Supporting Information

Design, Synthesis, and Cardioprotective Effects of *N*-Mercapto-Based Hydrogen Sulfide Donors

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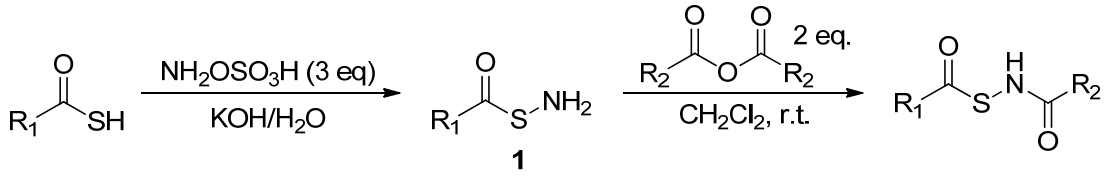
Materials and Methods: All solvents were reagent grade. Tetrahydrofuran (THF) was freshly distilled from sodium/benzophenone under argon. Reactions were magnetically stirred and monitored by thin layer chromatography (TLC) with 0.25 mm pre-coated silica gel plates. Flash chromatography was performed with silica gel 60 (particle size 0.040-0.062 mm). Yields refer to chromatographically and spectroscopically pure compounds, unless otherwise stated. Proton and carbon-13 NMR spectra were recorded on a 300 MHz spectrometer. Chemical shifts are reported relative to chloroform (δ7.26) for ^{1}H NMR and chloroform (δ77.0) for ^{13}C NMR.

Experimental Procedures and Compound Characterization Data

Preparation of *N*-(acylthio)amide-based H_2S donors



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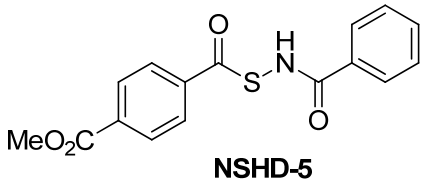
N-(acylthio)amide-based donors were synthesized from the corresponding thiocarboxylic acids. Briefly, to a stirred solution of KOH (280 mg, 5 mmol) in water (15 mL) was added thiocarboxylic acid (1 mmol) and hydroxylamine-*O*-sulfonic acid (339 mg, 3 mmol). The solution was stirred for 5 min at rt and then extracted with CH_2Cl_2 (X3). The organic layers were combined and concentrated to afford *S*-acylthiohydroxylamine (**1**) as white solid. This material was used for next step without further purification.

The intermediate **1** was dissolved in CH_2Cl_2, followed by the addition of the corresponding carboxylic anhydride (2 mmol). The resultant solution was stirred

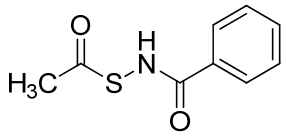
overnight at rt. The crude product was obtained upon removal of the solvent and purified by recrystallization in hexane.

Please refer to ref. S1 for the characterization data of donors **NSHD-1** – **NSHD-4** and **NSHD-6** – **NSHD-12**



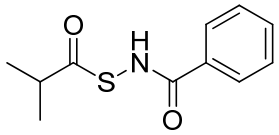
NSHD-5

NSHD-5 was prepared from 4-(methoxycarbonyl)benzothioic *S*-acid and benzoic anhydride. m. p. 184-186 ^{o}C ^{1}H NMR (300 MHz, DMSO-d_6) δ 10.18 (s, 1H), 8.06 (m, 6H), 7.59 (m, 3H), 3.89 (s, 3H); ^{13}C NMR (75 MHz, DMSO-d_6) δ 192.3, 168.5, 165.9, 137.8, 135.1, 133.5, 133.2, 130.9, 129.3, 128.7, 127.7, 53.4; IR (thin film) cm^{-1} 3159, 1717, 1703, 1647, 1455, 1437, 1404, 1274, 1209, 1108; mass spectrum (ESI/MS) m/z $[M+H]^+$ 316.1; calcd for $C_{16}H_{14}NO_4S$ 316.1; overall yield: 62 % (2 steps).



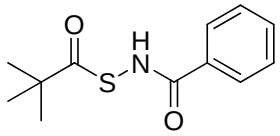
NSHD-13

NSHD-13 was prepared from thioacetic acid and benzoic anhydride. m. p. 83-86 ^{o}C ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.85 (d, J = 8.7 Hz, 2H), 7.54 (t, J = 7.5 Hz, 1H), 7.44 (t, J = 7.8 Hz, 2H), 7.37 (m, 1H), 2.32 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 195.6, 168.4, 133.0, 132.8, 129.0, 128.0, 26.5; IR (thin film) cm^{-1} 3261, 1723, 1692, 1664, 1599, 1581, 1452, 1422, 1262, 1099; mass spectrum (ESI/MS) m/z 195.9 $[M+H]^+$; calcd for $C_9H_{10}NO_2S$ 196.0; overall yield: 61 % (2 steps).



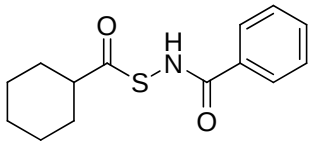
NSHD-14

NSHD-14 was prepared from 2-methylpropanethioic *S*-acid and benzoic anhydride. m. p. 103-106 ^{o}C ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.86 (m, 2H), 7.47 (m, 3H), 7.24 (s, 1H), 2.79 (m, 1H), 1.25 (s, 6H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 203.2, 168.4, 132.7, 130.4, 128.9, 127.9, 40.0, 19.0; IR (thin film) cm^{-1} 3263, 2996, 2927, 1717, 1655, 1561, 1541, 1498, 1452, 1420, 1267, 1248, 970; mass spectrum (ESI/MS) m/z 223.9 $[M+H]^+$; calcd for $C_{11}H_{14}NO_2S$ 224.1; overall yield: 67 % (2 steps).



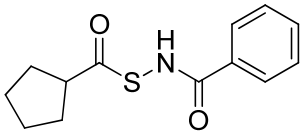
NSHD-15

NSHD-15 was prepared from 2,2-dimethylpropanethioic *S*-acid and benzoic anhydride. m. p. 102-103 ^{o}C ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.87 (d, J = 7.2 Hz, 2H), 7.53 (t, J = 7.8 Hz, 1H), 7.43 (t, J = 8.1 Hz, 2H), 7.02 (s, 1H), 1.30 (s, 9H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 205.6, 168.6, 133.4, 132.6, 128.9, 127.9, 45.5, 26.8; IR (thin film) cm^{-1} 3255, 2966, 2927, 1709, 1662, 1650, 1560, 1541, 1451, 1420, 1365, 1267, 1248, 935; mass spectrum (ESI/MS) m/z 238.0 $[M+H]^+$; calcd for $C_{12}H_{16}NO_2S$ 238.1; overall yield: 62 % (2 steps).



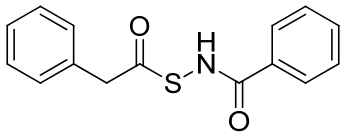
NSHD-16

NSHD-16 was prepared from cyclohexanecarbothioic *S*-acid and benzoic anhydride. m. p. 147-148 ^{o}C ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.85 (d, *J* = 8.4 Hz, 2H), 7.53 (t, *J* = 7.2 Hz, 1H), 7.43 (t, *J* = 7.8 Hz, 2H), 7.11 (s, 1H), 2.54 (m, 1H), 1.95 (m, 2H), 1.81 (m, 2H), 1.67 (m, 1H), 1.52 (m, 2H), 1.29 (m, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 202.0, 168.3, 133.2, 132.6, 128.9, 127.9, 49.4, 29.1, 25.5; IR (thin film) cm^{-1} 3279, 2927, 2857, 1705, 1654, 1552, 1537, 1451, 1416, 966; mass spectrum (ESI/MS) m/z 264.1 $[M+H]^+$; calcd for $C_{14}H_{18}NO_2S$ 264.1; overall yield: 76 % (2 steps).



NSHD-17

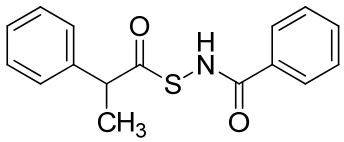
NSHD-17 was prepared from cyclopentanecarbothioic *S*-acid and benzoic anhydride. m. p. 126-128 ^{o}C ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.86 (d, *J* = 8.7 Hz, 2H), 7.54 (t, *J* = 7.5 Hz, 1H), 7.44 (t, *J* = 7.8 Hz, 2H), 7.09 (s, 1H), 3.01 (quin, *J* = 7.5 Hz, 1H), 1.92 (m, 4H), 1.69 (m, 4H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 202.2, 168.3, 133.2, 132.7, 129.0, 127.9,49.6, 30.5, 26.2; IR (thin film) cm^{-1} 3286, 2950, 2872, 1712, 1701, 1654, 1559, 1541, 1508, 1456, 1419, 994; mass spectrum (ESI/MS) m/z 272.0 $[M+Na]^+$; calcd for $C_{13}H_{15}NNaO_2S$ 272.1; overall yield: 69 % (2 steps).



NSHD-18

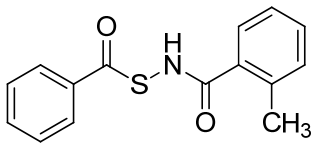
NSHD-18 was prepared from 2-phenylethanethioic *S*-acid and benzoic anhydride. m. p. 96-98 ^{o}C ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.82 (d, *J* = 7.2 Hz, 2H), 7.75 (s, 1H), 7.48 (t, *J* =

7.2 Hz, 1H), 7.36 (d, *J* = 7.8 Hz, 2H), 7.28 (m, 5H), 3.76 (s, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 197.5, 168.7, 132.9, 132.7, 132.0, 130.1, 129.1, 128.9, 128.1, 128.0, 46.7; IR (thin film) cm^{-1} 3292, 1705, 1662, 1556, 1541, 1451, 1416, 1353, 1158, 989; mass spectrum (ESI/MS) m/z 272.0 $[M+H]^+$; calcd for $C_{15}H_{14}NO_2S$ 272.1; overall yield: 71 % (2 steps).



NSHD-19

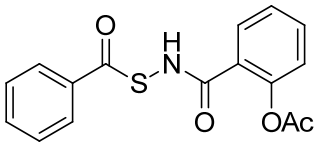
NSHD-19 was prepared from 2-phenylpropanethioic *S*-acid and benzoic anhydride. m. p. 121-122 ^oC ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.82 (d, *J* = 7.2 Hz, 2H), 7.54 (t, *J* = 7.2 Hz, 1H), 7.44 (t, *J* = 7.8 Hz, 2H), 7.36 (s, 5H), 6.91 (s, 1H), 3.92 (q, *J* = 7.2 Hz, 1H), 1.60 (d, *J* = 7.2 Hz, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 200.6, 168.2, 138.1, 133.2, 132.7, 129.2, 129.0, 128.6, 128.4, 127.8, 51.2, 18.1; IR (thin film) cm^{-1} 3420, 1700, 1661, 1499, 1453, 1423, 1264, 947; mass spectrum (ESI/MS) m/z 286.0 $[M+H]^+$; calcd for $C_{16}H_{16}NO_2S$ 286.1; overall yield: 61 % (2 steps).



NSHD-20

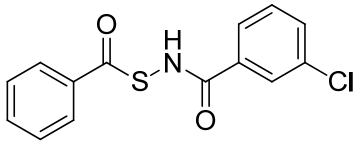
NSHD-20 was prepared from thiobenzoic acid and 2-methylbenzoic anhydride. m. p. 106-108 ^oC ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.93 (d, *J* = 7.5 Hz, 2H), 7.65 (t, *J* = 7.5 Hz, 2H), 7.51 (t, *J* = 7.8 Hz, 2H), 7.39 (t, *J* = 8.4 Hz, 1H), 7.28 (d, *J* = 7.8 Hz, 2H), 6.68 (s, 1H), 2.54 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 190.8, 171.1, 137.4, 134.8, 134.6, 134.4,

131.5, 131.1, 129.3, 127.5, 127.3, 126.1, 20.1; IR (thin film) cm^{-1} 3262, 1697, 1670, 1576, 1557, 1541, 1420, 1208, 902; mass spectrum (ESI/MS) m/z 272.0 $[M+H]^+$; calcd for $C_{15}H_{14}NO_2S$ 272.1; overall yield: 75 % (2 steps).



NSHD-21

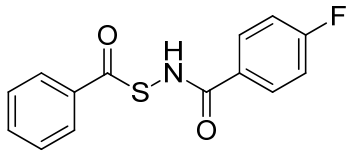
NSHD-21 was prepared from thiobenzoic acid and 2-(methoxycarbonyl)benzoic anhydride. m. p. 134-135 ^oC ^1H NMR (300 MHz, $CDCl_3$) δ 7.93 (m, 3H), 7.65 (m, 1H), 7.54 (m, 3H), 7.37 (m, 2H), 7.20 (d, *J* = 9.0 Hz, 1H), 2.44 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 190.2, 169.6, 166.6, 148.4, 134.7, 134.3, 133.1, 130.9, 129.3, 127.3, 127.0, 126.7, 123.8, 21.5; IR (thin film) cm^{-1} 3266, 1763, 1689, 1656, 1607, 1458, 1444, 1371, 1284, 1194; mass spectrum (ESI/MS) m/z 338.0 $[M+Na]^+$; calcd for $C_{16}H_{13}NNaO_4S$ 338.0; overall yield: 65 % (2 steps).



NSHD-22

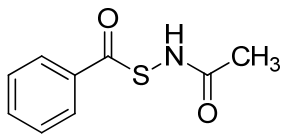
NSHD-22 was prepared from thiobenzoic acid and 3-chlorobenzoic anhydride. m. p. 96-98 ^oC ^1H NMR (300 MHz, $CDCl_3$) δ 8.08 (t, *J* = 1.8 Hz, 1H), 7.99 (dt, *J* = 7.8, 1.2 Hz, 1H), 7.81 (dt, *J* = 7.8, 1.2 Hz, 1H), 7.65 (tt, *J* = 7.5, 1.2 Hz, 1H), 7.52 (d, *J* = 8.1 Hz, 3H), 7.43 (dd, *J* = 7.8, 2.4 Hz, 2H), 7.13 (s, 1H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 190.8, 170.5, 134.7, 132.7, 130.4, 130.3, 130.0, 129.3, 128.3, 127.3, 126.0; IR (thin film) cm^{-1} 3246,

1699, 1573, 1438, 1307, 1253, 1208, 900, 748; mass spectrum (ESI/MS) m/z 291.9 $[M+H]^+$; calcd for $C_{14}H_{11}ClNO_2S$ 292.0; overall yield: 63 % (2 steps).



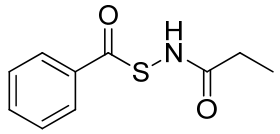
NSHD-23

NSHD-23 was prepared from thiobenzoic acid and 4-fluorobenzoic anhydride. m. p. 111-114 ^oC ^1H NMR (300 MHz, $CDCl_3$) δ 7.92 (m, 4H), 7.64 (t, J = 7.5 Hz, 1H), 7.48 (t, J = 8.1 Hz, 2H), 7.34 (s, 1H), 7.11 (t, J = 8.7 Hz, 2H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 191.1, 167.2, 134.7, 134.3, 130.6, 130.5, 129.3, 127.3, 116.3, 116.0; IR (thin film) cm^{-1} 3260, 1688, 1659, 1597, 1513, 1436, 1399, 1258, 1231, 1208, 1160, 1090; mass spectrum (ESI/MS) m/z 276.0 $[M+H]^+$; calcd for $C_{14}H_{11}FNO_2S$ 276.0; overall yield: 73 % (2 steps).



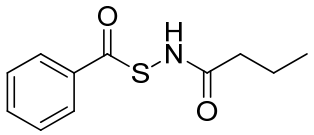
NSHD-24

NSHD-24 was prepared from thiobenzoic acid and acetic anhydride. m. p. 114-115 ^oC ^1H NMR (300 MHz, $CDCl_3$) δ 7.87 (d, J = 7.2 Hz, 2H), 7.61 (t, J = 6.9 Hz, 1H), 7.47 (t, J = 7.5 Hz, 2H), 6.73 (s, 1H), 2.30 (s, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 191.0, 171.7, 134.6, 134.3, 129.2, 127.3, 23.6; IR (thin film) cm^{-1} 3221, 1699, 1664, 1597, 1553, 1446, 1251, 1206, 899; mass spectrum (ESI/MS) m/z 413.2 $[2M+Na]^+$; calcd for $C_{18}H_{18}N_2NaO_4S_2$ 413.0; overall yield: 81 % (2 steps).



