

## Supporting information

Direct  $\alpha$ -Methylenation of triazines to terminal olefins with DMA

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## S1 General information

Unless otherwise noted, materials were obtained from commercial suppliers and used without further purification. All reactions were performed in a heating mantle in a sealed tube otherwise noted. Thin layer chromatography (TLC) was performed using silica gel 60 F254 and visualized using UV light. Column chromatography was performed with silica gel (mesh 300– 400). <sup>1</sup>H NMR and <sup>13</sup>C NMR spectra were recorded on a Bruker Avance 400 MHz or 600 MHz spectrometer in CDCl<sub>3</sub> or DMSO-*d*<sub>6</sub> with Me<sub>4</sub>Si as an internal standard. Data were reported as follows: chemical shift in ppm ( $\delta$ ), multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, br = broad, and m = multiplet), coupling constant in Hertz (Hz) and integration. HRMS and mass data were recorded by ESI on a TOF mass spectrometer.

### General procedure for the synthesis of 2

(a) Cu(OAc)<sub>2</sub> as catalyst ( $\geq 98.0\%$  purity ).

To a mixture of 6-benzyl-*N*<sup>2</sup>,*N*<sup>4</sup>-diphenyl-1,3,5-triazine-2,4-diamine (0.25 mmol), K<sub>2</sub>S<sub>2</sub>O<sub>8</sub> (0.5 mmol) in Anhydrous DMA (99.8% purity, water < 30 ppm) was added Cu(OAc)<sub>2</sub> (10 mol%). The resulting mixture was then sealed and stirred for 8 h at 140°C under Argon. After completion of the reaction, the reaction mixture was cooled to room temperature and extracted with ethyl acetate. The organic phase was dried over anhydrous Na<sub>2</sub>SO<sub>4</sub>. The crude residue was obtained after evaporation of the solvent in vacuum, and the residue was purified by flash chromatography with petroleum ether and ethyl acetate (v/v 10/1) as the eluent to give the pure product.

(b) NiCl<sub>2</sub> as catalyst ( $\geq 97.0\%$  purity ).

To a mixture of 6-benzyl-*N*<sup>2</sup>,*N*<sup>4</sup>-diphenyl-1,3,5-triazine-2,4-diamine (0.25 mmol), K<sub>2</sub>S<sub>2</sub>O<sub>8</sub> (0.5 mmol) in DMA (99.0% purity) was added NiCl<sub>2</sub> (5 mol%). The resulting mixture was then sealed and stirred for 4 h at 100°C under Argon. After completion of the reaction, the reaction mixture was cooled to room temperature and extracted with ethyl acetate. The organic phase was dried over anhydrous Na<sub>2</sub>SO<sub>4</sub>. The crude residue was obtained after evaporation of the solvent in vacuum, and the residue was purified by flash chromatography with petroleum ether and ethyl acetate (v/v 10/1) as the eluent to give the pure product.

## S2 investigation of intermediate C

To a mixture of 6-benzyl-*N*<sup>2</sup>,*N*<sup>4</sup>-diphenyl-1,3,5-triazine-2,4-diamine (**1a**) (0.25 mmol), K<sub>2</sub>S<sub>2</sub>O<sub>8</sub> (0.5 mmol) in Anhydrous DMA (99.8% purity, water < 30 ppm) was added Cu(OAc)<sub>2</sub> (10 mol%). The resulting mixture was then sealed and stirred for 2 h at 140°C under Argon. Intermediate **C** was observed by LCMS, which suggested that **C** might be the possibly intermediate in the reaction.

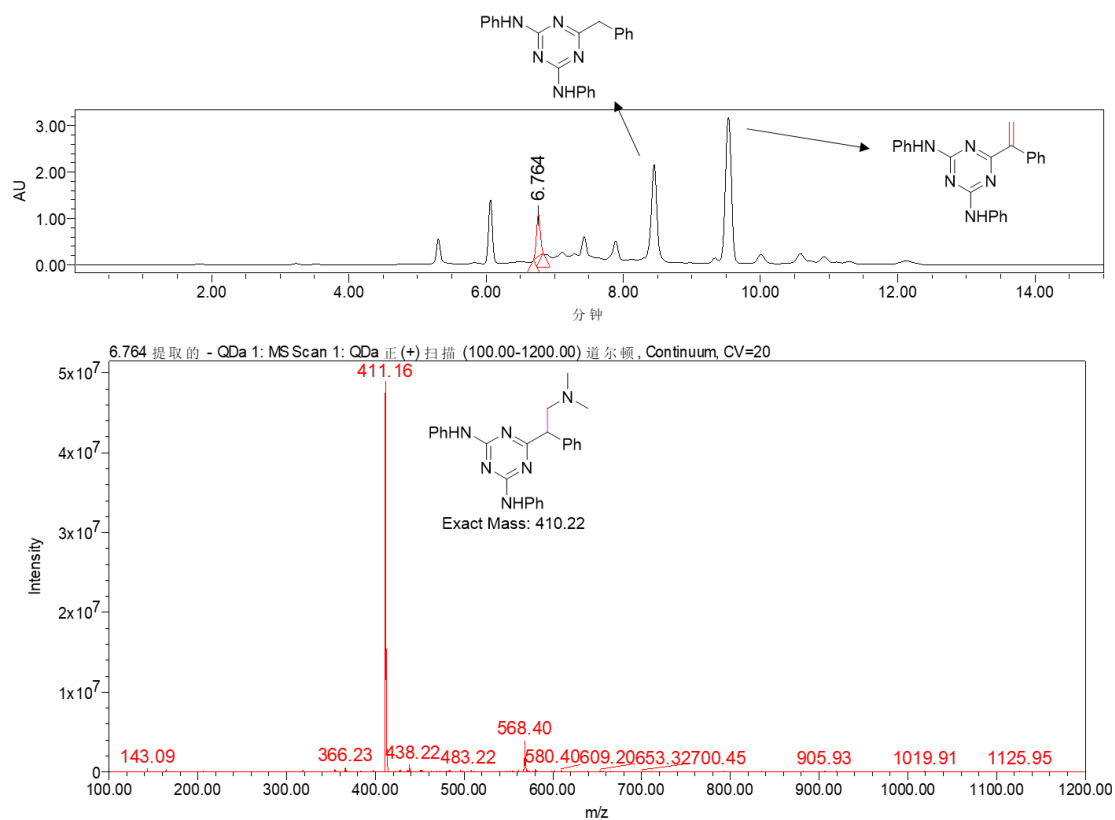
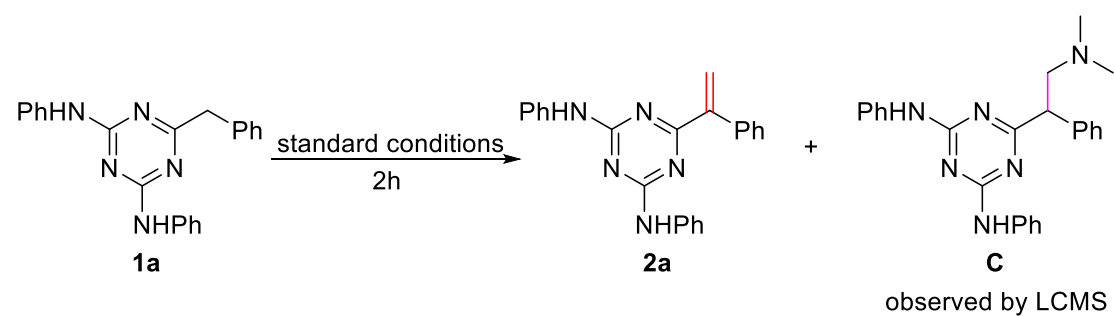
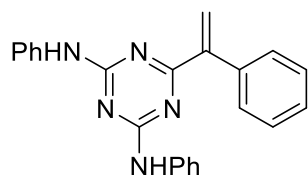


Figure 1. LCMS of the reaction in 2h

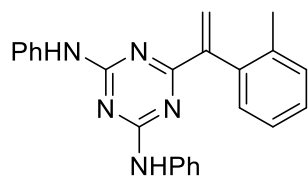
### S3 Characterization data of products

#### *N*<sup>2</sup>,*N*<sup>4</sup>-diphenyl-6-(1-phenylvinyl)-1,3,5-triazine-2,4-diamine (**2a**)



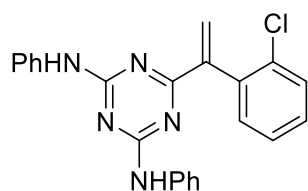
Yellow solid, yield 92.5 mg (76%), m.p: 99.8-101.2 °C. <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.64-7.51 (m, 5H), 7.51-7.43 (m, 3H), 7.39-7.34 (m, 3H), 7.29 (t, *J* = 7.6 Hz, 4H), 7.07 (t, *J* = 7.2 Hz, 2H), 6.62 (s, 1H), 5.85 (s, 1H); <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 173.0, 164.3, 147.5, 138.7, 138.3, 129.1, 128.9, 128.8, 127.9, 127.7, 123.5, 120.5; HRMS (ESI) [M + H]<sup>+</sup>, calcd for C<sub>23</sub>H<sub>20</sub>N<sub>5</sub>: 366.1719, found: 366.1713.

***N*<sup>2</sup>,*N*<sup>4</sup>-diphenyl-6-(1-(*o*-tolyl)vinyl)-1,3,5-triazine-2,4-diamine (2b)**



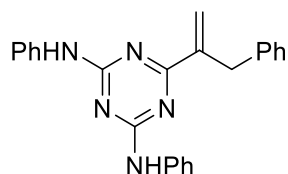
Yellow solid, yield 60.0 mg (63%), m.p: 144.0-145.0 °C. <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.61-7.49 (m, 4H), 7.38-7.29 (m, 5H), 7.27-7.24 (m, 3H), 7.09 (t, *J* = 6.9 Hz, 1H), 6.89 (s, 1H), 5.77 (s, 1H), 2.22 (s, 3H); <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 172.5, 164.5, 147.8, 139.6, 138.4, 136.6, 129.9, 129.6, 128.8, 127.6, 125.6, 125.0, 123.4, 120.2, 20.3; HRMS (ESI) [*M* + *H*]<sup>+</sup>, calcd for C<sub>24</sub>H<sub>22</sub>N<sub>5</sub>: 380.1875, found: 380.1876.

**6-(1-(2-chlorophenyl)vinyl)-*N*<sup>2</sup>,*N*<sup>4</sup>-diphenyl-1,3,5-triazine-2,4-diamine (2c)**



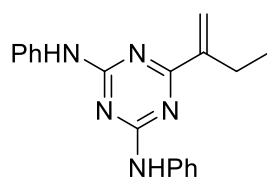
Yellow solid, yield 91.9 mg (92%), m.p: 177.8-179.0 °C. <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.54 (s, 1H), 7.49 – 7.43 (m, 1H), 7.41 – 7.22 (m, 2H), 7.09 (s, 1H), 6.89 (s, 1H), 5.84 (s, 1H); <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 171.8, 164.1, 145.8, 138.2, 133.7, 131.5, 129.2, 128.9, 128.7, 126.6, 126.0, 123.6, 123.5, 120.5; HRMS (ESI) [*M* + *H*]<sup>+</sup>, calcd for C<sub>23</sub>H<sub>19</sub>ClN<sub>5</sub>: 400.1329, found: 400.1331.

***N*<sup>2</sup>,*N*<sup>4</sup>-diphenyl-6-(3-phenylprop-1-en-2-yl)-1,3,5-triazine-2,4-diamine (2d)**



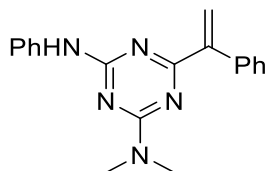
Yellow solid, yield 33.2 mg (34%), m.p: 143.3-144.5 °C. <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.61 (d, *J* = 7.9 Hz, 4H), 7.36 (t, *J* = 7.9 Hz, 4H), 7.32-7.27 (m, 4H), 7.26-7.20 (m, 1H), 7.18 (br, 2H), 7.12 (t, *J* = 7.3 Hz, 2H), 6.66 (s, 1H), 5.45 (s, 1H), 3.96 (s, 2H); <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 172.4, 164.4, 145.5, 139.8, 138.3, 129.2, 128.8, 128.3, 126.1, 123.5, 120.5, 38.2; HRMS (ESI) [*M* + *H*]<sup>+</sup>, calcd for C<sub>24</sub>H<sub>22</sub>N<sub>5</sub>: 380.1875, found: 380.1875.

**6-(but-1-en-2-yl)-*N*<sup>2</sup>,*N*<sup>4</sup>-diphenyl-1,3,5-triazine-2,4-diamine (2e)**



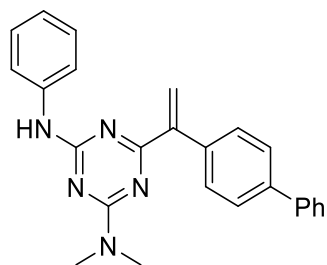
White solid, yield 42.8 mg (43%), m.p: 160.2-161.1 °C. <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.65 (d, *J* = 7.8 Hz, 4H), 7.37 (t, *J* = 7.8 Hz, 4H), 7.20 (s, 2H), 7.12 (t, *J* = 7.3 Hz, 2H), 6.50 (s, 1H), 5.55 (s, 1H), 2.63 (dd, *J* = 14.4, 7.1 Hz, 2H), 1.21 (t, *J* = 7.4 Hz, 3H); <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 172.9, 164.4, 148.0, 138.4, 128.9, 123.5, 120.5, 120.2, 25.1, 13.1; HRMS (ESI) [M + H]<sup>+</sup>, calcd for C<sub>19</sub>H<sub>20</sub>N<sub>5</sub>: 318.1719, found: 318.1714.

***N*<sup>2</sup>,*N*<sup>2</sup>-dimethyl-*N*<sup>4</sup>-phenyl-6-(1-phenylvinyl)-1,3,5-triazine-2,4-diamine (2f)**



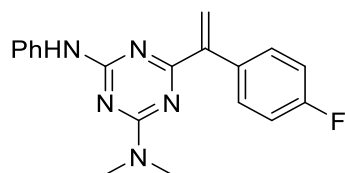
White solid, yield 52,0 mg (65%), m.p: 128.6-129.4 °C. <sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>) δ 7.58 (d, *J* = 7.9 Hz, 2H), 7.51 – 7.45 (m, 2H), 7.40 – 7.31 (m, 3H), 7.27 (t, *J* = 7.6 Hz, 2H), 7.09 (s, 1H), 7.01 (t, *J* = 7.4 Hz, 1H), 6.55 (s, 1H), 5.79 (d, *J* = 1.8 Hz, 1H), 3.20 (s, 3H), 3.19 (s, 3H); <sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>) δ 171.9, 165.5, 164.1, 147.9, 139.2, 139.1, 129.1, 128.8, 127.7, 127.5, 122.7, 122.6, 119, 36.3; HRMS (ESI) [M + H]<sup>+</sup>, calcd for C<sub>19</sub>H<sub>20</sub>N<sub>5</sub>: 318.1719, found: 318.1716.

**6-(1-([1,1'-biphenyl]-4-yl)vinyl)-*N*<sup>2</sup>,*N*<sup>2</sup>-dimethyl-*N*<sup>4</sup>-phenyl-1,3,5-triazine-2,4-diamine (2g)**



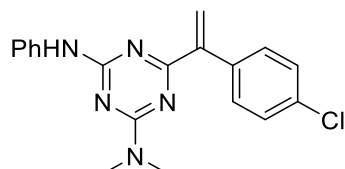
Light yellow solid, yield 45.2 mg (45%), m.p: 173.2-175.1 °C. <sup>1</sup>H NMR (400 MHz, DMSO) δ 9.58 (s, 1H), 7.76 (d, *J* = 6.7 Hz, 2H), 7.70 (d, *J* = 7.6 Hz, 2H), 7.67 (d, *J* = 8.2 Hz, 2H), 7.54 (d, *J* = 8.2 Hz, 2H), 7.48 (t, *J* = 7.6 Hz, 2H), 7.38 (t, *J* = 7.6 Hz, 1H), 7.27-7.16 (m, 2H), 6.95 (t, *J* = 7.1 Hz, 1H), 6.39 (s, 1H), 5.86 (s, 1H), 3.17 (s, 3H), 3.13 (s, 3H); <sup>13</sup>C NMR (100 MHz, DMSO) δ 171.9, 165.5, 164.3, 147.5, 140.4, 140.3, 139.7, 138.4, 129.6, 129.5, 128.8, 127.9, 127.0, 126.5, 122.4, 120.2, 36.3; HRMS (ESI) [M + H]<sup>+</sup>, calcd for C<sub>19</sub>H<sub>20</sub>N<sub>5</sub>: 394.2032, found: 394.2030.

**6-(1-(4-fluorophenyl)vinyl)-*N*<sup>2</sup>,*N*<sup>2</sup>-dimethyl-*N*<sup>4</sup>-phenyl-1,3,5-triazine-2,4-diamine (2h)**



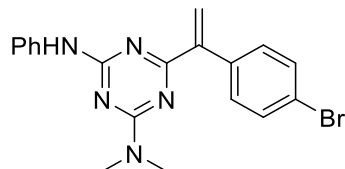
Yellow solid, yield 50.4 mg (60%), m.p: 87.8-89.0 °C. <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.62 (d, *J* = 7.8 Hz, 2H), 7.51-7.43 (m, 2H), 7.32 (t, *J* = 7.8 Hz, 2H), 7.11-7.04 (m, 3H), 6.63 (s, 1H), 5.83 (s, 1H), 3.24 (s, 3H), 3.20 (s, 3H); <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 164.9, 164.3, 162.5 (d, *J* = 246.3 Hz), 160.5, 138.6, 134.6, 130.8 (d, *J* = 8.0 Hz) 128.8, 123.8, 123.1, 119.9, 119.8, 114.62 (d, *J* = 21.4 Hz), 36.5. HRMS (ESI) [M + H]<sup>+</sup>, calcd for C<sub>19</sub>H<sub>19</sub>FN<sub>5</sub>: 336.1624, found: 336.1620.

**6-(1-(4-chlorophenyl)vinyl)-*N*<sup>2</sup>,*N*<sup>2</sup>-dimethyl-*N*<sup>4</sup>-phenyl-1,3,5-triazine-2,4-diamine (2i)**



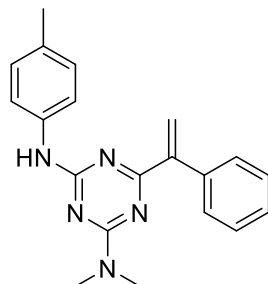
Yellow solid, yield 58.5 mg (67%), m.p: 103.7-105.3 °C. <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.60 (t, *J* = 6.6 Hz, 2H), 7.43 (t, *J* = 6.6 Hz, 2H), 7.37-7.26 (m, 4H), 7.22 (s, 2H), 7.11-6.96 (m, 1H), 6.61 (s, 1H), 5.80 (d, *J* = 5.4 Hz, 1H), 3.21 (s, 6H); <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 171.4, 165.4, 163.9, 146.8, 139.0, 137.5, 133.4, 130.5, 128.8, 127.8, 123.2, 122.7, 119.6, 36.3; HRMS (ESI) [M + H]<sup>+</sup>, calcd for C<sub>19</sub>H<sub>19</sub>ClN<sub>5</sub>: 352.1329, found: 352.1335.

**6-(1-(4-bromophenyl)vinyl)-*N*<sup>2</sup>,*N*<sup>2</sup>-dimethyl-*N*<sup>4</sup>-phenyl-1,3,5-triazine-2,4-diamine (2j)**



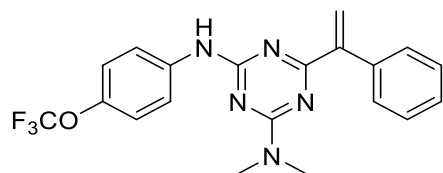
Yellow solid, yield 101.3 mg (69%), m.p: 103.3-105.4 °C. <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.61 (d, *J* = 7.8 Hz, 2H), 7.53-7.48 (m, 2H), 7.40-7.35 (m, 2H), 7.32 (t, *J* = 7.8 Hz, 2H), 7.06 (t, *J* = 7.8 Hz, 1H), 6.63 (s, 1H), 5.83 (d, *J* = 1.5 Hz, 1H), 3.23 (s, 3H), 3.20 (s, 3H); <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 170.8, 165.2, 163.4, 158.2, 146.5, 138.8, 137.8, 130.8, 128.8, 123.6, 122.9, 121.7, 119.7, 36.4; HRMS (ESI) [M + H]<sup>+</sup>, calcd for C<sub>19</sub>H<sub>19</sub>BrN<sub>5</sub>: 396.0824, found: 396.0830.

***N*<sup>2</sup>,*N*<sup>2</sup>-dimethyl-6-(1-phenylvinyl)-*N*<sup>4</sup>-(*p*-tolyl)-1,3,5-triazine-2,4-diamine (2k)**



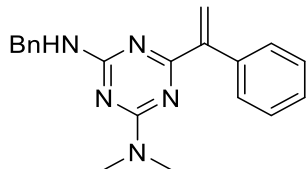
White solid, yield 54.0 mg (65%), m.p: 142.5-145.0 °C. <sup>1</sup>H NMR (400 MHz, DMSO) δ 9.45 (s, 1H), 7.68-7.51 (m, 2H), 7.44 (d, *J* = 6.6 Hz, 2H), 7.37 (t, *J* = 6.6 Hz, 2H), 7.34-7.31 (m, 1H), 7.17-6.89 (m, 2H), 6.35 (s, 1H), 5.77 (d, *J* = 1.1 Hz, 1H), 3.14 (s, 2H), 3.10 (s, 3H), 2.23 (s, 3H); <sup>13</sup>C NMR (100 MHz, DMSO) δ 171.9, 165.4, 164.2, 148.0, 139.3, 137.8, 131.2, 129.2, 129.0, 128.2, 127.9, 122.5, 120.2, 36.2, 20.8; HRMS (ESI) [M + H]<sup>+</sup>, calcd for C<sub>20</sub>H<sub>20</sub>N<sub>5</sub>: 332.1875, found: 332.1876.

***N*<sup>2</sup>,*N*<sup>2</sup>-dimethyl-6-(1-phenylvinyl)-*N*<sup>4</sup>-(4-(trifluoromethoxy)phenyl)-1,3,5-triazine-2,4-diamine (2l)**



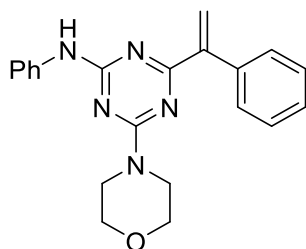
White solid, yield 57.7 mg (58%), m.p: 111.0-112.1 °C. <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.61 (d, *J* = 8.6 Hz, 2H), 7.53-7.46 (m, 2H), 7.43-7.32 (m, 3H), 7.14 (d, *J* = 8.6 Hz, 2H), 6.60 (s, 1H), 5.83 (d, *J* = 1.8 Hz, 1H), 3.22 (s, 6H); <sup>13</sup>C NMR (100 MHz, CDCl<sub>3</sub>) δ 171.6, 165.3, 163.5, 147.5, 144.1, 138.9, 137.7, 129.1, 127.7, 127.5, 123.3, 121.8-119.3 (m), 121.6, 120.5, 36.4; HRMS (ESI) [M + H]<sup>+</sup>, calcd for C<sub>20</sub>H<sub>19</sub>F<sub>3</sub>N<sub>5</sub>: 402.1542, found: 402.1541.

***N*<sup>2</sup>-benzyl-*N*<sup>4</sup>,*N*<sup>4</sup>-dimethyl-6-(1-phenylvinyl)-1,3,5-triazine-2,4-diamine (2m)**



Yellow solid, yield 60.8 mg (72%), m.p: 143.1-144.5 °C. <sup>1</sup>H NMR (600 MHz, CDCl<sub>3</sub>) δ 7.46 (d, *J* = 7.0 Hz, 3H), 7.35-7.27 (m, 6H), 7.27-7.22 (m, 2H), 6.39 (s, 1H), 5.73 (s, 1H), 5.59 (br, 1H), 4.59 (d, *J* = 5.5 Hz, 2H), 3.12 (s, 6H); <sup>13</sup>C NMR (150 MHz, CDCl<sub>3</sub>) δ 171.8, 165.9, 165.5, 148.0, 139.2, 129.2, 129.1, 128.9, 128.5, 127.7, 127.4, 127.1, 121.9, 44.8, 36.1; HRMS (ESI) [M + H]<sup>+</sup>, calcd for C<sub>20</sub>H<sub>22</sub>N<sub>5</sub>: 332.1875, found: 332.1871.

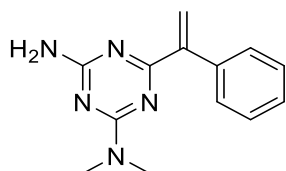
**4-morpholino-*N*-phenyl-6-(1-phenylvinyl)-1,3,5-triazin-2-amine (2n)**



White solid, yield 60.3 mg (67%), m.p: 105.3-106.4 °C. <sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 7.56 (d, *J* = 7.8 Hz, 2H), 7.48 (dd, *J* = 7.8, 1.7 Hz, 2H), 7.42-7.35 (m, 3H), 7.31 (t, *J* =

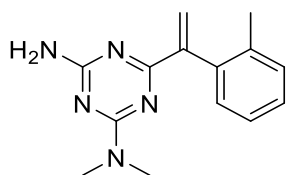
7.8 Hz, 2H), 7.07 (t,  $J = 7.8$  Hz, 1H), 6.59 (s, 1H), 5.84 (d,  $J = 1.7$  Hz, 1H), 3.94-3.83 (m, 4H), 3.81-3.72 (m, 4H);  $^{13}\text{C}$  NMR (100 MHz,  $\text{CDCl}_3$ )  $\delta$  171.9, 164.8, 163.8, 147.5, 138.8, 138.6, 129.0, 128.8, 127.8, 127.5, 123.4, 123.1, 119.9, 66.7, 43.8; HRMS (ESI)  $[\text{M} + \text{H}]^+$ , calcd for  $\text{C}_{21}\text{H}_{22}\text{N}_5\text{O}$ : 360.1824, found: 360.1829.

***N*<sup>2</sup>,*N*<sup>2</sup>-dimethyl-6-(1-phenylvinyl)-1,3,5-triazine-2,4-diamine (2o)**



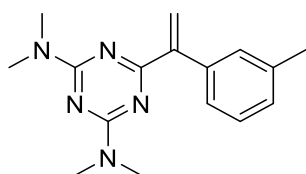
Yellow solid, yield 30.3 mg (50%), m.p: 176.7-178.0 °C.  $^1\text{H}$  NMR (400 MHz, DMSO)  $\delta$  7.39 (d,  $J = 7.0$  Hz, 2H), 7.34 (t,  $J = 7.0$  Hz, 2H), 7.30 (t,  $J = 7.0$  Hz, 1H), 6.78 (s, 2H), 6.24 (d,  $J = 1.6$  Hz, 1H), 5.69 (d,  $J = 1.6$  Hz, 1H), 3.03 (s, 6H);  $^{13}\text{C}$  NMR (100 MHz, DMSO)  $\delta$  171.9, 167.3, 165.8, 148.2, 139.5, 128.9, 128.2, 127.8, 121.6, 36.1; HRMS (ESI)  $[\text{M} + \text{H}]^+$ , calcd for  $\text{C}_{13}\text{H}_{16}\text{N}_5$ : 242.1406, found: 242.1406.

***N*<sup>2</sup>,*N*<sup>2</sup>-dimethyl-6-(1-(*o*-tolyl)vinyl)-1,3,5-triazine-2,4-diamine (2p)**



Yellow solid, yield 42.9 mg (53%), m.p: 183.5-184.9 °C.  $^1\text{H}$  NMR (400 MHz, DMSO)  $\delta$  7.26-7.14 (m, 3H), 7.13-7.04 (m, 1H), 6.73 (s, 2H), 6.55 (d,  $J = 2.4$  Hz, 1H), 5.46 (d,  $J = 2.4$  Hz, 1H), 3.00 (s, 6H), 2.06 (s, 3H);  $^{13}\text{C}$  NMR (100 MHz, DMSO)  $\delta$  171.3, 167.5, 165.8, 149.0, 140.5, 136.2, 130.0, 129.8, 127.6, 125.7, 123.5, 35.9, 20.4; HRMS (ESI)  $[\text{M} + \text{H}]^+$ , calcd for  $\text{C}_{14}\text{H}_{18}\text{N}_5$ : 256.1562, found: 256.1565.

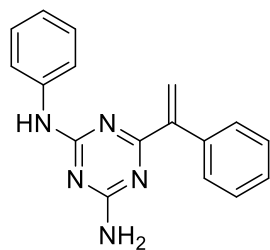
***N*<sup>2</sup>,*N*<sup>2</sup>,*N*<sup>4</sup>,*N*<sup>4</sup>-tetramethyl-6-(1-(*m*-tolyl)vinyl)-1,3,5-triazine-2,4-diamine (2q)**



Colorless oil, yield 46.9 mg (66%).  $^1\text{H}$  NMR (400 MHz,  $\text{CDCl}_3$ )  $\delta$  7.28-7.16 (m, 4H), 6.83 (d,  $J = 2.5$  Hz, 1H), 5.60 (d,  $J = 2.5$  Hz, 1H), 3.11 (s, 12H), 2.21 (s, 3H);  $^{13}\text{C}$  NMR (100 MHz,  $\text{CDCl}_3$ )  $\delta$  170.3, 165.6, 149.0, 140.6, 136.7, 129.8, 129.1, 126.9, 125.0, 123.0, 35.8, 20.4; HRMS (ESI)  $[\text{M} + \text{H}]^+$ , calcd for  $\text{C}_{16}\text{H}_{22}\text{N}_5$ : 284.1870, found: 284.1870.

***N*<sup>2</sup>-phenyl-6-(1-phenylvinyl)-1,3,5-triazine-2,4-diamine (2r)**



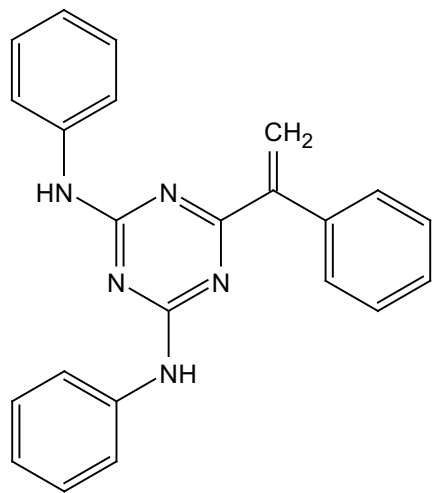


Yellow solid, yield 44.1 mg (60%), m.p: 173.0-175.2 °C. <sup>1</sup>H NMR (400 MHz, DMSO)  $\delta$  9.47 (s, 1H), 7.82-7.65 (m, 2H), 7.49-7.27 (m, 5H), 7.21 (t,  $J = 7.3$  Hz, 2H), 7.12 (br, 2H), 6.94 (t,  $J = 7.2$  Hz, 1H), 6.24 (s, 1H), 5.75 (s, 1H); <sup>13</sup>C NMR (100 MHz, DMSO)  $\delta$  173.0, 167.4, 164.8, 148.1, 140.4, 139.4, 128.9, 128.8, 128.3, 127.9, 122.3, 121.8, 120.3; HRMS (ESI) [M + H]<sup>+</sup>, calcd for C<sub>17</sub>H<sub>15</sub>N<sub>5</sub>: 289.1327, found: 289.1326.

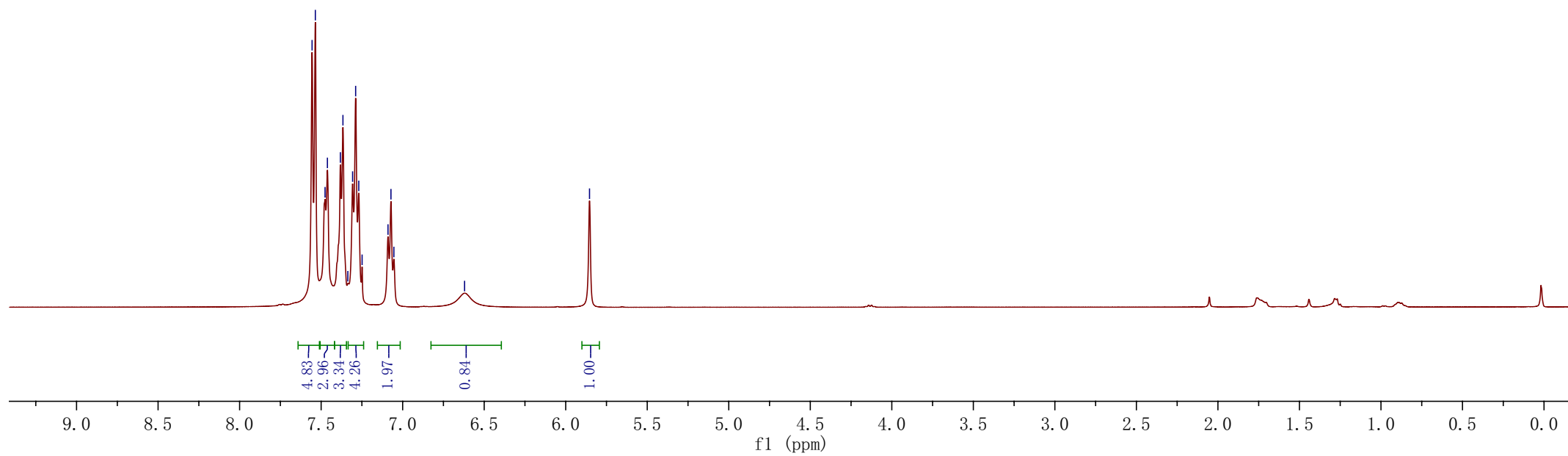
## **S4 NMR spectra of Products**

PROTON\_01  
WHF-ZM-01

7.5556  
7.5355  
7.4760  
7.4615  
7.3819  
7.3663  
7.3363  
7.3070  
7.2883  
7.2692  
7.2487  
7.0898  
7.0718  
7.0539  
6.6203  
5.8539



