Supporting Information For

One-pot synthesis of quinolines via Co(III)-catalyzed C–H activation/carbonylation/cyclization of anilines

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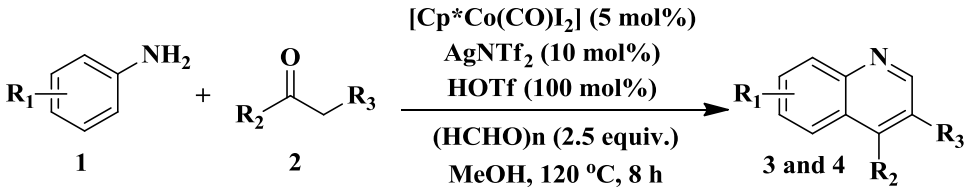
General Methods and Materials

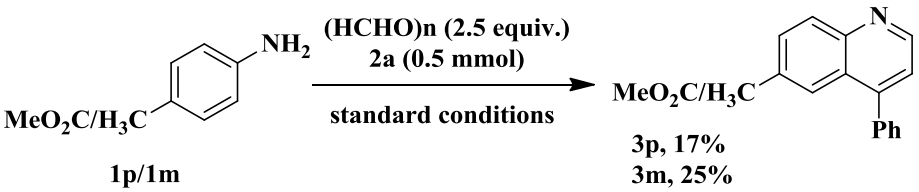
$AgNTf_2$ and HOTf were purchased from Energy Chemical and used without further purification. The cobalt catalyst $Cp^*Co(CO)I_2$ was synthesized according to previously described methods.[1] Other chemicals were purchased from commercial suppliers, further dried and purified if necessary. The water used was re-distillated and ion-free. ^1H and ^{13}C NMR spectra were achieved on a Bruker AVANCE 400 MHz spectrometer (^1H 400 MHz; ^{13}C 100 MHz) in $CDCl_3$. Abbreviations for data quoted are s-singlet; brs-broad singlet; d-doublet; t-triplet; dd-doublet of doublets; m-multiplet. High-resolution mass spectra were measured on a Waters Micromass GCT facility. Thin-layer chromatographies were done on pre-coated silica gel 60F254 plates (Merck). Silica gel 60H (200-300 mesh) manufactured by Qingdao Haiyang Chemical Group Co. (China) was used for general chromatography.

General catalytic procedure for the synthesis of quinolines

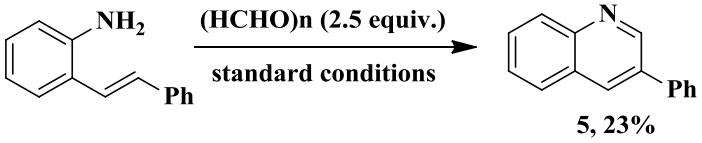


A reaction kettle (25 mL) was charged with amine **1** (0.5 mmol, 1 equiv.), acetophenone **2** (0.5 mmol, 1.2 equiv.), [Cp*Co(CO)I_2] (12.0 mg, 5.0 mol%), $AgNTf_2$ (20 mg, 10.0 mol%), $(HCHO)_n$ (1.25 mol, 2.5 equiv.), CH_3OH (2 mL), then the HOTf (0. 5 mmol) was added. The mixture was stirred at 120 ^oC for 8 hours under an atmosphere of air. The mixture was quenched by sat. aq. $NaHCO_3$, and diluted with 20 mL dichloromethane and washed with 10 mL H_2O. The aqueous layer was extracted twice with dichloromethane (10 mL) and the combined organic phase was dried over Na_2SO_4. After evaporation of the solvents, the residue was purified by silica gel chromatography (hexane/AcOEt = 10 : 1) to afford quinoline products. All other compounds are synthesized in a similar manner, with the yields listed in the main text calculated from the isolated, pure products.

Control experiments



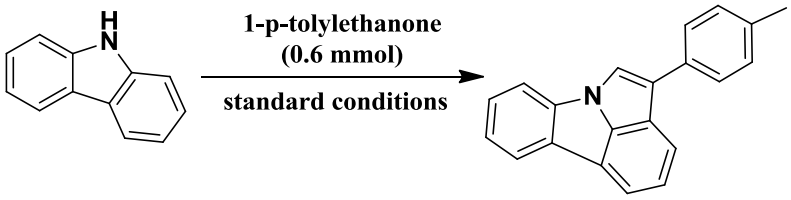
A reaction kettle (25 mL) was charged with *p*-tolylamine **1m** (0.5 mmol, 1 equiv), Methyl 4-aminobenzoate **1p** (0.5 mmol, 1 equiv), acetophenone **2** (0.5 mmol, 1.0 equiv), [Cp*Co(CO)I_2] (12.0 mg, 5.0 mol %), $AgNTf_2$ (20 mg, 10.0 mol%), $(HCHO)_n$ (1.25 mol), CH_3OH (2 mL), then the HOTf (0. 5 mmol) was added. The mixture was stirred at 120 ^oC for 8 hours under an atmosphere of air. The mixture was quenched by sat. aq. $NaHCO_3$, and diluted with 20 mL dichloromethane and washed with 10 mL H_2O. The aqueous layer was extracted twice with dichloromethane (10 mL) and the combined organic phase was dried over Na_2SO_4. After evaporation of the solvents, the residue was purified by silica gel chromatography (hexane/AcOEt = 10 : 1) to yield product **3m** (27.4 mg, 25%) and **3p** (22.4 mg, 17%).



A reaction kettle (25 mL) was charged with 2-styrylphenylamine (0.5 mmol, 1 equiv), [Cp*Co(CO)I_2] (12.0 mg, 5.0 mol %), $AgNTf_2$ (20 mg, 10.0 mol %), $(HCHO)_n$ (1.25 mol), CH_3OH (2 mL), then the HOTf (0. 5 mmol) was added. The mixture was stirred at 120 ^oC for 8 hours under an atmosphere of air. The mixture was quenched by sat. aq. $NaHCO_3$, and diluted with 20 mL dichloromethane and washed with 10 mL H_2O. The aqueous layer was extracted twice with dichloromethane (10 mL) and the combined organic phase was dried over Na_2SO_4. After evaporation of the solvents, the

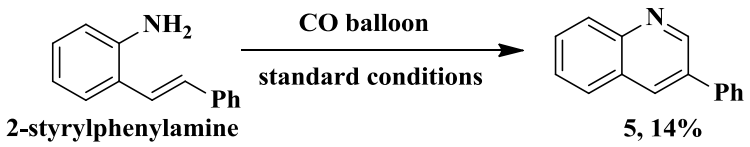
residue was purified by silica gel chromatography (hexane/AcOEt = 10 : 1) to yield product **5** (23.6 mg, 23%).

3-Phenylquinoline (5): **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 9.19 (s, 1H), 8.30 (s, 1H), 8.15 - 8.13 (d, *J* = 8.4 Hz, 1H), 7.89 - 7.87 (d, *J* = 8 Hz, 1H), 7.74 - 7.71 (m, 3H), 7.60 - 7.51 (m, 3H), 7.46 - 7.42 (m, 1H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 149.9, 147.3, 137.9, 133.8, 133.2, 129.4, 129.2, 129.2, 128.10, 128.0, 127.4, 127.0; **HRMS (ESI-TOF)** m/z calcd for $C_{15}H_{12}N$ $[M + H]^+$ 206.0964, found 206.0966.



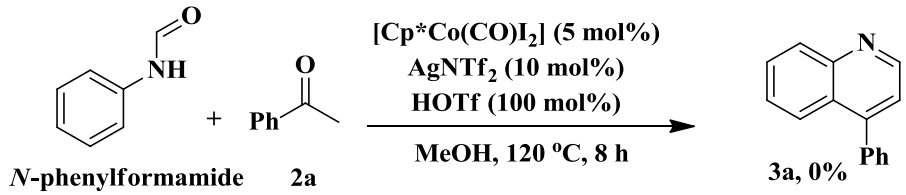
A reaction kettle (25 mL) was charged with 9*H*-Carbazole (0.5 mmol, 1 equiv.), 1-*p*-tolylethanone (0.6 mmol, 1.2 equiv.), [Cp*Co(CO)I_2] (12.0 mg, 5.0 mol%), $AgNTf_2$ (20 mg, 10.0 mol %), CH_3OH (2 mL), then the HOTf (0. 5 mmol) was added. The mixture was stirred at 120 ^{o}C for 8 hours under an atmosphere of air. The mixture was quenched by sat. aq. $NaHCO_3$, and diluted with 20 mL dichloromethane and washed with 10 mL H_2O. The aqueous layer was extracted twice with dichloromethane (10 mL) and the combined organic phase was dried over Na_2SO_4. After evaporation of the solvents, the residue was purified by silica gel chromatography (hexane/AcOEt = 20 : 1) to yield product **6** (59.0 mg, 42%).

4-*p*-Tolyl-pyrrolo[3,2,1-jk]carbazole (6): ^{1}H NMR (400 MHz, $CDCl_3$) δ ppm: 8.27 (d, *J* = 8.8 Hz, 2H), 7.73 - 7.77 (m, 4H), 7.39 - 7.42 (m, 4H), 7.32 (d, *J* = 8.0 Hz, 2H), 2.52 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 148.8, 147.5, 128.2, 132.9, 130.4, 129.9, 129.6, 129.2, 127.0, 125.5, 125.3, 21.4; **HRMS (ESI-TOF)** m/z calcd for $C_{21}H_{16}N$ $[M + H]^+$ 282.1283, found 282.1286.



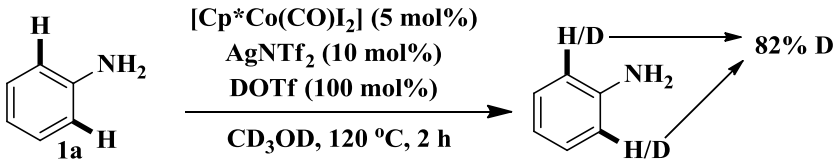
2-styrylphenylamine 5, 14%

A reaction kettle (25 mL) was charged with 2-styrylphenylamine (0.5 mmol, 1 equiv), [Cp*Co(CO)I_2] (12.0 mg, 5.0 mol %), $AgNTf_2$ (20 mg, 10.0 mol %), CH_3OH (2 mL), then the HOTf (0. 5 mmol) was added. The reaction was sealed with a rubber septum and a CO atmosphere was injected in the flask with a balloon and a needle. The mixture was stirred at 120 ^oC for 8 hours under an atmosphere of CO. The mixture was quenched by sat. aq. $NaHCO_3$, and diluted with 20 mL dichloromethane and washed with 10 mL H_2O. The aqueous layer was extracted twice with dichloromethane (10 mL) and the combined organic phase was dried over Na_2SO_4. After evaporation of the solvents, the residue was purified by silica gel chromatography (hexane/AcOEt = 10 : 1) to yield product **5** (14.4 mg, 14%).



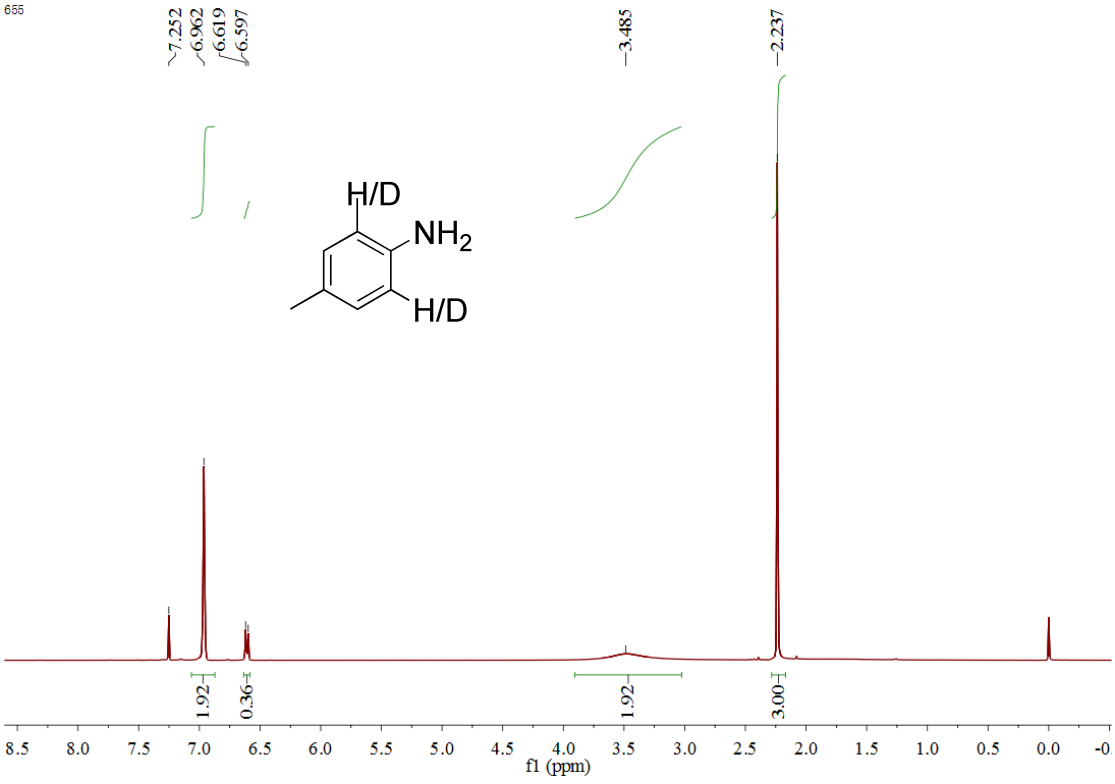
N-phenylformamide 2a 3a, 0%

A reaction kettle (25 mL) was charged with *N*-phenylformamide (0.5 mmol, 1 equiv), acetophenone **2** (0.5 mmol, 1.2 equiv), [Cp*CoI_2(CO)] (12.0 mg, 5.0 mol %), $AgNTf_2$ (20 mg, 10.0 mol%), CH_3OH (2 mL), then the HOTf (0. 5 mmol) was added. The mixture was stirred at 120 ^oC for 8 hours under an atmosphere of air. When the reactioin finished, no product 3a was obtained.

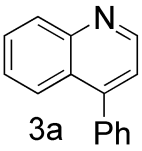


1a

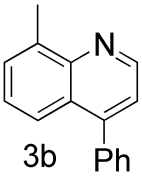
A reaction kettle (25 mL) was charged with *p*-tolylamine **1m** (0.5 mmol, 1 equiv), [Cp*Co(CO)I_2] (12.0 mg, 5.0 mol %), $AgNTf_2$ (20 mg, 10.0 mol%), CD_3OD (2 mL), then the DOTf (0. 5 mmol) was added. The mixture was stirred at 120 ^oC for 2 hours under an atmosphere of air. The mixture was quenched by sat. aq. $NaHCO_3$, and diluted with 20 mL dichloromethane and washed with 10 mL H_2O. The aqueous layer was extracted twice with dichloromethane (10 mL) and the combined organic phase was dried over Na_2SO_4. After evaporation of the solvents, the residue was purified by silica gel chromatography (hexane/AcOEt = 20 : 1) to yield product.



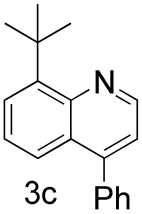
Characterization data for products



4-Phenylquinoline (3a): Obtained as a yellow liquid (64.9 mg, 63% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.93 (d, J = 4.0 Hz, 1H), 8.18 (d, J = 8.4 Hz, 1H), 7.91 (d, J = 8.4 Hz, 1H), 7.68 - 7.72 (t, 1H), 7.45 - 7.52 (m, 6H), 7.31 (d, J = 4.0 Hz, 1H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 150.0, 148.6, 148.4, 137.9, 129.7, 129.4, 129.2, 128.5, 128.3, 126.7, 126.5, 125.8, 121.2; **HRMS (ESI-TOF)** m/z calcd for $C_{15}H_{12}N$ $[M + H]^+$ 206.0970, found 209.0976.

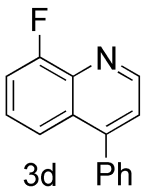


8-Methyl-4-phenylquinoline (3b): Obtained as a white solid (71.2 mg, 65% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.97 (d, J = 4.4 Hz, 1H), 7.75 (d, J = 8.4 Hz, 1H), 7.57 (d, J = 6.8 Hz, 1H), 7.45 - 7.53 (m, 5H), 7.35 - 7.39 (t, 1H), 7.32 (d, J = 4.4 Hz, 1H), 2.87 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 148.7, 147.7, 138.4, 137.3, 129.54, 129.49, 128.4, 128.2, 126.7, 126.2, 123.9, 120.1, 18.6; **HRMS (ESI-TOF)** m/z calcd for $C_{16}H_{14}N$ $[M + H]^+$ 220.1126, found 220.1128.

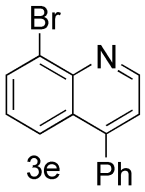


8-tert-Butyl-4-phenylquinoline (**3c**): Obtained as a yellow liquid (80.9 mg, 62% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.93 (d, J = 4.0 Hz, 1H), 7.73 (d, J = 8.4 Hz, 1H), 7.67 (d, J = 7.6 Hz, 1H), 7.40 - 7.50 (m, 5H), 7.34 - 7.38 (t, 1H), 7.24 (d, J = 4.0 Hz,

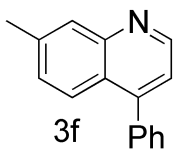
1H), 1.72 (s, 9H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 148.6, 148.3, 147.8, 146.7, 139.0, 129.6, 128.4, 128.0, 127.7, 125.9, 124.6, 120.5, 36.7, 31.1; **HRMS (ESI-TOF)** m/z calcd for $C_{19}H_{20}N$ $[M + H]^+$ 262.1596, found 262.1602.



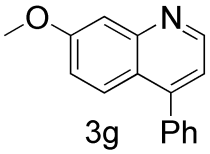
8-Fluoro-4-phenylquinoline (3d): Obtained as yellow liquid (56.9 mg, 51% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.98 (d, J = 4.0 Hz, 1H), 7.68 - 7.70 (t, 1H), 7.45 - 7.54 (m, 5H), 7.38 - 7.52 (m, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 159.4, 156.9, 149.9, 148.3 (d, J = 2.8 Hz), 138.9 (d, J = 11.3 Hz), 137.5, 129.3, 128.5, 128.4 (d, J = 1.5 Hz), 126.1 (d, J = 8.2 Hz), 122.1, 121.5 (d, J = 4.7 Hz), 113.2 (d, J = 18.9 Hz); **HRMS (ESI-TOF)** m/z calcd for $C_{15}H_{11}FN$ $[M + H]^+$ 224.0876, found 224.0878.



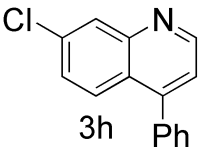
8-Bromo-4-phenylquinoline (3e): Obtained as a white solid (76.4 mg, 54% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 9.05 (d, J = 4.4 Hz, 1H), 8.04 (d, J = 7.2 Hz, 1H), 7.86 (d, J = 8.8 Hz, 1H), 7.44 - 7.53 (m, 5H), 7.37 (d, J = 4.4 Hz, 1H), 7.28 - 7.32 (t, 1H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 150.5, 149.0, 145.5, 137.4, 133.0, 129.4, 128.52, 128.50, 128.1, 126.7, 125.8, 125.1, 122.1; **HRMS (ESI-TOF)** m/z calcd for $C_{15}H_{15}BrN$ $[M + H]^+$ 284.0075, found 284.0079.



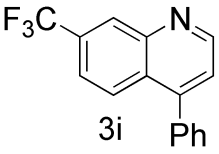
7-Methyl-4-phenylquinoline (3f): Obtained as a white solid (78.8 mg, 72% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.85 (d, J = 4.0 Hz, 1H), 8.06 (d, J = 8.4 Hz, 1H), 7.57 - 7.61 (t, 1H), 7.42 - 7.43 (m, 3H), 7.27 - 7.32 (m, 3H), 7.20 (d, J = 8.4 Hz, 1H), 2.01 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 149.7, 148.9, 148.6, 142.4, 135.6, 129.8, 128.9, 128.7, 127.9, 127.7, 126.2, 123.4, 24.4; **HRMS (ESI-TOF)** m/z calcd for $C_{16}H_{14}N$ $[M + H]^+$ 220.1126, found 220.1128.



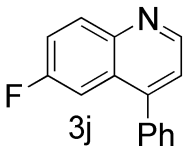
7-Methoxy-4-phenylquinoline (3g): Obtained as a white solid (83.4 mg, 71% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.78 (d, J = 4.4 Hz, 1H), 8.07 (d, J = 9.2 Hz, 1H), 7.46 - 7.53 (m, 5H), 7.35 - 7.38 (m, 1H), 7.25 (d, J = 4.4 Hz, 1H), 7.18 (d, J = 2.0 Hz, 1H), 3.76 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 157.8, 147.4, 147.0, 144.7, 138.2, 131.2, 129.2, 128.6, 128.2, 127.6, 121.62, 121.55, 103.6, 55.3; **HRMS (ESI-TOF)** m/z calcd for $C_{16}H_{14}NO$ $[M + H]^+$ 236.1075, found 236.1079.



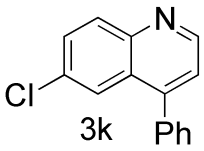
7-Chloro-4-phenylquinoline (3h): Obtained as a white solid (80.1 mg, 67% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.93 (d, J = 4.4 Hz, 1H), 8.17 (d, J = 1.2 Hz, 1H), 7.85 (d, J = 9.2 Hz, 1H), 7.42 - 7.55 (m, 6H), 7.33 (d, J = 4.4 Hz, 1H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 151.0, 149.1, 148.6, 137.5, 135.2, 129.4, 128.70, 128.67, 127.6, 127.3, 125.2, 121.4; **HRMS (ESI-TOF)** m/z calcd for $C_{15}H_{11}NCl$ $[M + H]^+$ 240.0580, found 240.0584.



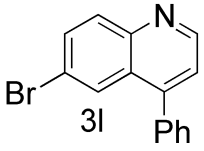
7-trifluoromethyl-4-phenylquinoline (3i): Obtained as a white solid (65.5 mg, 48% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.93 (d, J = 4.4 Hz, 1H), 8.17 (d, J = 1.2 Hz, 1H), 7.85 (d, J = 9.2 Hz, 1H), 7.42 - 7.55 (m, 6H), 7.33 (d, J = 4.4 Hz, 1H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 151.3, 148.6, 147.8, 137.2, 130.9, 129.5, 128.9, 128.8, 128.4, 127.7 (q, J = 8.6 Hz), 127.3, 122.9, 122.2 (q, J = 6.2 Hz); **HRMS (ESI-TOF)** m/z calcd for $C_{16}H_{11}NF_3$ $[M + H]^+$ 274.0844, found 274.0847.



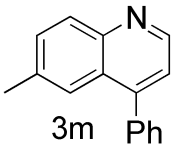
6-Fluoro-4-phenylquinoline (3j): Obtained as a white solid (68.0 mg, 61% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.88 (d, J = 4.4 Hz, 1H), 8.16 (dd, J = 8.8, 5.6 Hz, 1H), 7.43 - 7.52 (m, 7H), 7.30 (d, J = 4.4 Hz, 1H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 161.7, 159.2, 149.0 (d, J = 2.6 Hz), 147.8 (d, J = 5.6 Hz), 145.6, 137.3, 132.2 (d, J = 9.1 Hz), 129.1, 128.6, 128.5, 127.4 (d, J = 9.5 Hz), 121.6, 119.4 (d, J = 25.6 Hz), 109.0 (d, J = 22.9 Hz); **HRMS (ESI-TOF)** m/z calcd for $C_{15}H_{11}FN$ $[M + H]^+$ 224.0876, found 224.0878.



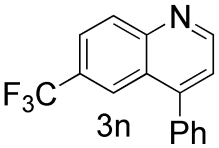
6-Chloro-4-phenylquinoline (3k): Obtained as a white solid (76.5 mg, 64% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.90 (d, J = 4.0 Hz, 1H), 8.09 (d, J = 8.8 Hz, 1H), 7.87 (s, 1H), 7.63 (d, J = 8.8 Hz, 1H), 7.44 - 7.52 (m, 5H), 7.31 - 7.32 (m, 1H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 150.0, 147.6, 147.0, 137.2, 132.5, 131.4, 130.1, 129.3, 128.7, 128.6, 127.3, 124.5, 121.9; **HRMS (ESI-TOF)** m/z calcd for $C_{15}H_{11}NCl$ $[M + H]^+$ 240.0580, found 240.0584.



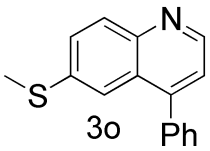
6-Bromo-4-phenylquinoline (3l): Obtained as a white solid (94.8 mg, 67% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.92 (d, J = 3.6 Hz, 1H), 8.03 (d, J = 10.4 Hz, 2H), 7.76 (d, J = 9.2 Hz, 1H), 7.45 - 7.52 (m, 5H), 7.31 - 7.32 (m, 1H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 150.1, 147.5, 147.2, 137.1, 132.7, 131.5, 129.3, 128.7, 128.6, 127.9, 127.8, 121.9, 120.8; **HRMS (ESI-TOF)** m/z calcd for $C_{15}H_{15}BrN$ $[M + H]^+$ 284.0075, found 284.0079.



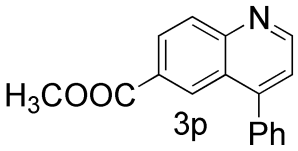
6-Methyl-4-phenylquinoline (3m): Obtained as a white solid (85.4 mg, 78% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.86 (d, J = 4.4 Hz, 1H), 8.07 (d, J = 8.4 Hz, 1H), 7.66 (s, 1H), 7.48 - 7.56 (m, 6H), 7.27 (d, J = 4.4 Hz, 1H), 2.46 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 149.1, 147.8, 147.3, 138.3, 136.5, 131.6, 129.59, 129.53, 128.6, 128.3, 126.7, 124.6, 121.4, 21.8; **HRMS (ESI-TOF)** m/z calcd for $C_{16}H_{14}N$ $[M + H]^+$ 220.1126, found 220.1128.



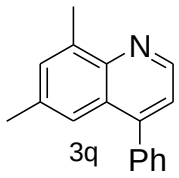
6-trifluoromethyl-4-phenylquinoline (3n): Obtained as a yellow liquid (73.7 mg, 54% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 9.03 (d, J = 4.4 Hz, 1H), 8.25 - 8.30 (m, 2H), 7.89 (d, J = 4.4 Hz, 1H), 7.48 - 7.57 (m, 5H), 7.42 (d, J = 4.4 Hz, 1H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 152.0, 149.7, 149.5, 137.0, 131.2, 129.4, 129.0, 128.9, 128.3 (q, J = 52.3 Hz), 125.9, 125.0 (q, J = 5.5 Hz), 123.9 (q, J = 8.9 Hz), 122.4; **HRMS (ESI-TOF)** m/z calcd for $C_{16}H_{11}NF_3$ $[M + H]^+$ 274.0844, found 274.0849.



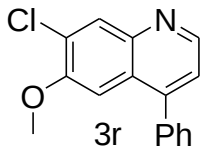
6-Methylsulfanyl-4-phenylquinoline (3o): Obtained as a white solid (76.6 mg, 61% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.84 (d, J = 4.4 Hz, 1H), 8.06 (d, J = 8.8 Hz, 1H), 7.66 (d, J = 1.2 Hz, 1H), 7.60 (dd, J = 8.8, 1.6 Hz, 1H), 7.48 - 7.54 (m, 5H), 7.29 (d, J = 4.4 Hz, 1H), 2.44 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 149.1, 147.1, 147.0, 137.9, 137.5, 130.1, 129.4, 128.73, 128.67, 128.5, 127.1, 121.9, 121.1, 15.7; **HRMS (ESI-TOF)** m/z calcd for $C_{16}H_{14}NS$ $[M + H]^+$ 252.0847, found 252.0852.



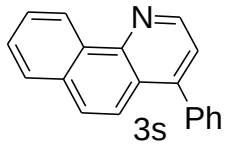
4-Phenylquinoline-6-carboxylic acid methyl ester (3p): Obtained as a yellow liquid (57.9 mg, 44% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.79 (d, J = 4.4 Hz, 1H), 8.18 (s, 1H), 7.49 - 7.56 (m, 5H), 7.27 (d, J = 4.4 Hz, 1H), 7.22 (s, 1H), 3.83 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 153.5, 148.6, 147.0, 144.5, 138.0, 130.7, 129.2, 128.8, 128.6, 127.5, 126.4, 121.8, 104.2, 56.2; **HRMS (ESI-TOF)** m/z calcd for $C_{16}H_{14}NO_2$ $[M + H]^+$ 264.1025, found 264.1032.



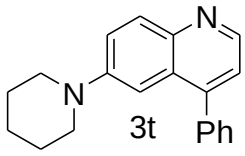
6,8-Dimethyl-4-phenylquinoline (3q): Obtained as a white solid (103.7 mg, 89% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.90 (d, J = 4.4 Hz, 1H), 7.48 - 7.54 (m, 6H), 7.43 (s, 1H), 7.28 (d, J = 4.4 Hz, 1H), 2.83 (s, 3H), 2.42 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 147.9, 147.8, 146.4, 138.7, 137.0, 136.0, 131.9, 129.6, 128.5, 128.1, 126.8, 122.6, 121.3, 21.8, 18.5; **HRMS (ESI-TOF)** m/z calcd for $C_{17}H_{16}N$ $[M + H]^+$ 234.1283, found 234.1286.



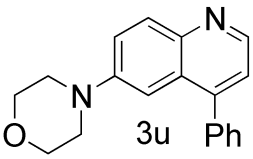
7-Chloro-6-methoxy-4-phenylquinoline (3r): Obtained as a white solid (96.8 mg, 72% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 9.01 (d, J = 4.0 Hz, 1H), 8.69 (s, 1H), 8.30 (d, J = 8.8 Hz, 1H), 8.20 (d, J = 8.8 Hz, 1H), 7.50 - 7.57 (m, 5H), 7.39 (d, J = 4.4 Hz, 1H), 3.92 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 166.7, 152.0, 150.6, 149.9, 137.3, 130.2, 129.6, 129.1, 128.8, 128.7, 128.2, 126.0, 122.1, 52.4; **HRMS (ESI-TOF)** m/z calcd for $C_{16}H_{13}ClNO$ $[M + H]^+$ 270.0686, found 270.0694.



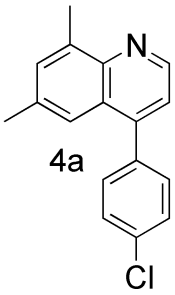
4-Phenyl-benzo[h]quinoline (3s): Obtained as a white solid (75.2 mg, 59% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 9.01 (d, J = 4.0 Hz, 1H), 8.69 (s, 1H), 8.30 (d, J = 8.8 Hz, 1H), 8.20 (d, J = 8.8 Hz, 1H), 7.50 - 7.57 (m, 5H), 7.39 (d, J = 4.4 Hz, 1H), 3.92 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 166.7, 152.0, 150.6, 149.9, 137.3, 130.2, 129.6, 129.1, 128.8, 128.7, 128.2, 126.0, 122.1, 52.4; **HRMS (ESI-TOF)** m/z calcd for $C_{19}H_{14}N$ $[M + H]^+$ 256.1126, found 256.1129.



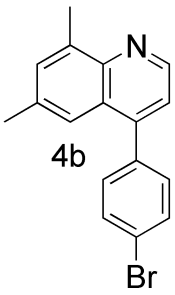
6-piperidin-1-yl-4-Phenylquinoline (3t): Obtained as a white solid (87.8 mg, 61% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.69 (d, J = 4.4 Hz, 1H), 8.01 (d, J = 9.2 Hz, 1H), 7.45 - 7.51 (m, 6H), 7.19 (d, J = 4.4 Hz, 1H), 7.13 (d, J = 2.0 Hz, 1H), 3.13 - 3.15 (m, 4H), 1.63 - 1.70 (m, 4H), 1.51 - 1.57 (m, 2H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 150.3, 146.8, 146.6, 144.1, 138.7, 130.3, 129.4, 128.6, 128.2, 127.8, 122.9, 121.6, 107.3, 50.5, 25.7, 24.2; **HRMS (ESI-TOF)** m/z calcd for $C_{20}H_{21}N_2$ $[M + H]^+$ 289.1705, found 289.1707.



6-Morpholin-4-yl-4-phenyl-quinoline (3u): Obtained as a yellow solid (92.8 mg, 64% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.64 (d, J = 4.4 Hz, 1H), 7.96 (d, J = 9.2 Hz, 1H), 7.36 - 7.45 (m, 6H), 7.13 (d, J = 4.4 Hz, 1H), 7.05 (d, J = 2.0 Hz, 1H), 3.73 - 3.75 (m, 4H), 3.04 - 3.06 (m, 4H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 149.4, 147.3, 146.9, 144.4, 138.5, 130.6, 129.3, 128.7, 128.3, 127.7, 121.8, 121.6, 107.1, 66.8, 49.2; **HRMS (ESI-TOF)** m/z calcd for $C_{19}H_{19}N_2O$ $[M + H]^+$ 291.1497, found 291.1502.

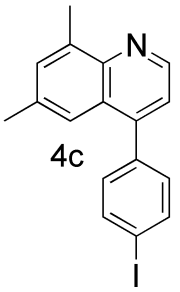


4-(4-Chloro-phenyl)-6,8-dimethyl-quinoline (4a): Obtained as a yellow solid (108.1 mg, 81% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.86 (d, J = 4.4 Hz, 1H), 7.35 - 7.46 (m, 6H), 7.19 (d, J = 4.4 Hz, 1H), 2.81 (s, 3H), 2.39 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 147.8, 146.6, 146.4, 137.2, 137.1, 136.3, 134.4, 132.0, 130.9, 128.7, 126.5, 122.3, 121.2, 21.8, 18.5; **HRMS (ESI-TOF)** m/z calcd for $C_{17}H_{15}ClN$ $[M + H]^+$ 268.0893, found 268.0899.

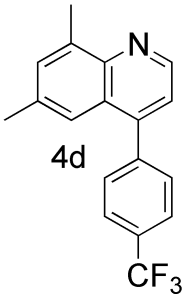


4-(4-Bromo-phenyl)-6,8-dimethyl-quinoline (4b): Obtained as a yellow solid (127.5 mg, 82% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.88 (d, J = 4.4 Hz, 1H), 7.64 (d, J = 8.0 Hz, 2H), 7.42 (s, 2H), 7.34 (d, J = 8.0 Hz, 2H), 7.23 (d, J = 4.4 Hz, 1H), 2.82 (s,

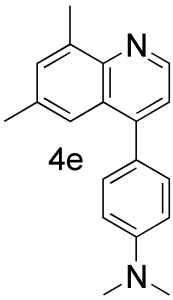
3H), 2.42 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 147.8, 146.6, 146.4, 137.6, 137.2, 136.3, 132.0, 131.7, 131.2, 126.5, 122.5, 122.2, 121.2, 21.8, 18.5; **HRMS (ESI-TOF)** m/z calcd for $C_{17}H_{15}BrN$ $[M + H]^+$ 312.0388, found 312.0393.



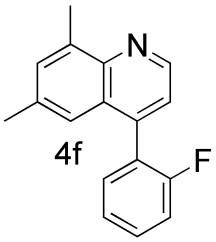
4-(4-Iodo-phenyl)-6,8-dimethyl-quinoline (4c): Obtained as a yellow solid (124.4 mg, 78% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.87 (d, J = 4.4 Hz, 1H), 7.82 (d, J = 8.0 Hz, 2H), 7.41 (s, 2H), 7.17 - 7.20 (t, 3H), 2.81 (s, 3H), 2.40 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 147.8, 146.6, 146.4, 137.6, 137.2, 136.3, 132.0, 131.7, 131.2, 126.5, 122.5, 122.2, 121.2, 21.8, 18.5; **HRMS (ESI-TOF)** m/z calcd for $C_{17}H_{15}IN$ $[M + H]^+$ 360.0249, found 360.0251.



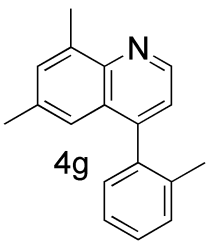
6,8-Dimethyl-4-(4-trifluoromethyl-phenyl)-quinoline (4d): Obtained as a yellow solid (103.8 mg, 69% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.91 (d, J = 4.4 Hz, 1H), 7.78 (d, J = 8.0 Hz, 2H), 7.59 (d, J = 8.0 Hz, 2H), 7.44 (s, 1H), 7.38 (s, 1H), 7.25 (d, J = 4.0 Hz, 1H), 2.83 (s, 3H), 2.42 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 147.7, 146.4, 146.3, 142.4, 137.3, 136.6, 132.2, 130.2 (d, J = 32.3 Hz), 129.9, 126.3, 125.5 (d, J = 7.4 Hz), 122.1, 121.1, 21.8, 18.5; **HRMS (ESI-TOF)** m/z calcd for $C_{18}H_{15}F_3N$ $[M + H]^+$ 302.1157, found 302.1163.



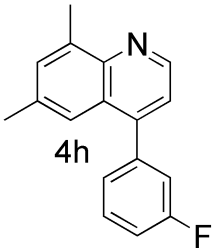
[4-(6,8-Dimethyl-quinolin-4-yl)-phenyl]-dimethyl-amine (4e): Obtained as a yellow solid (115.9 mg, 84% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.84 (d, J = 4.4 Hz, 1H), 7.66 (s, 1H), 7.37 - 7.39 (m, 3H), 7.23 (d, J = 4.4 Hz, 1H), 6.81 (d, J = 8.8 Hz, 2H), 3.00 (s, 3H), 2.82 (s, 3H), 2.40 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 150.4, 148.3, 147.9, 146.6, 136.8, 135.5, 131.7, 130.6, 127.1, 126.3, 123.1, 121.1, 112.1, 40.4, 21.8, 18.7; **HRMS (ESI-TOF)** m/z calcd for $C_{19}H_{21}N_2$ $[M + H]^+$ 277.1705, found 277.1712.



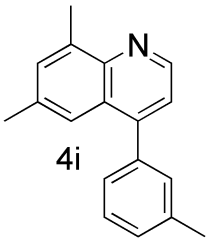
4-(2-Fluoro-phenyl)-6,8-dimethyl-quinoline (4f): Obtained as a yellow solid (90.4 mg, 72% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.92 (d, J = 4.4 Hz, 1H), 7.42 - 7.47 (m, 2H), 7.36 (t, 1H), 7.21 - 7.30 (m, 4H), 2.83 (s, 3H), 2.40 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 160.9, 158.5, 147.7, 146.2, 142.0, 137.0, 136.3, 132.1, 131.7 (d, J = 3.2 Hz), 130.3 (d, J = 7.9 Hz), 127.0, 126.1 (d, J = 16.0 Hz), 124.2 (d, J = 3.6 Hz), 122.3 (d, J = 39.6 Hz), 116.0 (d, J = 21.7 Hz), 21.8, 18.4; **HRMS (ESI-TOF)** m/z calcd for $C_{17}H_{15}FN$ $[M + H]^+$ 252.1189, found 252.1191.



