

Supporting Information

Tri-, Tetra- and Pentamers of 9,9'-Spirobifluorenes through Full *ortho*-Linkage: High Triplet-Energy Pure Hydrocarbon Host for Blue Phosphorescent Emitter

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General Information: *n*-Butyllithium in hexane was purchased from Alfa Asia Chemical Co. 2-isopropoxy-4,4,5,5-tetramethyl-[1,3,2]dioxaborolane was purchased from Aldrich Chemical Co. All reagents commercially available were used as received unless otherwise stated. The solvents (THF, diethyl ether, dichloromethane) were purified by conventional procedure and distilled under argon before using. All reactions were carried out using Schlenk tube in an argon atmosphere.

2,2'-Dibromobiphenyl (**1**), 9,9'-spirobifluorene-4-yl pinacol boronic ester (**5**) were synthesized according to the literature procedure.^{1,2}

¹H-NMR, ¹³C-NMR and DEPT ¹³C-NMR spectra were measured on Varian Unity 300 MHz spectrometer using CDCl₃ as solvent and tetramethylsilane as an internal reference. Elemental analysis of carbon, hydrogen and nitrogen was

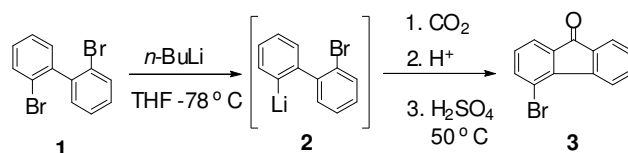
performed on Vario EL-III microanalyzer. EI-MS spectra were recorded on VJ-ZAB-3F-Mass spectrometer. MALDI-TOF mass spectrometric measurement was performed on Bruker Biflex III MALDI TOF instrument. Differential scanning calorimetry (DSC) was performed on a NETZSCH DSC 200 PC unit at a heating rate of $10\text{ }^{\circ}\text{C min}^{-1}$ from $30\text{ }^{\circ}\text{C}$ to $600\text{ }^{\circ}\text{C}$ under argon. UV-Vis absorption spectra were recorded on Shimadzu UV-2550 spectrophotometer. PL spectra were recorded on Hitachi F-4500 fluorescence spectrophotometer. Quantum yields measurements ($1 \times 10^{-5}\text{ M}$ in CH_2Cl_2) were performed according to the literature procedures and with the 9,10-diphenylanthracene as reference ($1 \times 10^{-5}\text{ M}$ in cyclohexane; $\Phi_{\text{F}} = 0.90$)³. Cyclic voltammetric measurements were carried out on a computer-controlled EG&G Potentiostat/Galvanostat model 283 using tetrabutylammonium hexafluorophosphate (0.1 M) as supporting electrolyte in freshly distilled CH_2Cl_2 solution and conventional three-electrode cell with a Pt work electrode of 2 mm diameter, a platinum-wire counter electrode and a Ag/AgCl reference electrode. The onset potential was determined from the intersection of two tangents drawn at the rising and background current of the cyclic voltammogram, then HOMO (eV) is calculated according to the formula: $- (4.8\text{ eV} + (E_{\text{onsets}} - E_{1/2(\text{Fc}/\text{Fc}^+)}))$, where the $E_{1/2}$ of ferrocene/ferrocenium ion (Fc/Fc⁺) redox couple as internal standard equals to 0.50 V.

OLED Fabrication and measurement: The hole-injection material MoO_3 , hole-transporting material (1,4-bis(1-naphthylphenylamino)-biphenyl) NPB, 4,4',4''-tri(*N*-carbazolyl)triphenylamine (TCTA),

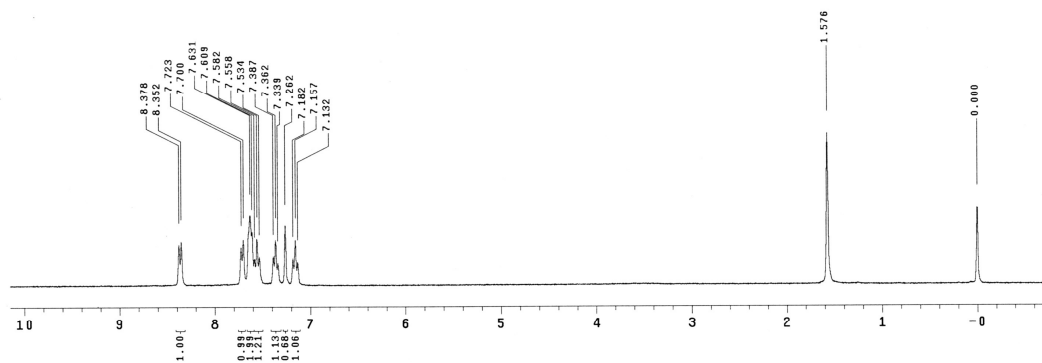
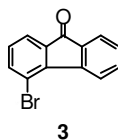
1,3,5-tris(*N*-phenylbenzimidazol-2-yl)benzene (TPBi) were commercially available. Commercial indium tin oxide (ITO) coated glass with sheet resistance of 10Ω/square was used as the starting substrates. Before device fabrication, the ITO glass substrates were pre-cleaned carefully and treated by UV/O₃ for 2 min. Then the sample was transferred to the deposition system. 10 nm of MoO₃ was firstly deposited to ITO substrates, followed by 80 nm NPB, 5 nm TCTA, 20 nm emissive layers and 40 nm TPBi. Finally, a cathode composed of 1 nm of lithium fluoride and 120 nm of aluminum was sequentially deposited onto the substrates in the vacuum of 10⁻⁶ Torr to construct the devices. In the deposition of the emissive layers, the host and guest were placed into different evaporator sources. The deposition rates of both host and guest were controlled with their correspondingly independent quartz crystal oscillators. The evaporation rates were monitored by a frequency counter and calibrated by a Dektak 6M profiler (Veeco). The I-V-B of EL devices was measured with a Keithley 2400 Source meter and a Keithley 2000 Source multimeter equipped with a calibrated silicon photodiode. The EL spectra were measured by JY SPEX CCD3000 spectrometer. All measurements were carried out at room temperature under ambient conditions.

Synthesis details

Synthesis of 4-bromo-9-H-fluoren-9-one (3)

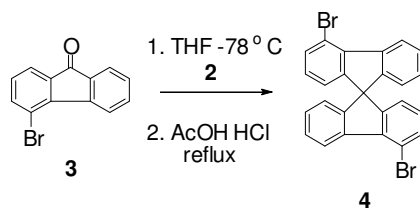


3 is a known compound and was synthesized by a modified literature procedure.⁴ A solution of 2,2'-dibromobiphenyl (1.25 g, 4 mmol) in THF (60 ml) was treated with 1.8 ml of *n*-BuLi (2.5 M in hexane, 4.5 mmol) under argon at -78 °C. The mixture was stirred for 40 min. And then carbon dioxide gas was passed into the mixture for 40 min. The mixture was stirred overnight. Then the reaction was quenched with water, extracted with ether and dried over anhydrous Na₂SO₄. After removing the solvent, the intermediate 2'-bromobiphenyl-2-carboxylic acid was obtained as yellow oil. Without further purification, the 2'-bromobiphenyl-2-carboxylic acid was stirred with 40 ml concentrated sulfuric acid at 50 °C for 2 h. After cooling to room temperature, the mixture was poured into 500 ml ice-water and stirred for 1 h. The crude product was filtered and purified by column chromatography on silica gel using 1: 10 ethyl acetate/petroleum as eluent to afford 4-bromo-9-*H*-fluoren-9-one (**3**) as a yellow solid. The whole yield is 42 %. ¹H NMR (300 MHz, CDCl₃, δ): 8.38 (d, *J* = 7.8 Hz, 1H), 7.23 (d, *J* = 6.9 Hz, 1H), 7.61 (m, 2H), 7.58 (t, *J* = 7.2 Hz, 1H), 7.36 (t, *J* = 7.5 Hz, 1H), 7.16 (t, *J* = 7.5 Hz, 1H). Melting point: 189-190 °C (literature³: 190-191 °C).



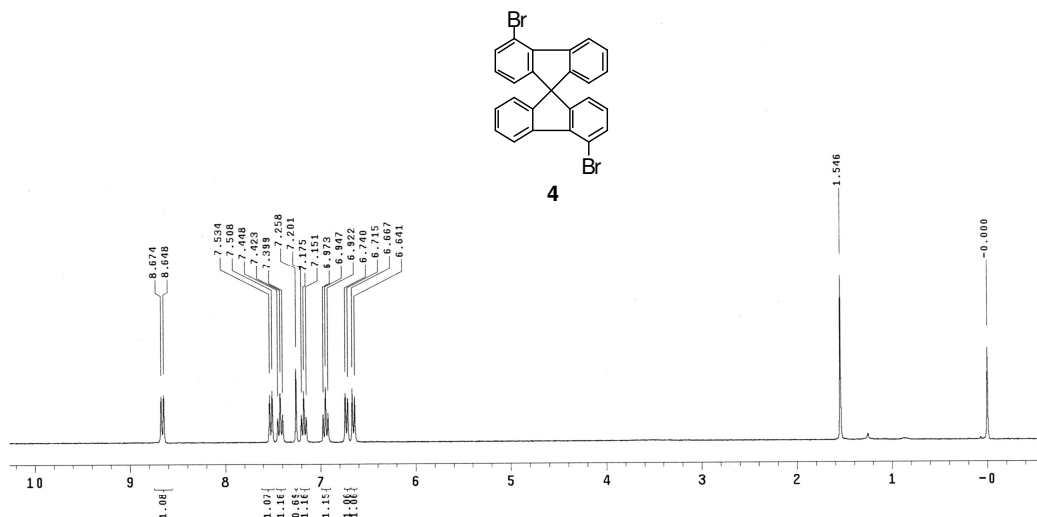
¹H NMR spectrum of **3**

Synthesis of 4,4'-dibromo-9,9'-spirobifluorene (**4**)