<sup>1</sup>H NMR (400 M), **2a** in CDCl<sub>3</sub>



20221010zm  
mz0820

173.0485

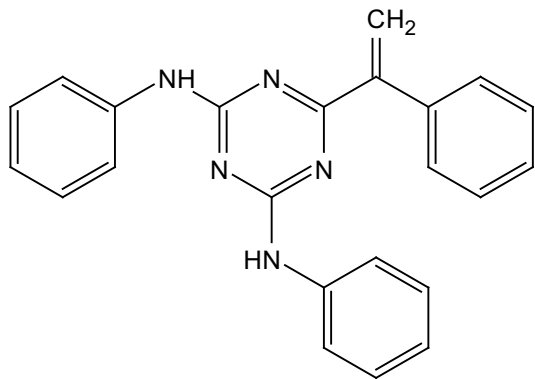
164.3504

147.5059

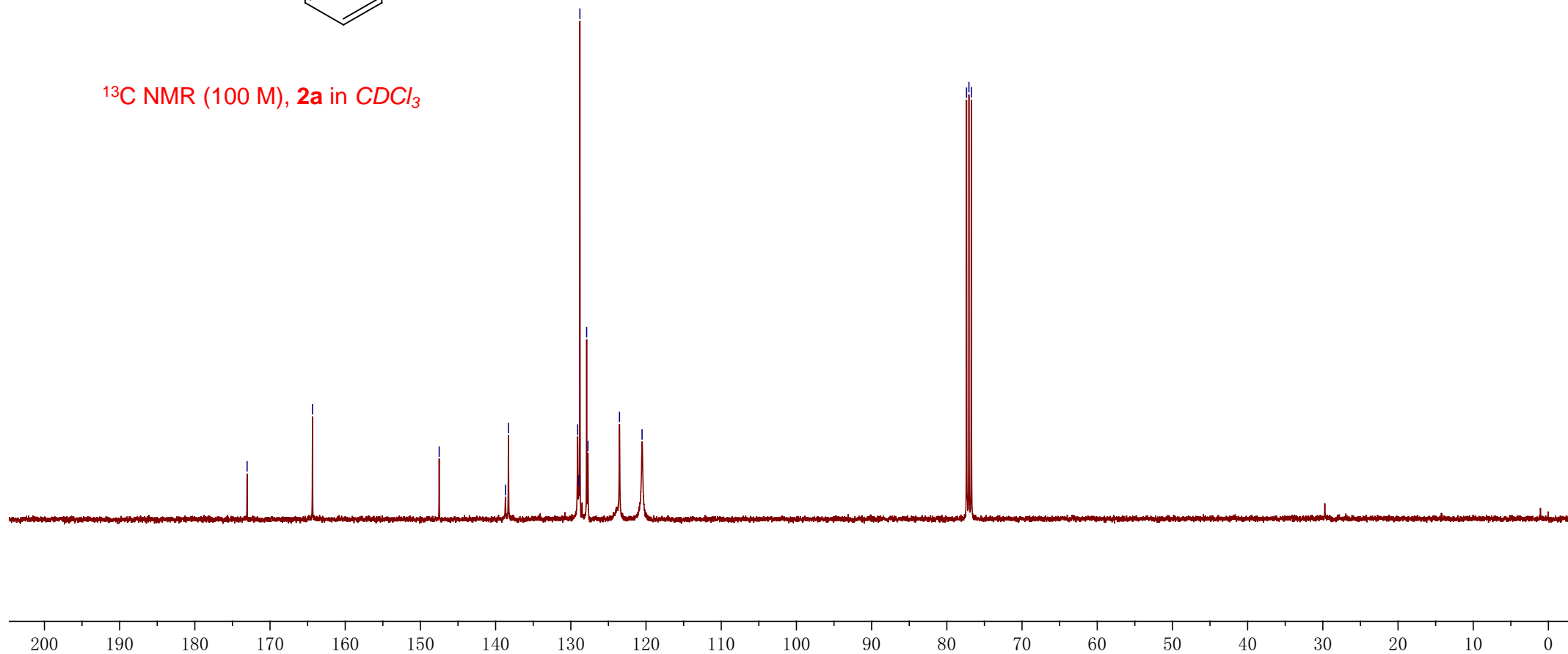
138.6931  
138.2917

129.0905  
128.9349  
128.7925  
127.8956  
127.7233  
123.5258  
120.5268

77.3764  
77.0588  
76.7415



<sup>13</sup>C NMR (100 M), 2a in CDCl<sub>3</sub>

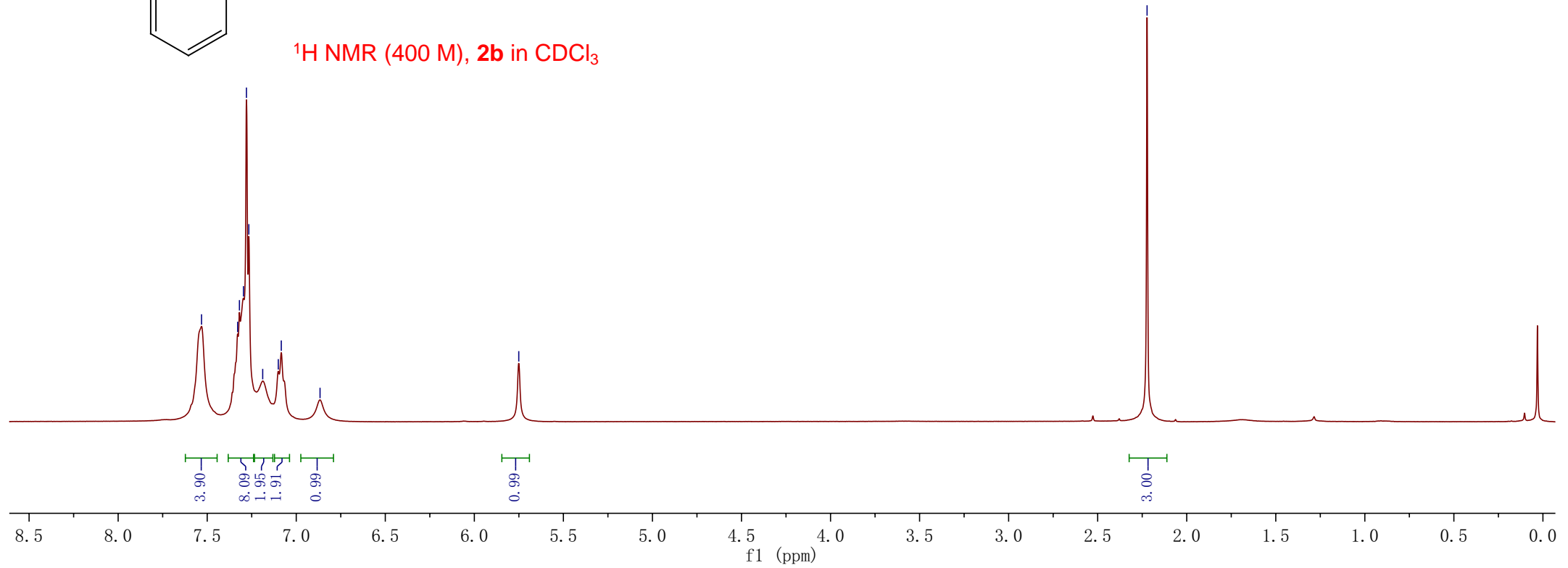
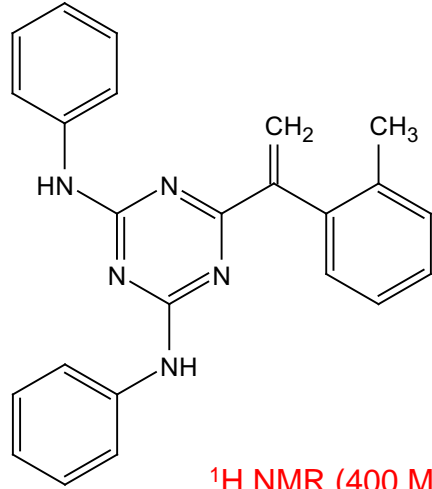


20220509zm  
zw6

7.5319  
7.3291  
7.3190  
7.2964  
7.2796  
7.2662  
6.8849

5.7505

2.2227



20220511zm  
zw6

—172.5155

—164.4573

—147.8536

—139.5762

—138.3766

—136.5834

—129.9415

—129.6306

—128.8055

—127.5961

—125.5674

—124.9963

—123.3786

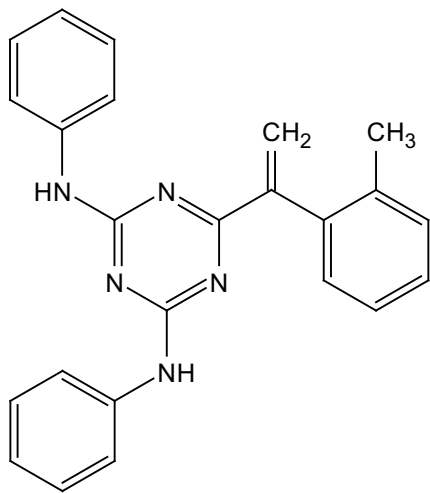
—120.2039

—77.3520

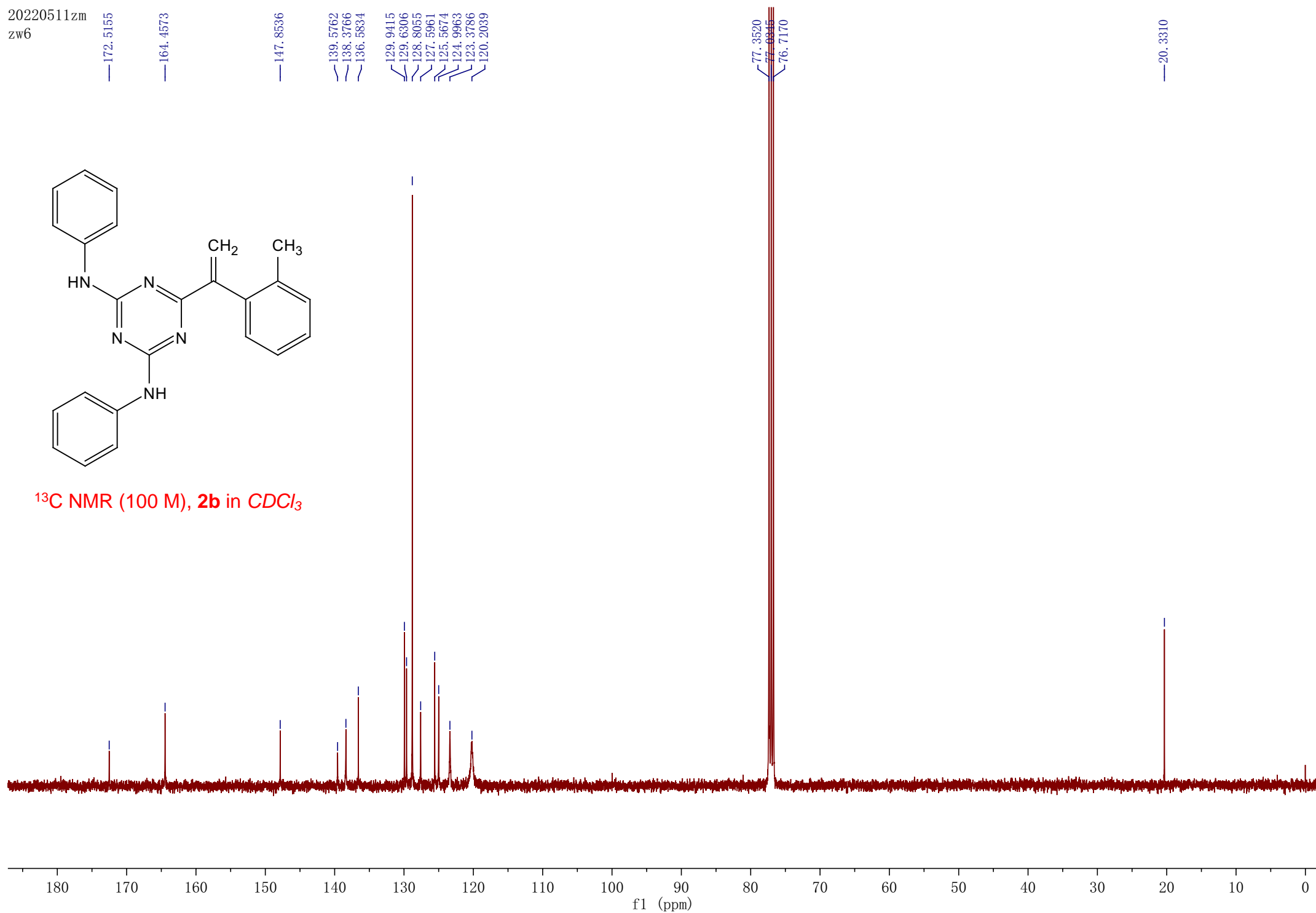
—77.0945

—76.7170

—20.3310



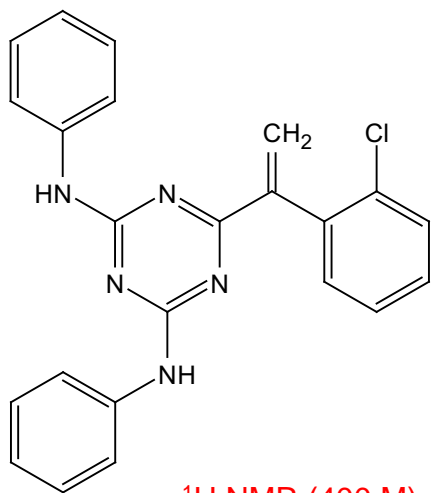
<sup>13</sup>C NMR (100 M), **2b** in CDCl<sub>3</sub>



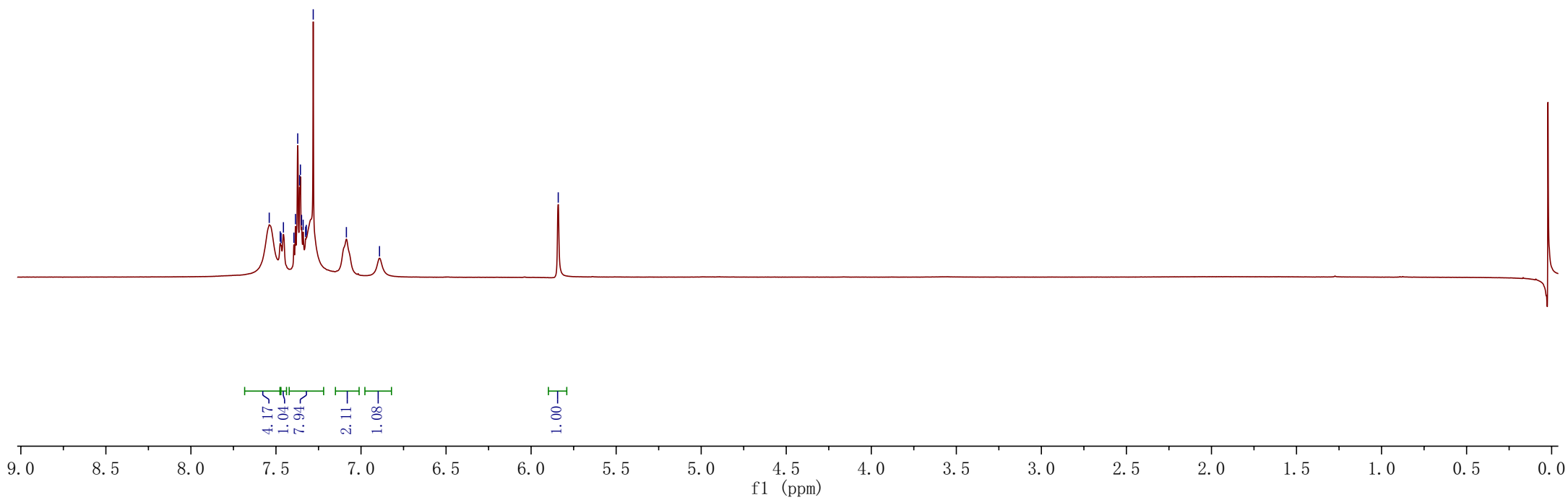
<sup>1</sup>H  
ZJH211018

7.5396  
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7.3946  
7.3853  
7.3722  
7.3609  
7.3562  
7.3496  
7.3402  
7.3258  
7.3216  
7.2809  
7.0860  
6.8913

5.8405



<sup>1</sup>H NMR (400 M), **2c** in CDCl<sub>3</sub>



13C  
1018

171.8006

164.1006

145.8390

138.2005

133.7393

131.5126

129.1879

128.9118

128.7742

126.6307

126.0814

123.5956

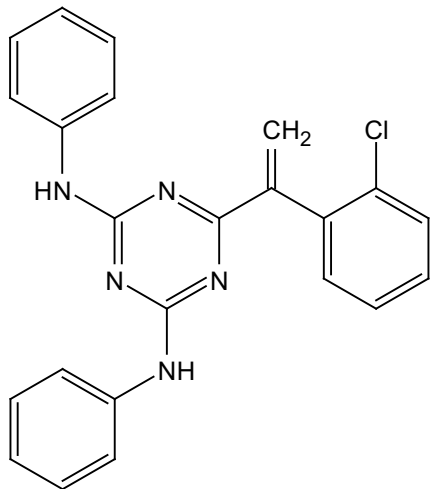
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120.4762

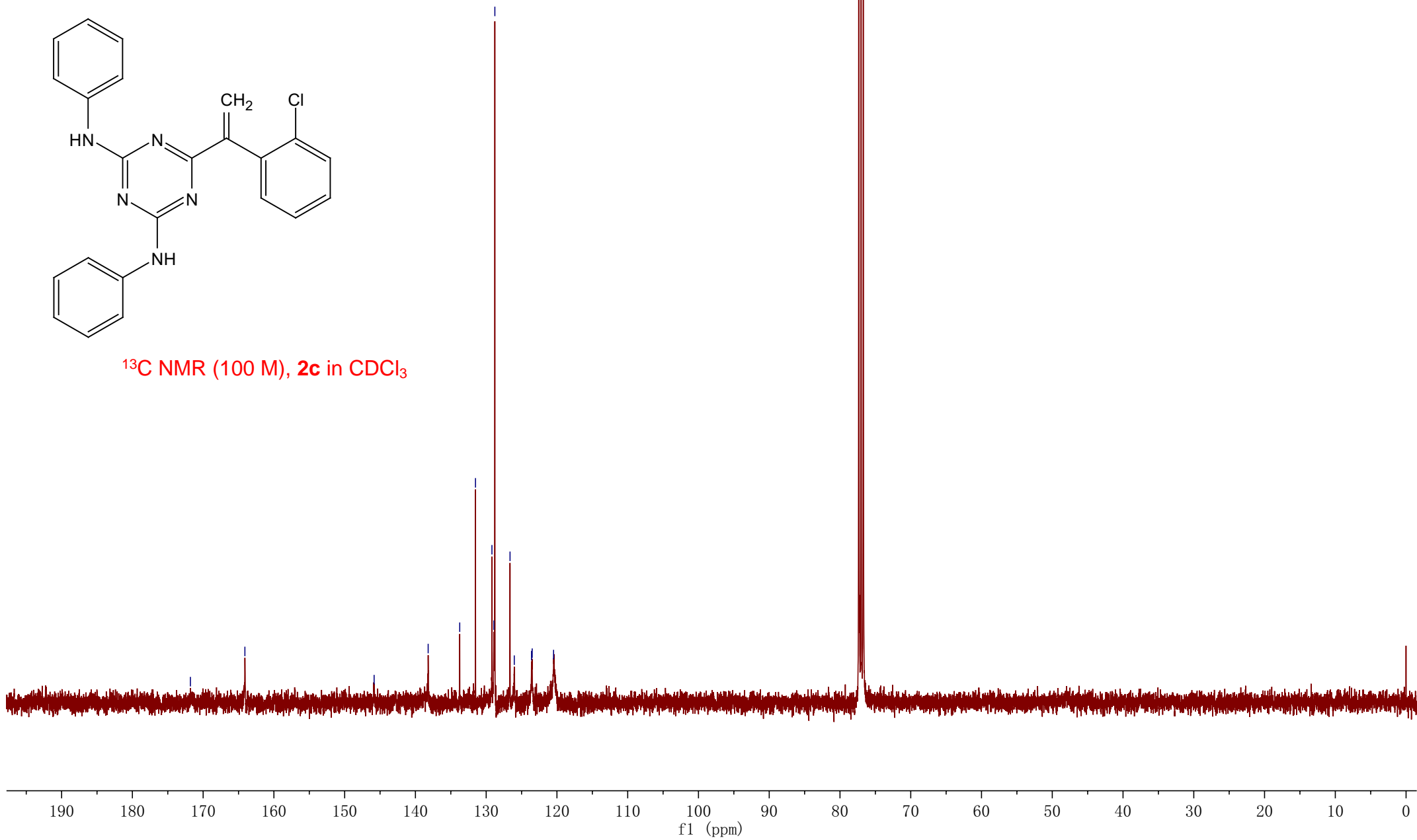
77.3406

77.0000

76.7055



<sup>13</sup>C NMR (100 M), **2c** in CDCl<sub>3</sub>

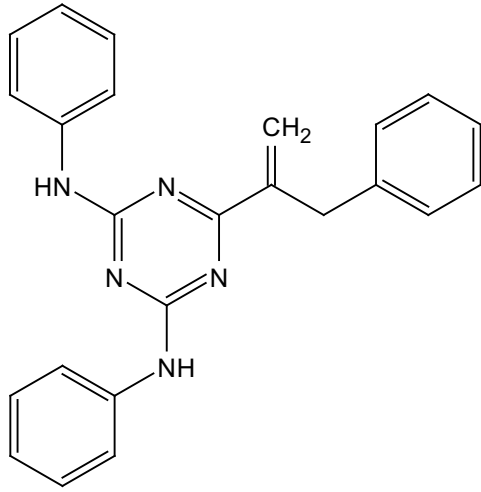




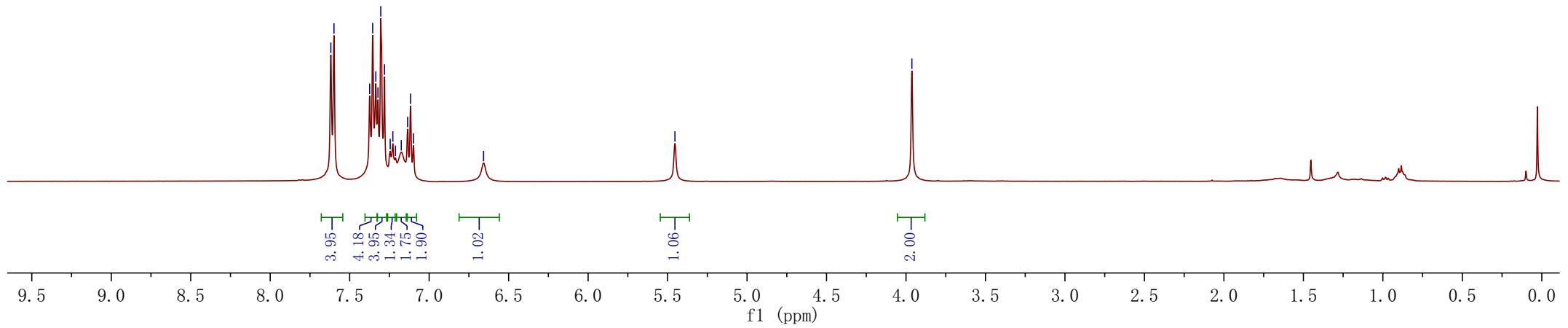
7.6185  
7.5988  
7.3745  
7.3554  
7.3356  
7.3221  
7.3044  
7.2810  
7.1355  
7.1171  
6.6576

5.4538

3.9630



<sup>1</sup>H NMR (400 M), **2d** in CDCl<sub>3</sub>



20220511zm  
zw2

172.3796

164.4106

145.5222

139.8215

138.3163

129.1639

128.8537

128.3171

126.0479

123.5251

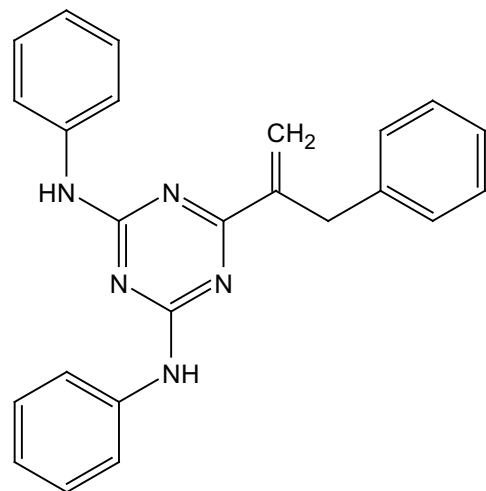
120.5415

77.3452

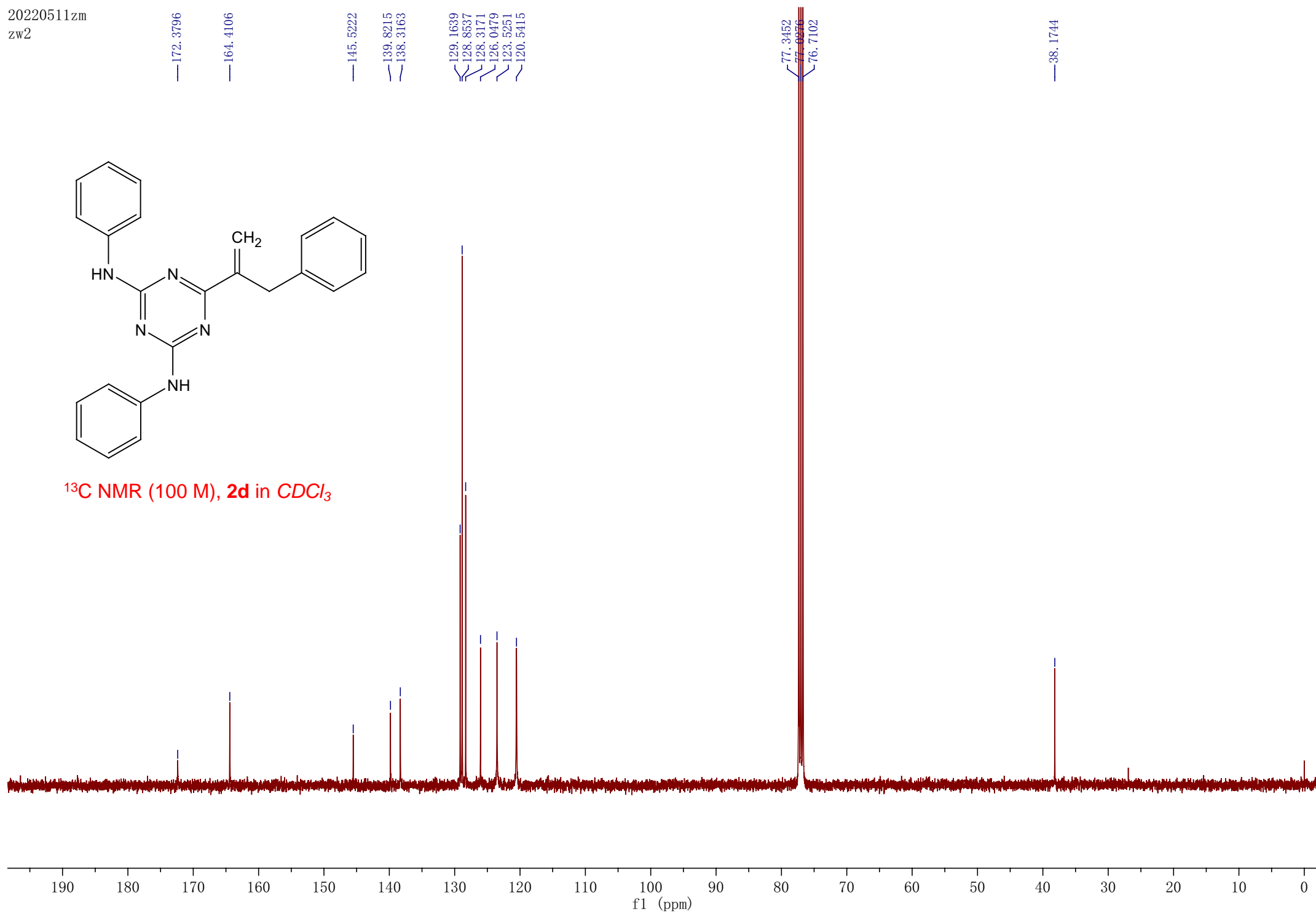
77.0256

76.7102

38.1744



<sup>13</sup>C NMR (100 M), 2d in CDCl<sub>3</sub>



20220509zm  
zw1

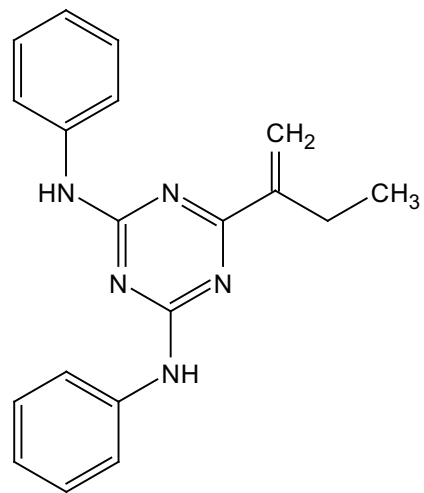
7.6596  
7.6400  
7.3863  
7.3671  
7.3474  
7.2810  
7.1967  
7.1357  
7.1173  
7.0990

6.4952

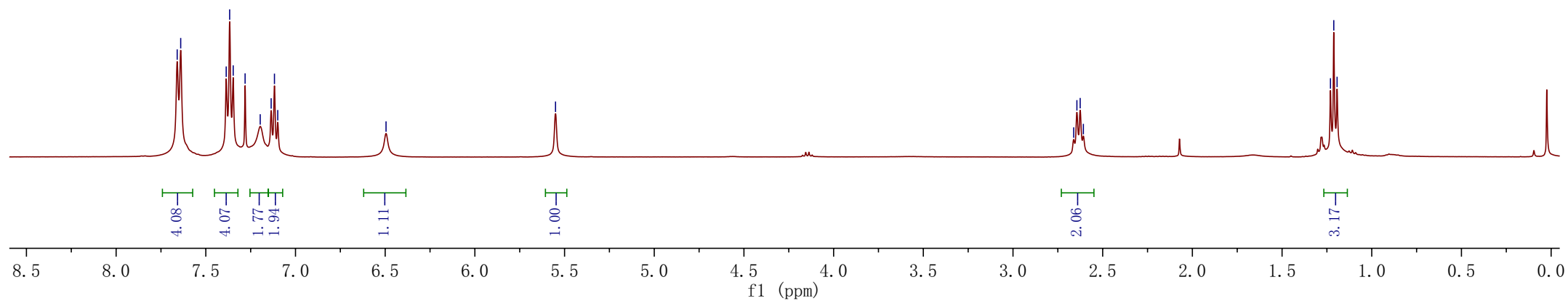
5.5503

2.6616  
2.6437  
2.6255  
2.6077

1.2301  
1.2117  
1.1933



<sup>1</sup>H NMR (400 M), **2e** in CDCl<sub>3</sub>



20220511zm  
zw1

172.9020

164.4438

147.9966

138.4380

128.8536

123.4513

120.4641

120.2828

120.2089

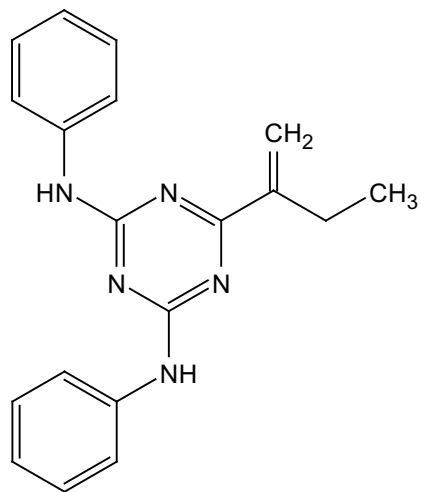
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77.0312

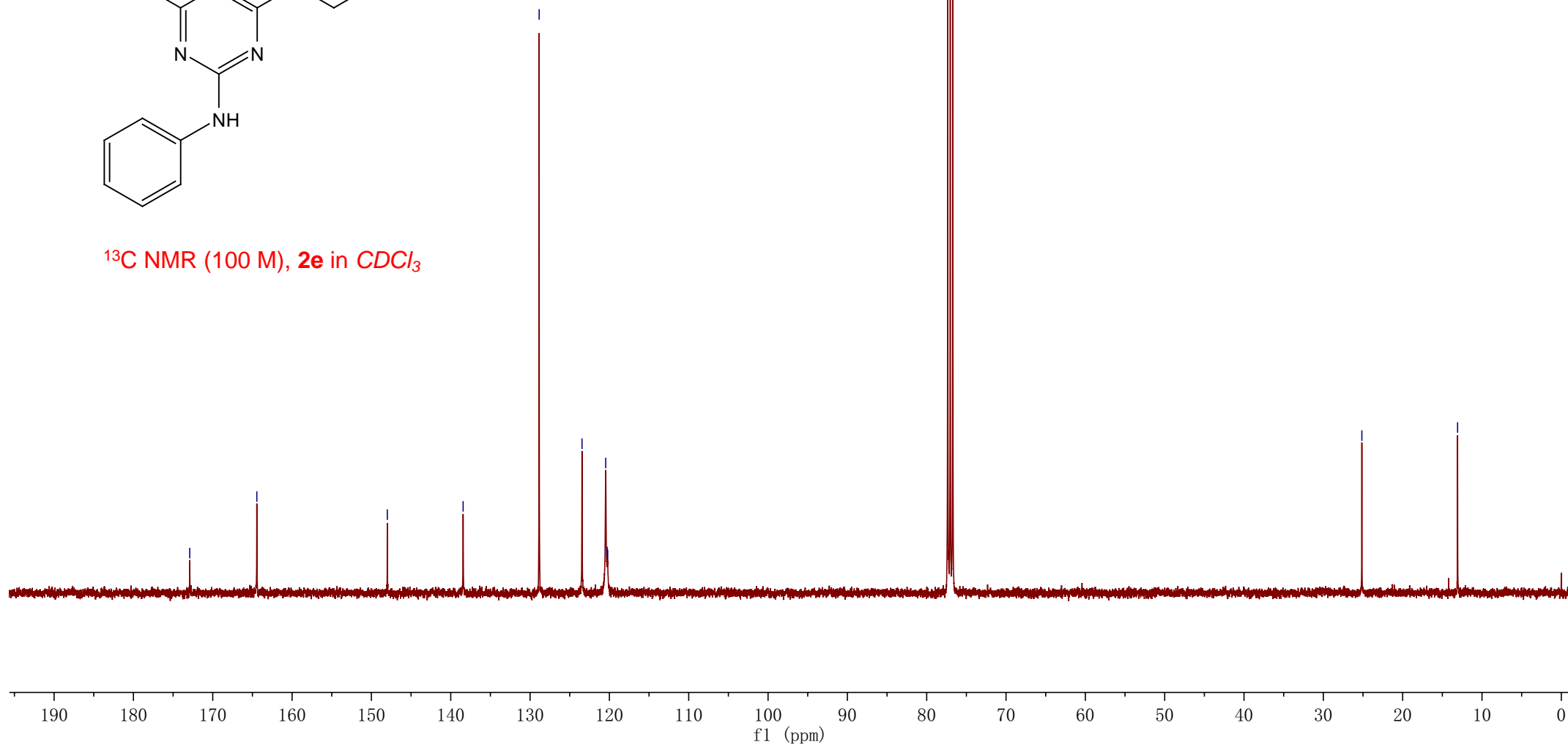
76.7137

25.1442

13.0762



<sup>13</sup>C NMR (100 M), **2e** in CDCl<sub>3</sub>



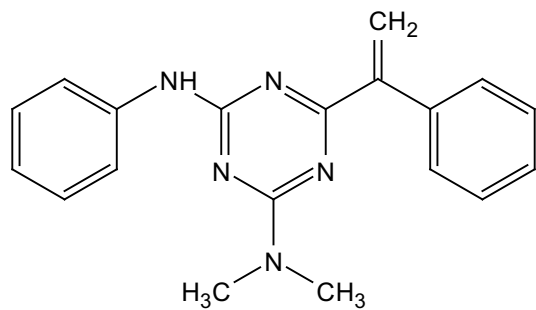
20191210-H1-WHF-ZM-P1  
20191210-H1-WHF-ZM-P1  
CDC13

7.5911  
7.5780  
7.4897  
7.4871  
7.4840  
7.4758  
7.4741  
7.3702  
7.3674  
7.3645  
7.3560  
7.3534  
7.3436  
7.3360  
7.3336  
7.3313  
7.3262  
7.3219  
7.3165  
7.3118  
7.3097  
7.2873  
7.2747  
7.2619  
7.2504  
7.0859  
7.0237  
7.0114  
6.9992  
6.5461

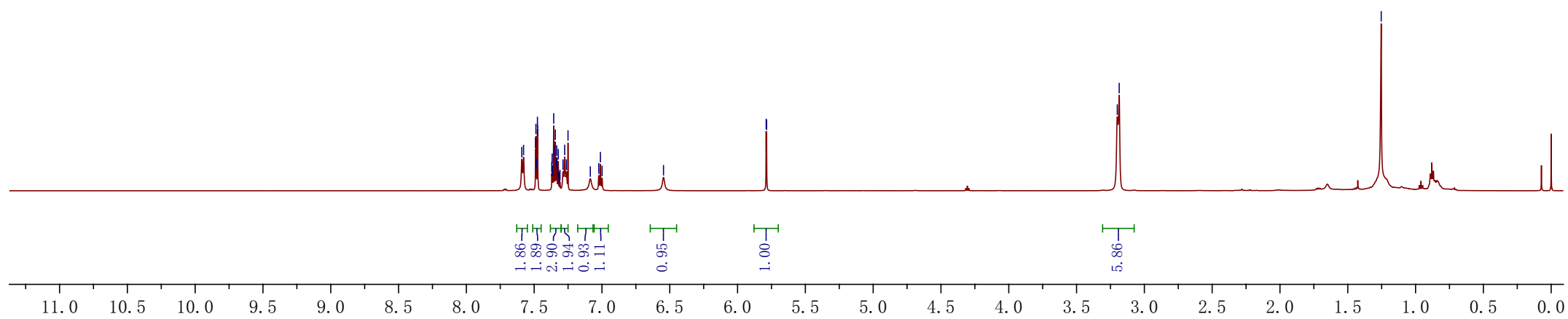
5.7890  
5.7860

3.1996  
3.1856

1.2532



<sup>1</sup>H NMR (600 M), **2f** in CDCl<sub>3</sub>



20191216-C13-WHF-ZM-P1  
20191216-C13-WHF-ZM-P1  
CDC13

— 171.9832

— 165.5242  
— 164.0592

— 147.9279

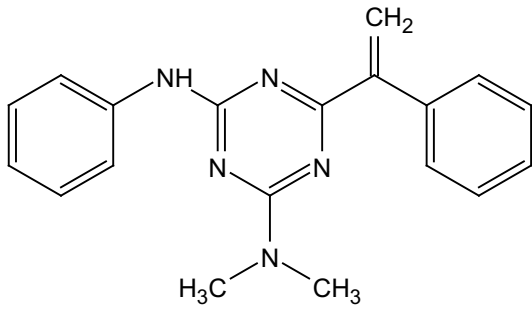
— 139.1524  
— 139.1143

— 129.0851  
— 128.7621  
— 127.6919  
— 127.4559  
— 122.7387  
— 122.6032  
— 119.5539

