

Supplementary Information

Condensation of nicotinaldehydes with acetophenones and NH₄OAc: A convenient synthesis and biological activities of 2',6'-diphenyl-3,4'-bipyridines[#]

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1. General procedure for the preparation of compounds.
2. Spectras of compounds.

Experimental Section

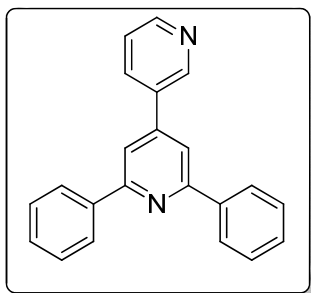
General

Nicotinaldehyde, 2-chloronicotinaldehyde and acetophenones were procured from Sigma-Aldrich. Copper acetate, ammonium acetate and solvents were obtained from local suppliers. All reactions were monitored by thin layer chromatography (TLC) on pre-coated silica gel 60 F254 (mesh); spots were visualized under UV light. Merck silica gel (100-200 mesh) was used for chromatography. ^1H NMR and ^{13}C NMR spectra were recorded on an Avance 300, 400, 500 MHz spectrometer in CDCl_3 using TMS as internal standard. IR spectra were recorded on a Nicolet 740 FT-IR spectrometer. Mass spectra were obtained on Agilent LCMS instrument. ESI-MS obtained on quato micro spectrometer. Melting points were determined in open glass capillary tubes on a Stuart melting point apparatus and are uncorrected.

General procedure for the preparation of 2',6'-diphenyl-3,4'-bipyridines (**3a-t**)

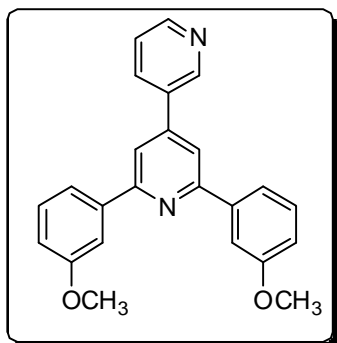
$\text{Cu}(\text{OAc})_2$ (30 mol%) was added to a stirred reaction mixture of nicotinaldehyde (**1a**, 1.0 mmol), acetophenone (**2a**, 2.0 mmol) and ammonium acetate (1.5 mmol). The contents were heated at 120 °C. The reaction was monitored by TLC, after completion of the reaction (6 h), the residue was purified by column chromatography by using silica gel (Hexane: Ethyl acetate, 20%) afforded 2',6'-diphenyl-3,4'-bipyridine **3a** in 70% yield. The target compounds **3b-t** were prepared under similar conditions with nicotinaldehydes **1a-e** with acetophenone **2a-j**. All the prepared compounds were unknown and characterized by spectral data.

2',6'-Diphenyl-3,4'-bipyridine (3a)



Yield: 70%, Colorless solid, M. P: 164-166°C, FT-IR (KBr): 3447, 3063, 2923, 1601, 1573, 1481, 1386, 1251, 1189, 1025, 774, 690 cm^{-1} . ^1H NMR (500 MHz, CDCl_3): δ 9.01 (s, 1H, aromatic), 8.73 (s, 1H, aromatic), 8.21 (d, $J = 7.3$ Hz, 4H, aromatic), 8.04 (d, $J = 7.8$ Hz, 1H, aromatic), 7.88 (s, 2H, aromatic), 7.53 (t, $J = 7.5$ Hz, 4H, aromatic), 7.47 (d, $J = 7.2$ Hz, 3H, aromatic) ppm. ^{13}C NMR (125 MHz, CDCl_3): δ 158.12, 150.14, 148.34, 147.17, 139.33, 134.75, 134.55, 129.34, 128.83, 127.17, 123.85, 116.90 ppm. ESI-MASS: (m/z) 309 $[\text{M}+\text{H}]^+$.

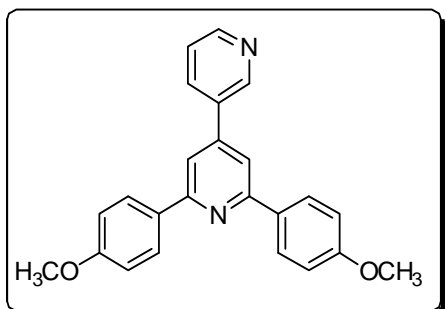
2',6'-Bis(3-methoxyphenyl)-3,4'-bipyridine (3b)



Yield: 61 %, Pale yellow solid, M. P: 128-130 °C, FT-IR (KBr): 3877, 3682, 3023, 2407, 1429, 1215, 739, 671 cm^{-1} . ^1H -NMR: (400 MHz, CDCl_3): δ 9.00 (d, $J = 1.7$ Hz, 1H, aromatic), 8.73 (d, $J = 3.5$ Hz, 1H, aromatic), 8.20-8.00 (m, 1H, aromatic), 7.86 (s, 2H, aromatic), 7.82-7.78 (m, 2H, aromatic), 7.75 (dd, $J = 7.7, 0.8$ Hz, 2H, aromatic), 7.48-7.41 (m, 3H, aromatic), 7.04-7.00 (m, 2H, aromatic), 3.92 (s, 6H, 2OCH₃) ppm. ^{13}C NMR: (101 MHz, CDCl_3): δ 160.12,

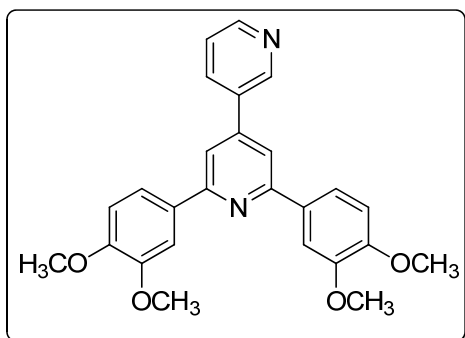
157.54, 150.09, 148.27, 146.98, 140.66, 134.61, 129.81, 123.88, 119.55, 117.18, 114.96, 112.74, 55.44 ppm. ESI-MASS: (M/z) 369 [M+H]⁺.

2',6'-Bis(4-methoxyphenyl)-3,4'-bipyridine (3c)



Yield: 77 %, Pale yellow solid, M. P: 134-136 °C, FT-IR (KBr): 3424, 3037, 2837, 1605, 1513, 1428, 1246, 1170, 1028, 834,760 cm⁻¹. ¹H NMR :(300 MHz, CDCl₃) δ 9.00 (s, 1H, aromatic), 8.72 (s, 1H, aromatic), 8.16 (d, *J* = 8.8 Hz, 4H, aromatic), 8.02 (d, *J* = 7.8 Hz, 1H, aromatic), 7.75 (s, 2H, aromatic), 7.58-7.41 (m, 1H, aromatic), 7.04 (d, *J* = 8.8 Hz, 4H, aromatic), 3.89 (s, 6H, aromatic, 2OCH₃) ppm. ¹³C NMR: (75 MHz, CDCl₃) δ160.71, 157.29, 149.92, 148.27, 146.76, 134.55, 131.95, 128.41, 123.84, 123.75, 115.41, 114.62, 114.13, 55.42 ppm. ESI-MASS: (M/z) 369 [M+H]⁺.

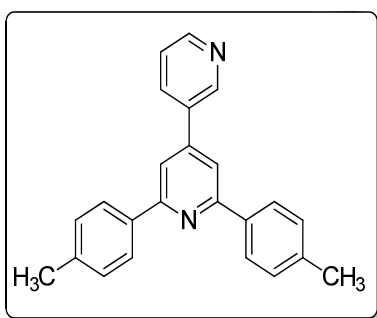
2',6'-Bis(3,4-dimethoxyphenyl)-3,4'-bipyridine (3d)



Yield: 73 %, Pale yellow solid, M. P: 136-138 °C, FT-IR (KBr): 3442, 3078, 2928, 2831, 1603, 1512, 1459, 1397, 1262, 1175, 1023, 825, 793 cm⁻¹. ¹H NMR: (400 MHz, CDCl₃): δ 9.01 (s, 1H,

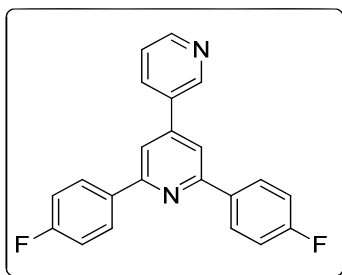
aromatic), 8.73 (s, 1H, aromatic), 8.04 (d, $J = 7.9$ Hz, 1H, aromatic), 7.88 (d, $J = 2.0$ Hz, 2H, aromatic), 7.83-7.70 (m, 4H, aromatic), 7.48 (dd, $J = 7.7, 5.0$ Hz, 1H, aromatic), 7.01 (d, $J = 8.4$ Hz, 2H, aromatic), 4.03 (s, 6H, aromatic, 2 OCH₃), 3.97 (s, 6H, 2 OCH₃) ppm. ¹³C NMR: (101 MHz, CDCl₃) δ 157.20, 150.30, 149.26, 148.21, 147.06, 146.84, 134.68, 132.18, 123.89, 119.68, 115.74, 111.15, 110.21, 56.05, 55.96 ppm. ESI-MASS: (M/z) 429 [M+H]⁺.

2',6'-Di-*p*-tolyl-3,4'-bipyridine (3e)



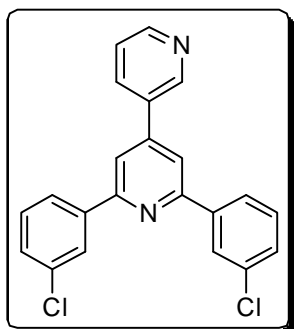
Yield: 70 %, colorless solid, M. P: 160-162 °C, FT-IR (KBr): 3448, 3027, 2918, 1600, 1541, 1247, 1179, 1020, 808, 708 cm⁻¹. ¹H NMR: (400 MHz, CDCl₃): δ 8.99 (d, $J = 1.9$ Hz, 1H, aromatic), 8.71 (dd, $J = 4.8, 1.3$ Hz, 1H, aromatic), 8.10 (d, $J = 8.2$ Hz, 4H, aromatic), 8.04-7.95 (m, 1H, aromatic), 7.81 (s, 2H, aromatic), 7.45 (dd, $J = 7.8, 4.9$ Hz, 1H, aromatic), 7.32 (d, $J = 8.0$ Hz, 4H, aromatic), 2.48 (s, 6H, 2CH₃) ppm. ¹³C NMR: (101 MHz, CDCl₃): δ 157.72, 149.99, 148.32, 146.79, 139.30, 136.53, 134.92, 134.55, 129.52, 127.03, 123.81, 116.24, 21.39 ppm. ESI-MASS: (M/z) 336 [M+H]⁺.

2',6'-Bis(4-fluorophenyl)-3,4'-bipyridine (3f)



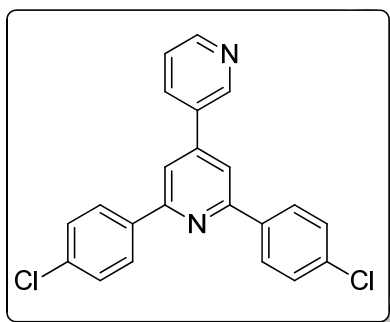
Yield: 79 %, Colorless solid, M. P: 232-234 °C, FT-IR (KBr): 3442, 3044, 2924, 1719, 1607, 1510, 1215, 1157, 829, 799 cm^{-1} . ^1H NMR: (500 MHz, CDCl_3) δ 8.99 (d, $J = 2.2$ Hz, 1H, aromatic), 8.74 (dd, $J = 4.8, 1.5$ Hz, 1H, aromatic), 8.21-8.16 (m, 4H, aromatic), 8.06-7.99 (m, 1H, aromatic), 7.81 (s, 2H, aromatic), 7.48 (dd, $J = 7.9, 4.8$ Hz, 1H, aromatic), 7.24-7.18 (m, 4H, aromatic) ppm. ^{13}C NMR: (125 MHz, CDCl_3): δ 164.79, 162.81, 156.86, 150.26, 148.28, 134.53, 128.96, 128.93, 123.87, 116.50, 115.86, 115.69 ppm. ESI-MASS: (M/z) 345 $[\text{M}+\text{H}]^+$.

3-(3,3'-dichloro-[1,1':3',1''-terphenyl]-5'-yl)pyridine (3g)



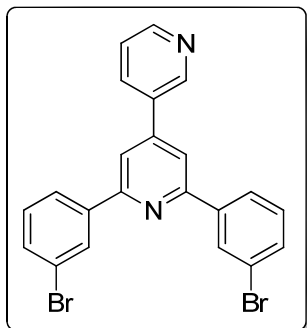
Yield: 75 %, Colorless solid, M. P: 168-170 °C, FT-IR (KBr): 3874, 3593, 3309, 3013, 2360, 1689, 1432, 1217, 813, 770, 674 cm^{-1} . ^1H NMR (300 MHz, CDCl_3): δ 8.18 (s, 2H, aromatic), 8.05 (t, $J = 6.0$ Hz, 3H, aromatic), 7.87 (s, 3H, aromatic), 7.50-7.43 (m, 6H, aromatic) ppm. ^{13}C NMR (75 MHz, CDCl_3) δ 156.58, 150.34, 148.22, 147.54, 140.72, 134.99, 134.53, 130.56, 130.11, 129.47, 127.29, 125.39, 125.24, 117.65, 117.51 ppm. ESI-MASS: (M/z) 377 $[\text{M}+\text{H}]^+$.

2',6'-Bis(4-chlorophenyl)-3,4'-bipyridine (3h)



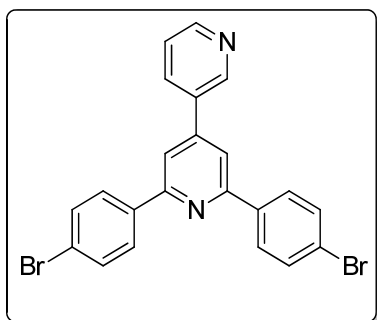
Yield: 72%, Colorless solid, M.P: 228-230 °C, FT-IR (KBr): 3442, 3073, 3035, 1901, 1601, 1546, 1494, 1382, 1089, 831, 799 cm^{-1} . ^1H NMR (400 MHz, CDCl_3): δ 8.99 (s, 1H, aromatic), 8.75 (s, 1H, aromatic), 8.13 (d, $J = 8.6$ Hz, 4H, aromatic), 8.02 (d, $J = 7.8$ Hz, 1H, aromatic), 7.85 (d, $J = 7.0$ Hz, 2H, aromatic), 7.50 (d, $J = 8.6$ Hz, 5H, aromatic) ppm. ^{13}C NMR (101 MHz, CDCl_3): δ 156.68, 150.28, 148.22, 147.38, 137.37, 135.61, 134.51, 129.03, 128.37, 116.86 ppm. ESI-MASS: (M/z) 327 $[\text{M}+\text{H}]^+$.

2',6'-Bis(3-bromophenyl)-3,4'-bipyridine (3i)



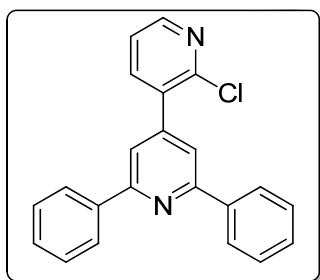
Yield: 71%, Pale brownish solid, M. P: 152-154°C, FT-IR (KBr): 3875, 3595, 3319, 1598, 1484, 1386, 1218, 771, 687 cm^{-1} . ^1H NMR: (500 MHz, CDCl_3) δ 8.33 (s, 2H, aromatic), 8.21-8.02 (m, 4H, aromatic), 7.86 (d, $J = 10.7$ Hz, 2H, aromatic), 7.70-7.53 (m, 4H, aromatic), 7.41 (t, $J = 7.8$ Hz, 2H, aromatic) ppm. ^{13}C NMR (125 MHz, CDCl_3): δ 156.51, 140.97, 134.70, 132.41, 130.40, 130.21, 128.89, 127.18, 125.75, 123.16, 117.56 ppm. ESI-MASS: (M/z) 467 $[\text{M}+\text{H}]^+$.

2',6'-Bis(4-bromophenyl)-3,4'-bipyridine (3j)



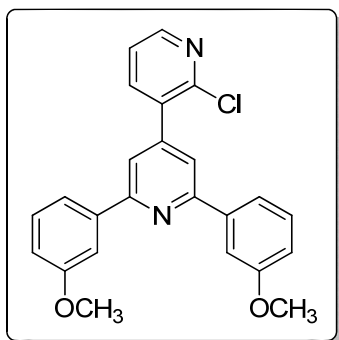
Yield: 64%, Pale brownish solid, M. P: 237-239 °C, FT-IR (KBr): 3422, 3034, 2923, 2851, 1906, 1604, 1577, 1547, 1483, 1378, 1071, 829, 800 cm^{-1} . ^1H NMR (400 MHz, CDCl_3): δ 8.99 (s, 1H, aromatic), 8.75 (s, 1H, aromatic), 8.04 (dd, $J = 18.5, 8.2$ Hz, 5H, aromatic), 7.85 (s, 2H, aromatic), 7.66 (d, $J = 8.5$ Hz, 4H, aromatic), 7.48 (dd, $J = 7.6, 4.9$ Hz, 1H, aromatic) ppm. ^{13}C NMR (101 MHz, CDCl_3): δ 156.81, 156.68, 150.34, 148.26, 147.46, 137.84, 134.54, 132.01, 128.67, 123.99, 116.94 ppm. ESI-MASS: (M/z) 467 $[\text{M}+\text{H}]^+$.

2-Chloro-2',6'-diphenyl-3,4'-bipyridine (3k)



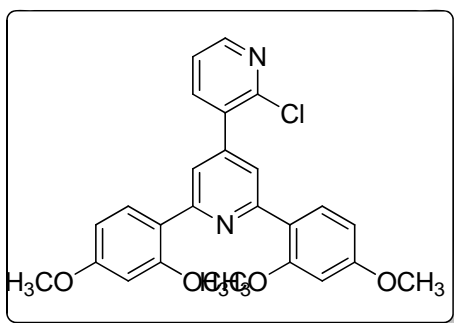
Yield: 82 %, colorless solid, M. P: 133-135 °C, FT-IR (KBr): 3448, 3060, 2104, 1599, 1557, 1416, 1381, 1241, 1122, 776, 738 cm^{-1} . ^1H NMR (400 MHz, CDCl_3): δ 8.50 (dd, $J = 4.8, 1.9$ Hz, 1H, aromatic), 8.20-8.17 (m, 4H, aromatic), 7.84-7.76 (m, 3H, aromatic), 7.54-7.49 (m, 4H, aromatic), 7.48-7.43 (m, 2H, aromatic), 7.40 (dd, $J = 7.5, 4.8$ Hz, 1H, aromatic) ppm. ^{13}C NMR (101 MHz, CDCl_3): δ 157.27, 149.55, 146.76, 139.38, 139.08, 135.12, 129.36, 128.82, 127.16, 122.80, 119.08 ppm. ESI-MASS: (M/z) 343 $[\text{M}+\text{H}]^+$.

2-Chloro-2',6'-bis(3-methoxyphenyl)-3,4'-bipyridine (3l)



Yield: 81 %, Pale yellow solid, M. P: 141-143 °C, FT-IR (KBr): 3422, 3085, 3109, 3000, 2904, 2832, 1912, 1748, 1667, 1595, 1044, 866, 687 cm^{-1} . ^1H NMR (400 MHz, CDCl_3): δ 8.50 (dd, $J = 4.8, 1.9$ Hz, 1H, aromatic), 8.07-7.57 (m, 7H, aromatic), 7.47-7.37 (m, 3H, aromatic), 7.01 (m, 2H, aromatic), 3.92 (s, 6H, 2OCH₃) ppm. ^{13}C NMR (101 MHz, CDCl_3): δ 160.12, 156.97, 149.56, 146.60, 140.52, 139.38, 135.16, 129.81, 122.80, 119.55, 119.37, 115.00, 112.71, 55.43 ppm. ESI-MASS: (M/z) 403 [M+H]⁺.

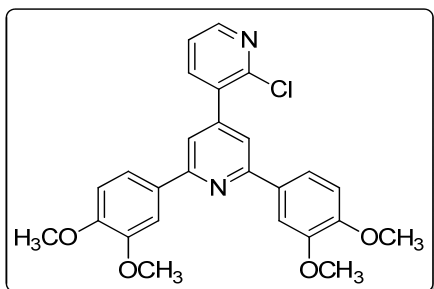
2-Chloro-2',6'-bis(2,4-dimethoxyphenyl)-3,4'-bipyridine (3m)



Yield: 72 %, Pale yellow solid, M. P: 130-132 °C, FT-IR (KBr): 3420, 2926, 2842, 1649, 1615, 1592, 1395, 1256, 1213, 1016, 825, 795 cm^{-1} . ^1H NMR (400 MHz, CDCl_3): δ 8.39 (dd, $J = 4.7, 1.8$ Hz, 2H, aromatic), 7.99 (dd, $J = 7.7, 1.7$ Hz, 2H, aromatic), 7.91 (s, 1H, aromatic), 7.79 (s, 1H, aromatic), 7.51 (s, 1H, aromatic), 7.29 (dd, $J = 7.6, 4.7$ Hz, 2H, aromatic), 6.60-6.58 (m, 1H, aromatic), 6.50 (s, 1H, aromatic), 3.91 (s, 6H, 2 OCH₃), 3.88 (s, 6H, 2 OCH₃) ppm. ^{13}C NMR:

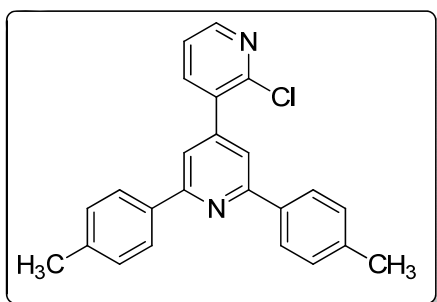
(101 MHz, CDCl₃): δ 189.44, 164.69, 160.62, 151.62, 150.00, 136.09, 135.98, 133.31, 131.55, 130.78, 122.78, 121.66, 105.47, 98.63, 55.81, 55.66 ppm. ESI-MASS: (M/z) 463 [M+H]⁺.

2-Chloro-2',6'-bis(3,4-dimethoxyphenyl)-3,4'-bipyridine (3n)



Yield: 67 %, Pale yellow solid, M. P: 124-126°C, FT-IR (KBr): 3877, 3594, 2925, 2856, 1659, 1593, 1518, 1412, 1271, 1214, 1162, 1024, 771, 691 cm⁻¹. ¹H NMR (400 MHz, CDCl₃): δ 8.43 (d, J = 2.9 Hz, 1H, aromatic), 8.04 (dd, J = 6.5, 4.7 Hz, 2H, aromatic), 7.64 (d, J = 11.8 Hz, 3H, aromatic), 7.49 (s, 1H, aromatic), 7.33 (dd, J = 7.6, 4.7 Hz, 2H, aromatic), 6.94 (d, J = 8.4 Hz, 2H, aromatic), 3.98 (s, 12H, 4 OCH₃). ¹³C NMR (101 MHz, CDCl₃): δ 188.04, 153.70, 151.71, 150.36, 149.43, 138.13, 136.18, 126.57, 123.39, 122.82, 110.88, 110.04, 56.18, 56.12 ppm. ESI-MASS: (M/z) 462 [M+H]⁺.

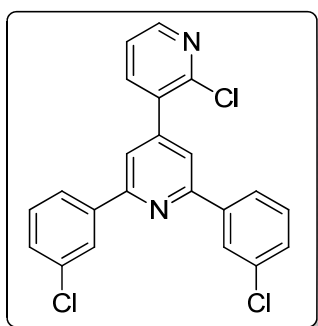
2-Chloro-2',6'-di-*p*-tolyl-3,4'-bipyridine (3o)



Yield: 79 %, Colorless solid, M. P: 180-182 °C, FT-IR (KBr): 3872, 3593, 3308, 3024, 2923, 2736, 2356, 1915, 1773, 1606, 1551, 1391, 1217, 1120, 1069, 819, 764 cm⁻¹. ¹H NMR (500 MHz, CDCl₃): δ 8.49 (dd, J = 4.8, 1.9 Hz, 1H, aromatic), 8.08 (d, J = 8.2 Hz, 4H, aromatic), 7.78

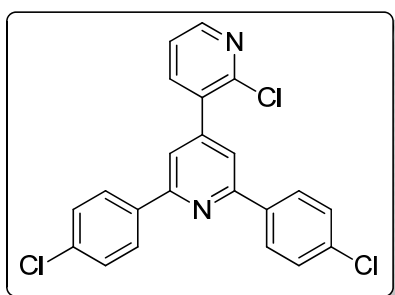
(dd, $J = 7.5, 1.9$ Hz, 1H, aromatic), 7.71 (s, 2H, aromatic), 7.39 (dd, $J = 7.5, 4.8$ Hz, 1H, aromatic), 7.31 (d, $J = 7.9$ Hz, 4H, aromatic), 2.43 (s, 6H, 2 CH₃) ppm. ¹³C NMR (125 MHz, CDCl₃): δ 157.17, 149.45, 149.43, 146.56, 139.38, 139.32, 136.40, 135.21, 129.51, 127.01, 122.75, 118.44, 21.38 ppm. ESI-MASS: (M/z) 371 [M+H]⁺.

2-Chloro-2',6'-bis(3-chlorophenyl)-3,4'-bipyridine (3p)



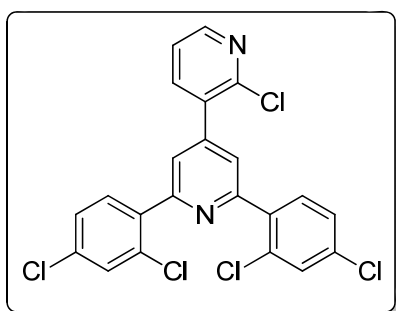
Yield: 73 %, Colorless solid, M. P: 184-186 °C, FT-IR (KBr): 3873, 3592, 3378, 3068, 1599, 1556, 1388, 1216, 1083, 879, 769, 699 cm⁻¹. ¹H NMR (400 MHz, CDCl₃): δ 8.52 (dd, $J = 4.7, 1.8$ Hz, 1H, aromatic), 8.16 (s, 2H, aromatic), 8.12-8.01 (m, 2H, aromatic), 7.89-7.72 (m, 3H, aromatic), 7.57-7.37 (m, 5H, aromatic) ppm. ¹³C NMR (101 MHz, CDCl₃): δ 156.05, 149.81, 140.59, 139.32, 134.99, 130.12, 129.50, 127.29, 125.25, 122.84, 119.72 ppm. ESI-MASS: (M/z) 413 [M+H]⁺.

