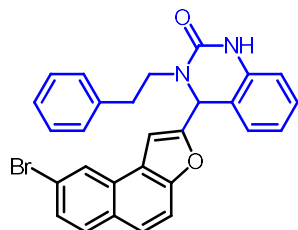


4-(8-Ethoxynaphtho[2,1-*b*]furan-2-yl)-3-phenethyl-3,4-dihydroquinazolin-2(1H)-one (3s)

The title compound was obtained as a yellow solid (194.3 mg, 84%). Mp: 182.0-183.5 °C.

¹H NMR (400 MHz, DMSO-*d*₆) δ 9.59 (s, 1H), 7.88 (d, *J* = 8.8 Hz, 1H), 7.74-7.64 (m, 2H), 7.53 (d, *J* = 8.8 Hz, 1H), 7.44 (s, 1H), 7.31-7.14 (m, 7H), 7.11 (dd, *J* = 8.8, 2.4 Hz, 1H), 6.98-6.86 (m, 2H), 6.01 (s, 1H), 4.22 (q, *J* = 7.2 Hz, 2H), 4.14-3.97 (m, 1H), 3.32-3.20 (m, 1H), 3.04-2.89 (m, 1H), 2.82-2.69 (m, 1H), 1.41 (t, *J* = 7.0 Hz, 3H). **¹³C NMR (100 MHz,**

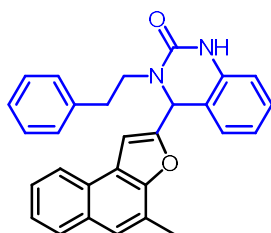
DMSO-d₆) δ 157.8, 156.0, 153.3, 152.9, 139.6, 137.6, 130.6, 129.1, 128.8, 127.0, 126.6, 125.6, 125.2, 122.7, 121.7, 119.0, 117.3, 114.3, 110.0, 104.1, 103.6, 63.8, 56.9, 47.6, 34.1, 15.1. **HRMS** (ESI-TOF) m/z calcd. for C₃₀H₂₇N₂O₃⁺ [M+H]⁺: 463.2016; found: 463.2025.



4-(8-bromonaphtho[2,1-b]furan-2-yl)-3-phenethyl-3,4-dihydroquinazolin-2(1H)-one (3t)

The title compound was obtained as a yellow solid (194.0 mg, 78%). Mp: 205.9-207.1 °C.

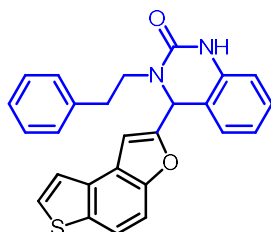
¹H NMR (400 MHz, DMSO-d₆) δ 9.59 (s, 1H), 8.62 (s, 1H), 7.97 (d, J = 8.8 Hz, 1H), 7.81 (d, J = 8.8 Hz, 1H), 7.77 (d, J = 8.8 Hz, 1H), 7.62 (d, J = 8.4 Hz, 1H), 7.55 (s, 1H), 7.33-7.11 (m, 7H), 6.99-6.84 (m, 2H), 6.04 (s, 1H), 4.11-3.95 (m, 1H), 3.30-3.19 (m, 1H), 3.01-2.90 (m, 1H), 2.81-2.68 (m, 1H). **¹³C NMR (100 MHz, DMSO-d₆)** δ 157.0, 153.2, 152.8, 139.5, 137.6, 131.3, 129.14, 129.10, 128.92, 128.86, 128.8, 128.2, 127.0, 126.6, 126.5, 125.7, 122.7, 121.7, 120.6, 118.8, 114.3, 113.4, 103.7, 56.8, 47.6, 34.1. **HRMS** (ESI-TOF) m/z calcd. for C₂₈H₂₂BrN₂O₂⁺ [M+H]⁺: 497.0859; found: 497.0855.



4-(4-Methylnaphtho[2,1-b]furan-2-yl)-3-phenethyl-3,4-dihydroquinazolin-2(1H)-one (3u)

The title compound was obtained as a yellow solid (157.7 mg, 73%). Mp: 207.1-208.4 °C.

¹H NMR (400 MHz, DMSO-d₆) δ 9.61 (s, 1H), 8.19 (d, J = 8.0 Hz, 1H), 7.89 (d, J = 8.0 Hz, 1H), 7.57 (s, 1H), 7.51 (t, J = 7.4 Hz, 1H), 7.45 (t, J = 7.4 Hz, 1H), 7.31 (s, 1H), 7.29-7.13 (m, 7H), 6.93 (t, J = 8.0 Hz, 2H), 6.05 (s, 1H), 4.16-4.02 (m, 1H), 3.35-3.21 (m, 1H), 3.04-2.93 (m, 1H), 2.85-2.72 (m, 1H), 2.52 (s, 3H). **¹³C NMR (100 MHz, DMSO-d₆)** δ 156.6, 153.4, 152.1, 139.6, 137.7, 130.8, 129.1, 128.9, 128.8, 128.3, 127.0, 126.6, 126.4, 126.0, 125.2, 124.9, 123.9, 122.7, 122.3, 121.7, 119.1, 114.3, 103.5, 56.8, 47.6, 34.1, 15.5. **HRMS** (ESI-TOF) m/z calcd. for C₂₉H₂₅N₂O₂⁺ [M+H]⁺: 433.1911; found: 433.1906.

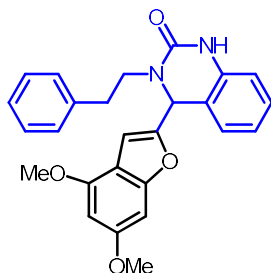


3-Phenethyl-4-(thieno[3,2-e]benzofuran-2-yl)-3,4-dihydroquinazolin-2(1H)-one (3v)

The title compound was obtained as a yellow solid (154.8 mg, 73%). Mp: 168.5-169.9 °C.

¹H NMR (400 MHz, DMSO-d₆) δ 9.58 (s, 1H), 7.93-7.76 (m, 3H), 7.57 (d, J = 8.8 Hz, 1H), 7.30-7.12 (m, 8H), 6.98-6.85 (m, 2H), 6.03 (s, 1H), 4.09-3.97 (m, 1H), 3.32-3.15 (m, 1H), 3.01-2.90 (m, 1H), 2.82-2.68 (m, 1H). **¹³C NMR (100 MHz, DMSO-d₆)** δ 156.9, 153.2, 152.8,

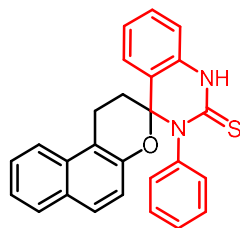
139.5, 137.6, 134.9, 133.0, 129.2, 129.1, 128.9, 128.8, 127.0, 126.6, 122.6, 122.5, 121.7, 119.1, 118.8, 114.3, 109.3, 103.4, 56.7, 47.5, 34.1. **HRMS** (ESI-TOF) m/z calcd. for $C_{26}H_{21}N_2O_2S^+$ $[M+H]^+$: 425.1318; found: 425.1313.



4-(4,6-Dimethoxybenzofuran-2-yl)-3-phenethyl-3,4-dihydroquinazolin-2(1H)-one (3w)

The title compound was obtained as a yellow solid (37.9 mg, 18%). Mp: 140.1-142.3 °C.

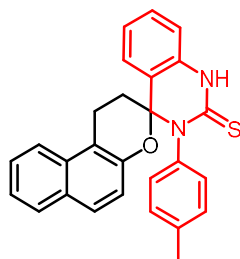
1H NMR (400 MHz, $CDCl_3$) δ 7.78 (s, 1H), 7.33-7.14 (m, 6H), 6.99 (d, $J = 7.6$ Hz, 1H), 6.91 (t, $J = 7.4$ Hz, 1H), 6.78 (d, $J = 8.0$ Hz, 1H), 6.55 (s, 1H), 6.49 (s, 1H), 6.26 (s, 1H), 5.32 (s, 1H), 4.28-4.16 (m, 1H), 3.84 (s, 3H), 3.78 (s, 3H), 3.40-3.28 (m, 1H), 3.03-2.92 (m, 1H), 2.92-2.80 (m, 1H). **^{13}C NMR (100 MHz, $CDCl_3$)** δ 159.2, 156.9, 153.9, 153.4, 139.2, 136.4, 128.9, 128.8, 128.5, 126.5, 126.3, 121.9, 118.3, 114.0, 111.5, 101.3, 94.3, 88.3, 57.8, 55.7, 55.5, 48.1, 34.6. **HRMS** (ESI-TOF) m/z calcd. for $C_{26}H_{25}N_2O_4^+$ $[M+H]^+$: 429.1809; found: 429.1812.



3'-Phenyl-1,2-dihydro-1'H-spiro[benzo[f]chromene-3,4'-quinazoline]-2'(3'H)-thione (5a)

The title compound was obtained as a yellow solid (143.0 mg, 70%). Mp: 222.9-224.4 °C.

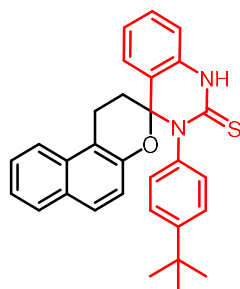
1H NMR (400 MHz, $DMSO-d_6$) δ 11.62 (s, 1H), 7.80 (d, $J = 8.0$ Hz, 1H), 7.75 (d, $J = 8.4$ Hz, 1H), 7.65 (d, $J = 8.8$ Hz, 1H), 7.48 (t, $J = 7.6$ Hz, 1H), 7.44-7.33 (m, 3H), 7.33-7.21 (m, 5H), 7.18 (d, $J = 7.6$ Hz, 1H), 7.03 (t, $J = 7.6$ Hz, 1H), 6.88 (d, $J = 8.8$ Hz, 1H), 2.90-2.71 (m, 2H), 2.64-2.53 (m, 1H), 2.50-2.38 (m, 1H). **^{13}C NMR (100 MHz, $DMSO-d_6$)** δ 176.1, 150.8, 140.5, 133.9, 132.1, 130.3, 129.2, 128.7, 128.6, 128.5, 128.2, 127.1, 124.8, 124.2, 123.6, 123.4, 122.7, 118.3, 114.9, 114.0, 88.6, 30.7, 18.4. **HRMS** (ESI-TOF) m/z calcd. for $C_{26}H_{21}N_2OS^+$ $[M+H]^+$: 409.1369; found: 409.1366.



3'-(p-Tolyl)-1,2-dihydro-1'H-spiro[benzo[f]chromene-3,4'-quinazoline]-2'(3'H)-thione (5b)

The title compound was obtained as a yellow solid (166.9 mg, 79%). Mp: 207.8-209.9 °C.

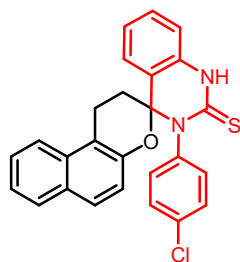
¹H NMR (400 MHz, DMSO-*d*₆) δ 11.57 (s, 1H), 7.86-7.74 (m, 2H), 7.67 (d, *J* = 9.2 Hz, 1H), 7.49 (t, *J* = 7.4 Hz, 2H), 7.43-7.33 (m, 2H), 7.27 (d, *J* = 7.6 Hz, 2H), 7.19-7.07 (m, 4H), 7.02 (t, *J* = 7.2 Hz, 1H), 6.90 (d, *J* = 8.8 Hz, 1H), 2.94-2.72 (m, 2H), 2.66-2.54 (m, 1H), 2.49-2.41 (m, 1H), 2.25 (s, 3H). **¹³C NMR (100 MHz, DMSO-*d*₆)** δ 176.2, 150.9, 137.8, 137.5, 133.8, 132.1, 130.3, 129.9, 129.2, 129.1, 128.7, 128.6, 127.2, 124.9, 124.2, 123.6, 123.3, 122.7, 118.4, 114.8, 113.9, 88.6, 30.5, 21.1, 18.5. **HRMS (ESI-TOF)** *m/z* calcd. for C₂₇H₂₃N₂OS⁺ [M+H]⁺: 423.1526; found: 423.1530.



3'-(4-*tert*-Butylphenyl)-1,2-dihydro-1'*H*-spiro[benzo[*f*]chromene-3,4'-quinazoline]-2'(3'*H*)-thione (5c)

The title compound was obtained as a yellow solid (199.8 mg, 86%). Mp: 223.4-224.8 °C.

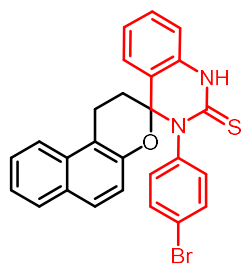
¹H NMR (400 MHz, DMSO-*d*₆) δ 11.59 (s, 1H), 7.79 (d, *J* = 8.0 Hz, 1H), 7.71 (d, *J* = 8.4 Hz, 1H), 7.64 (d, *J* = 8.8 Hz, 1H), 7.47 (t, *J* = 7.6 Hz, 1H), 7.43-7.32 (m, 2H), 7.32-7.16 (m, 5H), 7.04 (t, *J* = 7.8 Hz, 2H), 6.87 (d, *J* = 8.8 Hz, 1H), 2.92-2.64 (m, 2H), 2.63-2.54 (m, 1H), 2.49-2.34 (m, 1H), 1.19 (s, 9H). **¹³C NMR (100 MHz, DMSO-*d*₆)** δ 176.1, 150.8, 150.4, 137.9, 134.0, 132.1, 131.4, 130.3, 129.2, 128.7, 128.5, 127.1, 125.1, 124.9, 124.2, 123.6, 123.4, 122.6, 118.4, 114.8, 114.0, 88.4, 34.7, 31.5, 30.6, 18.5. **HRMS (ESI-TOF)** *m/z* calcd. for C₃₀H₂₉N₂OS⁺ [M+H]⁺: 465.1995; found: 465.1990.



3'-(4-Chlorophenyl)-1,2-dihydro-1'*H*-spiro[benzo[*f*]chromene-3,4'-quinazoline]-2'(3'*H*)-thione (5d)

The title compound was obtained as a yellow solid (168.3 mg, 76%). Mp: 239.5-241.0 °C.

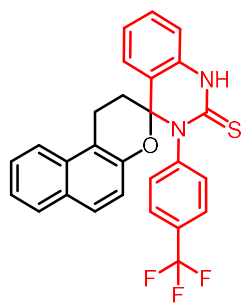
¹H NMR (400 MHz, DMSO-*d*₆) δ 11.68 (s, 1H), 7.81 (t, *J* = 8.2 Hz, 2H), 7.68 (d, *J* = 8.8 Hz, 1H), 7.50 (t, *J* = 7.0 Hz, 1H), 7.45-7.33 (m, 5H), 7.27 (d, *J* = 8.0 Hz, 2H), 7.16 (d, *J* = 8.0 Hz, 1H), 7.04 (t, *J* = 7.6 Hz, 1H), 6.91 (d, *J* = 8.8 Hz, 1H), 2.98-2.88 (m, 1H), 2.87-2.76 (m, 1H), 2.62-2.53 (m, 1H), 2.49-2.38 (m, 1H). **¹³C NMR (100 MHz, DMSO-*d*₆)** δ 176.0, 150.8, 139.3, 133.7, 132.9, 132.1, 130.4, 129.3, 128.7, 128.6, 127.2, 124.9, 124.3, 123.8, 123.3, 122.7, 118.2, 114.9, 114.0, 88.8, 30.7, 18.4. **HRMS (ESI-TOF)** *m/z* calcd. for C₂₆H₂₀ClN₂OS⁺ [M+H]⁺: 443.0979; found: 443.0982.



3'-(4-Bromophenyl)-1,2-dihydro-1'H-spiro[benzo[f]chromene-3,4'-quinazoline]-2'(3'H)-thione (5e)

The title compound was obtained as a yellow solid (165.7 mg, 68%). Mp: 246.3-247.6 °C.

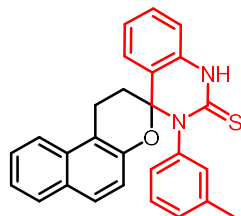
¹H NMR (400 MHz, DMSO-d₆) δ 11.70 (s, 1H), 7.90-7.73 (m, 2H), 7.67 (d, *J* = 8.4 Hz, 1H), 7.57-7.45 (m, 3H), 7.45-7.17 (m, 5H), 7.17-7.10 (m, 1H), 7.07-6.98 (m, 1H), 6.90 (d, *J* = 8.8 Hz, 1H), 3.09-2.67 (m, 2H), 2.60-2.49 (m, 1H), 2.49-2.30 (m, 1H). ¹³C NMR (100 MHz, DMSO-d₆) δ 175.9, 150.8, 139.7, 133.7, 132.4, 132.1, 131.5, 131.3, 130.4, 129.3, 128.7, 127.2, 124.8, 124.3, 123.8, 123.3, 122.7, 121.5, 118.2, 114.9, 114.0, 88.7, 30.7, 18.4. HRMS (ESI-TOF) *m/z* calcd. for C₂₆H₂₀BrN₂OS⁺ [M+H]⁺: 487.0474; found: 487.0468.



3'-(4-(Trifluoromethyl)phenyl)-1,2-dihydro-1'H-spiro[benzo[f]chromene-3,4'-quinazolinone]-2'(3'H)-thione (5f)

The title compound was obtained as a yellow solid (149.9 mg, 63%). Mp: 225.6-227.2 °C.

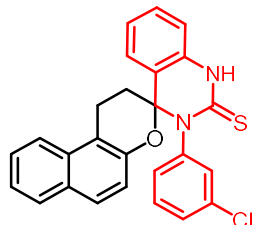
¹H NMR (400 MHz, DMSO-d₆) δ 11.75 (s, 1H), 7.87-7.75 (m, 2H), 7.75-7.53 (m, 5H), 7.52-7.47 (m, 1H), 7.45-7.35 (m, 2H), 7.30 (d, *J* = 7.6 Hz, 1H), 7.17 (d, *J* = 7.2 Hz, 1H), 7.11-7.00 (m, 1H), 6.89 (d, *J* = 8.4 Hz, 1H), 3.05-2.89 (m, 1H), 2.88-2.73 (m, 1H), 2.65-2.55 (m, 1H), 2.49-2.34 (m, 1H). ¹³C NMR (100 MHz, DMSO-d₆) δ 175.8, 150.7, 144.1, 133.7, 133.3, 132.1, 130.5, 129.3, 128.7, 127.2, 125.6, 124.8, 124.4, 123.9, 123.3, 122.7, 118.1, 115.0, 114.0, 88.9, 30.7, 18.4. ¹⁹F NMR (377 MHz, DMSO-d₆) δ -60.96 (s, 3F). HRMS (ESI-TOF) *m/z* calcd. for C₂₇H₂₀F₃N₂OS⁺ [M+H]⁺: 477.1243; found: 477.1240.



3'-(*m*-Tolyl)-1,2-dihydro-1'H-spiro[benzo[f]chromene-3,4'-quinazolinone]-2'(3'H)-thione (5g)

The title compound was obtained as a yellow solid (143.7 mg, 68%). Mp: 227.9-229.6 °C.

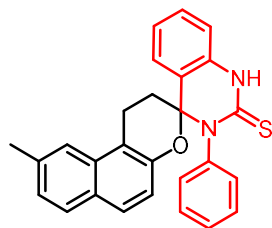
¹H NMR (400 MHz, DMSO-*d*₆) δ 11.59 (s, 1H), 7.88-7.62 (m, 3H), 7.53-7.33 (m, 3H), 7.32-6.84 (m, 8H), 2.91-2.49 (m, 4H), 2.32-1.96 (m, 3H). **¹³C NMR (100 MHz, DMSO-*d*₆)** δ 176.1, 150.8, 140.4, 137.7, 134.0, 132.6, 132.1, 130.3, 129.2, 128.9, 128.8, 128.7, 128.6, 128.3, 128.0, 127.1, 124.8, 124.2, 123.6, 123.4, 122.6, 118.4, 114.9, 88.3, 30.4, 21.1, 18.5. **HRMS (ESI-TOF)** *m/z* calcd. for C₂₇H₂₃N₂OS⁺ [M+H]⁺: 423.1526; found: 423.1520.



3'-(3-Chlorophenyl)-1,2-dihydro-1'*H*-spiro[benzo[*f*]chromene-3,4'-quinazoline]-2'(3'*H*)-thione (5h)

The title compound was obtained as a yellow solid (110.7 mg, 50%). Mp: 220.5-221.8 °C.

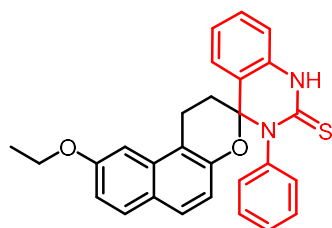
¹H NMR (400 MHz, DMSO-*d*₆) δ 11.72 (s, 1H), 7.87-7.74 (m, 2H), 7.69 (d, *J* = 9.2 Hz, 1H), 7.57-7.24 (m, 8H), 7.20 (d, *J* = 8.0 Hz, 1H), 7.05 (t, *J* = 7.6 Hz, 1H), 6.90 (d, *J* = 8.8 Hz, 1H), 3.02-2.76 (m, 2H), 2.67-2.55 (m, 1H), 2.50-2.35 (m, 1H). **¹³C NMR (100 MHz, DMSO-*d*₆)** δ 176.0, 150.7, 141.7, 133.7, 132.5, 132.1, 131.0, 130.4, 130.0, 129.3, 128.7, 128.4, 127.2, 124.9, 124.3, 123.8, 123.4, 122.7, 118.1, 115.0, 114.0, 88.7, 30.7, 18.4. **HRMS (ESI-TOF)** *m/z* calcd. for C₂₆H₂₀ClN₂OS⁺ [M+H]⁺: 443.0979; found: 443.0980.



9-Methyl-3'-phenyl-1,2-dihydro-1'*H*-spiro[benzo[*f*]chromene-3,4'-quinazoline]-2'(3'*H*)-thione (5i)

The title compound was obtained as a yellow solid (179.4 mg, 85%). Mp: 236.4-237.8 °C.

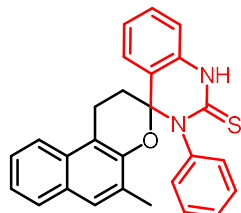
¹H NMR (400 MHz, DMSO-*d*₆) δ 11.59 (s, 1H), 7.69 (d, *J* = 8.0 Hz, 1H), 7.58 (d, *J* = 8.4 Hz, 1H), 7.54 (s, 1H), 7.46-7.35 (m, 2H), 7.34-7.24 (m, 5H), 7.22-7.15 (m, 2H), 7.08-6.99 (m, 1H), 6.78 (d, *J* = 8.4 Hz, 1H), 2.87-2.75 (m, 2H), 2.61-2.53 (m, 1H), 2.49-2.34 (m, 4H). **¹³C NMR (100 MHz, DMSO-*d*₆)** δ 176.1, 150.9, 140.5, 136.4, 133.9, 132.3, 132.1, 130.3, 128.6, 128.3, 128.2, 127.4, 126.3, 124.9, 123.6, 123.4, 121.8, 117.3, 114.8, 113.4, 88.6, 30.7, 22.1, 18.4. **HRMS (ESI-TOF)** *m/z* calcd. for C₂₇H₂₃N₂OS⁺ [M+H]⁺: 423.1526; found: 423.1530.



9-Ethoxy-3'-phenyl-1,2-dihydro-1'*H*-spiro[benzo[*f*]chromene-3,4'-quinazoline]-2'(3'*H*)-thione (5j)

The title compound was obtained as a yellow solid (147.1 mg, 65%). Mp: 260.9-262.6 °C.

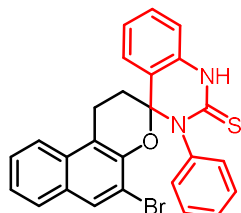
¹H NMR (400 MHz, DMSO-*d*₆) δ 11.57 (s, 1H), 7.70 (d, *J* = 8.8 Hz, 1H), 7.55 (d, *J* = 8.8 Hz, 1H), 7.47-7.36 (m, 2H), 7.36-7.22 (m, 5H), 7.17 (d, *J* = 8.0 Hz, 1H), 7.10-6.95 (m, 3H), 6.69 (d, *J* = 8.8 Hz, 1H), 4.11 (q, *J* = 6.8 Hz, 2H), 2.85-2.71 (m, 2H), 2.60-2.53 (m, 1H), 2.49-2.38 (m, 1H), 1.36 (t, *J* = 7.0 Hz, 3H). **¹³C NMR (100 MHz, DMSO-*d*₆)** δ 176.1, 157.8, 151.4, 140.4, 133.9, 133.5, 132.1, 130.3, 128.5, 128.3, 128.2, 124.8, 124.3, 123.6, 123.4, 116.3, 115.6, 114.8, 113.0, 102.8, 88.6, 63.5, 30.6, 18.5, 15.1. **HRMS (ESI-TOF)** *m/z* calcd. for C₂₈H₂₅N₂O₂S⁺ [M+H]⁺: 453.1631; found: 453.1637.



5-Methyl-3'-phenyl-1,2-dihydro-1'*H*-spiro[benzo[*f*]chromene-3,4'-quinazoline]-2'(3'*H*)-thione (5k)

The title compound was obtained as a yellow solid (162.5 mg, 77%). Mp: 225.9-227.3 °C.

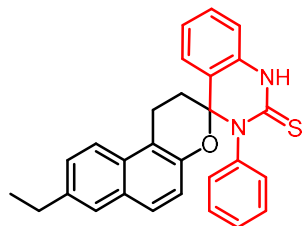
¹H NMR (400 MHz, DMSO-*d*₆) δ 11.58 (s, 1H), 7.74 (d, *J* = 8.4 Hz, 1H), 7.70 (d, *J* = 8.0 Hz, 1H), 7.49 (s, 1H), 7.45-7.37 (m, 3H), 7.37-7.23 (m, 6H), 7.07-6.96 (m, 2H), 3.10-2.91 (m, 1H), 2.74-2.61 (m, 1H), 2.51-2.43 (m, 2H), 2.01 (s, 3H). **¹³C NMR (100 MHz, DMSO-*d*₆)** δ 176.2, 150.1, 140.5, 133.9, 132.1, 131.7, 130.9, 130.3, 128.9, 128.6, 128.3, 127.9, 127.1, 126.2, 124.3, 123.8, 123.6, 122.5, 114.8, 113.5, 89.2, 30.2, 18.5, 16.9. **HRMS (ESI-TOF)** *m/z* calcd. for C₂₇H₂₃N₂OS⁺ [M+H]⁺: 423.1526; found: 423.1530.



5-Bromo-3'-phenyl-1,2-dihydro-1'*H*-spiro[benzo[*f*]chromene-3,4'-quinazoline]-2'(3'*H*)-thione (5l)

The title compound was obtained as a yellow solid (124.3 mg, 51%). Mp: 218.2-220.0 °C.

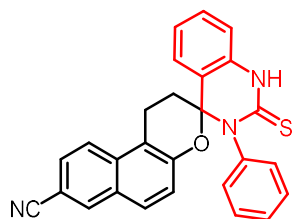
¹H NMR (400 MHz, DMSO-*d*₆) δ 11.69 (s, 1H), 8.09 (s, 1H), 7.88-7.75 (m, 2H), 7.52 (t, *J* = 7.2 Hz, 1H), 7.47-7.37 (m, 3H), 7.36-7.22 (m, 5H), 7.15 (d, *J* = 7.6 Hz, 1H), 7.04 (t, *J* = 7.2 Hz, 1H), 3.03-2.79 (m, 2H), 2.67-2.52 (m, 2H). **¹³C NMR (100 MHz, DMSO-*d*₆)** δ 176.2, 146.8, 140.3, 133.9, 132.2, 131.10, 131.08, 130.5, 129.8, 129.6, 128.5, 128.4, 128.0, 127.5, 125.3, 124.7, 123.8, 122.9, 116.4, 114.9, 112.1, 89.5, 30.7, 19.3. **HRMS (ESI-TOF)** *m/z* calcd. for C₂₆H₂₀BrN₂OS⁺ [M+H]⁺: 487.0474; found: 487.0480.



8-Ethyl-3'-phenyl-1,2-dihydro-1'H-spiro[benzo[f]chromene-3,4'-quinazoline]-2'(3'H)-thione (5m)

The title compound was obtained as a yellow solid (150.4 mg, 69%). Mp: 237.9-238.6 °C.

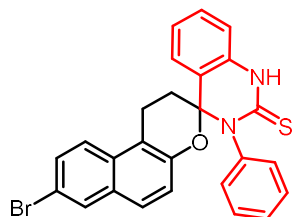
¹H NMR (400 MHz, DMSO-*d*₆) δ 11.60 (s, 1H), 7.67 (d, *J* = 7.2 Hz, 1H), 7.63-7.49 (m, 2H), 7.47-7.10 (m, 9H), 7.07-6.95 (m, 1H), 6.83 (d, *J* = 8.0 Hz, 1H), 2.92-2.62 (m, 4H), 2.60-2.39 (m, 2H), 1.22 (t, *J* = 7.8 Hz, 3H). **¹³C NMR (100 MHz, DMSO-*d*₆)** δ 176.1, 150.3, 140.5, 139.6, 133.9, 132.0, 130.5, 130.3, 129.4, 128.5, 128.2, 128.1, 128.1, 126.4, 124.8, 123.6, 123.5, 122.7, 118.2, 114.8, 113.9, 88.5, 30.7, 28.4, 18.4, 16.1. **HRMS (ESI-TOF)** *m/z* calcd. for C₂₈H₂₅N₂OS⁺ [M+H]⁺: 437.1682; found: 437.1678.



3'-Phenyl-2'-thioxo-1,2,2',3'-tetrahydro-1'H-spiro[benzo[f]chromene-3,4'-quinazoline]-8-carbonitrile (5n)

The title compound was obtained as a yellow solid (125.6 mg, 58%). Mp: 219.7-220.9 °C.

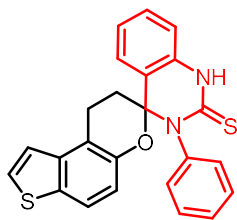
¹H NMR (400 MHz, DMSO-*d*₆) δ 11.65 (s, 1H), 8.44 (s, 1H), 7.91 (d, *J* = 8.8 Hz, 1H), 7.81 (d, *J* = 9.2 Hz, 1H), 7.75 (d, *J* = 8.8 Hz, 1H), 7.42 (t, *J* = 7.6 Hz, 2H), 7.32-7.16 (m, 6H), 7.10-7.02 (m, 2H), 2.95-2.82 (m, 1H), 2.79-2.71 (m, 1H), 2.70-2.61 (m, 1H), 2.58-2.52 (m, 1H). **¹³C NMR (100 MHz, DMSO-*d*₆)** δ 176.1, 153.3, 140.5, 134.9, 133.93, 133.89, 132.0, 130.5, 129.4, 128.6, 128.4, 128.2, 127.6, 124.9, 124.3, 123.8, 123.0, 120.3, 119.8, 114.9, 114.7, 106.4, 88.8, 30.5, 18.4. **HRMS (ESI-TOF)** *m/z* calcd. for C₂₇H₂₀N₃OS⁺ [M+H]⁺: 434.1322; found: 434.1325.



8-Bromo-3'-phenyl-1,2-dihydro-1'H-spiro[benzo[f]chromene-3,4'-quinazoline]-2'(3'H)-thione (5o)

The title compound was obtained as a yellow solid (138.5 mg, 57%). Mp: 238.9-240.2 °C.

¹H NMR (400 MHz, DMSO-*d*₆) δ 11.64 (s, 1H), 8.08 (s, 1H), 7.70 (d, *J* = 8.8 Hz, 1H), 7.65 (d, *J* = 8.8 Hz, 1H), 7.58 (d, *J* = 8.4 Hz, 1H), 7.46-7.35 (m, 2H), 7.34-7.15 (m, 6H), 7.05 (t, *J* = 7.2 Hz, 1H), 6.93 (d, *J* = 8.8 Hz, 1H), 2.90-2.78 (m, 1H), 2.78-2.67 (m, 1H), 2.65-2.56 (m, 1H), 2.50-2.39 (m, 1H). **¹³C NMR (100 MHz, DMSO-*d*₆)** δ 176.1, 151.2, 140.5, 133.9, 132.0, 130.7, 130.54, 130.45, 130.4, 129.9, 128.5, 128.3, 127.9, 125.1, 124.9, 123.7, 123.3, 119.6, 117.2, 114.9, 114.4, 88.6, 30.5, 18.4. **HRMS (ESI-TOF)** *m/z* calcd. for C₂₆H₂₀BrN₂OS⁺ [M+H]⁺: 487.0474; found: 487.0468.