NSHD-25

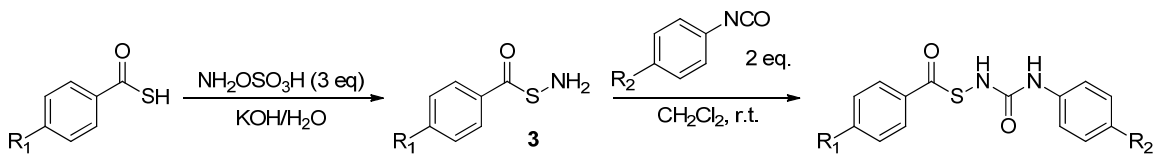
NSHD-25 was prepared from thiobenzoic acid and propionic anhydride. m. p. 132-133 ^{o}C ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.87 (d, *J* = 8.7 Hz, 2H), 7.62 (t, *J* = 7.2 Hz, 1H), 7.47 (t, *J* = 7.5 Hz, 2H), 6.56 (s, 1H), 2.53 (q, *J* = 7.5 Hz, 2H), 1.27 (t, *J* = 7.2 Hz, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 191.1, 175.3, 134.5, 129.2, 127.3, 30.2, 10.0; IR (thin film) cm^{-1} 3193, 1694, 1667, 1447, 1208, 1188, 1175, 1072, 898, 775; mass spectrum (ESI/MS) m/z 232.1 $[M+Na]^+$; calcd for $C_{10}H_{11}NNaO_2S$ 232.0; overall yield: 69 % (2 steps).



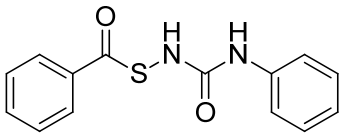
NSHD-26

NSHD-26 was prepared from thiobenzoic acid and butyric anhydride. m. p. 77-78 ^{o}C ^{1}H NMR (300 MHz, $CDCl_3$) δ 7.82 (d, *J* = 8.1 Hz, 2H), 7.56 (t, *J* = 7.5 Hz, 1H), 7.42 (t, *J* = 7.5 Hz, 2H), 6.31 (s, 1H), 2.42 (t, *J* = 6.9 Hz, 2H), 1.74 (q, *J* = 6.9 Hz, 2H), 0.97 (t, *J* = 7.5 Hz, 3H); ^{13}C NMR (75 MHz, $CDCl_3$) δ 191.0, 174.5, 134.5, 129.2, 127.3, 38.9, 19.4, 13.9; IR (thin film) cm^{-1} 3193, 1706, 1664, 1461, 1447, 1189, 1178, 1076, 896, 768; mass spectrum (ESI/MS) m/z 223.9 $[M+H]^+$; calcd for $C_{11}H_{14}NO_2S$ 224.1; overall yield: 74 % (2 steps).

Preparation of 1-(Benzoylthio)-3-phenylureas as H_2S donors

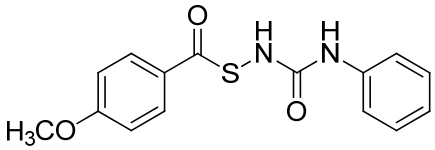


Intermediates **3** were synthesized following the procedure mentioned above. This intermediate was redissolved in CH_2Cl_2, followed by the addition of phenyl isocyanate derivatives (2 mmol). The resultant solution was allowed to stir overnight at rt. The products were obtained upon removal of the solvent and purified by recrystallization.



NSHD-27

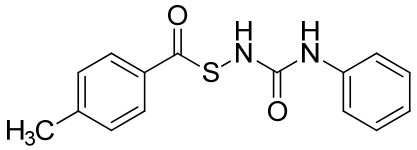
NSHD-27 was prepared from thiobenzoic acid and phenyl isocyanate. m. p. 184-186 ^{o}C ^{1}H NMR (300 MHz, DMSO-d_6) δ 9.11 (s, 1H), 7.99 (s, 1H), 7.88 (d, J = 7.5 Hz, 2H), 7.74 (t, J = 8.1 Hz, 1H), 7.59 (t, J = 7.5 Hz, 2H), 7.45 (d, J = 7.5 Hz, 2H), 7.24 (t, J = 7.8 Hz, 2H), 6.98 (t, J = 7.2 Hz, 1H); ^{13}C NMR (75 MHz, DMSO-d_6) δ 193.4, 155.0, 140.1, 135.2, 134.6, 130.1, 129.4, 127.2, 123.1, 119.3; IR (thin film) cm^{-1} 3271, 1692, 1640, 1599, 1520, 1458, 1441, 1203, 1174, 910; mass spectrum (ESI/MS) m/z 273.1 $[M+H]^+$; calcd for $C_{14}H_{13}N_2O_2S$ 273.1; overall yield: 77 % (2 steps).



NSHD-28

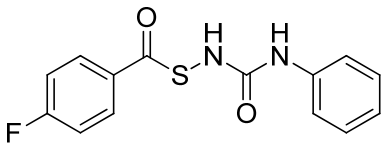
NSHD-28 was prepared from 4-methoxybenzothioic *S*-acid and phenyl isocyanate. m. p. 192-194 ^{o}C ^{1}H NMR (300 MHz, DMSO-d_6) δ 9.07 (s, 1H), 7.88 (t, J = 9.0 Hz, 3H), 7.45

(d, J = 9.0 Hz, 2H), 7.26 (t, J = 9.0 Hz, 2H), 7.11 (d, J = 9.0 Hz, 2H), 6.97 (t, J = 9.0 Hz, 1H), 3.85 (s, 3H); ^{13}C NMR (75 MHz, DMSO-d_6) δ 191.5, 164.7, 155.1, 140.1, 129.5, 129.4, 127.2, 123.0, 119.2, 115.4, 56.4; IR (thin film) cm^{-1} 3262, 1678, 1638, 1603, 1557, 1464, 1264, 1228, 1177, 1027, 903; mass spectrum (ESI/MS) m/z 325.1 $[M+Na]^+$; calcd for $C_{15}H_{14}N_2NaO_3S$ 325.1; overall yield: 70 % (2 steps)



NSHD-29

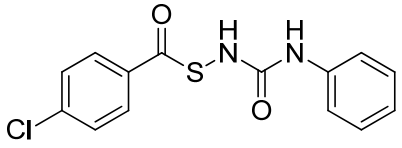
NSHD-29 was prepared from 4-methylbenzothioic *S*-acid and phenyl isocyanate. m. p. 204-206 ^{o}C ^{1}H NMR (300 MHz, DMSO-d_6) δ 9.10 (s, 1H), 7.94 (s, 1H), 7.78 (d, J = 9.0 Hz, 2H), 7.42 (dd, J = 18.0, 6.0 Hz, 4H), 7.26 (t, J = 9.0 Hz, 2H), 6.98 (t, J = 9.0 Hz, 1H), 2.38 (s, 3H); ^{13}C NMR (75 MHz, DMSO-d_6) δ 192.7, 155.1, 145.8, 140.1, 132.0, 130.6, 129.4, 127.2, 123.0, 119.3, 22.0; IR (thin film) cm^{-1} 3295, 1697, 1630, 1595, 1548, 1469, 1295, 1201, 1173, 896; mass spectrum (ESI/MS) m/z 309.1 $[M+Na]^+$; calcd for $C_{15}H_{14}N_2NaO_2S$ 309.1; overall yield: 74 % (2 steps)



NSHD-30

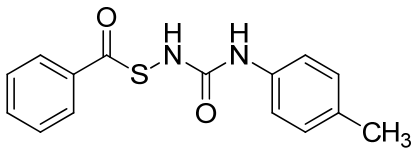
NSHD-30 was prepared from 4-fluorobenzothioic *S*-acid and phenyl isocyanate. m. p. 194-195 ^{o}C ^{1}H NMR (300 MHz, DMSO-d_6) δ 9.12 (s, 1H), 7.99 (m, 3H), 7.43 (m, 4H), 7.27 (t, J = 9.0 Hz, 2H), 6.98 (t, J = 9.0 Hz, 1H); ^{13}C NMR (75 MHz, DMSO-d_6) δ 192.0, 164.3, 154.8, 139.8, 130.9, 130.3, 129.4, 123.3, 119.3, 117.1; IR (thin film) cm^{-1} 3288,

3223, 1639, 1598, 1539, 1201, 1157, 902, 840; mass spectrum (ESI/MS) m/z 313.0 $[M+Na]^+$; calcd for $C_{14}H_{11}FN_2NaO_2S$ 313.0; overall yield: 64 % (2 steps).



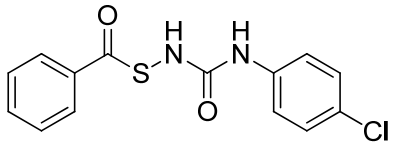
NSHD-31

NSHD-31 was prepared from 4-chlorobenzothioic *S*-acid and phenyl isocyanate. m. p. 197-199 ^oC ^1H NMR (300 MHz, DMSO-d_6) δ 9.13 (s, 1H), 8.03 (s, 3H), 7.91 (dt, J = 9.0, 3.0 Hz, 2H), 7.67 (dt, J = 9.0, 3.0 Hz, 2H), 7.45 (d, J = 9.0 Hz, 2H), 7.27 (t, J = 9.0 Hz, 2H), 6.99 (tt, J = 9.0, 3.0 Hz, 1H); ^{13}C NMR (75 MHz, DMSO-d_6) δ 192.5, 154.9, 140.0, 139.9, 133.2, 130.3, 129.4, 129.1, 123.1, 119.3 IR (thin film) cm^{-1} 3268, 1694, 1647, 1602, 1464, 1398, 1205, 1177, 1094, 902; mass spectrum (ESI/MS) m/z 307.0 $[M+H]^+$; calcd for $C_{14}H_{12}ClN_2O_2S$ 307.0; overall yield: 66 % (2 steps).



NSHD-32

NSHD-32 was prepared from benzothioic *S*-acid and 4-methylphenyl isocyanate. m. p. 207-208 ^oC ^1H NMR (300 MHz, DMSO-d_6) δ 9.00 (s, 1H), 7.91 (m, 3H), 7.74 (t, J = 9.0, Hz, 1H), 7.59 (t, J = 9.0 Hz, 2H), 7.34 (d, J = 9.0 Hz, 2H), 7.07 (d, J = 9.0, Hz, 2H), 2.23 (s, 3H); ^{13}C NMR (75 MHz, DMSO-d_6) δ 193.5, 155.0, 137.5, 135.2, 134.6, 131.9, 130.1, 129.8, 127.2, 119.4, 21.0; IR (thin film) cm^{-1} 3240, 1693, 1641, 1592, 1537, 1149, 1211, 1183, 1051, 903; mass spectrum (ESI/MS) m/z 287.1 $[M+H]^+$; calcd for $C_{15}H_{15}N_2O_2S$ 287.1; overall yield: 61 % (2 steps).



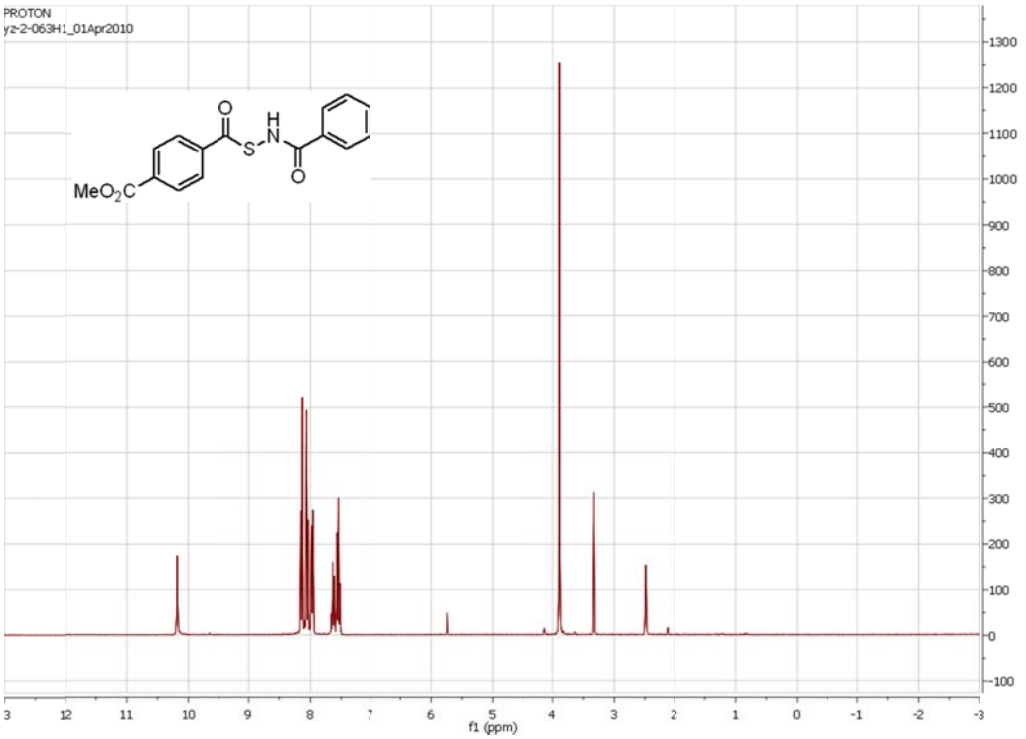
NSHD-33

NSHD-33 was prepared from benzothioic *S*-acid and 4-chlorophenyl isocyanate. m. p. 204-206 ^{o}C ^{1}H NMR (300 MHz, DMSO-d_6) δ 9.28 (s, 1H), 8.09 (s, 1H), 7.88 (d, J = 9.0 Hz, 2H), 7.73 (tt, J = 9.0, 3.0 Hz, 1H), 7.59 (t, J = 9.0 Hz, 2H), 7.50 (dt, J = 9.0, 3.0 Hz, 2H), 7.32 (dt, J = 9.0, 3.0 Hz, 2H); ^{13}C NMR (75 MHz, DMSO-d_6) δ 193.2, 155.0, 139.1, 135.2, 134.5, 130.2, 129.3, 127.2, 126.6, 120.9; IR (thin film) cm^{-1} 3281, 1687, 1660, 1610, 1549, 1460, 1447, 1203, 898; mass spectrum (ESI/MS) m/z 307.0 $[M+H]^{+}$; calcd for $C_{14}H_{12}ClN_2O_2S$ 307.0; overall yield: 65 % (2 steps).

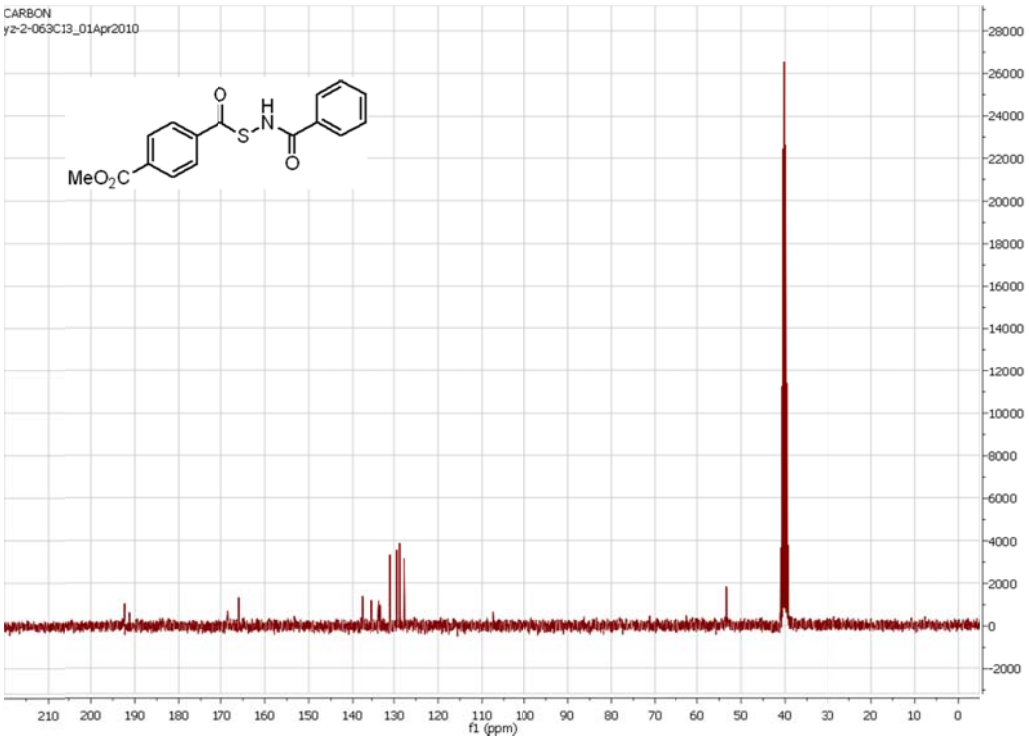
References:

S1. Zhao, Y.; Wang, H.; Xian, M. *J. Am. Chem. Soc.* **2011**, *133*, 15-17.

