Electronic Supplementary Material (ESI) for New Journal of Chemistry.

Supplementary data

Synthesis, characterization and first application of covalently immobilized nickel-porphyrin on graphene oxide for Suzuki cross coupling reaction

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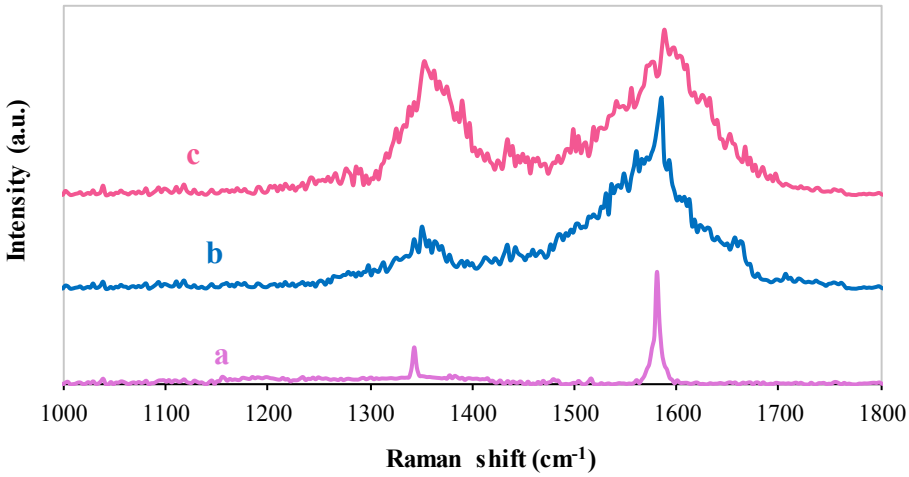


Fig. S1. Raman spectra of the (a) graphite, (b) GO and (c) GO/NiTAPP

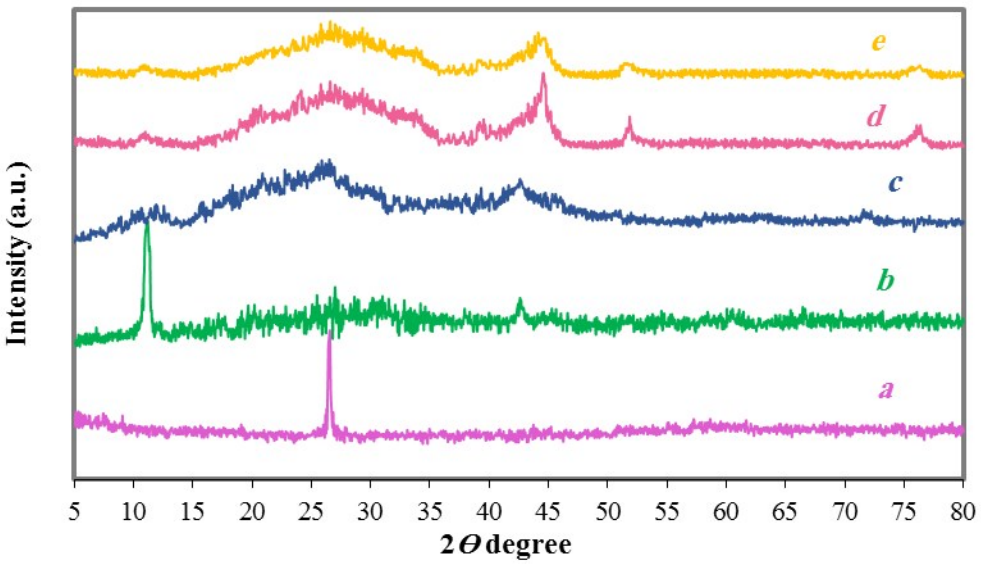


Fig. S2. XRD patterns of (a) graphite, (b) GO, (c) GO/TAPP, (d) GO/NiTAPP, (e) reused catalyst

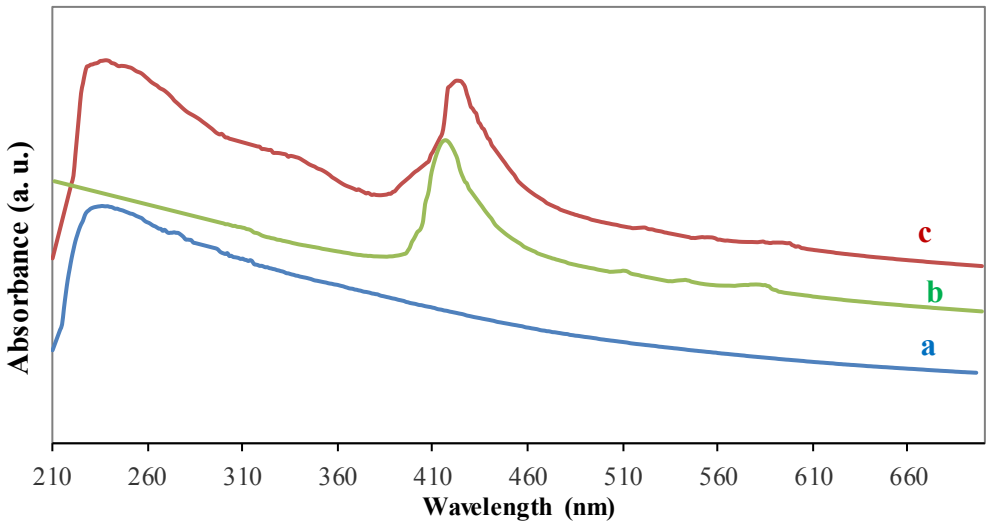
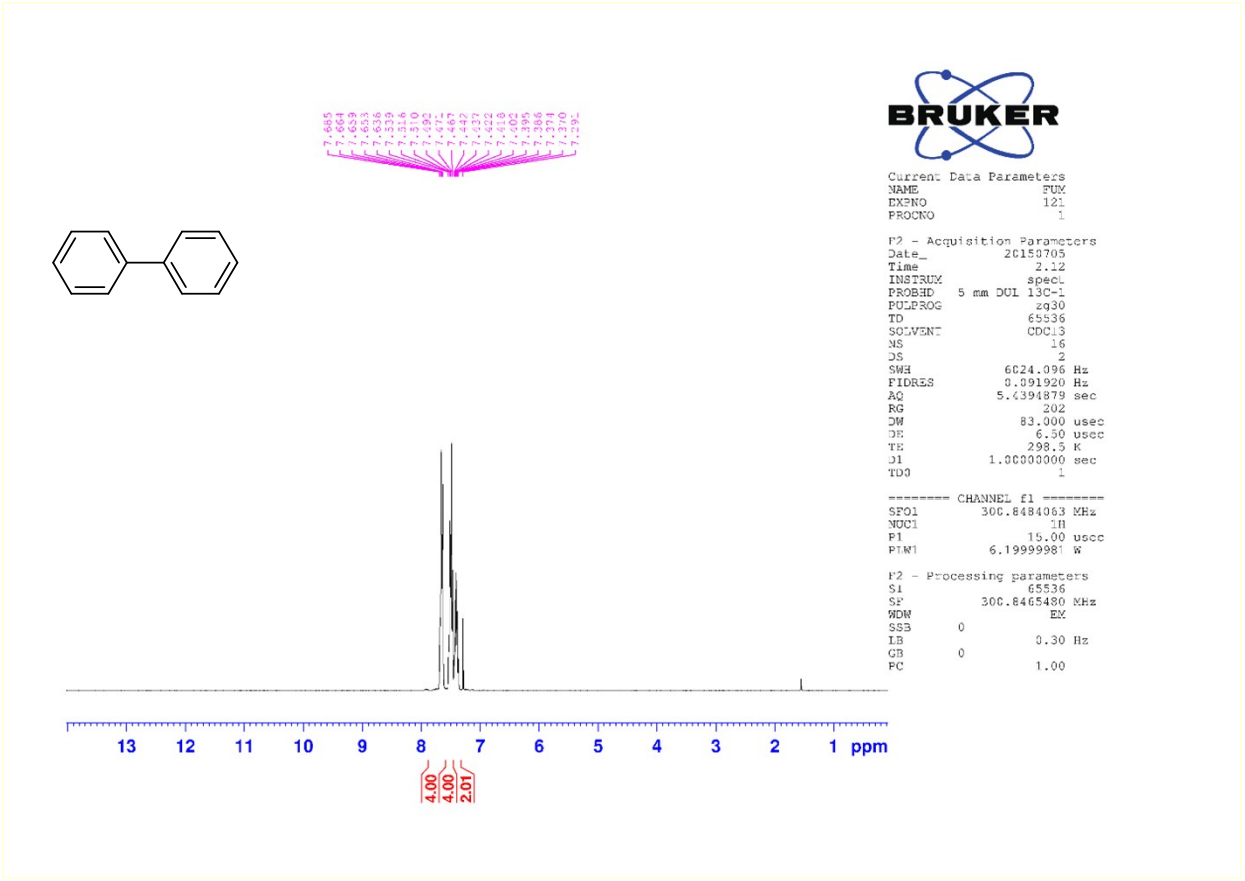
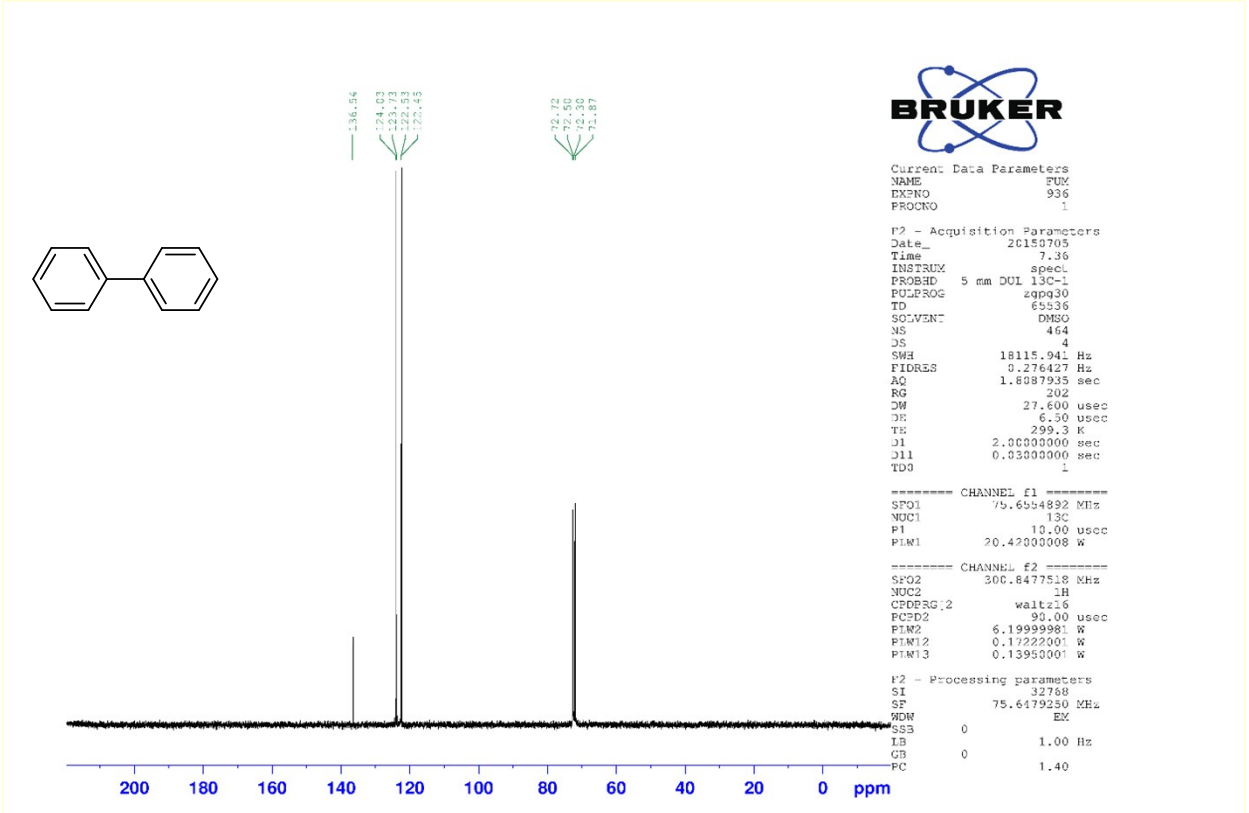


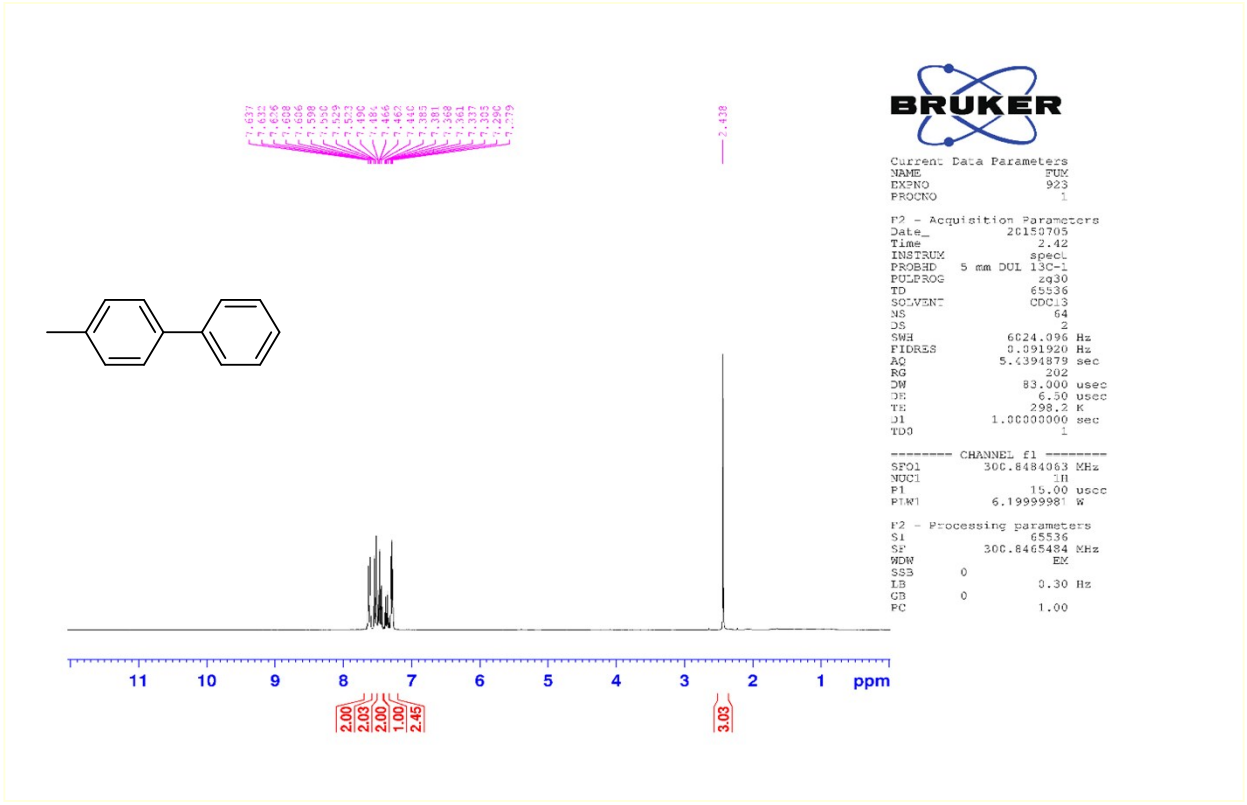
Fig. S3. UV-vis absorption of (a) GO, (b) TAPP, (c) GO/NiTAPP

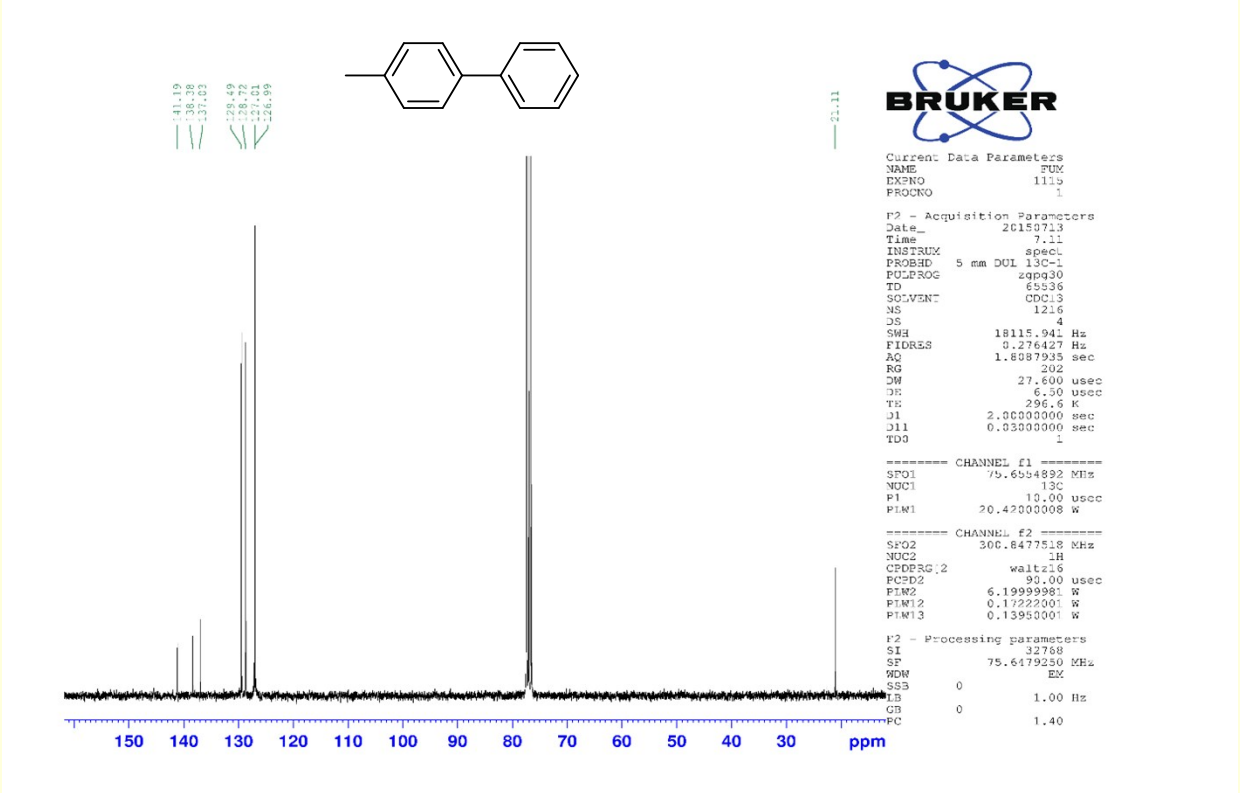
1,1'-Biphenyl (3a): White solid; mp: 70-72°C [1]; ^{1}H-NMR ($CDCl_3$, 300 MHz): δ = 7.37-7.40 (m, 2H), 7.43-7.53 (m, 4H), 7.63-7.68 (m, 4H); ^{13}C-NMR ($CDCl_3$, 75 MHz): δ = 122.45, 123.73, 124.03, 136.54.