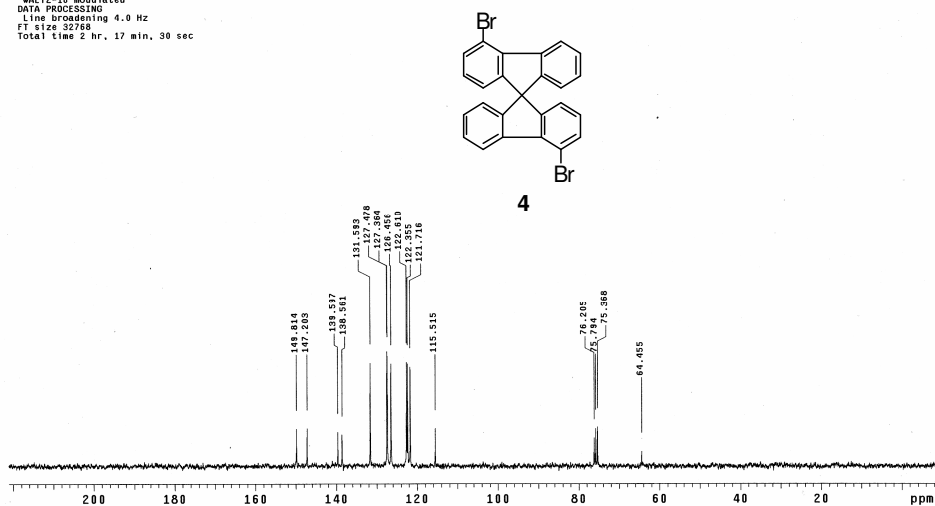
A solution of 2,2'-dibromobiphenyl (722 mg, 2.3 mmol) in THF (40 ml) was treated with 1.2 ml of *n*-BuLi (2.5 M in hexane, 3 mmol) under argon at -78°C . The mixture was stirred for 30 min. And a solution of 4-bromo-9-*H*-fluoren-9-one (460 mg, 1.8 mmol) in 10 ml of THF was added dropwise. The reaction proceeded at -78°C for 30 min and then was stirred overnight. The reaction was quenched by water

and extracted with ethyl acetate. The intermediate, 4-bromo-9-(2'-bromobiphenyl-2-yl)-9-*H*-fluoren-9-ol was obtained after the solvent was removed. Without further purification, a mixture of 4-bromo-9-(2'-bromobiphenyl-2-yl)-9-*H*-fluoren-9-ol, acetic acid (25 ml) and concentrated aqueous HCl (2 ml) was refluxed for 2 h. After cooled, the mixture was diluted with water and extracted with CHCl₃. The crude product was purified by column chromatography on silica gel using petroleum as eluent to give a white solid. The yield for two steps is 87 %. ¹H NMR (300 MHz, CDCl₃, δ): 8.67 (d, *J* = 7.8 Hz, 2H), 7.53 (d, *J* = 7.8 Hz, 2H), 7.42 (t, *J* = 7.5 Hz, 2H), 7.18 (t, *J* = 7.8 Hz, 2H), 6.95 (t, *J* = 7.8 Hz, 2H), 6.74 (d, *J* = 7.5 Hz, 2H), 6.67 (d, *J* = 7.8 Hz, 2H); ¹³C NMR (75MHz, CDCl₃, δ): 149.81, 147.20, 139.60, 138.56, 131.59, 127.48, 127.36, 126.46, 122.61, 122.36, 121.72, 115.52, 64.46; MS (EI) *m/z* Calcd. [M⁺]: 472.0, Found: 473.9; Anal. Calcd. for C₂₅H₁₄Br₂ (%): C, 63.32; H, 2.98. Found: C, 63.14; H, 2.84.

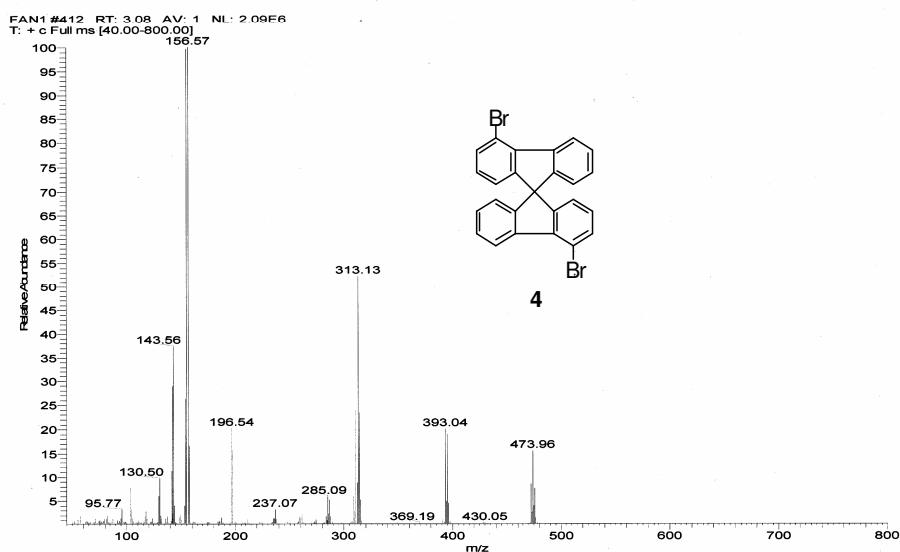


¹H NMR spectrum of 4

fancong-C-100115
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 Sample directory: File: CARBON
 Pulse Sequence: szpu1
 Solvent: CDCl3
 Ambient temperature
 Mercury-300BB "mercury300"
 Relax. delay 1.000 sec
 Pulse 28.0 degrees
 Acq. time 0.500 sec
 Width 17549.3 Hz
 32 repetitions
 OBSERVE C13 75.4553535 MHz
 DECOUPLE H1 300.0819042 MHz
 Power 00 dB
 continuously on
 WALTZ-16 modulated
 DATA PROCESSING
 Line broadening 4.0 Hz
 FT size 32768
 Total time 2 hr, 17 min, 30 sec

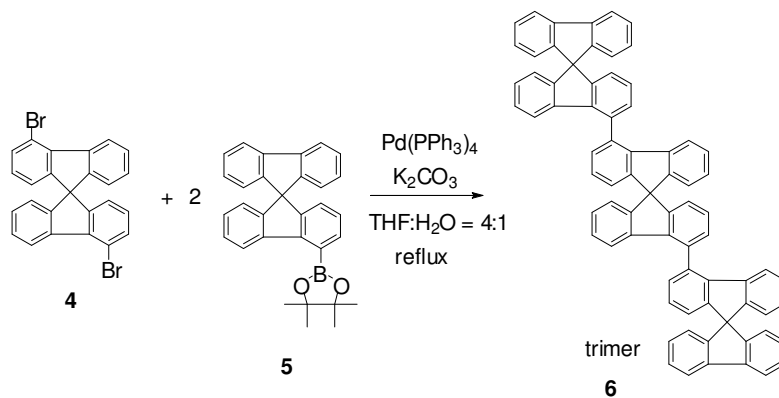


¹³C NMR spectrum of 4



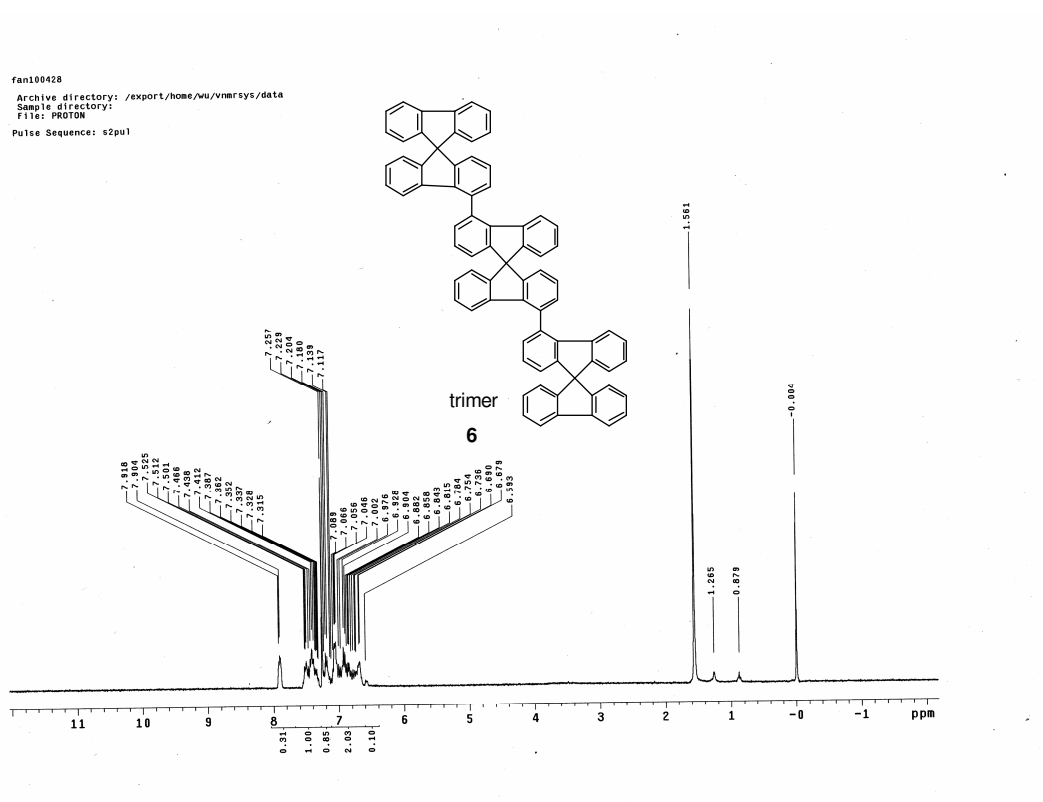
MS spectrum of **4**

Synthesis of trimer (6)

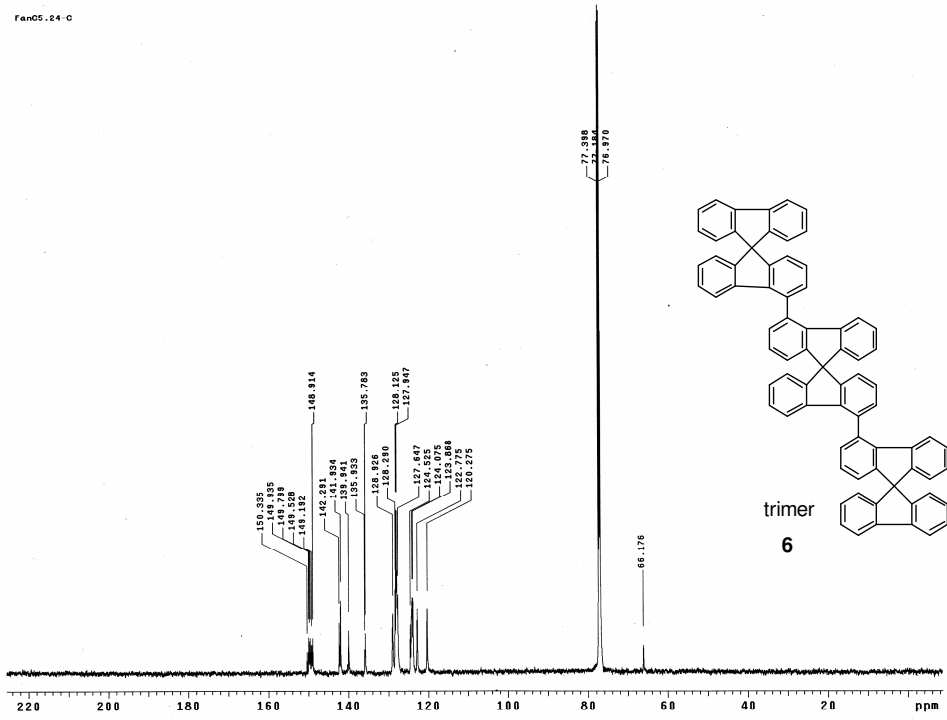


A mixture of 4,4'-dibromo-9,9'-spirobifluorene (187 mg, 0.4 mmol), 9,9'-spirobifluorene-4-yl pinacol boronic ester (432 mg, 1 mmol), Pd(PPh₃)₄ (22 mg, 5 % mmol) and potassium carbonate (1.35 g, 9.8 mmol) in 20 ml of THF and 5 ml of distilled water in a 100 ml round bottom flask was refluxed for 2 days under argon.