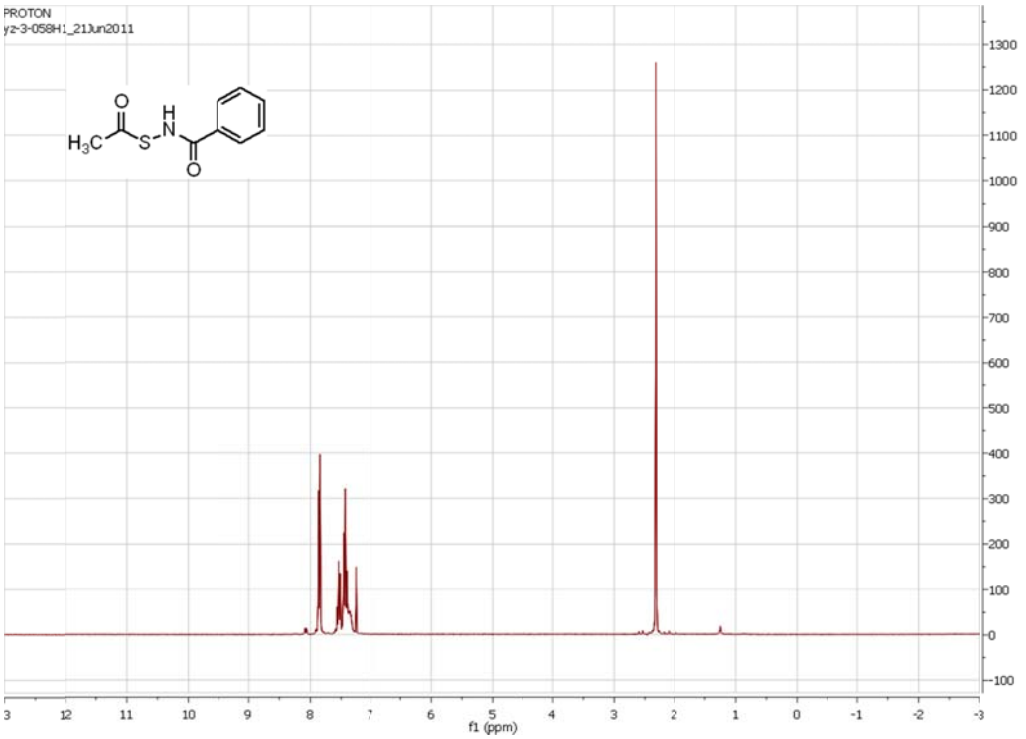
^{1}H NMR (300 MHz, DMSO-d_6) spectrum of **NSHD-5**



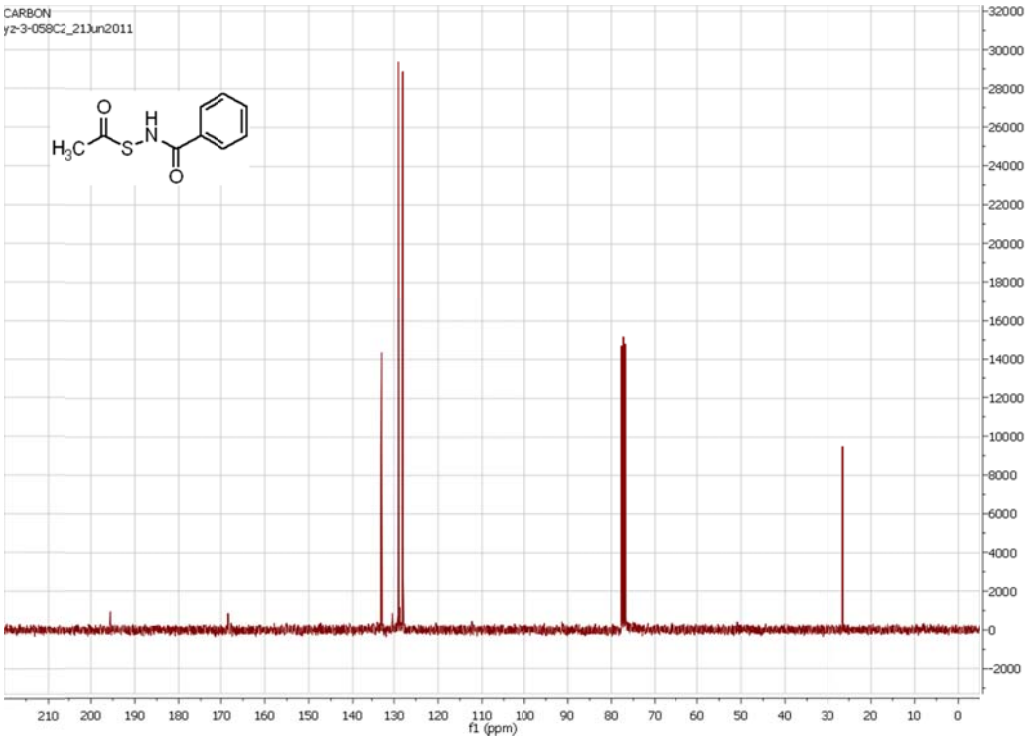
^{13}C NMR (75 MHz, DMSO-d_6) spectrum of **NSHD-5**



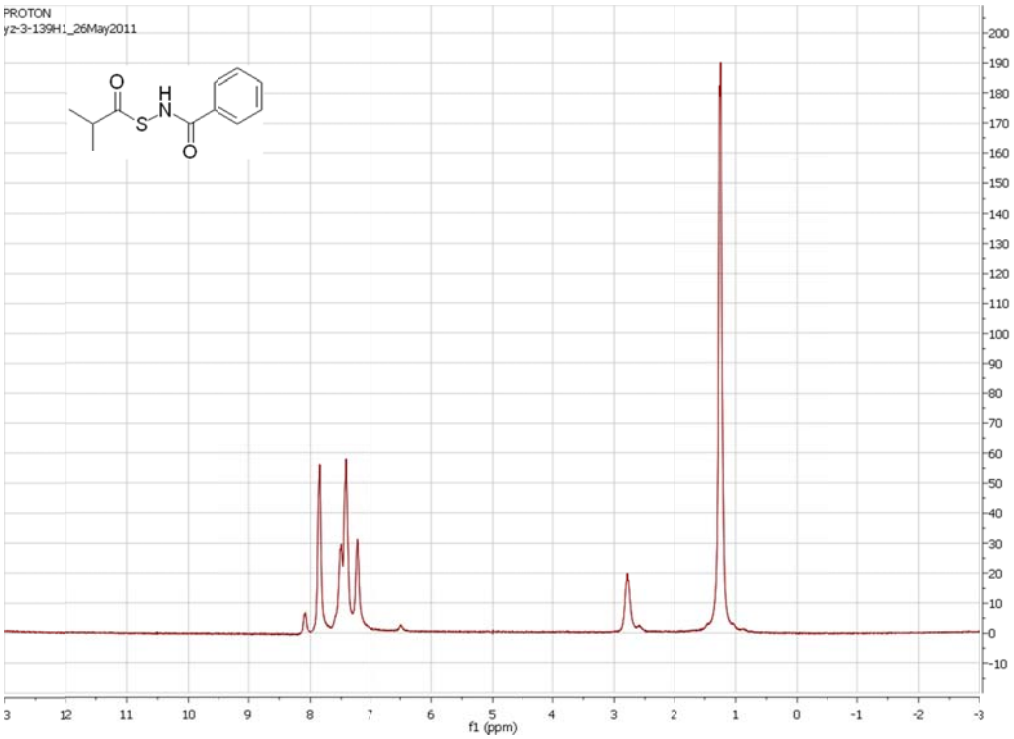
^{1}H NMR (300 MHz, $CDCl_3$) spectrum of **NSHD-13**



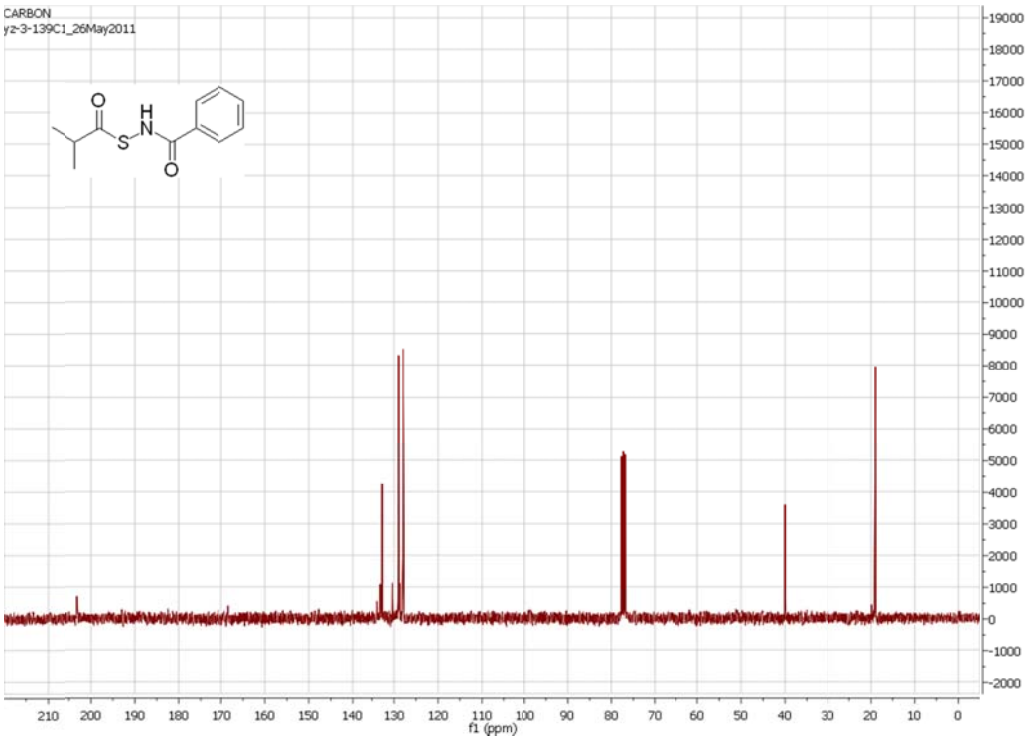
^{13}C NMR (75 MHz, $CDCl_3$) spectrum of **NSHD-13**



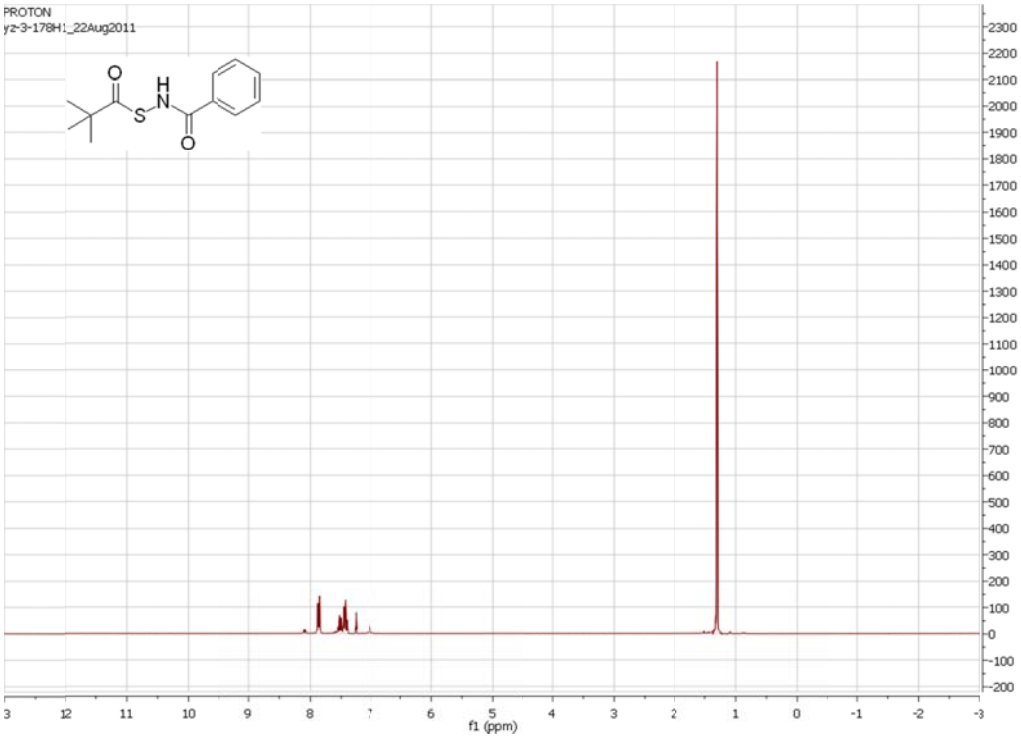
^{1}H NMR (300 MHz, $CDCl_3$) spectrum of **NSHD-14**



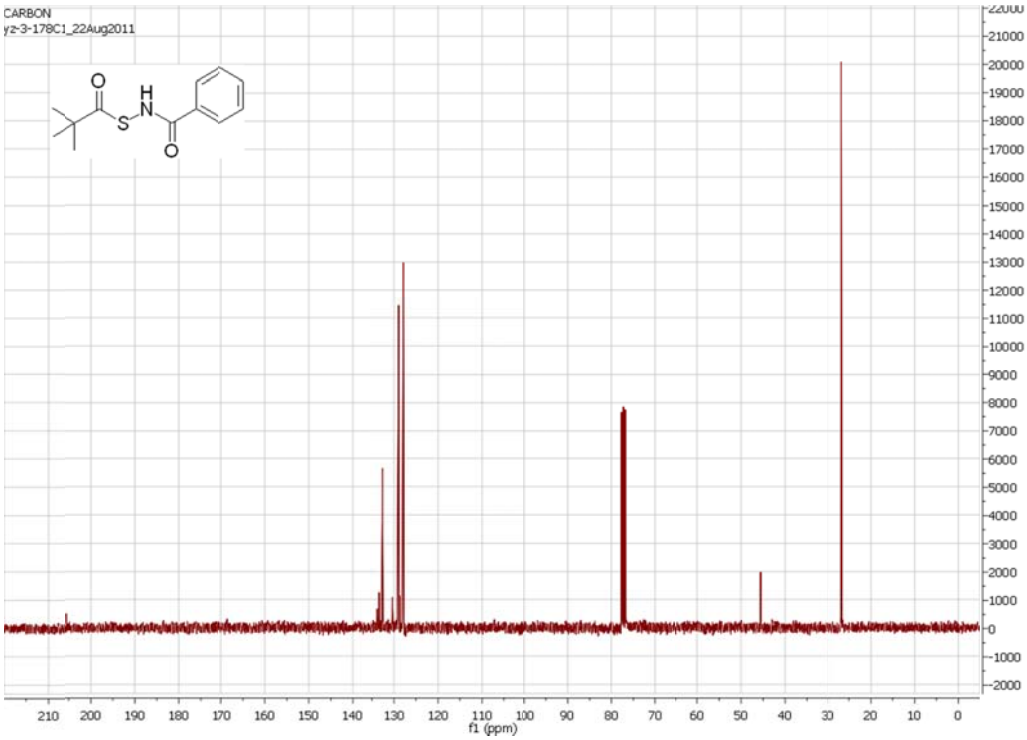
^{13}C NMR (75 MHz, $CDCl_3$) spectrum of **NSHD-14**



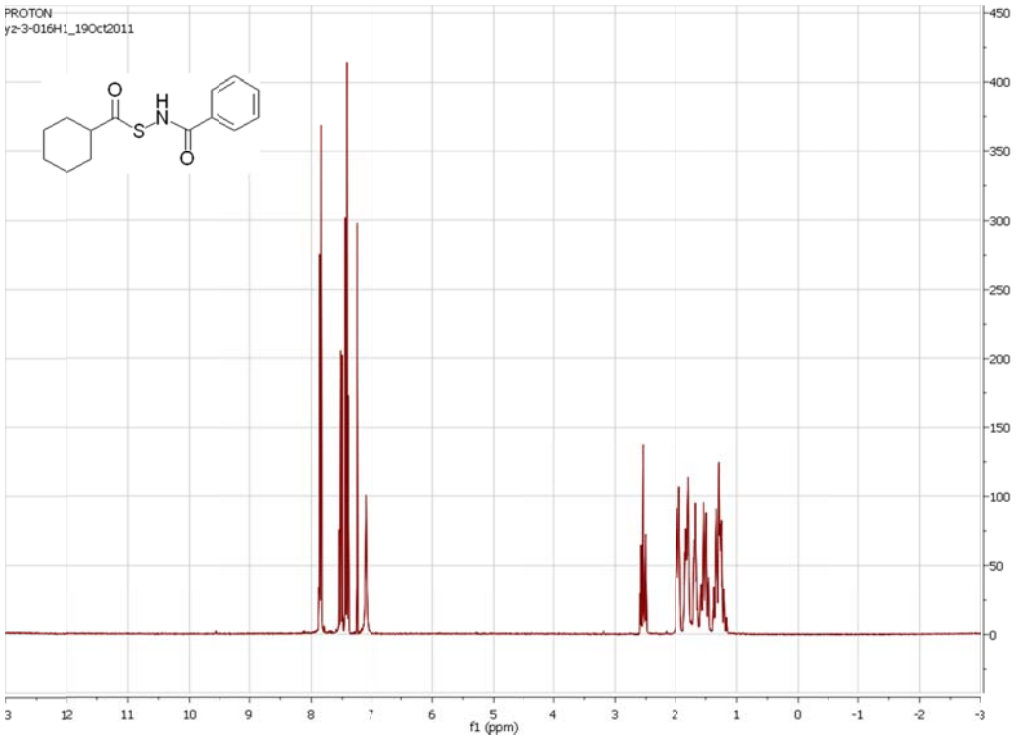
^{1}H NMR (300 MHz, $CDCl_3$) spectrum of **NSHD-15**