2-Chloro-2',6'-bis(4-chlorophenyl)-3,4'-bipyridine (3q)



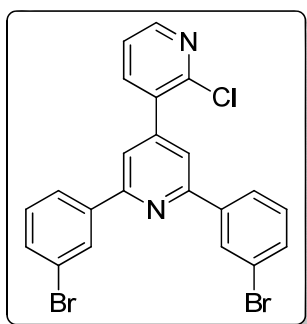
Yield: 78%, Colorless solid, M. P: 214-216 °C, FT-IR (KBr): 3688, 3022, 2408, 2689, 1525, 1427, 1367, 1215, 739, 671 cm^{-1} . ^1H NMR (300 MHz, CDCl_3): δ 8.52 (d, $J = 3.2$ Hz, 1H, aromatic), 8.11 (d, $J = 8.6$ Hz, 4H, aromatic), 7.82-7.70 (m, 3H, aromatic), 7.49 (d, $J = 8.6$ Hz, 4H, aromatic), 7.42 (dd, $J = 7.5, 4.8$ Hz, 1H, aromatic) ppm. ^{13}C NMR (75 MHz, CDCl_3): δ 156.68, 150.28, 148.22, 147.38, 137.37, 135.61, 134.51, 129.03, 128.37, 116.86 ppm. ESI-MASS: (M/z) 411 $[\text{M}+\text{H}]^+$.

2-Chloro-2',6'-bis(2,4-dichlorophenyl)-3,4'-bipyridine (3r)



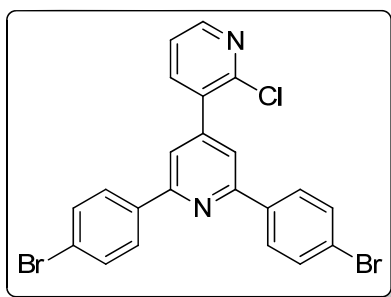
Yield: 77 %, Colorless solid, M. P: 192-194 °C, FT-IR (KBr): 3875, 3593, 3546, 3385, 1798, 1598, 1555, 1481, 1383, 1217, 1102, 1059, 820, 770, 676 cm^{-1} . ^1H NMR (500 MHz, CDCl_3): δ 8.51 (dd, $J = 4.8, 1.9$ Hz, 1H, aromatic), 8.07-7.70 (m, 5H, aromatic), 7.59-7.35 (m, 5H, aromatic) ppm. ^{13}C NMR (125 MHz, CDCl_3): δ 155.94, 149.86, 145.36, 139.56, 137.02, 135.36, 134.16, 133.03, 132.80, 130.07, 129.07, 128.41, 127.60, 123.93, 122.88 ppm. ESI-MASS: (M/z) 503 $[\text{M}+\text{H}]^+$.

2',6'-Bis(3-bromophenyl)-2-chloro-3,4'-bipyridine (3s)



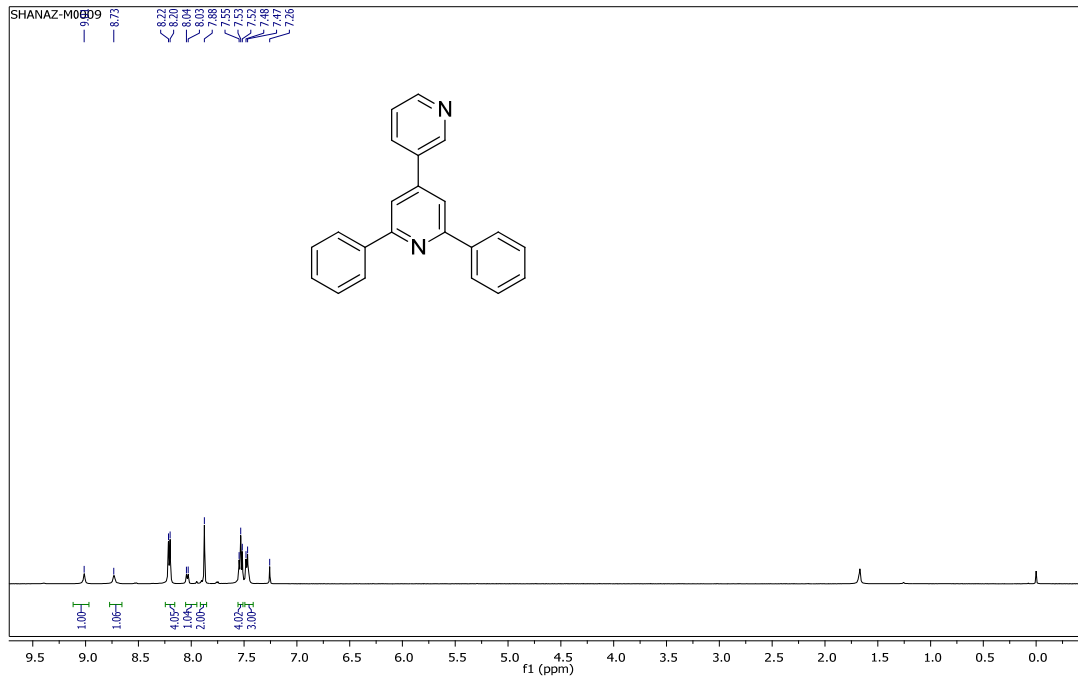
Yield: 82%, Pale brownish solid, M. P: 184-186 °C, FT-IR (KBr): 3679, 3023, 2403, 1429, 1358, 1215, 740, 671 cm^{-1} . ^1H NMR (400 MHz, CDCl_3): δ 8.53 (dd, $J = 4.8, 1.9$ Hz, 1H, aromatic), 8.31 (t, $J = 1.8$ Hz, 2H, aromatic), 8.11-8.06 (m, 2H, aromatic), 7.79-7.75 (m, 3H, aromatic), 7.64-7.56 (m, 2H, aromatic), 7.43 (dd, $J = 6.1, 3.4$ Hz, 2H, aromatic), 7.40 (s, 1H, aromatic) ppm. ^{13}C NMR (101 MHz, CDCl_3): δ 155.93, 149.80, 147.22, 140.82, 139.32, 132.41, 130.39, 130.18, 130.12, 125.74, 123.15, 122.85, 119.74 ppm. ESI-MASS: (M/z) 502 $[\text{M}+\text{H}]^+$.

2',6'-Bis(4-bromophenyl)-2-chloro-3,4'-bipyridine (3t)

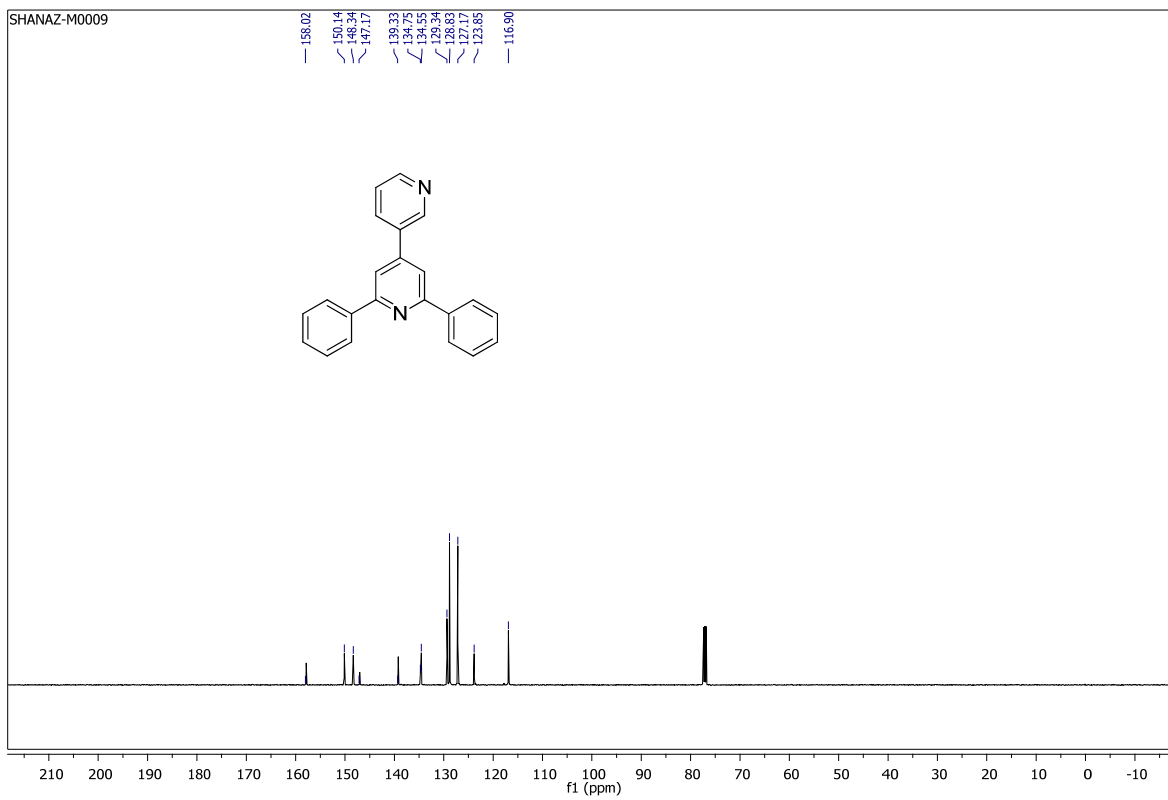


Yield: 80 %, Colorless solid, M. P: 218-220°C, FT-IR (KBr): 3876, 3685, 3593, 3532, 3023, 2405, 1432, 1215, 742, 671 cm^{-1} . ^1H NMR (400 MHz, CDCl_3): δ 8.52 (dd, $J = 4.7, 1.7$ Hz, 1H, aromatic), 8.08 (dd, $J = 27.1, 8.6$ Hz, 4H, aromatic), 7.82-7.71 (m, 3H, aromatic), 7.64 (d, $J = 8.6$ Hz, 3H, aromatic), 7.60-7.27 (m, 2H, aromatic) ppm. ^{13}C NMR (101 MHz, CDCl_3): δ 156.26, 149.75, 139.31, 137.72, 132.00, 129.04, 128.67, 128.39, 124.02, 122.83, 119.13 ppm. ESI-MASS: (M/z) 502 $[\text{M}+\text{H}]^+$.

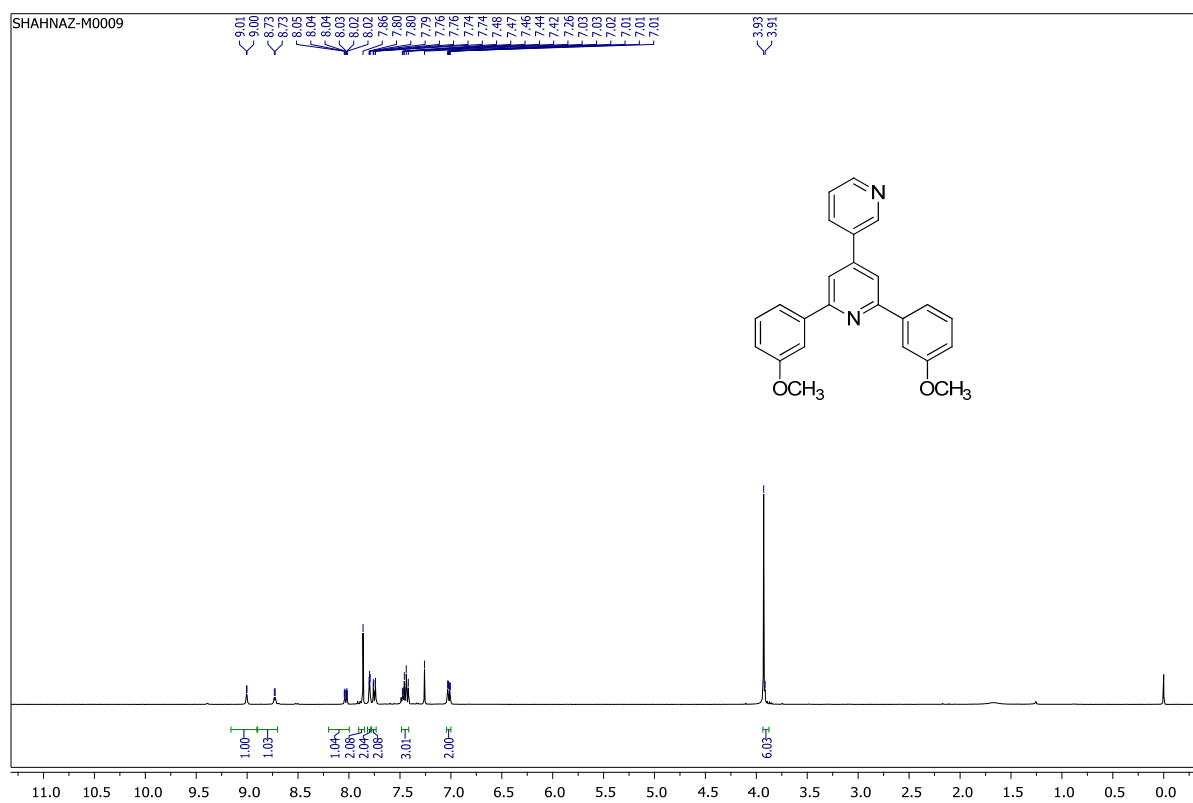
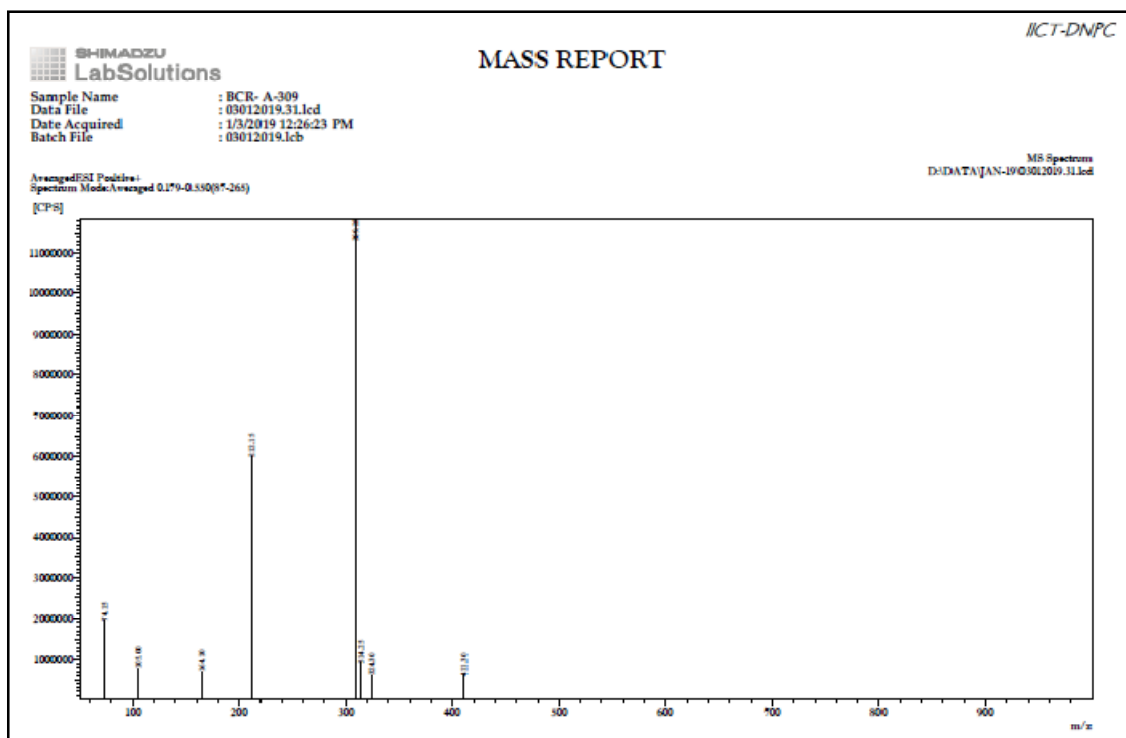
Spectra's Of Compounds 3a-t

