

Acidic tributyl phosphonium-based ionic liquid: An efficient catalyst for preparation of diverse pyridine systems via a cooperative vinylogous anomeric-based oxidation

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- 1: FT-IR spectrum of tributyl(3-sulfopropyl) phosphonium trifluoroacetate.
- 2: ¹H NMR spectrum of tributyl(3-sulfopropyl) phosphonium trifluoroacetate.
- 3: ¹³C NMR spectrum of tributyl(3-sulfopropyl) phosphonium trifluoroacetate.
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- 5: ¹H NMR spectrum of 2-amino-4-(2-methoxyphenyl)-6-phenylnicotinonitrile (1b).
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- 26: ¹H NMR spectrum of 2-amino-4-(4-hydroxyphenyl)-6-(naphthalen-2-yl)nicotinonitrile (1i).
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- 30: FT-IR spectrum of 2-amino-4-(2-chlorophenyl)-6-(naphthalen-2-yl)nicotinonitrile (1k).
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- 34: FT-IR spectrum of 2-amino-4-(4-nitrophenyl)-6-(naphthalen-2-yl)nicotinonitrile (1l).
- 35: FT-IR spectrum of 2'-(1*H*-indol-3-yl)-6'-(naphthalen-2-yl)-[3,4'-bipyridine]-3'-carbonitrile (1m).
- 36: ¹H NMR spectrum of 2'-(1*H*-indol-3-yl)-6'-(naphthalen-2-yl)-[3,4'-bipyridine]-3'-carbonitrile (1m).
- 37: ¹³C NMR spectrum of 2'-(1*H*-indol-3-yl)-6'-(naphthalen-2-yl)-[3,4'-bipyridine]-3'-carbonitrile (1m).
- 38: Mass spectrum of 2'-(1*H*-indol-3-yl)-6'-(naphthalen-2-yl)-[3,4'-bipyridine]-3'-carbonitrile (1m).
- 39: FT-IR spectrum of 2,4,6-triphenylpyridine (2a).
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- 43: FT-IR spectrum of 2,6-diphenyl-4,3'-bipyridine (2c).
- 44: Mass spectrum of 2,6-diphenyl-4,3'-bipyridine (2c).
- 45: FT-IR spectrum of 4-(4-chlorophenyl)-2,6-diphenylpyridine (2d).
- 46: ¹H NMR spectrum of 4-(4-chlorophenyl)-2,6-diphenylpyridine (2d).
- 47: ¹³C NMR spectrum of 4-(4-chlorophenyl)-2,6-diphenylpyridine (2d).
- 48: FT-IR spectrum of 3,5-dimethyl-2,4,6-triphenylpyridine (2e).
- 49: Mass spectrum of 3,5-dimethyl-2,4,6-triphenylpyridine (2e).
- 50: FT-IR spectrum of 2,6-di(naphthalen-2-yl)-4-(*p*-tolyl)pyridine (2f).
- 51: ¹H NMR spectrum of 2,6-di(naphthalen-2-yl)-4-(*p*-tolyl)pyridine (2f).
- 52: ¹³C NMR spectrum of 2,6-di(naphthalen-2-yl)-4-(*p*-tolyl)pyridine (2f).
- 53: FT-IR spectrum of 4-(3-fluorophenyl)-2,6-di(naphthalen-2-yl)pyridine (2g).

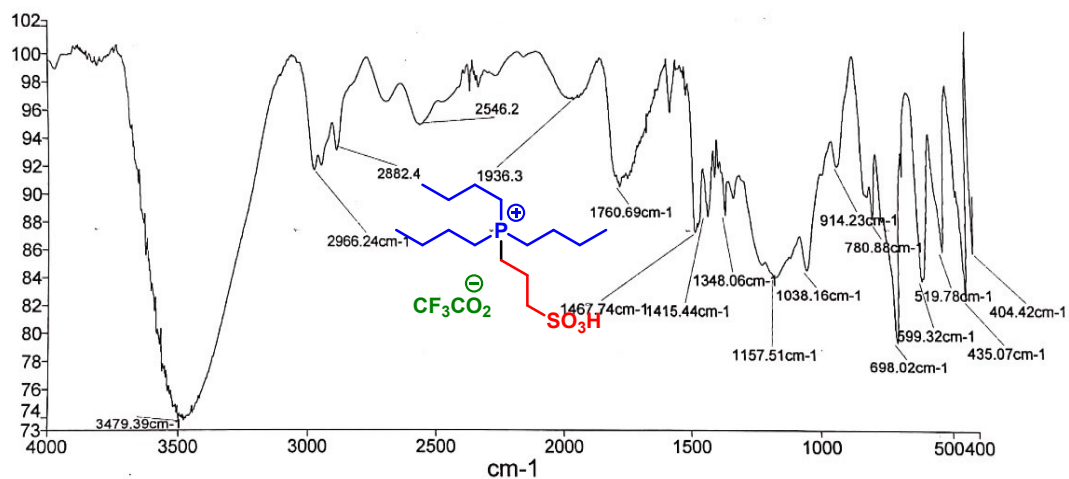
54: ^1H NMR spectrum of 4-(3-fluorophenyl)-2,6-di(naphthalen-2-yl)pyridine (2g).

55: ^{13}C NMR spectrum of 4-(3-fluorophenyl)-2,6-di(naphthalen-2-yl)pyridine (2g).

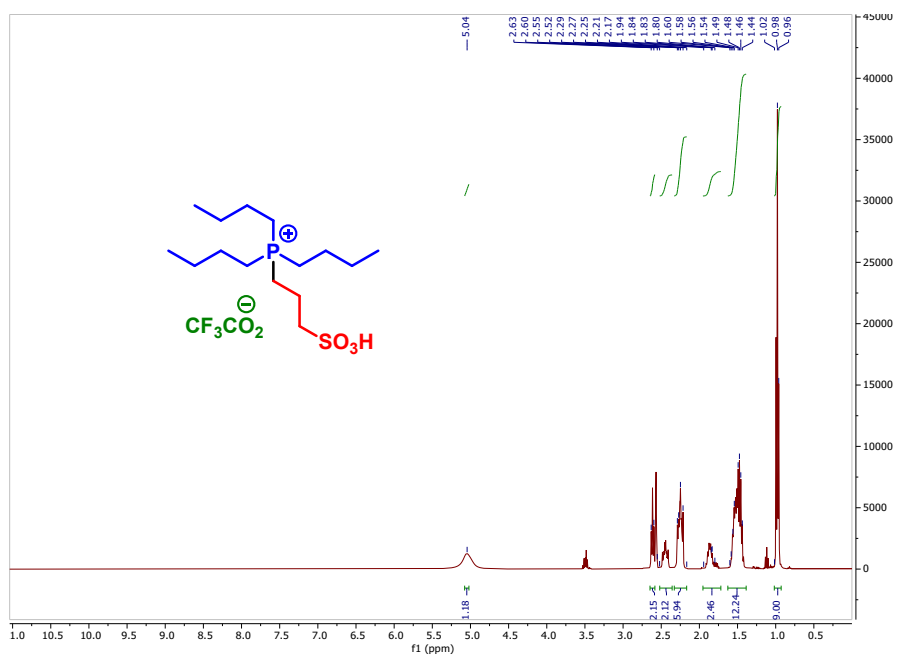
56: FT-IR spectrum of 4-(4-bromophenyl)-2,6-di(naphthalen-2-yl)pyridine (2h).

57: FT-IR spectrum of 4-(furan-2-yl)-2,6-di(naphthalen-2-yl)pyridine (2i).

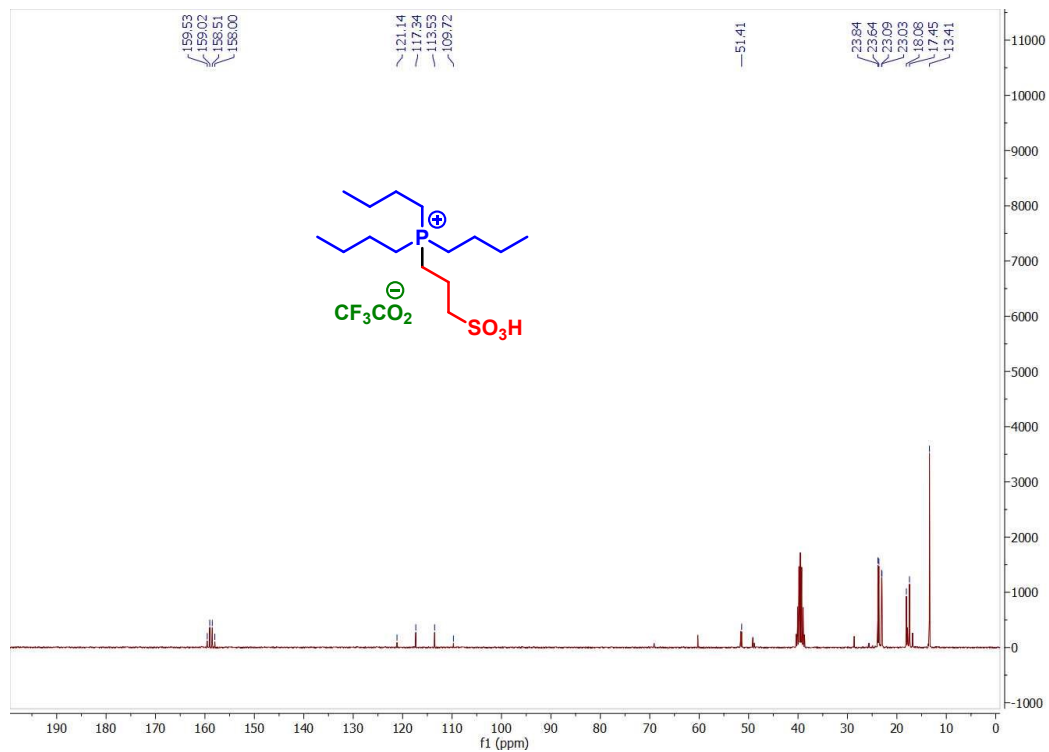
1: FT-IR spectrum of tributyl(3-sulfopropyl) phosphonium trifluoroacetate.



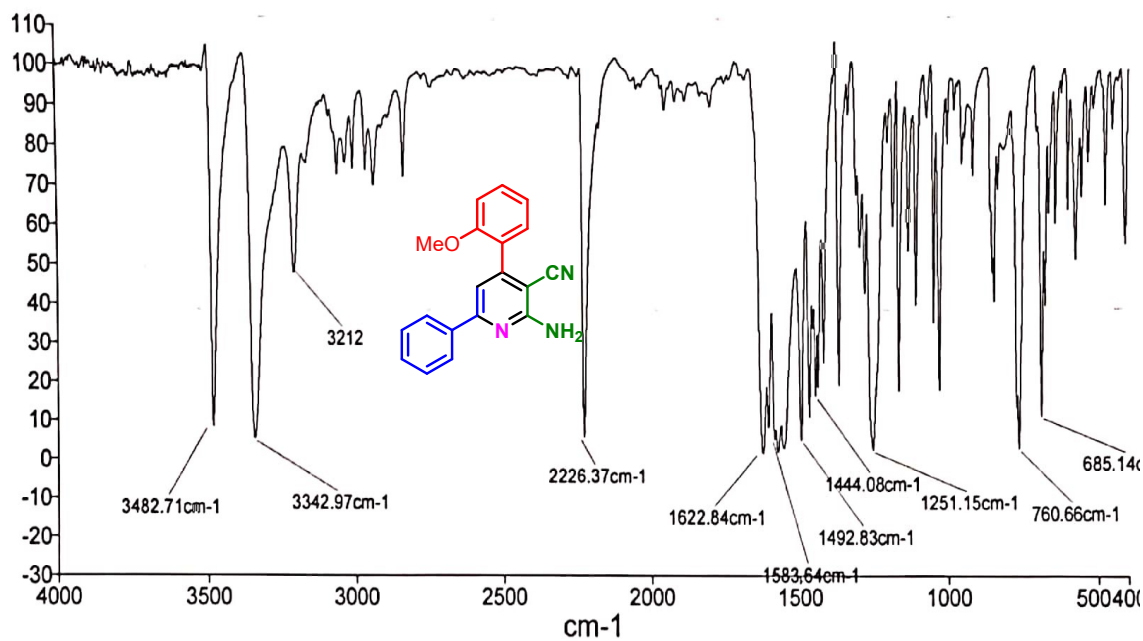
2: ¹H NMR spectrum of tributyl(3-sulfopropyl) phosphonium trifluoroacetate.



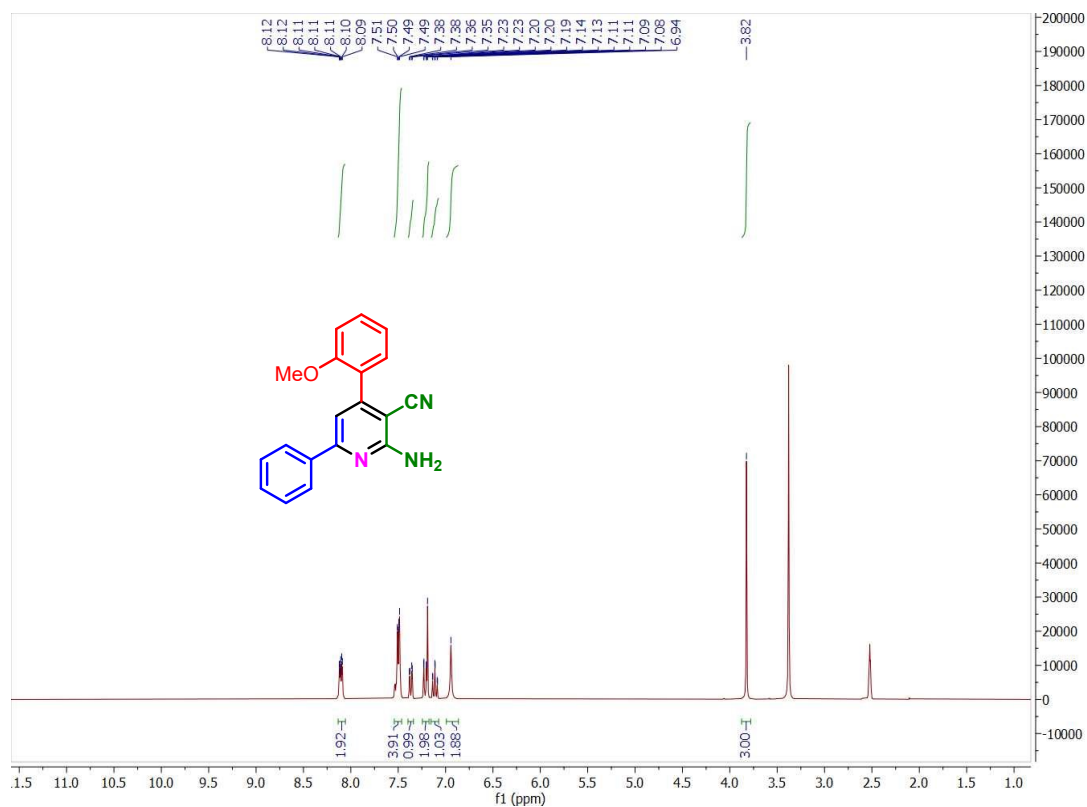
3: ^{13}C NMR spectrum of tributyl(3-sulfopropyl) phosphonium trifluoroacetate.



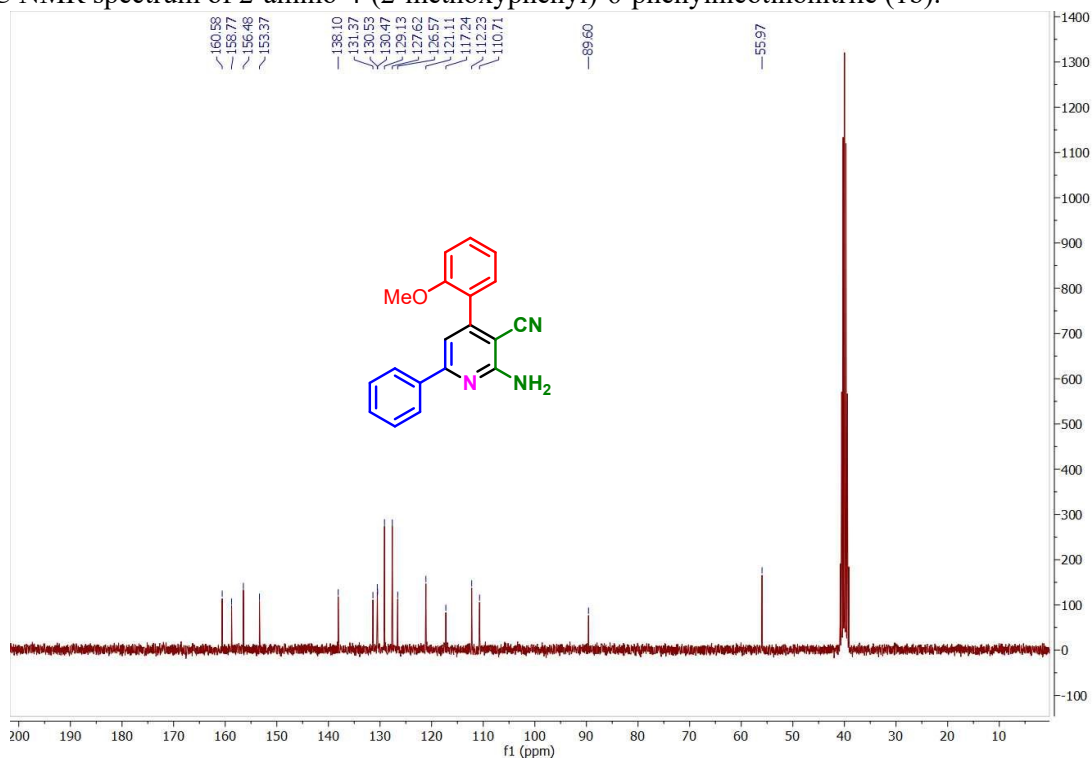
4: FT-IR spectrum of 2-amino-4-(2-methoxyphenyl)-6-phenylnicotinonitrile (1b).