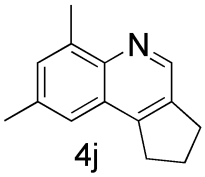
6,8-Dimethyl-4-*o*-tolyl-quinoline (4g): Obtained as a yellow solid (107.4 mg, 87% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.90 (d, J = 4.4 Hz, 1H), 7.29 - 7.40 (m, 4H), 7.18 - 7.20 (m, 2H), 7.07 (s, 1H), 2.84 (s, 3H), 2.37 (s, 3H), 2.03 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 147.91, 147.86, 146.2, 138.2, 136.9, 136.09, 136.06, 132.0, 130.1, 129.6, 128.2, 127.3, 125.7, 122.7, 121.4, 21.7, 20.0, 18.4; **HRMS (ESI-TOF)** m/z calcd for $C_{18}H_{18}N$ $[M + H]^+$ 248.1439, found 248.1442.



4-(3-Fluoro-phenyl)-6,8-dimethyl-quinoline (4h): Obtained as a yellow solid (85.3 mg, 68% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.90 (d, J = 4.4 Hz, 1H), 7.44 - 7.51 (m, 3H), 7.24 - 7.26 (m, 2H), 7.16 - 7.20 (t, 2H), 2.83 (s, 3H), 2.42 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 163.9, 161.5, 147.8, 146.5 (d, J = 13.3 Hz), 140.8 (d, J = 7.6 Hz), 137.1, 136.4, 132.0, 130.0 (d, J = 8.3 Hz), 126.5, 125.3 (d, J = 2.9 Hz), 122.3, 121.1, 116.7 (d, J = 21.9 Hz), 115.1 (d, J = 20.9 Hz), 21.8, 18.4; **HRMS (ESI-TOF)** m/z calcd for $C_{17}H_{15}FN$ $[M + H]^+$ 252.1189, found 252.1191.

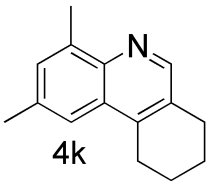


6,8-Dimethyl-4-*m*-tolyl-quinoline (4i): Obtained as a yellow solid (108.7 mg, 88% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.88 (d, J = 4.4 Hz, 1H), 7.50 (s, 1H), 7.38 - 7.42 (m, 2H), 7.25 - 7.29 (m, 4H), 2.83 (s, 3H), 2.45 (s, 3H), 2.41 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 148.1, 147.8, 146.4, 138.7, 138.2, 136.9, 135.9, 131.8, 130.2, 128.9, 128.3, 126.9, 126.7, 122.7, 121.2, 21.8, 21.5, 18.5; **HRMS (ESI-TOF)** m/z calcd for $C_{18}H_{18}N$ $[M + H]^+$ 248.1439, found 248.1442.



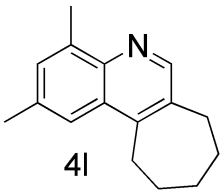
4j

6,8-Dimethyl-2,3-dihydro-1H-cyclopenta[c]quinoline (4j): Obtained as a yellow solid (70.9 mg, 72% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.78 (s, 1H), 7.40 (s, 1H), 7.34 (s, 1H), 3.20 - 3.24 (t, 2H), 3.10 - 3.14 (t, 2H), 2.78 (s, 3H), 2.49 (s, 3H), 2.22 - 2.30 (m, 2H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 149.3, 145.6, 144.7, 137.0, 136.4, 135.8, 130.8, 126.1, 121.1, 31.4, 31.1, 24.5, 21.7, 18.6; **HRMS (ESI-TOF)** m/z calcd for $C_{14}H_{16}N$ $[M + H]^+$ 198.1283, found 198.1286.



4k

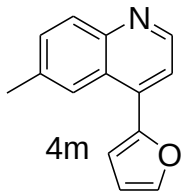
2,4-Dimethyl-7,8,9,10-tetrahydro-phenanthridine (4k): Obtained as a yellow solid (84.4 mg, 80% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.55 (s, 1H), 7.49 (s, 1H), 7.29 (s, 1H), 3.00 - 3.03 (t, 2H), 2.82 - 2.85 (t, 2H), 2.75 (s, 3H), 2.47 (s, 3H), 1.80 - 1.94 (m, 4H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 150.3, 144.0, 140.6, 137.0, 135.5, 130.5, 129.2, 127.5, 119.6, 27.2, 25.1, 22.6, 22.4, 21.9, 18.4; **HRMS (ESI-TOF)** m/z calcd for $C_{15}H_{18}N$ $[M + H]^+$ 212.1439, found 212.1444.



4l

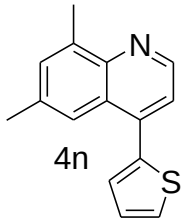
2,4-Dimethyl-8,9,10,11-tetrahydro-7H-cyclohepta[c]quinoline (4l): Obtained as a yellow liquid (76.5 mg, 68% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.61 (s, 1H), 7.70 (s, 1H), 7.31 (s, 1H), 3.16 - 3.19 (t, 2H), 2.92 - 2.95 (t, 2H), 2.77 (s, 3H), 2.48 (s, 3H), 1.87 - 1.93 (m, 2H), 1.65 - 1.68 (m, 4H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 149.4, 147.5, 145.1, 137.1, 135.3, 135.2, 130.6, 126.6, 120.1, 33.2, 32.5, 28.1, 27.5,

26.4, 22.0, 18.6; **HRMS (ESI-TOF)** m/z calcd for $C_{16}H_{20}N$ $[M + H]^+$ 226.1596, found 226.1604.



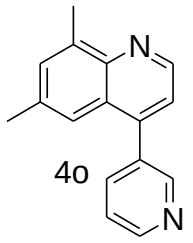
4m

4-Furan-2-yl-6,8-dimethyl-quinoline (4m): Obtained as a yellow solid (84.7 mg, 76% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.85 (d, J = 4.4 Hz, 1H), 8.04 (s, 1H), 7.64 (s, 1H), 7.53 (d, J = 4.4 Hz, 1H), 7.39 (s, 1H), 6.89 (d, J = 2.4 Hz, 1H), 6.57 - 6.59 (m, 1H), 2.79 (s, 3H), 2.48 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 151.5, 147.8, 146.8, 143.6, 137.1, 136.4, 135.2, 131.9, 124.6, 122.2, 118.7, 111.9, 111.8, 22.0, 18.7; **HRMS (ESI-TOF)** m/z calcd for $C_{15}H_{14}NO$ $[M + H]^+$ 224.1075, found 224.1077.

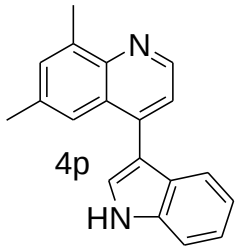


4n

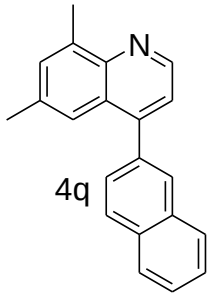
6,8-Dimethyl-4-thiophen-2-yl-quinoline (4n): Obtained as a yellow liquid (88.4 mg, 74% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.84 (d, J = 4.4 Hz, 1H), 7.87 (s, 1H), 7.46 (d, J = 5.2 Hz, 1H), 7.41 (s, 1H), 7.36 (d, J = 4.4 Hz, 1H), 7.31 - 7.32 (m, 1H), 7.17 - 7.19 (m, 1H), 2.81 (s, 3H), 2.44 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 147.7, 146.6, 140.2, 139.5, 137.1, 136.5, 132.1, 128.4, 127.7, 126.9, 126.5, 122.4, 121.8, 21.9, 18.6; **HRMS (ESI-TOF)** m/z calcd for $C_{15}H_{14}NS$ $[M + H]^+$ 240.0847, found 240.0849.



6,8-Dimethyl-4-pyridin-3-yl-quinoline (4o): Obtained as a yellow liquid (63.2 mg, 54% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.93 (d, J = 4.4 Hz, 1H), 8.73 - 8.75 (m, 2H), 7.82 (d, J = 7.6 Hz, 1H), 7.46 - 7.49 (m, 2H), 7.40 (s, 1H), 7.27 - 7.29 (m, 1H), 2.84 (s, 3H), 2.43 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 150.0, 149.5, 147.8, 146.4, 144.1, 137.3, 136.9, 136.7, 134.5, 132.2, 126.5, 123.3, 121.9, 121.5, 21.8, 18.5; **HRMS (ESI-TOF)** m/z calcd for $C_{16}H_{15}N_2$ $[M + H]^+$ 235.1235, found 235.1239.

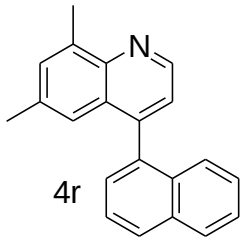


4-(1H-Indol-3-yl)-6,8-dimethyl-quinoline (4p): Obtained as a yellow solid (121.0 mg, 89% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.90 (d, J = 4.0 Hz, 1H), 8.88 (s, 1H), 7.79 (s, 1H), 7.59 (d, J = 8.0 Hz, 1H), 7.44 - 7.51 (t, 4H), 7.27 - 7.31 (t, 1H), 7.15 - 7.19 (t, 1H), 2.86 (s, 3H), 2.40 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 148.0, 146.6, 141.5, 136.8, 136.3, 135.6, 131.9, 127.6, 127.0, 124.4, 123.2, 122.8, 121.8, 120.6, 120.1, 114.6, 111.5, 21.8, 18.7; **HRMS (ESI-TOF)** m/z calcd for $C_{19}H_{17}N_2$ $[M + H]^+$ 273.1392, found 273.1397.



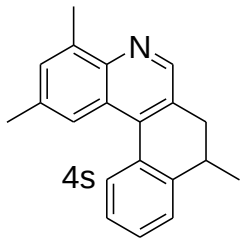
6,8-Dimethyl-4-naphthalen-2-yl-quinoline (4q): Obtained as a yellow solid (111.7 mg, 79% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.92 (d, J = 4.4 Hz, 1H), 7.89 -

7.97 (m, 4H), 7.52 - 7.59 (m, 4H), 7.42 (s, 1H), 7.35 (d, *J* = 4.4 Hz, 1H), 2.85 (s, 3H), 2.38 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 147.93, 147.85, 146.5, 137.1, 136.3, 136.2, 133.3, 133.0, 131.9, 128.6, 128.3, 128.0, 127.8, 127.6, 127.0, 126.62, 126.58, 122.8, 121.6, 21.8, 18.6; **HRMS (ESI-TOF)** m/z calcd for $C_{21}H_{18}N$ $[M + H]^+$ 284.1439, found 284.1442.



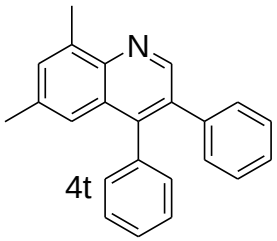
4r

6,8-Dimethyl-4-naphthalen-1-yl-quinoline (4r): Obtained as a yellow solid (100.5 mg, 71% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.97 (d, *J* = 4.0 Hz, 1H), 7.94 - 7.99 (t, 2H), 7.57 - 7.61 (t, 1H), 7.47 - 7.51 (t, 1H), 7.41 - 7.45 (t, 2H), 7.29 - 7.36 (m, 3H), 7.03 (s, 1H), 2.87 (s, 3H), 2.26 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 147.8, 146.7, 146.2, 136.9, 136.3, 136.1, 133.5, 132.1, 132.0, 128.5, 128.3, 128.1, 127.3, 126.4, 126.1, 125.3, 123.1, 122.5, 21.7, 18.5; **HRMS (ESI-TOF)** m/z calcd for $C_{21}H_{18}N$ $[M + H]^+$ 284.1439, found 284.1442.

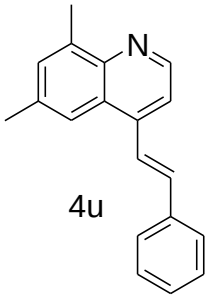


4s

2,4,8-Trimethyl-7,8-dihydro-benzo[k]phenanthridine (4s): Obtained as a yellow liquid (114.7 mg, 84% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.76 (s, 1H), 8.12 (s, 1H), 7.98 - 8.00 (t, 1H), 7.38 - 7.41 (m, 4H), 2.98 - 3.05 (m, 2H), 2.82 (s, 3H), 2.66 - 2.73 (m, 2H), 2.50 (s, 3H), 1.27 (d, *J* = 6.4 Hz, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 148.5, 146.7, 144.6, 138.4, 137.2, 135.9, 131.9, 130.7, 129.5, 129.1, 128.8, 126.2, 126.1, 124.4, 122.3, 34.3, 32.7, 22.0, 18.8, 18.4; **HRMS (ESI-TOF)** m/z calcd for $C_{20}H_{20}N$ $[M + H]^+$ 274.1596, found 274.1603.



6,8-Dimethyl-3,4-diphenylquinoline (4t): Obtained as a yellow solid (112.8 mg, 73% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.96 (s, 1H), 7.40 (s, 1H), 7.27 - 7.32 (m, 4H), 7.14 - 7.21 (m, 7H), 2.86 (s, 3H), 2.37 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 149.6, 145.3, 145.1, 138.6, 136.9, 136.7, 136.3, 132.9, 131.7, 130.6, 130.2, 128.1, 128.0, 127.5, 127.2, 126.9, 123.4, 21.9, 18.4; **HRMS (ESI-TOF)** m/z calcd for $C_{23}H_{20}N$ $[M + H]^+$ 310.1596, found 310.1602.



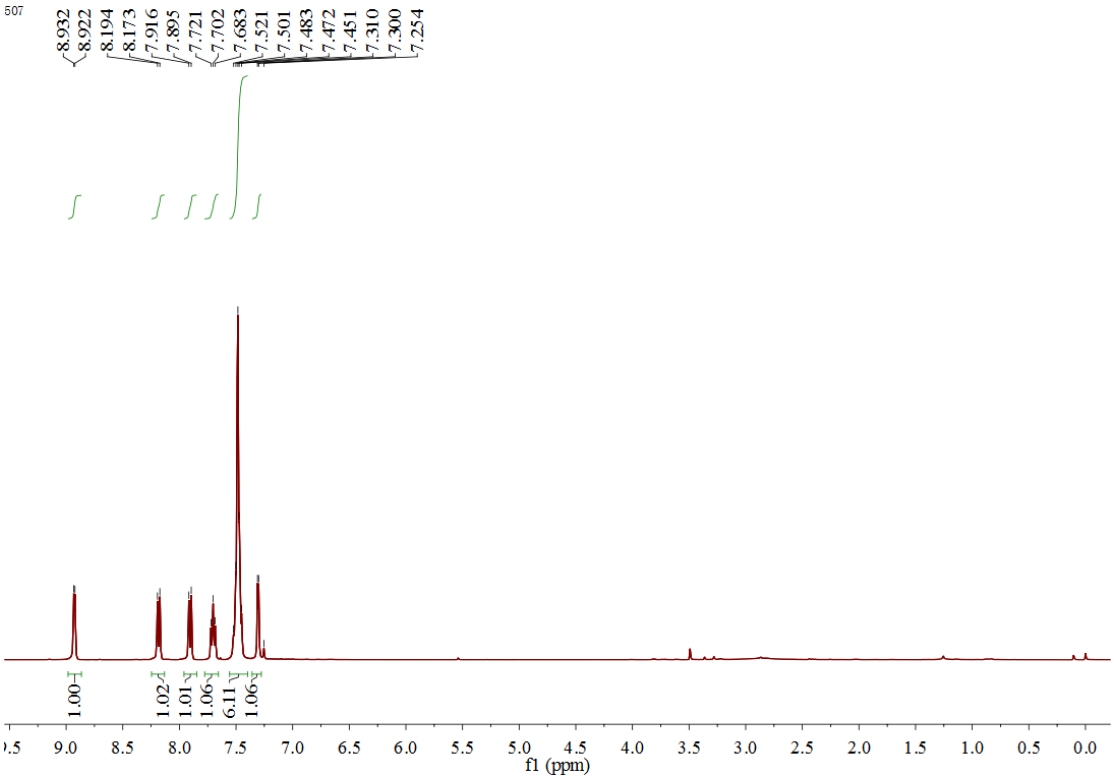
6,8-Dimethyl-4-styrylquinoline (4u): Obtained as a yellow solid (117.8 mg, 91% yield); **^{1}H NMR** (400 MHz, $CDCl_3$) δ ppm: 8.83 (d, J = 4.4 Hz, 1H), 7.75 - 7.79 (m, 2H), 7.60 (d, J = 7.2 Hz, 2H), 7.51 (d, J = 4.4 Hz, 1H), 7.39 - 7.43 (m, 3H), 7.31 - 7.35 (t, 1H), 7.25 (d, J = 16.4 Hz, 1H), 2.79 (s, 3H), 2.51 (s, 3H); **^{13}C NMR** (100 MHz, $CDCl_3$) δ ppm: 148.1, 146.4, 142.4, 137.2, 136.8, 135.9, 134.5, 131.9, 128.9, 128.6, 127.1, 126.4, 123.7, 120.4, 117.0, 21.9, 18.6; **HRMS (ESI-TOF)** m/z calcd for $C_{19}H_{18}N$ $[M + H]^+$ 260.1439, found 260.1443.

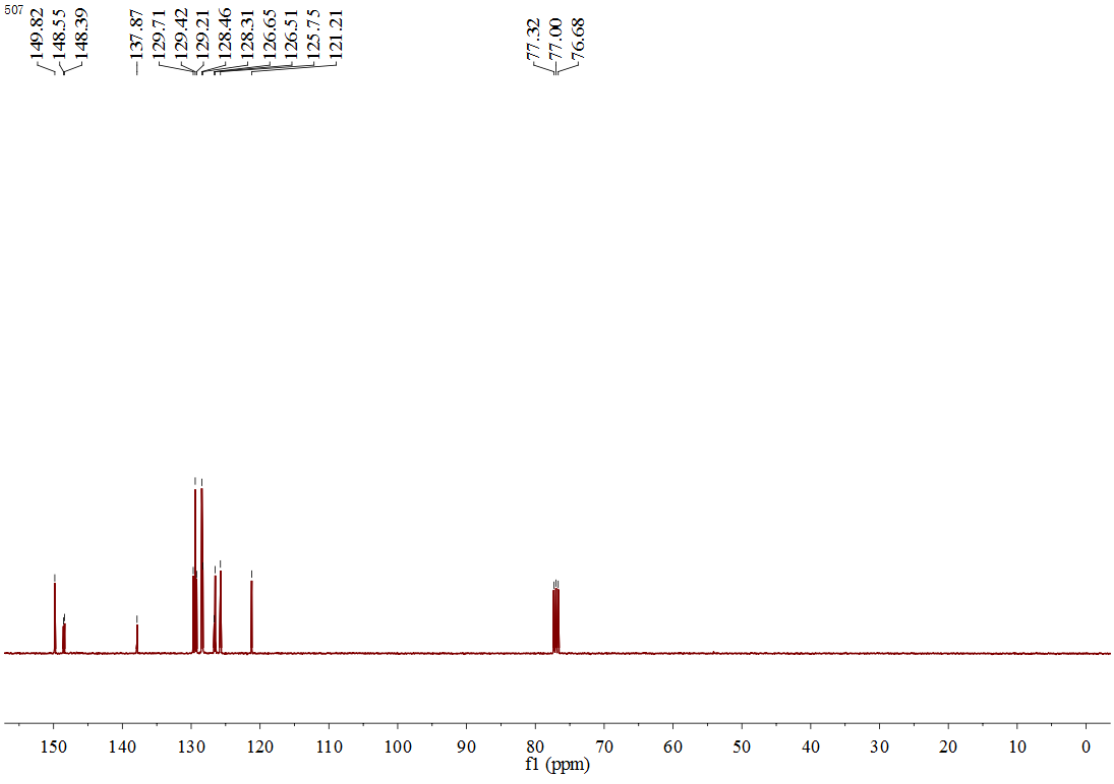
References:

(1) (a) W. Li, L. Weng, and G. Jin, *Inorg. Chem. Commun*., 2004, **7**, 1174; (b) B. Sun, T. Yoshino, S. Matsunaga and M. Kanai, *Adv. Synth. Catal*., 2014, **356**, 1491.

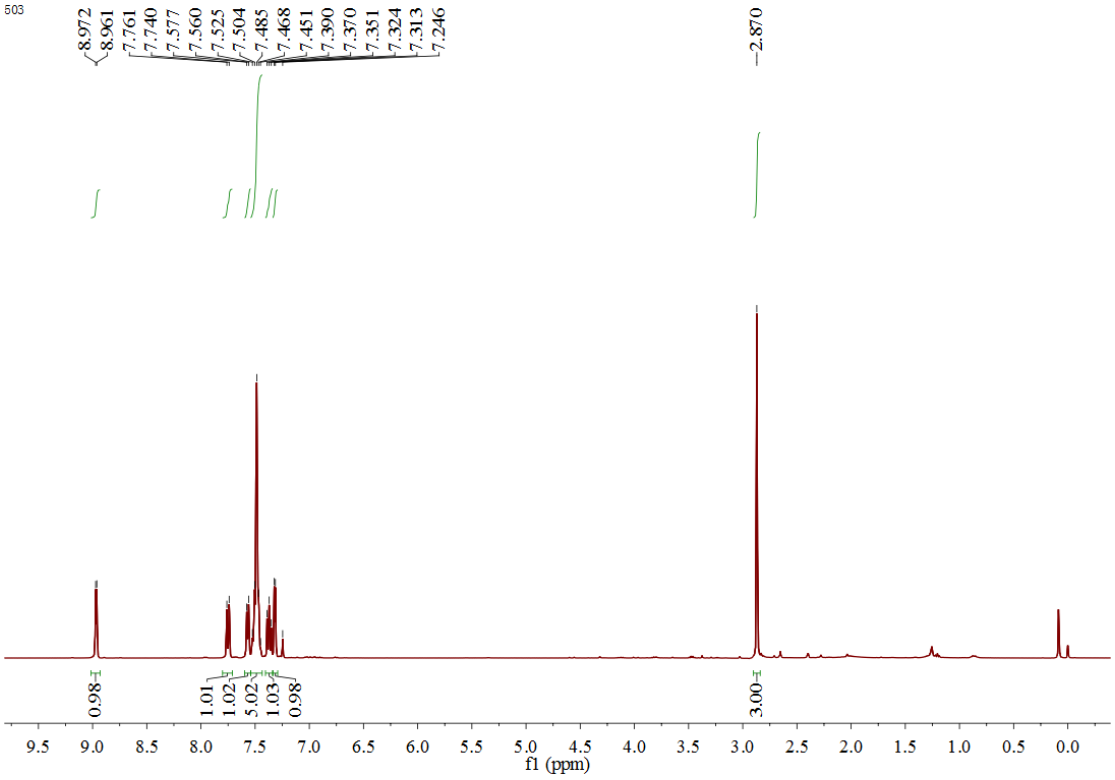
Copies of ^{1}H and ^{13}C NMR spectra of products

3a





3b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7.370
7.351
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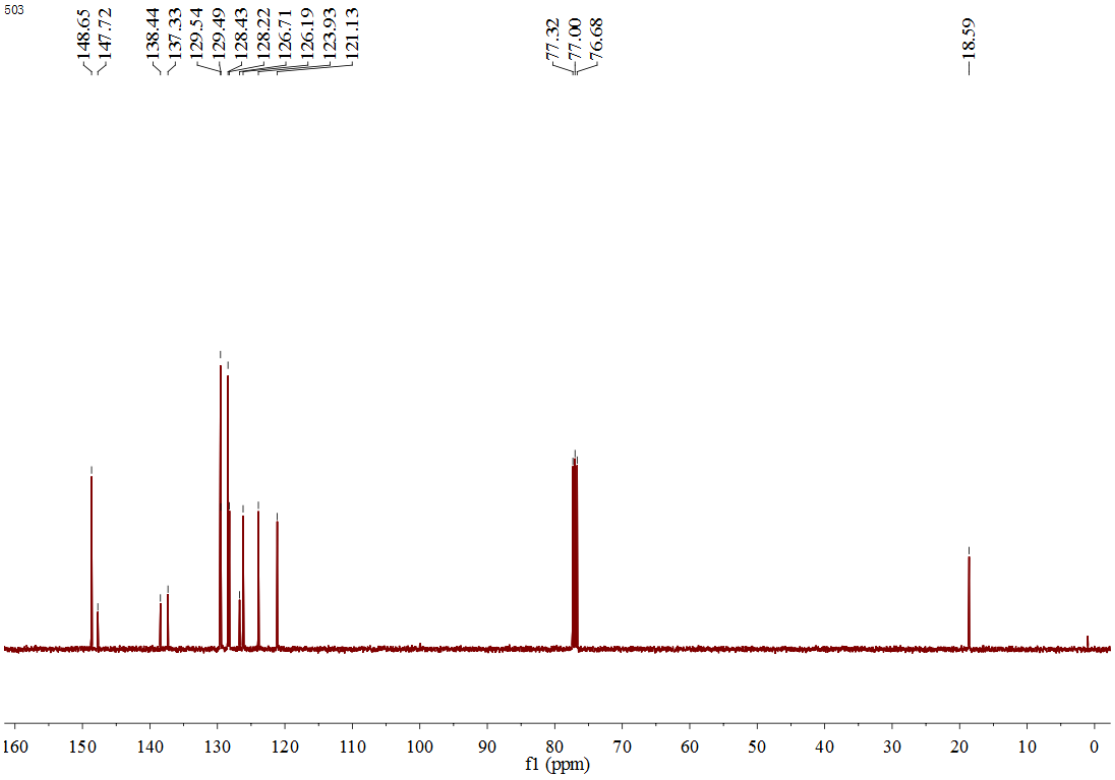
0.98
1.01
1.02
5.02
1.03
0.98
3.00
f1 (ppm)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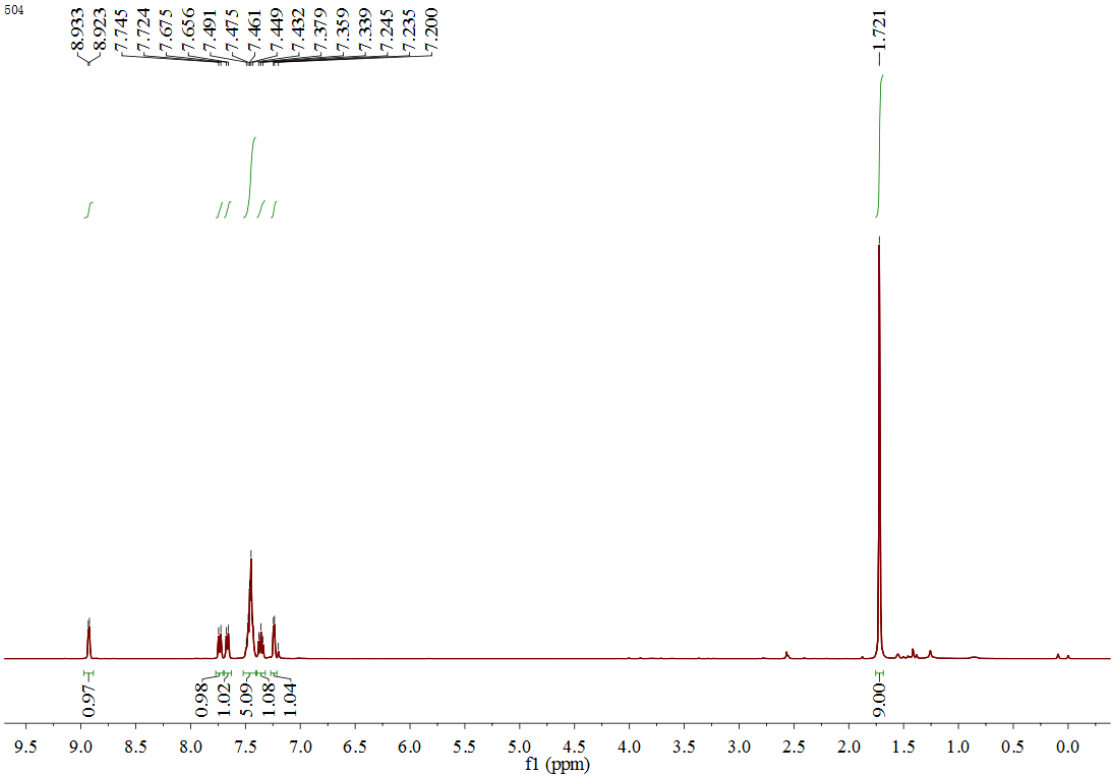
f1 (ppm)

3c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7.339
7.245
7.235
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0.98
1.02
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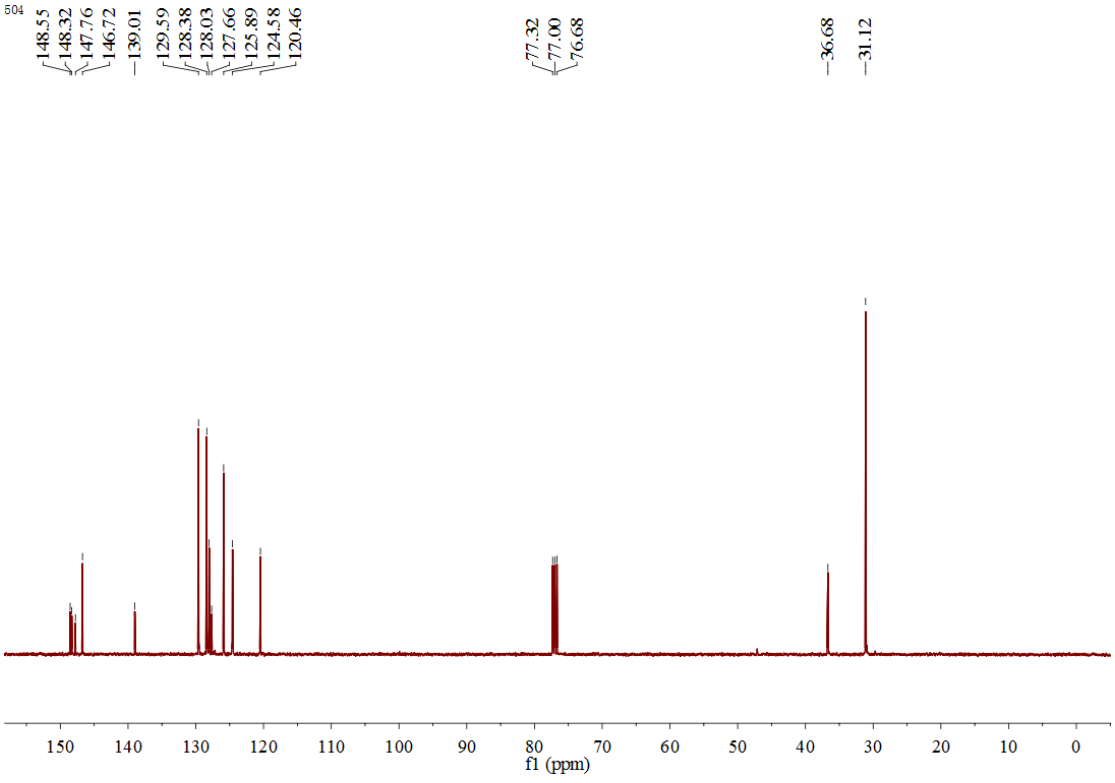
1.08
1.04
9.00
f1 (ppm)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128.03
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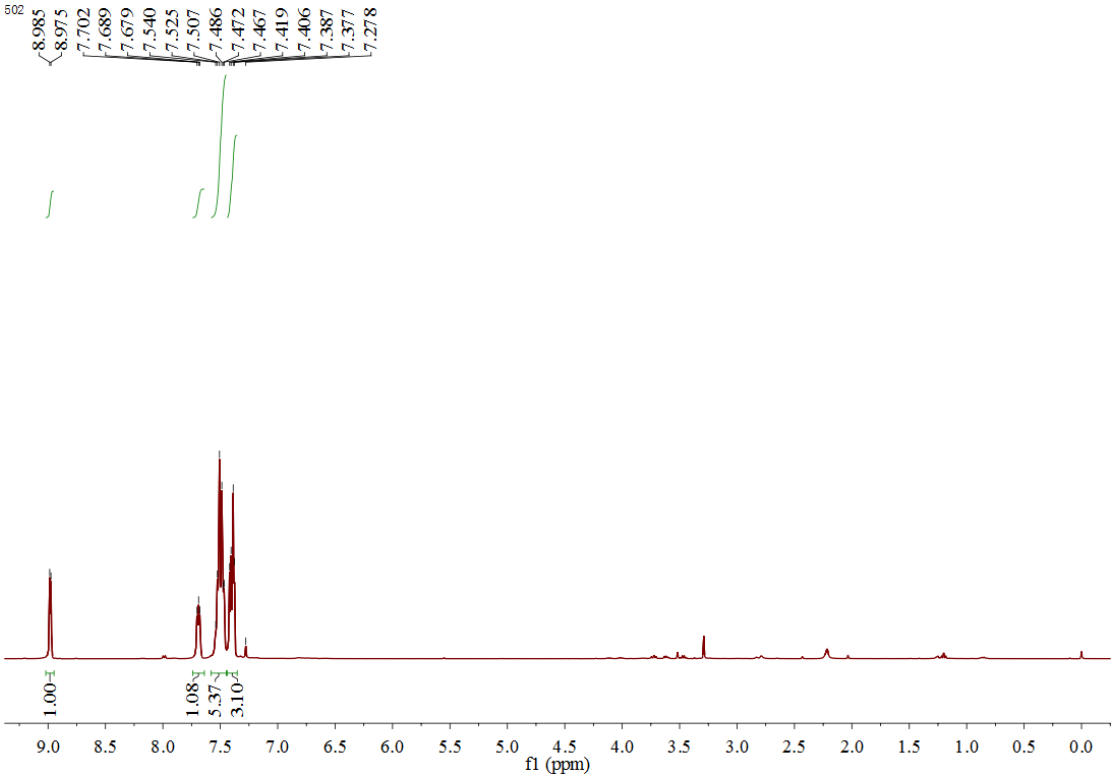
31.12
f1 (ppm)

3d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7.406
7.387
7.377
7.278
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1.08
5.37
3.10
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
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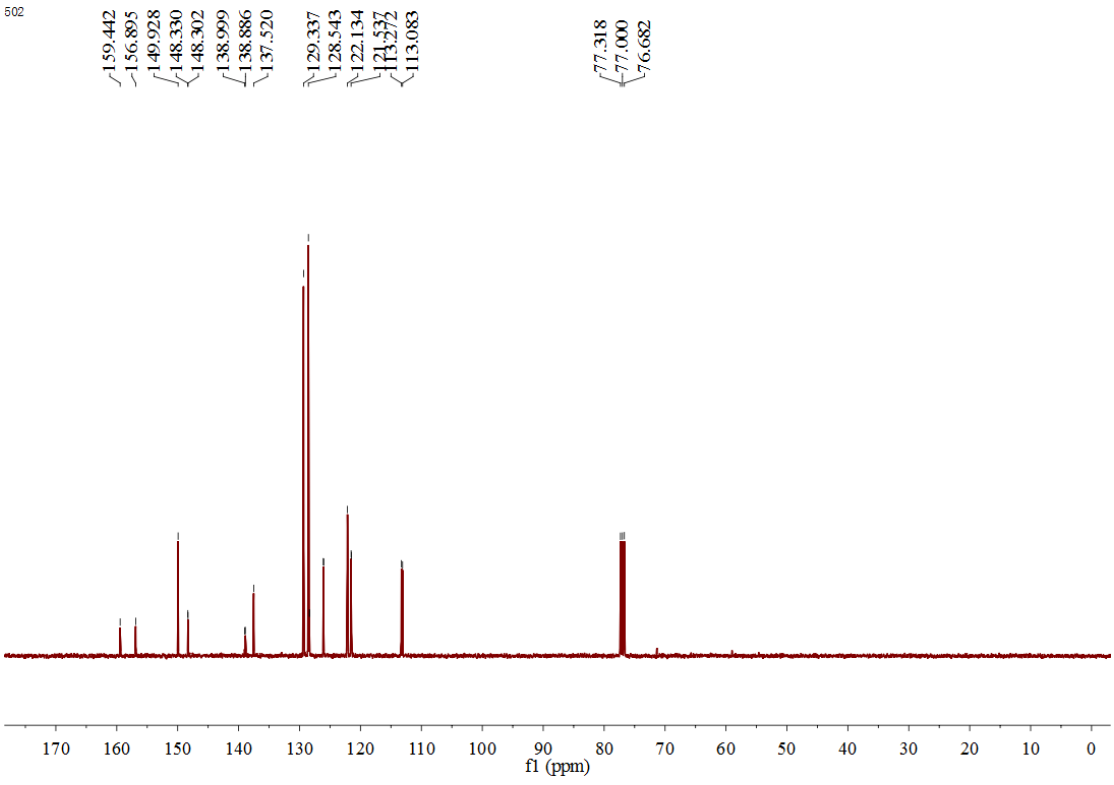
0.0
f1 (ppm)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113.083
77.318
77.000
76.682
170
160
150
140
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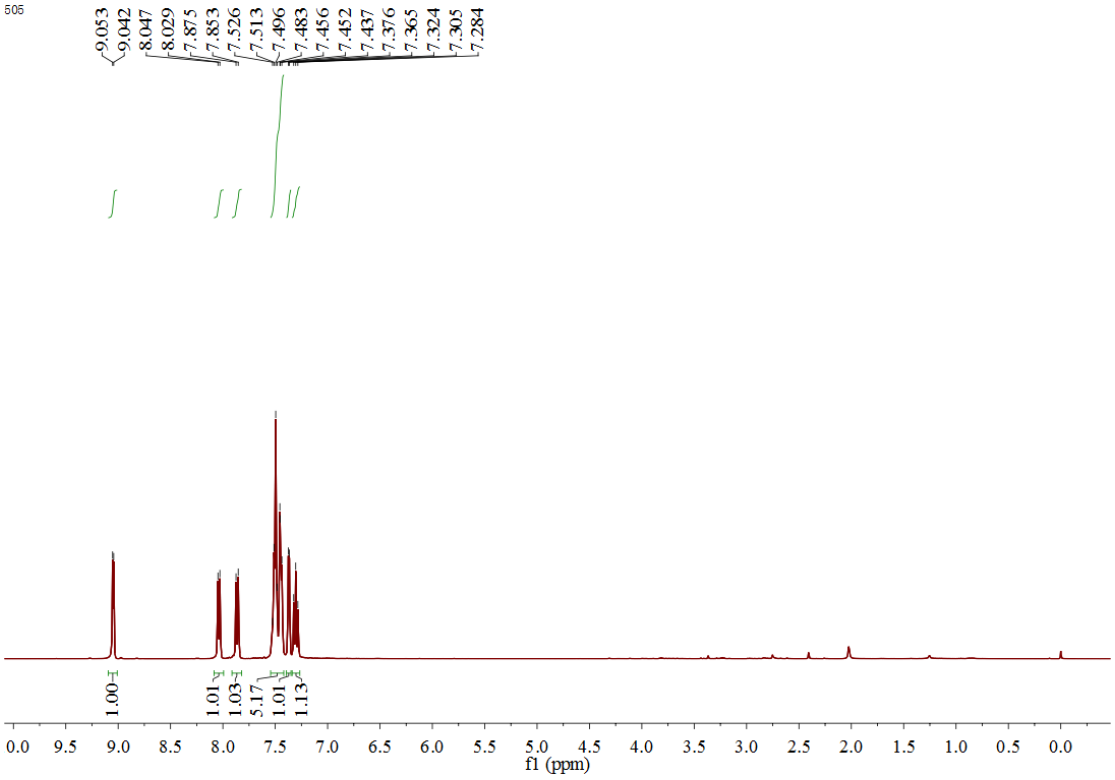
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