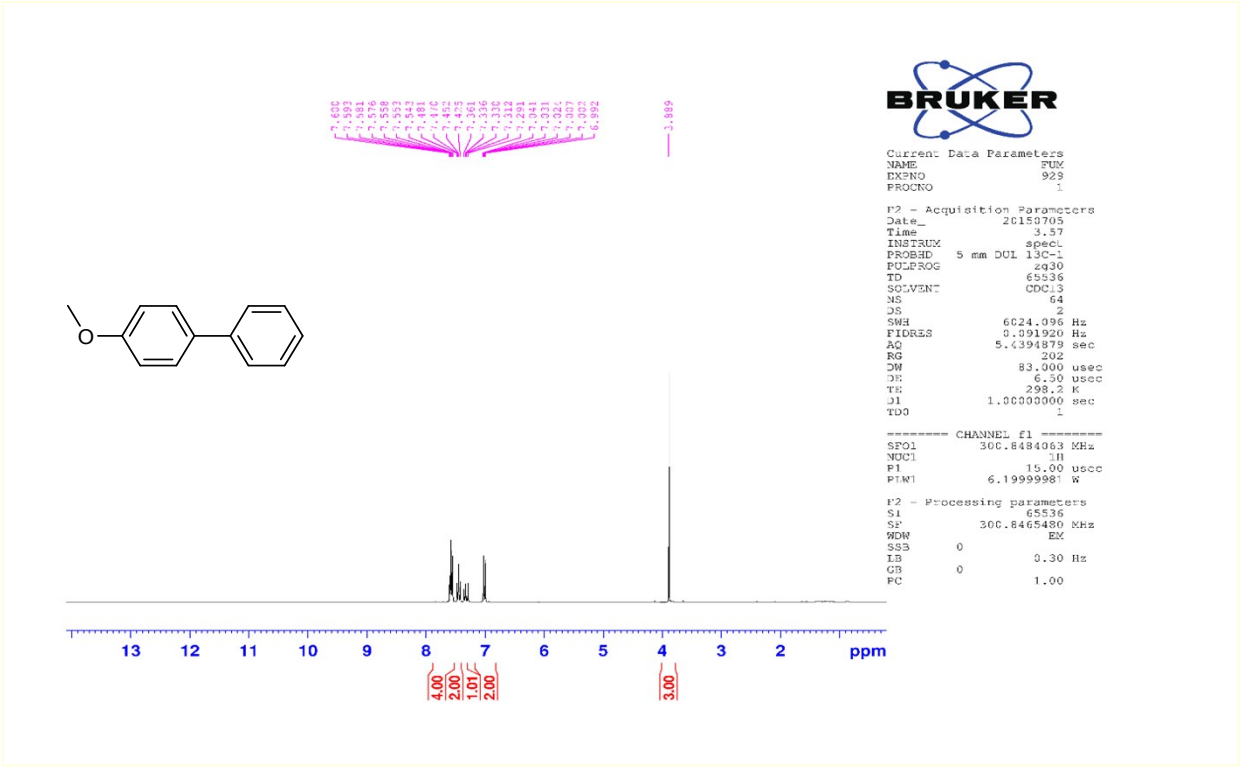


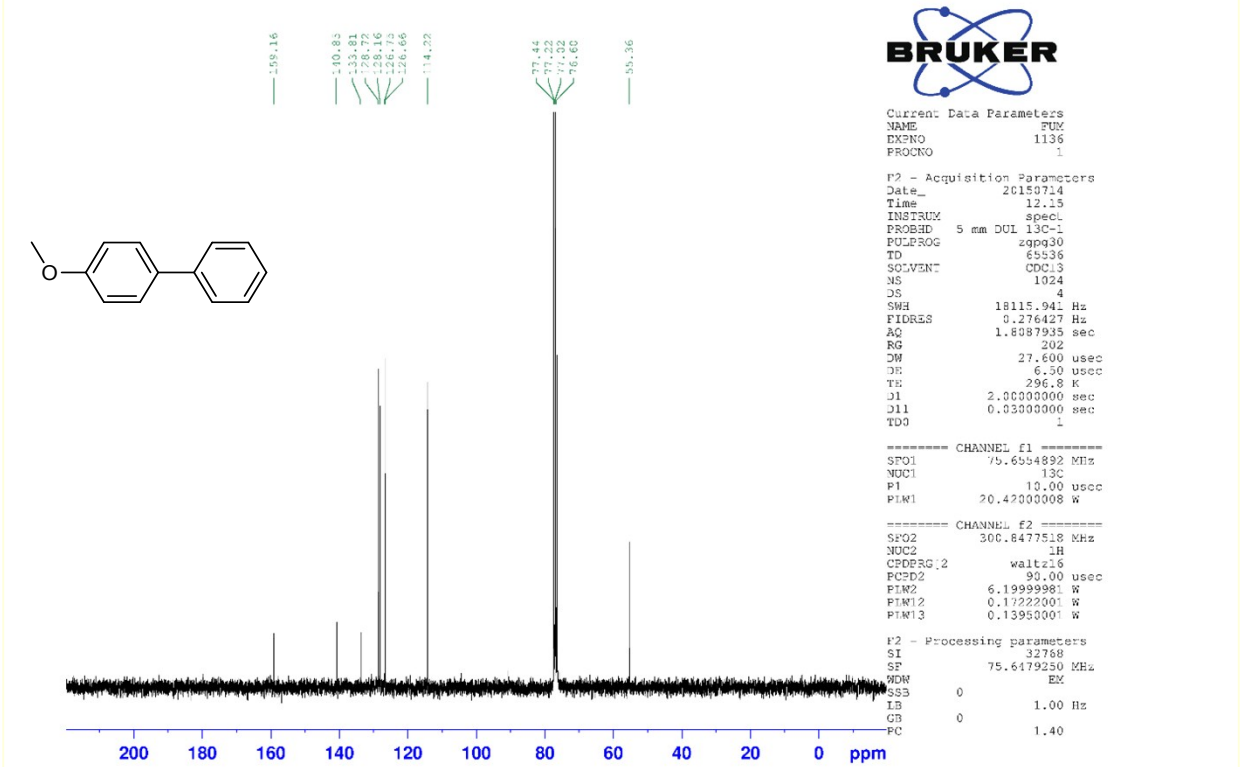
4-Methyl-1,1'-biphenyl (3b): White solid; mp: 45-47°C [2]; ^{1}H-NMR ($CDCl_3$, 300 MHz): δ = 2.43 (s, 3H), 7.27-7.63 (m, 9H); ^{13}C-NMR ($CDCl_3$, 75 MHz): δ = 21.11, 126.99, 128.72, 129.49, 137.03, 138.38, 141.19.



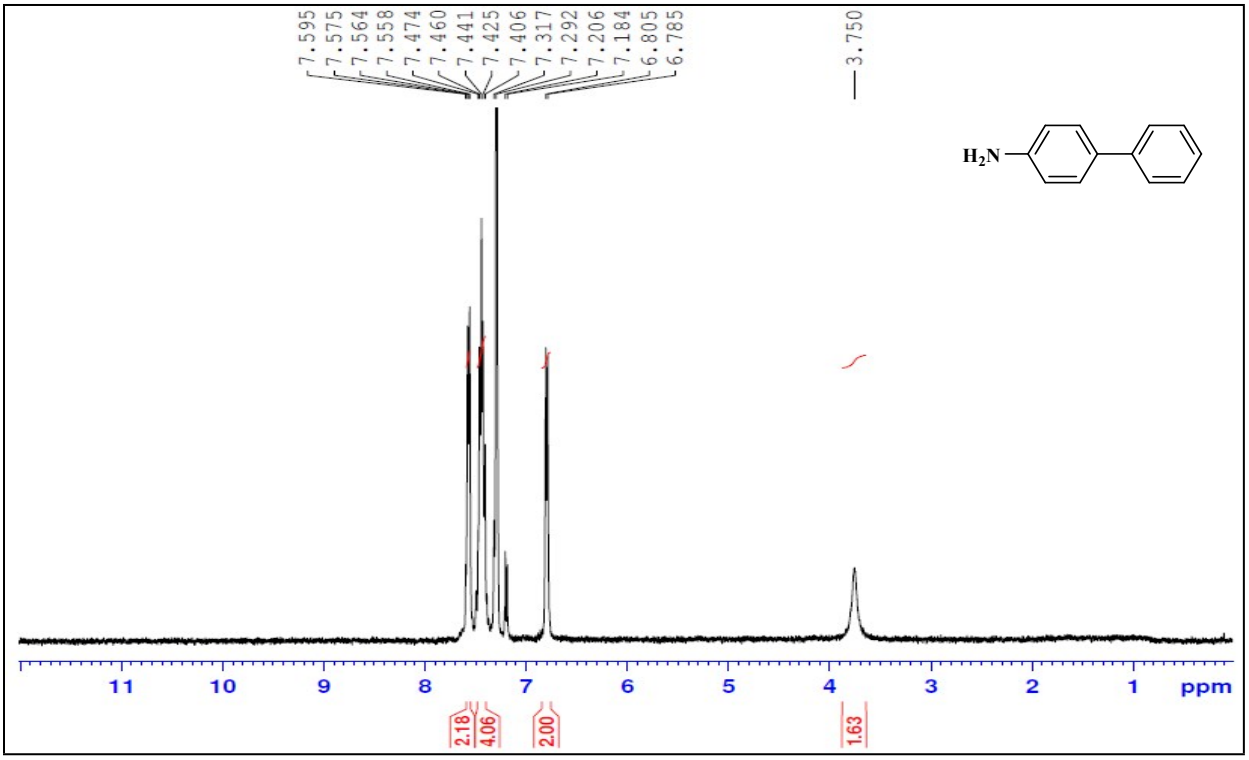


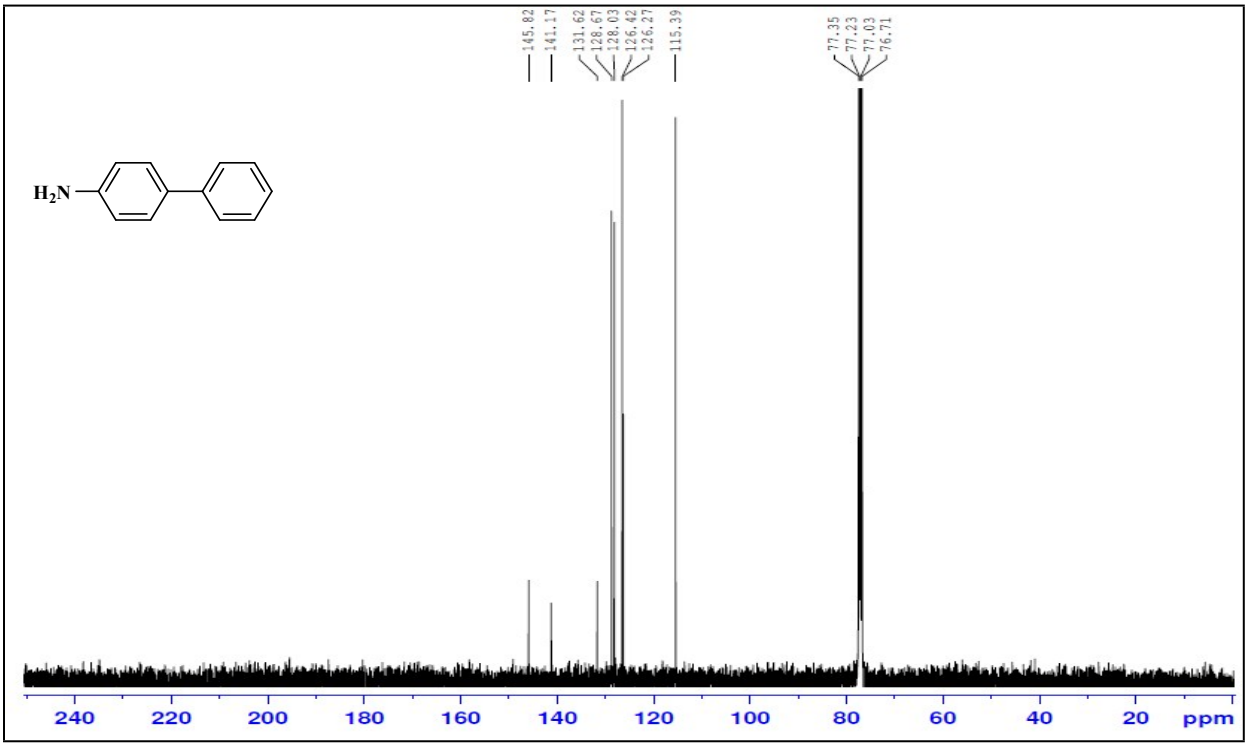
4-Methoxy-1,1'-biphenyl (3c): White solid; mp: 92-94°C [3]; ^{1}H-NMR ($CDCl_3$, 300 MHz): δ = 3.88 (s, 3H), 7.01 (d, J= 8.7 Hz, 2H), 7.29-7.36 (m, 1H), 7.46 (d, J= 8.7 Hz, 2H), 7.54-7.60 (m, 4H); ^{13}C-NMR ($CDCl_3$, 75 MHz): δ = 55.36, 114.22, 126.66, 126.75, 128.16, 128.72, 133.81, 140.85, 159.16.