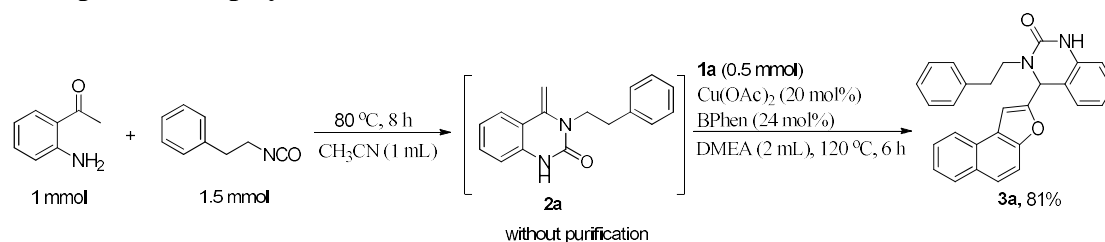


3-Phenyl-8',9'-dihydro-1H-spiro[quinazoline-4,7'-thieno[3,2-f]chromene]-2(3H)-thione (5p)

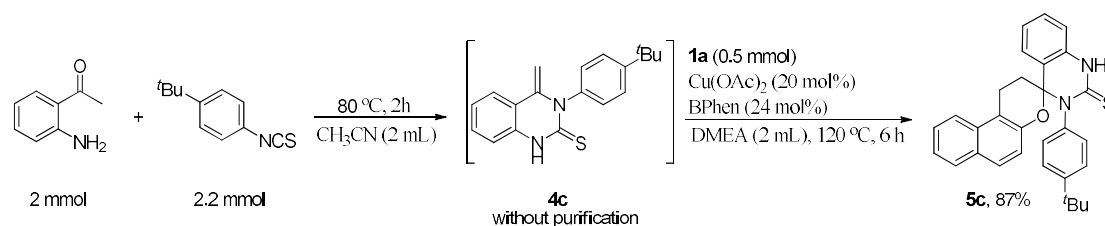
The title compound was obtained as a yellow solid (136.2 mg, 66%). Mp: 248.3-250.1 °C.

¹H NMR (400 MHz, DMSO-d₆) δ 11.56 (s, 1H), 7.73 (d, *J* = 5.2 Hz, 1H), 7.65 (d, *J* = 8.8 Hz, 1H), 7.40 (t, *J* = 7.2 Hz, 1H), 7.36-7.23 (m, 7H), 7.16 (d, *J* = 7.6 Hz, 1H), 7.05 (t, *J* = 7.6 Hz, 1H), 6.67 (d, *J* = 8.8 Hz, 1H), 2.82-2.74 (m, 1H), 2.73-2.65 (m, 1H), 2.59-2.51 (m, 1H), 2.47-2.39 (m, 1H). ¹³C NMR (100 MHz, DMSO-d₆) δ 176.0, 150.5, 140.5, 138.9, 133.8, 132.4, 132.1, 130.3, 129.1, 128.5, 128.2, 124.9, 123.6, 121.9, 115.8, 115.0, 114.8, 88.9, 30.9, 19.7. HRMS (ESI-TOF) *m/z* calcd. for C₂₄H₁₉N₂OS⁺ [M+H]⁺: 415.0933; found: 415.0929.

One-pot/two-step synthesis of 3a and 5c



To a 10-mL Schlenk tube was added 1-(2-aminophenyl)ethanone (135.3 mg, 1.0 mmol), (2-isocyanatoethyl)benzene (221.0 mg, 1.50 mmol), and CH₃CN (1 mL) under air. The resulting mixture was then stirred at 80 °C (heating mantle) for 8 h (monitored by TLC) and then cooled to room temperature. To the reaction mixture were then added 2-Naphthol **1a** (72.5 mg, 0.50 mmol), Cu(OAc)₂ (18.0 mg, 0.10 mmol), BPhen (40.3 mg, 0.12 mmol) and DMEA (2 mL) and the resulting mixture was then stirred at 120 °C (heating mantle) for 6 h (monitored by TLC) and then cooled to room temperature. The reaction mixture was diluted with CH₂Cl₂ (30 mL) and washed with H₂O (10 mL × 3). The organic fraction was then dried over anhydrous Na₂SO₄. Filtration, concentration, and purification by flash chromatography on silica gel (eluent: PE/EA=4/1) afforded product **3a** (170.0 mg, 81%) as a white solid.



To a 10-mL Schlenk tube was added 1-(2-aminophenyl)ethanone (270.3 mg, 2.0 mmol), 1-(*tert*-butyl)-4-isothiocyanatobenzene (420.8 mg, 2.2 mmol), and CH₃CN (2 mL) under air.

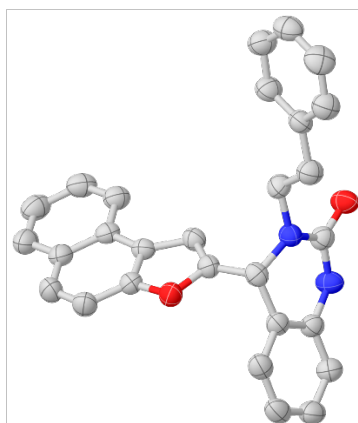
The resulting mixture was then stirred at 80 °C (heating mantle) for 2 h (monitored by TLC) and then cooled to room temperature. To the reaction mixture were then added 2-Naphthol **1a** (72.4 mg, 0.50 mmol), Cu(OAc)₂ (18.1 mg, 0.10 mmol), BPhen (40.4 mg, 0.12 mmol) and DMEA (2 mL) and the resulting mixture was then stirred at 120 °C (heating mantle) for 6 h (monitored by TLC) and then cooled to room temperature. The reaction mixture was diluted with CH₂Cl₂ (30 mL) and washed with H₂O (10 mL × 3). The organic fraction was then dried over anhydrous Na₂SO₄. Filtration, concentration, and purification by flash chromatography on silica gel (eluent: PE/EA=8/1) afforded product **5c** (201.8 mg, 87%) as a yellow solid.

Reference:

1. Yan, H.; Xiao, X. Q.; Hider, R. C.; Ma, Y. A Simple Metal-Free Cyclization for the Synthesis of 4-Methylene-3-Substituted Quinazolinone and Quinazolinthione Derivatives: Experiment and Theory. *Front. Chem.* **2019**, *7*, 584.

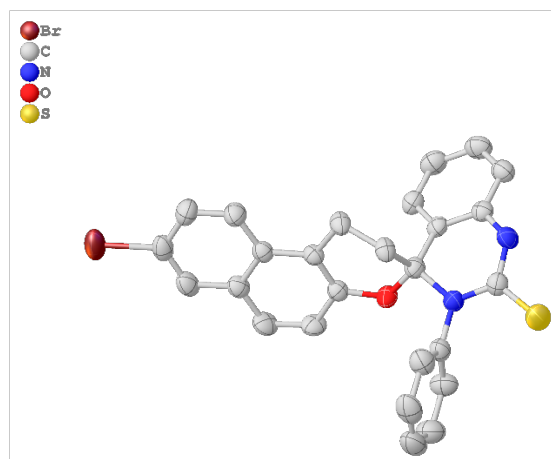
Crystal data and structure refinement for product 3a and 5o

Crystal data and structure refinement for 3a



CCDC	2252986
Empirical formula	C ₂₈ H ₂₂ N ₂ O ₂
Formula weight	418.47
Temperature/K	296.15
Crystal system	monoclinic
Space group	P2 ₁ /c
a/Å	11.729(11)
b/Å	8.819(8)
c/Å	20.73(2)
α/°	90
β/°	96.055(13)
γ/°	90
Volume/Å ³	2132(4)
Z	4
ρ _{calc} /cm ³	1.304
μ/mm ⁻¹	0.083
F(000)	880.0
Crystal size/mm ³	0.15 × 0.15 × 0.12
Radiation	MoKα (λ = 0.71073)
2θ range for data collection/°	3.492 to 57.214
Index ranges	-15 ≤ h ≤ 15, -11 ≤ k ≤ 11, -27 ≤ l ≤ 27
Reflections collected	28008
Independent reflections	5426 [R _{int} = 0.1302, R _{sigma} = 0.1147]
Data/restraints/parameters	5426/0/290
Goodness-of-fit on F ²	0.989
Final R indexes [I ≥ 2σ(I)]	R ₁ = 0.0652, wR ₂ = 0.1242
Final R indexes [all data]	R ₁ = 0.1915, wR ₂ = 0.1672
Largest diff. peak/hole / e Å ⁻³	0.20/-0.18

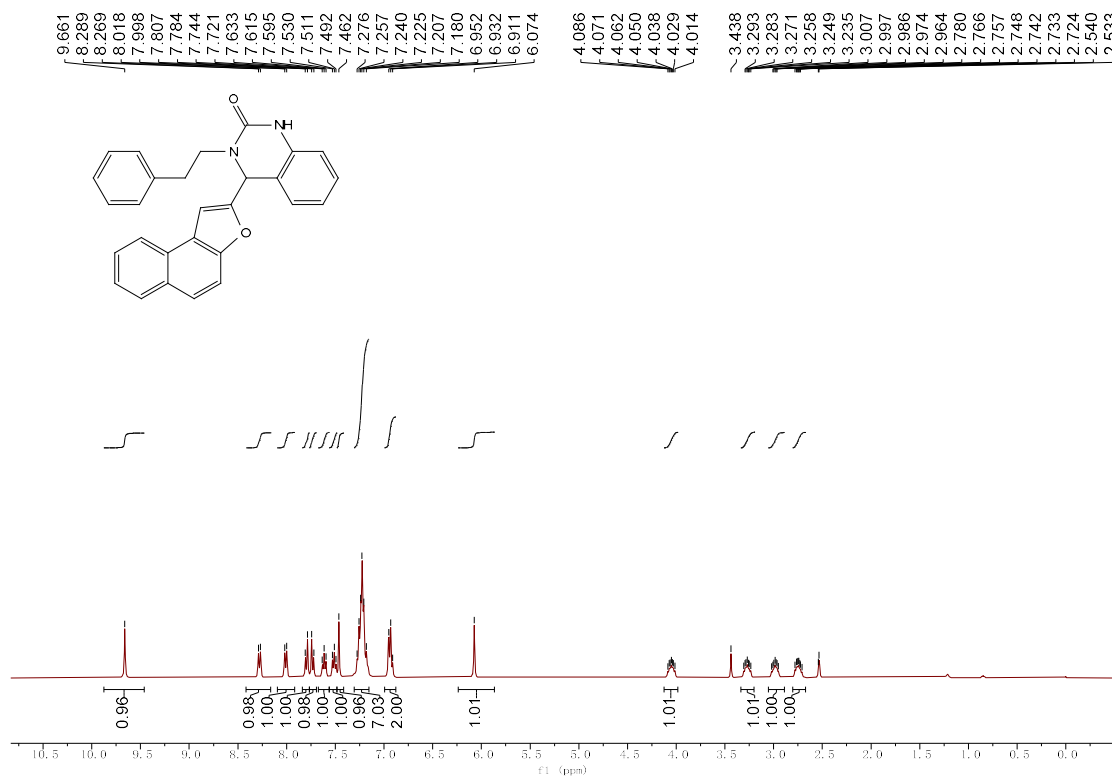
Crystal data and structure refinement for 5o



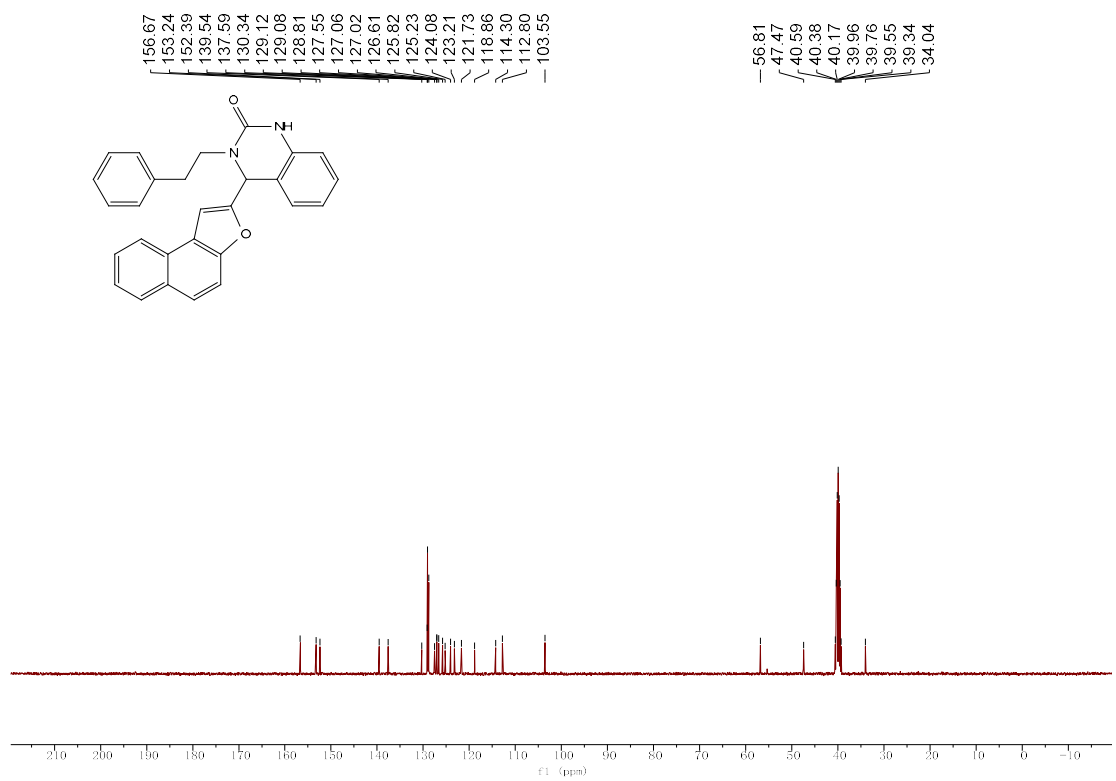
CCDC	2265608
Empirical formula	$C_{28}H_{25}BrN_2O_2S_2$
Formula weight	565.53
Temperature/K	296.15
Crystal system	monoclinic
Space group	$P2_1/n$
$a/\text{\AA}$	15.5495(14)
$b/\text{\AA}$	10.6842(9)
$c/\text{\AA}$	15.9646(14)
$\alpha/^\circ$	90
$\beta/^\circ$	103.979(2)
$\gamma/^\circ$	90
Volume/ \AA^3	2573.7(4)
Z	4
$\rho_{\text{calc}}/\text{g/cm}^3$	1.459
μ/mm^{-1}	1.788
F(000)	1160.0
Crystal size/ mm^3	$0.15 \times 0.15 \times 0.12$
Radiation	MoK α ($\lambda = 0.71073$)
2θ range for data collection/ $^\circ$	4.198 to 61.038
Index ranges	$-22 \leq h \leq 21, -14 \leq k \leq 15, -22 \leq l \leq 22$
Reflections collected	39018
Independent reflections	7341 [$R_{\text{int}} = 0.0573, R_{\text{sigma}} = 0.0511$]
Data/restraints/parameters	7341/0/318
Goodness-of-fit on F^2	1.009
Final R indexes [$I \geq 2\sigma(I)$]	$R_1 = 0.0461, wR_2 = 0.1042$
Final R indexes [all data]	$R_1 = 0.1030, wR_2 = 0.1254$
Largest diff. peak/hole / $e \text{\AA}^{-3}$	0.57/-0.50

NMR spectra

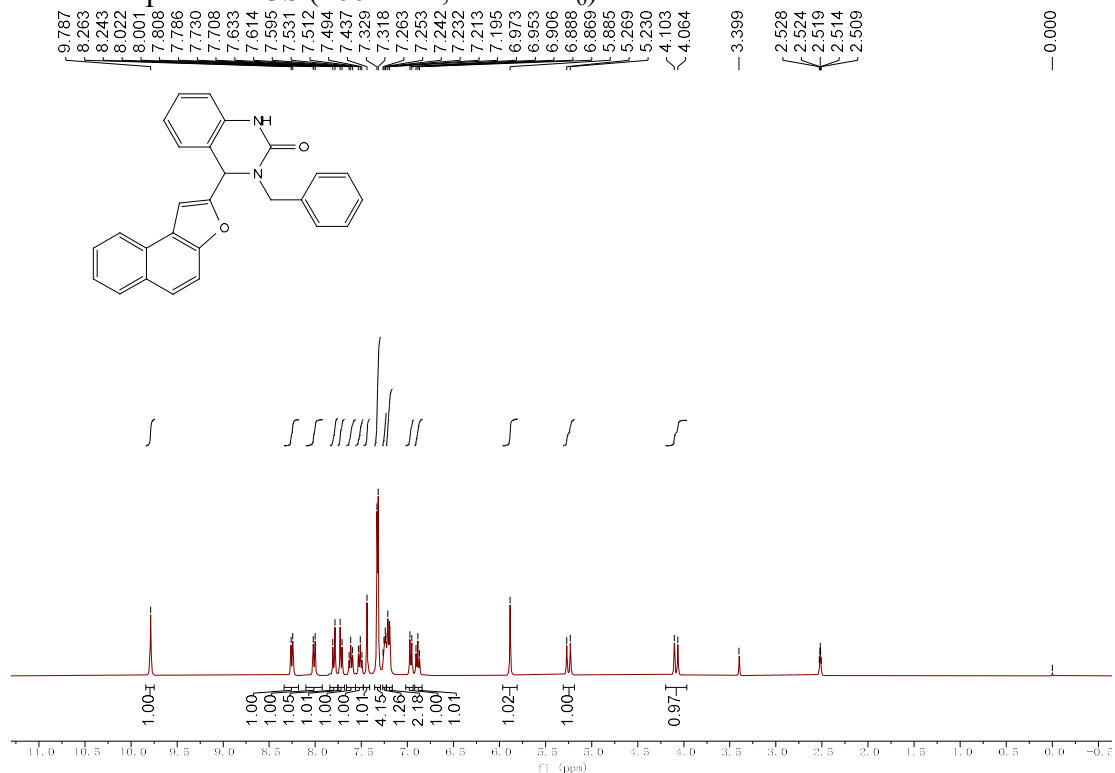
^1H NMR spectra of **3a** (400 MHz, DMSO- d_6)



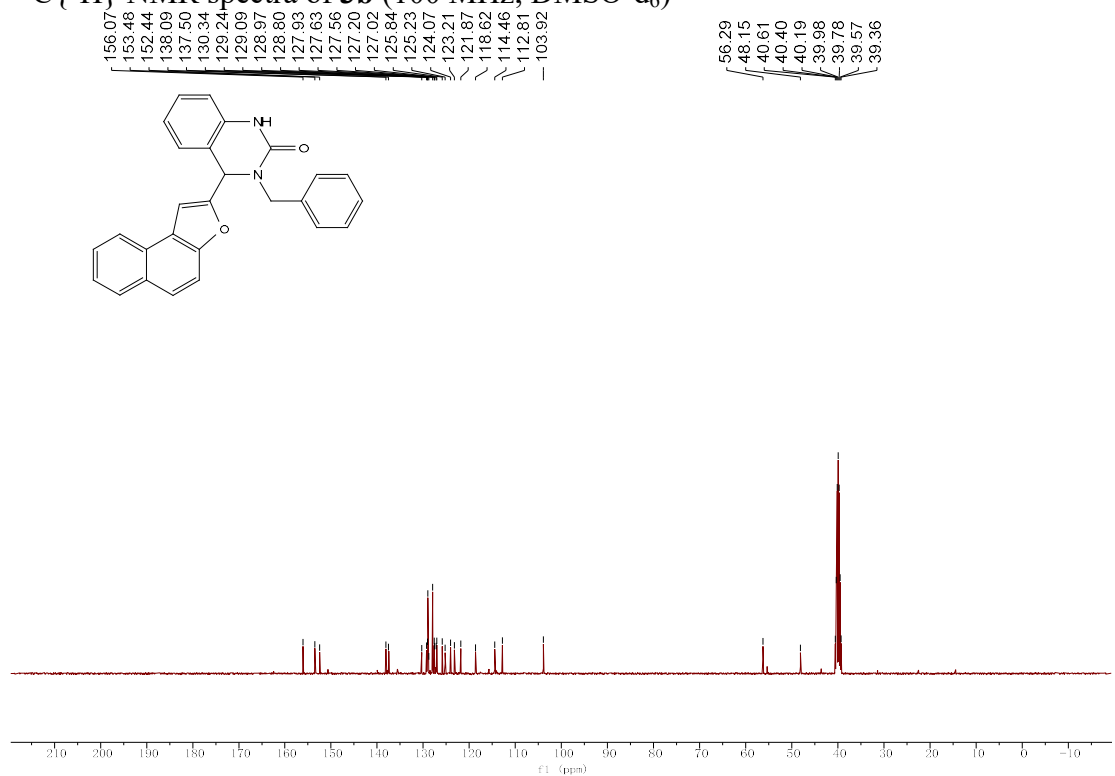
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **3a** (100 MHz, DMSO- d_6)



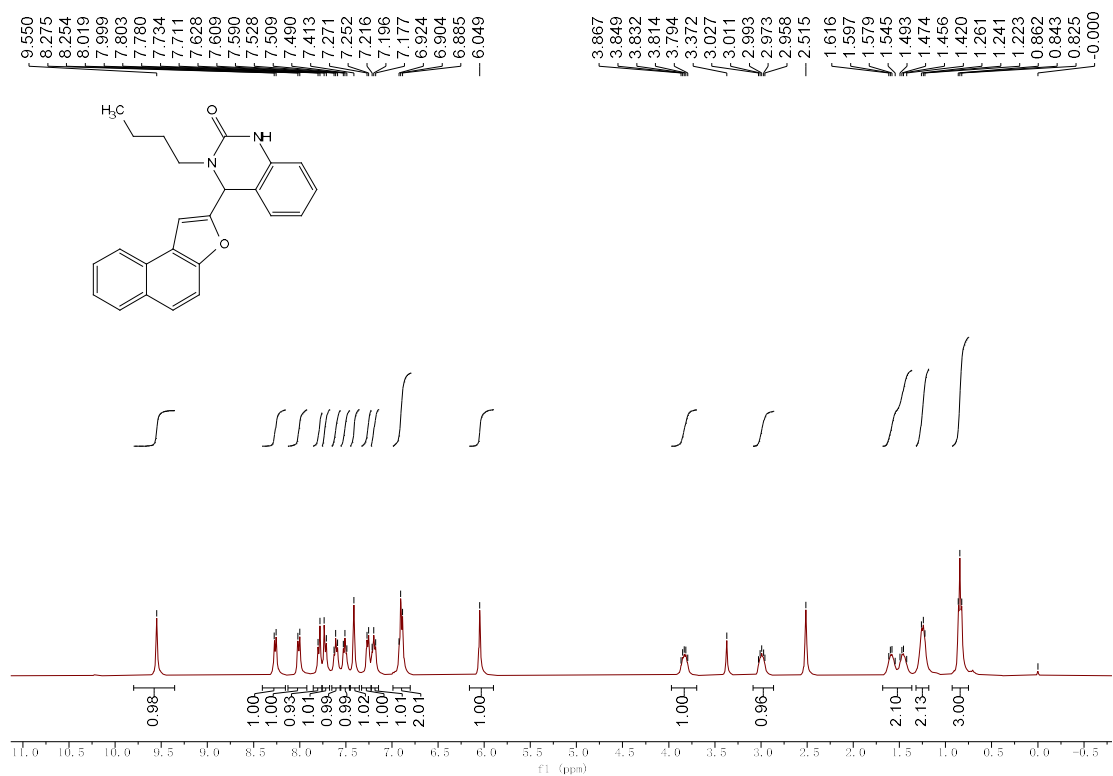
¹H NMR spectra of **3b** (400 MHz, DMSO-d₆)



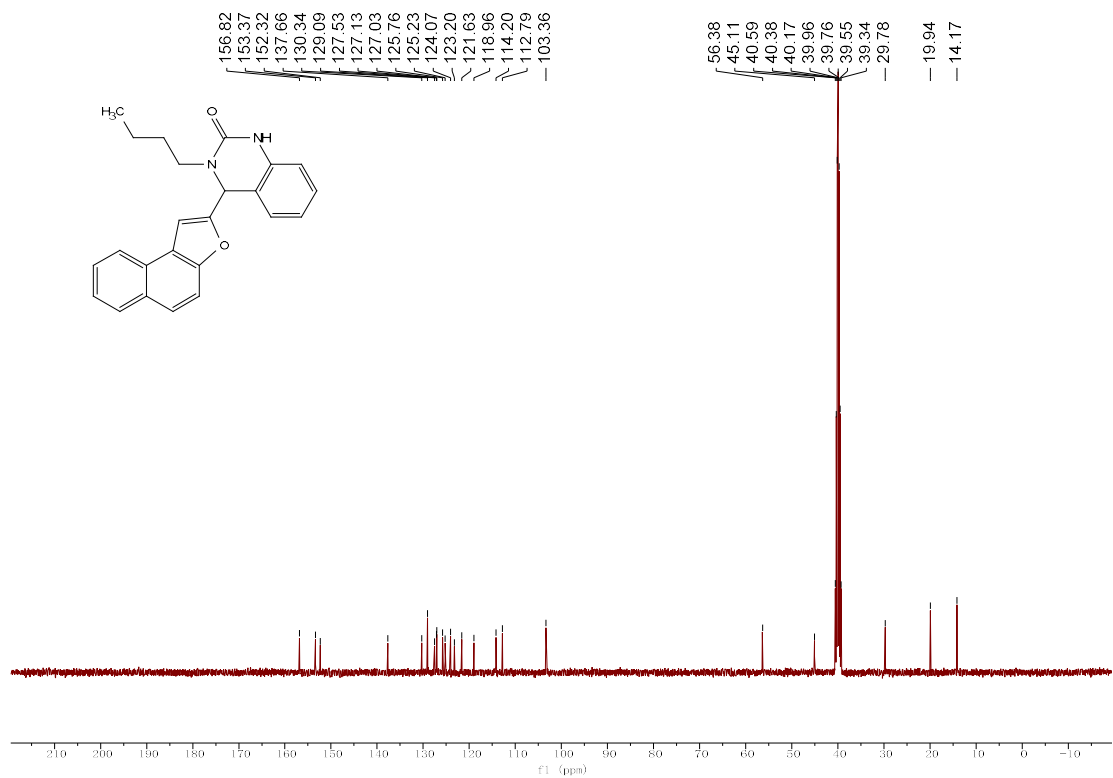
¹³C{¹H} NMR spectra of **3b** (100 MHz, DMSO-d₆)



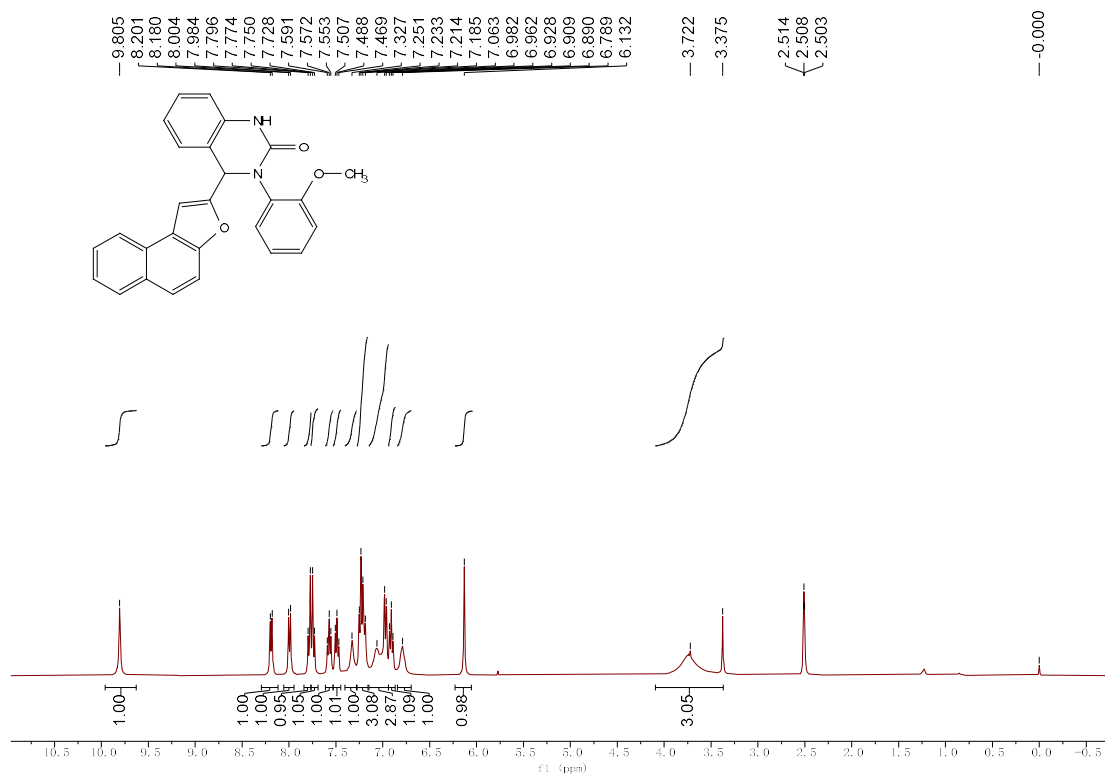
^1H NMR spectra of **3c** (400 MHz, DMSO- d_6)



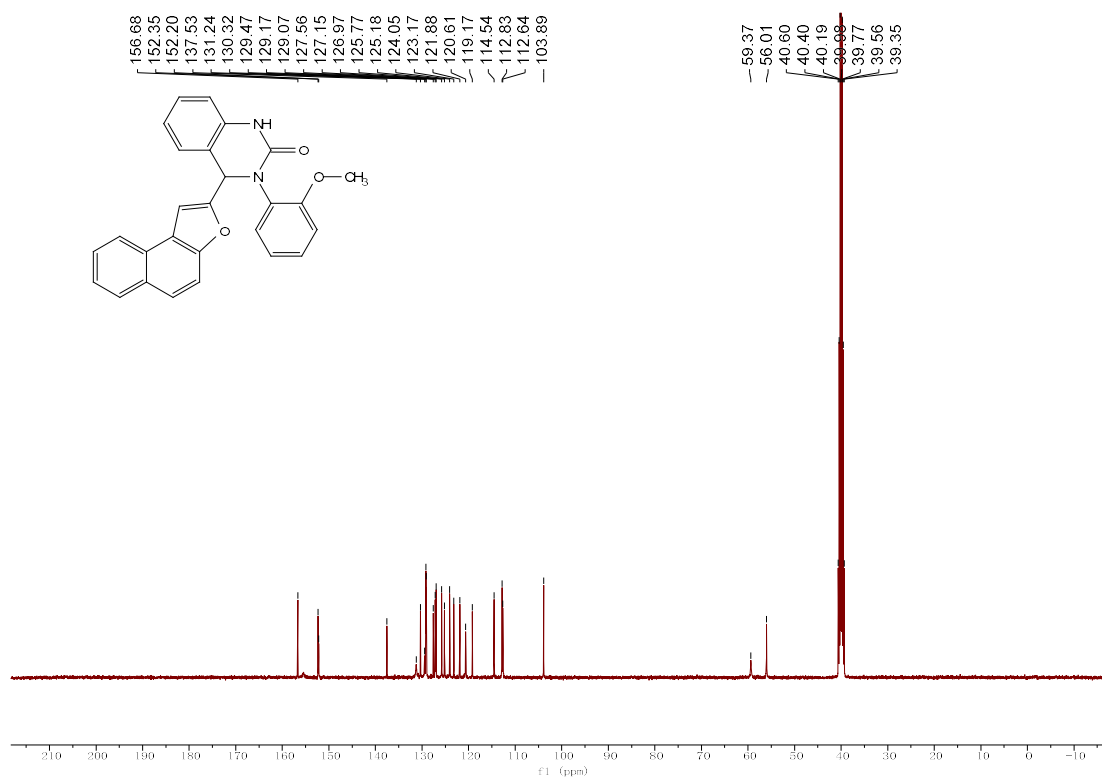
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **3c** (100 MHz, DMSO- d_6)



