Supporting Information

Iron-catalyzed oxidative decarbonylative α-alkylation of acyl-substituted furans with aliphatic aldehydes as the alkylating agents

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I. Copies of ^{1}H and ^{13}C NMR spectra of starting materials and products

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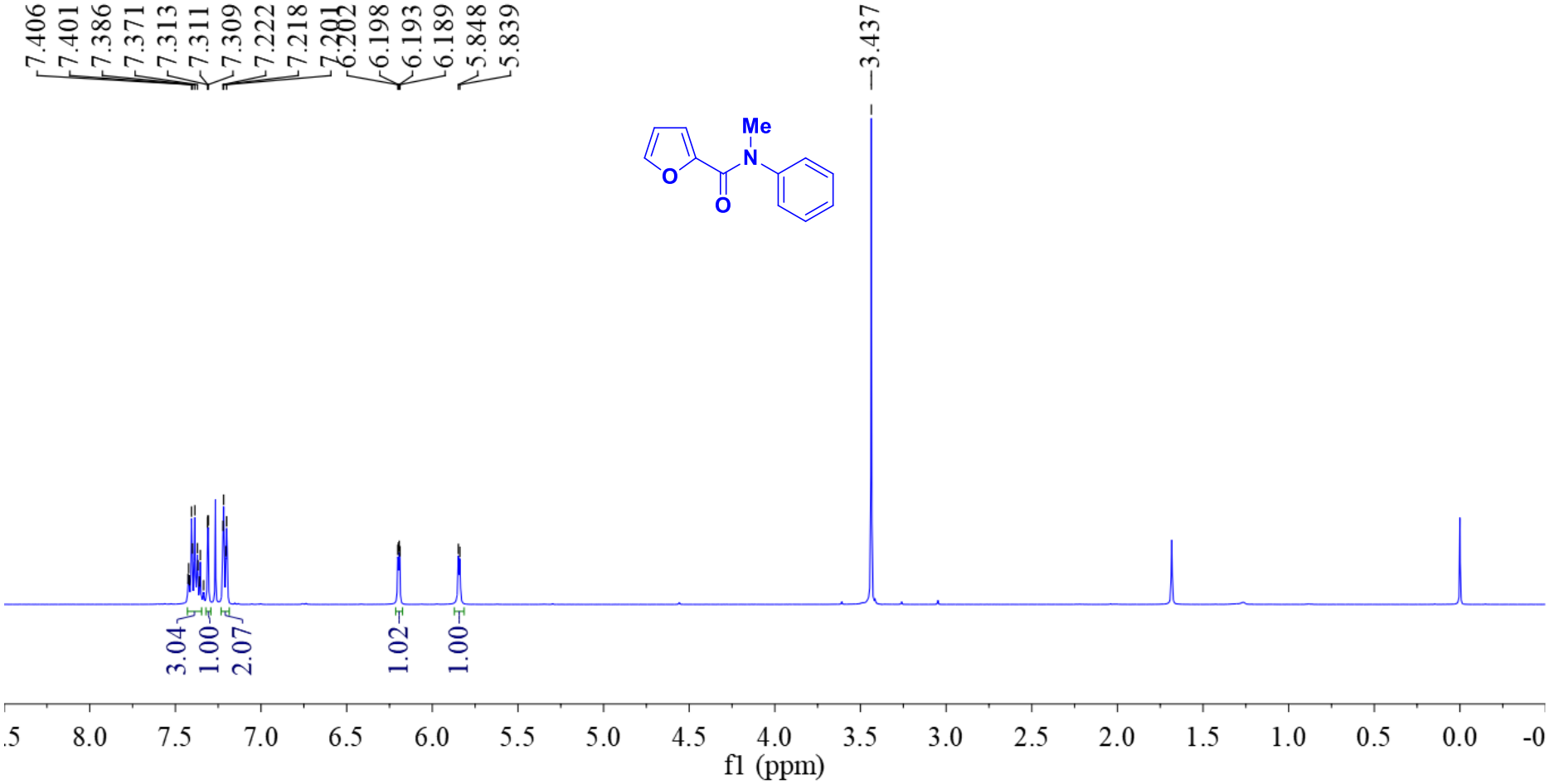


Figure S-2. $^{13}C\{^{1}H\}$ NMR spectrum of **(2a)** ($CDCl_3$, 100 MHz) ***N*-methyl-*N*-phenylfuran-2-carboxamide**

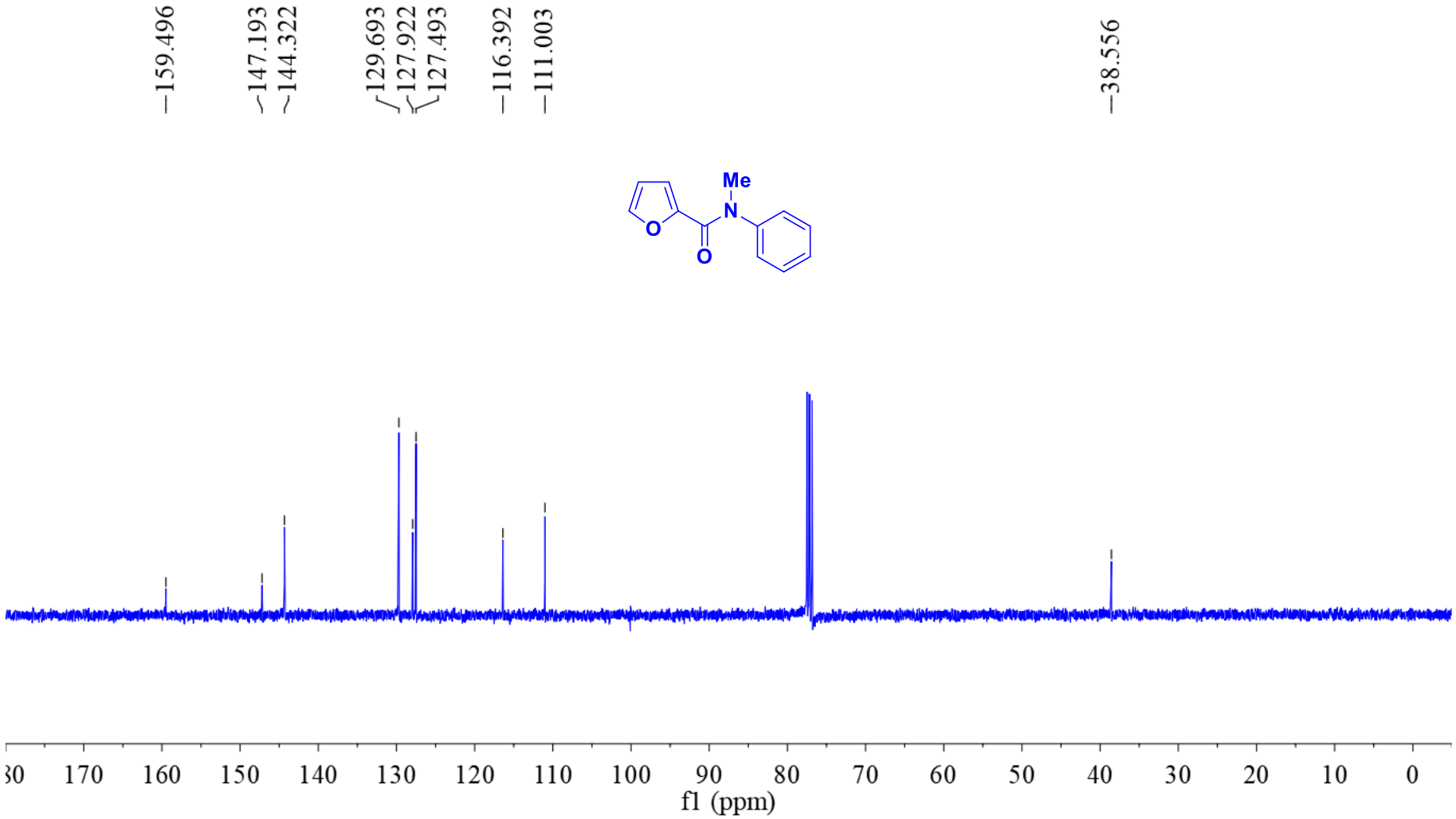


Figure S-3. ^{1}H NMR spectrum of **(2b)** ($CDCl_3$, 400 MHz) ***N,N*-dimethylfuran-2-carboxamide**

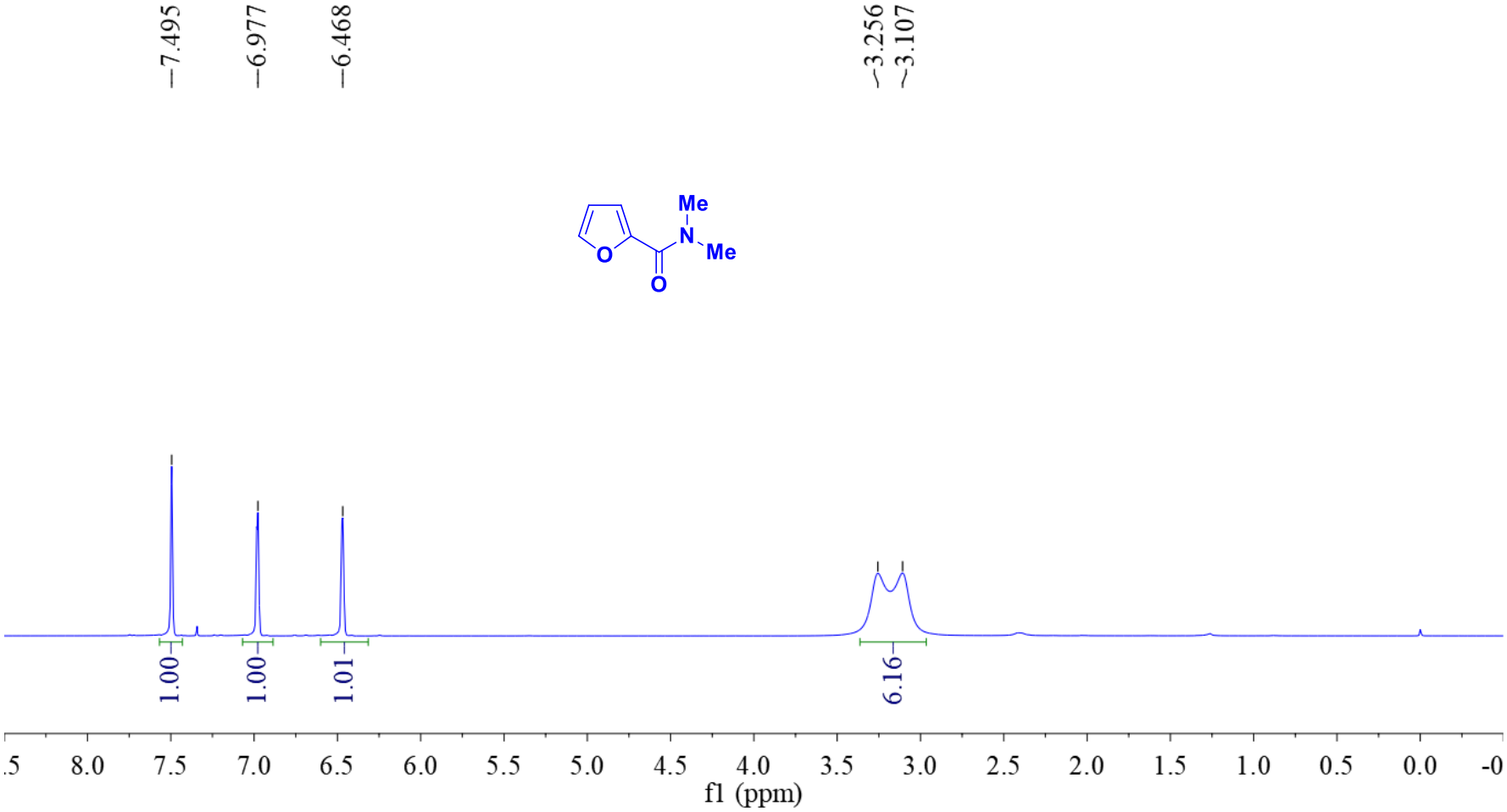


Figure S-4. $^{13}C\{^{1}H\}$ NMR spectrum of **(2b)** ($CDCl_3$, 100 MHz) ***N,N*-dimethylfuran-2-carboxamide**

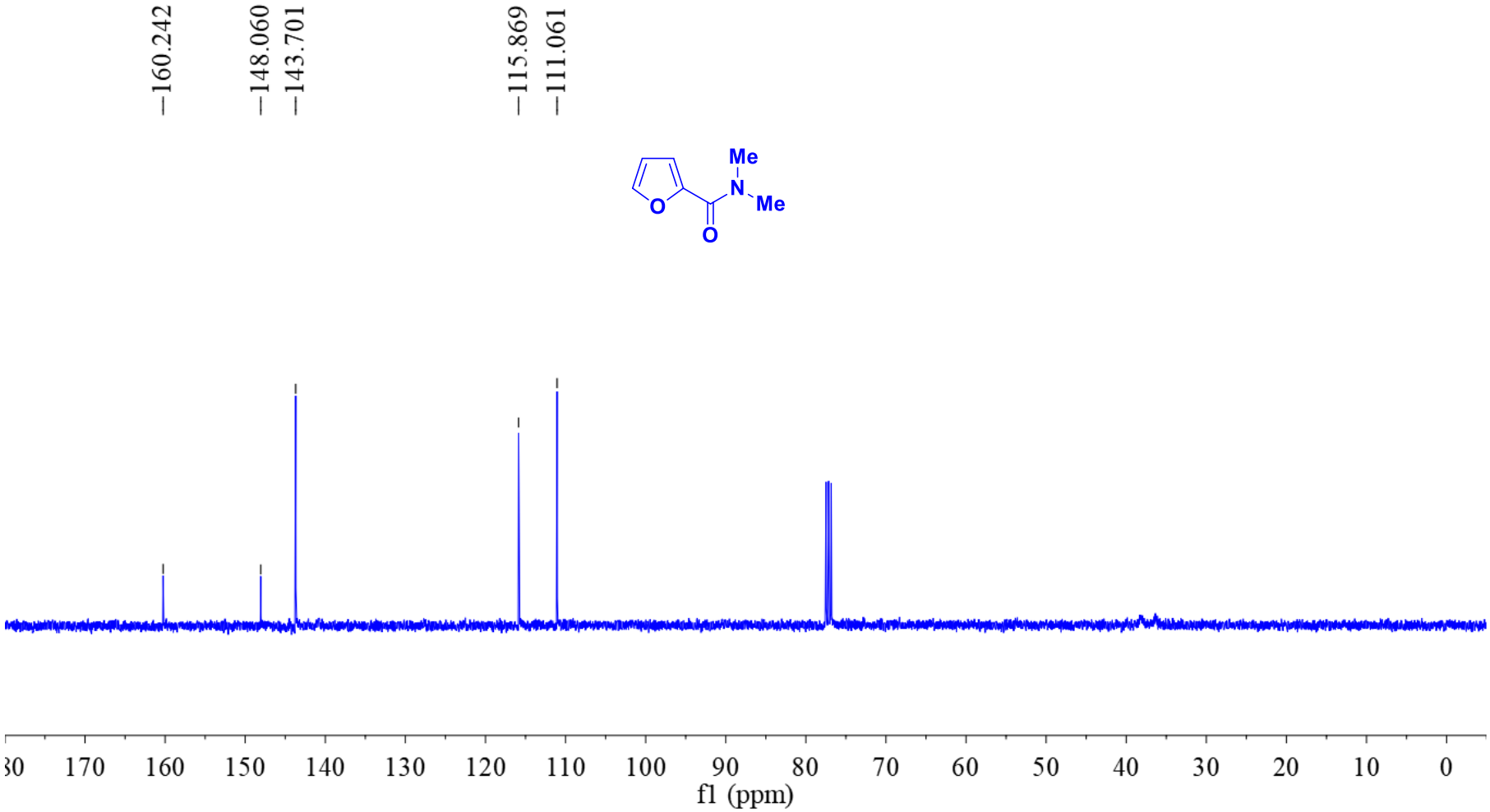


Figure S-5. ^{1}H NMR spectrum of **(2c)** ($CDCl_3$, 400 MHz) ***N,N*-diethylfuran-2-carboxamide**

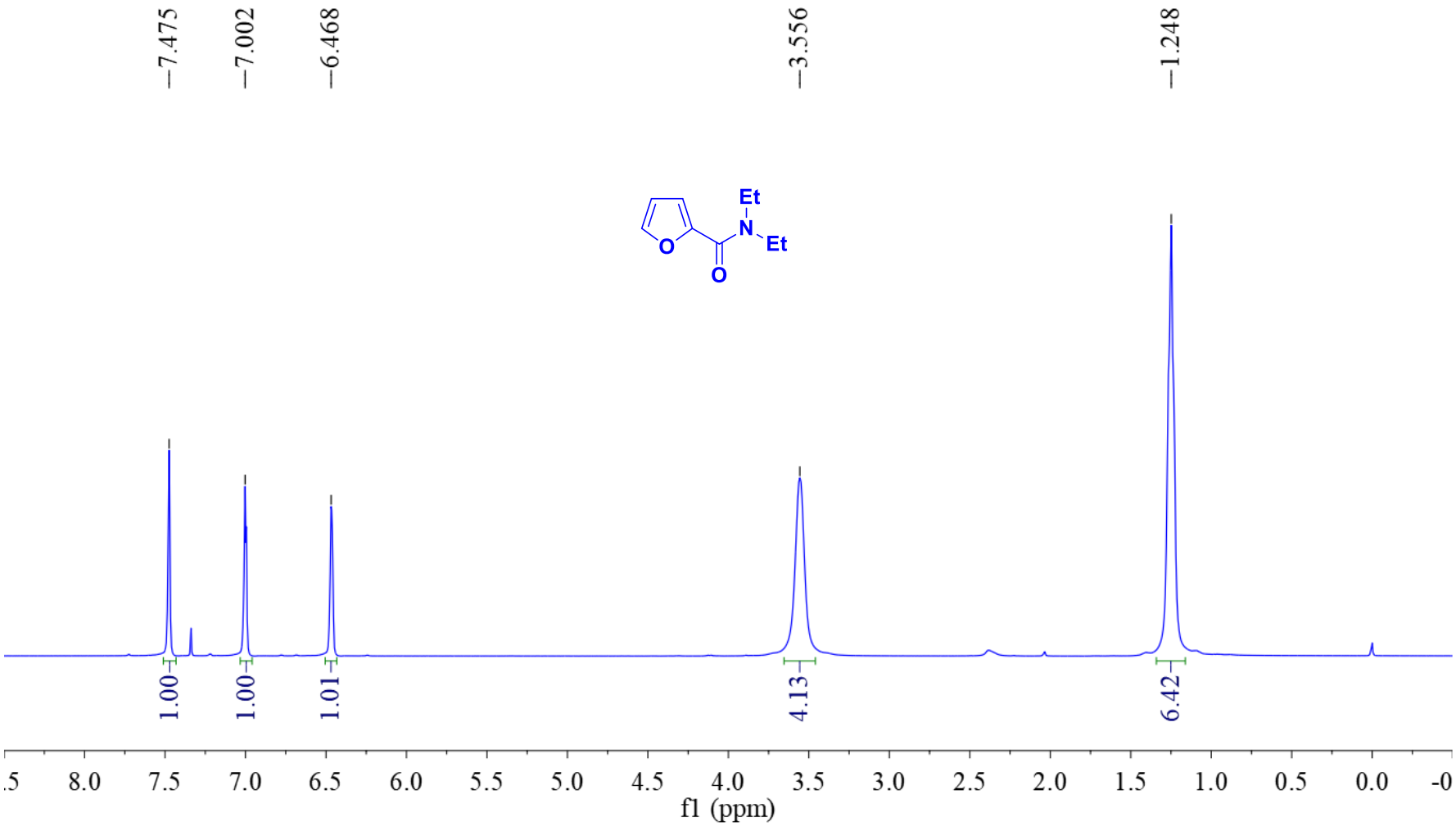


Figure S-6. $^{13}C\{^{1}H\}$ NMR spectrum of **(2c)** ($CDCl_3$, 100 MHz) ***N,N*-diethylfuran-2-carboxamide**

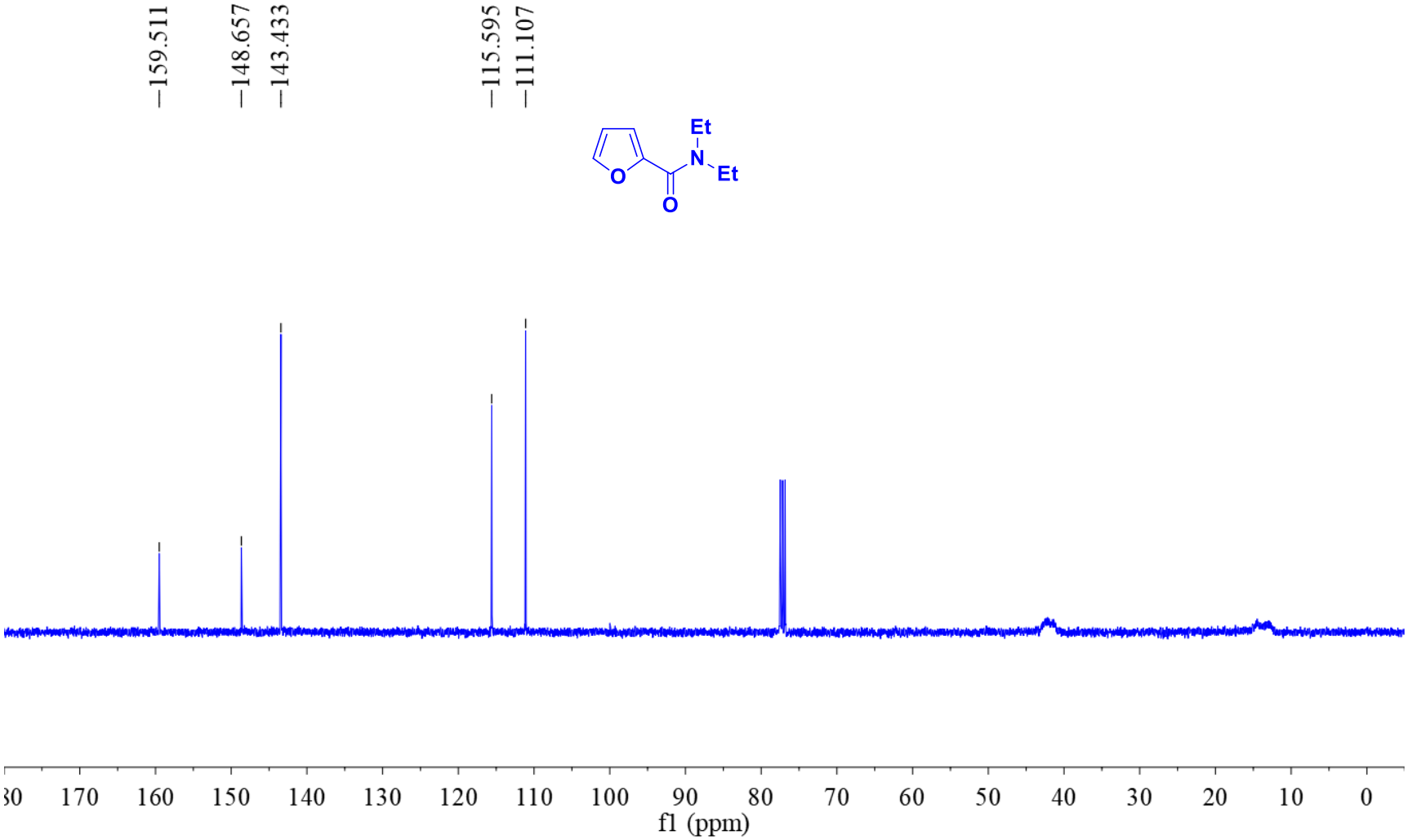


Figure S-7. ^{1}H NMR spectrum of **(2d)** ($CDCl_3$, 400 MHz) ***N*-(2-bromophenyl)-*N*-methylfuran-2-carboxamide**

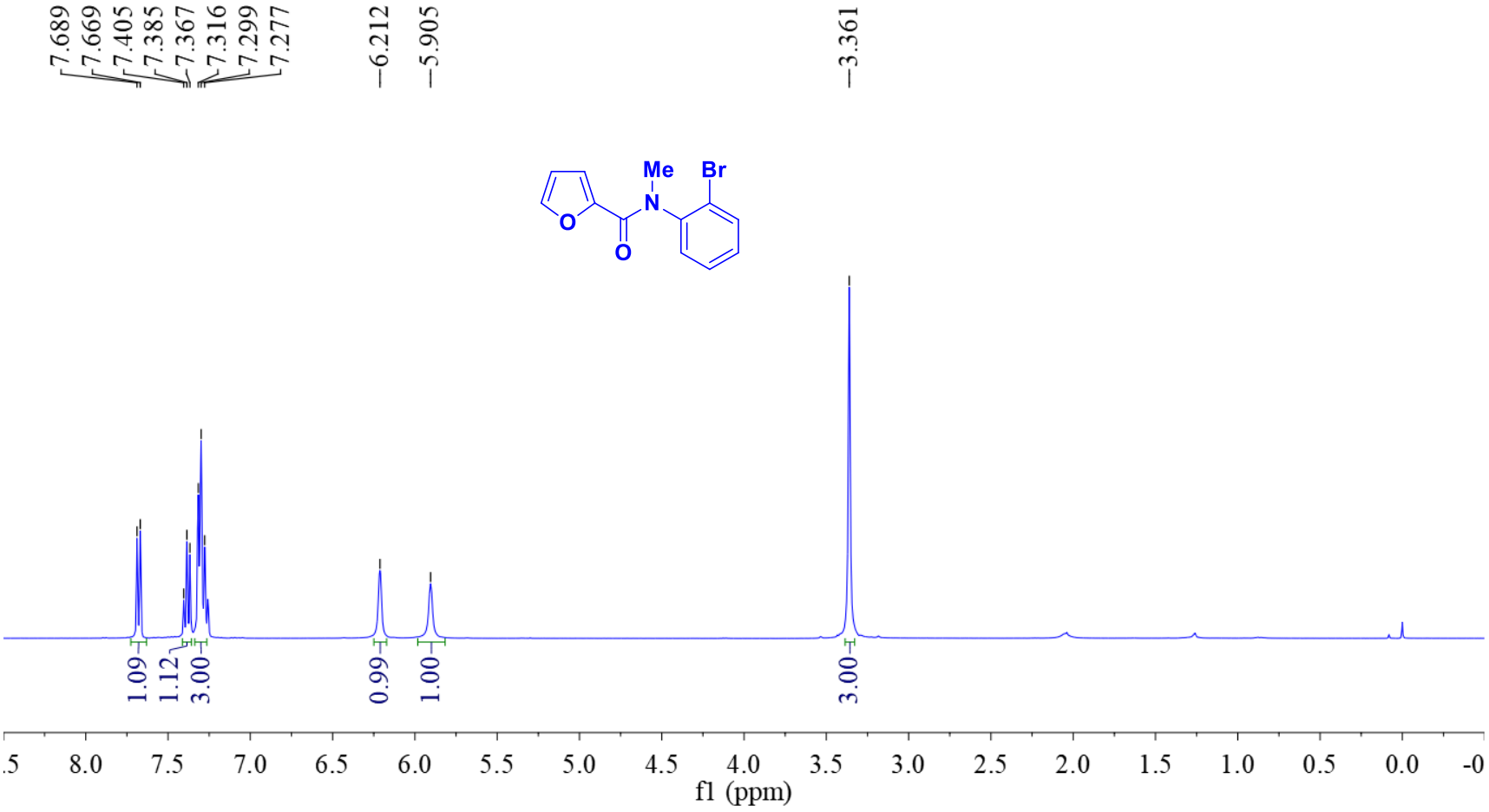


Figure S-8. $^{13}C\{^{1}H\}$ NMR spectrum of **(2d)** ($CDCl_3$, 100 MHz) ***N*-(2-bromophenyl)-*N*-methylfuran-2-carboxamide**

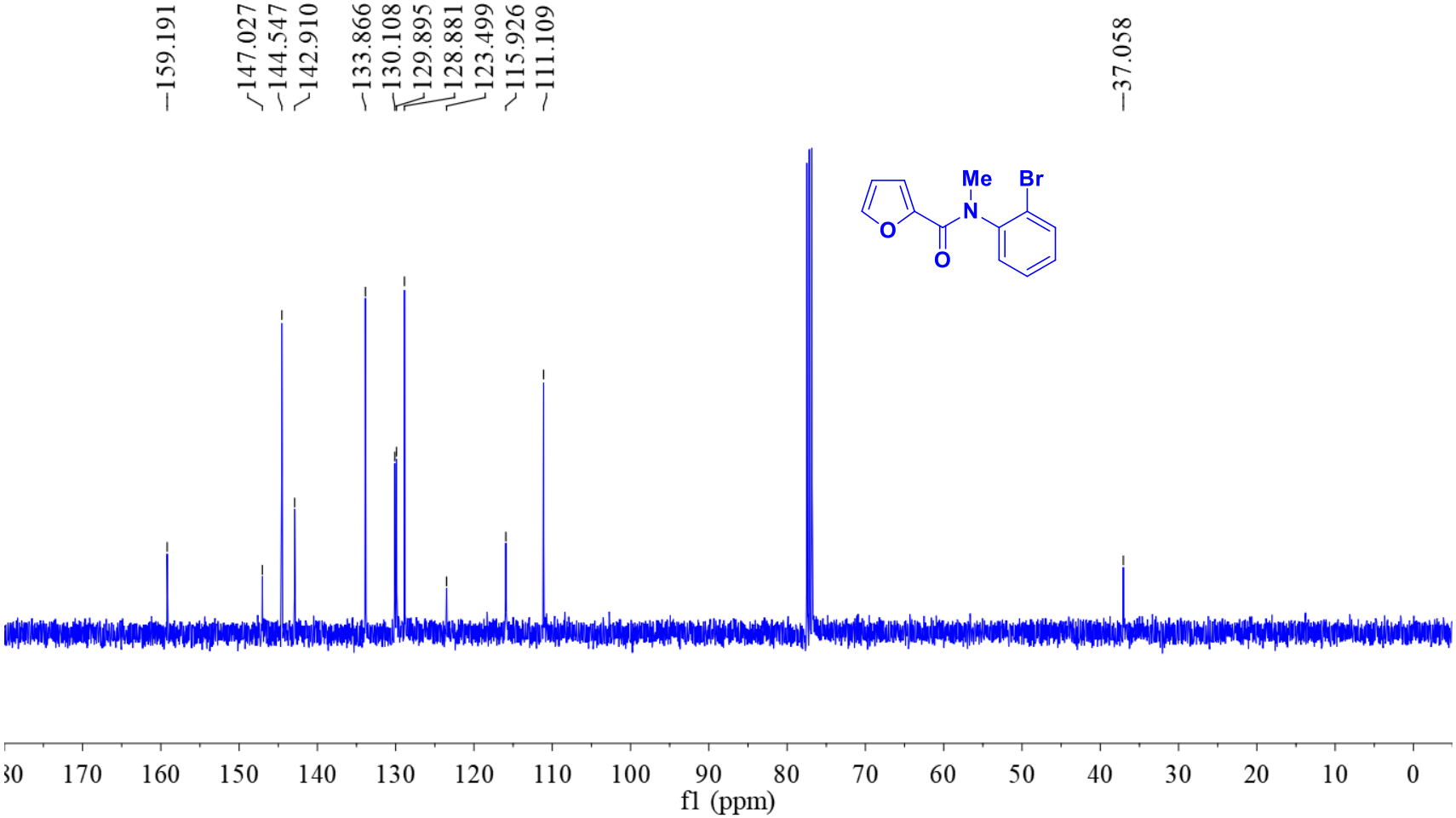


Figure S-9. ^{1}H NMR spectrum of **(2e)** ($CDCl_3$, 400 MHz) ***N*-(3-methoxyphenyl)-*N*-methylfuran-2-carboxamide**

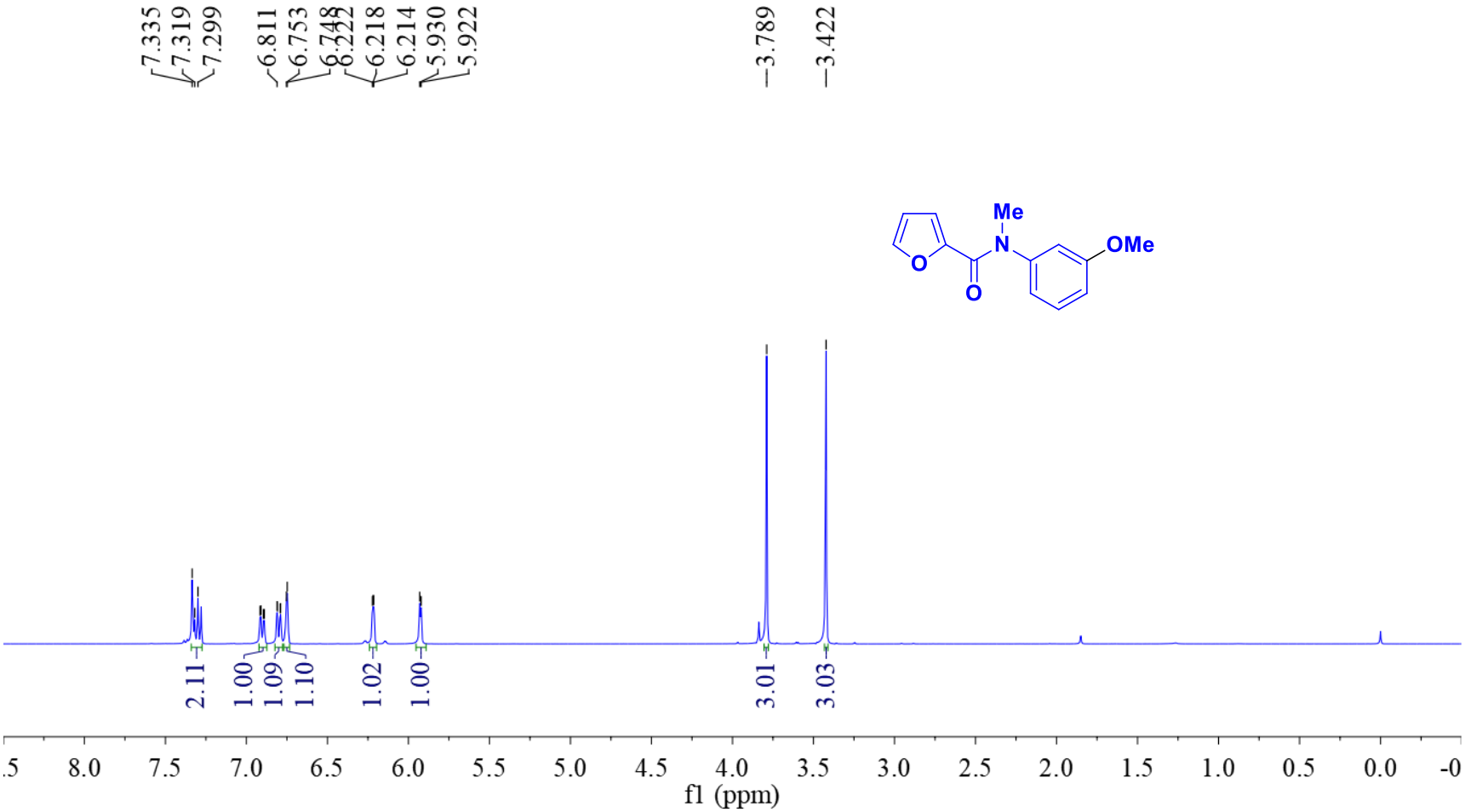


Figure S-10. $^{13}C\{^{1}H\}$ NMR spectrum of **(2e)** ($CDCl_3$, 100 MHz) ***N*-(3-methoxyphenyl)-*N*-methylfuran-2-carboxamide**

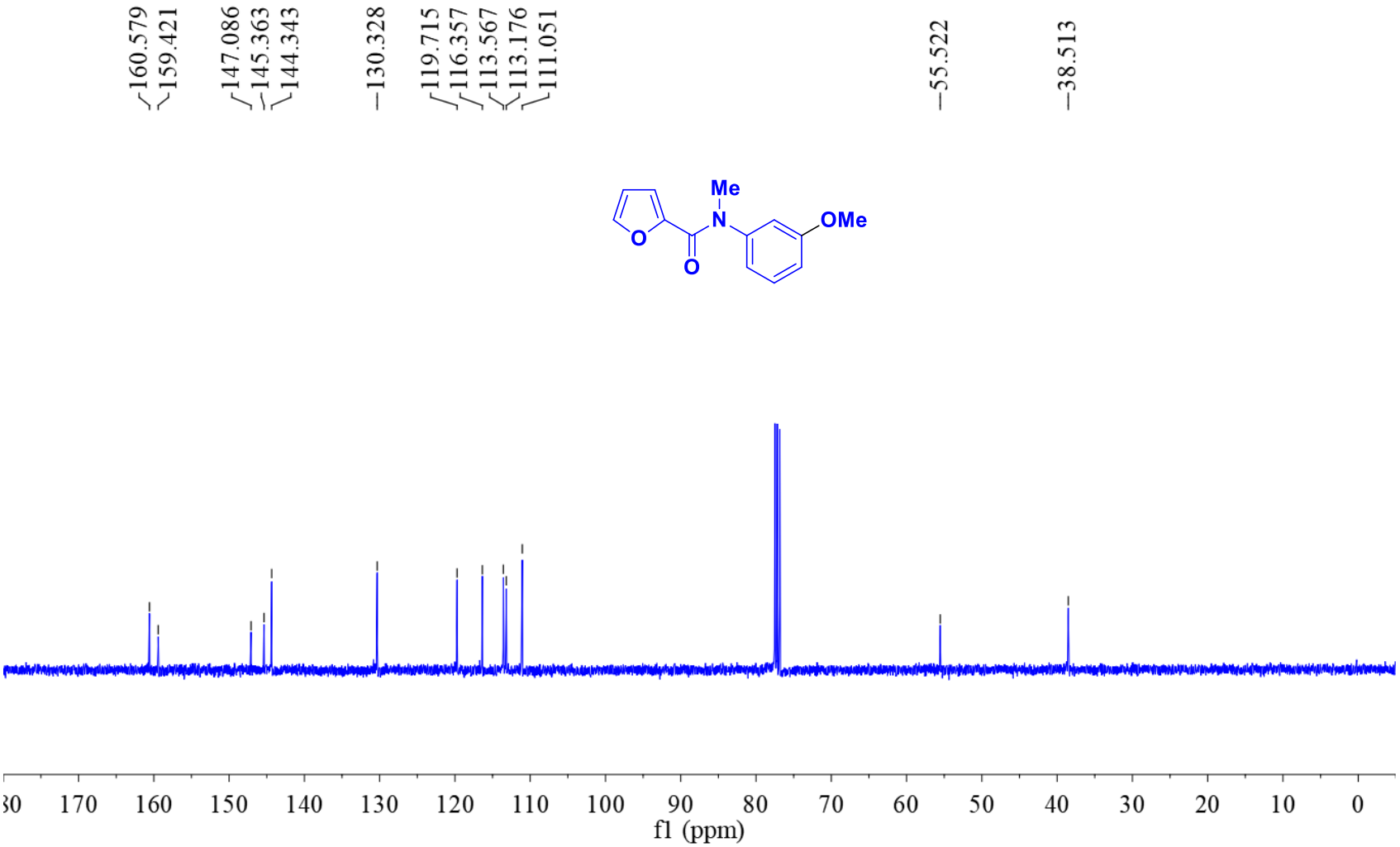


Figure S-11. ^{1}H NMR spectrum of **(2f)** ($CDCl_3$, 400 MHz) **furan-2-yl(pyrrolidin-1-yl)methanone**

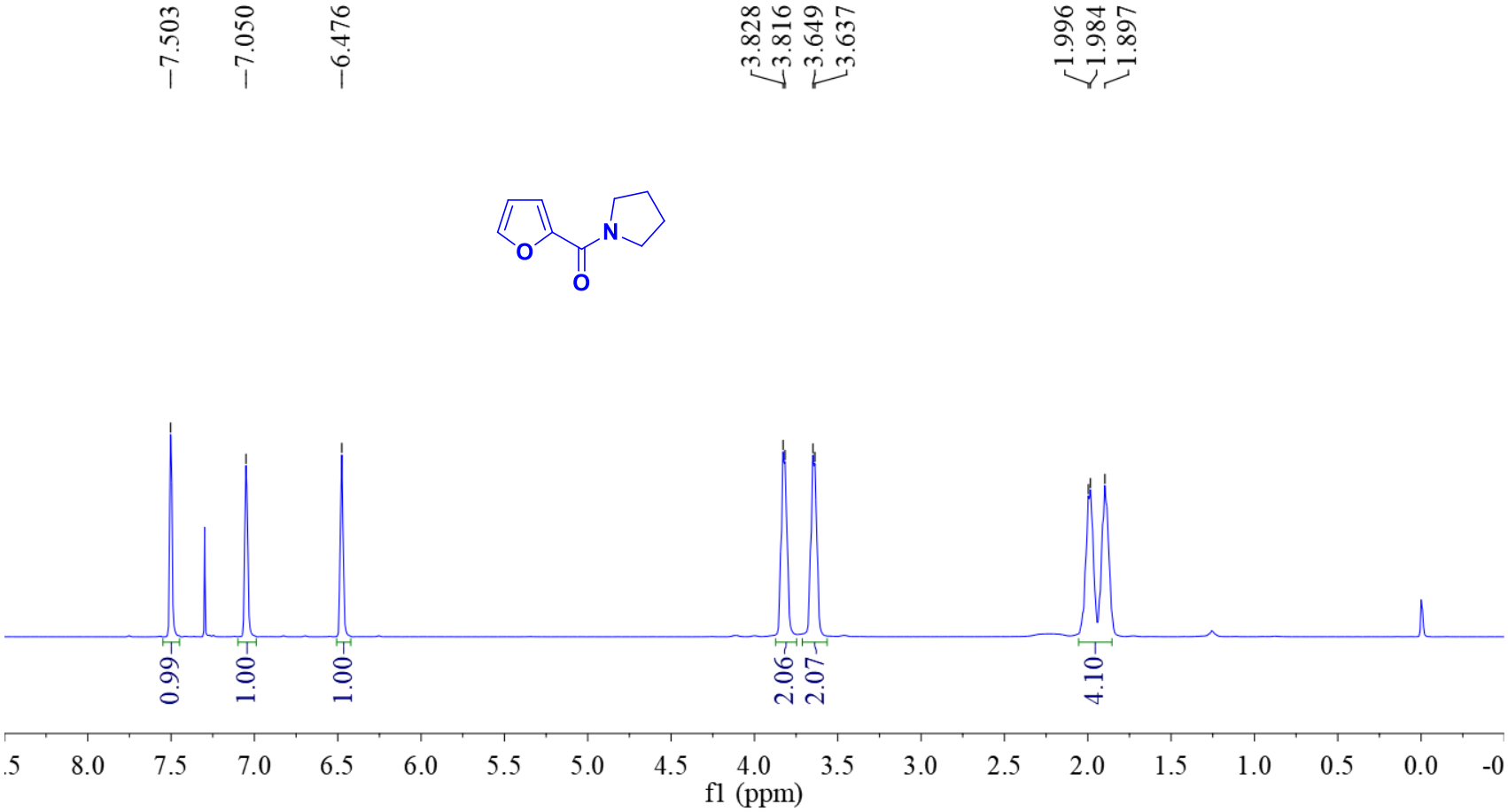


Figure S-12. $^{13}C\{^{1}H\}$ NMR spectrum of **(2f)** ($CDCl_3$, 100 MHz) **furan-2-yl(pyrrolidin-1-yl)methanone**

