

Supporting Information

Synthesis, structure and properties of polysubstituted benzo[g]chrysene by FeCl₃-promoted from diphenylacetylene and phenylacetaldehyde derivatives

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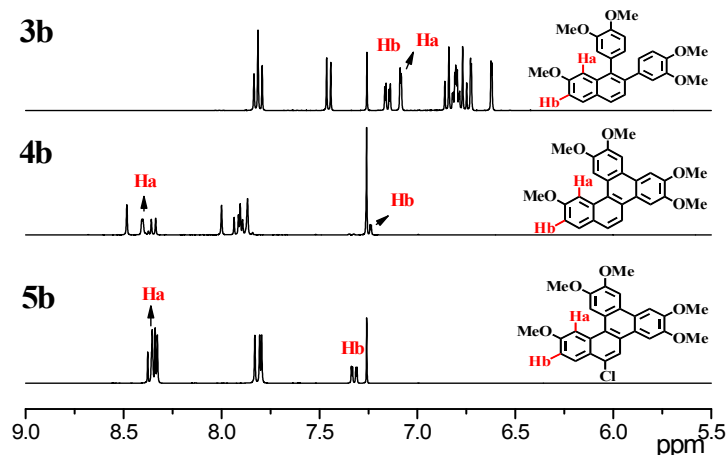


Figure S1. ^1H NMR spectral of **3b**, **4b** and **5b** in CDCl_3

The DSC traces of the BgCh derivatives with hexyloxy alkoxy chains are shown in figure s2 and the heating / cooling rate is $10\text{ }^\circ\text{C} / \text{min}$ under nitrogen atmosphere in commonly. The phase transition temperatures and enthalpy changes for studying compounds are summarized in Table S1. The peak temperatures are given in $^\circ\text{C}$ and the numbers in square brackets indicate the transition enthalpy (ΔH) in kJ mol^{-1} .

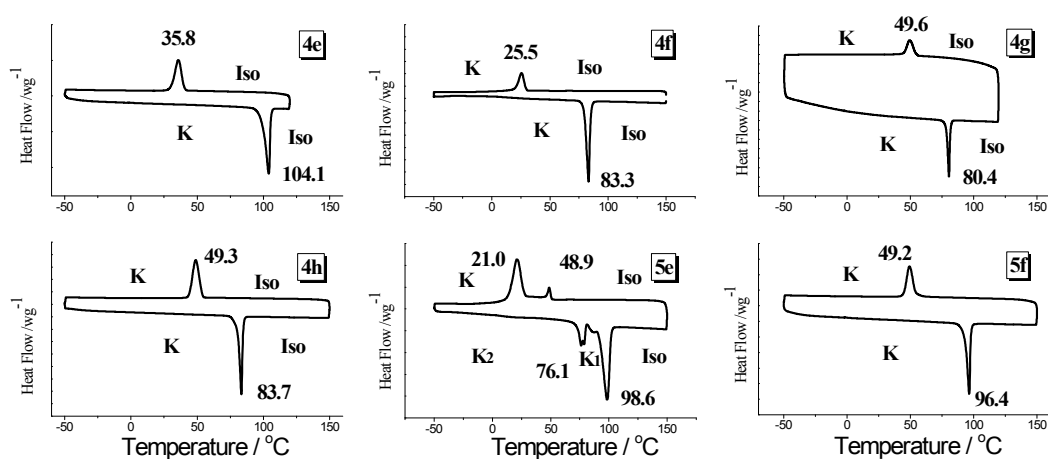


Figure S2. The DSC traces of the BgCh [4e~4h, 5e, 5f] with hexyloxy alkoxy chains. All the solid lines, except 5bd-2, were recorded on the second heating and first cooling circles at $10\text{ }^\circ\text{C} / \text{min}$.

Table S1 Transition temperatures and associated enthalpy values of the BgCh derivatives with hexyloxy alkoxy chains [4e~4h, 5e~5h].

compounds	Transitions ^{ab} T/°C [ΔH / kJ mol ⁻¹]	
	Heating	Cooling
4e	K – 104.1 [68.2] – Iso	Iso – 35.8 [41.5] – K
4f	K – 83.3 [61.3] – Iso	Iso – 25.5 [29.6] – K
4g	K – 80.4 [50.8] – Iso	Iso – 49.6 [33.8] – K
4h	K – 83.7 [63.9] – Iso	Iso – 49.3 [52.5] – K
5e	K ₂ – 76.1 [10.7] – K ₁ – 98.6 [31.9] – Iso	Iso – 48.9 [2.2] – Col _h – 21.0 [25.3] – K
5f	K – 96.4 [55.2] – Iso	Iso – 49.2 [41.5] – K
5g	K – 91.5 [61.2] – Iso	Iso – 36.4 [11.5] – K
		Iso – 34.3 [2.7] – Sp – -2.23 – g ^c
5h	Col _{rp} – 44.3 [11.6] – K ₂ – 57.6 [32.7] – K ₁ – 86.0 [55.8] – Col _h – 115.5 [4.5] – Iso	Iso – 112.4 [4.4] – Col _h – 35.3 [5.9] – Col _{rp}
	K – 88.9 [63.7] – Col _h – 115.5 [4.2] – Iso ^d	

^a K = Crystal; Col_h = hexagonal columnar phase; Col_{rp} = Rectangular Columnar plastic phase; Iso = Isotropic Liquid; Sp = spherulite. ^b Transitions determined by DSC (peak temperature) during the second heating and first cooling at 10 °C / min. ^c The cooling rate is 25 °C / min. ^d DSC trace on the first heating at 10 °C / min.

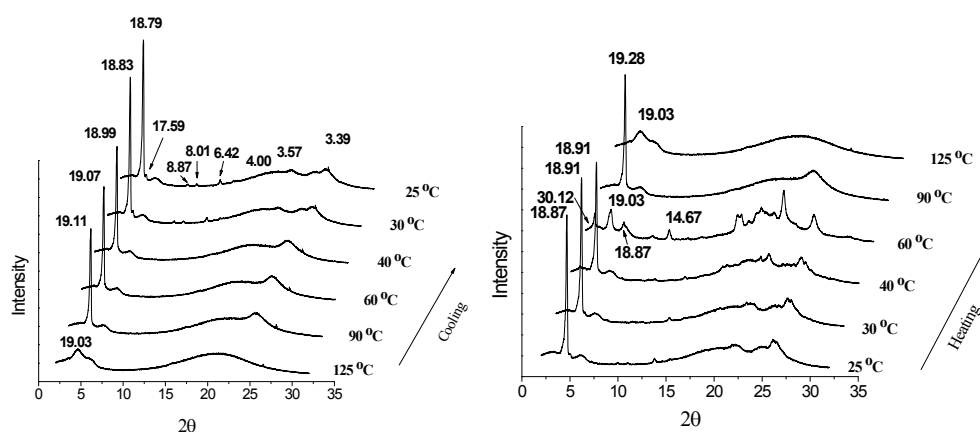


Figure S3. Temperature-dependent XRD diffraction of 5h scans from 25 to 130 °C on heating and cooling.

Molecular Geometry and Energy of the Electron-deficient Compound 4a

Using Gaussian 09, Revision A02, Gaussian, Inc., Wallingford C. T, 2009.

B3LYP/6-31G* opt(noeigen) freq=noraman test

#N Geom=AllCheck Guess=TCheck SCRF=Check Test GenChk UB3LYP/6-31G(d) Freq

Charge = 1 Multiplicity = 2

Optimization completed.

Item	Value	Threshold	Converged?
Maximum Force	0.000009	0.000450	YES
RMS Force	0.000002	0.000300	YES
Maximum Displacement	0.001605	0.001800	YES
RMS Displacement	0.000347	0.001200	YES

Predicted change in Energy=-9.759886D-09

Center Number	Atomic Number	Atomic Type	Coordinates (Angstroms)		
			X	Y	Z
1	6	0	-0.320374	3.863488	-0.738412
2	6	0	0.698948	2.953786	-0.732121
3	6	0	0.497736	1.606325	-0.310933
4	6	0	-0.846456	1.178704	-0.010040
5	6	0	-1.853190	2.201152	0.237168
6	6	0	-1.602637	3.539510	-0.194120
7	6	0	1.591994	0.679973	-0.187665
8	6	0	-1.131341	-0.226440	-0.022769
9	6	0	-0.055068	-1.169844	0.052568
10	6	0	1.329623	-0.692267	0.080136
11	6	0	-0.364160	-2.524869	0.070875
12	1	0	0.407116	-3.281511	0.144668
13	6	0	-1.676299	-3.015210	-0.034880
14	6	0	-2.745354	-2.080942	-0.228488
15	6	0	-2.451141	-0.732460	-0.210996
16	1	0	1.672530	3.259767	-1.094304
17	6	0	2.943627	1.109607	-0.251580
18	6	0	4.012757	0.255443	-0.049809
19	6	0	3.743329	-1.118146	0.245618
20	6	0	2.408272	-1.545960	0.298149
21	1	0	3.156289	2.154384	-0.425597
22	1	0	2.266938	-2.595183	0.526749
23	6	0	-2.582577	4.535263	-0.015297

24	6	0	-3.041227	1.964964	0.968683
25	6	0	-3.980544	2.969809	1.166375
26	6	0	-3.770372	4.253606	0.644505
27	1	0	-2.381394	5.540072	-0.376686
28	1	0	-4.873573	2.760321	1.747529
29	1	0	-4.513197	5.031866	0.789249
30	8	0	-3.976334	-2.600649	-0.458831
31	8	0	-1.765503	-4.345449	0.003295
32	8	0	4.633448	-2.086501	0.489130
33	8	0	5.315351	0.631547	-0.093033
34	6	0	-5.064025	-1.712249	-0.714533
35	1	0	-5.241798	-1.050085	0.141076
36	1	0	-4.882278	-1.115586	-1.616075
37	1	0	-5.933750	-2.351098	-0.868231
38	6	0	-2.997354	-5.096126	0.033364
39	1	0	-2.678044	-6.125226	0.197531
40	1	0	-3.636127	-4.761193	0.852255
41	1	0	-3.526395	-5.007860	-0.916018
42	6	0	6.064387	-1.916816	0.509414
43	1	0	6.432950	-1.593724	-0.465310
44	1	0	6.361360	-1.201790	1.278039
45	1	0	6.446486	-2.909471	0.748271
46	6	0	5.633185	1.990207	-0.390696
47	1	0	5.236020	2.666292	0.375928
48	1	0	6.722021	2.042575	-0.392704
49	1	0	5.250088	2.277884	-1.377084
50	1	0	-3.244552	-0.030584	-0.420136
51	1	0	-3.199754	1.002218	1.439394
52	1	0	-0.147046	4.873300	-1.100149

Statistical Thermodynamic Analysis

Temperature= 298.150 Kelvin Pressure= 1.00000 Atm

SCF Done: $E(\text{B3LYP}) = -1304.663571$

Sum of electronic and zero-point Energies= -1304.244290

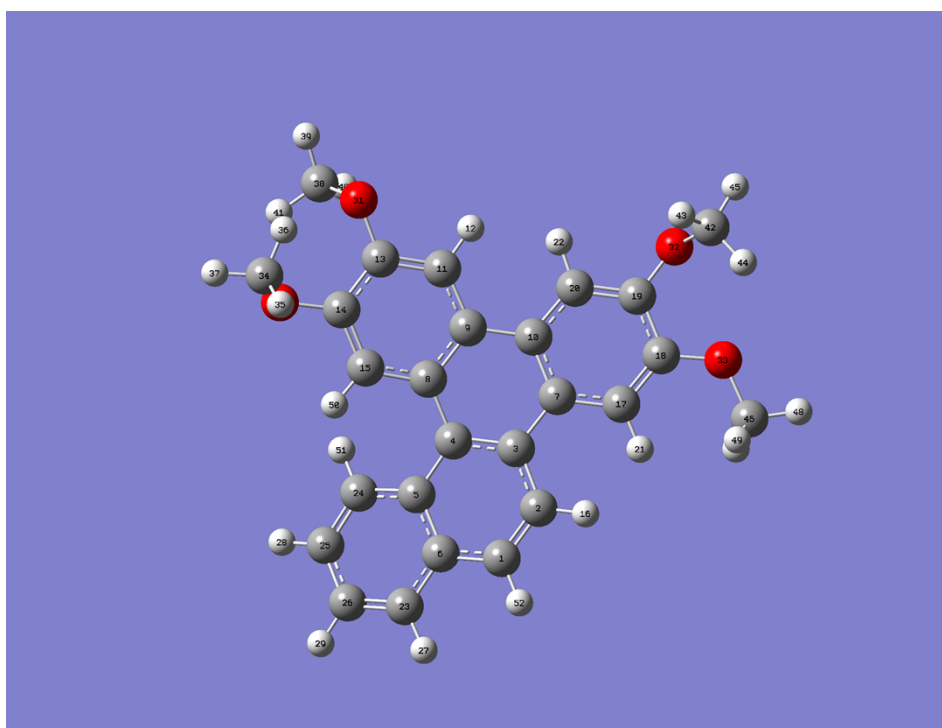
Sum of electronic and thermal Energies= -1304.218253

Sum of electronic and thermal Enthalpies= -1304.217308

Sum of electronic and thermal Free Energies= -1304.301474

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Frequencies --	19.8648	27.6147	39.7156
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Natural Population

Atom	No	Natural Charge	Core	Valence	Rydberg	Total
C	1	-0.19317	1.99904	4.17434	0.01979	6.19317
C	2	-0.20925	1.99907	4.19142	0.01876	6.20925
C	3	-0.02930	1.99902	4.01163	0.01865	6.02930
C	4	0.00335	1.99902	3.97878	0.01885	5.99665
C	5	-0.03605	1.99902	4.01882	0.01820	6.03605
C	6	-0.05551	1.99902	4.03768	0.01881	6.05551
C	7	-0.01966	1.99904	4.00140	0.01922	6.01966
C	8	-0.04247	1.99903	4.02531	0.01813	6.04247
C	9	-0.02384	1.99904	4.00607	0.01873	6.02384
C	10	-0.04668	1.99903	4.02906	0.01860	6.04668
C	11	-0.24166	1.99899	4.22447	0.01820	6.24166
H	12	0.23904	0.00000	0.75984	0.00112	0.76096
C	13	0.30927	1.99862	3.66357	0.02854	5.69073
C	14	0.29617	1.99861	3.67687	0.02836	5.70383
C	15	-0.24399	1.99900	4.22583	0.01916	6.24399
H	16	0.22394	0.00000	0.77515	0.00091	0.77606
C	17	-0.30021	1.99903	4.28522	0.01597	6.30021
C	18	0.34325	1.99867	3.63194	0.02614	5.65675
C	19	0.31252	1.99867	3.65893	0.02988	5.68748
C	20	-0.22580	1.99900	4.20876	0.01804	6.22580

H	21	0.22756	0.00000	0.77129	0.00115	0.77244
H	22	0.23919	0.00000	0.75970	0.00111	0.76081
C	23	-0.20503	1.99906	4.18672	0.01925	6.20503
C	24	-0.21427	1.99908	4.19583	0.01936	6.21427
C	25	-0.22757	1.99908	4.20812	0.02037	6.22757
C	26	-0.22453	1.99907	4.20513	0.02033	6.22453
H	27	0.22821	0.00000	0.77111	0.00068	0.77179
H	28	0.23296	0.00000	0.76656	0.00047	0.76704
H	29	0.23215	0.00000	0.76738	0.00047	0.76785
O	30	-0.63352	1.99975	6.61875	0.01502	8.63352
O	31	-0.63258	1.99975	6.61778	0.01505	8.63258
O	32	-0.62326	1.99975	6.60814	0.01538	8.62326
O	33	-0.60859	1.99973	6.59330	0.01555	8.60859
C	34	-0.23460	1.99943	4.21842	0.01675	6.23460
H	35	0.18748	0.00000	0.81139	0.00113	0.81252
H	36	0.20143	0.00000	0.79695	0.00163	0.79857
H	37	0.20365	0.00000	0.79580	0.00055	0.79635
C	38	-0.23496	1.99943	4.21876	0.01677	6.23496
H	39	0.20431	0.00000	0.79515	0.00054	0.79569
H	40	0.18738	0.00000	0.81147	0.00115	0.81262
H	41	0.20211	0.00000	0.79627	0.00162	0.79789
C	42	-0.23120	1.99943	4.21511	0.01667	6.23120
H	43	0.18116	0.00000	0.81761	0.00123	0.81884
H	44	0.20152	0.00000	0.79729	0.00119	0.79848
H	45	0.20422	0.00000	0.79523	0.00055	0.79578
C	46	-0.23772	1.99945	4.21947	0.01880	6.23772
H	47	0.19092	0.00000	0.80777	0.00130	0.80908
H	48	0.21518	0.00000	0.78442	0.00040	0.78482
H	49	0.18659	0.00000	0.81209	0.00132	0.81341
H	50	0.25128	0.00000	0.74752	0.00120	0.74872
H	51	0.24155	0.00000	0.75760	0.00085	0.75845
H	52	0.22905	0.00000	0.77029	0.00066	0.77095

Experimental Section

General methods:

^1H NMR and ^{13}C NMR spectra were recorded at room temperature on a Varian 400 spectrometer. Chemical shifts are given in ppm (δ) relative to tetramethylsilane (TMS). The NMR data of compounds 4a~4h were achieved from method two and the NMR chemical shift data and spectra of compounds 4a~4h from method one as shown at the end of the detail experiment section. Multistage mass was run on Thermal LCQ fleet with ion trap. Elemental analysis was carried out on an EA3000 CHN analyzer. The liquid crystalline properties were studied using an Olympus BX41 polarising optical microscopy (POM) with crossed polarizers and a Linkam T95-PE hot stage. Differential scanning calorimetry was performed on TA 100, and the X-ray diffraction (XRD) was carried out on a Rigaku Smart Lab (3) with a hot accessory. UV/Vis absorption spectra were recorded on a Perkin Elmer Lambda 850 spectrophotometer. Fluorescence spectra were recorded on a HORIBA Fluoromax-4p.

The intermediate materials of diphenylacetylene and phenylacetaldehyde derivatives were synthesized according to literatures procedure. All solvents were of AR quality, and chemicals were used as received.

General synthesis procedure for 3a-3h

1 equiv diphenylacetylene derivatives (**1a~1b**) and 1.2 equiv hyacinthin derivatives (**2a~2e**) were dissolved in DCE, then 0.6-2 equiv FeCl_3 was added and the mixture was stirred at room temperature until the derivatives of diphenylacetylene disappeared by thin layer chromatography (TLC) detected. The solvent was removed under vacuum and the residue was purified by column chromatography on silica gel. The final product was obtained from recrystallization.

Compound 3a. 1, 2-bis(3,4-dimethoxyphenyl)ethyne **1a** (268 mg, 0.9 mmol), 2-phenylacetaldehyde **2a** (132 mg, 1.1 mmol), FeCl_3 (179 mg, 1.1 mmol) and DCE 11 mL. Yield: 245 mg (68%) of light yellow powder. ^1H NMR (400MHz, CDCl_3): 7.91 (d, $J = 8.4\text{Hz}$, 2H), 7.77 (d, $J = 8.4\text{ Hz}$, 1H), 7.60 (d, $J = 8.4\text{ Hz}$, 1H), 7.48 (td, $J = 7.4\text{ Hz}$, $J = 0.8\text{ Hz}$, 1H), 7.42 (td, $J = 7.6\text{ Hz}$, $J = 1.2\text{ Hz}$ 1H), 6.76- 6.87 (m, 4H), 6.72 (sd, $J = 1.6\text{ Hz}$, 1H), 6.64 (sd, $J = 2.0\text{ Hz}$, 1H), 3.91 (s, 3H), 3.86 (s, 3H), 3.68 (s, 3H), 3.61 (s, 3H). ^{13}C NMR (100MHz, CDCl_3): 148.5, 147.9, 147.8, 147.4, 137.9, 137.1, 134.7, 132.8, 132.7, 131.7, 128.2, 127.8, 127.5, 126.7, 126.2, 125.5, 123.7, 122.1, 114.8, 113.6, 110.7, 110.47, 55.8, 55.7, 55.6. Mass (APCI, m/z), calcd for $\text{C}_{26}\text{H}_{24}\text{O}_4$: 400.17. Found: $[\text{M}+\text{H}]^+$, 401.10. Anal. Calcd for $\text{C}_{26}\text{H}_{24}\text{O}_4$: C, 77.98; H, 6.04. Found: C, 77.86; H, 5.80.

Compound 3b. 1,2-bis(3,4-dimethoxyphenyl)ethyne **1a** (314 mg, 1.05 mmol), 2-(4-methoxy phenyl)acetaldehyde **2b** (189 mg, 1.26 mmol), FeCl₃ (205 mg, 1.26 mmol), DCE 8 mL. Yield: 293 mg (65%) of light yellow powder. ¹H NMR (400MHz, CDCl₃): 7.79-7.84 (m, 2H), 7.45 (d, *J* = 8.4Hz, 1H), 7.15 (dd, *J* = 8.8 Hz, *J* = 2.6Hz, 1H), 7.09 (sd, *J* = 2.4Hz 1H), 6.75-6.86 (m, 4H), 6.72 (sd, *J* = 2Hz, 1H), 6.62 (sd, *J* = 2Hz, 1H), 3.90 (s, 3H), 3.85 (s, 3H), 3.73 (s, 3H), 3.68 (s, 3H), 3.61 (s, 3H). ¹³C NMR (100MHz, CDCl₃): 158.0, 148.6, 147.9, 147.7, 147.4, 138.6, 136.0, 135.0, 134.1, 132.0, 129.4, 128.3, 127.23, 126.1, 123.6, 122.1, 118.1, 114.8, 113.7, 110.8, 110.5, 105.4, 55.9, 55.8, 55.8, 55.6, 55.2. Mass (APCI, *m/z*), calcd for C₂₇H₂₆O₅: 430.18. Found: [M+H]⁺, 431.26. Anal. Calcd for C₂₇H₂₆O₅: C, 75.33; H, 6.09. Found: C, 75.05; H, 6.07.

Compound 3c. 1, 2-bis(3,4-dimethoxyphenyl)ethyne **1a** (596 mg, 2.0 mmol), 2-(4-(hexyloxy) phenyl) acetaldehyde **2c** (528 mg, 2.4 mmol), FeCl₃ (390 mg, 2.4 mmol), DCE 15 mL. Yield: 610 mg (61%) of light yellow powder. ¹H NMR (400MHz, CDCl₃): 7.78-7.83 (m, 2H), 7.44 (d, *J* = 8.4 Hz, 1H), 7.15 (dd, *J* = 9.0 Hz, *J* = 2.2 Hz, 1H), 7.06 (sd, *J* = 2.0 Hz, 1H), 6.80-6.86 (m, 4H), 6.72 (sd, *J* = 1.2 Hz, 1H), 6.61 (sd, *J* = 1.6 Hz, 1H), 3.91 (s, 3H), 3.84-3.87 (m, 5H), 3.68 (s, 3H), 3.60 (s, 3H), 1.72-1.76 (m, 2H), 1.40-1.44 (m, 2H), 1.29-1.32 (m, 4H), 0.89 (t, *J* = 6.8 Hz, 3H). ¹³C NMR (100MHz, CDCl₃): 157.5, 148.6, 147.9, 147.7, 147.4, 138.5, 135.9, 135.0, 134.1, 132.0, 129.3, 128.2, 127.2, 125.9, 123.6, 122.1, 118.4, 114.8, 113.7, 110.8, 110.5, 106.2, 67.9, 55.9, 55.8, 55.7, 55.6, 31.6, 29.1, 25.8, 22.6, 14.0. Mass (APCI, *m/z*), calcd for C₃₂H₃₆O₅: 500.26. Found: [M+H]⁺, 501.31. Anal. Calcd for C₃₂H₃₆O₅: C, 76.77; H, 7.25. Found: C, 76.57; H, 7.21.

