

## Supplementary Material

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

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<b>1-PREPARATION OF 1,1'- BIS(CHLOROALKYL)FERROCENES .....</b>	<b>4</b>
<b>1-1-SYNTHESIS OF 1,1'- BIS(3-CHLOROPROPYL)FERROCENE (4A) .....</b>	<b>4</b>
Fig. 1. $^1\text{H}$ NMR spectrum of (4a) (400 MHz, $\text{CDCl}_3$ ).....	4
Fig. 2. $^{13}\text{C}$ NMR spectrum of (4a) (100 MHz, $\text{CDCl}_3$ ).....	5
Fig. 3. Mass spectrum of (4a).....	5
<b>1-2- SYNTHESIS OF 1,1'- BIS(4-CHLOROBUTYL)FERROCENE (4B).....</b>	<b>6</b>
Fig. 4. $^1\text{H}$ NMR spectrum of (4b) (400 MHz, $\text{CDCl}_3$ ).....	6
Fig. 5. $^{13}\text{C}$ NMR spectrum of (4b) (100 MHz, $\text{CDCl}_3$ ).....	7
Fig. 6. Mass spectrum of (4b) .....	7
<b>2-PREPARATION OF 1,1'- BIS(BROMOALKYL)FERROCENE (5A-5B) .....</b>	<b>8</b>
<b>2-1- 1,1'- BIS(3-BROMOPROPYL)FERROCENE (5A) .....</b>	<b>8</b>
Fig. 7. $^1\text{H}$ NMR spectrum of (aa) (400 MHz, $\text{CDCl}_3$ ).....	8
Fig. 8. $^{13}\text{C}$ NMR spectrum of (5a) (100 MHz, $\text{CDCl}_3$ ).....	9
<b>2-2- 1,1'- BIS(4-BROMOBUTYL)FERROCENE (5B) .....</b>	<b>10</b>
Fig. 9. $^1\text{H}$ NMR spectrum of (5b) (400 MHz, $\text{CDCl}_3$ ).....	10

Fig. 10. $^{13}\text{C}$ NMR spectrum of (5b) (100 MHz, $\text{CDCl}_3$ ).....	11
<b>3-PREPARATION OF COMPOUNDS (6A-B) AND (7A-B) .....</b>	<b>12</b>
<b>3-1- 1,1'- BIS[3-(TRIS(TRIMETHYLSILYL)METHYL)PROPYL]FERROCENE (6A) ..</b>	<b>12</b>
Fig. 11. $^1\text{H}$ NMR spectrum of (6a) (400 MHz, $\text{CDCl}_3$ ).....	12
Fig. 12. $^{13}\text{C}$ NMR spectrum of (6a) (100 MHz, $\text{CDCl}_3$ ).....	13
<b>3-2- 1,1'- BIS[4-(TRIS(TRIMETHYLSILYL)METHYL)BUTYL]FERROCENE (6B) ....</b>	<b>14</b>
Fig. 13. $^1\text{H}$ NMR spectrum of (6b) (400 MHz, $\text{CDCl}_3$ ).....	14
Fig. 14. $^{13}\text{C}$ NMR spectrum of (6b) (100 MHz, $\text{CDCl}_3$ ).....	15
<b>3-3- 1,1'- BIS[3-(TRIS(DIMETHYLSILYL)METHYL)PROPYL]FERROCENE (7A)....</b>	<b>16</b>
Fig. 15. FT-IR spectrum of (7a).....	16
Fig. 16. $^1\text{H}$ NMR spectrum of (7a) (400 MHz, $\text{CDCl}_3$ ).....	17
Fig. 17. $^{13}\text{C}$ NMR spectrum of (7a) (100 MHz, $\text{CDCl}_3$ ).....	18
<b>3-4- 1,1'- BIS[4-(TRIS(DIMETHYLSILYL)METHYL)BUTYL]FERROCENE (7B).....</b>	<b>19</b>
Fig. 18. FT-IR spectrum of (7b).....	19
Fig. 19. $^1\text{H}$ NMR spectrum of (7b) (400 MHz, $\text{CDCl}_3$ ).....	20
Fig. 20. $^{13}\text{C}$ NMR spectrum of (7b) (100 MHz, $\text{CDCl}_3$ ).....	21
<b>4-SYNTHESIS OF 1,1'- BIS[(TRIS(DIMETHYLSILYL)METHYL)ALKYL]FERROCENE .....</b>	<b>22</b>
<b>4-1- SYNTHESIS OF 1,1'- BIS[3-(TRIS(METHOXYDIMETHYLSILYL)METHYL)PROPYL]FERROCENE (8A) .....</b>	<b>22</b>
Fig. 22. $^{13}\text{C}$ NMR spectrum of (8a) (100 MHz, $\text{CDCl}_3$ ).....	23
Fig. 23. $^1\text{H}$ NMR spectrum of (8b) (400 MHz, $\text{CDCl}_3$ ).....	24
Fig. 24. $^{13}\text{C}$ NMR spectrum of (8b) (100 MHz, $\text{CDCl}_3$ ).....	25
Fig. 25. $^1\text{H}$ NMR spectrum of (8c) (400 MHz, $\text{CDCl}_3$ ) .....	26
Fig. 26. $^{13}\text{C}$ NMR spectrum of (8c) (100 MHz, $\text{CDCl}_3$ ) .....	27

<b>Fig. 27. <math>^1\text{H}</math> NMR spectrum of (8d) (400 MHz, <math>\text{CDCl}_3</math>).....</b>	<b>28</b>
<b>Fig. 28. <math>^{13}\text{C}</math> NMR spectrum of (8d) (100 MHz, <math>\text{CDCl}_3</math>).....</b>	<b>29</b>
<b>Fig. 29. <math>^1\text{H}</math> NMR spectrum of (8e) (400 MHz, <math>\text{CDCl}_3</math>) .....</b>	<b>30</b>
<b>Fig. 30. <math>^{13}\text{C}</math> NMR spectrum of (8e) (100 MHz, <math>\text{CDCl}_3</math>) .....</b>	<b>31</b>
<b>Fig. 31. <math>^1\text{H}</math> NMR spectrum of (8g) (400 MHz, <math>\text{CDCl}_3</math>).....</b>	<b>32</b>
<b>Fig. 32. <math>^{13}\text{C}</math> NMR spectrum of (8g) (100 MHz, <math>\text{CDCl}_3</math>).....</b>	<b>33</b>
<b>Fig. 33. <math>^1\text{H}</math> NMR spectrum of (8h) (400 MHz, <math>\text{CDCl}_3</math>).....</b>	<b>34</b>
<b>Fig. 34. <math>^{13}\text{C}</math> NMR spectrum of (8h) (100 MHz, <math>\text{CDCl}_3</math>).....</b>	<b>35</b>
<b>Fig. 35. <math>^1\text{H}</math> NMR spectrum of (8i) (400 MHz, <math>\text{CDCl}_3</math>).....</b>	<b>36</b>
<b>Fig. 36. <math>^{13}\text{C}</math> NMR spectrum of (8i) (100 MHz, <math>\text{CDCl}_3</math>).....</b>	<b>37</b>
<b>Fig. 37. <math>^1\text{H}</math> NMR spectrum of (8j) (400 MHz, <math>\text{CDCl}_3</math>).....</b>	<b>38</b>
<b>Fig. 38. <math>^{13}\text{C}</math> NMR spectrum of (8j) (100 MHz, <math>\text{CDCl}_3</math>).....</b>	<b>39</b>
<b>Fig. 39. <math>^1\text{H}</math> NMR spectrum of (8k) (400 MHz, <math>\text{CDCl}_3</math>).....</b>	<b>40</b>
<b>Fig. 40. <math>^{13}\text{C}</math> NMR spectrum of (8k) (100 MHz, <math>\text{CDCl}_3</math>).....</b>	<b>41</b>

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

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

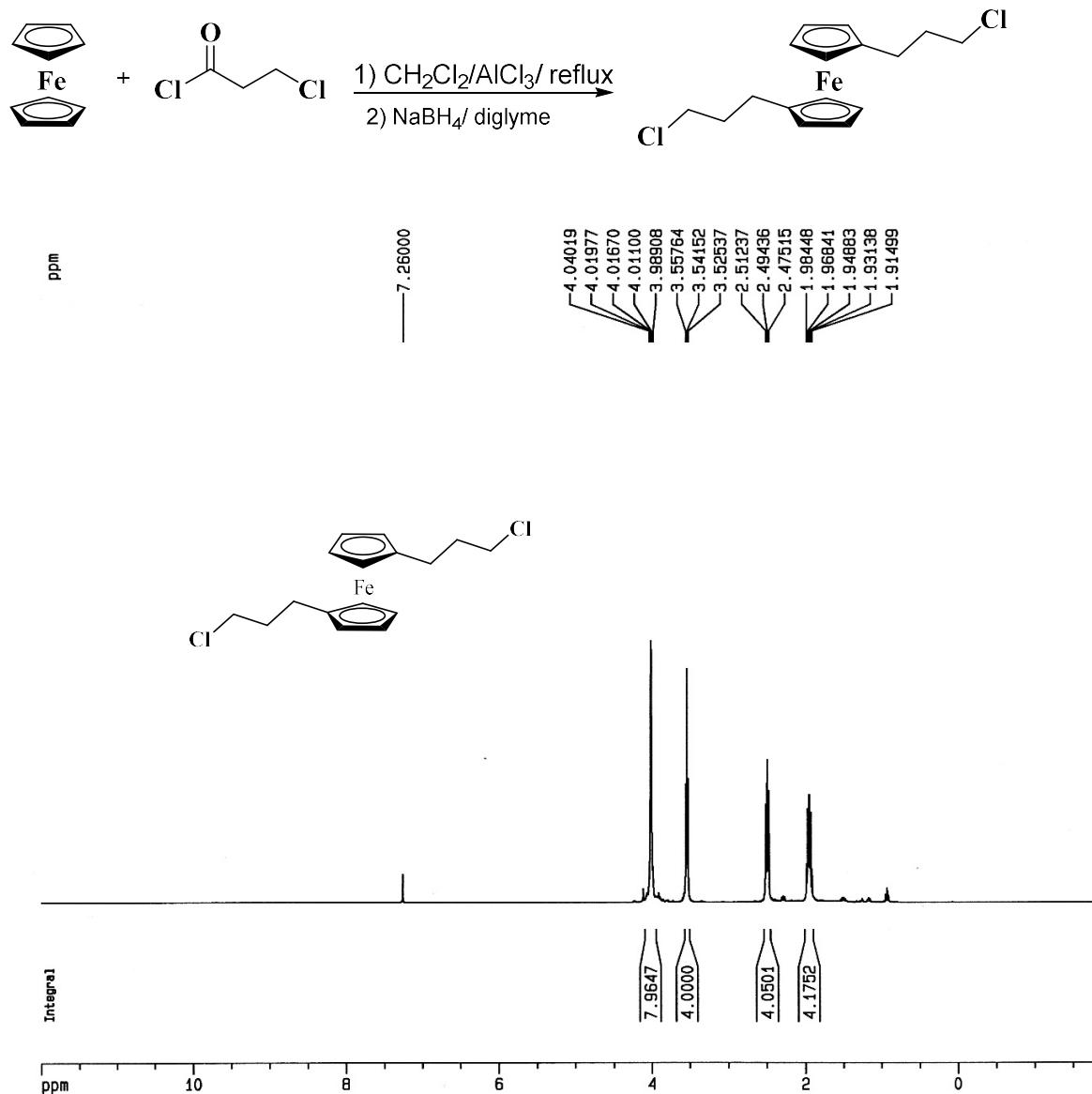


Fig. 1. <sup>1</sup>H NMR spectrum of (4a) (400 MHz,  $\text{CDCl}_3$ )