3e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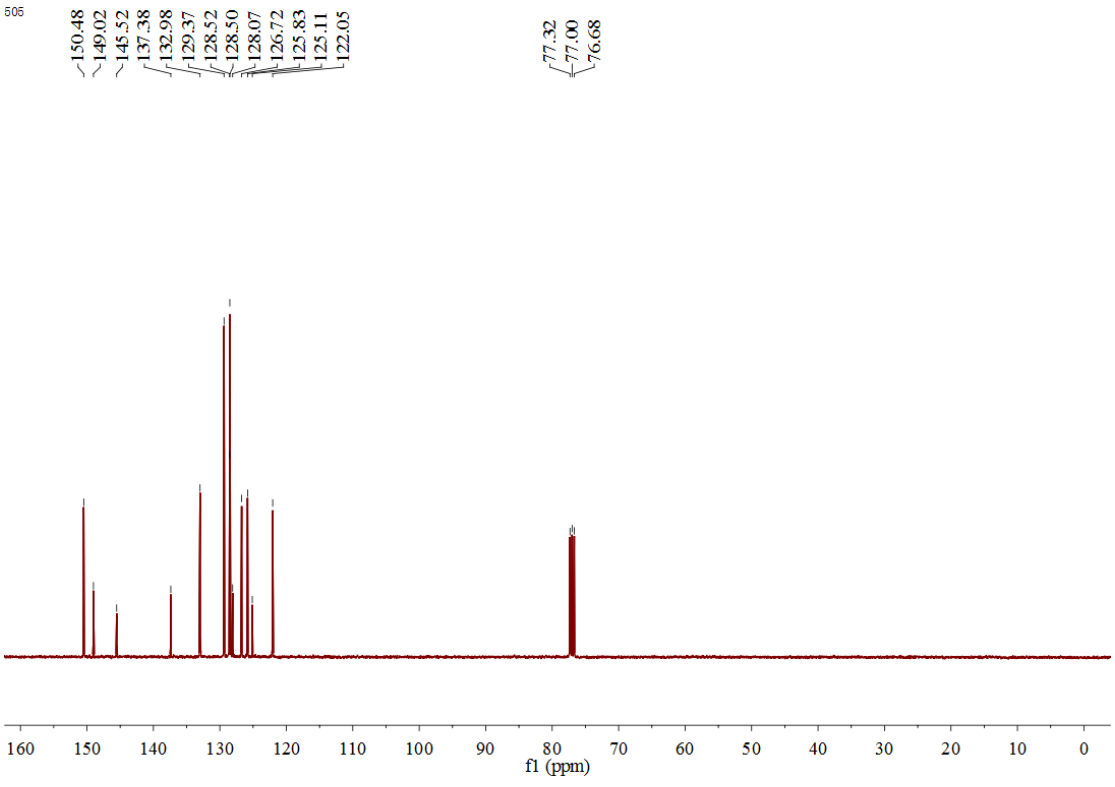
1.01
1.13
f1 (ppm)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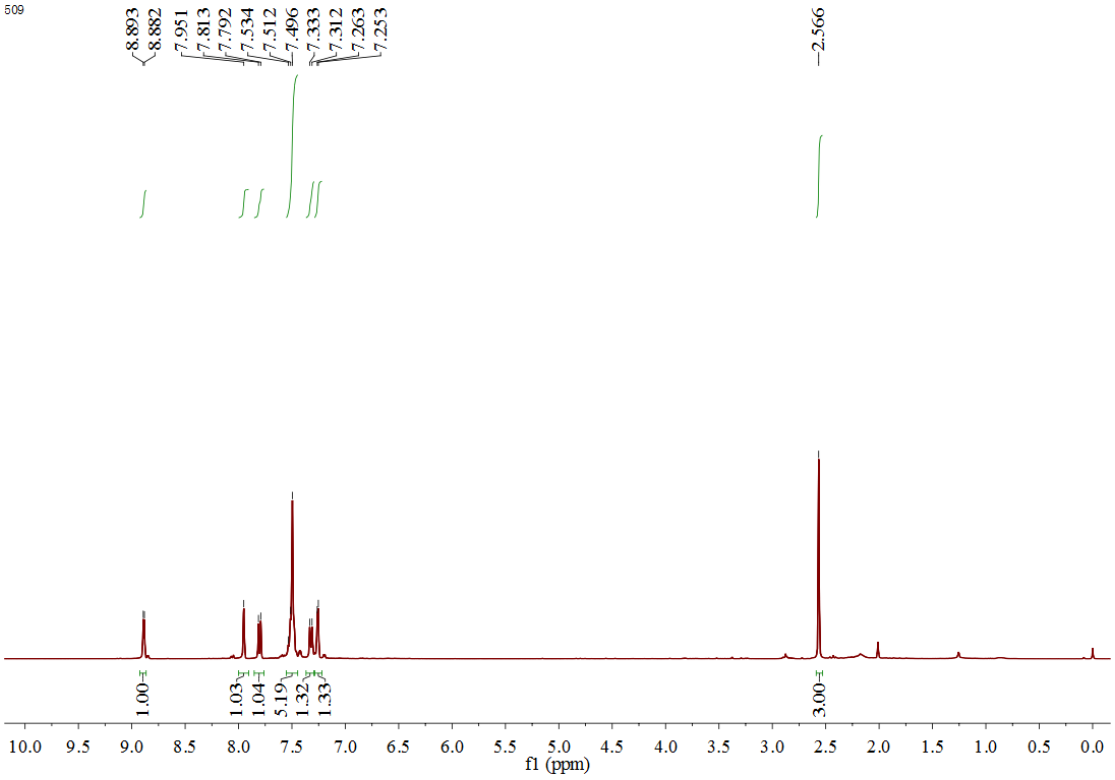
f1 (ppm)

3f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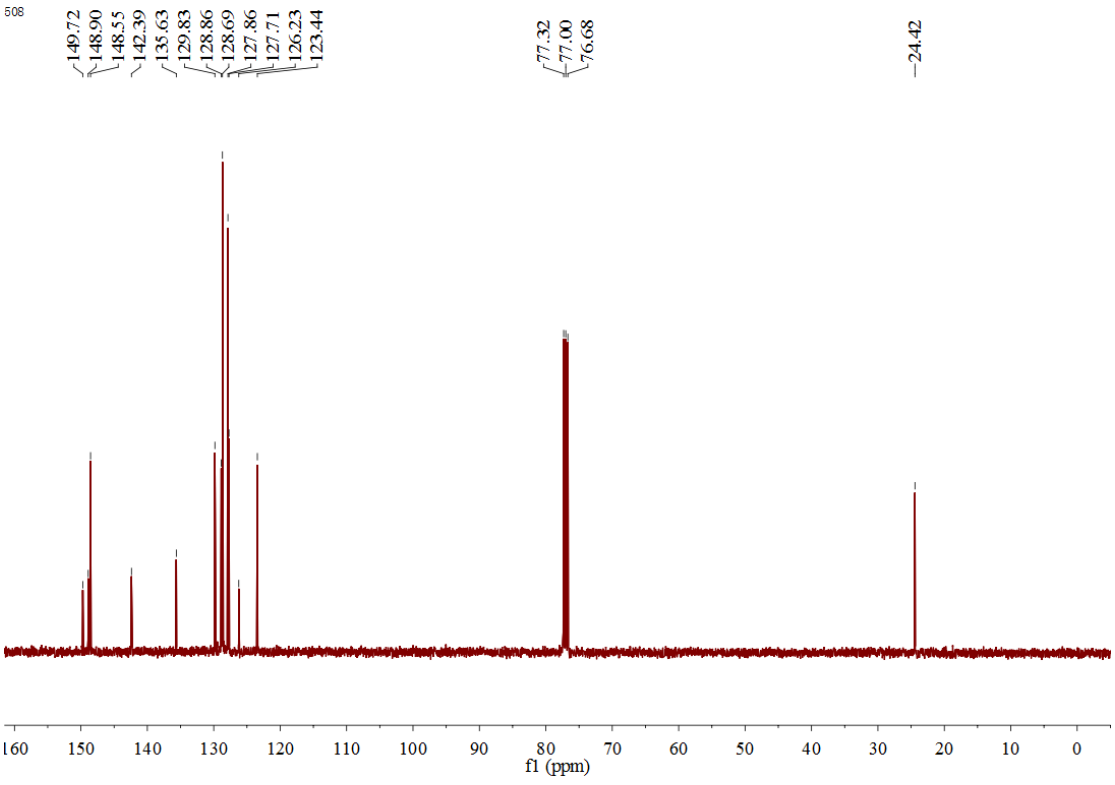
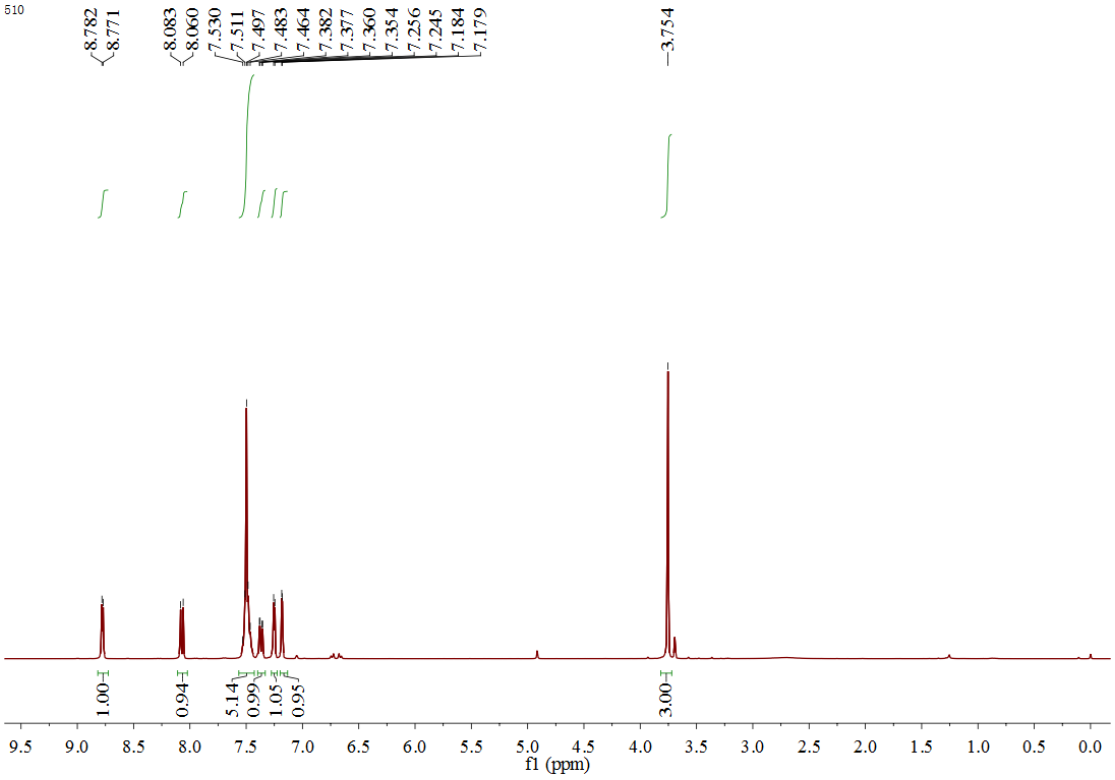
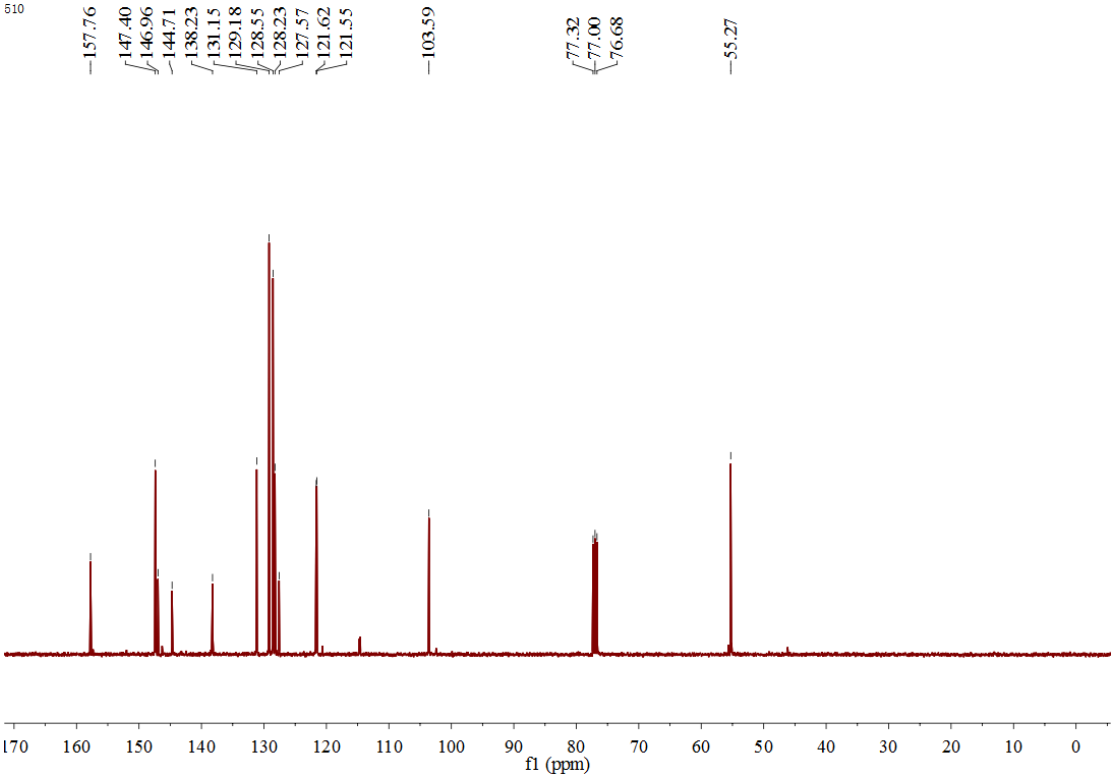
7.534
7.512
7.496
7.333
7.312
7.263
7.253
2.566
1.00
1.03
1.04
5.19
1.32
1.33
3.00
f1 (ppm)

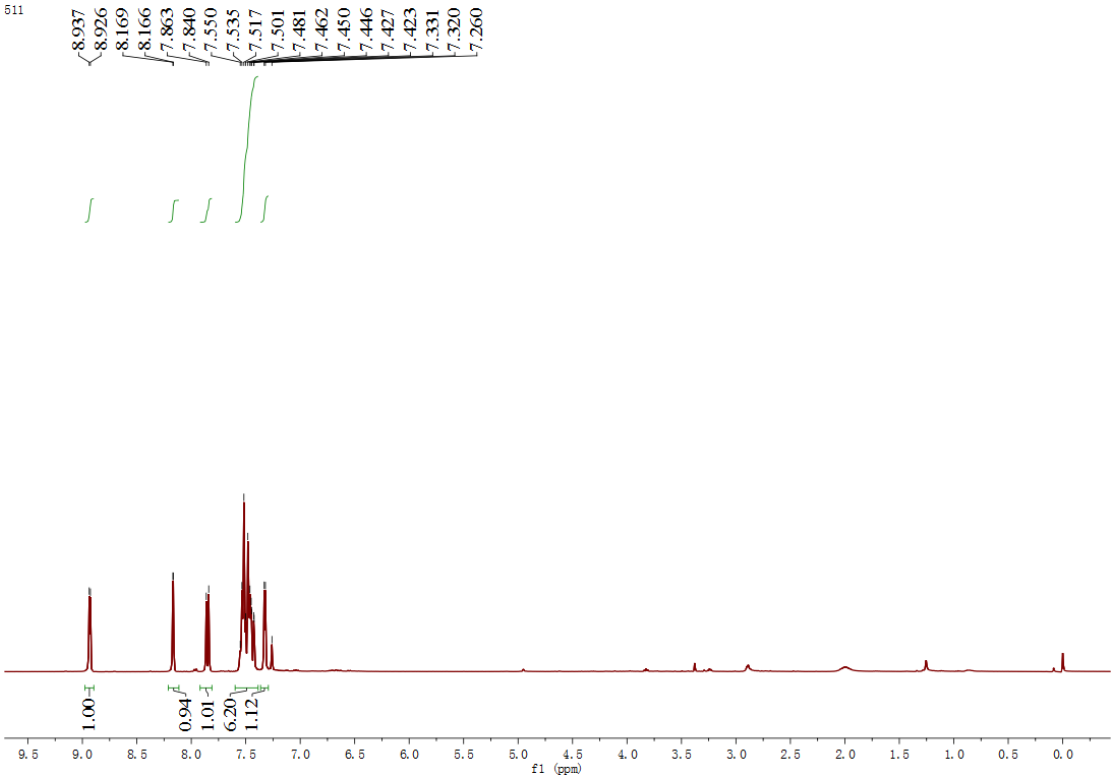

508
149.72
148.90
148.55
142.39
135.63
129.83
128.86
128.69
127.86
127.71
126.23
123.44
77.32
77.00
76.68
24.42
f1 (ppm)

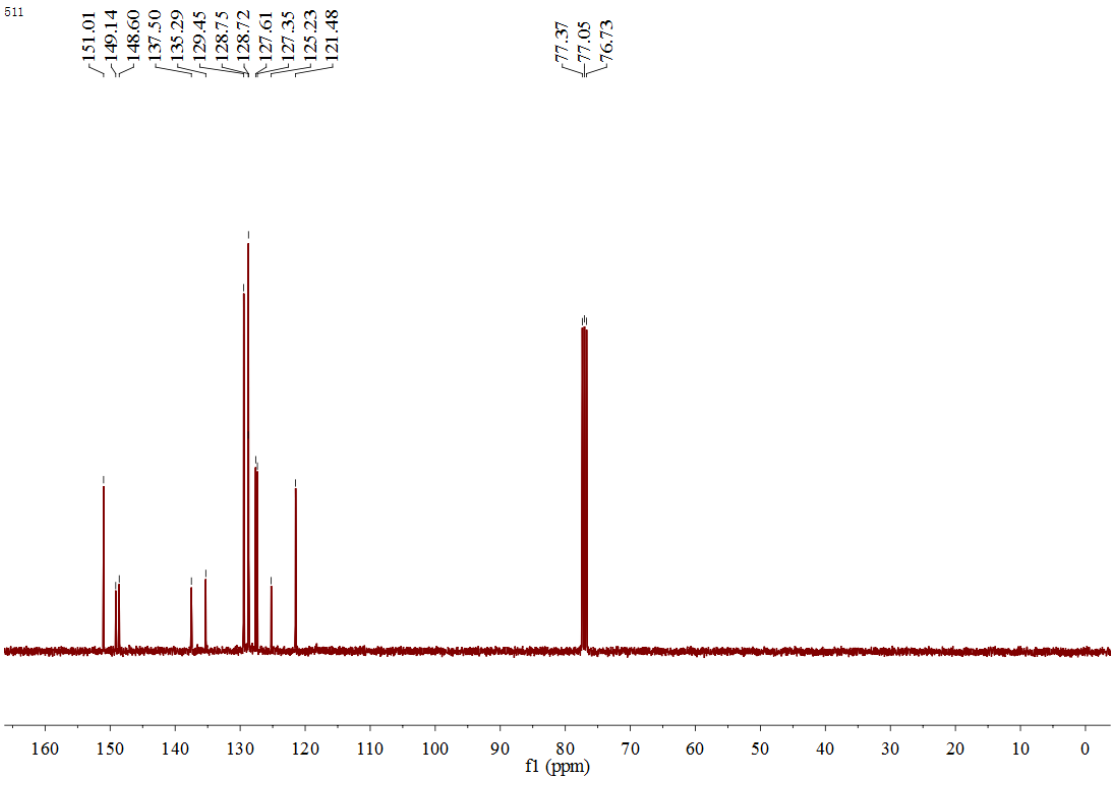
3g


8.782
8.771
8.083
8.060
7.530
7.511
7.497
7.483
7.464
7.382
7.377
7.360
7.354
7.256
7.245
7.184
7.179
3.754
1.00
0.94
5.14
0.99
1.05
0.95
3.00
f1 (ppm)

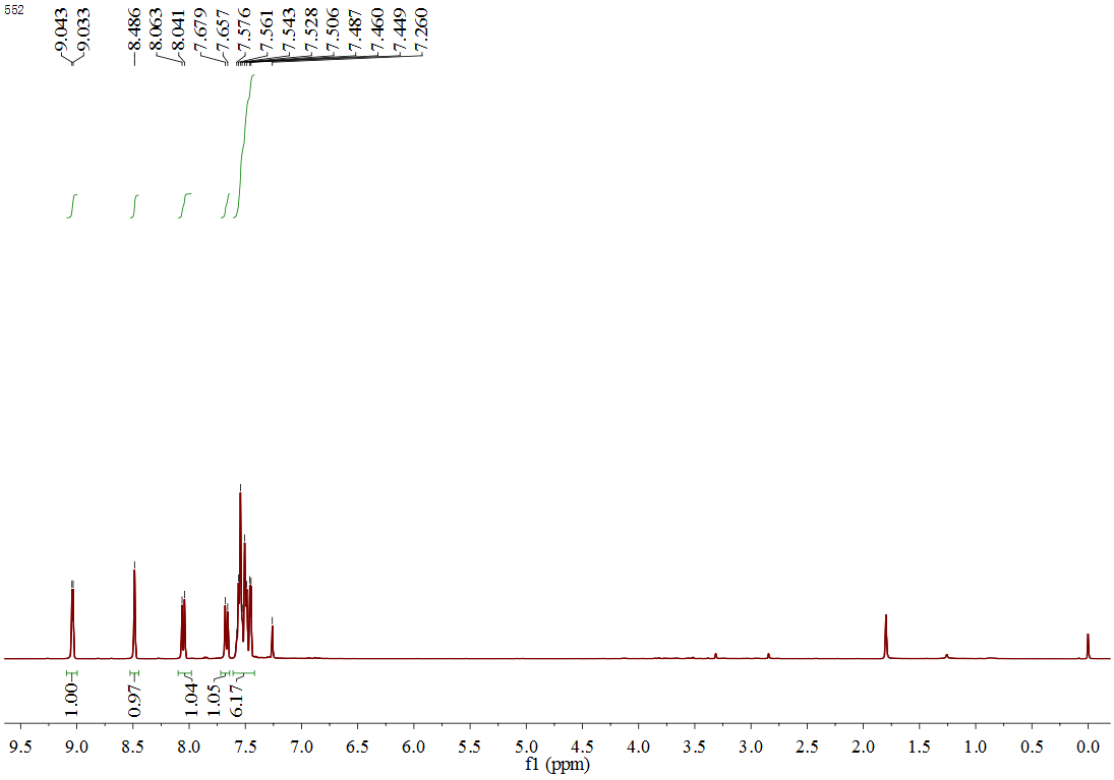

157.76
147.40
146.96
144.71
138.23
131.15
129.18
128.55
128.23
127.57
121.62
121.55
103.59
77.32
77.00
76.68
55.27
f1 (ppm)

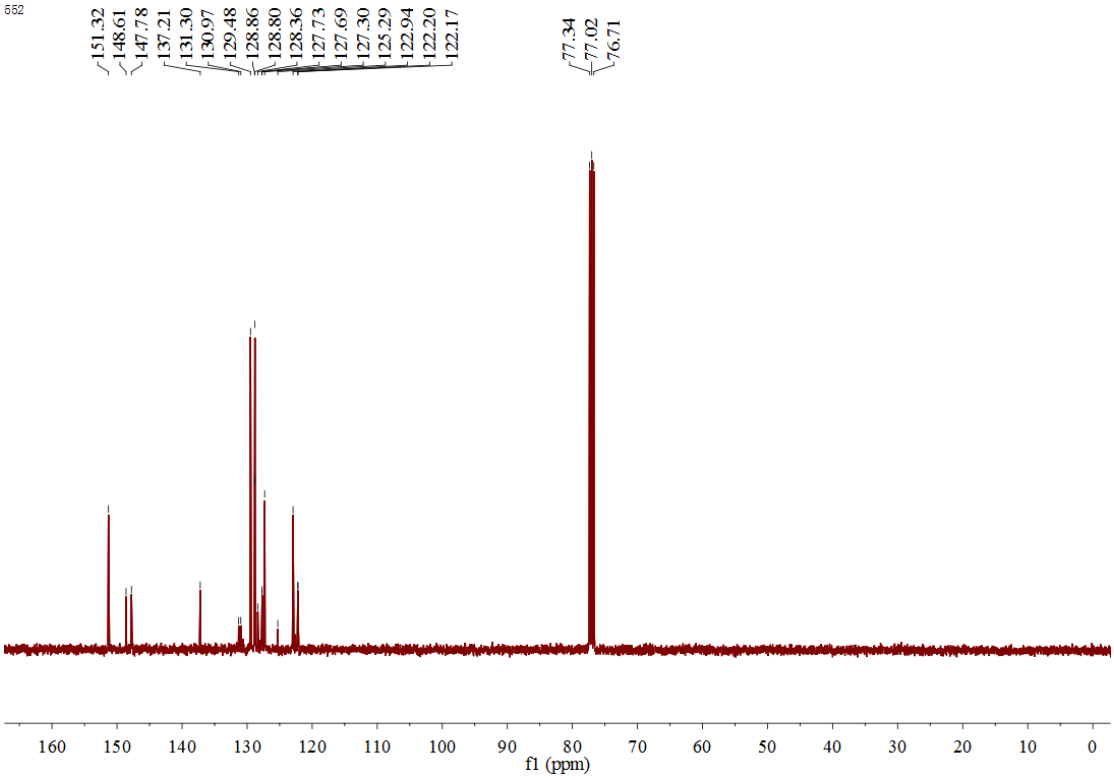
3h


511
8.937
8.926
8.169
8.166
7.863
7.840
7.550
7.535
7.517
7.501
7.481
7.462
7.450
7.446
7.427
7.423
7.331
7.320
7.260
1.00
0.94
1.01
6.20
1.12
f1 (ppm)

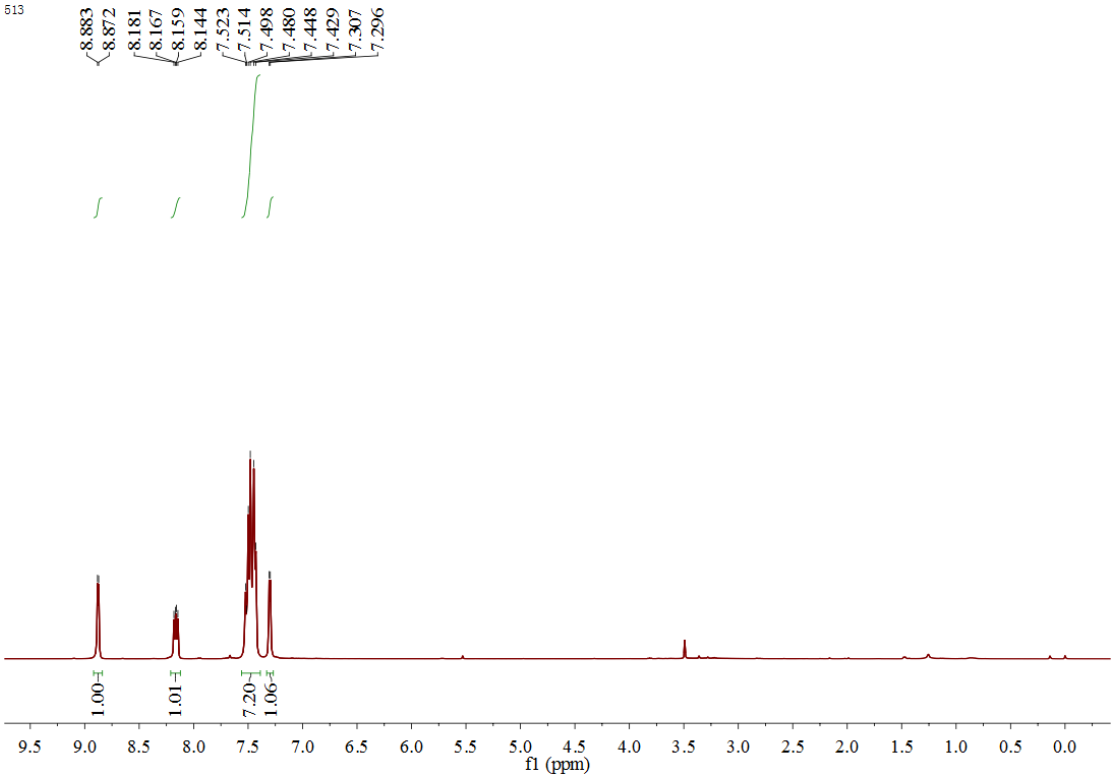

511
151.01
149.14
148.60
137.50
135.29
129.45
128.75
128.72
127.61
127.35
125.23
121.48
77.37
77.05
76.73
f1 (ppm)

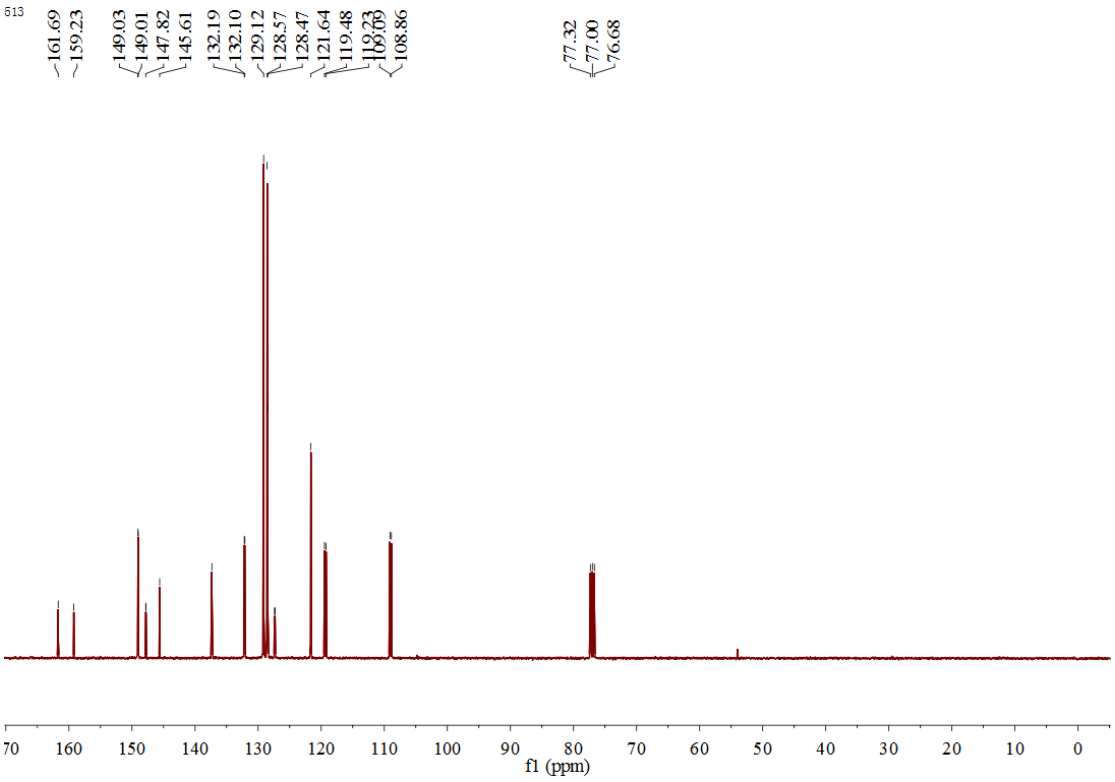
3i


552
9.043
9.033
8.486
8.063
8.041
7.679
7.657
7.576
7.561
7.543
7.528
7.506
7.487
7.460
7.449
7.260
1.00
0.97
1.04
1.05
6.17
f1 (ppm)

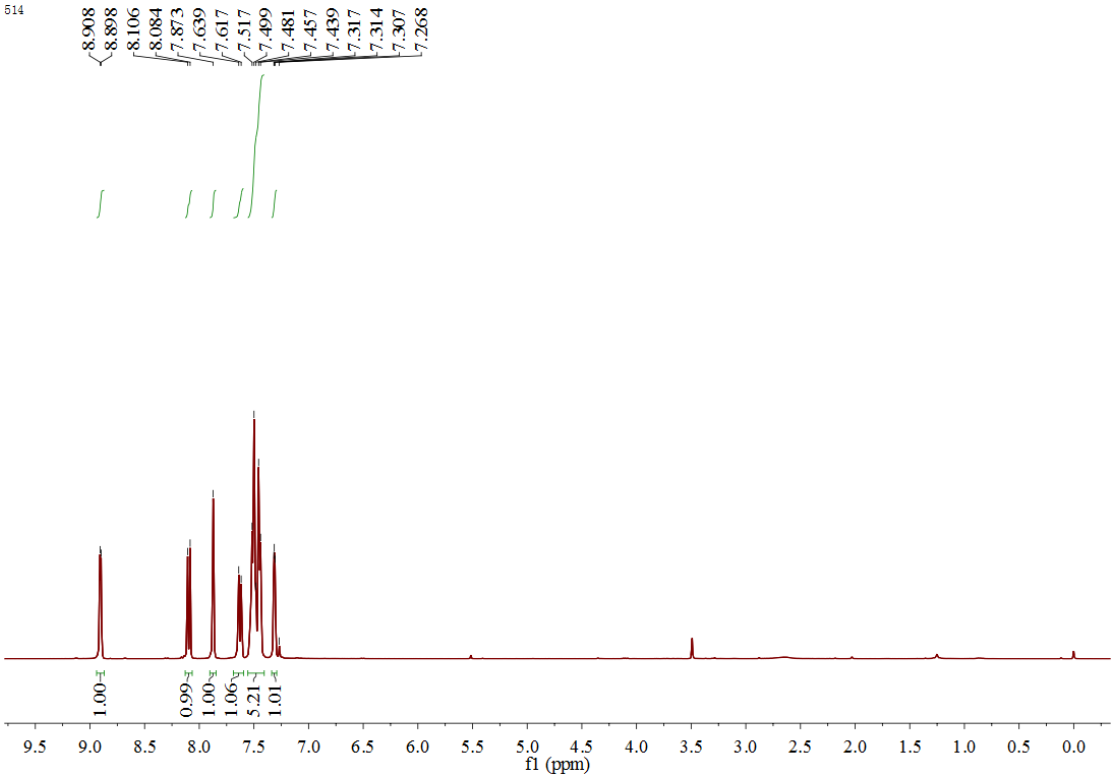

552
151.32
148.61
147.78
137.21
131.30
130.97
129.48
128.86
128.80
128.36
127.73
127.69
127.30
125.29
122.94
122.20
122.17
77.34
77.02
76.71
f1 (ppm)

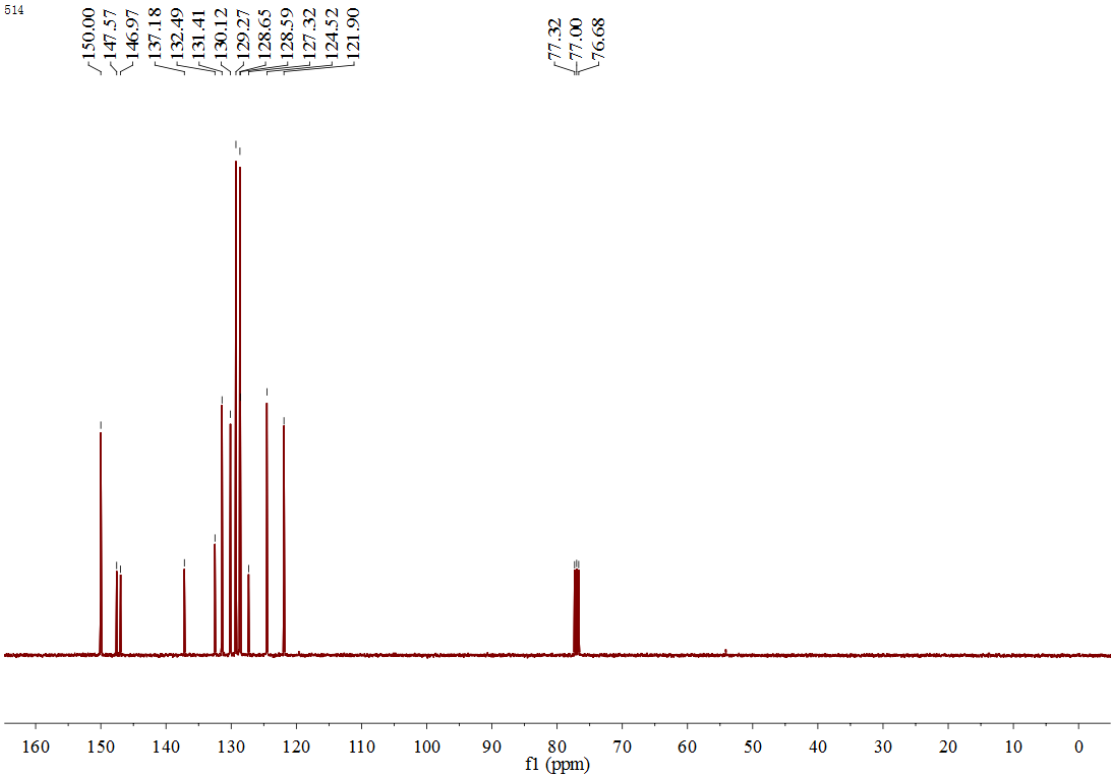
3j


513
8.883
8.872
8.181
8.167
8.159
8.144
7.523
7.514
7.498
7.480
7.448
7.429
7.307
7.296
1.00
1.01
7.20
1.06
f1 (ppm)

