Electronic Supplementary Material (ESI) for Organic Chemistry Frontiers.

Supplementary Information

An Efficient Synthesis of (NH)-Phenanthridinones via Ligand-Free Copper-Catalyzed Annulation

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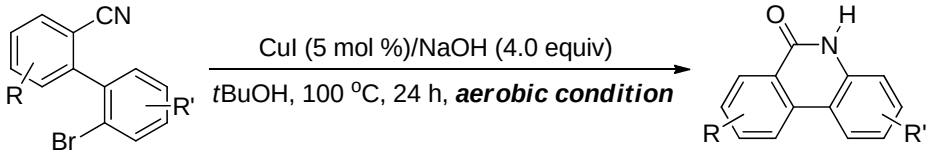
General information: All reagents were purchased from Sigma-Aldrich, Fisher-Acros, TCI, or Alfa-Aesar, and were used without further purification unless otherwise noted. THF and Et_2O were distilled from sodium, and CH_3CN was distilled from CaH_2. All manipulations of oxygen- and moisture-sensitive materials were conducted with a standard Schlenk technique. Flash column chromatography was performed using silica gel (230-400 mesh). Analytical thin layer chromatography (TLC) was performed on 60 F_{254} (0.25 mm) plates and visualization was accomplished with UV light (254 and 354 nm) and/or an aqueous alkaline $KMnO_4$ solution followed by heating. Proton and carbon nuclear magnetic resonance spectra (^{1}H NMR and ^{13}C NMR) were recorded on Bruck 300 or Bruck 600 spectrometer with Me_4Si or solvent resonance as the internal standard (^{1}H NMR, Me_4Si at 0 ppm, $CHCl_3$ at 7.26 ppm, DMSO at 2.49 ppm; ^{13}C NMR, Me_4Si at 0 ppm, $CDCl_3$ at 77.0 ppm, d_6-DMSO at 39.7 ppm). ^{1}H NMR data are reported as follows: chemical shift, multiplicity (s = singlet, d = doublet, t = triplet, q = quartet, quint = quintet, sext = sextet, sept = septet, br = broad, m = multiplet), coupling constants (Hz), and integration. IR spectral data were recorded on a Brucker TENSOR 37 spectrometer. Melting points (mp) were determined using a SRS OptiMelt MPA100. GC-MS data were obtained from the HP 5890 Series II GC/ HP 5972 GC MASS Spectrometer System. High Resolution Mass spectral data were obtained from the MAT-95XL HRMS by using EI method.

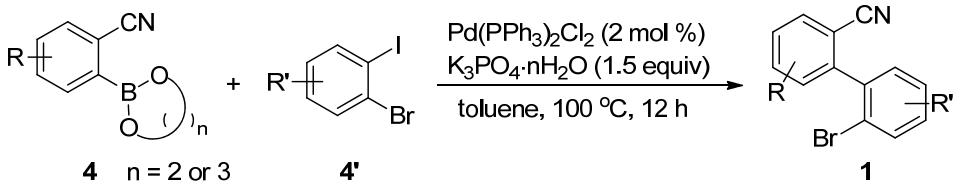
General procedure for the copper-catalyzed cyclization:



1 **2**

To a screw-capped vial (10-mL) were added CuI (0.025 mmol, 4.8 mg, 5 mol %), NaOH (2.0 mmol, 80 mg, 4.0 equiv), and substrate **1** (0.5 mmol, 1.0 equiv) in *t*BuOH (5 mL). The vial was then sealed with cap and allowed to stir at 100 °C for 24 h. The crude reaction mixture was diluted with ethyl acetate (20 mL) and H_2O (10 mL). The mixture was then kept stirring at 70 °C for 30 min then the aqueous layer was removed and the organic layer was concentrated *in vacuo*. The residue was allowed to quickly flow through a short flash column chromatography by using ethyl acetate as eluent and then concentrated *in vacuo*, following washed by DCM to give the pure product. Products **2** were obtained according to this procedure. The known structures were characterized by the HRMS, ^{1}H NMR and ^{13}C NMR spectra of reported literatures. Spectral data, melting point, HRMS data and the copies of ^{1}H NMR and ^{13}C NMR spectra for all compounds are listed below.

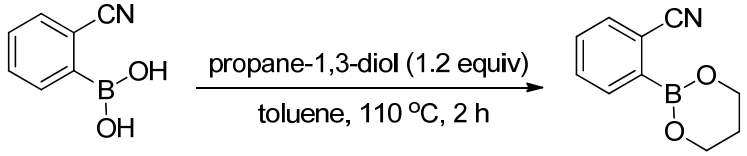
General procedure for the synthesis of substrate (1):[1]



4 n = 2 or 3 **4'** **1**

To a Schlenk tube (50-mL) were added $Pd(PPh_3)_2Cl_2$ (70.1 mg, 0.1 mmol, 2 mol %), $K_3PO_4 \cdot nH_2O$ (1727 mg, 7.5 mmol) and substrate **4** (5 mmol). The mixture was closed by a septum, purged by nitrogen gas for several times then the dry toluene (20 mL) was added into the mixture and allowed to stir for a while; *o*-bromoiodoarene **4'** (7.5 mmol) was then slowly injected into the mixture by a syringe. The septum was removed and the Schlenk tube was sealed with cap; again quickly purged by nitrogen gas for several times and move to oil bath and allowed to stir at 100 °C for 12 h. The crude reaction mixture was diluted with CH_2Cl_2, filtered through a thin Celite pad to remove salt and concentrated *in vacuo*. The residue was isolated through flash column chromatography by using hexane and ethyl acetate as eluent to give compound **1**. Compounds **1a**–**1z** and **1C1**–**1C4** were obtained according to this procedure.

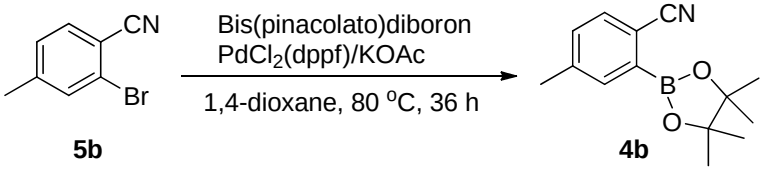
Synthesis of 2-(1,3,2-dioxaborinan-2-yl)benzonitrile (4a):



(1 equiv) **4a**

To a screw-capped vial (20-mL) were added (2-cyanophenyl)boronic acid (735 mg, 5 mmol), propane-1,3-diol (456 mg, 6 mmol) in 20 mL dry toluene. The mixture was allowed to stir at 110 °C for 2 h. The crude reaction mixture was diluted with CH_2Cl_2, quickly flow through a flash column, concentrated *in vacuo* and directly used for the next step.

Synthesis of 4-methyl-2-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)benzonitrile (4b):[2]

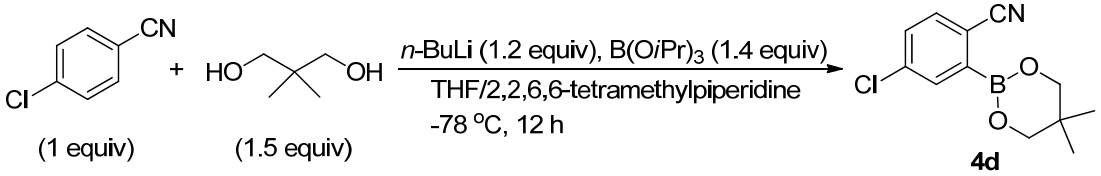


5b **4b**

To a one-neck round bottom flask (25-mL) were added 2-bromo-4-methylbenzonitrile **5b** (980 mg, 5 mmol), Bis(pinacolato)diboron (1.524 g, 6 mmol), $PdCl_2(dppf)$ (109.8 mg, 0.15 mmol, 3 mol %) and KOAc (1.47 g, 15 mmol). The mixture was closed by a septum, purged by nitrogen gas for several times then the dry 1,4-dioxane (10 mL) was then added into the reaction mixture and kept stirring at 80 °C for 36 h. The crude

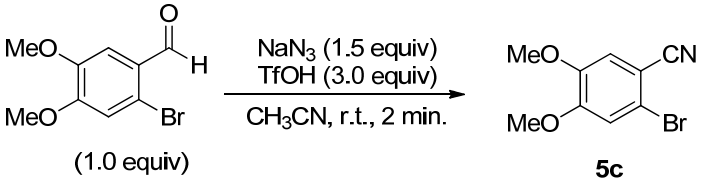
reaction mixture was diluted with CH_2Cl_2, extracted by $NaHCO_3$. The combined organic layer was collected, dried over the $MgSO_4$ and concentrated *in vacuo* then purified after re-crystallization under hexane to give corresponding product **4b** (851 mg, 70%). Compounds 4,5-dimethoxy-2-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)benzonitrile (**4c**), 4-fluoro-2-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)benzonitrile (**4e**) and 6-(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)benzo[*d*][1,3]dioxole-5-carbonitrile (**4k**), were obtained according to this procedure.

Synthesis of 4-chloro-2-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)benzonitrile (4d):[3]



To a one-neck round bottom flask (25-mL) were added 14 mL dry THF and 1 mL 2,2,6,6-tetramethylpiperidine. The flask was kept under -10 °C and 3.75 mL *n*-BuLi (1.6 M in hexane) was then injected into the solution and kept stirring for 10 min; the solution was then cooled to -78 °C. The $B(OiPr)_3$ (700.5 mg, 7 mmol) was injected into the solution, and then the 4-chlorobenzonitrile/THF solution (685.0 mg, 5 mmol) was slowly injected into the solution and allowed to stir at room temperature for 12 h. Acetic acid (0.4 mL) and 2,2-dimethylpropane-1,3-diol (780 mg, 7.5 mmol) were sequentially injected into the reaction mixture and kept stirring at room temperature for 2 h. The crude reaction mixture was diluted with CH_2Cl_2, extracted by $NaHCO_3$. The combined organic layer was collected, dried over the $MgSO_4$ and concentrated *in vacuo* then purified after re-crystallization under hexane to give product **4d** (561.4 mg, 45 %). Compounds 2-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)-4-(trifluoromethylbenzonitrile (**4f**), 2-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)-6-methoxybenzonitrile (**4g**), 2-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)-6-(trifluoromethyl)benzonitrile (**4h**), 2-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)-5-(trifluoromethyl)benzonitrile (**4i**) and 3-(5,5-dimethyl-1,3,2-dioxaborinan-2-yl)-2-naphthonitrile (**4j**) were obtained according to this procedure.

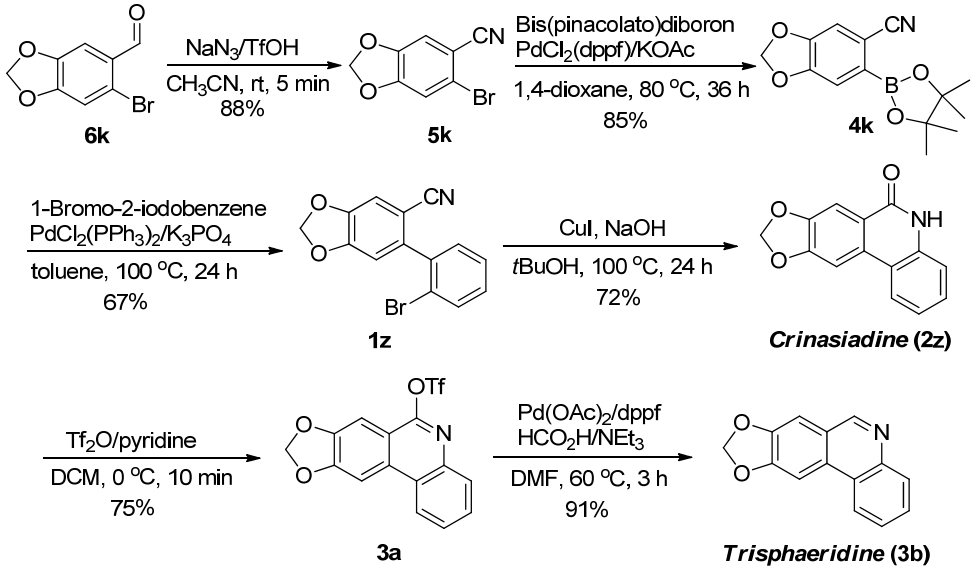
Synthesis of 2-bromo-4,5-dimethoxybenzonitrile (5c):[4]



To a one-neck round bottom flask (25-mL) were added 2-bromo-4,5-dimethoxybenzaldehyde (1225 mg, 5 mmol), NaN_3 (487.5 mg, 7.5 mmol) and 10 mL CH_3CN. TfOH (2250 mg, 15 mmol) was then slowly injected into the reaction mixture and kept

stirring for 2 minutes. The crude reaction mixture was diluted with CH_2Cl_2, filtered through a thin Celite pad to remove salt, and concentrated *in vacuo*. The residue was isolated through a short flash column chromatography by using ethyl acetate as eluent to give the pure compound **5c** (908 mg, 75%); White solid, mp: 110–111°C; ^{1}H NMR (600 MHz, $CDCl_3$): δ 7.06 (s, 1H), 7.04 (s, 1H), 3.92 (s, 3H), 3.88 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 153.1, 148.4, 117.6, 117.5, 115.5, 115.2, 106.8, 56.4, 56.3; Registry Number: [109305-98-8]. **6-Bromobenzo[*d*][1,3]dioxole-5-carbonitrile** (**5k**) was obtained according to this procedure; White solid, mp: 103–104 °C; ^{1}H NMR (600 MHz, $CDCl_3$): δ 7.07 (s, 1H), 7.00 (s, 1H), 6.09 (s, 2H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 152.2, 147.4, 118.9, 117.3, 113.3, 112.5, 107.9, 103.1; Registry Number: [6120-26-9].

Synthesis of natural alkaloids Crinasiadine (2z) and Trisphaeridine (3b):



6-Bromobenzo[*d*][1,3]dioxole-5-carbaldehyde 6k (98%) was purchased from Alfa Aesar. The synthesis of **6-bromobenzo[*d*][1,3]dioxole-5-carbonitrile 5k** is according to the procedure for the synthesis of **5c**, and the reported yield of **5k** is for 10 mmol scale. **6-Bromobenzo[*d*][1,3]dioxole-5-carbonitrile** (**5k**): White solid, mp: 103–104 °C; ^{1}H NMR (600 MHz, $CDCl_3$): δ 7.07 (s, 1H), 7.00 (s, 1H), 6.09 (s, 2H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 152.2, 147.4, 118.9, 117.3, 113.3, 112.5, 107.9, 103.1; Registry Number: [6120-26-9]. Synthesis of compound **4k** is according to the procedure of the synthesis of **4b**, and the reported yield is for 8 mmol scale. **6-(4,4,5,5-Tetramethyl-1,3,2-dioxaborolan-2-yl)benzo[*d*][1,3]dioxole-5-carbonitrile** (**4k**): Brown solid, mp: 149–151 °C; ^{1}H NMR (600 MHz, $CDCl_3$): δ 7.27 (s, 1H), 7.09 (s, 1H), 6.06 (s, 2H), 1.36 (s, 12H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 150.4, 149.8, 118.8, 113.2, 111.0, 102.2, 84.7, 24.8; HRMS: $C_{14}H_{16}BNO_4$ calculated 273.1172, found 273.1165; New compound. Synthesis of compound **1z** is according to the general procedure to synthesize **1**, and the reported yield is for 5 mmol scale. Synthesis of crinasiadine **2z**

is according to the general procedure to synthesize **2** in 0.5 mmol scale.

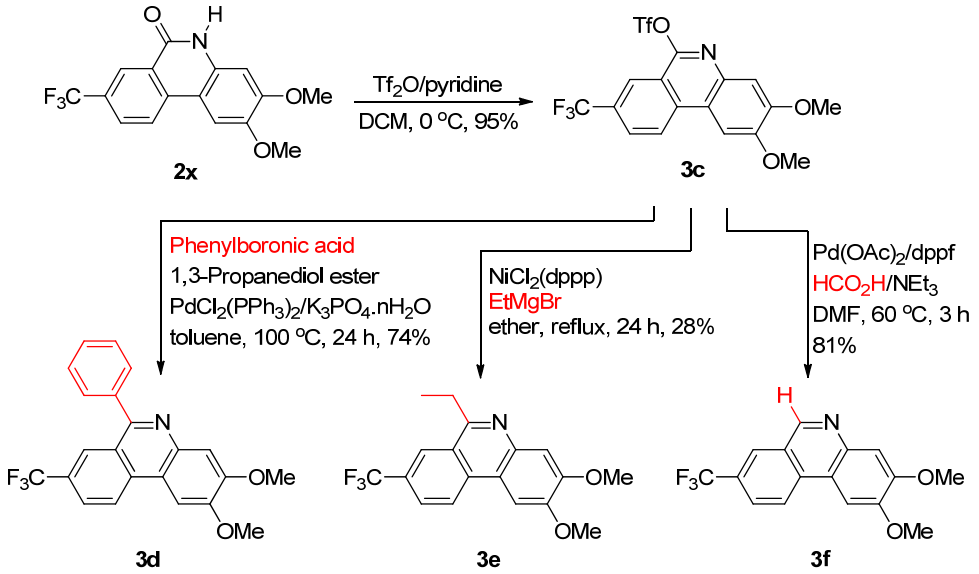
Synthesis of [1,3]dioxolo[4,5-*j*]phenanthridin-6-yltrifluoromethanesulfonate (3a):

To a screw-capped vial (10-mL) were added crinasiadine **2z** (119.5 mg, 0.5 mmol) in 5 mL dichloromethane, and the solution was kept stirring at 0 °C. Tf_2O (215.8 mg, 0.765 mmol, 1.53 equiv) and pyridine (60.5 mg, 0.765 mmol, 1.53 equiv) were then slowly injected into the reaction mixture. The vial was then sealed with cap and allowed to stir under ice bath at 0 °C for 10 min. The crude reaction mixture was diluted with CH_2Cl_2, extracted by $NaHCO_3$. The combined organic layer was collected, dried over the $MgSO_4$ and concentrated *in vacuo*. The residue was isolated through a short flash column chromatography by using ethyl acetate as eluent to give the pure compound **3a** (139.2 mg, 75%).

Synthesis of natural alkaloid trisphaeridine (3b):

Reactions were conducted in glove box under nitrogen atmosphere. To a screw-capped vial (10-mL) were added compound **3a** (185.6 mg, 0.5 mmol), $Pd(OAc)_2$ (6.2 mg, 0.027 mmol, 5.4 mol %), dppf (17.7 mg, 0.065 mmol, 13 mol %) in 5 mL DMF. The reaction mixture was allowed to stir at room temperature for a while. Formic acid (HCO_2H, 58.5 mg, 1.2 mmol, 2.4 equiv) and NEt_3 (150.5 mg, 1.5 mmol, 3.0 equiv) were then slowly injected into the reaction. The vial was then sealed with cap and kept stirring at 60 °C for 3 h. The crude reaction mixture was diluted with CH_2Cl_2, extracted by $NaHCO_3$. The combined organic layer was collected, dried over the $MgSO_4$ and concentrated *in vacuo*. The residue was isolated through a short flash column chromatography by using ethyl acetate as eluent to give the pure compound **3b** (101.6 mg, 91%).

Synthesis of phenanthridine derivatives 3c–3f:



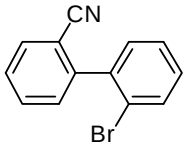
Compound **3c** was synthesized according to the procedure to synthesize **3a** in 3 mmol scale. Compound **3d** was synthesized according to the general procedure for the

synthesis of **1** in 0.5 mmol scale. Compound **3f** was synthesized according to the procedure to synthesize **3b** in 0.5 mmol scale.

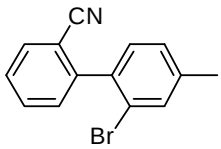
Synthesis of 6-ethyl-2,3-dimethoxy-8-(trifluoromethyl)phenanthridine (3e):

Reactions were conducted in glove box under nitrogen atmosphere. To a screw-capped vial (10-mL) was added compound **3c** (228 mg, 0.5 mmol), $NiCl_2$(dppp) (14 mg, 0.025 mmol, 5 mol %) in 10 mL dry Et_2O. The vial was then sealed with cap and kept stirring at room temperature for a while. EtMgBr (3 M, 1 mL, 3 mmol, 6.0 equiv) was then slowly injected into the reaction. The vial was allowed to stir and reflux for 24 h. The crude reaction mixture was diluted with CH_2Cl_2, extracted by $NaHCO_3$. The combined organic layer was collected, dried over the $MgSO_4$ and concentrated *in vacuo*. The residue was isolated through a column chromatography by using hexane as eluent to give the pure compound **3e** (46.9 mg, 28%).

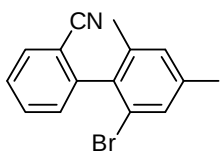
Spectral Data for all substrates:



2'-Bromo-[1,1'-biphenyl]-2-carbonitrile (1a): White solid (1.097 g, 85%), eluent (2% ethyl acetate in hexane), mp: 66–67 °C; IR (KBr): 3064, 2230, 1601, 811, 763, 658, 619 cm^{-1}; ^1H NMR (600 MHz, $CDCl_3$): δ 7.77 (dd, *J* = 7.8, 0.6 Hz, 1H), 7.72 (dd, *J* = 8.4, 0.6 Hz, 1H), 7.66 (td, *J* = 7.8, 1.2 Hz, 1H), 7.50 (td, *J* = 7.8, 1.2 Hz, 1H), 7.44–7.41 (m, 2H), 7.35–7.30 (m, 2H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 144.7, 139.0, 133.1, 132.8, 132.3, 130.9, 130.7, 130.3, 128.2, 127.5, 122.8, 117.7, 112.9; HRMS: $C_{13}H_8BrN$ calculated 256.9840, found 256.9837; Registry Number: [54245-41-9].

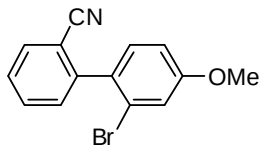


2'-Bromo-4'-methyl-[1,1'-biphenyl]-2-carbonitrile (1b): Yellow solid (952 mg, 70%), eluent (2% ethyl acetate in hexane), mp: 87–89 °C; IR (KBr): 3464, 2226, 1657, 1552, 672, 433 cm^{-1}; ^1H NMR (600 MHz, $CDCl_3$): δ 7.75 (d, *J* = 7.8 Hz, 1H), 7.64 (td, *J* = 7.8, 1.2 Hz, 1H), 7.54 (s, 1H), 7.48 (t, *J* = 7.8 Hz, 1H), 7.42 (d, *J* = 7.8 Hz, 1H), 7.22 (s, 2H), 2.40 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 144.8, 140.6, 136.1, 133.6, 132.8, 132.2, 130.9, 130.6, 128.3, 128.1, 122.5, 117.9, 113.1, 20.9; HRMS: $C_{14}H_{10}BrN$ calculated 270.9997, found 270.9991; New compound.

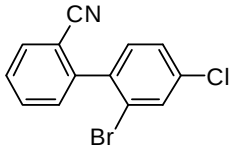


2'-Bromo-4',6'-dimethyl-[1,1'-biphenyl]-2-carbonitrile (1c): White solid (572 mg, 40%), eluent (2% ethyl acetate in hexane), mp: 93–95 ^oC; IR (KBr): 3023, 2920, 2229, 1607, 1441, 1377, 1219, 770, 578 cm^{-1}; ^1H NMR (600 MHz, $CDCl_3$): δ 7.77 (dd, *J* = 7.2, 0.6 Hz, 1H), 7.67 (td, *J* = 7.8, 1.2 Hz, 1H), 7.49 (td, *J* = 7.2, 1.2 Hz, 1H), 7.38 (s,

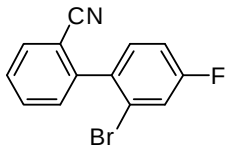
1H), 7.30 (d, *J* = 7.8 Hz, 1H), 7.08 (s, 1H), 2.35 (s, 3H), 2.06 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 144.7, 140.1, 137.9, 135.6, 132.8, 132.7, 130.7, 130.6, 130.1, 128.0, 123.2, 117.5, 113.3, 20.8 (2C); HRMS: $C_{15}H_{12}BrN$ calculated 285.0153, found 285.0150; New compound.



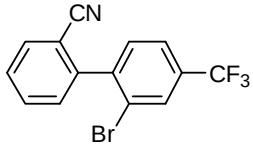
2'-Bromo-4'-methoxy-[1,1'-biphenyl]-2-carbonitrile (1d): White solid (576 mg, 40%), eluent (5% ethyl acetate in hexane), mp: 97–99 ^{o}C; IR (KBr): 3062, 2837, 2229, 1607, 1471, 767, 533 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$): δ 7.74 (dd, *J* = 7.8, 1.2 Hz, 1H), 7.63 (td, *J* = 7.8, 1.2 Hz, 1H), 7.47 (td, *J* = 7.8, 1.2 Hz, 1H), 7.42 (d, *J* = 7.8 Hz, 1H), 7.26–7.24 (m, 2H), 6.95 (dd, *J* = 8.4, 2.4 Hz, 1H), 3.85 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 160.3, 144.5, 132.7, 132.2, 131.4, 131.2, 131.1, 128.0, 123.1, 118.3, 117.9, 113.5, 113.2, 55.6; HRMS: $C_{14}H_{10}BrNO$ calculated 286.9946, found 286.9940; New compound.



2'-Bromo-4'-chloro-[1,1'-biphenyl]-2-carbonitrile (1e): Yellow oil (834 mg, 57%), eluent (5% ethyl acetate in hexane); IR (KBr): 3078, 2226, 1466, 808, 764, 533 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$): δ 7.76 (d, *J* = 7.8 Hz, 1H), 7.72 (d, *J* = 2.4 Hz, 1H), 7.66 (td, *J* = 8.4, 0.6 Hz, 1H), 7.51 (t, *J* = 8.4 Hz, 1H), 7.41 (s, 1H), 7.40 (d, *J* = 1.2 Hz, 1H), 7.28 (d, *J* = 8.4 Hz, 1H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 143.5, 137.5, 135.4, 132.8, 132.7, 132.4, 131.6, 130.6, 128.5, 127.8, 123.3, 117.5, 112.8; HRMS: $C_{13}H_7BrClN$ calculated 290.9450, found 290.9454; New compound.

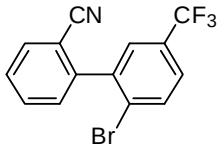


2'-Bromo-4'-fluoro-[1,1'-biphenyl]-2-carbonitrile (1f): White solid (884 mg, 64%), eluent (5% ethyl acetate in hexane), mp: 84–85 ^{o}C; IR (KBr): 3065, 2226, 1602, 1474, 1199, 766, 536 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$): δ 7.77 (dd, *J* = 7.8, 0.6 Hz, 1H), 7.66 (td, *J* = 7.8, 1.2 Hz, 1H), 7.51 (td, *J* = 7.8, 1.2 Hz, 1H), 7.47 (dd, *J* = 8.4, 2.4 Hz, 1H), 7.41 (dd, *J* = 7.8, 0.6 Hz, 1H), 7.33 (dd, *J* = 8.4, 6.0 Hz, 1H), 7.15 (td, *J* = 8.4, 2.4 Hz, 1H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 162.4 (d, *J* = 252.0 Hz), 143.8, 135.2, 132.9, 132.4, 132.0 (d, *J* = 9.0 Hz), 130.9, 128.5, 123.3 (d, *J* = 10.5 Hz), 120.5 (d, *J* = 24.0 Hz), 117.6, 114.9 (d, *J* = 21.0 Hz), 113.2; HRMS: $C_{13}H_7BrFN$ calculated 274.9746, found 274.9743; New compound.

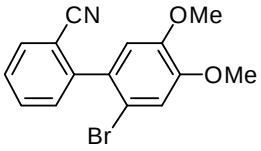


2'-Bromo-4'-(trifluoromethyl)-[1,1'-biphenyl]-2-carbonitrile (1g): White solid (880 mg, 54%), eluent (5% ethyl acetate in hexane), mp: 92–93 ^{o}C; IR (KBr): 3065, 2232, 1396, 1322,

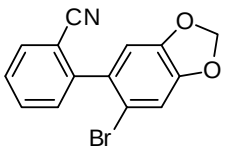
1086, 772, 669, 425 cm^{-1}; ^1H NMR (600 MHz, $CDCl_3$): δ 7.99 (s, 1H), 7.80 (d, *J* = 7.8 Hz, 1H), 7.70 (t, *J* = 8.4 Hz, 2H), 7.56 (t, *J* = 7.8 Hz, 1H), 7.47 (d, *J* = 7.8 Hz, 1H), 7.42 (d, *J* = 7.8 Hz, 1H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 143.3, 142.6, 132.9, 132.6, 132.4 (q, *J* = 33.0 Hz), 131.4, 130.3, 130.1 (q, *J* = 3.0 Hz), 128.9, 124.4 (q, *J* = 3.0 Hz), 123.3, 122.9 (q, *J* = 271.5 Hz), 117.3, 112.6; HRMS: $C_{14}H_7BrF_3N$ calculated 324.9714, found 324.9711; New compound.



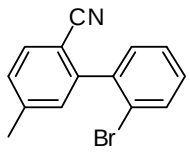
2'-Bromo-5'-(trifluoromethyl)-[1,1'-biphenyl]-2-carbonitrile (1h): White solid (668 mg, 41%), eluent (5% ethyl acetate in hexane), mp: 122–123 °C; IR (KBr): 3070, 2229, 1333, 1136, 1086, 766, 533 cm^{-1}; ^1H NMR (600 MHz, $CDCl_3$): δ 7.86 (d, *J* = 7.8 Hz, 1H), 7.79 (dd, *J* = 7.8, 0.6 Hz, 1H), 7.70 (td, *J* = 7.8, 1.2 Hz, 1H), 7.60 (d, *J* = 1.8 Hz, 1H), 7.58–7.54 (m, 2H), 7.43 (dd, *J* = 7.8, 0.6 Hz, 1H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 143.2, 139.9, 133.8, 132.9, 132.6, 130.4, 130.1 (q, *J* = 33.0 Hz), 128.9, 127.6 (q, *J* = 3.0 Hz), 127.0, 126.9 (q, *J* = 3.0 Hz), 123.5 (q, *J* = 271.5 Hz), 117.2, 112.9; HRMS: $C_{14}H_7BrF_3N$ calculated 324.9714, found 324.9711; New compound.



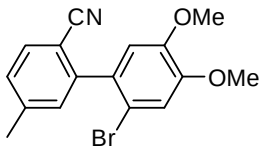
2'-Bromo-4',5'-dimethoxy-[1,1'-biphenyl]-2-carbonitrile (1i): White solid (827 mg, 52%), eluent (5% ethyl acetate in hexane), mp: 98–99 °C; IR (KBr): 3004, 2837, 2226, 1485, 1216, 1016, 766, 558 cm^{-1}; ^1H NMR (600 MHz, $CDCl_3$): δ 7.75 (d, *J* = 7.8 Hz, 1H), 7.64 (t, *J* = 7.8 Hz, 1H), 7.48 (t, *J* = 7.2 Hz, 1H), 7.44 (d, *J* = 7.8 Hz, 1H), 7.15 (s, 1H), 6.82 (s, 1H), 3.93 (s, 3H), 3.87 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 149.9, 148.4, 144.7, 132.8, 132.3, 131.1, 131.0, 128.1, 117.9, 115.8, 113.6, 113.3, 113.1, 56.2, 56.2; HRMS: $C_{15}H_{12}BrNO_2$ calculated 317.0051, found 317.0050; New compound.



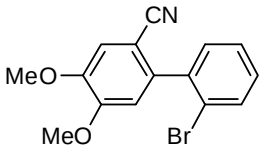
2-(6-Bromobenzo[*d*][1,3]dioxol-5-yl)benzonitrile (1j): Yellow solid (997 mg, 66%), eluent (5% ethyl acetate in hexane), mp: 131–133 °C; IR (KBr): 2920, 2226, 1649, 1471, 1227, 764, 542 cm^{-1}; ^1H NMR (600 MHz, $CDCl_3$): δ 7.74 (dd, *J* = 7.2, 0.6 Hz, 1H), 7.63 (td, *J* = 7.8, 1.2 Hz, 1H), 7.48 (td, *J* = 7.8, 1.2 Hz, 1H), 7.39 (dd, *J* = 7.2, 0.6 Hz, 1H), 7.14 (s, 1H), 6.79 (s, 1H), 6.05 (d, *J* = 3.0 Hz, 2H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 148.9, 147.5, 144.8, 132.8, 132.4, 132.0, 131.0, 128.2, 117.7, 113.8, 113.3, 113.0, 110.5, 102.2; HRMS: $C_{14}H_8BrNO_2$ calculated 300.9738, found 300.9740; New compound.



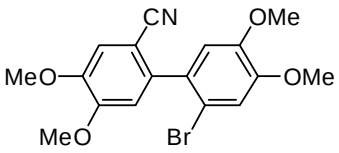
2'-Bromo-5-methyl-[1,1'-biphenyl]-2-carbonitrile (1k): White solid (1.13 g, 69%), eluent (2% ethyl acetate in hexane), mp: 65–67 ^{o}C; IR (KBr): 3053, 2920, 2226, 1607, 1477, 761, 541 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$): δ 7.73 (dd, *J* = 7.8, 1.2 Hz, 1H), 7.67 (d, *J* = 7.8 Hz, 1H), 7.43 (td, *J* = 7.8, 1.2 Hz, 1H), 7.36–7.31 (m, 3H), 7.26 (s, 1H), 2.49 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 144.5, 143.2, 139.1, 132.9, 132.5, 131.2, 130.8, 130.0, 128.9, 127.3, 122.7, 117.9, 109.8, 21.8; HRMS: $C_{14}H_{10}BrN$ calculated 270.9997, found 270.9991; New compound.



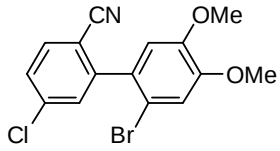
2'-Bromo-4',5'-dimethoxy-5-methyl-[1,1'-biphenyl]-2-carbonitrile (1l): White solid (798 mg, 48%), eluent (5% ethyl acetate in hexane), mp: 131–134 ^{o}C; IR (KBr): 3001, 2840, 2226, 1607, 1513, 1333, 1219, 1022, 783, 530 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$): δ 7.62 (d, *J* = 7.8 Hz, 1H), 7.27 (dd, *J* = 8.4, 0.6 Hz, 1H), 7.23 (s, 1H), 7.13 (s, 1H), 6.80 (s, 1H), 3.92 (s, 3H), 3.86 (s, 3H), 2.45 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 149.7, 148.2, 144.6, 143.2, 132.6, 131.6, 131.1, 128.8, 118.2, 115.6, 113.4, 113.0, 110.2, 56.2, 56.1, 21.8; HRMS: $C_{16}H_{14}NO_2Br$ calculated 333.0187, found 333.0193; New compound.



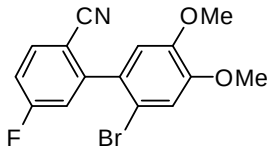
2'-Bromo-4,5-dimethoxy-[1,1'-biphenyl]-2-carbonitrile (1m): Yellow solid (890 mg, 56%), eluent (5% ethyl acetate in hexane), mp: 123–125 ^{o}C; IR (KBr): 3061, 2936, 2845, 2224, 1269, 1019, 766, 547 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$): δ 7.70 (d, *J* = 7.8 Hz, 1H), 7.40 (t, *J* = 7.8 Hz, 1H), 7.35 (d, *J* = 7.2 Hz, 1H), 7.29 (t, *J* = 7.2 Hz, 1H), 7.15 (s, 1H), 6.87 (s, 1H), 3.95 (s, 3H), 3.93 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 152.0, 148.6, 139.1, 138.9, 133.1, 131.2, 130.1, 127.5, 123.1, 118.1, 114.1, 113.4, 104.2, 56.2, 56.2; HRMS: $C_{15}H_{12}BrNO_2$ calculated 317.0051, found 317.0049; New compound.



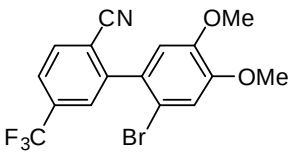
2'-Bromo-4,4',5,5'-tetramethoxy-[1,1'-biphenyl]-2-carbonitrile (1n): White solid (964 mg, 51%), eluent (5% ethyl acetate in hexane), mp: 194–195 ^{o}C; IR (KBr): 3004, 2837, 2226, 1485, 1216, 1016, 766, 558 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$): δ 7.14 (s, 2H), 6.88 (s, 1H), 6.84 (s, 1H), 3.95 (s, 3H), 3.94 (s, 3H), 3.92 (s, 3H), 3.88 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 152.0, 149.8, 148.5, 148.3, 139.2, 130.8, 118.3, 115.7, 114.1, 113.7, 113.6, 113.3, 104.4, 56.2 (4C); HRMS: $C_{17}H_{16}BrNO_4$ calculated 377.0263, found 377.0261; New compound.



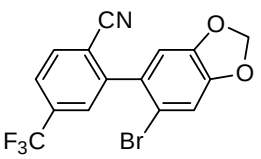
2'-Bromo-5-chloro-4',5'-dimethoxy-[1,1'-biphenyl]-2-carbonitrile (1o): White solid (635 mg, 36%), eluent (5% ethyl acetate in hexane), mp: 167–170 ^{o}C; IR (KBr): 3012, 2840, 2226, 1610, 1516, 1263, 1177, 1094, 1027, 816, 783, 525 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$): δ 7.67 (d, *J* = 8.4 Hz, 1H), 7.46 (dd, *J* = 7.8, 1.8 Hz, 1H), 7.44 (d, *J* = 1.8 Hz, 1H), 7.14 (s, 1H), 6.79 (s, 1H), 3.92 (s, 3H), 3.87 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 150.2, 148.4, 146.2, 138.8, 133.8, 131.3, 129.6, 128.5, 117.1, 115.7, 113.2, 112.9, 111.7, 56.2, 56.2; HRMS: $C_{15}H_{11}BrClNO_2$ calculated 350.9662, found 350.9660; New compound.



2'-Bromo-5-fluoro-4',5'-dimethoxy-[1,1'-biphenyl]-2-carbonitrile (1p): White solid (420 mg, 25%), eluent (5% ethyl acetate in hexane), mp: 144–145 ^{o}C; IR (KBr): 3078, 2840, 2229, 1616, 1480, 1213, 1169, 1027, 789, 533 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$): δ 7.75 (dd, *J* = 8.4, 5.4 Hz, 1H), 7.20–7.15 (m, 2H), 7.14 (s, 1H), 6.81 (s, 1H), 3.93 (s, 3H), 3.87 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 164.3 (d, *J* = 255.0 Hz), 150.2, 148.4, 147.6 (d, *J* = 9.0 Hz), 135.1 (d, *J* = 9.0 Hz), 129.7, 118.7 (d, *J* = 22.5 Hz), 117.2, 115.8, 115.8 (d, *J* = 22.5 Hz), 113.3, 112.8, 109.5, 56.2, 56.2; HRMS: $C_{15}H_{11}BrFNO_2$ calculated 334.9957, found 334.9957; New compound.

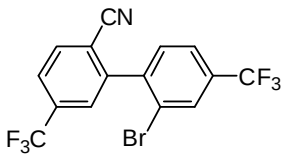


2'-Bromo-4',5'-dimethoxy-5-(trifluoromethyl)-[1,1'-biphenyl]-2-carbonitrile (1q): White solid (386 mg, 20%), eluent (5% ethyl acetate in hexane), mp: 175–177 ^{o}C; IR (KBr): 3009, 2934, 2232, 1519, 1413, 1335, 1172, 1136, 1025, 786, 539 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$): δ 7.88 (d, *J* = 7.8 Hz, 1H), 7.74 (d, *J* = 8.4 Hz, 1H), 7.72 (s, 1H), 7.17 (s, 1H), 6.82 (s, 1H), 3.94 (s, 3H), 3.89 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 150.4, 148.6, 145.6, 134.1 (q, *J* = 33.0 Hz), 133.4, 129.4, 128.1 (q, *J* = 3.0 Hz), 124.9 (q, *J* = 3.0 Hz), 123.0 (q, *J* = 271.5 Hz), 116.8, 116.7, 115.8, 113.3, 113.0, 56.3, 56.2; HRMS: $C_{16}H_{11}BrF_3NO_2$ calculated 384.9925, found 384.9923; New compound.

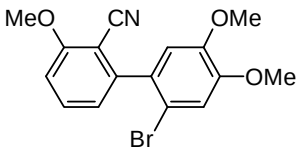


2-(6-Bromobenzo[*d*][1,3]dioxol-5-yl)-4-(trifluoromethyl)benzonitrile (1r): Yellow solid (666 mg, 36%), eluent (5% ethyl acetate in hexane), mp: 118–120 ^{o}C; IR (KBr): 3087, 2920, 2235, 1483, 1441 ,1324, 1235, 1133, 849, 533 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$): δ 7.88 (d, *J* = 7.8 Hz, 1H), 7.74 (d, *J* = 7.8 Hz, 1H), 7.67 (s, 1H), 7.16 (s, 1H), 6.79 (s, 1H), 6.07 (s, 2H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 149.4, 147.7, 145.6, 134.2 (q, *J* = 33.0 Hz), 133.4, 130.5, 128.0 (q, *J* = 3.0 Hz), 125.0 (q, *J* = 3.0

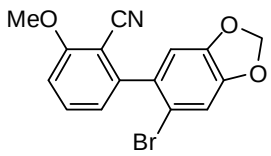
Hz), 123.0 (q, J = 271.5 Hz), 116.9, 116.5, 113.7, 113.2, 110.3, 102.4; HRMS: $C_{15}H_7BrF_3NO_2$ calculated 368.9612, found 368.9605; New compound.



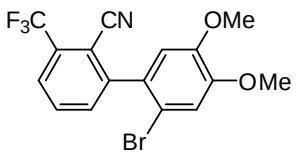
2'-Bromo-4',5-bis(trifluoromethyl)-[1,1'-biphenyl]-2-carbonitrile (1s): White solid (935 mg, 41%), eluent (3% ethyl acetate in hexane), mp: 91–92 ^oC; ^1H NMR (600 MHz, $CDCl_3$): δ 8.02 (s, 1H), 7.95 (d, J = 8.4 Hz, 1H), 7.83 (d, J = 8.4 Hz, 1H), 7.74 (d, J = 8.4 Hz, 1H), 7.71 (s, 1H), 7.50 (d, J = 7.8 Hz, 1H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 144.2, 141.2, 134.5 (q, J = 33.0), 133.6, 133.1 (q, J = 33.0 Hz), 131.3, 130.4 (q, J = 4.5 Hz), 127.4 (q, J = 3.0 Hz), 125.8 (q, J = 3.0 Hz), 124.7 (q, J = 3.0 Hz), 123.2, 122.8 (q, J = 271.5 Hz), 122.8 (q, J = 271.5 Hz), 116.3, 116.0; HRMS: $C_{15}H_6BrF_6N$ calculated 392.9588, found 392.9589; New compound.



2'-bromo-3,4',5'-trimethoxy-[1,1'-biphenyl]-2-carbonitrile (1t): Yellow solid (836 mg, 48%), eluent (5% ethyl acetate in hexane), mp: 109–110 ^oC; IR (KBr): 3009, 2845, 2226, 1516, 1480, 1435, 1377, 1210, 1063, 786, 555 cm^{-1}; ^1H NMR (600 MHz, $CDCl_3$): δ 7.56 (t, J = 7.8 Hz, 1H), 7.13 (s, 1H), 6.99 (d, J = 7.8 Hz, 2H), 6.81 (s, 1H), 3.98 (s, 3H), 3.91 (s, 3H), 3.86 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 161.6, 149.8, 148.3, 146.4, 133.3, 130.9, 122.8, 115.7, 115.3, 113.5, 112.9, 110.1, 102.8, 56.2, 56.2, 56.2; HRMS: $C_{16}H_{14}BrNO_3$ calculated 347.0517, found 347.0520; New compound.

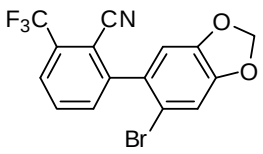


2-(6-Bromobenzo[*d*][1,3]dioxol-5-yl)-6-methoxybenzonitrile (1u): Yellow solid (980 mg, 59%), eluent (5% ethyl acetate in hexane), mp: 109–110 ^oC; IR (KBr): 3017, 2912, 2845, 2224, 1586, 1469, 1233, 1033, 797, 555 cm^{-1}; ^1H NMR (600 MHz, $CDCl_3$): δ 7.55 (t, J = 7.8 Hz, 1H), 7.12 (s, 1H), 6.98 (d, J = 9.0 Hz, 1H), 6.93 (d, J = 7.8 Hz, 1H), 6.77 (s, 1H), 6.04 (d, J = 9.6 Hz, 2H), 3.98 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 161.6, 148.8, 147.4, 146.5, 133.4, 132.0, 122.8, 115.1, 113.7, 113.0, 110.5, 110.3, 103.0, 102.1, 56.2; HRMS: $C_{15}H_{10}BrNO_3$ calculated 330.9844, found 330.9837; New compound.

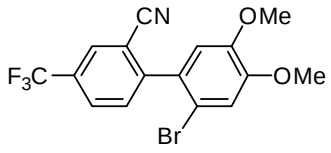


2'-Bromo-4',5'-dimethoxy-3-(trifluoromethyl)-[1,1'-biphenyl]-2-carbonitrile (1v): White solid (1.10 g, 57%), eluent (5% ethyl acetate in hexane), mp: 163–165 ^oC; IR (KBr): 3015, 2845, 2232, 1632, 1513, 1333, 1216, 1136, 1025, 791, 555 cm^{-1}; ^1H NMR (600 MHz, $CDCl_3$): δ 7.82 (d, J = 7.8 Hz, 1H), 7.76 (t, J = 7.8 Hz,

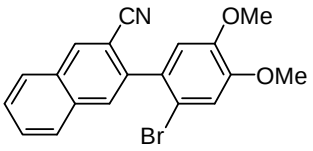
1H), 7.65 (d, J = 7.8 Hz, 1H), 7.16 (s, 1H), 6.82 (s, 1H), 3.93 (s, 3H), 3.88 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 150.3, 148.5, 147.3, 134.4, 133.4 (q, J = 31.5 Hz), 132.1, 129.7, 125.7 (q, J = 4.5 Hz), 122.4 (q, J = 273.0 Hz), 115.7, 114.2, 113.3, 113.0, 110.8, 56.2 (2C); HRMS: $C_{16}H_{11}BrF_3NO_2$ calculated 384.9925, found 384.9931; New compound.



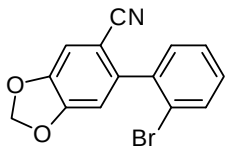
2-(6-Bromobenzo[*d*][1,3]dioxol-5-yl)-6-(trifluoromethyl)benzonitrile (1w): Yellow solid (796 mg, 43%), eluent (5% ethyl acetate in hexane), mp: 131–132 ^{o}C; IR (KBr): 3090, 2909, 2237, 1474, 1322, 1138, 1041, 816, 597 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$): δ 7.82 (d, J = 7.8 Hz, 1H), 7.76 (t, J = 7.8 Hz, 1H), 7.60 (d, J = 7.8 Hz, 1H), 7.15 (s, 1H), 6.79 (s, 1H), 6.07 (d, J = 6.0 Hz, 2H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 149.3, 147.6, 147.3, 134.3, 133.3 (q, J = 31.5 Hz), 132.2, 130.8, 125.8 (q, J = 4.5 Hz), 122.4 (q, J = 273.0 Hz), 114.0, 113.7, 113.1, 110.8, 110.3, 102.3; HRMS: $C_{15}H_7BrF_3NO_2$ calculated 368.9612, found 368.9609, New compound.



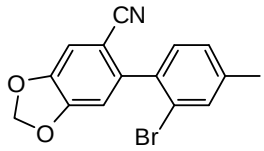
2'-Bromo-4',5'-dimethoxy-4-(trifluoromethyl)-[1,1'-biphenyl]-2-carbonitrile (1x): Yellow solid (967 mg, 51%), eluent (5% ethyl acetate in hexane), mp: 144–145 ^{o}C; IR (KBr): 3078, 2843, 2232, 1496, 1327, 1172, 1086, 1019, 789, 536 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.00 (s, 1H), 7.88 (dd, J = 8.4, 1.2 Hz, 1H), 7.61 (d, J = 8.4 Hz, 1H), 7.16 (s, 1H), 6.81 (s, 1H), 3.93 (s, 3H), 3.87 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 150.4, 148.5, 148.0, 132.0, 130.7 (q, J = 33.0 Hz), 129.7 (q, J = 3.0 Hz), 129.4, 128.9 (q, J = 1.5 Hz), 122.9 (q, J = 271.5 Hz), 116.5, 115.8, 114.2, 113.2, 112.7, 56.2, 56.2; HRMS: $C_{16}H_{11}BrF_3NO_2$ calculated 384.9925, found 384.9937; New compound.



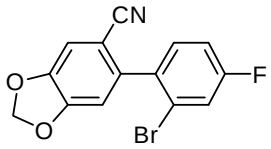
3-(2-Bromo-4,5-dimethoxyphenyl)-2-naphthonitrile (1y): White solid (586 mg, 32%), eluent (5% ethyl acetate in hexane), mp: 161–162 ^{o}C; IR (KBr): 3054, 2851, 2226, 1513, 1446, 1210, 1174, 755, 544 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.33 (s, 1H), 7.95 (d, J = 8.4 Hz, 1H), 7.91 (d, J = 8.4 Hz, 1H), 7.86 (s, 1H), 7.68 (td, J = 7.8, 0.6 Hz, 1H), 7.63 (td, J = 8.4, 1.2 Hz, 1H), 7.19 (s, 1H), 6.90 (s, 1H), 3.95 (s, 3H), 3.89 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 149.9, 148.3, 138.9, 134.9, 134.4, 131.5, 131.1, 130.1, 129.4, 128.2 (2C), 127.8, 118.2, 115.7, 113.9, 113.7, 111.2, 56.3, 56.2; HRMS: $C_{19}H_{14}NO_2Br$ calculated 369.0189, found 369.0189; New compound.



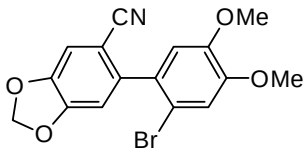
6-(2-Bromophenyl)benzo[*d*][1,3]dioxole-5-carbonitrile (1z): White solid (1.01 g, 67%), eluent (5% ethyl acetate in hexane), mp:137–138 ^{o}C; IR (KBr): 2915, 2224, 1626, 1471, 1377, 1252, 1044, 761, 547 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$): δ 7.67 (dd, *J* = 7.8, 1.2 Hz, 1H), 7.38 (td, *J* = 7.8, 1.2 Hz, 1H), 7.31 (dd, *J* = 7.8, 1.8 Hz, 1H), 7.27 (td, *J* = 7.8, 1.8 Hz, 1H), 7.10 (s, 1H), 6.82 (s, 1H), 6.08 (s, 2H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 150.9, 147.3, 140.9, 138.6, 132.9, 130.9, 130.1, 127.3, 122.9, 117.6, 111.2, 110.8, 105.1, 102.5; HRMS: $C_{14}H_8NO_2Br$ calculated 300.9738, found 300.9735; New compound.



6-(2-Bromo-4-methylphenyl)benzo[*d*][1,3]dioxole-5-carbonitrile (1C1): White solid (869 mg, 55%), eluent (5% ethyl acetate in hexane), mp: 139–140 ^{o}C; IR (KBr): 2920, 2226, 1649, 1477, 1371, 1258, 1036, 822, 539 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$): δ 7.51 (s, 1H), 7.19 (s, 2H), 7.10 (s, 1H), 6.82 (s, 1H), 6.11 (s, 2H), 2.38 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 151.0, 147.3, 141.2, 140.6, 135.7, 133.5, 130.7, 128.3, 122.7, 117.9, 111.3, 111.1, 105.5, 102.5, 20.8; HRMS: $C_{15}H_{10}NO_2Br$ calculated 314.9895, found 314.9896; New compound.

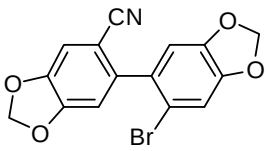


6-(2-bromo-4-fluorophenyl)benzo[*d*][1,3]dioxole-5-carbonitrile (1C2): White solid (928 mg, 58%), eluent (5% ethyl acetate in hexane), mp: 136–138 ^{o}C; IR (KBr): 3448, 3084, 2920, 2226, 1602, 1505, 1480, 1371, 1238, 1041, 933, 869, 822, 733 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$): δ 7.44 (dd, *J* = 8.4, 3.0 Hz, 1H), 7.30 (dd, *J* = 8.4, 6.0 Hz, 1H), 7.12 (td, *J* = 7.8, 2.4 Hz, 1H), 7.11 (s, 1H), 6.81 (s, 1H), 6.13 (d, *J* = 1.8 Hz, 2H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 162.4 (d, *J* = 252.0 Hz), 151.1, 147.6, 140.2, 134.9 (d, *J* = 3.0 Hz), 132.1 (d, *J* = 7.5 Hz), 123.5 (d, *J* = 10.5 Hz), 120.5 (d, *J* = 24.0 Hz), 117.6, 114.8 (d, *J* = 22.5 Hz), 111.5, 111.1, 105.7, 102.6; HRMS: $C_{14}H_7BrFNO_2$ calculated 318.9644, found 318.9640; New compound.



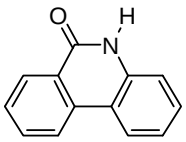
6-(2-bromo-4,5-dimethoxyphenyl)benzo[*d*][1,3]dioxole-5-carbonitrile (1C3): White solid (634 mg, 35%), eluent (5% ethyl acetate in hexane), mp: 116–118 ^{o}C; IR (KBr): 3012, 2940, 2843, 2227, 1485, 1252, 1033, 786, 530 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$): δ 7.10 (s, 1H), 7.08 (s, 1H), 6.82 (s, 1H), 6.79 (s, 1H), 6.09 (s, 2H), 3.89 (s, 3H), 3.84 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 150.9, 149.7, 148.1, 147.2, 141.0, 130.5, 117.9, 115.5, 113.5, 113.2, 111.2, 111.2, 105.5, 102.5, 56.1, 56.0; HRMS: $C_{16}H_{12}NO_4Br$ calculated 360.9950, found 360.9955; New

compound.

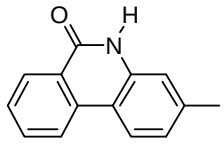


6'-Bromo-[5,5'-bibenzo[*d*][1,3]dioxole]-6-carbonitrile (1C4): White solid (640 mg, 37%), eluent (5% ethyl acetate in hexane), mp: 192–193 ^{o}C; IR (KBr): 3456, 2904, 2226, 1619, 1507, 1474, 1238, 1044, 933, 864 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$): δ 7.11 (s, 1H), 7.09 (s, 1H), 6.79 (s, 1H), 6.76 (s, 1H), 6.12 (d, *J* = 4.2 Hz, 2H), 6.04 (d, *J* = 6.6 Hz, 2H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 151.1, 148.8, 147.4, 147.4, 141.2, 131.7, 117.8, 114.0, 113.0, 111.4, 111.2, 110.6, 105.7, 102.6, 102.2; HRMS: $C_{15}H_8BrNO_4$ calculated 344.9637, found 344.9638; New compound.

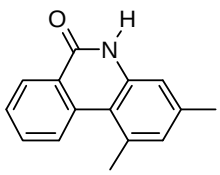
Spectral Data for all products:



Phenanthridin-6(5*H*)-one (2a): White solid (88.9 mg, 91%), mp: 289–291 °C; IR (KBr): 2918, 1629, 1602, 1358, 747, 725, 685, 508 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ 11.67 (br, 1H), 8.49 (d, *J* = 8.4 Hz, 1H), 8.37 (d, *J* = 7.8 Hz, 1H), 8.31 (d, *J* = 7.8 Hz, 1H), 7.84 (td, *J* = 7.8, 1.2 Hz, 1H), 7.63 (t, *J* = 7.2 Hz, 1H), 7.48 (td, *J* = 7.5, 0.6 Hz, 1H), 7.36 (d, *J* = 8.4 Hz, 1H), 7.25 (t, *J* = 7.8 Hz, 1H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 160.9, 136.7, 134.4, 132.9, 129.7, 128.0, 127.6, 125.8, 123.4, 122.7, 122.4, 117.7, 116.3; HRMS: $C_{13}H_9NO$ calculated 195.0684, found 195.0684; Registry Number: [1015-89-0].