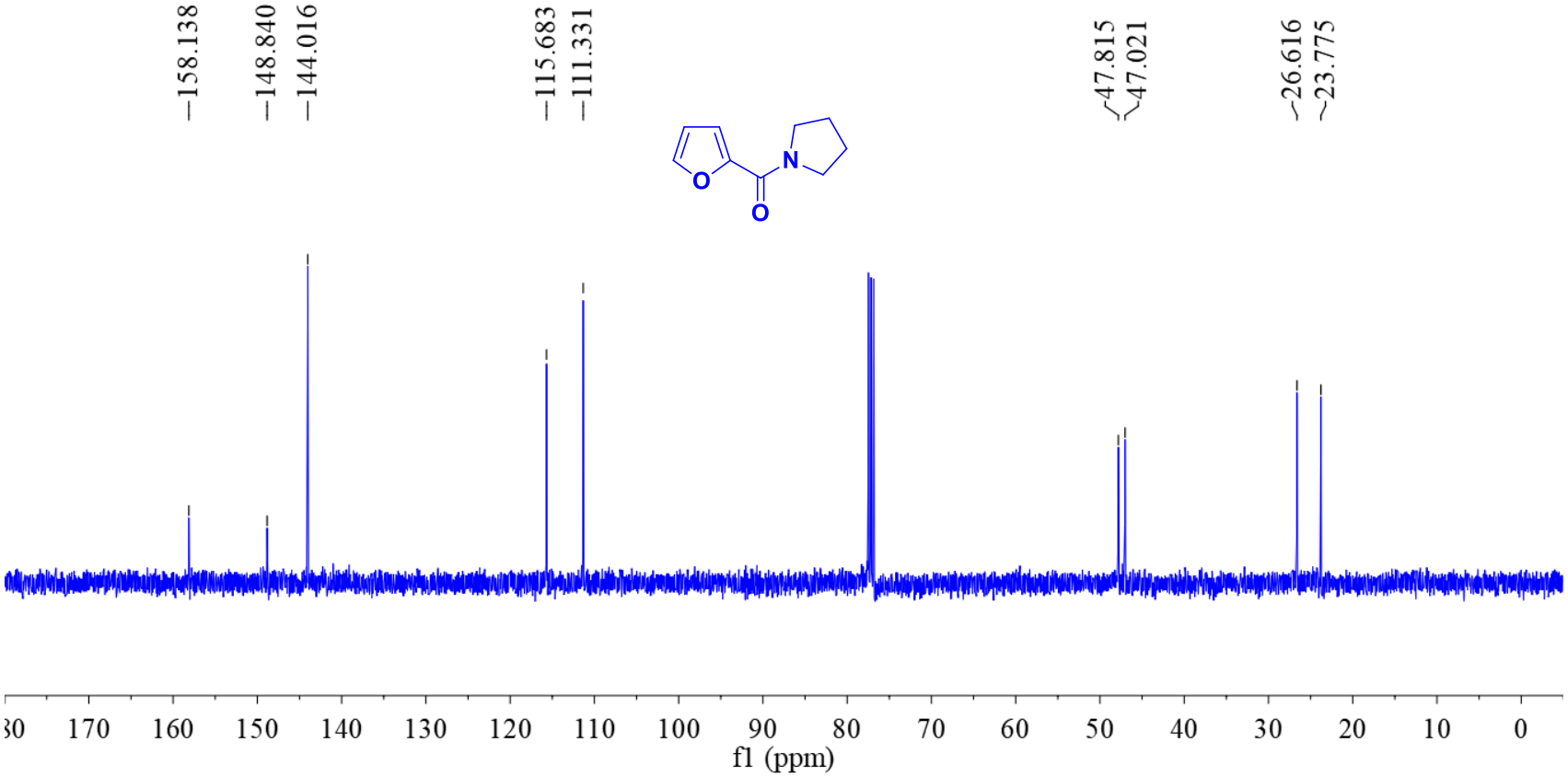


Figure S-13. ^{1}H NMR spectrum of **(2g)** ($CDCl_3$, 400 MHz) **furan-2-yl(piperidin-1-yl)methanone**

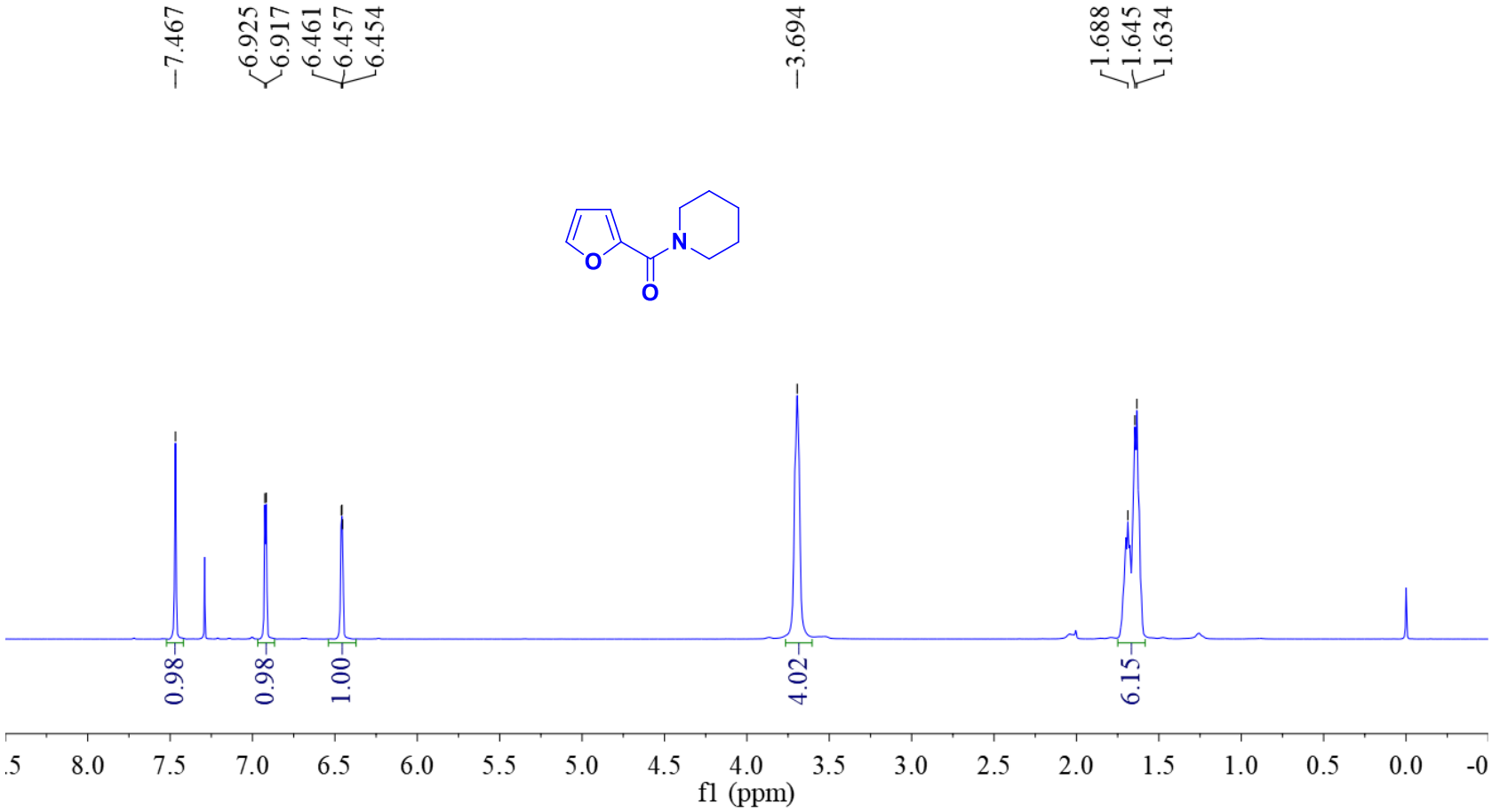


Figure S-14. $^{13}C\{^{1}H\}$ NMR spectrum of **(2g)** ($CDCl_3$, 100 MHz) **furan-2-yl(piperidin-1-yl)methanone**

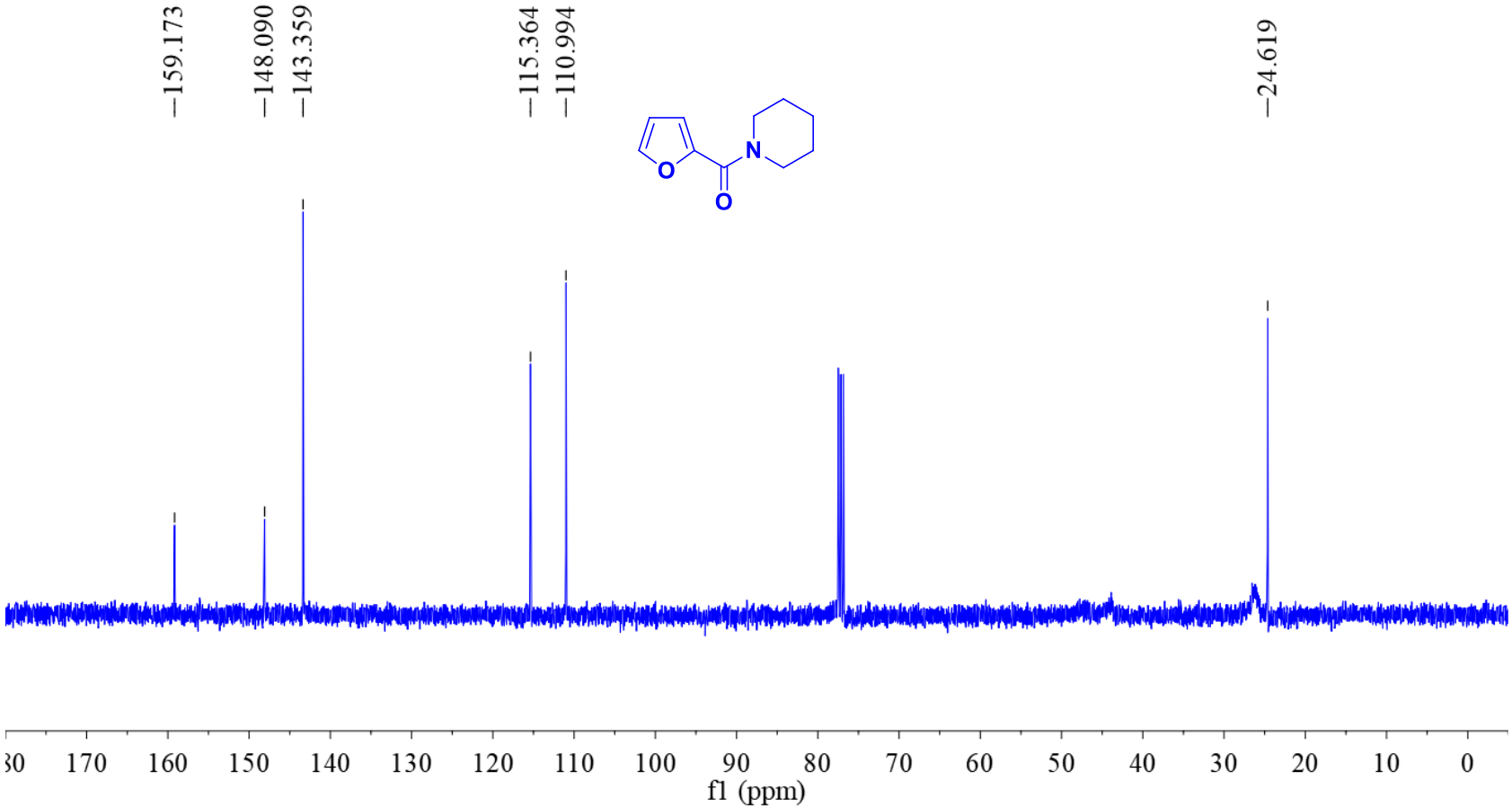


Figure S-15. ^{1}H NMR spectrum of **(2h)** ($CDCl_3$, 400 MHz) ***N*-methoxy-*N*-methylfuran-2-carboxamide**

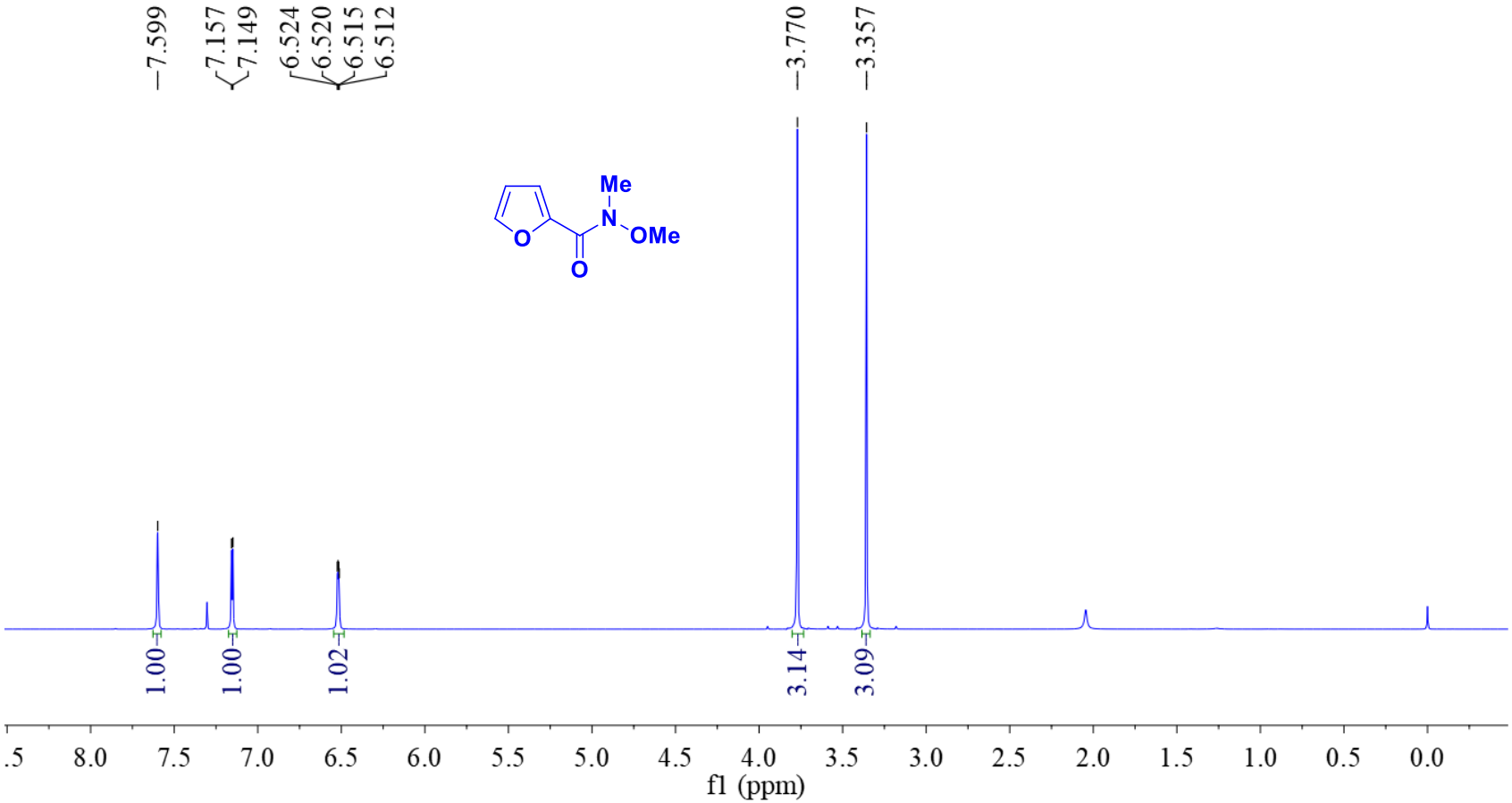
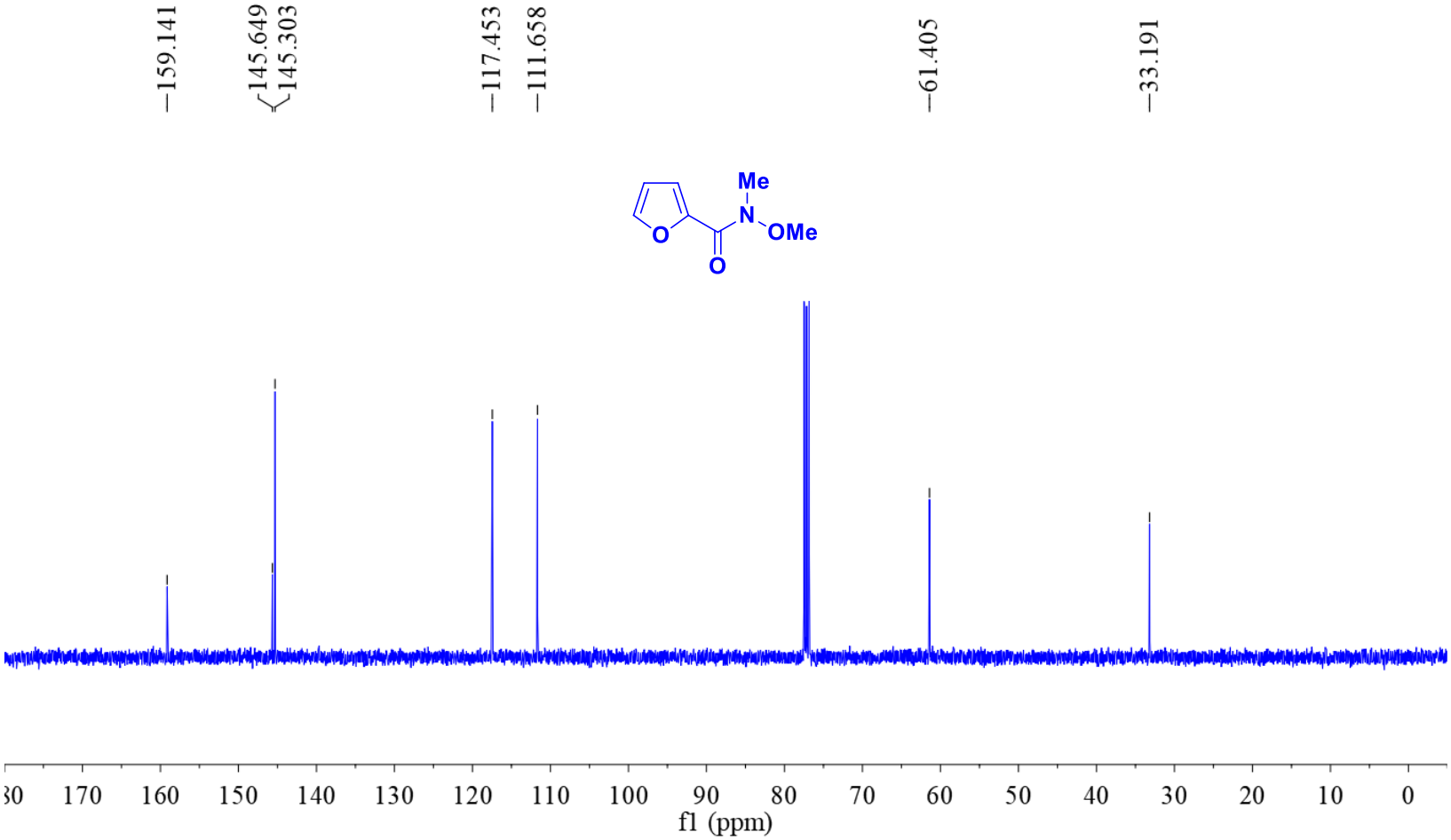


Figure S-16. $^{13}C\{^{1}H\}$ NMR spectrum of **(2h)** ($CDCl_3$, 100 MHz) ***N*-methoxy-*N*-methylfuran-2-carboxamide**



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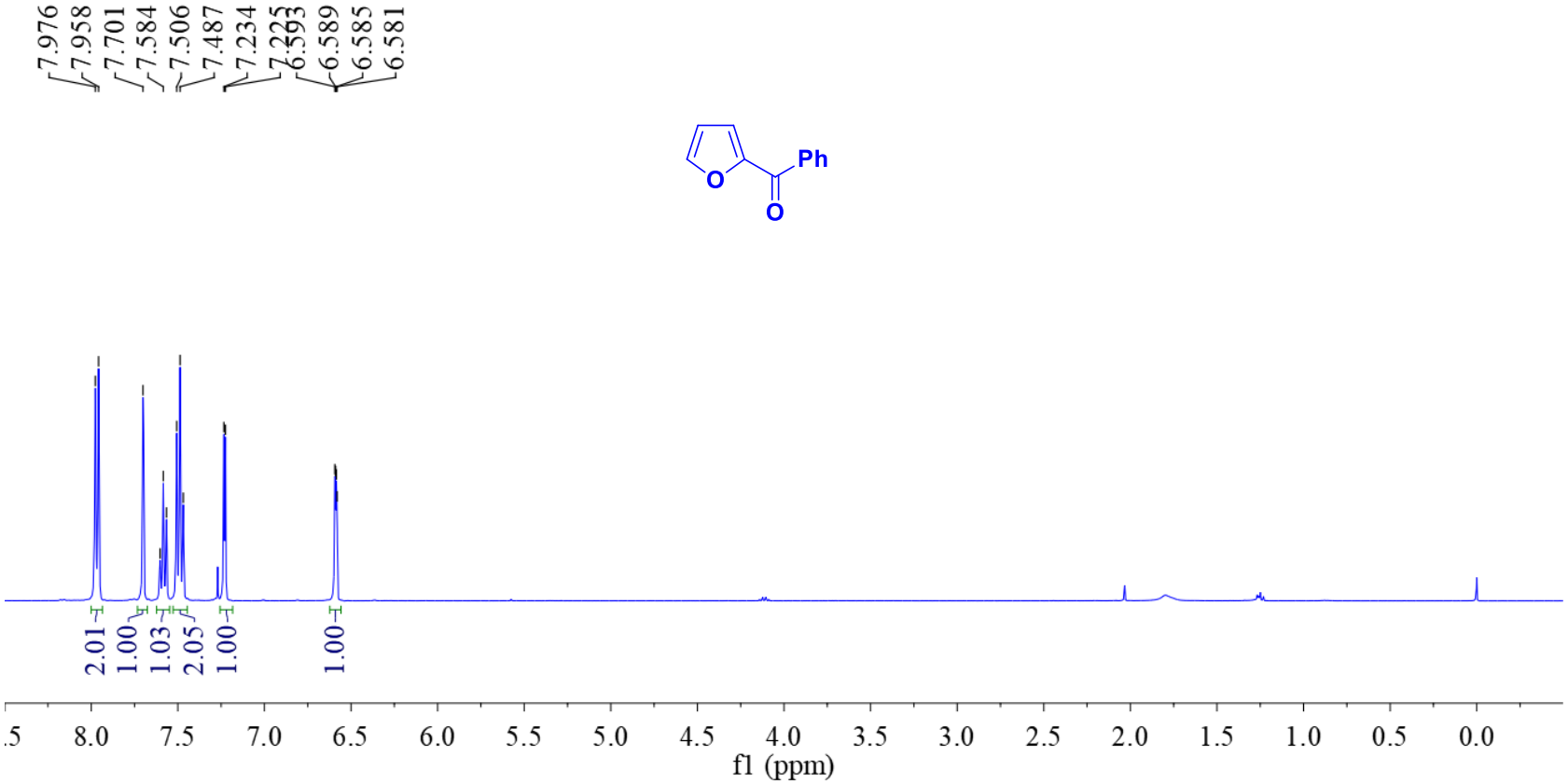


Figure S-18. $^{13}C\{^{1}H\}$ NMR spectrum of **(2l)** ($CDCl_3$, 100 MHz) **furan-2-yl(phenyl)methanone**

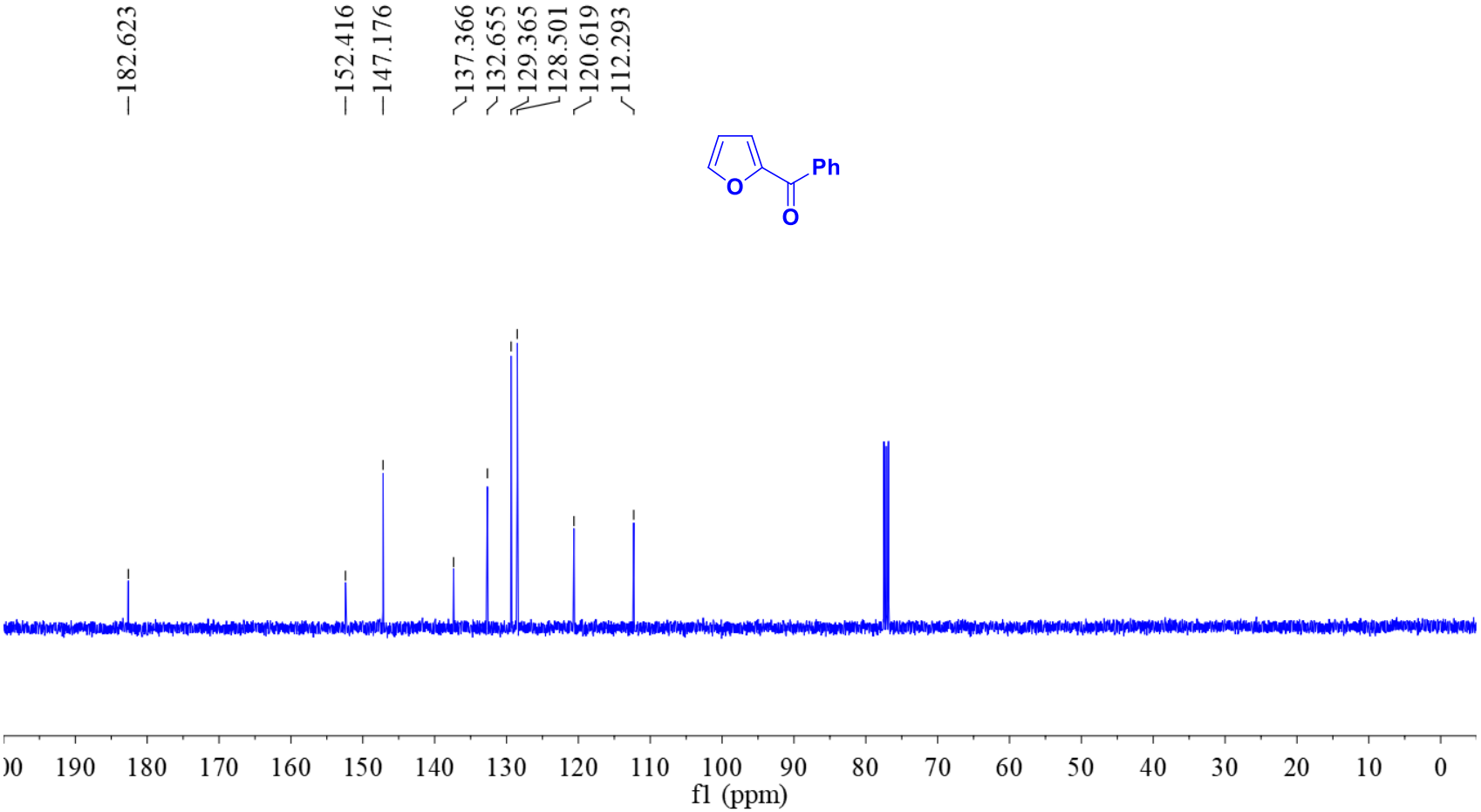


Figure S-19. ^{1}H NMR spectrum of **(2o)** ($CDCl_3$, 400 MHz) **1-(furan-2-yl)-2,2-dimethylpropan-1-one**

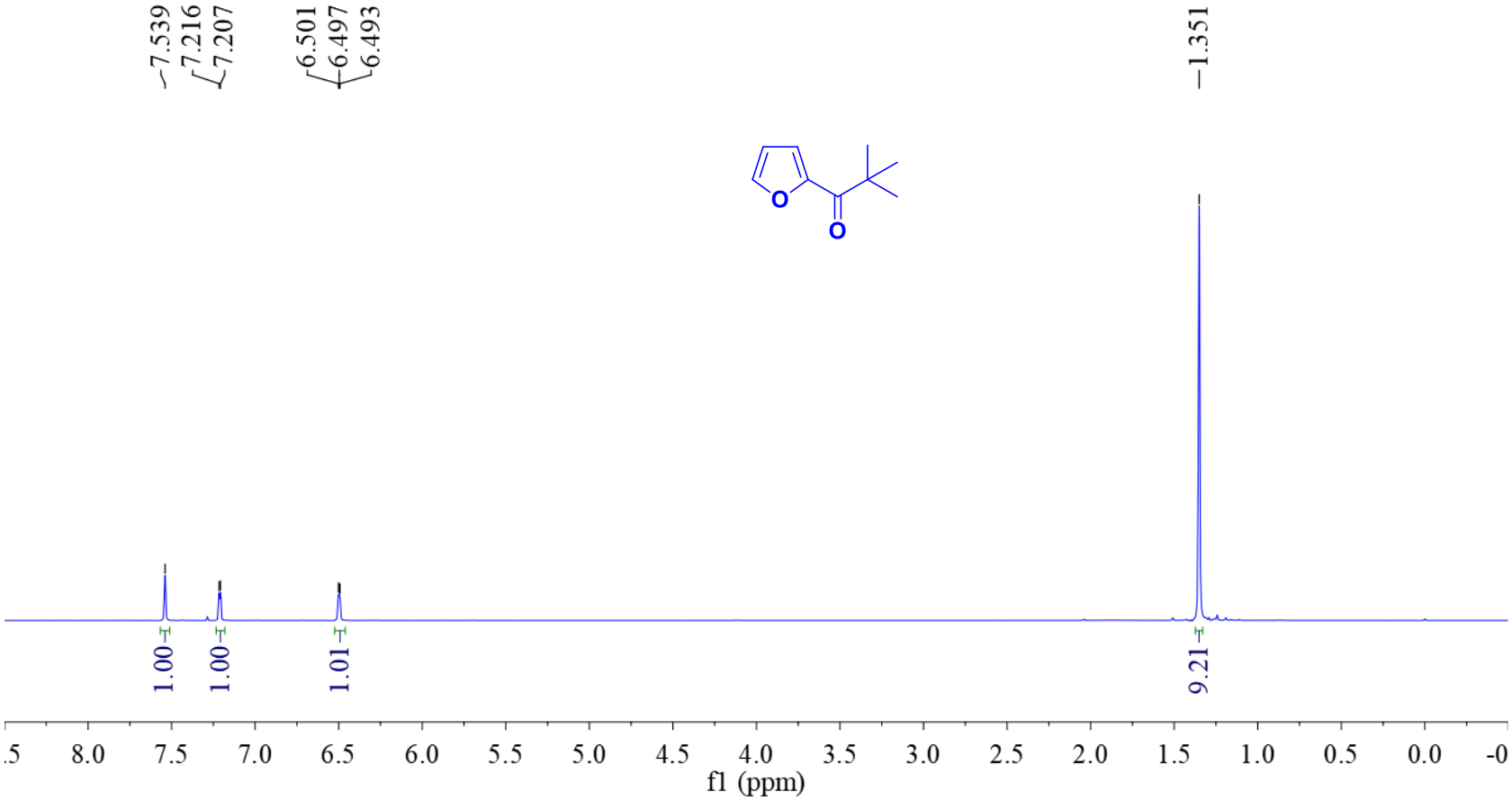


Figure S-20. $^{13}C\{^{1}H\}$ NMR spectrum of **(2o)** ($CDCl_3$, 100 MHz) **1-(furan-2-yl)-2,2-dimethylpropan-1-one**

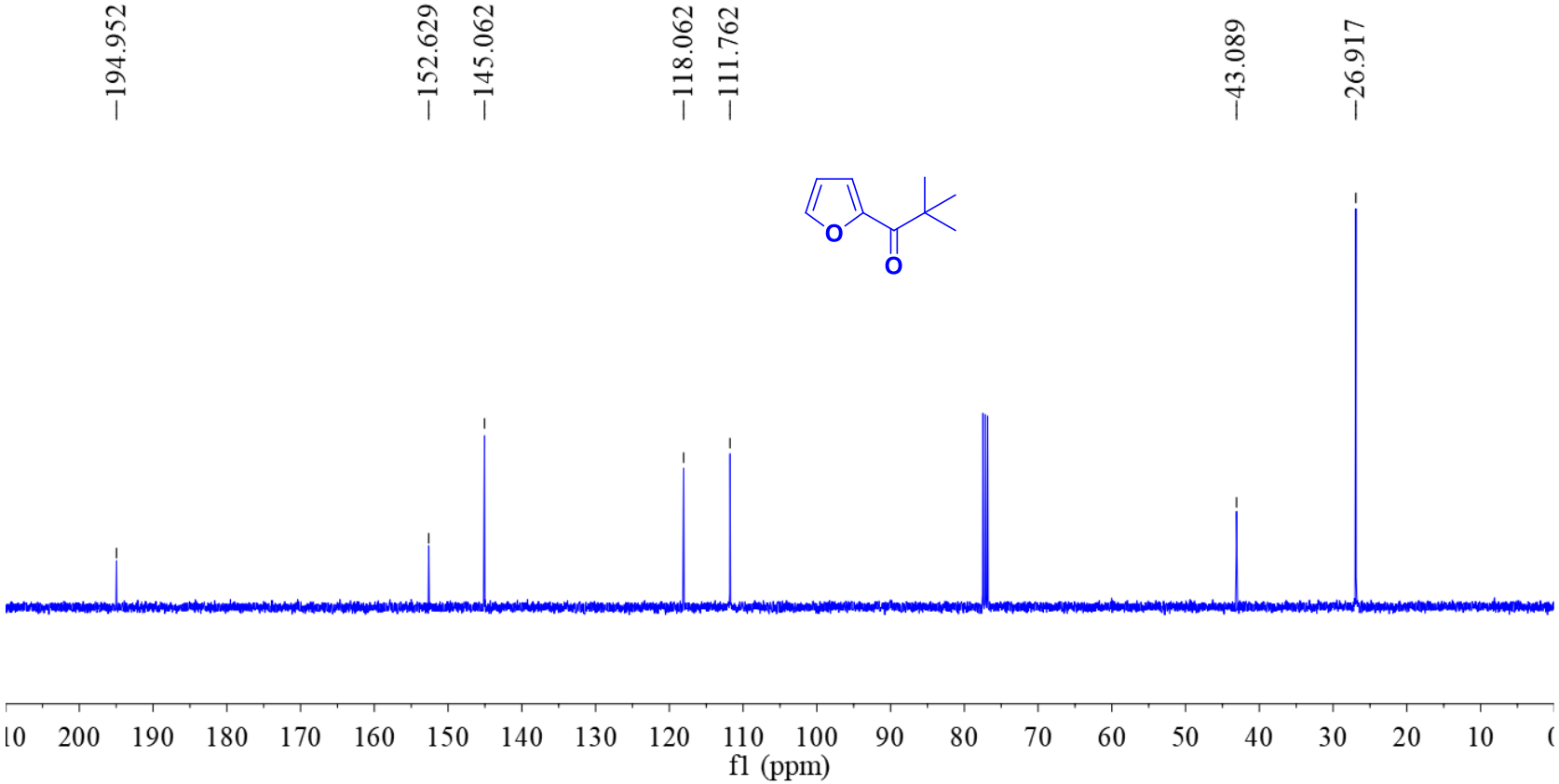


Figure S-21. ^{1}H NMR spectrum of **(2p)** ($CDCl_3$, 400 MHz) **2-phenylfuran**

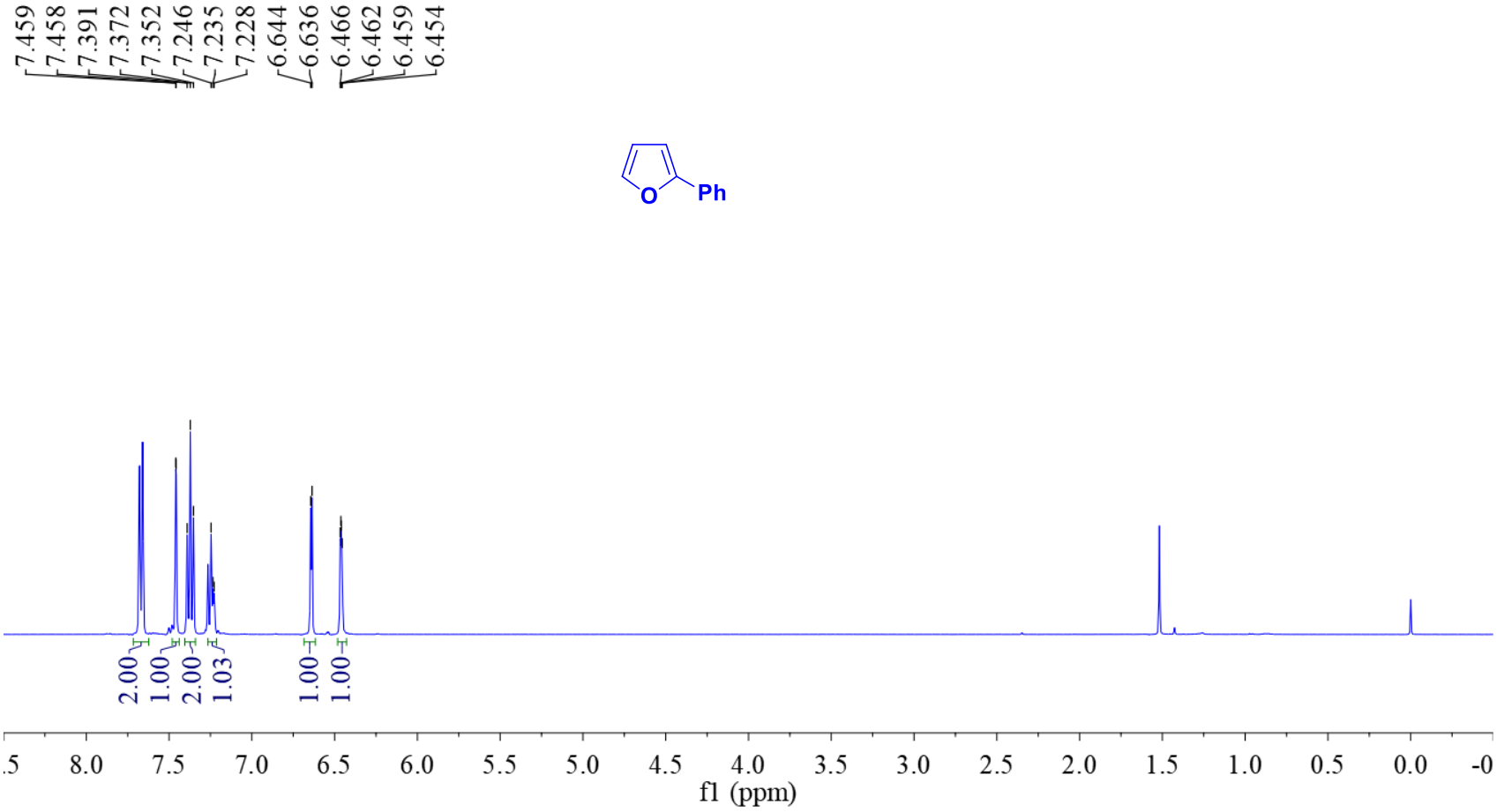


Figure S-22. $^{13}C\{^{1}H\}$ NMR spectrum of **(2p)** ($CDCl_3$, 100 MHz) **2-phenylfuran**

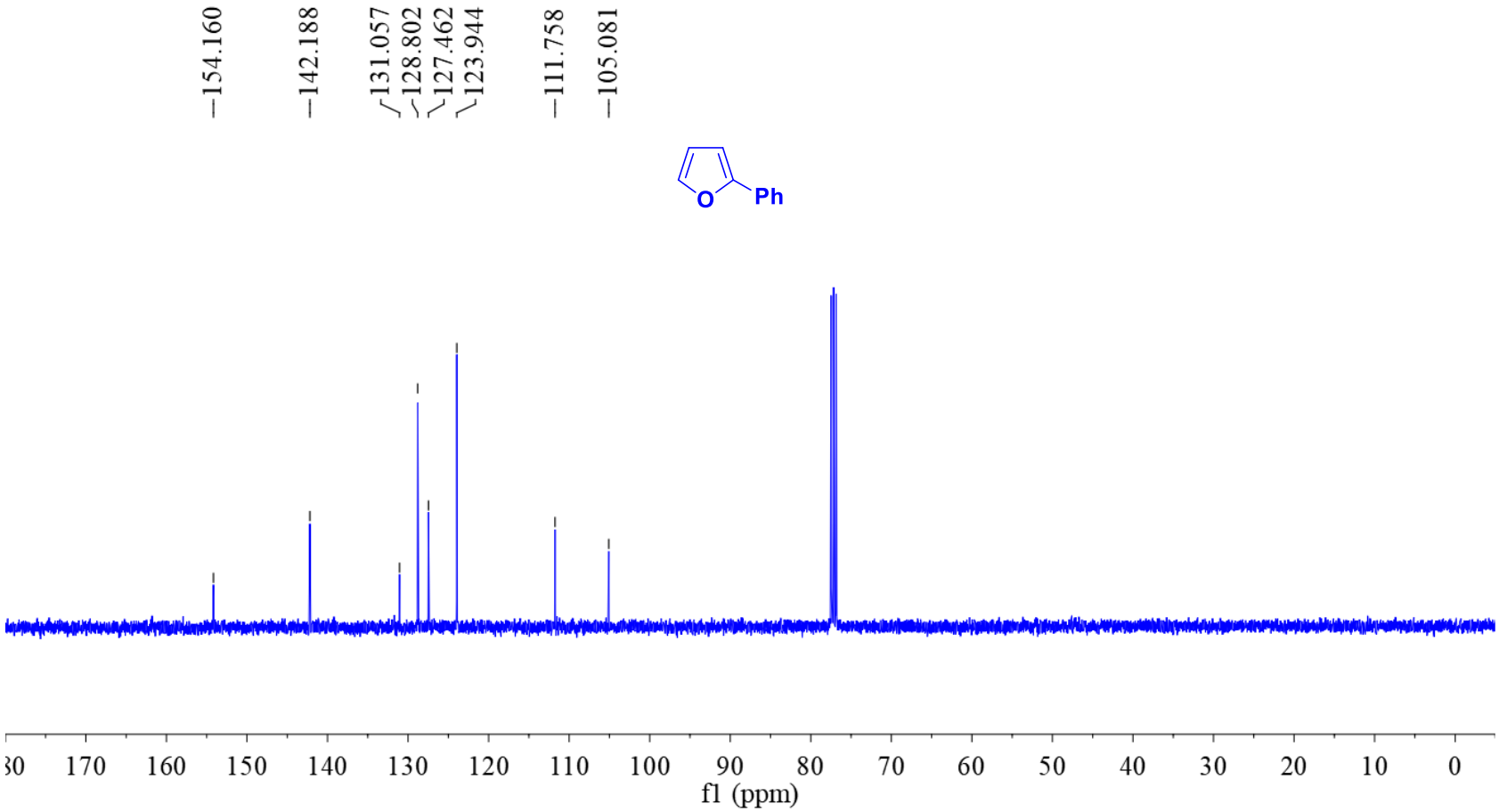


Figure S-23. ^{1}H NMR spectrum of **(2s)** ($CDCl_3$, 400 MHz) ***N*-methyl-*N*-phenylfuran-3-carboxamide**