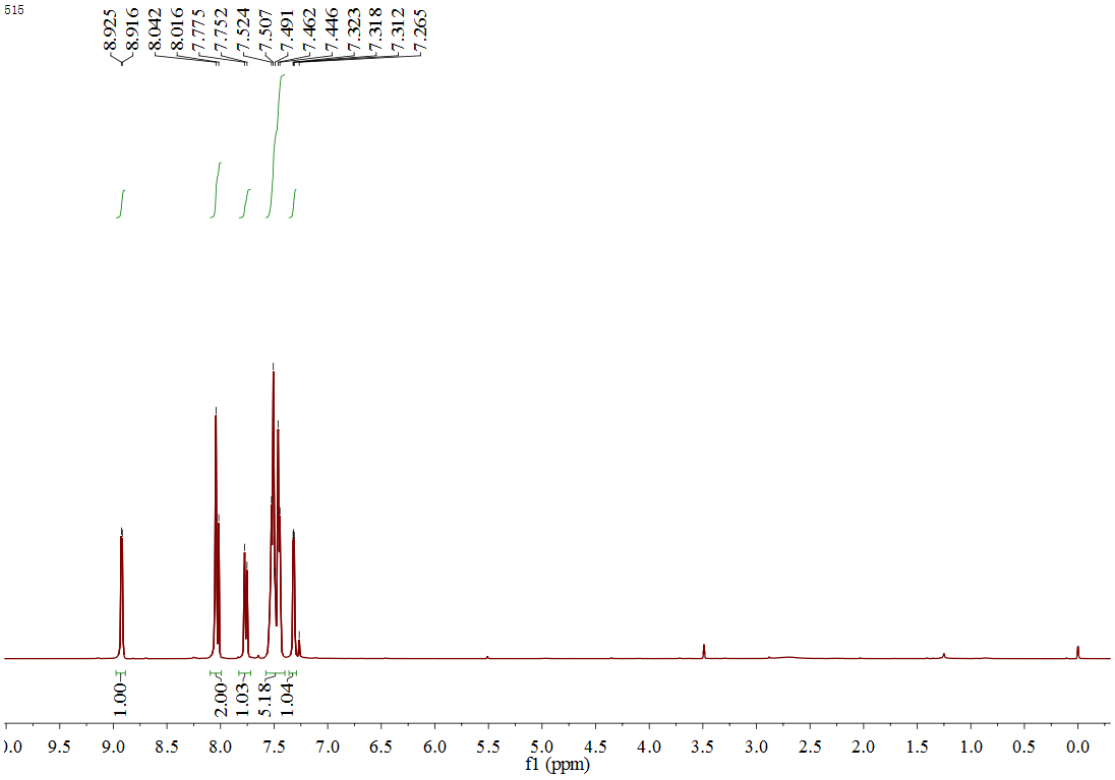

513
161.69
159.23
149.03
149.01
147.82
145.61
132.19
132.10
129.12
128.57
128.47
121.64
119.48
77.32
77.00
76.68
f1 (ppm)

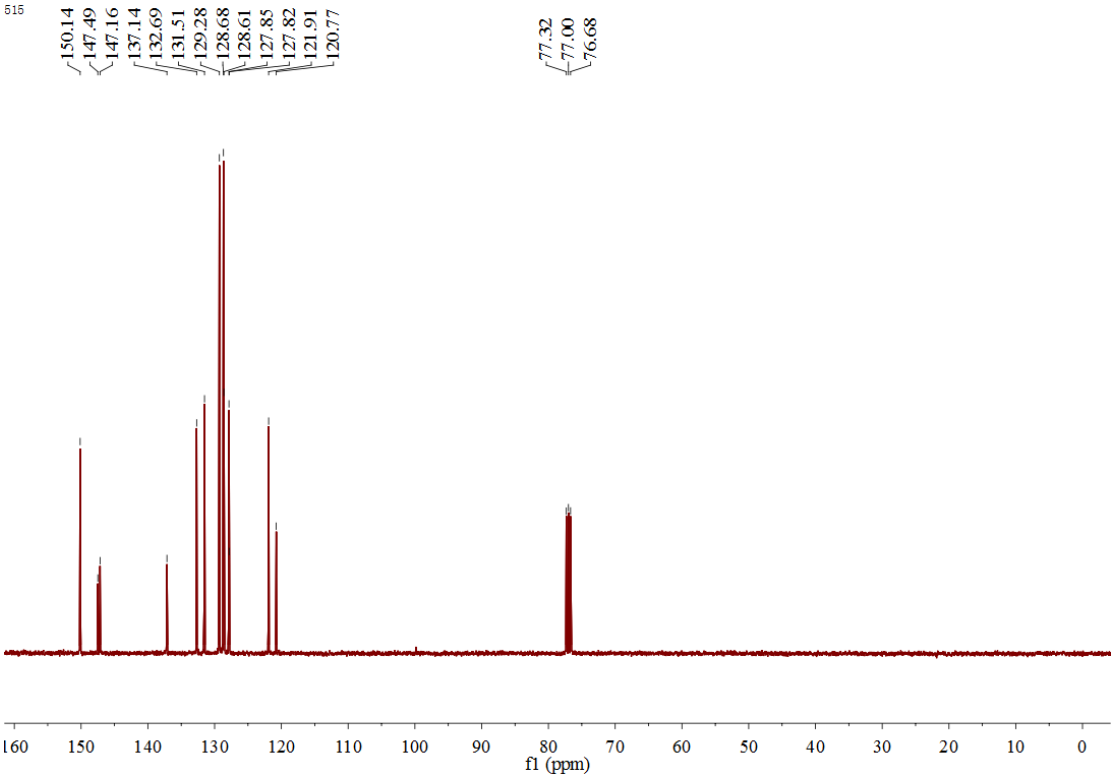
3k


514
8.908
8.898
8.106
8.084
7.873
7.639
7.617
7.517
7.499
7.481
7.457
7.439
7.317
7.314
7.307
7.268
1.00
0.99
1.00
1.06
5.21
1.01
f1 (ppm)

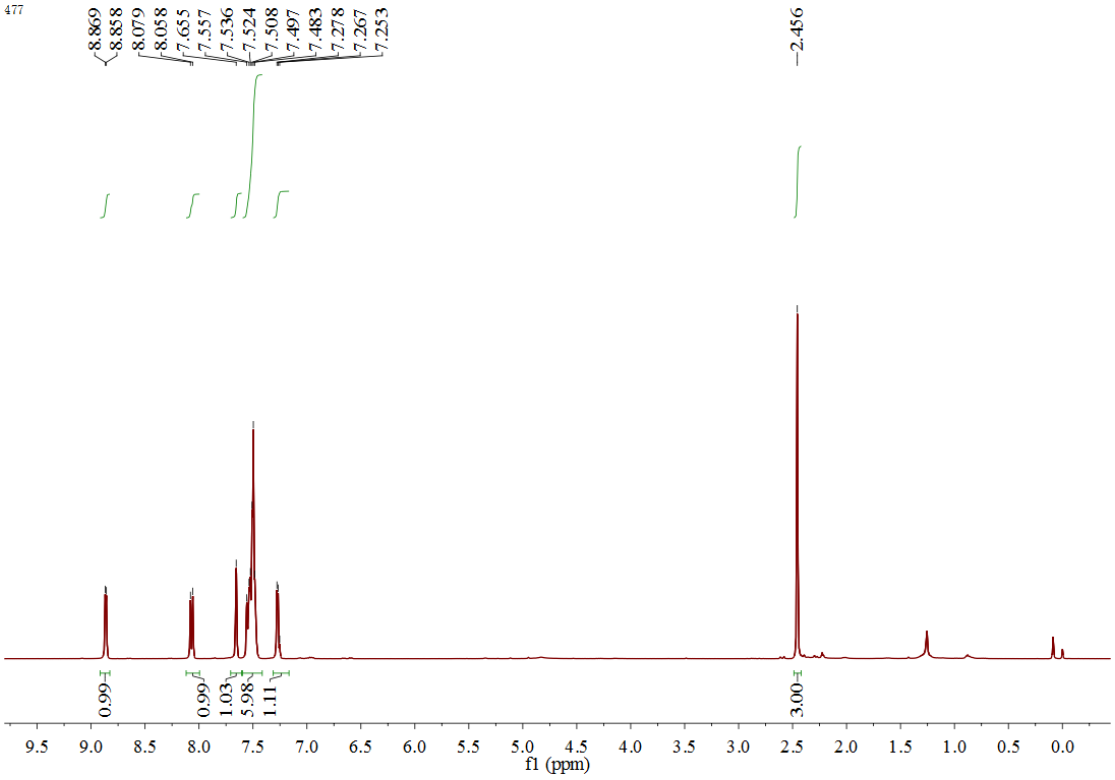

514
150.00
147.57
146.97
137.18
132.49
131.41
130.12
129.27
128.65
128.59
127.32
124.52
121.90
77.32
77.00
76.68
f1 (ppm)

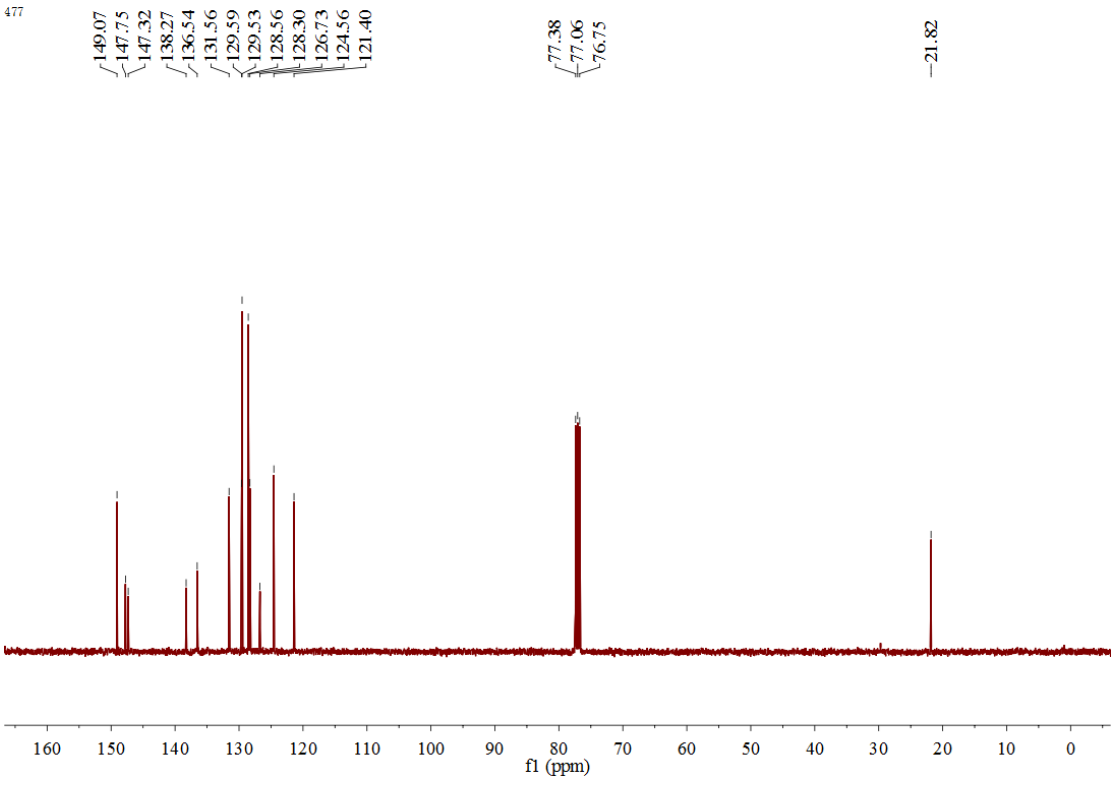
3l


515
8.925
8.916
8.042
8.016
7.775
7.752
7.524
7.507
7.491
7.462
7.446
7.323
7.318
7.312
7.265
1.00
2.00
1.03
5.18
1.04
f1 (ppm)

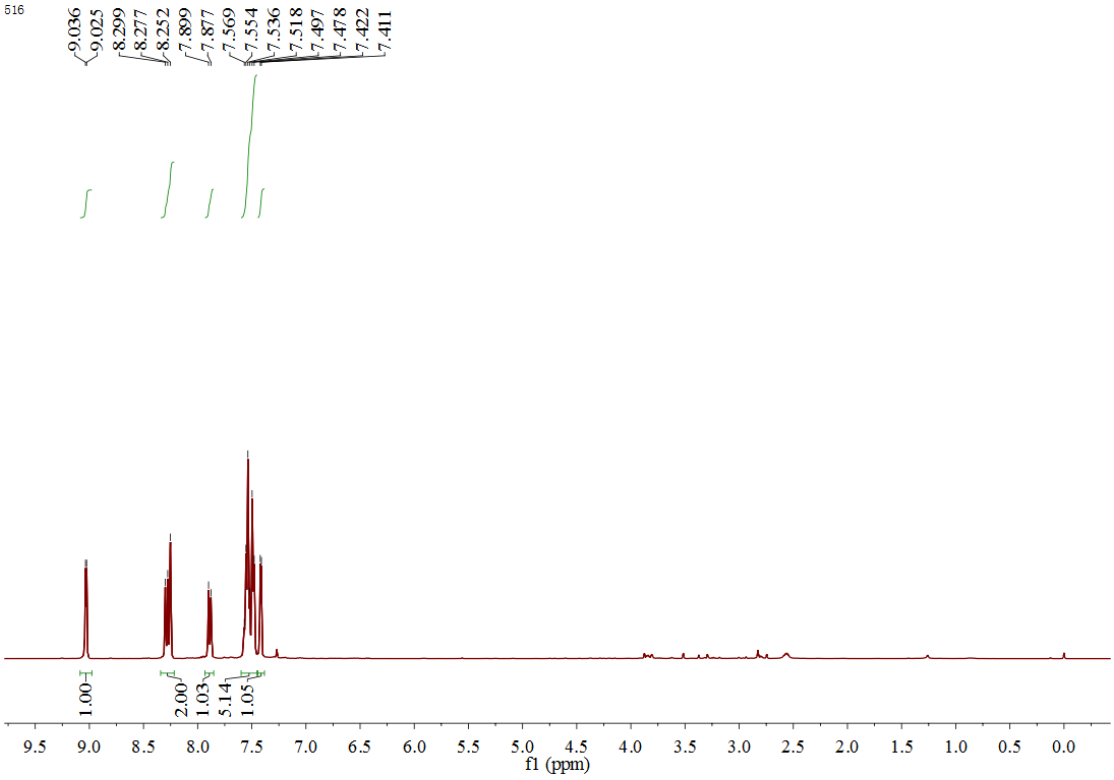

515
150.14
147.49
147.16
137.14
132.69
131.51
129.28
128.68
128.61
127.85
127.82
121.91
120.77
77.32
77.00
76.68
f1 (ppm)

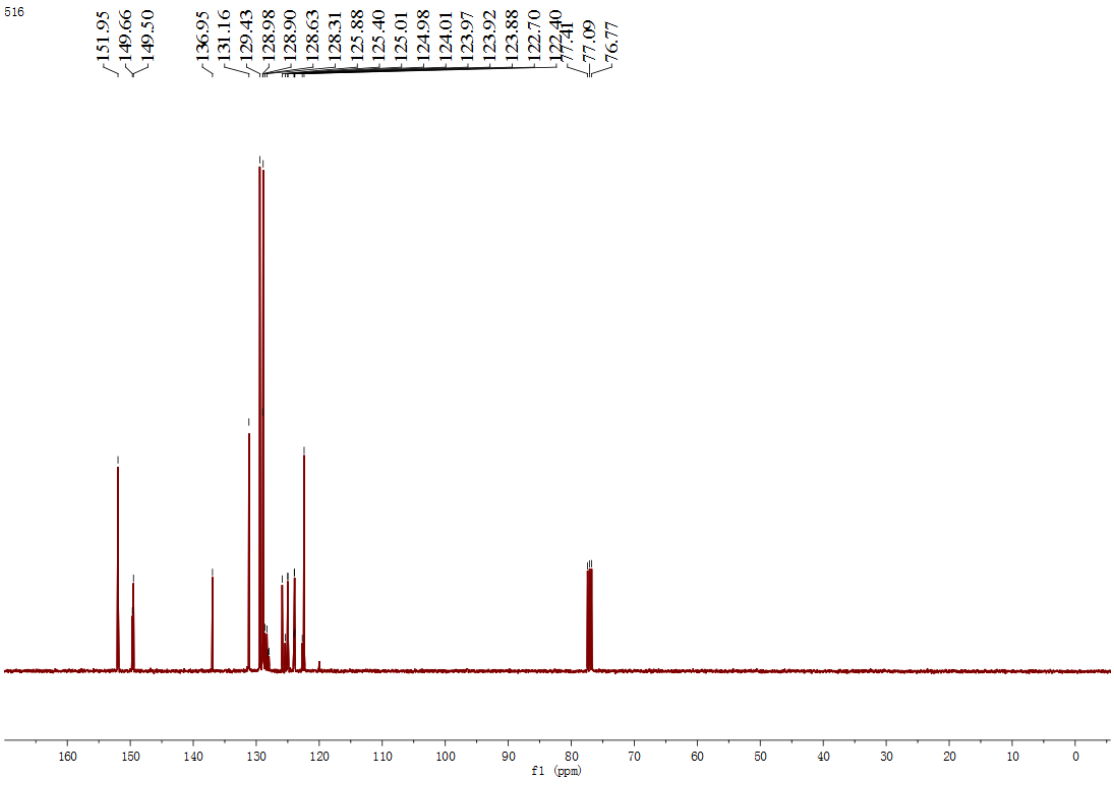
3m


477
8.869
8.858
8.079
8.058
7.655
7.557
7.536
7.524
7.508
7.497
7.483
7.278
7.267
7.253
2.456
0.99
0.99
1.03
5.98
1.11
3.00
f1 (ppm)

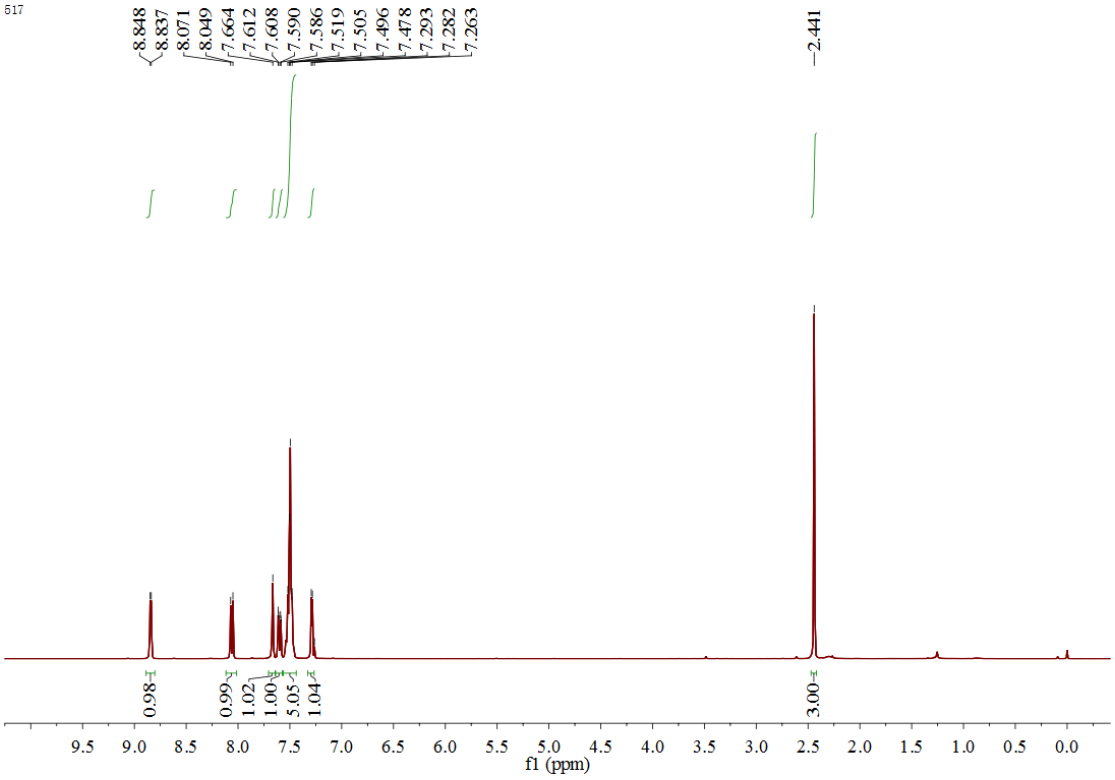

477
149.07
147.75
147.32
138.27
136.54
131.56
129.59
129.53
128.56
128.30
126.73
124.56
121.40
77.38
77.06
76.75
21.82
f1 (ppm)

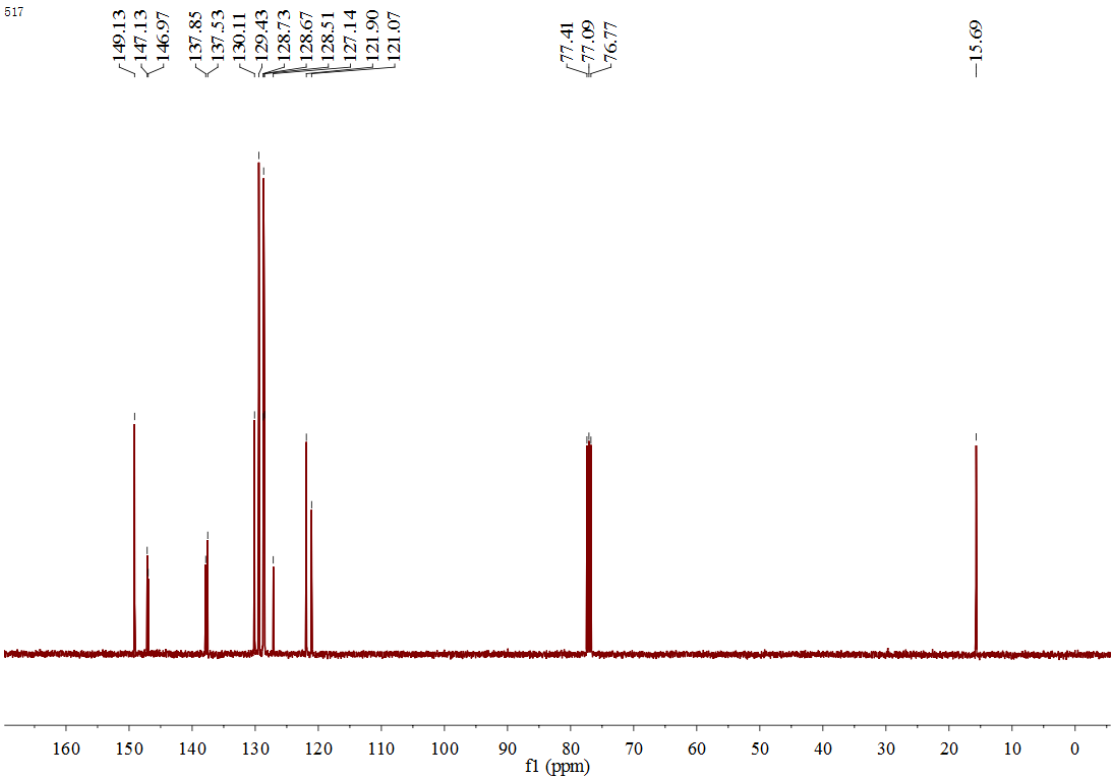
3n


516
9.036
9.025
8.299
8.277
8.252
7.899
7.877
7.569
7.554
7.536
7.518
7.497
7.478
7.422
7.411
1.00
2.00
1.03
5.14
1.05
f1 (ppm)

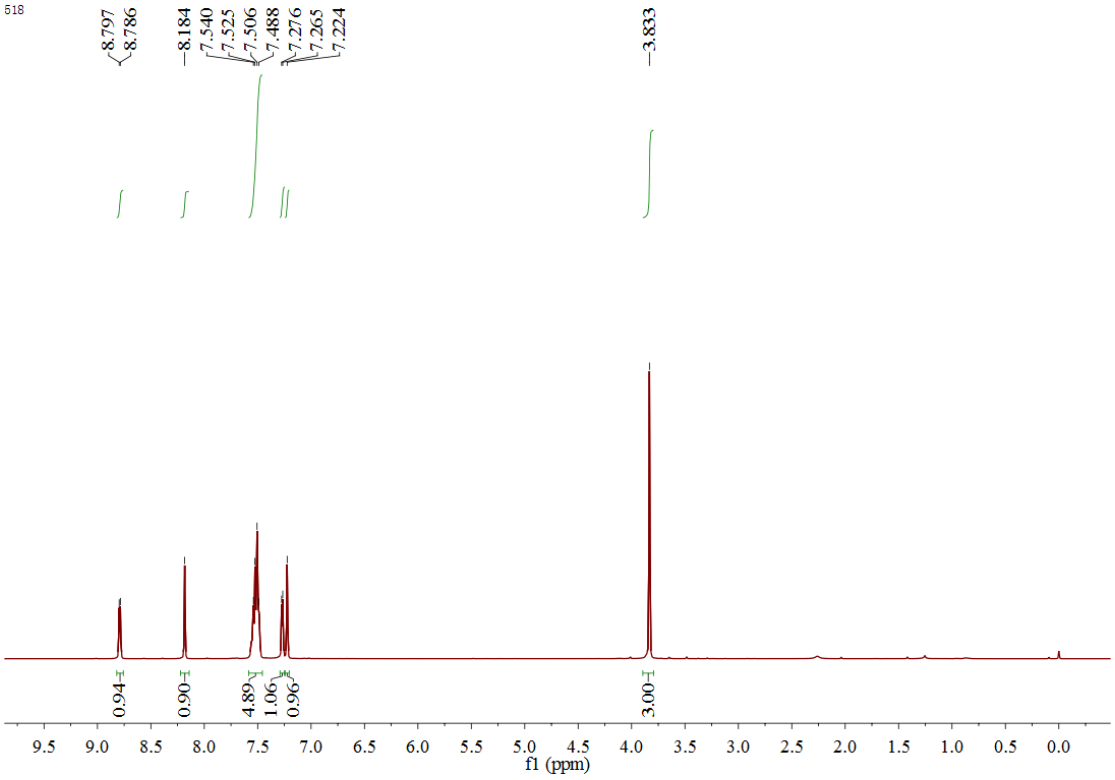

516
151.95
149.66
149.50
136.95
131.16
129.43
128.98
128.90
128.63
128.31
125.88
125.40
125.01
124.98
124.01
123.97
123.92
123.88
122.70
122.40
77.41
77.09
76.77
f1 (ppm)

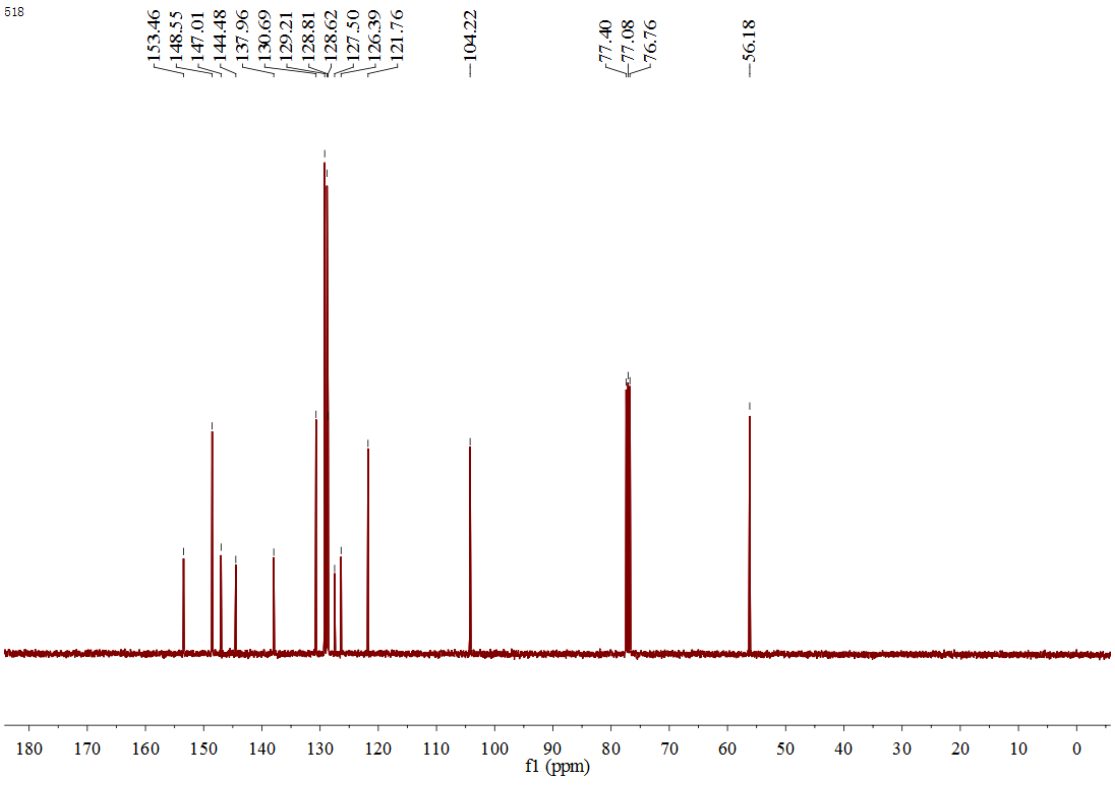
3o


517
8.848
8.837
8.071
8.049
7.664
7.612
7.608
7.590
7.586
7.519
7.505
7.496
7.478
7.293
7.282
7.263
2.441
0.98
0.99
1.02
1.00
5.05
1.04
3.00
f1 (ppm)

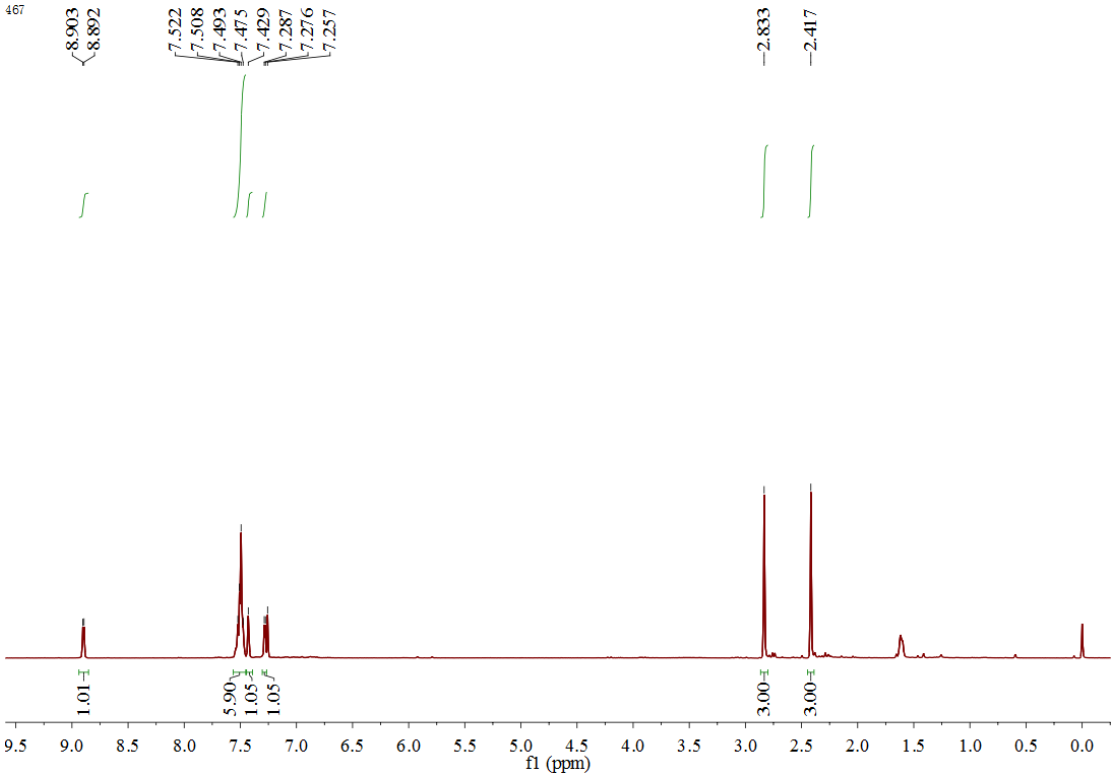

517
149.13
147.13
146.97
137.85
137.53
130.11
129.43
128.73
128.67
128.51
127.14
121.90
121.07
77.41
77.09
76.77
15.69
f1 (ppm)

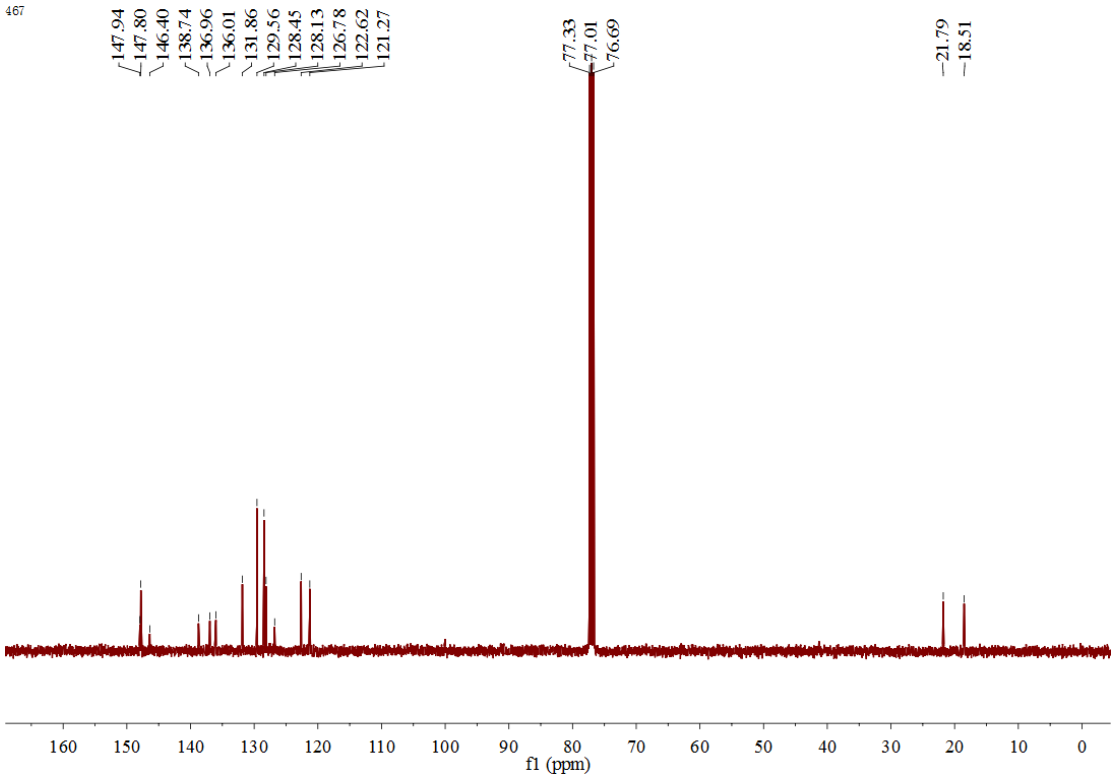
3p


518
8.797
8.786
8.184
7.540
7.525
7.506
7.488
7.276
7.265
7.224
3.833
0.94
0.90
4.89
1.06
0.96
3.00
f1 (ppm)

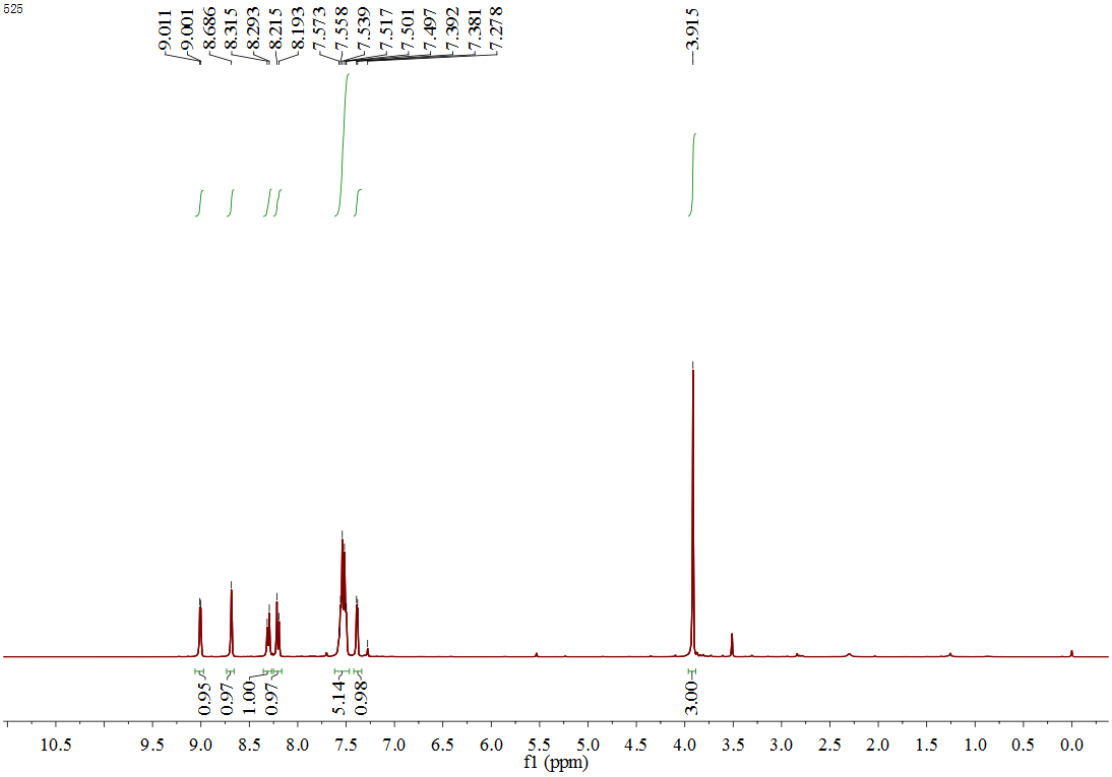

518
153.46
148.55
147.01
144.48
137.96
130.69
129.21
128.81
128.62
127.50
126.39
121.76
104.22
77.40
77.08
76.76
56.18
f1 (ppm)

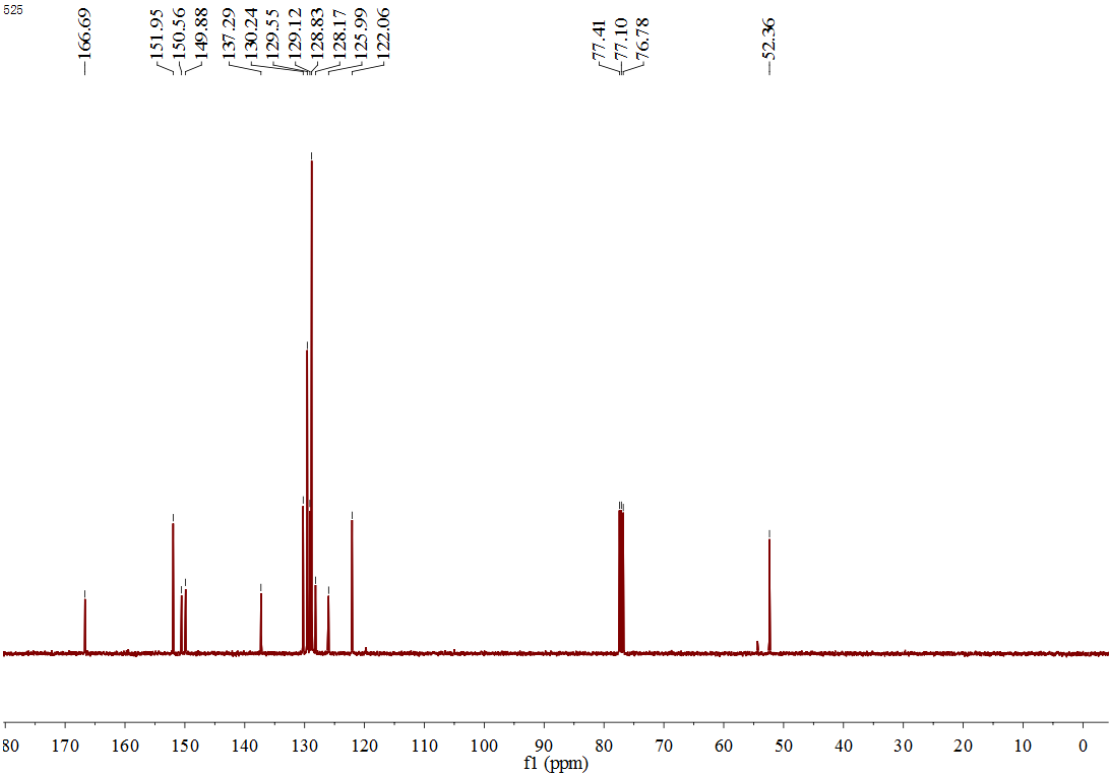
3q


467
8.903
8.892
7.522
7.508
7.493
7.475
7.429
7.287
7.276
7.257
2.833
2.417
1.01
5.90
1.05
1.05
3.00
3.00
f1 (ppm)

