Electronic Supplementary Material (ESI) for Chemical Communications

Supporting Information

Novel Preparation of Chiral α-Amino Acids Using the Mitsunobu-Tsunoda Reaction

Anaïs F. M. Noisier, Craig S. Harris, and Margaret A. Brimble*

School of Chemical Sciences and The Maurice Wilkins Centre for Molecular Biodiscovery, The University of Auckland, 23 Symonds Street, Auckland, New Zealand

General Information

All reagents were purchased as reagent grade and used without further purification. Solvents for reactions were dried according to standard procedures.[1] Sealed-tubes, screw cap vials or round-bottom flasks equipped with reflux condensers were used without noticeable differences. Analytical thin layer chromatography (TLC) was performed on 0.2 mm aluminium plates of silica gel 60 F_{254} (Merck) and compounds were visualised by ultra-violet fluorescence or by staining with potassium permanganate, vanillin, or ninhydrin solutions, followed by heating the plate as appropriate. Preparative LCMS was carried out using Waters 600 Pumps linked to a Waters 2700 Sample Manager and a Waters micro mass ZMD mass detector. Samples were routinely filtered and injected at concentrations of around 50 mg of expected product per mL of DMF. Flash chromatography was performed using Davisil® chromatographic silica (LC60Å 40-63 micron) (Grace GmbH & Co. KG) with indicated solvents. Ion-exchange chromatography was performed with Dowex resin 50W x4 20/50 mesh (Sigma-Aldrich) with water then 5% ammonia solution. Reversed-phase chromatography was performed using Davisil® chromatographic C18 bonded silica (633NC18E 60Å 35-70 micron) (Grace GmbH & Co. KG) with indicated solvents. Infrared spectra were obtained using a Perkin Elmer Spectrum One Fourier Transform infrared spectrometer with a universal ATR sampling accessory using neat samples and absorption maxima are expressed in wavenumbers (cm^{-1}). Optical rotations were measured at 20 °C using either a Perkin Elmer Polarimeter or a Rudolph Research Analytical Autopol IV at λ = 598 nm and are given in units of 10^{-1} deg cm^2 g^{-1}. Nuclear magnetic resonance (NMR) spectra were recorded on either a Bruker AVANCE DRX300 spectrometer operating at 300 MHz for ^1H nuclei and 75 MHz for ^{13}C nuclei or on a Bruker AVANCE DRX400 spectrometer operating at 400 MHz for ^1H nuclei and 100 MHz for ^{13}C nuclei or on a Bruker Biospin AVANCE 500 spectrometer operating at 500 MHz for ^1H nuclei and 125 MHz for ^{13}C nuclei at 298 K. Chemical shifts are reported in parts per million (ppm) relative to the TMS signal at δ_H 0.00 ppm (^1H NMR) in $CDCl_3$-$SiMe_4$ solvent or were referenced to the residual methanol signal at δ_H 3.31 ppm in MeOD-d_4 or were referenced to the residual water signal at δ_H 4.79 ppm in D_2O. The ^{13}C values were referenced to the residual chloroform signal at δ_C 77.0 ppm in $CDCl_3$-$SiMe_4$ solvent or residual methanol signal at δ_C 49.00 ppm. ^1H NMR shift values are reported as chemical shift (δ), relative integral, multiplicity (s, singlet; d, doublet; t, triplet; m, multiplet; br s, broad singlet; br d, broad doublet; dd, doublet of doublets; td, triplet of doublets; qd, quadruplet of doublets; ddd, doublet of doublets of doublets; ddt, doublet of

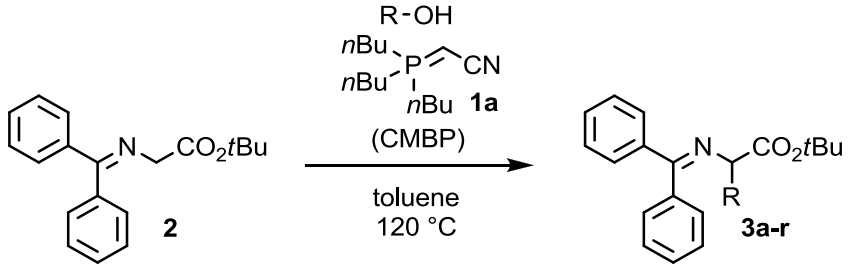
doublets of triplets), coupling constant (*J* in Hz) and assignments. ^{13}C values are reported as chemical shift (δ) and assignment. Assignments were made with the aid of HSQC experiments. Electrospray ionisation mass spectra (ESI-MS) were recorded on a Bruker micrOTOF-Q II spectrometer. Samples were introduced using direct flow injection at 0.1-0.2 mL/min into an ESI source in positive or negative mode. Enantiomeric excesses were determined by chiral HPLC on a Dionex Ultimate 3000 system using a Chirobiotic T 250x4.6 mm 5 µm column, at a flow rate of 1 mL/min. An isocratic mixture of water (A) and CH_3CN (B) was used with detection at 210 nm for aromatic amino acids and 200 nm for non-aromatic amino acids. The samples were injected at a volume of 5 µL and a concentration of 1 mg/mL for aromatic amino acids and of 5 mg/mL for non-aromatic ones.

Cyanomethylenetributylphosphorane (CMBP) was purchased from Tokyo Chemical Industry Co., Ltd. (TCI) or was prepared according to the procedure by Tsunoda *et al*.[2] and used in the reaction without further purification[1]. *N*-(Diphenylmethylene)glycine *tert*-butyl ester, 2-aminobenzophenone, *N*-methylimidazole, nickel nitrate hexahydrate, benzyl bromide and the alcohols were purchased from Sigma-Aldrich with the exception of 2-thienylmethanol, allyl alcohol and 4-chlorobenzyl alcohol purchased from Acros and benzyl alcohol purchased from Scharlau. L-Proline and glycine were purchased from GL Biochem.

[1] Similar yields were obtained when using either the commercially available or crude CMPB.

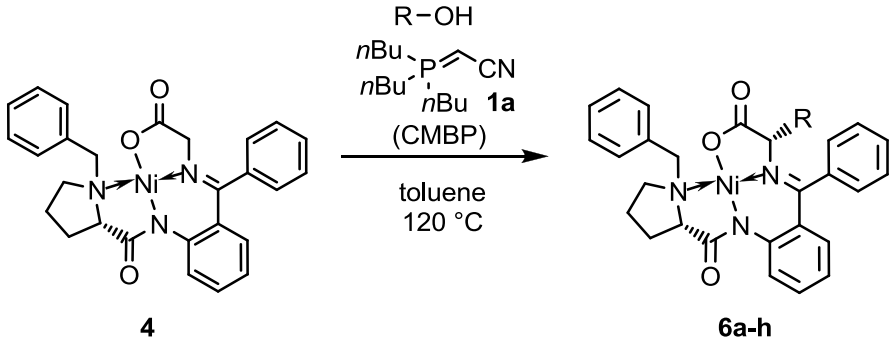
General Procedures

*1) General procedure **A** for the synthesis of racemic amino acid derivatives **3a-r***



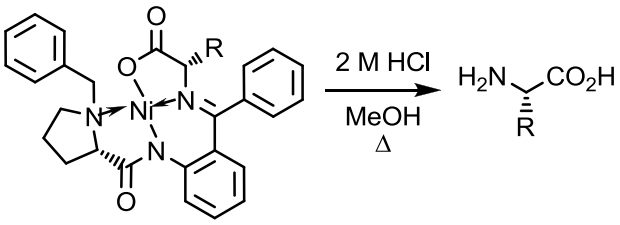
N-(Diphenylmethylene)-Gly-CO_2tBu **2** (0.29 mmol, 86 mg), (cyanomethylene)tributyl phosphorane **1a** (0.58 mmol, 152 µL) and alcohol (0.58 mmol) were combined in toluene (0.3 mL). The brown mixture was heated at 120 °C overnight. The brown solution was allowed to cool down to room temperature and was purified to yield the desired product.

*2) General procedure **B** for the synthesis of alkylated glycine-nickel-(S)-BPB complexes **6a-h***



Glycine-nickel-(*S*)-2-[*N*-(*N'*-benzylprolyl)amino]benzophenone **4** (0.29 mmol, 145 mg), (cyanomethylene)tributylphosphorane **1a** (0.58 mmol, 152 µL) and alcohol (0.58 mmol) were combined in toluene (0.3 mL) and the red mixture heated at 120 °C overnight. The red solution was allowed to cool to room temperature and then purified to yield the desired product.

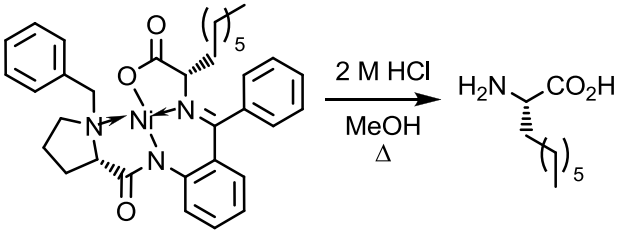
*3) General procedure **C** for the synthesis of enantiopure amino acids **7a-g***



6a-g **7a-g**

Substituted nickel complex **6** was dissolved in MeOH (*c* = 0.05 mol/L) and 2 M HCl (*c* = 0.1 mol/L) was added and the bright red solution was heated at reflux (80°C) for 1h. The resulting yellow to green solution was allowed to cool to room temperature then 28% ammonia solution was added until the pH reached 9-10. The BPB was recovered by extraction with CH_2Cl_2. The intense blue aqueous layer was concentrated to dryness. The blue solid was dissolved in water, purified by ion-exchange chromatography and then lyophilised to yield the desired product.

*4) Procedure for the synthesis of (S)-2-amino-nonanoic acid hydrochloride **7h***

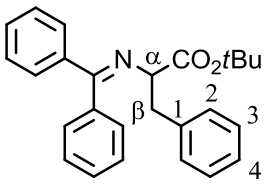


6h **7h**

(*S*)-heptylglycine-Ni-(*S*)-BPB **6h** (0.16 mmol, 93 mg) was dissolved in MeOH (*c* = 0.05 mol/L) and 2 M HCl (*c* = 0.1 mol/L) was added, the bright red solution was heated at reflux (80°C) for 1h. The resulting yellow to green solution was allowed to cool down to room temperature. The solvent was concentrated *in vacuo*, water was added, the beige precipitate was centrifuged and the aqueous layer was purified by reversed-phase C18 chromatography (0-70% MeOH in water) and lyophilized to yield the desired product as a white solid.

Characterization data

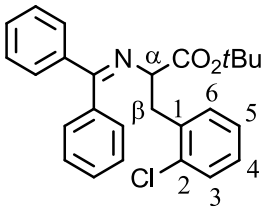
tert-Butyl 2-(diphenylmethyleneamino)-3-phenylpropanoate **3a**:



This compound was prepared following general procedure **A** using benzyl alcohol (60 µL). Purification by flash chromatography (Et_2O/hexane, 1/9 + 1% NEt_3) yielded the desired product as a brown oil. Yield: (91 mg, 82%).

^1H NMR and ^{13}C NMR data are in agreement with that reported in the literature.[3]

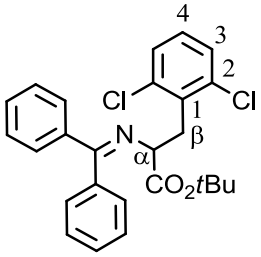
tert-Butyl 2-(diphenylmethyleneamino)-3-(2-(chloro)phenyl)propanoate **3b**:



This compound was prepared following general procedure **A** using 2-chlorobenzyl alcohol (83 mg). Purification by flash chromatography (Et_2O/hexane, 1/9 + 1% NEt_3) yielded the desired product as a brown oil. Yield: (71 mg, 58%).

^1H NMR data are in agreement with that reported in the literature.[4]

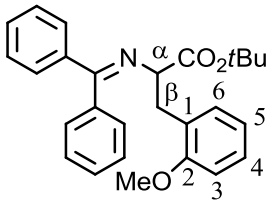
tert-Butyl 3-(2,6-dichlorophenyl)-2-(diphenylmethyleneamino)propanoate **3c**:



This compound was prepared following general procedure **A** using 2,6-dichlorobenzyl alcohol (103 mg). Purification by preparative chromatography yielded the desired product as a brown oil. Yield: (90 mg, 68%).

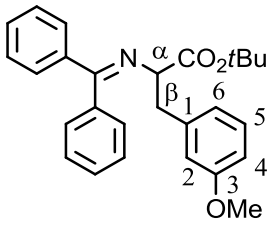
^1H NMR and ^{13}C NMR data are in agreement with that reported in the literature.[5]

tert-Butyl 2-(diphenylmethyleneamino)-3-(2-methoxyphenyl)propanoate **3d**:



This compound was prepared following general procedure **A** using 2-methoxybenzyl alcohol (77 µL). Purification by flash chromatography (Et_2O/hexane, 1/9 + 1% NEt_3) yielded the desired product as a brown oil. Yield: (93 mg, 77%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 1.48 (9H, s, CH_3/CO_2tBu), 3.06 (1H, dd, *J* = 13.2, 9.5 Hz, βCH_2), 3.39 (1H, dd, *J* = 13.2, 4.4 Hz, βCH_2), 3.53 (3H, s, OCH_3), 4.32 (1H, dd, *J* = 9.5, 4.4 Hz, αCH), 6.68 (2H, br d, *J* = 5.5 Hz, ar), 6.72 (1H, d, *J* = 8.1 Hz, 3-CH), 6.81 (1H, t, *J* = 7.3 Hz, 5-CH), 7.13 (1H, d, *J* = 7.3 Hz, 6-CH), 7.17 (1H, t, *J* = 8.1 Hz, 4-CH), 7.29-7.39 (6H, m, ar), 7.58 (2H, d, *J* = 7.3 Hz, ar); ^{13}C NMR (125 MHz, $CDCl_3$): δ 28.0 (3 x CH_3/CO_2tBu), 34.3 (βCH_2), 54.7 (OCH_3), 65.5 (αCH), 80.8 (C/CO_2tBu), 109.8 (3-CH), 119.9 (5-CH), 126.4 (1-C), 127.5 (1 x CH/ar), 127.8 (4 x CH/ar), 127.9 (2 x CH/ar), 127.9 (1 x CH/ar), 128.7 (2 x CH/ar), 129.8 (1 x CH/ar), 131.9, 136.5, 139.8 (3 x C/ar), 157.7 (2-C), 169.9 *(C=N), 171.2 *(C=O/CO_2tBu); IR υ_{max} (neat): 2975, 1727, 1659, 1599, 1494, 1447, 1368, 1277, 1150, 1027, 941, 919, 845, 754, 698, 638 cm^{-1}; MS (ESI) *m/z*: 416.2226 $[M + H]^+$, 360.1605 $[M - C(CH_3)_3]^+$ ($[M + H]^+$, $C_{27}H_{30}NO_3$ requires 416.2220).

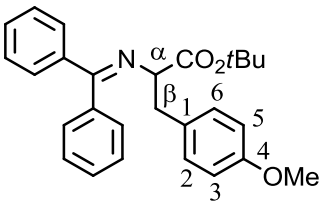
tert-Butyl 2-(diphenylmethyleneamino)-3-(3-methoxyphenyl)propanoate **3e**:



This compound was prepared following general procedure **A** using 3-methoxybenzyl alcohol (72 µL). Purification by flash chromatography (EtOAc/hexane, 1/9 + 1% NEt_3) yielded the desired product as a brown oil. Yield: (76 mg, 63%); ^{1}H NMR (400 MHz, $CDCl_3$): δ 1.45 (9H, s, CH_3/CO_2tBu), 3.14 (1H, dd, *J* = 13.3, 9.3 Hz, βCH_2), 3.21 (1H, dd, *J* = 13.3, 4.3 Hz, βCH_2), 3.65 (3H, s, OCH_3), 4.12 (1H, dd, *J* = 9.4, 4.4 Hz, αCH), 6.59 (1H, br s, ar), 6.62-6.67 (3H, m, ar), 6.72 (1H, dd, *J* = 8.0, 2.4 Hz, ar), 7.08-7.12 (1H, m, ar), 7.26-7.39 (6H,

m, ar), 7.58 (2H, d, *J* = 7.0 Hz, ar); ^{13}C NMR (100 MHz, $CDCl_3$): δ 28.1 (3 x CH_3/CO_2*t*Bu), 39.7 (βCH_2), 55.0 (OCH_3), 67.9 (αCH), 81.2 (C/CO_2*t*Bu), 112.5 (4-CH), 114.7 (2-CH), 122.3 (6-C), 127.7, 127.9, 128.0 (6 x CH/ar), 128.2 (1 x CH/ar), 128.7 (2 x CH/ar), 129.0, 130.1 (2 x CH/ar), 136.4, 139.6, 139.9 (3 x C/ar), 159.4 (3-C), 170.3 *(C=N), 170.8 *(C=O/CO_2*t*Bu); IR υ_{max} (neat): 2983, 1725, 1663, 1590, 1489, 1445, 1368, 1278, 1150, 1027, 945, 700, 640 cm^{-1}; MS (ESI) *m/z*: 438.2045 $[M + Na]^+$, 416.2220 $[M + H]^+$, 360.1596 $[M - C(CH_3)_3]^+$ ($[M + H]^+$, $C_{27}H_{30}NO_3$ requires 416.2220).

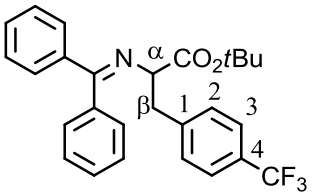
<u>*tert*-Butyl 2-(diphenylmethyleneamino)-3-(4-methoxyphenyl)propanoate **3f**:</u>



This compound was prepared following general procedure **A** using 4-methoxybenzyl alcohol (72 µL). Purification by flash chromatography (Et_2O/hexane, 1/9 + 1% NEt_3) yielded the desired product as a brown oil. Yield: (82 mg, 68%).

^{1}H NMR and ^{13}C NMR data are in agreement with that reported in the literature.[6]

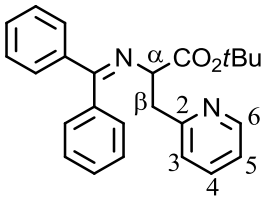
<u>*tert*-Butyl 2-(diphenylmethyleneamino)-3-(4-(trifluoromethyl)phenyl)propanoate **3g**:</u>



N-(Diphenylmethylene)-Gly-CO_2*t*Bu **2** (0.29 mmol, 86 mg), (cyanomethylene)tributyl phosphorane **1a** (0.87 mmol, 228 µL) and 4-trifluoromethylbenzyl alcohol (0.87 mmol, 119 µL) were combined in toluene (0.3 mL). The brown mixture was heated at 120 °C overnight. The brown solution was allowed to cool down to room temperature. Purification by preparative chromatography yielded the desired product as a brown oil. Yield: (67 mg, 51%).

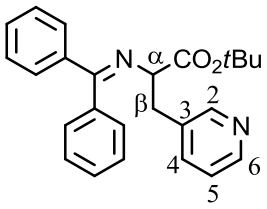
^{1}H NMR and ^{13}C NMR data are in agreement with that reported in the literature.[3]

tert-Butyl 2-(diphenylmethyleneamino)-3-(pyridin-2-yl)propanoate **3h**:



This compound was prepared following general procedure **A** using pyridin-2-ylmethanol (56 µL). Purification by flash chromatography (EtOAc/hexane, 1/4 + 1% NEt_3) yielded the desired product as a yellow oil. Yield: (57 mg, 54%); R_f 0.29 (EtOAc/hexane, 1/4); ^{1}H NMR (400 MHz, $CDCl_3$): δ 1.44 (9H, s, CH_3/CO_2tBu), 3.37 (1H, dd, *J* = 13.3, 9.3 Hz, βCH_2), 3.44 (1H, dd, *J* = 13.3, 4.1 Hz, βCH_2), 4.44 (1H, dd, *J* = 9.4, 4.1 Hz, αCH), 6.70 (2H, d, *J* = 6.8 Hz, ar), 7.06 (1H, dddd, *J* = 7.5, 5.9, 4.9, 1.1 Hz, ar), 7.16 (1H, d, *J* = 7.7 Hz, ar), 7.25-7.40 (6H, m, ar), 7.48-7.58 (3H, m, ar), 8.41 (1H, dddd, *J* = 4.9, 2.7, 1.8, 0.8 Hz, 6-CH); ^{13}C NMR (100 MHz, $CDCl_3$): δ 28.0 (3 x CH_3/CO_2tBu), 42.0 (βCH_2), 66.4 (αCH), 81.2 (C/CO_2tBu), 121.2 (5-CH), 124.6 (3-CH), 127.7, 127.9, 128.1 (6 x CH/ar), 128.4 (1 x CH/ar), 128.8 (2 x CH/ar), 130.1, 136.0 (2 x CH/ar), 136.2, 139.6 (2 x C/ar), 149.2 (6-CH), 158.7 (2-C), 170.7 *(C=N), 170.7 *(C=O/CO_2tBu); IR υ_{max} (neat): 2977, 1728, 1592, 1252, 1148, 1068, 696 cm^{-1}; MS (ESI) *m/z*: 409.1875 $[M + Na]^+$, 387.2056 $[M + H]^+$, 331.1436 $[M - C(CH_3)_3]^+$ ($[M + H]^+$, $C_{25}H_{27}N_2O_2$ requires 387.2067).

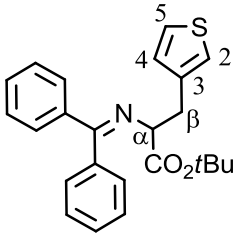
tert-Butyl 2-(diphenylmethyleneamino)-3-(pyridin-3-yl)propanoate **3i**:



This compound was prepared following general procedure **A** using pyridin-3-ylmethanol (56 µL). Purification by preparative chromatography yielded the desired product as a brown oil. Yield: (41 mg, 37%).

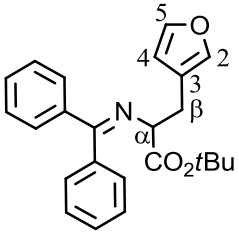
^{1}H NMR and ^{13}C NMR data are in agreement with that reported in the literature.[7]

tert-Butyl 2-(diphenylmethyleneamino)-3-(thiophen-3-yl)propanoate **3j**:



This compound was prepared following general procedure **A** using 3-thiophenemethanol (55 µL). Purification by preparative chromatography yielded the desired product as a brown oil. Yield: (26 mg, 23%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 1.44 (9H, s, CH_3/CO_2*t*Bu), 3.20 (1H, dd, *J* = 13.9, 8.8 Hz, βCH_2), 3.25 (1H, dd, *J* = 13.9, 4.5 Hz, βCH_2), 4.10 (1H, dd, *J* = 8.8, 4.5 Hz, αCH), 6.74 (2H, d, *J* = 6.2 Hz, ar), 6.80 (1H, d, *J* = 4.8 Hz, 4-CH), 6.91 (1H, d, *J* = 3.0 Hz, 2-CH), 7.15 (1H, dd, *J* = 4.8, 3.0 Hz, 5-CH), 7.30-7.39 (6H, m, ar), 7.60 (2H, d, *J* = 7.2 Hz, ar); ^{13}C NMR (125 MHz, $CDCl_3$): δ 28.0 (3 x CH_3/CO_2*t*Bu), 33.8 (βCH_2), 67.3 (αCH), 81.1 (C/CO_2*t*Bu), 122.3 (2-CH), 124.8 (5-CH), 127.6, 128.0, 128.1 (6 x CH/ar), 128.2 (1 x CH/ar), 128.7 (2 x CH/ar), 129.3, 130.1 (2 x CH/ar), 136.4 (1 x C/ar), 138.6 (3-C), 139.6 (1 x C/ar), 170.4 *(C=N), 170.7 *(C=O/CO_2*t*Bu); IR υ_{max} (neat): 2976, 1728, 1658, 1598, 1447, 1368, 1317, 1276, 1149, 941, 919, 843, 768, 698, 637 cm^{-1}; MS (ESI) *m/z*: 414.1505 $[M + Na]^+$, 392.1688 $[M + H]^+$, 336.1070 $[M - C(CH_3)_3]^+$ ($[M + H]^+$, $C_{24}H_{26}NO_2S$ requires 392.1679).

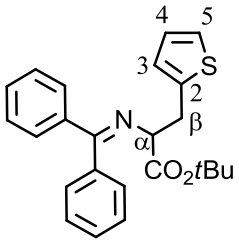
tert-Butyl 2-(diphenylmethyleneamino)-3-(furan-3-yl)propanoate **3k**:



This compound was prepared following general procedure **A** using 3-furanmethanol (50 µL). Purification by preparative chromatography yielded the desired product as a brown oil. Yield: (68 mg, 62%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 1.44 (9H, s, CH_3/CO_2*t*Bu), 2.99 (1H, dd, *J* = 14.3, 8.5 Hz, βCH_2), 3.04 (1H, dd, *J* = 14.3, 4.8 Hz, βCH_2), 4.06 (1H, dd, *J* = 8.5, 4.8 Hz, αCH), 6.16 (1H, s, 4-CH), 6.93 (2H, br s, ar), 7.19 (1H, s, 2-CH), 7.28 (1H, s, 5-CH), 7.33 (2H, t, *J* = 7.7 Hz, ar), 7.36-7.39 (4H, m, ar), 7.63 (2H, d, *J* = 7.3 Hz, ar); ^{13}C NMR

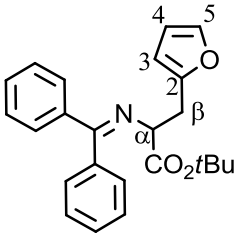
(125 MHz, $CDCl_3$): δ 28.0 (3x CH_3/CO_2tBu), 28.9 (βCH_2), 66.8 (αCH), 81.1 (C/CO_2tBu), 112.0 (4-CH), 121.1 (3-C), 127.7, 128.0, 128.2 (6 x CH/ar), 128.3 (1 x CH/ar), 128.7 (2 x CH/ar), 130.2 (1 x CH/ar), 136.4, 139.5 (2 x C/ar), 140.2 (2-CH), 142.3 (5-CH), 170.3 *(C=N), 170.7 *(C=O/CO_2tBu); IR υ_{max} (neat): 2932, 1729, 1661, 1623, 1599, 1446, 1367, 1276, 1149, 1124, 847, 780, 697, 638 cm^{-1}; MS (ESI) *m/z*: 398.1712 $[M + Na]^+$, 376.1897 $[M + H]^+$, 320.1281 $[M - C(CH_3)_3]^+$ ($[M + H]^+$, $C_{24}H_{26}NO_3$ requires 376.1907).

tert-Butyl 2-(diphenylmethyleneamino)-3-(thiophen-2-yl)propanoate **3l**:



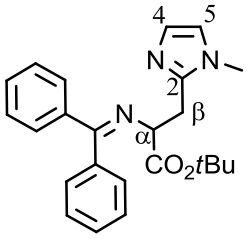
This compound was prepared following general procedure **A** using 2-thiophenemethanol (55 µL). Purification by preparative chromatography yielded the desired product as a brown oil. Yield: (88 mg, 77%); ^1H NMR (500 MHz, $CDCl_3$): δ 1.45 (9H, s, CH_3/CO_2tBu), 3.39-3.47 (2H, m, βCH_2), 4.13 (1H, dd, *J* = 7.9, 4.7 Hz, αCH), 6.78-6.91 (4H, m, ar), 7.10 (1H, d, *J* = 5.0 Hz, 5-CH), 7.32-7.41 (6H, m, ar), 7.66 (2H, d, *J* = 7.6 Hz, ar); ^{13}C NMR (125 MHz, $CDCl_3$): δ 28.0 (3x CH_3/CO_2tBu), 33.6 (βCH_2), 67.5 (αCH), 81.3 (C/CO_2tBu), 124.1 (5-CH), 126.2 $^{\#}$(3-CH), 126.5 $^{\#}$(4-CH), 127.6, 127.9, 128.1 (6 x CH/ar), 128.3 (1 x CH/ar), 128.9 (2 x CH/ar), 130.2 (1 x CH/ar), 136.4, 139.5 (2 x C/ar), 140.4 (2-C), 170.2 *(C=N), 170.9 *(C=O/CO_2tBu); IR υ_{max} (neat): 2977, 1728, 1659, 1623, 1598, 1446, 1368, 1316, 1276, 1148, 941, 919, 845, 764, 695, 638 cm^{-1}; MS (ESI) *m/z*: 414.1506 $[M + Na]^+$, 392.1679 $[M + H]^+$, 336.1058 $[M - C(CH_3)_3]^+$ ($[M + H]^+$, $C_{24}H_{26}NO_2S$ requires 392.1679).

tert-Butyl 2-(diphenylmethyleneamino)-3-(furan-2-yl)propanoate **3m**:



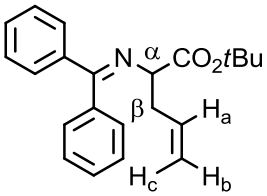
This compound was prepared following general procedure **A** using 2-furanmethanol (50 µL). Purification by preparative chromatography yielded the desired product as a brown oil. Yield: (62 mg, 57%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 1.45 (9H, s, CH_3/CO_2tBu), 3.21 (1H, dd, *J* = 14.8, 8.8 Hz, βCH_2), 3.27 (1H, dd, *J* = 14.8, 4.4 Hz, βCH_2), 4.24 (1H, dd, *J* = 8.8, 4.4 Hz, αCH), 6.02 (1H, d, *J* = 2.9 Hz, 3-CH), 6.24 (1H, br s, 4-CH), 6.88 (2H, d, *J* = 6.3 Hz, ar), 7.24 (1H, s, 5-CH), 7.31 (2H, t, *J* = 7.7 Hz, ar), 7.36-7.39 (4H, m, ar), 7.60 (2H, d, *J* = 7.2 Hz, ar); ^{13}C NMR (125 MHz, $CDCl_3$): δ 28.0 (3x CH_3/CO_2tBu), 32.0 (βCH_2), 65.3 (αCH), 81.2 (C/CO_2tBu), 107.3 (3-CH), 110.3 (4-CH), 127.8, 127.9, 128.1 (6 x CH/ar), 128.4 (1 x CH/ar), 128.8 (2 x CH/ar), 130.1 (1 x CH/ar), 136.3, 139.7 (2 x C/ar), 141.0 (5-CH), 152.3 (2-C), 170.3 *(C=N), 170.8 *(C=O/CO_2tBu); IR υ_{max} (neat): 2978, 1728, 1657, 1598, 1447, 1368, 1316, 1276, 1149, 941, 919, 844, 763, 698, 637 cm^{-1}; MS (ESI) *m/z*: 398.1727 $[M + Na]^+$, 376.1905 $[M + H]^+$, 320.1285 $[M - C(CH_3)_3]^+$ ($[M + H]^+$, $C_{24}H_{26}NO_3$ requires 376.1907).

tert-Butyl 2-(diphenylmethyleneamino)-3-(1-methyl-1H-imidazol-2-yl)propanoate **3n**:



This compound was prepared following general procedure **A** using (1-methyl-imidazol-2-yl) methanol (65 mg). Purification by preparative chromatography yielded the desired product as a brown oil. Yield: (33 mg, 29%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 1.41 (9H, s, CH_3/CO_2tBu), 3.28 (1H, dd, *J* = 14.5, 9.5 Hz, βCH_2), 3.35 (1H, dd, *J* = 14.5, 4.2 Hz, βCH_2), 3.53 (3H, s, *N*-CH_3), 4.41 (1H, dd, *J* = 9.5, 4.2 Hz, αCH), 6.69 (1H, s, 5-CH), 6.73 (2H, d, *J* = 6.2 Hz, ar), 6.89 (1H, s, 4-CH), 7.30 (2H, t, *J* = 7.8 Hz, ar), 7.32-7.38 (4H, m, ar), 7.60 (2H, d, *J* = 7.4 Hz, ar); ^{13}C NMR (125 MHz, $CDCl_3$): δ 27.9 (3x CH_3/CO_2tBu), 30.4 (βCH_2), 33.0 (N-CH_3), 66.0 (αCH), 81.3 (C/CO_2tBu), 120.4 (5-CH), 127.3 (4-CH), 127.6, 128.0, 128.2 (6 x CH/ar), 128.5 (1 x CH/ar), 128.7 (2 x CH/ar), 130.3 (1 x CH/ar), 135.8, 139.2 (2 x C/ar), 145.4 (2-C), 170.1 *(C=N), 171.0 *(C=O/CO_2tBu); IR υ_{max} (neat): 2977, 1730, 1626, 1497, 1447, 1365, 1284, 1152, 1071, 844, 825, 774, 765, 699, 649 cm^{-1}; MS (ESI) *m/z*: 390.2188 $[M + H]^+$, ($[M + H]^+$, $C_{24}H_{28}N_3O_2$ requires 390.2176).

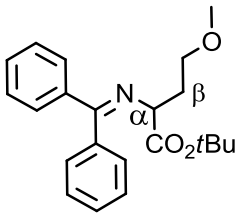
tert-Butyl 2-(diphenylmethyleneamino)pent-4-enoate **3o**:



This compound was prepared following general procedure **A** using allyl alcohol (39 µL). Purification by preparative chromatography yielded the desired product as a brown oil. Yield: (69 mg, 70%).

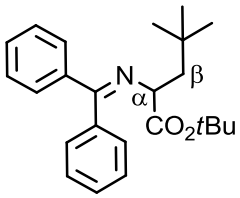
^{1}H NMR and ^{13}C NMR data are in agreement with that reported in the literature.[3]

tert-Butyl 2-(diphenylmethyleneamino)-4-methoxybutanoate **3p**:



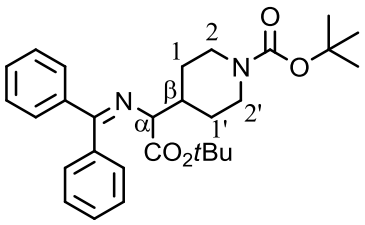
This compound was prepared following general procedure **A** using 2-methoxyethanol (46 µL). Purification by preparative chromatography yielded the desired product as a brown oil. Yield: (38 mg, 37%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 1.43 (9H, s, CH_3/CO_2*t*Bu), 2.13-2.25 (2H, m, βCH_2), 3.25 (3H, s, OCH_3), 3.33-3.39 (1H, m, C*H*$_2$$OCH_3$), 3.43-3.47 (1H, m, C*H*$_2$$OCH_3$), 4.09 (1H, dd, *J* = 8.4, 5.3 Hz, αCH), 7.18-7.20 (2H, m, ar), 7.33 (2H, t, *J* = 7.7 Hz, ar), 7.39 (1H, t, *J* = 7.3 Hz, ar), 7.41-7.46 (3H, m, ar), 7.66 (2H, d, *J* = 7.3 Hz, ar); ^{13}C NMR (125 MHz, $CDCl_3$): δ 28.0 (3x CH_3/CO_2*t*Bu), 33.4 (βCH_2), 58.4 (OCH_3), 62.9 (αCH), 69.1 (*C*$H_2$$OCH_3$), 80.9 (C/$CO_2$*t*Bu), 127.8, 127.9, 128.2 (6 x CH/ar), 128.5 (1 x CH/ar), 128.7 (2 x CH/ar), 130.1 (1 x CH/ar), 136.5, 139.7 (2 x C/ar), 170.5 *(C=N), 171.2 *(C=O/CO_2*t*Bu); IR υ_{max} (neat): 2976, 1729, 1660, 1447, 1368, 1277, 1150, 1118, 1028, 847, 780, 766, 697, 638 cm^{-1}; MS (ESI) *m/z*: 376.1887 $[M + Na]^+$, 354.2070 $[M + H]^+$, 298.1443 $[M - C(CH_3)_3]^+$ ($[M + H]^+$, $C_{22}H_{28}NO_3$ requires 354.2064).

tert-Butyl 2-(diphenylmethyleneamino)-4,4-dimethylpentanoate **3q**:



This compound was prepared following general procedure **A** using 2,2-dimethylpropanol (51 mg). Purification by preparative chromatography yielded the desired product as a brown oil. Yield: (34 mg, 32%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 0.78 (9H, s, CH_3/C(CH_3)$_3$), 1.45 (9H, s, CH_3/CO_2*t*Bu), 1.75 (1H, dd, *J* = 14.0, 6.5 Hz, βCH_2), 2.08 (1H, dd, *J* = 14.0, 5.4 Hz, βCH_2), 4.00 (1H, dd, *J* = 6.5, 5.4 Hz, αCH), 7.19-7.21 (2H, m, ar), 7.32 (2H, t, *J* = 7.7 Hz, ar), 7.37 (1H, t, *J* = 7.2 Hz, ar), 7.43-7.47 (3H, m, ar), 7.63 (2H, d, *J* = 7.2 Hz, ar); ^{13}C NMR (125 MHz, $CDCl_3$): δ 28.0 (3x CH_3/CO_2*t*Bu), 29.8 (C(*C*H_3)$_3$), 30.5 (*C*(CH_3)$_3$), 47.1 (βCH_2), 64.5 (αCH), 80.7 (C/CO_2*t*Bu), 127.8, 127.9, 128.3 (6 x CH/ar), 128.5 (1 x CH/ar), 128.7 (2 x CH/ar), 130.0 (1 x CH/ar), 136.8, 139.7 (2 x C/ar), 168.9 *(C=N), 172.2 *(C=O/CO_2*t*Bu); IR υ_{max} (neat): 2974, 2941, 2905, 2868, 1711, 1627, 1444, 1366, 1273, 1251, 1156, 849, 780, 768, 704, 693, 653 cm^{-1}; MS (ESI) *m/z*: 388.2256 $[M + Na]^+$, 366.2434 $[M + H]^+$, 310.1808 $[M - C(CH_3)_3]^+$ ($[M + H]^+$, $C_{24}H_{32}NO_2$ requires 366.2434).

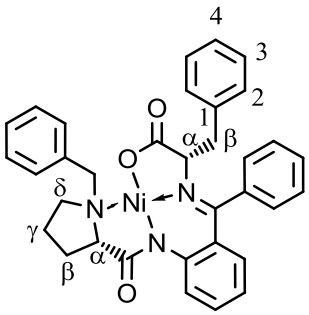
tert-Butyl 4-(2-tert-butoxy-1-(diphenylmethyleneamino)-2-oxoethyl)piperidine-1-carboxylate **3r**:



This compound was prepared following general procedure **A** using *N*-Boc-4-hydroxypiperidine (117 mg). Purification by preparative chromatography yielded the desired product as a brown oil. Yield: (58 mg, 42%); ^{1}H NMR (500 MHz, $CDCl_3$): δ 1.14 (1H, br s, $^{\#}$1-CH_{ax}), 1.39 (1H, br s, $^{\#}$1'-CH_{ax}), 1.46 (18H, s, CH_3/Boc + CH_3/CO_2*t*Bu), 1.66-1.74 (2H, m, 1,1'-CH_{eq}), 2.19 (1H, br s, βCH), 2.69 (2H, br s, 2,2'-CH_{ax}), 3.72 (1H, d, *J* = 7.5 Hz, αCH), 4.10 (2H, br s, 2,2'-CH_{eq}), 7.13-7.16 (2H, m, ar), 7.31 (2H, t, *J* = 7.6 Hz, ar), 7.38 (1H, t, *J* = 7.2 Hz, ar), 7.41-7.46 (3H, m, ar), 7.64 (2H, d, *J* = 7.5 Hz, ar); ^{13}C NMR (125 MHz, $CDCl_3$): δ 28.3 $^{\#}$(1-CH_2), 28.5 (3 x CH_3/Boc), 28.9 (3 x CH_3/CO_2*t*Bu), 29.3 $^{\#}$(1'-CH_2), 40.4

(βCH), 44.2 (2,2'-CH_2), 71.3 (αCH), 79.7 (C/Boc), 81.5 (C/CO_2*t*Bu), 128.3, 128.4, 128.8 (6 x CH/ar), 128.9 (1 x CH/ar), 129.2 (2 x CH/ar), 130.7 (1 x CH/ar), 137.0, 139.9 (2 x C/ar), 155.2 (C=O/Boc), 170.8 *(C=N), 170.9 *(C=O/CO_2*t*Bu); IR υ_{max} (neat): 2976, 1730, 1689, 1624, 1420, 1366, 1147, 845, 769, 697 cm^{-1}; MS (ESI) *m/z*: 501.2728 $[M + Na]^+$, 479.2914 $[M + H]^+$, 423.2293 $[M - C(CH_3)_3]^+$ ($[M + H]^+$, $C_{29}H_{39}N_2O_4$ requires 479.2904).

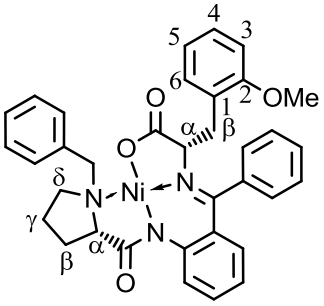
(*S*)-Phenylalanine-Ni-(*S*)-BPB **6a**:



This compound was prepared following general procedure **B** using benzyl alcohol (60 µL). Diastereoisomeric ratio: 90/10 (99/1). Purification by flash chromatography (acetone/CH_2Cl_2, 1/9) yielded the desired product as a red oil. Yield: (128 mg, 75%). $[\alpha]_D^{20}$ +2196.9 (*c* 0.1, $CHCl_3$).

^{1}H NMR data are in agreement with that reported in the literature for (*S*,*S*)-diastereoisomer.[8]

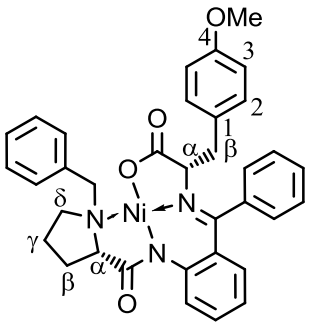
(*S*)-2-Methoxyphenylalanine-Ni-(*S*)-BPB **6b**:



This compound was prepared following general procedure **B** using 2-methoxybenzyl alcohol (77 µL). Diastereoisomeric ratio: 87/13 (99/1). Purification by flash chromatography (acetone/CH_2Cl_2, 1/9) yielded the desired product as a red oil. Yield: (129 mg, 72%); R_f 0.28 (acetone/CH_2Cl_2, 1/9); $[\alpha]_D^{20}$ +1771.0 (*c* 0.1, $CHCl_3$); ^{1}H NMR (400 MHz, $CDCl_3$): δ 1.56-1.64 (1H, m, Pro γCH_2), 1.93-1.99 (1H, m, Pro δCH_2), 2.18-2.32 (3H, m, Pro βCH_2 + Pro γCH_2), 2.86 (1H, dd, *J* = 13.5, 4.3 Hz, βCH_2), 3.01-3.06 (1H, m, Pro δCH_2),

3.26-3.34 (5H, m, Pro αCH + OCH_3 + βCH_2), 3.47 (1H, d, *J* = 12.7 Hz, NCH_2Ph), 4.21 (1H, dd, *J* = 5.0, 4.6 Hz, αCH), 4.25 (1H, d, *J* = 12.7 Hz, NCH_2Ph), 6.63-6.68 (2H, m, ar), 6.96 (1H, d, *J* = 8.3 Hz, ar), 6.99-7.05 (2H, m, ar), 7.10-7.16 (2H, m, ar), 7.23-7.30 (4H, m, ar), 7.37-7.45 (2H, m, ar), 7.48-7.55 (2H, m, ar), 8.00 (2H, d, *J* = 7.0 Hz, ar), 8.28 (1H, d, *J* = 8.5 Hz, ar); ^{13}C NMR (100 MHz, $CDCl_3$): δ 23.1 (Pro γCH_2), 30.8 (Pro βCH_2), 34.6 (βCH_2), 54.6 (OCH_3), 57.1 (Pro δCH_2), 63.4 (NCH_2Ph), 70.3 (Pro αCH), 71.7 (αCH), 110.3 (3-CH), 120.4, 121.1, 123.1 (3 x CH/ar), 124.5, 126.2 (2 x C/ar), 127.2, 128.3 (2 x CH/ar), 128.7 (3 x CH/ar), 128.8 (2 x CH/ar), 128.9, 129.5 (2 x CH/ar), 131.5 (2 x CH/ar), 132.1, 132.7 (2 x CH/ar), 133.3 (1 x C/ar), 133.4 (1 x CH/ar), 134.4, 142.6 (2 x C/ar), 158.5 (2-C), 171.3 (C=N), 178.8 *(CO_2), 180.3 *(CON); IR υ_{max} (neat): 2939, 1662, 1630, 1589, 1438, 1334, 1250, 11643, 910, 751, 725, 702 cm^{-1}; MS (ESI) *m/z*: 640.1694 $[M + Na]^+$, 618.1889 $[M + H]^+$ ($[M + H]^+$, $C_{35}H_{34}N_3NiO_4$ requires 618.1897).