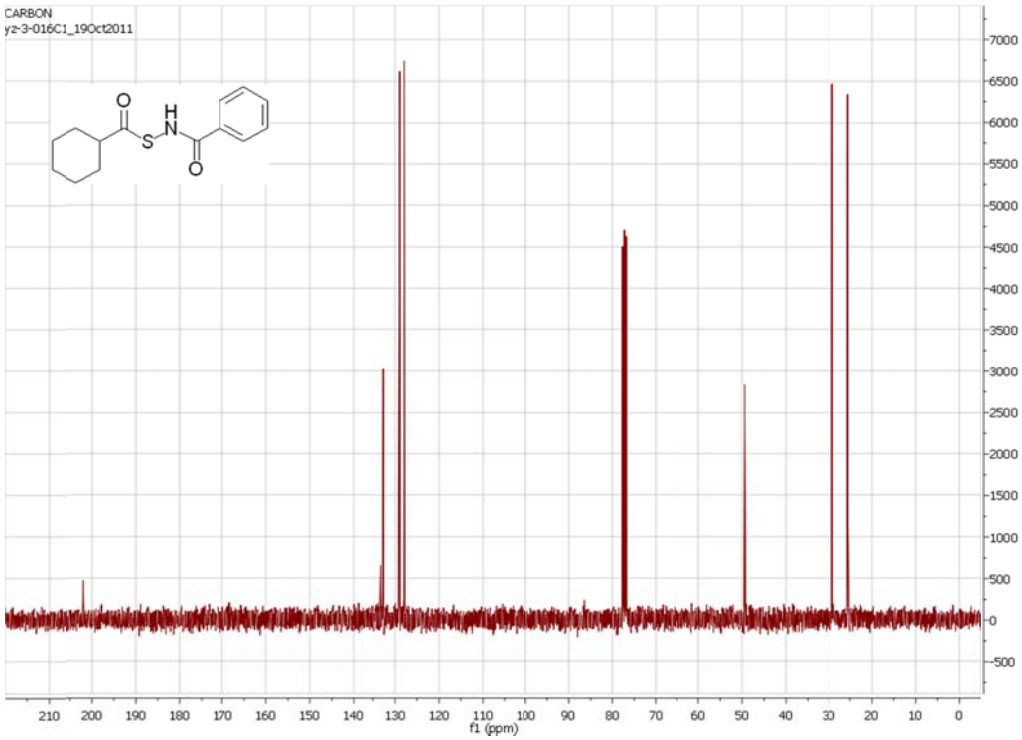
^{13}C NMR (75 MHz, $CDCl_3$) spectrum of **NSHD-15**



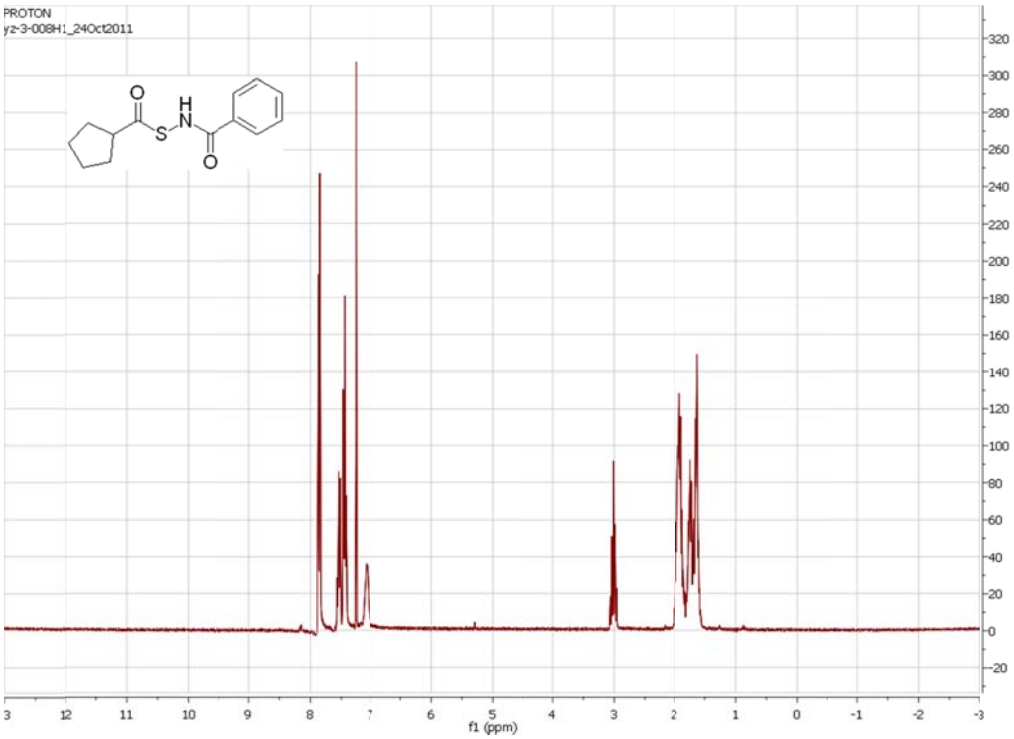
^{1}H NMR (300 MHz, $CDCl_3$) spectrum of **NSHD-16**



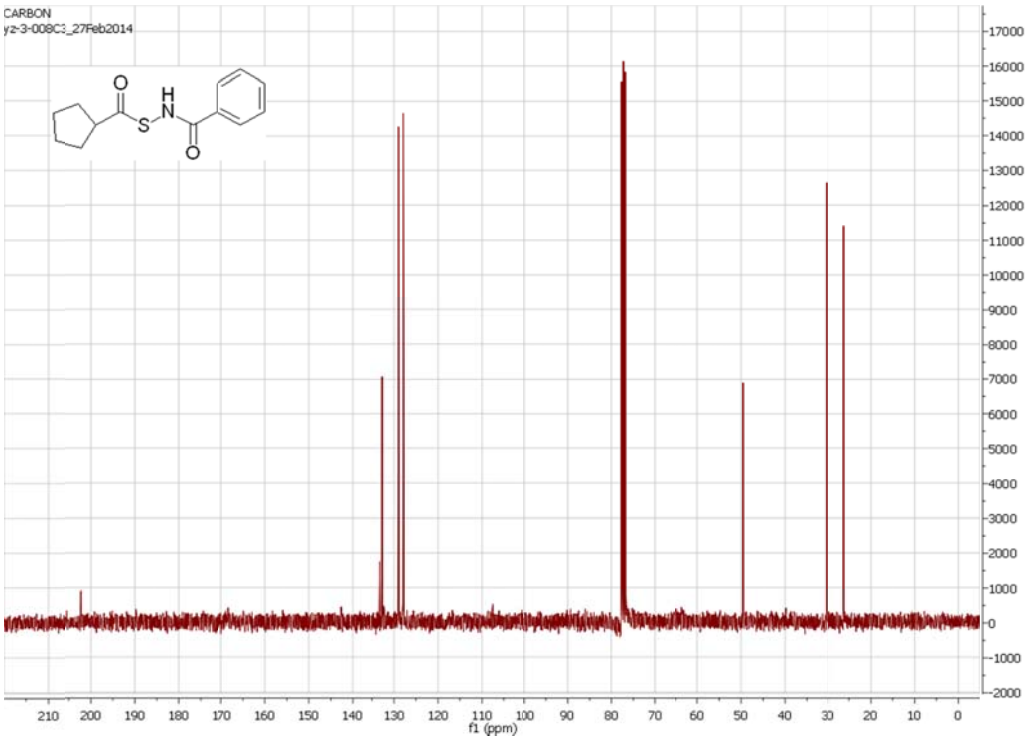
^{13}C NMR (75 MHz, $CDCl_3$) spectrum of **NSHD-16**



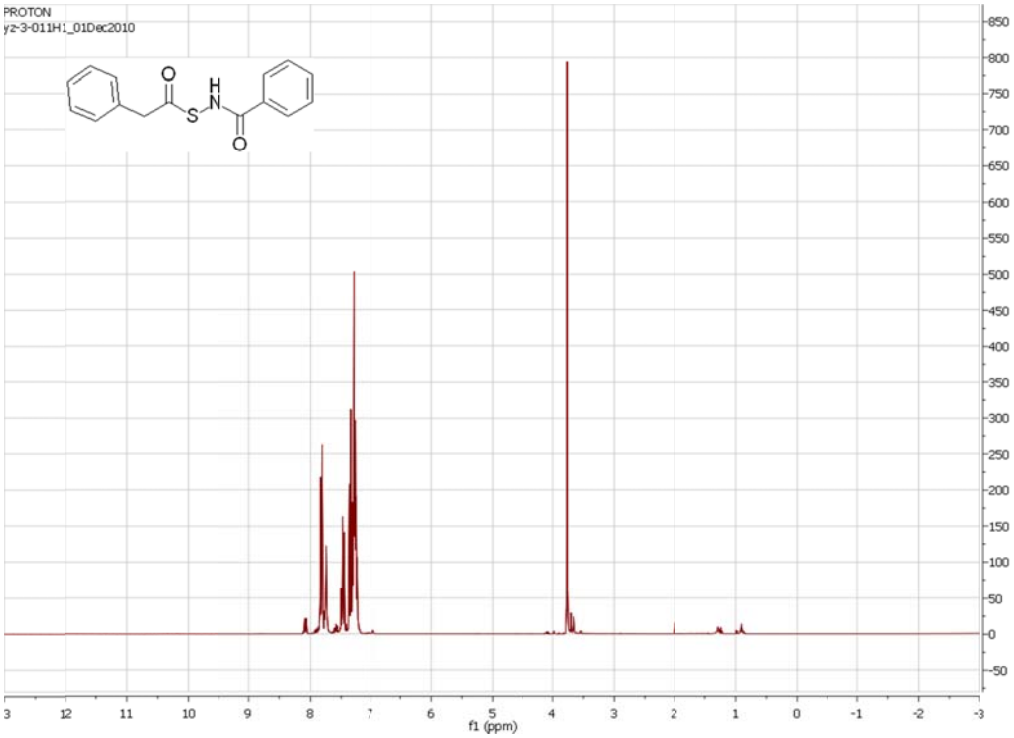
^{1}H NMR (300 MHz, $CDCl_3$) spectrum of **NSHD-17**



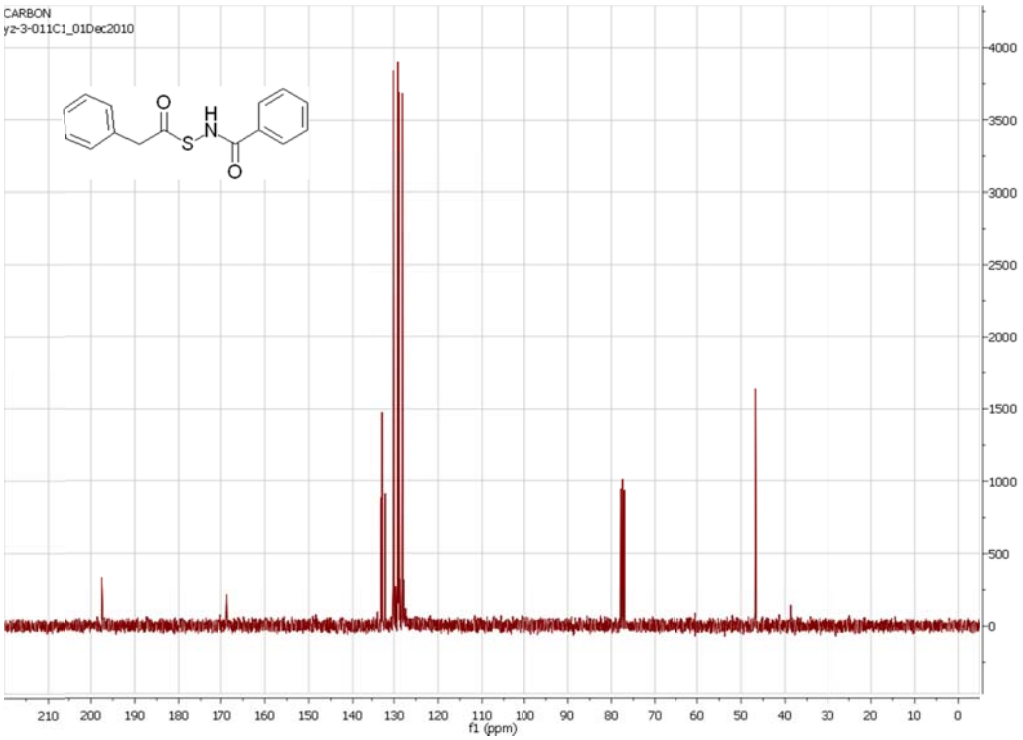
^{13}C NMR (75 MHz, $CDCl_3$) spectrum of **NSHD-17**



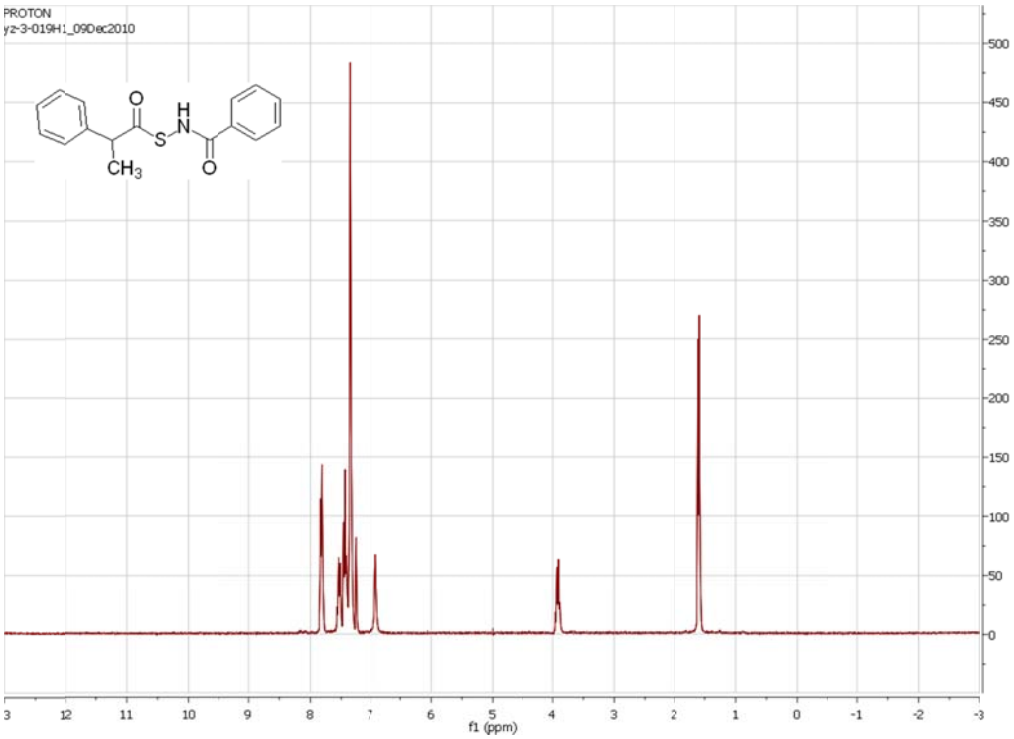
^{1}H NMR (300 MHz, $CDCl_3$) spectrum of **NSHD-18**



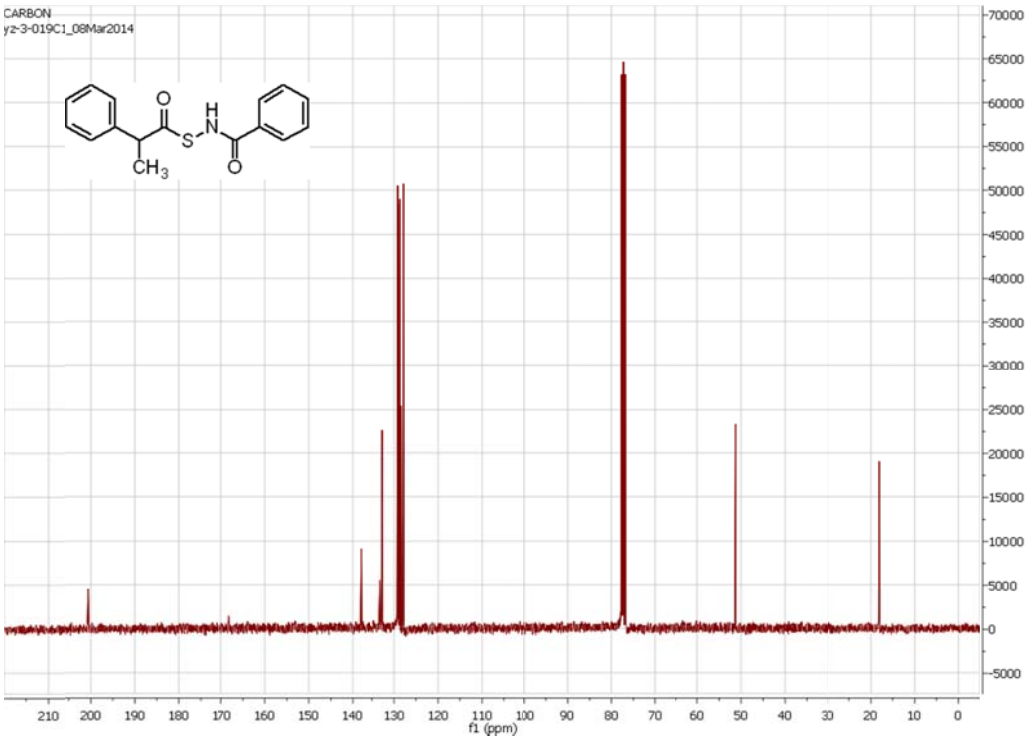
^{13}C NMR (75 MHz, $CDCl_3$) spectrum of **NSHD-18**



