Electronic Supplementary Material (ESI) for ChemComm.

Supporting Information

Facile Iodine-promoted synthesis of *bis*(1-imidazo[1,5-*a*]pyridyl)arylmethanes and exploration of applications

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1. General Information

Commercially available reagents and solvents were used as received without further purification. Dry solvents were collected from the solvent dispenser system. For chromatographic purifications, technical-grade solvents were used. Reactions were magnetically stirred and monitored by thin layer chromatography (TLC) using Merck Silica Gel 60 F254 plates. Column chromatography was performed using Silica Gel 60 (300–400 mesh). Nuclear magnetic resonance (NMR) data were recorded on a Bruker Avance 400 (400 MHz, ^{1}H-NMR; 101MHz, ^{13}C-NMR). Chemical shifts (δ) are reported in ppm with the solvent resonance employed as the internal standard (chloroform at 7.26 ppm for ^{1}H-NMR and 77.16 ppm for ^{13}C-NMR spectroscopy). Signals are reported as s = singlet, d = doublet, t = triplet, q = quartet, m = multiplet or unresolved, br = broad signal, coupling constants in Hz, integration. Mass spectra were measured with Thermo Finnigan LCQ-Advantage. High resolution mass spectral (HRMS) analysis was measured on a Bruker microTOF-Q II instrument using ESI techniques.

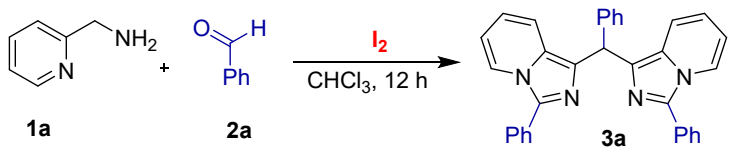
2. General experimental procedure for the synthesis of 1,1'-(phenylmethylene)bis(3-phenylimidazo[1,5-*a*]pyridine) and its derivatives

2.1. General procedure 1 for the synthesis of BimPy compounds (3a-k)

A pressure tube with a magnetic stirring bar was charged with 2-picolylamine (54 mg, 0.5 mmol), aldehyde (1.25 mmol) then $CHCl_3$ solvent (0.3 ml) was added at room temperature. Then 127 mg (0.5 mmol) of I_2 was added to the mixture. The mixture was raised the temperature to 50^0C and stirred overnight. After completion of the reaction, the reaction mixture was cooled to room temperature and washed with saturated solution of $NaHCO_3$ (50 mL). Then the reaction mixture was extracted with ethyl acetate (3 times), and the organic layer was dried over anhydrous Na_2SO_4 and was concentrated under vacuum. The desired product was isolated by column chromatography (eluent: hexane/DCM/ethyl acetate (9/4/1)). Importantly, reactions should be performed in pressure tube in to prevent the evaporation of $CHCl_3$ solvent. The reaction of **1a** and **2a** was also examined in round

bottom flask using condenser and product **3a** was only obtained in 41% yield due to the slow loss of $CHCl_3$ solvent after few hours.

A study to investigate the dependence of reaction time and the formation of BimPy **3a** was carried out as described in Figure 1.



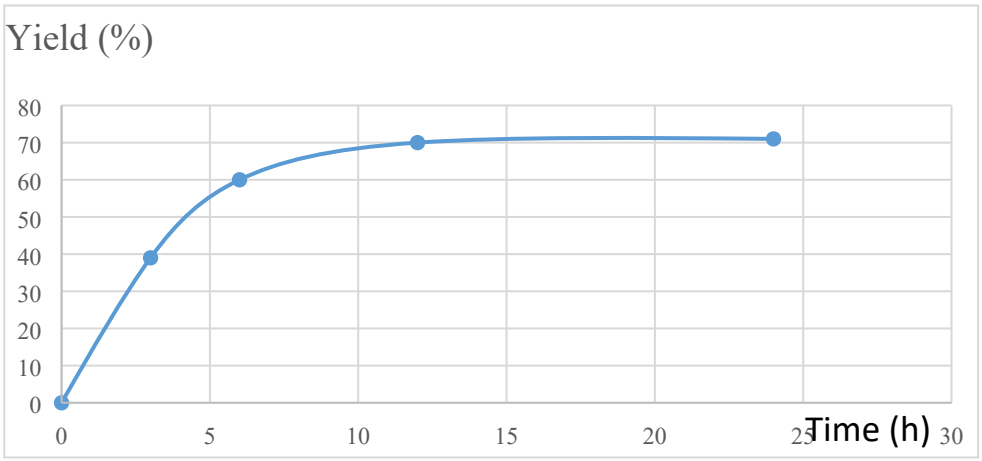


Figure 1: Plot of reaction time vs yield

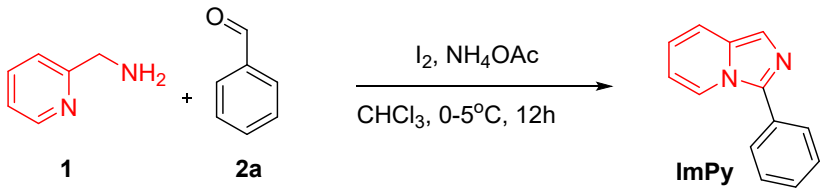
2.2. General procedure 2 for the synthesis of compounds (4a-h)

2.2.1. Procedure for the preparation of ImPy

A pressure tube with a magnetic stirring bar was charged with 54 mg (0.5 mmol) 2-picolylamine, 53 mg (0.5 mmol) benzaldehyde, 77 mg (1 mmol) NH_4OAc and then 0.3 ml $CHCl_3$ was added. The reaction mixture was stirred for 5 min at room temperature. Then I_2 (0.5 mmol) was added to the mixture. The reaction mixture was stirred for 12h in an ice bath. After completion of the reaction, the reaction mixture was cooled to room temperature then extracted with ethyl acetate/water (x3). The collected ethyl acetate layer was evaporated under reduced pressure. The desired product was isolated by column chromatography (eluent: hexane/ethyl acetate (4/1)).

Table 1: Optimization for the preparation of ImPy.[1]

[1] (a) S. Tahara, F. Shibahara, T. Maruyama and T. Murai, *Chem. Commun.*, 2009, 7009–7011; (b) T. Murai, E. Nagaya, F. Shibahara and T. Maruyama, *Org. Biomol. Chem.*, 2012, **10**, 4943-4945.

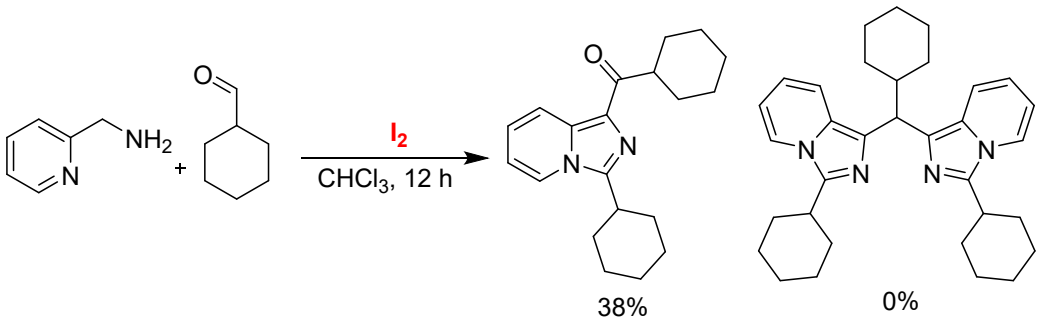


Entry	Catalyst	Solvent	Additive	Temperature (°C)	Yield (%)
1	I_2 (0.5 equiv.)	$CHCl_3$	-	0	16
2	I_2 (1 equiv.)	$CHCl_3$	-	0	28
3	I_2 (2 equiv.)	$CHCl_3$	-	0	17
4	**I_2 (1 equiv.)**	**$CHCl_3$**	**NH_4OAc**	**0**	**55**

Reaction condition: ***1*** *(0.5 mmol, 1 equiv.),* ***2a*** *(0.5 mmol, 1 equiv.), NH_4OAc (1 mmol, 2 equiv.), solvent (0.3 ml), 0°C, 12h.*

2.2.2. Procedure for the preparation of cyclohexyl(3-cyclohexylimidazo[1,5-a]pyridin-1-yl)methanone

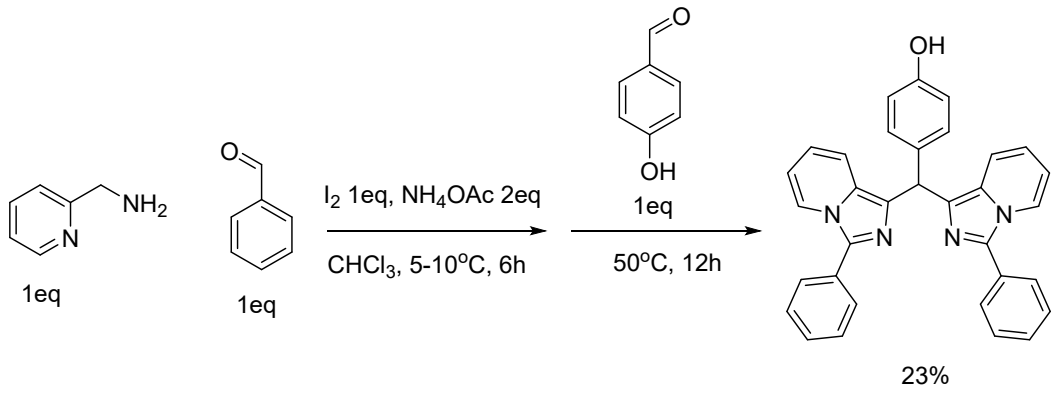
A pressure tube with a magnetic stirring bar was charged with 54 mg (0.5 mmol) 2-picolylamine, 56 mg (0.5 mmol) cyclohexane carbaldehyde, and then 0.3 ml $CHCl_3$ was added. The reaction mixture was stirred for 5 min at room temperature. Then I_2 (0.5 mmol) was added to the mixture. The reaction mixture was stirred for 12h in an ice bath. After completion of the reaction, the reaction mixture was cooled to room temperature then extracted with ethyl acetate/water (x3). The collected ethyl acetate layer was evaporated under reduced pressure. Cyclohexyl(3-cyclohexylimidazo[1,5-a]pyridin-1-yl)methanone was isolated by column chromatography in 38% yield (eluent: hexane/ethyl acetate (4/1)).



Scheme 1: The formation of cyclohexyl(3-cyclohexylimidazo[1,5-a]pyridin-1-yl)methanone

A pressure tube with a magnetic stirring bar was charged with 54 mg (0.5 mmol) 2-picolylamine, 53 mg (0.5 mmol) benzaldehyde, 77 mg (1 mmol) NH_4OAc and then

0.3 ml $CHCl_3$ was added. The reaction mixture was stirred for 5 min at room temperature. Then I_2 (0.5 mmol) was added to the mixture. The reaction mixture was stirred for 6h in an ice bath. After that, 4-hydroxybenzaldehyde, 122 mg (1 mmol) was introduced into reaction mixture. After completion of the reaction in 12h stirring at 50 °C, the reaction mixture was cooled to room temperature then extracted with ethyl acetate/water (x3). The collected ethyl acetate layer was evaporated under reduced pressure. The desired product was isolated by column chromatography in 23% yield (eluent: hexane/ethyl acetate (4/1)).

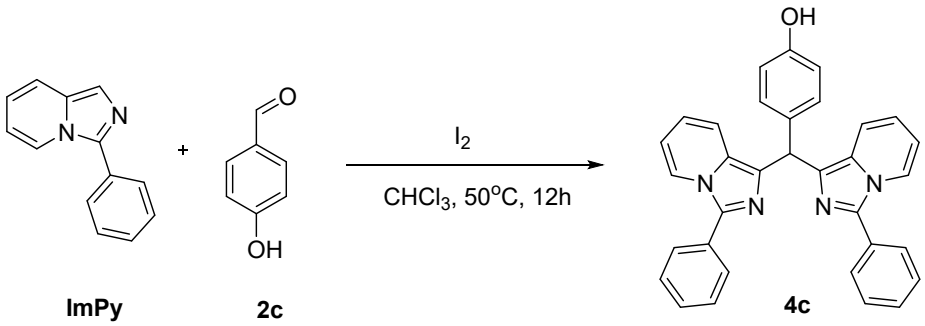


Scheme 2: Tandem one-pot procedure for the synthesis of BimPys

2.2.3. General procedure 2 for the synthesis of BimPy compounds (4a-h)

A pressure tube with a magnetic stirring bar was charged with 97 mg (0.5 mmol) 3-phenylimidazo[1,5-*a*]pyridine, 0.5 mmol aldehyde and then 0.3 ml $CHCl_3$ were added and stirred at room temperature. Then the reaction tube was added 13 mg (0.05 mmol) I_2 and raised the temperature to 50°C. The mixture was stirred for 12h. After completion of the reaction, the reaction mixture was cooled to room temperature then treated with saturated $Na_2S_2O_3$ solution and extracted with ethyl acetate/water (x3). The organic layer was dried over anhydrous Na_2SO_4 and evaporated under reduced pressure. The desired product was isolated by column chromatography (eluent: hexane/DCM/ethyl acetate (9/4/1)). Importantly, reactions should be performed in pressure tube in to prevent the evaporation of $CHCl_3$ solvent.

Table 2: Optimization for the preparation of BimPy (**4c)**



ImPy 2c 4c

Entry	Catalyst	Solvent	Additive	Temperature (°C)	Yield (%)
1	**I_2 (0.1 equiv.)**	**$CHCl_3$**	**-**	**50**	**85**
2	I_2 (0.1 equiv.)	$CHCl_3$	NH_4OAc (0.2 equiv.)	50	40

Reaction condition: ***ImPy*** *(0.5 mmol, 1 equiv.),* ***2c*** *(0.75 mmol, 1.5 equiv.), $CHCl_3$ (0.3 ml), 50°C, 12h.*

A study to investigate the dependence of reaction time and the formation of BimPy **4c** was carried out as described in Figure 2.

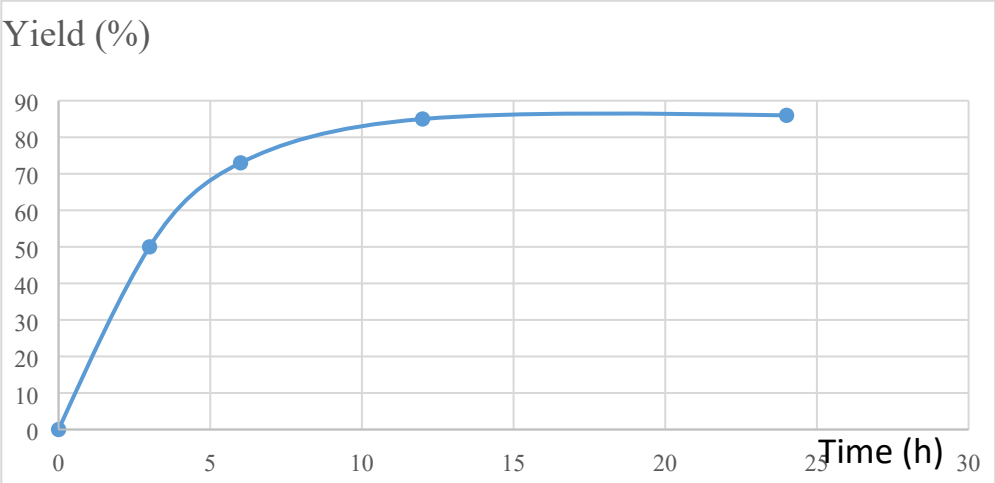


Figure 2: Plot of reaction time vs yield

3. Materials and methods in anticancer studies

3.1. Materials and chemicals

- Embryonic stem cell line (benign cells): HEK-293A
- Human cancer cell lines
  + MCF-7: human breast carcinoma
  + SK-LU-1: human lung carcinoma

+ HepG2: human hepatocellular carcinoma

Cell culture medium: DMEM (Dulbecco s Modified Eagle Medium) or MEME (Minimum Esental Medium with Eagle salt), with the addition of L-glutamine, sodium pyruvate, $NaHCO_3$, penicillin/streptomycin, 10% FBS (Fetal Bovine). Serum), Trypsin-EDTA (0.05%)

Basic tools and equipment: Inverted microscope (Axiovert 40 CFL); Cell Counting Chamber (Fisher, USA); Spectrometer (BioTek); CO_2 incubator, -80^oC deep refrigerator, liquid nitrogen tank, analytical balance, pH meter and common laboratory instruments.

Other basic chemicals: DMSO (Dimethyl sulfoxide), TCA (Trichloroacetic acid), Tris base, PBS (phosphate buffered saline), Ellipticine, SRB (Sulforhodamine B), Acetic acid etc.

Embryonic stem cell line (benign cells): HEK-293A was purchased from Invitrogen (Invitrogen # P/N 51-0036); Other cancerous cell lines (MCF-7: human breast carcinoma, SK-LU-1: human lung carcinoma and HepG2: human hepatocellular carcinoma) were kindly provided by Prof. Dr. Chi-Ying Huang, National Yang Ming Chiao Tung University, Taipei, Taiwan.

3.2. Method for determination of cytotoxicity (cytotoxic assay) for cells cultured monolayer

The in vitro cytotoxicity test method was confirmed by the US National Cancer Institute (NCI) as a standard cytotoxicity test to screen and detect substances capable of inhibiting growth or kill TBUT under in vitro conditions. This test was performed according to the method of Skekan et al. (1990).[2] The test was carried out to determine the total cellular protein content basing on the optical density (OD) measurement when the protein composition of the cells was stained by Sulforhodamine B (SRB). The measured OD value is directly proportional to the amount of SRB attached to the protein molecule, so the more cells (the more protein) the larger OD value. The test is carried out under the following specific conditions:

- Trypsin zing experimental cells to leave cells and count in the counting chamber to adjust the density according to each experiment. Performing the introduce of 190 μL of cells in 96-wells plate for testing.

[2] P. Skehan, R. Storeng, D. Scudiero, A. Monks, J. McMahon, D. Vistica, J.T. Warren, H. Bokesch, S. Kenney, M.R. Boyd *J. Nat.l. Cancer Inst.* 1990, **82**, 1107-1112.

- The test sample was dissolved in 100% DMSO to obtain a stock concentration of 20 mM. Dilute the sample on a 96-wells plate with cell culture medium (without FBS) into 4 concentration ranges from high to low. Diluted reagents at different concentrations (10 μL) were introduced into the wells of the cell-prepared 96-wells plate above. Wells without reagent but containing TBUT (190 μL) + DMSO 1% (10 μL) will be used as day 0 control. After 1 hour, the day 0 control wells of cell will be fixed with TCA 20% (Trichloracetic acid).
- Incubation in the incubator for 72 hours. After 72 h, cells were fixed with TCA for 1 h, stained with SRB for 30 min at 37 ^{o}C, washed 3 times with acetic acid, and then dried at room temperature.
- 10 mM unbuffered Tris base was used to dissolve the amount of SRB, gently shaked for 10 minutes and then read the OD results at 540 nm on an ELISA Plate Reader (Biotek).
- The test was repeated 3 times to ensure the accuracy. Ellipticine at concentrations of 10 μg/mL; 2 μg/mL; 0.4 μg/mL; 0.08 μg/mL was used as the reference control.
- DMSO 1% is always used as negative control (final concentration in test well is 0.05%). The IC_{50} value (concentration that inhibits 50% of growth) will be determined using Table Curve 2Dv4 computer software.
- According to the standards of the US National Cancer Institute (NCI),[3] the extract is considered to have good activity with $IC_{50} \leq 20$ μg/ml, while the purified substance is considered to have good activity when $IC_{50} \leq 5$ μM

3.3. Anticancer activities with normal cells

Table 3: Cytotoxicity of BimPys against the normal cell line (IC_{50}: μM)

Entry	Compound	IC_{50}
1	3b	3.99±0.18
2	3c	3.25±0.15
3	4b	4.36±0.11

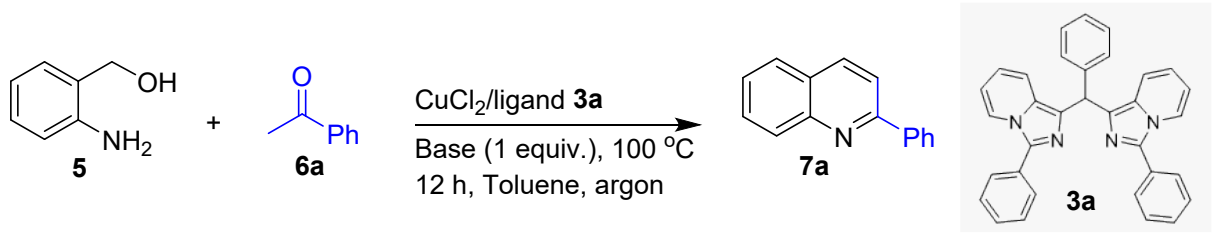
[3] J.P. Hughes, S. Rees, S.B. Kalindjian, K.L. Philpott, *British J. Pharmacol.* 2011, **162**, 1239-1249.

4	**Ellipticine**	1.63±0.02

4. Using 1,1'-(phenylmethylene)bis(3-phenylimidazo[1,5-a]pyridine) as a ligand to synthesis quinoline (6a-c)

A pressure tube with a magnetic stir bar was charged with 2-amino benzyl alcohol (62 mg, 0.5 mmol), ketone (0.6 mmol), $CuCl_2$ (3.36 mg, 0.025 mmol, 5 mol%), ligand (12 mg, 0.025 mmol, 5 mol%) and KO*t*Bu (56 mg, 0.5 mmol, 1 equiv), toluene (1 mL). The reaction mixture was heated at 100 °C for 12h. After completion of the reaction, the reaction mixture was cooled to room temperature. Then reaction mixture extracted with ethyl acetate (x3), and the organic layer was dried over anhydrous Na_2SO_4 and was concentrated under vacuum. The desired product was isolated by column chromatography (eluent: ethyl acetate/hexane).

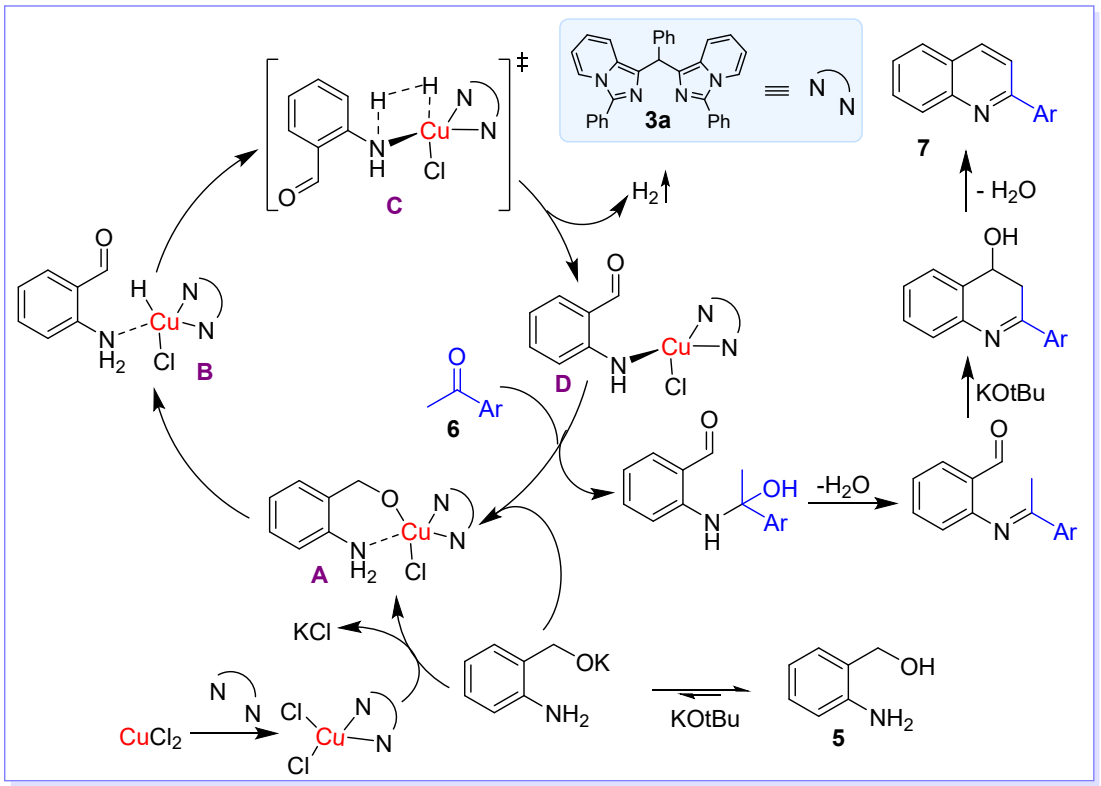
Table 4: Optimization for the Cu-catalysed preparation of quinoline 7a



Entry	Catalyst/**3a** (5 mol%)	Solvent (1 mL)	Base (1 equiv.)	Temperature (°C)	Yield[a] (%)
1	$Cu(OAc)_2$	Toluene	KOH	100	65
2	$CuCl_2$	Toluene	KOH	100	81
3	$CuCl_2$	Toluene	K_2CO_3	100	34
4	**$CuCl_2$**	**Toluene**	**KO*t*Bu**	**100**	**98**
5	$CuCl_2$	Dioxane	KO*t*Bu	100	73
6	$CuCl_2$	DMSO	KO*t*Bu	100	84
7	$CuCl_2$	Toluene	KO*t*Bu	90	88
8	$CuCl_2$	Toluene	KO*t*Bu	100	35[b]

Reaction conditions:[a] Cu salt (3.36 mg, 5 mol%), ligand **3a** (5 mol%), ***5*** *(0.5 mmol, 1 equiv.),* ***6a*** *(0.6 mmol, 1.2 equiv.), solvent (1.0 ml), 100°C, 12h;* [b] *The same condition was used in the absence of ligand* ***3a****.*

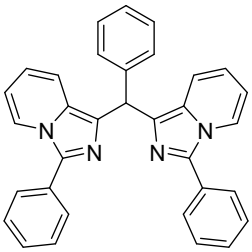
Relying on previous transition metal-catalyzed syntheses of quinolines via the acceptorless dehydrogenation pathway,[4] we propose a plausible mechanism involving the presence of a copper catalyst for this research (Scheme 3).



Scheme 3: Proposed mechanism for the synthesis of quinolines in the presence of $CuCl_2$/**3a** catalyst.

5. Characterization data of compounds 3a-k, 4a-h:

1,1'-(phenylmethylene)bis(3-phenylimidazo[1,5-*a*]pyridine)[1] **(3a)**

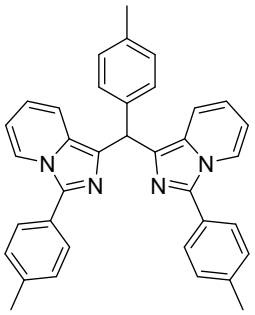


The general procedure was followed by using 2-picolylamine (54 mg, 0.5 mmol), benzaldehyde (133 mg, 1.25 mmol). The desired product was isolated by column chromatography (silica gel, hexane/DCM/ethyl acetate (9/4/1)) to yield **3a** (83 mg, 70 %) as a bright green solid.

[4] a) M. Maji, D. Panja, I. Borthakur, S. Kundu, *Org. Chem. Front*. 2021, **8**, 2673–2709; b) N. Hofmann, K. C. Hultzsch, *Eur. J. Org. Chem*. 2021, **46**, 6206–6223.

^{1}H NMR (500 MHz, Chloroform-*d*) δ 8.16 (dt, *J* = 7.2, 1.2 Hz, 2H), 7.81 – 7.75 (m, 4H), 7.56 – 7.44 (m, 9H), 7.42 – 7.34 (m, 2H), 7.30 (t, *J* = 7.7 Hz, 2H), 7.24 – 7.17 (m, 1H), 6.54 (ddd, *J* = 9.3, 6.3, 1.0 Hz, 2H), 6.45 (ddd, *J* = 7.5, 6.3, 1.2 Hz, 2H), 6.38 (s, 1H). ^{13}C NMR (126 MHz, Chloroform-*d*) δ 143.21, 136.69, 134.05, 130.68, 128.86, 128.83, 128.59, 128.33, 128.20, 128.19, 126.23, 121.14, 119.78, 117.68, 112.94, 45.11.