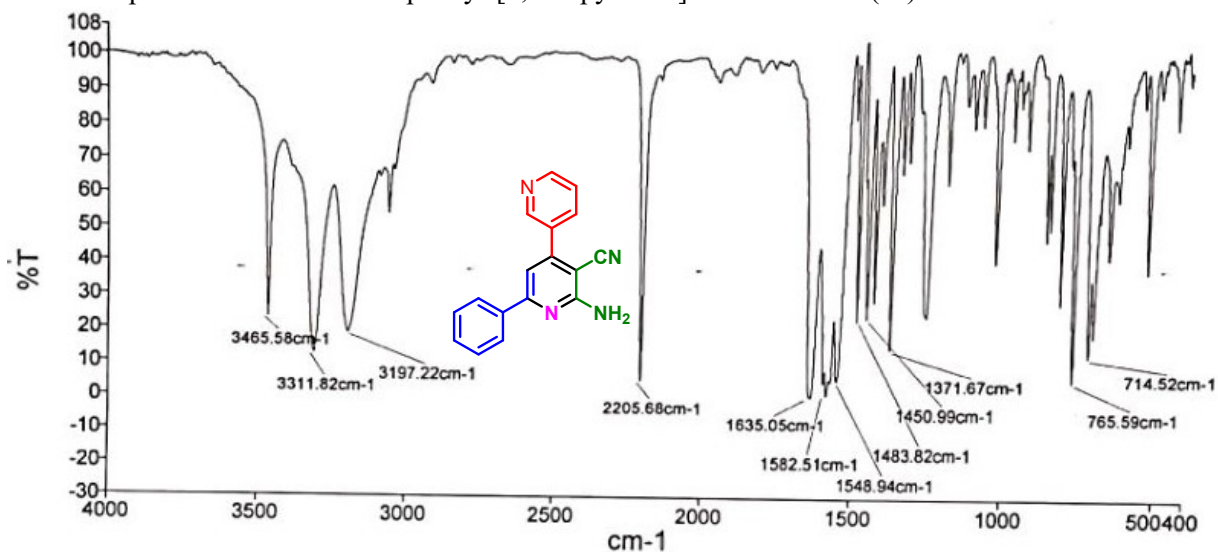
5: ^1H NMR spectrum of 2-amino-4-(2-methoxyphenyl)-6-phenylnicotinonitrile (1b).



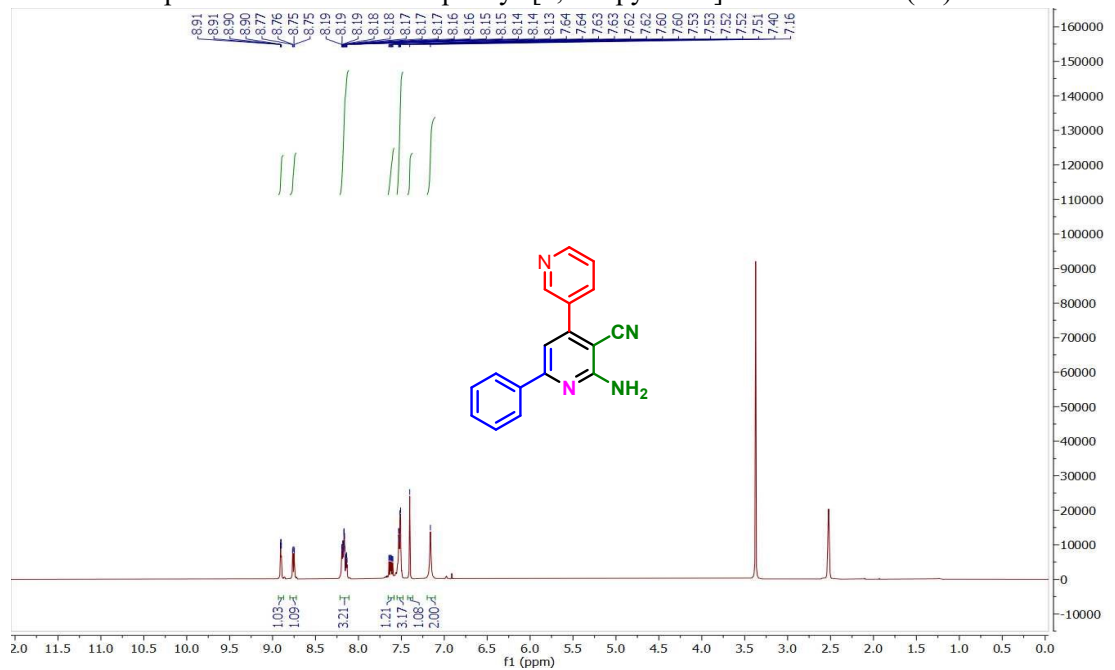
6: ^{13}C NMR spectrum of 2-amino-4-(2-methoxyphenyl)-6-phenylnicotinonitrile (1b).



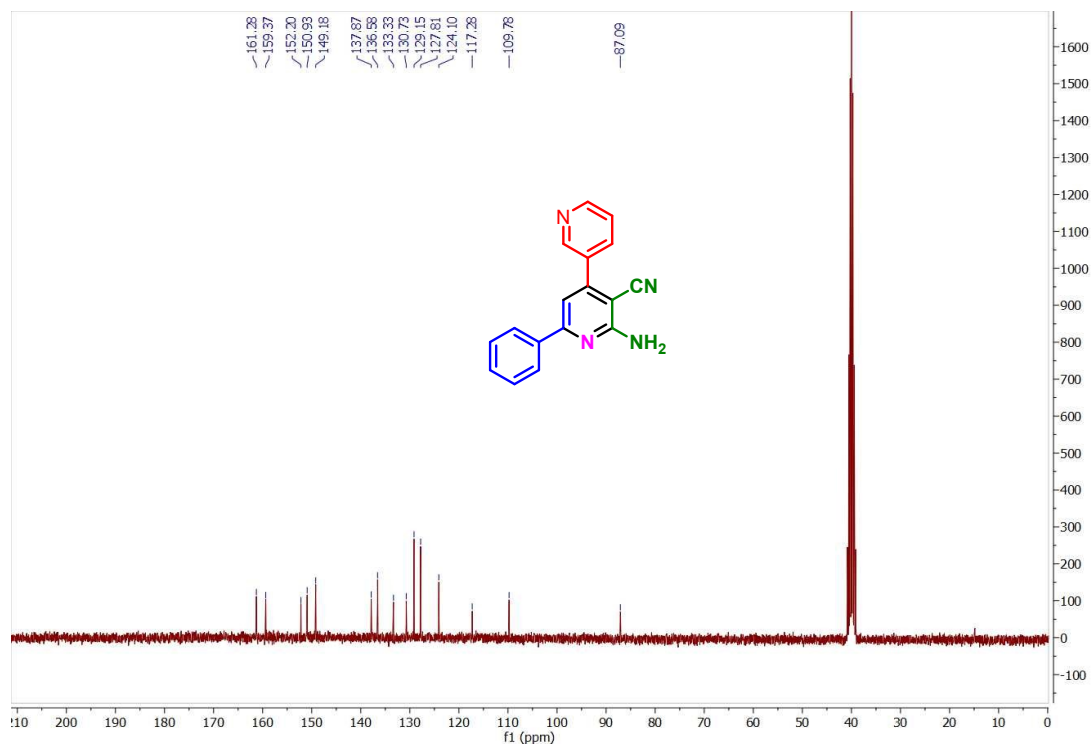
7: FT-IR spectrum of 2'-amino-6'-phenyl-[3,4'-bipyridine]-3'-carbonitrile (1c).



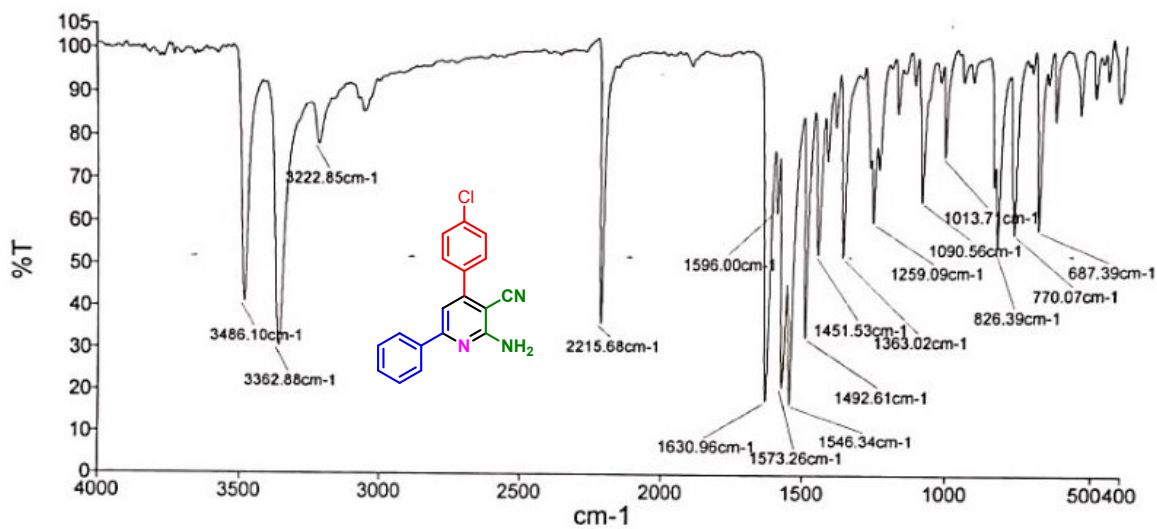
8: ¹H NMR spectrum of 2'-amino-6'-phenyl-[3,4'-bipyridine]-3'-carbonitrile (1c).



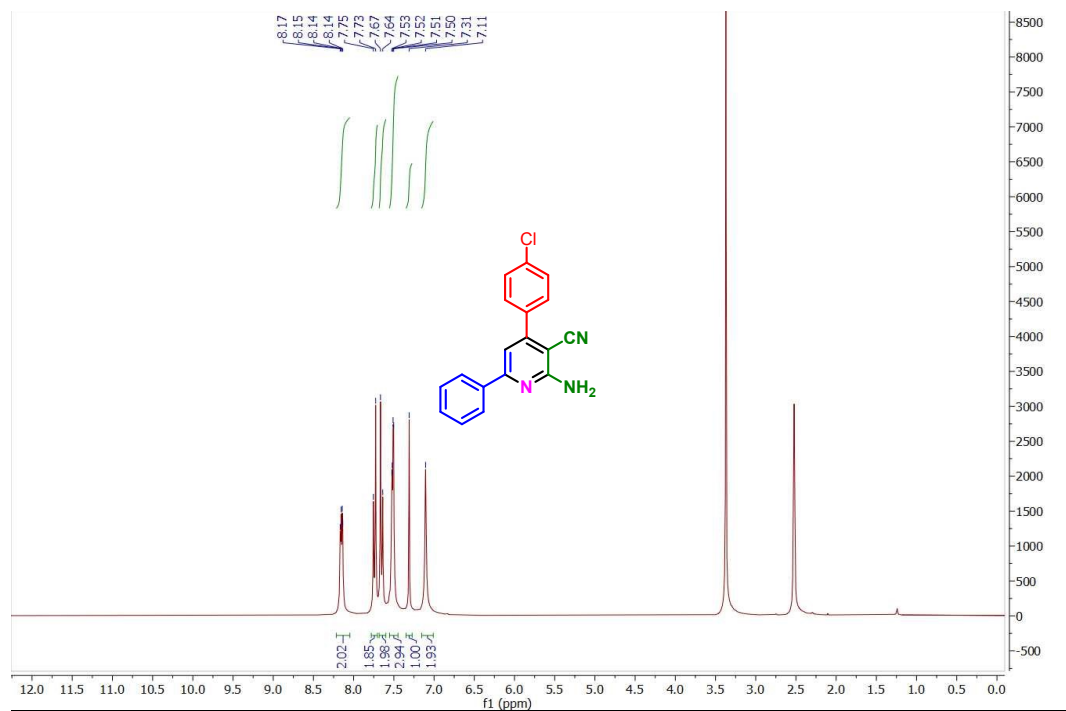
9: ¹³C NMR spectrum of 2'-amino-6'-phenyl-[3,4'-bipyridine]-3'-carbonitrile (1c).



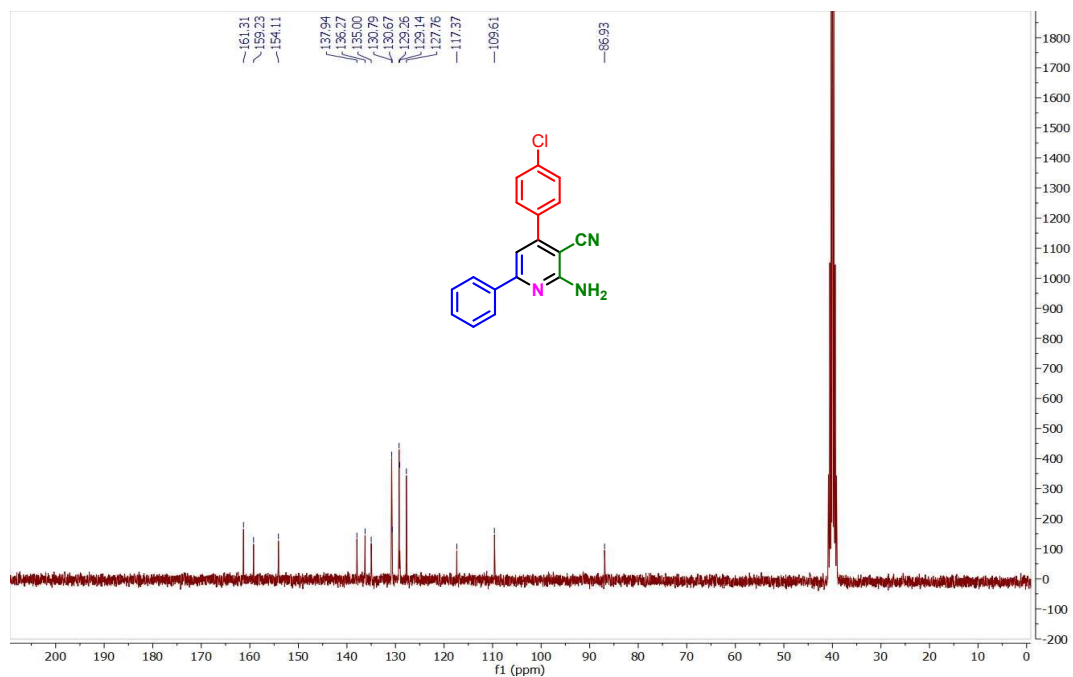
10: FT-IR spectrum of 2-amino-4-(4-chlorophenyl)-6-phenylnicotinonitrile (1d).



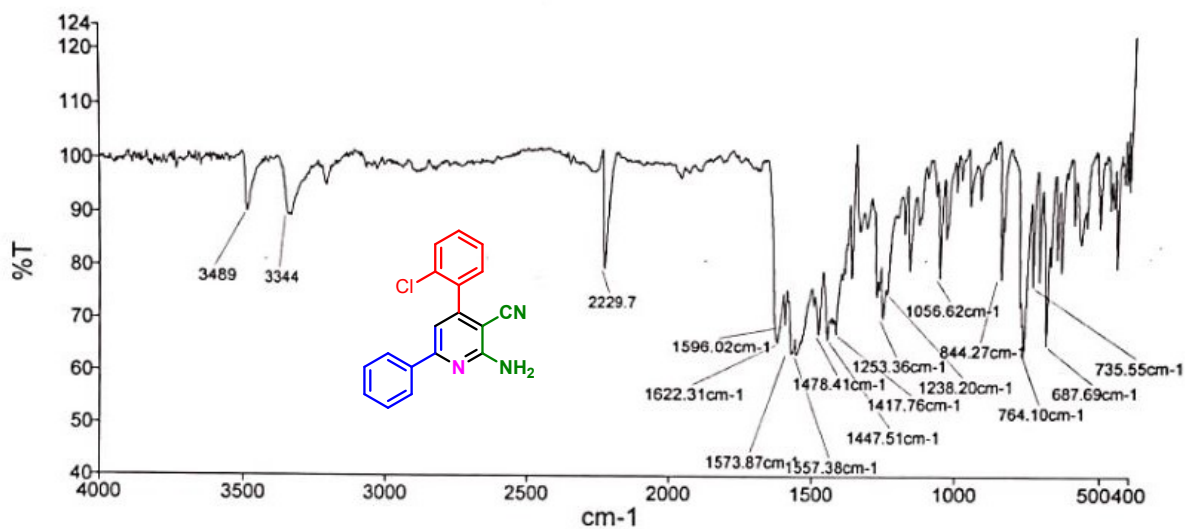
11: ¹H NMR spectrum of 2-amino-4-(4-chlorophenyl)-6-phenylnicotinonitrile (1d).