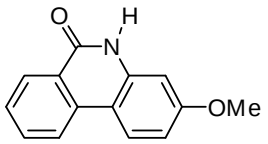


3-Methylphenanthridin-6(5*H*)-one (2b): White solid (81.4 mg, 86%), mp: 222–224 °C; IR (KBr): 3420, 3004, 2918, 1663, 1438, 1405, 1310, 1016, 952, 705 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ 11.59 (br, 1H), 8.43 (d, *J* = 7.8 Hz, 1H), 8.28 (dd, *J* = 7.8, 0.6 Hz, 1H), 8.24 (d, *J* = 7.8 Hz, 1H), 7.81 (td, *J* = 7.8, 1.2 Hz, 1H), 7.59 (t, *J* = 7.8 Hz, 1H), 7.15 (s, 1H), 7.08 (d, *J* = 8.4 Hz, 1H), 2.37 (s, 3H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 161.2, 139.6, 136.8, 134.6, 133.0, 127.7 (2C), 125.5, 123.8, 123.4, 122.6, 116.2, 115.5, 21.3; HRMS: $C_{14}H_{11}NO$ calculated 209.0841, found 209.0840; Registry Number: [39161-53-0].

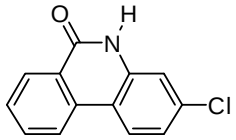


1,3-Dimethylphenanthridin-6(5*H*)-one (2c): White solid (74.8 mg, 67%), mp: 258–260 °C; IR (KBr): 3423, 3006, 2914, 1663, 1438, 1405, 1319, 1025, 952, 708, 664 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ 11.60 (br, 1H), 8.51 (d, *J* = 9.0 Hz, 1H), 8.38 (d, *J* = 7.8 Hz, 1H), 7.82 (t, *J* = 8.4 Hz, 1H), 7.61 (t, *J* = 7.2 Hz, 1H), 7.08 (s, 1H), 6.94 (s,

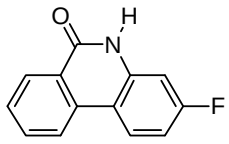
1H), 2.84 (s, 3H), 2.32 (s, 3H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 160.8, 138.3, 137.9, 135.8, 135.7, 132.3, 128.2, 127.8, 126.9, 126.6, 126.4, 114.9, 114.7, 25.8, 20.9; HRMS: $C_{15}H_{13}NO$ calculated 223.0997, found 223.0993; New compound.



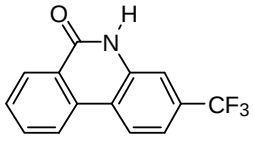
3-Methoxyphenanthridin-6(5*H*)-one (2d): White solid (87.8 mg, 78%), mp: 249–250 °C; IR (KBr): 3417, 3006, 2918, 1657, 1435, 1408, 1316, 1022, 955, 703 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ 11.55 (br, 1H), 8.33 (d, *J* = 8.4 Hz, 1H), 8.25 (td, *J* = 7.5, 0.6 Hz, 2H), 7.77 (td, *J* = 7.8, 1.2 Hz, 1H), 7.53 (t, *J* = 7.2 Hz, 1H), 6.88 (d, *J* = 2.4 Hz, 1H), 6.84 (dd, *J* = 9.0, 2.4 Hz, 1H), 3.81 (s, 3H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 161.4, 160.5, 138.3, 134.7, 132.9, 127.6, 126.9, 124.9, 124.6, 122.2, 111.3, 110.3, 99.7, 55.5; HRMS: $C_{14}H_{11}NO_2$ calculated 225.0790, found 225.0792; Registry Number: [38088-94-7].



3-Chlorophenanthridin-6(5*H*)-one (2e): White solid (82.7 mg, 72%), mp: 280–282 °C; IR (KBr): 3423, 3006, 2920, 1649, 1435, 1405, 1321, 1094, 1022, 952, 708, 669 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ 11.74 (br, 1H), 8.47 (d, *J* = 8.4 Hz, 1H), 8.39 (d, *J* = 9.0 Hz, 1H), 8.30 (d, *J* = 7.2 Hz, 1H), 7.85 (td, *J* = 7.8, 1.2 Hz, 1H), 7.65 (t, *J* = 7.2 Hz, 1H), 7.38 (d, *J* = 2.4 Hz, 1H), 7.28 (dd, *J* = 9.0, 2.4 Hz, 1H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 161.0, 137.8, 133.9, 133.7, 133.2, 128.5, 127.7, 125.7, 125.5, 123.0, 122.4, 116.8, 115.5; HRMS: $C_{13}H_8ClNO$ calculated 229.0294, found 229.0293; Registry Number: [20927-47-3].

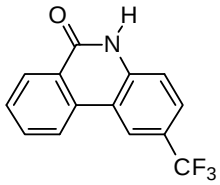


3-Fluorophenanthridin-6(5*H*)-one (2f): White solid (84.9 mg, 89%), mp: 266–268 °C; IR (KBr): 3428, 3003, 2912, 1646, 1438, 1405, 1316, 1019, 947, 708, 663 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ 11.76 (br, 1H), 8.46–8.42 (m, 2H), 8.29 (dd, *J* = 7.8, 1.2 Hz, 1H), 7.84 (td, *J* = 7.8, 1.2 Hz, 1H), 7.62 (t, *J* = 7.8 Hz, 1H), 7.12–7.09 (m, 2H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 162.6 (d, *J* = 243 Hz), 161.1, 138.3 (d, *J* = 12.0 Hz), 133.9, 133.1, 127.9, 127.6, 125.9 (d, *J* = 9.0 Hz), 125.2, 122.7, 114.6, 109.9 (d, *J* = 22.5 Hz), 102.2 (d, *J* = 24.0 Hz); HRMS: $C_{13}H_8NOF$ calculated 213.0590, found 213.0594; Registry Number: [220998-74-3].

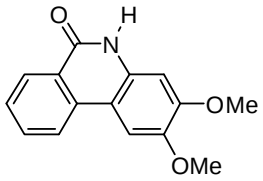


3-(Trifluoromethyl)phenanthridin-6(5*H*)-one (2g): White solid (111.9 mg, 85%), mp: 297–299 °C; IR (KBr): 3414, 3004, 2915, 1657, 1438, 1405, 1316, 1019, 952, 708 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ 11.88 (br, 1H), 8.56 (d, *J* = 8.4 Hz,

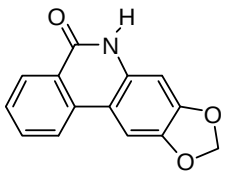
1H), 8.53 (d, *J* = 7.8 Hz, 1H), 8.32 (d, *J* = 7.8 Hz, 1H), 7.88 (td, *J* = 7.5, 0.6 Hz, 1H), 7.70 (t, *J* = 7.8 Hz, 1H), 7.65 (s, 1H), 7.51 (d, *J* = 8.4 Hz, 1H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 160.9, 136.8, 133.3, 133.2, 129.5 (q, *J* = 30.0 Hz), 129.4, 127.7, 126.5, 124.9, 124.1 (q, *J* = 270.5 Hz), 123.5, 121.0, 118.3 (q, *J* = 4.5 Hz), 113.0 (q, *J* = 4.5 Hz); HRMS: $C_{14}H_8F_3NO$ calculated 263.0558, found 263.0555; Registry Number: [263403-83-4].



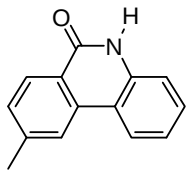
2-(Trifluoromethyl)phenanthridin-6(5*H*)-one (2h): White solid (121.1 mg, 92%), mp: 285–287 °C; IR (KBr): 3414, 3004, 2920, 1655, 1438, 1405, 1313, 1025, 952, 703 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ 11.98 (br, 1H), 8.70 (s, 1H), 8.65 (d, *J* = 8.4 Hz, 1H), 8.32 (d, *J* = 7.8 Hz, 1H), 7.87 (t, *J* = 7.8 Hz, 1H), 7.79 (d, *J* = 8.4 Hz, 1H), 7.69 (t, *J* = 7.2 Hz, 1H), 7.51 (d, *J* = 9.0 Hz, 1H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 161.1, 139.5, 133.5, 133.3, 129.0, 127.6, 126.1, 126.0, 124.7 (q, *J* = 270.0 Hz), 123.4, 122.9 (q, *J* = 31.5 Hz), 121.0, 117.9, 117.1; HRMS: $C_{14}H_8F_3NO$ calculated 263.0558, found 263.0559; Registry Number: [75121-11-8].



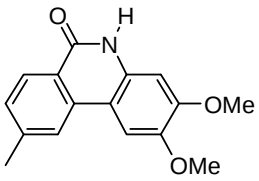
2,3-Dimethoxyphenanthridin-6(5*H*)-one (2i): Yellow solid (76.6 mg, 68%), mp: 253–255 °C; IR (KBr): 3417, 2998, 2918, 1655, 1430, 1399, 1316, 1025, 950, 705, 666 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ 11.48 (br, 1H), 8.42 (d, *J* = 8.4 Hz, 1H), 8.27 (dd, *J* = 8.4, 1.2 Hz, 1H), 7.79−7.76 (m, 2H), 7.52 (td, *J* = 7.8, 0.6 Hz, 1H), 6.95 (s, 1H), 3.88 (s, 3H), 3.81 (s, 3H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 160.9, 151.0, 145.3, 134.7, 132.6, 131.6, 127.6, 126.7, 124.9, 122.6, 110.2, 105.7, 99.3, 56.3, 55.7; HRMS: $C_{15}H_{13}NO_3$ calculated 255.0895, found 255.0891; Registry Number: [146776-43-4].



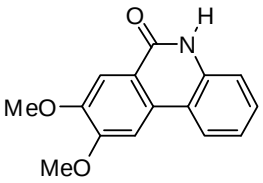
[1,3]Dioxolo[4,5-*b*]phenanthridin-5(6*H*)-one (2j): White solid (67.0 mg, 56%), mp: 320–322 °C; IR (KBr): 3412, 3001, 2923, 1649, 1435, 1408, 1316, 1013, 947, 713, 672 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ 11.55 (br, 1H), 8.36 (d, *J* = 8.4 Hz, 1H), 8.25 (d, *J* = 7.8 Hz, 1H), 7.93 (s, 1H), 7.77 (t, *J* = 7.8 Hz, 1H), 7.54 (t, *J* = 7.8 Hz, 1H), 6.89 (s, 1H), 6.09 (s, 2H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 160.8, 149.0, 144.0, 134.8, 132.8, 132.7, 127.5, 127.0, 124.6, 122.7, 111.4, 102.2, 101.8, 96.4; HRMS: $C_{14}H_9NO_3$ calculated 239.0582, found 239.0587; New compound.



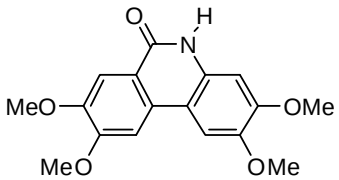
Phenaglydon (2k): White solid (75.3 mg, 72%), mp: 266–268 °C; IR (KBr): 3483, 3023, 2881, 1674, 1619, 1369, 755, 677 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ 11.57 (br, 1H), 8.33 (d, *J* = 7.8 Hz, 1H), 8.28 (s, 1H), 8.19 (d, *J* = 8.4 Hz, 1H), 7.46–7.42 (m, 2H), 7.33 (d, *J* = 9.6 Hz, 1H), 7.22 (t, *J* = 7.8 Hz, 1H), 2.51 (s, 3H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 161.0, 143.2, 136.9, 134.4, 129.6, 129.3, 127.7, 123.6, 123.4, 122.6, 122.3, 117.7, 116.3, 21.7; HRMS: $C_{14}H_{11}NO$ calculated 209.0841, found 209.0841; Registry Number: [107622-37-7].



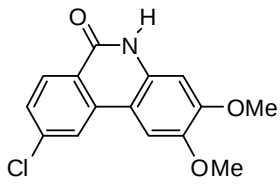
2,3-Dimethoxy-9-methylphenanthridin-6(5*H*)-one (2l): Yellow solid (111.8 mg, 83%), mp: 324–326 °C; IR (KBr): 3426, 3004, 2918, 1652, 1438, 1405, 1319, 1022, 953, 708 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ 11.35 (br, 1H), 8.25 (s, 1H), 8.14 (d, *J* = 8.4 Hz, 1H), 7.77 (s, 1H), 7.35 (d, *J* = 7.8 Hz, 1H), 6.91 (s, 1H), 3.89 (s, 3H), 3.80 (s, 3H), 2.51 (s, 3H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 160.9, 151.0, 145.2, 142.9, 134.7, 131.8, 128.0, 127.6, 122.6, 122.4, 110.2, 105.7, 99.3, 56.3, 55.7, 21.7; HRMS: $C_{16}H_{15}NO_3$ calculated 269.1052, found 269.1055; New compound.



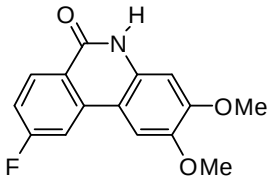
8,9-dimethoxyphenanthridin-6(5*H*)-one (2m): White solid (94.6 mg, 84%), mp: 262–264 °C; IR (KBr): 3434, 3004, 2923, 1657, 1441, 1408, 1313, 1025, 710, 672 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ 11.59 (br, 1H), 8.37 (d, *J* = 8.4 Hz, 1H), 7.86 (s, 1H), 7.70 (s, 1H), 7.42 (t, *J* = 7.8, 1H), 7.33 (d, *J* = 8.4 Hz, 1H), 7.22 (t, *J* = 7.8 Hz, 1H), 4.00 (s, 3H), 3.89 (s, 3H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 160.6, 153.5, 149.6, 136.2, 129.2, 128.7, 123.3, 122.1, 119.5, 117.8, 116.1, 108.1, 104.3, 56.3, 55.8; HRMS: $C_{15}H_{13}NO_3$ calculated 255.0895, found 255.0889; Registry Number: [50879-53-3].



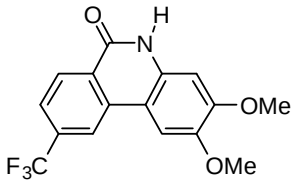
2,3,8,9-Tetramethoxyphenanthridin-6(5*H*)-one (2n): Yellow solid (111.9 mg, 71%), mp: 278–279 °C; IR (KBr): 3417, 3001, 2920, 1657, 1438, 1319, 1027, 955, 700 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ 11.44 (br, 1H), 7.74 (s, 1H), 7.74 (s, 1H), 7.66 (s, 1H), 6.95 (s, 1H), 4.02 (s, 3H), 3.90 (s, 3H), 3.87 (s, 3H), 3.80 (s, 3H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 160.5, 153.4, 150.4, 148.7, 145.1, 131.1, 129.6, 118.4, 110.4, 108.1, 106.2, 104.1, 99.3, 56.7, 56.4, 55.6 (2C); HRMS: $C_{17}H_{17}NO_5$ calculated 315.1107, found 315.1102; Registry Number: [146776-42-3].



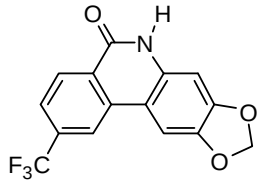
9-Chloro-2,3-dimethoxyphenanthridin-6(5*H*)-one (2o): Yellow solid (79.7 mg, 55%), mp: 328–330 °C; IR (KBr): 3425, 3001, 2918, 1652, 1438, 1405, 1313, 1022, 952, 708 cm^{-1}; ^1H NMR (600 MHz, DMSO-d_6): δ 11.55 (br, 1H), 8.59 (d, *J* = 1.8 Hz, 1H), 8.24 (d, *J* = 8.4 Hz, 1H), 7.83 (s, 1H), 7.55 (dd, *J* = 8.4, 1.8 Hz, 1H), 6.92 (s, 1H), 3.89 (s, 3H), 3.81 (s, 3H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 160.3, 151.7, 145.5, 138.3, 136.6, 132.2, 129.9, 126.9, 123.5, 122.3, 109.3, 106.0, 99.2, 56.5, 55.8; HRMS: $C_{15}H_{12}ClNO_3$ calculated 289.0506, found 289.0505; New compound.



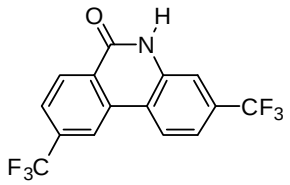
9-Fluoro-2,3-dimethoxyphenanthridin-6(5*H*)-one (2p): White solid (87.4 mg, 64%), mp: 307–308 °C; IR (KBr): 3423, 3001, 2915, 1655, 1435, 1410, 1319, 1013, 950, 705 cm^{-1}; ^1H NMR (600 MHz, DMSO-d_6): δ 11.46 (br, 1H), 8.31–8.28 (m, 2H), 7.76 (s, 1H), 7.34 (t, *J* = 8.4 Hz, 1H), 6.91 (s, 1H), 3.88 (s, 3H), 3.81 (s, 3H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 165.3 (d, *J* = 246.0 Hz), 160.3, 151.6, 145.4, 137.6 (d, *J* = 10.5 Hz), 132.2, 131.0 (d, *J* = 10.5 Hz), 121.6, 114.8 (d, *J* = 22.5 Hz), 109.7, 108.5 (d, *J* = 24.0 Hz), 106.2, 99.1, 56.4, 55.7; HRMS: $C_{15}H_{12}FNO_3$ calculated 273.0801, found 273.0803; New compound.



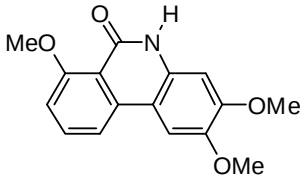
2,3-Dimethoxy-9-(trifluoromethyl)phenanthridin-6(5*H*)-one (2q): Yellow solid (114.8 mg, 71%), mp: 328–330 °C; IR (KBr): 3420, 3004, 2915, 1651, 1435, 1408, 1319, 1022, 952, 705 cm^{-1}; ^1H NMR (600 MHz, DMSO-d_6): δ 11.72 (br, 1H), 8.83 (s, 1H), 8.45 (d, *J* = 7.8 Hz, 1H), 7.94 (s, 1H), 7.82 (dd, *J* = 8.4, 1.2 Hz, 1H), 6.96 (s, 1H), 3.92 (s, 3H), 3.83 (s, 3H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 160.0, 151.8, 145.6, 135.3, 132.7 (q, *J* = 31.5 Hz), 132.1, 129.1, 127.4, 124.2 (q, *J* = 271.5 Hz), 122.4, 120.3, 109.5, 106.2, 99.2, 56.5, 55.7; HRMS: $C_{16}H_{12}F_3NO_3$ calculated 323.0769, found 323.0768; New compound.



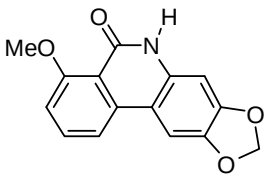
2-(Trifluoromethyl)-[1,3]dioxolo[4,5-*b*]phenanthridin-5(6*H*)-one (2r): White solid (92.2 mg, 60%), mp: 336–338 ^oC; IR (KBr): 3420, 3006, 2920, 2121, 1652, 1441, 1410, 1316, 1025, 953, 714 cm^{-1}; ^1H NMR (600 MHz, DMSO-d_6): δ 11.82 (br, 1H), 8.74 (s, 1H), 8.43 (d, *J* = 7.8 Hz, 1H), 8.16 (s, 1H), 7.83 (d, *J* = 8.4 Hz, 1H), 6.91 (s, 1H), 6.12 (s, 2H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 160.0, 149.8, 144.3, 135.4, 133.4, 132.6 (q, *J* = 30.0 Hz), 129.1, 127.2, 124.2 (q, *J* = 273.0 Hz), 122.7, 120.3, 110.8, 102.7, 102.1, 96.5; HRMS: $C_{15}H_8F_3NO_3$ calculated 307.0456, found 307.0462; New compound.



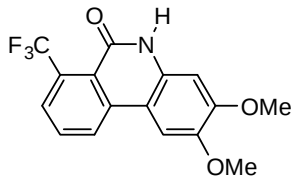
3,9-Bis(trifluoromethyl)phenanthridin-6(*5H*)-one (2s): Pale yellow solid (142.4 mg, 86%), mp: 270–271 °C; IR (KBr): 3425, 3015, 2920, 1652, 1438, 1402, 1322, 1019, 958, 716 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ 12.05 (s, 1H), 8.83 (s, 1H), 8.70 (d, *J* = 8.4 Hz, 1H), 8.44 (d, *J* = 8.4 Hz, 1H), 7.95 (d, *J* = 8.4 Hz, 1H), 7.62 (s, 1H), 7.49 (d, *J* = 8.4 Hz, 1H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 159.9, 137.2, 133.8, 133.1 (q, *J* = 31.5 Hz), 130.3 (q, *J* = 31.5 Hz), 129.2, 129.2, 125.6, 125.2, 124.0 (q, *J* = 271.5, $2CF_3$), 121.0, 120.0. 118.5, 113.1 (q, *J* = 4.5 Hz); HRMS: $C_{15}H_7F_6NO$ calculated 331.0432, found 331.0430; New compound.



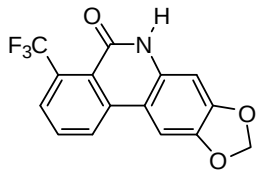
2,3,7-Trimethoxyphenanthridin-6(5*H*)-one (2t): Yellow solid (89.9 mg, 63%), mp: 268–270 °C; IR (KBr): 3417, 3006, 2920, 1646, 1435, 1410, 1316, 1022, 950, 711, 669 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ 11.07 (br, 1H), 7.94 (d, *J* = 7.8 Hz, 1H), 7.68–7.66 (m, 2H), 7.06 (d, *J* = 7.8 Hz, 1H), 6.84 (s, 1H), 3.85 (s, 3H), 3.84 (s, 3H), 3.79 (s, 3H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 161.2, 159.7, 151.3, 145.0, 137.6, 133.4, 132.3, 114.5, 114.0, 109.7, 109.6, 106.3, 98.4, 56.4, 56.1, 55.7; HRMS: $C_{16}H_{15}NO_4$ calculated 285.1001, found 285.1000; New compound.



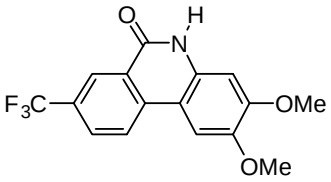
4-Methoxy-[1,3]dioxolo[4,5-*b*]phenanthridin-5(6*H*)-one (2u): Yellow solid (76.7 mg, 57%), mp: 284–286 °C; IR (KBr): 3431, 3001, 2918, 1649, 1438, 1319, 1022, 950, 708 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ 11.15 (br, 1H), 7.87 (d, *J* = 8.4 Hz, 1H), 7.83 (s, 1H), 7.65 (t, *J* = 8.4 Hz, 1H), 7.06 (d, *J* = 8.4 Hz, 1H), 6.79 (s, 1H), 6.06 (s, 2H), 3.84 (s, 3H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 161.1, 159.5, 149.2, 143.7, 137.6, 133.5, 133.4, 114.4, 113.9, 110.9, 109.7, 102.6, 101.7, 95.6, 56.0; HRMS: $C_{15}H_{11}NO_4$ calculated 269.0688, found 269.0685; New compound.



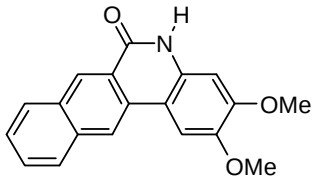
2,3-Dimethoxy-7-(trifluoromethyl)phenanthridin-6(5*H*)-one (2v): White solid (100.2 mg, 62%), mp: 322–324 °C; IR (KBr): 3417, 3006, 2915, 1657, 1438, 1413, 1319, 1022, 963, 705, 666 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ 11.56 (br, 1H), 8.81 (d, *J* = 8.4 Hz, 1H), 7.95 (d, *J* = 7.8 Hz, 1H), 7.91 (t, *J* = 7.8 Hz, 1H), 7.83 (s, 1H), 6.94 (s, 1H), 3.89 (s, 3H), 3.83 (s, 3H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 158.3, 151.9, 145.3, 137.5, 132.2, 131.9, 128.9 (q, *J* = 31.5 Hz), 127.8, 126.4, 124.1 (q, *J* = 271.5 Hz), 122.1, 109.2, 106.2, 98.5, 56.4, 55.7; HRMS: $C_{16}H_{12}F_3NO_3$ calculated 323.0769, found 323.0765; New compound.



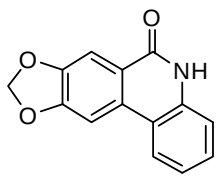
4-(Trifluoromethyl)-[1,3]dioxolo[4,5-*b*]phenanthridin-5(6*H*) -one (2w): White solid (78.3 mg, 51%), mp: 346–348 °C; IR (KBr): 3420, 3001, 2918, 1652, 1435, 1405, 1316, 1019, 955, 708 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ 11.65 (br, 1H), 8.70 (d, *J* = 8.4 Hz, 1H), 7.97 (s, 1H), 7.95 (d, *J* = 7.2 Hz, 1H), 7.89 (t, *J* = 7.8 Hz, 1H), 6.87 (s, 1H), 6.11 (s, 2H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 158.2, 149.8, 144.1, 137.6, 133.4, 132.0, 128.8 (q, *J* = 31.5 Hz), 127.8, 126.6, 124.2 (q, *J* = 271.5 Hz), 121.9, 110.4, 102.5, 102.0, 95.8; HRMS: $C_{15}H_8F_3NO_3$ calculated 307.0456, found 307.0461; New compound.



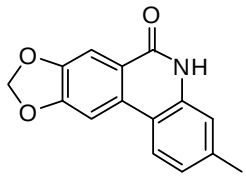
2,3-Dimethoxy-8-(trifluoromethyl)phenanthridin-6(5*H*) -one (2x): White solid (151.9 mg, 94%), mp: 299–300 °C; IR (KBr): 3423, 3006, 2912, 1655, 1438, 1405, 1319, 1025, 955, 705 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ 11.75 (br, 1H), 8.69 (d, *J* = 9.0 Hz, 1H), 8.50 (s, 1H), 8.08 (dd, *J* = 8.4, 1.8 Hz, 1H), 7.86 (s, 1H), 6.96 (s, 1H), 3.90 (s, 3H), 3.84 (s, 3H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 160.1, 152.2, 145.6, 137.9, 132.7, 128.4, 126.7 (q, *J* = 31.5 Hz), 124.7, 124.6, 124.3 (q, *J* = 270.0 Hz), 124.3, 109.2, 106.1, 99.3, 56.3, 55.8; HRMS: $C_{16}H_{12}F_3NO_3$ calculated 323.0769, found 323.0763; New compound.



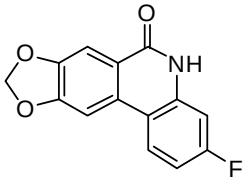
2,3-Dimethoxybenzo[*j*]phenanthridin-6(5*H*)-one (2y): Yellow solid (137.4 mg, 90%), mp: 284–286 °C; IR (KBr): 3425, 3004, 2918, 1652, 1438, 1405, 1313, 1019, 950, 703 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ 11.33 (br, 1H), 8.98 (s, 1H), 8.92 (s, 1H), 8.17 (d, *J* = 7.8 Hz, 1H), 8.13 (d, *J* = 7.8 Hz, 1H), 7.96 (s, 1H), 7.68 (t, *J* = 7.2 Hz, 1H), 7.57(t, *J* = 7.8 Hz, 1H), 6.94 (s, 1H), 3.94 (s, 3H), 3.83 (s, 3H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 161.2, 150.9, 145.3, 135.1, 131.2, 131.1, 131.0, 129.3, 128.7, 128.5, 127.9, 126.3, 123.7, 120.8, 110.4, 106.3, 99.7, 56.4, 55.7; HRMS: $C_{19}H_{15}NO_3$ calculated 305.1052, found 305.1053; New compound.



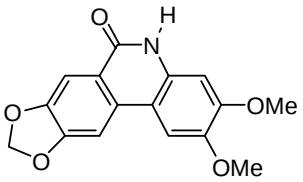
Crinasiadine (2z): White solid (86.1 mg, 72%), mp: 365–367 ^{o}C; IR (KBr): 3414, 3004, 2915, 1657, 1435, 1408, 1319, 1019, 950, 703 cm^{-1}; ^{1}H NMR (600 MHz, DMSO-d_6): δ 11.61 (br, 1H), 8.28 (d, *J* = 8.4 Hz, 1H), 8.03 (s, 1H), 7.63 (s, 1H), 7.42 (t, *J* = 7.8 Hz, 1H), 7.32 (d, *J* = 7.8 Hz, 1H), 7.20 (t, *J* = 7.2 Hz, 1H), 6.22 (s, 2H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 160.3, 152.3, 148.2, 136.1, 131.4, 128.9, 123.3, 122.2, 121.2, 117.9, 116.1, 105.2, 102.4, 101.7; HRMS: $C_{14}H_9NO_3$ calculated 239.0582, found 239.0581; Registry Number: [40141-86-4].



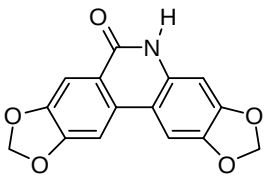
3-Methyl-[1,3]dioxolo[4,5-*j*]phenanthridin-6(5*H*)-one (C1): White solid (82.3 mg, 65%), mp: 332–334 °C; IR (KBr): 3420, 3004, 2915, 1652, 1441, 1405, 1322, 1019, 958, 708 cm^{-1}; ^1H NMR (600 MHz, DMSO-d_6): δ 11.52 (br, 1H), 8.15 (d, *J* = 8.4 Hz, 1H), 7.96 (s, 1H), 7.60 (s, 1H), 7.11 (s, 1H), 7.03 (d, *J* = 8.4 Hz, 1H), 6.20 (s, 2H), 2.36 (s, 3H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 160.5, 152.3, 147.9, 138.7, 136.1, 131.5, 123.5, 123.3, 120.7, 115.9, 115.6, 105.2, 102.3, 101.5, 21.2; HRMS: $C_{15}H_{11}NO_3$ calculated 253.0739, found 253.0738; New compound.



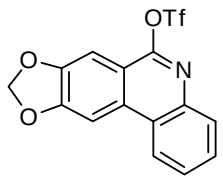
3-Fluoro-[1,3]dioxolo[4,5-*j*]phenanthridin-6(*5H*)-one (C2): White solid (68.2 mg, 53%), mp: 364–366 °C; IR (KBr): 3395, 3009, 2918, 1668, 1438, 1408, 1249, 1013, 952, 716 cm^{-1}; ^1H NMR (600 MHz, DMSO-d_6): δ 11.7 (br, 1H), 8.35 (dd, *J* = 8.4, 6.0 Hz, 1H), 8.00 (s, 1H), 7.61 (s, 1H), 7.09–7.05 (m, 2H), 6.22 (s, 2H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 162.2 (d, *J* = 243.0 Hz), 160.5, 152.5, 148.1, 137.6 (d, *J* = 10.5 Hz), 131.0, 125.9 (d, *J* = 9 Hz), 120.5, 114.8, 109.8 (d, *J* = 22.5 Hz), 105.2, 102.5, 101.9 (d, *J* = 25.5 Hz), 101.8; HRMS: $C_{14}H_8FNO_3$ calculated 257.0488, found: 257.0485; New compound.



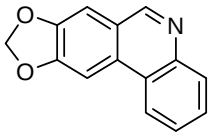
2,3-Dimethoxy-[1,3]dioxolo[4,5-*j*]phenanthridin-6(5*H*)-one (C3): Yellow solid (70.3 mg, 47%), mp: 345–346 °C; IR (KBr): 3420, 3004, 2918, 1649, 1441, 1408, 1316, 1022, 950, 703 cm^{-1}; ^1H NMR (600 MHz, DMSO-d_6): δ 11.40 (br, 1H), 8.02 (s, 1H), 7.70 (s, 1H), 7.58 (s, 1H), 6.89 (s, 1H), 6.19 (s, 2H), 3.87 (s, 3H), 3.79 (s, 3H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 160.2, 152.2, 150.5, 147.2, 145.2, 131.8, 130.9, 120.0, 110.6, 105.9, 105.1, 102.2, 101.6, 99.0, 56.4, 55.7; HRMS: $C_{16}H_{13}NO_5$ calculated 299.0794, found 299.0790; New compound.



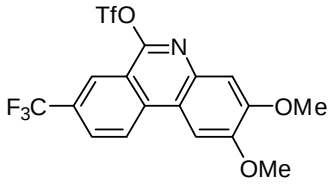
Bis([1,3]dioxolo)[4,5-*b*:4',5'-*j*]phenanthridin-6(*5H*)-one (C4): White solid (45.3 mg, 32%), mp:390–392 °C; IR (KBr): 3417, 3009, 2920, 1655, 1435, 1408, 1316, 1019, 955, 705 cm^{-1}; ^1H NMR (600 MHz, DMSO-d_6): δ 11.53 (br, 1H), 7.91 (s, 1H), 7.86 (s, 1H), 7.57 (s, 1H), 6.86 (s, 1H), 6.18 (s, 2H), 6.07 (s, 2H); ^{13}C NMR (150 MHz, DMSO-d_6): δ 160.2, 152.2, 148.4, 147.4, 143.8, 132.0, 131.9, 119.9, 111.7, 105.0, 102.2, 102.1, 101.7, 101.5, 96.2; HRMS: $C_{15}H_9NO_5$ calculated 283.0481, found 283.0484; New compound.



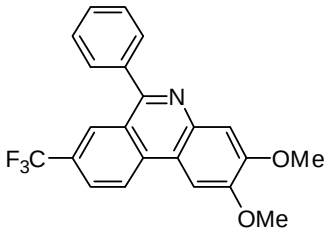
[1,3]Dioxolo[4,5-*j*]phenanthridin-6-yltrifluoromethanesulfonate (3a): White solid (139.2 mg, 75%), mp: 162–164 °C; IR (KBr): 3414, 3009, 2918, 1660, 1441, 1405, 1322, 1022, 955, 708 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.27 (d, *J* = 7.8 Hz, 1H), 8.00 (d, *J* = 7.8 Hz, 1H), 7.84 (s, 1H), 7.69 (t, *J* = 7.2 Hz, 1H), 7.64 (td, *J* = 7.8, 0.6 Hz, 1H), 7.43 (s, 1H), 6.19 (s, 2H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 152.7, 151.1, 149.1, 140.9, 134.5, 129.5, 129.0, 127.5, 124.5, 122.0, 118.7 (q, *J* = 318.0 Hz), 114.4, 102.5, 101.2, 100.6; HRMS: $C_{15}H_8F_3NO_5S$ calculated 371.0075, found 371.0078; New compound.



Trisphaeridine (3b): Yellow solid (101.6 mg, 91%), mp: 140–142 °C; IR (KBr): 3414, 3006, 2918, 1660, 1494, 1466, 1435, 1316, 1260, 1027, 950, 758, 706 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$): δ 9.06 (s, 1H), 8.33 (d, *J* = 8.4 Hz, 1H), 8.13 (d, *J* = 8.4 Hz, 1H), 7.85 (s, 1H), 7.67 (td, *J* = 8.4, 1.2 Hz, 1H), 7.60 (td, *J* = 7.8, 0.6 Hz, 1H), 7.28 (s, 1H), 6.13 (s, 2H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 151.7, 151.4, 148.1, 144.1, 130.1, 130.0, 127.9, 126.6, 124.2, 123.0, 121.9, 105.4, 101.9, 99.8; HRMS: $C_{14}H_9NO_2$ calculated 223.0633, found 223.0628; Registry Number: [224-11-3].

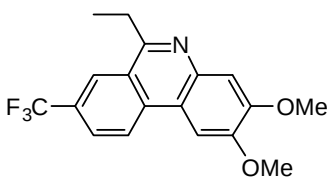


2,3-Dimethoxy-8-(trifluoromethyl)phenanthridin-6-yltrifluoromethanesulfonate (3c): White solid (1.30 g, 95%, 3 mmole scale), mp: 147–149 °C; IR (KBr): 3425, 3004, 2915, 1646, 1507, 1416, 1360, 1016, 952, 905 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.55 (d, *J* = 9.0 Hz, 1H), 8.40 (s, 1H), 8.05 (d, *J* =8.4 Hz, 1H), 7.76 (s, 1H), 7.44 (s, 1H), 4.13 (s, 3H), 4.08 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 152.7, 150.7, 150.0, 137.9, 137.4, 129.3 (q, *J* = 33.0 Hz), 127.7, 123.5 (q, *J* = 270.0 Hz), 123.2, 121.7, 118.7 (q, *J* = 318.0 Hz), 118.0, 116.7, 109.6, 102.1, 56.4, 56.3; HRMS: $C_{17}H_{11}F_6NO_5S$ calculated 455.0262, found 455.0246; New compound.

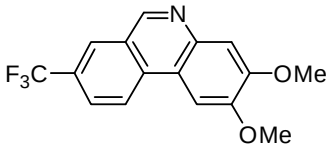


2,3-Dimethoxy-6-phenyl-8-(trifluoromethyl)phenanthridine (3d): White solid (141.8 mg, 74%), mp: 166–168 °C; IR (KBr): 3004, 2918, 1663, 1505, 1444, 1410, 1316, 1025, 958, 708 cm^{-1}; ^{1}H NMR (600 MHz, $CDCl_3$): δ 8.62 (d, *J* = 8.4 Hz, 1H), 8.38 (s, 1H), 7.97 (d, *J* = 9.0 Hz, 1H), 7.86 (s, 1H), 7.71 (d, *J* =7.2 Hz, 2H), 7.67 (s, 1H), 7.58 (t, *J* = 7.8, 2H), 7.55 (t, *J* = 7.2 Hz, 1H), 4.15 (s, 3H), 4.06 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 159.1, 152.0, 150.0, 140.9, 139.1, 134.9, 129.7 (2C), 128.9, 128.7 (2C), 127.8 (q, *J* = 33.0 Hz), 126.3 (q, *J* = 3.0 Hz), 125.8, 124.0 (q, *J* = 271.5 Hz), 123.5, 122.8, 117.1, 110.4, 101.7, 56.2 (2C); HRMS: $C_{22}H_{16}F_3NO_2$ calculated 383.1133,

found 383.1127; New compound.



2,3-Dimethoxy-8-(trifluoromethyl)phenanthridine (3e): Yellow solid (46.9 mg, 28%), mp: 127–129 °C; IR (KBr): 3001, 2920, 1652, 1438, 1405, 1316, 1027, 952, 705 cm^{-1}; ^1H NMR (600 MHz, $CDCl_3$): δ 8.59 (d, *J* = 8.4 Hz, 1H), 8.50 (s, 1H), 7.96 (dd, *J* = 8.4, 1.2 Hz, 1H), 7.82 (s, 1H), 7.57 (s, 1H), 4.13 (s, 3H), 4.08 (s, 3H), 3.42 (q, *J* = 7.8 Hz, 2H), 1.52 (t, *J* = 7.8 Hz, 3H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 161.1, 151.9, 149.4, 140.9, 134.6, 127.8 (q, *J* = 31.5 Hz), 125.6, 124.2 (q, *J* = 270.0 Hz), 123.8 (q, *J* = 3.0 Hz), 123.4, 123.1, 116.8, 109.9, 101.9, 56.4, 56.2, 29.0, 13.6; HRMS: $C_{18}H_{16}F_3NO_2$ calculated 335.1133, found 335.1125; New compound.



2,3-Dimethoxy-8-(trifluoromethyl)phenanthridine (3f): Yellow solid (124.4 mg, 81%), mp: 160–162 °C; IR (KBr): 3006, 2920, 1668, 1619, 1505, 1416, 1224, 1130, 1016, 952, 900, 811 cm^{-1}; ^1H NMR (600 MHz, $CDCl_3$): δ 9.20 (s, 1H), 8.53 (d, *J* = 9.0 Hz, 1H), 8.29 (s, 1H), 7.96 (d, *J* =8.4 Hz, 1H), 7.81 (s, 1H), 7.60 (s, 1H), 4.13 (s, 3H), 4.08 (s, 3H); ^{13}C NMR (150 MHz, $CDCl_3$): δ 151.9, 151.0, 150.0, 141.6, 134.0, 128.2 (q, *J* = 33.0 Hz), 126.3 (q, *J* = 3.0 Hz), 126.2, 124.7, 124.0 (q, *J* = 270.0 Hz), 122.5, 117.5, 110.1, 101.8, 56.2, 56.2; HRMS: $C_{16}H_{12}F_3NO_2$ calculated 307.0820, found 307.0824; New compound.

References

(1) Urawa, Y.; Naka, H.; Miyazawa, M.; Souda, S.; Ogura, K. *J. Organomet. Chem.* **2002**, *653*, 269.

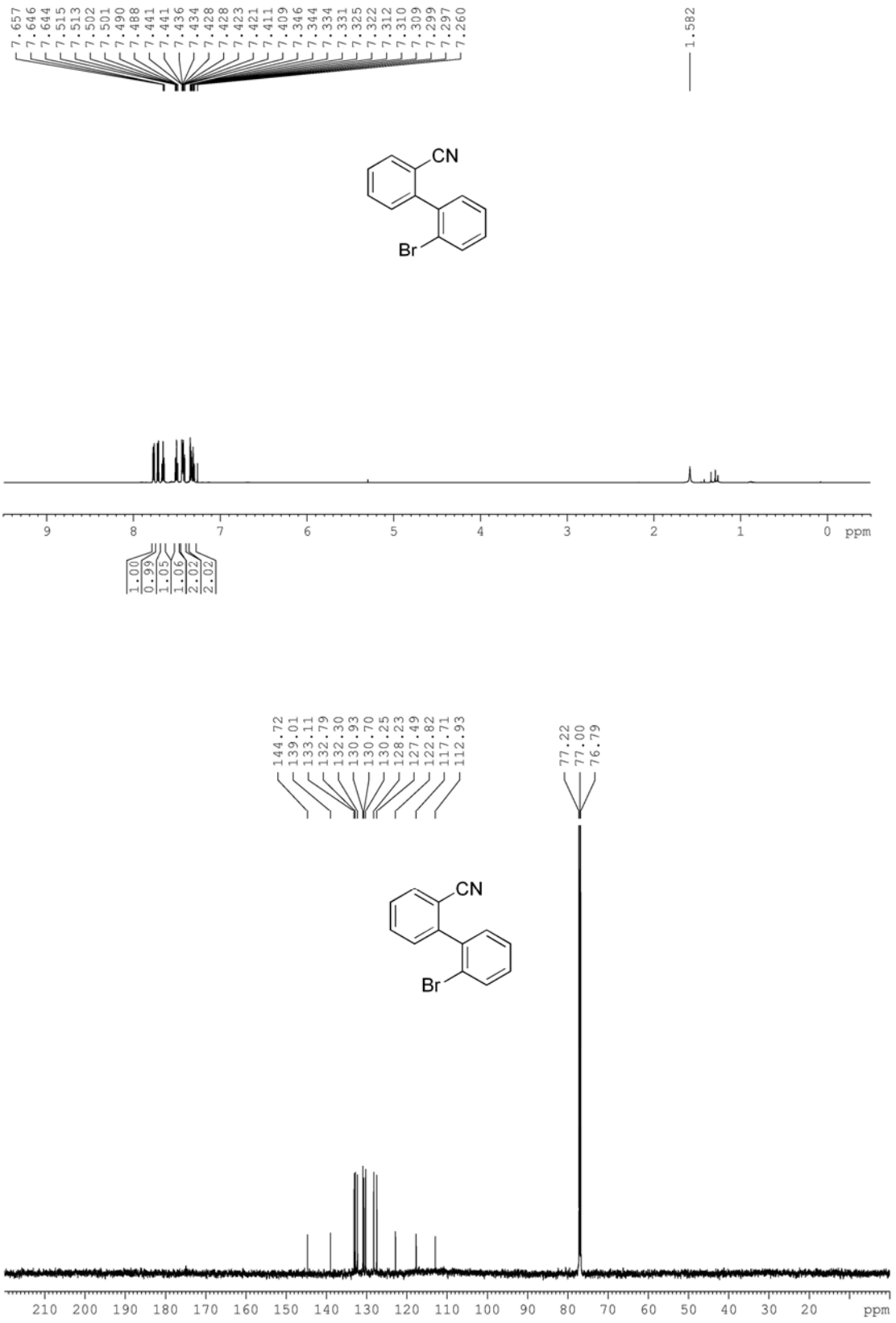
(2) Wan, J.-C.; Huang, J.-M.; Jhan, Y.-H.; Hsieh, J.C. *Org. Lett.* **2013,** *15*, 2742.

(3) Lysén, M.; Hansen, H. M.; Begtrup, M.; Kristensen, J. L. *J. Org. Chem.* **2006**, *71*, 2518.

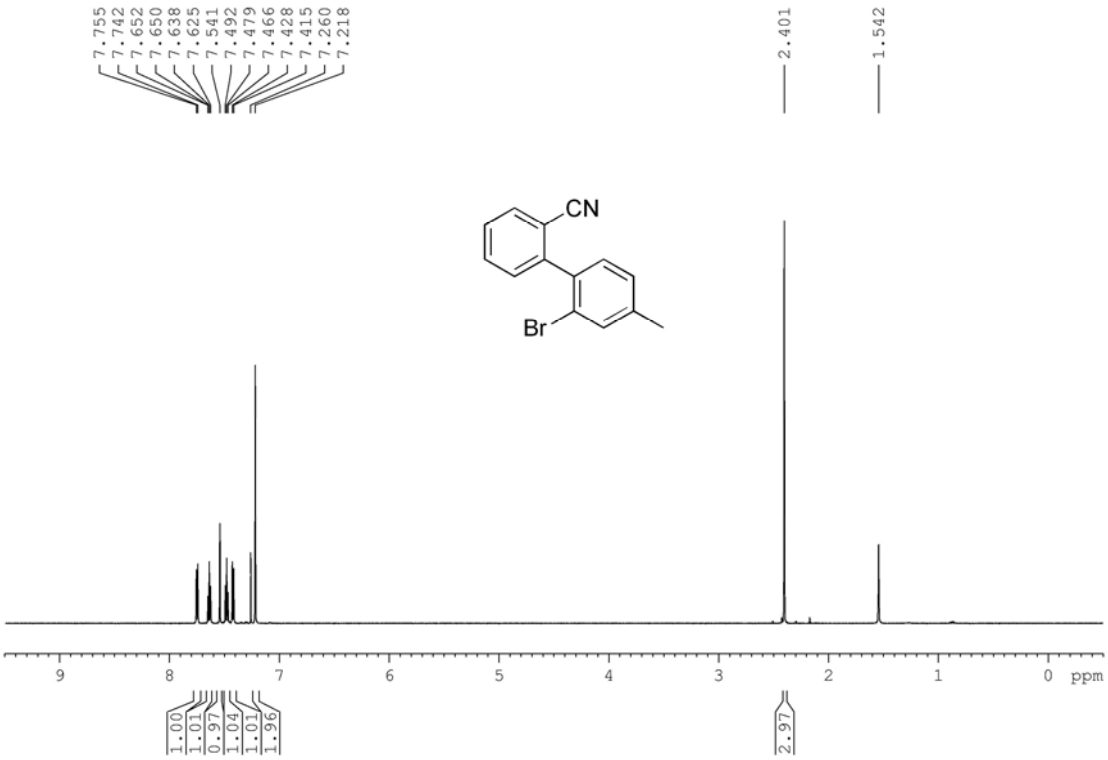
(4) Rokade, B. V.; Prabhu, K. R. *J. Org. Chem.* **2012**, *77*, 5364.

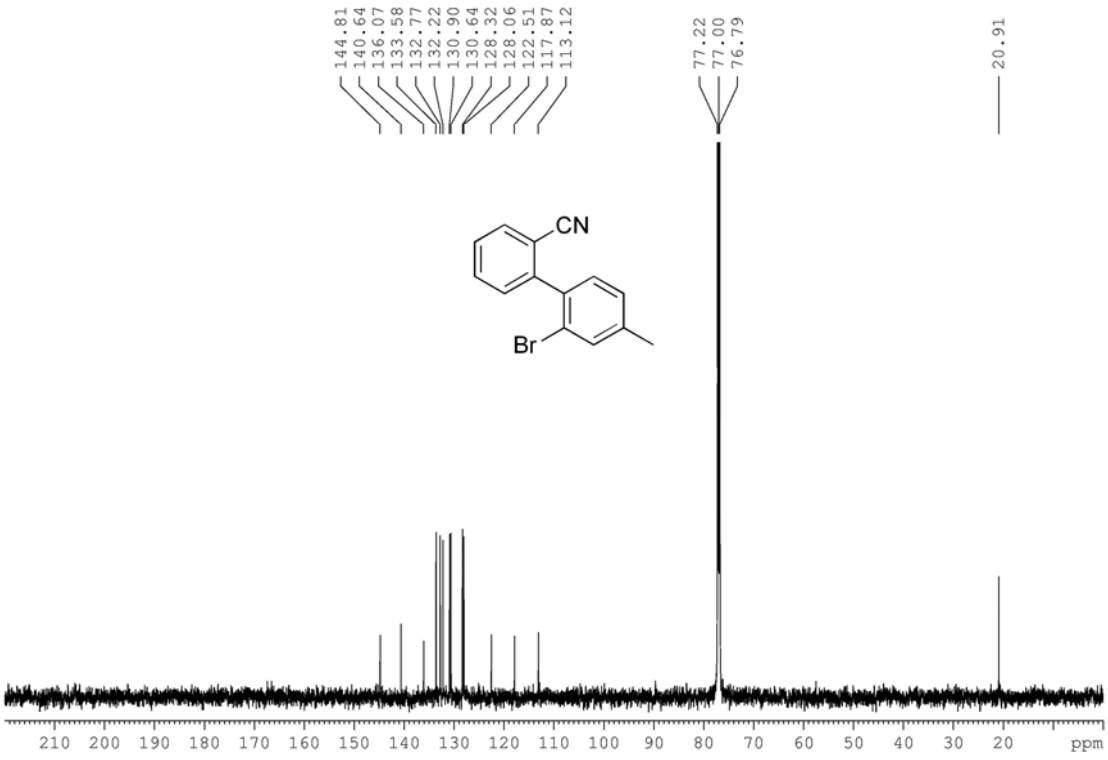
^{1}H and ^{13}C NMR Spectra for Substartes (600 MHz, $CDCl_3$)

2'-Bromo-[1,1'-biphenyl]-2-carbonitrile (1a)

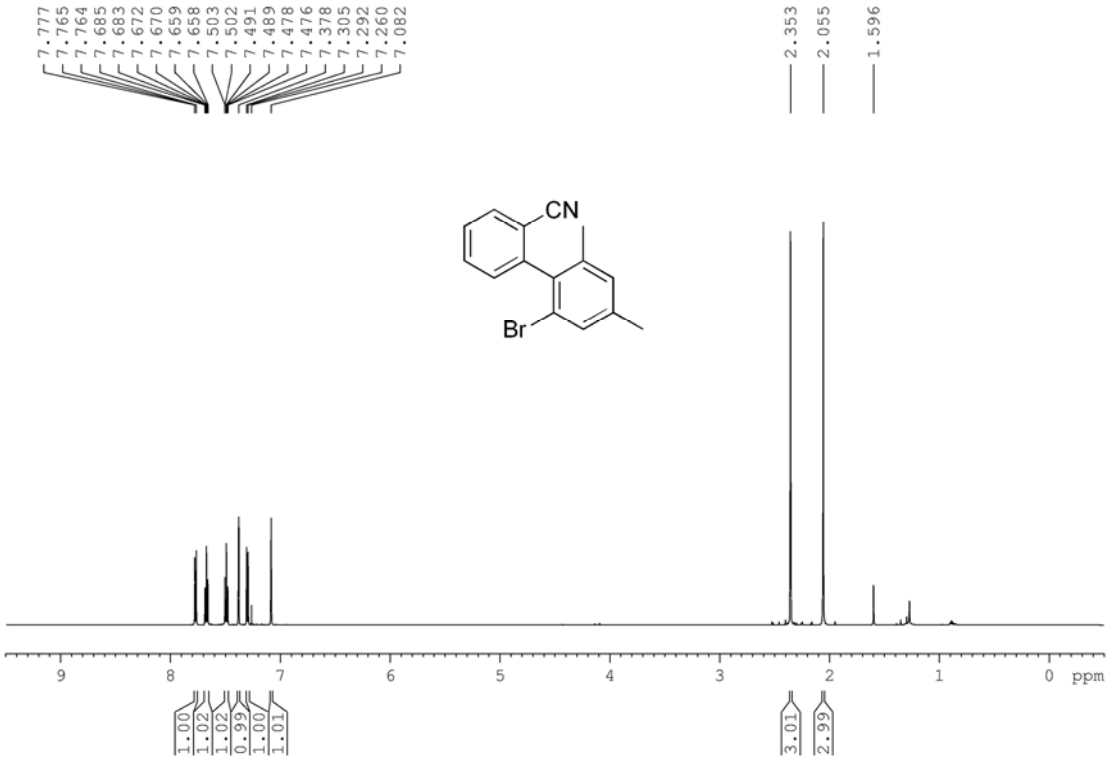


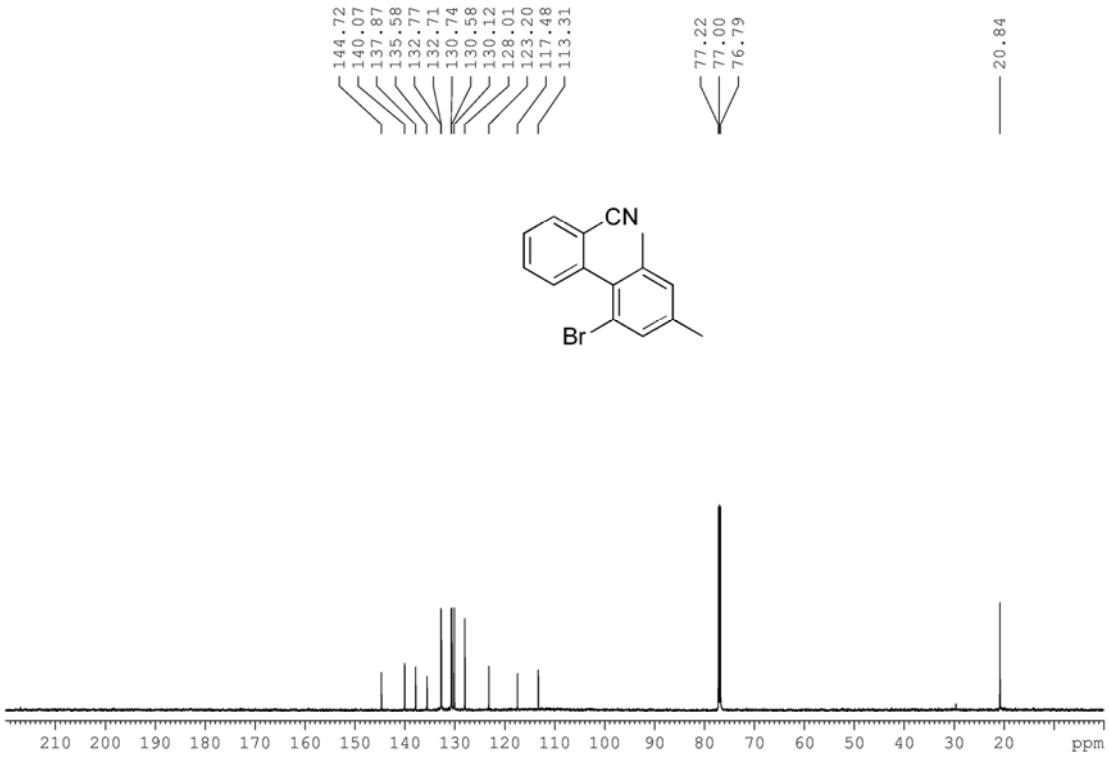
2'-Bromo-4'-methyl-[1,1'-biphenyl]-2-carbonitrile (1b)



