

Electronic Supplementary Information

Rhodium-Catalyzed Z-Alkenylation of *gem*- Difluoropropenes: Access to Fluorinated (1Z,4Z)-Dienes

Jiang-Min Yan, Kai-Xian Ma, Rui-Hong Chen, Xue-Mei Huang, Zi-Xin Ye, Qing-Hua

Li* and Tang-Lin Liu*

School of Chemistry and Chemical Engineering, Southwest University, Chongqing,
400715, P. R. China.

E-mail: liuschop@swu.edu.cn; liqinghua@swu.edu.cn

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I General Information

^1H NMR and ^{13}C NMR spectra were recorded on a Bruker Avance 600 MHz instruments. Chemical shifts were reported in parts per million (ppm), and the residual solvent peak was used as an internal reference: proton (chloroform δ 7.26), carbon (chloroform δ 77.16) or tetramethylsilane (TMS δ 0.00) was used as a reference. Multiplicity was indicated as follows: s (singlet), d (doublet), t (triplet), q (quartet), m (multiplet), dd (doublet of doublet), bs (broad singlet). Coupling constants were reported in Hertz (Hz). All high resolution mass spectra (HRMS) were obtained on a Bruker Apex-2. For thin layer chromatography (TLC), Qingdao Haiyang Chemical was used, and compounds were visualized with a UV light at 254 nm. Further visualization was achieved by staining with iodine, or potassium permanganate solution followed by heating using a heat gun. Flash chromatography separations were performed on Qingdao Haiyang Chemical 200-300 mesh silica gel. All reactions were carried out under a nitrogen atmosphere. All commercially available reagents were used as received for the reactions without any purification. All solvents were dried on alumina columns using a solvent dispensing system.

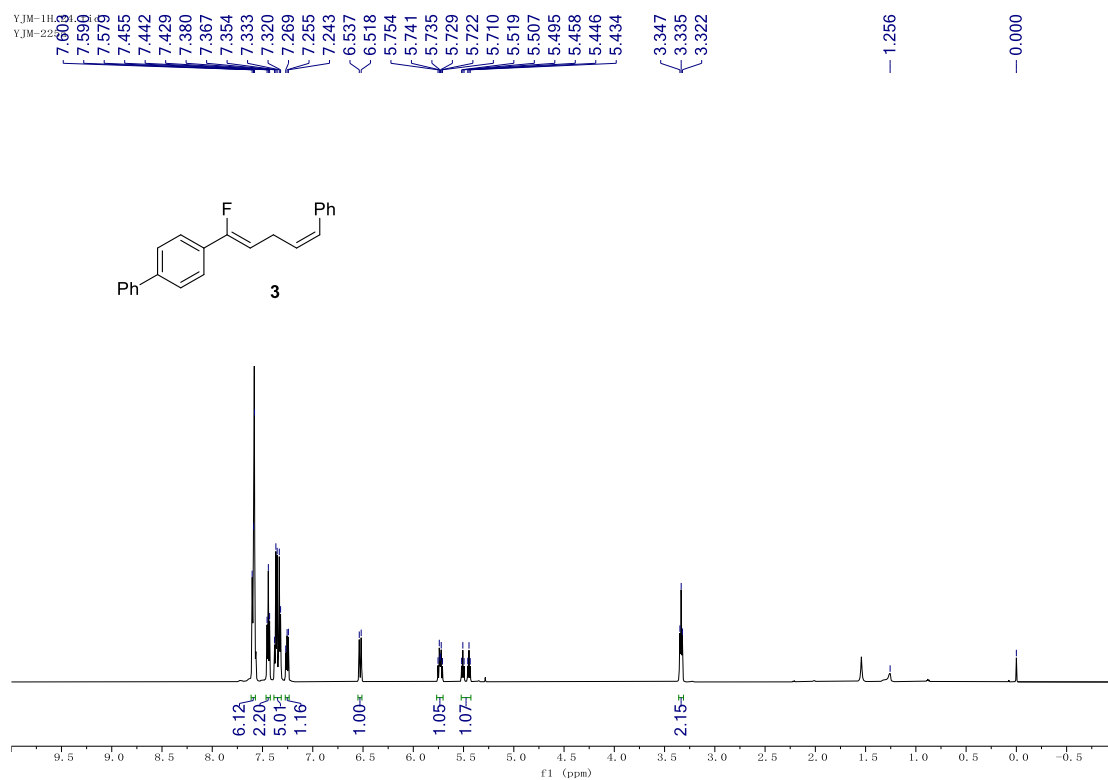
Materials: $[\text{Rh}(\text{COD})_2]\text{BF}_4$ and LiO'Bu were obtained from commercial suppliers and used without further purification. All Solvents were purified by standard procedure before use. Allylic *gem*-Difluorides,¹⁻² allylic alcohols³⁻⁴ are synthesis via the known procedures.

II References

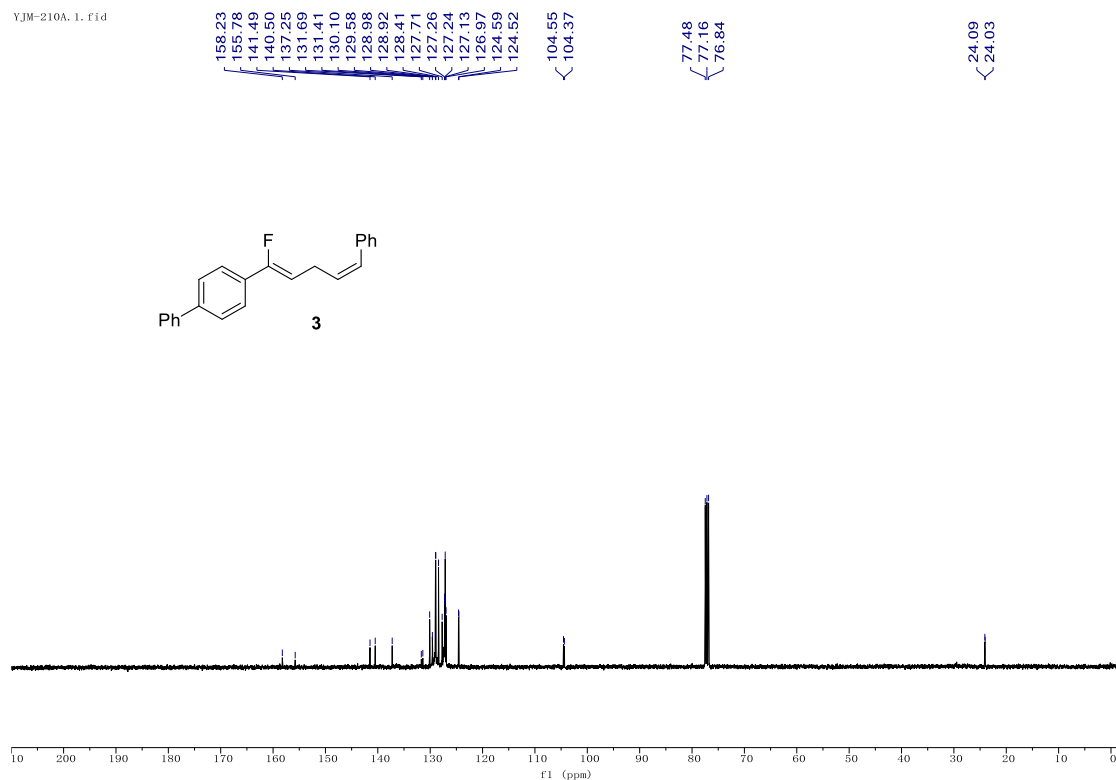
- 1 Q.-Q. Min, Z. Yin, Z. Feng, W.-H. Guo and X. Zhang, *J. Am. Chem. Soc.* 2014, **136**, 1230-1233.
- 2 T. W Butcher, J. L. Yang, W. M. Amberg, N. B. Watkins, N. D. Wilkinson and J. F. Hartwig, *Nature* 2020, **583**, 548-553.
- 3 Loui, H. J.; Schneider, C., *Org. Lett.* 2022, **24**, 1496-1501.
- 4 X. Wen, X. Shi, X. Qiao, Z. Wu and G. Bai, *Chem. Commun.* 2017, **53**, 5372-5375.

III NMR spectra

^1H NMR (600 MHz, CDCl_3)

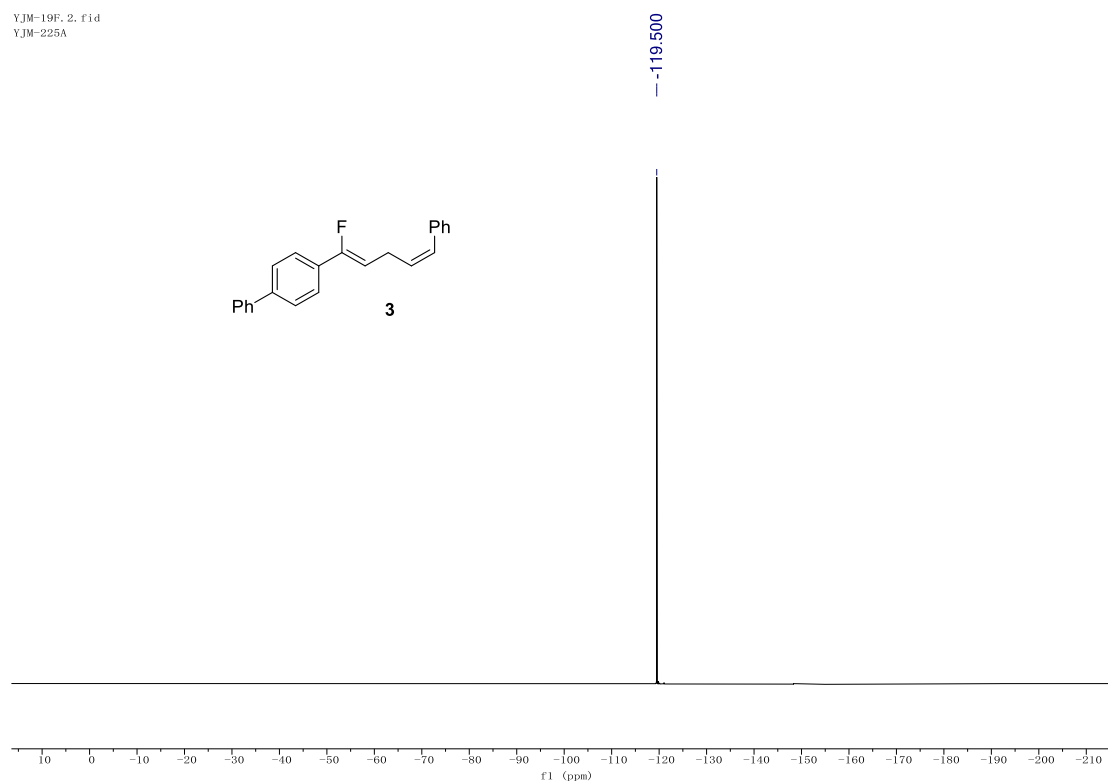


^{13}C NMR (101 MHz, CDCl_3)



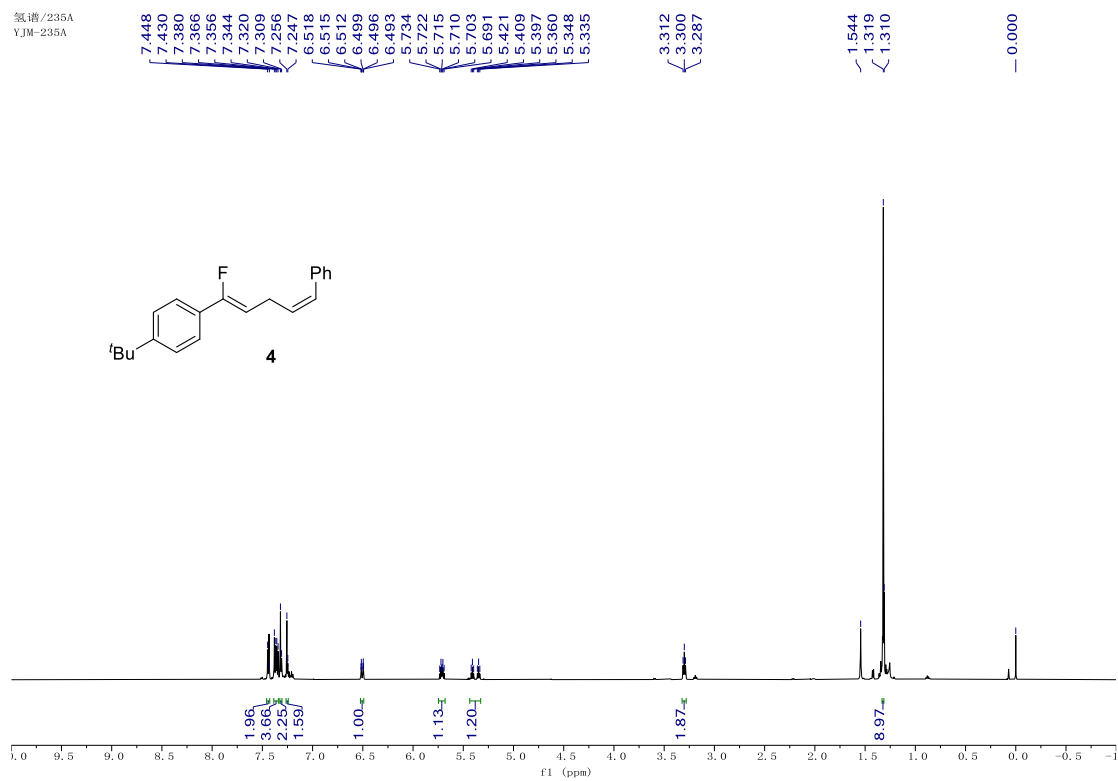
¹⁹F NMR (565 MHz, CDCl₃)

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YJM-225A



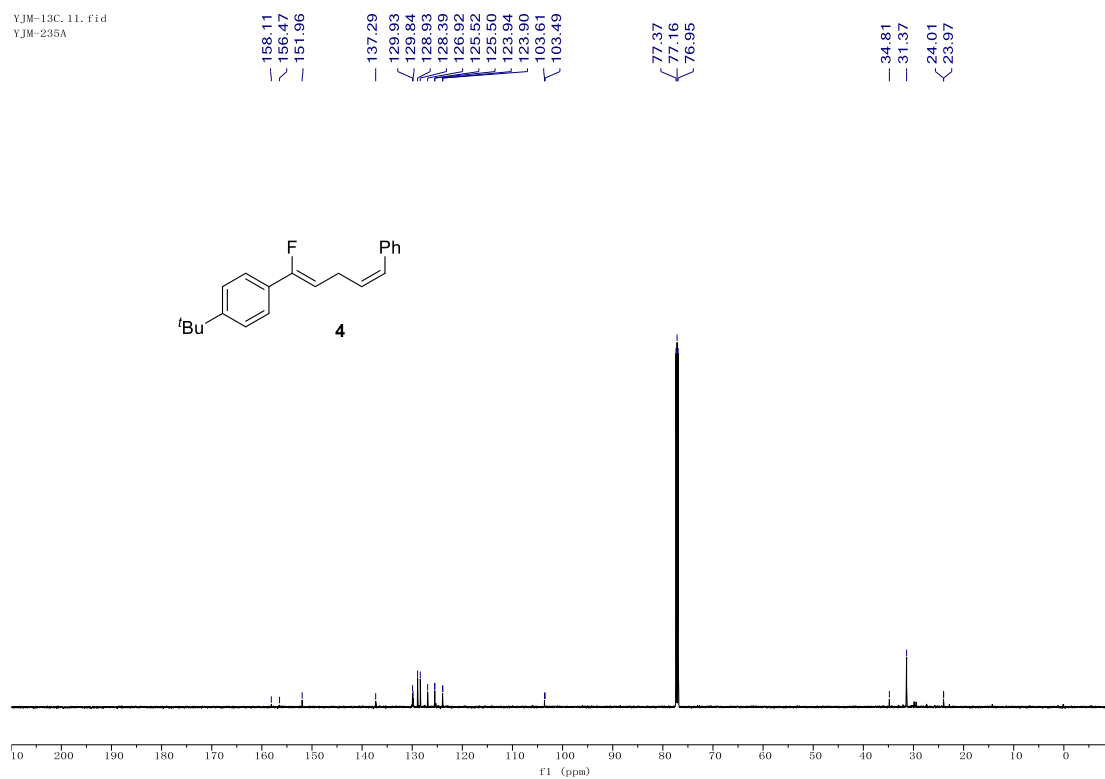
¹H NMR (600 MHz, CDCl₃)

氢谱/235A
YJM-235A



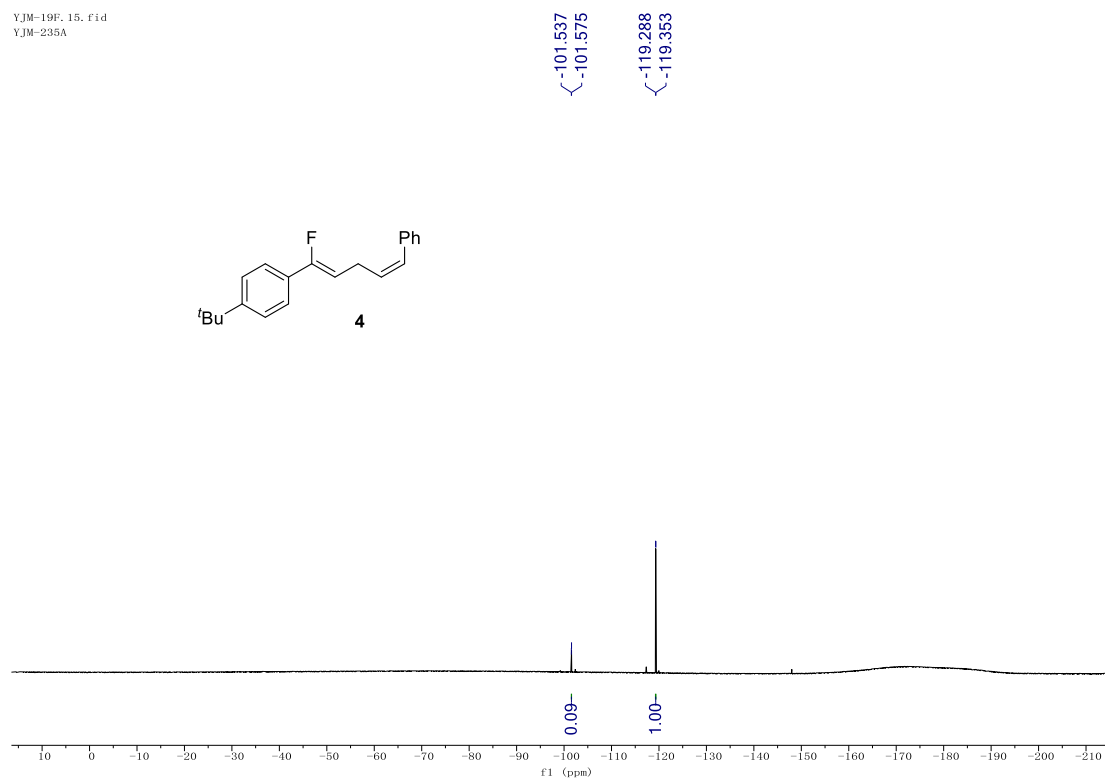
¹³C NMR (151 MHz, CDCl₃)

YJM-13C_11.fid
YJM-235A



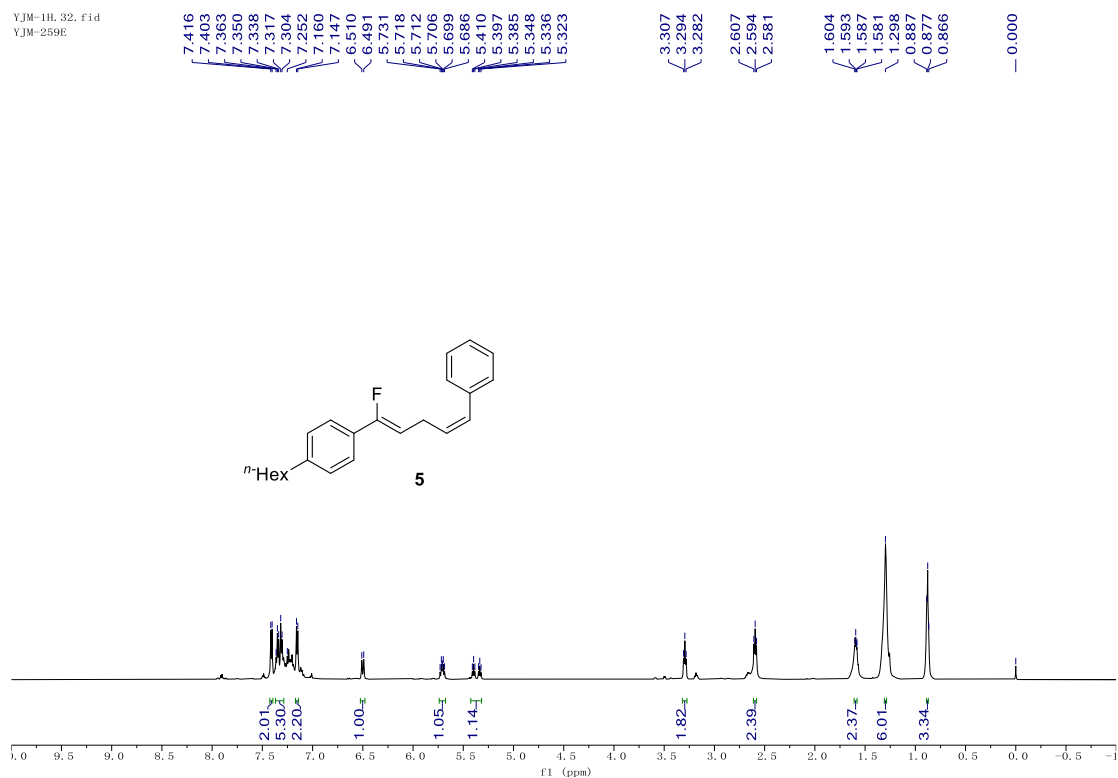
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YJM-235A



