

Supplementary Material
Synthesis of novel Bis[(tris(dimethylsilyl)methyl)alkyl]ferrocene derivatives as new ferrocenyl multi-functional silyl ether compounds

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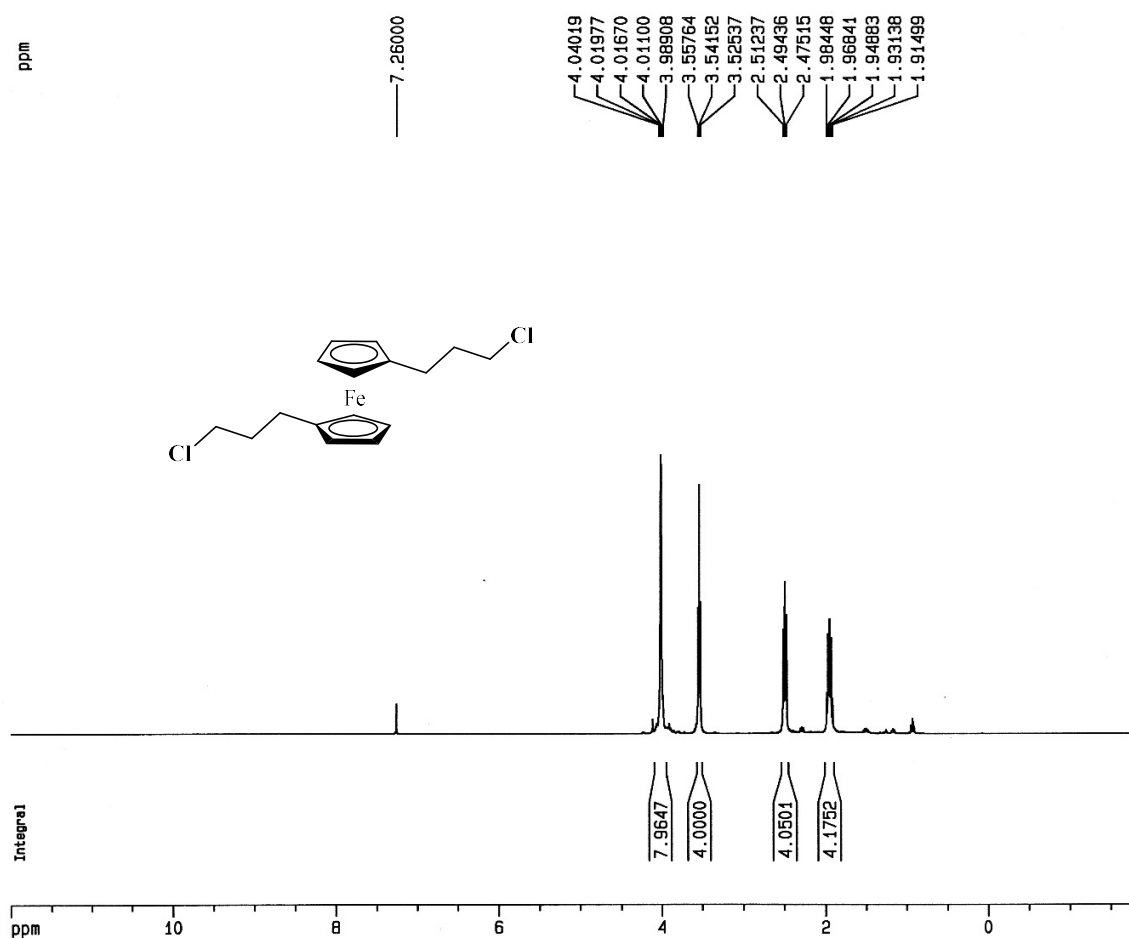
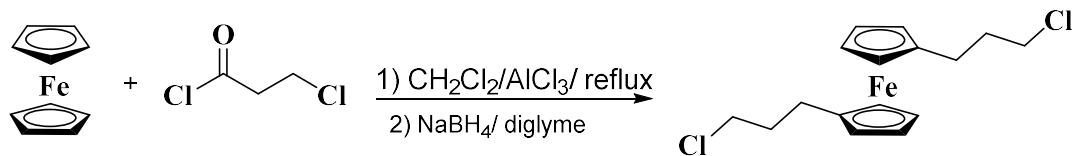
1-PREPARATION OF 1,1'- BIS(CHLOROALKYL)FERROCENES	4
1-1-SYNTHESIS OF 1,1'- BIS(3-CHLOROPROPYL)FERROCENE (4A).....	4
Fig. 1. ¹ H NMR spectrum of (4a) (400 MHz, CDCl ₃).....	4
Fig. 2. ¹³ C NMR spectrum of (4a) (100 MHz, CDCl ₃).....	5
Fig. 3. Mass spectrum of (4a).....	5
1-2- SYNTHESIS OF 1,1'- BIS(4-CHLOROBUTYL)FERROCENE (4B).....	6
Fig. 4. ¹ H NMR spectrum of (4b) (400 MHz, CDCl ₃).....	6
Fig. 5. ¹³ C NMR spectrum of (4b) (100 MHz, CDCl ₃).....	7
Fig. 6. Mass spectrum of (4b)	7
2-PREPARATION OF 1,1'- BIS(BROMOALKYL)FERROCENE (5A-5B)	8
2-1- 1,1'- BIS(3-BROMOPROPYL)FERROCENE (5A)	8
Fig. 7. ¹ H NMR spectrum of (aa) (400 MHz, CDCl ₃).....	8
Fig. 8. ¹³ C NMR spectrum of (5a) (100 MHz, CDCl ₃).....	9
2-2- 1,1'- BIS(4-BROMOBUTYL)FERROCENE (5B).....	10
Fig. 9. ¹ H NMR spectrum of (5b) (400 MHz, CDCl ₃).....	10

Fig. 10. ¹³ C NMR spectrum of (5b) (100 MHz, CDCl ₃).....	11
3-PREPARATION OF COMPOUNDS (6A-B) AND (7A-B)	12
3-1- 1,1'- BIS[3-(TRIS(TRIMETHYLSILYL)METHYL)PROPYL]FERROCENE (6A) ..	12
Fig. 11. ¹ H NMR spectrum of (6a) (400 MHz, CDCl ₃)	12
Fig. 12. ¹³ C NMR spectrum of (6a) (100 MHz, CDCl ₃).....	13
3-2- 1,1'- BIS[4-(TRIS(TRIMETHYLSILYL)METHYL)BUTYL]FERROCENE (6B)	14
Fig. 13. ¹ H NMR spectrum of (6b) (400 MHz, CDCl ₃).....	14
Fig. 14. ¹³ C NMR spectrum of (6b) (100 MHz, CDCl ₃).....	15
3-3- 1,1'- BIS[3-(TRIS(DIMETHYLSILYL)METHYL)PROPYL]FERROCENE (7A).....	16
Fig. 15. FT-IR spectrum of (7a)	16
Fig. 16. ¹ H NMR spectrum of (7a) (400 MHz, CDCl ₃)	17
Fig. 17. ¹³ C NMR spectrum of (7a) (100 MHz, CDCl ₃).....	18
3-4- 1,1'- BIS[4-(TRIS(DIMETHYLSILYL)METHYL)BUTYL]FERROCENE (7B).....	19
Fig. 18. FT-IR spectrum of (7b)	19
Fig. 19. ¹ H NMR spectrum of (7b) (400 MHz, CDCl ₃).....	20
Fig. 20. ¹³ C NMR spectrum of (7b) (100 MHz, CDCl ₃).....	21
4-SYNTHESIS OF 1,1'- BIS[(TRIS(DIMETHYLSILYL)METHYL)ALKYL]FERROCENE	22
4-1- SYNTHESIS OF 1,1'- BIS[3- (TRIS(METHOXYDIMETHYLSILYL)METHYL)PROPYL]FERROCENE (8A)	22
Fig. 22. ¹³ C NMR spectrum of (8a) (100 MHz, CDCl ₃).....	23
Fig. 23. ¹ H NMR spectrum of (8b) (400 MHz, CDCl ₃).....	24
Fig. 24. ¹³ C NMR spectrum of (8b) (100 MHz, CDCl ₃).....	25
Fig. 25. ¹ H NMR spectrum of (8c) (400 MHz, CDCl ₃)	26
Fig. 26. ¹³ C NMR spectrum of (8c) (100 MHz, CDCl ₃).....	27

Fig. 27. ^1H NMR spectrum of (8d) (400 MHz, CDCl_3).....	28
Fig. 28. ^{13}C NMR spectrum of (8d) (100 MHz, CDCl_3).....	29
Fig. 29. ^1H NMR spectrum of (8e) (400 MHz, CDCl_3)	30
Fig. 30. ^{13}C NMR spectrum of (8e) (100 MHz, CDCl_3)	31
Fig. 31. ^1H NMR spectrum of (8g) (400 MHz, CDCl_3)	32
Fig. 32. ^{13}C NMR spectrum of (8g) (100 MHz, CDCl_3).....	33
Fig. 33. ^1H NMR spectrum of (8h) (400 MHz, CDCl_3).....	34
Fig. 34. ^{13}C NMR spectrum of (8h) (100 MHz, CDCl_3).....	35
Fig. 35. ^1H NMR spectrum of (8i) (400 MHz, CDCl_3).....	36
Fig. 36. ^{13}C NMR spectrum of (8i) (100 MHz, CDCl_3).....	37
Fig. 37. ^1H NMR spectrum of (8j) (400 MHz, CDCl_3).....	38
Fig. 38. ^{13}C NMR spectrum of (8j) (100 MHz, CDCl_3).....	39
Fig. 39. ^1H NMR spectrum of (8k) (400 MHz, CDCl_3).....	40
Fig. 40. ^{13}C NMR spectrum of (8k) (100 MHz, CDCl_3).....	41

1-Preparation of 1,1'- bis(chloroalkyl)ferrocenes

1-1-Synthesis of 1,1'- bis(3-chloropropyl)ferrocene (4a)

Fig. 1. ^1H NMR spectrum of (4a) (400 MHz, CDCl_3)

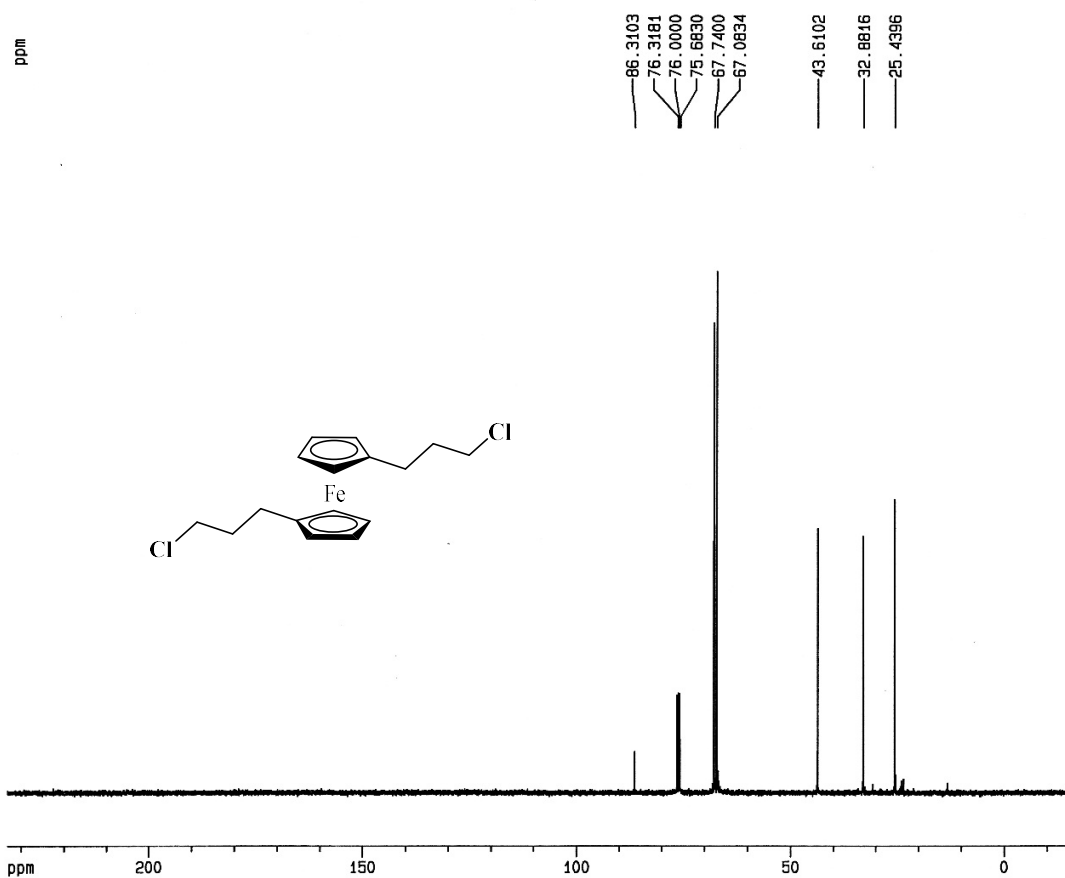
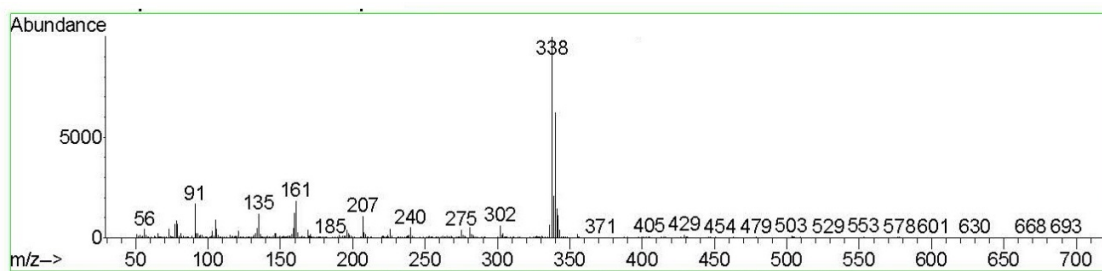
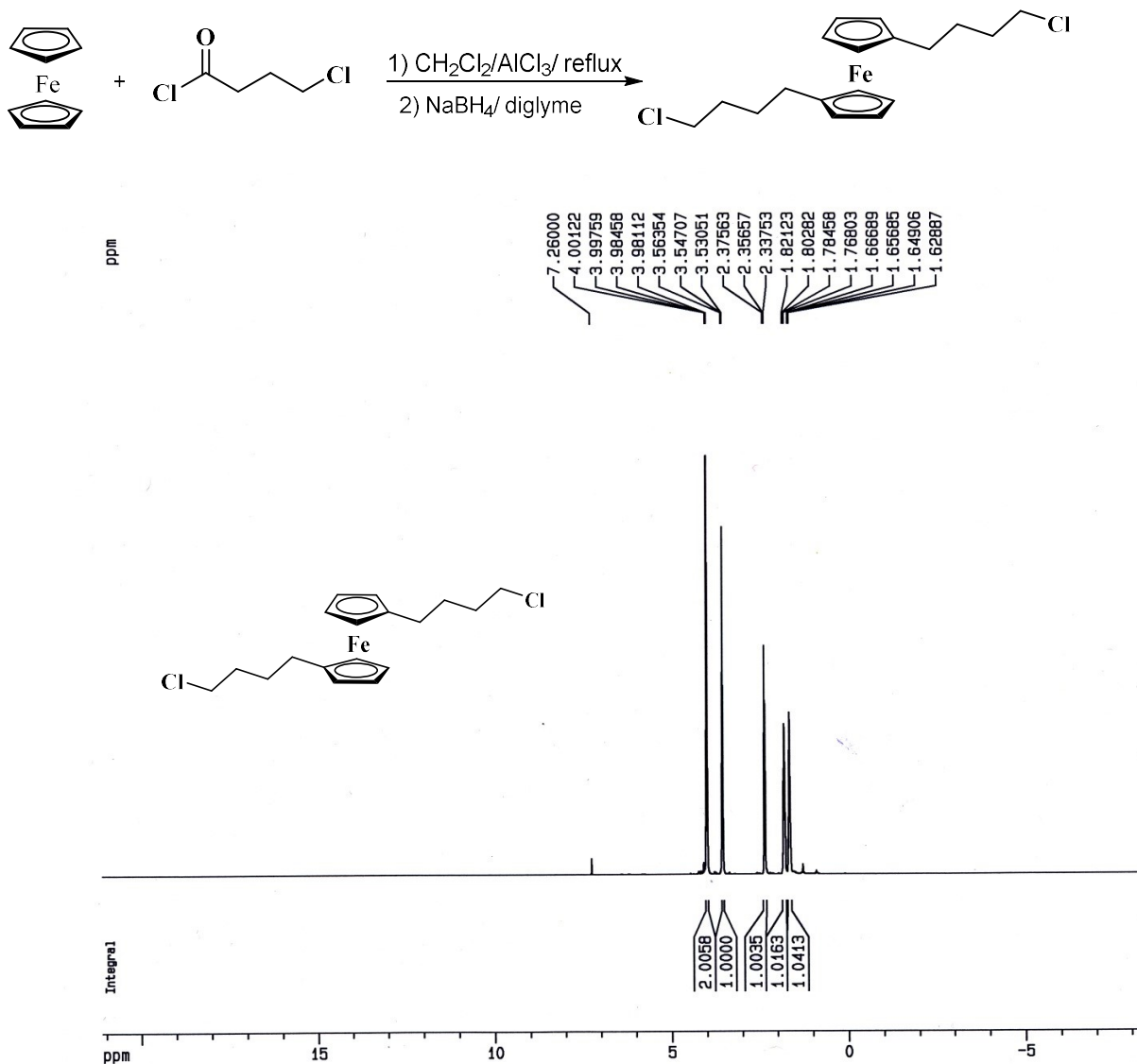
Fig. 2. ^{13}C NMR spectrum of (4a) (100 MHz, CDCl_3)