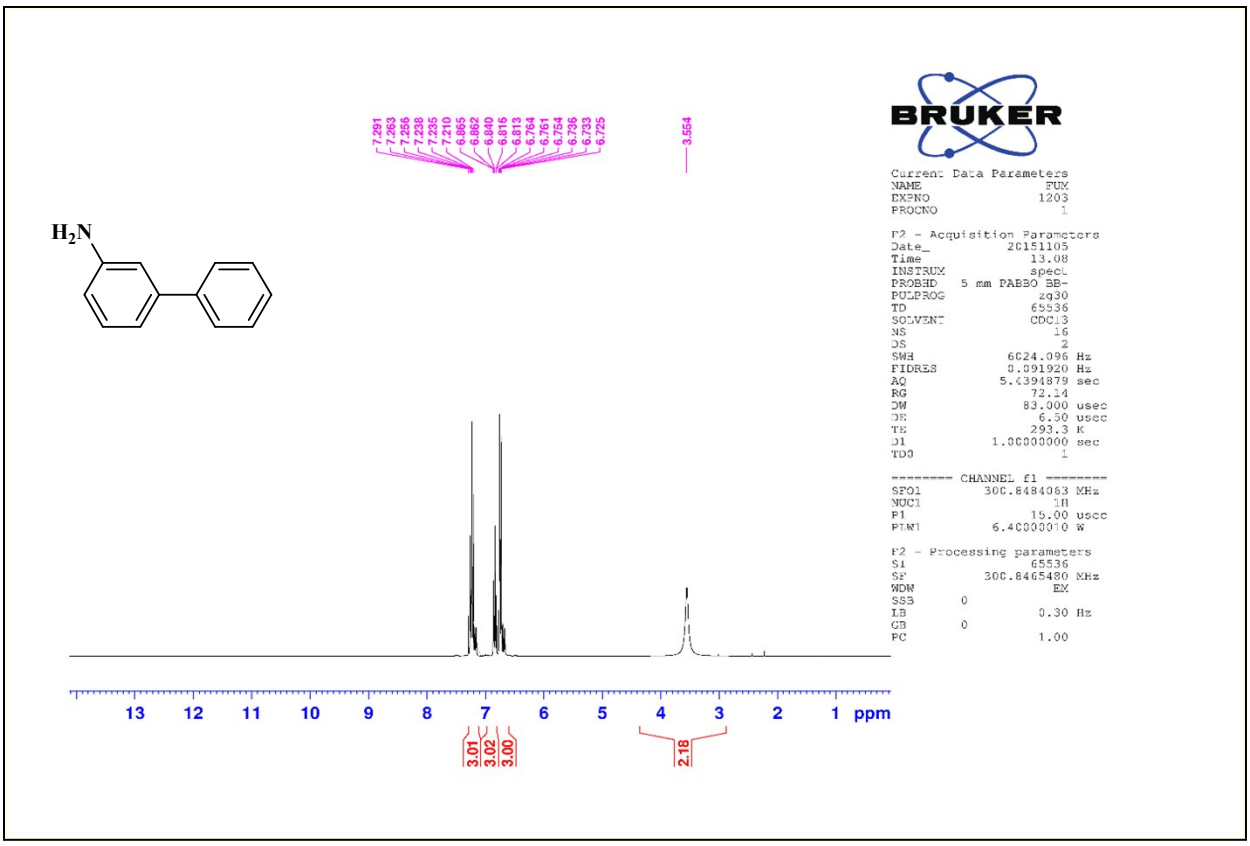


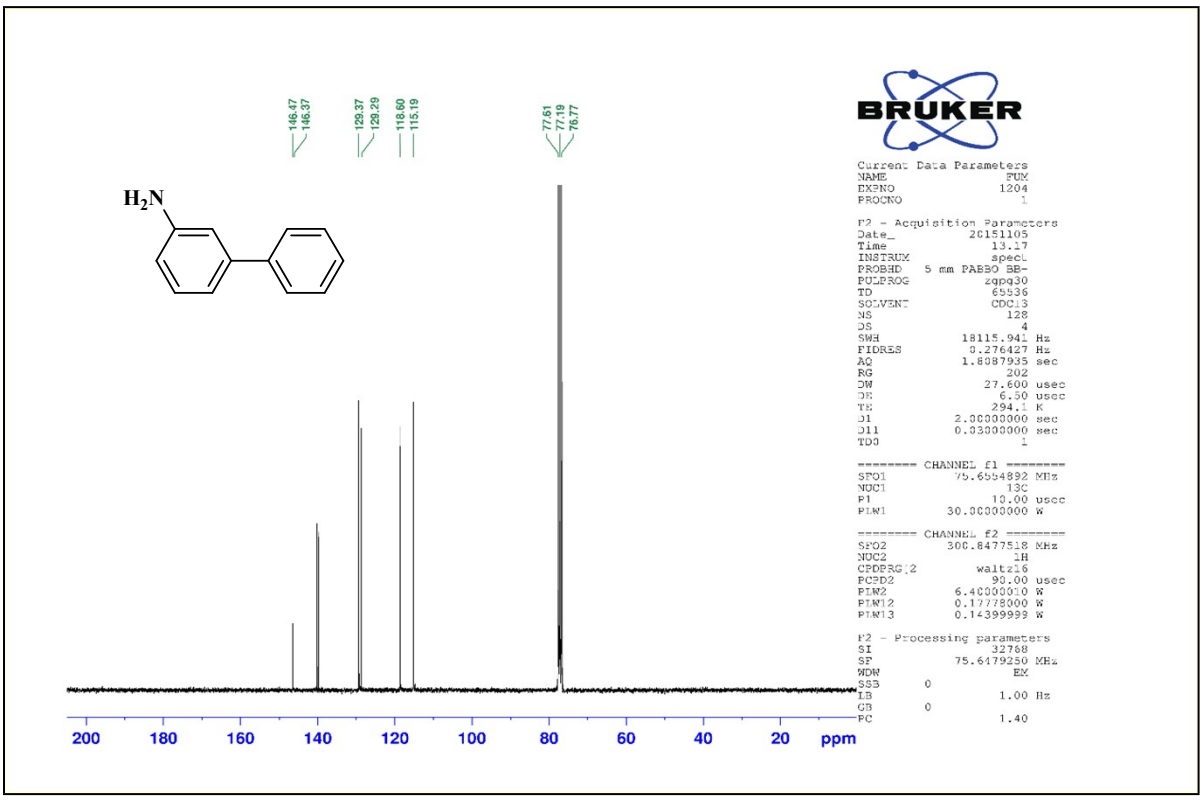
[1,1'-Biphenyl]-4-amine (3d): Yellow solid; mp: 54-56°C [3]; ^{1}H-NMR ($CDCl_3$, 300 MHz): δ = 3.75 (br, 2H), 6.80 (d, J =6.0 Hz, 2H), 7.20 (d, J =6.6 Hz, 1H), 7.41-7.56 (m, 4H), 7.58 (t, J =6.0 Hz, 2H); ^{13}C-NMR ($CDCl_3$, 75 MHz): δ = 115.39, 126.27, 126.42, 128.03, 128.67, 131.62, 141.17, 145.82.



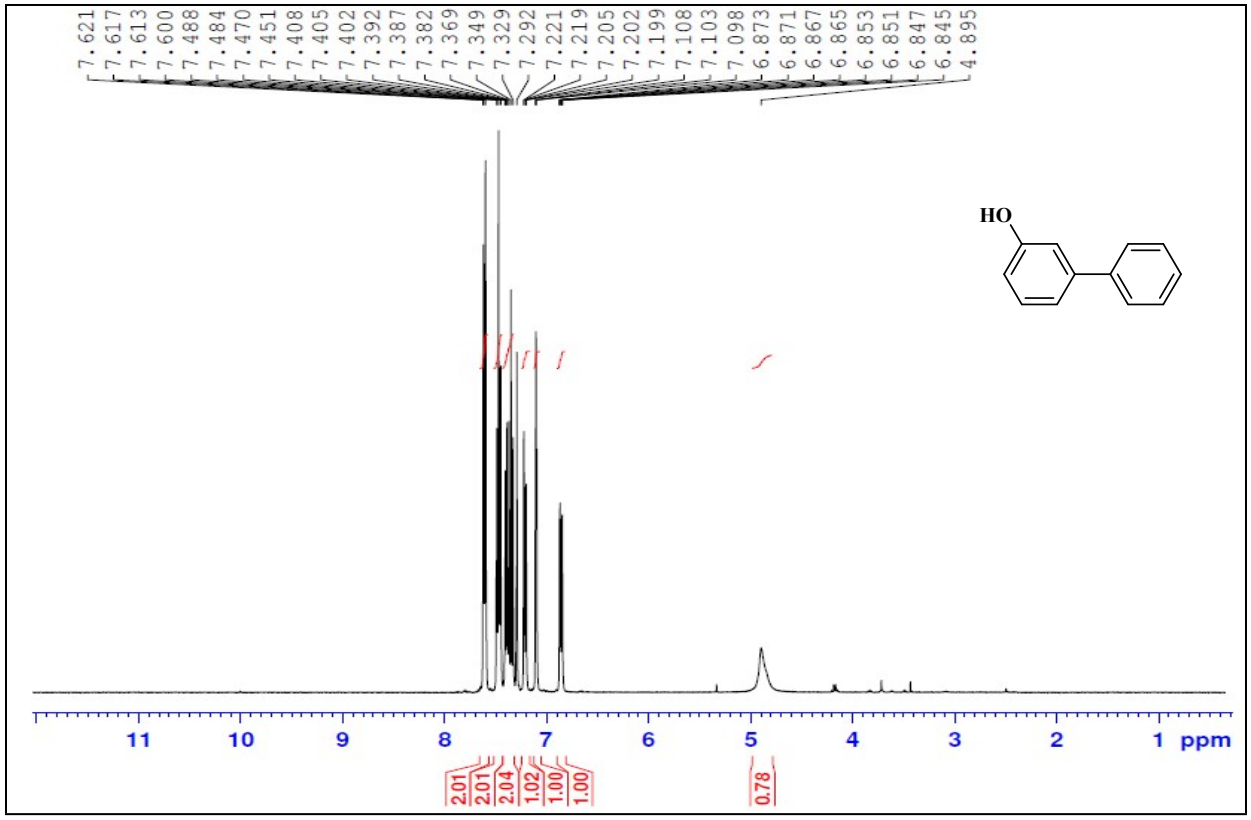


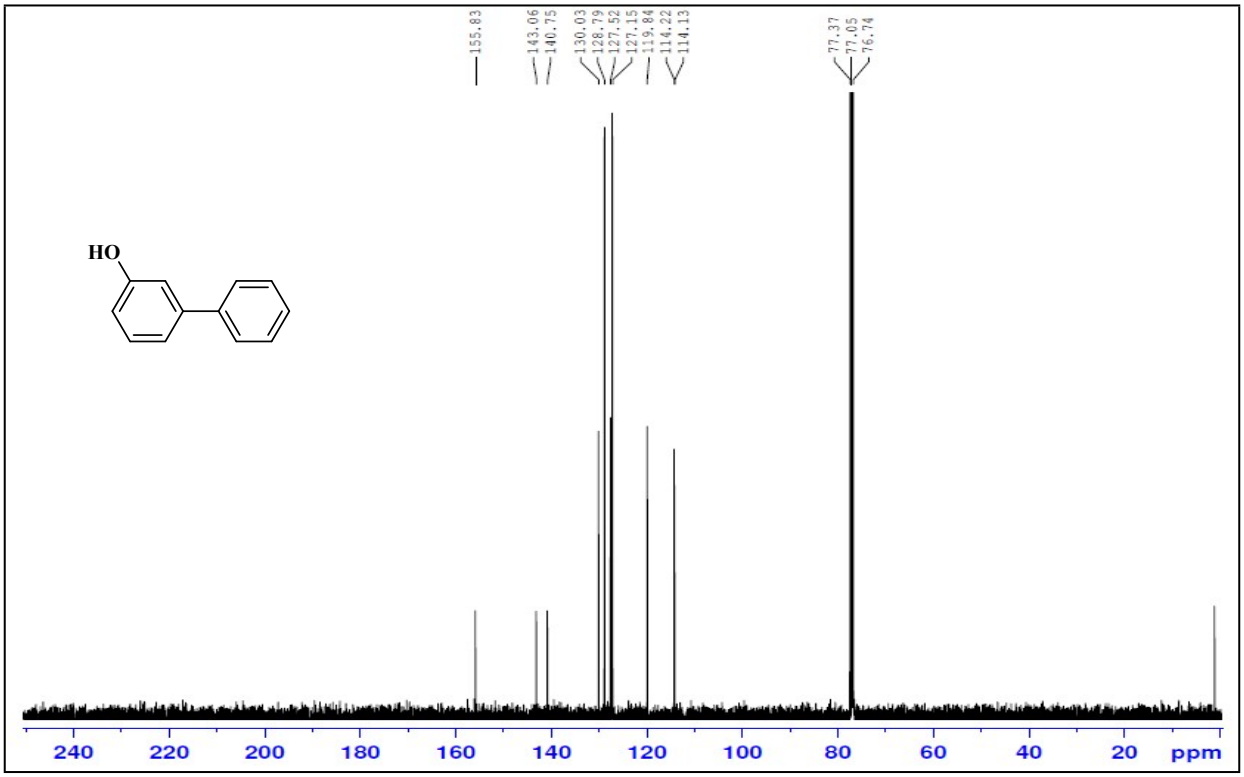
[1,1'-biphenyl]-3-amine (3e): Yellow solid; mp: 31-33°C [4]; ^{1}H-NMR ($CDCl_3$, 300 MHz): δ = 3.55 (s, 2H), 6.72-6.76 (m, 3H), 6.81-6.86 (m, 3H), 7.21-7.29 (m, 3H); ^{13}C-NMR ($CDCl_3$, 75 MHz): δ = 115.19, 118.60, 129.29, 129.37, 146.37, 146.47.



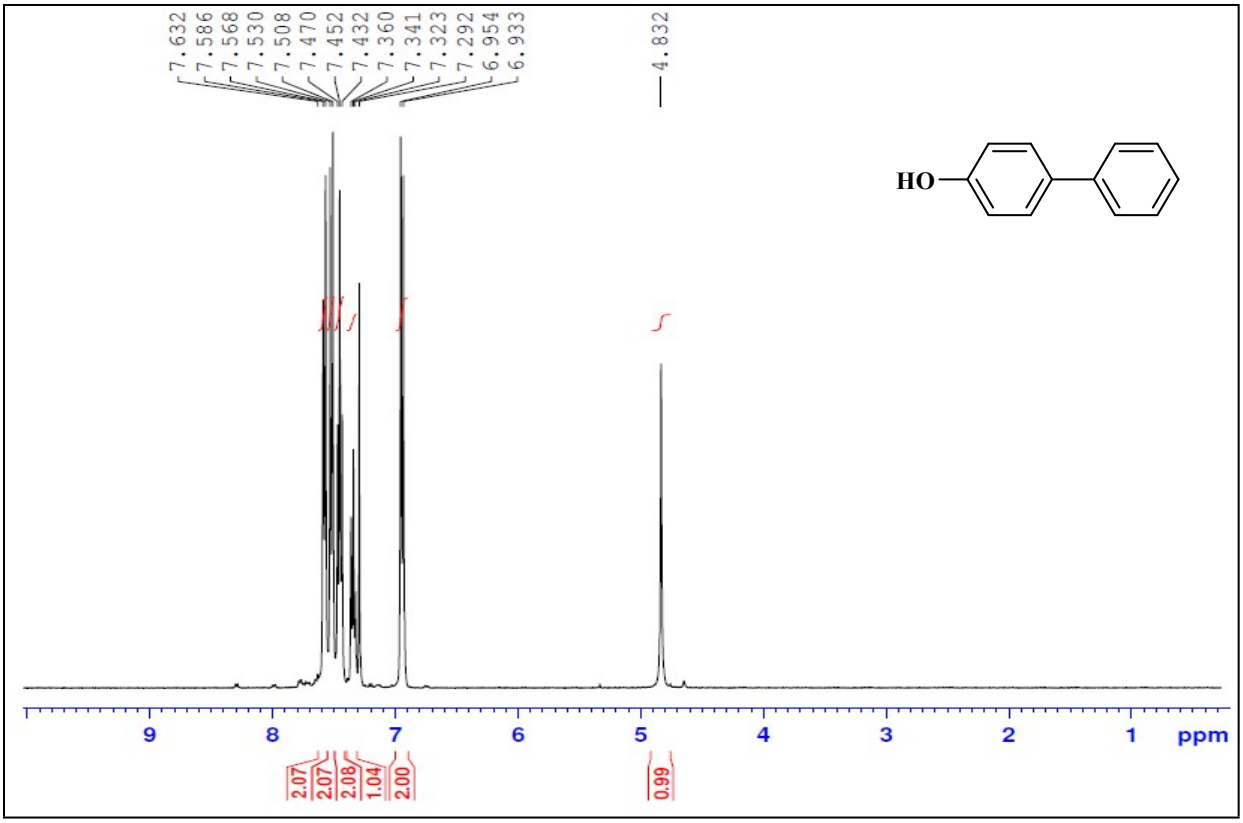


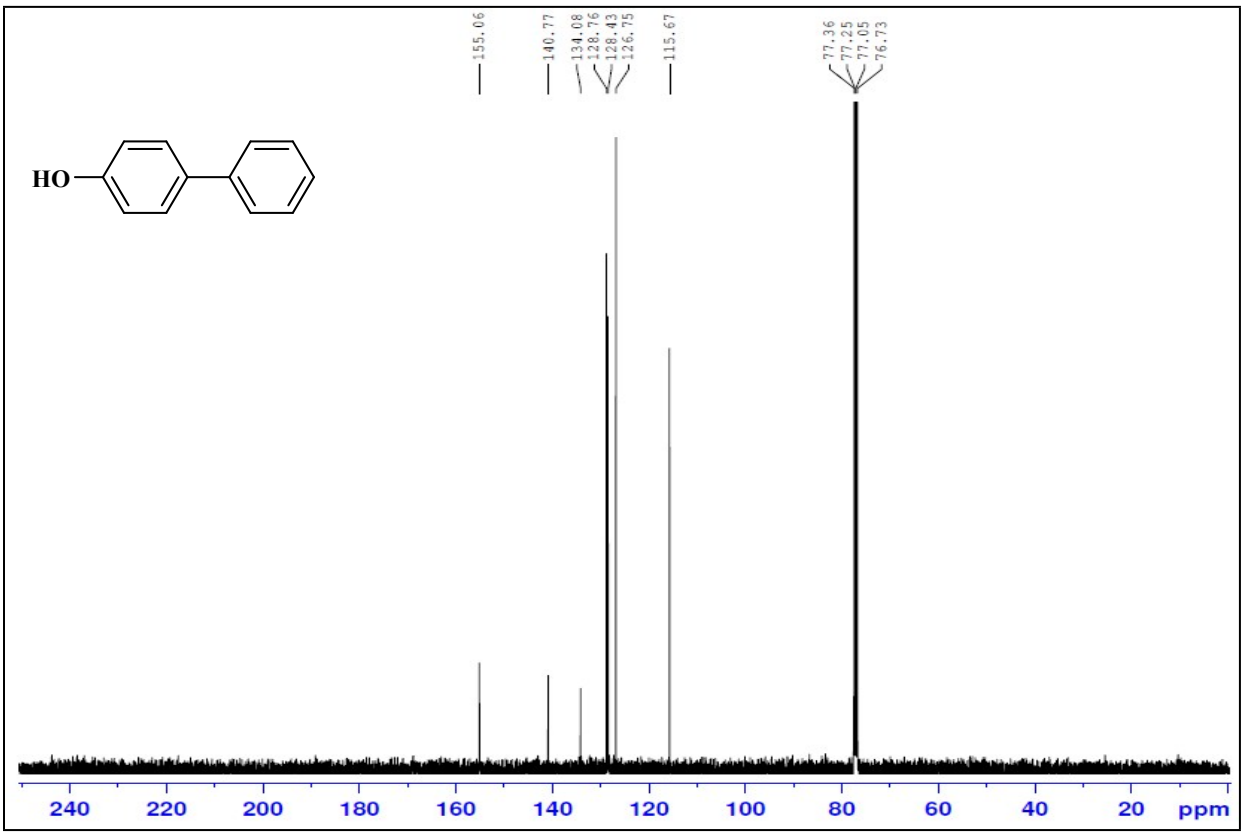
[1,1'-Biphenyl]-3-ol (3f): Colorless solid, mp: 75-77°C [5]; ^{1}H-NMR ($CDCl_3$, 300 MHz): δ = 4.90 (br, 1H), 6.84-6.87 (m, 1H), 7.10 (t, J = 1.5 Hz, 1H), 7.20-7.22 (m, 1H), 7.33-7.41 (m, 2H), 7.45-7.49 (m, 2H), 7.60-7.62 (m, 2H); ^{13}C-NMR ($CDCl_3$, 75 MHz): δ = 114.13, 114.22, 119.84, 127.15, 127.52, 128.79, 130.03, 140.75, 143.06, 155.83.