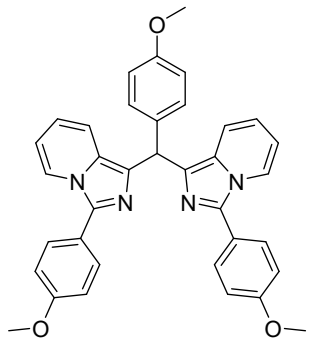
1,1'-(*p*-tolylmethylene)bis(3-(*p*-tolyl)imidazo[1,5-*a*]pyridine) (3b)



The general procedure was followed by using 2-picolylamine (54 mg, 0.5 mmol), 4-methylbenzaldehyde (150 mg, 1.25 mmol). The desired product was isolated by column chromatography (silica gel, hexane/DCM/ethyl acetate (9/4/1)) to yield **3b** (88 mg, 68 %) as a bright green solid, mp 137^{o}C.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.13 (dt, *J* = 7.3, 1.1 Hz, 2H), 7.71 – 7.64 (m, 4H), 7.52 (dt, *J* = 9.3, 1.3 Hz, 2H), 7.44 – 7.40 (m, 2H), 7.32 – 7.27 (m, 4H), 7.13 – 7.08 (m, 2H), 6.52 (ddd, *J* = 9.3, 6.3, 1.0 Hz, 2H), 6.42 (ddd, *J* = 7.4, 6.3, 1.3 Hz, 2H), 6.34 (s, 1H), 2.41 (s, 6H), 2.32 (s, 3H).^{13}C NMR (151 MHz, Chloroform-*d*) δ 140.29, 138.22, 136.77, 135.59, 134.05, 129.53, 128.90, 128.70, 128.33, 128.11, 127.83, 121.16, 119.84, 117.40, 112.76, 44.70, 21.40, 21.09. HRMS (ESI) m/z: $[M+H]^{+}$ Calcd for $C_{36}H_{30}N_4$ 519.25432; found: 519.2518

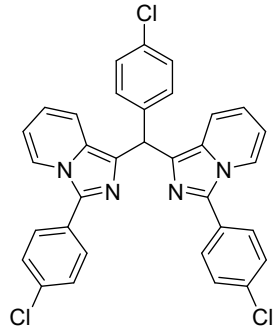
1,1'-((4-methoxyphenyl)methylene)bis(3-(4-methoxyphenyl)imidazo[1,5-*a*]pyridine)[1] (3c)



The general procedure was followed by using 2-picolylamine (54 mg, 0.5 mmol), 4-methoxybenzaldehyde (170 mg, 1.25 mmol). The desired product was isolated by column chromatography (silica gel, hexane/DCM/ethyl acetate (9/4/2)) to yield **3c** (86 mg, 61 %) as a bright green solid.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.06 (dt, *J* = 7.3, 1.1 Hz, 2H), 7.73 – 7.63 (m, 4H), 7.45 – 7.35 (m, 4H), 7.03 – 6.95 (m, 4H), 6.86 – 6.80 (m, 2H), 6.49 (ddd, *J* = 9.3, 6.3, 1.0 Hz, 2H), 6.40 (ddd, *J* = 7.4, 6.3, 1.2 Hz, 2H), 6.29 (s, 1H), 3.83 (s, 6H), 3.76 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 159.71, 158.02, 136.64, 135.47, 133.94, 129.82, 129.64, 128.07, 123.13, 121.07, 119.69, 117.32, 114.31, 113.59, 112.71, 55.36, 55.23, 44.21.

1,1'-((4-chlorophenyl)methylene)bis(3-(4-chlorophenyl)imidazo[1,5-a]pyridine) (3d)

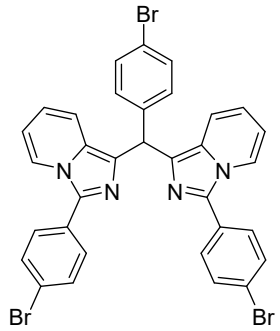


The general procedure was followed by using 2-picolylamine (54 mg, 0.5 mmol), 4-chlorobenzaldehyde (176 mg, 1.25 mmol). The desired product was isolated by column chromatography (silica gel, hexane/DCM/ethyl acetate (9/4/1)) to yield **3d** (99 mg, 68 %) as a bright green solid, mp 100,7°C.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.07 (dt, *J* = 7.3, 1.2 Hz, 2H), 7.71 – 7.62 (m, 4H), 7.49 (dt, *J* = 9.3, 1.3 Hz, 2H), 7.44 – 7.35 (m, 6H), 7.27 – 7.18 (m, 2H), 6.56 (ddd, *J* = 9.3, 6.3, 1.0 Hz, 2H), 6.45 (ddd, *J* = 7.4, 6.3, 1.2 Hz, 2H), 6.27 (s, 1H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 141.48, 135.64, 134.21, 133.68, 132.09, 130.15,

129.24, 129.16, 128.97, 128.78, 128.34, 121.03, 119.51, 118.23, 113.43, 44.25. HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{33}H_{21}Cl_3N_4$ 579.09046; found: 579.0883.

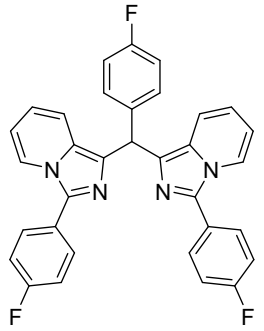
1,1'-((4-bromophenyl)methylene)bis(3-(4-bromophenyl)imidazo[1,5-*a*]pyridine) (3e)



The general procedure was followed by using 2-picolylamine (54 mg, 0.5 mmol), 4-bromobenzaldehyde (231 mg, 1.25 mmol). The desired product was isolated by column chromatography (silica gel, hexane/DCM/ethyl acetate (9/4/1)) to yield **3e** (105 mg, 59 %) as a bright green solid, mp 131°C.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.11 (dt, *J* = 7.3, 1.1 Hz, 3H), 7.67 – 7.62 (m, 4H), 7.62 – 7.57 (m, 4H), 7.52 (dt, *J* = 9.3, 1.2 Hz, 2H), 7.39 (d, *J* = 8.6 Hz, 2H), 7.36 – 7.31 (m, 2H), 6.60 (ddd, *J* = 9.3, 6.4, 1.0 Hz, 3H), 6.50 (ddd, *J* = 7.4, 6.4, 1.3 Hz, 2H), 6.26 (s, 1H); ^{13}C NMR (151 MHz, Chloroform-*d*) δ 141.97, 135.66, 133.62, 132.11, 131.28, 130.51, 129.48, 129.40, 128.82, 122.40, 121.03, 120.25, 119.54, 118.26, 113.48, 44.29. HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{33}H_{21}Br_3N_4$ 710.9389; found: 710.9372.

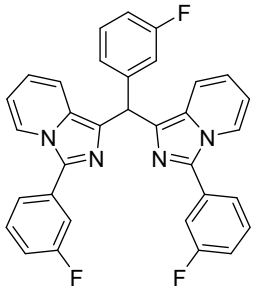
1,1'-((4-fluorophenyl)methylene)bis(3-(4-fluorophenyl)imidazo[1,5-*a*]pyridine) (3f)



The general procedure was followed by using 2-picolylamine (54 mg, 0.5 mmol), 4-fluorobenzaldehyde (155 mg, 1.25 mmol). The desired product was isolated by column chromatography (silica gel, hexane/DCM/ethyl acetate (9/4/1)) to yield **3f** (85 mg, 64 %) as a bright green solid, mp 109,4°C.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.07 (dt, *J* = 7.3, 1.1 Hz, 2H), 7.78 – 7.67 (m, 4H), 7.51 – 7.39 (m, 4H), 7.21 – 7.11 (m, 4H), 7.03 – 6.94 (m, 2H), 6.56 (ddd, *J* = 9.3, 6.4, 1.0 Hz, 2H), 6.45 (ddd, *J* = 7.4, 6.3, 1.3 Hz, 2H), 6.32 (s, 1H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 162.68 (d, *J* = 248.8 Hz), 161.53 (d, *J* = 244.4 Hz), 138.75 (d, *J* = 3.1 Hz), 135.88, 133.74, 130.29 (d, *J* = 7.9 Hz), 130.05 (d, *J* = 8.2 Hz), 128.46, 126.71 (d, *J* = 3.4 Hz), 120.95, 119.45, 117.96, 116.00 (d, *J* = 21.8 Hz), 114.97 (d, *J* = 21.1 Hz), 113.19, 44.19. HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{33}H_{21}F_3N_4$ 531.17911; found: 531.1769.

1,1'-((3-fluorophenyl)methylene)bis(3-(3-fluorophenyl)imidazo[1,5-*a*]pyridine) (3g)

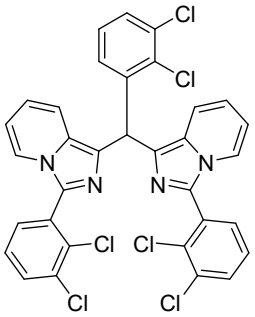


The general procedure was followed by using 2-picolylamine (54 mg, 0.5 mmol), 3-fluorobenzaldehyde (155 mg, 1.25 mmol). The desired product was isolated by column chromatography (silica gel, hexane/DCM/ethyl acetate (9/4/1)) to yield **3g** (95 mg, 72 %) as a bright green solid, mp 112,3°C.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.22 (dt, *J* = 7.3, 1.2 Hz, 2H), 7.64 – 7.58 (m, 4H), 7.55 (ddd, *J* = 9.8, 2.6, 1.5 Hz, 2H), 7.47 (td, *J* = 8.0, 5.9 Hz, 2H), 7.31 – 7.26 (m, 2H), 7.25 – 7.21 (m, 1H), 7.11 (tdd, *J* = 8.4, 2.6, 1.0 Hz, 2H), 6.94 (dtd, *J* = 9.1, 4.9, 2.6 Hz, 1H), 6.66 (ddd, *J* = 9.2, 6.3, 1.0 Hz, 2H), 6.55 (ddd, *J* = 7.4, 6.3, 1.3 Hz, 2H), 6.37 (d, *J* = 0.8 Hz, 1H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 163.06 (d, *J* = 246.5 Hz), 162.90 (d, *J* = 245.0 Hz), 145.59 (d, *J* = 6.9 Hz), 135.47 (d, *J* = 2.9 Hz), 133.57, 132.54 (d, *J* = 8.3 Hz), 130.51 (d, *J* = 8.6 Hz), 129.59 (d, *J* = 8.1 Hz), 128.98, 124.44 (d, *J* = 2.8 Hz), 123.41 (d, *J* = 2.9 Hz), 121.11, 119.57, 118.40, 115.71 (d, *J* = 21.9 Hz), 115.29 (d, *J* = 21.2 Hz), 115.05 (d, *J* = 22.9 Hz), 113.53, 113.21 (d, *J* =

21.1 Hz), 44.54 (d, *J* = 2.0 Hz). HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{33}H_{21}F_3N_4$ 531.17911; found: 531.1771.

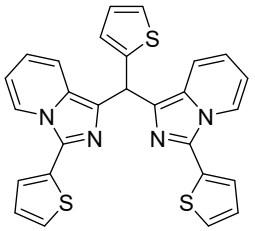
1,1'-((2,3-dichlorophenyl)methylene)bis(3-(2,3-dichlorophenyl)imidazo[1,5-*a*]pyridine) (3h)



The general procedure was followed by using 2-picolylamine (54 mg, 0.5 mmol), 2,3-dichlorobenzaldehyde (219 mg, 1.25 mmol). The desired product was isolated by column chromatography (silica gel, hexane/DCM/ethyl acetate (9/4/1)) to yield **3h** (85 mg, 50 %) as a bright green solid, mp 173,7°C.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.55 (dd, *J* = 8.0, 1.6 Hz, 2H), 7.50 – 7.42 (m, 6H), 7.33 (dd, *J* = 8.0, 1.6 Hz, 1H), 7.28 (t, *J* = 7.9 Hz, 2H), 7.18 – 7.05 (m, 3H), 6.78 (s, 1H), 6.59 (ddd, *J* = 9.3, 6.4, 1.0 Hz, 2H), 6.50 (ddd, *J* = 7.4, 6.3, 1.2 Hz, 2H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 142.82, 134.10, 133.70, 132.95, 132.86, 132.44, 131.66, 131.64, 131.61, 131.37, 129.52, 128.72, 128.57, 127.70, 127.02, 121.97, 118.80, 118.63, 112.89, 42.78. HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{33}H_{18}Cl_6N_4$ 680.97354; found: 680.9733.

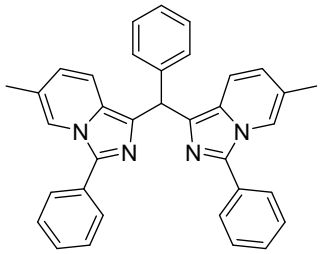
1,1'-((2,3-dichlorophenyl)methylene)bis(3-(2,3-dichlorophenyl)imidazo[1,5-*a*]pyridine) (3i)



The general procedure was followed by using 2-picolylamine (54 mg, 0.5 mmol), thiophene-2-carbaldehyde (140 mg, 1.25 mmol). The desired product was isolated by column chromatography (silica gel, hexane/DCM/ethyl acetate (9/6/1)) to yield (**3i**) (80 mg, 65 %) as a bright yellow solid, mp 238,5°C.

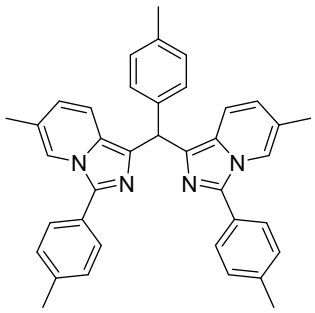
^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.22 (dt, *J* = 7.2, 1.1 Hz, 2H), 7.77 (dt, *J* = 9.3, 1.2 Hz, 2H), 7.46 (dd, *J* = 3.6, 1.1 Hz, 2H), 7.36 (dd, *J* = 5.1, 1.1 Hz, 2H), 7.16 (dd, *J* = 5.1, 1.3 Hz, 1H), 7.13 (dd, *J* = 5.1, 3.6 Hz, 2H), 6.99 (dt, *J* = 3.5, 1.2 Hz, 1H), 6.91 (dd, *J* = 5.1, 3.5 Hz, 1H), 6.65 (ddd, *J* = 9.2, 6.4, 1.0 Hz, 2H), 6.57 (ddd, *J* = 7.4, 6.4, 1.3 Hz, 2H), 6.50 (s, 1H), . ^{13}C NMR (151 MHz, DMSO-d_6) δ 96.09, 94.97, 93.41, 90.69, 89.77, 88.61, 87.90, 87.86, 86.88, 86.54, 83.70, 82.12, 80.27, 75.94, 2.80. HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{27}H_{18}N_4S_3$ 495.0727; found: 495.0759.

1,1'-(phenylmethylene)bis(6-methyl-3-phenylimidazo[1,5-a]pyridine) (3j)



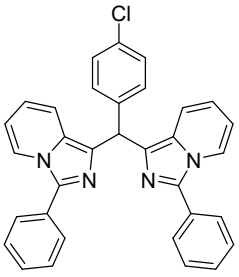
The general procedure was followed by using (5-methylpyridin-2-yl)methanamine (61 mg, 0.5 mmol), benzaldehyde (133 mg, 1.25 mmol). The desired product was isolated by column chromatography (silica gel, hexane/DCM/ethyl acetate (9/6/1)) to yield (**3j**) (85 mg, 67 %) as a bright green solid; mp 104^{o}C; ^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.93 (q, *J* = 1.3, 1.3, 1.3 Hz, 2H), 7.77 – 7.72 (m, 4H), 7.50 – 7.41 (m, 6H), 7.38 – 7.30 (m, 4H), 7.25 (dd, *J* = 8.4, 7.0 Hz, 2H), 7.19 – 7.14 (m, 1H), 6.39 (dd, *J* = 9.4, 1.4 Hz, 2H), 6.32 (s, 1H), 2.11 (d, *J* = 1.4 Hz, 6H). ^{13}C NMR (126 MHz, Chloroform-*d*) δ 143.39, 136.20, 134.03, 130.91, 128.85, 128.21, 128.18, 127.87, 126.19, 126.18, 122.49, 122.47, 121.32, 121.30, 119.09, 118.17, 45.20, 18.49; HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{35}H_{28}N_4$ 505.2386; found: 505.2362.

1,1'-(p-tolylmethylene)bis(6-methyl-3-(p-tolyl)imidazo[1,5-a]pyridine) (3k)



The general procedure was followed by using (5-methylpyridin-2-yl)methanamine (61 mg, 0.5 mmol), 4-methylbenzaldehyde (150 mg, 1.25 mmol). The desired product was isolated by column chromatography (silica gel, hexane/DCM/ethyl acetate (9/6/1)) to yield (**3k**) (89 mg, 65 %) as a bright green solid; mp 107°C; ^{1}H NMR (600 MHz, Chloroform-*d*) δ 7.89 (q, *J* = 1.3, 1.3, 1.3 Hz, 2H), 7.67 – 7.61 (m, 4H), 7.40 – 7.34 (m, 4H), 7.28 – 7.23 (m, 4H), 7.07 – 7.03 (m, 2H), 6.36 (dd, *J* = 9.4, 1.4 Hz, 2H), 6.30 (s, 1H), 2.37 (s, 6H), 2.27 (s, 3H), 2.10 (d, *J* = 1.4 Hz, 6H). ^{13}C NMR (126 MHz, Chloroform-*d*) δ 140.38, 138.09, 136.22, 135.50, 133.93, 129.95, 129.50, 128.87, 128.73, 128.69, 128.20, 127.95, 127.61, 122.32, 122.29, 121.07, 121.05, 119.20, 118.15, 44.52, 21.39, 21.08, 18.48; HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{38}H_{34}N_4$ 547.2856; found: 547.2837.

1,1'-((4-chlorophenyl)methylene)bis(3-phenylimidazo[1,5-*a*]pyridine)[1] (4a)

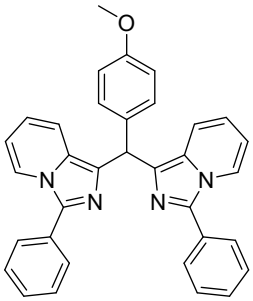


The general procedure was followed by using 3-phenylimidazo[1,5-*a*]pyridine (97 mg, 0.5 mmol), 4-methoxybenzaldehyde (70 mg, 0.5 mmol). The desired product was isolated by column chromatography (silica gel, hexane/DCM/ethyl acetate (9/4/1)) to yield **4a** (110 mg, 86 %) as a bright green solid.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.16 (dt, *J* = 7.3, 1.2 Hz, 2H), 7.82 – 7.74 (m, 4H), 7.56 (dt, *J* = 9.3, 1.3 Hz, 2H), 7.51 – 7.43 (m, 7H), 7.41 – 7.35 (m, 2H), 7.30 – 7.26 (m, 2H), 6.57 (ddd, *J* = 9.3, 6.3, 1.0 Hz, 2H), 6.44 (ddd, *J* = 7.4, 6.3, 1.2 Hz, 2H), 6.36 (s, 1H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 141.83, 136.81, 133.51,

131.97, 130.54, 130.26, 128.93, 128.57, 128.45, 128.30, 128.15, 121.23, 119.51, 118.00, 113.07, 44.37.

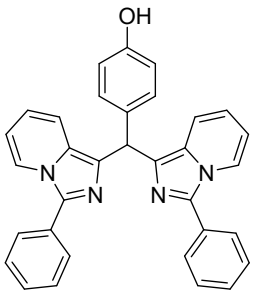
1,1'-((4-methoxyphenyl)methylene)bis(3-phenylimidazo[1,5-*a*]pyridine)[1] **(4b)**



The general procedure was followed by using 3-phenylimidazo[1,5-*a*]pyridine (97 mg, 0.5 mmol), 4-methoxybenzaldehyde (68 mg, 0.5 mmol). The desired product was isolated by column chromatography (silica gel, hexane/DCM/ethyl acetate (9/4/1)) to yield **4b** (113 mg, 89 %) as a bright green solid.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.16 (dt, *J* = 7.3, 1.1 Hz, 2H), 7.80 – 7.74 (m, 4H), 7.50 – 7.45 (m, 7H), 7.45 – 7.42 (m, 2H), 7.38 (ddt, *J* = 7.9, 6.9, 1.3 Hz, 2H), 6.89 – 6.80 (m, 2H), 6.54 (ddd, *J* = 9.3, 6.3, 1.0 Hz, 2H), 6.44 (ddd, *J* = 7.4, 6.3, 1.3 Hz, 2H), 6.34 (s, 1H), 3.77 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 155.09, 146.46, 141.78, 141.60, 131.94, 128.95, 128.15, 122.66, 119.13, 118.38, 113.56, 111.60, 110.31, 108.08, 107.65, 39.63, 29.71.

4-(bis(3-phenylimidazo[1,5-*a*]pyridin-1-yl)methyl)phenol (4c)

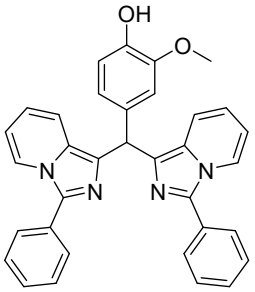


The general procedure was followed by using 3-phenylimidazo[1,5-*a*]pyridine (97 mg, 0.5 mmol), 4-hydroxybenzaldehyde (61 mg, 0.5 mmol). The desired product was isolated by column chromatography (silica gel, hexane/DCM/ethyl acetate (9/5/3)) to yield **4c** (105 mg, 85 %) as a bloody red solid, mp 201°C.

^{1}H NMR (600 MHz, DMSO-d_6) δ 9.25 (s, 1H), 8.34 (dt, *J* = 7.2, 1.1 Hz, 2H), 7.82 – 7.73 (m, 4H), 7.56 – 7.46 (m, 6H), 7.44 – 7.36 (m, 2H), 7.33 – 7.25 (m, 2H), 6.74 – 6.69 (m, 2H), 6.67 (ddd, *J* = 9.3, 6.3, 0.9 Hz, 2H), 6.60 (ddd, *J* = 7.4, 6.3, 1.3 Hz, 2H), 6.19 (s, 1H). ^{13}C NMR (151 MHz, DMSO-d_6) δ 155.62, 135.59, 134.39, 133.21,

130.06, 129.55, 128.86, 128.13, 127.77, 127.47, 121.55, 118.77, 118.04, 114.82, 113.24, 42.75. HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{33}H_{24}N_4O$ 493.20229; found: 493.1999.

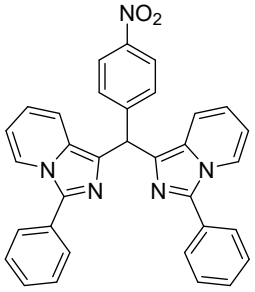
4-(bis(3-phenylimidazo[1,5-*a*]pyridin-1-yl)methyl)-2-methoxyphenol (4d)



The general procedure was followed by using 3-phenylimidazo[1,5-*a*]pyridine (97 mg, 0.5 mmol), 4-hydroxy-3-methoxybenzaldehyde (76 mg, 0.5 mmol). The desired product was isolated by column chromatography (silica gel, hexane/DCM/ethyl acetate (9/6/2)) to yield **4d** (105 mg, 80 %) as a red solid, mp 116,5°C.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.15 (dt, *J* = 7.3, 1.1 Hz, 2H), 7.79 – 7.73 (m, 4H), 7.49 – 7.43 (m, 4H), 7.42 – 7.34 (m, 4H), 7.12 (d, *J* = 2.0 Hz, 1H), 6.96 (ddd, *J* = 8.2, 2.0, 0.7 Hz, 1H), 6.80 (d, *J* = 8.2 Hz, 1H), 6.53 (ddd, *J* = 9.3, 6.3, 1.0 Hz, 2H), 6.44 (ddd, *J* = 7.4, 6.3, 1.3 Hz, 2H), 6.28 (s, 1H), 3.76 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 146.55, 144.28, 136.65, 134.81, 134.19, 130.53, 128.86, 128.43, 128.37, 128.20, 121.44, 121.12, 119.74, 117.73, 114.11, 112.97, 112.07, 55.97, 44.67. HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{34}H_{26}N_4O_2$ 523.21285; found: 523.2114.

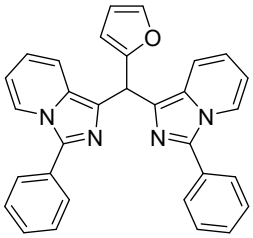
1,1'-((4-nitrophenyl)methylene)bis(3-phenylimidazo[1,5-a]pyridine) (4e)



The general procedure was followed by using 3-phenylimidazo[1,5-*a*]pyridine (97 mg, 0.5 mmol), 4-nitrobenzaldehyde (76 mg, 0.5 mmol). The desired product was isolated by column chromatography (silica gel, hexane/DCM/ethyl acetate (9/4/2)) to yield **4e** (91 mg, 70 %) as a bright green solid, mp 97,3°C.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.19 (dt, *J* = 7.3, 1.1 Hz, 2H), 8.16 – 8.11 (m, 2H), 7.79 – 7.74 (m, 4H), 7.71 – 7.65 (m, 2H), 7.59 (dt, *J* = 9.3, 1.2 Hz, 2H), 7.52 – 7.45 (m, 4H), 7.39 (ddt, *J* = 8.0, 6.9, 1.3 Hz, 2H), 6.61 (ddd, *J* = 9.3, 6.3, 1.0 Hz, 2H), 6.49 (ddd, *J* = 7.4, 6.3, 1.2 Hz, 2H), 6.42 (s, 1H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 150.93, 146.45, 137.05, 132.35, 130.33, 129.71, 129.70, 128.98, 128.69, 128.61, 128.12, 123.42, 121.35, 119.15, 118.47, 118.45, 113.21, 44.67. HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{33}H_{23}N_5O_2$ 522.19245; found: 522.1917.

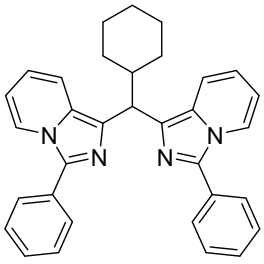
1,1'-(furan-2-ylmethylene)bis(3-phenylimidazo[1,5-a]pyridine) (4f)



The general procedure was followed by using 3-phenylimidazo[1,5-*a*]pyridine (97 mg, 0.5 mmol), furan-2-carbaldehyde (48 mg, 0.5 mmol). The desired product was isolated by column chromatography (silica gel, hexane/DCM/ethyl acetate (9/4/1)) to yield **4f** (96 mg, 82 %) as a bright green solid, mp 79^{o}C.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.15 (dt, *J* = 7.3, 1.1 Hz, 2H), 7.80 – 7.73 (m, 4H), 7.51 – 7.43 (m, 6H), 7.41 – 7.34 (m, 3H), 6.58 (ddd, *J* = 9.3, 6.3, 1.0 Hz, 2H), 6.45 (ddd, *J* = 7.4, 6.3, 1.3 Hz, 2H), 6.37 (s, 1H), 6.35 (dd, *J* = 3.3, 1.9 Hz, 1H), 6.30 (dt, *J* = 3.2, 1.0 Hz, 1H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 155.64, 141.48, 136.70, 131.89, 130.57, 128.85, 128.45, 128.36, 128.17, 121.17, 119.48, 117.97, 113.00, 110.34, 107.57, 39.73. HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{31}H_{22}N_4O$ 467.18664; found: 467.1848.

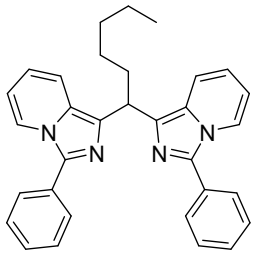
1,1'-(cyclohexylmethylene)bis(3-phenylimidazo[1,5-a]pyridine) (4g)



The general procedure was followed by using 3-phenylimidazo[1,5-*a*]pyridine (97 mg, 0.5 mmol), cyclohexanecarbaldehyde (84 mg, 0.75 mmol). The desired

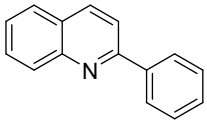
product was isolated by column chromatography (silica gel, hexane/DCM/ethyl acetate (9/4/1)) to yield **5g** (48 mg, 40 %) as a brown solid; mp 92°C; ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.13 (dt, *J* = 7.2, 1.1, 1.1 Hz, 2H), 8.07 (dt, *J* = 9.2, 1.3, 1.3 Hz, 2H), 7.81 – 7.75 (m, 4H), 7.53 – 7.46 (m, 4H), 7.42 – 7.36 (m, 2H), 6.60 (ddd, *J* = 9.2, 6.3, 1.0 Hz, 2H), 6.45 (ddd, *J* = 7.4, 6.2, 1.2 Hz, 2H), 4.52 (d, *J* = 10.5 Hz, 1H), 2.76 – 2.65 (m, 1H), 1.65 (tq, *J* = 11.2, 11.2, 8.0, 5.8, 5.8 Hz, 5H), 1.34 – 1.21 (m, 2H), 1.21 – 1.12 (m, 1H), 1.07 (qd, *J* = 12.6, 11.7, 11.7, 3.7 Hz, 2H); ^{13}C NMR (151 MHz, Chloroform-*d*) δ 136.06, 128.88, 128.68, 128.32, 128.28, 128.21, 128.06, 120.90, 120.17, 117.03, 113.04, 41.58, 32.12, 26.67, 26.30; HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{33}H_{30}N_4$ 483.2543; found: 483.2522.

1,1'-(hexane-1,1-diyl)bis(3-phenylimidazo[1,5-a]pyridine) (4h)



The general procedure was followed by using 3-phenylimidazo[1,5-*a*]pyridine (97 mg, 0.5 mmol), hexanal (75 mg, 0.75 mmol). The desired product was isolated by column chromatography (silica gel, hexane/DCM/ethyl acetate (9/4/1)) to yield **5h** (59 mg, 50 %) as a brown syrup; ^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.13 (dt, *J* = 7.3, 1.1, 1.1 Hz, 2H), 7.80 (ddd, *J* = 8.2, 3.4, 1.3 Hz, 7H), 7.50 (dd, *J* = 8.4, 7.1 Hz, 4H), 7.42 – 7.35 (m, 2H), 6.55 (ddd, *J* = 9.3, 6.3, 1.0 Hz, 2H), 6.42 (ddd, *J* = 7.4, 6.3, 1.3 Hz, 2H), 4.83 (t, *J* = 7.9, 7.9 Hz, 1H), 2.57 – 2.48 (m, 2H), 1.47 – 1.33 (m, 5H), 1.33 – 1.25 (m, 2H), 0.85 (t, *J* = 7.3, 7.3 Hz, 3H); ^{13}C NMR (151 MHz, Chloroform-*d*) δ 136.13, 135.65, 130.81, 128.91, 128.24, 128.08, 127.83, 120.99, 119.70, 117.07, 112.95, 39.24, 34.89, 31.85, 27.99, 22.65, 14.13; HRMS (ESI) m/z: $[M+H]^+$ Calcd for $C_{32}H_{30}N_4$ 471.2543; found: 471.2528.

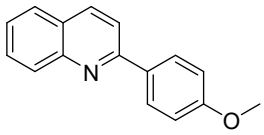
2-phenylquinoline (7a)[5]



The general procedure was followed by using 2-amino benzyl alcohol (62 mg, 0.5 mmol) and acetophenone (72 mg, 0.6 mmol). The desired product was isolated by column chromatography (silica gel, hexane/ethyl acetate (20/1)) to yield **7a** (101 mg, 98 %) as a white solid.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.24 – 8.16 (m, 4H), 7.87 (d, *J* = 8.5 Hz, 1H), 7.82 (dd, *J* = 8.1, 1.5 Hz, 1H), 7.74 (ddd, *J* = 8.4, 6.8, 1.5 Hz, 1H), 7.58 – 7.51 (m, 3H), 7.51 – 7.46 (m, 1H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 157.38, 148.36, 139.74, 136.79, 129.80, 129.69, 129.37, 128.88, 127.63, 127.51, 127.24, 126.31, 119.01.