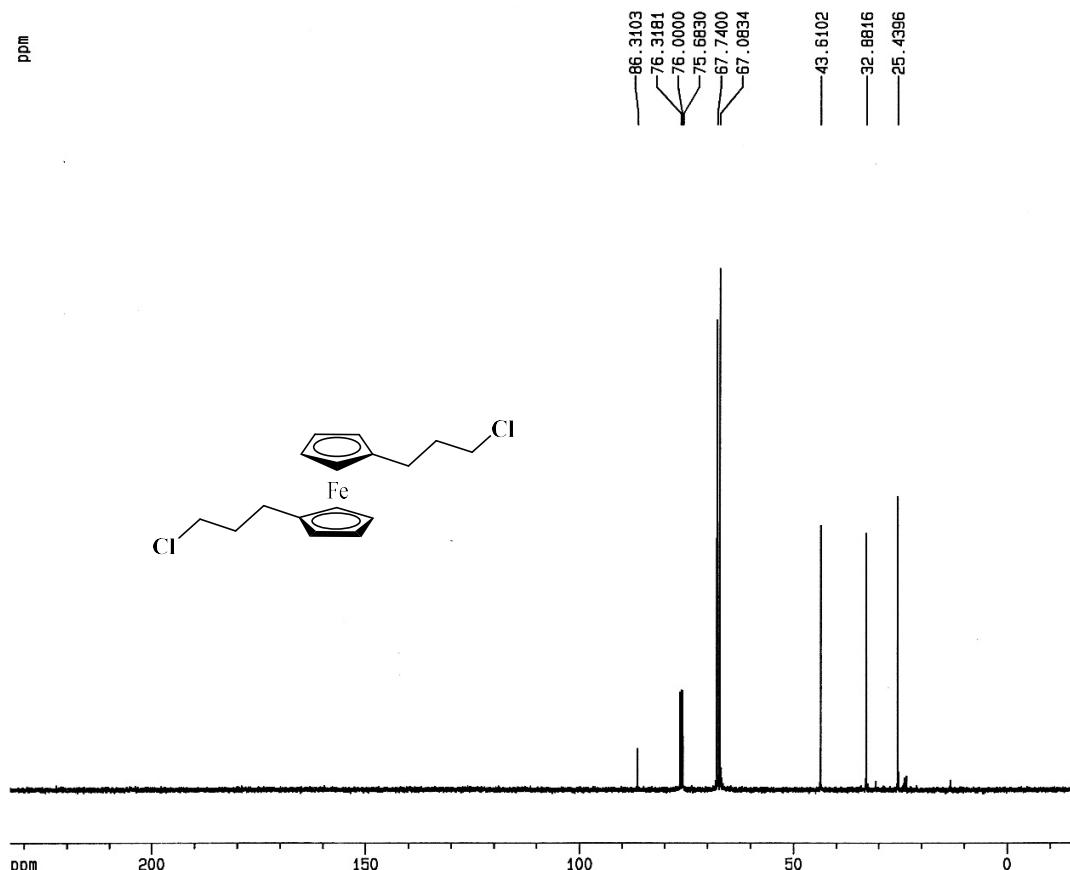


Fig. 2.  $^{13}\text{C}$  NMR spectrum of (4a) (100 MHz,  $\text{CDCl}_3$ )

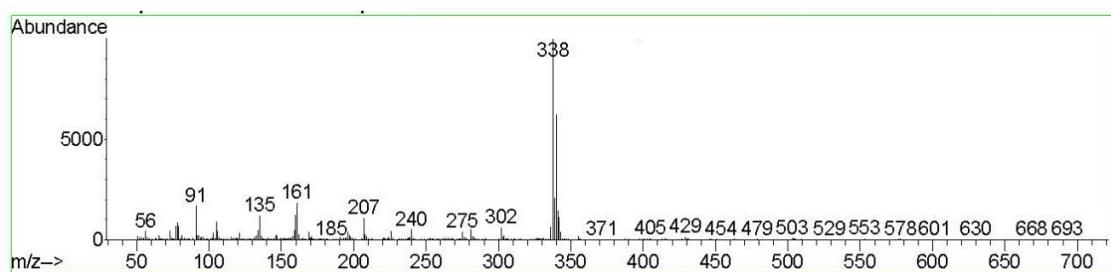


Fig. 3. Mass spectrum of (4a)

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

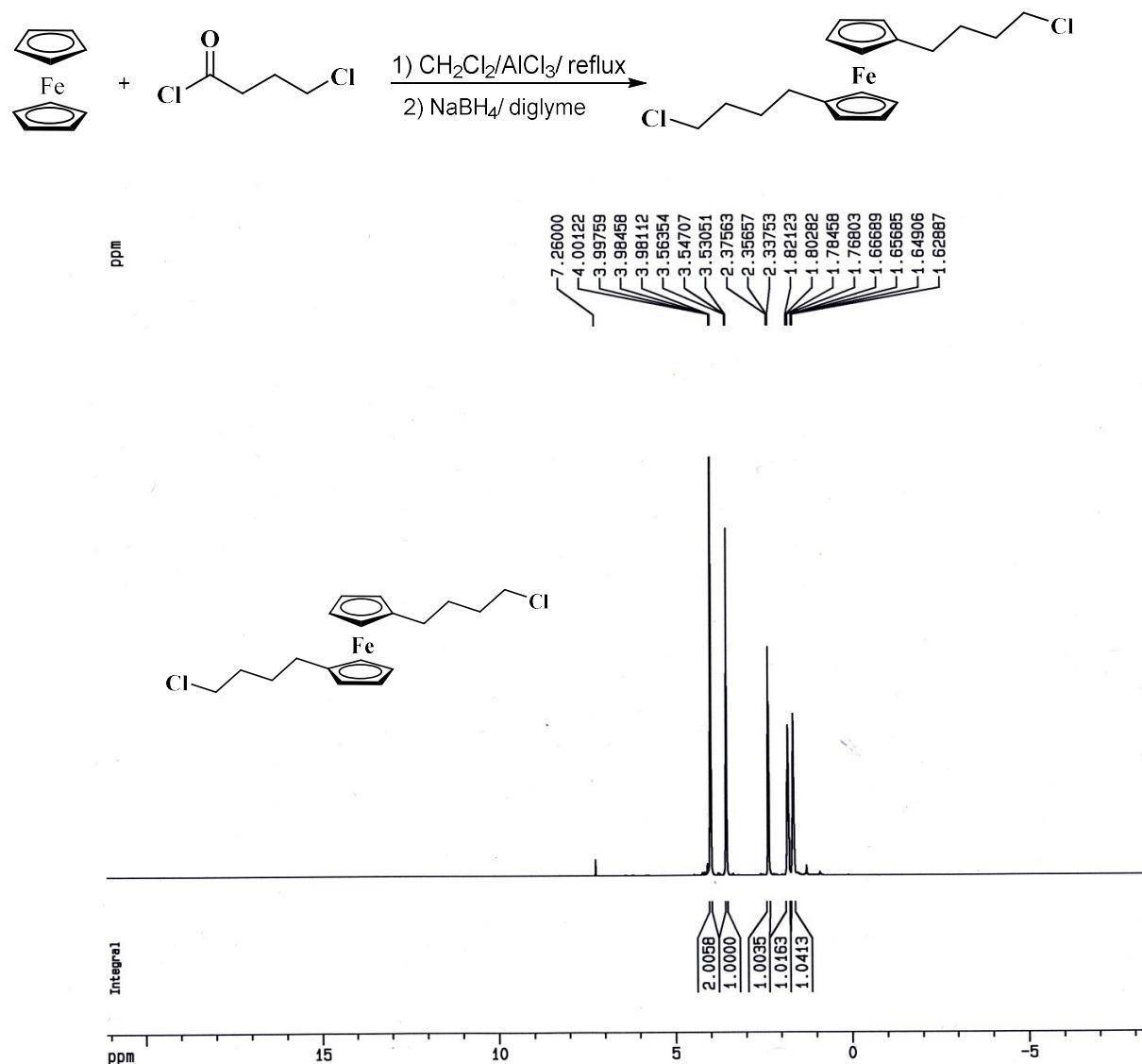


Fig. 4. <sup>1</sup>H NMR spectrum of (4b) (400 MHz, CDCl<sub>3</sub>)

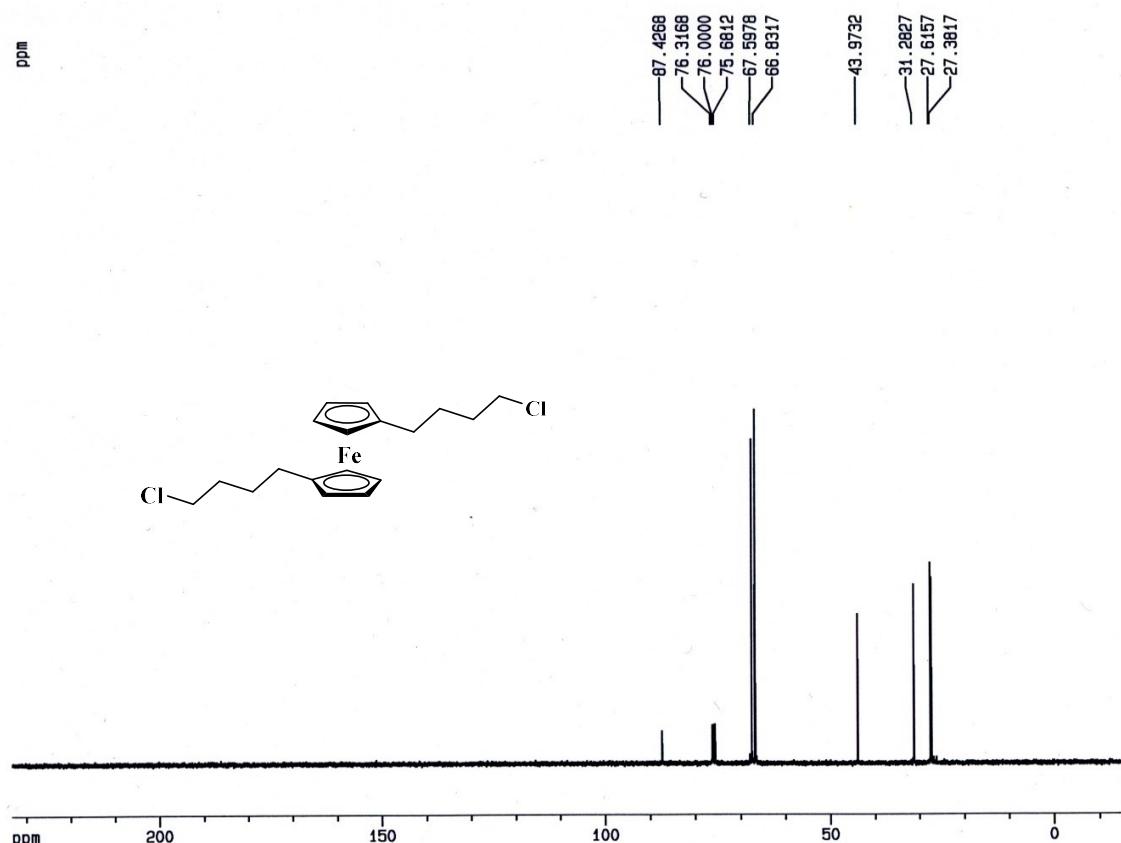


Fig. 5.  $^{13}\text{C}$  NMR spectrum of (4b) (100 MHz,  $\text{CDCl}_3$ )

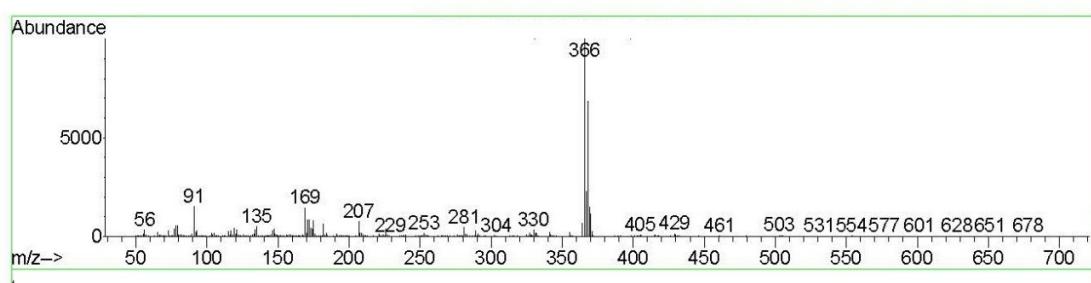


Fig. 6. Mass spectrum of (4b)