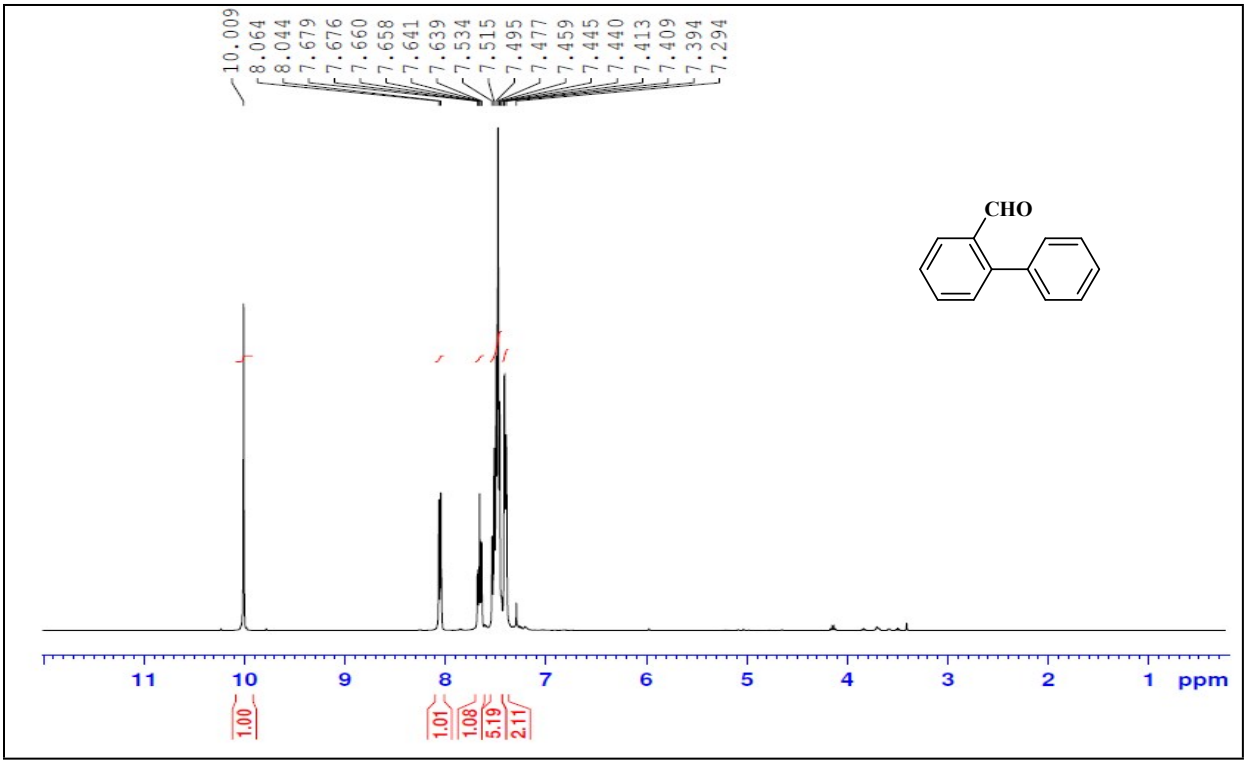


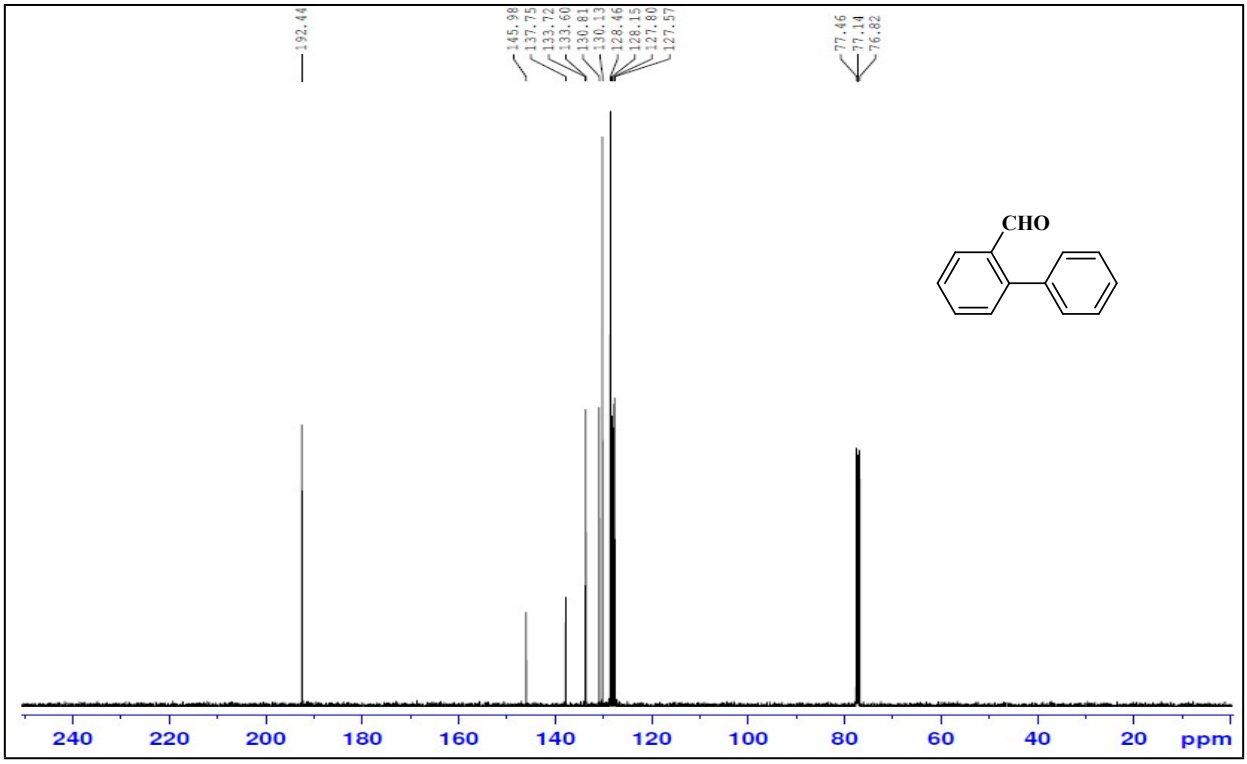
[1,1'-Biphenyl]-4-ol (3g): White solid; mp: 168-170°C [5]; ^{1}H-NMR ($CDCl_3$, 300 MHz): δ = 4. 83 (s, 1H), 6.94 (d, J = 6.3 Hz, 2H), 7.32-7.36 (m, 1H), 7.45 (t, J = 6.0 Hz, 2H), 7.52 (d, J =6.6 Hz, 2H), 7.58 (d, J = 5.4 Hz, 1H); ^{13}C-NMR ($CDCl_3$, 75 MHz): δ = 115.67, 126.75, 128.43, 128.76, 134.08, 140.77, 155.06.



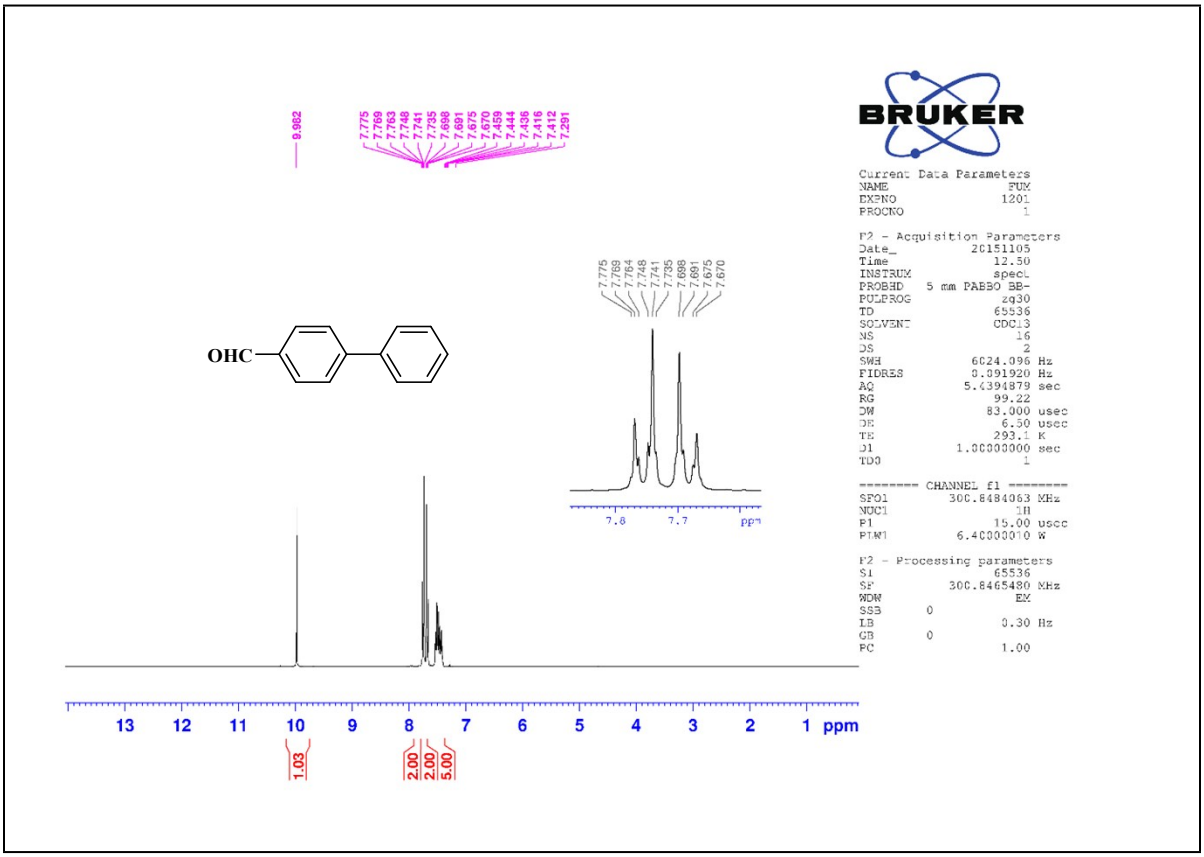


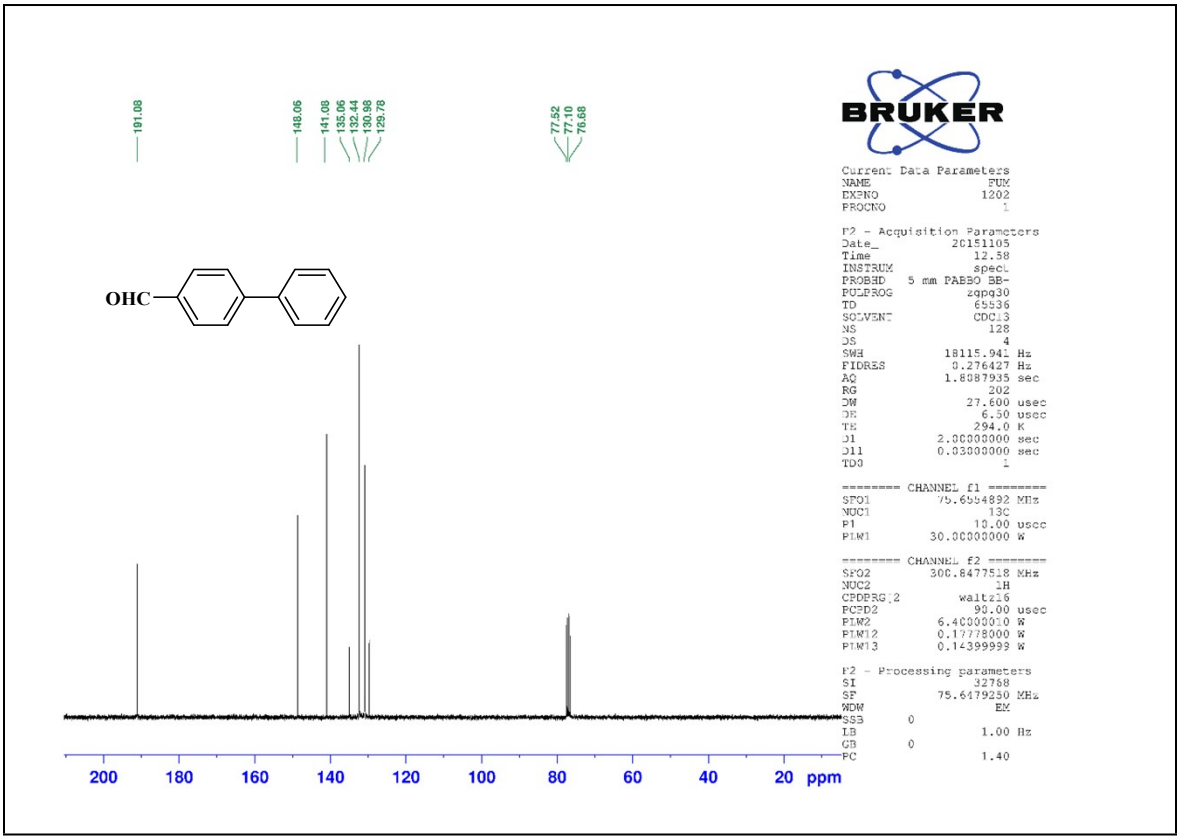
[1,1'-Biphenyl]-2-carbaldeyhde (3h): white solid; mp: 72-74°C [1]; ^{1}H-NMR ($CDCl_3$, 300 MHz): δ = 7.39-7.46 (m, 2H), 7.48-7.53 (m, 5H), 7.64-7.68 (m, 1H), 8.05 (d, J= 6.0, 1H), 10.01 (s, 1H); ^{13}C-NMR ($CDCl_3$, 75 MHz): δ = 127.57, 127.80, 128.15, 128.46, 130.13, 130.81, 133.60, 133.72, 137.75, 145.98, 192.44.