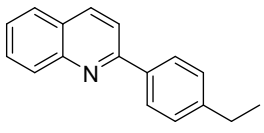
3-(4-methoxyphenyl)quinoline (7b)[4]



The general procedure was followed by using 2-amino benzyl alcohol (62 mg, 0.5 mmol) and 1-(4-methoxyphenyl)ethan-1-one (90 mg, 0.6 mmol). The desired product was isolated by column chromatography (silica gel, hexane/ethyl acetate (15/1)) to yield (**7b**) (101 mg, 85 %) as a white solid.

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.20 – 8.11 (m, 4H), 7.83 (d, *J* = 8.6 Hz, 1H), 7.80 (dd, *J* = 8.1, 1.4 Hz, 1H), 7.71 (ddd, *J* = 8.4, 6.8, 1.5 Hz, 1H), 7.49 (ddd, *J* = 8.0, 6.8, 1.2 Hz, 1H), 7.09 – 7.02 (m, 2H), 3.89 (s, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 160.85, 156.93, 148.33, 136.61, 132.31, 129.56, 128.90, 127.43, 126.93, 125.91, 118.55, 114.25, 55.40.

2-(4-ethylphenyl)quinoline (7c)[4]



The general procedure was followed by using 2-amino benzyl alcohol (62 mg, 0.5 mmol) and 1-(4-ethylphenyl)ethan-1-one (89 mg, 0.6 mmol). The desired product was isolated by column chromatography (silica gel, hexane/ethyl acetate (20/1)) to yield **6c** (105 mg, 90 %) as a white solid.

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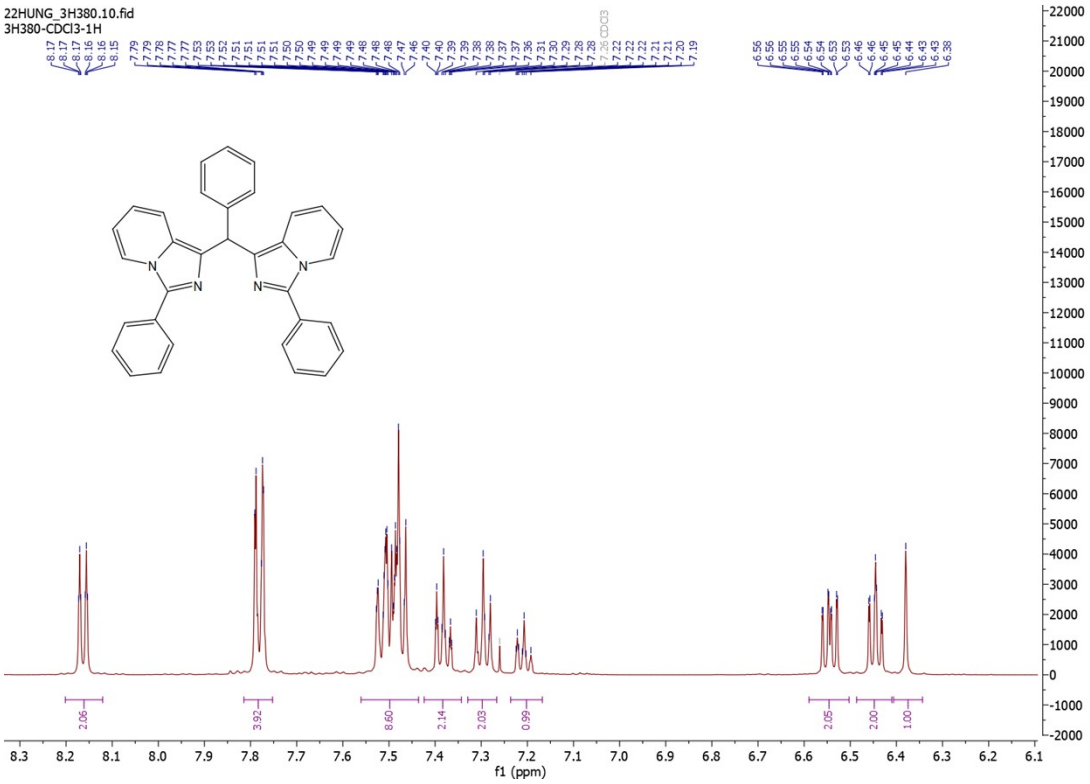
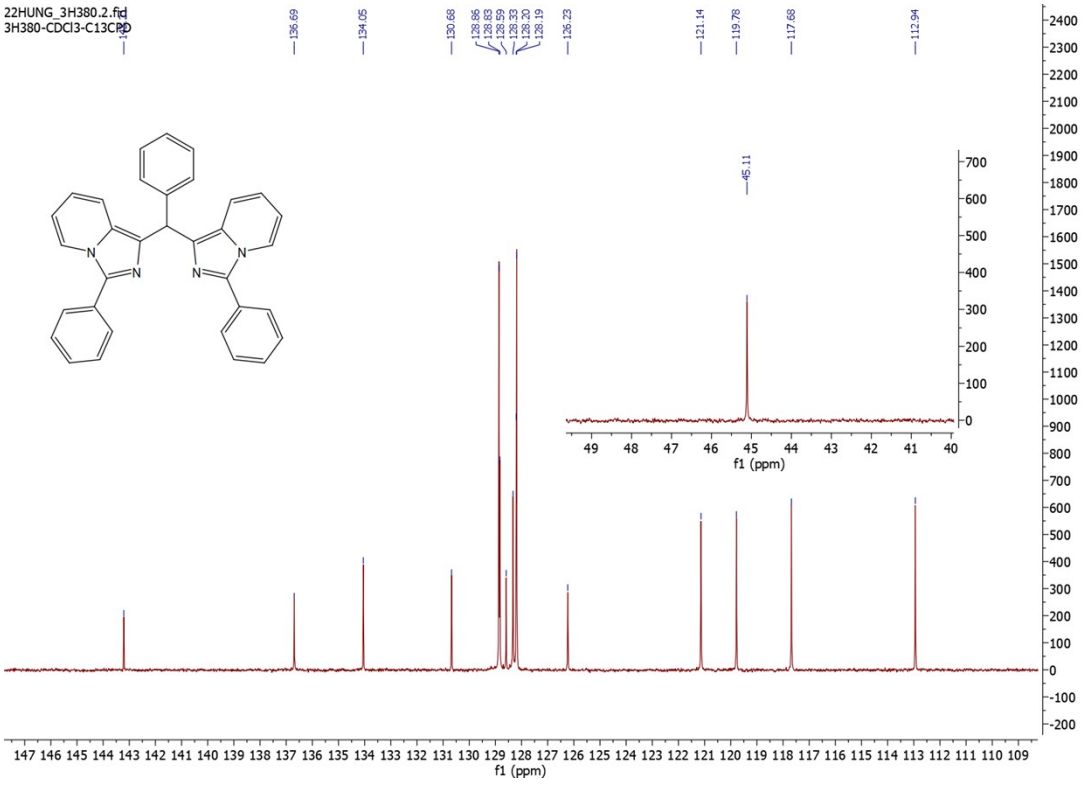
[5] M. T. Ha, N. T. Nguyen, N. H. Tran, Q. V. Ho, N. T. Son, V. H. Nguyen, H. Nguyen, D. V. Do, T. Q. Hung, B. K. Mai and T. T. Dang, *Chem. Asian J.*, 2022, **17**, e202200909

^{1}H NMR (600 MHz, Chloroform-*d*) δ 8.26 (d, *J* = 8.5 Hz, 1H), 8.22 (dd, *J* = 8.6, 0.9 Hz, 1H), 8.14 – 8.08 (m, 2H), 7.87 (d, *J* = 8.6 Hz, 1H), 7.82 (dd, *J* = 8.0, 1.4 Hz, 1H), 7.73 (ddd, *J* = 8.4, 6.9, 1.5 Hz, 1H), 7.53 (ddd, *J* = 8.1, 6.8, 1.2 Hz, 1H), 7.40 – 7.34 (m, 2H), 2.74 (q, *J* = 7.6 Hz, 2H), 1.30 (t, *J* = 7.6 Hz, 3H). ^{13}C NMR (151 MHz, Chloroform-*d*) δ 157.28, 147.83, 146.05, 137.12, 136.62, 129.86, 129.31, 128.45, 127.73, 127.47, 127.12, 126.28, 119.01, 28.76, 15.51.

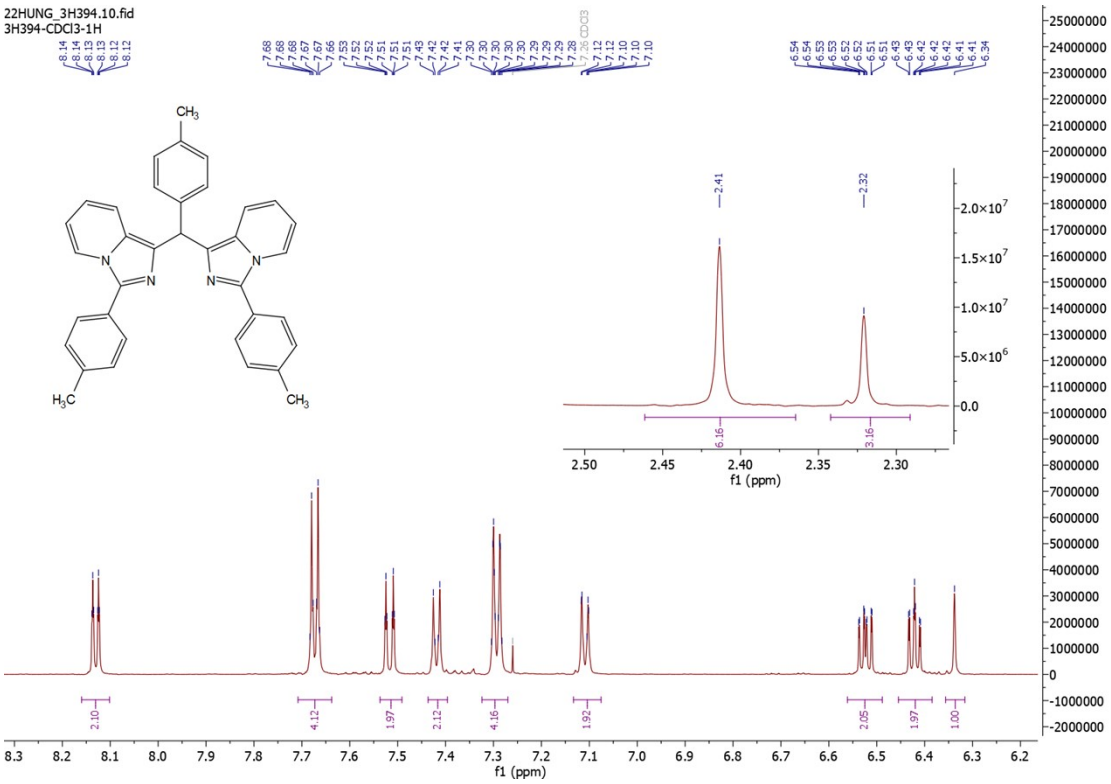
6. Copies of NMR spectra

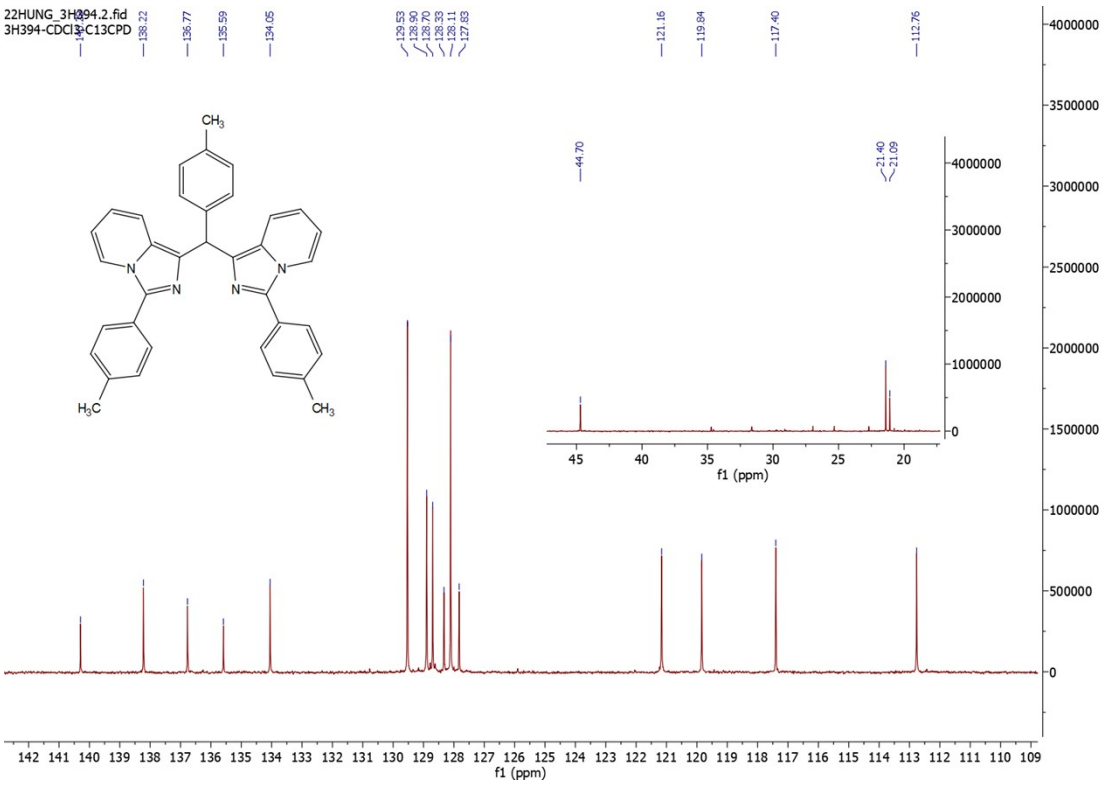
1,1'-(phenylmethylene)bis(3-phenylimidazo[1,5-a]pyridine) (3a)

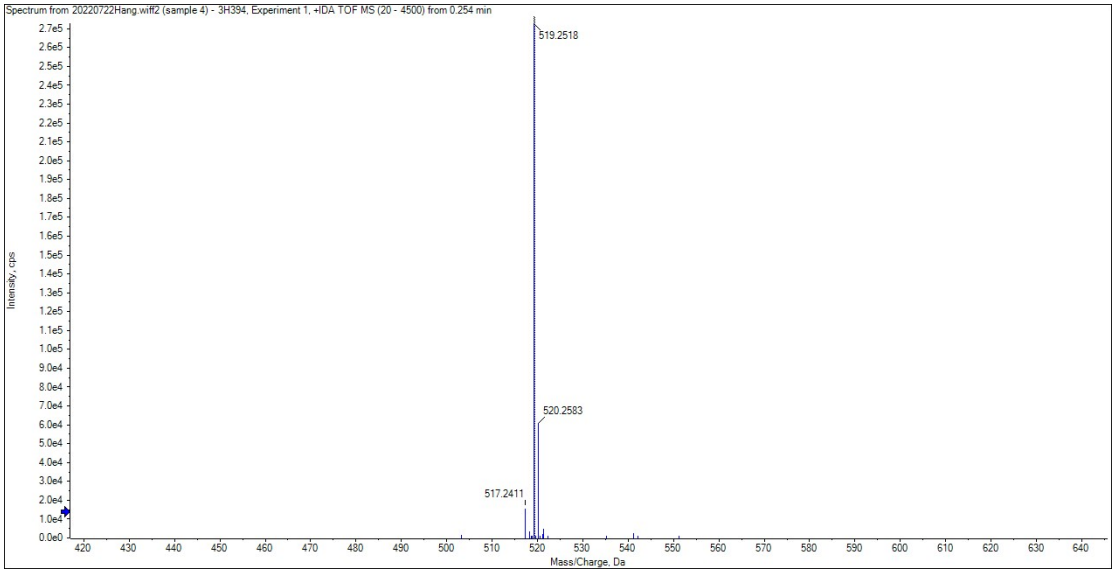




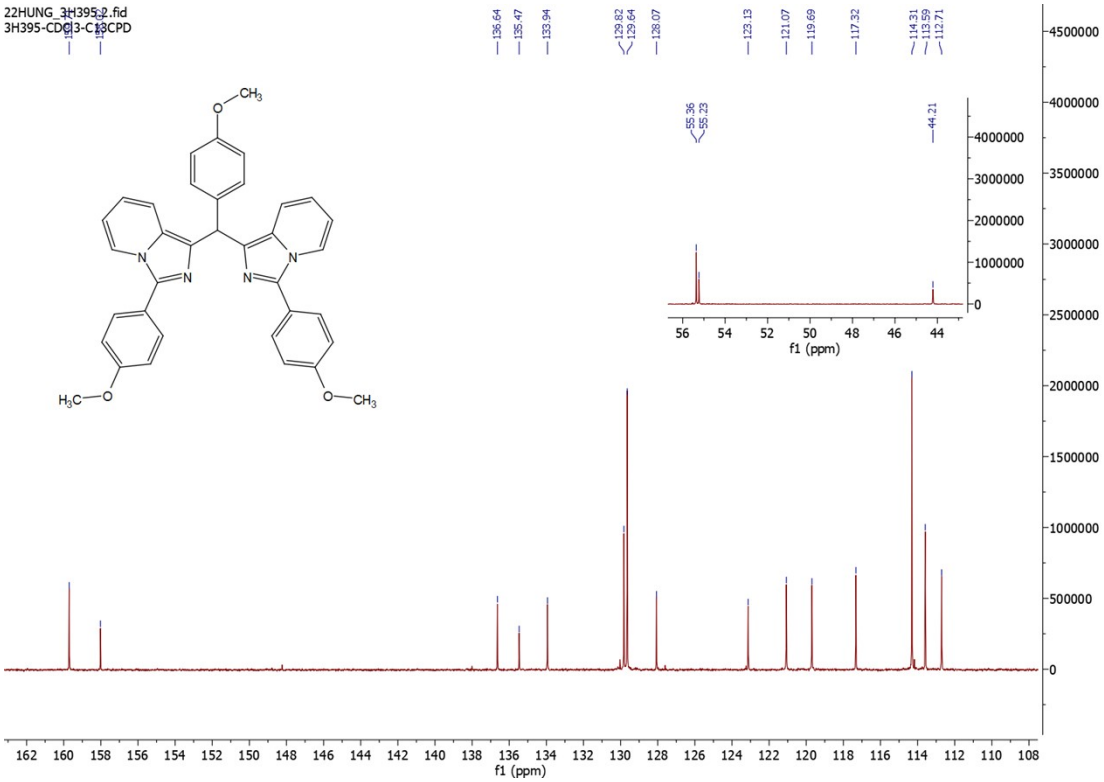
1,1'-(p-tolylmethylene)bis(3-(p-tolyl)imidazo[1,5-a]pyridine) (3b)

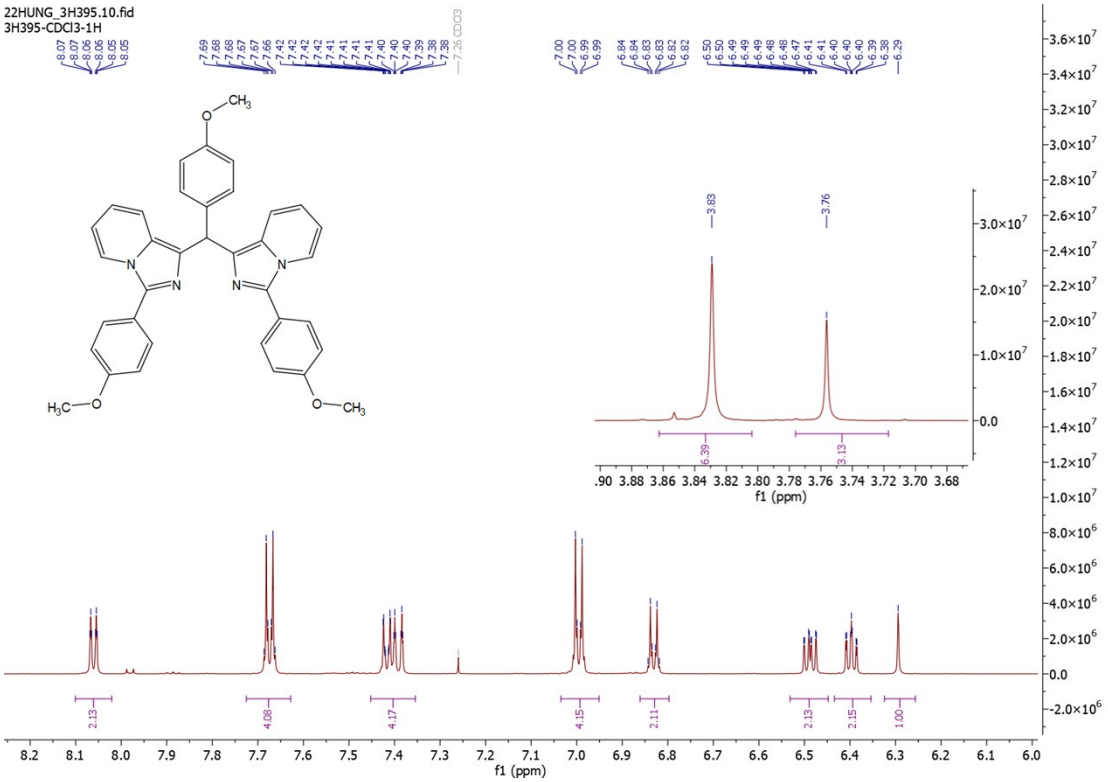




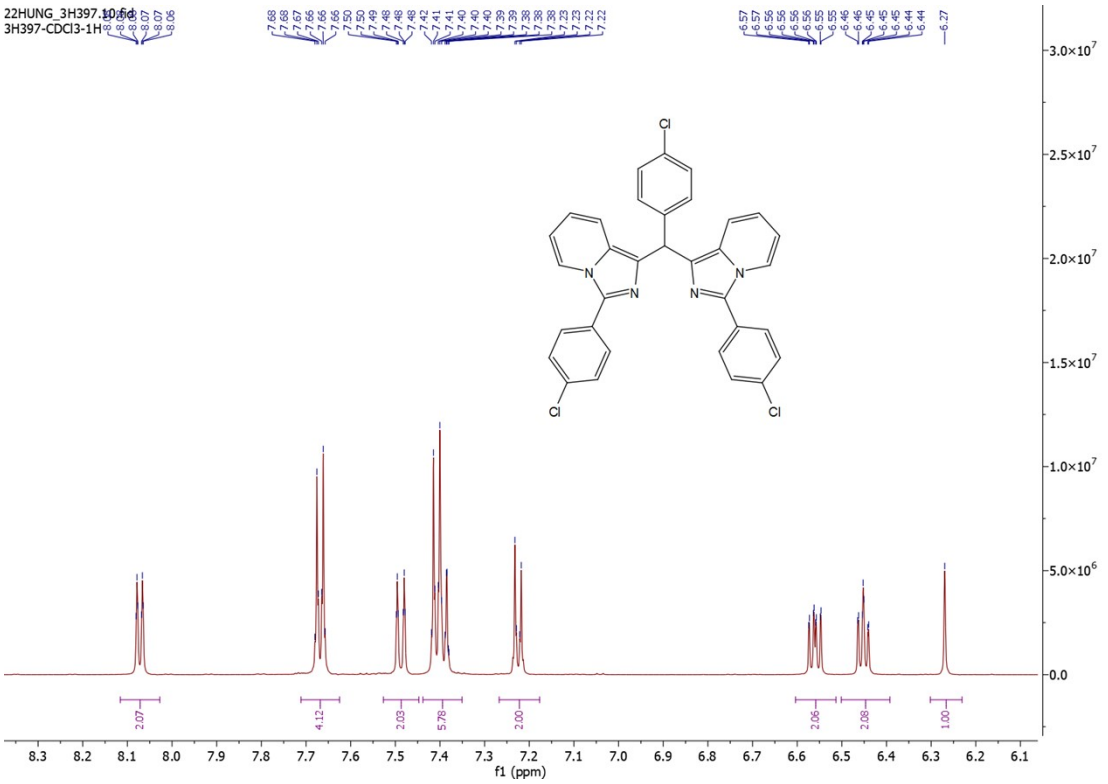


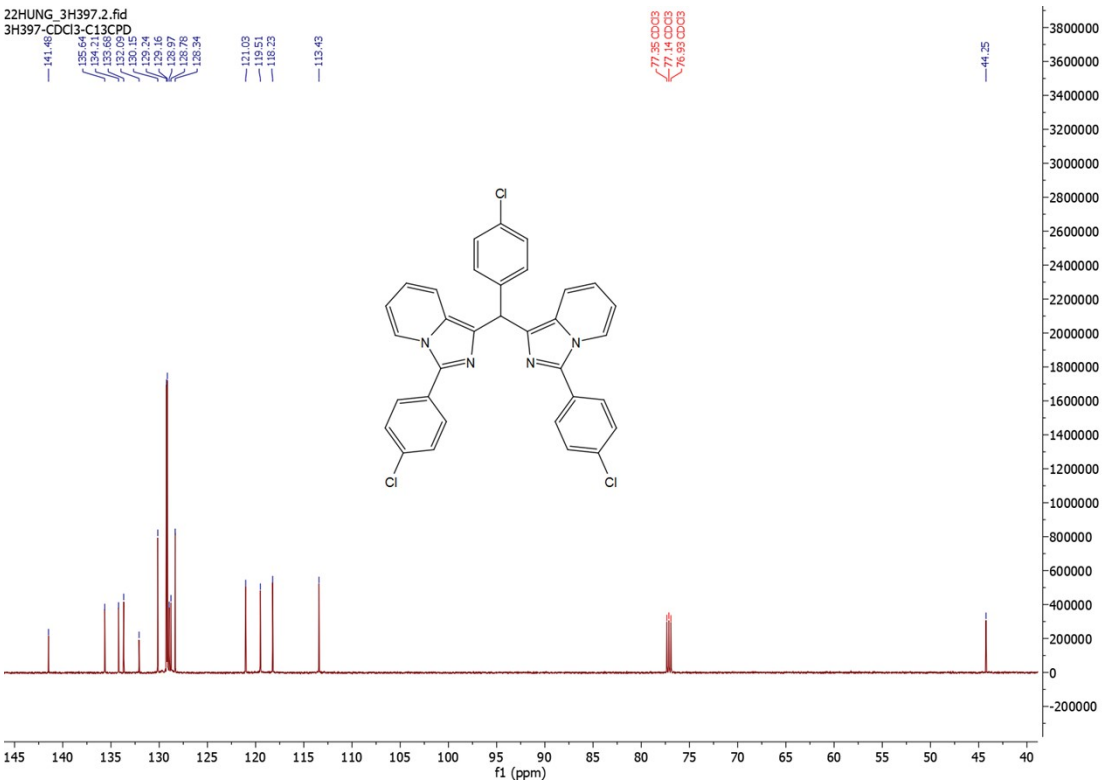
1,1'-((4-methoxyphenyl)methylene)bis(3-(4-methoxyphenyl)imidazo[1,5-a]pyridine) (3c)

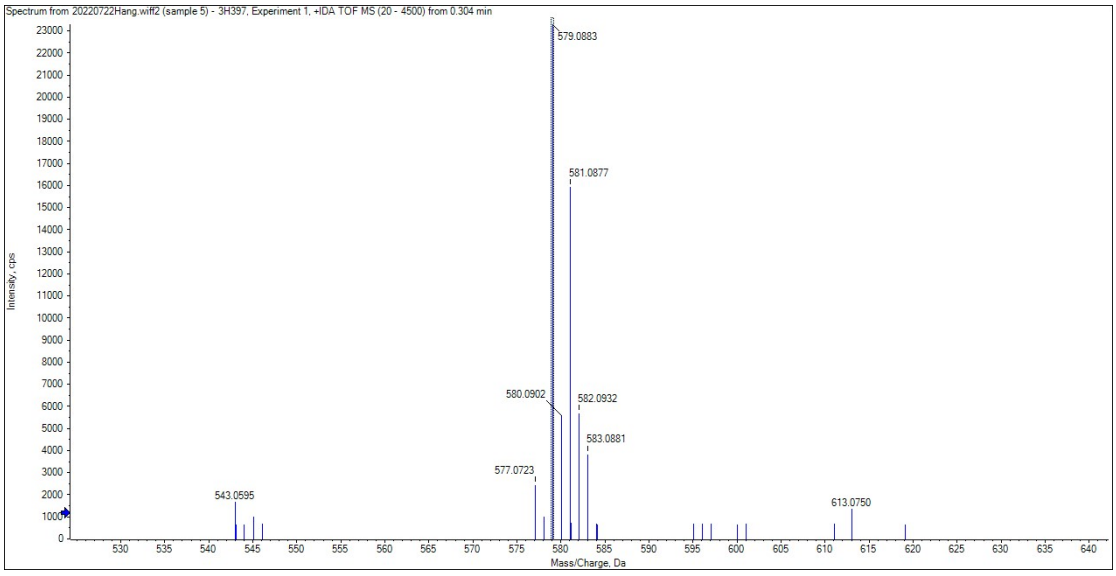




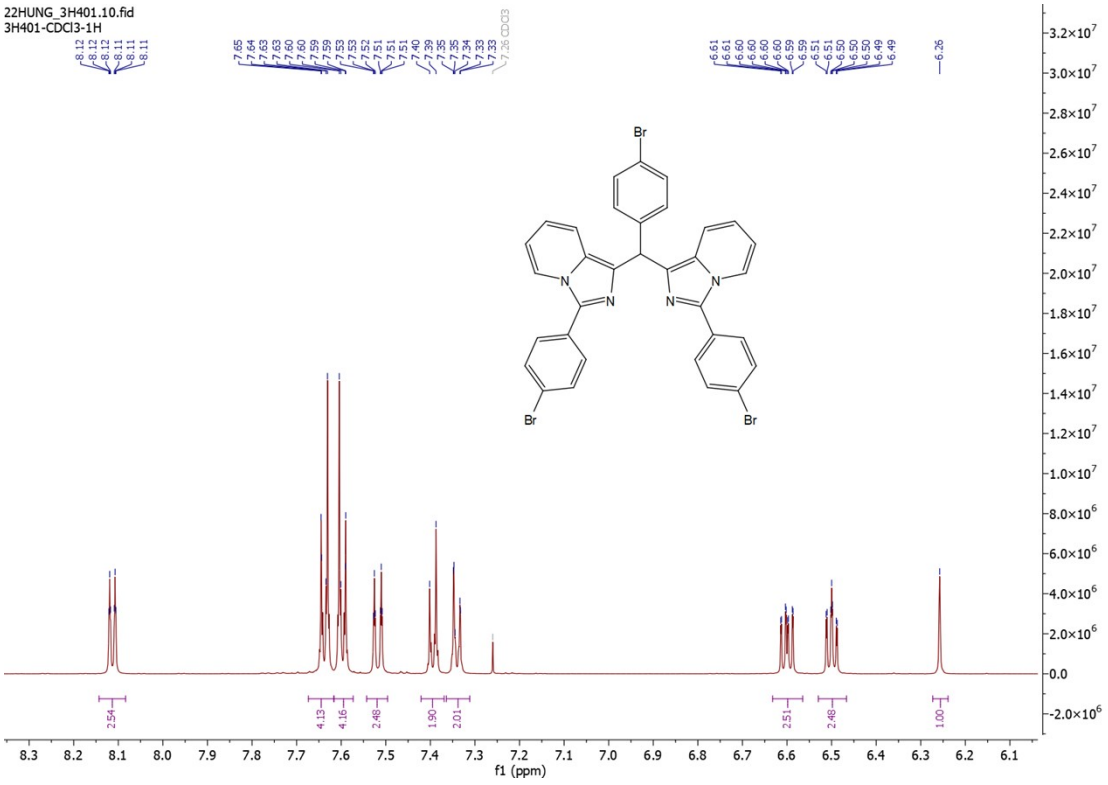
1,1'-((4-chlorophenyl)methylene)bis(3-(4-chlorophenyl)imidazo[1,5-a]pyridine) (3d)