Fig. 3. Mass spectrum of (4a)

1-2- Synthesis of 1,1'- bis(4-chlorobutyl)ferrocene (4b)

Fig. 4. ¹H NMR spectrum of (4b) (400 MHz, CDCl₃)

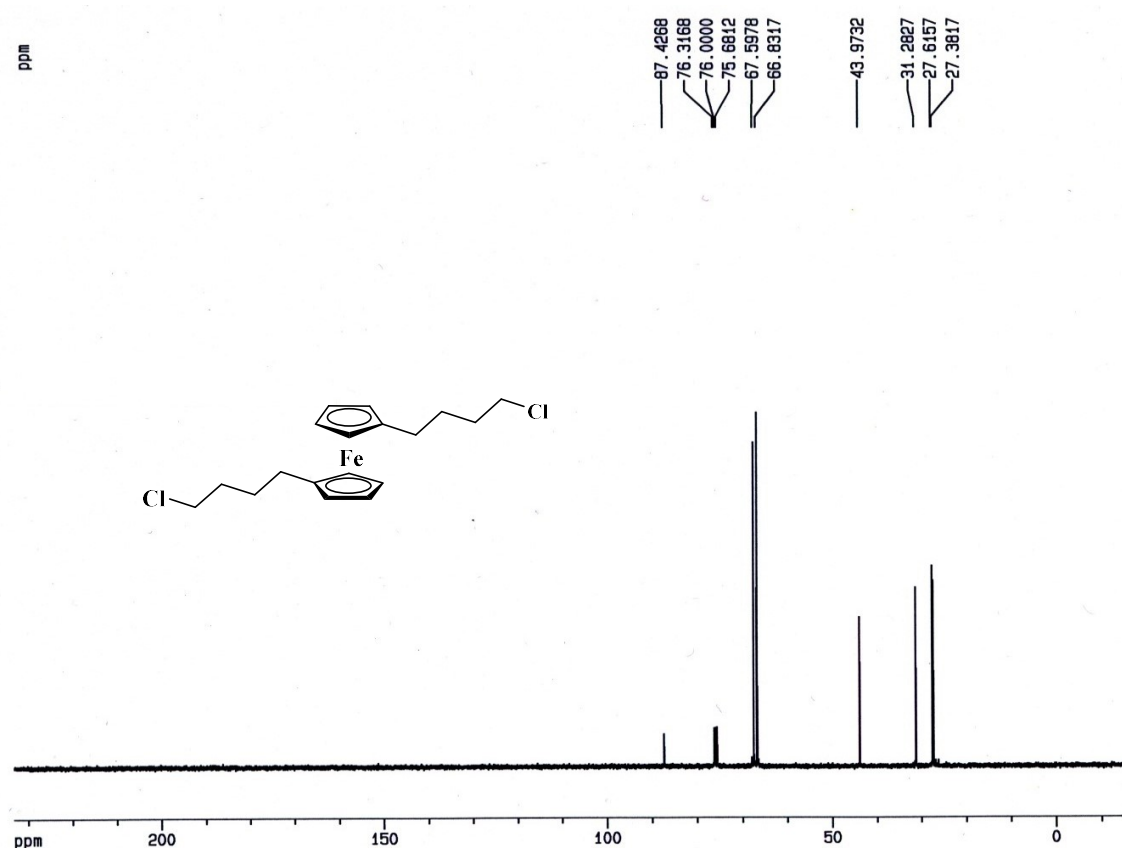
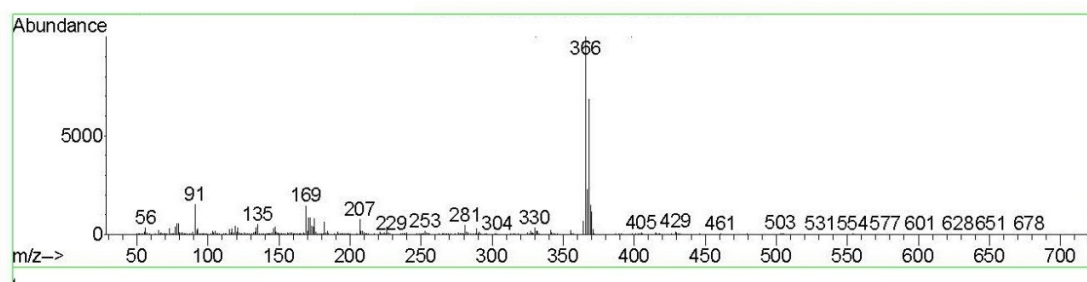
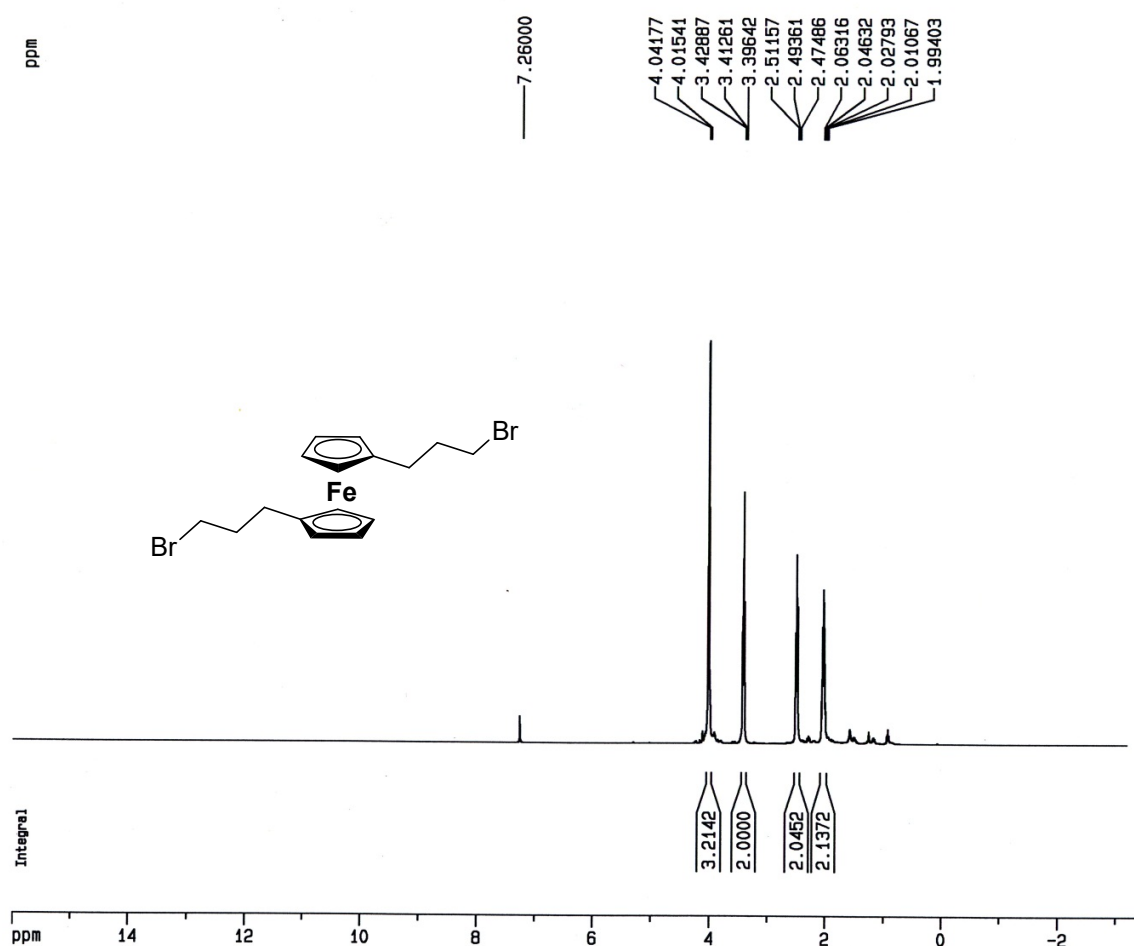
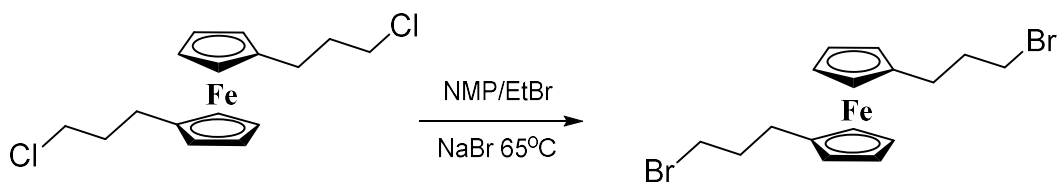
Fig. 5. ^{13}C NMR spectrum of (4b) (100 MHz, CDCl_3)

Fig. 6. Mass spectrum of (4b)

2-Preparation of 1,1'- bis(bromoalkyl)ferrocene (5a-5b)

2-1- 1,1'- Bis(3-bromopropyl)ferrocene (5a)

Fig. 7. ¹H NMR spectrum of (aa) (400 MHz, CDCl₃)

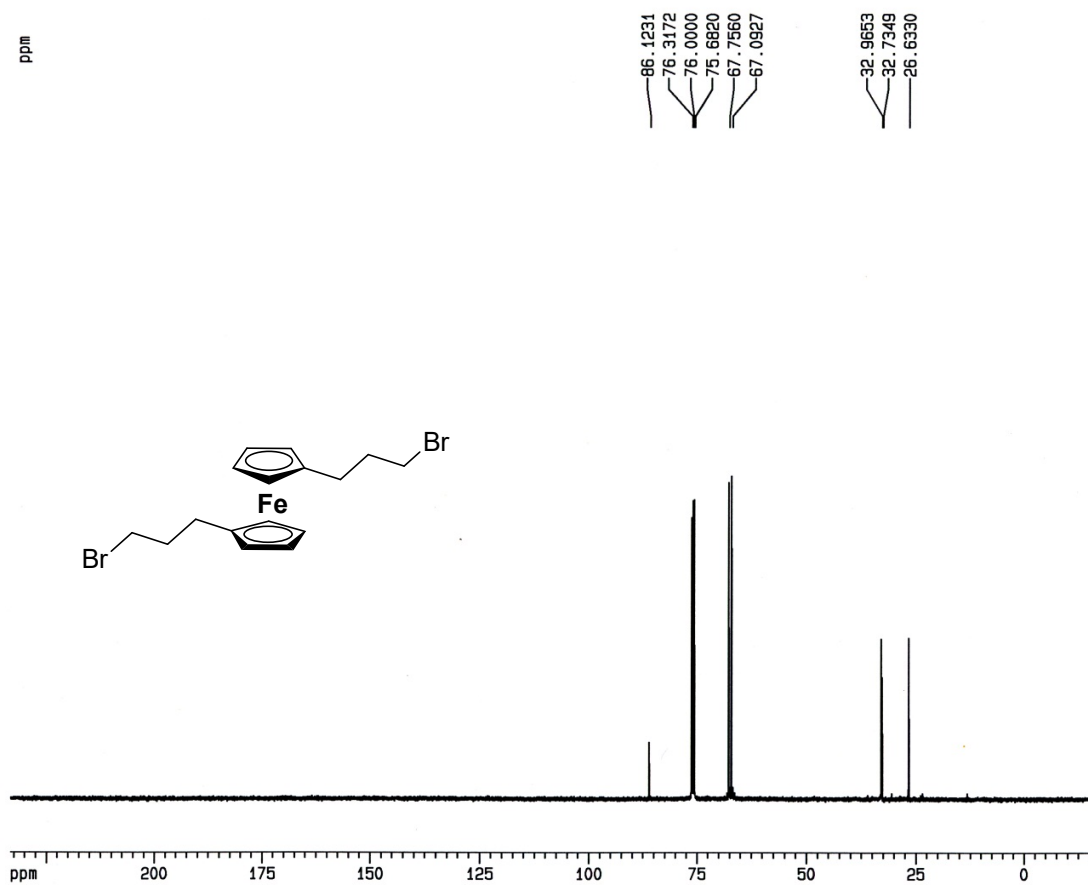
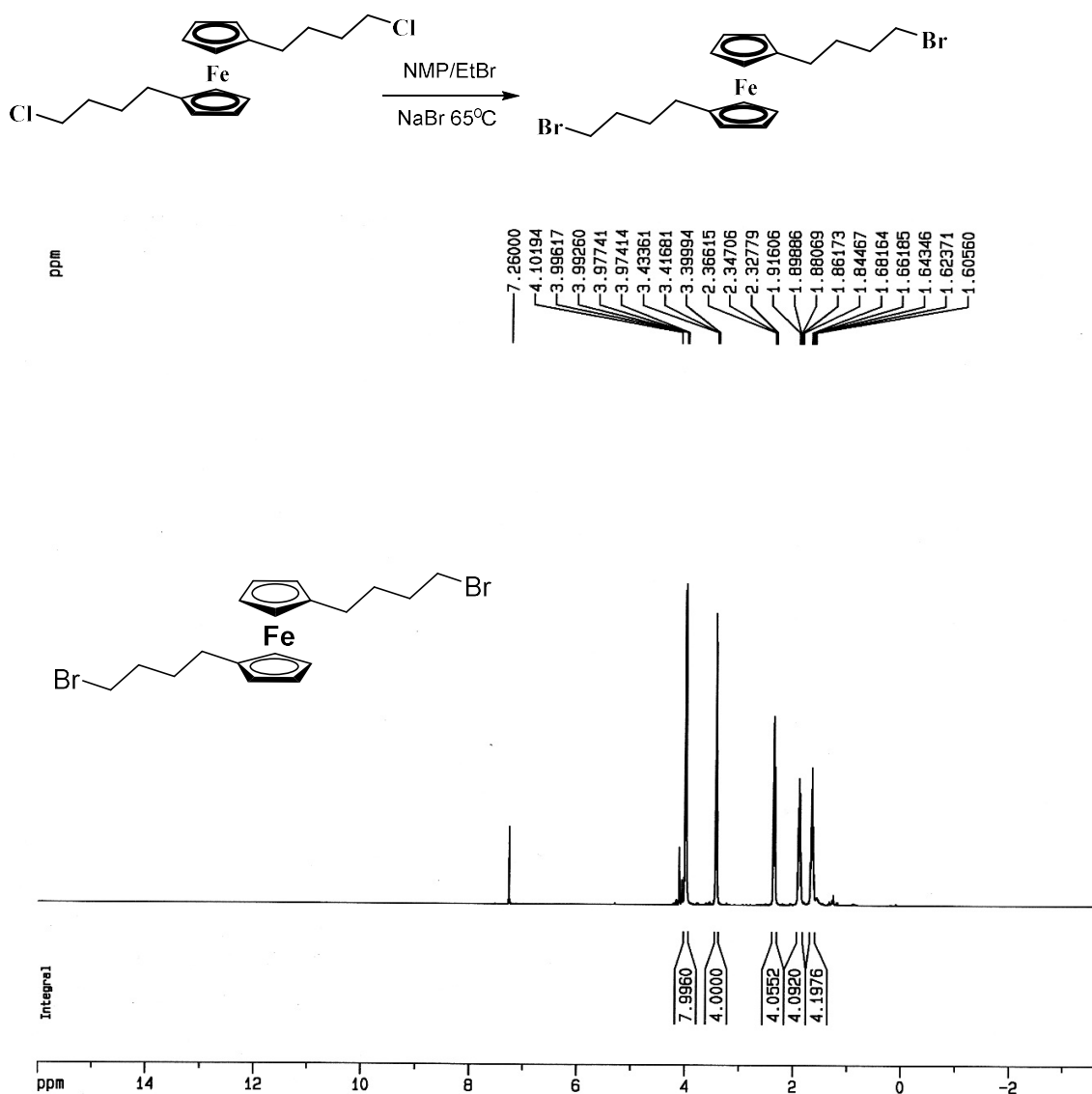


Fig. 8. ¹³C NMR spectrum of (5a) (100 MHz, CDCl₃)

2-2- 1,1'- Bis(4-bromobutyl)ferrocene (5b)

Fig. 9. ¹H NMR spectrum of (5b) (400 MHz, CDCl₃)