Compound 3d. 1, 2-bis(3, 4-dimethoxyphenyl)ethyne **1a** (298 mg, 1.0 mmol), 2-(3,4-dimethoxy phenyl) acetaldehyde **2d** (216 mg, 1.2 mmol), FeCl₃ (195 mg, 1.2 mmol), DCE 10 mL. Yield: 285 mg (62%) of light yellow powder. ¹H NMR (400MHz, CDCl₃): 7.75 (d, *J* = 8.4 Hz, 1H), 7.46 (d, *J* = 8.4 Hz, 1H), 7.19 (s, 1H), 7.09 (s, 1H), 6.73-6.86 (m, 5H), 6.61 (s, 1H), 4.04 (s, 1H), 3.91 (s, 1H), 3.86 (s, 1H), 3.77 (s, 1H), 3.68 (s, 1H), 3.61 (s, 1H). ¹³C NMR (100MHz, CDCl₃): 149.5, 149.2, 148.5, 147.8, 147.6, 147.2, 136.5, 135.8, 135.1, 132.1, 128.7, 128.4, 126.6, 125.9, 123.5, 122.0, 114.6, 113.6, 110.7, 110.4, 106.2, 105.6, 55.9, 55.8, 55.8, 55.8, 55.7, 55.6. Mass (APCI, *m/z*), calcd for C₂₈H₂₈O₆: 460.19. Found: [M+H]⁺, 461.28. Anal. Calcd for C₂₈H₂₈O₆: C, 73.03; H, 6.13. Found: C, 72.73; H, 6.08.

Compound 3e. 1, 2-bis(3, 4-bis(hexyloxy)phenyl)ethyne **1b** (289 mg, 0.5 mmol), 2-phenyl acetaldehyde **2a** (72 mg, 0.6 mmol), FeCl₃ (78 mg, 0.48 mmol), DCE 4 mL. Yield: 218 mg (64%) of light yellow oil. ¹H NMR (400MHz, CDCl₃): 7.88 (dd, *J* = 8.8 Hz, *J* =

2.8 Hz, 1H), 1.76 (d, $J = 8.4$ Hz, 1H), 7.58 (d, $J = 8.4$ Hz, 1H), 7.46 (t, $J = 7.0$ Hz, 1H), 7.39 (t, $J = 7.6$ Hz, 1H), 6.73-6.84 (m, 4H), 6.70 (s, 1H), 6.65 (s, 1H), 3.93-4.02 (m, 4H), 3.66-3.84 (m, 4H), 1.67-1.83 (m, 8H), 1.25-1.49 (m, 24H), 0.86-0.92 (m, 12H). ^{13}C NMR (100MHz, CDCl_3): 148.6, 148.1, 147.9, 147.6, 138.0, 137.2, 134.8, 133.0, 132.7, 131.8, 128.4, 127.8, 127.3, 126.9, 126.1, 125.4, 123.8, 122.3, 117.3, 116.2, 113.1, 113.0, 69.2, 69.1, 31.7, 31.6, 31.5, 29.4, 29.3, 29.2, 29.1, 25.8, 25.7, 25.6, 22.6, 14.0. Mass (APCI, m/z), calcd for $\text{C}_{46}\text{H}_{64}\text{O}_4$: 680.48. Found: $[\text{M}+\text{H}]^+$, 681.37. Anal. Calcd for $\text{C}_{46}\text{H}_{64}\text{O}_4$: C, 81.13; H, 9.47. Found: C, 80.92; H, 9.27.

Compound 3f. 1,2-bis(3,4-bis(hexyloxy)phenyl)ethyne **1b** (289 mg, 0.5 mmol), 2-(4-methoxy phenyl)acetaldehyde **2b** (90 mg, 0.6 mmol), FeCl_3 (87 mg, 0.54 mmol), DCE 4 mL. Yield: 264 mg (74%) of light yellow oil. ^1H NMR (400MHz, CDCl_3): 7.77-7.81 (m, 2H), 7.44 (d, $J = 8.4$ Hz, 1H), 7.13 (dd, $J = 8.8$ Hz, $J = 2.0$ Hz, 1H), 7.08 (sd, $J = 2.0$ Hz, 1H), 6.83 (d, $J = 8.4$ Hz, 1H), 6.72-6.74 (m, 4H), 6.64 (s, 1H), 3.80-4.01 (m, 4H), 3.66-3.86 (m, 7H), 1.76-1.87 (m, 4H), 1.65-1.72 (m, 4H), 1.58 (s, 2H), 1.44-1.50 (m, 4H), 1.29-1.40 (m, 22H), 0.87-0.94 (m, 12H). ^{13}C NMR (100MHz, CDCl_3): 156.8, 147.6, 147.0, 146.8, 146.5, 137.6, 135.1, 134.0, 133.1, 131.0, 128.3, 127.1, 126.0, 125.1, 122.7, 121.2, 116.9, 116.1, 115.1, 112.2, 112.0, 104.4, 68.1, 68.0, 54.1, 30.7, 30.6, 28.7, 28.4, 28.3, 28.2, 28.1, 24.8, 24.7, 24.6, 21.6, 21.5, 13.0. Mass (APCI, m/z), calcd for $\text{C}_{47}\text{H}_{66}\text{O}_5$: 710.49. Found: $[\text{M}+\text{H}]^+$, 711.53. Anal. Calcd for $\text{C}_{47}\text{H}_{66}\text{O}_5$: C, 79.39; H, 9.36. Found: C, 79.05; H, 9.25.

Compound 3g. 1,2-bis(3,4-bis(hexyloxy)phenyl)ethyne **1b** (192 mg, 0.33 mmol), 2-(4-(hexyloxy)phenyl) acetaldehyde **2c** (108 mg, 0.49 mmol), FeCl_3 (43 mg, 0.26 mmol), DCE 4 mL. Yield: 167 mg (65%) of light yellow oil. ^1H NMR (400MHz, CDCl_3): 7.77-7.80 (m, 2H), 7.43 (d, $J = 8.4$ Hz, 1H), 7.13 (dd, $J = 8.8$ Hz, $J = 2.0$ Hz, 1H), 7.06 (s, 1H), 6.83 (d, $J = 8.0$ Hz, 1H), 6.71-6.74 (m, 4H), 6.64 (s, 1H), 3.66-4.01 (m, 10H), 1.67-1.84 (m, 10H), 1.31-1.50 (m, 30H), 0.89-0.94 (m, 15H). ^{13}C NMR (100MHz, CDCl_3): 157.3, 148.5, 147.9, 147.6, 147.4, 138.5, 136.0, 135.0, 134.1, 132.0, 129.2, 128.1, 127.0, 126.0, 123.7, 122.2, 118.3, 116.8, 115.9, 113.0, 112.8, 106.1, 69.1, 69.0, 68.9, 67.8, 31.7, 31.6, 29.4, 29.3, 29.2, 29.1, 29.0, 25.8, 25.7, 25.6, 22.6, 14.1, 14.0. Mass (APCI, m/z), calcd for $\text{C}_{52}\text{H}_{76}\text{O}_5$: 780.57. Found: $[\text{M}+\text{H}]^+$, 781.66. Anal. Calcd for $\text{C}_{52}\text{H}_{76}\text{O}_5$: C, 79.95; H, 9.81. Found: C, 79.68; H, 9.67.

Compound 3h. 1,2-bis(3,4-bis(hexyloxy)phenyl)ethyne **1b** (289 mg, 0.5 mmol), 2-(3,4-bis (hexyloxy)phenyl) acetaldehyde **2e** (192 mg, 0.6 mmol), FeCl_3 (81 mg, 0.5 mmol), DCE 10 mL. Yield: 255 mg (58%) of light yellow oil. ^1H NMR (400MHz, CDCl_3): 7.69

(d, $J = 8.4$ Hz, 1H), 7.42 (d, $J = 8.4$ Hz, 1H), 7.16 (s, 1H), 7.06 (s, 1H), 6.82 (d, $J = 8.4$ Hz, 1H), 6.70-6.73 (m, 4H), 6.62 (s, 1H), 4.14 (t, $J = 4.6$ Hz, 2H), 3.92-4.01 (m, 4H), 3.65-3.86 (m, 6H), 1.75-1.92 (m, 12H), 1.25-1.54 (m, 36H), 0.87-0.94 (m, 18H). ^{13}C NMR (100MHz, CDCl_3): 149.3, 149.1, 148.4, 147.9, 147.6, 147.2, 136.3, 135.8, 135.2, 132.2, 128.6, 128.5, 126.5, 125.6, 123.6, 122.1, 116.8, 116.0, 112.9, 112.8, 107.6, 107.3, 69.1, 69.0, 68.9, 68.8, 68.6, 31.7, 31.6, 29.4, 29.3, 29.2, 29.0, 28.9, 25.7, 25.6, 22.6, 14.1, 14.04. Mass (APCI, m/z), calcd for $\text{C}_{58}\text{H}_{88}\text{O}_6$: 880.66. Found: $[\text{M}+\text{H}]^+$, 881.75. Anal. Calcd for $\text{C}_{58}\text{H}_{88}\text{O}_6$: C, 79.04; H, 10.06. Found: C, 79.31; H, 9.97.

General synthesis procedure for 4a-4h

Method one

1 equiv diphenylacetylene derivatives (**1a-1b**) and 1.2-1.5 equiv hyacinthin derivatives (**2a-2e**) were dissolved in DCE, then 3-5 equiv FeCl_3 was added and the mixture was stirred at room temperature until the derivatives of diphenylacetylene disappeared by TLC detected. The solvent was removed under vacuum and the residue was purified by column chromatography on silica gel. The final product was obtained from recrystallization.

Method two

1 equiv 1, 2-dibenzyl naphthalene derivatives **3a-3h** was dissolved in DCE, then 3-5 equiv FeCl_3 was added and the mixture was stirred at room temperature until the derivatives of **3a-3h** was disappeared by TLC detected. The solvent was removed under vacuum and the residue was purified by column chromatography on silica gel. The final product was obtained from recrystallization.

Compound 4a.

Method one: 1,2-bis(3,4-dimethoxyphenyl)ethyne **1a** (150 mg, 0.5 mmol), 2-phenylacetaldehyde **2a** (72 mg, 0.6 mmol), FeCl_3 (406 mg, 2.5 mmol), DCE 10 mL. Yield: 110 mg (55%) of yellow powder.

Method two: **3a** (120 mg, 0.3 mmol), FeCl_3 (195 mg, 1.2 mmol), DCE 4 mL. Yield: 84 mg (71%) of yellow powder. ^1H NMR (400MHz, CDCl_3): 8.98 (d, $J = 8.4$ Hz, 1H), 8.47 (d, $J = 8.8$ Hz, 1H), 8.41 (s, 1H), 8.00-8.02 (m, 2H), 7.95 (d, $J = 8.8$ Hz, 1H), 7.88 (s, 1H), 7.86 (s, 1H), 7.56-7.63 (m, 2H), 4.17 (s, 3H), 4.16 (s, 3H), 4.15 (s, 3H), 4.06 (s, 3H). ^{13}C NMR (100MHz, CDCl_3): 149.5, 149.1, 148.8, 147.9, 133.1, 130.2, 128.28, 127.6, 126.9, 126.6, 126.0, 125.7, 125.5, 125.2, 124.1, 123.6, 123.5, 120.8, 110.9, 104.9, 104.2, 103.8, 56.1, 56.0. Mass (APCI, m/z), calcd for $\text{C}_{26}\text{H}_{22}\text{O}_4$: 398.15. Found: $[\text{M}+\text{H}]^+$, 399.16. Anal. Calcd for $\text{C}_{26}\text{H}_{22}\text{O}_4$: C, 78.37; H, 5.57. Found: C, 78.52; H, 5.35.

Compounds 4b.

Method one: 1,2-bis(3,4-dimethoxyphenyl)ethyne **1a** (298 mg, 1.0 mmol), 2-(4-methoxyphenyl) acetaldehyde **2b** (180 mg, 1.2 mmol), FeCl₃ (813 mg, 5 mmol), DCE 10 mL. Yield: 175 mg (41%) of yellow powder.

Method two: 3ab (143 mg, 0.33 mmol), FeCl₃ (244 mg, 1.5 mmol), DCE 4 mL. Yield: 114 mg (81%) of yellow powder. ¹H NMR (400MHz, CDCl₃): 8.48 (s, 1H), 8.40 (sd, *J* = 2.0 Hz, 1H), 8.35 (d, *J* = 9.2 Hz, 1H), 8.00 (s, 1H), 7.87-7.94(m, 4H), 7.25 (dd, *J* = 8.0 Hz, *J* = 2.4 Hz, 1H), 4.14-4.18 (m, 9H), 4.07 (s, 3H), 3.98 (s, 3H). ¹³C NMR (100MHz, CDCl₃): 158.0, 149.5, 149.1, 148.7, 147.7, 131.4, 129.8, 128.2, 127.6, 126.4, 125.3, 125.2, 124.2, 123.8, 123.7, 118.6, 116.9, 110.0, 108.1, 105.0, 104.3, 103.8, 56.2, 56.1, 56.0, 55.5. Mass (APCI, *m/z*), calcd for C₂₇H₂₄O₅: 428.16. Found: [M+H]⁺, 429.19. Anal. Calcd for C₂₇H₂₄O₅: C, 75.68; H, 5.65. Found: C, 75.31; H, 5.69.

Compounds 4c.

Method one: 1,2-bis(3,4-dimethoxyphenyl)ethyne **1a** (298 mg, 1.0 mmol), 2-(4-(hexyloxy)phenyl) acetaldehyde **2c** (264 mg, 1.2 mmol), FeCl₃ (813 mg, 5 mmol), DCE 15 mL. Yield: 214 mg (43%) of yellow powder.

Method two: 3ac (100 mg, 0.2 mmol), FeCl₃ (130 mg, 0.8 mmol), DCE 5 mL. Yield: 78 mg (78%) of yellow powder. ¹H NMR (400MHz, CDCl₃): 8.48 (s, 1H), 8.39 (d, *J* = 1.6 Hz, 1H), 8.33 (d, *J* = 8.8 Hz, 1H), 7.99 (s, 1H), 7.86-7.92 (m, 4H), 7.24 (dd, *J* = 8.8 Hz, *J* = 2.0 Hz, 1H), 4.18 (s, 3H), 4.16 (s, 3H), 4.10-4.14 (m, 5H), 4.06 (s, 3H), 1.85-1.89 (m, 2H), 1.49-1.55 (m, 2H), 1.35-1.38 (m, 4H), 0.90-0.93 (m, 3H). ¹³C NMR (100MHz, CDCl₃): 157.6, 149.5, 149.8, 148.6, 147.7, 131.4, 129.7, 128.1, 127.5, 126.4, 125.3, 125.1, 124.1, 123.8, 123.7, 118.5, 117.3, 110.1, 108.9, 105.0, 104.3, 103.8, 68.4, 56.1, 56.0, 31.6, 29.4, 25.8, 22.6, 14.0. Mass (APCI, *m/z*), calcd for C₃₂H₃₄O₅: 498.24. Found: [M+H]⁺, 499.32. Anal. Calcd for C₃₂H₃₄O₅: C, 77.08; H, 6.87. Found: C, 77.32; H, 6.84.

Compounds 4d.

Method one: 1,2-bis(3,4-dimethoxyphenyl)ethyne **1a** (149 mg, 0.5 mmol), 2-(3,4-dimethoxyphenyl) acetaldehyde **2d** (108 mg, 0.6 mmol), FeCl₃ (325 mg, 2.0 mmol), DCE 7 mL. Yield: 78 mg (34%) of yellow powder.

Method two: 3ad (262 mg, 0.57 mmol), FeCl₃ (397 mg, 2.44 mmol), Yield: 172 mg (66%) of yellow powder. ¹H NMR (CDCl₃, 400MHz): 8.40 (s, 1H), 8.35-8.37 (m, 2H), 7.97 (s, 1H), 7.89 (s, 1H), 7.81-7.83 (m, 2H), 7.33 (s, 1H), 4.17 (s, 3H), 4.15 (s, 3H), 4.14 (s, 3H), 4.09 (s, 3H), 4.06 (s, 3H), 4.05 (s, 3H). ¹³C NMR (CDCl₃, 100MHz): 149.2, 149.1, 148.9, 148.6, 147.6, 128.8, 126.2, 125.5, 125.4, 125.3, 125.2, 123.9, 123.6, 123.5, 119.3, 110.0,

108.0, 107.4, 104.7, 104.4, 103.8, 56.1, 56.0, 55.9. Mass (APCI, m/z), calcd for C₂₈H₂₆O₆: 458.17. Found: [M+H]⁺, 459.29. Anal. Calcd for C₂₈H₂₆O₆: C, 73.35; H, 5.72. Found: C, 73.18; H, 5.68.

Compounds 4e.

Method one: 1,2-bis(3,4-bis(hexyloxy)phenyl)ethyne **1b** (145 mg, 0.25 mmol), 2-phenylacetaldehyde **2a** (36 mg, 0.3 mmol), FeCl₃ (203 mg, 1.25 mmol), DCE 4 mL. Yield: 41 mg (24%) of light yellow powder.

Method two: **3e** (119 mg, 0.17 mmol), FeCl₃ (85 mg, 0.52 mmol). Yield: 78 mg (68%) of light yellow powder. ¹H NMR (400MHz, CDCl₃): 8.96 (d, *J* = 8.0 Hz, 1H), 8.46 (d, *J* = 7.2 Hz, 1H), 8.39 (s, 1H), 8.02 (s, 1H), 8.00 (dd, *J* = 8.0 Hz, *J* = 1.6 Hz, 1H), 7.90-7.93 (m, 3H), 7.54-7.62 (m, 2H), 4.24-4.31 (m, 6H), 4.18 (t, *J* = 6.4 Hz, 2H), 1.91-2.00 (m, 8H), 1.53-1.62 (m, 8H), 1.37-1.44 (m, 16H), 0.90-0.96 (m, 12H). ¹³C NMR (100MHz, CDCl₃): 149.6, 149.2, 148.9, 148.0, 133.0, 130.3, 128.0, 127.4, 127.0, 126.3, 126.1, 125.6, 125.4, 125.3, 124.4, 123.8, 123.6, 121.0, 113.1, 107.2, 106.8, 106.5, 69.6, 69.4, 69.3, 31.7, 29.4, 29.3, 25.9, 25.8, 22.7, 14.1. Mass (APCI, m/z), calcd for C₄₆H₆₂O₄: 678.46. Found: [M+H]⁺, 679.38. Anal. Calcd for C₄₆H₆₂O₄: C, 81.37; H, 9.20. Found: C, 81.11; H, 9.03.

Compounds 4f.

Method one: 1,2-bis(3,4-bis(hexyloxy)phenyl)ethyne **1b** (145 mg, 0.25 mmol), 2-(4-methoxyphenyl) acetaldehyde **2b** (45 mg, 0.3 mmol), FeCl₃ (163 mg, 1.0 mmol), DCE 4 mL. Yield: 35 mg (20%) of light yellow powder.

Method two: **3f** (264 mg, 0.37 mmol), FeCl₃ (202 mg, 1.24 mmol). Yield: 186 mg (71%) of light yellow powder. ¹H NMR (CDCl₃, 400MHz): 8.46 (s, 1H), 8.31-8.39 (m, 2H), 8.01 (s, 1H), 7.86-7.92 (m, 4H), 7.23 (dd, *J* = 8.8 Hz, *J* = 2.0 Hz, 1H), 4.23-4.31 (m, 6H), 4.16 (t, *J* = 6.6 Hz, 2H), 3.97 (s, 3H), 1.90-1.99 (m, 8H), 1.51-1.59 (m, 8H), 1.25-1.41 (m, 16H), 0.90-0.96 (m, 12H). ¹³C NMR (CDCl₃, 100MHz): 157.8, 149.6, 149.2, 148.7, 147.9, 131.4, 129.7, 128.2, 127.6, 126.4, 126.2, 125.3, 124.4, 123.9, 123.8, 118.7, 116.8, 112.2, 108.1, 107.3, 107.0, 106.6, 69.6, 69.4, 55.5, 55.4, 31.7, 31.6, 29.4, 29.3, 25.8, 22.7, 14.1. Mass (APCI, m/z), calcd for C₄₇H₆₄O₅: 708.48. Found: [M+H]⁺, 709.39. Anal. Calcd for C₄₇H₆₄O₅: C, 79.62; H, 9.10. Found: C, 79.75; H, 8.93.

Compounds 4g.

Method one: 1,2-bis(3,4-bis(hexyloxy)phenyl)ethyne **1b** (193 mg, 0.33 mmol), 2-(4-(hexyloxy) phenyl)acetaldehyde **2c** (88 mg, 0.4 mmol), FeCl₃ (217 mg, 1.34 mmol), DCE 10 mL. Yield: 36 mg (14%) of light yellow powder.

Method two: **3g** (163 mg, 0.21 mmol), FeCl₃ (103 mg, 0.63 mmol). Yield: 128 mg (78%)

of light yellow powder. ^1H NMR (CDCl_3 , 400MHz): 8.46 (s, 1H), 8.38 (sd, $J = 2.0$ Hz, 1H), 8.31 (d, $J = 7.2$ Hz, 1H), 8.01 (s, 1H), 7.88-7.91 (m, 3H), 7.85 (d, $J = 7.2$ Hz, 1H), 7.22 (dd, $J = 8.8$ Hz, $J = 2.4$ Hz, 1H), 4.23-4.31 (m, 6H), 4.16 (t, $J = 6.6$ Hz, 2H), 4.11 (t, $J = 6.4$ Hz, 2H), 1.90-1.99 (m, 10H), 1.51-1.61 (m, 10H), 1.35-1.43 (m, 20H), 0.90-0.96 (m, 15H). ^{13}C NMR (CDCl_3 , 100MHz): 157.5, 149.6, 149.2, 148.5, 147.9, 131.5, 129.6, 128.1, 127.6, 126.2, 125.3, 125.2, 124.3, 123.9, 123.8, 118.6, 117.2, 112.0, 108.7, 107.3, 106.8, 106.5, 69.6, 69.6, 69.4, 69.3, 68.3, 31.7, 31.6, 29.4, 29.3, 25.9, 25.8, 22.7, 22.6, 14.1, 14.0. Mass (APCI, m/z), calcd for $\text{C}_{52}\text{H}_{74}\text{O}_5$: 778.55. Found: $[\text{M}+\text{H}]^+$, 779.52. Anal. Calcd for $\text{C}_{52}\text{H}_{74}\text{O}_5$: C, 80.16; H, 9.57. Found: C, 79.79; H, 9.46.

Compounds 4h.

Method one: 1,2-bis(3,4-bis(hexyloxy)phenyl)ethyne **1b** (193 mg, 0.33 mmol), 2-(3,4-bis(hexyloxy) phenyl)acetaldehyde **2e** (128 mg, 0.4 mmol), FeCl_3 (215 mg, 1.32 mmol), DCE 10 mL. Yield: 30 mg (10%) of light yellow powder.

Method two: **3h** (77 mg, 0.09 mmol), FeCl_3 (50 mg, 0.31 mmol). Yield: 55 mg (72%) of light yellow powder. ^1H NMR (CDCl_3 , 400MHz): 8.40 (s, 1H), 8.37 (s, 1H), 8.32 (d, $J = 9.2$ Hz, 1H), 7.99 (s, 1H), 7.91 (s, 1H), 7.87 (s, 1H), 7.77 (d, $J = 8.8$ Hz, 1H), 7.30 (s, 1H), 4.23-4.30 (m, 6H), 4.20 (t, $J = 6.8$ Hz, 2H), 4.14 (td, $J = 6.8$ Hz, $J = 1.6$ Hz, 4H), 1.91-1.97 (m, 12H), 1.52-1.61 (m, 12H), 1.35-1.42 (m, 24H), 0.92-0.96 (m, 18H). ^{13}C NMR (CDCl_3 , 100MHz): 149.2, 149.2, 148.9, 148.5, 147.8, 128.9, 126.0, 125.4, 125.3, 124.1, 123.8, 119.1, 112.0, 109.9, 108.7, 107.1, 106.9, 106.8, 69.7, 69.6, 69.4, 69.3, 69.2, 68.8, 31.7, 31.7, 31.6, 29.4, 29.3, 29.2, 25.9, 25.8, 22.7, 22.6, 14.1, 14.0. Mass (APCI, m/z), calcd for $\text{C}_{58}\text{H}_{86}\text{O}_6$: 878.64. Found: $[\text{M}+\text{H}]^+$, 879.58. Anal. Calcd for $\text{C}_{58}\text{H}_{86}\text{O}_6$: C, 79.22; H, 9.86. Found: C, 78.97; H, 9.75.