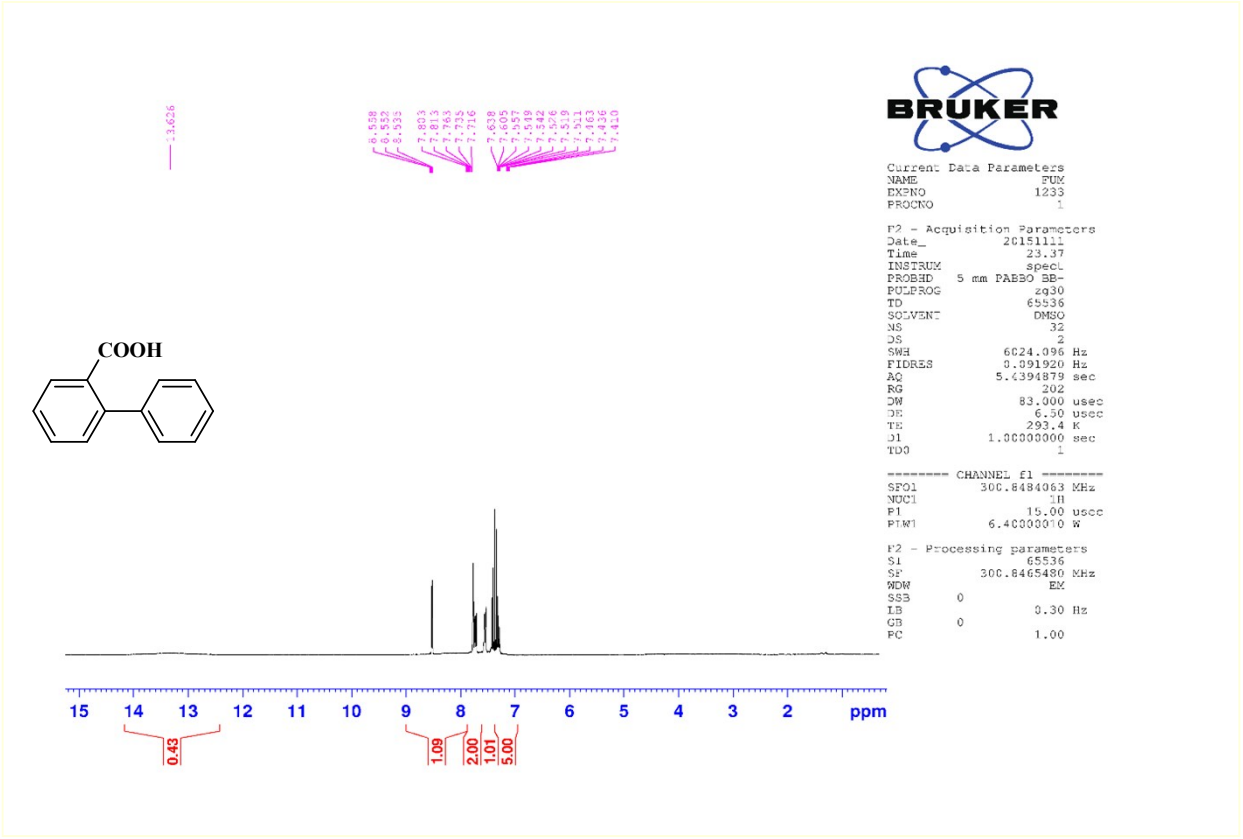


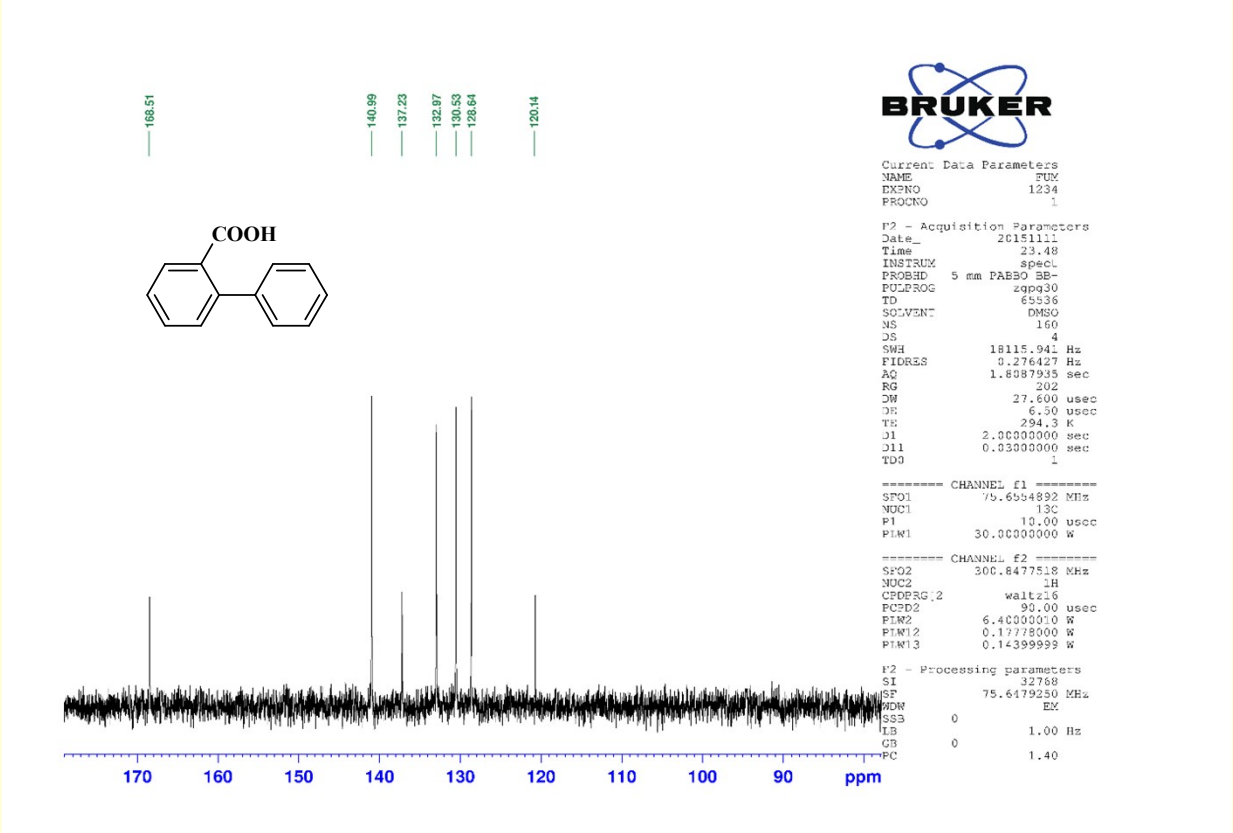
[1,1'-Biphenyl]-4-carbaldeyhde (3i): White solid; mp: 57-59°C [2]; ^{1}H-NMR ($CDCl_3$, 300 MHz): δ = 7.41-7.45 (m, 5H), 7.68 (d, J= 6.9, 2H), 7.75 (d, J= 6.9, 2H), 9.98 (s, 1H); ^{13}C-NMR ($CDCl_3$, 75 MHz): δ = 129.78, 130.98, 132.44, 135.06, 141.08, 148.06, 191.08.



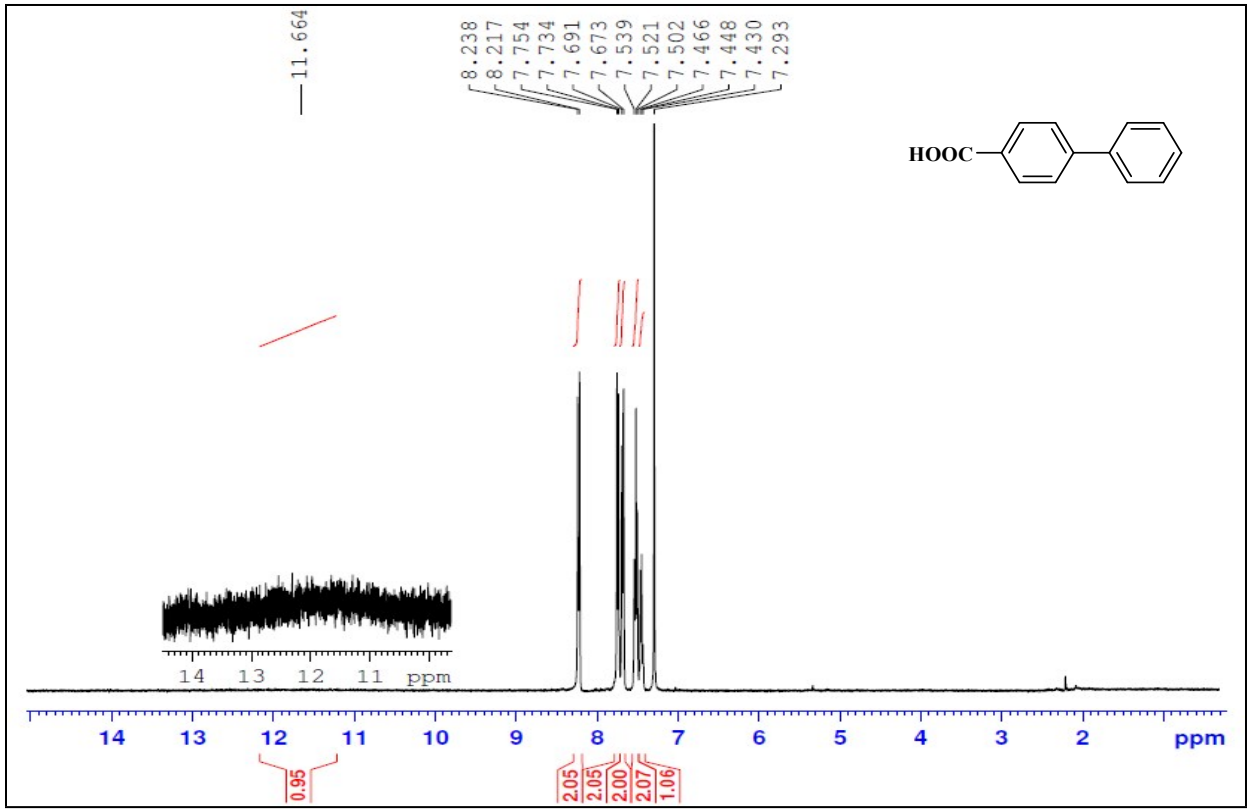


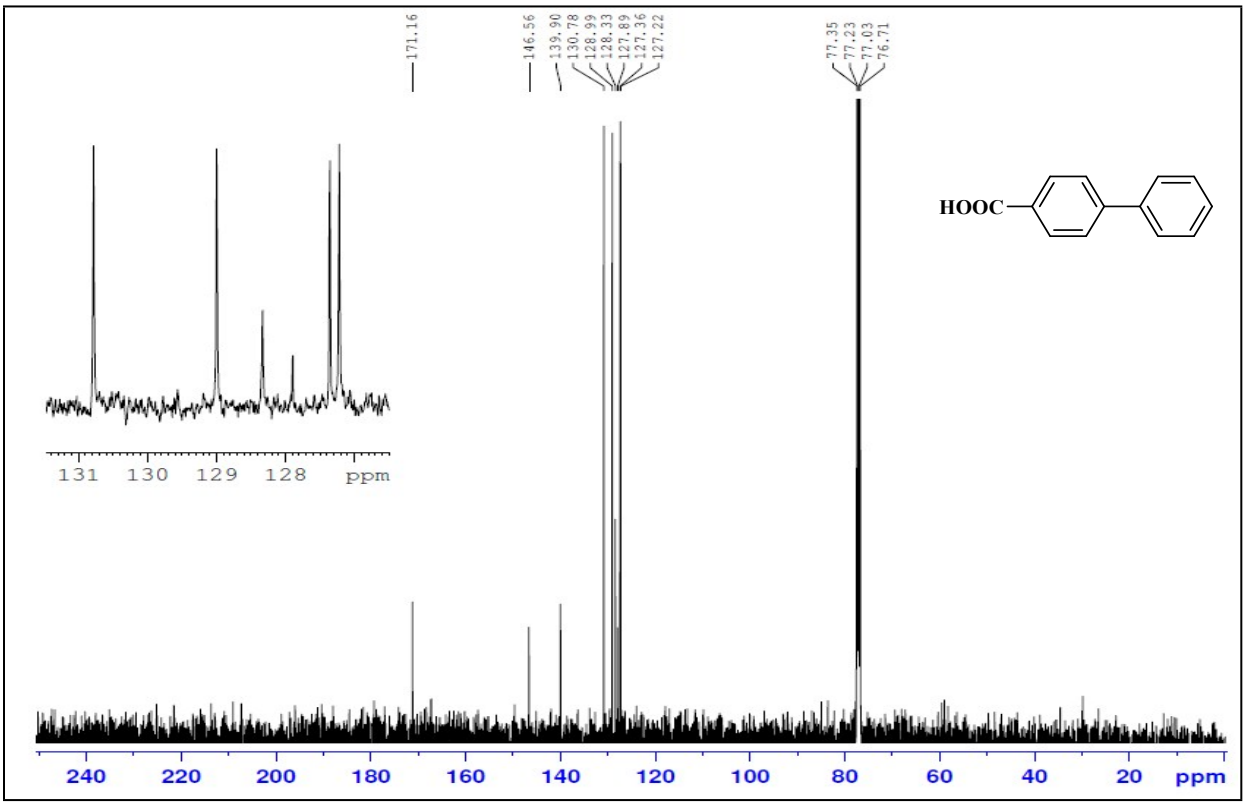
[1,1'-biphenyl]-2-carboxylic acid (3j): White solid; mp: 113-115 °C [6]; ^{1}H-NMR ($CDCl_3$, 300 MHz): δ = 7.41-7.54 (m, 5H), 7.55-7.63 (m, 1H), 7.71-7.80 (m, 2H), 8.53-8.55 (m, 1H), 13.62 (broad, 1H); ^{13}C-NMR ($CDCl_3$, 75 MHz): δ = 120.14, 128.64, 130.53, 132.97, 137.23, 140.99, 168.51.



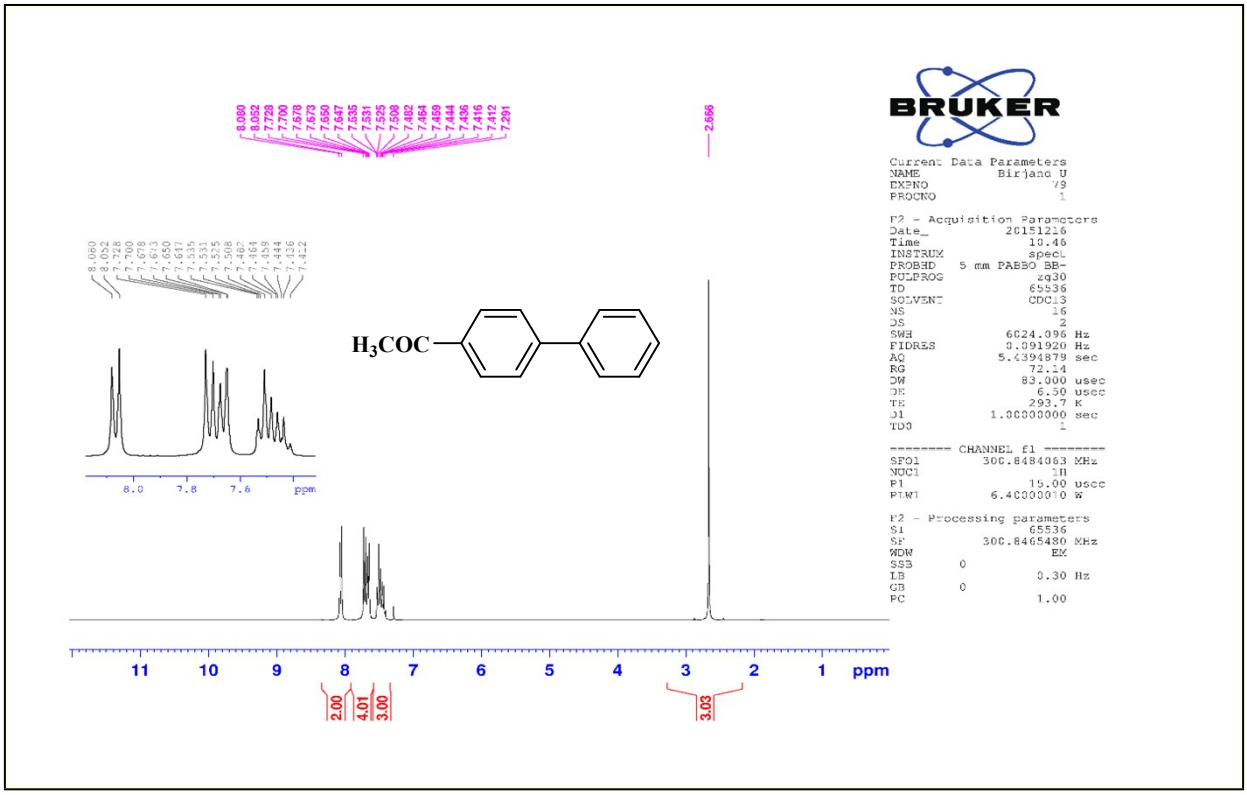


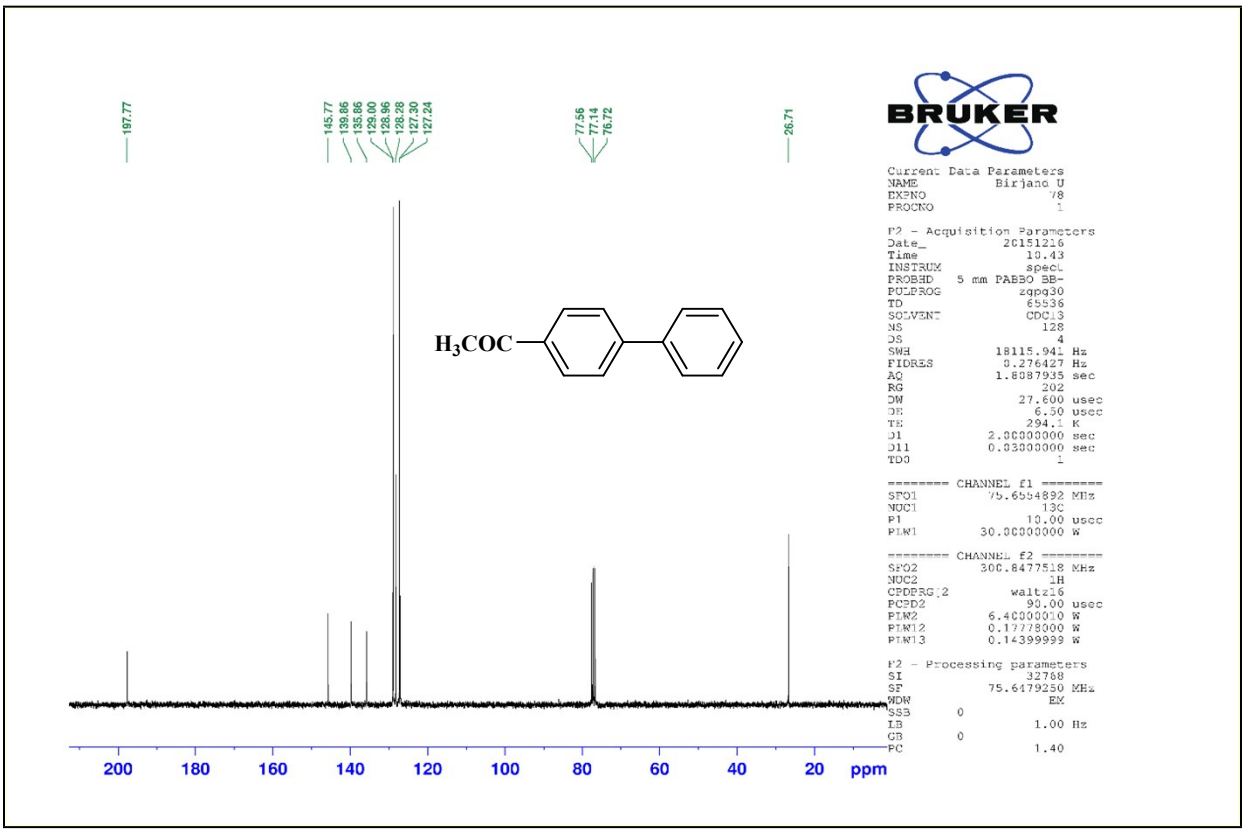
[1,1'-Biphenyl]-4-carboxylic acid (3k): White solid; mp: 220-222°C [2]; ^{1}H-NMR ($CDCl_3$, 300 MHz): δ = 7.45 (t, J =5.4 Hz, 1H), 7.52 (t, J =5.4 Hz, 2H), 7.68 (d, J =5.4 Hz, 2H), 7.76 (d, J =6.0 Hz, 2H), 8.23 (d, J =6.3 Hz, 2H) 11.66 (br, 1H); ^{13}C-NMR ($CDCl_3$, 75 MHz): δ = 127.22, 127.36, 127.89, 128.33, 128.99, 130.78, 139.90, 146.56, 171.16.