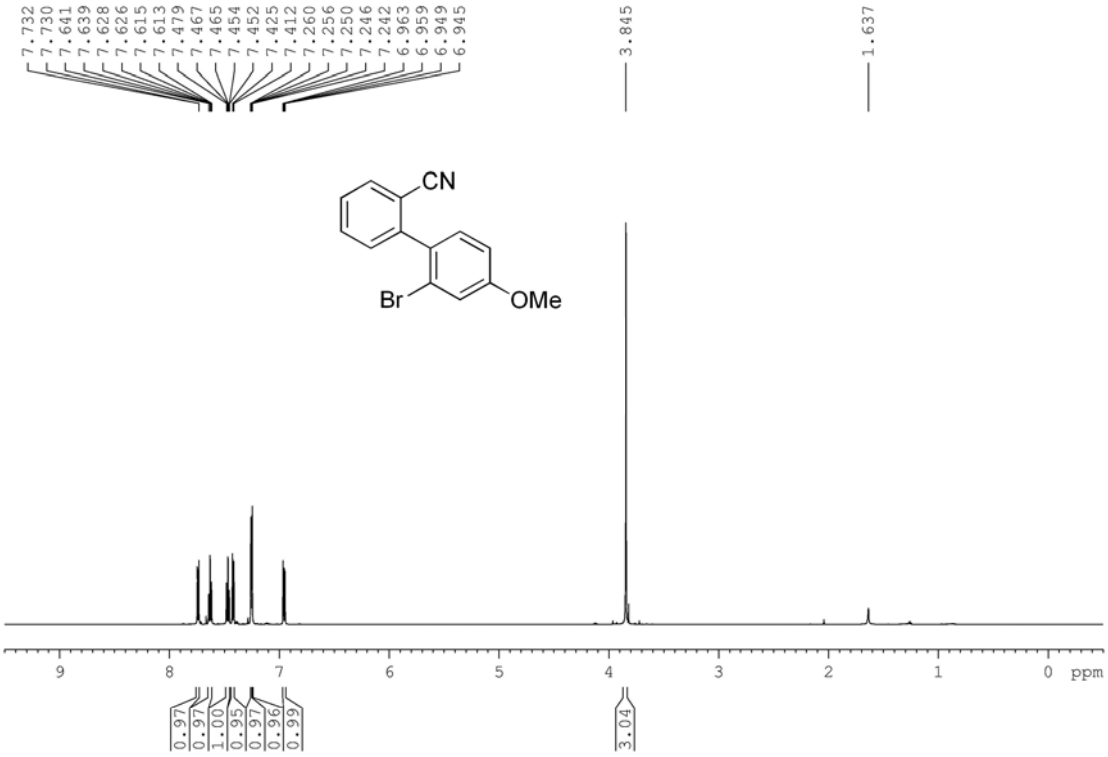


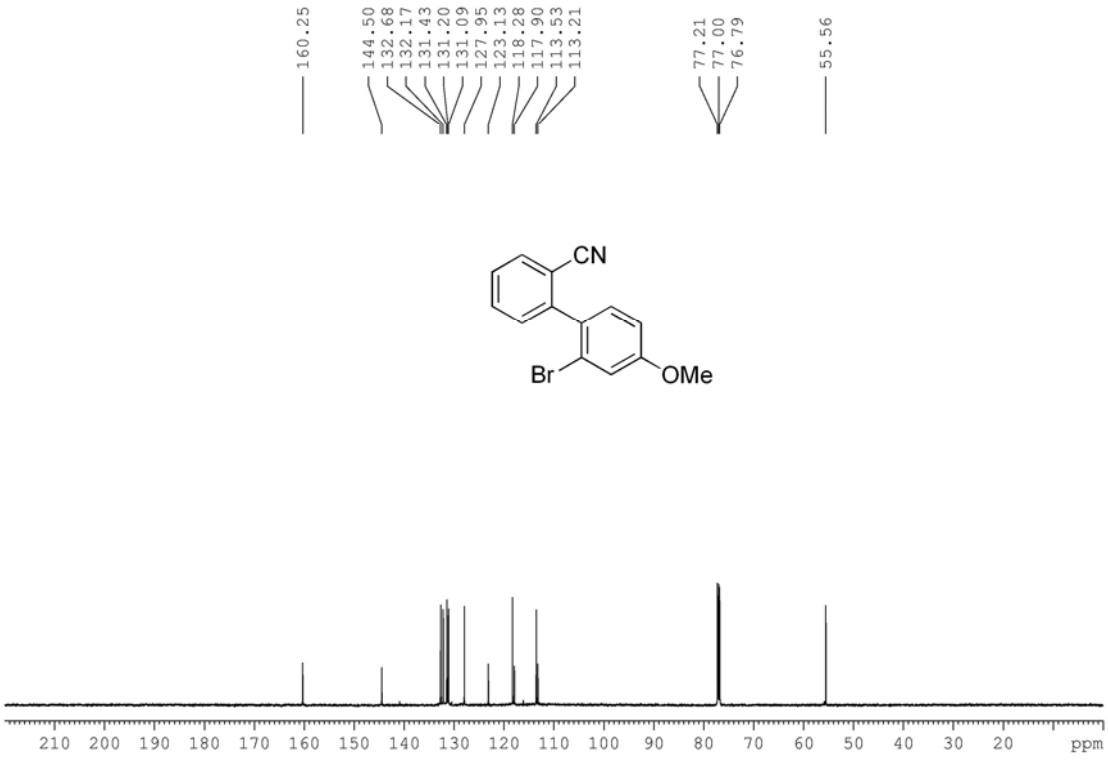
2'-Bromo-4',6'-dimethyl-[1,1'-biphenyl]-2-carbonitrile (1c)



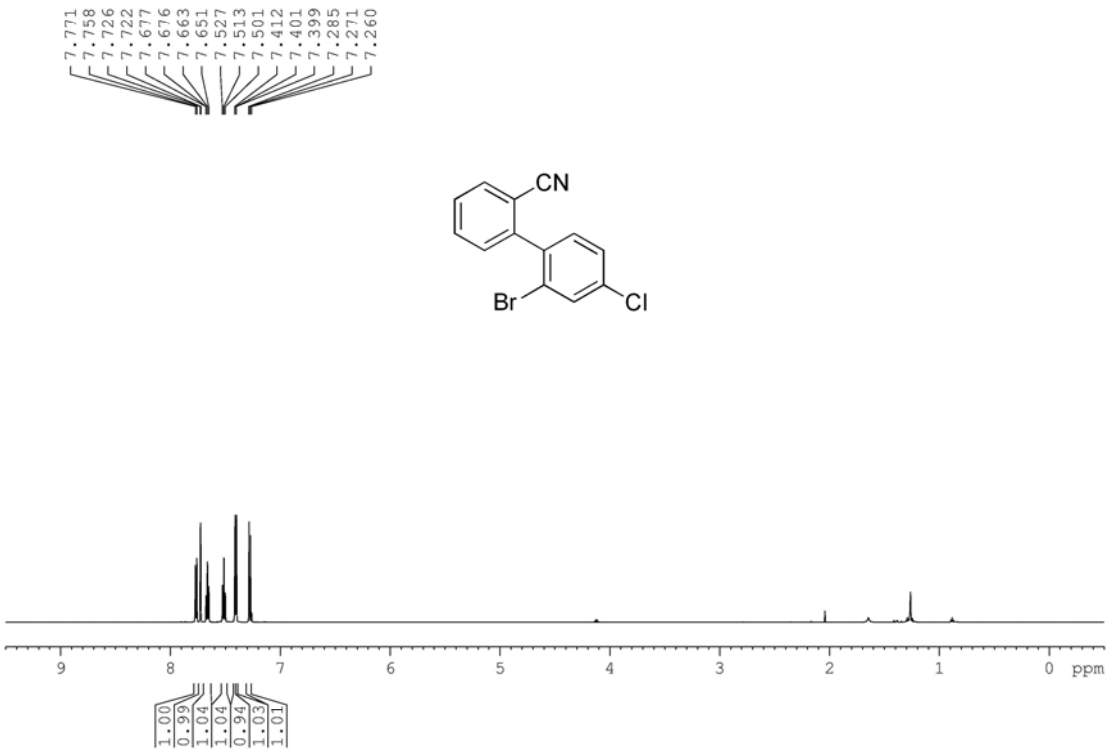


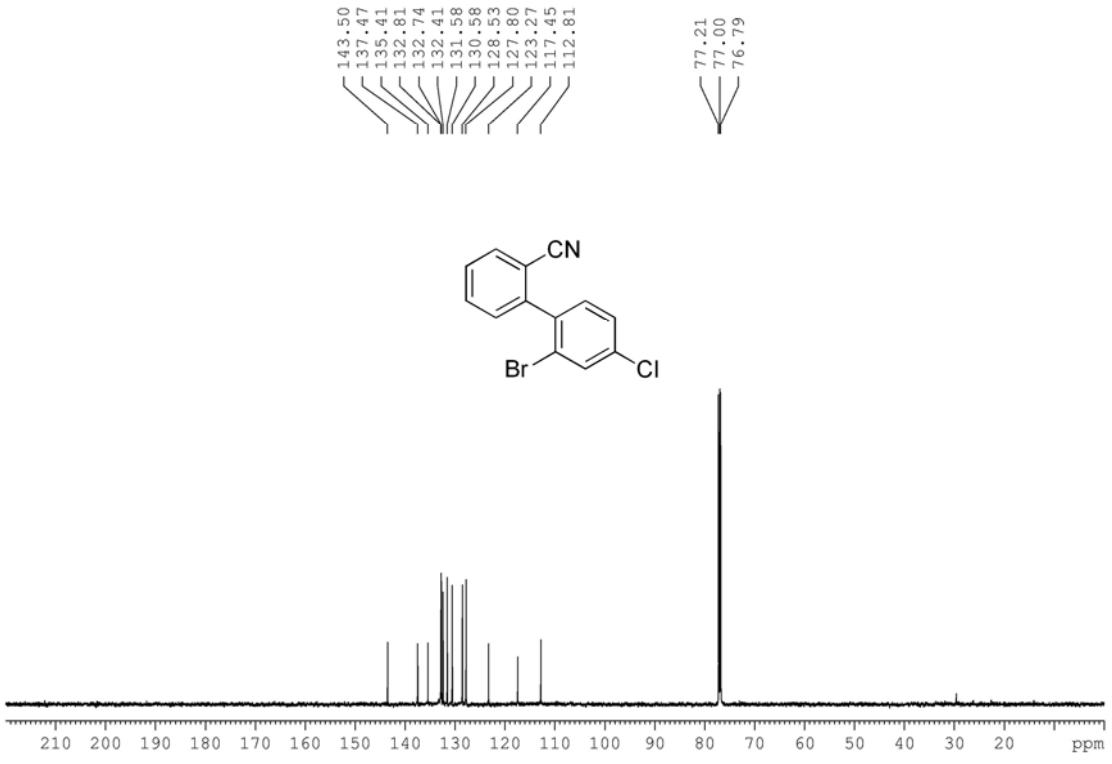
2'-Bromo-4'-methoxy-[1,1'-biphenyl]-2-carbonitrile (1d)



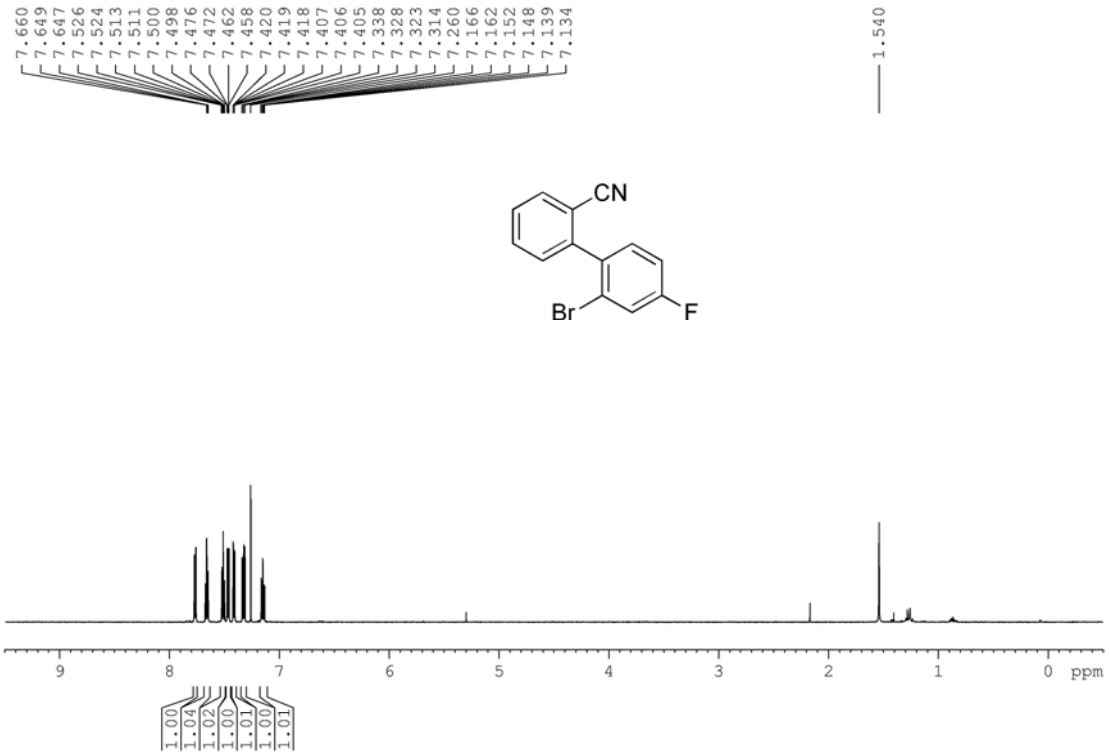


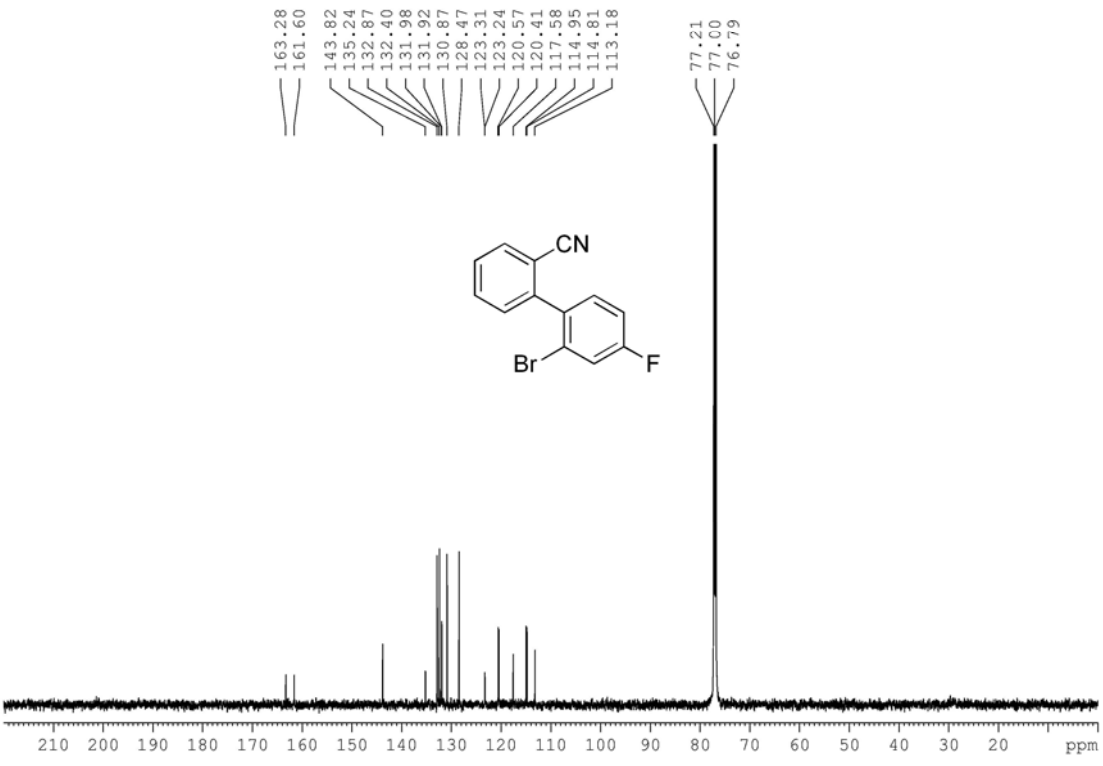
2'-Bromo-4'-chloro-[1,1'-biphenyl]-2-carbonitrile (1e)



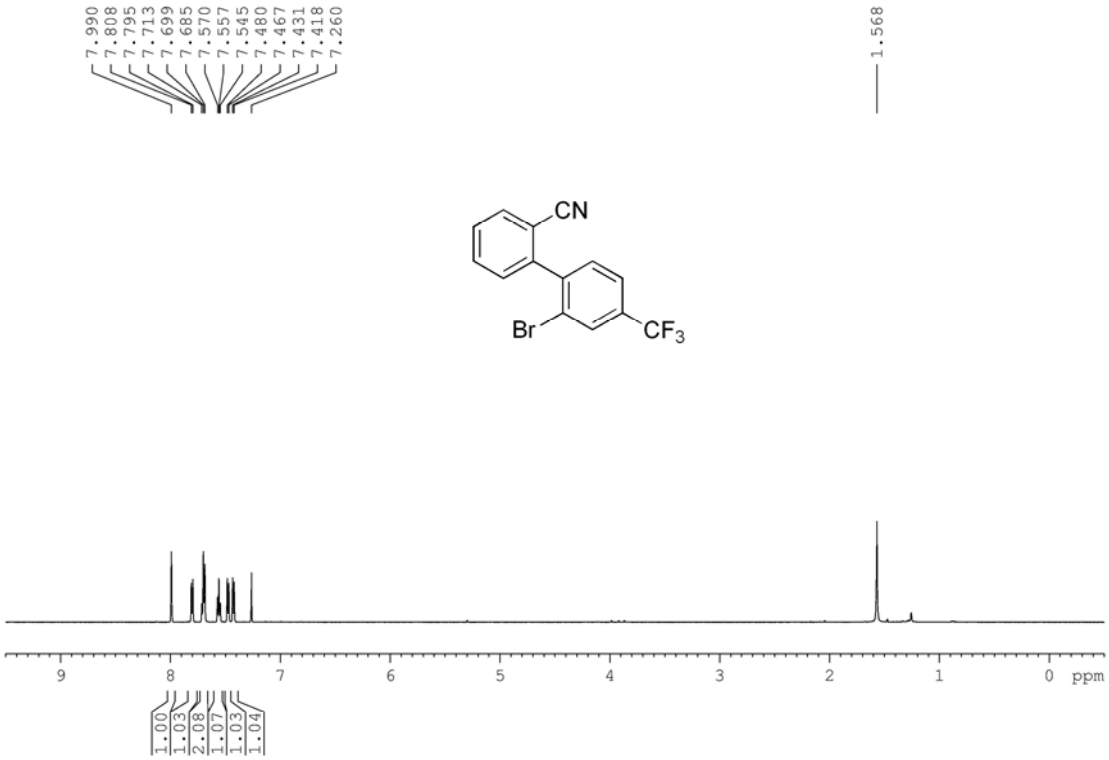


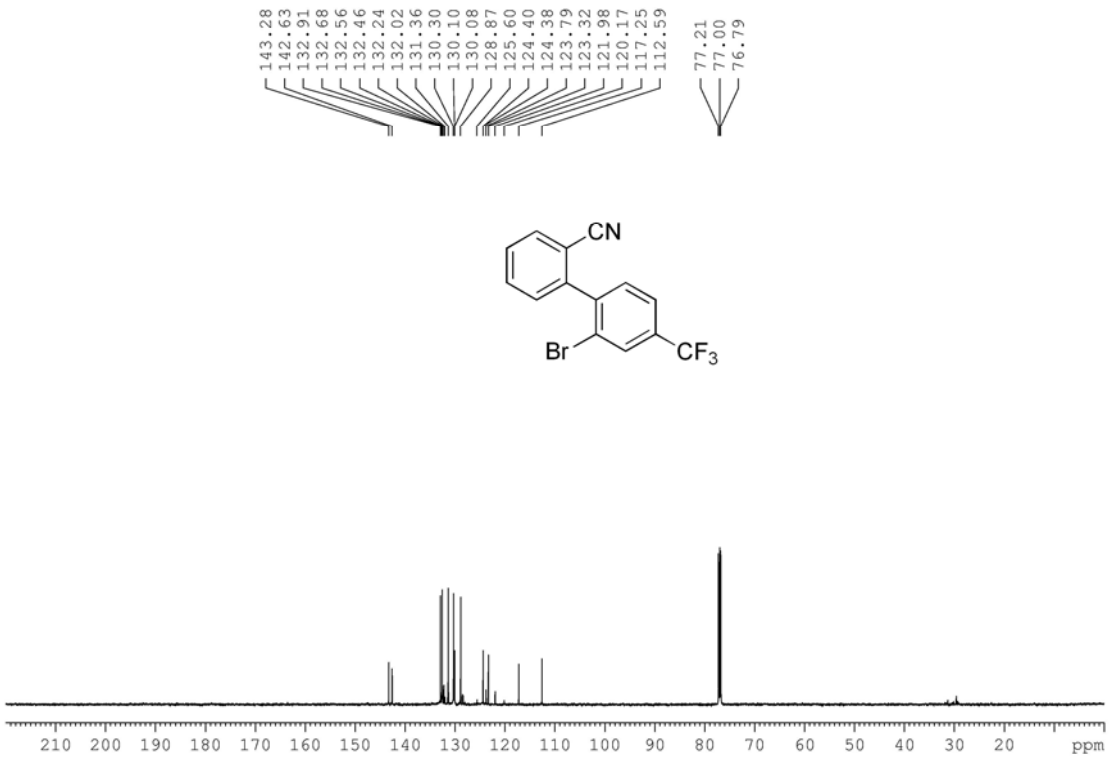
2'-Bromo-4'-fluoro-[1,1'-biphenyl]-2-carbonitrile (1f)



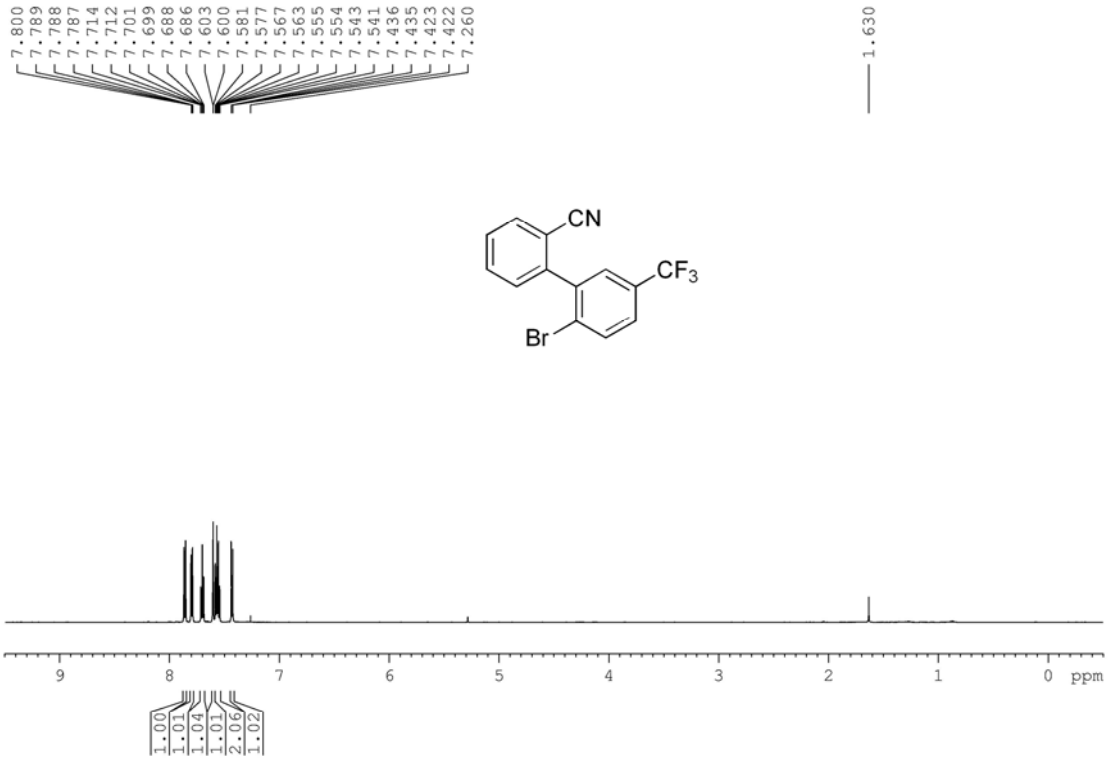


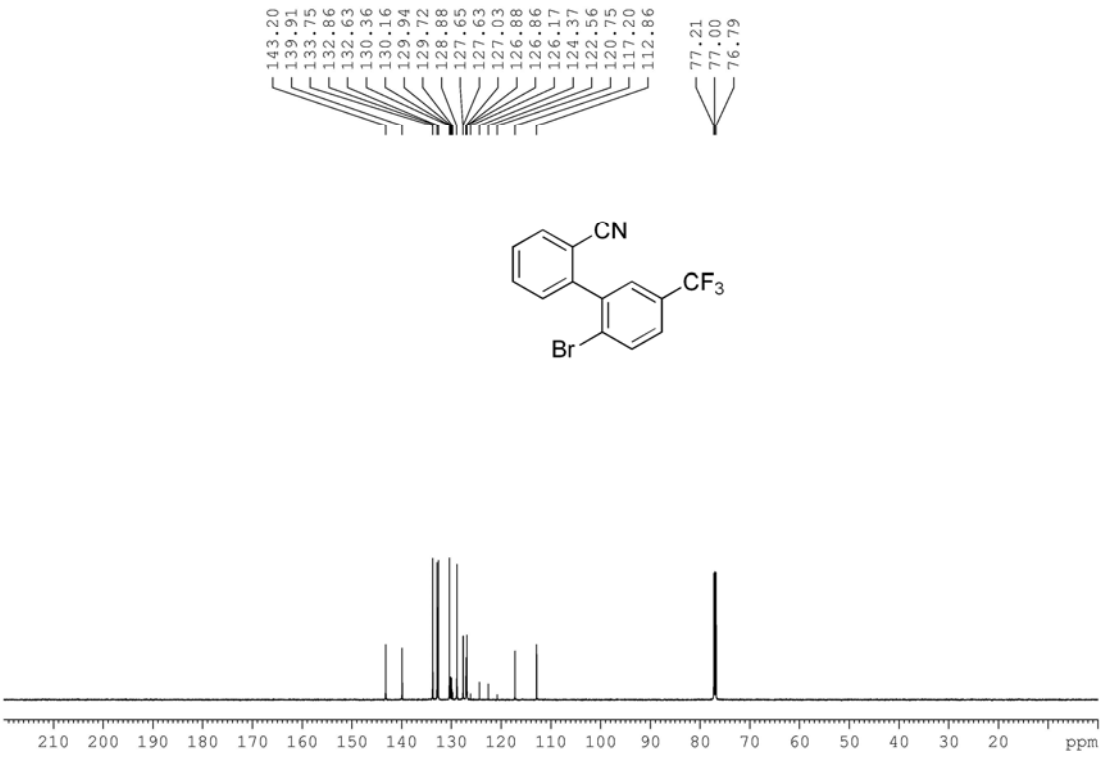
2'-Bromo-4'-(trifluoromethyl)-[1,1'-biphenyl]-2-carbonitrilele (1g)



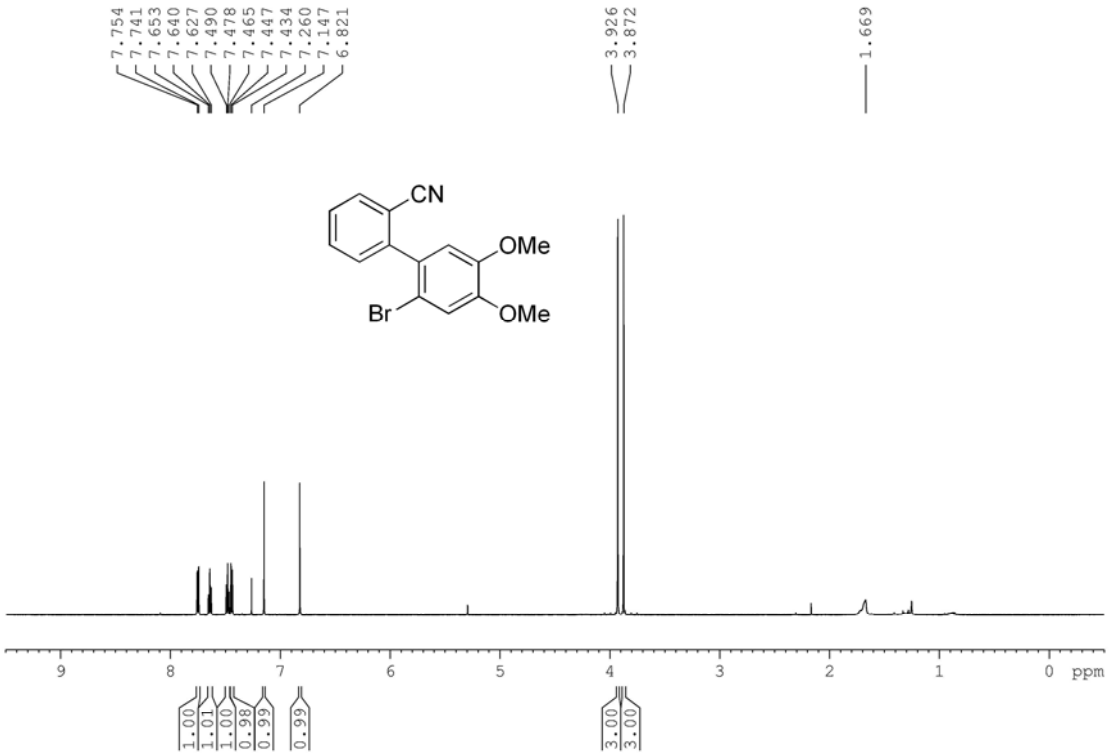


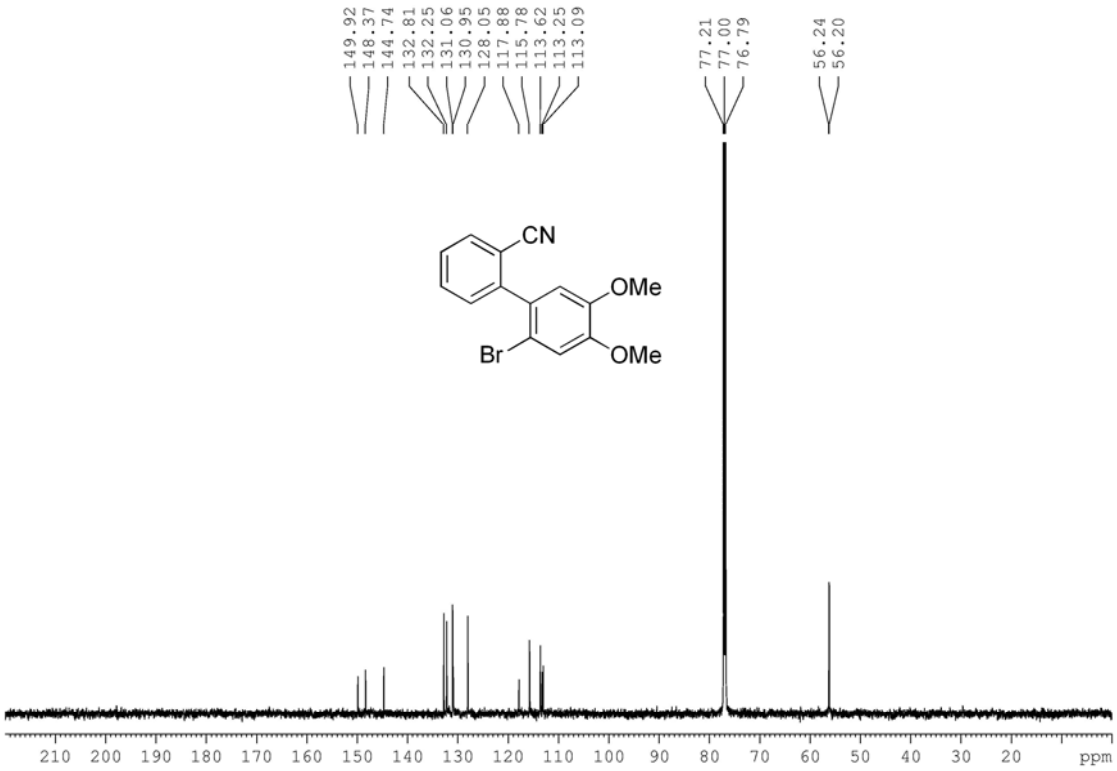
2'-Bromo-5'-(trifluoromethyl)-[1,1'-biphenyl]-2-carbonitrile (1h)



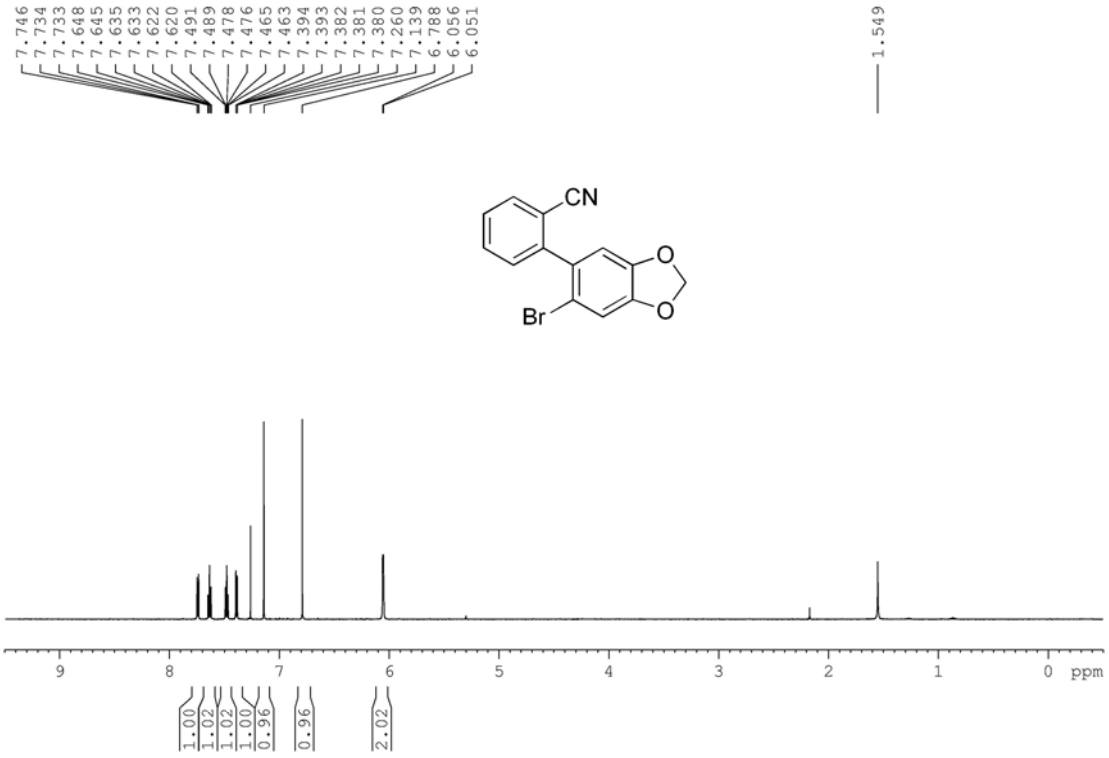


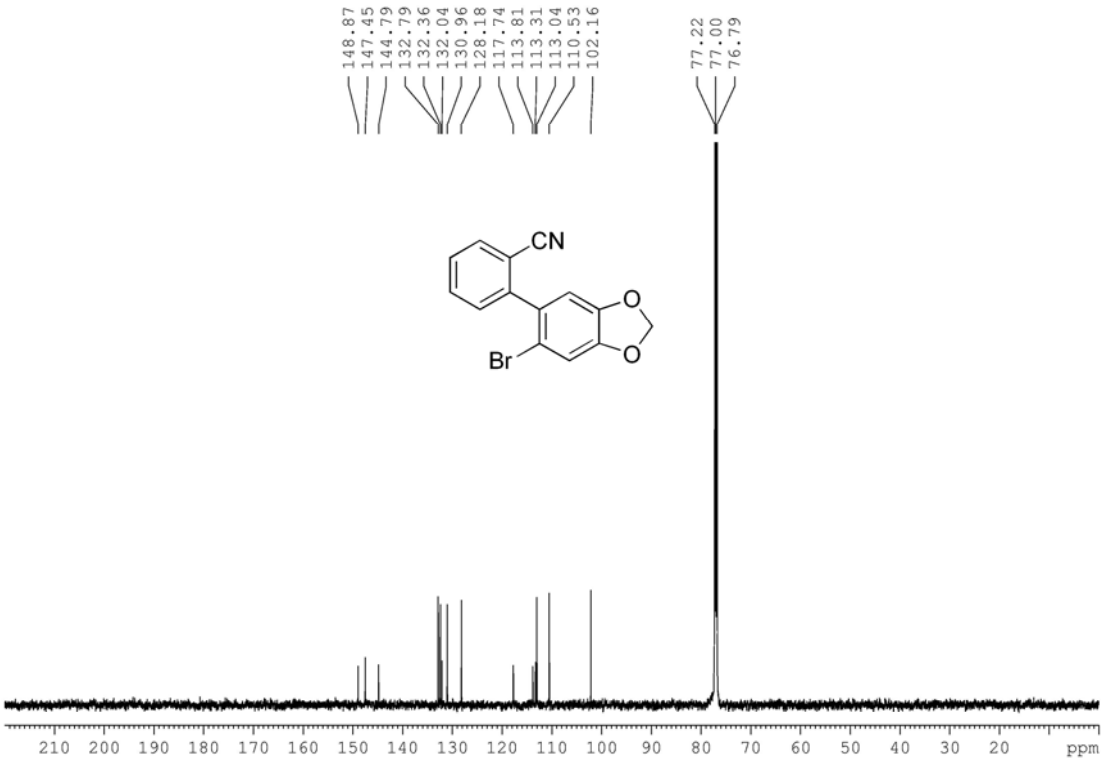
2'-Bromo-4',5'-dimethoxy-[1,1'-biphenyl]-2-carbonitrile (1i)



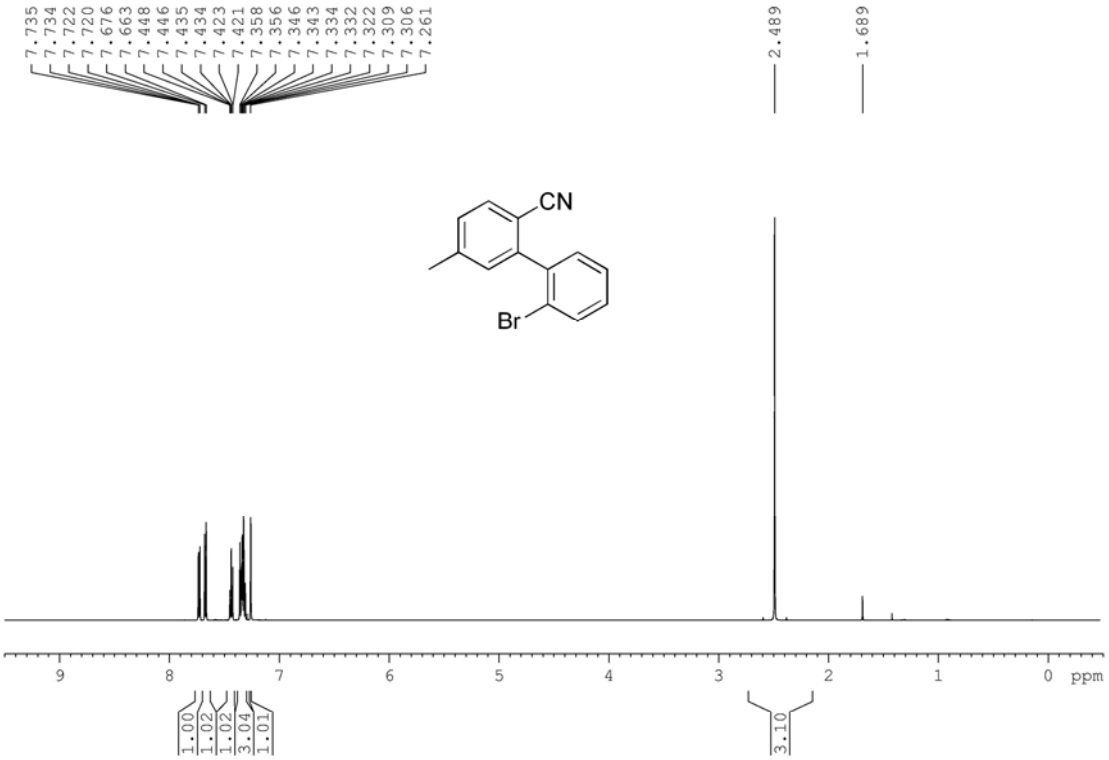


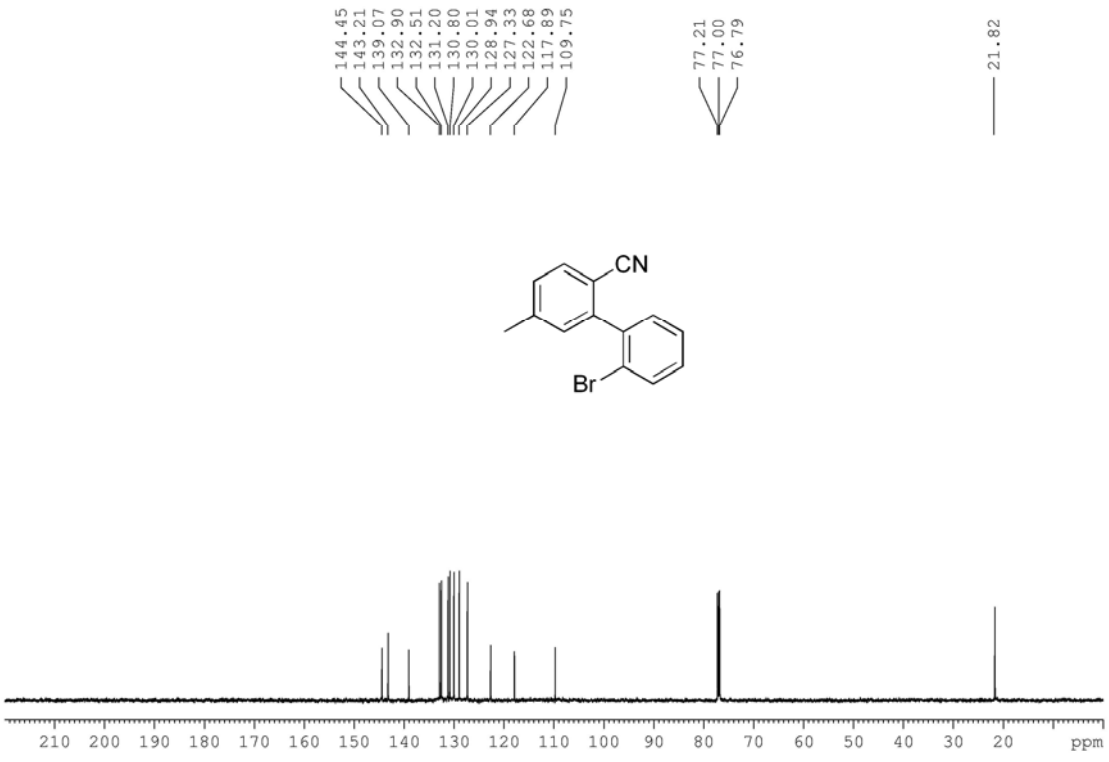
2-(6-Bromobenzo[*d*][1,3]dioxol-5-yl)benzonitrile (1j)



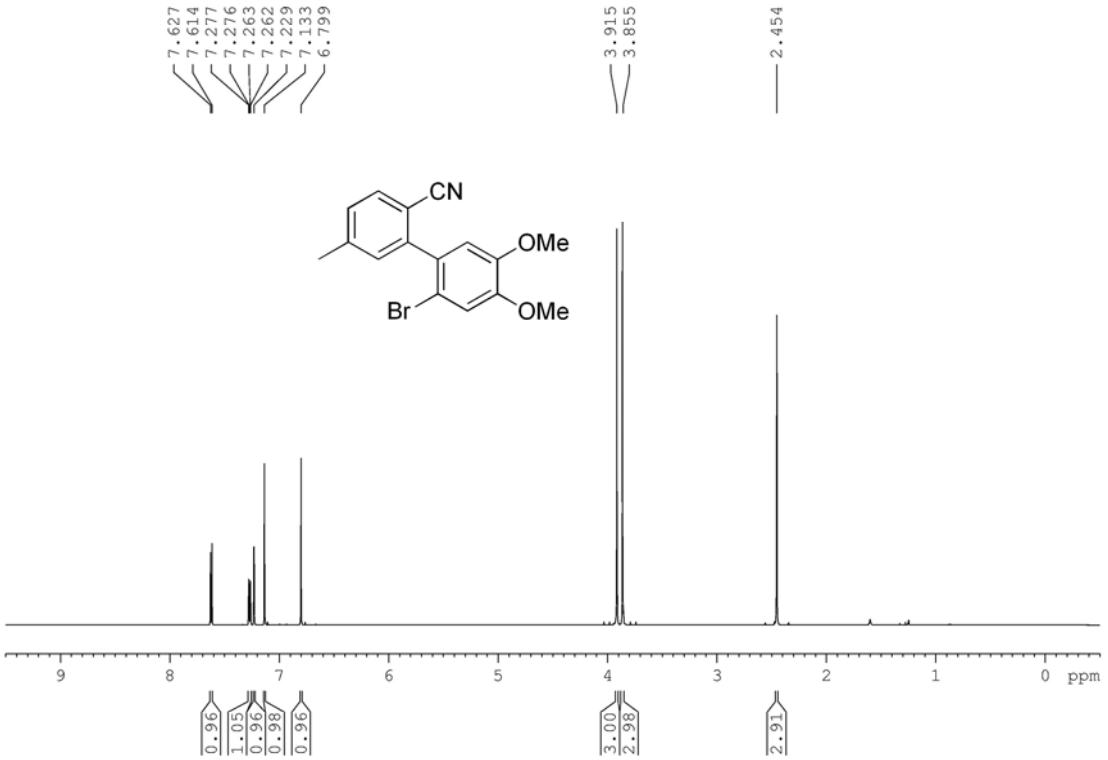


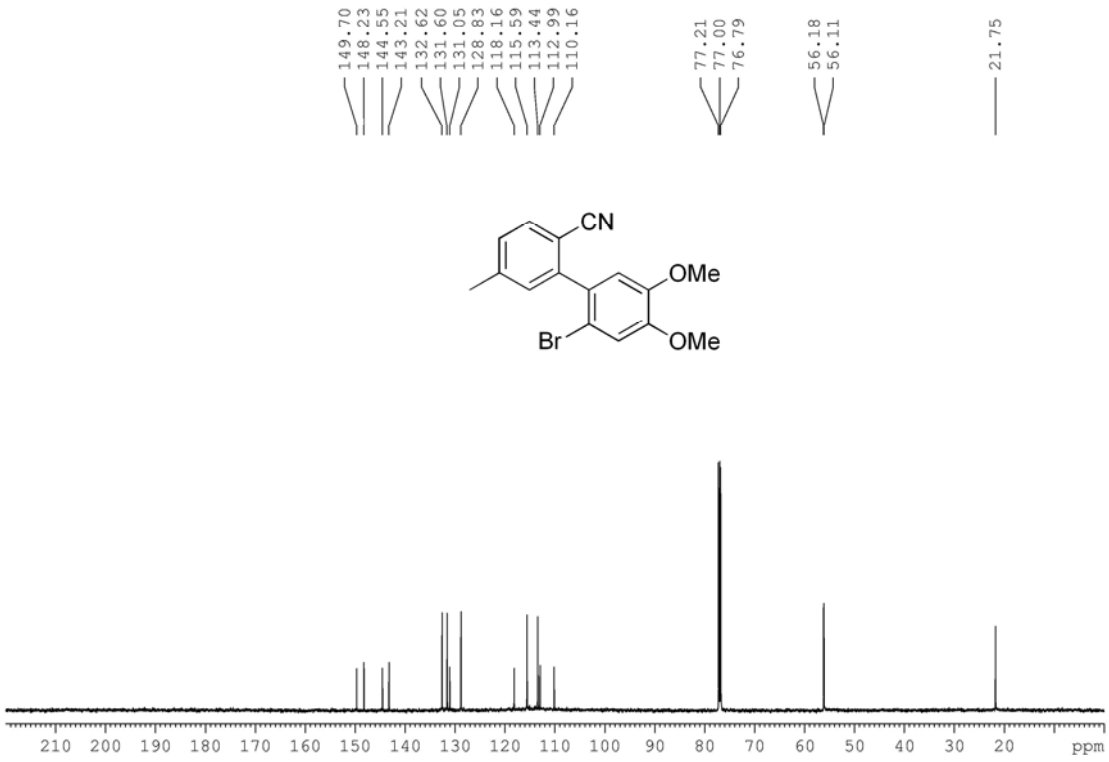
2'-Bromo-5-methyl-[1,1'-biphenyl]-2-carbonitrile (1k)



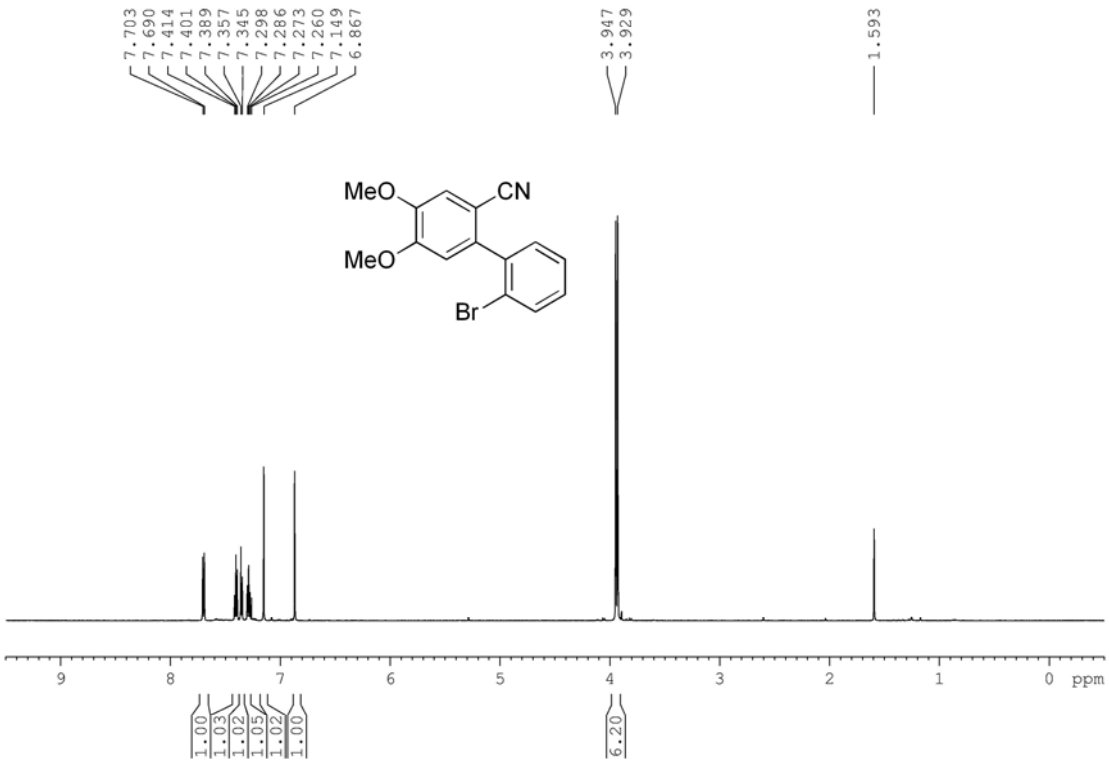


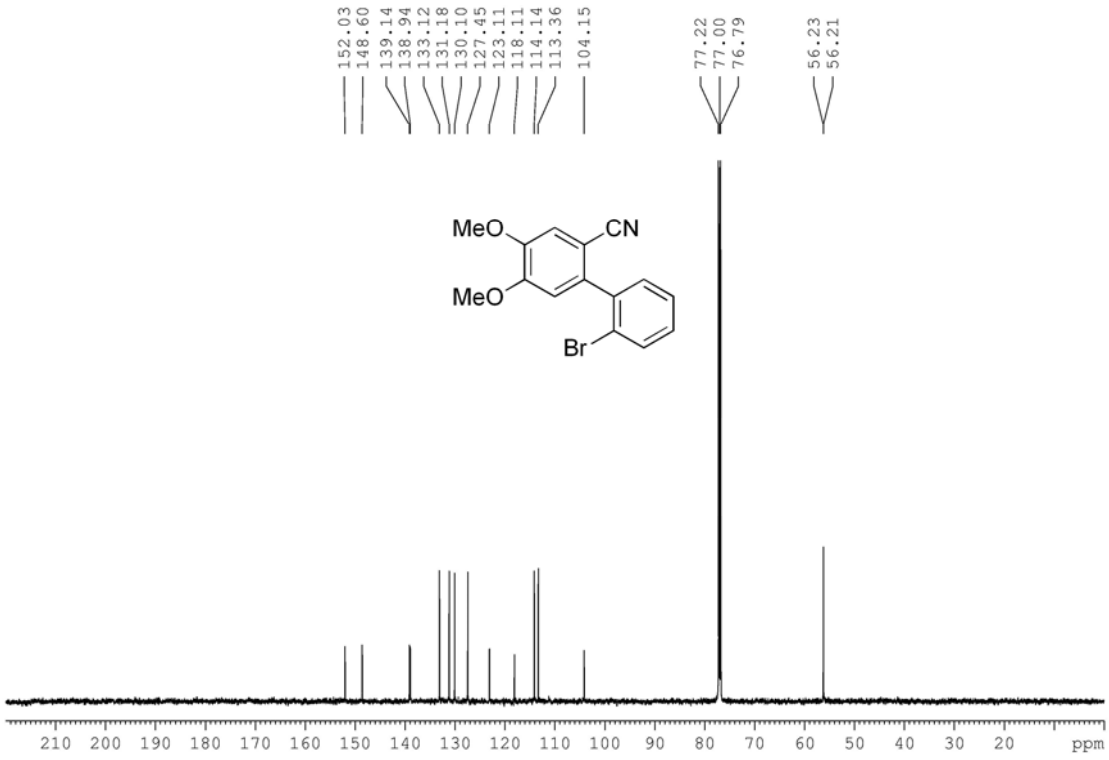
2'-Bromo-4',5'-dimethoxy-5-methyl-[1,1'-biphenyl]-2-carbonitrile (1l)