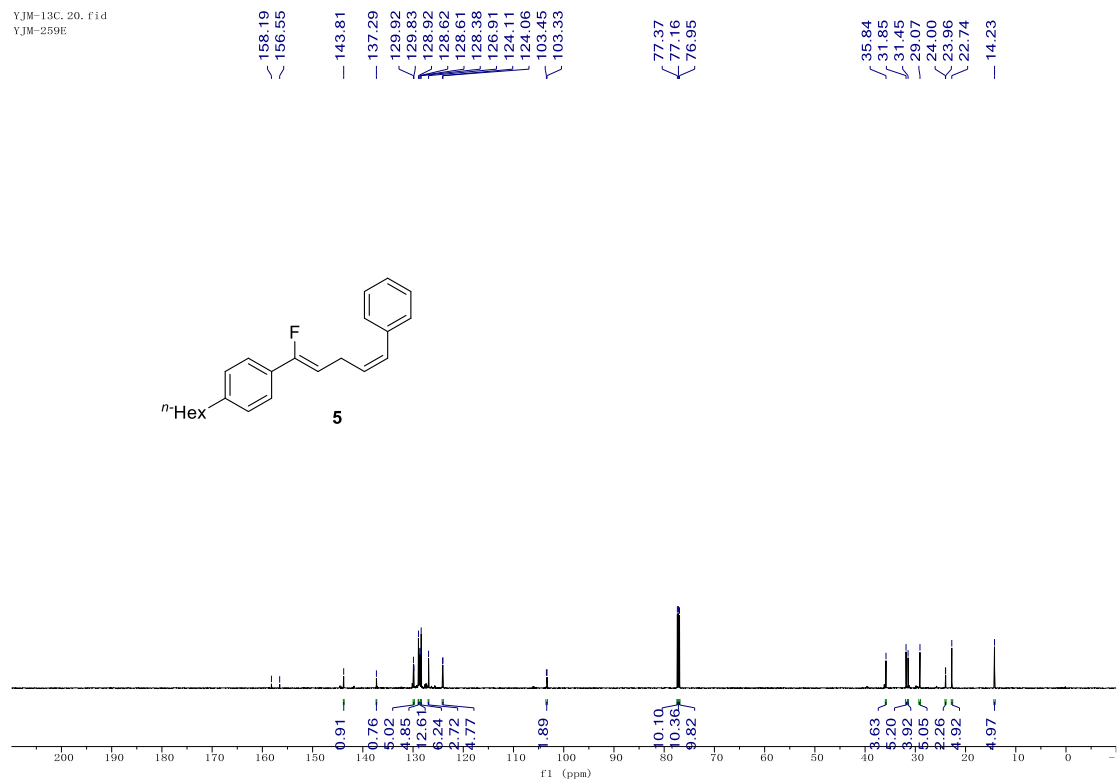
¹H NMR (600 MHz, CDCl₃)

YJM-1H_32.fid
YJM-259E



¹³C NMR (151 MHz, CDCl₃)

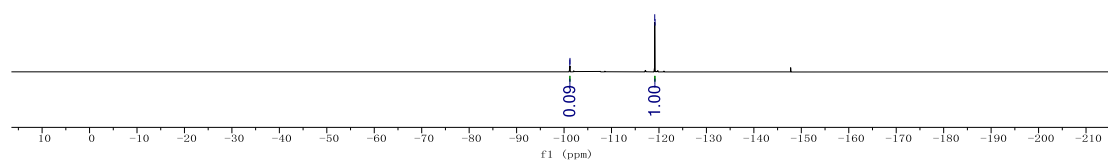
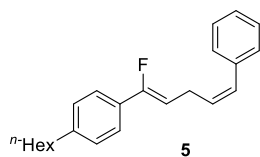
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YJM-259E



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YJM-19F_22.fid
YJM-259E

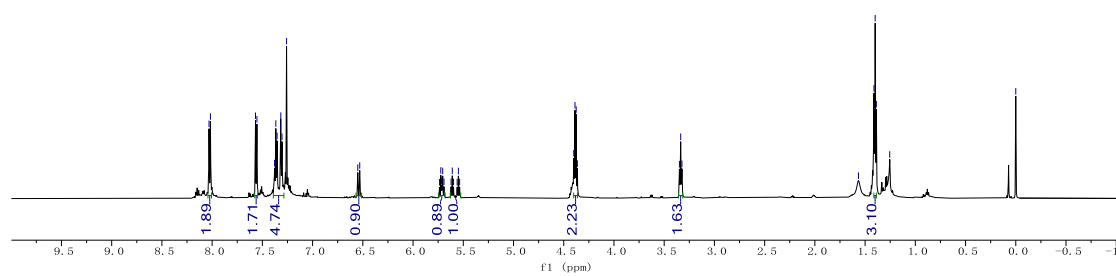
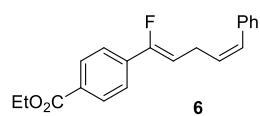
-101.209
-101.246
-119.109
-119.174



¹H NMR (600 MHz, CDCl₃)

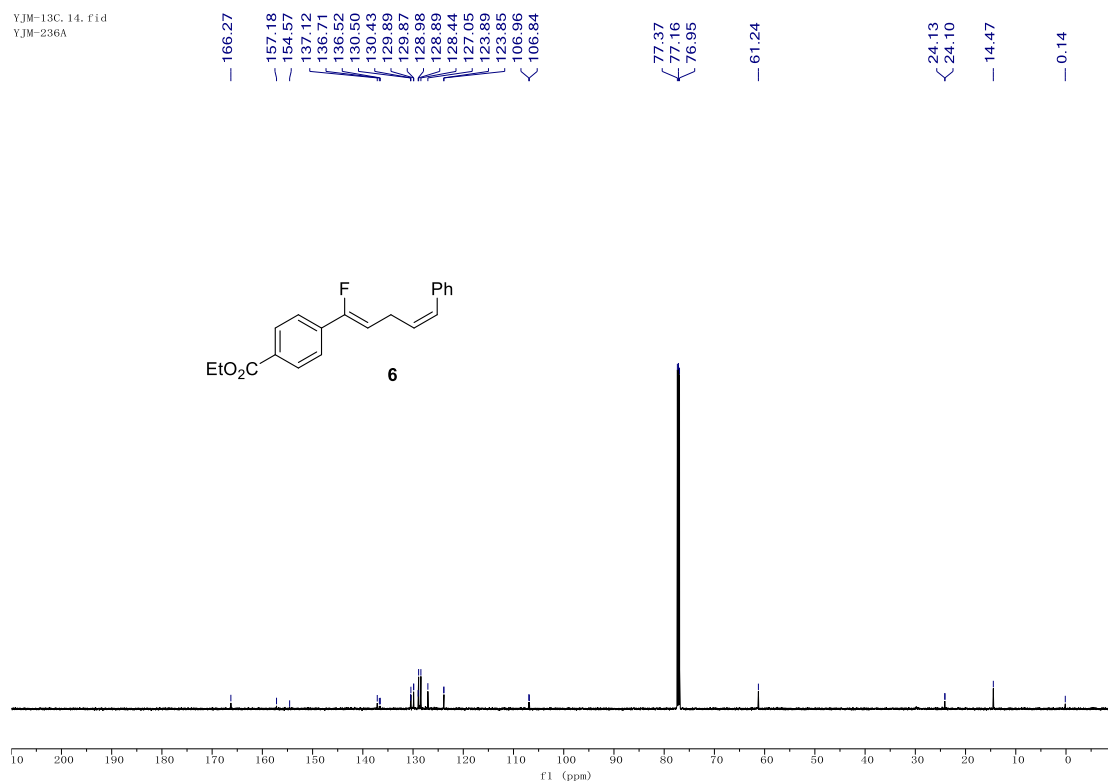
YJM-1H_97.fid
YJM-236a

8.031
8.017
7.568
7.554
7.379
7.366
7.354
7.319
7.316
7.304
7.259
6.550
6.531
5.736
5.724
5.717
5.711
5.705
5.692
5.609
5.597
5.561
5.549
5.536
4.400
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3.348
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3.323
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1.400
1.388
1.255
-0.000



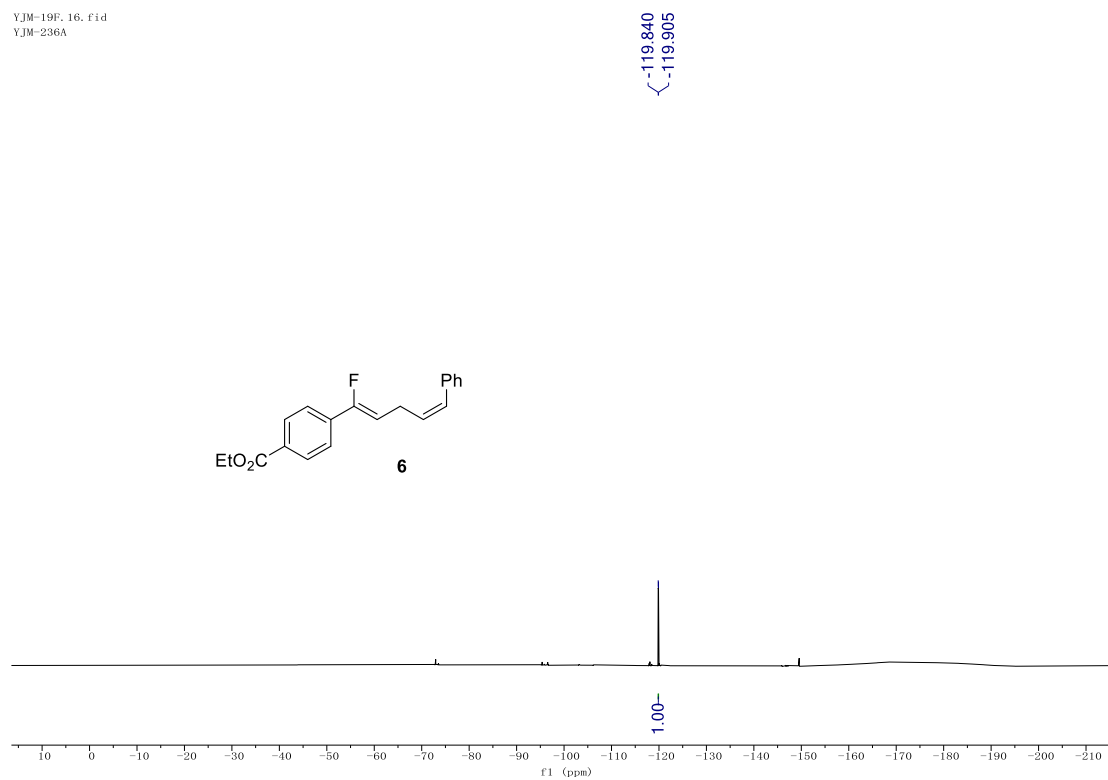
¹³C NMR (151 MHz, CDCl₃)

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YJM-236A

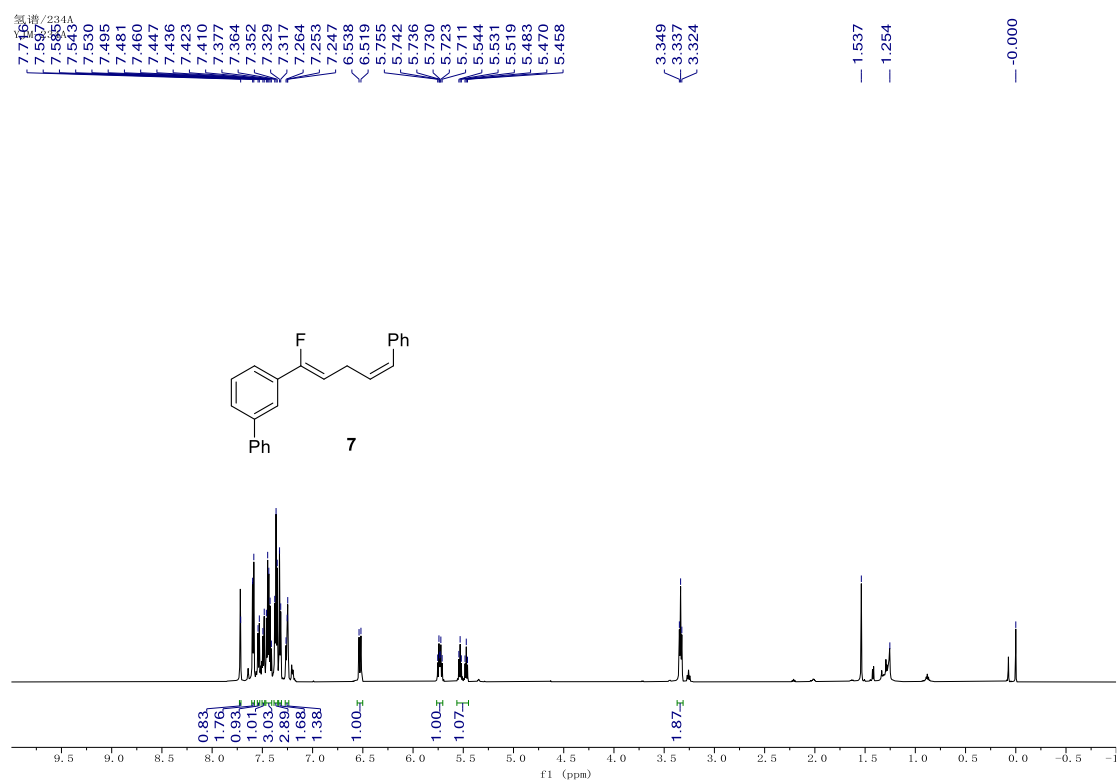


¹⁹F NMR (565 MHz, CDCl₃)

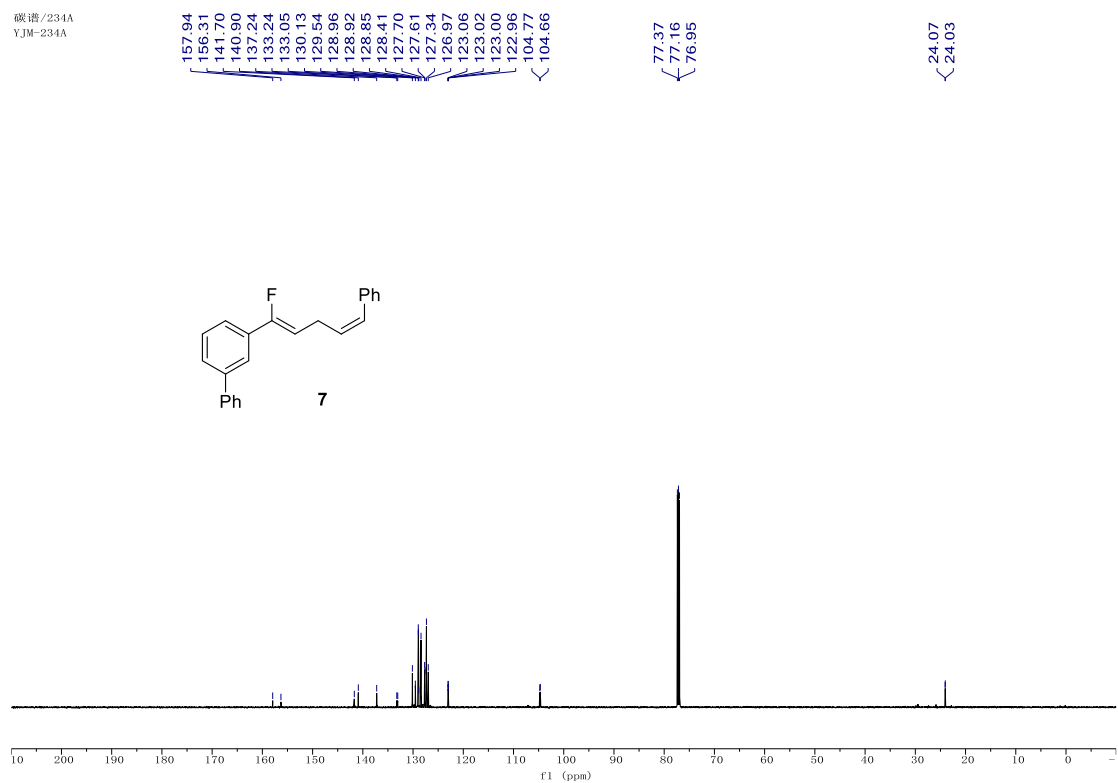
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YJM-236A



¹H NMR (600 MHz, CDCl₃)

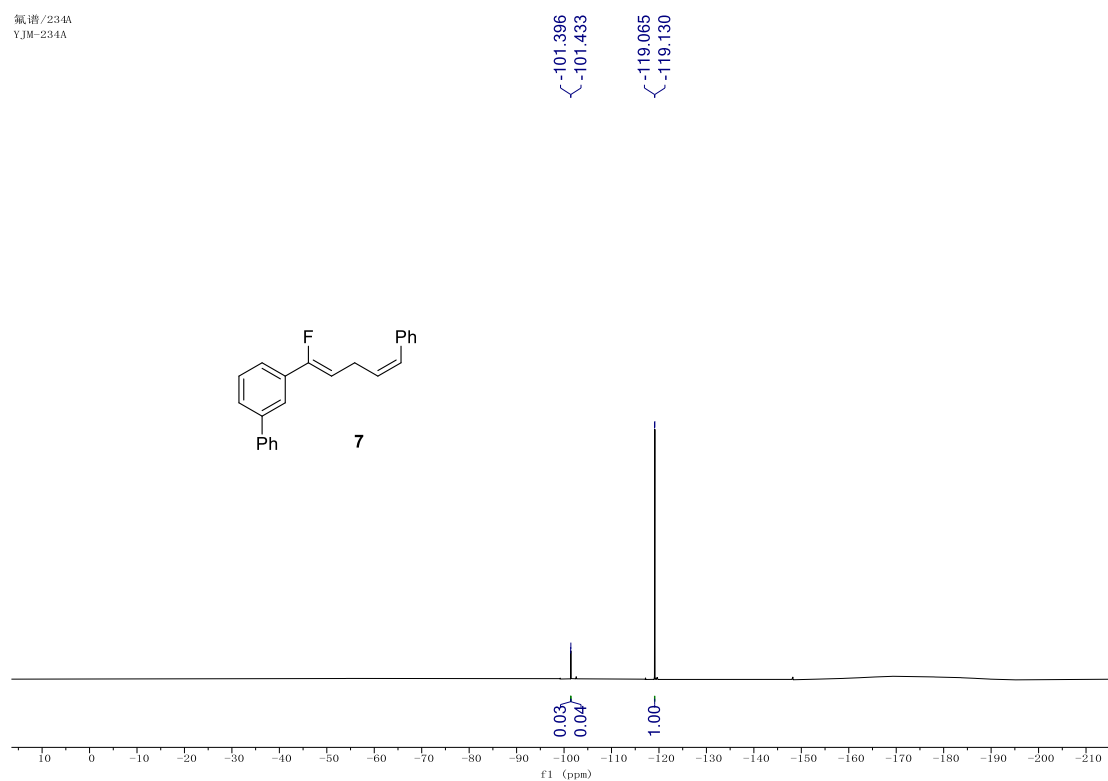


¹³C NMR (151 MHz, CDCl₃)



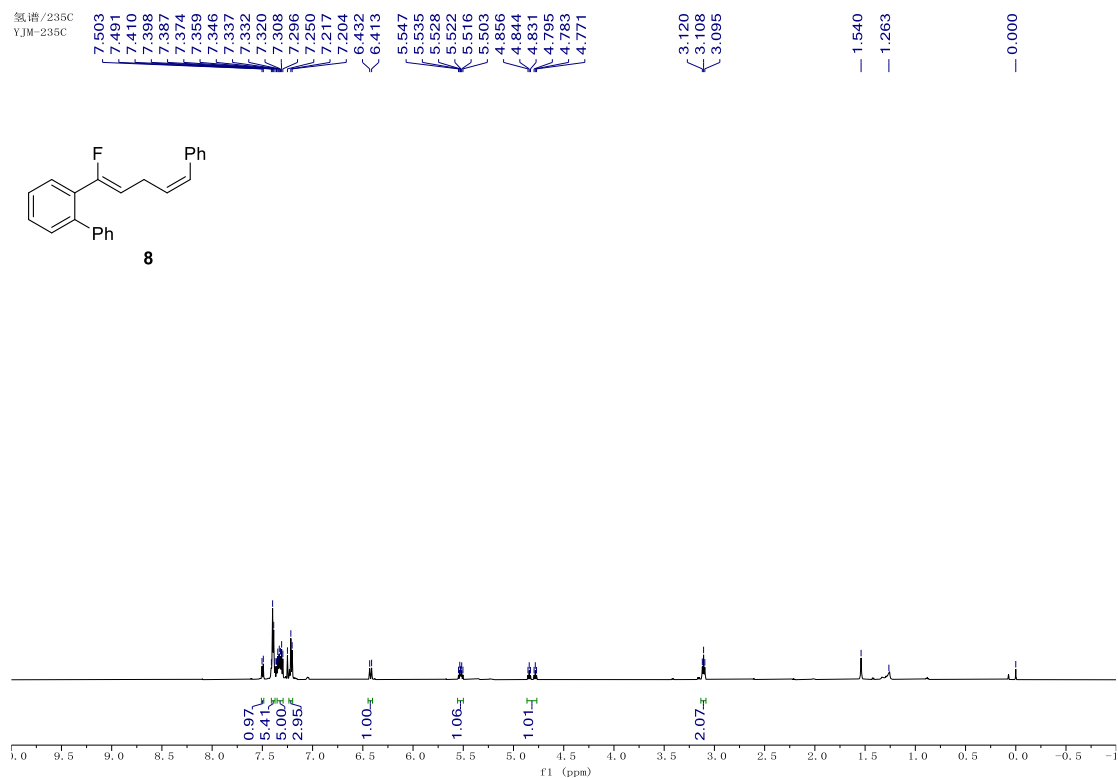
¹⁹F NMR (565 MHz, CDCl₃)

氟谱 / 234A
YJM-234A



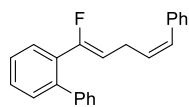
¹H NMR (600 MHz, CDCl₃)

氢谱 / 235C
YJM-235C



¹³C NMR (151 MHz, CDCl₃)

碳谱/235C
YJM-235C

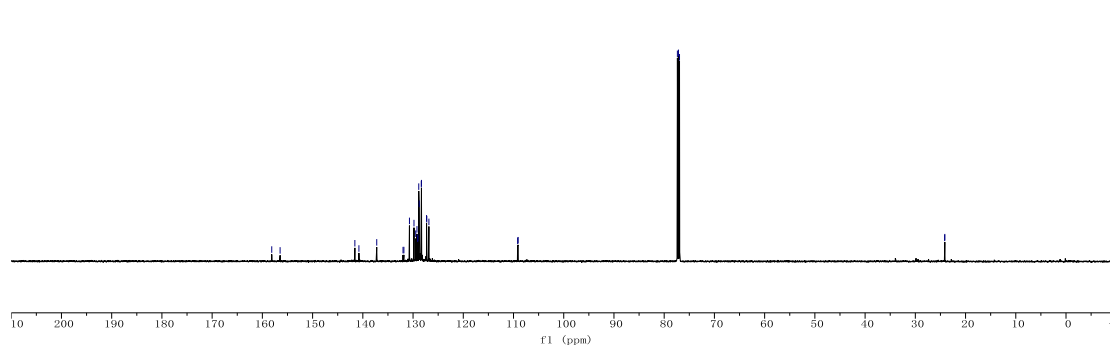


8

158.13
156.47
141.58
140.78
137.23
132.00
131.92
130.72
129.81
129.47
129.08
129.05
128.86
128.77
128.36
128.33
127.31
127.27
126.84
109.18
109.07