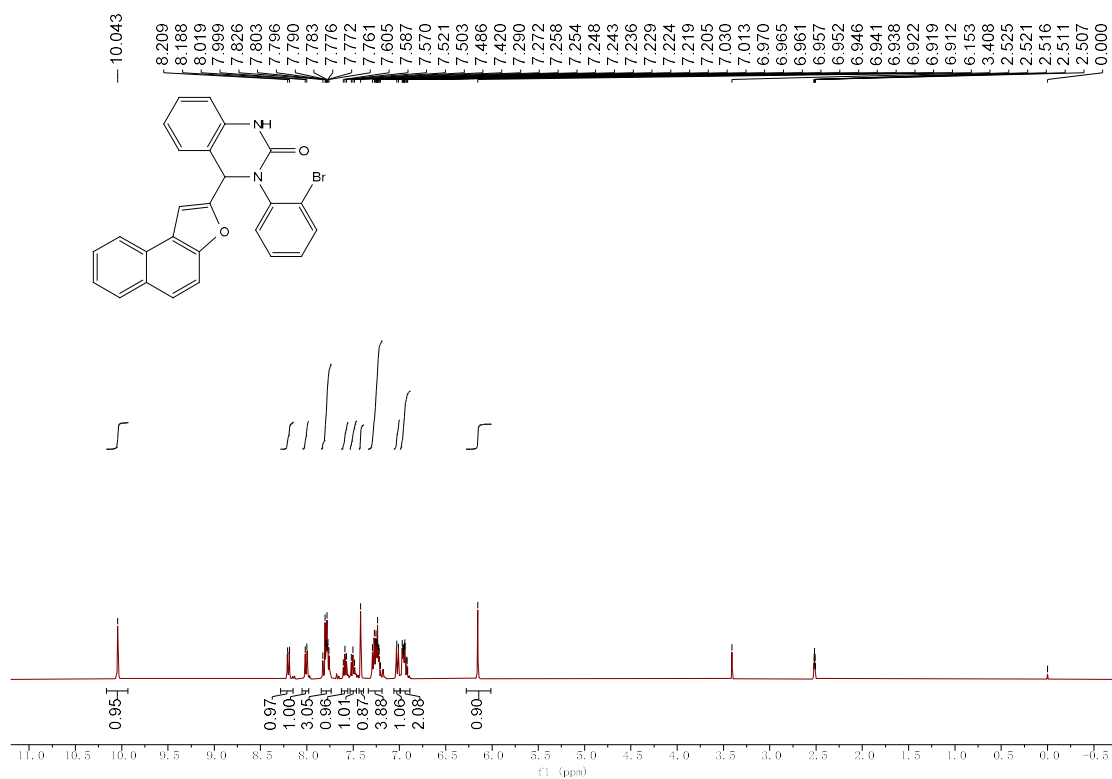
^1H NMR spectra of **3d** (400 MHz, DMSO-d_6)



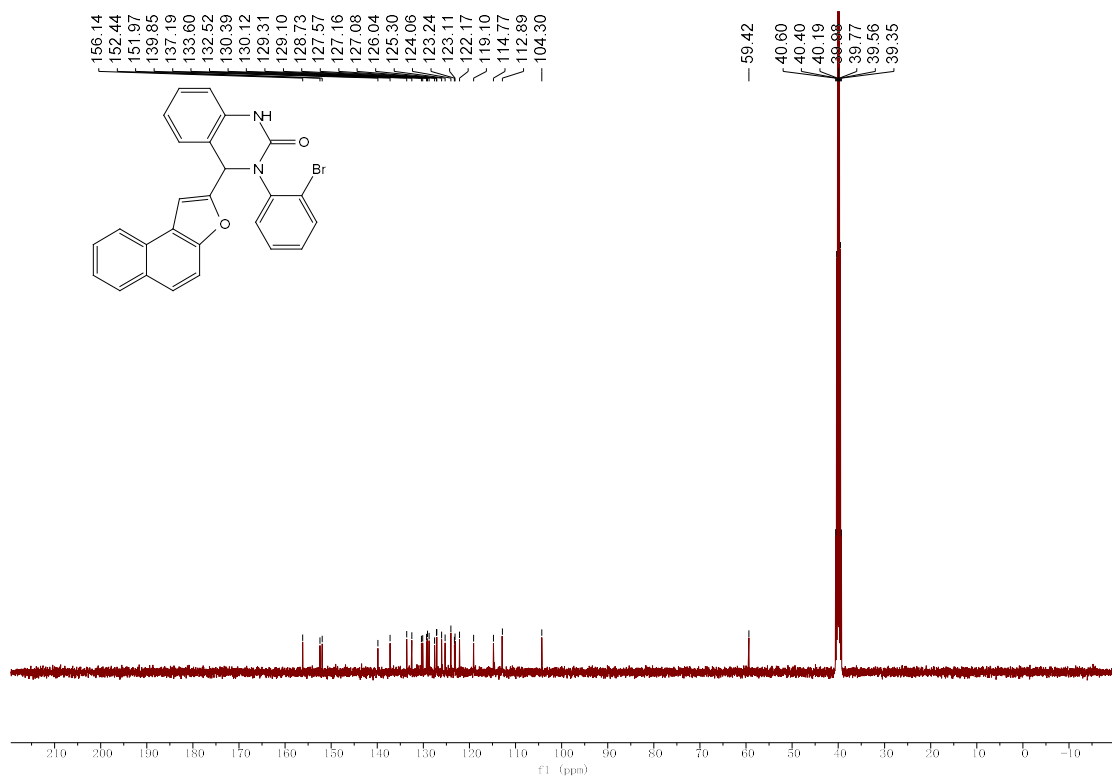
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **3d** (100 MHz, DMSO-d_6)



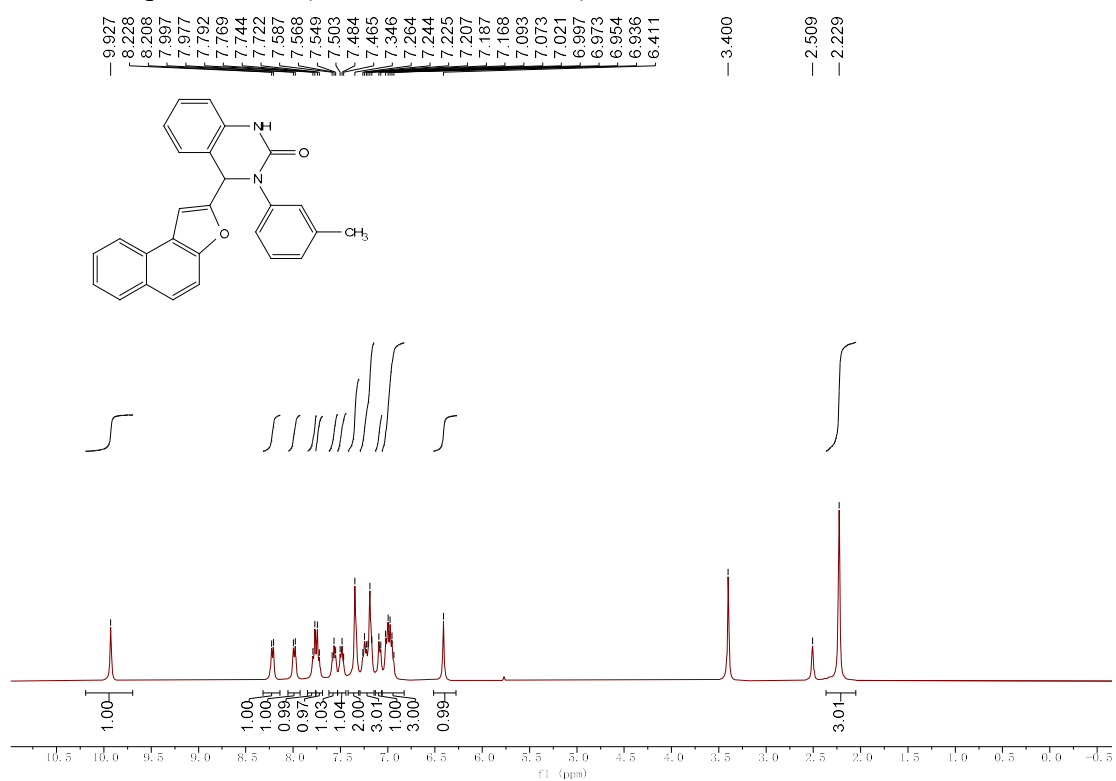
^1H NMR spectra of **3e** (400 MHz, DMSO- d_6)



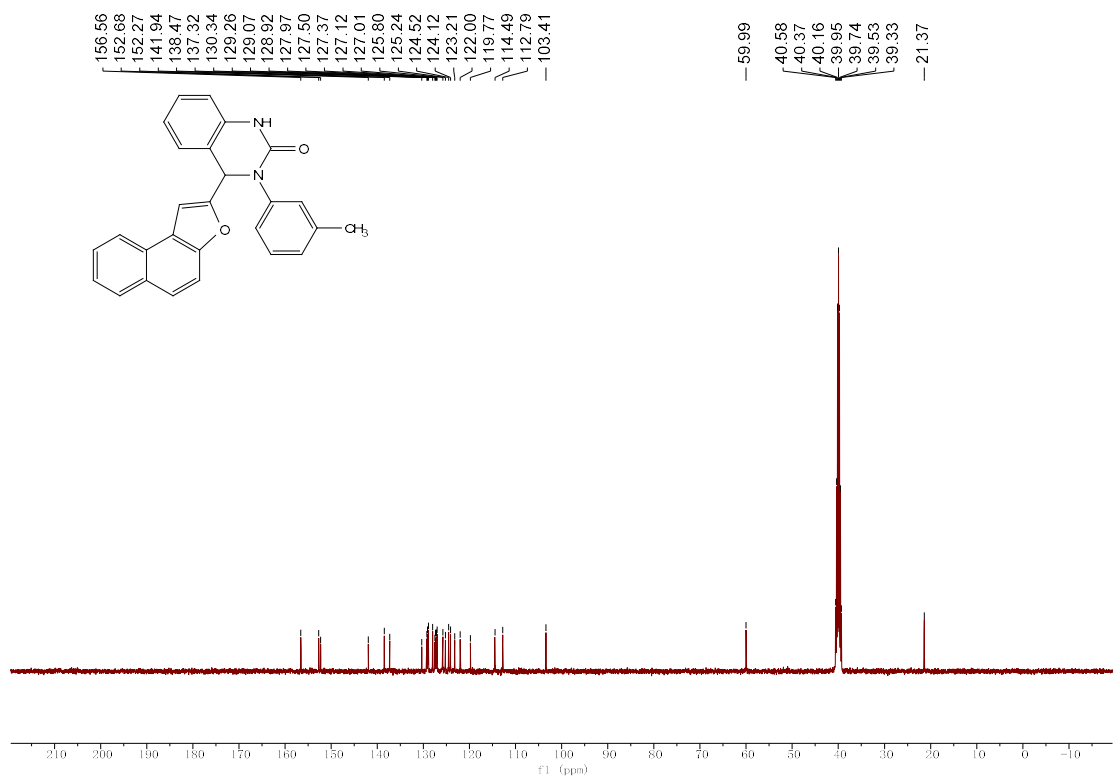
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **3e** (100 MHz, DMSO- d_6)



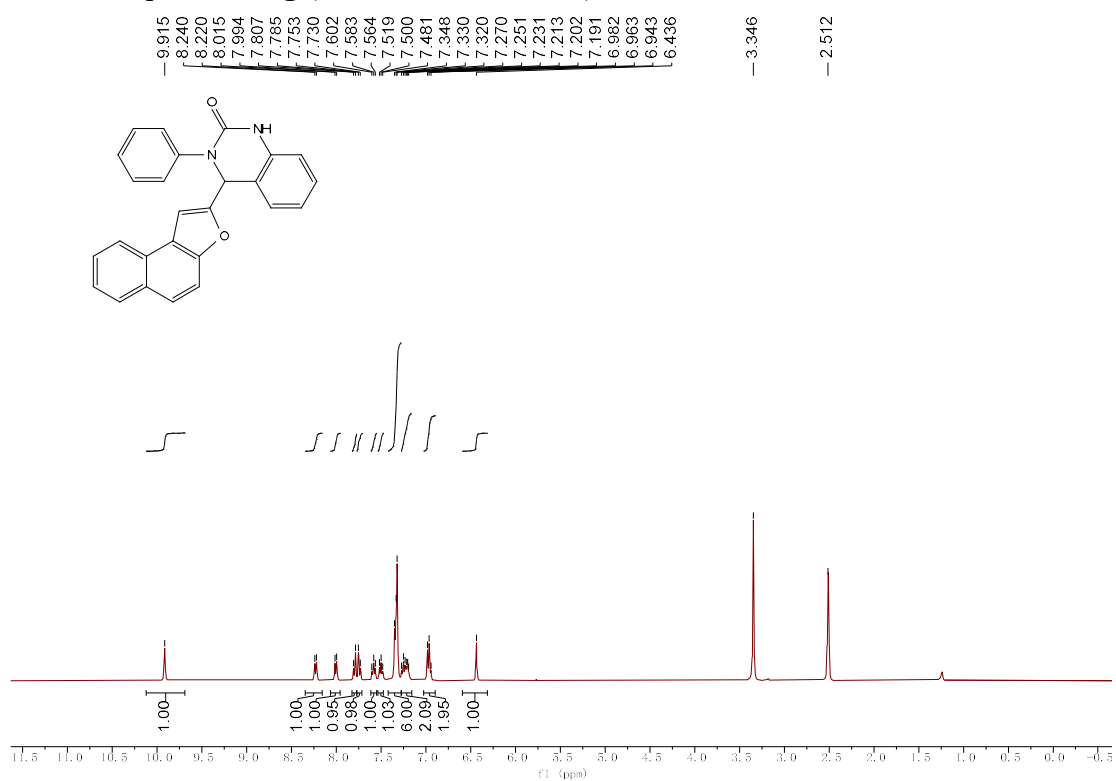
¹H NMR spectra of **3f** (400 MHz, DMSO-d₆)



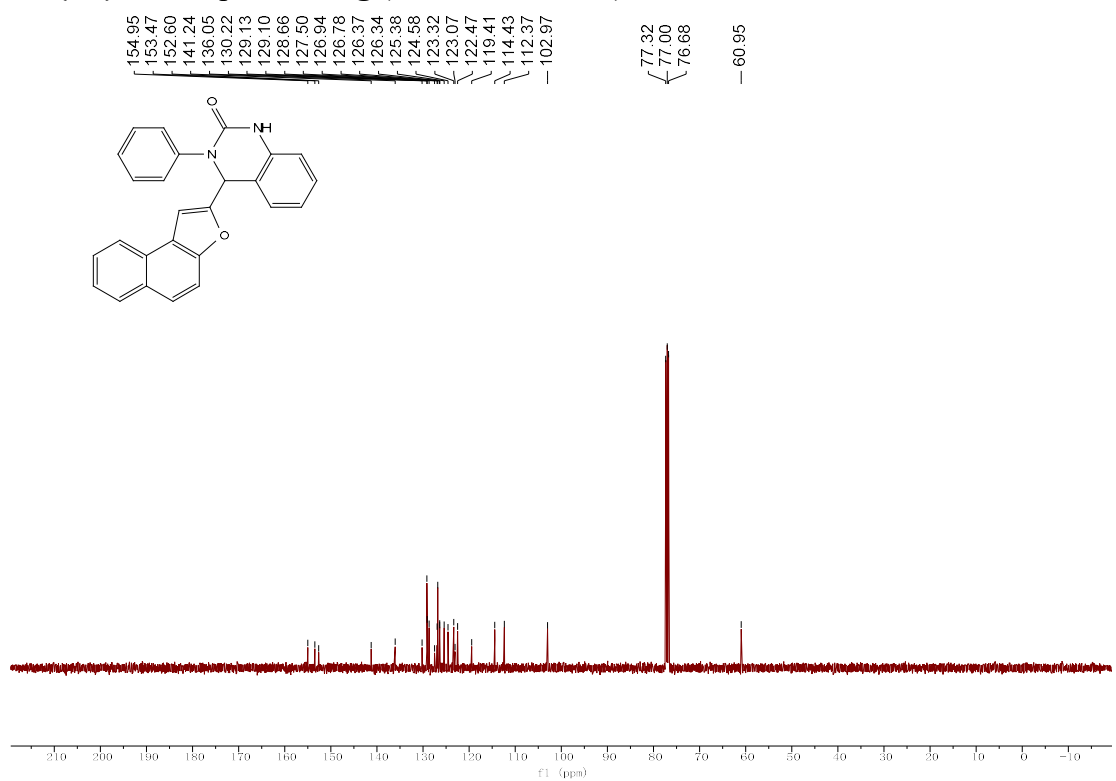
¹³C{¹H} NMR spectra of **3f** (100 MHz, DMSO-d₆)



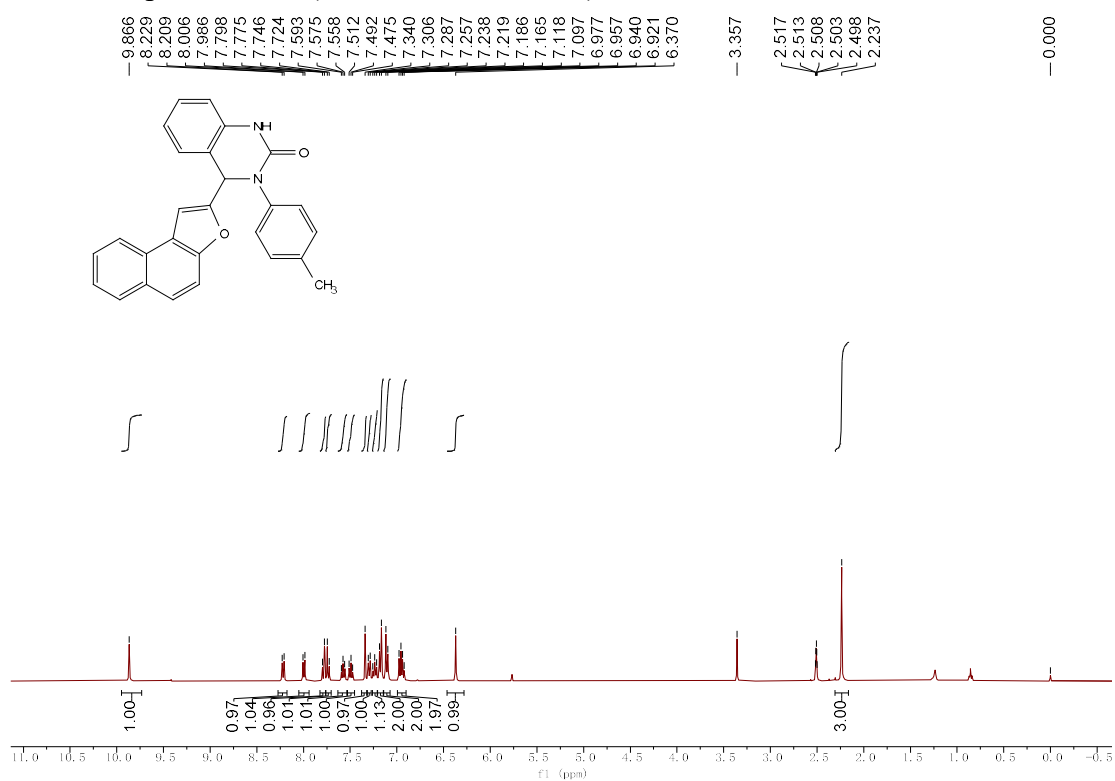
^1H NMR spectra of **3g** (400 MHz, DMSO- d_6)



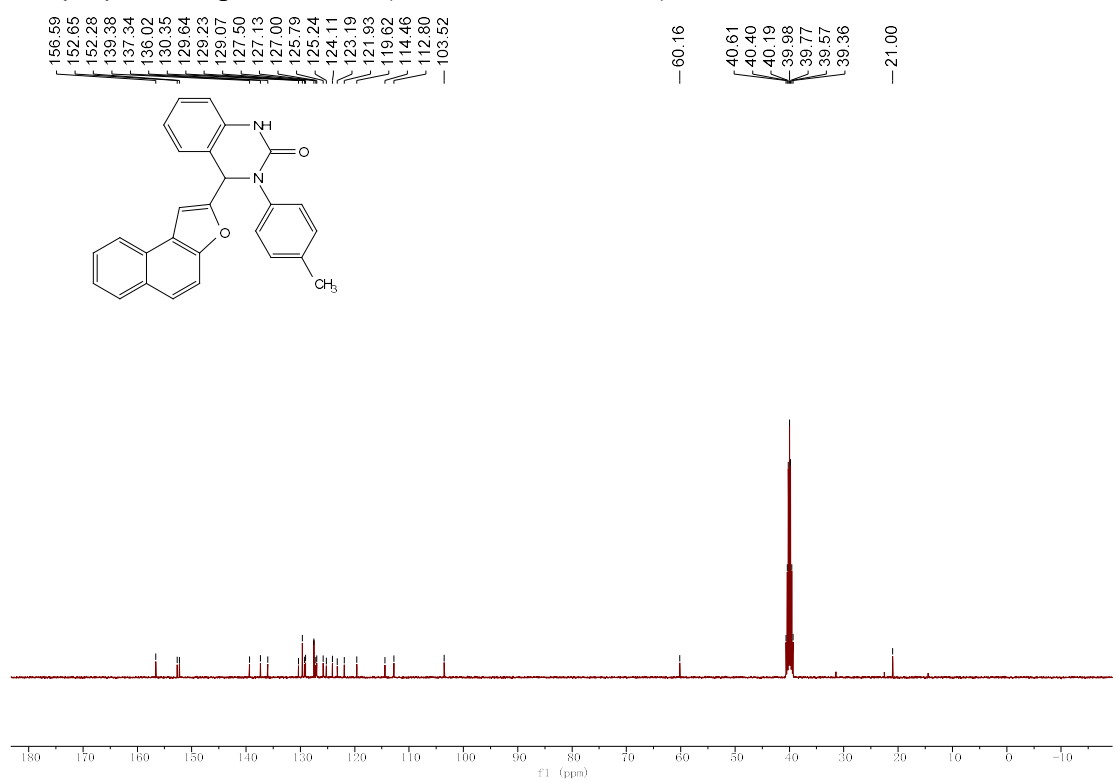
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **3g** (100 MHz, CDCl_3)



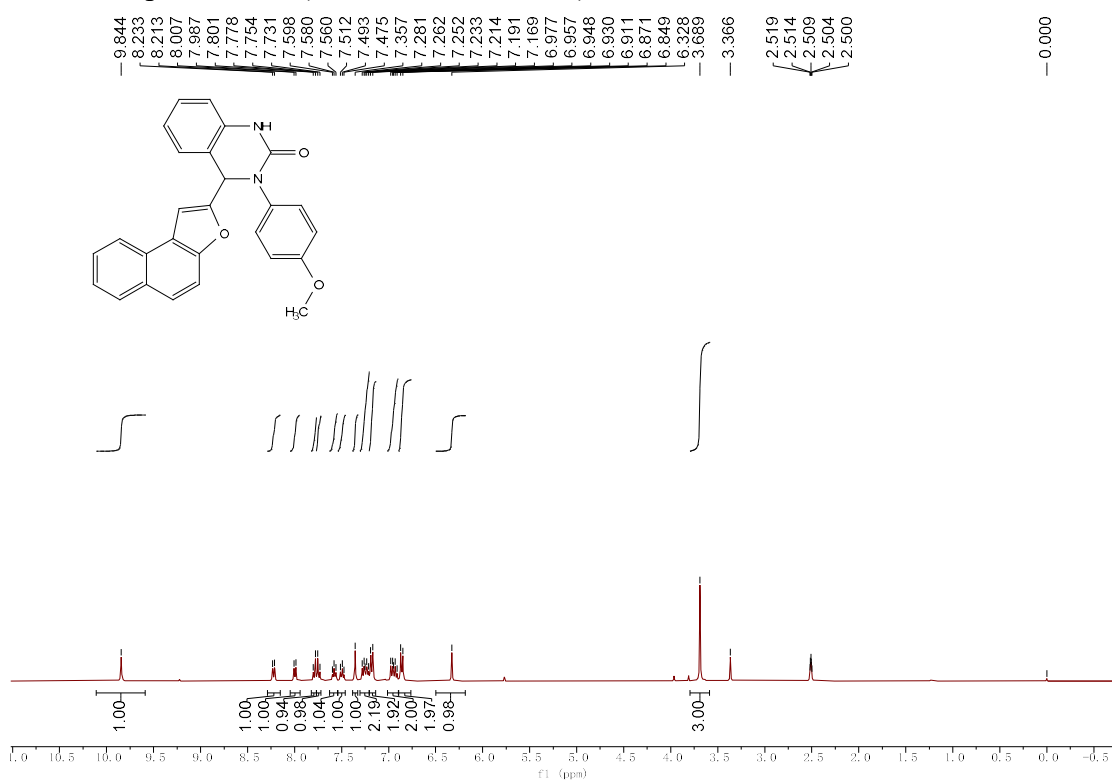
¹H NMR spectra of **3h** (400 MHz, DMSO-d₆)



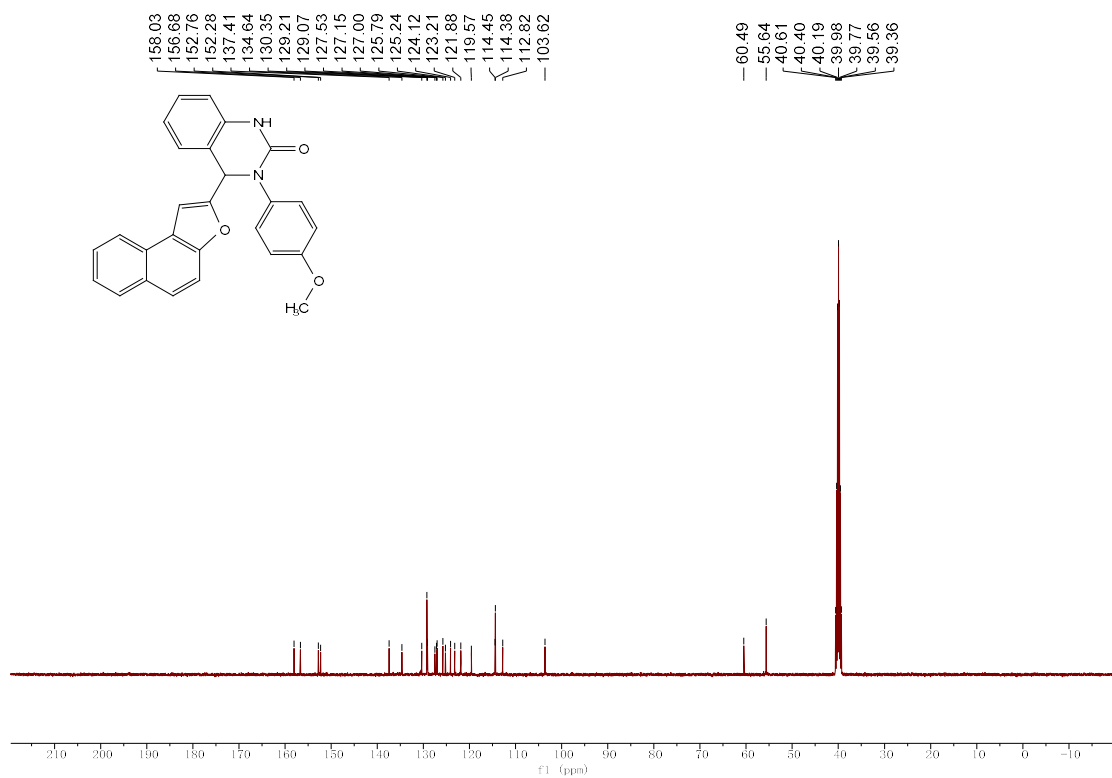
¹³C{¹H} NMR spectra of **3h** (100 MHz, DMSO-d₆)



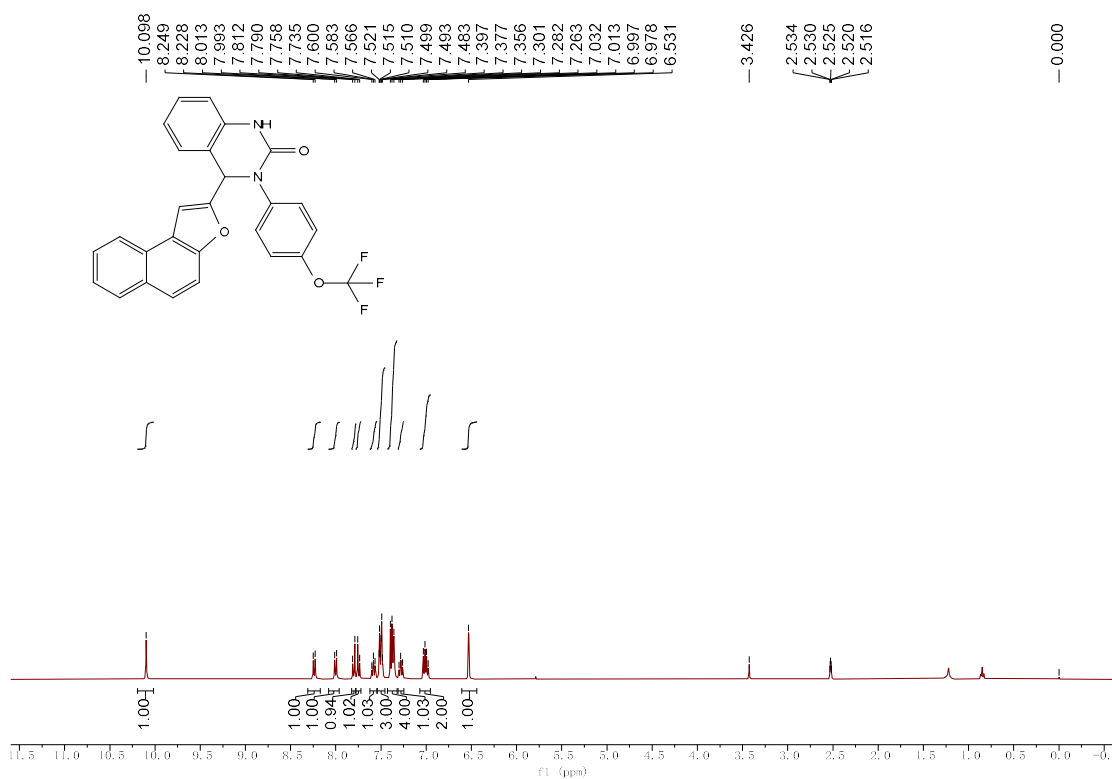
¹H NMR spectra of **3i** (400 MHz, DMSO-d₆)



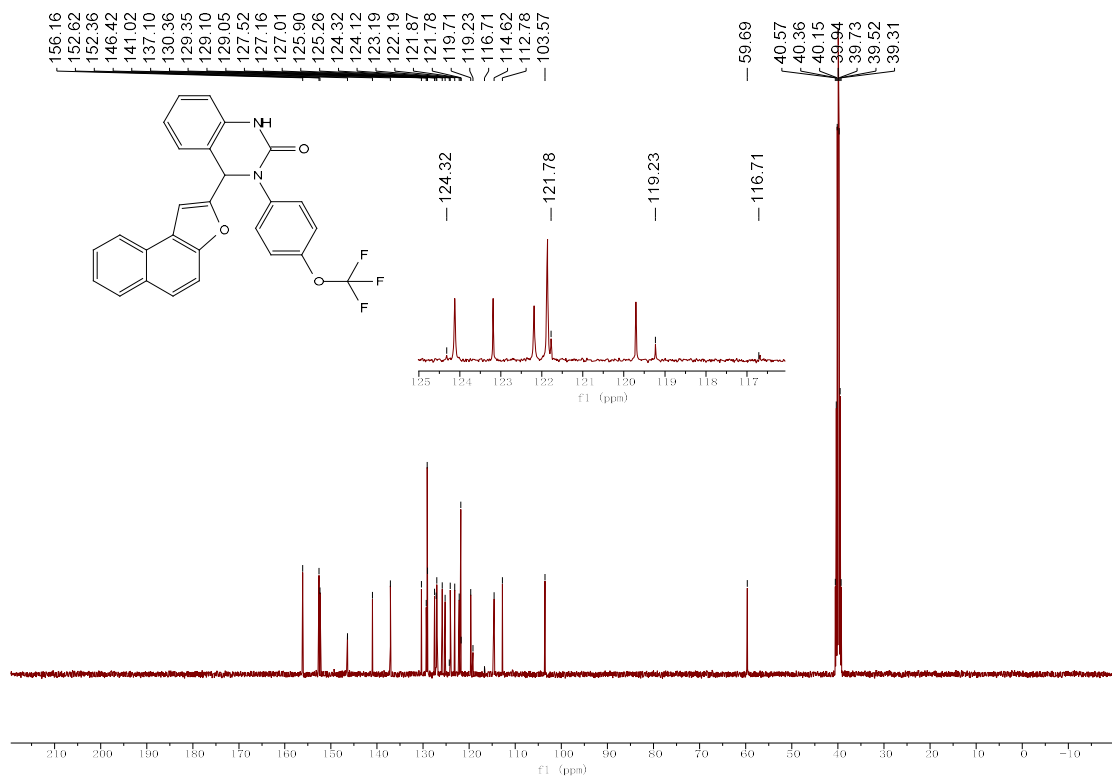
¹³C{¹H} NMR spectra of **3i** (100 MHz, DMSO-d₆)