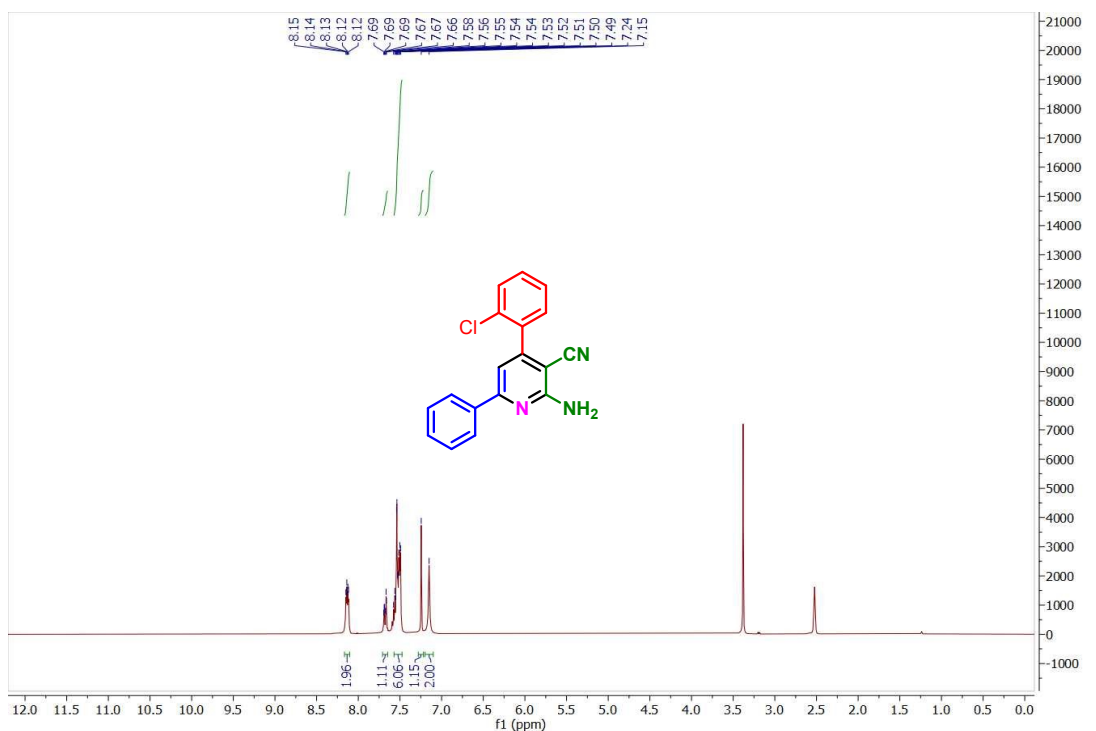
12: ¹³C NMR spectrum of 2-amino-4-(4-chlorophenyl)-6-phenylnicotinonitrile (1d).



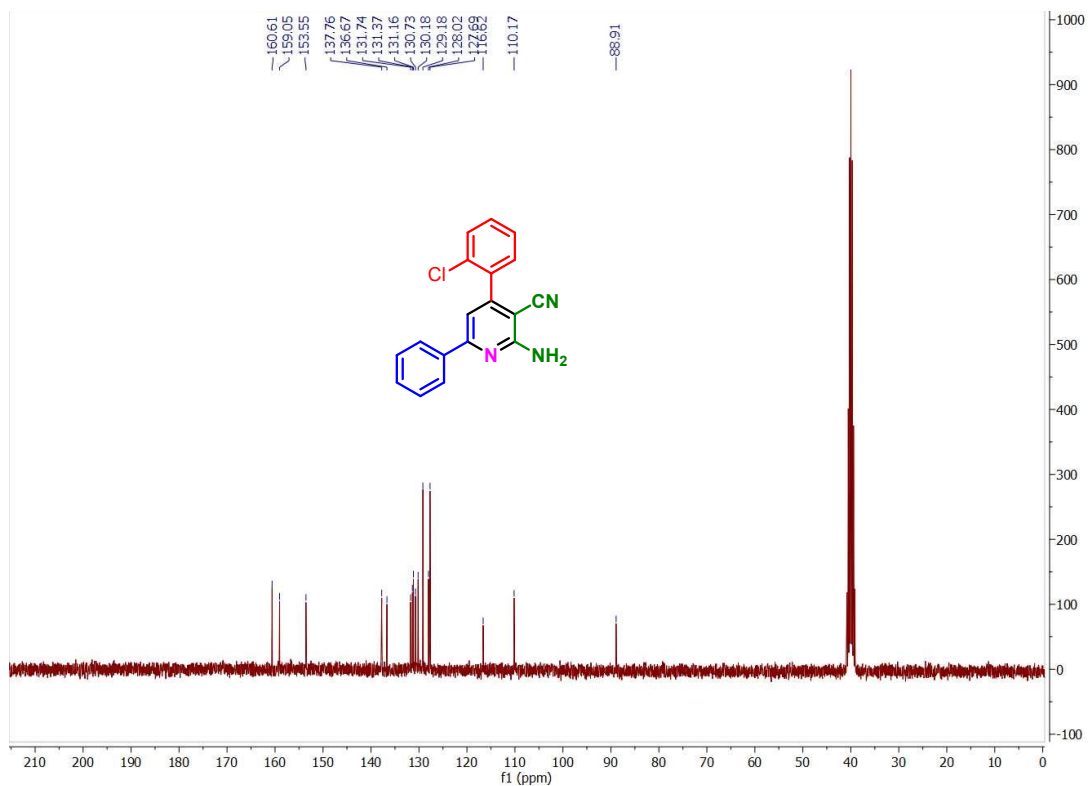
13: FT-IR spectrum of 2-amino-4-(2-chlorophenyl)-6-phenylnicotinonitrile (1e).



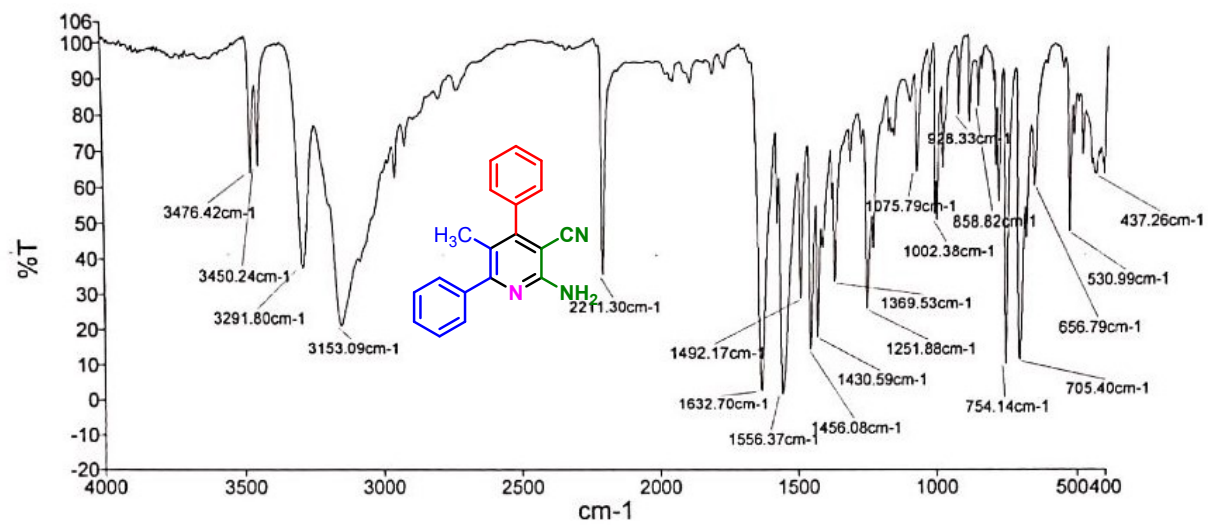
14: ¹H NMR spectrum of 2-amino-4-(2-chlorophenyl)-6-phenylnicotinonitrile (1e).



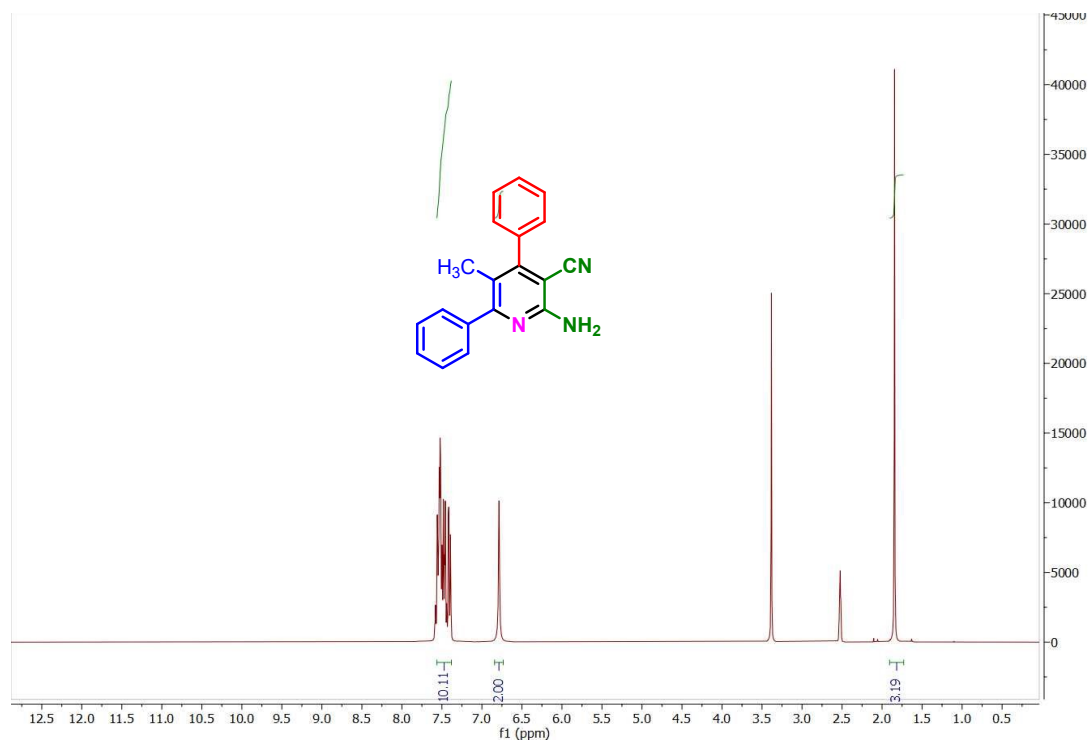
15: ¹³C NMR spectrum of 2-amino-4-(2-chlorophenyl)-6-phenylnicotinonitrile (1e).



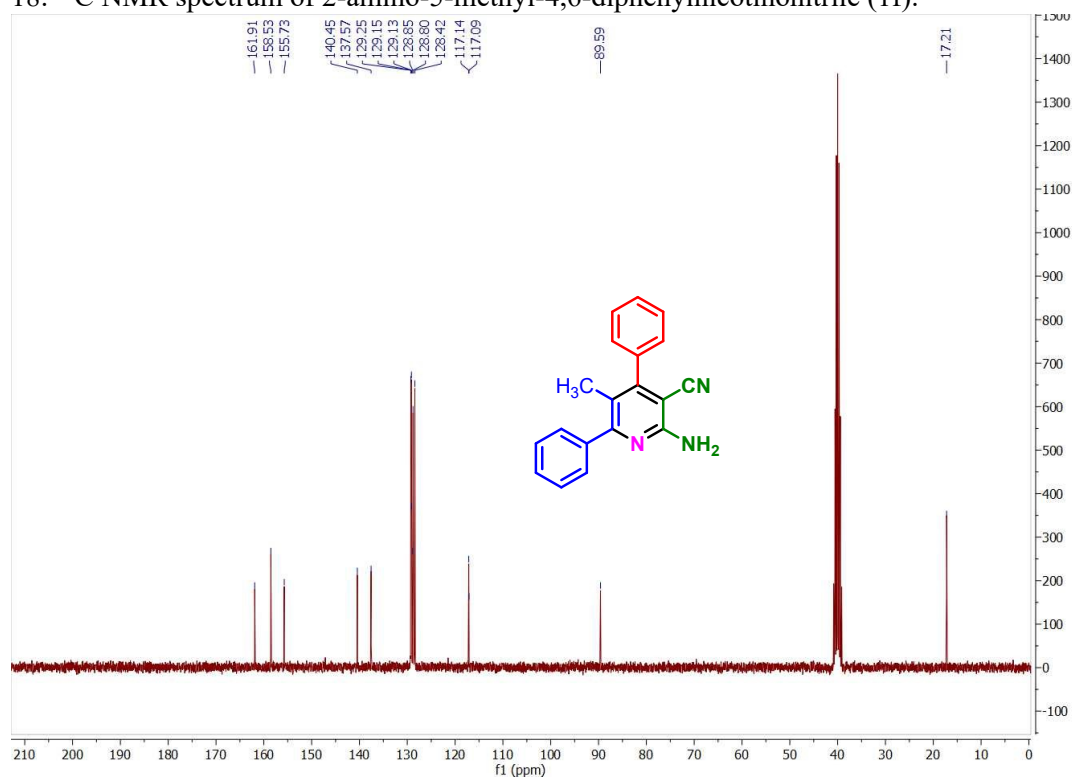
16: FT-IR spectrum of 2-amino-5-methyl-4,6-diphenylnicotinonitrile (1f).



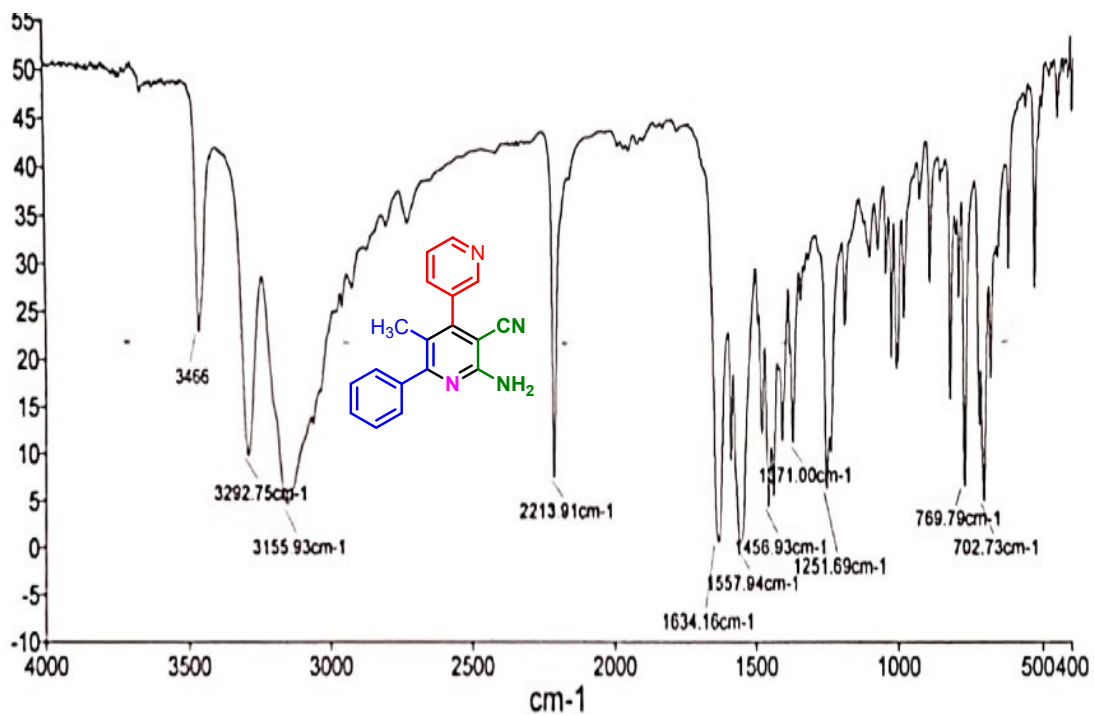
17: ¹H NMR spectrum of 2-amino-5-methyl-4,6-diphenylnicotinonitrile (1f).