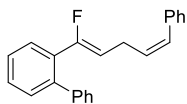
77.37
77.16
76.95

24.16
24.13



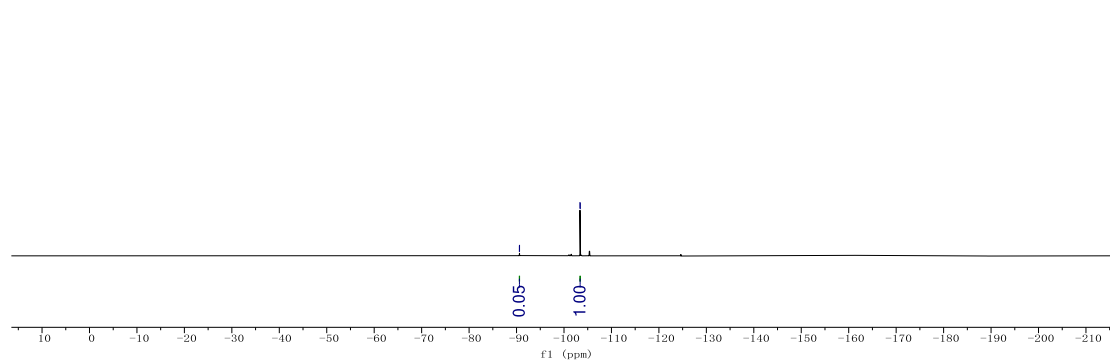
¹⁹F NMR (565 MHz, CDCl₃)

氟谱/235C
YJM-235C

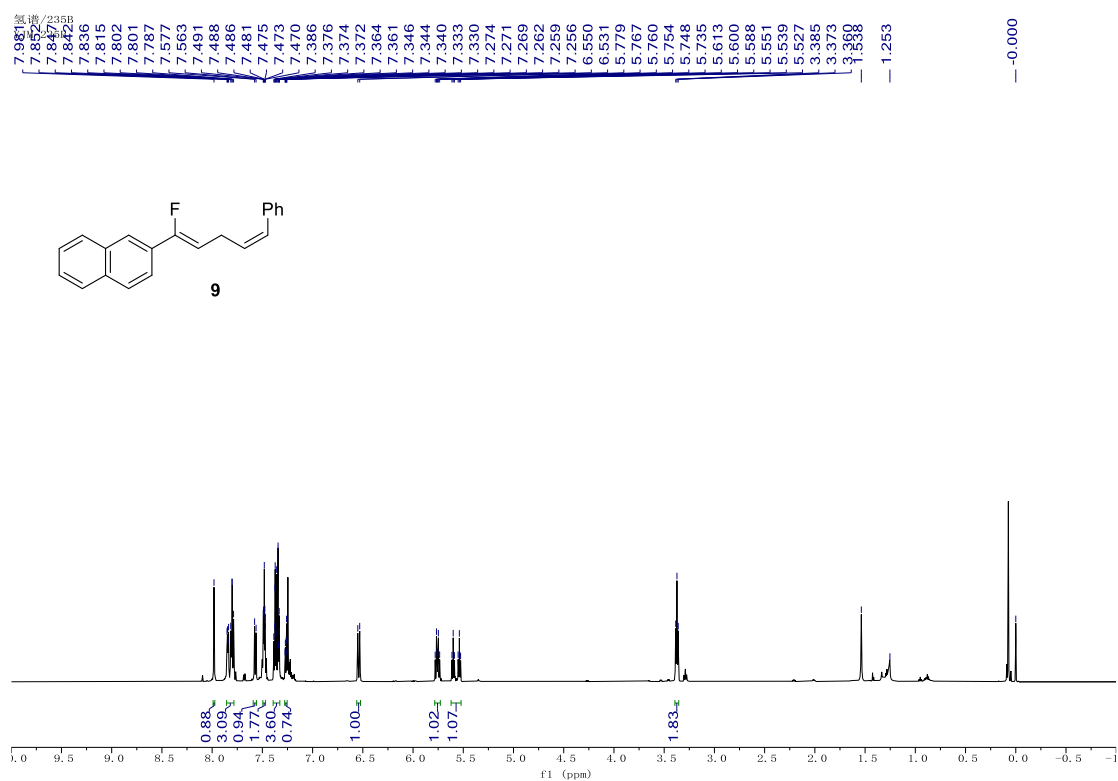


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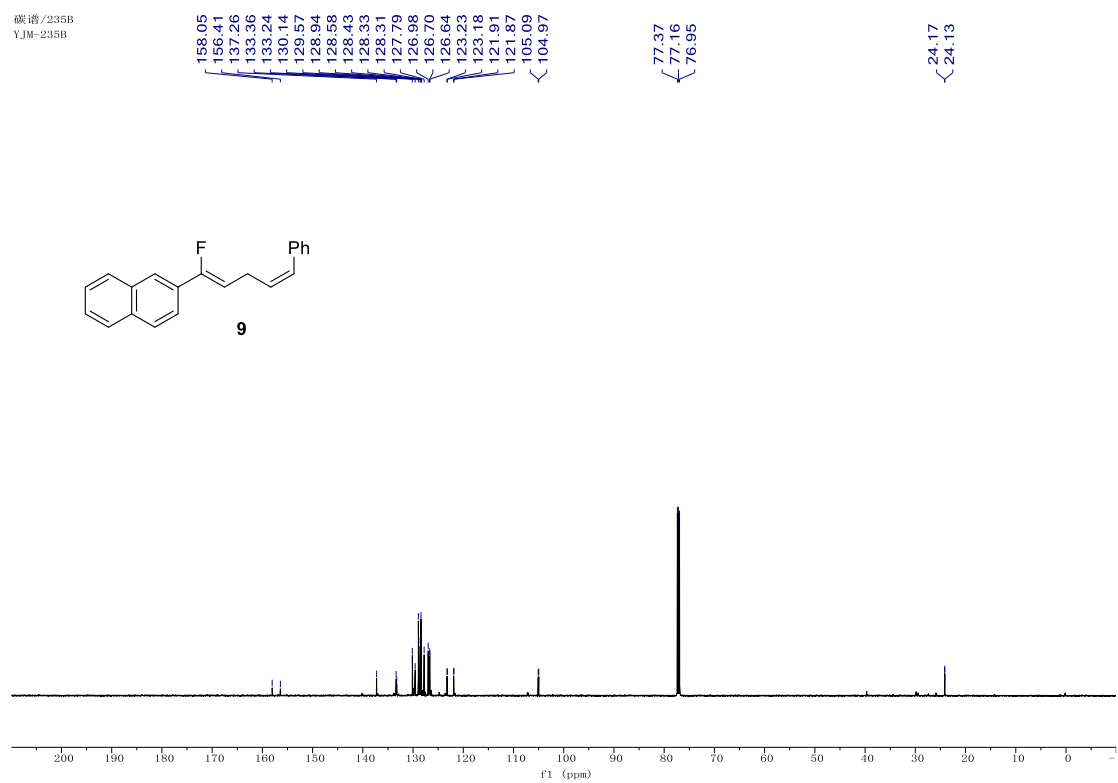
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-103.430



¹H NMR (600 MHz, CDCl₃)

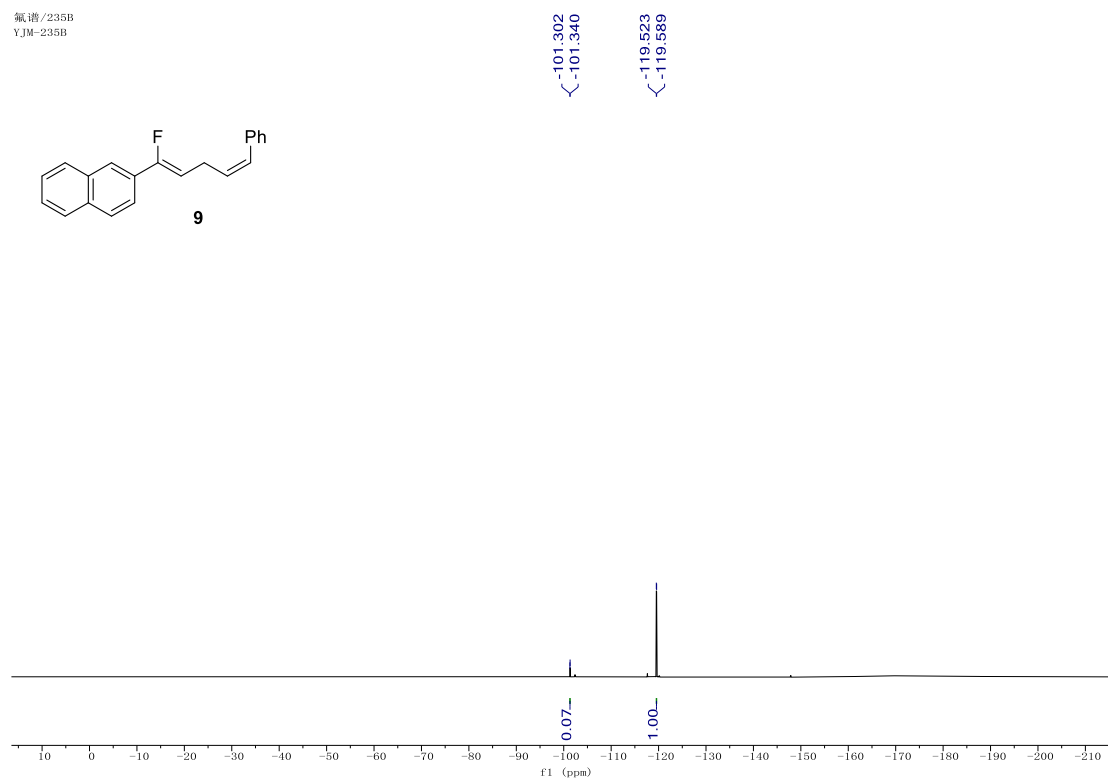


¹³C NMR (151 MHz, CDCl₃)



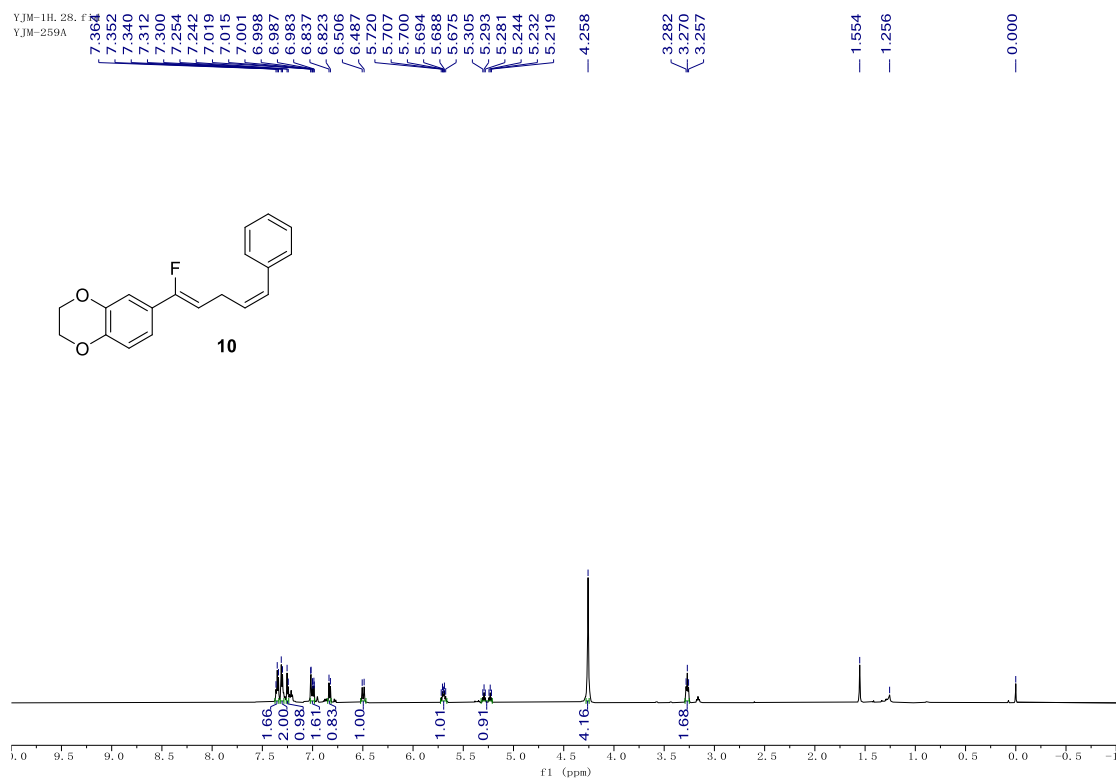
¹⁹F NMR (565 MHz, CDCl₃)

氟谱/235B
YJM-235B



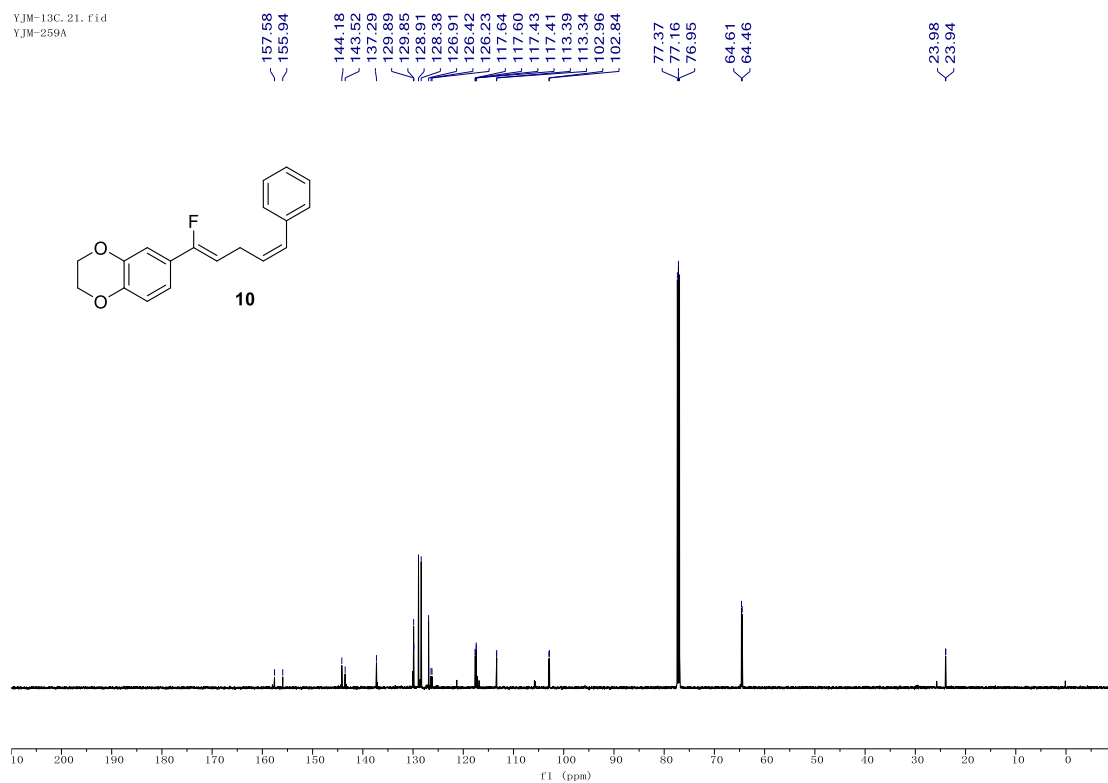
¹H NMR (600 MHz, CDCl₃)

YJM-1H, 28, f
YJM-259A



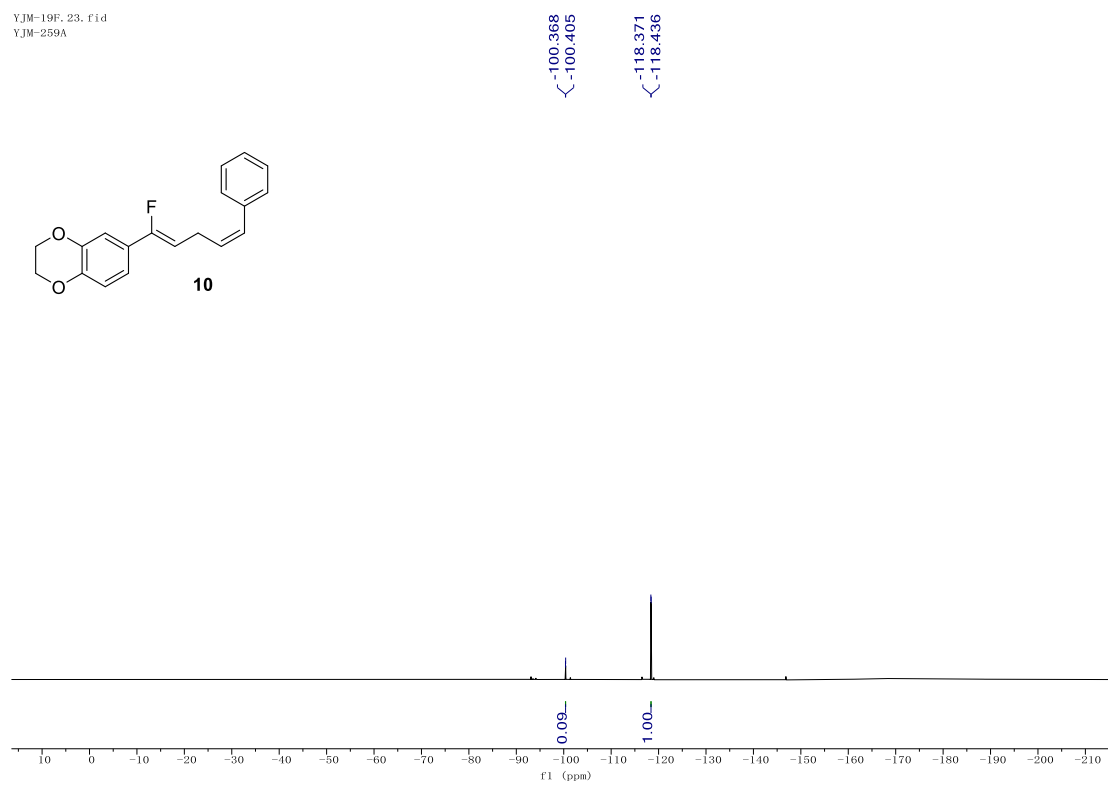
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YJM-13C. 21. f1d
YJM-259A



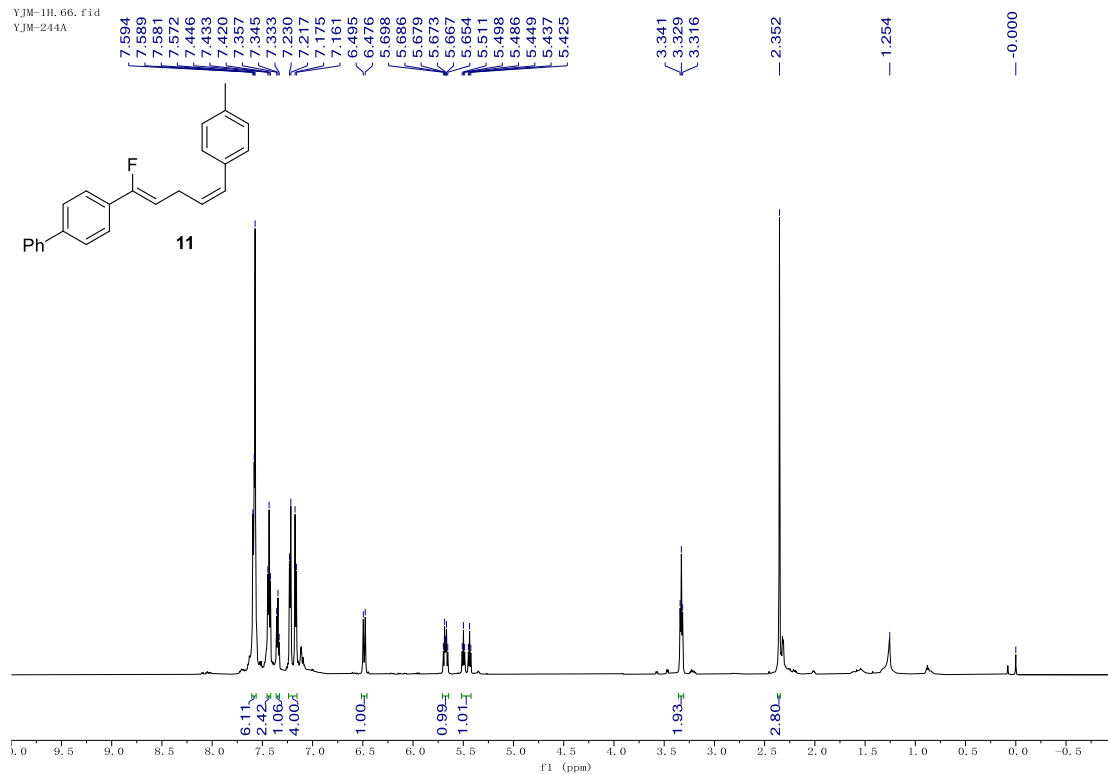
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YJM-19F. 23. f1d
YJM-259A