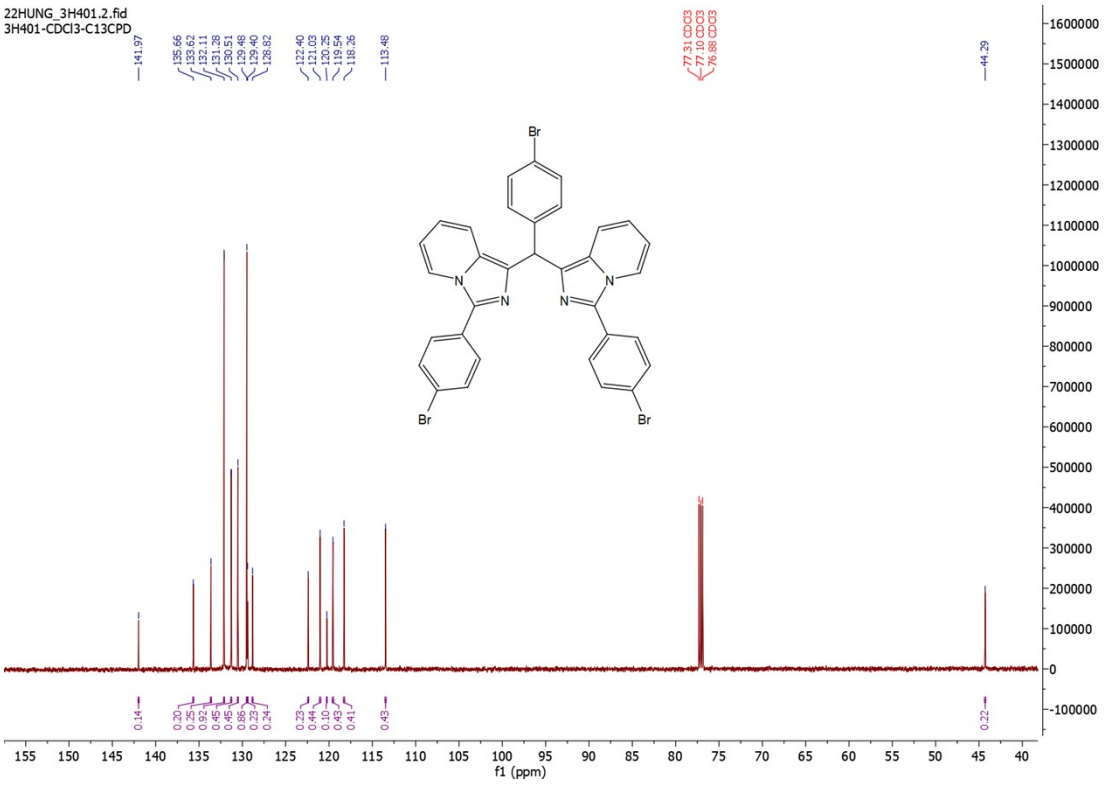


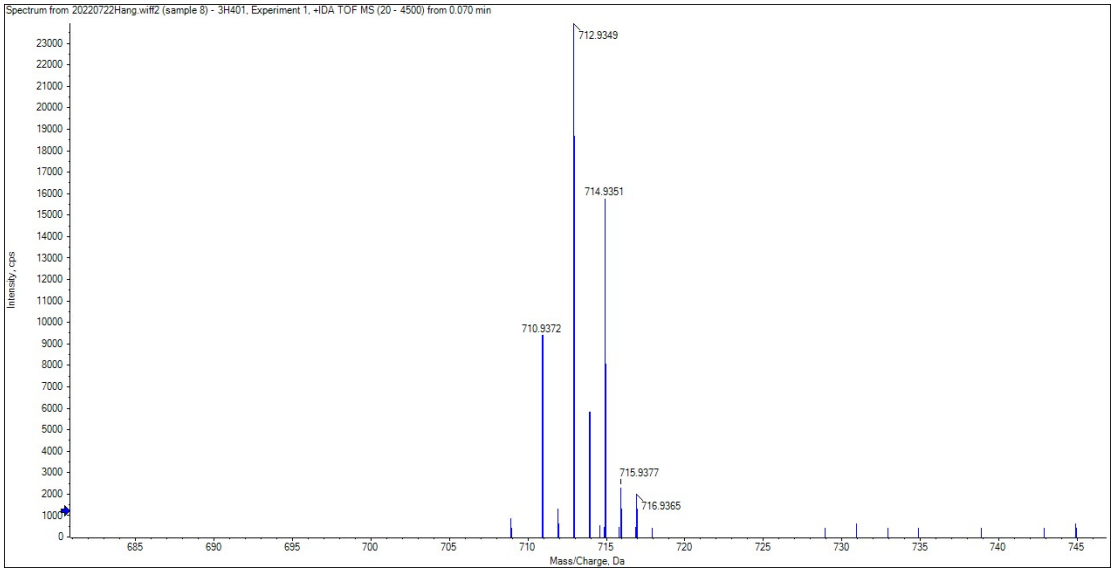




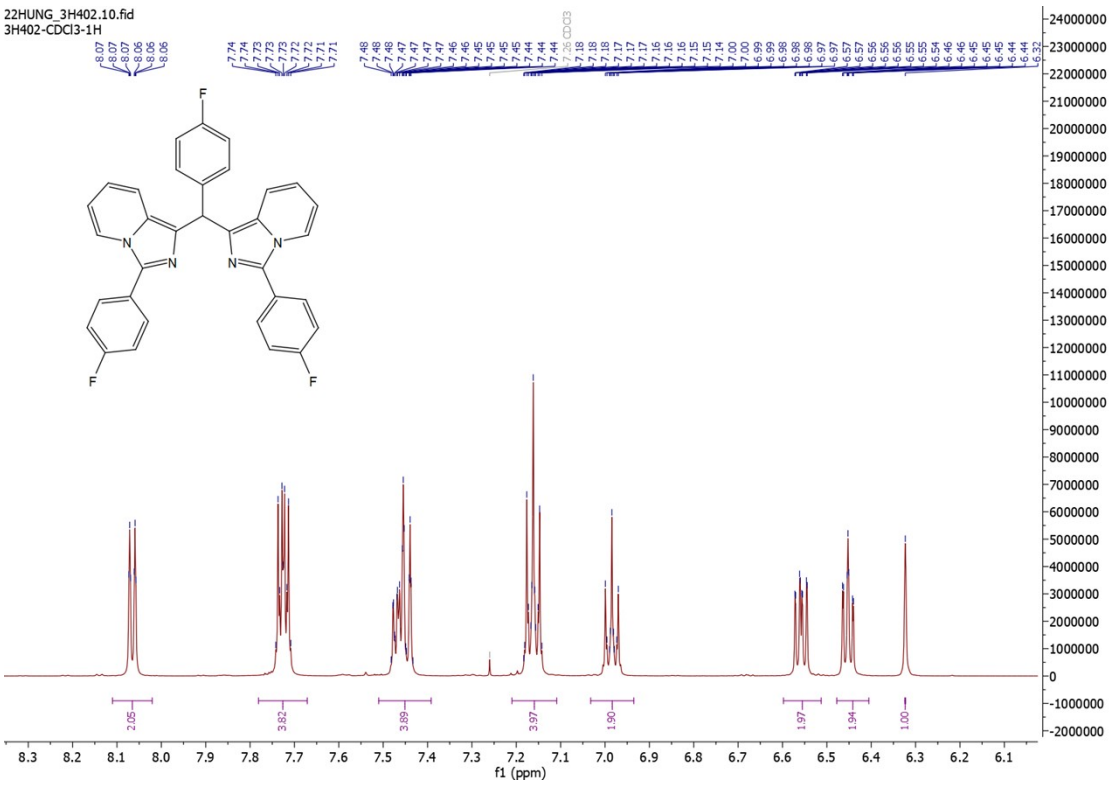
1,1'-((4-bromophenyl)methylene)bis(3-(4-bromophenyl)imidazo[1,5-a]pyridine) (3e)

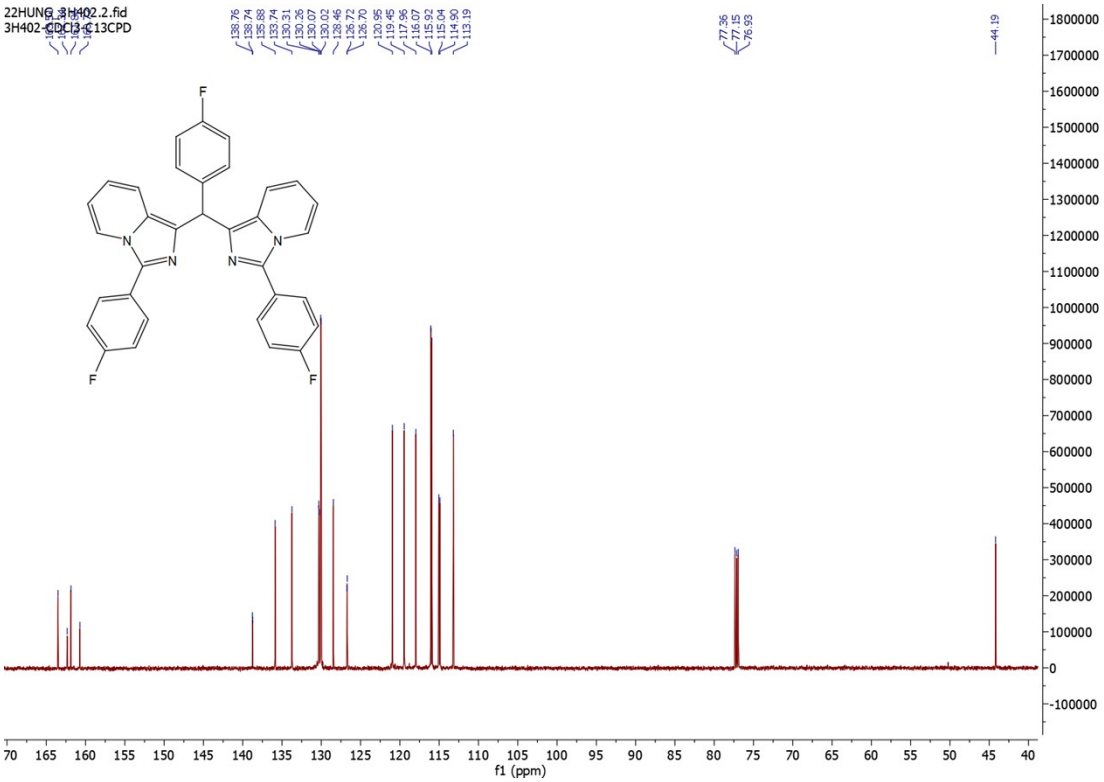

22HUNG_3H401.10.fid
3H401-CDCl3-1H
f1 (ppm)

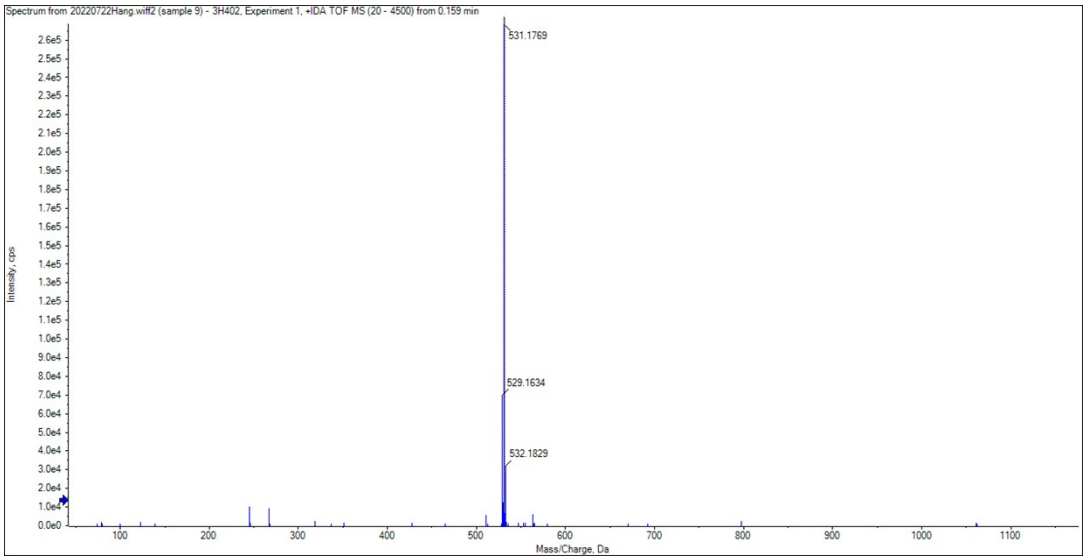

22HUNG_3H401.2.fid
3H401-CDCl3-C13CPD
f1 (ppm)



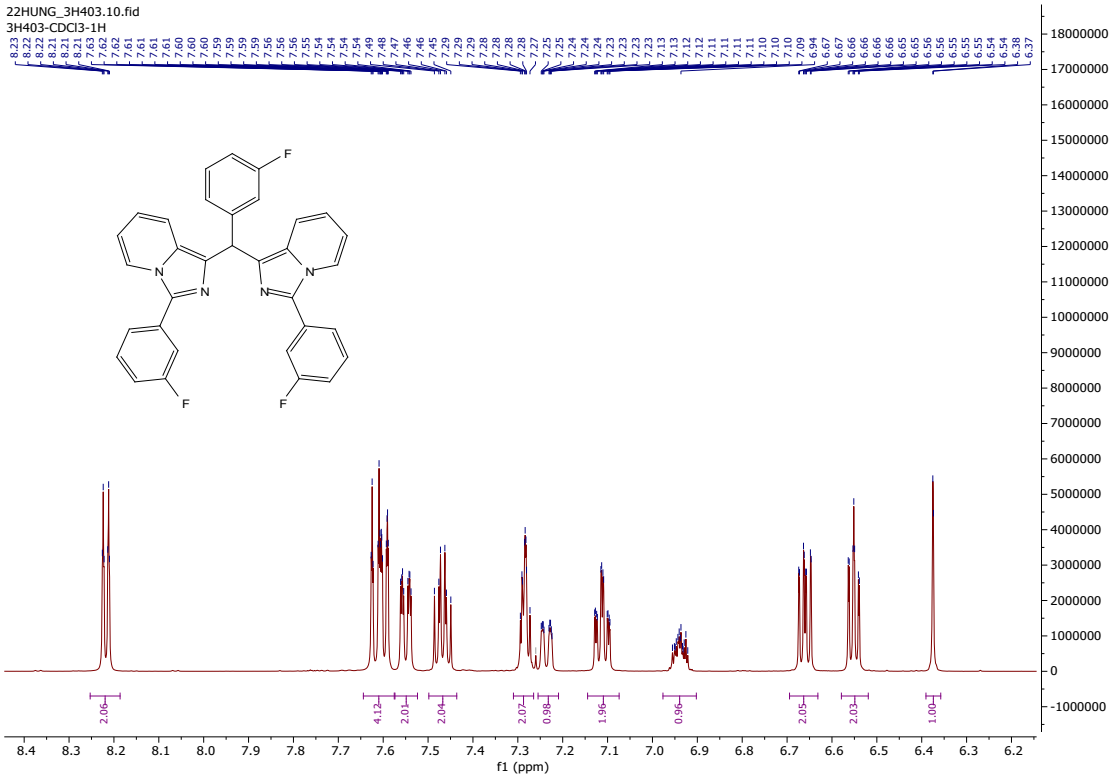
1,1'-((4-fluorophenyl)methylene)bis(3-(4-fluorophenyl)imidazo[1,5-a]pyridine) (3f)

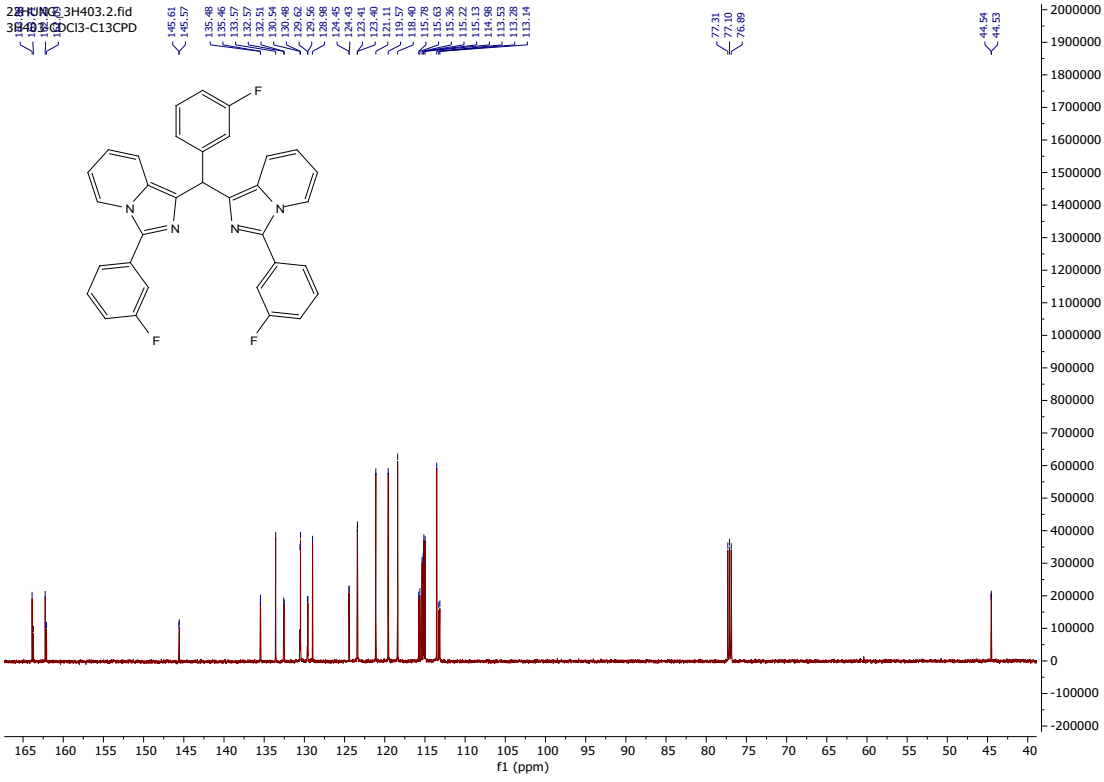


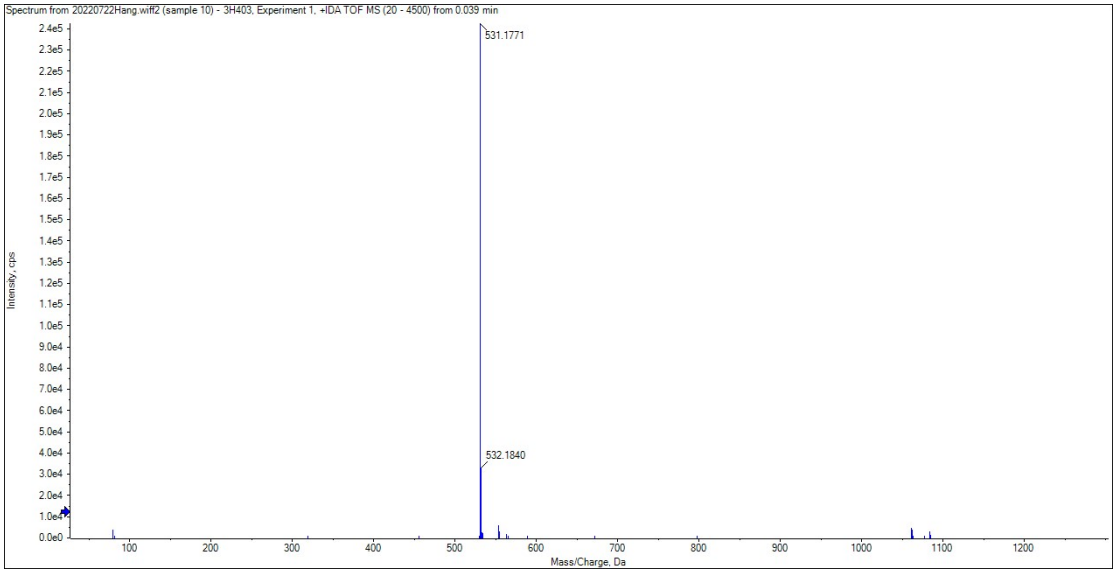

22HUNG_3H402.2.fid
3H402-CDCl3-C13CPD
138.76
138.74
135.88
133.74
130.31
130.26
130.07
130.02
128.46
126.72
126.70
120.95
119.45
117.56
116.07
115.92
115.04
114.90
113.19
77.36
77.15
76.93
44.19
F
N
N
N
F
F
f1 (ppm)


Spectrum from 20220722Hang.wiff2 (sample 9) - 3H402, Experiment 1, +IDA TOF MS (20 - 4500) from 0.159 min
531.1769
529.1634
532.1829
Intensity, cps
Mass/Charge, Da

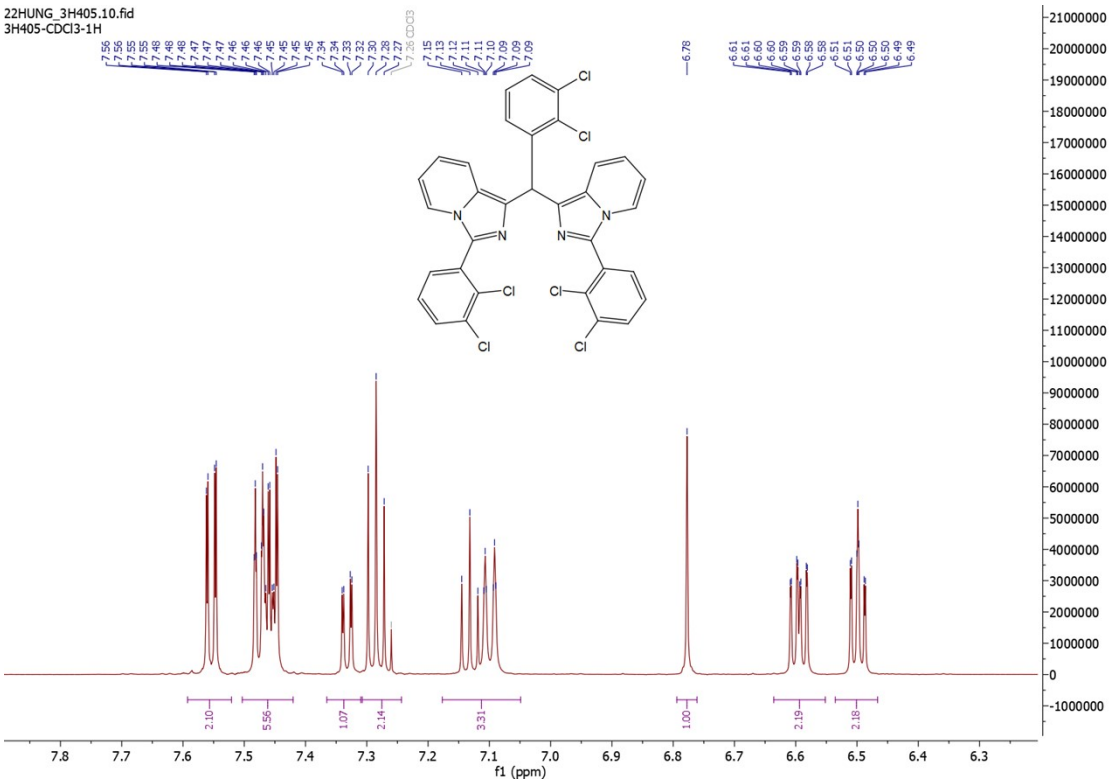
1,1'-((3-fluorophenyl)methylene)bis(3-(3-fluorophenyl)imidazo[1,5-a]pyridine) (3g)