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

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

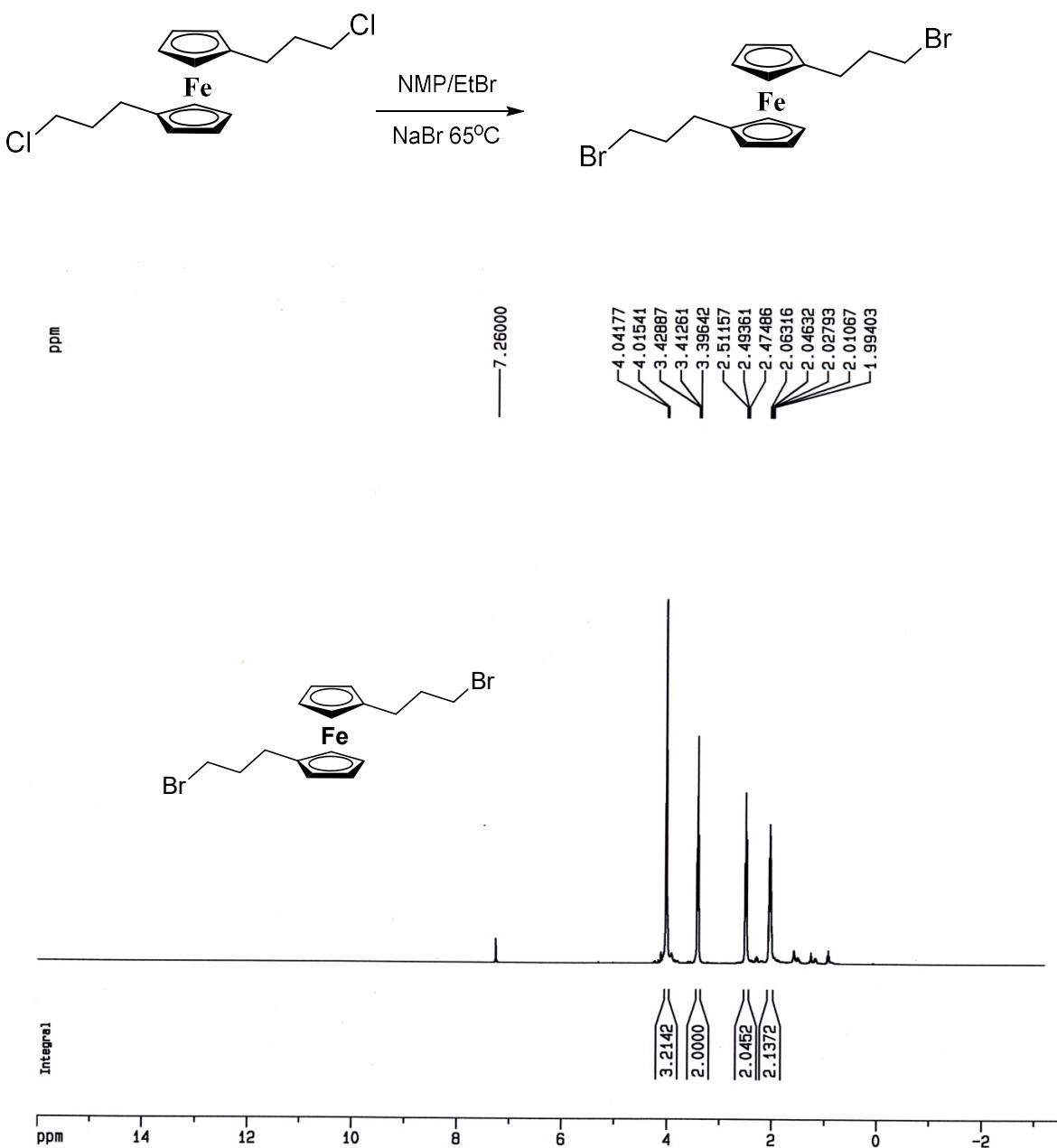


Fig. 7. <sup>1</sup>H NMR spectrum of (aa) (400 MHz, CDCl<sub>3</sub>)

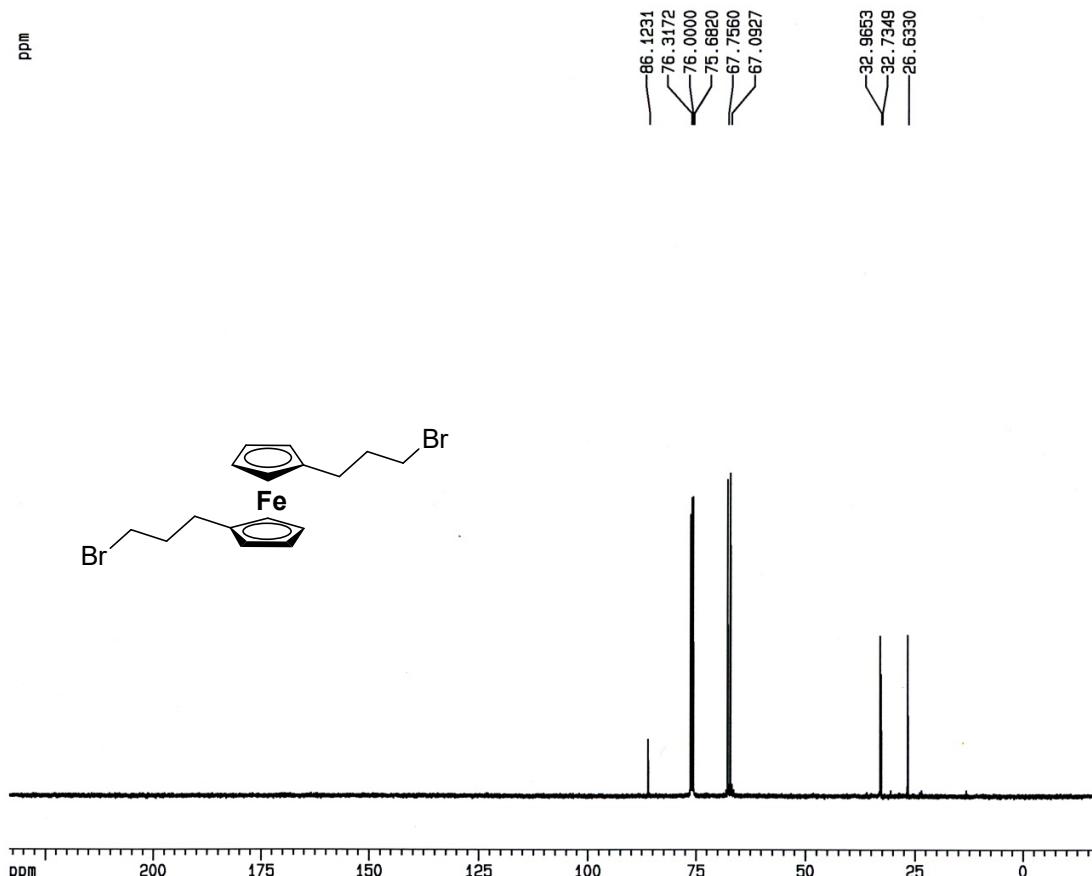


Fig. 8. <sup>13</sup>C NMR spectrum of (5a) (100 MHz, CDCl<sub>3</sub>)

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

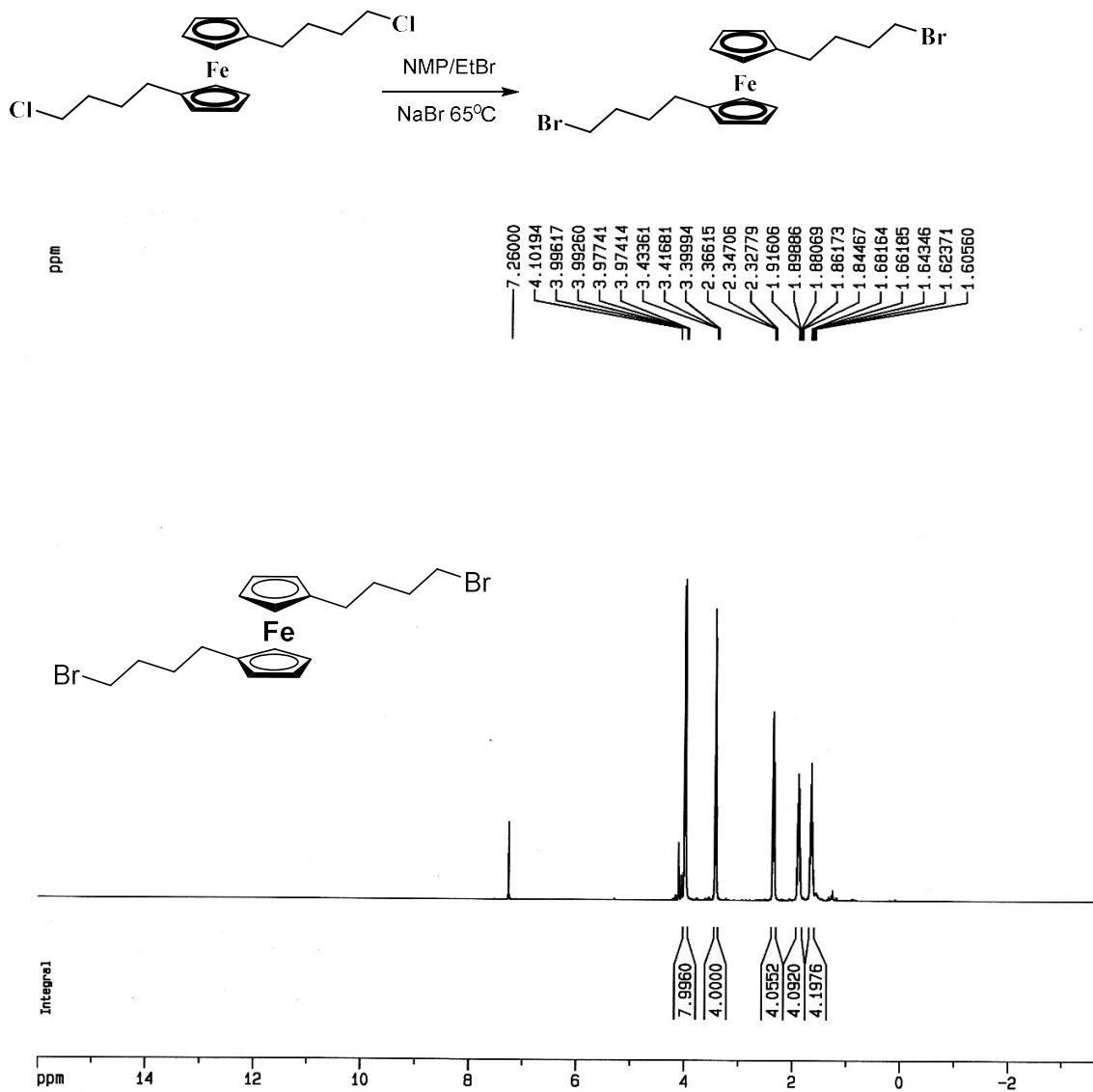


Fig. 9. <sup>1</sup>H NMR spectrum of (5b) (400 MHz, CDCl<sub>3</sub>)

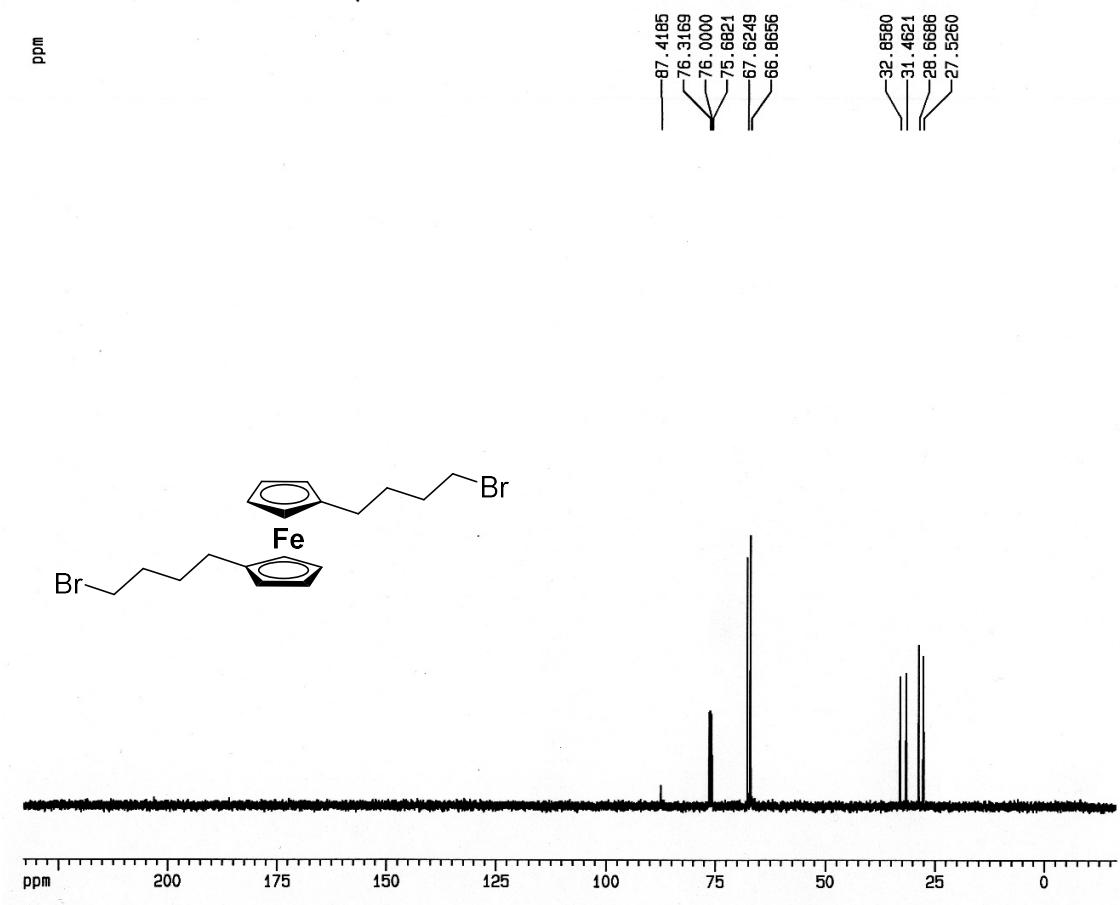


Fig. 10. <sup>13</sup>C NMR spectrum of (5b) (100 MHz, CDCl<sub>3</sub>)