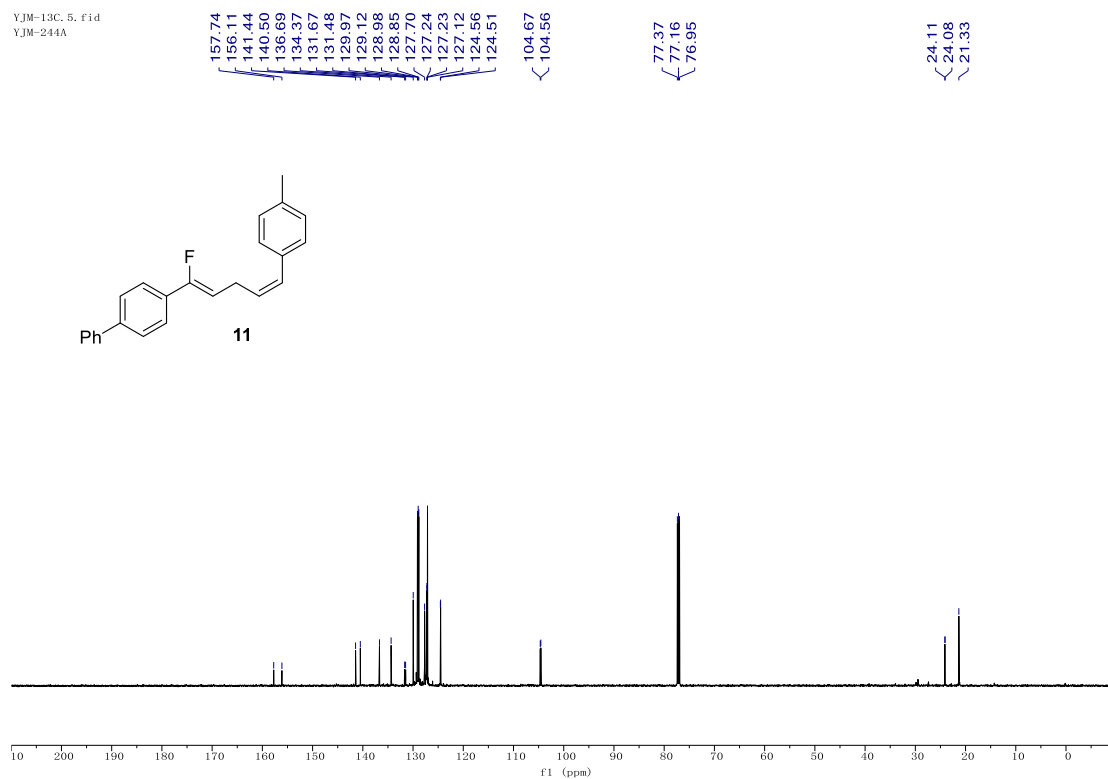
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YJM-1H, 66, f1d
YJM-244A



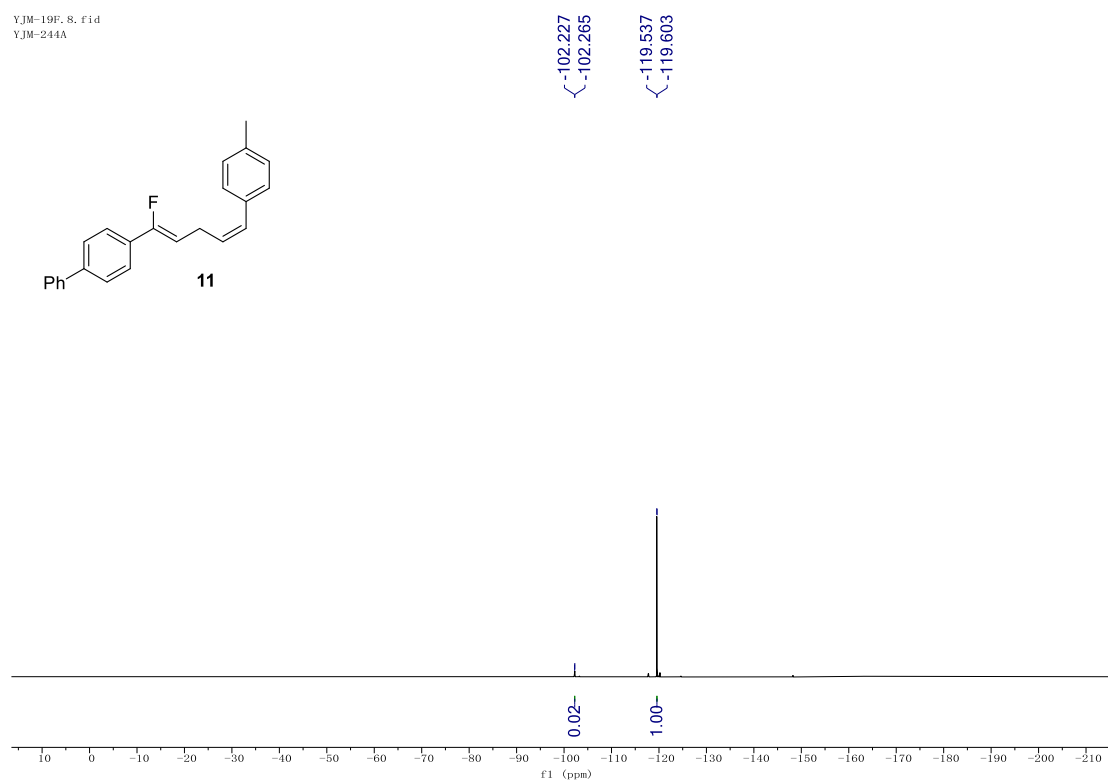
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YJM-13C, 5, f1d
YJM-244A

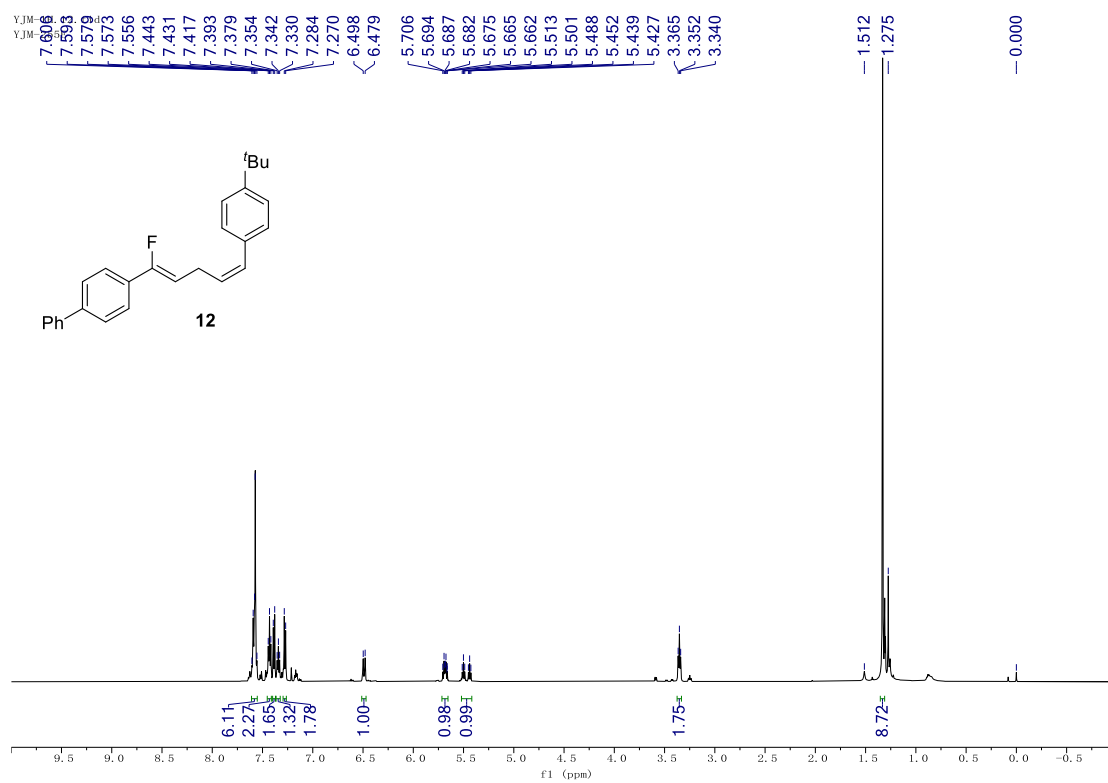


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YJM-19F, 8, f1d
YJM-244A

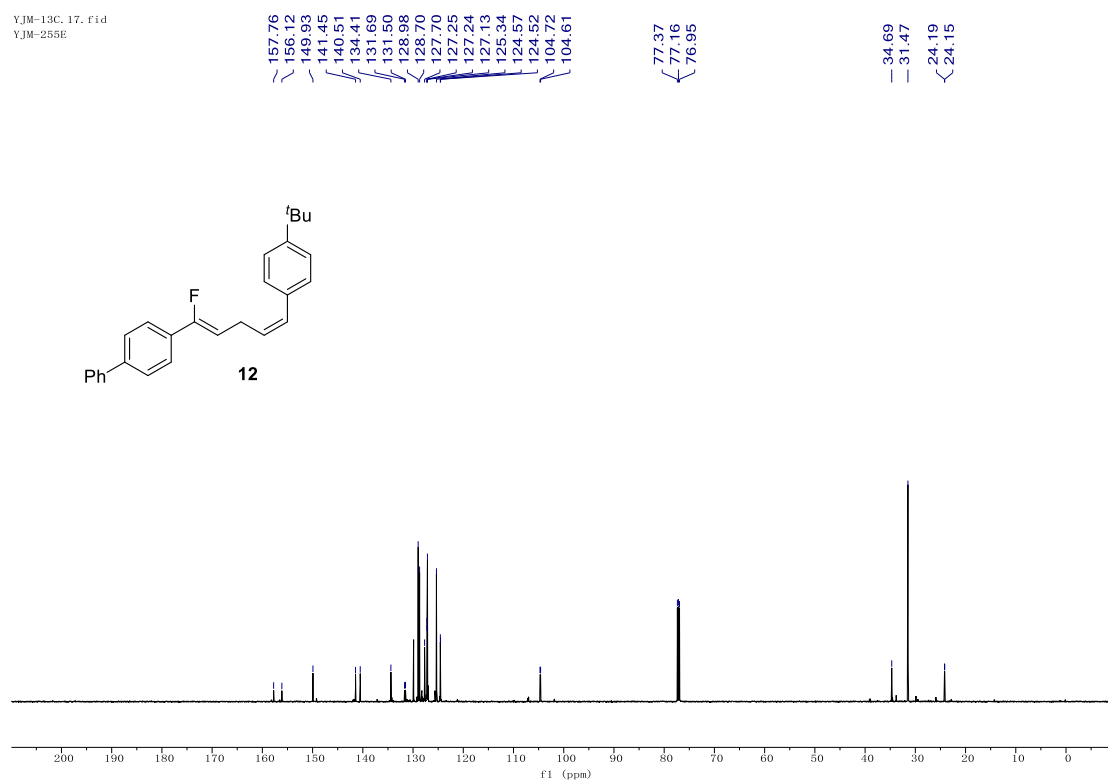


¹H NMR (600 MHz, CDCl₃)



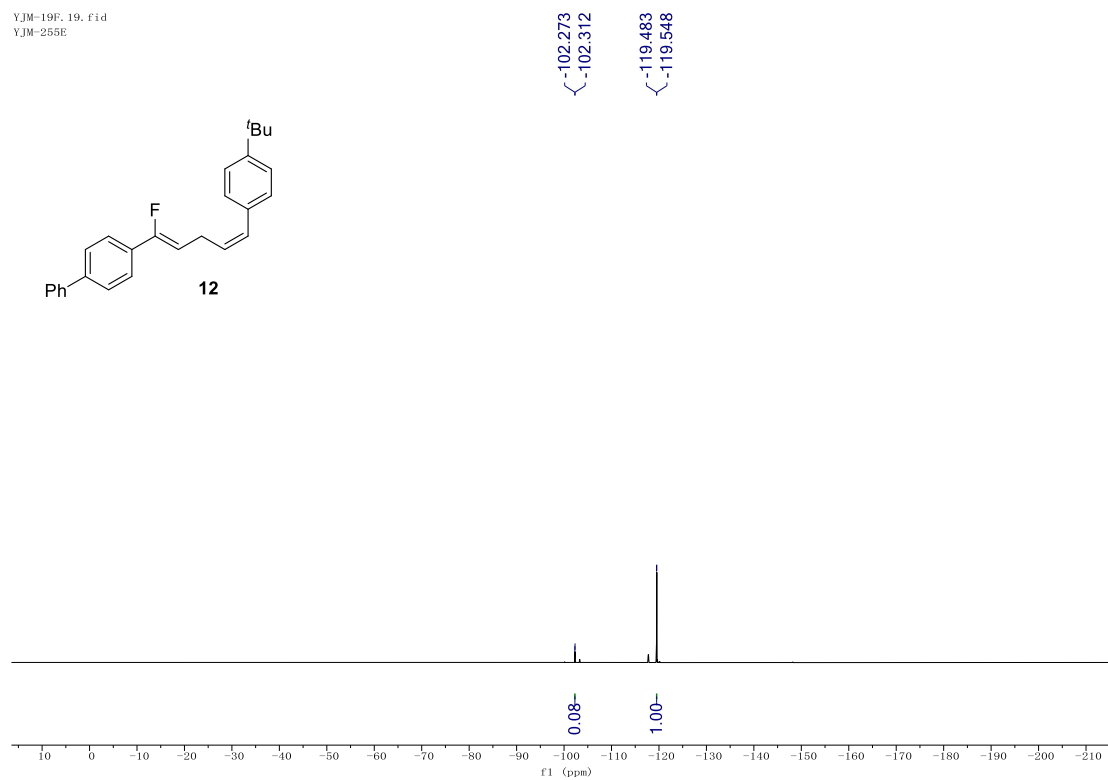
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YJM-13C. 17. fid
YJM-255E



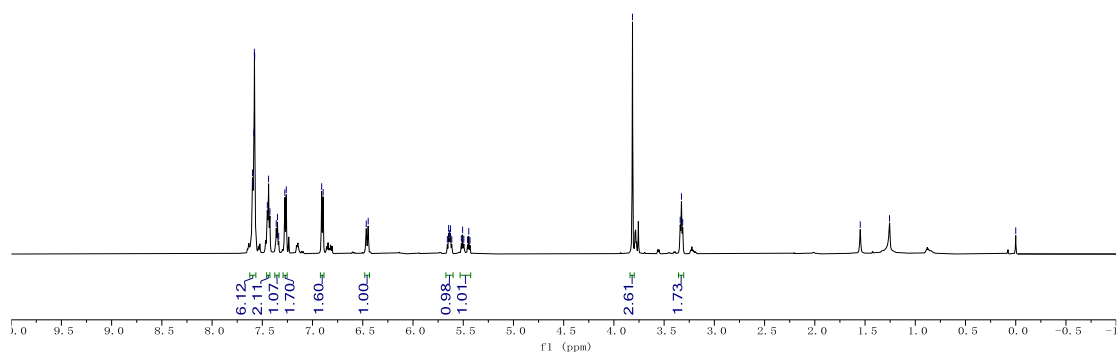
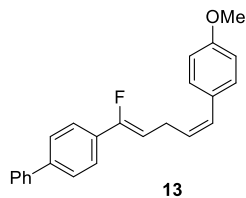
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YJM-19F. 19. fid
YJM-255E



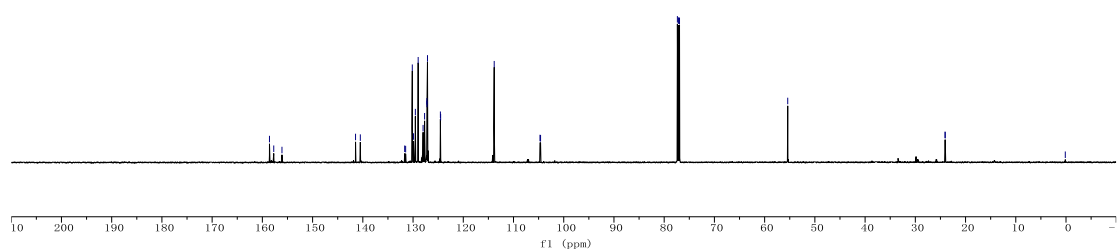
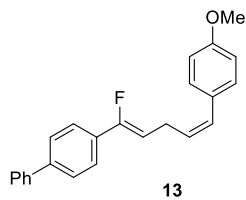
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YJM-1H, 43, f1.d
YJM-244E



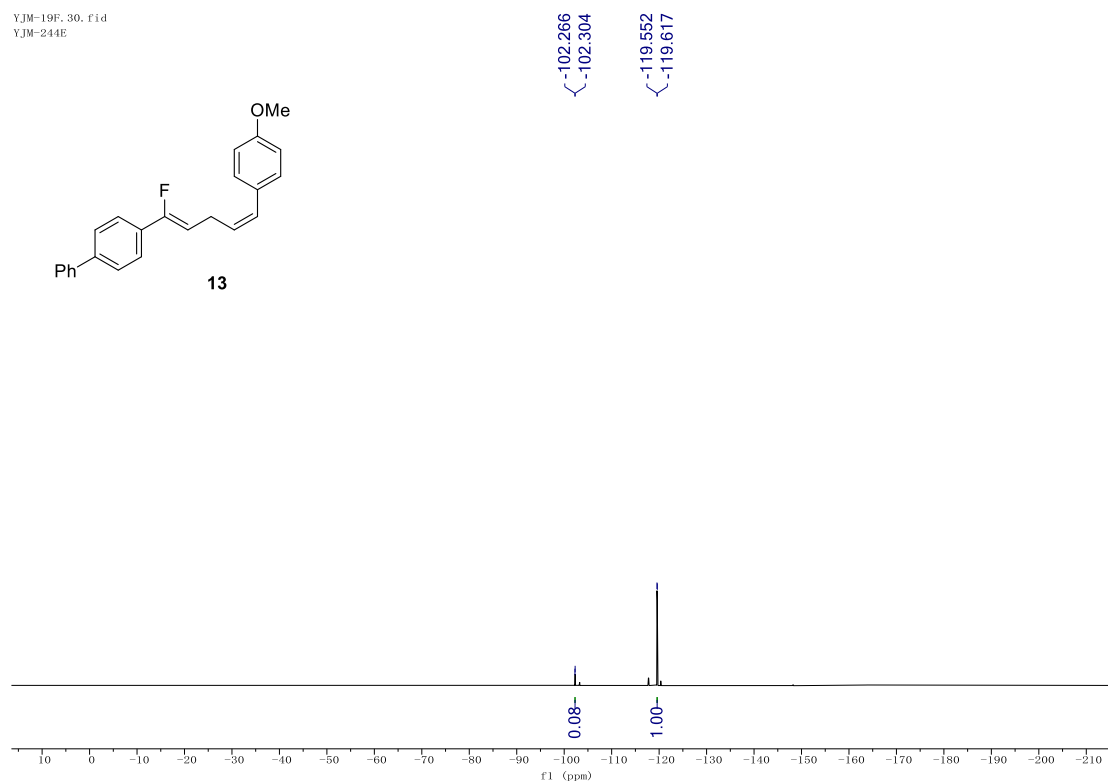
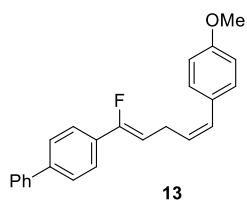
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YJM-13C, 28, f1.d
YJM-244E



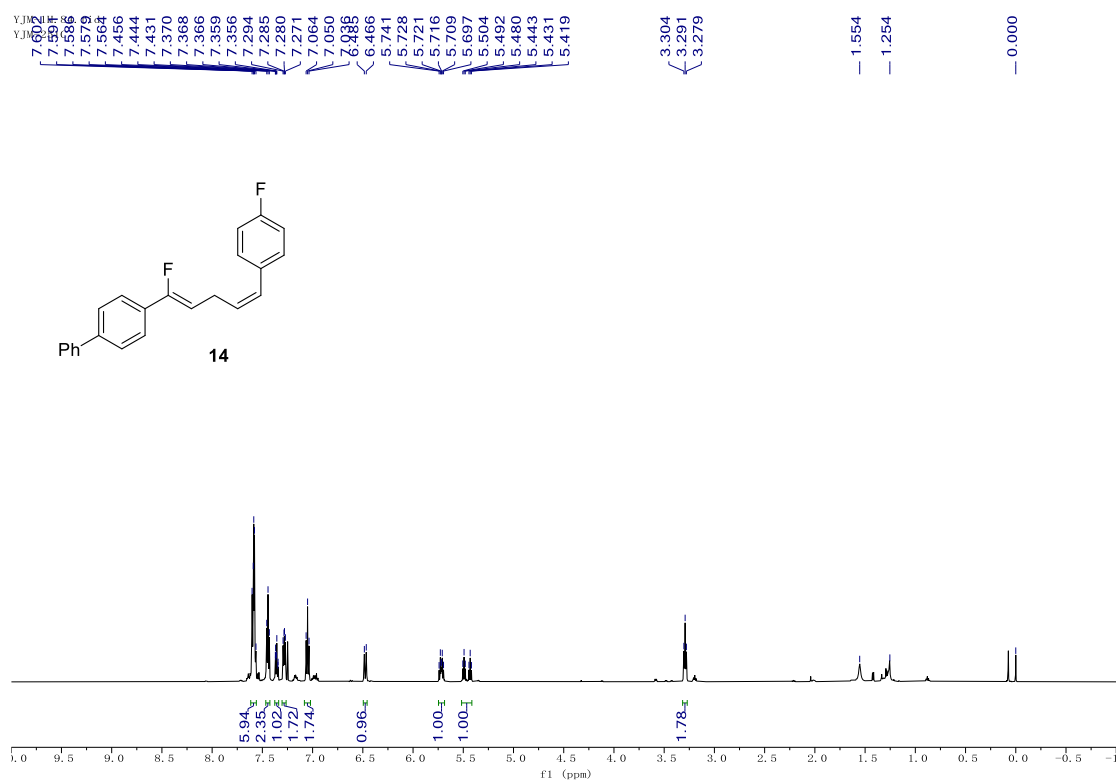
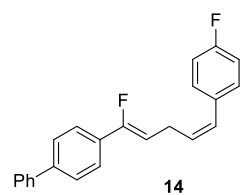
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YJM-19F, 30, f1d
YJM-244E



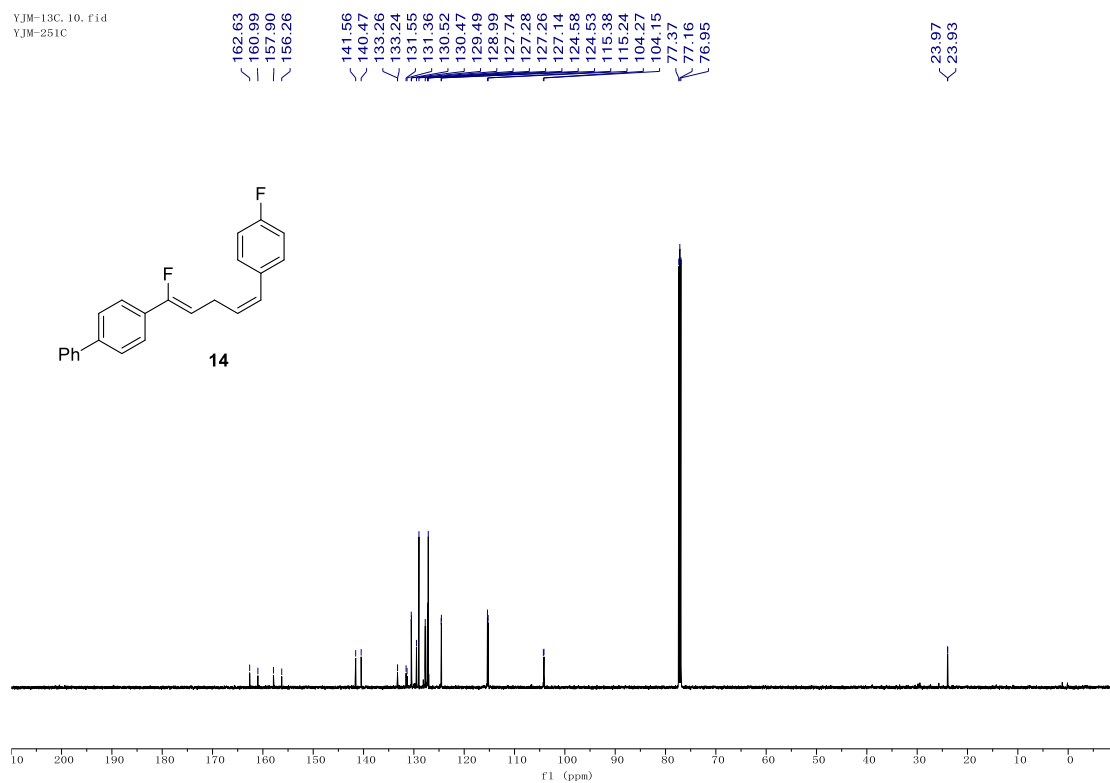
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YJM-19H, 30, f1d
YJM-244E