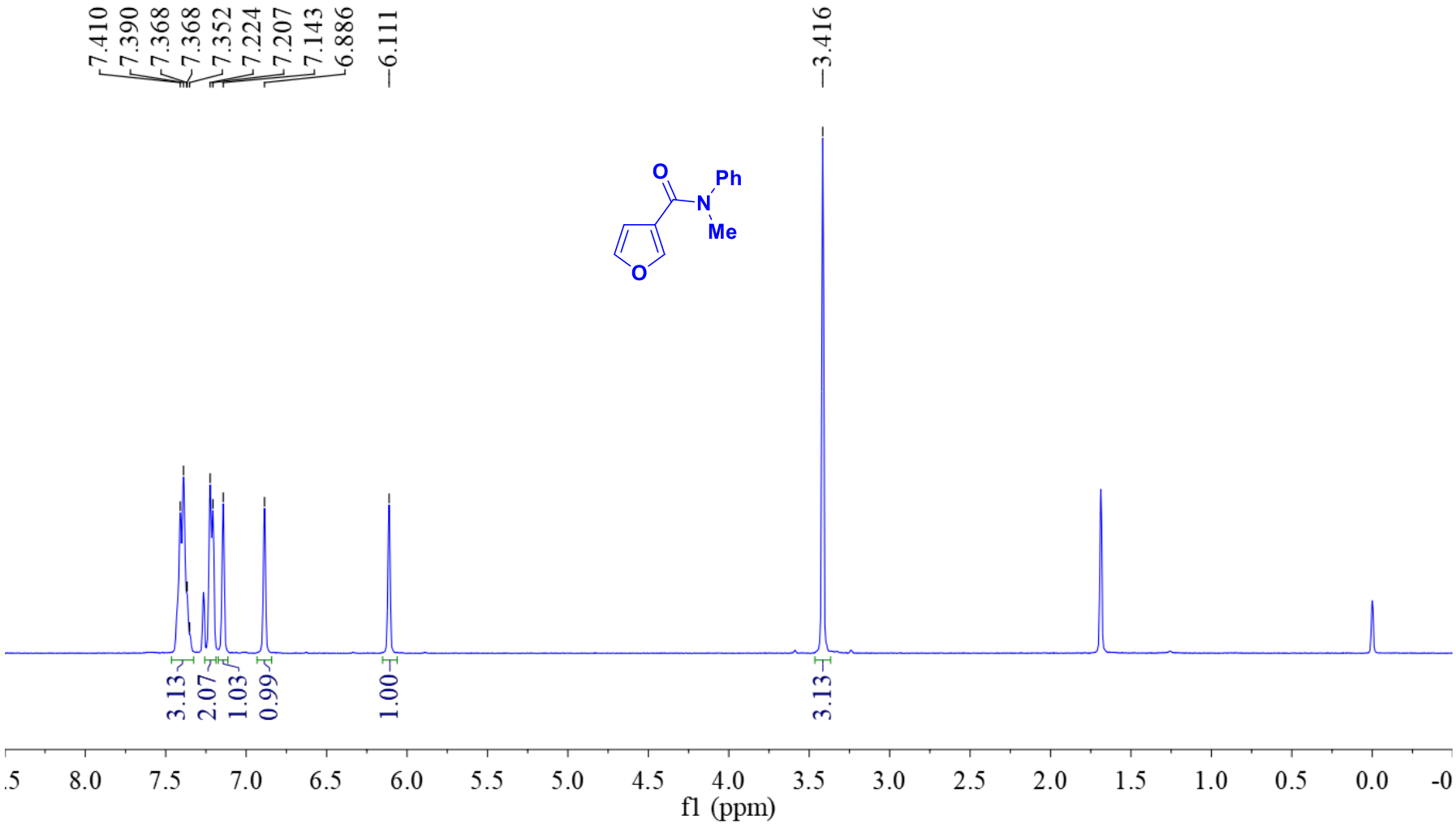


Figure S-24. $^{13}C\{^{1}H\}$ NMR spectrum of **(2s)** ($CDCl_3$, 100 MHz) ***N*-methyl-*N*-phenylfuran-3-carboxamide**

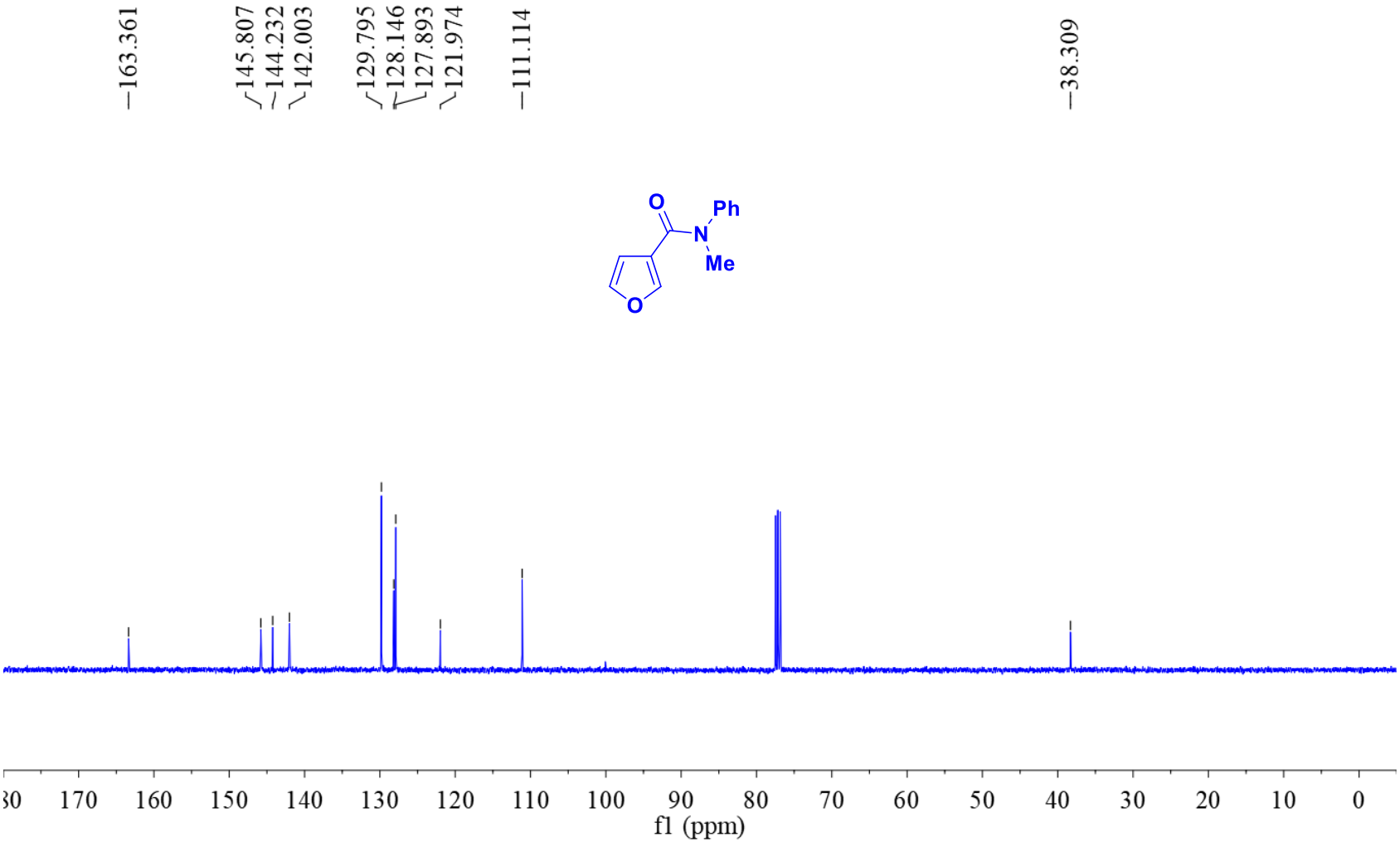


Figure S-25. ^{1}H NMR spectrum of **(3c)** ($CDCl_3$, 400 MHz) **1-methylcyclohexanecarboxaldehyde**

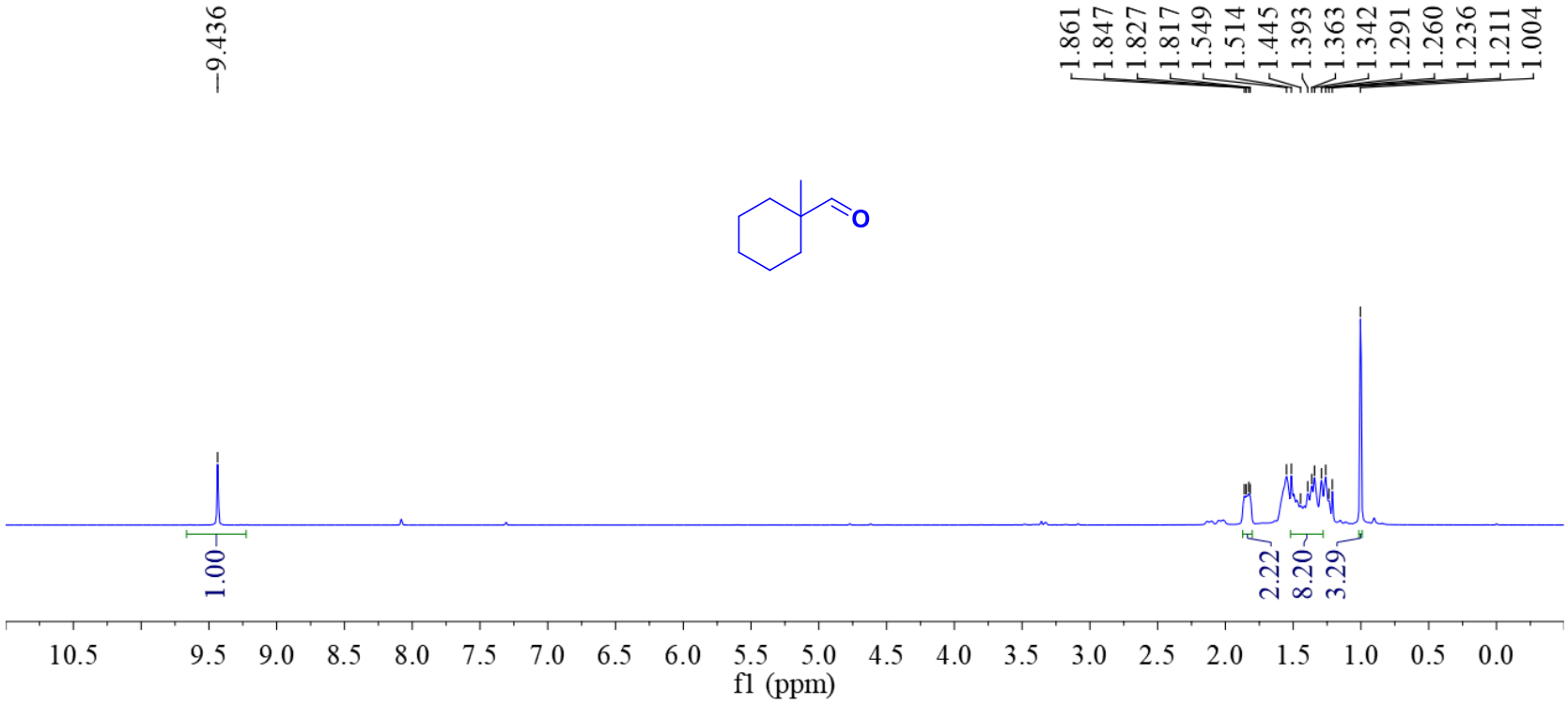


Figure S-26. ^{1}H NMR spectrum of **(1a)** ($CDCl_3$, 400 MHz) **5-(*tert*-butyl)-*N*-methyl-*N*-phenylfuran-2-carboxamide**

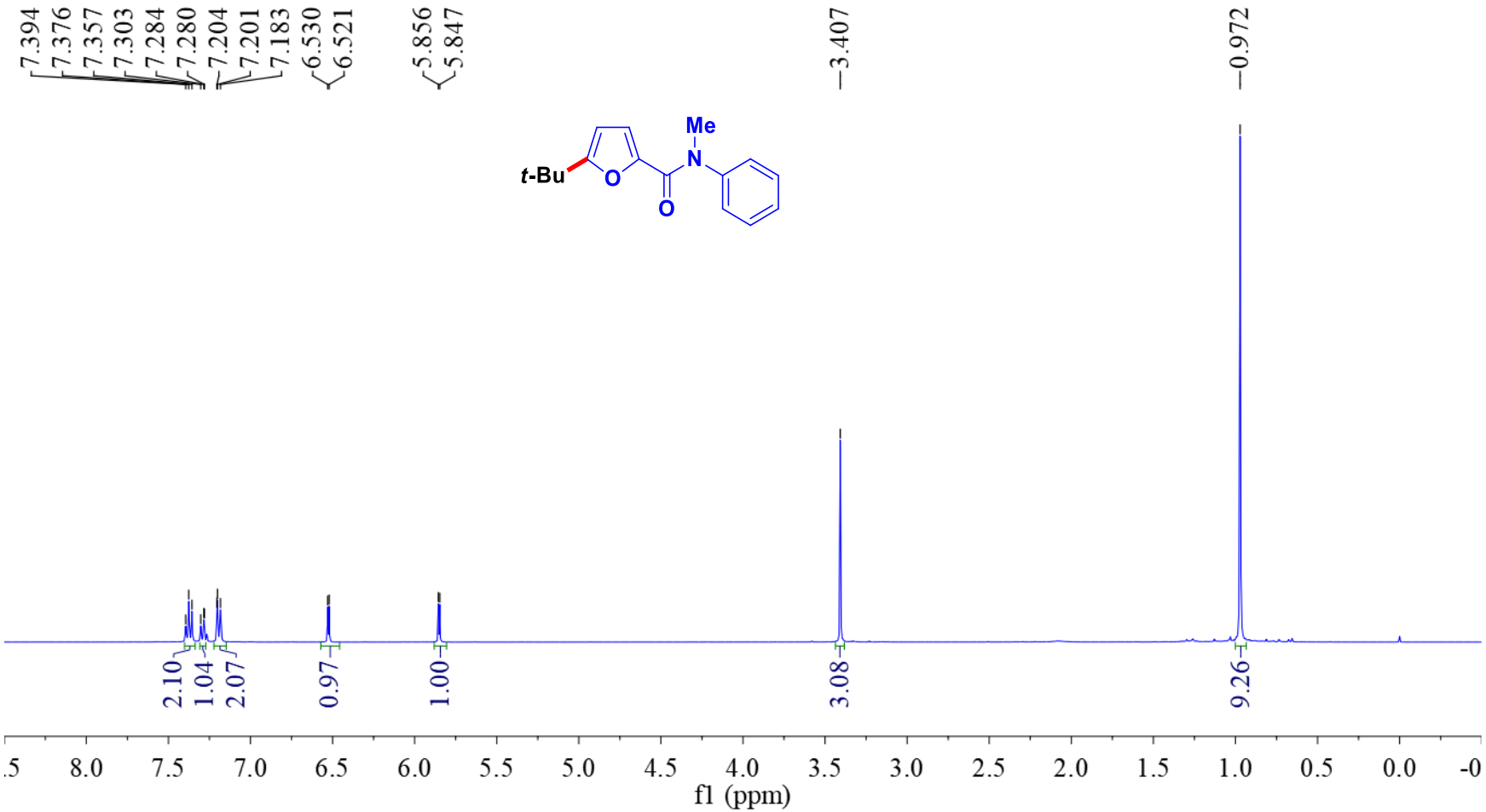


Figure S-27. $^{13}C\{^{1}H\}$ NMR spectrum of **(1a)** ($CDCl_3$, 100 MHz) **5-(*tert*-butyl)-*N*-methyl-*N*-phenylfuran-2-carboxamide**

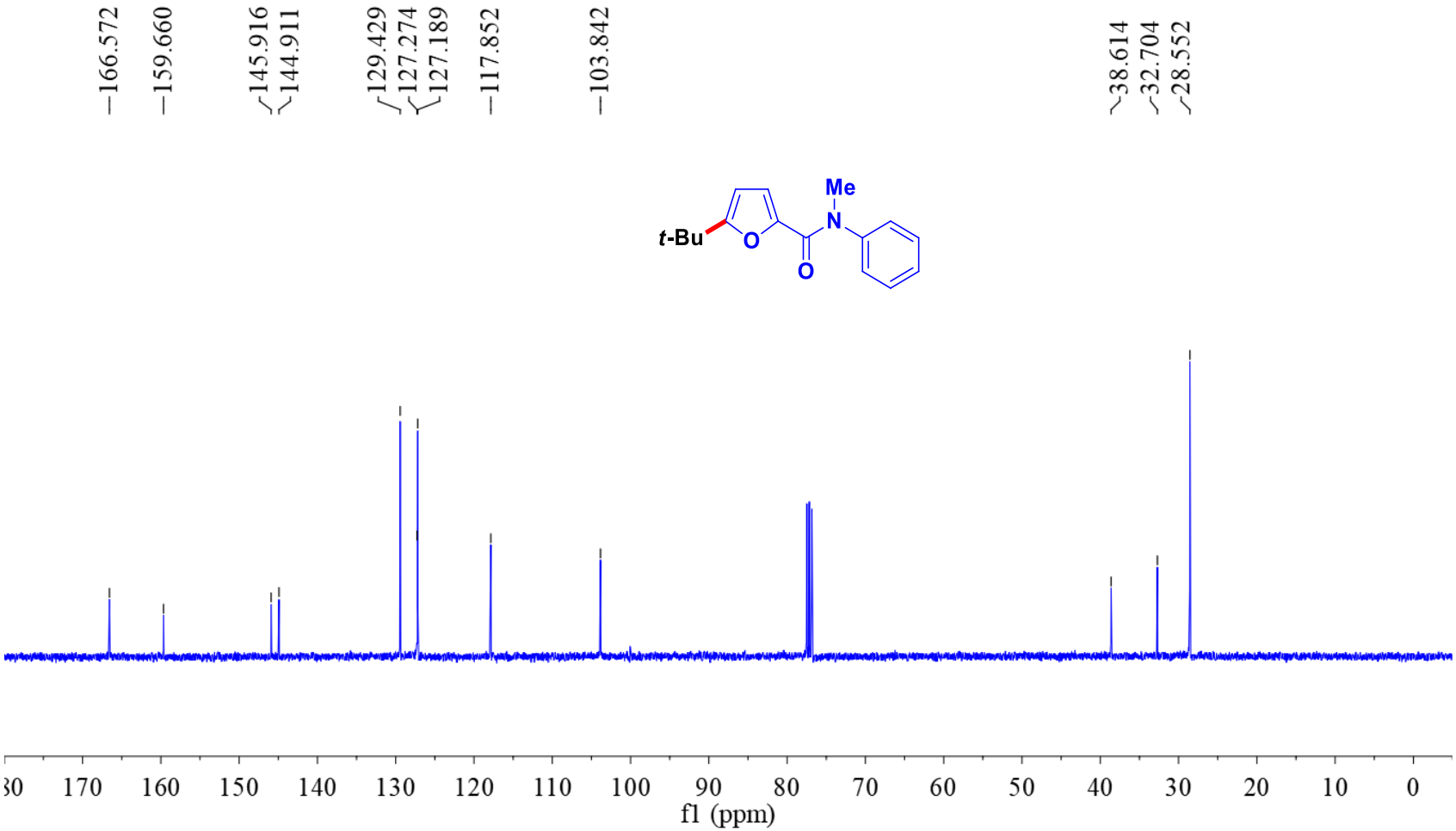


Figure S-28. ^{1}H NMR spectrum of **(1b)** ($CDCl_3$, 400 MHz) **5-(*tert*-butyl)-*N*, *N*-dimethylfuran-2-carboxamide**

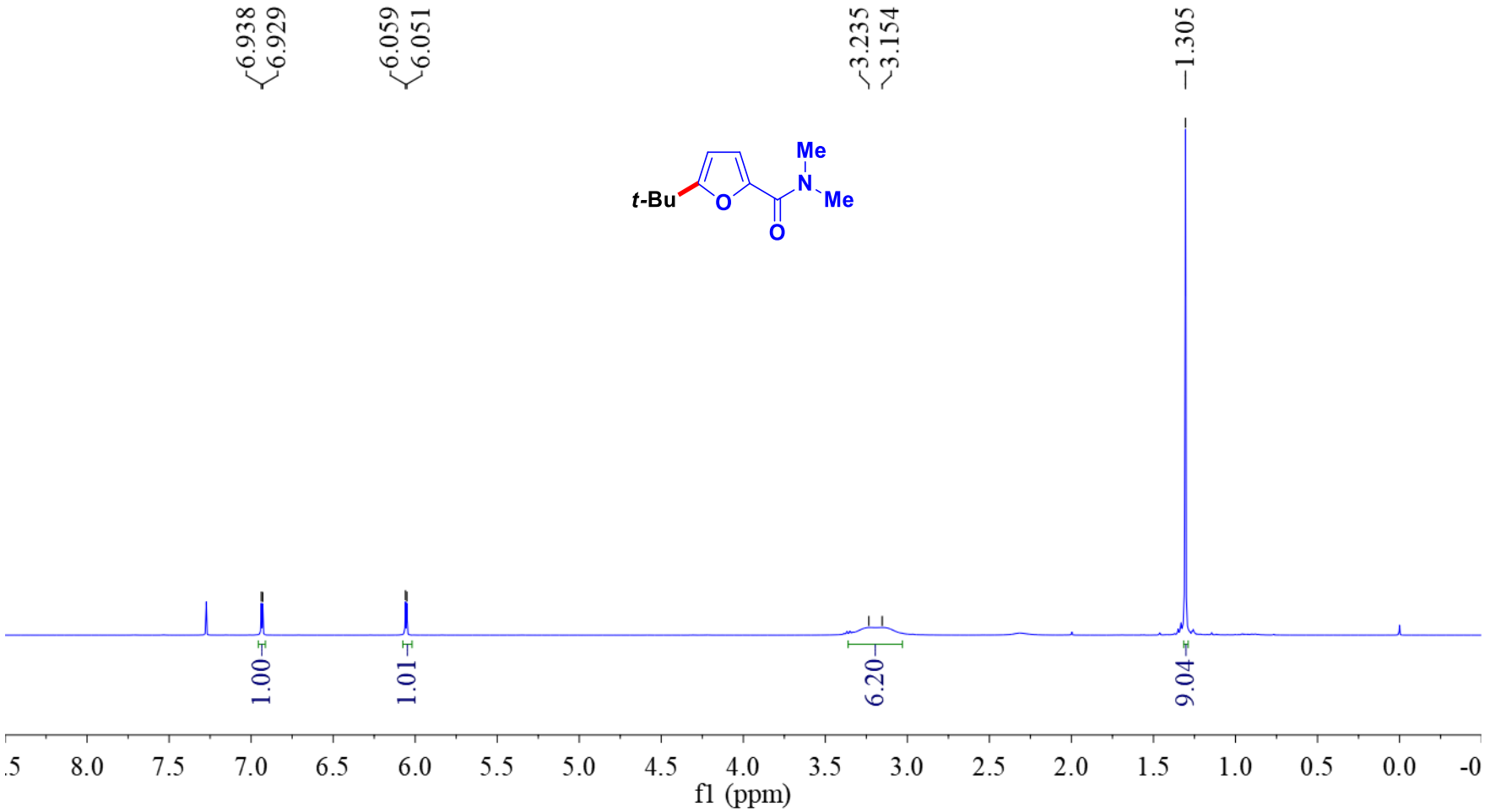


Figure S-29. $^{13}C\{^{1}H\}$ NMR spectrum of **(1b)** ($CDCl_3$, 100 MHz) **5-(*tert*-butyl)-*N*, *N*-dimethylfuran-2-carboxamide**

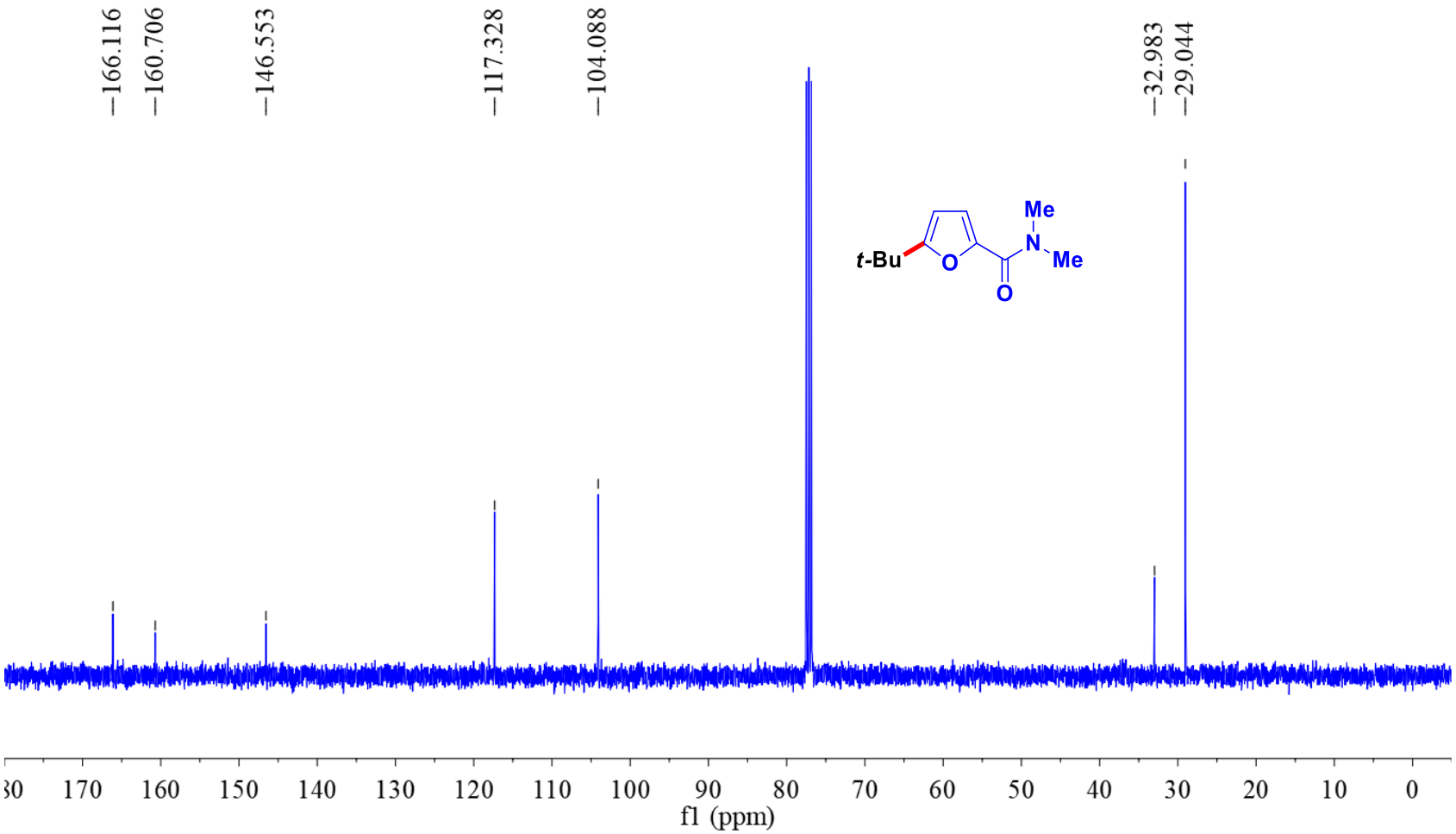


Figure S-30. ^{1}H NMR spectrum of **(1c)** ($CDCl_3$, 400 MHz) **5-(*tert*-butyl)-*N*, *N*-diethylfuran-2-carboxamide**

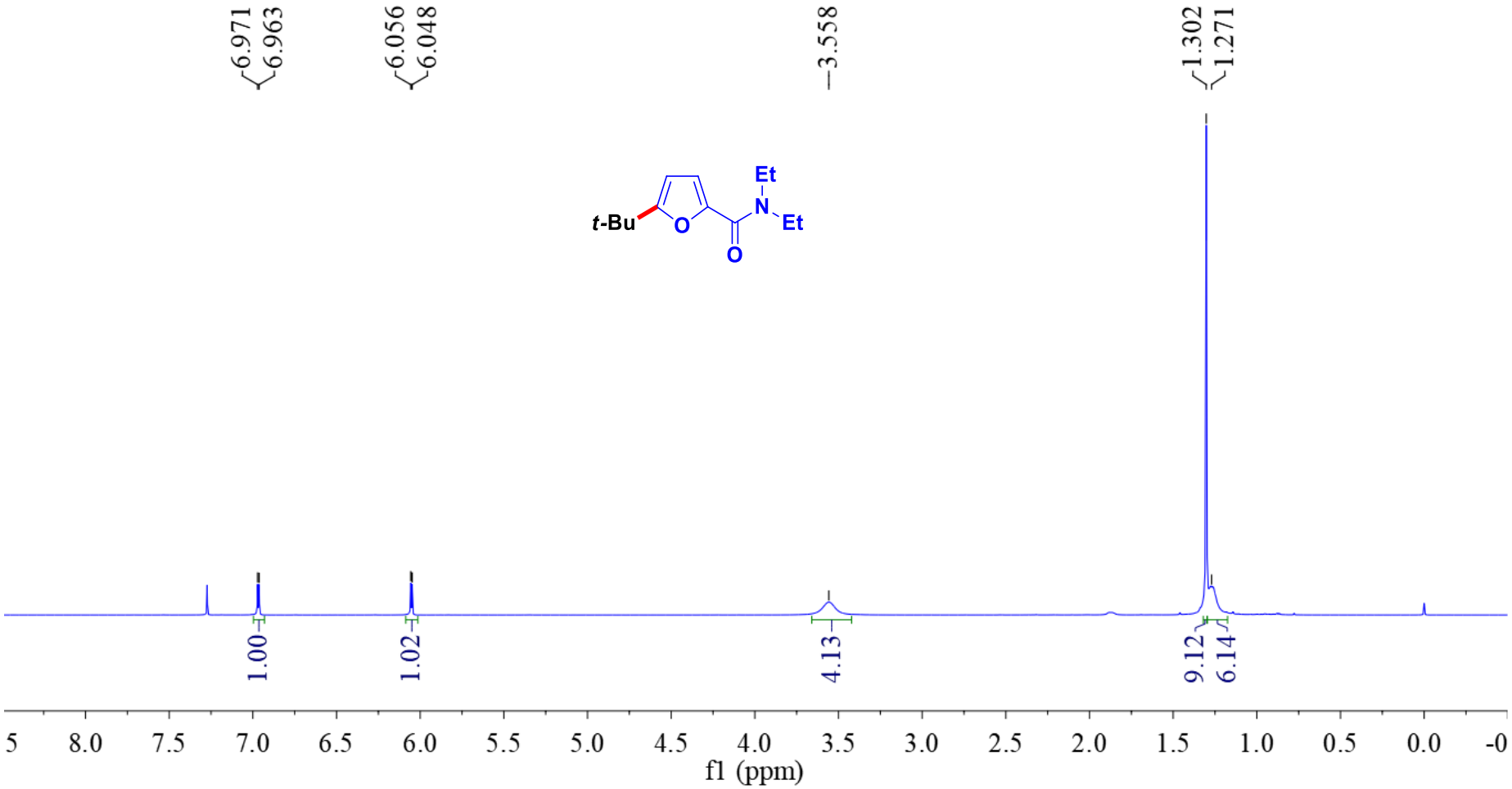


Figure S-31. $^{13}C\{^{1}H\}$ NMR spectrum of **(1c)** ($CDCl_3$, 100 MHz) **5-(*tert*-butyl)-*N*, *N*-diethylfuran-2-carboxamide**

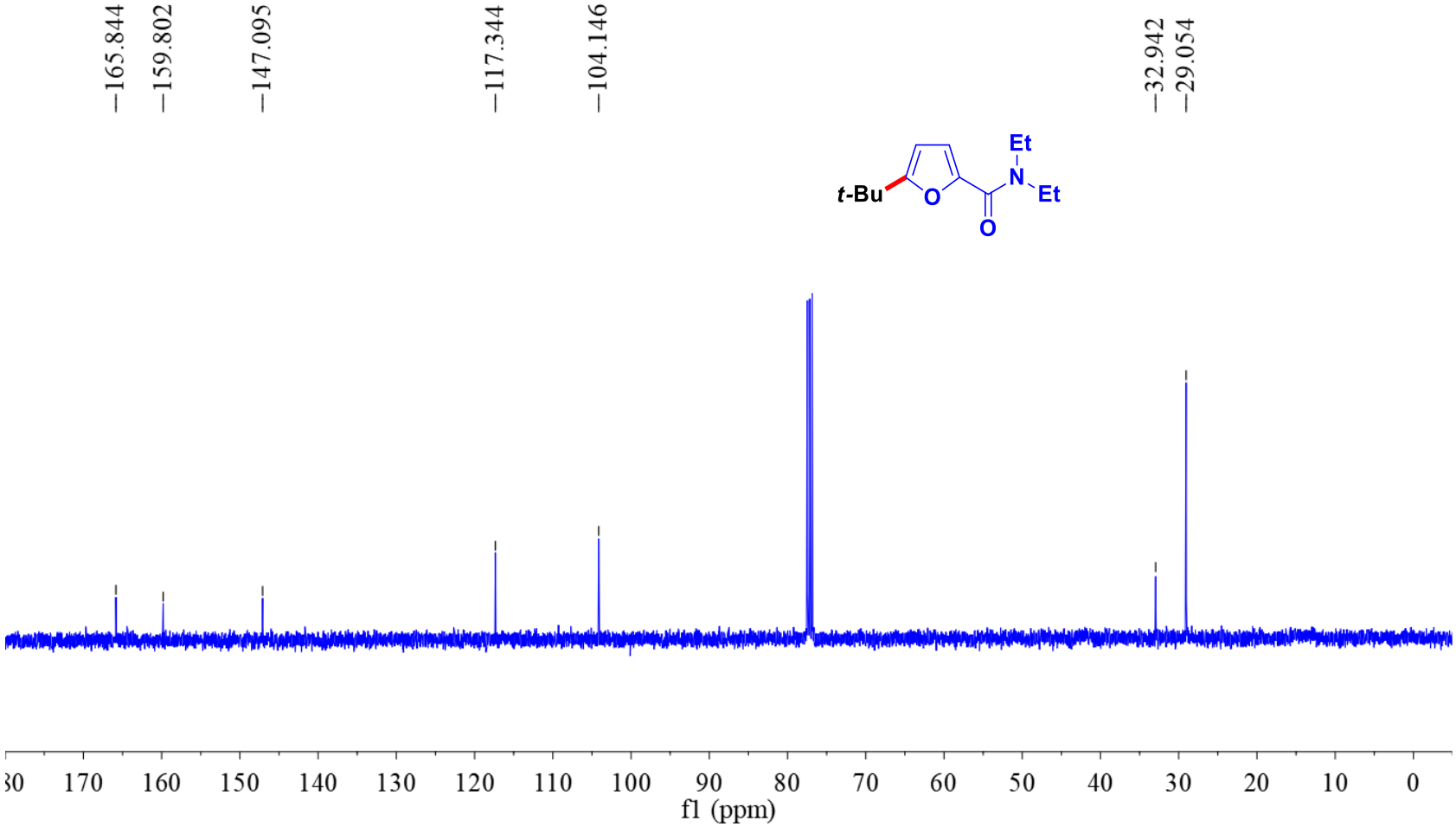


Figure S-32. ^{1}H NMR spectrum of **(1d)** ($CDCl_3$, 400 MHz) ***N*-(2-bromophenyl)-5-(*tert*-butyl)-*N*-methylfuran-2-carboxamide**

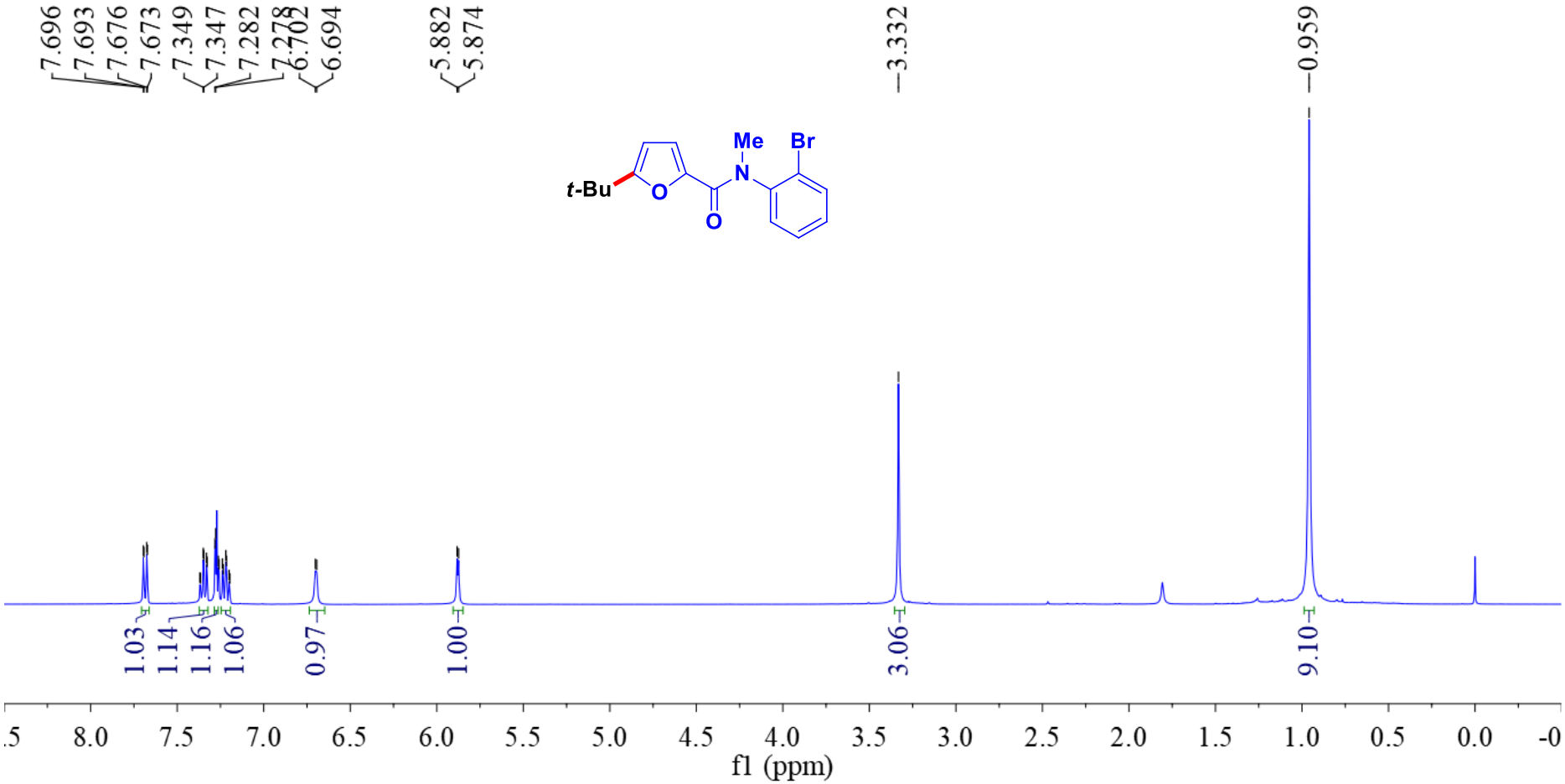


Figure S-33. $^{13}C\{^{1}H\}$ NMR spectrum of **(1d)** ($CDCl_3$, 100 MHz) ***N*-(2-bromophenyl)-5-(*tert*-butyl)-*N*-methylfuran-2-carboxamide**

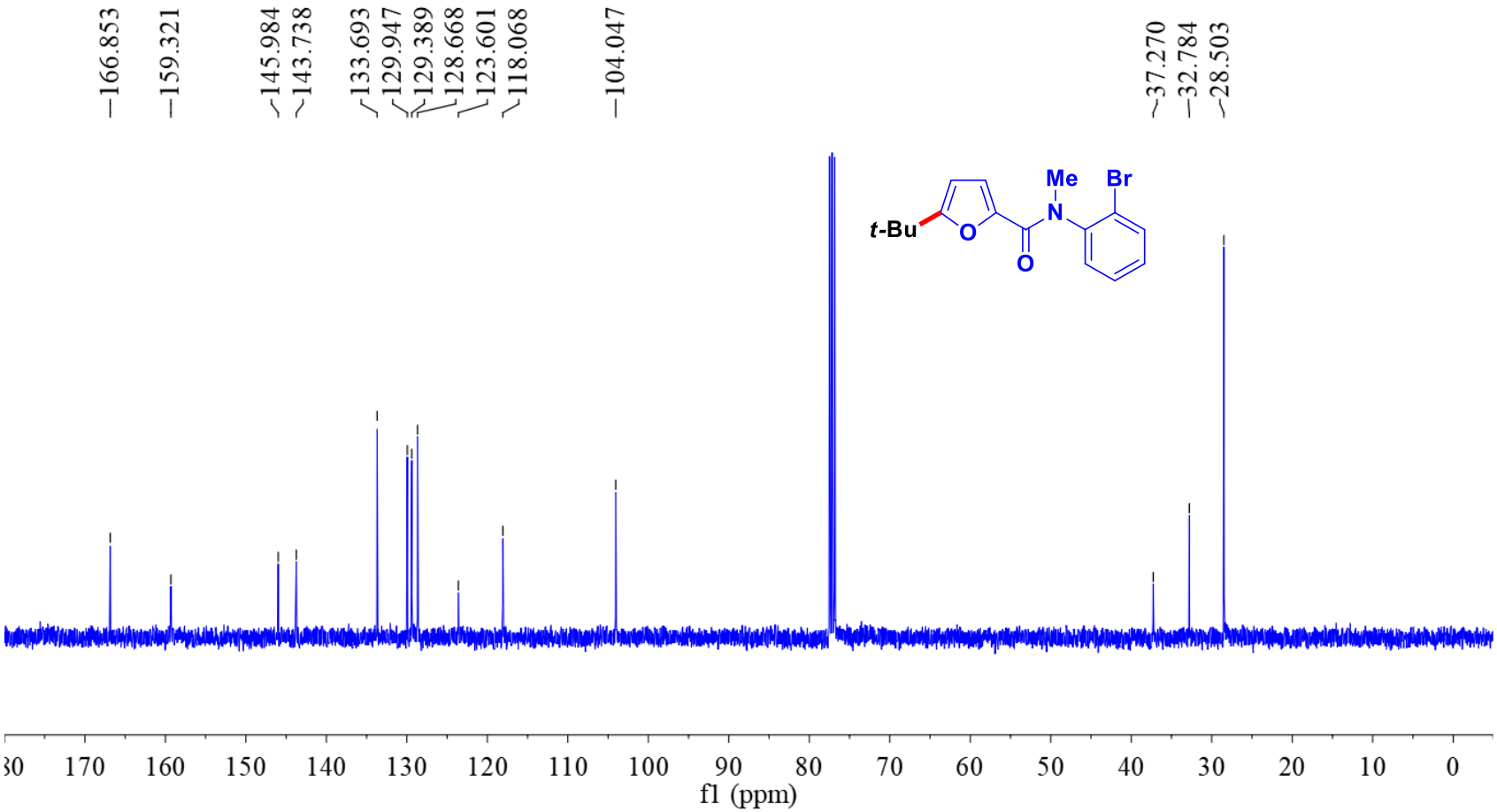


Figure S-34. ^{1}H NMR spectrum of **(1e)** ($CDCl_3$, 400 MHz) **5-(*tert*-butyl)-*N*-(3-methoxyphenyl)-*N*-methylfuran-2-carboxamide**

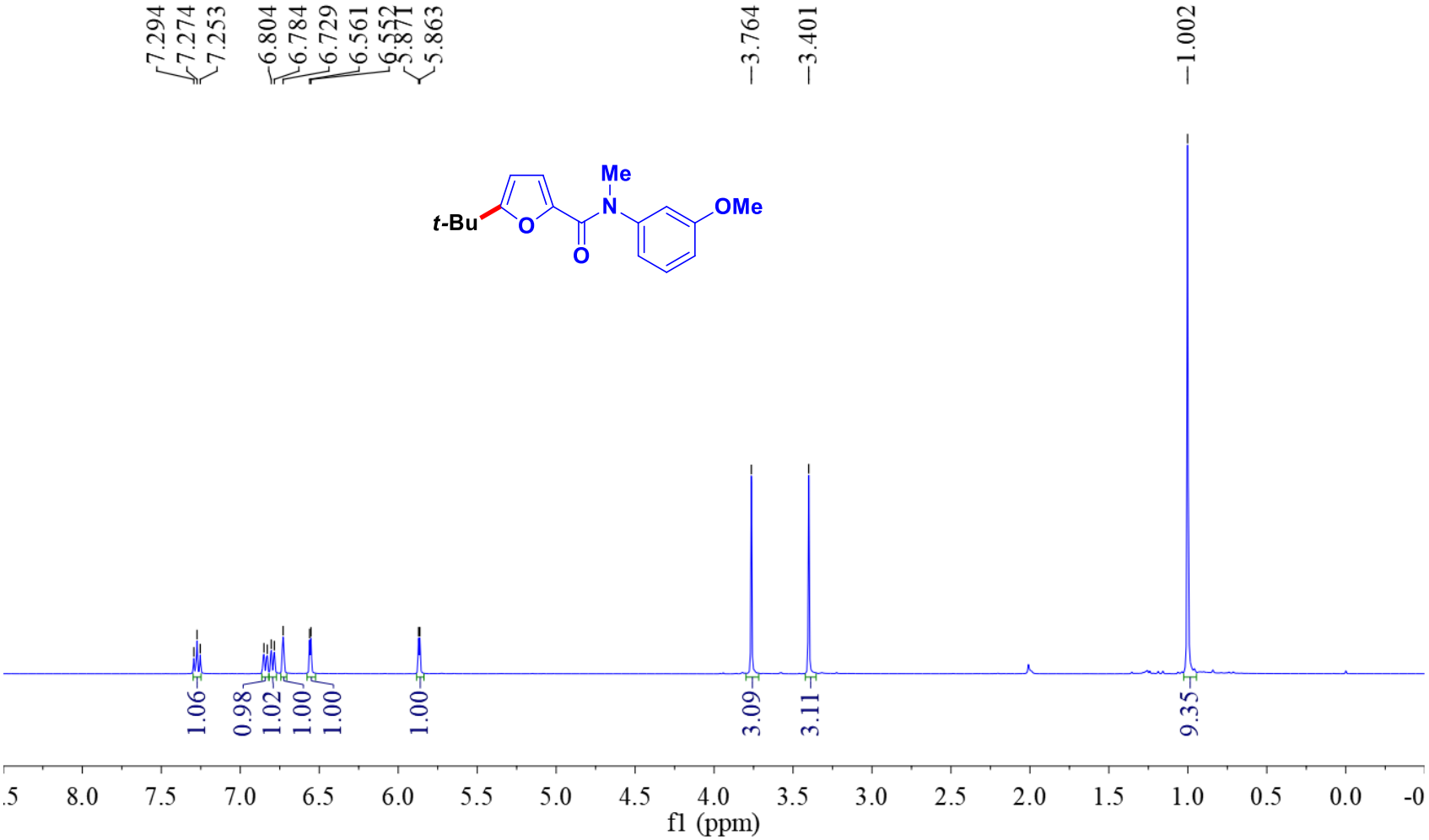


Figure S-35. $^{13}C\{^{1}H\}$ NMR spectrum of **(1e)** ($CDCl_3$, 100 MHz) **5-(*tert*-butyl)-*N*-(3-methoxyphenyl)-*N*-methylfuran-2-carboxamide**