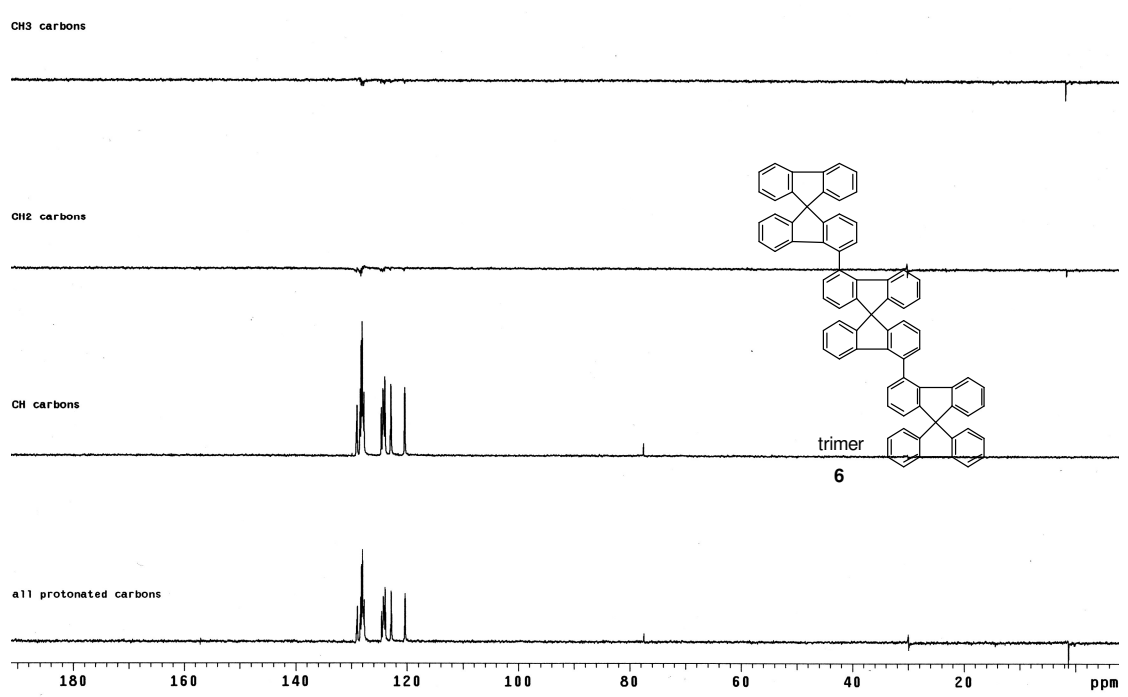
The mixture was extracted with CHCl_3 and dried over anhydrous Na_2SO_4 . The crude product was purified by column chromatography on silica gel using 1: 10 ethyl acetate/petroleum as eluent to give a white solid. Yield: 56 %. ^1H NMR (300 MHz, CDCl_3 , δ): 7.92-7.90 (m, 3H), 7.53-7.32 (m, 10H), 7.23-7.12 (m, 10H), 7.09-6.59 (m, 21H); ^{13}C NMR (75 MHz, CDCl_3 , δ): 150.34, 149.94, 149.80, 149.53, 149.19, 148.91, 142.29, 141.93, 139.94, 135.93, 135.78, 128.93, 128.29, 128.13, 127.95, 127.65, 124.53, 124.08, 123.87, 122.78, 120.28, 66.18; MS (MALDI-TOF): m/z Calcd [M^+]: 944.3, Found: 944.4; Anal. Calcd. for $\text{C}_{75}\text{H}_{44}$ (%): C, 95.31; H, 4.69. Found: C, 95.70; H, 5.06.



^1H NMR spectrum of 6

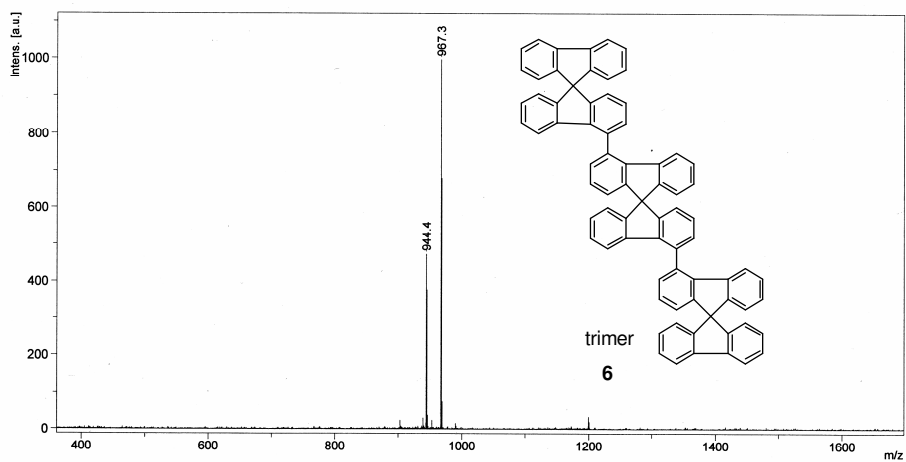
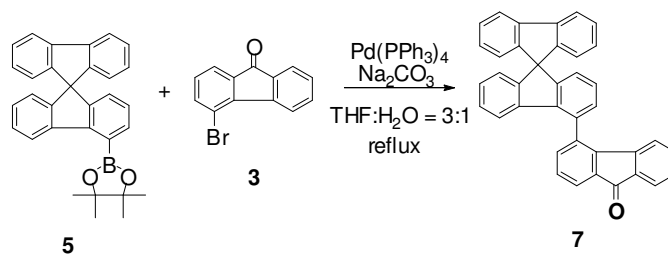


^{13}C NMR spectrum of **6**



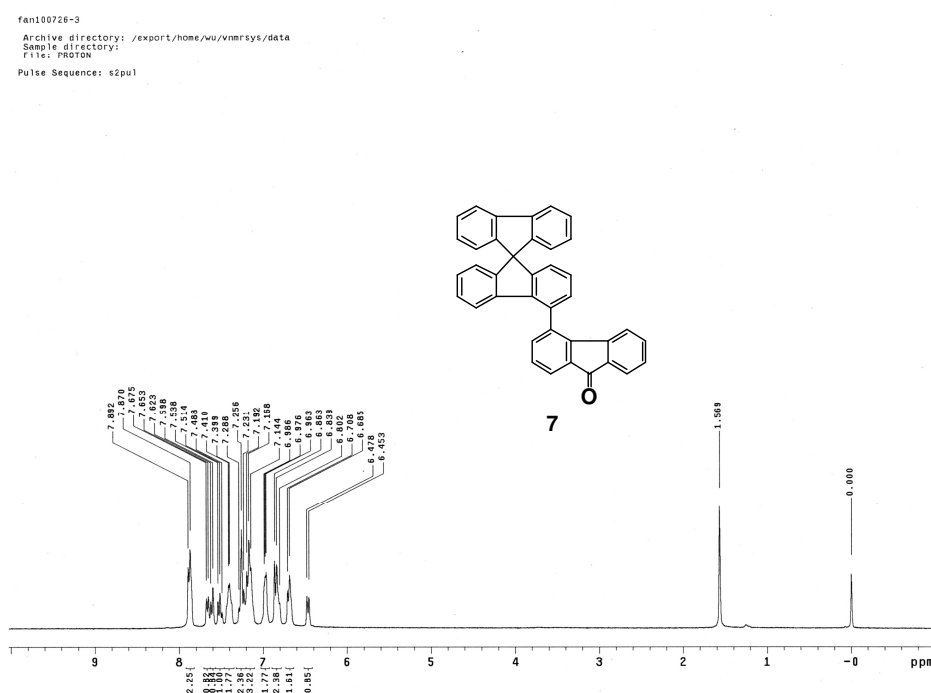
DEPT ^{13}C NMR spectrum of **6**

MALDI-TOF,CCA,FC1,2009,12,10

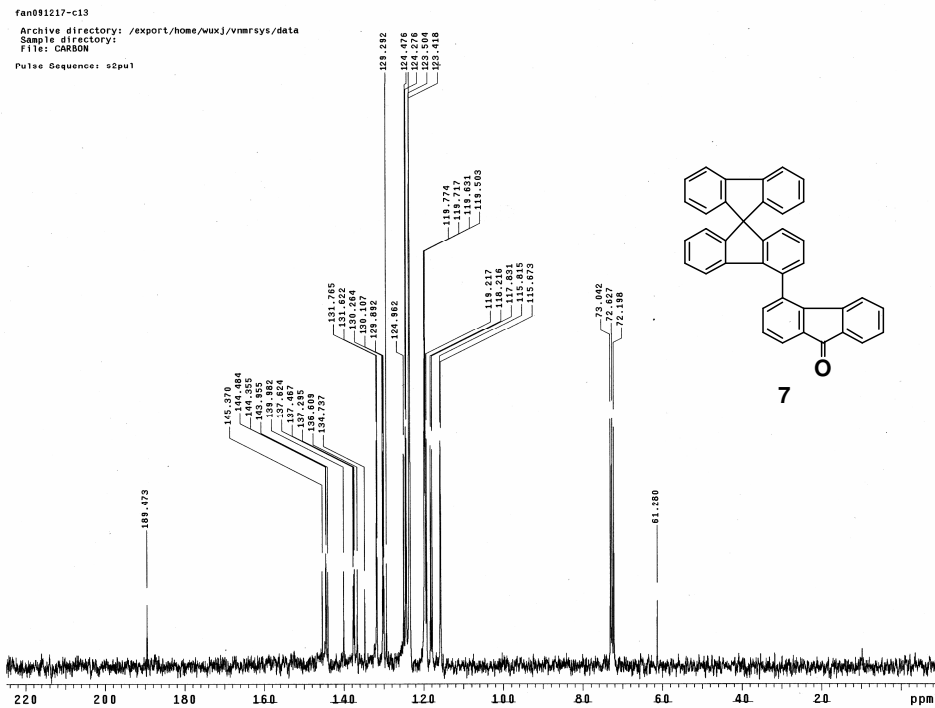
MS (MALDI-TOF) spectrum of **6***Synthesis of 4-(9,9'-spirobifluorene-4-yl)-9-H-fluoren-9-one (7)*

A mixture of 4-bromo-9-*H*-fluoren-9-one (310 mg, 1.2 mmol), (9,9'-spirobifluorene-4-yl) pinacol boronic ester (530 mg, 1.2 mmol), Pd(PPh₃)₄ (30 mg, 0.03 mmol) and sodium carbonate (1.3 g, 12 mmol) in 20 ml of THF and 6 ml of distilled water in a 100 ml round bottom flask was refluxed for 2 days under argon. The mixture was extracted with ethyl acetate and dried over anhydrous Na₂SO₄. The