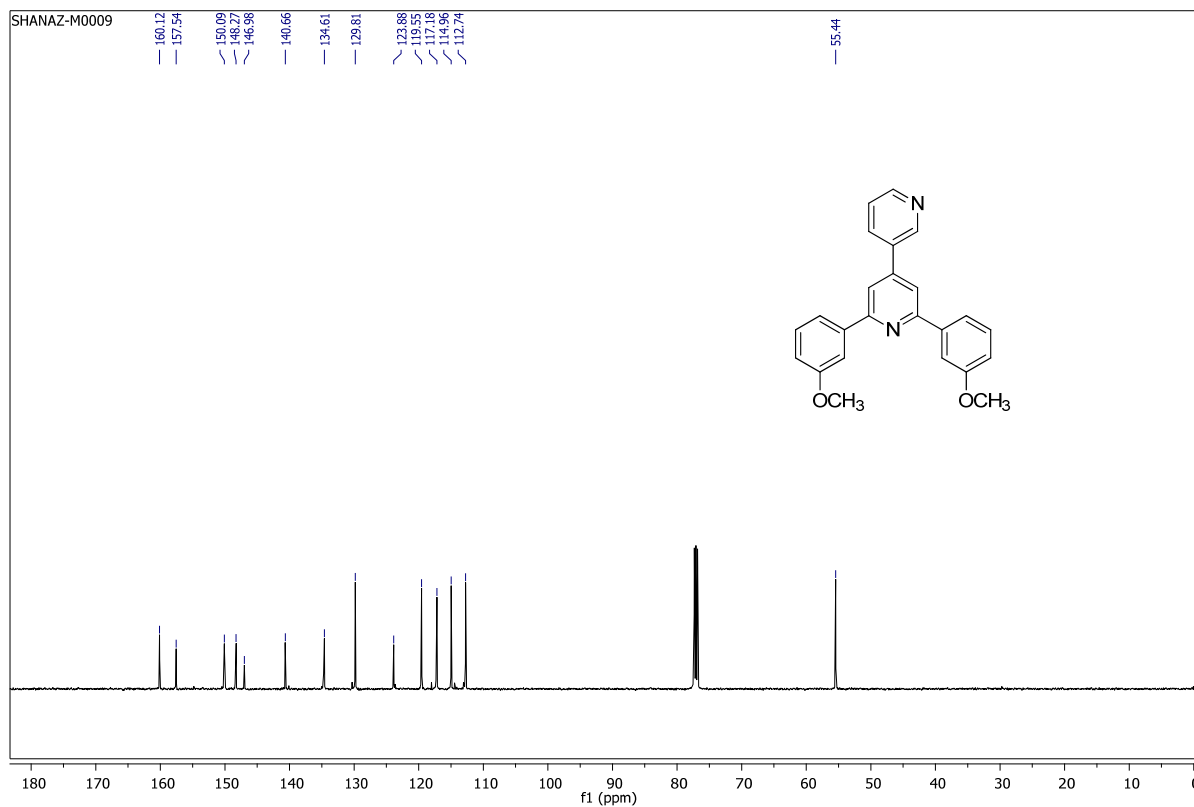


¹H-NMR Spectrum of Compound 3a

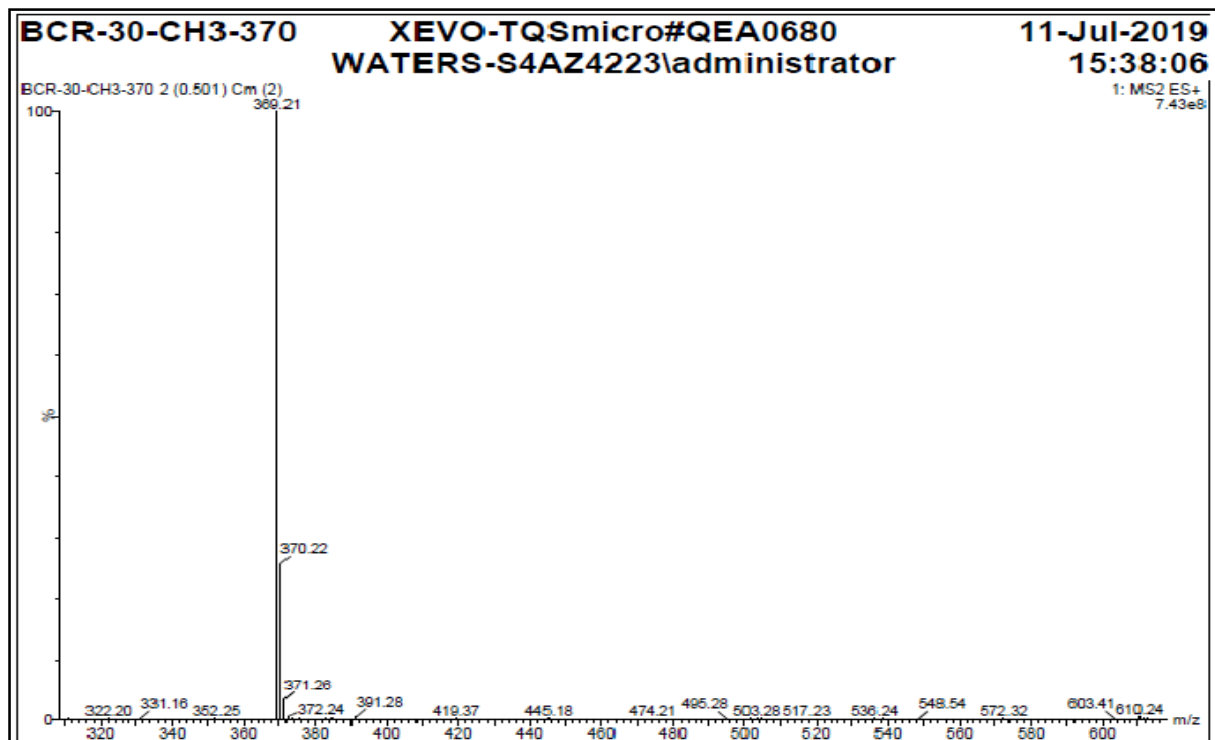


¹³C NMR Spectrum of compound 3a

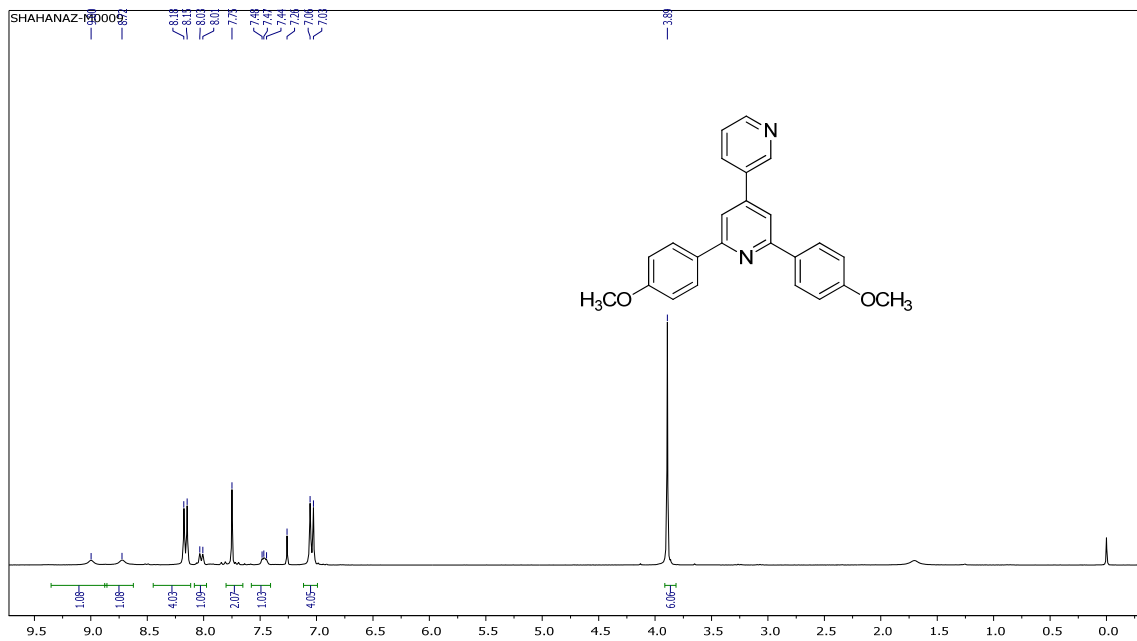




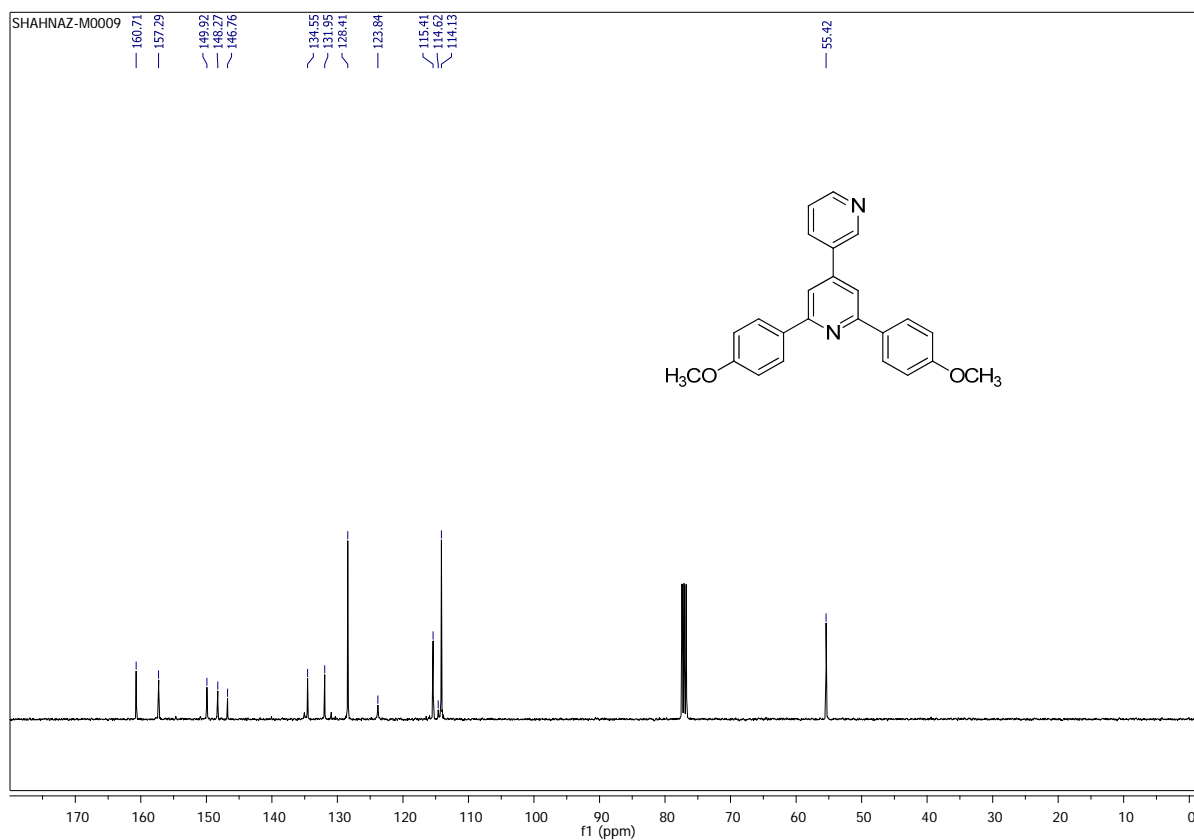
¹³C NMR Spectrum of compound 3b



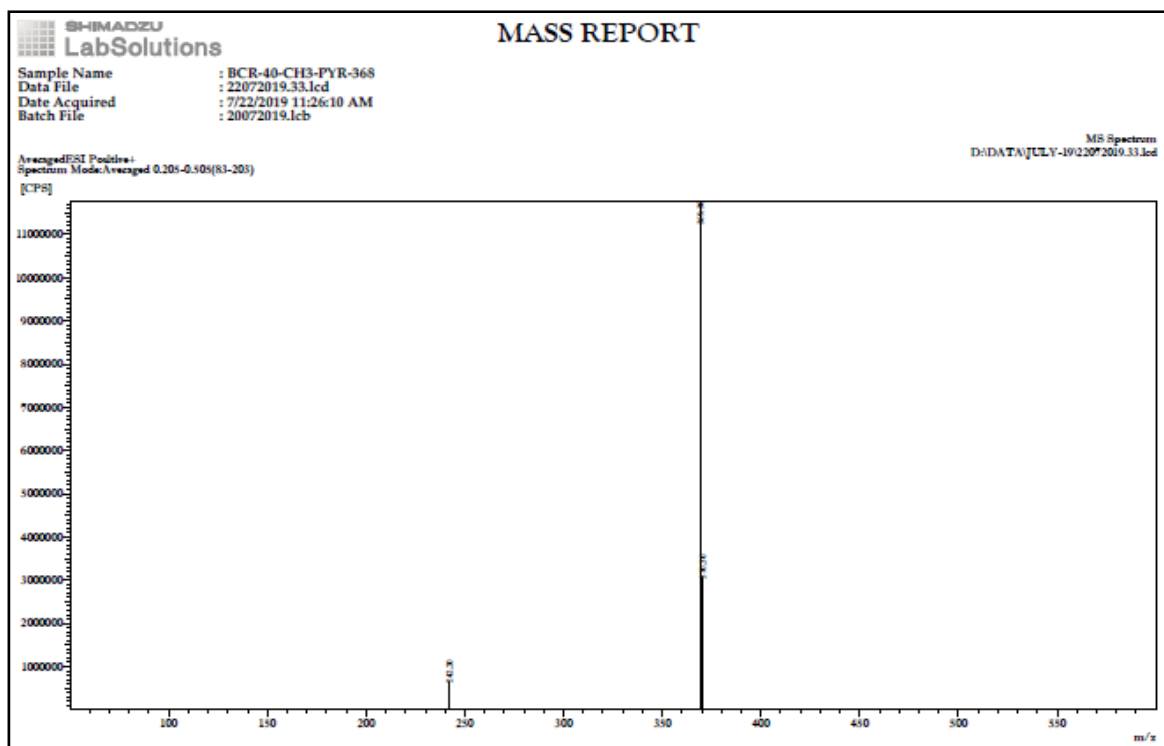
Mass Spectrum of compound 3b



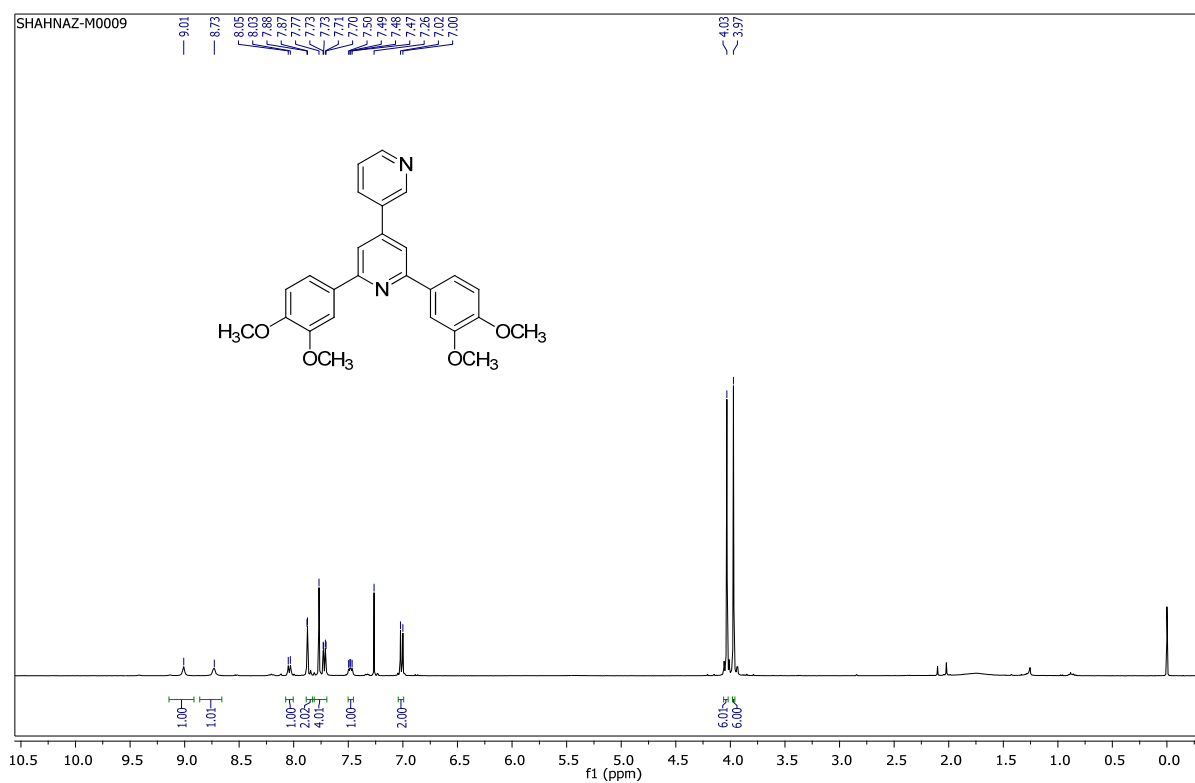
¹H-NMR Spectrum of Compound 3c



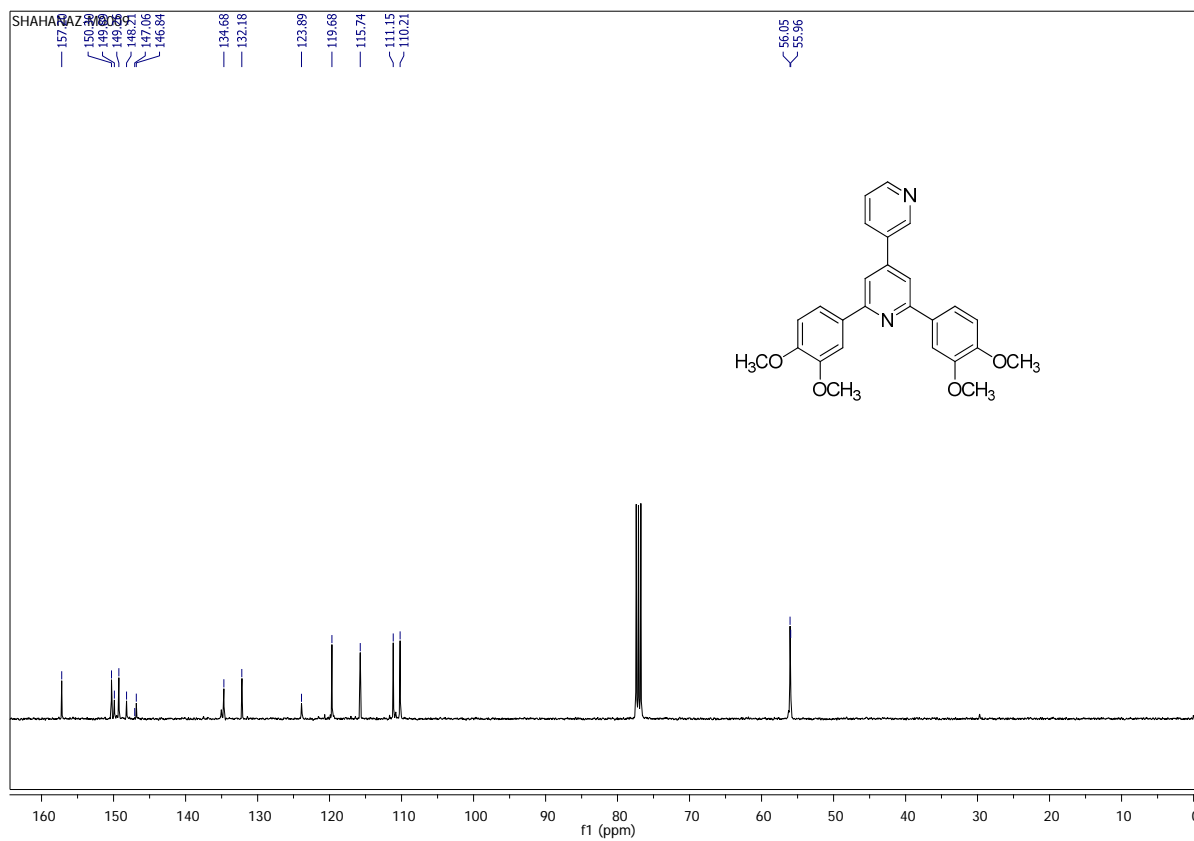
¹³C NMR Spectrum of compound 3c



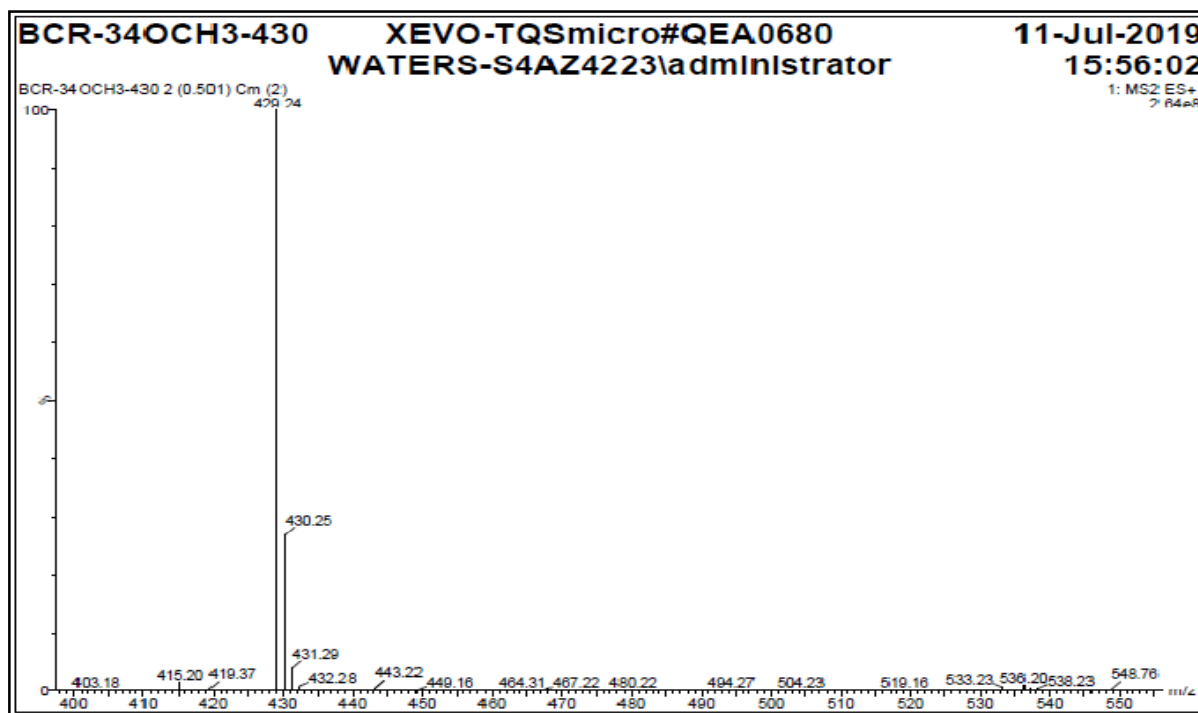
Mass Spectrum of compound 3c



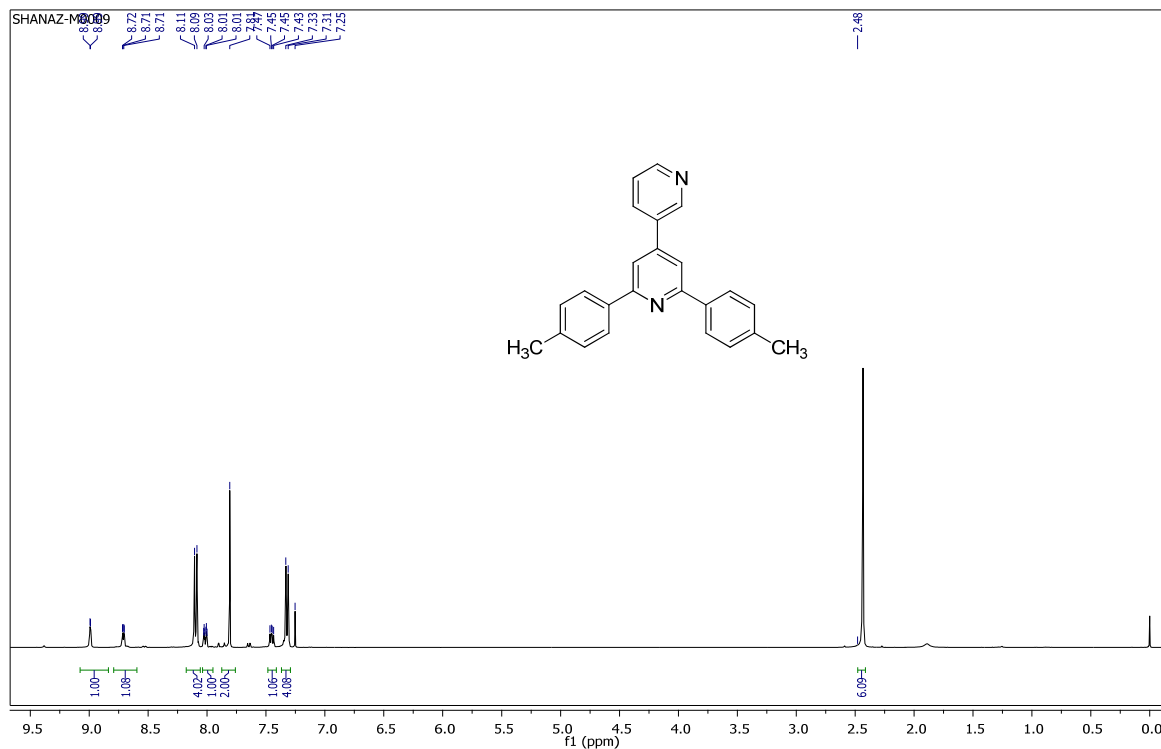
¹H-NMR Spectrum of Compound 3d



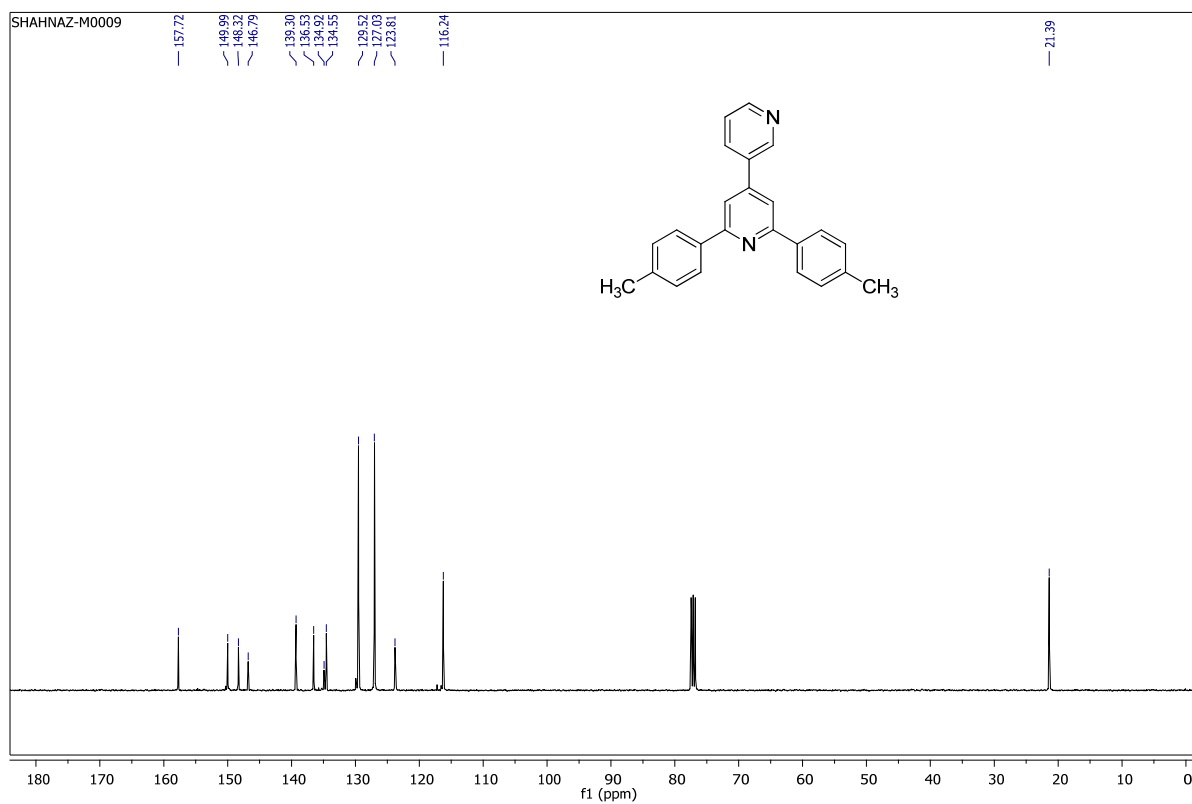
¹³C NMR Spectrum of compound 3d