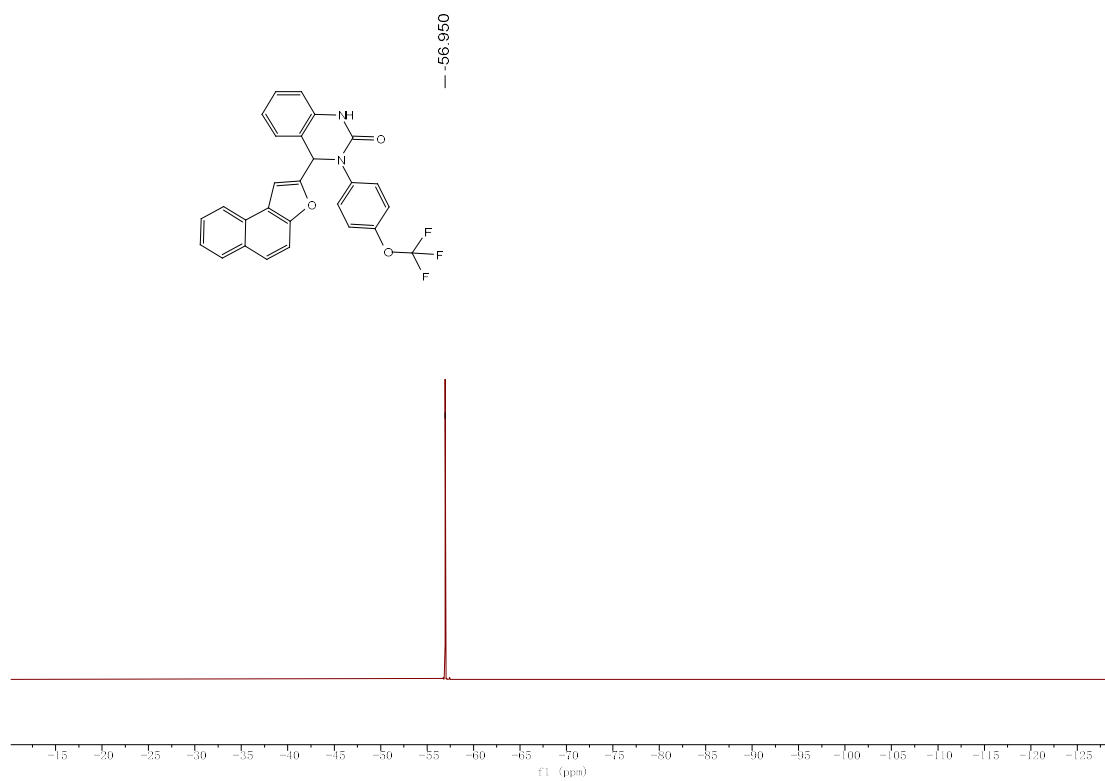
^1H NMR spectra of **3j** (400 MHz, DMSO- d_6)



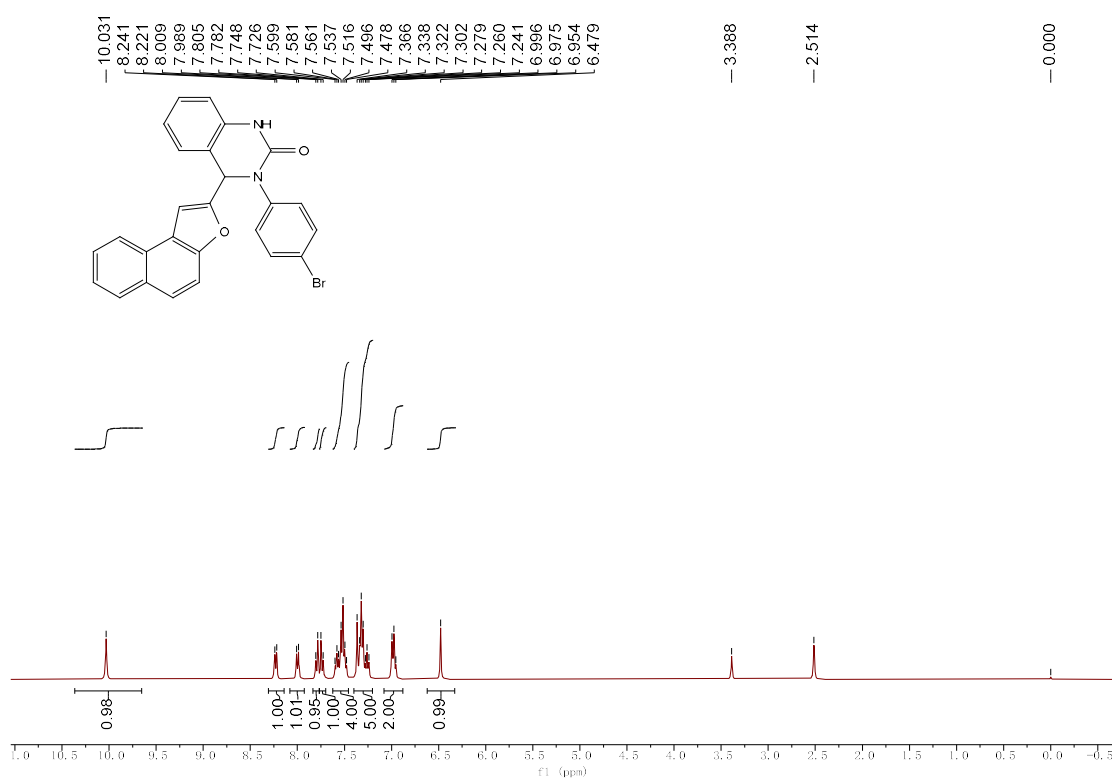
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **3j** (100 MHz, DMSO- d_6)



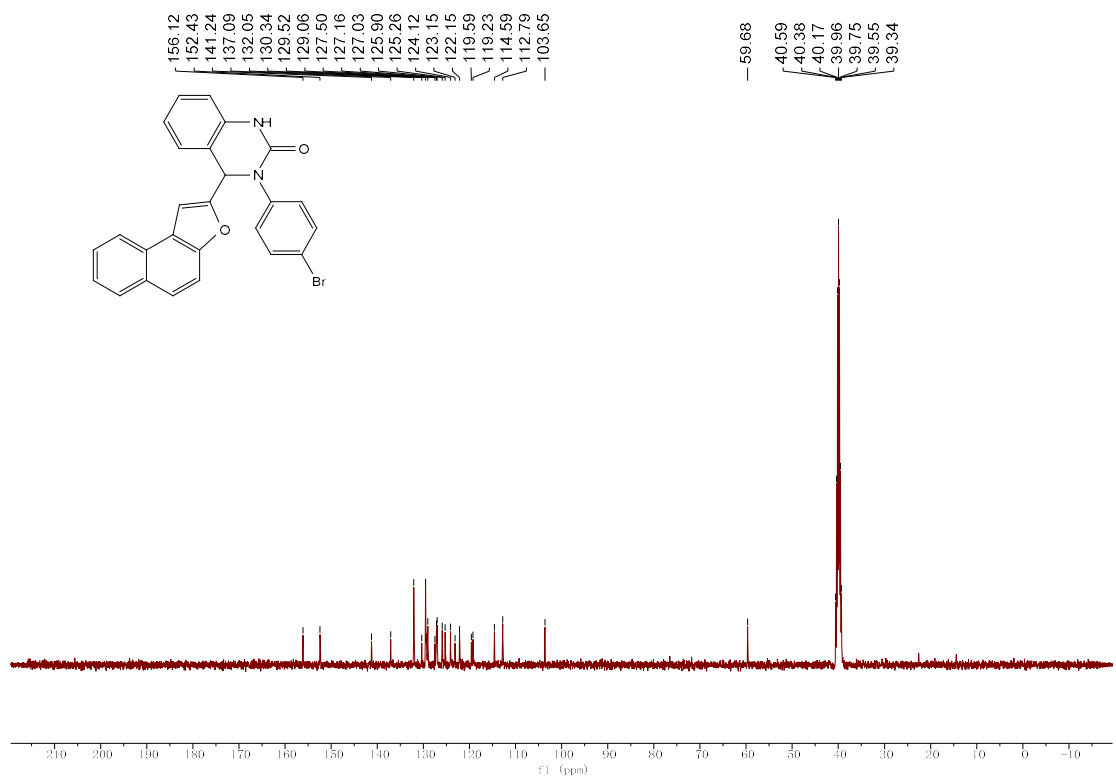
$^{19}\text{F}\{^1\text{H}\}$ NMR spectra of **3j** (377 MHz, DMSO- d_6)



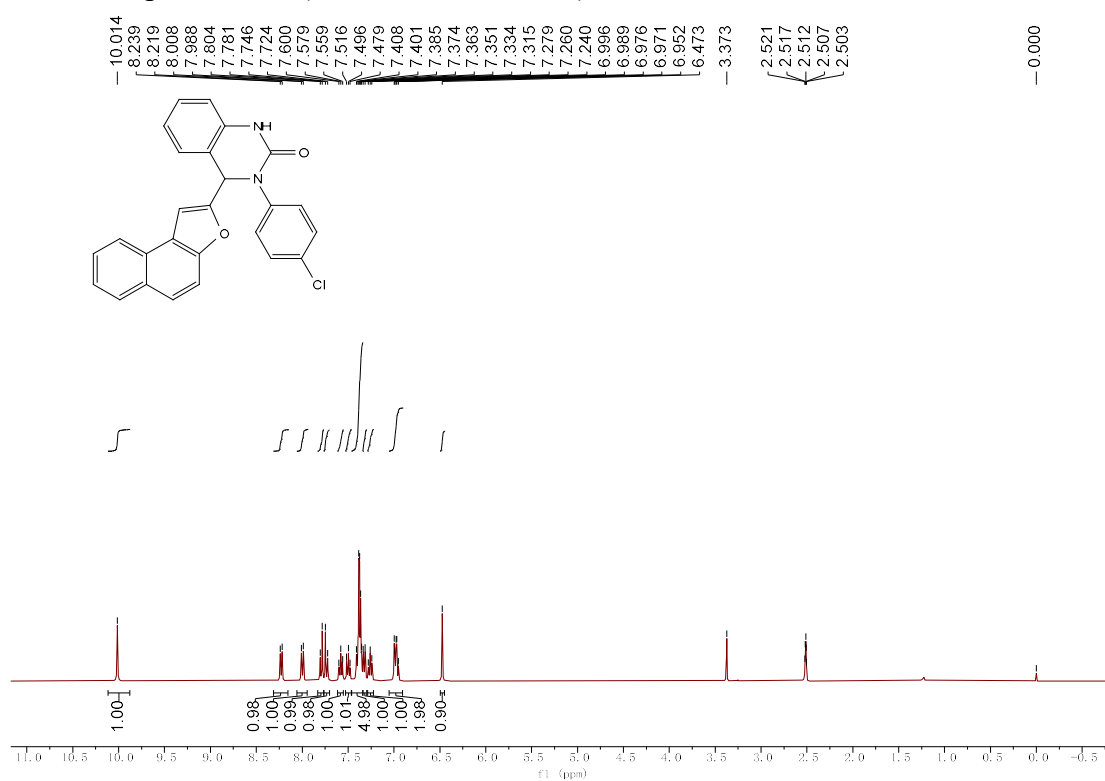
^1H NMR spectra of **3k** (400 MHz, DMSO- d_6)



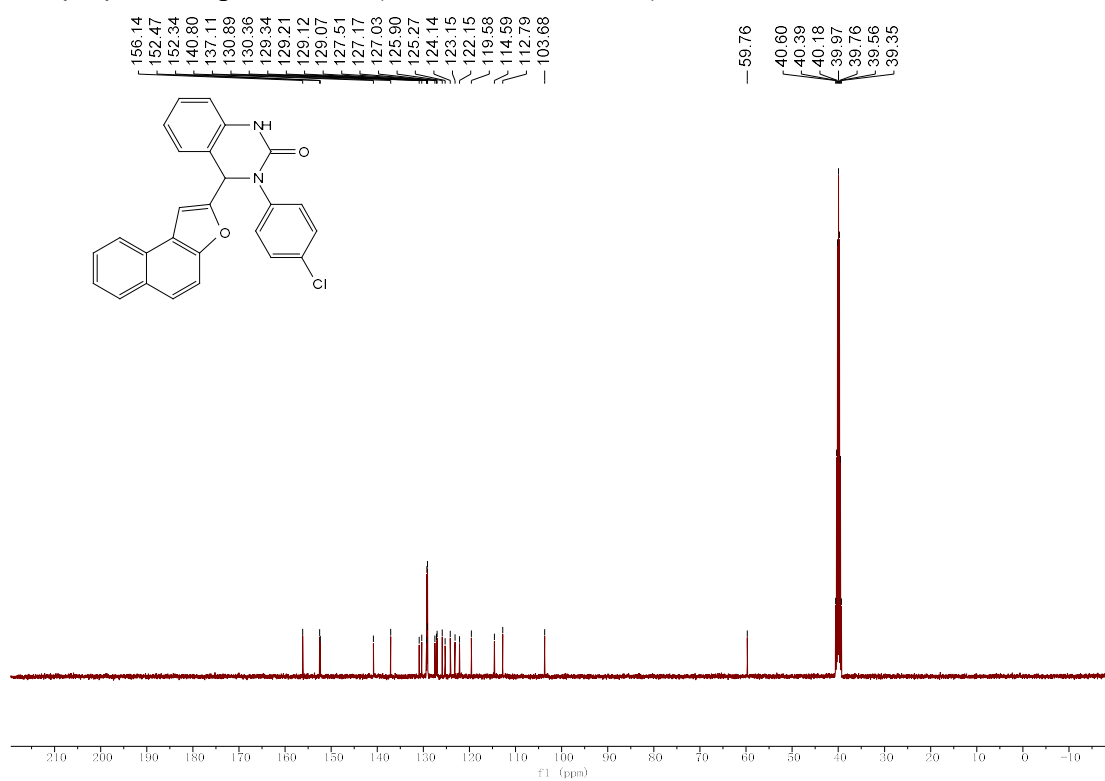
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **3k** (100 MHz, DMSO- d_6)



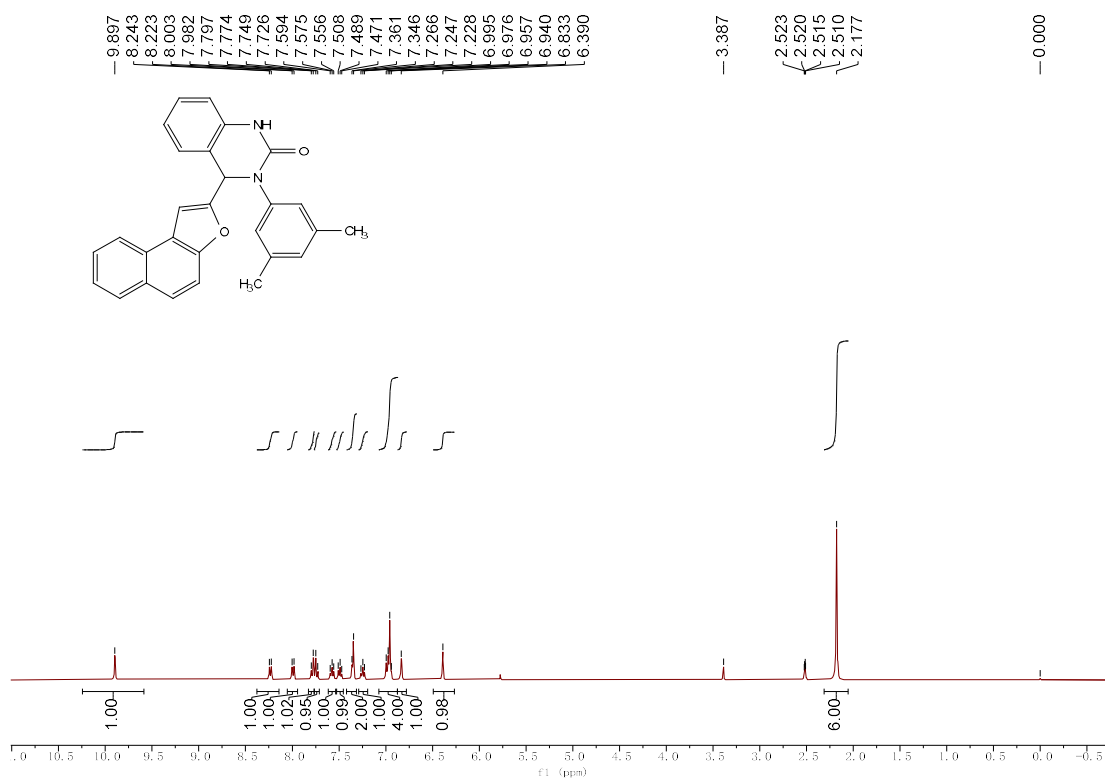
^1H NMR spectra of **31** (400 MHz, DMSO- d_6)



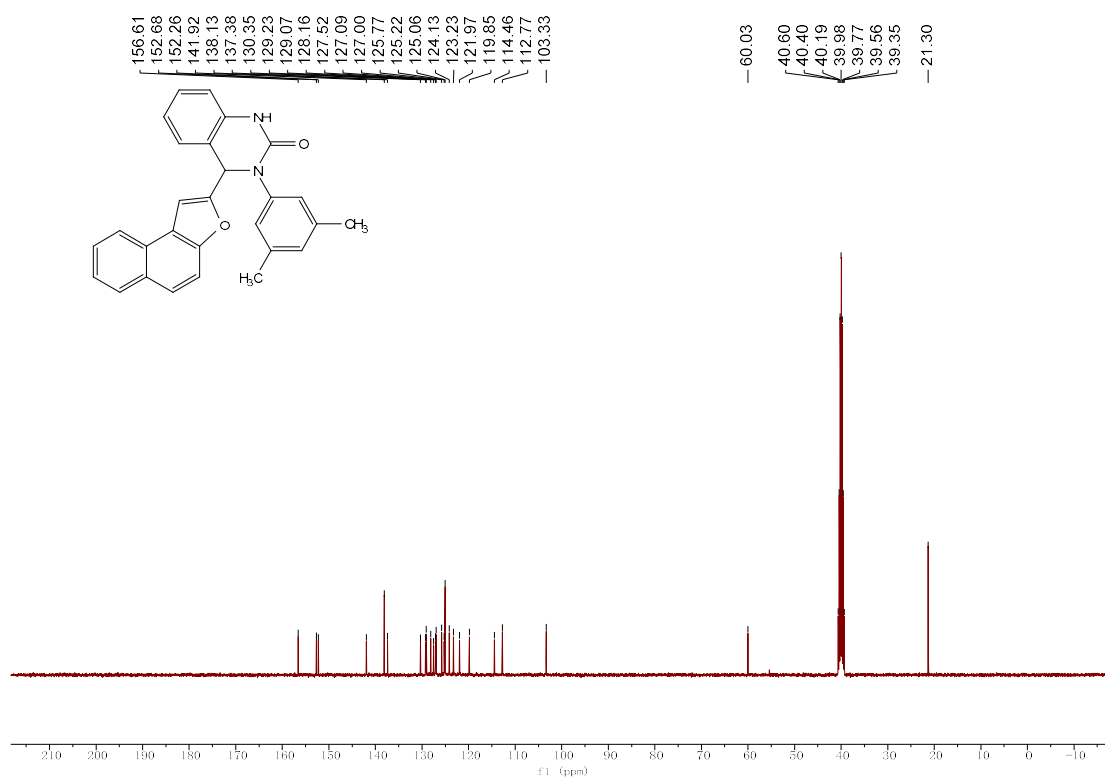
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **31** (100 MHz, DMSO- d_6)



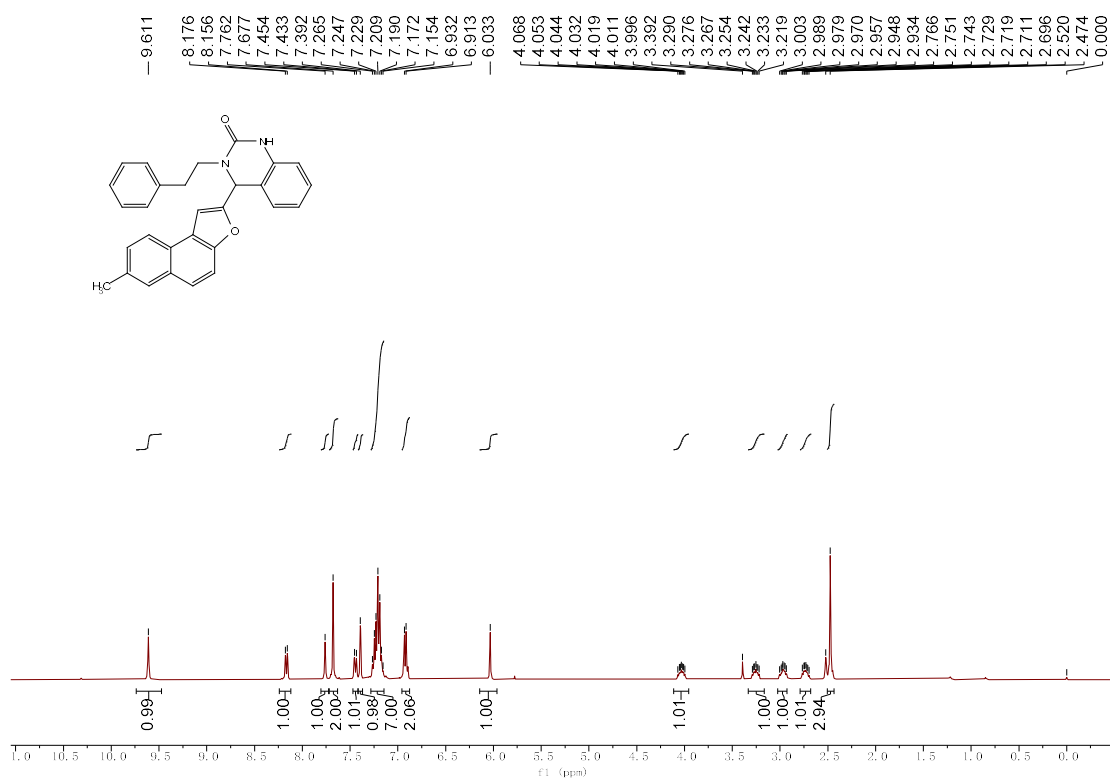
^1H NMR spectra of **3m** (400 MHz, DMSO- d_6)



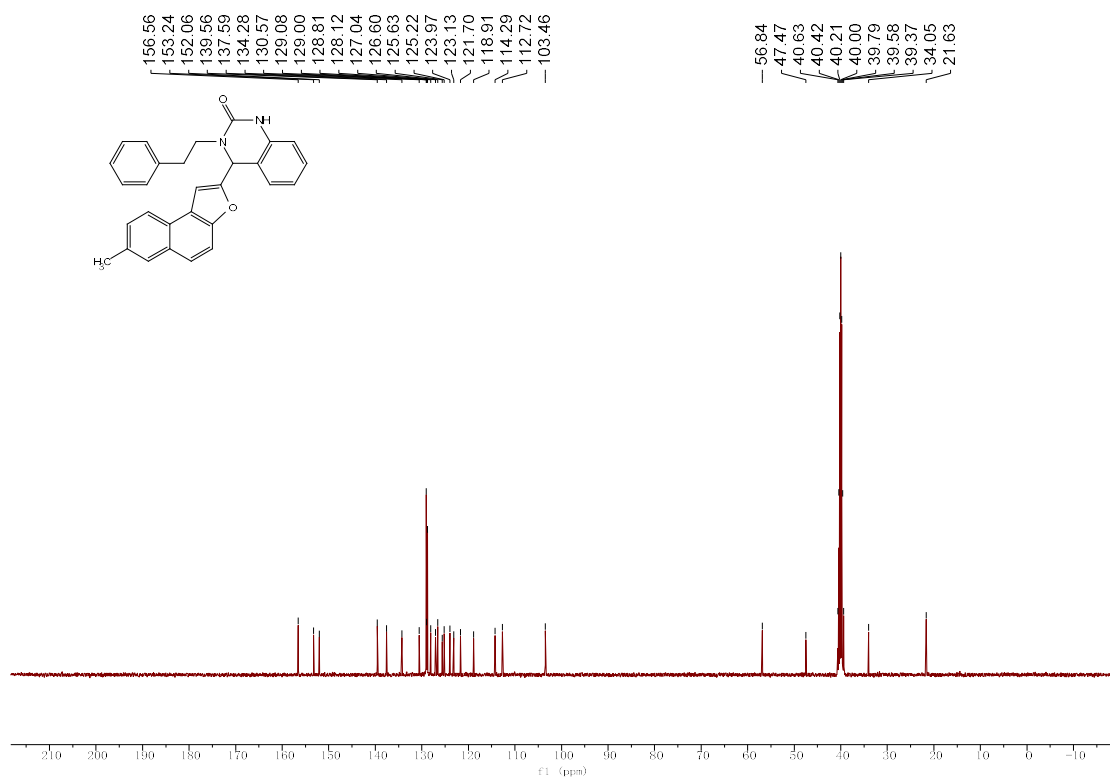
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **3m** (100 MHz, DMSO- d_6)



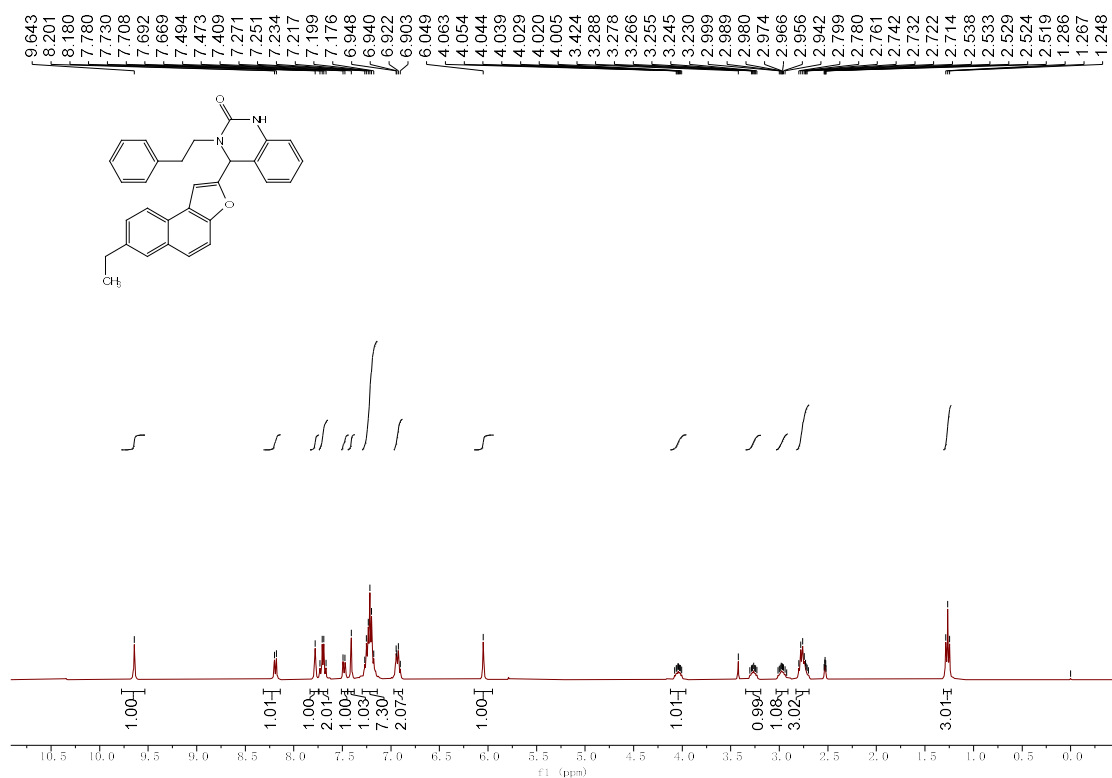
^1H NMR spectra of **3n** (400 MHz, DMSO- d_6)



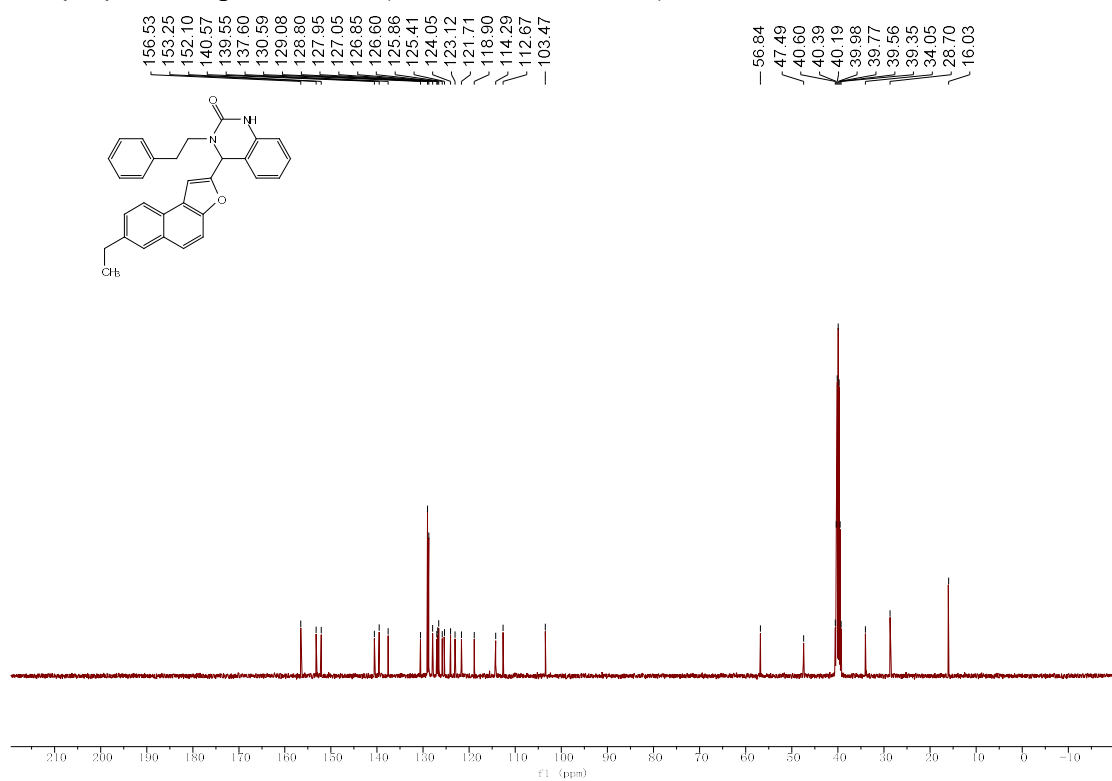
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **3n** (100 MHz, DMSO- d_6)



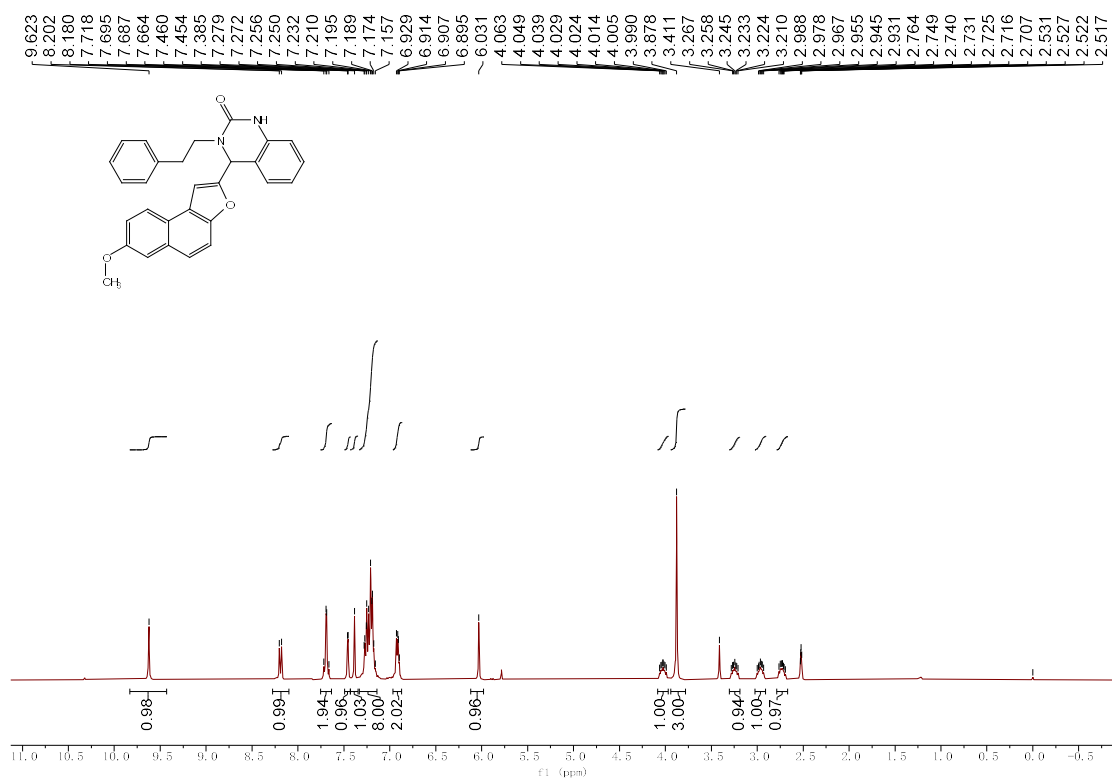
^1H NMR spectra of **3o** (400 MHz, DMSO- d_6)