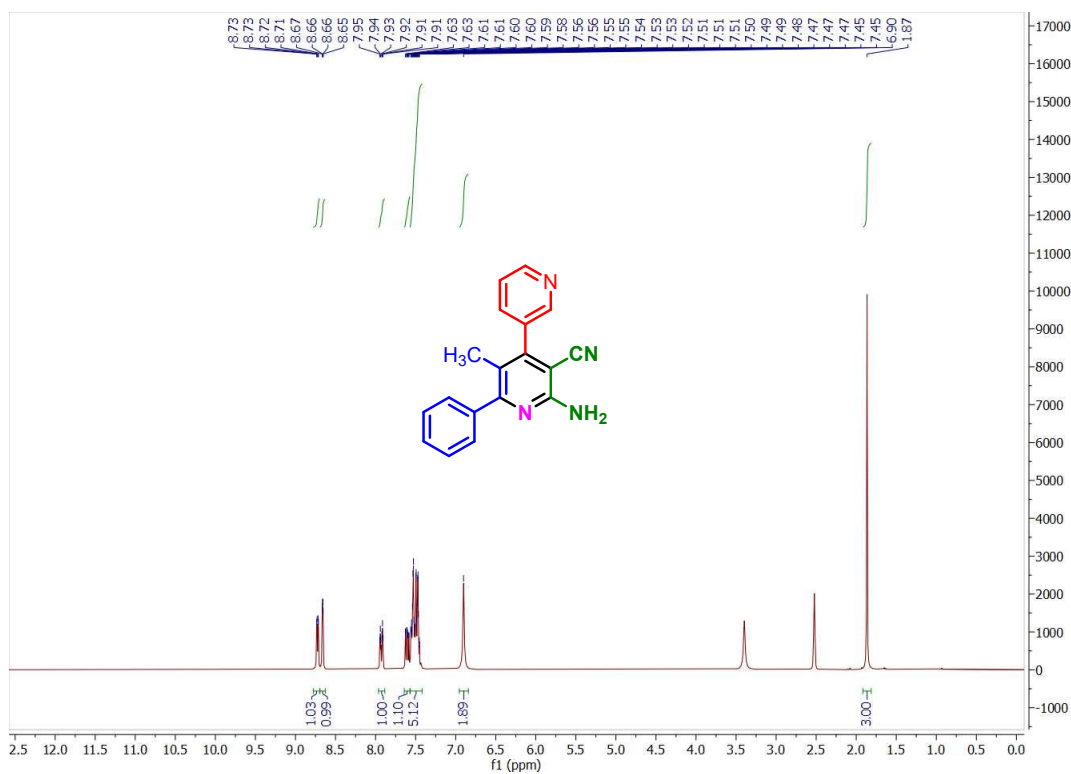
18: ¹³C NMR spectrum of 2-amino-5-methyl-4,6-diphenylnicotinonitrile (1f).



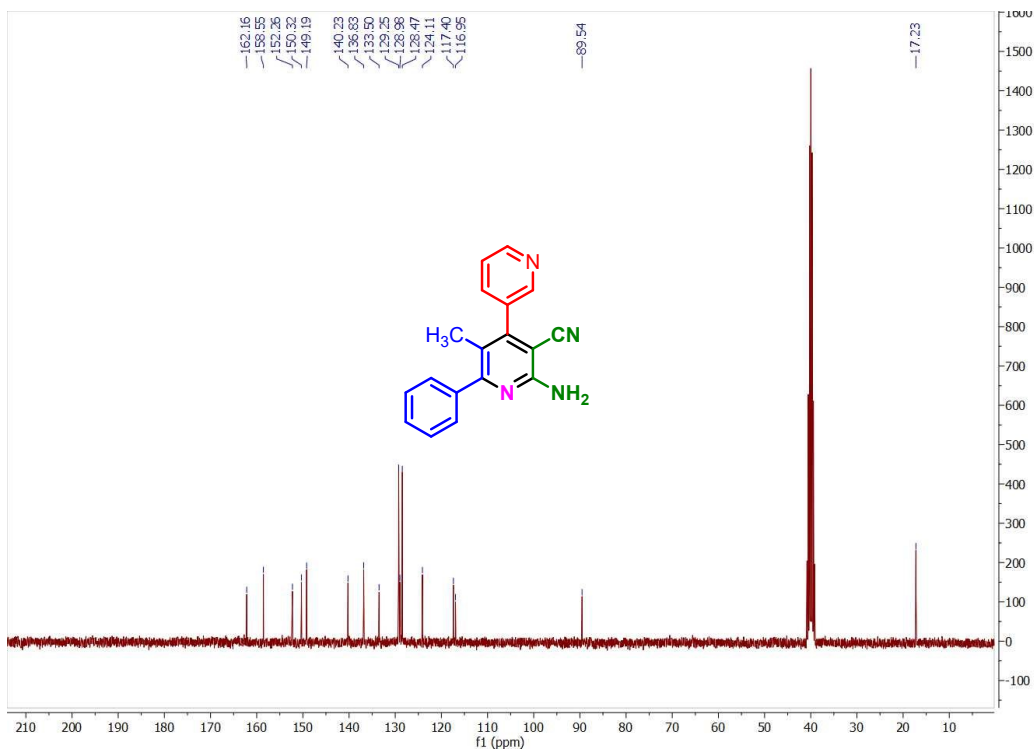
19: FT-IR spectrum of 2'-amino-5'-methyl-6'-phenyl-[3,4'-bipyridine]-3'-carbonitrile (1h).



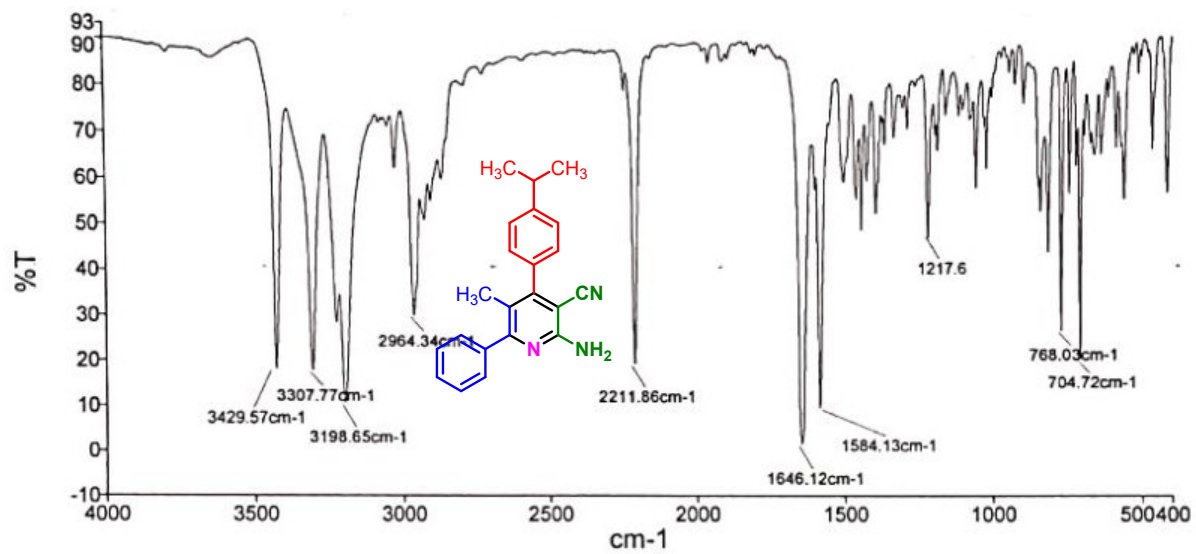
20: ¹H NMR spectrum of 2'-amino-5'-methyl-6'-phenyl-[3,4'-bipyridine]-3'-carbonitrile (1h).



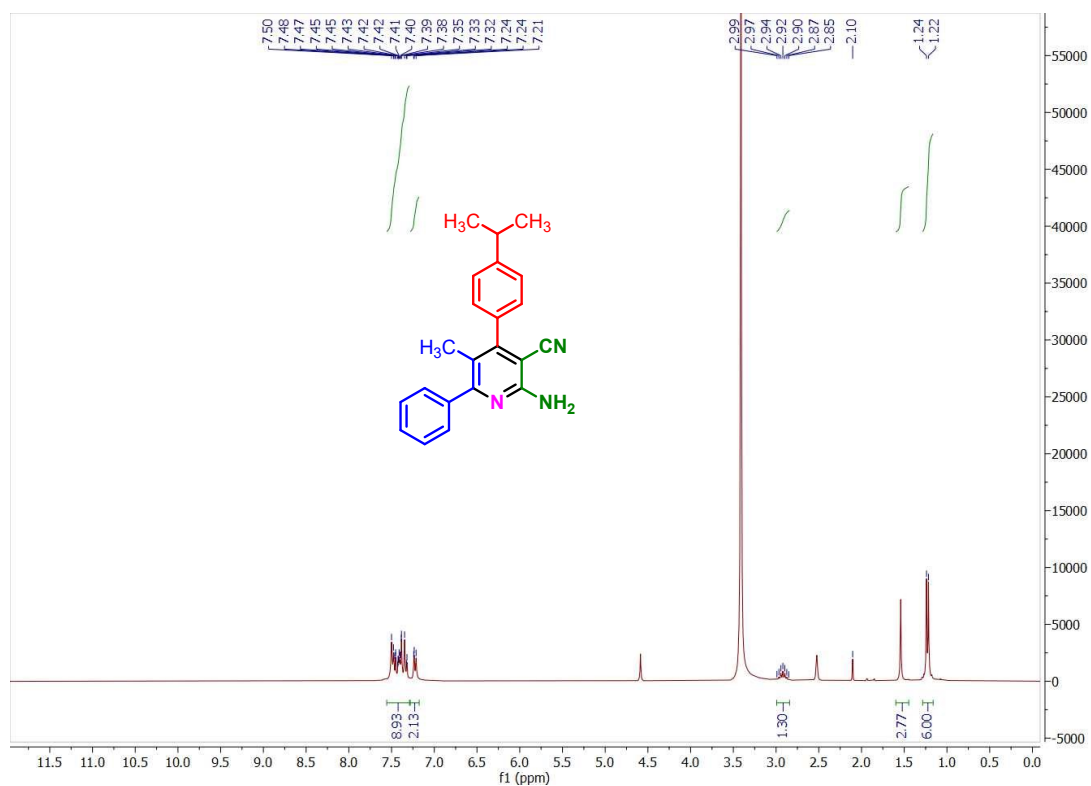
21: ¹³C NMR spectrum of 2'-amino-5'-methyl-6'-phenyl-[3,4'-bipyridine]-3'-carbonitrile (1h).



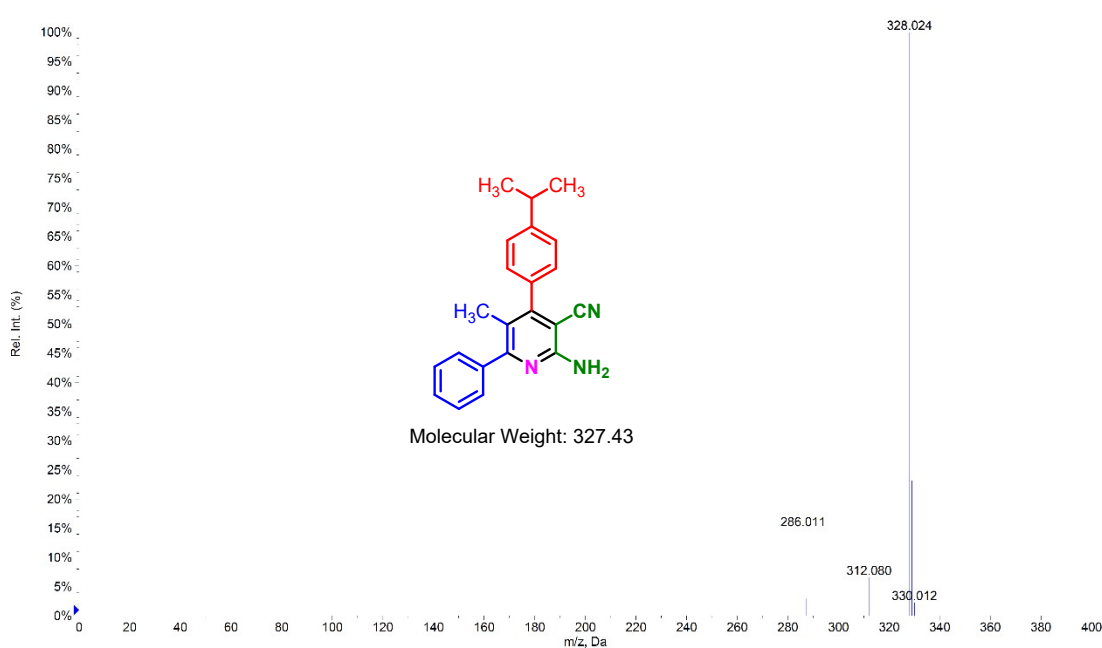
22: FT-IR spectrum of 2-amino-4-(4-isopropylphenyl)-5-methyl-6-phenylnicotinonitrile (1g).



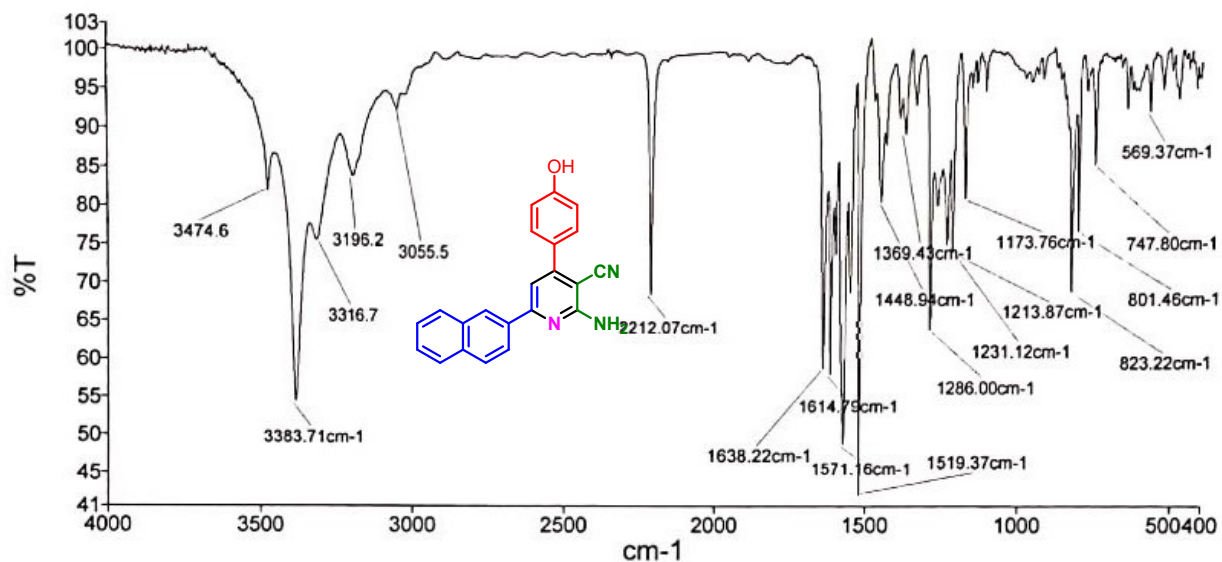
23: ^1H NMR spectrum of 2-amino-4-(4-isopropylphenyl)-5-methyl-6-phenylnicotinonitrile (1g).



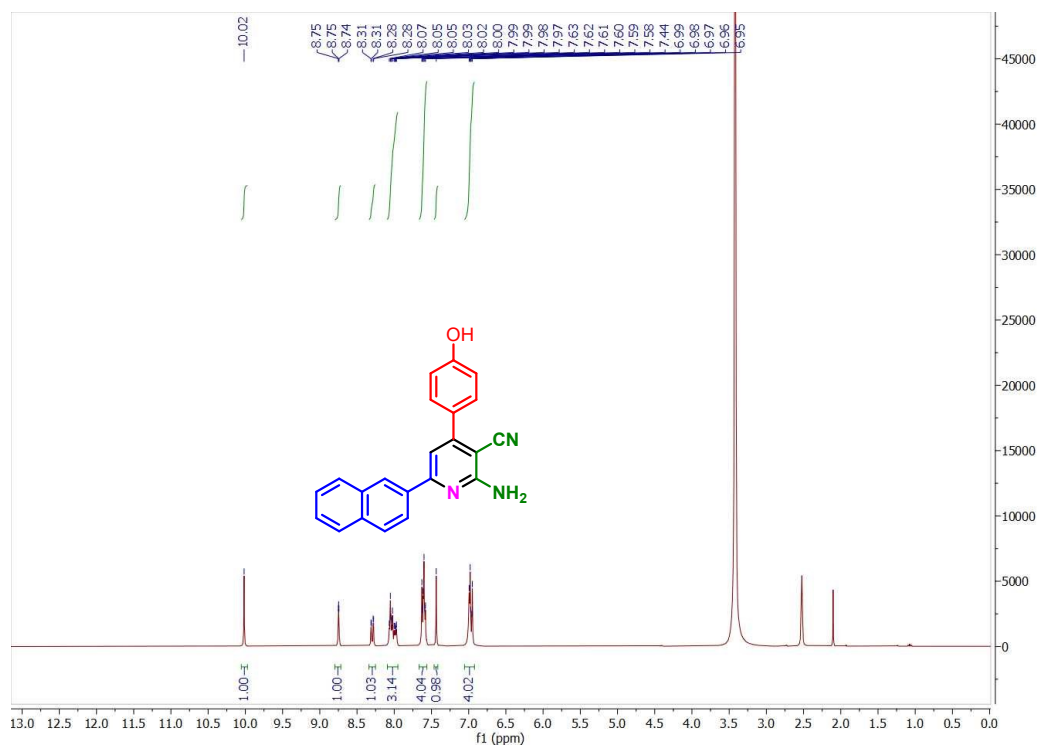
24: Mass spectrum of 2-amino-4-(4-isopropylphenyl)-5-methyl-6-phenylnicotinonitrile (1g).