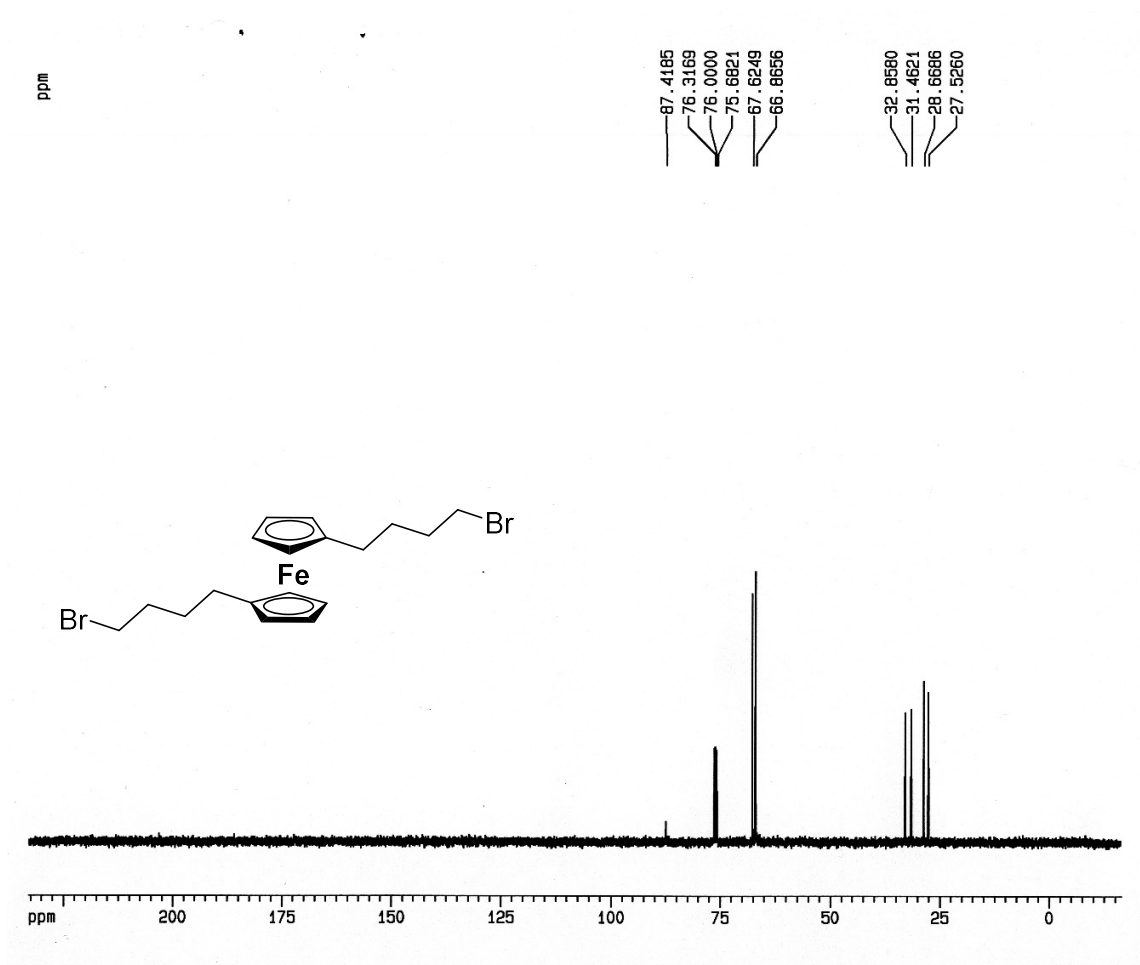


Fig. 10. ^{13}C NMR spectrum of (5b) (100 MHz, CDCl_3)

3-Preparation of compounds (6a-b) and (7a-b)

3-1- 1,1'- Bis[3-(tris(trimethylsilyl)methyl)propyl]ferrocene (6a)

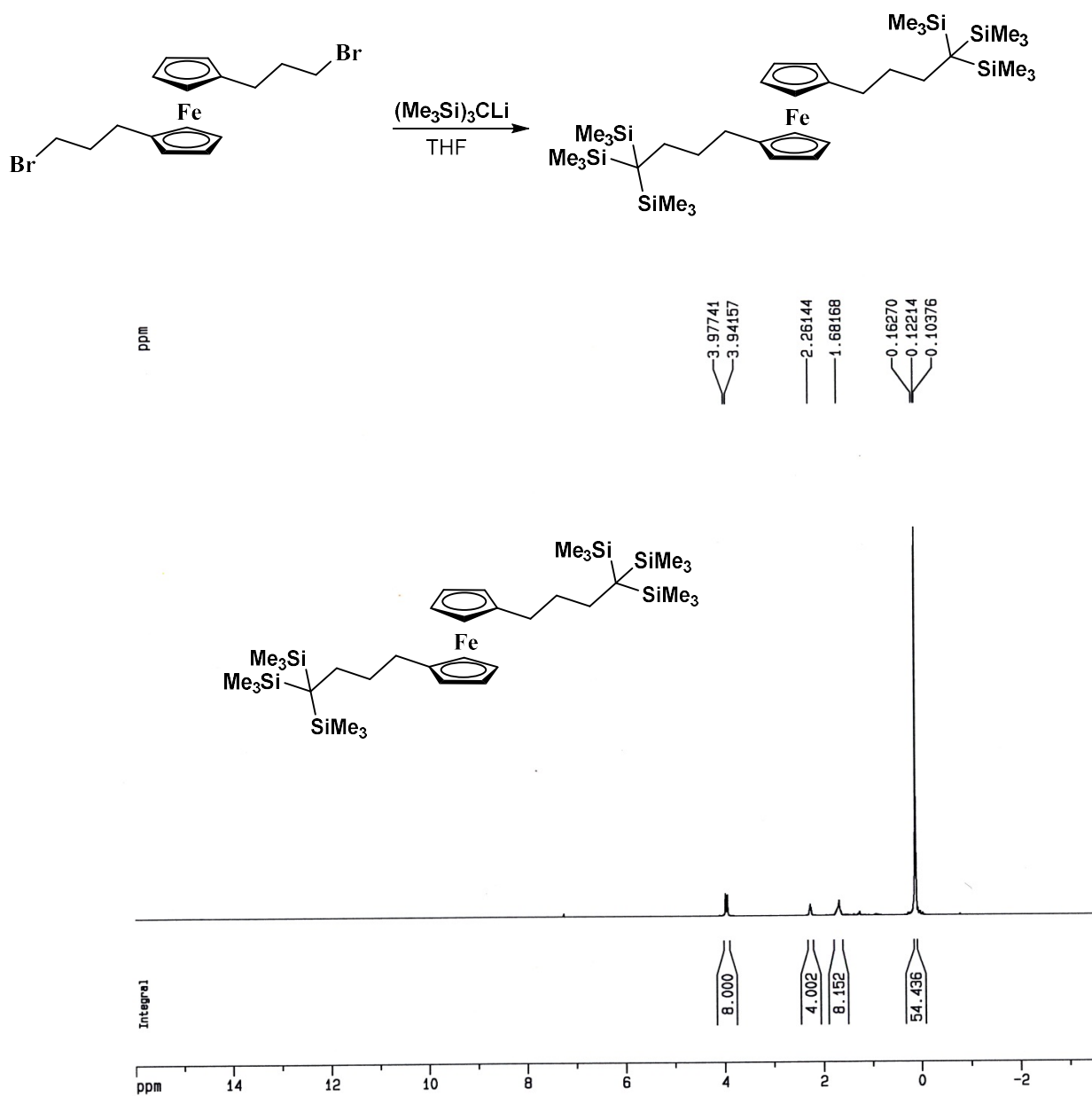


Fig. 11. ¹H NMR spectrum of (6a) (400 MHz, CDCl₃)

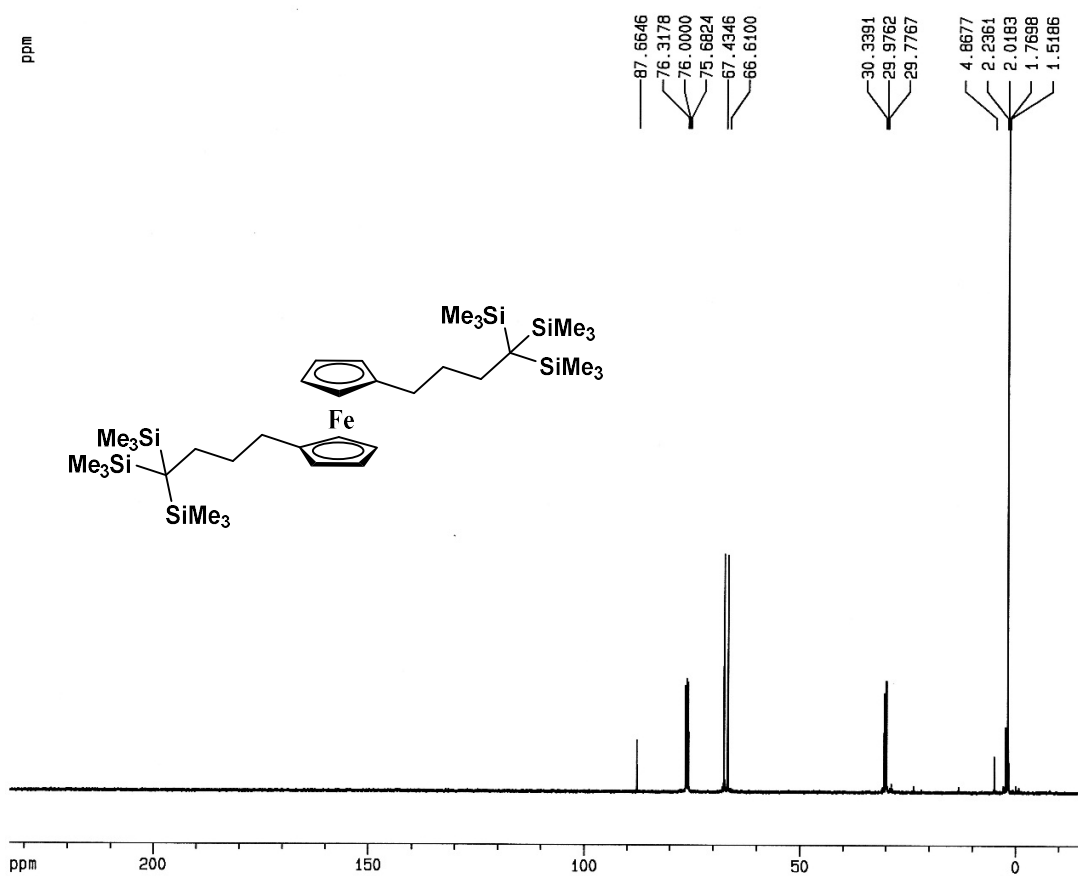
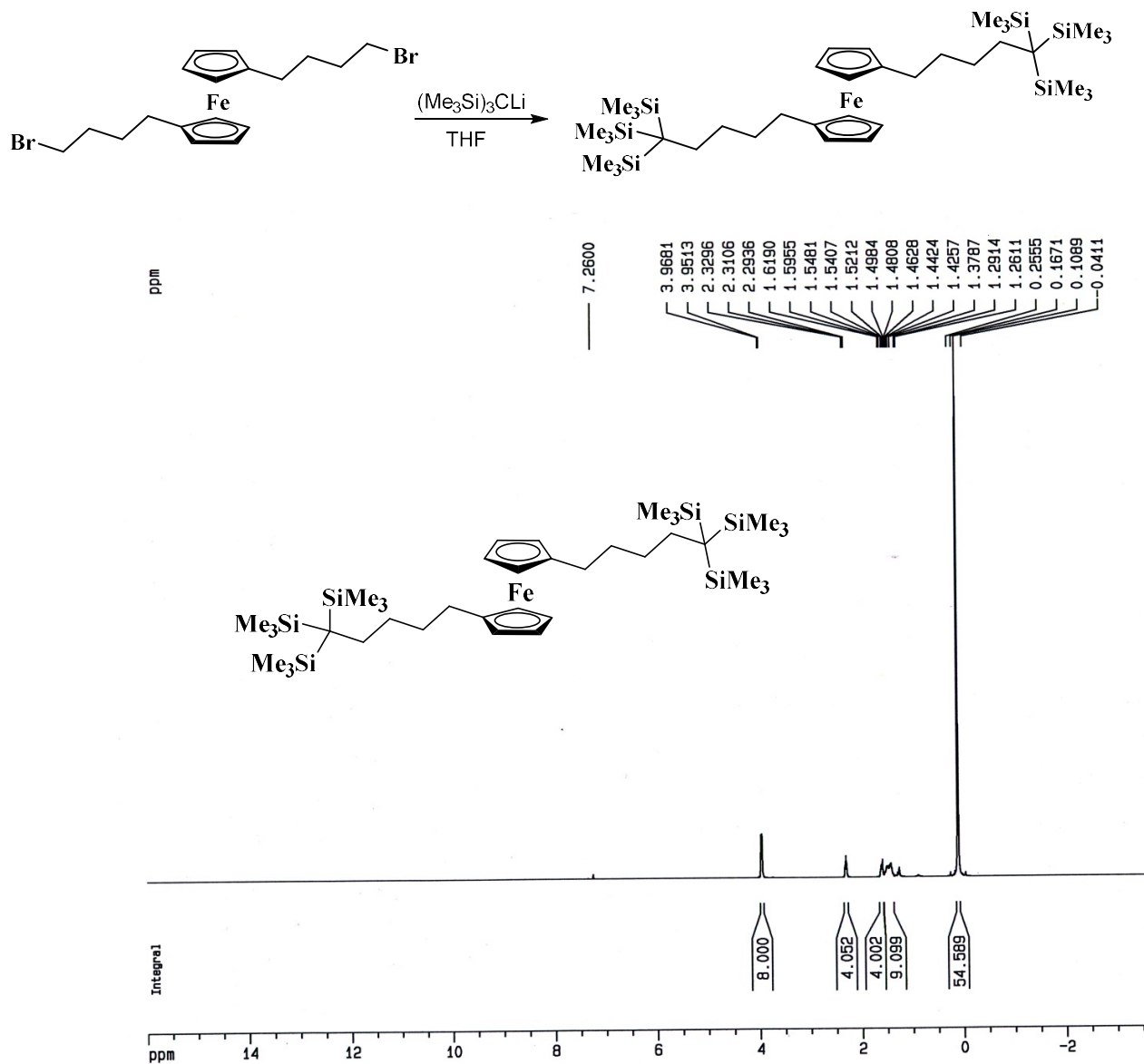
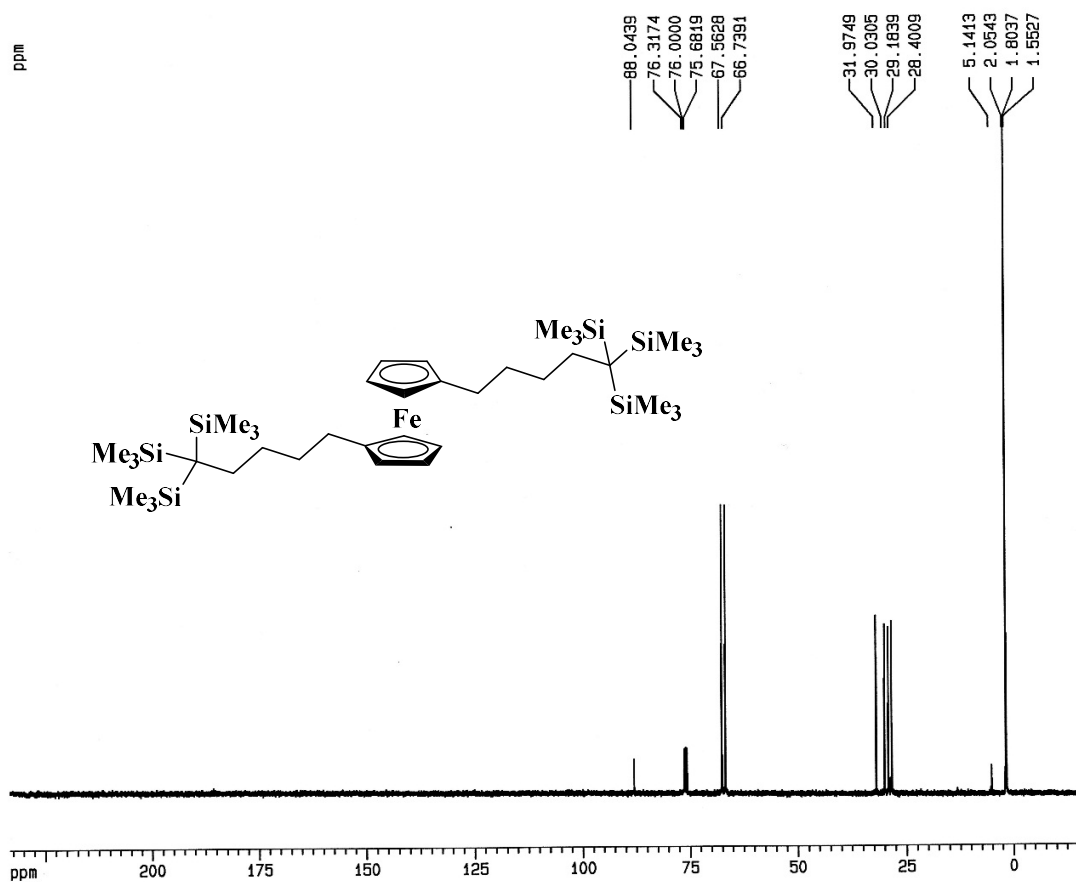


Fig. 12. ¹³C NMR spectrum of (6a) (100 MHz, CDCl₃)

3-2- 1,1'- Bis[4-(tris(trimethylsilyl)methyl)butyl]ferrocene (6b)

Fig. 13. ¹H NMR spectrum of (6b) (400 MHz, CDCl₃)

Fig. 14. ¹³C NMR spectrum of (6b) (100 MHz, CDCl₃)

3-3- 1,1'- Bis[3-(tris(dimethylsilyl)methyl)propyl]ferrocene (7a)