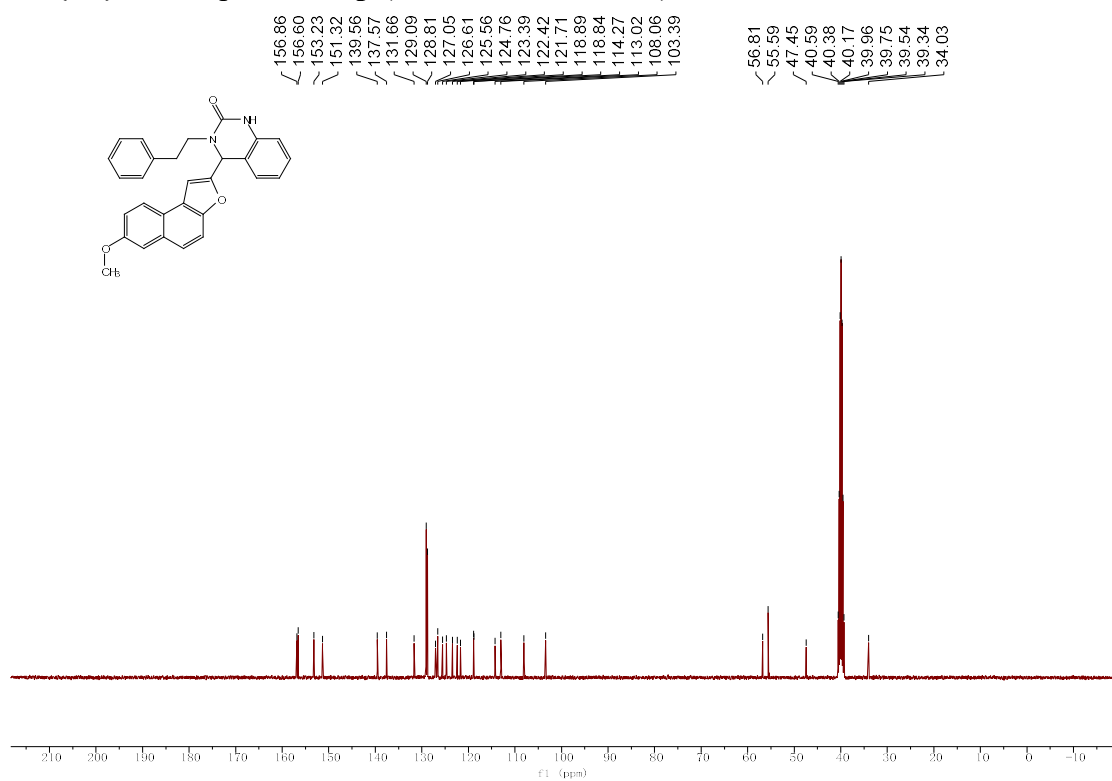
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **3o** (100 MHz, DMSO- d_6)



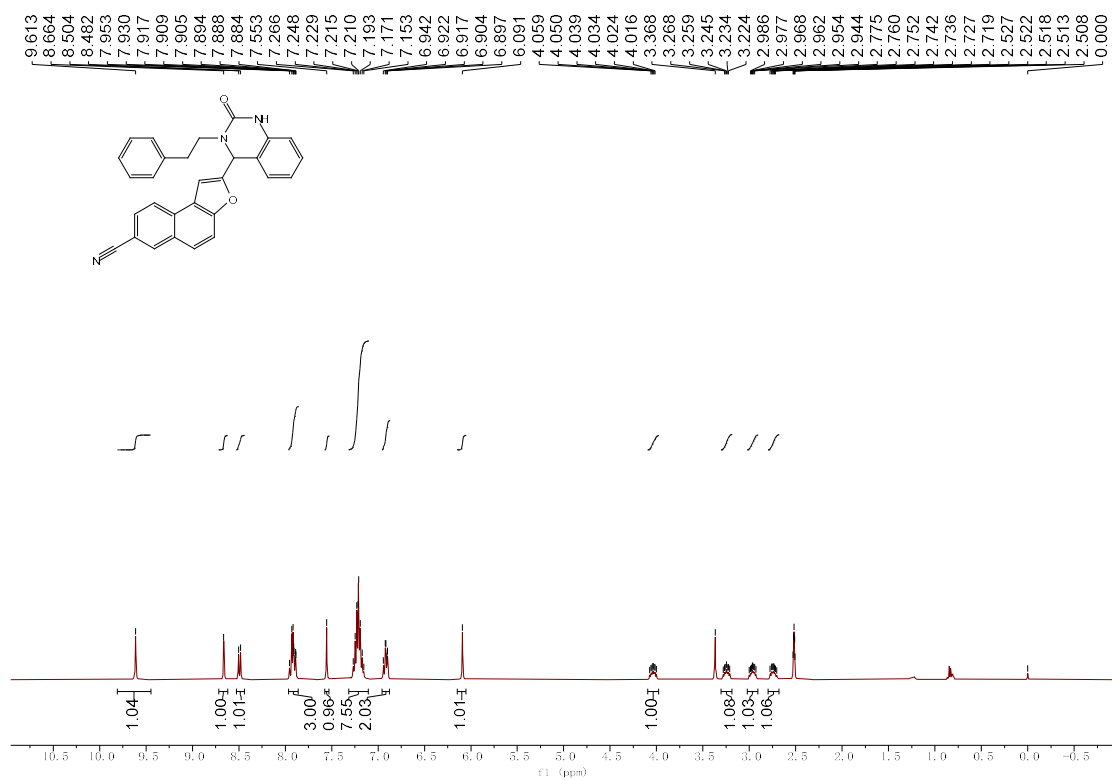
^1H NMR spectra of **3p** (400 MHz, DMSO- d_6)



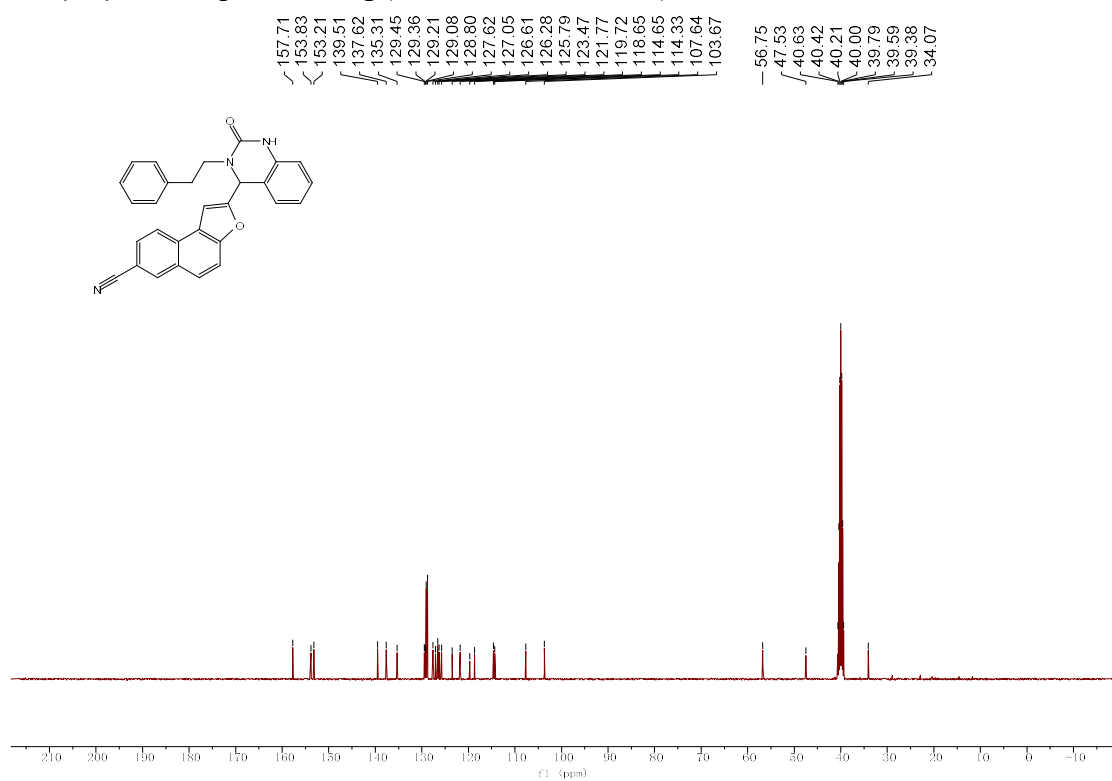
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **3p** (100 MHz, DMSO- d_6)



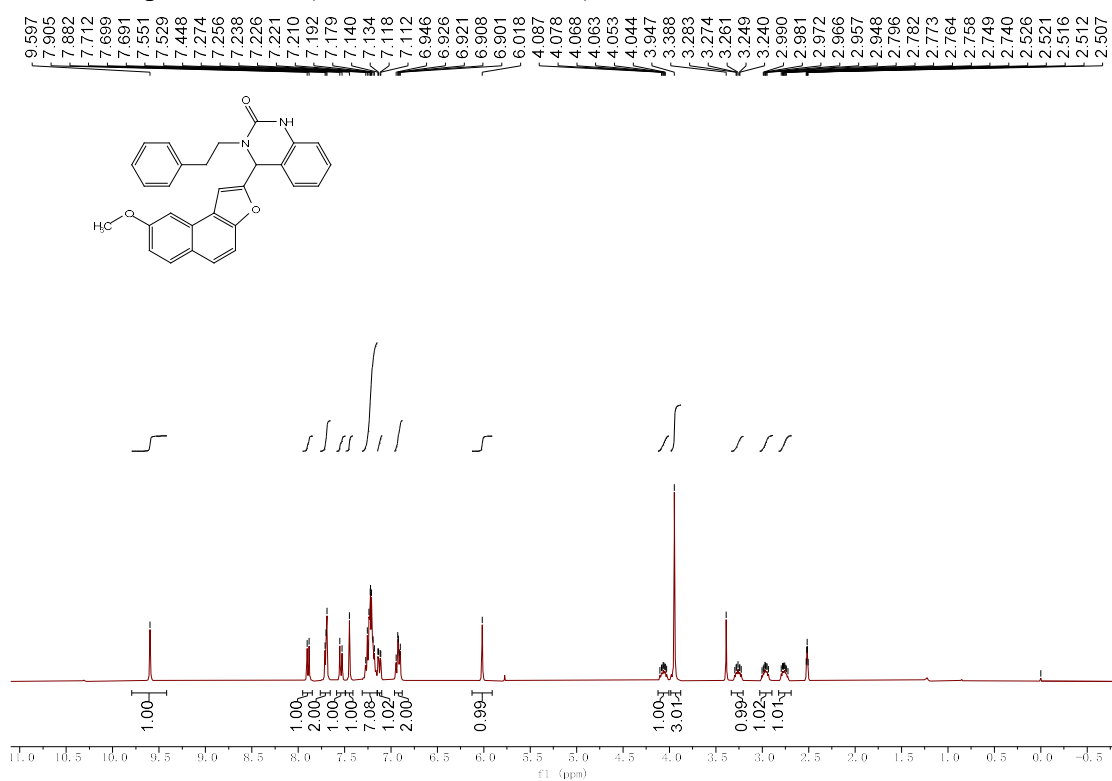
^1H NMR spectra of **3q** (400 MHz, DMSO- d_6)



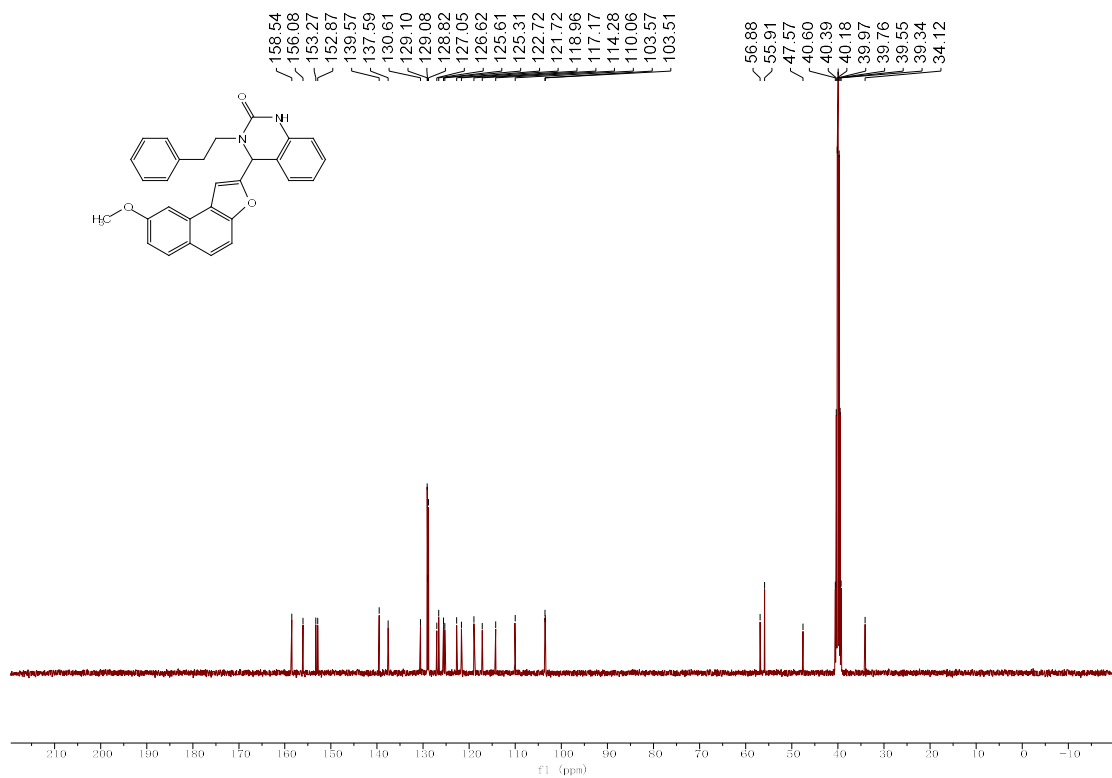
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **3q** (100 MHz, DMSO- d_6)



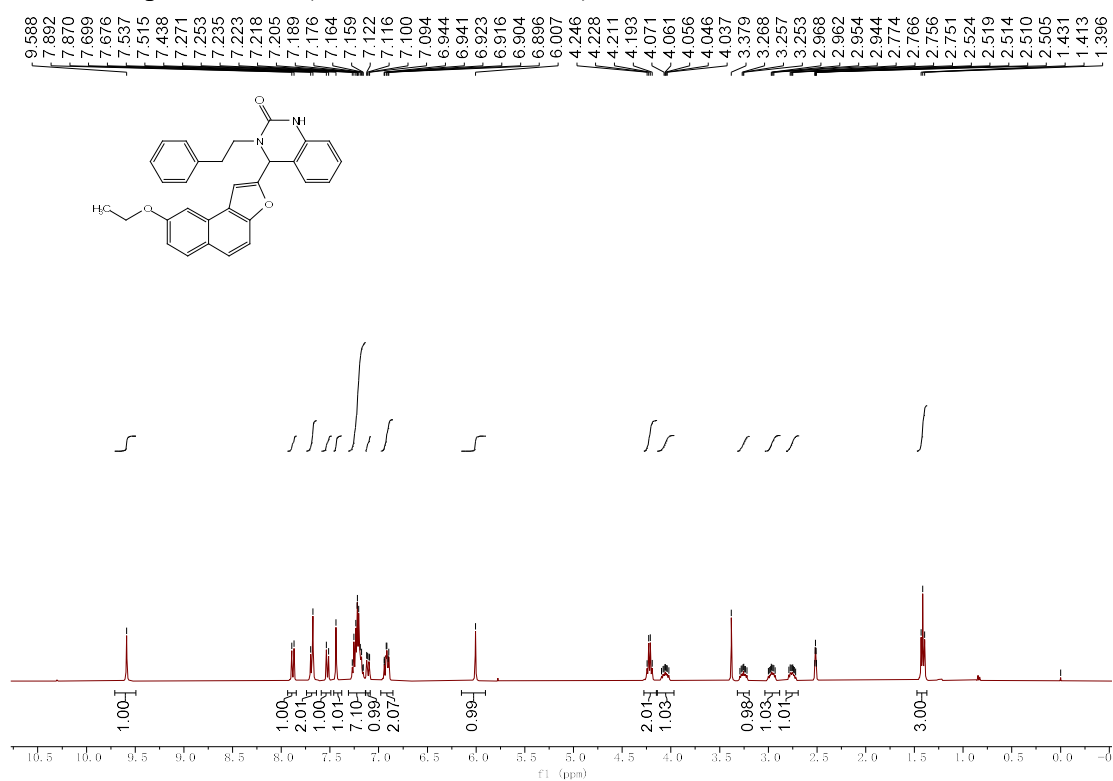
^1H NMR spectra of **3r** (400 MHz, DMSO- d_6)



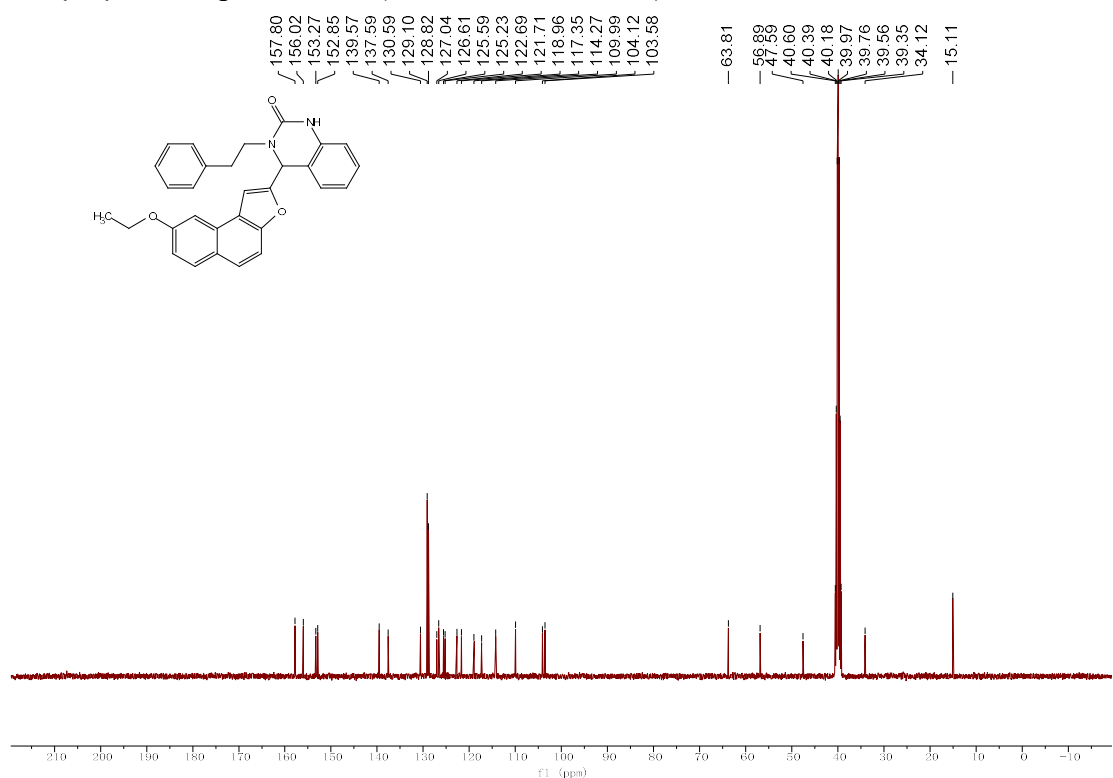
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **3r** (100 MHz, DMSO- d_6)



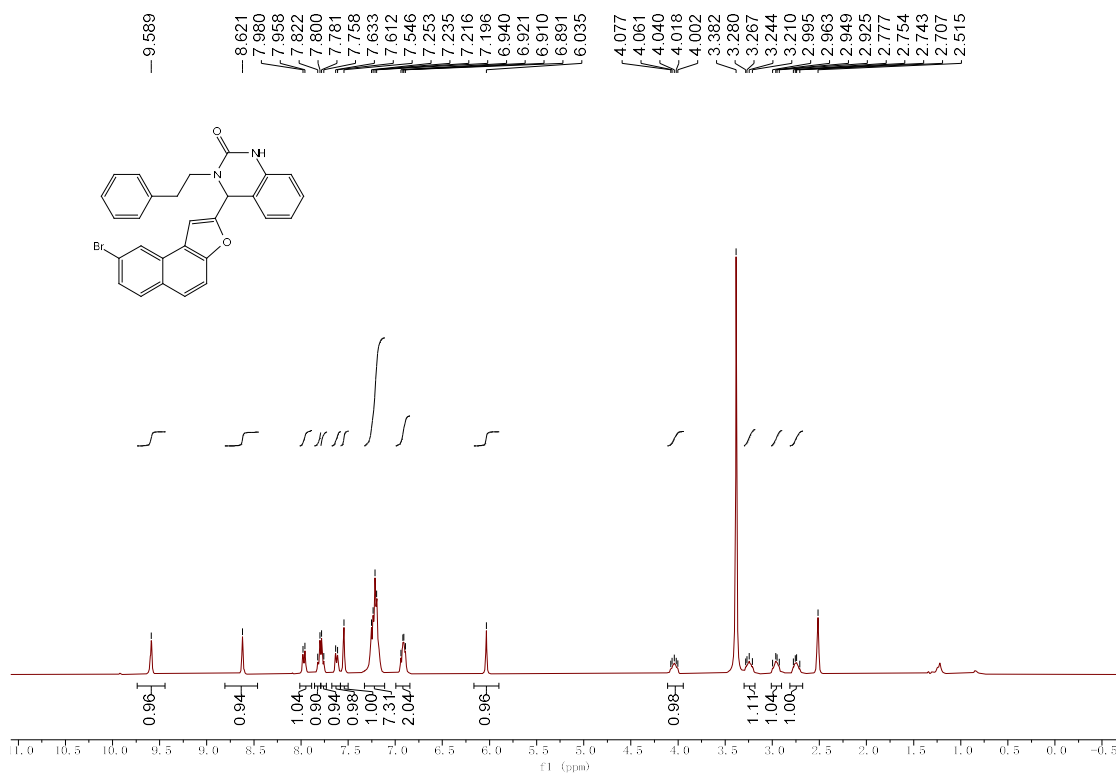
^1H NMR spectra of **3s** (400 MHz, DMSO- d_6)



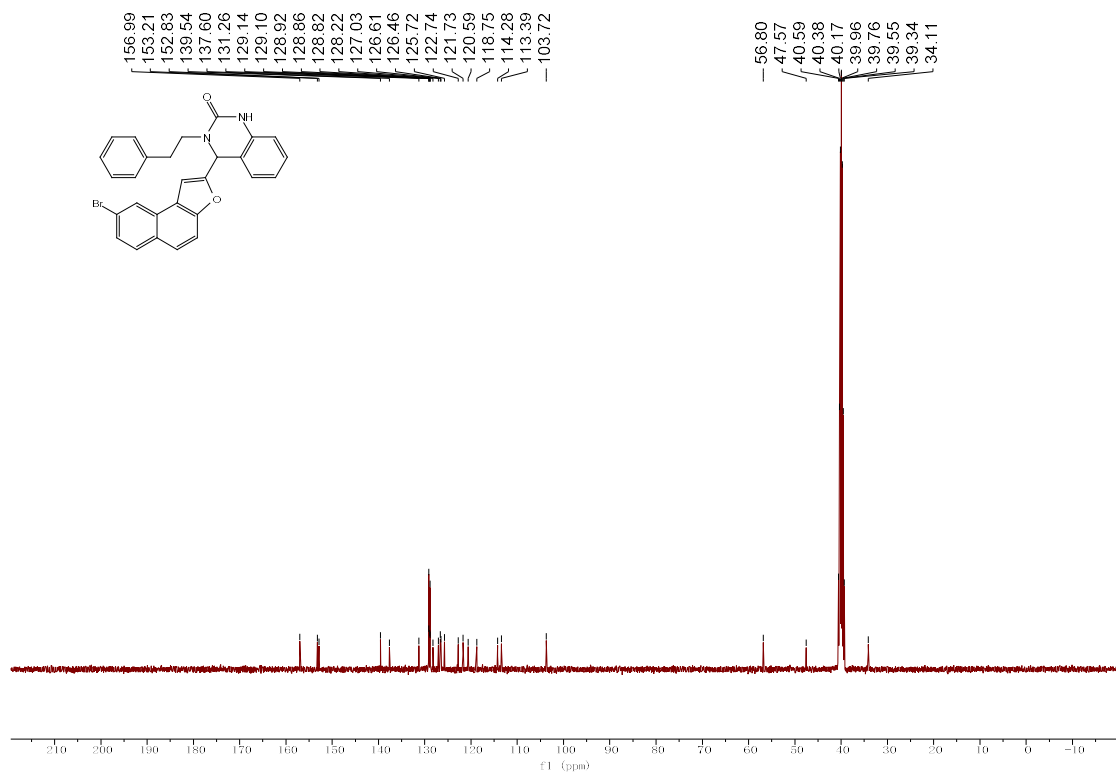
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **3s** (100 MHz, DMSO- d_6)



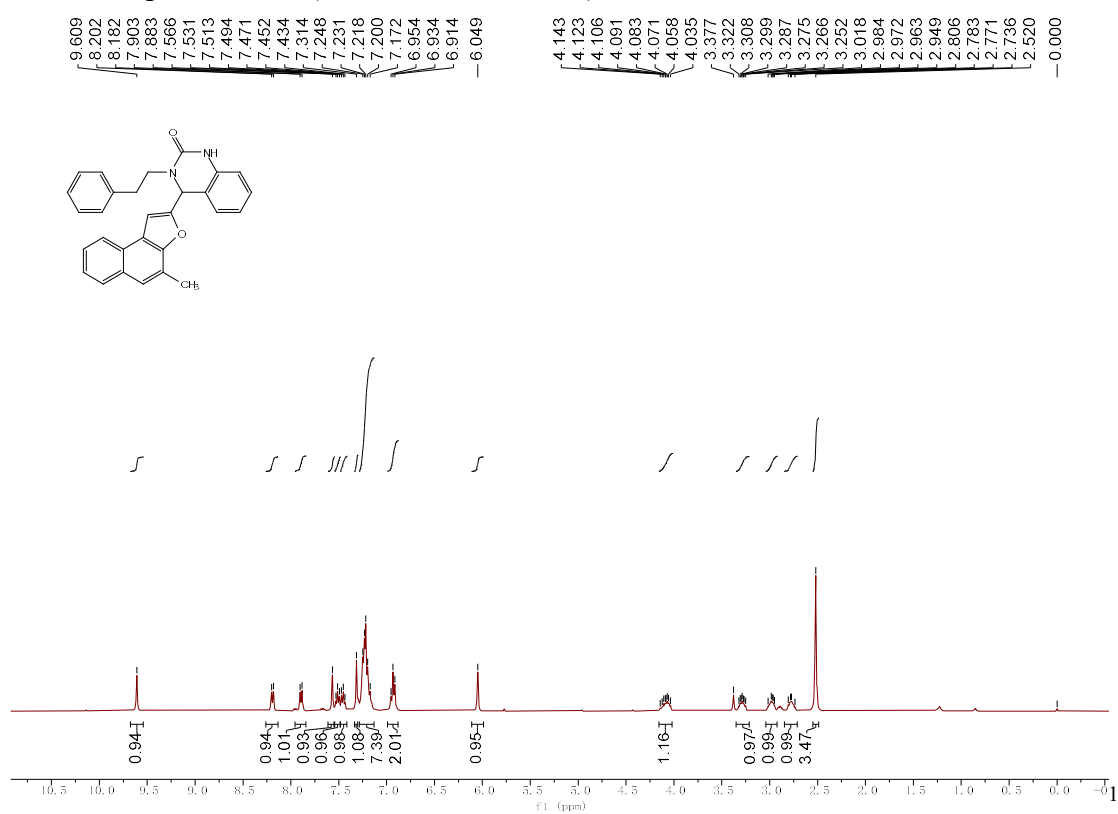
^1H NMR spectra of **3t** (400 MHz, DMSO- d_6)



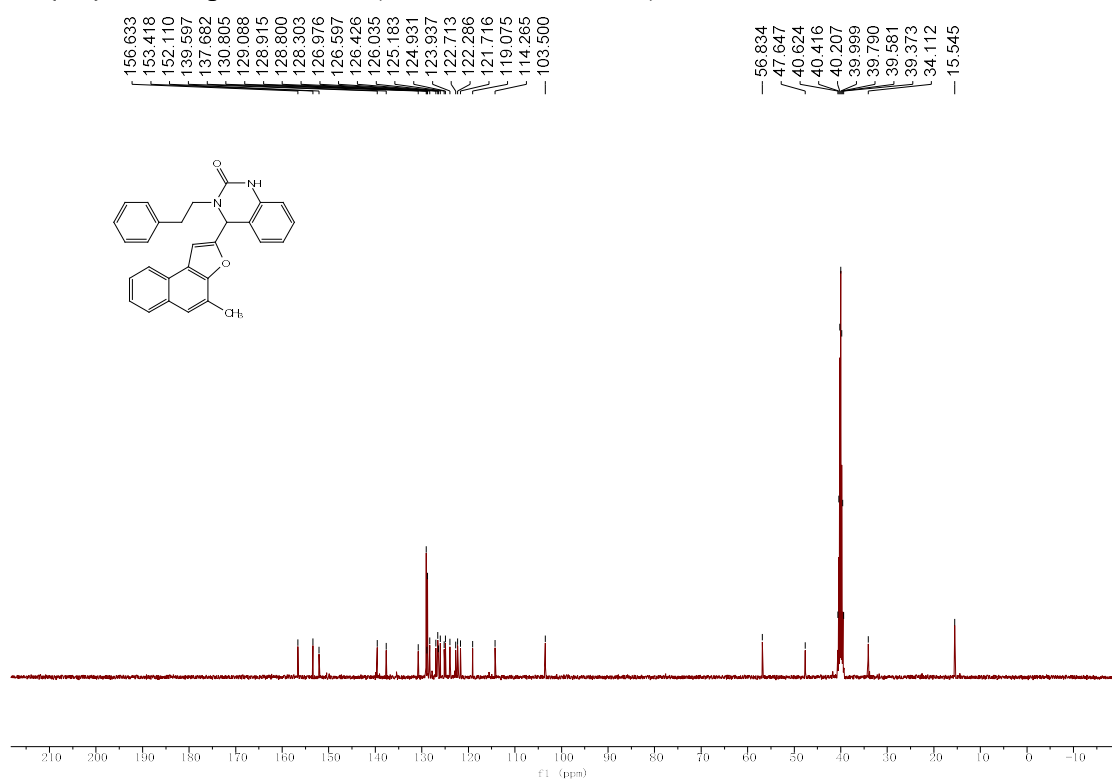
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **3t** (100 MHz, DMSO- d_6)



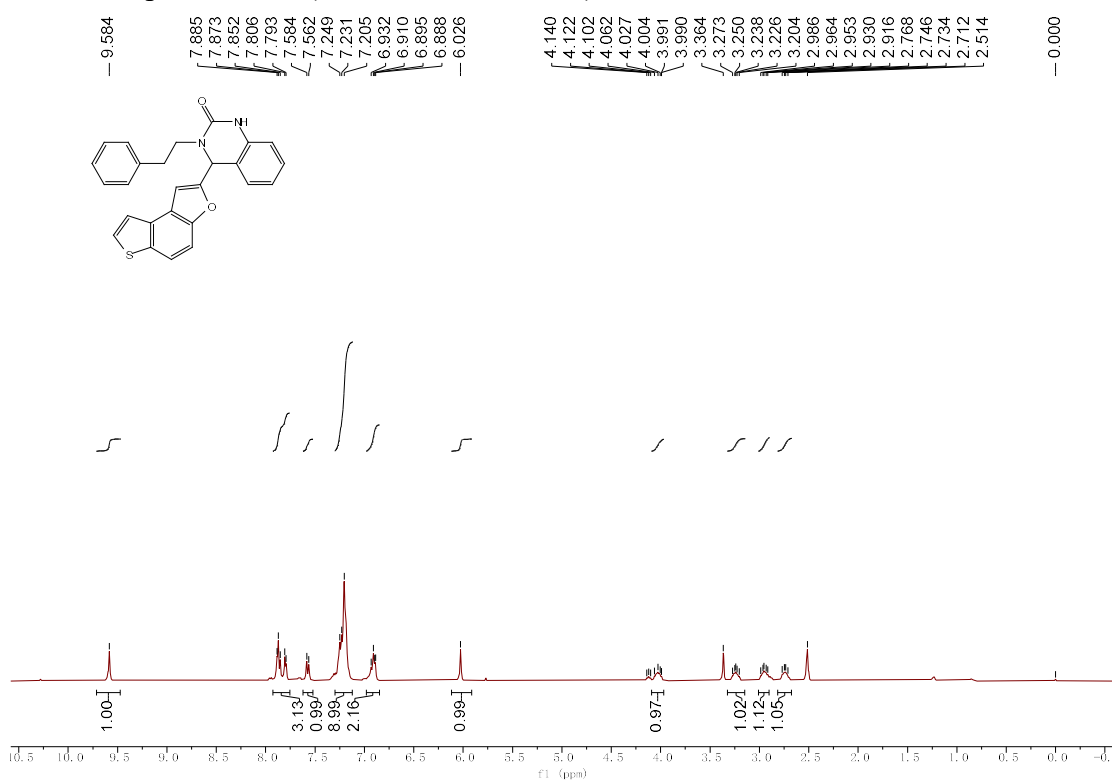
^1H NMR spectra of **3u** (400 MHz, DMSO- d_6)