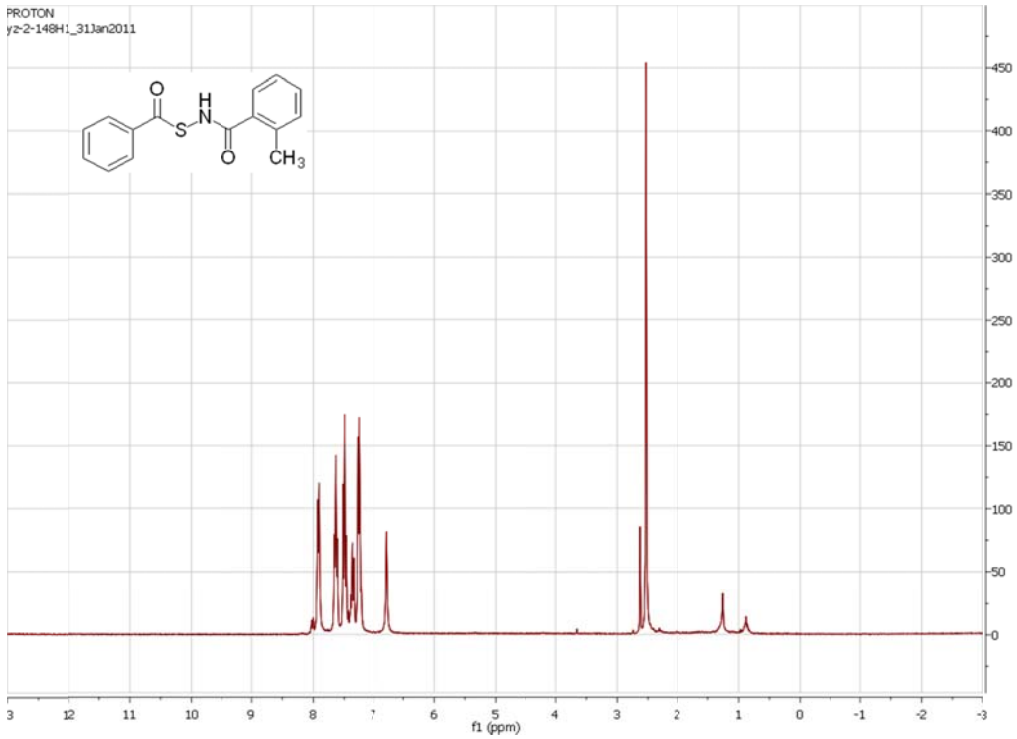
^{1}H NMR (300 MHz, $CDCl_3$) spectrum of **NSHD-19**



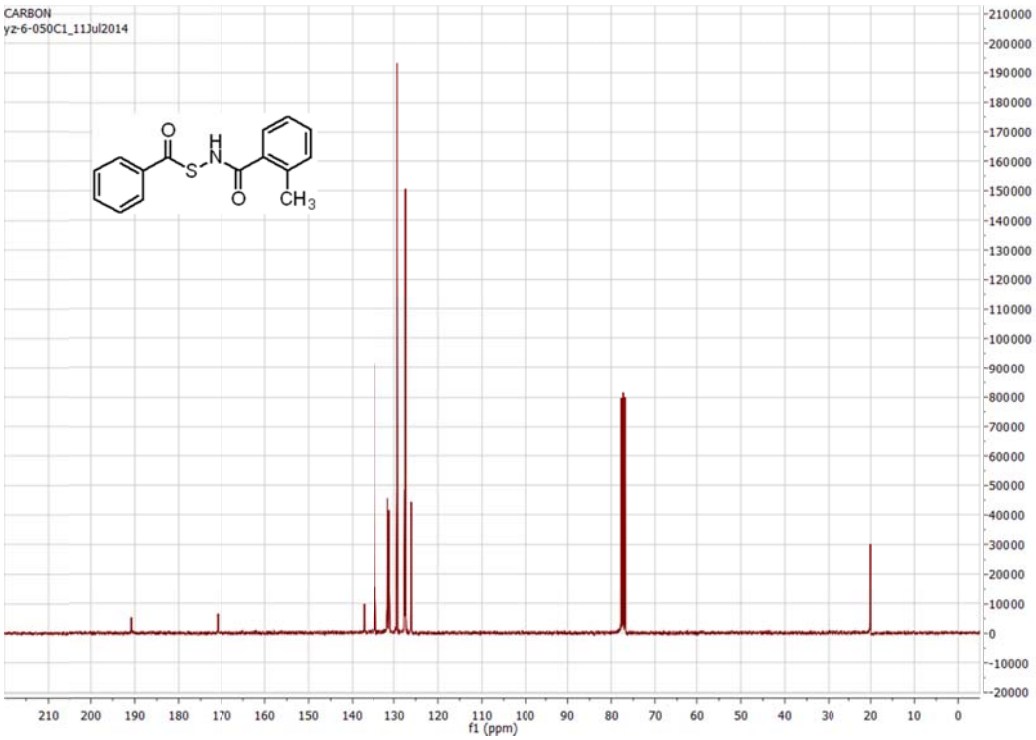
^{13}C NMR (75 MHz, $CDCl_3$) spectrum of **NSHD-19**



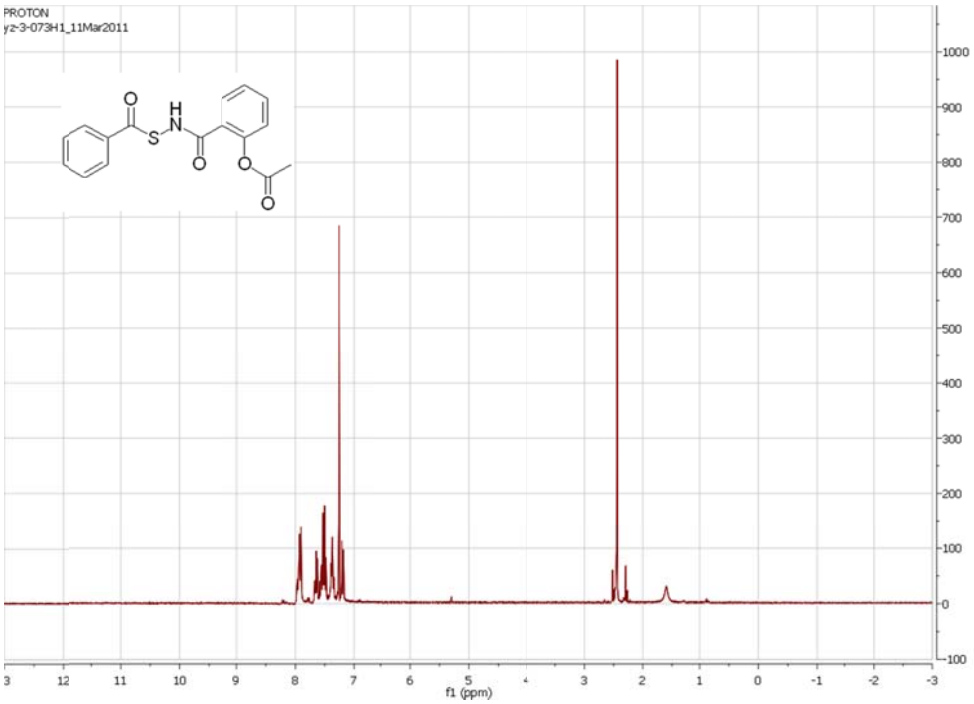
^{1}H NMR (300 MHz, $CDCl_3$) spectrum of **NSHD-20**



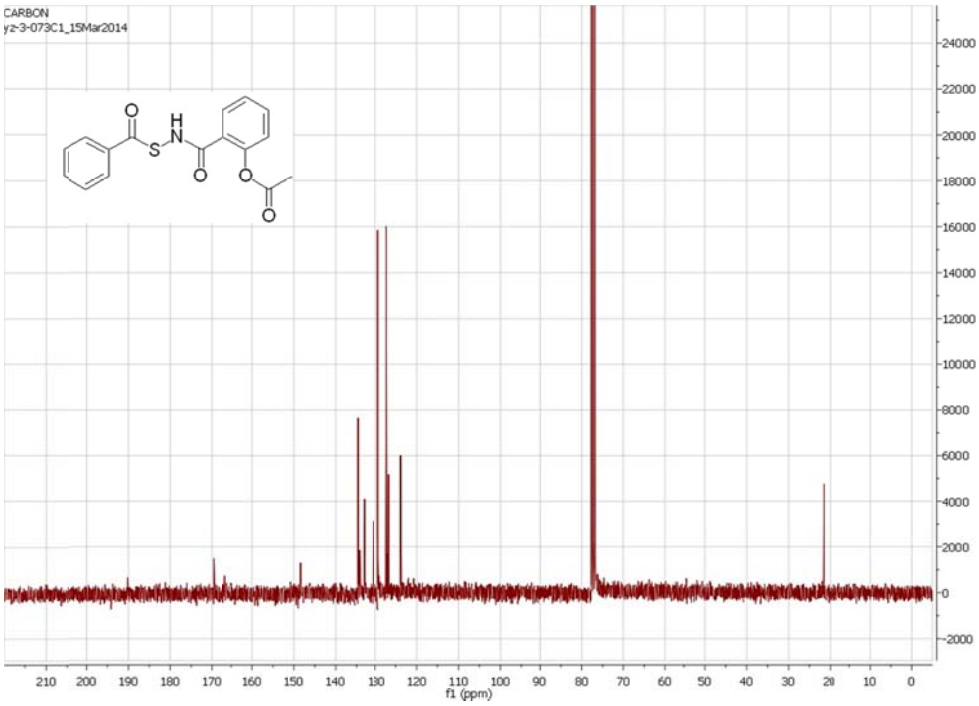
^{13}C NMR (75 MHz, $CDCl_3$) spectrum of **NSHD-20**



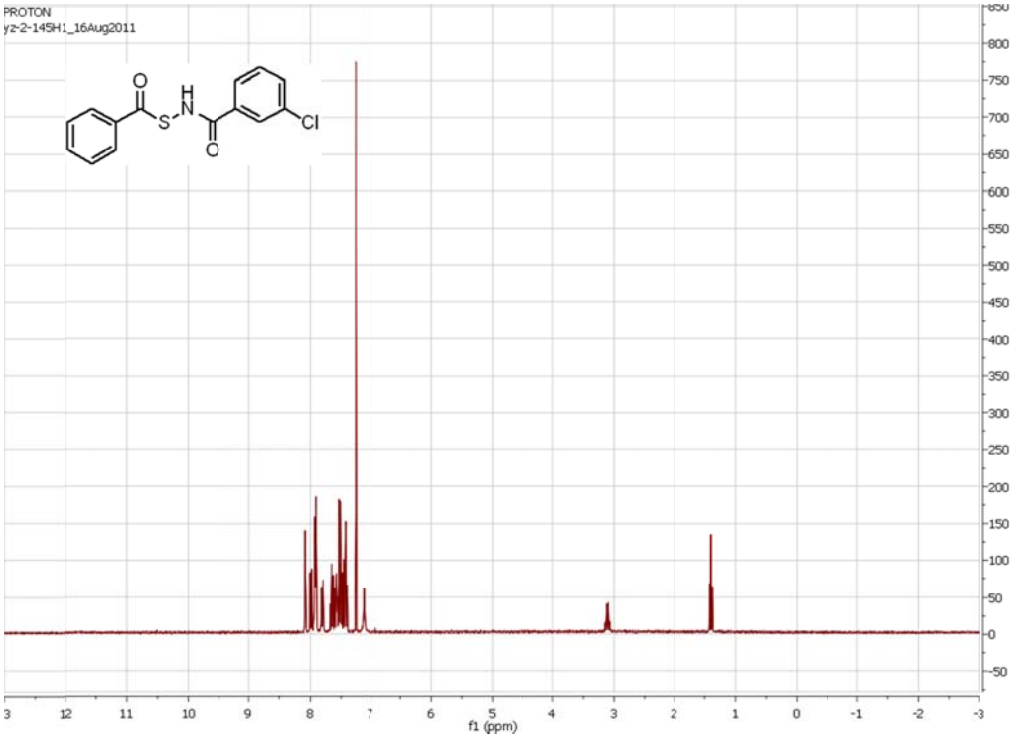
^{1}H NMR (300 MHz, $CDCl_3$) spectrum of **NSHD-21**



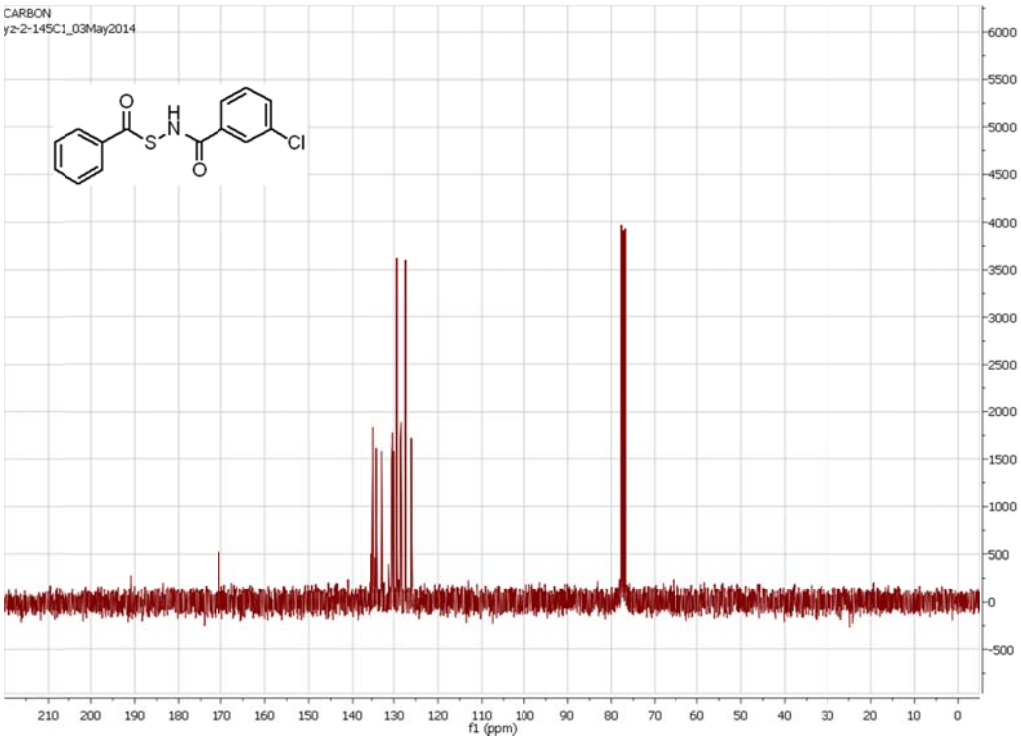
^{13}C NMR (75 MHz, $CDCl_3$) spectrum of **NSHD-21**



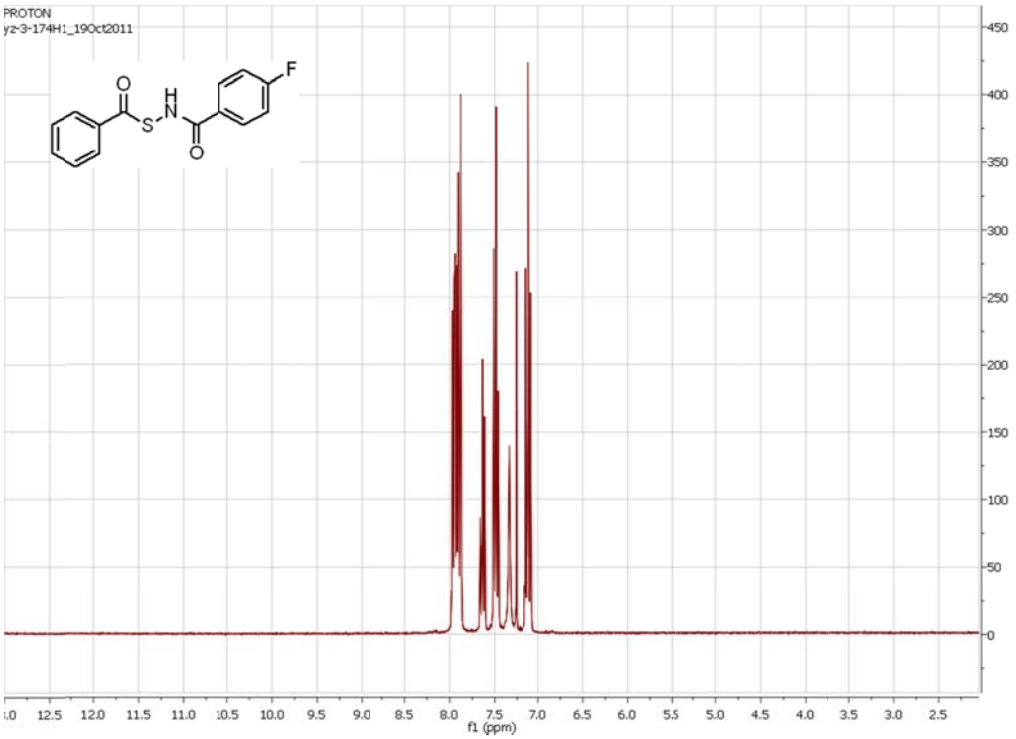
^{1}H NMR (300 MHz, $CDCl_3$) spectrum of **NSHD-22**