General synthesis procedure for benzo[g]chrysene derivatives 5a-5h

1 equiv of 1, 2-dibenzyl naphthalene derivatives 3aa-3bd was dissolved in DCE, then 7-10 equiv FeCl_3 was added and the mixture was stirred at room temperature until the derivatives of 3aa-3bd was disappeared by TLC detected. The solvent was removed under vacuum and the residue was purified by column chromatography on silica gel. The final product was obtained from recrystallization.

Compound 5a. **3a** (100 mg, 0.25 mmol), FeCl_3 (406 mg, 2.5 mmol), DCE 10 mL. Yield: 78 mg (72%) of yellow powder. ^1H NMR (400MHz, CDCl_3): 8.89 (d, $J = 7.2$ Hz, 1H), 8.46 (s, 1H), 8.43 (dd, $J = 8.0$ Hz, $J = 1.6$ Hz, 1H), 8.22 (s, 1H), 7.78 (s, 2H), 7.77 (s, 1H), 7.59-7.67 (m, 2H), 4.13 (s, 3H), 4.12 (s, 3H), 4.11 (s, 3H), 4.00 (s, 3H). ^{13}C NMR (100MHz, CDCl_3): 149.8, 149.2, 149.0, 148.0, 131.3, 130.1, 130.0, 127.9, 126.8, 126.3,

126.2, 125.3, 125.2, 124.8, 124.3, 122.9, 122.6, 121.1, 110.7, 104.5, 104.1, 103.7, 56.1, 56.0. Mass (APCI, m/z), calcd for $C_{26}H_{21}ClO_4$: 432.11. Found: $[M+H]^+$, 433.19. Anal. Calcd for $C_{26}H_{21}ClO_4$: C, 72.14; H, 4.89. Found: C, 72.18; H, 4.85.

Compound 5b. 3b (130 mg, 0.3 mmol), $FeCl_3$ (498 mg, 3.06 mmol), DCE 5 mL. Yield: 113 mg (81%) of light yellow powder. 1H NMR (400MHz, $CDCl_3$): 8.33-8.38 (m, 4H), 7.83 (s, 1H), 7.80 (d, $J = 4.4$ Hz, 2H), 7.32 (dd, $J = 8.8$ Hz, $J = 2.4$ Hz, 1H), 4.16 (s, 1H), 4.15 (s, 1H), 4.14 (s, 1H), 4.04 (s, 1H), 3.97 (s, 1H). ^{13}C NMR (100MHz, $CDCl_3$): 158.4, 149.8, 149.2, 148.8, 147.9, 132.7, 130.2, 127.6, 126.5, 125.2, 125.1, 124.5, 124.3, 123.2, 122.7, 118.9, 117.3, 110.0, 108.7, 104.7, 104.3, 103.7, 56.1, 56.0, 55.6. Mass (APCI, m/z), calcd for $C_{27}H_{23}ClO_5$: 462.12. Found: $[M+H]^+$, 463.20. Anal. Calcd for $C_{27}H_{23}ClO_5$: C, 70.05; H, 5.01. Found: C, 70.13; H, 4.97.

Compound 5c. 3c (100 mg, 0.2 mmol), $FeCl_3$ (326 mg, 2.01 mmol), DCE 5 mL. Yield: 72 mg (68%) of light yellow powder. 1H NMR (400MHz, $CDCl_3$): 8.34-8.37 (m, 4H), 7.84 (s, 1H), 7.81 (d, $J = 4.4$ Hz, 2H), 7.32 (dd, $J = 9.2$ Hz, $J = 2.4$ Hz, 1H), 4.16 (s, 3H), 4.15 (s, 3H), 4.14 (s, 3H), 4.11 (t, $J = 6.8$ Hz, 2H), 4.04 (s, 3H), 1.85-1.88 (m, 2H), 1.48-1.58 (m, 2H), 1.35-1.38 (m, 4H), 0.91 (t, $J = 6.8$ Hz, 3H). ^{13}C NMR (100MHz, $CDCl_3$): 158.1, 149.8, 149.2, 148.8, 147.8, 132.7, 130.2, 127.5, 126.4, 125.2, 125.0, 124.4, 124.3, 123.2, 122.7, 118.7, 117.7, 110.0, 109.3, 104.7, 104.3, 103.7, 68.4, 56.1, 56.0, 31.5, 29.3, 25.8, 22.6, 14.0. Mass (APCI, m/z), calcd for $C_{32}H_{33}ClO_5$: 532.20. Found: $[M+H]^+$, 533.29. Anal. Calcd for $C_{32}H_{33}ClO_5$: C, 72.10; H, 6.24. Found: C, 71.91; H, 6.17.

Compound 5d. 3d (71 mg, 0.15 mmol), $FeCl_3$ (171 mg, 1.05 mmol), DCE 5 mL. Yield: 56 mg (74%) of light yellow powder. 1H NMR (400MHz, $CDCl_3$): 8.41 (s, 1H), 8.34 (s, 1H), 8.29 (s, 1H), 7.86 (s, 1H), 7.83 (s, 1H), 7.82 (s, 1H), 7.76 (s, 1H), 4.15-4.18 (m, 12H), 4.06 (s, 3H), 4.04 (s, 3H). ^{13}C NMR (100MHz, $CDCl_3$): 149.5, 149.3, 149.2, 149.1, 148.8, 147.7, 129.0, 126.4, 126.2, 125.8, 125.3, 124.5, 123.7, 123.0, 122.8, 119.4, 109.9, 108.3, 104.4, 104.3, 103.7, 56.1, 56.0. Mass (APCI, m/z), calcd for $C_{28}H_{25}ClO_6$: 492.13. Found: $[M+H]^+$, 493.22. Anal. Calcd for $C_{28}H_{25}ClO_6$: C, 68.22; H, 5.11. Found: C, 67.95; H, 5.01.

Compound 5e. 3e (90 mg, 0.13 mmol), $FeCl_3$ (148 mg, 0.91 mmol), DCE 5 mL. Yield: 72 mg (77%) of light yellow powder. 1H NMR (400MHz, $CDCl_3$): 8.95 (dd, $J = 7.2$ Hz, $J = 2.0$ Hz, 1H), 8.53 (s, 1H), 8.46 (dd, $J = 7.2$ Hz, $J = 2.4$ Hz, 1H), 8.28 (s, 1H), 7.87-7.90 (m, 3H), 7.64-7.68 (m, 2H), 4.25-4.31 (m, 6H), 4.16 (t, $J = 6.2$ Hz, 2H), 1.95-1.98 (m, 8H), 1.55-1.62 (m, 8H), 1.36-1.43 (m, 16H), 0.92-0.96 (m, 12H). ^{13}C NMR (100MHz, $CDCl_3$): 149.9, 149.4, 149.2, 148.2, 131.4, 130.0, 128.1, 126.9, 126.2, 125.6, 125.5, 125.4, 124.7, 124.5, 123.1, 122.8, 121.2, 113.2, 113.1, 106.8, 106.5, 69.6, 69.4, 31.7, 31.6, 29.4,

29.3, 25.9, 25.8, 22.7, 14.1. Mass (APCI, m/z), calcd for $C_{46}H_{61}ClO_4$: 712.43. Found: $[M+H]^+$, 713.27. Anal. Calcd for $C_{46}H_{61}ClO_4$: C, 77.44; H, 8.62. Found: C, 77.29; H, 8.45.

Compound 5f. 3f (116 mg, 0.16 mmol), $FeCl_3$ (182 mg, 1.12 mmol), DCE 5 mL. Yield: 92 mg (76%) of light yellow powder. 1H NMR ($CDCl_3$, 400MHz): 8.35-8.38 (m, 4H), 7.89 (s, 1H), 7.88 (s, 1H), 7.86 (s, 1H), 7.31 (dd, $J = 7.2\text{Hz}$, $J = 2.4\text{Hz}$, 1H), 4.24-4.30 (m, 6H), 4.14 (t, $J = 6.6\text{ Hz}$, 2H), 3.97 (s, 3H), 1.89-1.99 (m, 8H), 1.57-1.61 (m, 8H), 1.25-1.42 (m, 16H), 0.93-0.96 (m, 12H). ^{13}C NMR ($CDCl_3$, 100MHz): 158.3, 149.9, 149.4, 148.9, 148.1, 132.8, 130.1, 127.7, 126.4, 125.4, 125.1, 124.6, 124.5, 123.3, 122.9, 119.0, 117.4, 112.2, 108.6, 106.9, 106.5, 69.6, 69.4, 55.5, 31.7, 31.6, 29.4, 29.3, 25.9, 25.8, 22.7, 22.6, 14.1, 14.0. Mass (APCI, m/z), calcd for $C_{47}H_{63}ClO_5$: 742.44. Found: $[M+H]^+$, 743.21. Anal. Calcd for $C_{47}H_{63}ClO_5$: C, 75.93; H, 8.54. Found: C, 75.67; H, 8.42.

Compound 5g. 3g (71 mg, 0.09 mmol), $FeCl_3$ (103 mg, 0.63 mmol), DCE 5 mL. Yield: 53 mg (74%) of light yellow powder. 1H NMR ($CDCl_3$, 400MHz): 8.34-8.37 (m, 4H), 7.89 (s, 1H), 7.87 (s, 1H), 7.86 (s, 1H), 7.30 (dd, $J = 9.2\text{Hz}$, $J = 2.4\text{ Hz}$, 1H), 4.24-4.30 (m, 6H), 4.10-4.16 (m, 4H), 1.84-1.99 (m, 10H), 1.56-1.61 (m, 10H), 1.35-1.42 (m, 20H), 0.92-0.96 (m, 15H). ^{13}C NMR ($CDCl_3$, 100MHz): 158.0, 149.9, 149.4, 148.8, 148.1, 132.8, 130.1, 127.7, 126.3, 125.4, 125.0, 124.6, 124.5, 123.3, 122.9, 118.9, 117.8, 112.1, 109.3, 107.0, 106.8, 106.5, 69.7, 69.6, 69.5, 69.4, 68.4, 31.7, 31.6, 29.4, 29.3, 25.9, 25.8, 22.7, 22.6, 14.1, 14.0. Mass (APCI, m/z), calcd for $C_{52}H_{73}ClO_5$: 812.51. Found: $[M+H]^+$, 813.39. Anal. Calcd for $C_{52}H_{73}ClO_5$: C, 76.77; H, 9.04. Found: C, 76.88; H, 8.88.

Compound 5h. 3h (80 mg, 0.09 mmol), $FeCl_3$ (100 mg, 0.62 mmol), DCE 5 mL. Yield: 61 mg (73%) of light yellow powder. 1H NMR ($CDCl_3$, 400MHz): 8.40 (s, 1H), 8.35 (s, 1H), 8.30 (s, 1H), 7.88 (s, 1H), 7.87 (s, 1H), 7.85 (s, 1H), 7.73 (s, 1H), 4.24-4.30 (m, 8H), 4.10-4.16 (m, 4H), 1.88-1.99 (m, 12H), 1.50-1.60 (m, 12H), 1.35-1.42 (m, 24H), 0.93-0.96 (m, 18H). ^{13}C NMR ($CDCl_3$, 100MHz): 149.5, 149.4, 149.3, 149.2, 148.7, 148.0, 128.9, 126.5, 126.1, 125.8, 125.4, 124.7, 124.0, 123.3, 123.2, 119.3, 112.0, 112.0, 110.1, 106.9, 106.7, 106.6, 105.4, 69.7, 69.5, 69.4, 69.3, 69.2, 68.9, 31.7, 31.6, 29.4, 29.3, 29.2, 29.1, 25.9, 25.8, 22.7, 22.6, 14.1, 14.0. Mass (APCI, m/z), calcd for $C_{58}H_{85}ClO_6$: 912.60. Found: $[M+H]^+$, 913.55. Anal. Calcd for $C_{58}H_{85}ClO_6$: C, 76.24; H, 9.38. Found: C, 76.06; H, 9.14.

The NMR data of compounds 4a-4h from method one.

4a (method one)

¹H NMR (400MHz, CDCl₃): 8.97 (d, *J* = 8.0 Hz, 1H), 8.47 (d, *J* = 9.2 Hz, 1H), 8.40 (s, 1H), 7.99-8.02 (m, 2H), 7.93 (d, *J* = 8.8 Hz, 1H), 7.87 (s, 1H), 7.85 (s, 1H), 7.57-7.61 (m, 2H), 4.17 (s, 3H), 4.14 (s, 3H), 4.06 (s, 3H). ¹³C NMR (100MHz, CDCl₃): 149.7, 149.0, 148.8, 147.8, 133.0, 130.2, 128.3, 127.6, 126.9, 126.6, 126.0, 125.6, 125.5, 125.2, 124.1, 123.6, 123.4, 120.8, 110.8, 104.8, 104.0, 103.7, 56.1, 56.0.

4b (method one)

¹H NMR (400MHz, CDCl₃): 8.48 (s, 1H), 8.40 (sd, *J* = 2 Hz, 1H), 8.34 (d, *J* = 9.2 Hz, 1H), 8.00 (s, 1H), 7.86-7.94 (m, 4H), 7.25 (dd, *J* = 8.8 Hz, *J* = 2.4 Hz, 1H), 4.18 (s, 3H), 4.17 (s, 3H), 4.14 (s, 3H), 4.07 (s, 1H), 3.08 (s, 1H). ¹³C NMR (100MHz, CDCl₃): 157.9, 149.5, 149.0, 148.6, 147.7, 131.4, 129.8, 128.2, 127.5, 126.4, 125.3, 125.1, 124.1, 123.7, 123.6, 118.6, 116.9, 110.0, 108.0, 104.9, 104.3, 103.7, 56.1, 56.0, 55.5.

4c (method one)

¹H NMR (400MHz, CDCl₃): 8.48 (s, 1H), 8.39 (sd, *J* = 1.2 Hz, 1H), 8.00 (s, 1H), 7.87-7.93 (m, 4H), 7.24 (dd, *J* = 6.6 Hz, *J* = 2.4 Hz, 1H), 4.18 (s, 3H), 4.17 (s, 3H), 4.15 (s, 3H), 4.12 (t, *J* = 6.6 Hz, 2H), 4.07 (s, 3H), 1.84-1.90 (m, 2H), 1.49-1.52 (m, 2H), 1.34-1.38 (m, 4H), 0.89-0.93 (m, 3H). ¹³C NMR (100MHz, CDCl₃): 157.6, 149.5, 149.0, 148.6, 147.6, 131.4, 129.7, 128.1, 127.5, 126.4, 125.2, 125.1, 124.1, 123.8, 123.7, 118.5, 117.3, 110.0, 108.8, 104.9, 104.2, 103.7, 68.3, 56.1, 56.1, 56.0, 31.6, 29.4, 25.8, 22.6, 14.1.

4d (method one)

¹H NMR (400MHz, CDCl₃): 8.42 (s, 1H), 8.37-8.39 (m, 2H), 7.99 (s, 1H), 7.90 (s, 1H), 7.83-7.86 (m, 2H), 7.34 (s, 1H), 4.18 (s, 1H), 4.16 (s, 1H), 4.15 (s, 1H), 4.10 (s, 1H), 4.06 (s, 1H). ¹³C NMR (100MHz, CDCl₃): 149.2, 149.0, 148.9, 148.6, 147.6, 128.8, 126.1, 125.5, 125.4, 125.2, 125.2, 123.9, 123.6, 123.5, 119.2, 109.9, 108.0, 107.4, 104.7, 104.4, 103.8, 56.1, 56.0, 55.9.

4e (method one)

¹H NMR (400MHz, CDCl₃): ¹H NMR (400MHz, CDCl₃): 8.96 (d, *J* = 8.0 Hz, 1H), 8.46 (d, *J* = 7.2 Hz, 1H), 8.39 (s, 1H), 7.99-8.02 (m, 2H), 7.89-7.93 (m, 3H), 7.54-7.63 (m, 2H), 4.24-4.31 (m, 6H), 4.18 (t, *J* = 6.6 Hz, 2H), 1.95-1.98 (m, 8H), 1.59-1.60 (m, 8H), 1.37-1.41 (m, 16H), 0.94 (t, *J* = 7.2 Hz, 18H). ¹³C NMR (100MHz, CDCl₃): 149.6, 149.2,

148.9, 148.0, 133.0, 130.2, 128.1, 127.7, 127.0, 126.4, 126.0, 125.5, 125.4, 125.3, 124.4, 123.8, 123.6, 120.9, 113.1, 107.2, 106.9, 106.6, 69.6, 31.7, 31.6, 29.4, 29.3, 25.9, 25.8, 22.7, 14.1.

4f (method one)

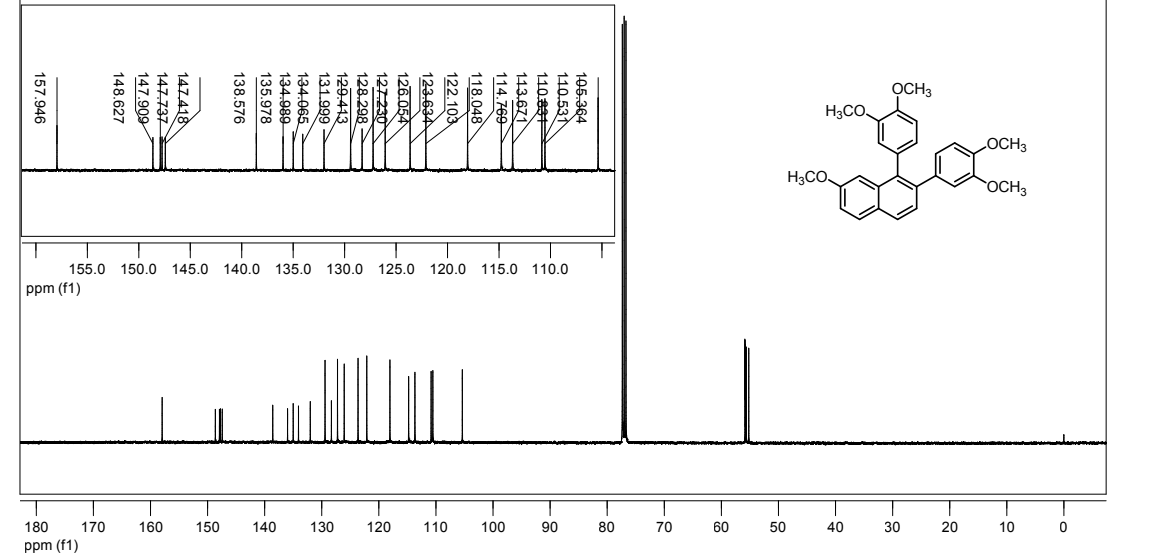
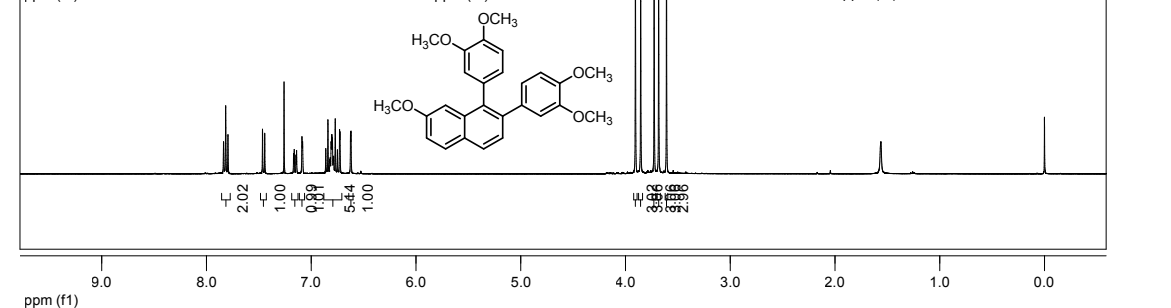
¹H NMR (400MHz, CDCl₃): 8.46 (s, 1H), 8.39 (sd, *J* = 2 Hz, 1H), 8.32 (d, *J* = 8.8 Hz, 1H), 8.00 (s, 1H), 7.84-7.92 (m, 4H), 7.23 (dd, *J* = 8.8 Hz, *J* = 2.4 Hz, 1H), 4.23-4.31 (m, 6H), 4.16 (t, *J* = 6.6 Hz, 2 H), 3.07 (s, 3H), 1.90-1.99 (m, 8H), 1.56-1.61 (m, 8H), 1.35-1.43 (m, 16 H), 0.90-0.96 (m, 12H). ¹³C NMR (100MHz, CDCl₃): 157.8, 149.6, 149.2, 148.6, 147.9, 131.4, 129.7, 128.2, 127.6, 126.2, 125.3, 124.3, 123.9, 123.8, 118.7, 116.8, 112.1, 108.0, 107.3, 106.9, 106.5, 69.6, 69.5, 69.3, 55.4, 31.7, 31.6, 29.7, 29.4, 29.3, 25.9, 25.8, 22.7, 22.6, 14.1, 14.0.

4g (method one)

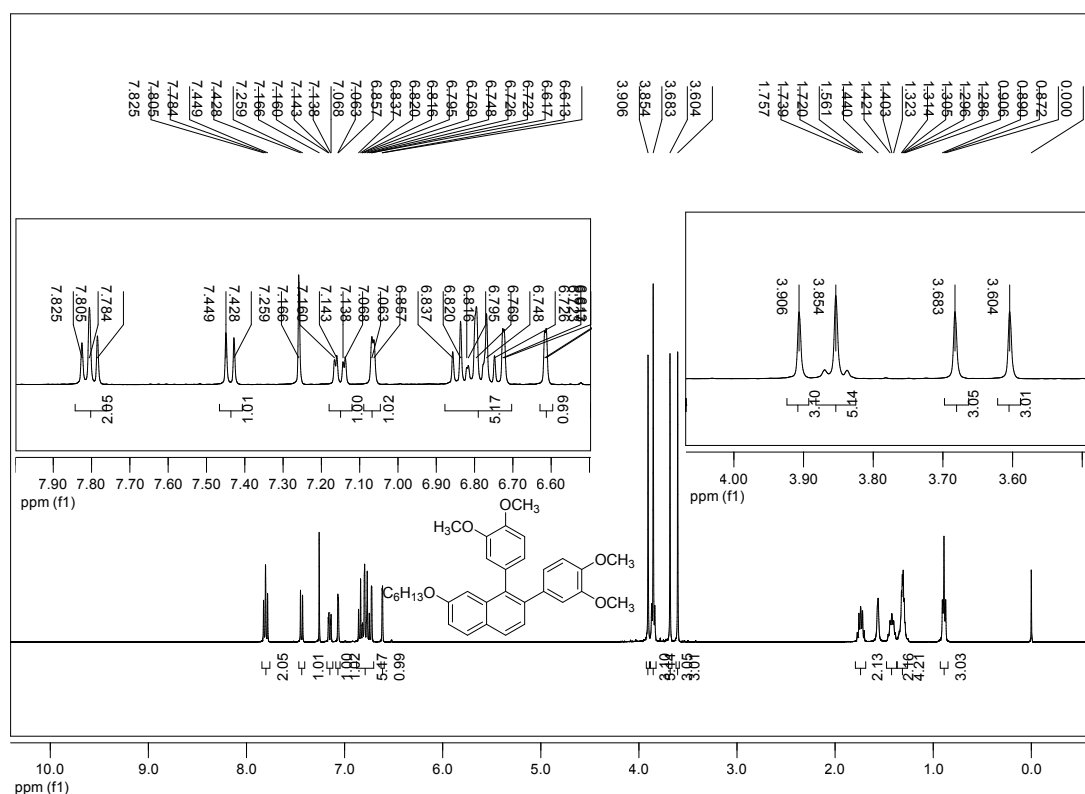
¹H NMR (400MHz, CDCl₃): 8.57 (s, 1H), 8.38 (sd, *J* = 2 Hz, 1H), 8.31 (d, *J* = 9.2 Hz, 1H), 8.00 (s, 1H), 7.88-7.91 (m, 3H), 7.84 (d, *J* = 8.8 Hz, 1H), 7.22 (dd, *J* = 8.8 Hz, *J* = 2.4 Hz, 1H), 4.23-4.32 (m, 6H), 4.16 (t, *J* = 6.6 Hz, 2H), 4.11 (t, *J* = 6.8 Hz, 2H), 1.86-2.00 (m, 10H), 1.51-1.61 (m, 10 H), 1.35-1.42 (m, 20H), 0.90-0.96 (m, 15H). ¹³C NMR (100MHz, CDCl₃): 157.5, 149.6, 149.2, 148.6, 147.9, 131.5, 129.6, 128.1, 127.6, 126.2, 125.3, 124.3, 123.9, 123.8, 118.6, 117.2, 112.1, 108.8, 107.4, 106.9, 106.6, 69.7, 69.6, 69.4, 69.3, 68.2, 31.7, 31.6, 29.5, 29.4, 29.3, 25.9, 25.8, , 22.7, 22.6, 14.0, 14.0.