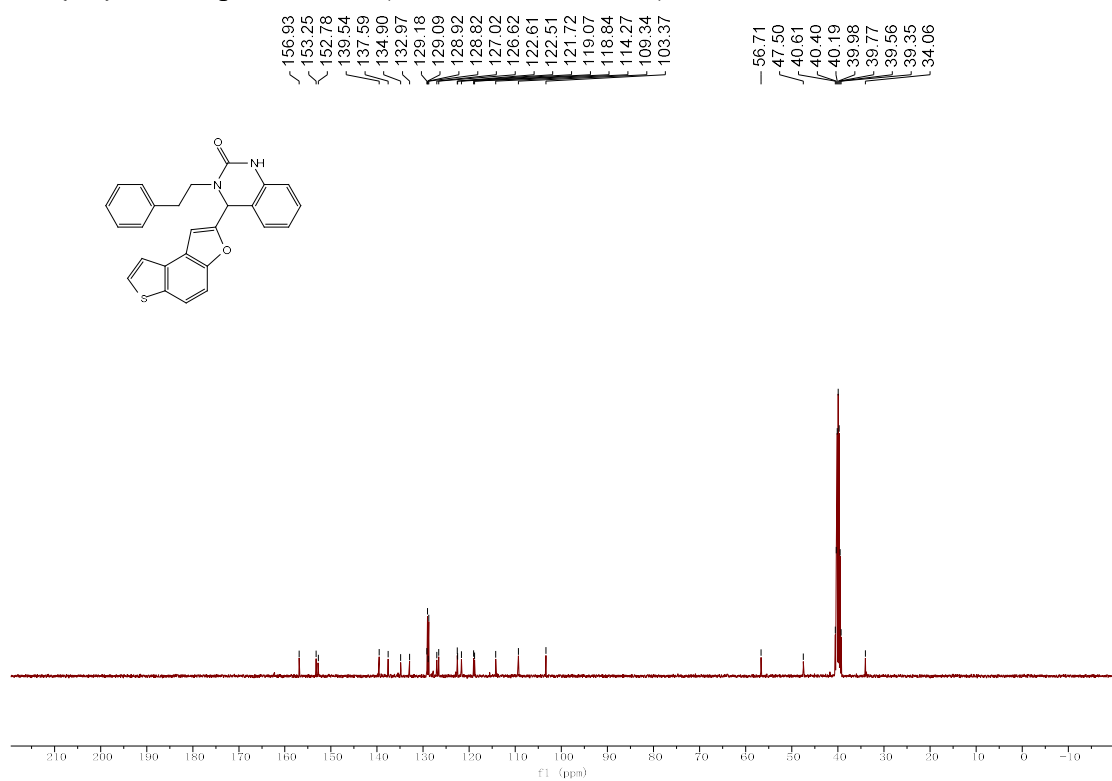
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **3u** (100 MHz, DMSO- d_6)



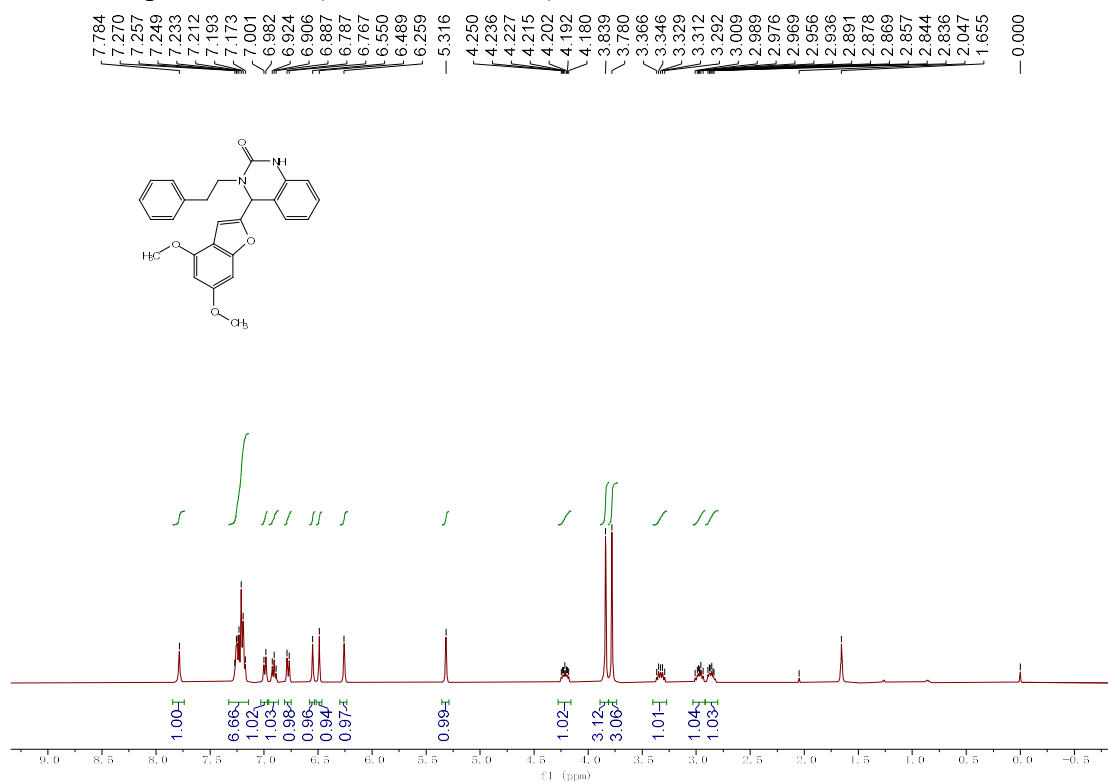
^1H NMR spectra of **3v** (400 MHz, DMSO- d_6)



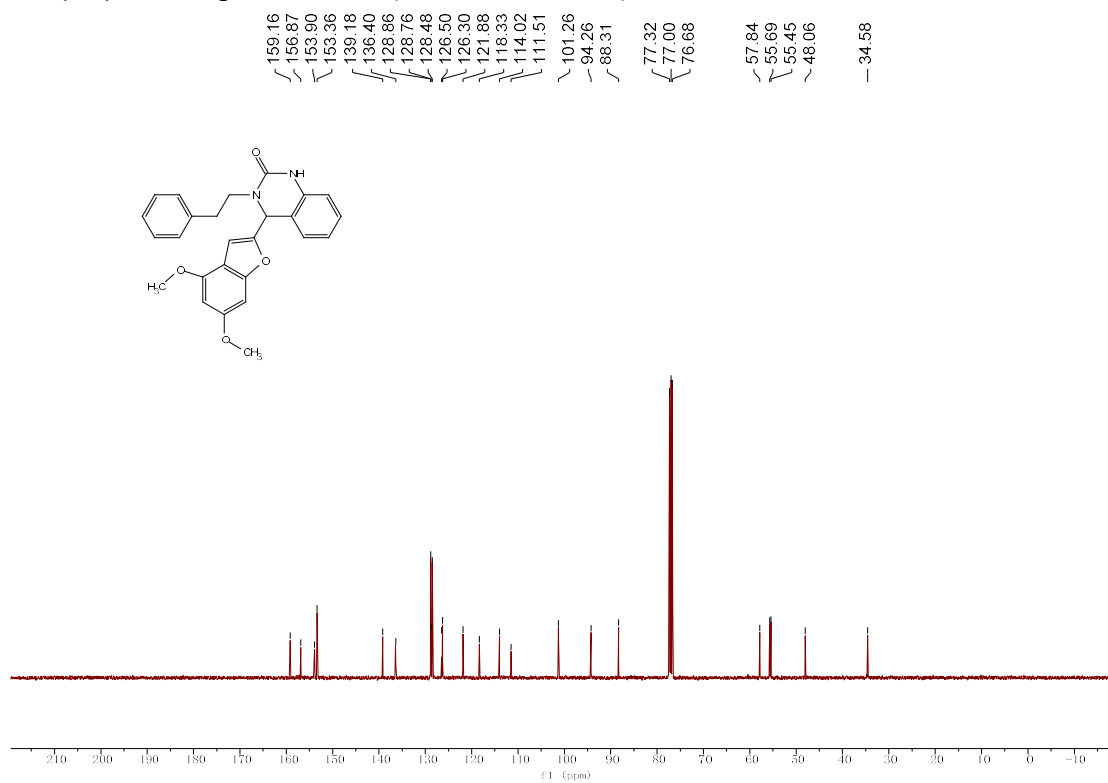
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **3v** (100 MHz, DMSO- d_6)



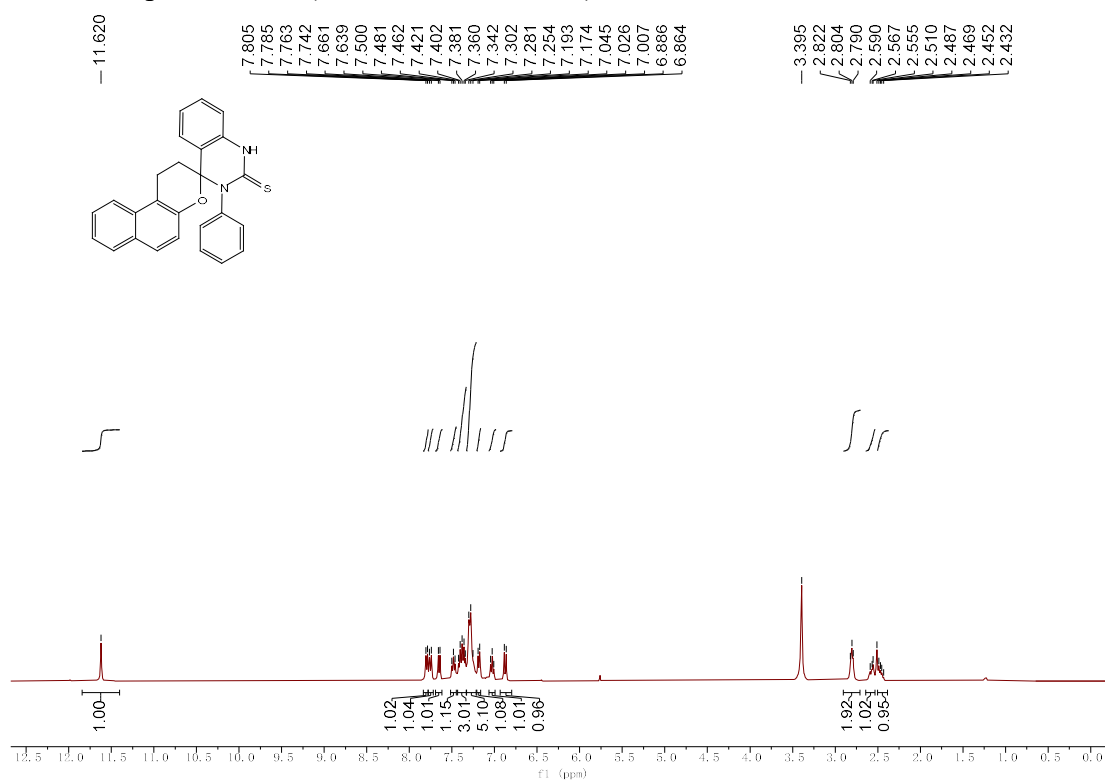
^1H NMR spectra of **3w** (400 MHz, CDCl_3)



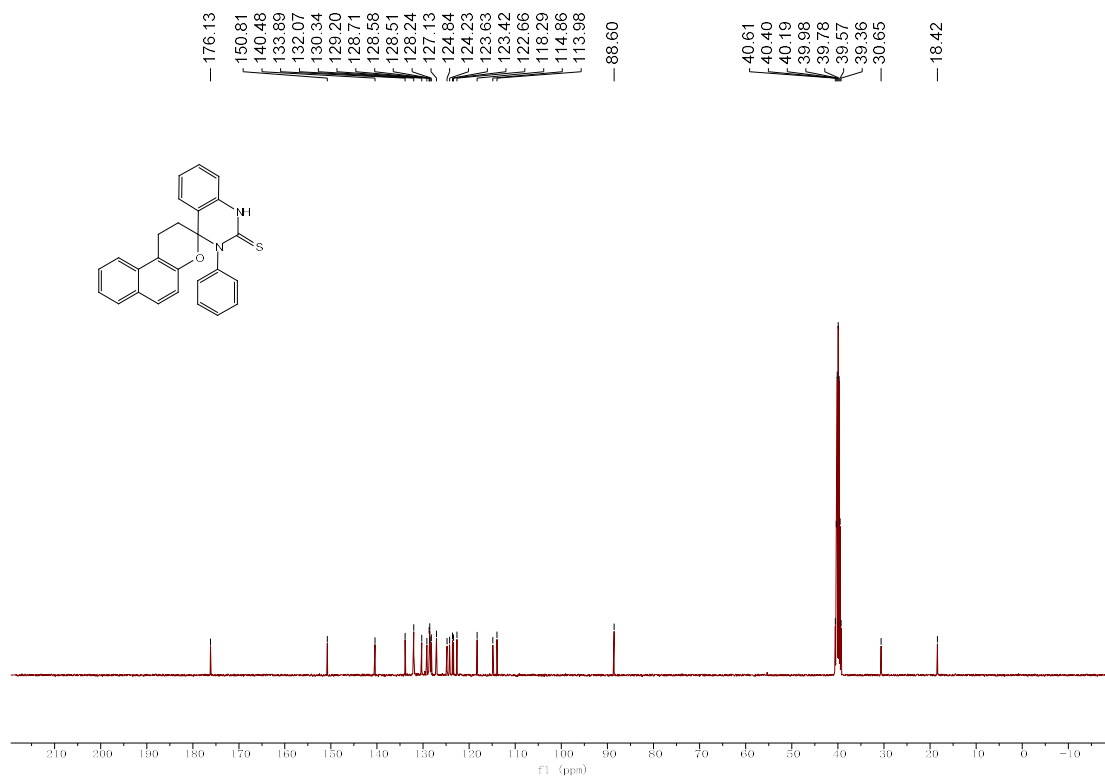
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **3w** (100 MHz, CDCl_3)



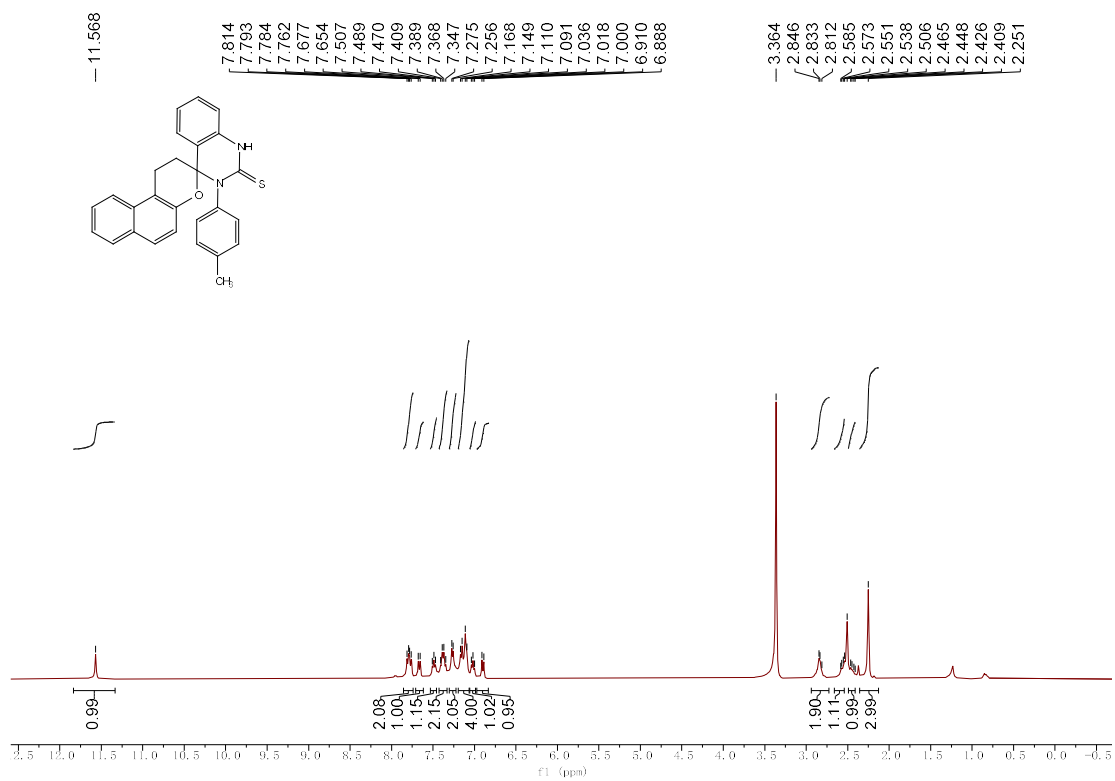
^1H NMR spectra of **5a** (400 MHz, DMSO- d_6)



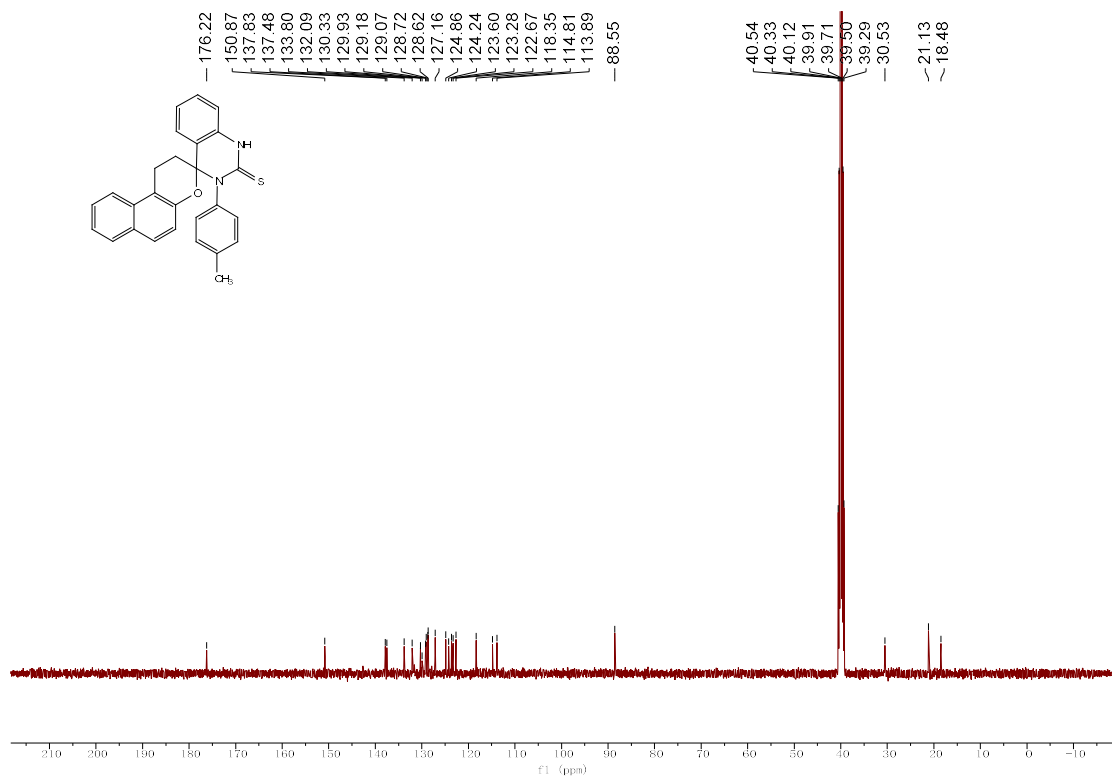
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **5a** (100 MHz, DMSO- d_6)



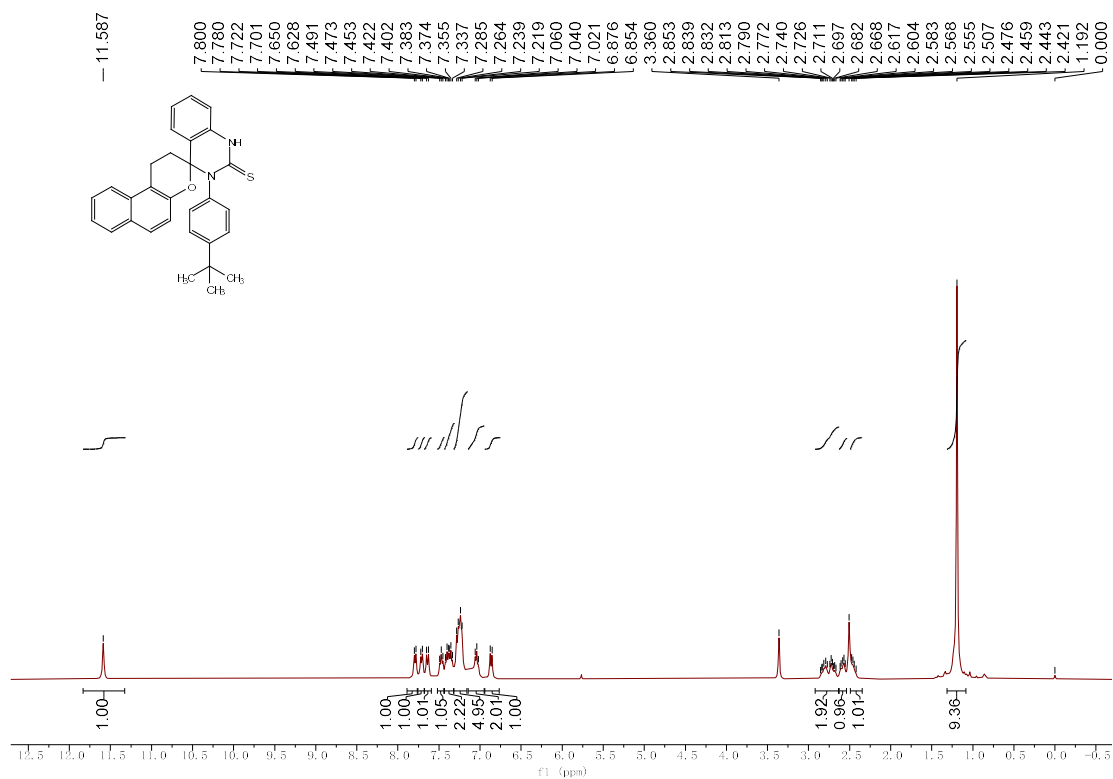
^1H NMR spectra of **5b** (400 MHz, DMSO- d_6)



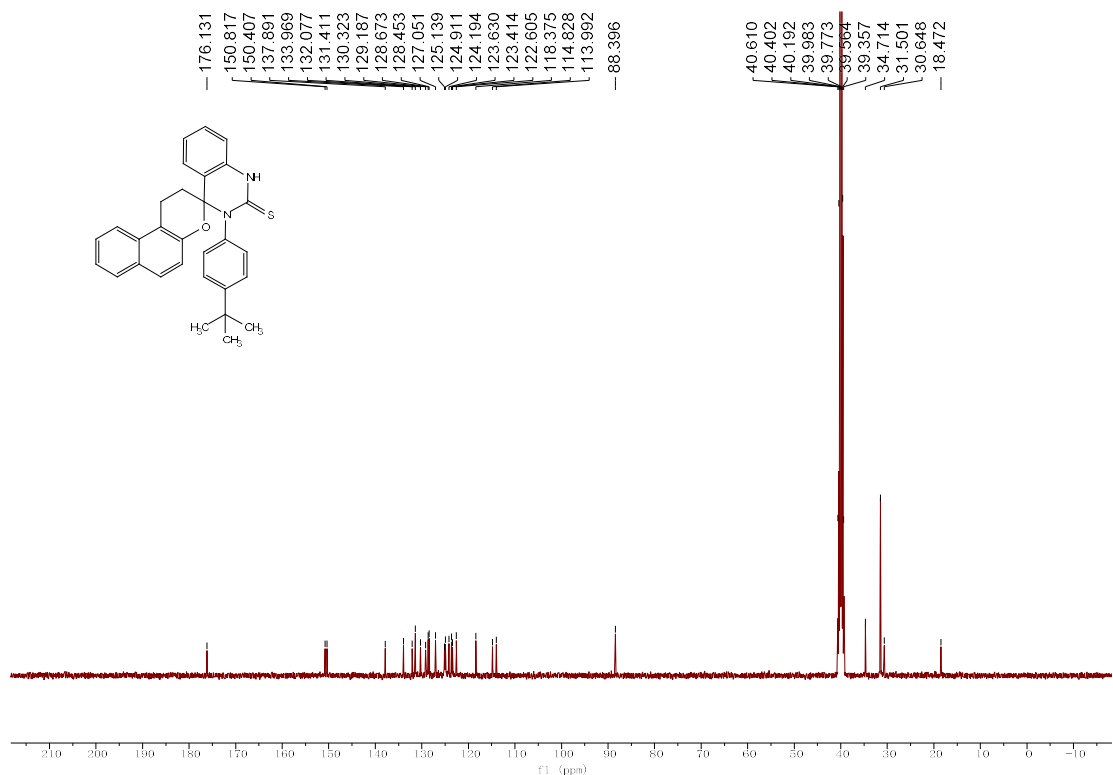
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **5b** (100 MHz, DMSO- d_6)



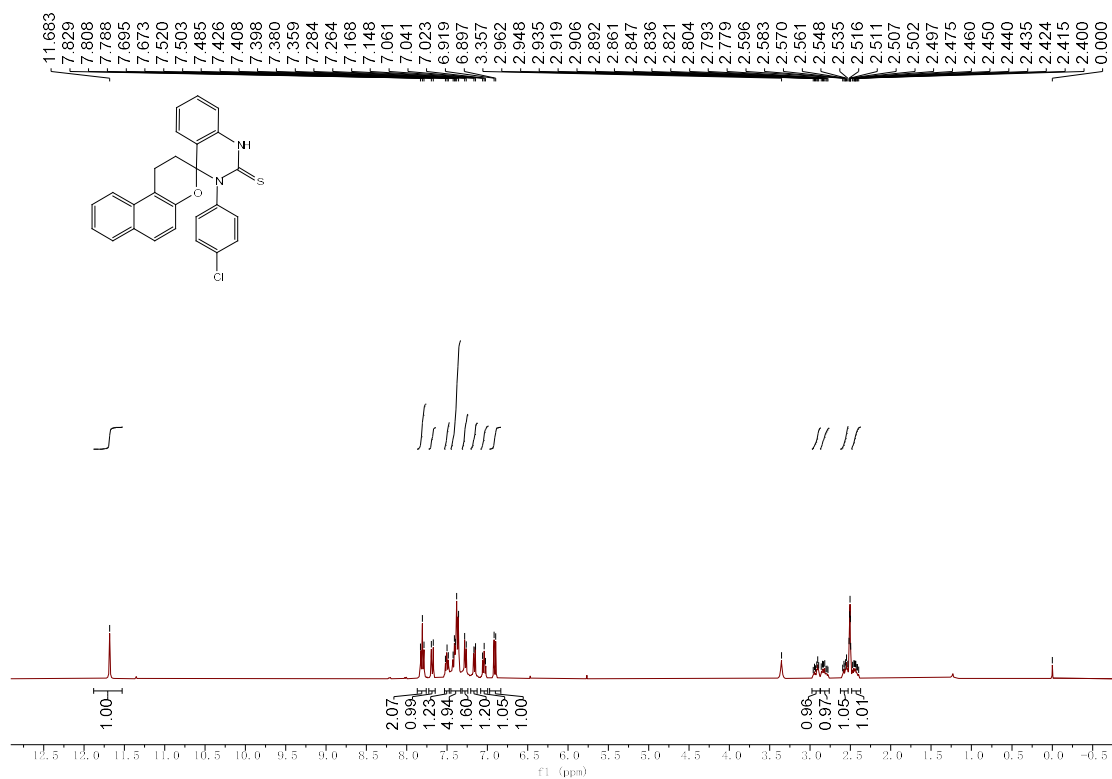
^1H NMR spectra of **5c** (400 MHz, DMSO- d_6)



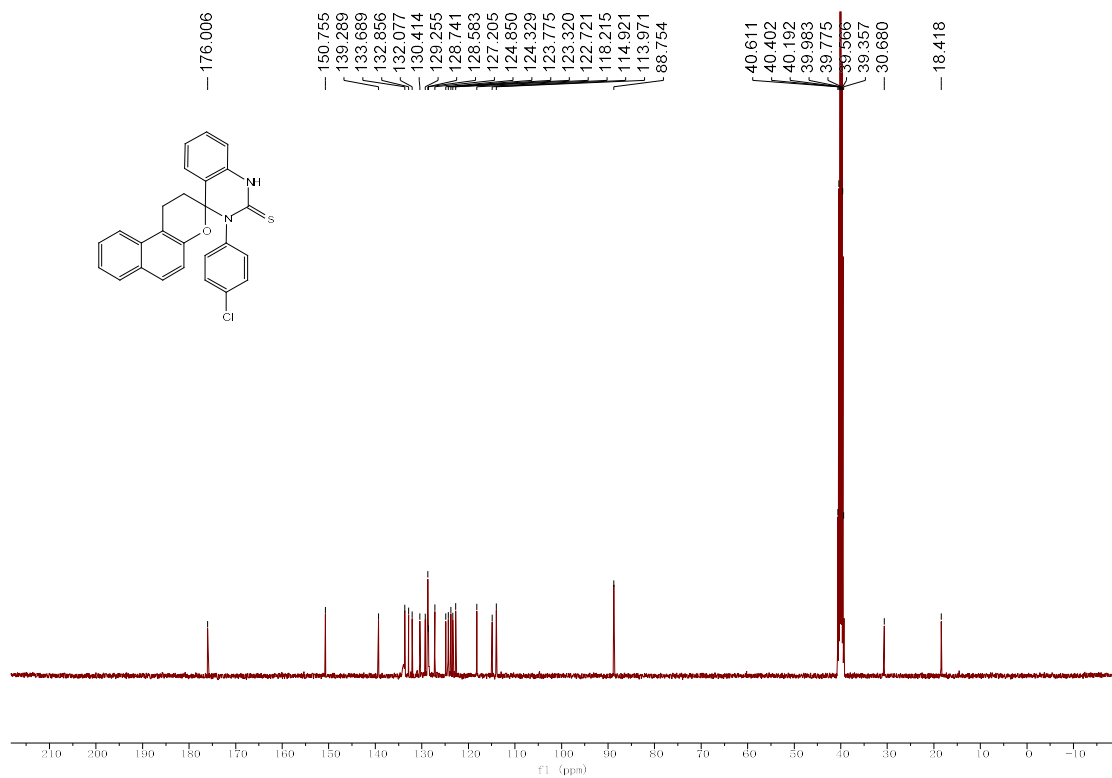
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **5c** (100 MHz, DMSO- d_6)



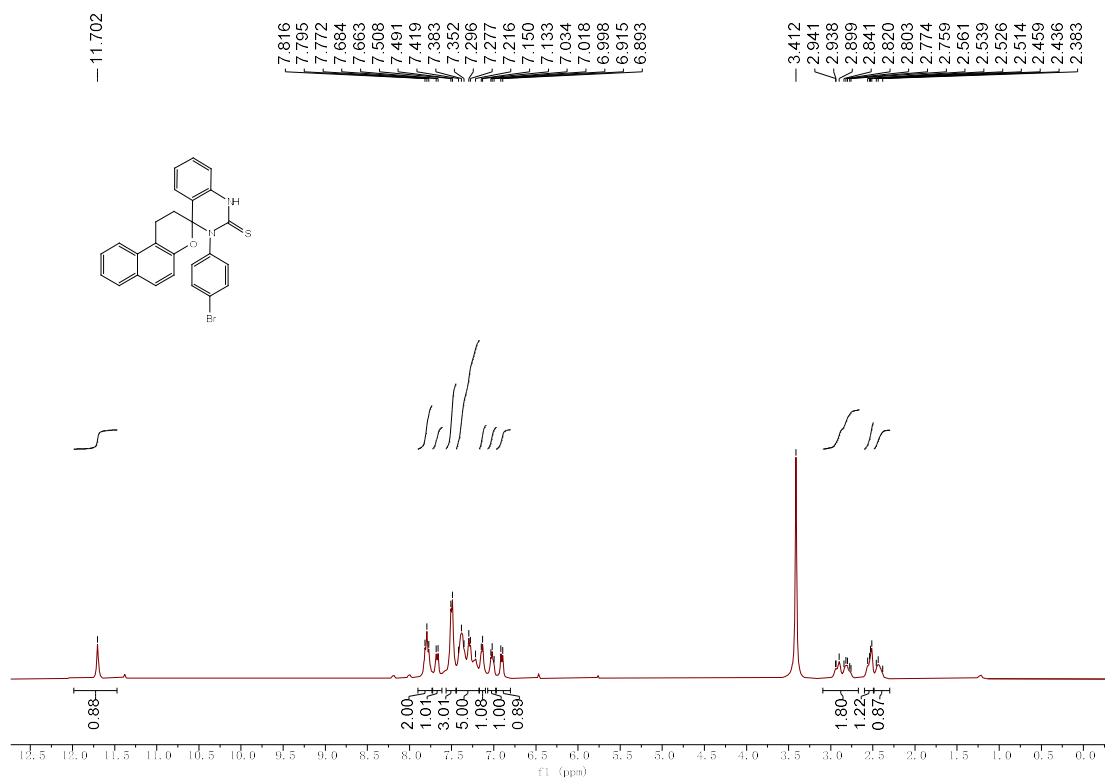
^1H NMR spectra of **5d** (400 MHz, DMSO- d_6)