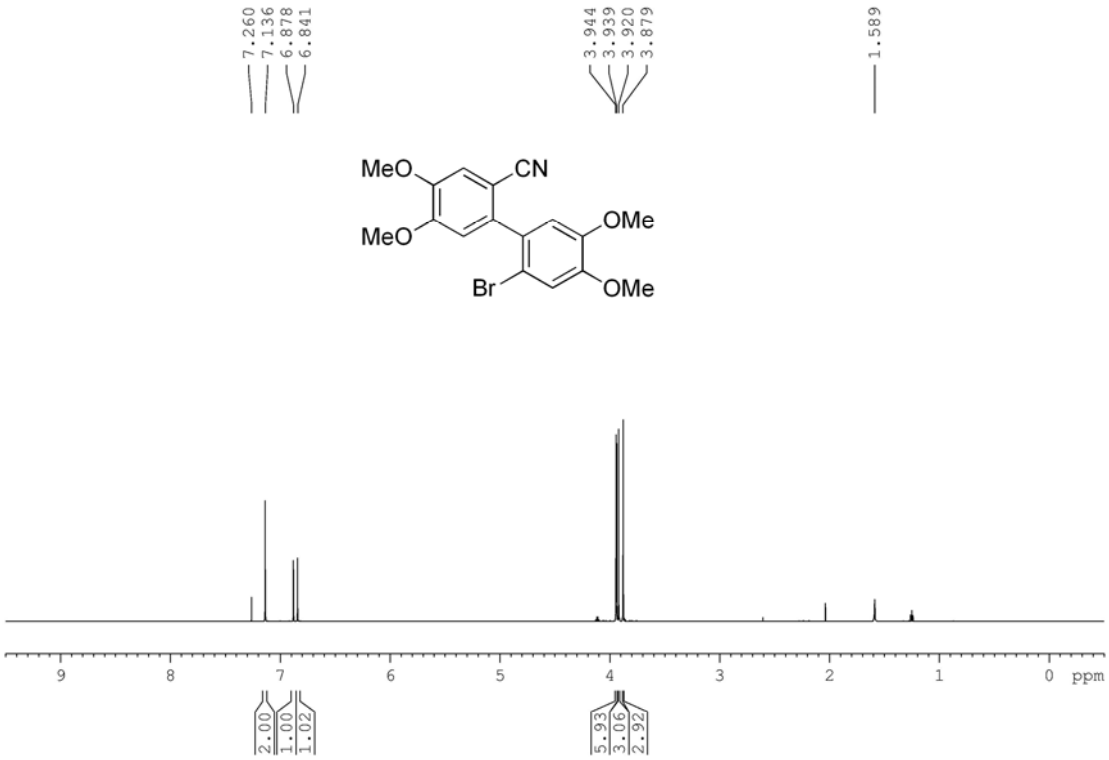


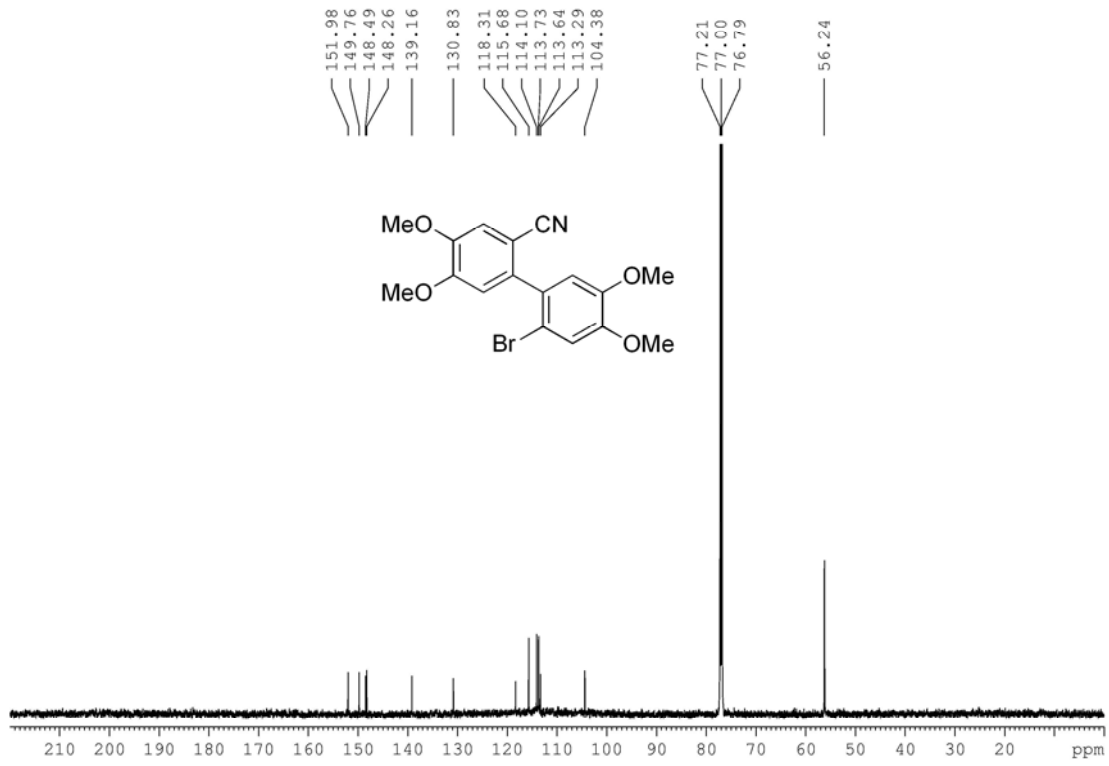
2'-Bromo-4,5-dimethoxy-[1,1'-biphenyl]-2-carbonitrile (1m)



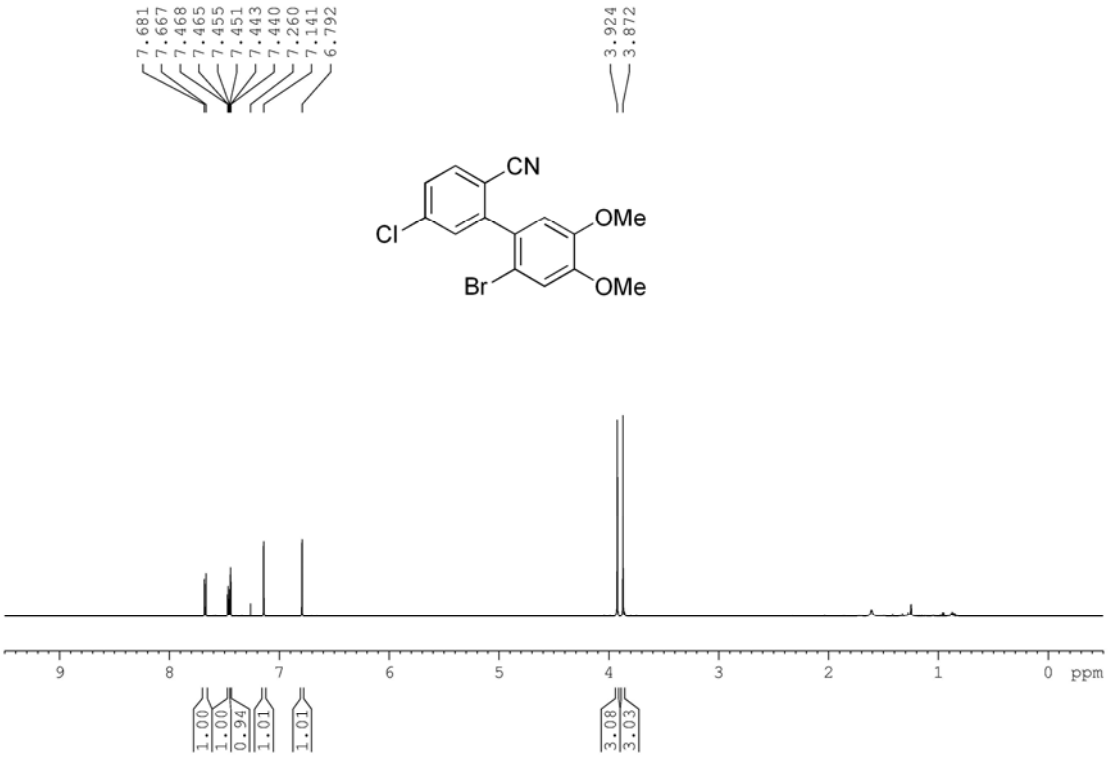


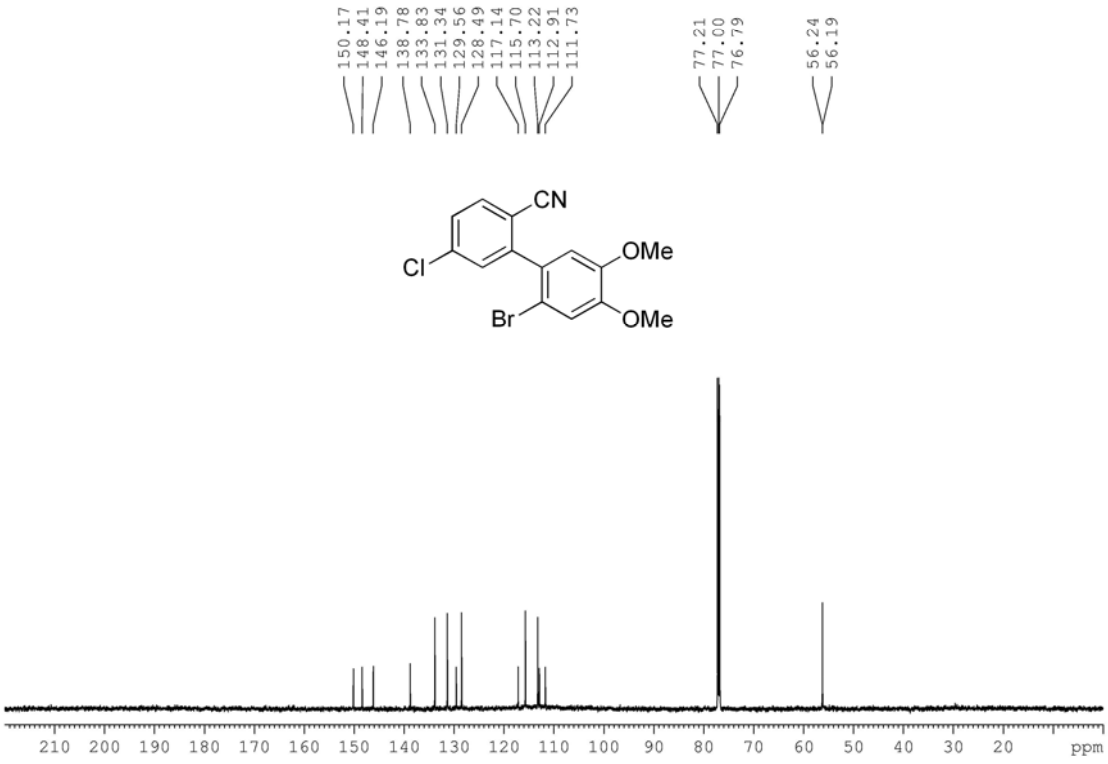
2'-Bromo-4,4',5,5'-tetramethoxy-[1,1'-biphenyl]-2-carbonitrile (1n)



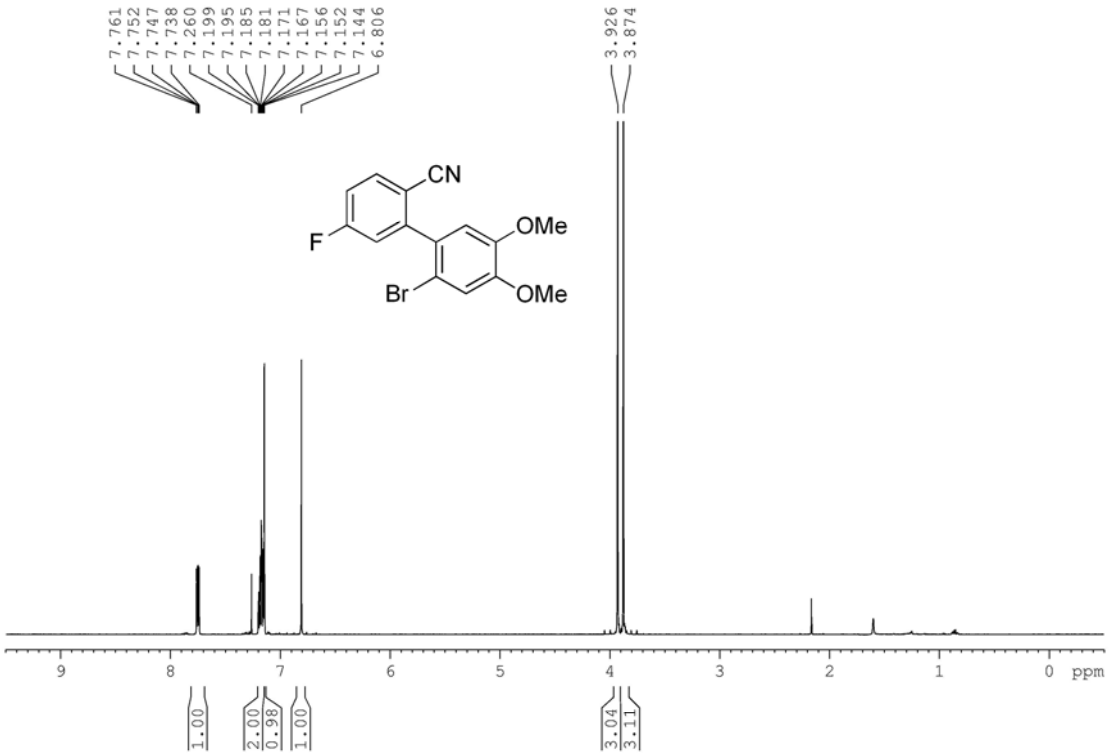


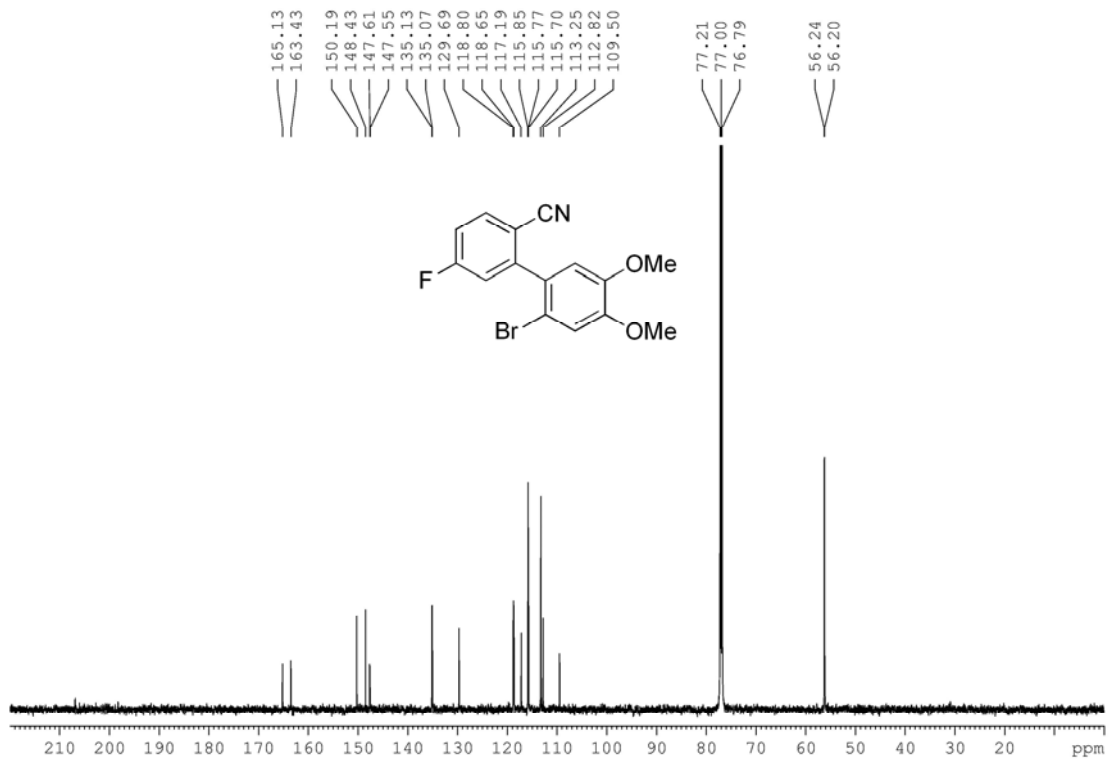
2'-Bromo-5-chloro-4',5'-dimethoxy-2-cyanobiphenyl (1o)



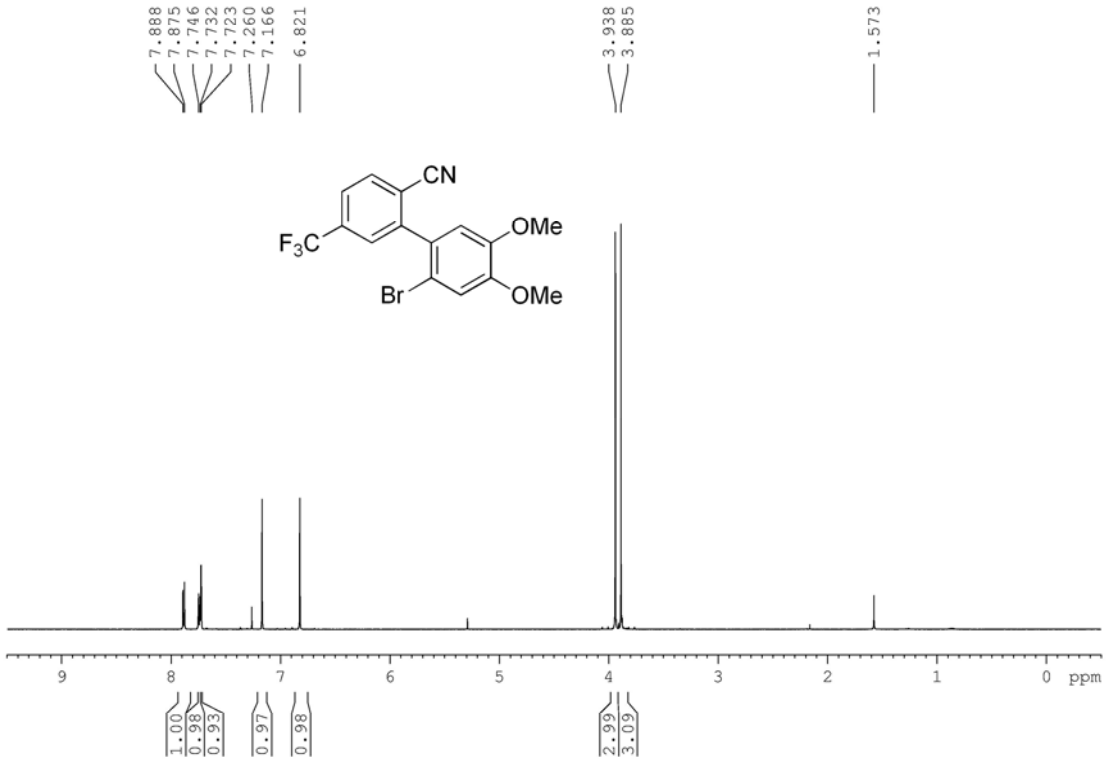


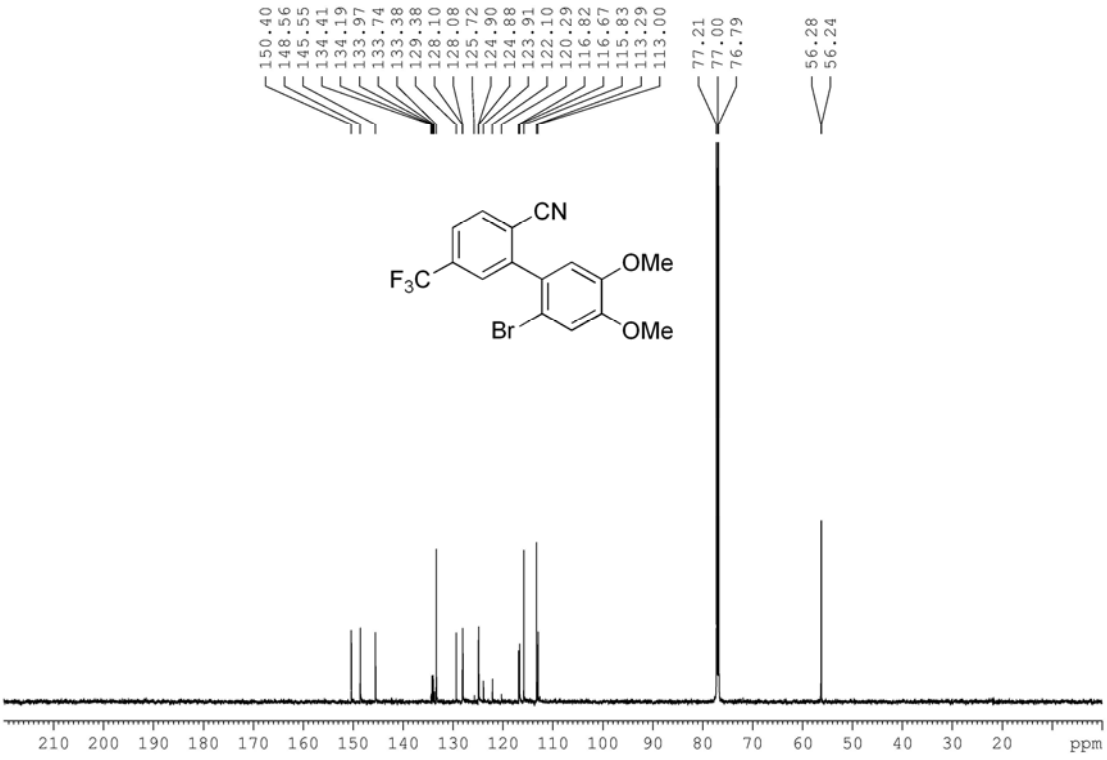
2'-Bromo-5-fluoro-4',5'-dimethoxy-[1,1'-biphenyl]-2-carbonitrile (1p)



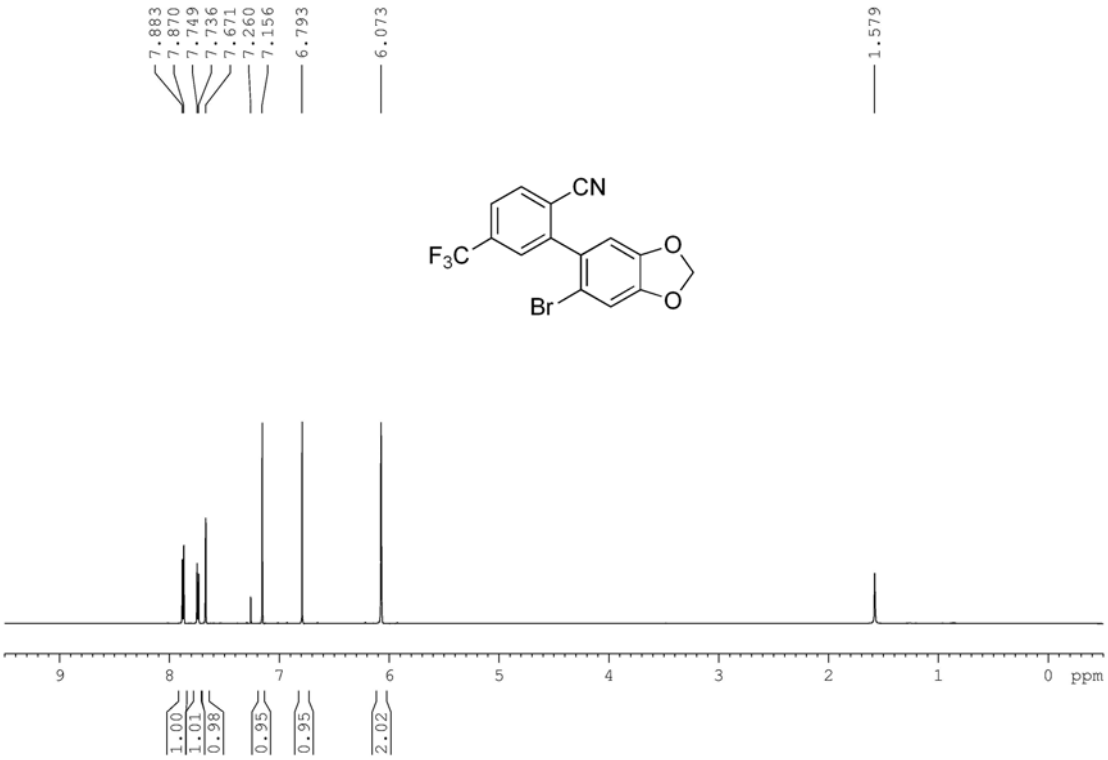


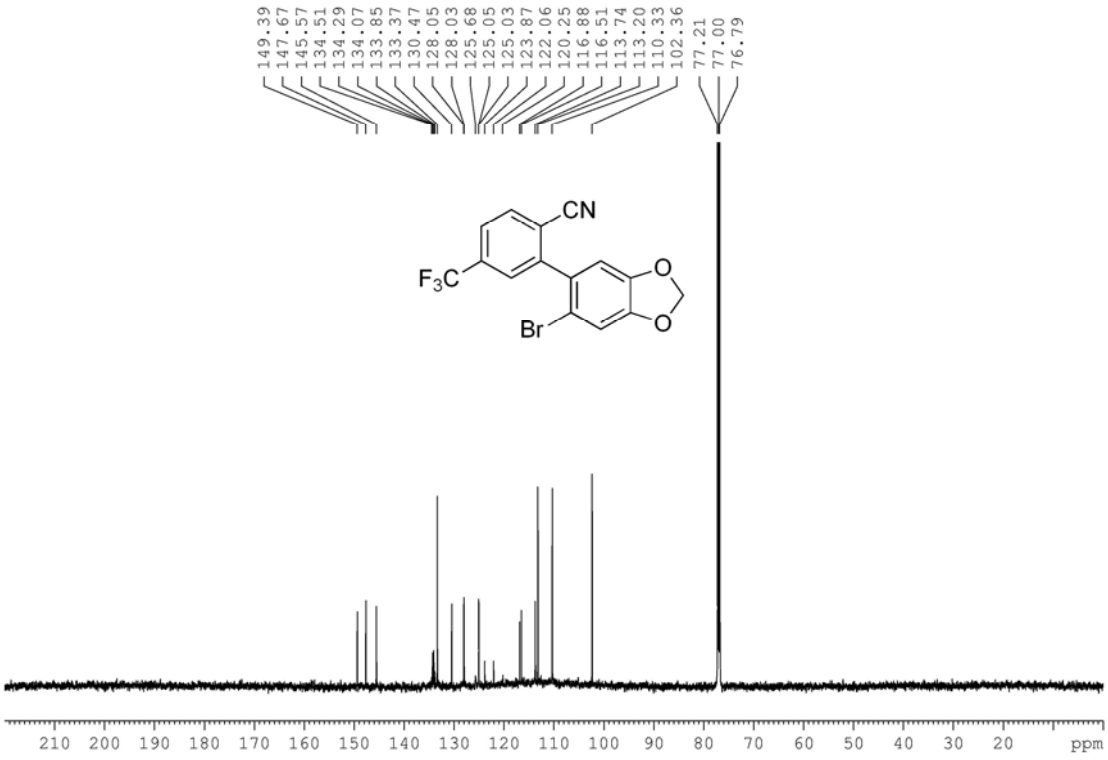
2'-Bromo-4',5'-dimethoxy-5-(trifluoromethyl)-[1,1'-biphenyl]-2-carbonitrile (1q)



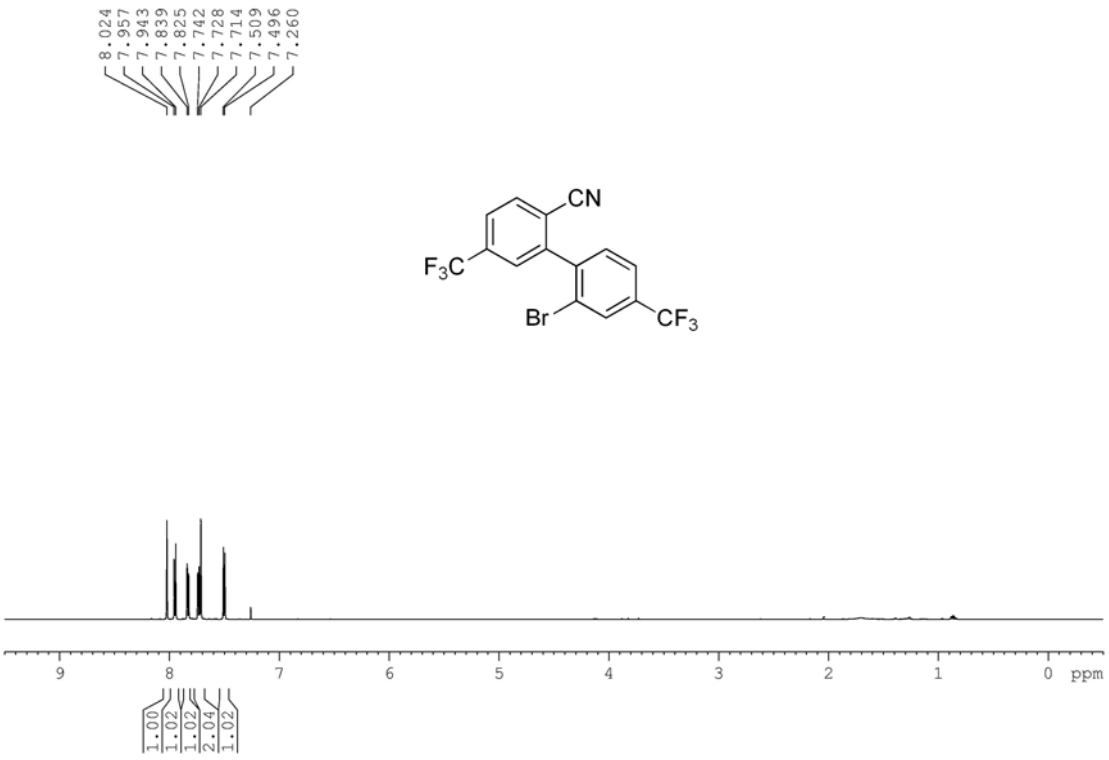


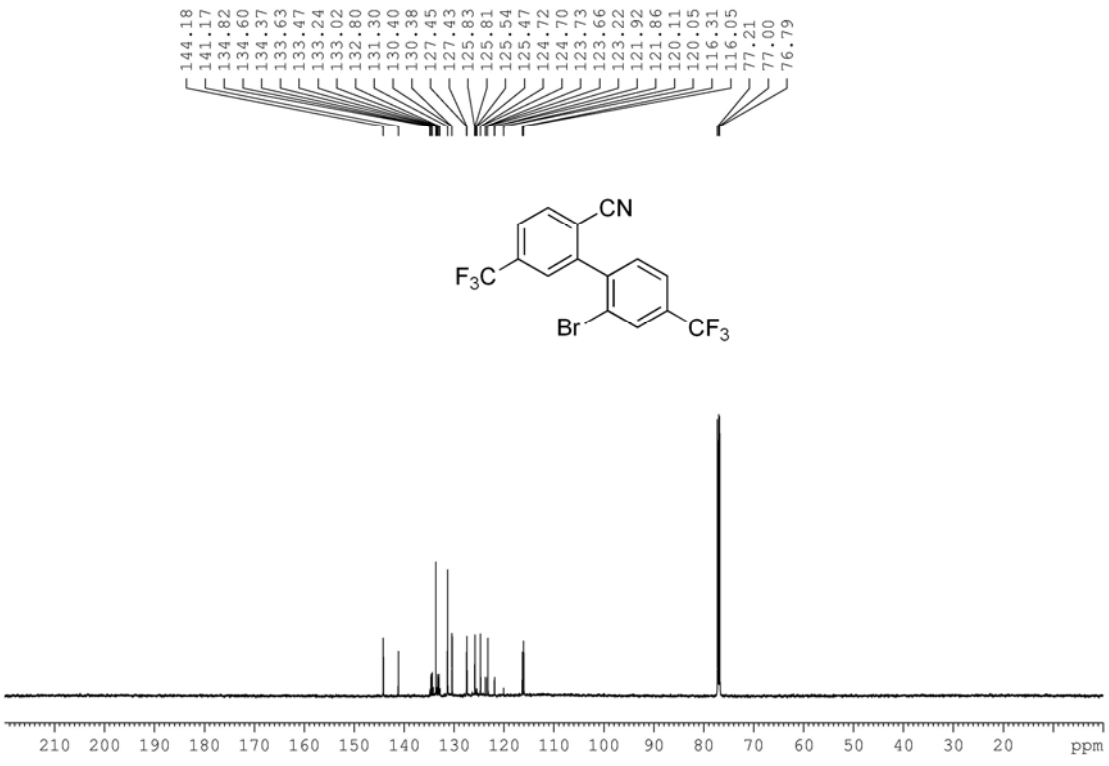
2-(6-Bromobenzo[*d*][1,3]dioxol-5-yl)-4-(trifluoromethyl)benzonitrile (1r)



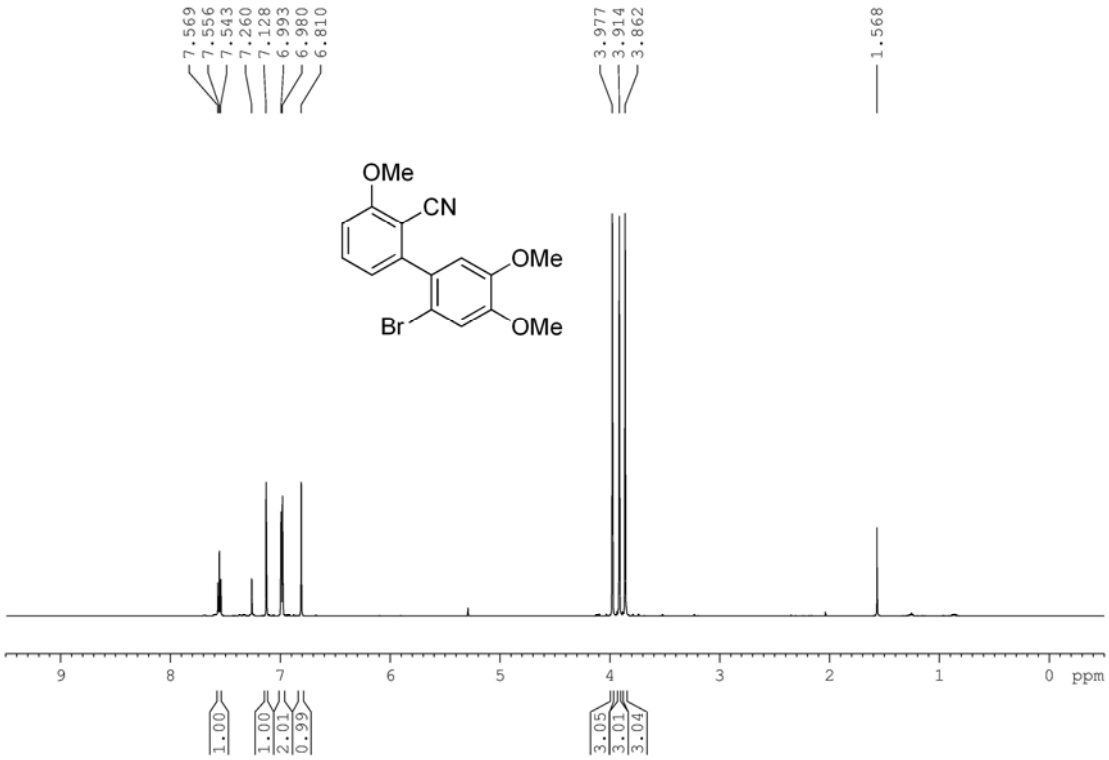


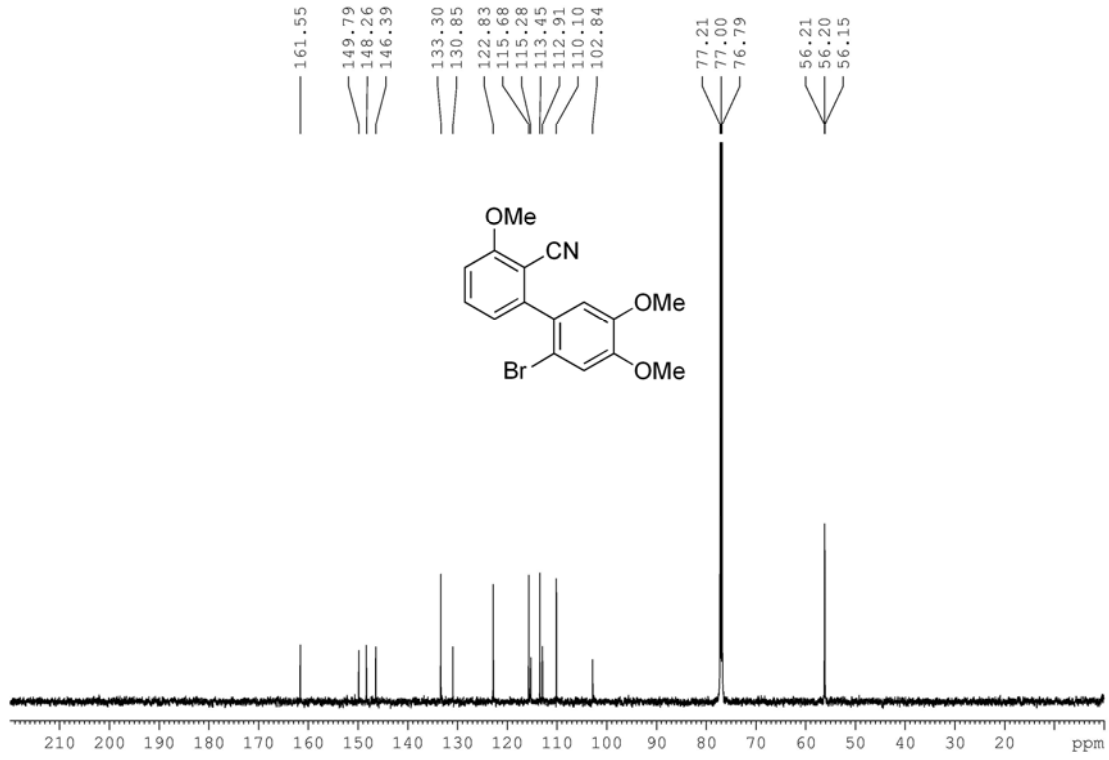
2'-Bromo-4',5-bis(trifluoromethyl)-[1,1'-biphenyl]-2-carbonitrile (1s)



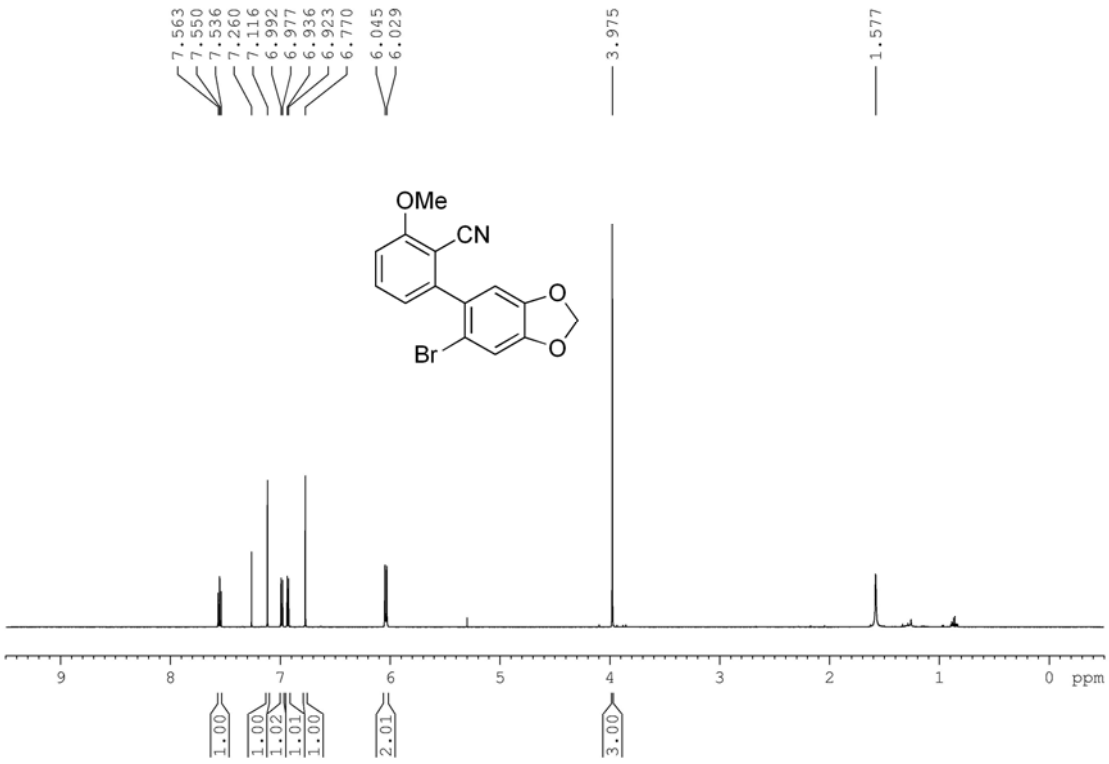


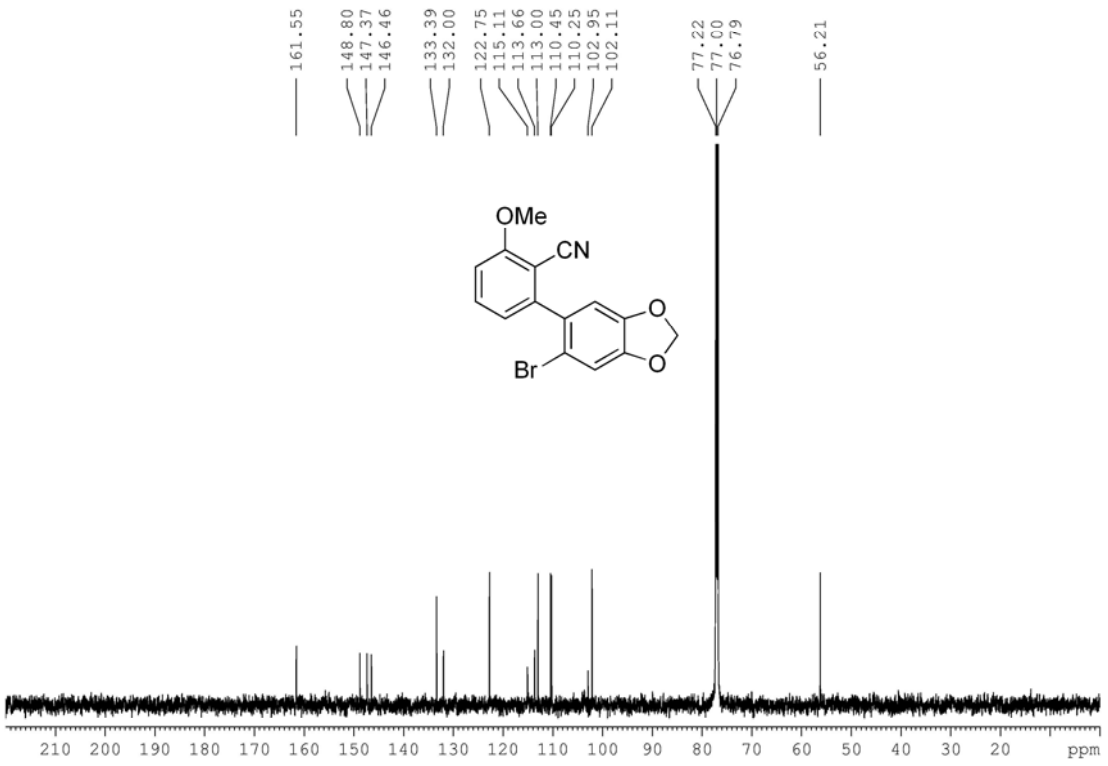
2'-Bromo-3,4',5'-trimethoxy-[1,1'-biphenyl]-2-carbonitrile (1t)



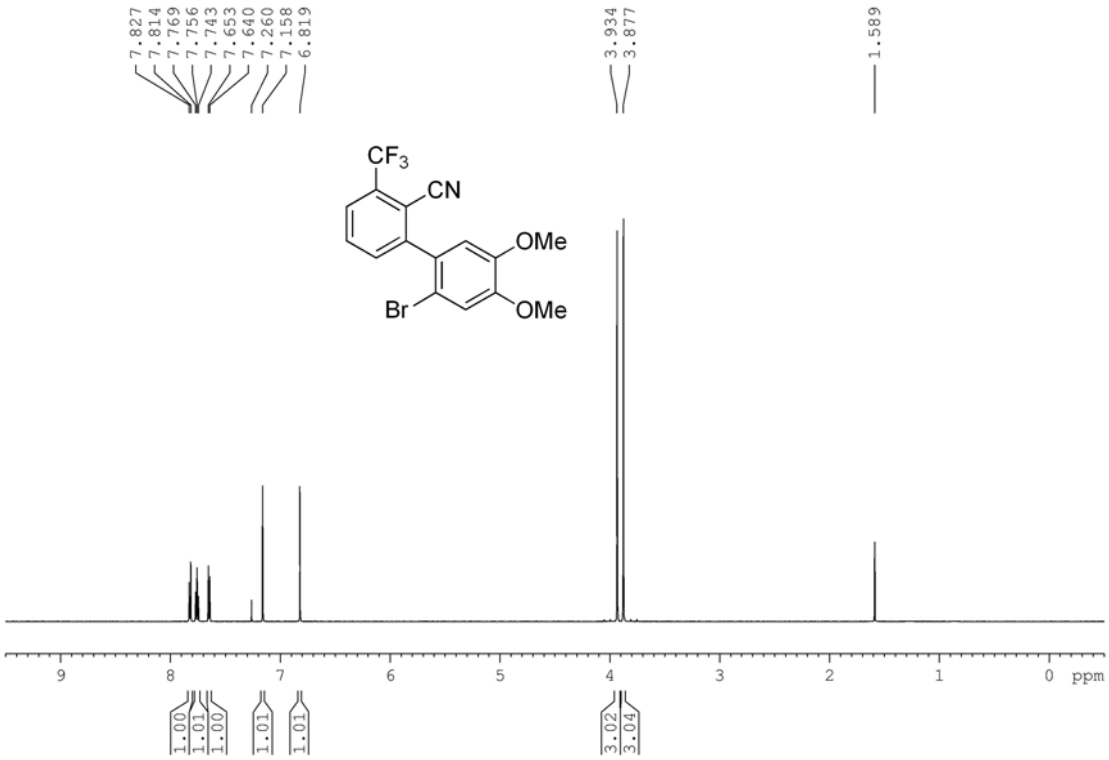


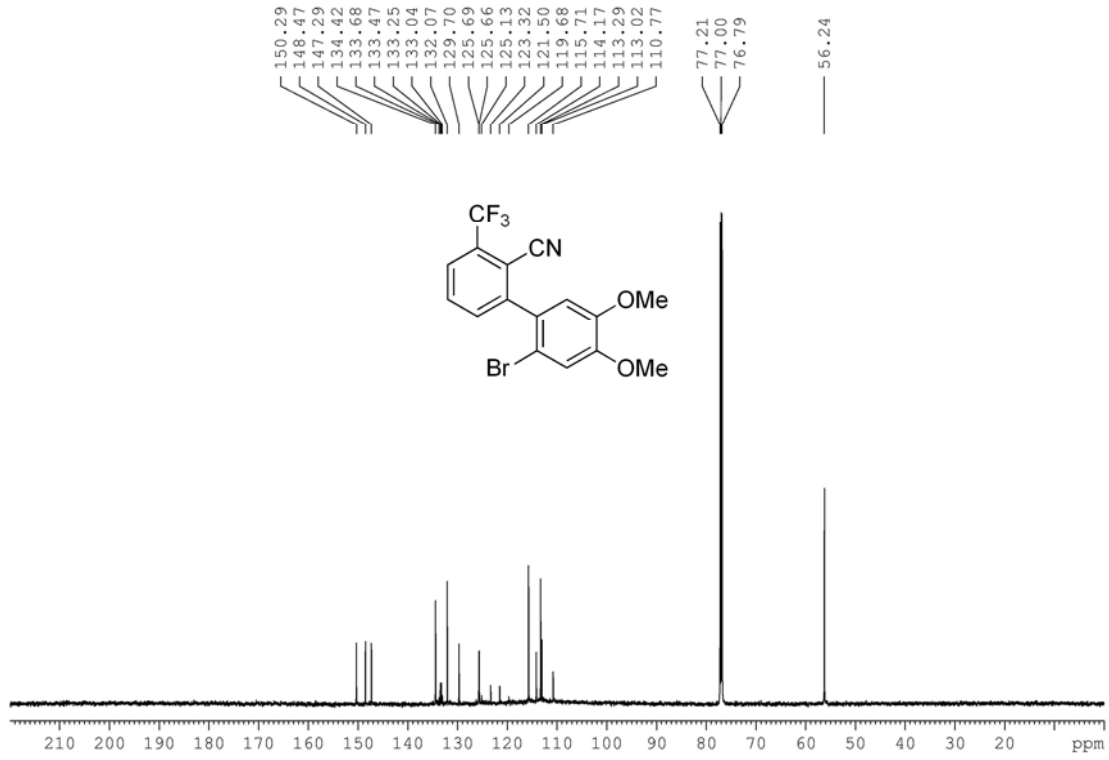
2-(6-Bromobenzo[*d*][1,3]dioxol-5-yl)-6-methoxybenzonitrile (1u)



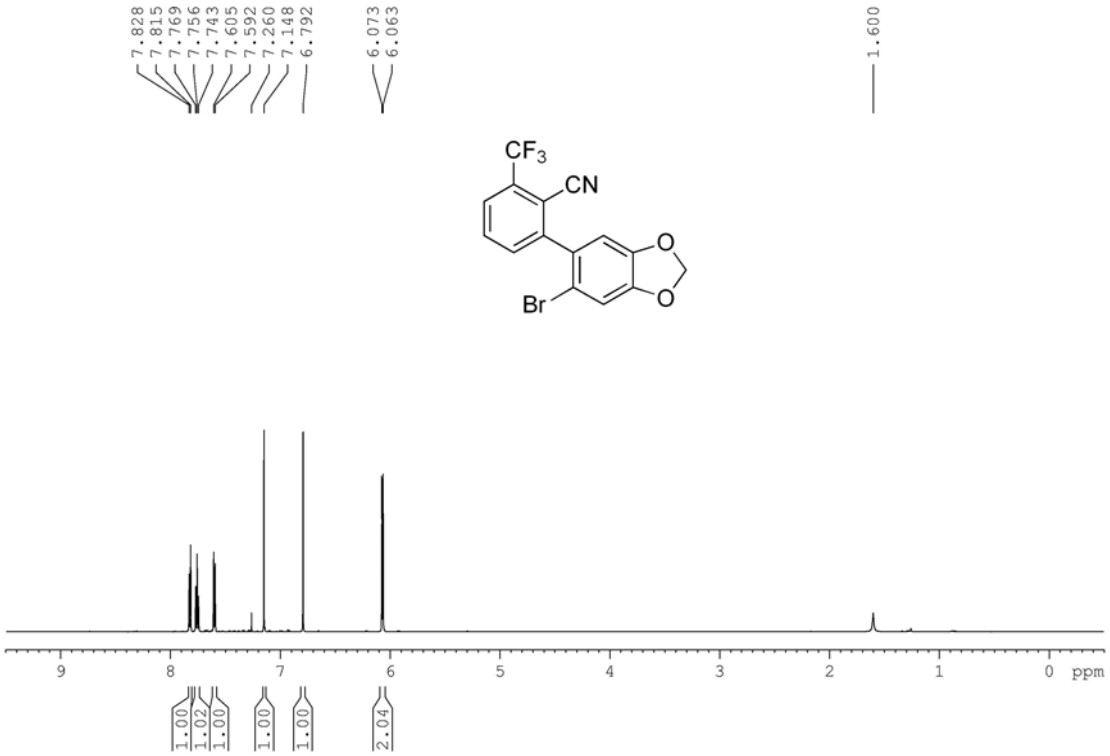


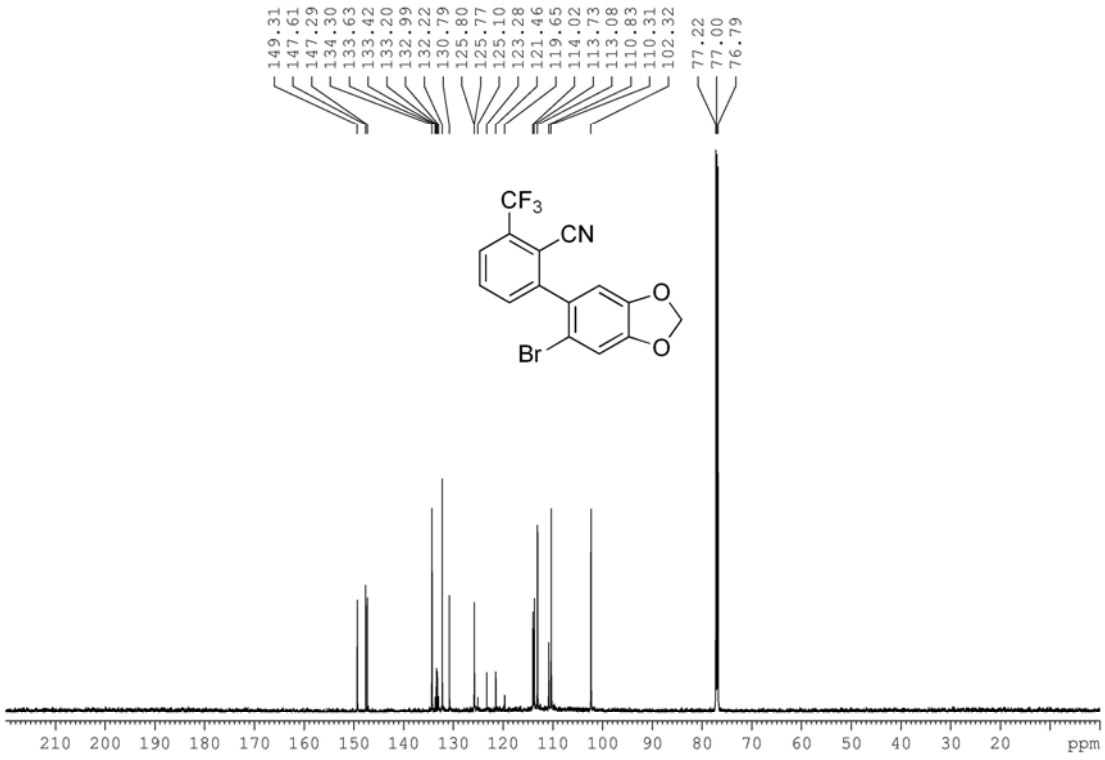
2'-Bromo-4',5'-dimethoxy-3-(trifluoromethyl)-[1,1'-biphenyl]-2-carbonitrile (1v)



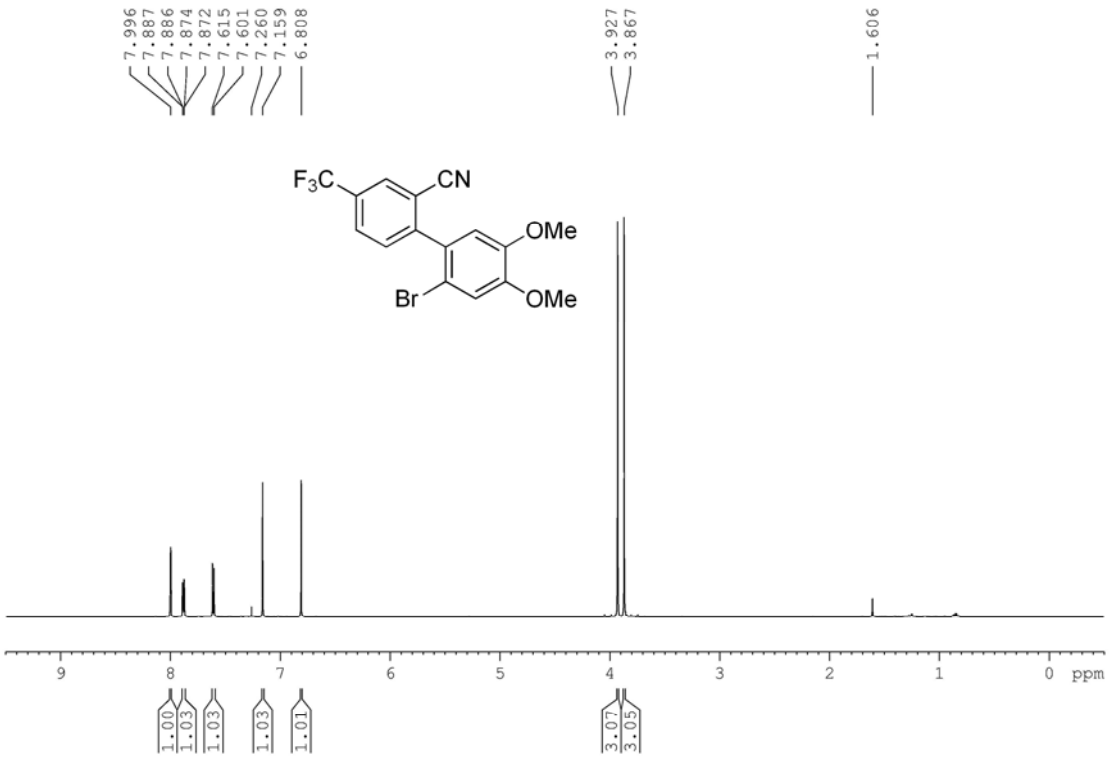


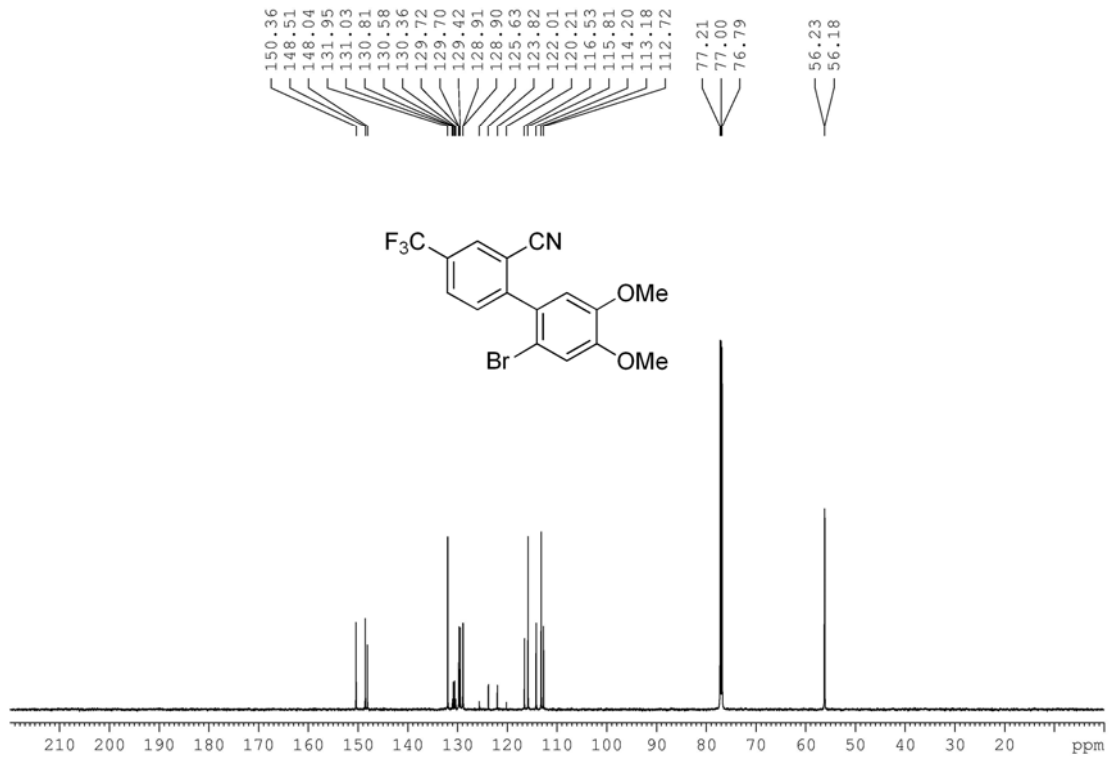
2-(6-Bromobenzo[*d*][1,3]dioxol-5-yl)-6-(trifluoromethyl)benzonitrile (1w)