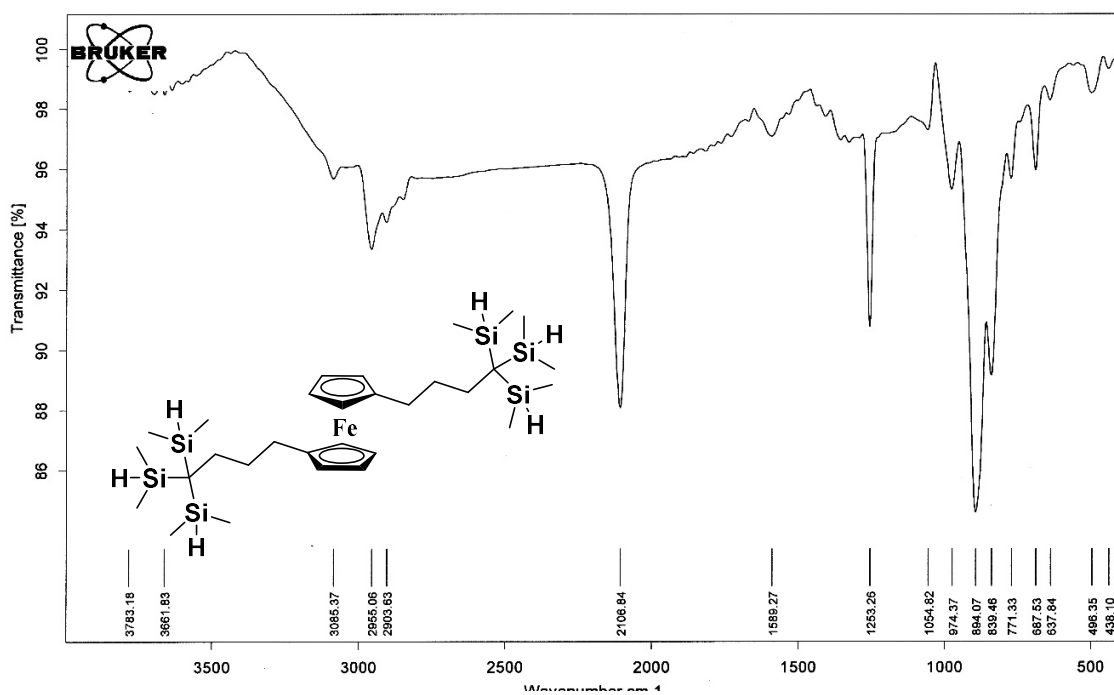
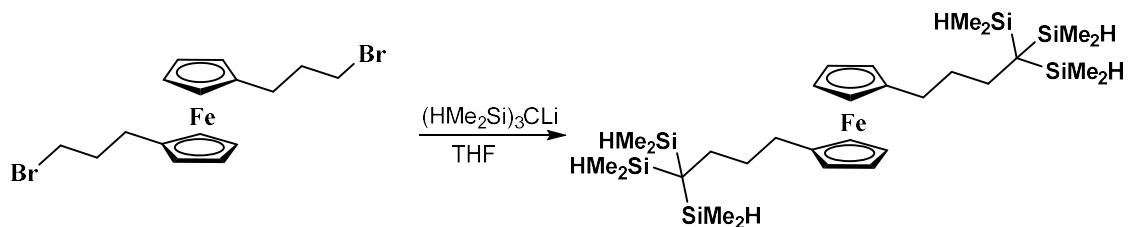
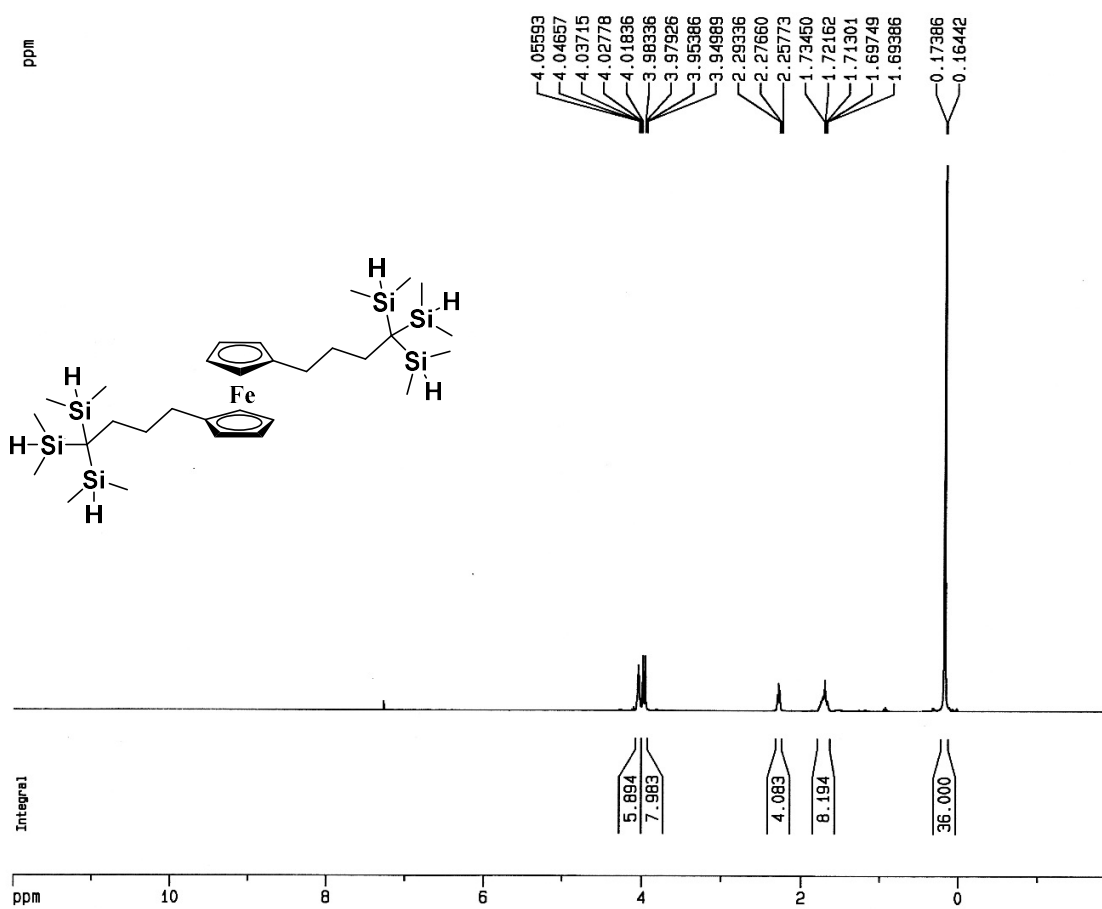


Fig. 15. FT-IR spectrum of (7a)

طیف ^1H NMR در CDCl_3 (II)Fig. 16. ^1H NMR spectrum of (7a) (400 MHz, CDCl_3)

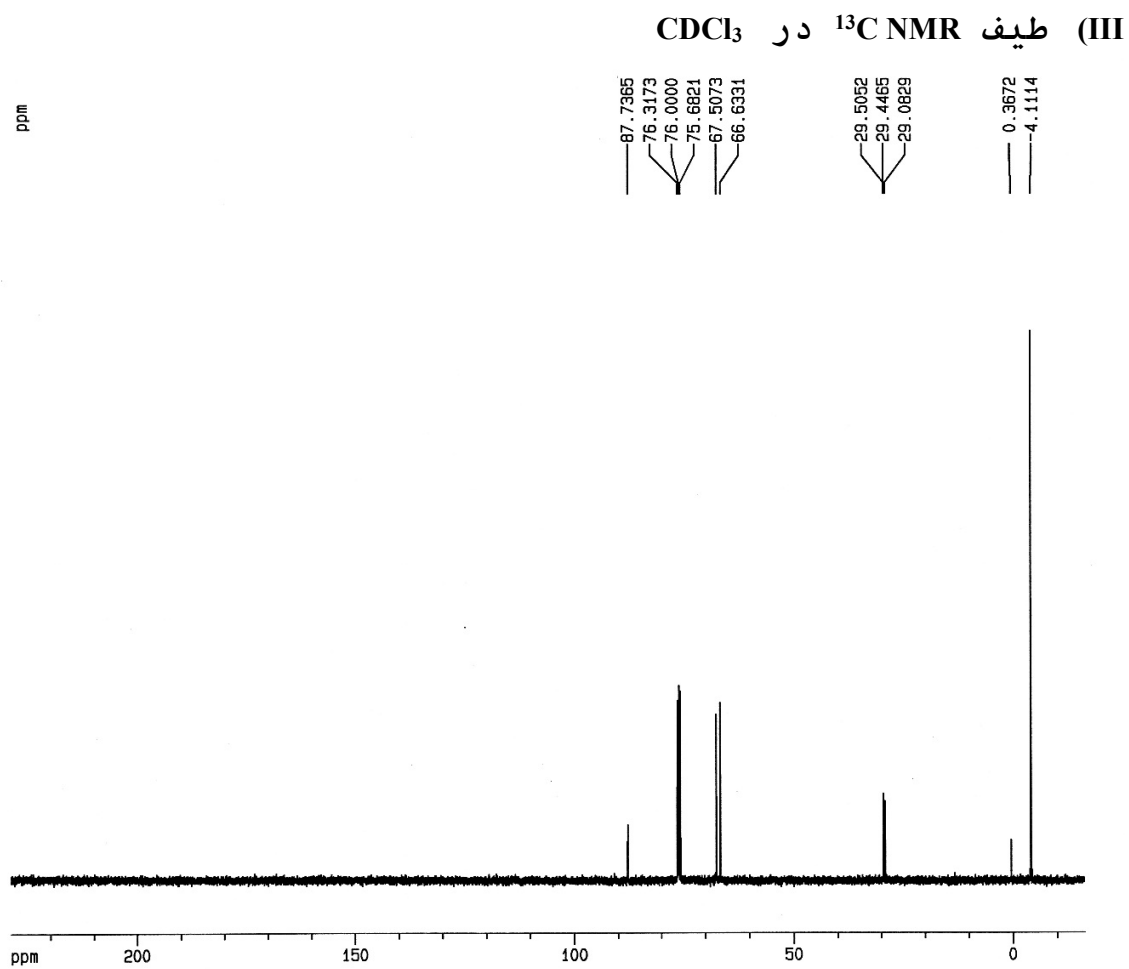


Fig. 17. ^{13}C NMR spectrum of (7a) (100 MHz, CDCl_3)

3-4- 1,1'- Bis[4-(tris(dimethylsilyl)methyl)butyl]ferrocene (7b)

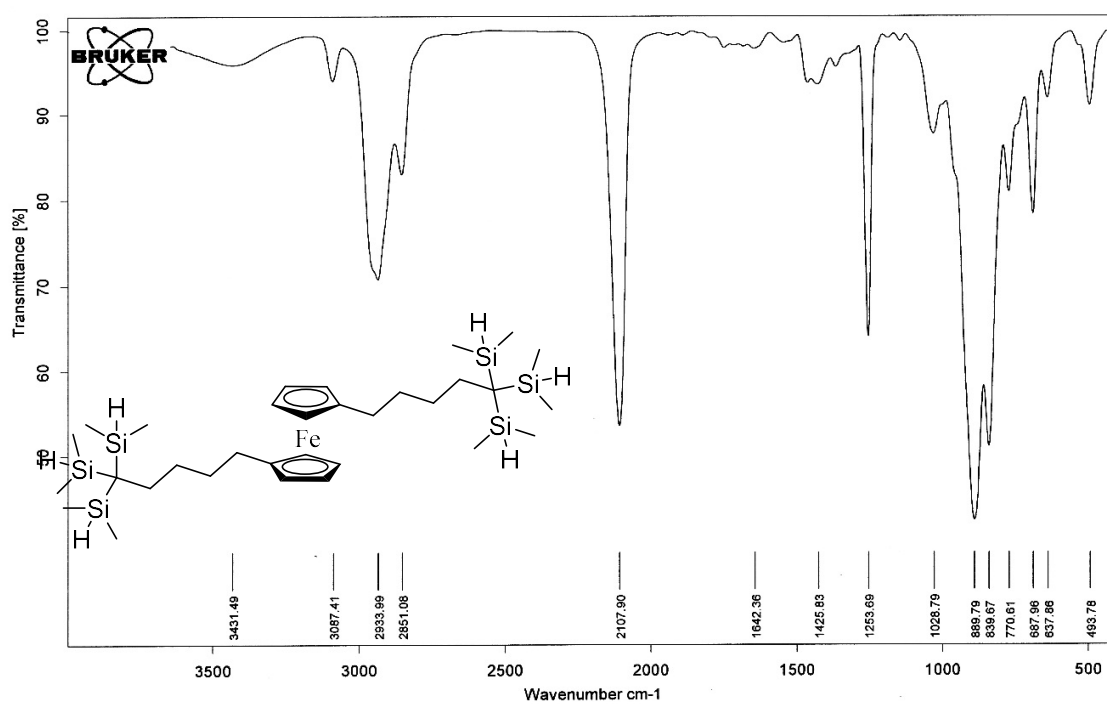
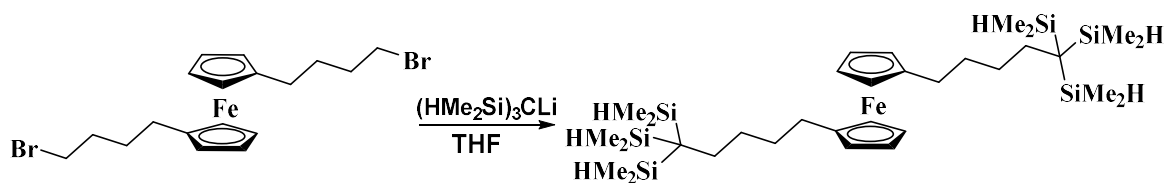
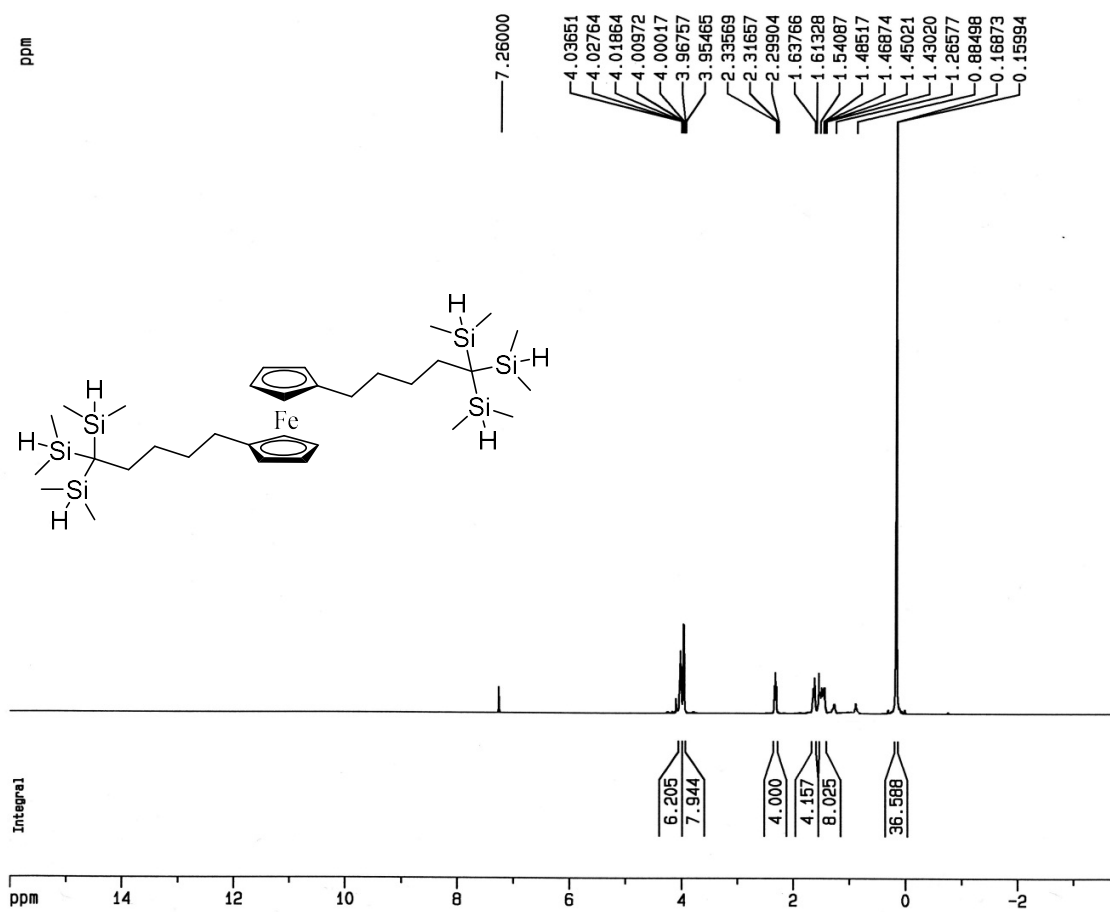


Fig. 18. FT-IR spectrum of (7b)

Fig. 19. ^1H NMR spectrum of (7b) (400 MHz, CDCl_3)