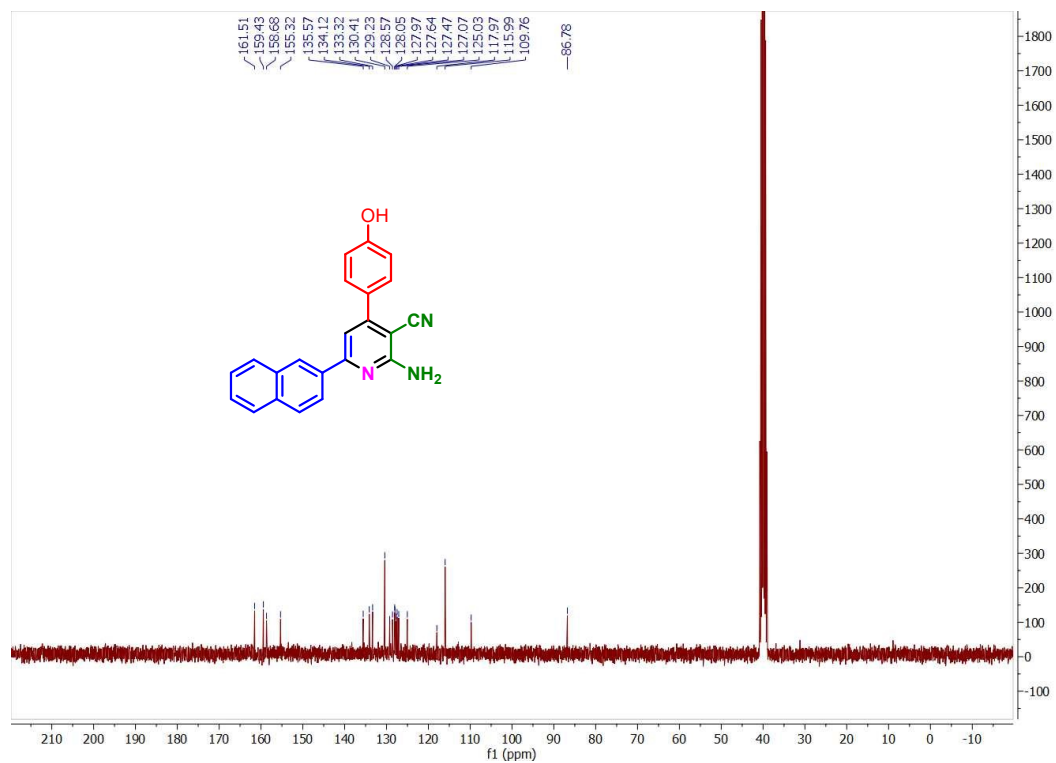
25: FT-IR spectrum of 2-amino-4-(4-hydroxyphenyl)-6-(naphthalen-2-yl)nicotinonitrile (1i).



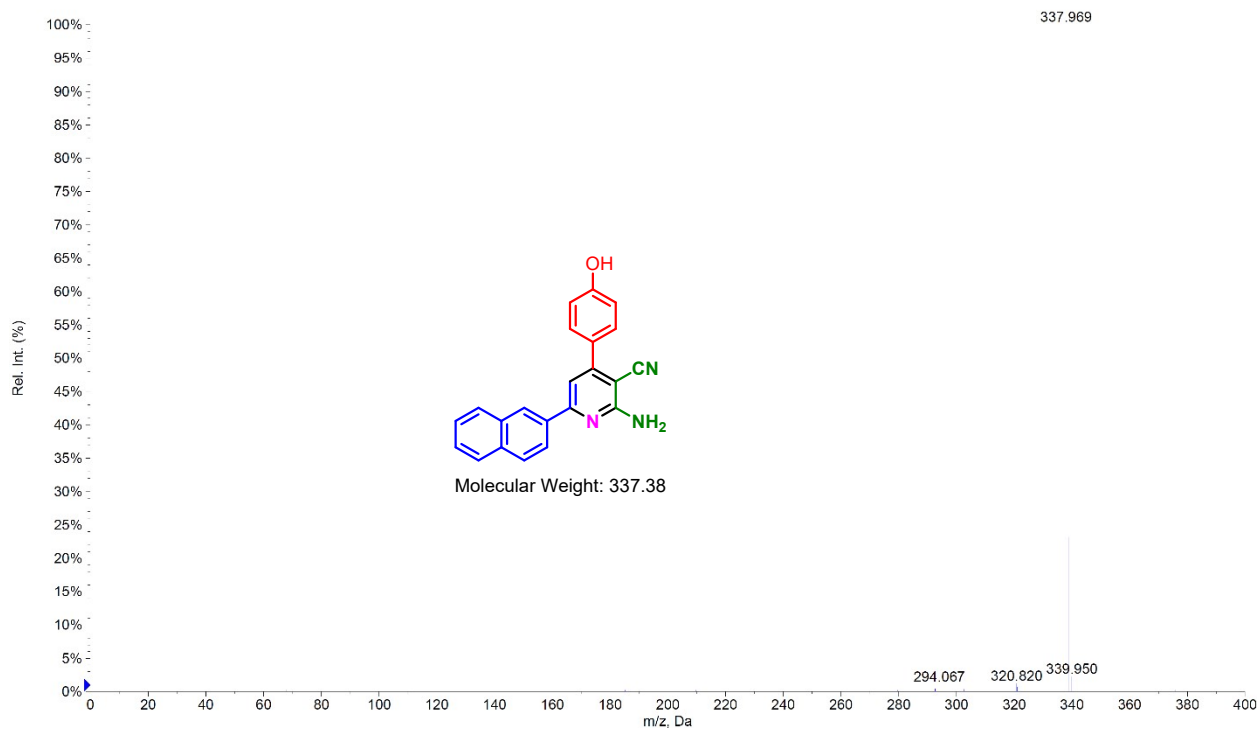
26: ¹H NMR spectrum of 2-amino-4-(4-hydroxyphenyl)-6-(naphthalen-2-yl)nicotinonitrile (1i).



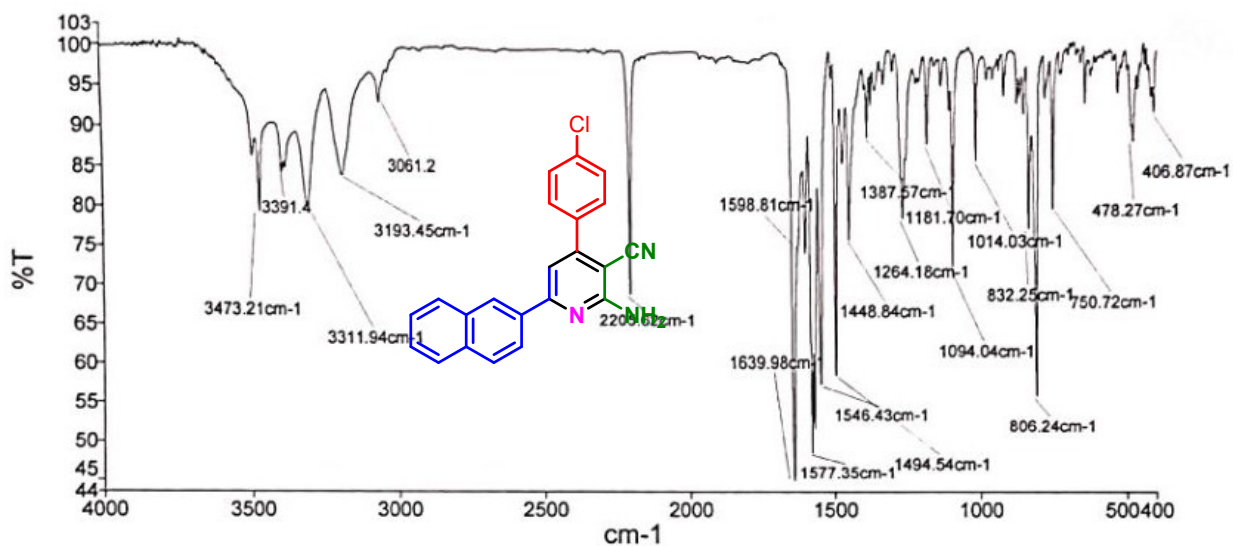
27: ¹³C NMR spectrum of 2-amino-4-(4-hydroxyphenyl)-6-(naphthalen-2-yl)nicotinonitrile (1i).



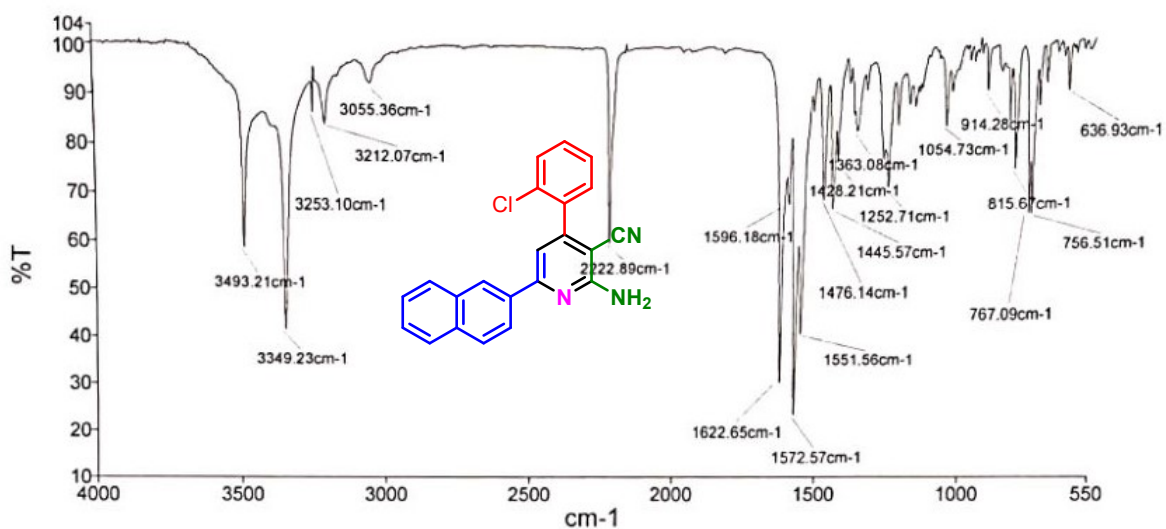
28: Mass spectrum of 2-amino-4-(4-hydroxyphenyl)-6-(naphthalen-2-yl)nicotinonitrile (1i).



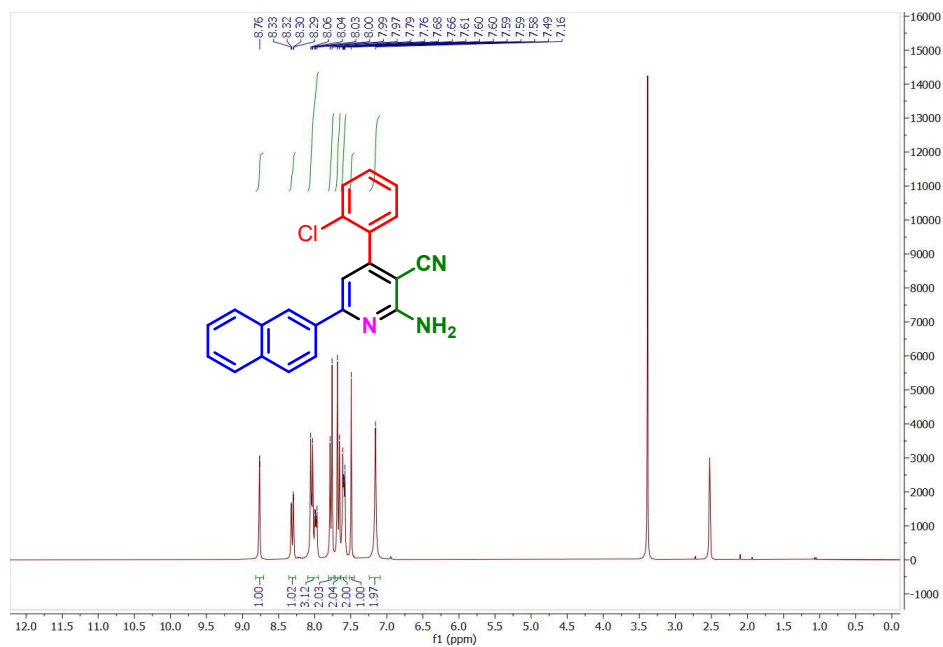
29: FT-IR spectrum of 2-amino-4-(4-chlorophenyl)-6-(naphthalen-2-yl)nicotinonitrile (1j).



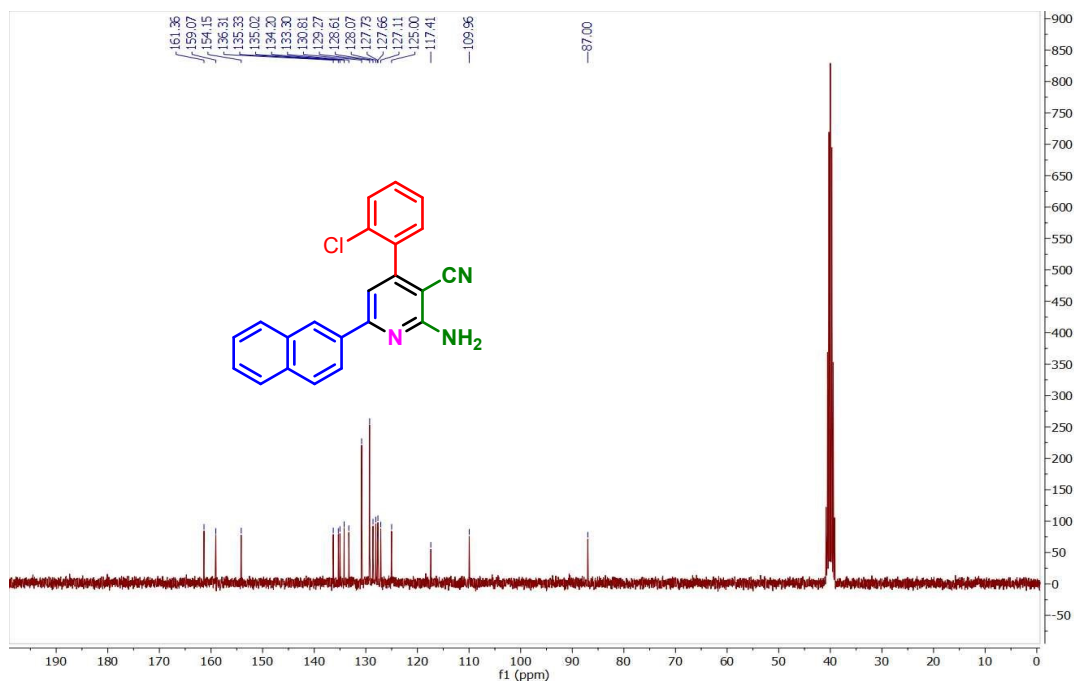
30: FT-IR spectrum of 2-amino-4-(2-chlorophenyl)-6-(naphthalen-2-yl)nicotinonitrile (1k).



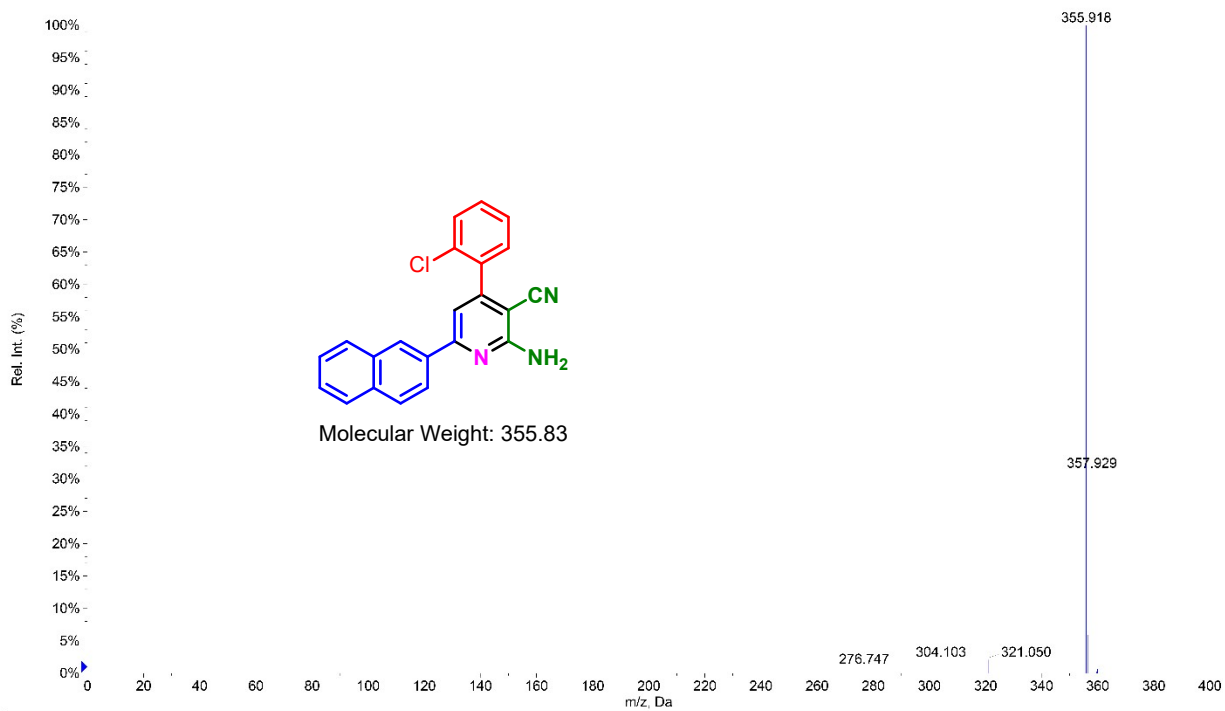
31: ^1H NMR spectrum of 2-amino-4-(2-chlorophenyl)-6-(naphthalen-2-yl)nicotinonitrile (1k).