4h (method one)

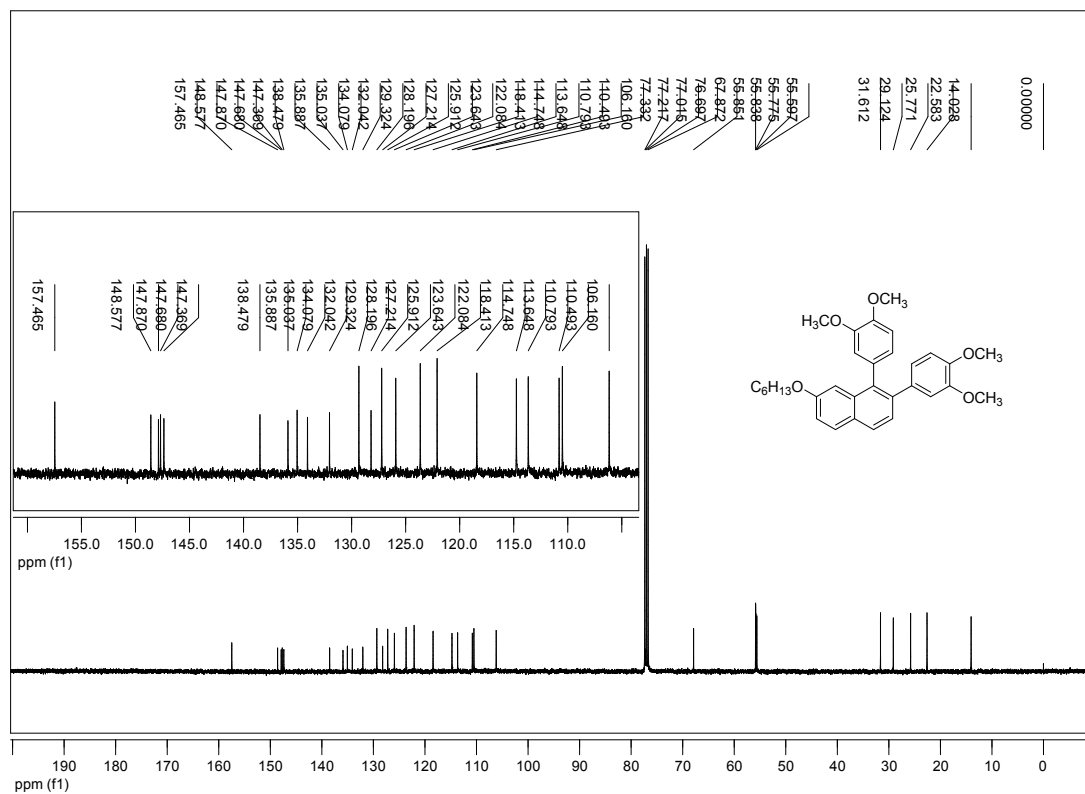
¹H NMR (400MHz, CDCl₃): 8.40 (s, 1H), 8.42 (s, 1H), 8.37 (d, *J* = 7.2 Hz, 1H), 8.04 (s, 1H), 7.96 (s, 1H), 7.92 (s, 1H), 7.82 (d, *J* = 8.8 Hz, 1H), 7.35 (s, 1H), 8.18-8.30 (m, 8H), 4.12-4.16 (m, 4H), 1.91-1.97 (m, 12H), 1.57-1.59 (m, 12H), 1.35-1.43 (m, 24H), 0.89-0.96 (m, 18H). ¹³C NMR (100MHz, CDCl₃): 149.2, 149.1, 148.8, 148.4, 147.8, 128.8, 126.0, 125.4, 125.3, 125.2, 124.1, 123.8, 123.7, 119.1, 111.9, 109.8, 108.6, 107.0, 106.8, 106.7, 69.7, 69.5, 69.3, 69.2, 69.1, 68.8, 31.7, 31.6, 29.4, 29.3, 29.2, 25.9, 25.8, 22.7, 22.6, 14.1, 14.0.



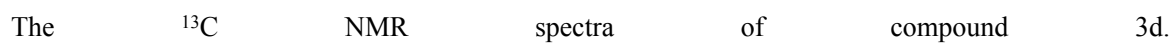
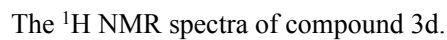
3c



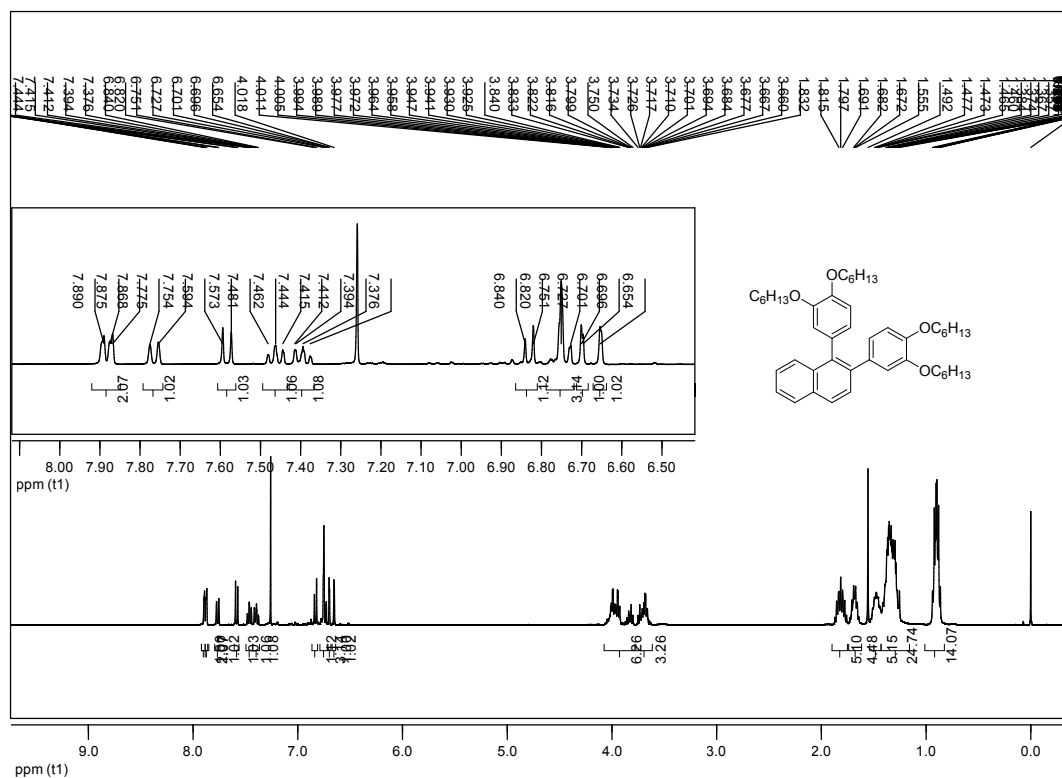
The ¹H NMR spectra of compound 3c.



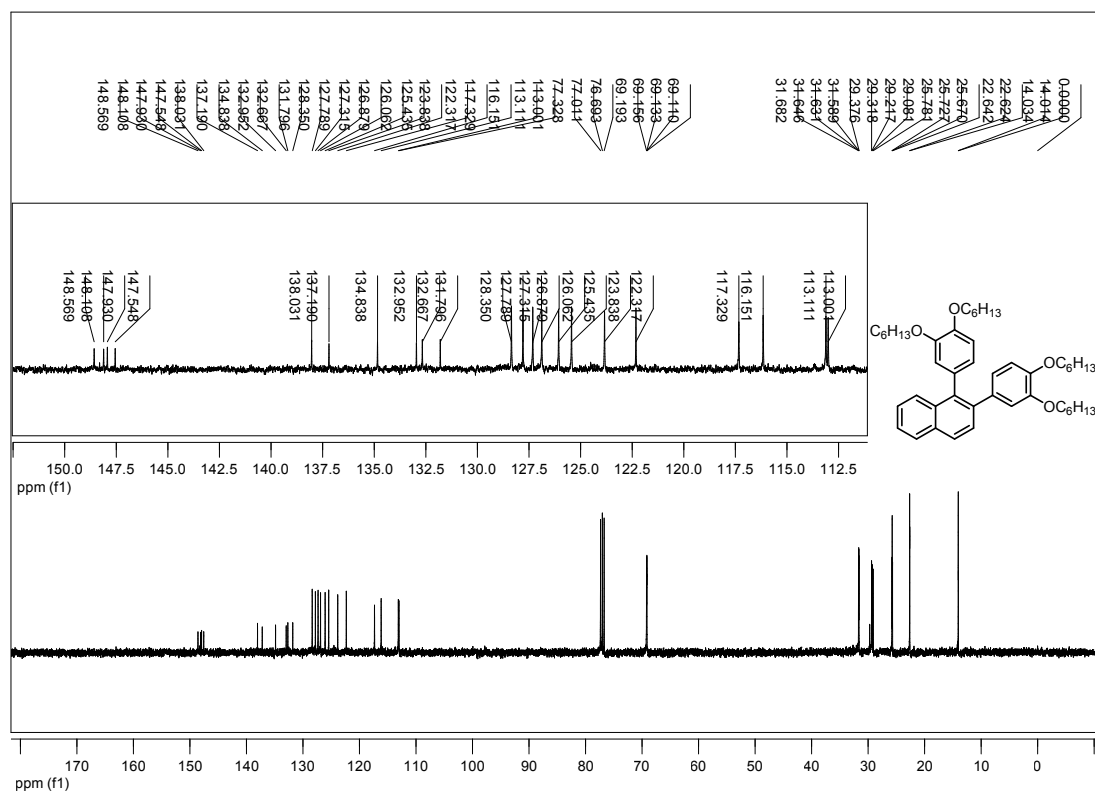
The ¹³C NMR spectra of compound 3c.



3e



The ¹H NMR spectra of compound 3e.



The ¹³C NMR spectra of compound 3e.

Figure 1 displays the ^1H NMR spectra of compound **1**. The top spectrum shows the ^1H NMR in CDCl_3 , with peaks labeled from 7.428 to 1.426 ppm. The bottom spectrum shows the ^1H NMR in $\text{DMSO}-d_6$, with peaks labeled from 13.0 to -1.0 ppm. The chemical structure of compound **1** is shown in the middle, featuring a central biphenyl system with various substituents including a methoxy group, a hexadecyloxy group, and a 4,4'-bis(hexadecyloxy)phenylene group.

¹H NMR (400 MHz, CDCl₃)

Chemical shifts (ppm): 7.567, 7.589, 7.611, 6.968, 6.968, 5.4124, 3.0671, 3.0699, 3.0653, 2.8681, 2.8366, 2.8295, 2.8193, 2.792, 2.755, 2.666, 2.610, 2.550, 2.464, 2.452, 2.394, 1.299, 0.000.

¹³C NMR (100 MHz, CDCl₃)

Chemical shifts (ppm): 156.797, 147.574, 147.043, 146.770, 146.489, 137.570, 135.089, 133.016, 133.017, 128.296, 127.189, 126.05, 125.123, 122.697, 121.241, 116.943, 116.064, 115.084, 112.153, 111.955, 104.354.

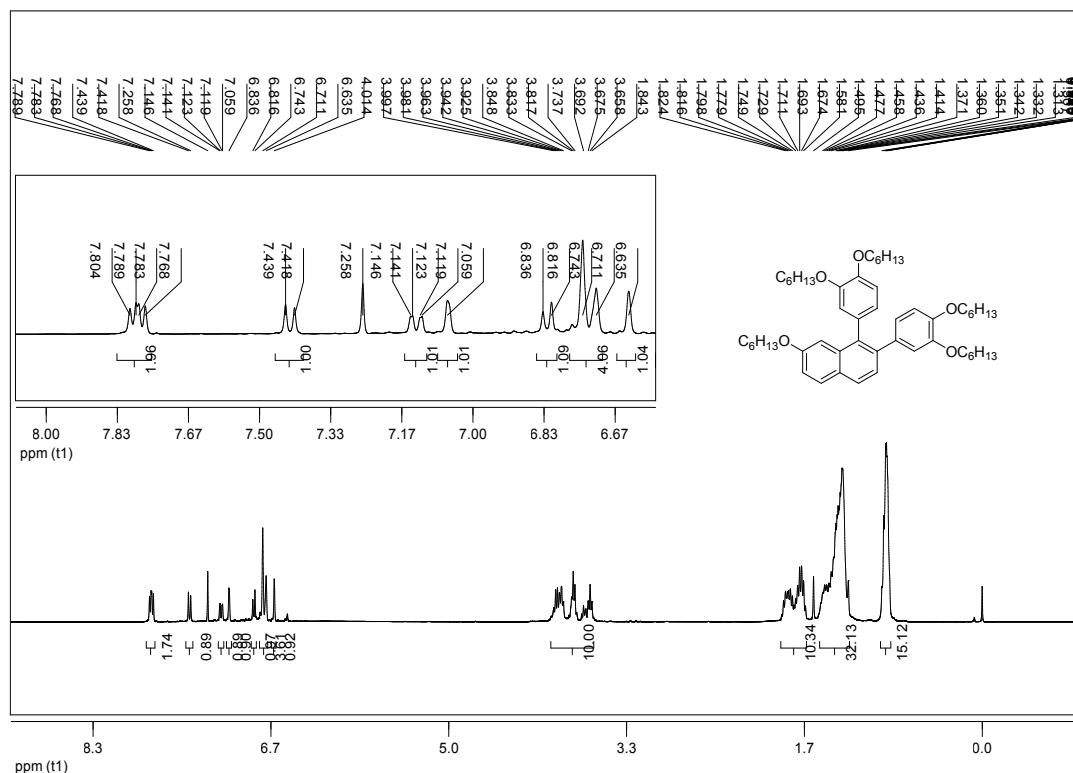
Chemical Structure of Compound 10:

COc1ccc2cc(ccc2c1)C3=CC=C(C=C3)C(=CC=C4C=C(C=C4)COC5=CC=CC=C5)OC6=CC=CC=C6

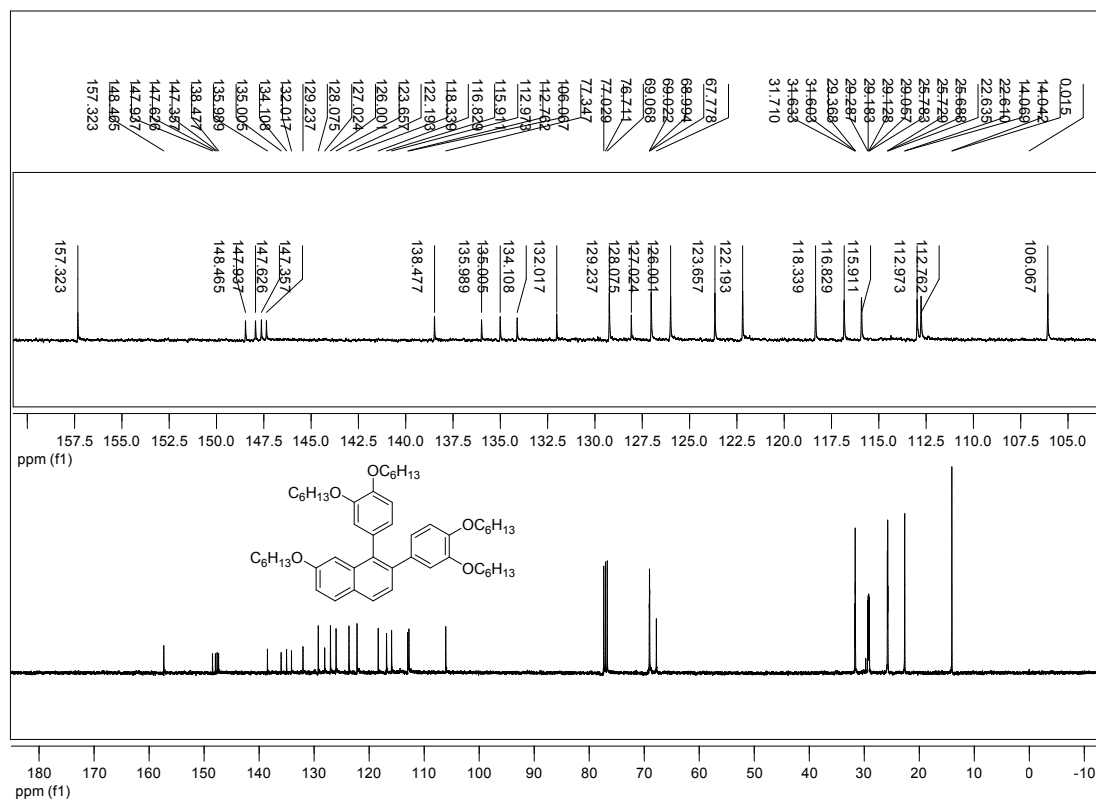
Structure description: 1-(4-(benzyloxy)phenyl)-4-(benzyloxy)-2-methylnaphthalene.

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3g

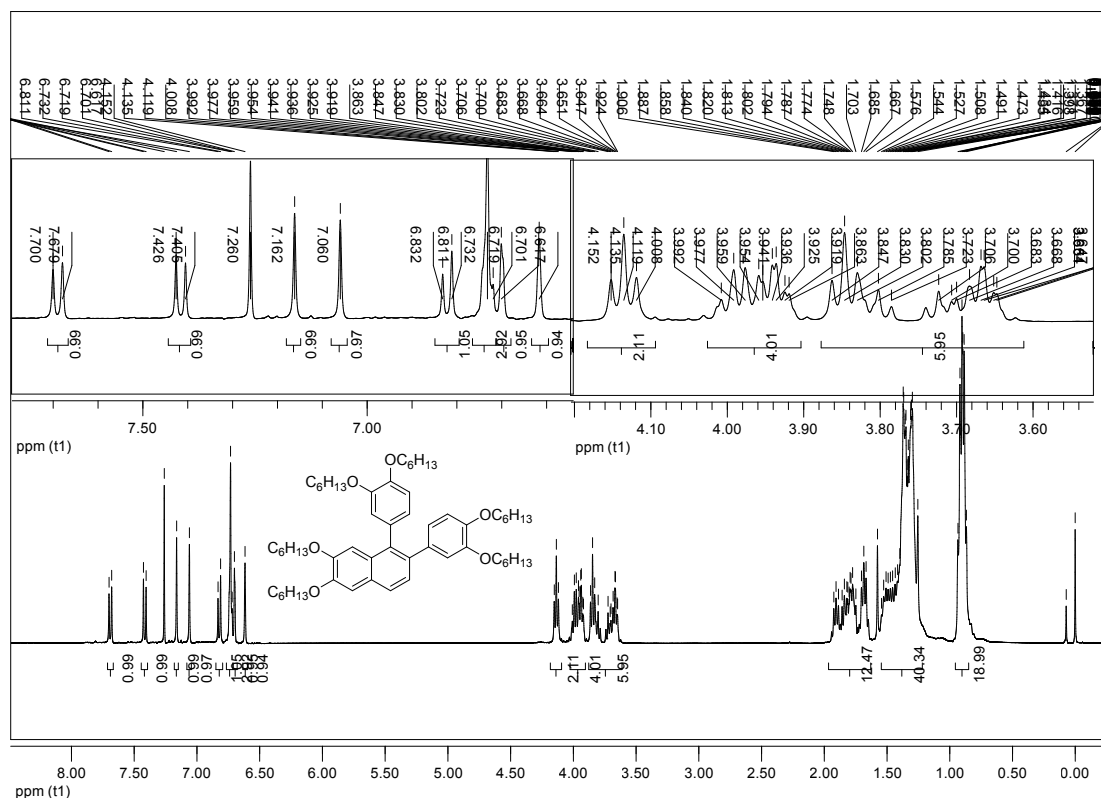


The ¹H NMR spectra of compound 3g.

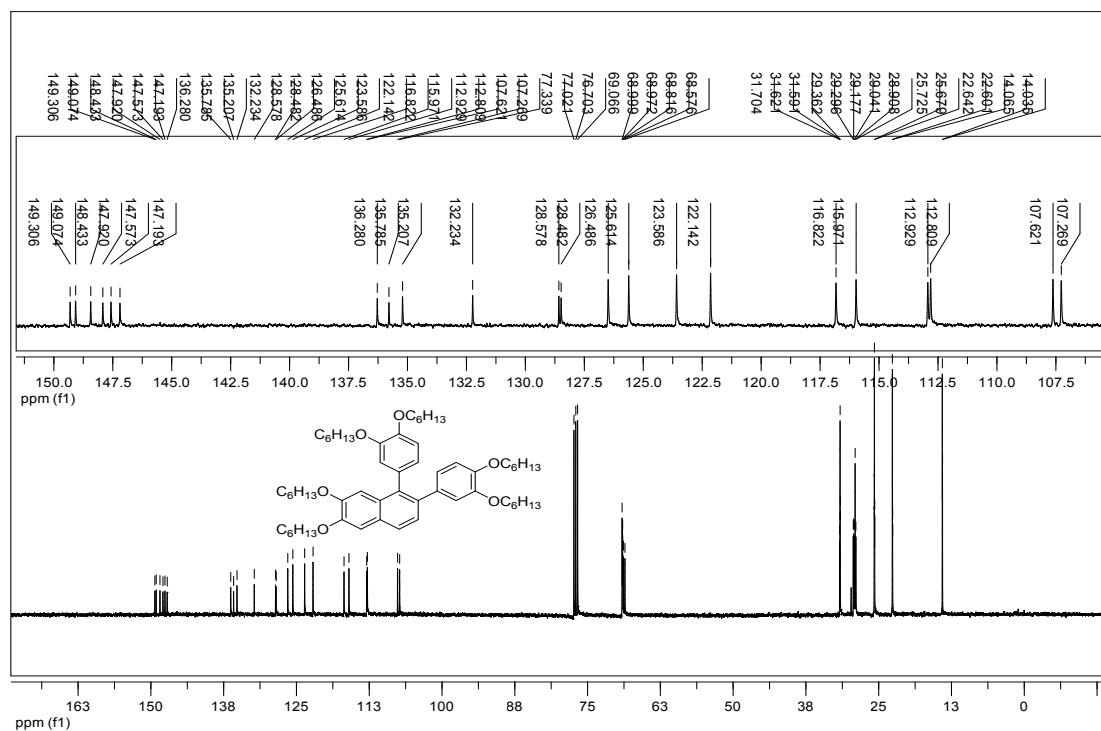


The ¹³C NMR spectra of compound 3g.