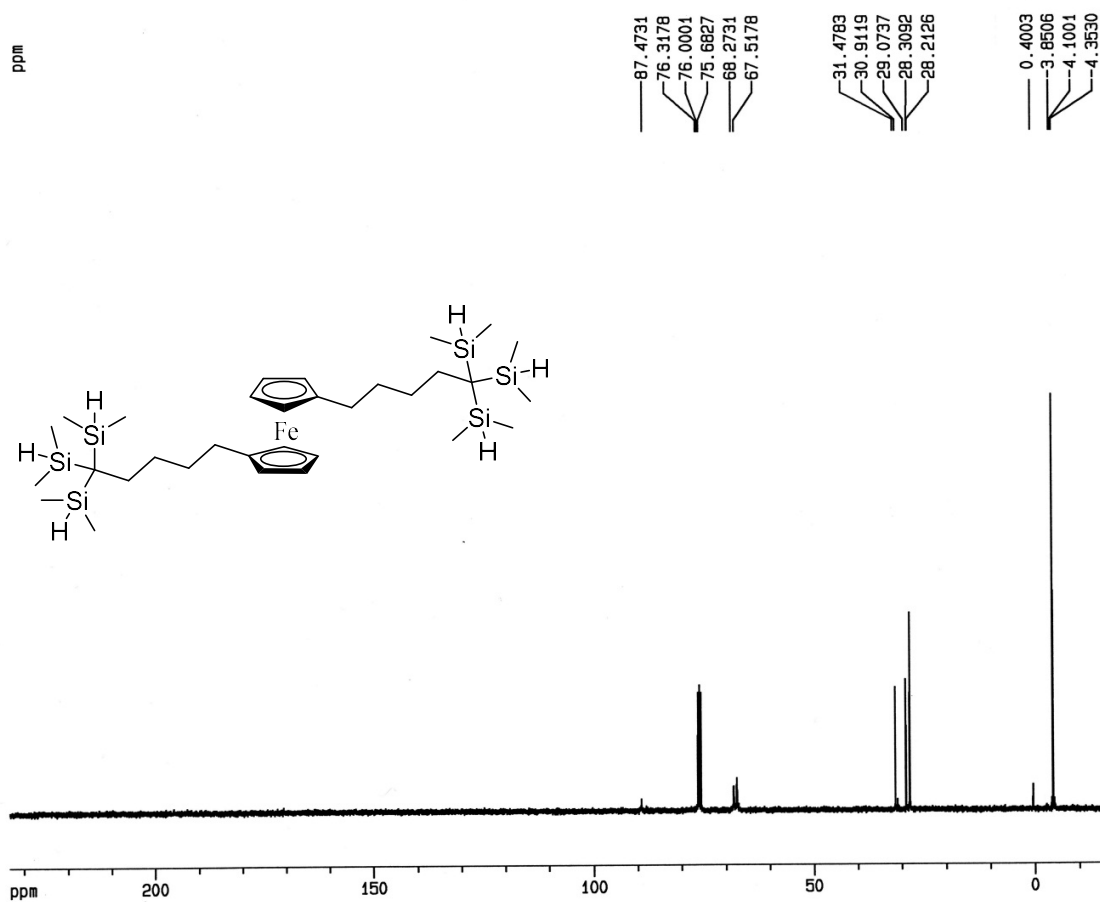
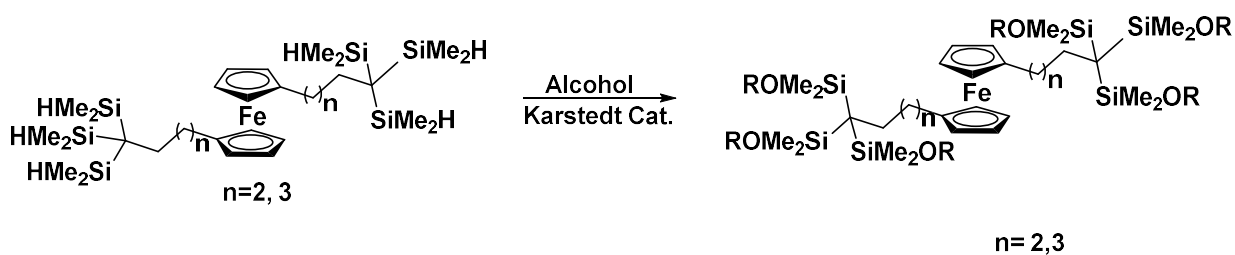
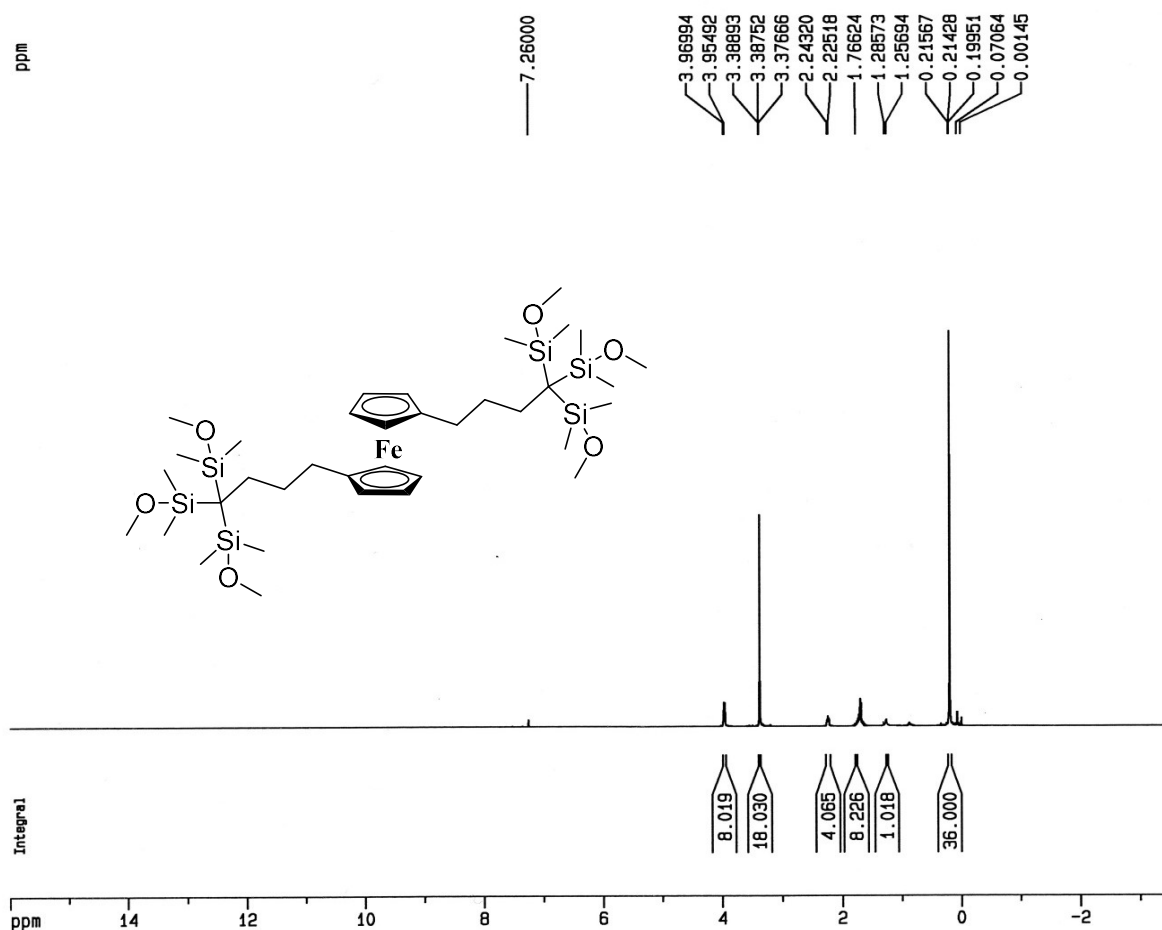


Fig. 20. ^{13}C NMR spectrum of (7b) (100 MHz, CDCl_3)

4-Synthesis of 1,1'-Bis[(tris(dimethylsilyl)methyl)alkyl]ferrocene



4-1- Synthesis of 1,1'- Bis[3-(tris(methoxydimethylsilyl)methyl)propyl]ferrocene (8a)

Fig. 21. ^1H NMR spectrum of (8a) (400 MHz, CDCl_3)

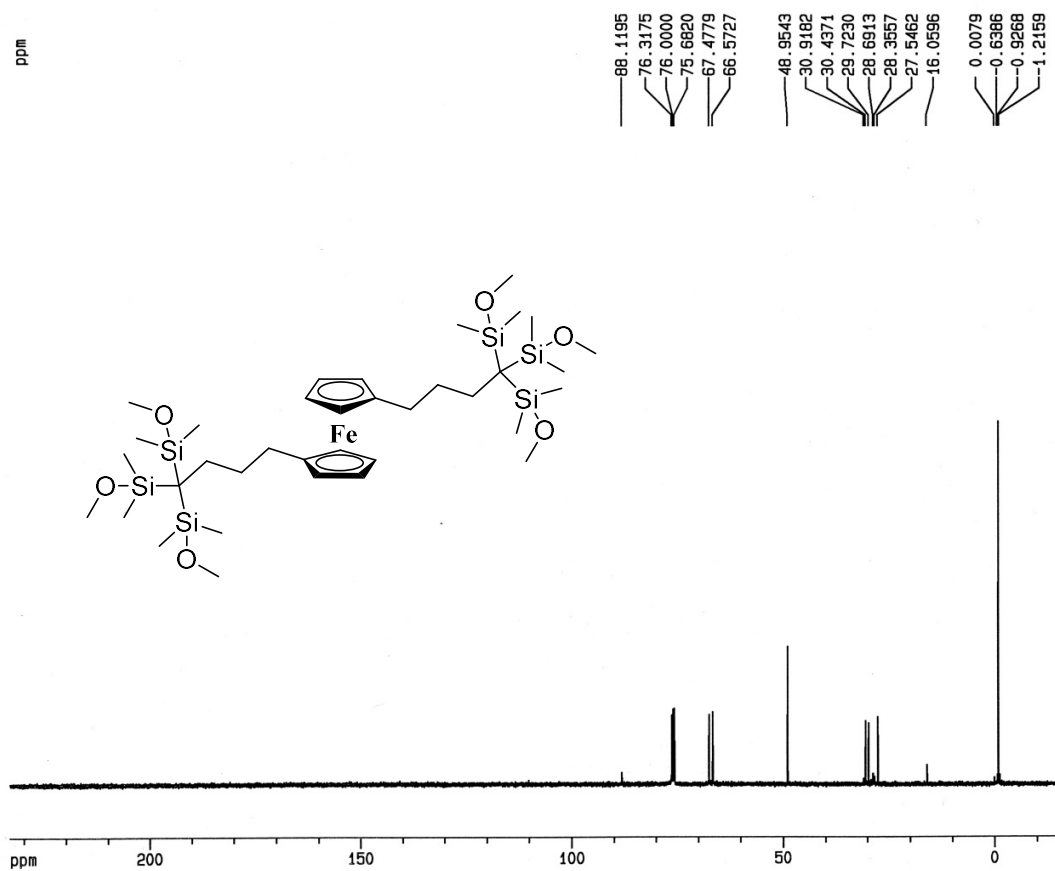


Fig. 22. ¹³C NMR spectrum of (8a) (100 MHz, CDCl₃)

4-2- 1,1' - Bis[3-(tris(ethoxydimethylsilyl)methyl)propyl]ferrocene (8b)

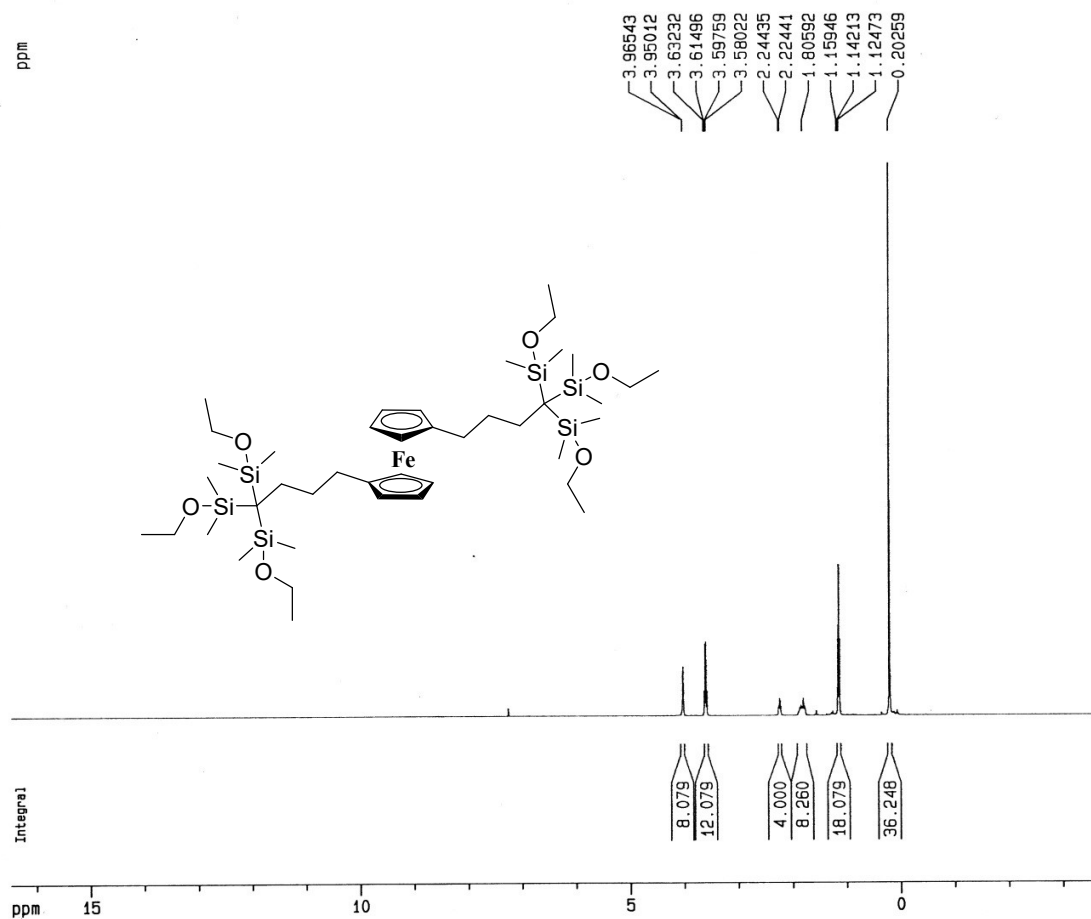


Fig. 23. ¹H NMR spectrum of (8b) (400 MHz, CDCl₃)

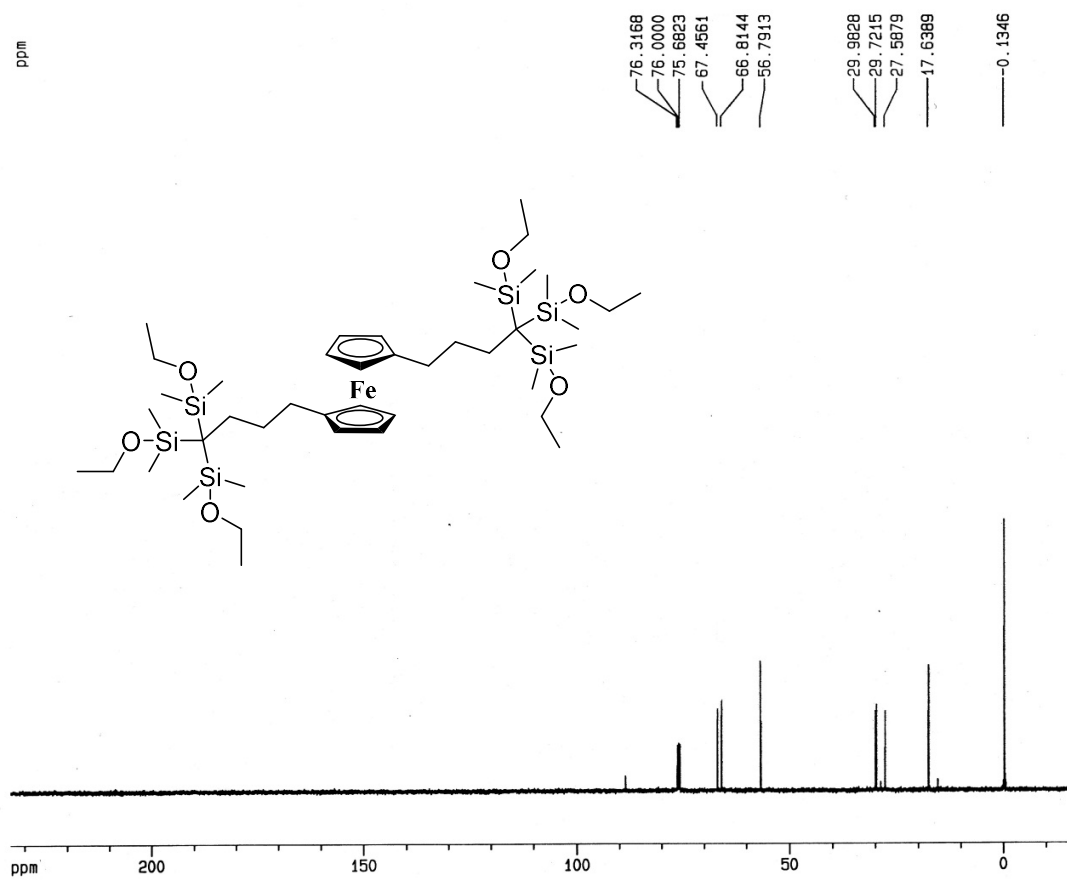
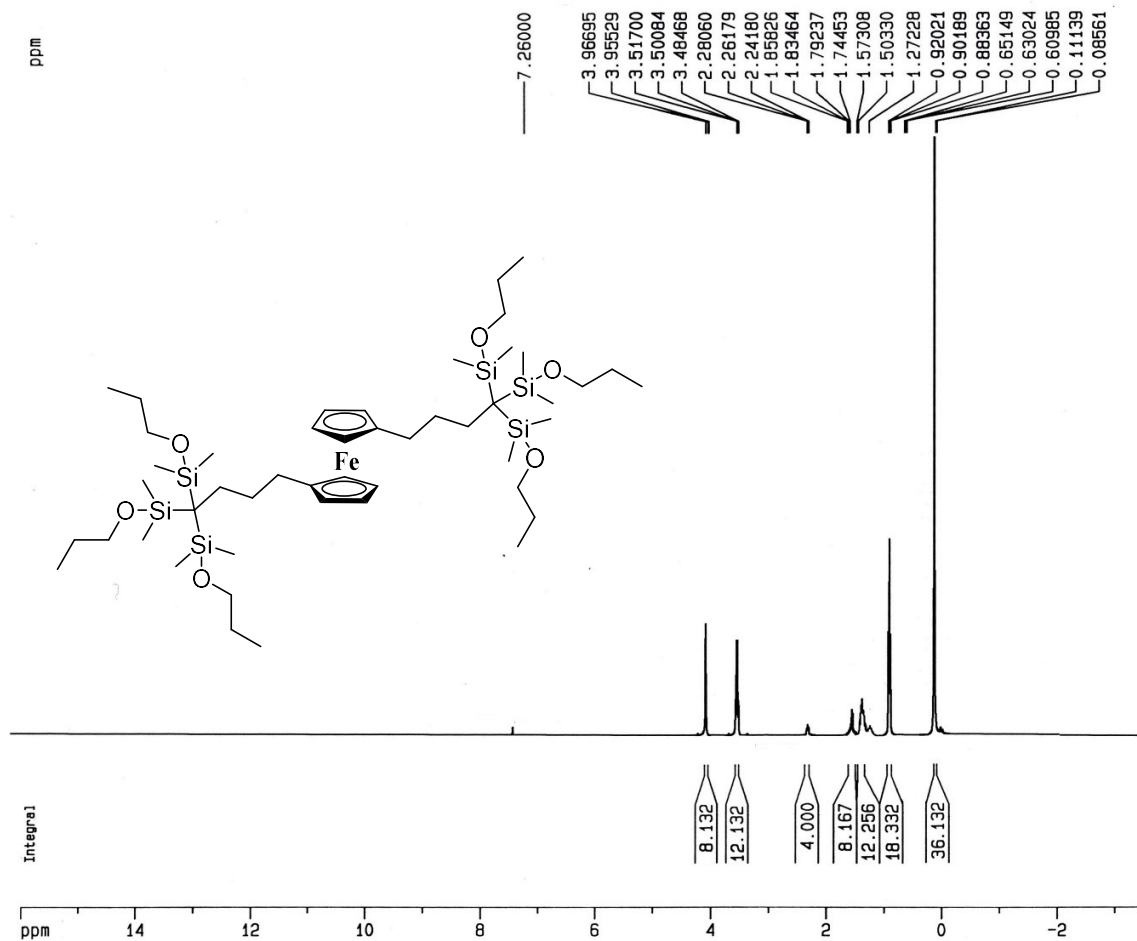