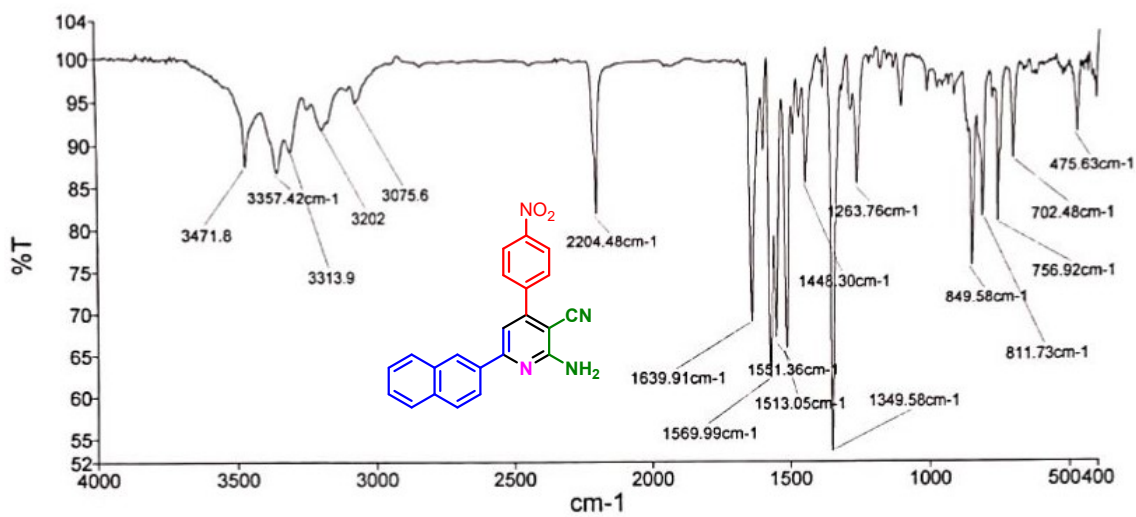
32: ^{13}C NMR spectrum of 2-amino-4-(2-chlorophenyl)-6-(naphthalen-2-yl)nicotinonitrile (1k).

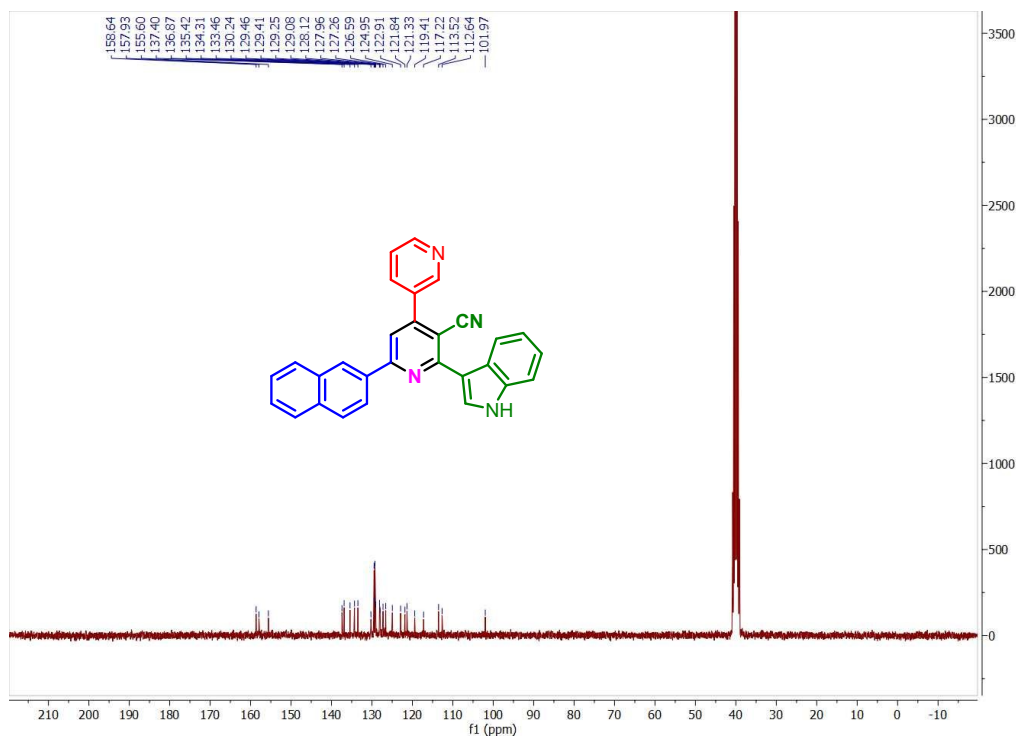


33: Mass spectrum of 2-amino-4-(2-chlorophenyl)-6-(naphthalen-2-yl)nicotinonitrile (1k).

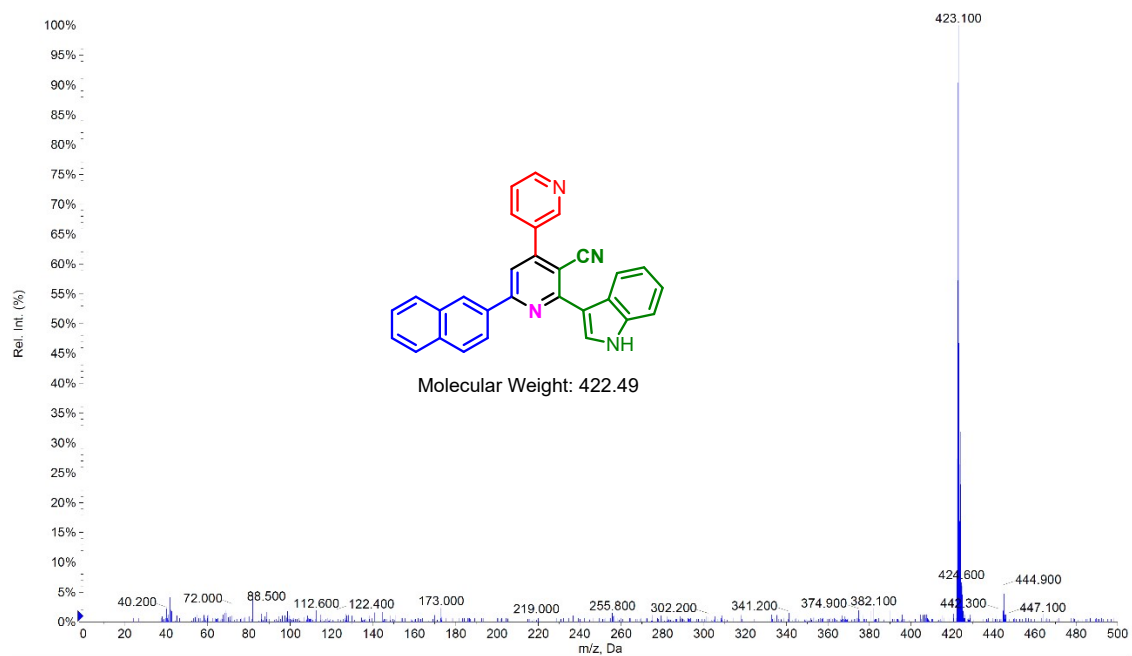


34: FT-IR spectrum of 2-amino-4-(4-nitrophenyl)-6-(naphthalen-2-yl)nicotinonitrile (11).

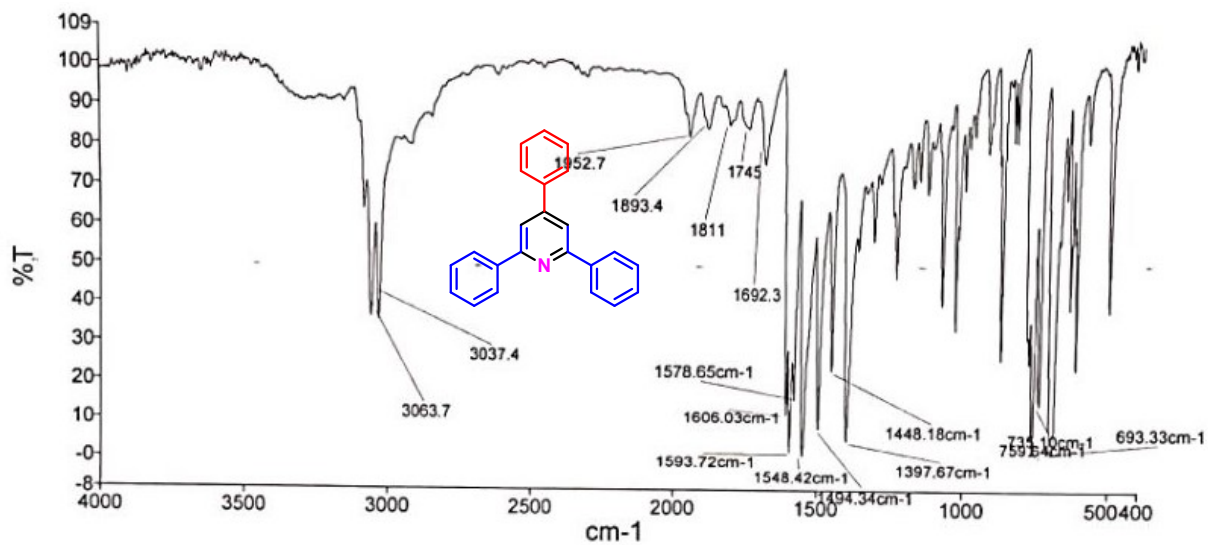




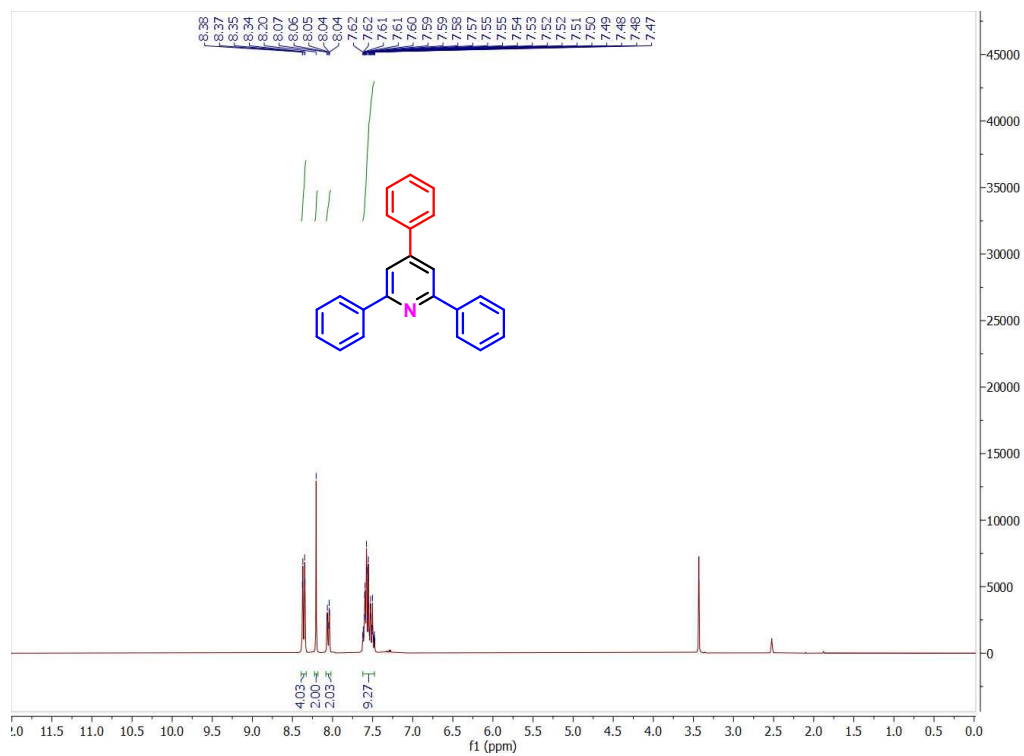
38: Mass spectrum of 2'-(1H-indol-3-yl)-6'-(naphthalen-2-yl)-[3,4'-bipyridine]-3'-carbonitrile (1m).



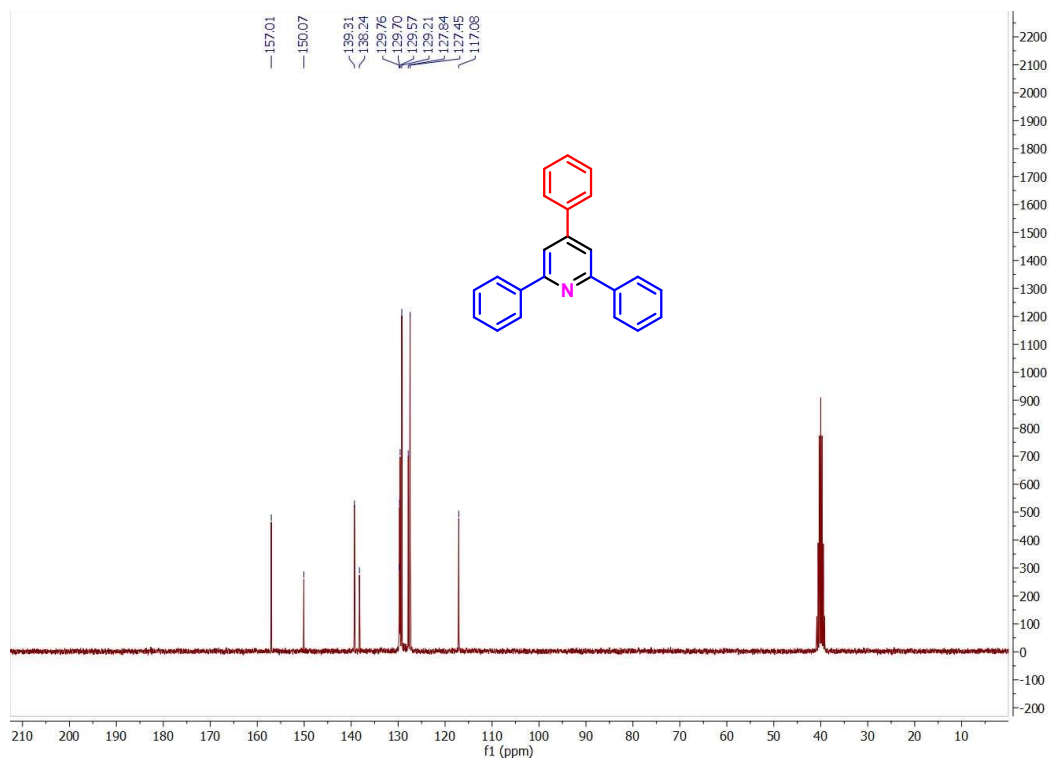
39: FT-IR spectrum of 2,4,6-triphenylpyridine (2a).



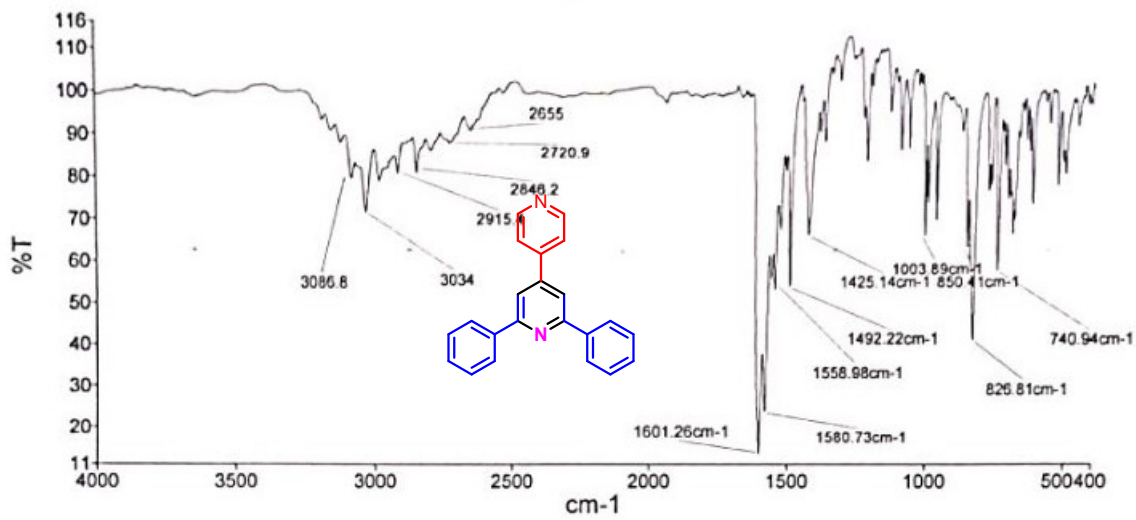
40: ^1H NMR spectrum of 2,4,6-triphenylpyridine (2a).