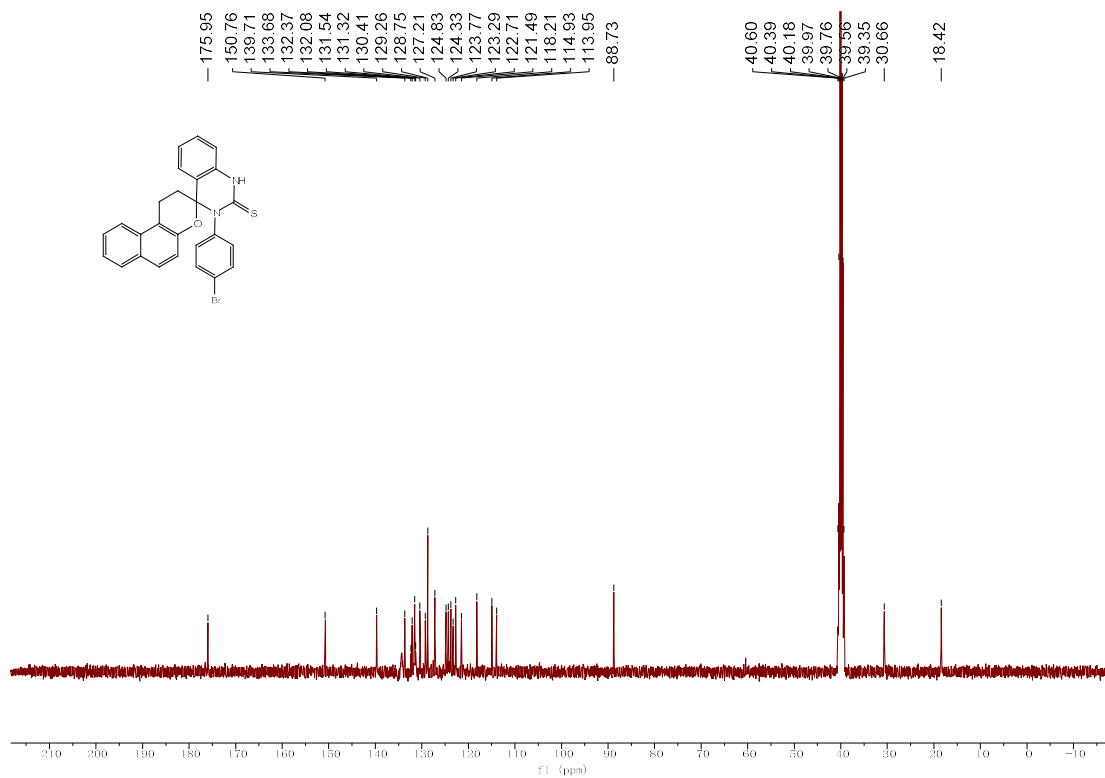
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **5d** (100 MHz, DMSO- d_6)



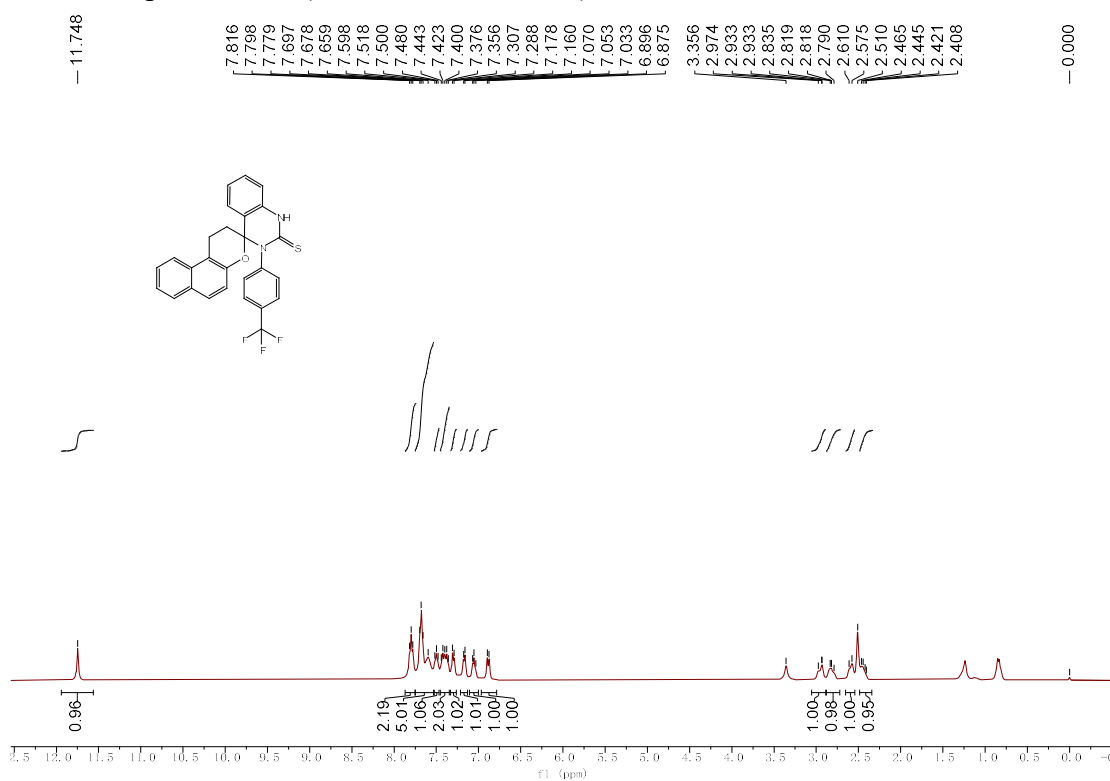
^1H NMR spectra of **5e** (400 MHz, DMSO- d_6)



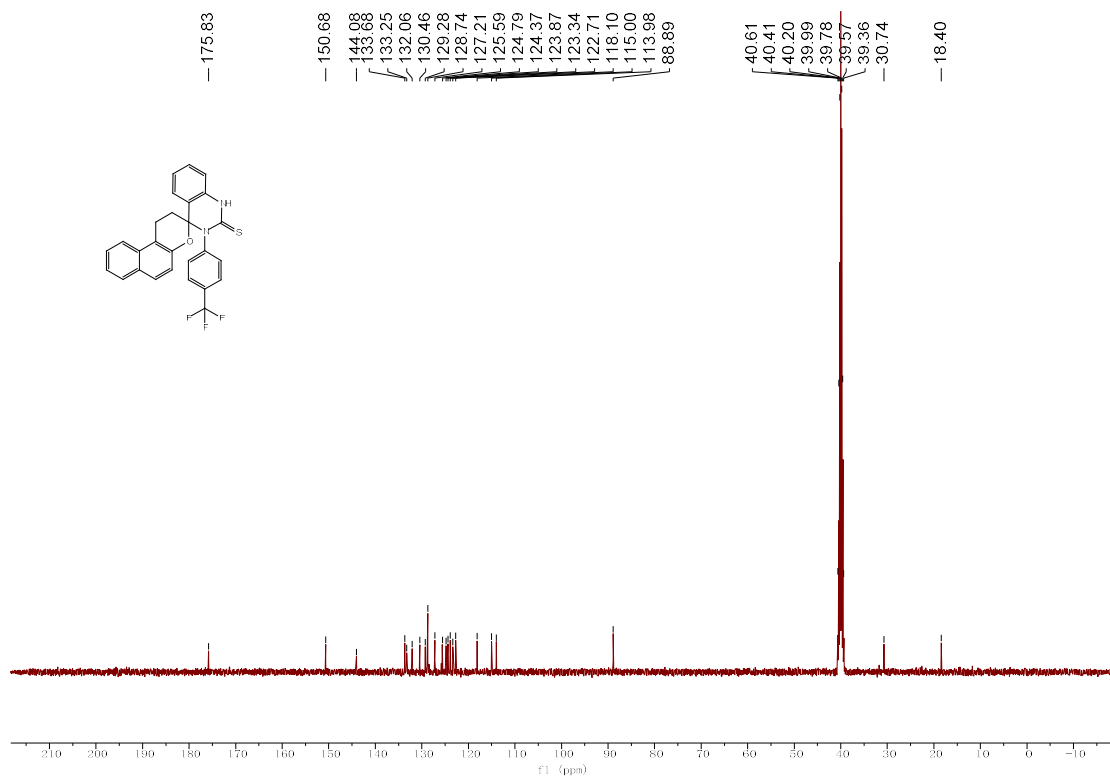
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **5e** (100 MHz, DMSO- d_6)



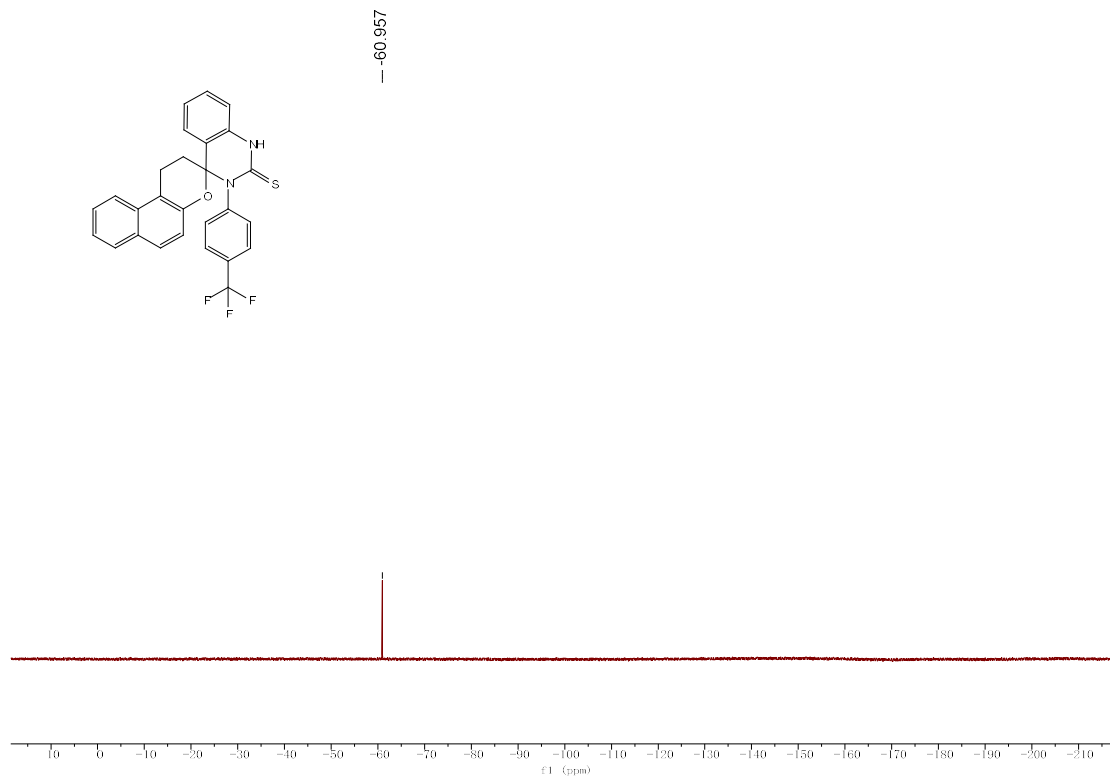
^1H NMR spectra of **5f** (400 MHz, DMSO- d_6)



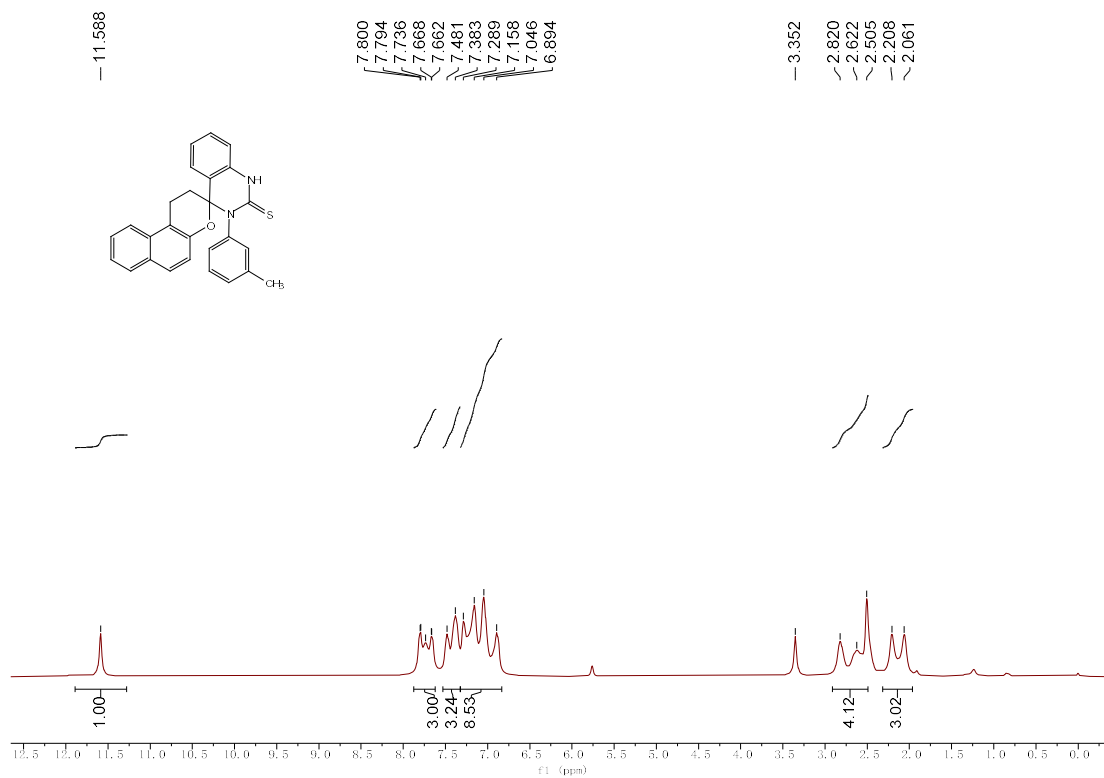
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **5f** (100 MHz, DMSO- d_6)



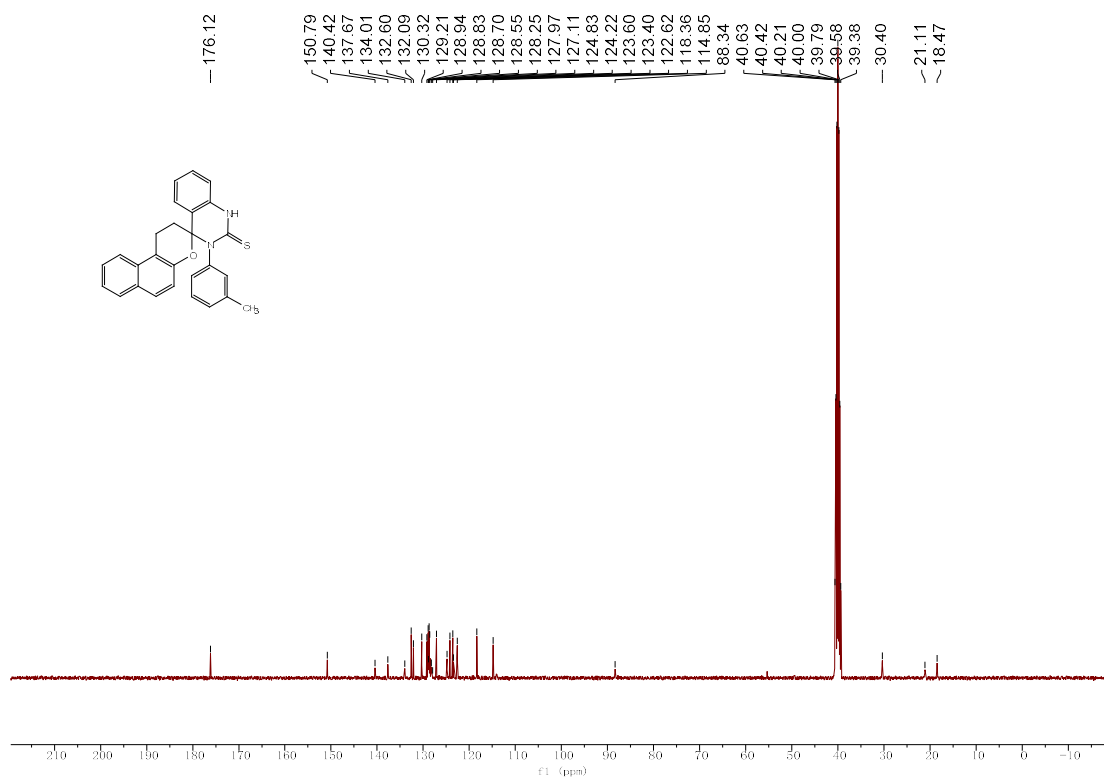
$^{19}\text{F}\{^1\text{H}\}$ NMR spectra of **5f** (377 MHz, DMSO- d_6)



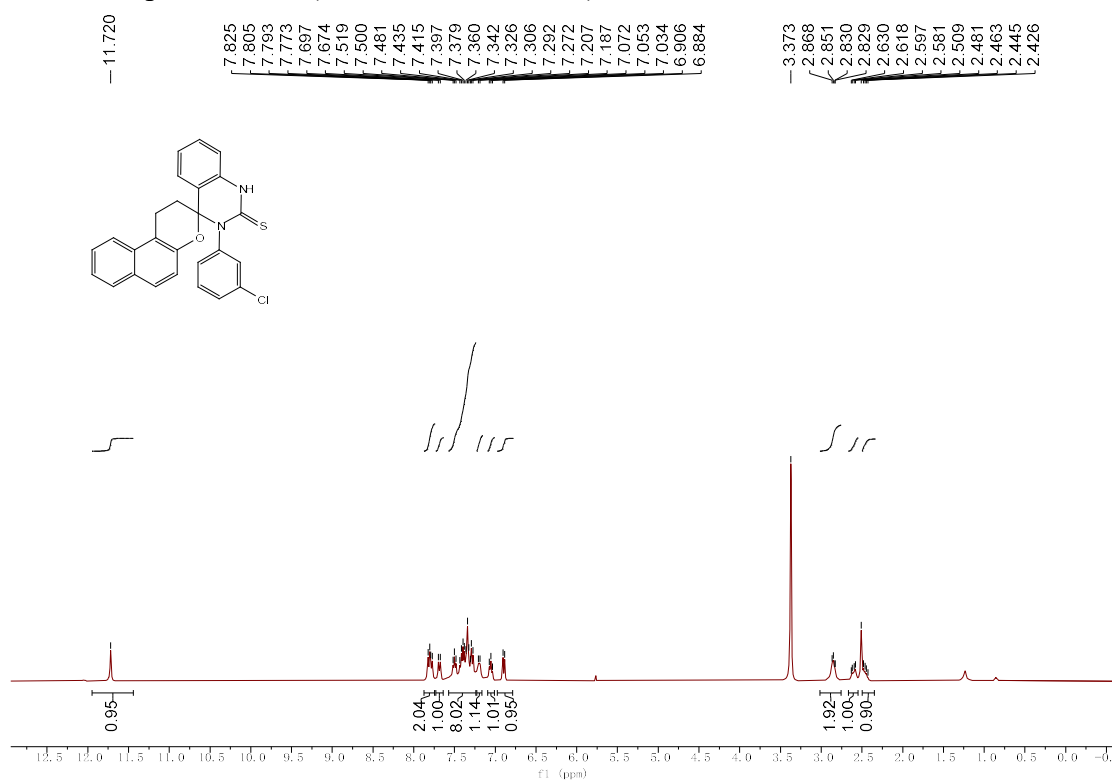
^1H NMR spectra of **5g** (400 MHz, DMSO- d_6)



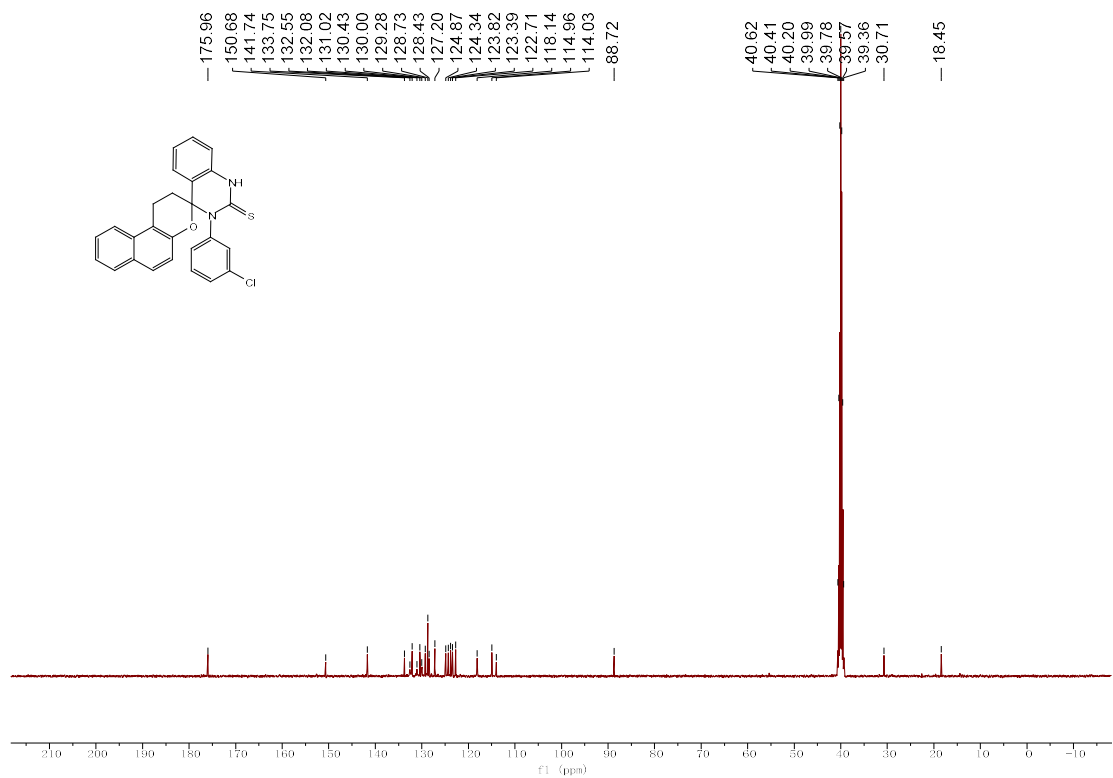
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **5g** (100 MHz, DMSO- d_6)



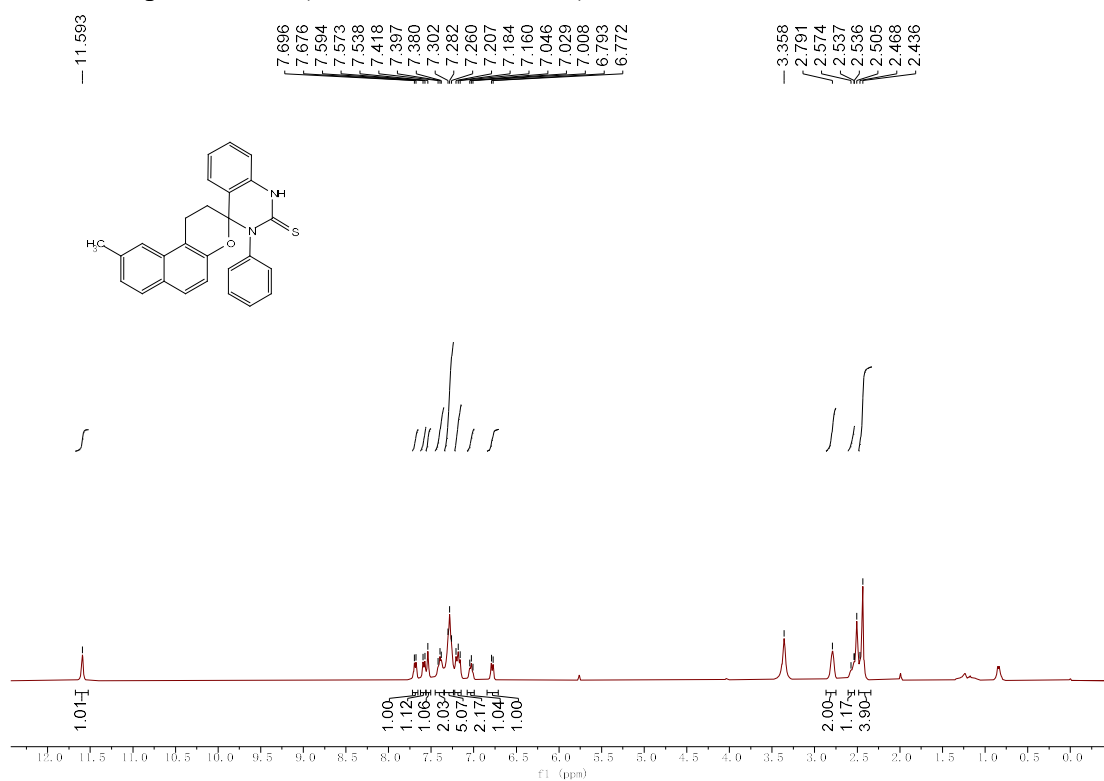
^1H NMR spectra of **5h** (400 MHz, DMSO- d_6)



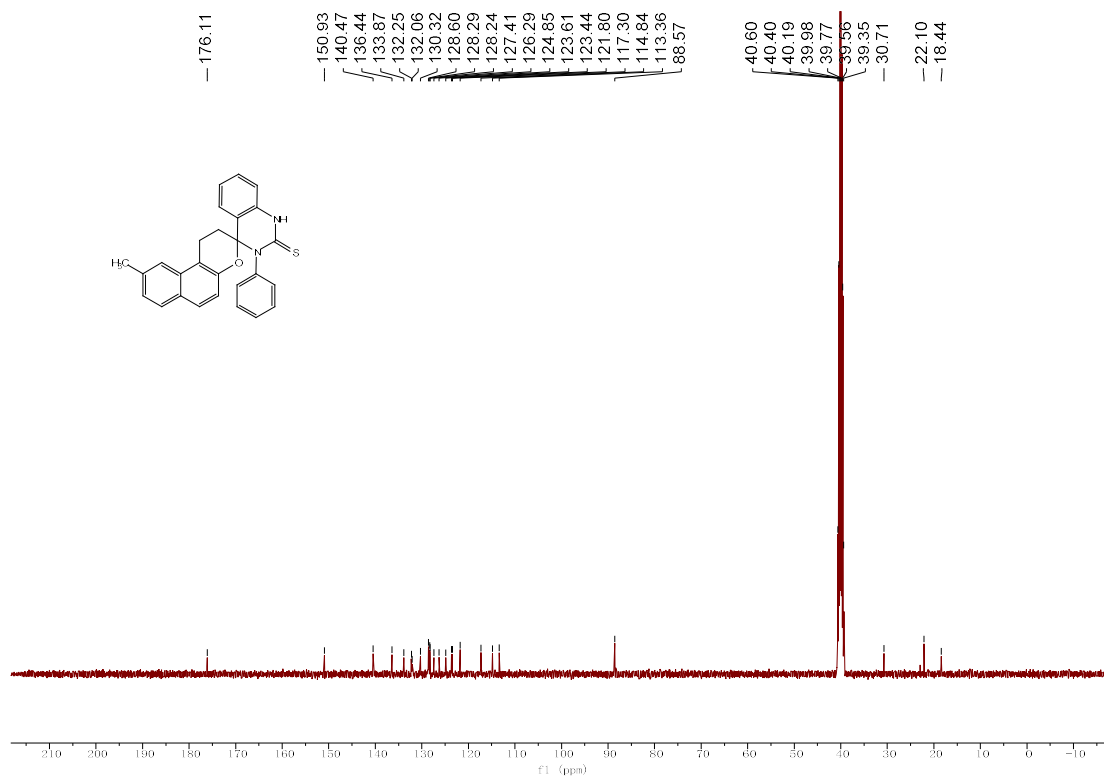
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **5h** (100 MHz, DMSO- d_6)



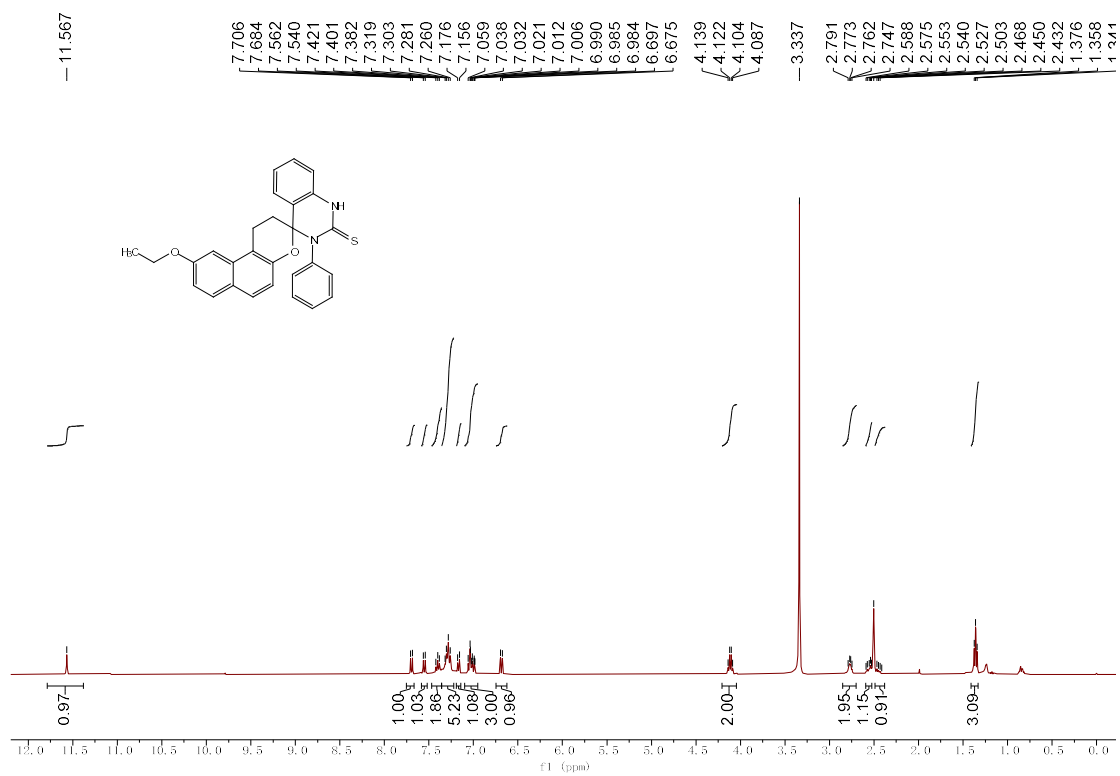
^1H NMR spectra of **5i** (400 MHz, DMSO- d_6)