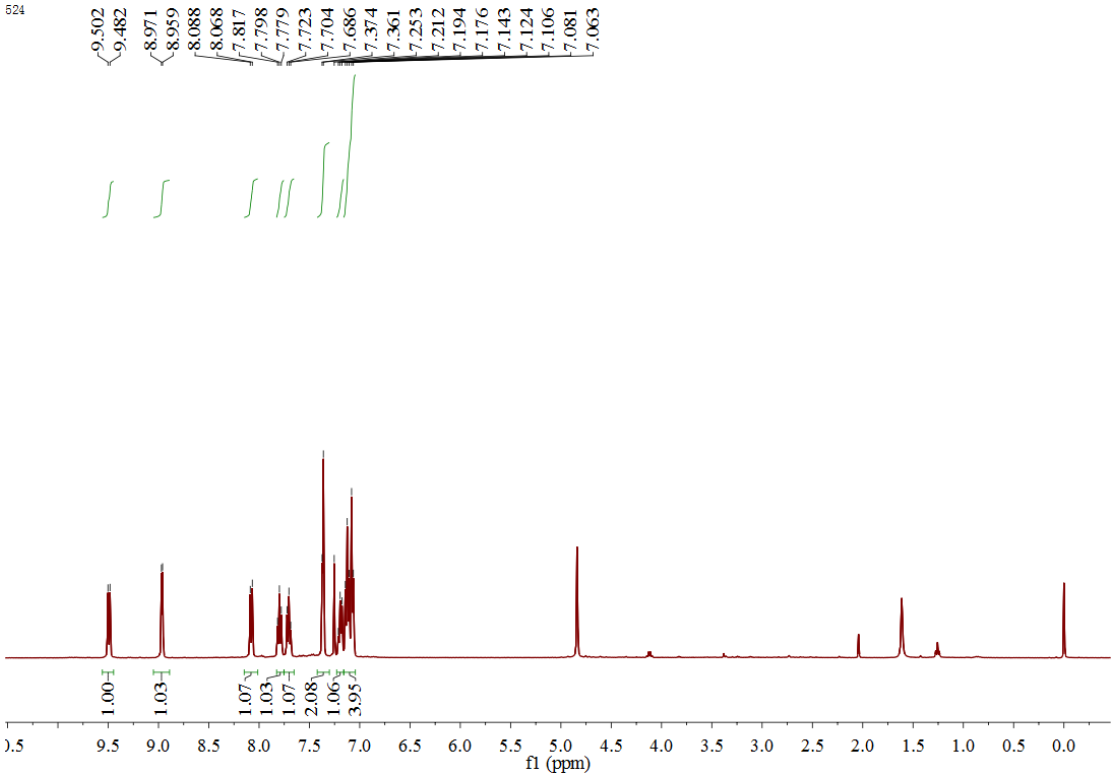

467
147.94
147.80
146.40
138.74
136.96
136.01
131.86
129.56
128.45
128.13
126.78
122.62
121.27
77.33
77.01
76.69
21.79
18.51
f1 (ppm)

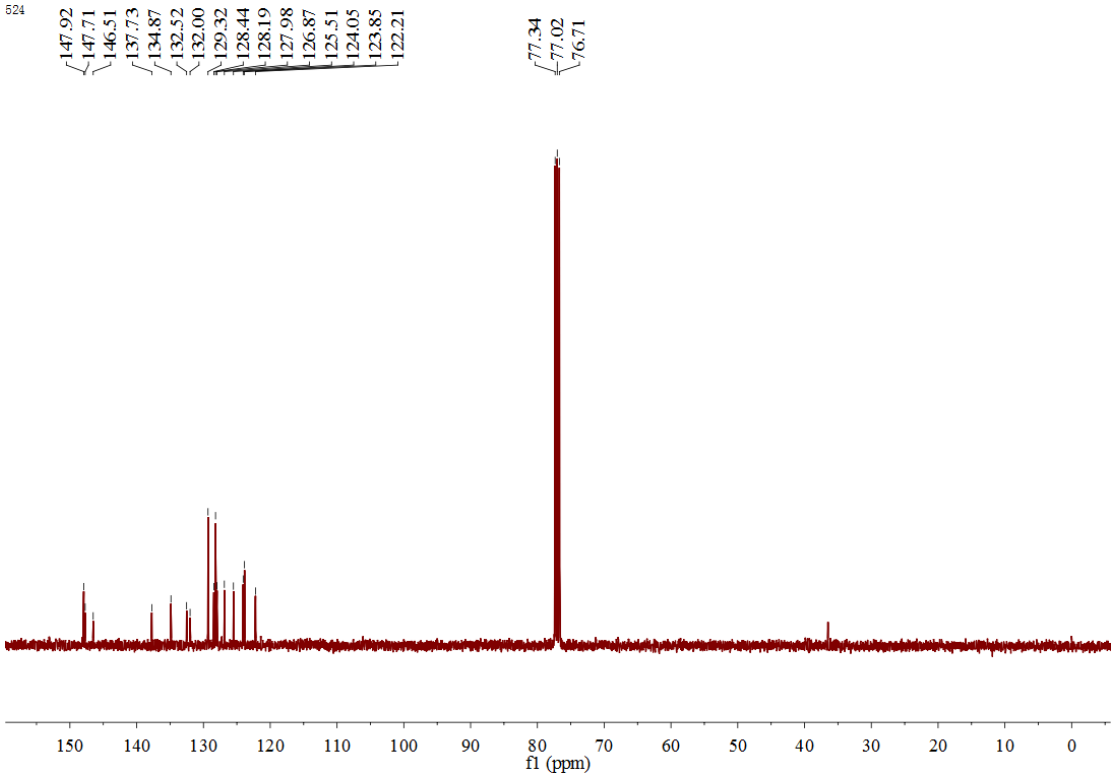
3r


525
9.011
9.001
8.686
8.315
8.293
8.215
8.193
7.573
7.558
7.539
7.517
7.501
7.497
7.392
7.381
7.278
3.915
0.95
0.97
1.00
0.97
5.14
0.98
3.00
f1 (ppm)

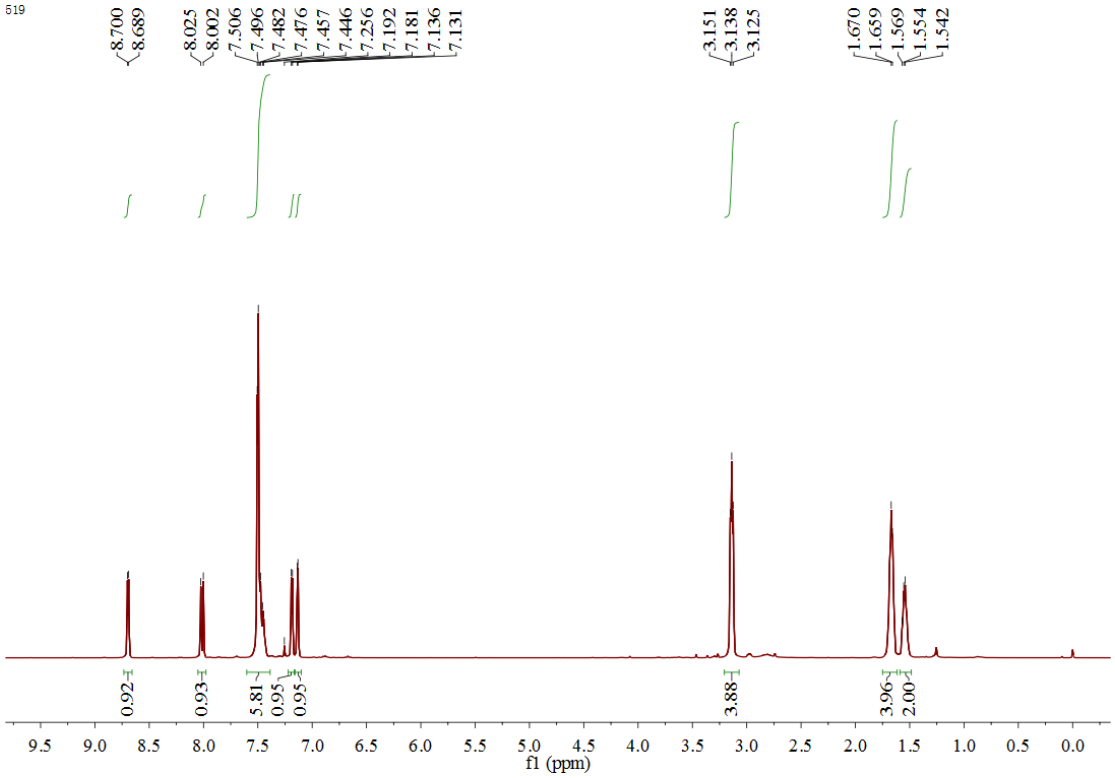

525
166.69
151.95
150.56
149.88
137.29
130.24
129.55
129.12
128.83
128.17
125.99
122.06
77.41
77.10
76.78
52.36
f1 (ppm)

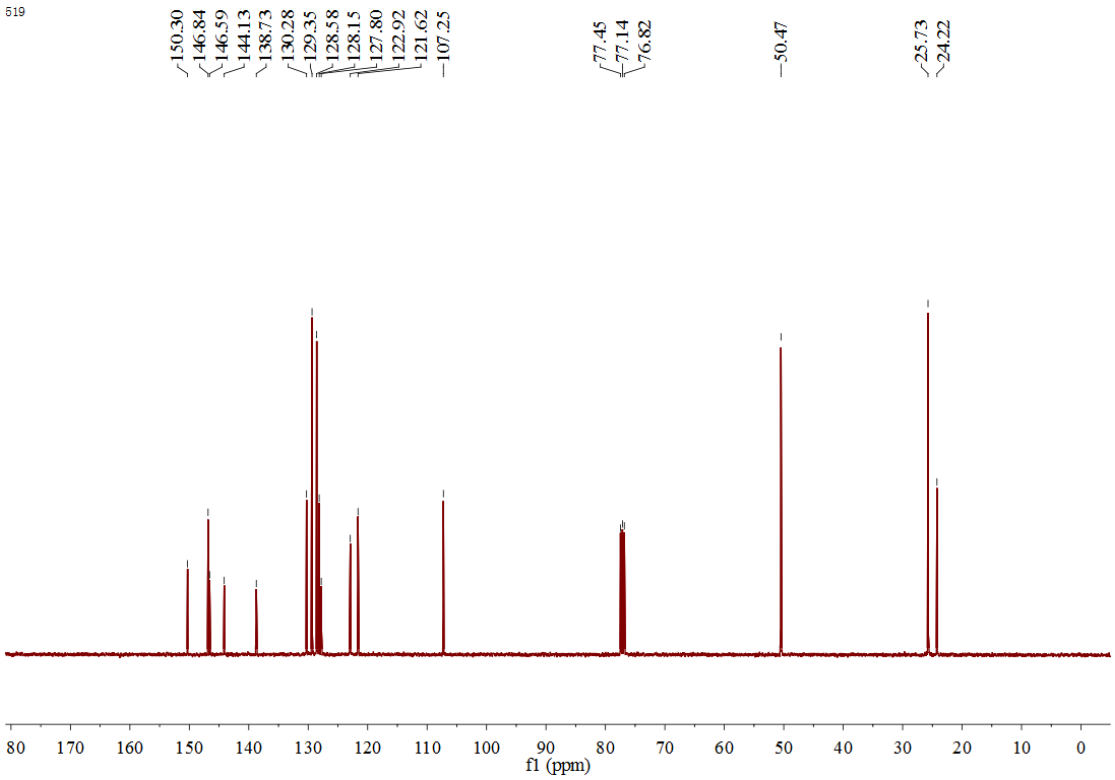
3s


524
9.502
9.482
8.971
8.959
8.088
8.068
7.817
7.798
7.779
7.723
7.704
7.686
7.374
7.361
7.253
7.212
7.194
7.176
7.143
7.124
7.106
7.081
7.063
1.00
1.03
1.07
1.03
1.07
2.08
1.06
3.95
f1 (ppm)

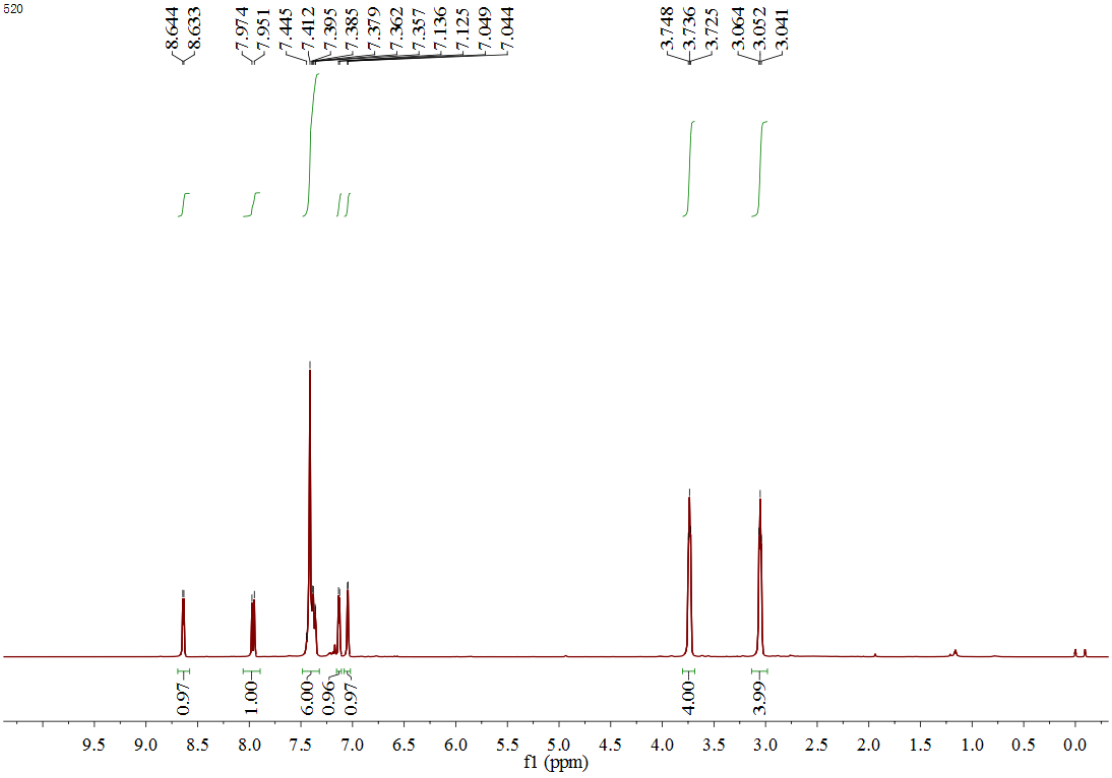

524
147.92
147.71
146.51
137.73
134.87
132.52
132.00
129.32
128.44
128.19
127.98
126.87
125.51
124.05
123.85
122.21
77.34
77.02
76.71
f1 (ppm)

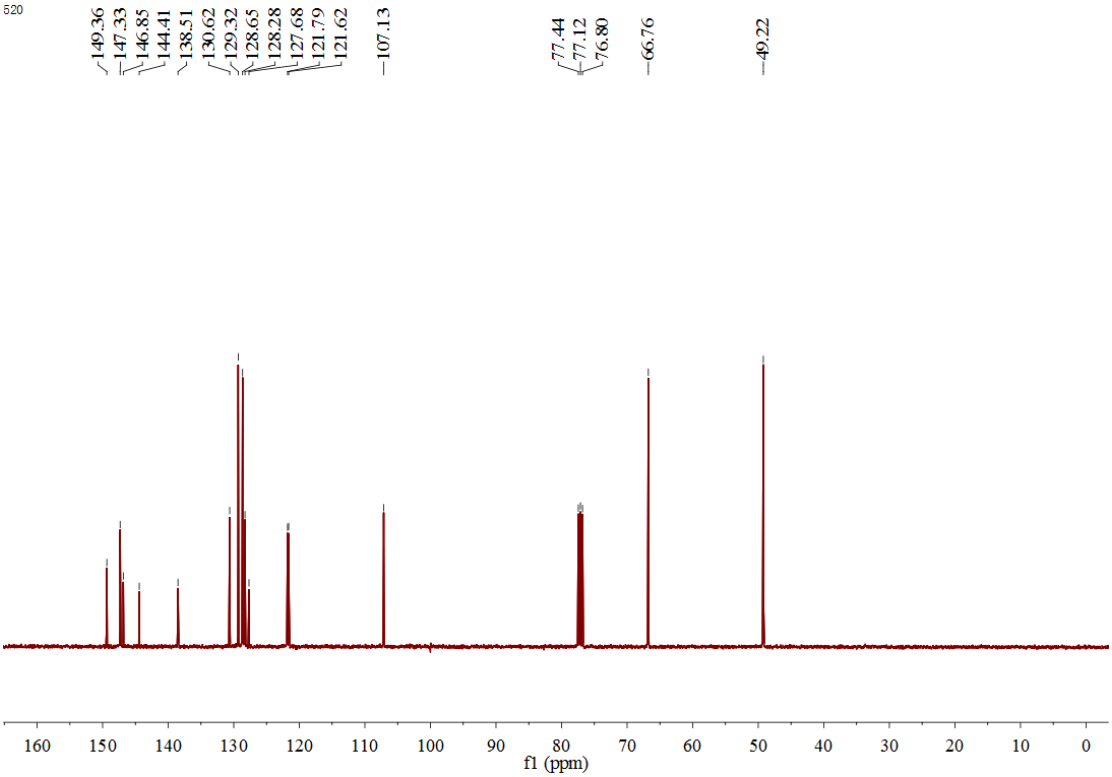
3t


519
8.700
8.689
8.025
8.002
7.506
7.496
7.482
7.476
7.457
7.446
7.256
7.192
7.181
7.136
7.131
3.151
3.138
3.125
1.670
1.659
1.569
1.554
1.542
0.92
0.93
5.81
0.95
0.95
3.88
3.96
2.00
f1 (ppm)

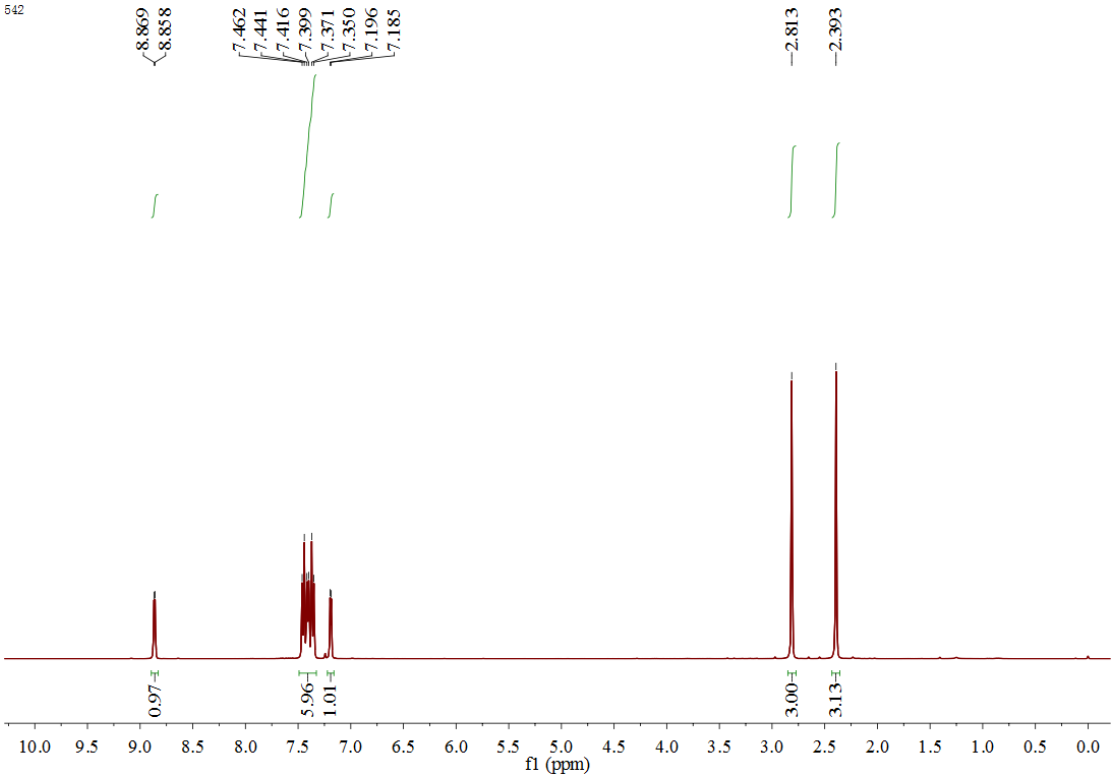

519
150.30
146.84
146.59
144.13
138.73
130.28
129.35
128.58
128.15
127.80
122.92
121.62
107.25
77.45
77.14
76.82
50.47
25.73
24.22
f1 (ppm)

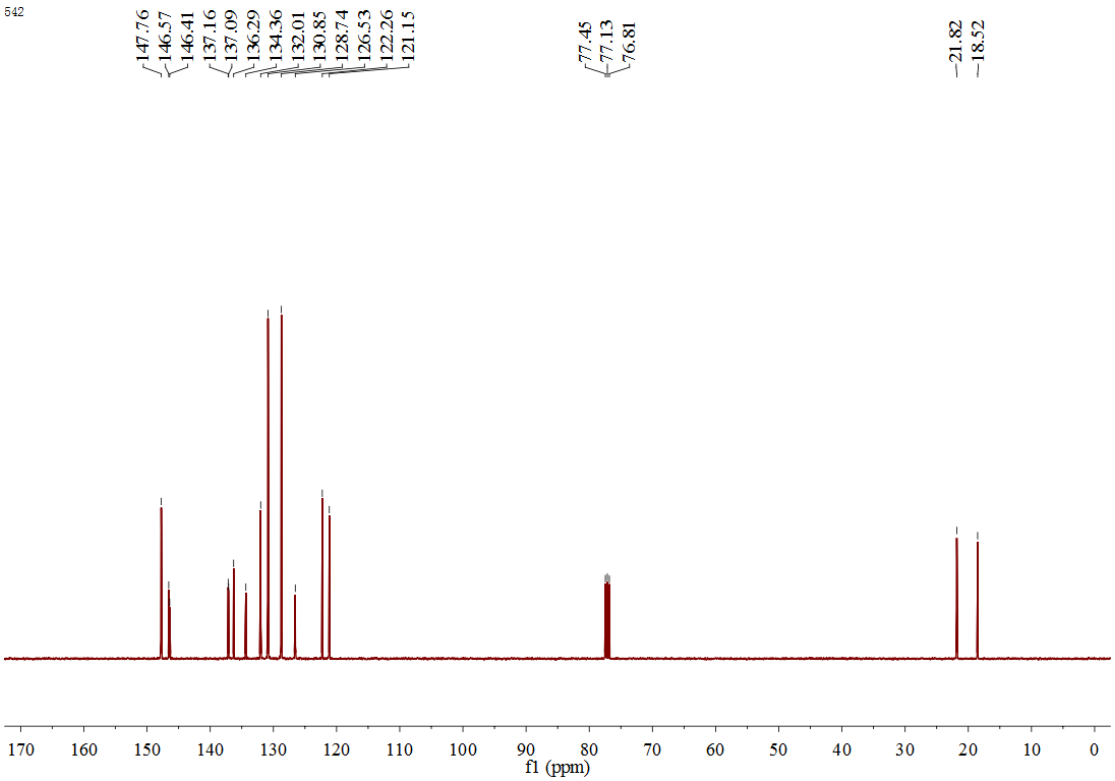
3u


520
8.644
8.633
7.974
7.951
7.445
7.412
7.395
7.385
7.379
7.362
7.357
7.136
7.125
7.049
7.044
3.748
3.736
3.725
3.064
3.052
3.041
0.97
1.00
6.00
0.96
0.97
4.00
3.99
f1 (ppm)

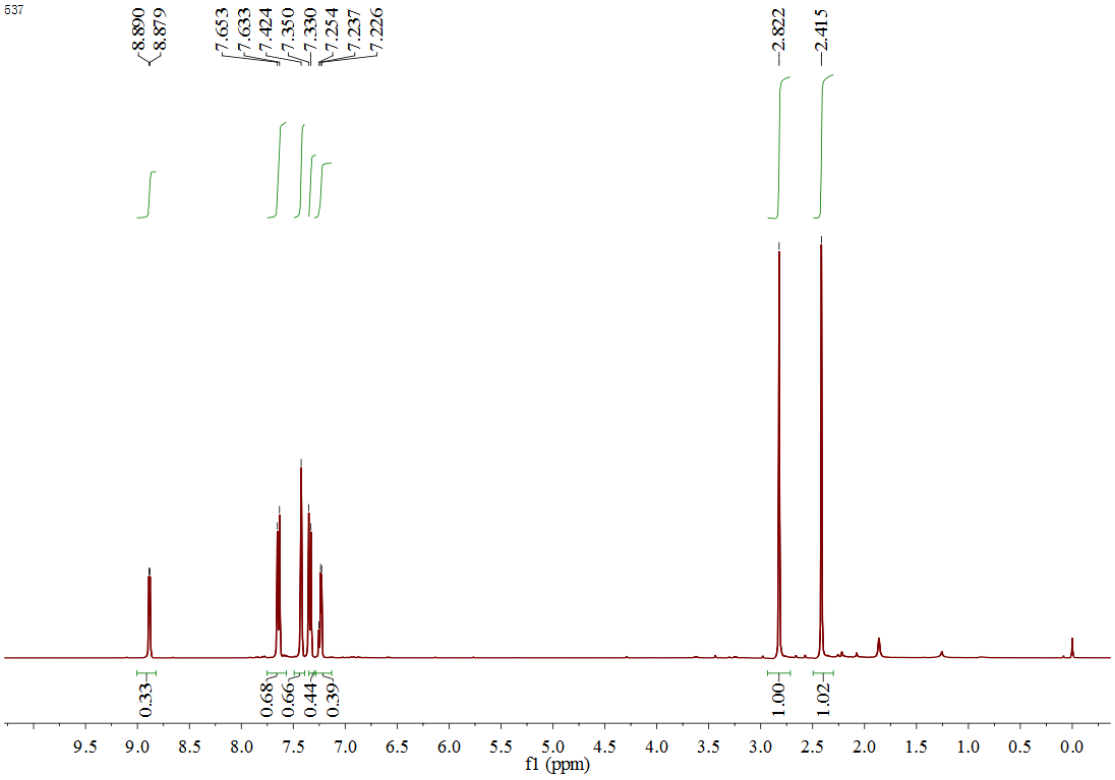

520
149.36
147.33
146.85
144.41
138.51
130.62
129.32
128.65
128.28
127.68
121.79
121.62
107.13
77.44
77.12
76.80
66.76
49.22
f1 (ppm)

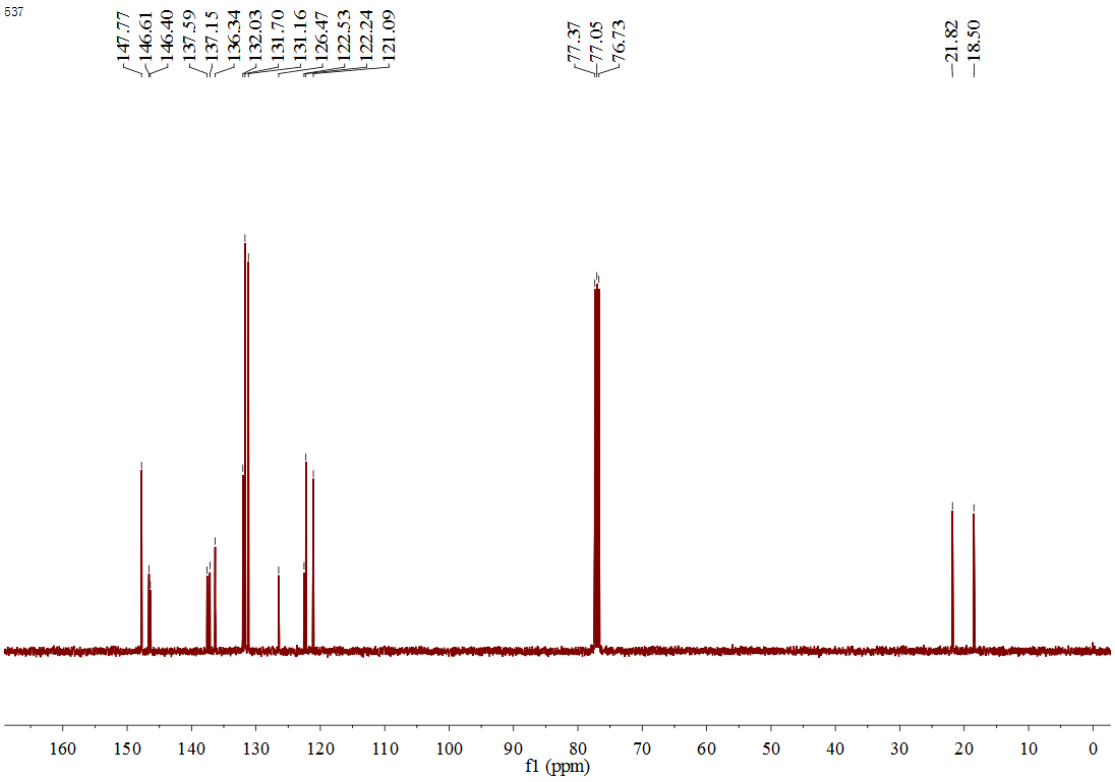
4a


542
8.869
8.858
7.462
7.441
7.416
7.399
7.371
7.350
7.196
7.185
2.813
2.393
0.97
5.96
1.01
3.00
3.13
f1 (ppm)

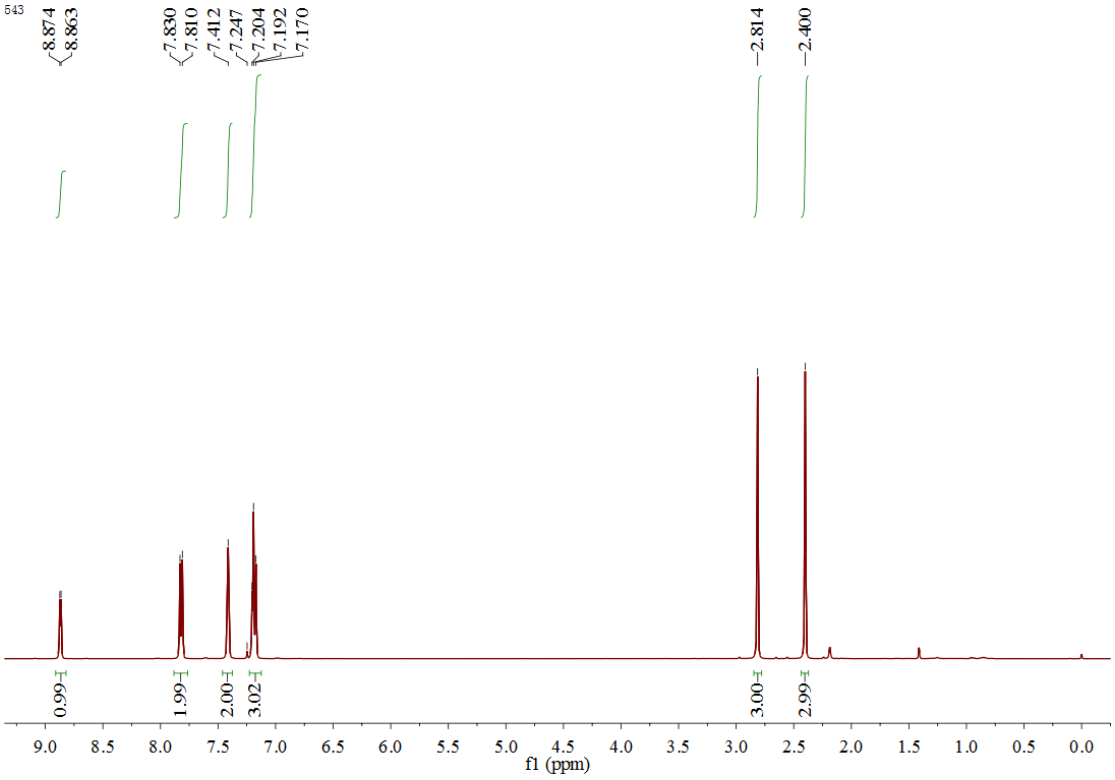

542
147.76
146.57
146.41
137.16
137.09
136.29
134.36
132.01
130.85
128.74
126.53
122.26
121.15
77.45
77.13
76.81
21.82
18.52
f1 (ppm)

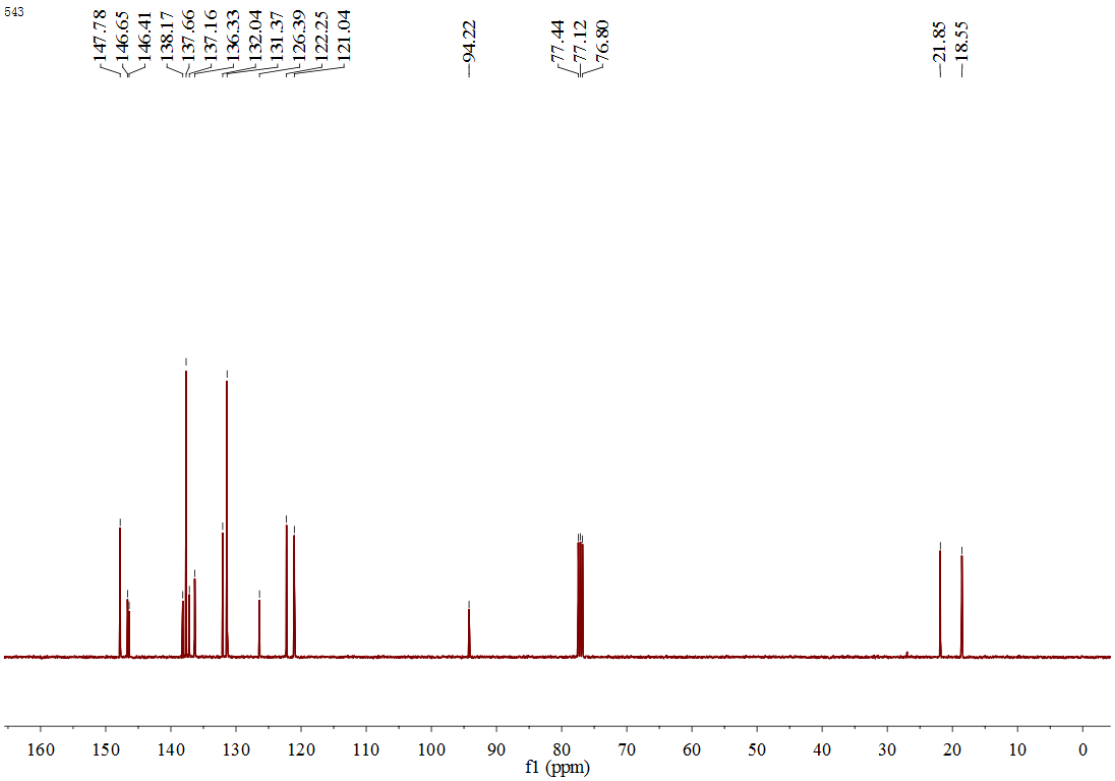
4b


537
8.890
8.879
7.653
7.633
7.424
7.350
7.330
7.254
7.237
7.226
2.822
2.415
0.33
0.68
0.66
0.44
0.39
1.00
1.02
f1 (ppm)

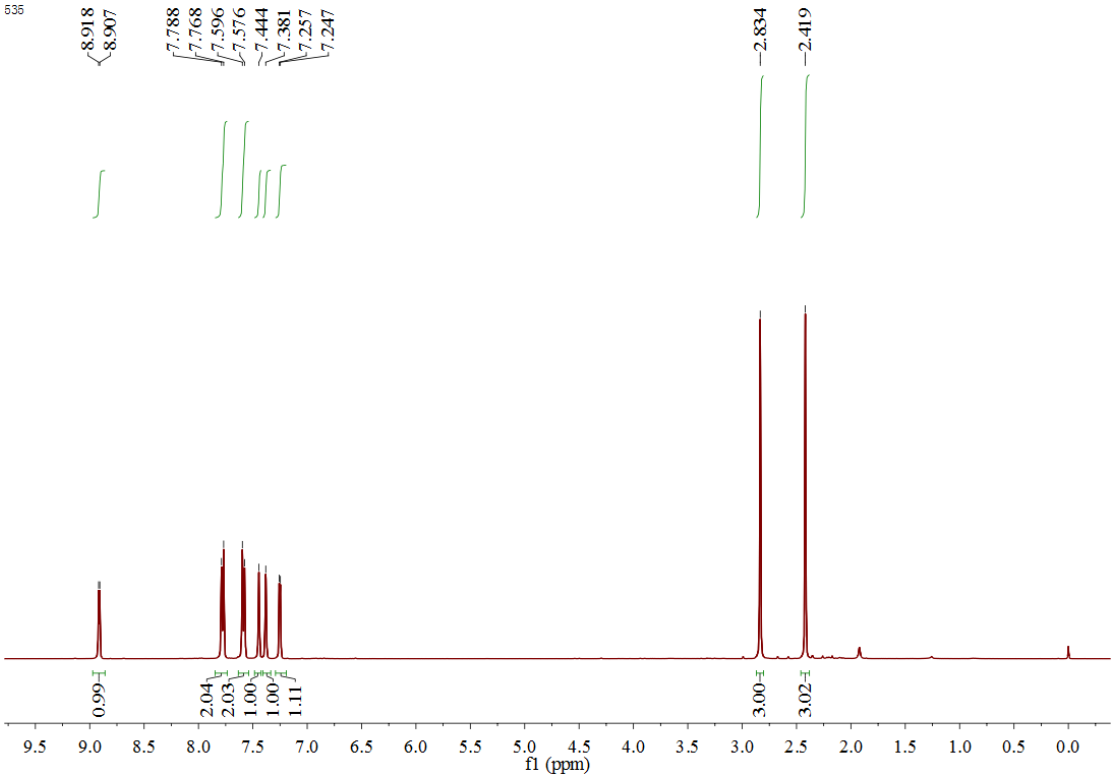

537
147.77
146.61
146.40
137.59
137.15
136.34
132.03
131.70
131.16
126.47
122.53
122.24
121.09
77.37
77.05
76.73
21.82
18.50
f1 (ppm)