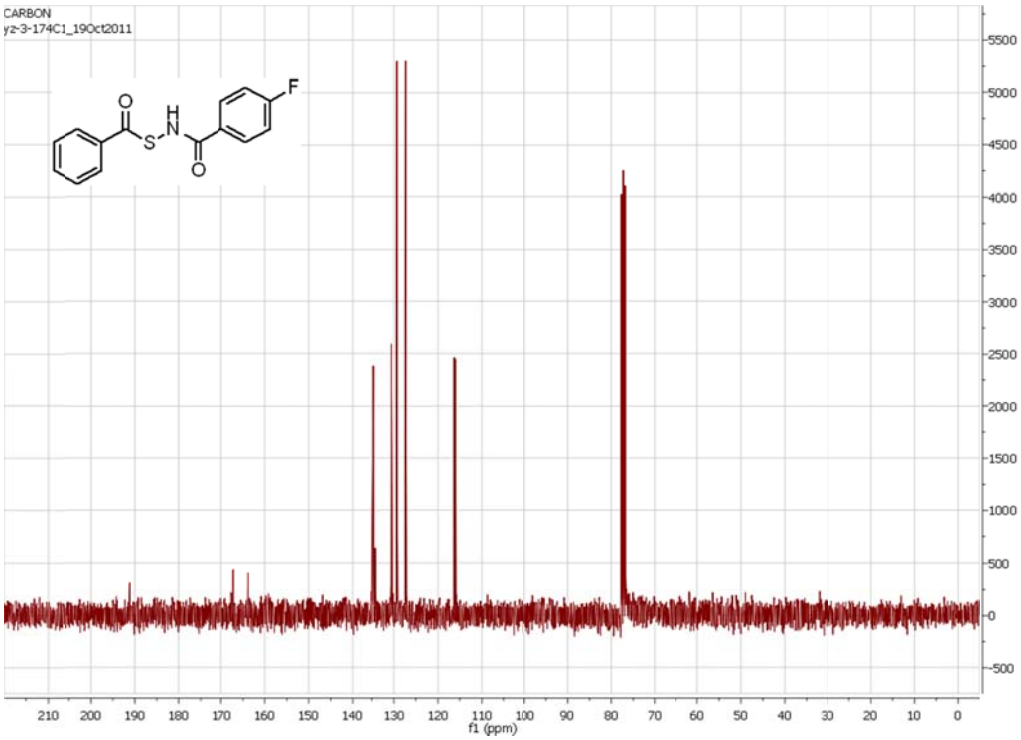
^{13}C NMR (75 MHz, $CDCl_3$) spectrum of **NSHD-22**



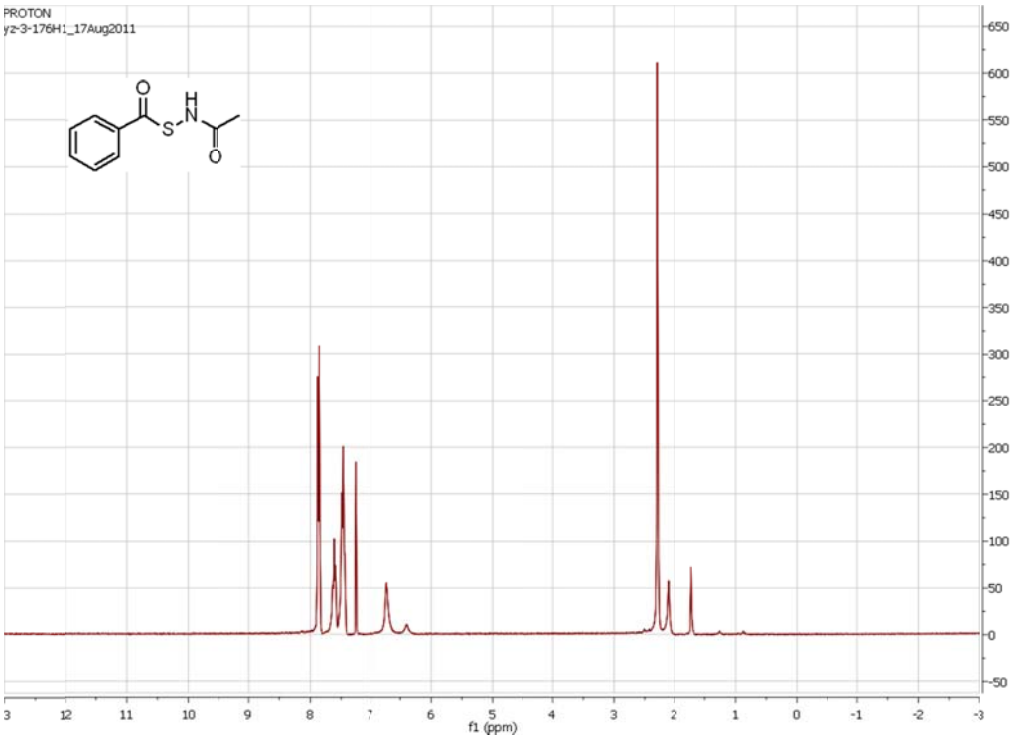
^{1}H NMR (300 MHz, $CDCl_3$) spectrum of **NSHD-23**



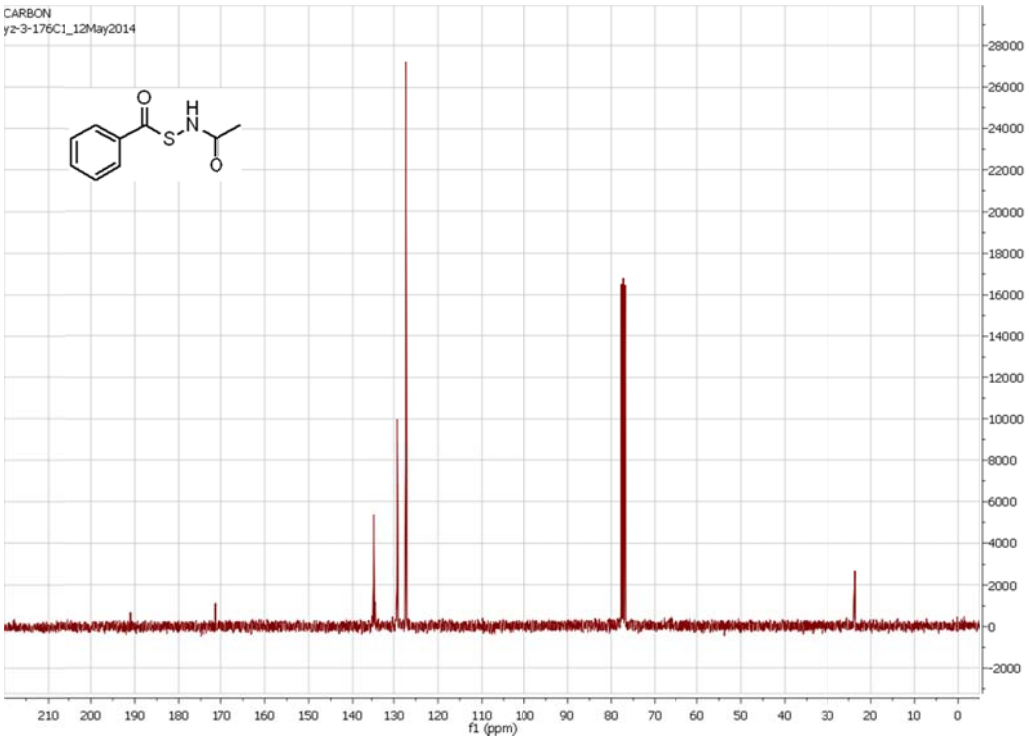
^{13}C NMR (75 MHz, $CDCl_3$) spectrum of **NSHD-23**



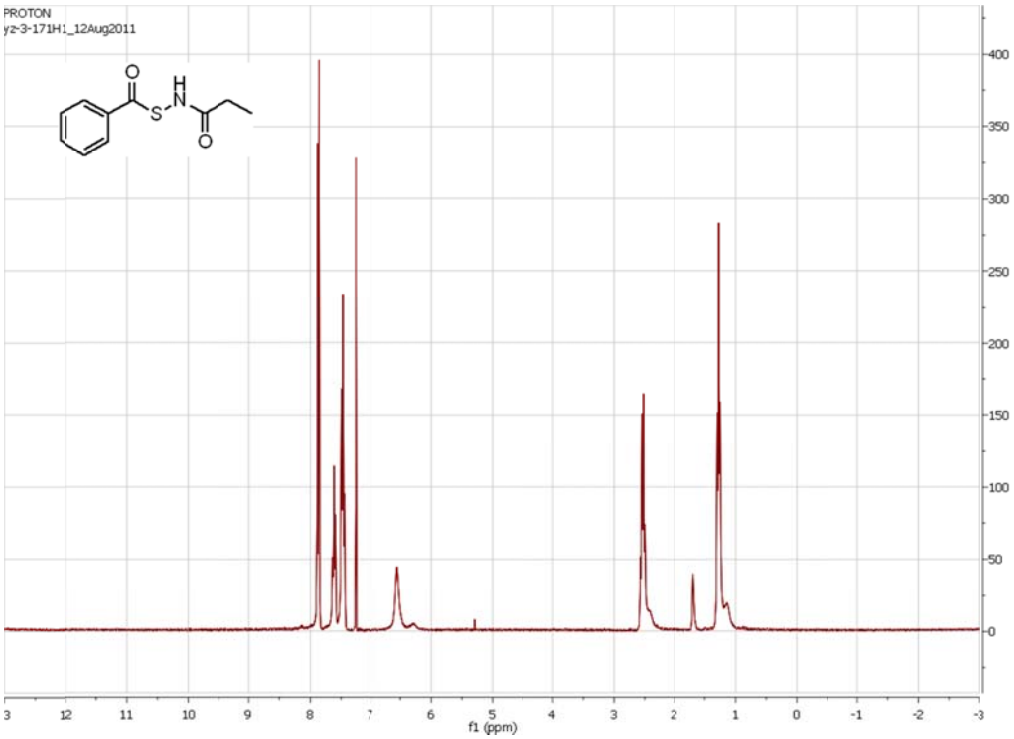
^{1}H NMR (300 MHz, $CDCl_3$) spectrum of **NSHD-24**



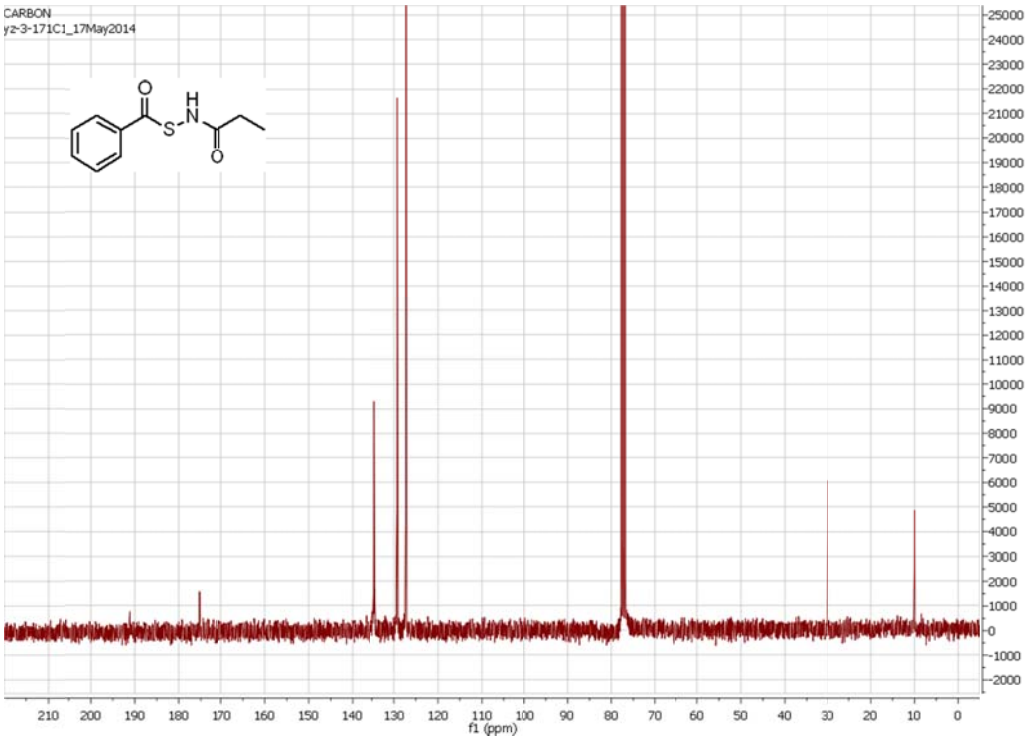
^{13}C NMR (75 MHz, $CDCl_3$) spectrum of **NSHD-24**



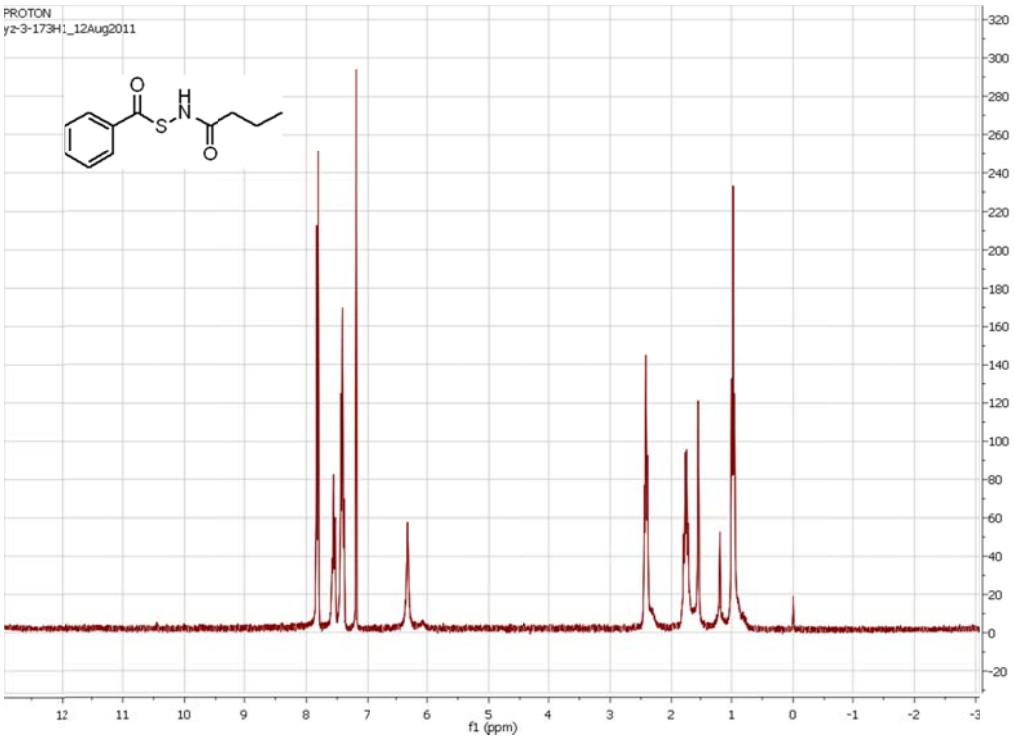
^{1}H NMR (300 MHz, $CDCl_3$) spectrum of **NSHD-25**



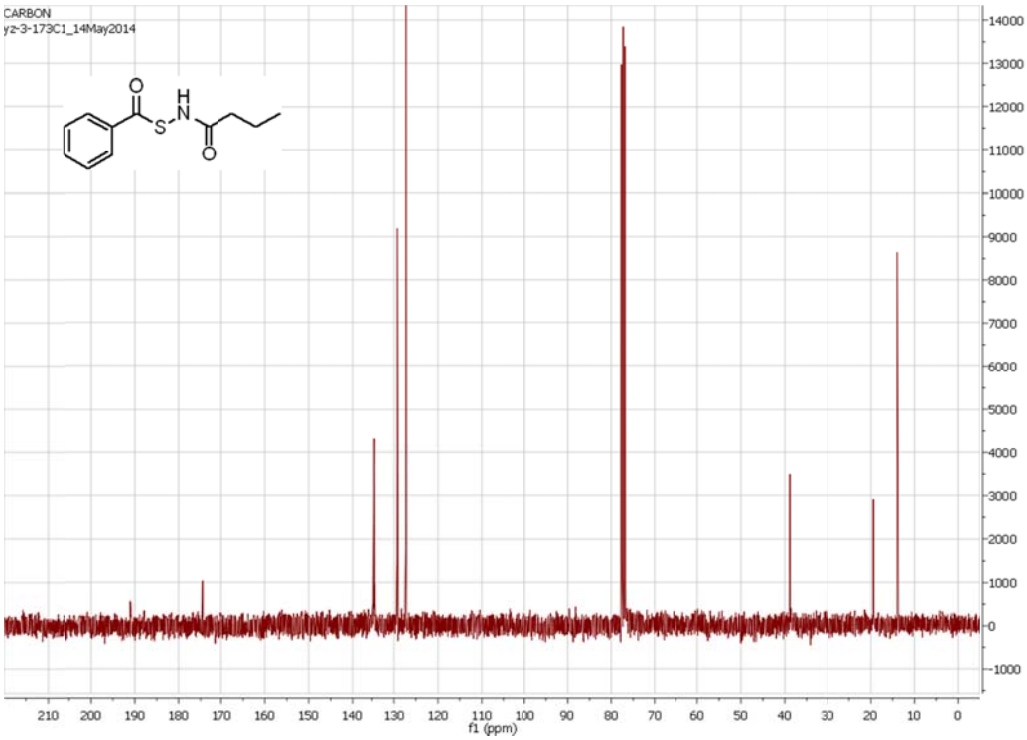
^{13}C NMR (75 MHz, $CDCl_3$) spectrum of **NSHD-25**