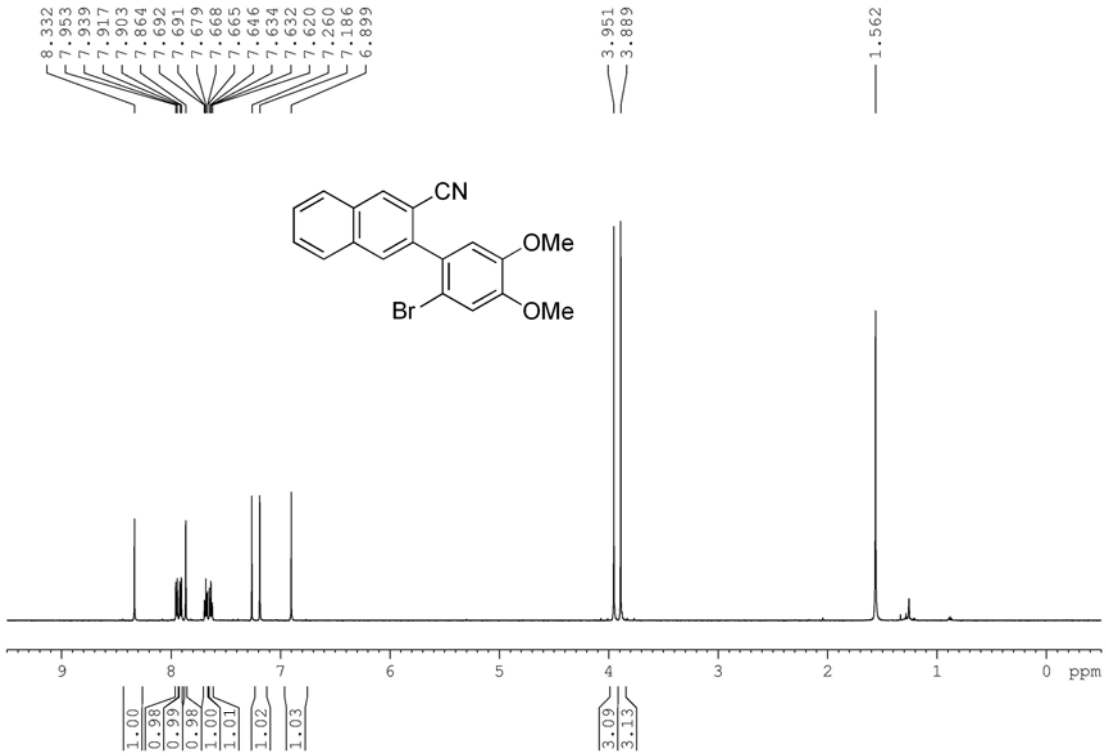


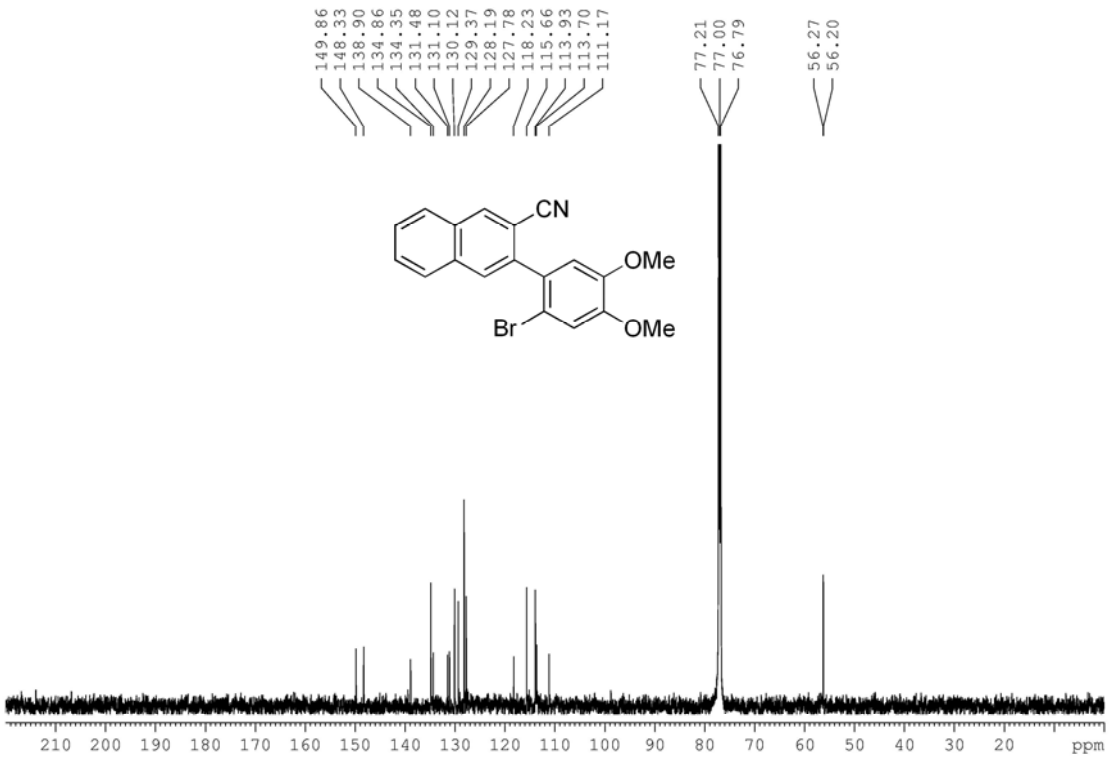
2'-Bromo-4',5'-dimethoxy-4-(trifluoromethyl)-[1,1'-biphenyl]-2-carbonitrile (1x)



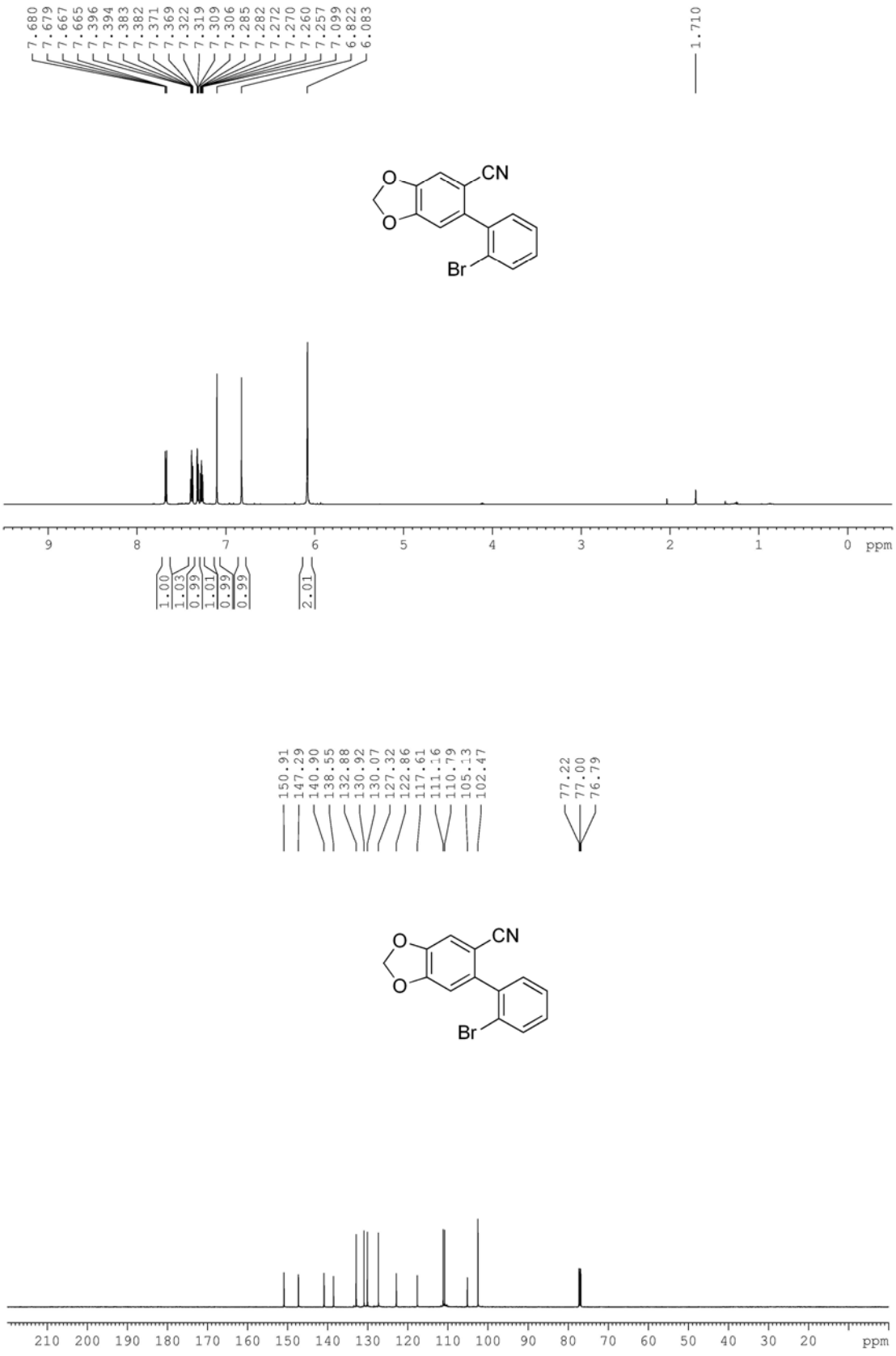


3-(2-Bromo-4,5-dimethoxyphenyl)-2-naphthonitrile (1y)

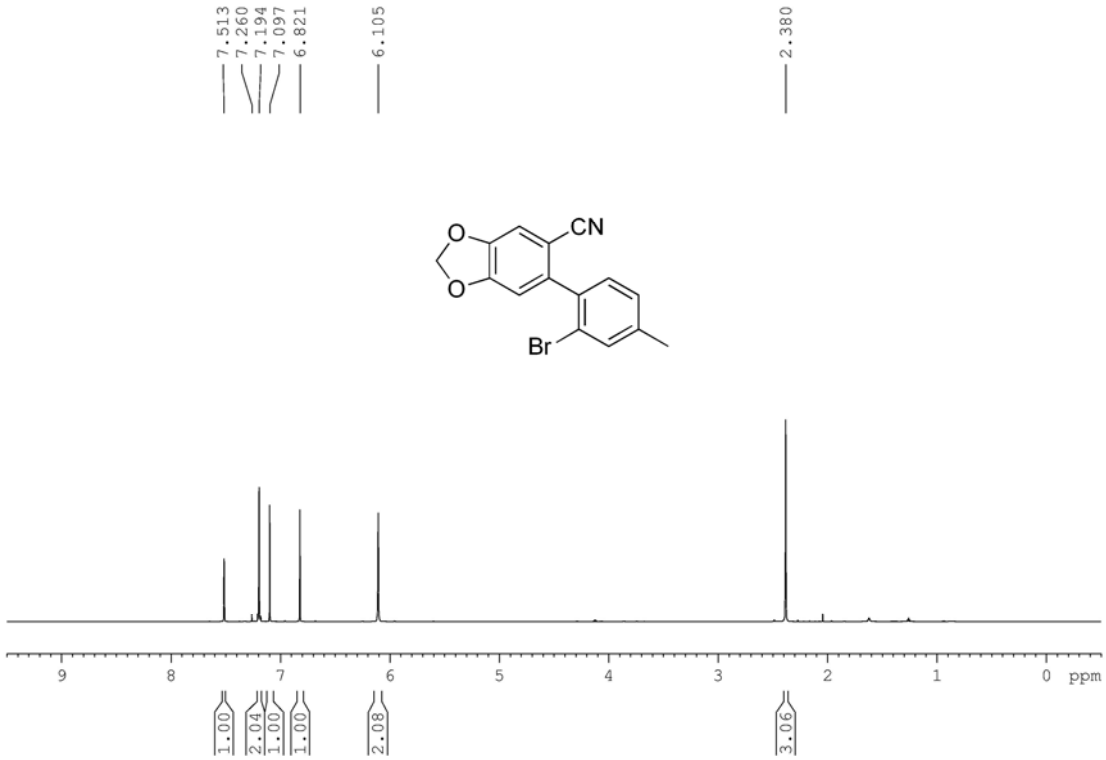


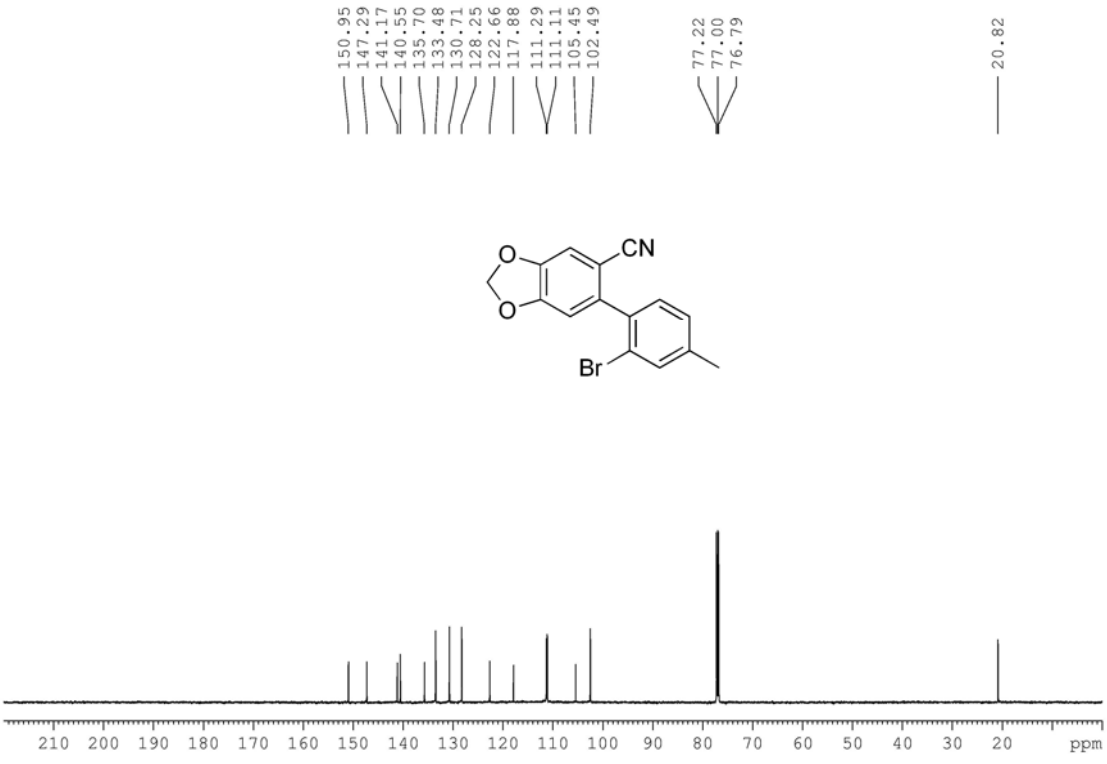


6-(2-Bromophenyl)benzo[*d*][1,3]dioxole-5-carbonitrile (1z)

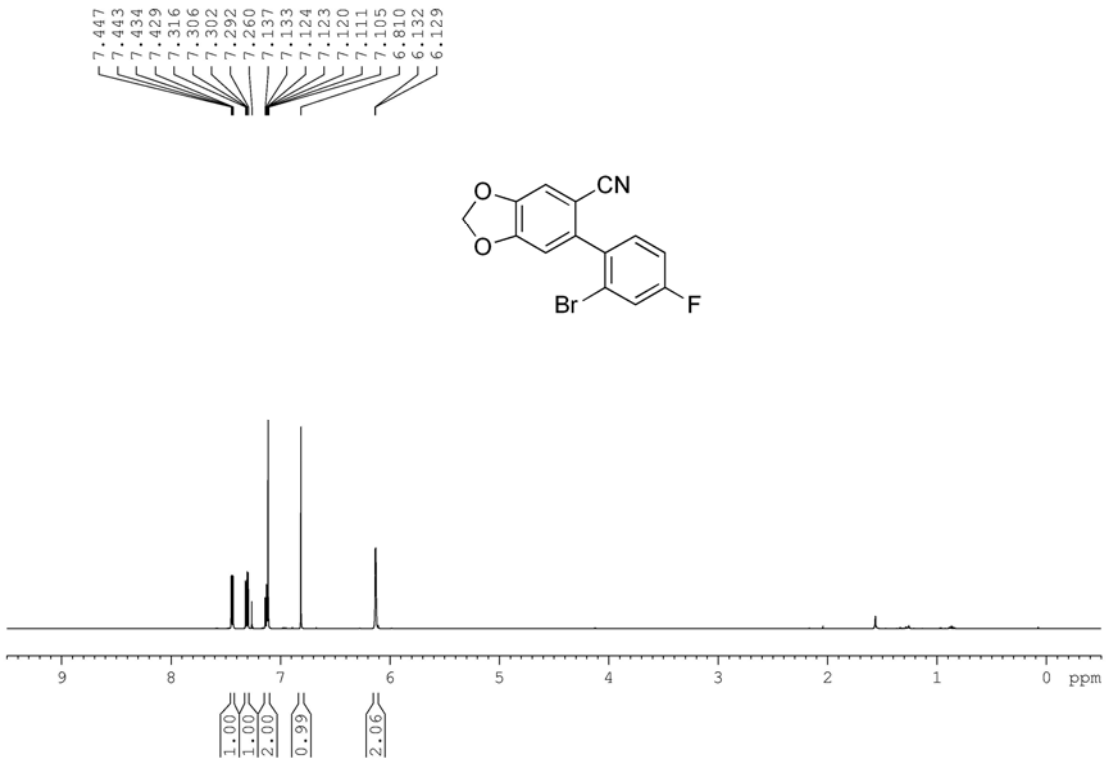


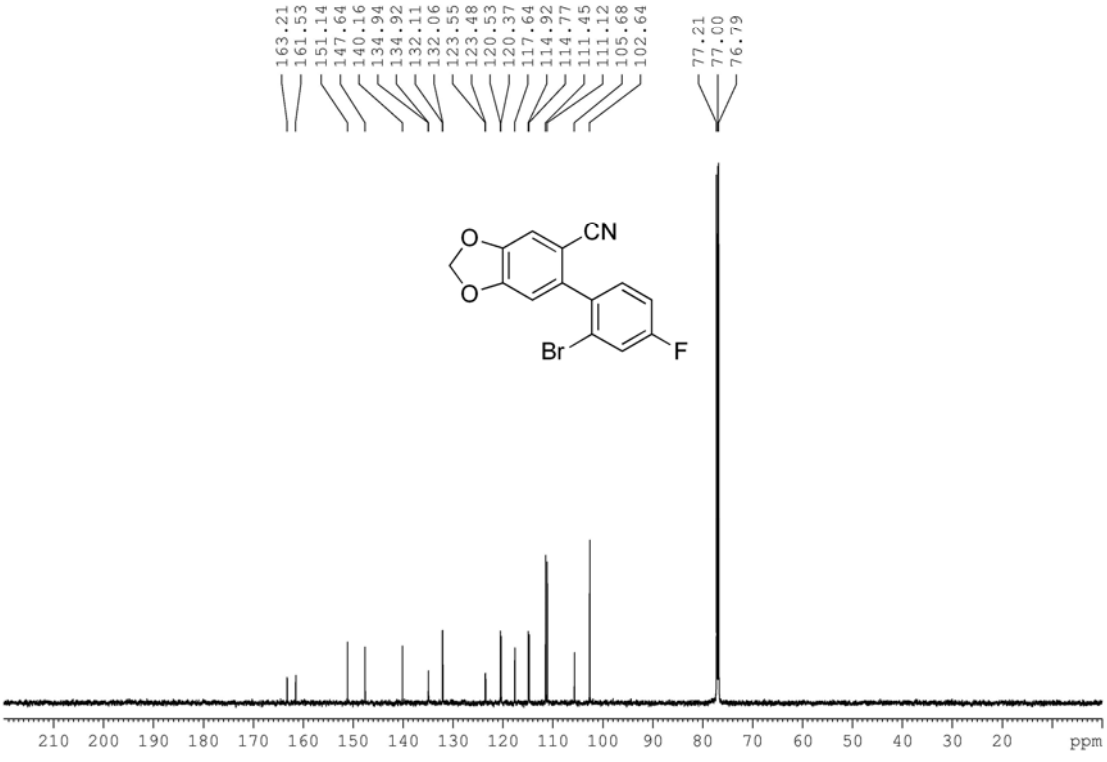
6-(2-Bromo-4-methylphenyl)benzo[*d*][1,3]dioxole-5-carbonitrile (1C1)



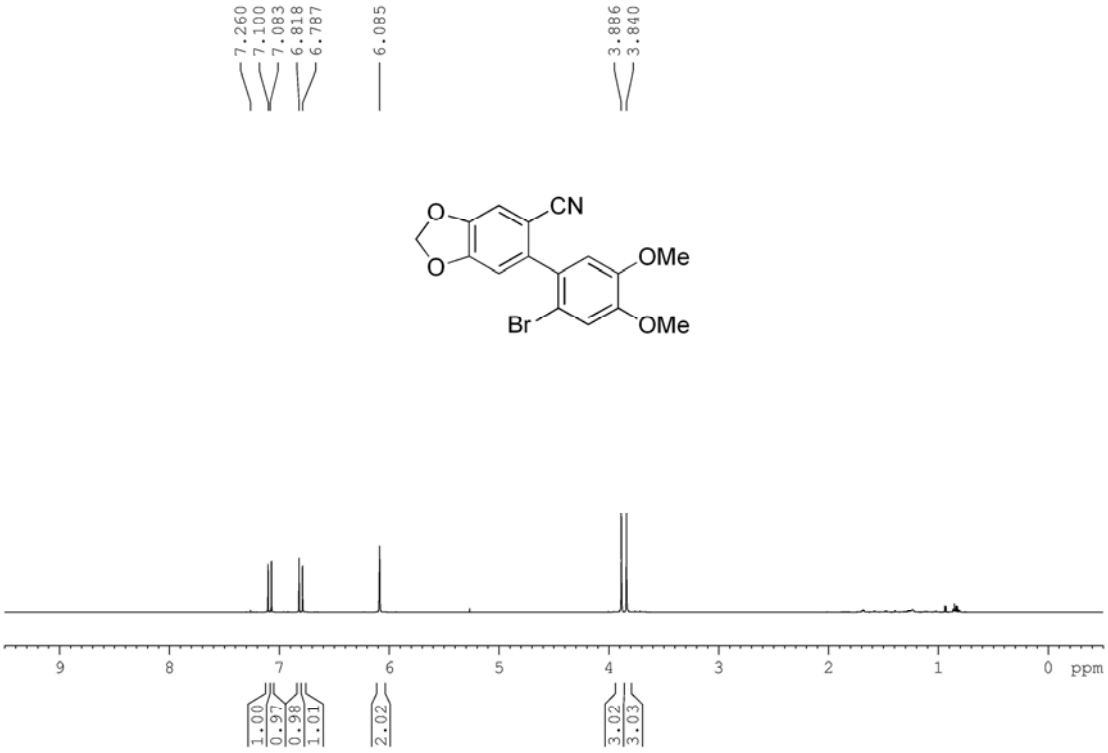


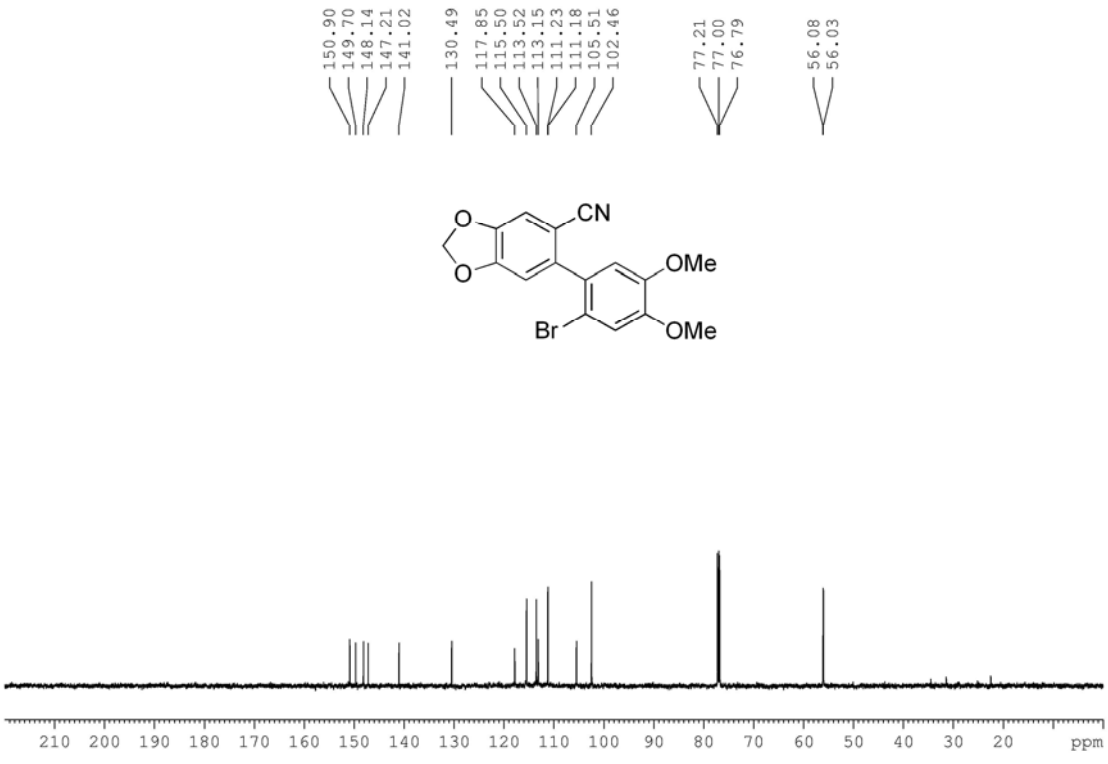
6-(2-Bromo-4-fluorophenyl)benzo[*d*][1,3]dioxole-5-carbonitrile (1C2)





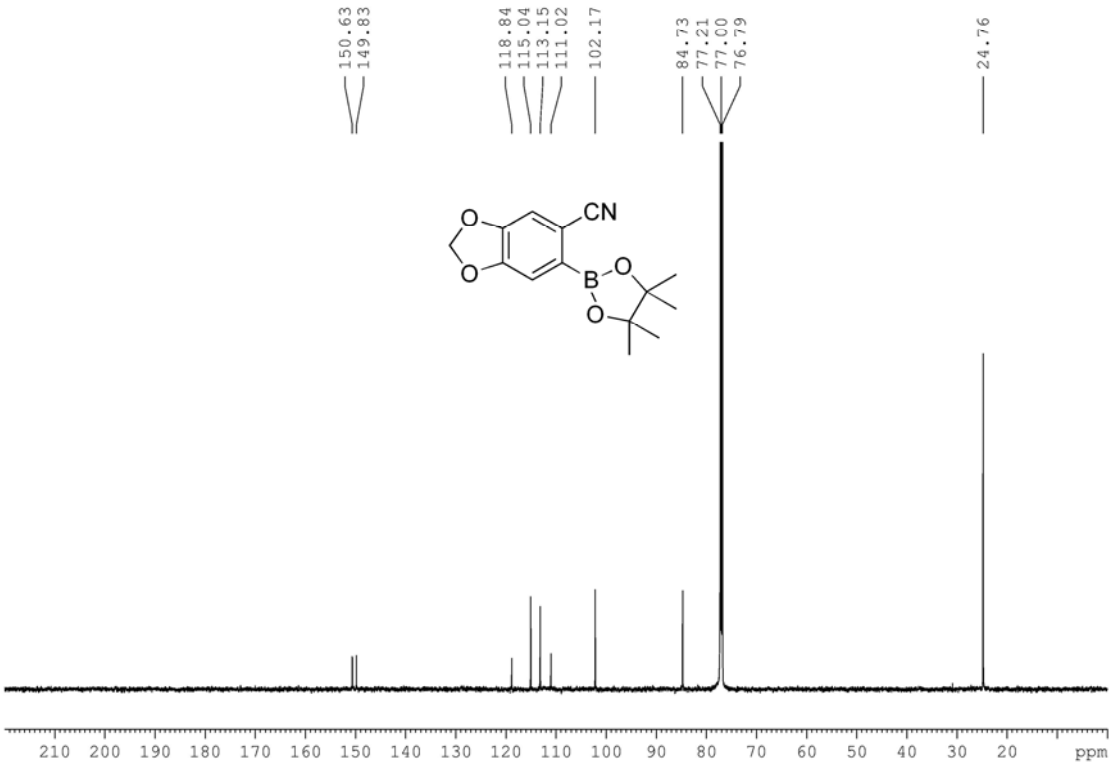
3-(2-Bromo-4,5-dimethoxyphenyl)-2-naphthonitrile (1C3)



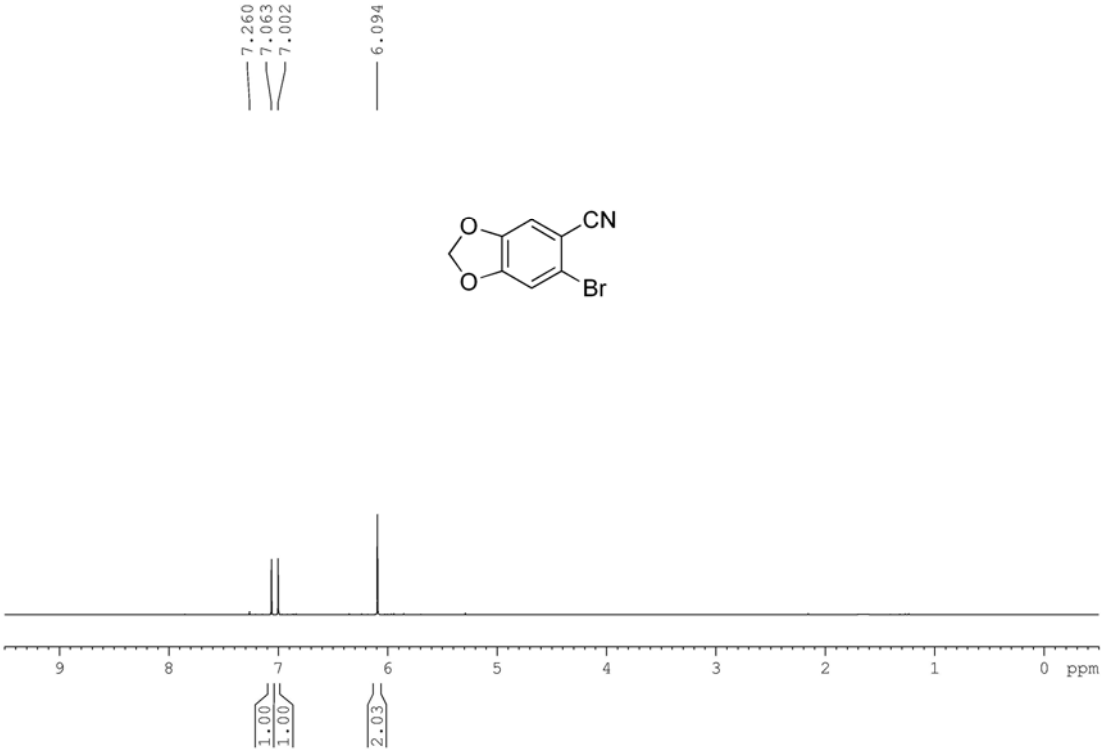


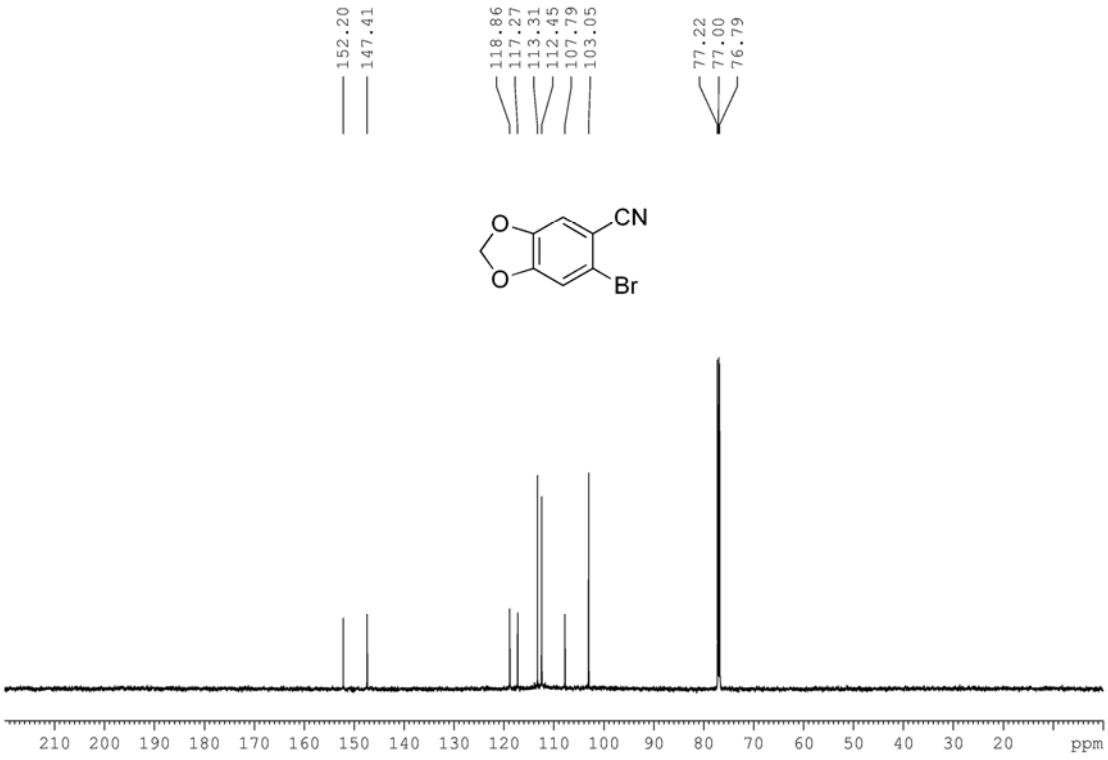
6'-Bromo-[5,5'-bibenzo[*d*][1,3]dioxole]-6-carbonitrile (1C4)

6-(4,4,5,5-Tetramethyl- 1,3,2-dioxaborolan-2-yl)benzo[*d*][1,3]dioxole-5-carbonitrile (**4k**)



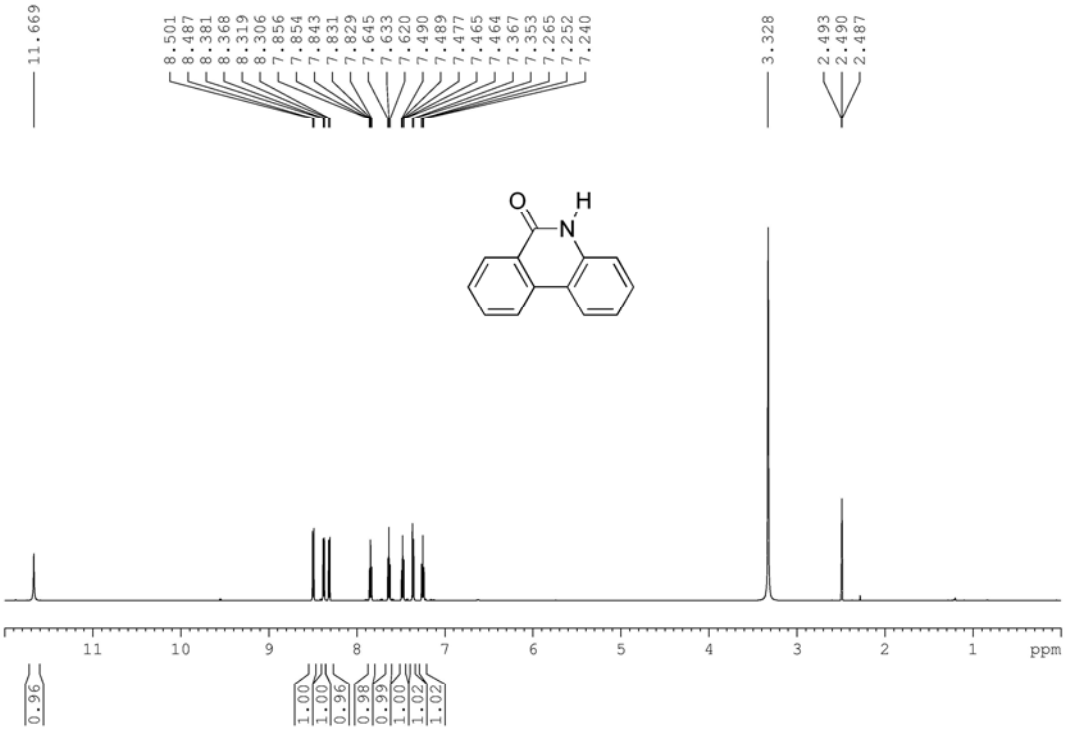
6-Bromobenzo[*d*][1,3]dioxole-5-carbonitrile (5k)

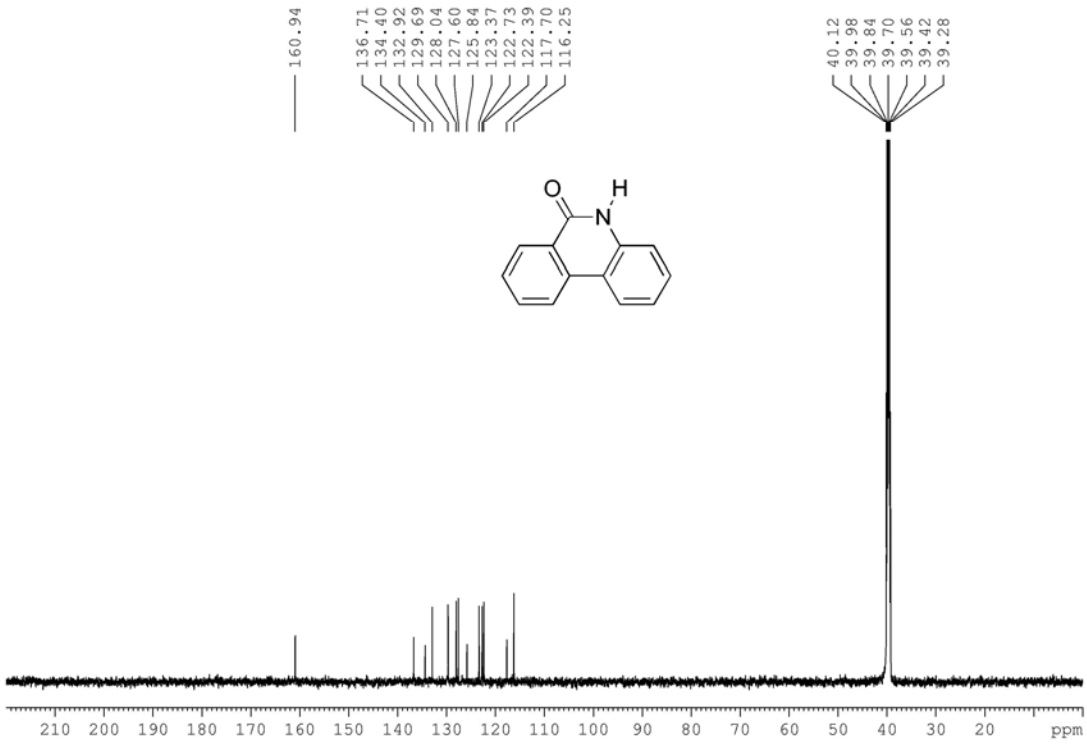




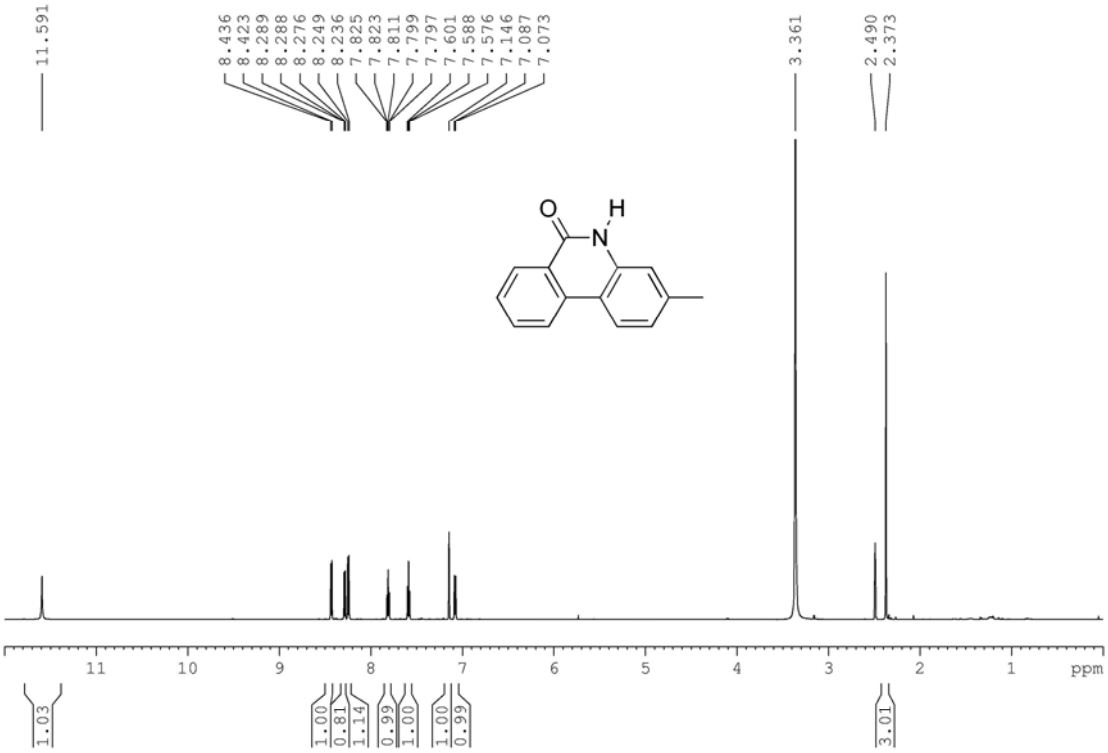
^{1}H and ^{13}C NMR Spectra for Products (600 MHz, DMSO-d_6 and $CDCl_3$)

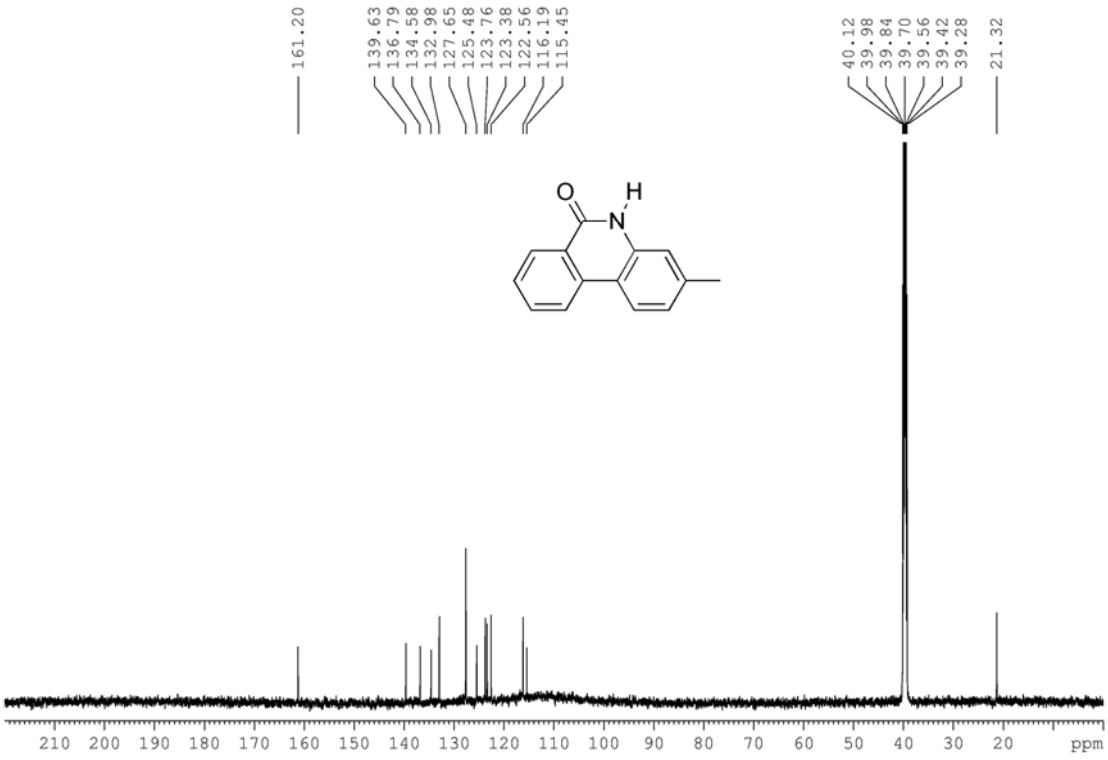
Phenanthridin-6(5*H*)-one (2a)



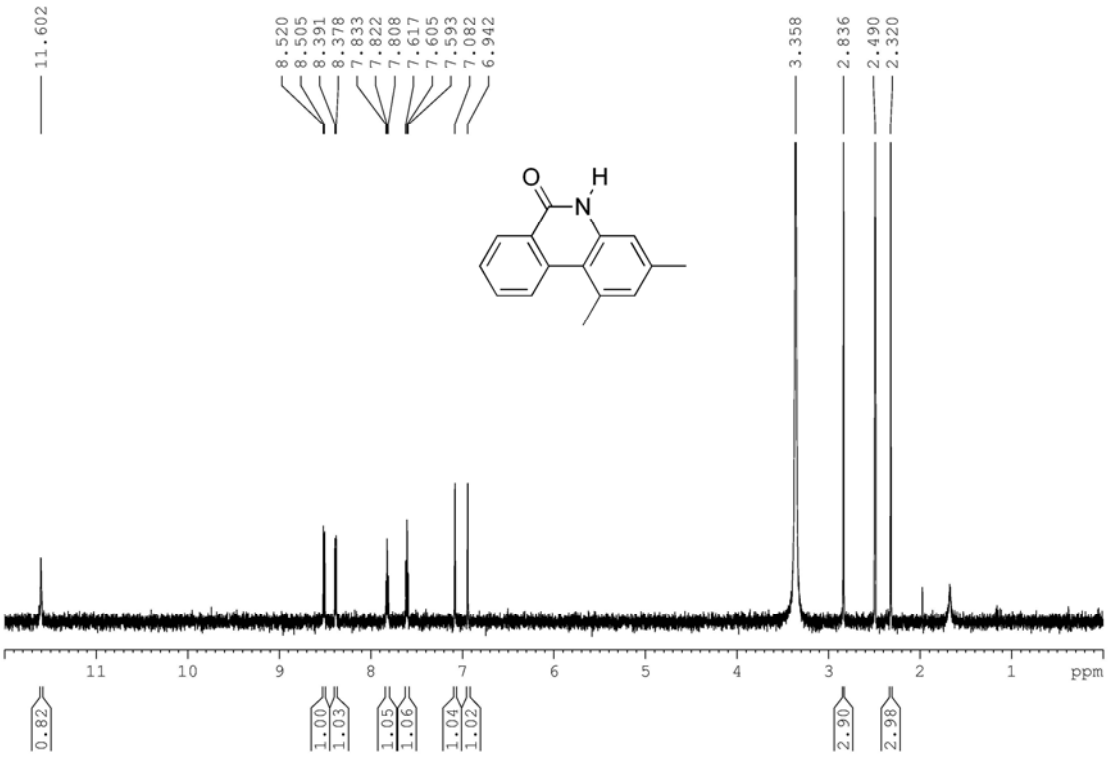


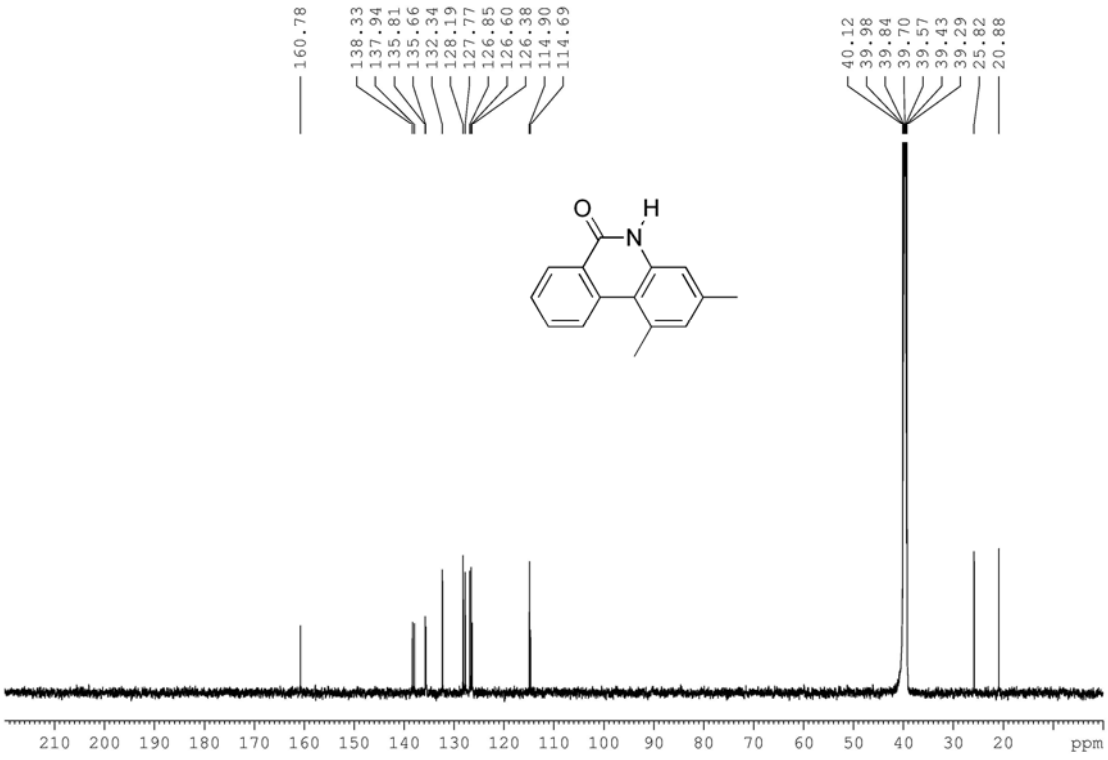
3-Methylphenanthridin-6(5*H*)-one (2b)



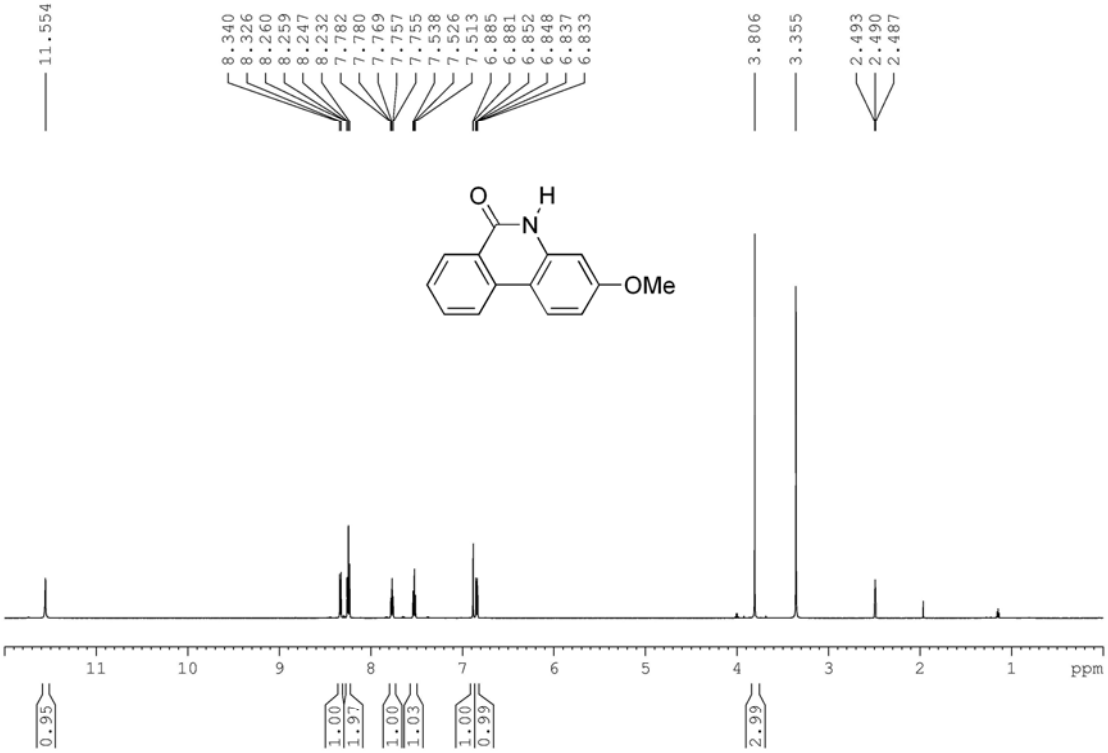


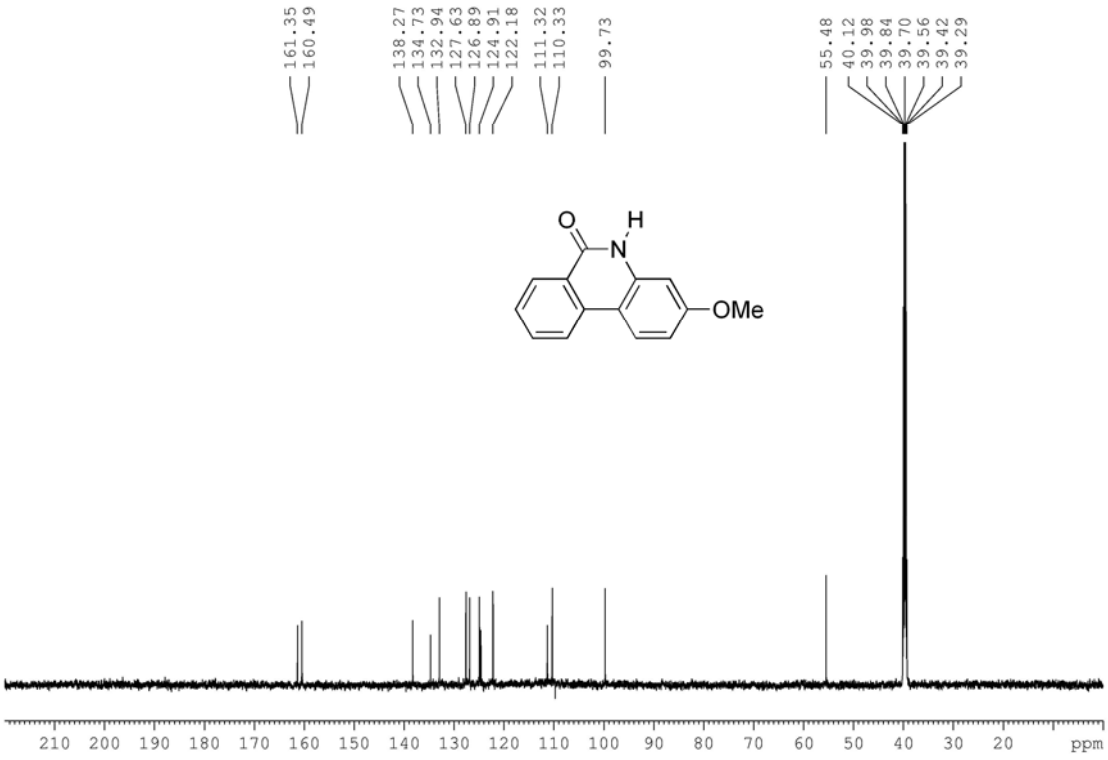
1,3-Dimethylphenanthridin-6(5*H*)-one (2c)