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

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

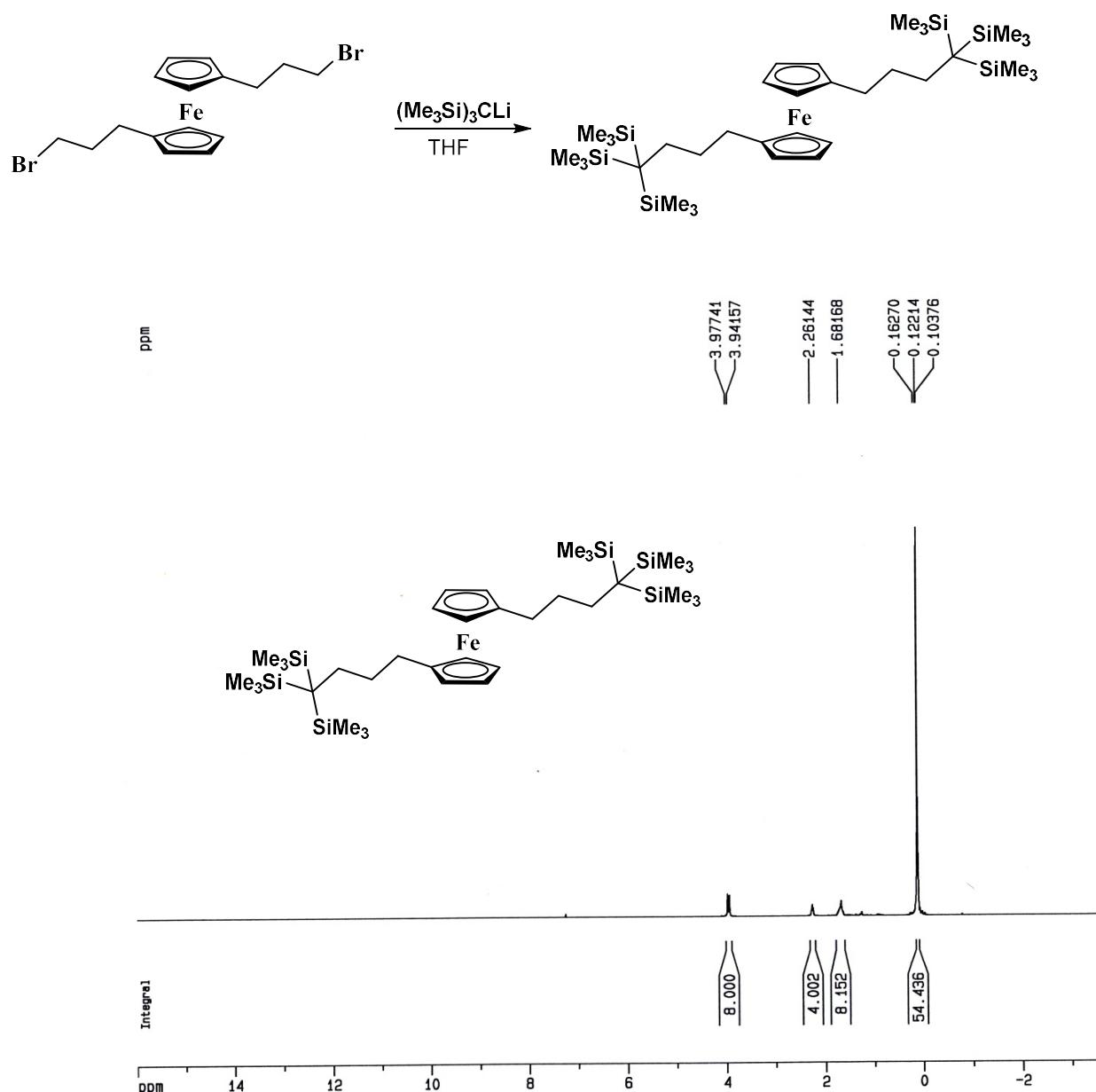


Fig. 11. <sup>1</sup>H NMR spectrum of (6a) (400 MHz,  $\text{CDCl}_3$ )

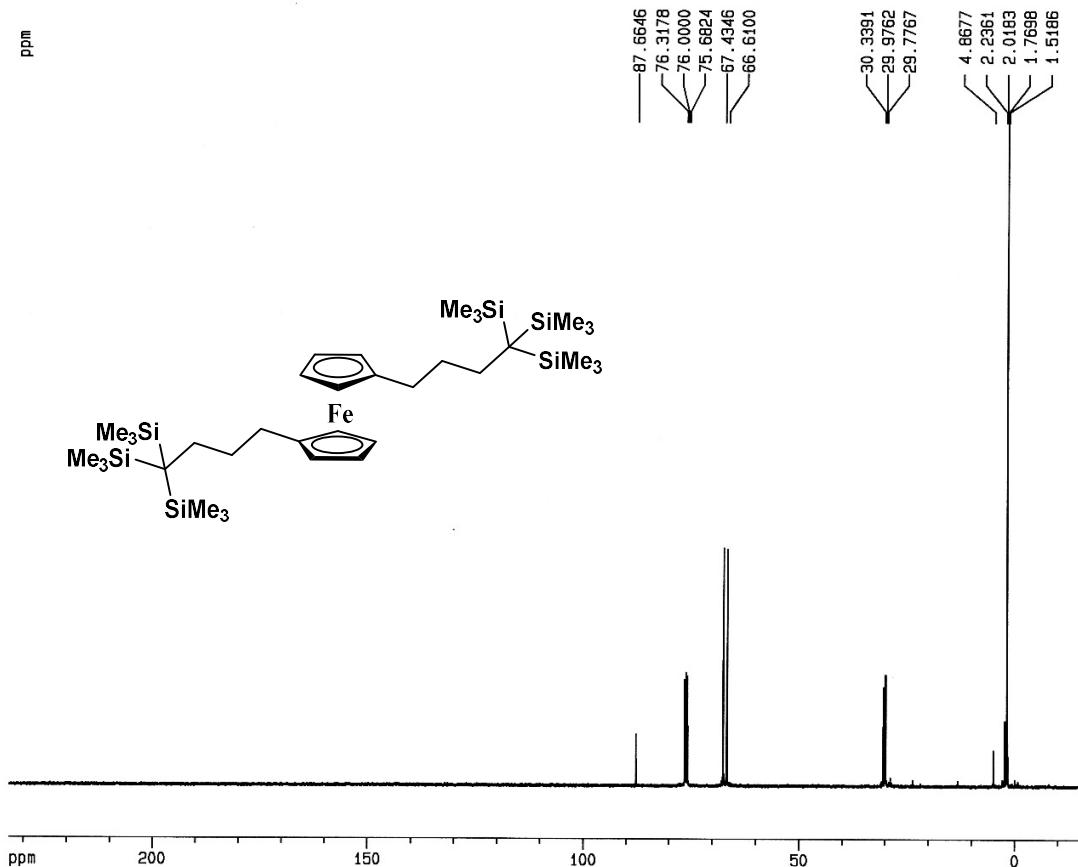


Fig. 12.  $^{13}\text{C}$  NMR spectrum of (6a) (100 MHz,  $\text{CDCl}_3$ )

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

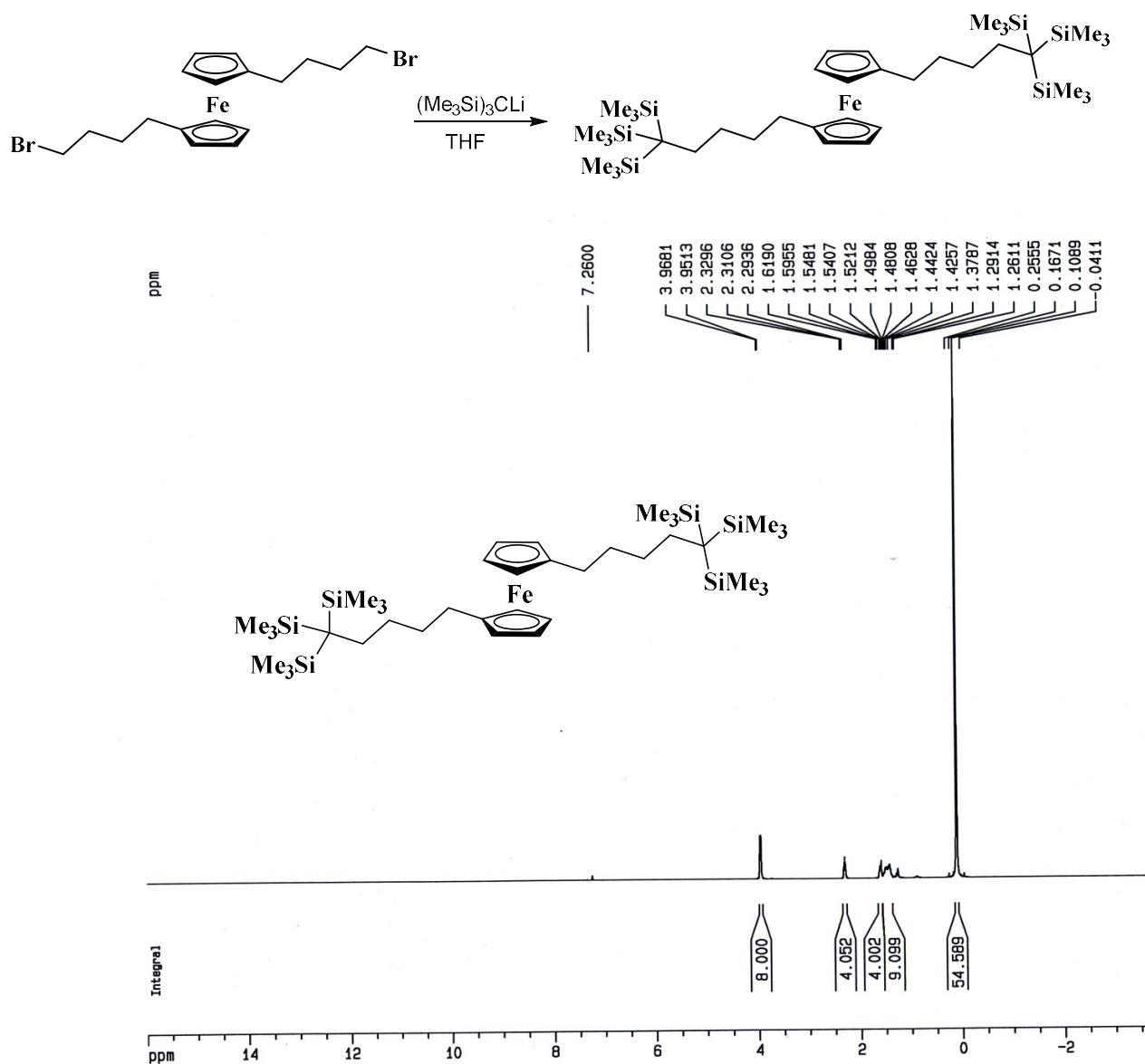


Fig. 13. <sup>1</sup>H NMR spectrum of (6b) (400 MHz, CDCl<sub>3</sub>)

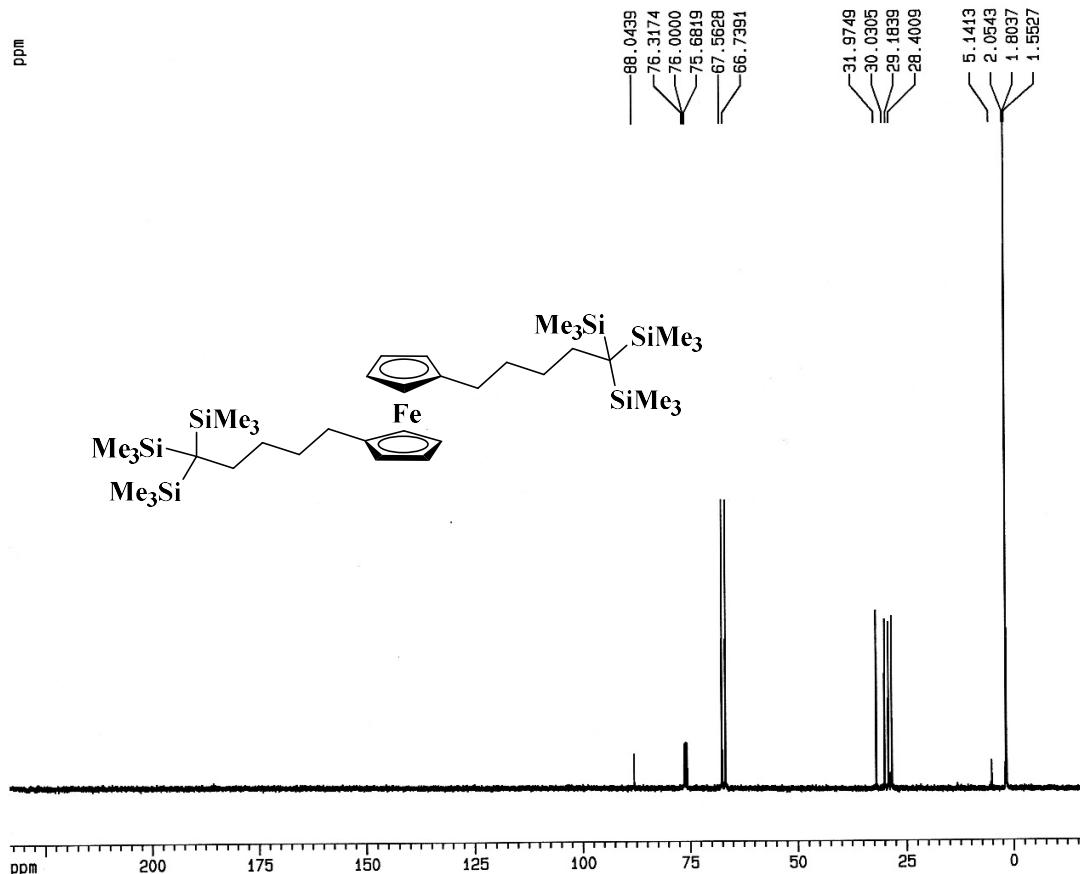


Fig. 14.  $^{13}\text{C}$  NMR spectrum of (6b) (100 MHz,  $\text{CDCl}_3$ )