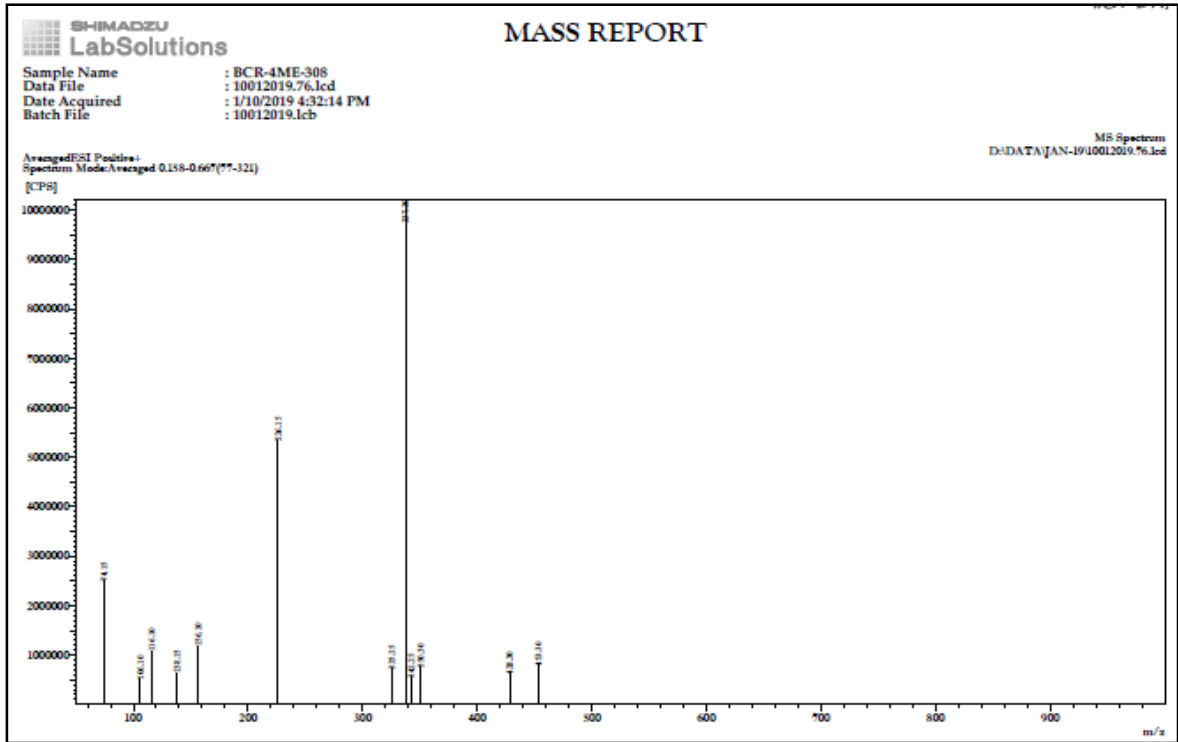
Mass Spectrum of compound 3d



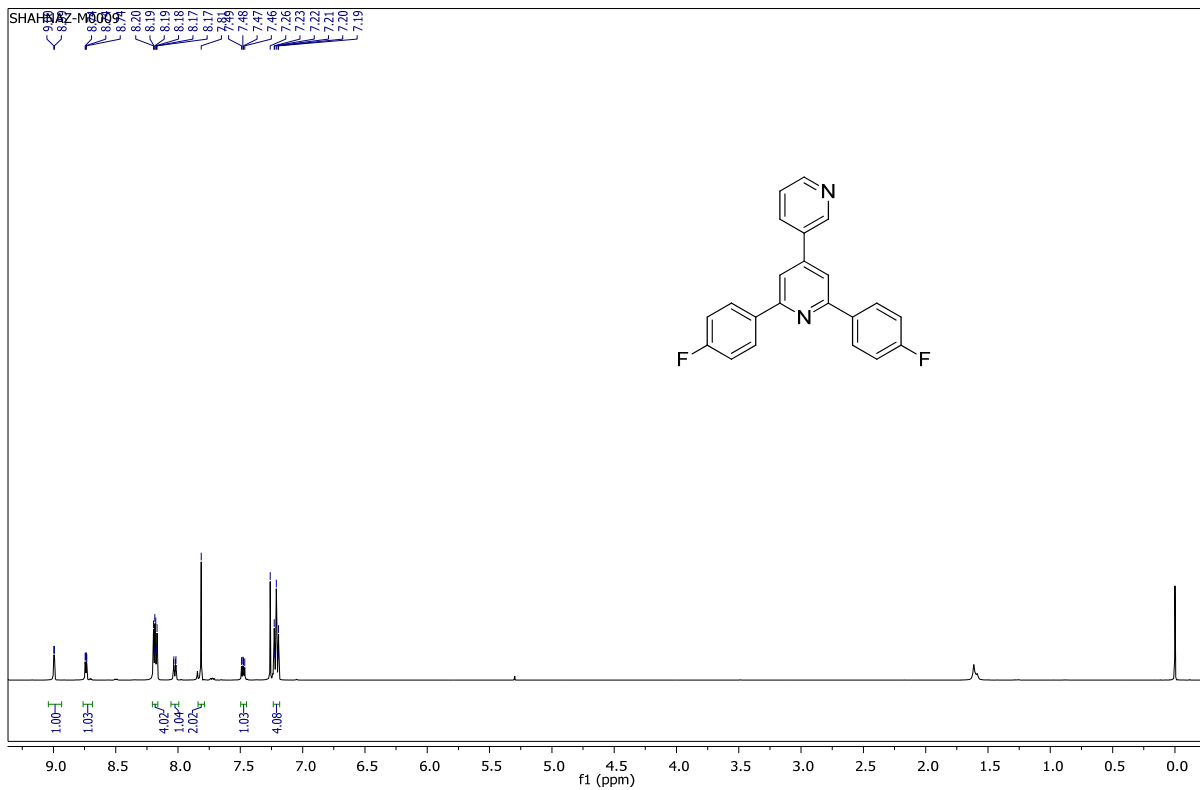
¹H-NMR Spectrum of Compound 3e



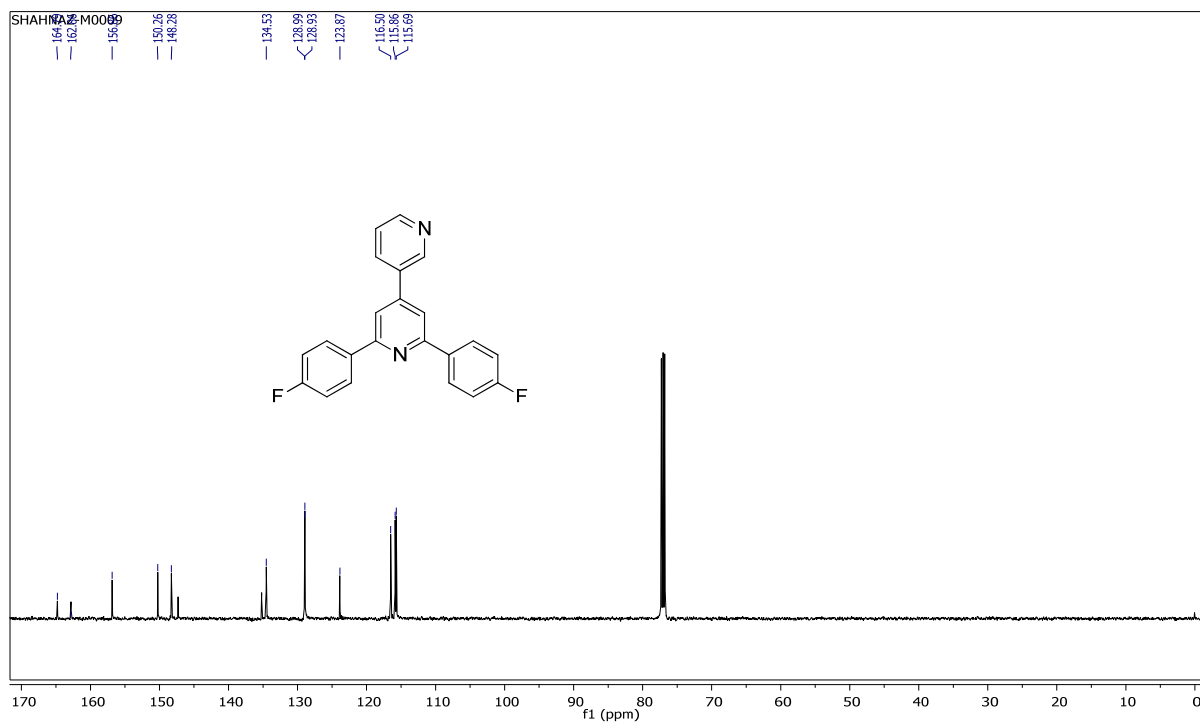
¹³C NMR Spectrum of compound 3e



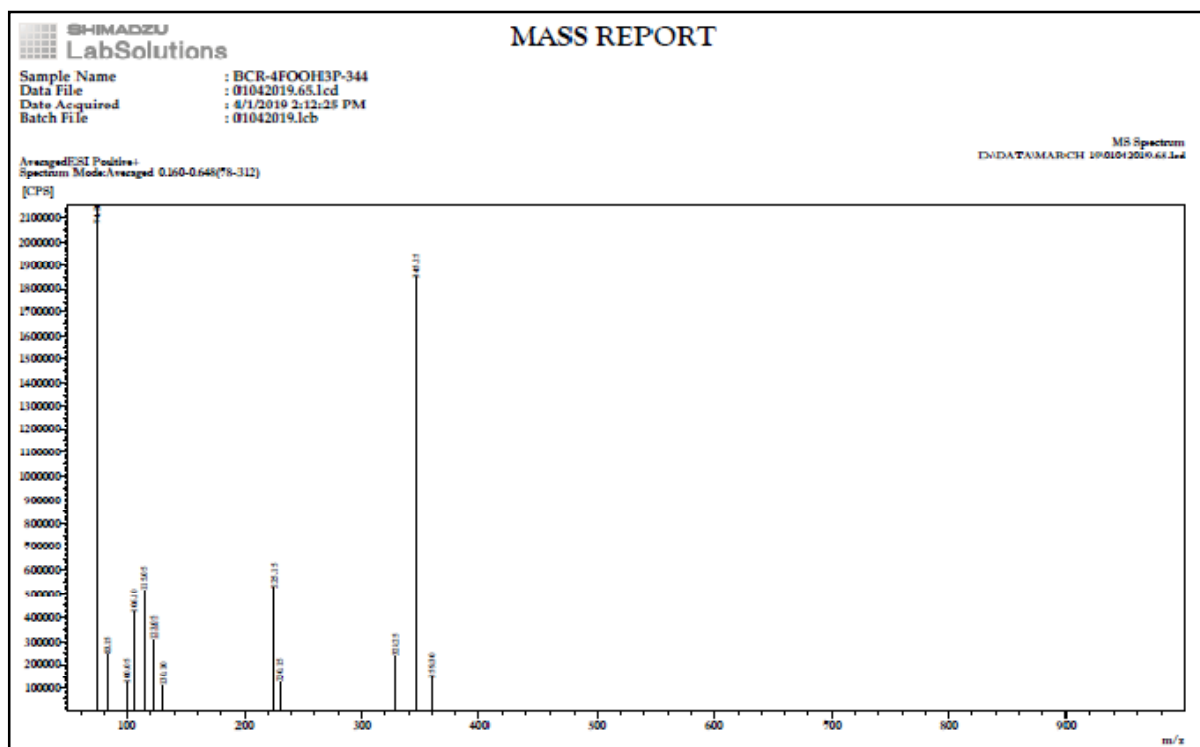
Mass Spectrum of Compound 3e



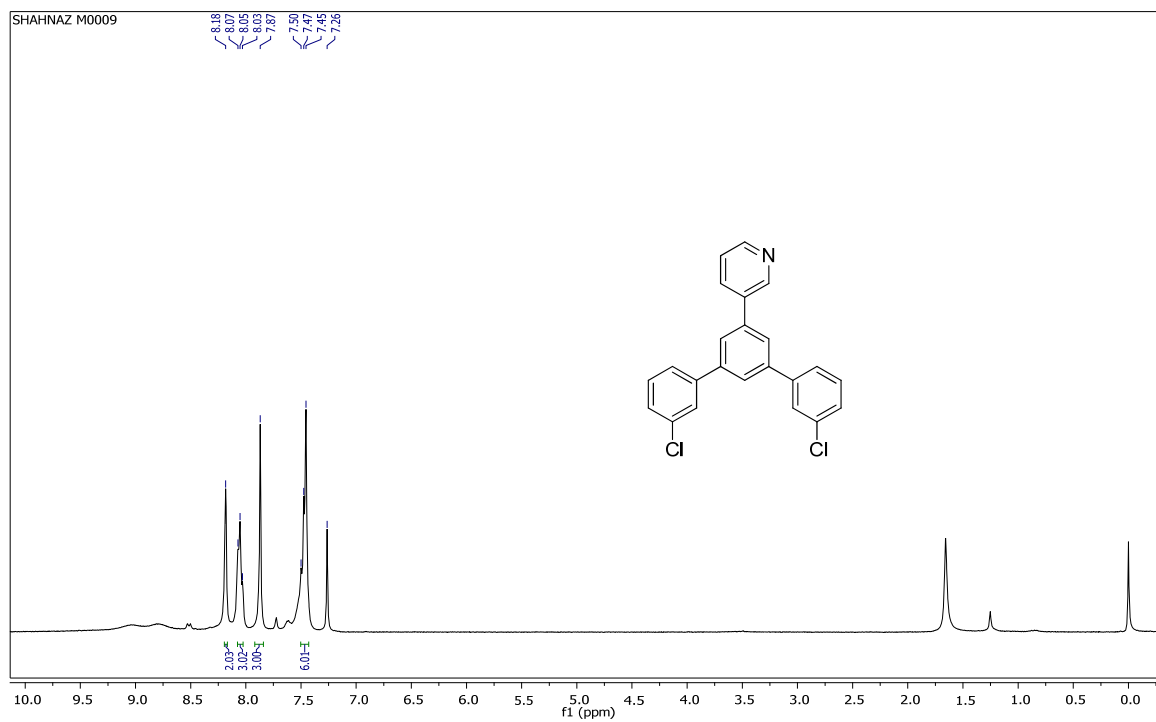
¹H-NMR Spectrum of Compound 3f



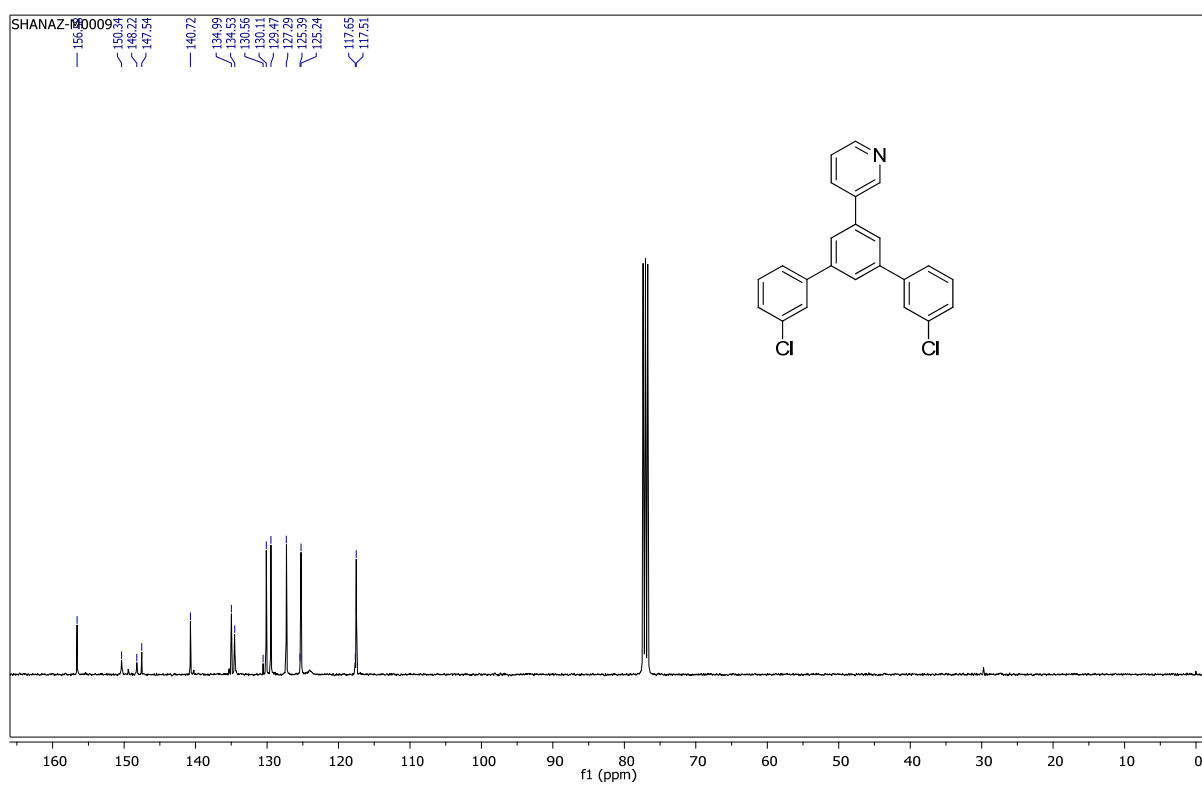
^{13}C NMR Spectrum of compound 3f



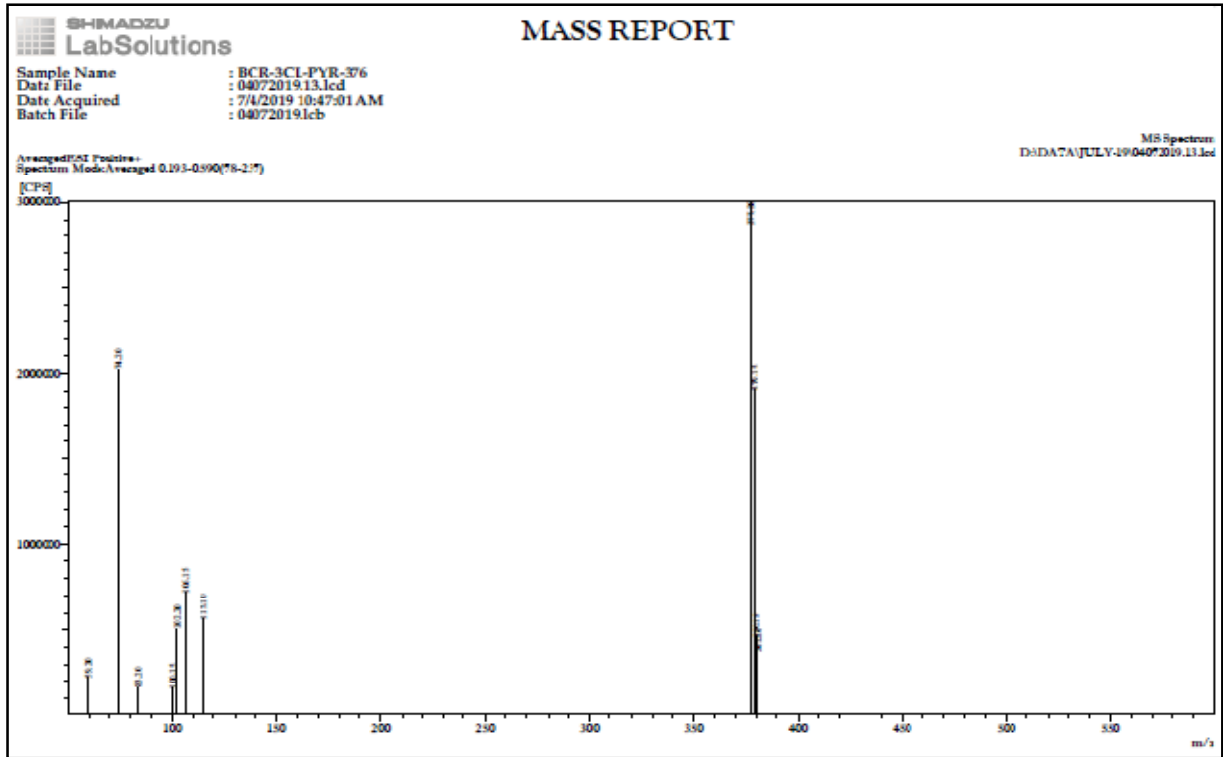
Mass Spectrum of Compound 3f



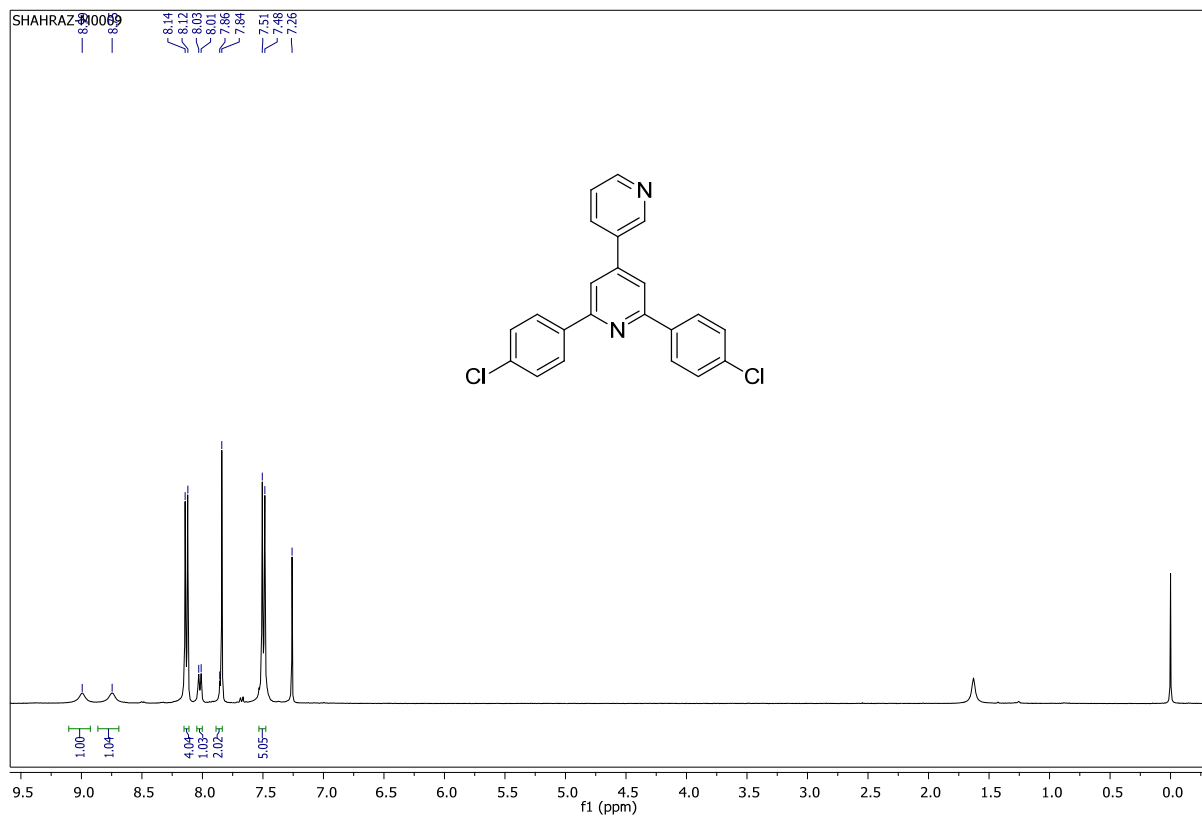
¹H-NMR Spectrum of Compound 3g



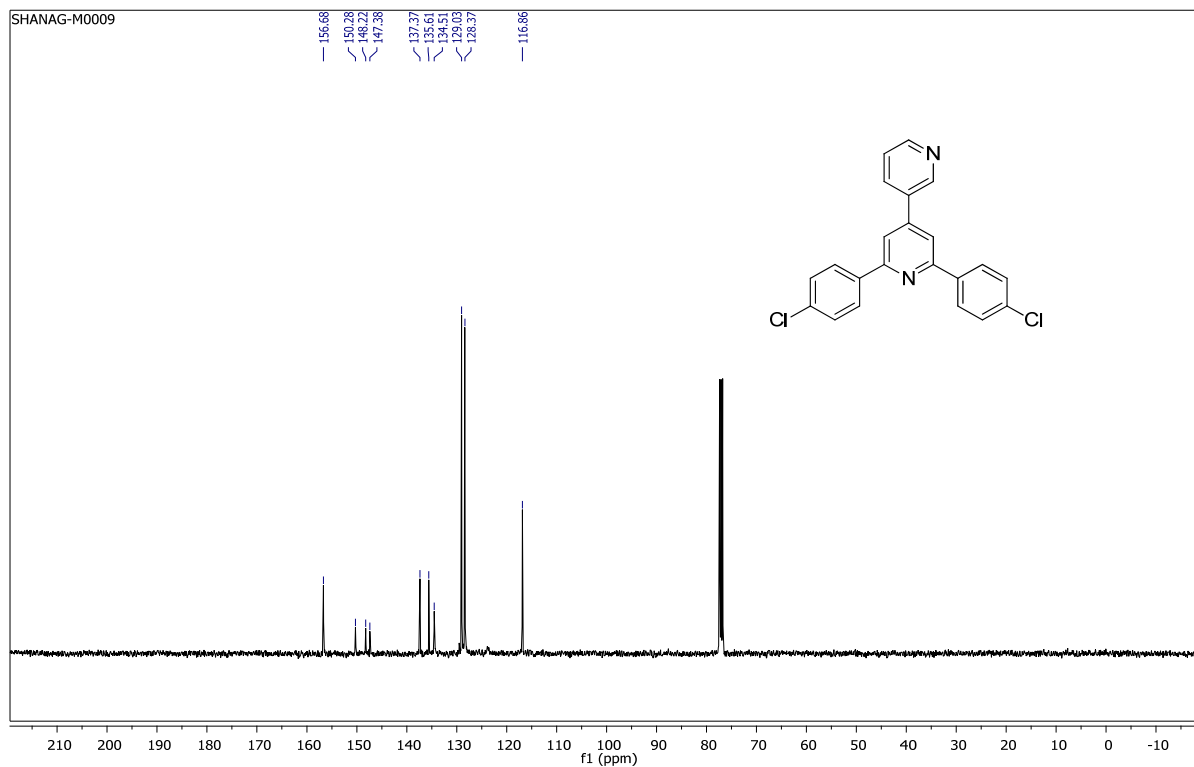
¹³C NMR Spectrum of compound 3g



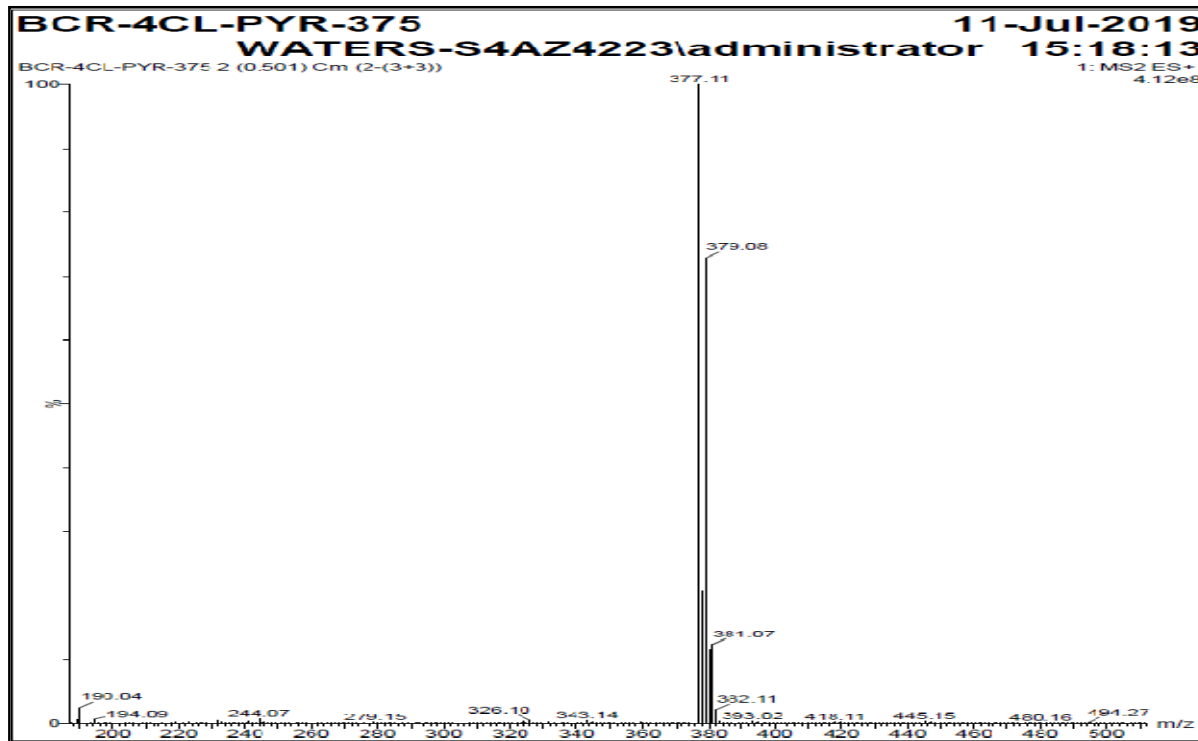
Mass Spectrum of compound 3g