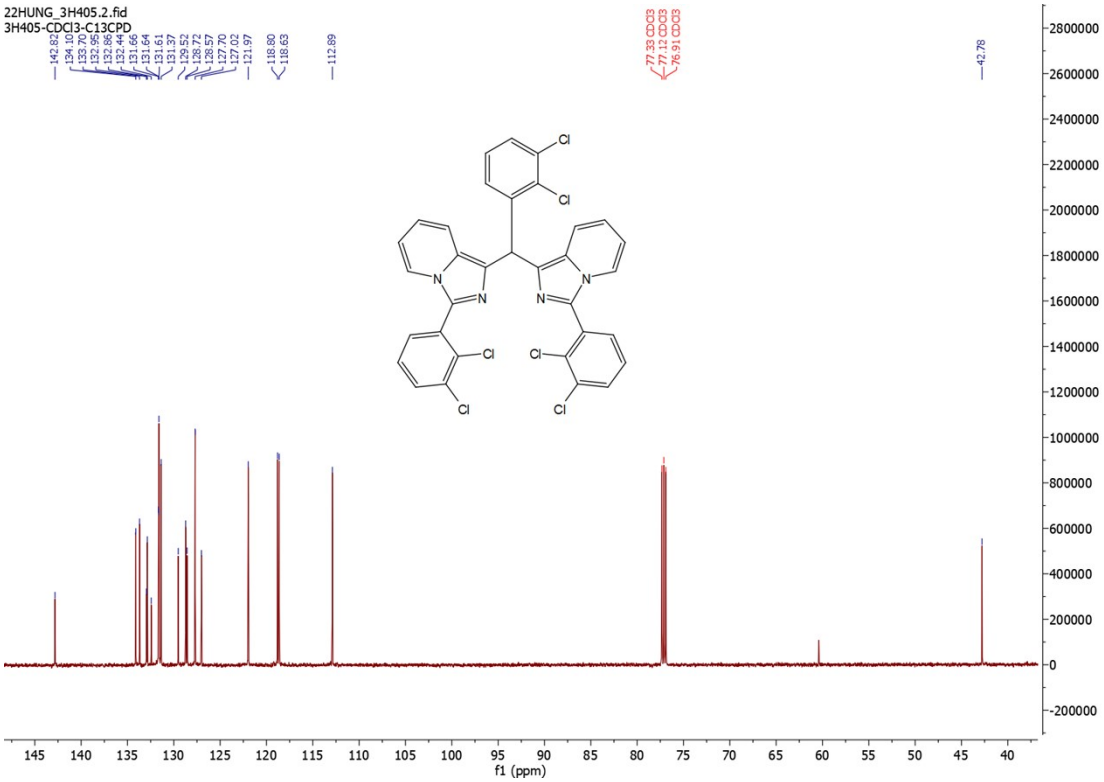


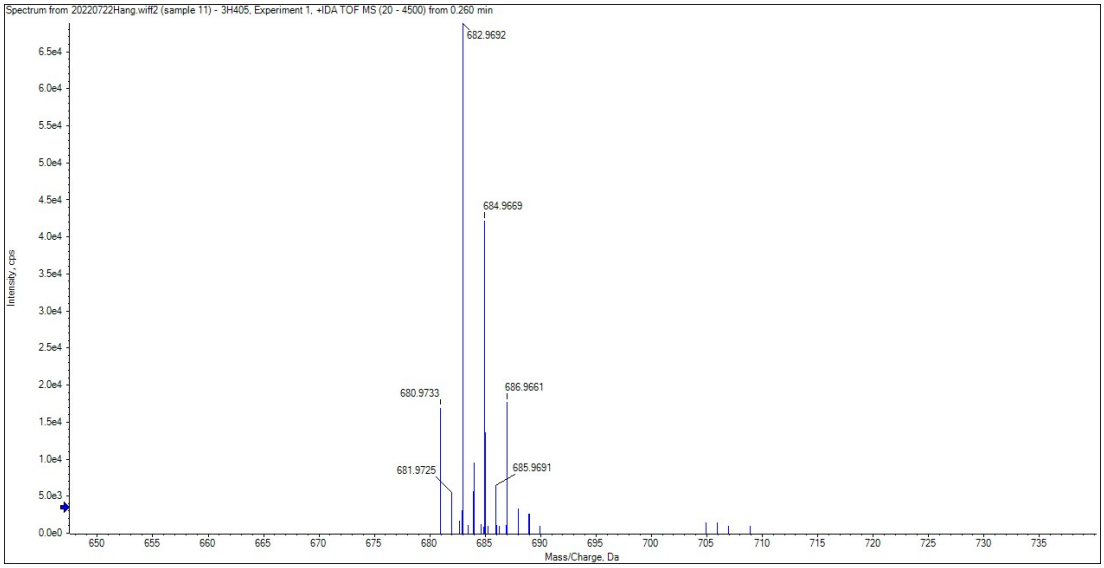




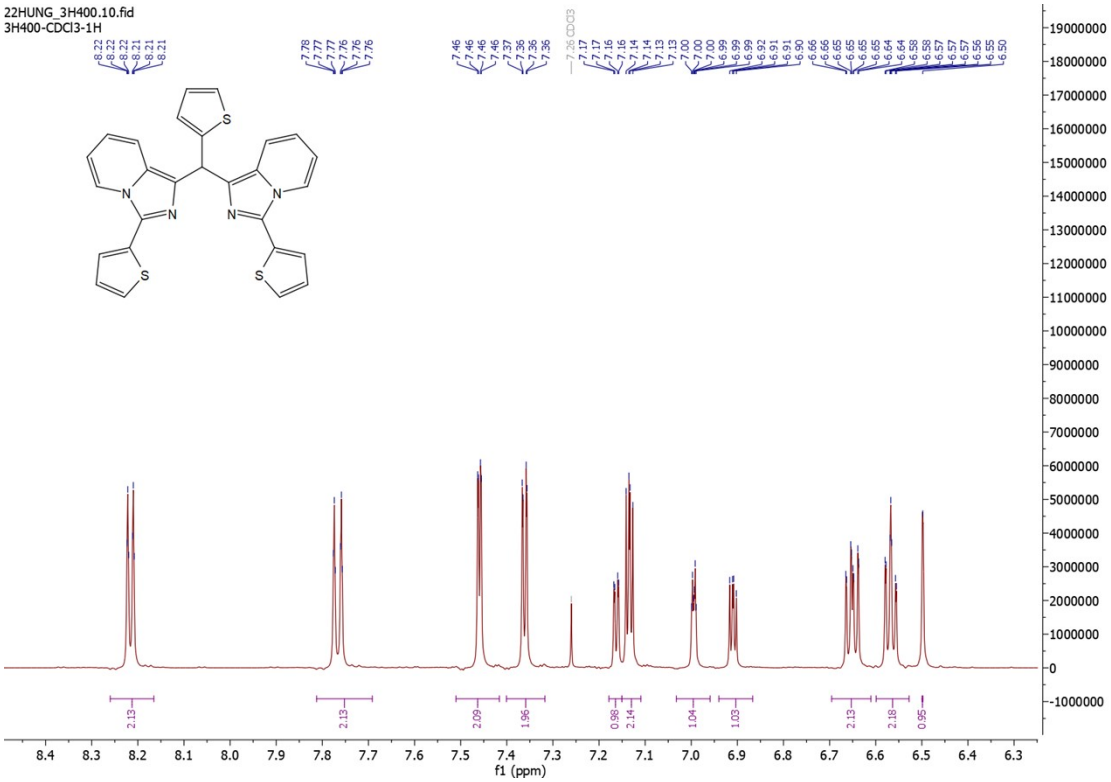
1,1'-((2,3-dichlorophenyl)methylene)bis(3-(2,3-dichlorophenyl)imidazo[1,5-a]pyridine) (3h)

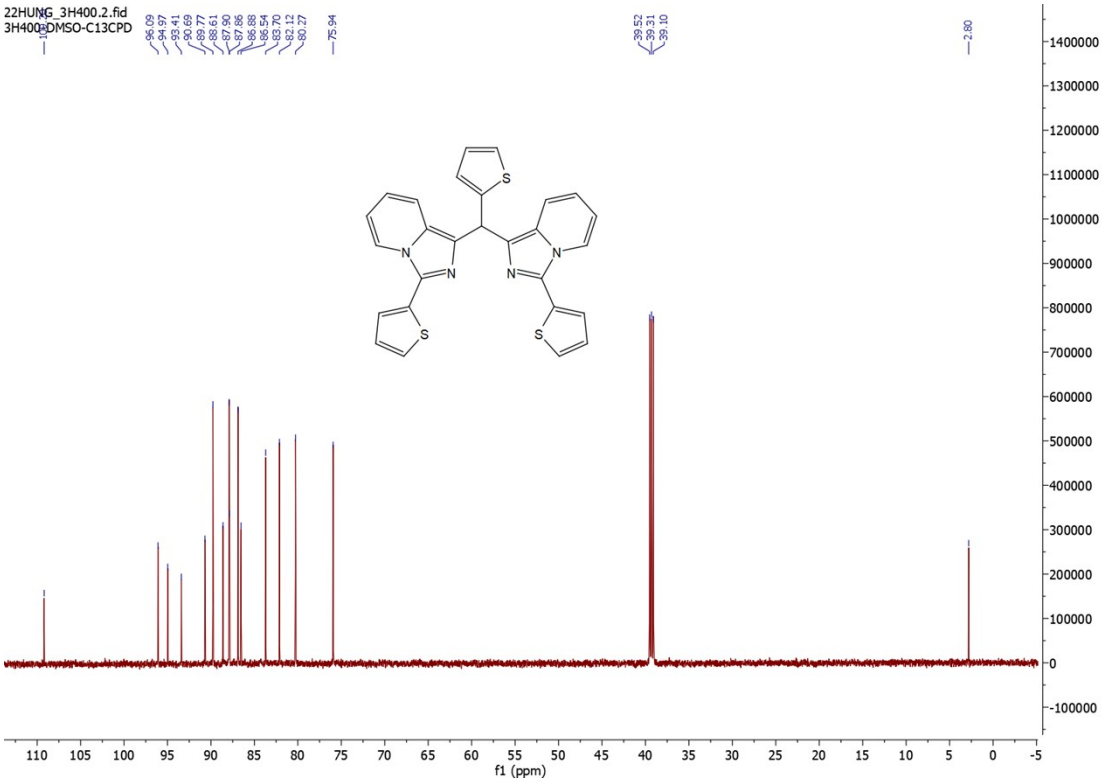


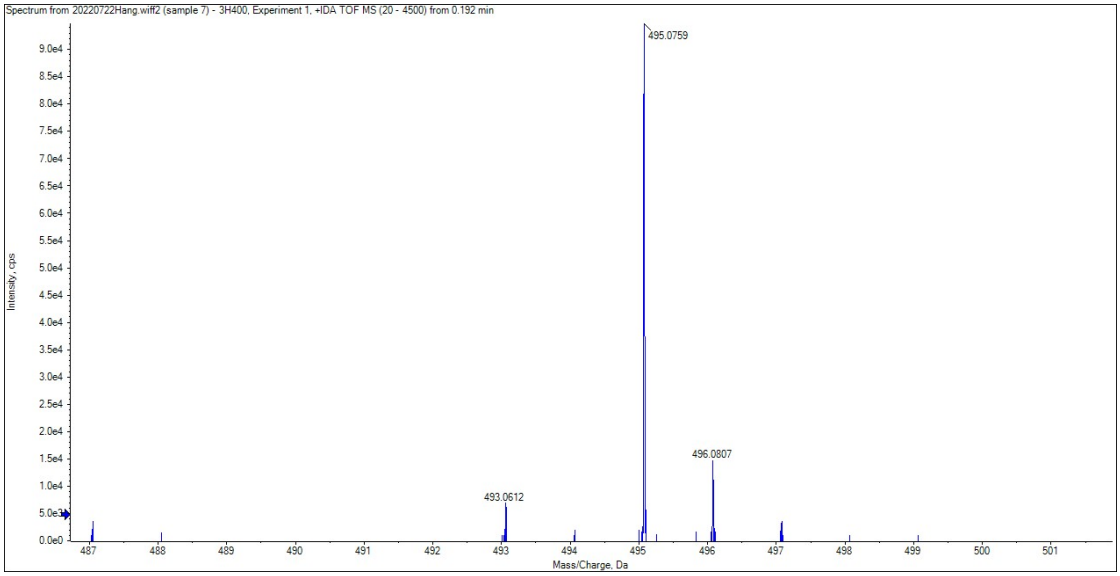

22HUNG_3H405.2.fid
3H405-CDCl3-C13CPD
142.82
134.10
133.70
132.95
132.86
132.44
131.66
131.64
131.61
131.37
129.52
128.72
128.57
127.70
127.02
121.97
118.80
118.63
112.89
77.33 CDCl3
77.12 CDCl3
76.91 CDCl3
42.78
Cl
Cl
N
N
N
N
Cl
Cl
Cl
Cl
f1 (ppm)


Spectrum from 20220722Hang.wiff2 (sample 11) - 3H405, Experiment 1, +IDA TOF MS (20 - 4500) from 0.260 min
682.9692
684.9669
680.9733
686.9661
681.9725
685.9691
Intensity, cps
Mass/Charge, Da

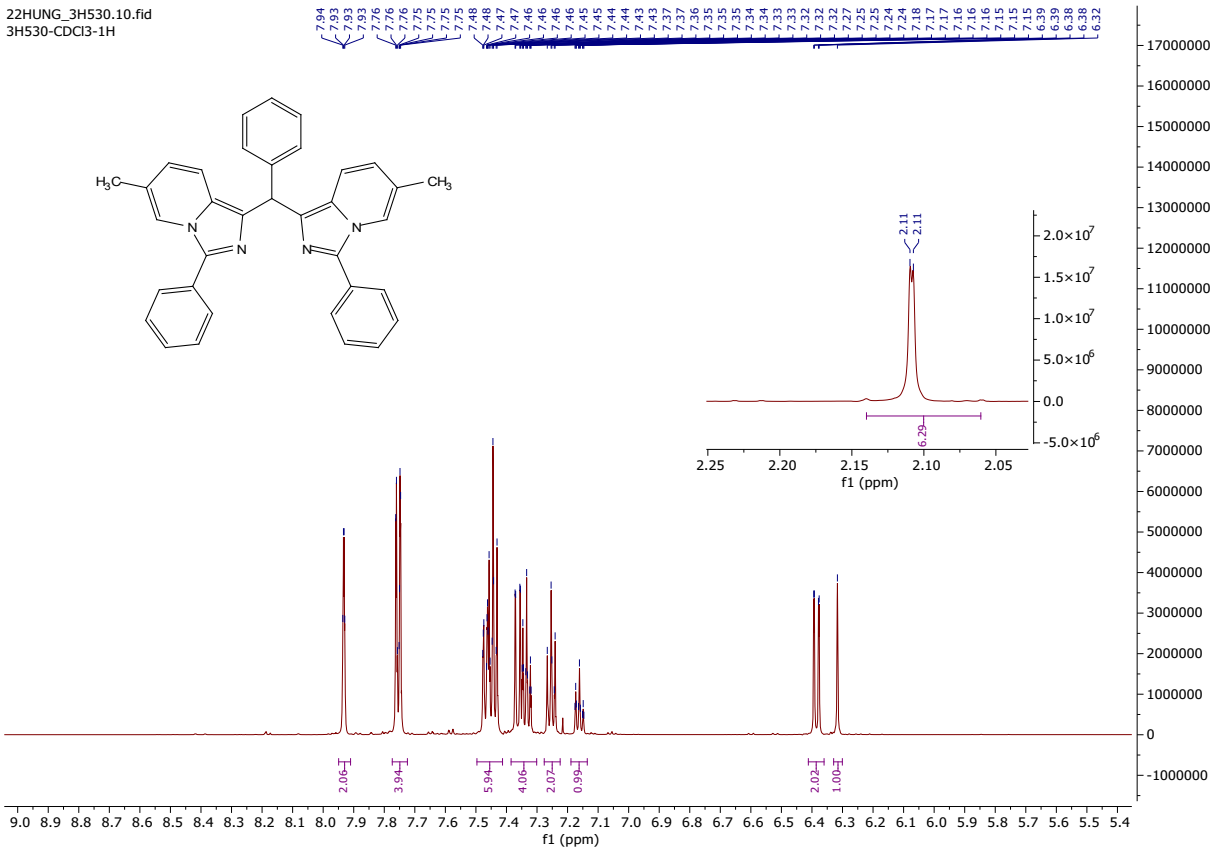
1,1'-((2,3-dichlorophenyl)methylene)bis(3-(2,3-dichlorophenyl)imidazo[1,5-a]pyridine) (3i)

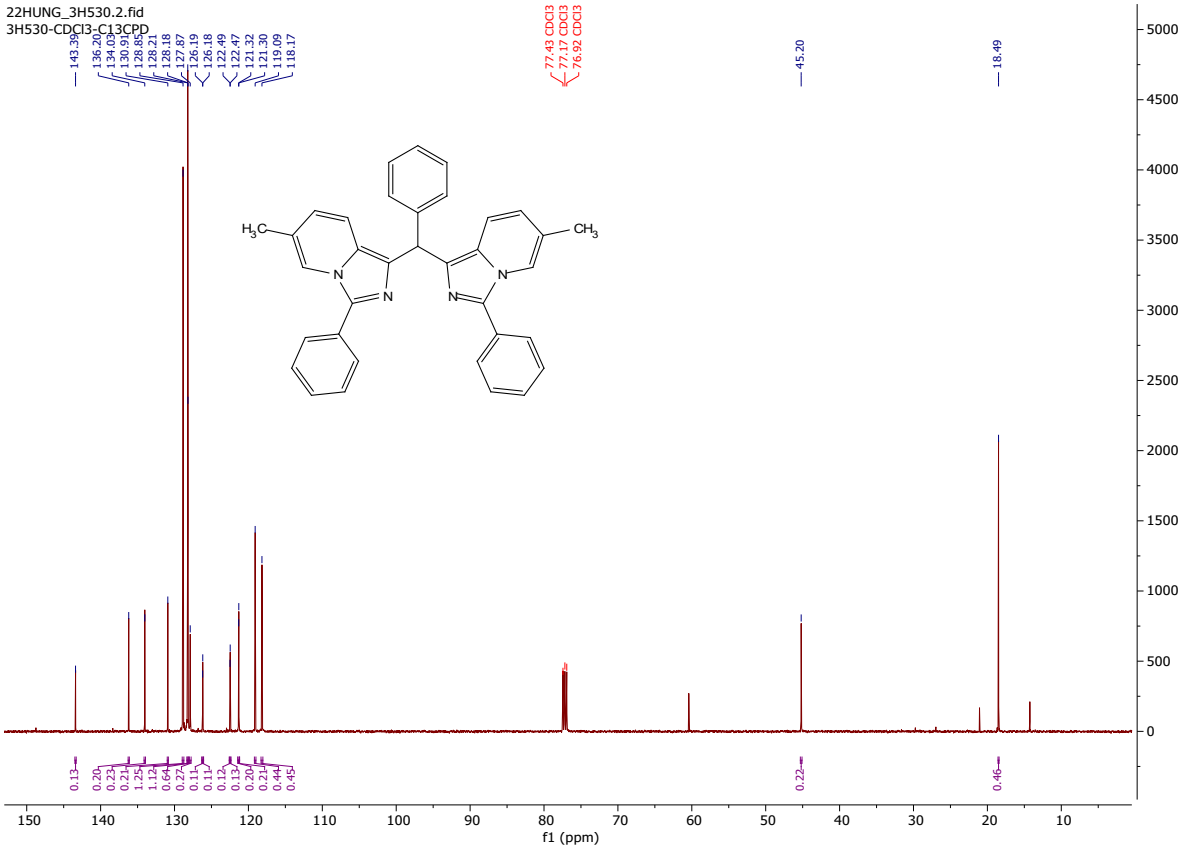


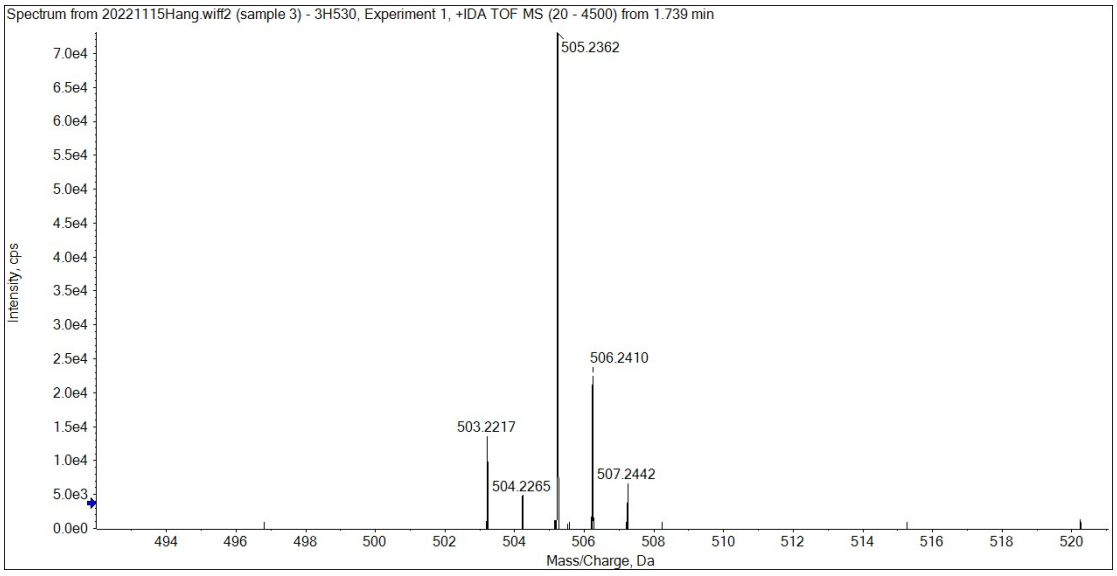




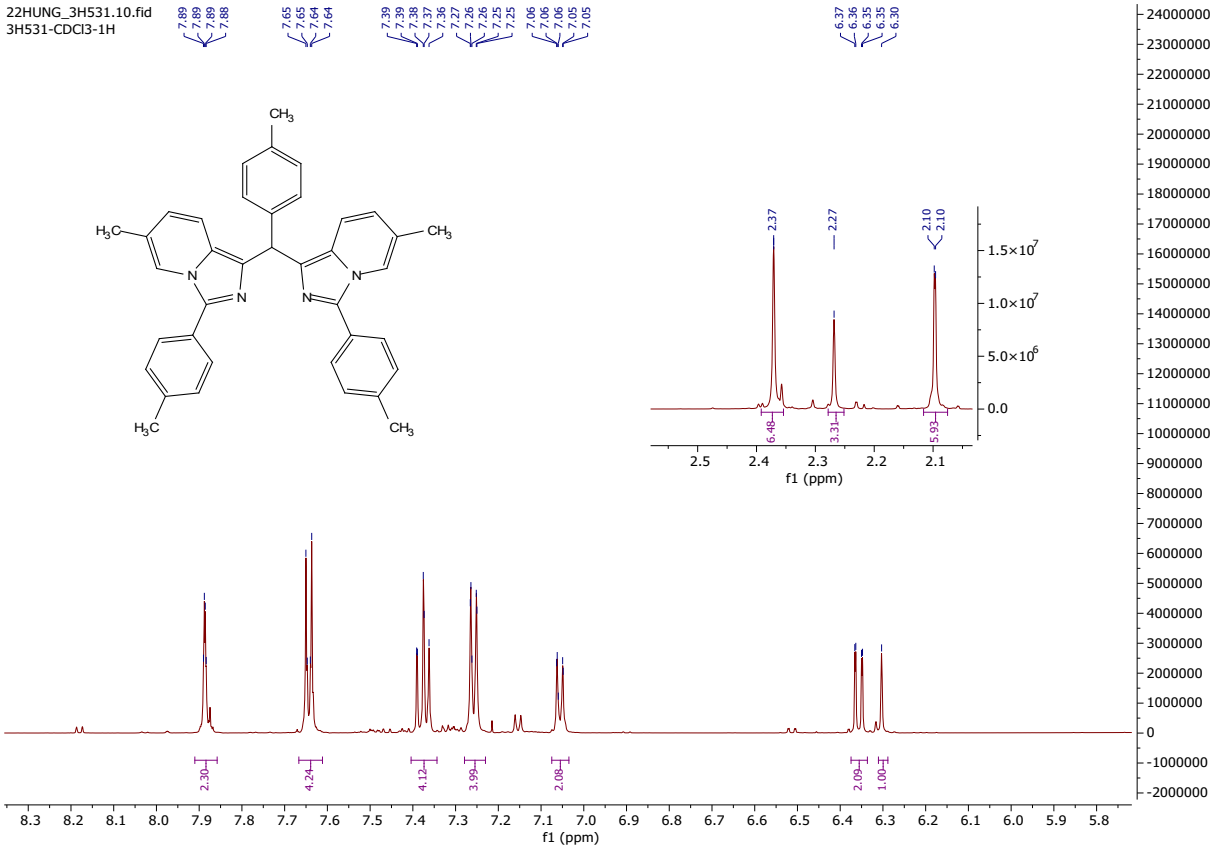
1,1'-(phenylmethylene)bis(6-methyl-3-phenylimidazo[1,5-a]pyridine) (3j)

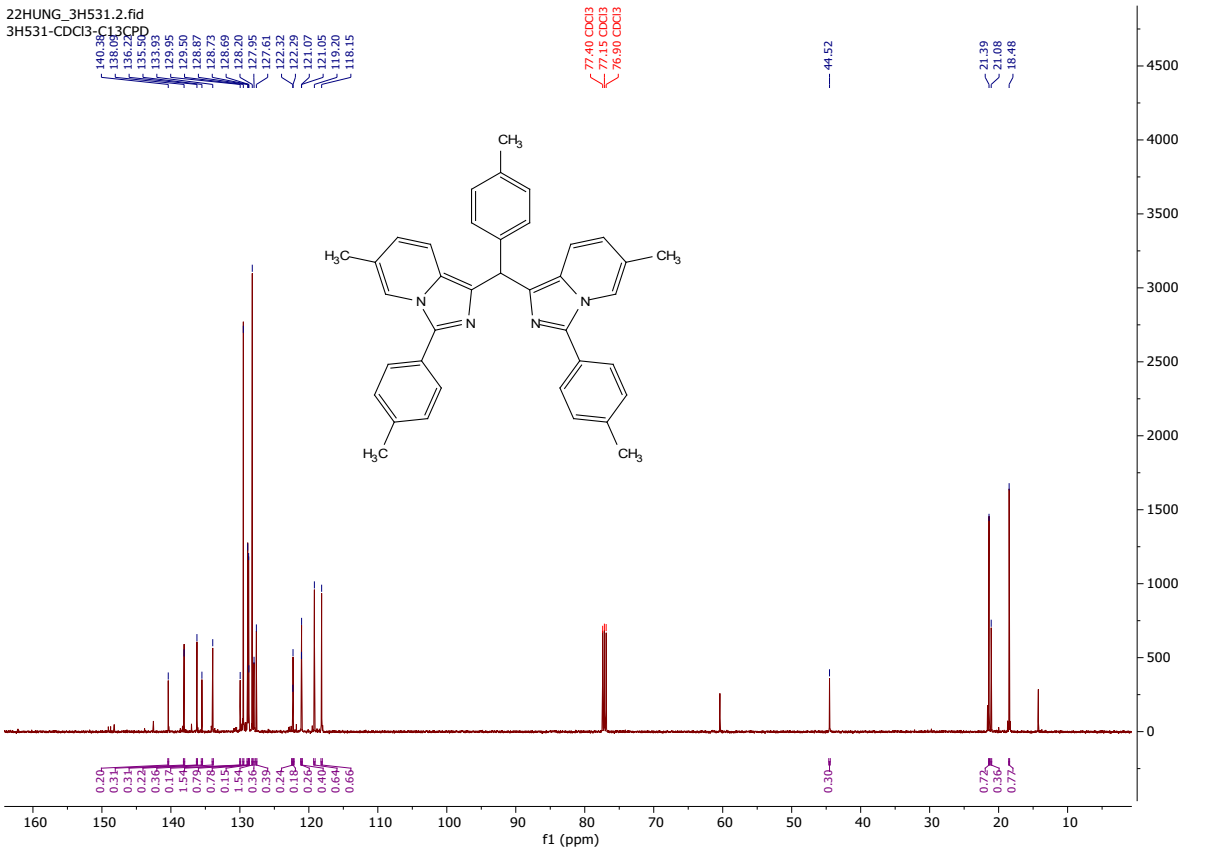


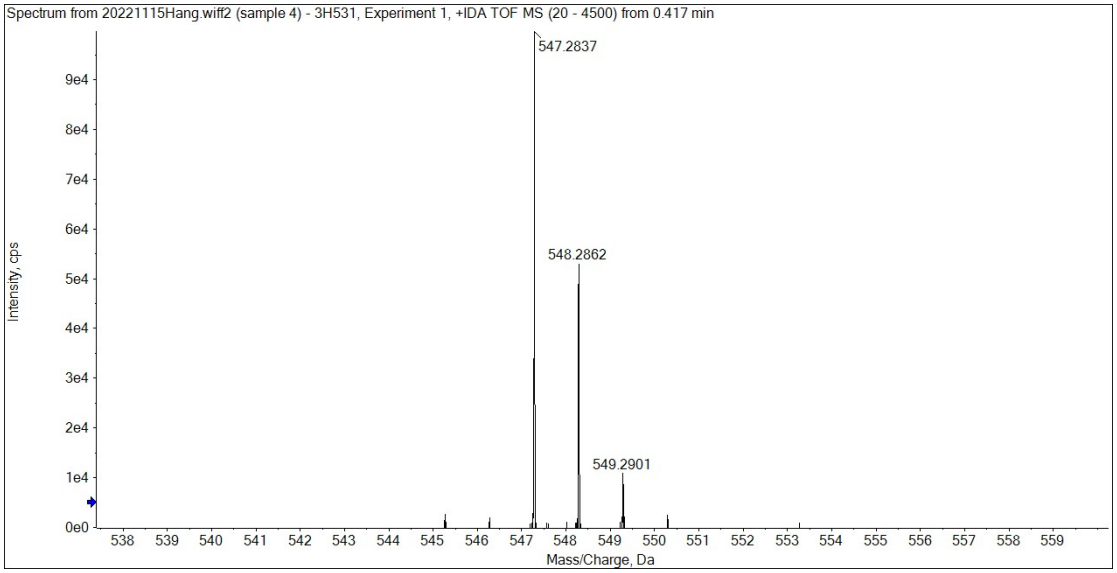




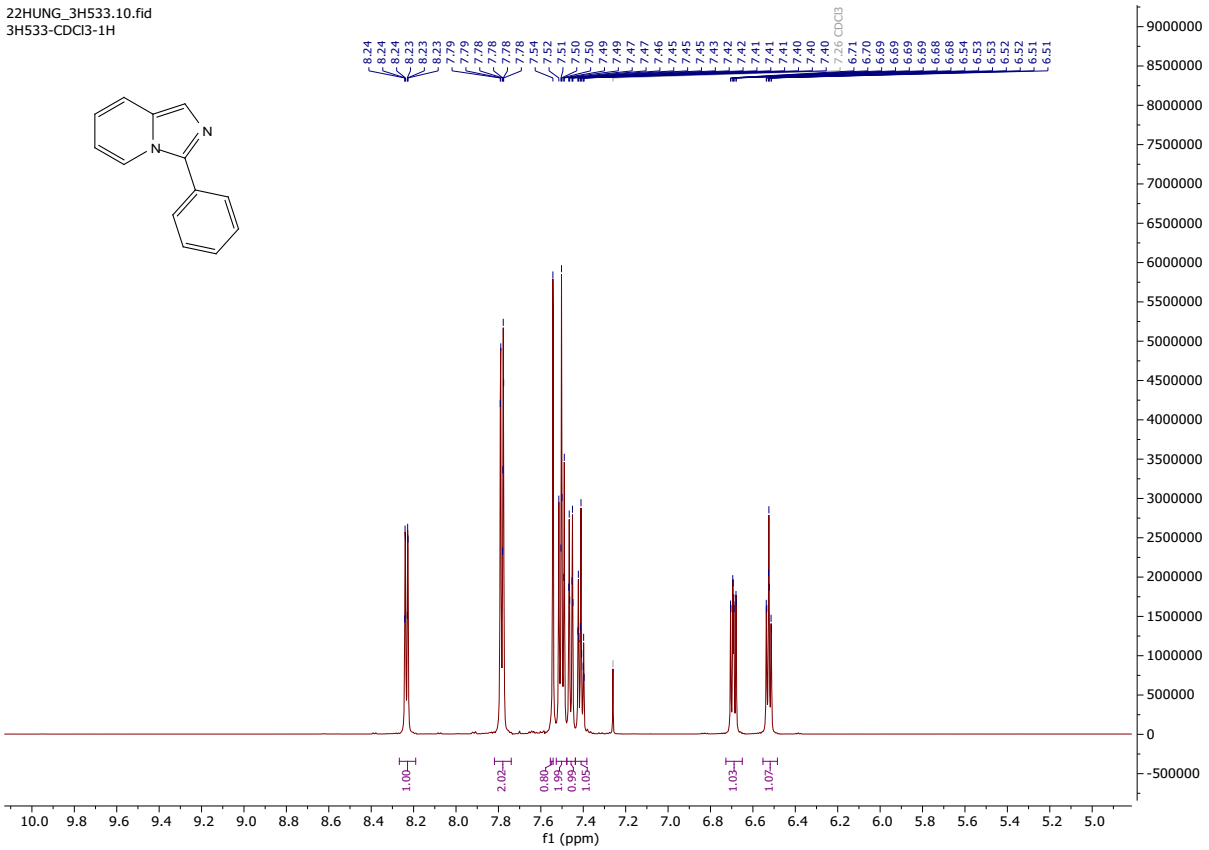
1,1'-(p-tolylmethylene)bis(6-methyl-3-(p-tolyl)imidazo[1,5-a]pyridine) (3k)