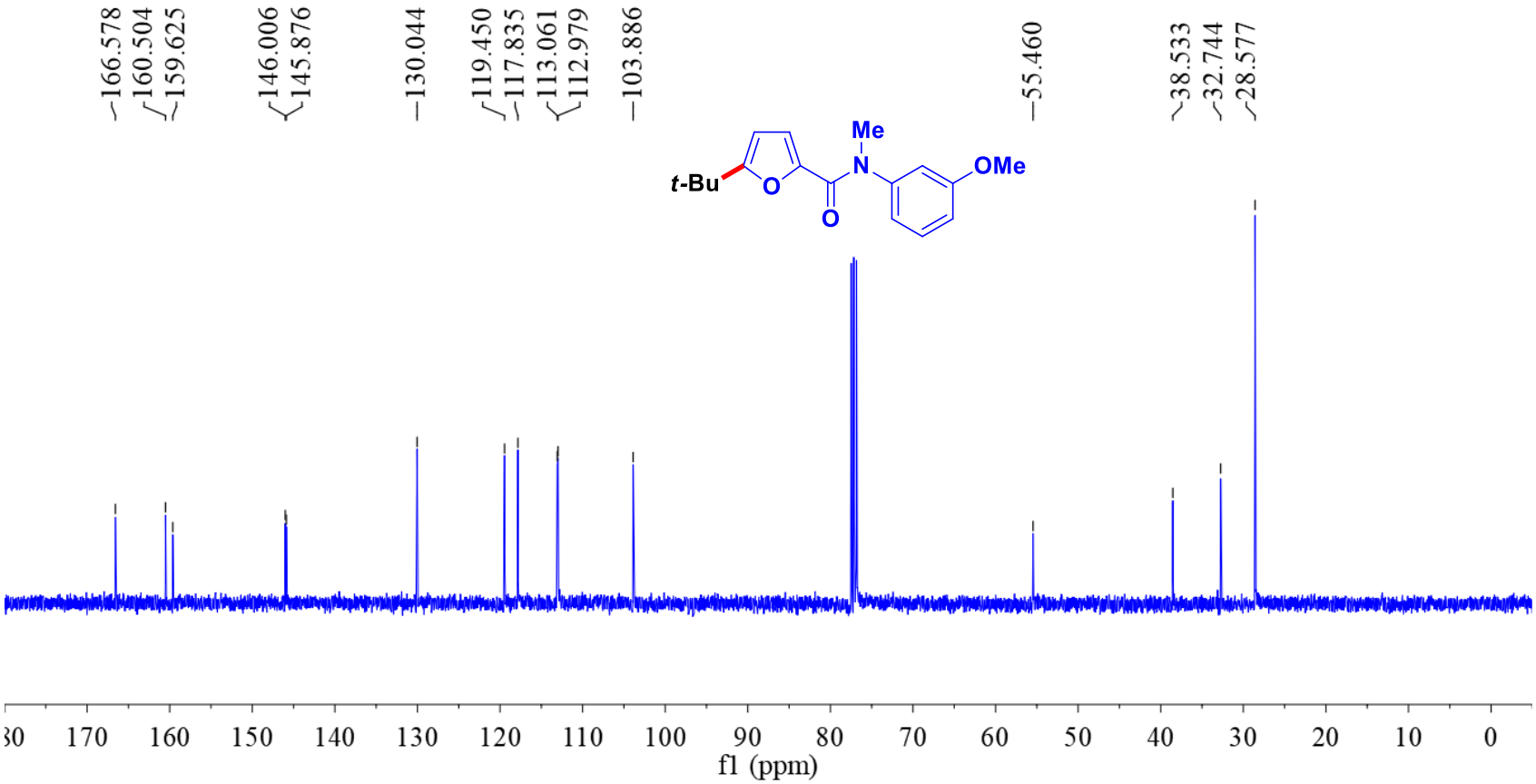


Figure S-36. ^{1}H NMR spectrum of **(1f)** ($CDCl_3$, 400 MHz) **(5-(*tert*-butyl)furan-2-yl)(pyrrolidin-1-yl)methanone**

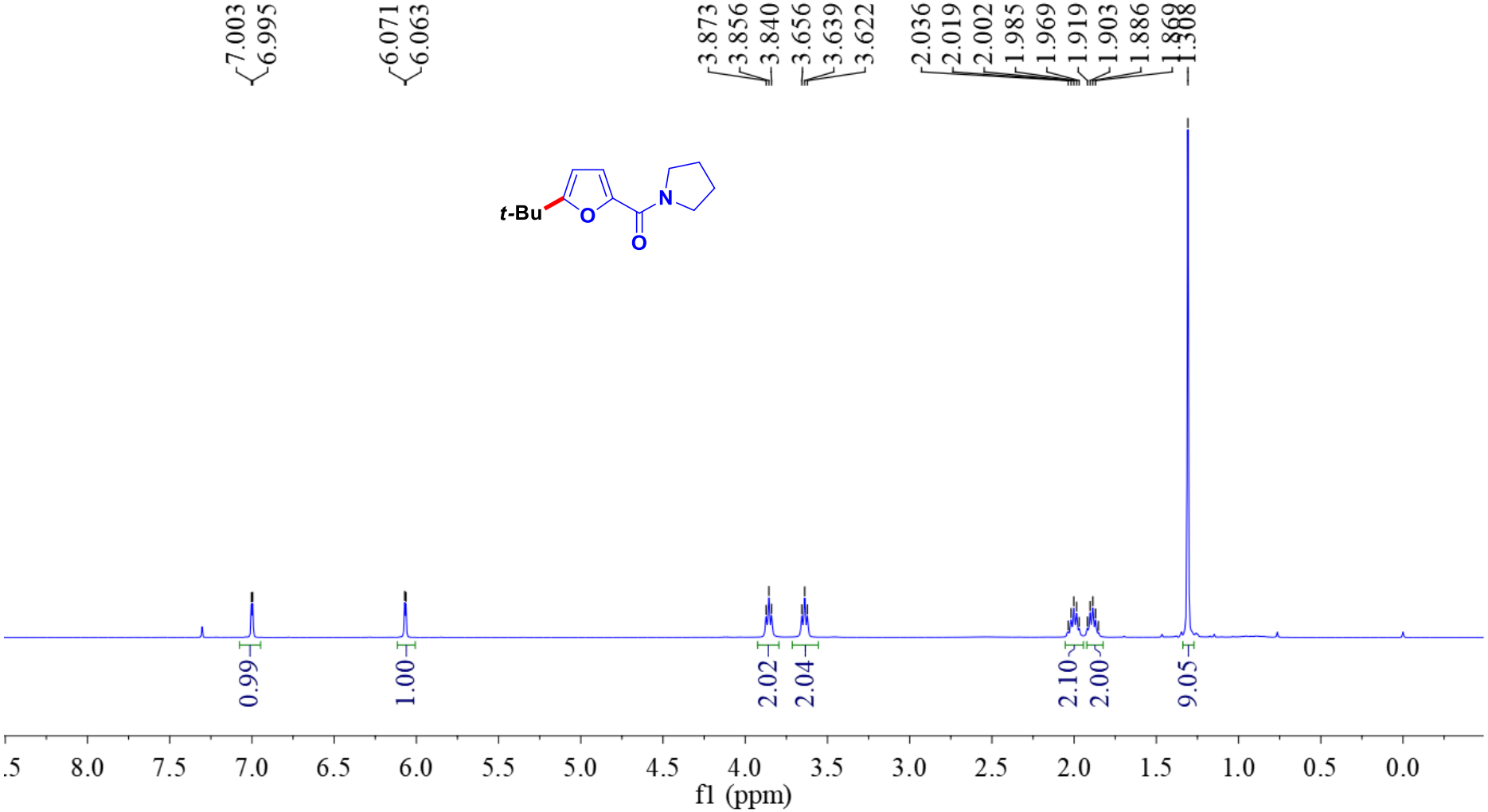


Figure S-37. $^{13}C\{^{1}H\}$ NMR spectrum of **(1f)** ($CDCl_3$, 100 MHz) **(5-(*tert*-butyl)furan-2-yl)(pyrrolidin-1-yl)methanone**

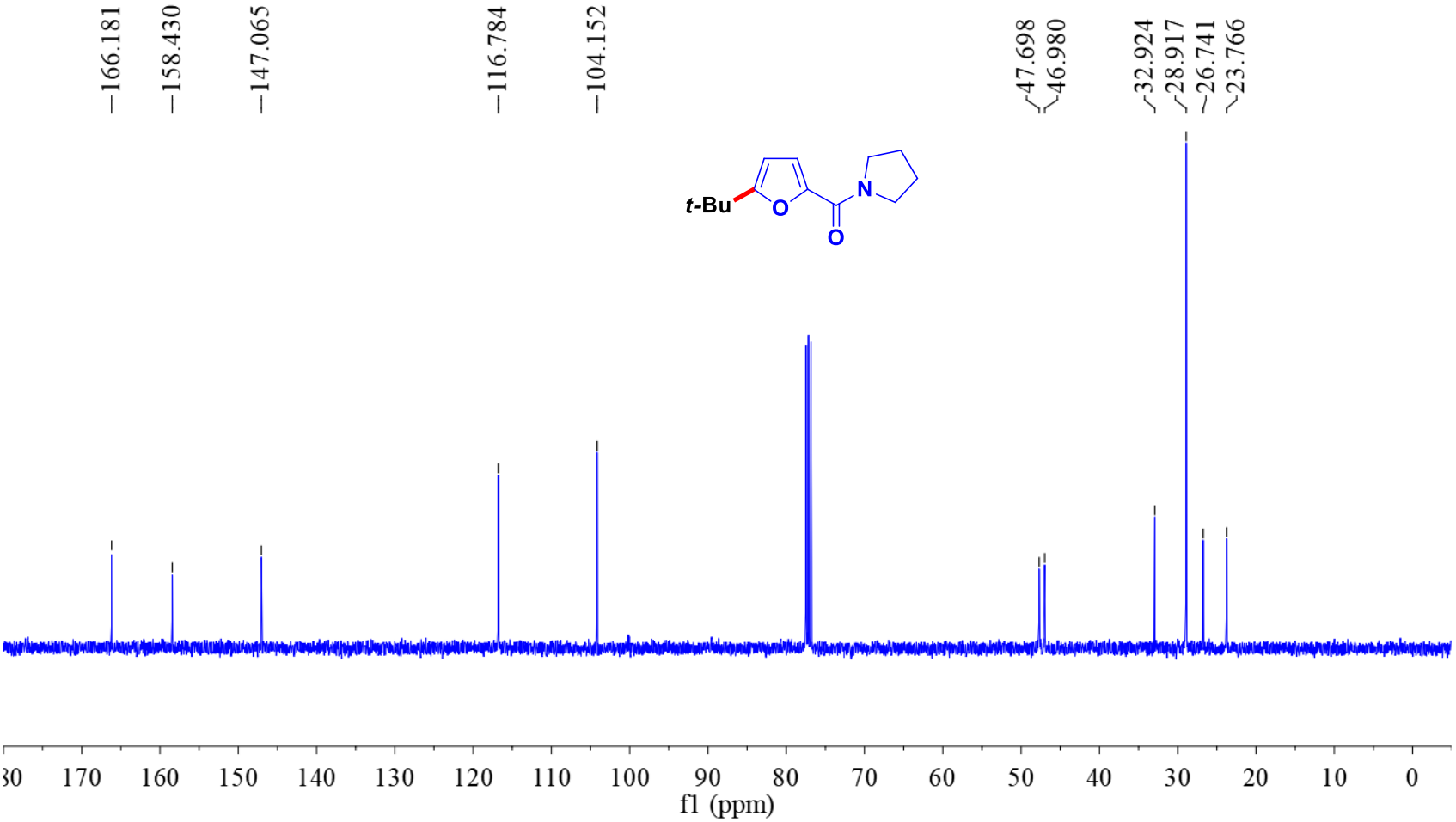


Figure S-38. ^{1}H NMR spectrum of **(1g)** ($CDCl_3$, 400 MHz) **(5-(*tert*-butyl)furan-2-yl)(piperidin-1-yl)methanone**

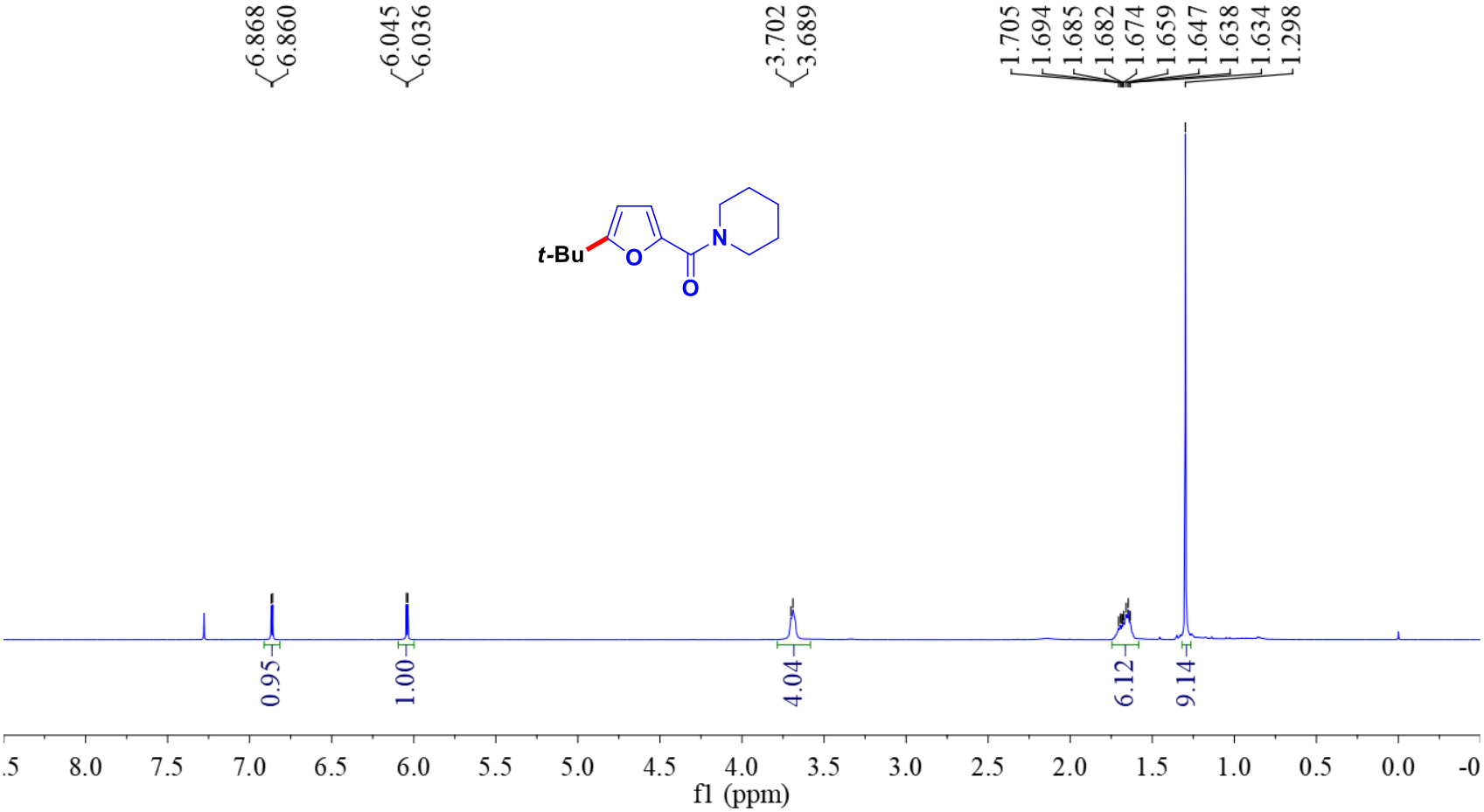


Figure S-39. $^{13}C\{^{1}H\}$ NMR spectrum of **(1g)** ($CDCl_3$, 100 MHz) **(5-(*tert*-butyl)furan-2-yl)(piperidin-1-yl)methanone**

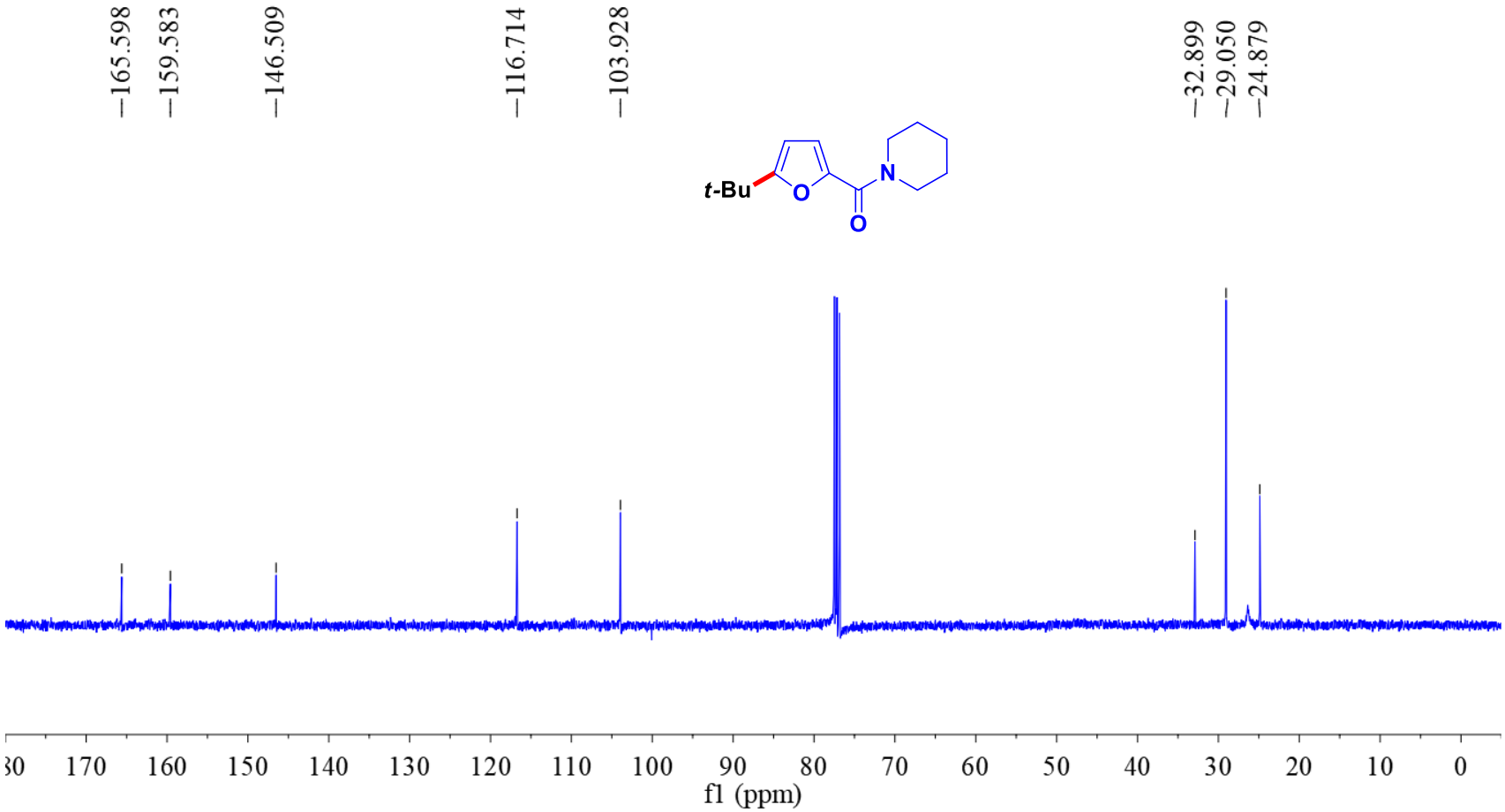


Figure S-40. ^{1}H NMR spectrum of **(1h)** ($CDCl_3$, 400 MHz) **5-(*tert*-butyl)-*N*-methoxy-*N*-methylfuran-2-carboxamide**

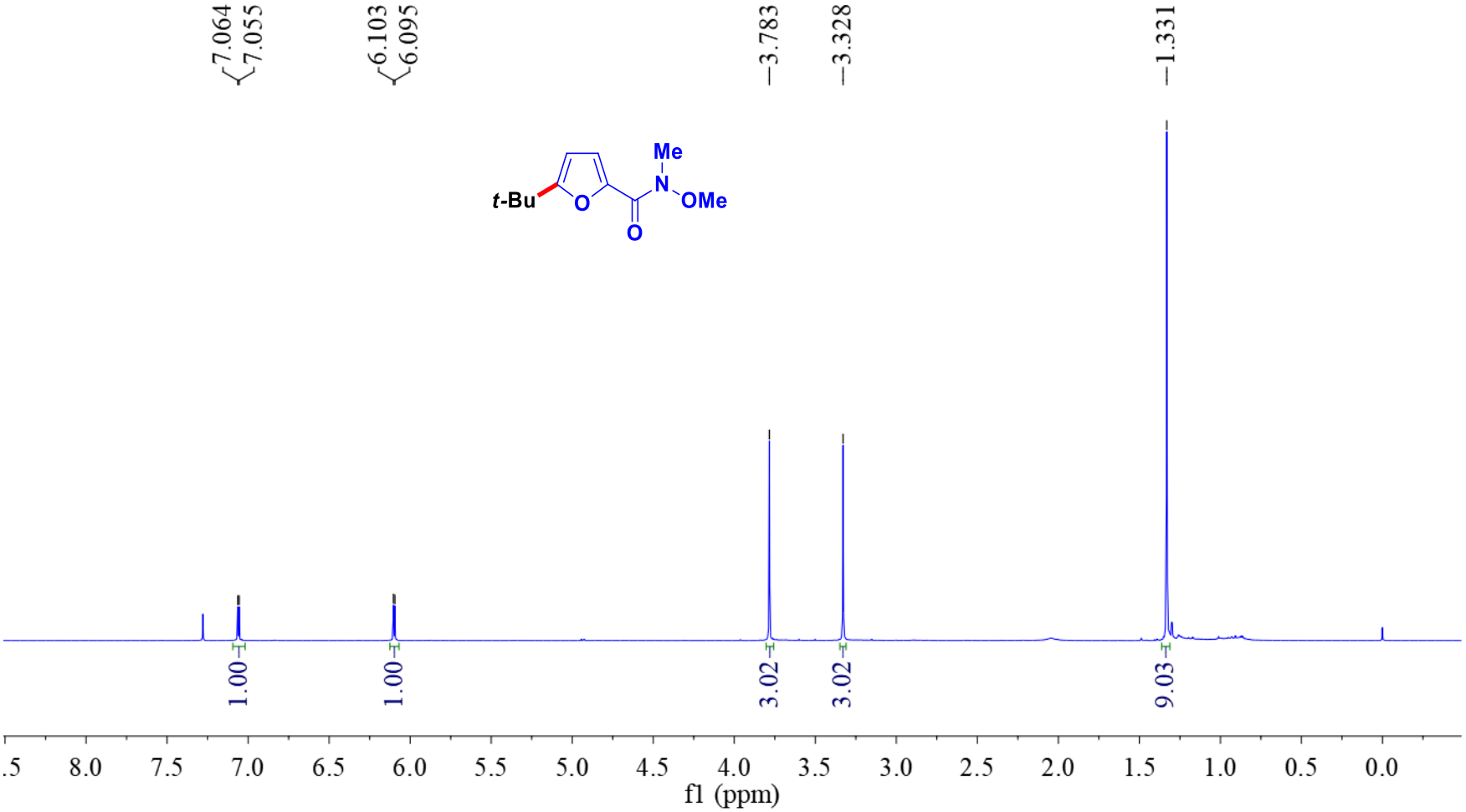


Figure S-41. $^{13}C\{^{1}H\}$ NMR spectrum of **(1h)** ($CDCl_3$, 100 MHz) **5-(*tert*-butyl)-*N*-methoxy-*N*-methylfuran-2-carboxamide**

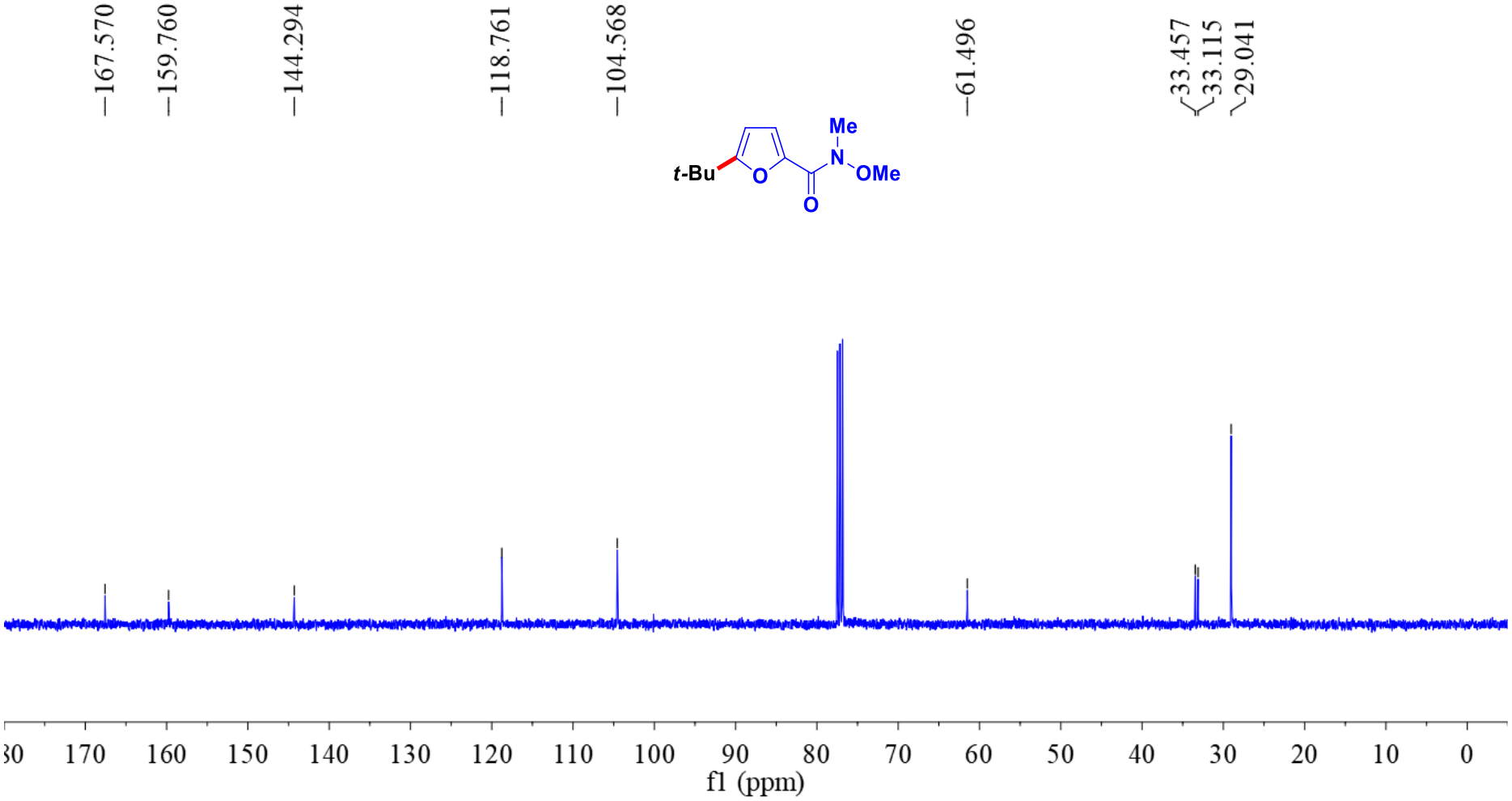


Figure S-42. ^{1}H NMR spectrum of **(1i)** ($CDCl_3$, 400 MHz) **methyl 5-(*tert*-butyl)furan-2-carboxylate**

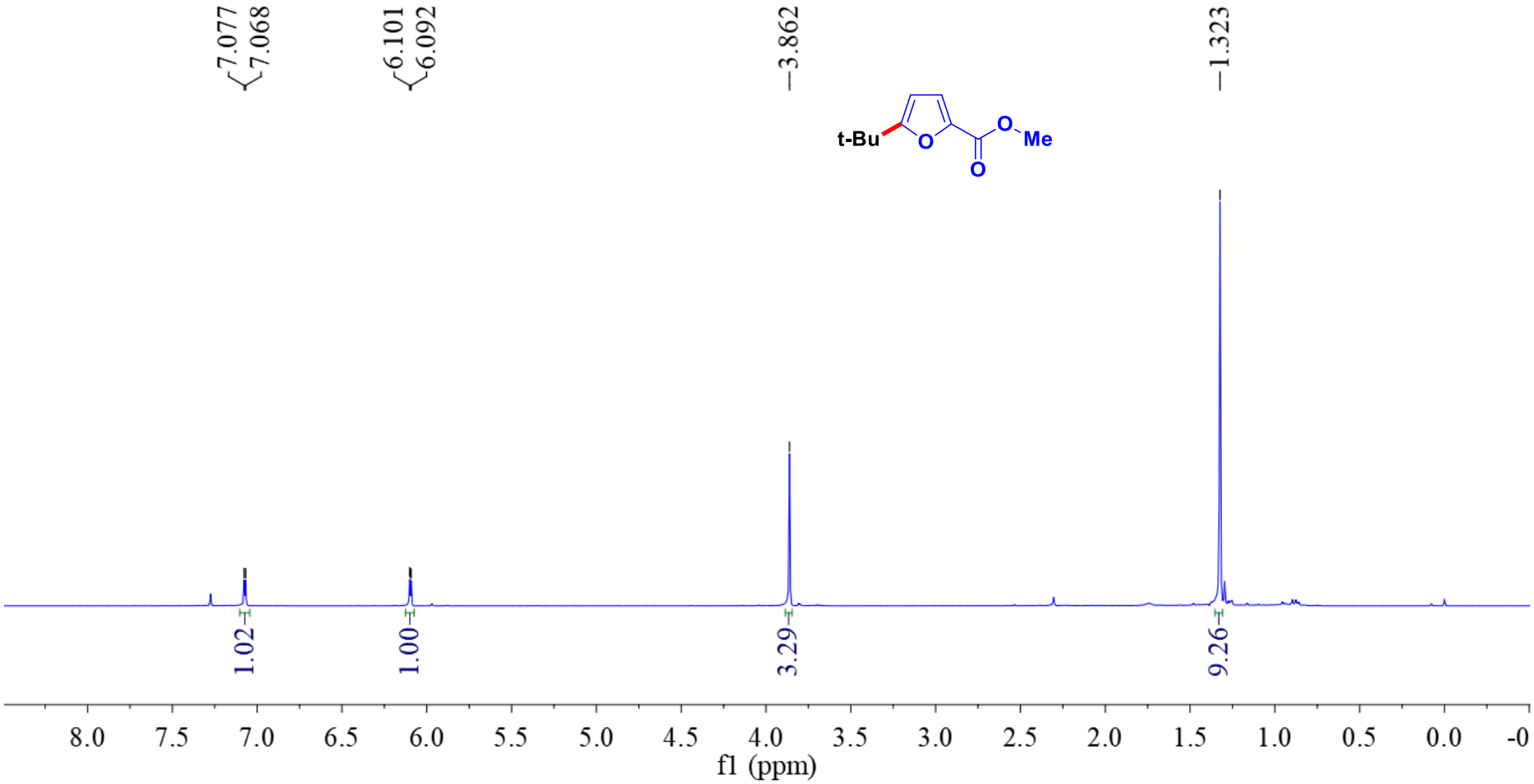


Figure S-43. $^{13}C\{^{1}H\}$ NMR spectrum of **(1i)** ($CDCl_3$, 100 MHz) **methyl 5-(*tert*-butyl)furan-2-carboxylate**

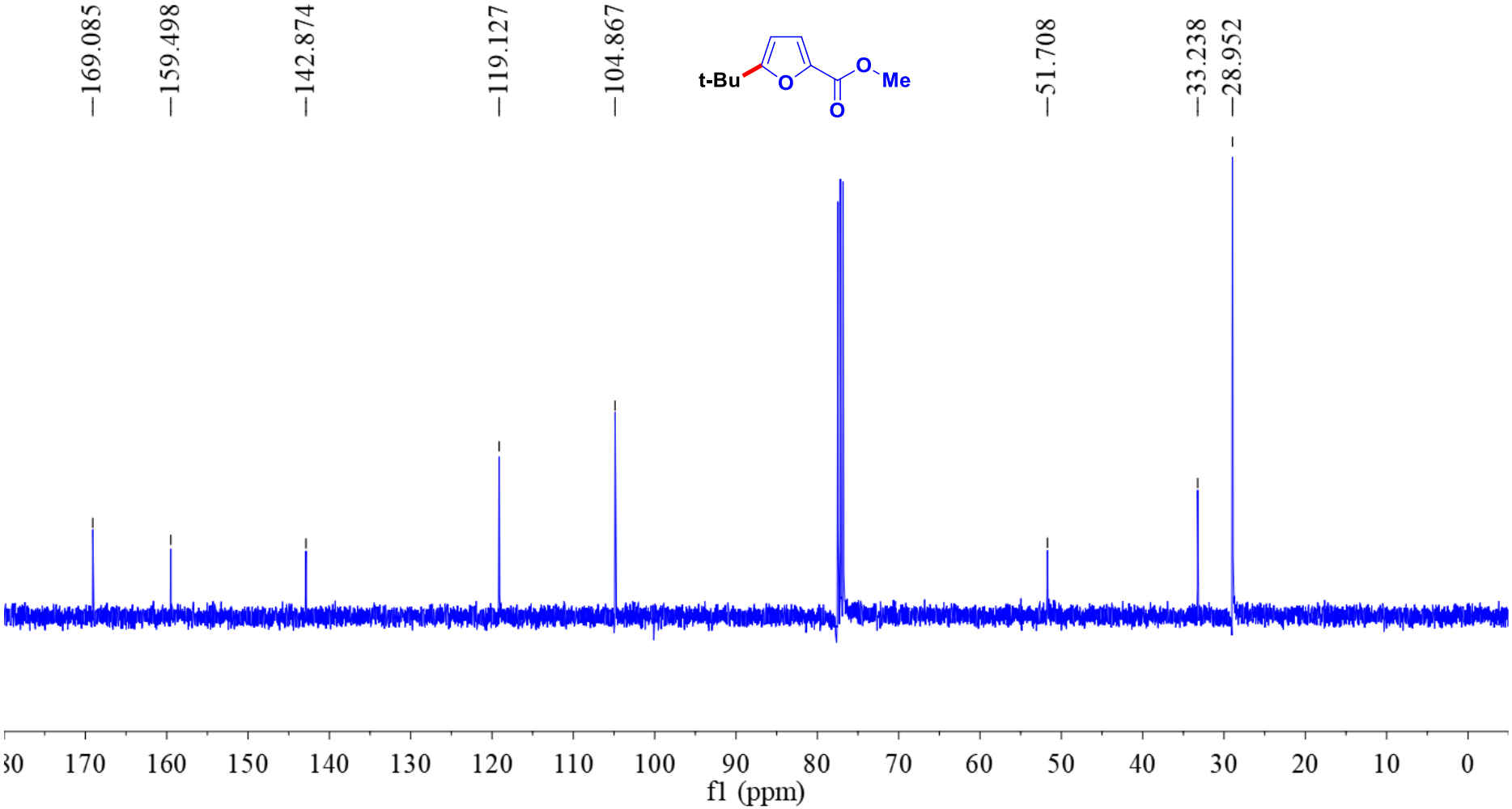


Figure S-44. ^{1}H NMR spectrum of **(1j)** ($CDCl_3$, 400 MHz) **ethyl 5-(*tert*-butyl)furan-2-carboxylate**

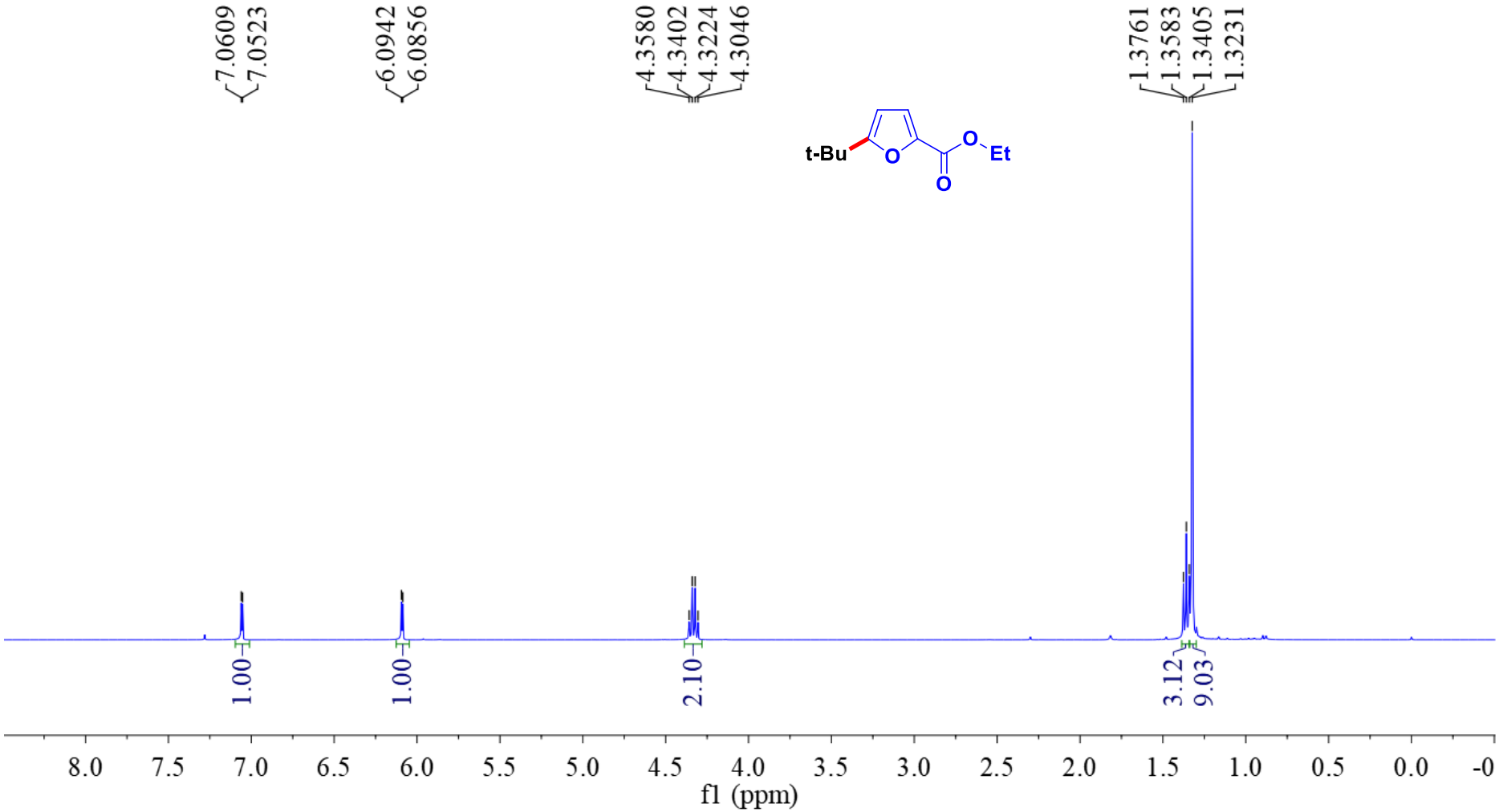


Figure S-45. $^{13}C\{^{1}H\}$ NMR spectrum of **(1j)** ($CDCl_3$, 100 MHz) **ethyl 5-(*tert*-butyl)furan-2-carboxylate**

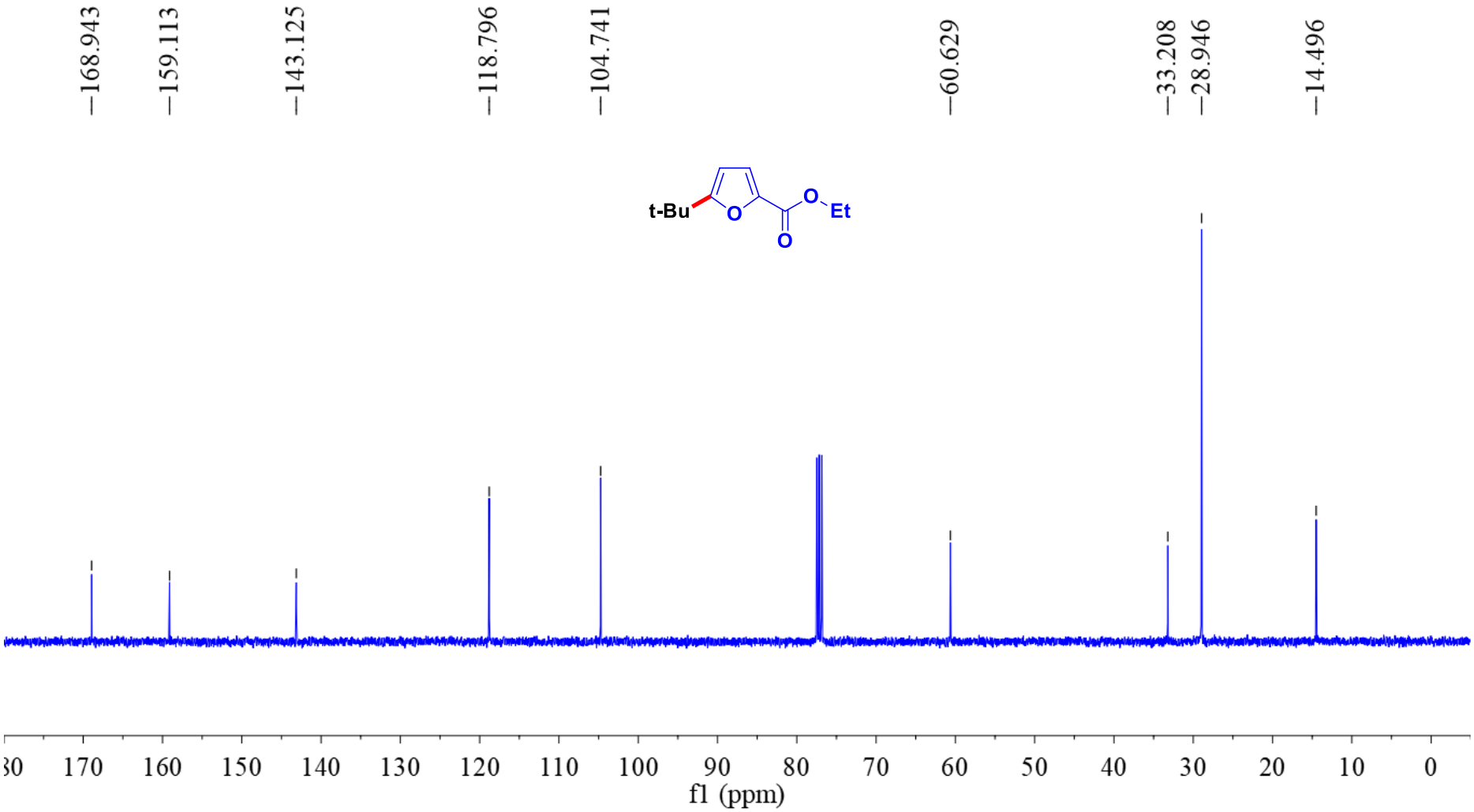


Figure S-46. ^{1}H NMR spectrum of **(1k)** ($CDCl_3$, 400 MHz) **isopropyl 5-(*tert*-butyl)furan-2-carboxylate**