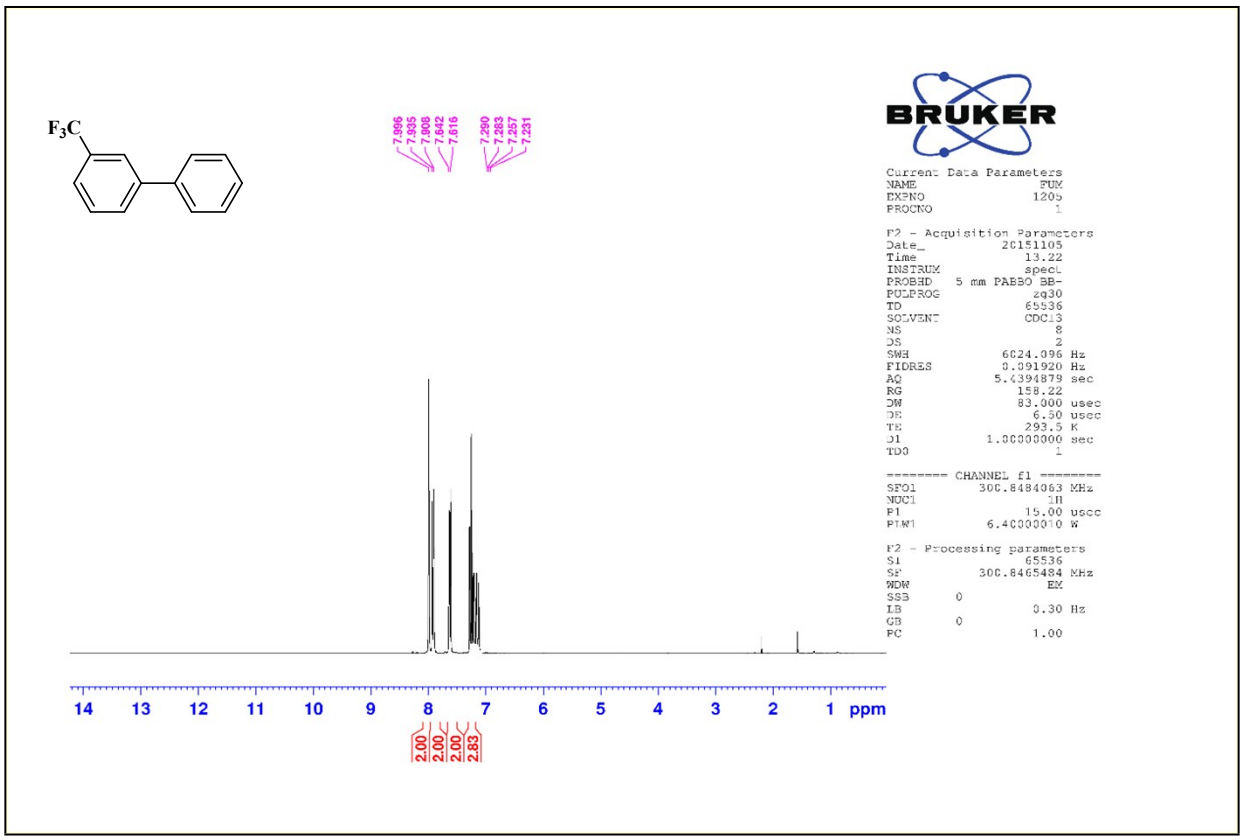


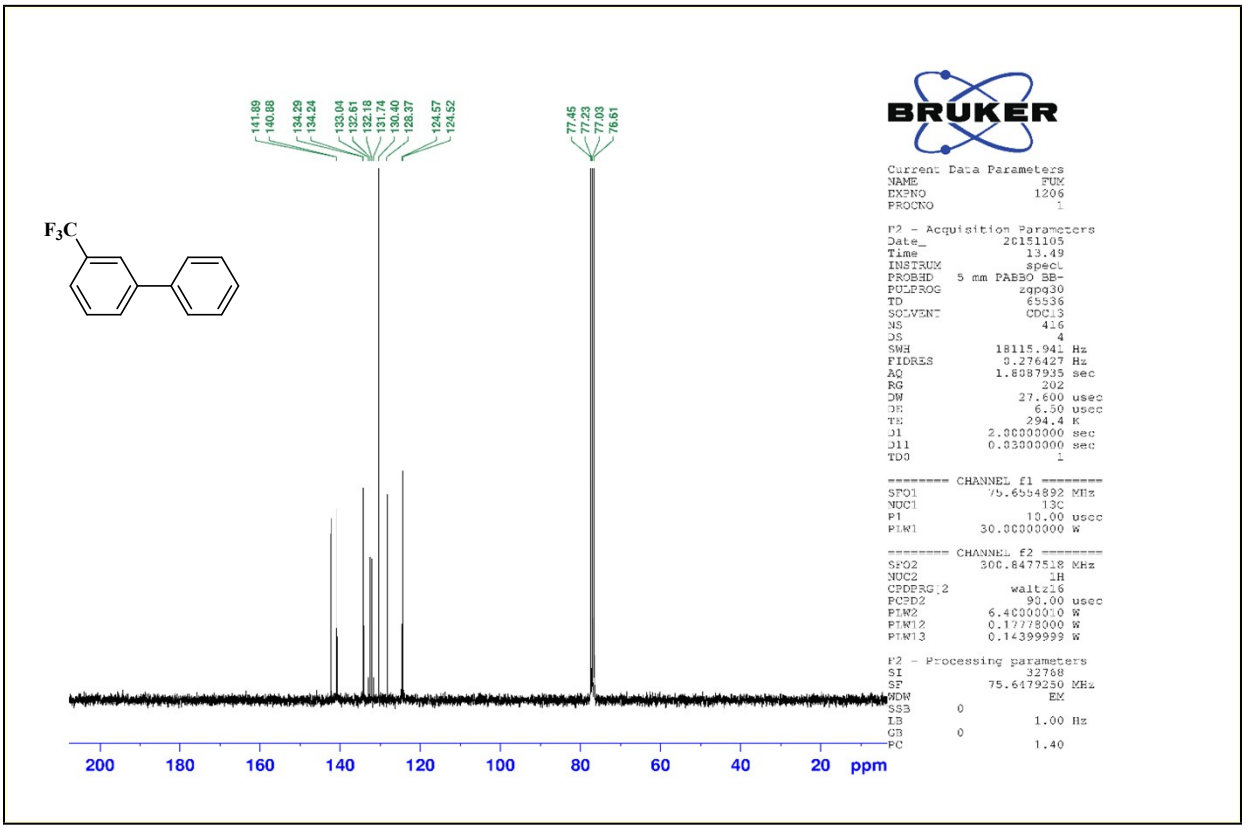
1-([1,1'-biphenyl]-4-yl)ethan-1-one (3l): White solid; mp: 119-121 °C [2]; ^{1}H-NMR ($CDCl_3$, 300 MHz): δ = 2.66 (s, 3H), 7.41-7.53 (m, 3H), 7.64-7.67 (m, 2H), 7.71 (d, J= 8.4 Hz, 2H), 8.06 (d, J= 8.4 Hz, 2H); ^{13}C-NMR ($CDCl_3$, 75 MHz): δ = 26.71, 127.24, 127.30, 128.28, 128.96, 129.00, 135.86, 139.86, 145.77, 197.77.



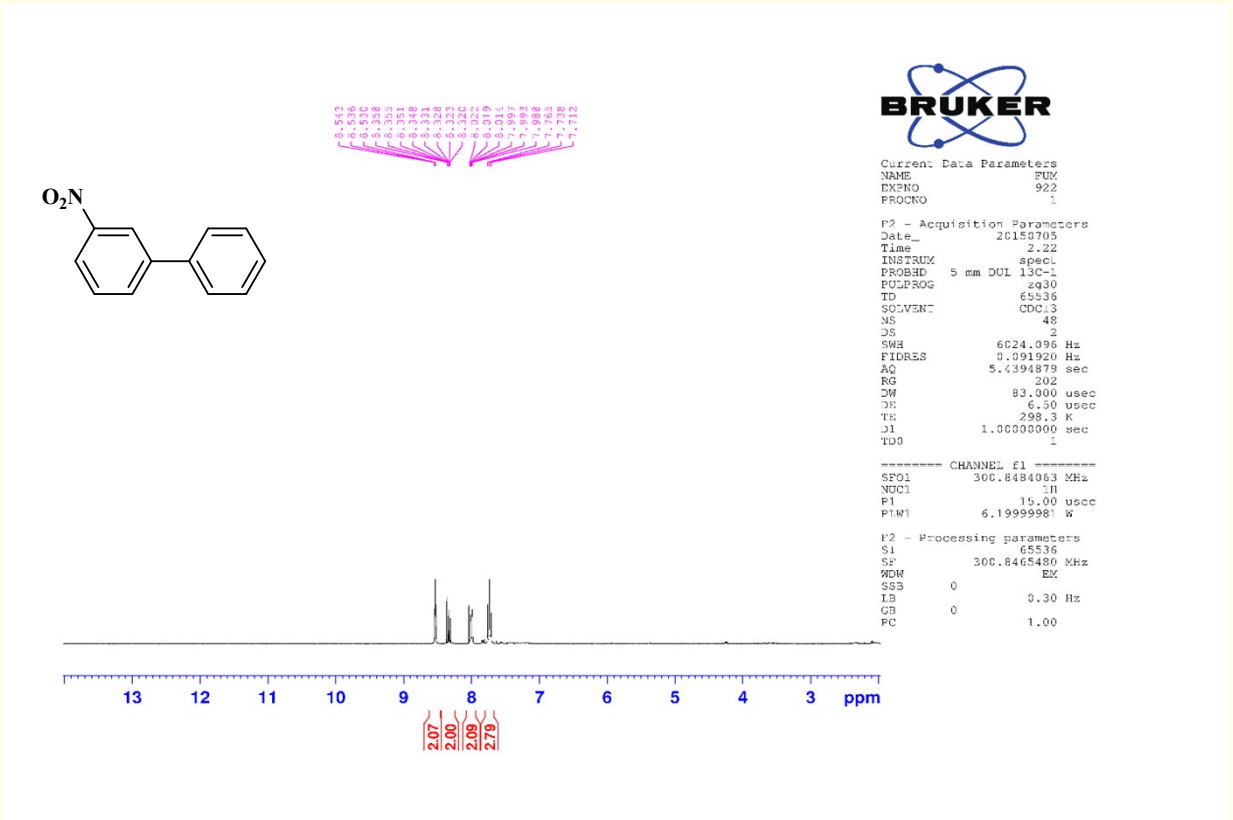


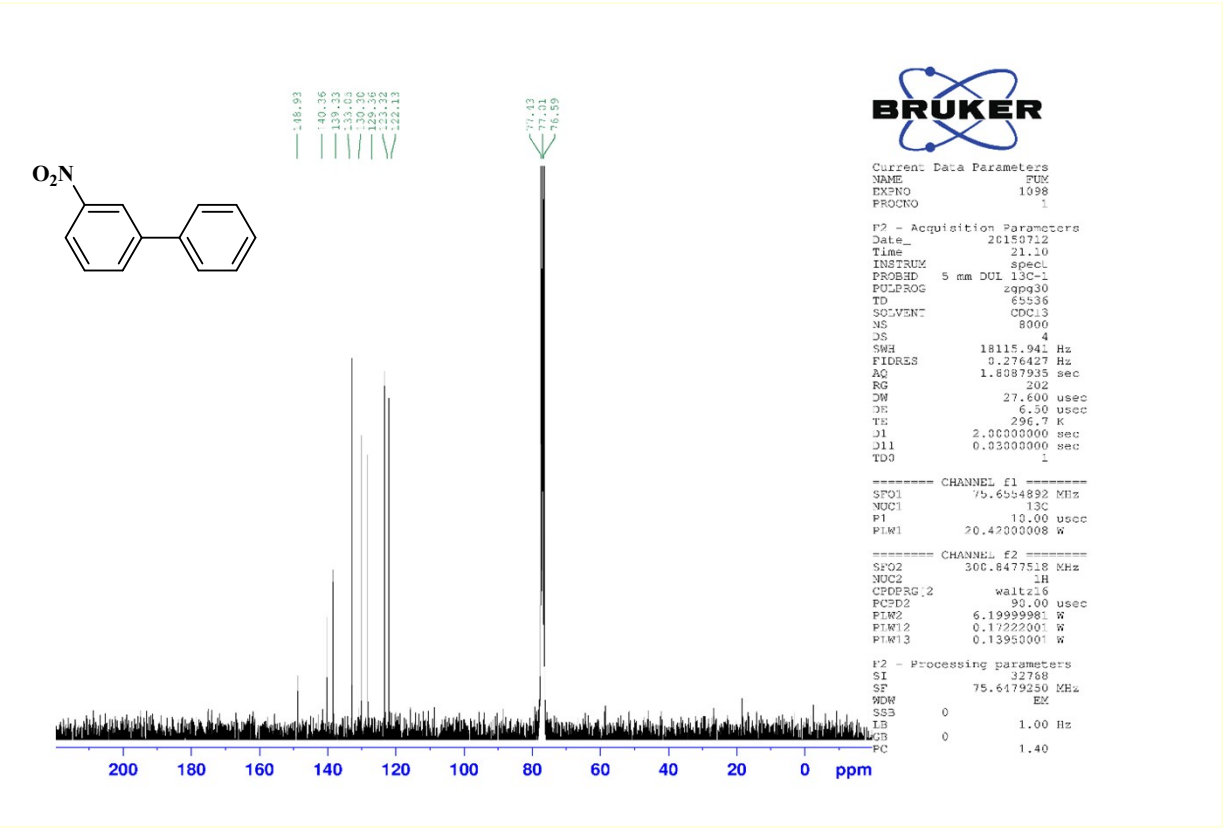
3-(trifluoromethyl)-1,1'-biphenyl (3m): White solid; mp: 41-43 °C [6]; ^{1}H-NMR ($CDCl_3$, 300 MHz): δ = 7.23-7.29 (m, 3H), 7.61-7.64 (m, 2H), 7.90-7.99 (m, 4H); ^{13}C-NMR ($CDCl_3$, 75 MHz): δ = 124.52, 124.57, 128.37, 130.40, 131.74, 132.18, 132.61, 133.04, 134.24, 134.29, 140.88, 141.89.