Fig. 24. ¹³C NMR spectrum of (8b) (100 MHz, CDCl₃)

4-3- 1,1'-Bis[3-(tris(propoxydimethylsilyl)methyl)propyl]ferrocene (8c)

Fig. 25. ^1H NMR spectrum of (8c) (400 MHz, CDCl_3)

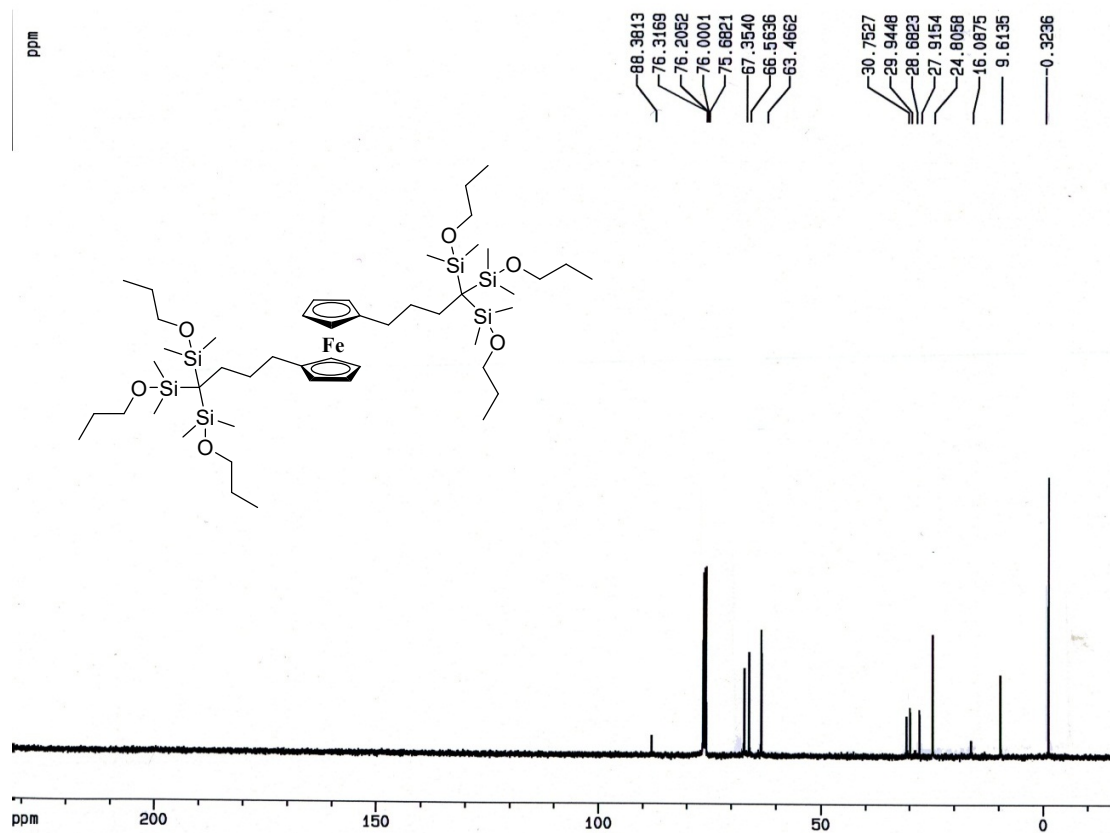
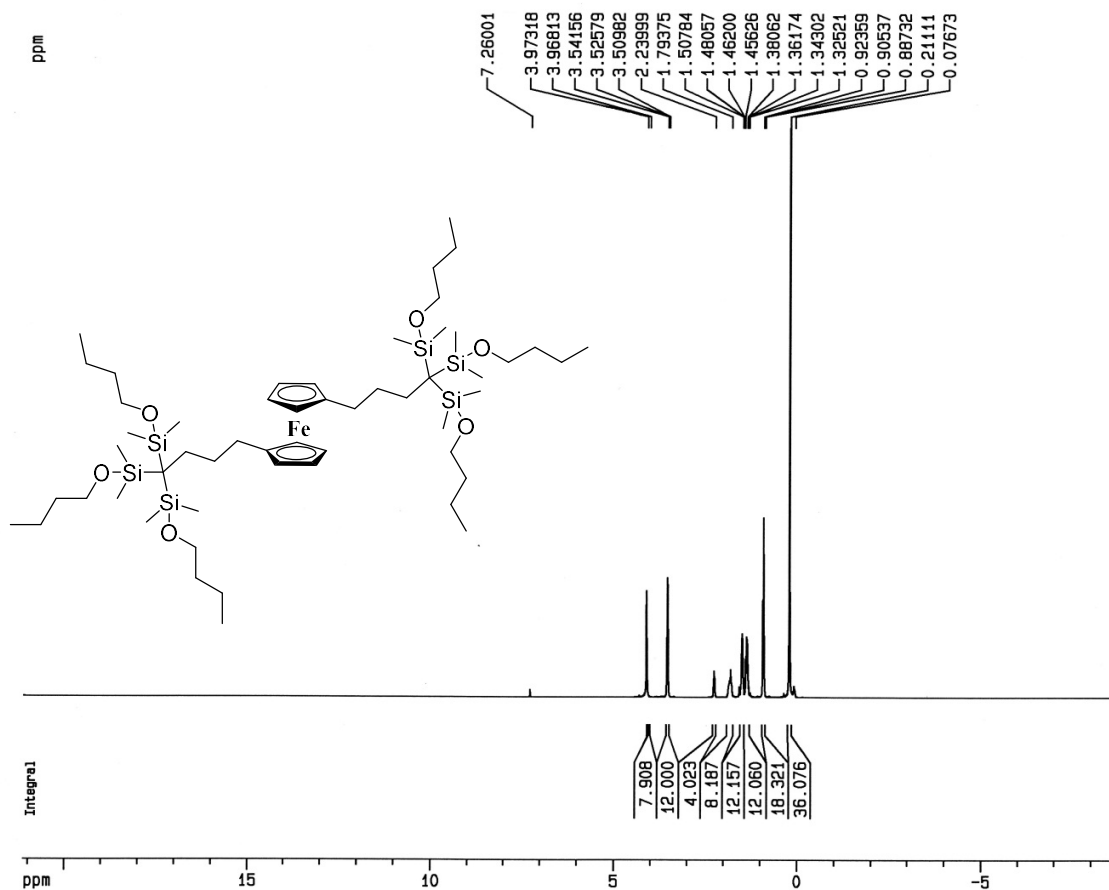


Fig. 26. ¹³C NMR spectrum of (8c) (100 MHz, CDCl₃)

1,1'- Bis[3-(tris(butoxydimethylsilyl)methyl)propyl]ferrocene (8d)Fig. 27. ^1H NMR spectrum of (8d) (400 MHz, CDCl_3)

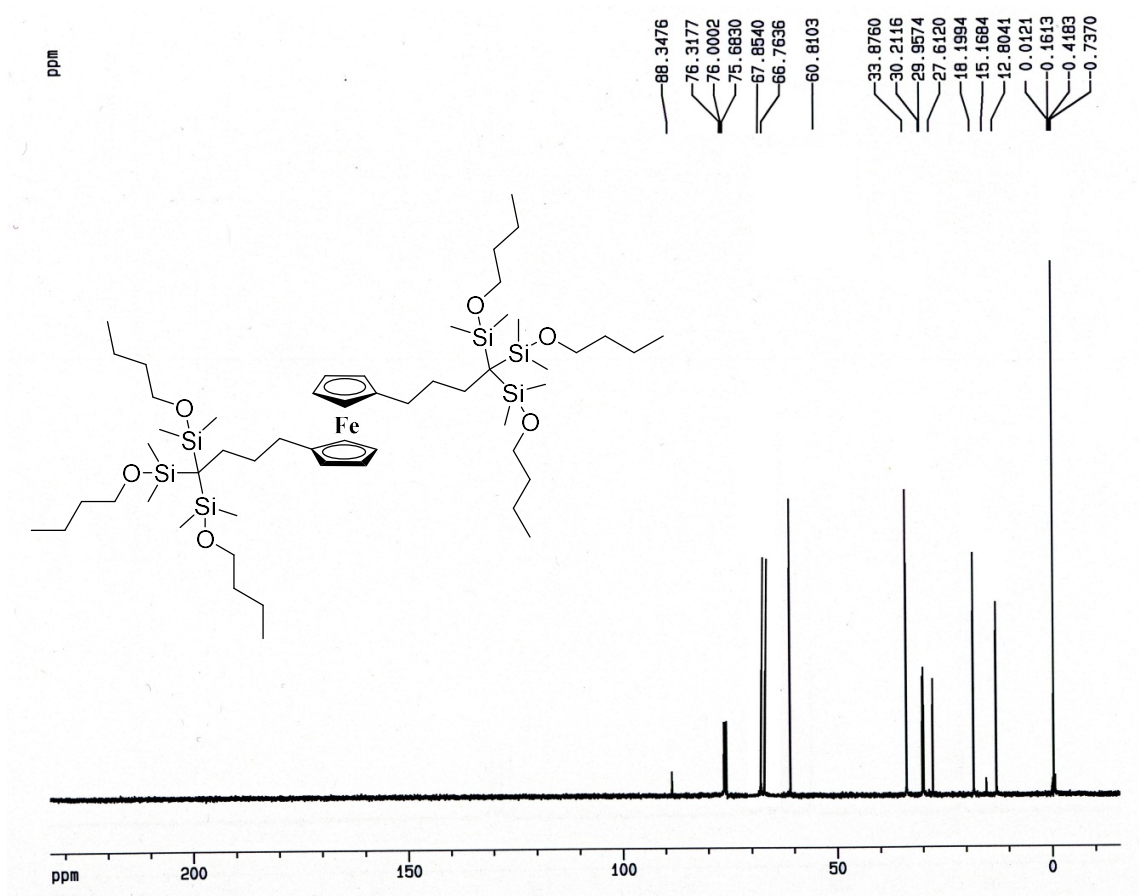
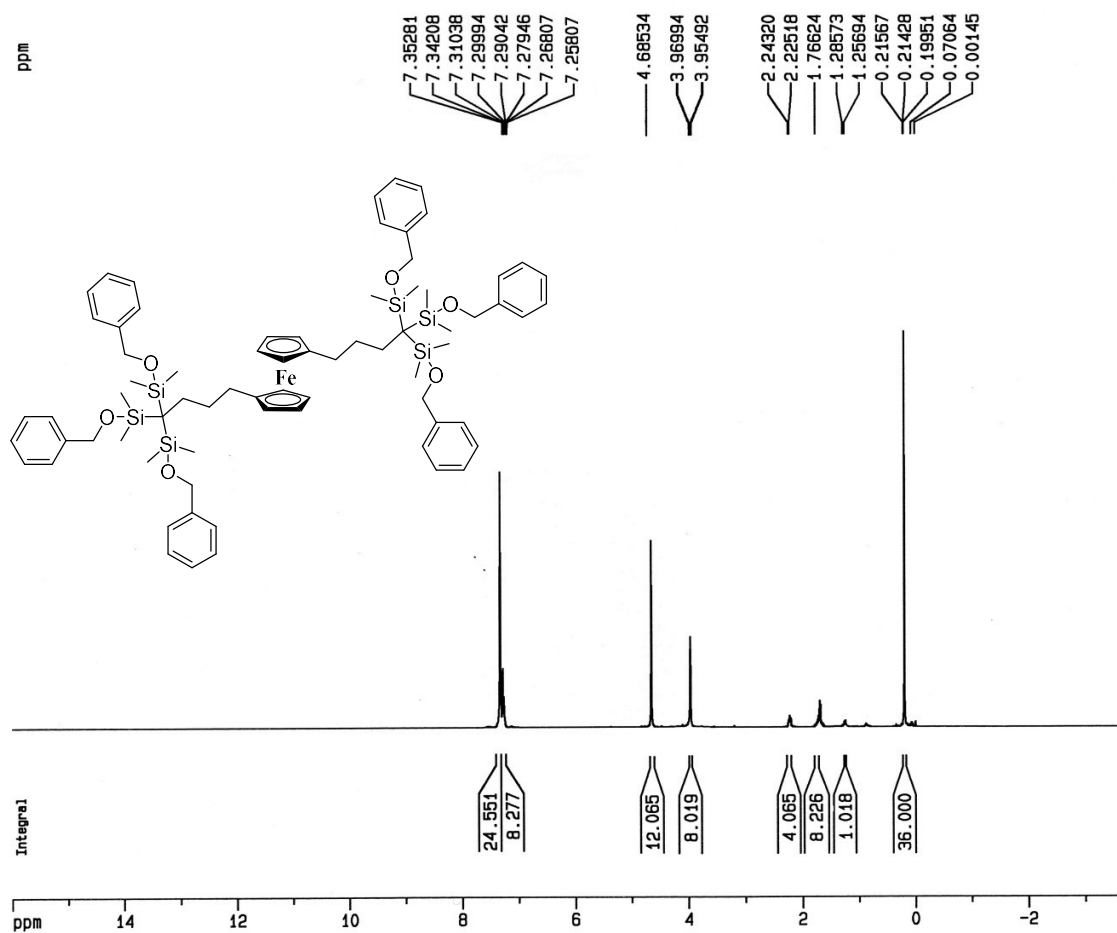


Fig. 28. ¹³C NMR spectrum of (8d) (100 MHz, CDCl₃)

4-5- 1,1'- Bis[3-(tris(benzyloxymethyl)dimethylsilyl)propyl]ferrocene (8e)

Fig. 29. ¹H NMR spectrum of (8e) (400 MHz, CDCl₃)