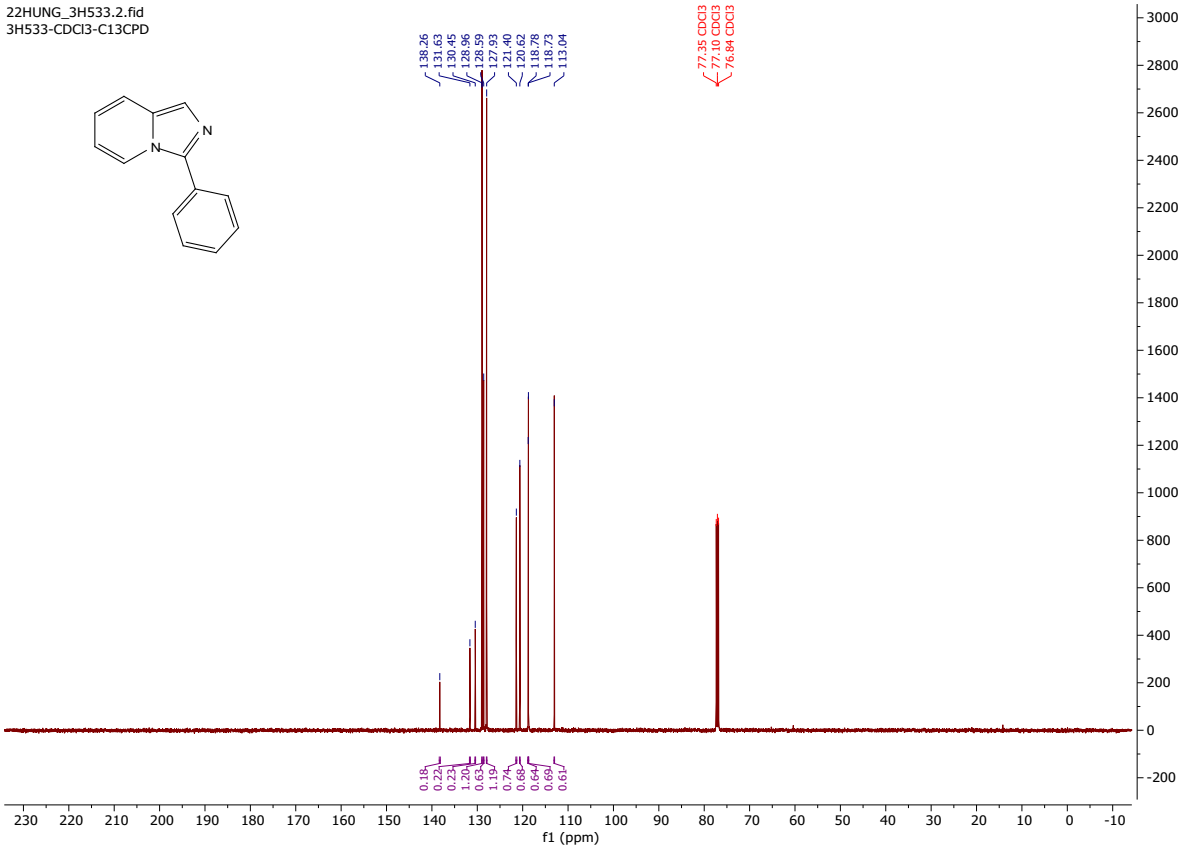

22HUNG_3H531.10.fid
3H531-CDCl3-1H
f1 (ppm)


22HUNG_3H531.2.fid
3H531-CDCl3-C13CPD
f1 (ppm)

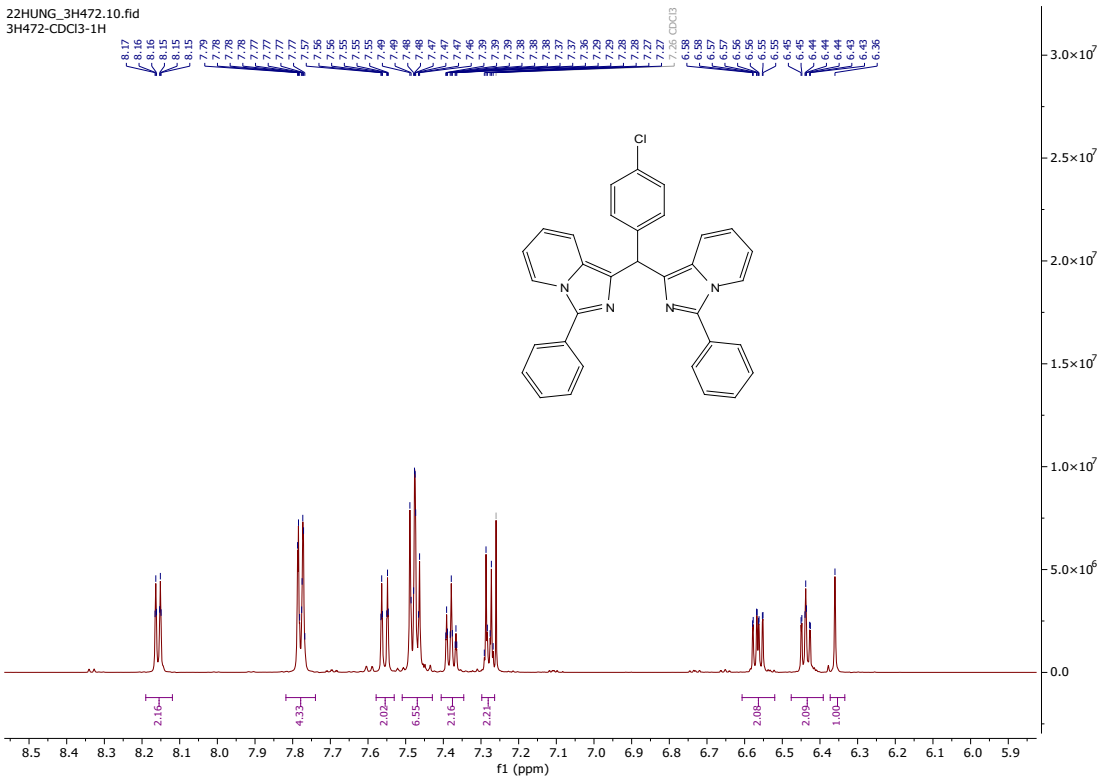


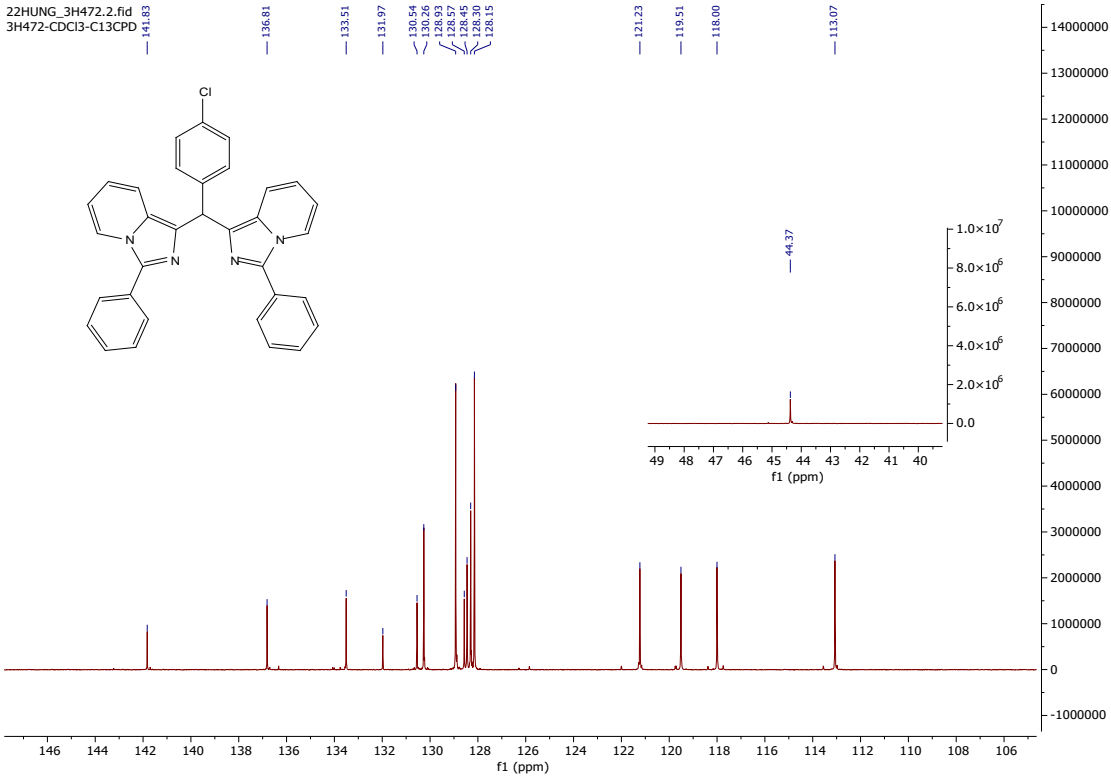
3-phenylimidazo[1,5-a]pyridine (ImPy)



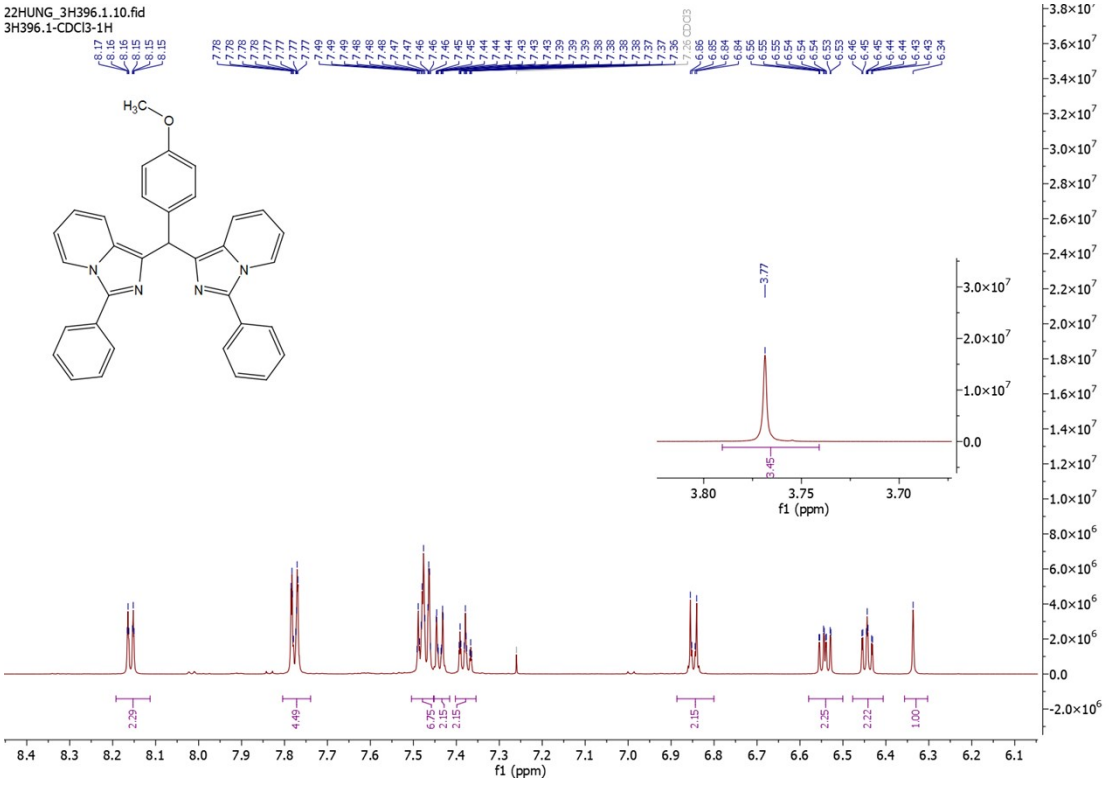


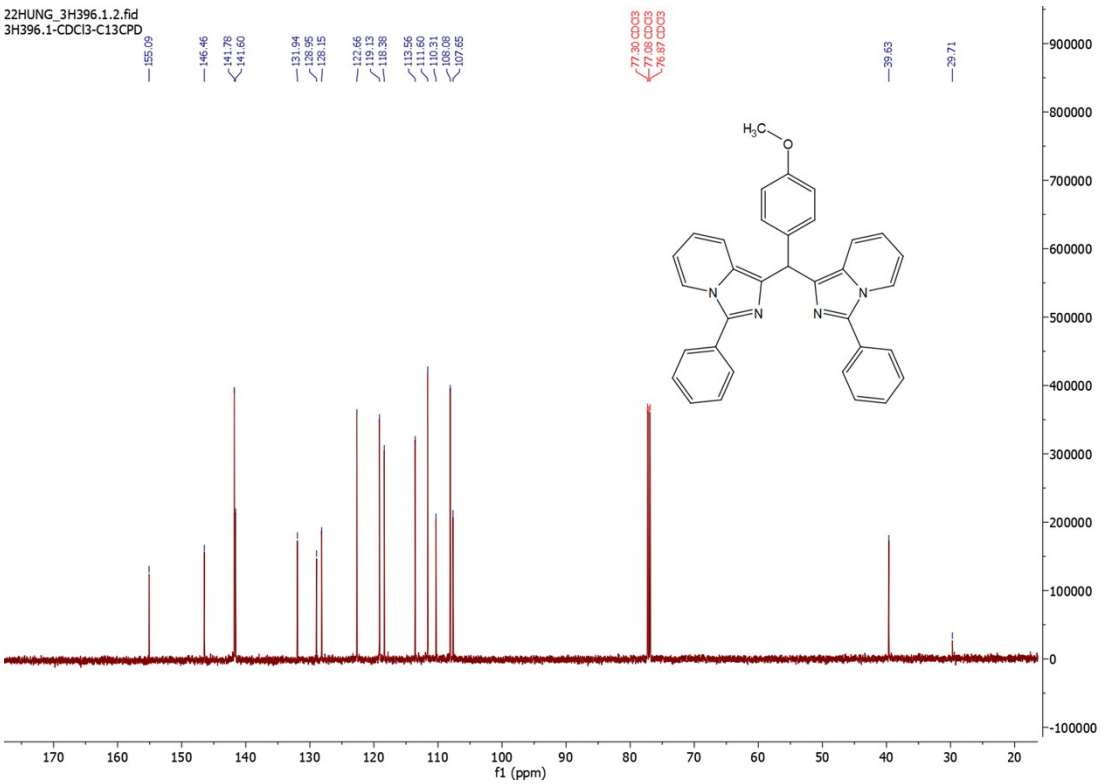
1,1'-((4-chlorophenyl)methylene)bis(3-phenylimidazo[1,5-*a*]pyridine) (4a)



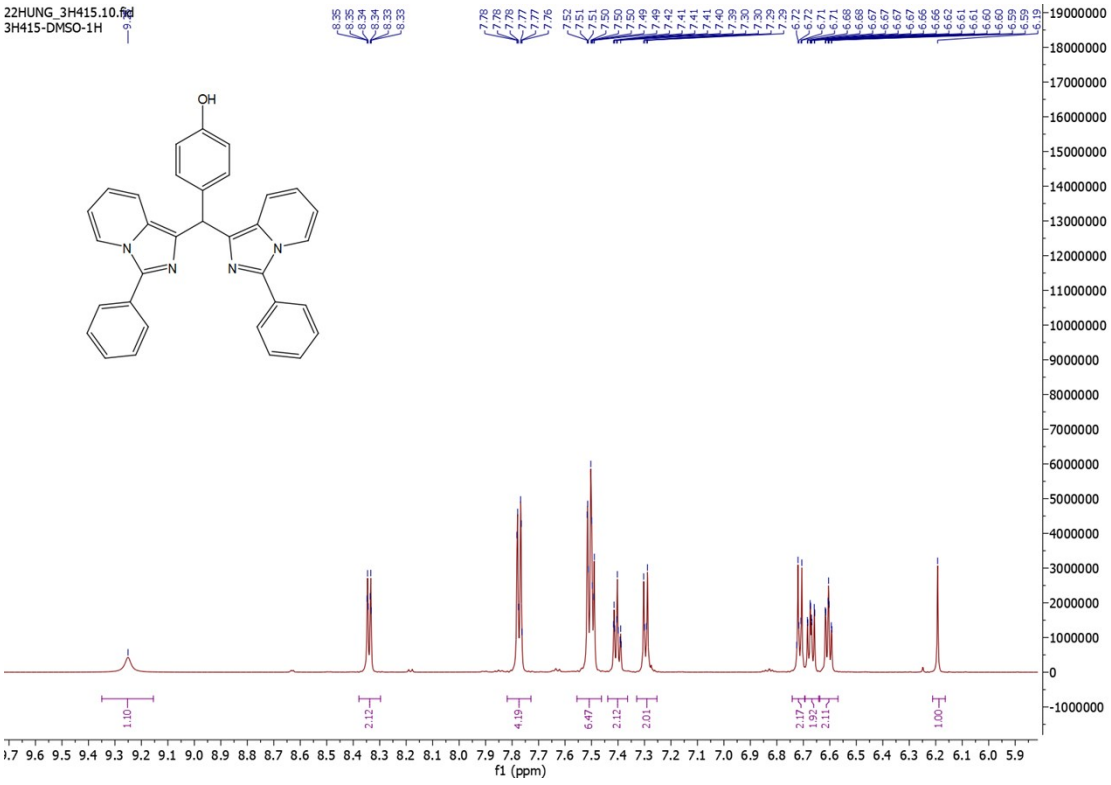


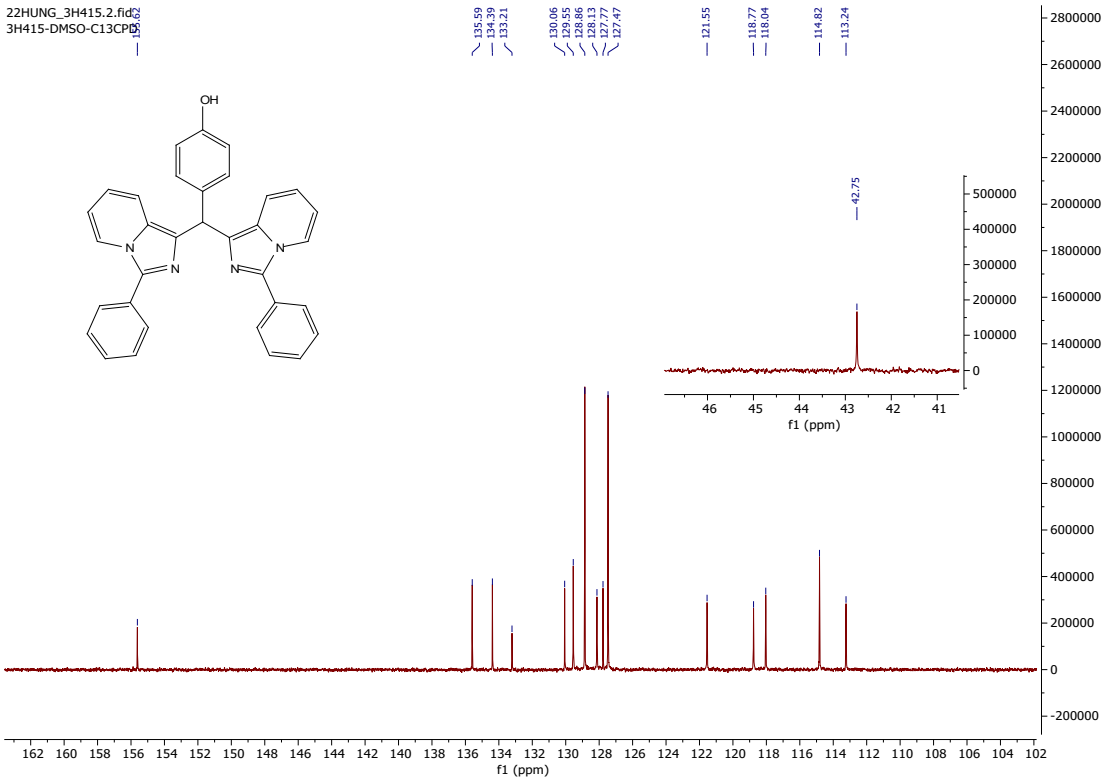
1,1'-((4-methoxyphenyl)methylene)bis(3-phenylimidazo[1,5-a]pyridine) (4b)

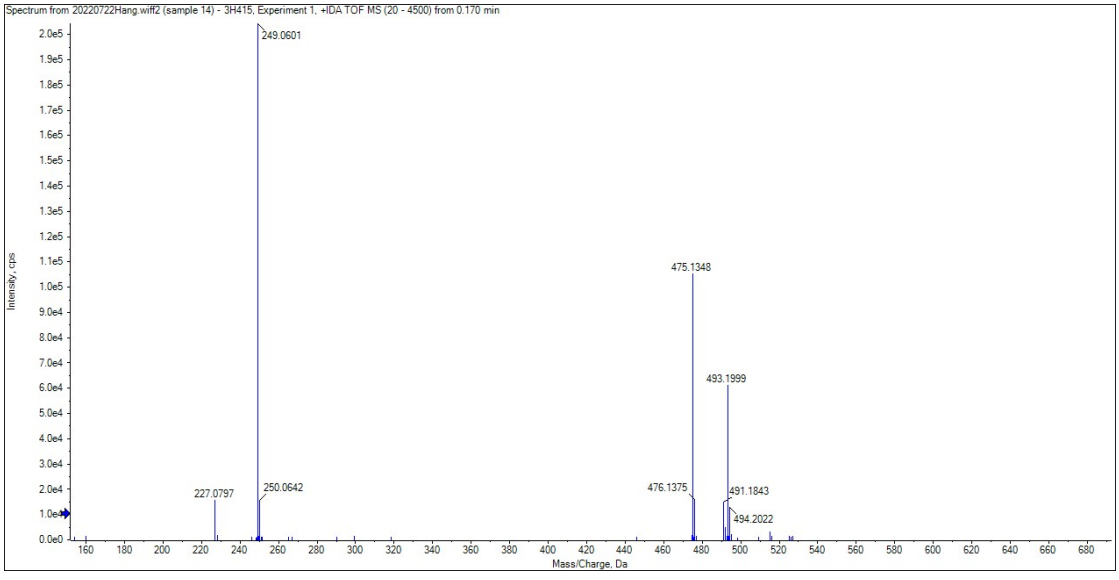




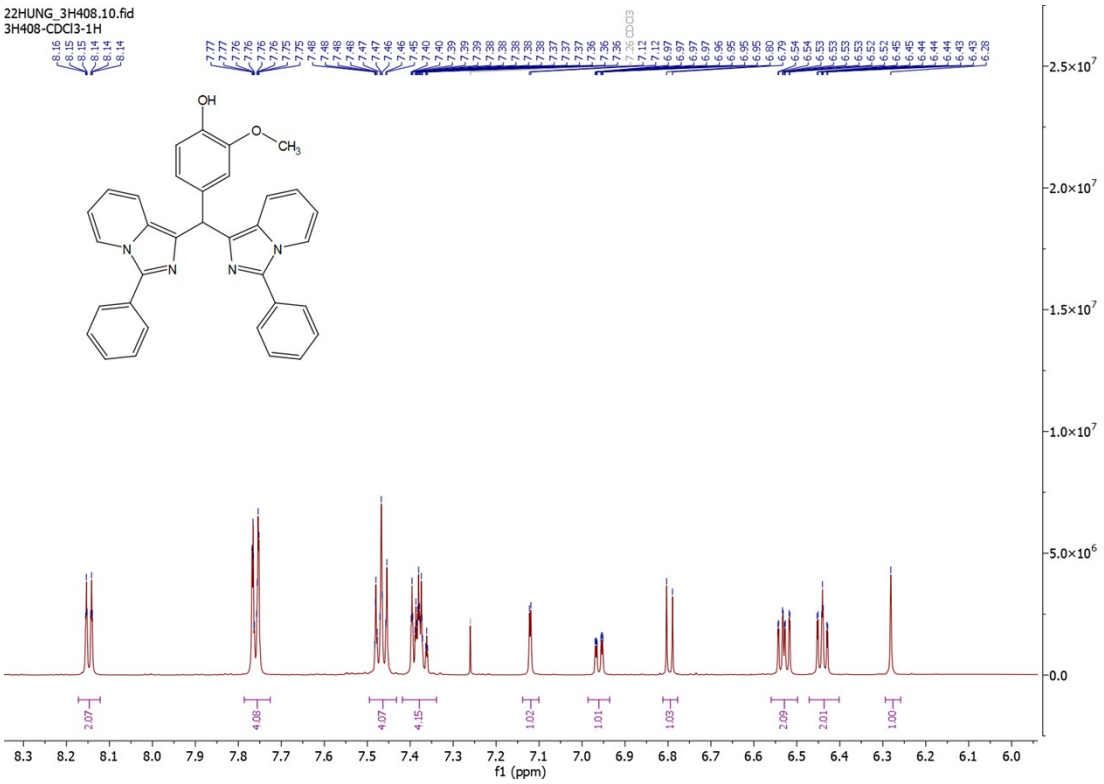
3-(bis(3-phenylimidazo[1,5-a]pyridin-1-yl)methyl)phenol (4c)

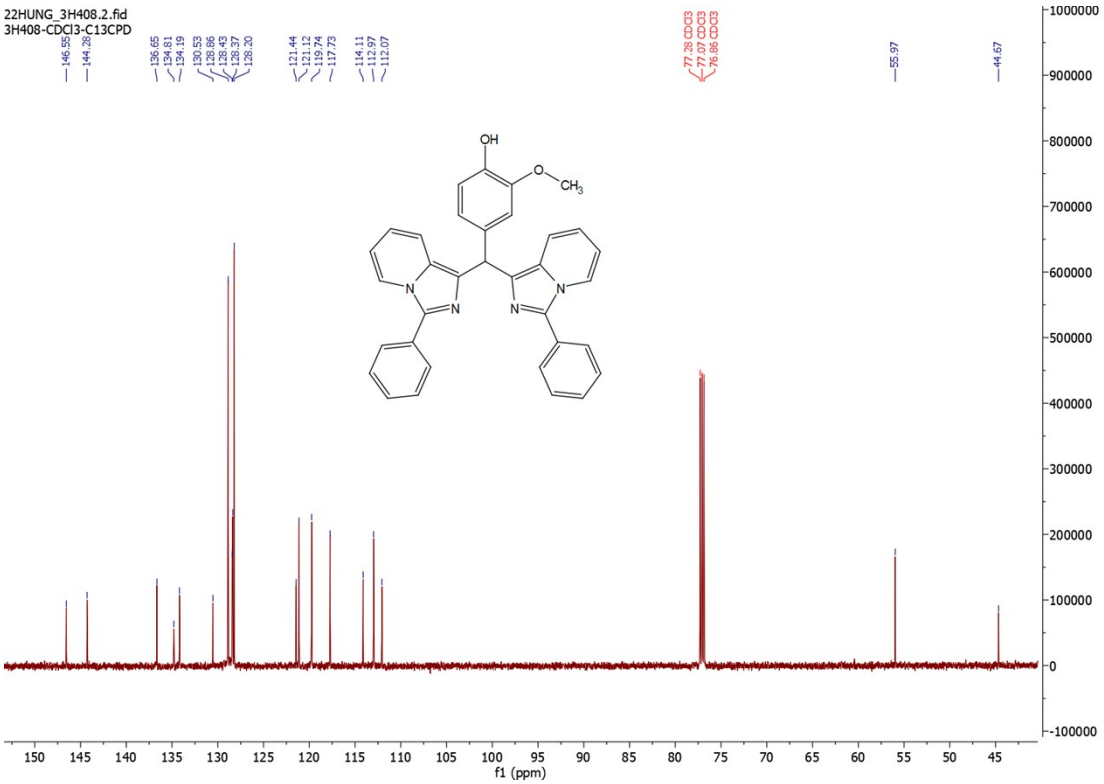


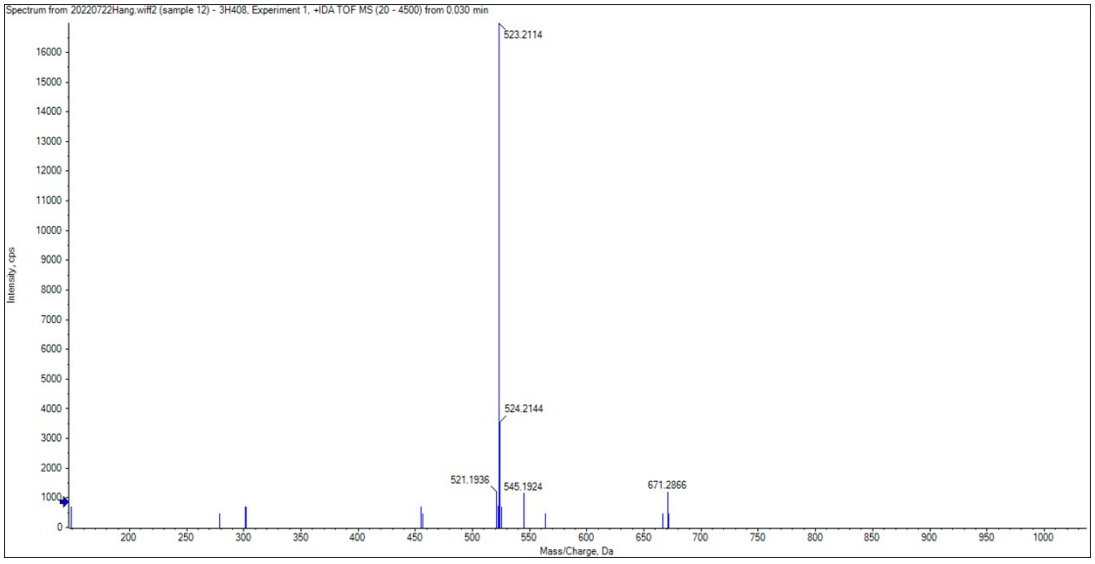

22HUNG_3H415.2.fid
3H415-DMSO-C13CPD
156.62
135.59
134.39
133.21
130.06
129.55
128.86
128.13
127.77
127.47
121.55
118.77
118.04
114.82
113.24
42.75
OH
N
N
N
N
f1 (ppm)
f1 (ppm)