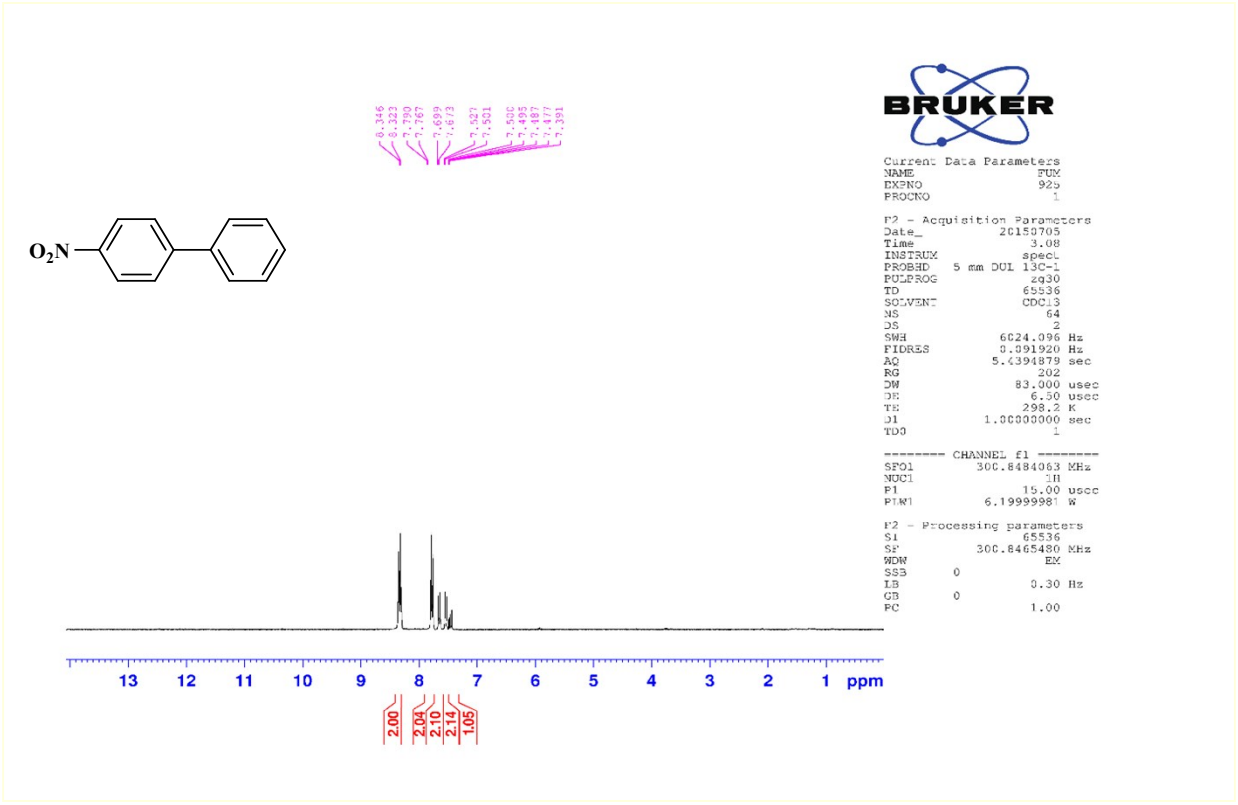


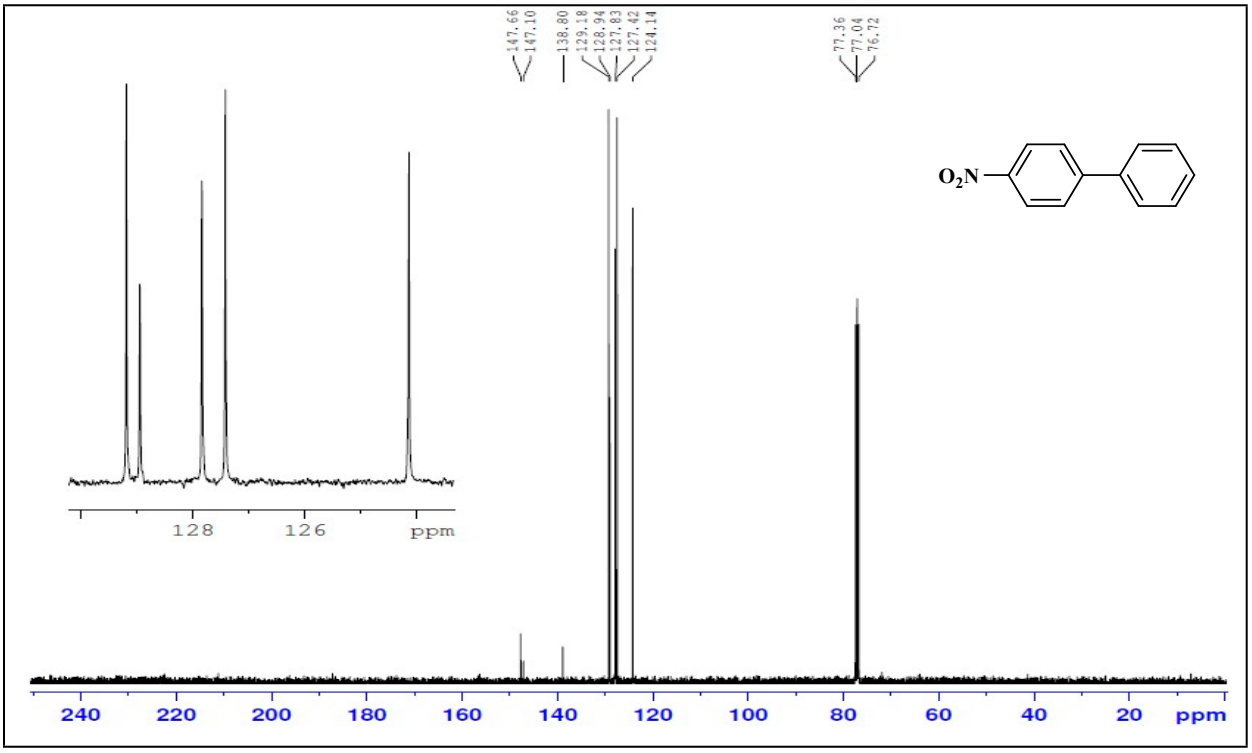
3-nitro-1,1'-biphenyl (3n): Yellow solid; mp: 58-60 °C [7]; ^{1}H-NMR ($CDCl_3$, 300 MHz): δ = 7.71-8.02 (m, Ar, 5H), 8.32-8.54 (m, Ar-NO_2, 4H); ^{13}C-NMR ($CDCl_3$, 75 MHz): δ = 122.13. 123.32, 129.36, 130.30, 133.05, 139.33, 140.36, 148.93.



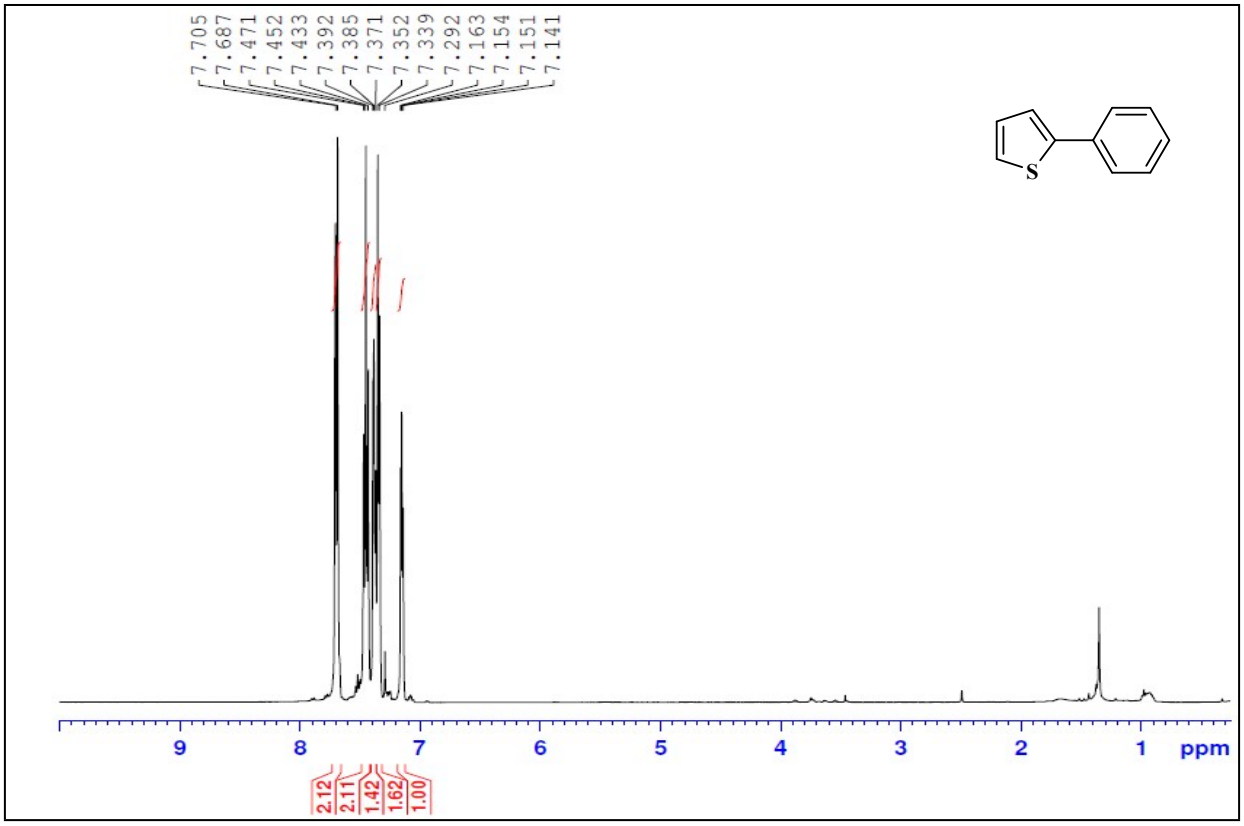


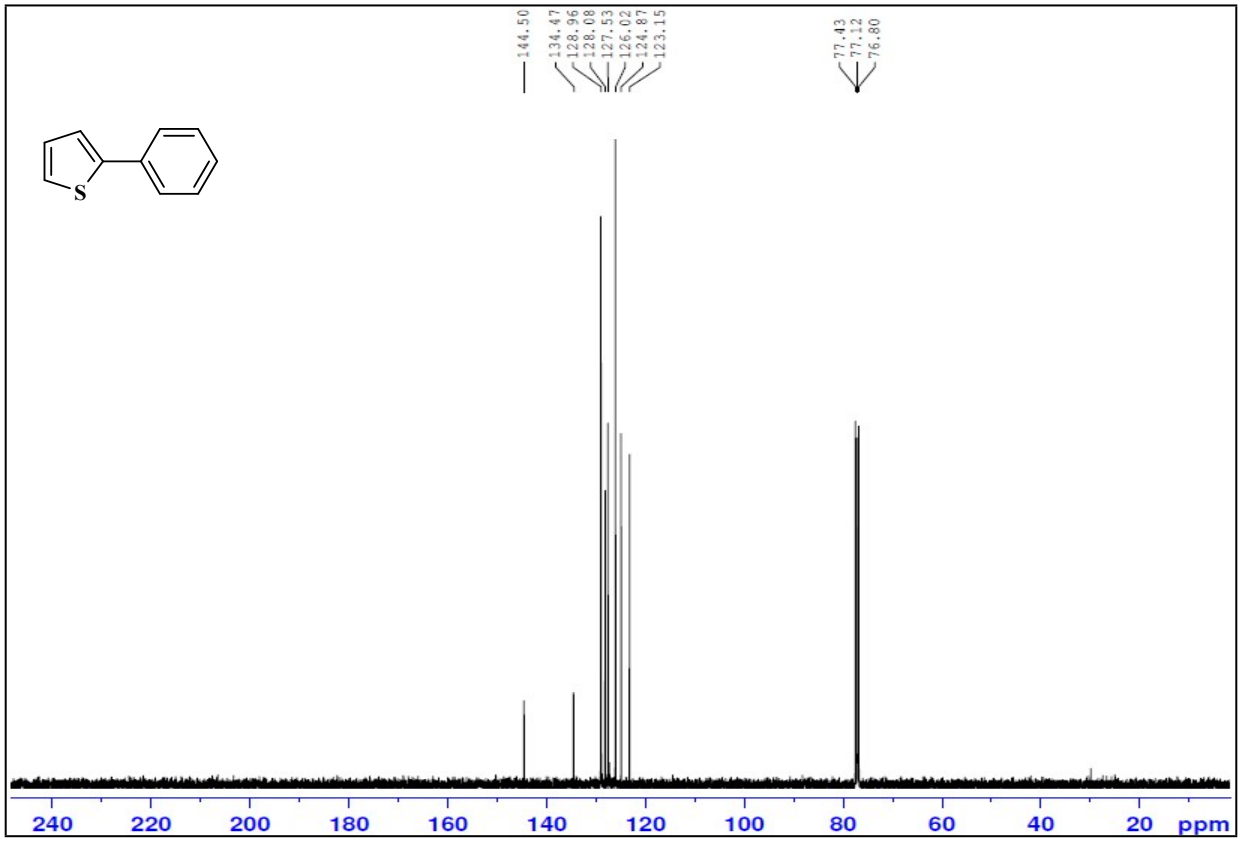
4-Nitro-1,1'-biphenyl (3o): Yellow solid; mp: 113-115°C [3]; ^{1}H-NMR ($CDCl_3$, 300 MHz): δ = 7.39-7.50 (m, 1H), 7.51 (d, 2H, J=7.8), 7.68 (d, 2H, J=7.8), 7.77 (d, 2H, J=6.9), 8.33 (d, 2H, J=6.9); ^{13}C-NMR ($CDCl_3$, 75 MHz): δ = 124.14, 127.42, 127.83, 128.94, 129.18, 138.80, 147.10, 147.66.