3h

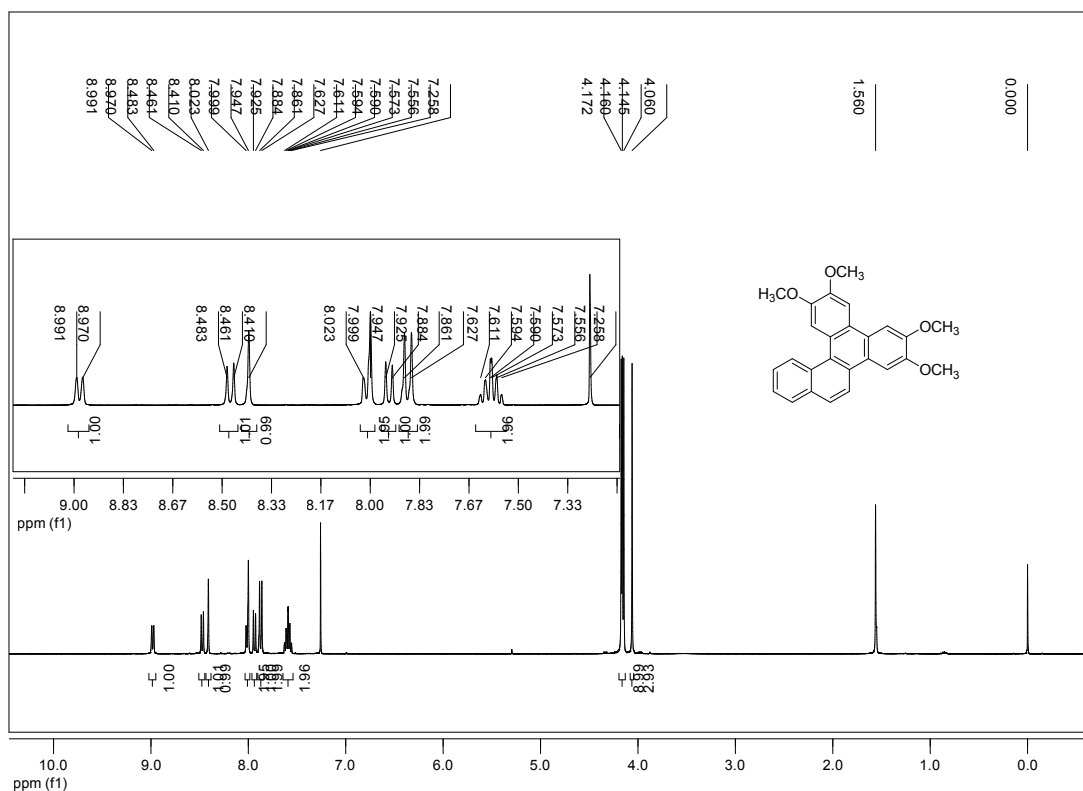


The ¹H NMR spectra of compound 3h.

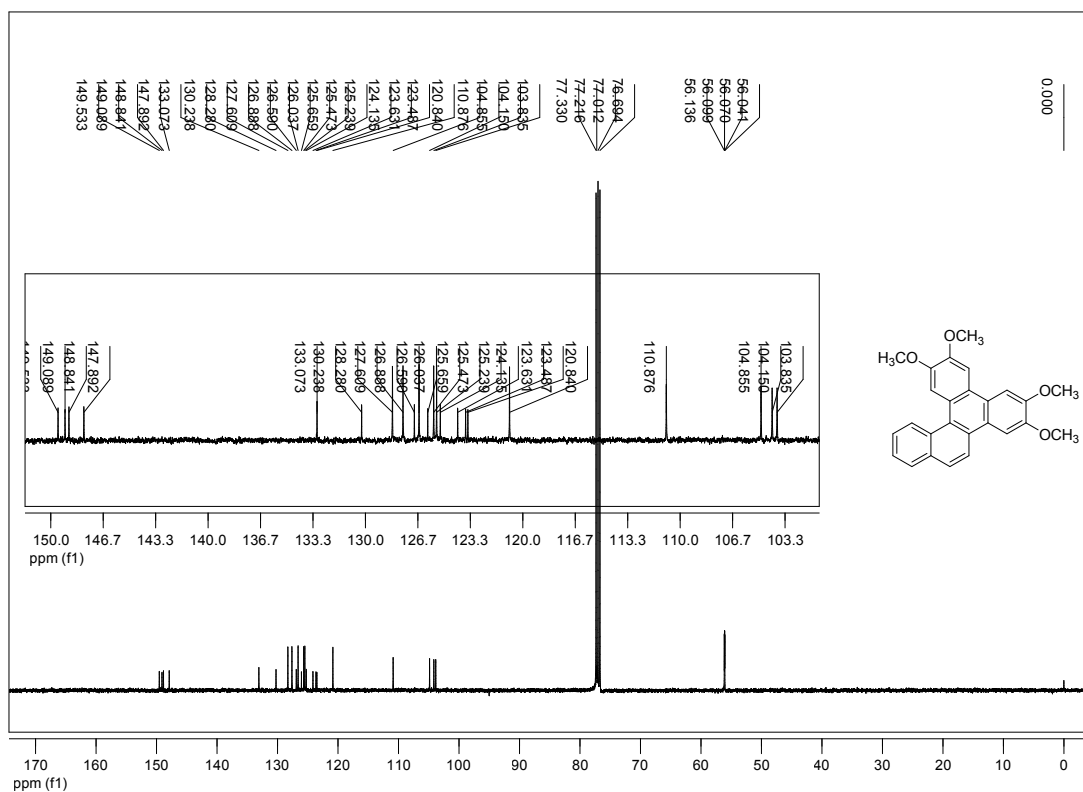


The ¹³C NMR spectra of compound 3h.

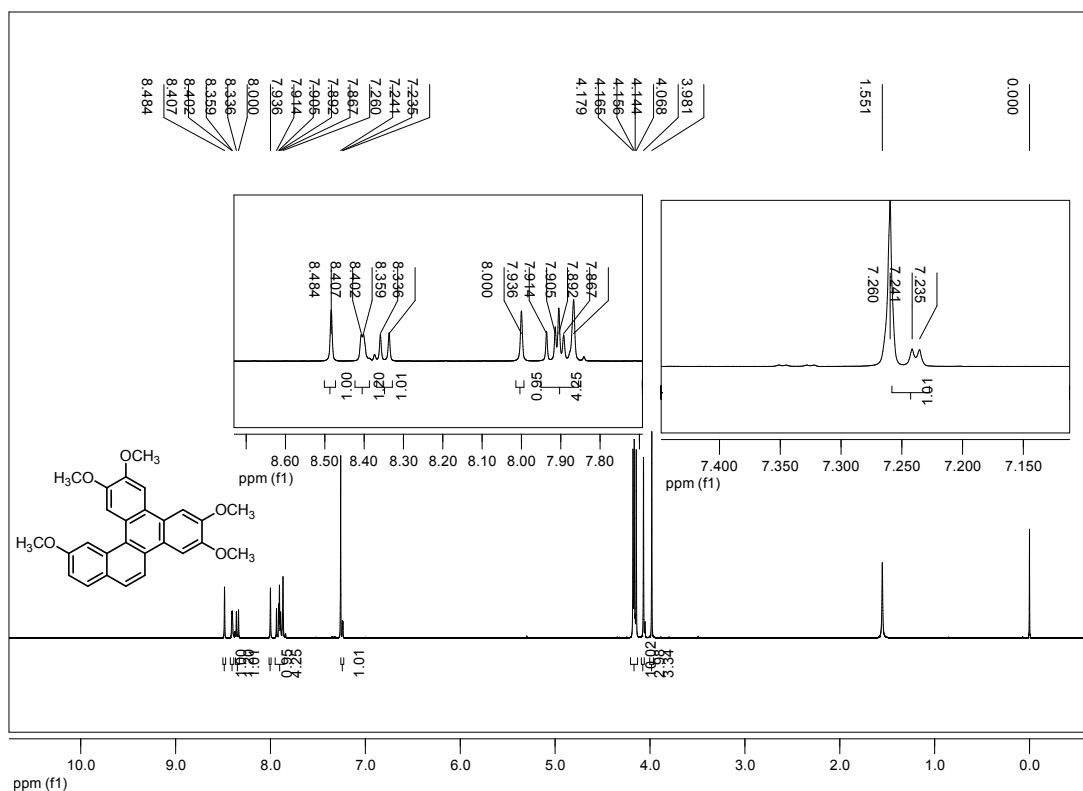
4a (method two)



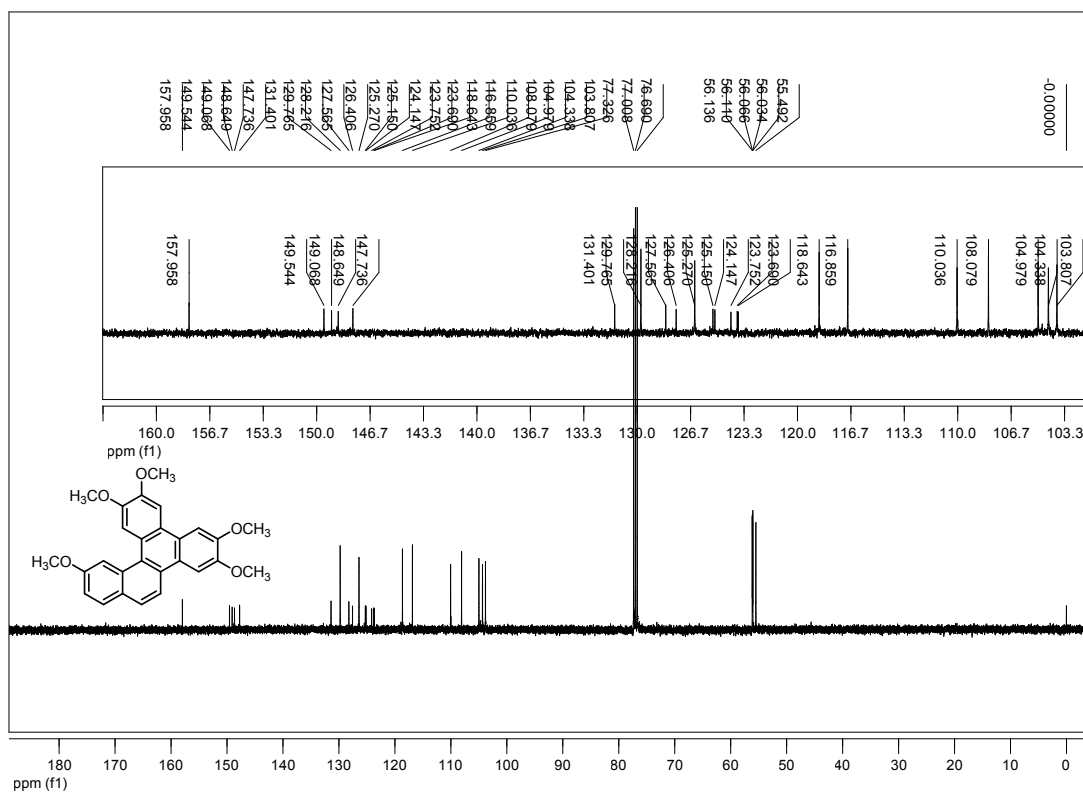
The ^1H NMR spectra of compound 4a which was prepared using method two.



The ^{13}C NMR spectra of compound 4a which was prepared using method two

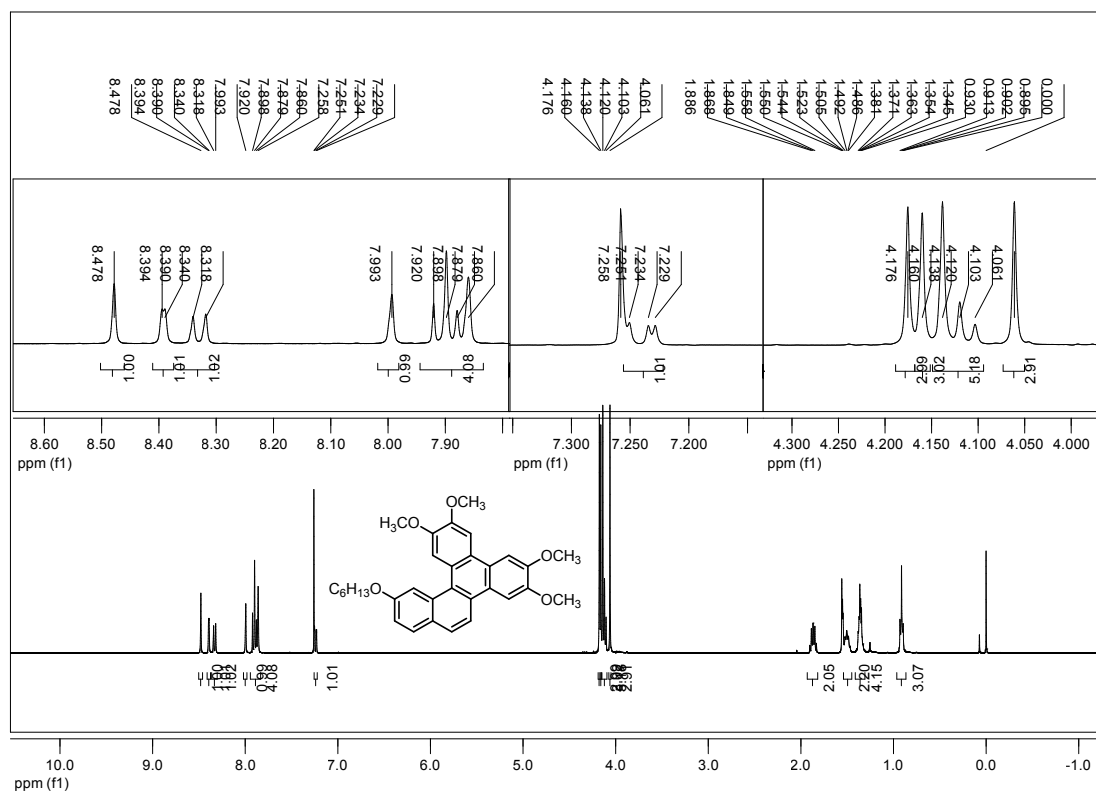


The ¹H NMR spectra of compound 4b which was prepared using method two.

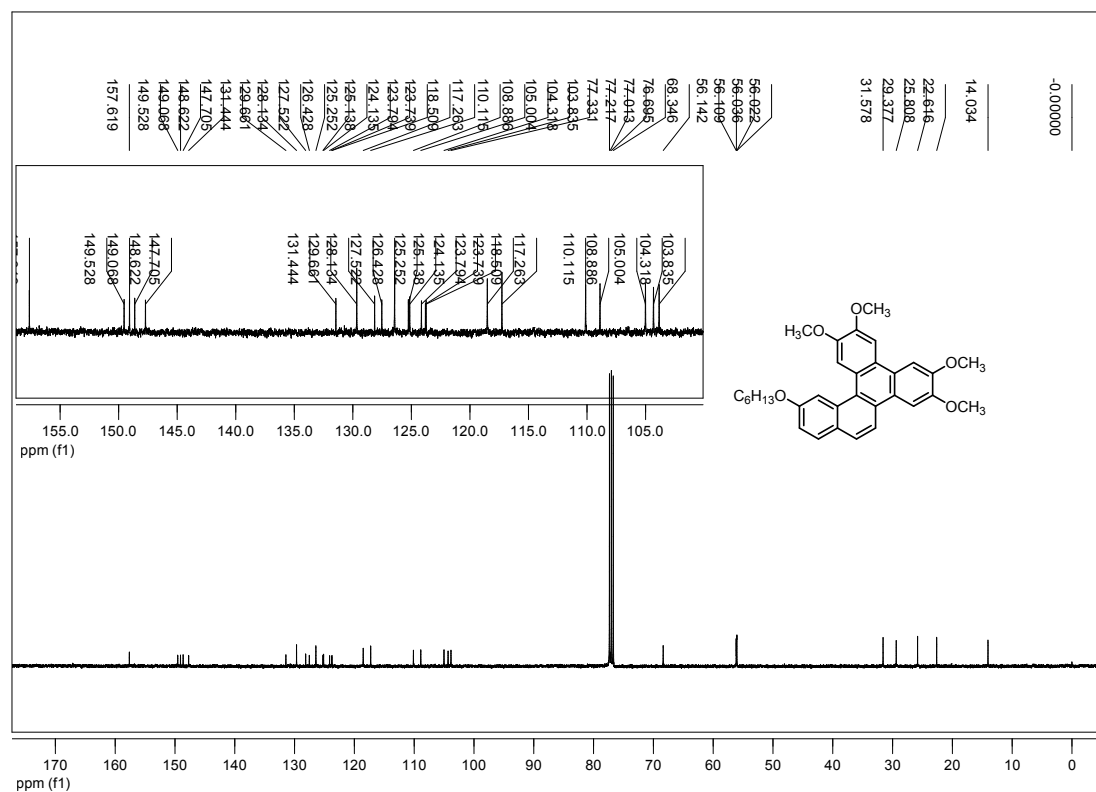


The ^{13}C NMR spectra of compound 4b which was prepared using method two

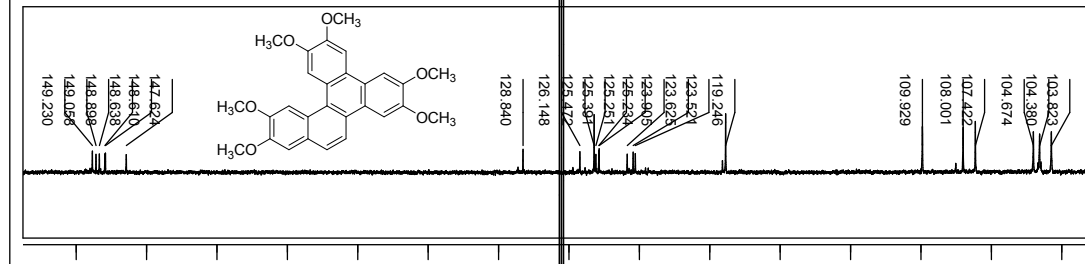
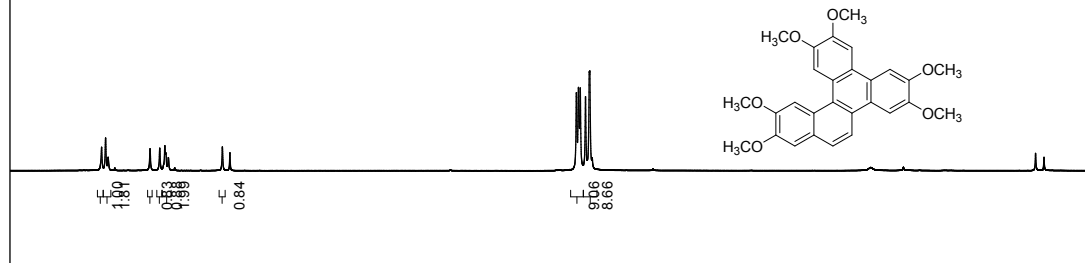
4c (method two)



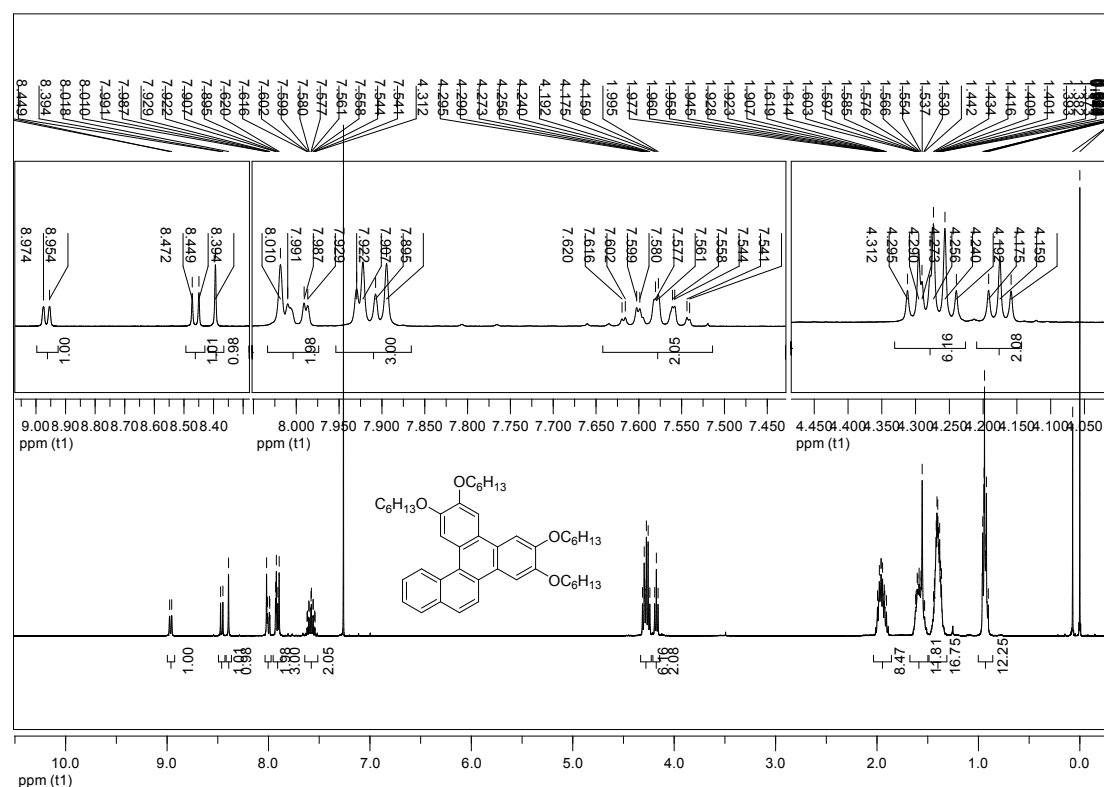
The ¹H NMR spectra of compound 4c which was prepared using method two.



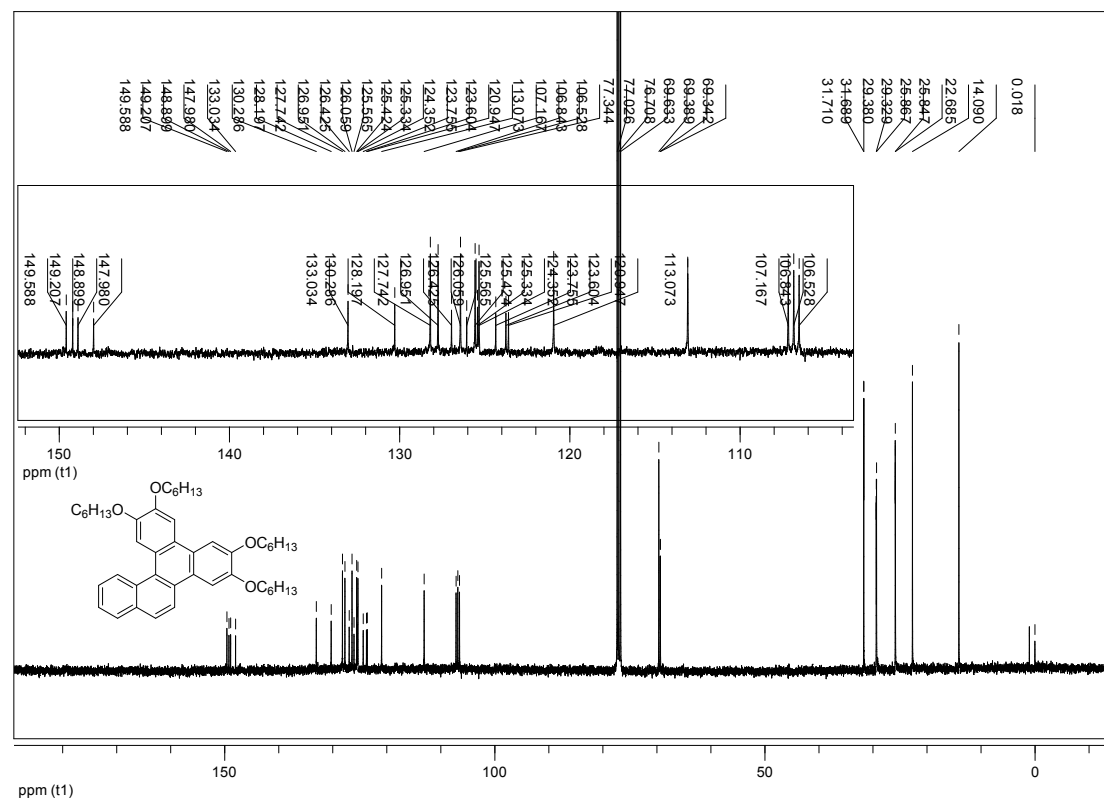
The ^{13}C NMR spectra of compound 4c which was prepared using method two



4e (method two)



The ¹H NMR spectra of compound 4e which was prepared using method two.