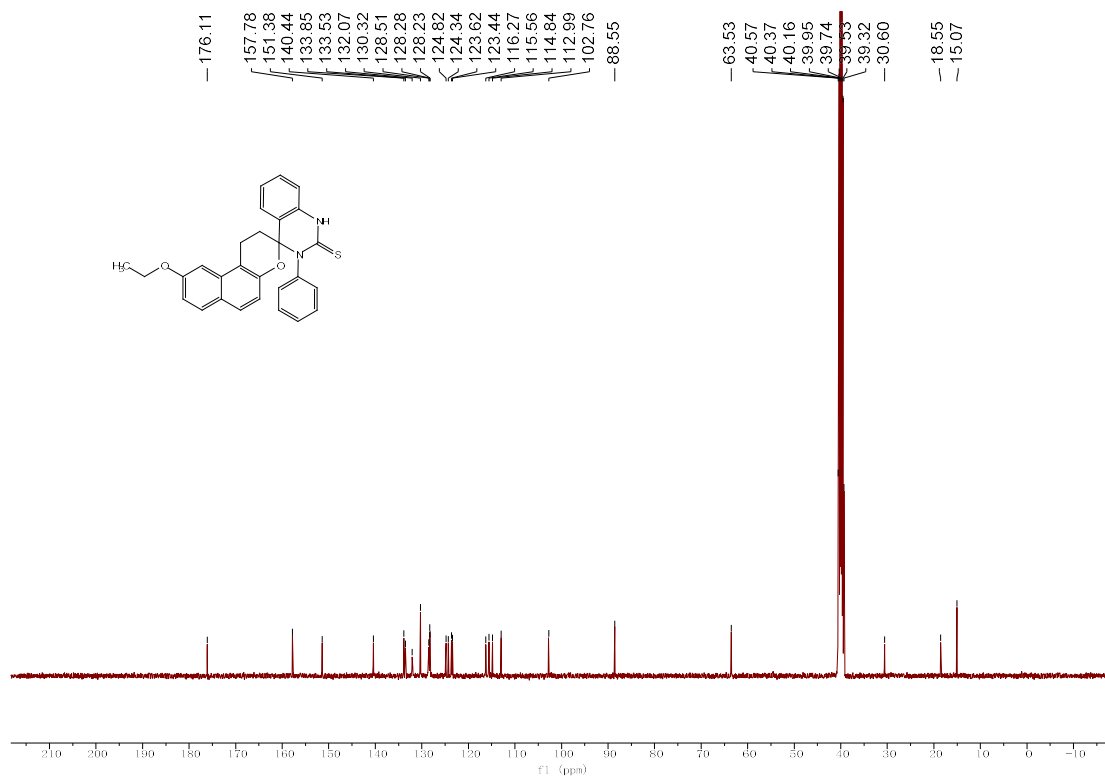
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **5i** (100 MHz, DMSO- d_6)



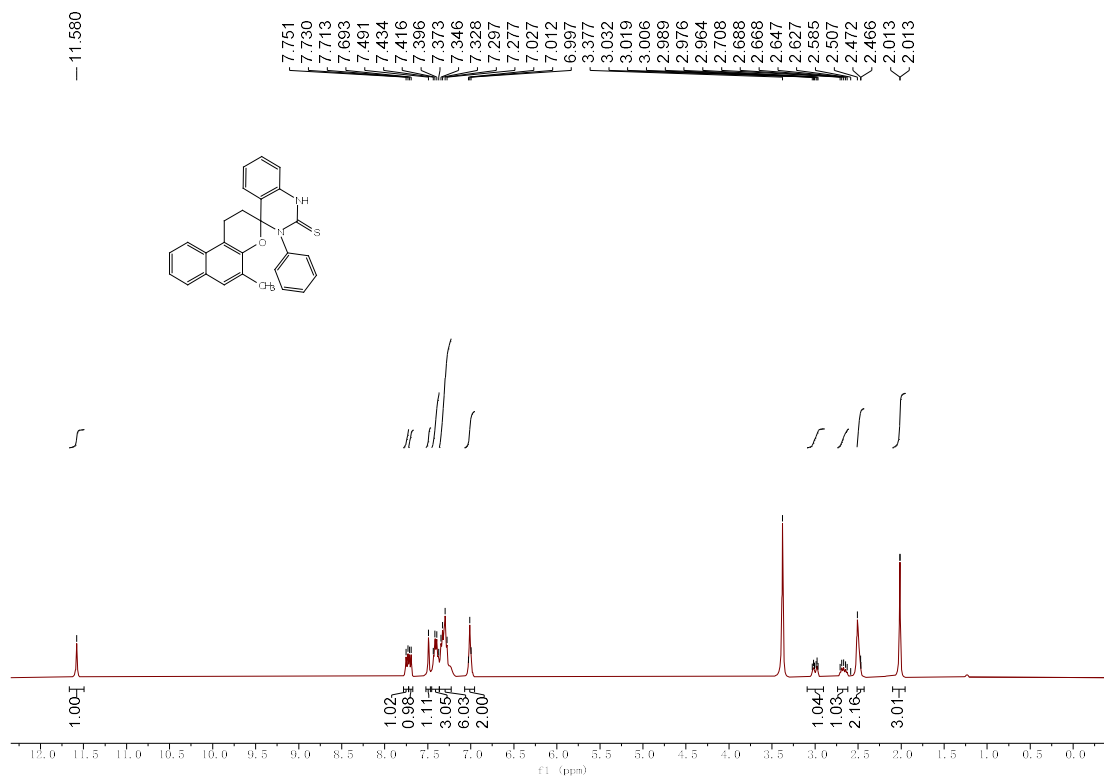
^1H NMR spectra of **5j** (400 MHz, DMSO- d_6)



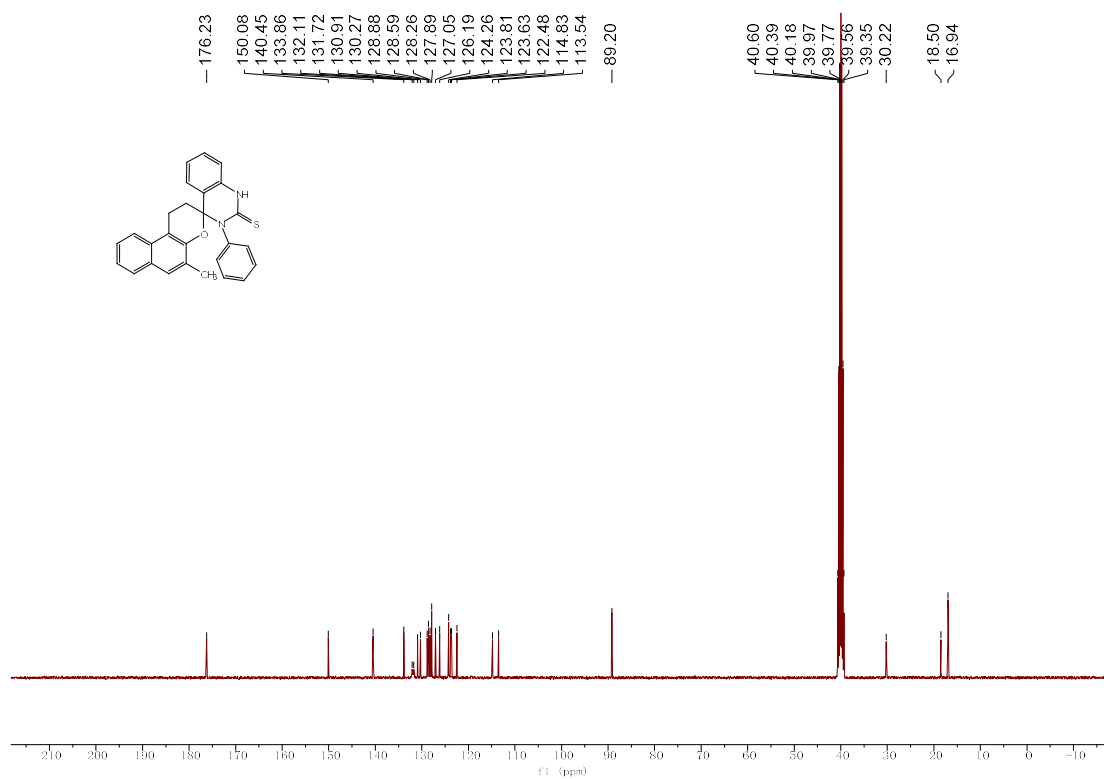
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **5j** (100 MHz, DMSO- d_6)



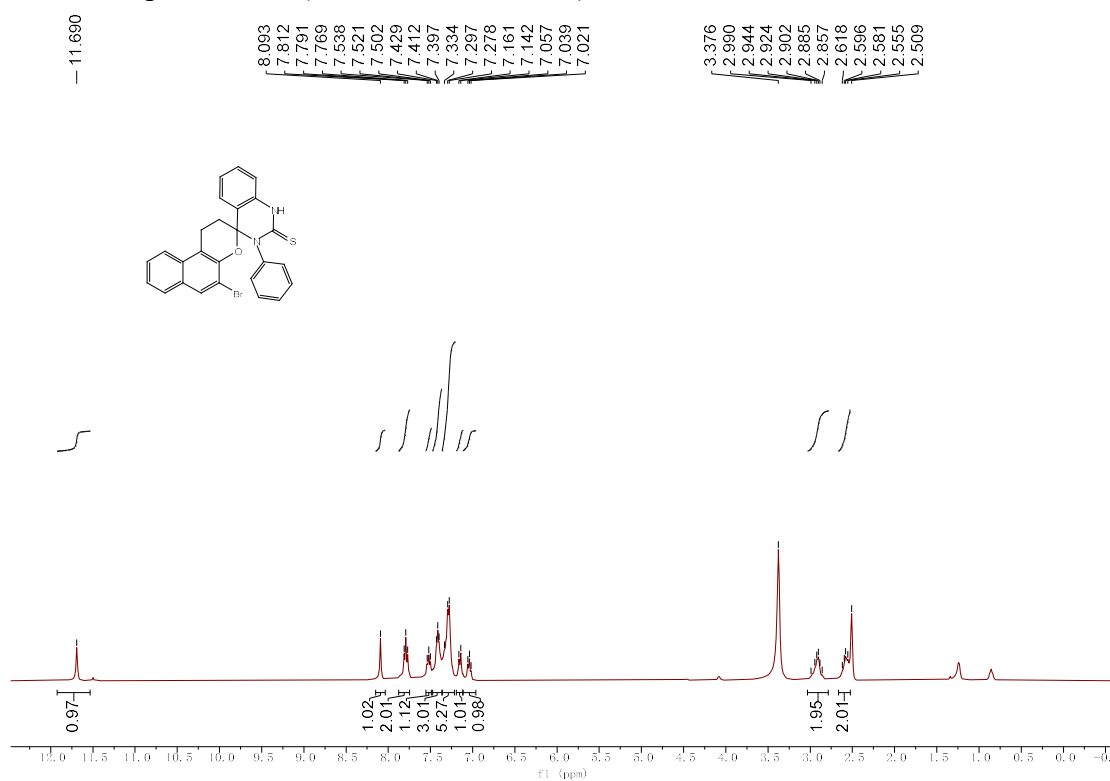
^1H NMR spectra of **5k** (400 MHz, DMSO- d_6)



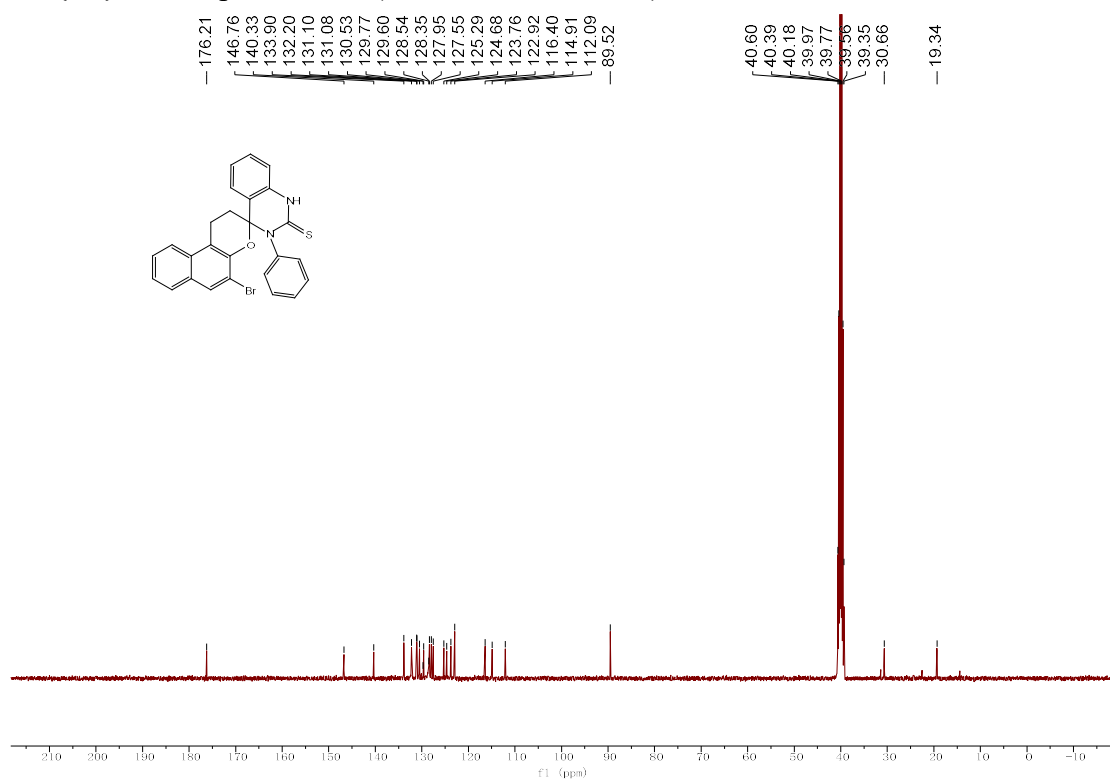
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **5k** (100 MHz, DMSO- d_6)



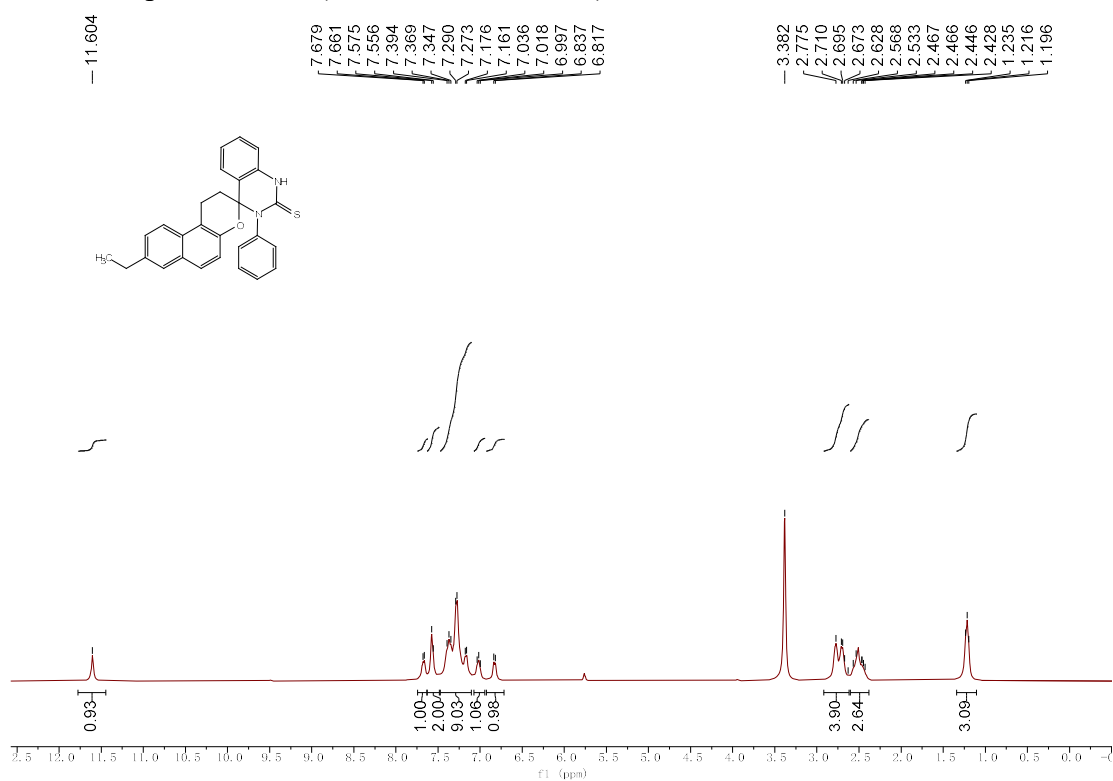
^1H NMR spectra of **5I** (400 MHz, DMSO- d_6)



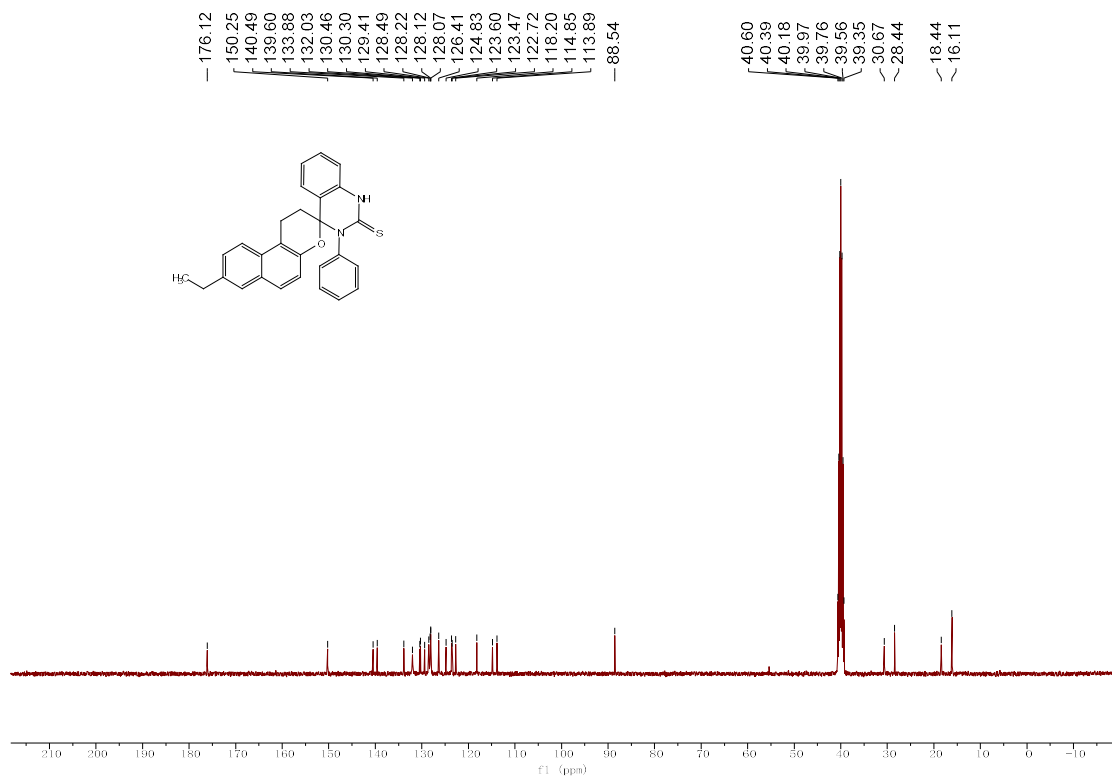
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **5I** (100 MHz, DMSO- d_6)



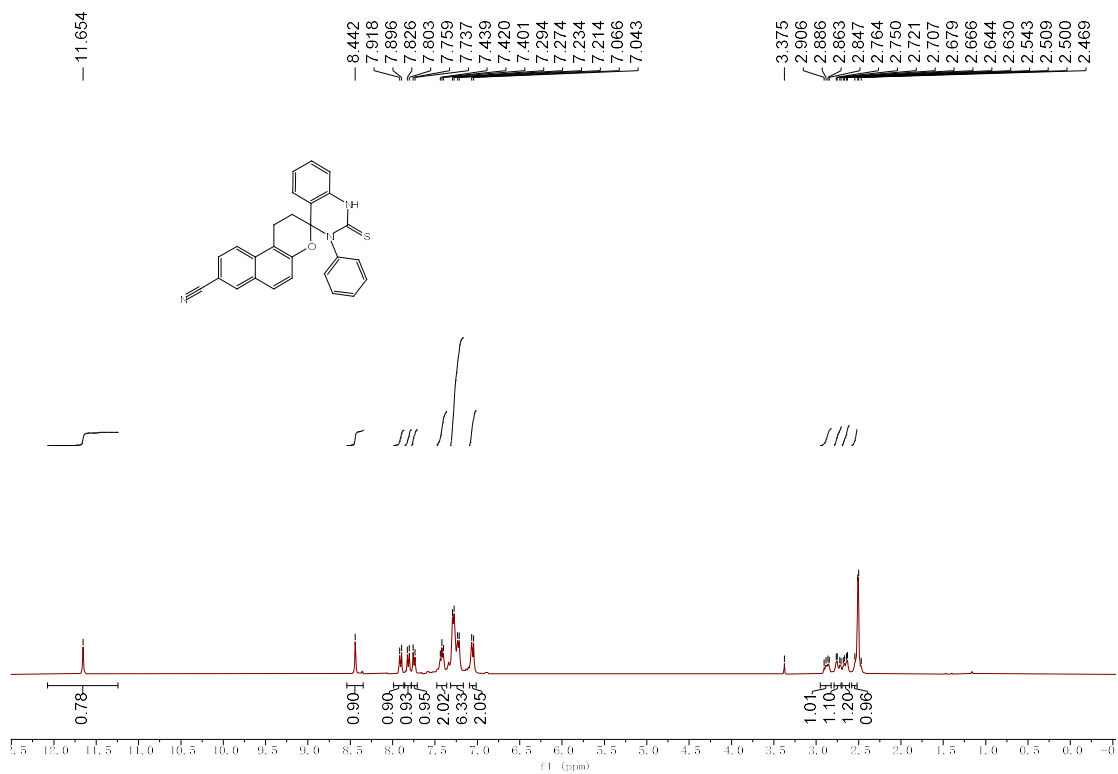
^1H NMR spectra of **5m** (400 MHz, DMSO- d_6)



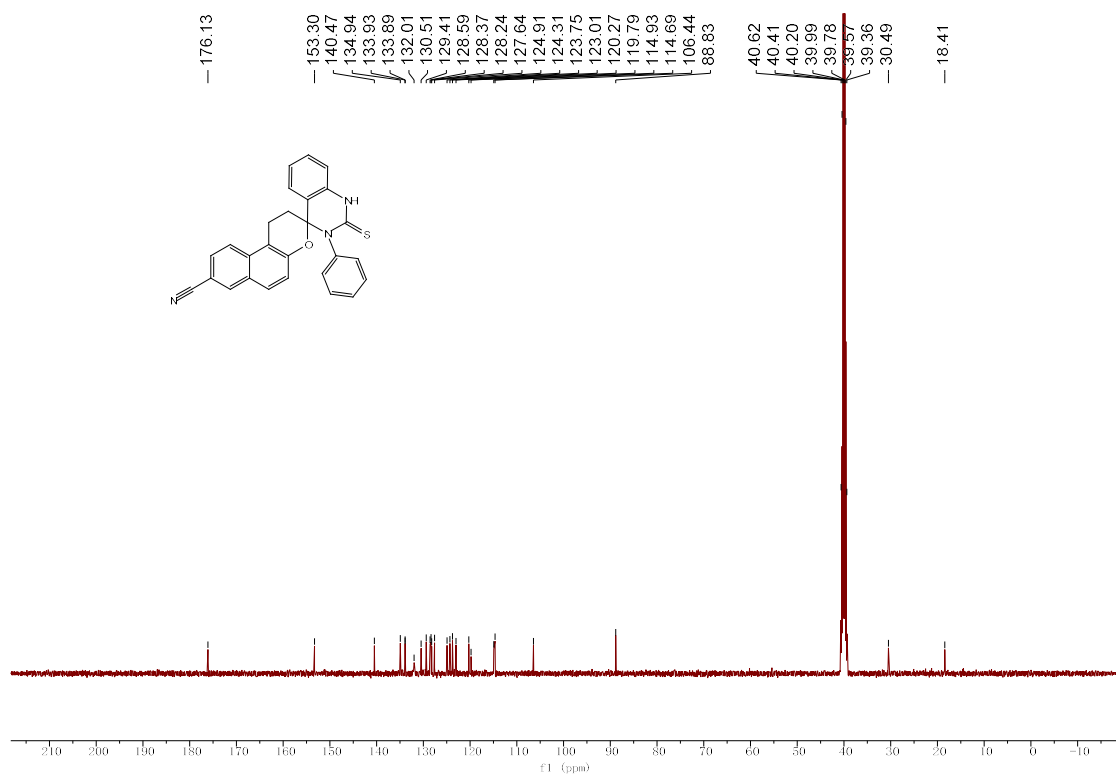
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **5m** (100 MHz, DMSO- d_6)



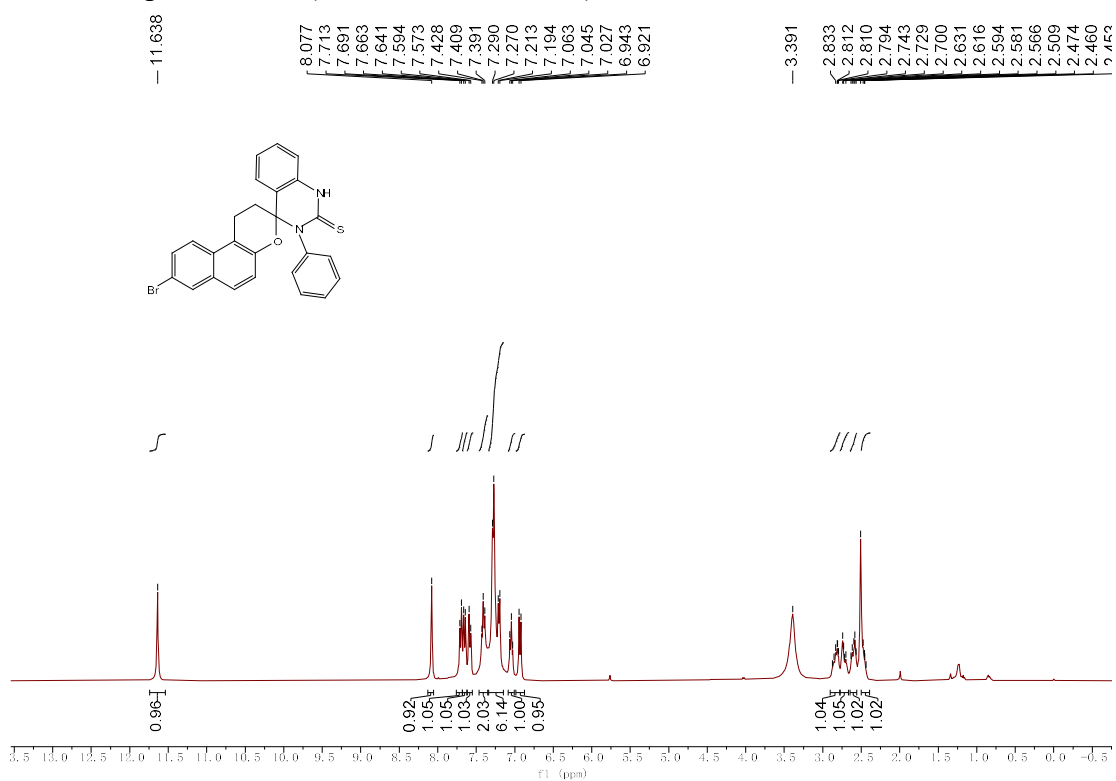
^1H NMR spectra of **5n** (400 MHz, DMSO- d_6)



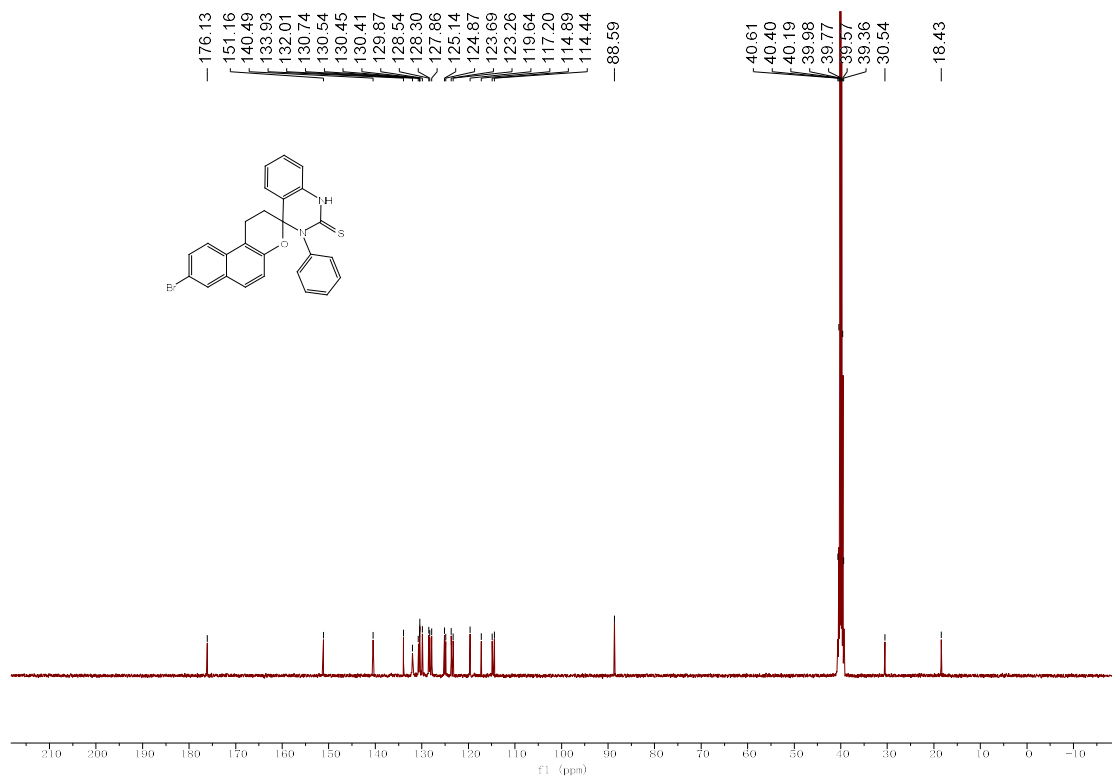
$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **5n** (100 MHz, DMSO- d_6)



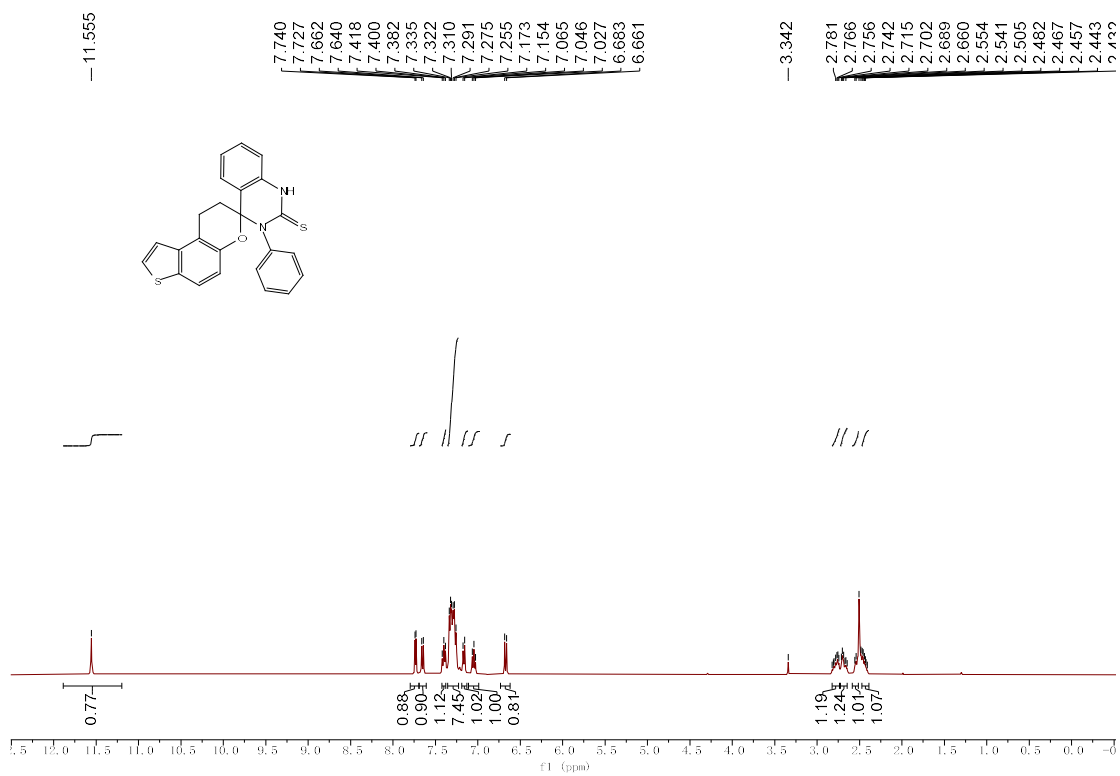
^1H NMR spectra of **5o** (400 MHz, DMSO- d_6)



$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **5o** (100 MHz, DMSO- d_6)



^1H NMR spectra of **5p** (400 MHz, DMSO- d_6)



$^{13}\text{C}\{^1\text{H}\}$ NMR spectra of **5p** (100 MHz, DMSO- d_6)