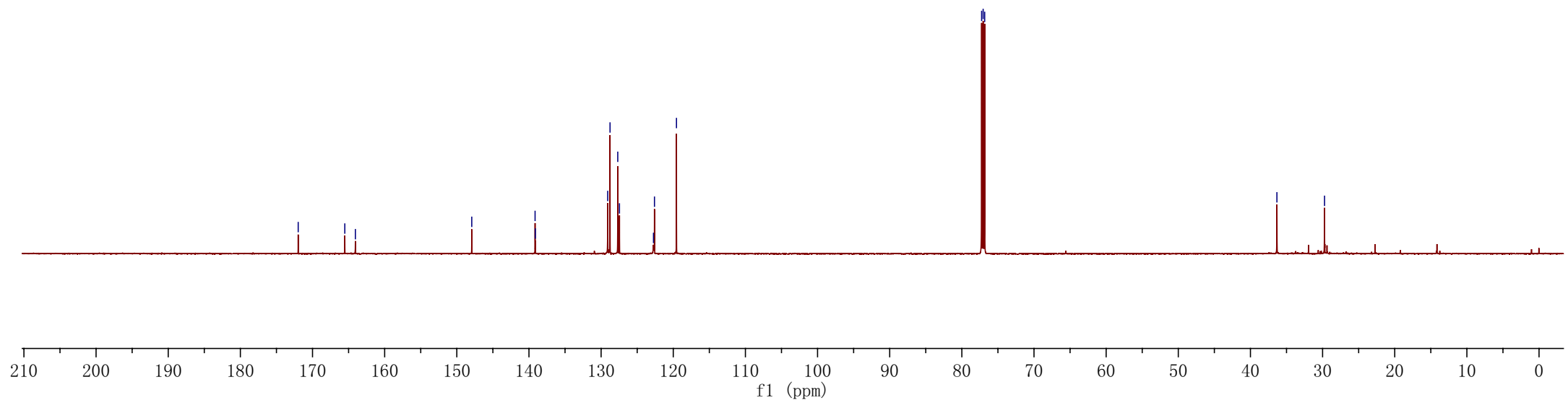
— 77.2596  
— 77.0480  
— 76.8364

— 36.3306

— 29.7301



<sup>13</sup>C NMR (150 M), **2f** in CDCl<sub>3</sub>



20220621zm  
mz220615a

9.5775

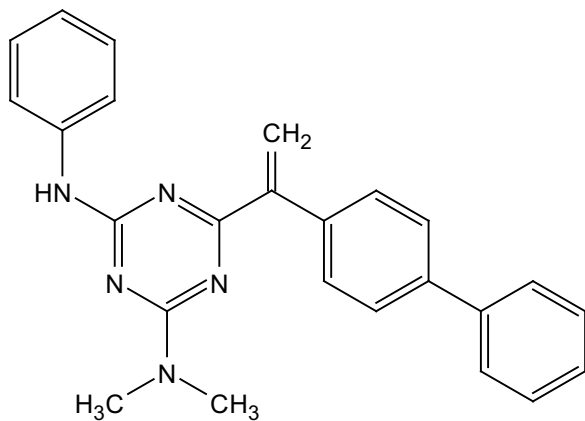
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7.6924  
7.6810  
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7.5303  
7.5023  
7.4836  
7.4645  
7.3951  
7.3769  
7.3585  
7.2411  
6.9668  
6.9490  
6.9314

6.3925

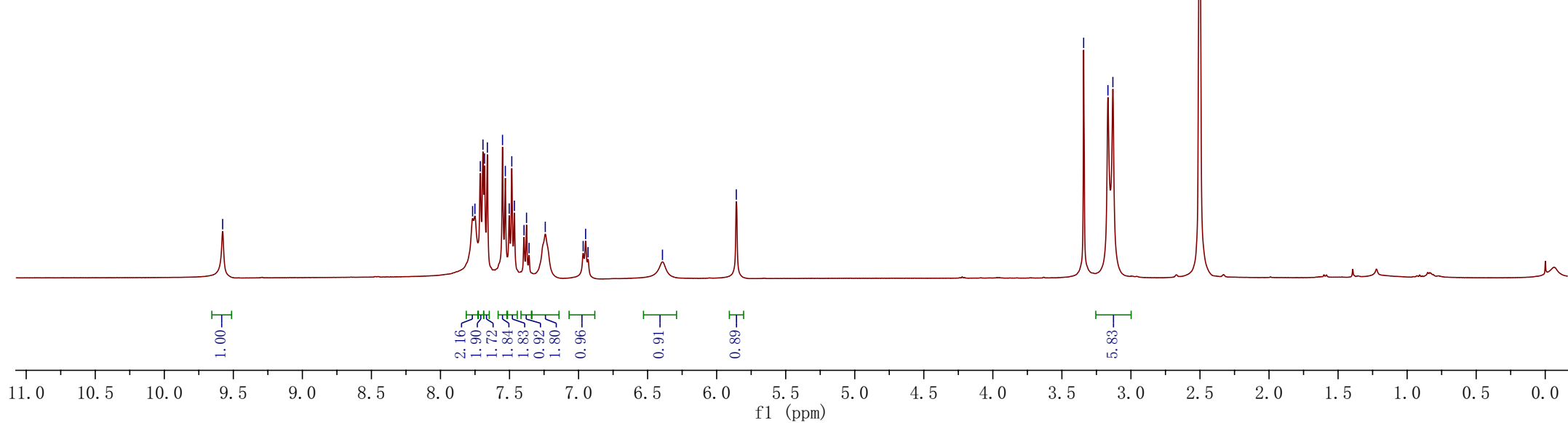
5.8577

3.3425  
3.1666  
3.1308

2.5026



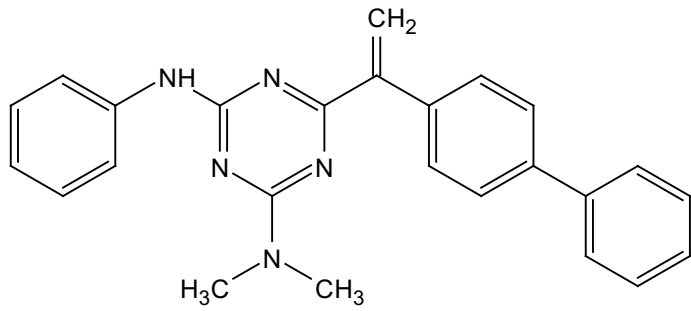
**<sup>1</sup>H NMR (400 M), 2g in DMSO-d<sub>6</sub>**



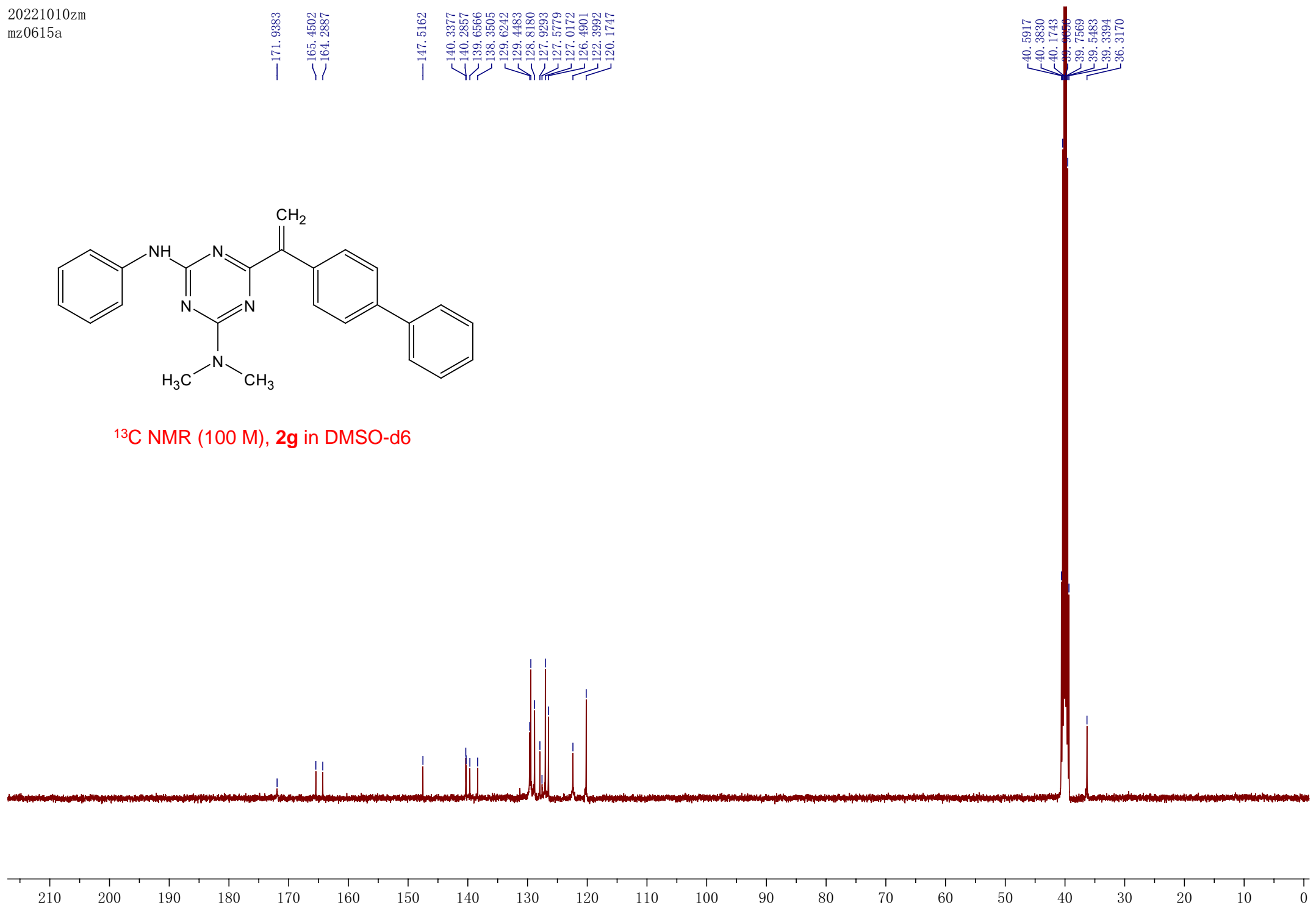
20221010zm  
mz0615a

171.9383  
165.4502  
164.2887  
147.5162  
140.3377  
140.2857  
139.6566  
138.3505  
129.6242  
129.4483  
128.8180  
127.9293  
127.5779  
127.0172  
126.4901  
122.3992  
120.1747

40.5917  
40.3830  
40.1743  
39.9656  
39.7569  
39.5483  
39.3394  
36.3170



<sup>13</sup>C NMR (100 M), 2g in DMSO-d<sub>6</sub>



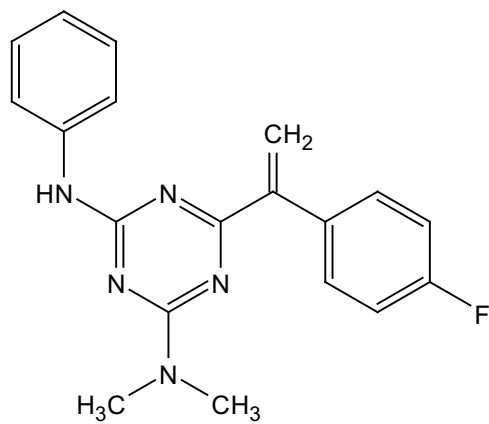


目标化合物  
ww20210106a

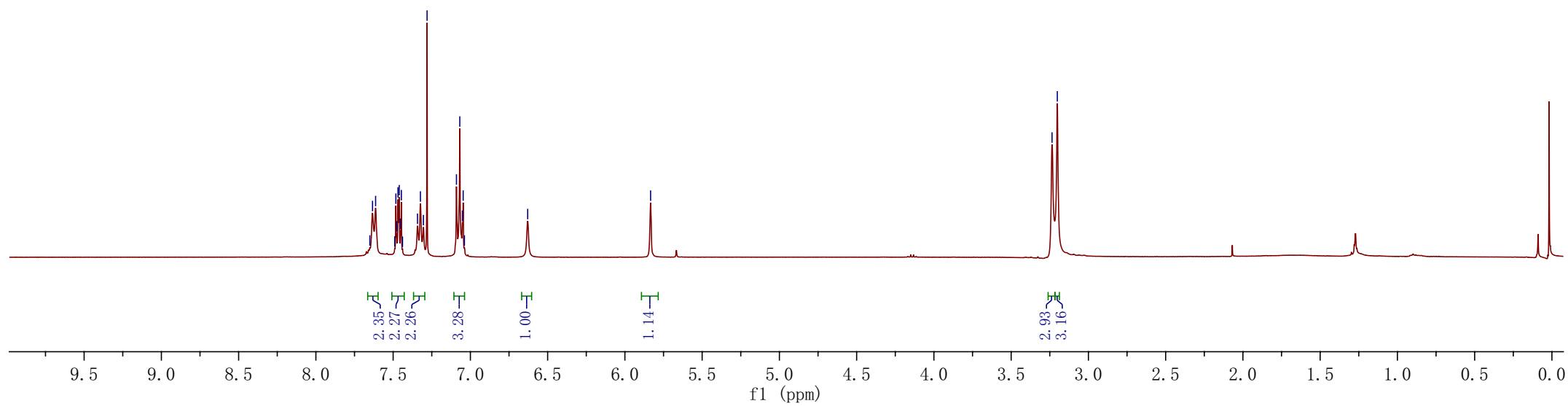
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7.6135  
7.4896  
7.4823  
7.4769  
7.4686  
7.4604  
7.4520  
7.4467  
7.4392  
7.3423  
7.3234  
7.3038  
7.2804  
7.0902  
7.0686  
7.0516  
7.0467  
7.0386  
6.6291

5.8336

3.2353  
3.2012



<sup>1</sup>H NMR (400 M), 2h in CDCl<sub>3</sub>



20220304zm  
ww20210106a

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160.4738

138.5818

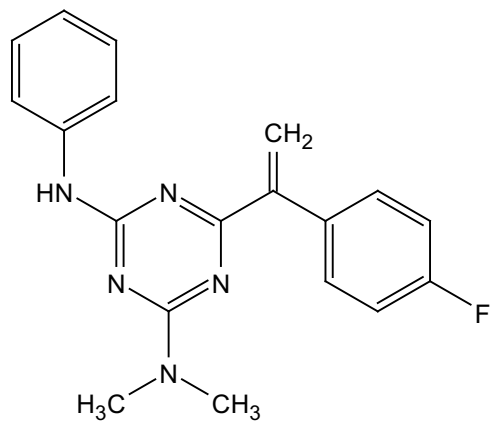
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123.8037  
123.1340  
119.8815

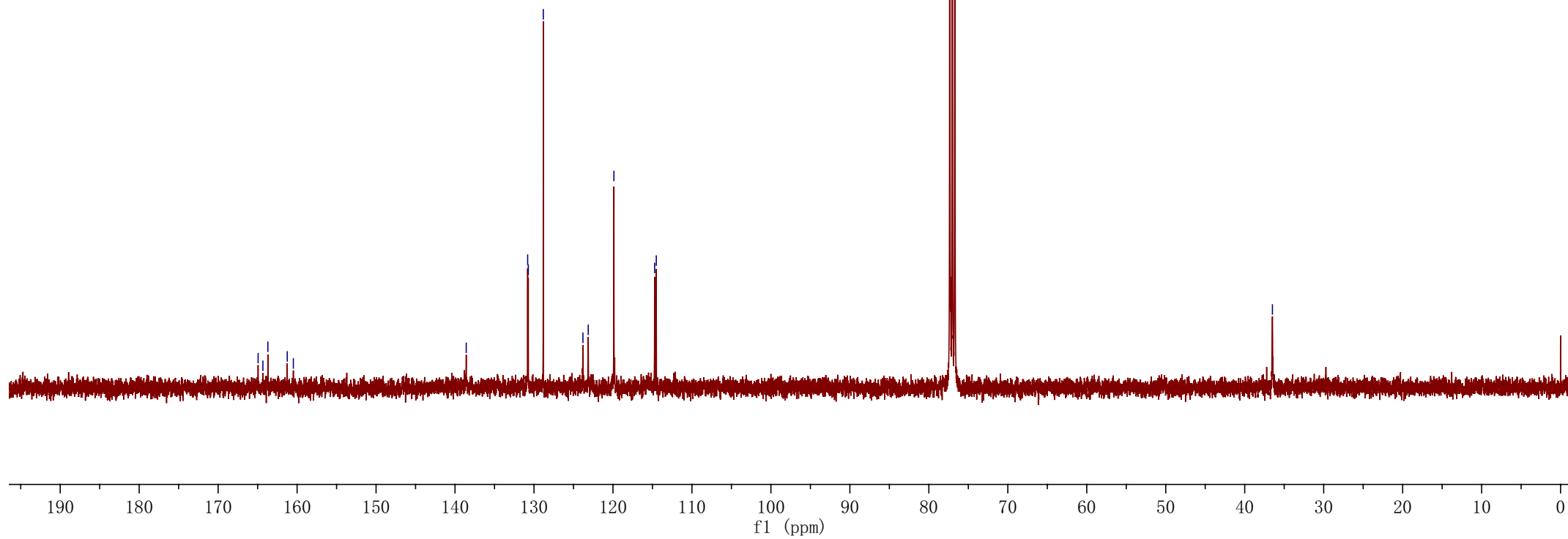
114.7268  
114.5146

77.3461  
77.0996  
76.7111

36.4921



<sup>13</sup>C NMR (100 M), 2h in CDCl<sub>3</sub>

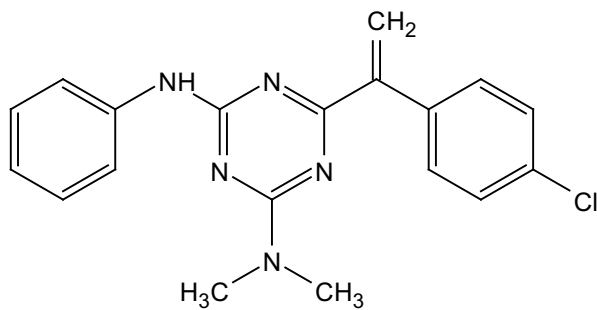


NMR  
1t0228

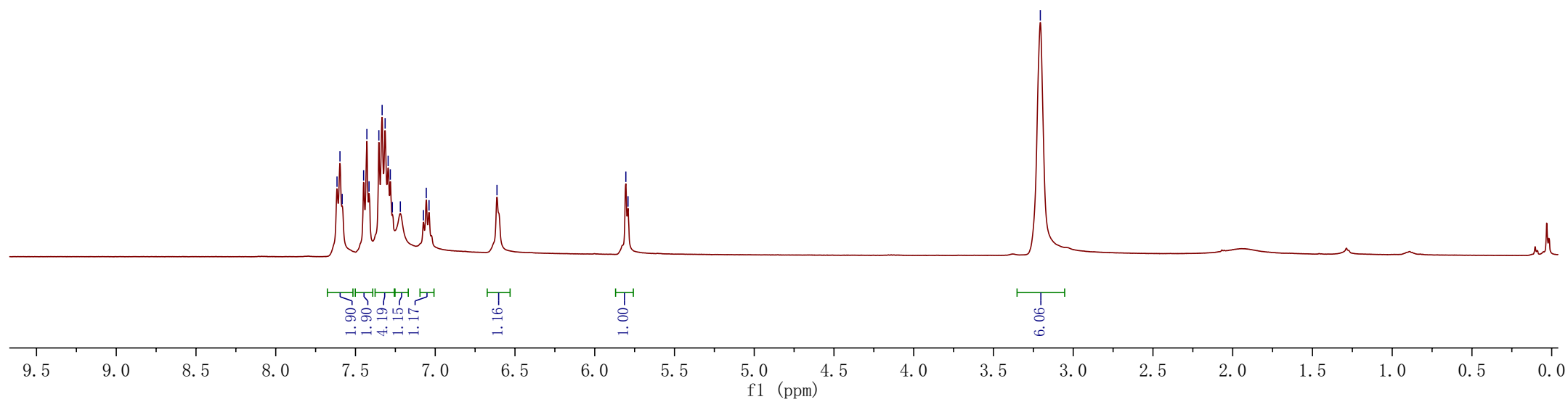
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7.4285  
7.4150  
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7.3329  
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7.2953  
7.2816  
7.2689  
7.2188  
7.0740  
7.0562  
7.0389  
6.6128

5.8049  
5.7913

3.2062



<sup>1</sup>H NMR (400 M), **2i** in CDCl<sub>3</sub>



20220511zm  
1t7

171.4284

165.4427  
163.9682

146.7867

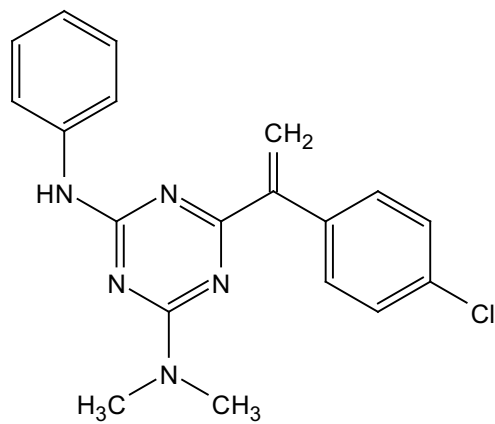
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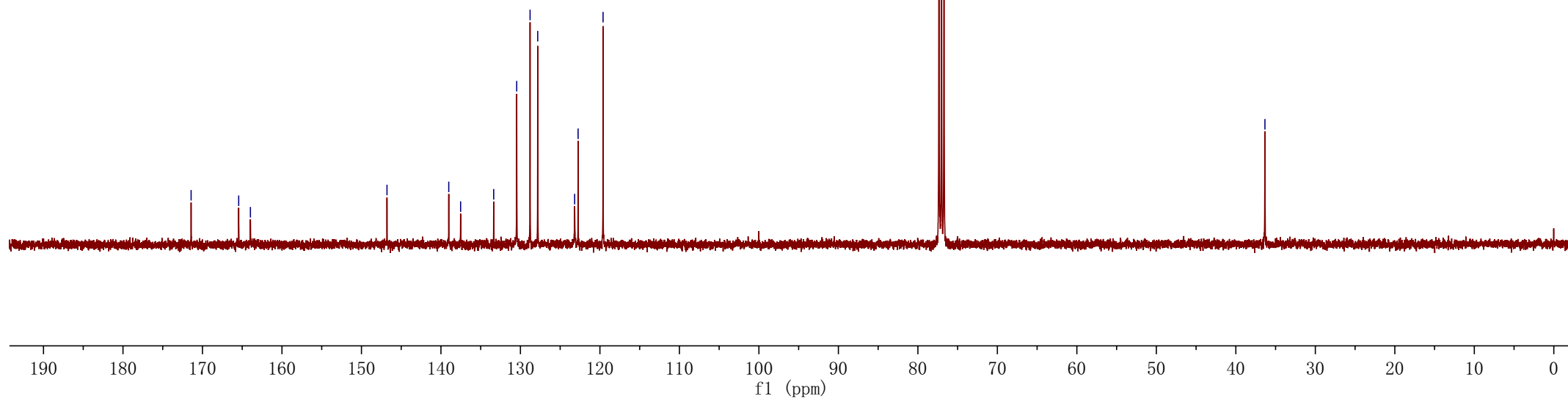
123.1790  
122.7451  
119.6037

77.3482  
77.0308  
76.7133

36.3396



<sup>13</sup>C NMR (100 M), 2i in CDCl<sub>3</sub>

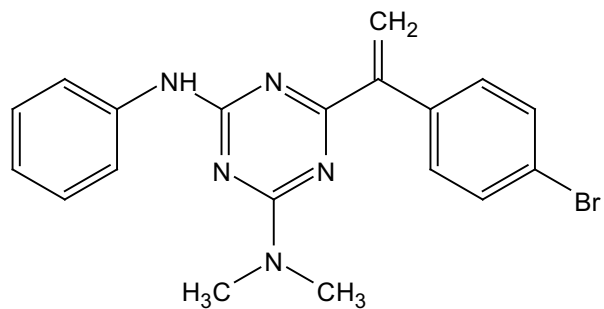


20220112zm  
WW20220106

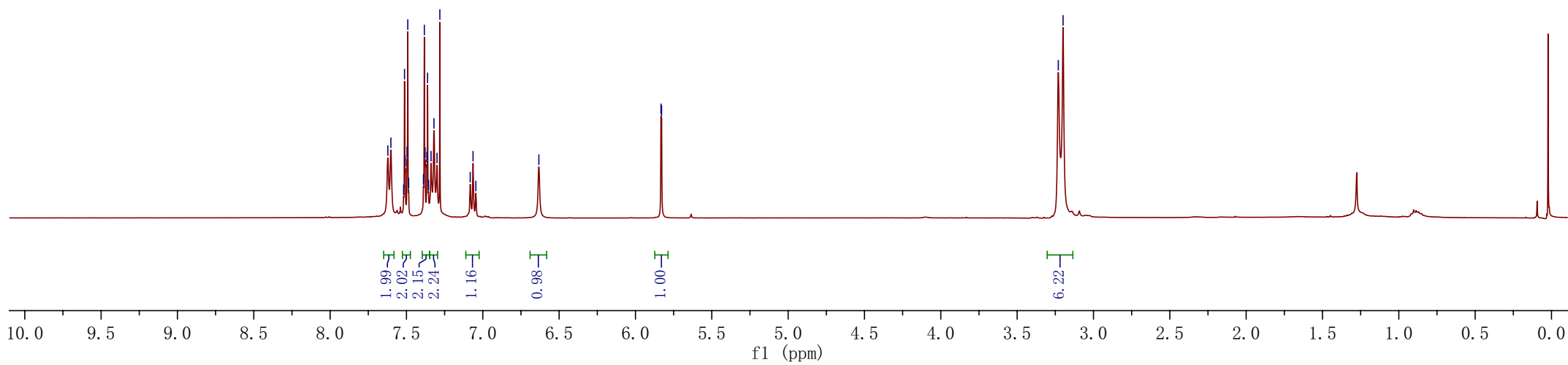
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7.4855  
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7.3829  
7.3781  
7.3662  
7.3617  
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7.3389  
7.3198  
7.2998  
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7.0639  
7.0455  
6.6328

5.8328  
5.8291

3.2305  
3.1992

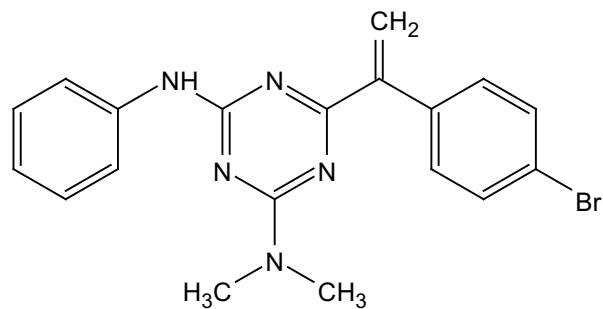


<sup>1</sup>H NMR (400 M), 2j in CDCl<sub>3</sub>

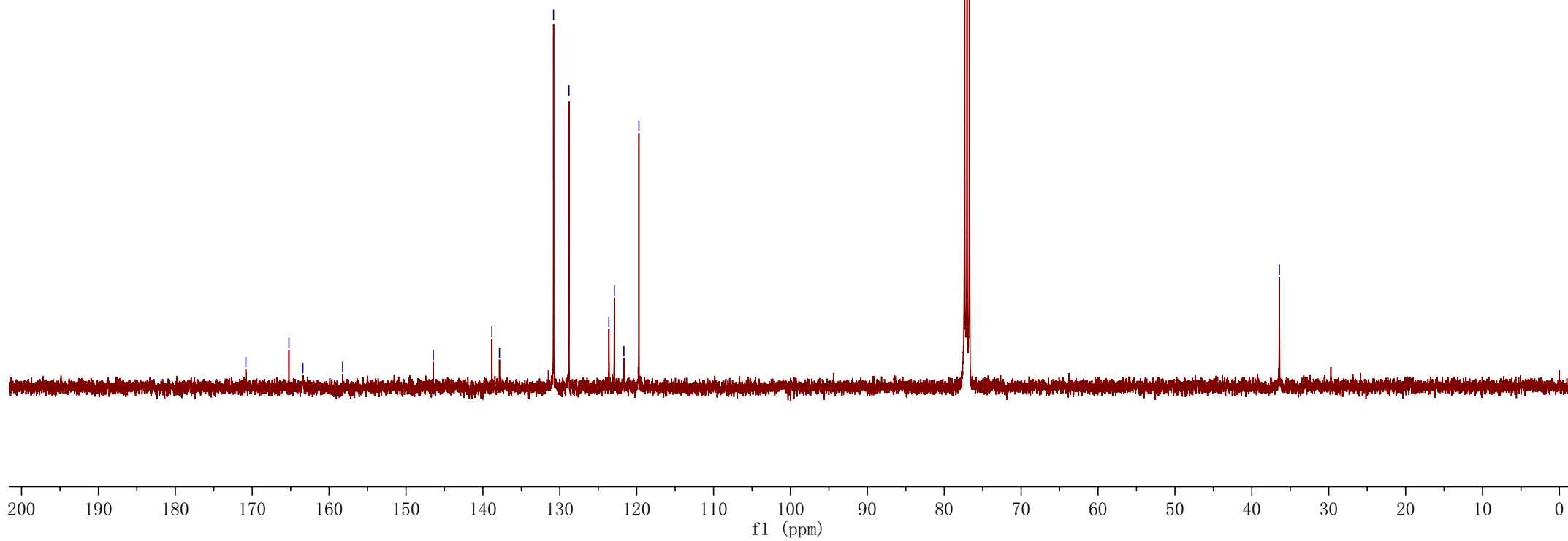


20220117zm  
ww20220106

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158.2353  
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138.8294  
137.8459  
130.8104  
128.8066  
123.6142  
122.9098  
121.6661  
119.7084  
77.3516  
77.0846  
76.7165  
36.4182



<sup>13</sup>C NMR (100 M), **2j** in CDCl<sub>3</sub>



—9.52

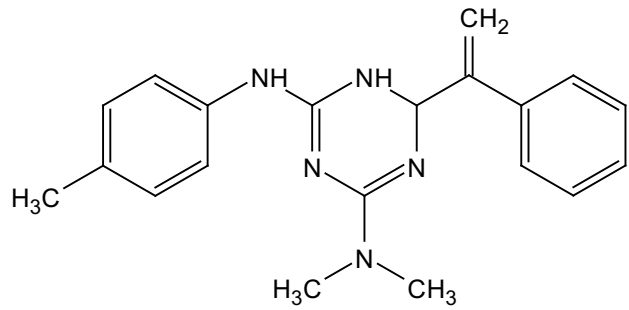
7.75  
7.74  
7.34  
7.32  
7.24  
7.18  
7.16  
6.97  
6.95  
6.93

—6.30

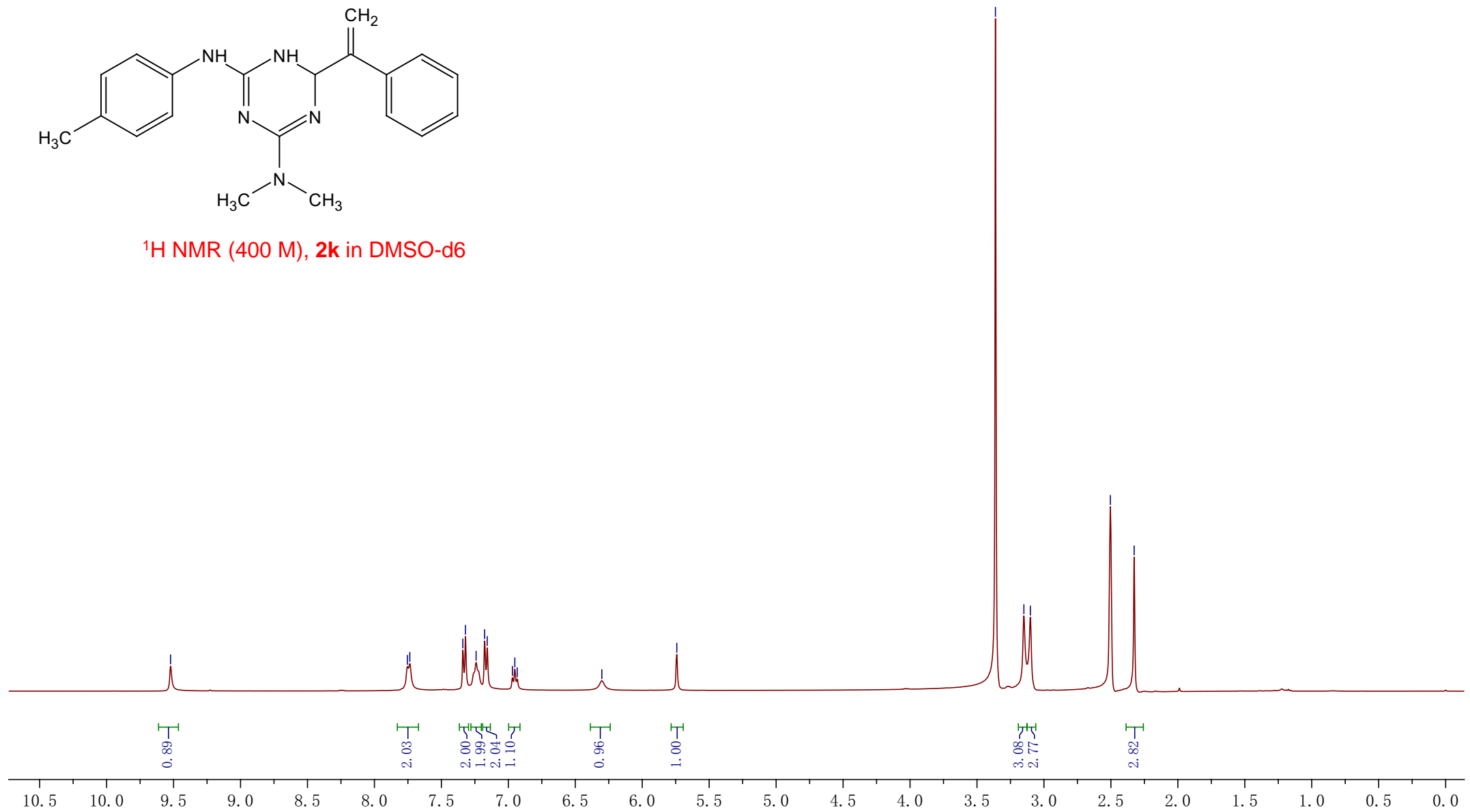
—5.74

3.36  
3.15  
3.10

—2.50  
—2.33

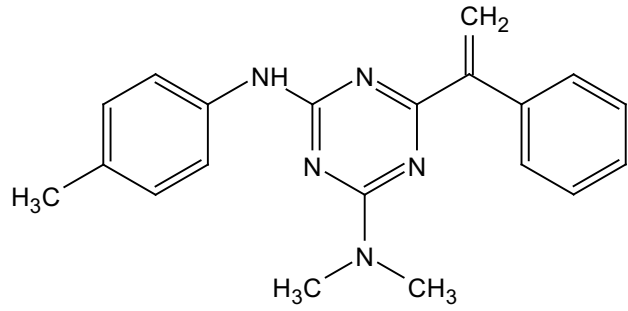


<sup>1</sup>H NMR (400 M), **2k** in DMSO-d<sub>6</sub>



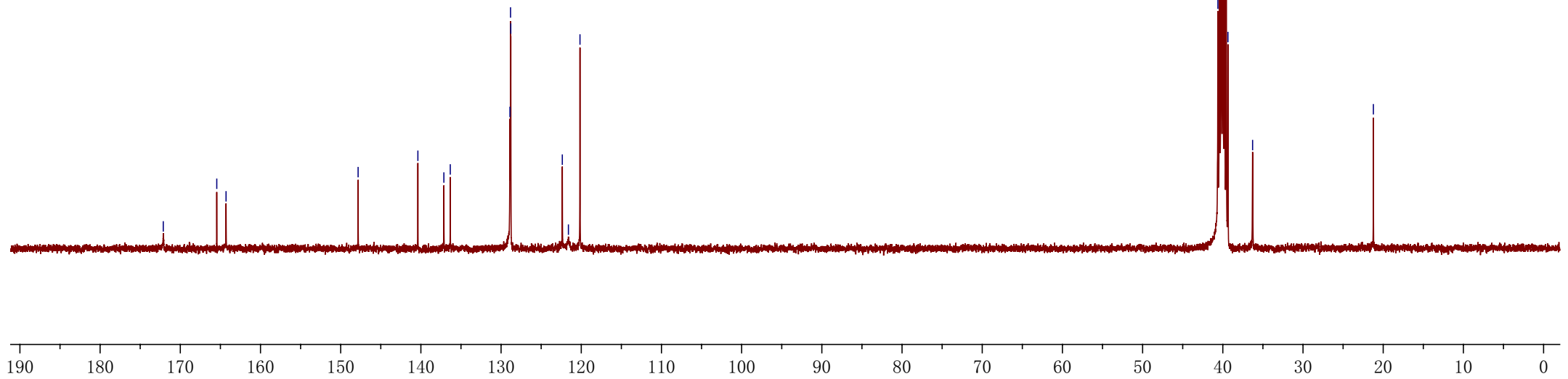
20220713zm  
zqhome

172.12  
165.45  
164.29  
147.83  
140.37  
137.13  
136.33  
128.89  
128.82  
128.79  
122.36  
121.60  
120.16