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

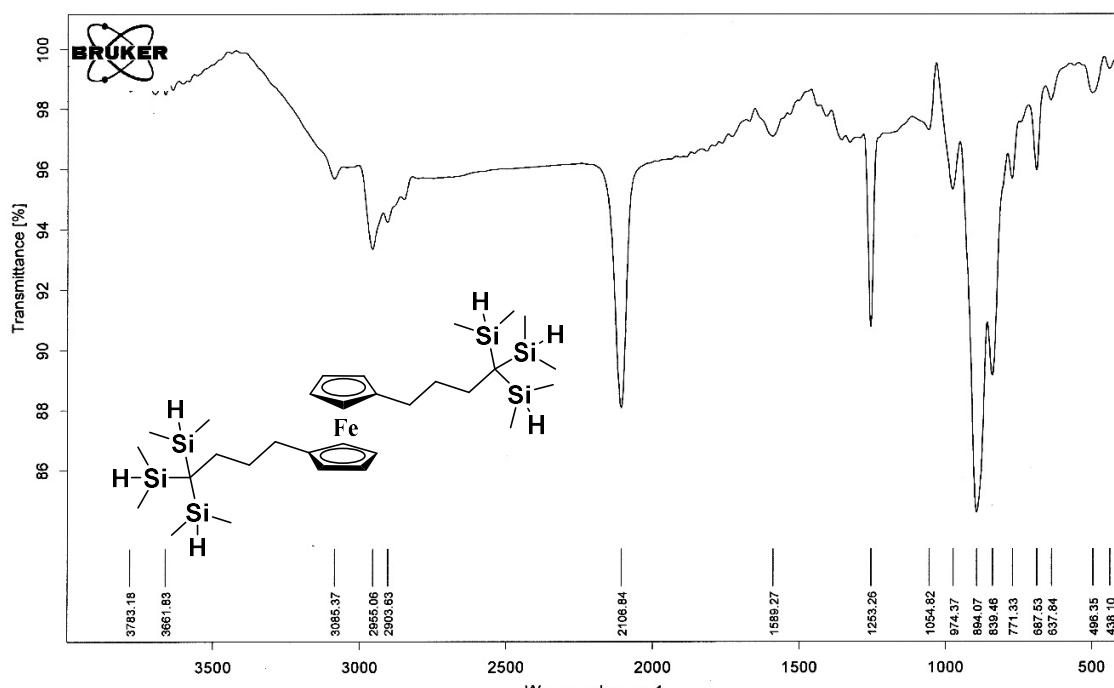
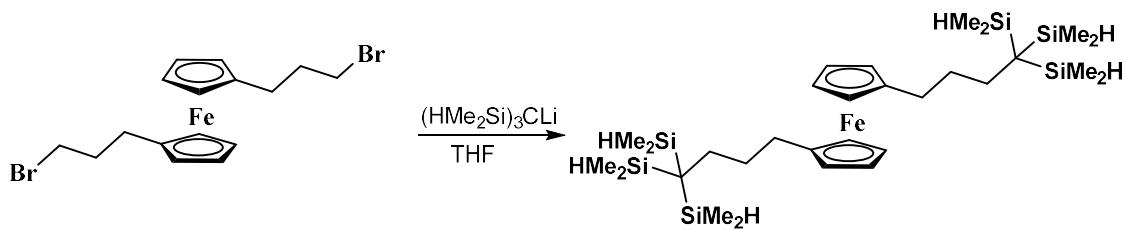


Fig. 15. FT-IR spectrum of (7a)

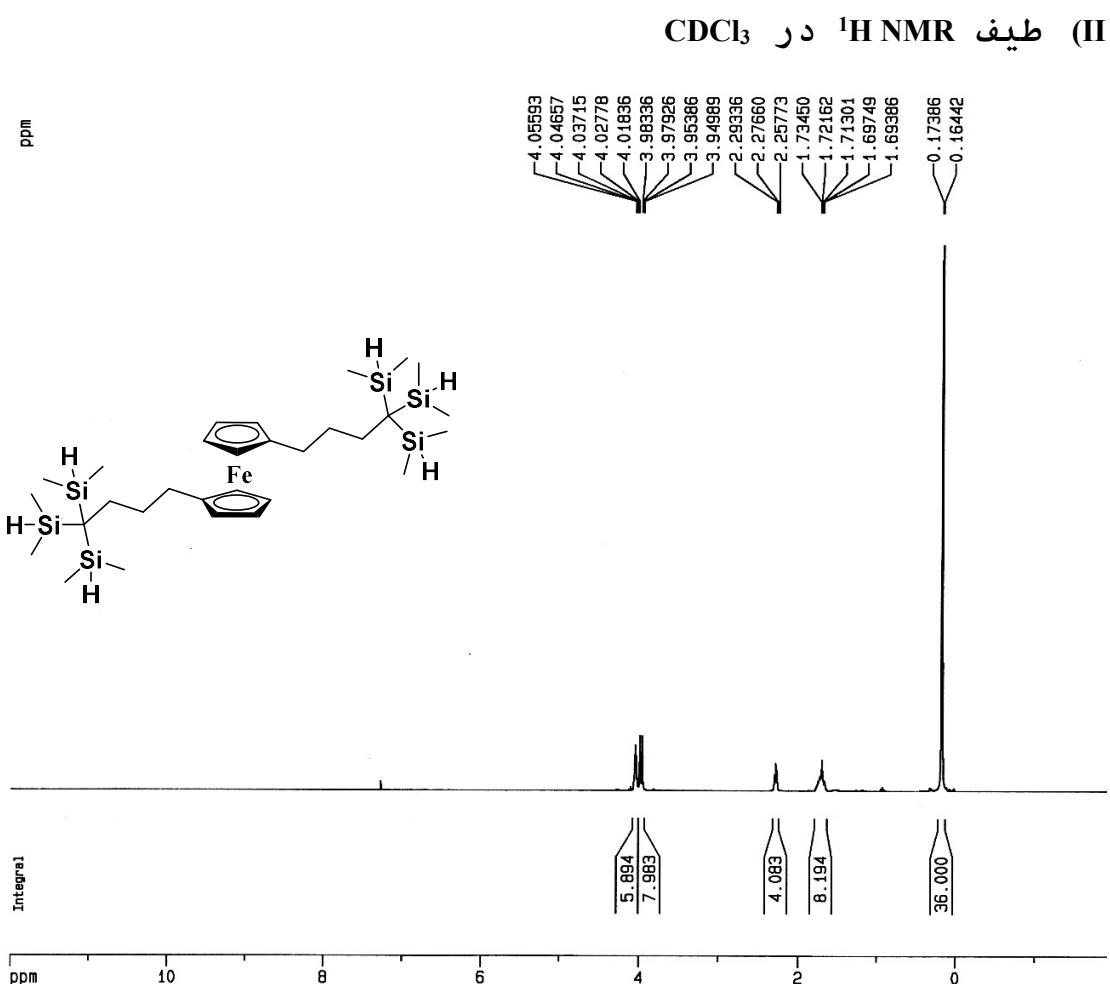


Fig. 16. <sup>1</sup>H NMR spectrum of (7a) (400 MHz, CDCl<sub>3</sub>)

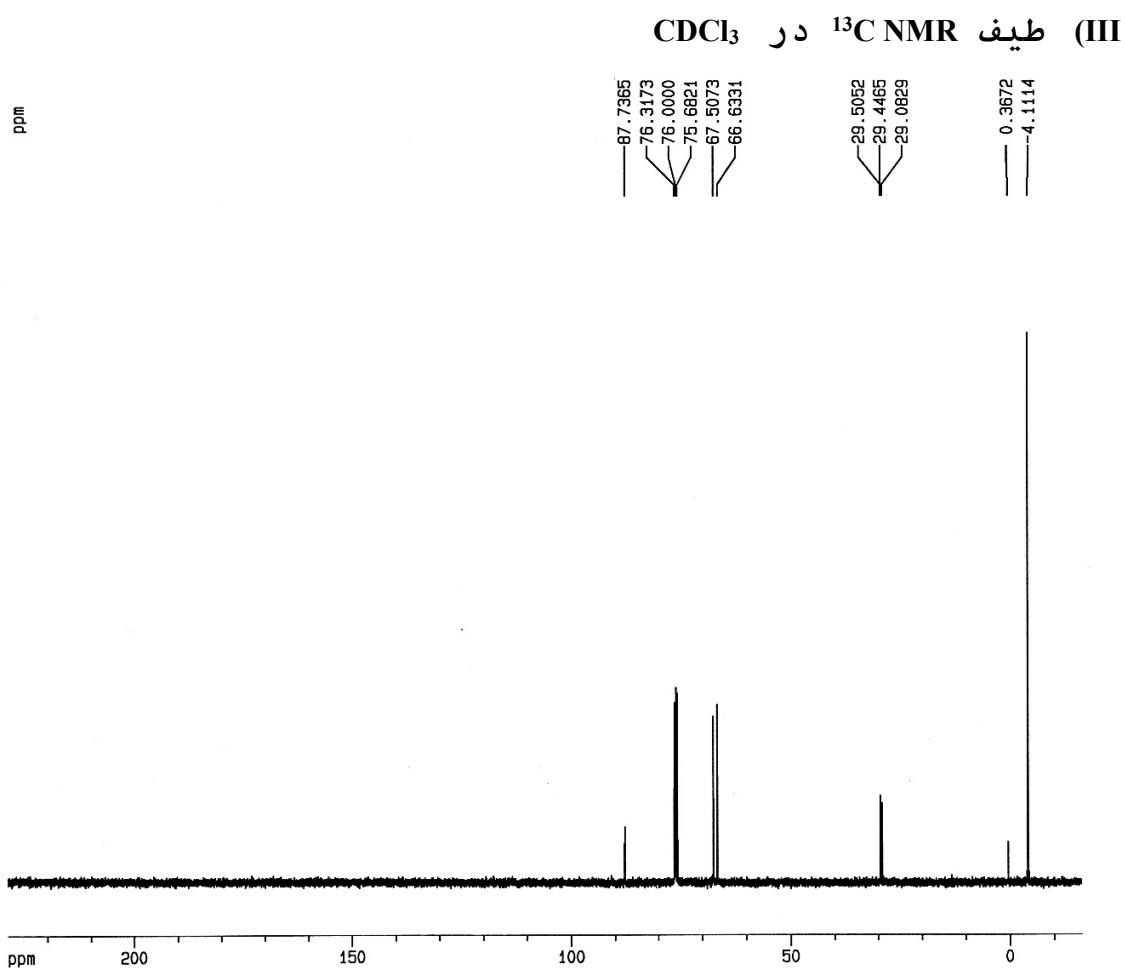


Fig. 17. <sup>13</sup>C NMR spectrum of (7a) (100 MHz, CDCl<sub>3</sub>)

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

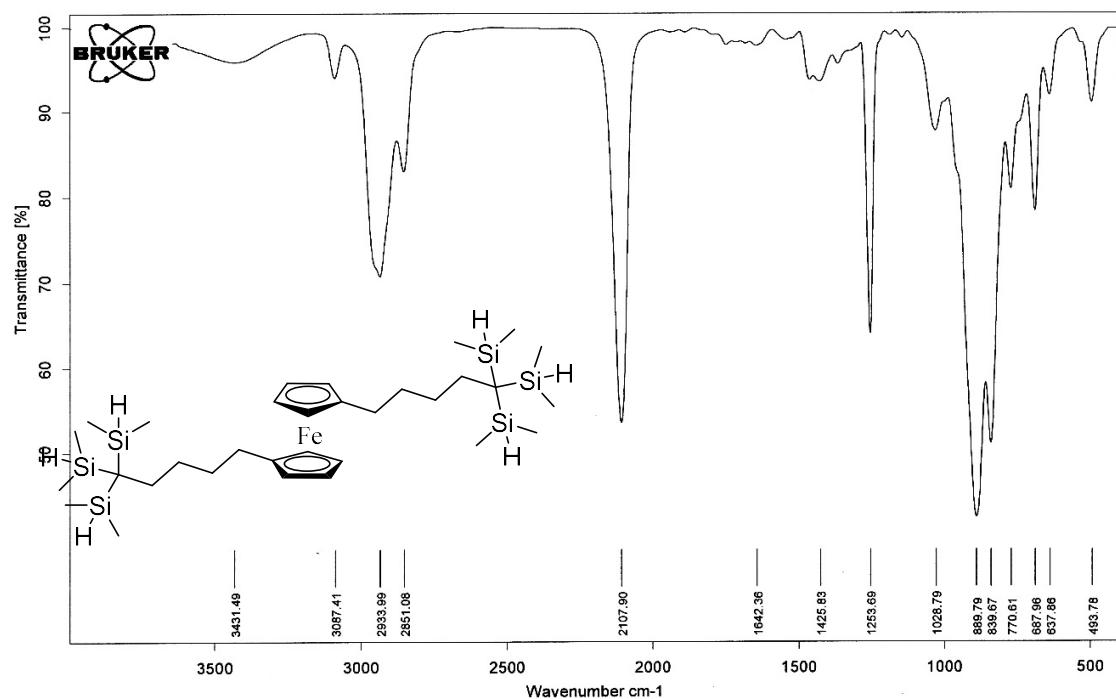
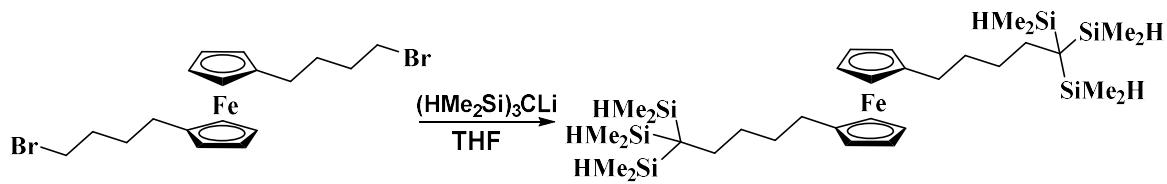