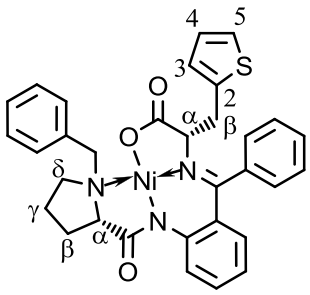
(*S*)-4-Methoxyphenylalanine-Ni-(*S*)-BPB **6c**:



This compound was prepared following general procedure **B** using 4-methoxybenzyl alcohol (80 mg). Diastereoisomeric ratio: 90/10 (99/1). Purification by flash chromatography (acetone/CH_2Cl_2, 1/9) yielded the desired product as a red oil. Yield: (106 mg, 59%). $[\alpha]_D^{20}$ +1830.0 (*c* 0.1, $CHCl_3$).

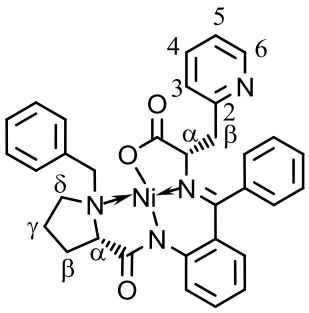
^1H NMR data are in agreement with that reported in the literature for (*S*,*S*)-diastereoisomer.[9]

(*S*)-3-(Thien-2-yl)alanine-Ni-(*S*)-BPB **6d**:



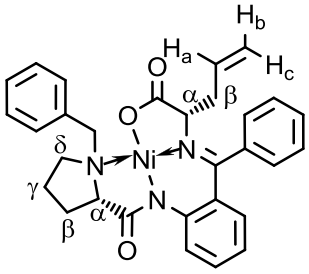
This compound was prepared following general procedure **B** using 2-ethanolthiophene (55 mg). Diastereoisomeric ratio: 96/4 (99/1). Purification by flash chromatography (acetone/CH_2Cl_2, 1/9) yielded the desired product as a red oil. Yield: (117 mg, 68%); R_f 0.28 (acetone/CH_2Cl_2, 1/9); $[\alpha]_D^{20}$ +1598.0 (*c* 0.1, $CHCl_3$); ^{1}H NMR (500 MHz, $CDCl_3$): δ 1.69-1.75 (1H, m, Pro γCH_2), 1.91-1.96 (1H, m, Pro δCH_2), 2.29-2.50 (3H, m, Pro γCH_2 + Pro βCH_2), 2.89 (1H, dd, *J* = 14.9, 5.9 Hz, βCH_2), 3.16-3.19 (1H, m, Pro δCH_2), 3.29-3.34 (2H, m, βCH_2 + Pro αCH), 3.53 (1H, d, *J* = 12.7 Hz, NCH_2Ph), 4.26 (1H, dd, *J* = 5.6, 3.7 Hz, αCH), 4.33 (1H, d, *J* = 12.7 Hz, NCH_2Ph), 6.68 (2H, d, *J* = 4.1 Hz, ar), 6.96 (1H, d, *J* = 7.5 Hz, ar), 7.01 (1H, d, *J* = 2.9 Hz, ar), 7.12-7.19 (3H, m, ar), 7.29-7.33 (3H, m, ar), 7.37 (1H, d, *J* = 5.0 Hz, ar), 7.45 (1H, t, *J* = 7.2 Hz, ar), 7.51-7.56 (2H, m, ar), 7.98 (2H, d, *J* = 7.4 Hz, ar), 8.26 (1H, d, *J* = 8.7 Hz, ar); ^{13}C NMR (125 MHz, $CDCl_3$): δ 22.9 (Pro γCH_2), 30.6 (Pro βCH_2), 33.3 (βCH_2), 56.9 (Pro δCH_2), 63.2 (N*C*H_2Ph), 70.3 (Pro αCH), 70.9 (αCH), 120.6, 123.5, 125.5 (3 x CH/ar), 126.2 (1 x C/ar), 126.9, 127.5, 127.9, 128.1 (4 x CH/ar), 128.8 (2 x CH/ar), 128.8, 129.0, 129.1, 129.9 (4 x CH/ar), 131.5 (2 x CH/ar), 132.4 (1 x CH/ar), 133.1 (1 x C/ar), 133.5 (1 x CH/ar), 134.3, 137.0, 142.9 (3 x C/ar), 171.7 (C=N), 178.7 *(CO_2), 180.2 *(CON); IR υ_{max} (neat): 3061, 2939, 2231, 1666, 1631, 1585, 1542, 1438, 1336, 1254, 1164, 909, 751, 725, 700 cm^{-1}; MS (ESI) *m/z*: 616.1159 $[M + Na]^+$, 594.1346 $[M + H]^+$ ($[M + Na]^+$, $C_{32}H_{29}N_3NaNiO_3S$ requires 616.1175).

(*S*)-β-(2-Pyridyl)-α-alanine-Ni-(*S*)-BPB **6e**:



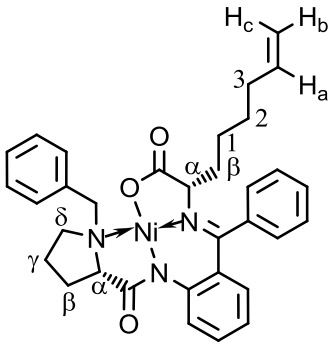
This compound was prepared following general procedure **B** using 2-pyridylcarbinol (56 µL). Diastereoisomeric ratio: 87/13 (99/1). Purification by flash chromatography (acetone/CH_2Cl_2, 3/7) yielded the desired product as a red oil. Yield: (142 mg, 83%); R_f 0.17 (acetone/CH_2Cl_2, 3/7); $[\alpha]_D^{20}$ +1914.6 (*c* 0.1, $CHCl_3$); ^{1}H NMR (400 MHz, $CDCl_3$): δ 1.78-1.86 (1H, m, Pro γCH_2), 1.97 (1H, ddd, *J* = 17.2, 10.6, 6.7 Hz, Pro δCH_2), 2.31-2.46 (2H, m, Pro βCH_2), 2.63-2.76 (1H, m, Pro γCH_2), 3.13 (1H, dd, *J* = 13.6, 6.7 Hz, βCH_2), 3.22-3.26 (2H, m, βCH_2 + Pro δCH_2), 3.33 (1H, dd, *J* = 10.0, 7.0 Hz, Pro αCH), 3.54 (1H, d, *J* = 12.6 Hz, NCH_2Ph), 4.31-4.36 (2H, m, NCH_2Ph + αCH), 6.65 (2H, d, *J* = 4.3 Hz, ar), 7.05 (1H, d, *J* = 7.7 Hz, ar), 7.11-7.19 (3H, m, ar), 7.23-7.33 (4H, m, ar), 7.41 (1H, t, *J* = 7.7 Hz, ar), 7.48-7.56 (2H, m, ar), 7.65 (1H, td, *J* = 7.9, 1.9 Hz, ar), 7.99 (2H, d, *J* = 7.2 Hz, ar), 8.21 (1H, d, *J* = 8.4 Hz, ar), 8.59 (1H, d, *J* = 4.9 Hz, ar); ^{13}C NMR (100 MHz, $CDCl_3$): δ 23.3 (Pro γCH_2), 30.6 (Pro βCH_2), 42.0 (βCH_2), 56.9 (Pro δCH_2), 63.1 (N*C*H_2Ph), 70.3 $^{\#}$(Pro αCH), 70.5 $^{\#}$(αCH), 120.6, 122.1, 123.4, 124.4 (4 x CH/ar), 126.4 (1 x C/ar), 127.0, 128.2 (2 x CH/ar), 128.8 (2 x CH/ar), 128.8 (3 x CH/ar), 129.6 (1 x CH/ar), 131.5 (2 x CH/ar), 132.2 (1 x CH/ar), 133.1 (1 x C/ar), 133.5 (1 x CH/ar), 134.3 (1 x C/ar), 136.5 (1 x CH/ar), 142.6 (1 x C/ar), 149.7 (6-C), 156.5 (2-C), 171.4 (C=N), 178.8 *(CO_2), 180.1 *(CON); IR υ_{max} (neat): 2953, 2234, 1667, 1631, 1587, 1438, 1335, 1256, 1165, 910, 751, 725, 702 cm^{-1}; MS (ESI) *m/z*: 611.1548 $[M + Na]^+$, 589.1733 $[M + H]^+$ ($[M + H]^+$, $C_{33}H_{31}N_4NiO_3$ requires 589.1744).

(*S*)-Allylglycine-Ni-(*S*)-BPB **6f**:



This compound was prepared following general procedure **B** using allyl alcohol (39 µL). Diastereoisomeric ratio: 90/10. Purification by flash chromatography (acetone/CH_2Cl_2, 1/9) yielded the desired product as a red oil. Yield: (123 mg, 78%). $[\alpha]_D^{20}$ +1843.0 (*c* 0.1, $CHCl_3$). ^1H NMR and ^{13}C NMR data are in agreement with that reported in the literature for the (*S*,*S*)-diastereoisomer.[10]

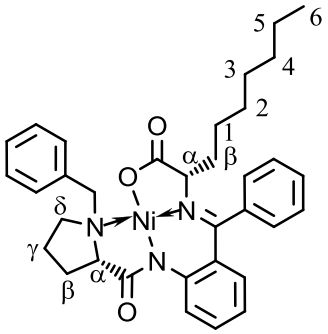
(*S*)-Hex-5-enyl-glycine-Ni-(*S*)-BPB **6g**:



This compound was prepared following general procedure **B** using 5-hexen-1-ol (70 µL). Diastereoisomeric ratio: 89/11 (99/1). Purification by flash chromatography (acetone/CH_2Cl_2, 1/9) yielded the desired product as a red oil. Yield: (78 mg, 46%); R_f 0.30 (acetone/CH_2Cl_2, 1/9); $[\alpha]_D^{20}$ +2285.0 (*c* 0.1, $CHCl_3$); ^1H NMR (400 MHz, $CDCl_3$): δ 1.20-1.32 (2H, m, 2-CH_2), 1.60-1.68 (2H, m, βCH_2 + 1-CH_2), 1.77-1.89 (1H, m, 1-CH_2), 1.90-1.97 (1H, m, βCH_2), 2.00-2.08 (3H, m, 3-CH_2 + Pro δCH_2), 2.12-2.19 (1H, m, Pro γCH_2), 2.48-2.58 (1H, m, Pro βCH_2), 2.73-2.82 (1H, m, Pro βCH_2), 3.44-3.55 (3H, m, Pro γCH_2 + Pro δCH_2 + Pro αCH), 3.59 (1H, d, *J* = 12.7 Hz, NCH_2Ph), 3.92 (1H, dd, *J* = 8.0, 3.4 Hz, αCH), 4.44 (1H, d, *J* = 12.7 Hz, NCH_2Ph), 4.92-5.00 (2H, m, H_b + H_c), 5.71-5.81 (1H, m, H_a), 6.61-6.68 (2H, m, ar), 6.92 (1H, d, *J* = 6.9 Hz, ar), 7.14 (1H, ddd, *J* = 8.8, 6.6, 2.2 Hz, ar), 7.19 (1H, t, *J* = 7.5 Hz, ar), 7.25-7.27 (1H, m, ar), 7.35 (2H, t, *J* = 7.6 Hz ar), 7.43-7.54 (3H, m, ar), 8.04 (2H, d, *J* = 7.0 Hz, ar), 8.14 (1H, d, *J* = 9.2 Hz, ar); ^{13}C NMR (100 MHz, $CDCl_3$): δ 23.7

(Pro γCH_2), 24.8 (1-CH_2), 28.6 (2-CH_2), 30.8 (Pro βCH_2), 33.5 (3-CH_2), 35.2 (βCH_2), 56.9 (Pro δCH_2), 63.1 (N*C*H_2Ph), 70.3 ≈(αCH), 70.3 ≈(Pro αCH), 114.7 (CH_bH_c), 120.7, 123.7 (2 x CH/ar), 126.6 (1 x C/ar), 127.2, 127.6 (2 x CH/ar), 128.9 (5 x CH/ar), 129.7 (1 x CH/ar), 131.6 (2 x CH/ar), 132.1 (1 x CH/ar), 133.2 (1 x C/ar), 133.2 (1 x CH/ar), 133.9 (1 x C/ar), 138.5 (CH_a), 142.3 (1 x C/ar), 170.4 (C=N), 179.5 *(CO_2), 180.4 *(CON); IR υ_{max} (neat): 2923, 2857, 1670, 1634, 1588, 1439, 1334, 1255, 1165, 1065, 912, 752, 702 cm^{-1}; MS (ESI) *m/z*: 602.1915 $[M + Na]^+$, 580.2100 $[M + H]^+$ ($[M + H]^+$, $C_{33}H_{36}N_3NiO_3$ requires 580.2105).

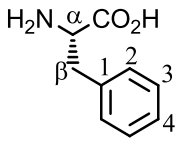
(*S*)-Heptylglycine-Ni-(*S*)-BPB **6h**:



This compound was prepared following general procedure **B** using heptan-1-ol (82 µL). Diastereoisomeric ratio: 86/14 (99/1). Purification by flash chromatography (acetone/CH_2Cl_2, 1/9) yielded the desired product as a red oil. Yield: (104 mg, 60%); R_f 0.37 (acetone/CH_2Cl_2, 1/9); $[\alpha]_D^{20}$ +2280.0 (*c* 0.1, $CHCl_3$); ^{1}H NMR (400 MHz, $CDCl_3$): δ 0.87 (3H, m, 6-CH_3), 1.22-1.30 (8H, m, 2-CH_2 + 3-CH_2 + 4-CH_2 + 5-CH_2), 1.58-1.67 (3H, m, βCH_2 + 1-CH_2), 1.89-1.98 (1H, m, βCH_2), 2.03-2.18 (2H, m, Pro γCH_2 + Pro δCH_2), 2.48-2.58 (1H, m, Pro βCH_2), 2.74-2.81 (1H, m, Pro βCH_2), 3.47 (1H, dd, *J* = 10.9, 5.9 Hz, Pro αCH), 3.50-3.58 (2H, m, Pro γCH_2 + Pro δCH_2), 3.59 (1H, d, *J* = 12.7 Hz, NCH_2Ph), 3.92 (1H, dd, *J* = 8.0, 3.2 Hz, αCH), 4.44 (1H, d, *J* = 12.7 Hz, NCH_2Ph), 6.61-6.68 (2H, m, ar), 6.92 (1H, d, *J* = 7.3 Hz, ar), 7.13 (1H, ddd, *J* = 8.6, 6.6, 2.1 Hz, ar), 7.19 (1H, t, *J* = 7.5 Hz, ar), 7.25-7.27 (1H, m, ar), 7.35 (2H, t, *J* = 7.6 Hz, ar), 7.42-7.53 (3H, m, ar), 8.05 (2H, d, *J* = 7.4 Hz, ar), 8.14 (1H, d, *J* = 8.6 Hz, ar); ^{13}C NMR (100 MHz, $CDCl_3$): δ 14.1 (6-CH_3), 22.6 (5-CH_2), 23.6 (Pro γCH_2), 25.4 (1-CH_2), 29.1 #(2-CH_2), 29.3 #(3-CH_2), 30.8 (Pro βCH_2), 31.7 (4-CH_2), 35.4 (βCH_2), 57.0 (Pro δCH_2), 63.1 (N*C*H_2Ph), 70.3 ≈(αCH), 70.5 ≈(Pro αCH), 120.7, 123.7 (2 x CH/ar), 126.6 (1 x C/ar), 127.2, 127.6 (2 x CH/ar), 128.9 (3 x CH/ar), 128.9 (2 x CH/ar), 129.7 (1 x CH/ar), 131.6 (2 x CH/ar), 132.1 (1 x CH/ar), 133.2 (1 x CH/ar + 1 x C/ar), 133.9, 142.2 (2 x C/ar), 170.3 (C=N), 179.5 *(CO_2), 180.4 *(CON); IR υ_{max} (neat): 2924, 2855,

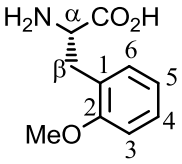
1670, 1635, 1589, 1440, 1334, 1256, 1165, 1065, 752, 702 cm^{-1}; MS (ESI) *m/z*: 618.2220 $[M + Na]^+$, 596.2404 $[M + H]^+$ ($[M + H]^+$, $C_{34}H_{40}N_3NiO_3$ requires 596.2418).

L-Phenylalanine **7a**:



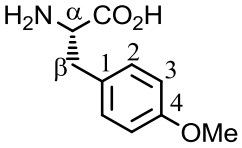
This compound was prepared following general procedure **C** using (*S*)-phenylalanine-Ni-(*S*)-BPB (1.69 mmol, 990 mg) to yield the desired product as a white solid. Yield: (220 mg, 79%); ee: 95% (according to analytical chiral HPLC: $R_{t\ (major)}$ 11.8 min, $R_{t\ (minor)}$ 13.5 min, 80% B); $[\alpha]_D^{20}$ -23.0 (*c* 0.1, H_2O) (lit.,[11] -34.7 (*c* 2, H_2O)).
^1H NMR data are in agreement with that reported in the literature.[12]

2-Methoxy-L-phenylalanine **7b**:



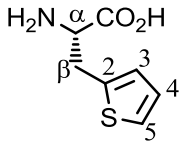
This compound was prepared following general procedure **C** using (*S*)-2-methoxy phenylalanine-Ni-(*S*)-BPB (0.21 mmol, 132 mg) to yield the desired product as a white solid. Yield: (28 mg, 67%). ee: >99% (according to analytical chiral HPLC: $R_{t\ (major)}$ 13.0 min, $R_{t\ (minor)}$ 14.5 min, 80% B); $[\alpha]_D^{20}$ -38.0 (*c* 0.1, H_2O) (lit.,[13] -52.85 (*c* 1, H_2O)).

4-Methoxy-L-phenylalanine **7c**:



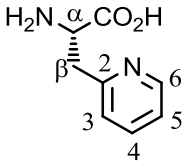
This compound was prepared following general procedure **C** using (*S*)-4-methoxy phenylalanine-Ni-(*S*)-BPB (0.15 mmol, 91 mg) to yield the desired product as a white solid. Yield: (25 mg, 87%); ee: 96% (according to analytical chiral HPLC: $R_{t\ (major)}$ 12.0 min, $R_{t\ (minor)}$ 13.5 min, 80% B); $[\alpha]_D^{20}$ -18.0 (*c* 0.1, H_2O) (lit.,[14] -9 (*c* 0.71, 1 M HCl)).
^1H NMR and ^{13}C NMR data are in agreement with that reported in the literature.[15]

3-Thiophen-2-yl-L-alanine **7d**:



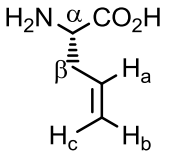
This compound was prepared following general procedure **C** using (*S*)-3-(thien-2-yl)alanine-Ni-(*S*)-BPB (0.16 mmol, 97 mg) to yield the desired product as a white solid. Yield: (22 mg, 79%); ee: 92% (according to analytical chiral HPLC: $R_{t\ (major)}$ 11.9 min, $R_{t\ (minor)}$ 13.3 min, 80% B); $[\alpha]_D^{20}$ -18.0 (*c* 0.1, H_2O) (lit.,[16] -30 (*c* 0.5, H_2O)).
^{1}H NMR data are in agreement with that reported in the literature.[16]

3-Pyridin-2-yl-L-alanine **7e**:



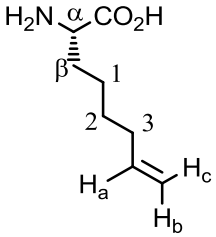
This compound was prepared following general procedure **C** using (*S*)-β-(2-pyridyl)-α-alanine-Ni-(*S*)-BPB (0.13 mmol, 77 mg) to yield the desired product as a white solid. Yield: (22 mg, >99%); ee: 96% (according to analytical chiral HPLC: $R_{t\ (major)}$ 18.2 min, $R_{t\ (minor)}$ 21.4 min, 70% B); $[\alpha]_D^{20}$ +46.0 (*c* 0.1, 1 M HCl) (lit.,[17] +49.7 (*c* 0.9, 1 M HCl)); ^{1}H NMR (400 MHz, D_2O): δ 3.30 (1H, dd, *J* = 15.1, 7.9 Hz, βCH_2), 3.44 (1H, dd, *J* = 15.1, 5.1 Hz, βCH_2), 4.16 (1H, dd, *J* = 7.9, 5.1 Hz, αCH), 7.39-7.42 (2H, m, ar), 7.87 (1H, td, *J* = 7.8, 1.8 Hz, 4-CH), 8.52 (1H, d, *J* = 4.8 Hz, 6-CH); ^{13}C NMR (100 MHz, D_2O): δ 37.2 (βCH_2), 54.6 (αCH), 123.1, 124.6 (3,5-CH), 138.5 (4-CH), 148.7 (6-CH), 155.4 (2-C), 173.5 (CO_2H); IR υ_{max} (neat): 3005, 2921, 1578, 1512, 1400, 1313, 1134, 1076, 851, 691 cm^{-1}; MS (ESI) *m/z*: 189.0639 $[M + Na]^+$, 167.0819 $[M + H]^+$ ($[M + H]^+$, $C_8H_{11}N_2O_2$ requires 167.0815).

(*S*)-Allylglycine **7f**:



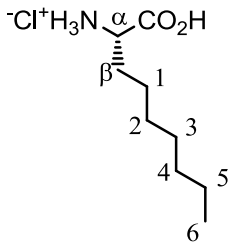
This compound was prepared following general procedure **C** using (*S*)-allylglycine-Ni-(*S*)-BPB (0.13 mmol, 71 mg) to yield the desired product as a white solid. Yield: (15 mg, >99%); ee: 81% (according to analytical chiral HPLC: $R_{t\ (major)}$ 13.8 min, $R_{t\ (minor)}$ 16.5 min, 80% B); $[\alpha]_D^{20}$ -23.0 (*c* 0.1, H_2O) (lit.,[18] -36.5 (*c* 4, H_2O)).
^1H NMR and ^{13}C NMR data are in agreement with that reported in the literature.[19]

(*S*)-2-Amino-7-octenoic acid **7g**:



This compound was prepared following general procedure **C** using (*S*)-hex-5-enyl-glycine-Ni-(*S*)-BPB (0.13 mmol, 77 mg) to yield the desired product as a white solid. Yield: (21 mg, >99%); ee: 95% (according to analytical chiral HPLC: $R_{t\ (major)}$ 7.3 min, $R_{t\ (minor)}$ 8.3 min, 70% B); $[\alpha]_D^{20}$ +26.0 (*c* 0.1, H_2O); ^1H NMR (400 MHz, D_2O): δ 1.34-1.52 (4H, m, 1, 2-CH_2), 1.86-1.93 (2H, m, βCH_2), 2.09-2.15 (2H, m, 3-CH_2), 3.76 (1H, dd, *J* = 6.3, 6.3 Hz, αCH), 5.03 (1H, dd, *J* = 10.3, 0.9 Hz, H_b), 5.10 (1H, dd, *J* = 17.0, 1.8 Hz, H_c), 5.93 (1H, ddt, *J* = 17.0, 10.3, 6.7 Hz, H_a); ^{13}C NMR (100 MHz, D_2O): δ 23.7 (1-CH_2), 27.6 (2-CH_2), 30.2 (βCH_2), 32.6 (3-CH_2), 54.8 (αCH), 114.4 (CH_bH_c), 139.6 (CH_a), 179.5 (CO_2H); IR υ_{max} (neat): 2922, 1577, 1513, 1406, 1320, 1096, 910, 661 cm^{-1}; MS (ESI) *m/z*: 180.0999 $[M + Na]^+$, 158.1178 $[M + H]^+$ ($[M + H]^+$, $C_8H_{16}NO_2$ requires 158.1176).

(*S*)-2-Amino-nonanoic acid hydrochloride **7h**:



(*S*)-heptylglycine-Ni-(*S*)-BPB (0.16 mmol, 93 mg) **6h** was dissolved in MeOH (*c* = 0.05 mol/L) and 2 M HCl (*c* = 0.1 mol/L) was added, the bright red solution was heated at reflux (80°C) for 1h. The resulting yellow to green solution was allowed to cool down to room temperature. The solvent was concentrated *in vacuo*, water was added, the beige precipitate was centrifuged and the aqueous layer was purified by reversed-phase C18 chromatography (0-70% MeOH in water) and lyophilized to yield the desired product as a white solid. Yield: (21 mg, 64%); *ee*: 97% (according to analytical chiral HPLC: $R_{t\ (major)}$ 6 .2 min, $R_{t\ (minor)}$ 7.5 min, 70% B); $[\alpha]_D^{20}$ +25.0 (*c* 0.1, AcOH) (lit.,[20] -25 (*c* 0. 5, AcOH) for (*R*)-2-amino-nonanoic acid hydrochloride).

^{1}H NMR data are in agreement with that reported in the literature.[20]

References

[1] D. D. Perrin, D. R. Perrin and W. L. F. Armarego, in *Purification of Laboratory Chemicals*, 2nd ed., Oxford, 1980.

[2] I. Sakamoto, T. Nishii, F. Ozaki, H. Kaku, M. Tanaka and T. Tsunoda, *Chem. Pharm. Bull.,* 2005, **53**, 1508.

[3] T. Okino and Y. Takemoto, *Org. Lett.,* 2001, **3**, 1515.

[4] X. Wang, L. Yin, T. Yang and Y. Wang, *Tetrahedron: Asymmetry,* 2007, **18**, 108.

[5] T. Ooi, M. Kameda and K. Maruoka, *J. Am. Chem. Soc.,* 2003, **125**, 5139.

[6] A. Siva and E. Murugan, *Synthesis,* 2005, **17**, 2927.

[7] S. Kumar, M. E. Sobhia and U. Ramachandran, *Tetrahedron: Asymmetry,* 2005, **16**, 2599.

[8] Y. N. Belokon, V. I. Bakhmutov, N. I. Chernoglazova, K. A. Kochetkov, S. V. Vitt, N. S. Garbalinskaya and V. M. Belikov, *J. Chem. Soc., Perkin Trans. 1,* 1988, 305.

[9] P. Řehulka, A. Popkov, M. Nádvorník, J. Planeta, K. Mazanec and J. Chmelík, *J. Mass Spectrom.,* 2006, **41**, 448.

[10] S. Collet, P. Bauchat, R. Danion-Bougot and D. Danion, *Tetrahedron: Asymmetry,* 1998, **9**, 2121.

[11] S. D. Bull, S. G. Davies, S. W. Epstein and J. V. A. Ouzman, *Tetrahedron: Asymmetry,* 1998, **9**, 2795.

[12] S. A. Bradley, A. Ouyang, J. Purdie, T. A. Smitka, T. Wang and A. Kaerner, *J. Am. Chem. Soc.,* 2010, **132**, 9531.

[13] S. N. Danthi and R. A. Hill, *J. Heterocycl. Chem.,* 1997, **34**, 835.

[14] H. E. Smith and J. R. Neergaard, *J. Am. Chem. Soc.,* 1997, **119**, 116.

[15] S. Liu, Y. Yang, X. Zhen, J. Li, H. He, J. Feng and A. Whiting, *Org. Biomol. Chem.*, 2012, **10**, 663.

[16] C. M. Bladon, *J. Chem. Soc., Perkin Trans. 1,* 1990, 1151.

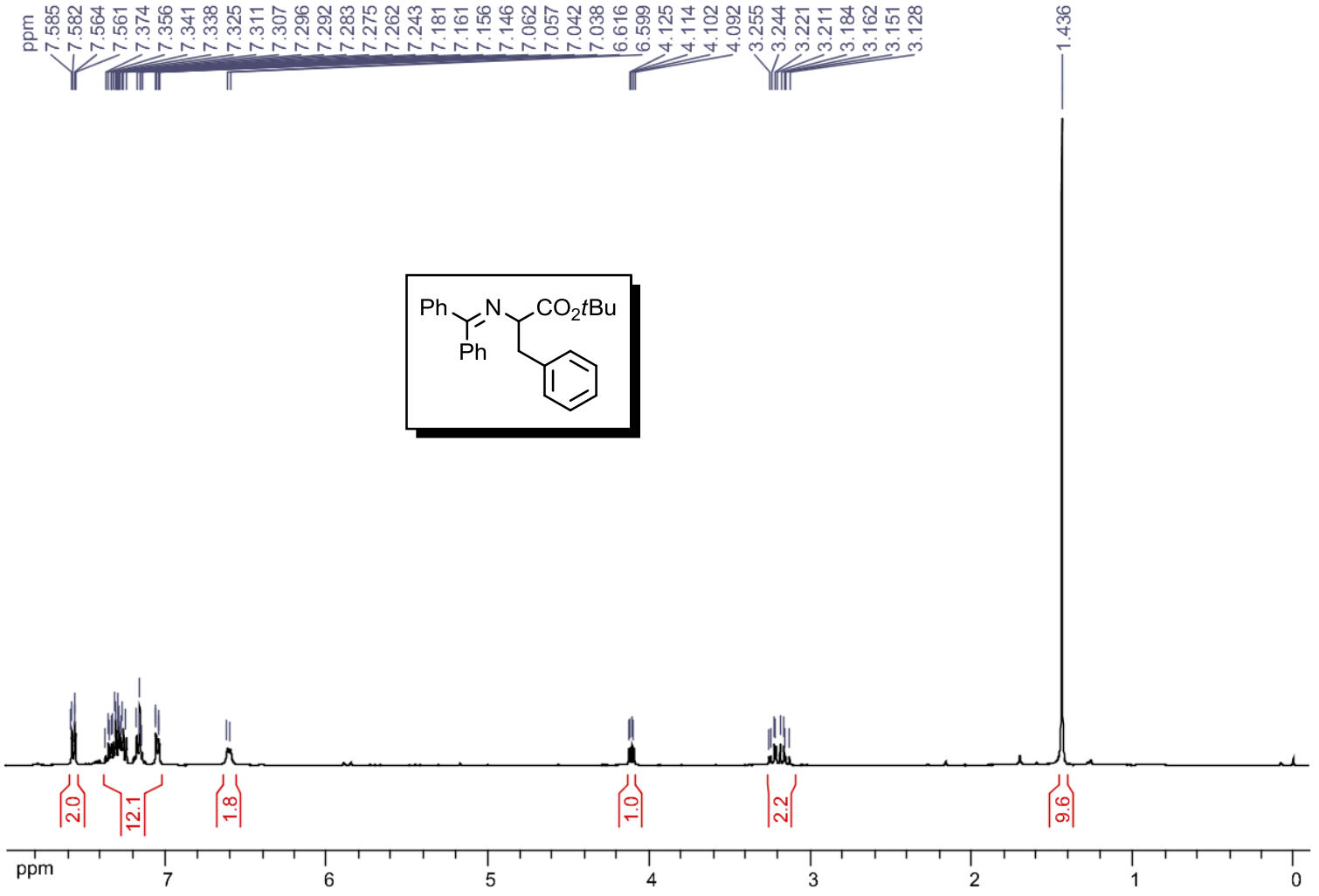
[17] C. Hoes, J. Raap, W. Bloemhoff and K. E. T. Kerling, *Recl. Trav. Chim. Pay. B.,* 1980, **99**, 99.

[18] D. Halie, J. Perard-Viret and J. Royer, *Heterocycles,* 2006, **68**, 2471.

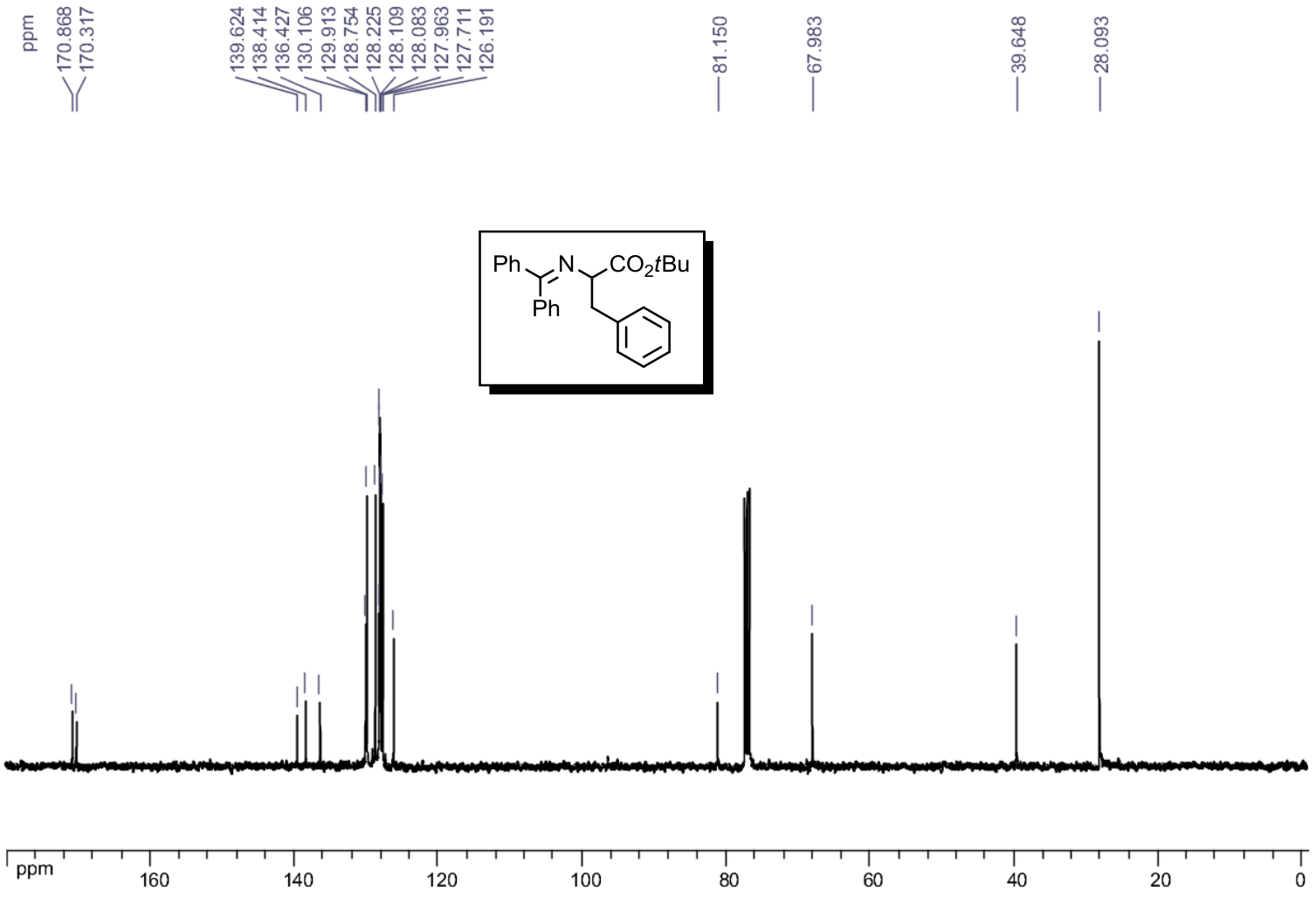
[19] L. Saniere, L. Leman, J. J. Bourguignon, P. Dauban and R. H. Dodd, *Tetrahedron,* 2004, **60**, 5889.

[20] S. G. Davies, S. W. Epstein, A. C. Garner, O. Ichihara and A. D. Smith, *Tetrahedron: Asymmetry,* 2002, **13**, 1555.

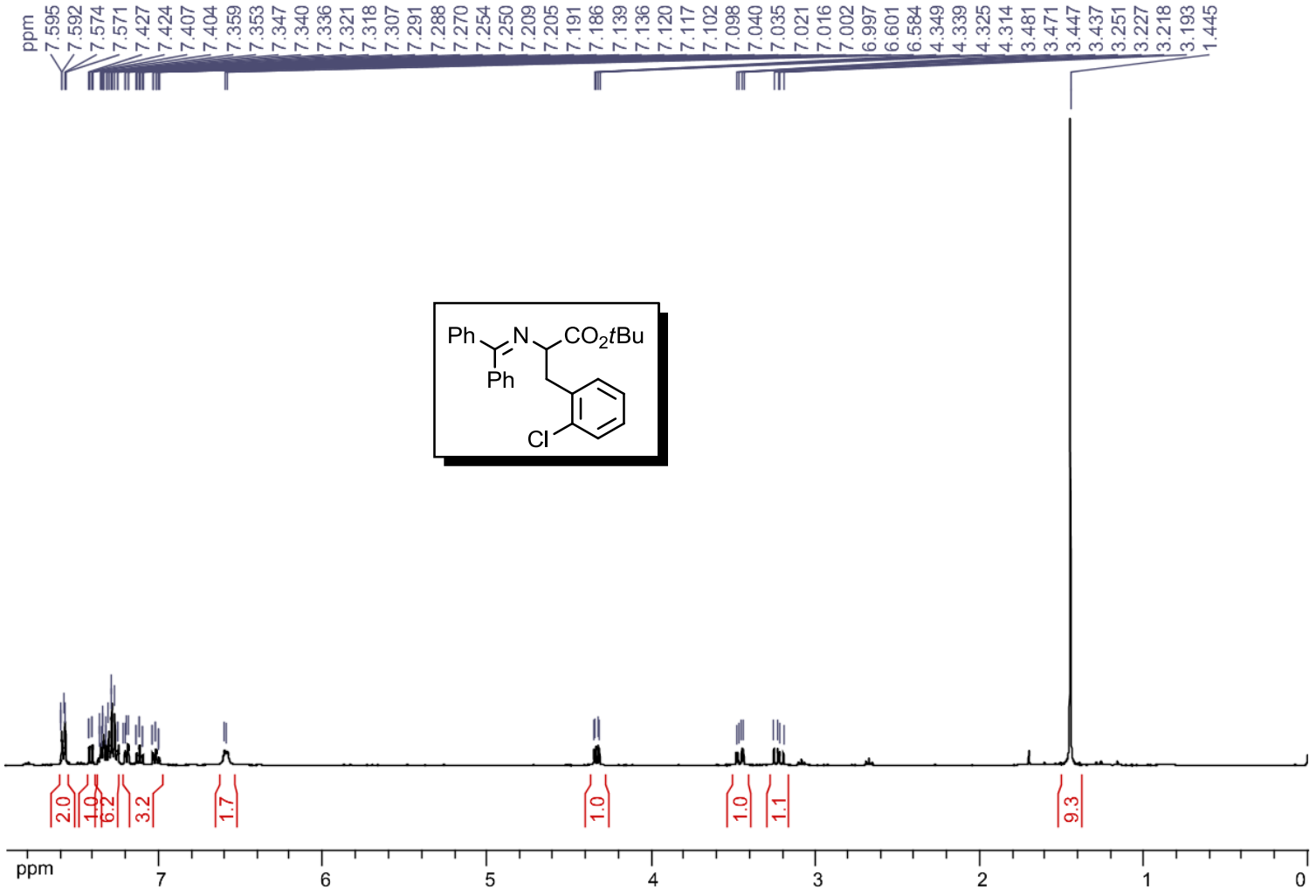
^{1}H NMR spectra (400 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-phenylpropanoate (3a)



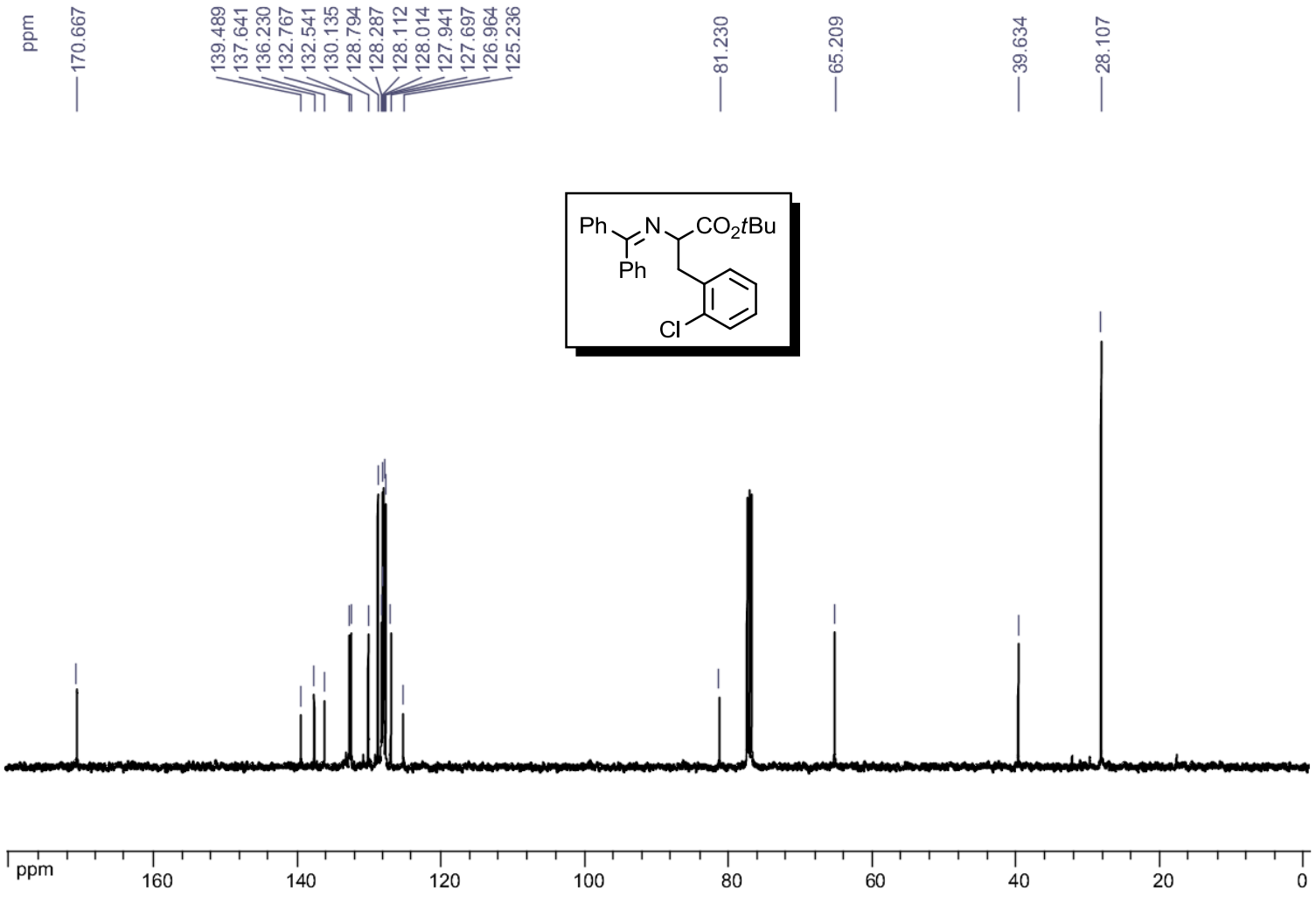
^{13}C NMR spectra (100 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-phenylpropanoate (3a)