<sup>13</sup>C NMR (100 M), 2k in DMSO-d<sub>6</sub>

40.61  
40.41  
40.20  
39.78  
39.57  
39.36  
36.29  
21.22



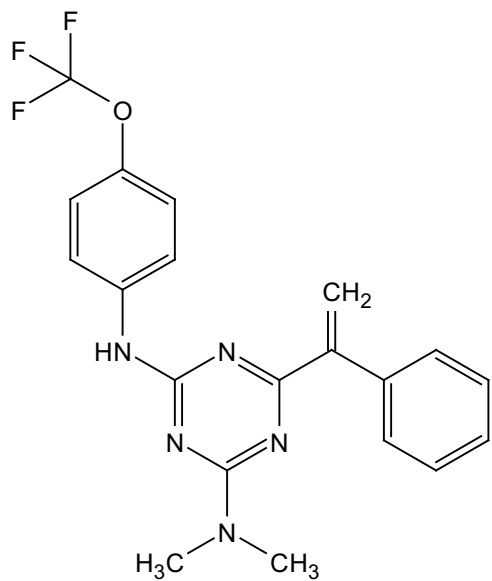


<sup>1</sup>H  
ww20211130

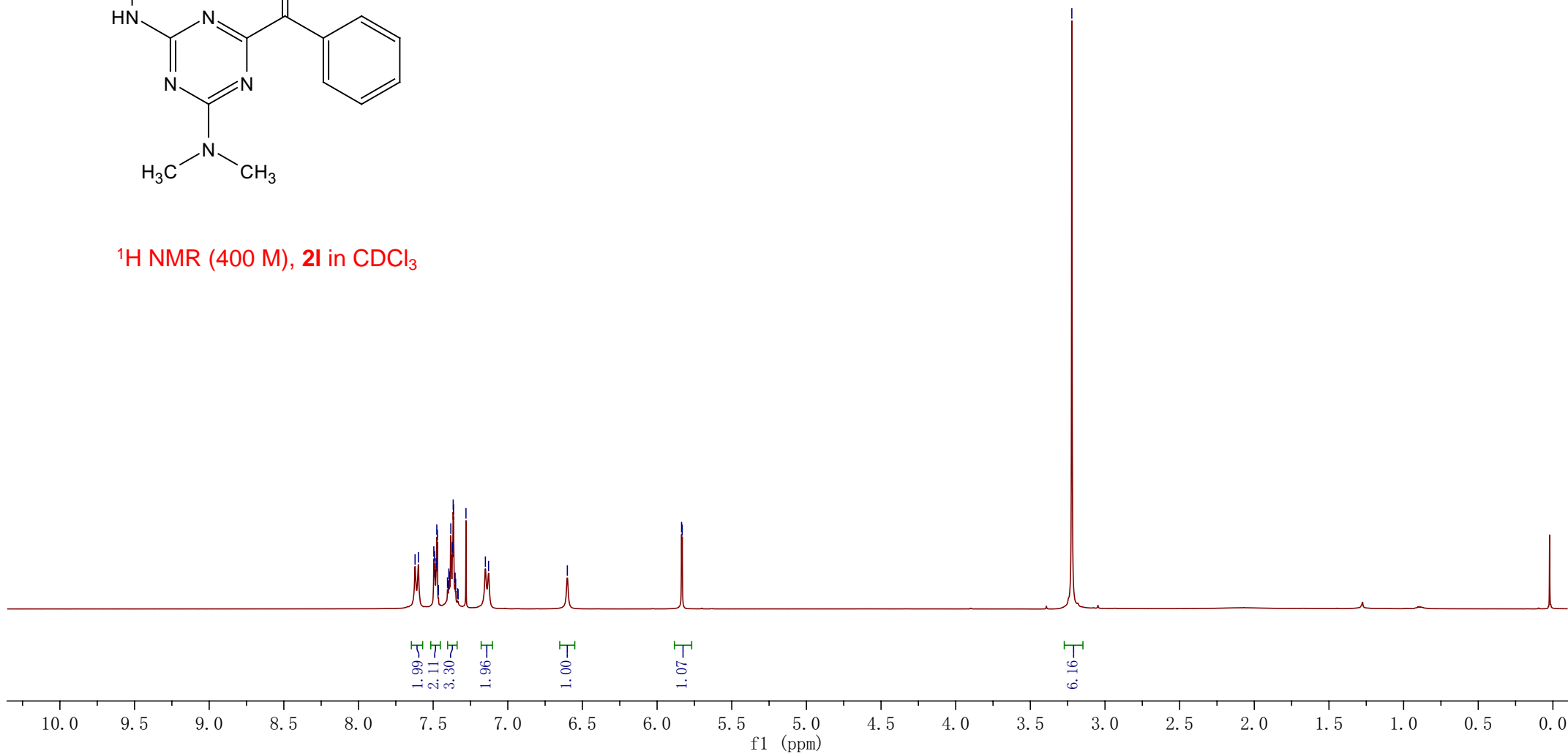
7.6211  
7.5991  
7.4954  
7.4904  
7.4856  
7.4797  
7.4756  
7.4716  
7.4646  
7.4038  
7.3998  
7.3950  
7.3904  
7.3816  
7.3712  
7.3657  
7.3635  
7.3529  
7.3492  
7.3368  
7.3328  
7.2801  
7.1501  
7.1289  
6.6013

5.8361  
5.8316

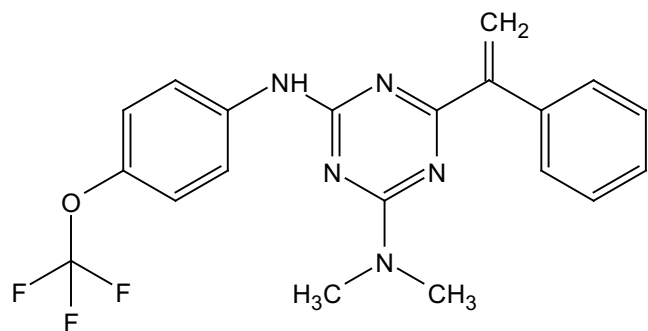
3.2222



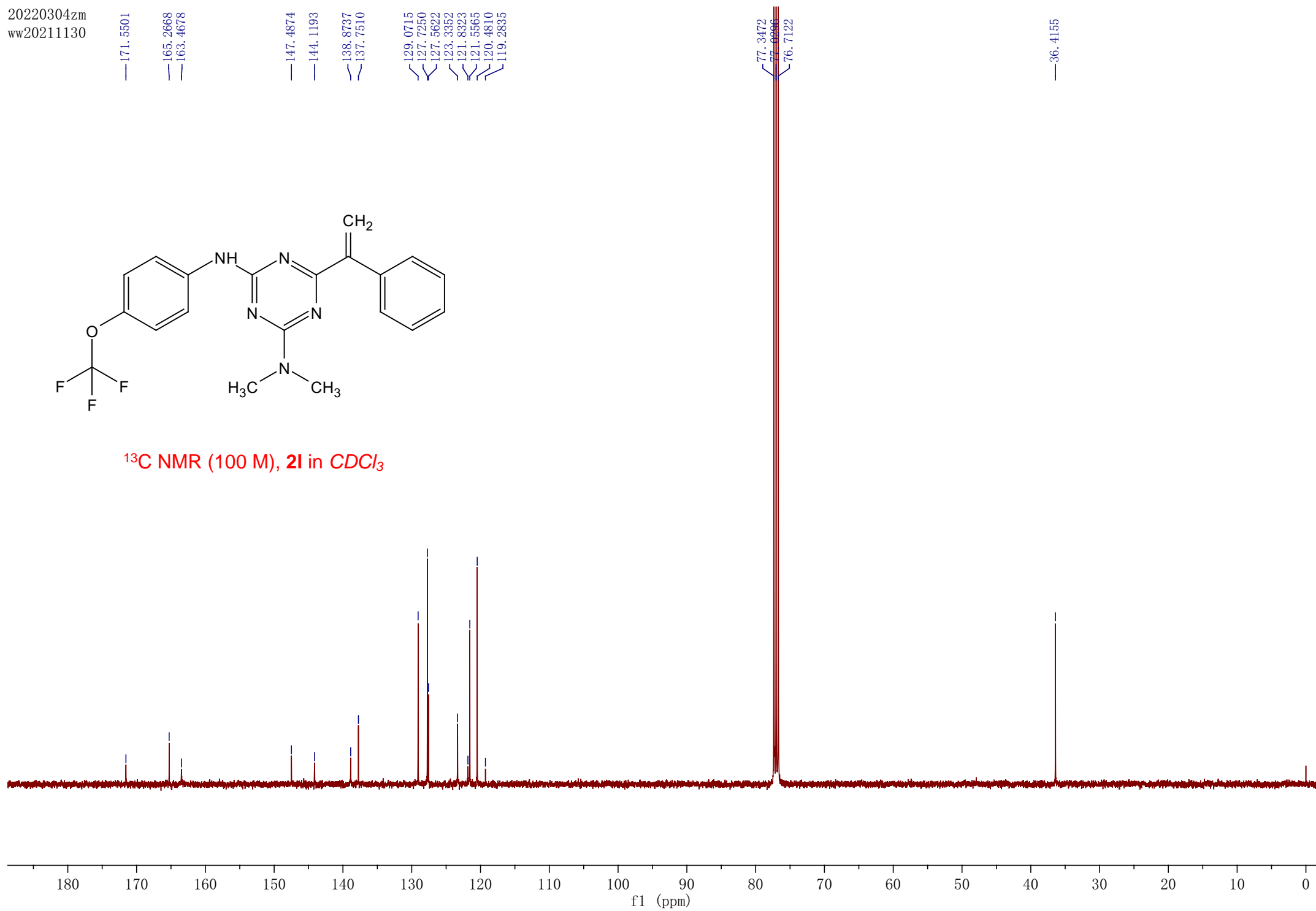
<sup>1</sup>H NMR (400 M), **21** in CDCl<sub>3</sub>



20220304zm  
ww20211130



<sup>13</sup>C NMR (100 M), **2I** in CDCl<sub>3</sub>



20190419-H1-WHF  
20190419-H1-WHF  
CDC13

7.46135  
7.45958  
7.45818  
7.3111  
7.2995  
7.2934  
7.2908  
7.2793  
7.2740  
7.2691  
7.2672  
7.2551  
7.2423  
7.2266

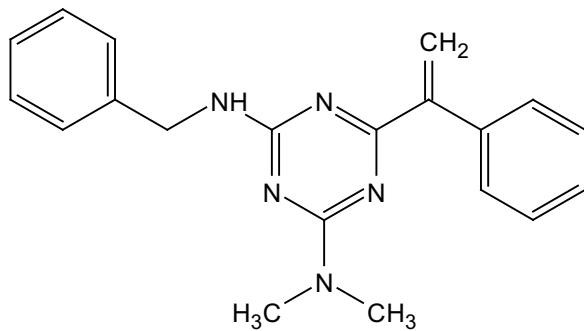
6.3937

5.7260

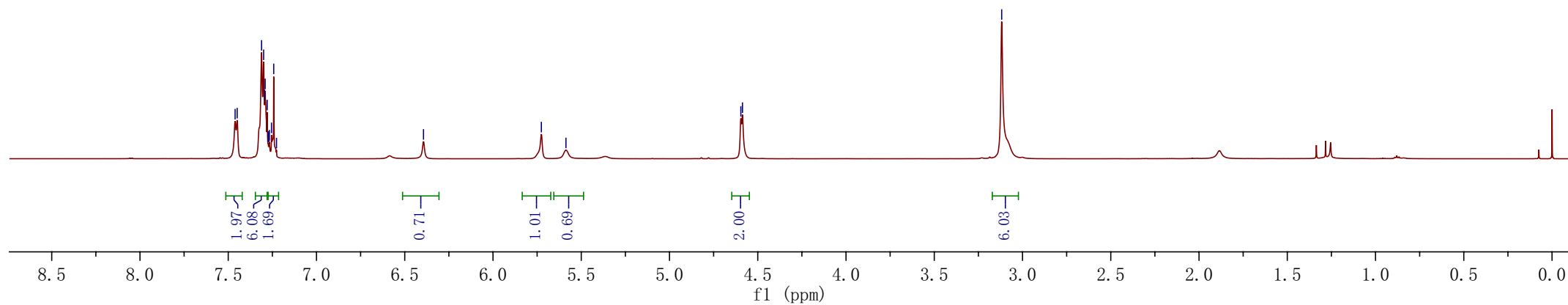
5.5867

4.5658  
4.5866

3.1180



<sup>1</sup>H NMR (600 M), 2m in CDCl<sub>3</sub>



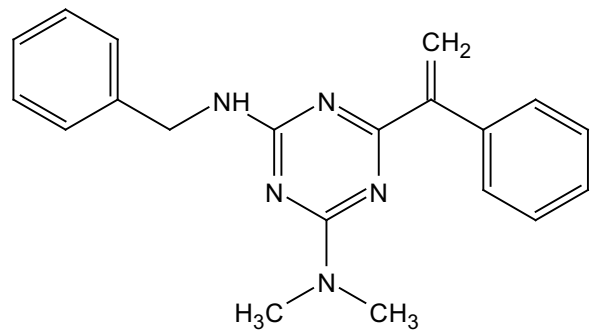
20190425-C13-WHF-328  
CDC13

171.8508  
165.8609  
165.5323  
148.0432  
139.2285  
129.2558  
129.1875  
128.9293  
128.4983  
127.6717  
127.4152  
127.1649  
121.8752

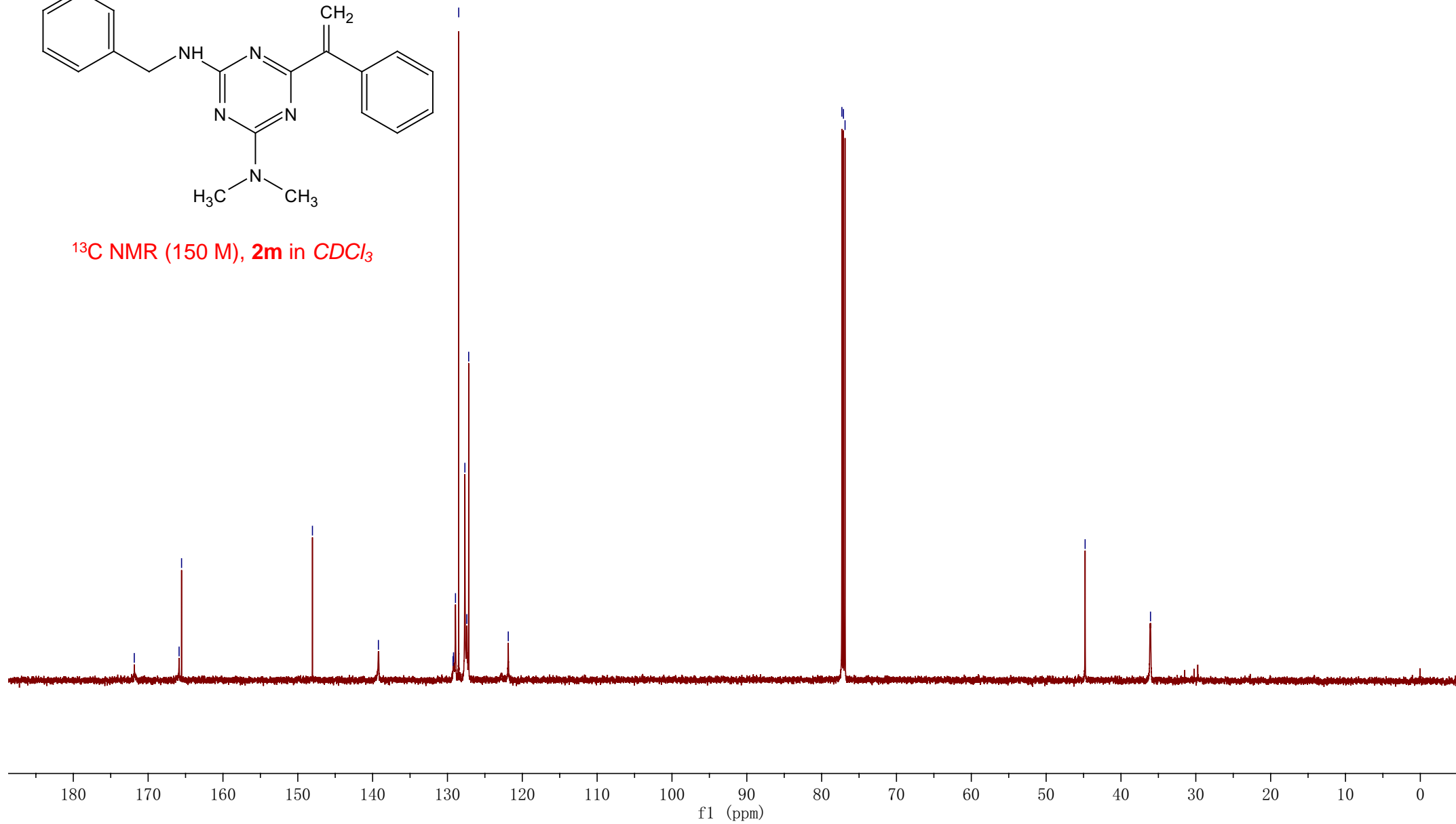
77.2939  
77.0824  
76.8706

44.7908

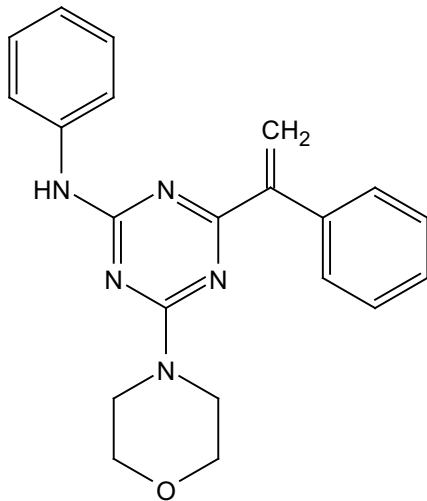
36.0535



<sup>13</sup>C NMR (150 M), 2m in CDCl<sub>3</sub>

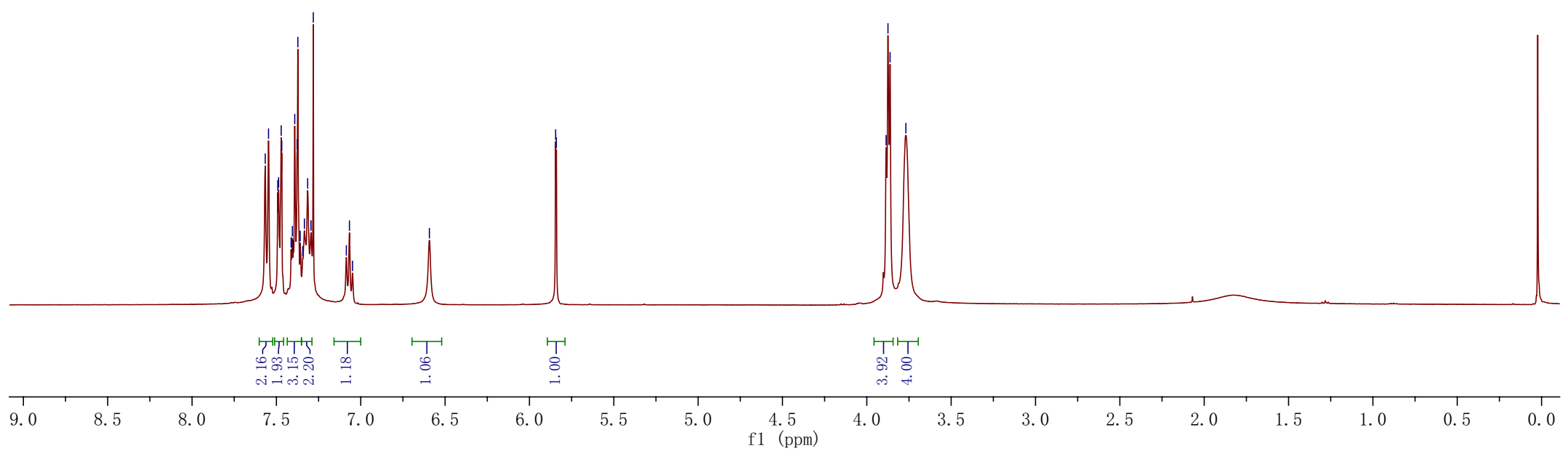


<sup>1</sup>H  
ZM210918

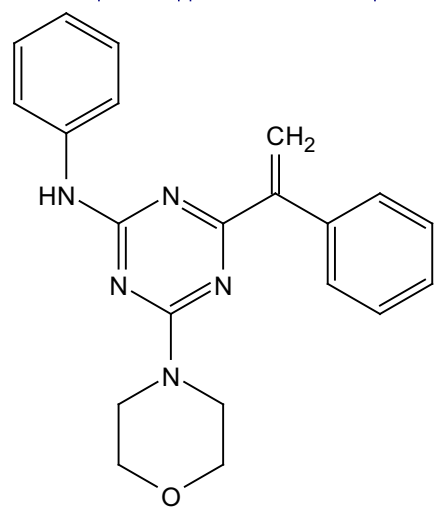


7.2663  
7.2467  
7.1918  
7.4872  
7.4718  
7.4682  
7.4128  
7.4052  
7.4004  
7.3913  
7.3772  
7.3728  
7.3590  
7.3437  
7.3341  
7.3147  
7.2950  
7.2813  
7.0854  
7.0671  
7.0488  
6.5932  
5.8447  
5.8405  
3.8856  
3.8746  
3.8620  
3.7684

<sup>1</sup>H NMR (400 M), **2n** in CDCl<sub>3</sub>



<sup>13</sup>C  
ZM210908



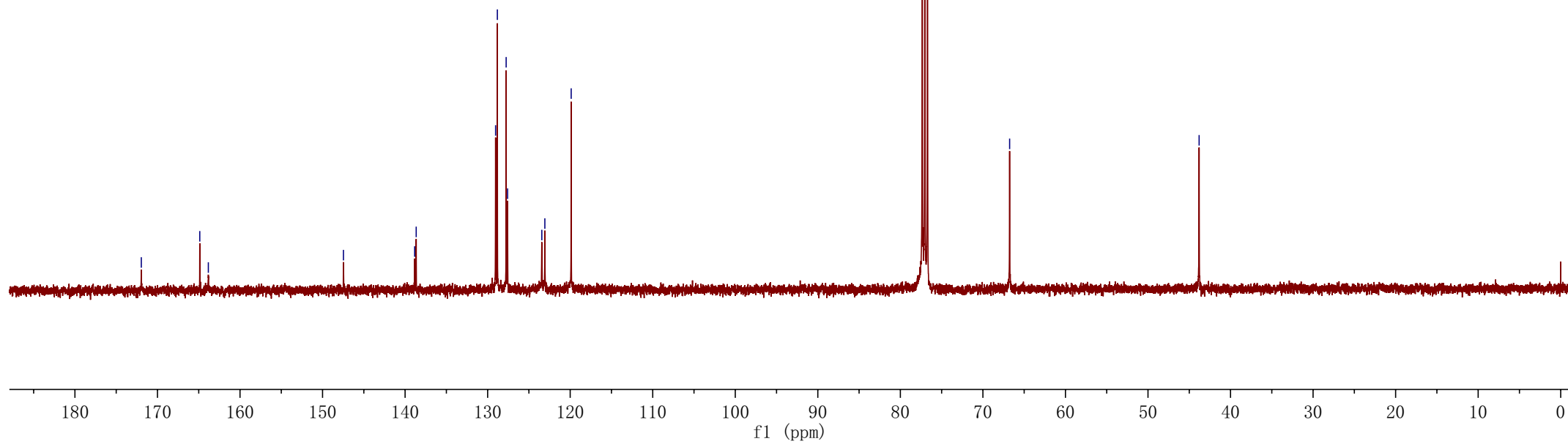
171.9584  
164.8741  
163.8365  
147.4694  
138.8409  
138.6554  
129.0372  
128.8232  
127.7571  
127.5830  
123.4365  
123.0693  
119.8787

77.3489  
77.0000  
76.7138

66.7619

43.8054

<sup>13</sup>C NMR (100 M), **2n** in CDCl<sub>3</sub>



1y0320b

7.3974  
7.3794  
7.3494  
7.3329  
7.3139  
7.3041  
7.2868

6.7788

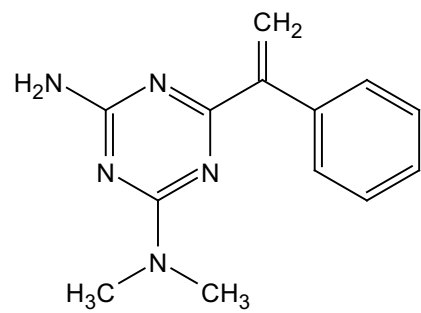
6.2436  
6.2395

5.6910  
5.6868

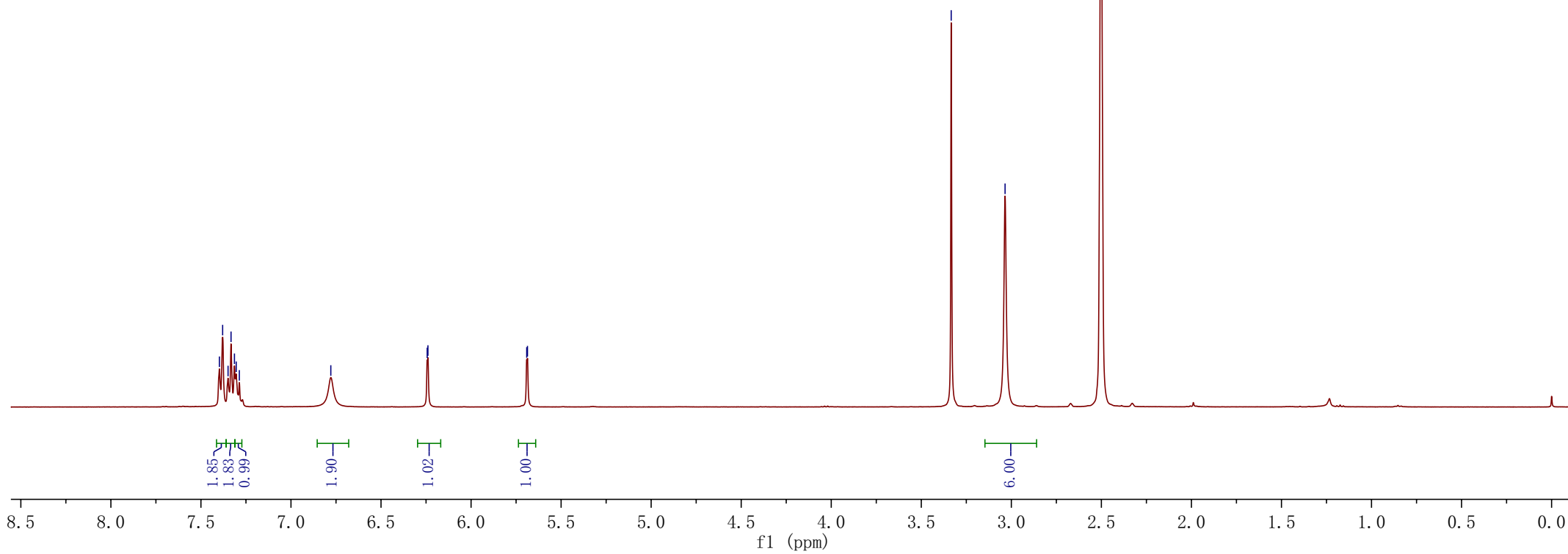
3.3339

3.0348

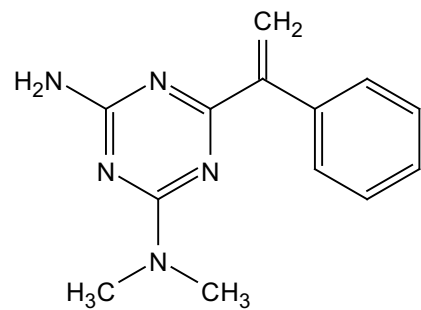
2.5021



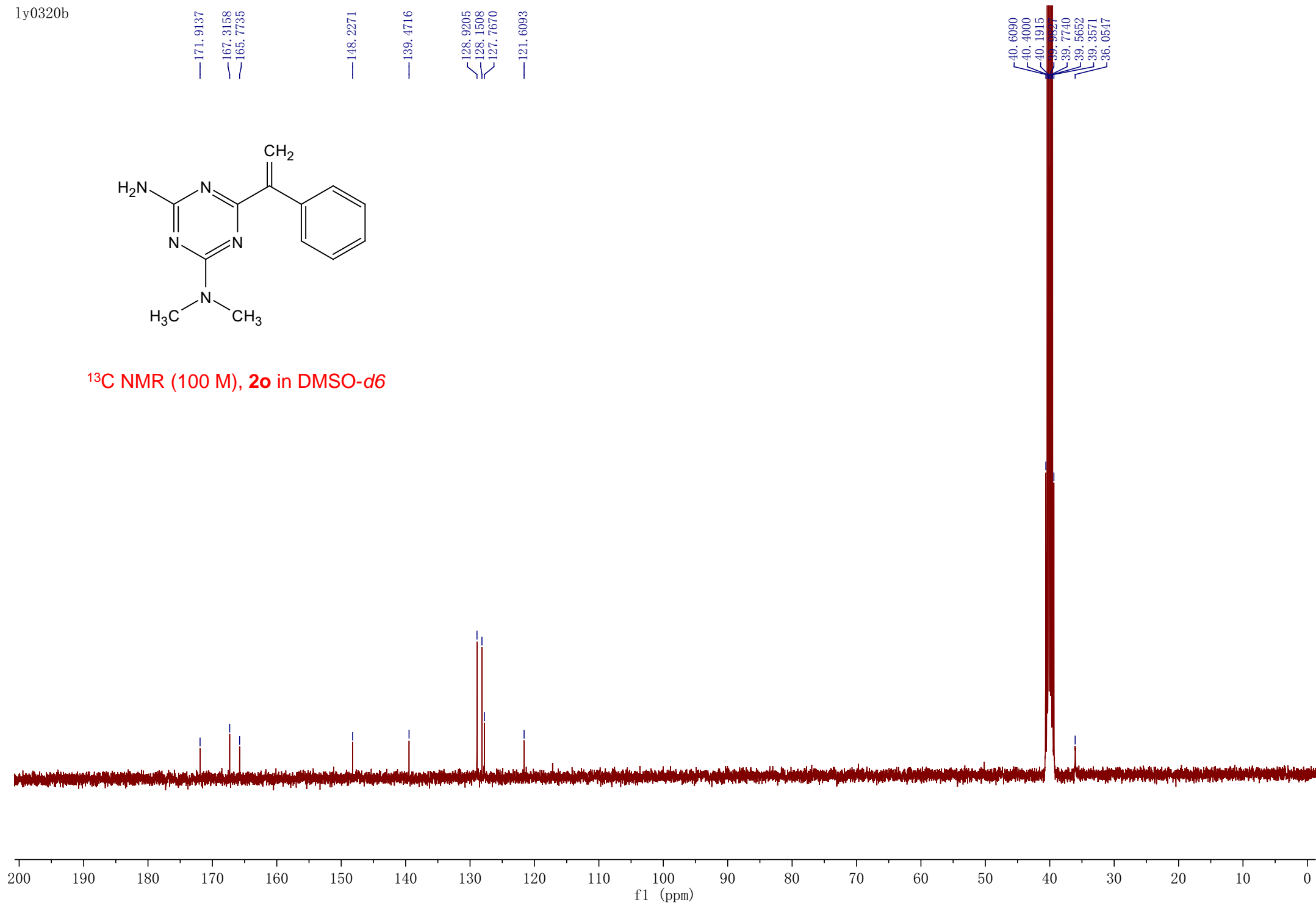
<sup>1</sup>H NMR (400 M), **2o** in DMSO-*d*<sub>6</sub>



1y0320b



<sup>13</sup>C NMR (100 M), 2o in DMSO-d<sub>6</sub>





ljhww20220315c

7.2096  
7.1941  
7.1741  
7.1578  
7.1527  
7.1148  
7.1105  
7.0930  
6.7284  
6.5500  
6.5440

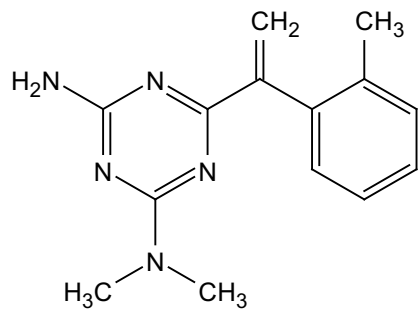
5.4661  
5.4601

3.3433

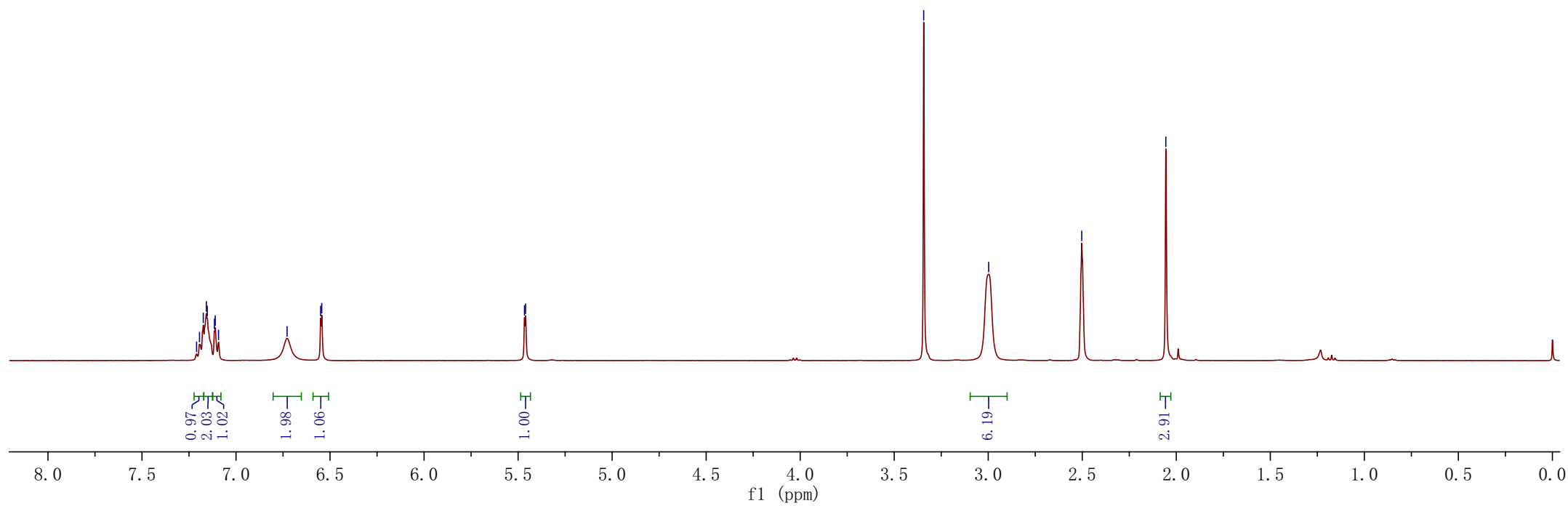
2.9977

2.5028

2.0556



**<sup>1</sup>H NMR (400 M), 2p in DMSO-d<sub>6</sub>**



ljhww20220315c

171.2862  
167.4836  
165.7957

149.0860

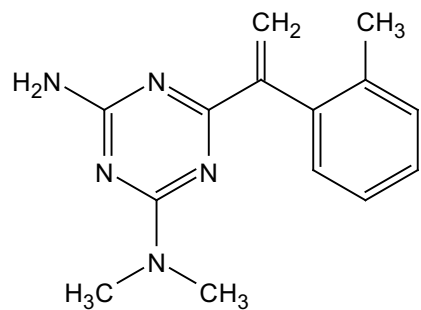
140.5043

136.1908

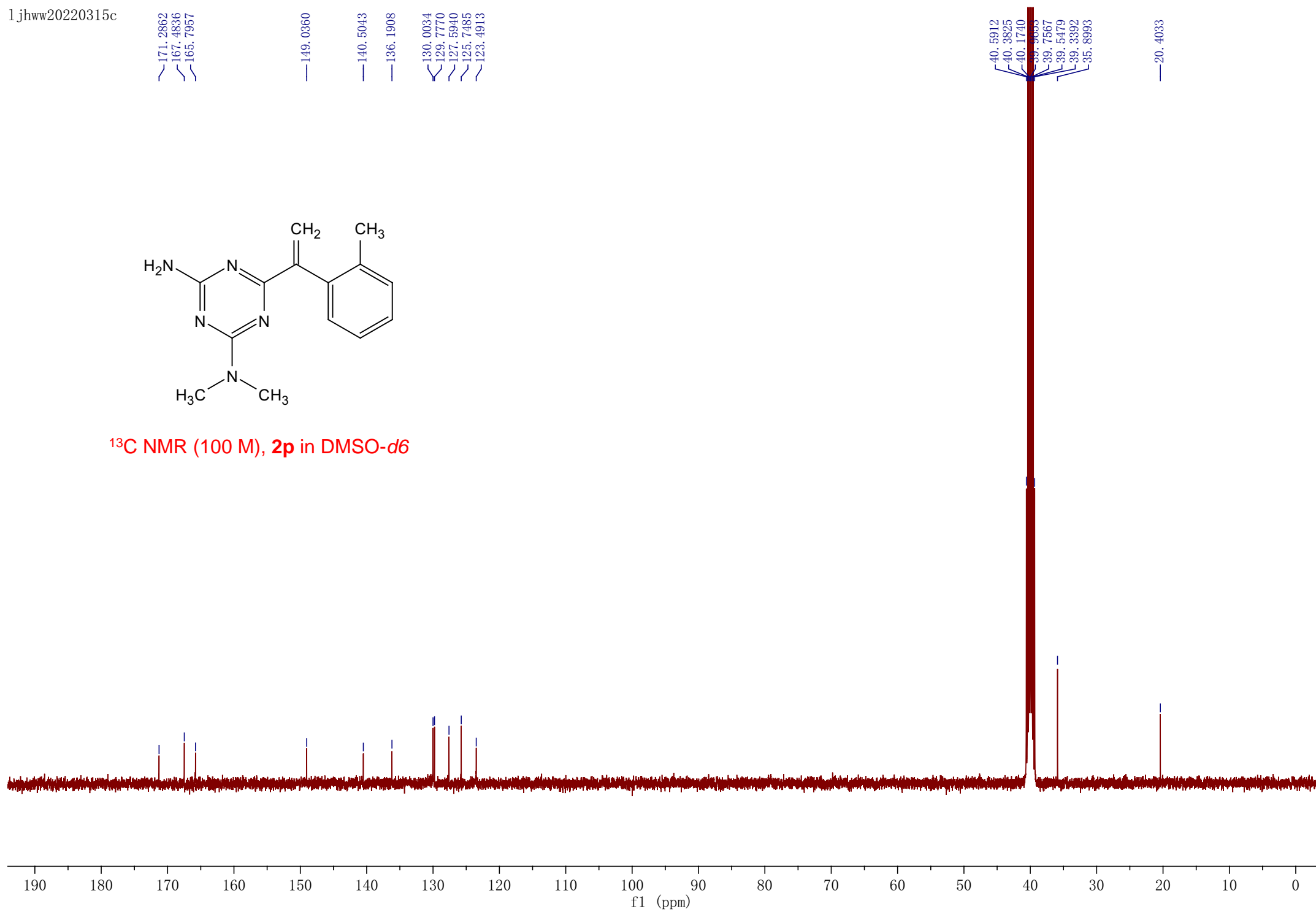
130.0034  
129.7770  
127.5940  
125.7485  
123.4913