The ¹³C NMR spectra of compound 4e which was prepared using method two

Chemical structure of compound 10: COc1ccc2c(c1)c3cc(OC6H13)cc(OC6H13)c3cc2c4ccccc4

¹H NMR spectra of compound 10 in CDCl₃. The top spectrum shows the full range from 0 to 9 ppm. The middle spectrum is an expansion of the aromatic region (7.2–8.6 ppm). The bottom spectrum is an expansion of the aliphatic region (3.9–4.5 ppm). Integration values are provided below the peaks.

Peak Data Summary:

Chemical Shift (ppm)	Integration
0.000	0.00
0.896	0.03
0.912	0.03
0.928	0.03
0.934	0.03
0.956	0.03
1.255	0.17
1.351	0.17
1.366	0.17
1.368	0.17
1.379	0.17
1.387	0.17
1.400	0.17
1.513	0.17
1.533	0.17
1.564	0.17
1.582	0.17
1.593	0.17
1.600	0.17
1.917	0.17
1.938	0.17
1.954	0.17
1.970	0.17
1.990	0.17
3.966	0.03
4.146	0.17
4.163	0.17
4.232	0.17
4.249	0.17
4.269	0.17
4.306	0.17
7.260	0.03
7.863	0.17
7.882	0.17
7.891	0.17
7.917	0.17
8.005	0.17
8.311	0.17
8.334	0.17
8.385	0.17
8.463	0.17

Chemical structure of 1-methoxy-2,3-bis(13-methoxyphenyl)anthracene is shown. The structure is labeled with $\text{C}_6\text{H}_{13}\text{O}$, OC_6H_{13} , H_3CO , and C_6H_5 groups.

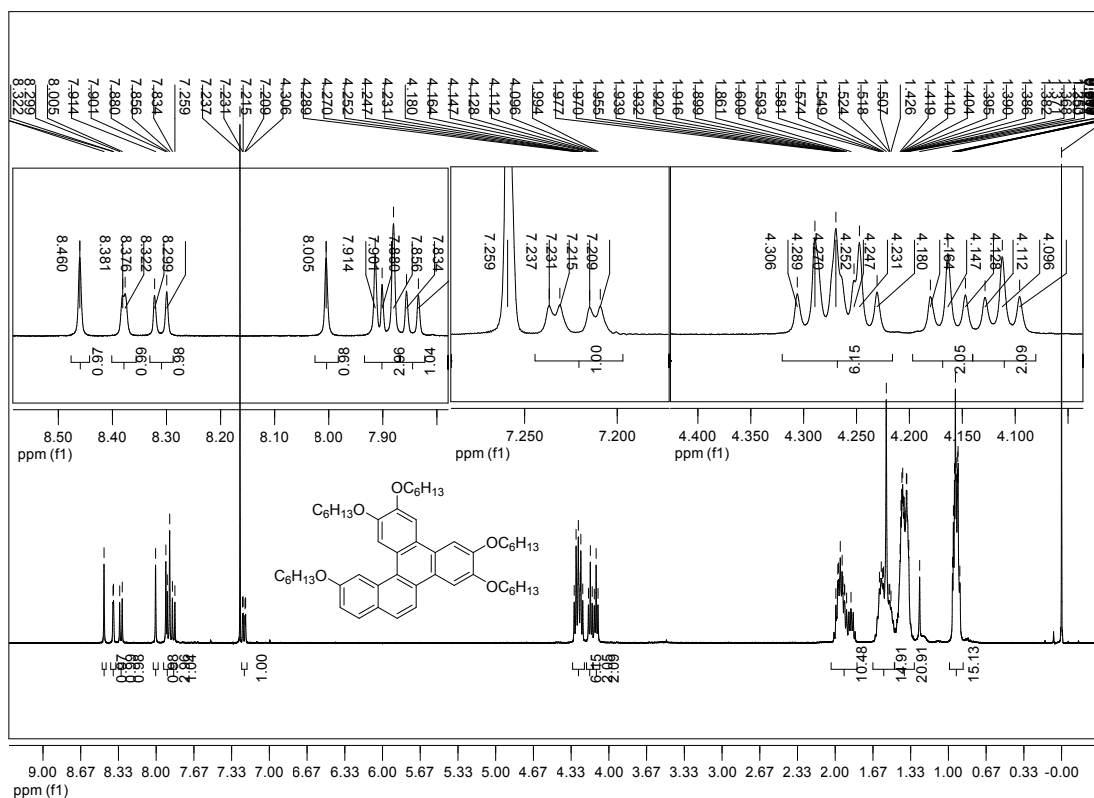
^{13}C NMR spectrum (ppm (f1)) showing peaks from 157.843 to 14.052. The spectrum is divided into two regions: 150-160 ppm and 10-150 ppm.

Peak list (ppm):

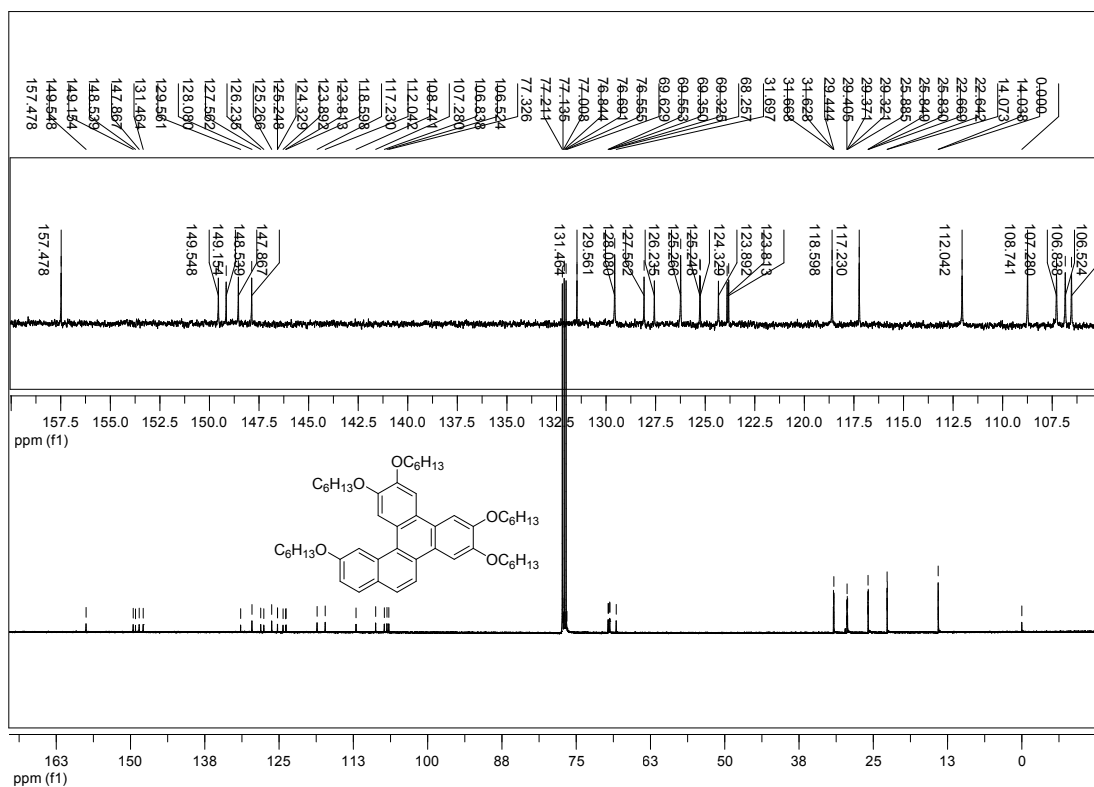
- 157.843
- 149.603
- 149.194
- 148.647
- 147.943
- 129.656
- 129.313
- 128.879
- 128.647
- 128.196
- 126.414
- 126.215
- 125.313
- 124.367
- 123.879
- 123.606
- 123.373
- 122.800
- 122.538
- 122.324
- 122.158
- 121.964
- 121.738
- 121.582
- 121.385
- 121.185
- 120.985
- 120.770
- 120.570
- 118.824
- 118.738
- 118.600
- 118.484
- 118.384
- 118.284
- 118.184
- 118.084
- 117.984
- 117.884
- 117.784
- 117.684
- 117.584
- 117.484
- 117.384
- 117.284
- 117.184
- 117.084
- 116.984
- 116.884
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- 116.584
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- 93.384
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- 90.084
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- 89.584
- 89.484
- 89.384
- 89.284
- 89.184
<

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4g (method two)



The ¹H NMR spectra of compound 4g which was prepared using method two.



The ¹³C NMR spectra of compound 4g which was prepared using method two

¹H NMR spectrum of compound 10 in CDCl₃. The spectrum shows peaks from 0 to 9 ppm. Aromatic and alkene protons appear between 7.3 and 8.5 ppm. Alkyl protons from the hexyloxy chains appear between 1.2 and 2.0 ppm. Integration values are provided below the peaks.

Chemical structure of compound 10 is shown, featuring a central benzene ring substituted with four hexyloxy groups (C₆H₁₃O).

Peak list (ppm): 8.401, 8.350, 8.329, 8.306, 7.980, 7.905, 7.884, 7.873, 7.862, 7.803, 7.784, 7.762, 7.744, 7.674, 7.650, 7.626, 7.601, 7.577, 7.553, 7.529, 7.505, 7.481, 7.457, 7.433, 7.409, 7.385, 7.361, 7.337, 7.313, 7.289, 7.265, 7.241, 7.217, 7.193, 7.169, 7.145, 7.121, 7.097, 7.073, 7.049, 7.025, 7.001, 6.977, 6.953, 6.929, 6.905, 6.881, 6.857, 6.833, 6.809, 6.785, 6.761, 6.737, 6.713, 6.689, 6.665, 6.641, 6.617, 6.593, 6.569, 6.545, 6.521, 6.497, 6.473, 6.449, 6.425, 6.401, 6.377, 6.353, 6.329, 6.305, 6.281, 6.257, 6.233, 6.209, 6.185, 6.161, 6.137, 6.113, 6.089, 6.065, 6.041, 6.017, 5.993, 5.969, 5.945, 5.921, 5.897, 5.873, 5.849, 5.825, 5.801, 5.777, 5.753, 5.729, 5.705, 5.681, 5.657, 5.633, 5.609, 5.585, 5.561, 5.537, 5.513, 5.489, 5.465, 5.441, 5.417, 5.393, 5.369, 5.345, 5.321, 5.297, 5.273, 5.249, 5.225, 5.201, 5.177, 5.153, 5.129, 5.105, 5.081, 5.057, 5.033, 5.009, 4.985, 4.961, 4.937, 4.913, 4.889, 4.865, 4.841, 4.817, 4.793, 4.769, 4.745, 4.721, 4.697, 4.673, 4.649, 4.625, 4.601, 4.577, 4.553, 4.529, 4.505, 4.481, 4.457, 4.433, 4.409, 4.385, 4.361, 4.337, 4.313, 4.289, 4.265, 4.241, 4.217, 4.193, 4.169, 4.145, 4.121, 4.097, 4.073, 4.049, 4.025, 4.001, 3.977, 3.953, 3.929, 3.905, 3.881, 3.857, 3.833, 3.809, 3.785, 3.761, 3.737, 3.713, 3.689, 3.665, 3.641, 3.617, 3.593, 3.569, 3.545, 3.521, 3.497, 3.473, 3.449, 3.425, 3.401, 3.377, 3.353, 3.329, 3.305, 3.281, 3.257, 3.233, 3.209, 3.185, 3.161, 3.137, 3.113, 3.089, 3.065, 3.041, 3.017, 2.993, 2.969, 2.945, 2.921, 2.897, 2.873, 2.849, 2.825, 2.801, 2.777, 2.753, 2.729, 2.705, 2.681, 2.657, 2.633, 2.609, 2.585, 2.561, 2.537, 2.513, 2.489, 2.465, 2.441, 2.417, 2.393, 2.369, 2.345, 2.321, 2.297, 2.273, 2.249, 2.225, 2.201, 2.177, 2.153, 2.129, 2.105, 2.081, 2.057, 2.033, 2.009, 1.985, 1.961, 1.937, 1.913, 1.889, 1.865, 1.841, 1.817, 1.793, 1.769, 1.745, 1.721, 1.697, 1.673, 1.649, 1.625, 1.601, 1.577, 1.553, 1.529, 1.505, 1.481, 1.457, 1.433, 1.409, 1.385, 1.361, 1.337, 1.313, 1.289, 1.265, 1.241, 1.217, 1.193, 1.169, 1.145, 1.121, 1.097, 1.073, 1.049, 1.025, 1.001, 0.977, 0.953, 0.929, 0.905, 0.881, 0.857, 0.833, 0.809, 0.785, 0.761, 0.737, 0.713, 0.689, 0.665, 0.641, 0.617, 0.593, 0.569, 0.545, 0.521, 0.497, 0.473, 0.449, 0.425, 0.401, 0.377, 0.353, 0.329, 0.305, 0.281, 0.257, 0.233, 0.209, 0.185, 0.161, 0.137, 0.113, 0.089, 0.065, 0.041, 0.017, 0.000.

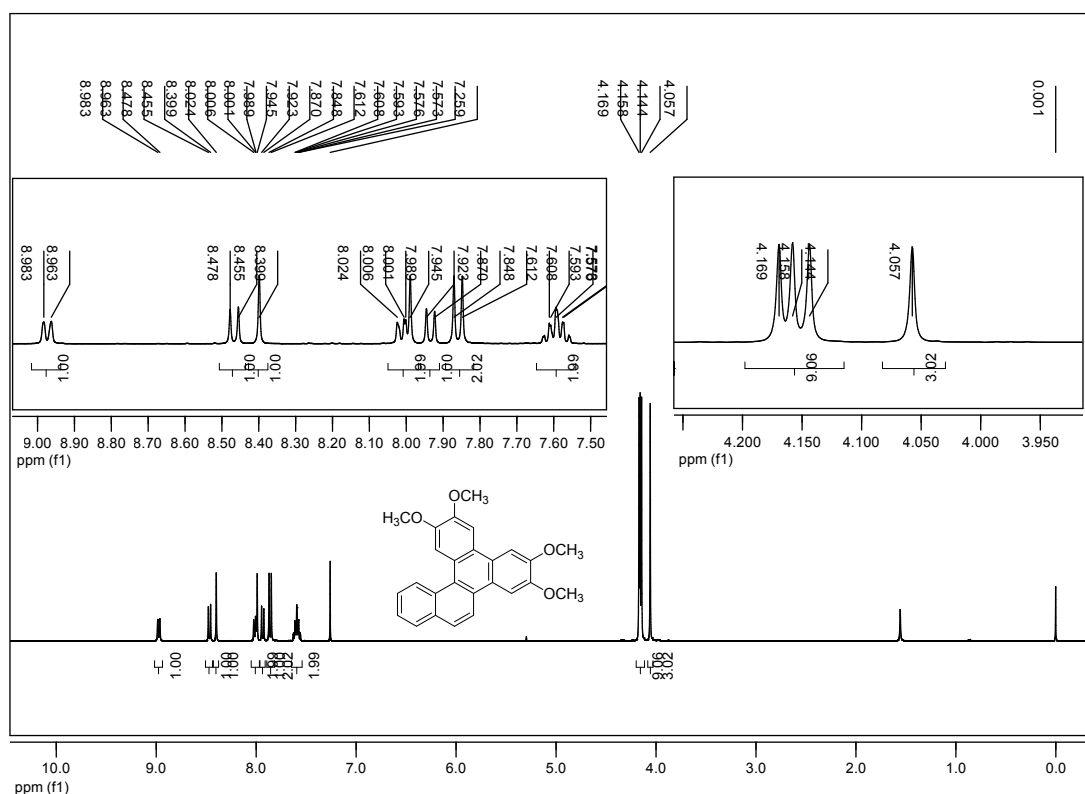
¹H NMR (400 MHz, CDCl₃)

Chemical structure of compound 10 is shown above the spectra. The structure is a central benzene ring substituted with four OC_6H_{13} groups and two $\text{C}_6\text{H}_{13}\text{O}$ groups.

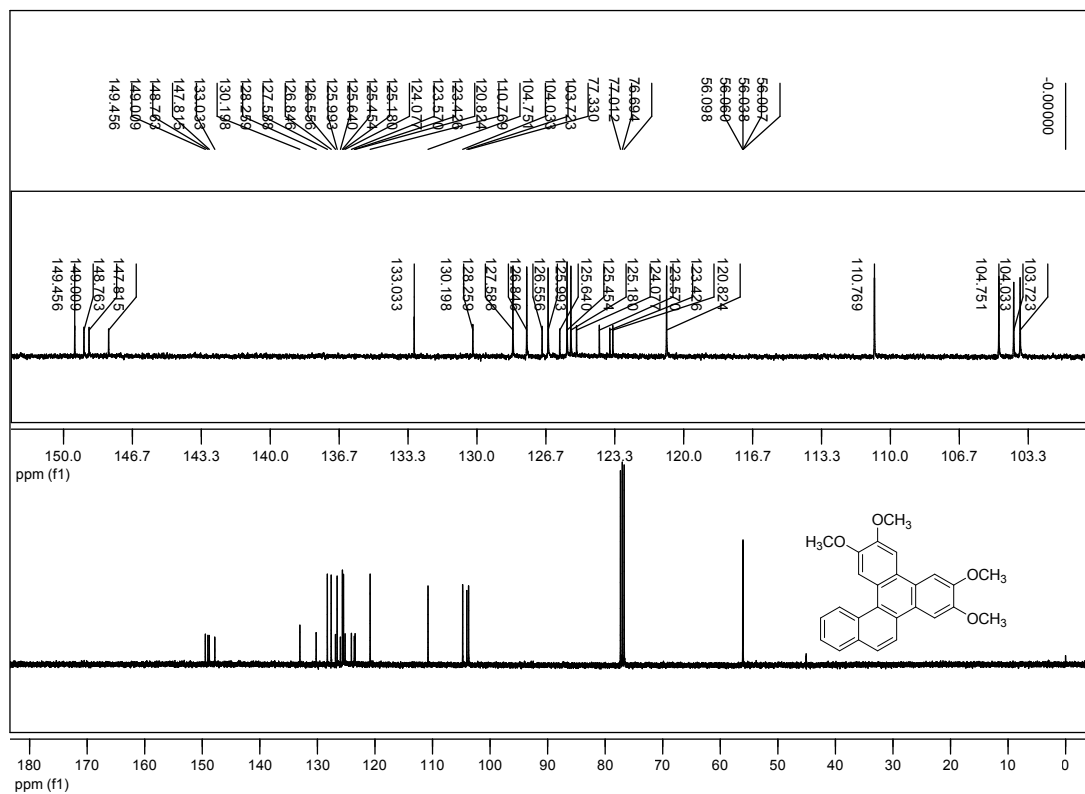
¹³C NMR (100 MHz, CDCl₃)

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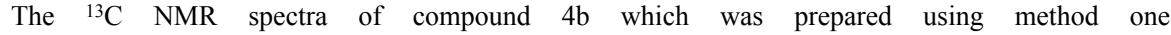
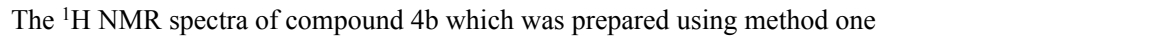
4a (method one)



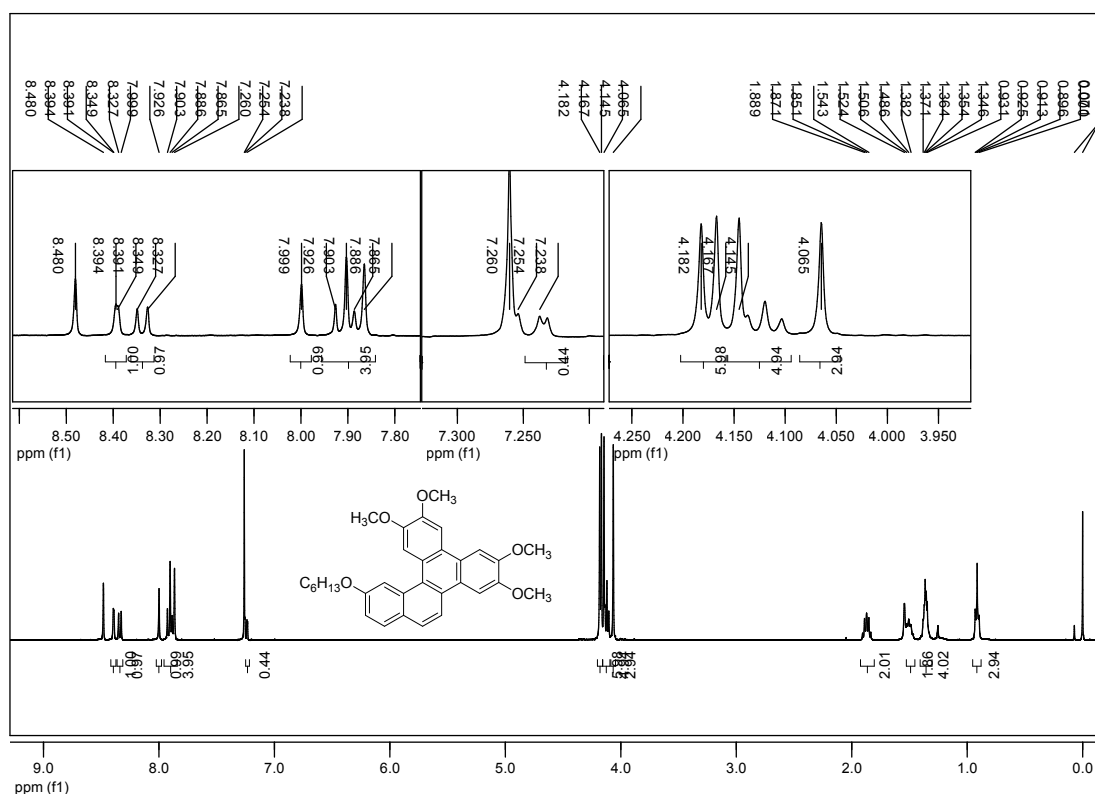
The ¹H NMR spectra of compound 4a which was prepared using method one