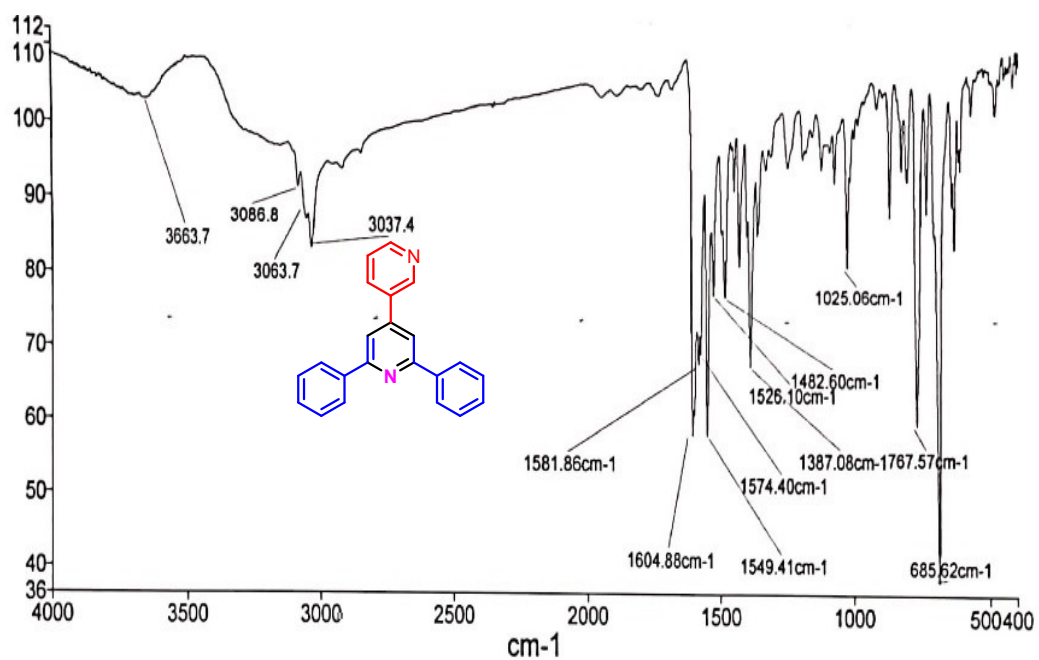
41: ^{13}C NMR spectrum of 2,4,6-triphenylpyridine (2a).



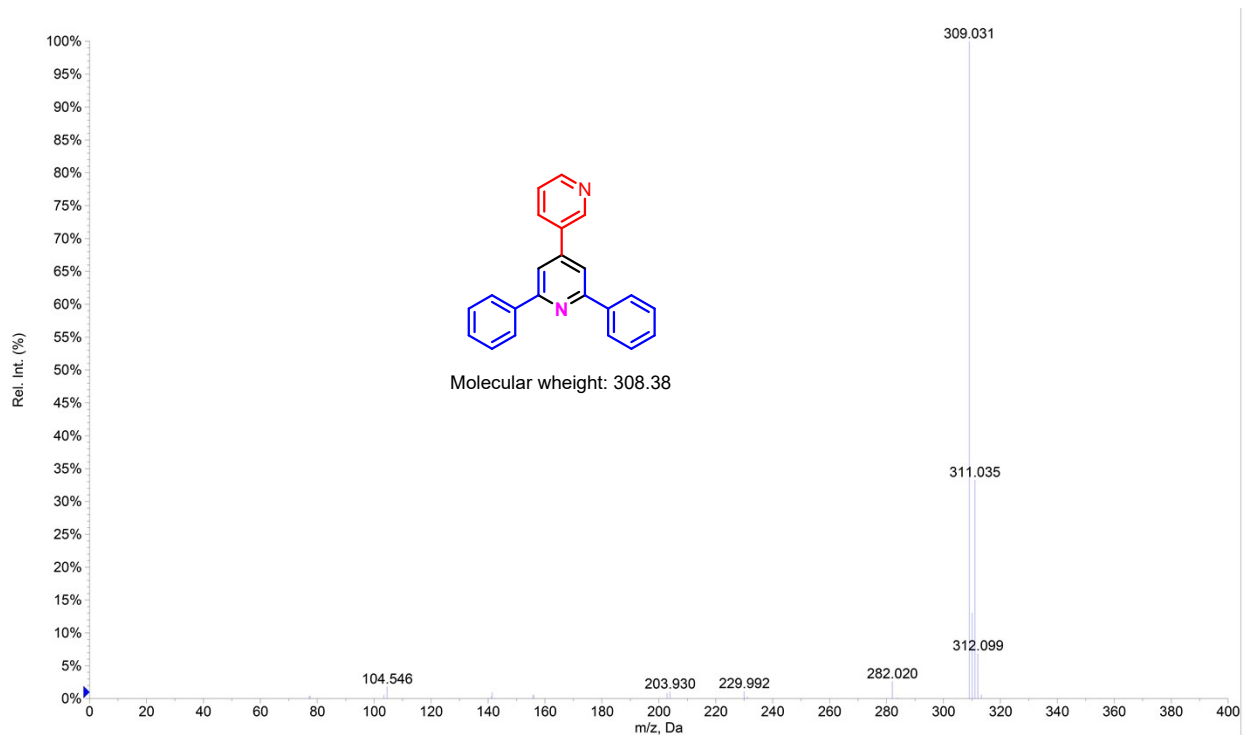
42: FT-IR spectrum of 2,6-diphenyl-4,4'-bipyridine (2b).



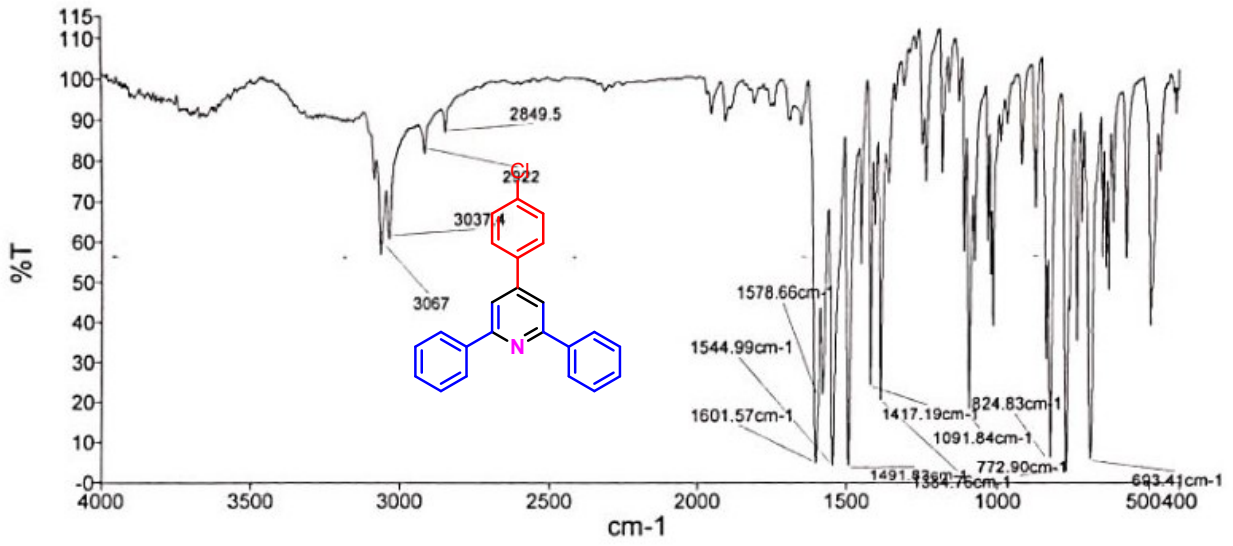
43: FT-IR spectrum of 2,6-diphenyl-4,3'-bipyridine (2c).



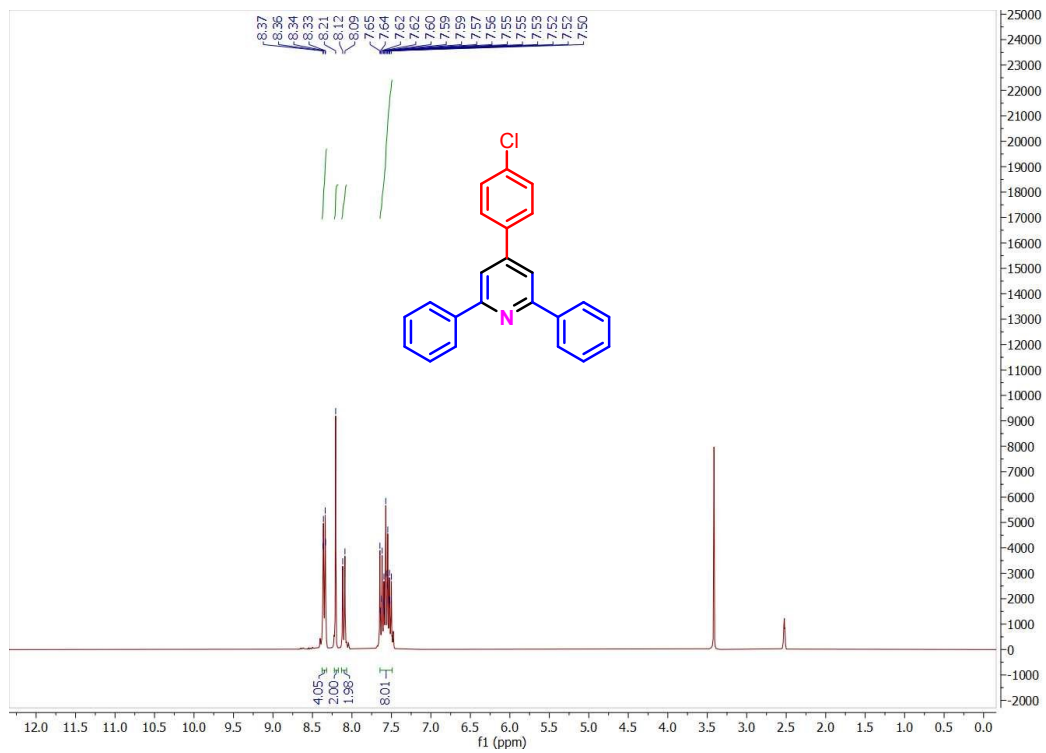
44: Mass spectrum of 2,6-diphenyl-4,3'-bipyridine (2c).



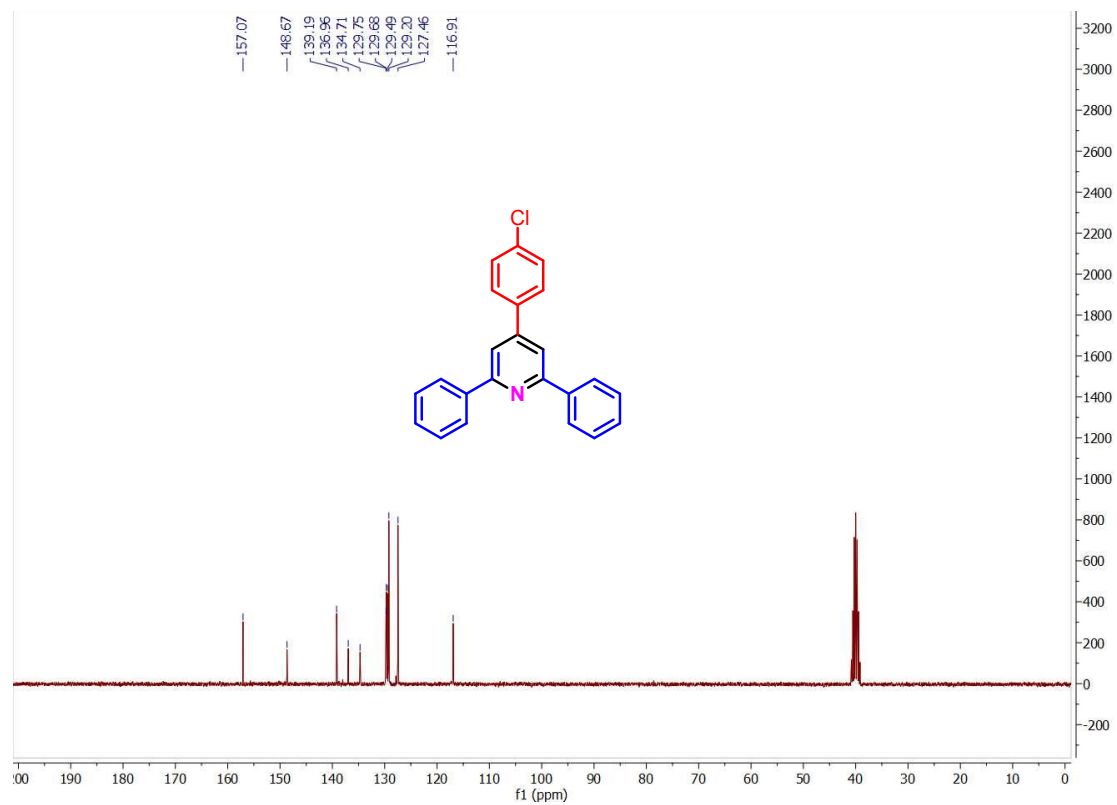
45: FT-IR spectrum of 4-(4-chlorophenyl)-2,6-diphenylpyridine (2d).



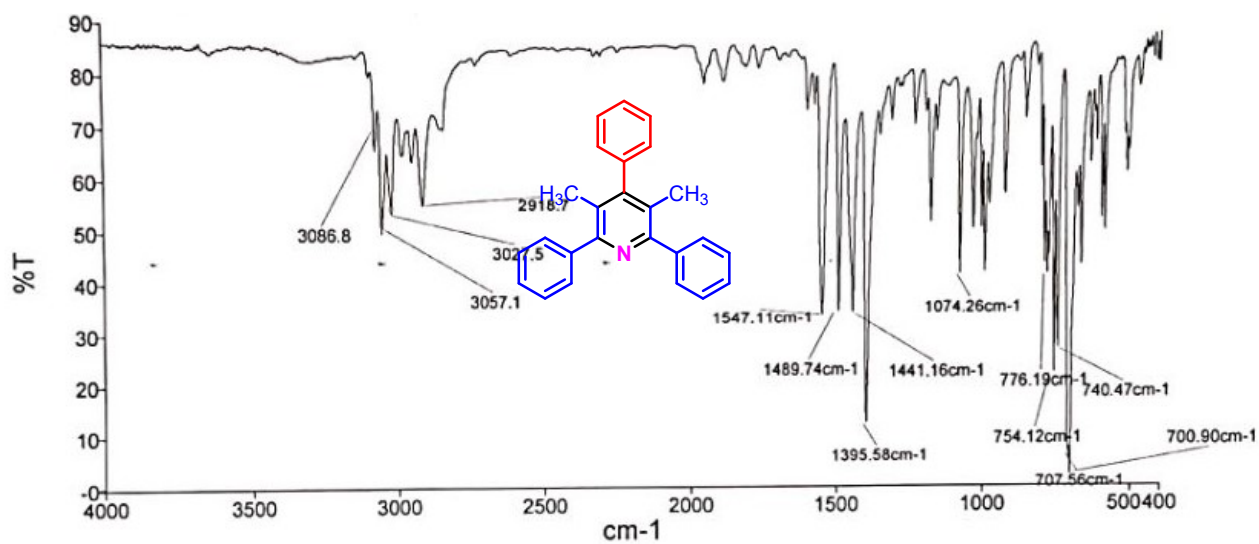
46: ¹H NMR spectrum of 4-(4-chlorophenyl)-2,6-diphenylpyridine (2d).



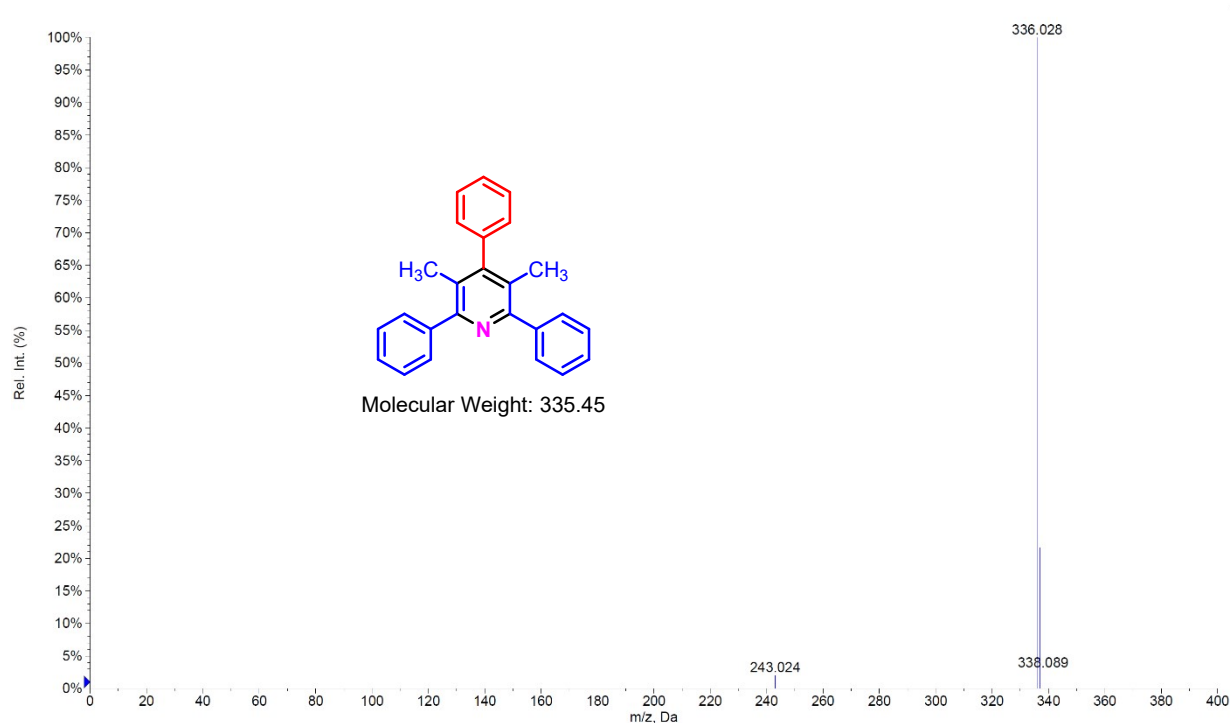
47: ¹³C NMR spectrum of 4-(4-chlorophenyl)-2,6-diphenylpyridine (2d).