40.5912  
40.3825  
40.1740  
39.9655  
39.7567  
39.5479  
39.3392  
35.8993

20.4033



<sup>13</sup>C NMR (100 M), **2p** in DMSO-*d*<sub>6</sub>



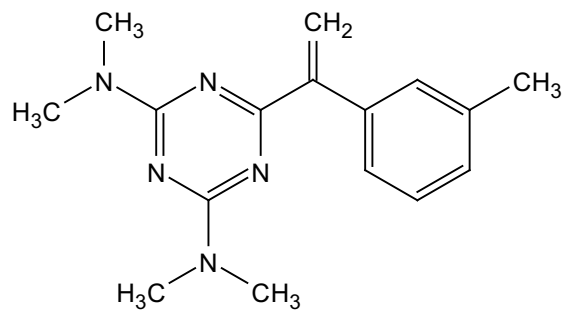
20220607zm  
ZW0523

7.2570  
7.2433  
7.2346  
7.2278  
7.2127  
7.2052  
6.8363  
6.8302

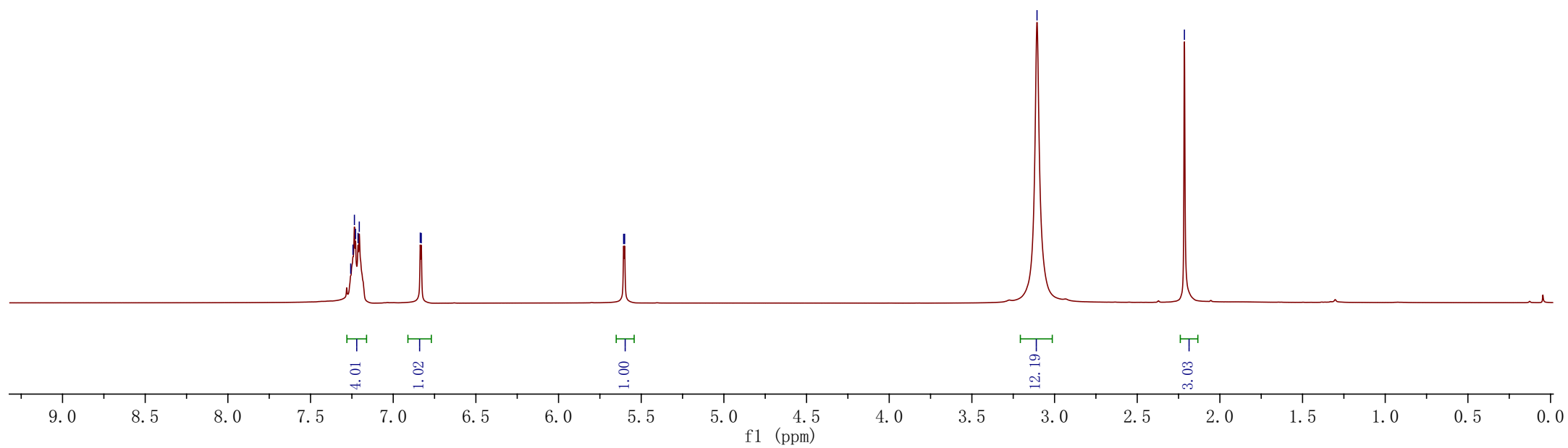
5.6064  
5.6003

3.1060

2.2146



<sup>1</sup>H NMR (400 M), **2q** in CDCl<sub>3</sub>



20220615zm  
ZW0523

—170.3332

—165.6242

—149.0069

—140.5767

—136.6933

—129.7706

—129.1236

—126.9447

—125.0304

—123.0176

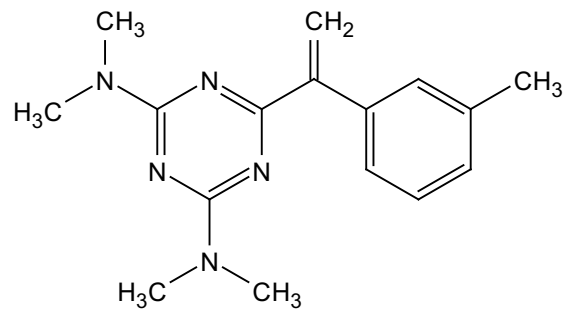
—77.3670

—77.0496

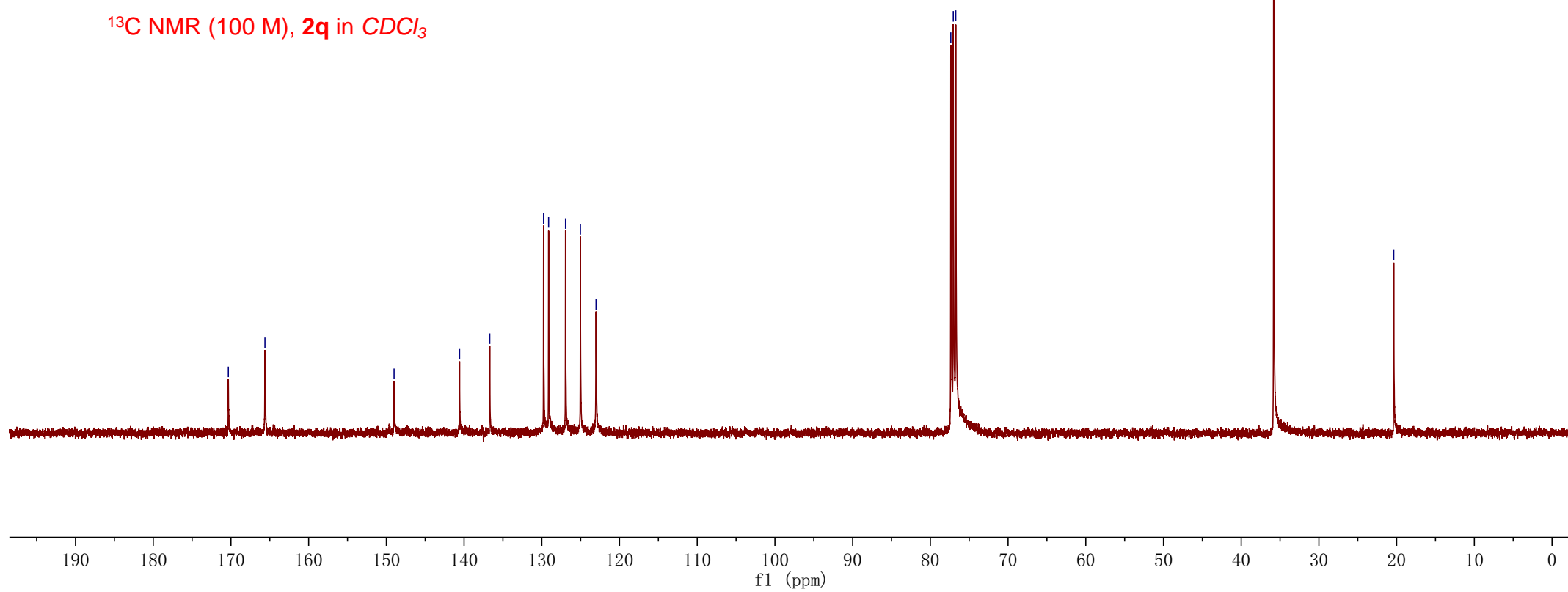
—76.7317

—35.8271

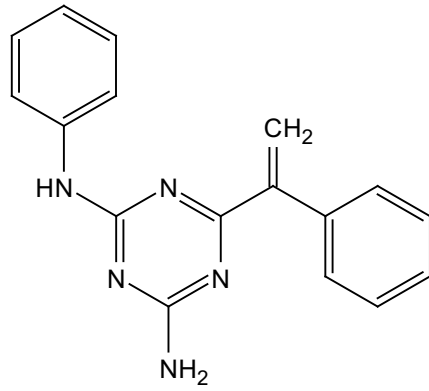
—20.3712



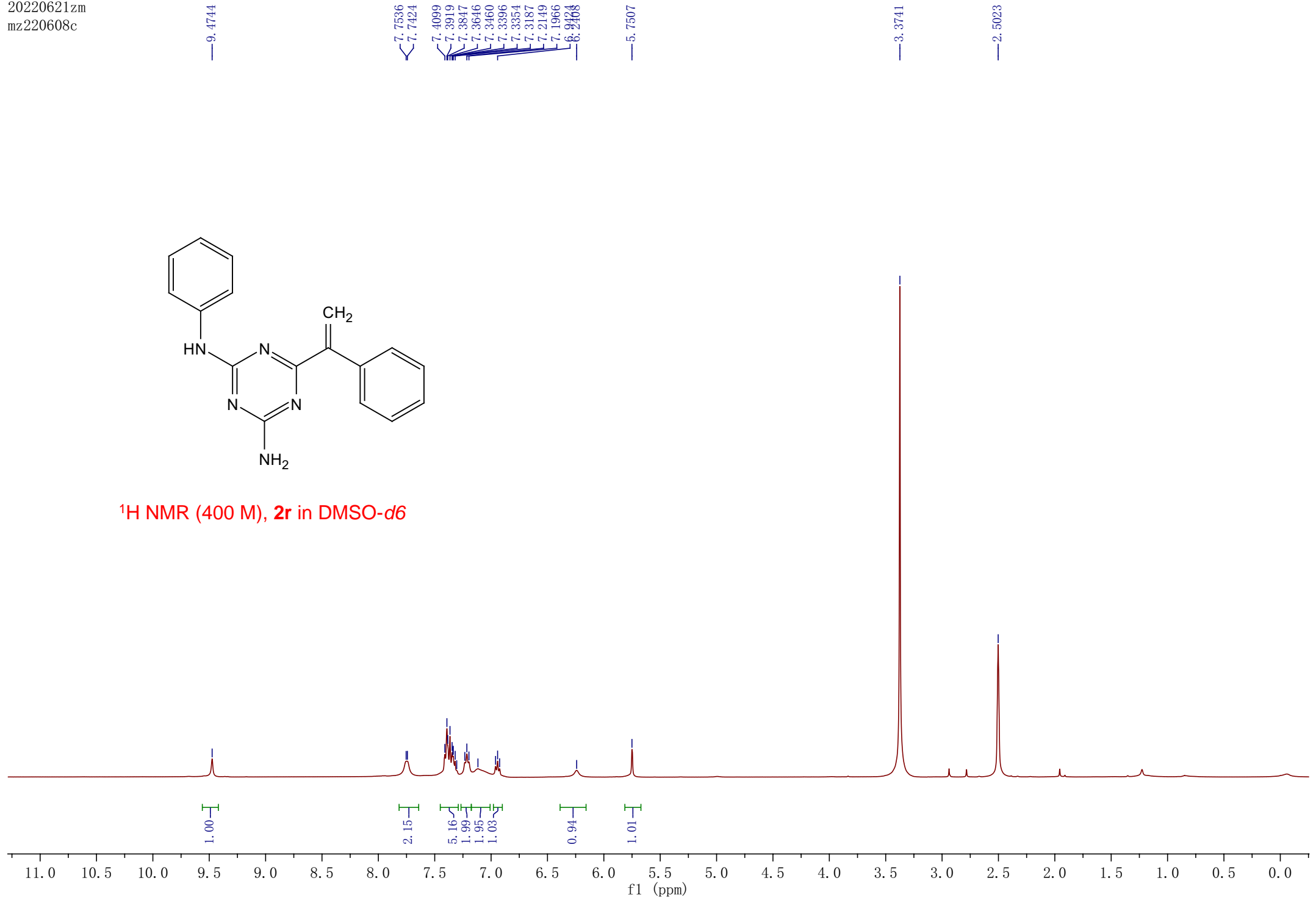
<sup>13</sup>C NMR (100 M), **2q** in CDCl<sub>3</sub>



20220621zm  
mz220608c



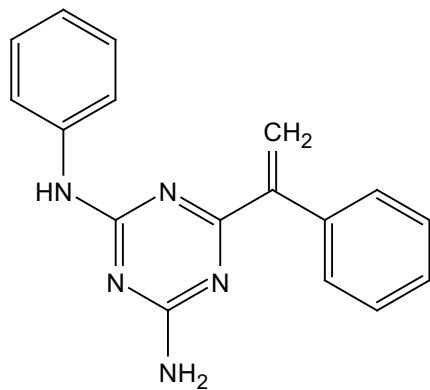
**<sup>1</sup>H NMR (400 M), 2r in DMSO-d<sub>6</sub>**



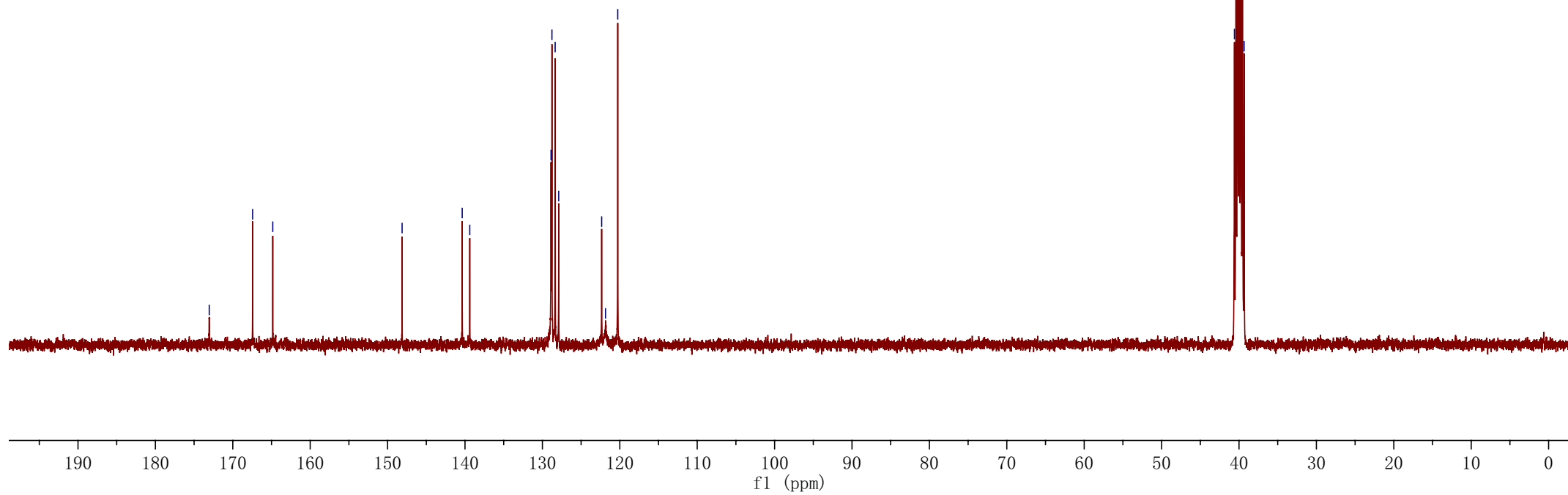
20220623zm  
mz220608c

173.0439  
167.4395  
164.8355  
148.1261  
140.3623  
139.3836  
128.8871  
128.7676  
128.3527  
127.8944  
122.3435  
121.8429  
120.2655

40.5930  
40.3846  
40.1760  
39.9676  
39.7585  
39.5496  
39.3413



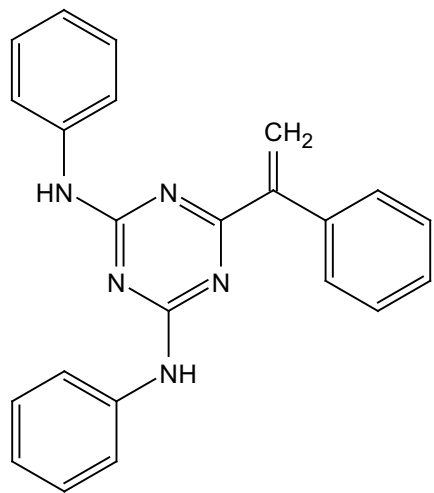
<sup>13</sup>C NMR (100 M), 2r in DMSO-d<sub>6</sub>



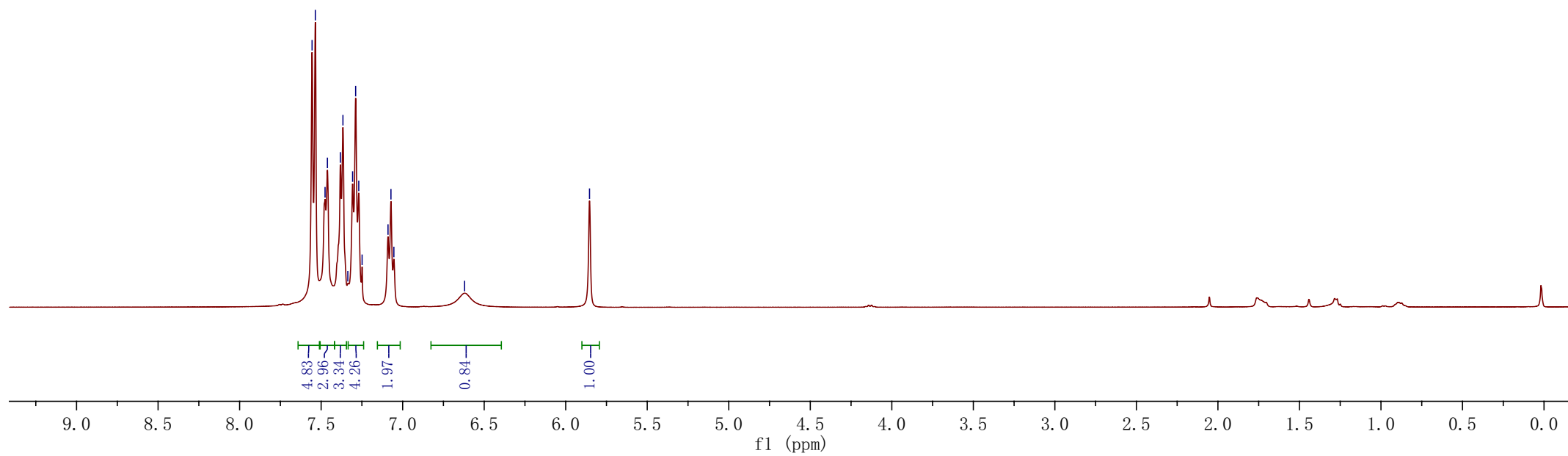
PROTON\_01  
WHF-ZM-01

7.5556  
7.5355  
7.4760  
7.4615  
7.3819  
7.3663  
7.3363  
7.3070  
7.2883  
7.2692  
7.2487  
7.0898  
7.0718  
7.0539  
6.6203

5.8539



<sup>1</sup>H NMR (400 M), 2a in CDCl<sub>3</sub>



20221010zm  
mz0820

173.0485

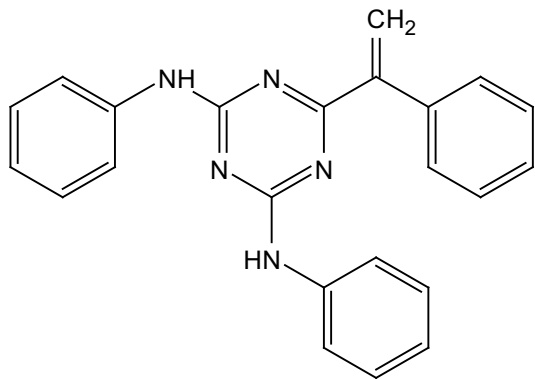
164.3504

147.5059

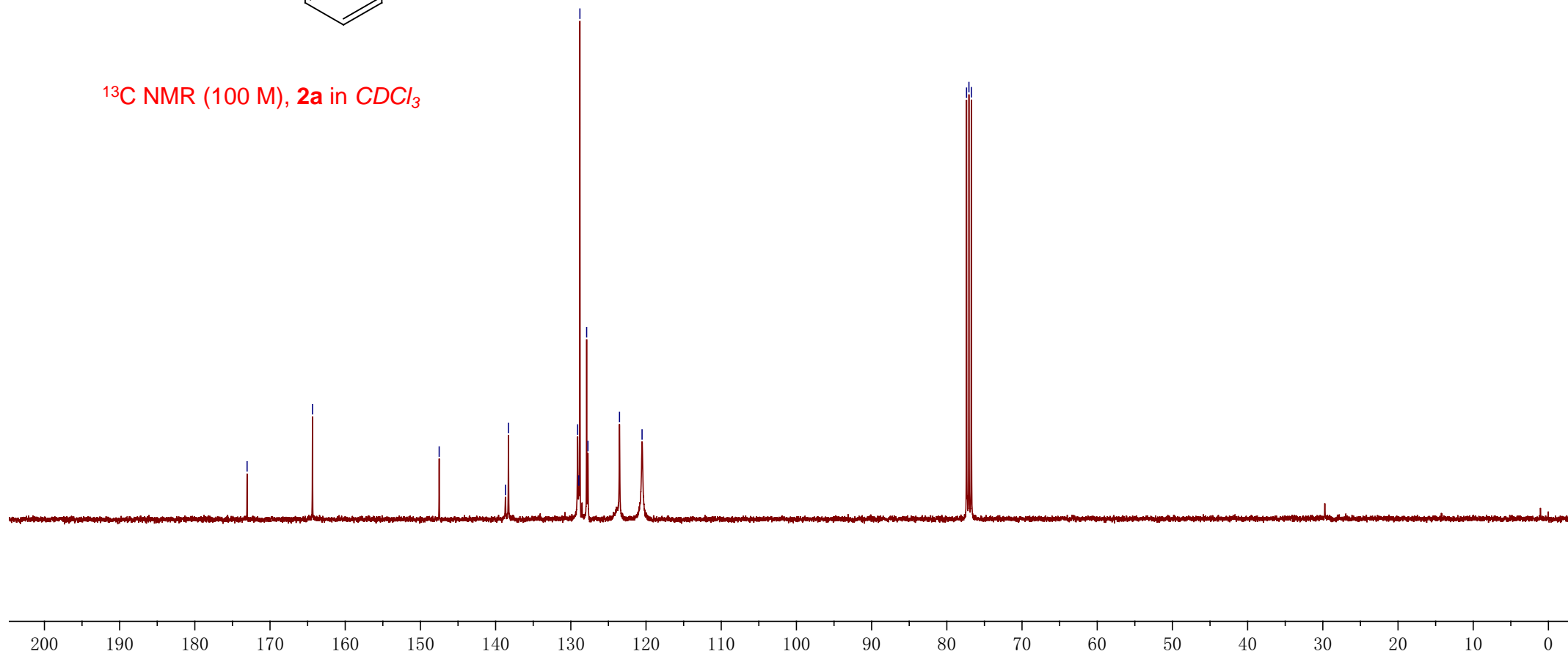
138.6931  
138.2917

129.0905  
128.9349  
128.7925  
127.8956  
127.7233  
123.5258  
120.5268

77.3764  
77.0588  
76.7415



<sup>13</sup>C NMR (100 M), 2a in CDCl<sub>3</sub>



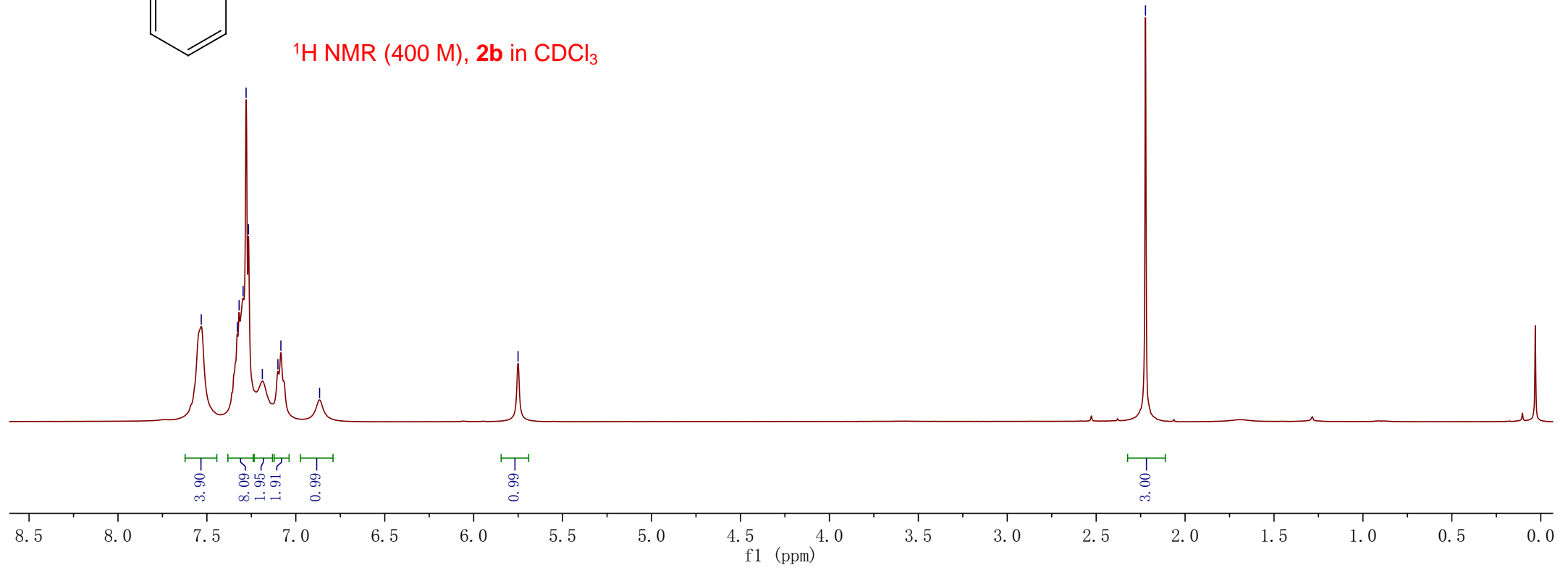
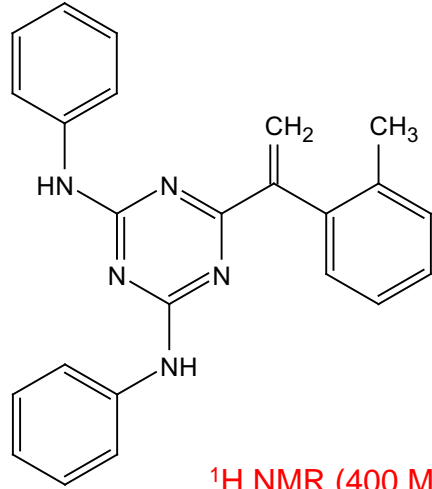


20220509zm  
zw6

7.5319  
7.3291  
7.3190  
7.2964  
7.2796  
7.2662  
6.8849

5.7505

2.2227



20220511zm  
zw6

172.5155

164.4573

147.8536

139.5762

138.3766

136.5834

129.9415

129.6306

128.8055

127.5961

125.5674

124.9963

123.3786

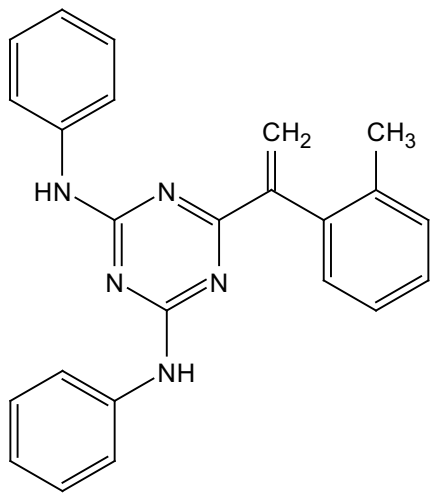
120.2039

77.3520

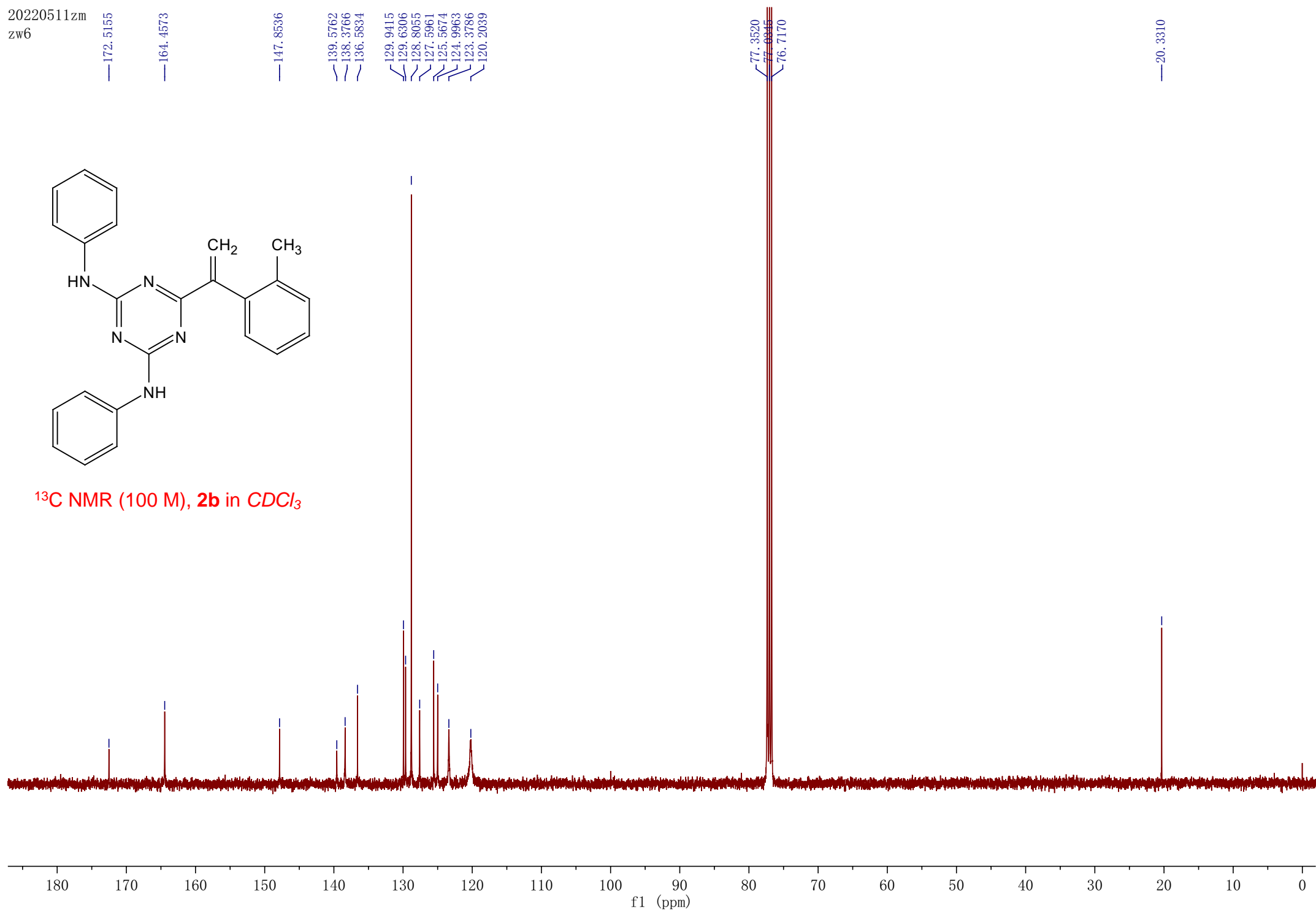
77.0945

76.7170

20.3310



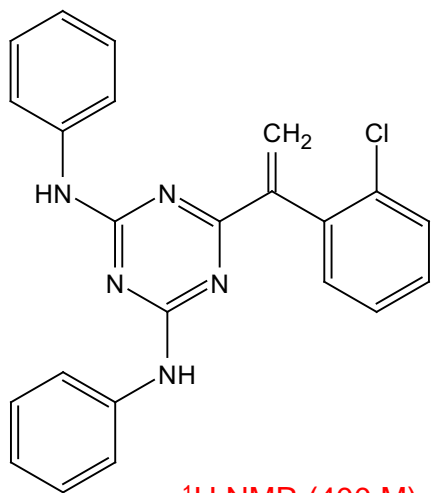
<sup>13</sup>C NMR (100 M), **2b** in CDCl<sub>3</sub>



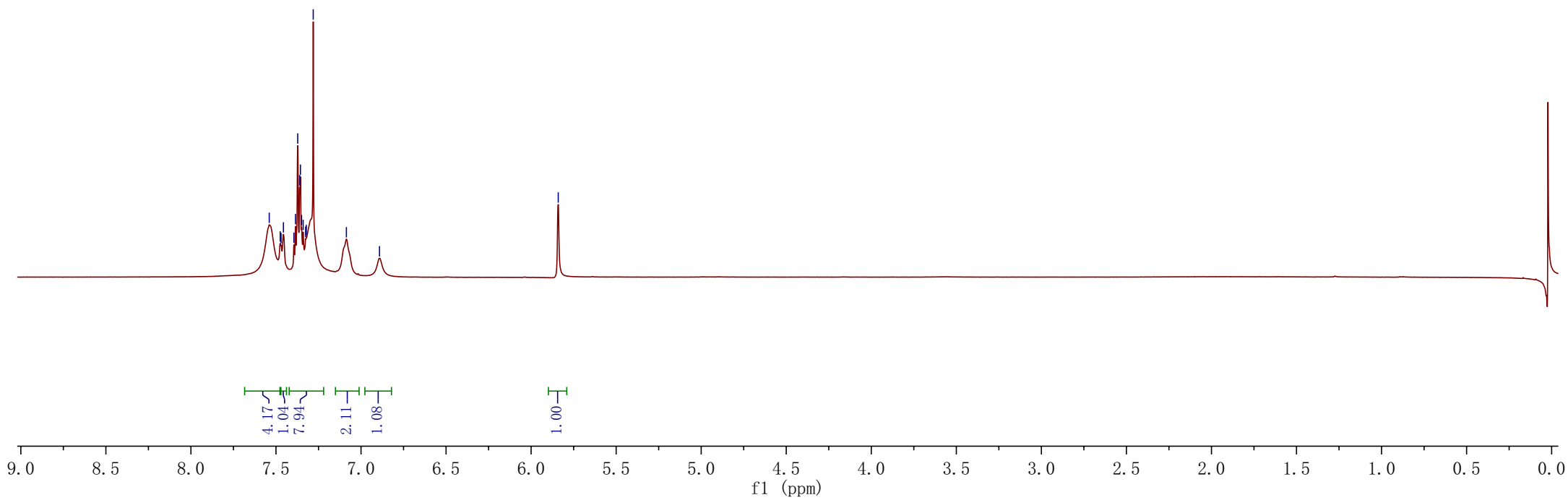
<sup>1</sup>H  
ZJH211018

7.5396  
7.4750  
7.4699  
7.4562  
7.3946  
7.3853  
7.3722  
7.3609  
7.3562  
7.3496  
7.3402  
7.3258  
7.3216  
7.2809  
7.0860  
6.8913