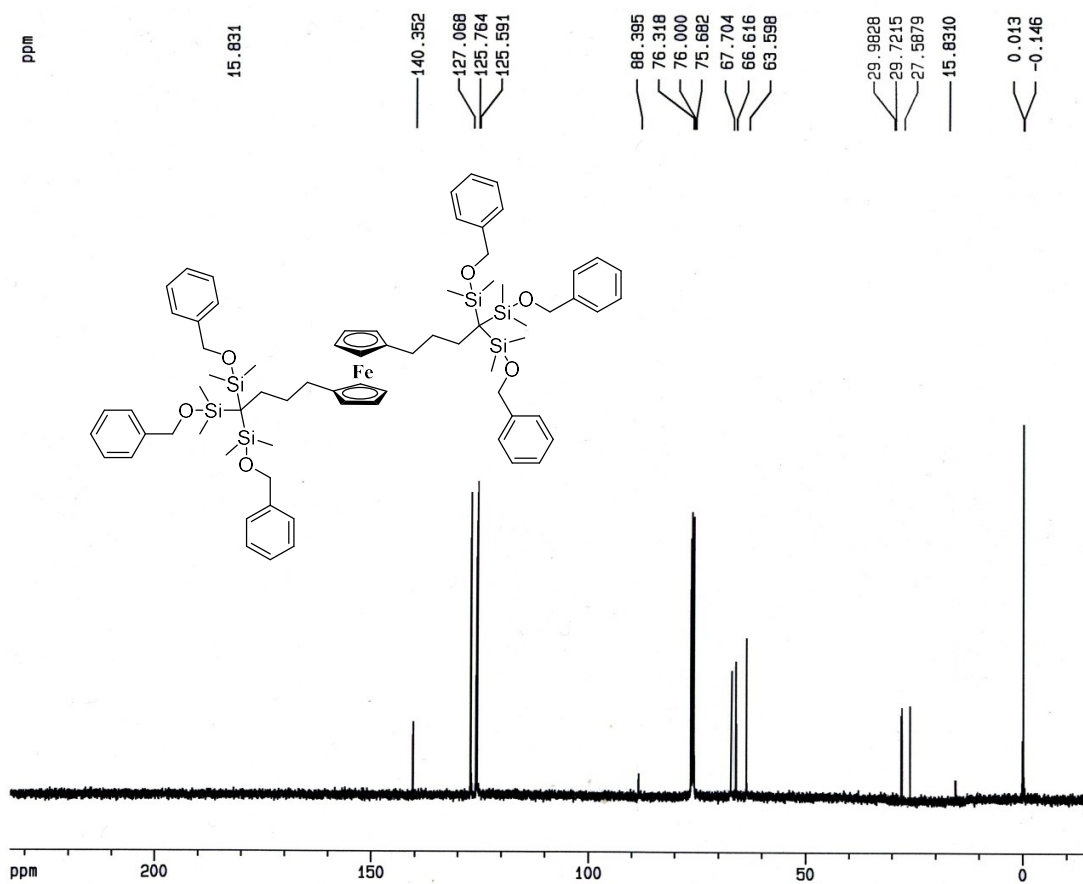
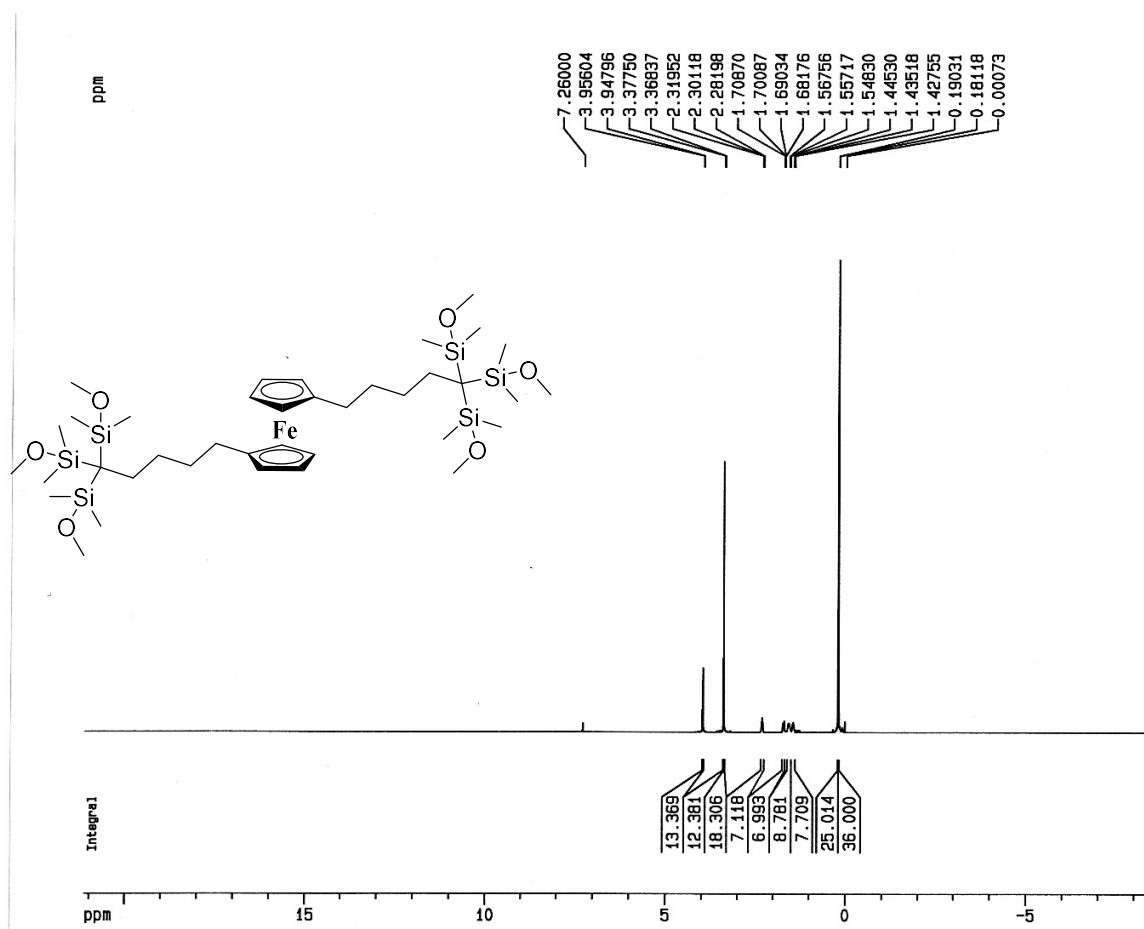


Fig. 30. ¹³C NMR spectrum of (8e) (100 MHz, CDCl₃)

5-6- 1,1'- Bis[4-(tris(methoxydimethylsilyl)methyl)butyl]ferrocene (8g)

Fig. 31. ¹H NMR spectrum of (8g) (400 MHz, CDCl₃)

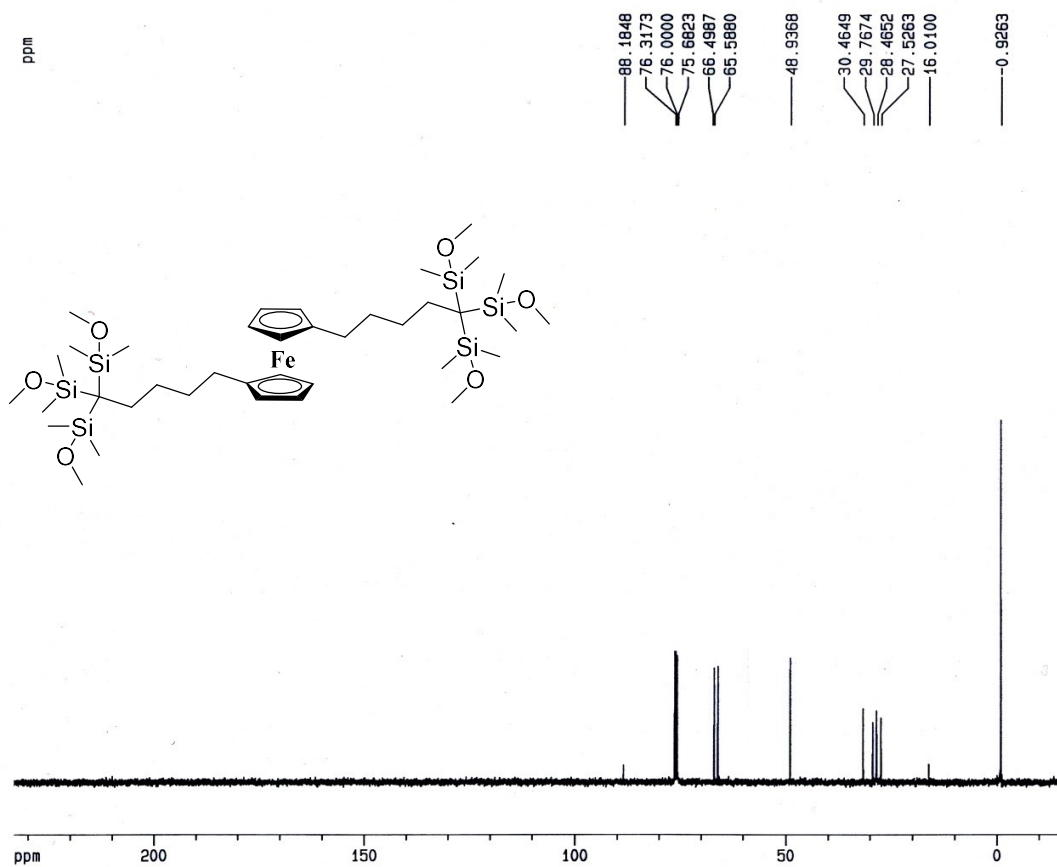
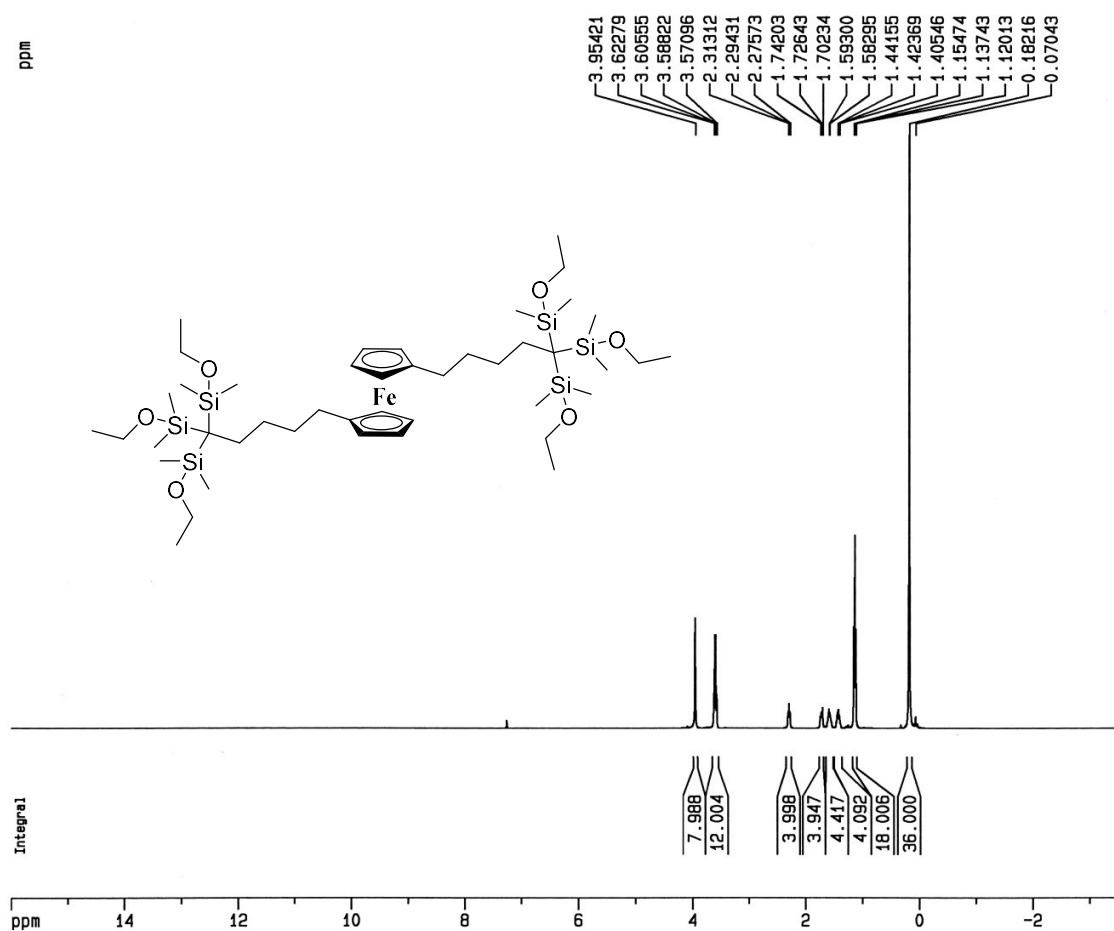


Fig. 32. ¹³C NMR spectrum of (8g) (100 MHz, CDCl₃)

5-7- 1,1'- Bis[4-(tris(ethoxydimethylsilyl)methyl)butyl]ferrocene (8h)

Fig. 33. ¹H NMR spectrum of (8h) (400 MHz, CDCl₃)

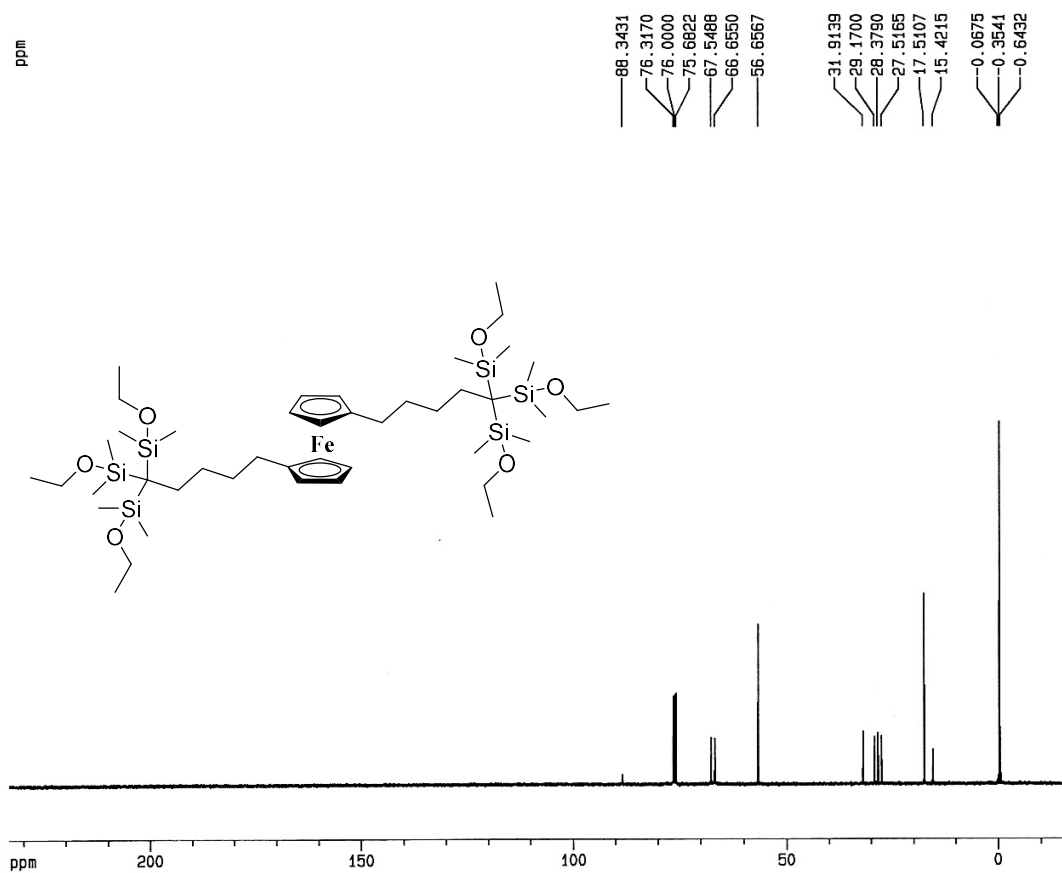
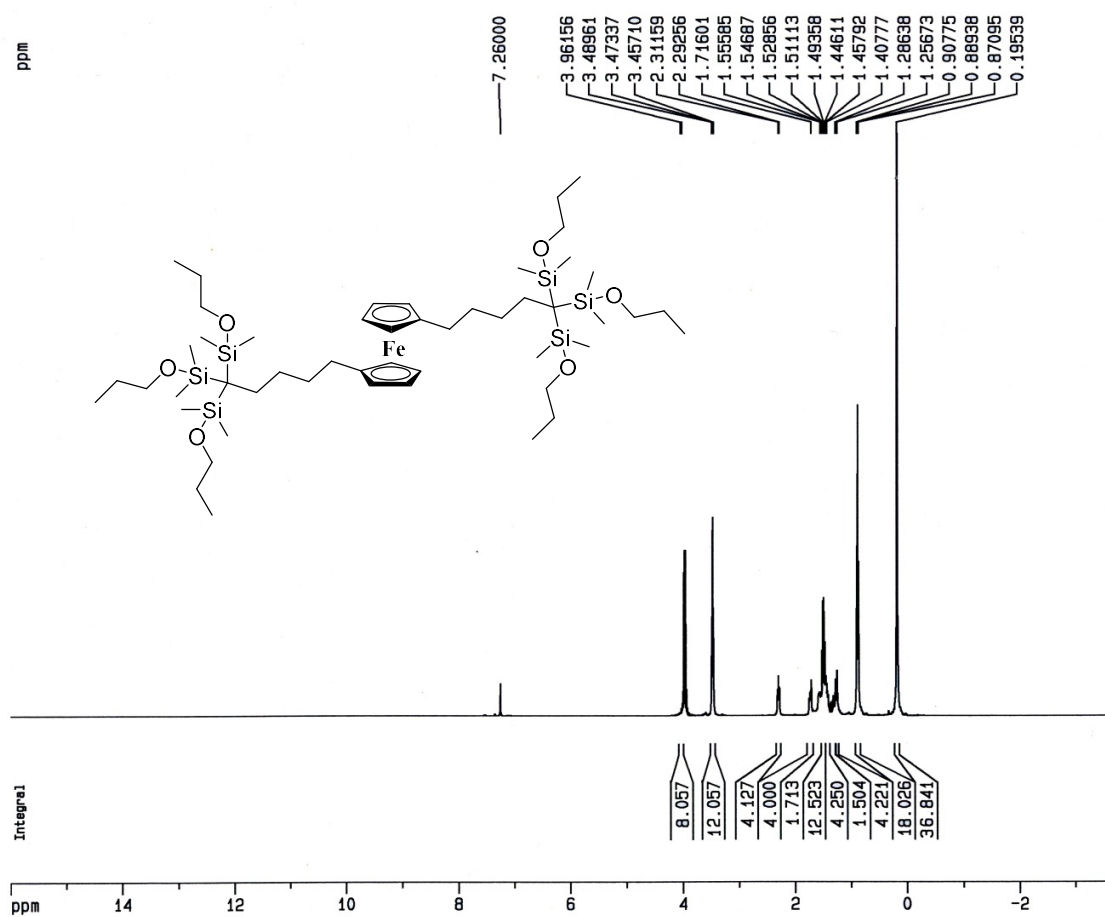