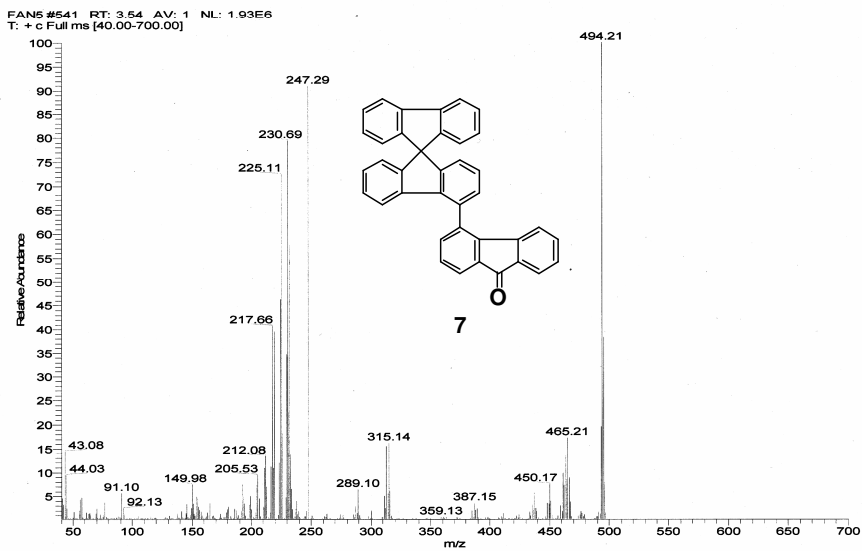
crude product was purified by column chromatography on silica gel using 1: 3 ethyl acetate/petroleum as eluent to give a yellow solid. Yield: 81 %. ^1H NMR (300 MHz, CDCl_3 , δ): 7.90-7.87 (m, 3H), 7.67 (d, $J = 6.6$ Hz, 1H), 7.62 (d, $J = 7.5$ Hz, 1H), 7.51 (t, $J = 7.2$ Hz, 1H), 7.41-7.40 (m, 2H), 7.29-7.23 (m, 2H), 7.19-7.14 (m, 4H), 6.99-6.96 (m, 2H), 6.86-6.80 (m, 3H), 6.71-6.69 (m, 2H), 6.48 (d, $J = 7.5$ Hz, 1H); ^{13}C NMR (75 MHz, CDCl_3 , δ): 189.47, 145.37, 144.48, 144.36, 143.96, 139.98, 137.62, 137.47, 137.30, 136.61, 134.74, 131.77, 131.62, 130.36, 130.11, 129.89, 129.29, 124.96, 124.48, 124.28, 123.50, 123.42, 119.77, 119.72, 119.63, 119.50, 119.22, 118.22, 117.83, 115.82, 115.67, 61.28; MS (EI) m/z Calcd $[\text{M}^+]$: 494.2, Found: 494.2; Anal. Calcd. for $\text{C}_{38}\text{H}_{22}\text{O}$ (%): C, 92.28; H, 4.48. Found: C, 91.90; H, 4.87.



^1H NMR spectrum of 7

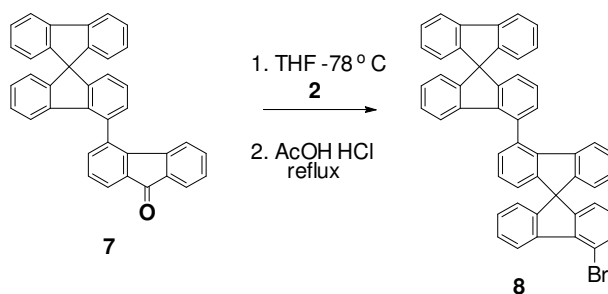


^{13}C NMR spectrum of 7



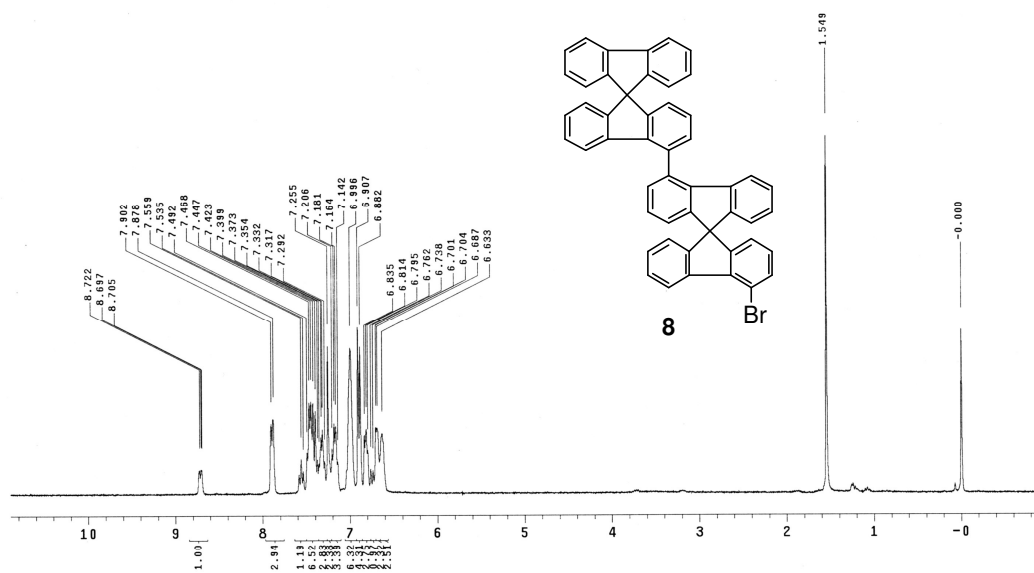
MS spectrum of 7

Synthesis of 4-(4'-bromo-9,9'-spirobifluorene-4-yl)-9,9'-spirobifluorene (8)

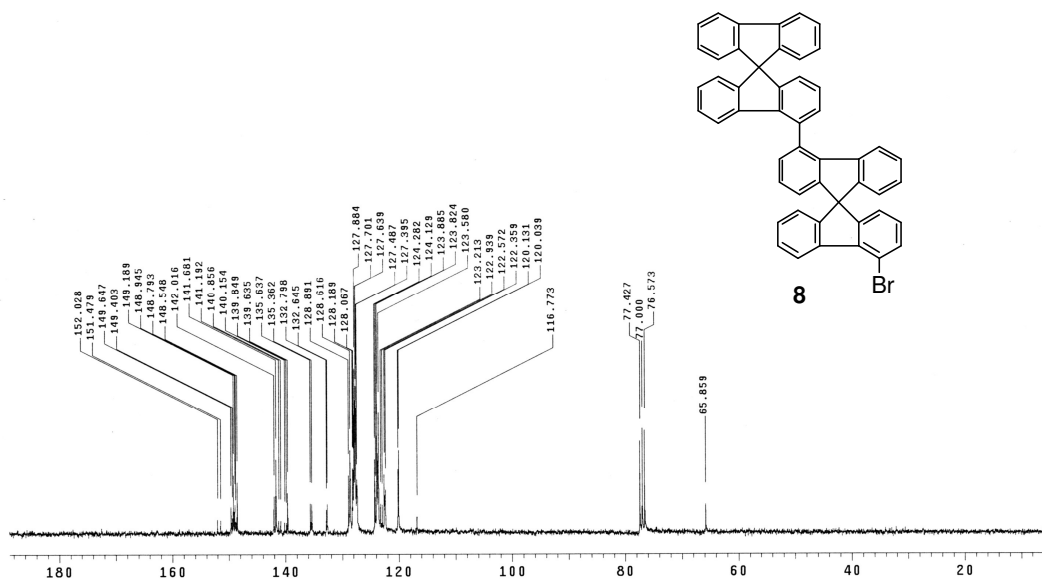


A solution of 2,2'-dibromobiphenyl (624 mg, 2 mmol) in THF (40 ml) was treated with 0.9 ml of *n*-BuLi (2.2 M in hexane, 2 mmol) under argon at -78 °C. The mixture was stirred for 30 min. Then a solution of 4-(9,9'-spirobifluorene-4-yl)-9-*H*-fluoren-9-one (481 mg, 1 mmol) in 10 ml of THF was added dropwise. After 30 min, the reaction was quenched by water and extracted by ethyl acetate. The intermediate was obtained as yellow oil after the solvent was removed. A mixture of the intermediate, acetic acid (20 ml) and concentrated aqueous HCl (1 ml) was refluxed in a 100 ml round bottom flask for 1 h. After cooled, the mixture was diluted with water and extracted with ethyl acetate. The product was purified by column chromatography on silica gel using 1: 10 ethyl acetate/petroleum as eluent to give a white solid. The yield for two steps is 91 %. ¹H NMR (300 MHz, CDCl₃, δ): 8.72-8.71 (m, 1H), 7.90-7.88 (m, 2H), 7.56 (t, *J* = 7.5 Hz, 1H) 7.50-7.26 (m, 9H), 7.21-7.14 (m, 6H), 6.99-6.84 (m, 4H), 6.81-6.63 (m, 6H); ¹³C NMR (75 MHz, CDCl₃, δ): 152.03, 151.48, 149.65, 149.40, 149.19, 148.95, 148.79, 148.55, 142.02, 141.68, 141.19, 140.86, 140.15, 139.64, 135.64, 135.36, 132.80, 132.65, 128.89, 128.62, 128.19, 128.07, 127.88, 127.70, 127.64, 127.49, 127.40, 124.28, 124.13, 123.89, 123.82, 123.58, 123.21, 122.94, 122.57, 122.36, 120.13, 120.04,

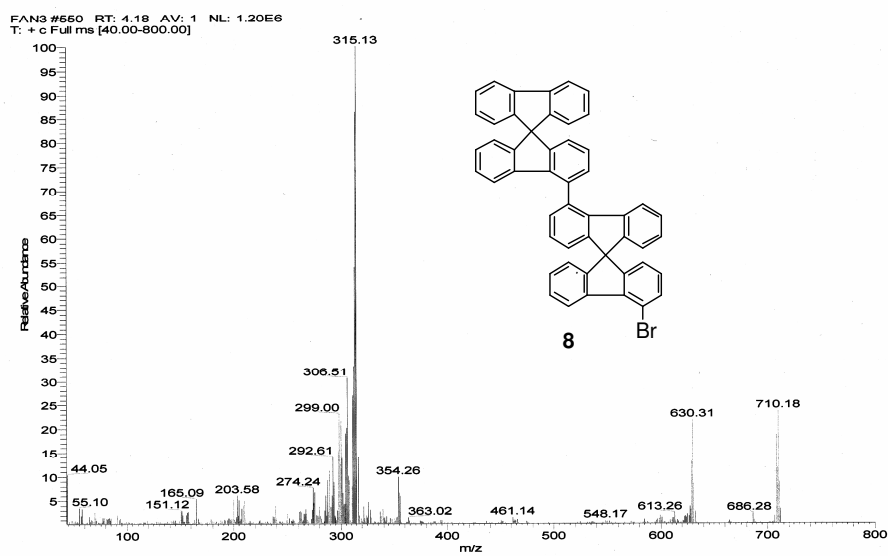
116.77, 65.86; MS (EI) m/z Calcd $[M]^+$: 708.2, Found: 710.1; Anal. Calcd. for $C_{50}H_{29}Br$ (%): C, 84.62; H, 4.12. Found: C, 84.22; H, 4.35.