Spectrum from 20220722Hang.wiff2 (sample 14) - 3H415, Experiment 1, +IDA TOF MS (20 - 4500) from 0.170 min
Intensity, cps
249.0601
475.1348
493.1999
227.0797
250.0642
476.1375
491.1843
494.2022
Mass/Charge, Da

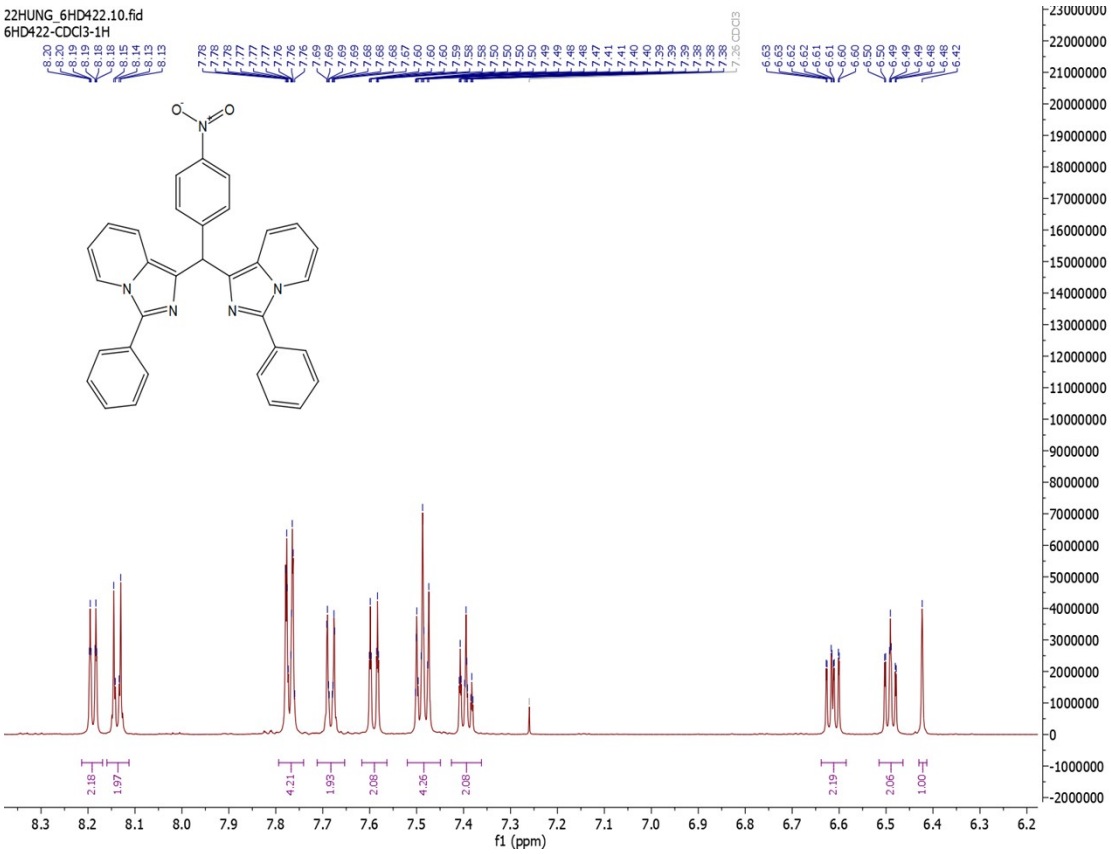
4-(bis(3-phenylimidazo[1,5-a]pyridin-1-yl)methyl)-2-methoxyphenol (4d)

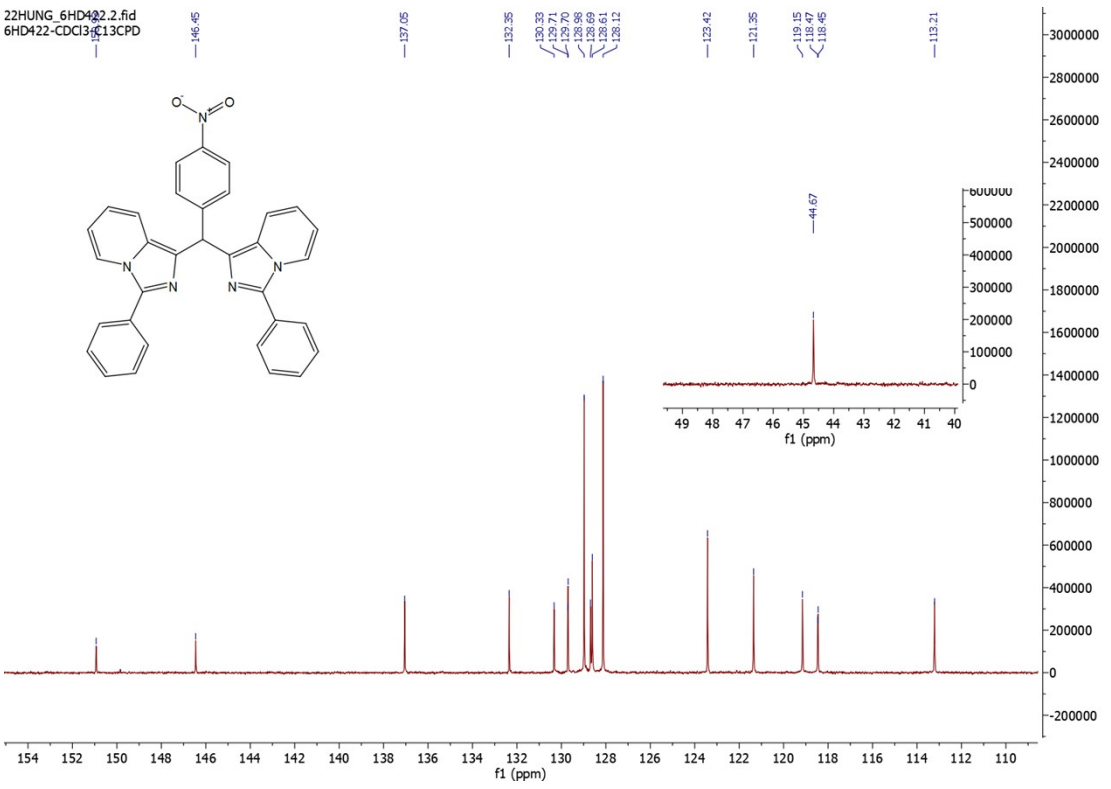


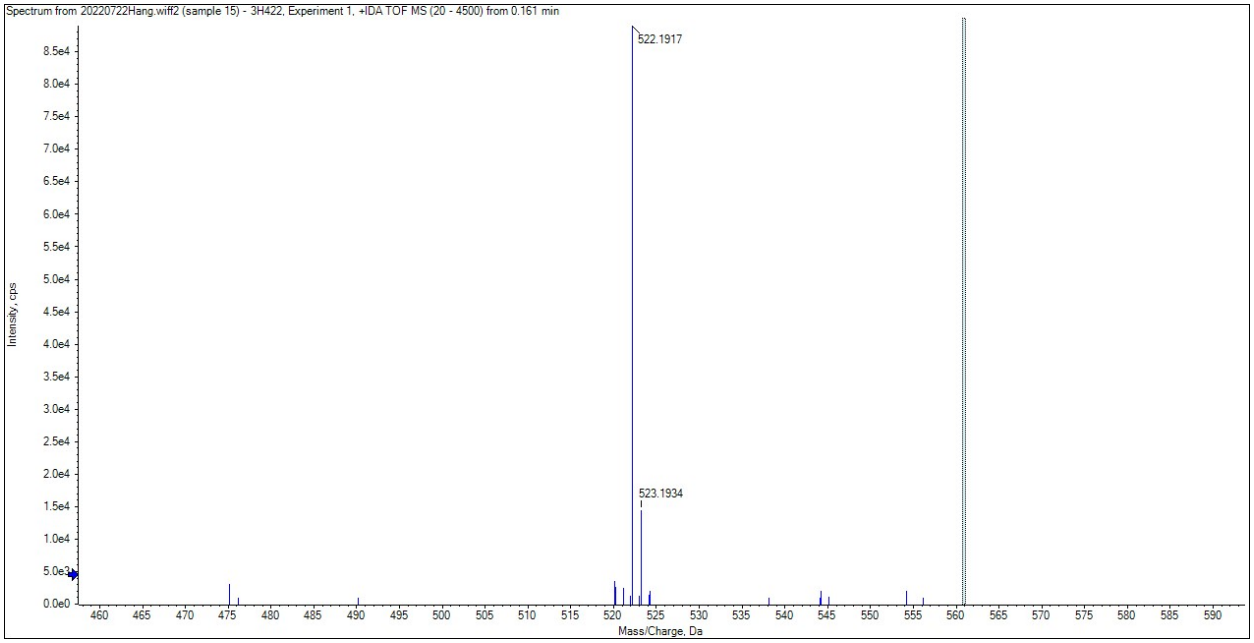




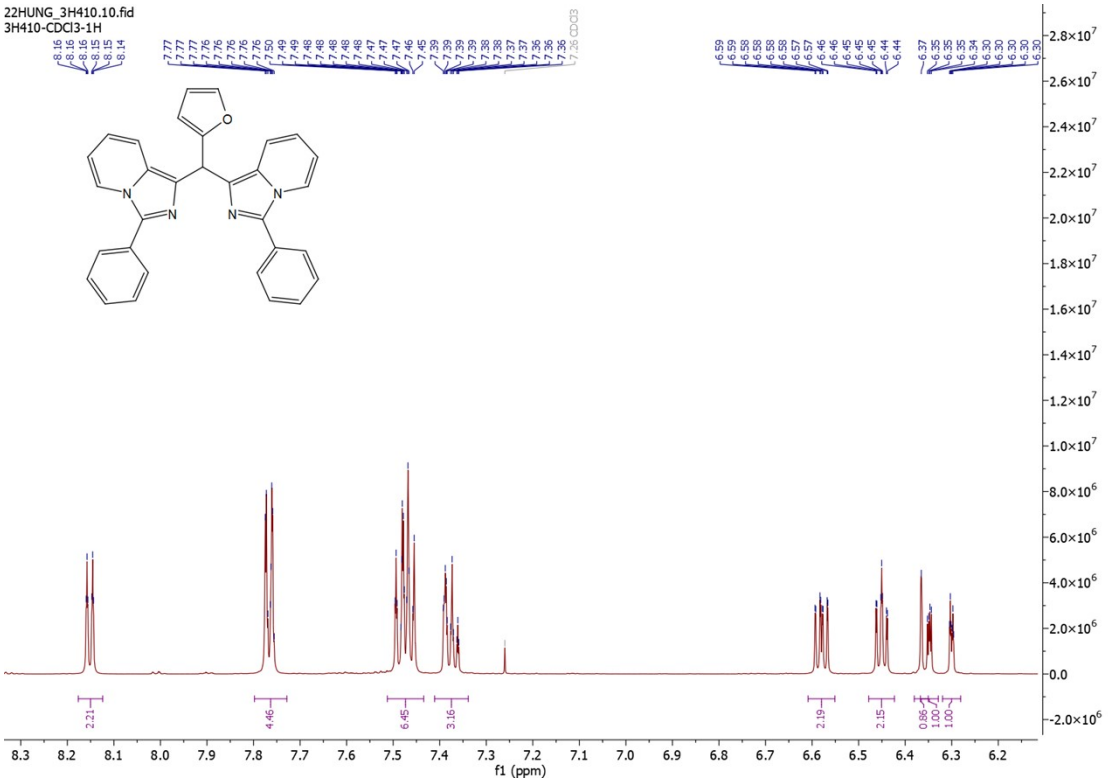
1,1'-((4-nitrophenyl)methylene)bis(3-phenylimidazo[1,5-a]pyridine) (4e)

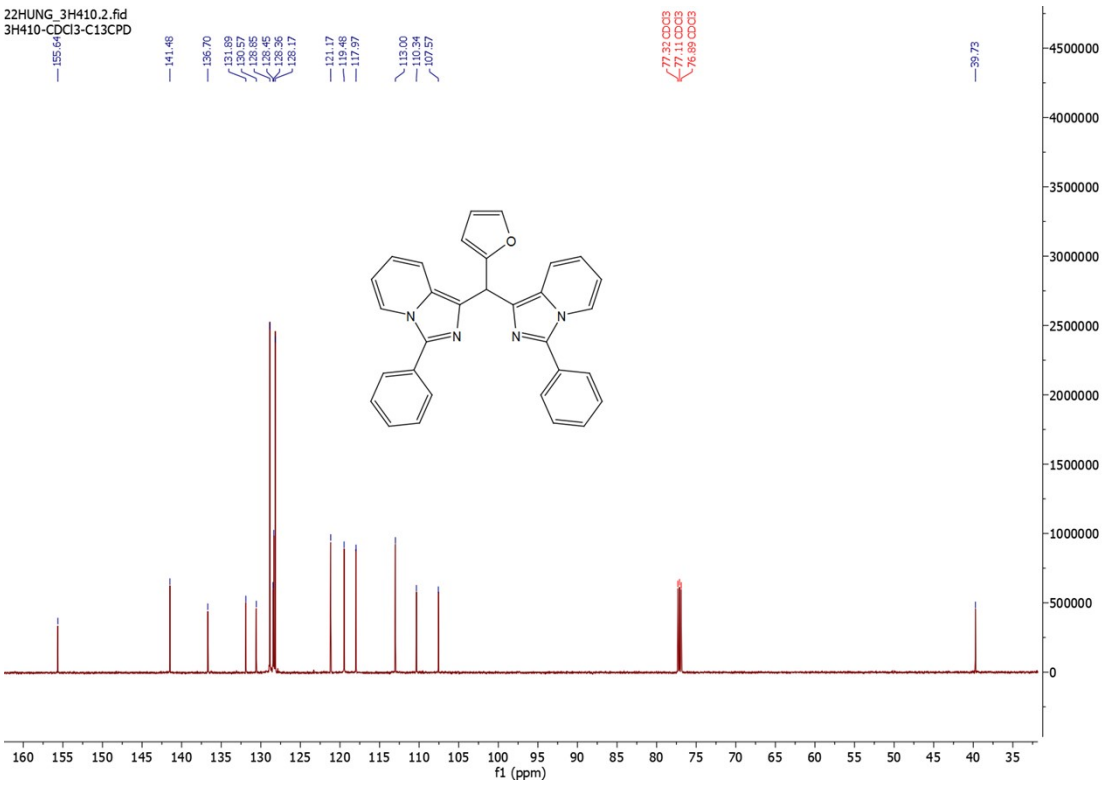

22HUNG_6HD422.10.fid
6HD422-CDCl3-1H
f1 (ppm)

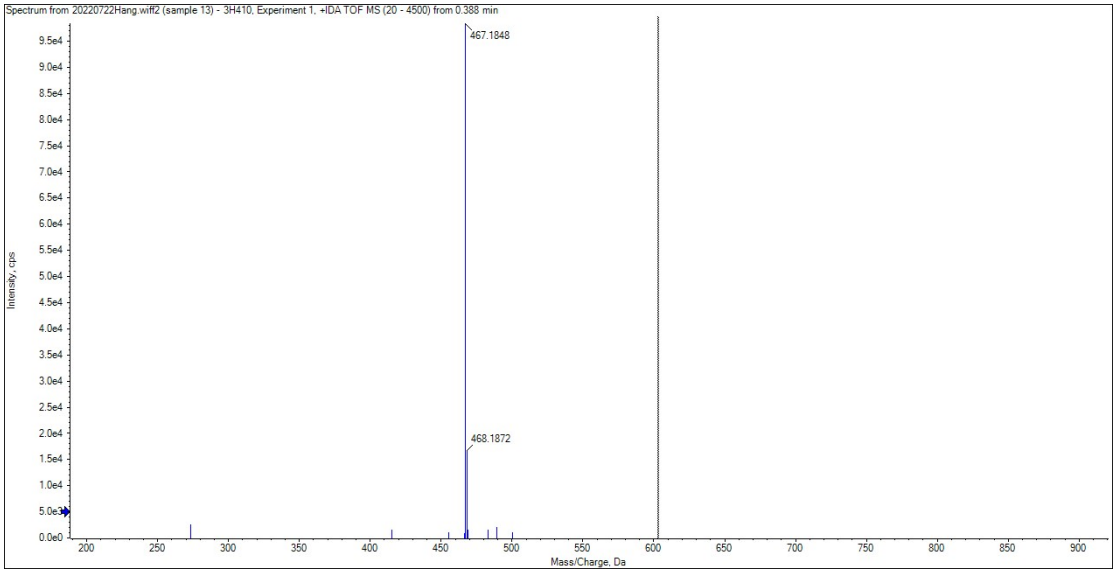

22HUNG_6HD422.2.fid
6HD422-CDCl3-C13CPD
f1 (ppm)



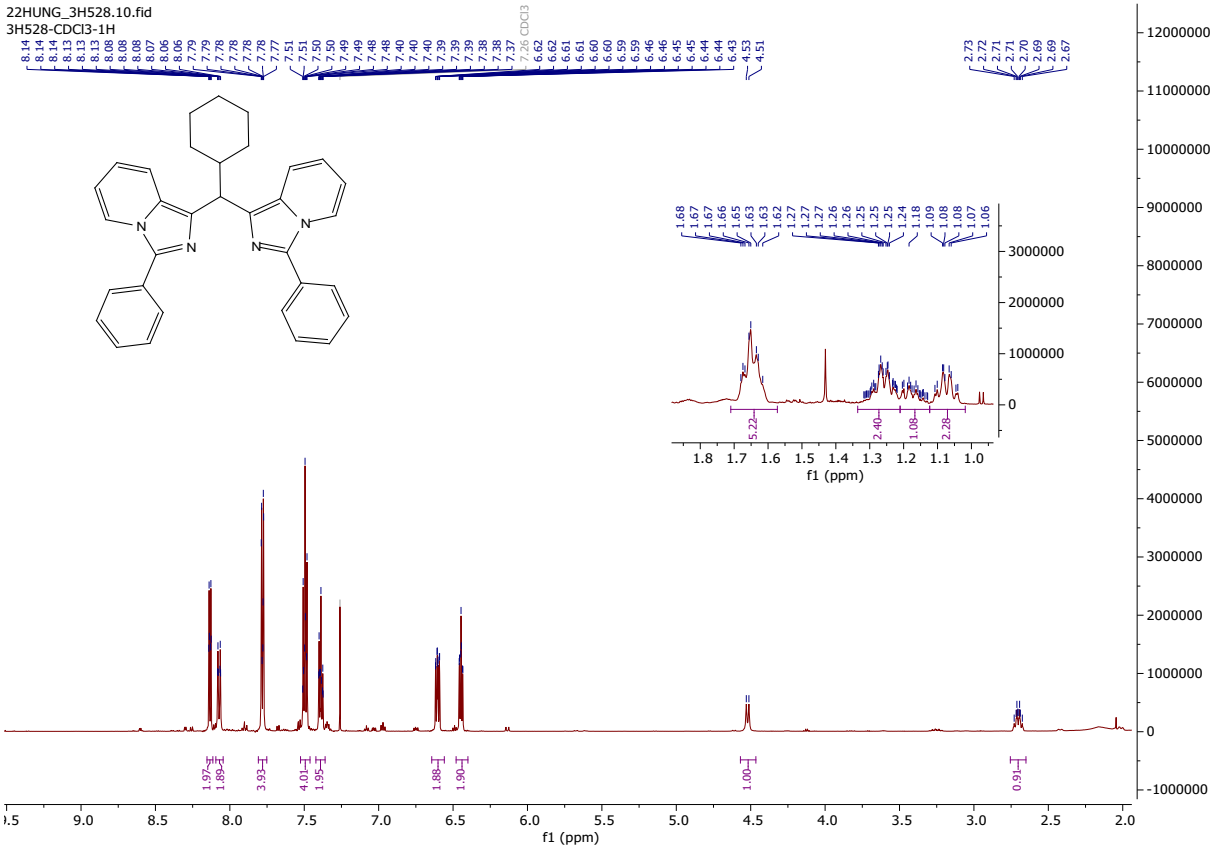
1,1'-(furan-2-ylmethylene)bis(3-phenylimidazo[1,5-a]pyridine) (4f)

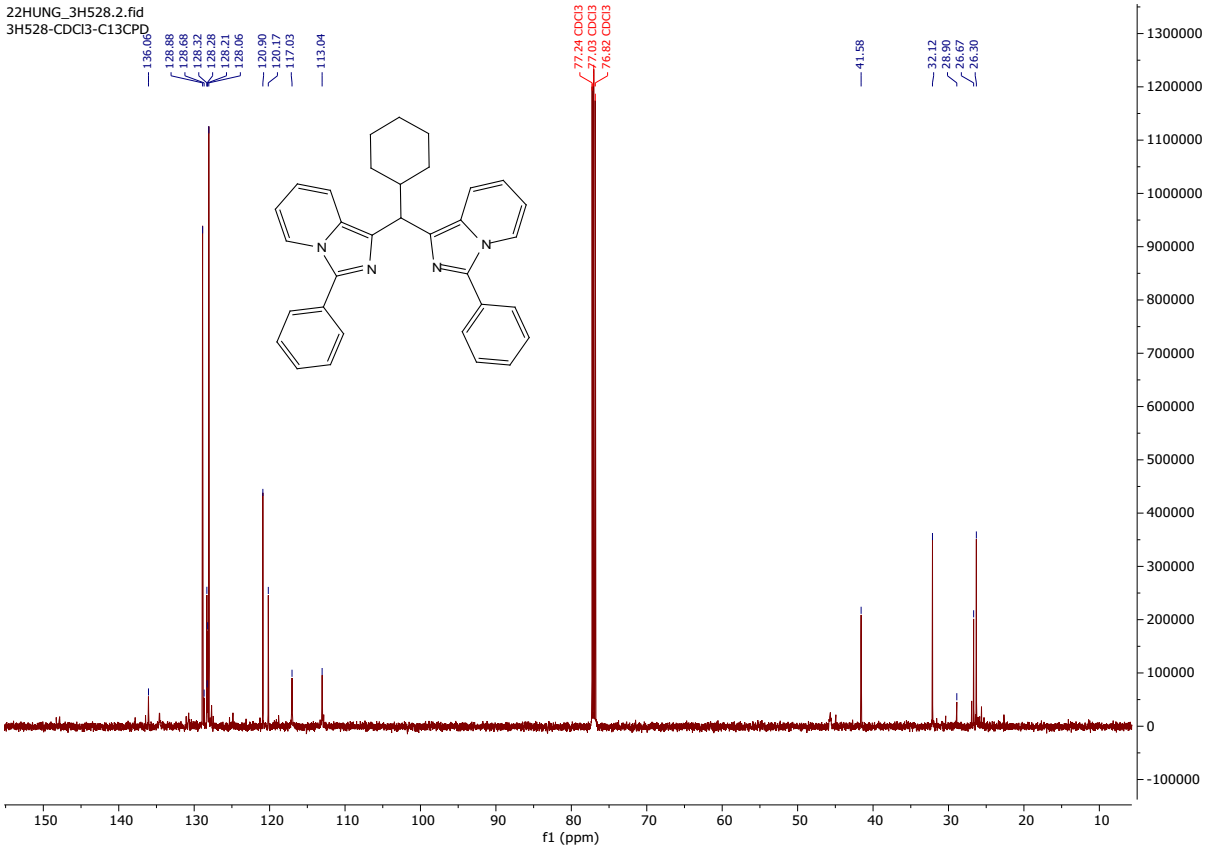

22HUNG_3H410.10.fid
3H410-CDCl3-1H
f1 (ppm)

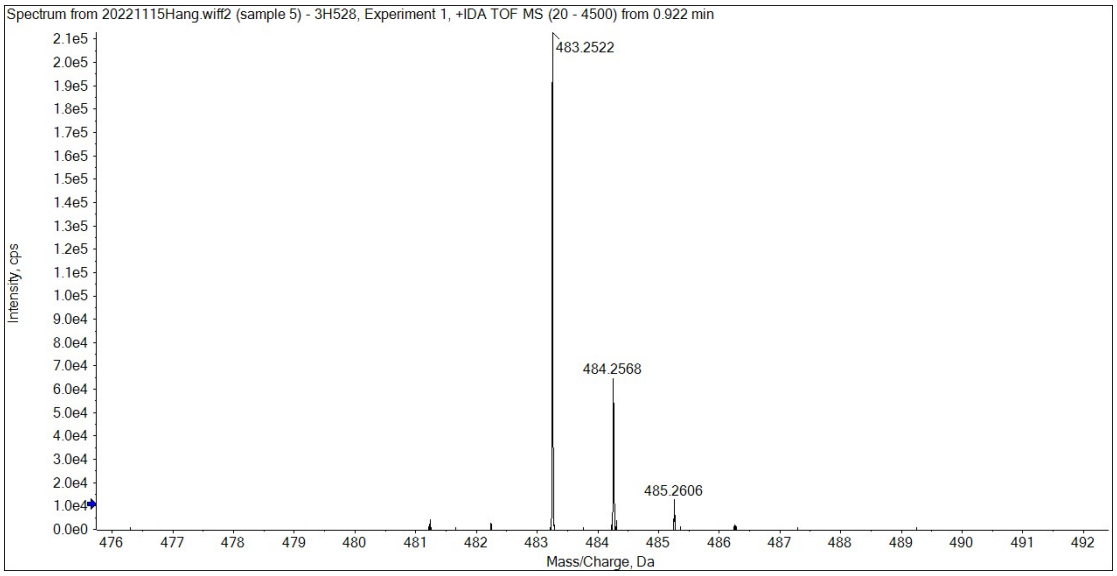

22HUNG_3H410.2.fid
3H410-CDCl3-C13CPD
f1 (ppm)



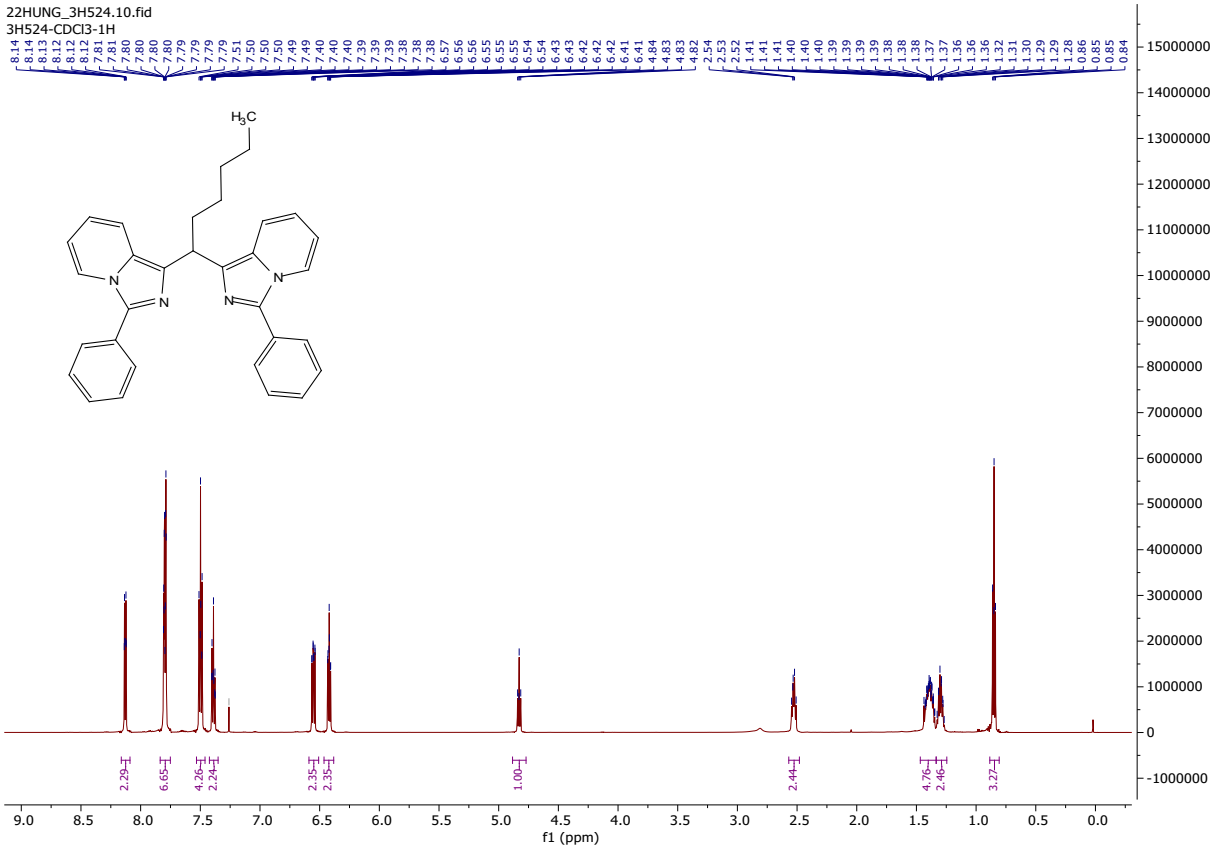
1,1'-(cyclohexylmethylene)bis(3-phenylimidazo[1,5-a]pyridine) (4g)