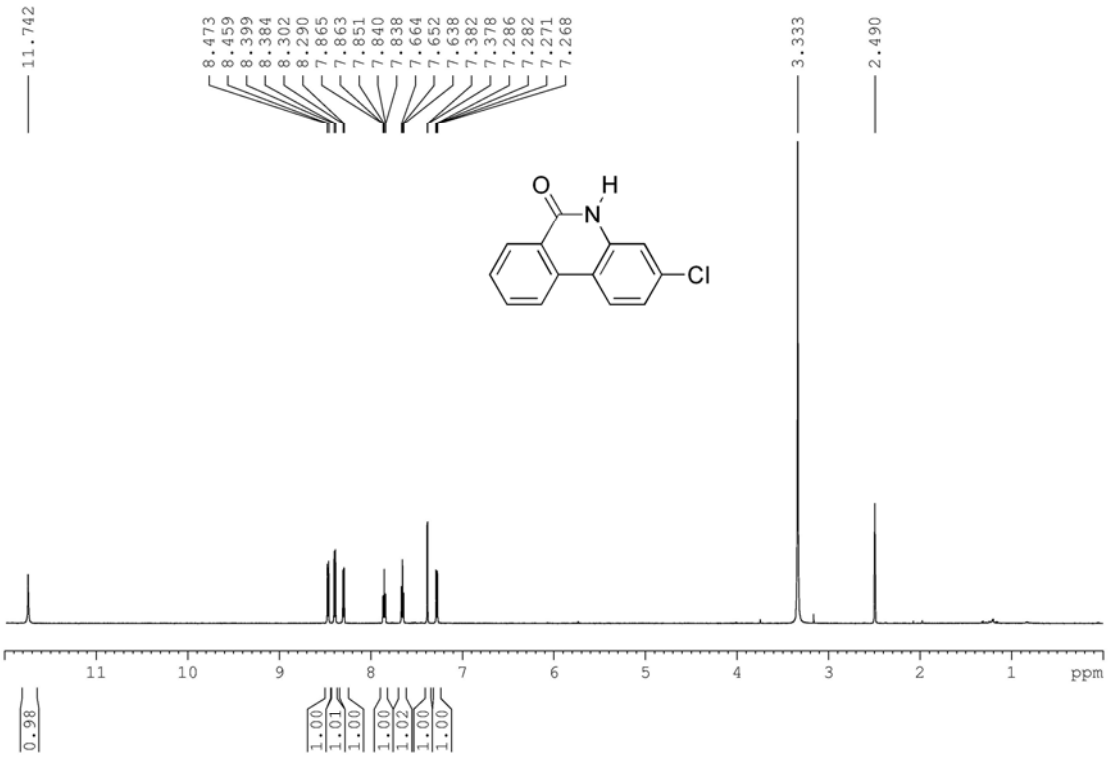


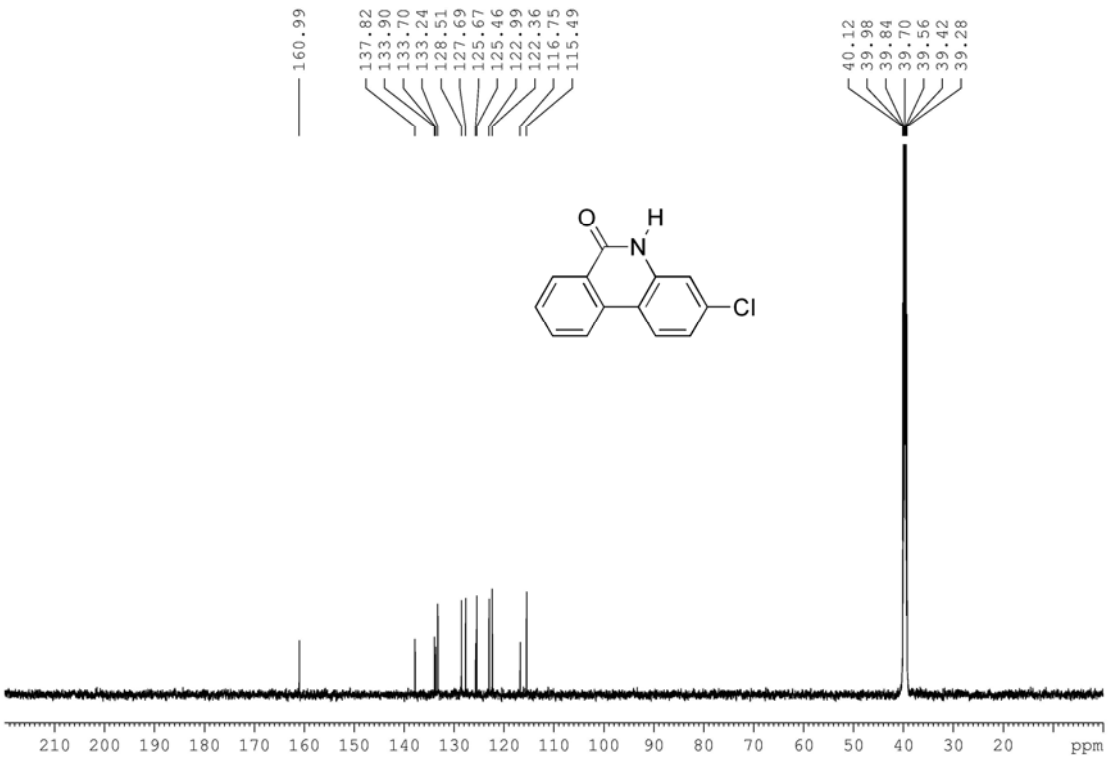
3-Methoxyphenanthridin-6(5*H*)-one (2d)



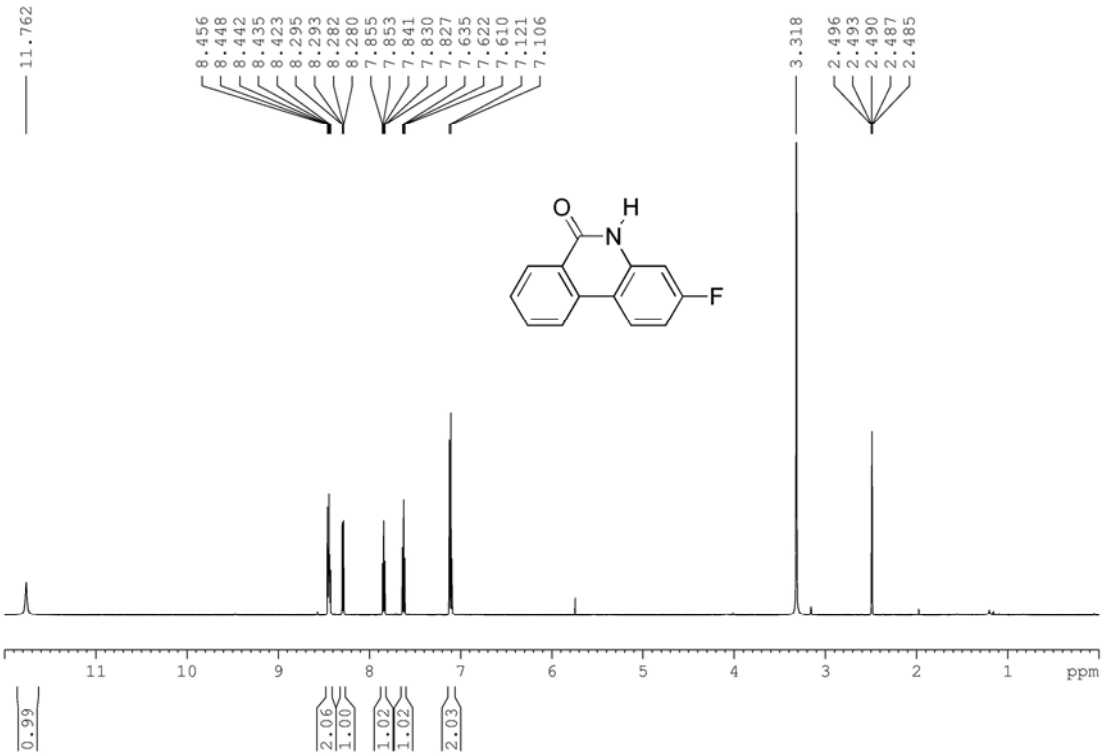


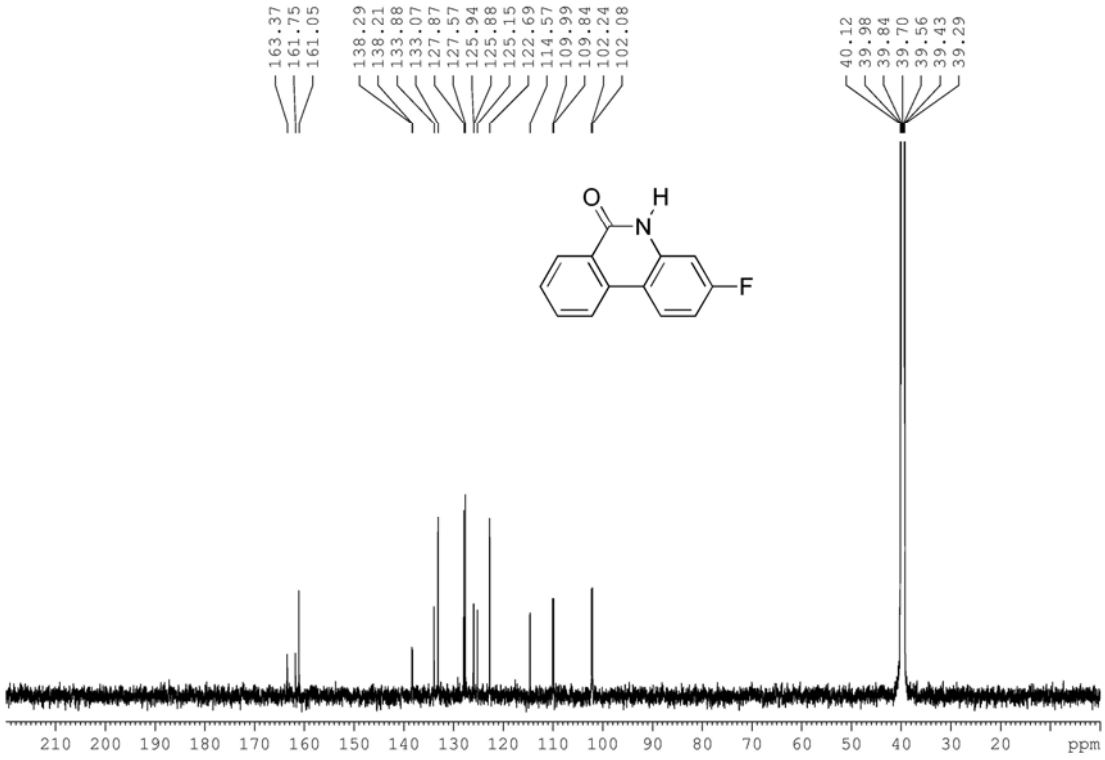
3-Chlorophenanthridin-6(5*H*)-one (2e)



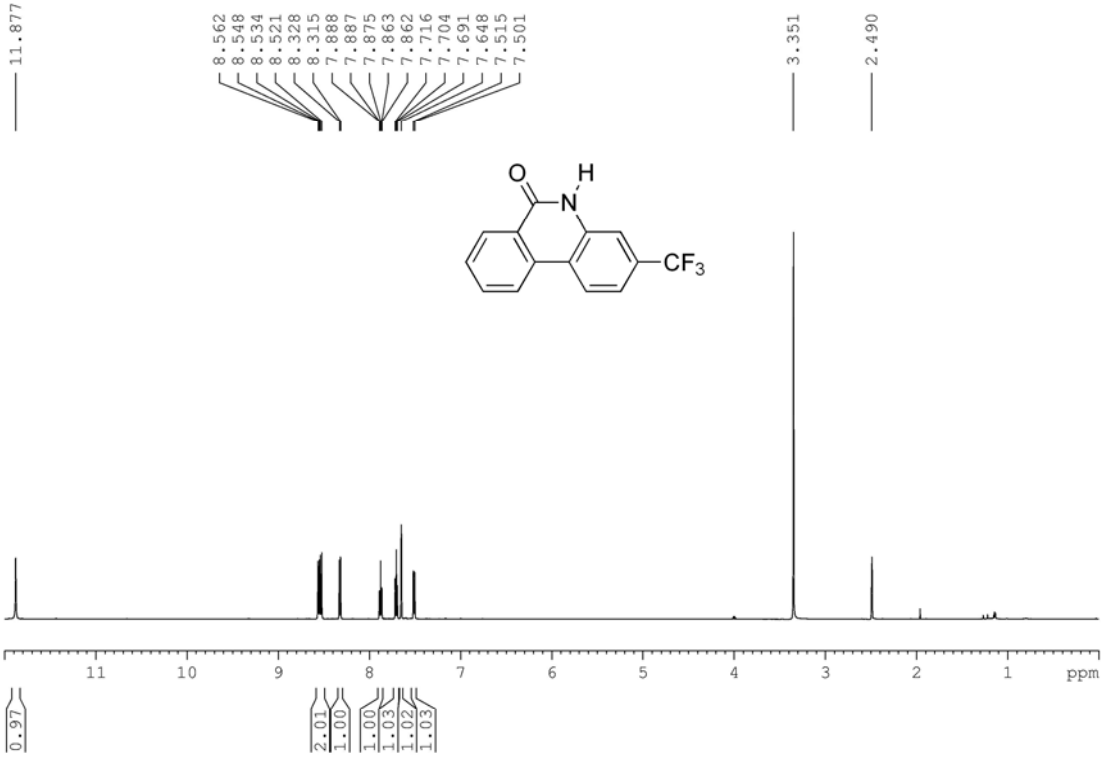


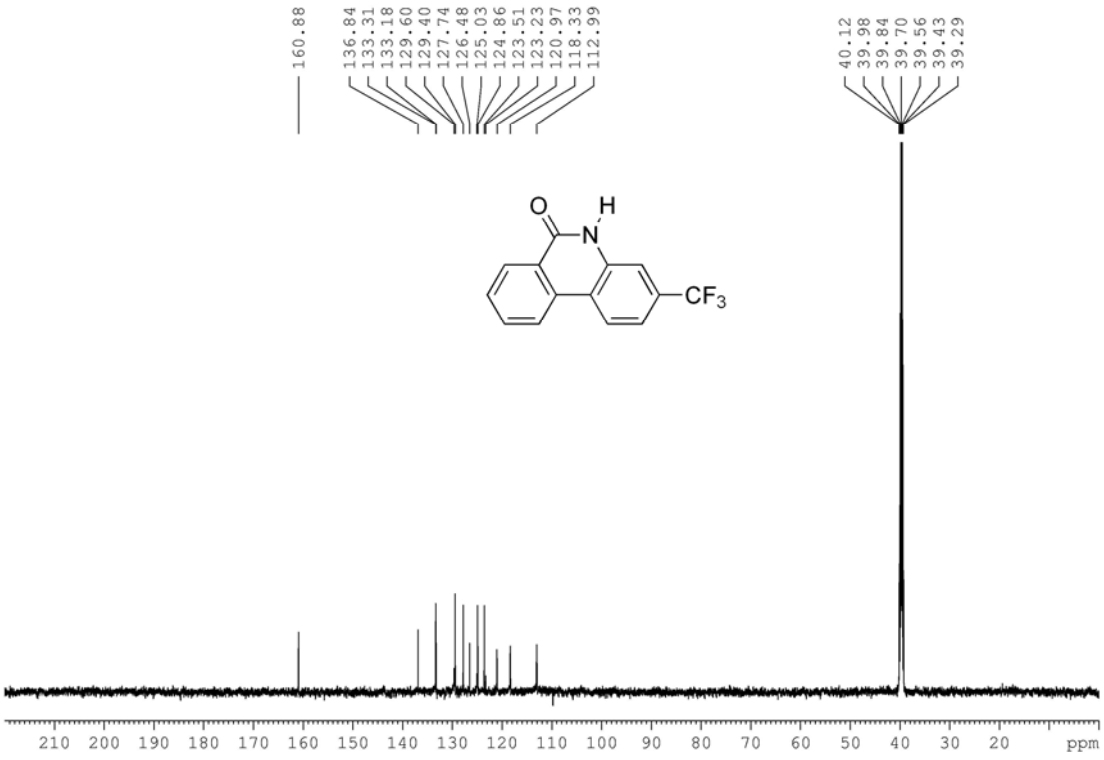
3-Fluorophenanthridin-6(5*H*)-one (2f)



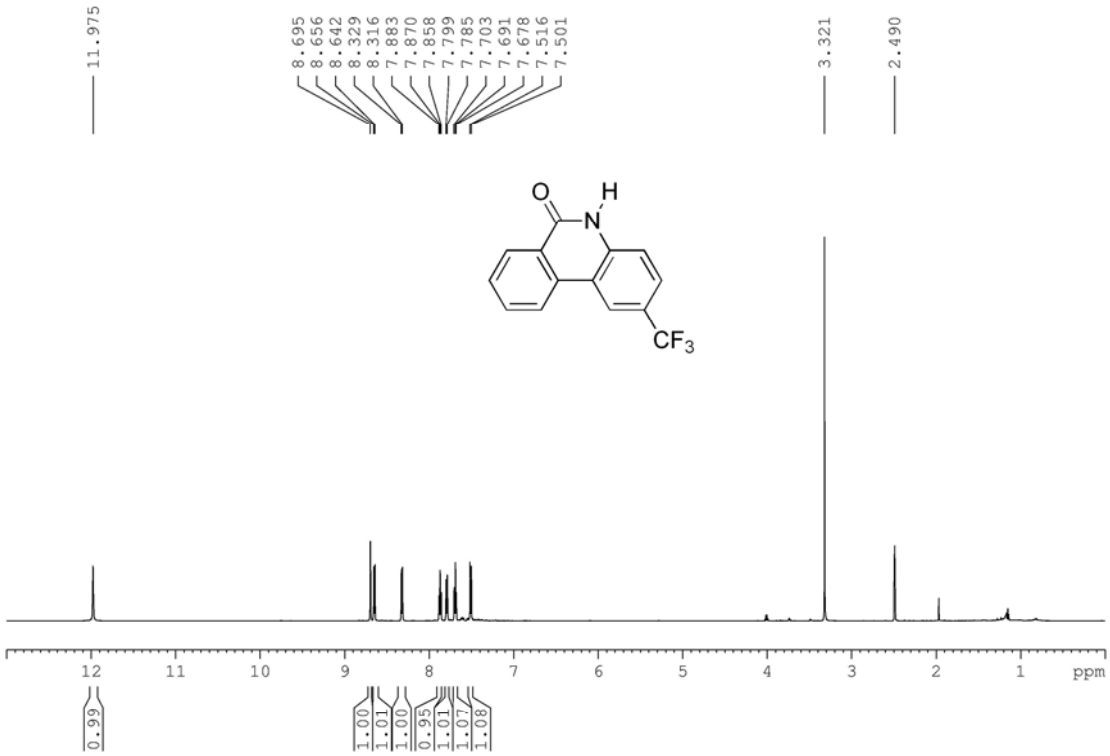


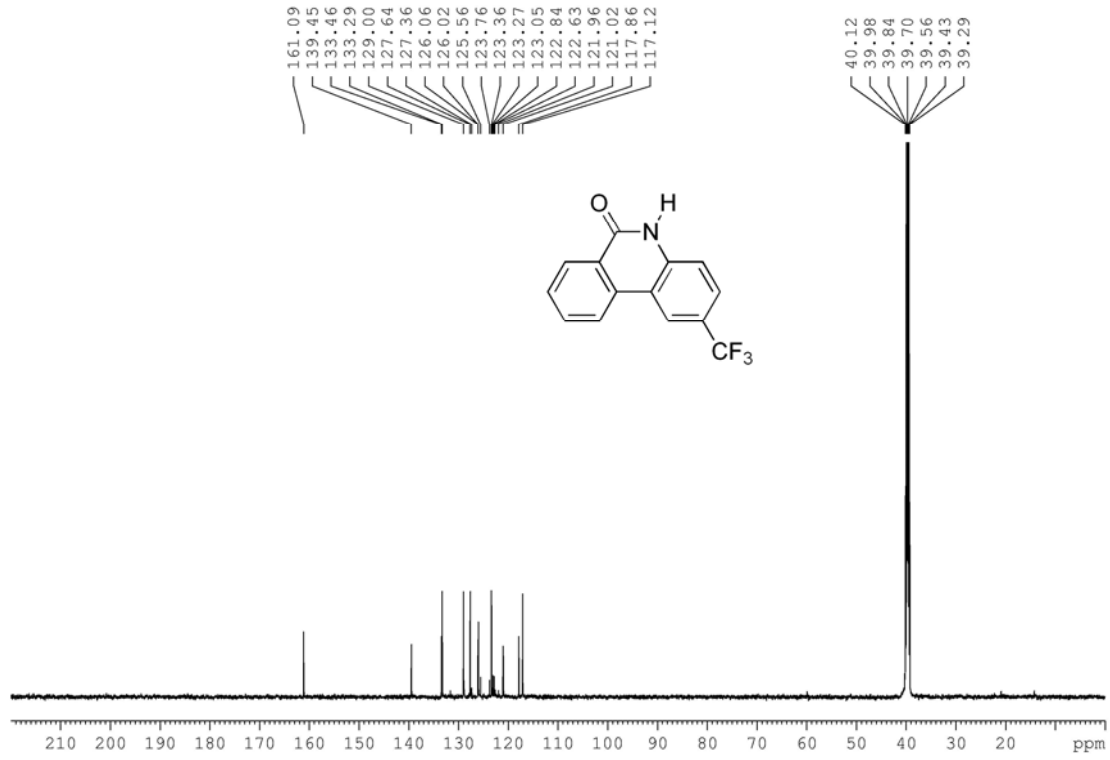
3-(Trifluoromethyl)phenanthridin-6(5H)-one (2g)



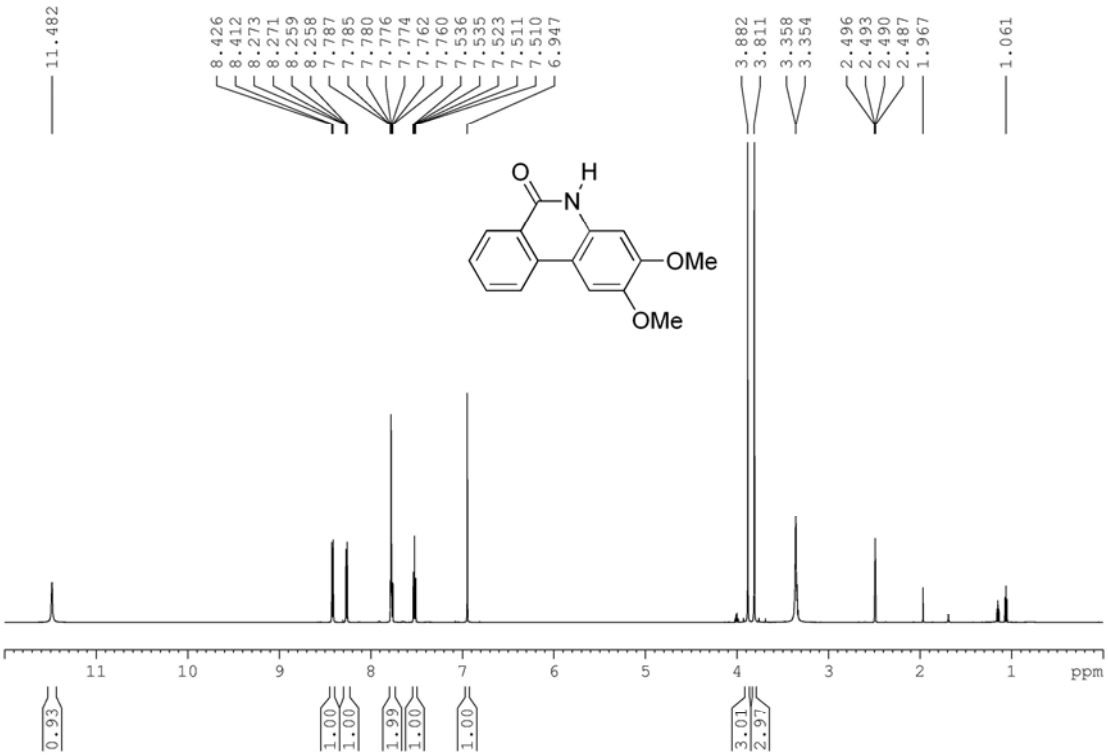


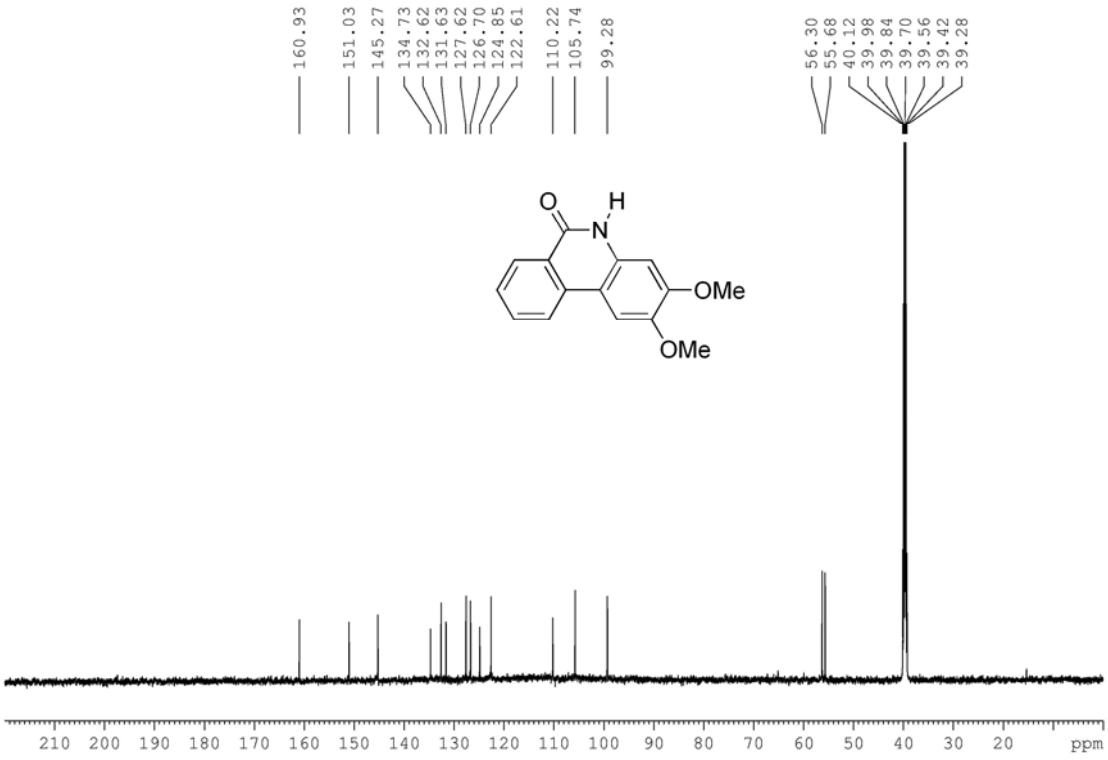
2-(Trifluoromethyl)phenanthridin-6(5*H*)-one (2h)



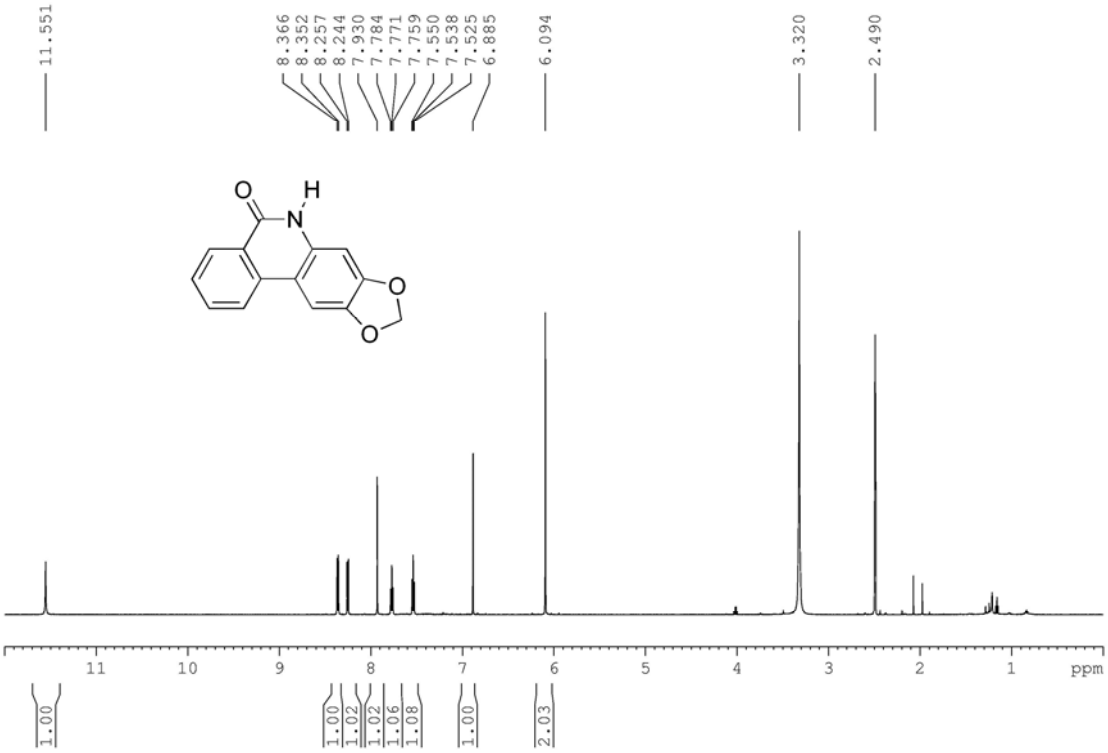


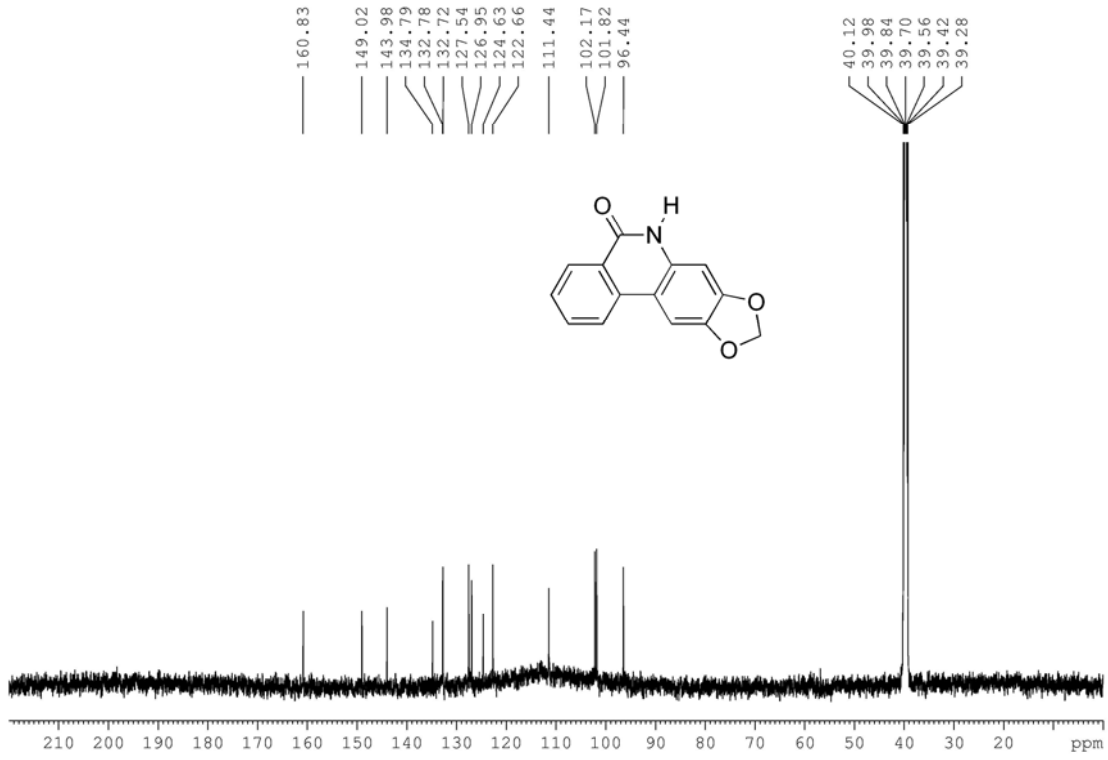
2,3-Dimethoxyphenanthridin-6(5*H*)-one (2i)



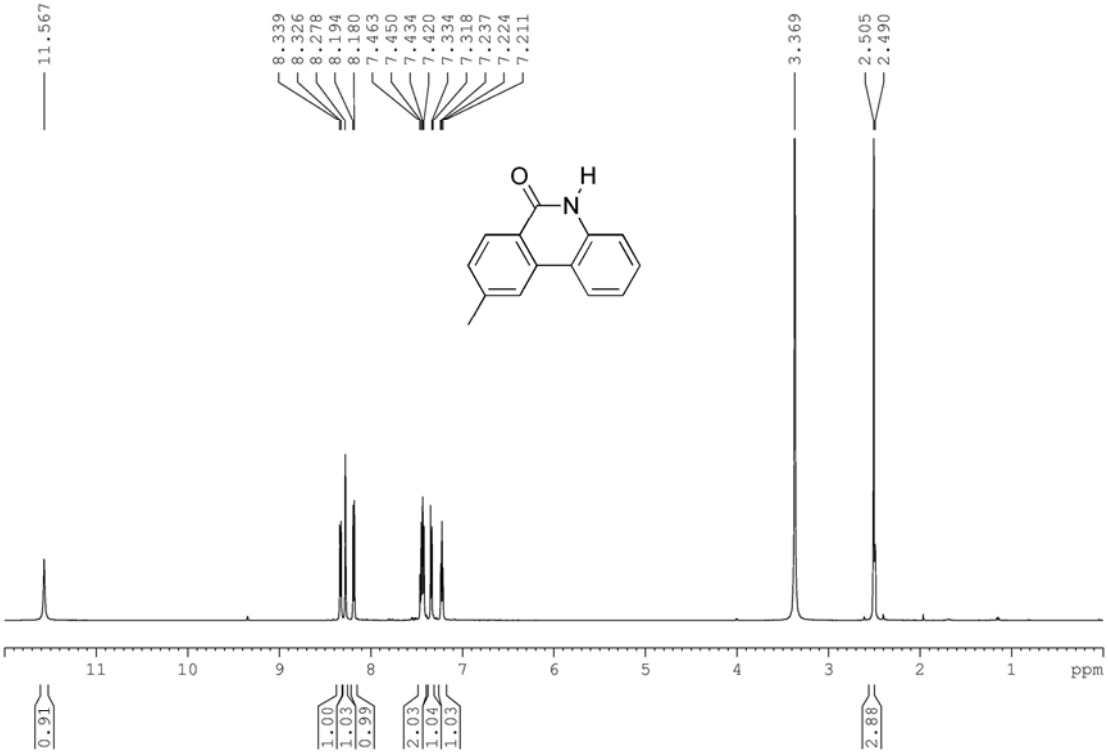


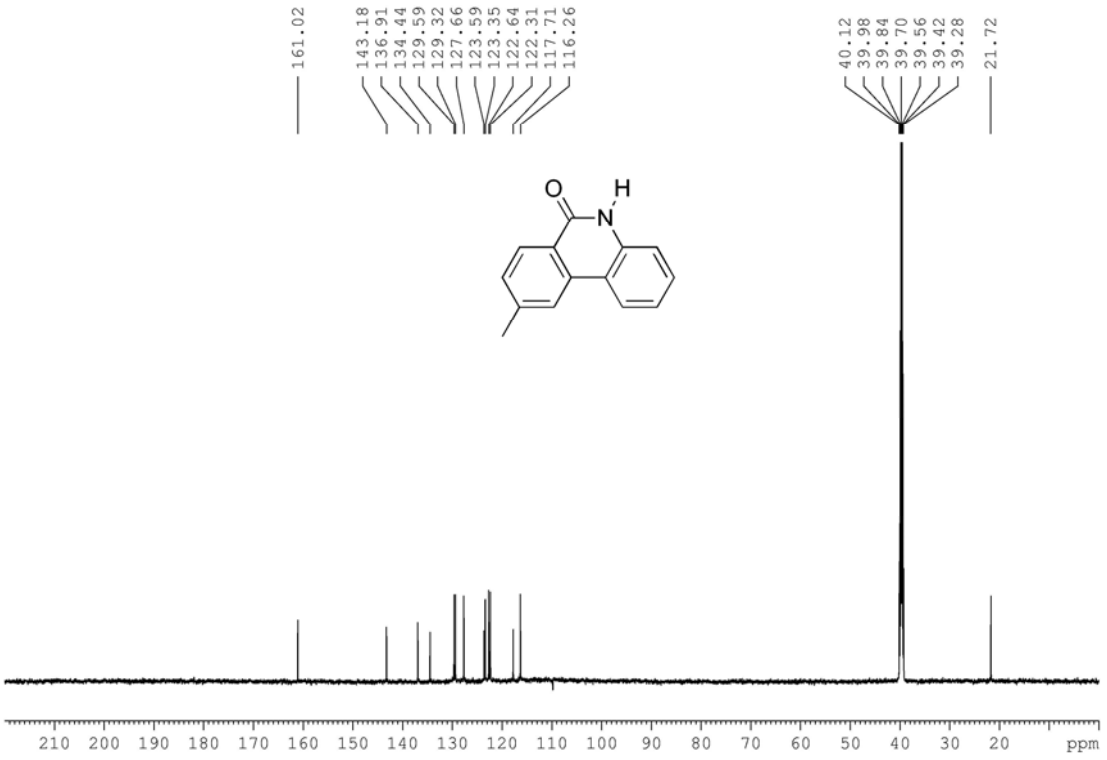
[1,3]Dioxolo[4,5-*b*]phenanthridin-5(6*H*)-one (2j)



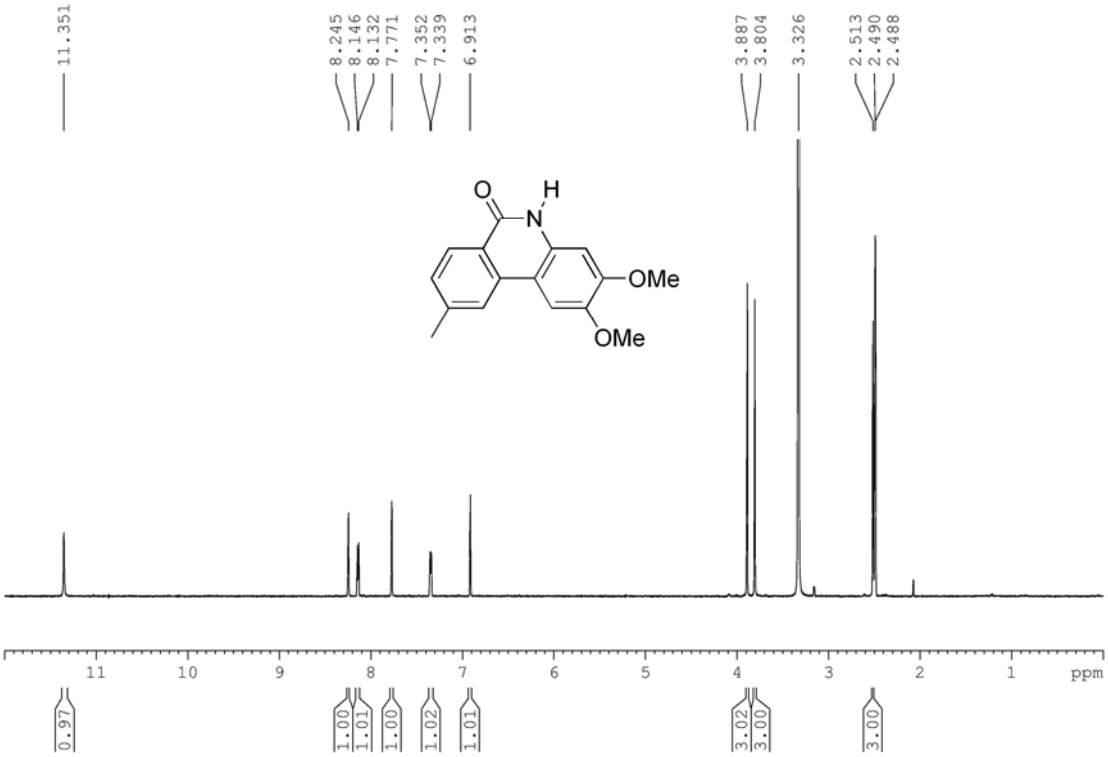


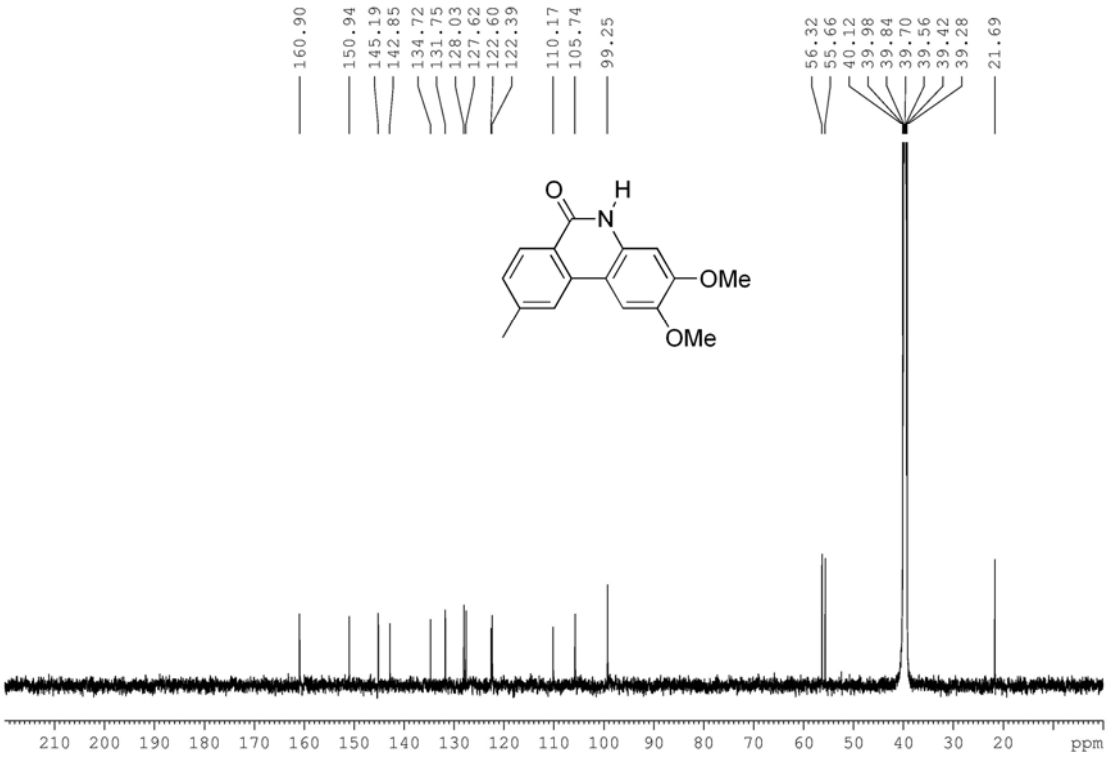
Phenaglydon (2k)



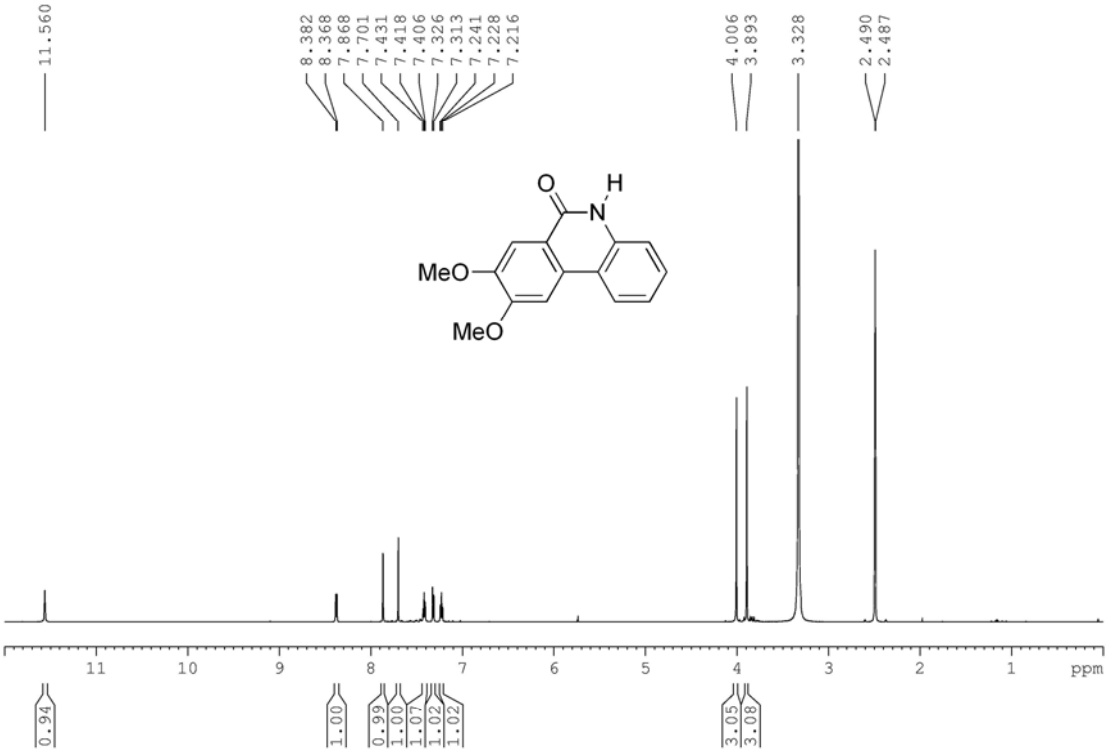


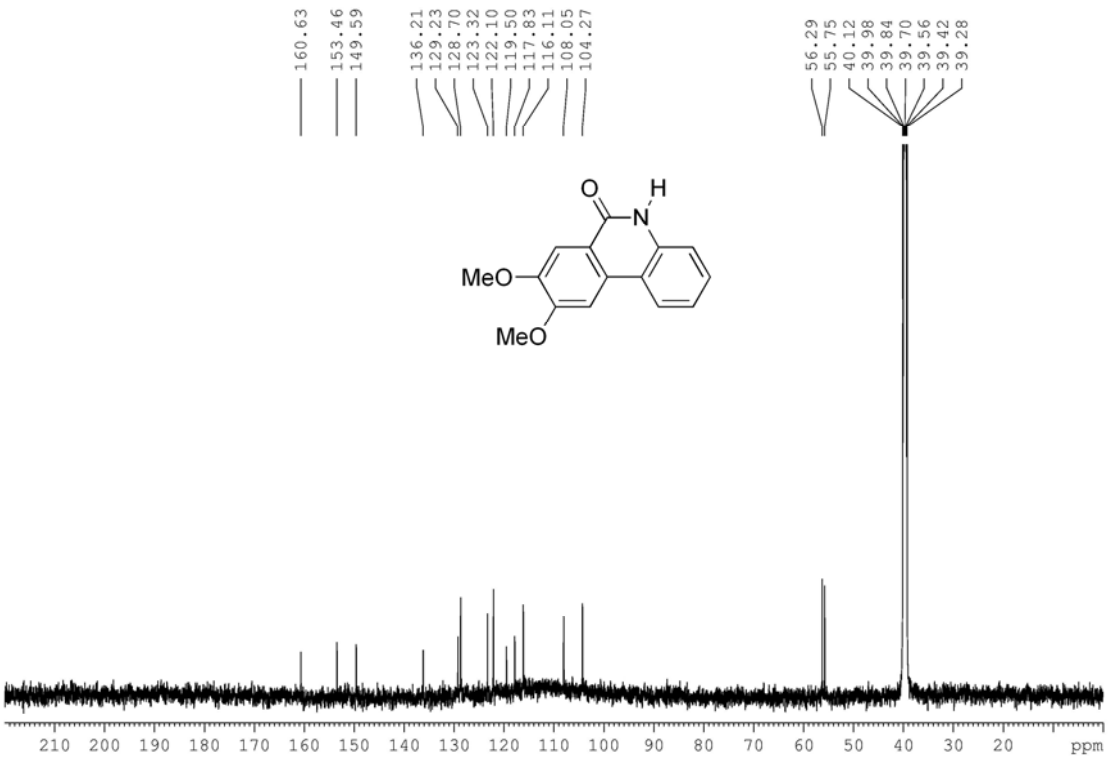
2,3-Dimethoxy-9-methylphenanthridin-6(5*H*)-one (2l)



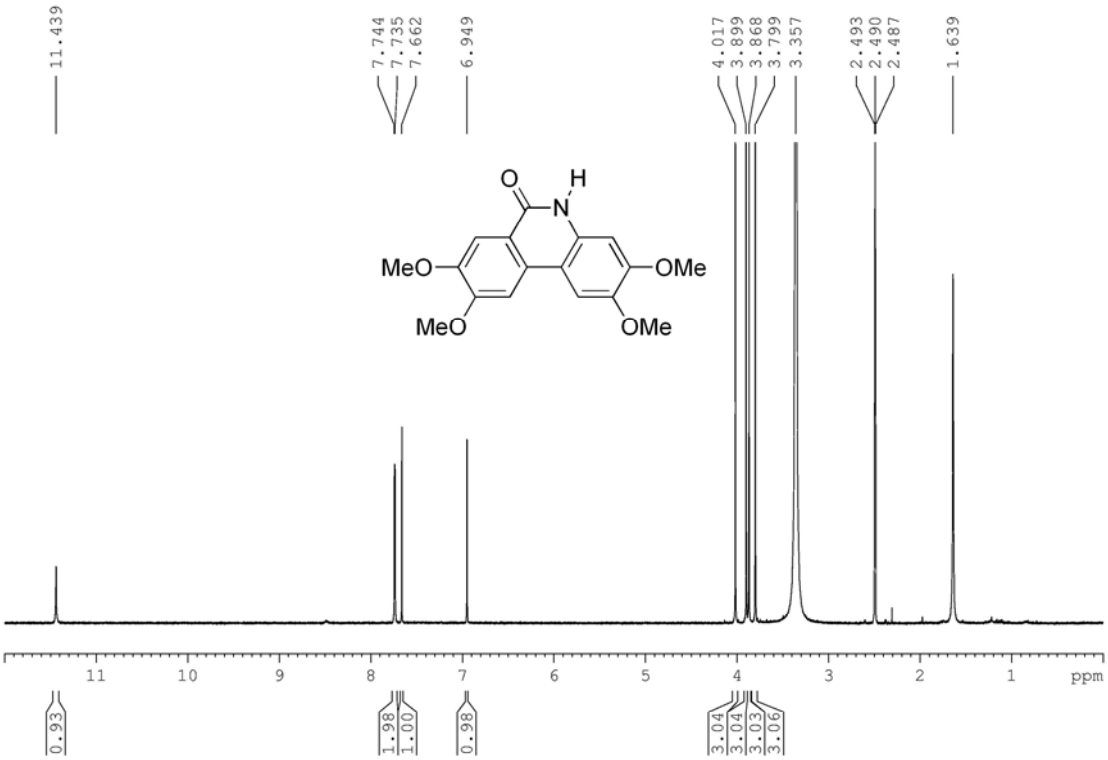


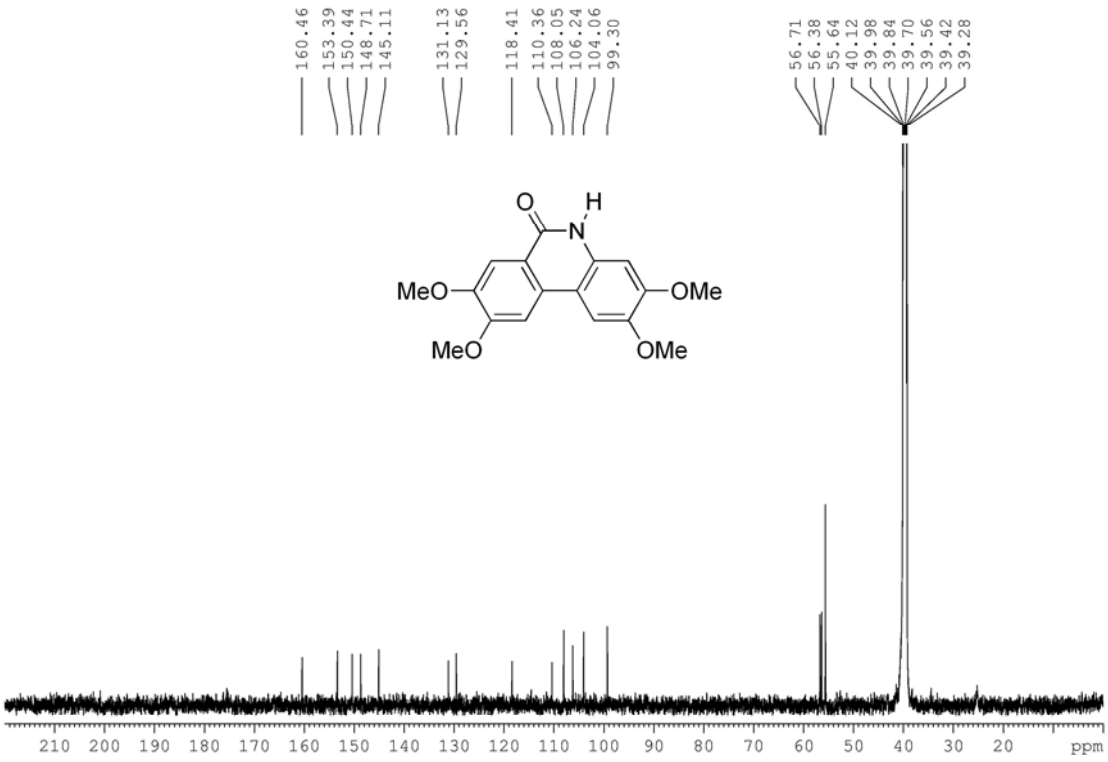
8,9-Dimethoxyphenanthridin-6(5*H*)-one (2m)