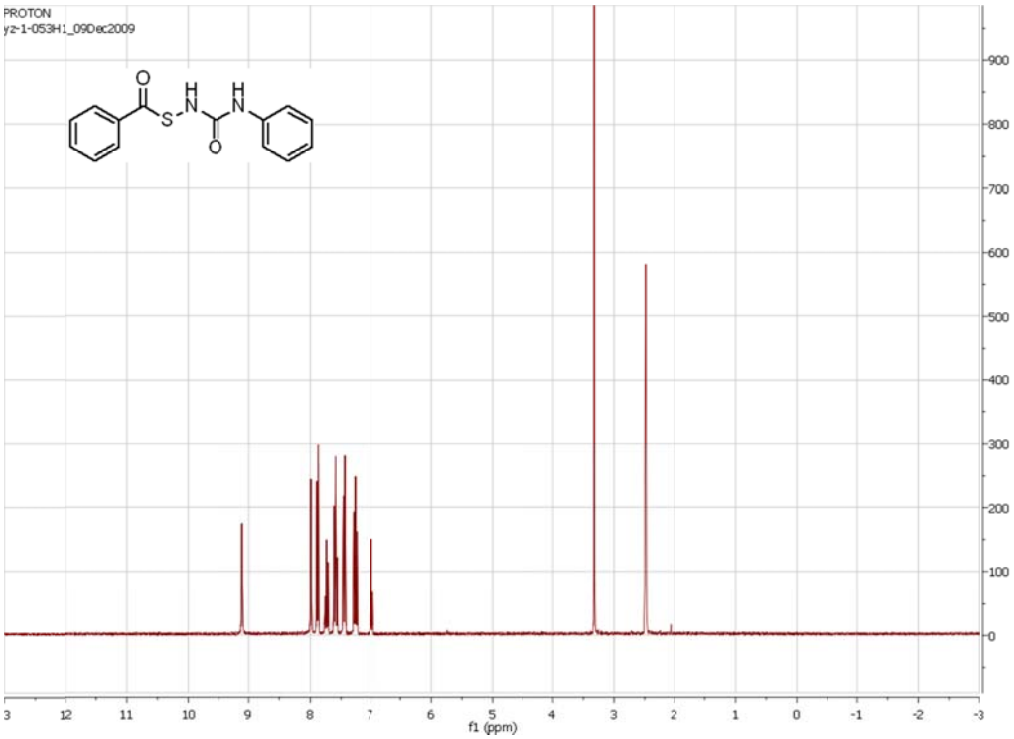
^{1}H NMR (300 MHz, $CDCl_3$) spectrum of **NSHD-26**



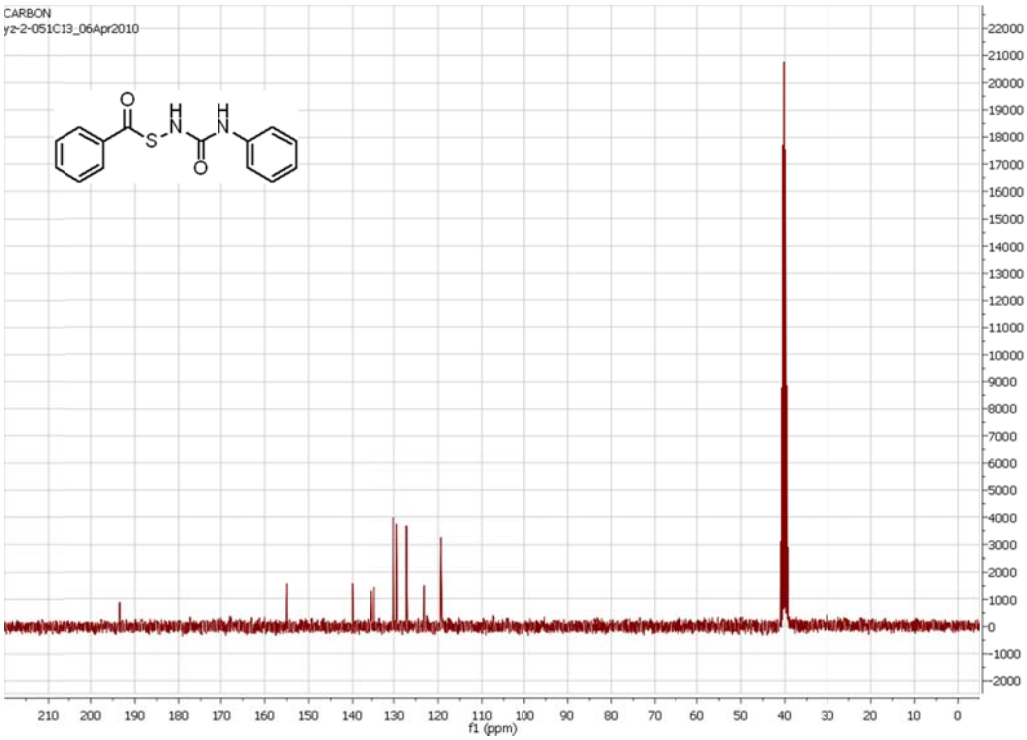
^{13}C NMR (75 MHz, $CDCl_3$) spectrum of **NSHD-26**



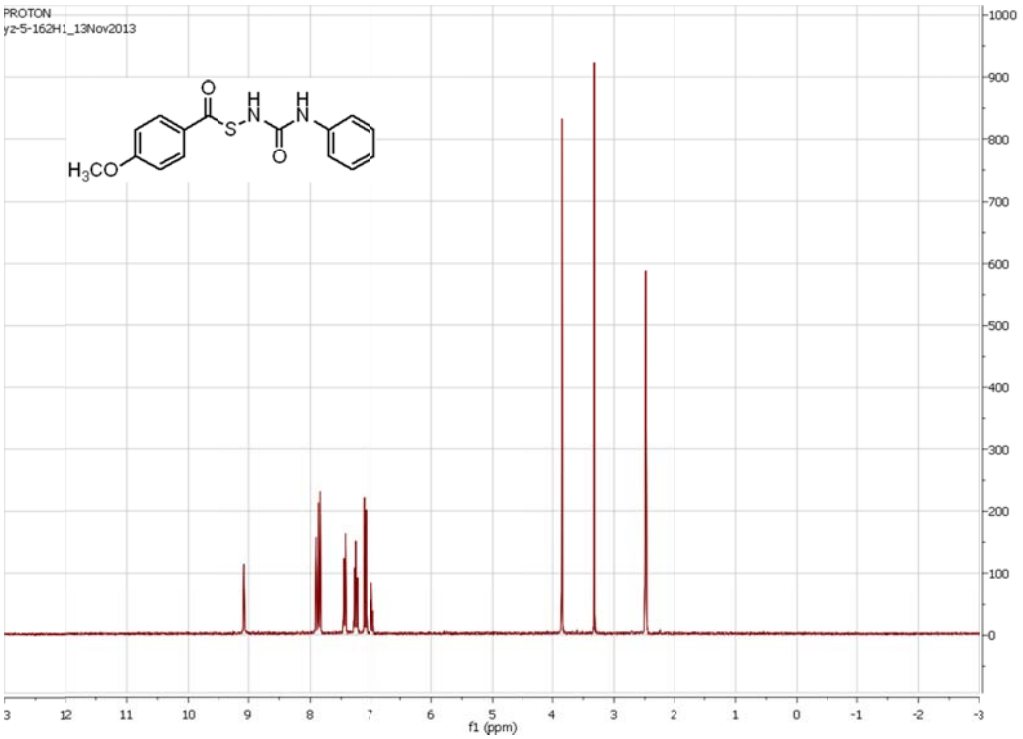
^{1}H NMR (300 MHz, DMSO-d_6) spectrum of **NSHD-27**



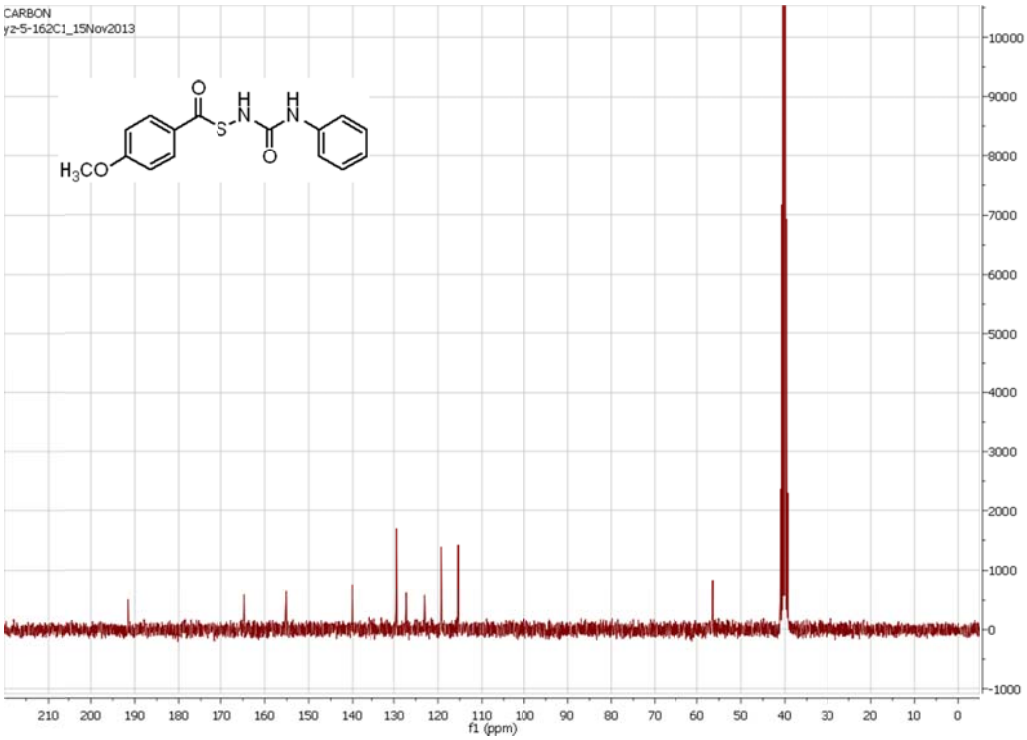
^{13}C NMR (75 MHz, DMSO-d_6) spectrum of **NSHD-27**



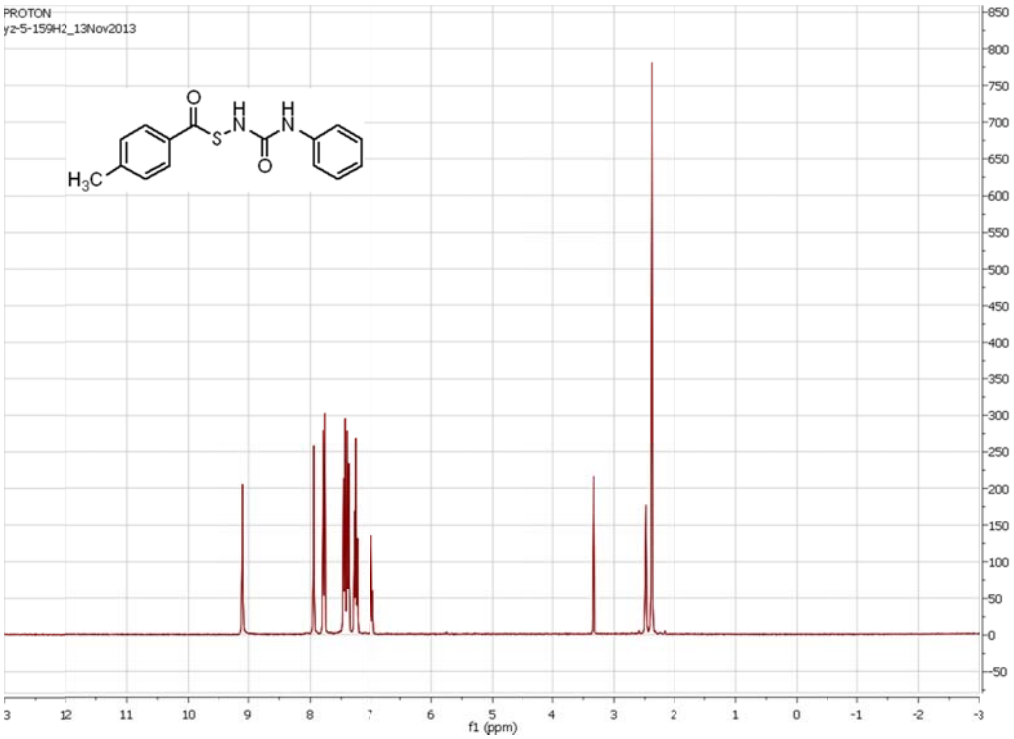
^{1}H NMR (300 MHz, DMSO-d_6) spectrum of **NSHD-28**



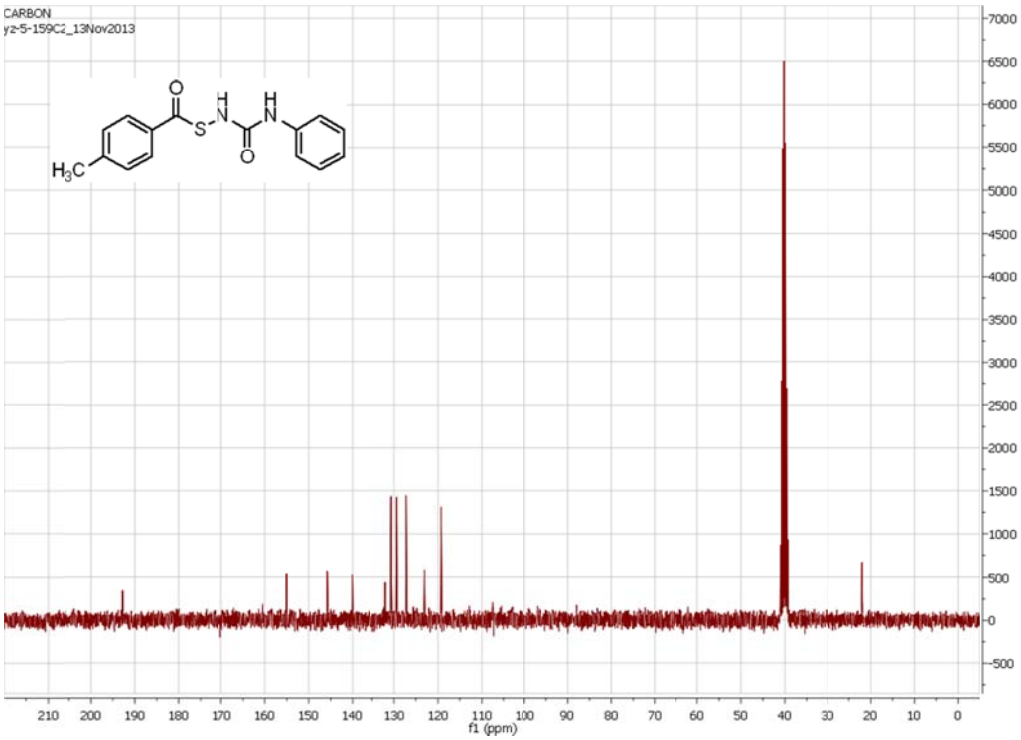
^{13}C NMR (75 MHz, DMSO-d_6) spectrum of **NSHD-28**