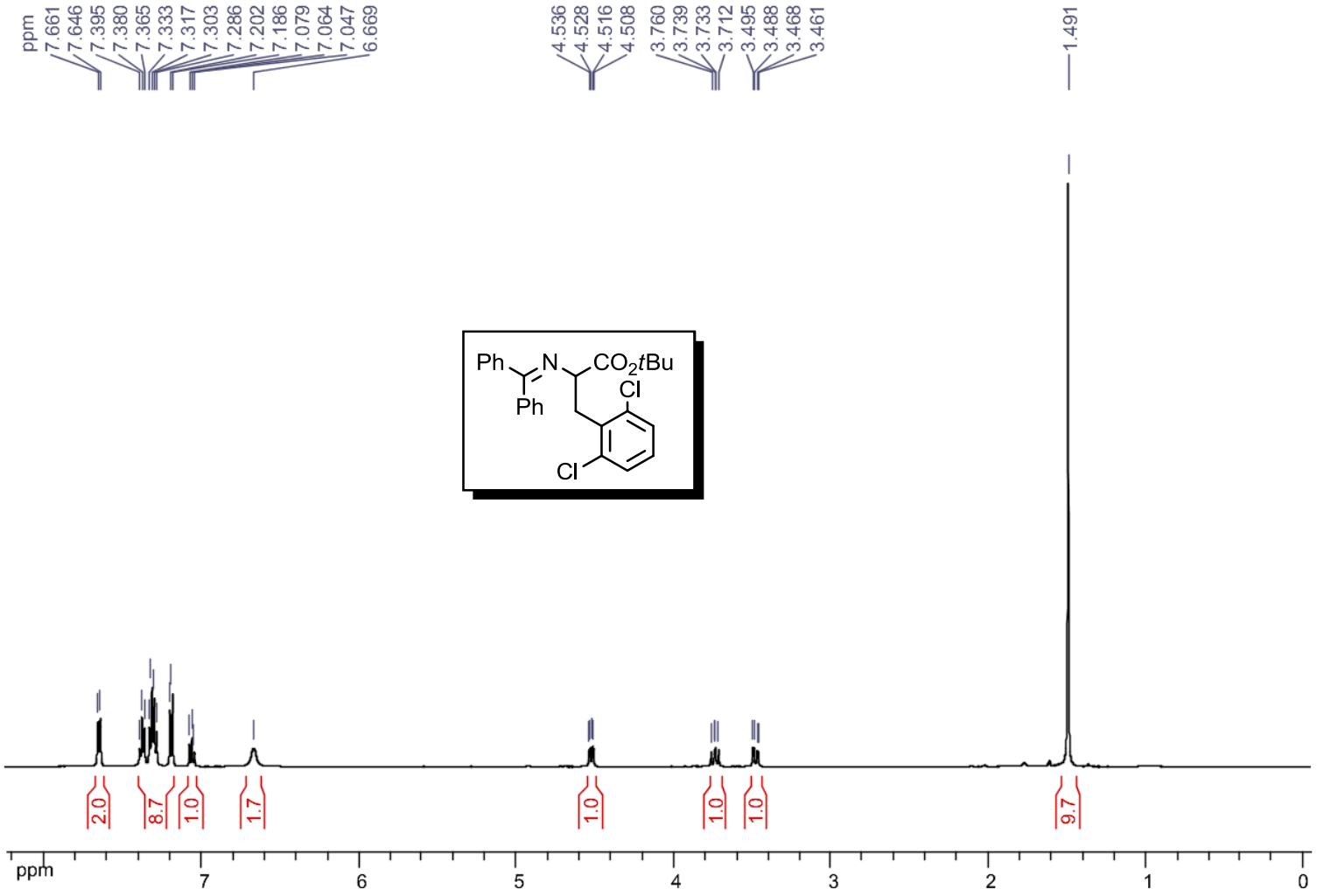
^{1}H NMR spectra (400 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-(2-(chloro)phenyl)propanoate (3b)



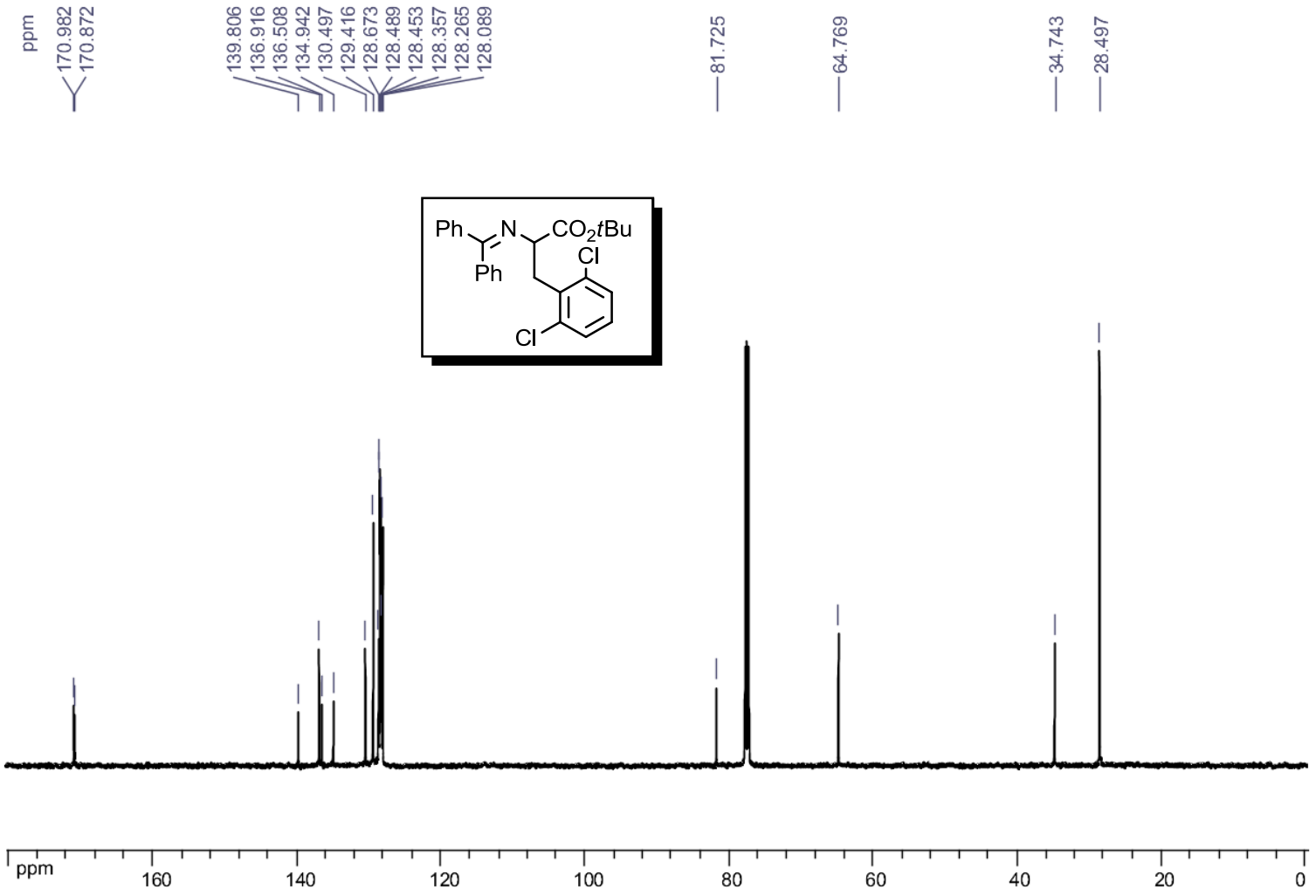
^{13}C NMR spectra (100 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-(2-(chloro)phenyl)propanoate (3b)



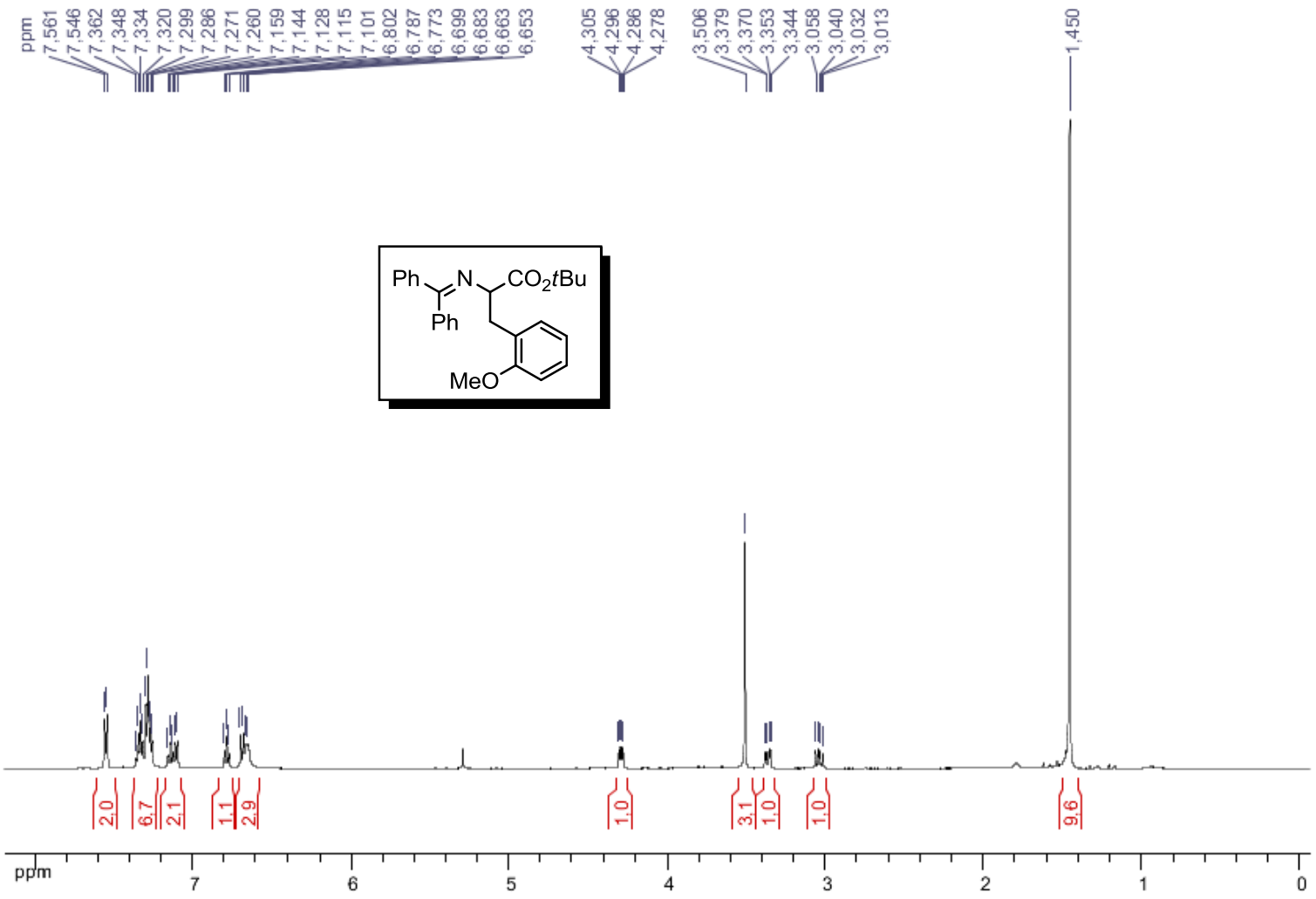
^{1}H NMR spectra (500 MHz, $CDCl_3$) of *tert*-Butyl 3-(2,6-dichlorophenyl)-2-(diphenylmethyleneamino)propanoate (3c)



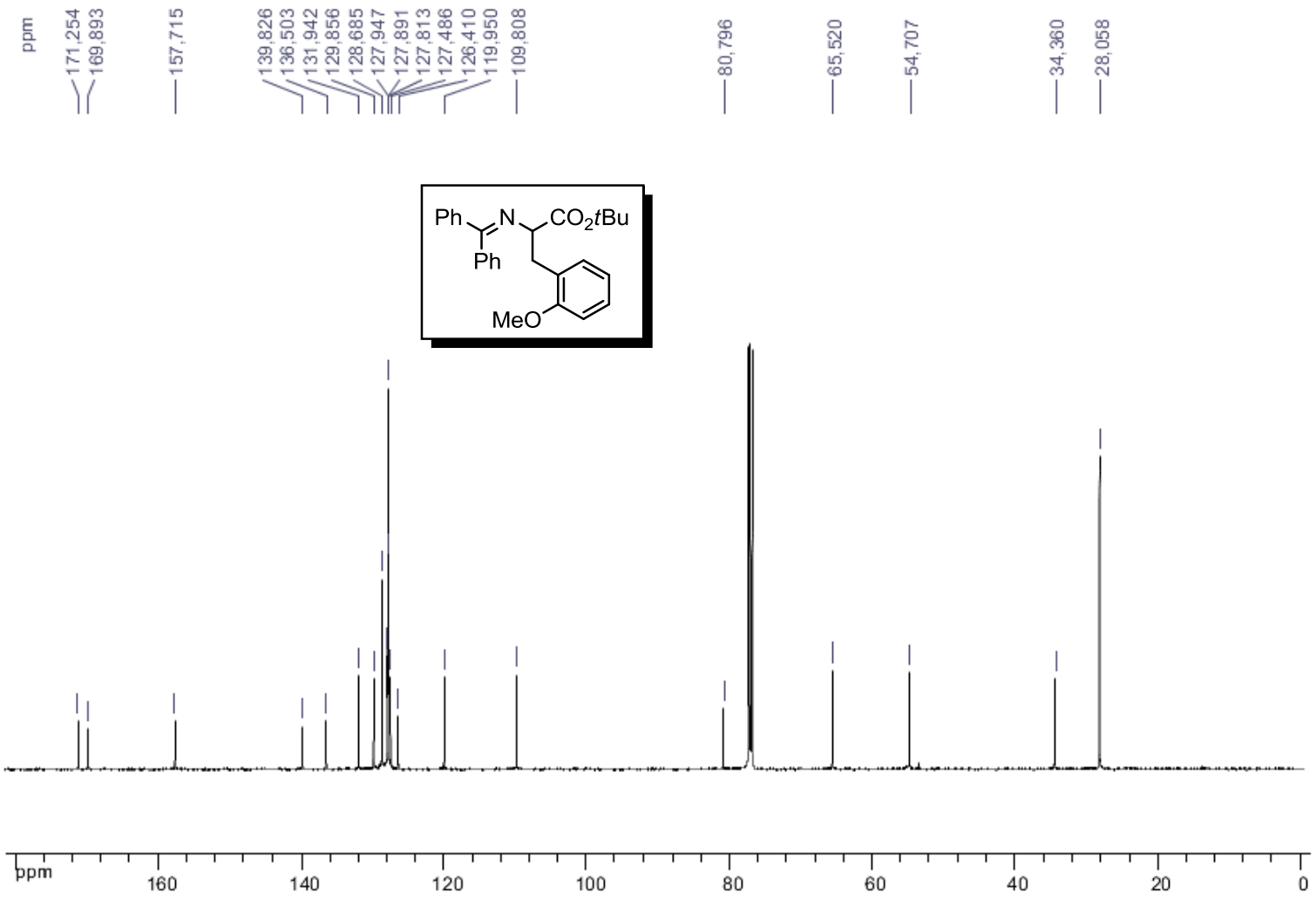
^{13}C NMR spectra (125 MHz, $CDCl_3$) of *tert*-Butyl 3-(2,6-dichlorophenyl)-2-(diphenylmethyleneamino)propanoate (3c)



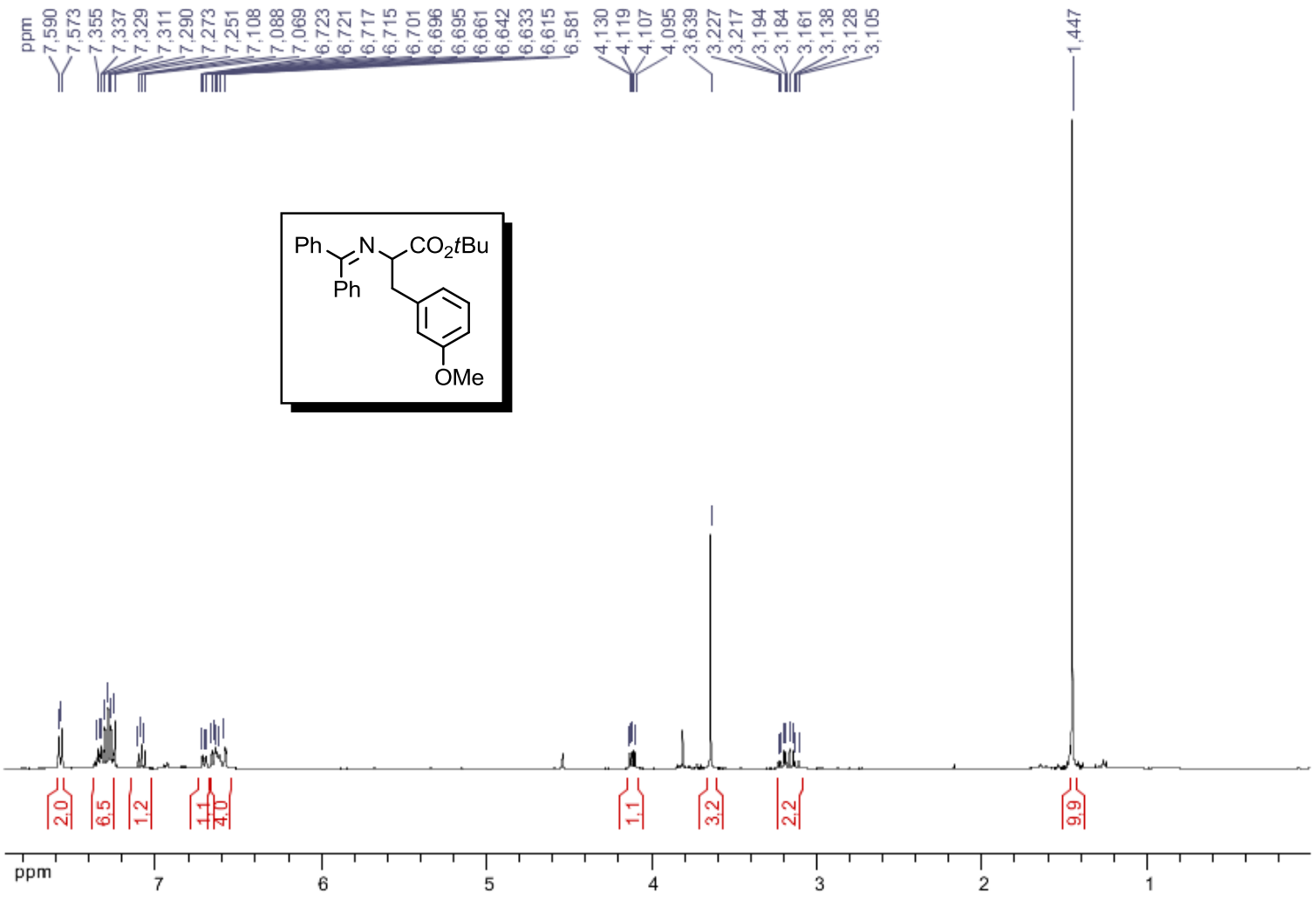
^{1}H NMR spectra (500 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-(2-methoxyphenyl)propanoate (3d)



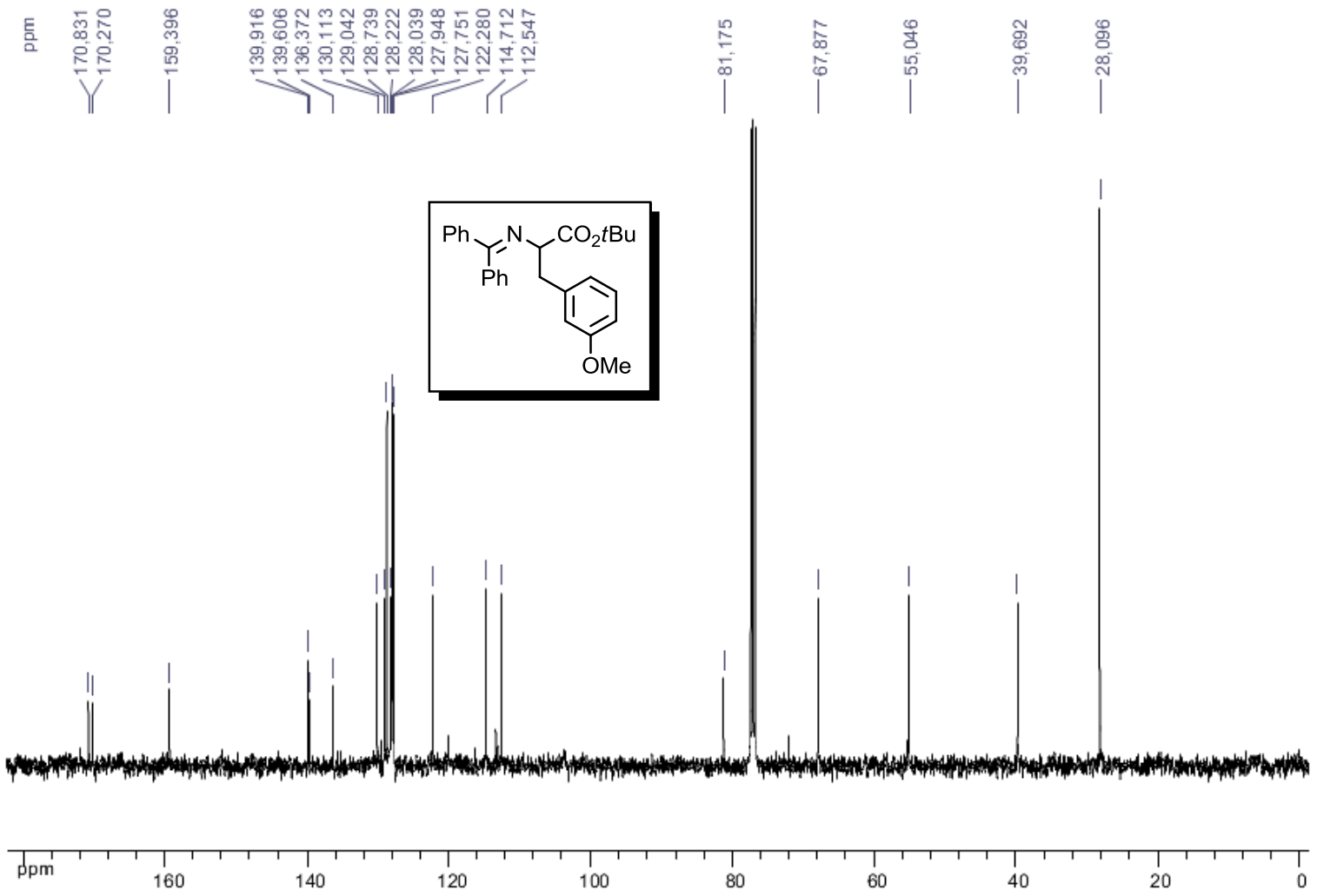
^{13}C NMR spectra (125 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-(2-methoxyphenyl)propanoate (3d)



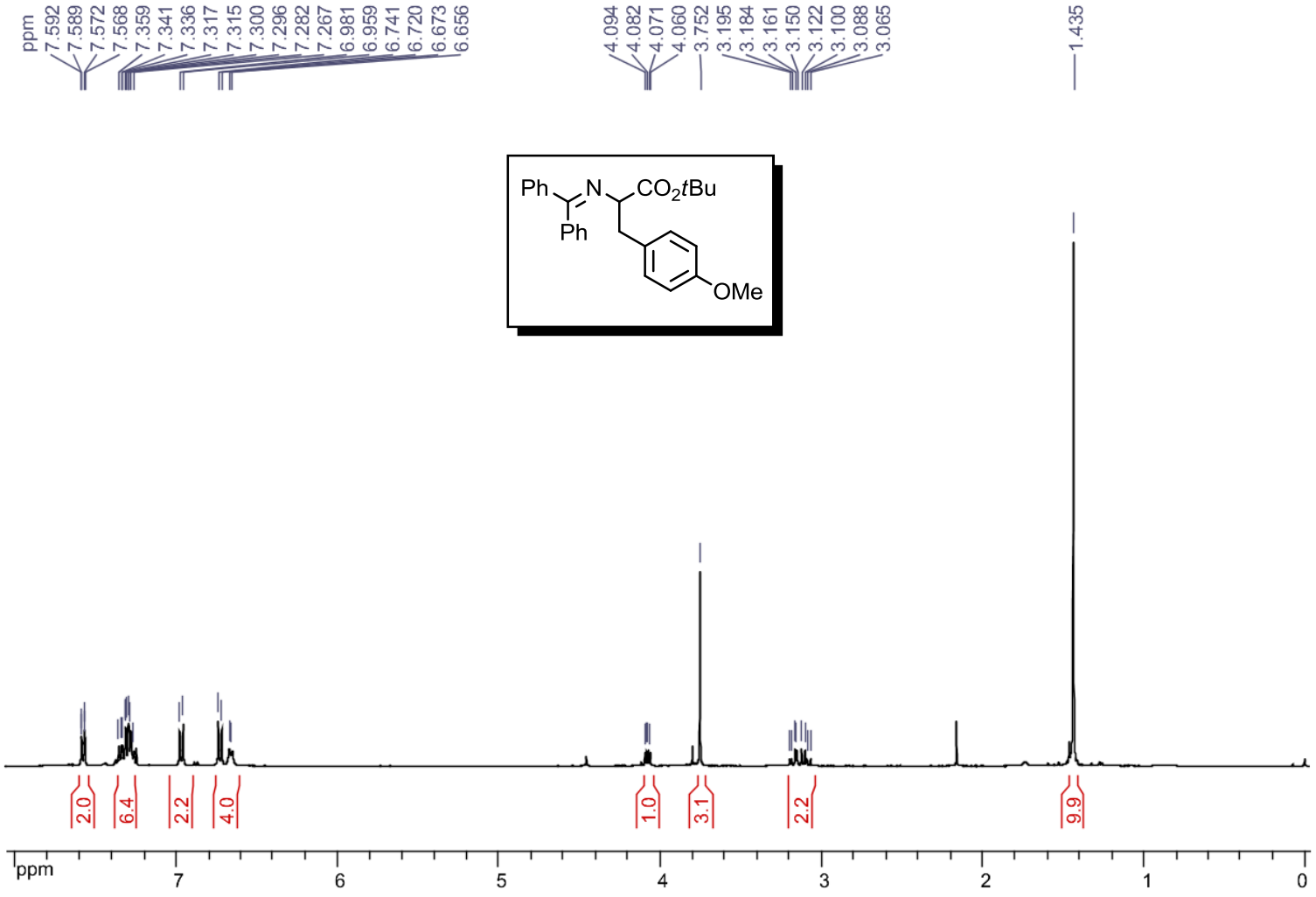
^{1}H NMR spectra (400 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-(3-methoxyphenyl)propanoate (3e)



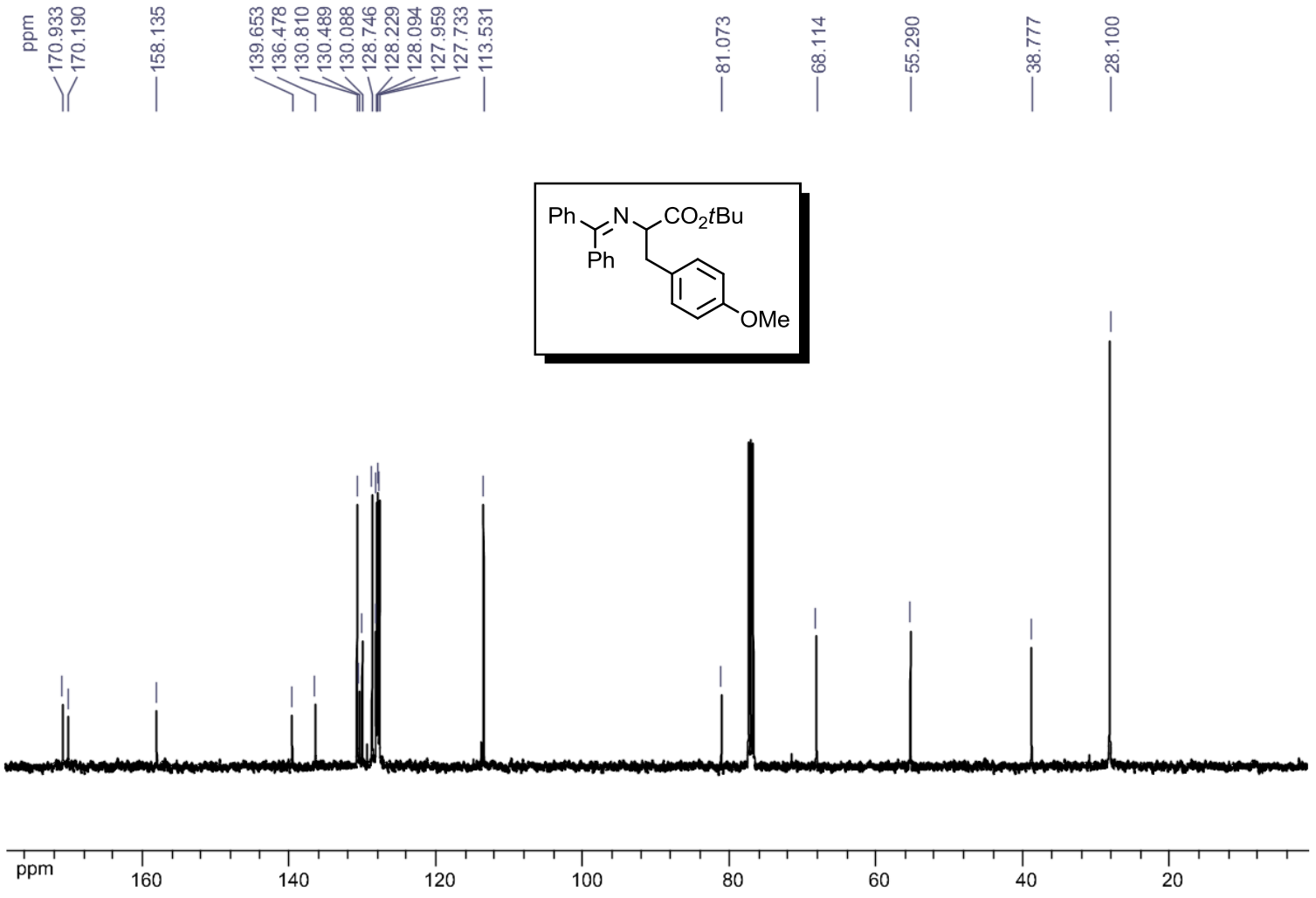
^{13}C NMR spectra (100 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-(3-methoxyphenyl)propanoate (3e)



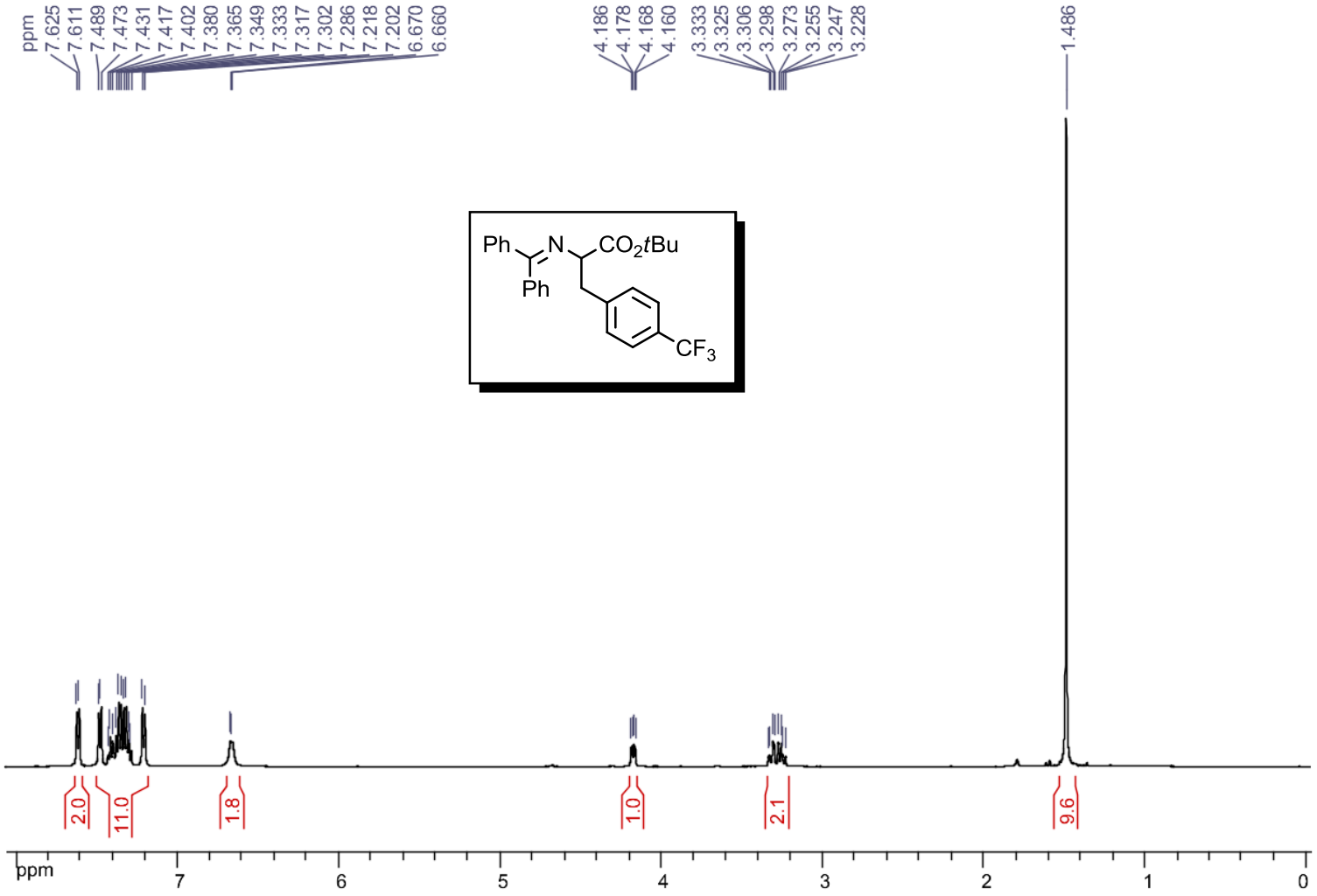
^{1}H NMR spectra (400 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-(4-methoxyphenyl)propanoate (3f)



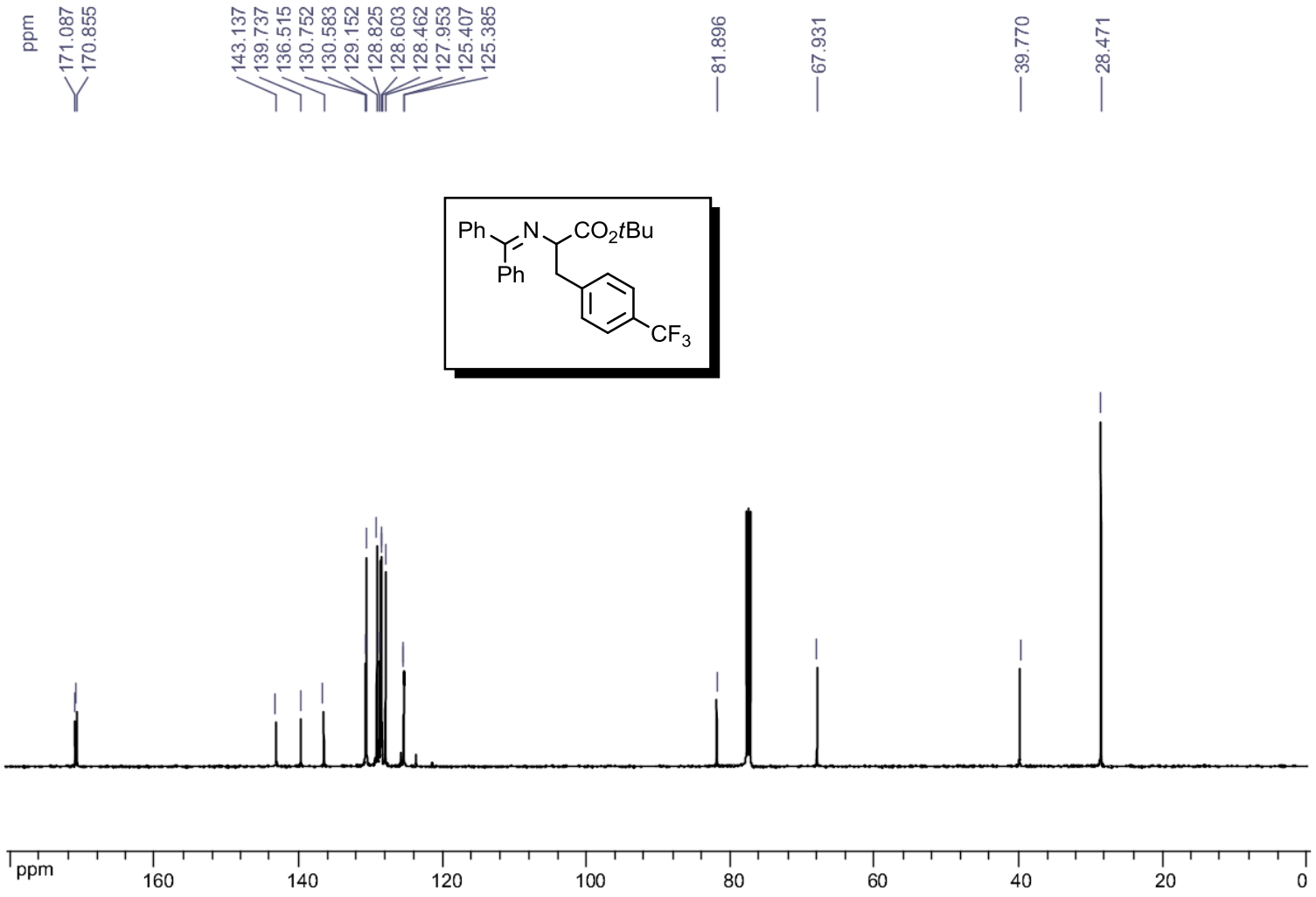
^{13}C NMR spectra (100 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-(4-methoxyphenyl)propanoate (3f)



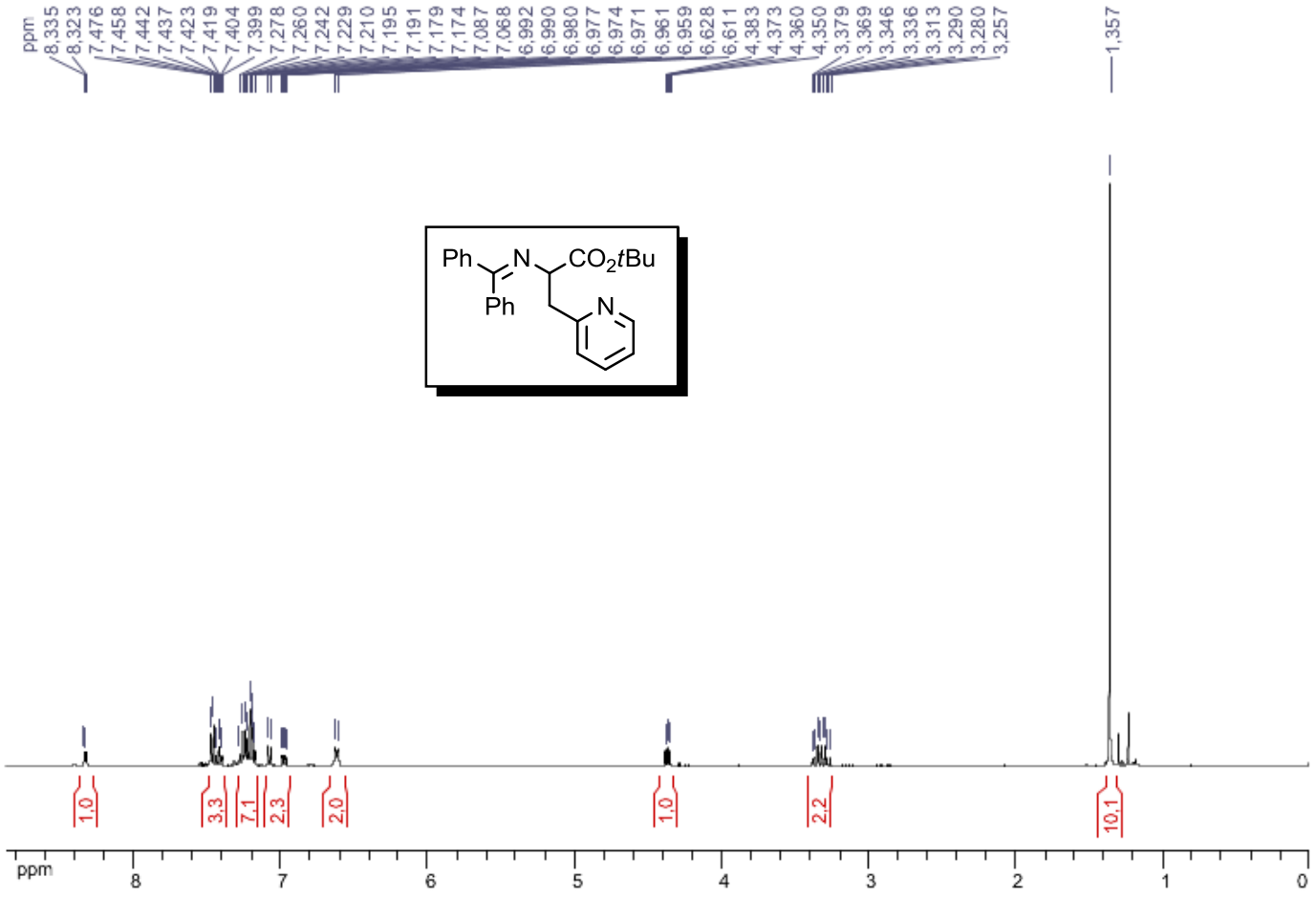
^{1}H NMR spectra (500 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-(4-(trifluoromethyl)phenyl)propanoate (3g)