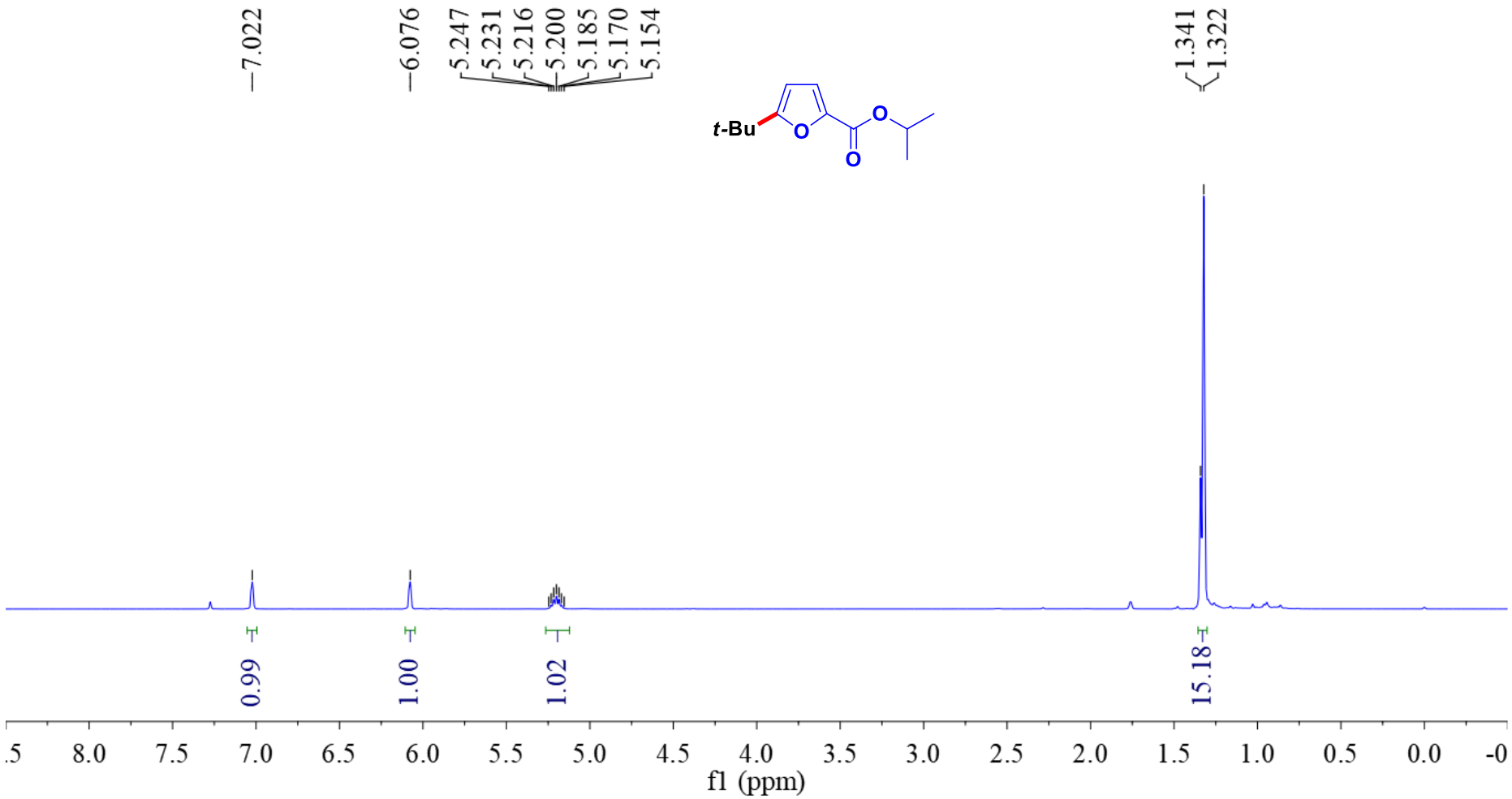


Figure S-47. $^{13}C\{^{1}H\}$ NMR spectrum of **(1k)** ($CDCl_3$, 100 MHz) **isopropyl 5-(*tert*-butyl)furan-2-carboxylate**

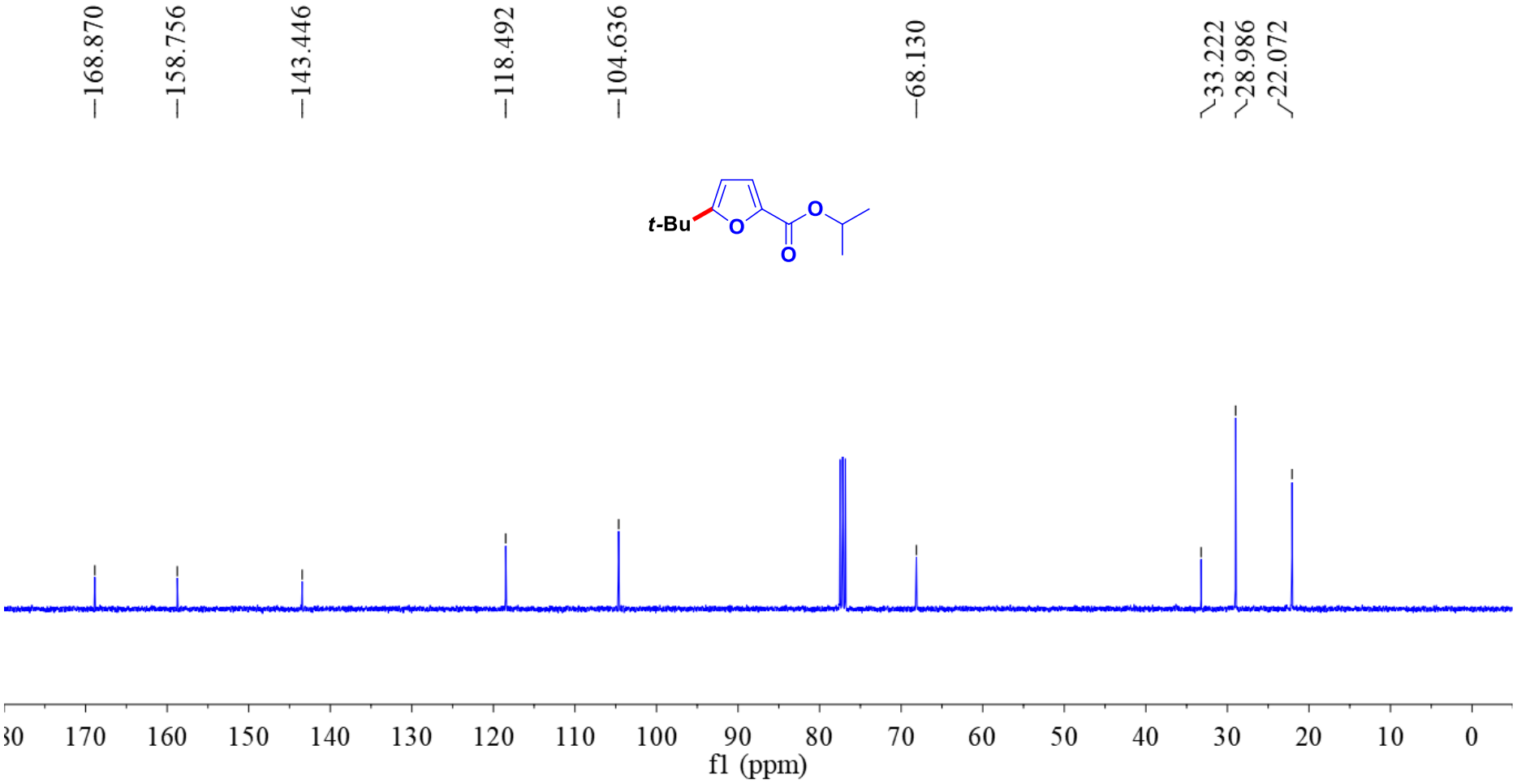


Figure S-48. ^{1}H NMR spectrum of **(1l)** ($CDCl_3$, 400 MHz) **(5-(*tert*-butyl)furan-2-yl)(phenyl)methanone**

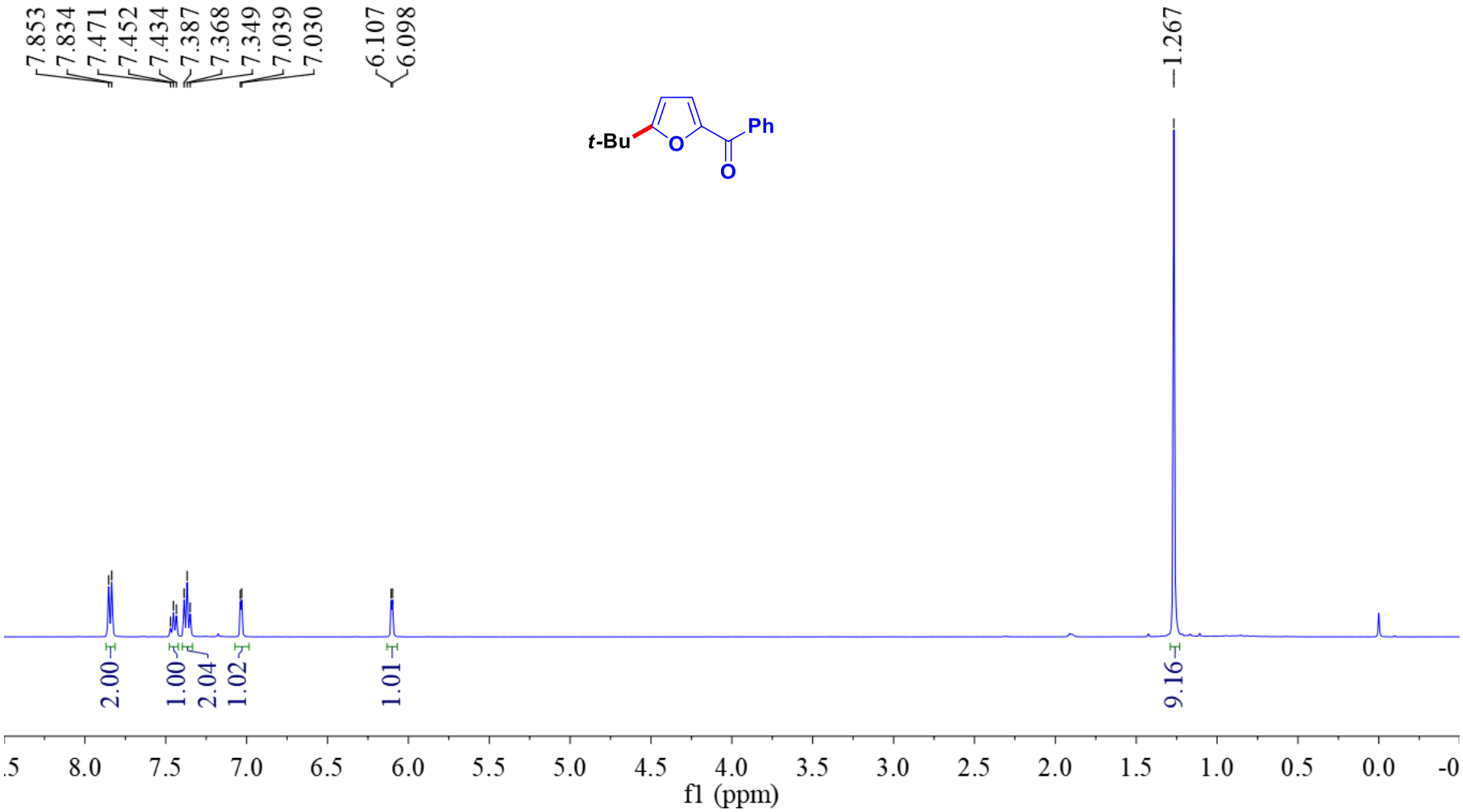


Figure S-49. $^{13}C\{^{1}H\}$ NMR spectrum of **(1l)** ($CDCl_3$, 100 MHz) **(5-(*tert*-butyl)furan-2-yl)(phenyl)methanone**

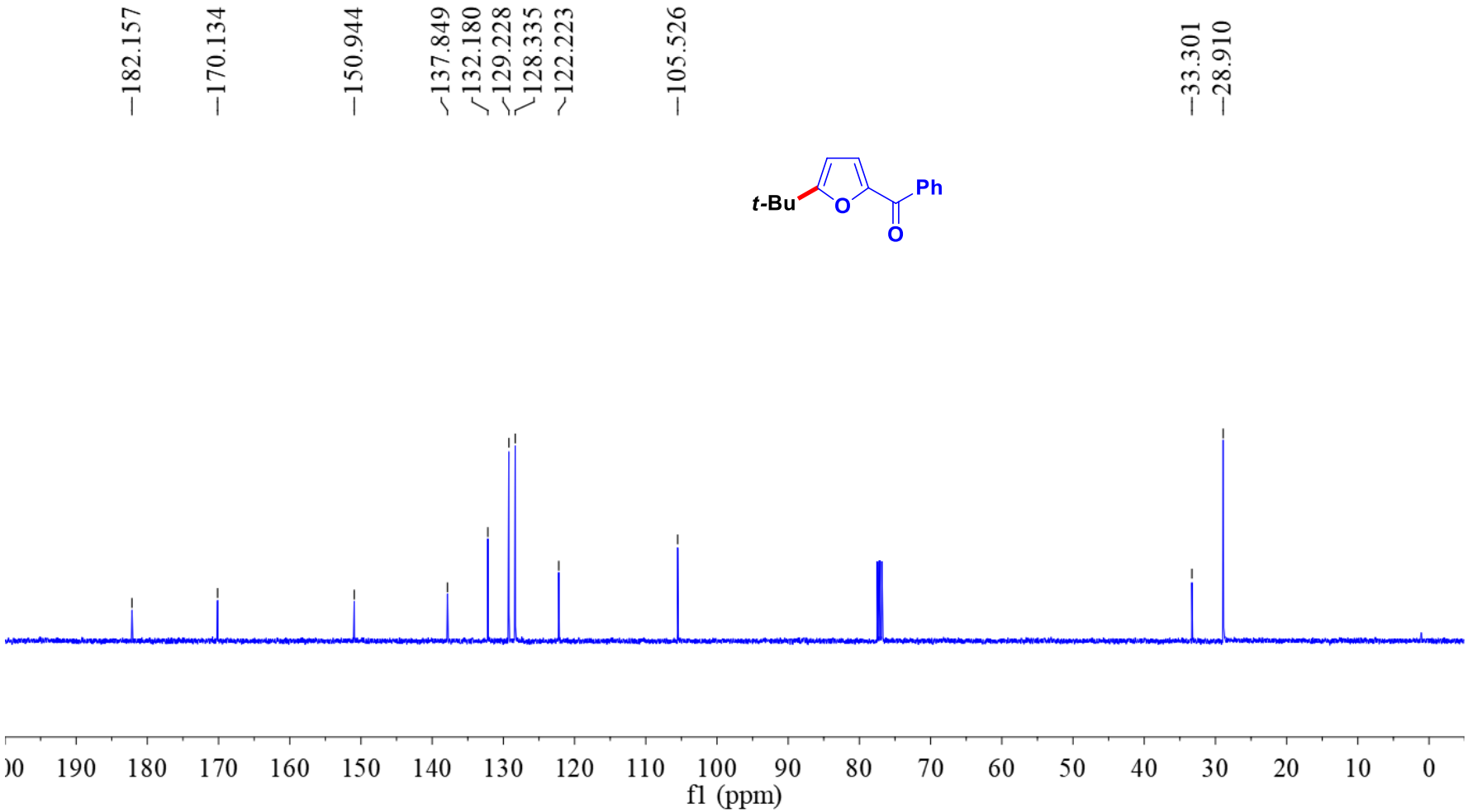


Figure S-50. ^{1}H NMR spectrum of **(1m)** ($CDCl_3$, 400 MHz) **5-(*tert*-butyl)furan-2-carbaldehyde**

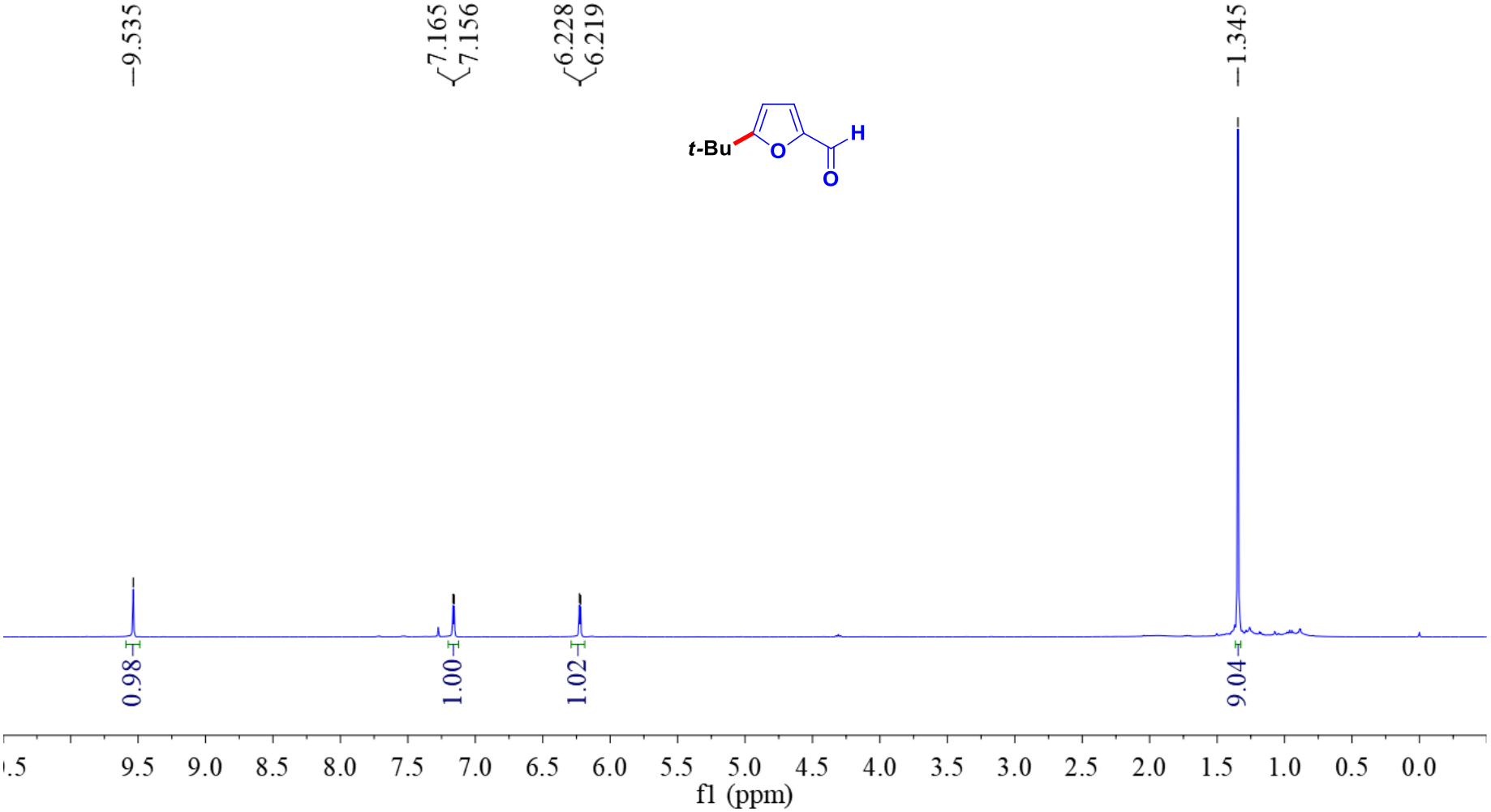


Figure S-51. $^{13}C\{^{1}H\}$ NMR spectrum of **(1m)** ($CDCl_3$, 100 MHz) **5-(*tert*-butyl)furan-2-carbaldehyde**

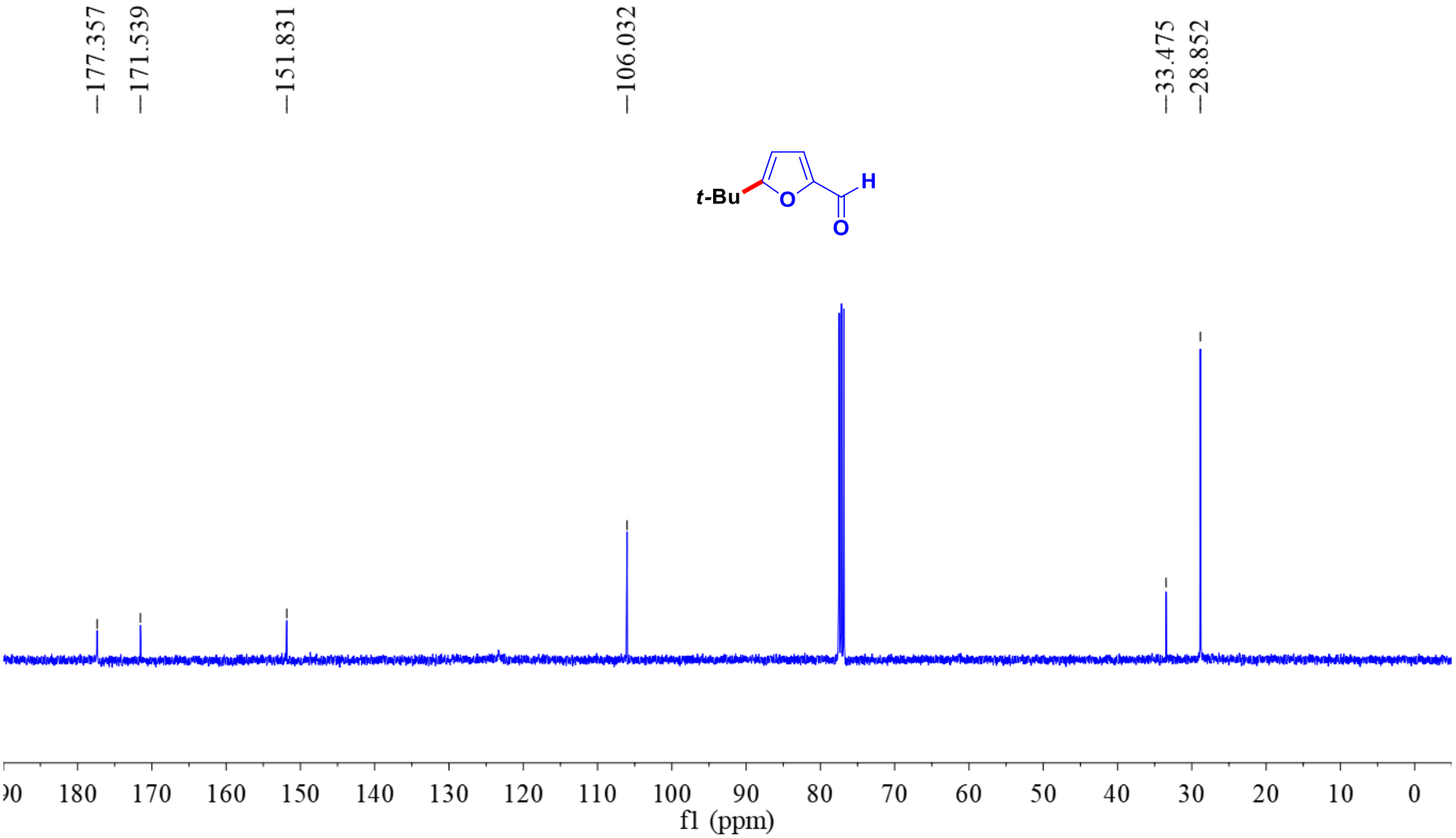


Figure S-52. ^{1}H NMR spectrum of **(1n)** ($CDCl_3$, 400 MHz) **1-(5-(*tert*-butyl)furan-2-yl)ethanone**

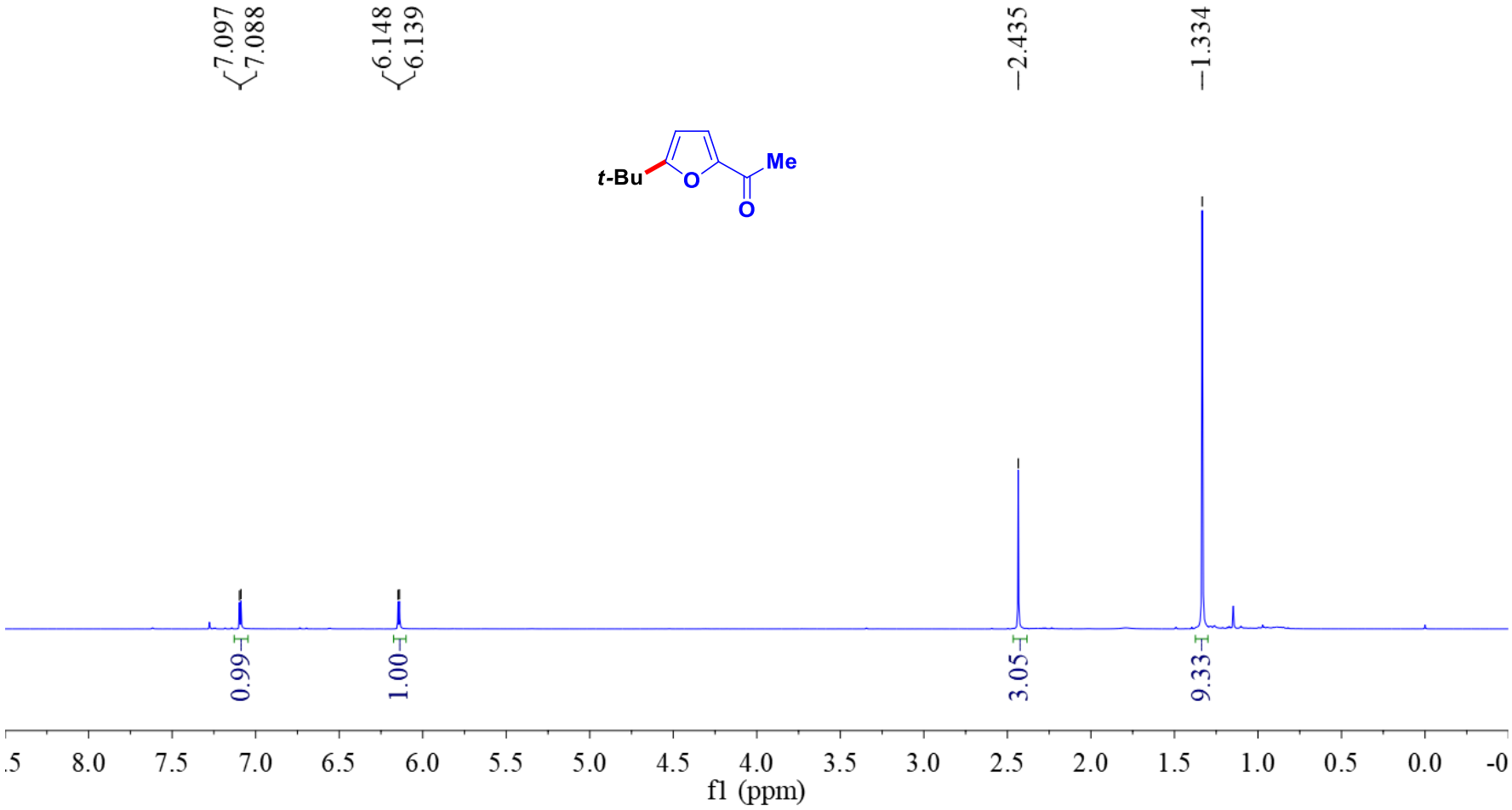


Figure S-53. $^{13}C\{^{1}H\}$ NMR spectrum of **(1n)** ($CDCl_3$, 100 MHz) **1-(5-(*tert*-butyl)furan-2-yl)ethanone**

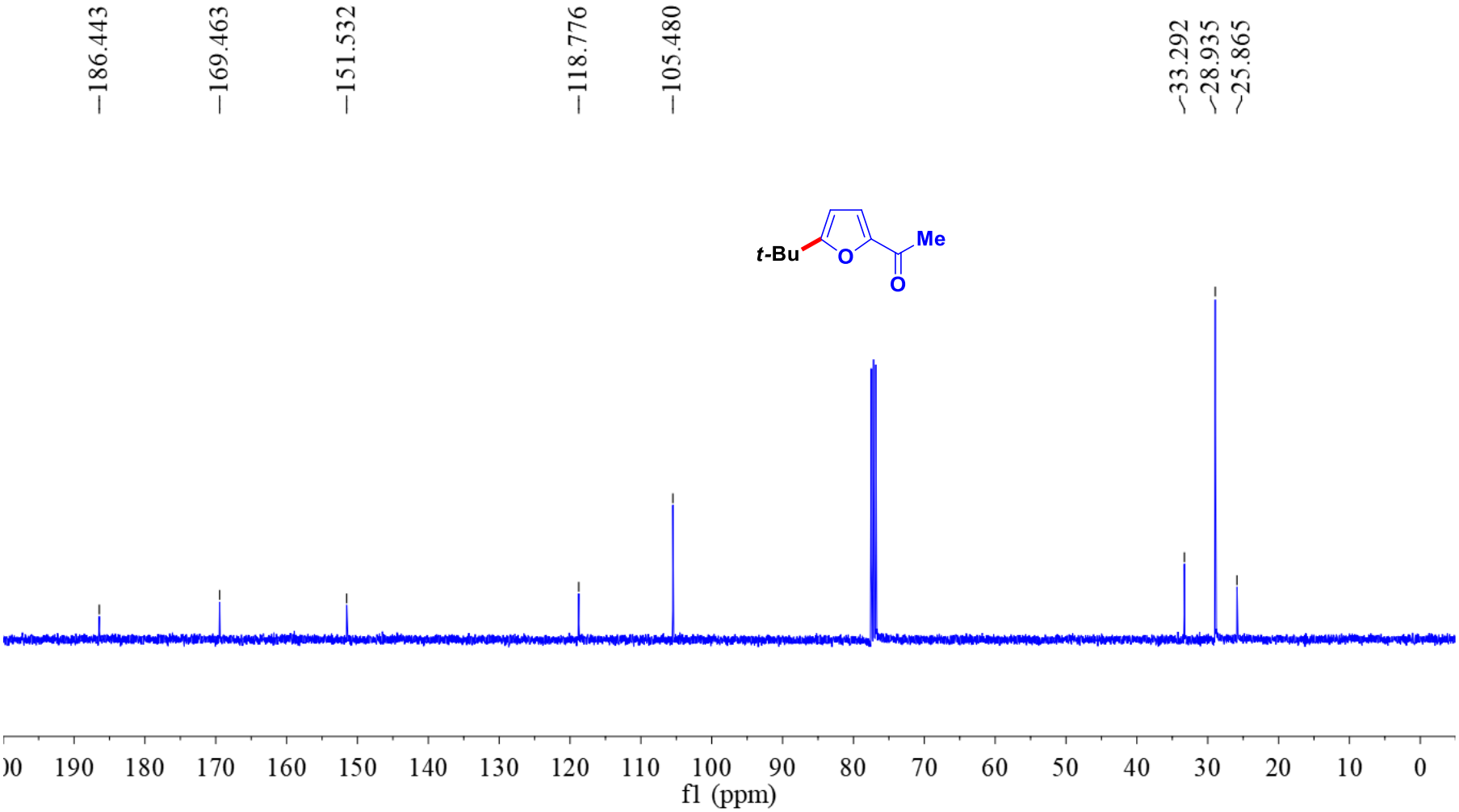


Figure S-54. ^{1}H NMR spectrum of **(1o)** ($CDCl_3$, 400 MHz) **1-(5-(*tert*-butyl)furan-2-yl)-2,2-dimethylpropan-1-one**

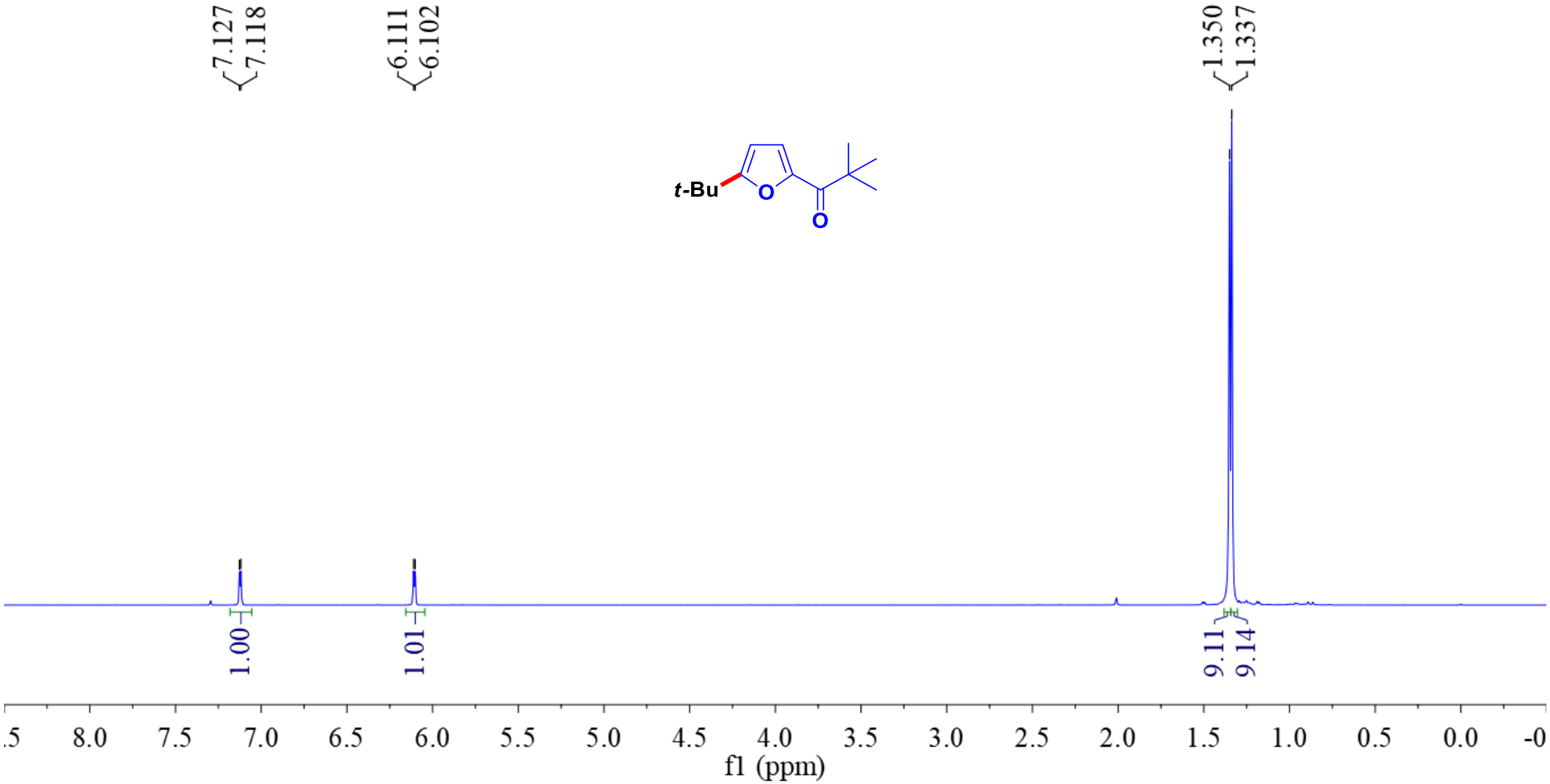


Figure S-55. $^{13}C\{^{1}H\}$ NMR spectrum of **(1o)** ($CDCl_3$, 100 MHz) **1-(5-(*tert*-butyl)furan-2-yl)-2,2-dimethylpropan-1-one**

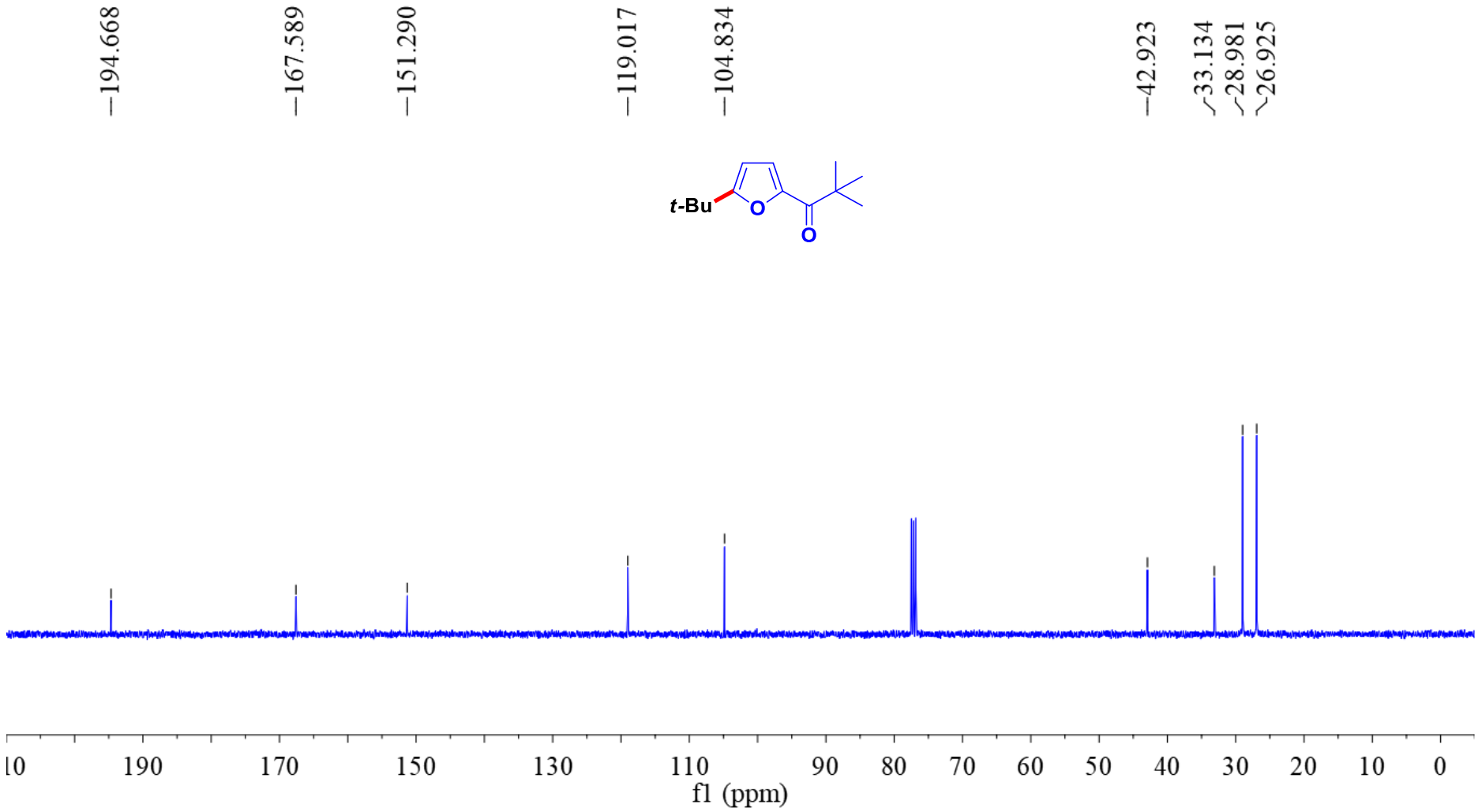


Figure S-56. ^{1}H NMR spectrum of **(1p)** ($CDCl_3$, 400 MHz) **2-(*tert*-butyl)-5-phenylfuran**

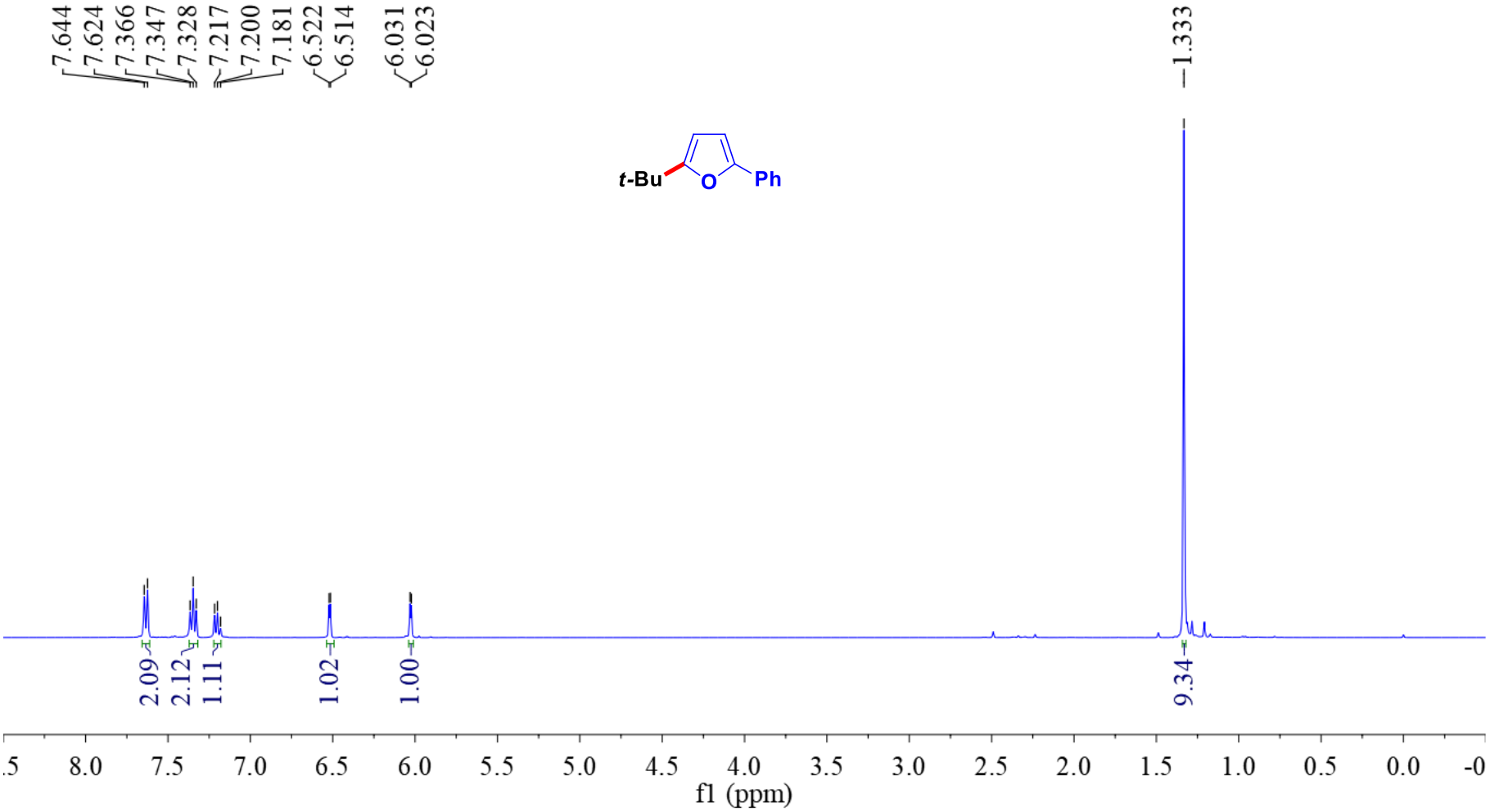


Figure S-57. $^{13}C\{^{1}H\}$ NMR spectrum of **(1p)** ($CDCl_3$, 100 MHz) **2-(*tert*-butyl)-5-phenylfuran**