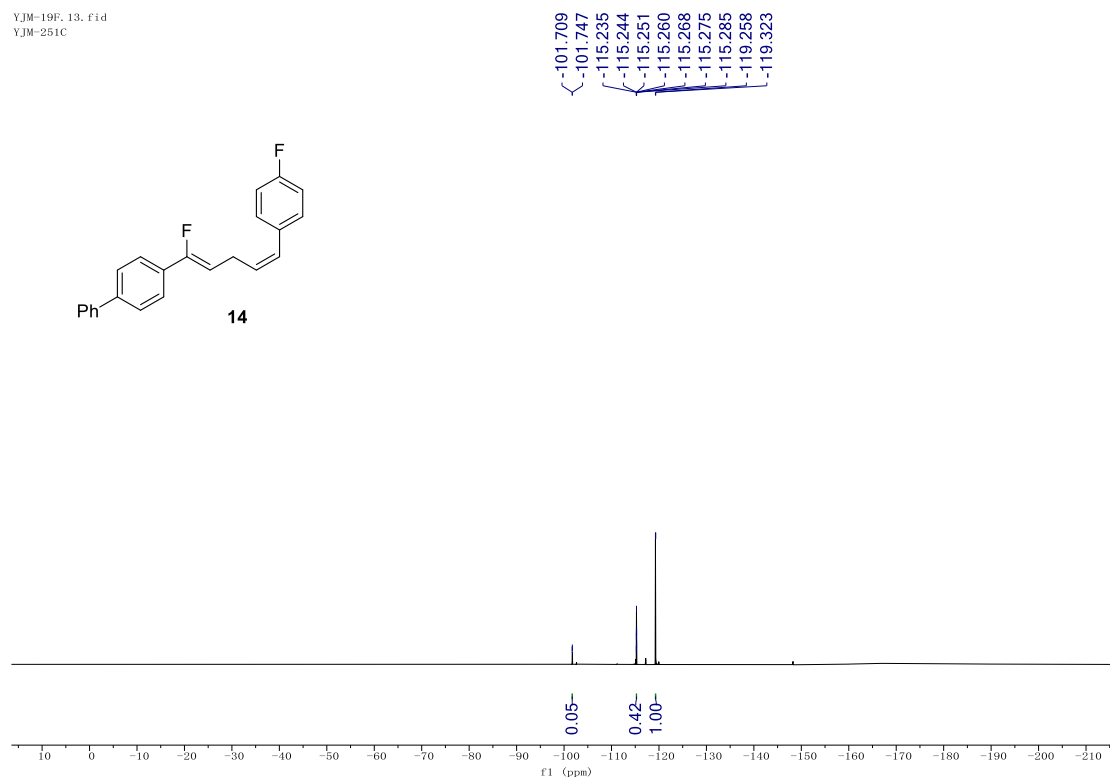
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YJM-13C. 10. f1d
YJM-251C



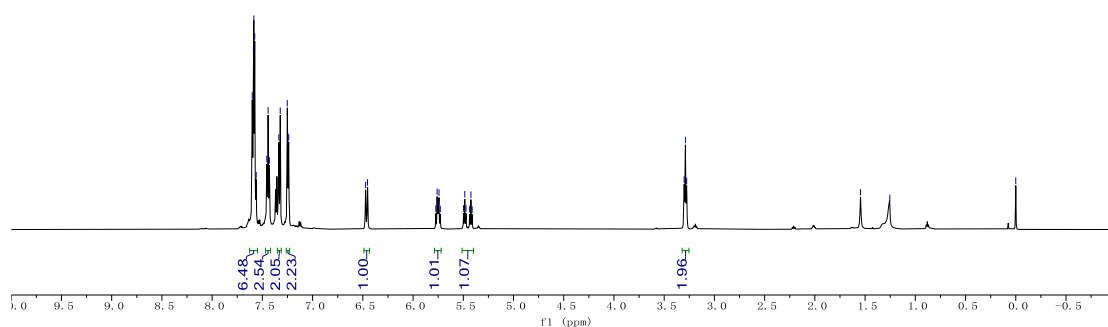
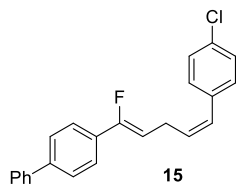
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YJM-19F. 13. f1d
YJM-251C



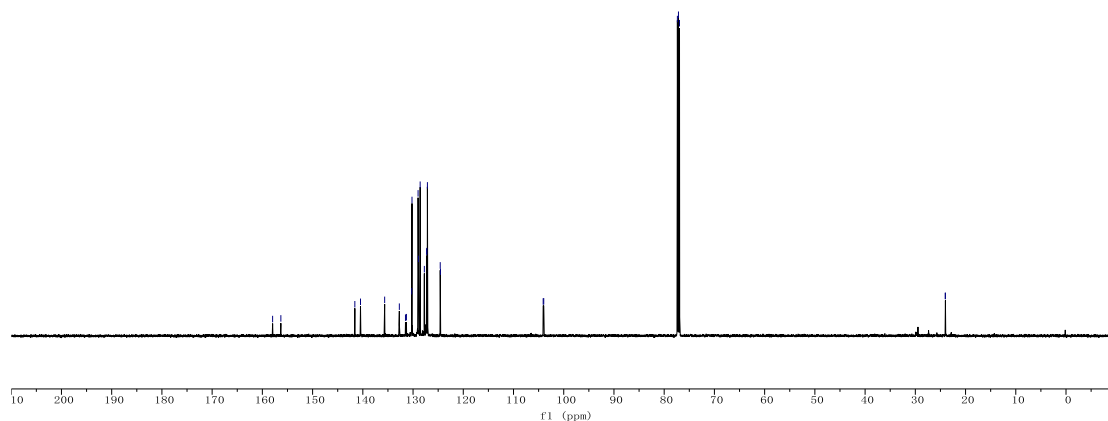
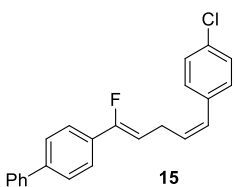
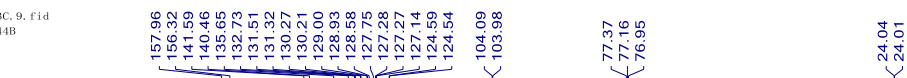
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YJM-1H, 73, f1d
YJM-244b



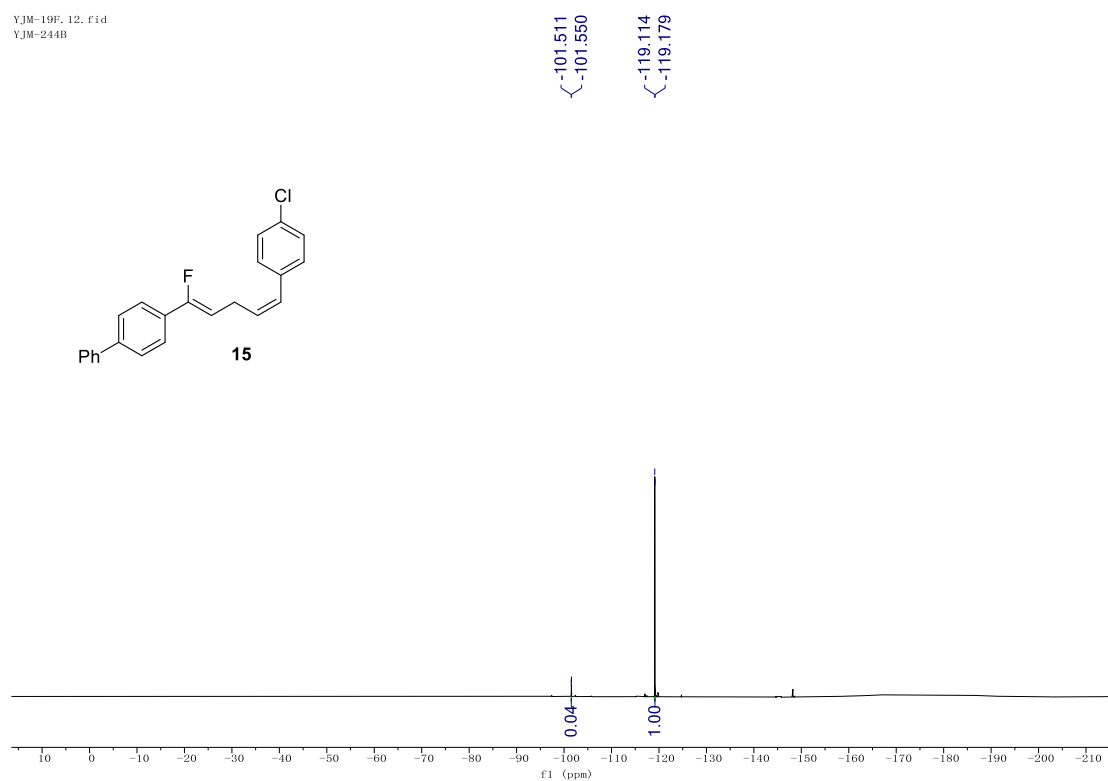
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YJM-13C, 9, f1d
YJM-244B



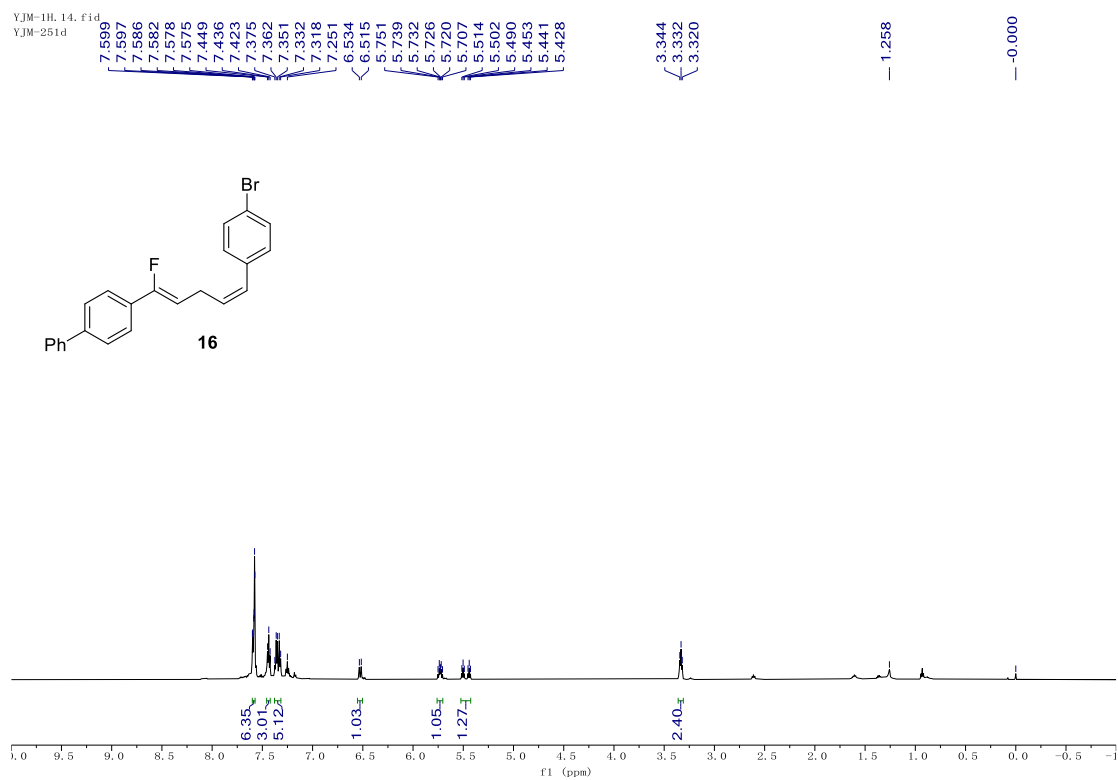
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YJM-19F. 12. fid
YJM-244B



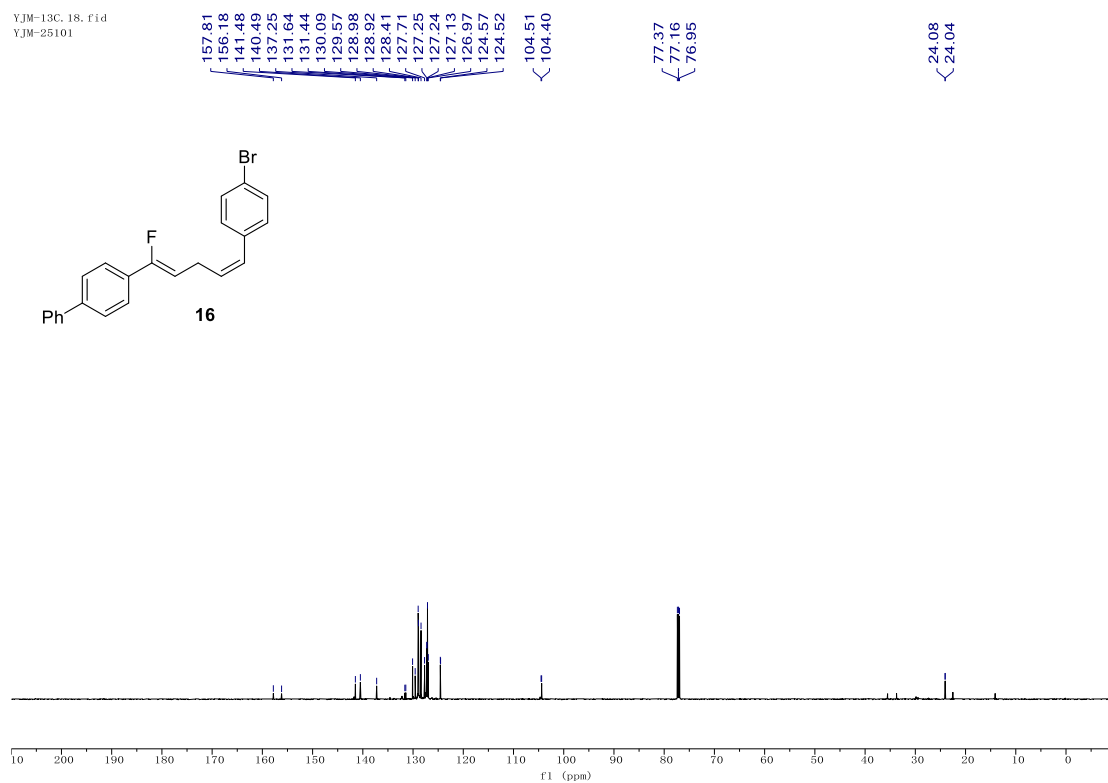
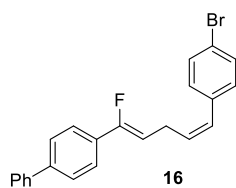
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YJM-1H. 14. fid
YJM-251d



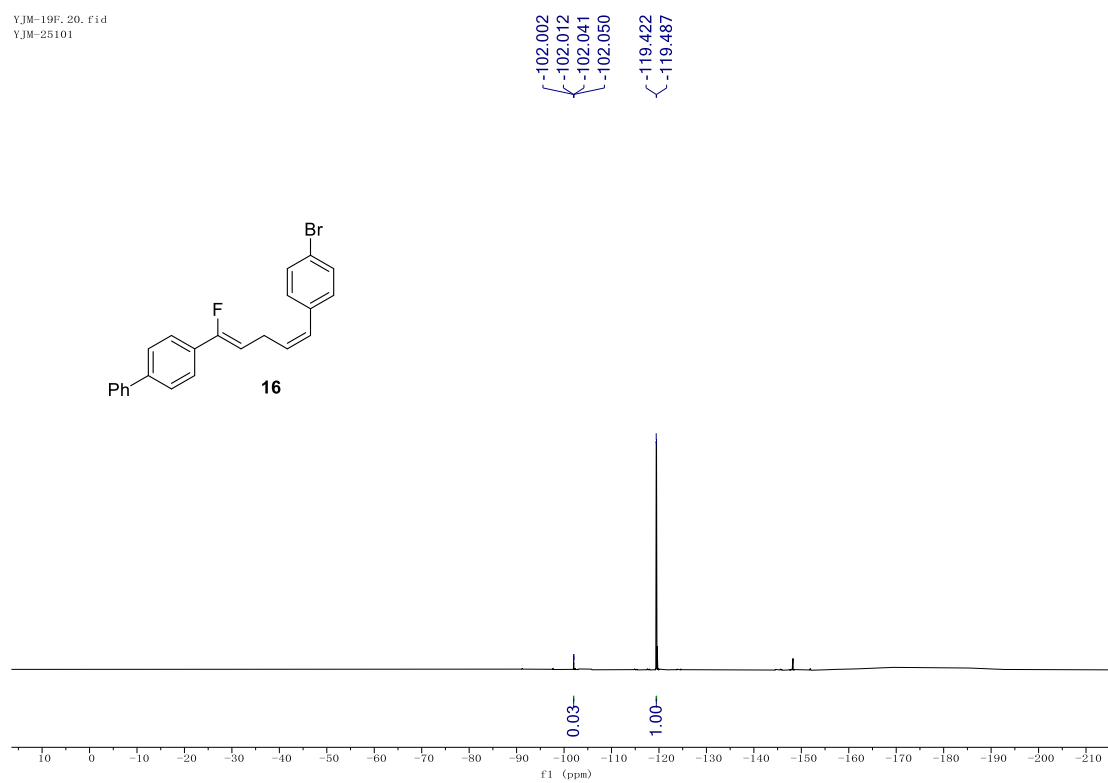
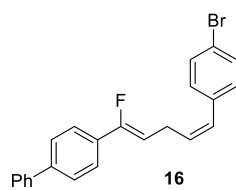
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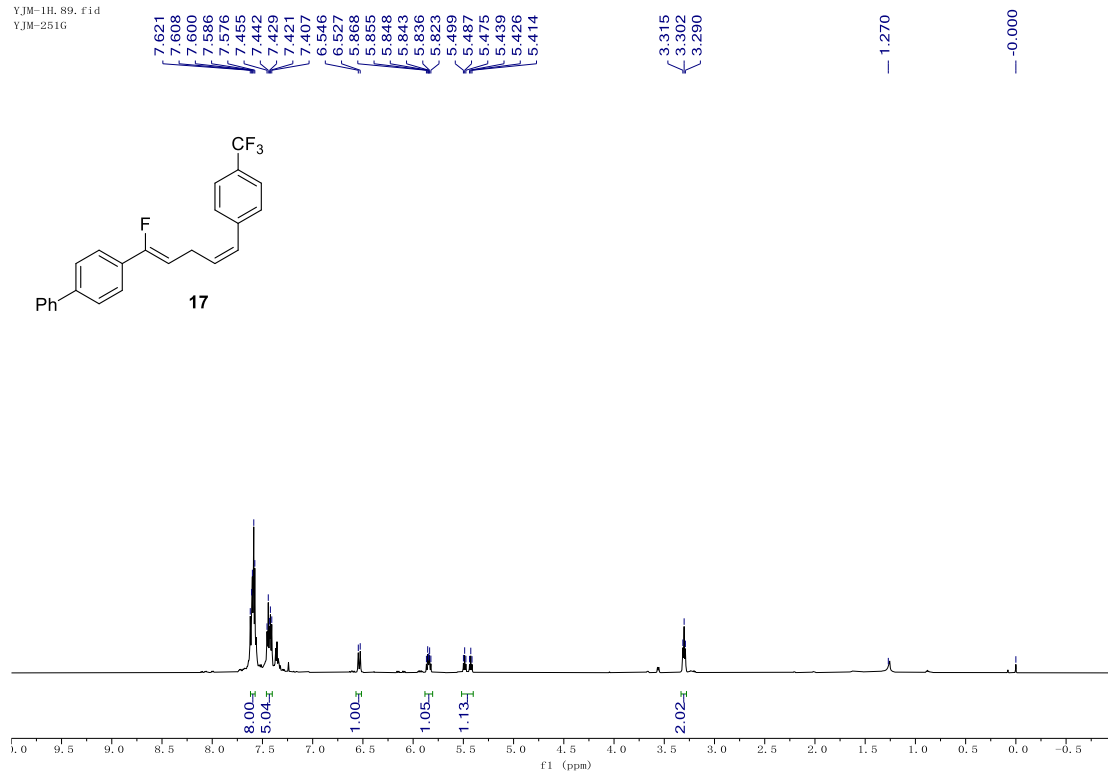
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YJM-19F_20.fid
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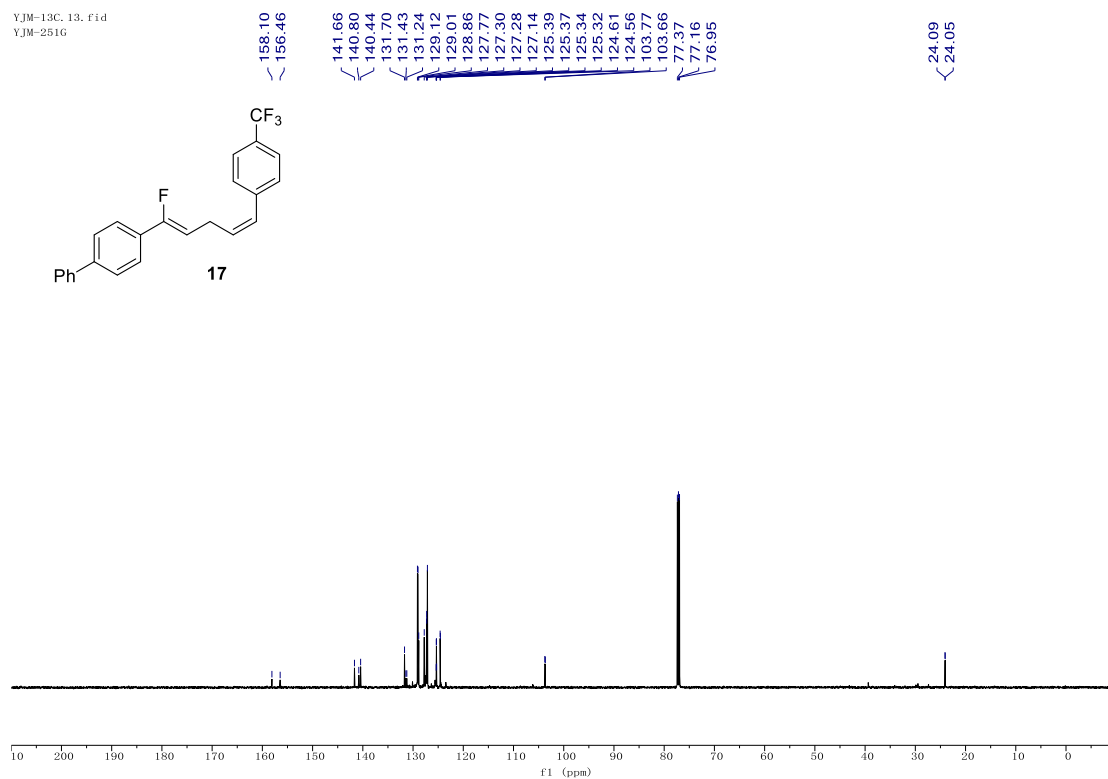
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YJM-1H. 89. f1d
YJM-251G