Fig. 18. FT-IR spectrum of (7b)

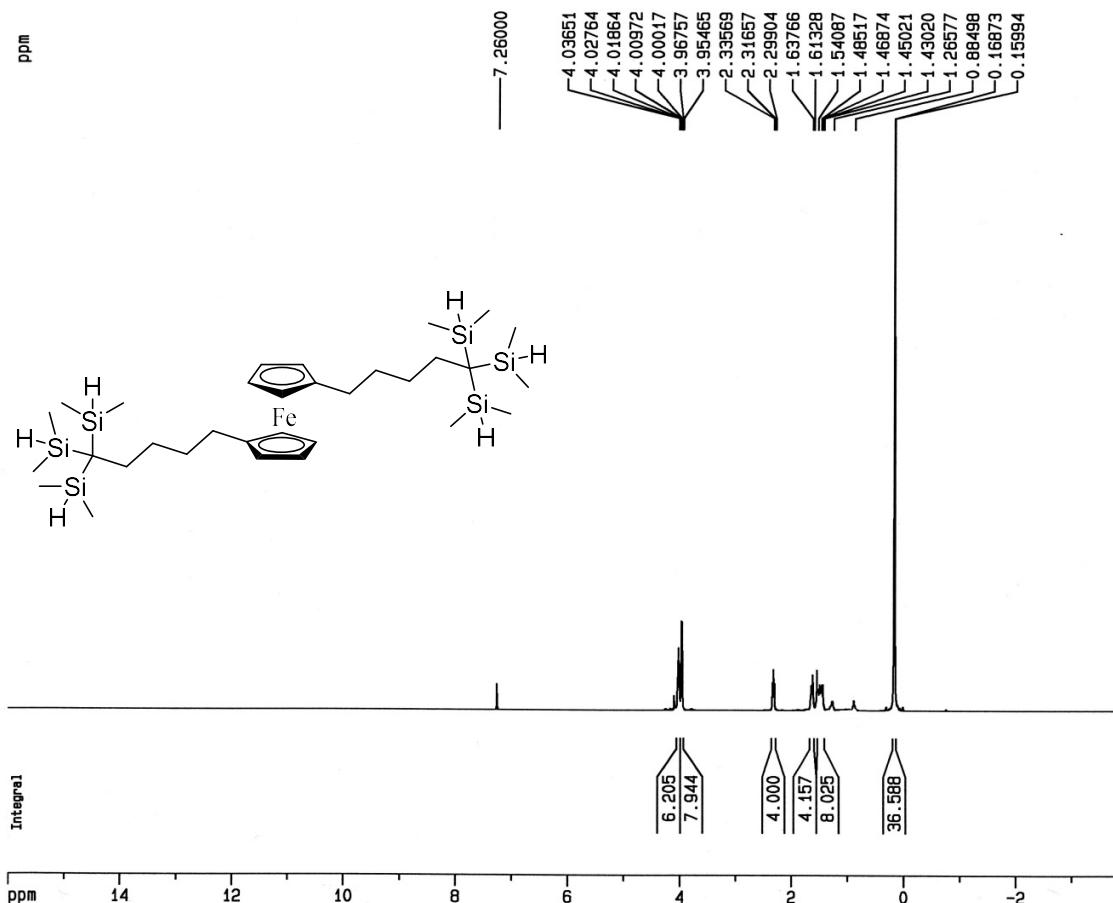


Fig. 19.  $^1\text{H}$  NMR spectrum of (7b) (400 MHz,  $\text{CDCl}_3$ )

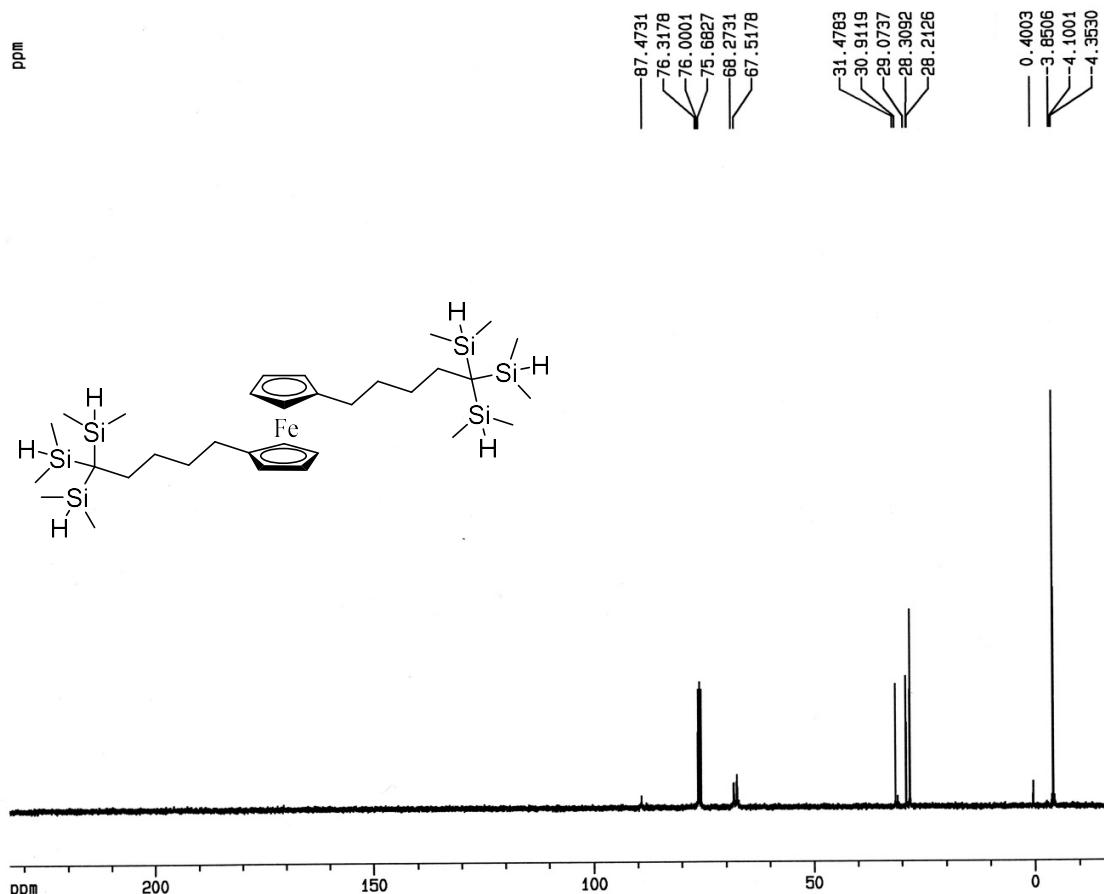
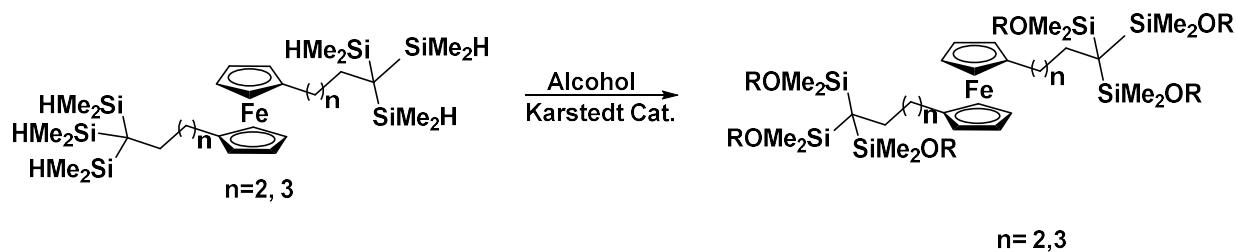


Fig. 20.  $^{13}\text{C}$  NMR spectrum of (7b) (100 MHz,  $\text{CDCl}_3$ )

#### 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)

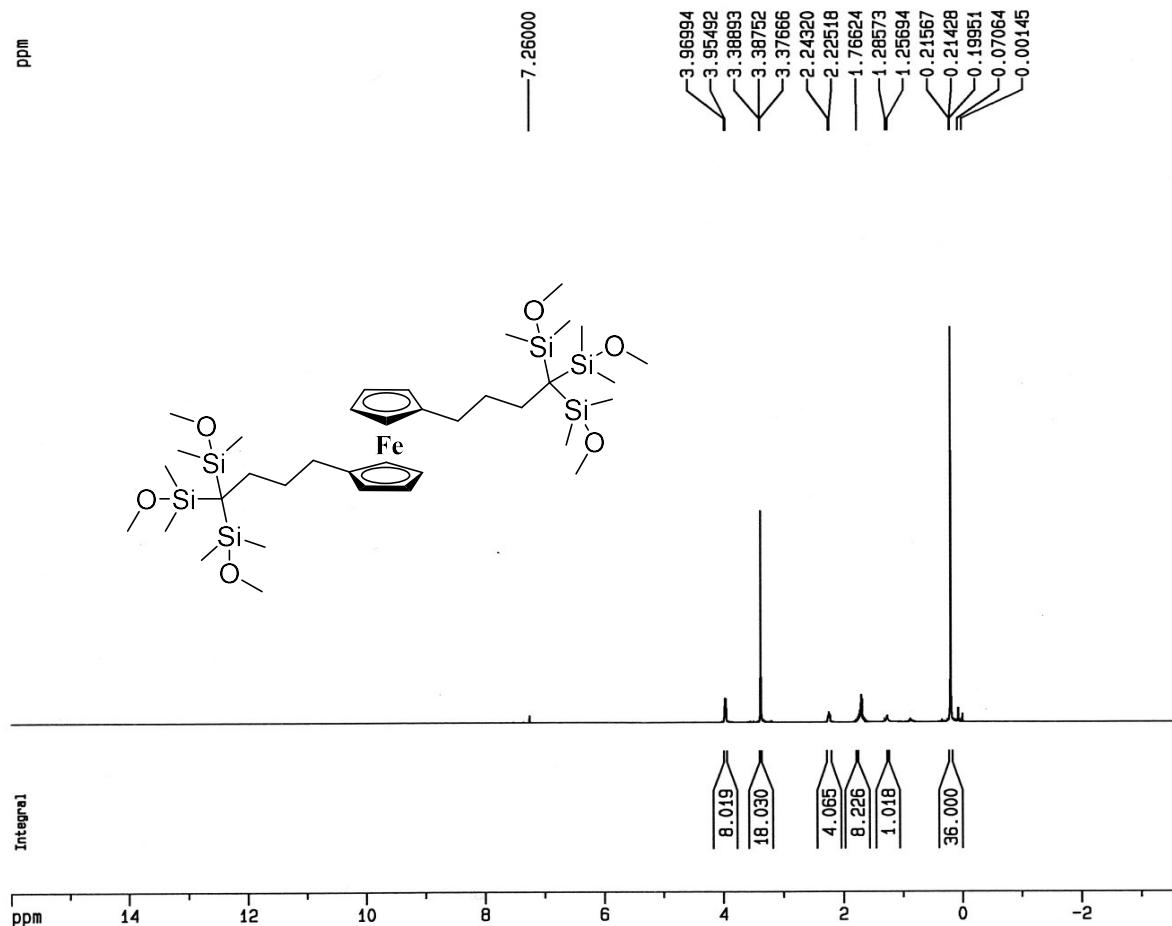


Fig. 21.  $^1\text{H}$  NMR spectrum of (8a) (400 MHz,  $\text{CDCl}_3$ )