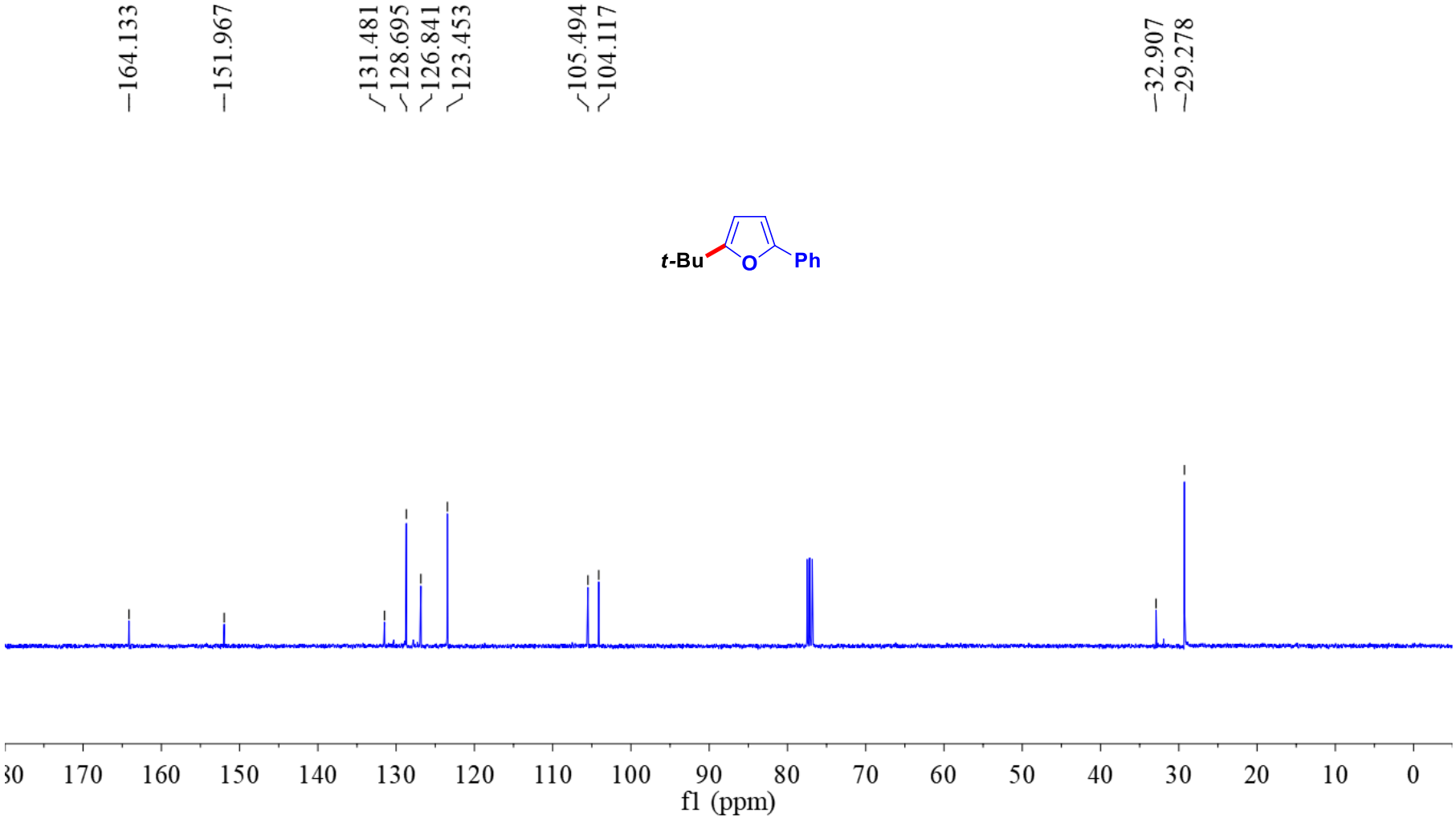


Figure S-58. ^{1}H NMR spectrum of **(1r)** ($CDCl_3$, 400 MHz) **2-(*tert*-butyl)benzofuran**

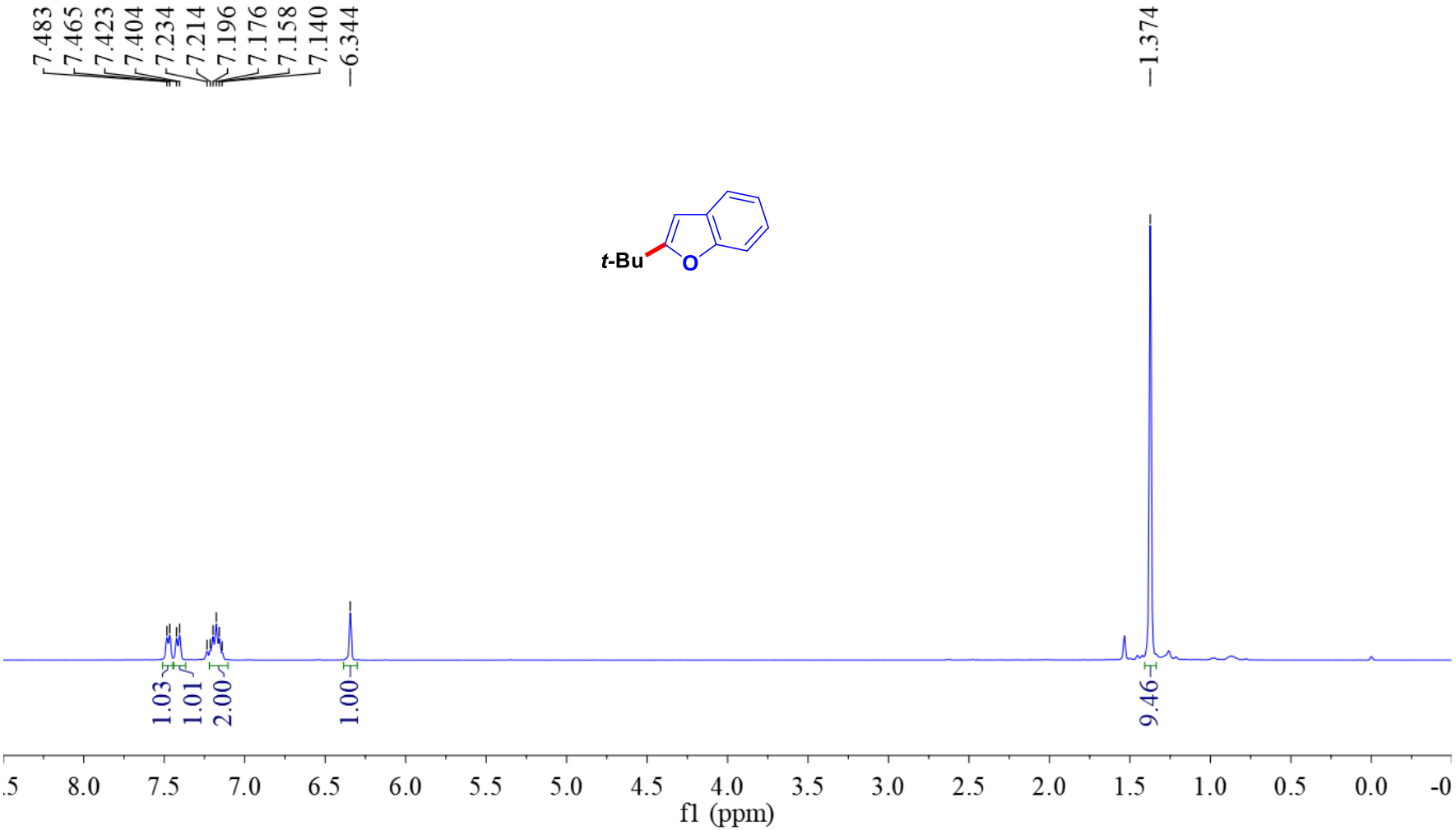


Figure S-59. $^{13}C\{^{1}H\}$ NMR spectrum of **(1r)** ($CDCl_3$, 100 MHz) **2-(*tert*-butyl)benzofuran**

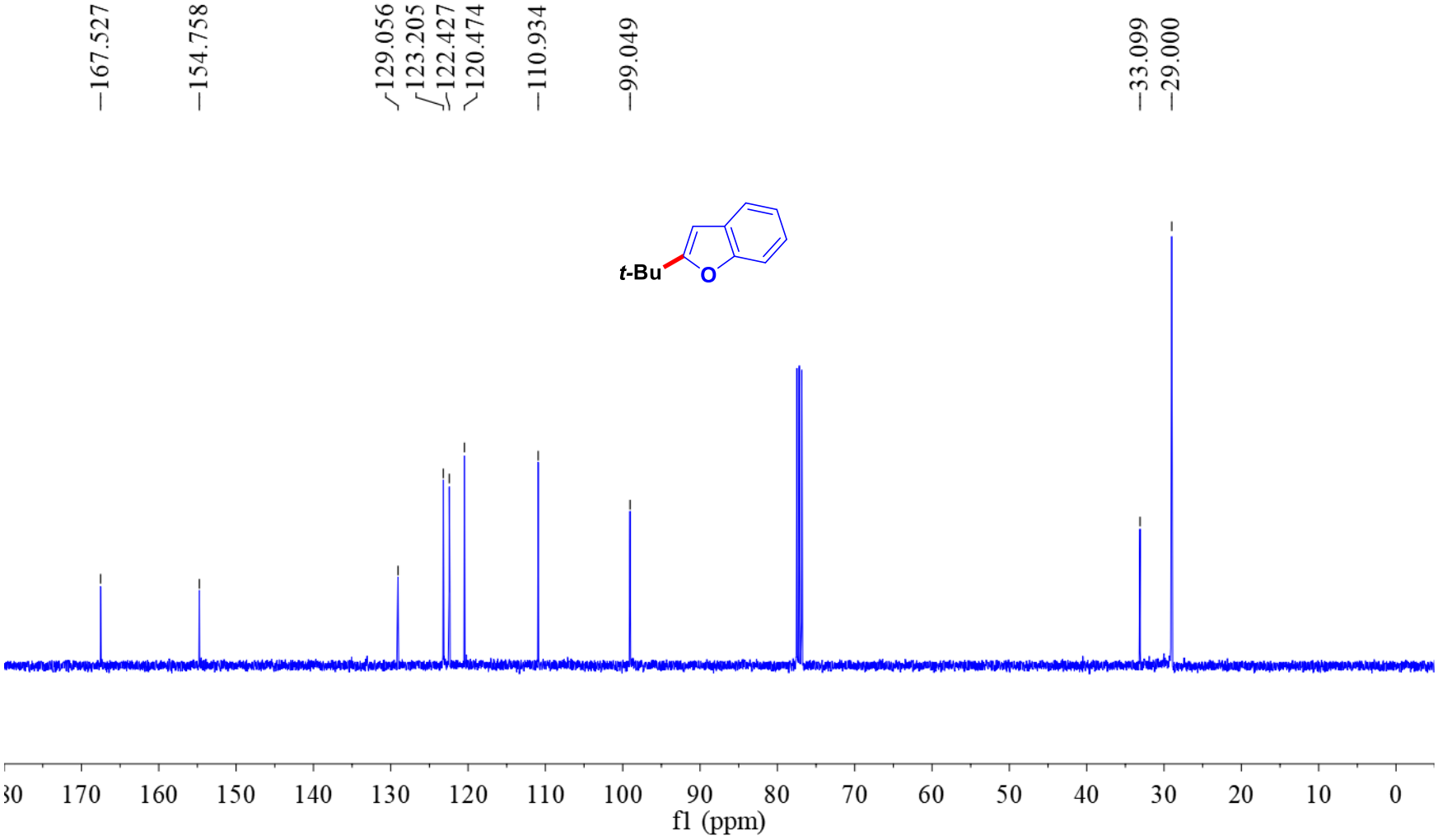


Figure S-60. ^{1}H NMR spectrum of **(1s)** ($CDCl_3$, 400 MHz) **2,5-di-*tert*-butyl-*N*-methyl-*N*-phenylfuran-3-carboxamide**

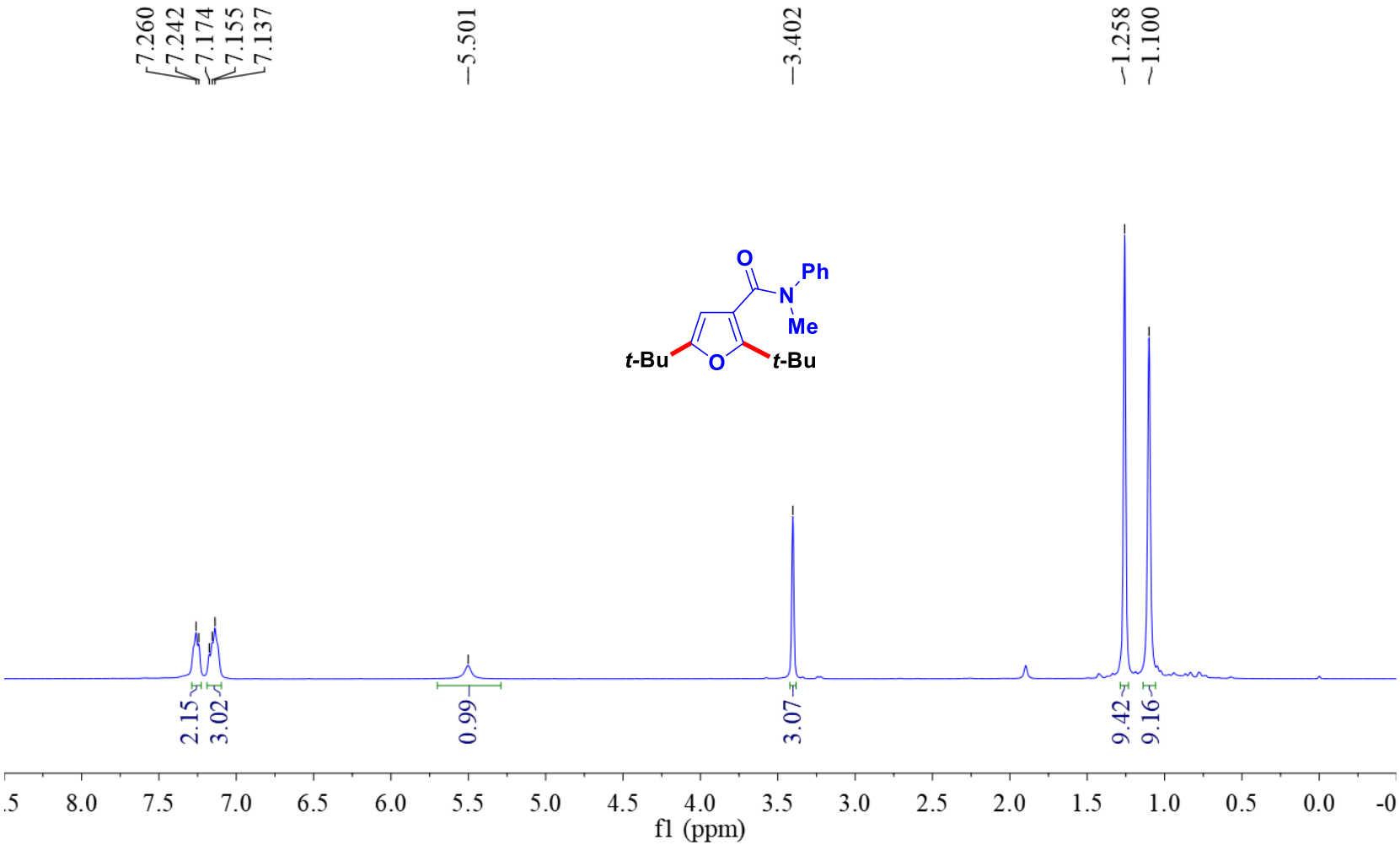


Figure S-61. $^{13}C\{^{1}H\}$ NMR spectrum of **(1s)** ($CDCl_3$, 100 MHz) **2,5-di-*tert*-butyl-*N*-methyl-*N*-phenylfuran-3-carboxamide**

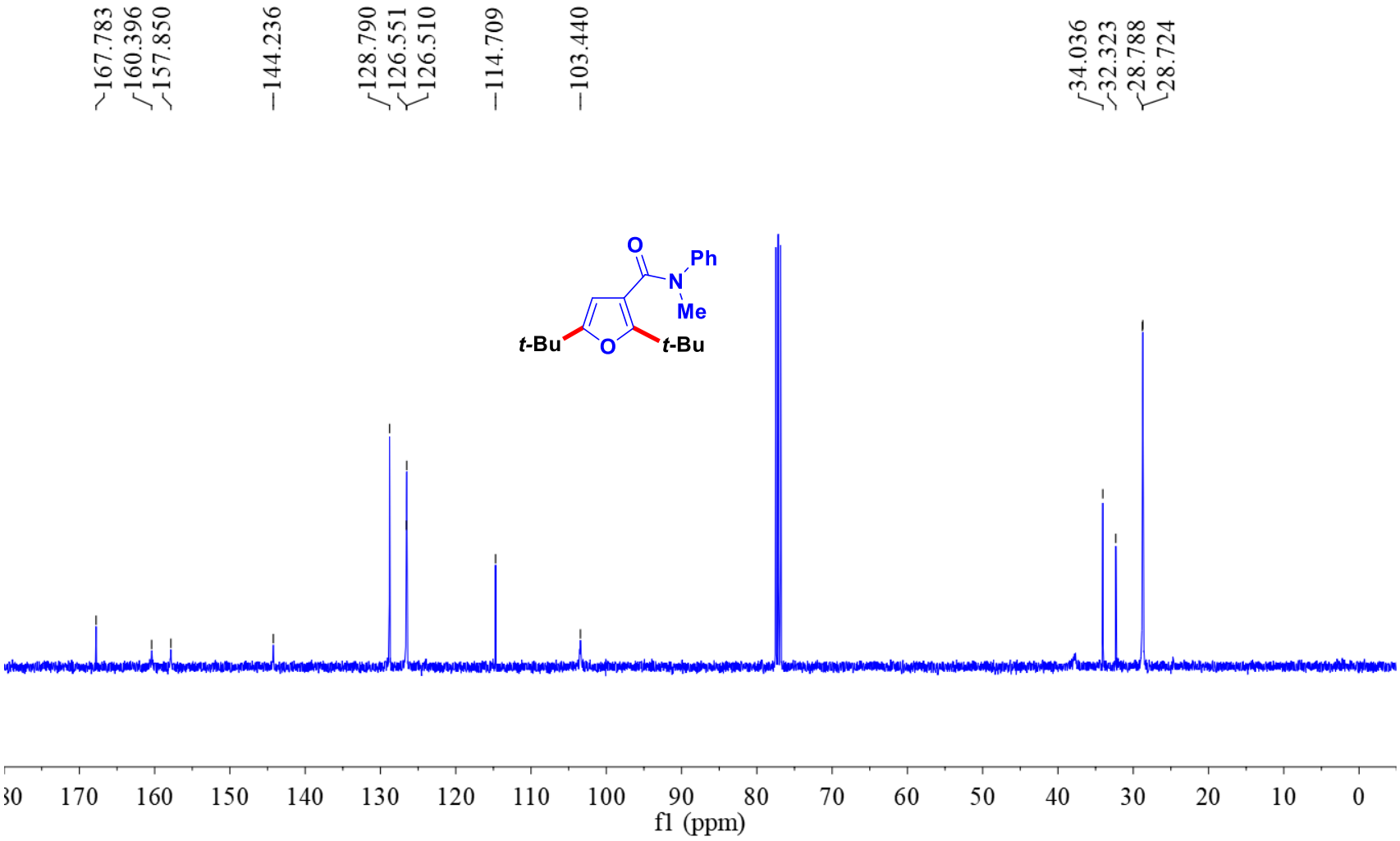


Figure S-62. ^{1}H NMR spectrum of **(1t)** ($CDCl_3$, 400 MHz) **5-(1-methylcyclohexyl)- *N*-methyl-*N*-phenylfuran-2-carboxamide**

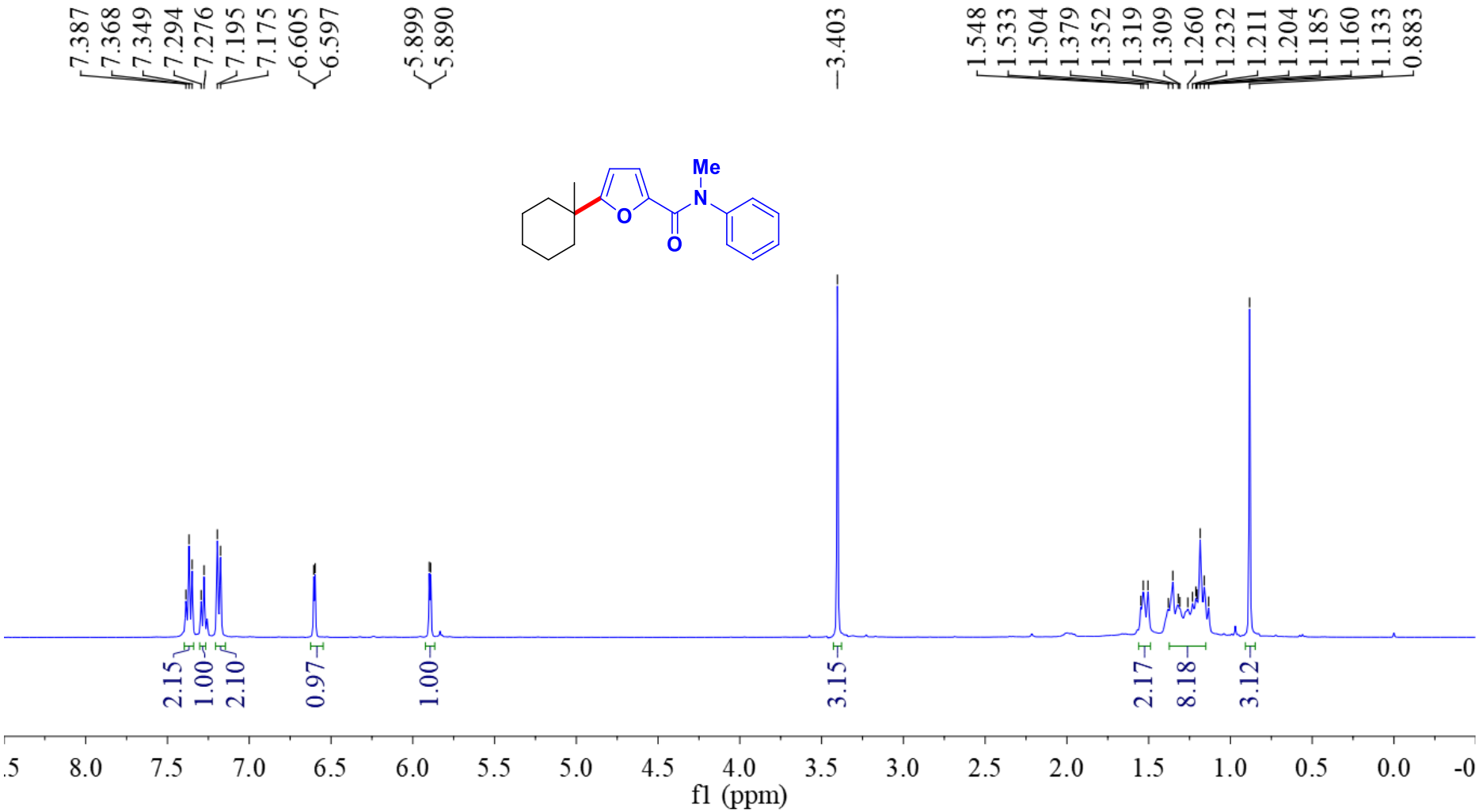


Figure S-63. $^{13}C\{^{1}H\}$ NMR spectrum of **(1t)** ($CDCl_3$, 100 MHz) **5-(1-methylcyclohexyl)- *N*-methyl-*N*-phenylfuran-2-carboxamide**

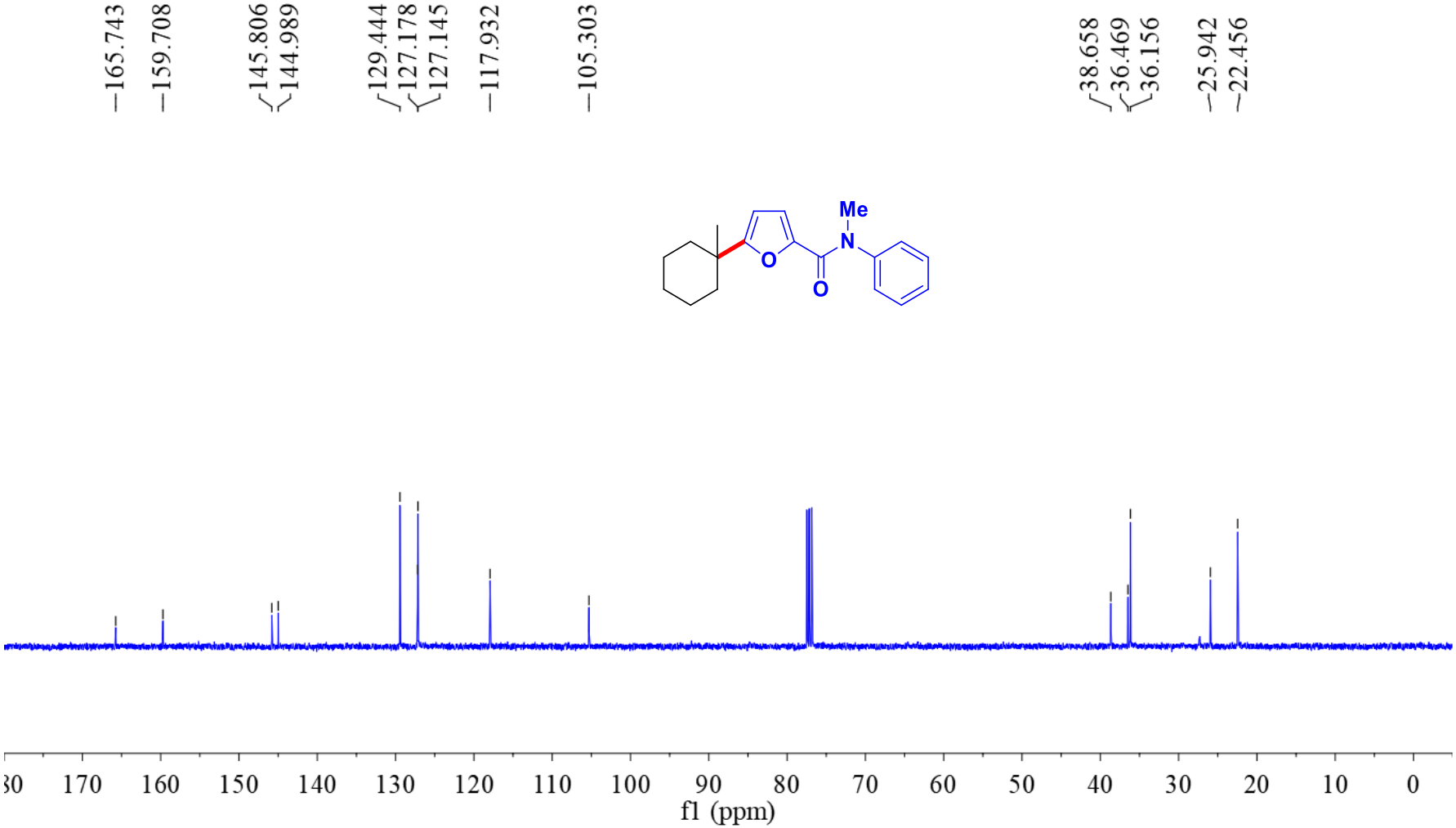


Figure S-64. ^{1}H NMR spectrum of **(1u)** ($CDCl_3$, 400 MHz) **5-(1-(4-isopropylphenyl)propan-2-yl)-*N*-methyl-*N*-phenylfuran-2-carboxamide**

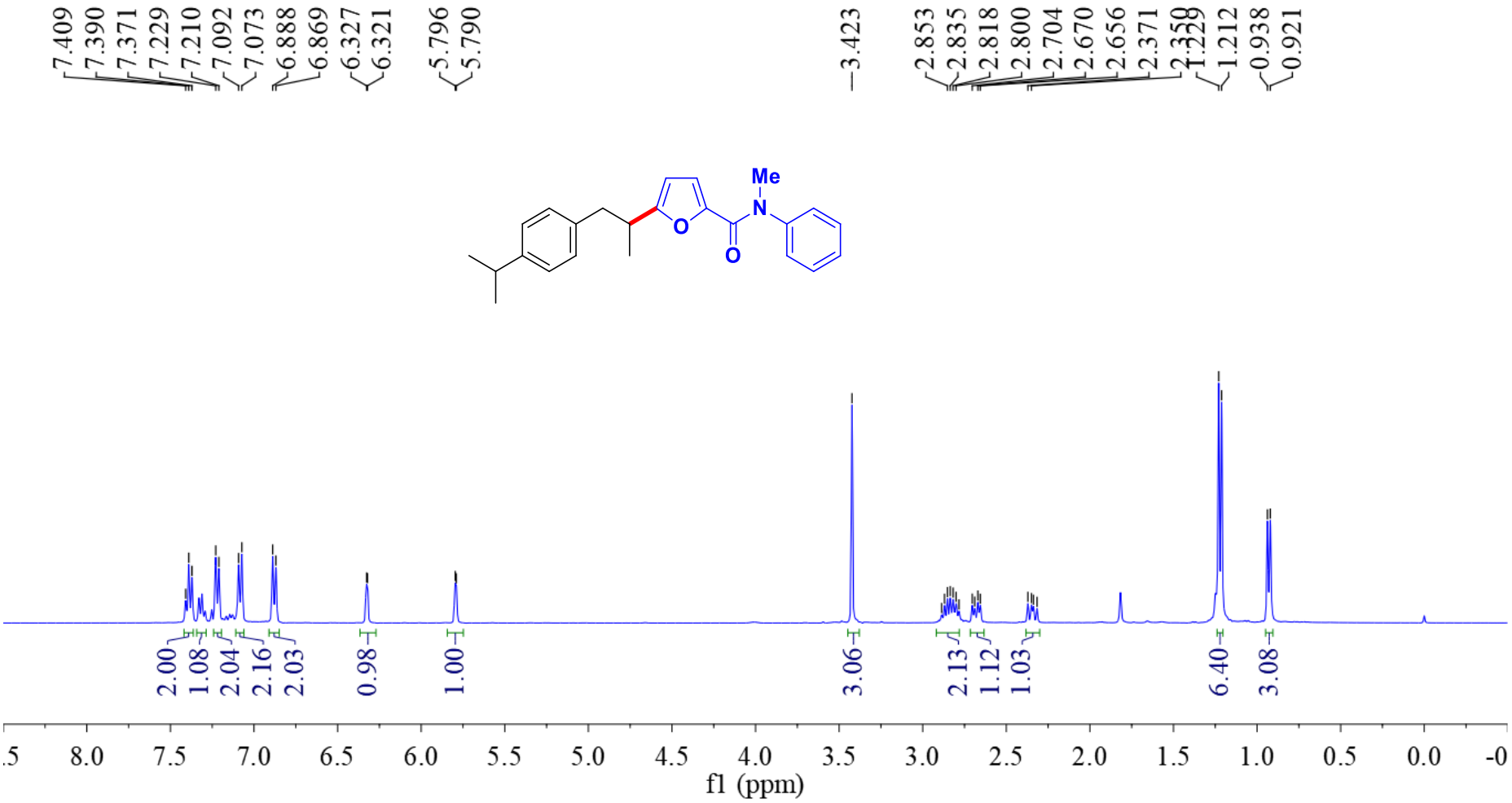


Figure S-65. $^{13}C\{^{1}H\}$ NMR spectrum of **(1u)** ($CDCl_3$, 100 MHz) **5-(1-(4-isopropylphenyl)propan-2-yl)-*N*-methyl-*N*-phenylfuran-2-carboxamide**

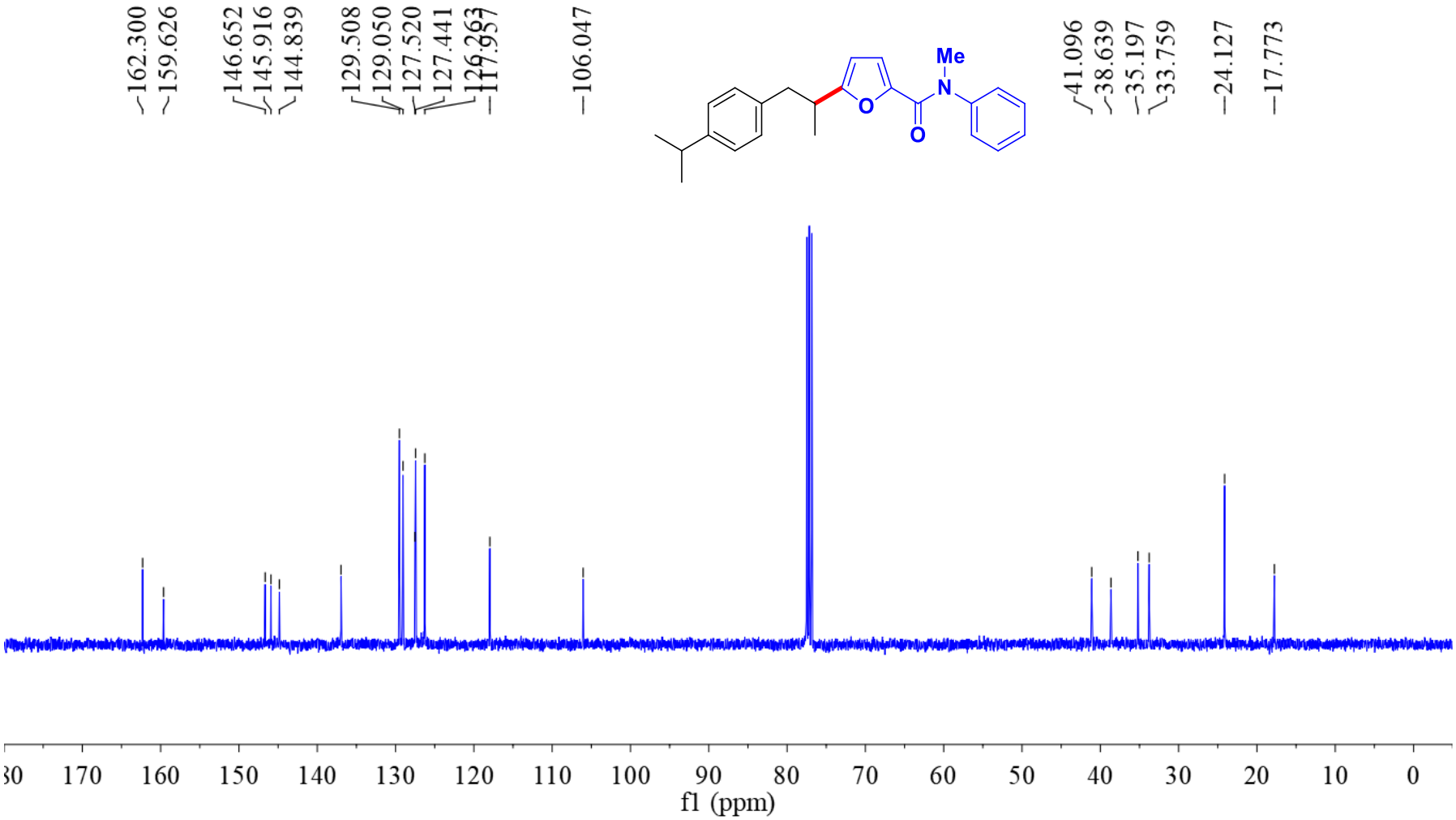


Figure S-66. ^{1}H NMR spectrum of **(1v)** ($CDCl_3$, 400 MHz) **5-(1-(4-(tert-butyl)phenyl)propan-2-yl)-*N*-methyl-*N*-phenylfuran-2-carboxamide**

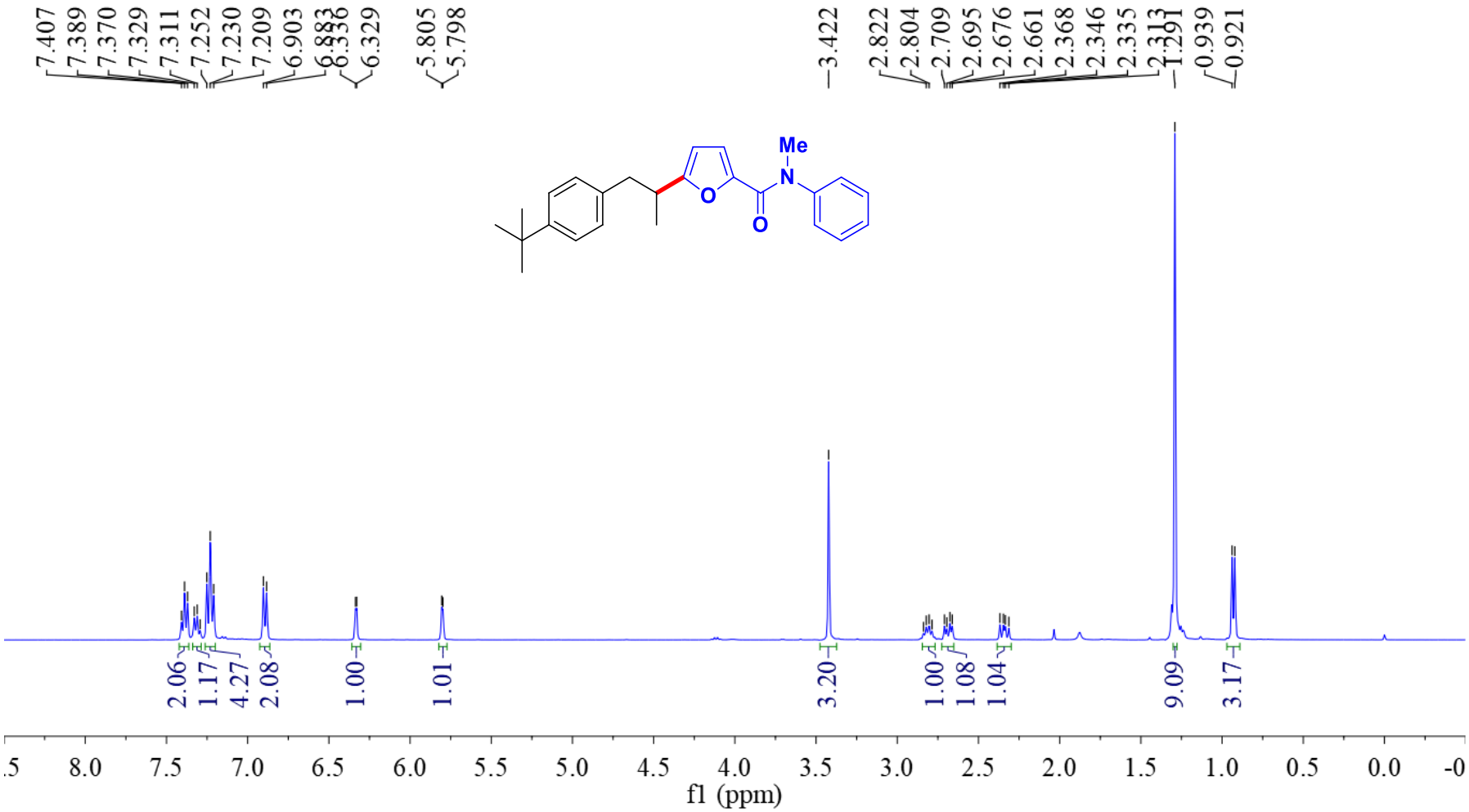


Figure S-67. $^{13}C\{^{1}H\}$ NMR spectrum of **(1v)** ($CDCl_3$, 100 MHz) **5-(1-(4-(tert-butyl)phenyl)propan-2-yl)-*N*-methyl-*N*-phenylfuran-2-carboxamide**

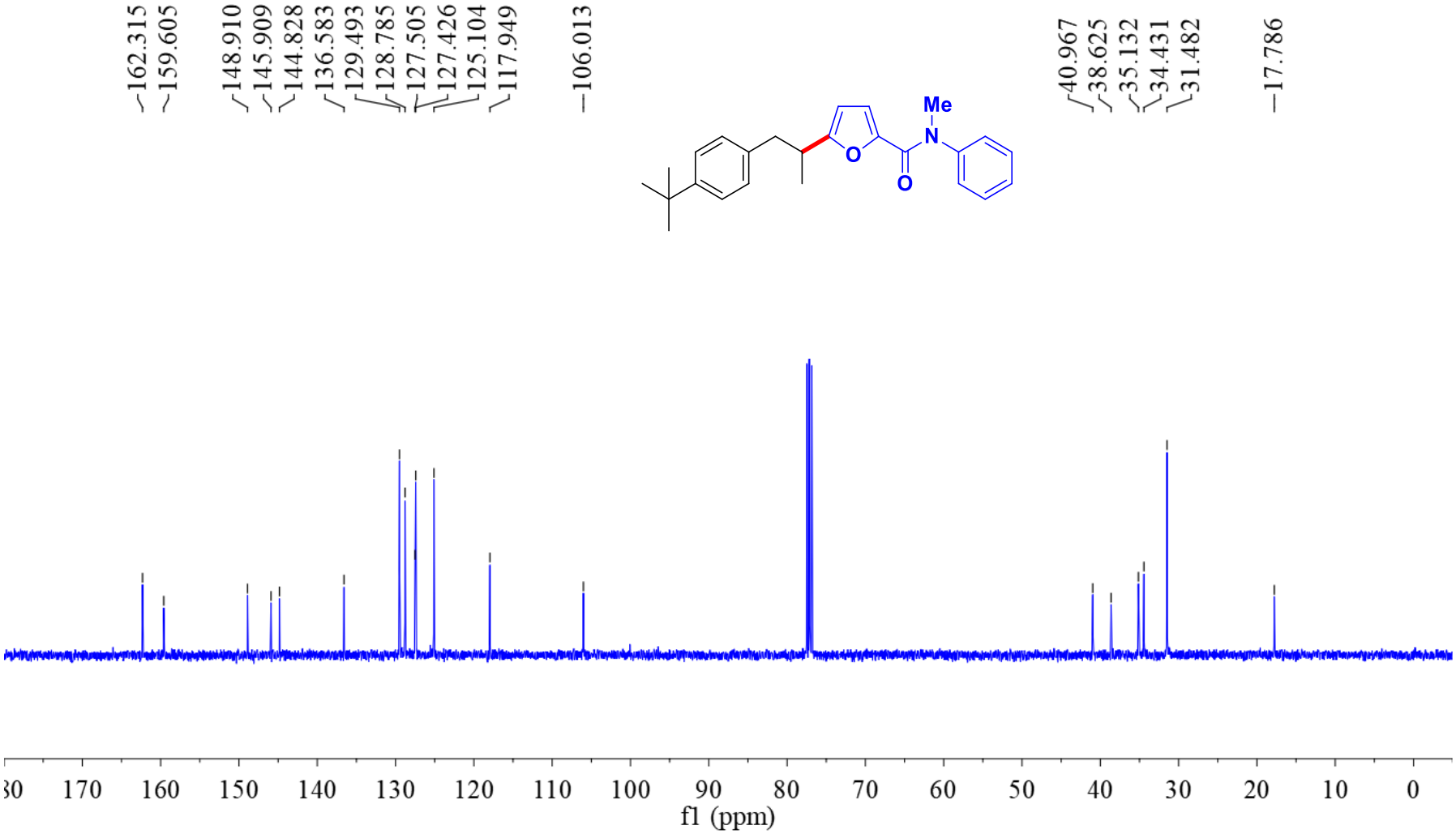


Figure S-68. ^{1}H NMR spectrum of **(1w)** ($CDCl_3$, 400 MHz) **5-cyclohexyl-*N*-methyl-*N*-phenylfuran-2-carboxamide**