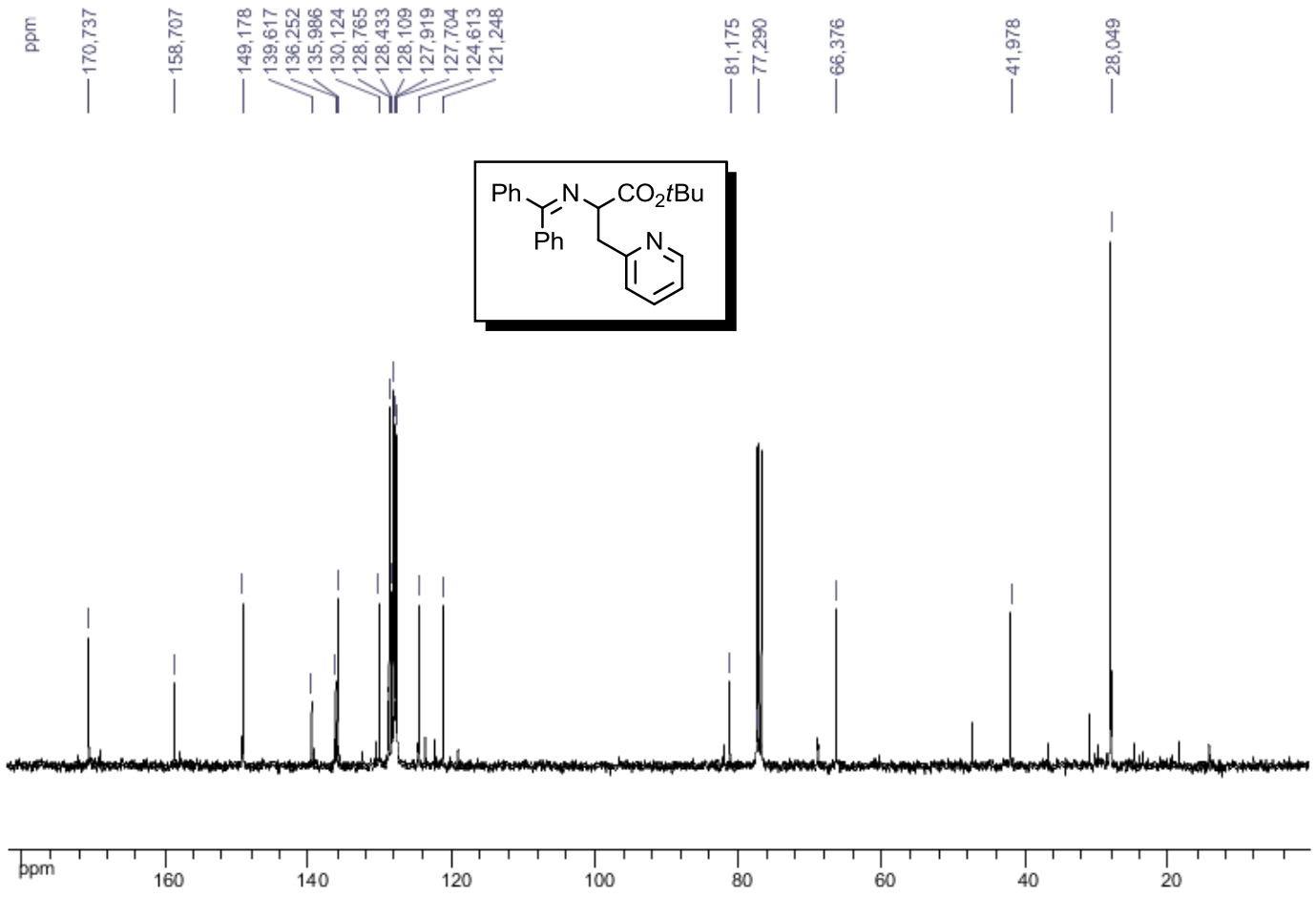
^{13}C NMR spectra (125 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-(4-(trifluoromethyl)phenyl)propanoate (3g)



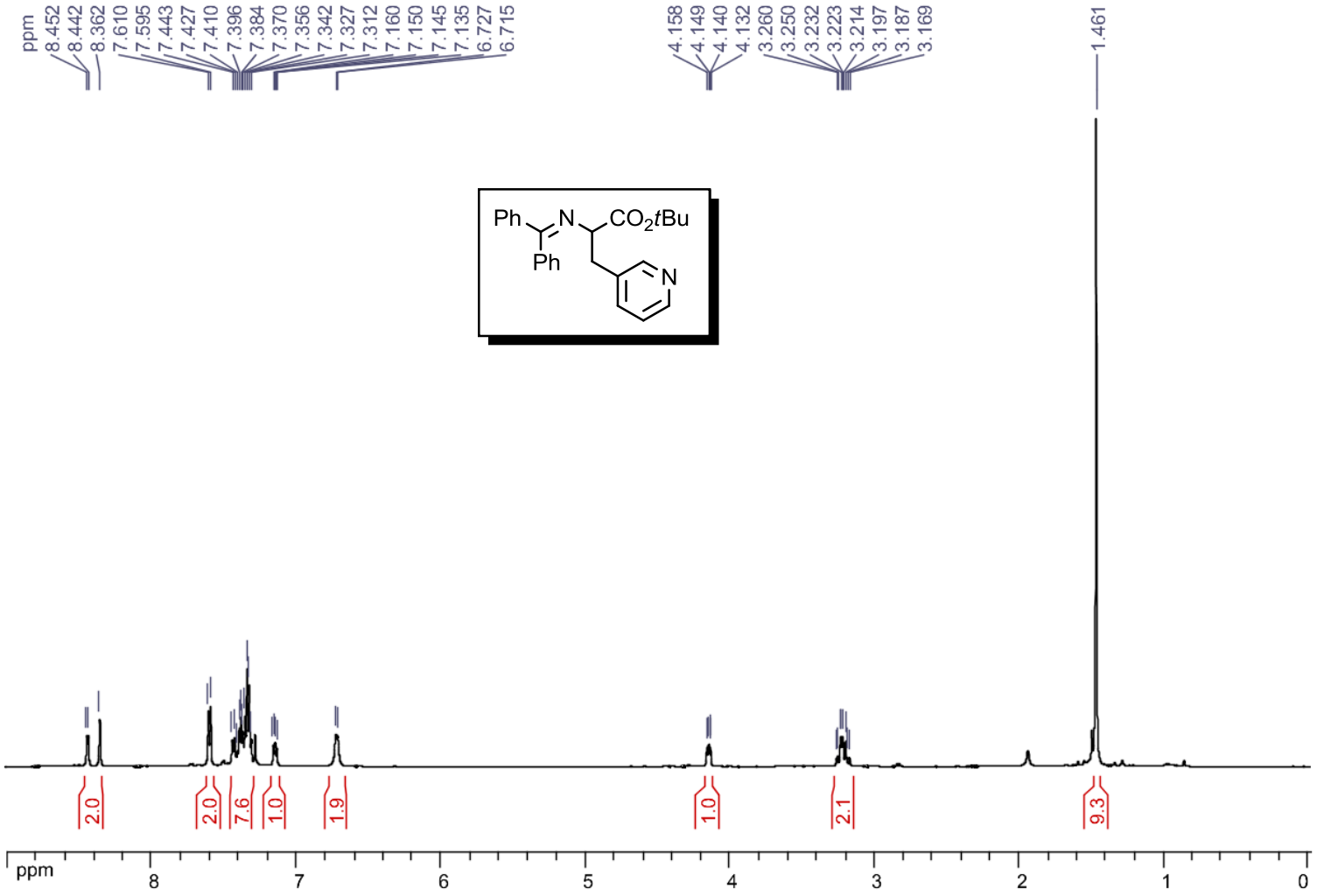
^{1}H NMR spectra (400 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-(pyridin-2-yl)propanoate (3h)



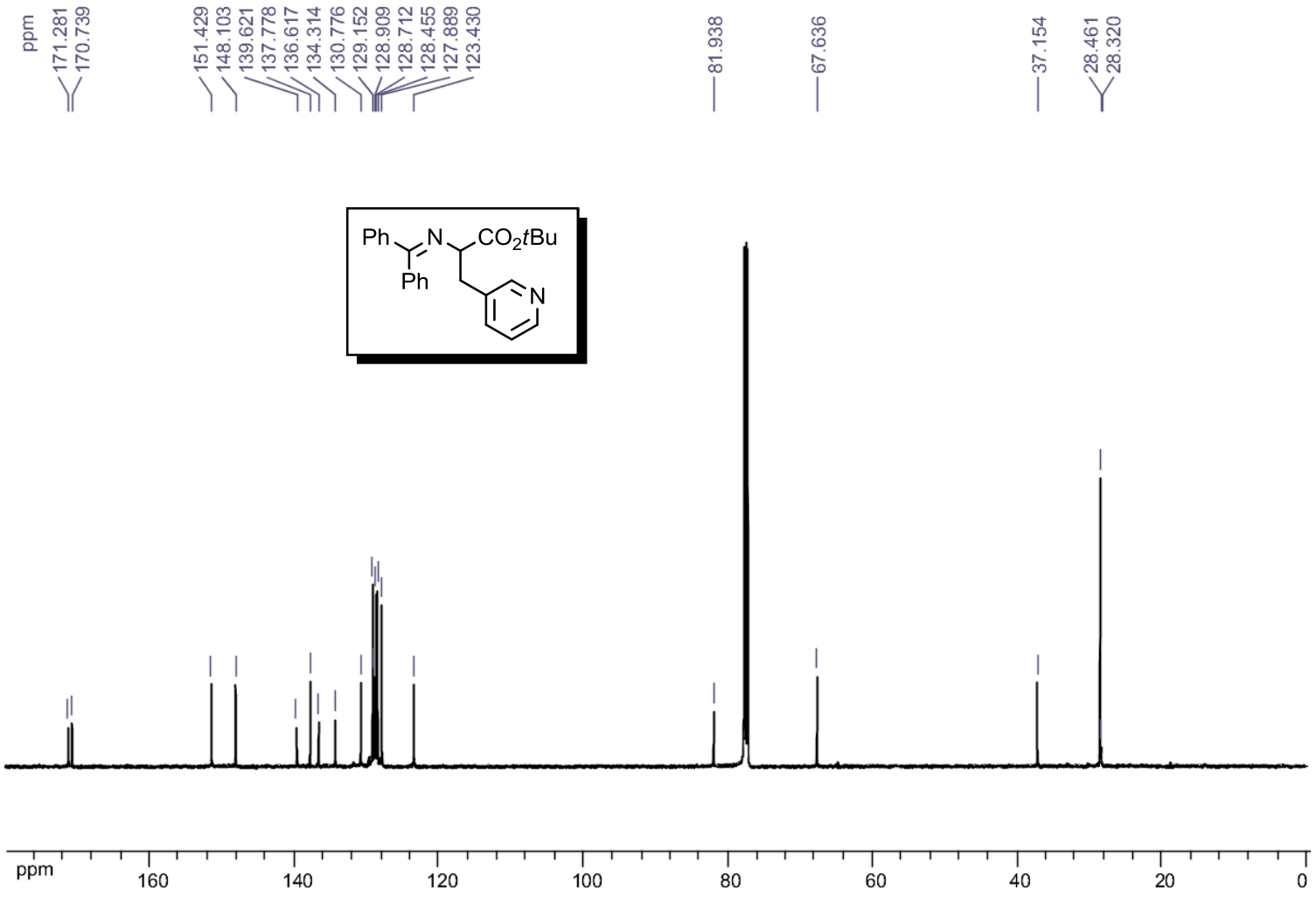
^{13}C NMR spectra (100 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-(pyridin-2-yl)propanoate (3h)



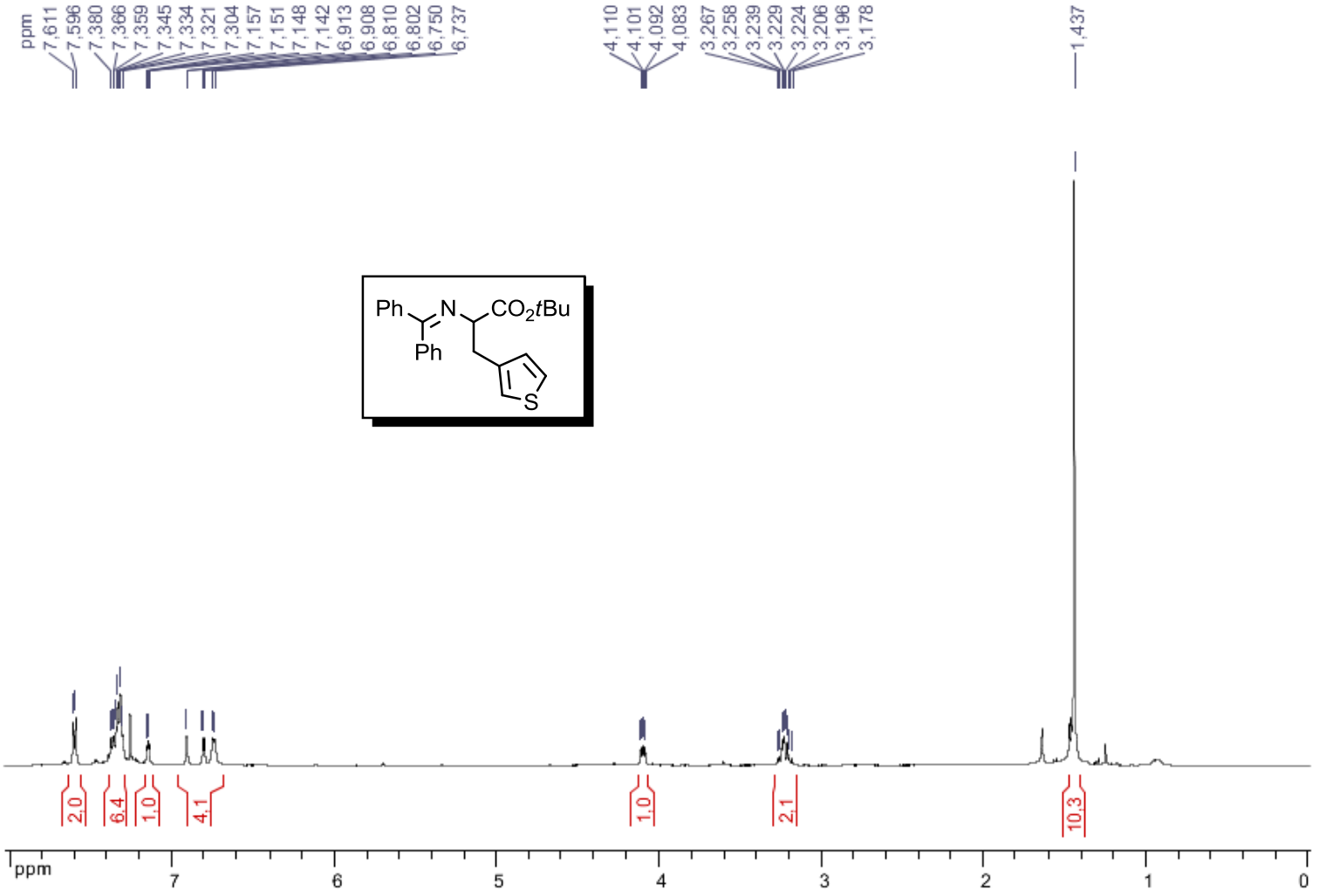
^{1}H NMR spectra (500 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-(pyridin-3-yl)propanoate (3i)



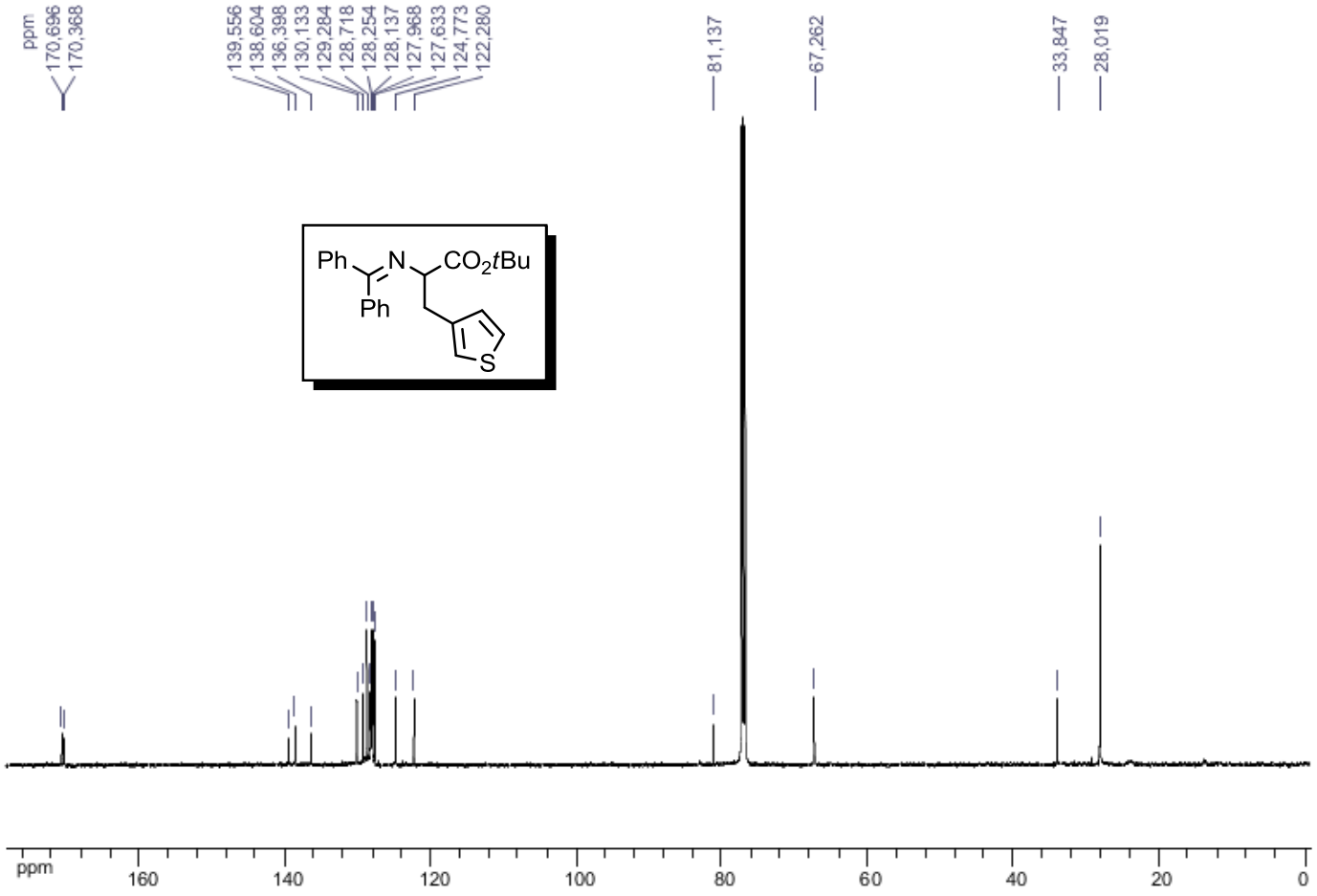
^{13}C NMR spectra (100 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-(pyridin-3-yl)propanoate (3i)



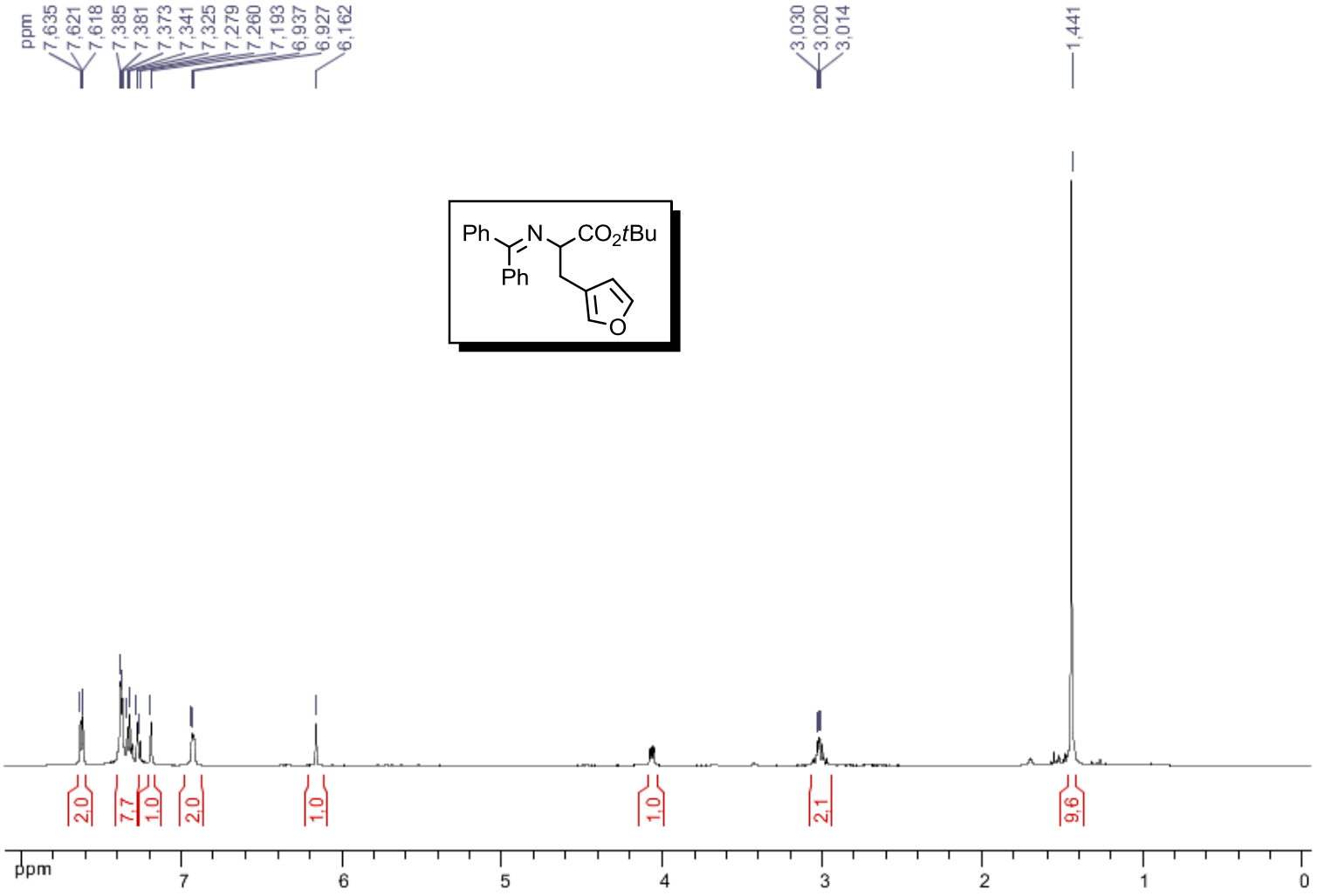
^{1}H NMR spectra (500 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-(thiophen-3-yl)propanoate (3j)



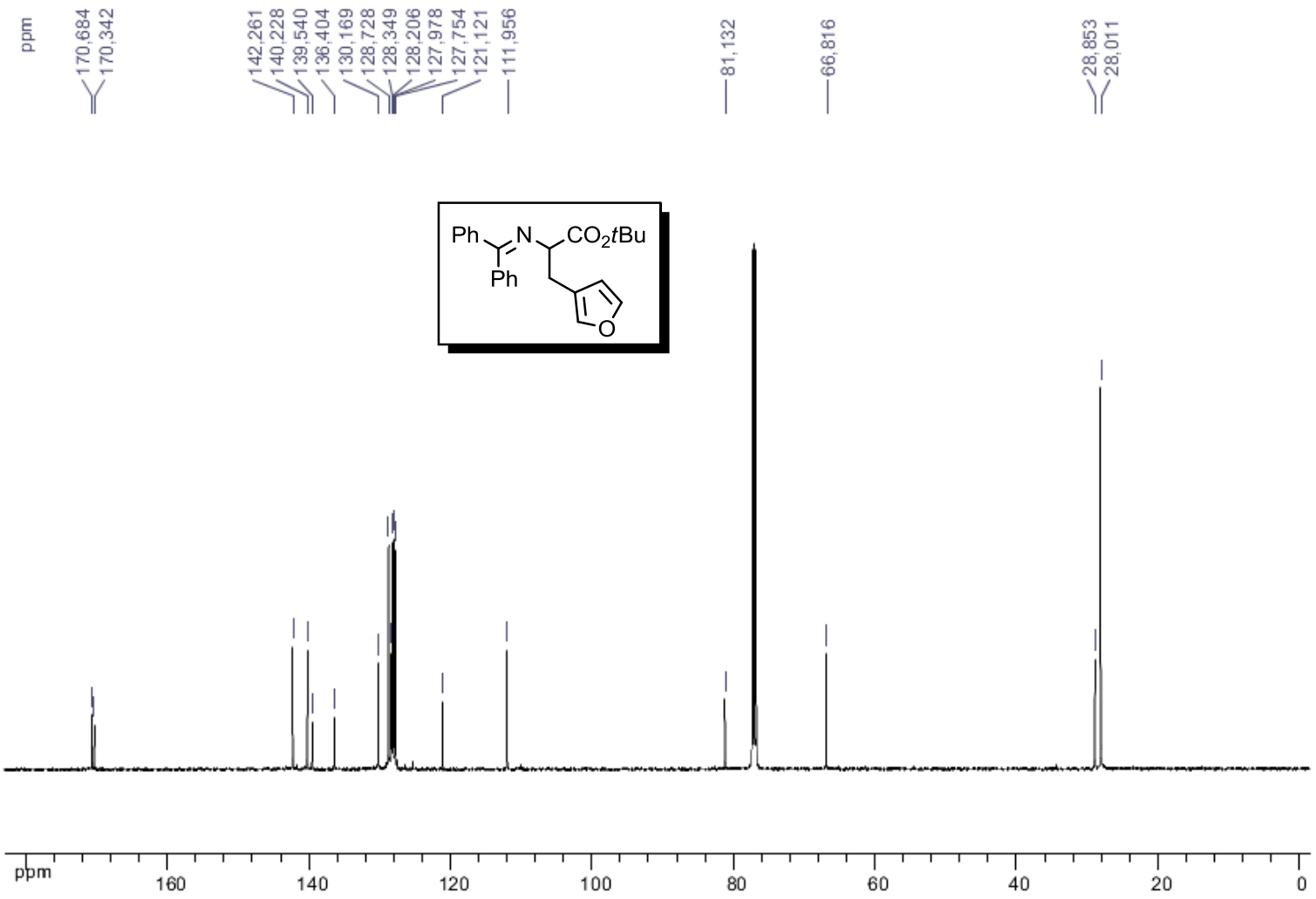
^{13}C NMR spectra (125 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-(thiophen-3-yl)propanoate (3j)



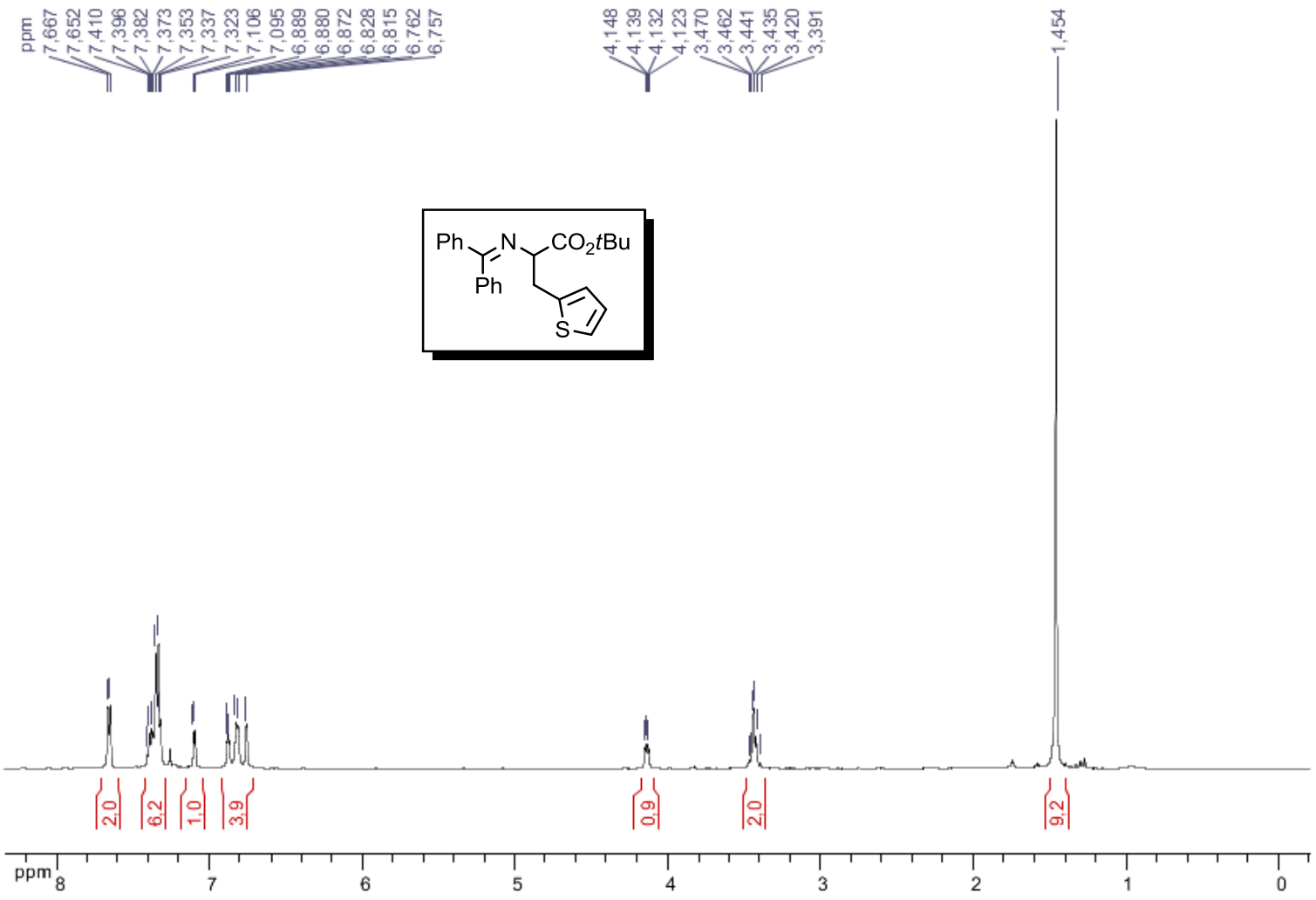
^{1}H NMR spectra (500 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-(furan-3-yl)propanoate (3k)



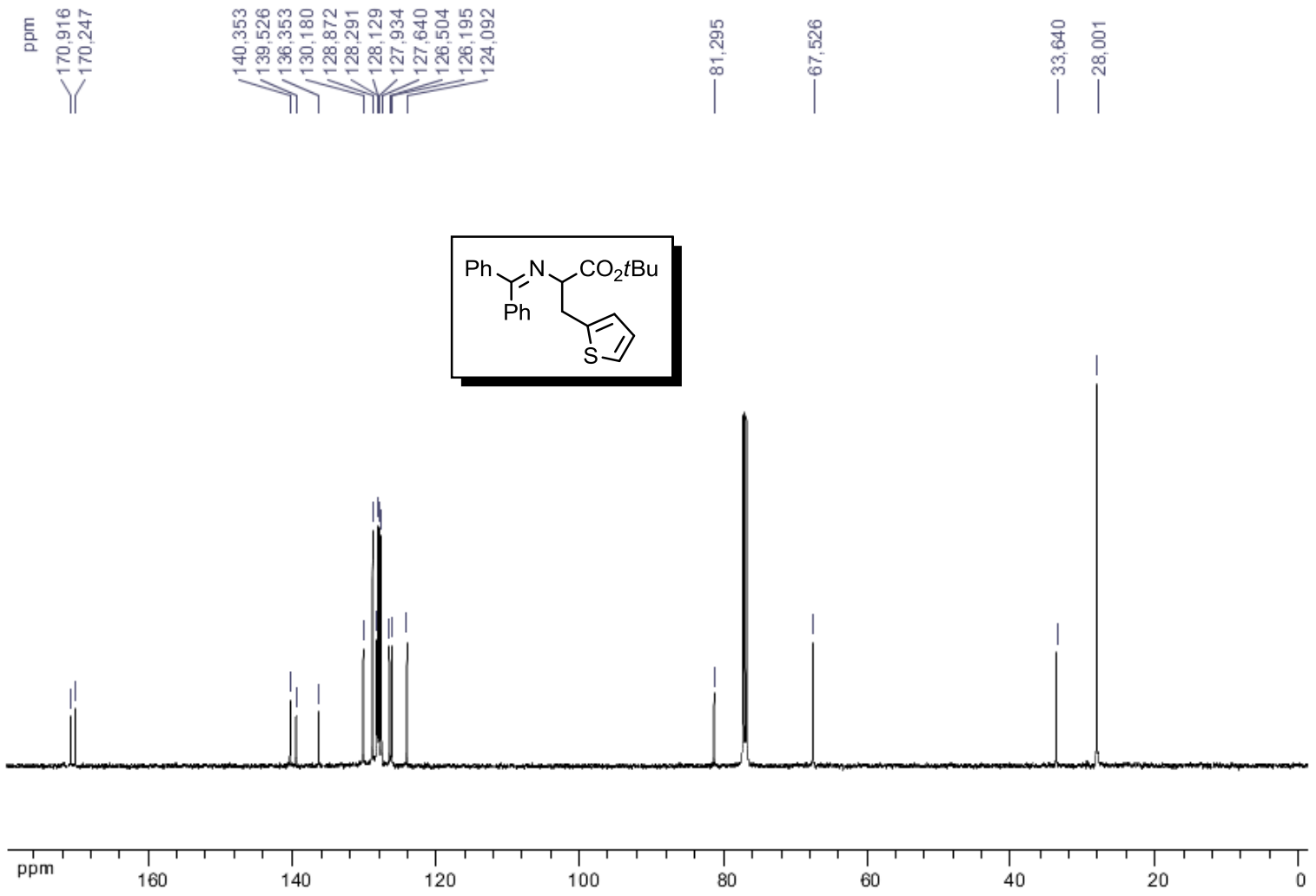
^{13}C NMR spectra (125 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-(furan-3-yl)propanoate (3k)



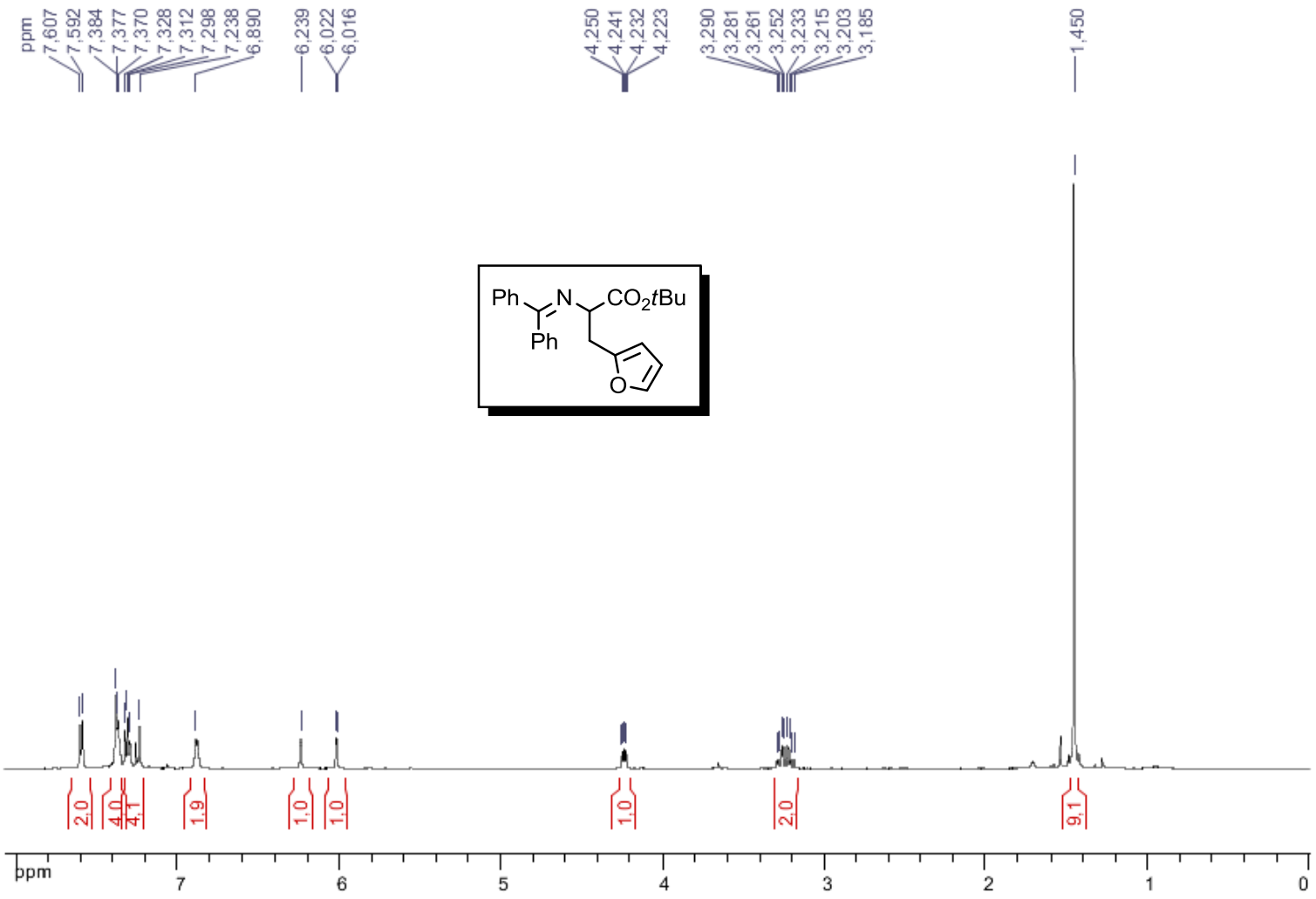
^{1}H NMR spectra (500 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-(thiophen-2-yl)propanoate (3l)



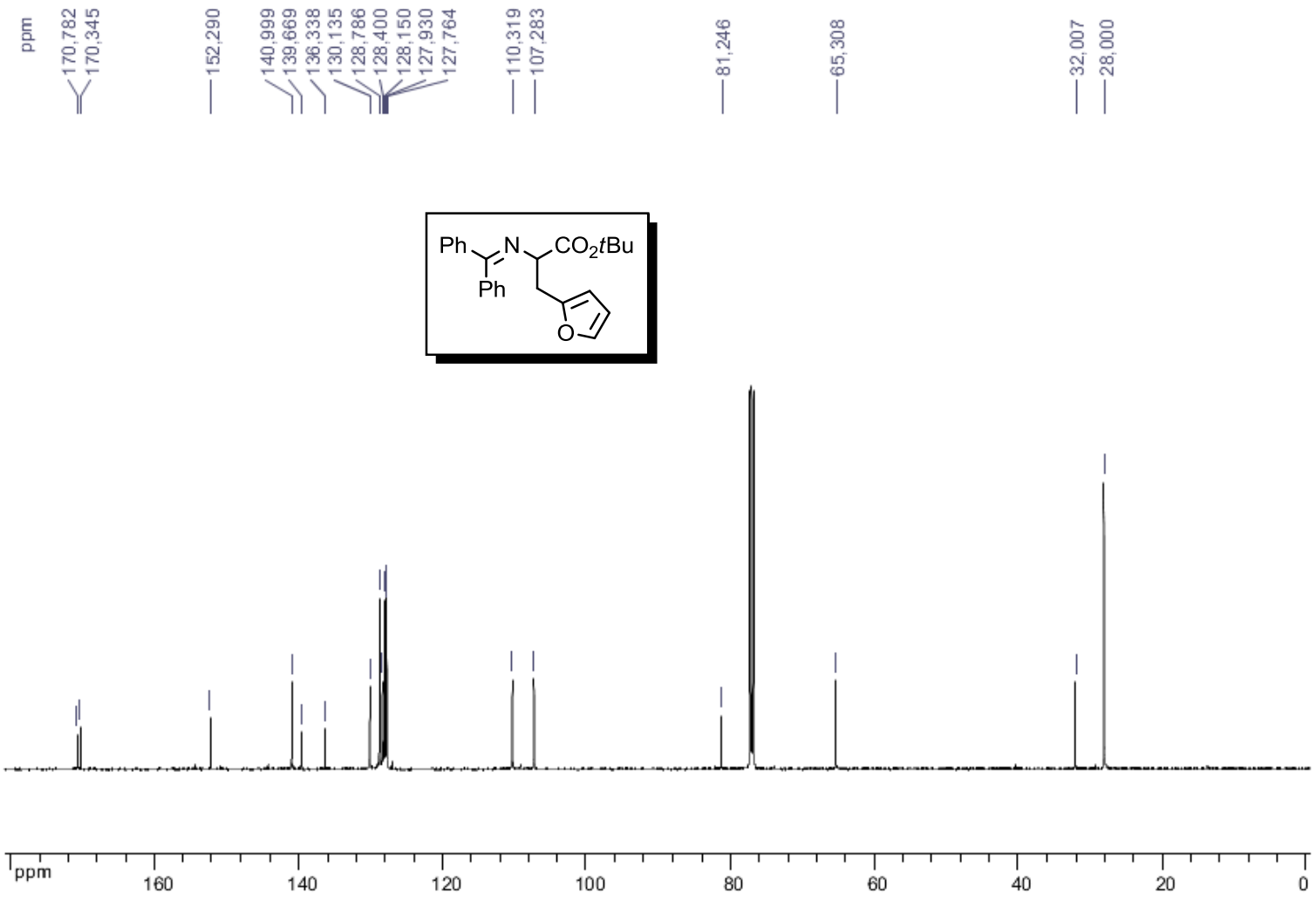
^{13}C NMR spectra (125 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-(thiophen-2-yl)propanoate (3l)