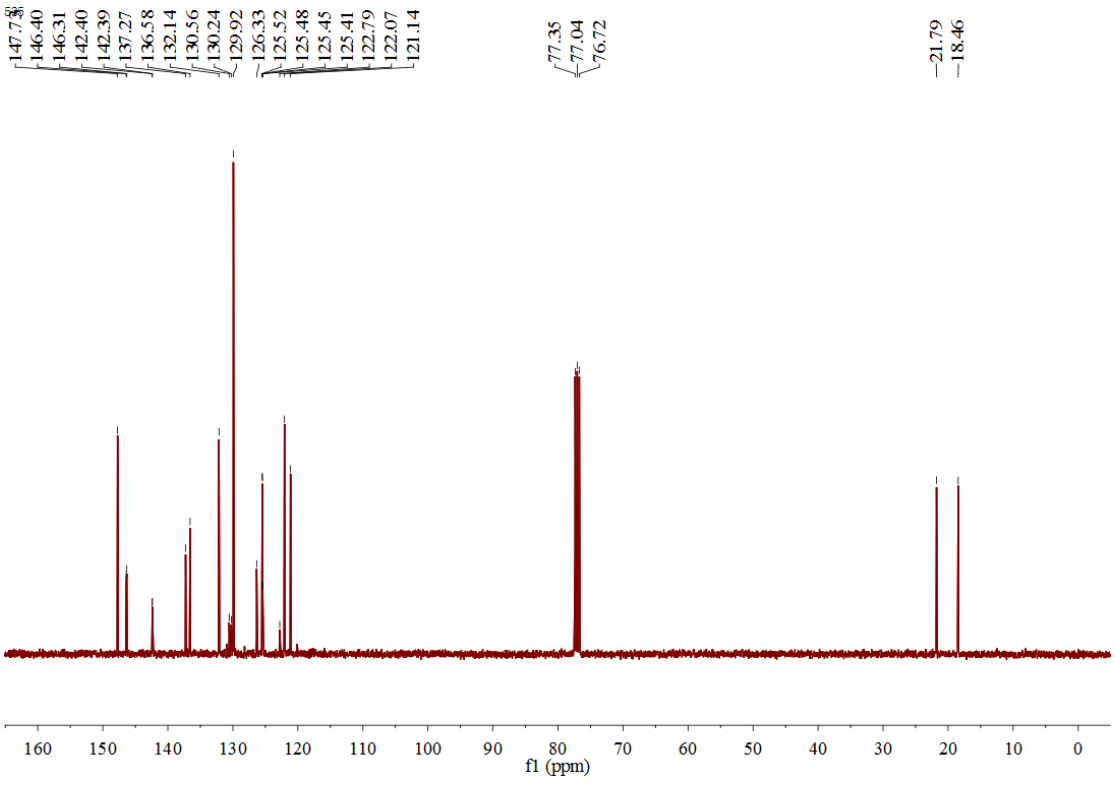
4c


543
8.874
8.863
7.830
7.810
7.412
7.247
7.204
7.192
7.170
2.814
2.400
0.99
1.99
2.00
3.02
3.00
2.99
f1 (ppm)

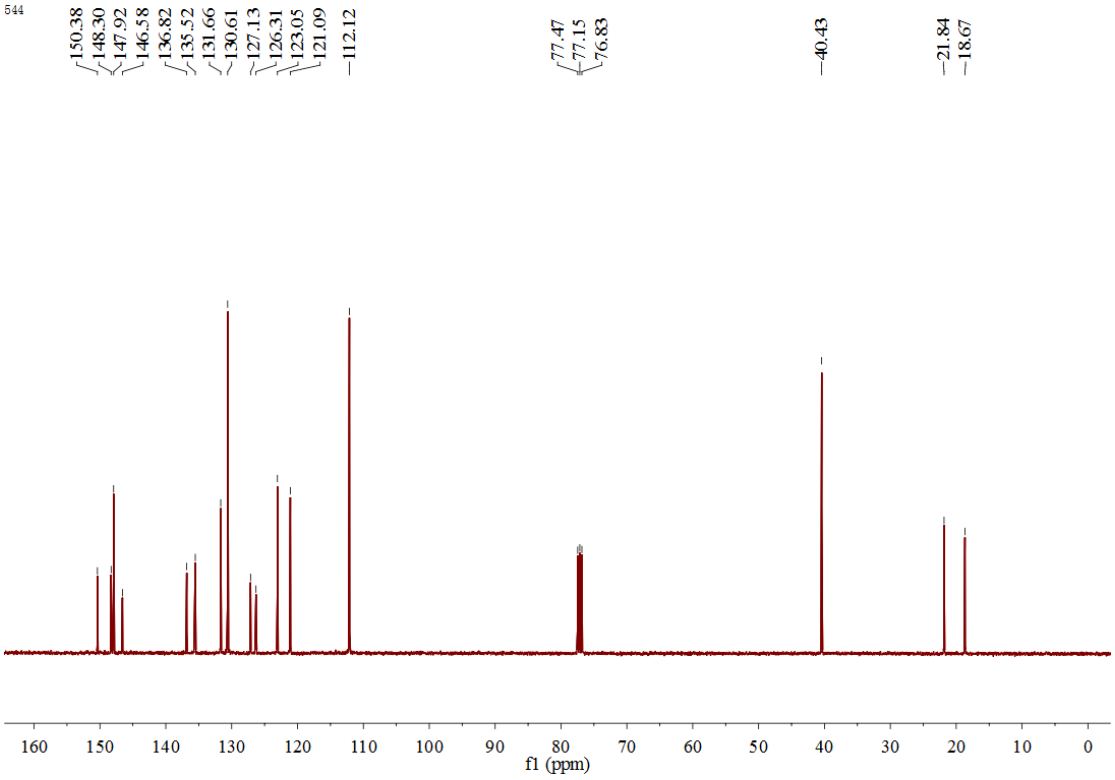

543
147.78
146.65
146.41
138.17
137.66
137.16
136.33
132.04
131.37
126.39
122.25
121.04
94.22
77.44
77.12
76.80
21.85
18.55
f1 (ppm)

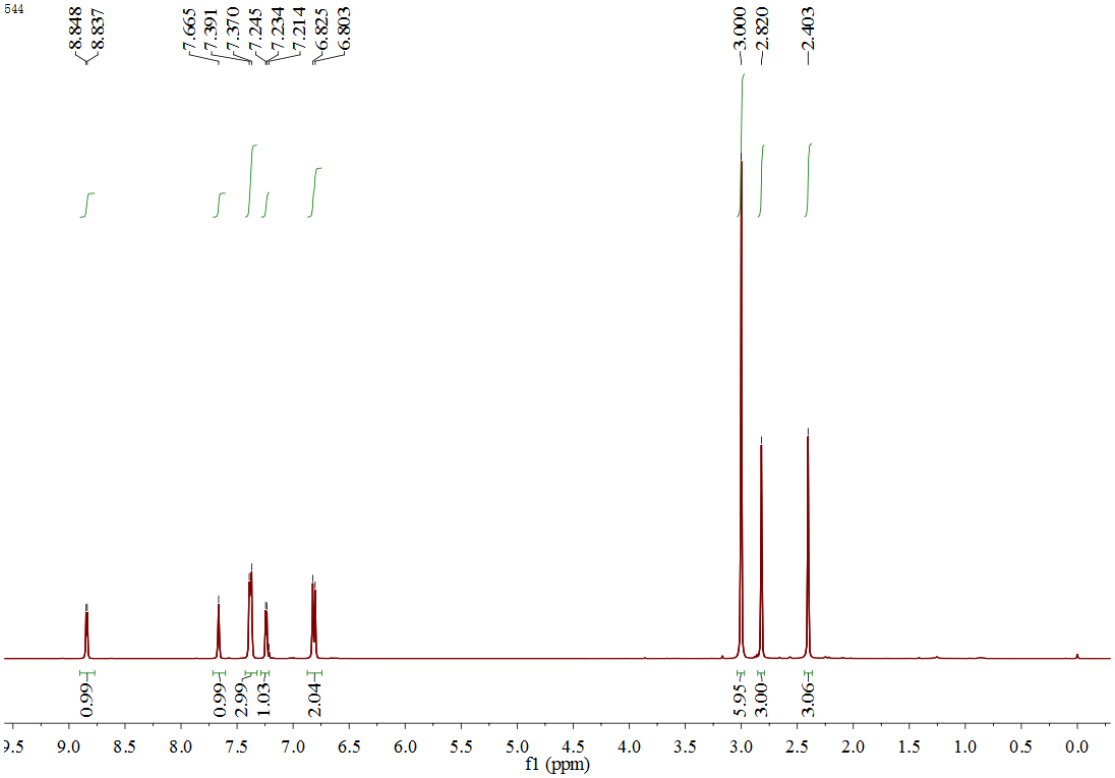
4d


8.918
8.907
7.788
7.768
7.596
7.576
7.444
7.381
7.257
7.247
2.834
2.419
0.99
2.04
2.03
1.00
1.00
1.11
3.00
3.02
f1 (ppm)

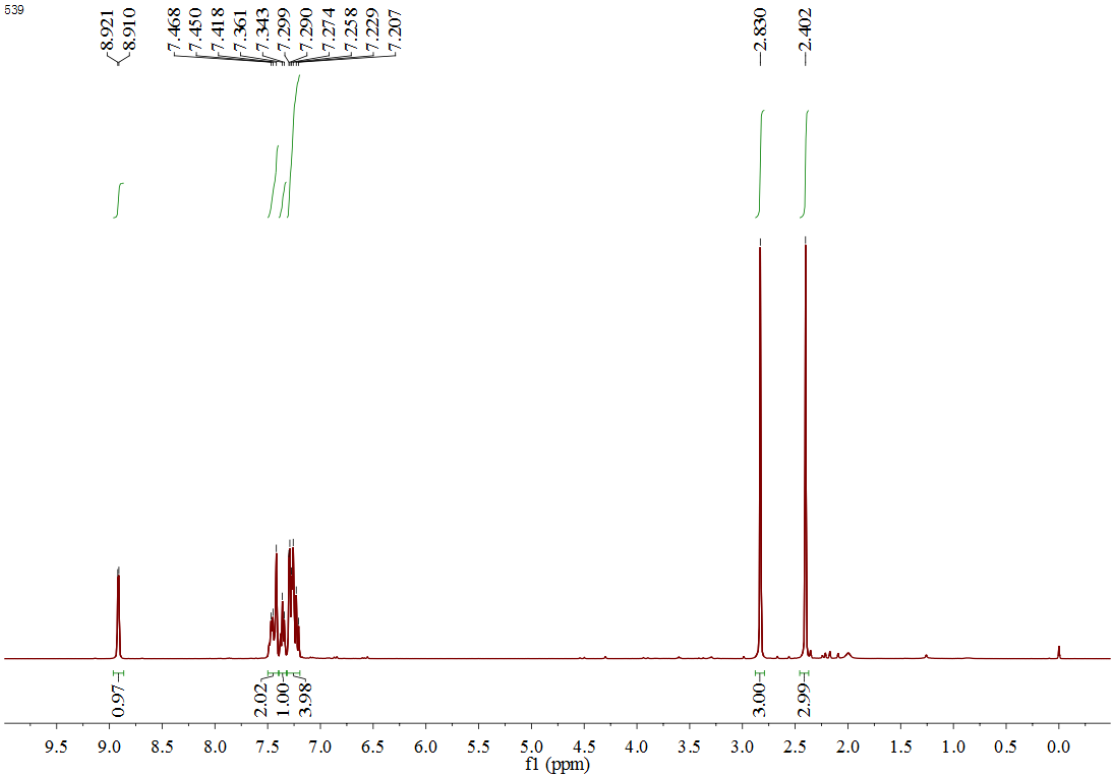

146.40
146.31
142.40
142.39
137.27
136.58
132.14
130.56
130.24
129.92
126.33
125.52
125.48
125.45
125.41
122.79
122.07
121.14
77.35
77.04
76.72
21.79
18.46
f1 (ppm)

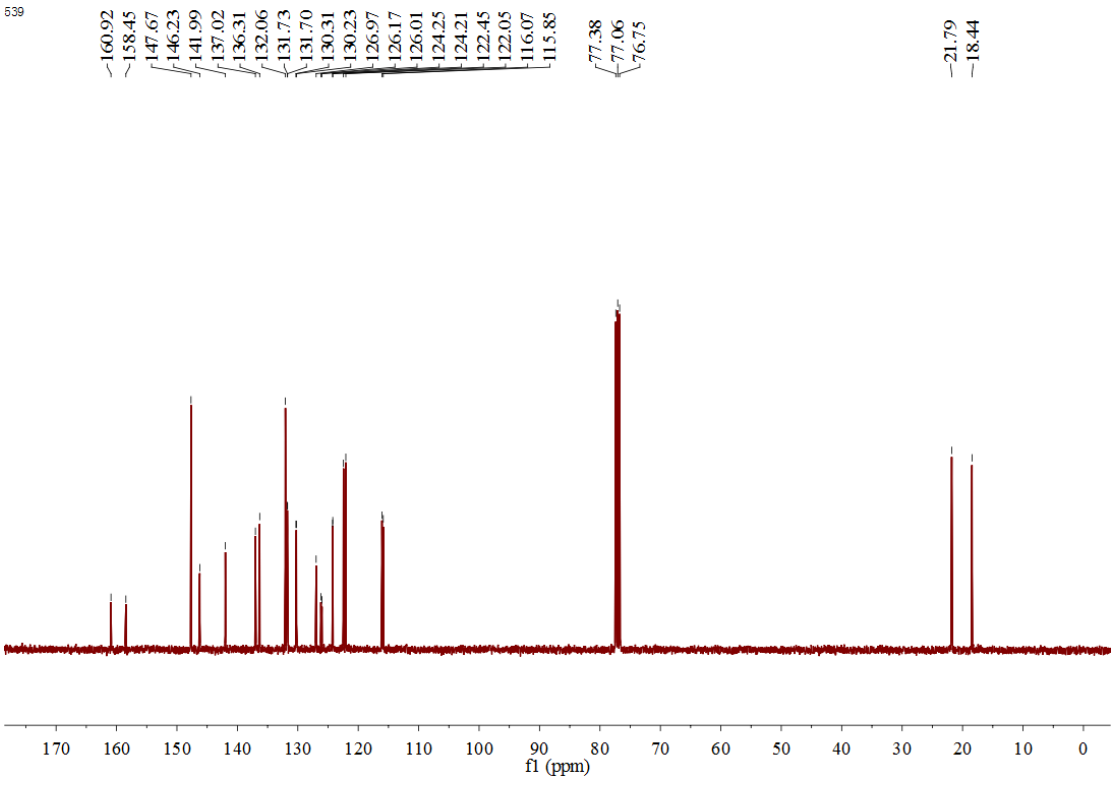
4e


544
150.38
148.30
147.92
146.58
136.82
135.52
131.66
130.61
127.13
126.31
123.05
121.09
112.12
77.47
77.15
76.83
40.43
21.84
18.67
160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0
f1 (ppm)

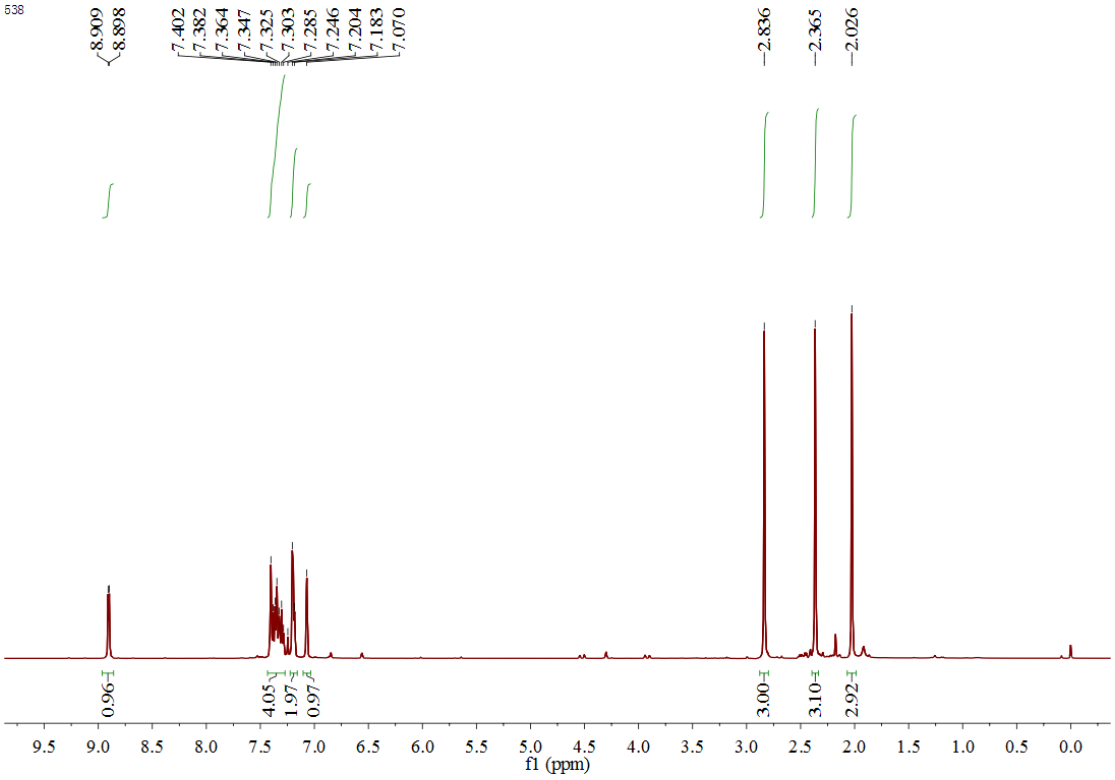

544
8.848
8.837
7.665
7.391
7.370
7.245
7.234
7.214
6.825
6.803
3.000
2.820
2.403
0.99
0.99
2.99
1.03
2.04
5.95
3.00
3.06
9.5 9.0 8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0
f1 (ppm)

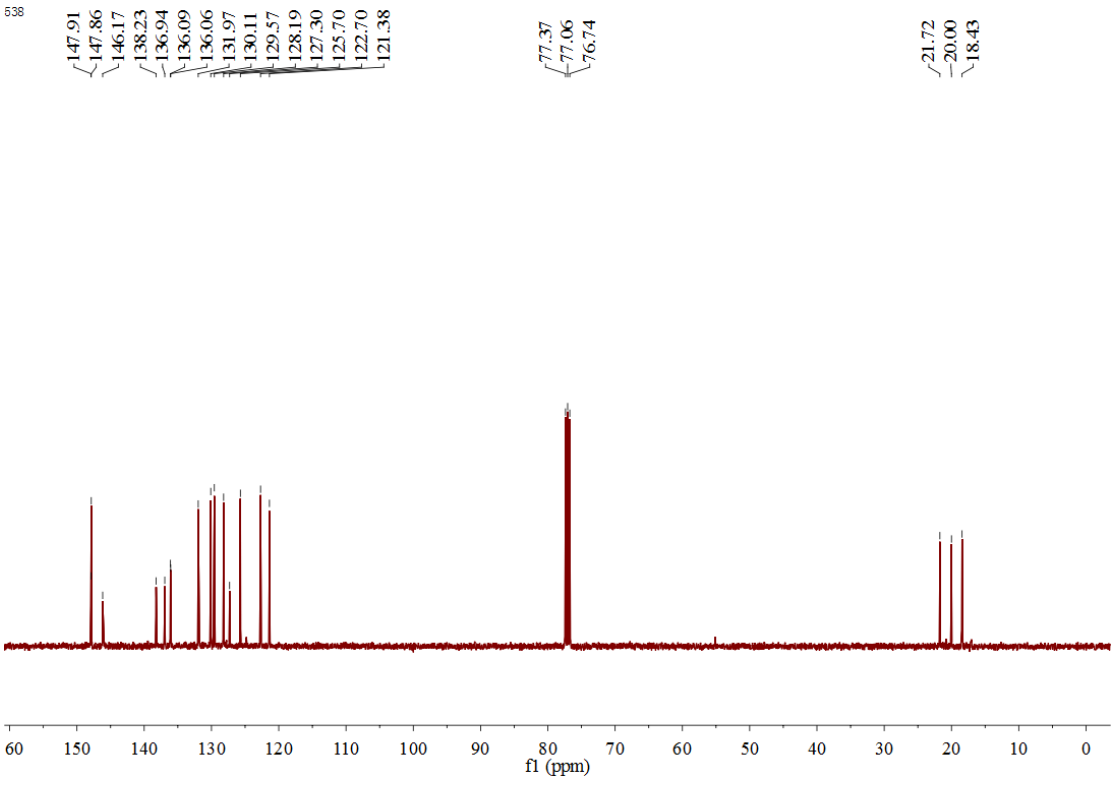
4f


539
8.921
8.910
7.468
7.450
7.418
7.361
7.343
7.299
7.290
7.274
7.258
7.229
7.207
2.830
2.402
0.97
2.02
1.00
3.98
3.00
2.99
f1 (ppm)

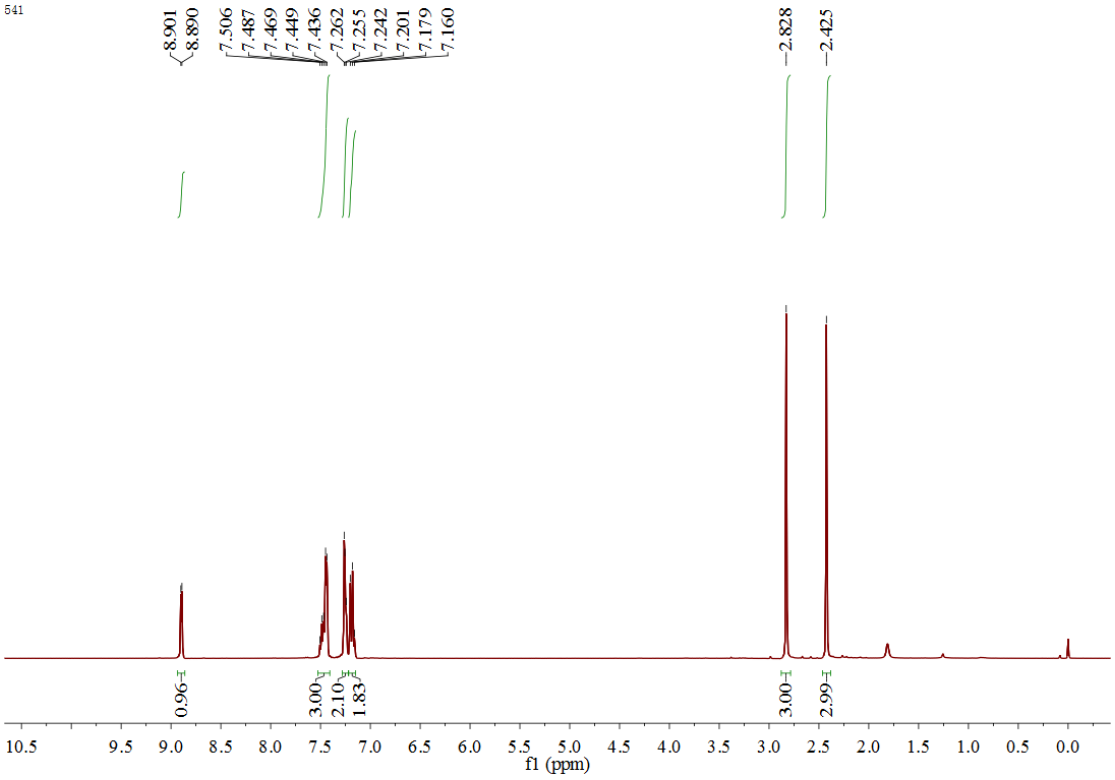

539
160.92
158.45
147.67
146.23
141.99
137.02
136.31
132.06
131.73
131.70
130.31
130.23
126.97
126.17
126.01
124.25
124.21
122.45
122.05
116.07
115.85
77.38
77.06
76.75
21.79
18.44
f1 (ppm)

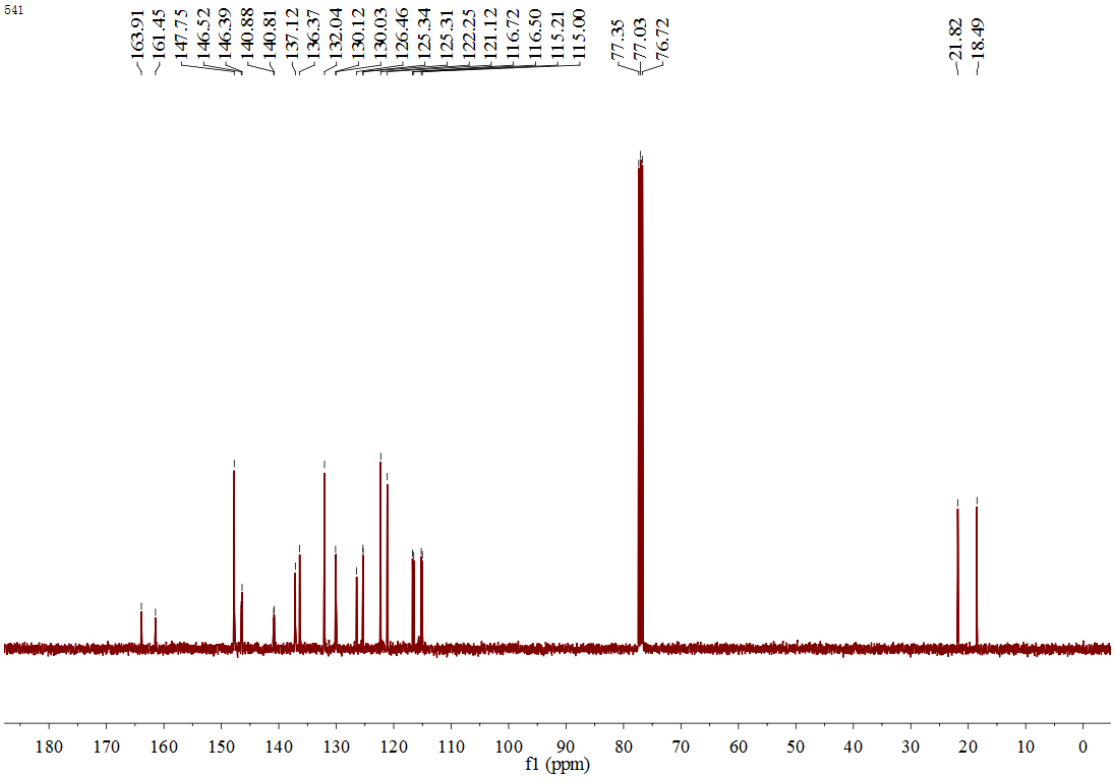
4g


538
8.909
8.898
7.402
7.382
7.364
7.347
7.325
7.303
7.285
7.246
7.204
7.183
7.070
2.836
2.365
2.026
0.96
4.05
1.97
0.97
3.00
3.10
2.92
f1 (ppm)

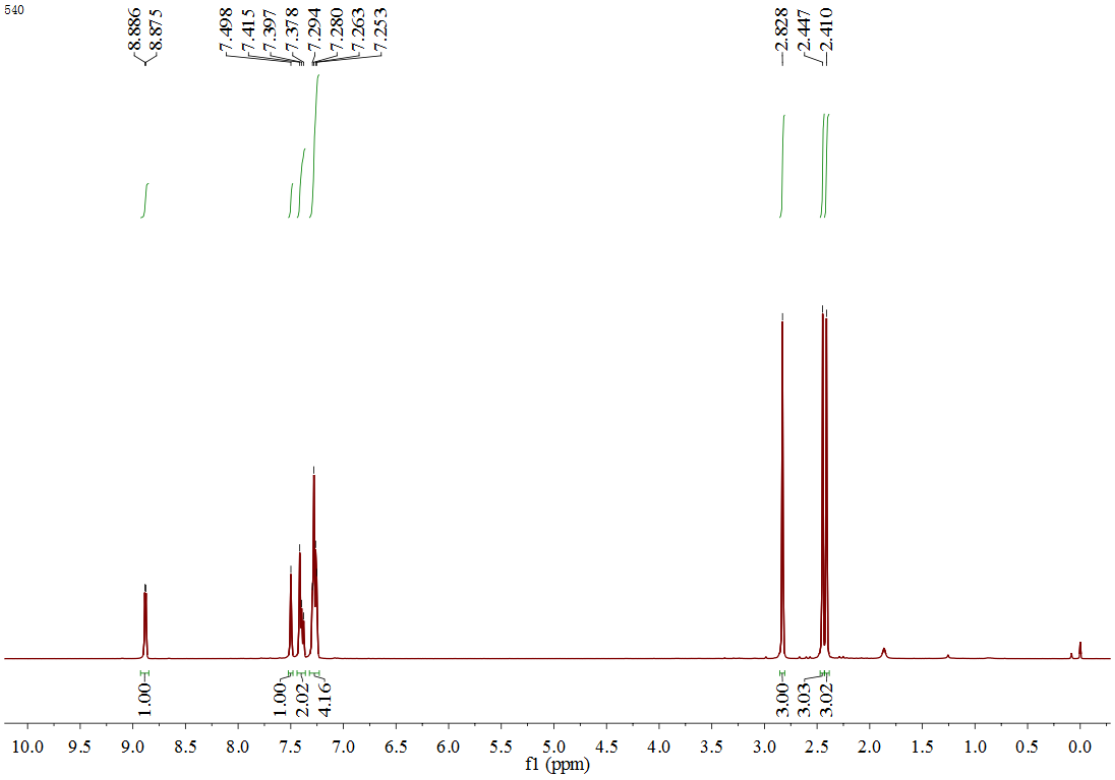

538
147.91
147.86
146.17
138.23
136.94
136.09
136.06
131.97
130.11
129.57
128.19
127.30
125.70
122.70
121.38
77.37
77.06
76.74
21.72
20.00
18.43
f1 (ppm)

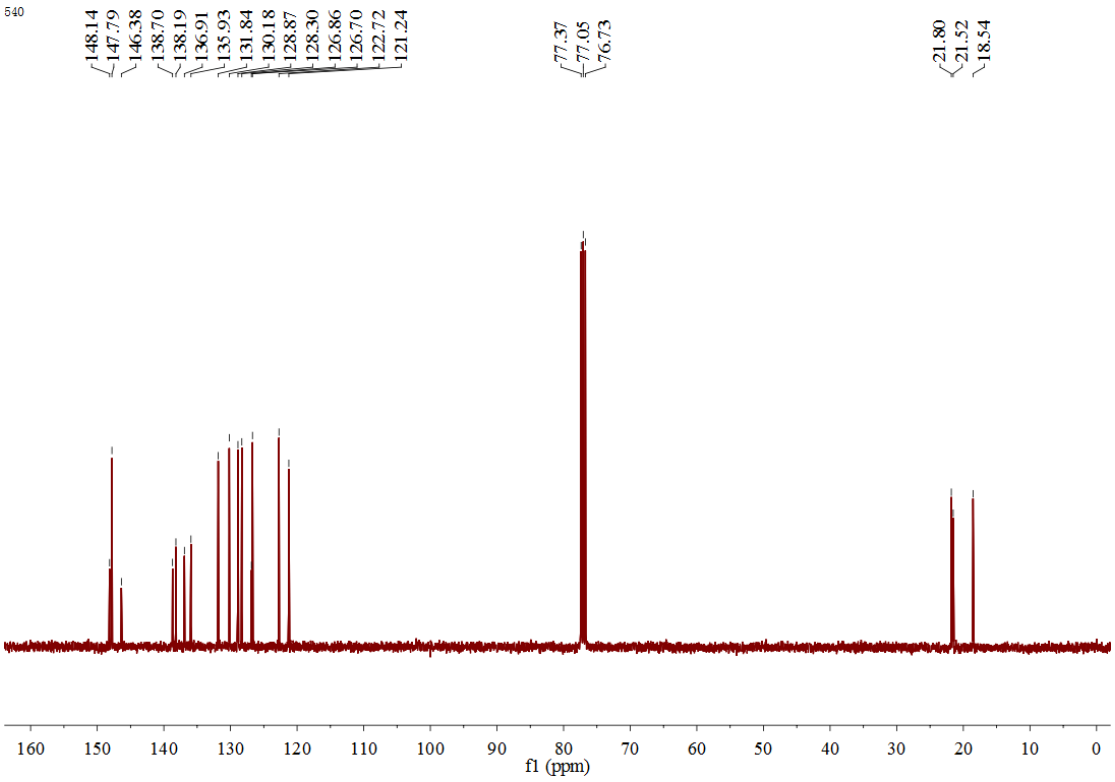
4h


541
8.901
8.890
7.506
7.487
7.469
7.449
7.436
7.262
7.255
7.242
7.201
7.179
7.160
2.828
2.425
0.96
3.00
2.10
1.83
3.00
2.99
f1 (ppm)

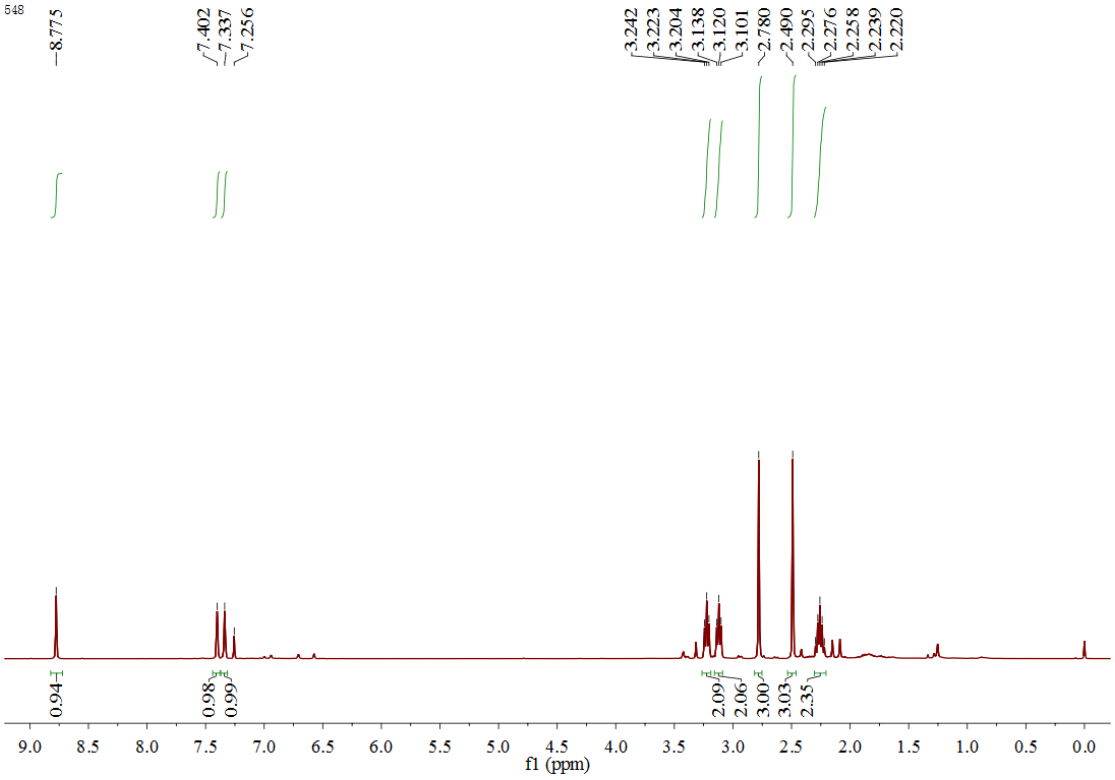

541
163.91
161.45
147.75
146.52
146.39
140.88
140.81
137.12
136.37
132.04
130.12
130.03
126.46
125.34
125.31
122.25
121.12
116.72
116.50
115.21
115.00
77.35
77.03
76.72
21.82
18.49
f1 (ppm)

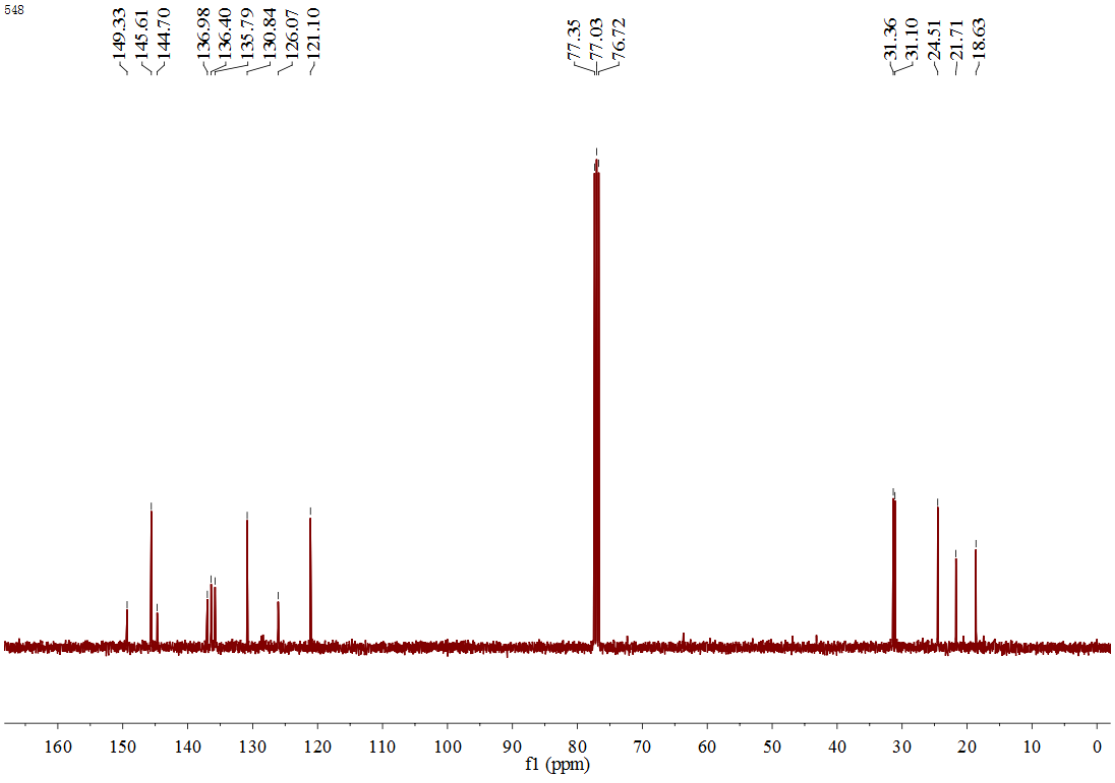
4i


8.886
8.875
7.498
7.415
7.397
7.378
7.294
7.280
7.263
7.253
2.828
2.447
2.410
1.00
1.00
2.02
4.16
3.00
3.03
3.02
f1 (ppm)