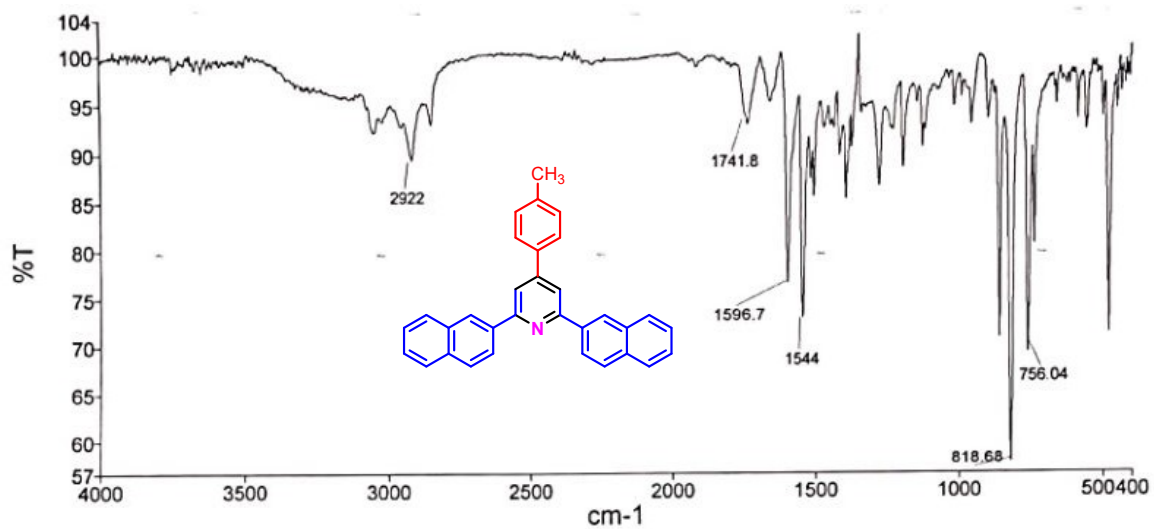
48: FT-IR spectrum of 3,5-dimethyl-2,4,6-triphenylpyridine (2e).



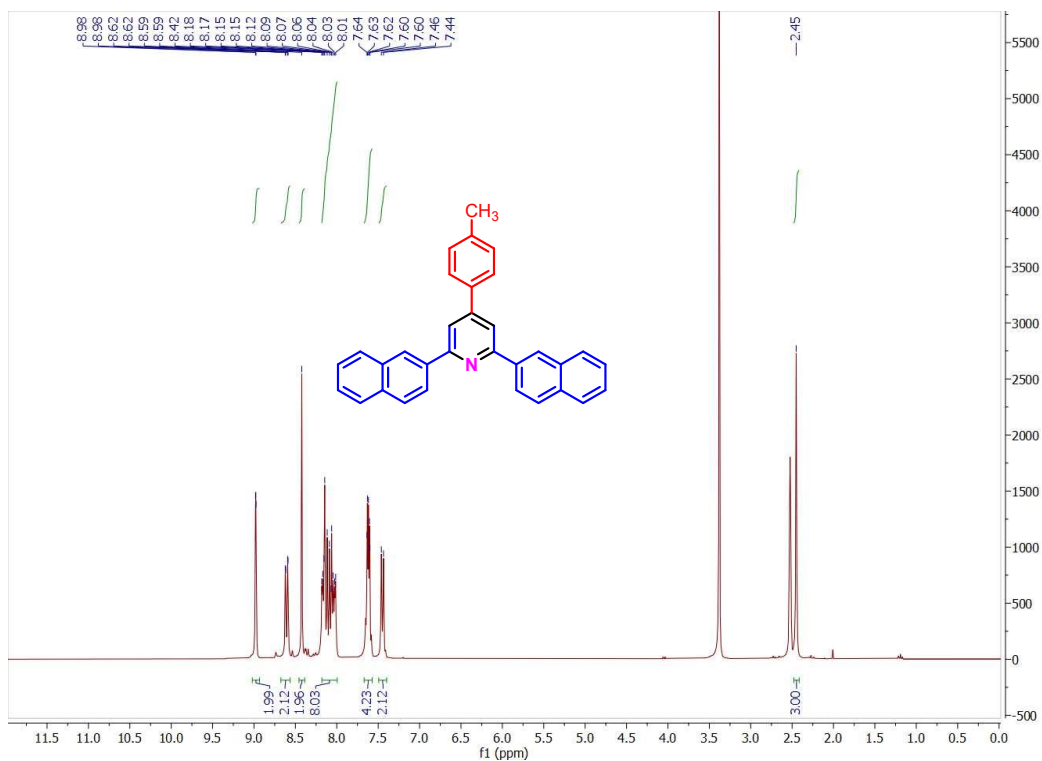
49: Mass spectrum of 3,5-dimethyl-2,4,6-triphenylpyridine (2e).



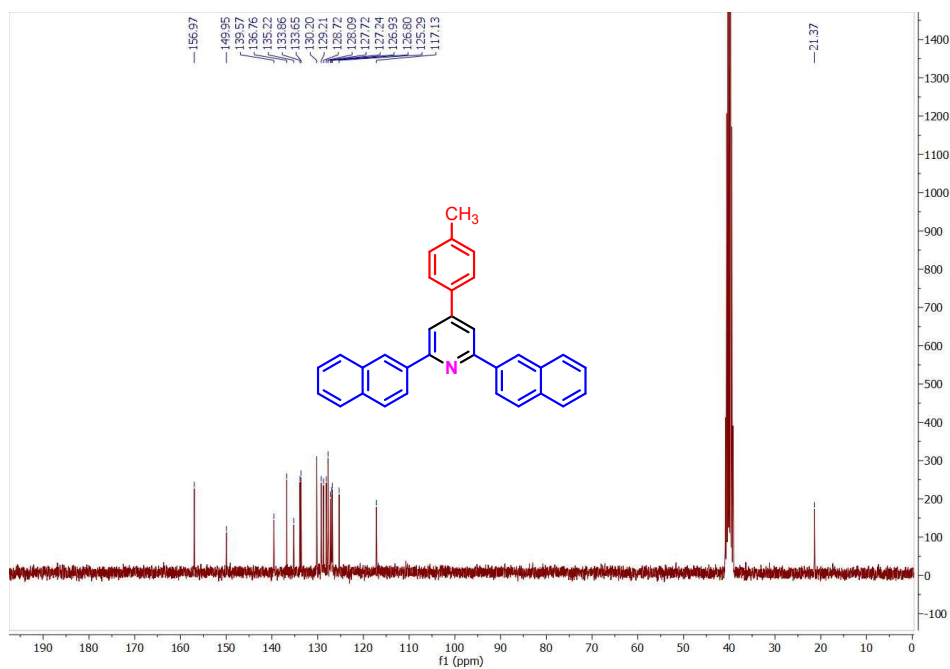
50: FT-IR spectrum of 2,6-di(naphthalen-2-yl)-4-(*p*-tolyl)pyridine (2f).



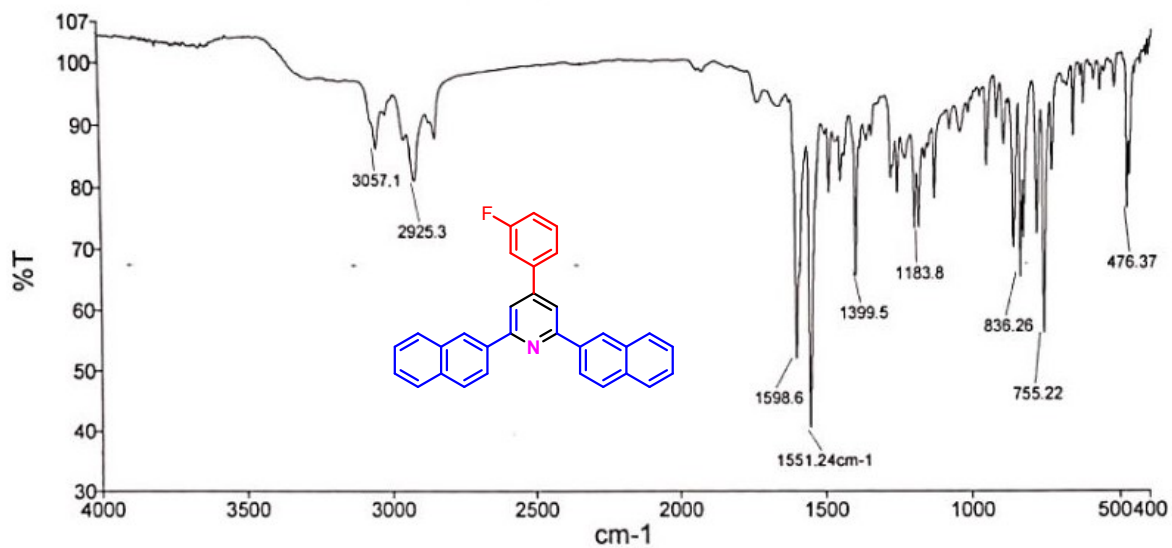
51: ¹H NMR spectrum of 2,6-di(naphthalen-2-yl)-4-(*p*-tolyl)pyridine (2f).



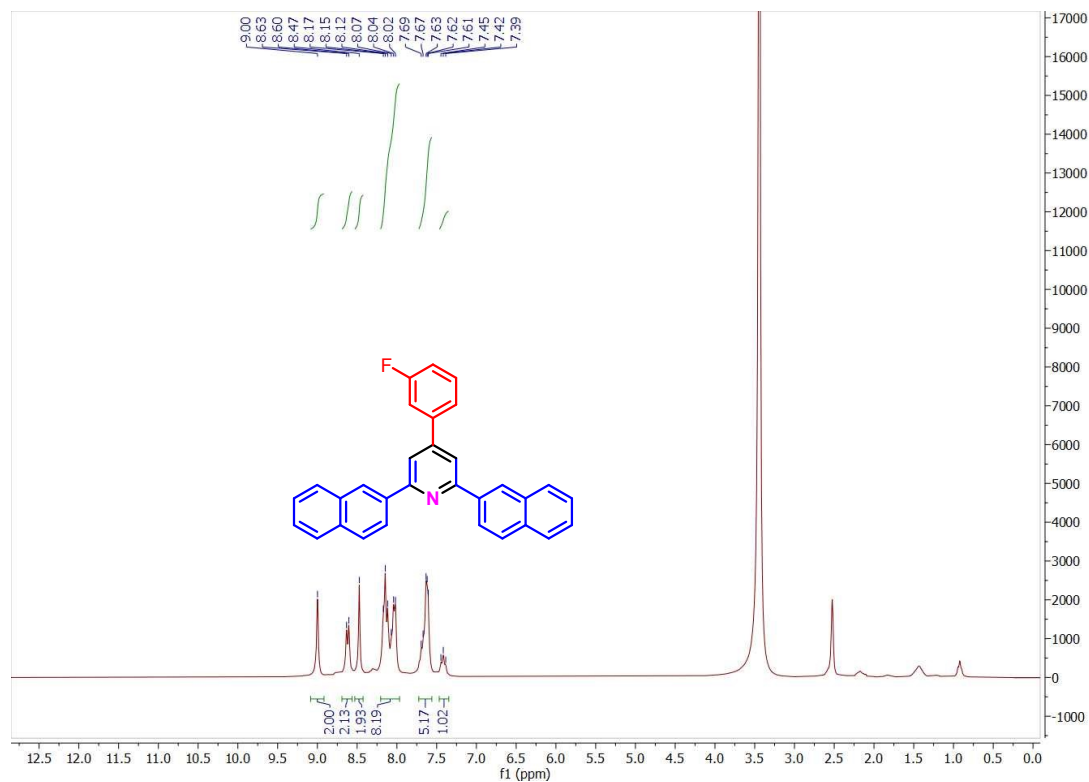
52: ¹³C NMR spectrum of 2,6-di(naphthalen-2-yl)-4-(p-tolyl)pyridine (2f).



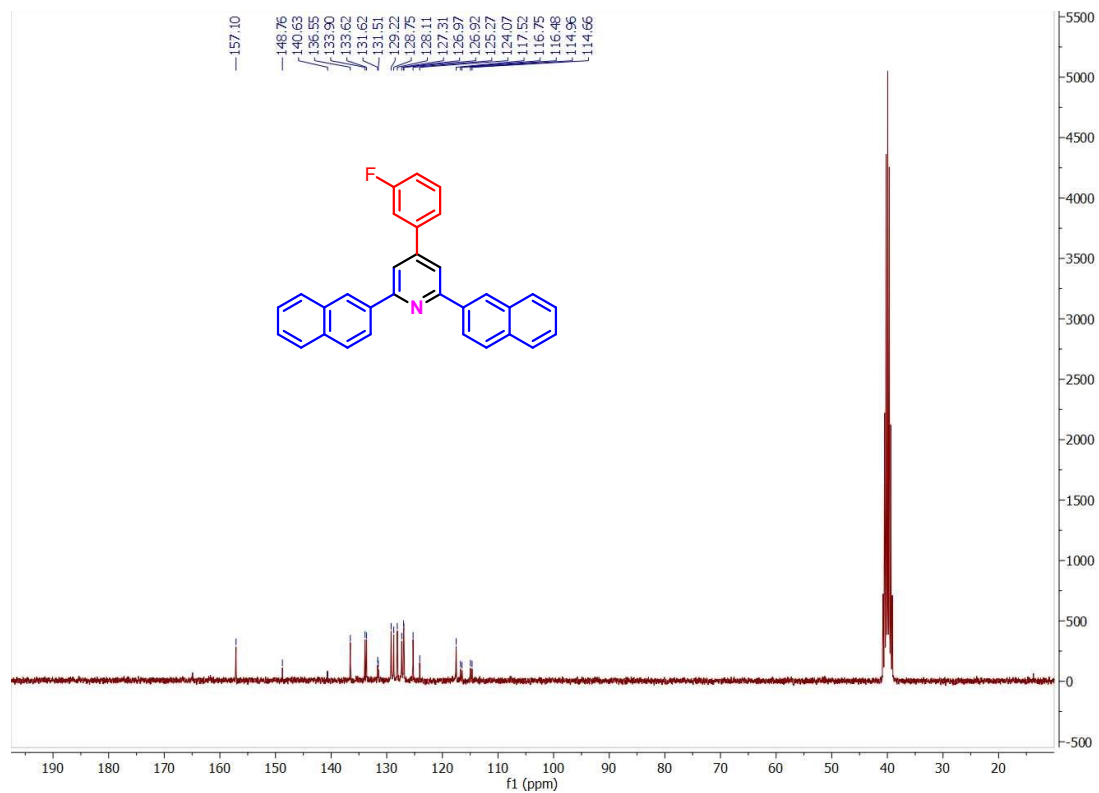
53: FT-IR spectrum of 4-(3-fluorophenyl)-2,6-di(naphthalen-2-yl)pyridine (2g).



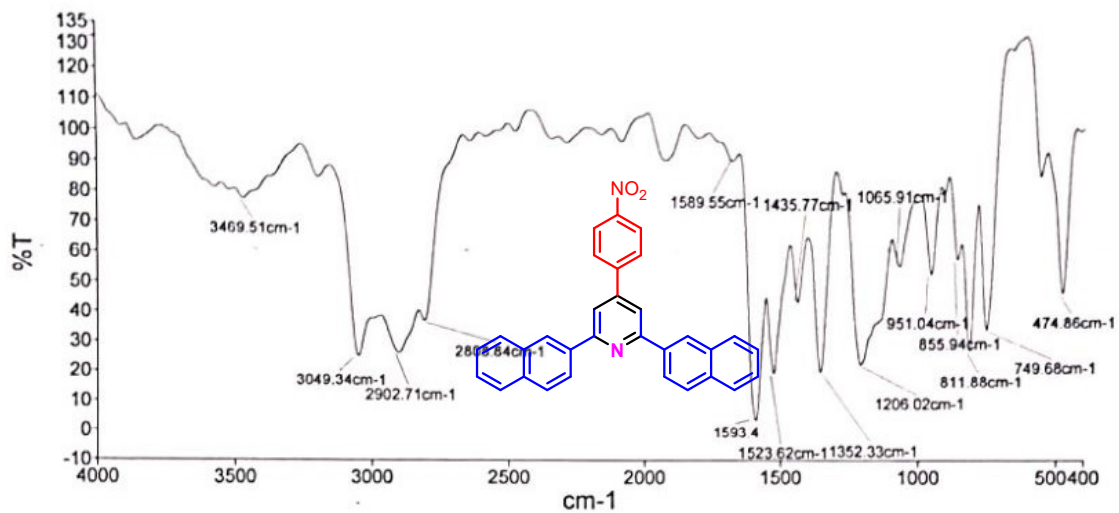
54: ¹H NMR spectrum of 4-(3-fluorophenyl)-2,6-di(naphthalen-2-yl)pyridine (2g).



55: ¹³C NMR spectrum of 4-(3-fluorophenyl)-2,6-di(naphthalen-2-yl)pyridine (2g).



56: FT-IR spectrum of 4-(4-bromophenyl)-2,6-di(naphthalen-2-yl)pyridine (2h).



57: FT-IR spectrum of 4-(furan-2-yl)-2,6-di(naphthalen-2-yl)pyridine (2i).