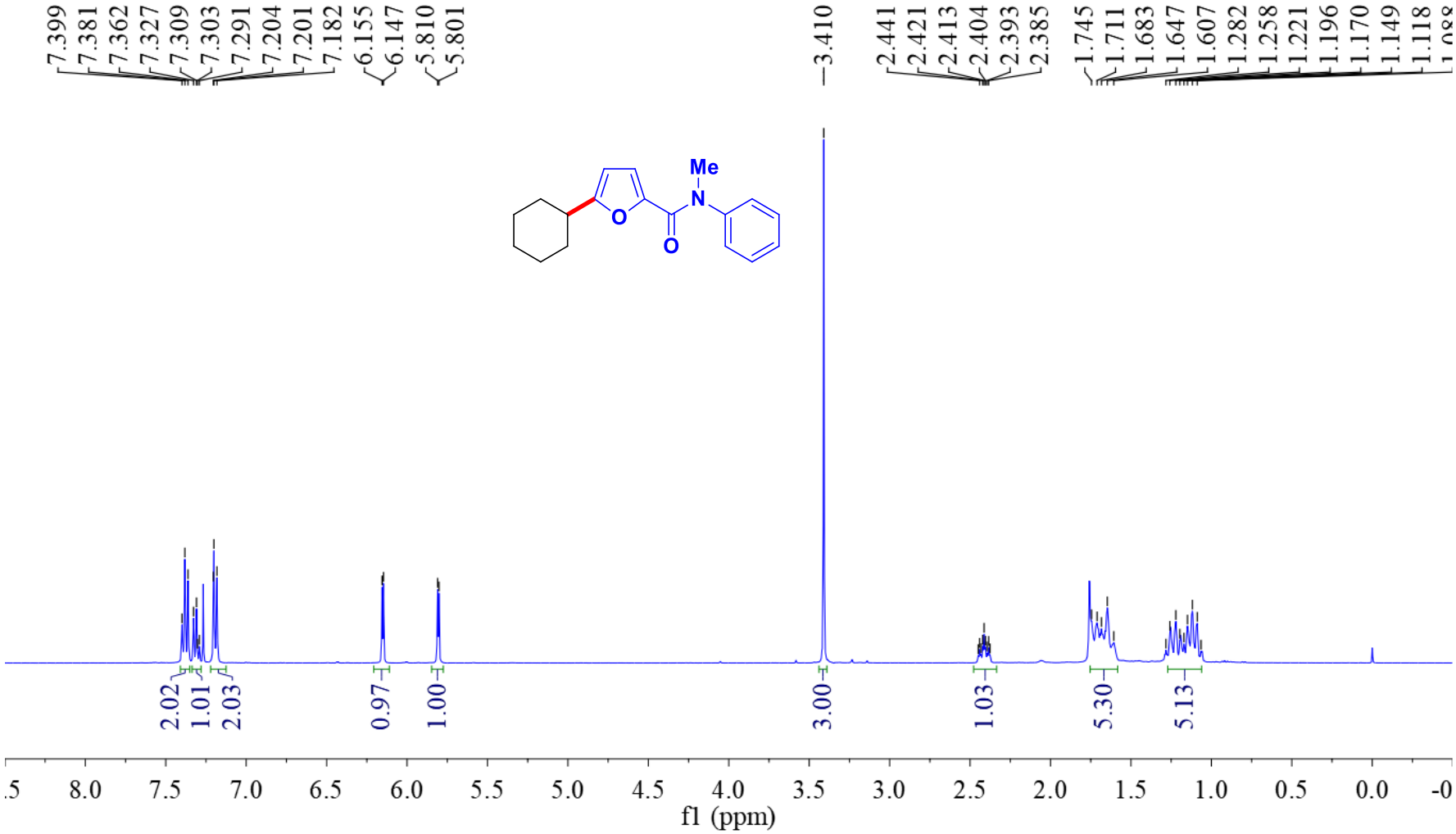


Figure S-69. $^{13}C\{^{1}H\}$ NMR spectrum of **(1w)** ($CDCl_3$, 100 MHz) **5-cyclohexyl-*N*-methyl-*N*-phenylfuran-2-carboxamide**

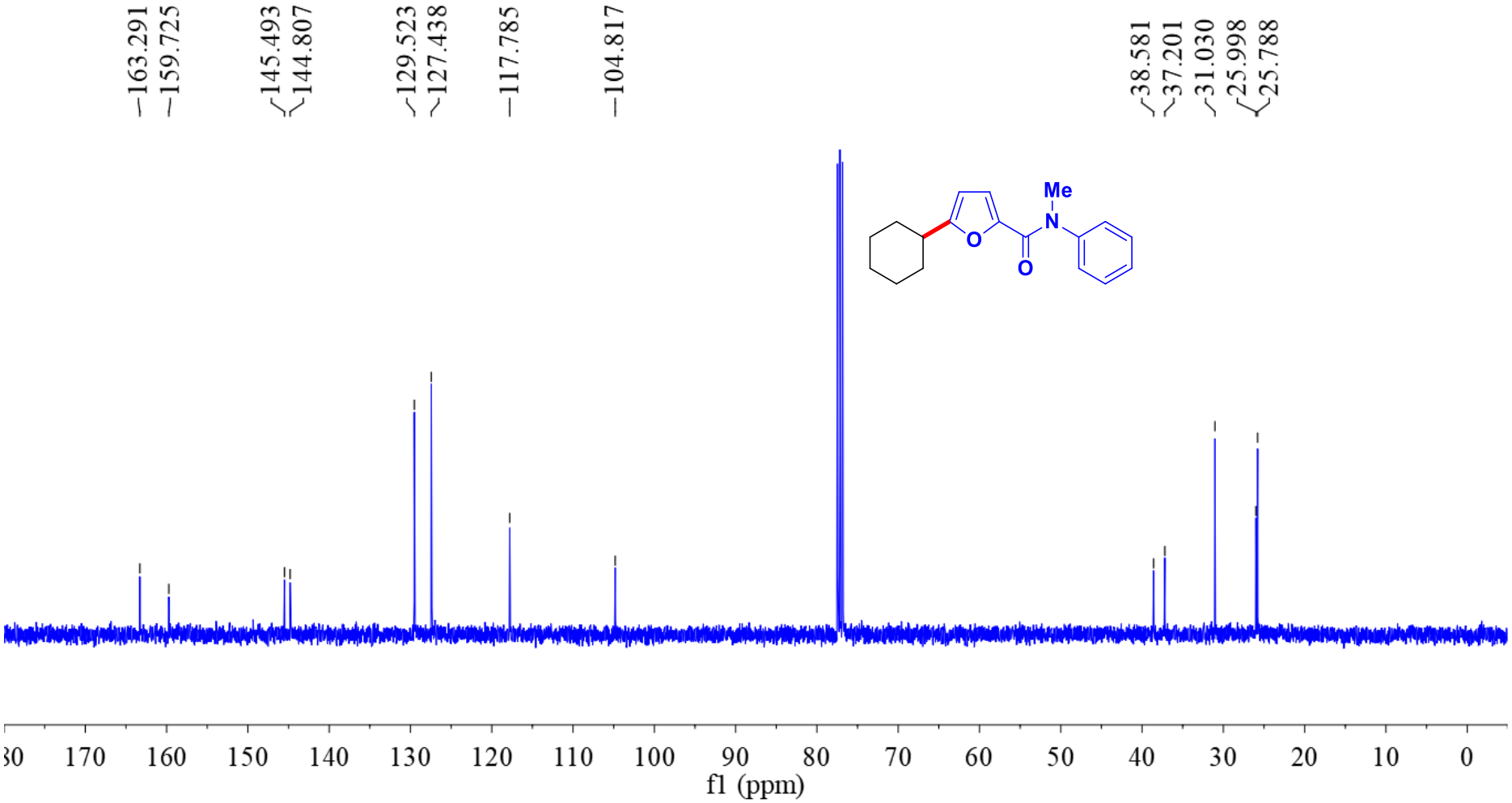


Figure S-70. ^{1}H NMR spectrum of **(1x)** ($CDCl_3$, 400 MHz) **5-cyclopentyl-*N*-methyl-*N*-phenylfuran-2-carboxamide**

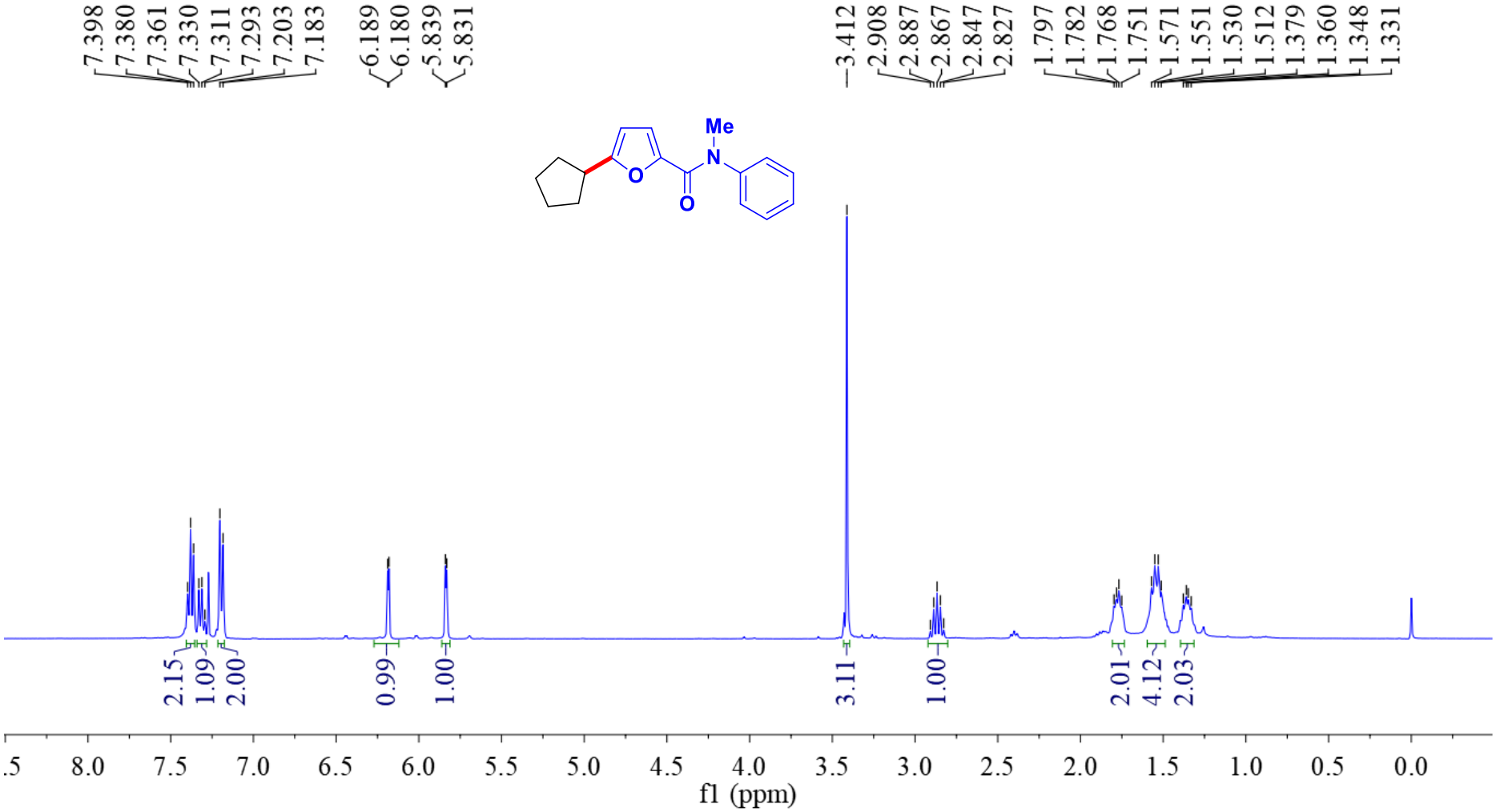


Figure S-71. $^{13}C\{^{1}H\}$ NMR spectrum of **(1x)** ($CDCl_3$, 100 MHz) **5-cyclopentyl-*N*-methyl-*N*-phenylfuran-2-carboxamide**

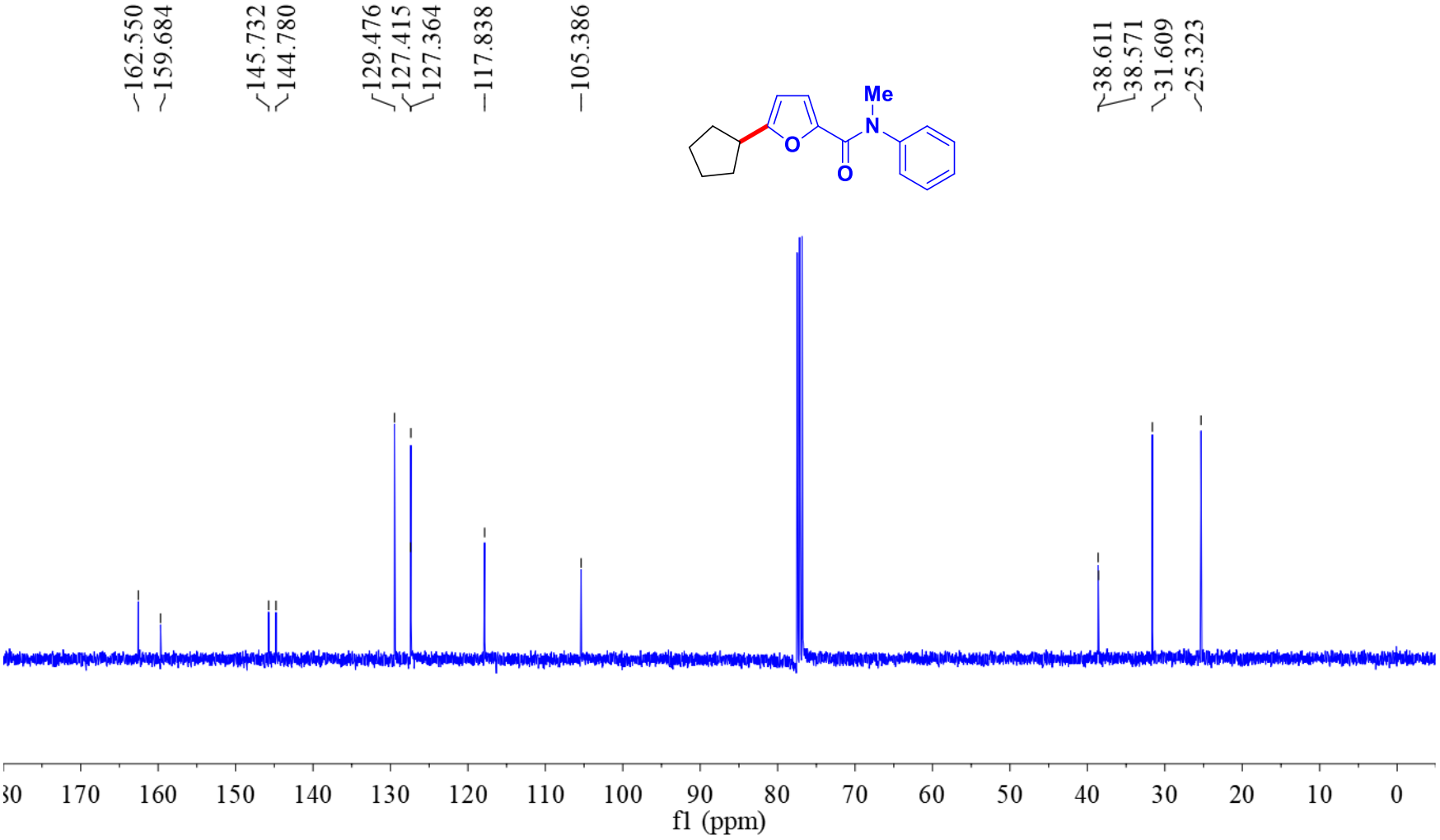


Figure S-72. ^{1}H NMR spectrum of **(1y)** ($CDCl_3$, 400 MHz) **5-(cyclohex-3-en-1-yl)-*N*-methyl-*N*-phenylfuran-2-carboxamide**

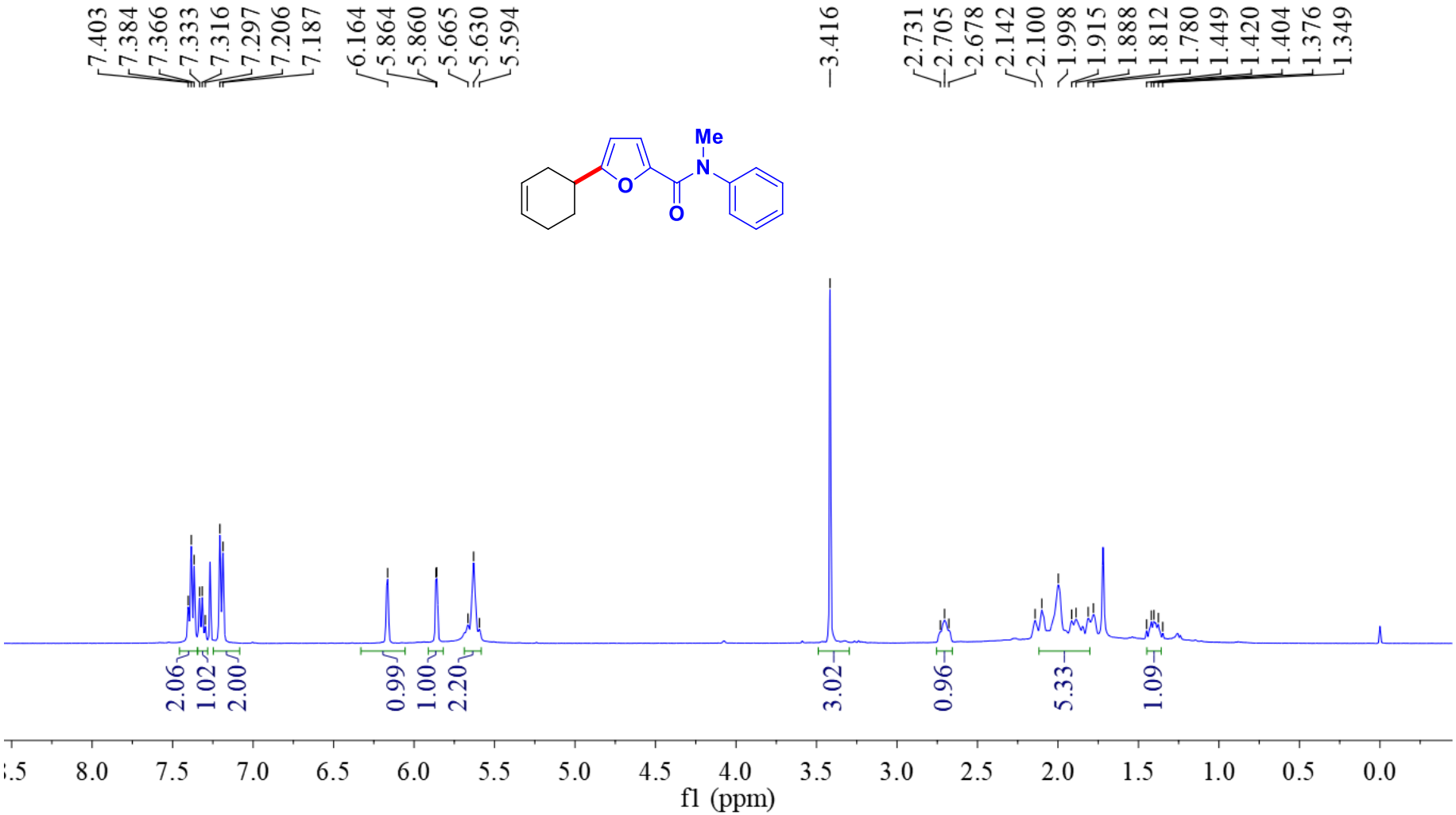


Figure S-73. $^{13}C\{^{1}H\}$ NMR spectrum of **(1y)** ($CDCl_3$, 100 MHz) **5-(cyclohex-3-en-1-yl)-*N*-methyl-*N*-phenylfuran-2-carboxamide**

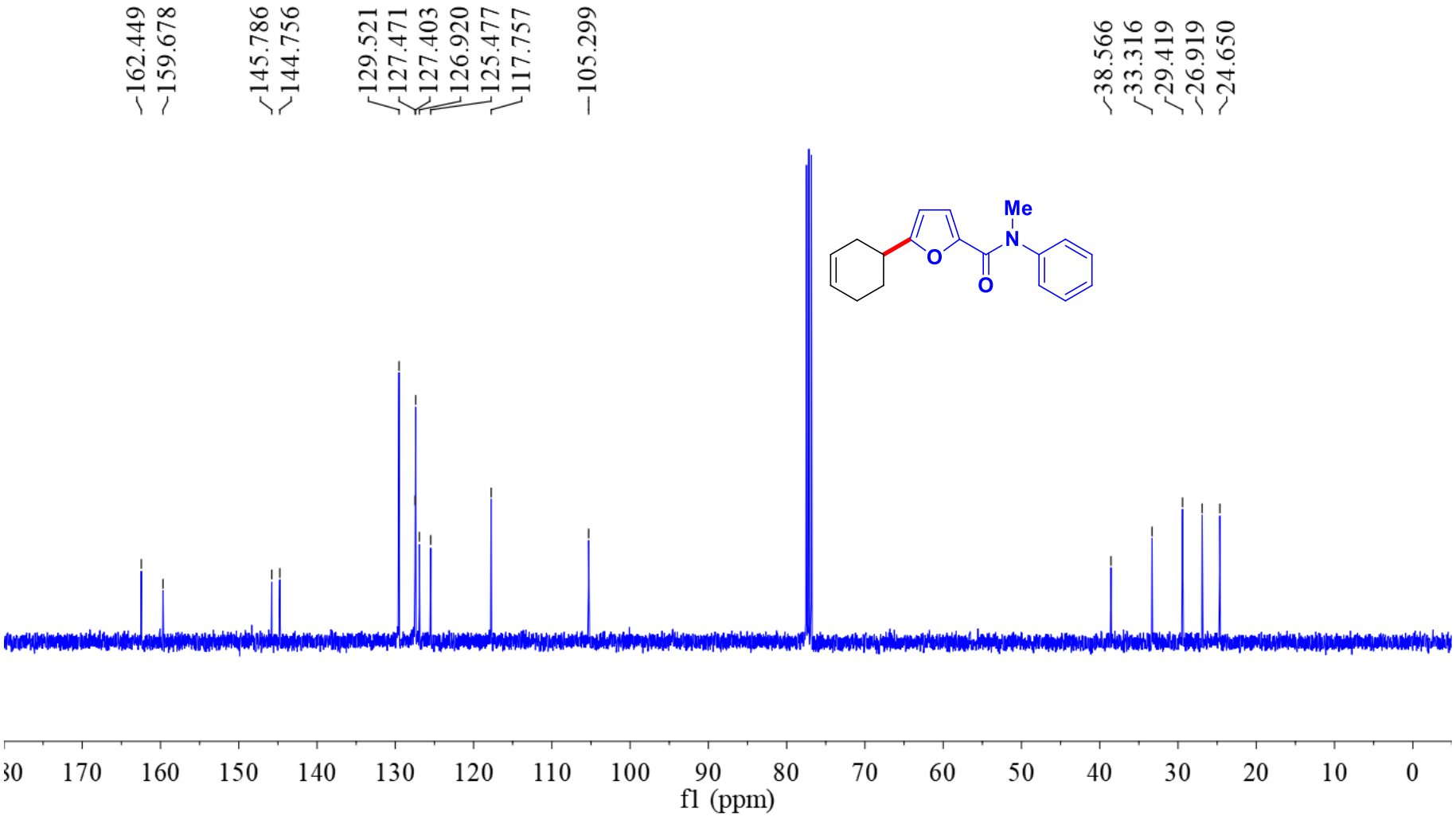


Figure S-74. ^{1}H NMR spectrum of **(1z)** ($CDCl_3$, 400 MHz) **5-isopropyl-*N*-methyl-*N*-phenylfuran-2-carboxamide**

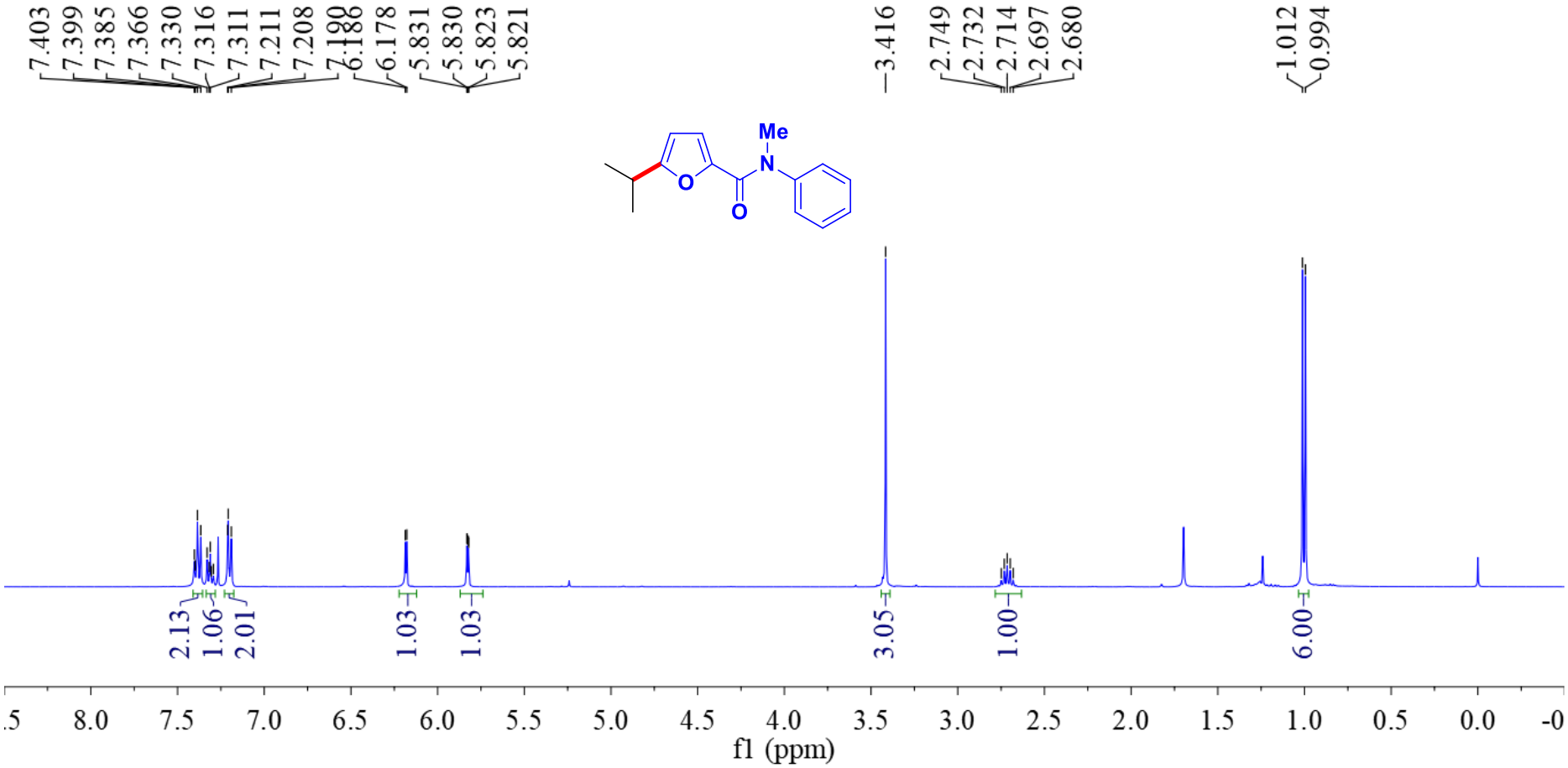


Figure S-75. $^{13}C\{^{1}H\}$ NMR spectrum of **(1z)** ($CDCl_3$, 100 MHz) **5-isopropyl-*N*-methyl-*N*-phenylfuran-2-carboxamide**

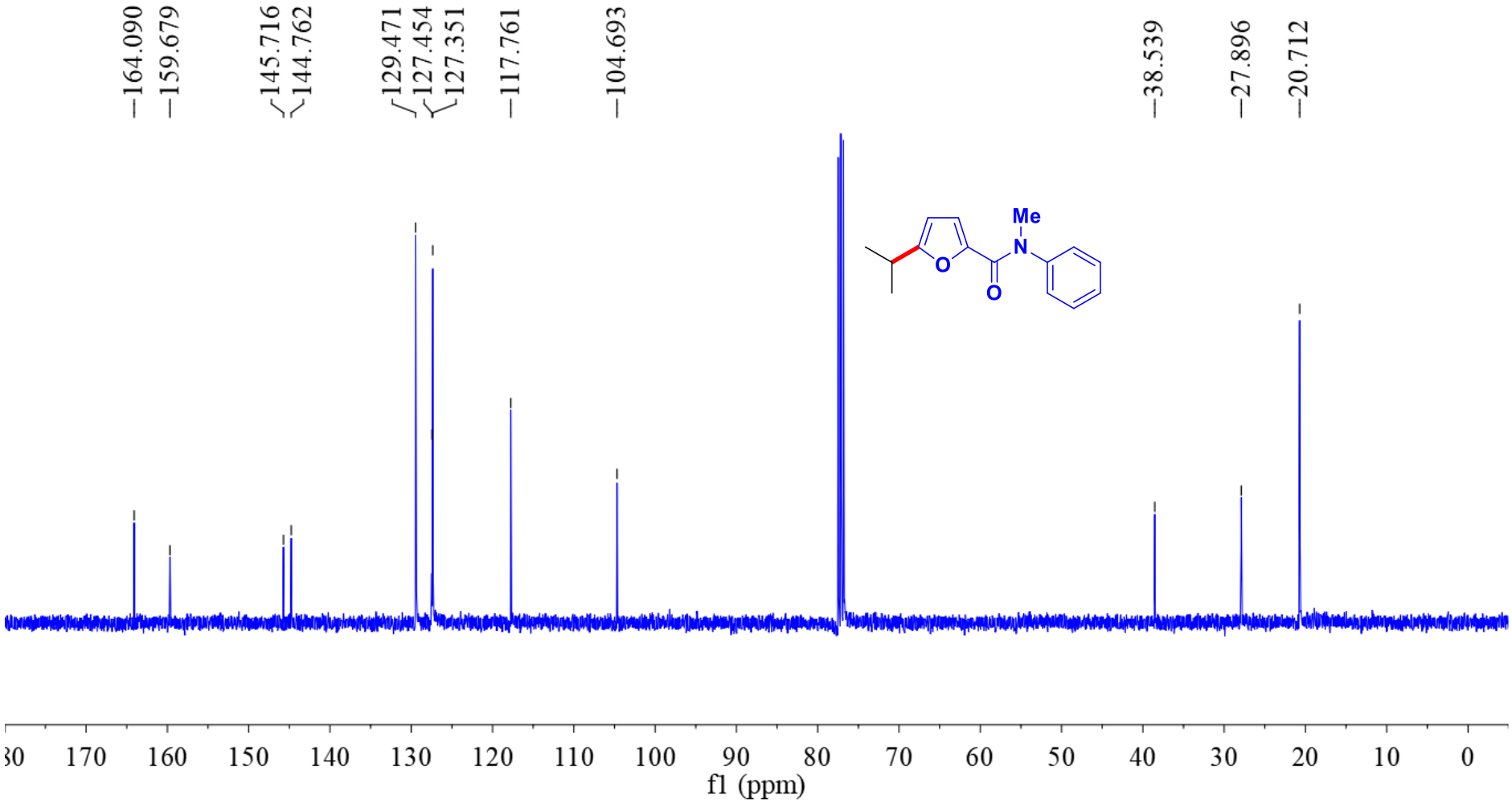


Figure S-76. ^{1}H NMR spectrum of **(1aa)** ($CDCl_3$, 400 MHz) **5-(heptan-3-yl)-*N*-methyl-*N*-phenylfuran-2-carboxamide**

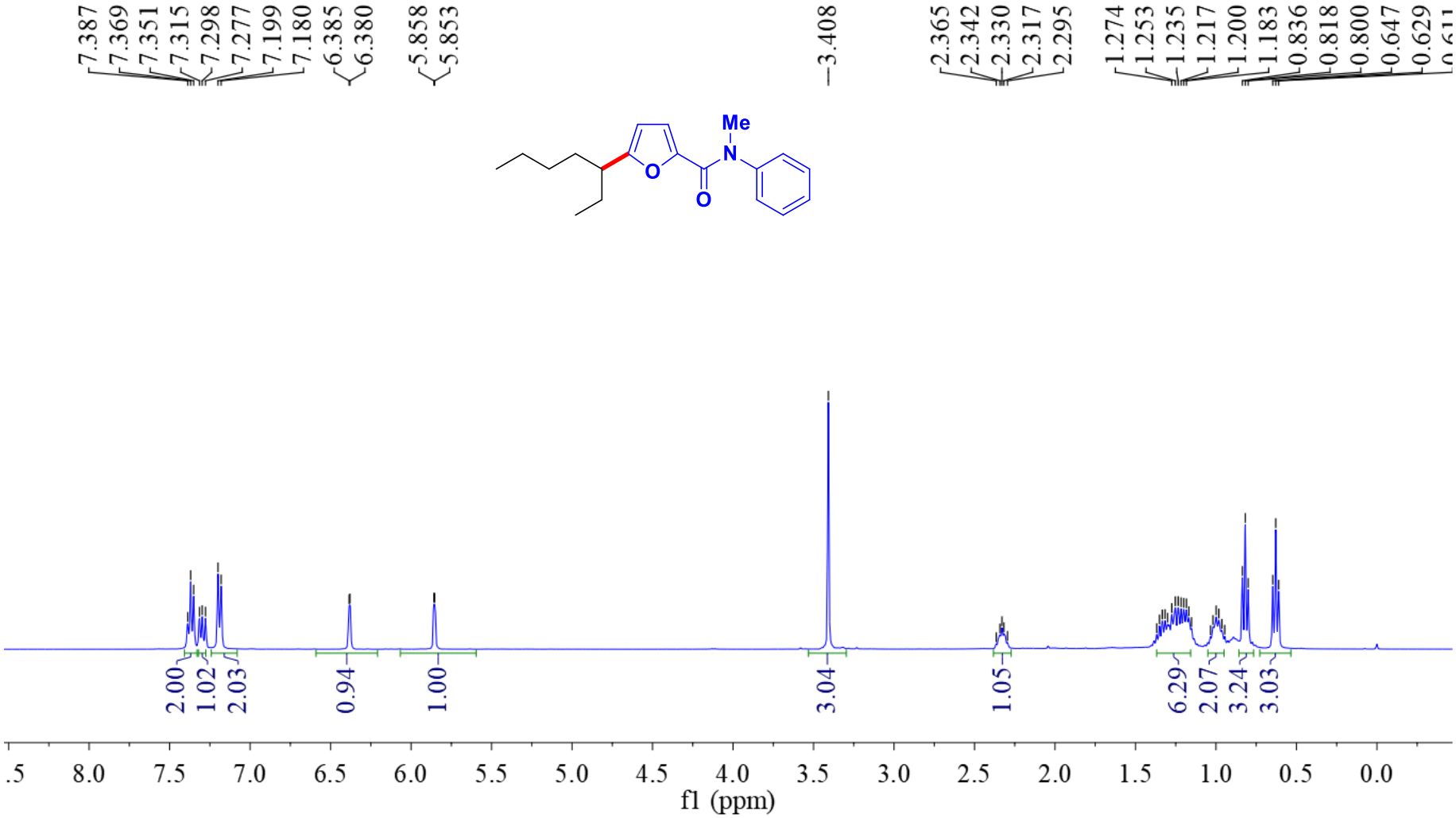


Figure S-77. $^{13}C\{^{1}H\}$ NMR spectrum of **(1aa)** ($CDCl_3$, 100 MHz) **5-(heptan-3-yl)-*N*-methyl-*N*-phenylfuran-2-carboxamide**

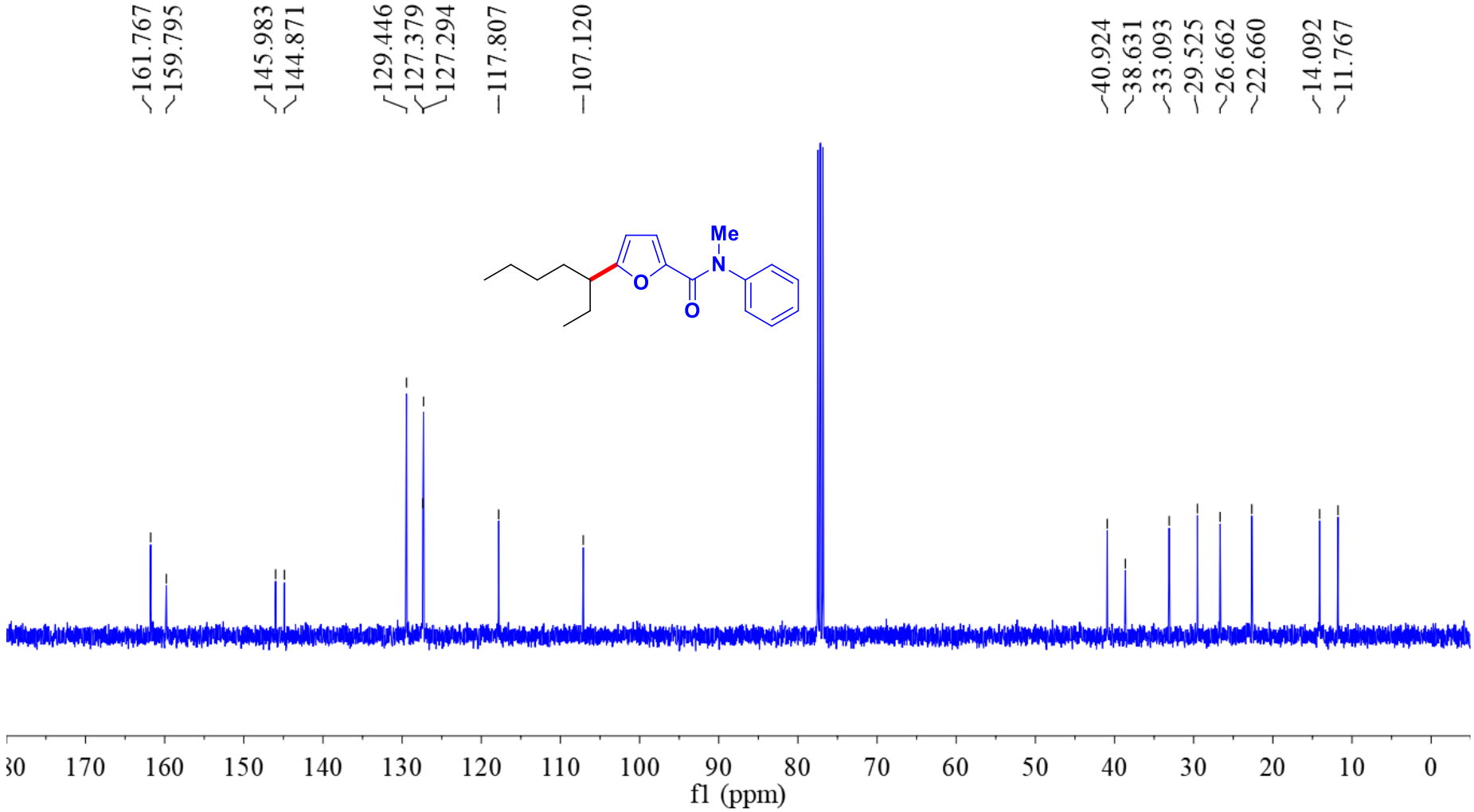


Figure S-78. ^{1}H NMR spectrum of **(1ab)** ($CDCl_3$, 400 MHz) ***N*-methyl-5-(pentan-3-yl)-*N*-phenylfuran-2-carboxamide**

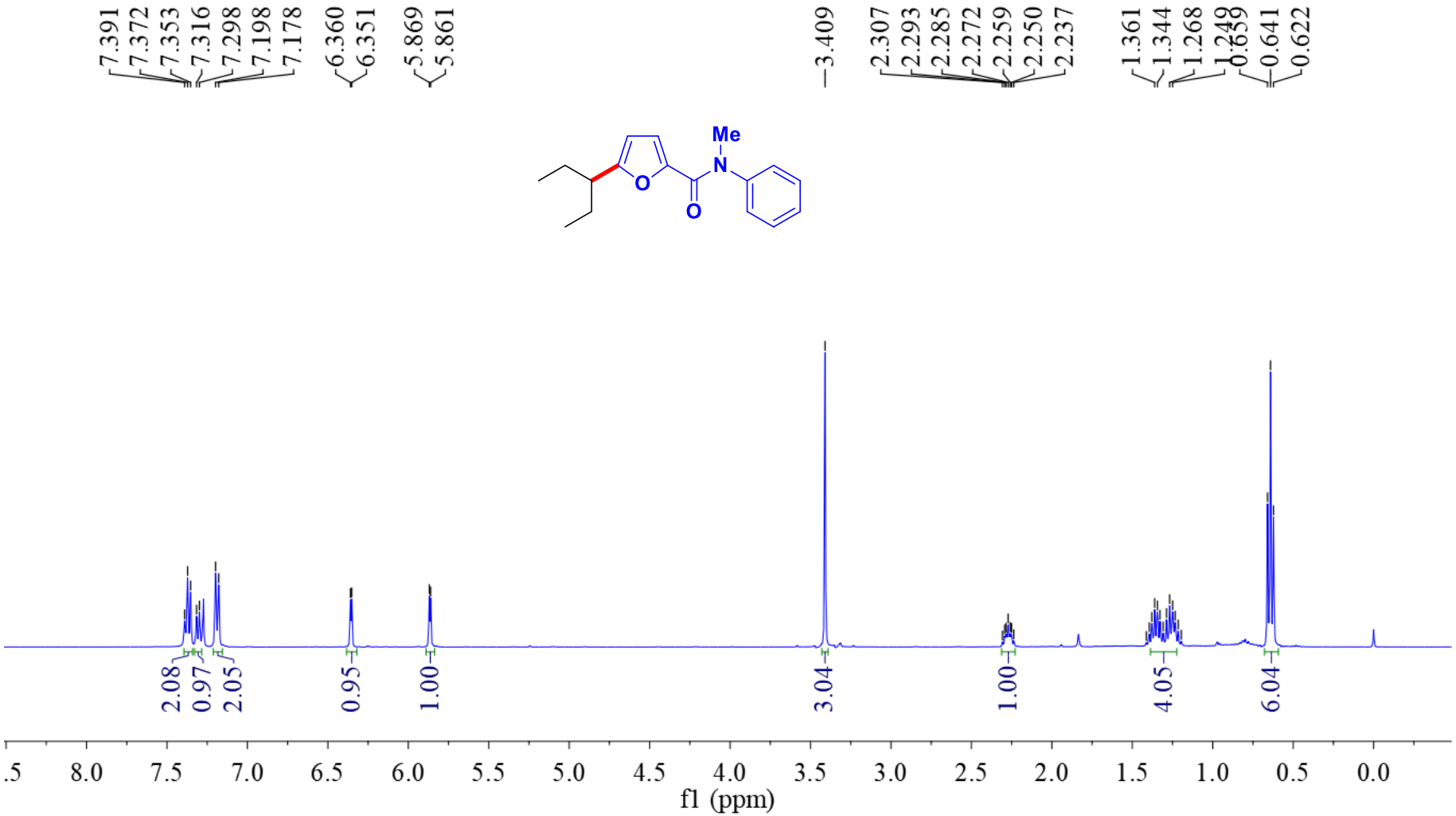


Figure S-79. $^{13}C\{^{1}H\}$ NMR spectrum of **(1ab)** ($CDCl_3$, 100 MHz) ***N*-methyl-5-(pentan-3-yl)-*N*-phenylfuran-2-carboxamide**