5.8405



<sup>1</sup>H NMR (400 M), **2c** in CDCl<sub>3</sub>



13C  
1018

171.8006

164.1006

145.8390

138.2005

133.7393

131.5126

129.1879

128.9118

128.7742

126.6307

126.0814

123.5956

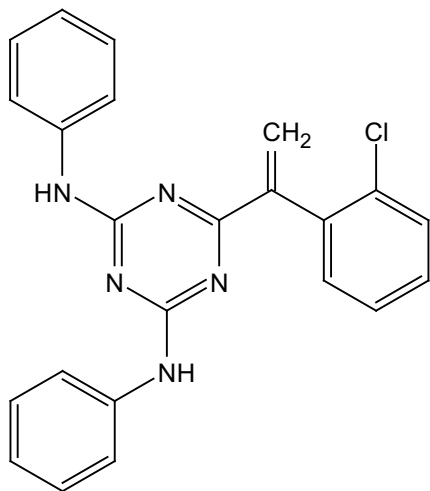
123.4976

120.4762

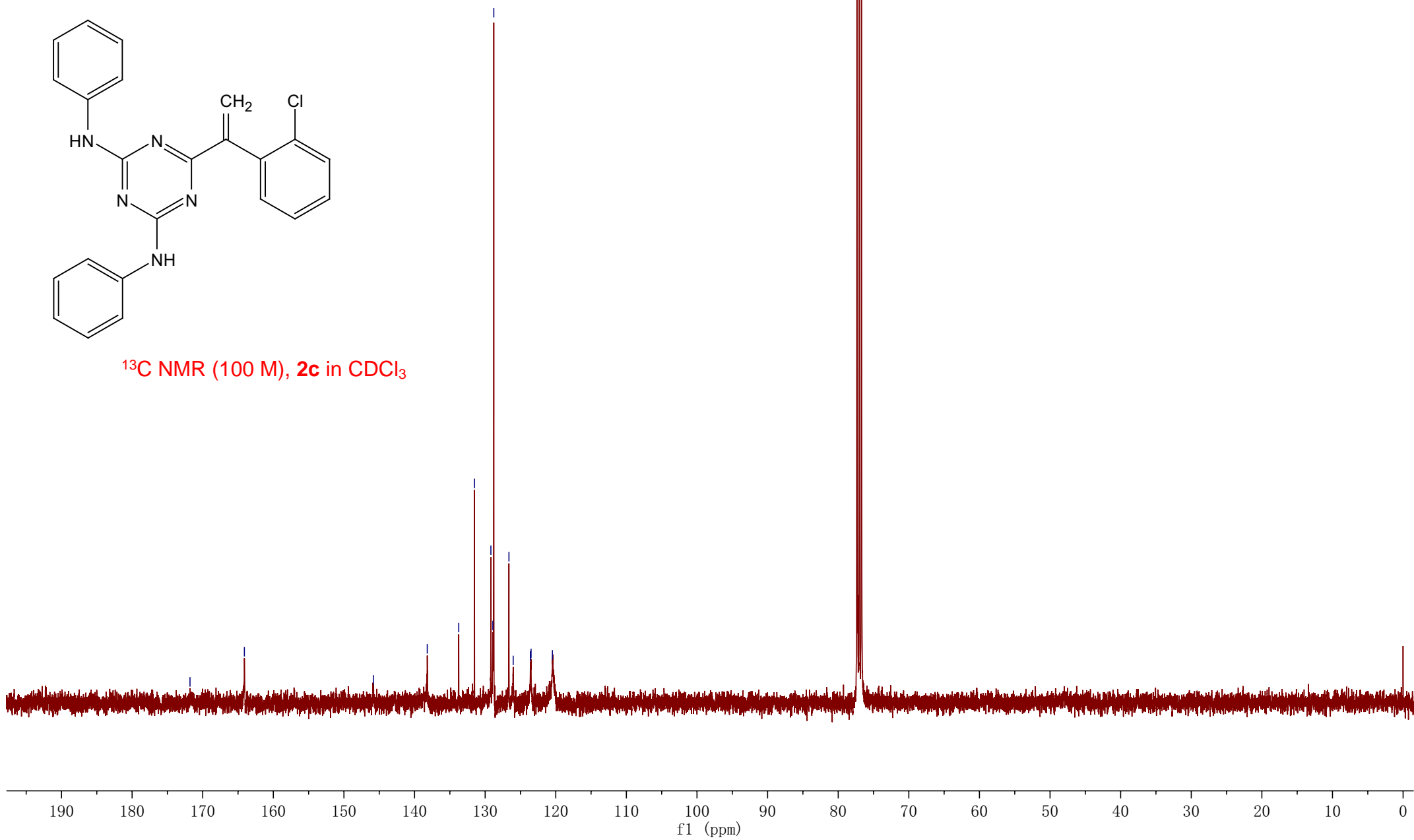
77.3406

77.0000

76.7055



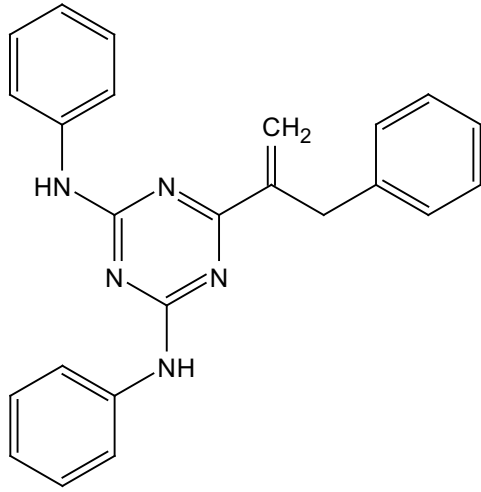
<sup>13</sup>C NMR (100 M), **2c** in CDCl<sub>3</sub>



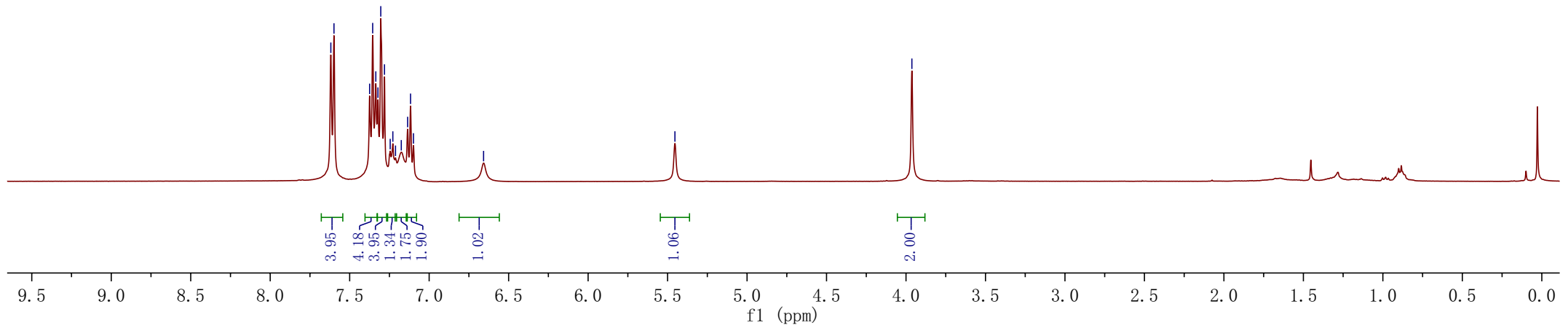
7.6185  
7.5988  
7.3745  
7.3554  
7.3356  
7.3221  
7.3044  
7.2810  
7.1355  
7.1171  
6.6576

5.4538

3.9630



<sup>1</sup>H NMR (400 M), 2d in CDCl<sub>3</sub>



20220511zm  
zw2

172.3796

164.4106

145.5222

139.8215

138.3163

129.1639

128.8537

128.3171

126.0479

123.5251

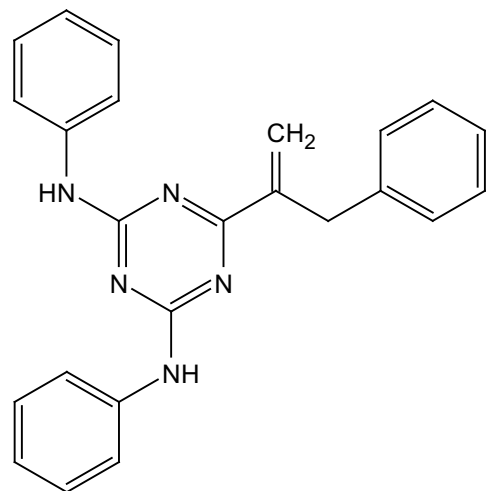
120.5415

77.3452

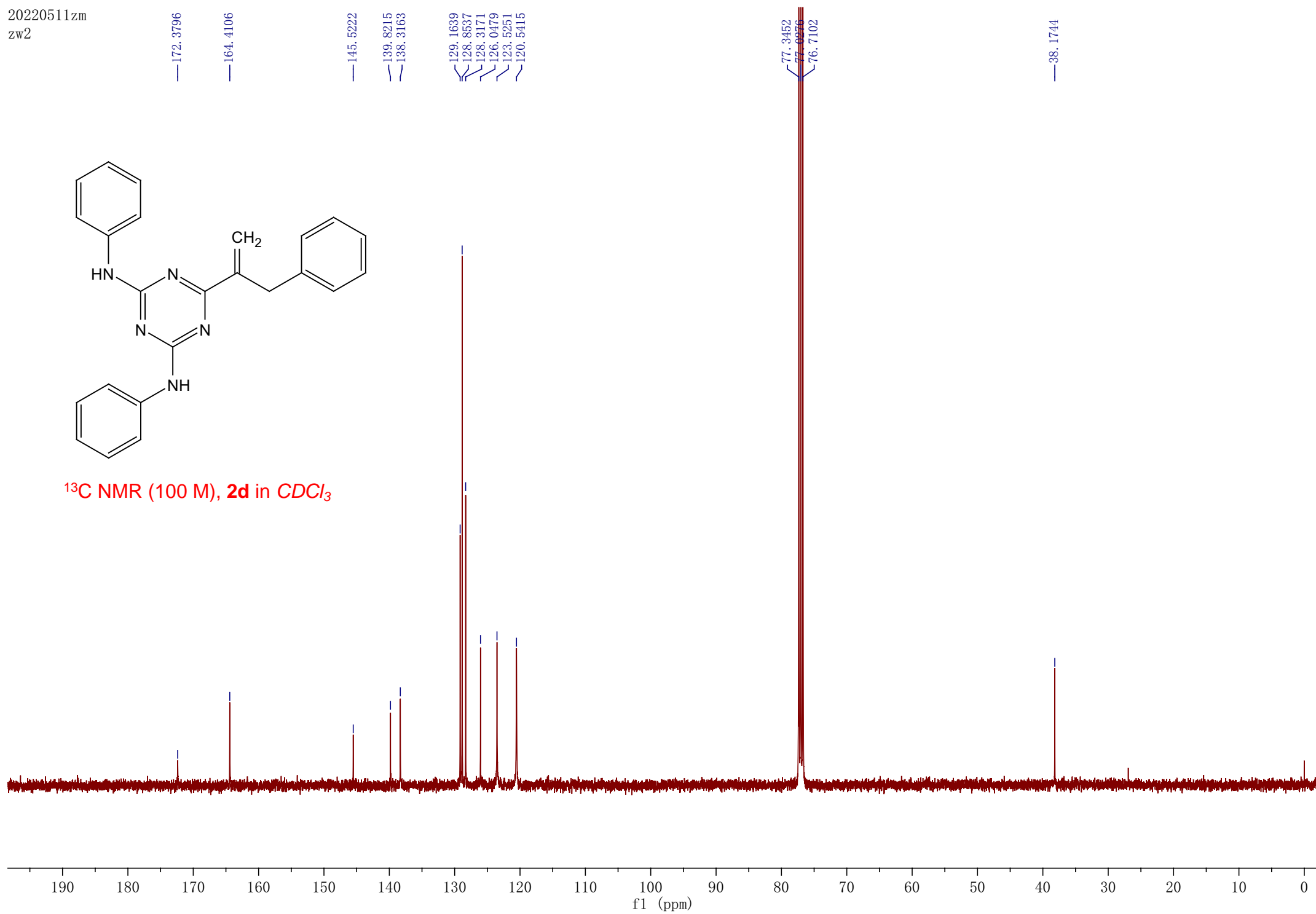
77.0256

76.7102

38.1744



<sup>13</sup>C NMR (100 M), 2d in CDCl<sub>3</sub>



20220509zm  
zw1

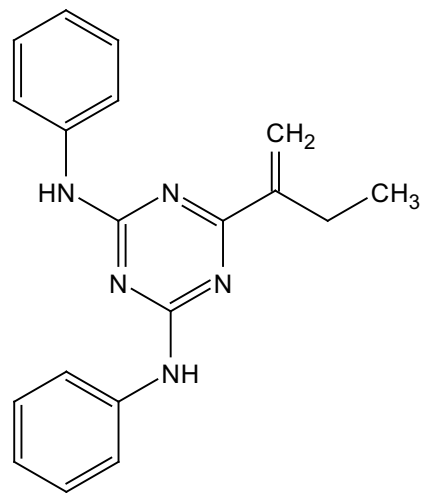
7.6596  
7.6400  
7.3863  
7.3671  
7.3474  
7.2810  
7.1967  
7.1357  
7.1173  
7.0990

6.4952

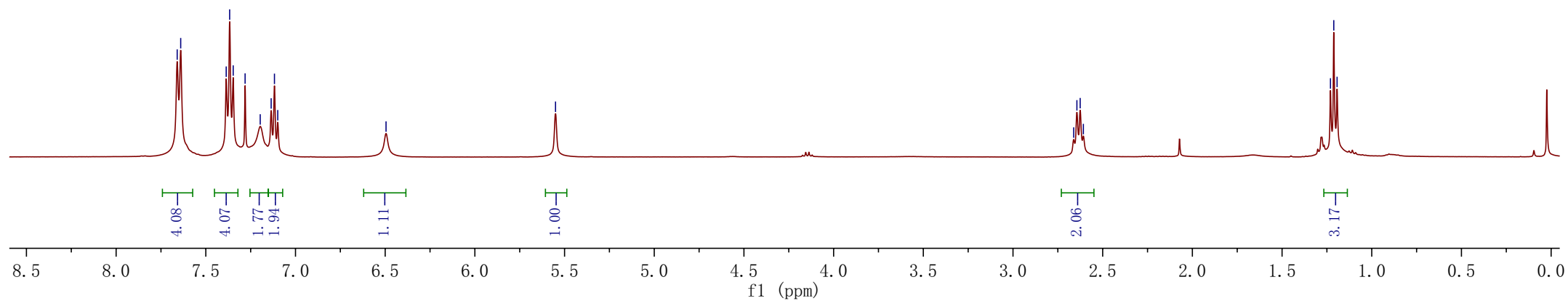
5.5503

2.6616  
2.6437  
2.6255  
2.6077

1.2301  
1.2117  
1.1933



**<sup>1</sup>H NMR (400 M), 2e in CDCl<sub>3</sub>**



20220511zm  
zw1

—172.9020

—164.4438

—147.9966

—138.4380

—128.8536

—123.4513

—120.4641

—120.2828

—120.2089

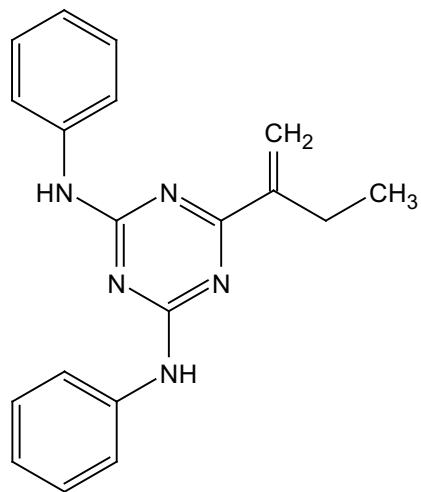
—77.3488

—77.0312

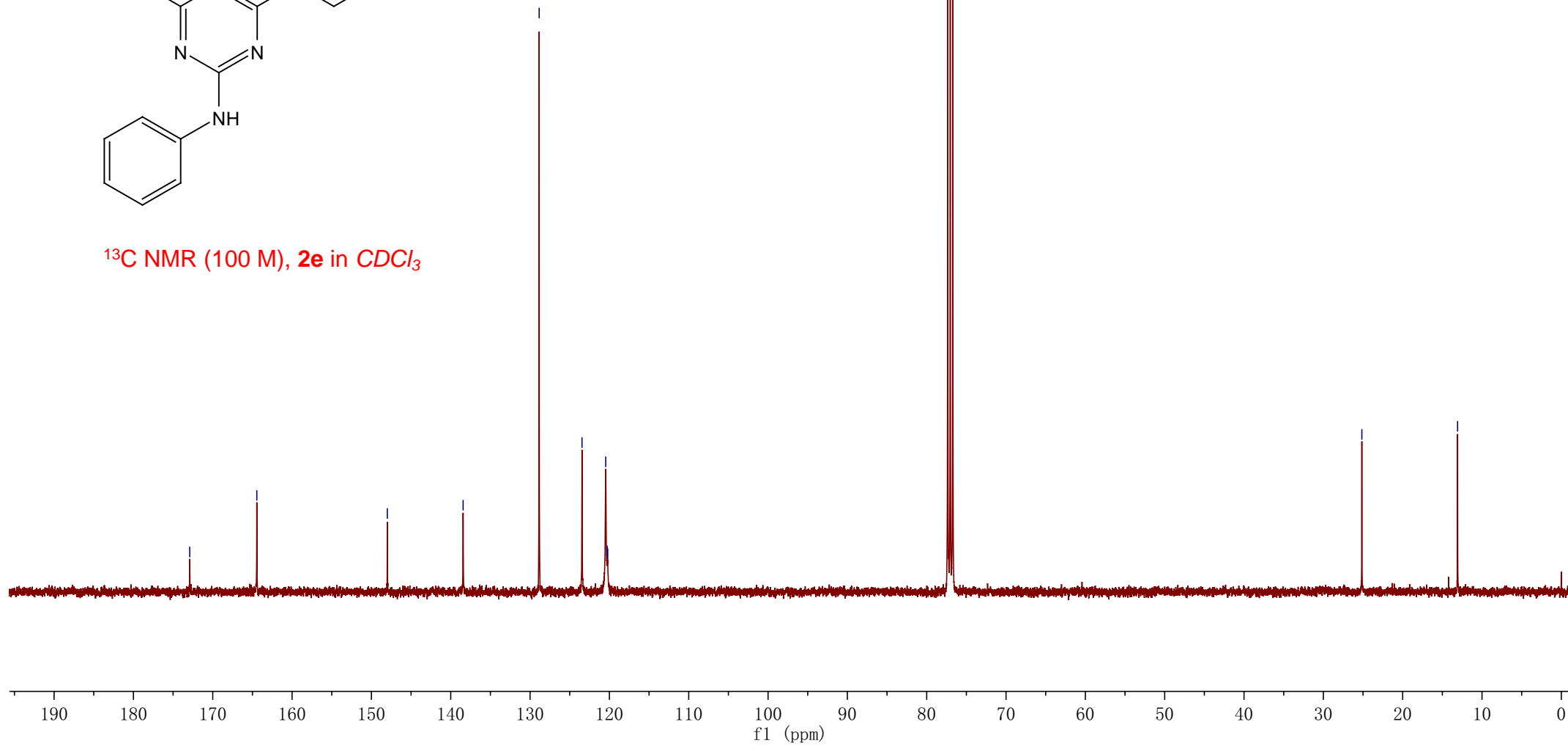
—76.7137

—25.1442

—13.0762



<sup>13</sup>C NMR (100 M), **2e** in CDCl<sub>3</sub>





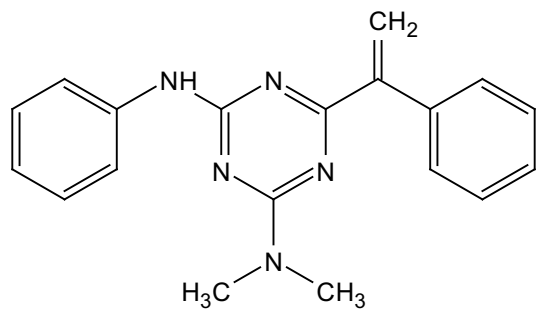
20191210-H1-WHF-ZM-P1  
20191210-H1-WHF-ZM-P1  
CDC13

7.5911  
7.5780  
7.4897  
7.4871  
7.4840  
7.4758  
7.4741  
7.3702  
7.3674  
7.3645  
7.3560  
7.3534  
7.3436  
7.3360  
7.3336  
7.3313  
7.3262  
7.3219  
7.3165  
7.3118  
7.3097  
7.2873  
7.2747  
7.2619  
7.2504  
7.0859  
7.0237  
7.0114  
6.9992  
6.5461

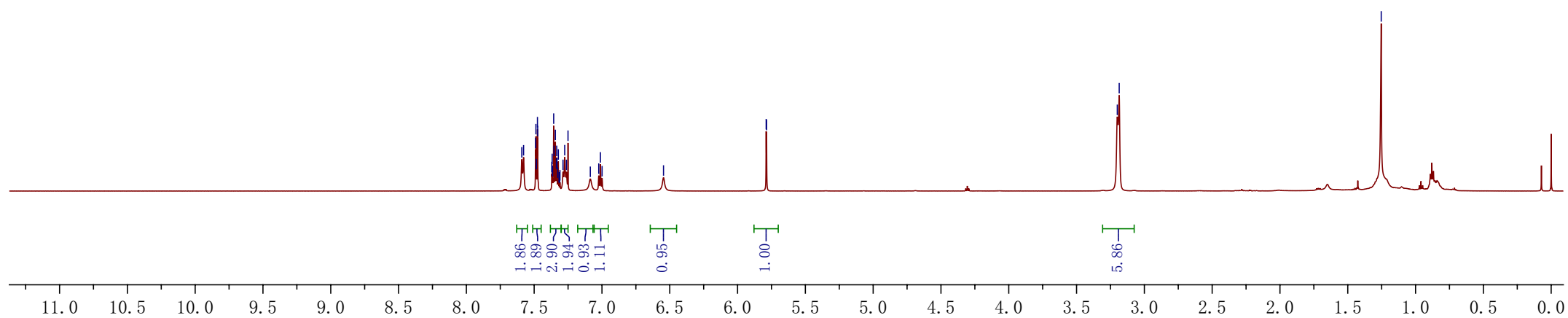
5.7890  
5.7860

3.1996  
3.1856

1.2532



<sup>1</sup>H NMR (600 M), **2f** in CDCl<sub>3</sub>



20191216-C13-WHF-ZM-P1  
20191216-C13-WHF-ZM-P1  
CDC13

— 171.9832

— 165.5242  
— 164.0592

— 147.9279

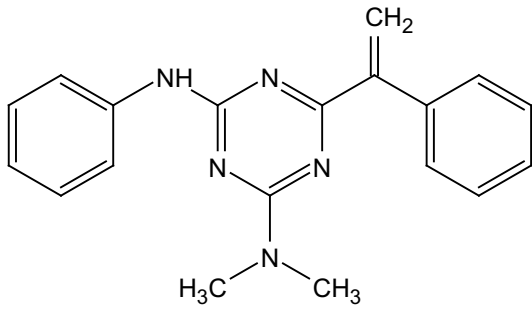
— 139.1524  
— 139.1143

— 129.0851  
— 128.7621  
— 127.6919  
— 127.4559  
— 122.7387  
— 122.6032  
— 119.5539

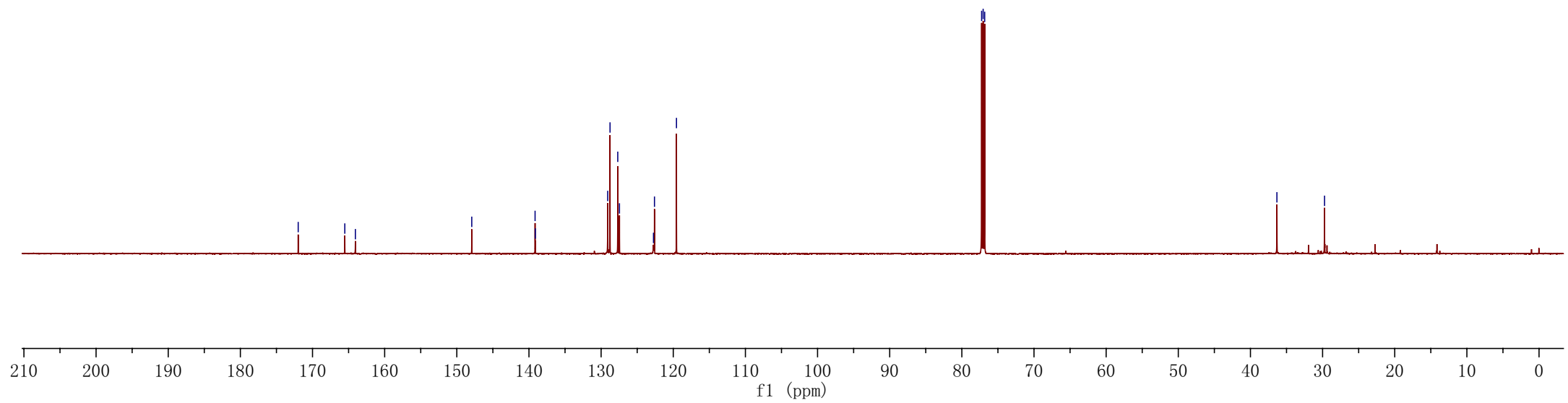
— 77.2596  
— 77.0480  
— 76.8364

— 36.3306

— 29.7301



<sup>13</sup>C NMR (150 M), **2f** in CDCl<sub>3</sub>



20220621zm  
mz220615a

9.5775

7.7674  
7.7506  
7.7115  
7.6924  
7.6810  
7.6604  
7.5507  
7.5303  
7.5023  
7.4836  
7.4645  
7.3951  
7.3769  
7.3585  
7.2411  
6.9668  
6.9490  
6.9314

6.3925

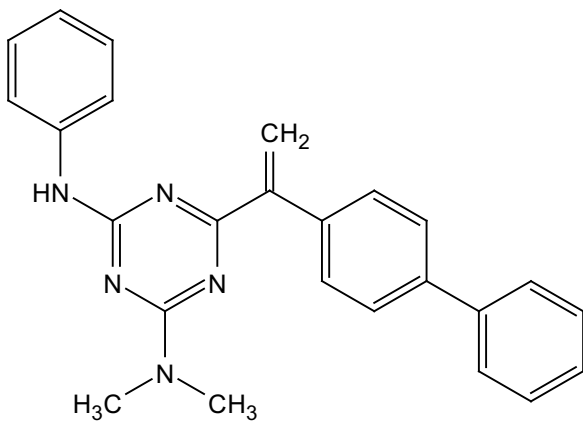
5.8577

3.3425

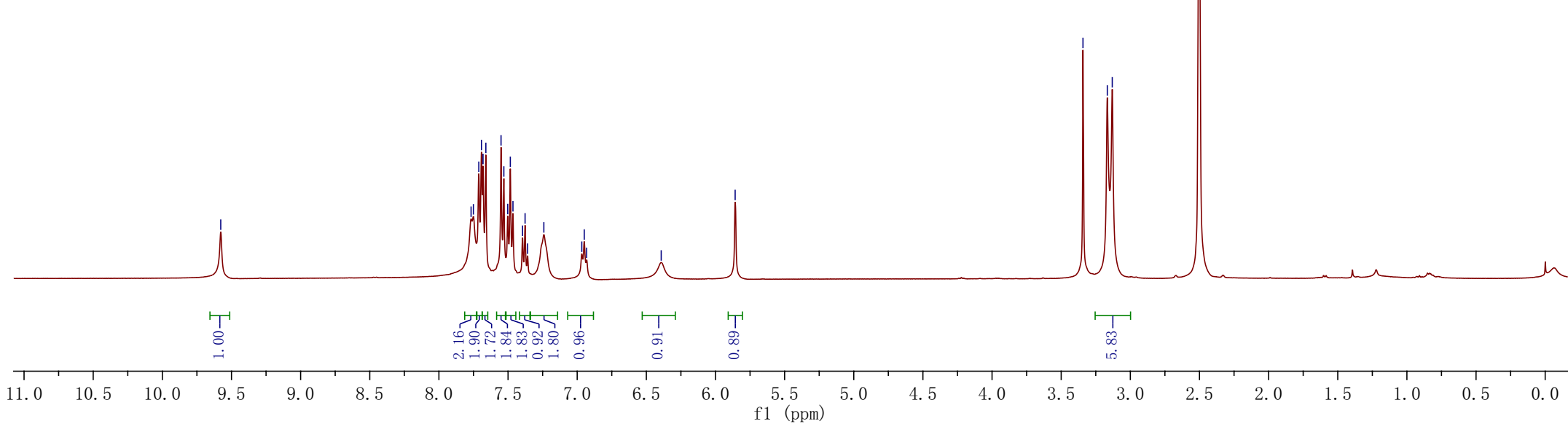
3.1666

3.1308

2.5026



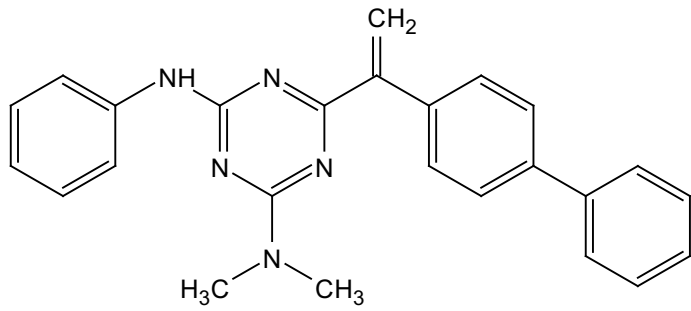
**<sup>1</sup>H NMR (400 M), 2g in DMSO-d<sub>6</sub>**



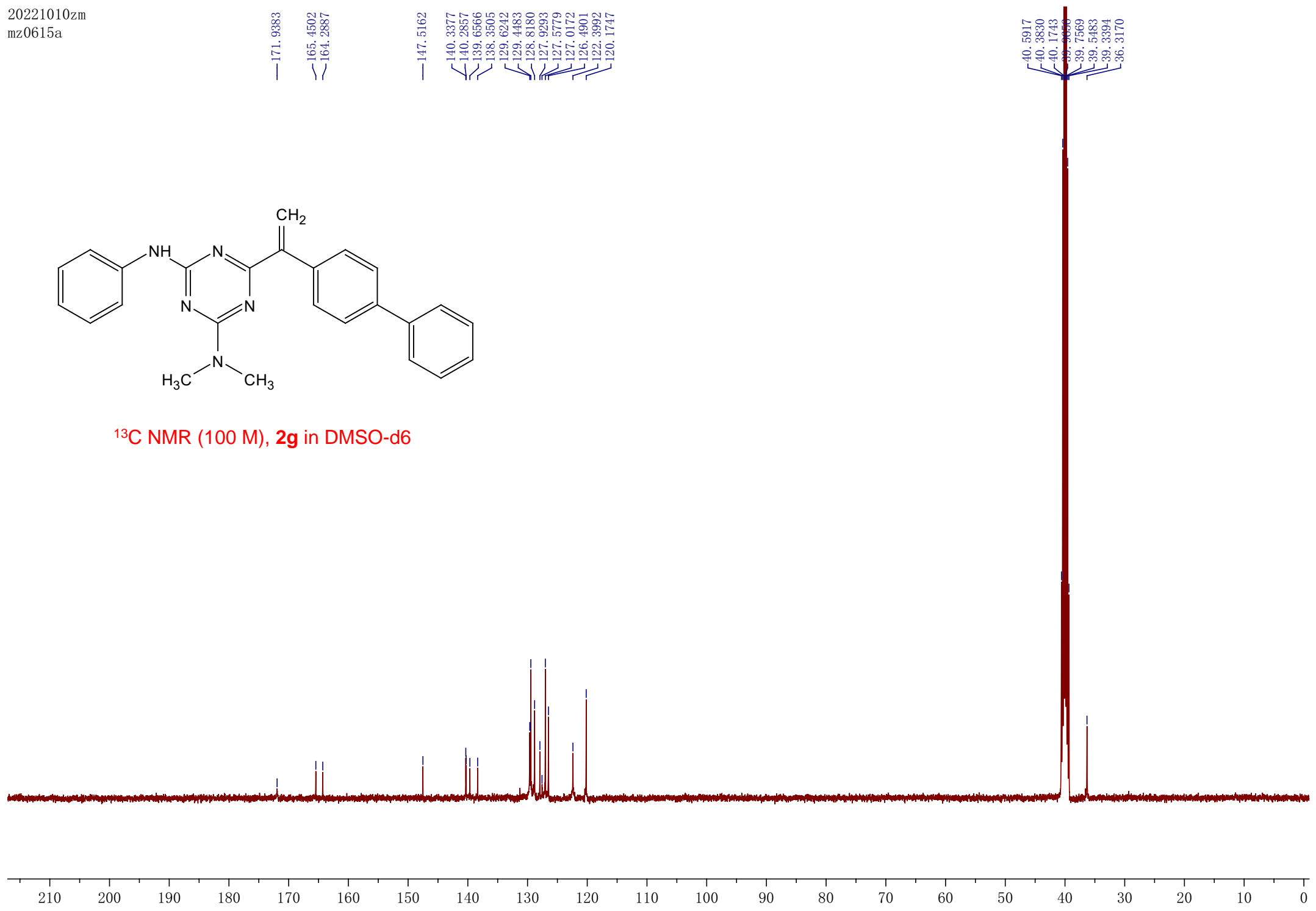
20221010zm  
mz0615a

171.9383  
165.4502  
164.2887  
147.5162  
140.3377  
140.2857  
139.6566  
138.3505  
129.6242  
129.4483  
128.8180  
127.9293  
127.5779  
127.0172  
126.4901  
122.3992  
120.1747

40.5917  
40.3830  
40.1743  
39.9656  
39.7569  
39.5483  
39.3394  
36.3170



<sup>13</sup>C NMR (100 M), 2g in DMSO-d<sub>6</sub>

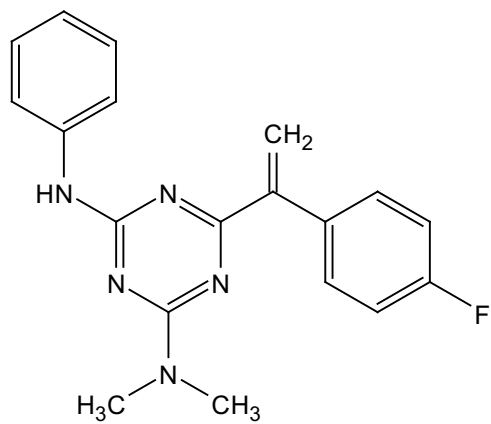


目标化合物  
ww20210106a

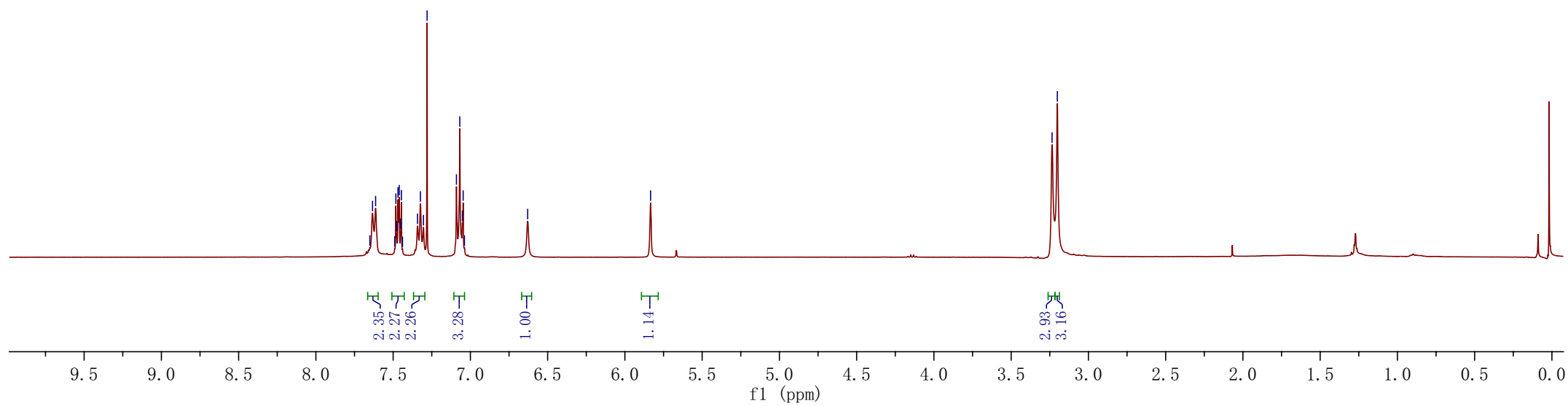
7.6507  
7.6334  
7.6135  
7.4896  
7.4823  
7.4769  
7.4686  
7.4604  
7.4520  
7.4467  
7.4392  
7.3423  
7.3234  
7.3038  
7.2804  
7.0902  
7.0686  
7.0516  
7.0467  
7.0386  
6.6291