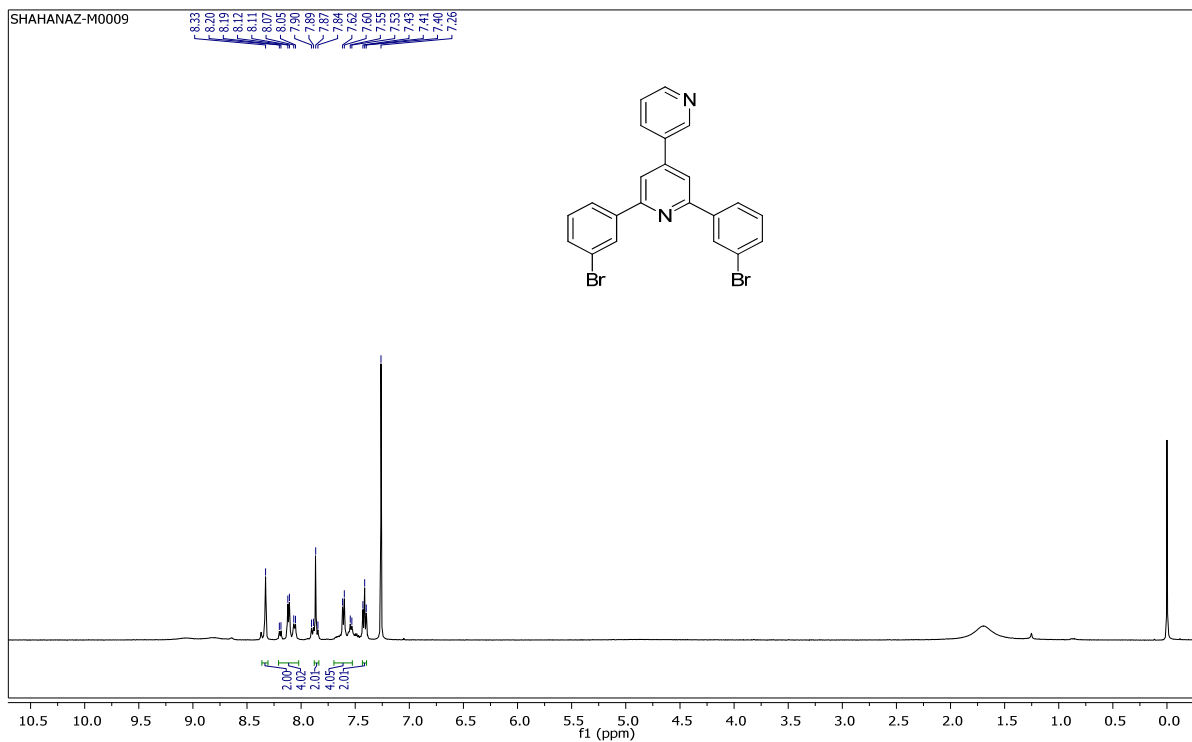
¹H-NMR Spectrum of Compound 3h



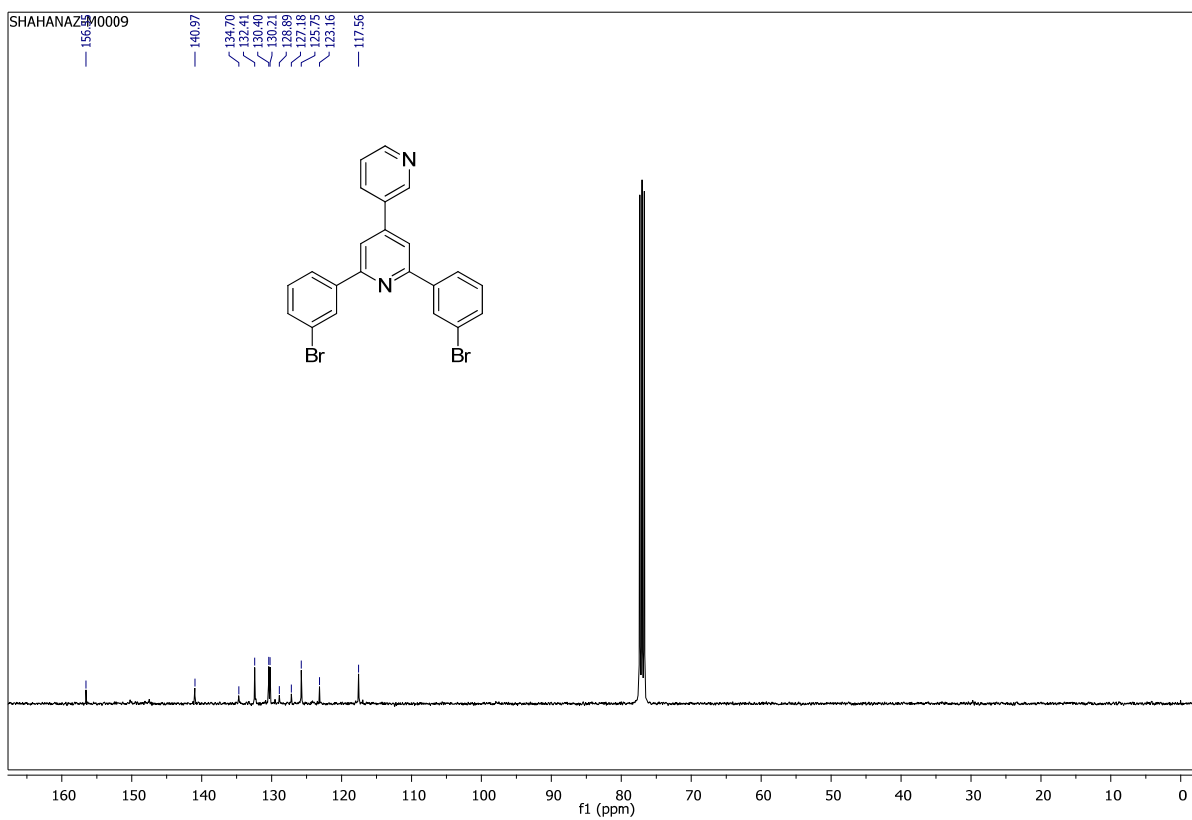
¹³C NMR Spectrum of compound 3h



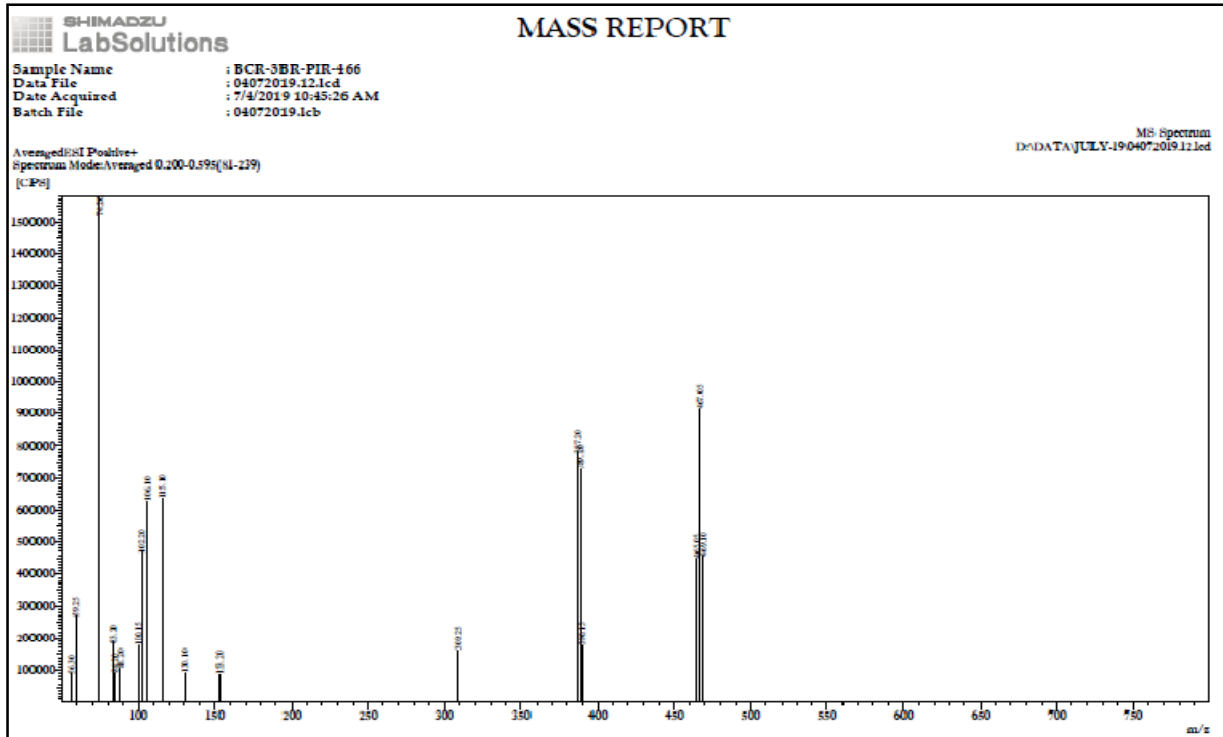
Mass Spectrum of compound 3h



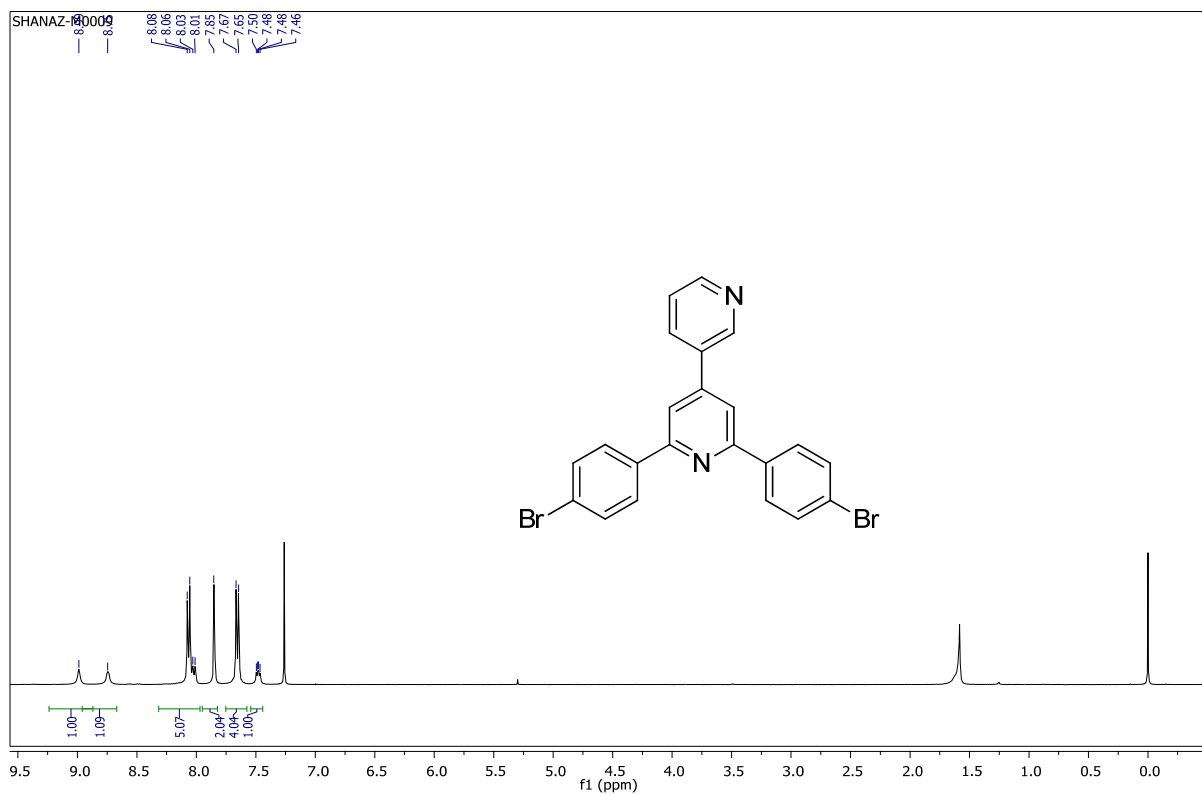
¹H-NMR Spectrum of Compound 3i



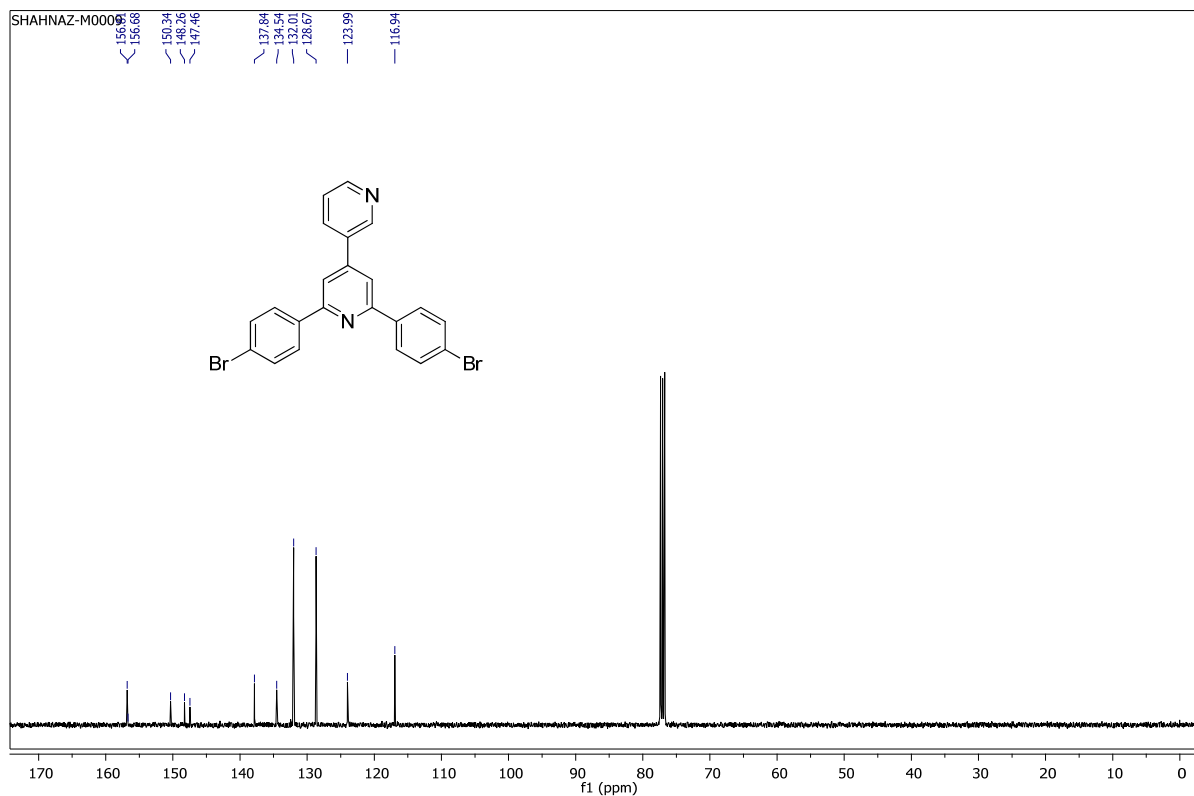
¹³C NMR Spectrum of compound 3i



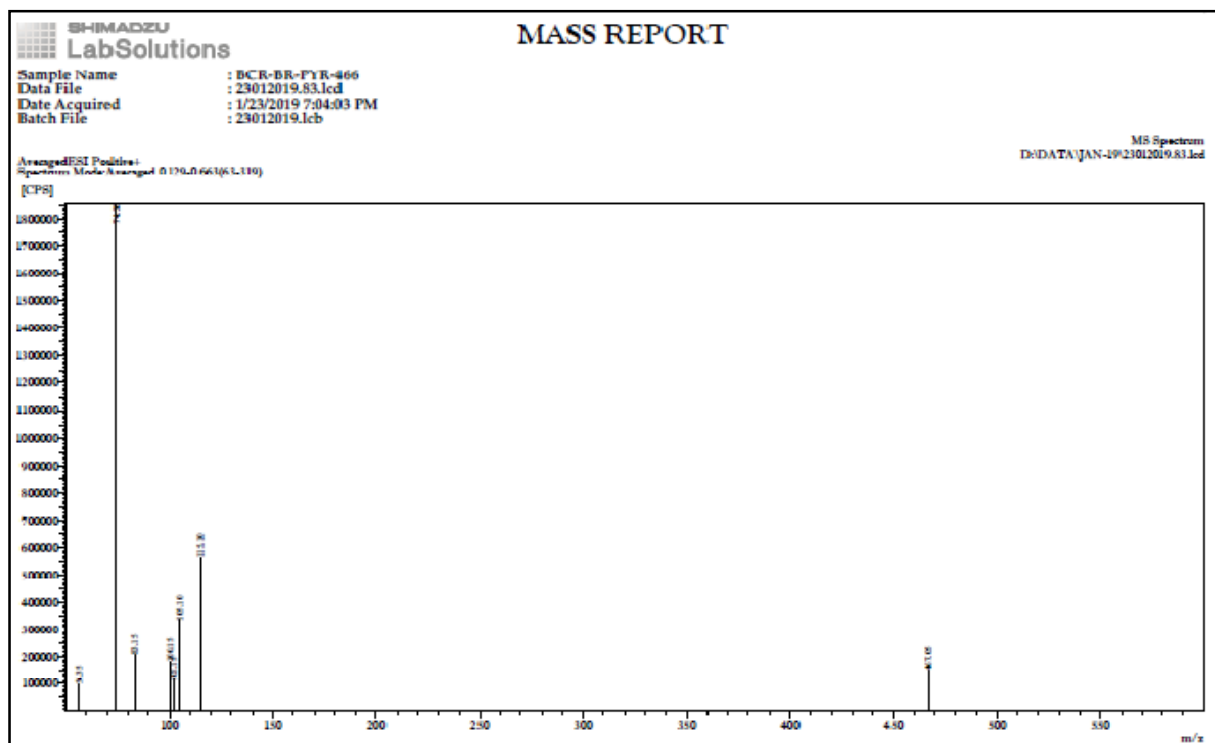
Mass Spectrum of compound 3i



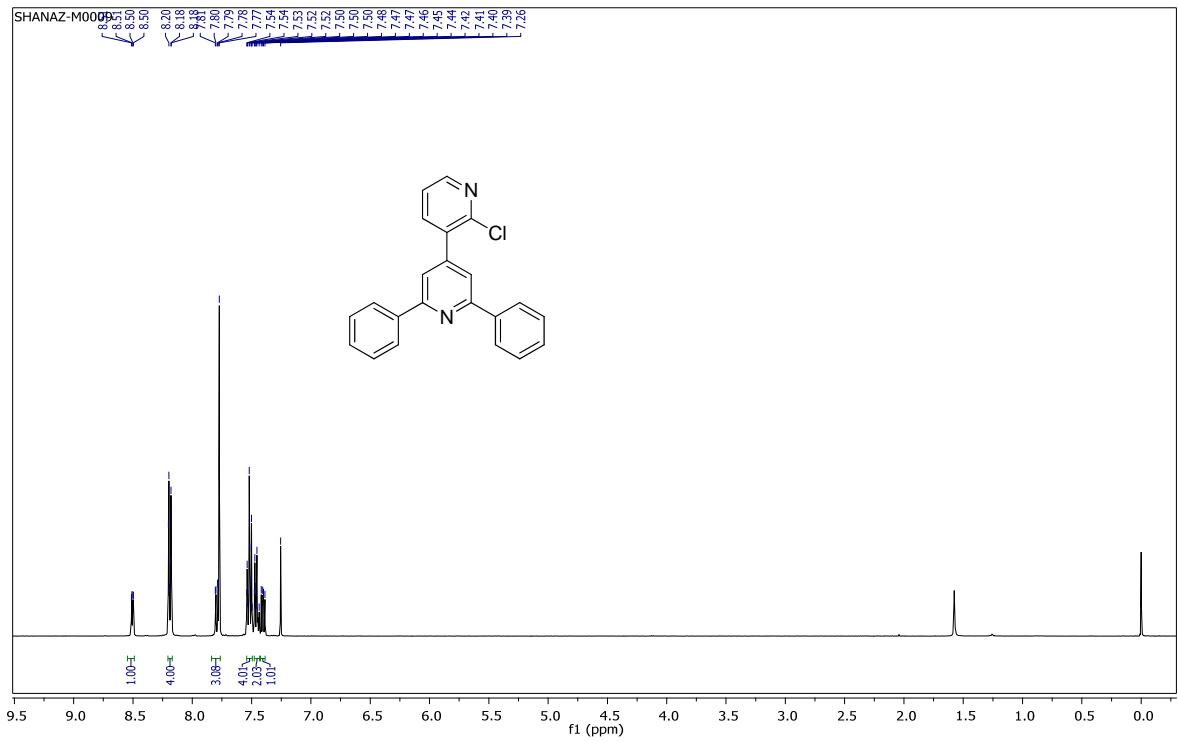
¹H-NMR Spectrum of compound 3j



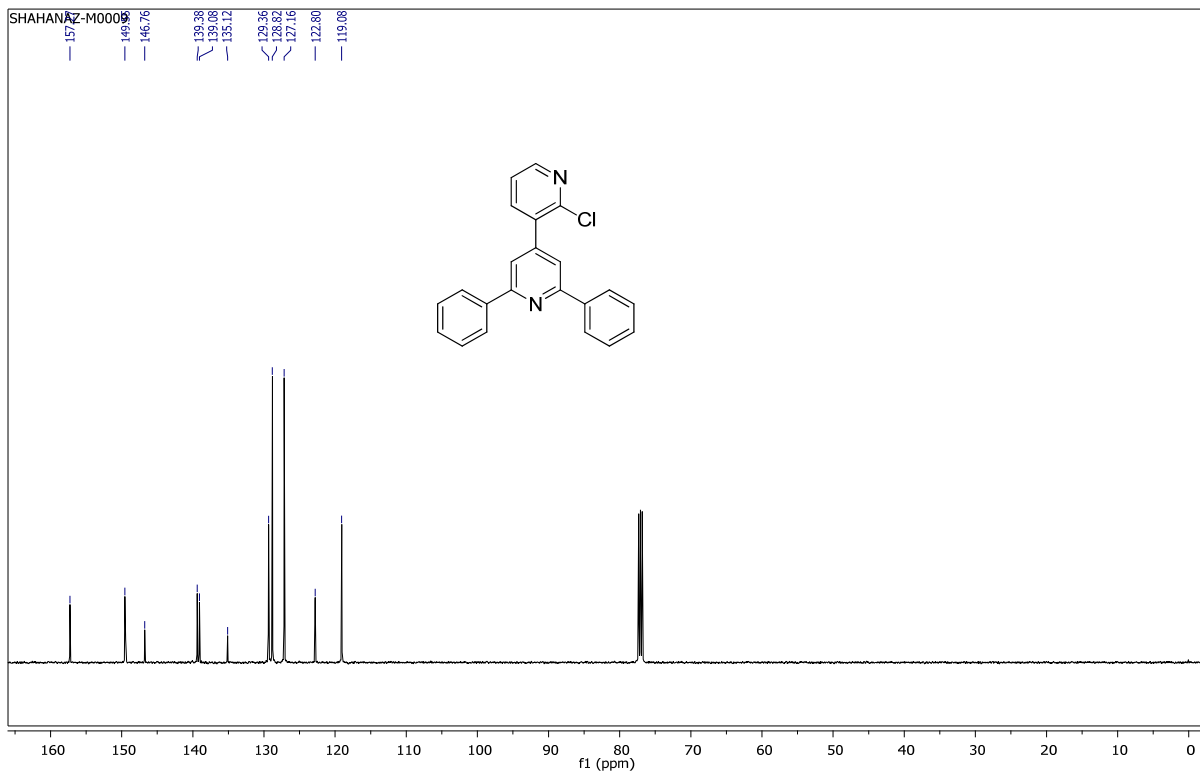
¹³C NMR Spectrum of compound 3j



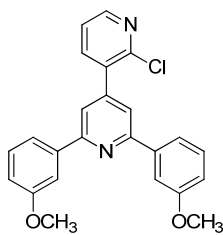
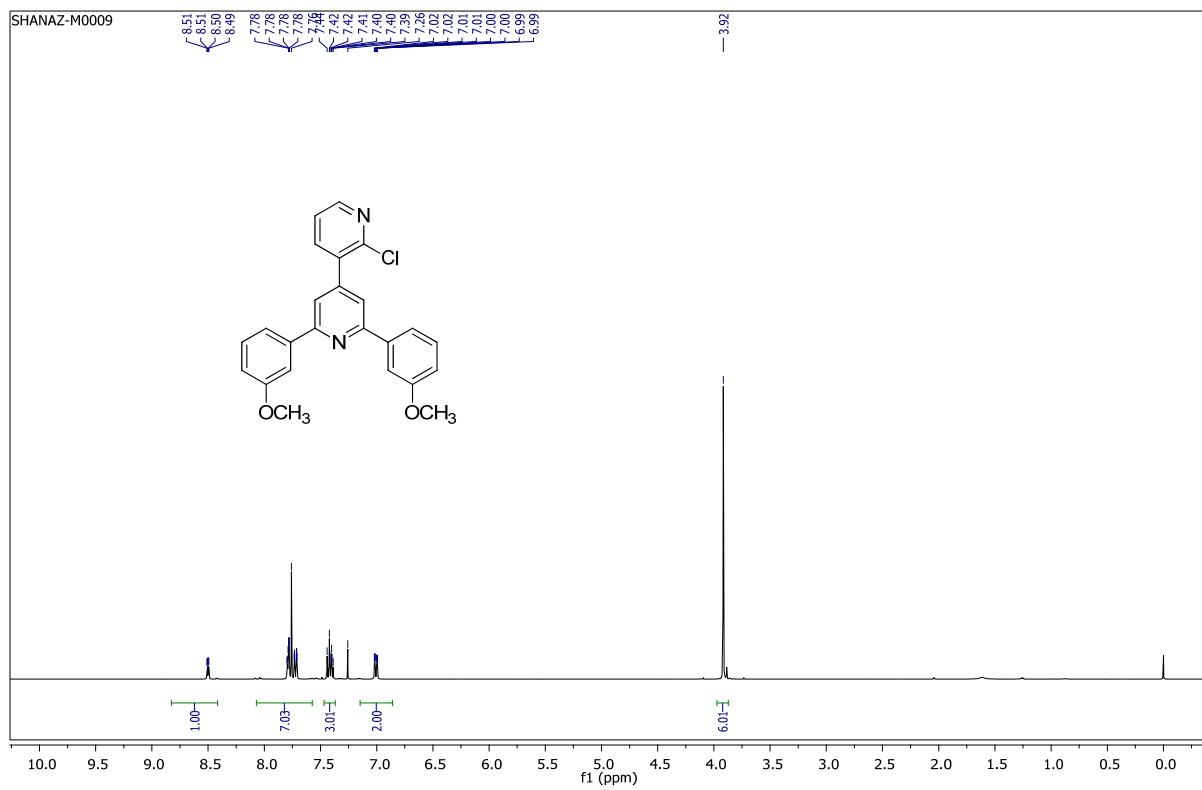
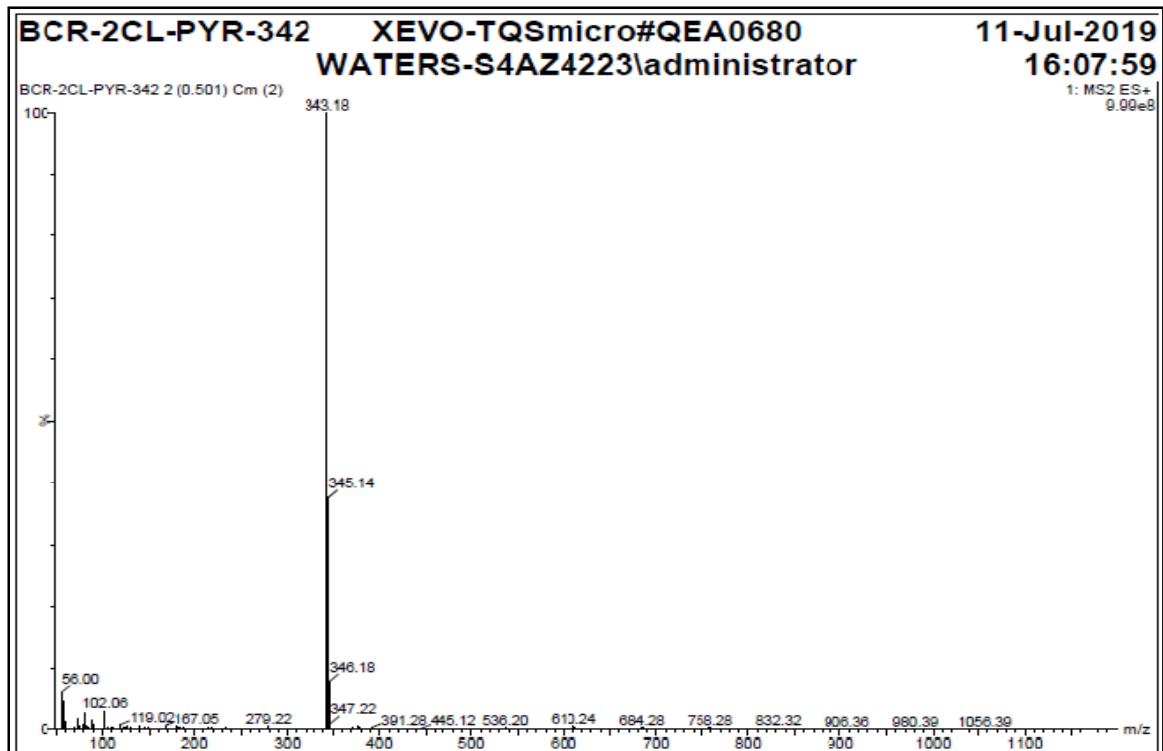
Mass Spectrum of compound 3j