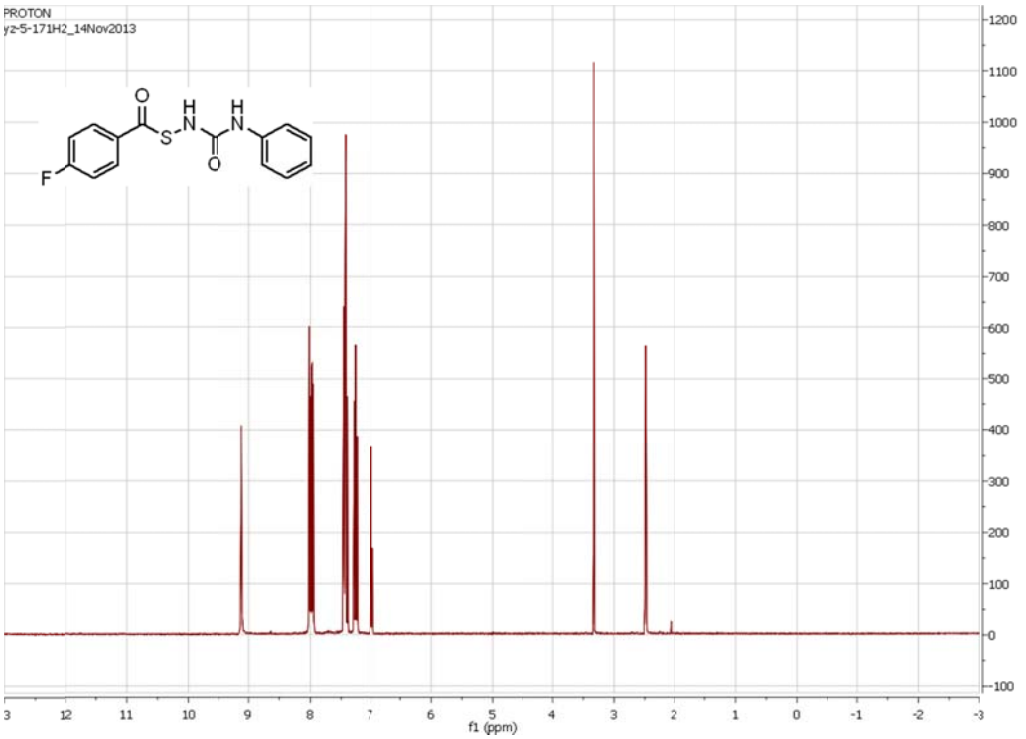
^{1}H NMR (300 MHz, DMSO-d_6) spectrum of **NSHD-29**



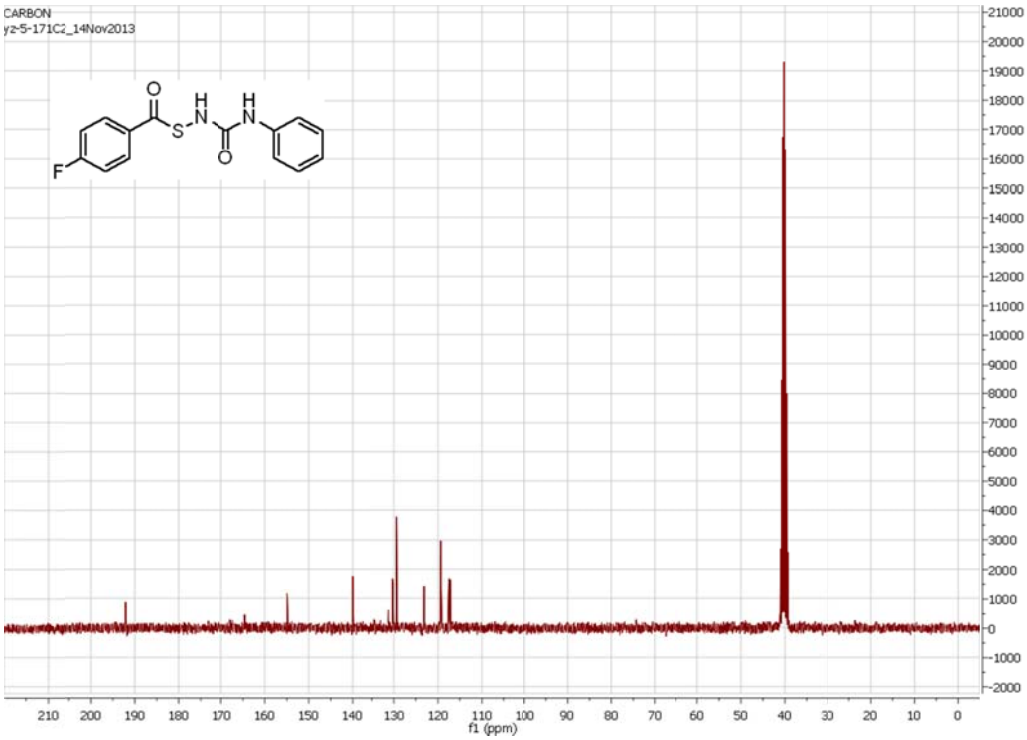
^{13}C NMR (75 MHz, DMSO-d_6) spectrum of **NSHD-29**



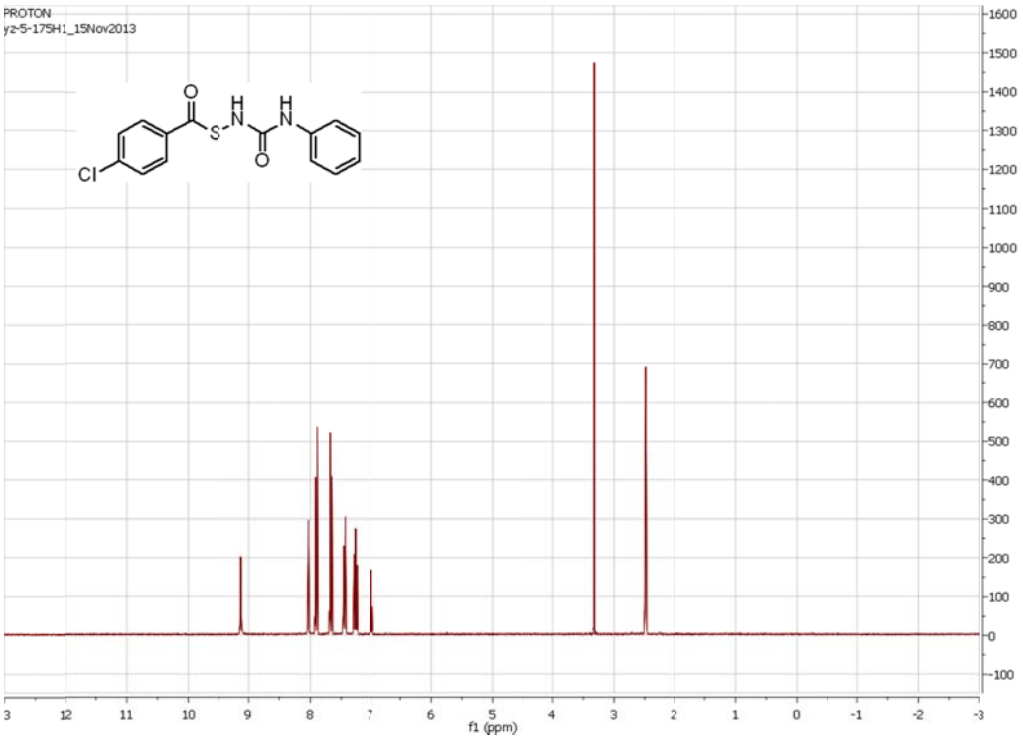
^{1}H NMR (300 MHz, DMSO-d_6) spectrum of **NSHD-30**



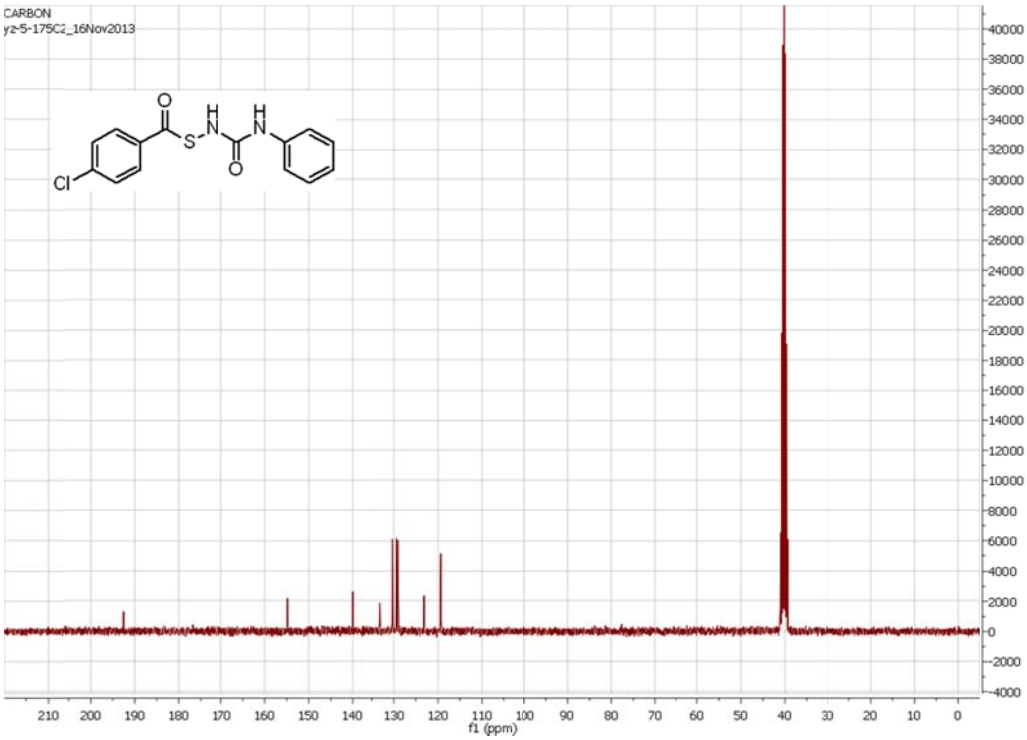
^{13}C NMR (75 MHz, DMSO-d_6) spectrum of **NSHD-30**



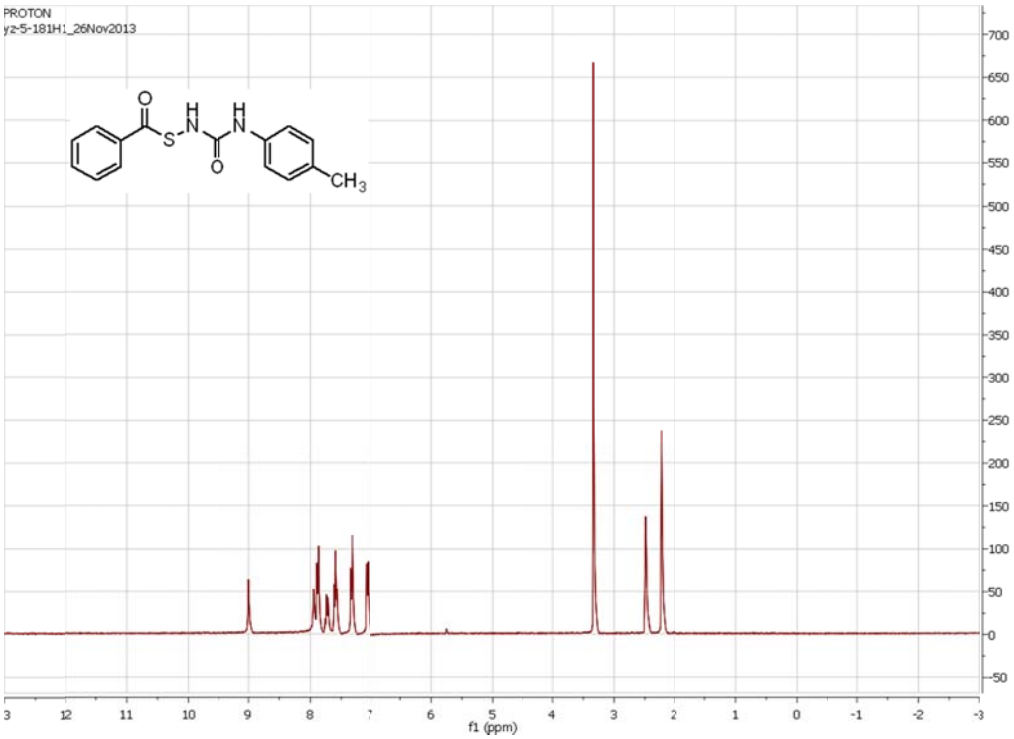
^{1}H NMR (300 MHz, DMSO-d_6) spectrum of **NSHD-31**



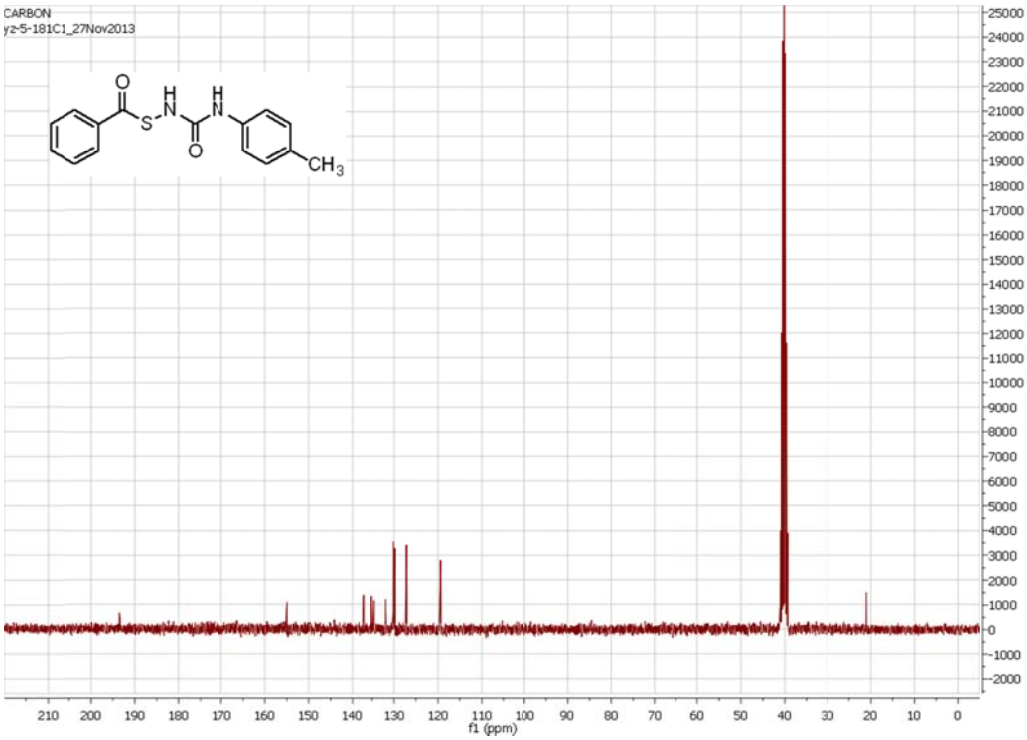
^{13}C NMR (75 MHz, DMSO-d_6) spectrum of **NSHD-31**



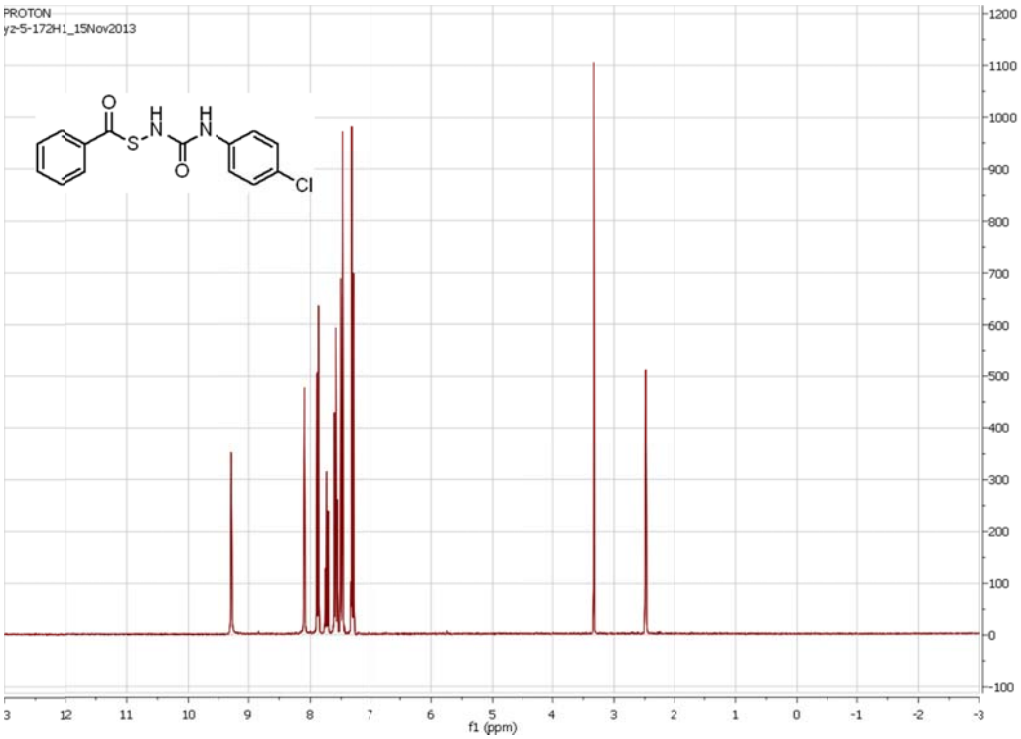
^{1}H NMR (300 MHz, DMSO-d_6) spectrum of **NSHD-32**



^{13}C NMR (75 MHz, DMSO-d_6) spectrum of **NSHD-32**



^{1}H NMR (300 MHz, DMSO-d_6) spectrum of **NSHD-33**



^{13}C NMR (75 MHz, DMSO-d_6) spectrum of **NSHD-33**