1H NMR spectrum of **8**

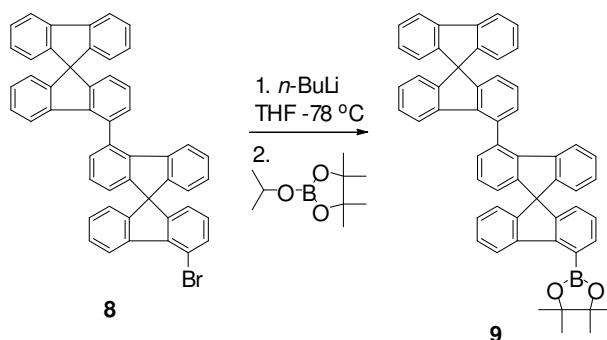


¹³C NMR spectrum of **8**

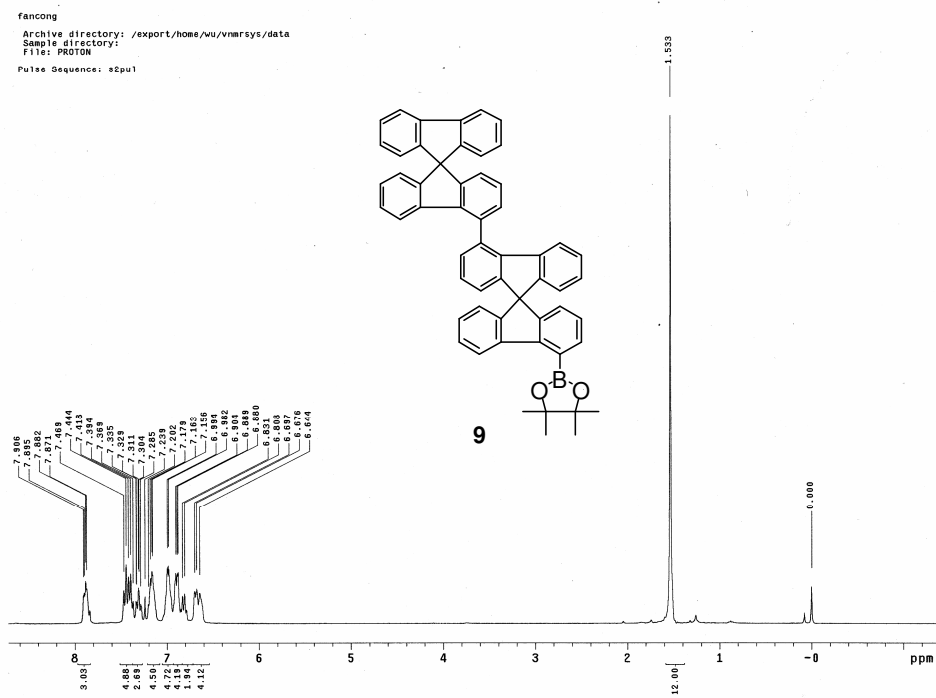


MS spectrum of **8**

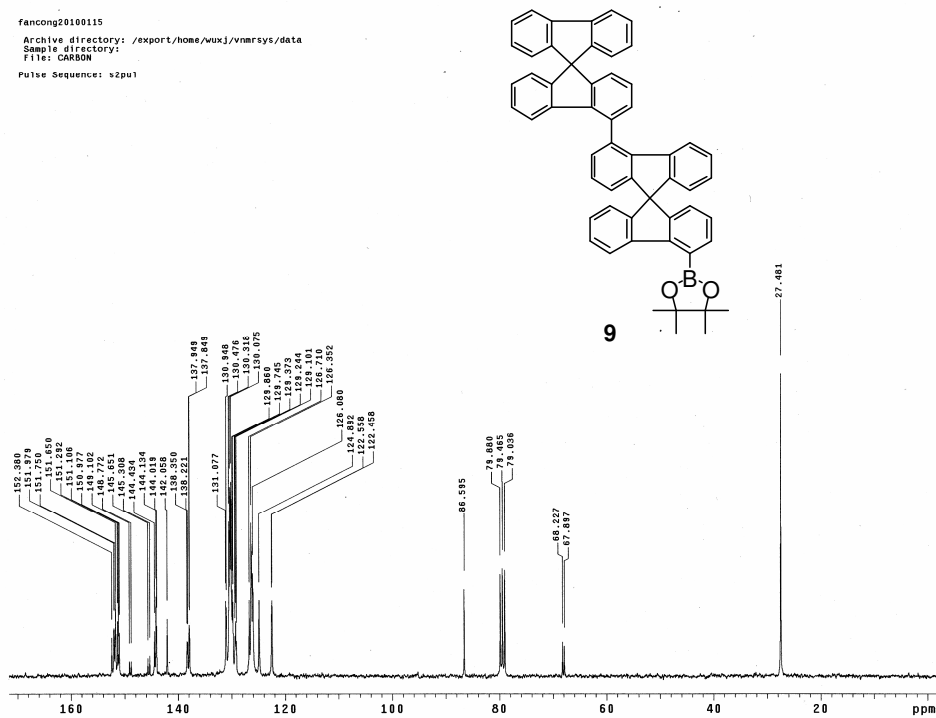
Synthesis of 4-(4'-(9,9'-spirobifluorene-4-yl)-9,9'-spirobifluorene-4-yl)pinacol boronic ester (9)



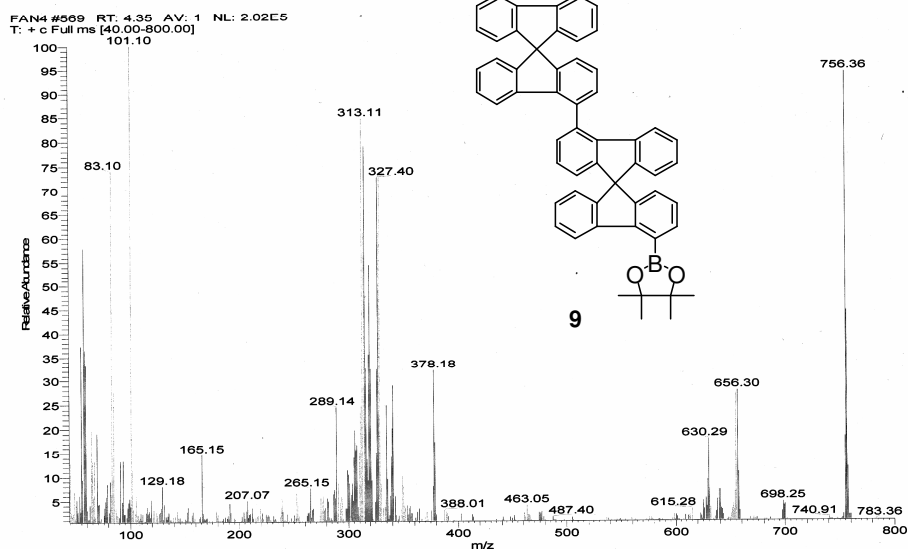
A solution of (4'-bromo-9,9'-spirobifluorene-4-yl)-9,9'-spirobifluorene (537 mg, 0.8 mmol) in THF (40 ml) was treated with 0.5 ml of *n*-BuLi (2.2 M in hexane, 1.1 mmol) under argon at -78 °C. After the mixture was stirred for 1 h, 2-isopropoxy-4,4,5,5-tetramethyl-[1,3,2]dioxaborolane (0.22 ml, 1.1 mmol) was added dropwise. The reaction was stirred for 30 min at -78 °C and warmed to room temperature. Then the reaction was quenched by water and extracted by ethyl acetate. The crude product was purified by column chromatography on silica gel using 1: 10 ethyl acetate/petroleum as eluent to give a white solid. Yield: 46 %. ¹H NMR (300 MHz, CDCl₃, δ): 7.91-7.87 (m, 3H), 7.47-7.37 (m, 5H), 7.34-7.29 (m, 2H), 7.20-7.16 (m, 5H), 6.99-6.98 (m, 4H), 6.90-6.88(m, 4H), 6.83-6.81 (m, 2H), 6.70-6.64 (m, 4H), 1.53 (s, 12H); ¹³C NMR (75 MHz, CDCl₃, δ): 152.38, 151.98, 151.75, 151.65, 151.29, 151.11, 150.98, 149.10, 148.77, 145.65, 145.31, 144.43, 144.13, 144.02, 142.06, 138.35, 138.22, 137.95, 137.85, 131.08, 130.95, 130.48, 130.32, 130.08, 129.86, 129.75, 129.37, 129.24, 129.10, 126.71, 126.35, 126.08, 124.89, 122.56, 122.46, 86.60, 68.23, 67.90, 27.48; MS (EI) *m/z* Calcd [M⁺]: 756.3, Found: 756.3; Anal. Calcd. for C₅₆H₄₁BO₂ (%): C, 88.88; H, 5.46. Found: C, 88.86; H, 5.36.