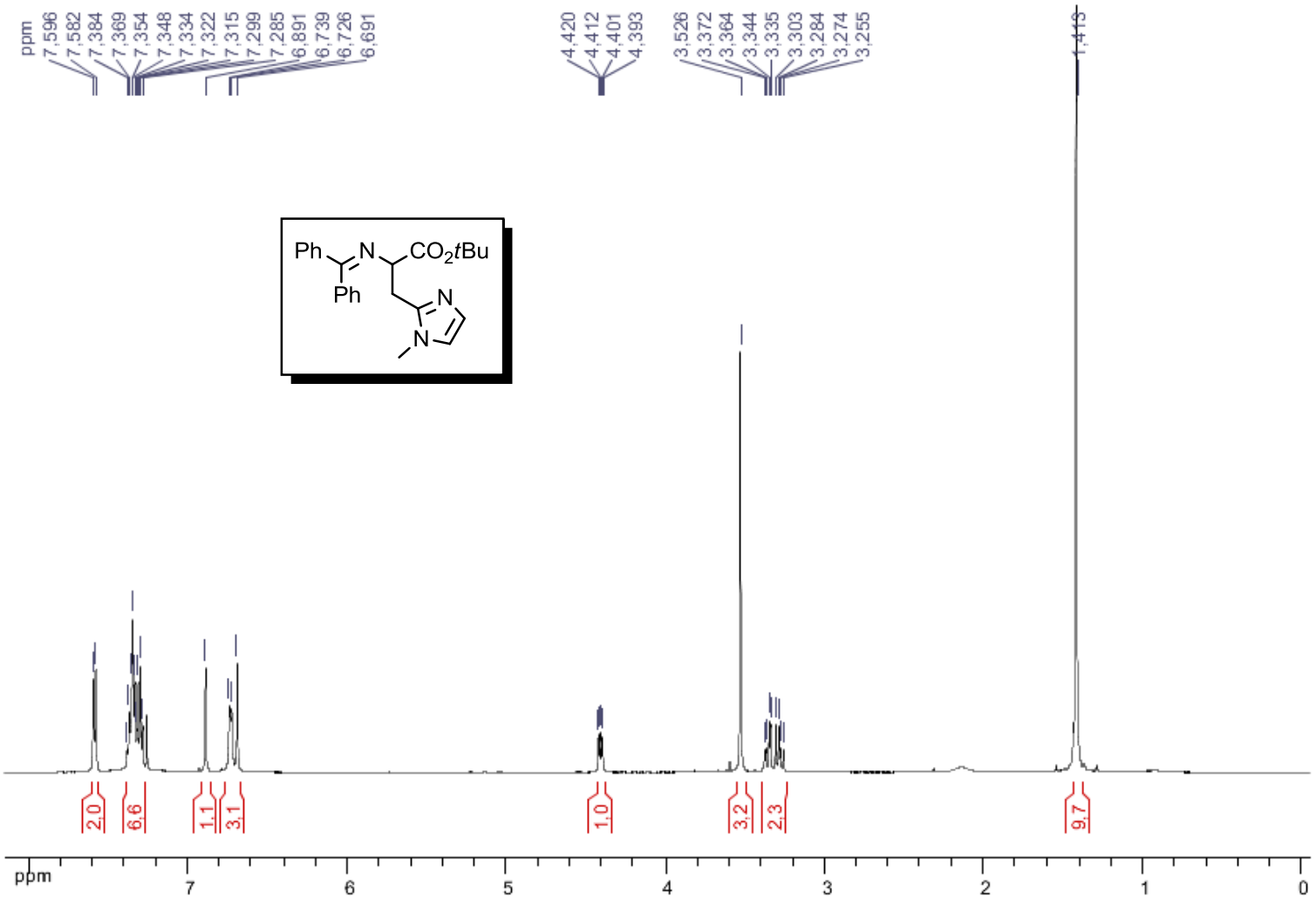
^{1}H NMR spectra (500 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-(furan-2-yl)propanoate (3m)



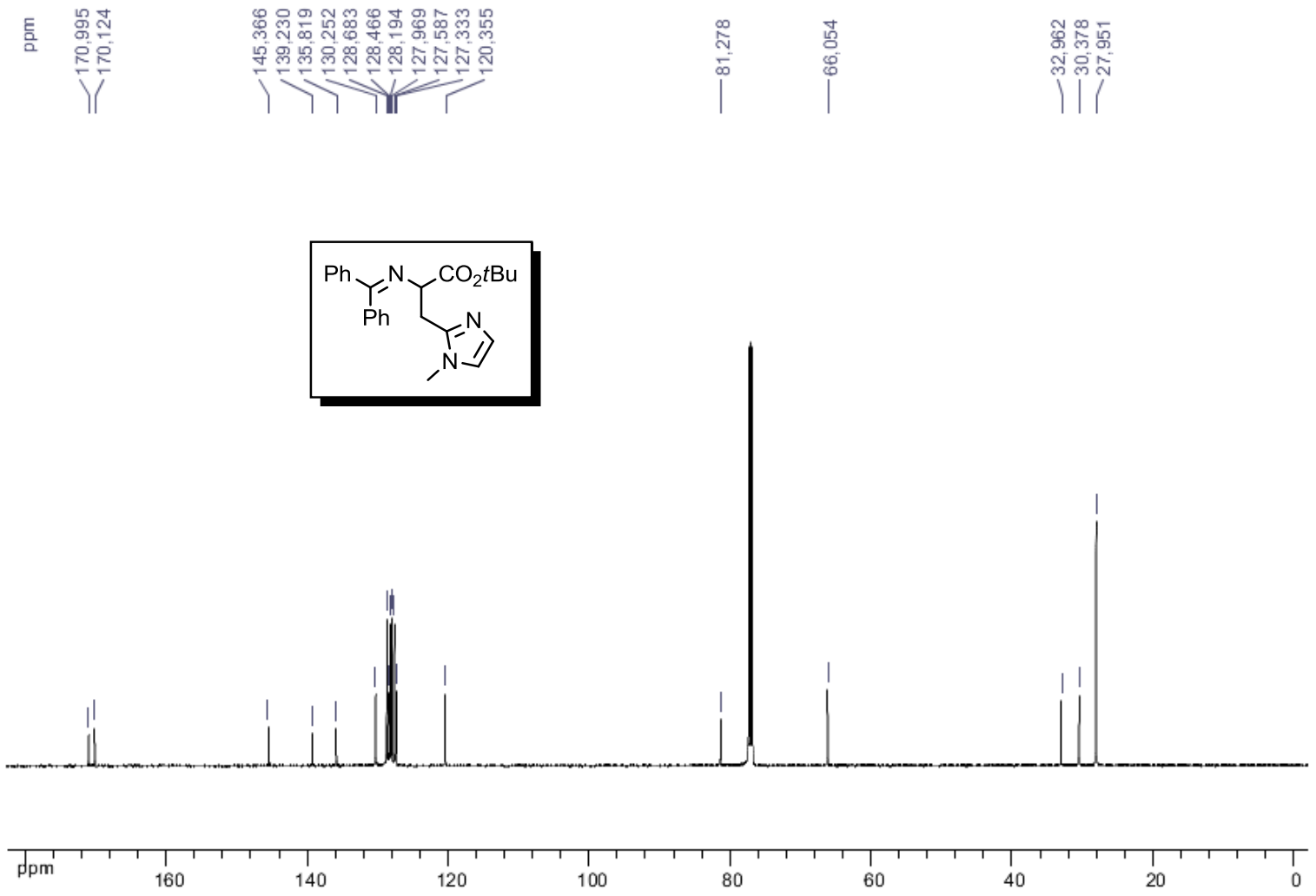
^{13}C NMR spectra (125 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-(furan-2-yl)propanoate (3m)



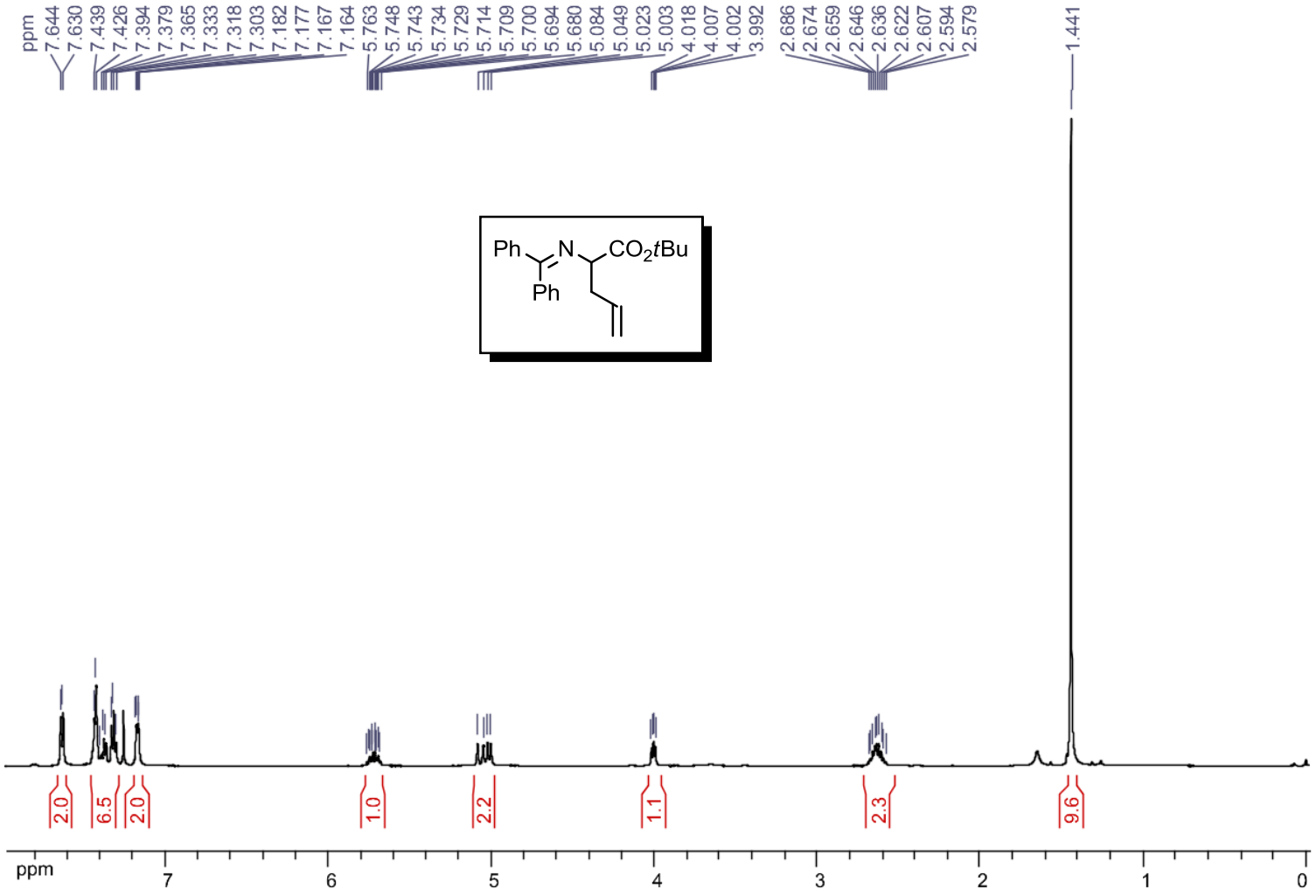
^{1}H NMR spectra (500 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-(1-methyl-1H-imidazol-2-yl)propanoate (3n)



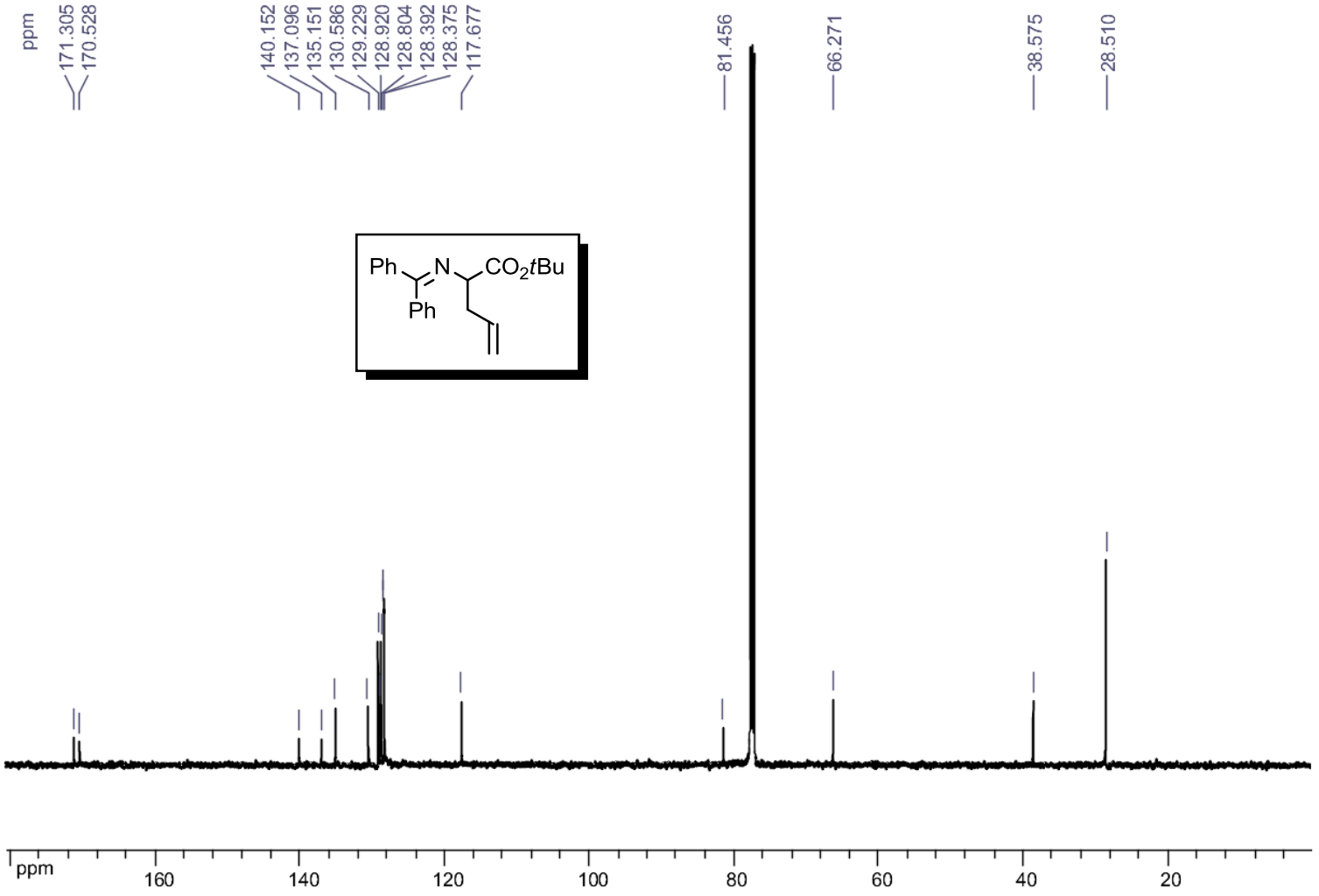
^{13}C NMR spectra (125 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-3-(1-methyl-1H-imidazol-2-yl)propanoate (3n)



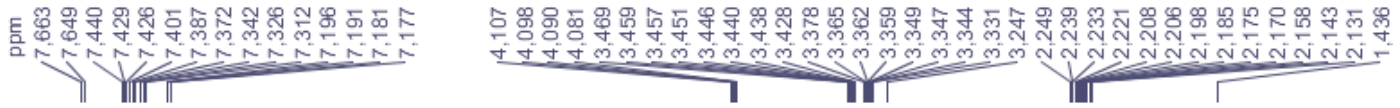
^{1}H NMR spectra (500 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)pent-4-enoate (3o)

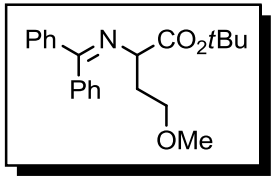


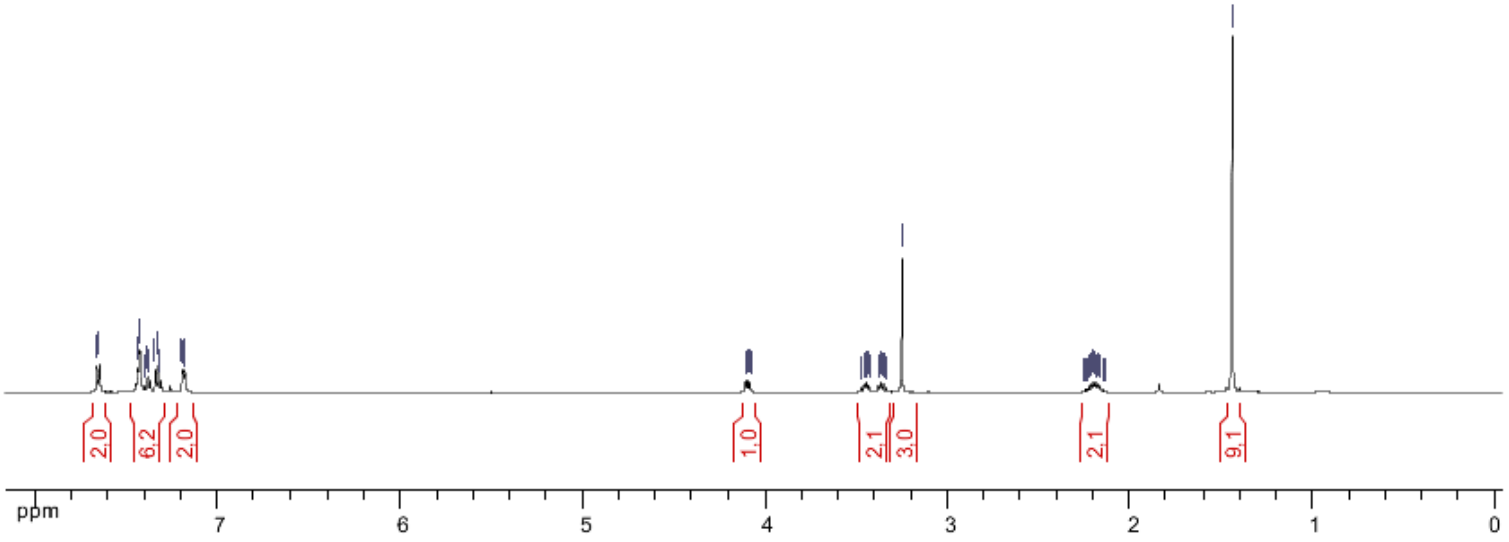
^{13}C NMR spectra (125 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)pent-4-enoate (3o)



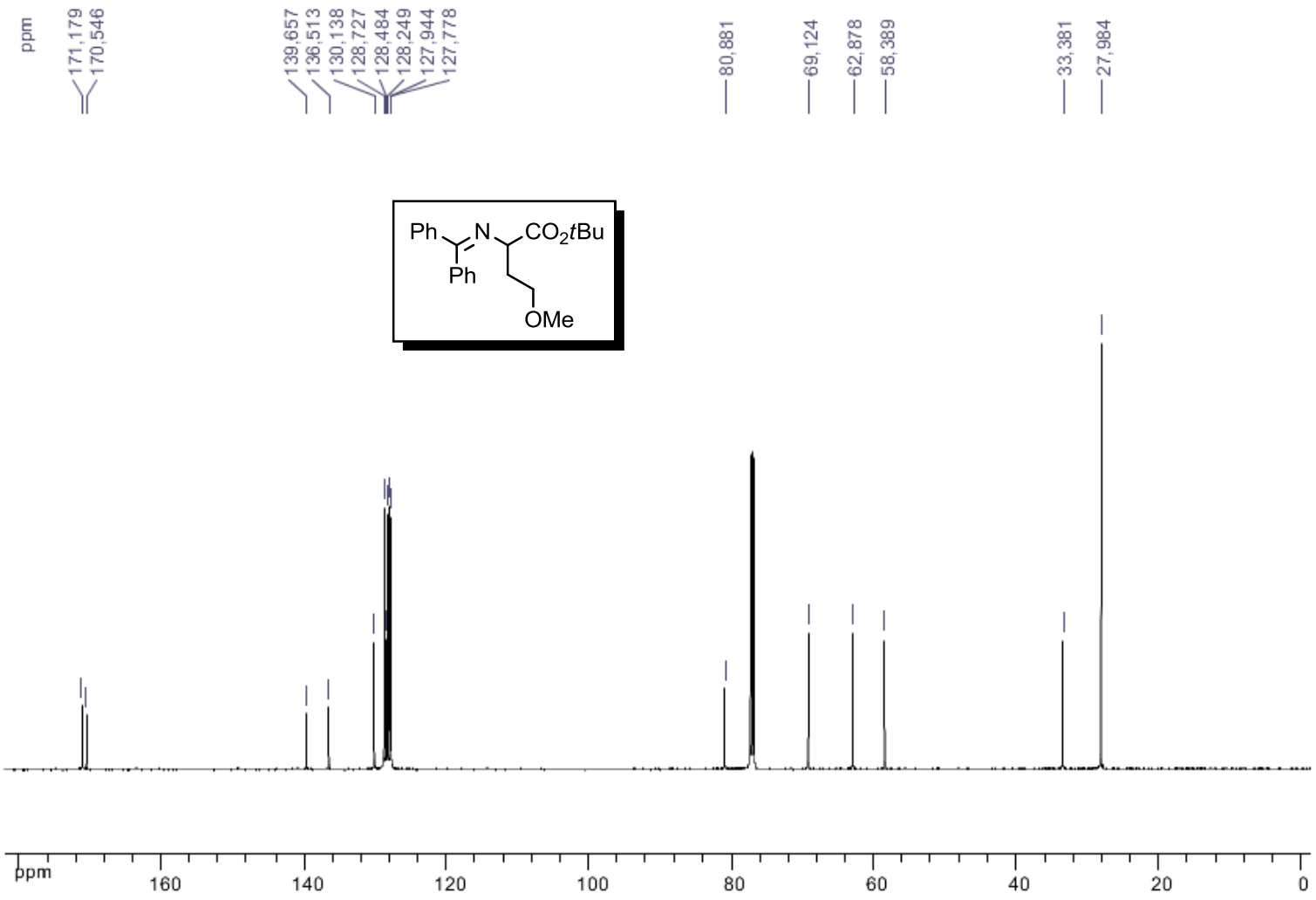
^{1}H NMR spectra (500 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-4-methoxybutanoate (3p)



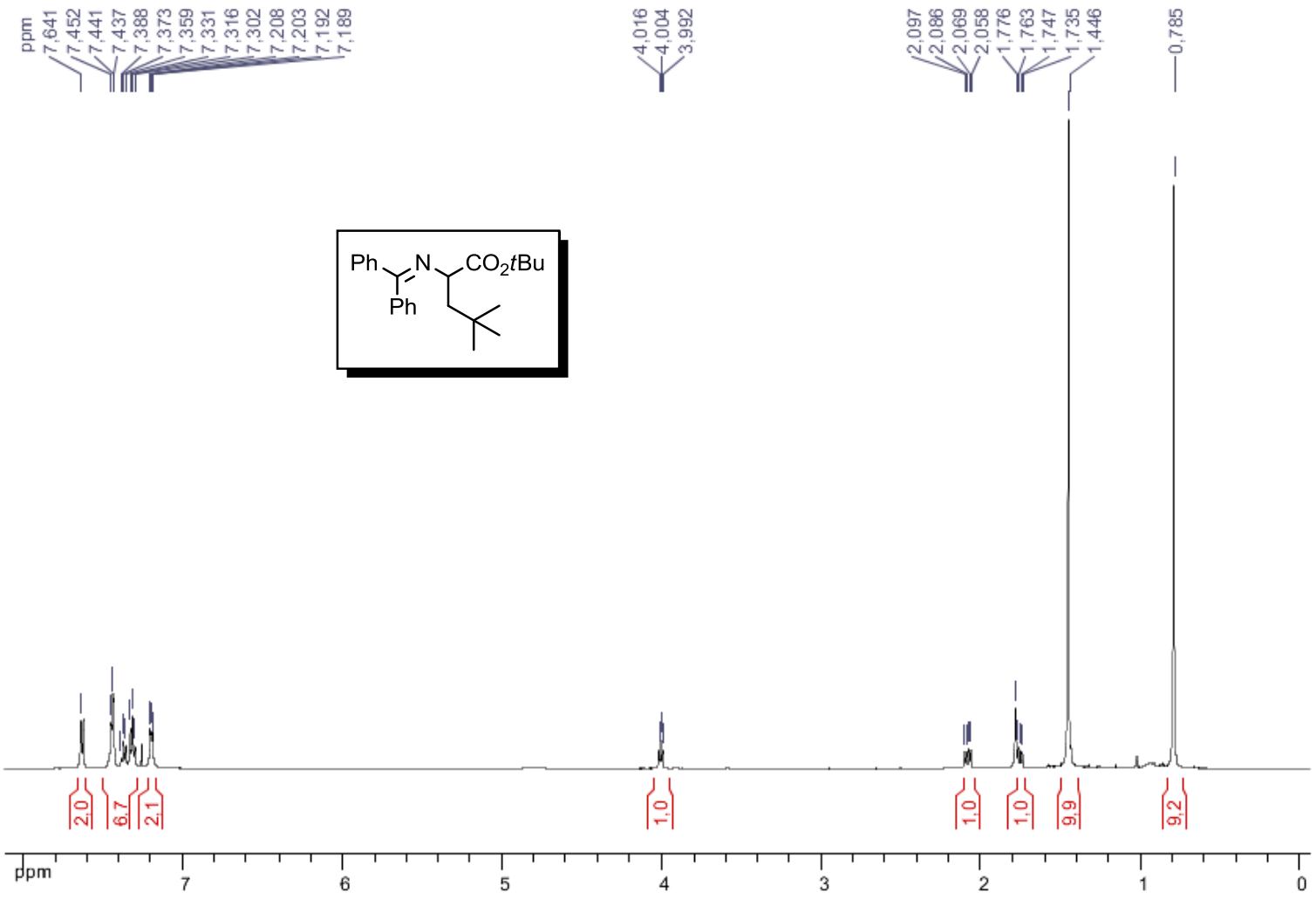




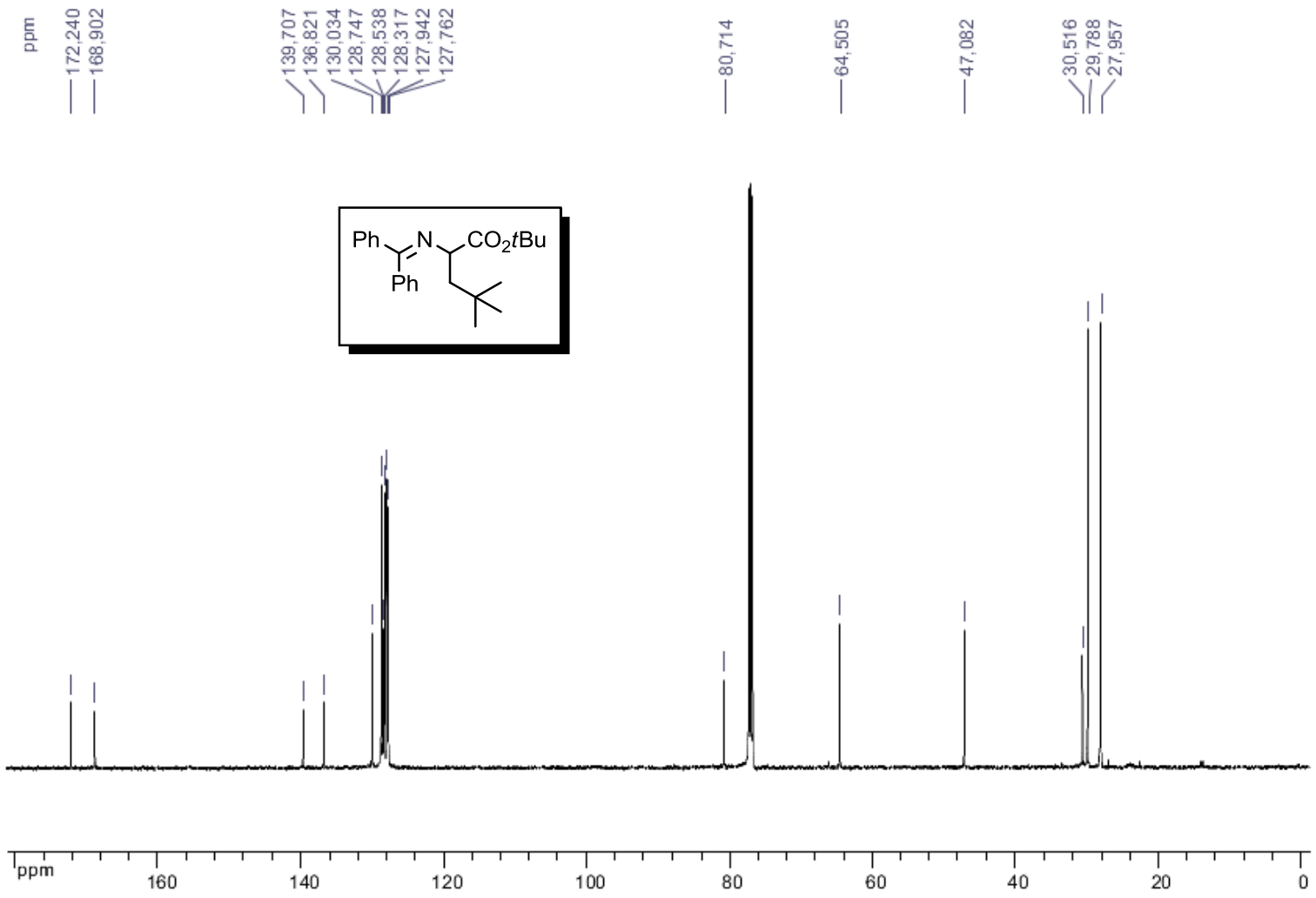
^{13}C NMR spectra (125 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-4-methoxybutanoate (3p)



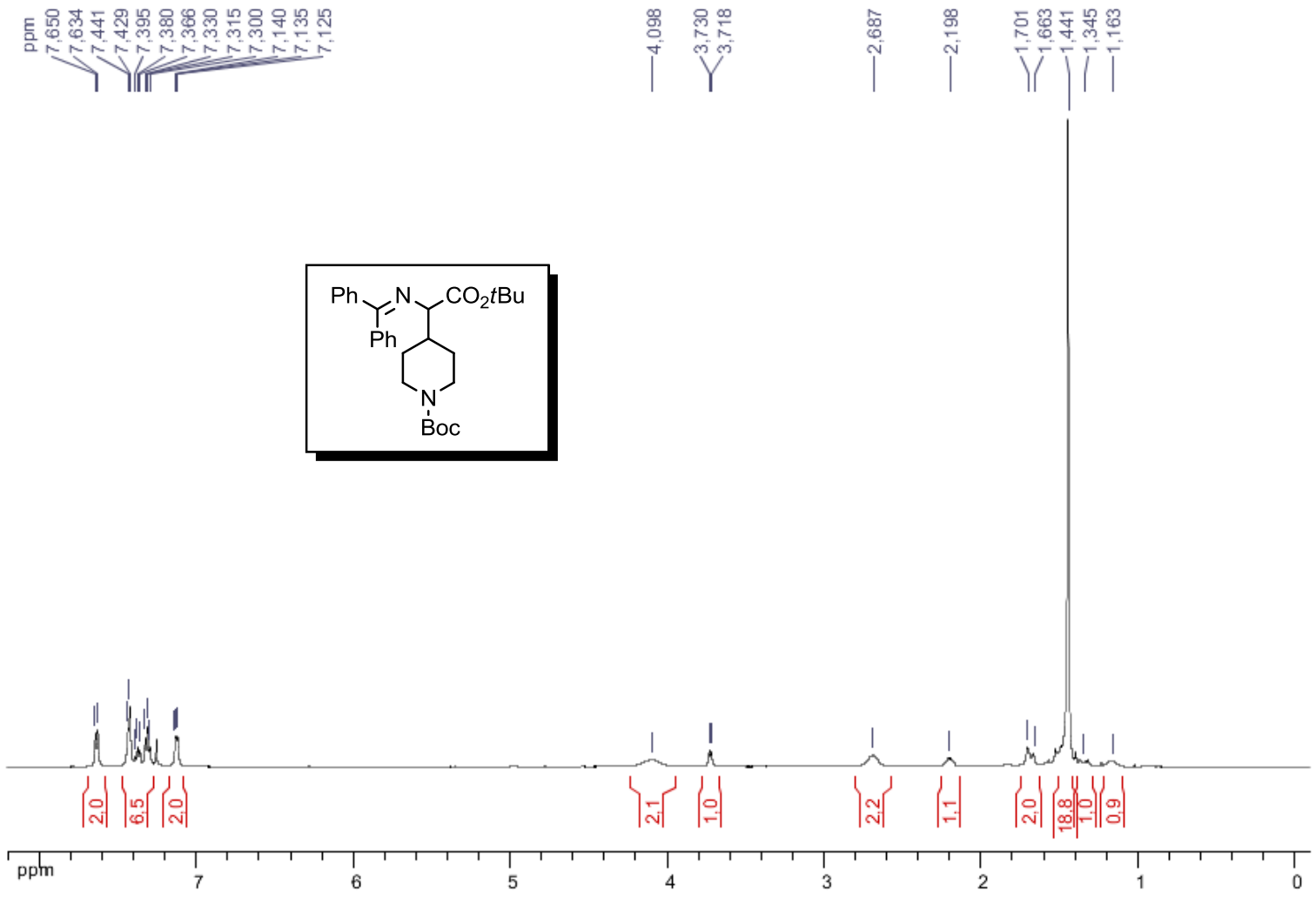
^{1}H NMR spectra (500 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-4,4-dimethylpentanoate (3q)



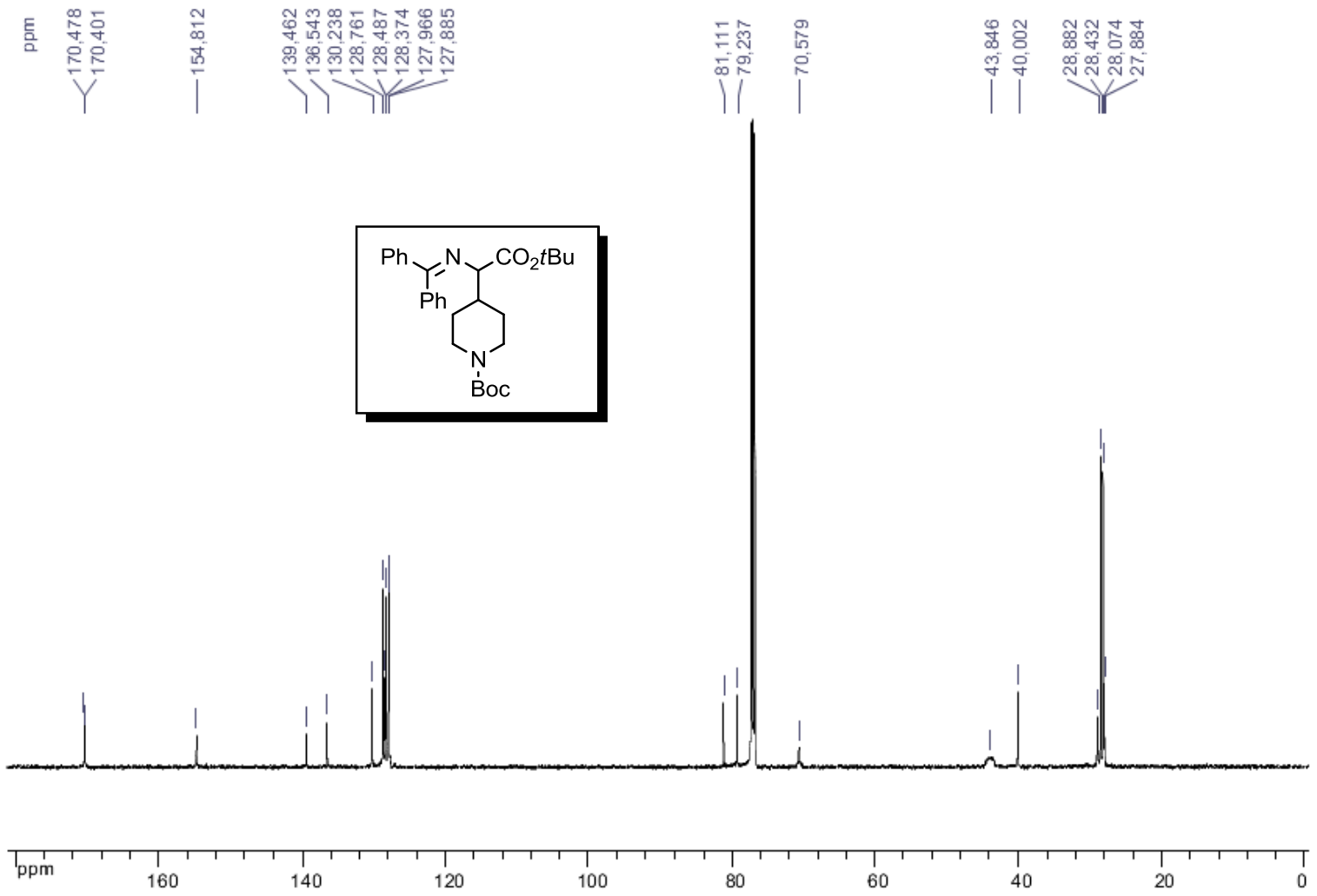
^{13}C NMR spectra (125 MHz, $CDCl_3$) of *tert*-Butyl 2-(diphenylmethyleneamino)-4,4-dimethylpentanoate (3q)



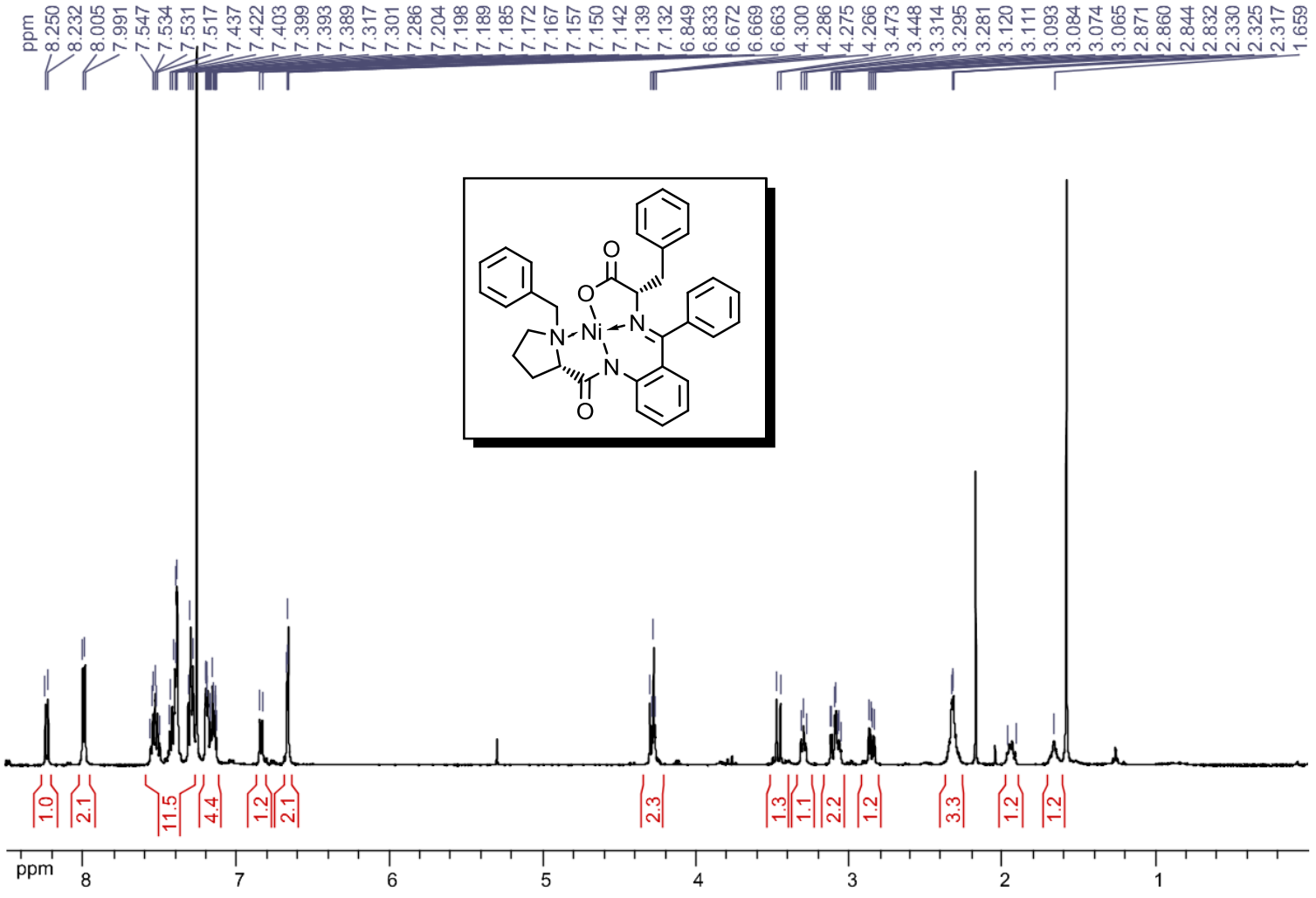
^{1}H NMR spectra (500 MHz, $CDCl_3$) of *tert*-Butyl 4-(2-tert-butoxy-1-(diphenylmethyleneamino)-2-oxoethyl)piperidine-1-carboxylate (3r)



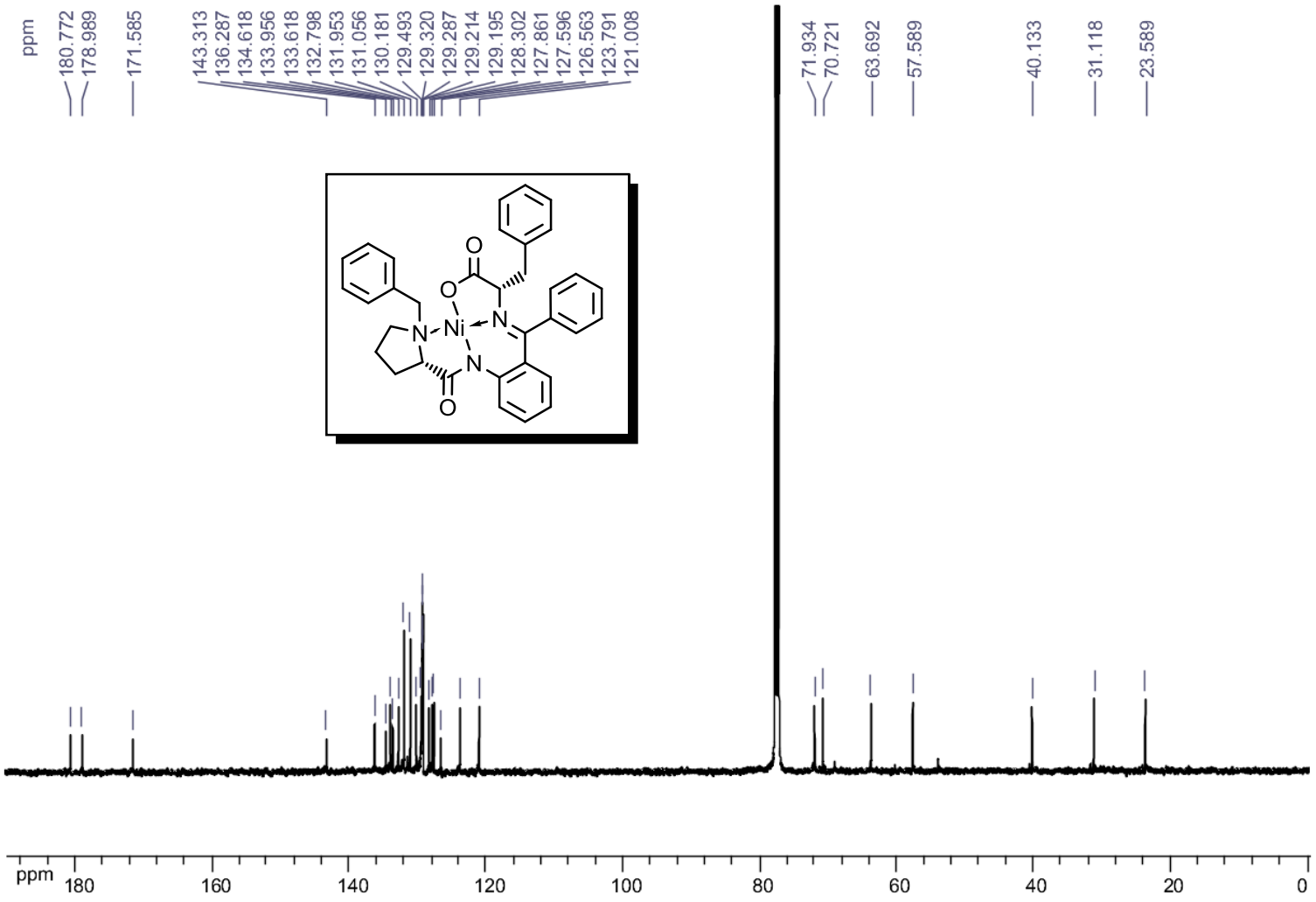
^{13}C NMR spectra (125 MHz, $CDCl_3$) of *tert*-Butyl 4-(2-tert-butoxy-1-(diphenylmethyleneamino)-2-oxoethyl)piperidine-1-carboxylate (3r)