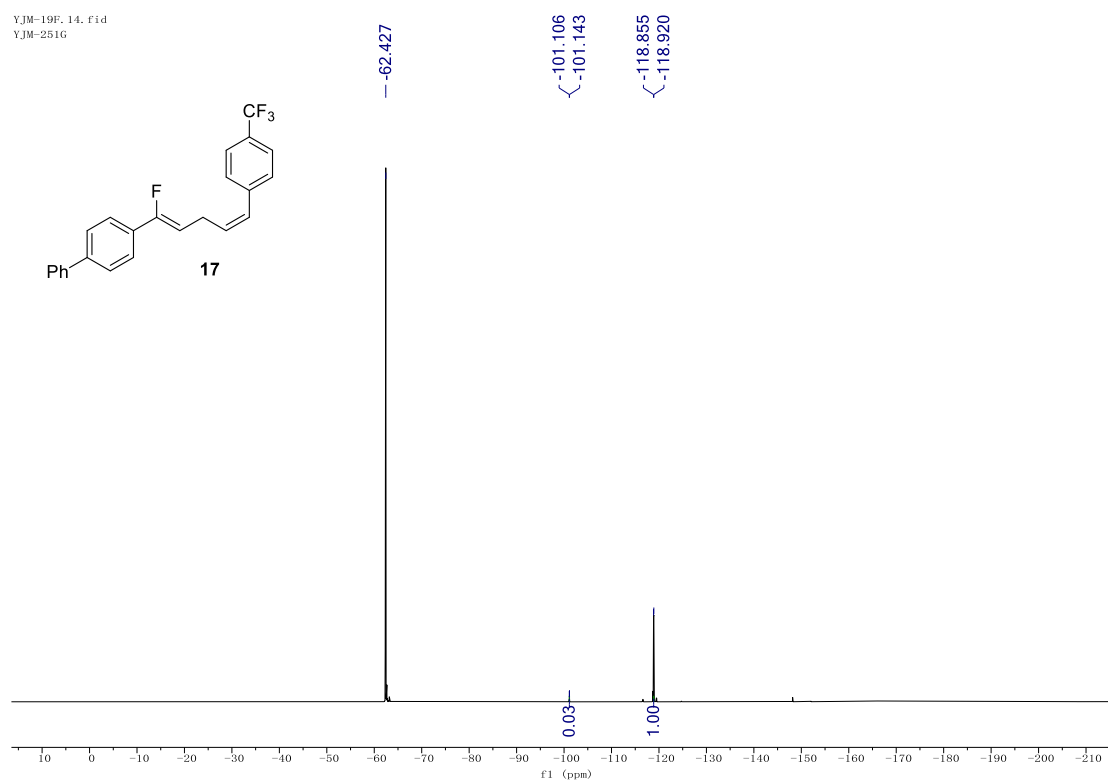
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YJM-13C. 13. f1d
YJM-251G



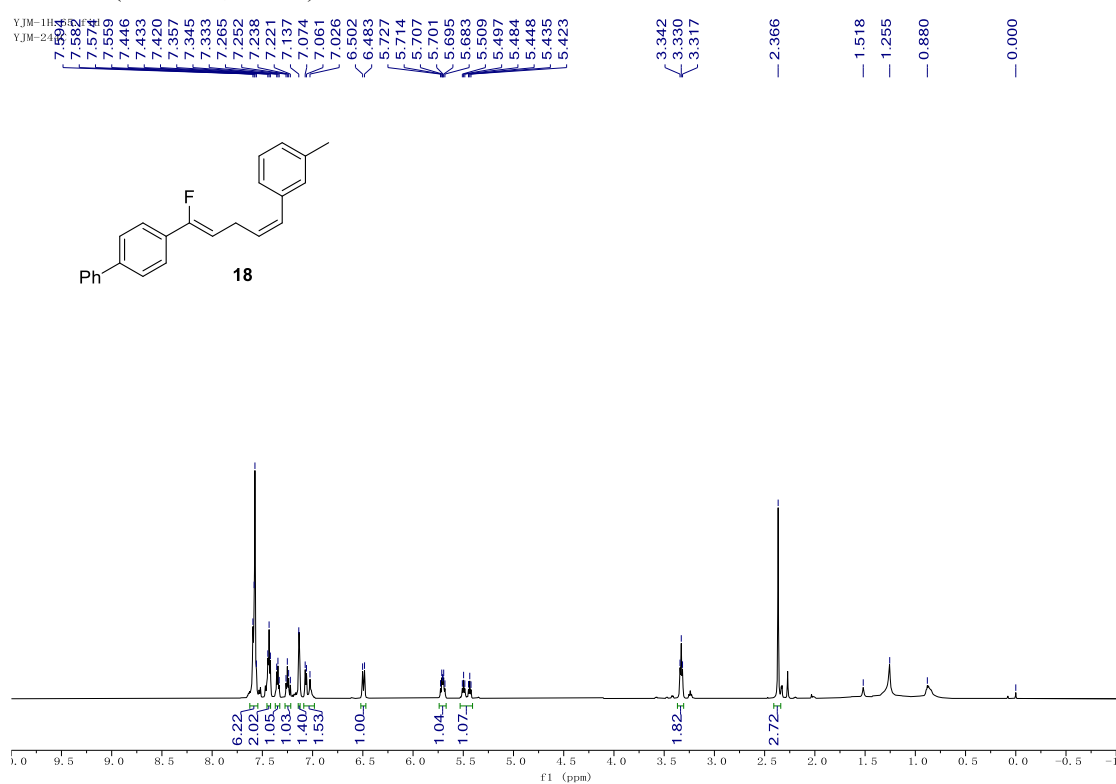
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YJM-19F_14.fid
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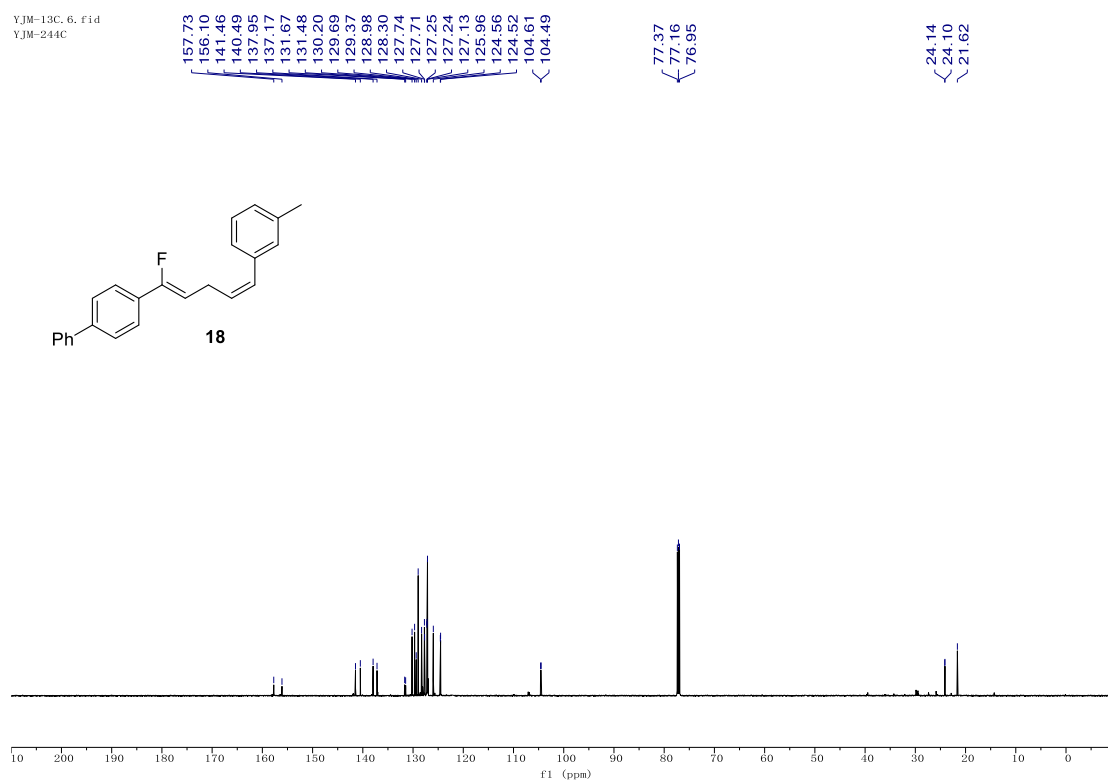
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YJM-241G



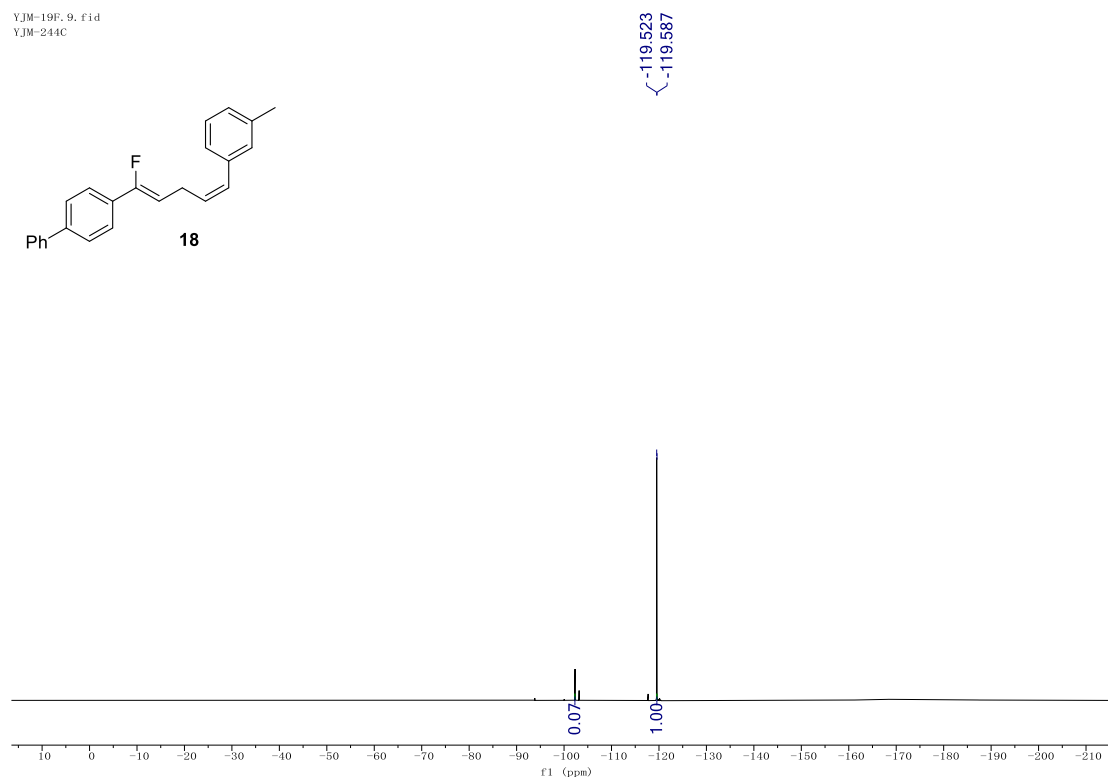
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YJM-244C

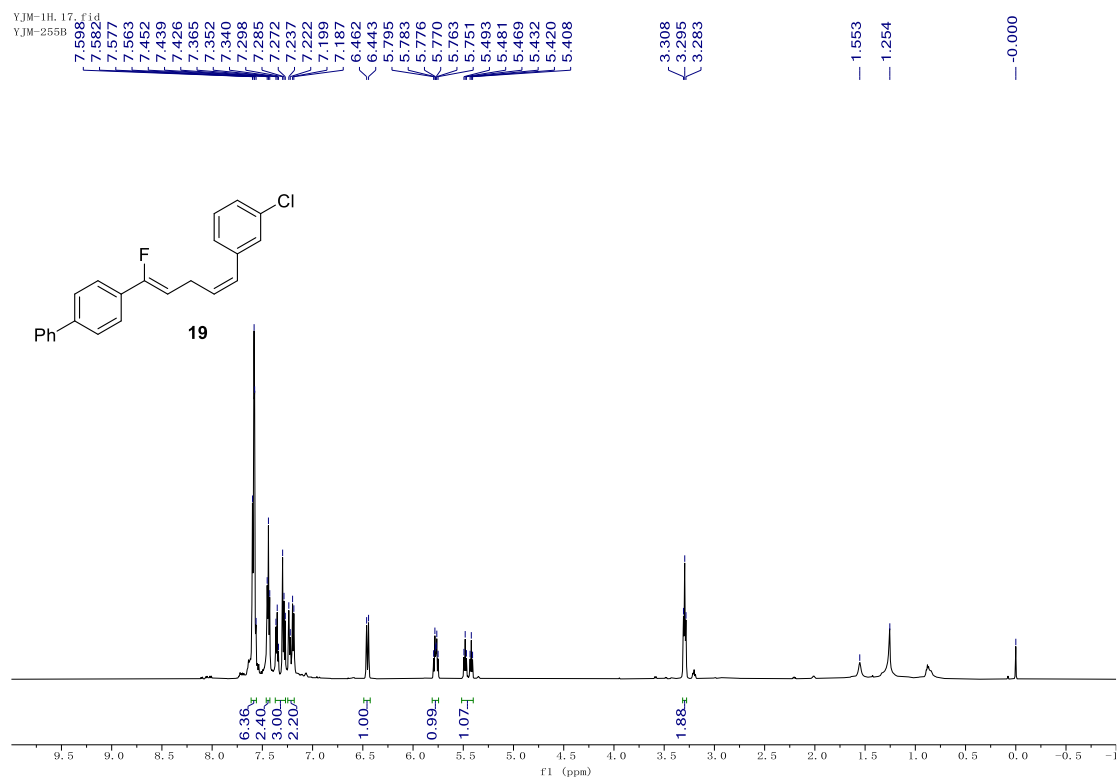


¹⁹F NMR (565 MHz, CDCl₃)

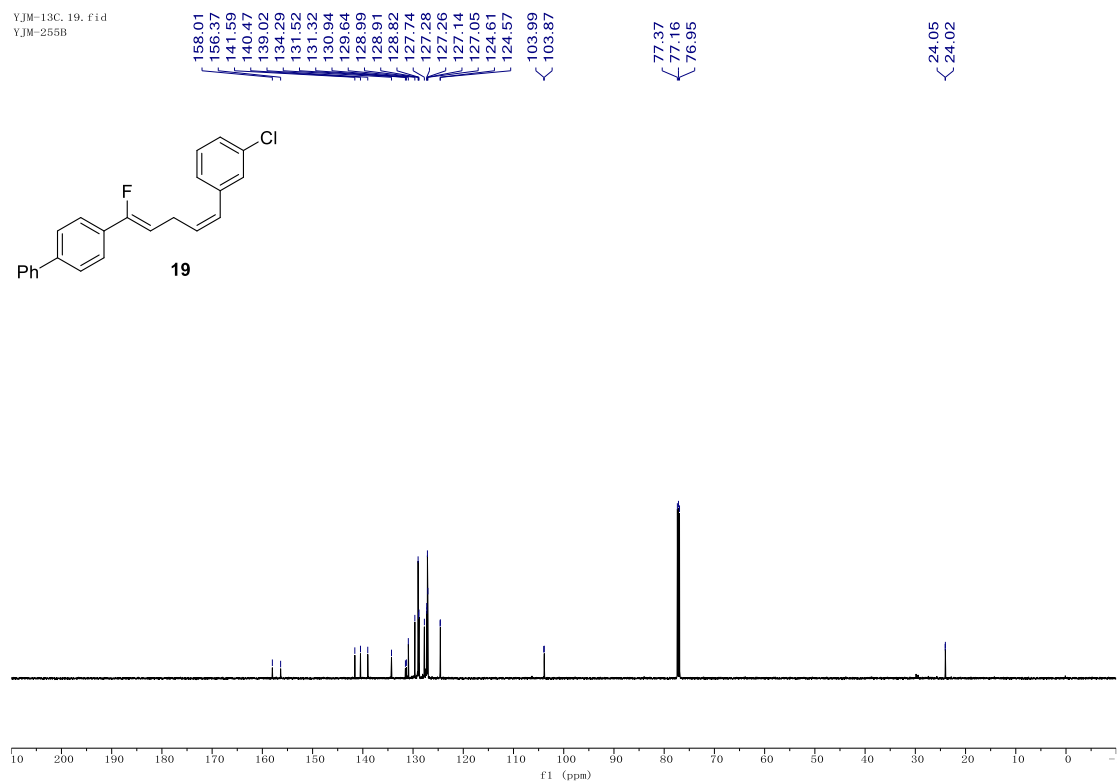
YJM-19F. 9. fid
YJM-244C



¹H NMR (600 MHz, CDCl₃)

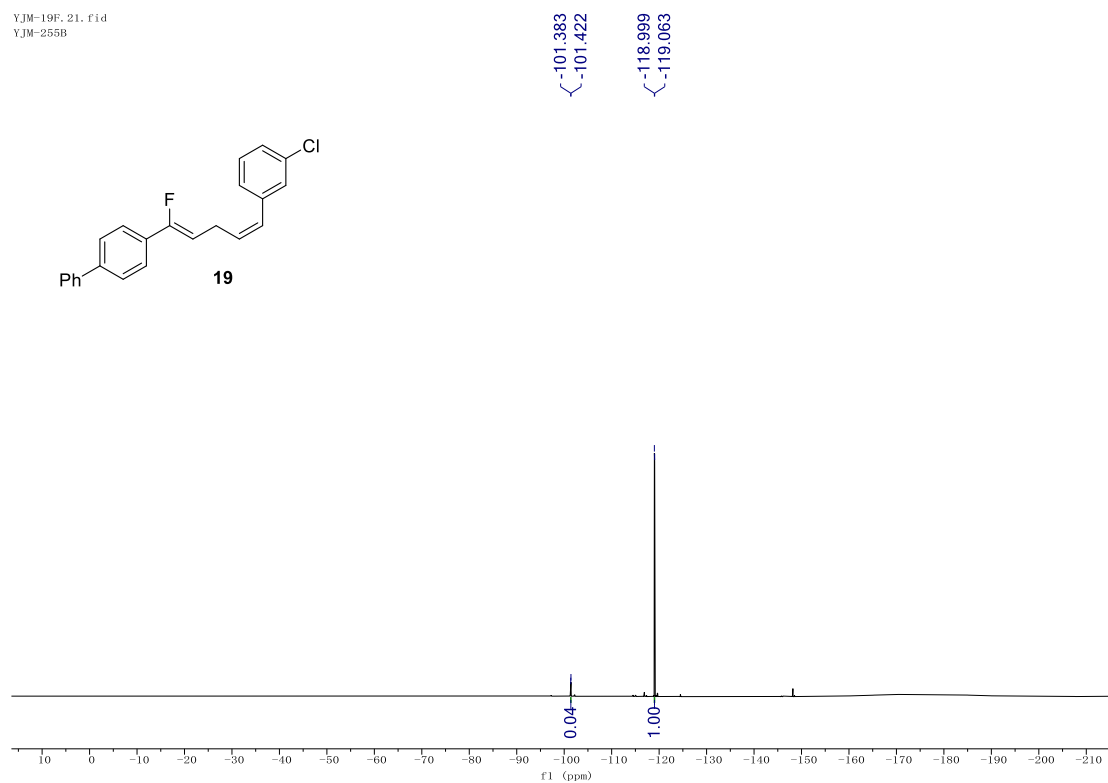
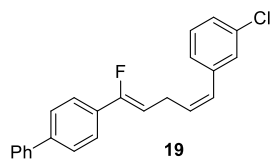


¹³C NMR (151 MHz, CDCl₃)