¹H NMR spectrum of 9

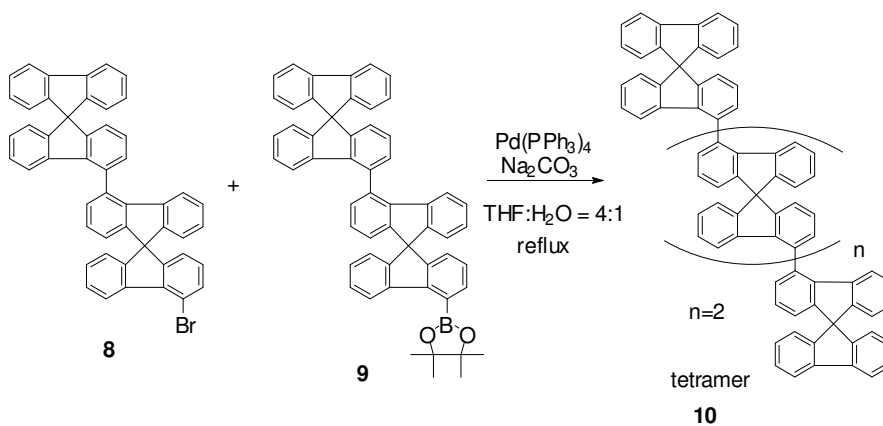


¹³C NMR spectrum of 9



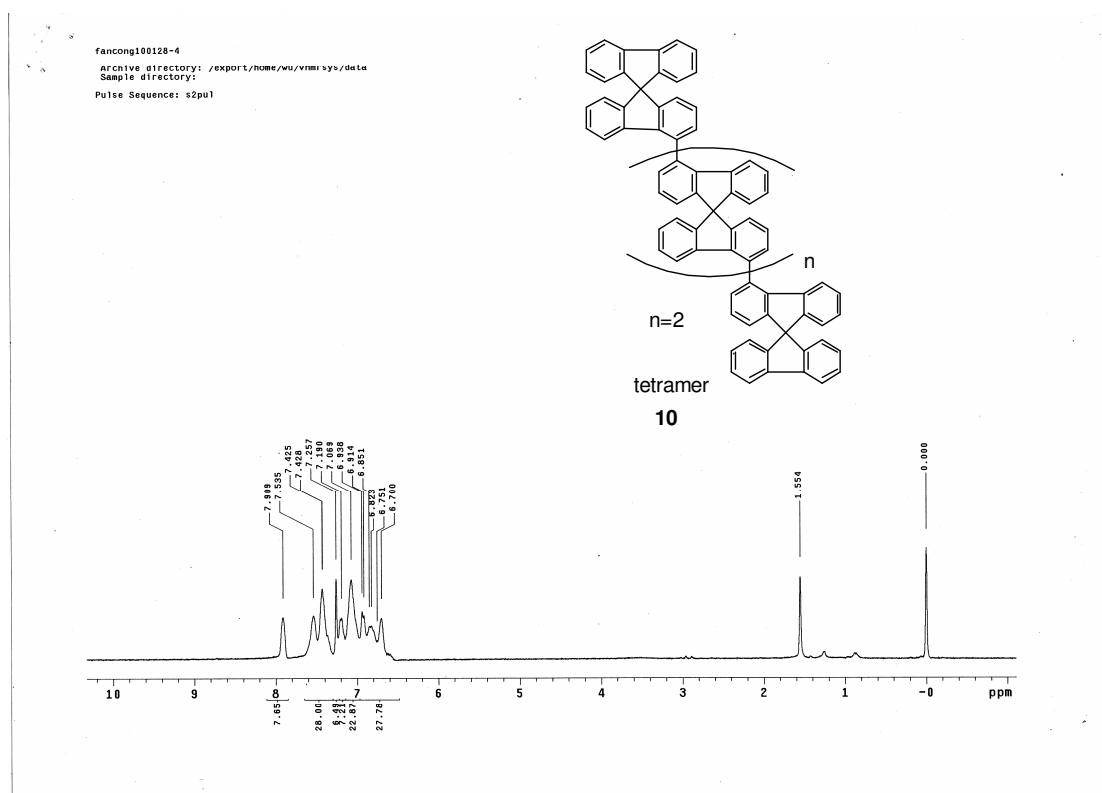
MS spectrum of **9**

Synthesis of tetramer (10)



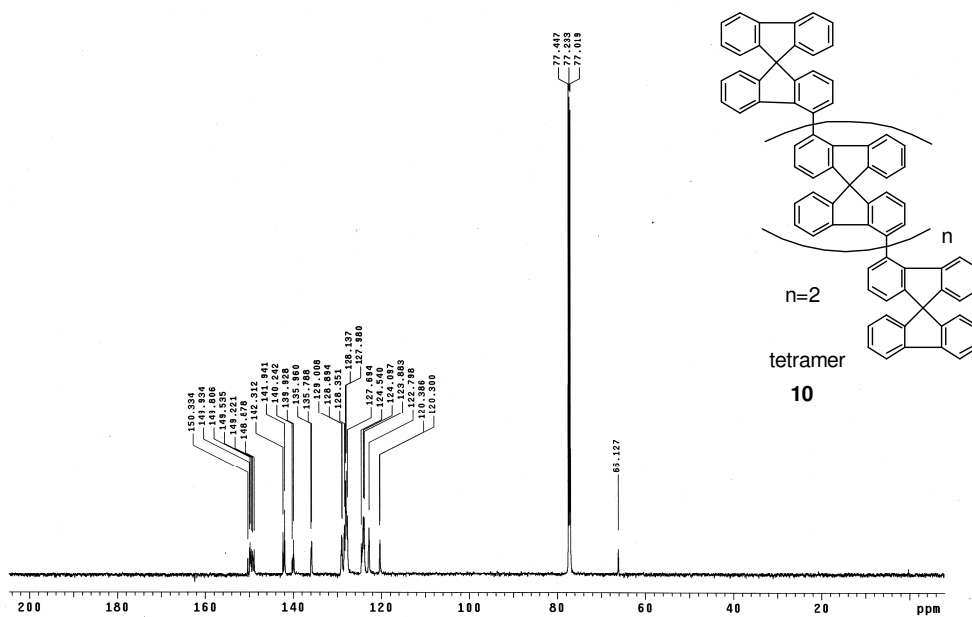
A mixture of 4'-(9,9'-spirobifluorene-4-yl)-9,9'-spirobifluorene-4-yl-pinacol boronic ester (190 mg, 0.25 mmol), 4-(4'-bromo-9,9'-spirobifluorene-4-yl)-9,9'-spirobifluorene (249 mg, 0.35 mmol), Pd(PPh₃)₄ (20 mg, 0.02 mmol) and sodium carbonate (530 mg, 5 mmol) in 10 ml of

THF and 2.5 ml of distilled water in a 50 ml round bottom flask was refluxed for 2 days under argon. The crude product was filtered and washed by water and ethanol. The product was further purified by column chromatography on silica gel using 1: 3 ethyl acetate/petroleum as eluent to give a white solid. Yield: 50 %. ^1H NMR (300 MHz, CDCl_3 , δ): 7.91 (m, 5H), 7.54-7.43 (m, 17H), 7.19 (m, 5H), 7.07-6.94 (m, 15H), 6.91-6.70 (m, 16H); ^{13}C NMR (75 MHz, CDCl_3 , δ): 150.33, 149.93, 149.81, 149.54, 149.22, 148.88, 142.31, 141.94, 140.24, 139.93, 135.96, 135.79, 129.00, 128.89, 128.35, 128.14, 127.98, 127.69, 124.54, 124.10, 123.88, 122.80, 120.39, 120.30, 66.13; MS (MALDI-TOF) m/z Calcd $[\text{M}^+]$: 1258.5, Found: 1259.5; Anal. Calcd. for $\text{C}_{100}\text{H}_{58}$ (%): C, 95.36; H, 4.64. Found: C, 95.20; H, 4.26.



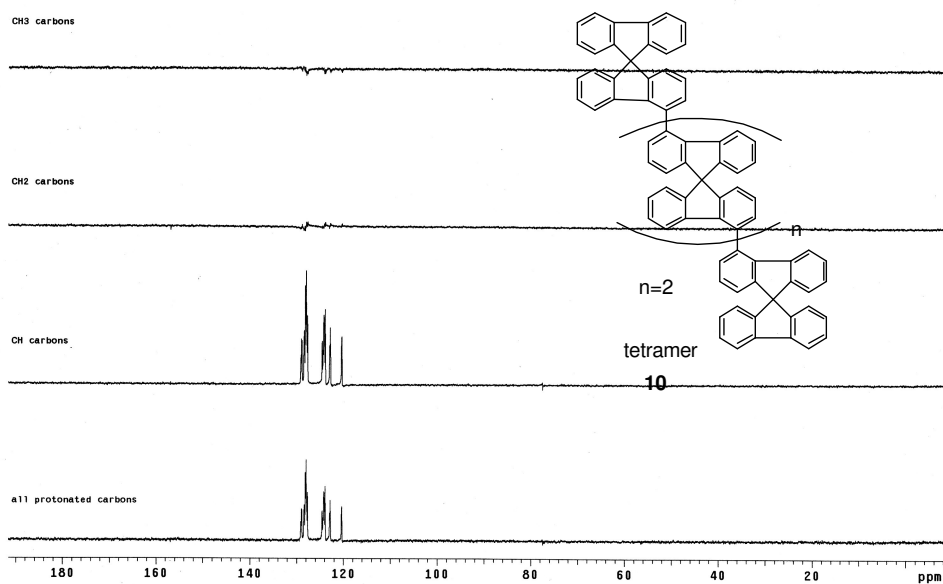
^1H NMR spectrum of **10**

FanC6.18-C



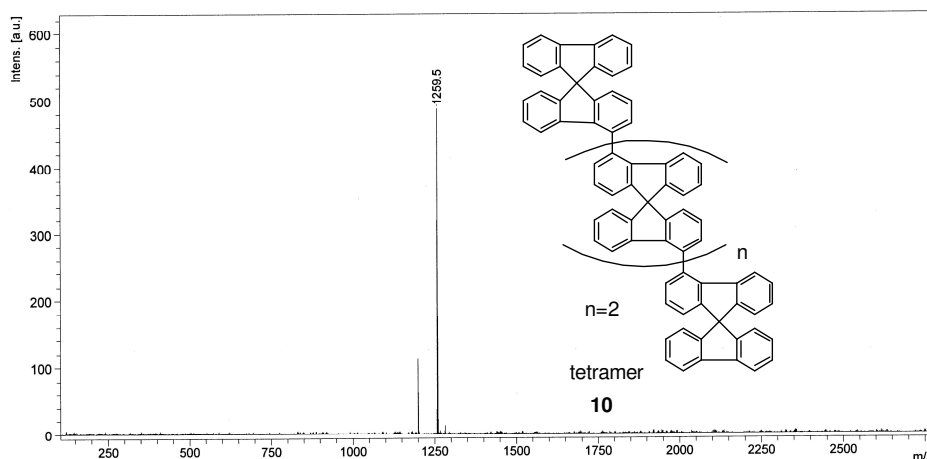
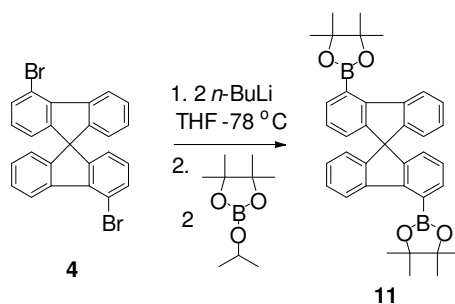
^{13}C NMR spectrum of **10**