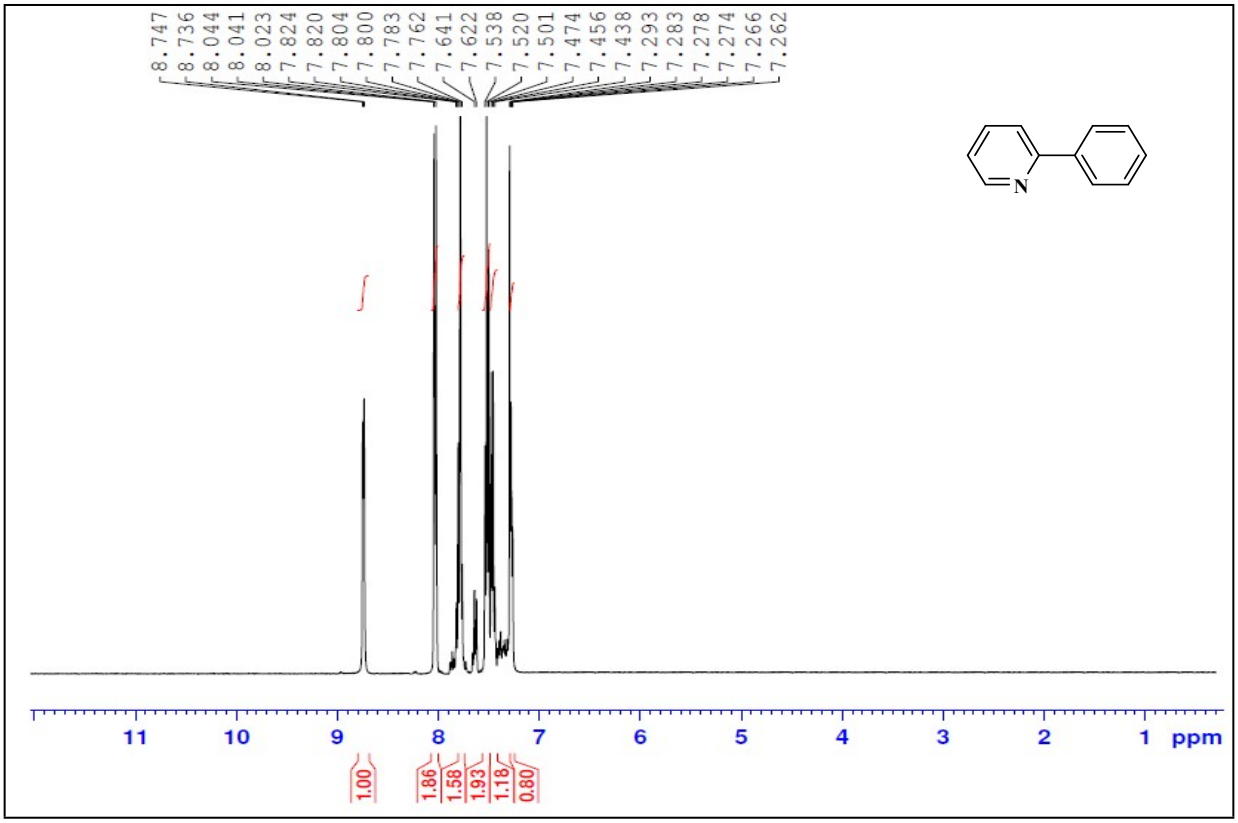


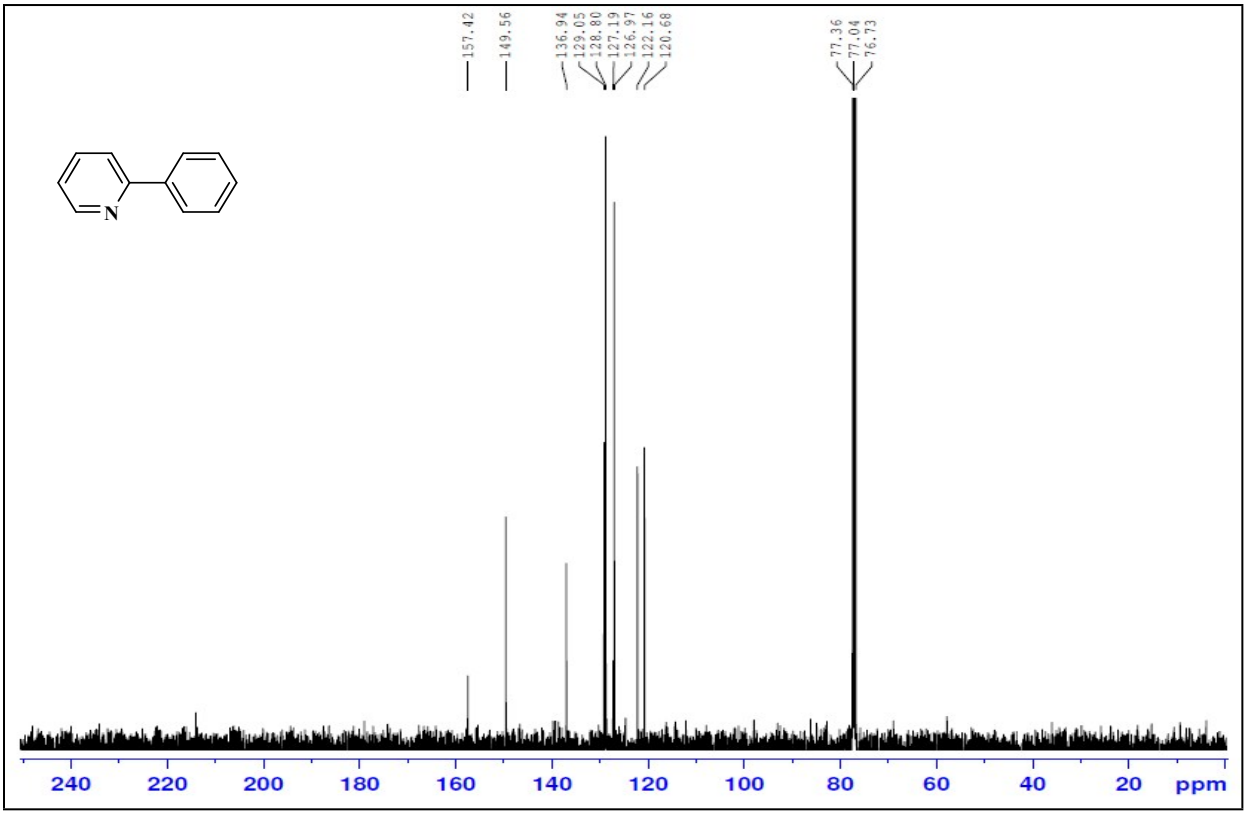
2-Phenylthiophene (3p): White solid; mp: 39-41°C [8]; ^{1}H-NMR ($CDCl_3$, 300 MHz): δ = 7.14-7.16 (m, 1H), 7.34-7.39 (m, 3H), 7.45 (t, J = 5.7 Hz, 2H), 7.70 (d, J =5.4 Hz, 2H); ^{13}C-NMR ($CDCl_3$, 75 MHz): δ = 123.15, 124.87, 126.02, 127.53, 128.08, 128.96, 134.47, 144.50.



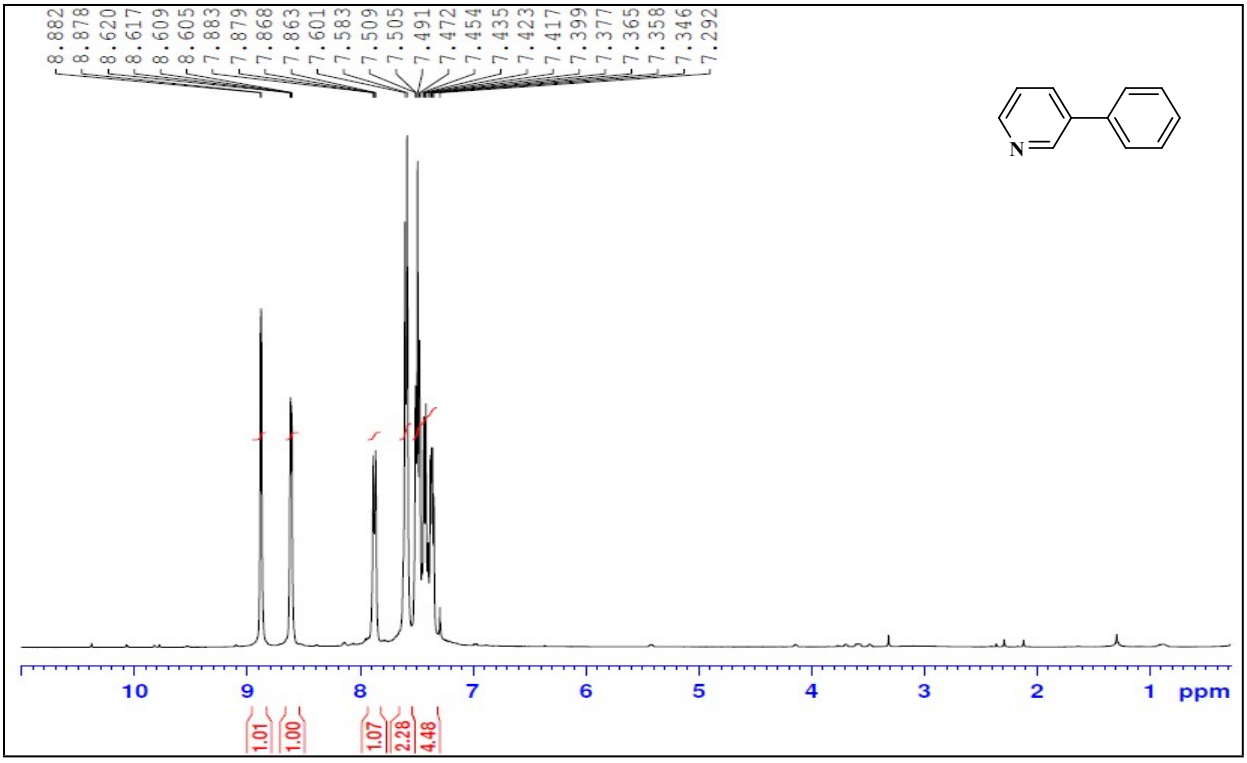


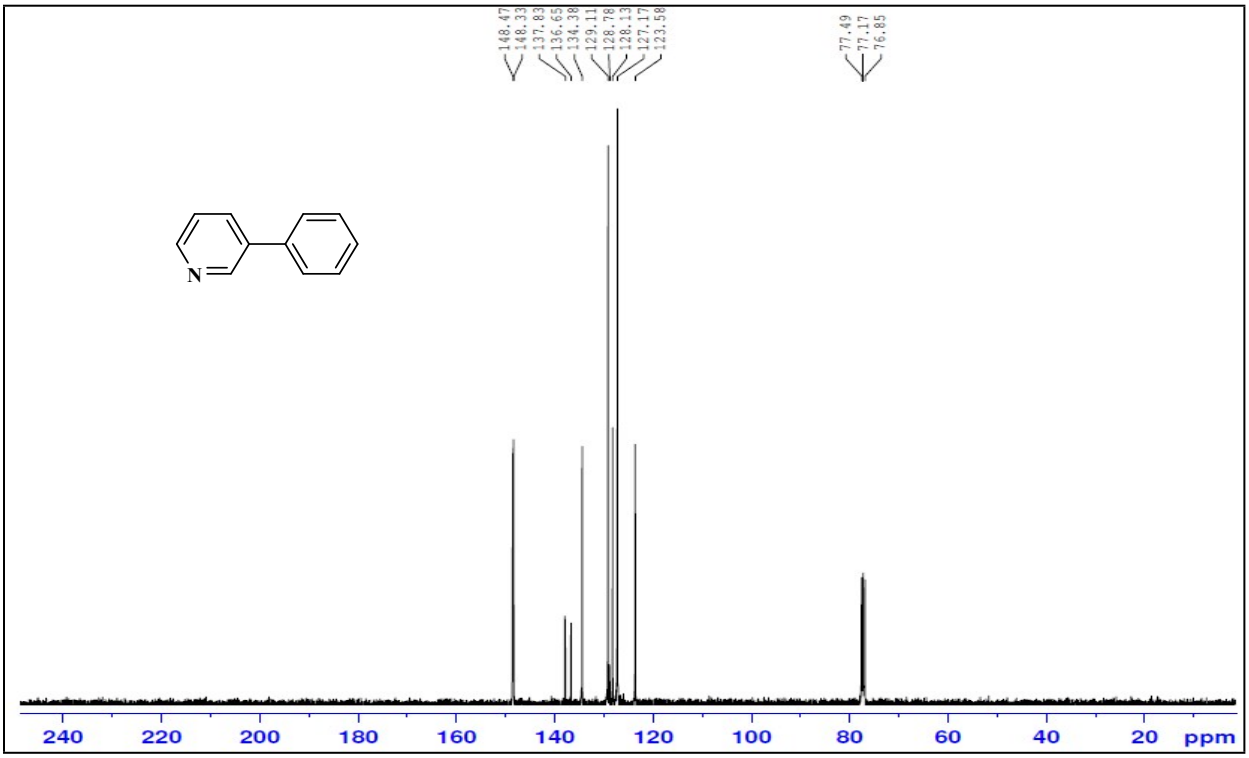
2-Phenylpyridine (3q): light yellow oil [8]; ^{1}H-NMR ($CDCl_3$, 300 MHz): δ = 7.26-7.28 (m, 1H), 7.46 (t, J =5.4 Hz, 1H), 7.52 (t, J =5.7 Hz, 2H), 7.76-7.82 (m, 2H), 8.02-8.04 (m, 2H), 8.74 (d, J =3.3 Hz, 1H); ^{13}C-NMR ($CDCl_3$, 75 MHz): δ = 120.68, 122.16, 126.97, 127.19, 128.80, 129.05, 136.94, 149.56, 157.42.



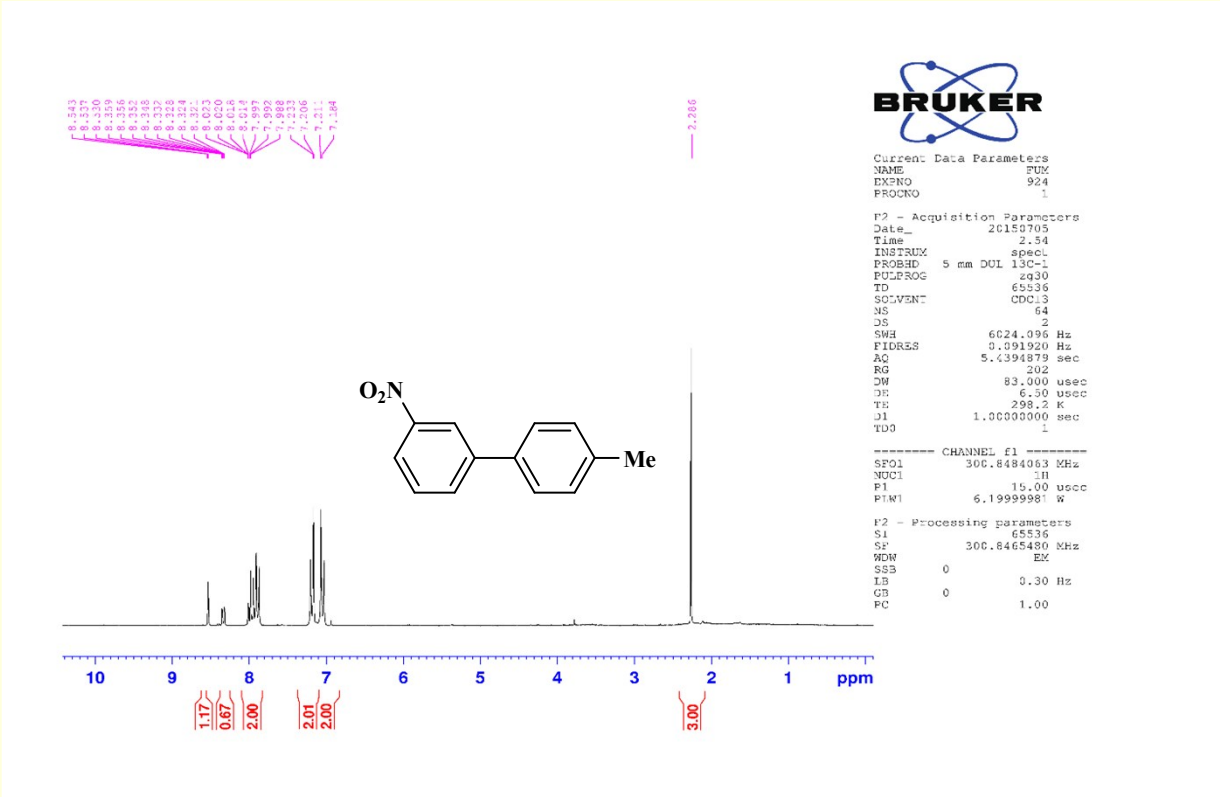


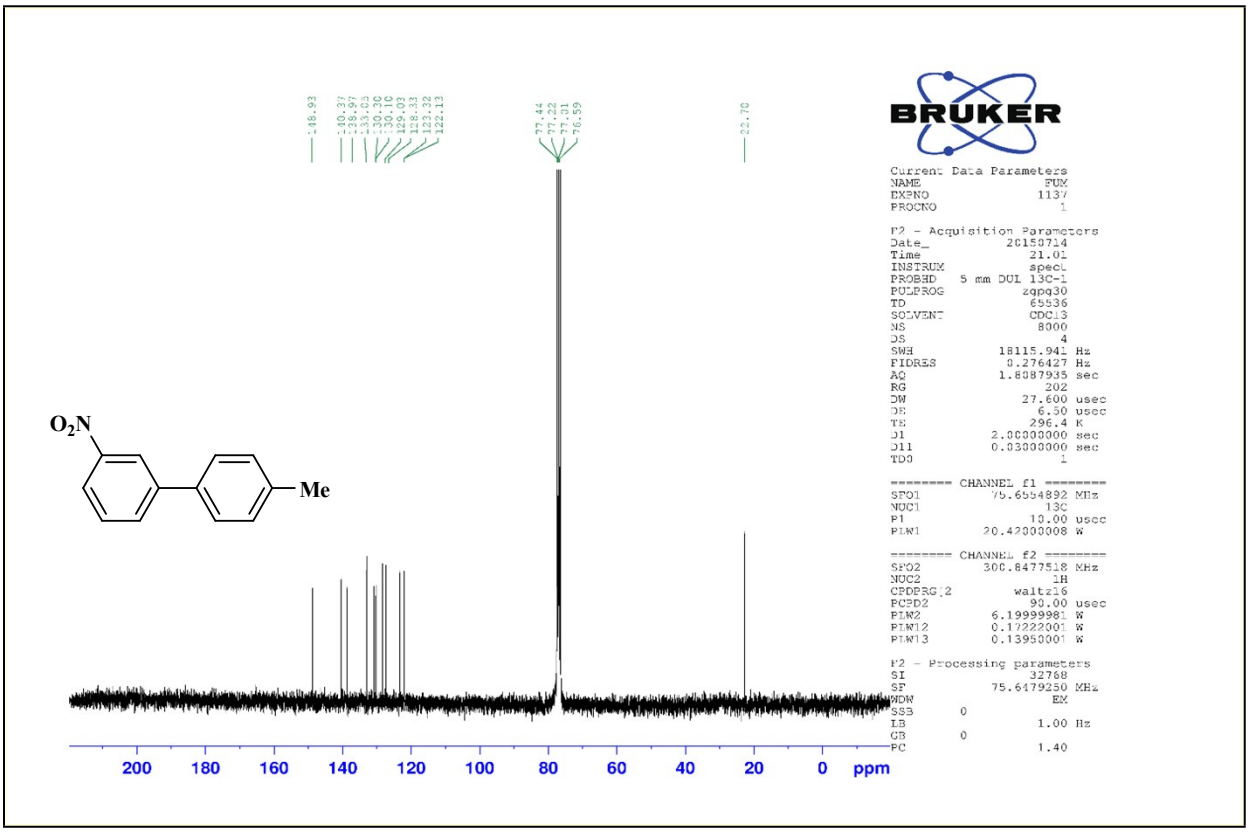
3-Phenylpyridine (3r): colorless oil [8]; ^{1}H-NMR ($CDCl_3$, 300 MHz): δ = 7.34-7.51 (m, 4H), 7.59 (d, J =5.4 Hz, 2H), 7.86-7.88 (dd, J =4.7, 1.5 Hz, 1H), 8.61-8.62 (dd, J =3.5, 1.2 Hz, 1H), 8.88 (d, J =1.2 Hz, 1H); ^{13}C-NMR ($CDCl_3$, 75 MHz): δ = 123.58, 127.17, 128.13, 128.78, 129.11, 134.38, 136.65, 137.83, 148.33, 148.47.





4'-methyl-3-nitro-1,1'-biphenyl (3s): With solid; mp: 75-77 °C [6]; ^{1}H-NMR ($CDCl_3$, 300 MHz): δ = 2.28 (s, 3H), 7.18 (d, 2H, *J*= 8.1 Hz), 7.22 (d, 2H, *J*= 8.1 Hz), 7.98-8.02 (m, 2H), 8.32-8.35 (m, 1H), 8.53-8.54 (m, 1H); ^{13}C-NMR ($CDCl_3$, 75 MHz): δ = 22.70, 122.13, 123.32, 128.33, 129.03, 130.10, 130.30, 133.05, 138.97, 140.37, 148.93.





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