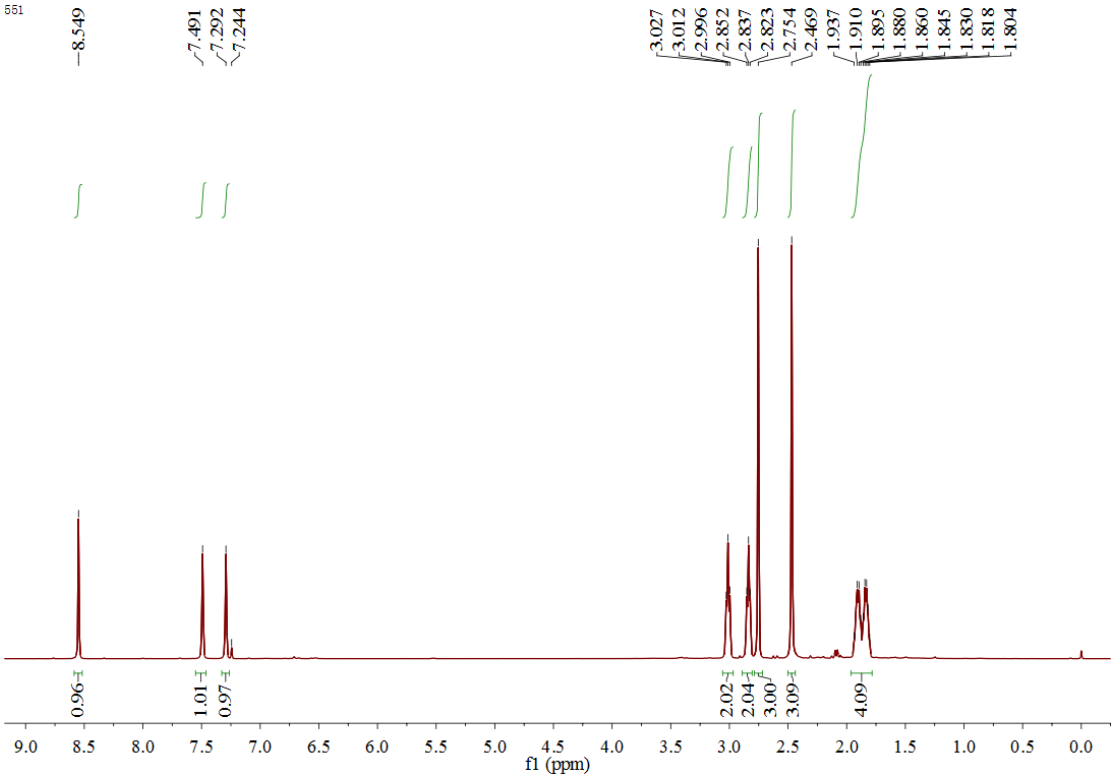

148.14
147.79
146.38
138.70
138.19
136.91
135.93
131.84
130.18
128.87
128.30
126.86
126.70
122.72
121.24
77.37
77.05
76.73
21.80
21.52
18.54
f1 (ppm)

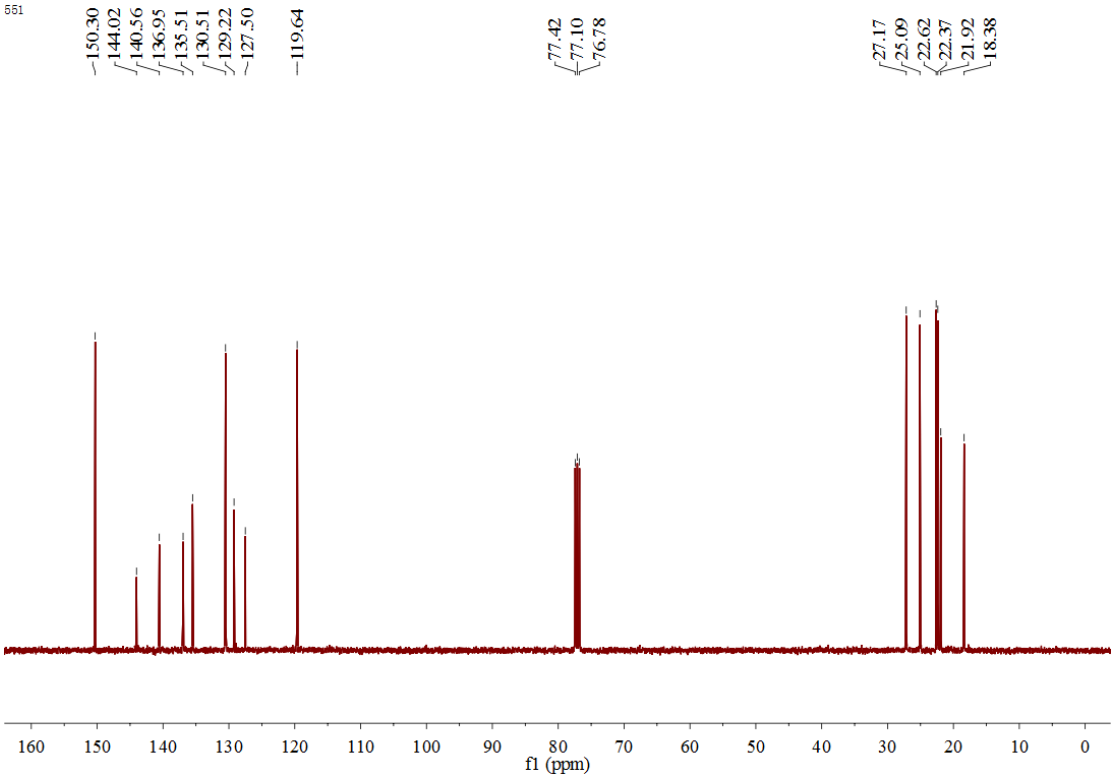
4j


548
8.775
7.402
7.337
7.256
3.242
3.223
3.204
3.138
3.120
3.101
2.780
2.490
2.295
2.276
2.258
2.239
2.220
0.94
0.98
0.99
2.09
2.06
3.00
3.03
2.35
f1 (ppm)

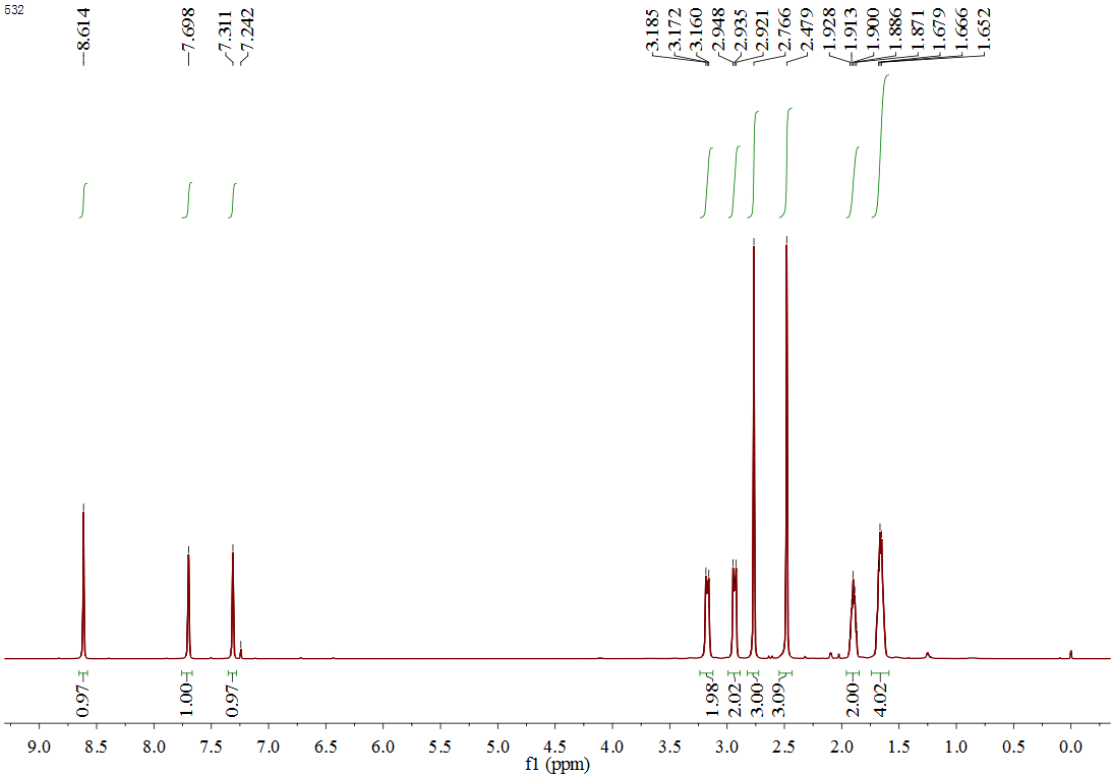

548
149.33
145.61
144.70
136.98
136.40
135.79
130.84
126.07
121.10
77.35
77.03
76.72
31.36
31.10
24.51
21.71
18.63
f1 (ppm)

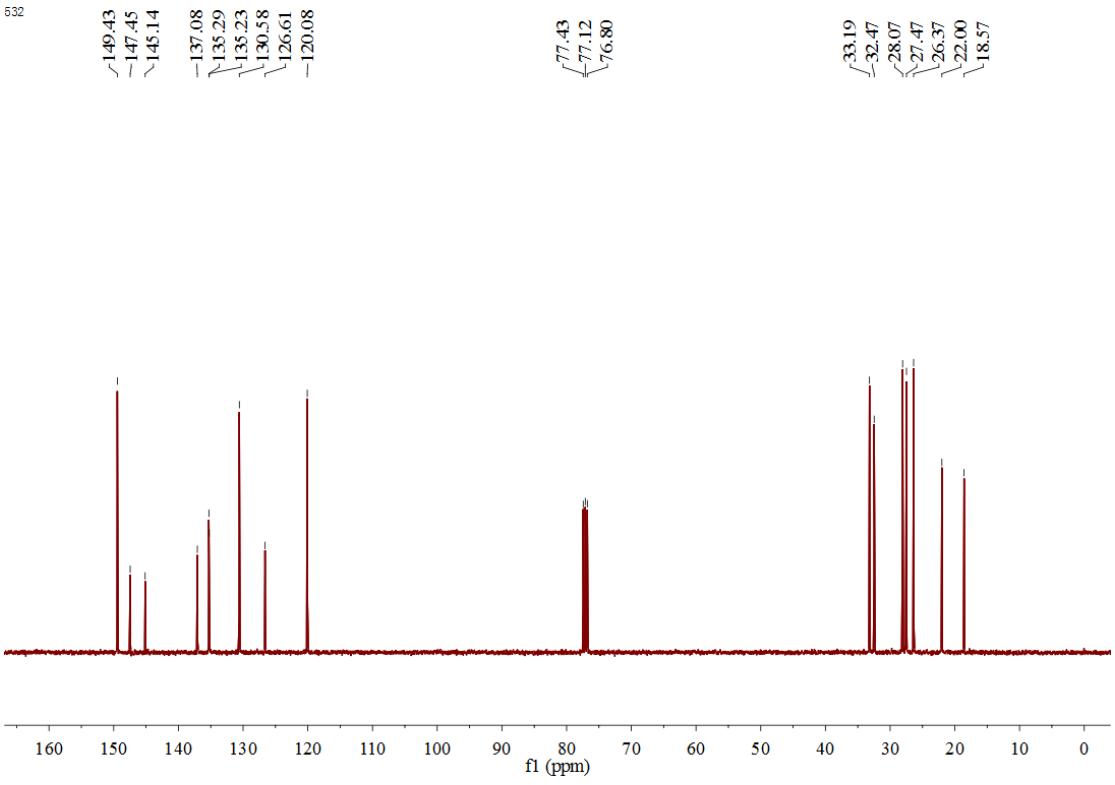
4k


8.549
7.491
7.292
7.244
3.027
3.012
2.996
2.852
2.837
2.823
2.754
2.469
1.937
1.910
1.895
1.880
1.860
1.845
1.830
1.818
1.804
0.96
1.01
0.97
2.02
2.04
3.00
3.09
4.09
f1 (ppm)

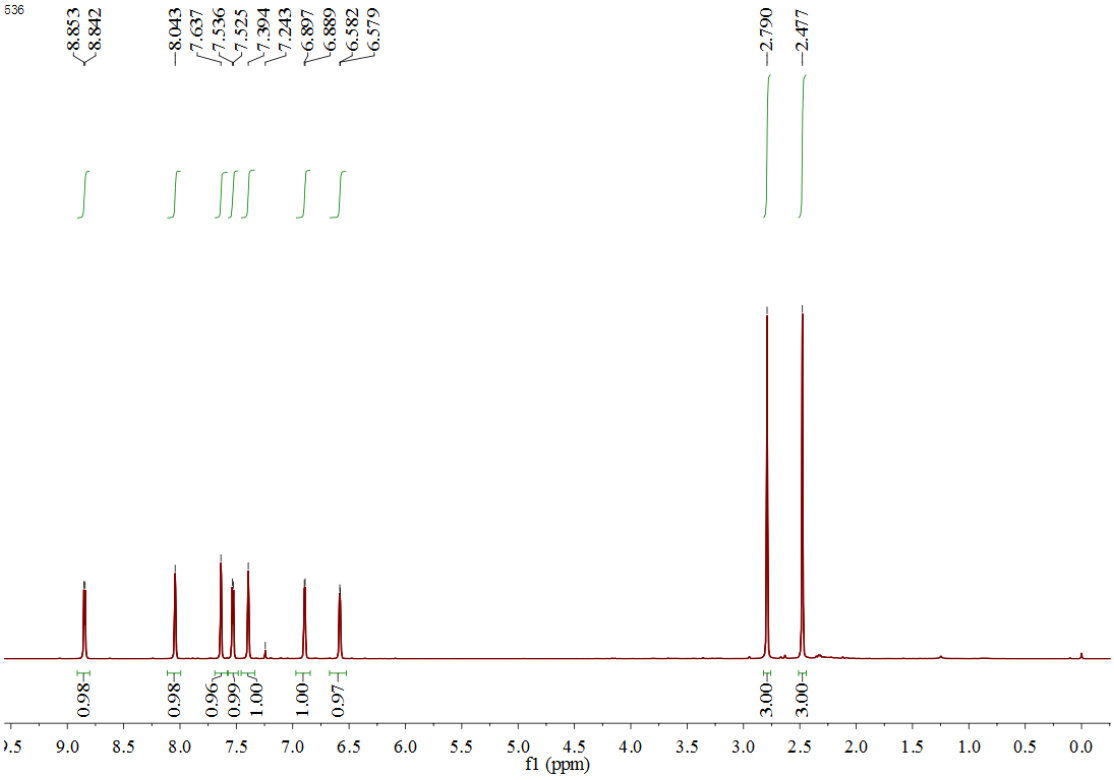

150.30
144.02
140.56
136.95
135.51
130.51
129.22
127.50
119.64
77.42
77.10
76.78
27.17
25.09
22.62
22.37
21.92
18.38
f1 (ppm)

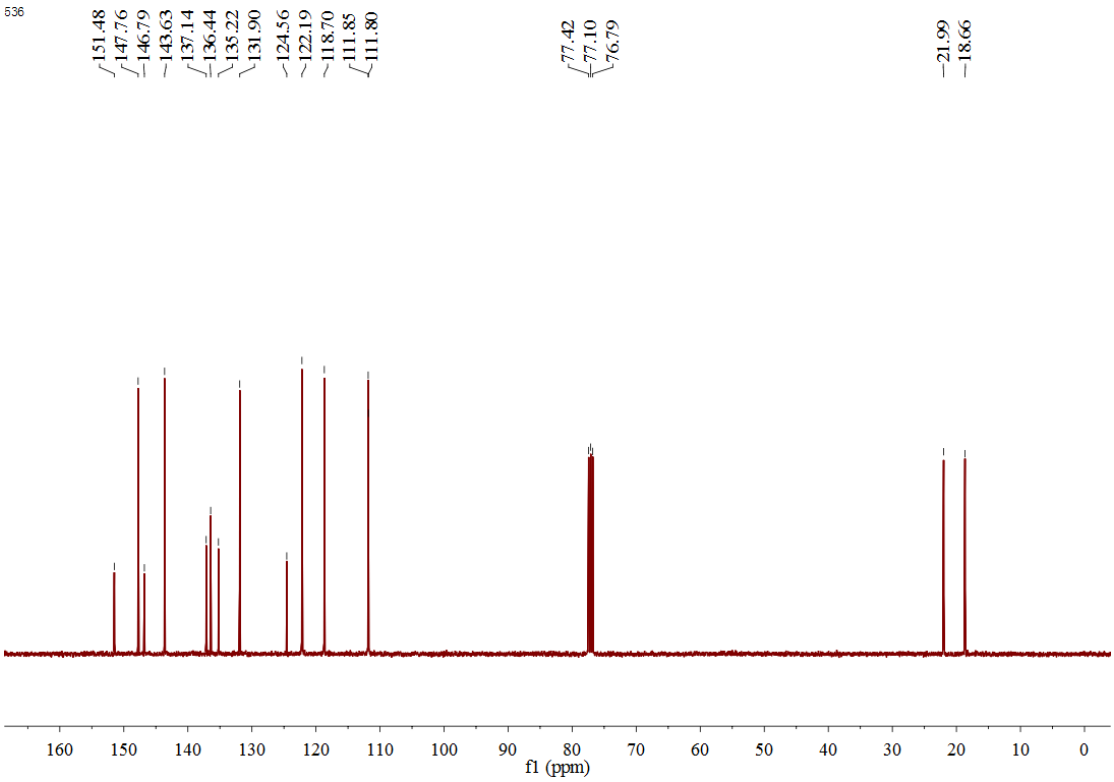
4l


8.614
7.698
7.311
7.242
3.185
3.172
3.160
2.948
2.935
2.921
2.766
2.479
1.928
1.913
1.900
1.886
1.871
1.679
1.666
1.652
0.97
1.00
0.97
1.98
2.02
3.00
3.09
2.00
4.02
f1 (ppm)

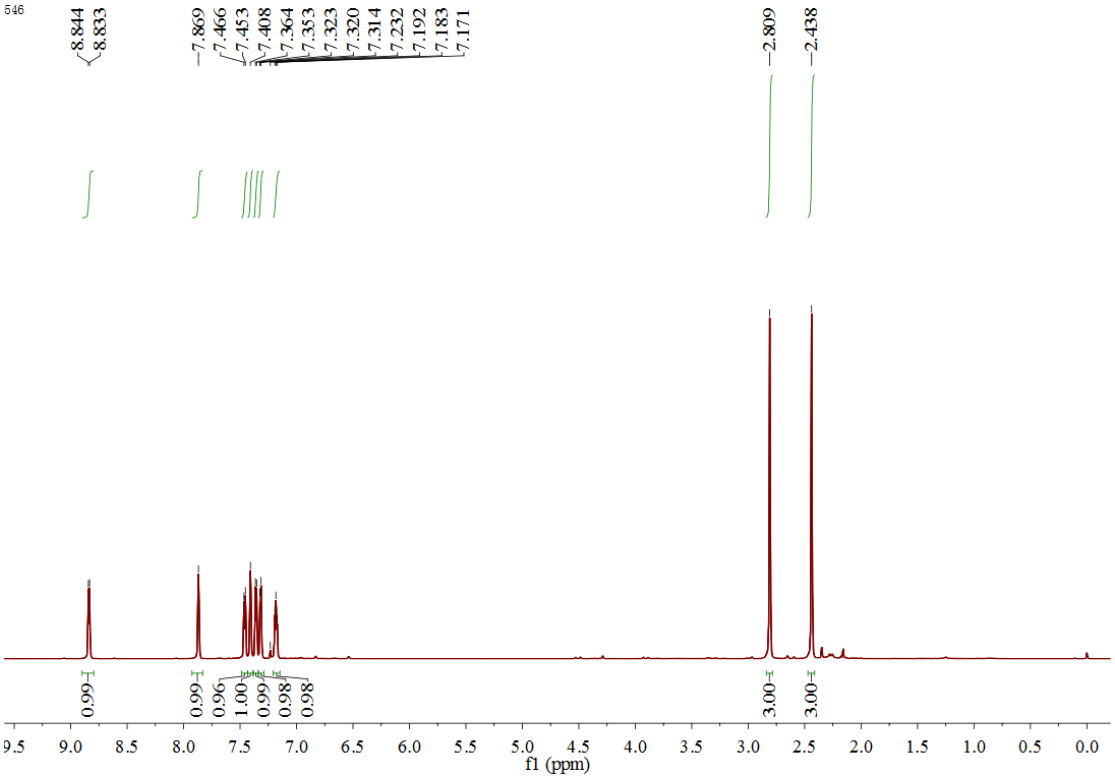

149.43
147.45
145.14
137.08
135.29
135.23
130.58
126.61
120.08
77.43
77.12
76.80
33.19
32.47
28.07
27.47
26.37
22.00
18.57
f1 (ppm)

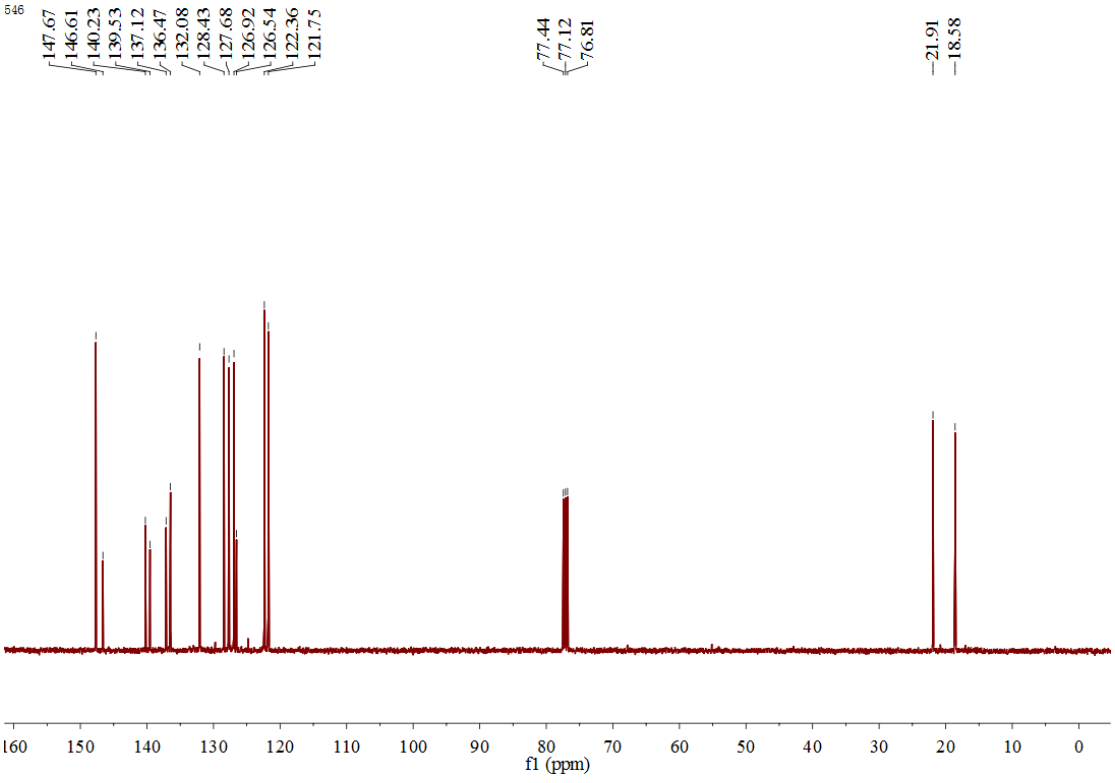
4m


8.853
8.842
8.043
7.637
7.536
7.525
7.394
7.243
6.897
6.889
6.582
6.579
2.790
2.477
0.98
0.98
0.96
0.99
1.00
1.00
0.97
3.00
3.00
f1 (ppm)

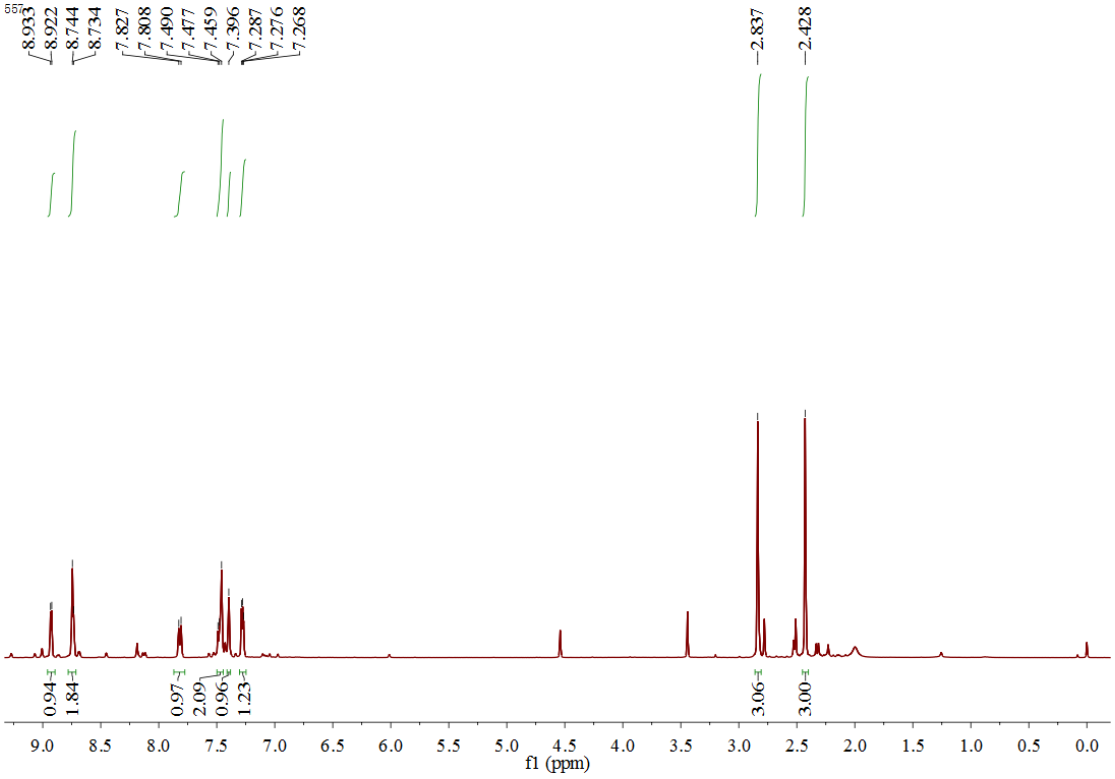

151.48
147.76
146.79
143.63
137.14
136.44
135.22
131.90
124.56
122.19
118.70
111.85
111.80
77.42
77.10
76.79
21.99
18.66
f1 (ppm)

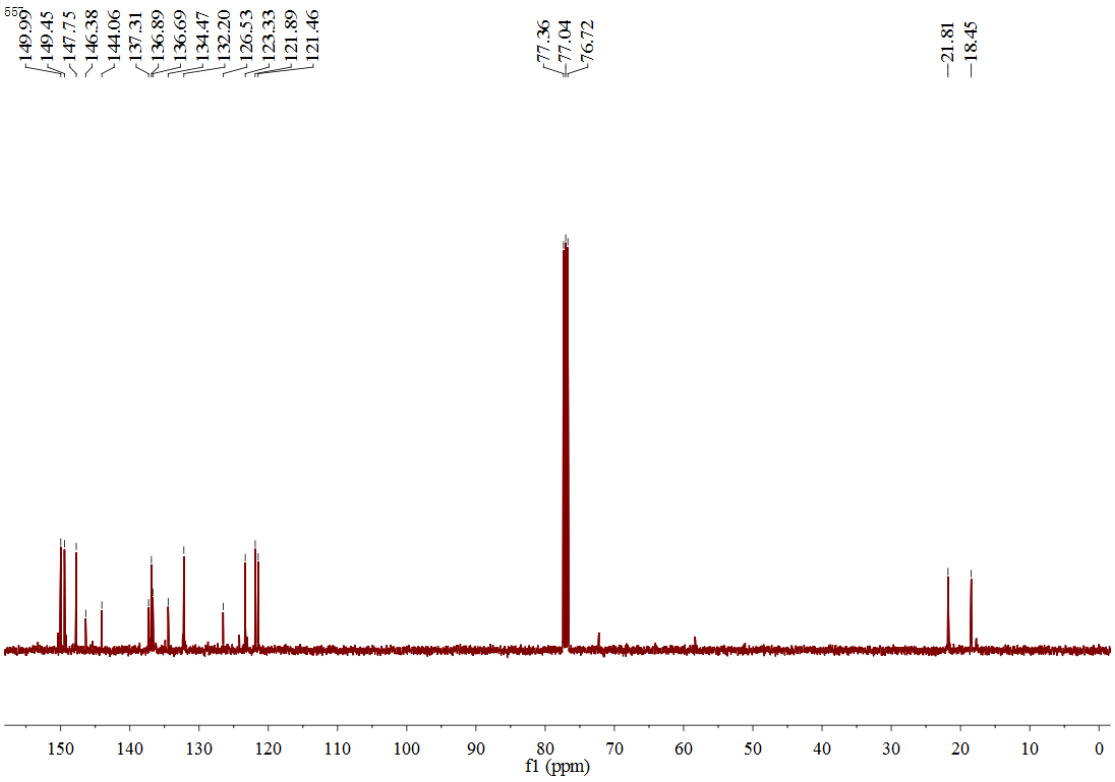
4n


546
8.844
8.833
7.869
7.466
7.453
7.408
7.364
7.353
7.323
7.320
7.314
7.232
7.192
7.183
7.171
2.809
2.438
0.99
0.99
0.96
1.00
0.99
0.98
0.98
3.00
3.00
f1 (ppm)

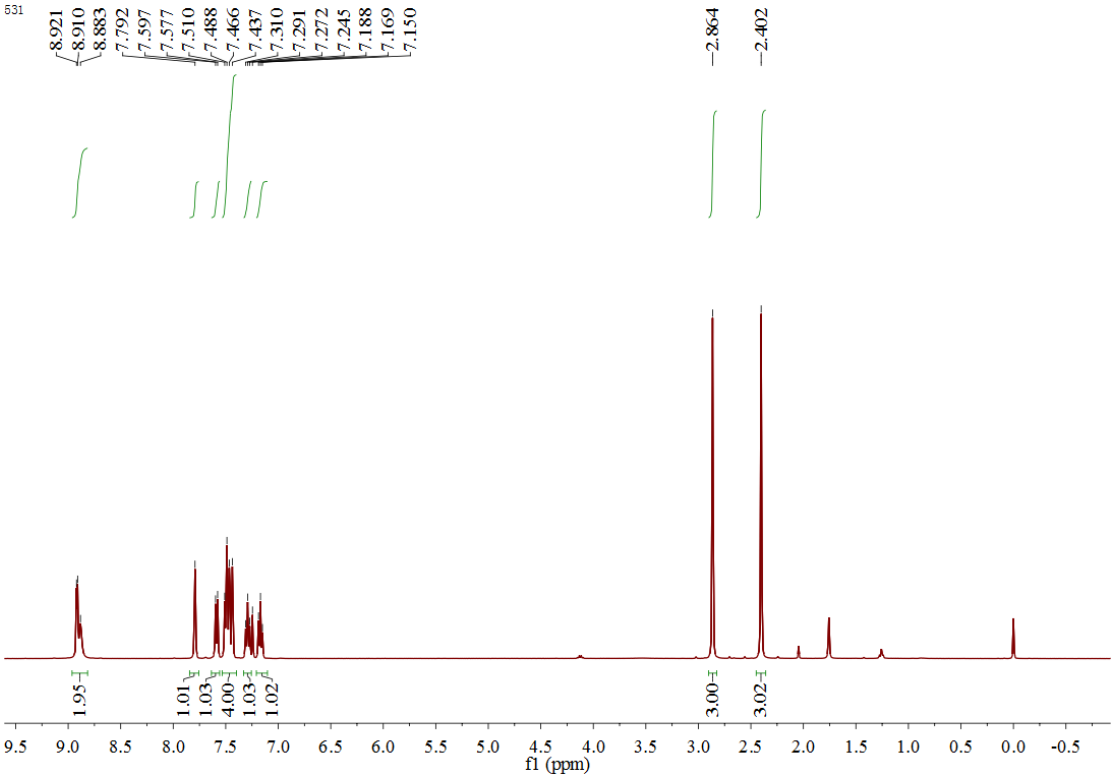

546
147.67
146.61
140.23
139.53
137.12
136.47
132.08
128.43
127.68
126.92
126.54
122.36
121.75
77.44
77.12
76.81
21.91
18.58
f1 (ppm)

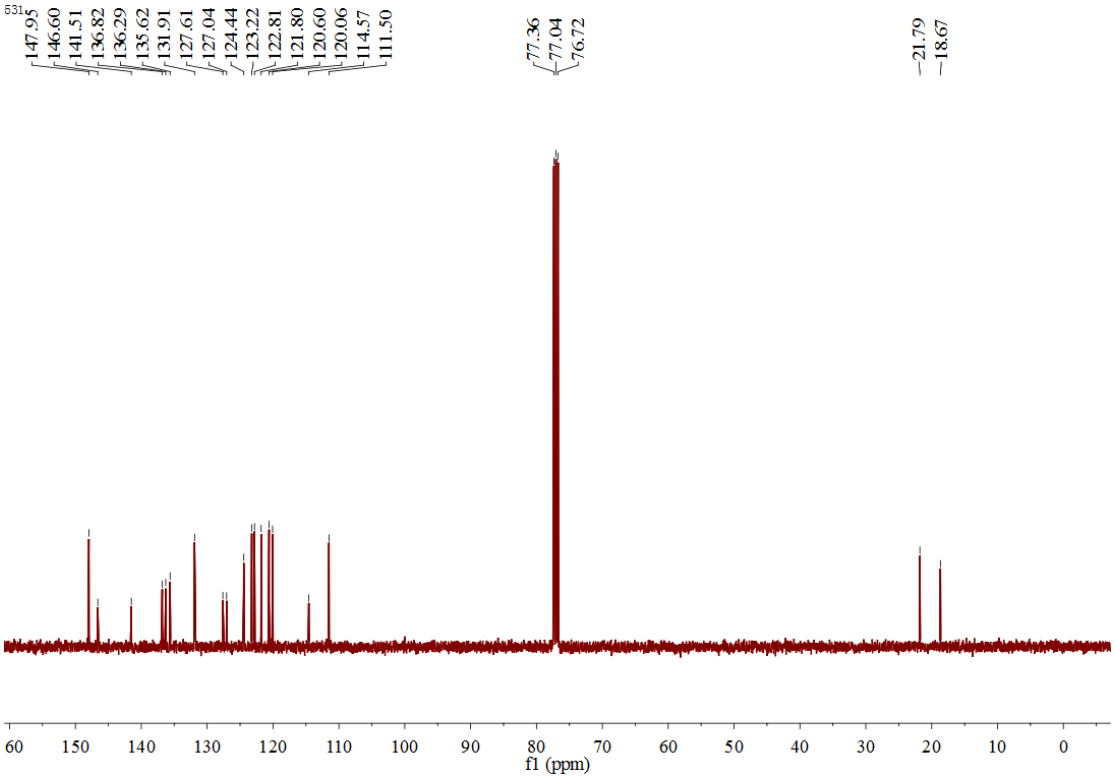
4o


8.933
8.922
8.744
8.734
7.827
7.808
7.490
7.477
7.459
7.396
7.287
7.276
7.268
2.837
2.428
0.94
1.84
0.97
2.09
0.96
1.23
3.06
3.00
f1 (ppm)

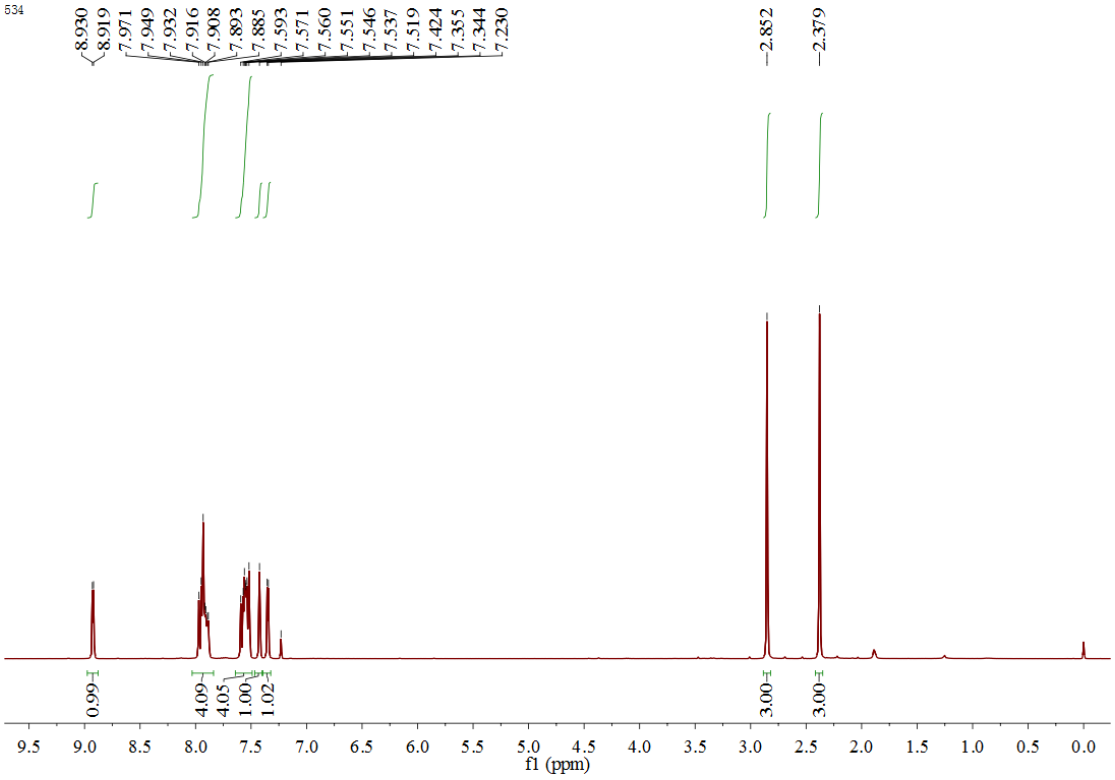

149.99
149.45
147.75
146.38
144.06
137.31
136.89
136.69
134.47
132.20
126.53
123.33
121.89
121.46
77.36
77.04
76.72
21.81
18.45
f1 (ppm)