5.8336

3.2353  
3.2012



<sup>1</sup>H NMR (400 M), 2h in CDCl<sub>3</sub>



20220304zm  
ww20210106a

164.9330  
164.3311  
163.6989  
161.2508  
160.4738

138.5818

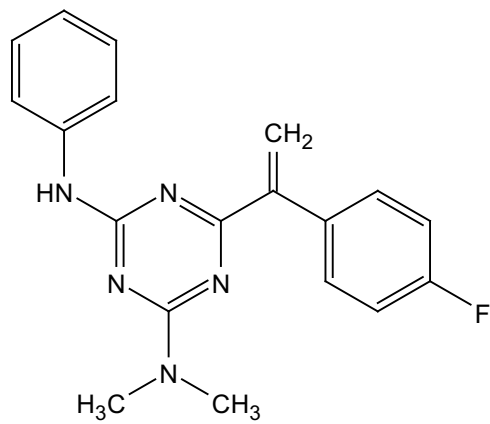
130.8034  
130.7241  
128.8224

123.8037  
123.1340  
119.8815

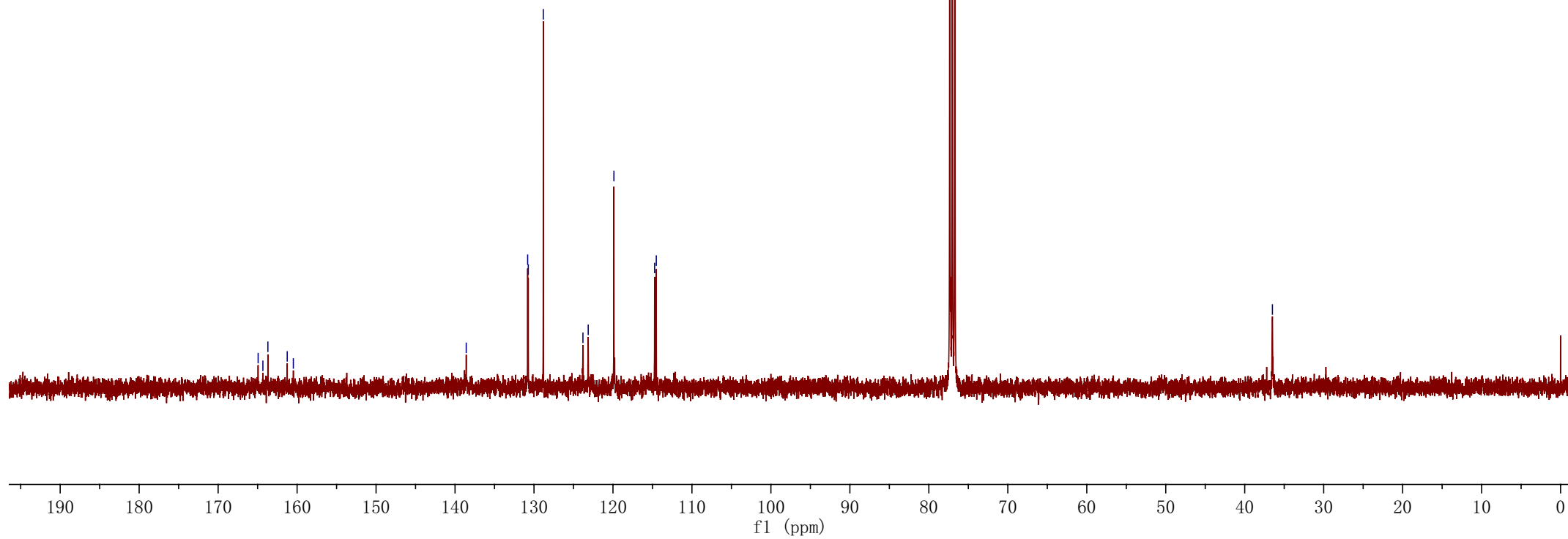
114.7268  
114.5146

77.3461  
77.0996  
76.7111

36.4921



<sup>13</sup>C NMR (100 M), 2h in CDCl<sub>3</sub>

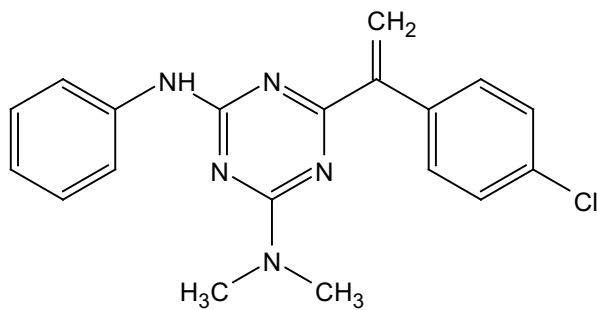


NMR  
1t0228

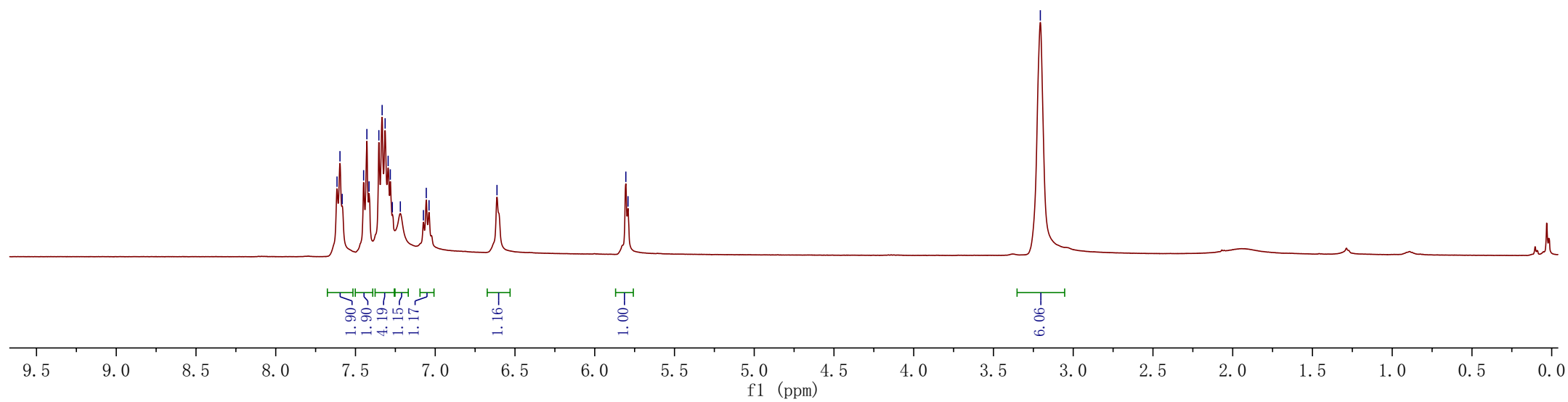
7.6158  
7.5973  
7.5834  
7.4490  
7.4285  
7.4150  
7.3535  
7.3329  
7.3142  
7.2953  
7.2816  
7.2689  
7.2188  
7.0740  
7.0562  
7.0389  
6.6128

5.8049  
5.7913

3.2062



<sup>1</sup>H NMR (400 M), **2i** in CDCl<sub>3</sub>



20220511zm  
1t7

171.4284

165.4427  
163.9682

146.7867

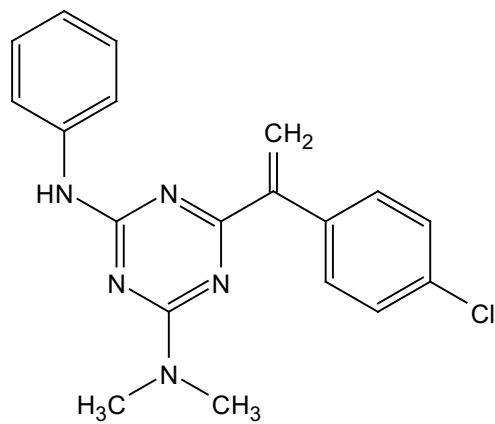
139.0163  
137.5254

133.3639  
130.4676  
128.7864  
127.8258

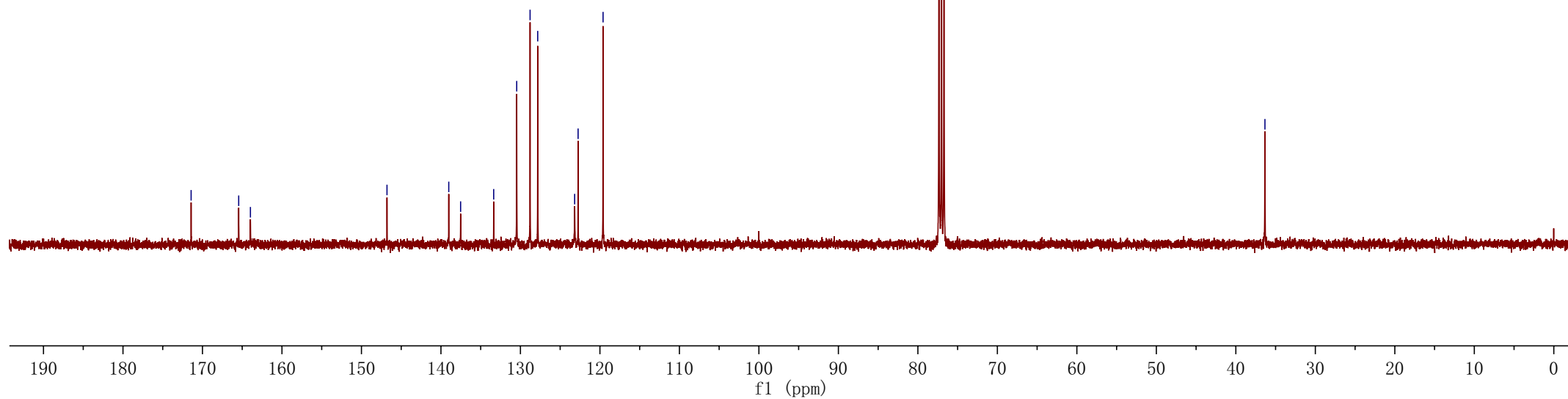
123.1790  
122.7451  
119.6037

77.3482  
77.0308  
76.7133

36.3396



$^{13}\text{C}$  NMR (100 M), **2i** in  $\text{CDCl}_3$



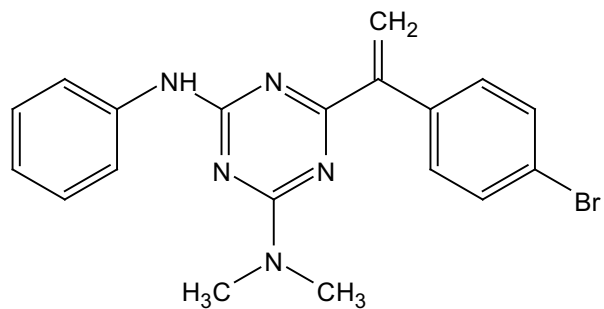


20220112zm  
WW20220106

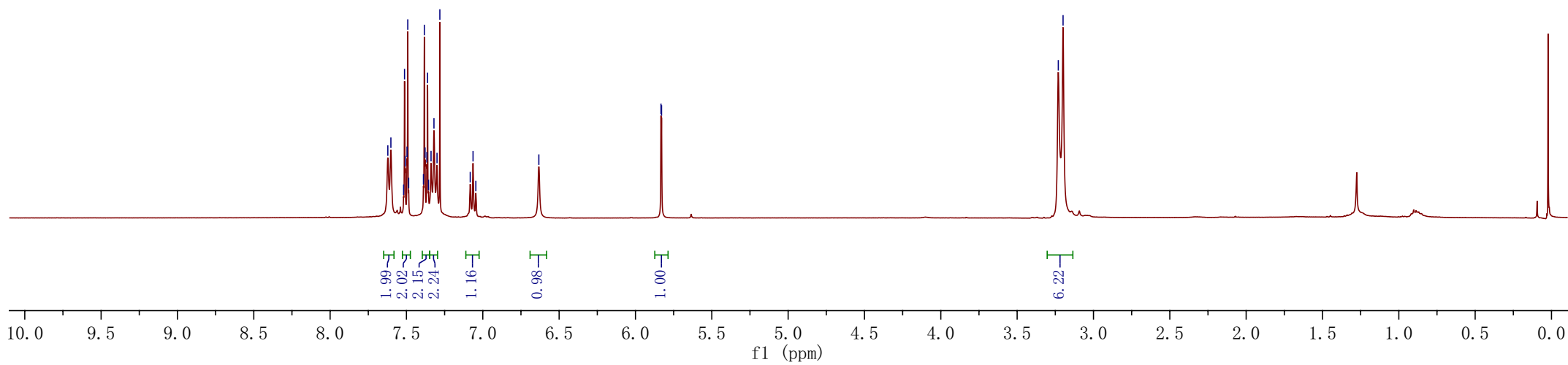
7.6219  
7.6020  
7.5186  
7.5126  
7.5080  
7.4961  
7.4914  
7.4855  
7.3887  
7.3829  
7.3781  
7.3662  
7.3617  
7.3557  
7.3389  
7.3198  
7.2998  
7.2812  
7.0823  
7.0639  
7.0455  
6.6328

5.8328  
5.8291

3.2305  
3.1992

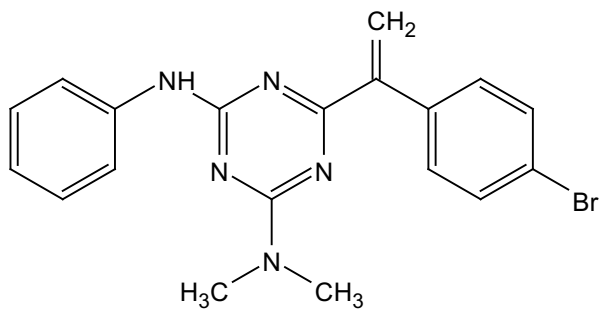


<sup>1</sup>H NMR (400 M), 2j in CDCl<sub>3</sub>

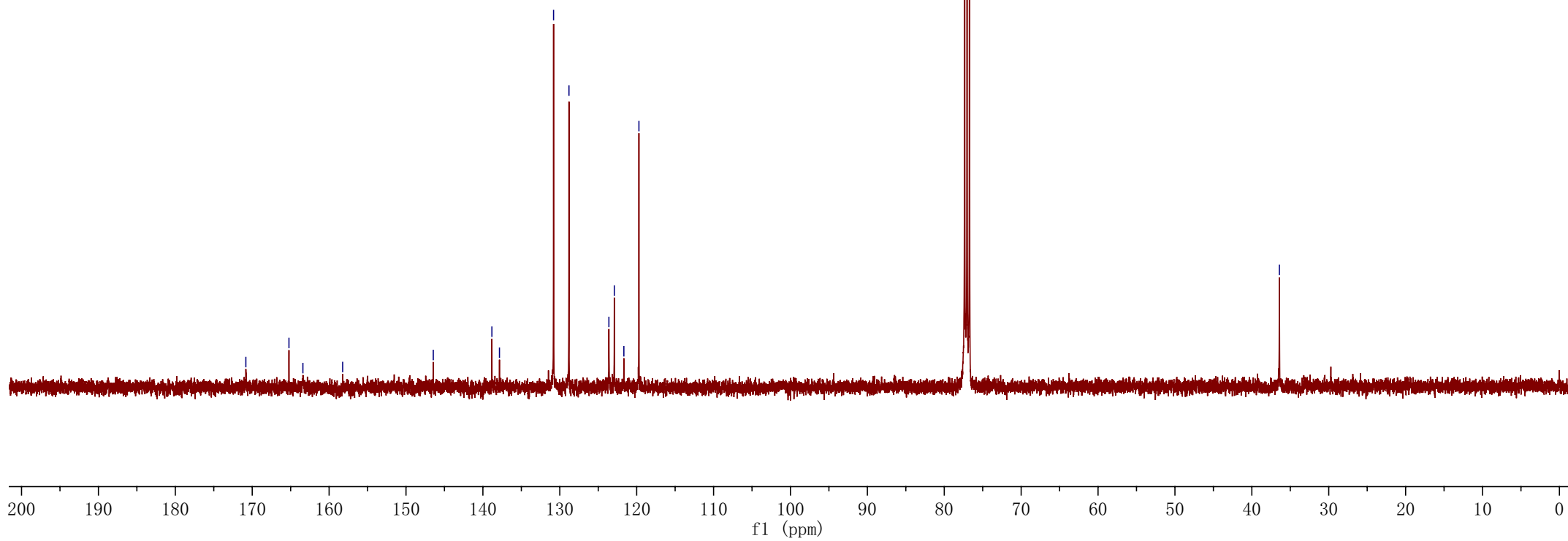


20220117zm  
ww20220106

170.8265  
165.2213  
163.4079  
158.2353  
146.4533  
138.8294  
137.8459  
130.8104  
128.8066  
123.6142  
122.9098  
121.6661  
119.7084  
77.3516  
77.0846  
76.7165  
36.4182



<sup>13</sup>C NMR (100 M), **2j** in CDCl<sub>3</sub>



—9.52

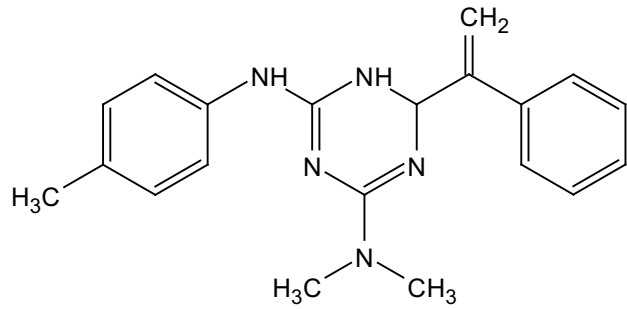
7.75  
7.74  
7.34  
7.32  
7.24  
7.18  
7.16  
6.97  
6.95  
6.93

—6.30

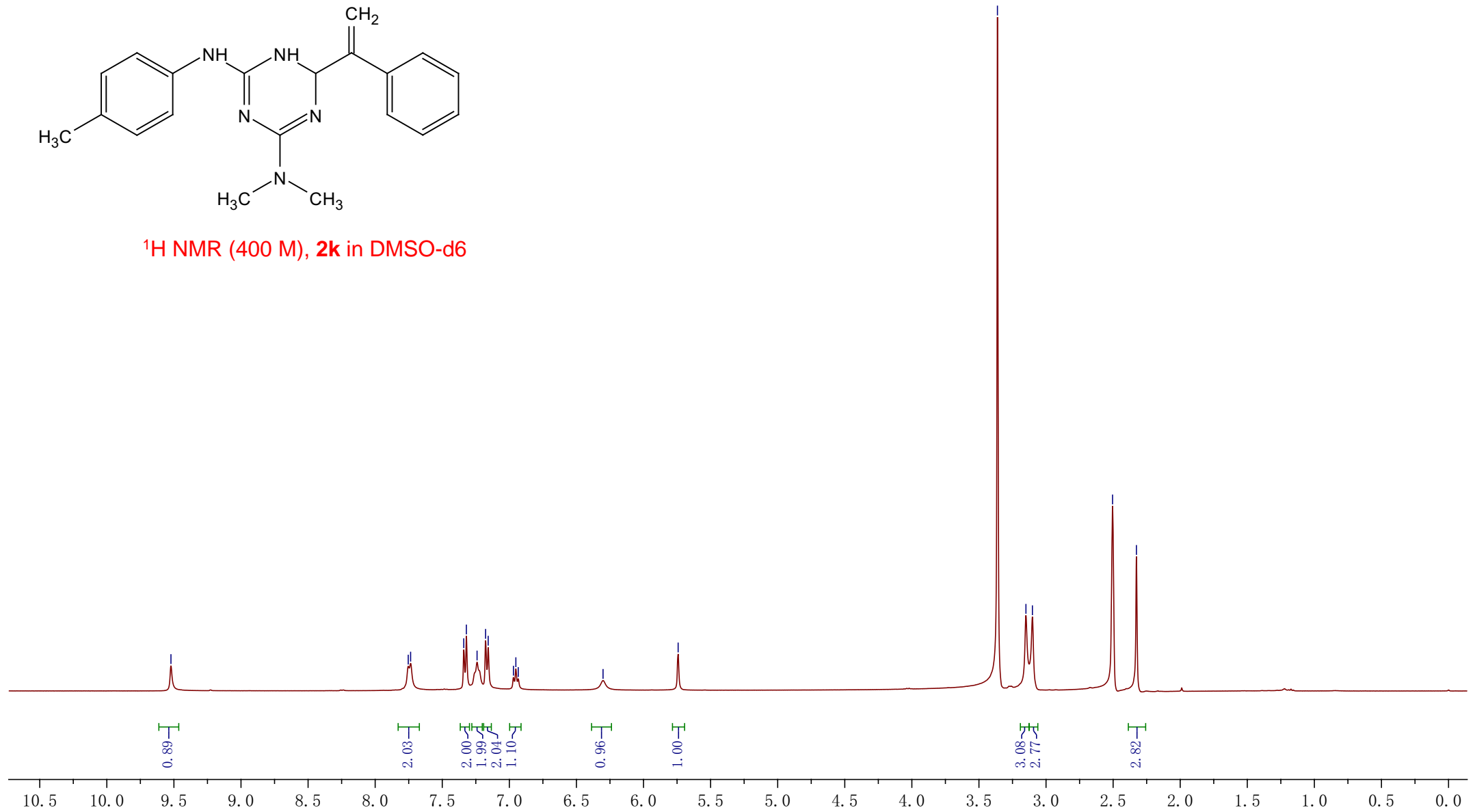
—5.74

3.36  
3.15  
3.10

—2.50  
—2.33



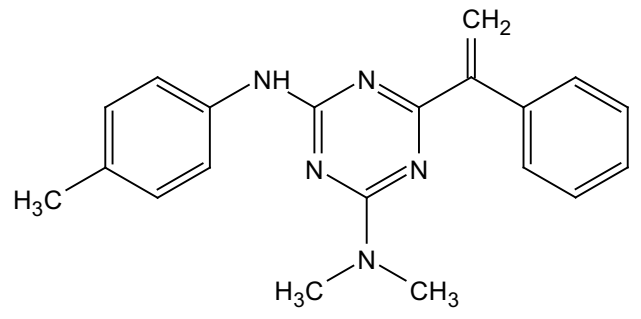
**<sup>1</sup>H NMR (400 M), **2k** in DMSO-d<sub>6</sub>**



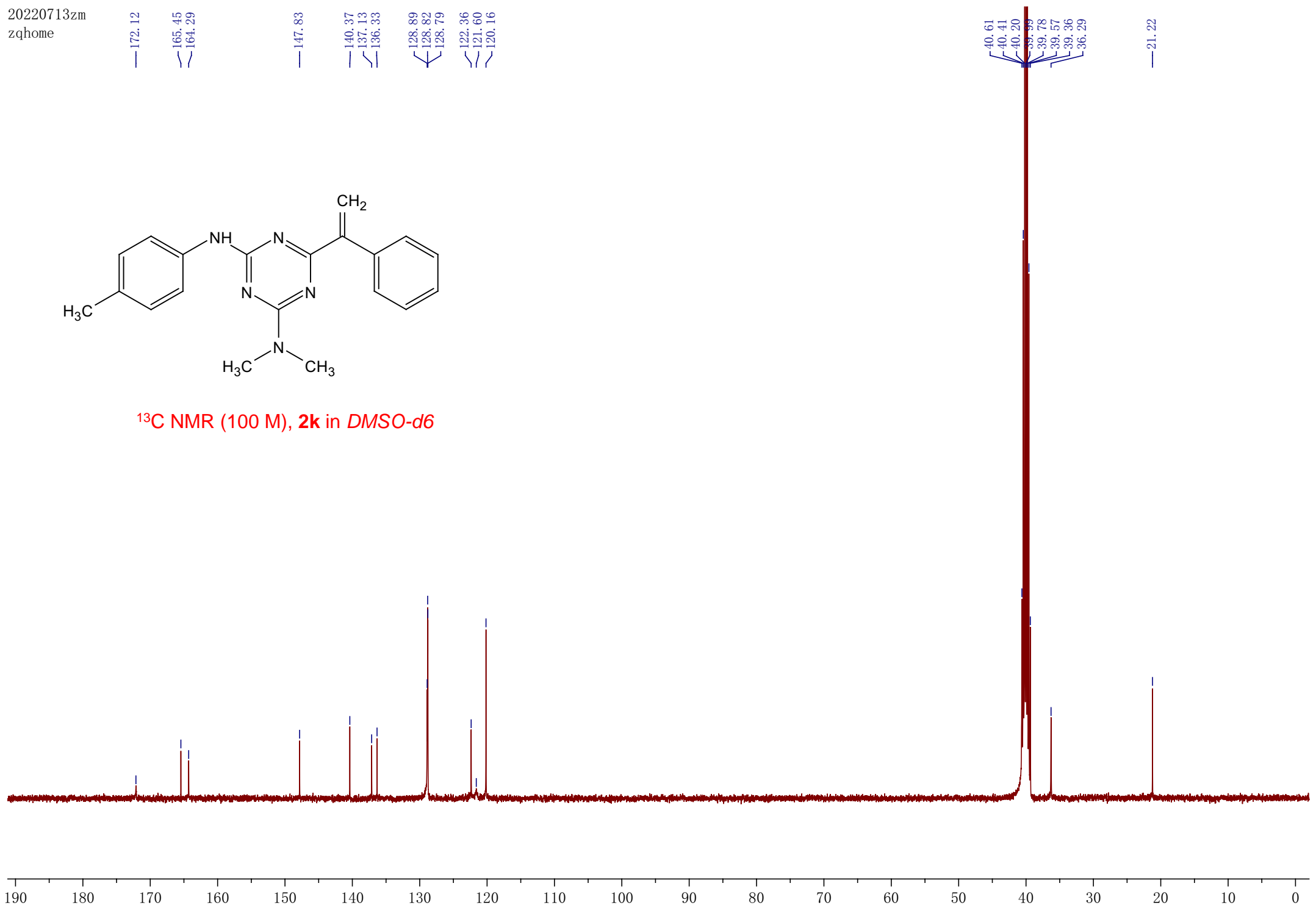
20220713zm  
zqhome

172.12  
165.45  
164.29  
147.83  
140.37  
137.13  
136.33  
128.89  
128.82  
128.79  
122.36  
121.60  
120.16

40.61  
40.41  
40.20  
39.78  
39.57  
39.36  
36.29  
21.22



<sup>13</sup>C NMR (100 M), 2k in DMSO-d<sub>6</sub>

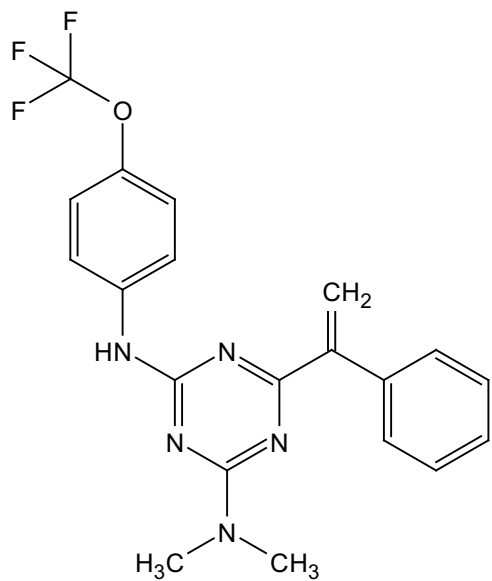


<sup>1</sup>H  
ww20211130

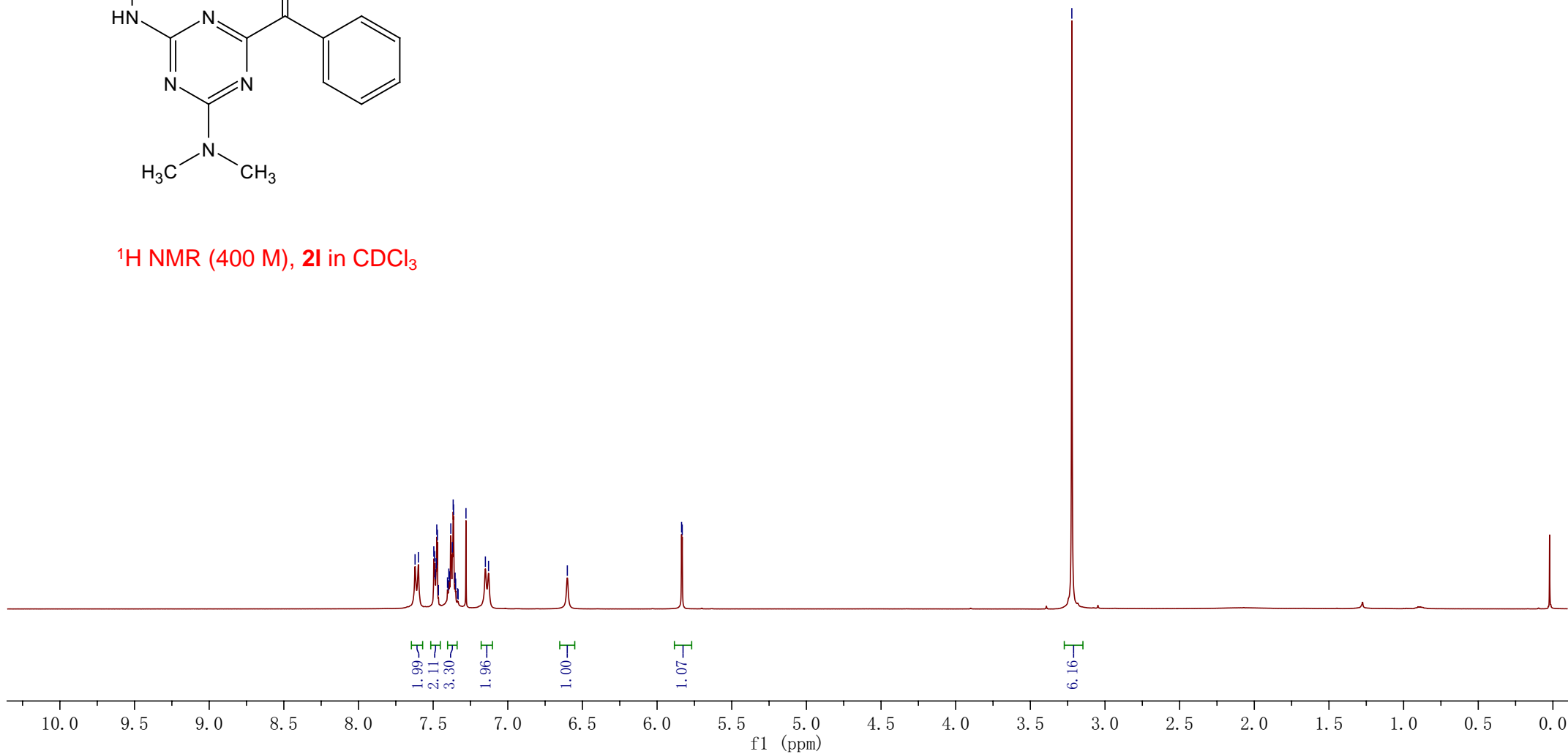
7.6211  
7.5991  
7.4954  
7.4904  
7.4856  
7.4797  
7.4756  
7.4716  
7.4646  
7.4038  
7.3998  
7.3950  
7.3904  
7.3816  
7.3712  
7.3657  
7.3635  
7.3529  
7.3492  
7.3368  
7.3328  
7.2801  
7.1501  
7.1289  
6.6013

5.8361  
5.8316

3.2222



<sup>1</sup>H NMR (400 M), **21** in CDCl<sub>3</sub>



20220304zm  
ww20211130

171.5501

165.2668  
163.4678

147.4874

144.1193

138.8737  
137.7510

129.0715  
127.7250

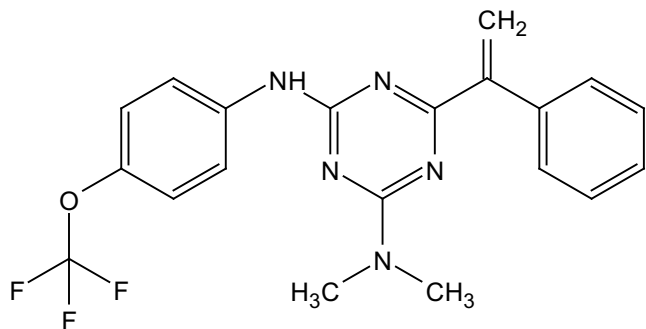
127.5622  
123.3352

121.8323  
121.5565

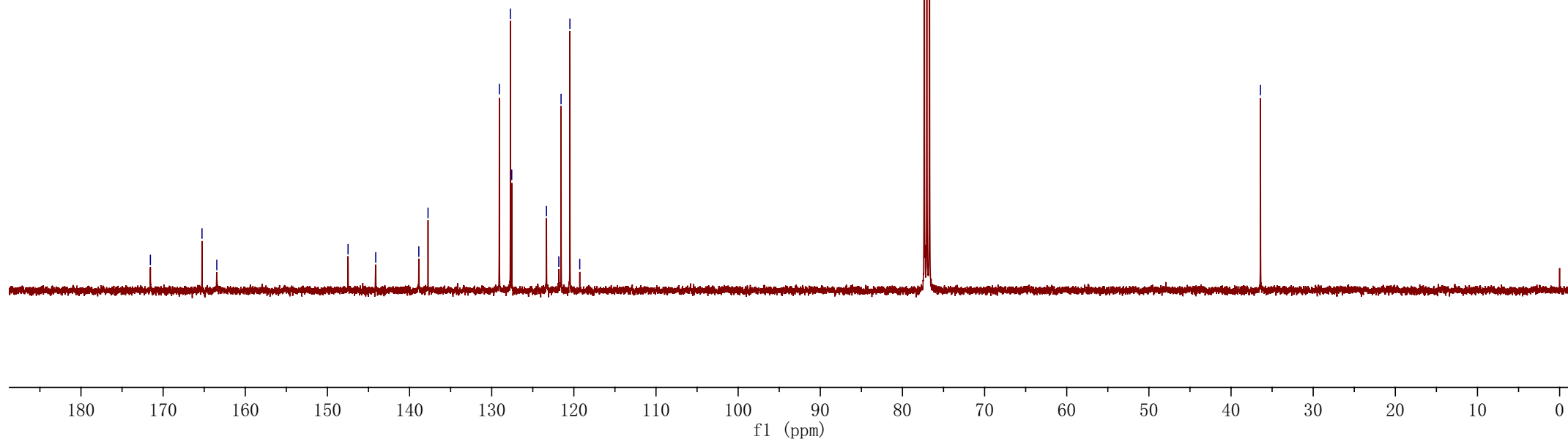
120.4810  
119.2835

77.3472  
77.0996  
76.7122

36.4155



<sup>13</sup>C NMR (100 M), **2I** in CDCl<sub>3</sub>



20190419-H1-WHF  
20190419-H1-WHF  
CDC13

7.46135  
7.45958  
7.45818  
7.3111  
7.2995  
7.2934  
7.2908  
7.2793  
7.2740  
7.2691  
7.2672  
7.2551  
7.2423  
7.2266

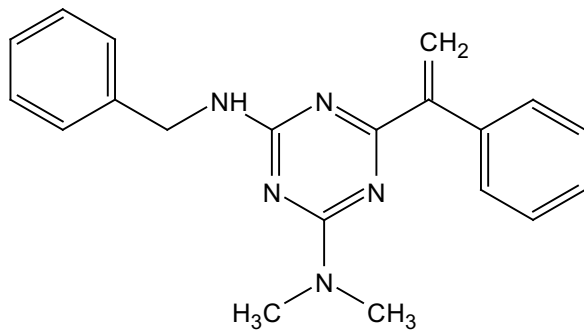
6.3937

5.7260

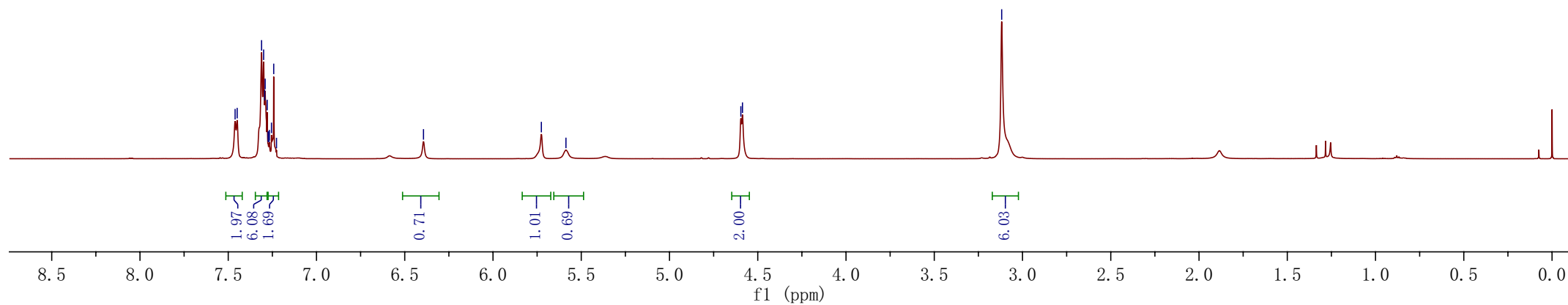
5.5867

4.5658  
4.5866

3.1180



<sup>1</sup>H NMR (600 M), 2m in CDCl<sub>3</sub>



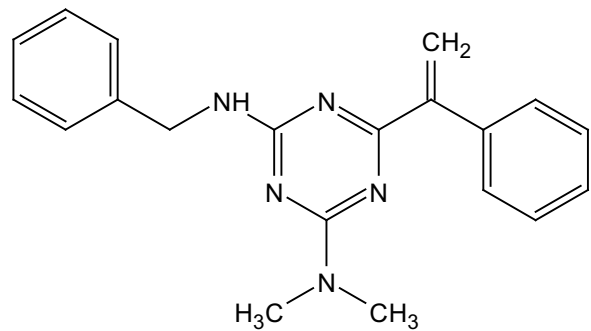
20190425-C13-WHF-328  
CDC13

171.8508  
165.8609  
165.5323  
148.0432  
139.2285  
129.2558  
129.1875  
128.9293  
128.4983  
127.6717  
127.4152  
127.1649  
121.8752