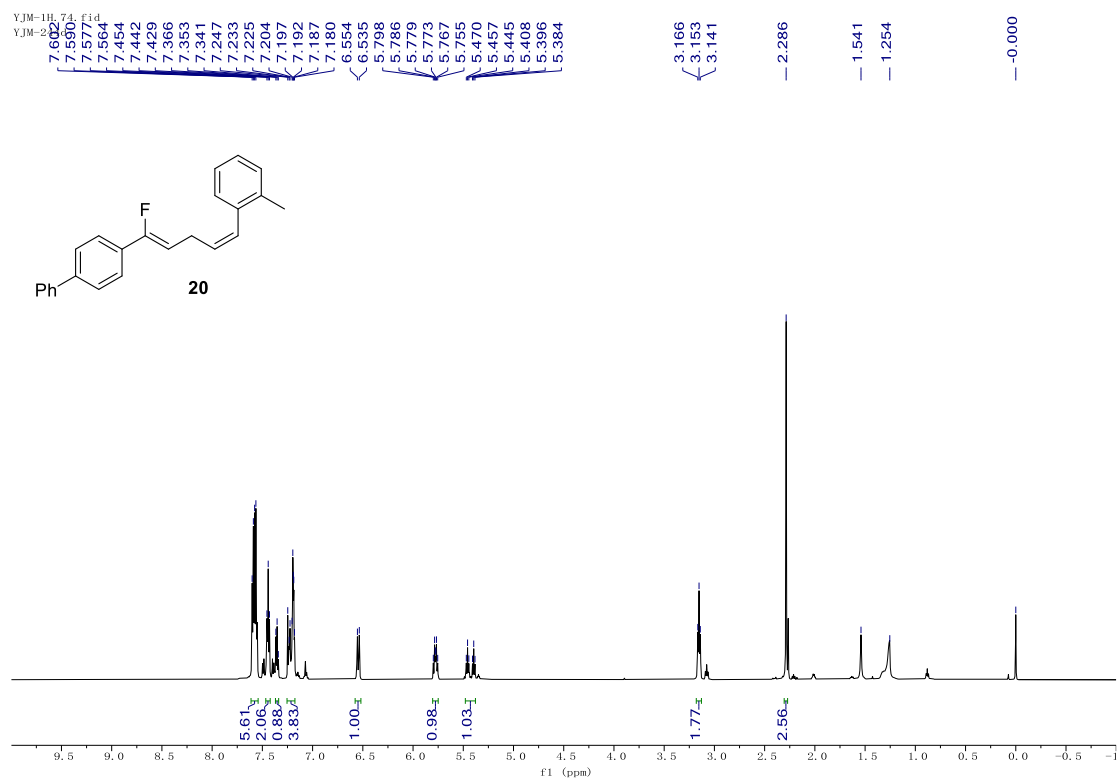
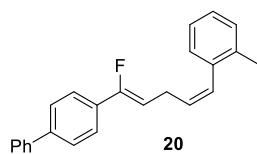
¹⁹F NMR (565 MHz, CDCl₃)

YJM-19F, 21, f1d
YJM-255B



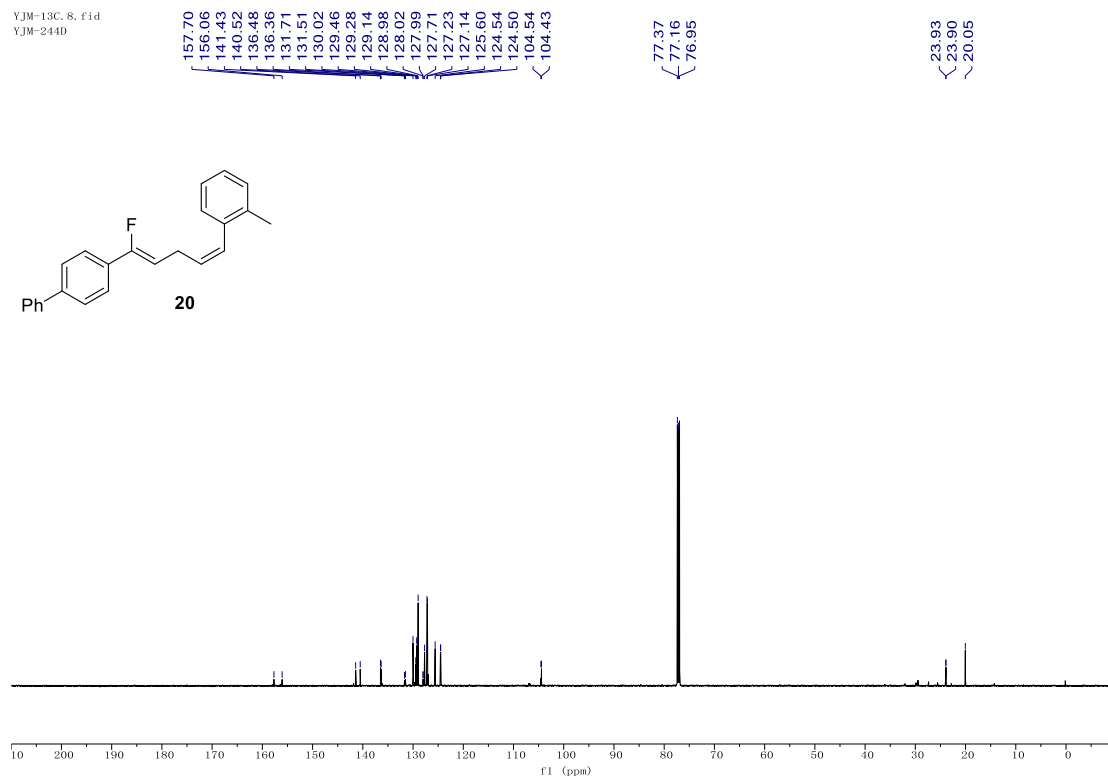
¹H NMR (600 MHz, CDCl₃)

YJM-1H, 74, f1d
YJM-255B



¹³C NMR (151 MHz, CDCl₃)

YJM-13C. 8. fid
YJM-244D

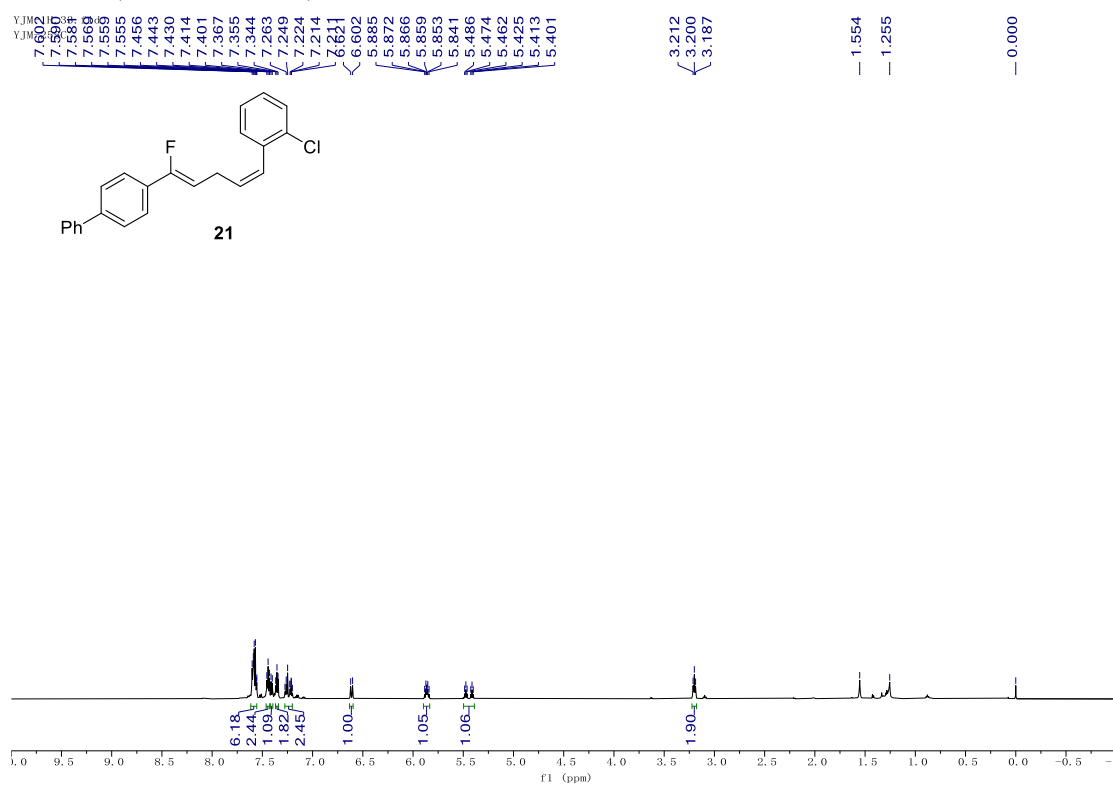


¹⁹F NMR (565 MHz, CDCl₃)

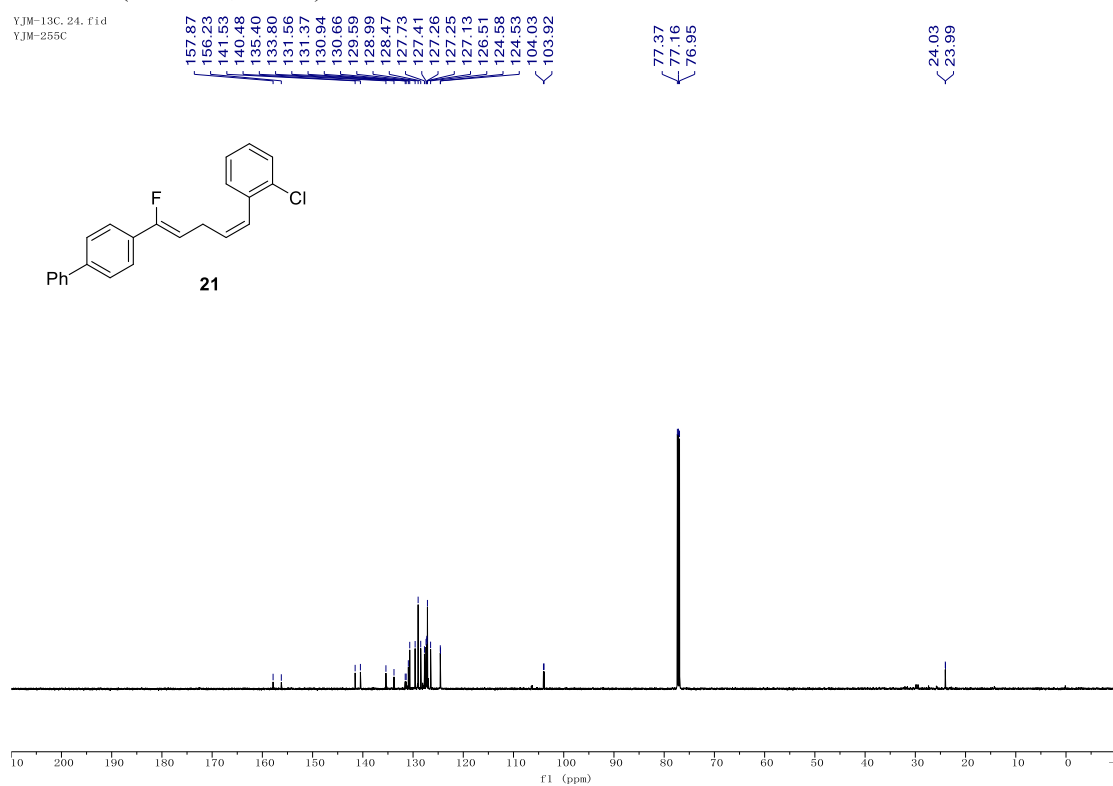
YJM-19F. 11. fid
YJM-244D



¹H NMR (600 MHz, CDCl₃)

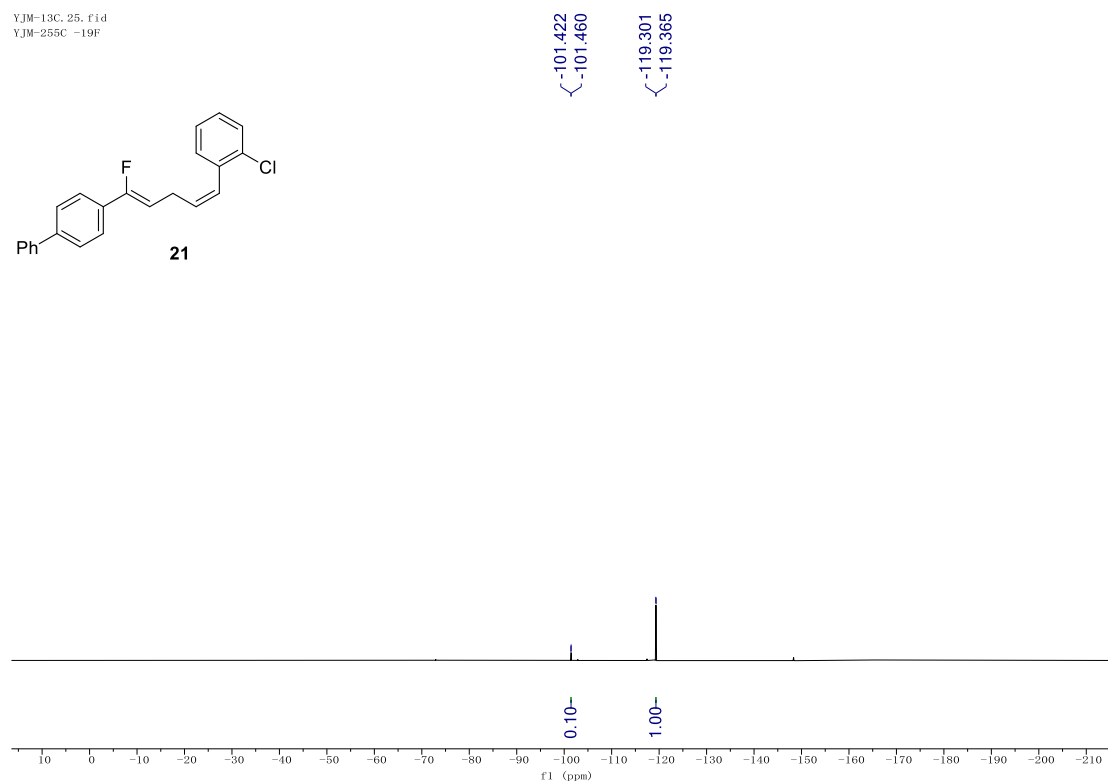
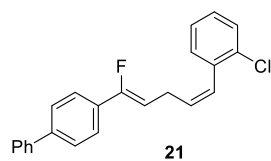


¹³C NMR (151 MHz, CDCl₃)



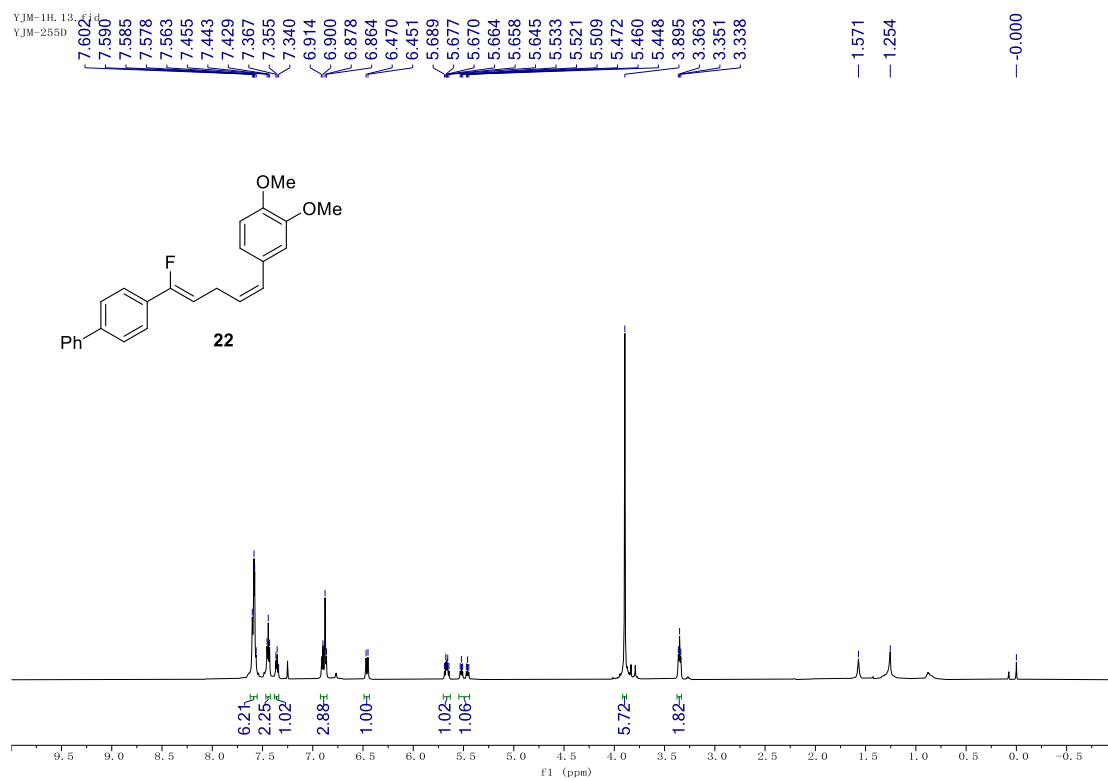
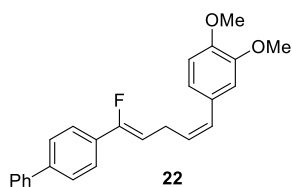
¹⁹F NMR (565 MHz, CDCl₃)

YJM-13C, 25, f1d
YJM-255C -19F



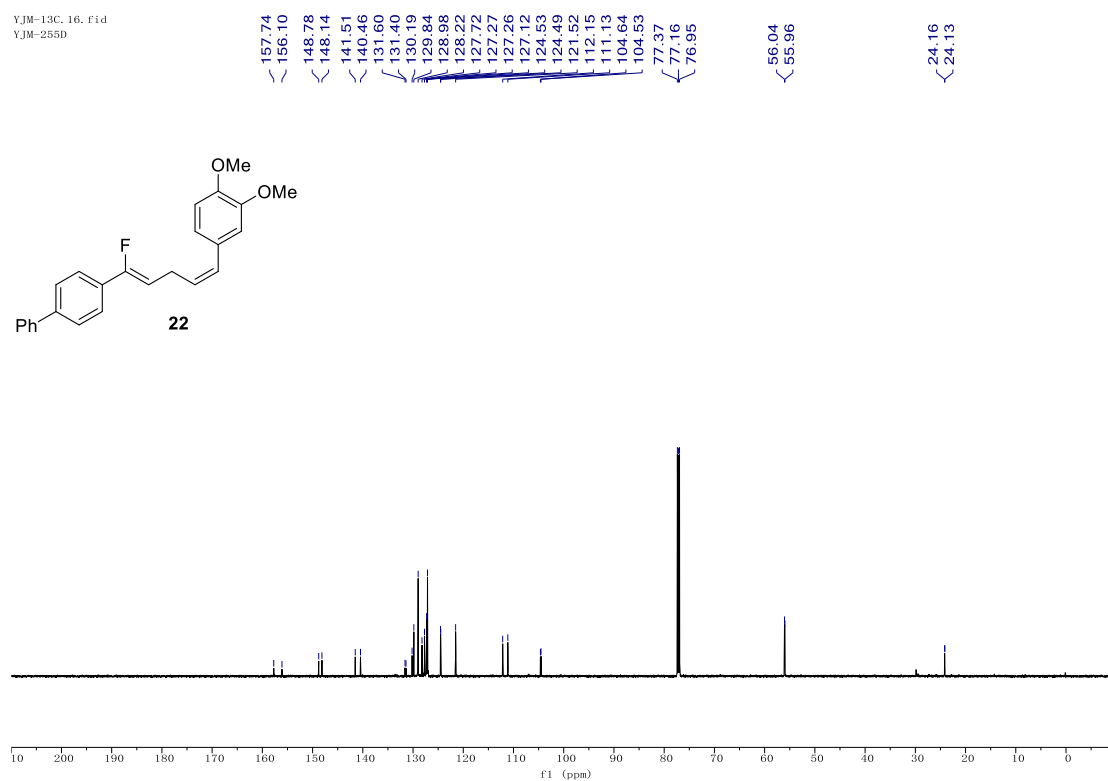
¹H NMR (600 MHz, CDCl₃)

YJM-1H, 13, f1d
YJM-255D



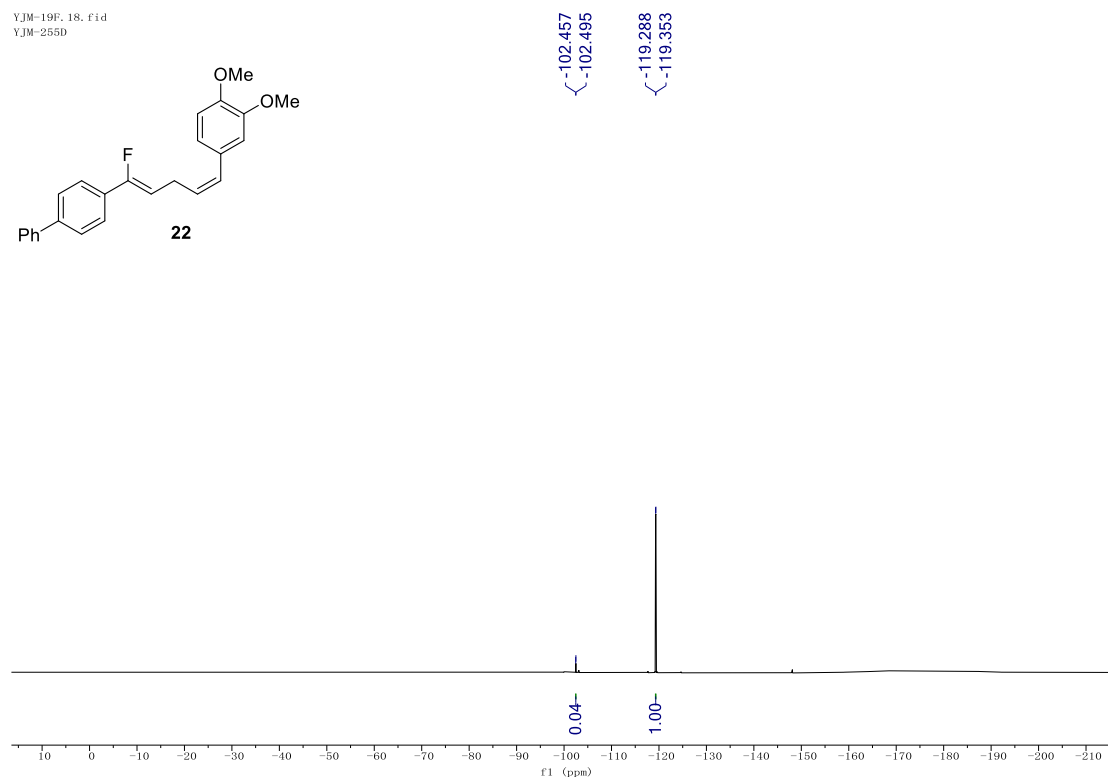
¹³C NMR (151 MHz, CDCl₃)