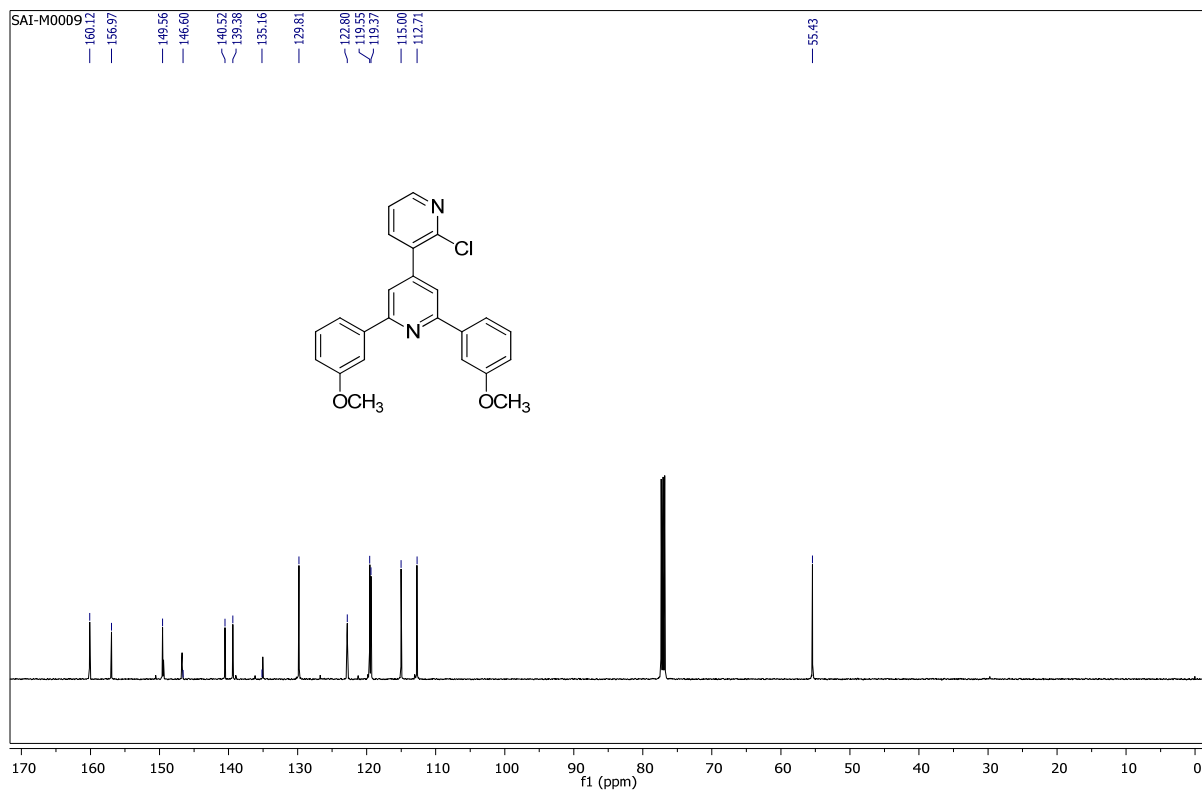


¹H-NMR Spectrum of Compound 3k

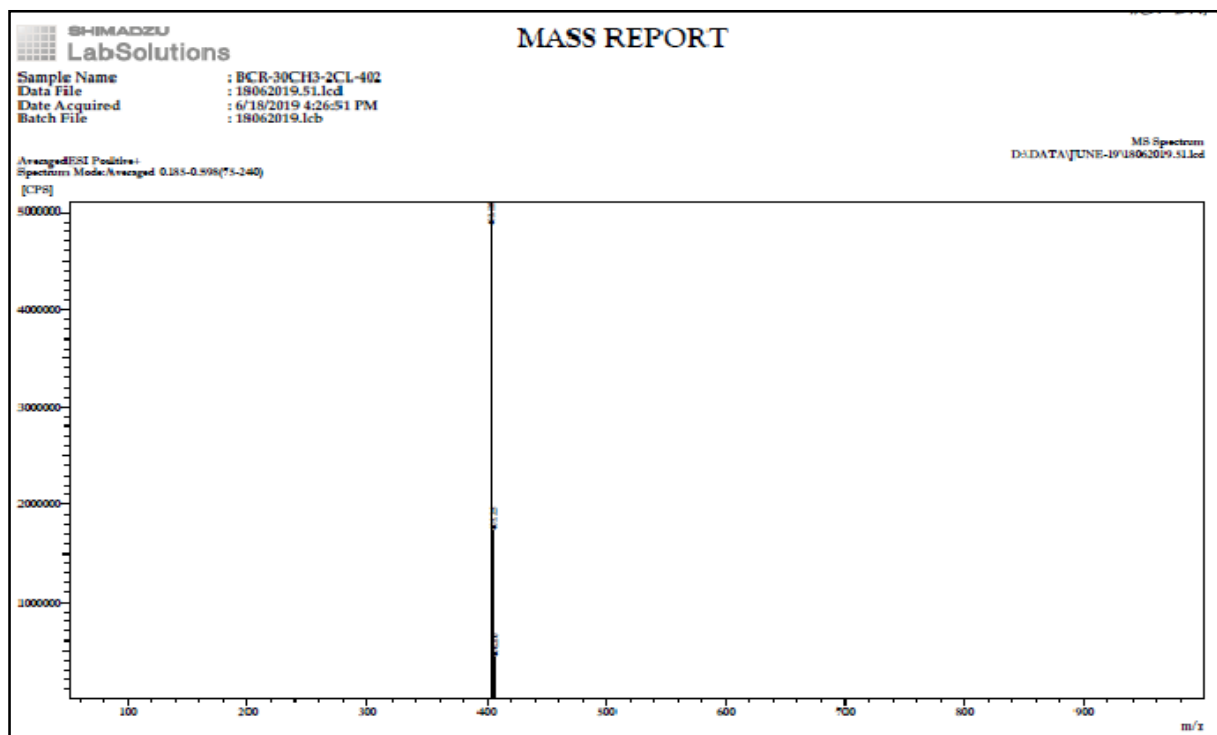


¹³C NMR Spectrum of compound 3k

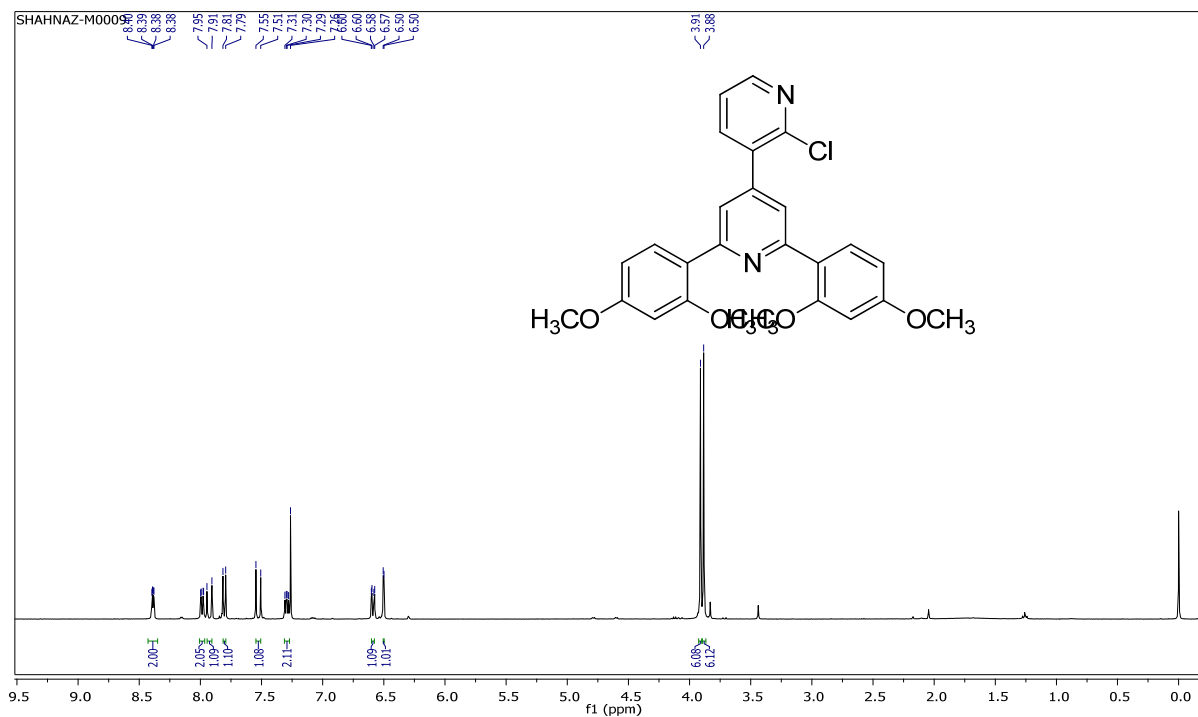




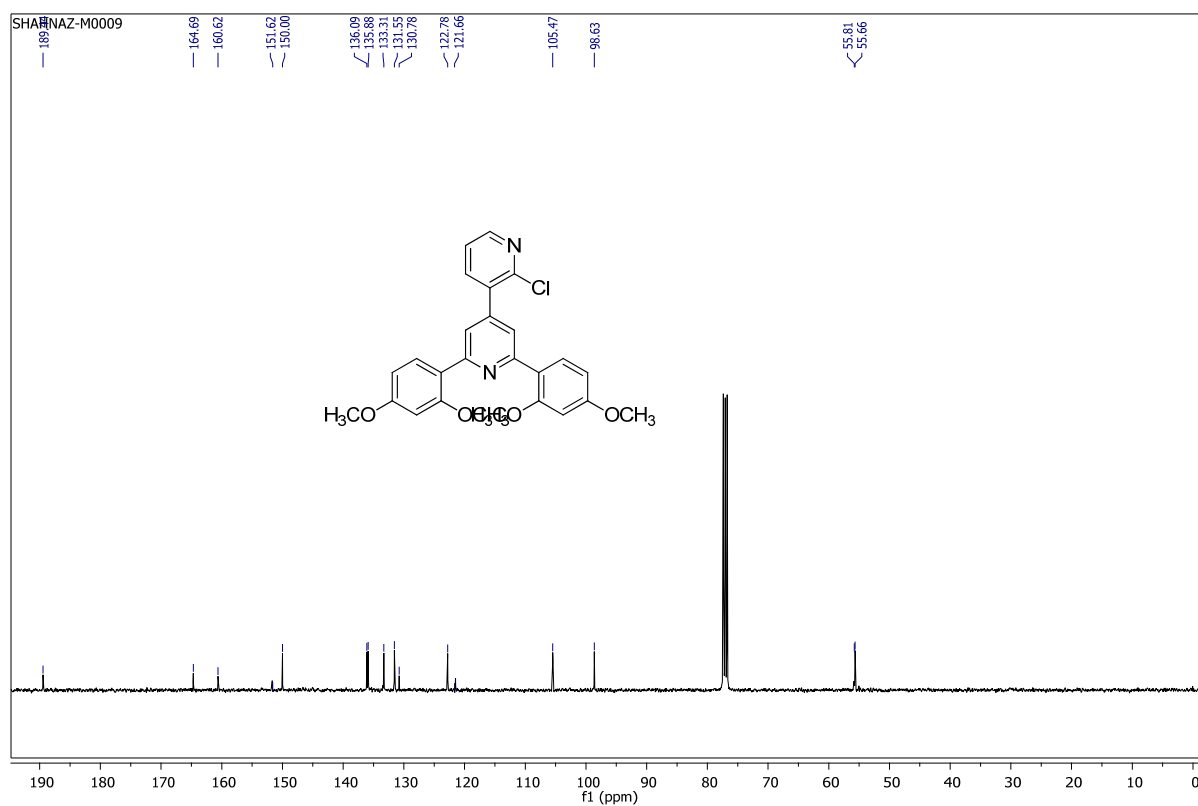
¹³C NMR Spectrum of compound 31



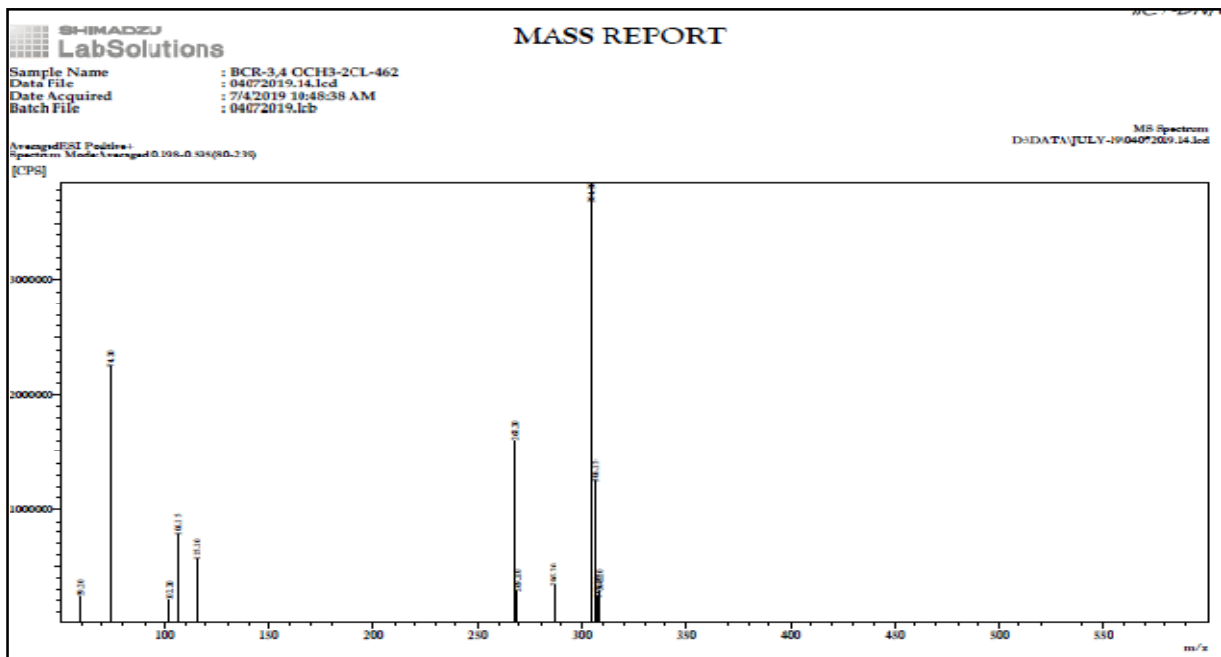
Mass Spectrum of compound 31



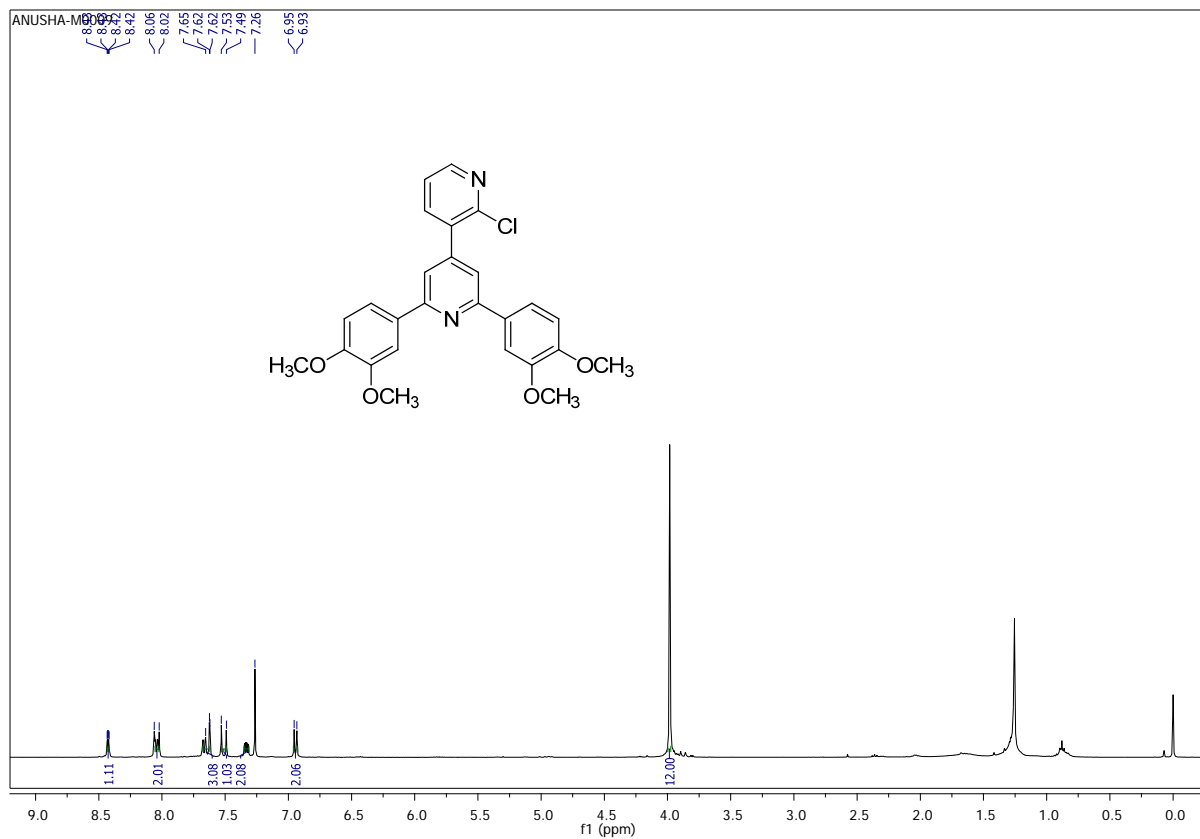
¹H-NMR Spectrum of Compound 3m



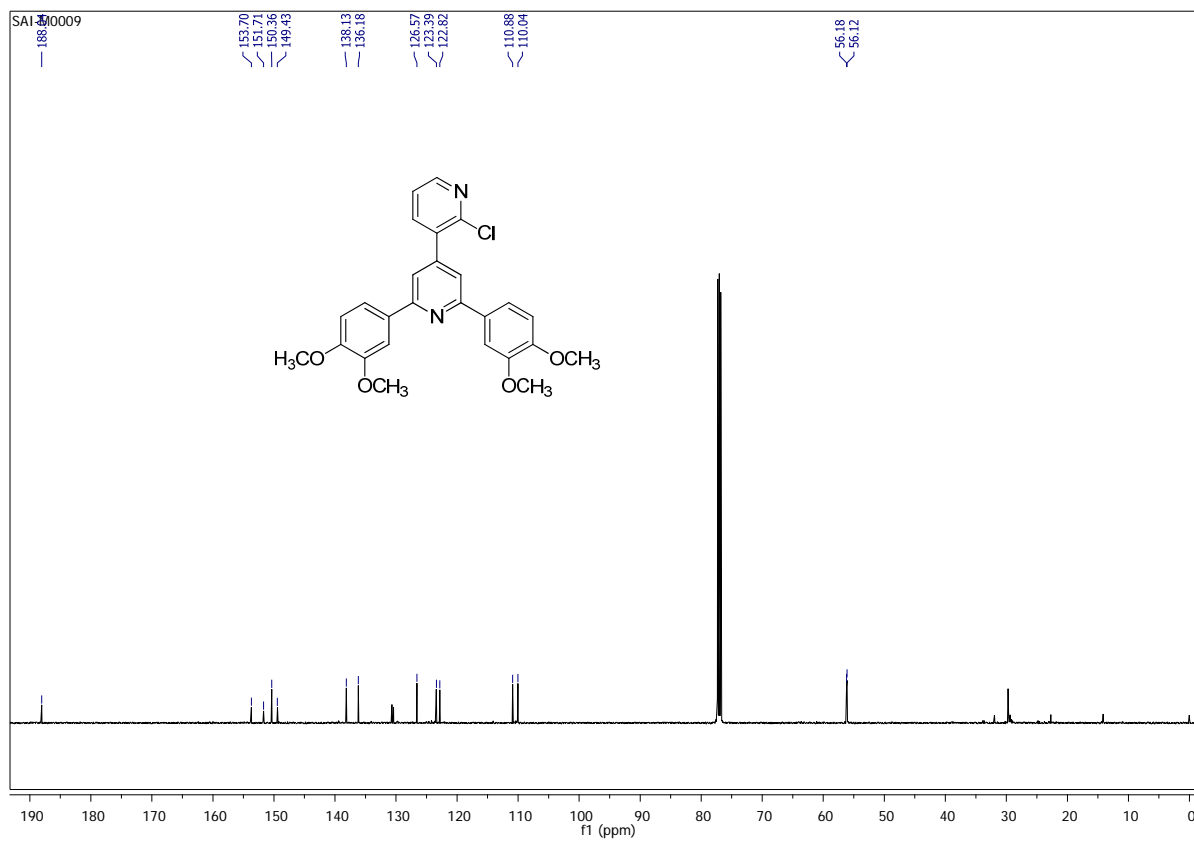
¹³C NMR Spectrum of compound 3m



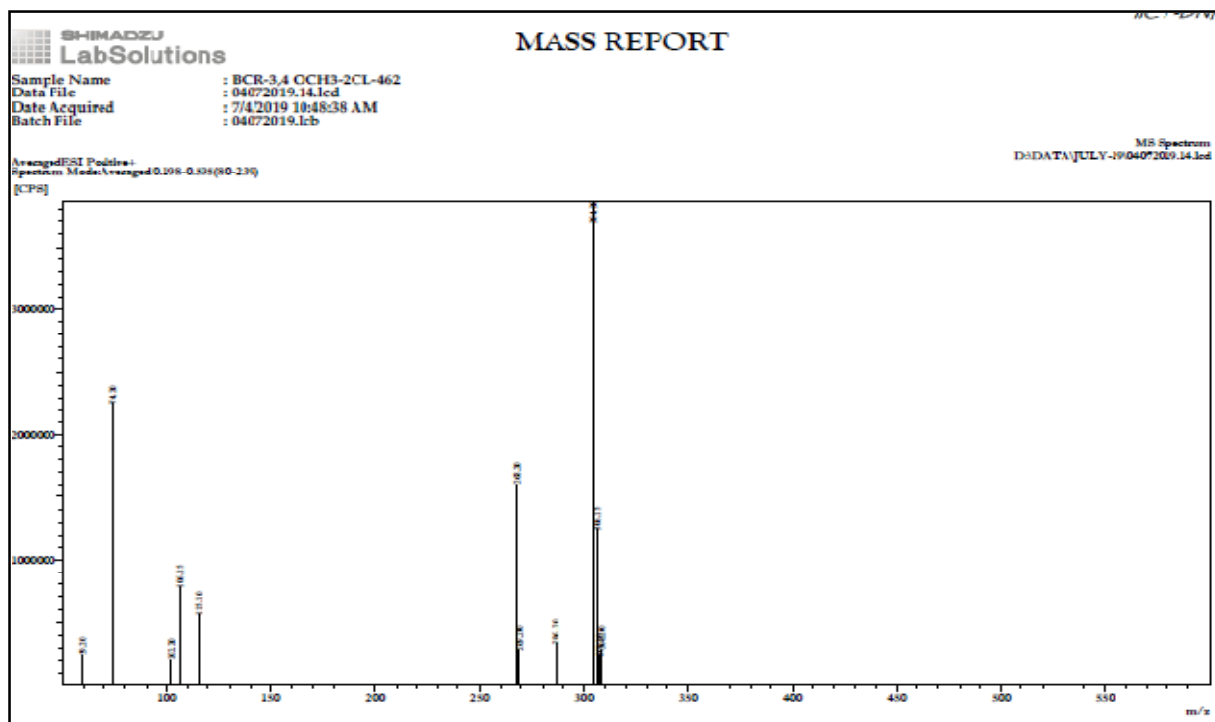
Mass Spectrum of compound 3m



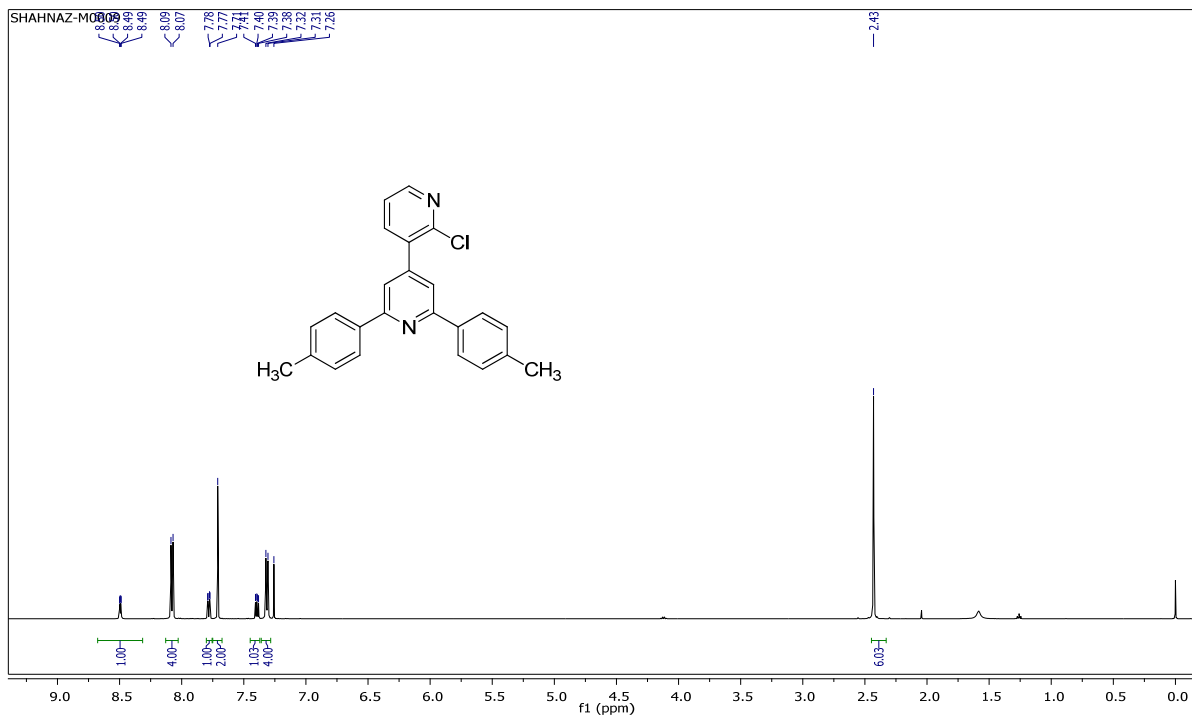
¹H-NMR Spectrum of Compound 3n



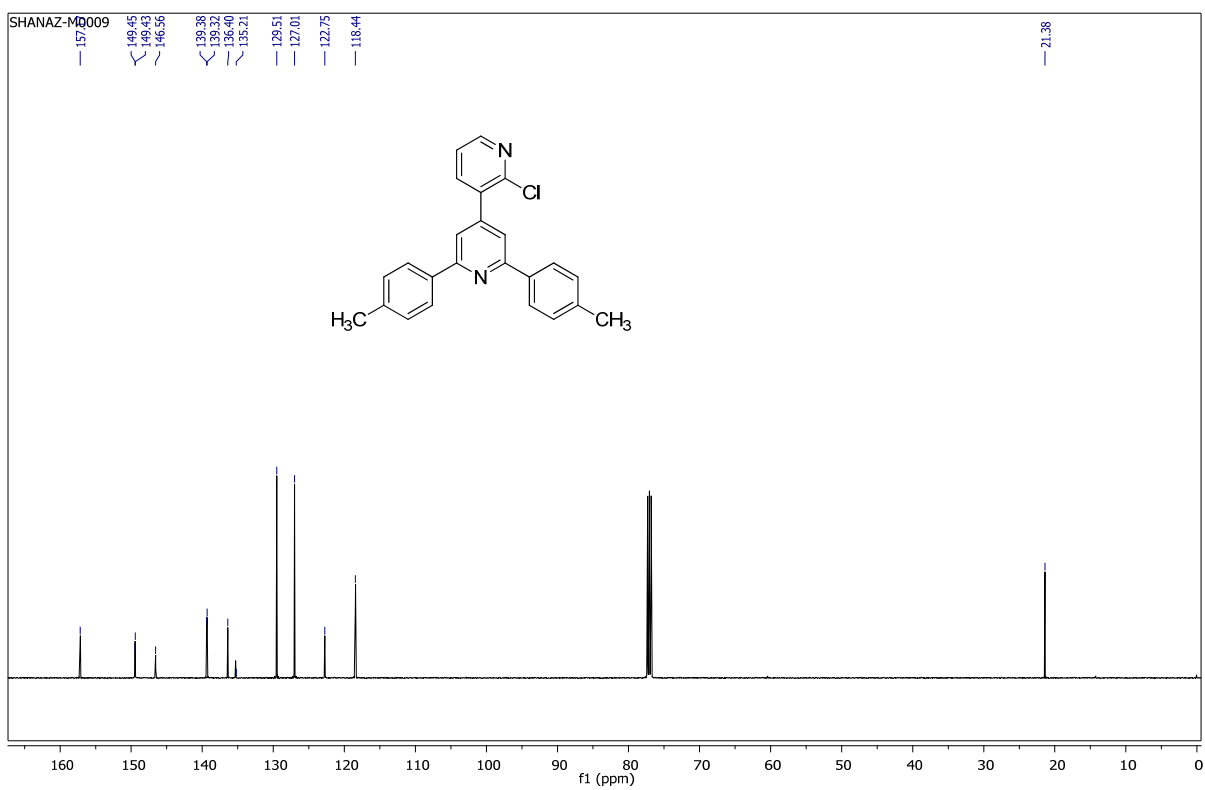
¹³C NMR Spectrum of compound 3n



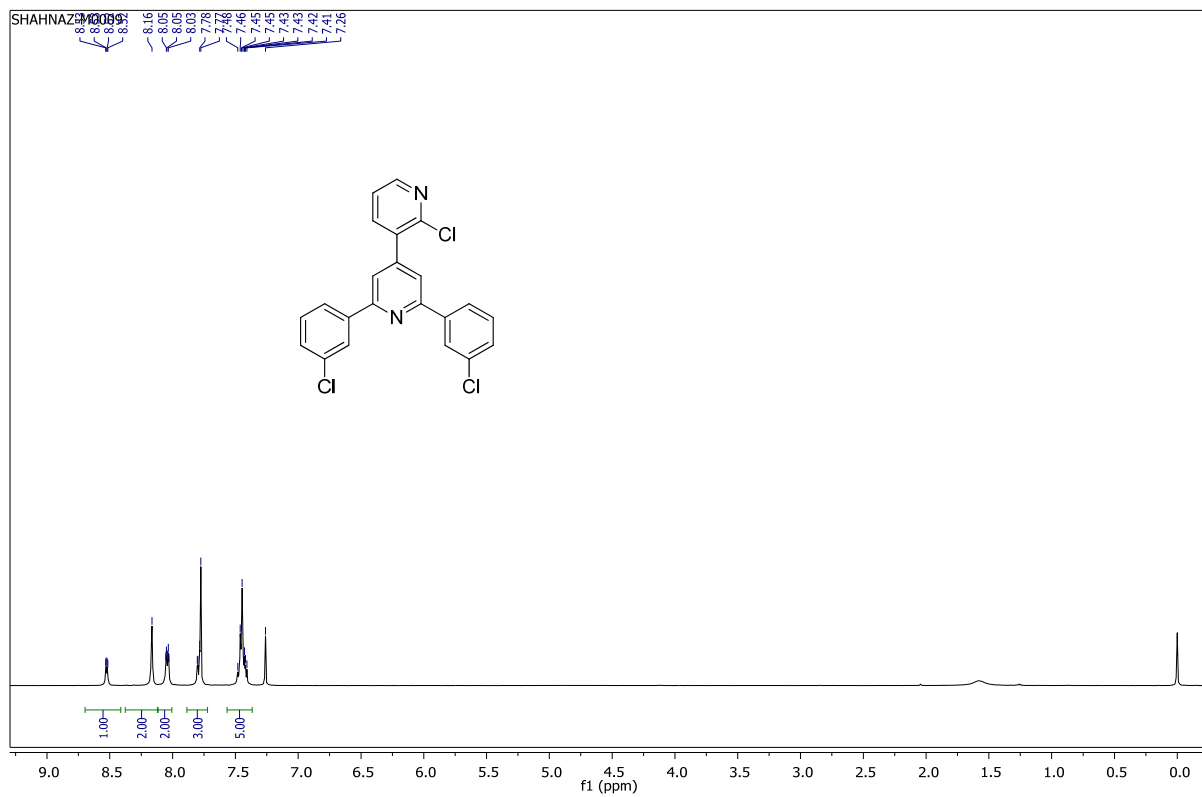
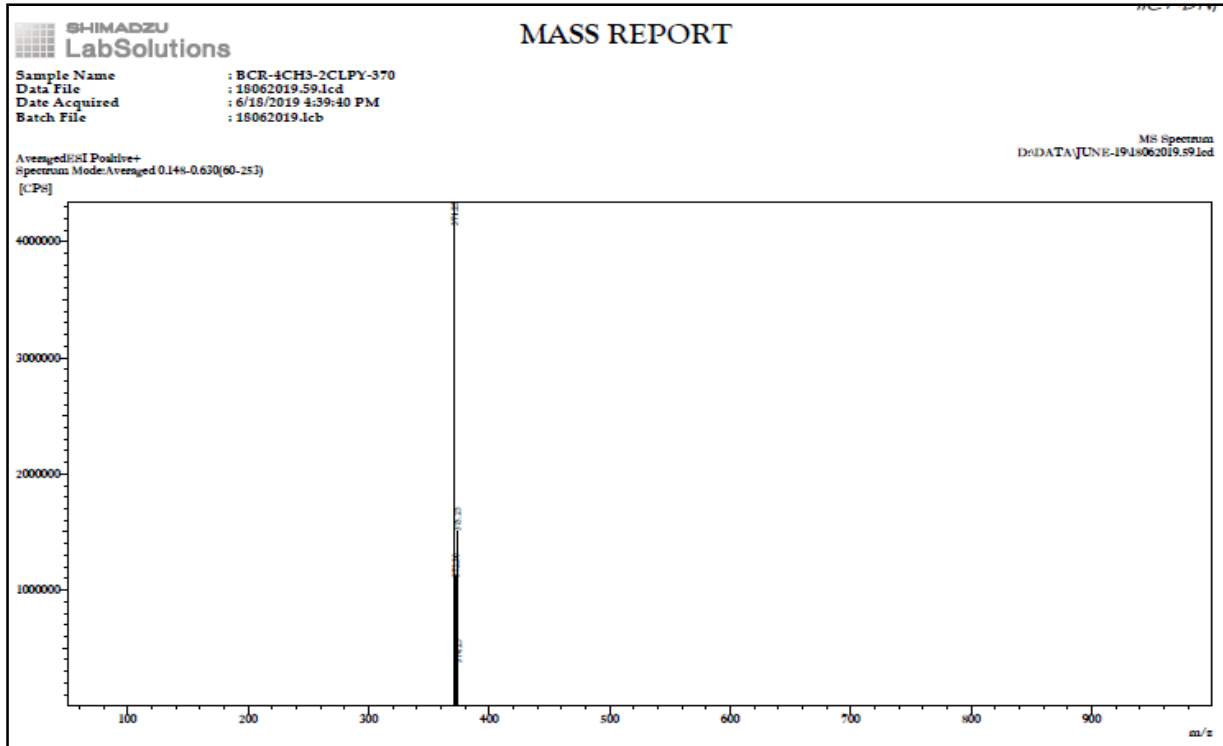
Mass Spectrum of compound 3n