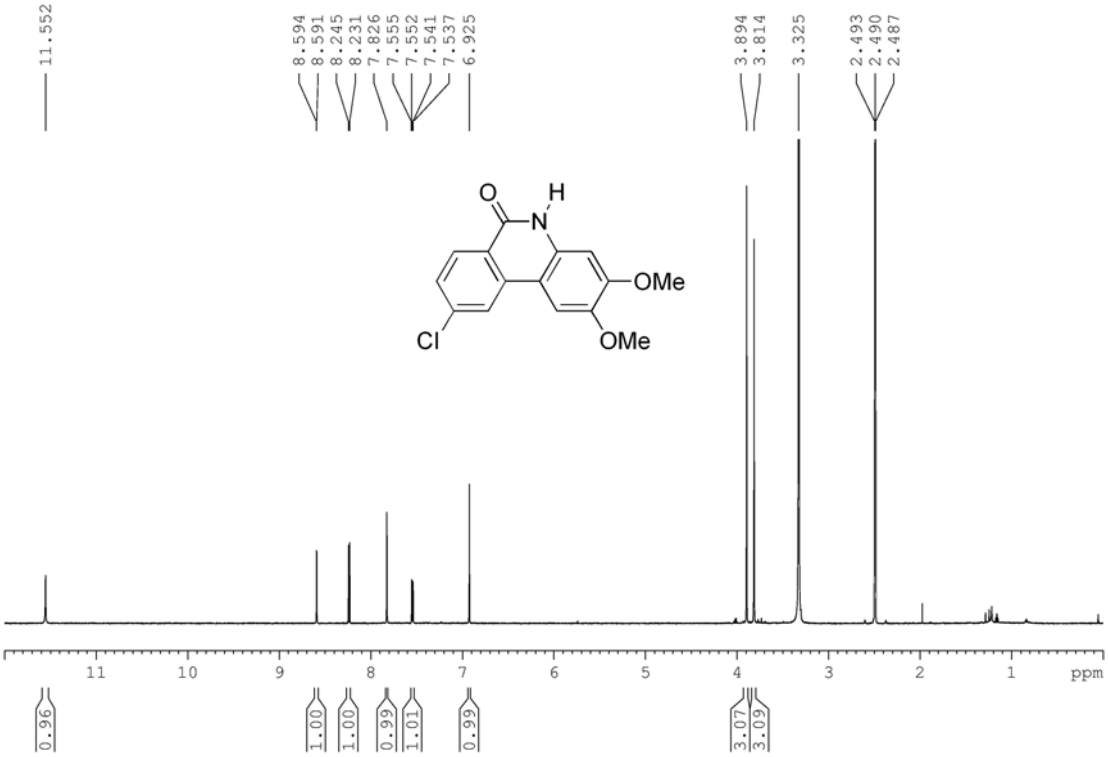


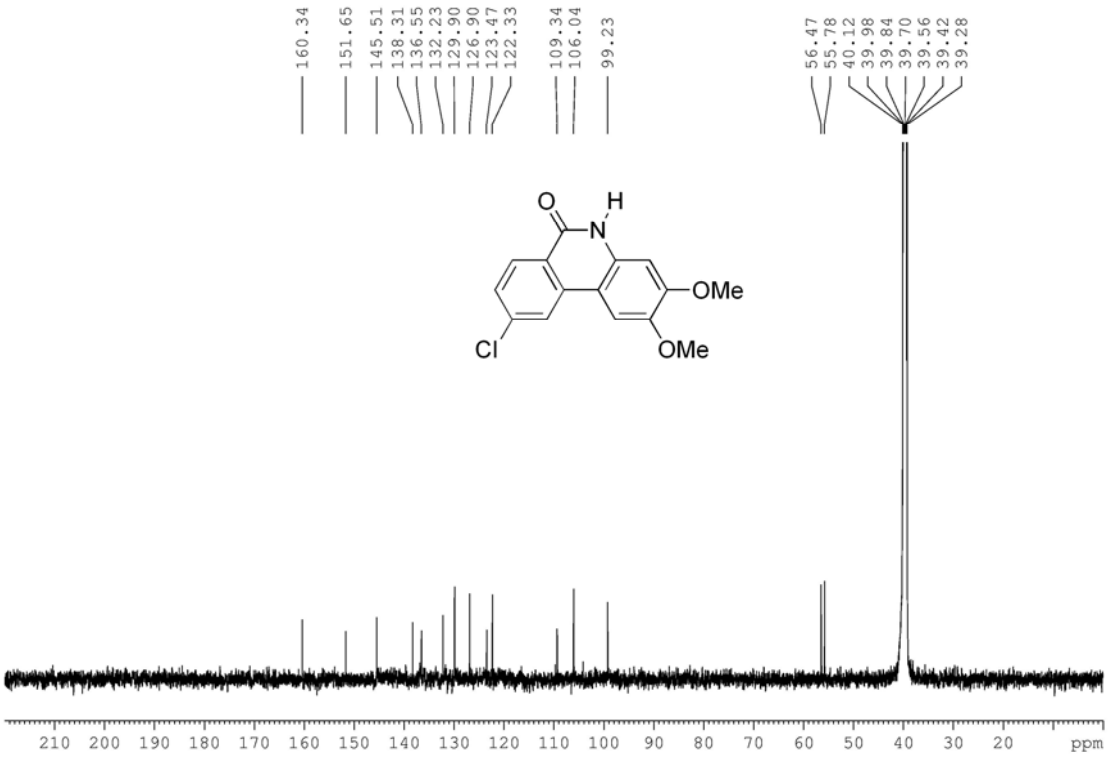
2,3,8,9-Tetramethoxyphenanthridin-6(5*H*)-one (2n)



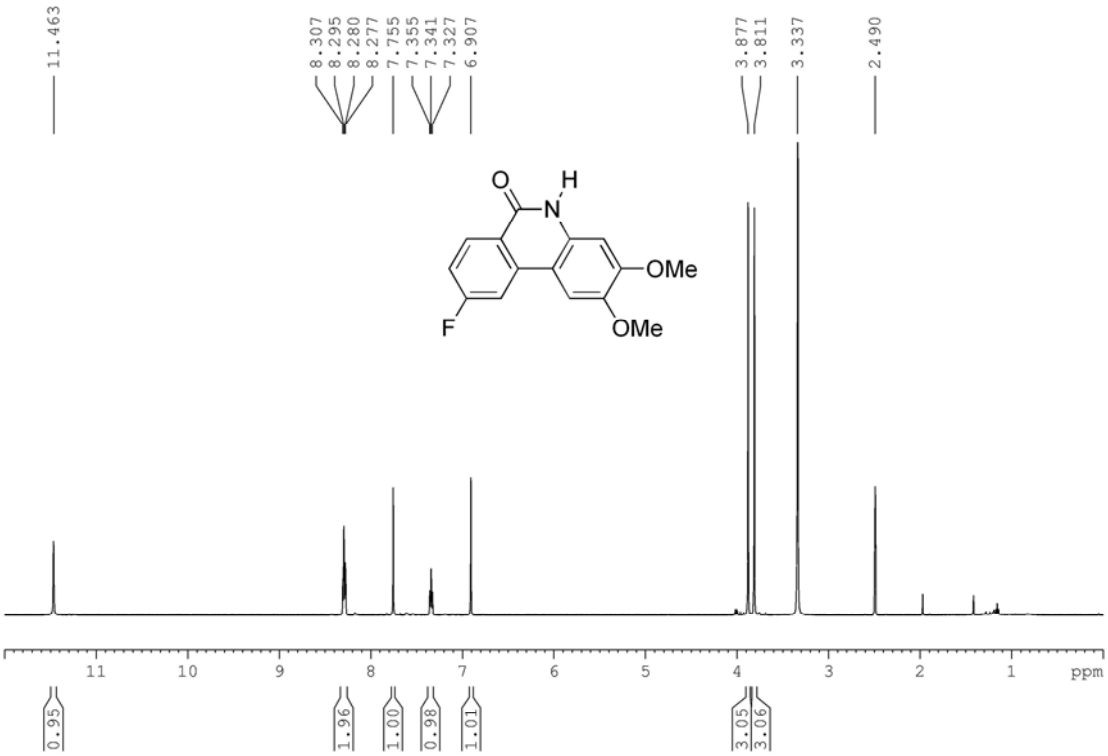


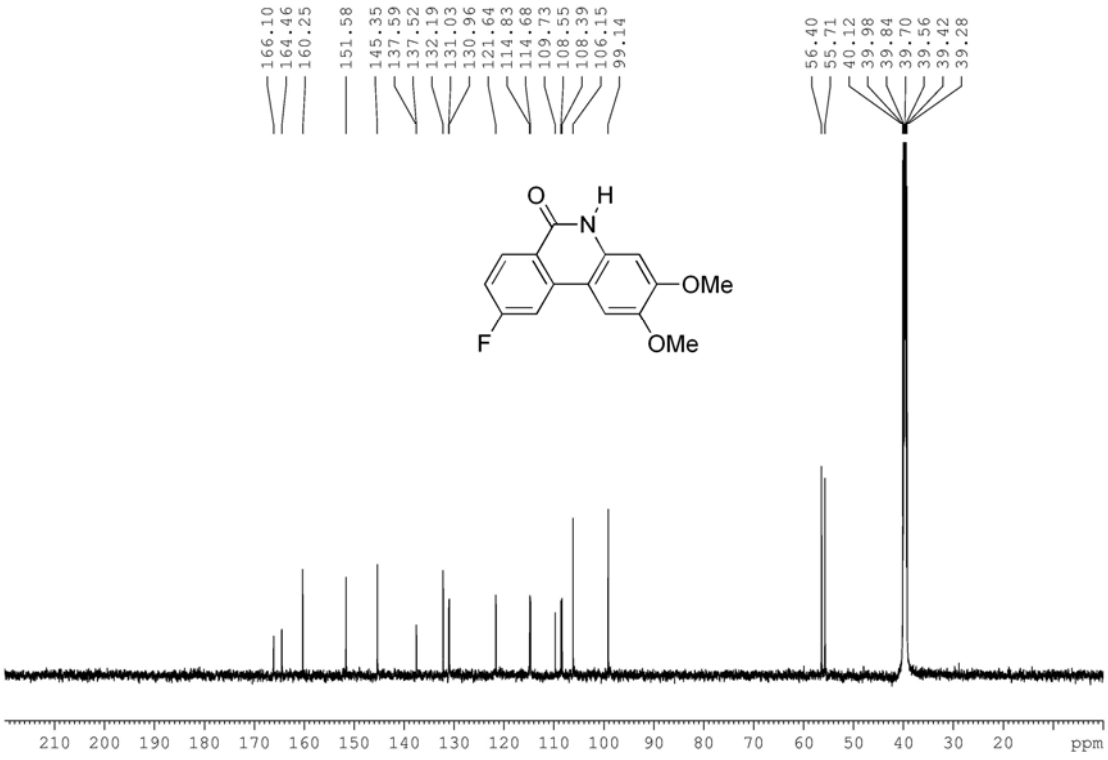
9-Chloro-2,3-dimethoxyphenanthridin-6(5*H*)-one (2o)



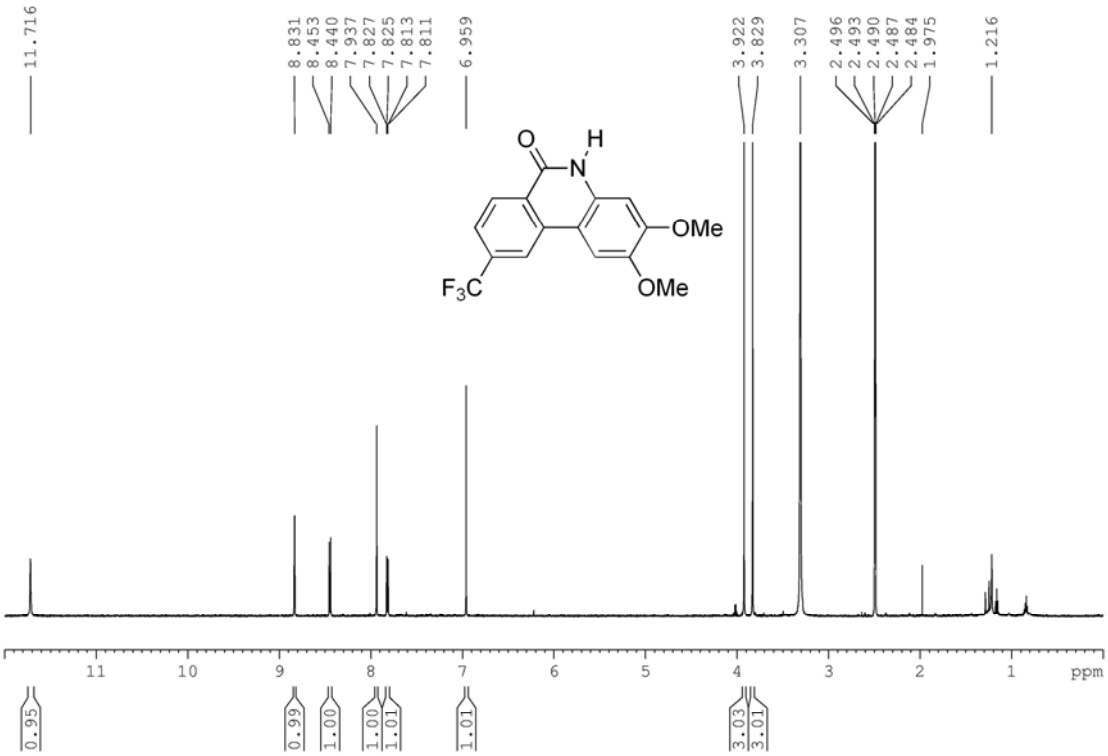


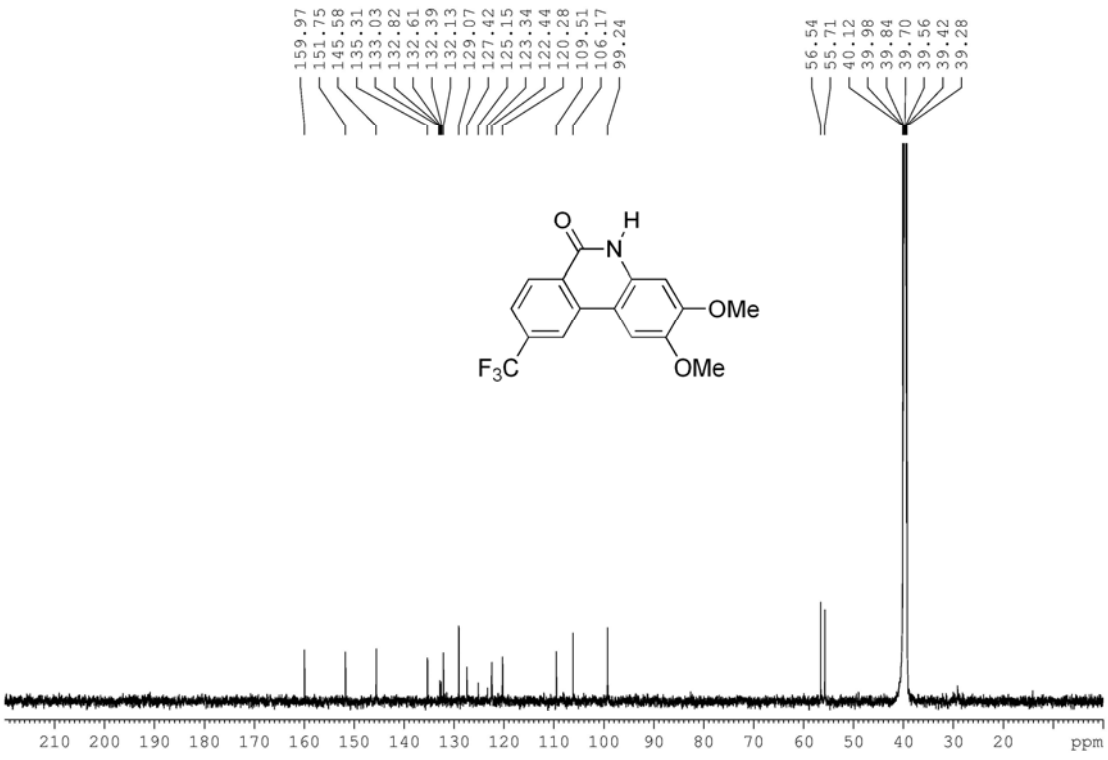
9-Fluoro-2,3-dimethoxyphenanthridin-6(5*H*)-one (2p)



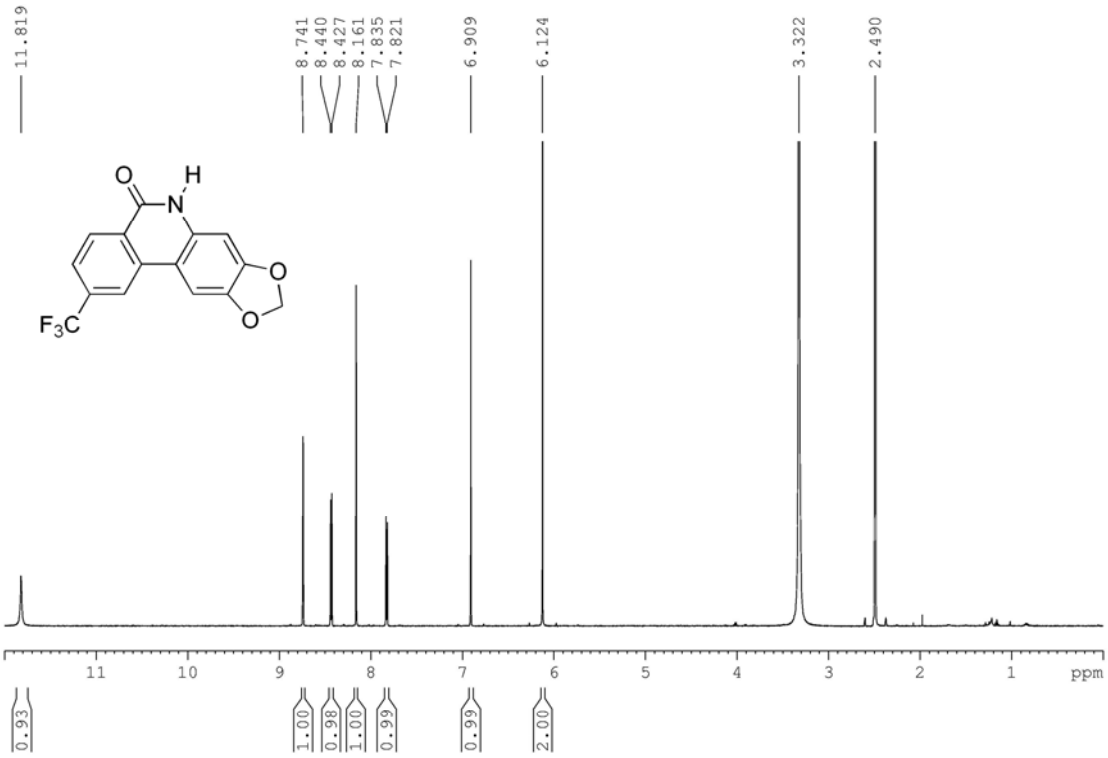


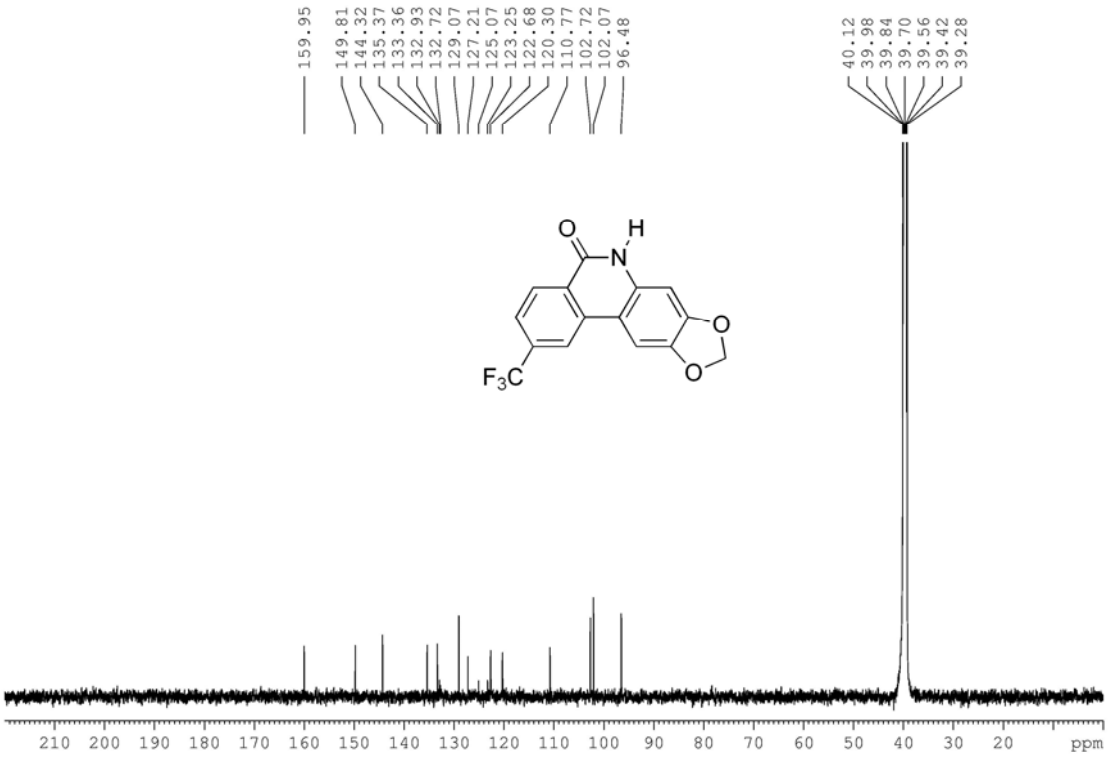
2,3-Dimethoxy-9-(trifluoromethyl)phenanthridin-6(5*H*)-one (2q)



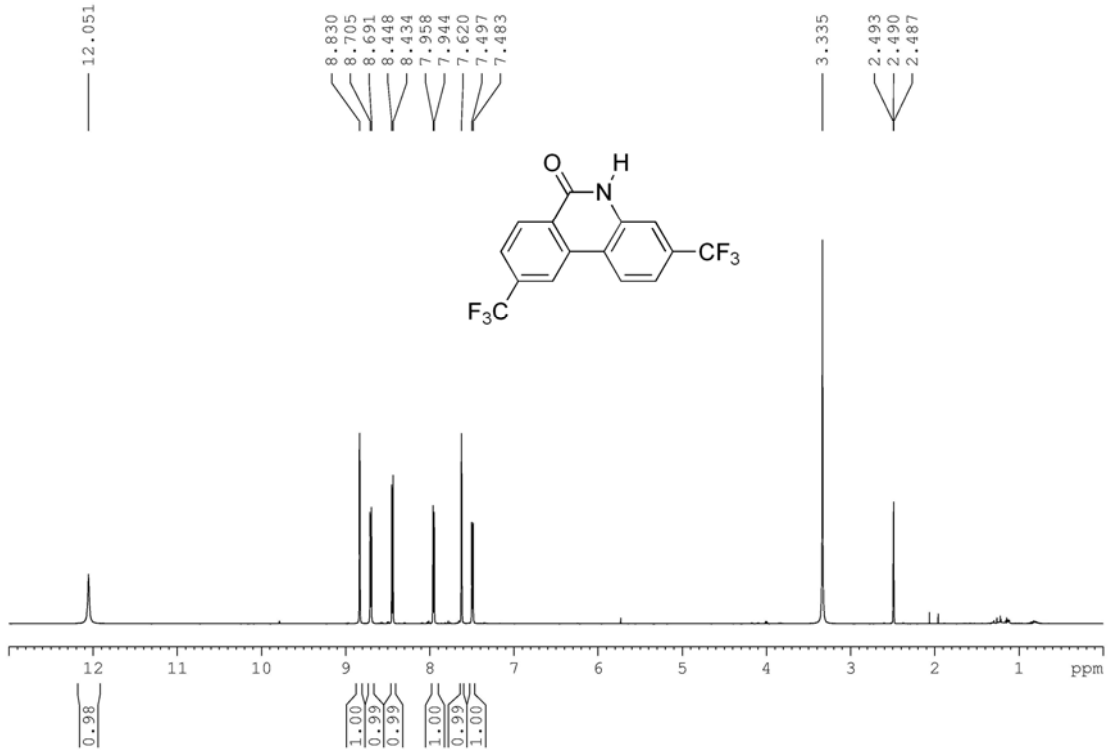


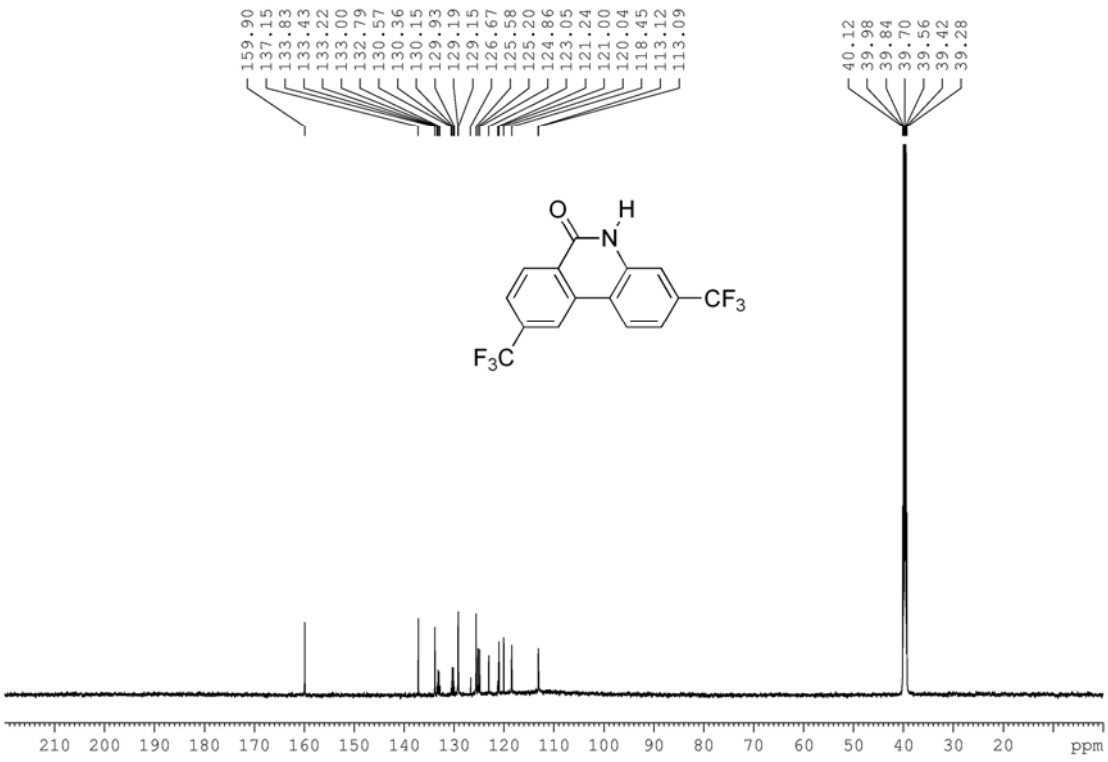
2-(Trifluoromethyl)-[1,3]dioxolo[4,5-*b*]phenanthridin-5(6*H*)-one (2r)



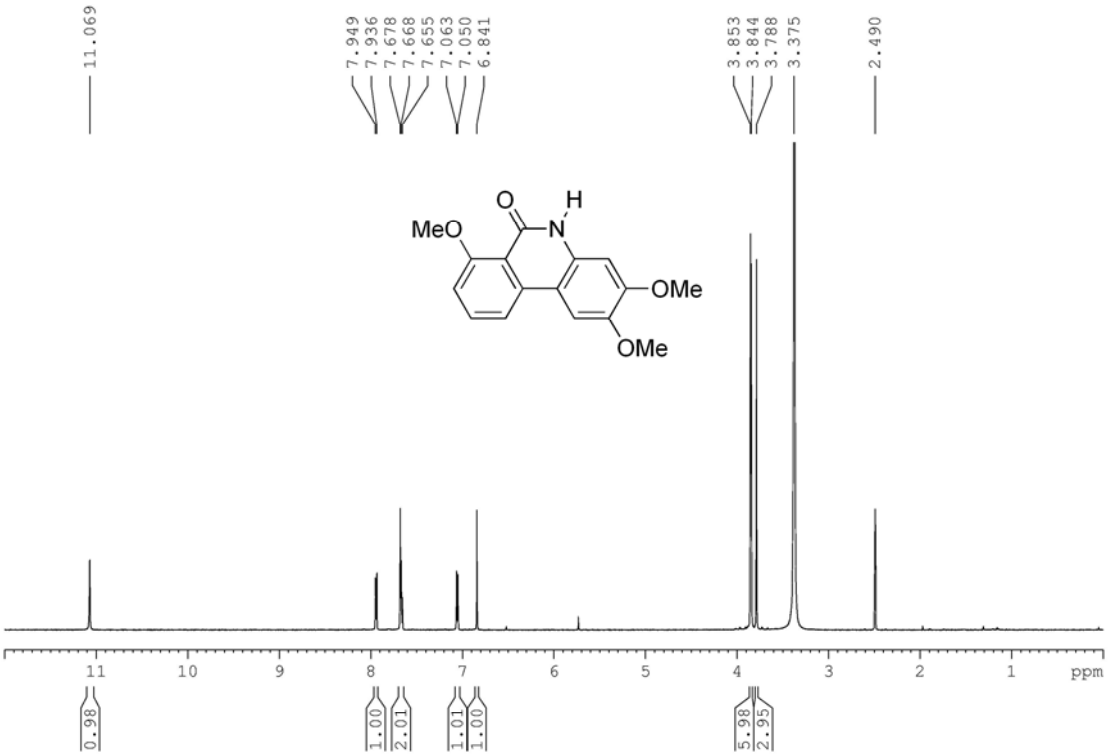


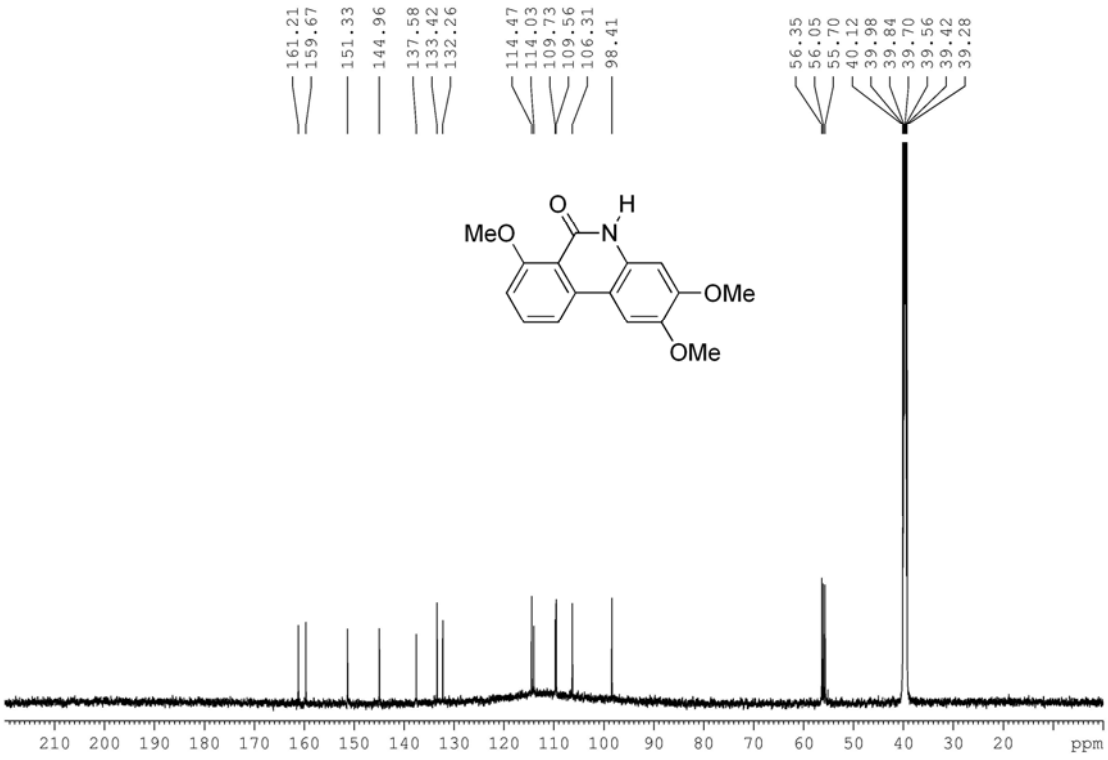
3,9-Bis(trifluoromethyl)phenanthridin-6(*5H*)-one (2s)



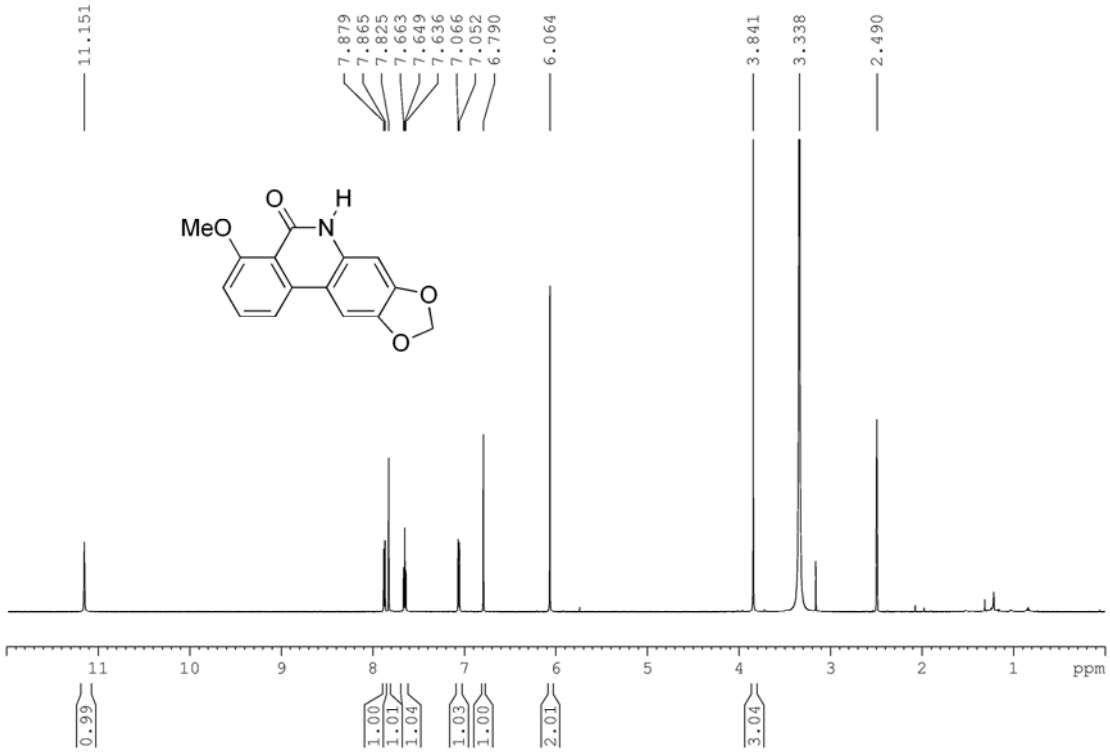


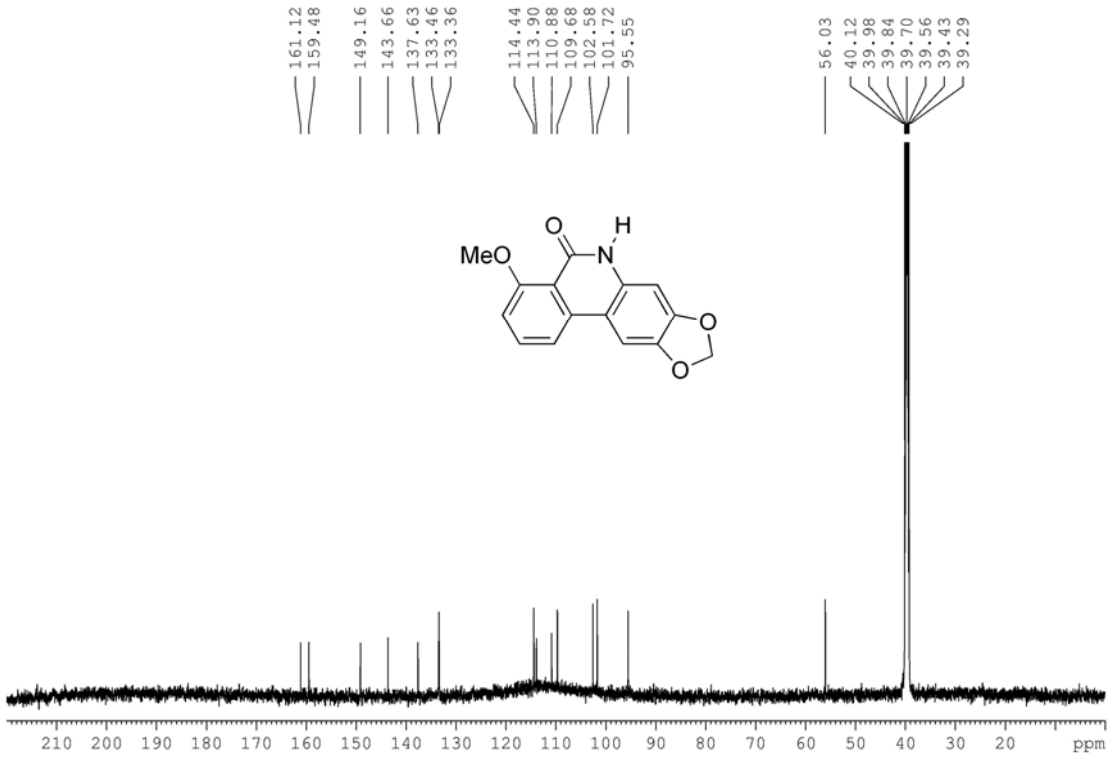
2,3,7-Trimethoxyphenanthridin-6(5*H*)-one (2t)



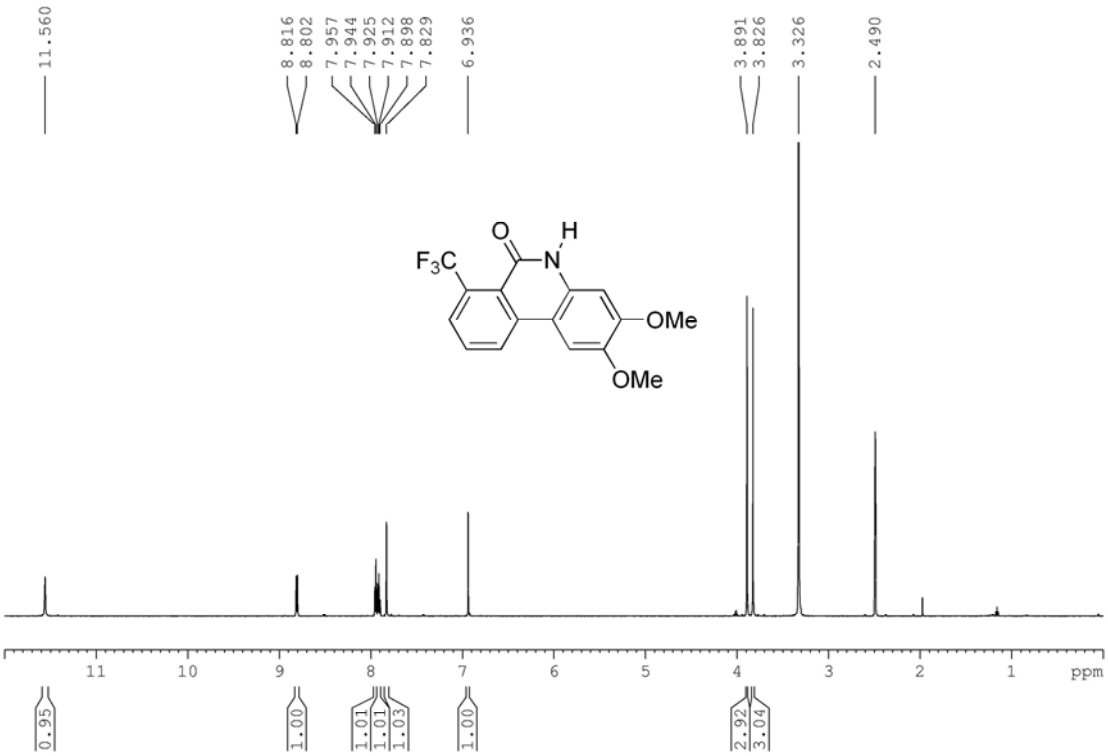


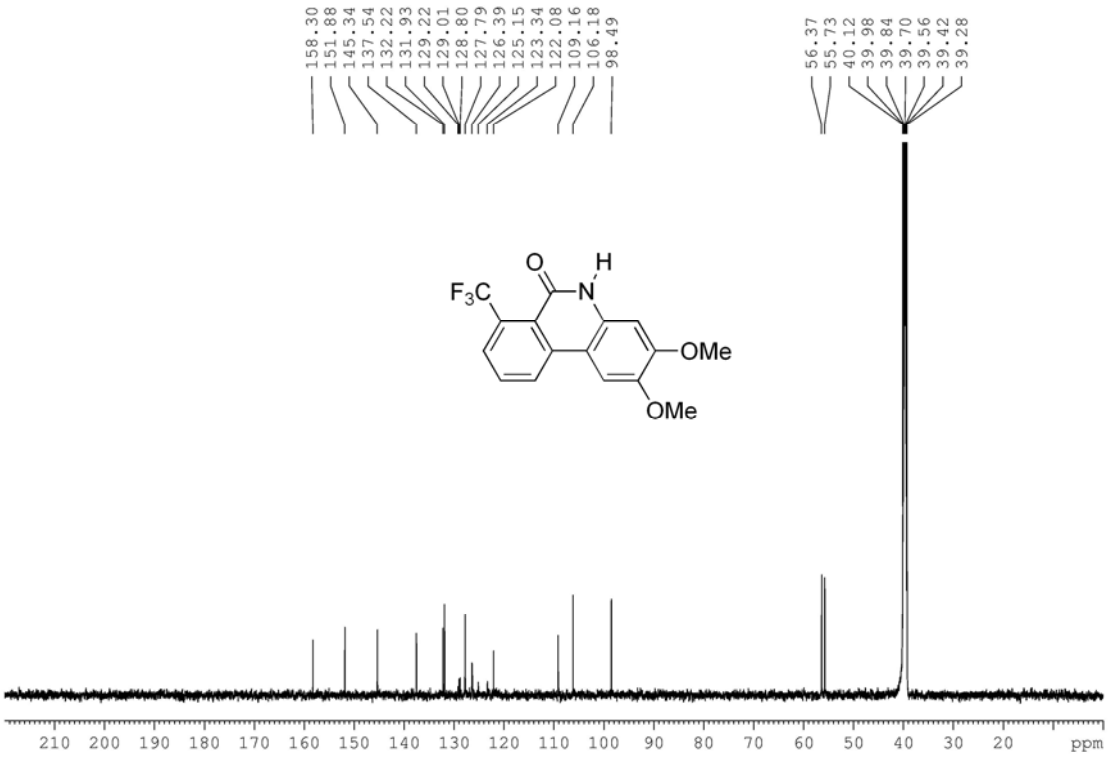
4-Methoxy-[1,3]dioxolo[4,5-*b*]phenanthridin-5(6*H*)-one (2u)



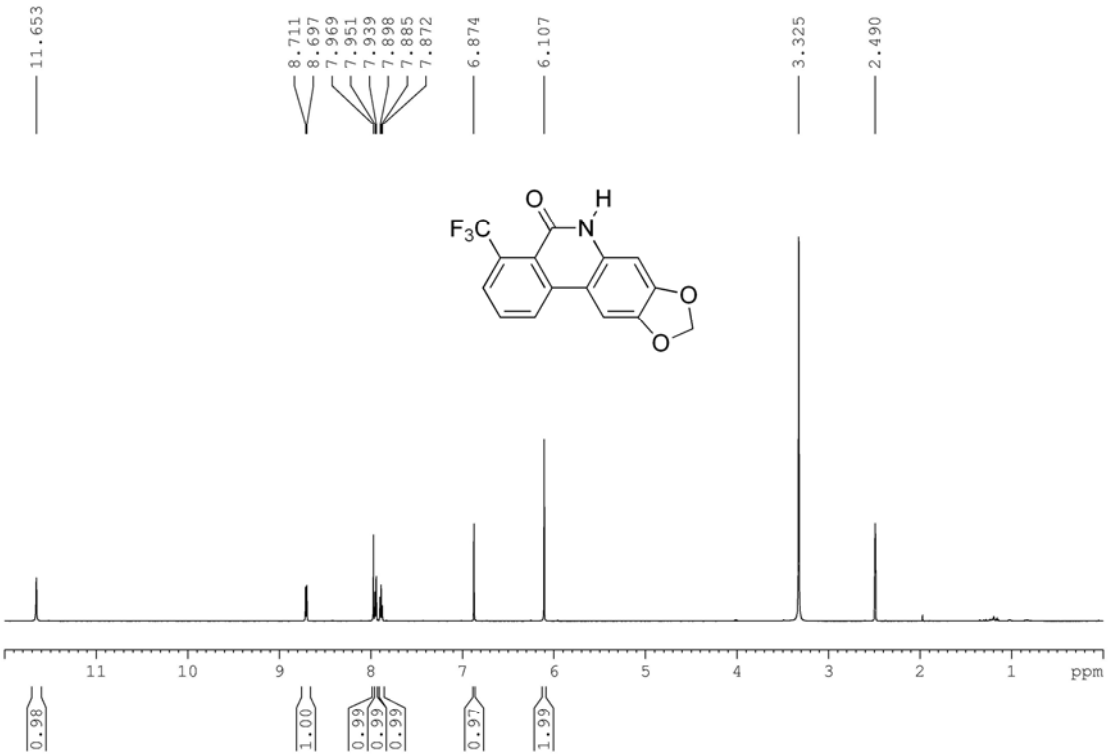


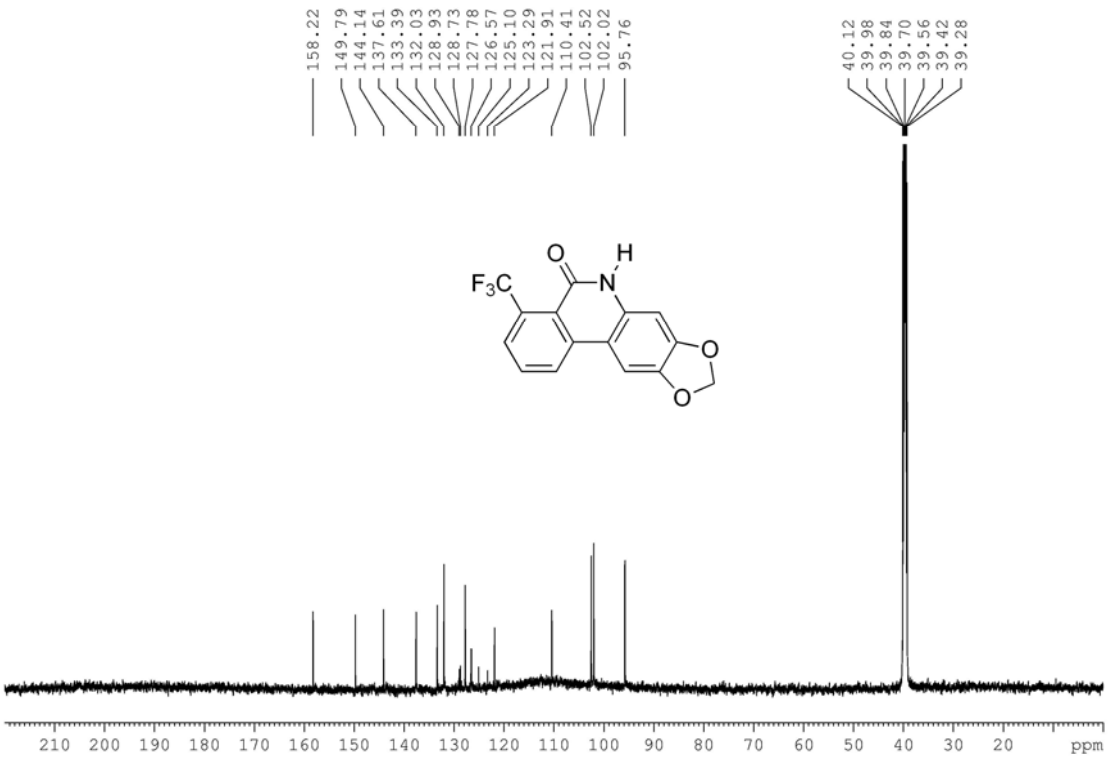
2,3-Dimethoxy-7-(trifluoromethyl)phenanthridin-6(5*H*)-one (2v)



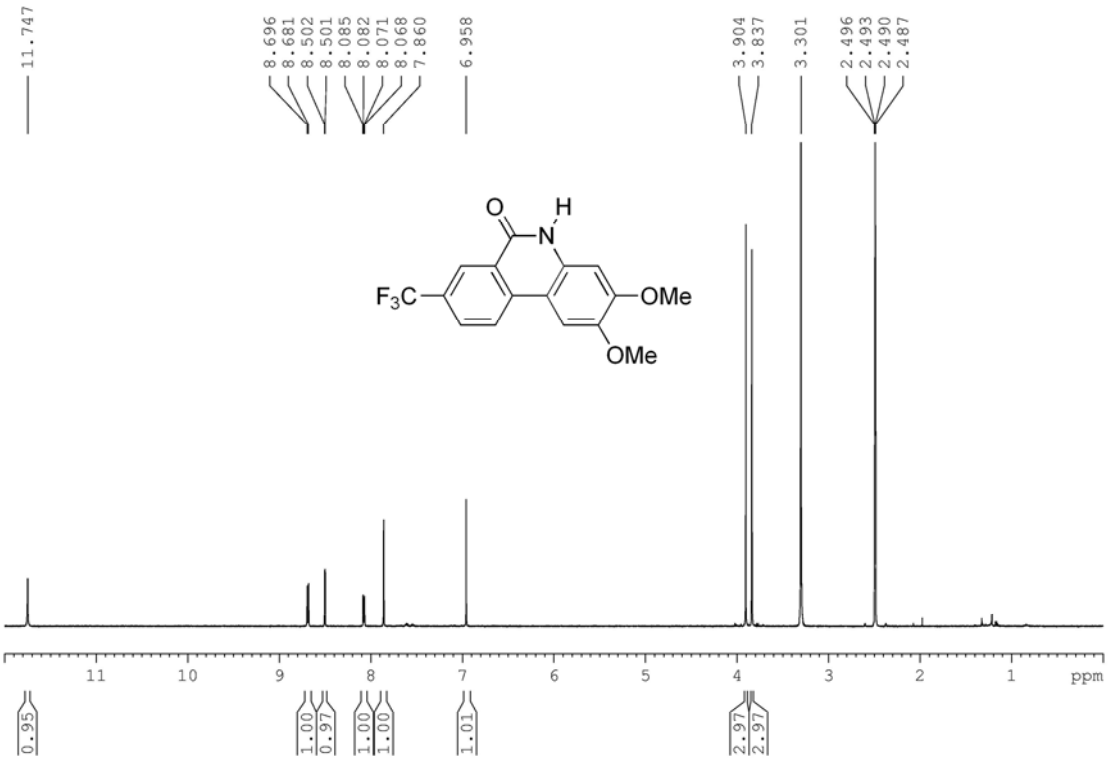


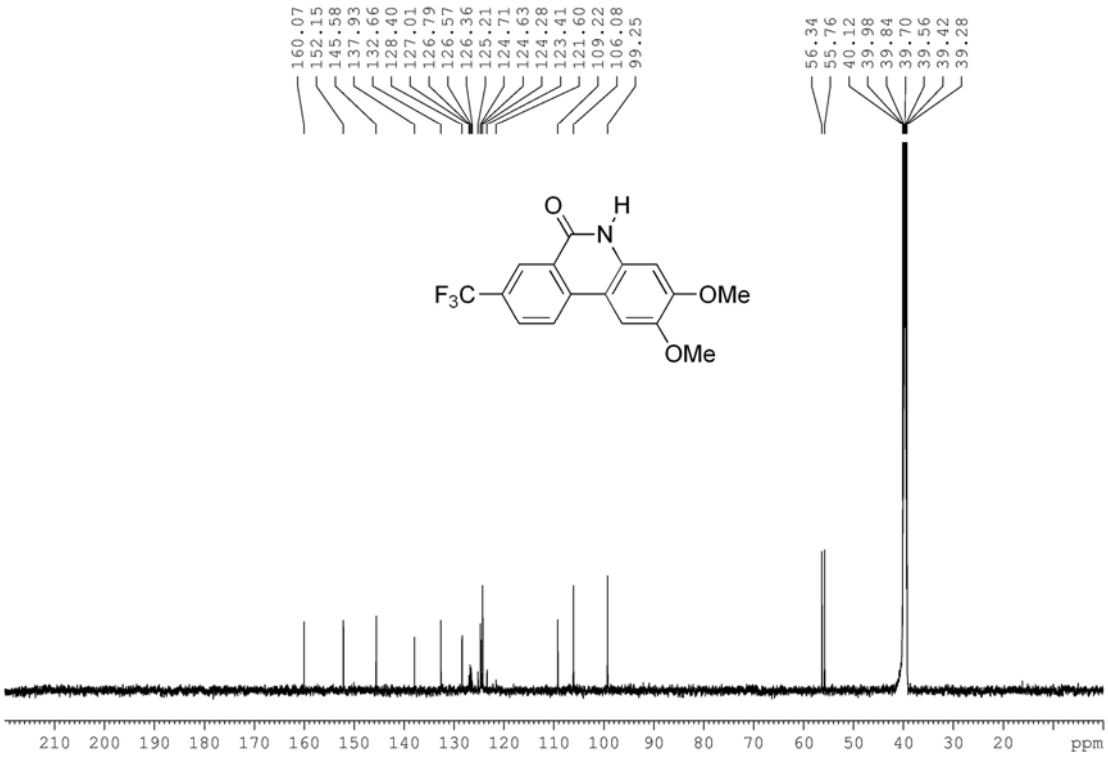
4-(Trifluoromethyl)-[1,3]dioxolo[4,5-*b*]phenanthridin-5(6*H*)-one (2w)



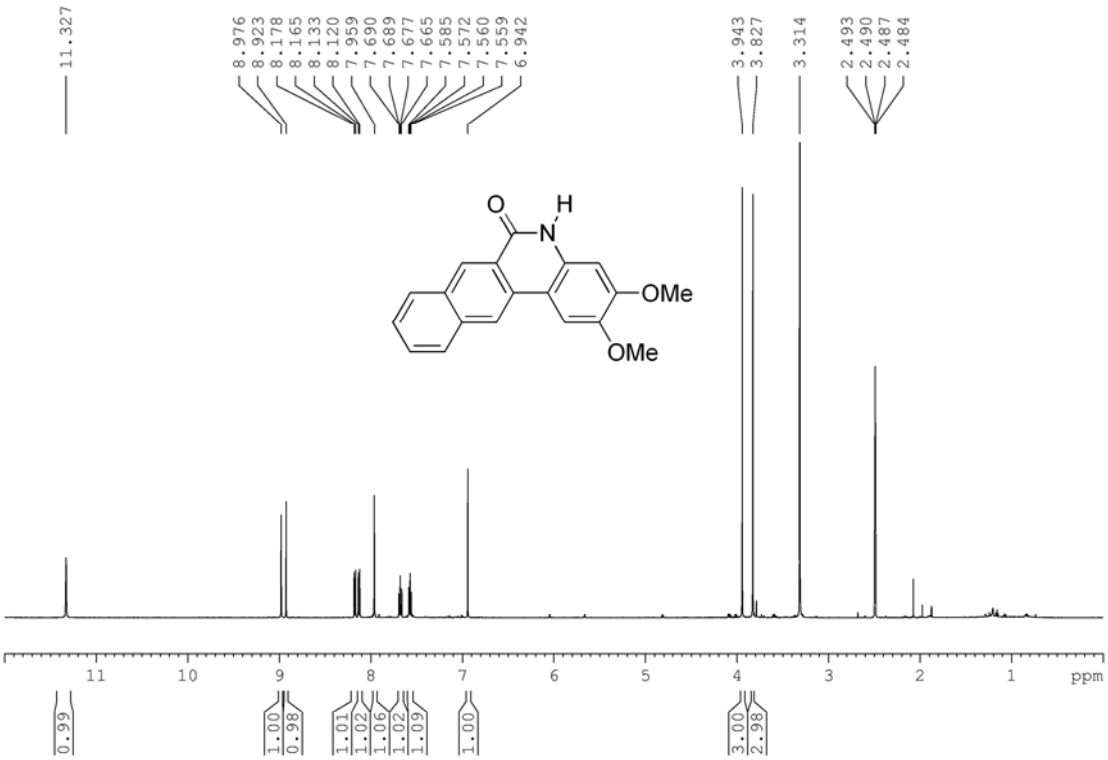


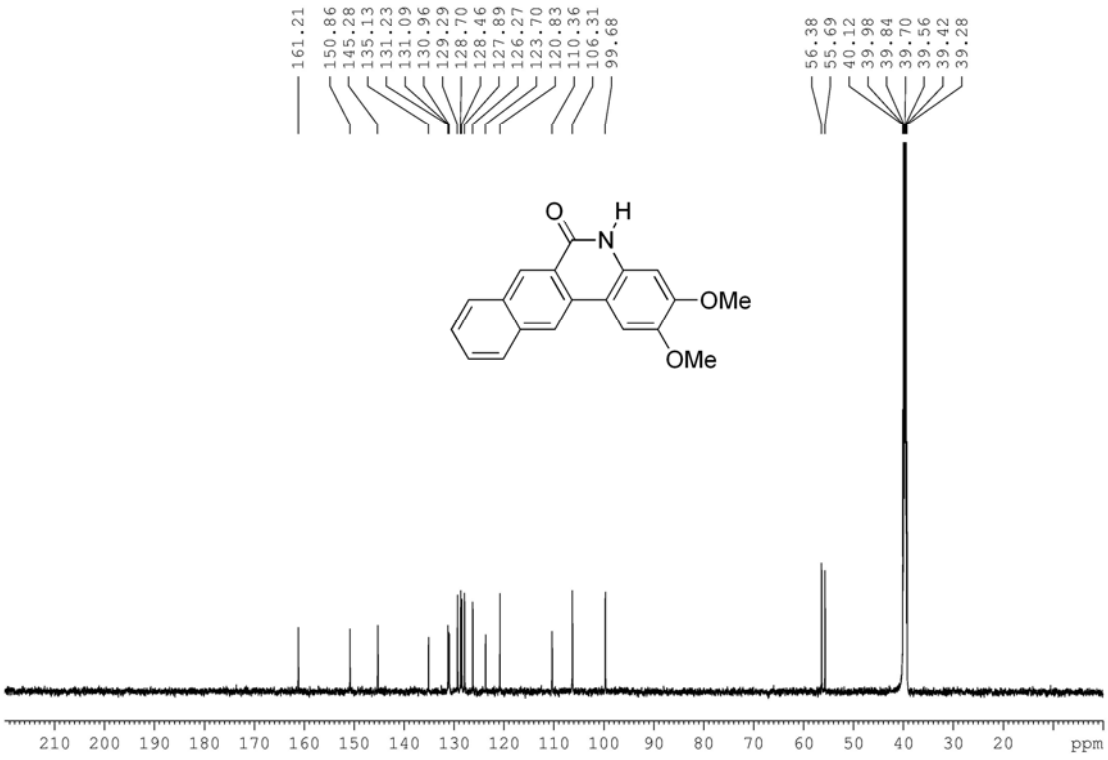
2,3-Dimethoxy-8-(trifluoromethyl)phenanthridin-6(5*H*)-one (2x)