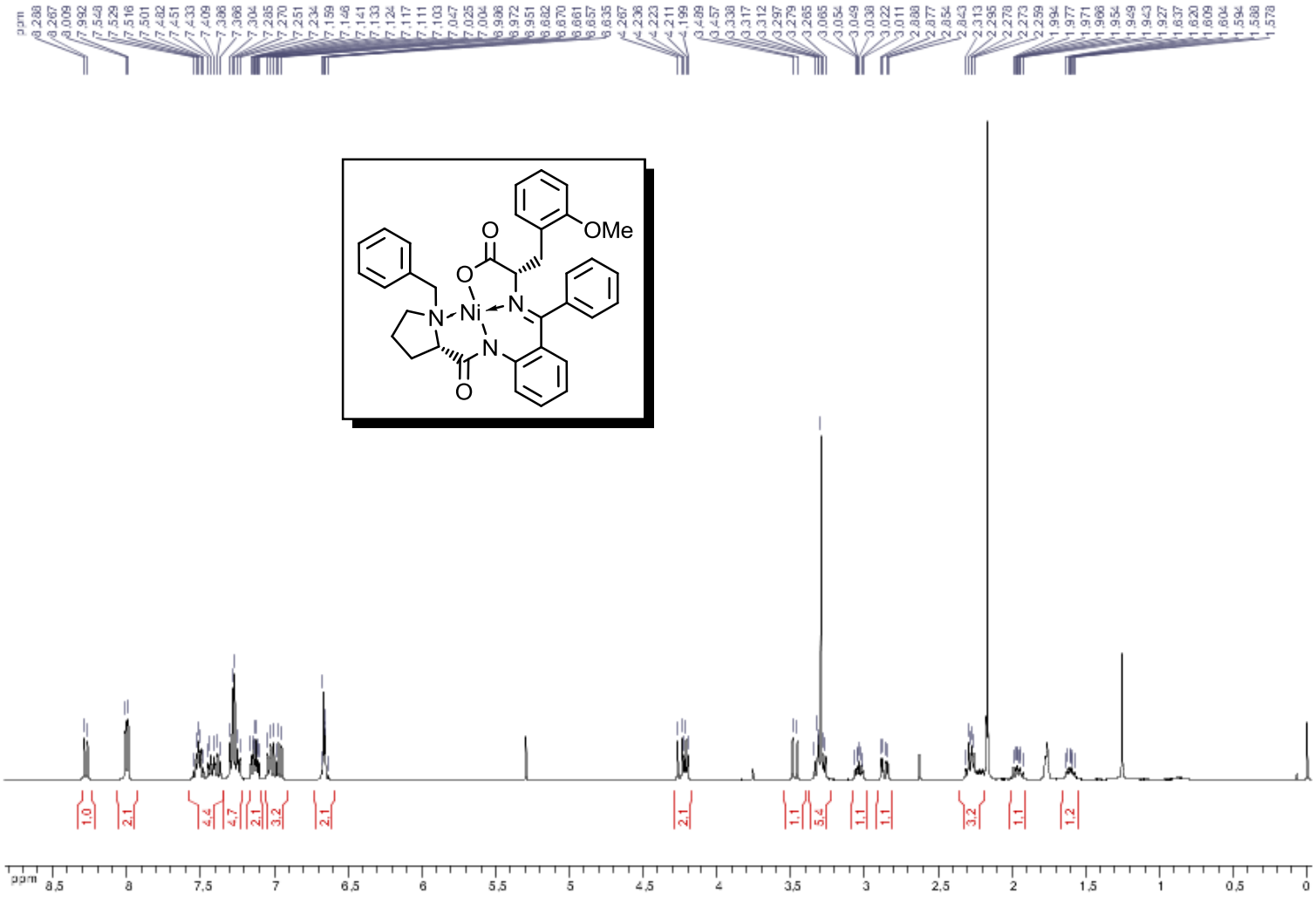
^{1}H NMR spectra (400 MHz, $CDCl_3$) of (*S*)-Phenylalanine-Ni-(*S*)-BPB (6a)



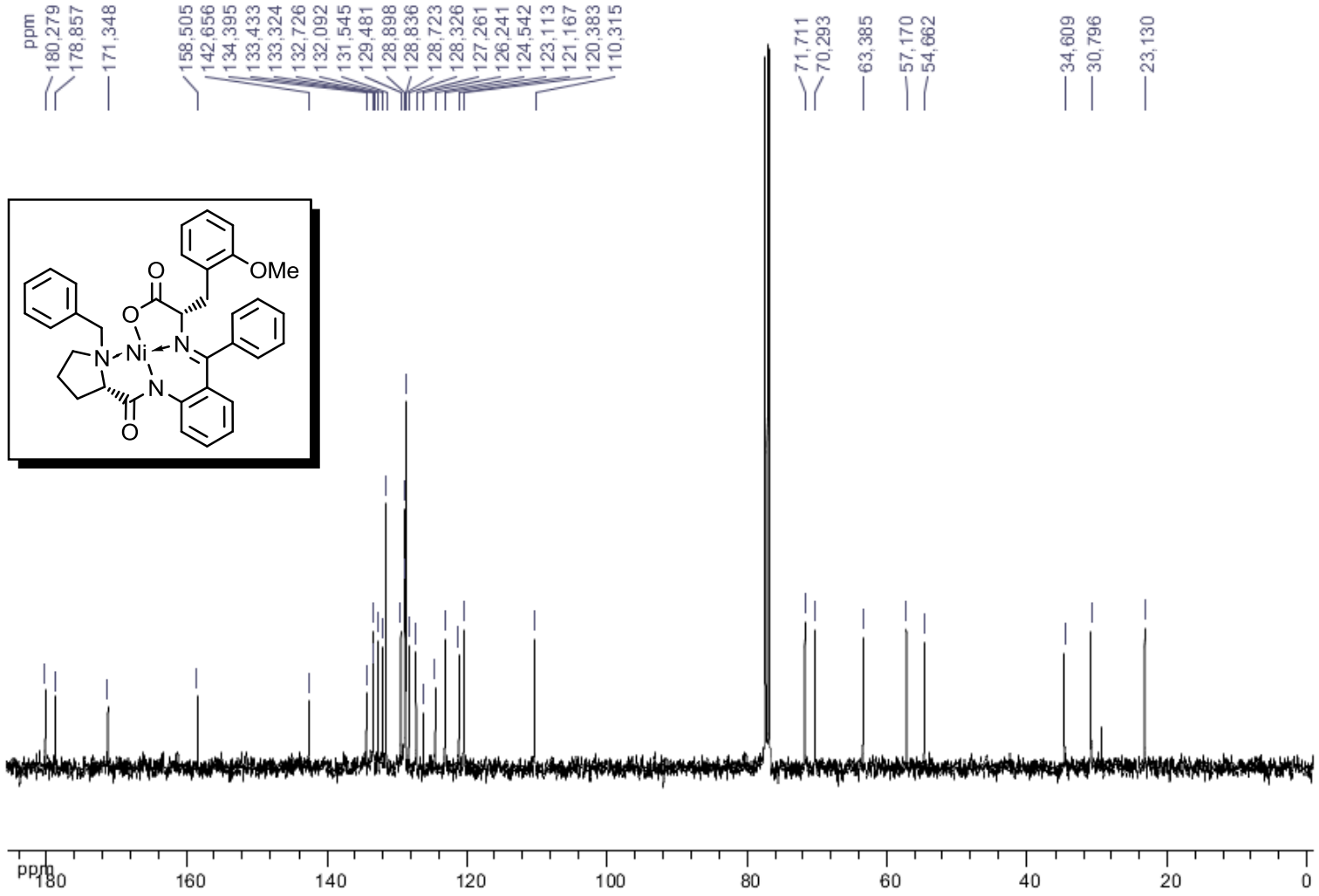
^{13}C NMR spectra (125 MHz, $CDCl_3$) of (*S*)-Phenylalanine-Ni-(*S*)-BPB (6a)



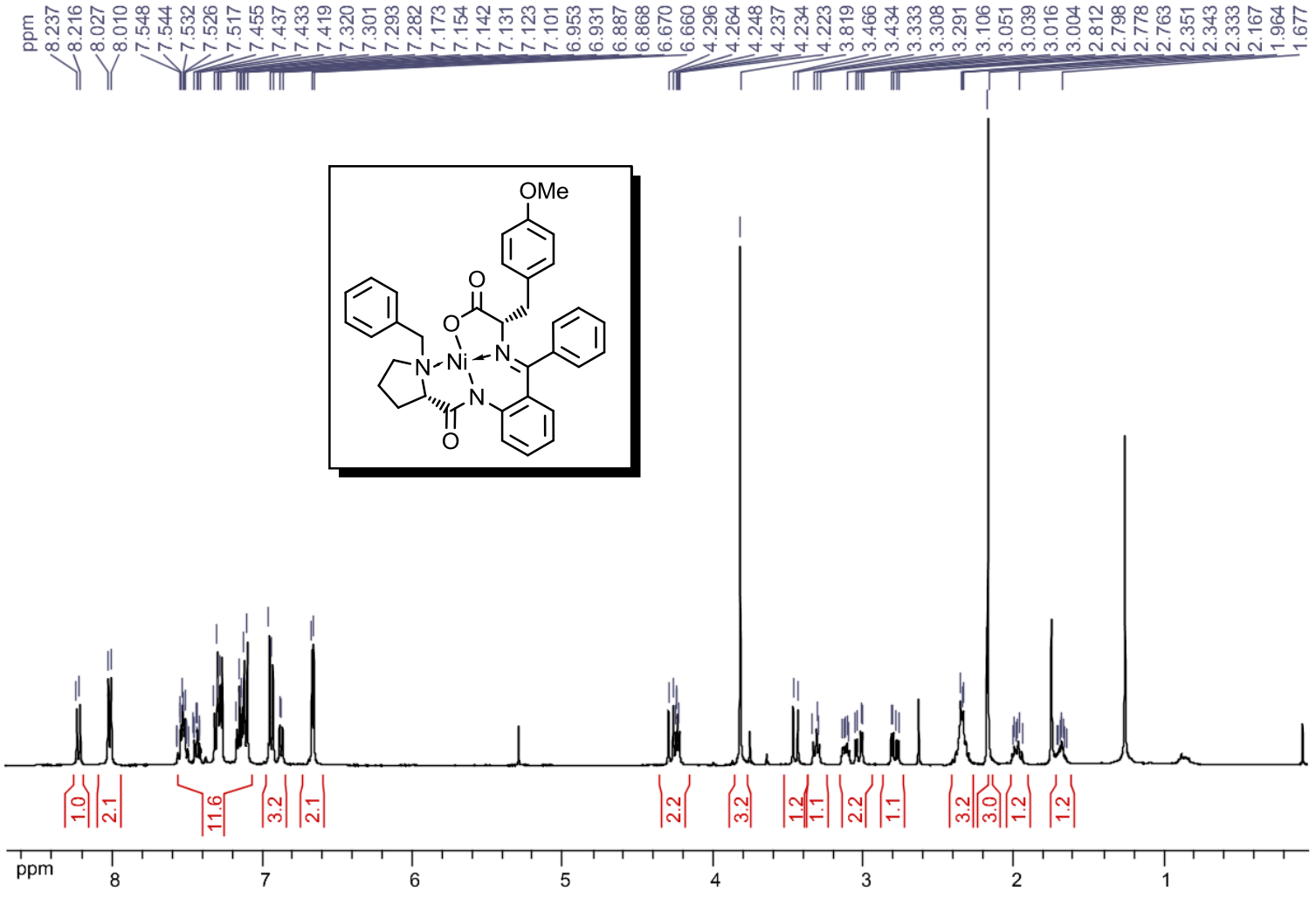
^{1}H NMR spectra (400 MHz, $CDCl_3$) of (*S*)-2-Methoxyphenylalanine-Ni-(*S*)-BPB (6b)



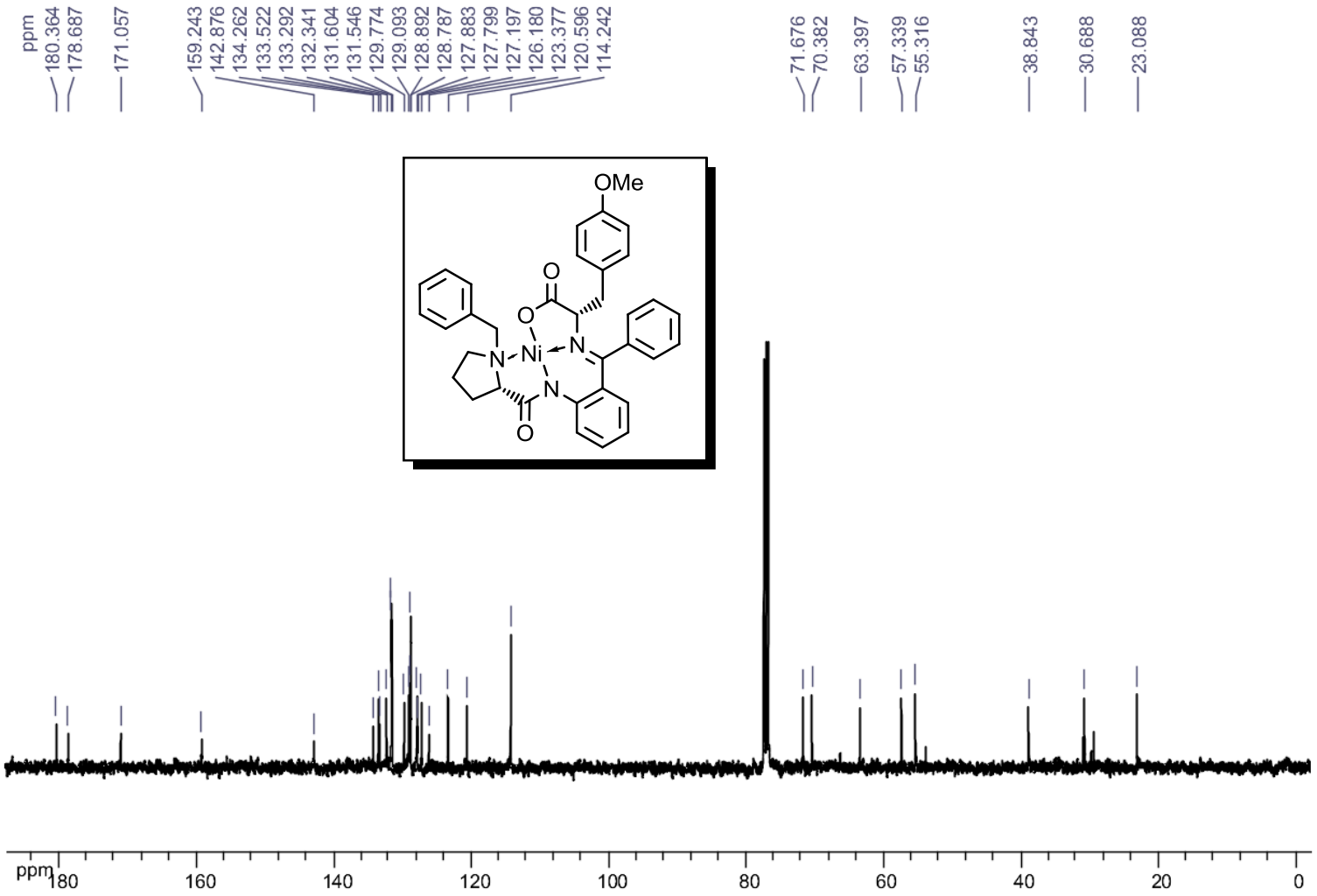
^{13}C NMR spectra (100 MHz, $CDCl_3$) of (*S*)-2-Methoxyphenylalanine-Ni-(*S*)-BPB (6b)



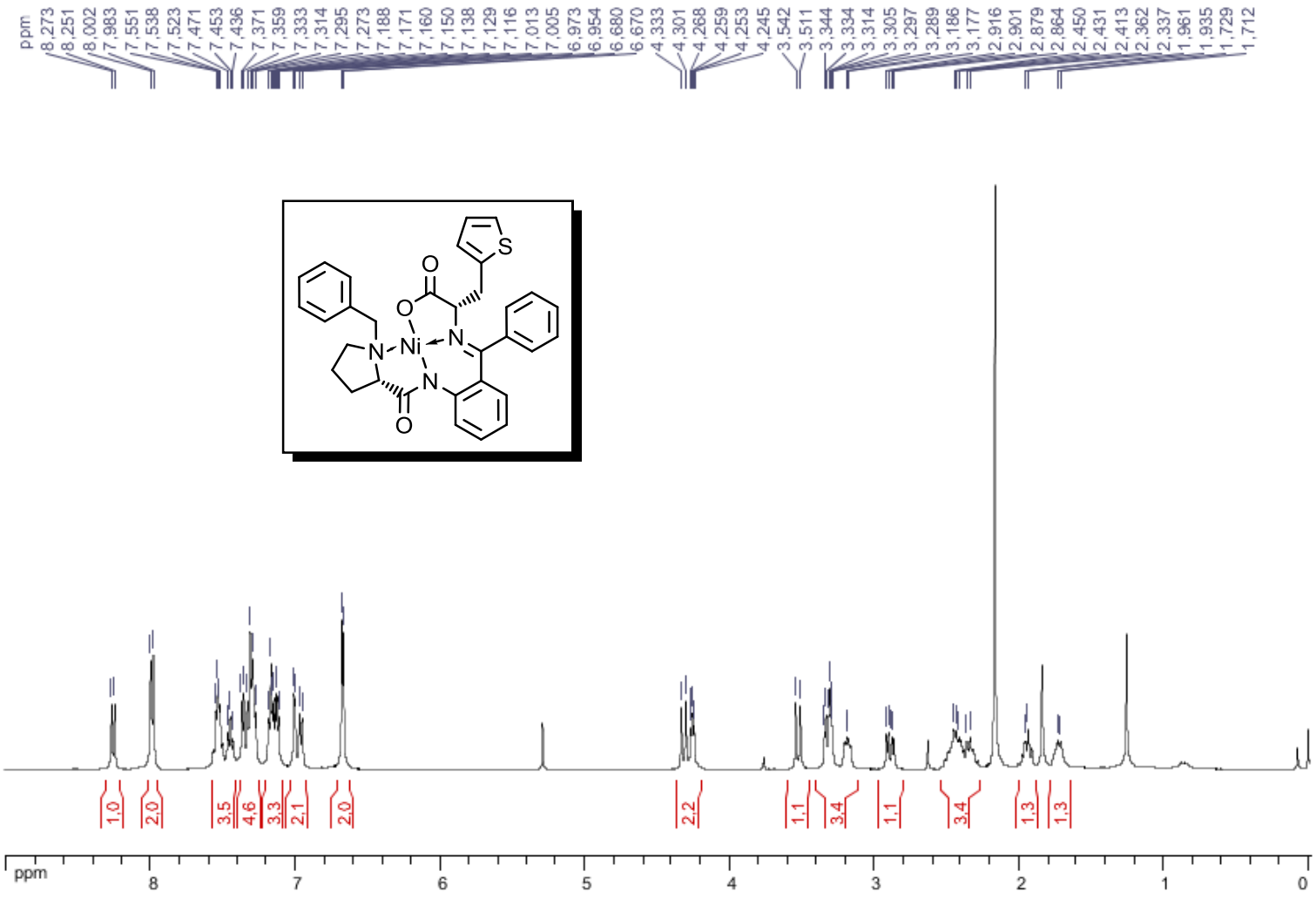
^{1}H NMR spectra (400 MHz, $CDCl_3$) of (*S*)-4-Methoxyphenylalanine-Ni-(*S*)-BPB (6c)



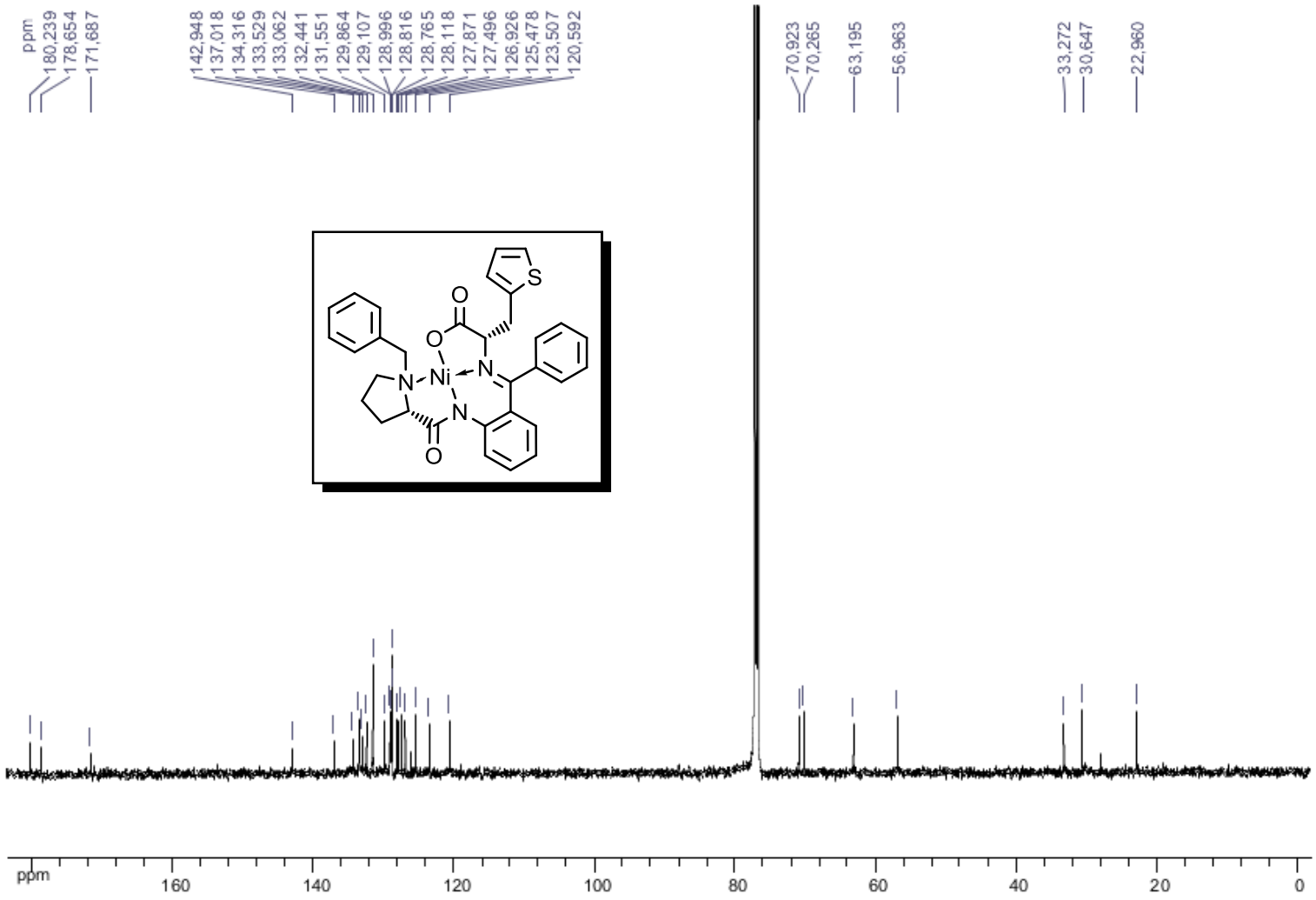
^{13}C NMR spectra (125 MHz, $CDCl_3$) of (*S*)-4-Methoxyphenylalanine-Ni-(*S*)-BPB (6c)



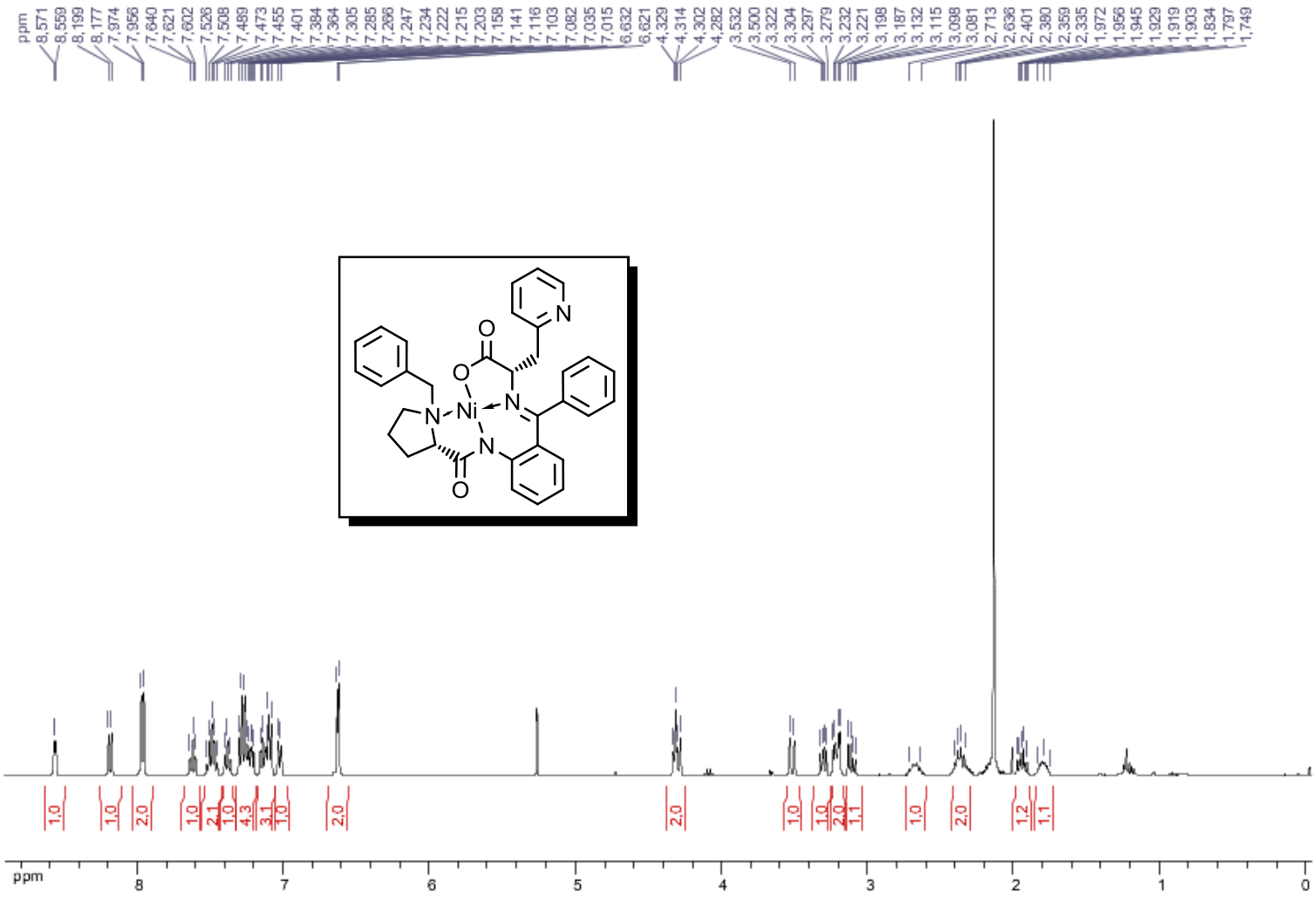
^{1}H NMR spectra (400 MHz, $CDCl_3$) of (*S*)-3-(Thien-2-yl)alanine-Ni-(*S*)-BPB (6d)



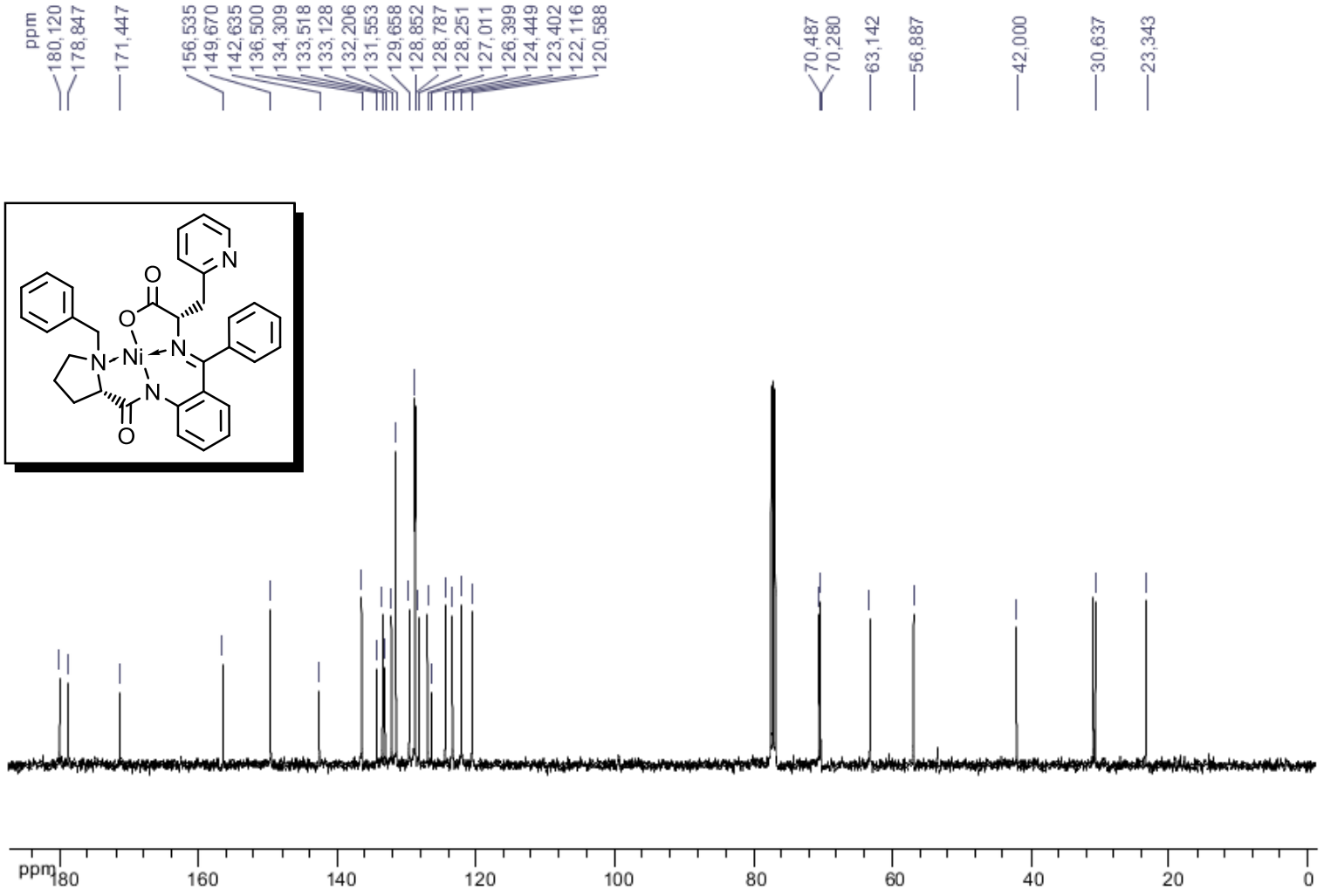
^{13}C NMR spectra (125 MHz, $CDCl_3$) of (*S*)-3-(Thien-2-yl)alanine-Ni-(*S*)-BPB (6d)



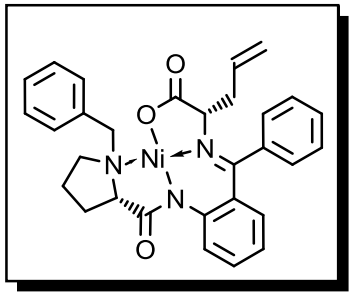
^{1}H NMR spectra (400 MHz, $CDCl_3$) of (*S*)-β-(2-Pyridyl)-α-alanine-Ni-(*S*)-BPB (6e)



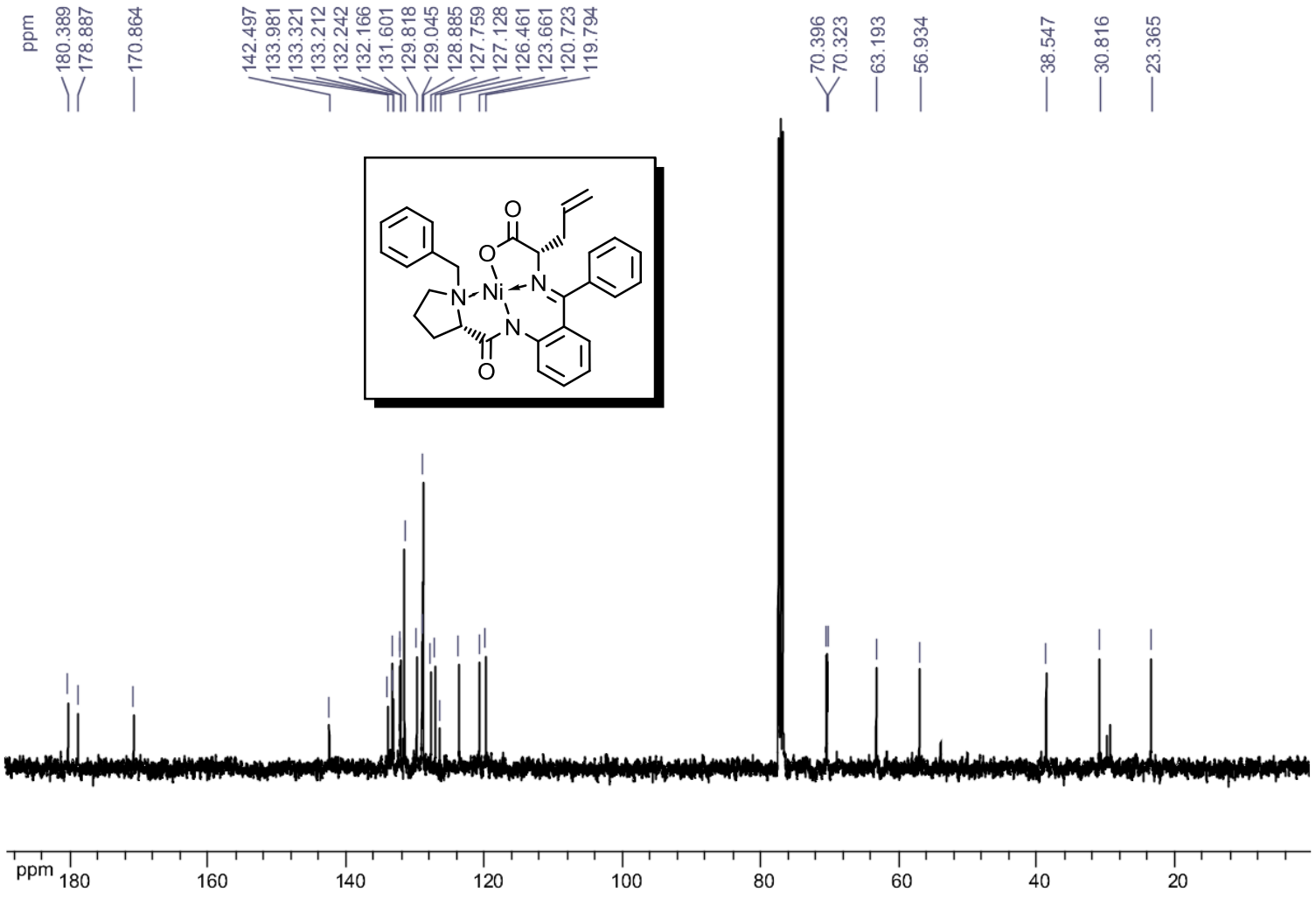
^{13}C NMR spectra (100 MHz, $CDCl_3$) of (*S*)-β-(2-Pyridyl)-α-alanine-Ni-(*S*)-BPB (6e)



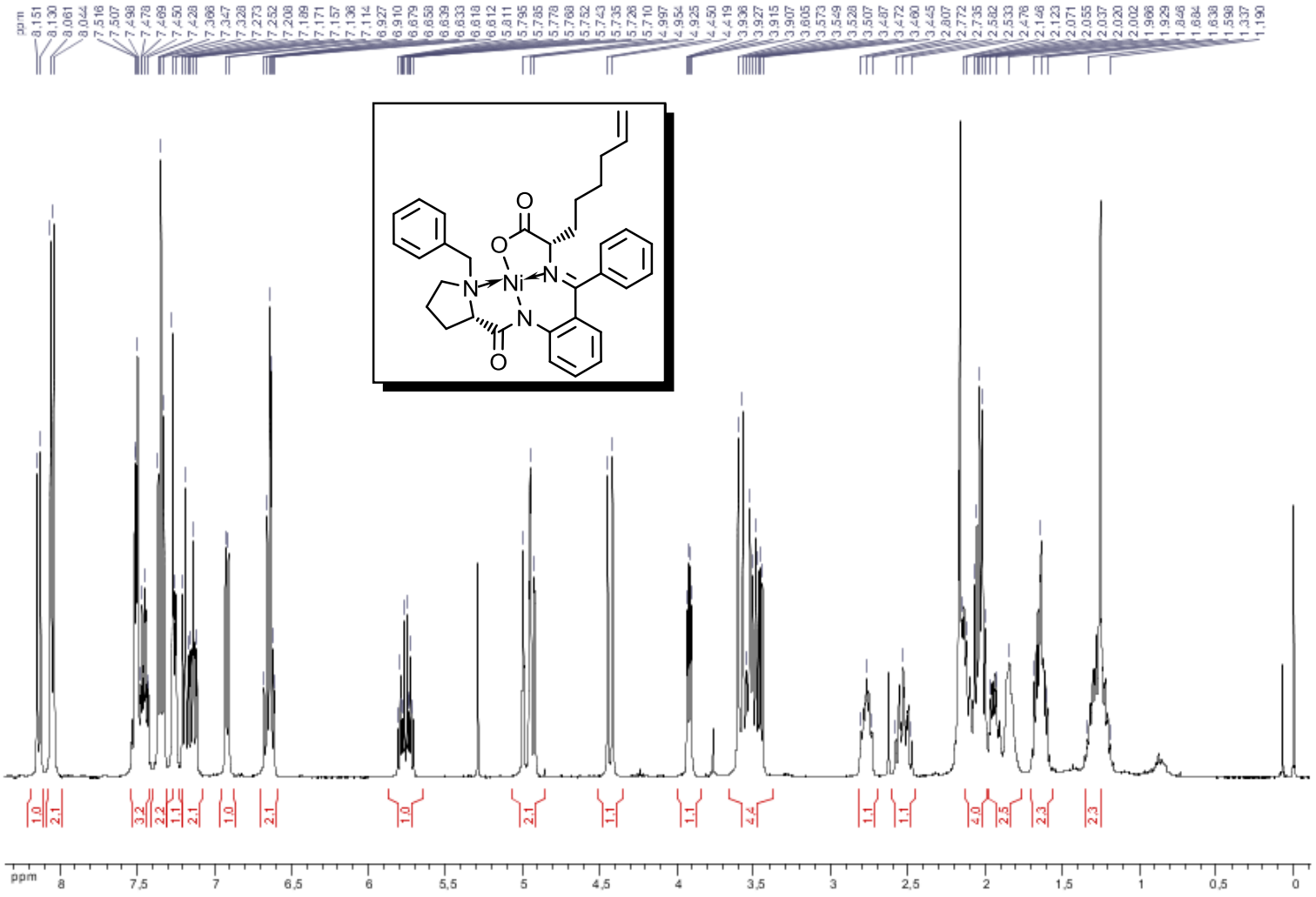
^{1}H NMR spectra (400 MHz, $CDCl_3$) of (*S*)-Allylglycine-Ni-(*S*)-BPB (6f) (dr: 90/10)



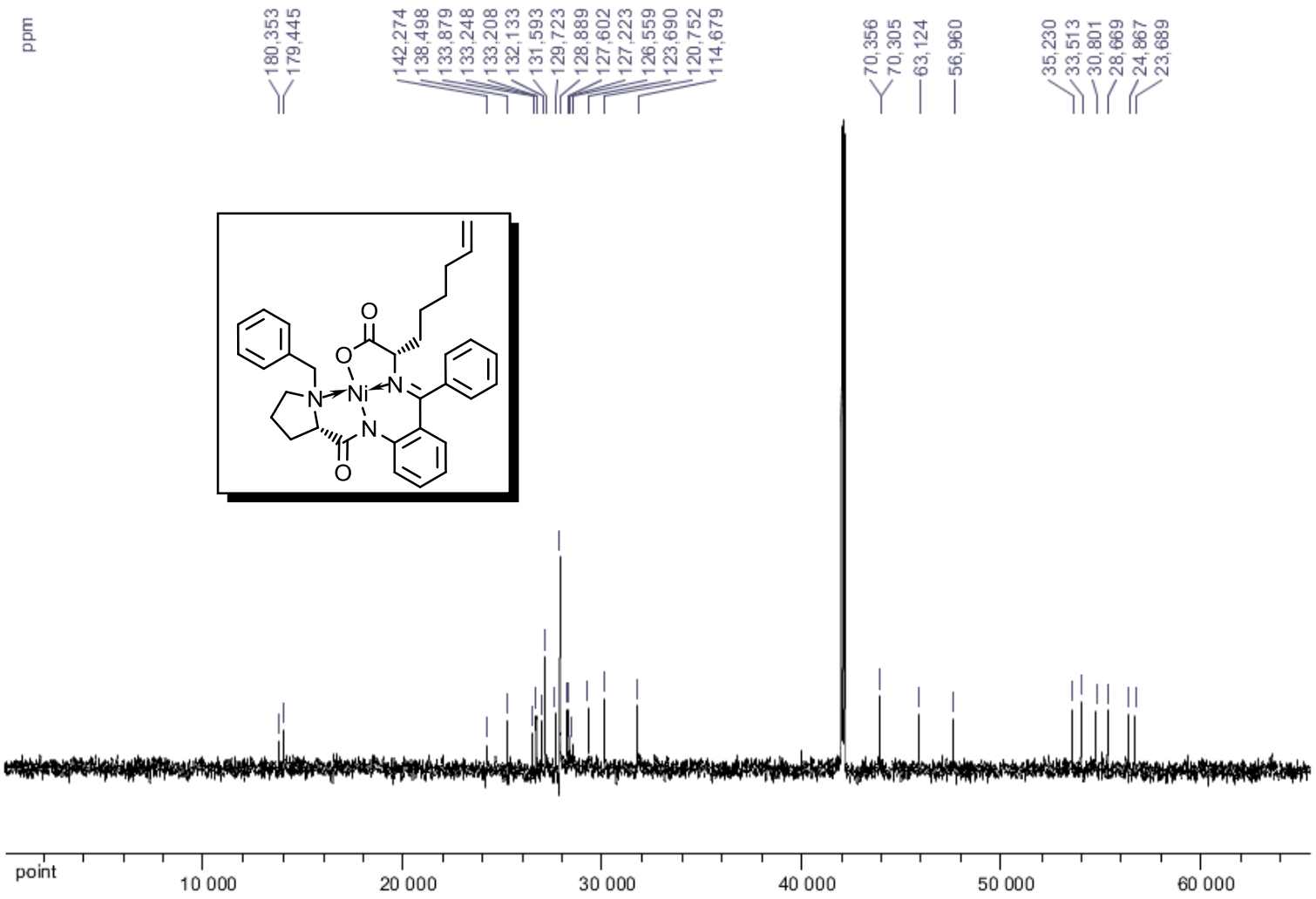
^{13}C NMR spectra (100 MHz, $CDCl_3$) of (*S*)-Allylglycine-Ni-(*S*)-BPB (6f) (dr: 90/10)