Fig. 34. ^{13}C NMR spectrum of (8h) (100 MHz, CDCl_3)

4-8- 1,1' - Bis[4-(tris(propoxydimethylsilyl)methyl)butyl]ferrocene (8i)

Fig. 35. ^1H NMR spectrum of (8i) (400 MHz, CDCl_3)

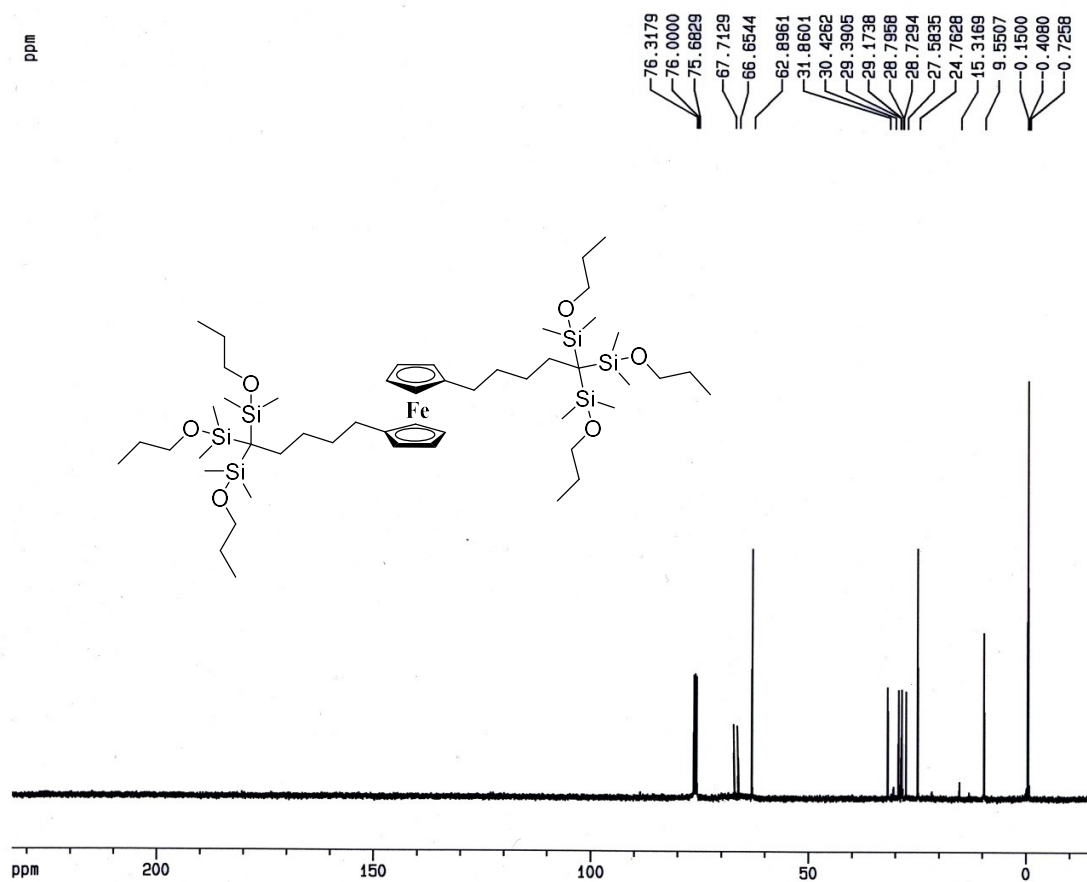
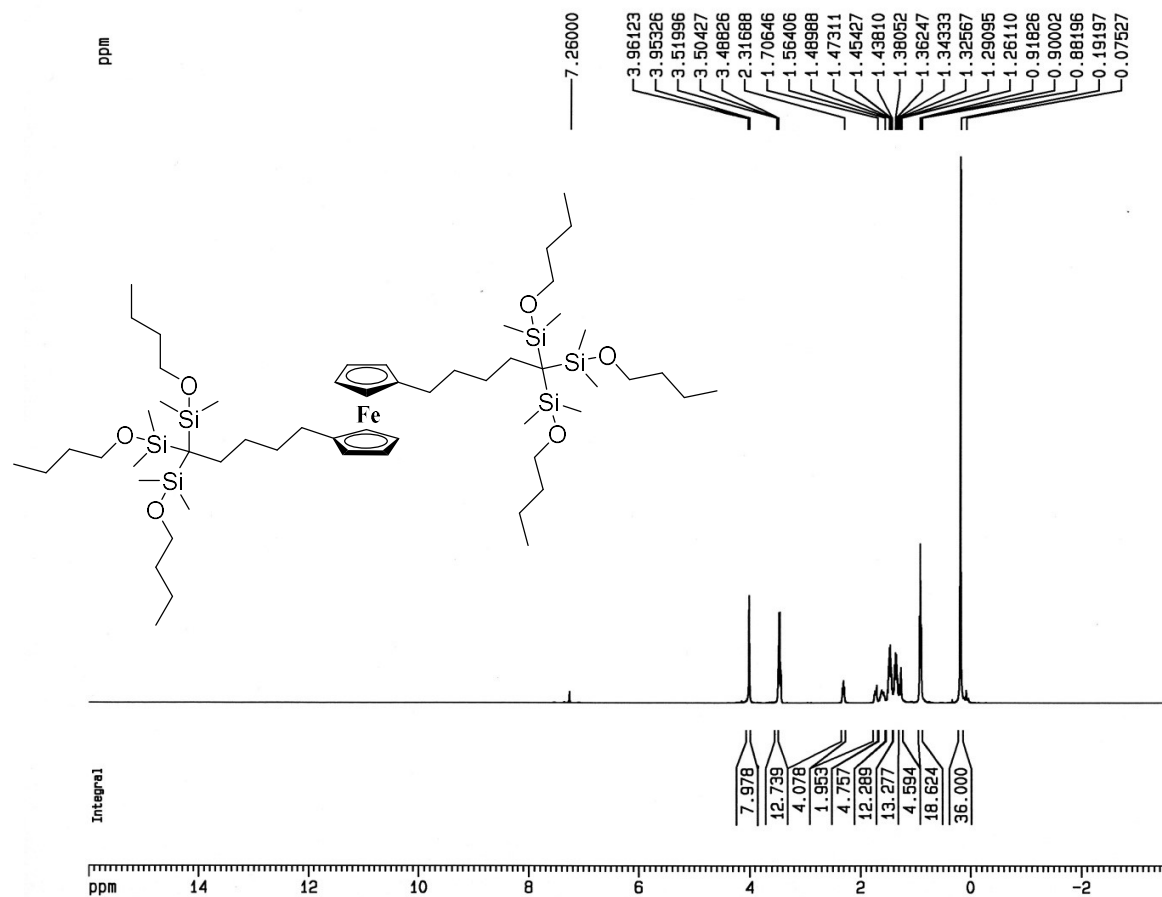


Fig. 36. ¹³C NMR spectrum of (8i) (100 MHz, CDCl₃)

4-9- 1,1'- Bis[4-(tris(butoxydimethylsilyl)methyl)butyl]ferrocene (**8j**)Fig. 37. ^1H NMR spectrum of (**8j**) (400 MHz, CDCl_3)

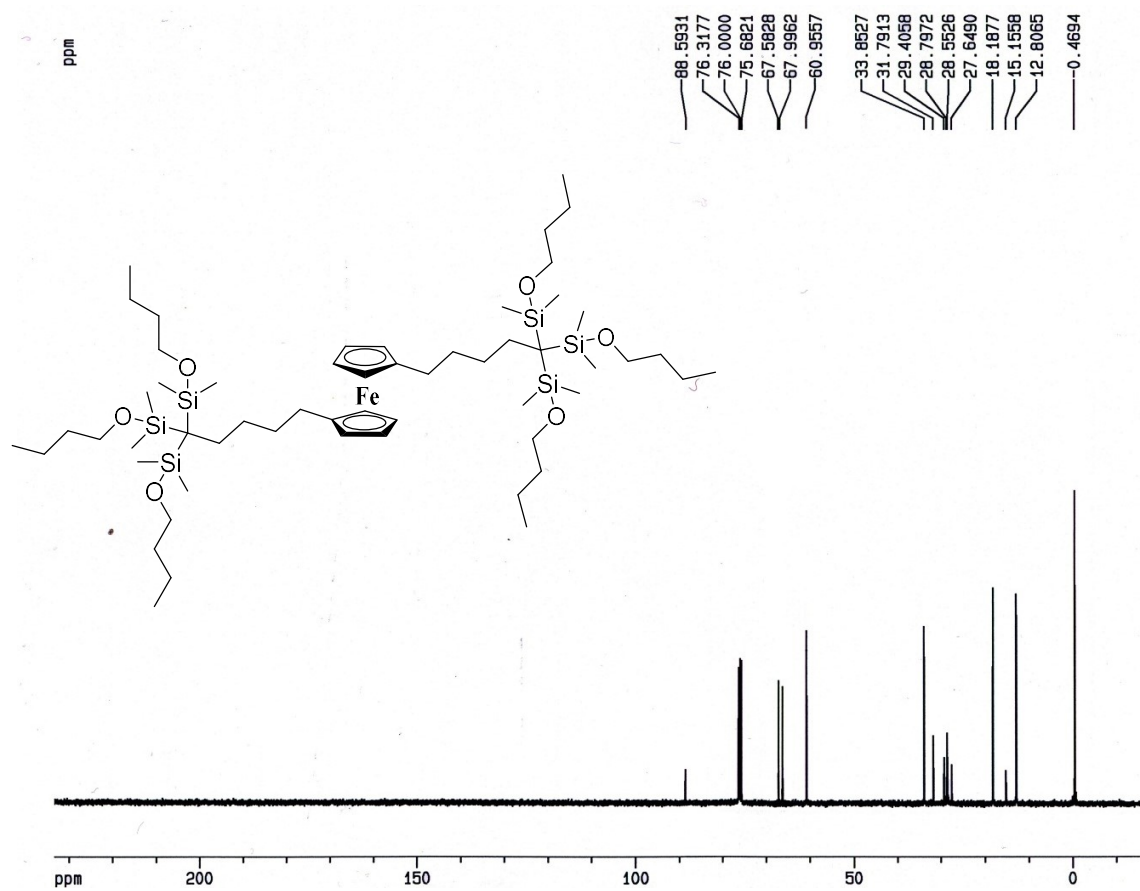
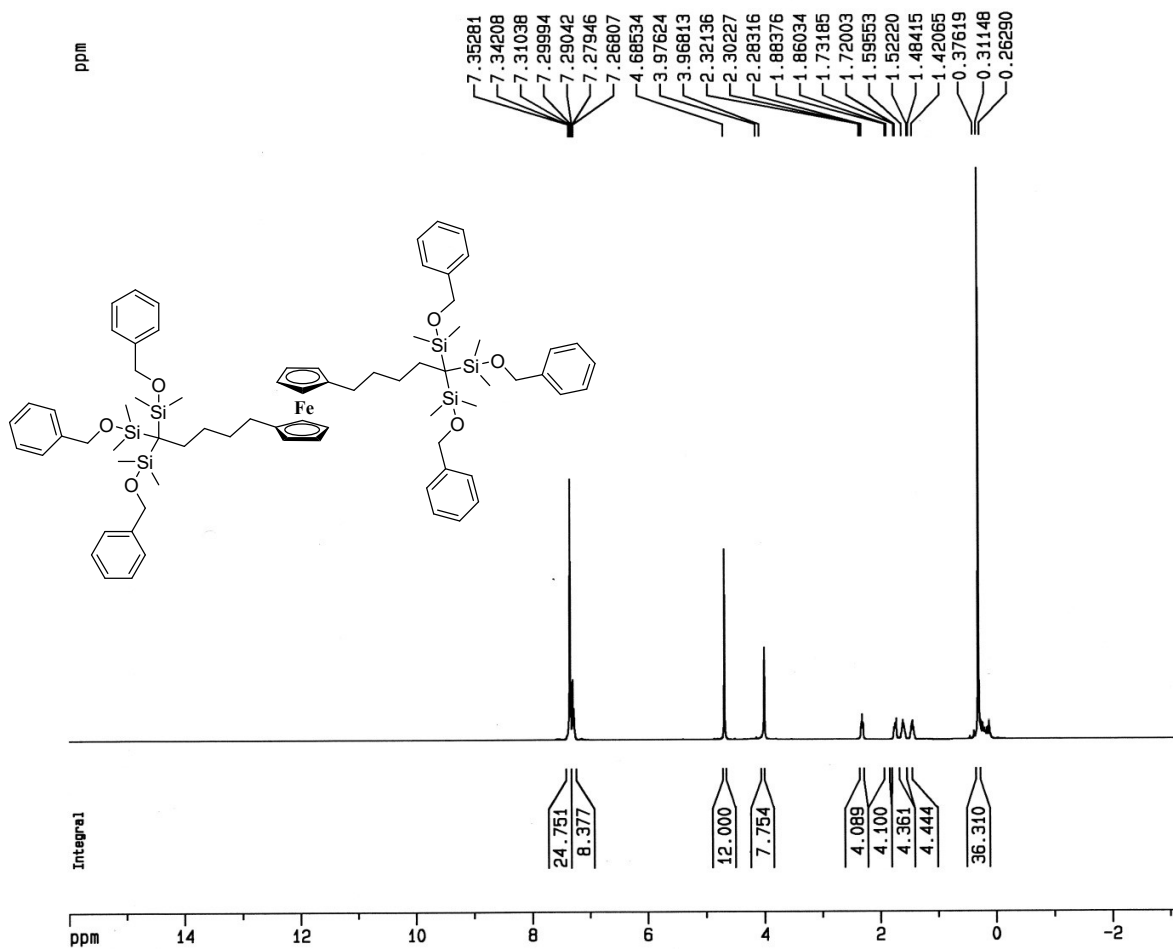


Fig. 38. ¹³C NMR spectrum of (8j) (100 MHz, CDCl₃)

4-10- 1,1'- Bis[4-(tris(benzyloxymethyl)silyl)methyl]butyl]ferrocene (8k)

Fig. 39. ¹H NMR spectrum of (8k) (400 MHz, CDCl₃)

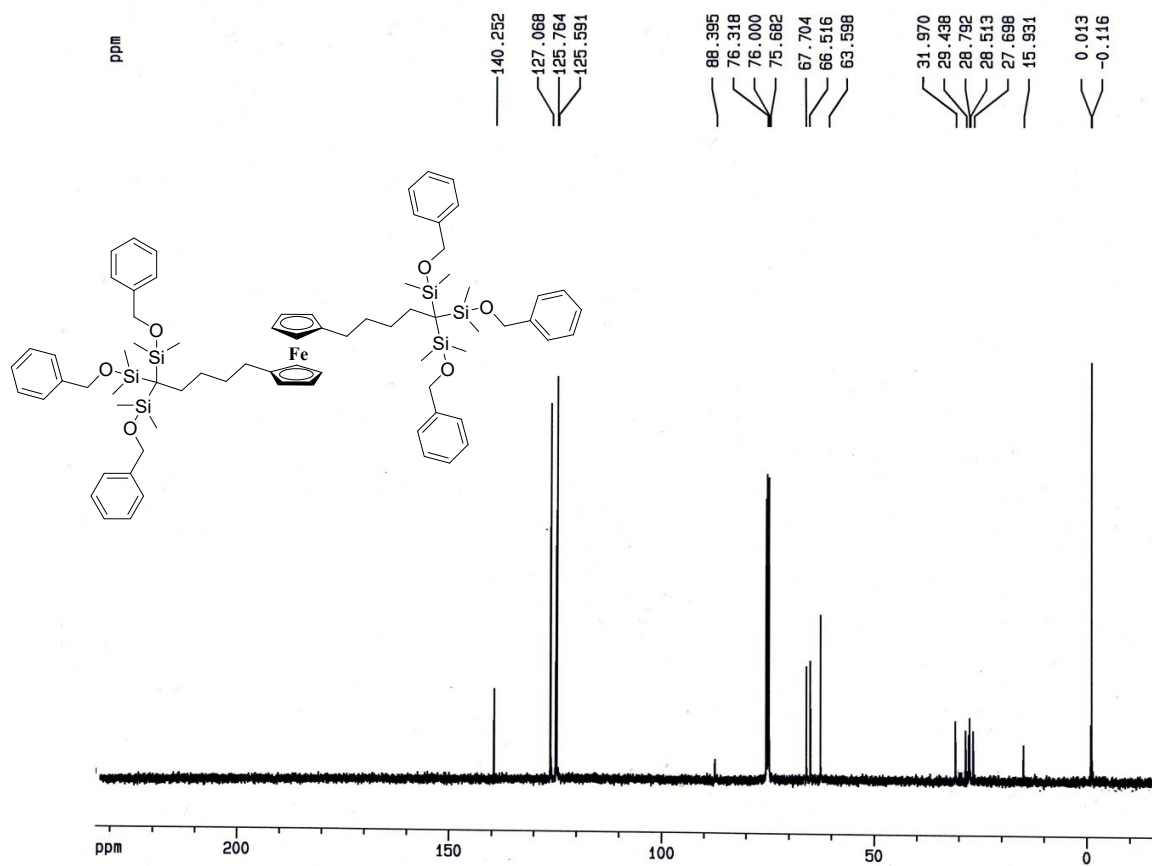


Fig. 40. ^{13}C NMR spectrum of (8k) (100 MHz, CDCl_3)