YJM-13C_16.fid
YJM-255D

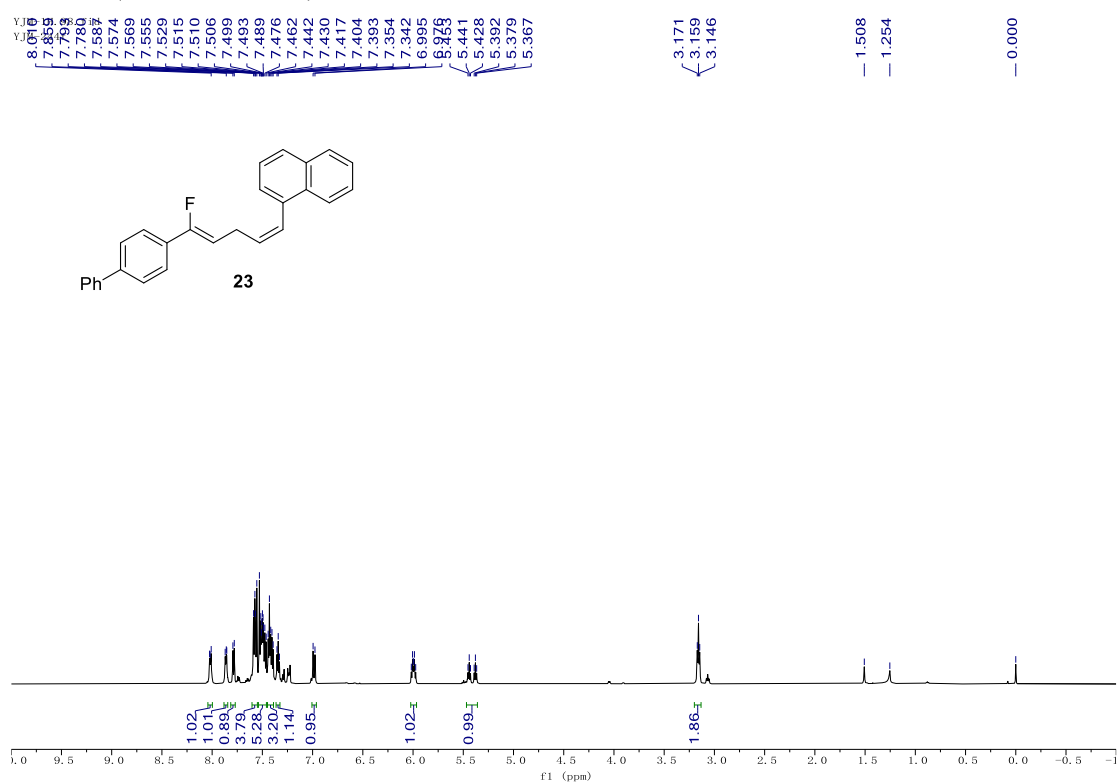


¹⁹F NMR (565 MHz, CDCl₃)

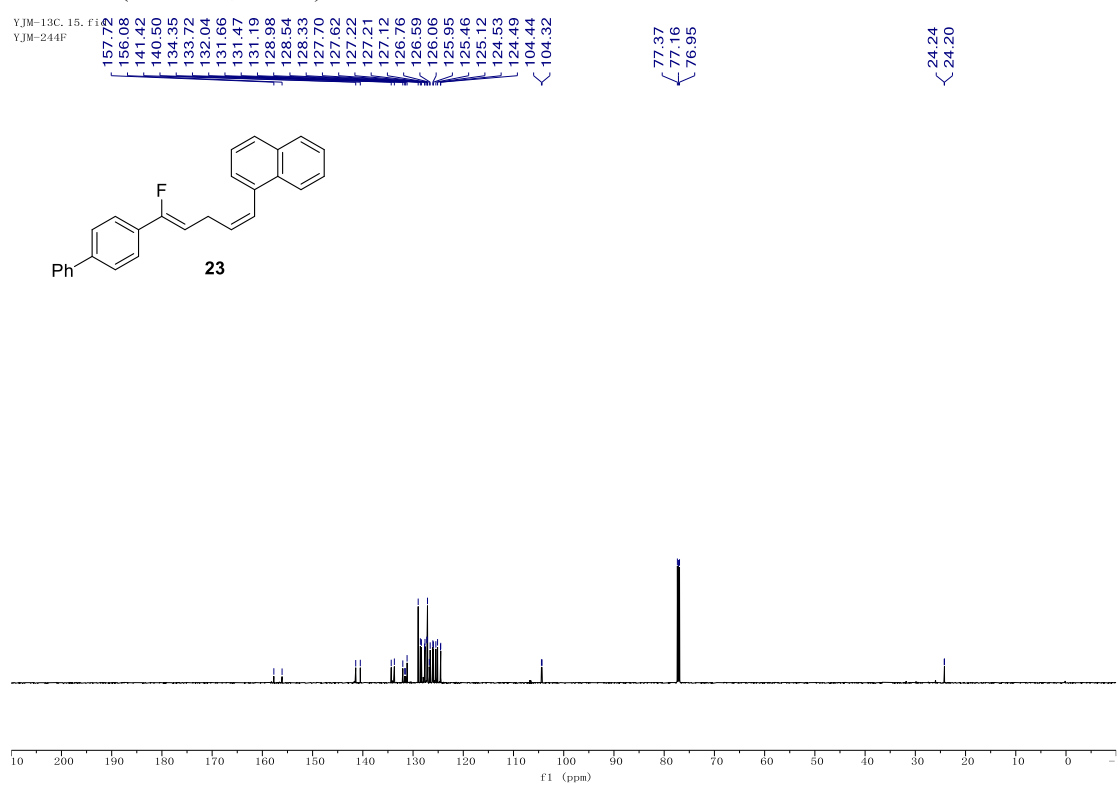
YJM-19F_18.fid
YJM-255D



¹H NMR (600 MHz, CDCl₃)

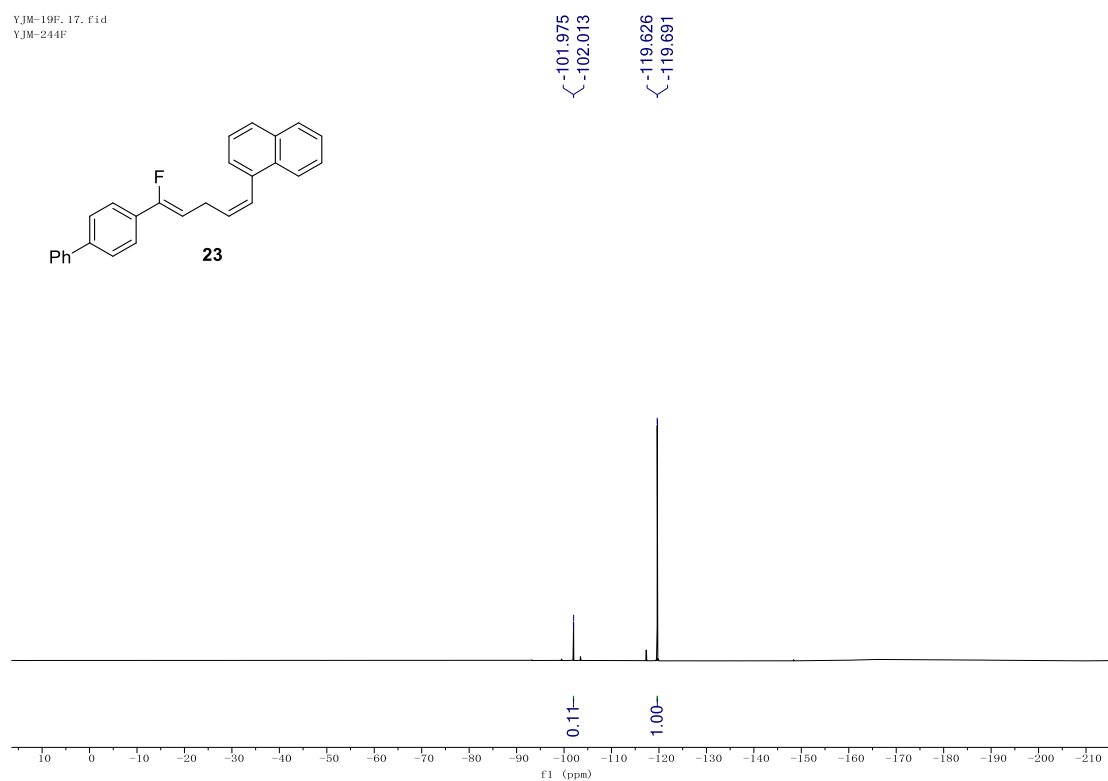


¹³C NMR (151 MHz, CDCl₃)



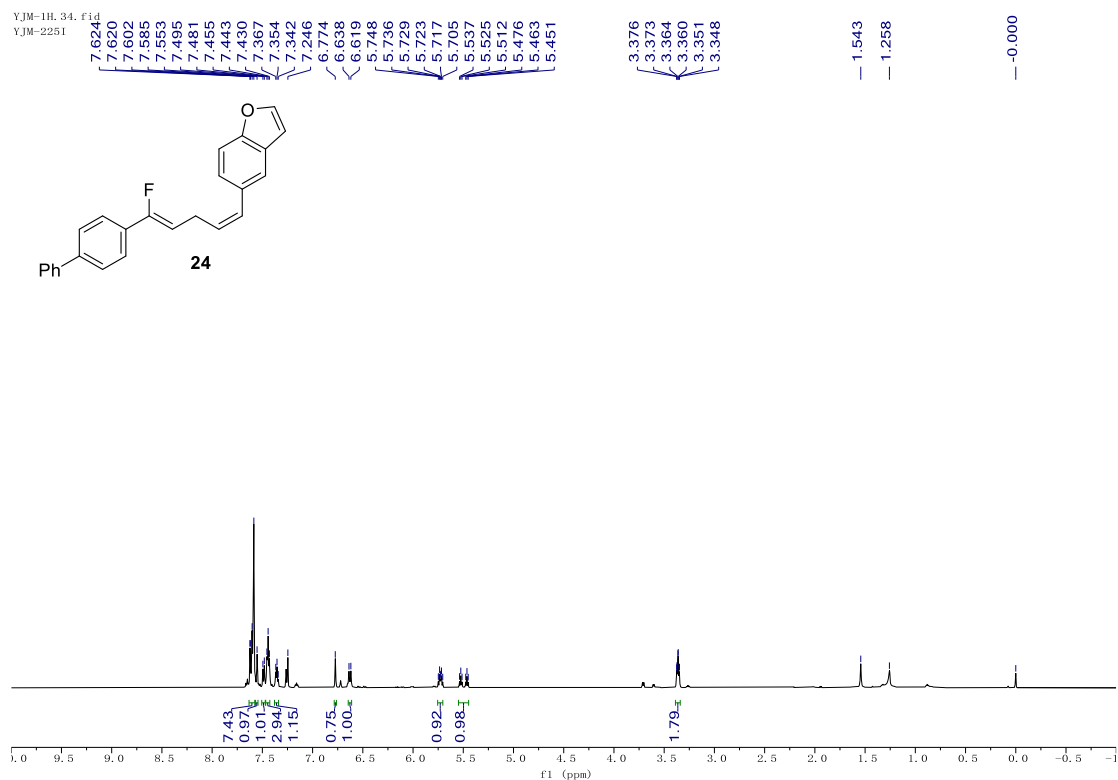
¹⁹F NMR (565 MHz, CDCl₃)

YJM-19F_17.fid
YJM-244F



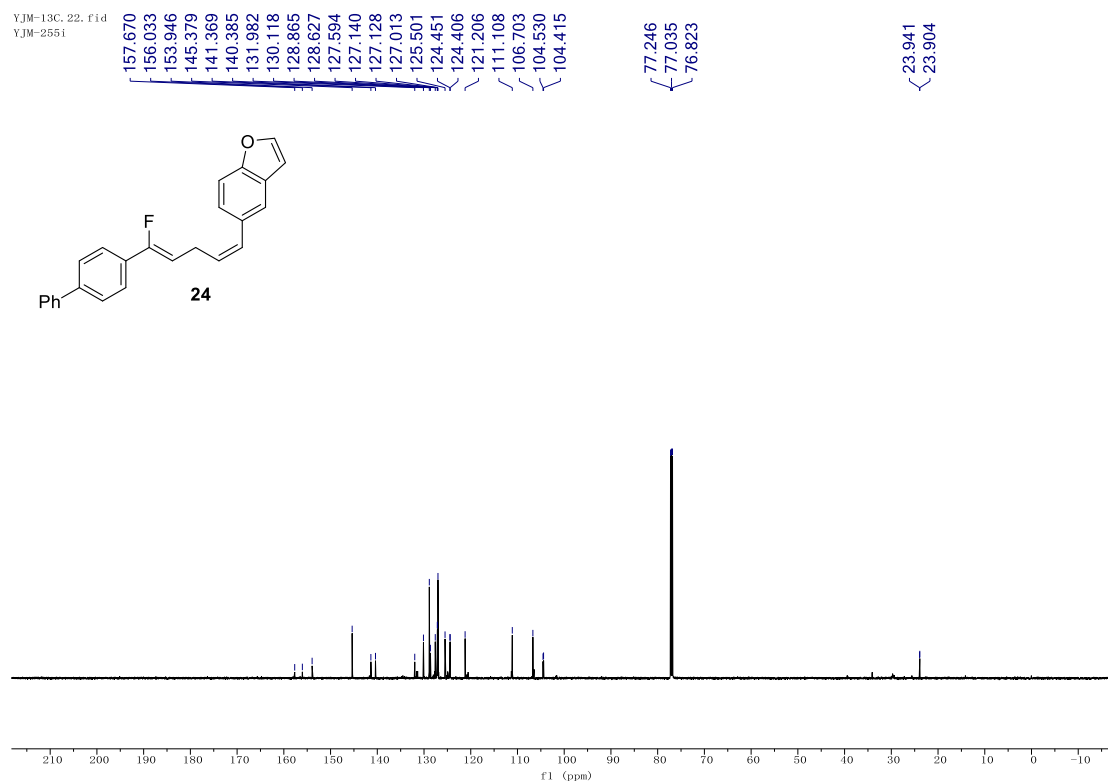
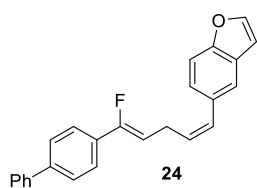
¹H NMR (600 MHz, CDCl₃)

YJM-1H_34.fid
YJM-2251



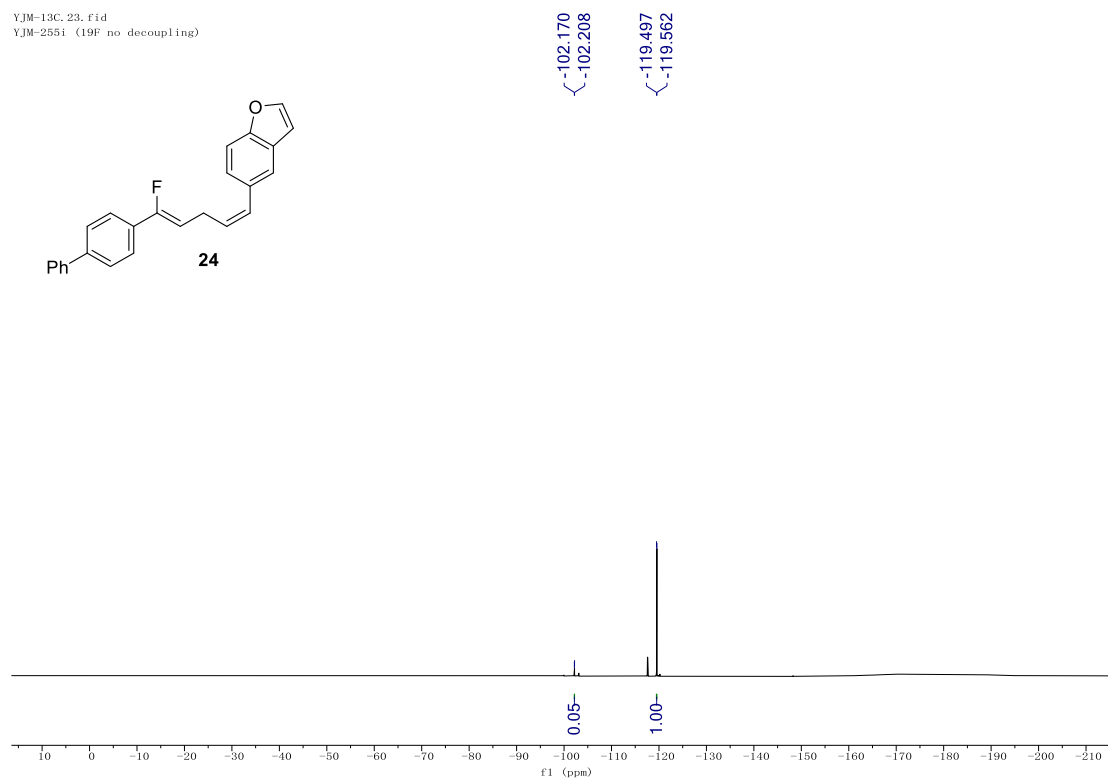
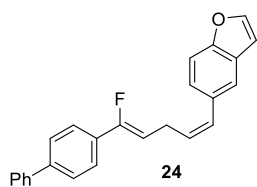
¹³C NMR (151 MHz, CDCl₃)

YJM-13C_22.fid
YJM-255i



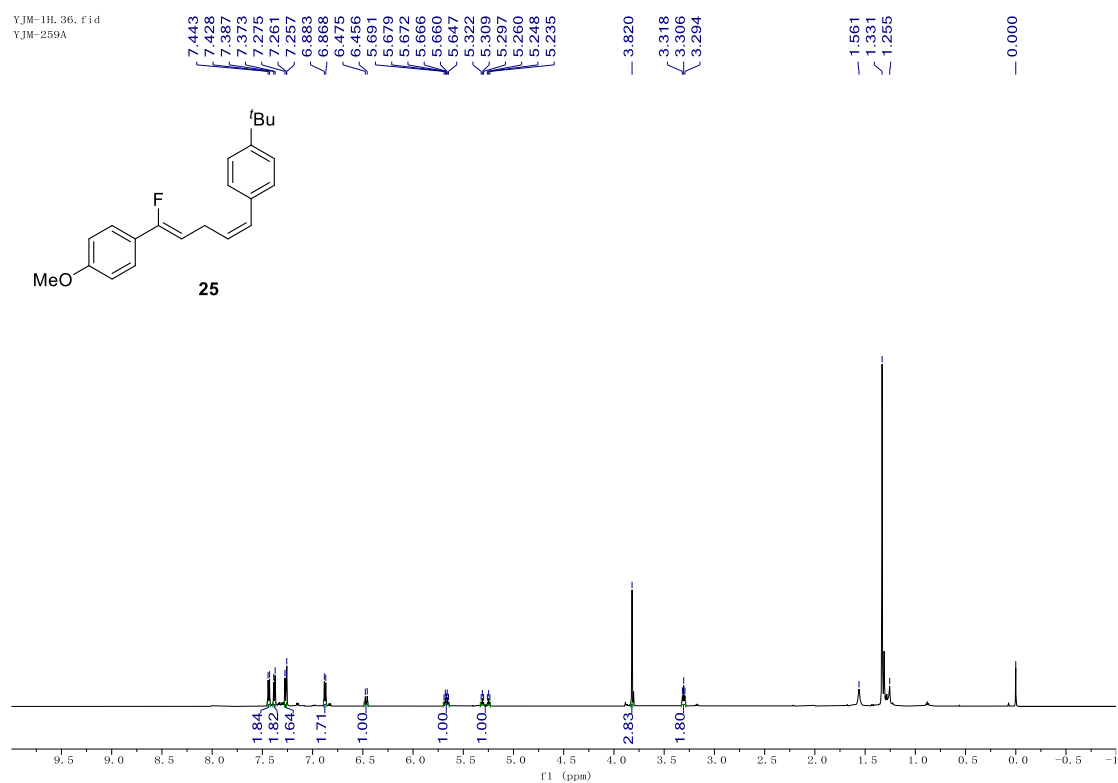
¹⁹F NMR (565 MHz, CDCl₃)

YJM-13C_23.fid
YJM-255i (19F no decoupling)



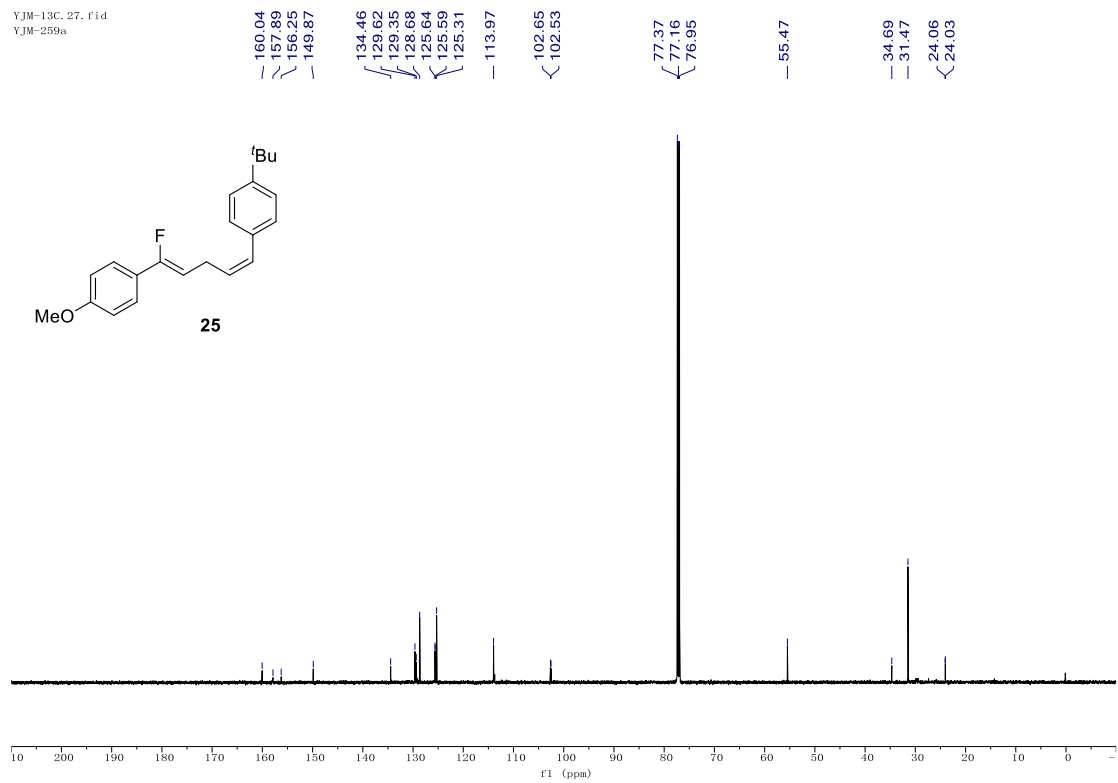
¹H NMR (600 MHz, CDCl₃)

YJM-1H_36.fid
YJM-259A



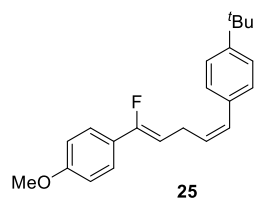
¹³C NMR (151 MHz, CDCl₃)

YJM-13C_27.fid
YJM-259a



¹⁹F NMR (565 MHz, CDCl₃)

YJM-13C, 26, f1d
YJM-259a (19F, no decoupling)



~100.762
~100.800

~118.595
~118.661