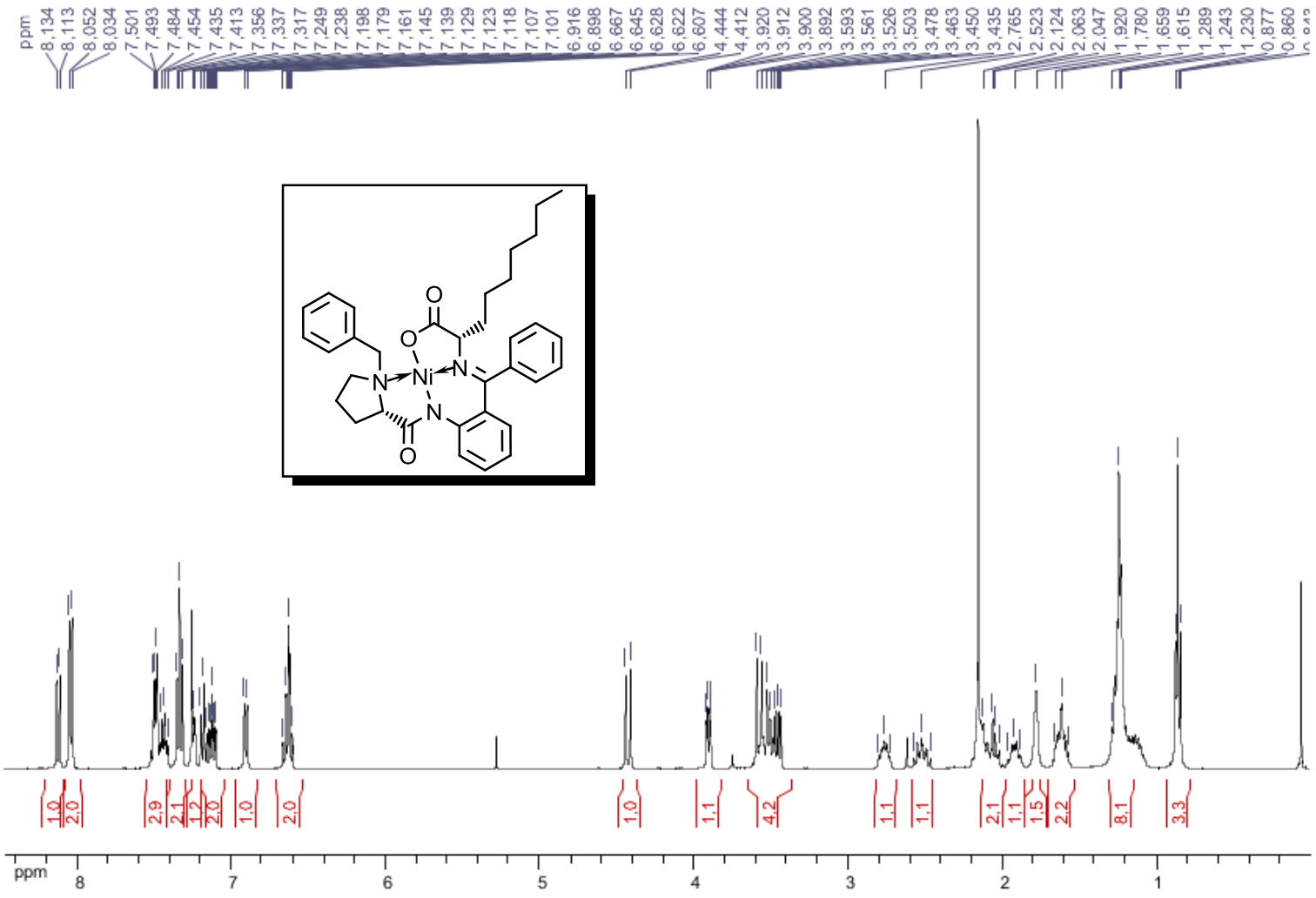
^{1}H NMR spectra (400 MHz, $CDCl_3$) of (*S*)-Hex-5-enyl-glycine-Ni-(*S*)-BPB (6g)



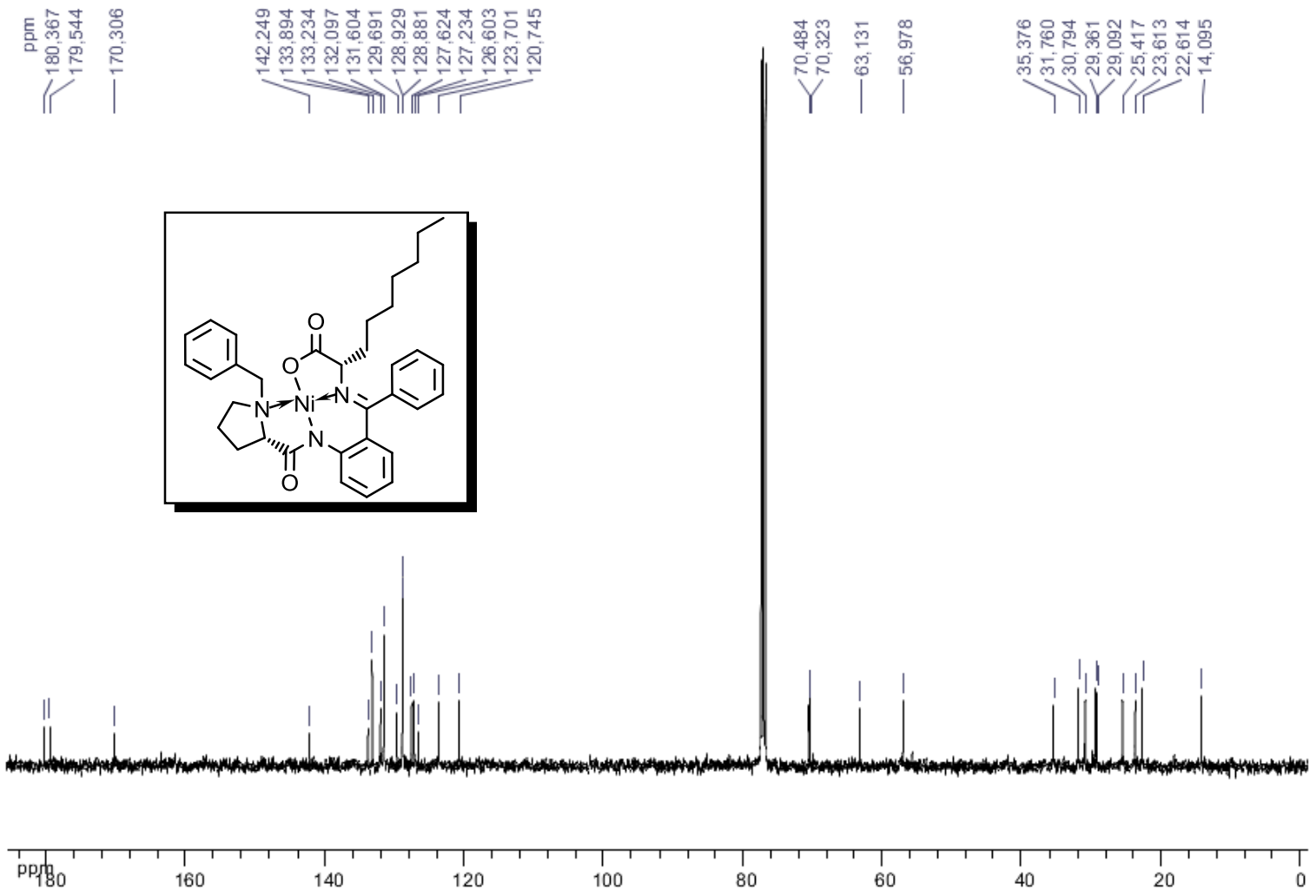
^{13}C NMR spectra (100 MHz, $CDCl_3$) of (*S*)-Hex-5-enyl-glycine-Ni-(*S*)-BPB (6g)



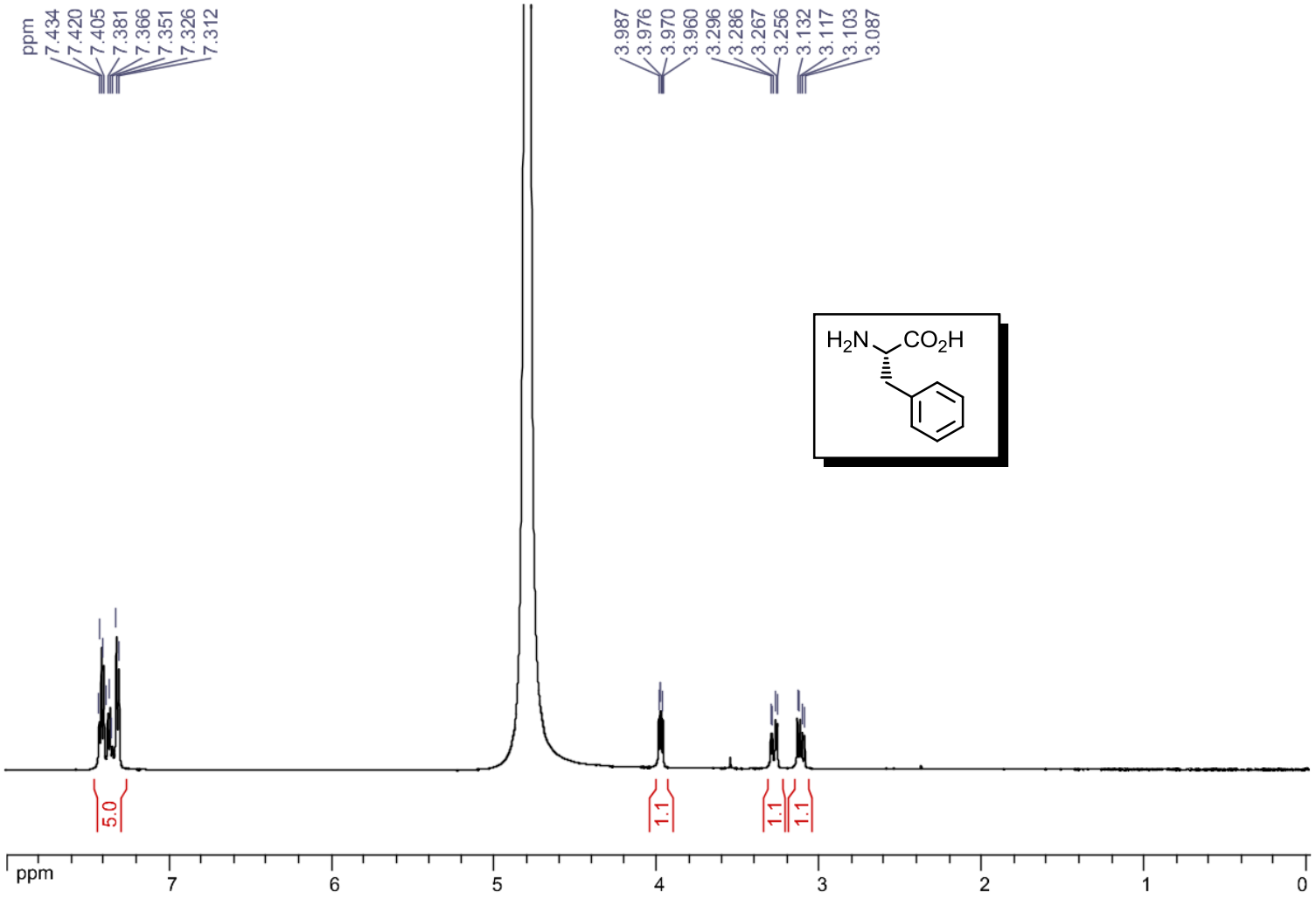
^{1}H NMR spectra (400 MHz, $CDCl_3$) of (*S*)-Heptylglycine-Ni-(*S*)-BPB (6h)



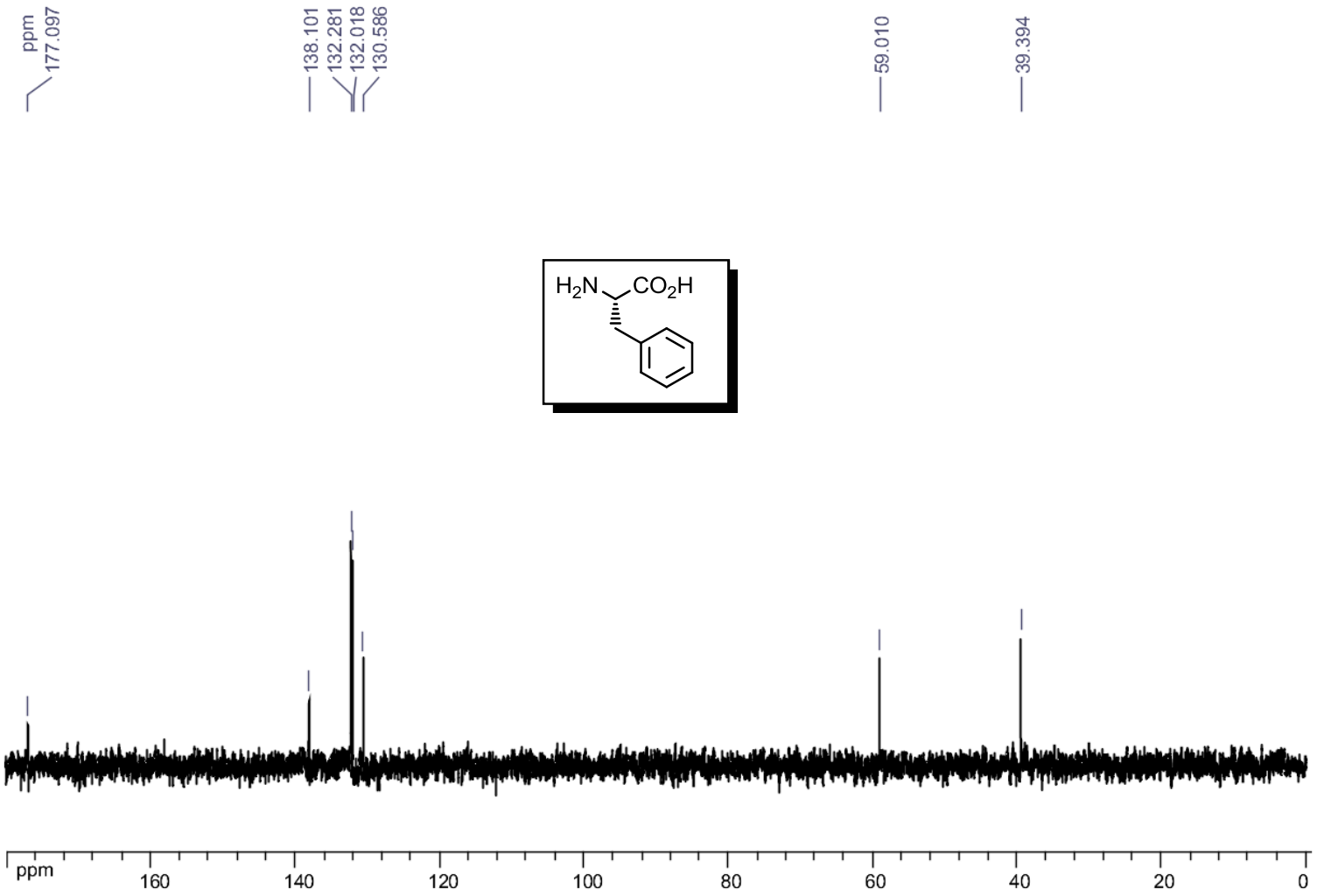
^{13}C NMR spectra (100 MHz, $CDCl_3$) of (*S*)-Heptylglycine-Ni-(*S*)-BPB (6h)



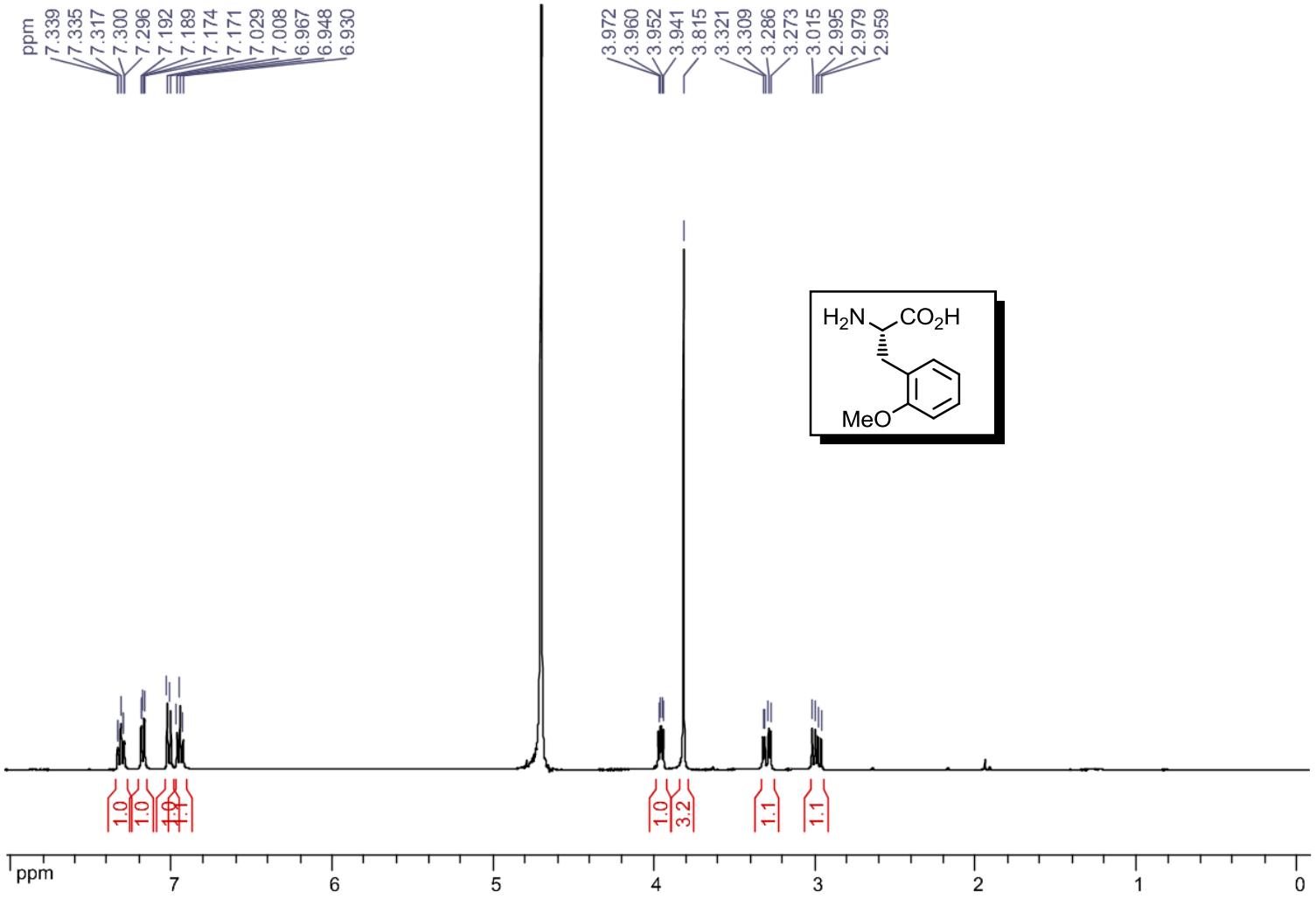
^{1}H NMR spectra (400 MHz, D_2O) of L-Phenylalanine (7a)



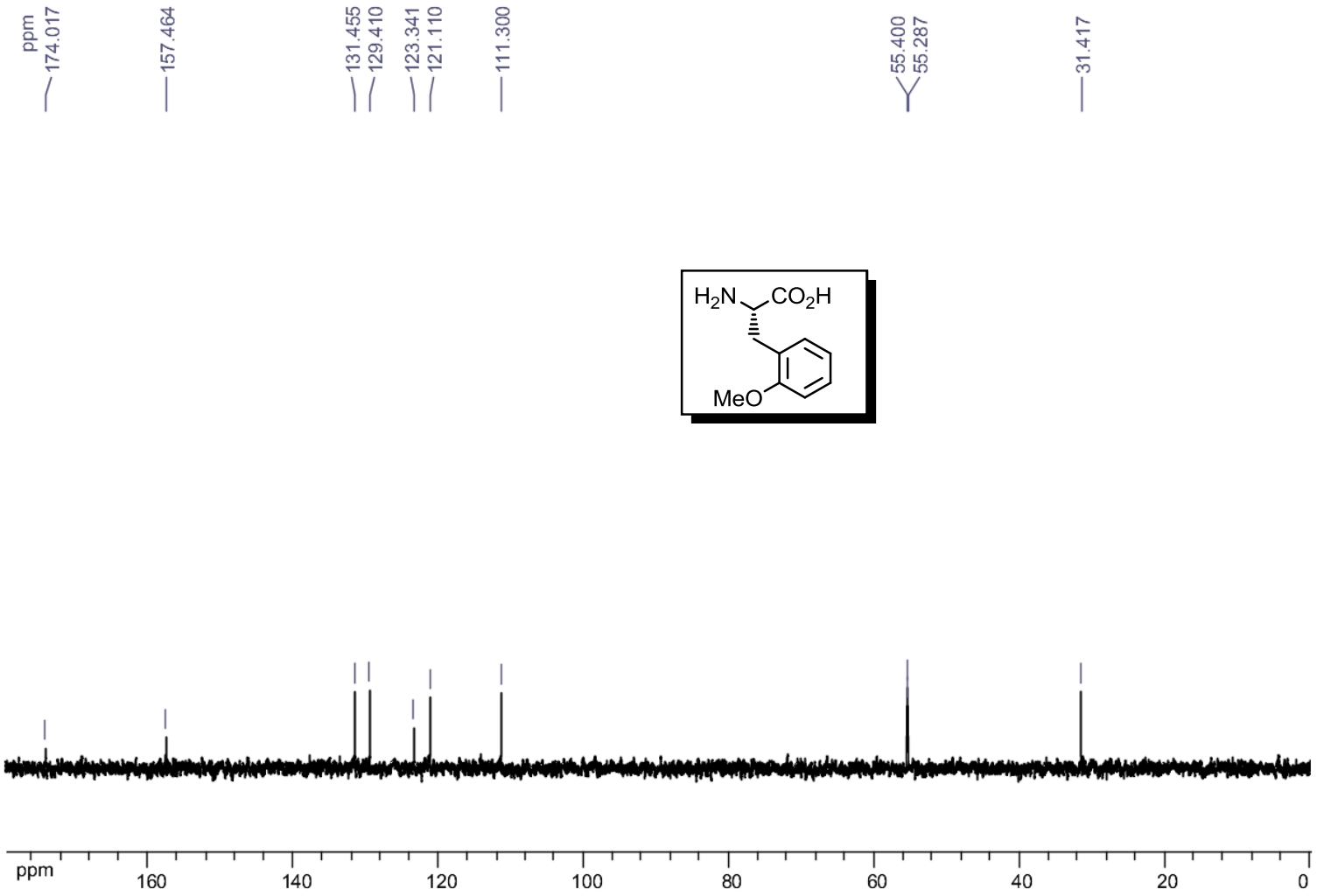
^{13}C NMR spectra (100 MHz, D_2O) of L-Phenylalanine (7a)



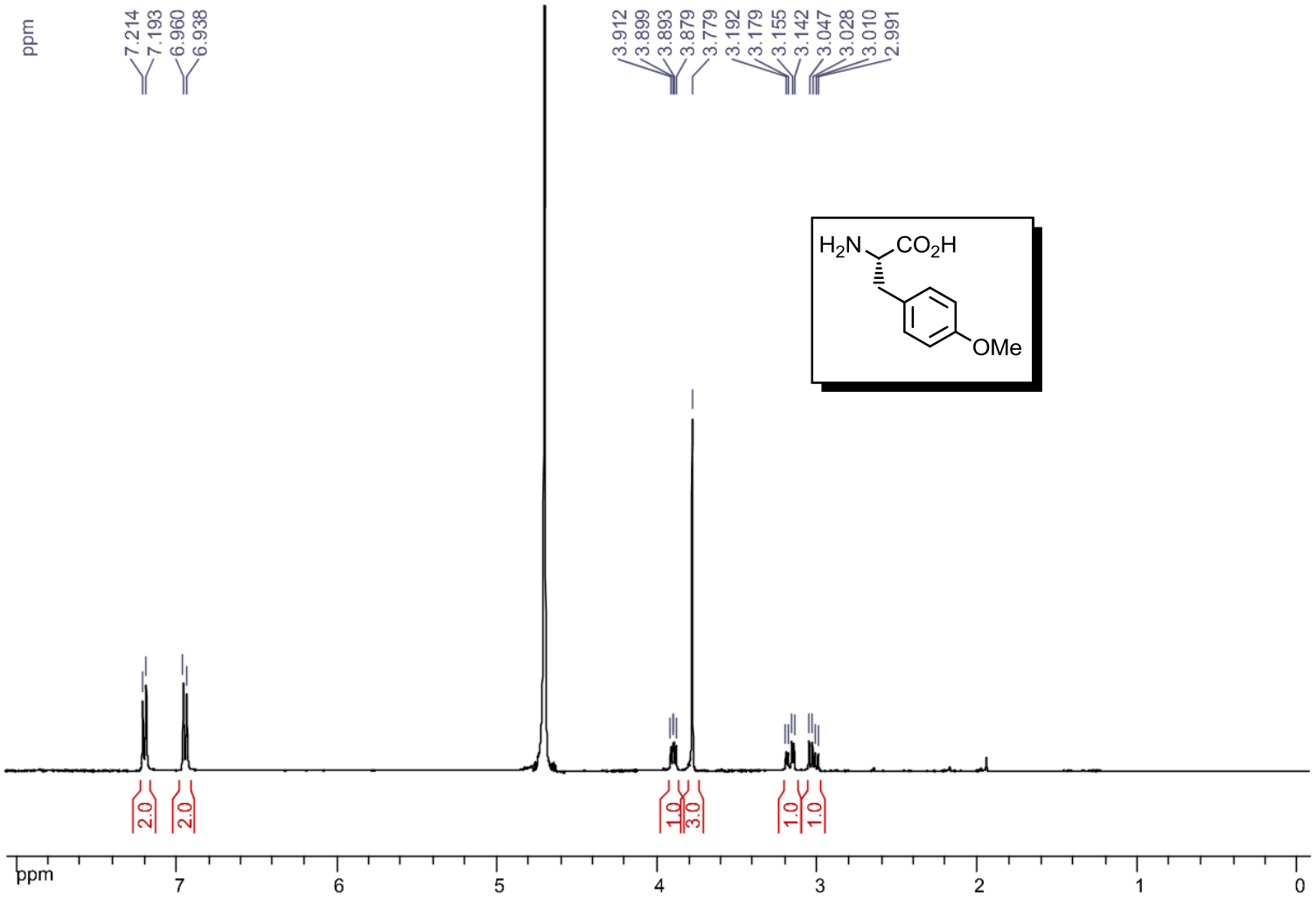
^{1}H NMR spectra (400 MHz, D_2O) of 2-Methoxy-L-phenylalanine (7b)



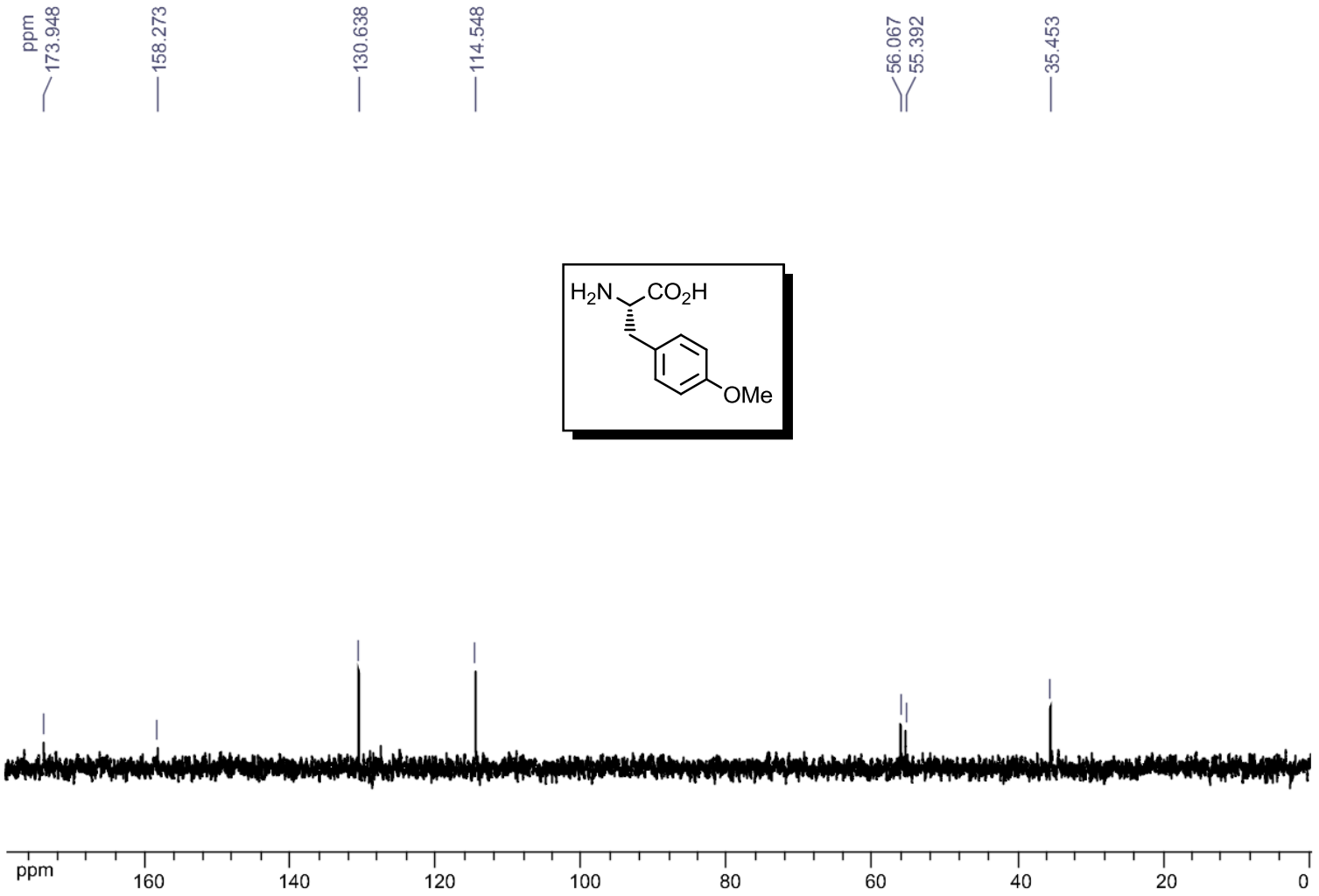
^{13}C NMR spectra (100 MHz, D_2O) of 2-Methoxy-L-phenylalanine (7b)



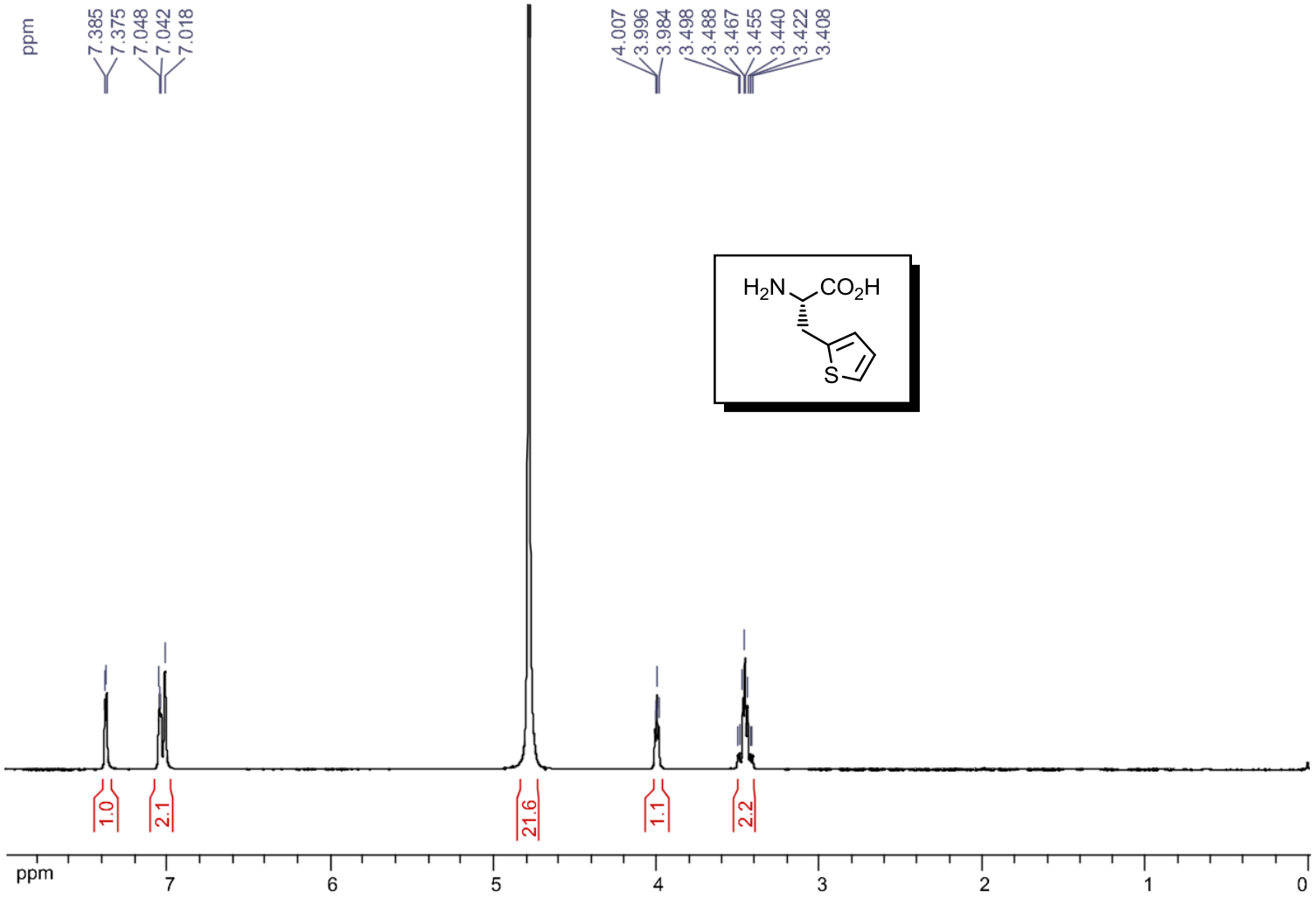
^{1}H NMR spectra (400 MHz, D_2O) of 4-Methoxy-L-phenylalanine (7c)



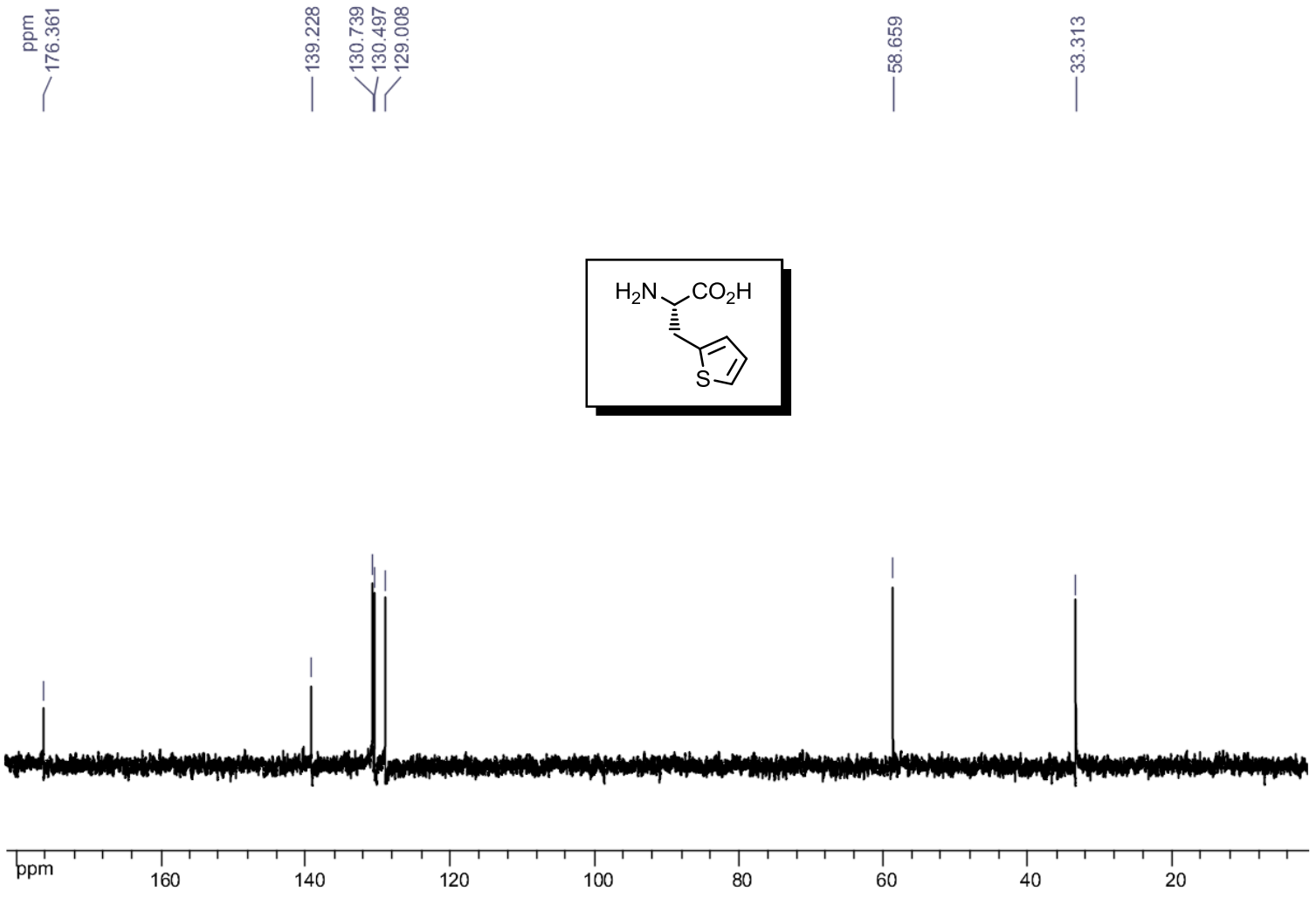
^{13}C NMR spectra (100 MHz, D_2O) of 4-Methoxy-L-phenylalanine (7c)



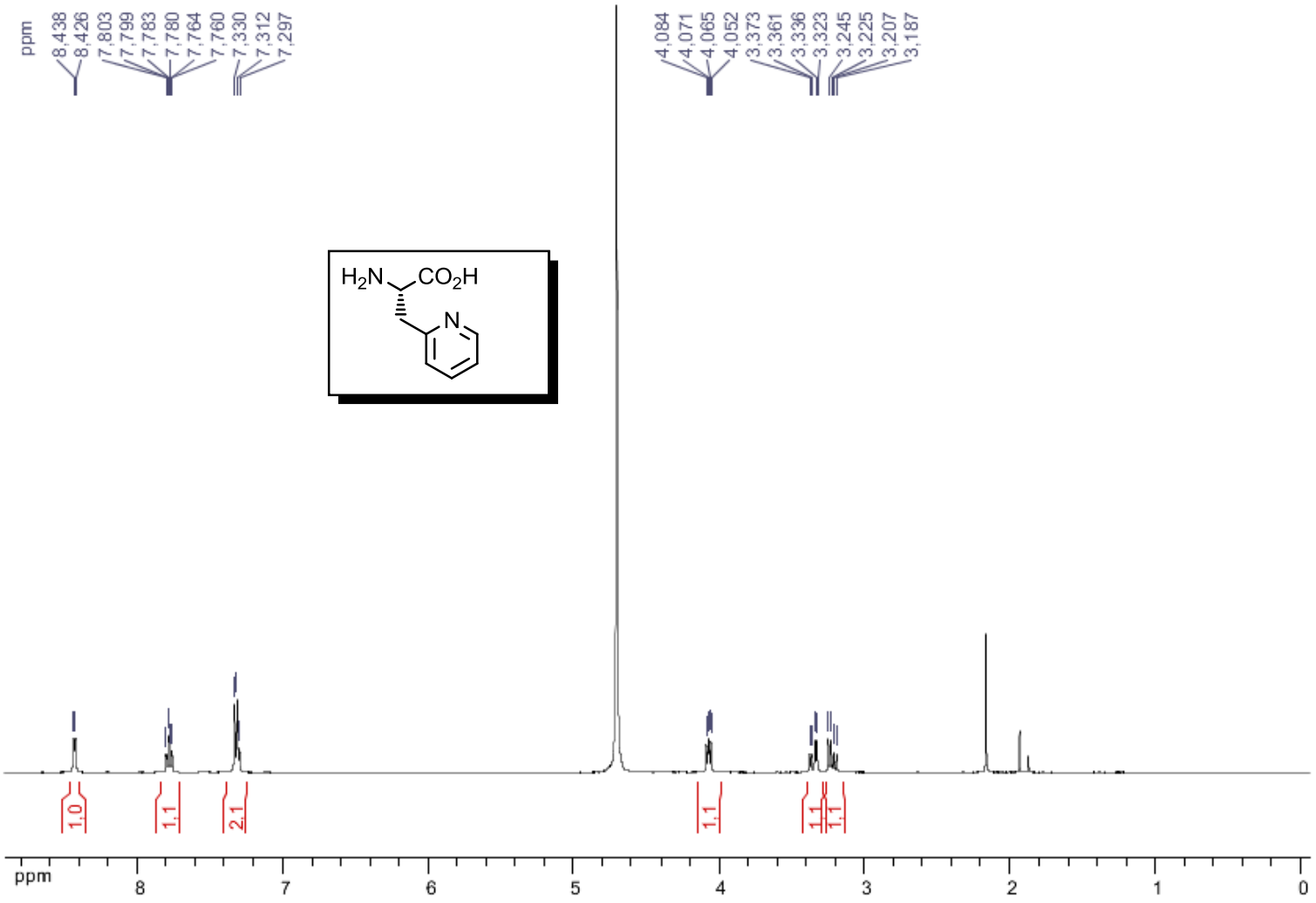
^{1}H NMR spectra (400 MHz, D_2O) of 3-Thiophen-2-yl-L-alanine (7d)