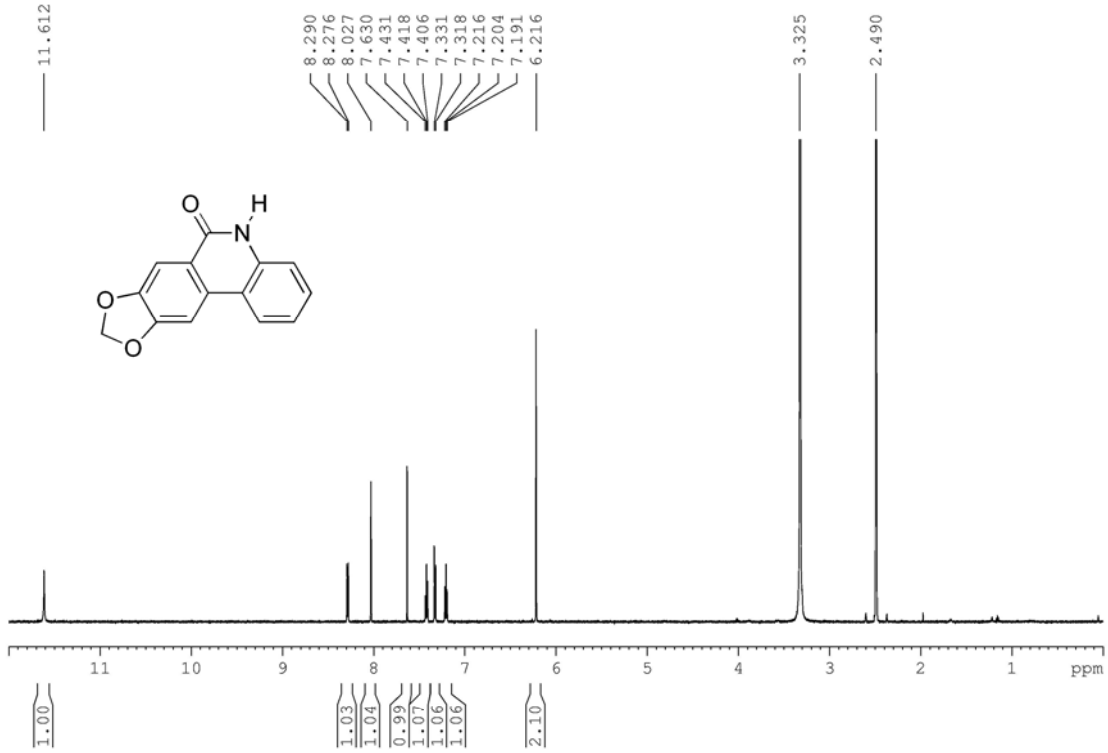


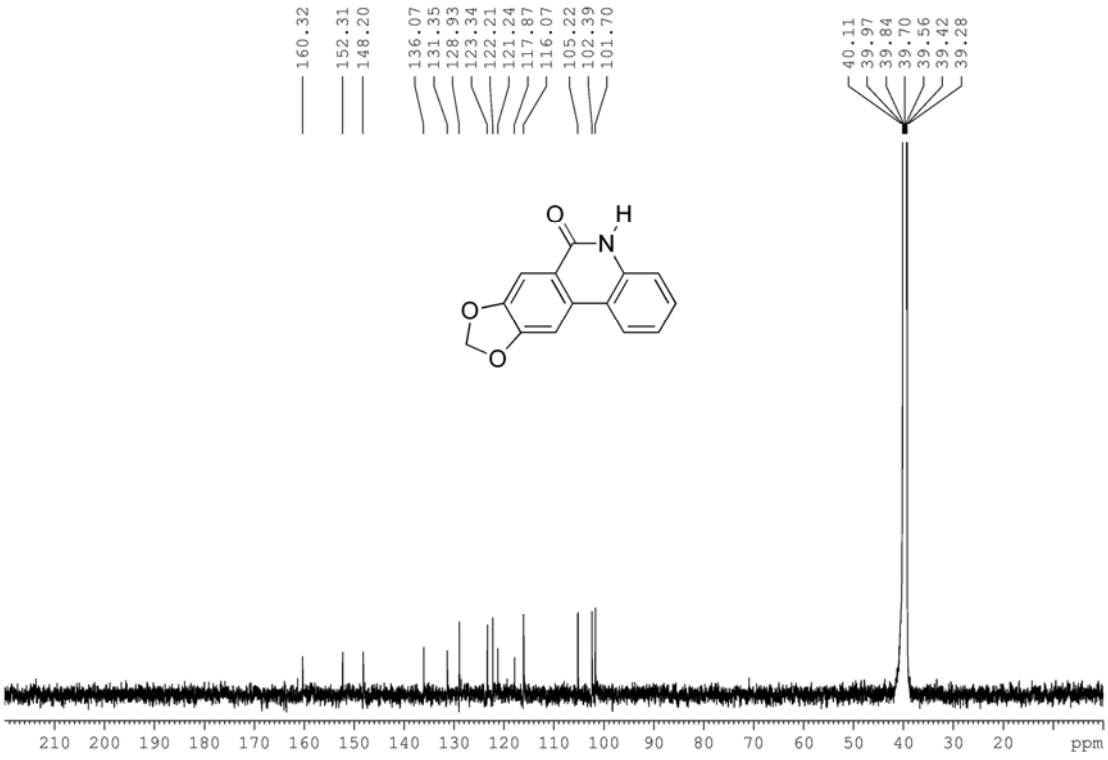
2,3-Dimethoxybenzo[*j*]phenanthridin-6(5*H*)-one (2y)



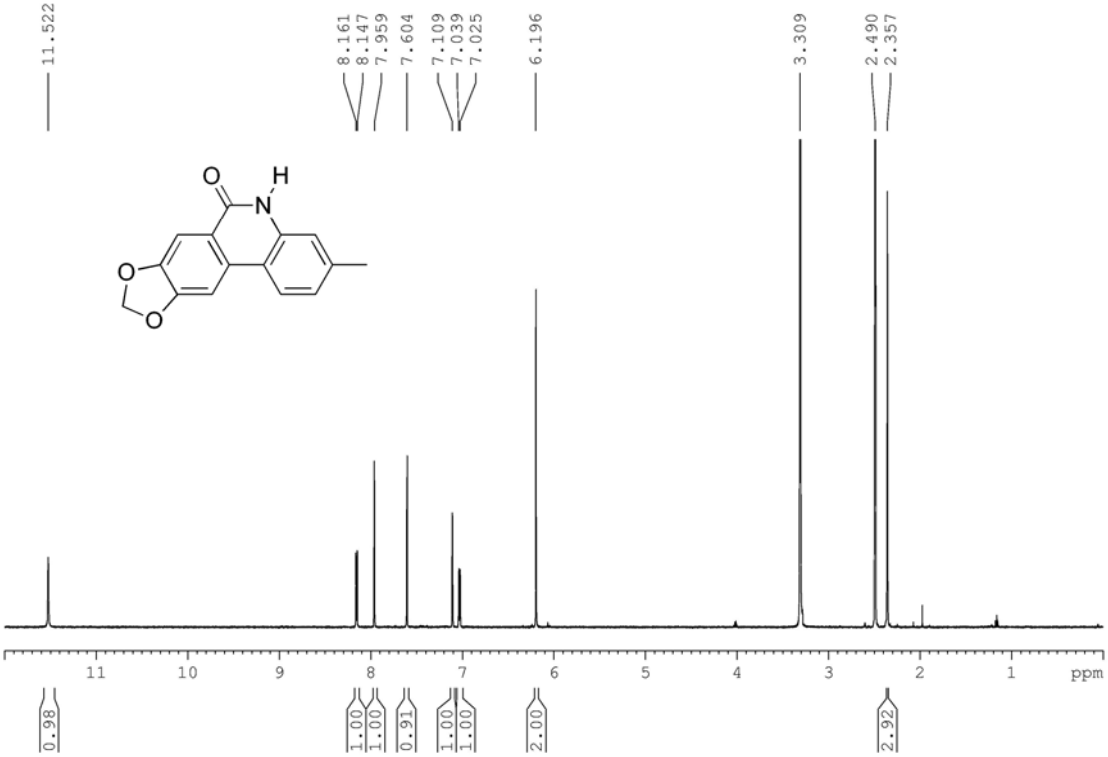


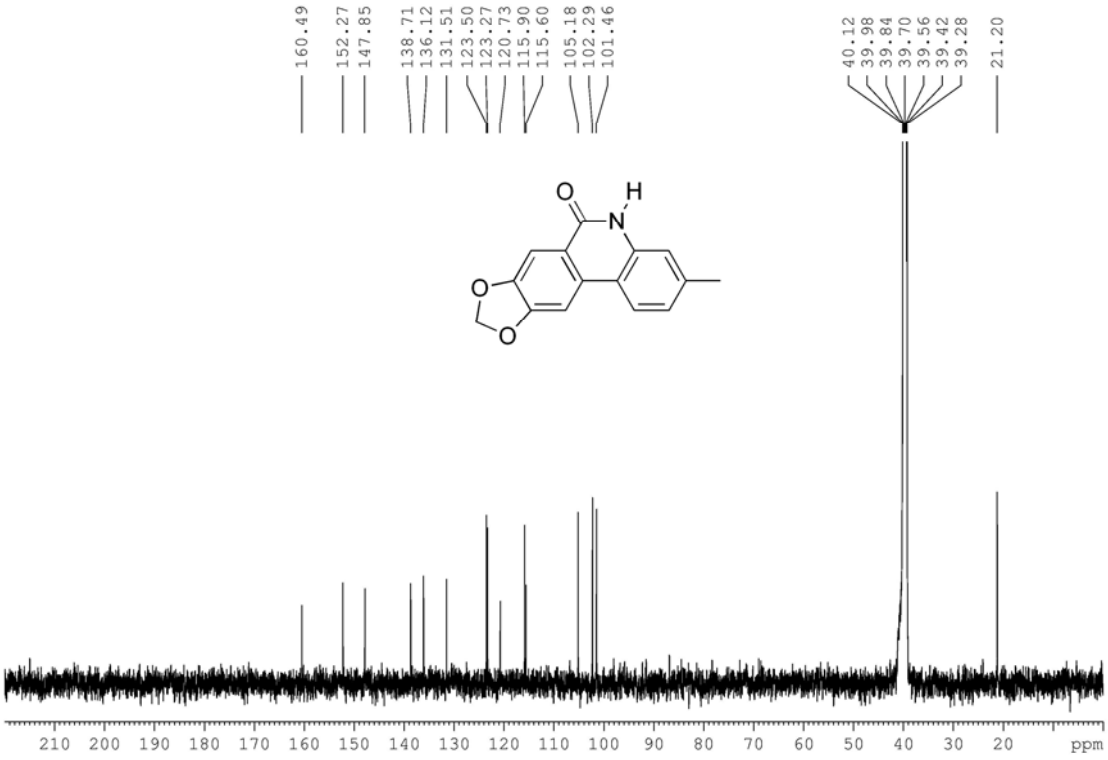
Crinasiadine (2z)



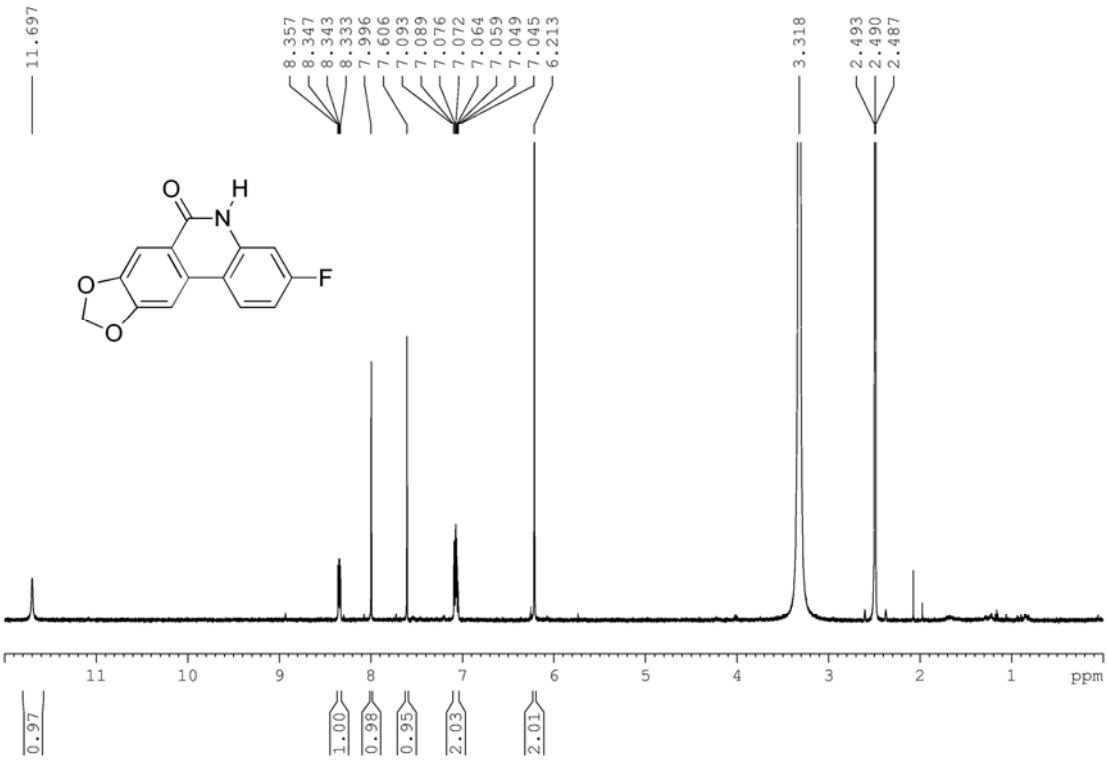


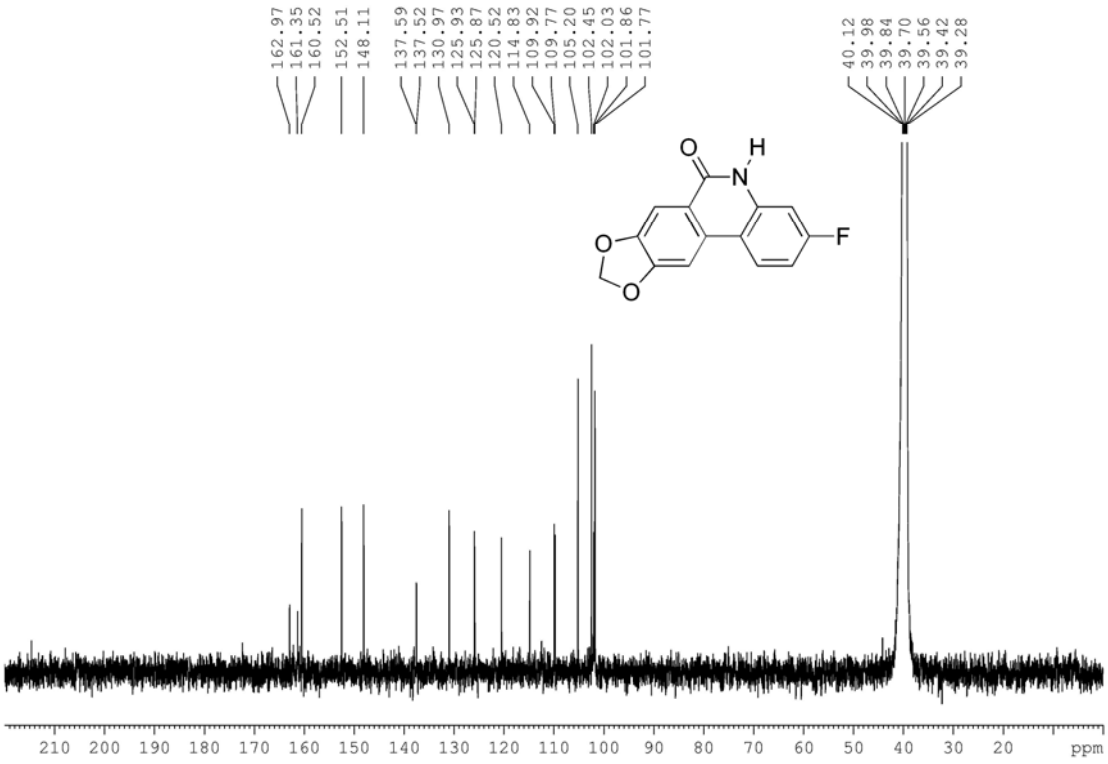
3-Methyl-[1,3]dioxolo[4,5-*j*]phenanthridin-6(5*H*)-one (C1)



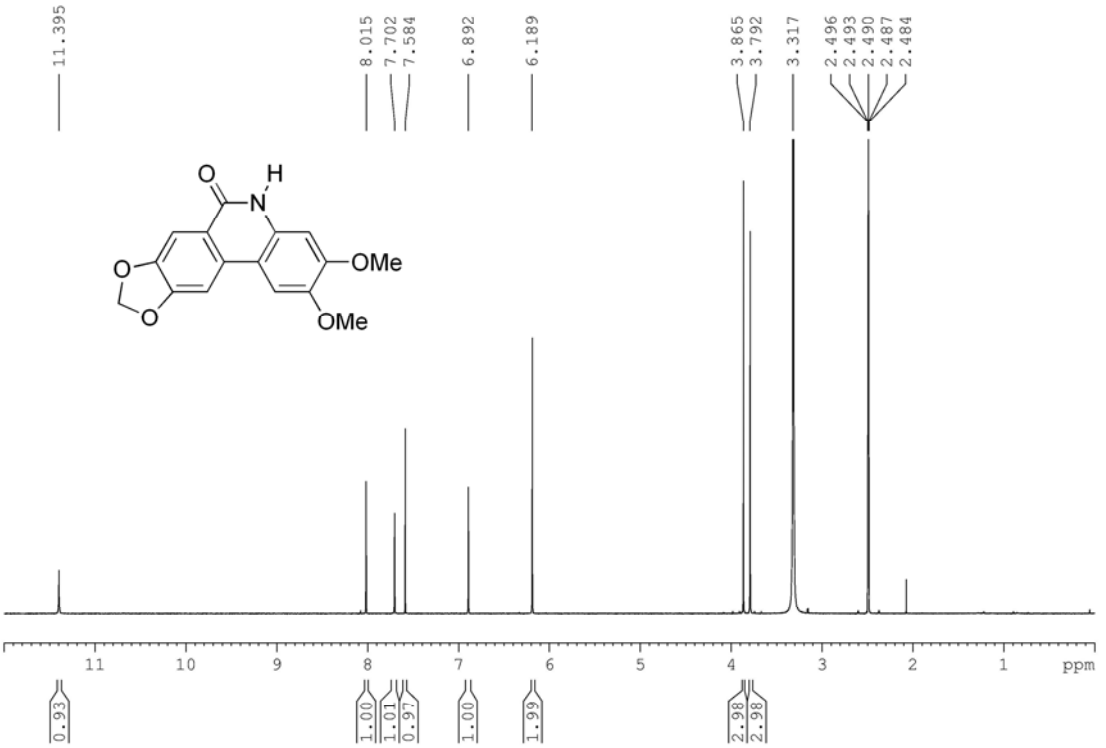


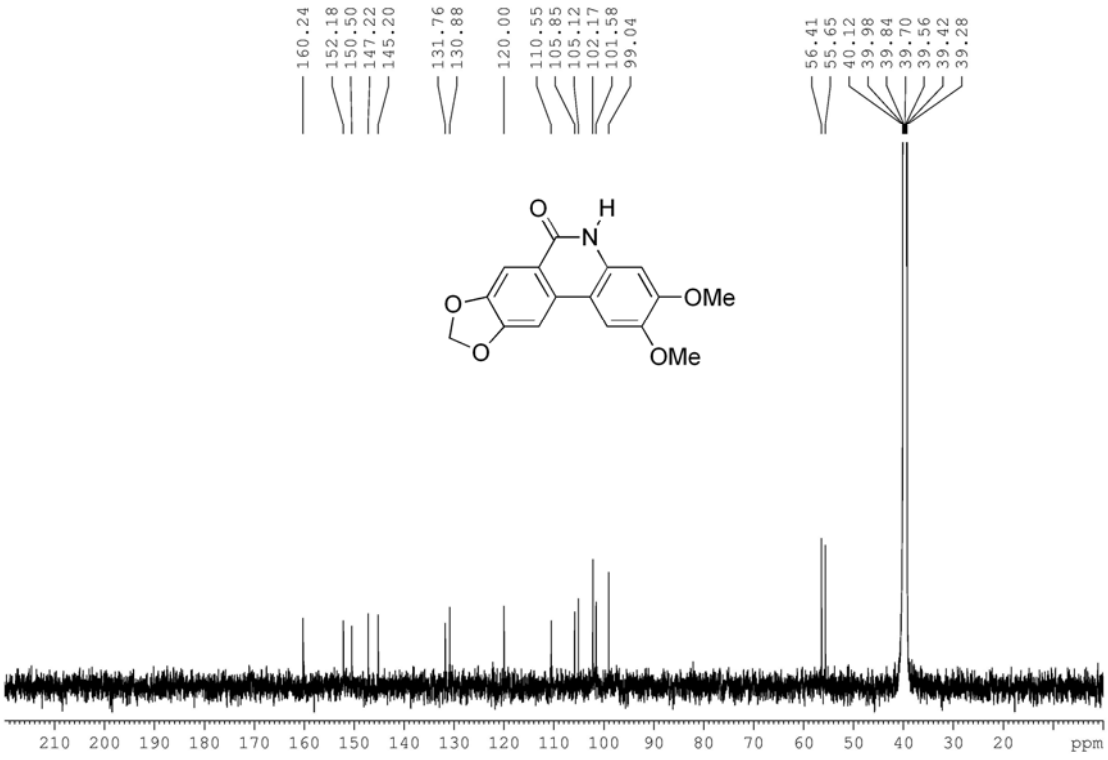
3-Fluoro-[1,3]dioxolo[4,5-*j*]phenanthridin-6(*5H*)-one (C2)



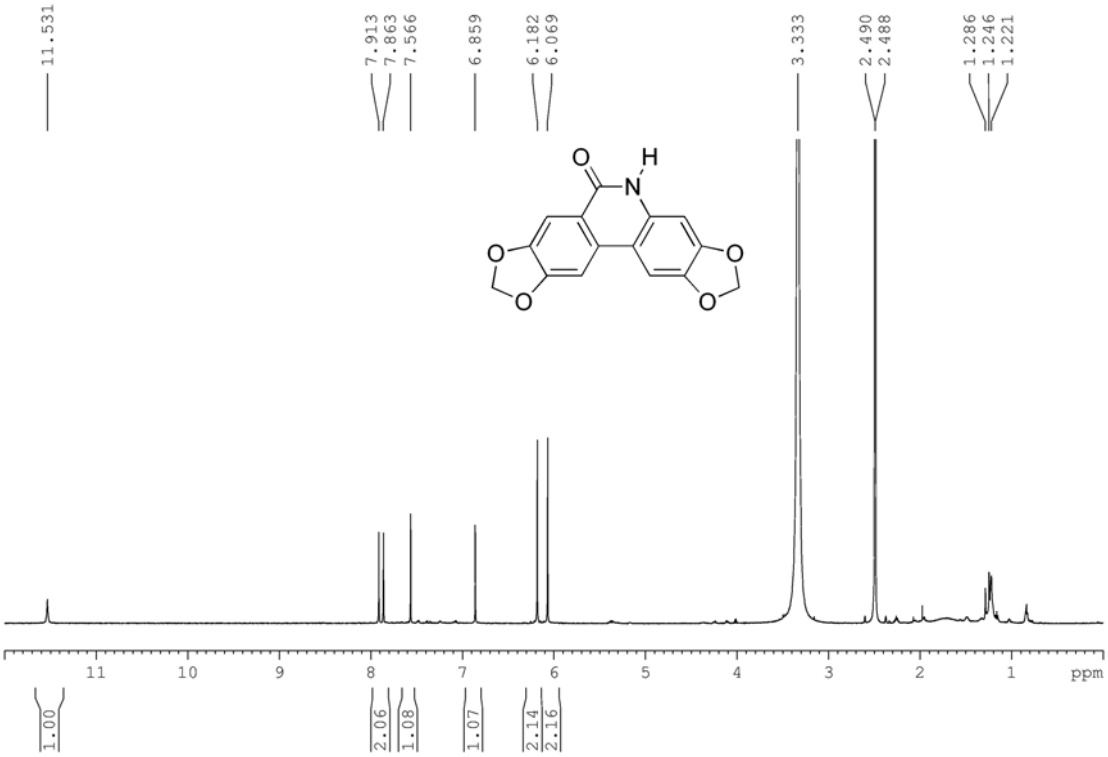


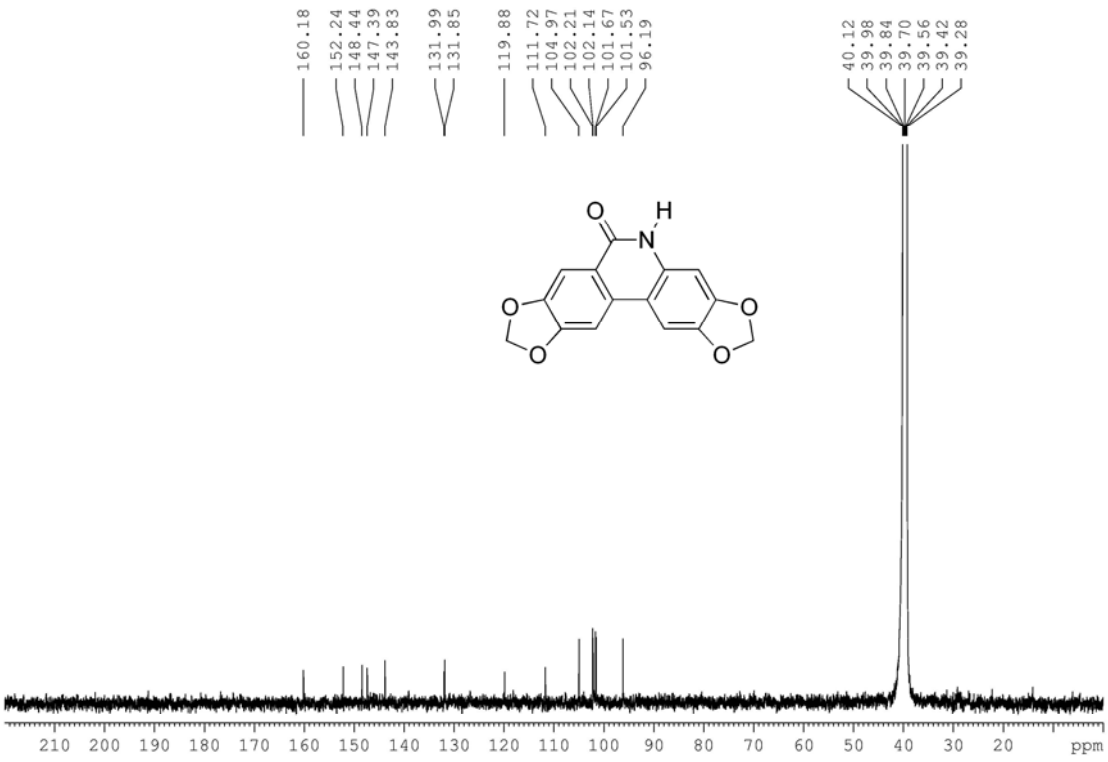
2,3-Dimethoxy-[1,3]dioxolo[4,5-*j*]phenanthridin-6(5*H*)-one (C3)



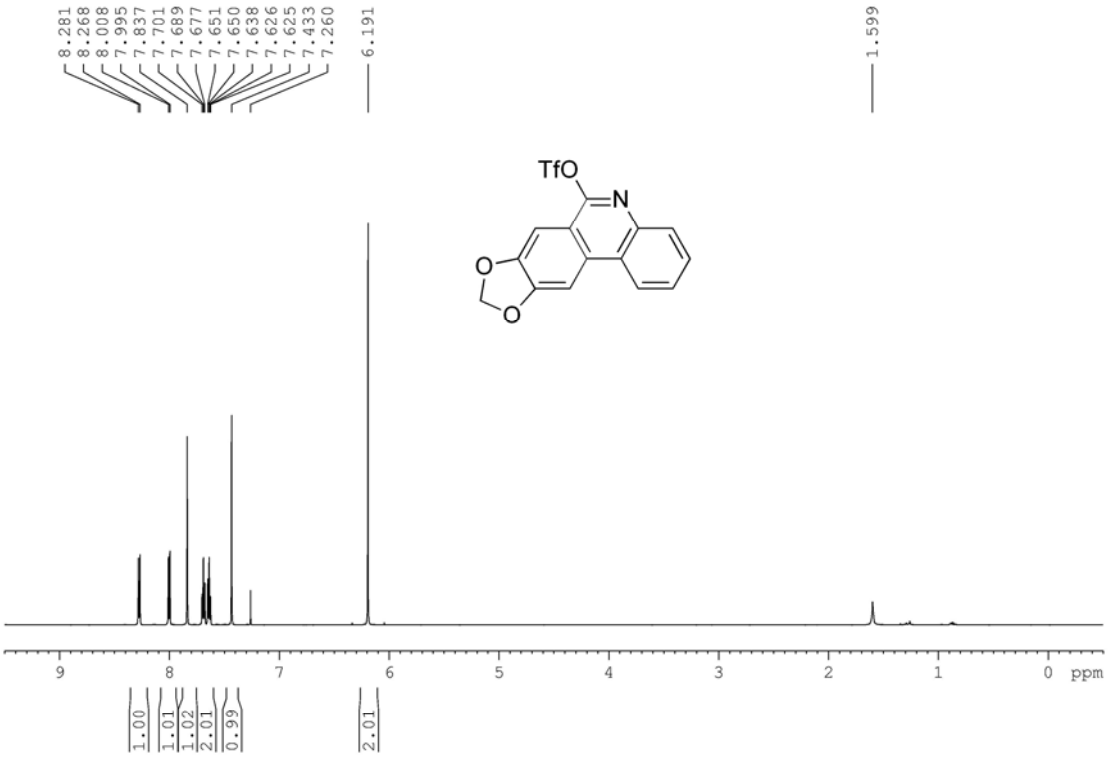


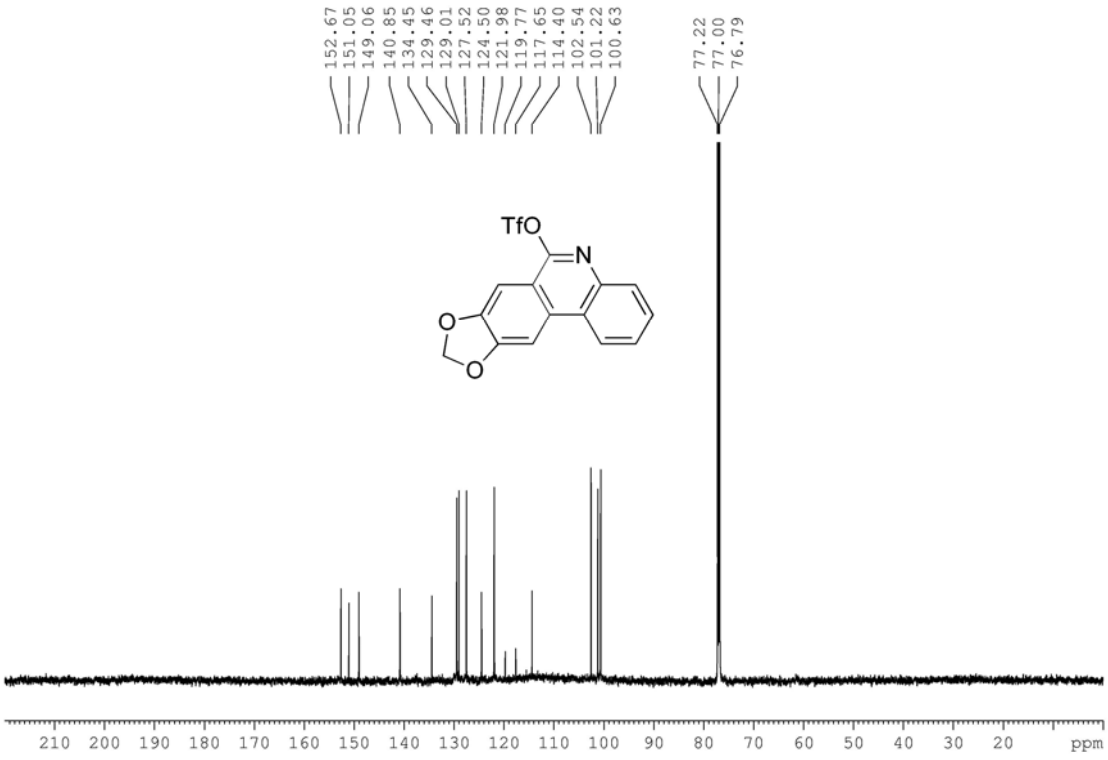
Bis([1,3]dioxolo)[4,5-b:4',5'-*j*]phenanthridin-6(5*H*)-one (C4)



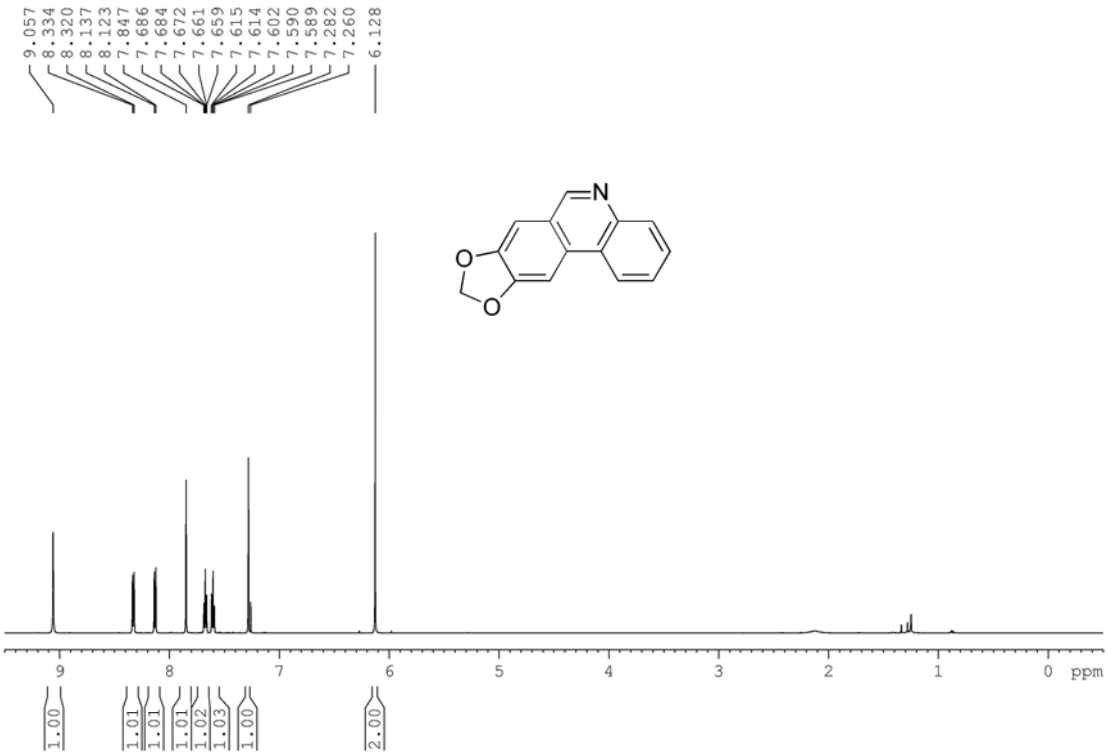


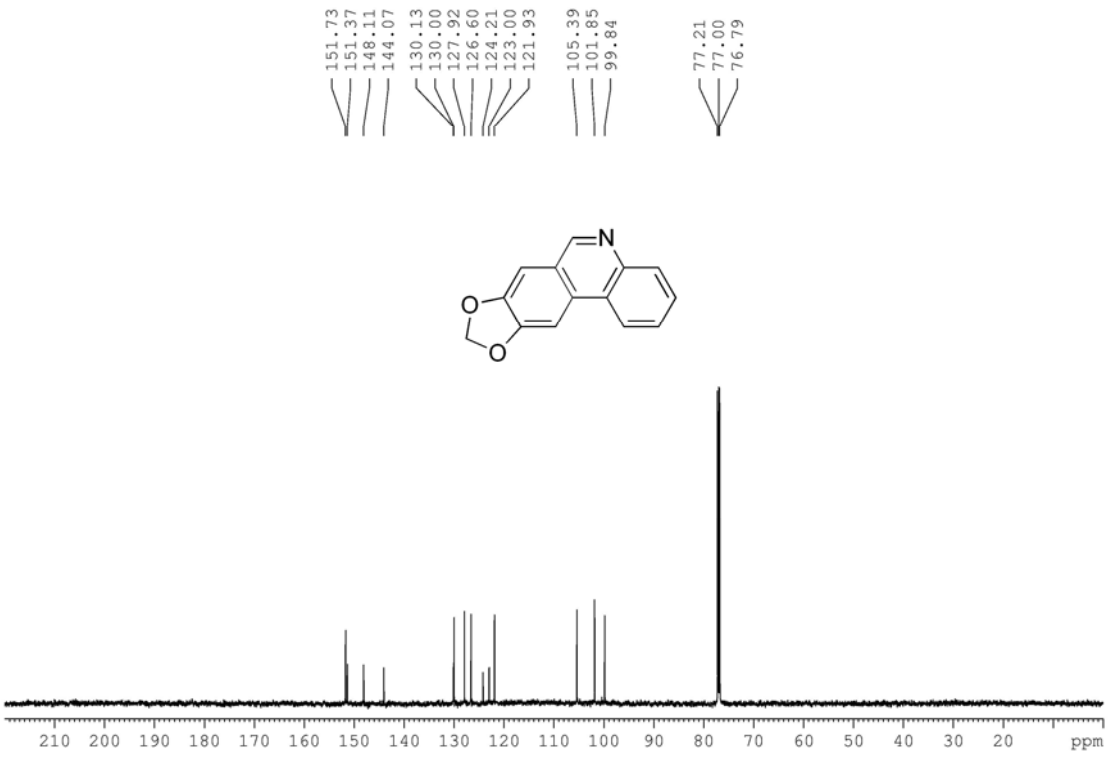
[1,3]Dioxolo[4,5-*j*]phenanthridin-6-yltrifluoromethanesulfonate (3a)



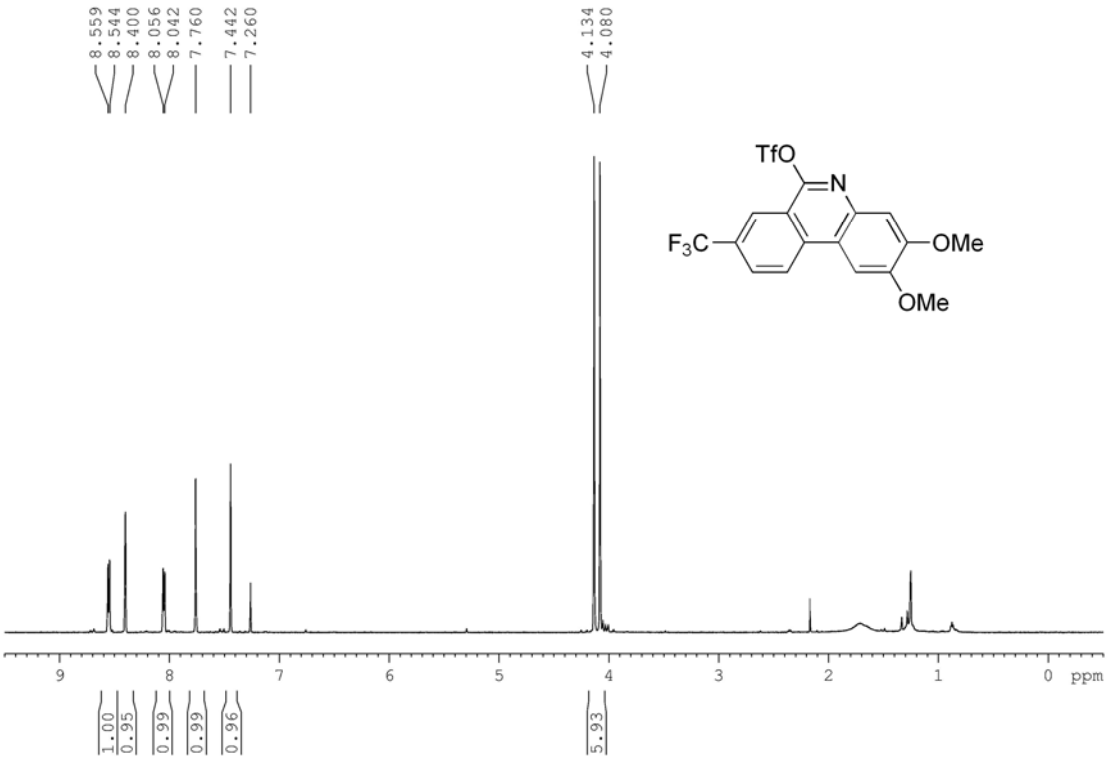


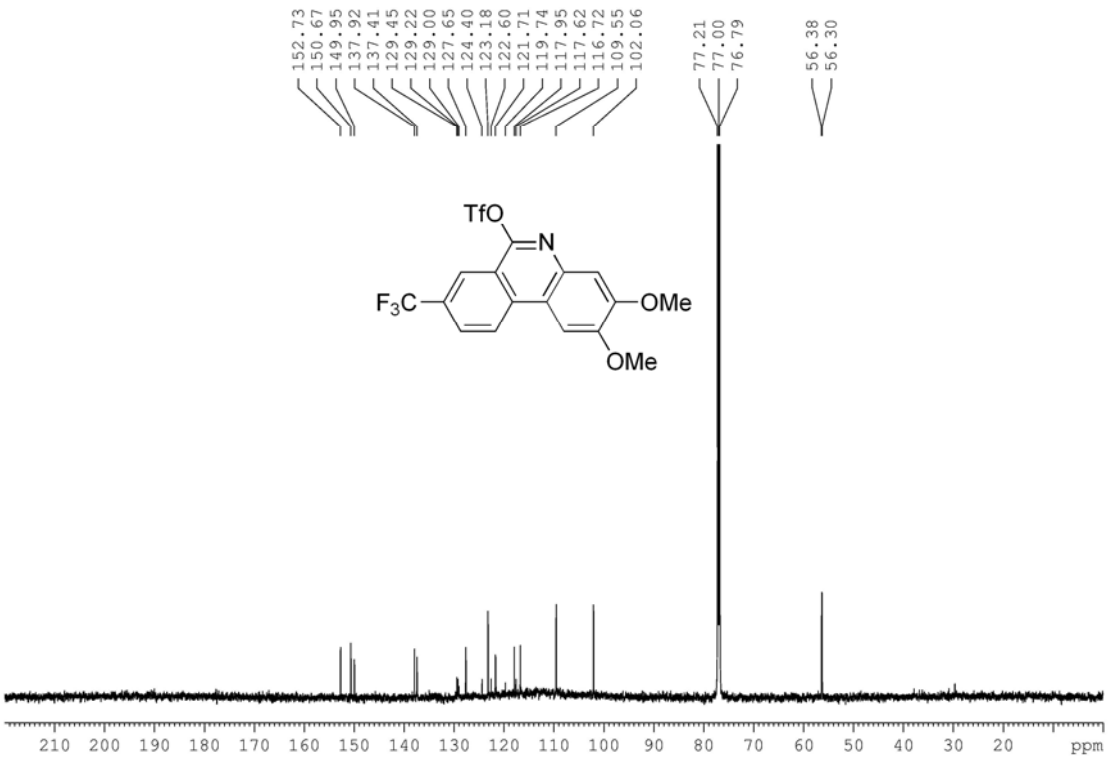
Trisphaeridine (3b)



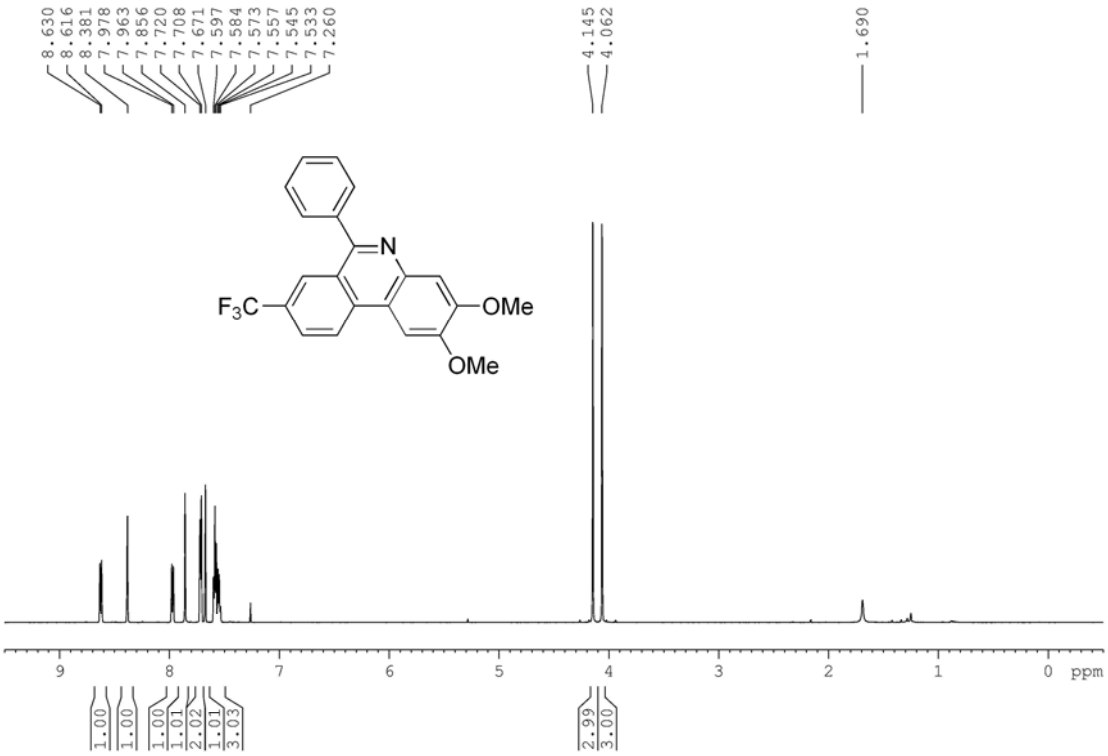


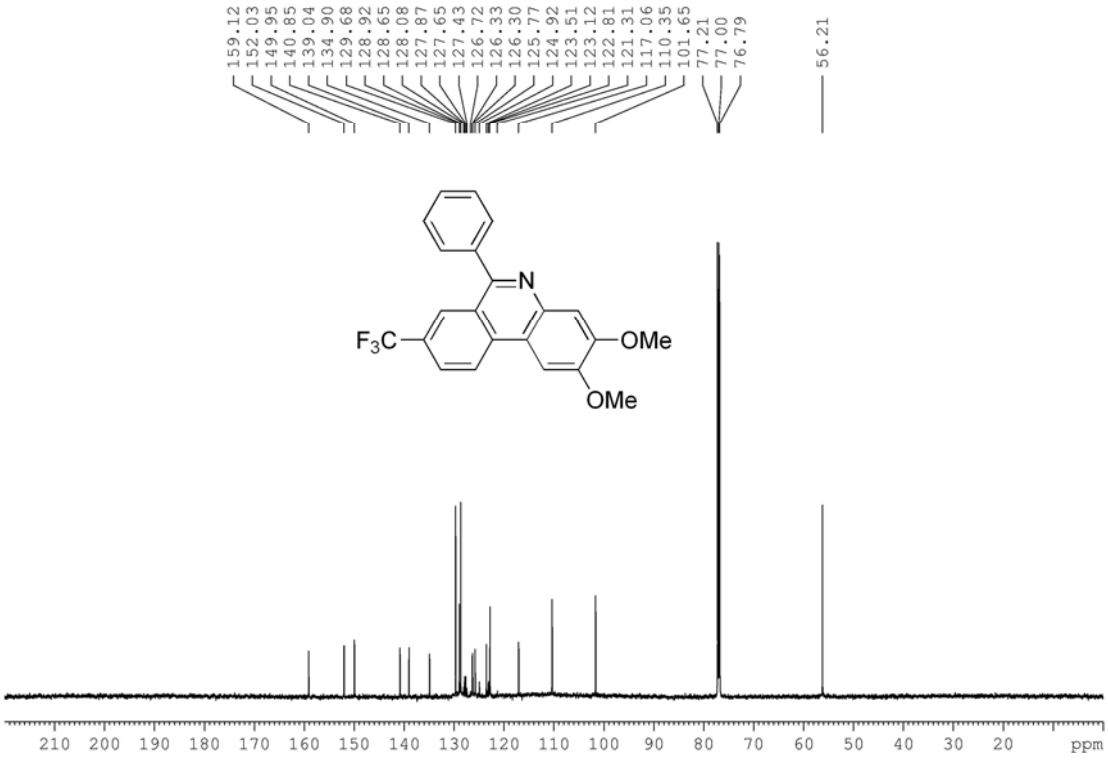
2,3-Dimethoxy-8-(trifluoromethyl)phenanthridin-6-yltrifluoromethanesulfonate (3c)



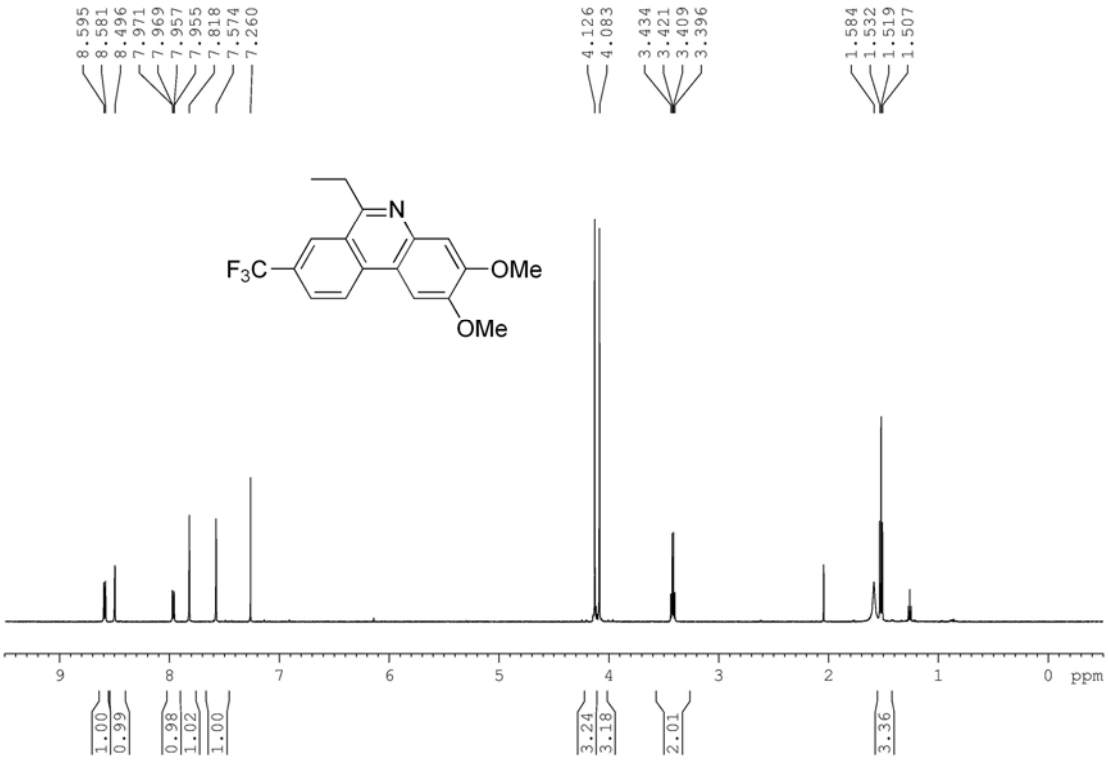


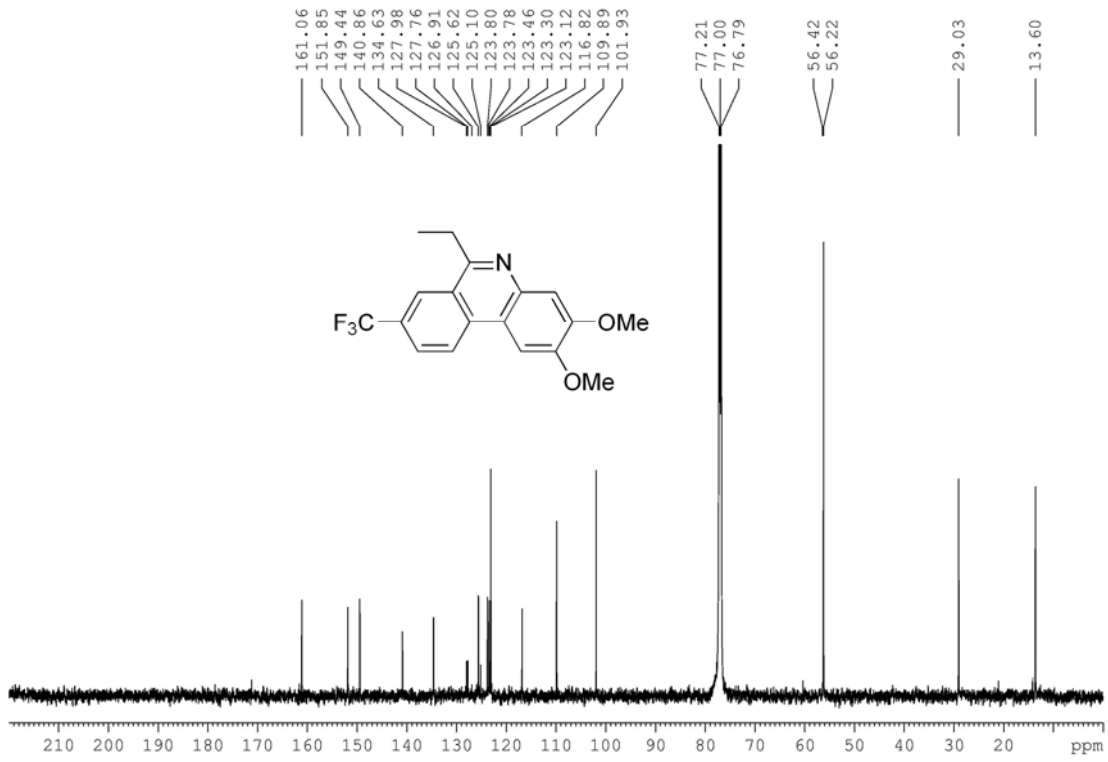
2,3-Dimethoxy-6-phenyl-8-(trifluoromethyl)phenanthridine (3d)





6-Ethyl-2,3-dimethoxy-8-(trifluoromethyl)phenanthridine (3e)





2,3-Dimethoxy-8-(trifluoromethyl)phenanthridine (3f)