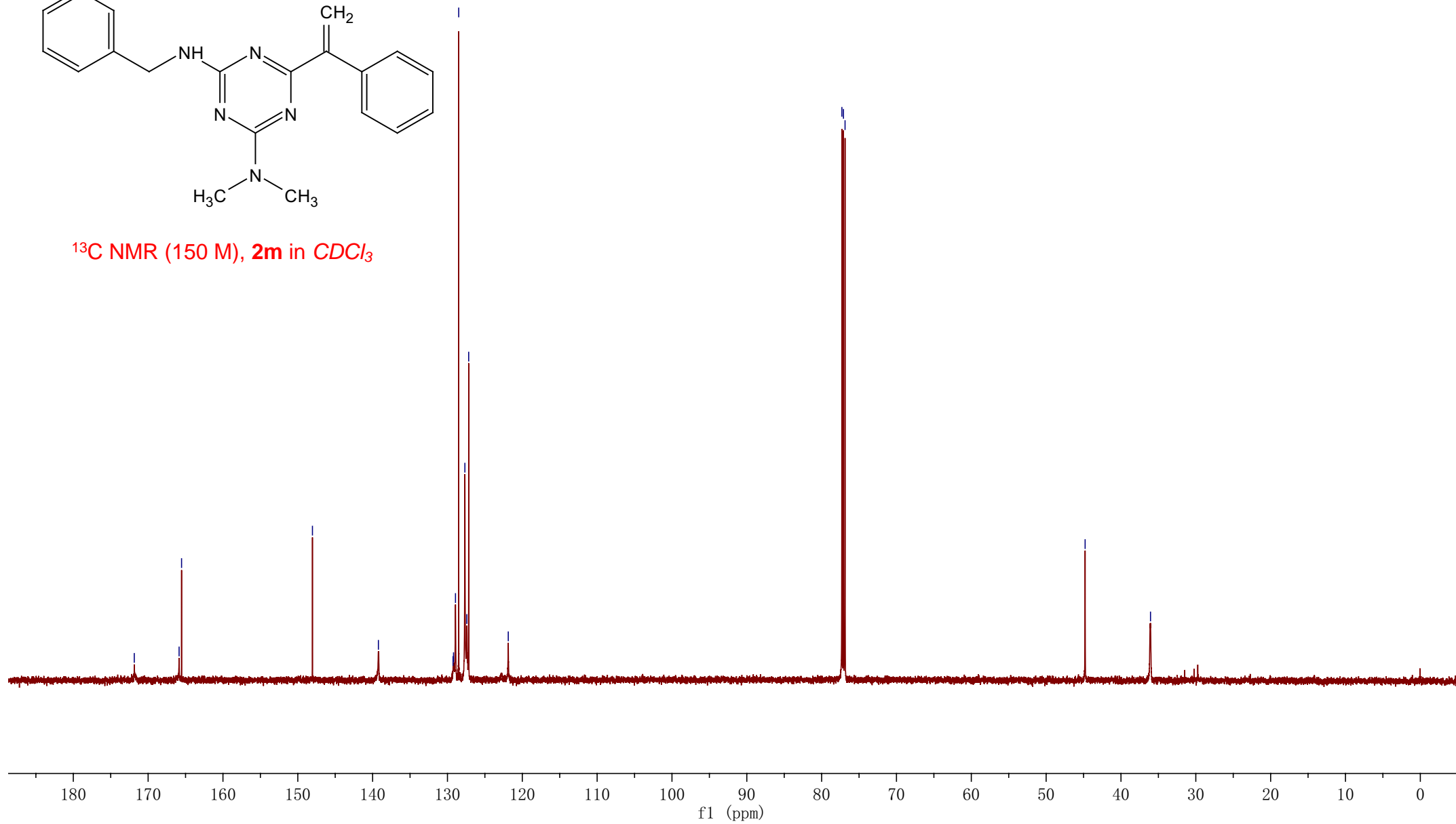
77.2939  
77.0824  
76.8706

44.7908

36.0535

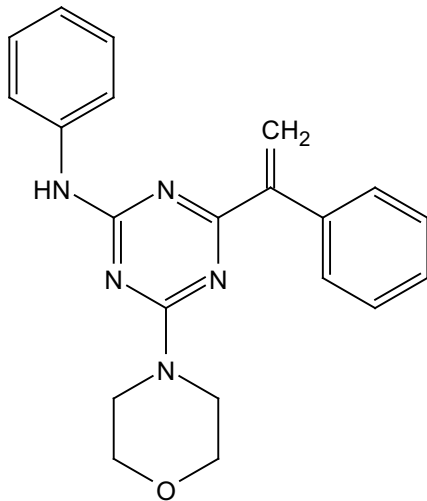


<sup>13</sup>C NMR (150 M), 2m in CDCl<sub>3</sub>





<sup>1</sup>H  
ZM210918

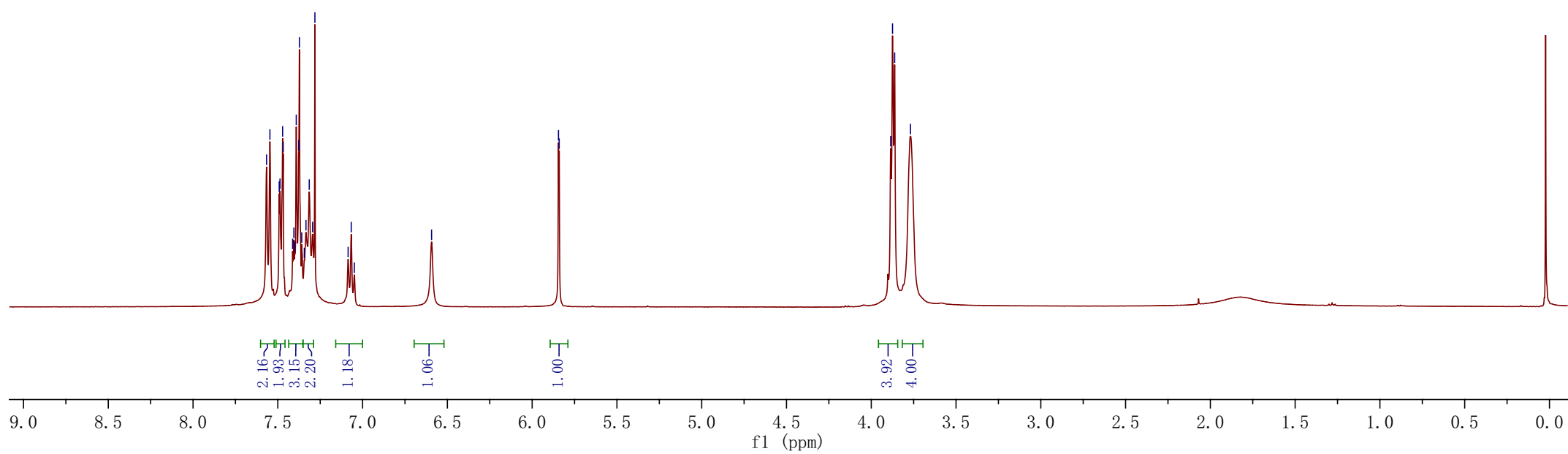


— 6.5932

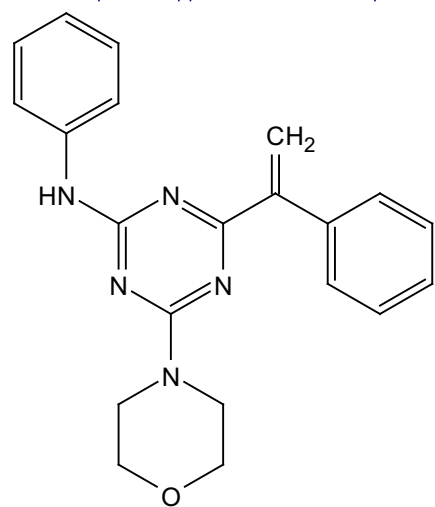
< 5.8447  
> 5.8405

< 3.8856  
> 3.8746  
< 3.8620  
> 3.7684

<sup>1</sup>H NMR (400 M), **2n** in CDCl<sub>3</sub>



<sup>13</sup>C  
ZM210908



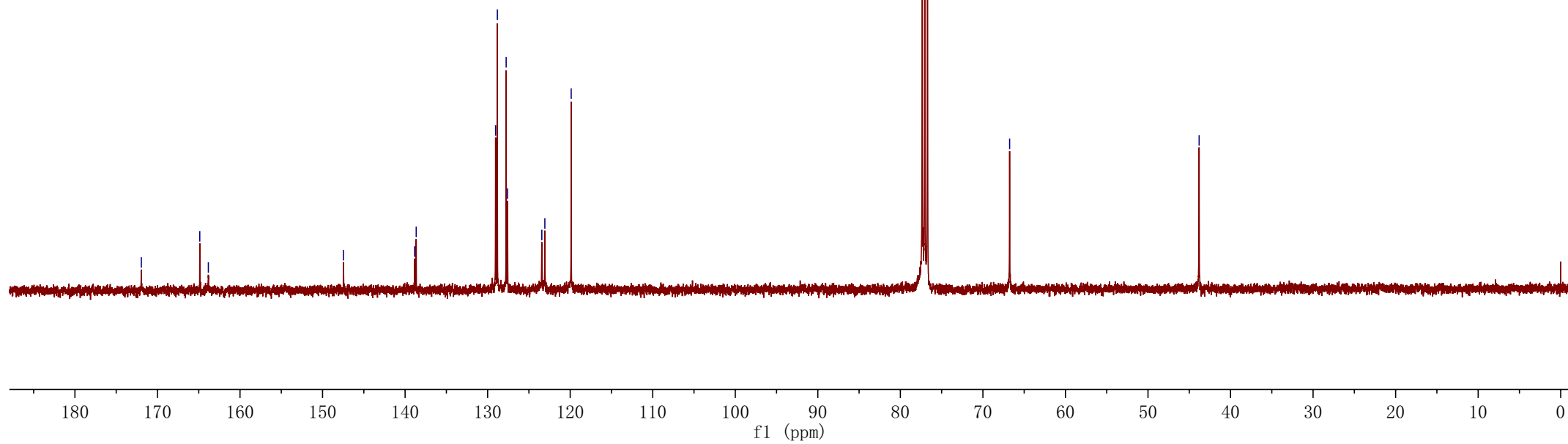
171.9584  
164.8741  
163.8365  
147.4694  
138.8409  
138.6554  
129.0372  
128.8232  
127.7571  
127.5830  
123.4365  
123.0693  
119.8787

77.3489  
77.0813  
76.7138

66.7619

43.8054

<sup>13</sup>C NMR (100 M), **2n** in CDCl<sub>3</sub>



1y0320b

7.3974  
7.3794  
7.3494  
7.3329  
7.3139  
7.3041  
7.2868

6.7788

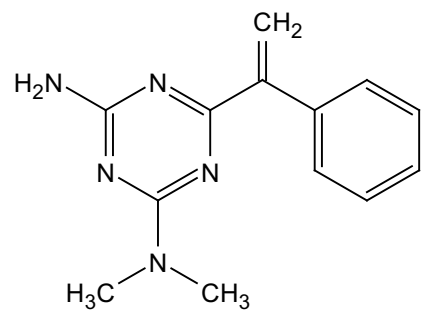
6.2436  
6.2395

5.6910  
5.6868

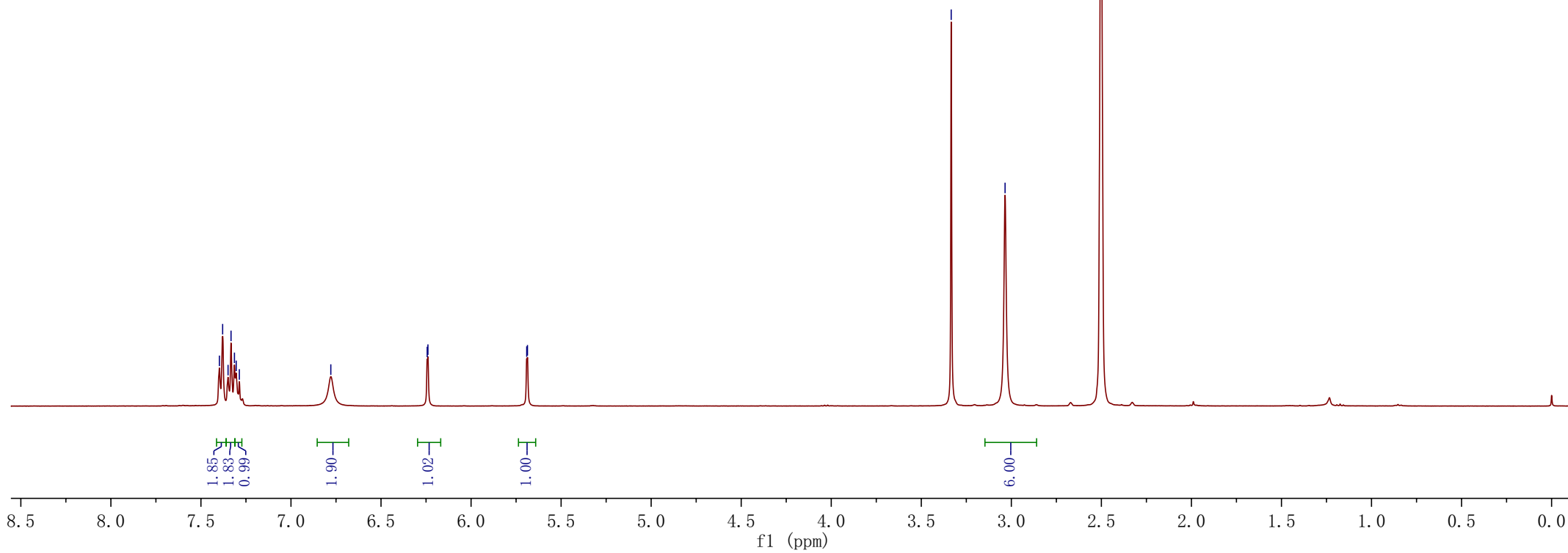
3.3339

3.0348

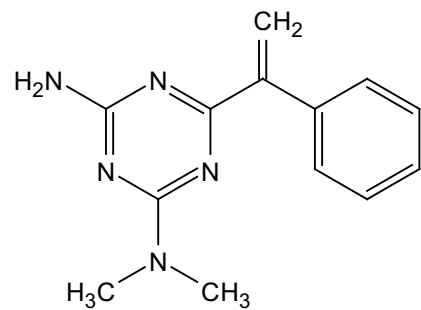
2.5021



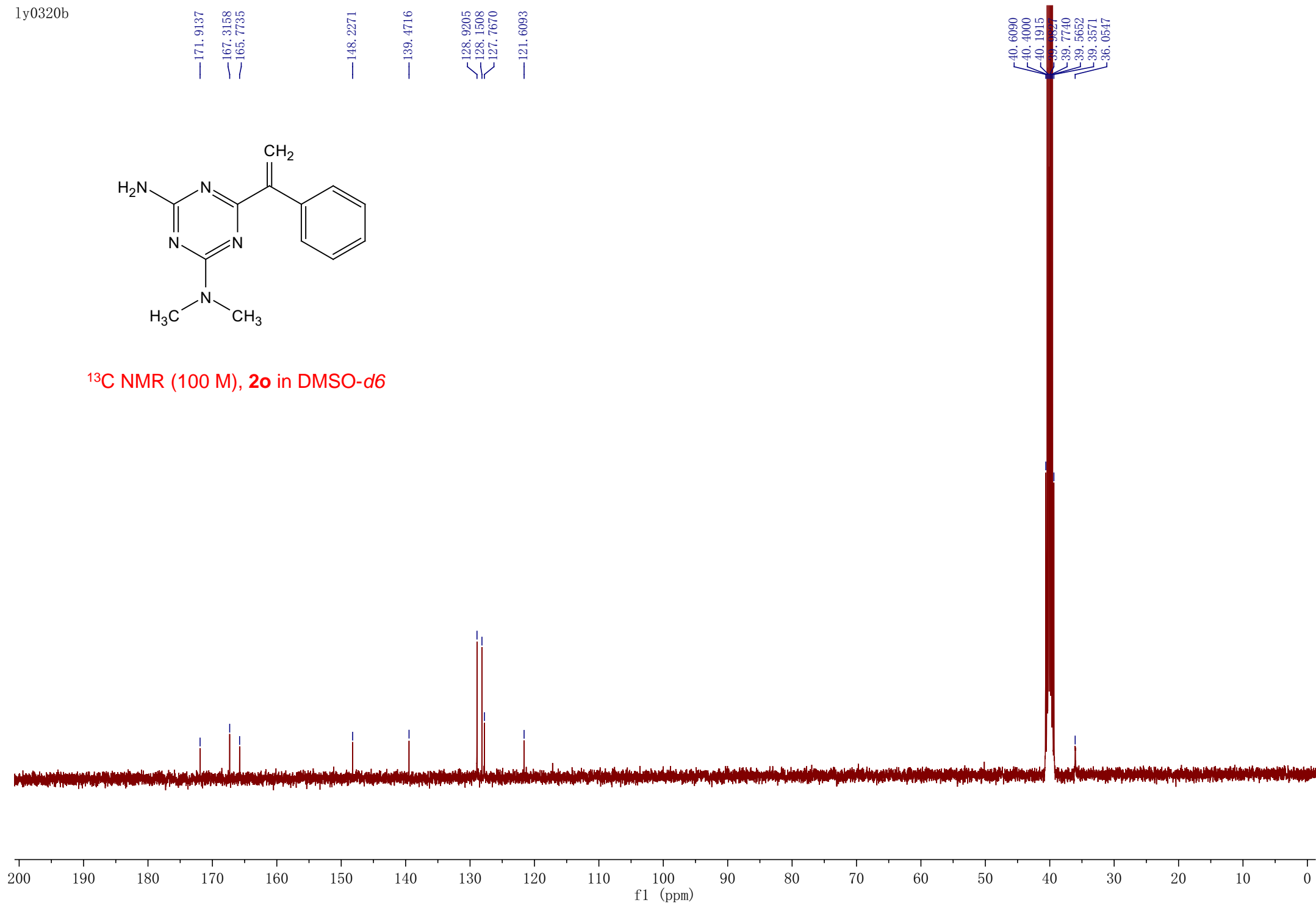
<sup>1</sup>H NMR (400 M), **2o** in DMSO-*d*<sub>6</sub>



1y0320b



<sup>13</sup>C NMR (100 M), **2o** in DMSO-*d*<sub>6</sub>



ljhww20220315c

7.2096  
7.1941  
7.1741  
7.1578  
7.1527  
7.1148  
7.1105  
7.0930  
— 6.7284  
6.5500  
6.5440

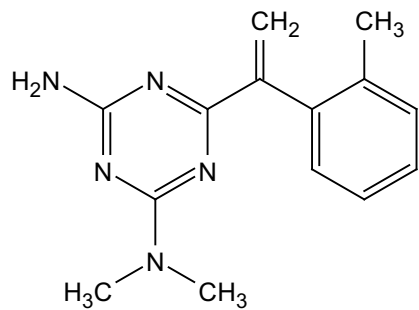
5.4661  
5.4601

— 3.3433

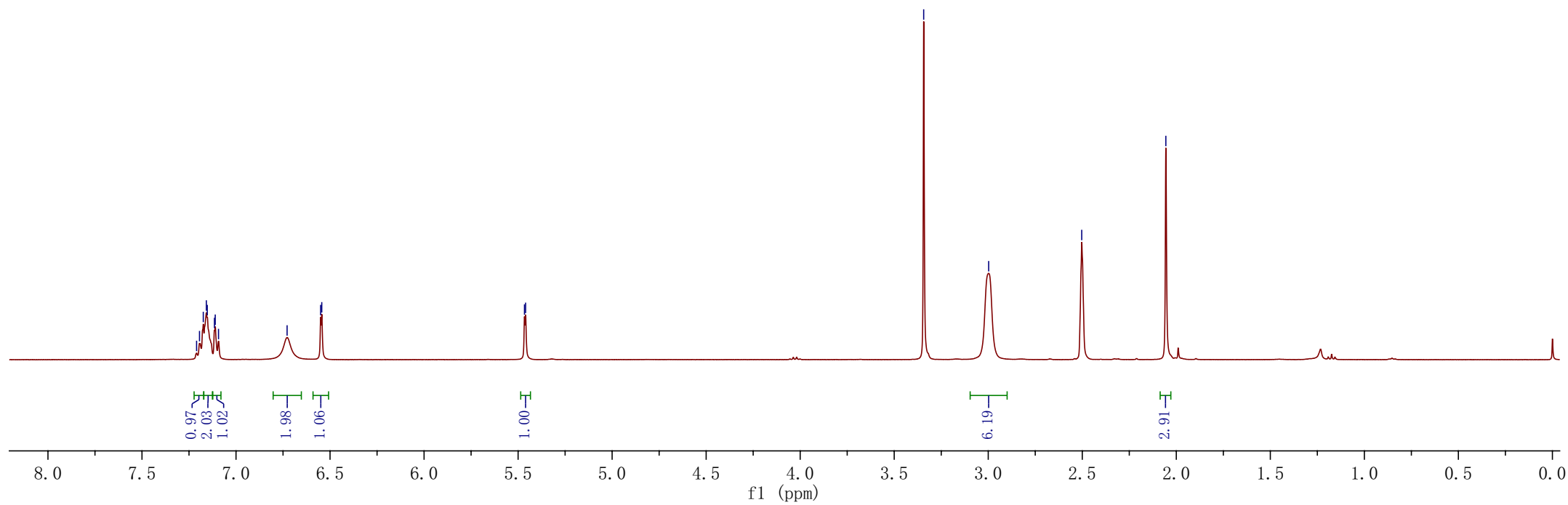
— 2.9977

— 2.5028

— 2.0556



**<sup>1</sup>H NMR (400 M), 2p in DMSO-d<sub>6</sub>**



ljhww20220315c

171.2862  
167.4836  
165.7957

149.0860

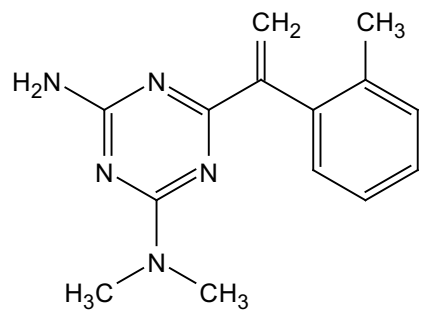
140.5043

136.1908

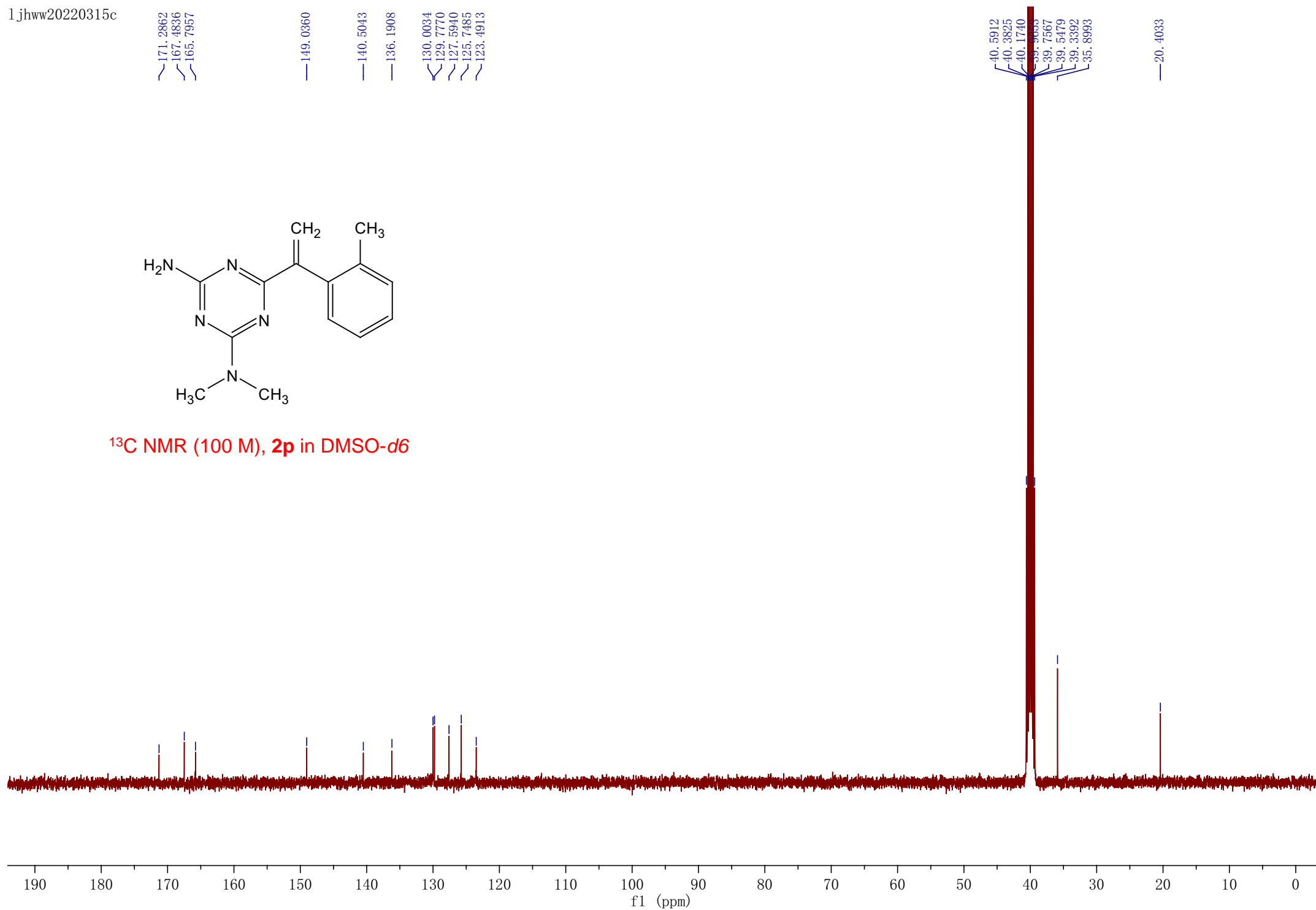
130.0034  
129.7770  
127.5940  
125.7485  
123.4913

40.5912  
40.3825  
40.1740  
39.9655  
39.7567  
39.5479  
39.3392  
35.8993

20.4033



<sup>13</sup>C NMR (100 M), **2p** in DMSO-d<sub>6</sub>



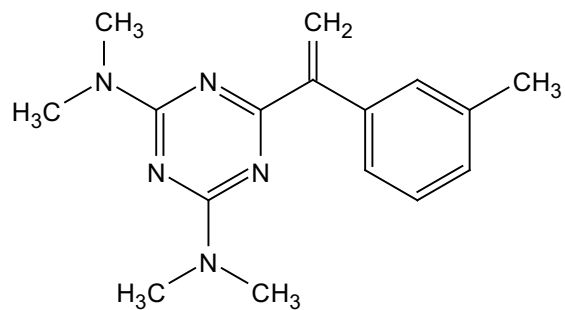
20220607zm  
ZW0523

7.2570  
7.2433  
7.2346  
7.2278  
7.2127  
7.2052  
6.8863  
6.8802

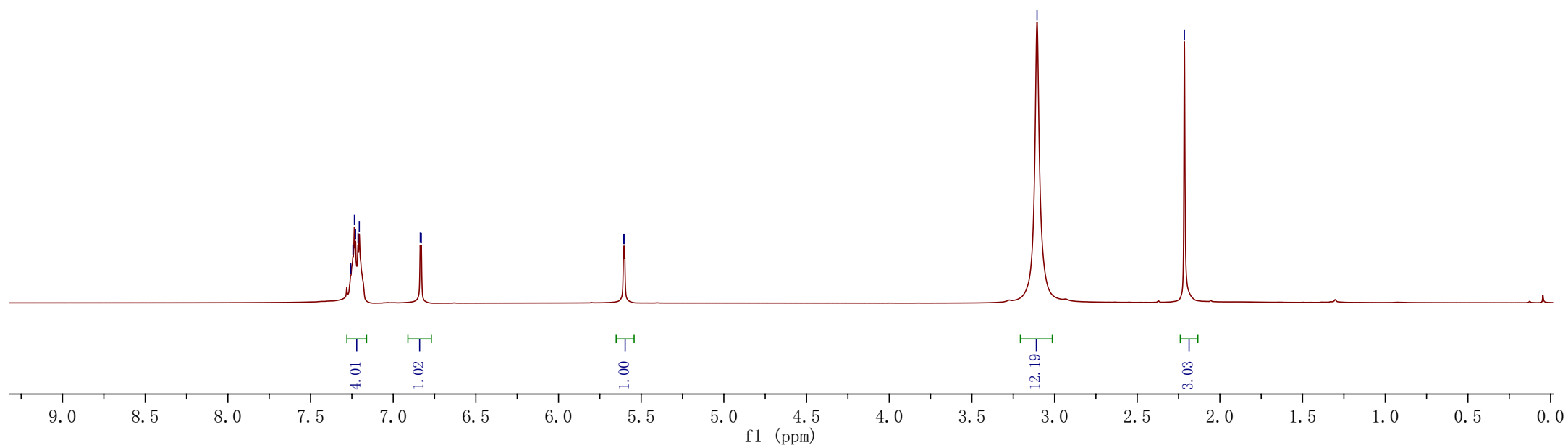
5.6064  
5.6003

3.1060

2.2146



<sup>1</sup>H NMR (400 M), **2q** in CDCl<sub>3</sub>



20220615zm  
ZW0523

—170.3332

—165.6242

—149.0069

—140.5767

—136.6933

—129.7706

—129.1236

—126.9447

—125.0304

—123.0176

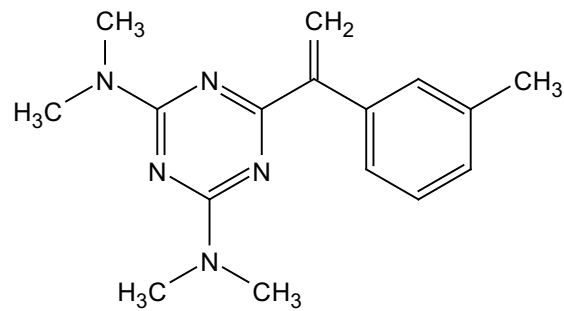
—77.3670

—77.0496

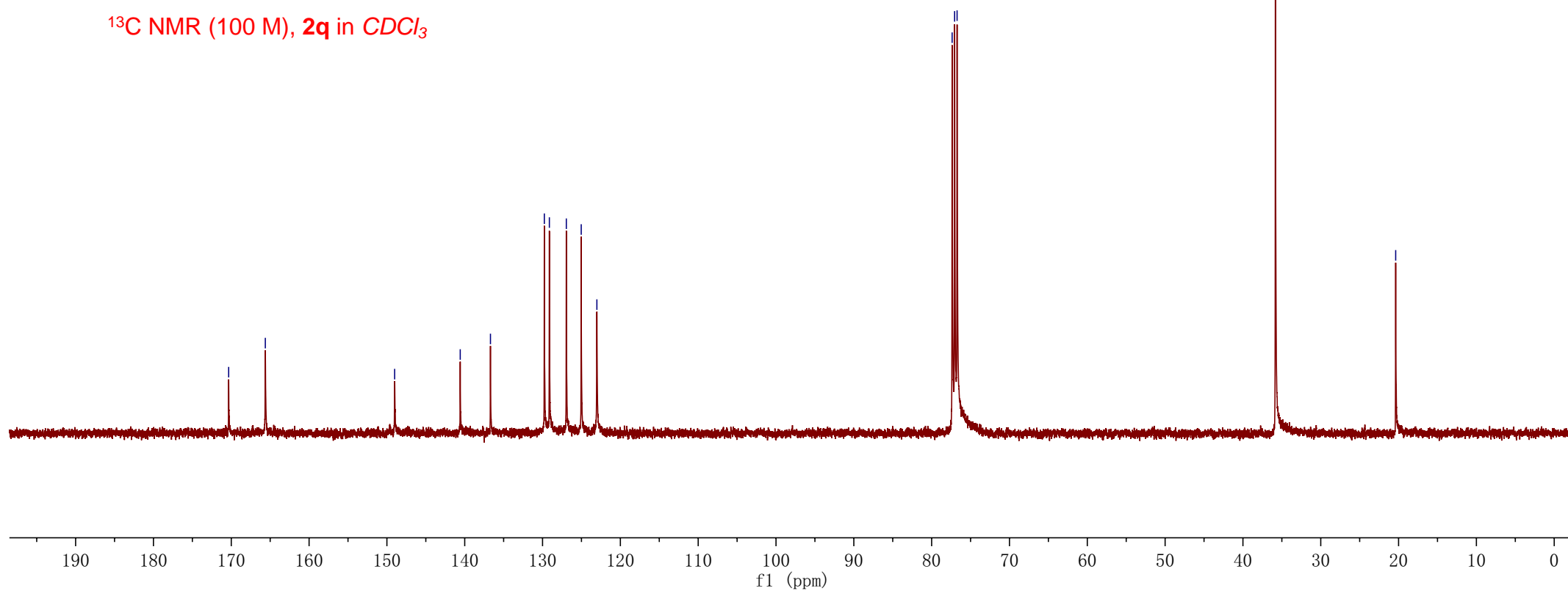
—76.7317

—35.8271

—20.3712

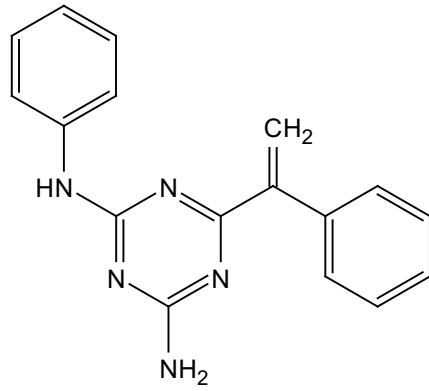


<sup>13</sup>C NMR (100 M), **2q** in CDCl<sub>3</sub>

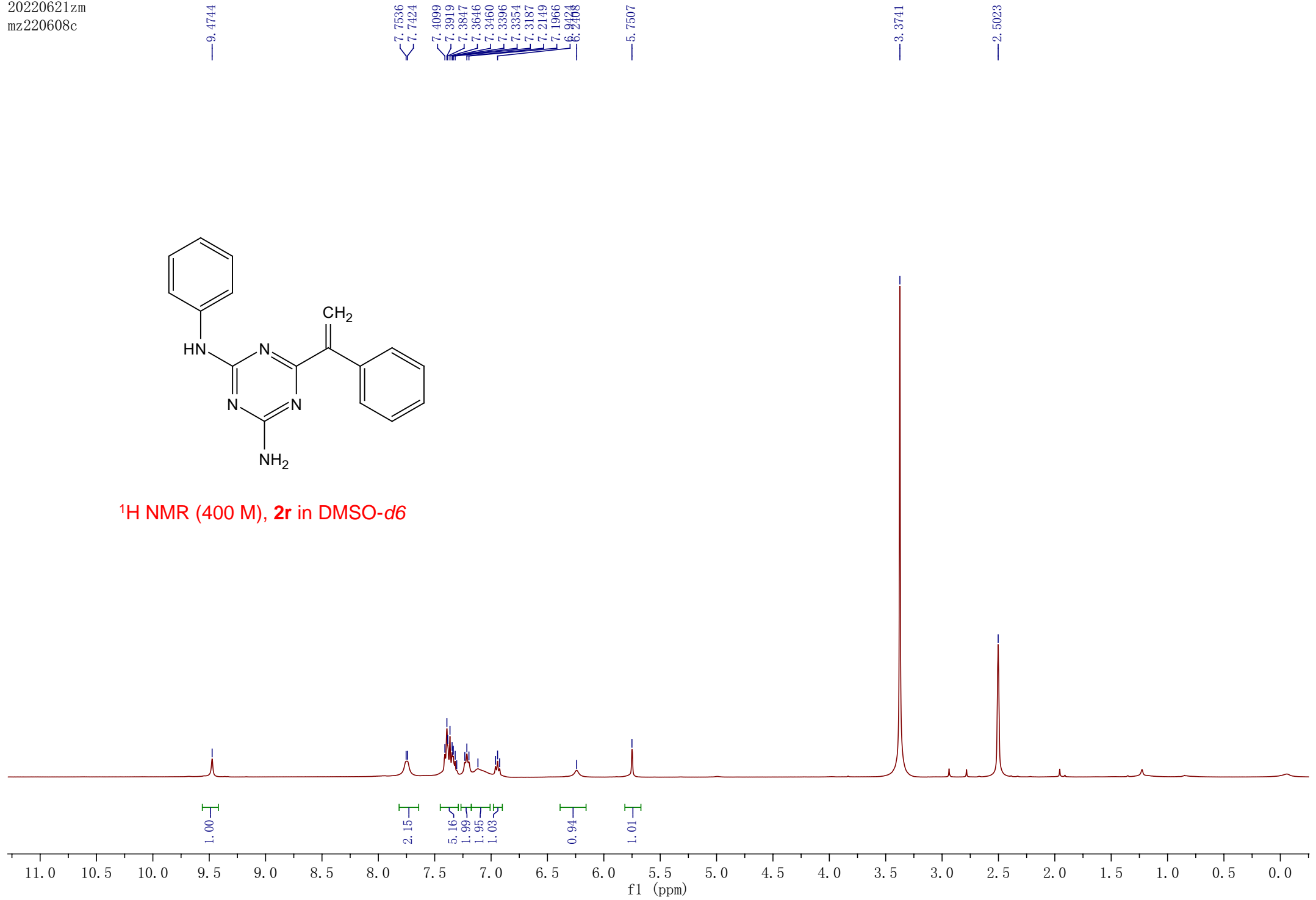




20220621zm  
mz220608c



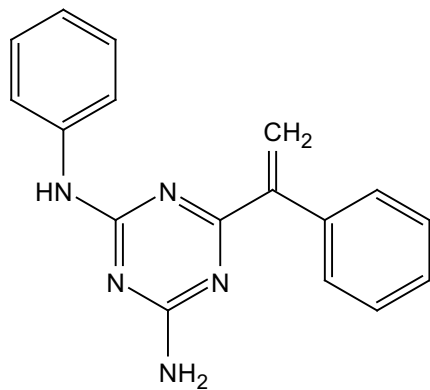
**<sup>1</sup>H NMR (400 M), 2r in DMSO-d<sub>6</sub>**



20220623zm  
mz220608c

173.0439  
167.4395  
164.8355  
148.1261  
140.3623  
139.3836  
128.8871  
128.7676  
128.3527  
127.8944  
122.3435  
121.8429  
120.2655

40.5930  
40.3846  
40.1760  
39.9676  
39.7585  
39.5496  
39.3413



<sup>13</sup>C NMR (100 M), 2r in DMSO-d<sub>6</sub>