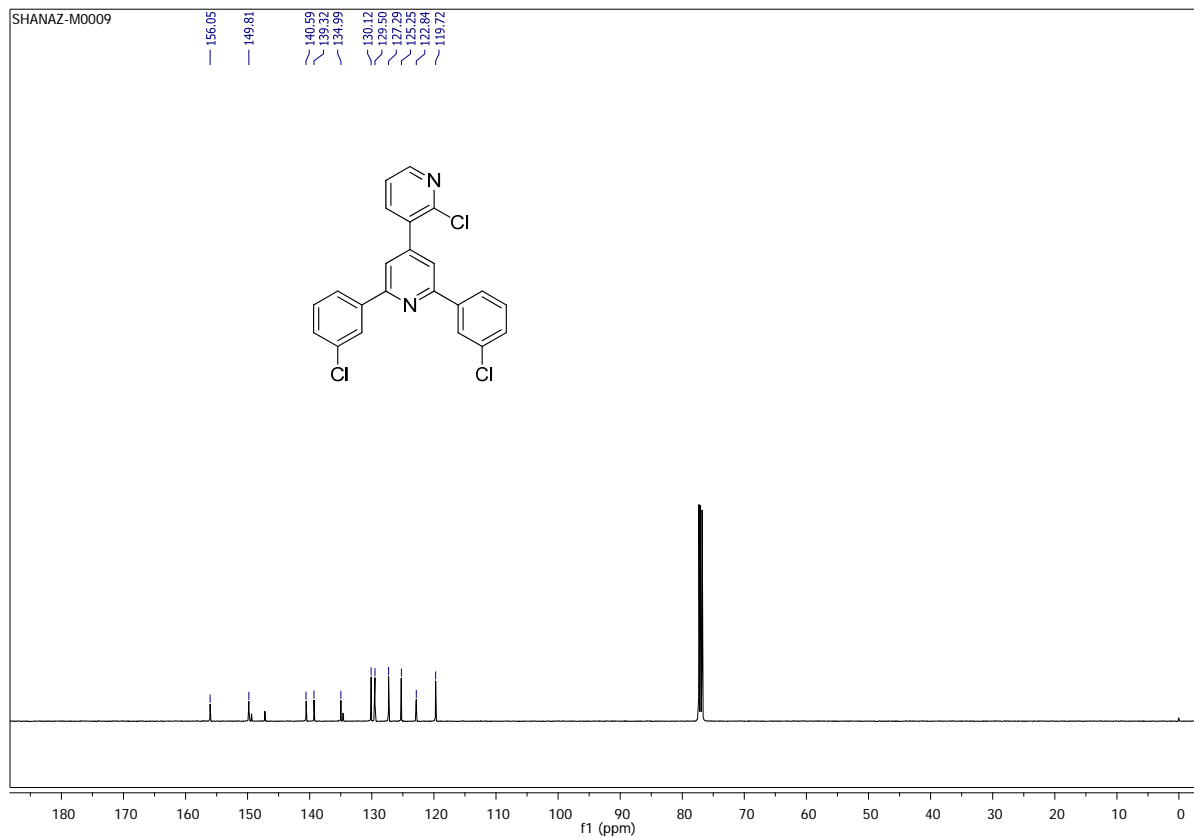


¹H-NMR Spectrum of Compound 30

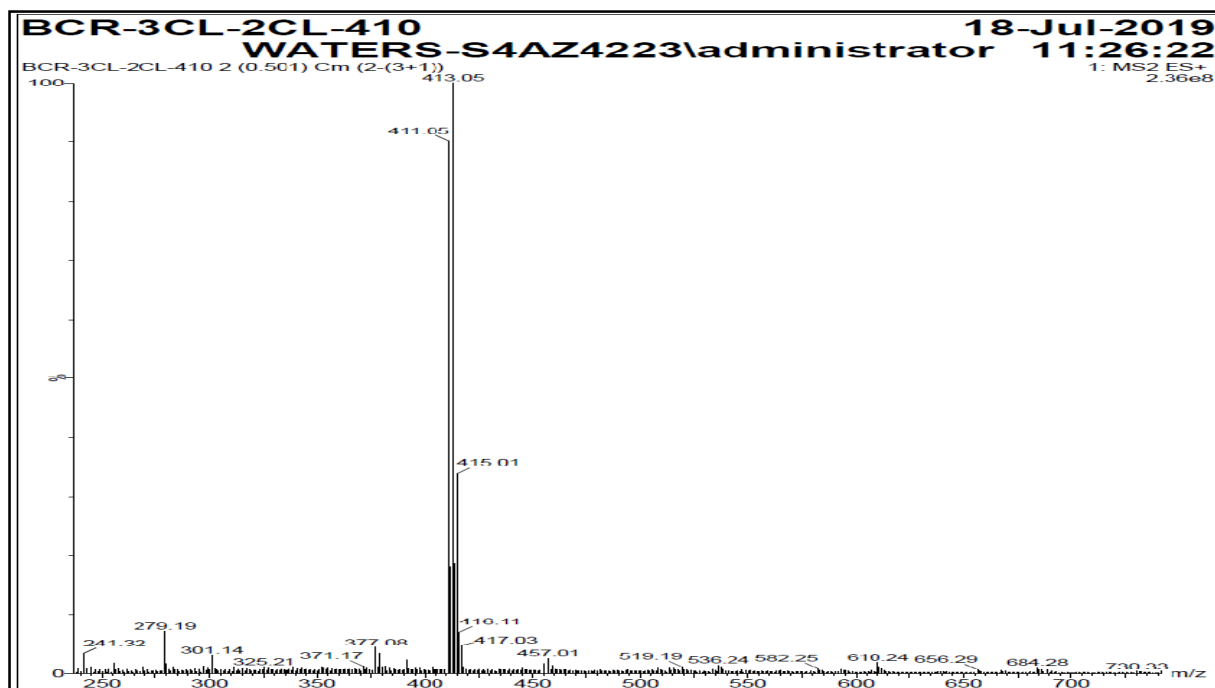


¹³C NMR Spectrum of compound 30

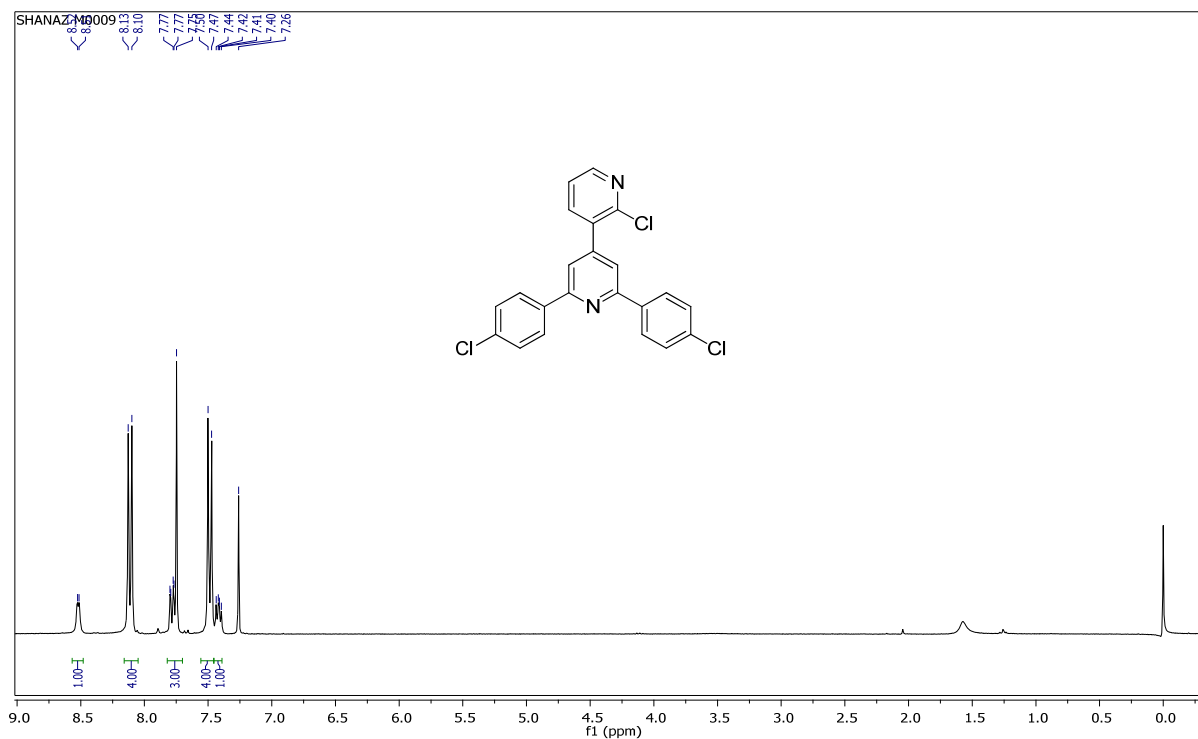




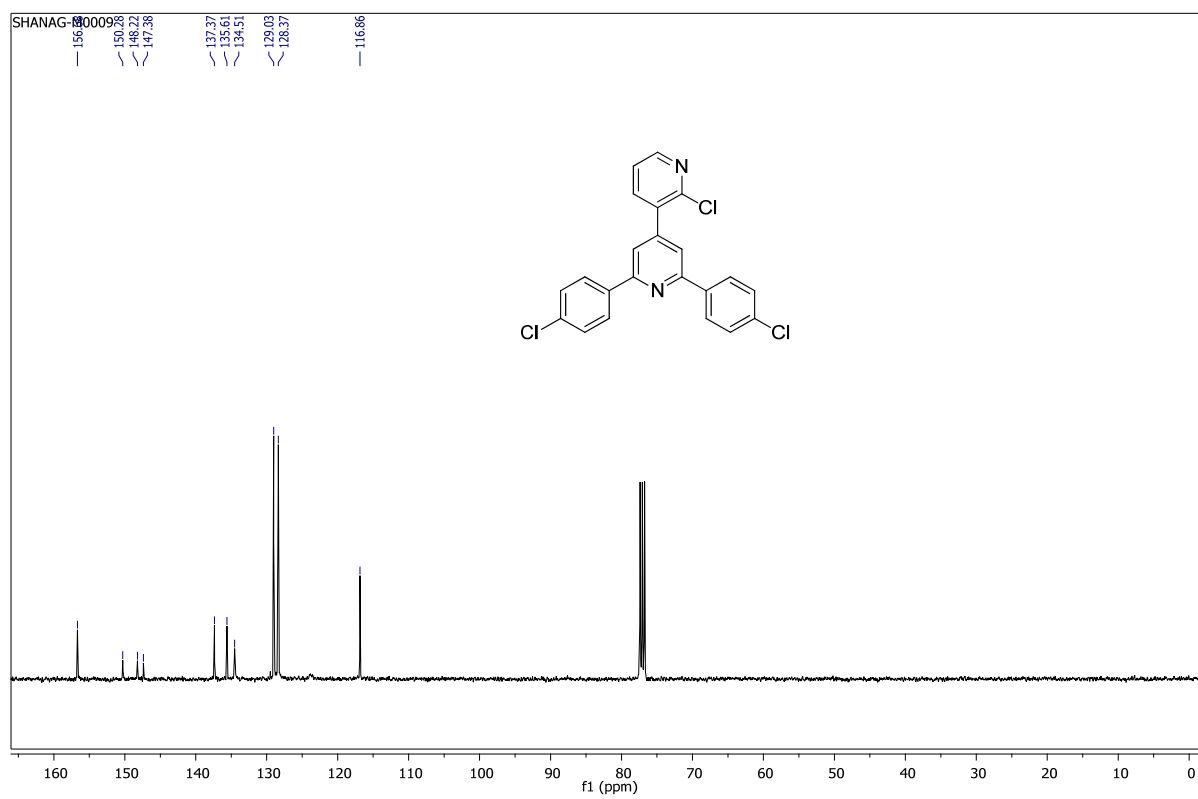
^{13}C NMR Spectrum of compound 3p



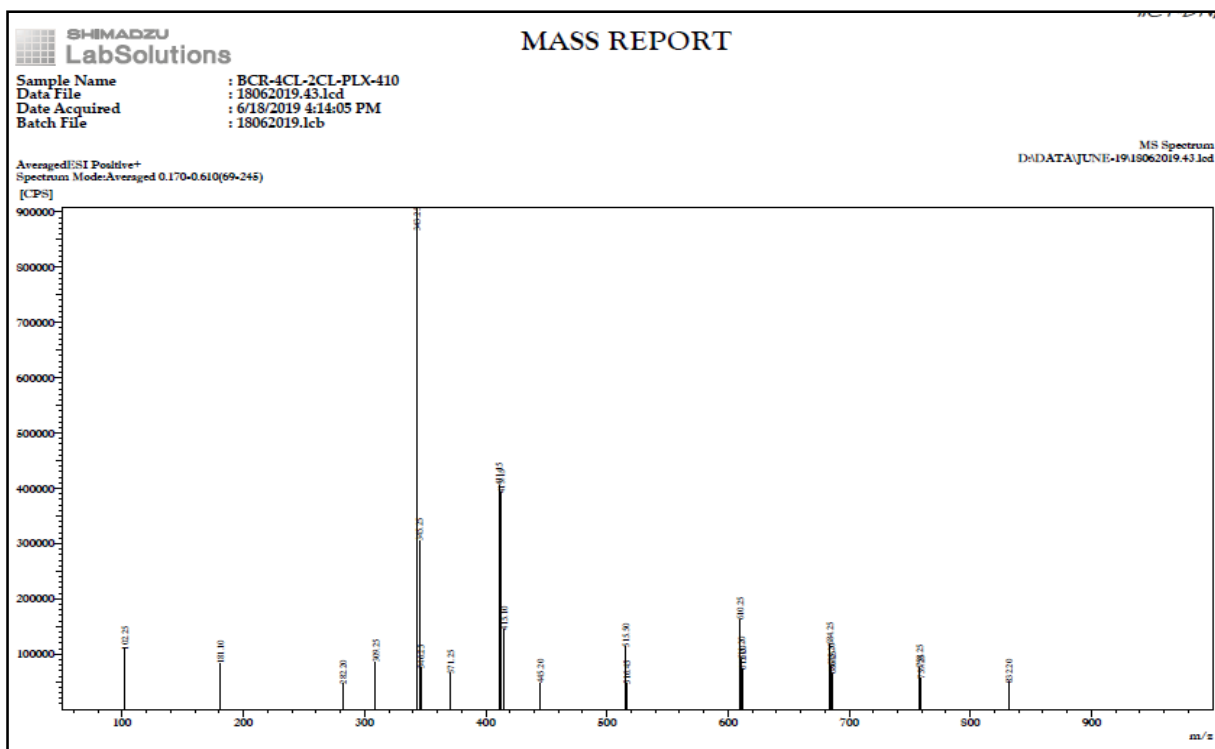
Mass Spectrum of compound 3p



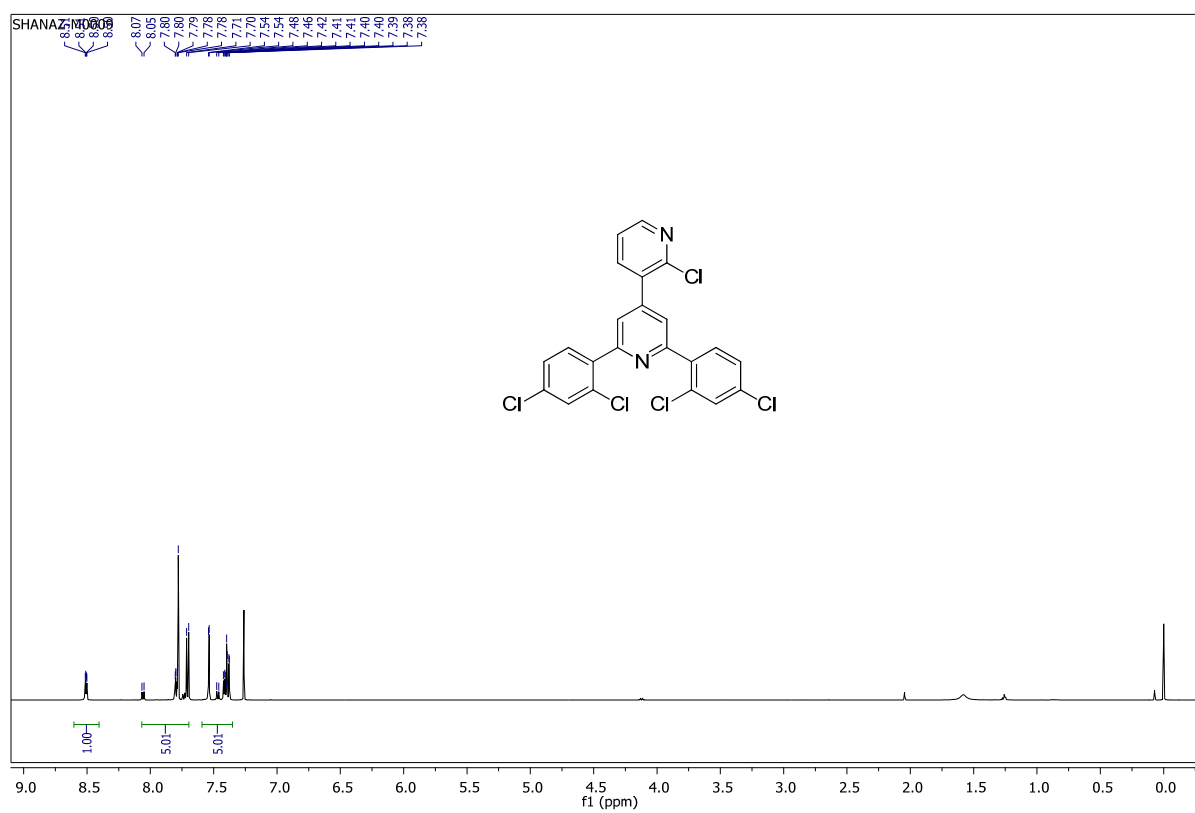
¹H-NMR Spectrum of Compound 3q



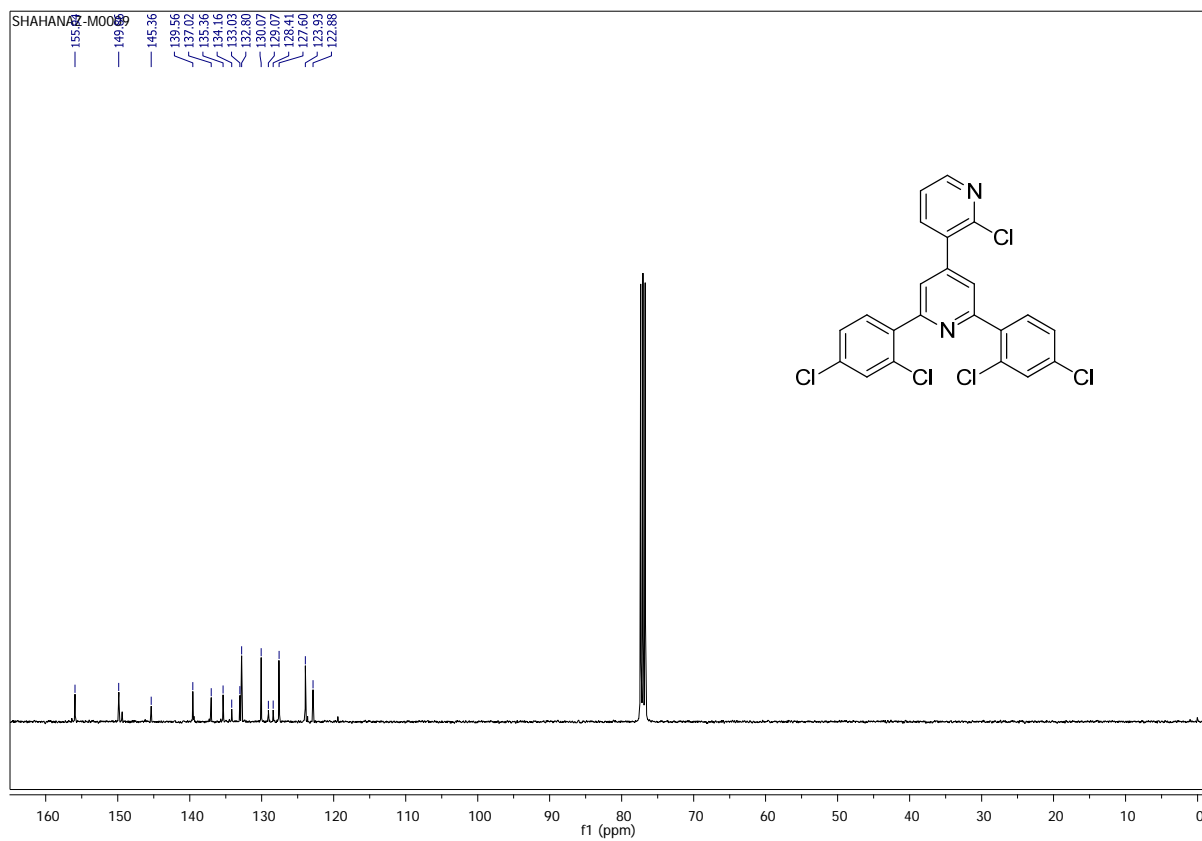
¹³C NMR Spectrum of compound 3q



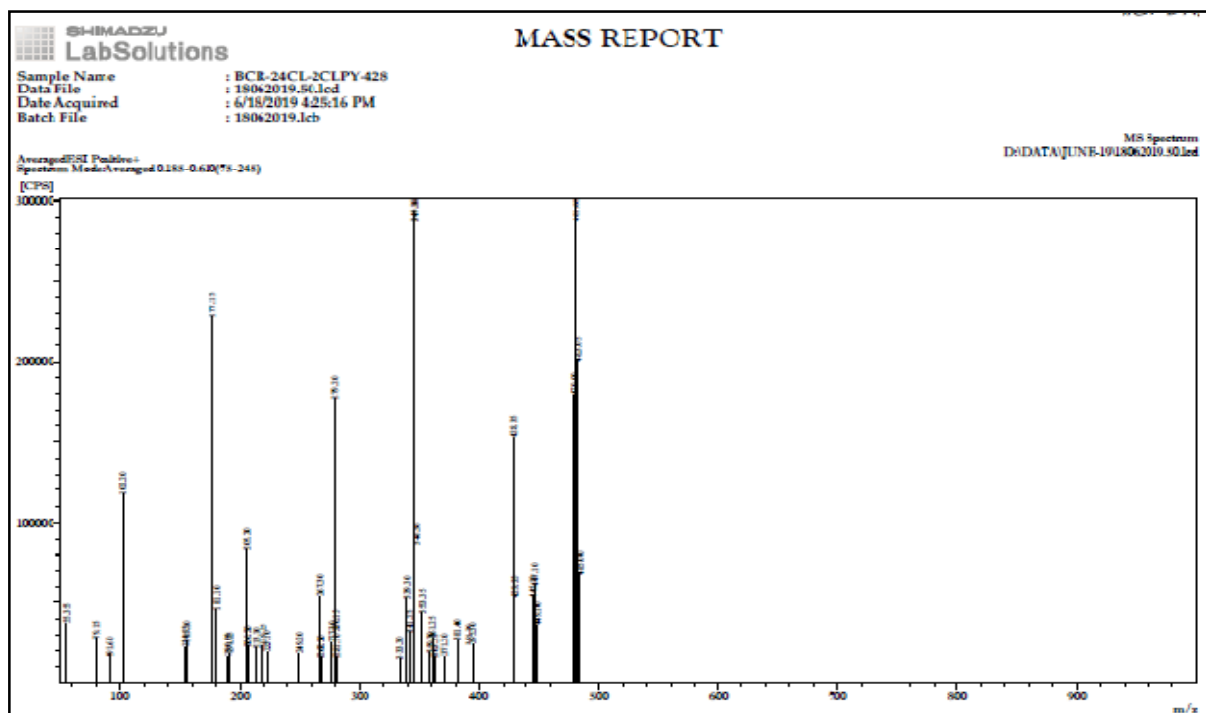
Mass Spectrum of compound 3q