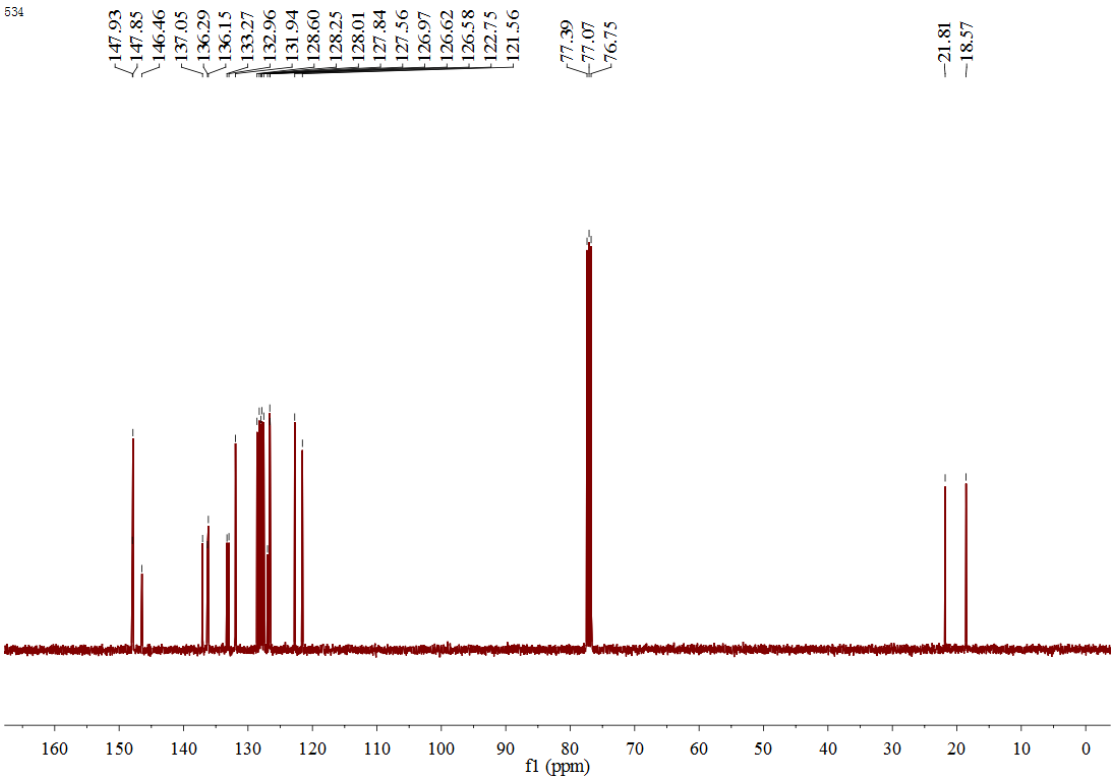
4p


531
8.921
8.910
8.883
7.792
7.597
7.577
7.510
7.488
7.466
7.437
7.310
7.291
7.272
7.245
7.188
7.169
7.150
2.864
2.402
1.95
1.01
1.03
4.00
1.03
1.02
3.00
3.02
f1 (ppm)

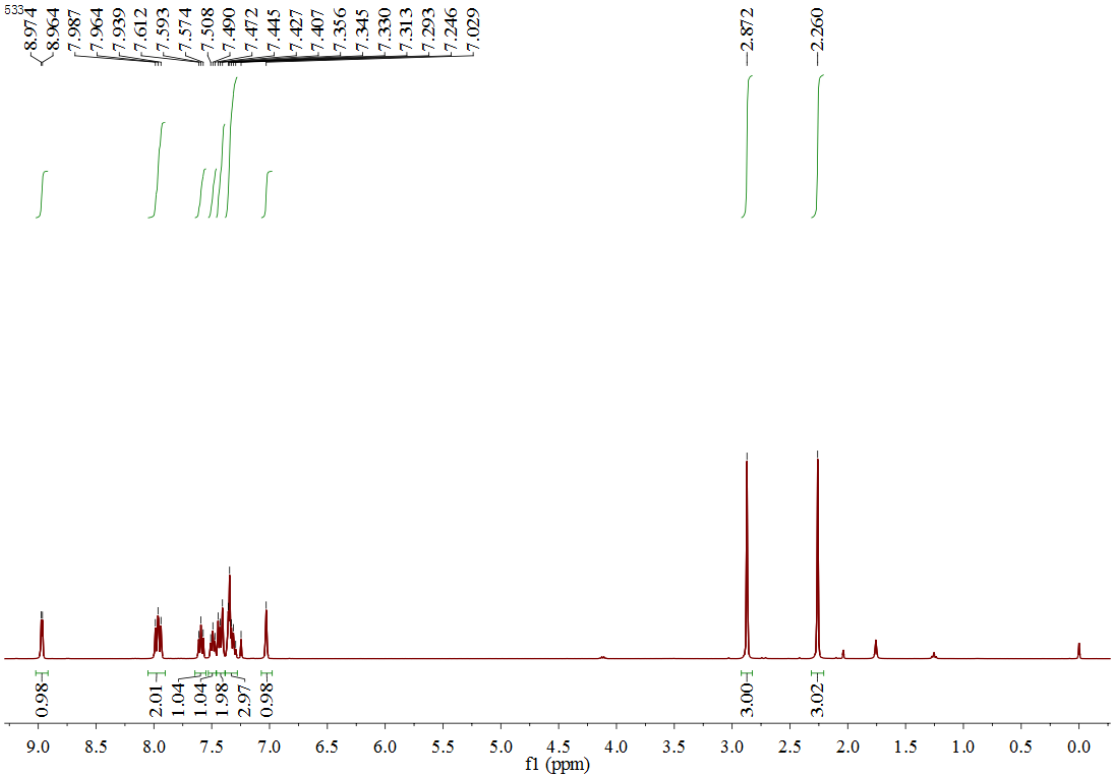

531
147.95
146.60
141.51
136.82
136.29
135.62
131.91
127.61
127.04
124.44
123.22
122.81
121.80
120.60
120.06
114.57
111.50
77.36
77.04
76.72
21.79
18.67
f1 (ppm)

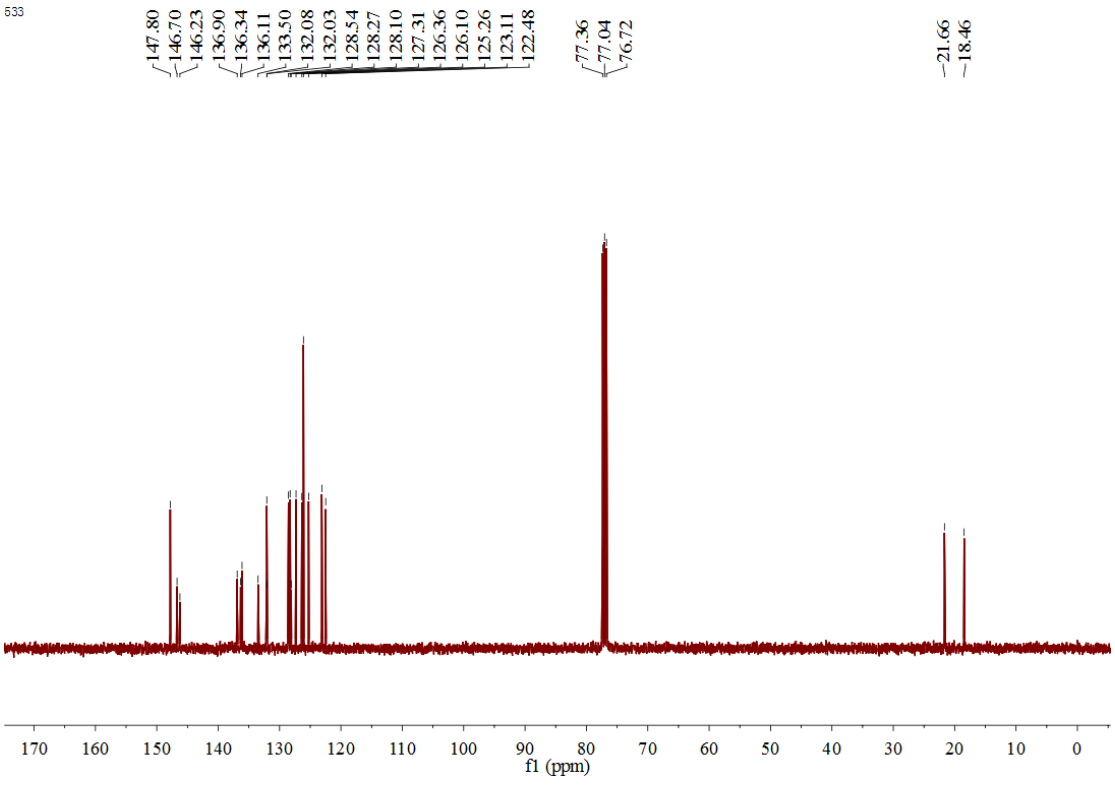
4q


534
8.930
8.919
7.971
7.949
7.932
7.916
7.908
7.893
7.885
7.593
7.571
7.560
7.551
7.546
7.537
7.519
7.424
7.355
7.344
7.230
2.852
2.379
0.99
4.09
4.05
1.00
1.02
3.00
3.00
f1 (ppm)

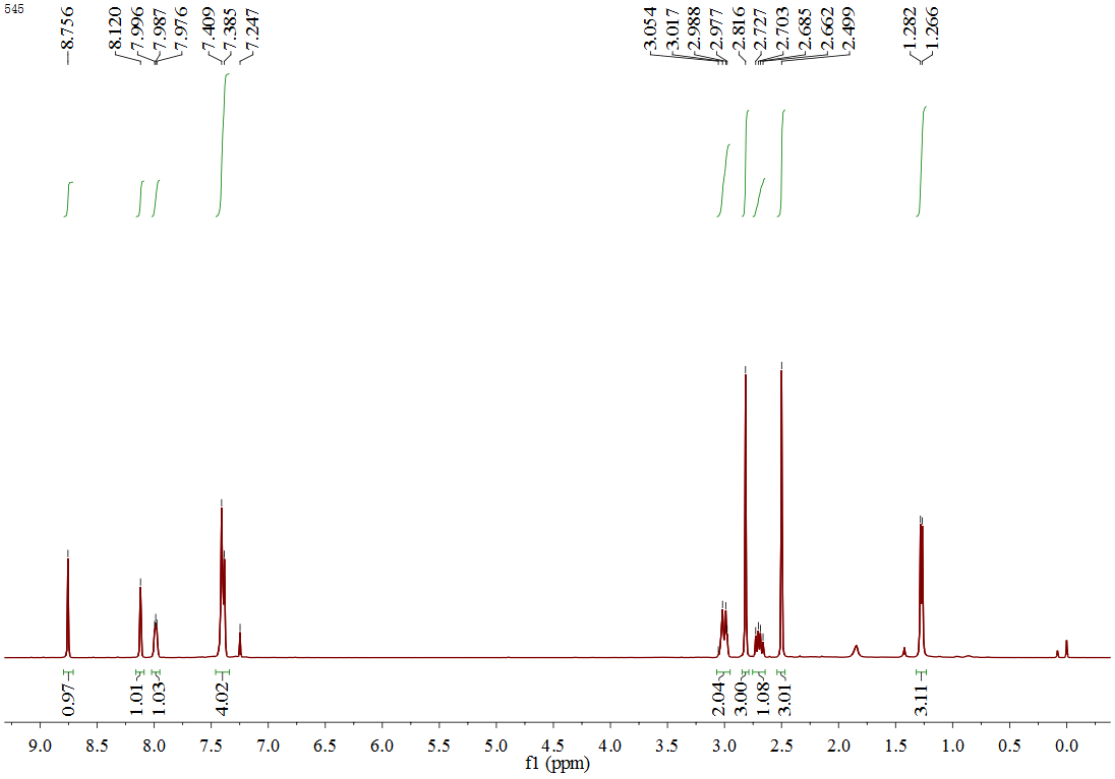

534
147.93
147.85
146.46
137.05
136.29
136.15
133.27
132.96
131.94
128.60
128.25
128.01
127.84
127.56
126.97
126.62
126.58
122.75
121.56
77.39
77.07
76.75
21.81
18.57
f1 (ppm)

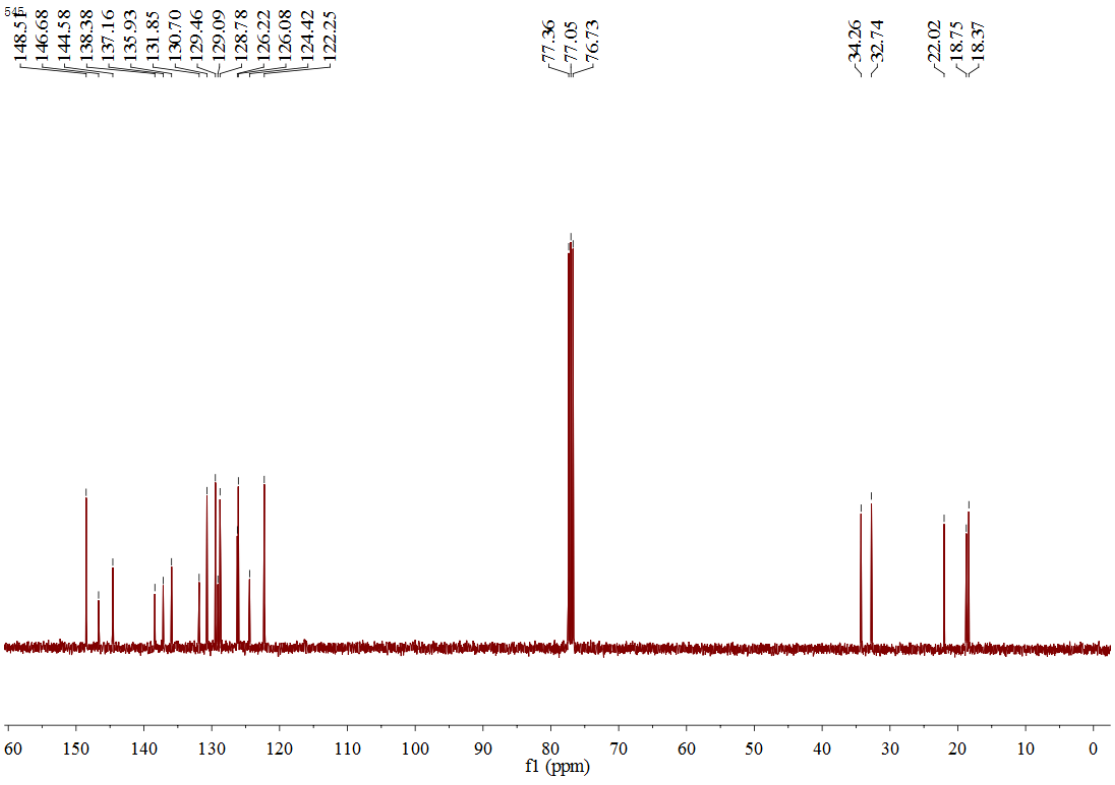
4r


533
8.974
8.964
7.987
7.964
7.939
7.612
7.593
7.574
7.508
7.490
7.472
7.445
7.427
7.407
7.356
7.345
7.330
7.313
7.293
7.246
7.029
2.872
2.260
0.98
2.01
1.04
1.04
1.98
2.97
0.98
3.00
3.02
f1 (ppm)

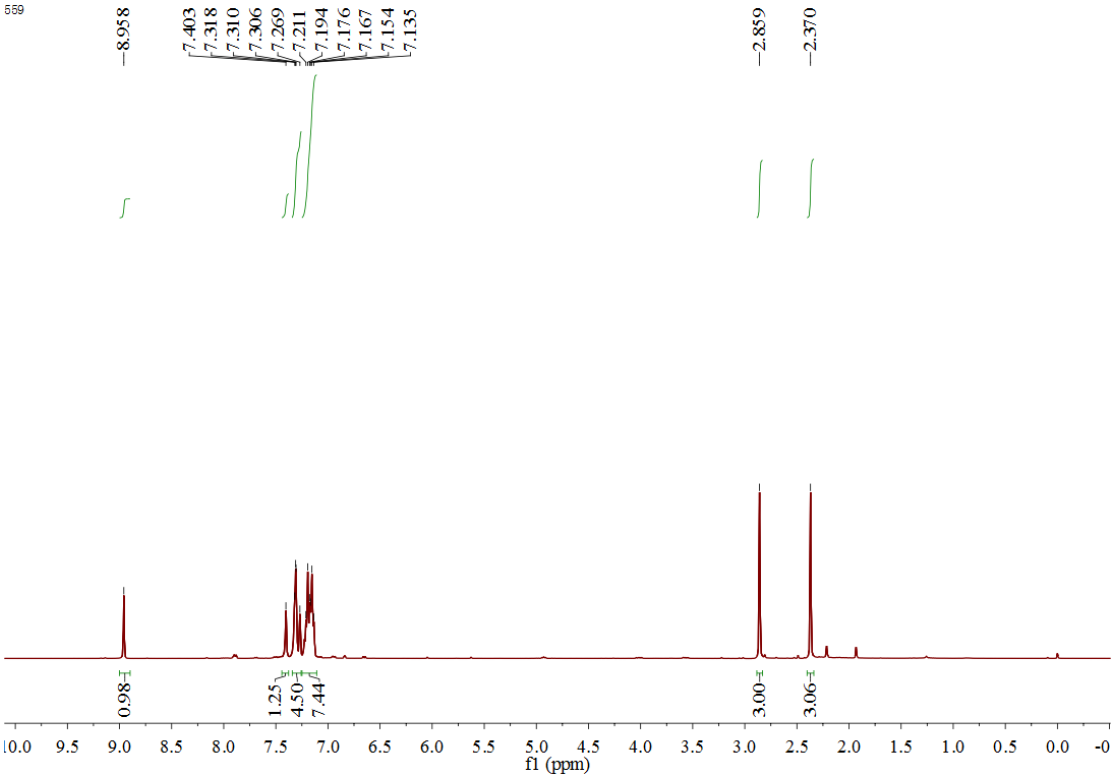

533
147.80
146.70
146.23
136.90
136.34
136.11
133.50
132.08
132.03
128.54
128.27
128.10
127.31
126.36
126.10
125.26
123.11
122.48
77.36
77.04
76.72
21.66
18.46
f1 (ppm)

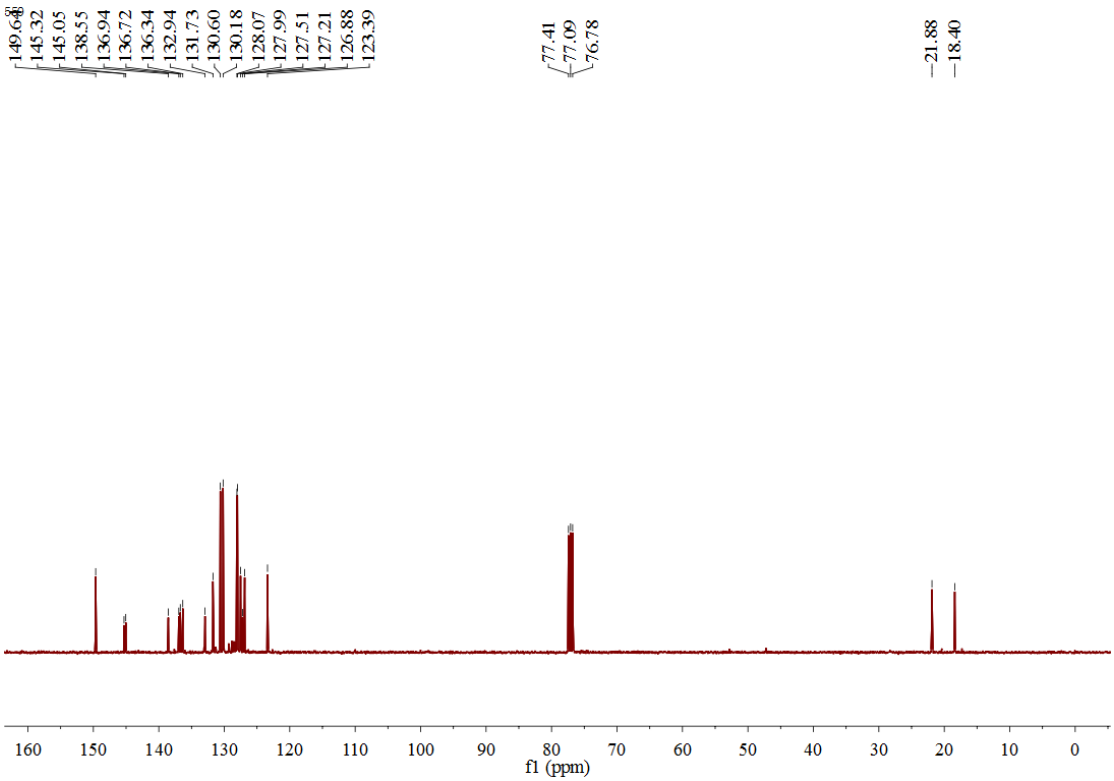
4s


8.756
8.120
7.996
7.987
7.976
7.409
7.385
7.247
3.054
3.017
2.988
2.977
2.816
2.727
2.703
2.685
2.662
2.499
1.282
1.266
0.97
1.01
1.03
4.02
2.04
3.00
1.08
3.01
3.11
f1 (ppm)

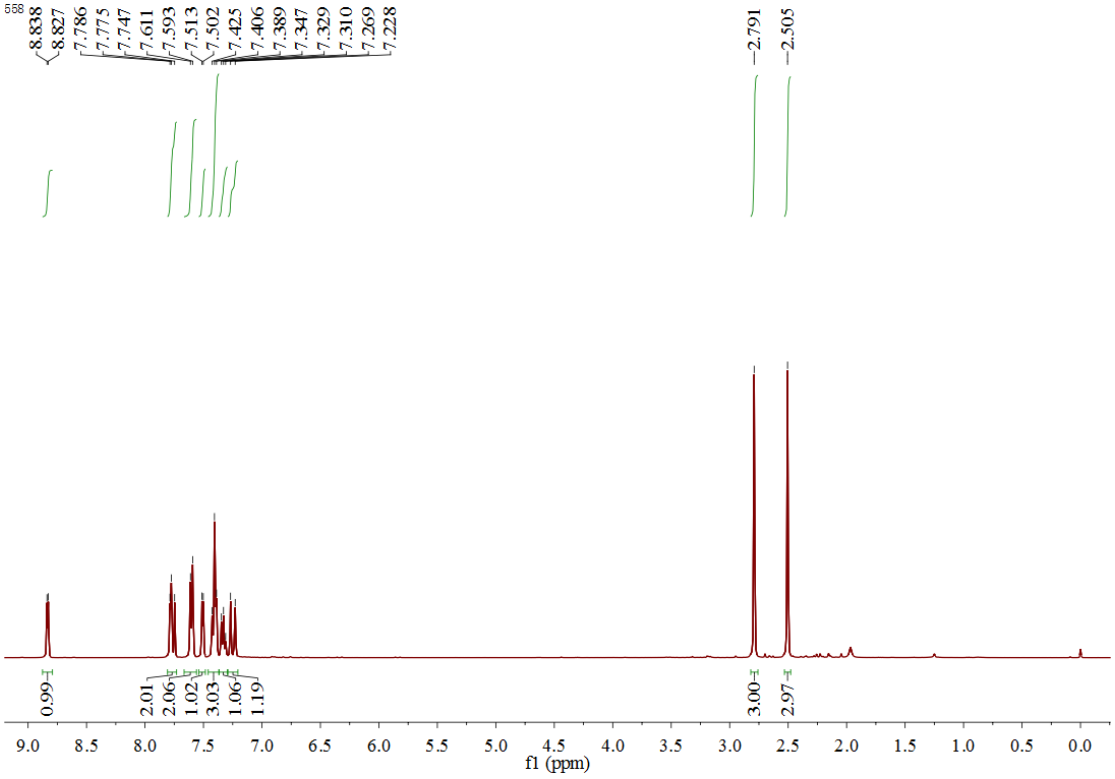

148.51
146.68
144.58
138.38
137.16
135.93
131.85
130.70
129.46
129.09
128.78
126.22
126.08
124.42
122.25
77.36
77.05
76.73
34.26
32.74
22.02
18.75
18.37
f1 (ppm)

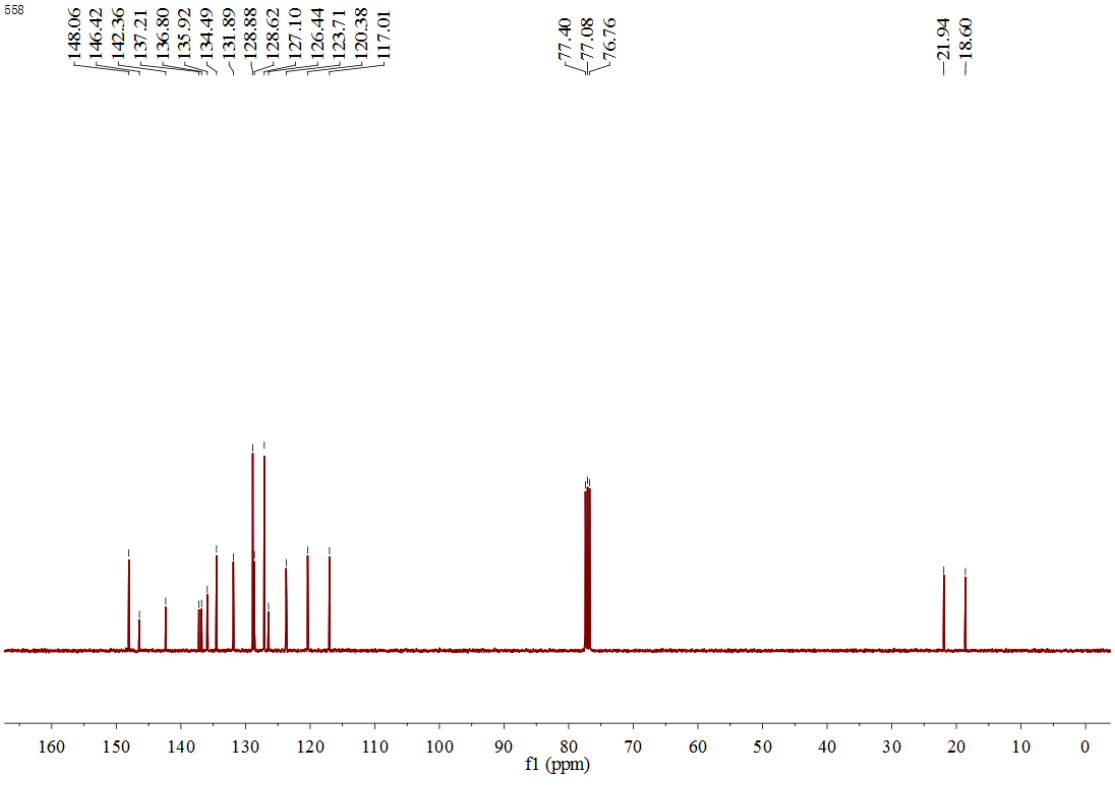
4t


559
8.958
7.403
7.318
7.310
7.306
7.269
7.211
7.194
7.176
7.167
7.154
7.135
2.859
2.370
0.98
1.25
4.50
7.44
3.00
3.06
f1 (ppm)

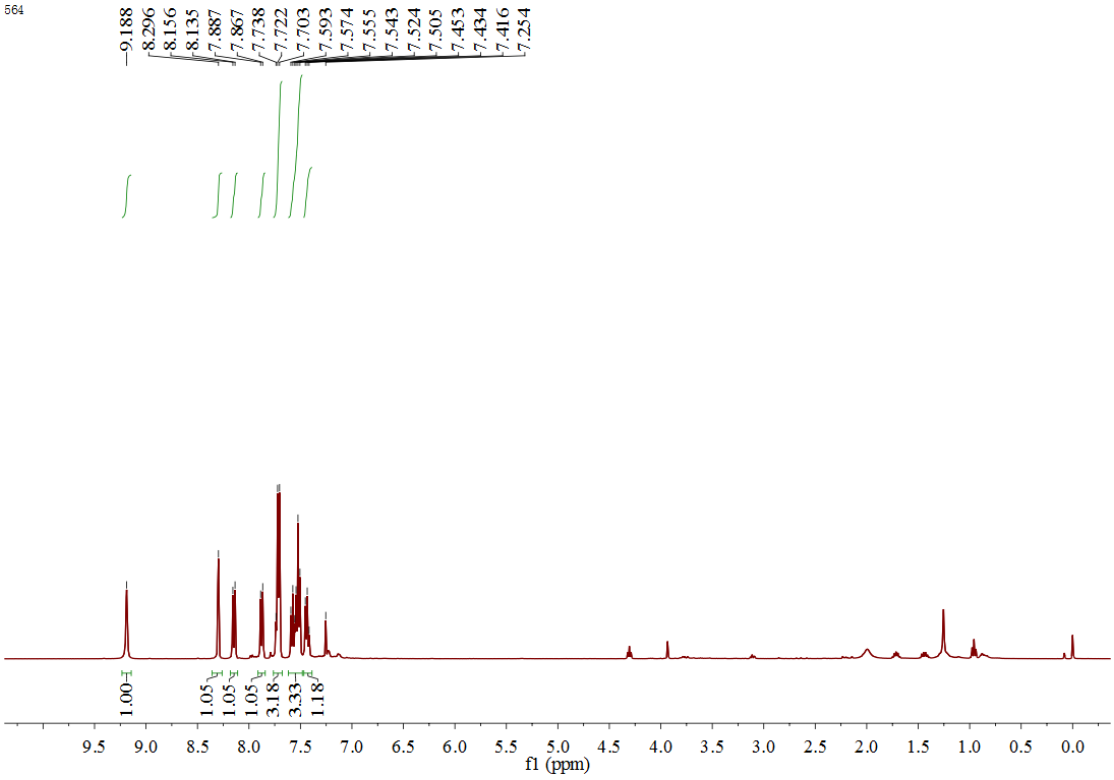

149.64
145.32
145.05
138.55
136.94
136.72
136.34
132.94
131.73
130.60
130.18
128.07
127.99
127.51
127.21
126.88
123.39
77.41
77.09
76.78
21.88
18.40
f1 (ppm)

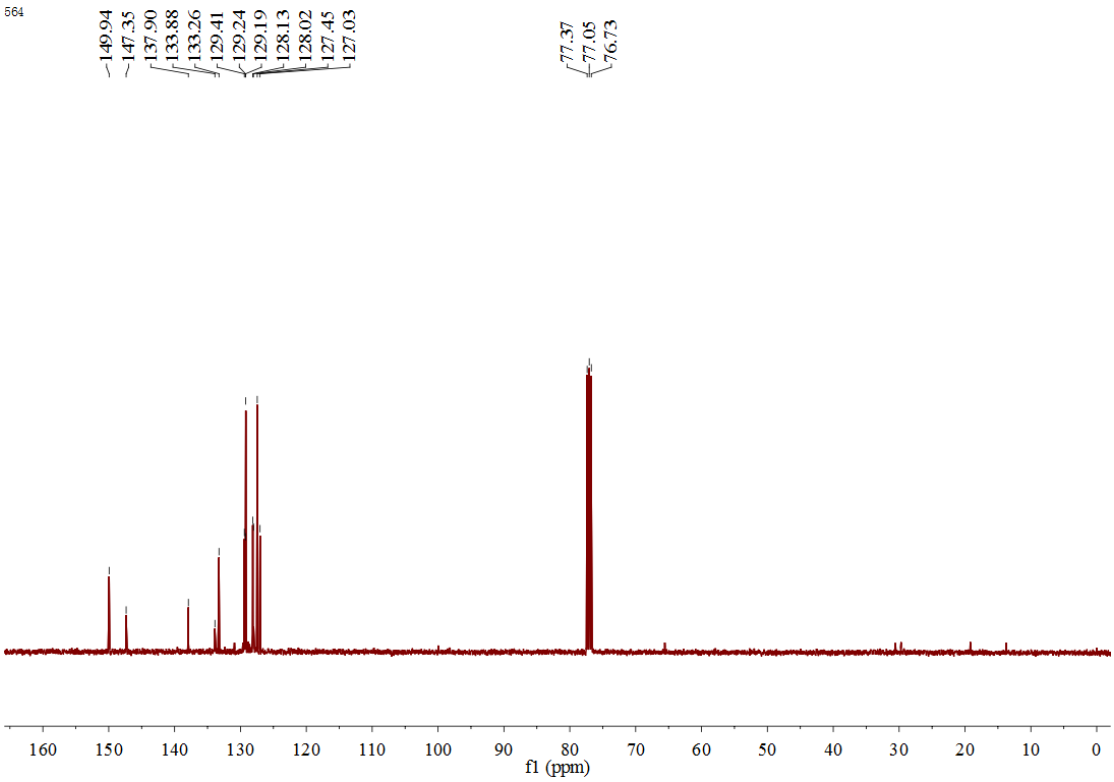
4u


558
8.838
8.827
7.786
7.775
7.747
7.611
7.593
7.513
7.502
7.425
7.406
7.389
7.347
7.329
7.310
7.269
7.228
2.791
2.505
0.99
2.01
2.06
1.02
3.03
1.06
1.19
3.00
2.97
f1 (ppm)

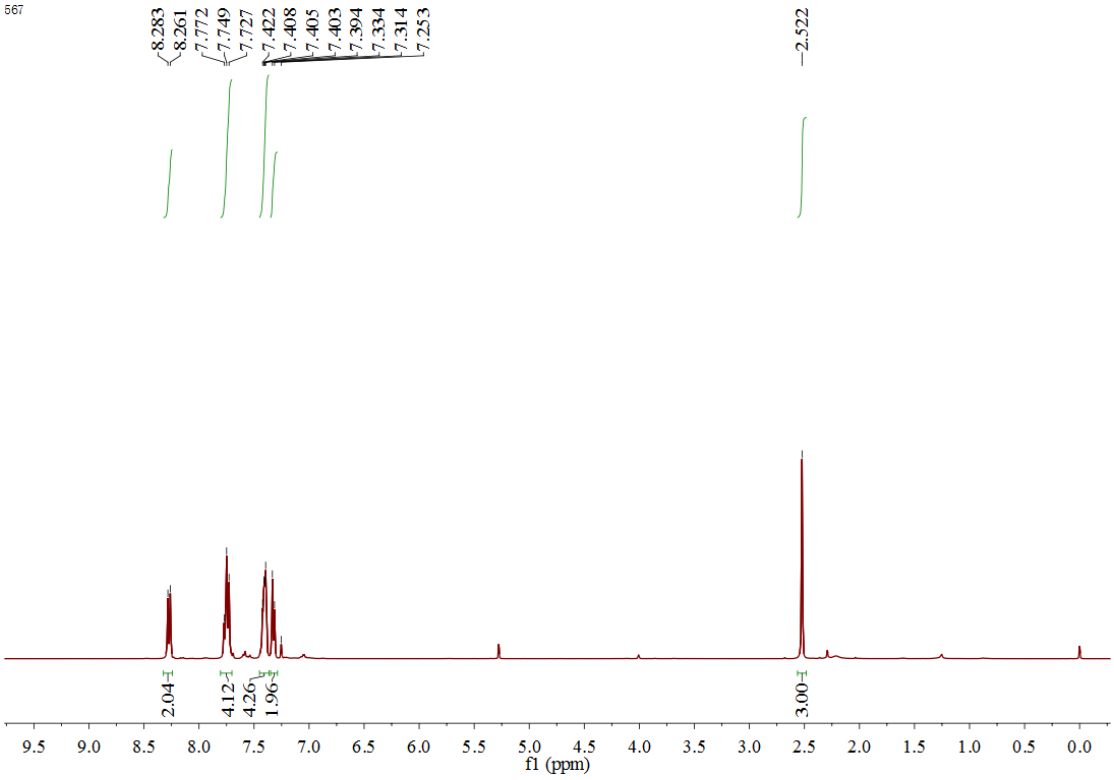

558
148.06
146.42
142.36
137.21
136.80
135.92
134.49
131.89
128.88
128.62
127.10
126.44
123.71
120.38
117.01
77.40
77.08
76.76
21.94
18.60
f1 (ppm)

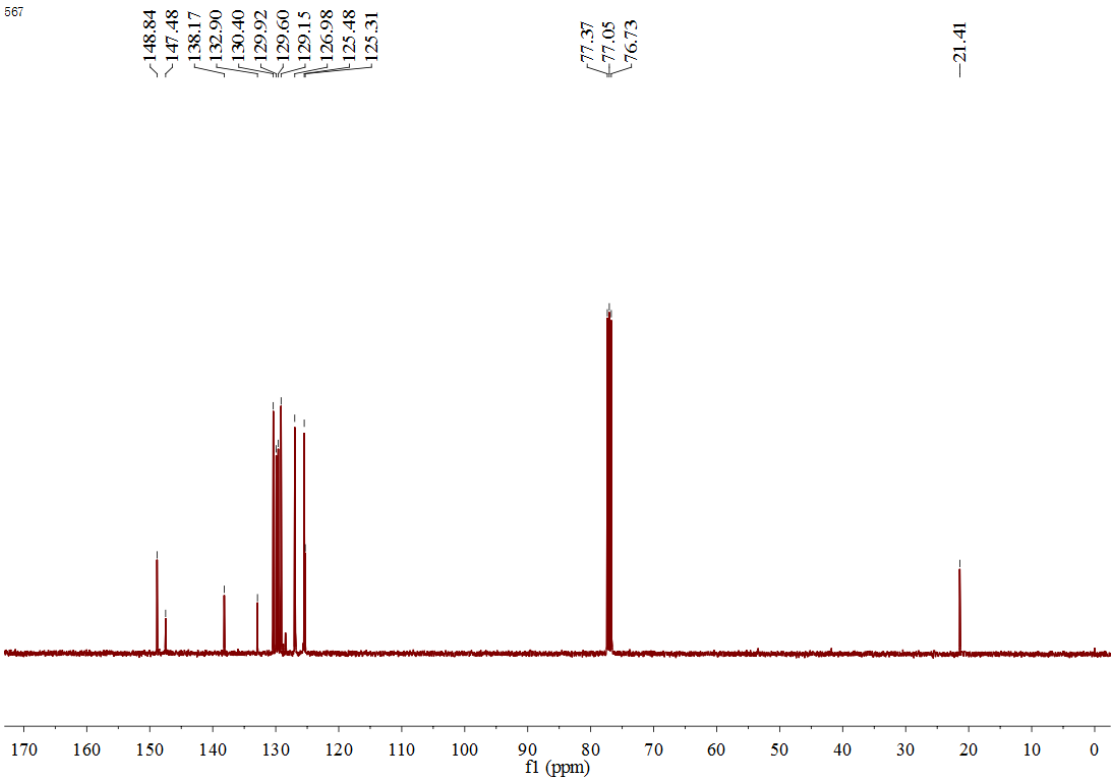
5


564
9.188
8.296
8.156
8.135
7.887
7.867
7.738
7.722
7.703
7.593
7.574
7.555
7.543
7.524
7.505
7.453
7.434
7.416
7.254
1.00
1.05
1.05
1.05
3.18
3.33
1.18
f1 (ppm)


564
149.94
147.35
137.90
133.88
133.26
129.41
129.24
129.19
128.13
128.02
127.45
127.03
77.37
77.05
76.73
f1 (ppm)

6


567
8.283
8.261
7.772
7.749
7.727
7.422
7.408
7.405
7.403
7.394
7.334
7.314
7.253
2.522
2.04
4.12
4.26
1.96
3.00
f1 (ppm)


567
148.84
147.48
138.17
132.90
130.40
129.92
129.60
129.15
126.98
125.48
125.31
77.37
77.05
76.73
21.41
f1 (ppm)