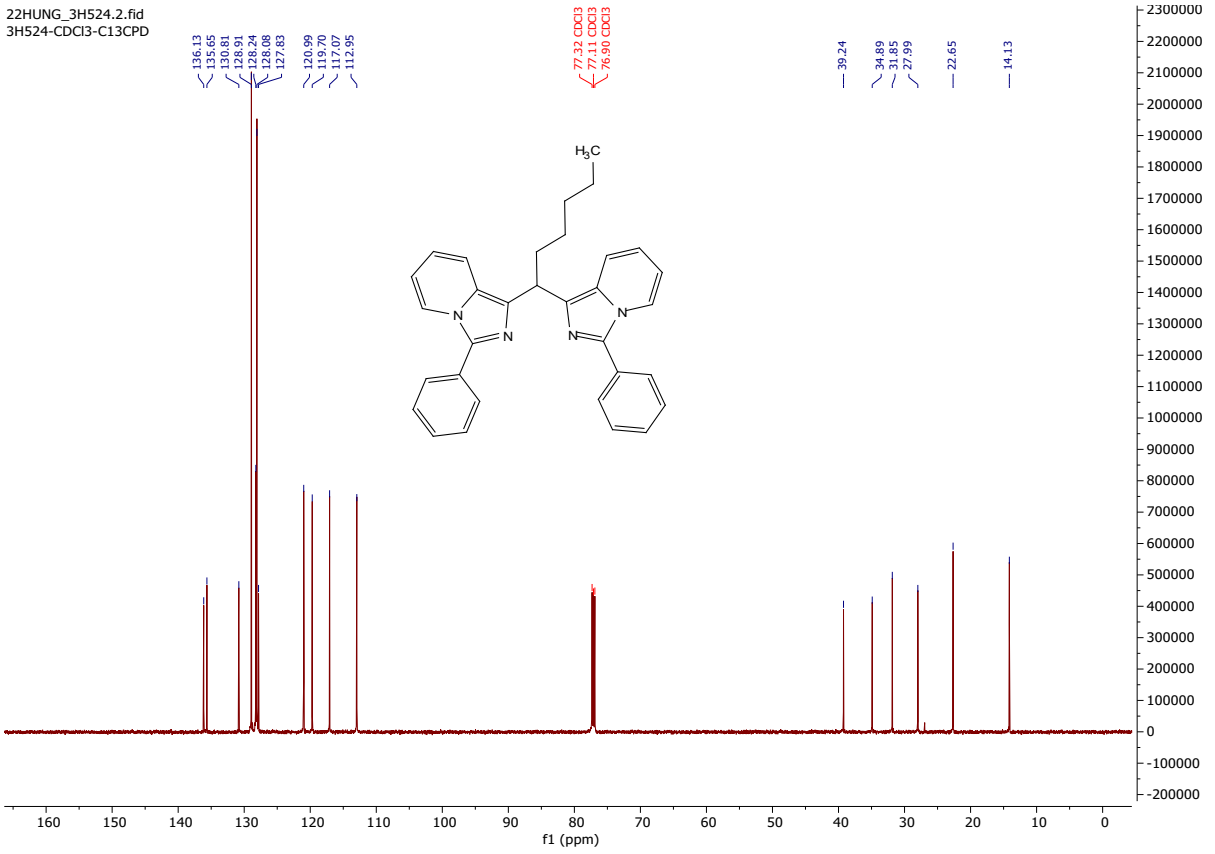


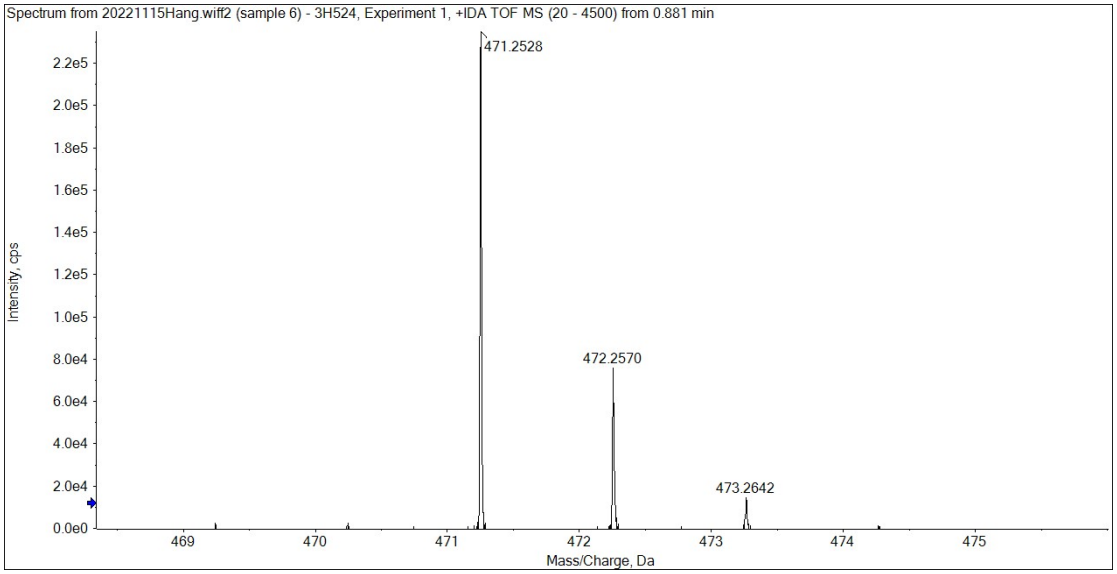




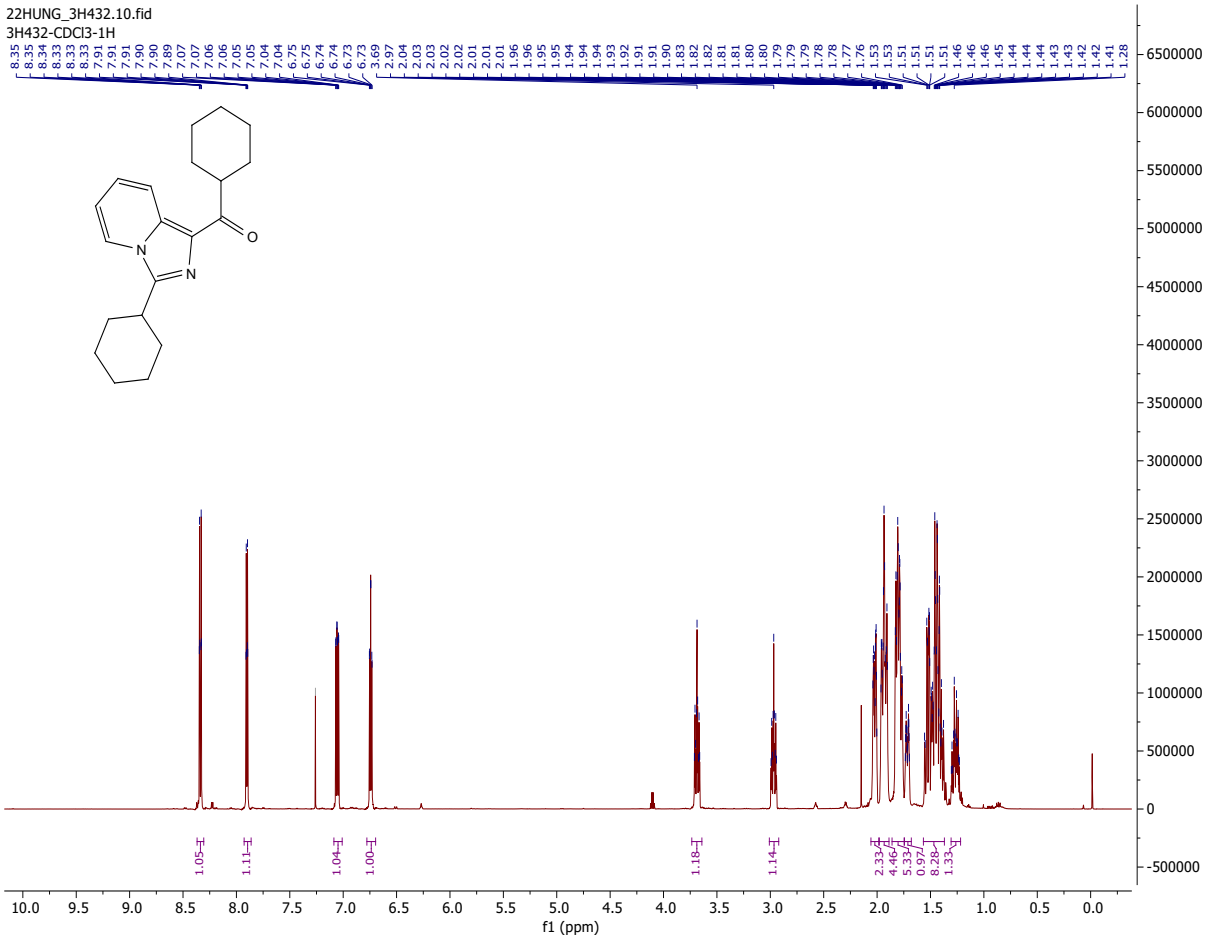
1,1'-(hexane-1,1-diyl)bis(3-phenylimidazo[1,5-a]pyridine) (4h)

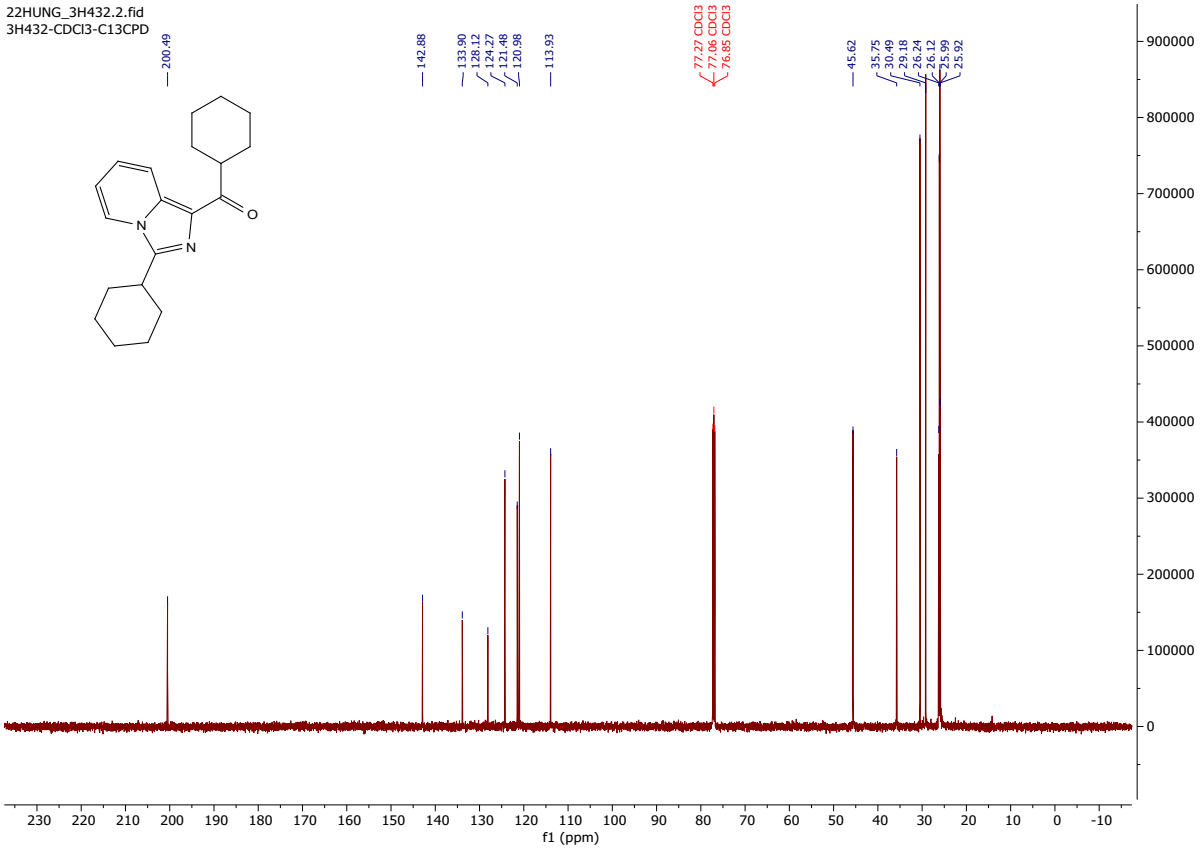

22HUNG_3H524.10.fid
3H524-CDCl3-1H
H3C
N
N
N
N
2.29
6.65
4.26
2.24
2.35
2.35
1.00
2.44
4.76
2.46
3.27
f1 (ppm)


22HUNG_3H524.2.fid
3H524-CDCl3-C13CPD
136.13
135.65
130.81
128.91
128.24
128.08
127.83
120.99
119.70
117.07
112.95
77.32 CDCl3
77.11 CDCl3
76.90 CDCl3
39.24
34.89
31.85
27.99
22.65
14.13
H3C
N
N
N
N
f1 (ppm)

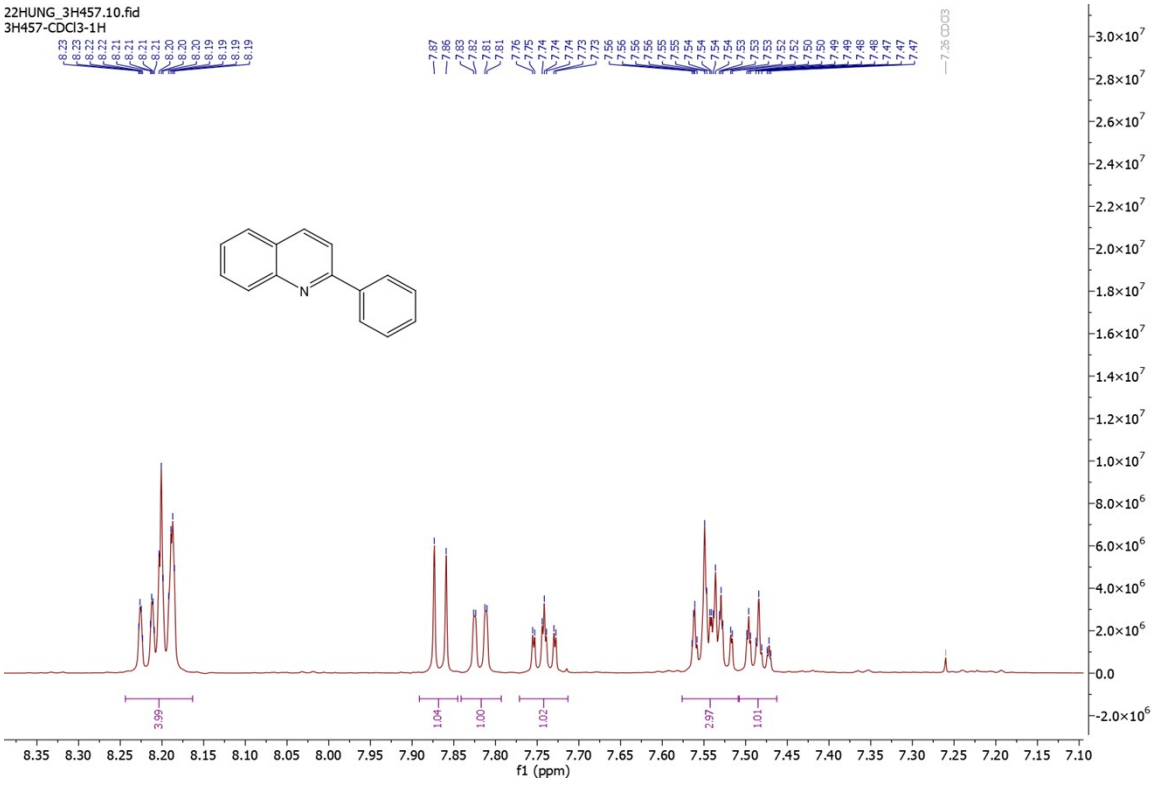


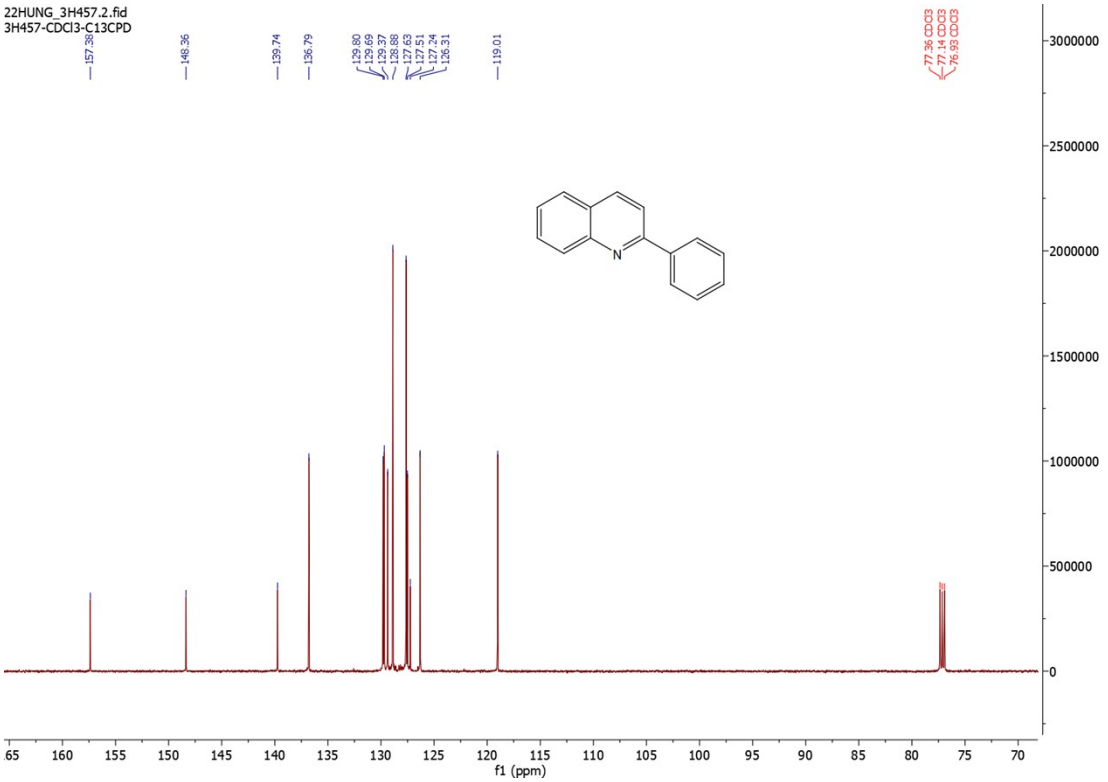
Cyclohexyl(3-cyclohexylimidazo[1,5-a]pyridin-1-yl)methanone



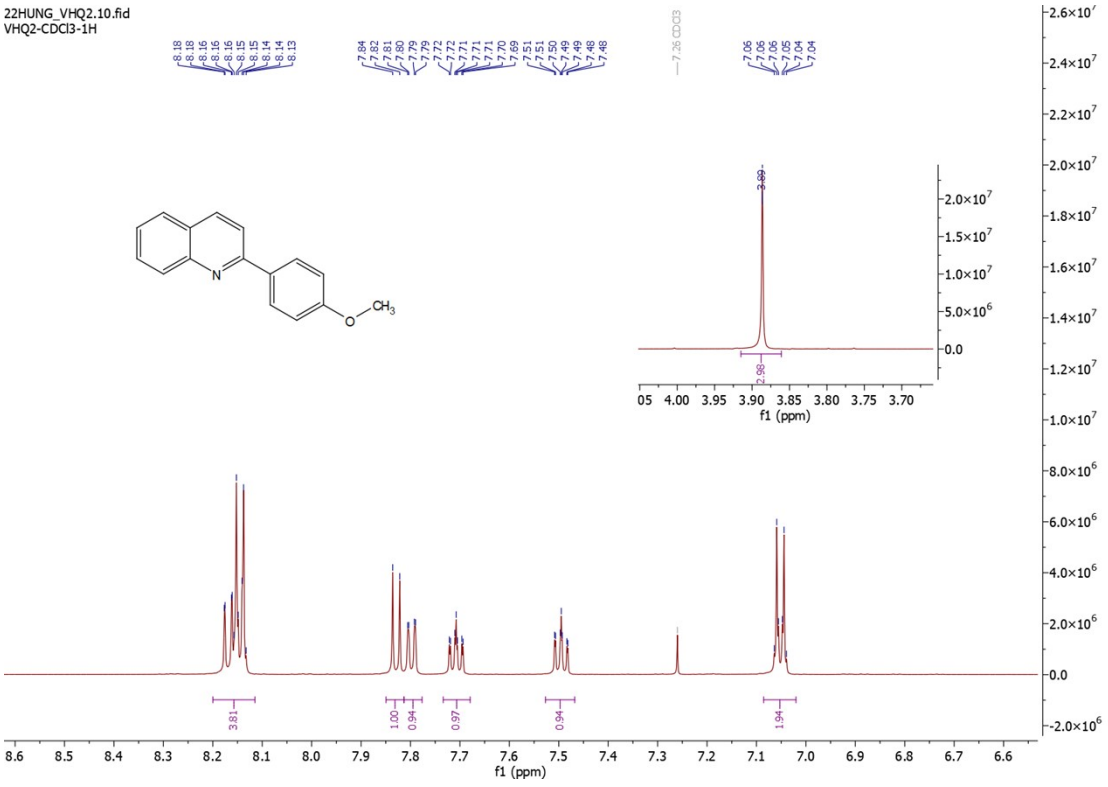


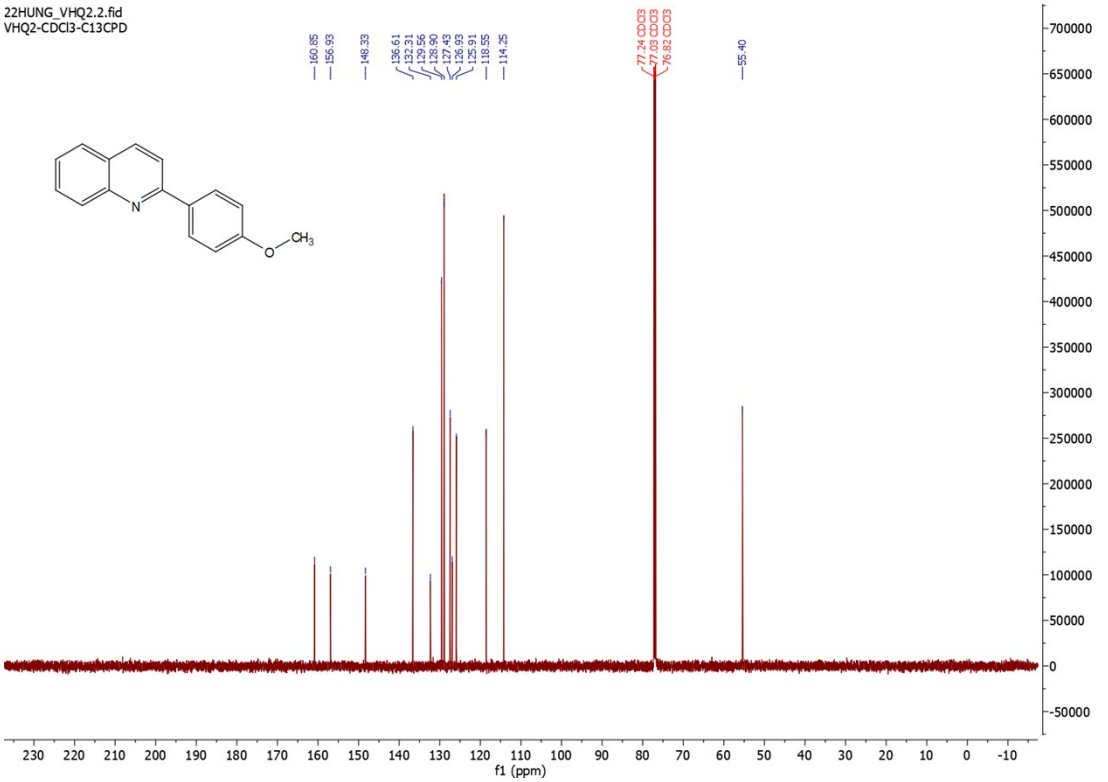
4-phenylquinoline (7a)



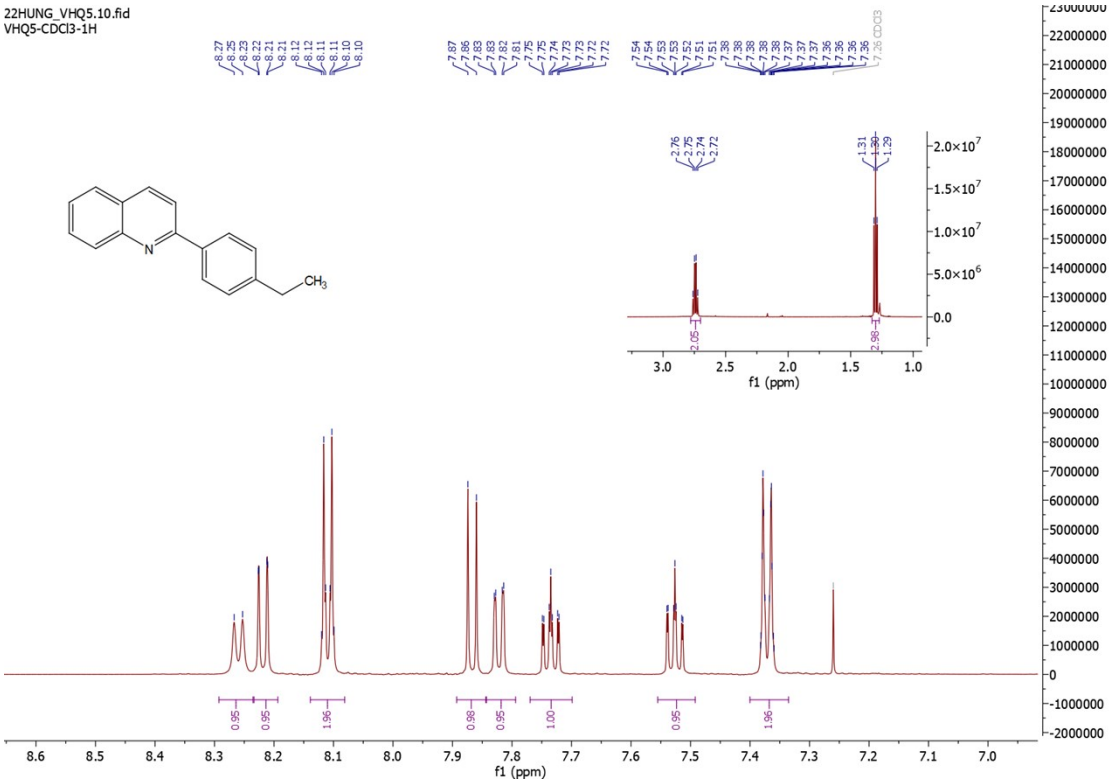


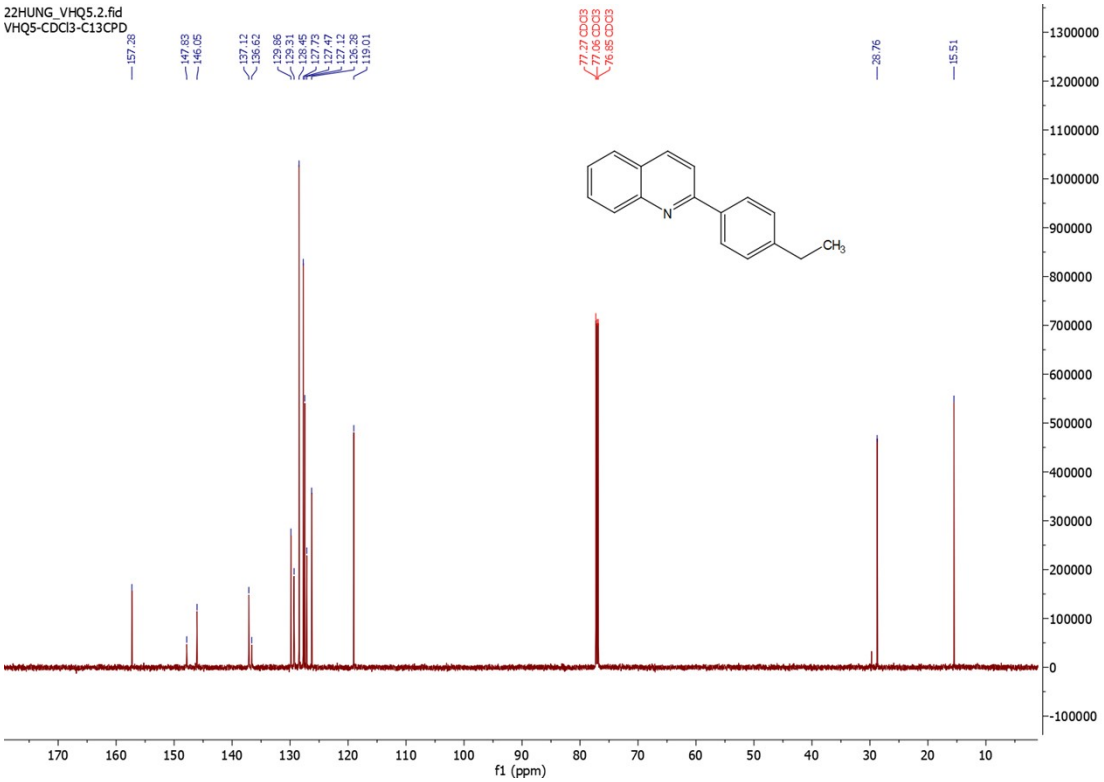
4-(4-methoxyphenyl)quinoline (7b)





2-(4-ethylphenyl)quinoline (7c)




22HUNG_VHQ5.2.fid
VHQ5-CDCl3-C13CPD
157.28
147.83
146.05
137.12
136.62
129.86
129.31
128.45
127.73
127.47
127.12
126.28
119.01
77.27 CDCl3
77.06 CDCl3
76.85 CDCl3
28.76
15.51
N
CH3
f1 (ppm)