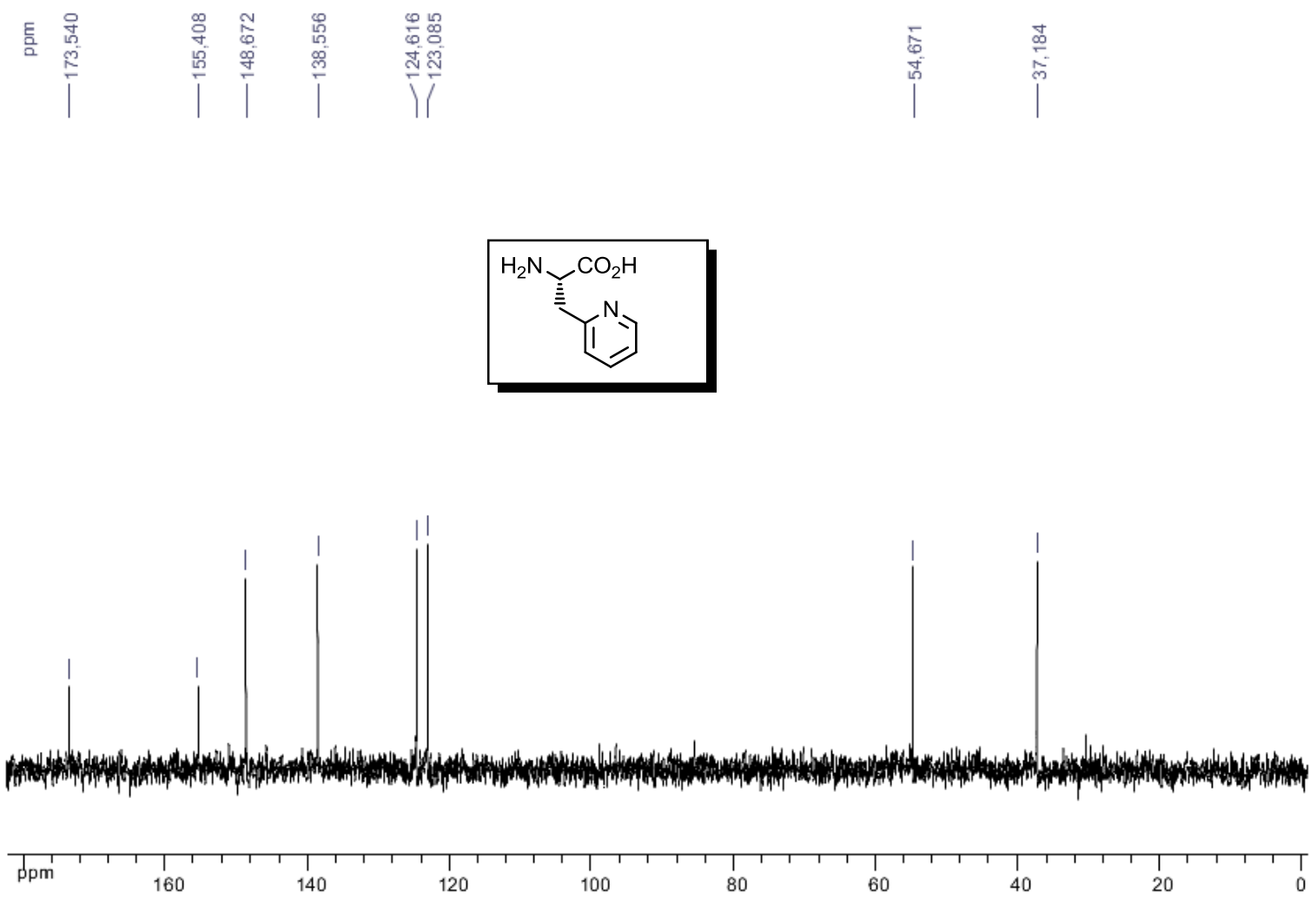
^{13}C NMR spectra (100 MHz, D_2O) of 3-Thiophen-2-yl-L-alanine (7d)



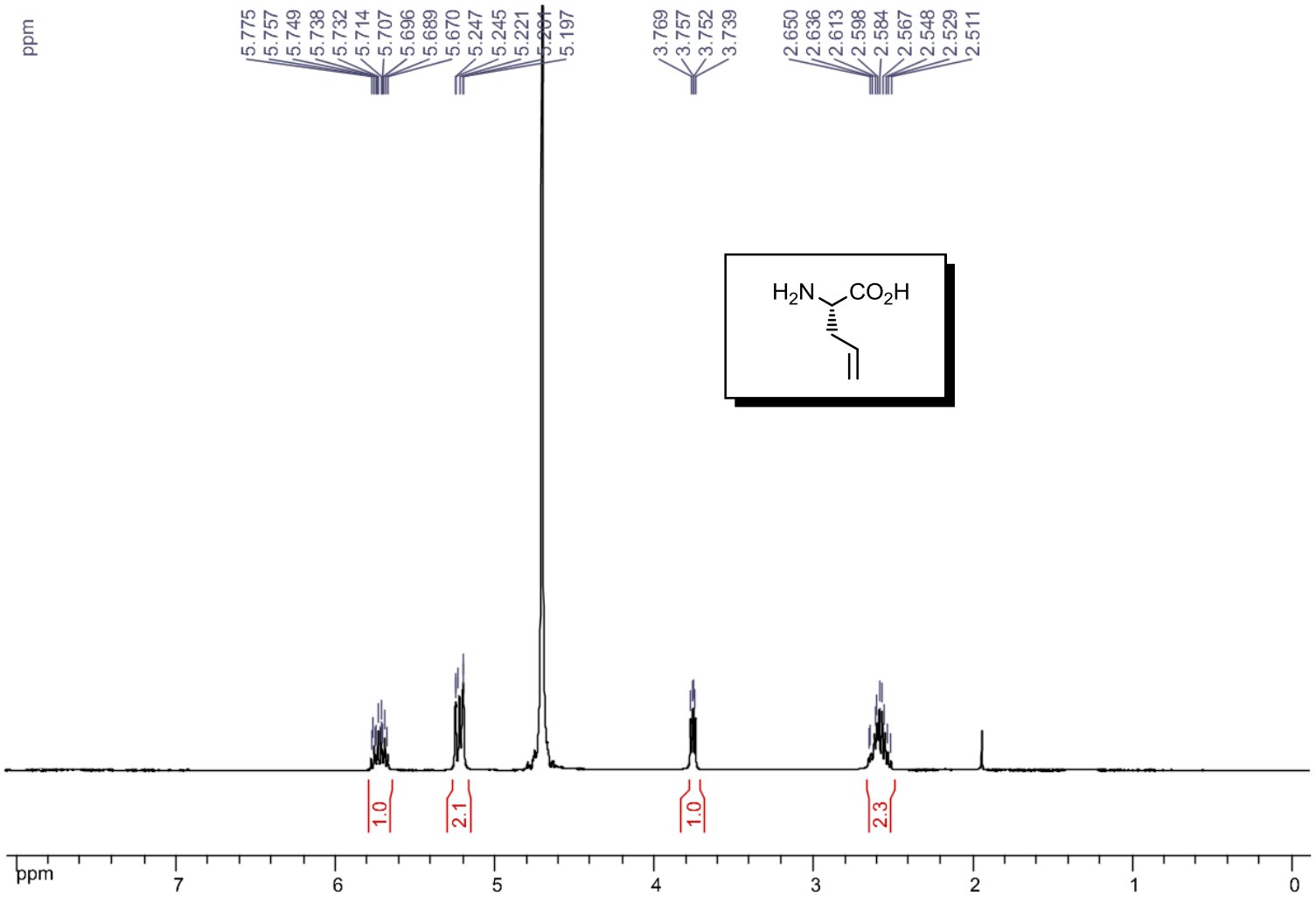
^{1}H NMR spectra (400 MHz, D_2O) of 3-Pyridin-2-yl-L-alanine (7e)



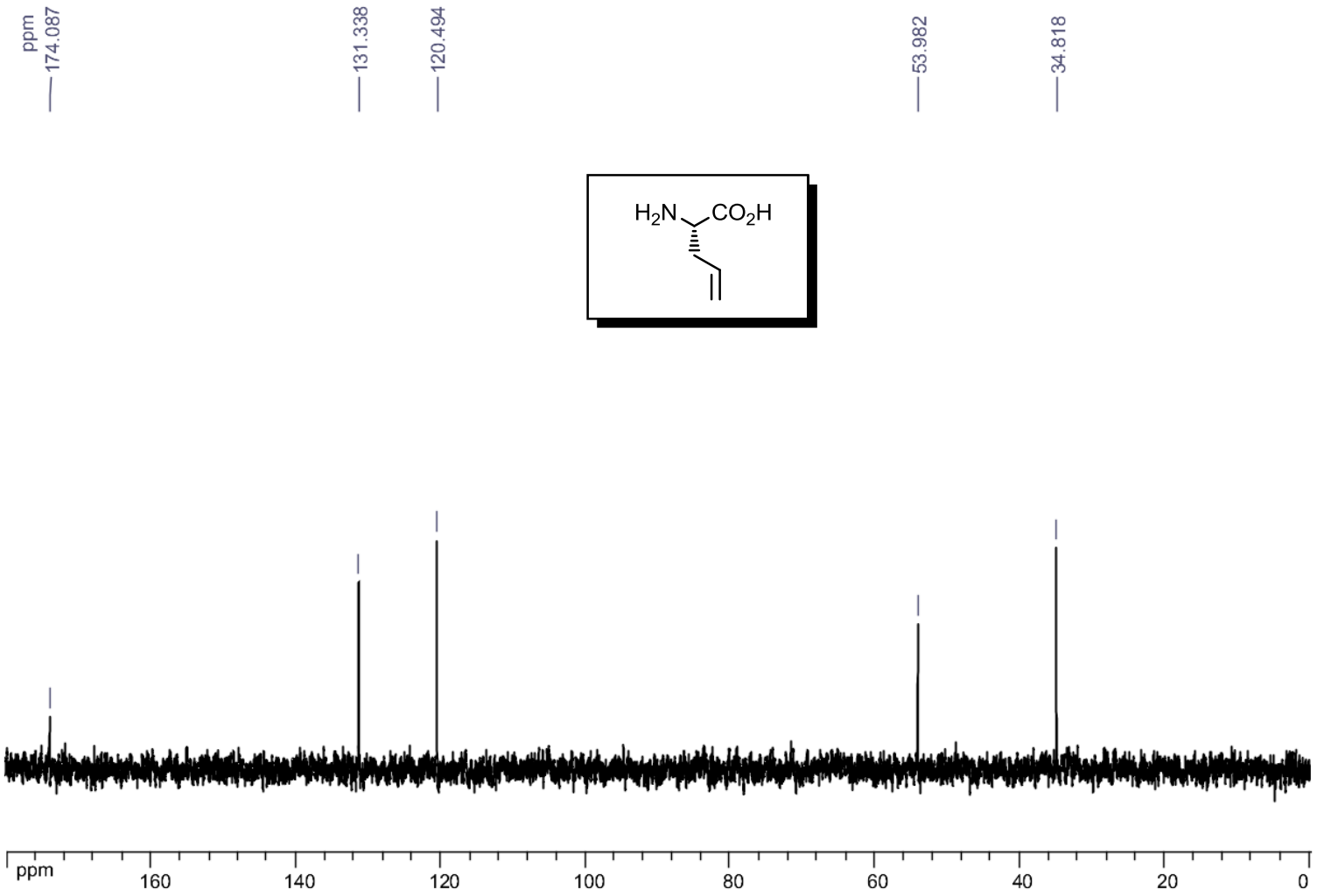
^{13}C NMR spectra (100 MHz, D_2O) of 3-Pyridin-2-yl-L-alanine (7e)



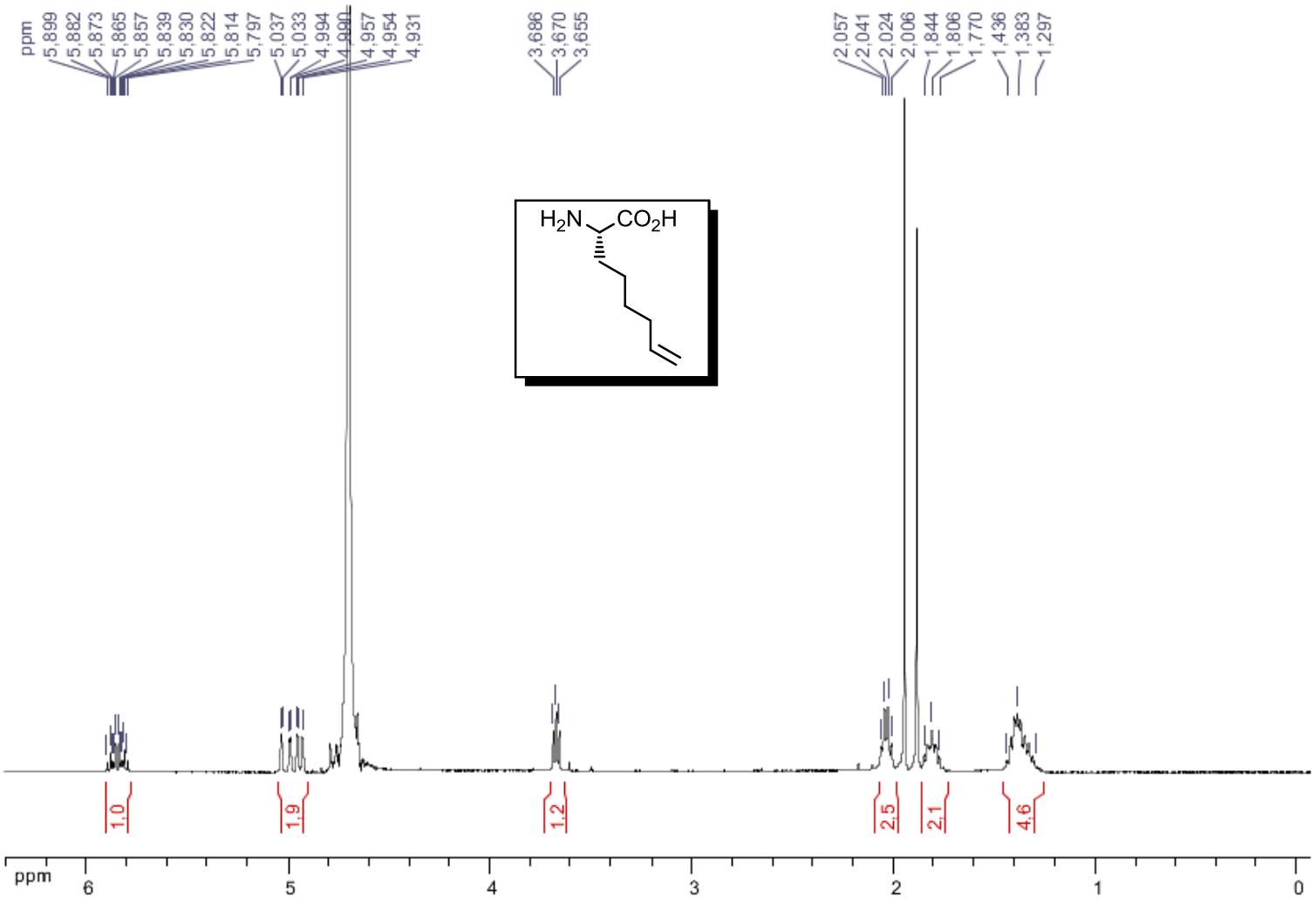
^{1}H NMR spectra (400 MHz, D_2O) of (*S*)-Allylglycine (7f)



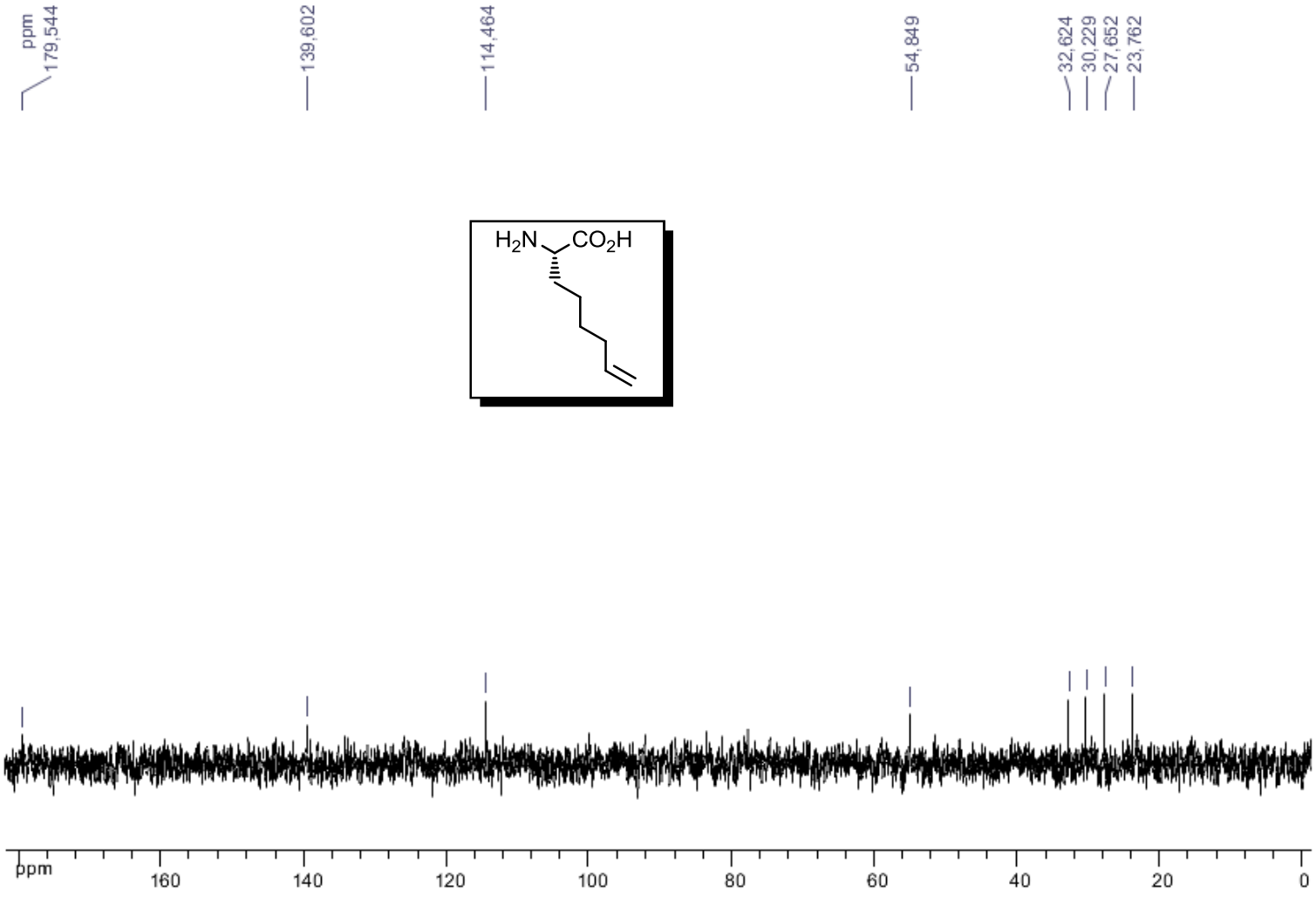
^{13}C NMR spectra (100 MHz, D_2O) of (*S*)-Allylglycine (7f)



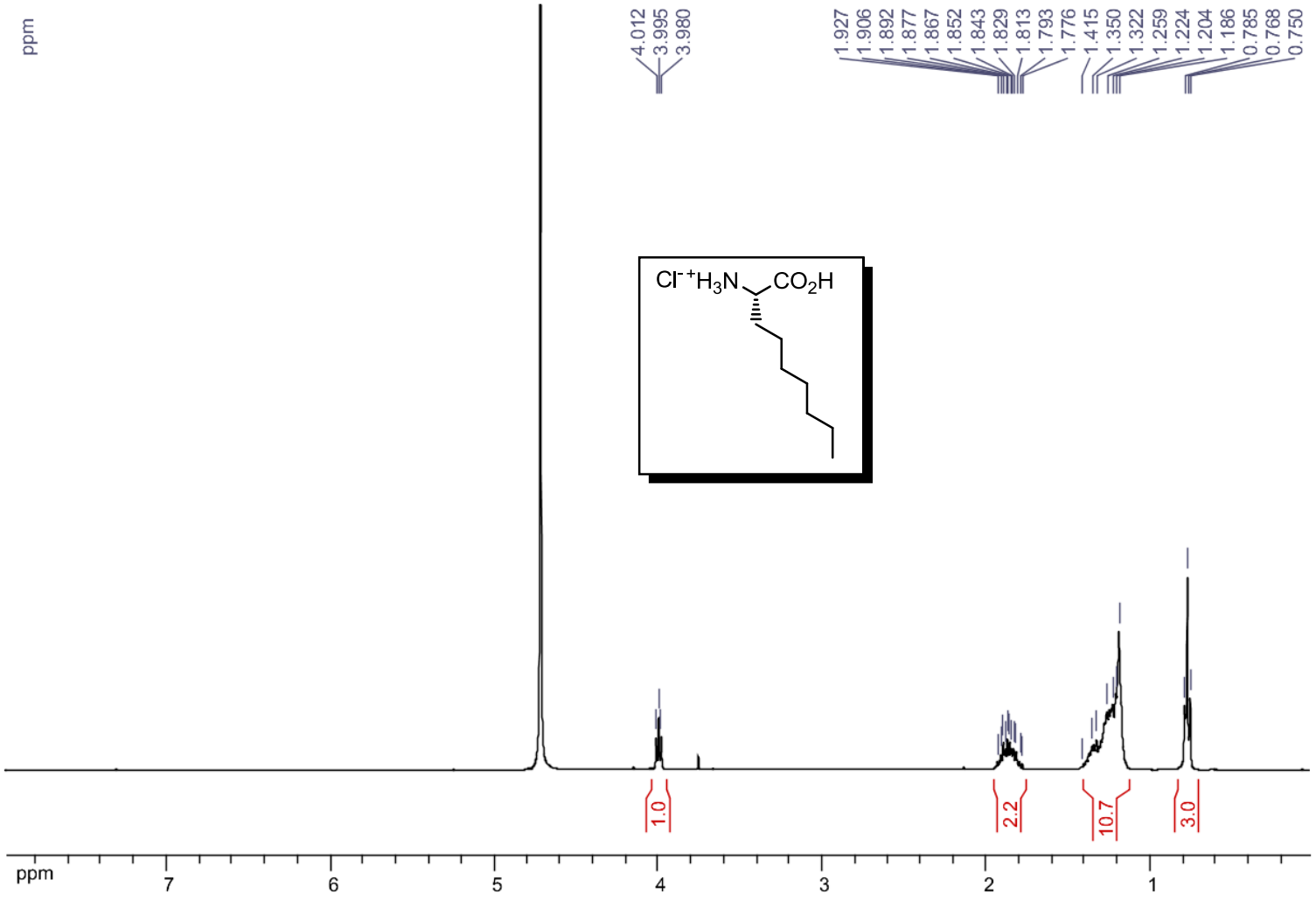
^{1}H NMR spectra (400 MHz, D_2O) of (*S*)-2-Amino-7-octenoic acid (7g)



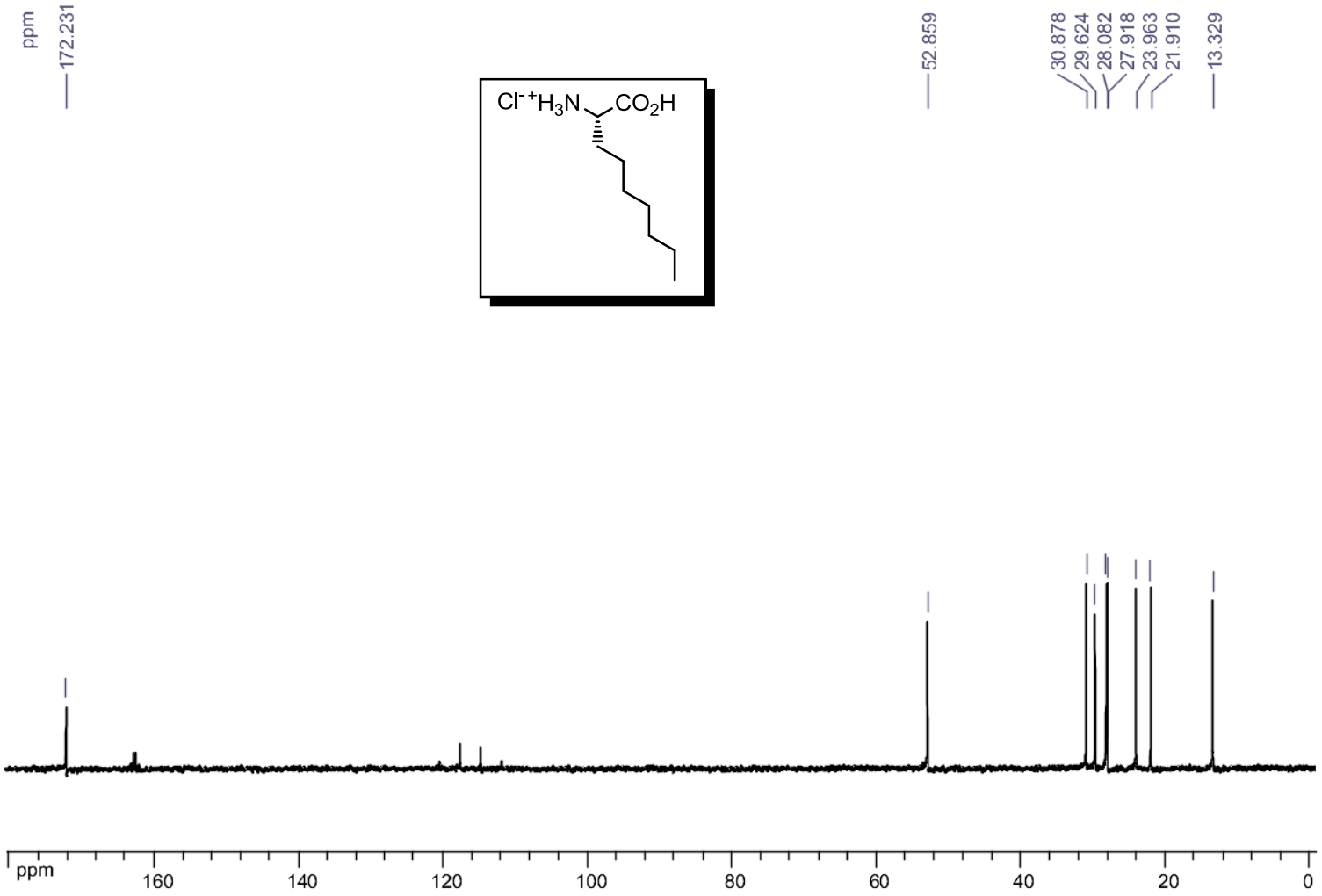
^{13}C NMR spectra (100 MHz, D_2O) of (*S*)-2-Amino-7-octenoic acid (7g)



^{1}H NMR spectra (400 MHz, D_2O) of (*S*)-2-Amino-nonanoic acid hydrochloride (7h)

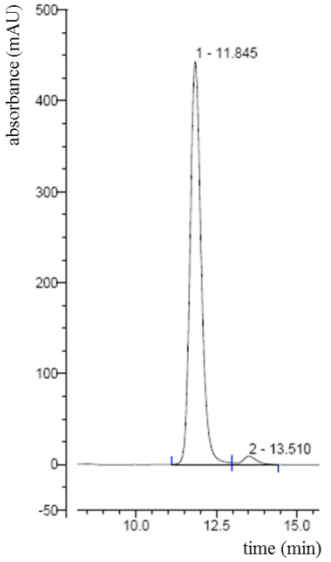


^{13}C NMR spectra (100 MHz, D_2O) of (*S*)-2-Amino-nonanoic acid hydrochloride (7h)

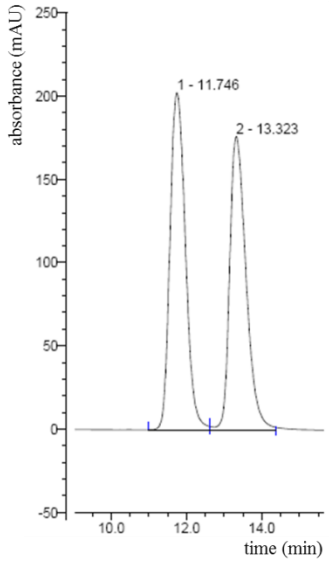


Analytical chiral reversed-phase HPLC profiles of L-phenylalanine (7a) and D,L-phenylalanine

7a: $R_{t\ (major)}$ 11.8 min, $R_{t\ (minor)}$ 13.5 min, λ = 210 nm, 80% B, ee = 95%



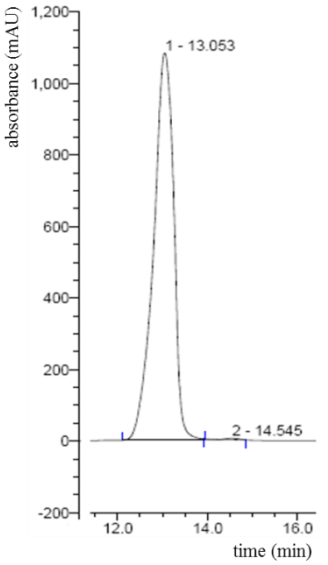
No.	Ret.Time min	Height mAU	Area mAU*min	Rel.Area %
1	11.85	443.732	176.964	97.54
2	13.51	9.089	4.471	2.46
Total:		452.821	181.435	100.00



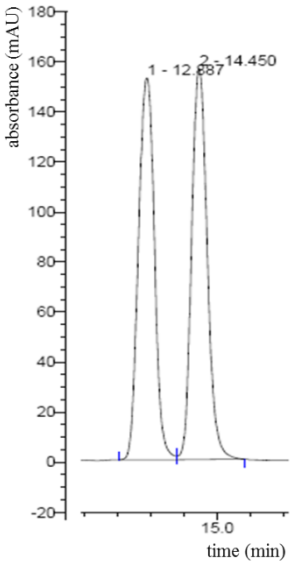
No.	Ret.Time min	Height mAU	Area mAU*min	Rel.Area %
1	11.75	202.393	96.103	52.02
2	13.32	176.130	88.626	47.98
Total:		378.523	184.729	100.00

Analytical chiral reversed-phase HPLC profiles of 2-methoxy-L-phenylalanine (7b) and 2-methoxy-D,L-phenylalanine

7b: $R_{t\ (major)}$ 13.0 min, $R_{t\ (minor)}$ 14.5 min, λ = 210 nm, 80% B, ee: > 99%



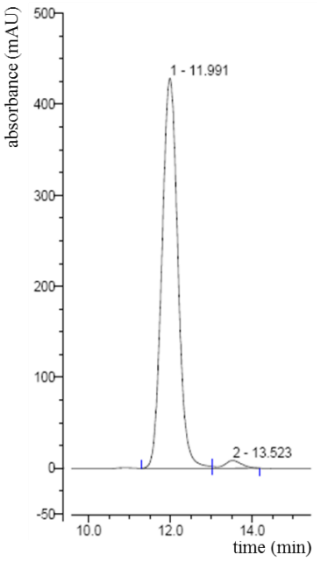
No.	Ret.Time min	Height mAU	Area mAU*min	Rel.Area %
1	13.05	1082.454	563.208	99.84
2	14.55	3.931	0.899	0.16
Total:		1086.384	564.107	100.00



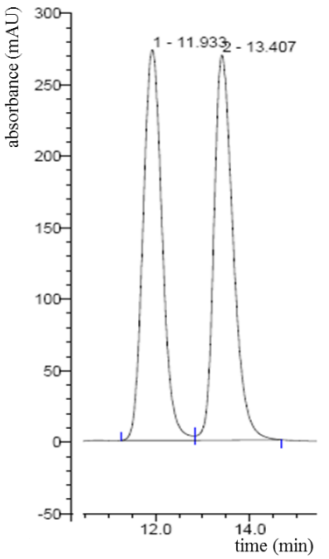
No.	Ret.Time min	Height mAU	Area mAU*min	Rel.Area %
1	12.89	152.555	84.542	50.01
2	14.45	156.259	84.493	49.99
Total:		308.814	169.035	100.00

Analytical chiral reversed-phase HPLC profiles of 4-methoxy-L-phenylalanine (7c) and 4-methoxy-D,L-phenylalanine

7c: $R_{t\ (major)}$ 12.0 min, $R_{t\ (minor)}$ 13.5 min, λ = 210 nm, 80% B, ee: 96%



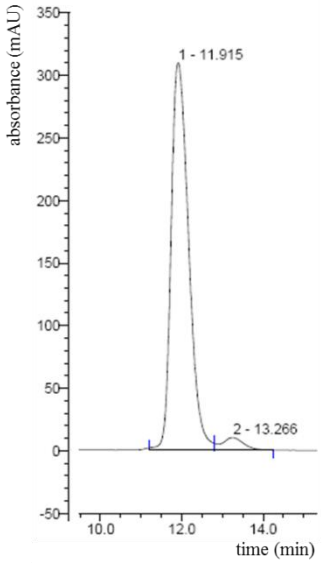
No.	Ret.Time min	Height mAU	Area mAU*min	Rel.Area %
1	11.99	428.907	193.312	97.89
2	13.52	8.447	4.163	2.11
Total:		437.354	197.475	100.00



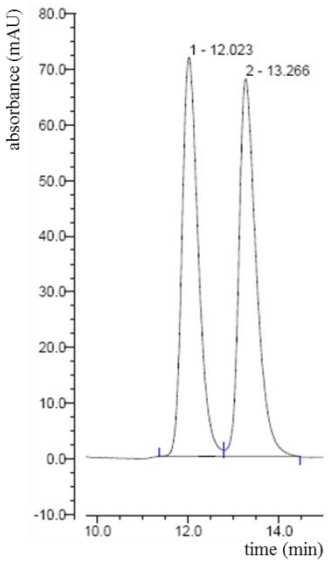
No.	Ret.Time min	Height mAU	Area mAU*min	Rel.Area %
1	11.93	273.465	127.658	50.17
2	13.41	269.487	126.781	49.83
Total:		542.951	254.438	100.00

Analytical chiral reversed-phase HPLC profiles of 3-thiophen-2-yl-L-alanine (7d) and 3-thiophen-2-yl-D,L-alanine

7d: $R_{t\ (major)}$ 11.9 min, $R_{t\ (minor)}$ 13.3 min, λ = 210 nm, 80% B, ee: 92%



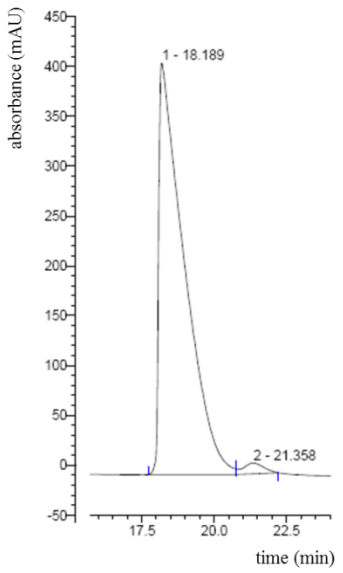
No.	Ret.Time min	Height mAU	Area mAU*min	Rel.Area %
1	11.91	309.503	154.016	96.12
2	13.27	9.985	6.210	3.88
Total:		319.488	160.226	100.00

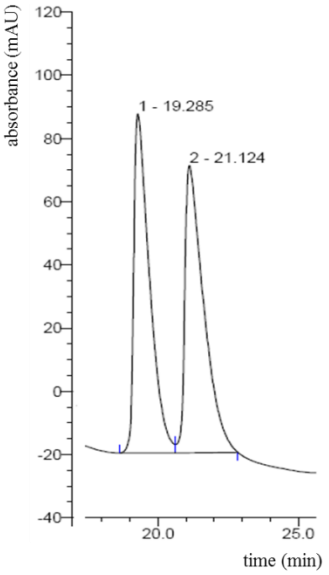


No.	Ret.Time min	Height mAU	Area mAU*min	Rel.Area %
1	12.02	71.785	29.694	49.78
2	13.27	67.907	29.961	50.22
Total:		139.692	59.655	100.00

Analytical chiral reversed-phase HPLC profiles of 3-pyridin-2-yl-L-alanine (7e) and 3-pyridin-2-yl-D,L-alanine

7e: $R_{t\ (major)}$ 18.2 min, $R_{t\ (minor)}$ 21.4 min, λ = 210 nm, 70% B, ee: 96%



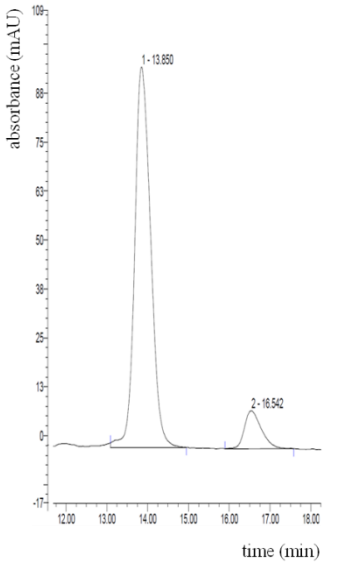


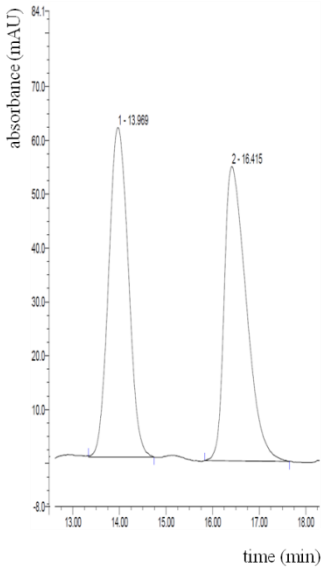
No.	Ret.Time min	Height mAU	Area mAU*min	Rel.Area %
1	18.19	413.056	419.281	97.88
2	21.36	10.861	9.074	2.12
Total:		423.917	428.355	100.00

No.	Ret.Time min	Height mAU	Area mAU*min	Rel.Area %
1	19.29	107.327	69.618	49.48
2	21.12	90.913	71.083	50.52
Total:		198.240	140.702	100.00

Analytical chiral reverse-phase HPLC profiles of L-allylglycine (7f) and D,L-allylglycine

7f: $R_{t\ (major)}$ 13.8 min, $R_{t\ (minor)}$ 16.5 min, λ = 200 nm, 80% B, ee: 81%



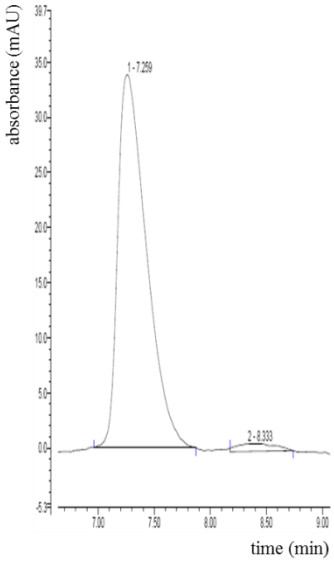


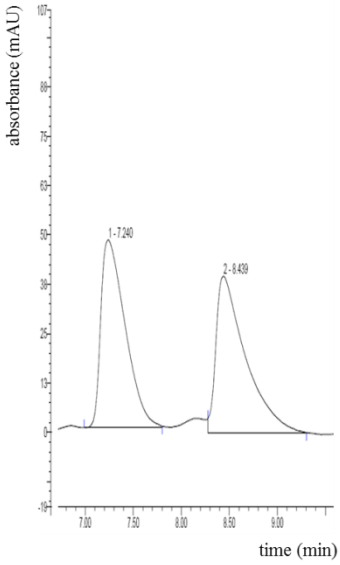
No.	Ret.Time min	Height mAU	Area mAU*min	Rel.Area %
1	13.85	96.989	43.926	90.38
2	16.54	9.708	4.677	9.62
Total:		106.697	48.603	100.00

No.	Ret.Time min	Height mAU	Area mAU*min	Rel.Area %
1	13.97	61.253	30.018	49.99
2	16.41	54.685	30.036	50.01
Total:		115.937	60.054	100.00

Analytical chiral reversed-phase HPLC profiles of L-2-amino-7-octenoic acid (7g) and D,L-2-amino-7-octenoic acid

7g: $R_{t\ (major)}$ 7.3 min, $R_{t\ (minor)}$ 8.3 min, λ = 200 nm, 70% B, ee: 95%



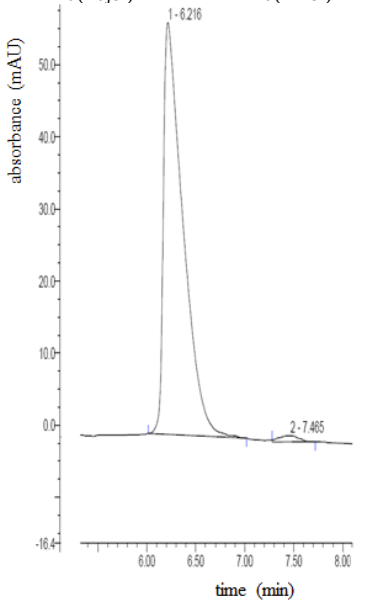


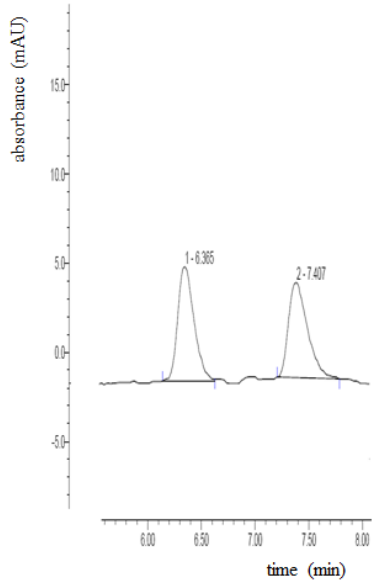
No.	Ret.Time min	Height mAU	Area mAU*min	Rel.Area %
1	7.26	33.836	10.022	97.27
2	8.33	0.702	0.281	2.73
Total:		34.538	10.303	100.00

No.	Ret.Time min	Height mAU	Area mAU*min	Rel.Area %
1	7.24	47.563	13.964	49.72
2	8.44	39.591	14.121	50.28
Total:		87.153	28.085	100.00

Analytical chiral reversed-phase HPLC profiles of L-2-amino-nonanoic acid hydrochloride (7h) and D,L-2-amino-nonanoic acid hydrochloride

7h: $R_{t\ (major)}$ 6.2 min, $R_{t\ (minor)}$ 7.5 min, λ = 200 nm, 70% B, ee: 97%





No.	Ret.Time min	Height mAU	Area mAU*min	Rel.Area %
1	6.22	57.105	13.189	98.49
2	7.47	0.836	0.202	1.51
Total:		57.941	13.391	100.00

No.	Ret.Time min	Height mAU	Area mAU*min	Rel.Area %
1	6.37	6.412	1.134	50.84
2	7.41	5.318	1.097	49.16
Total:		11.730	2.231	100.00