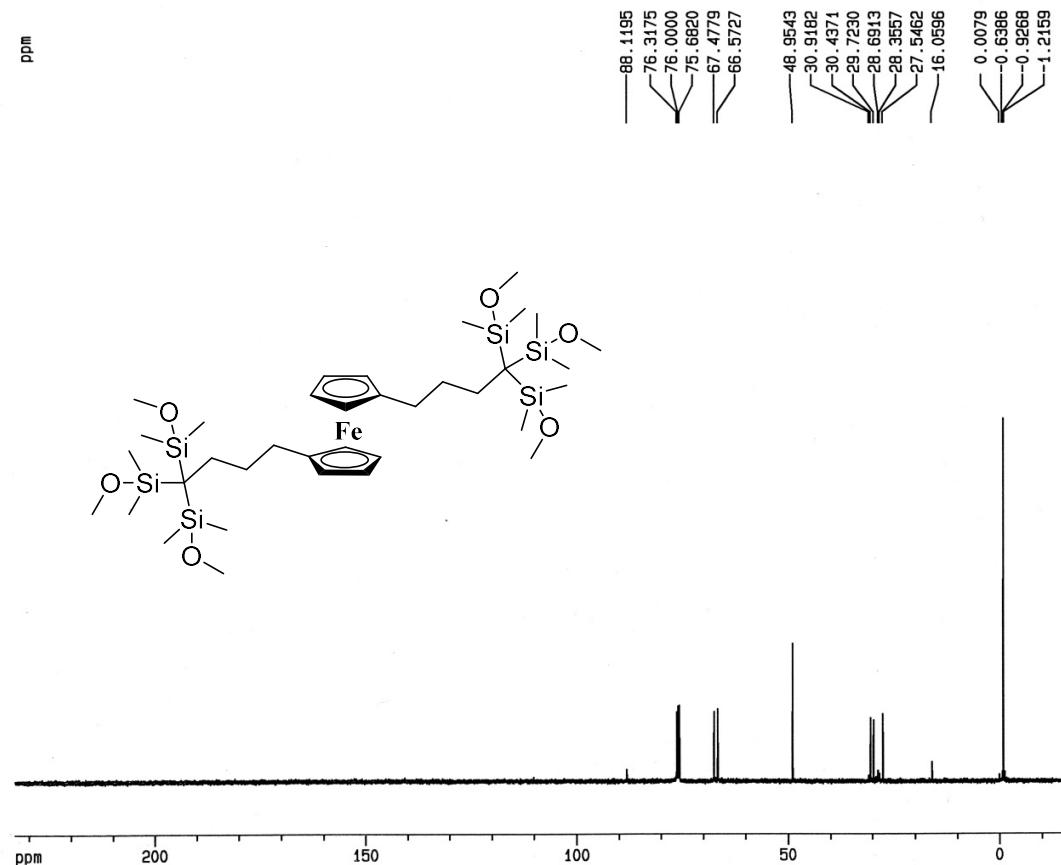


Fig. 22.  $^{13}\text{C}$  NMR spectrum of (8a) (100 MHz,  $\text{CDCl}_3$ )

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

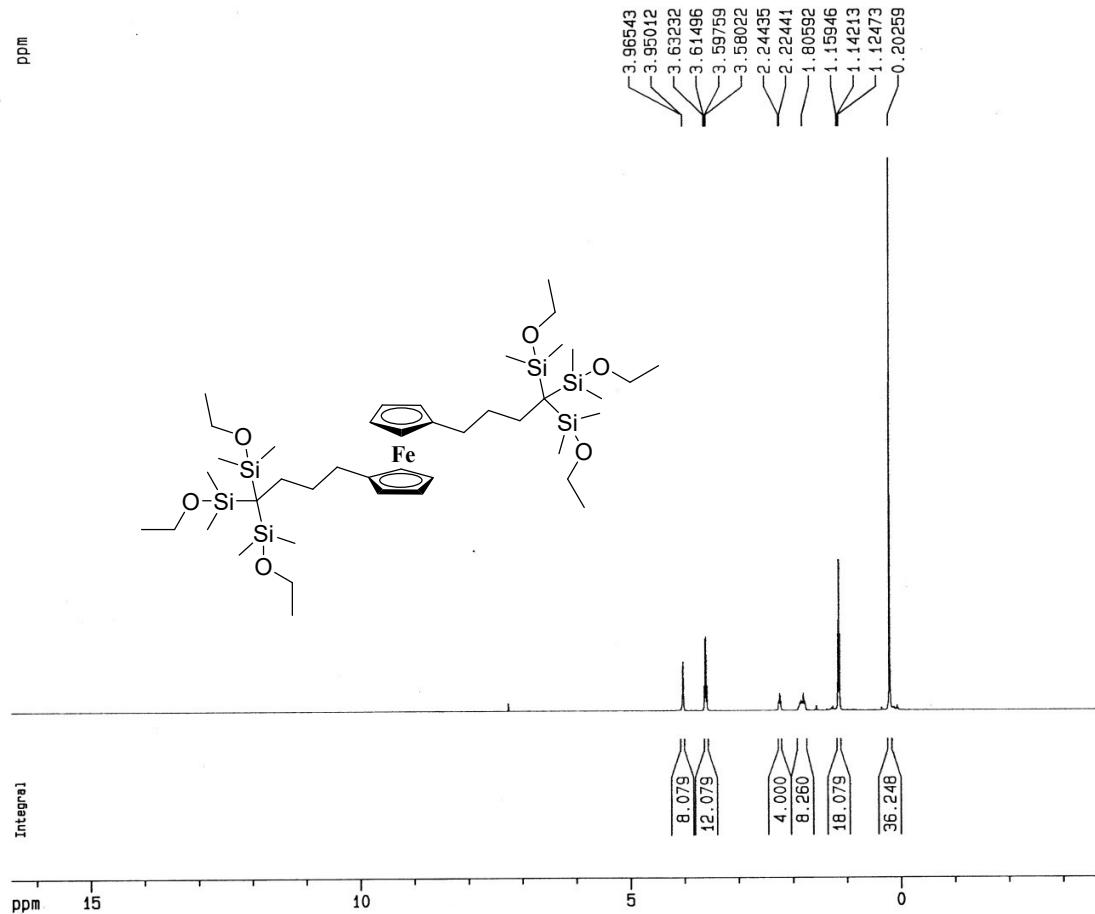


Fig. 23.  $^1\text{H}$  NMR spectrum of (8b) (400 MHz,  $\text{CDCl}_3$ )

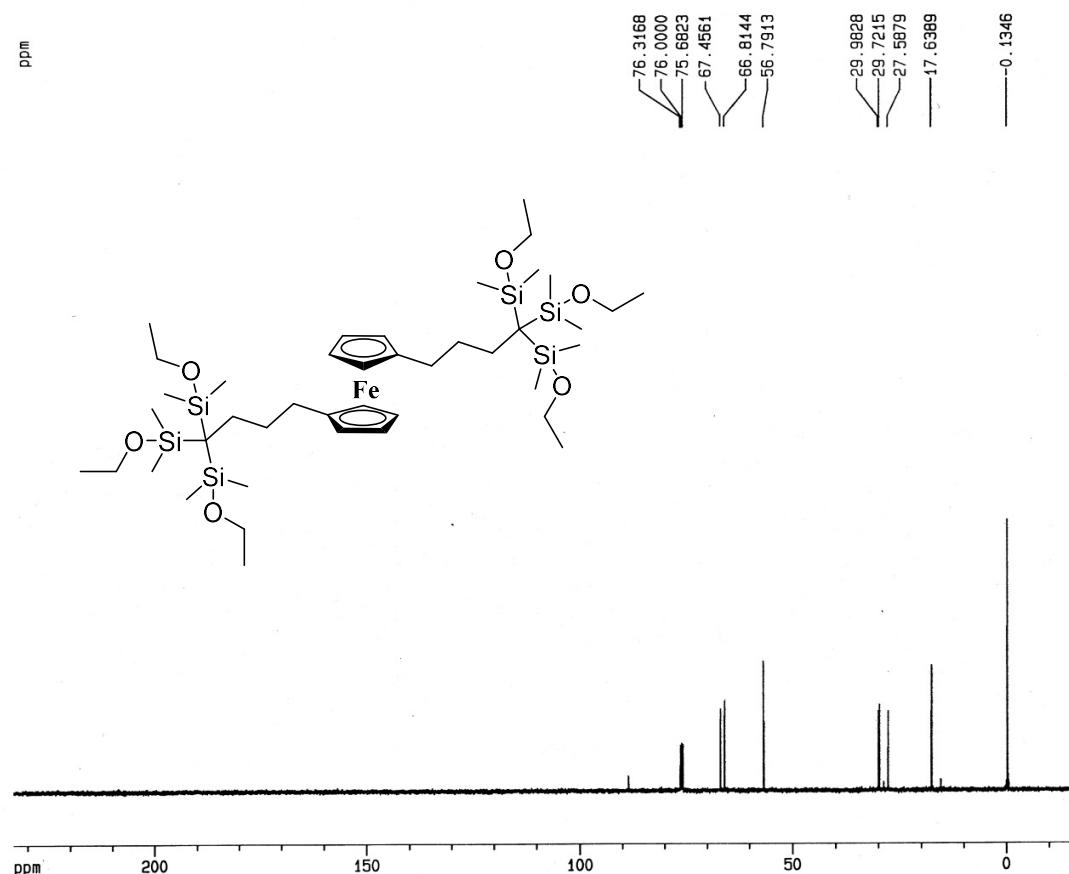


Fig. 24.  $^{13}\text{C}$  NMR spectrum of (8b) (100 MHz,  $\text{CDCl}_3$ )

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

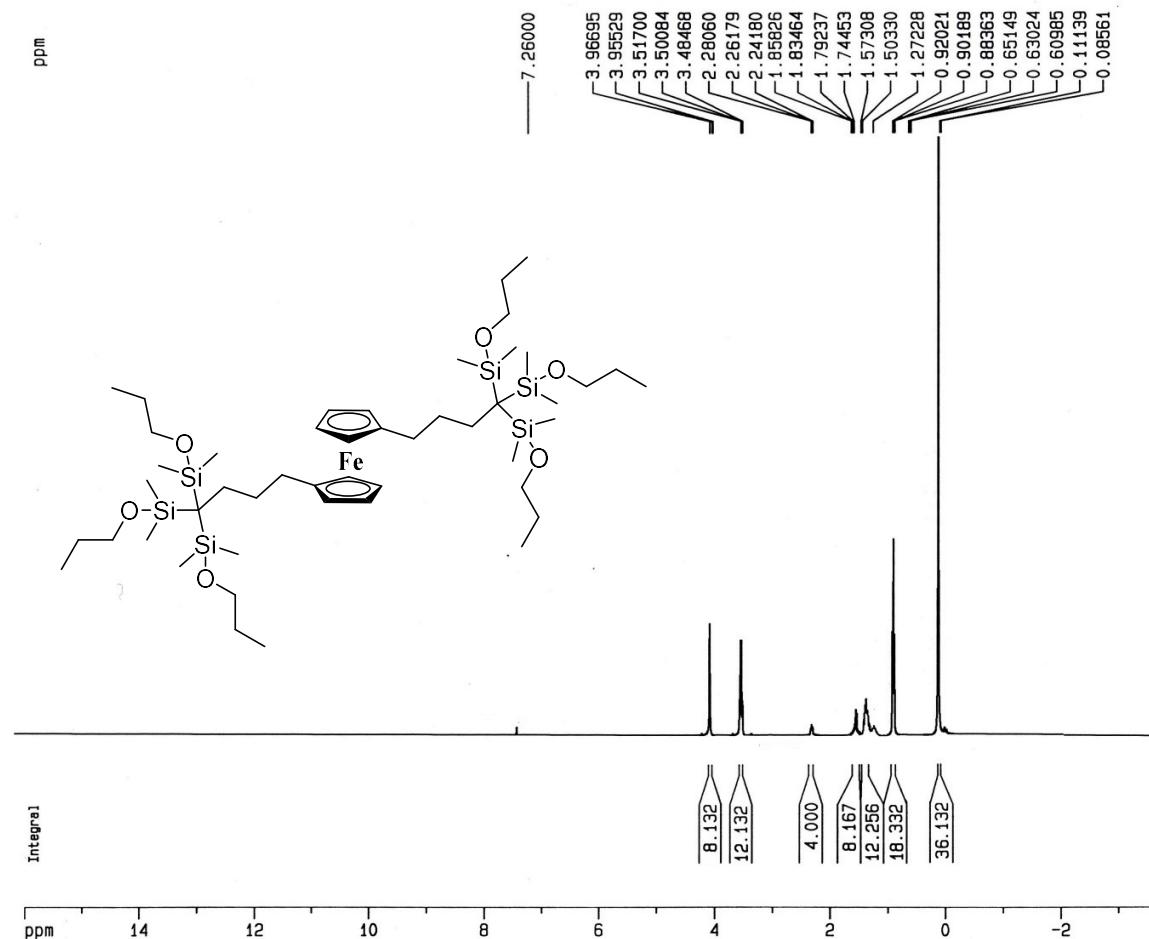


Fig. 25.  $^1\text{H}$  NMR spectrum of (8c) (400 MHz,  $\text{CDCl}_3$ )