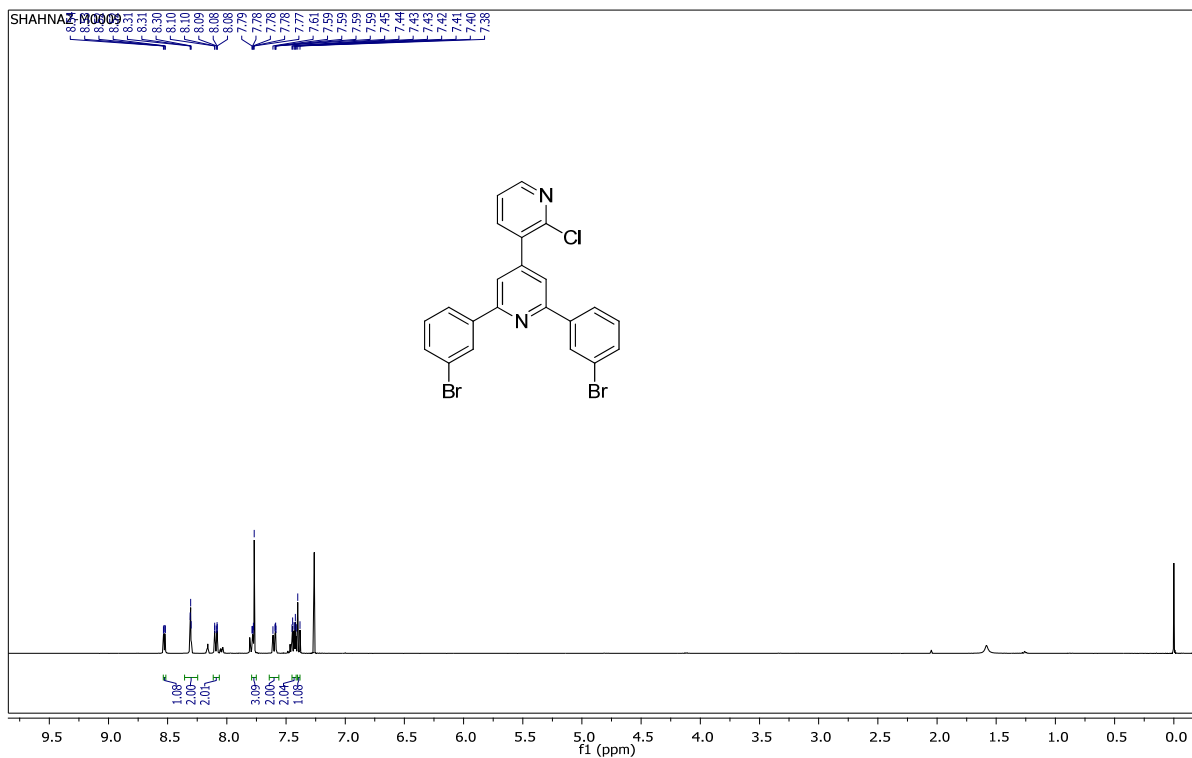
¹H-NMR Spectrum of Compound 3r



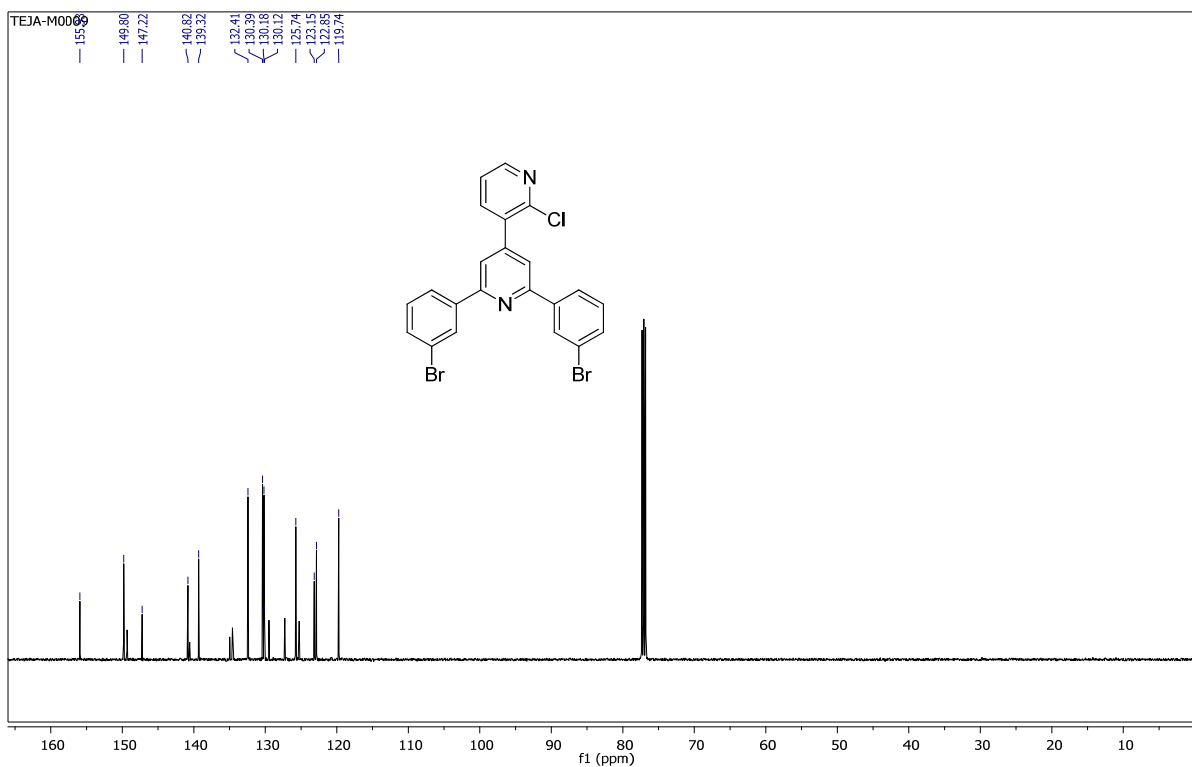
¹³C NMR Spectrum of compound 3r



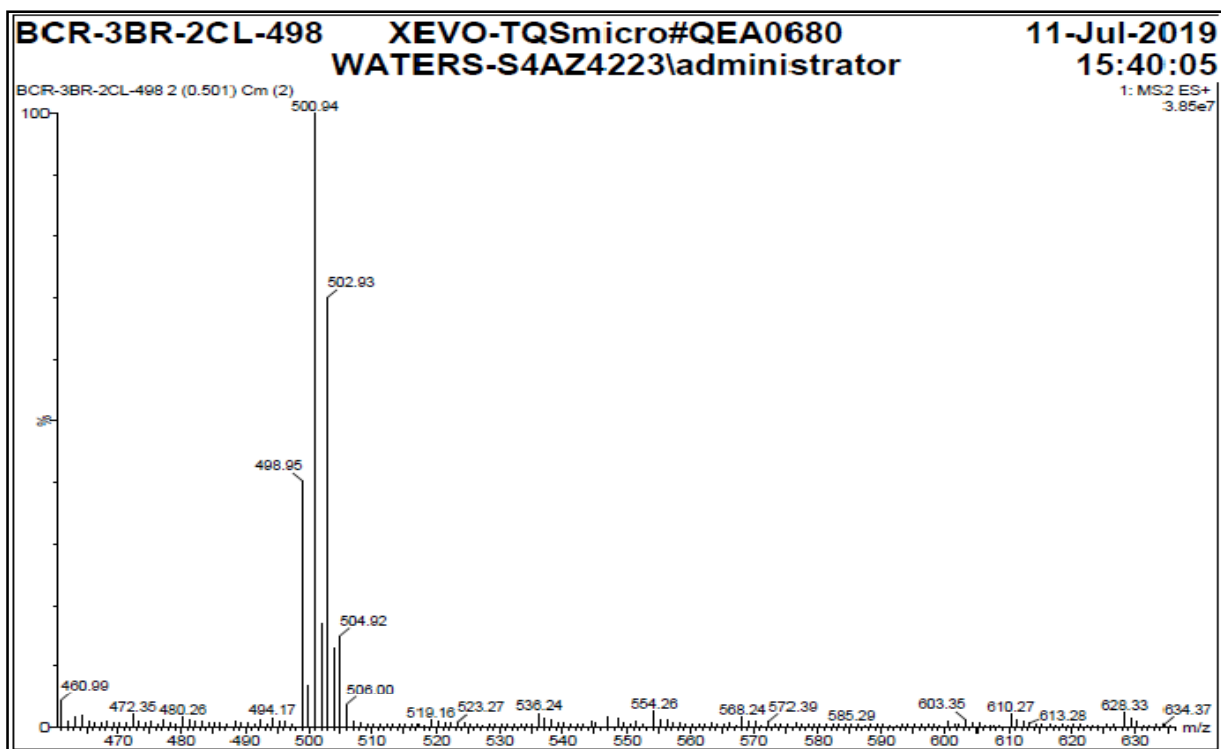
Mass Spectrum of compound 3r



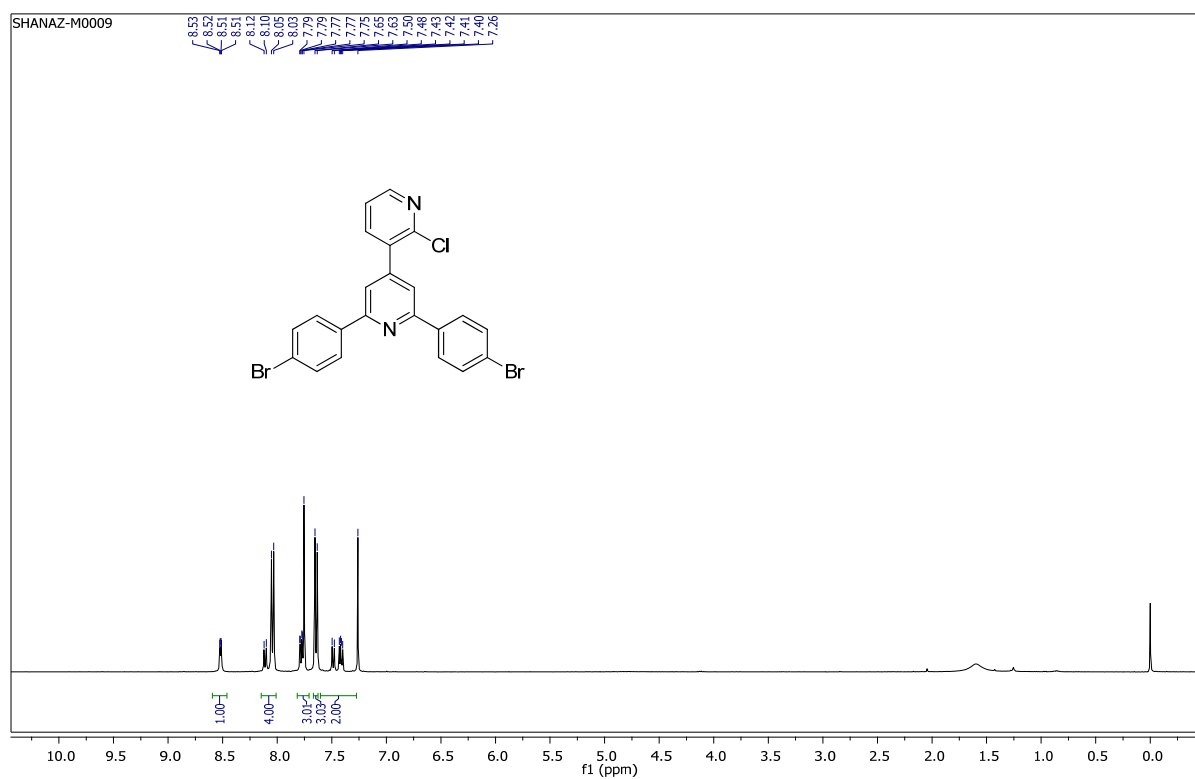
¹H-NMR Spectrum of Compound 3s



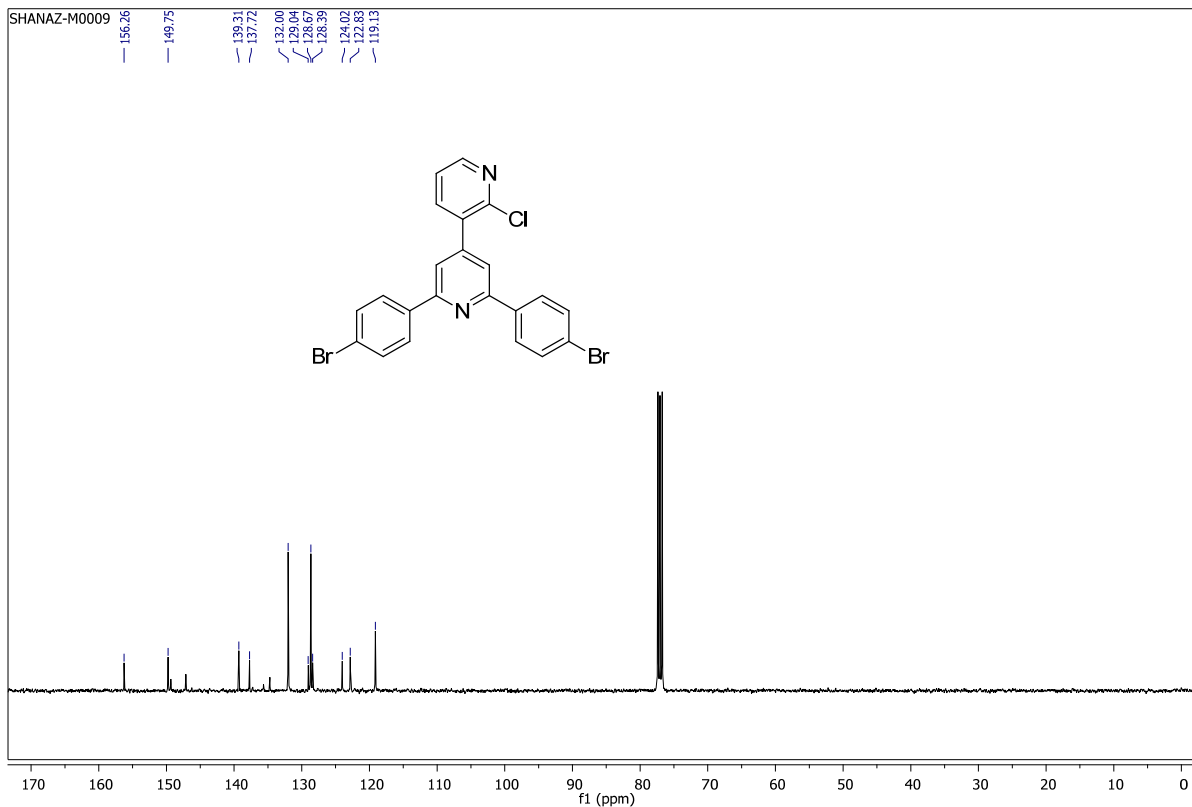
¹³C NMR Spectrum of compound 3s



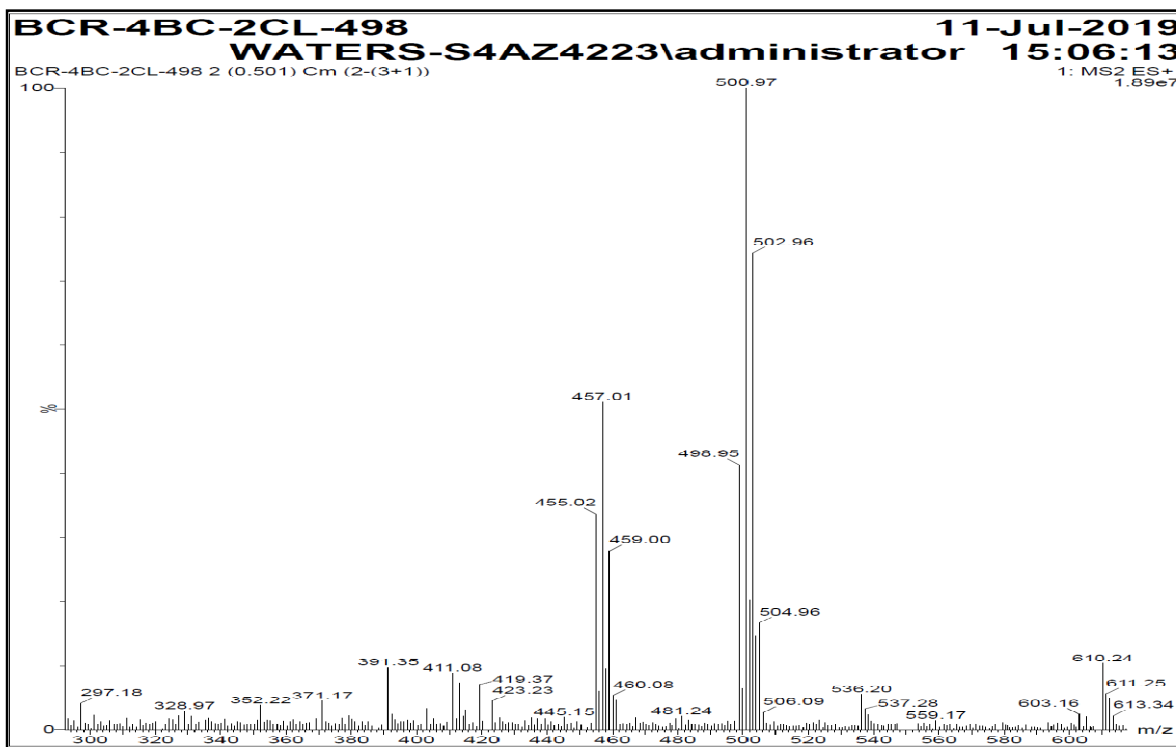
Mass Spectrum of compound 3s



¹H-NMR Spectrum of Compound 3t



¹³C NMR Spectrum of compound 3t



Mass Spectrum of compound 3t