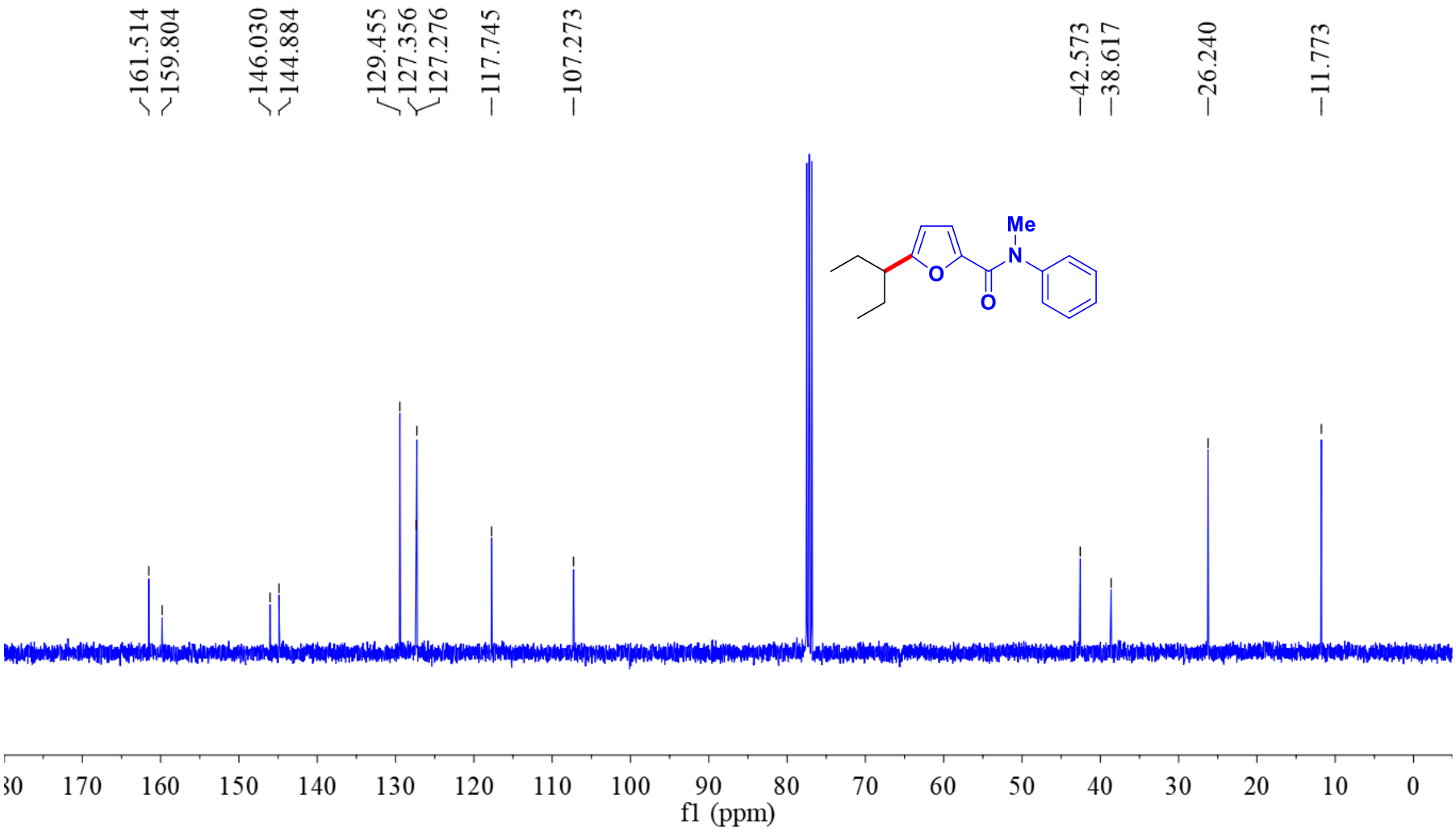


Figure S-80. ^{1}H NMR spectrum of **(1ac)** ($CDCl_3$, 400 MHz) ***N*-methyl-5-(pentan-2-yl)-*N*-phenylfuran-2-carboxamide**

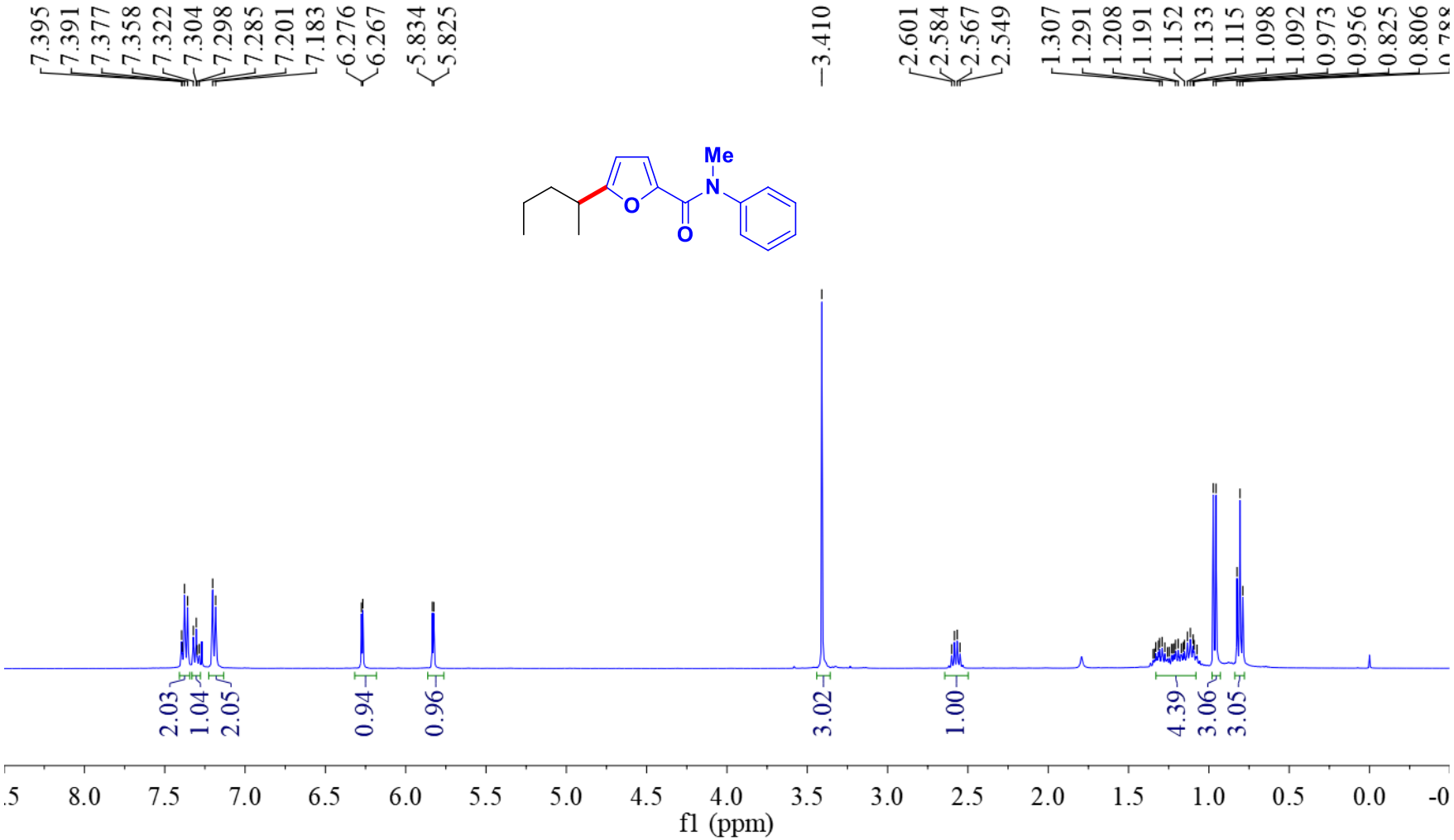


Figure S-81. $^{13}C\{^{1}H\}$ NMR spectrum of **(1ac)** ($CDCl_3$, 100 MHz) ***N*-methyl-5-(pentan-2-yl)-*N*-phenylfuran-2-carboxamide**

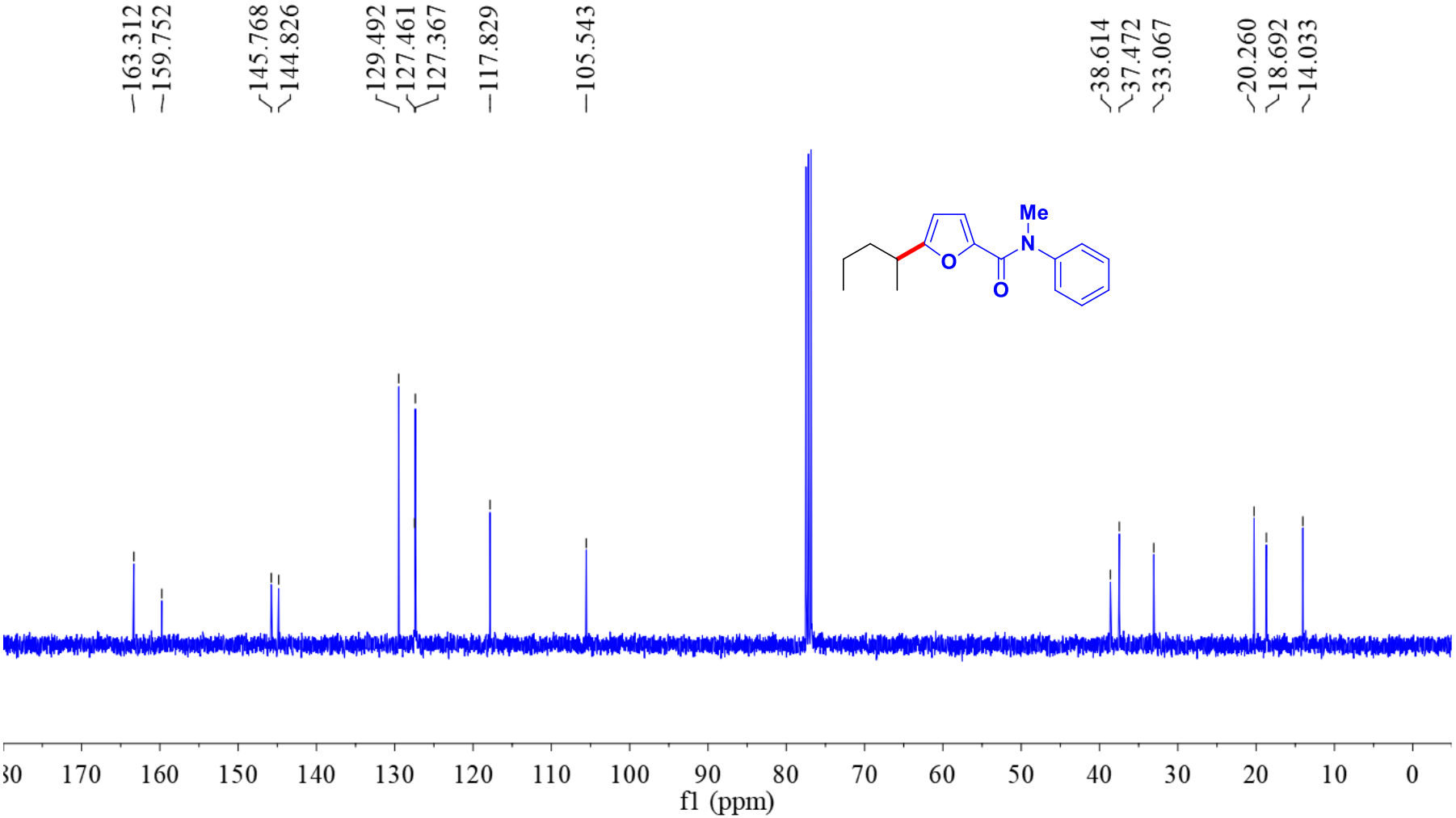


Figure S-82. ^{1}H NMR spectrum of **(1ad)** ($CDCl_3$, 400 MHz) **5-(*sec*-butyl)-*N*-methyl-*N*-phenylfuran-2-carboxamide**

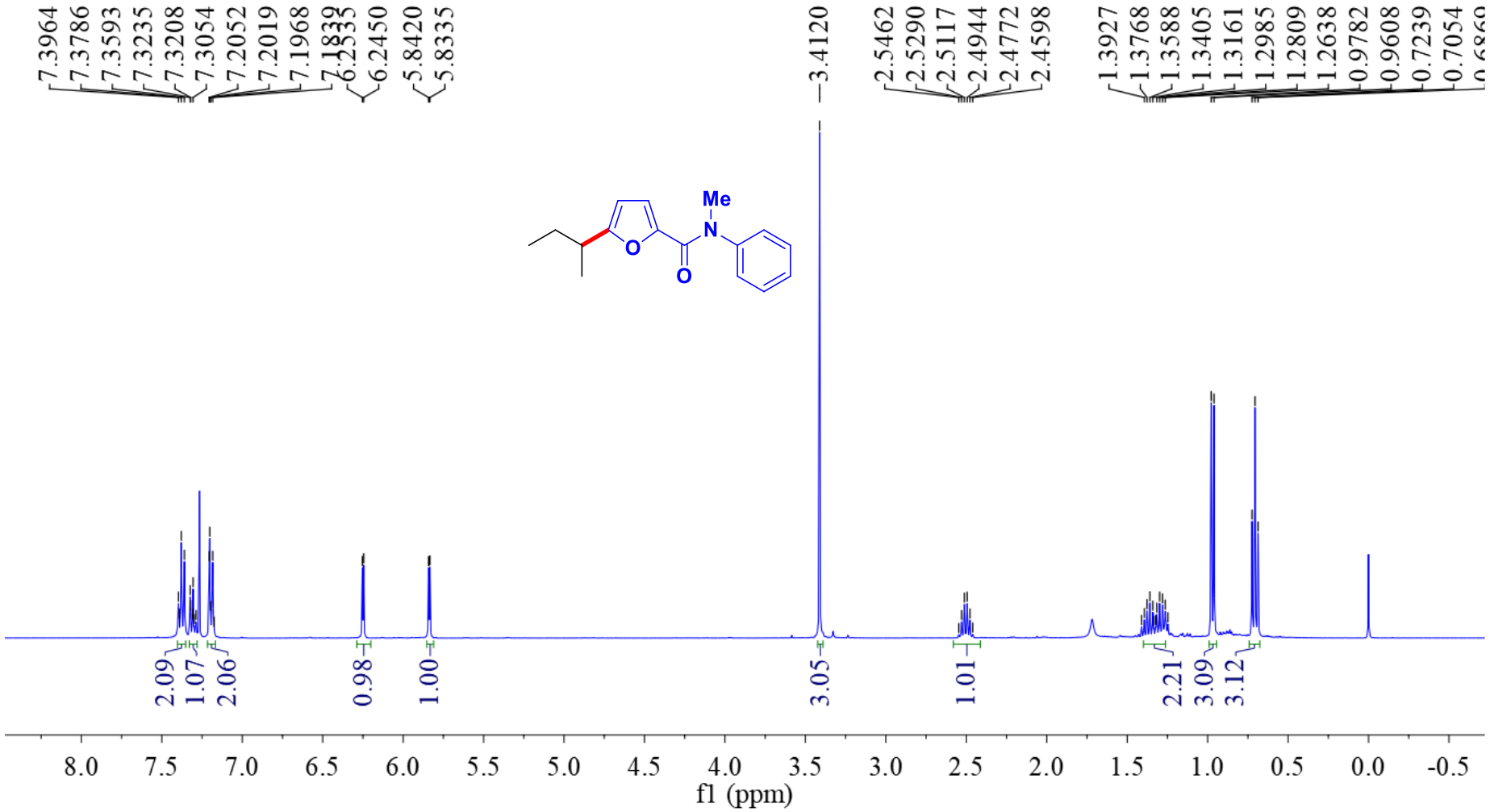


Figure S-83. $^{13}C\{^{1}H\}$ NMR spectrum of **(1ad)** ($CDCl_3$, 100 MHz) **5-(*sec*-butyl)-*N*-methyl-*N*-phenylfuran-2-carboxamide**

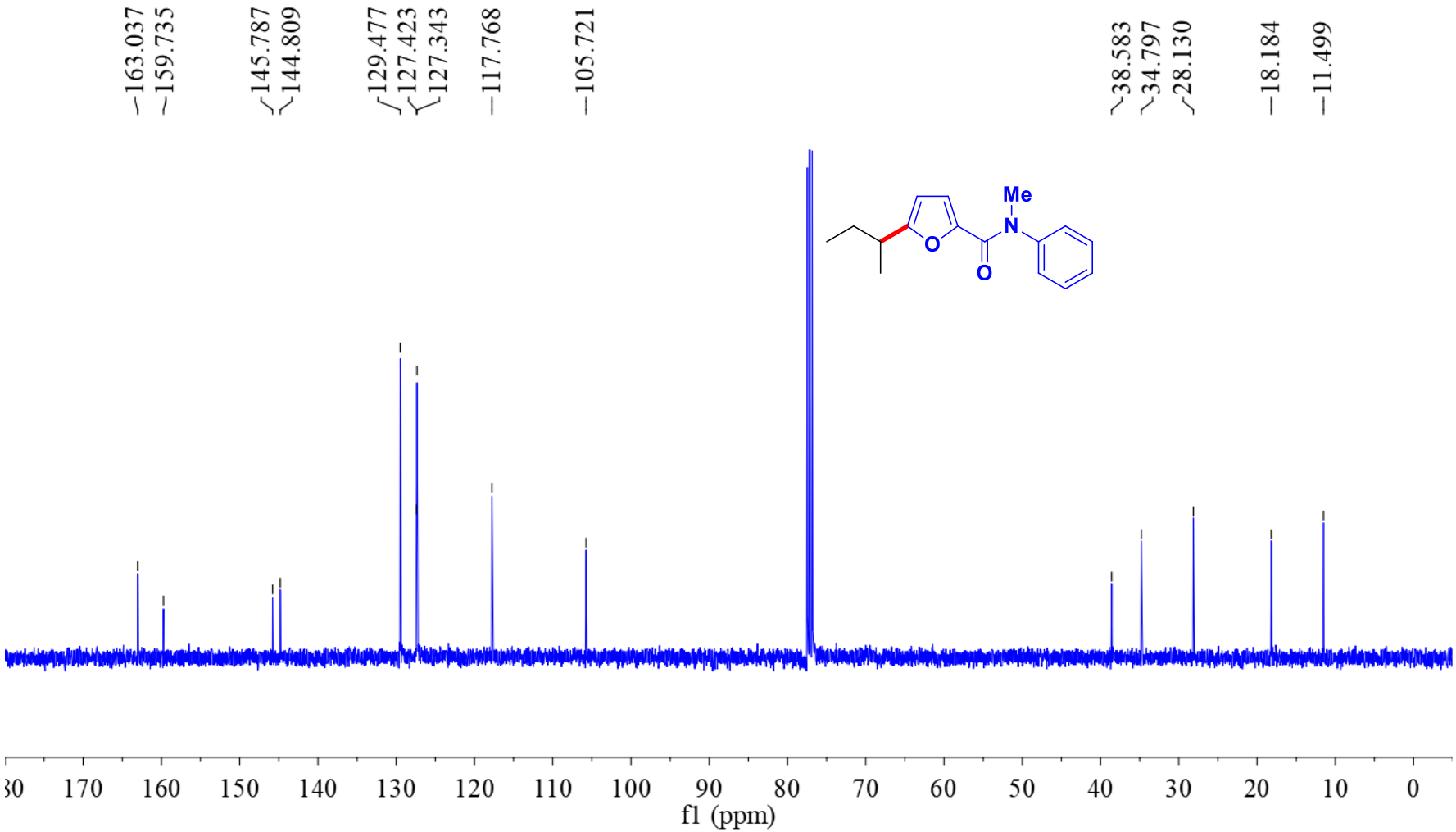


Figure S-84. ^{1}H NMR spectrum of **(1ae)** ($CDCl_3$, 400 MHz) ***N*-methyl-*N*-phenyl-5-propylfuran-2-carboxamide**

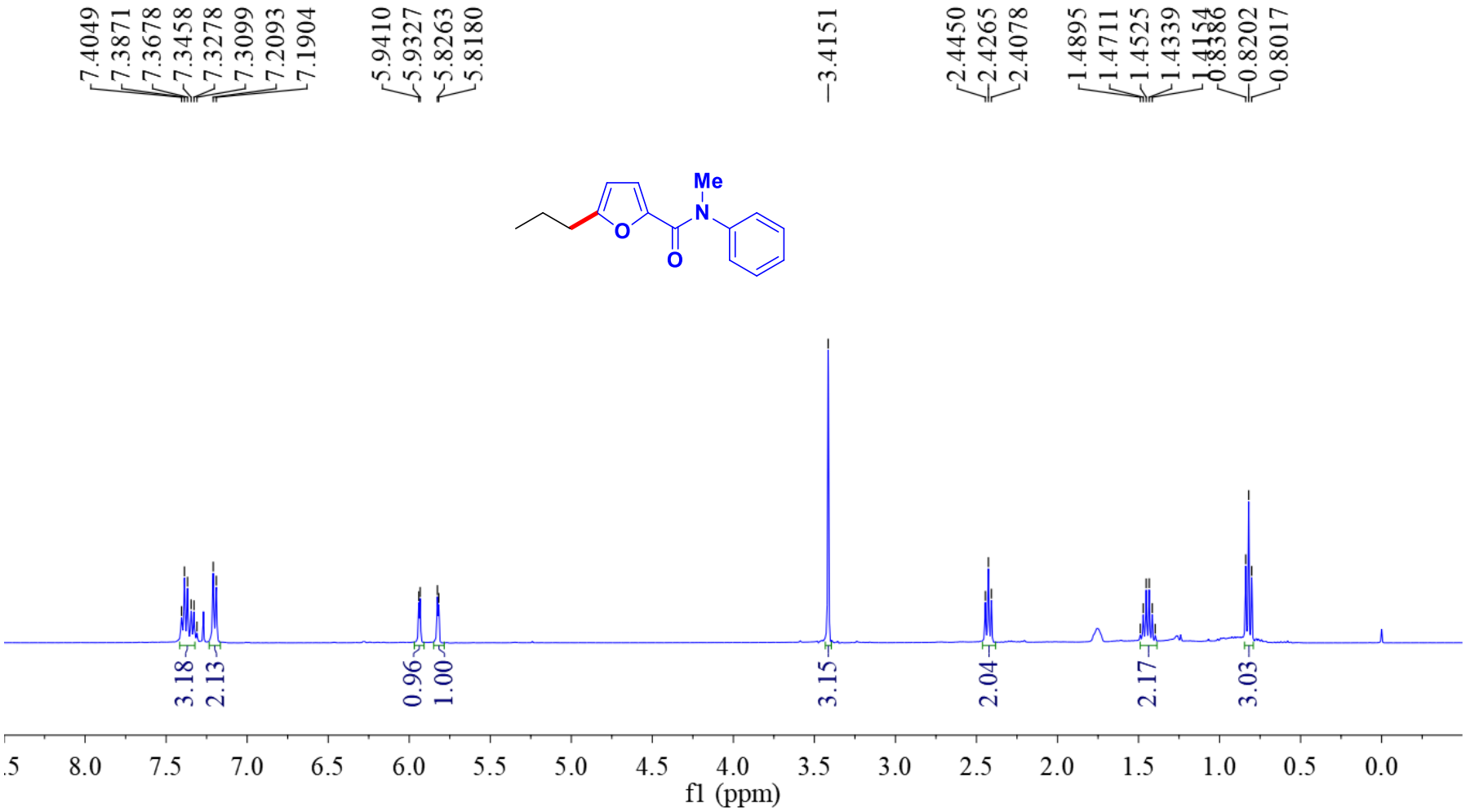


Figure S-85. $^{13}C\{^{1}H\}$ NMR spectrum of **(1ae)** ($CDCl_3$, 100 MHz) ***N*-methyl-*N*-phenyl-5-propylfuran-2-carboxamide**

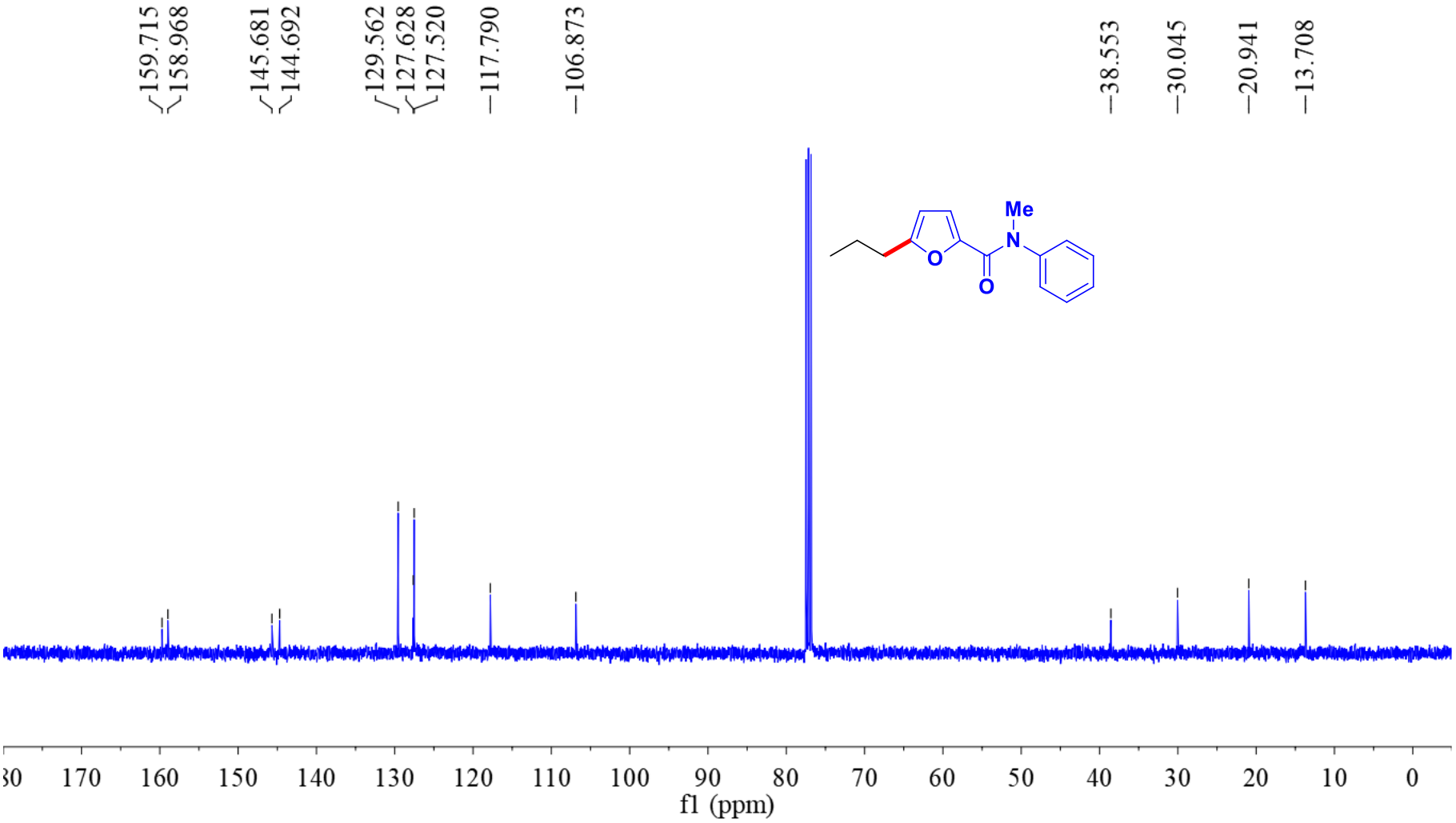


Figure S-86. ^{1}H NMR spectrum of **(1af)** ($CDCl_3$, 400 MHz) **(1af) 5-isobutyl-*N*-methyl-*N*-phenylfuran-2-carboxamide**

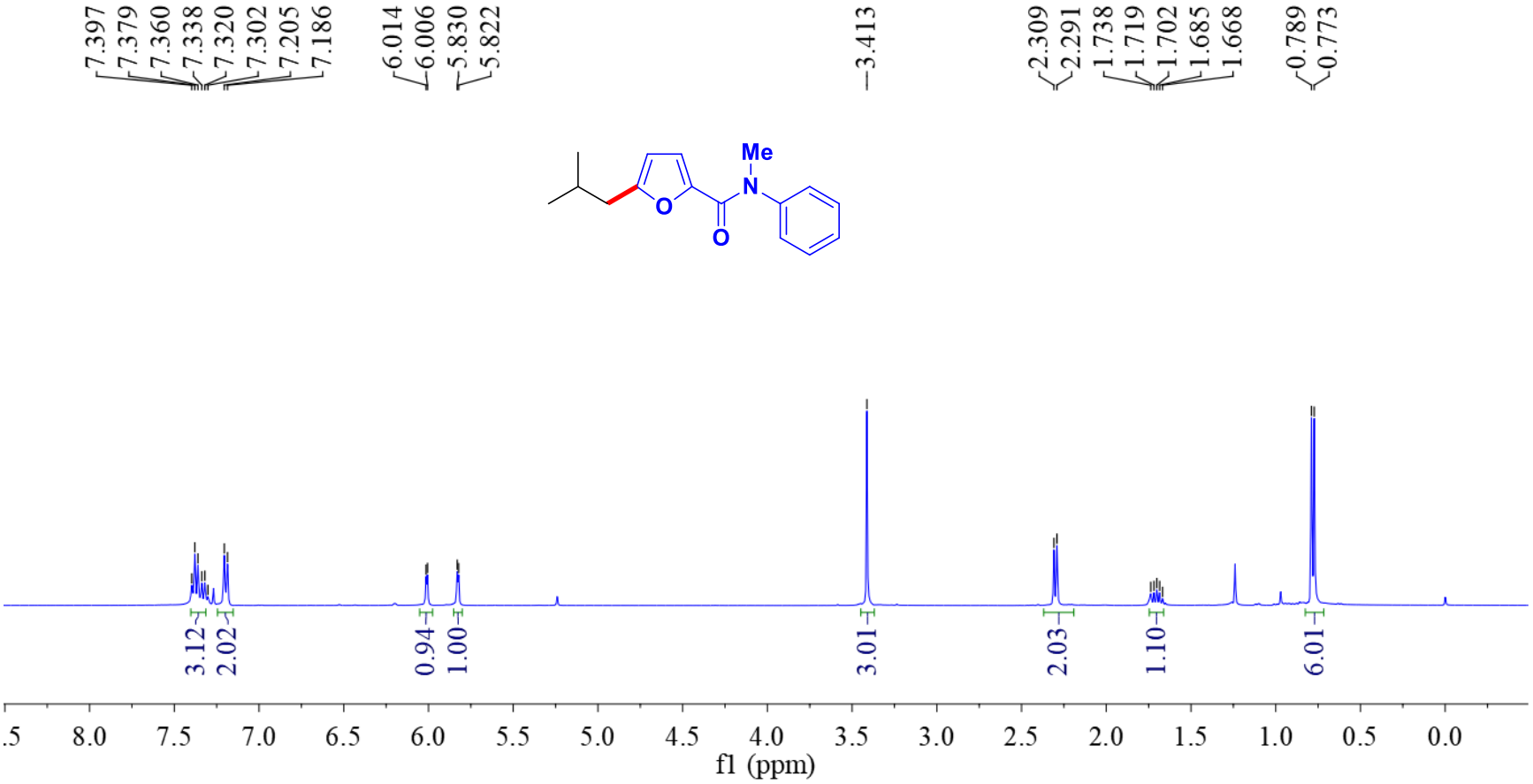


Figure S-87. $^{13}C\{^{1}H\}$ NMR spectrum of **(1af)** ($CDCl_3$, 100 MHz) **5-isobutyl-*N*-methyl-*N*-phenylfuran-2-carboxamide**

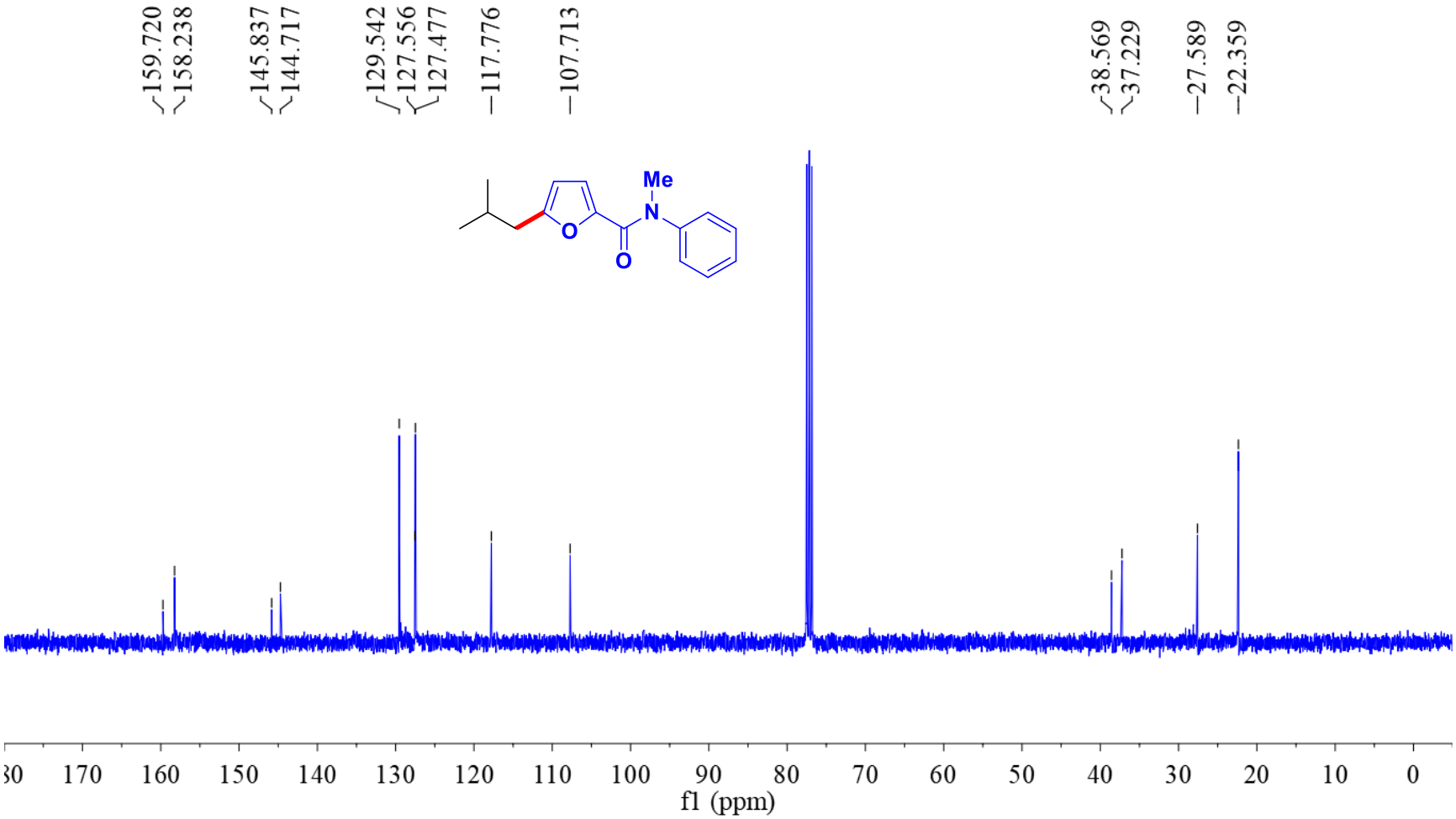


Figure S-88. ^{1}H NMR spectrum of **(1ag)** ($CDCl_3$, 400 MHz) **5-butyl-*N*-methyl-*N*-phenylfuran-2-carboxamide**

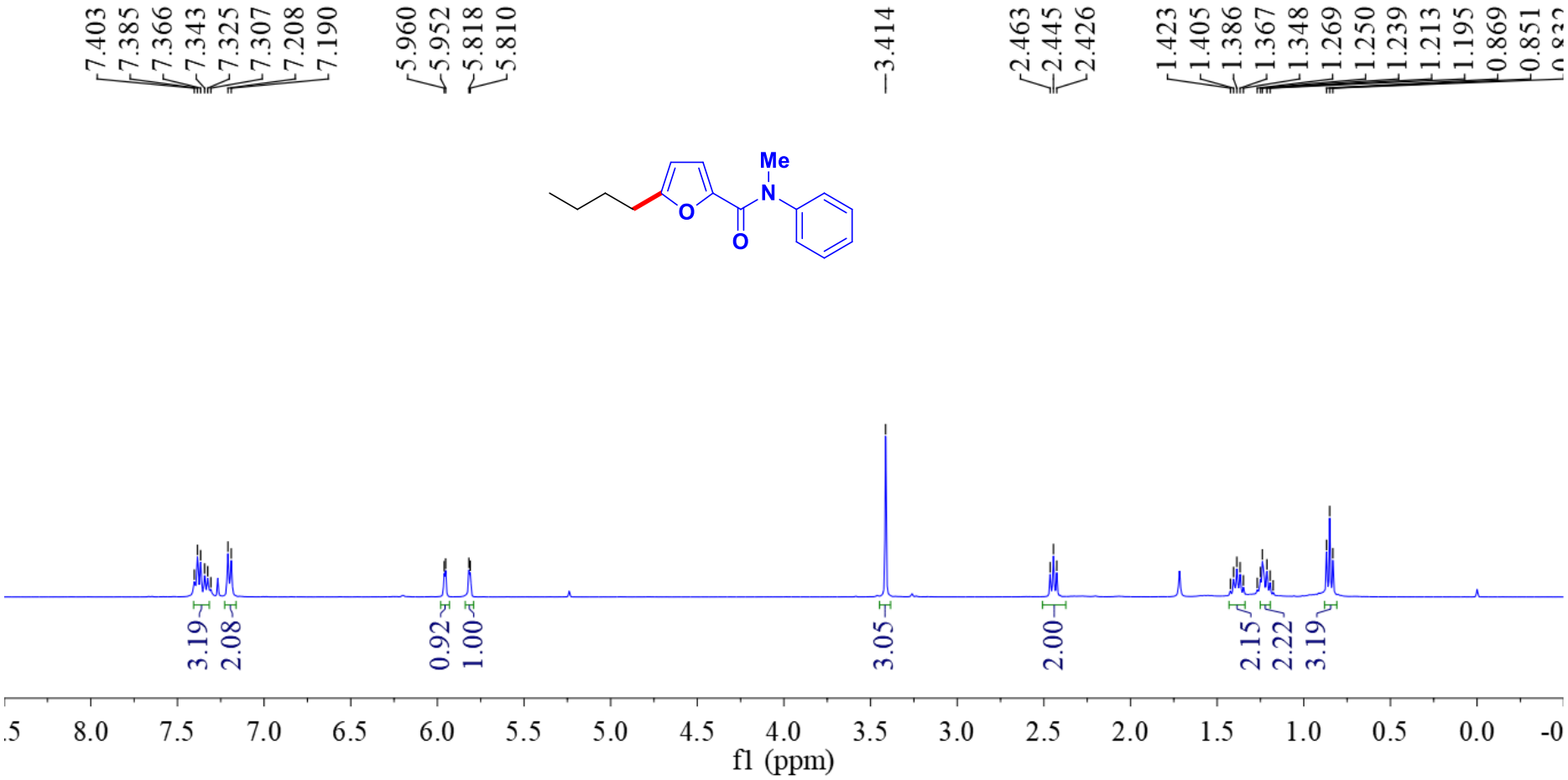
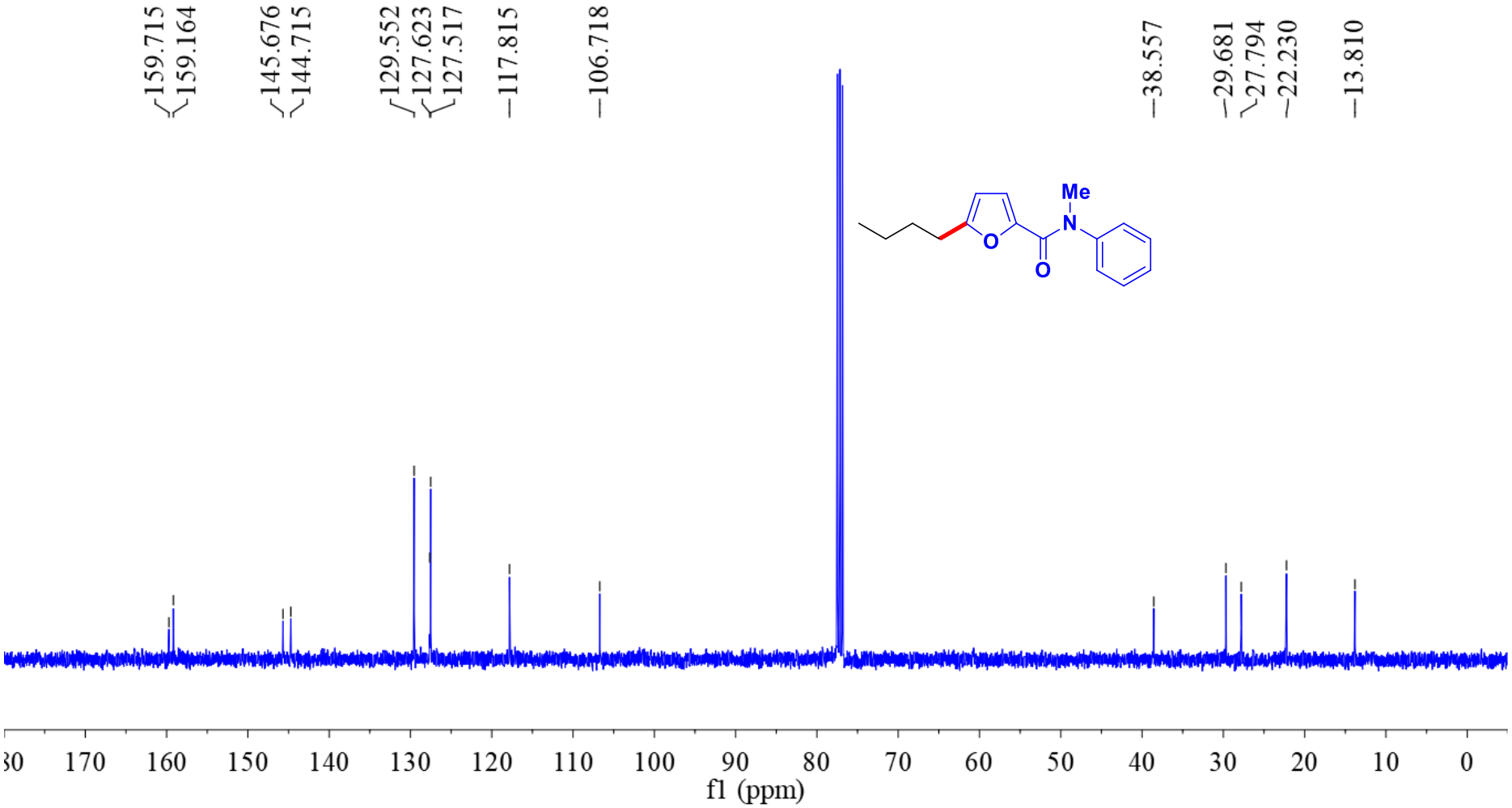


Figure S-89. $^{13}C\{^{1}H\}$ NMR spectrum of **(1ag)** ($CDCl_3$, 100 MHz) **5-butyl-*N*-methyl-*N*-phenylfuran-2-carboxamide**



II. Control experiments

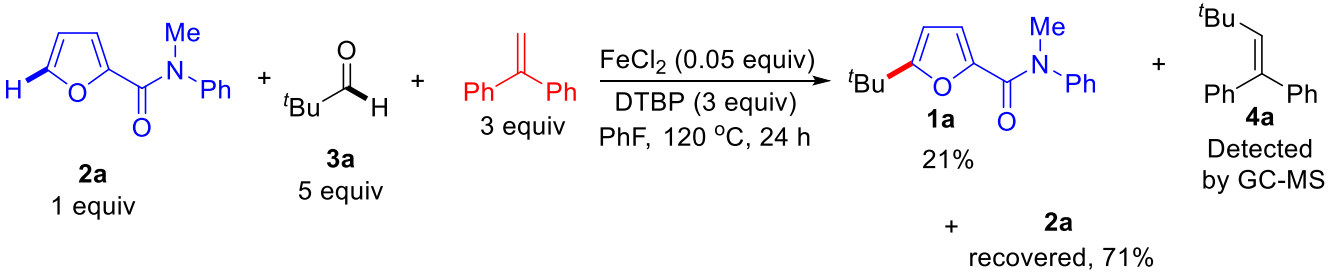


Figure S-90. the product of alkyl radical trapping (**4a**)