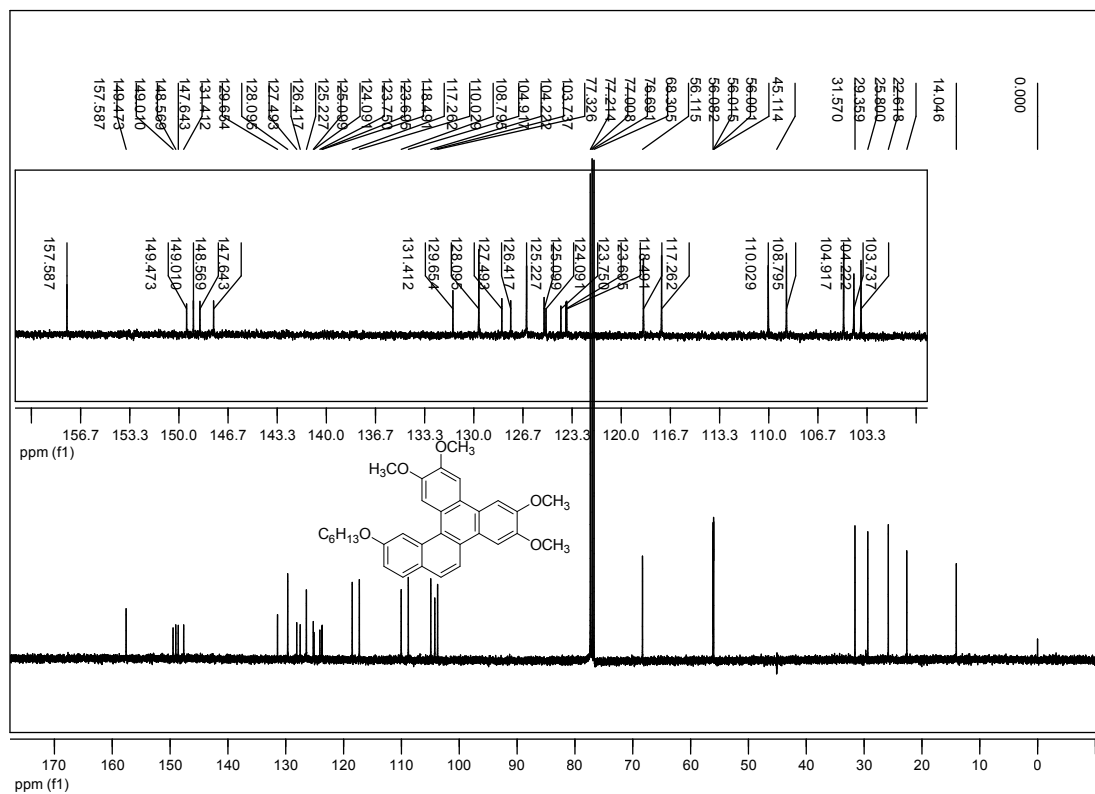
The ¹³C NMR spectra of compound 4a which was prepared using method one



4c (method one)

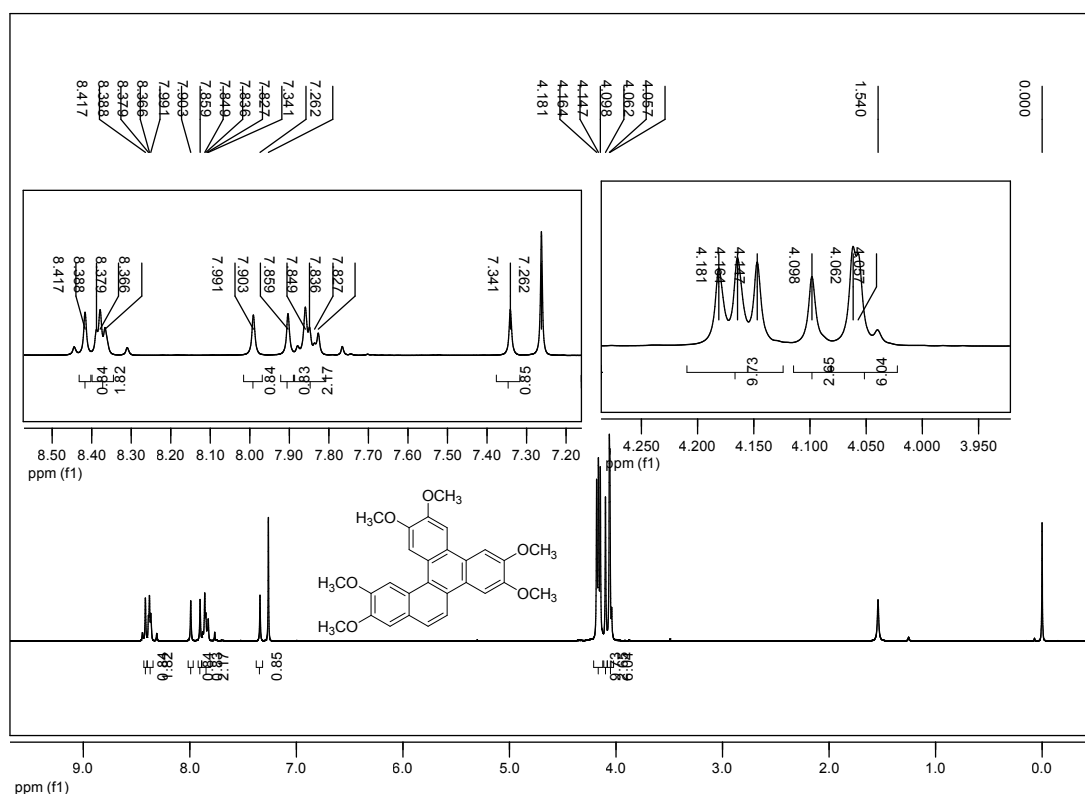


The ¹H NMR spectra of compound 4c which was prepared using method one

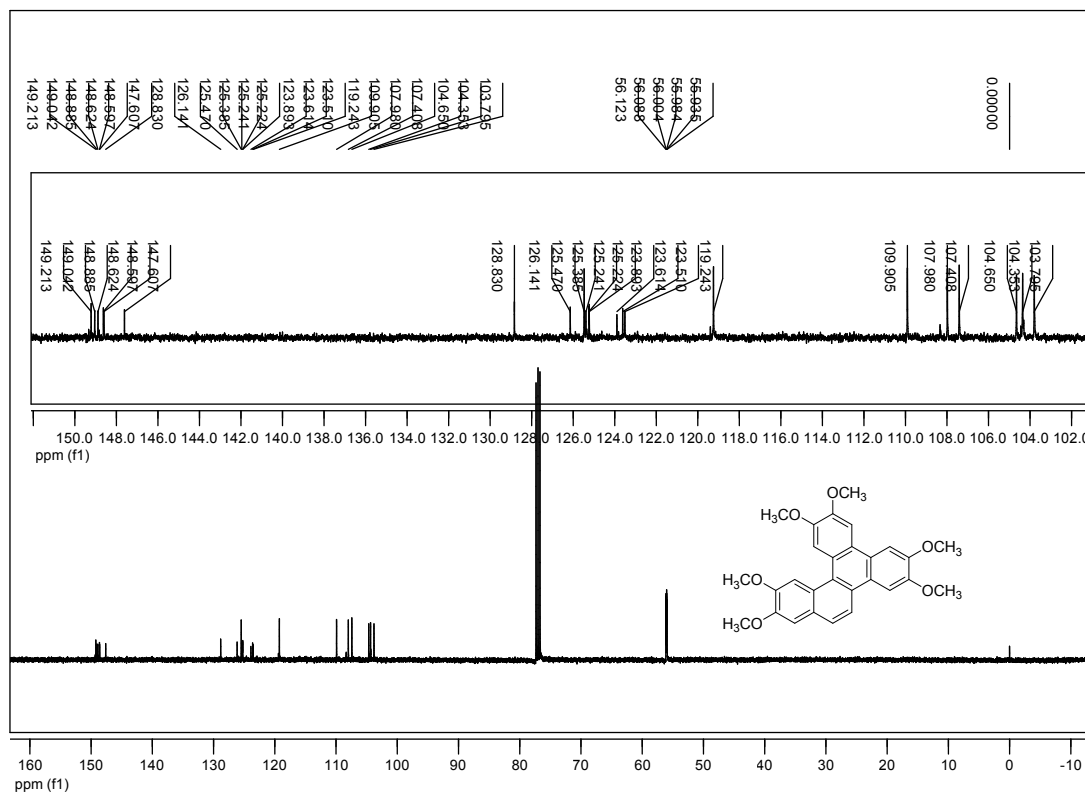


The ¹³C NMR spectra of compound 4c which was prepared using method one

4d (method one)

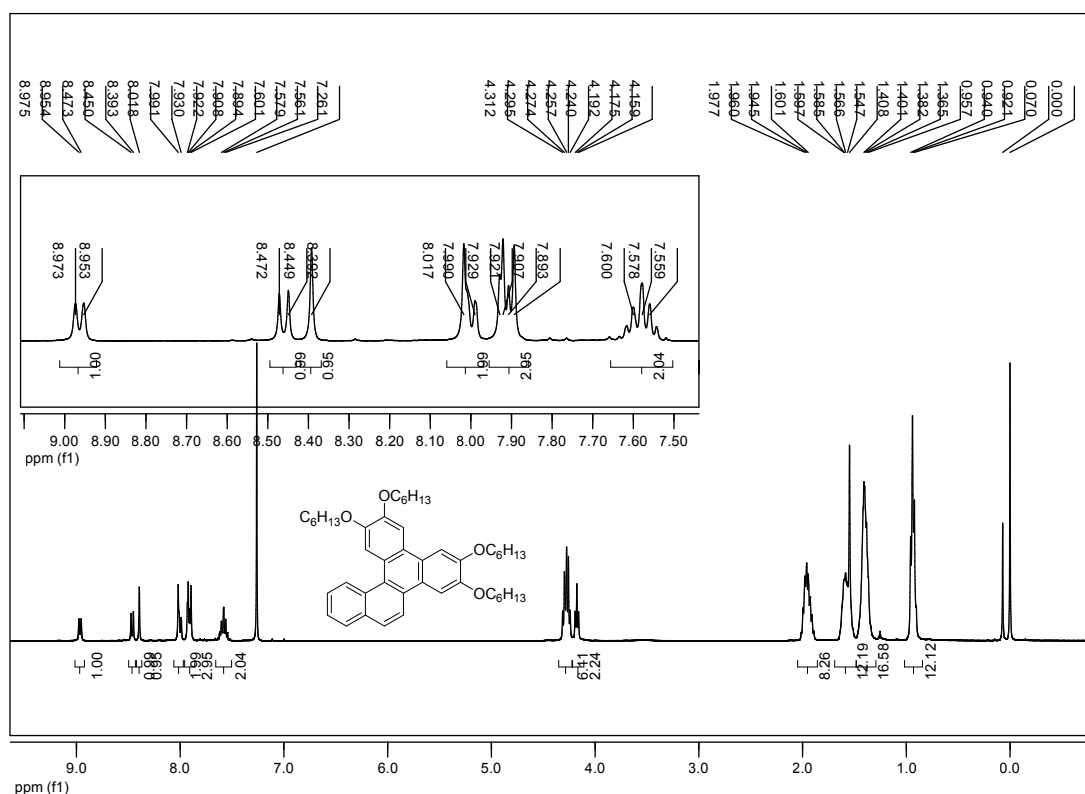


The ¹H NMR spectra of compound 4d which was prepared using method one

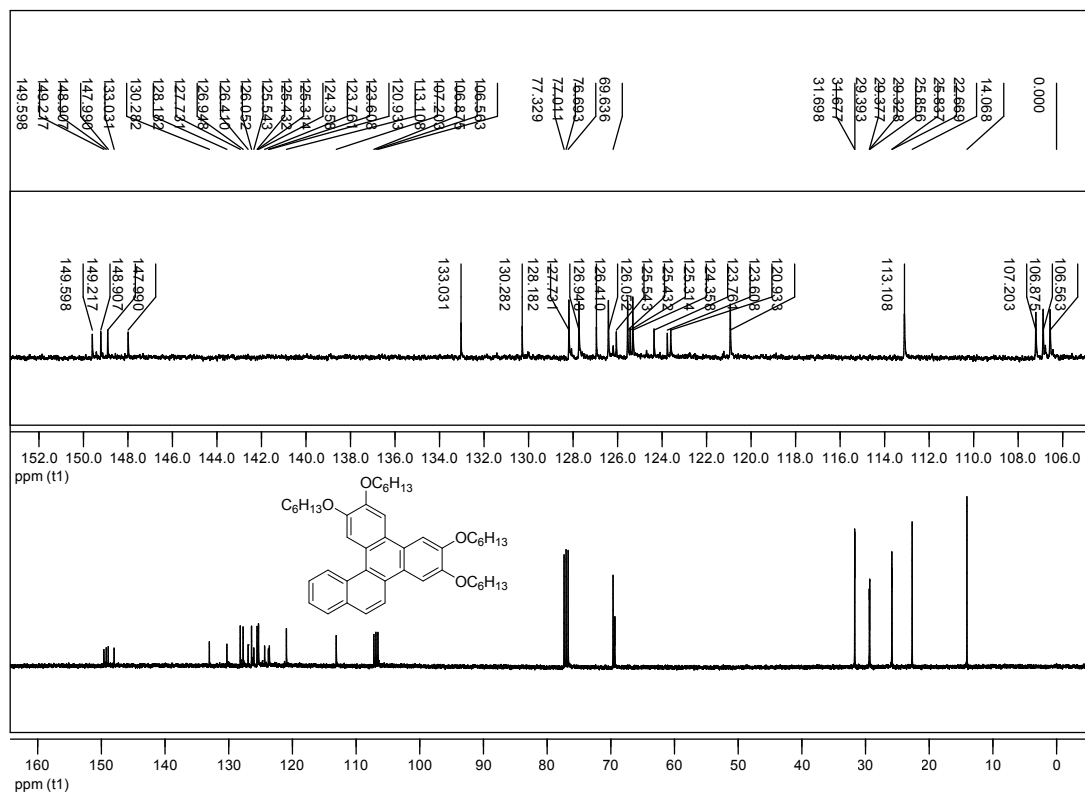


The ¹³C NMR spectra of compound 4d which was prepared using method one

4e (method one)

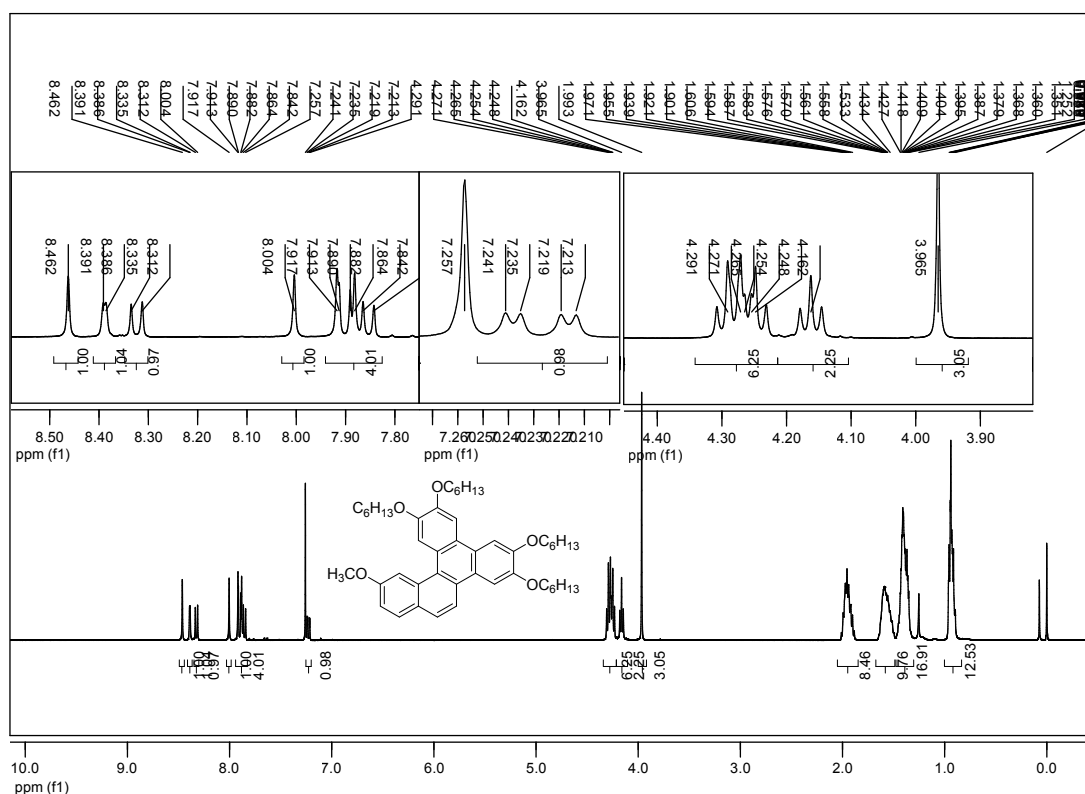


The ¹H NMR spectra of compound 4e which was prepared using method one

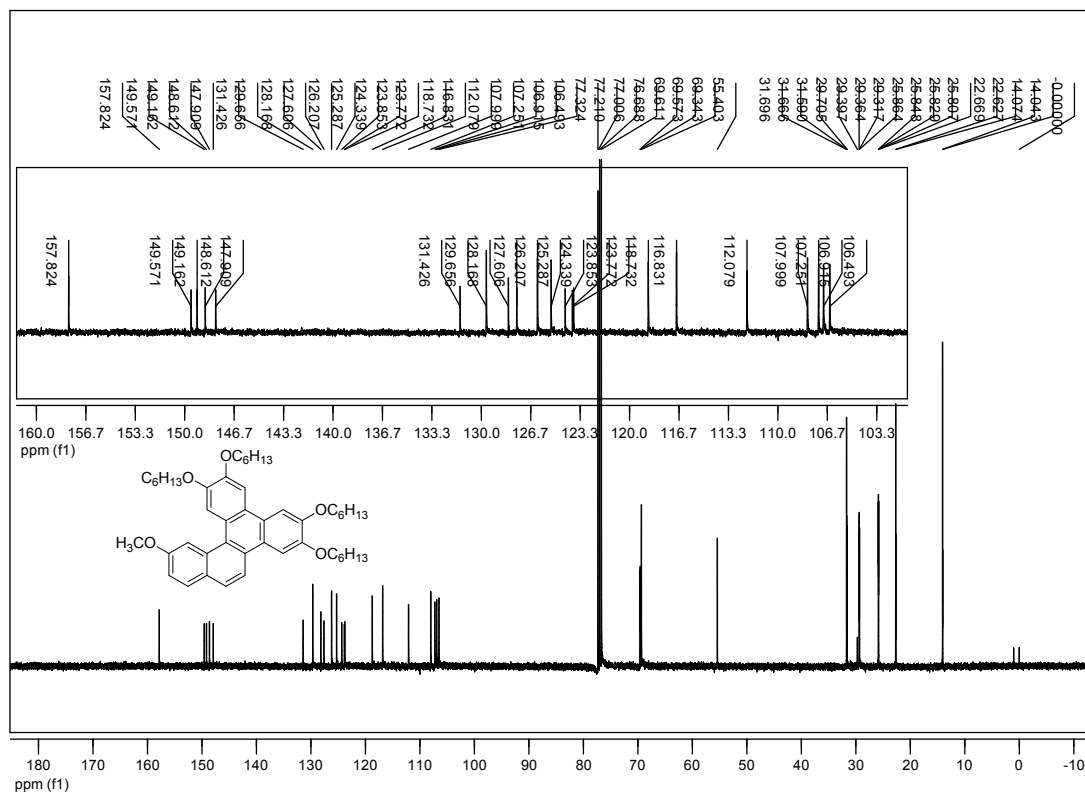


The ^{13}C NMR spectra of compound 4e which was prepared using method one

4f (method one)

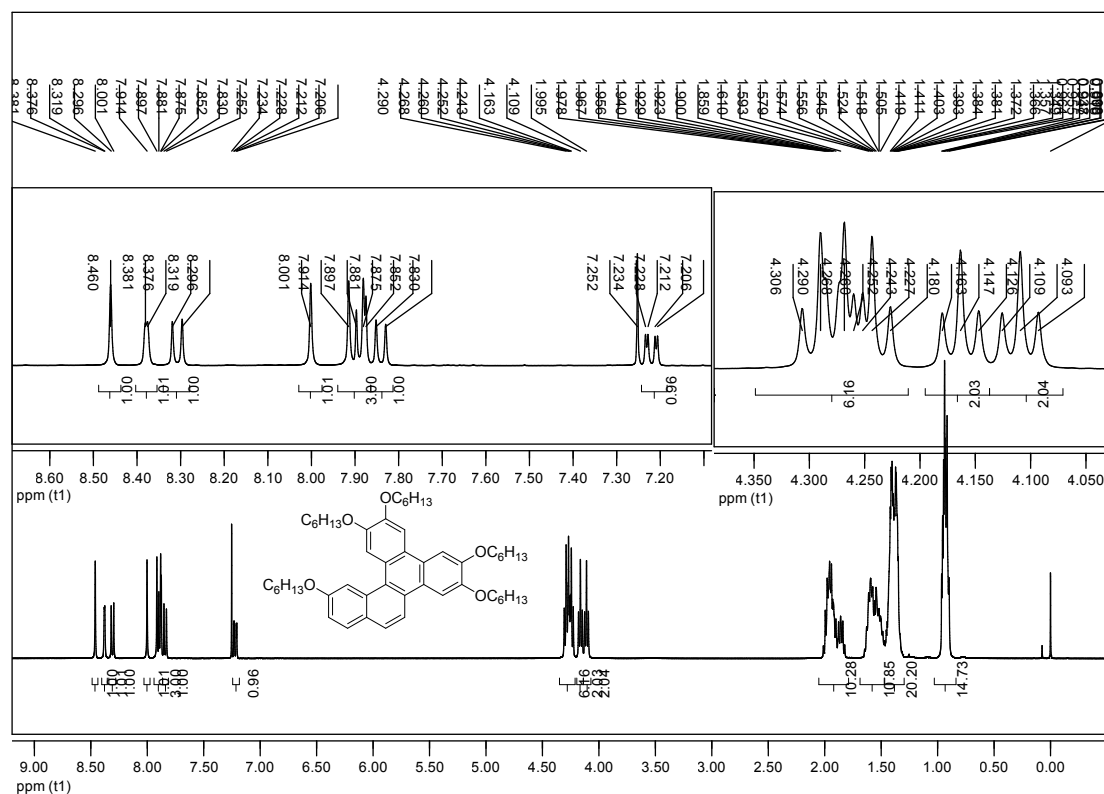


The ¹H NMR spectra of compound 4f which was prepared using method one

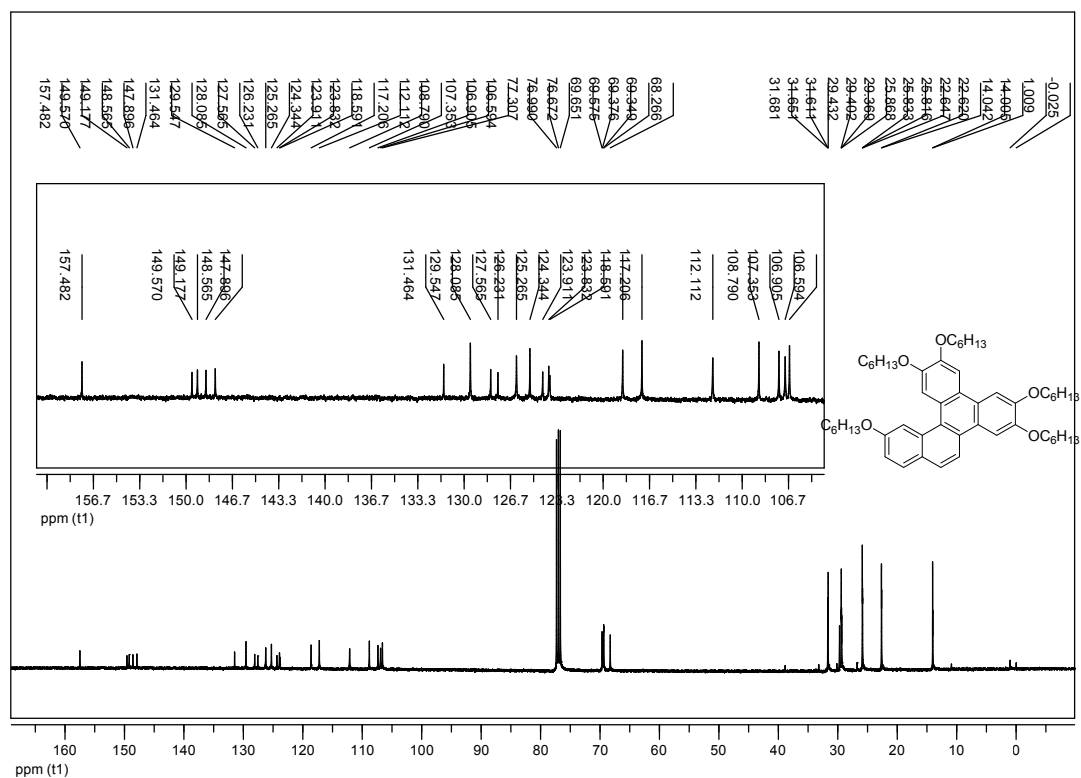


The ¹³C NMR spectra of compound 4f which was prepared using method one

4g (method one)