FanB15-2-dept



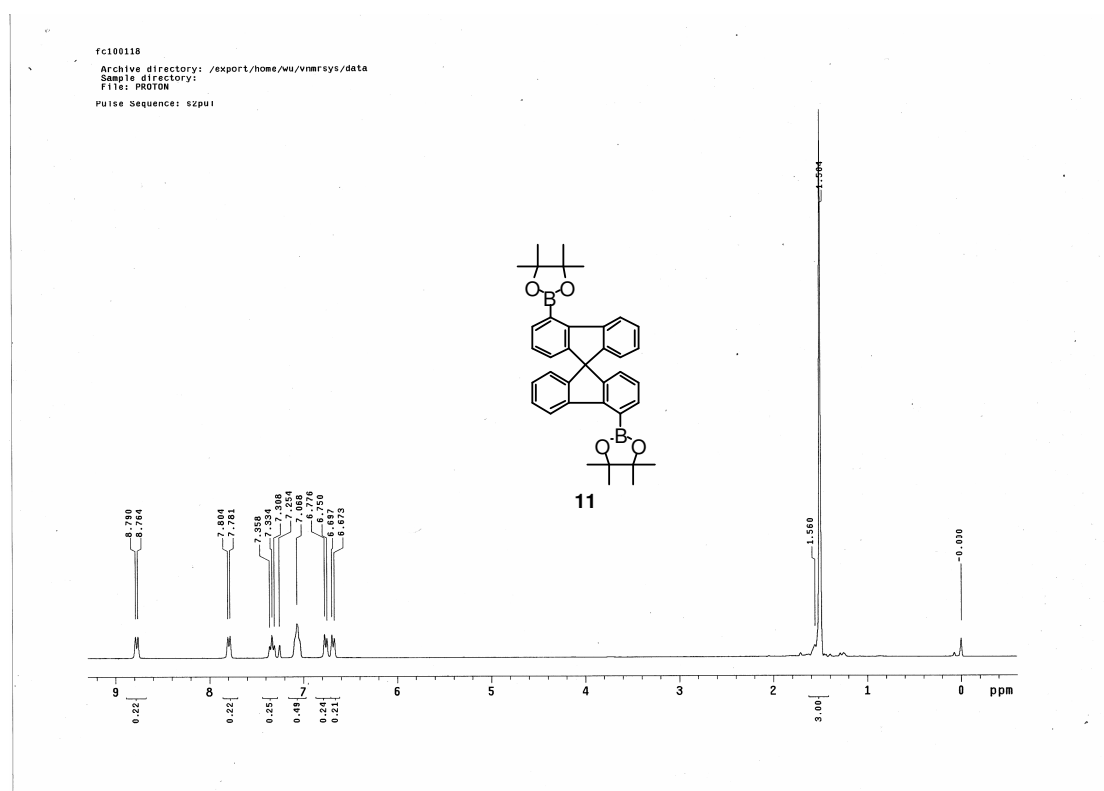
DEPT ^{13}C NMR spectrum of **10**

MALDI-TOF, DHB, fan, 2010, 07, 05

MS (MALDI-TOF) spectrum of **10****Synthesis of****4,4'-bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-9,9'-****spirobifluorene (11)**

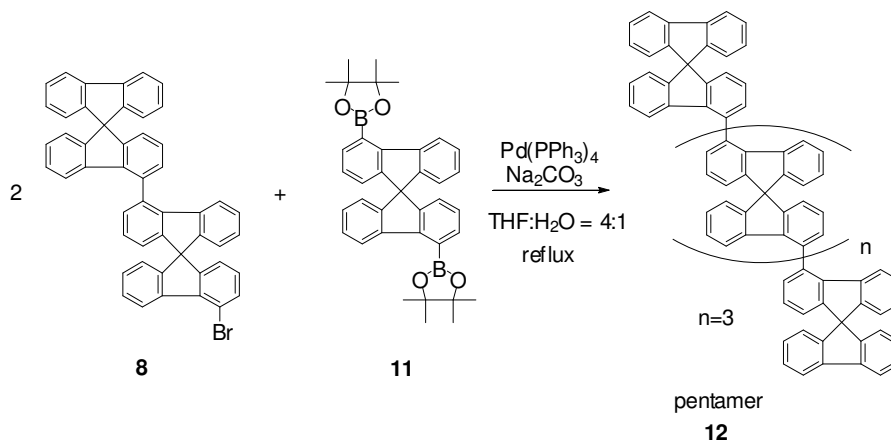
A solution of 4,4'-dibromo-9,9'-spirobifluorene (236 mg, 0.5 mmol) in THF (20 ml) was treated with 0.55 ml of *n*-BuLi (2.2 M in hexane, 1.2 mmol) under argon at -78 °C. After the mixture was stirred for 30 min, 2-isopropoxy-4,4,5,5-tetramethyl-[1,3,2]dioxaborolane (0.31 ml, 1.5 mmol) was added dropwise. The reaction was stirred for 30 min at -78 °C and warmed to room

temperature. Then the reaction was quenched by water and extracted by ethyl acetate. The crude product was purified by column chromatography on silica gel using 1: 10 ethyl acetate/petroleum as eluent to give a white solid. Yield: 46 %. ^1H NMR (300 MHz, CDCl_3 , δ): 8.79 (d, $J = 9.0$ Hz, 2H), 7.80 (d, $J = 6.0$ Hz, 2H), 7.33 (t, $J = 9.0$ Hz, 2H), 7.07, (m, 4H), 6.78 (d, $J = 9.0$ Hz, 2H), 6.70 (d, $J = 9.0$ Hz, 2H), 1.50 (s, 24H); ^{13}C NMR (75 MHz, CDCl_3 , δ): 148.84, 148.70, 145.95, 142.48, 135.18, 127.19, 126.94, 126.26, 126.18, 123.31, 123.24, 83.63, 64.73, 24.54; MS (EI) m/z Calcd [M^+]: 568.3, Found: 568.4; Anal. Calcd. for $\text{C}_{37}\text{H}_{38}\text{B}_2\text{O}_4$ (%): C, 78.20; H, 6.74. Found: C, 77.85; H, 6.62.



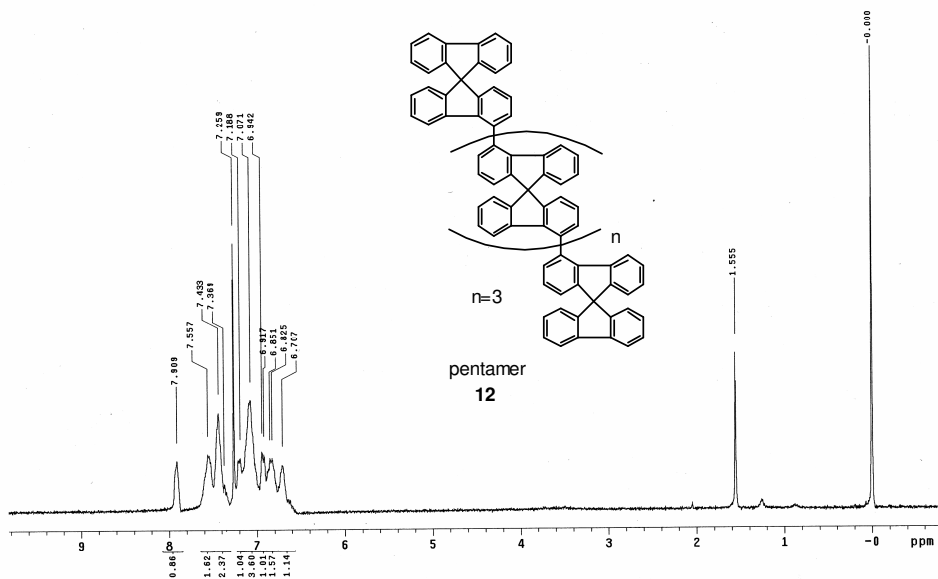
^1H NMR spectrum of **11**

Synthesis of pentamer (12)



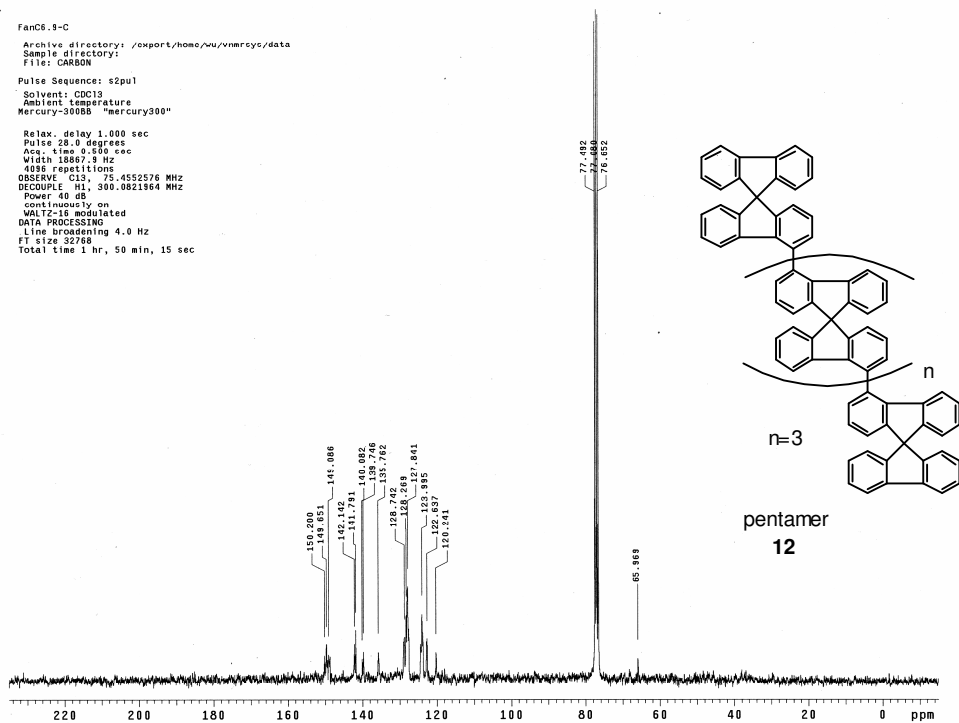
A mixture of 4,4'-bis(4,4,5,5-tetramethyl-1,3,2-dioxaborolan-2-yl)-9,9'-spirobifluorene (227 mg, 0.4 mmol), 4-(4'-bromo-9,9'-spirobifluorene-4-yl)-9,9'-spirobifluorene (710 mg, 1 mmol), Pd(PPh₃)₄ (20 mg, 0.02 mmol) and sodium carbonate (848 mg, 8 mmol) in 16 ml of THF and 4 ml of distilled water in a 50 ml round bottom flask was refluxed for 2 days under argon. The crude product was filtered and washed by water and ethanol. The product was further purified by column chromatography on silica gel using 1: 1 CHCl₃/petroleum as eluent to give a white solid. Yield: 80 %. ¹H NMR (300 MHz, CDCl₃, δ): 7.91 (m, 5H), 7.56 (m, 9H), 7.43 (m, 13H), 7.19 (m, 6H), 7.07 (m, 19H), 6.94 (m, 5H), 6.85 (m, 9H), 6.71 (m, 6H); ¹³C NMR (75 MHz, CDCl₃, δ): 150.20, 149.65, 149.09, 142.14, 141.79, 140.08, 139.75, 135.76, 128.74, 128.27, 127.84, 123.99, 122.64, 120.24, 65.97; MS (MALDI-TOF): m/z Calcd [M⁺]: 1572.6, Found: 1573.5; Anal. Calcd. for C₁₂₅H₇₂ (%): C, 95.39; H, 4.61. Found: C, 95.72; H, 4.26.

fancong100126-5
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 Sample directory:
 File: PKTON
 Pulse Sequence: s2pul