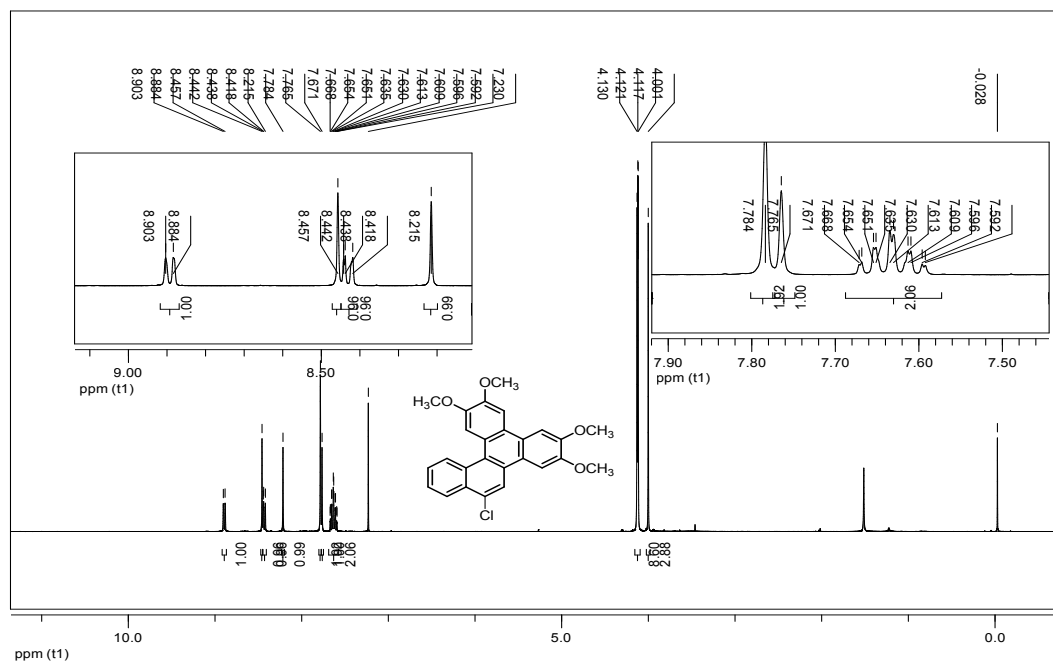


The ¹H NMR spectra of compound 4g which was prepared using method one

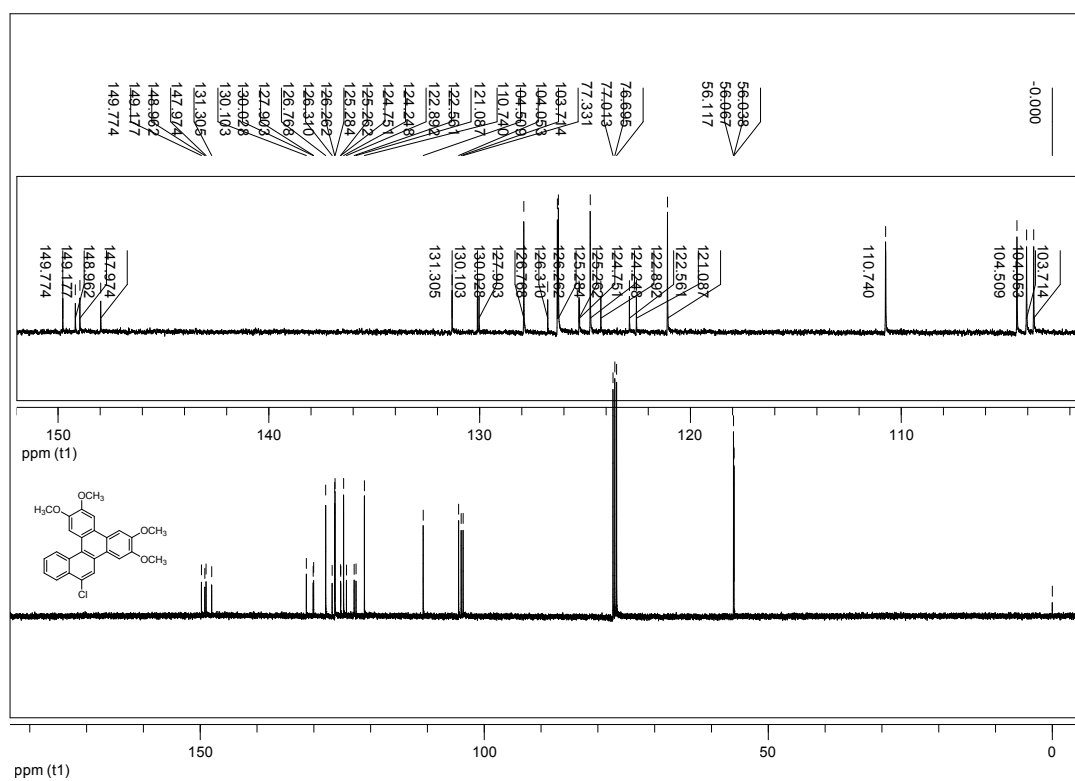


The ^{13}C NMR spectra of compound 4g which was prepared using method one

5a

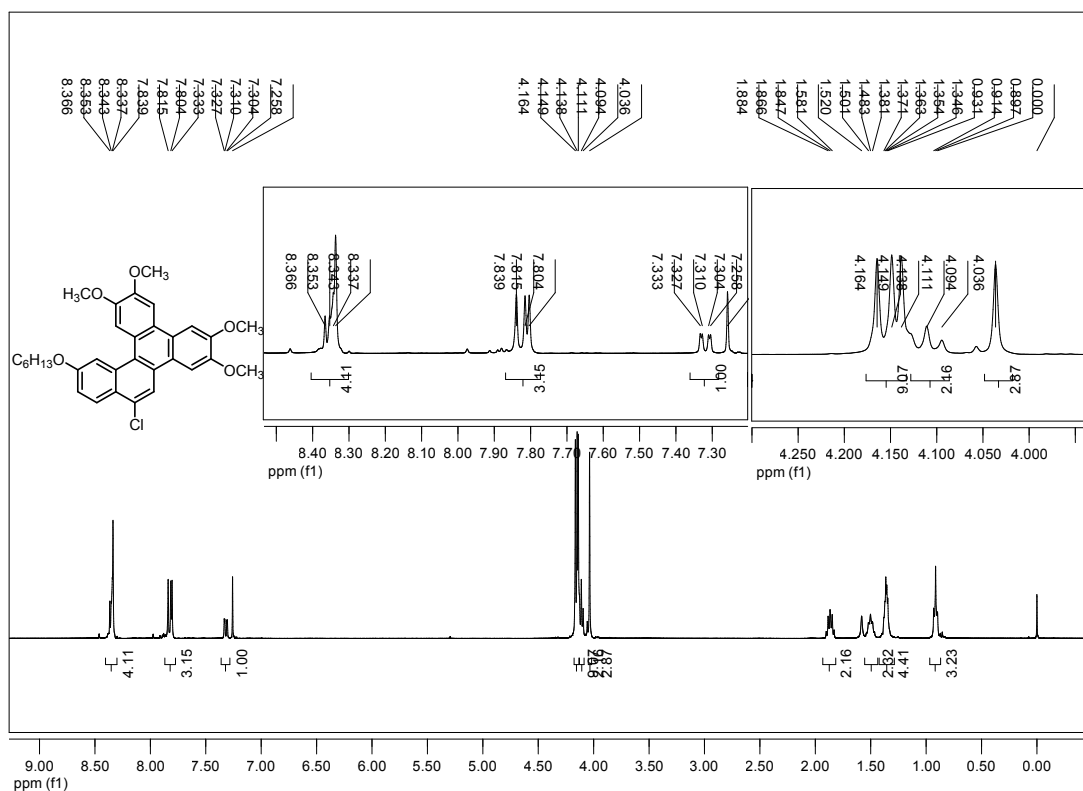


The ^1H NMR spectra of compound 5a.

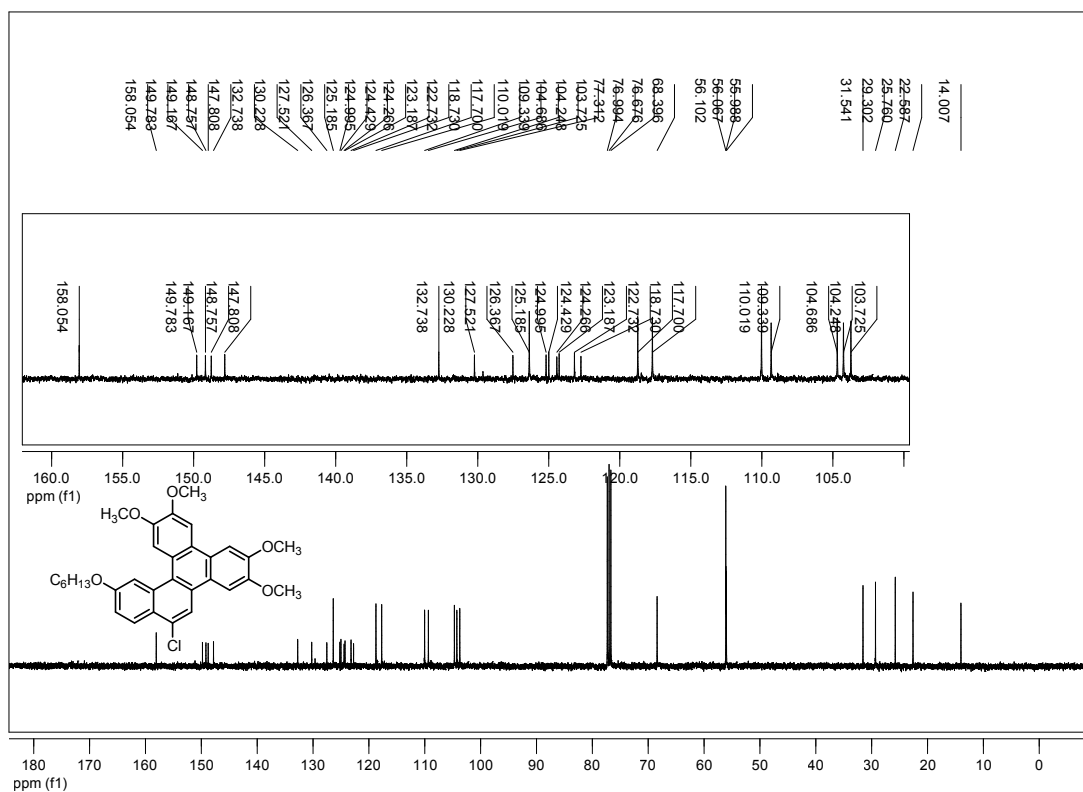


The ^{13}C NMR spectra of compound 5a.

5c

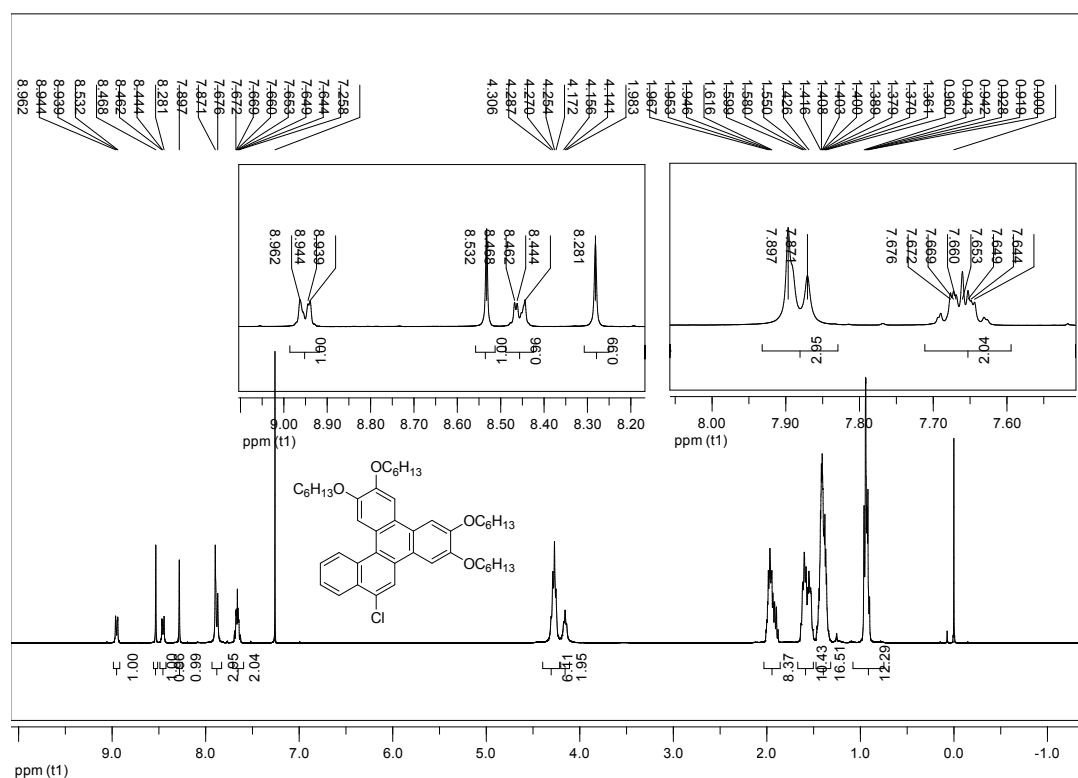


The ¹H NMR spectra of compound 5c.

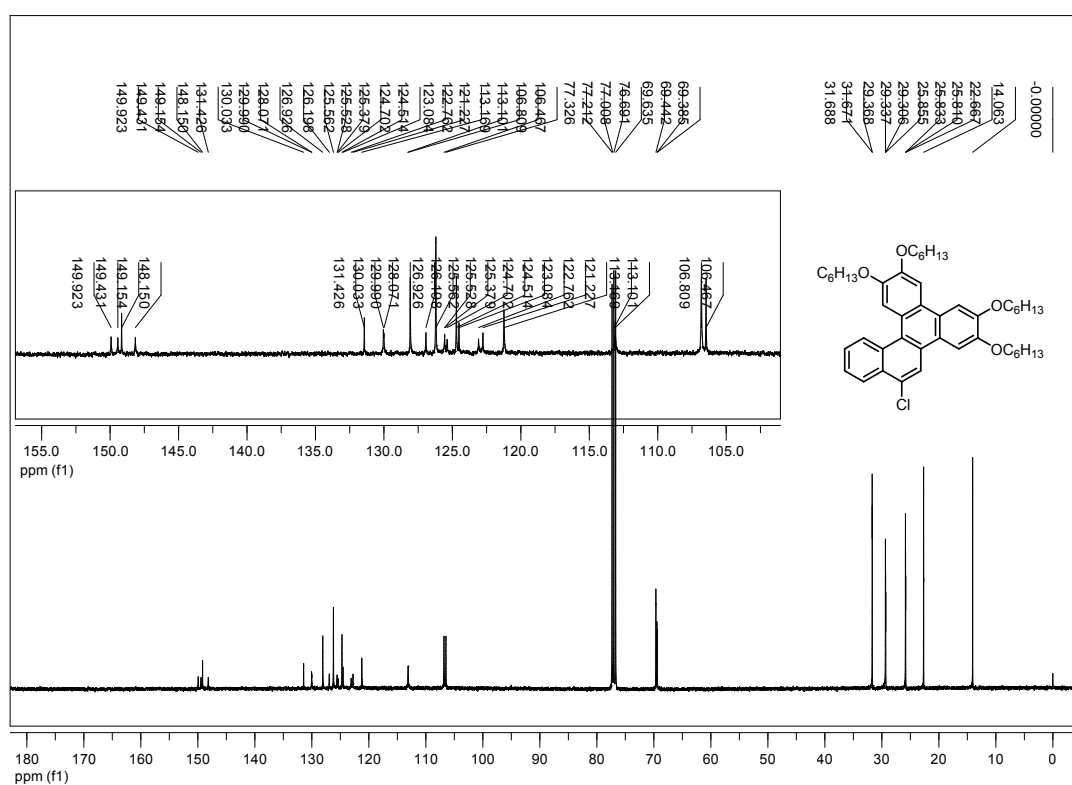


The ¹³C NMR spectra of compound 5c.

5e

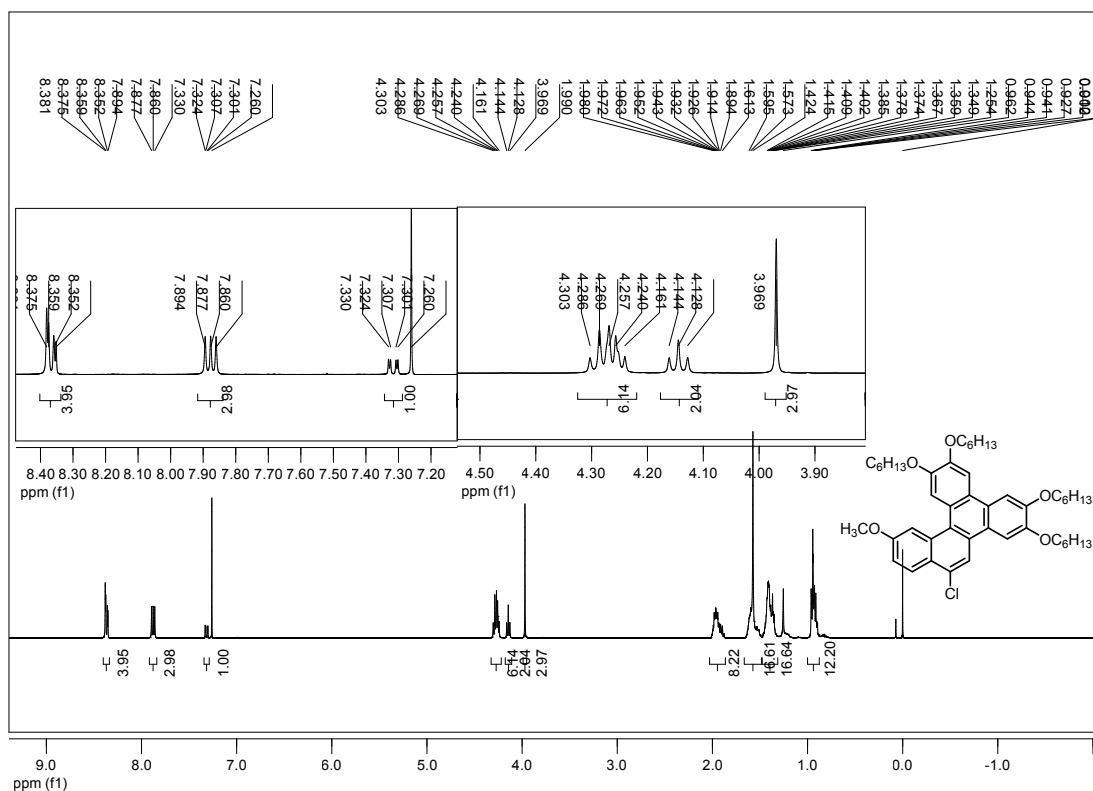


The ¹H NMR spectra of compound 5e.

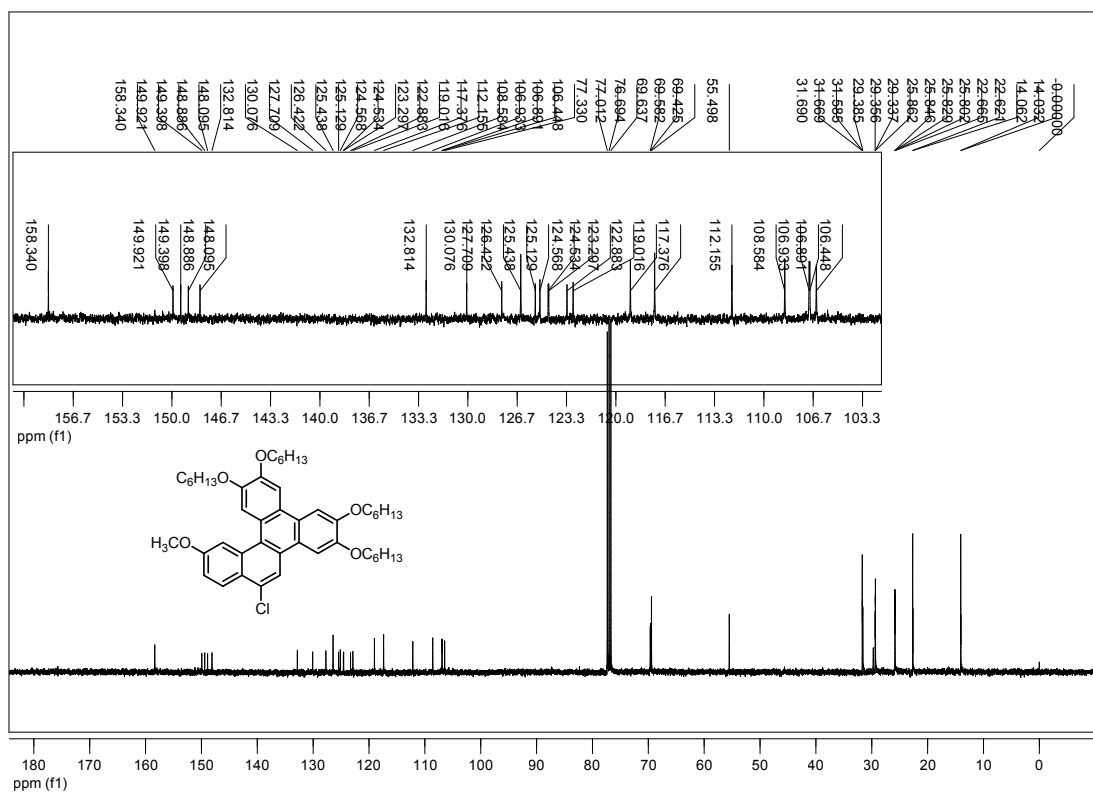


The ¹³C NMR spectra of compound 5e.

5f

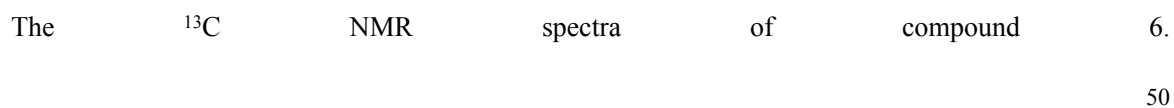


The ¹H NMR spectra of compound 5f.



The ¹³C NMR spectra of compound 5f.

The ^1H NMR spectra of compound 6.



Chemical structure of 1,2,3,4-tetra-methoxyphenanthrene is shown as an inset. The ¹³C NMR spectrum displays peaks corresponding to the structure, with the following chemical shifts (ppm) labeled:

158.354, 149.771, 149.189, 148.907, 147.808, 134.149, 130.349, 128.387, 125.839, 125.385, 124.225, 123.106, 122.224, 122.105, 121.777, 117.777, 109.991, 108.465, 104.568, 103.650, 97.660.

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