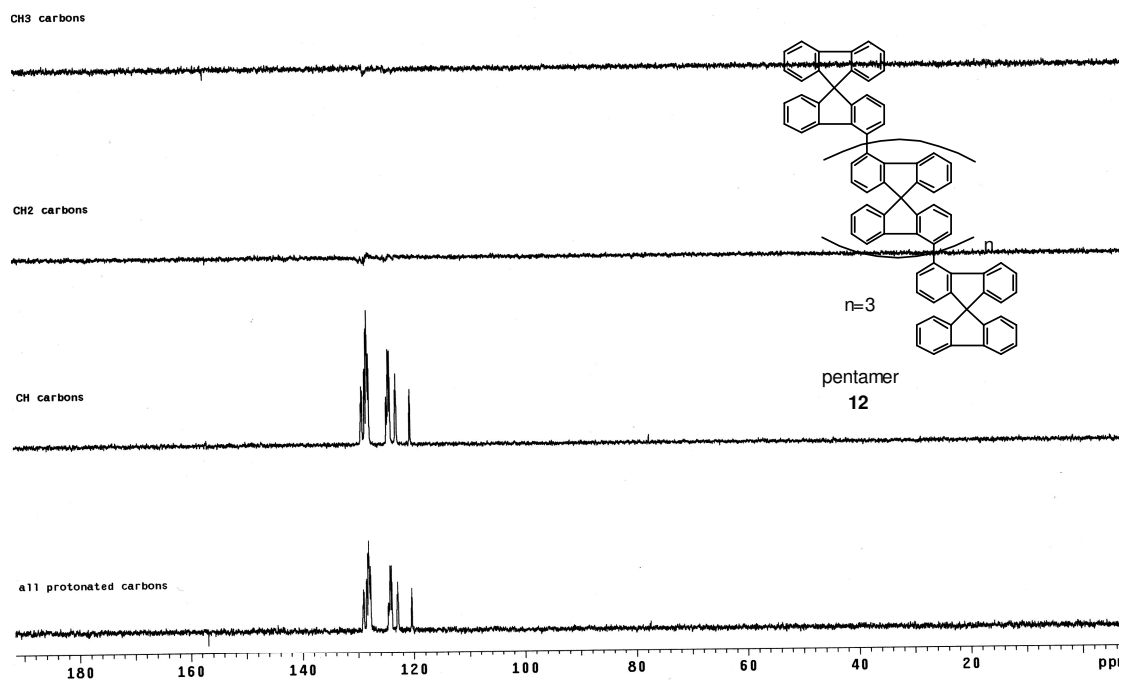


^1H NMR spectrum of 12

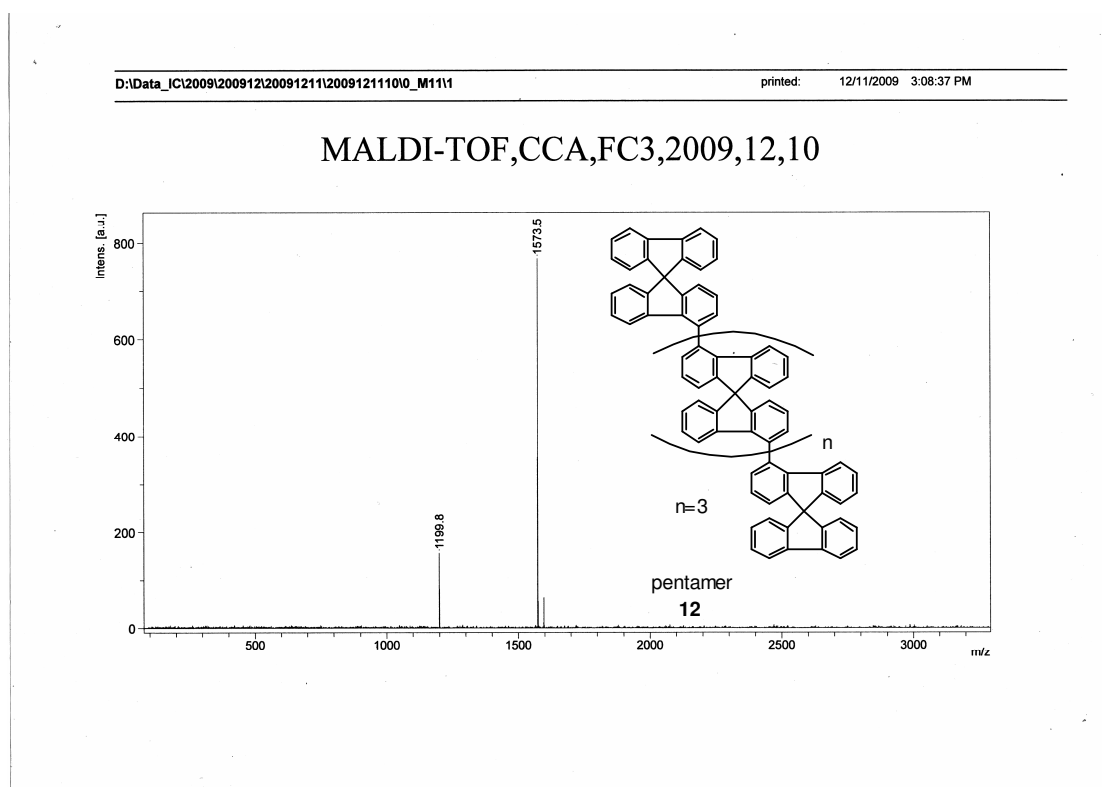
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 4096 repetitions
 OBSERVE C13, 75.4552576 MHz
 DECOUPLE H1, 300.0821964 MHz
 Power 40 dB
 continuously on
 MALTZ-IS modulated
 DATA PROCESSING
 Line broadening 4.0 Hz
 FI size 52768
 Total time 1 hr, 50 min, 15 sec



^{13}C NMR spectrum of 12



DEPT ^{13}C NMR spectrum of **12**



MS (MALDI-TOF) spectrum of **12**

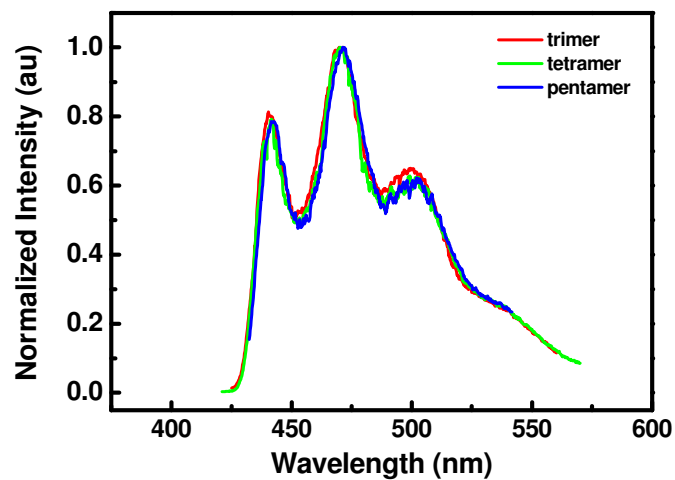


Figure S1. Phosphorescence spectra of the three oligomers in 2-methyl-THF solution at 77K.

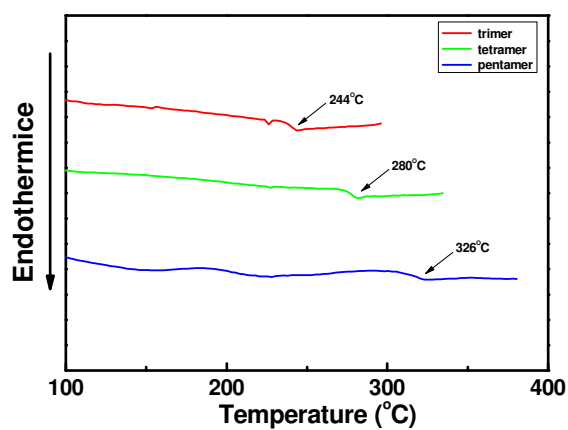


Figure S2. Differential scanning calorimetry (DSC) thermogram of the three oligomers

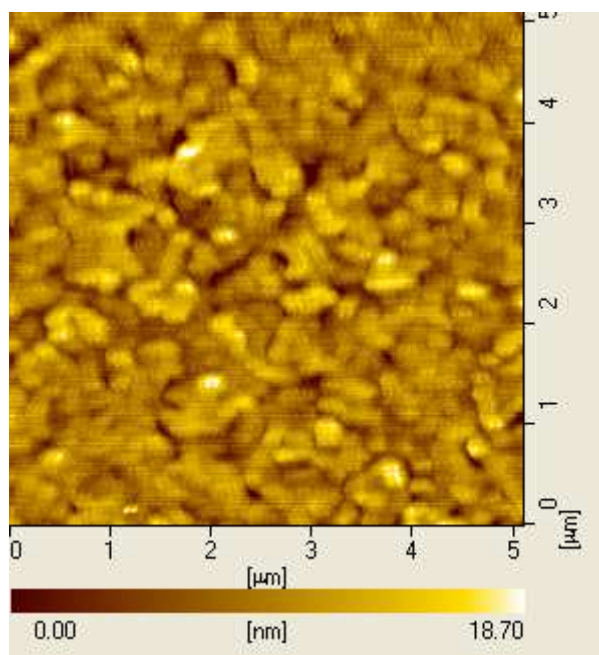


Figure S3. AFM image of the trimer (RMS = 2.84 nm). The trimer was deposited on a glass substrate around 220 °C in the vacuum of 10^{-6} Torr, and then it was transferred to a desiccator after 1 hour. The morphology of the film was measured by using AFM in ambient atmosphere and room temperature.

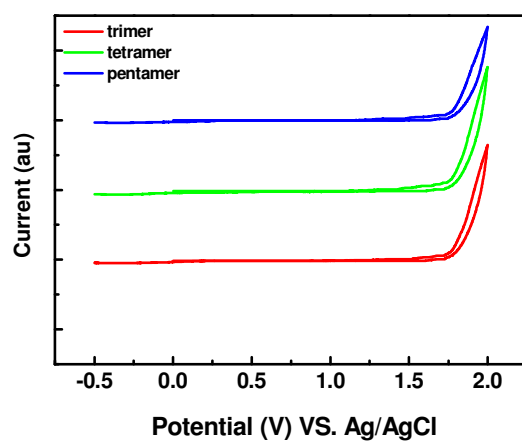


Figure S4. Cyclic voltammogram of the three oligomers vs. Ag/AgCl.

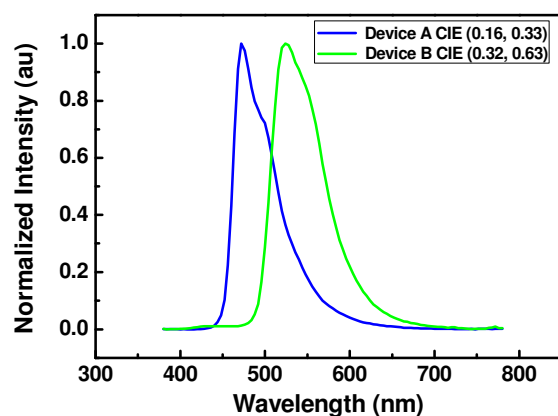


Figure S5. EL spectra for devices A and B.

References

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