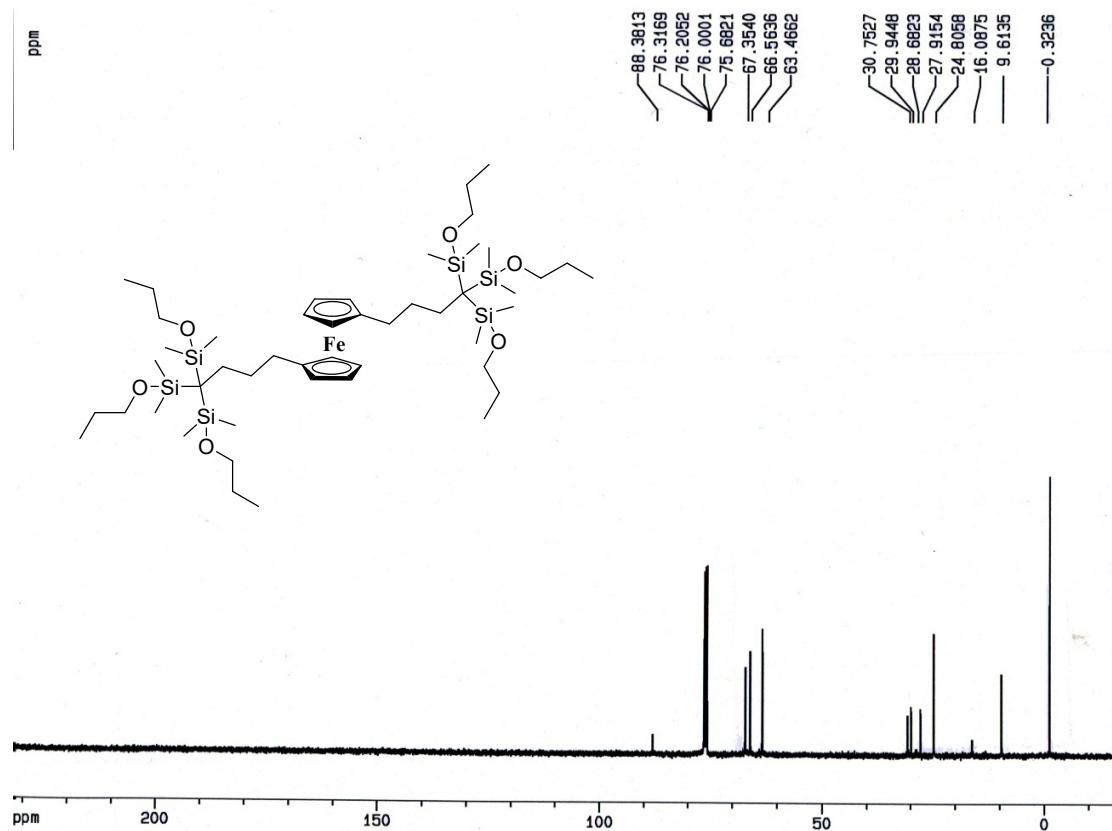


Fig. 26.  $^{13}\text{C}$  NMR spectrum of (8c) (100 MHz,  $\text{CDCl}_3$ )

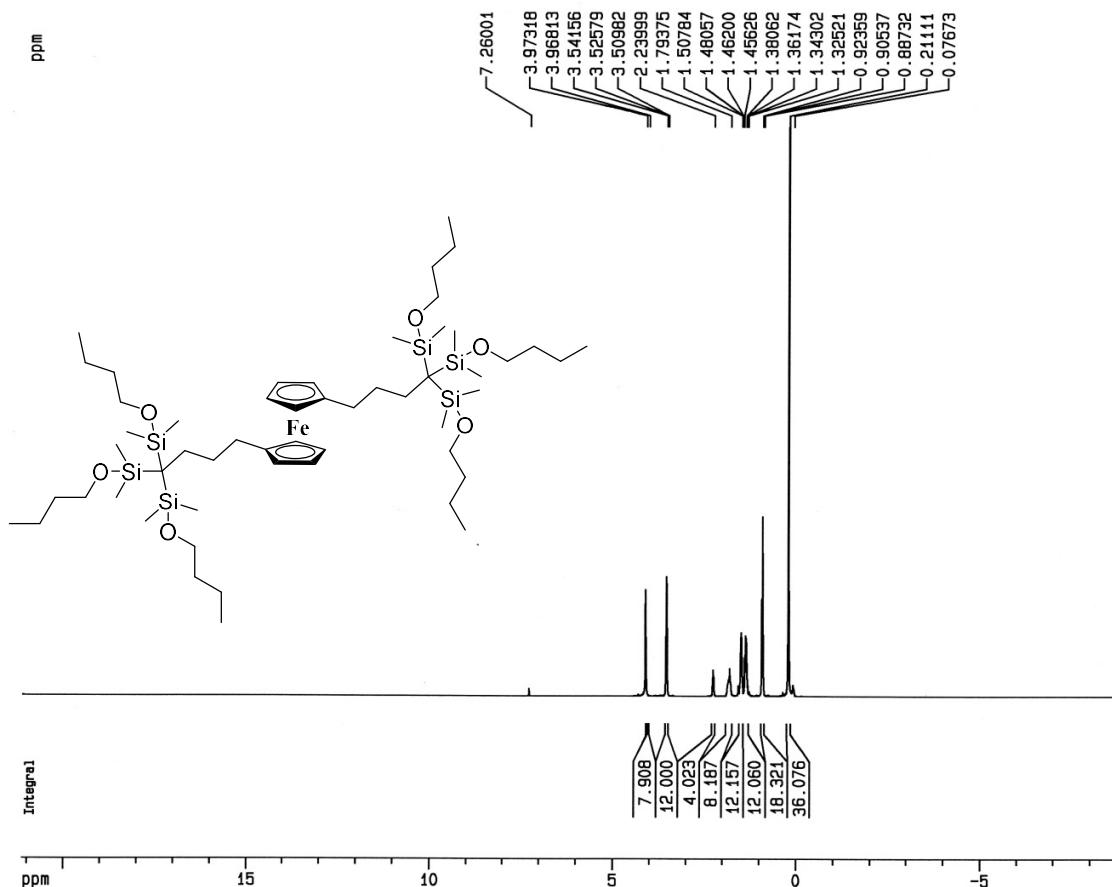
**1,1'-Bis[3-(tris(butoxydimethylsilyl)methyl)propyl]ferrocene (8d)**

Fig. 27. <sup>1</sup>H NMR spectrum of (8d) (400 MHz, CDCl<sub>3</sub>)

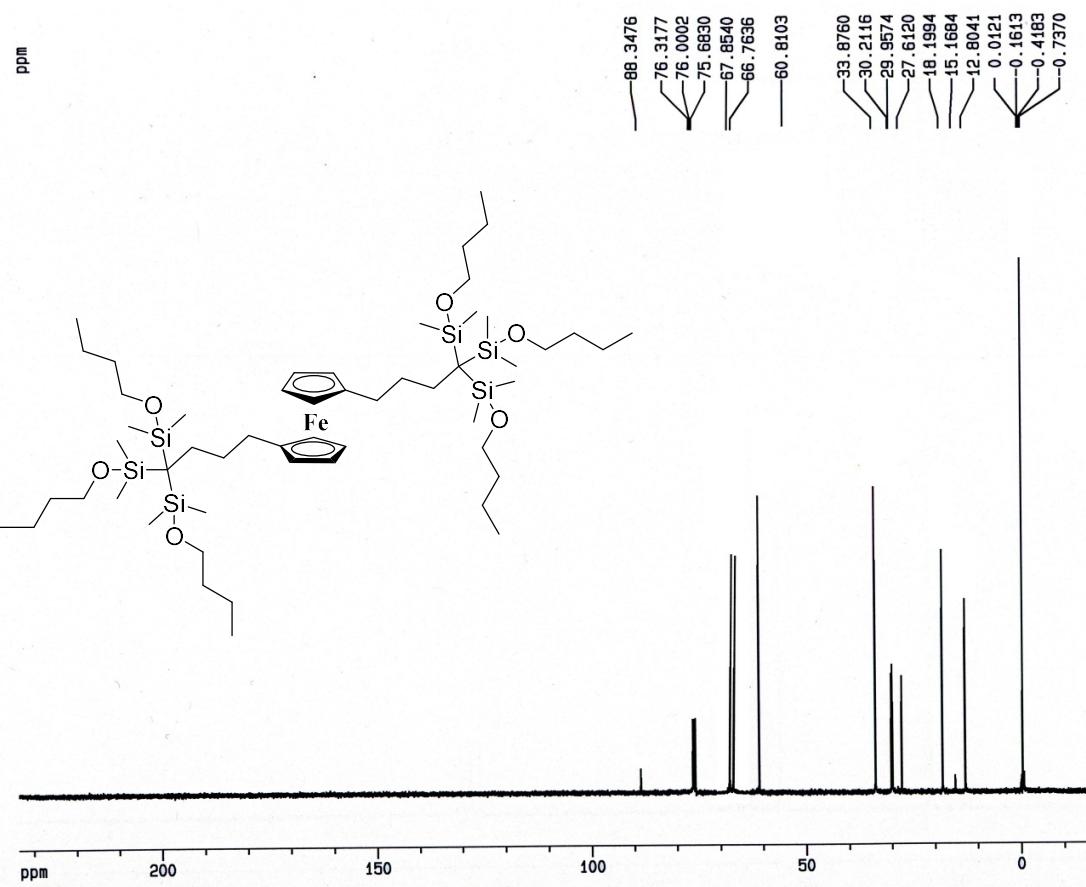


Fig. 28.  $^{13}\text{C}$  NMR spectrum of (8d) (100 MHz,  $\text{CDCl}_3$ )

#### 4-5- 1,1'-Bis[3-(tris(benzyloxydimethylsilyl)methyl)propyl]ferrocene (8e)

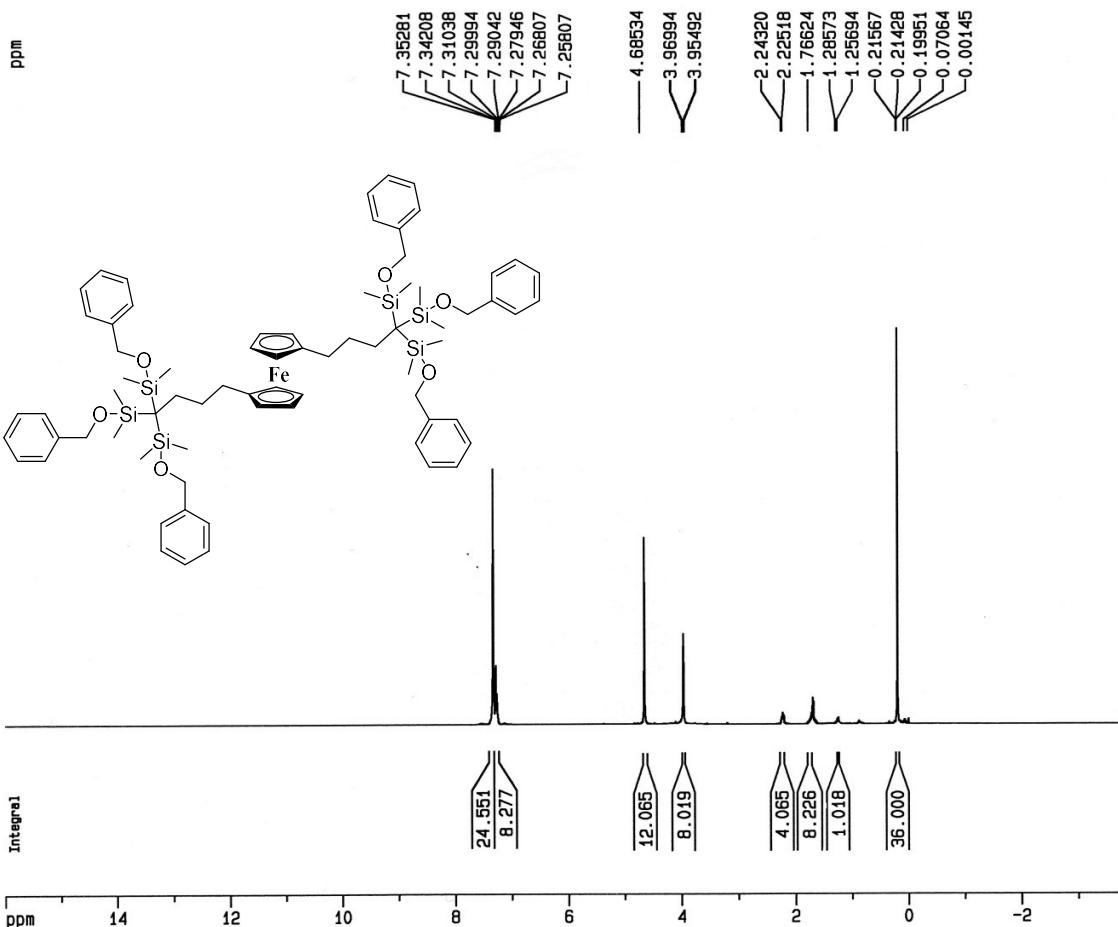


Fig. 29.  $^1\text{H}$  NMR spectrum of (8e) (400 MHz,  $\text{CDCl}_3$ )

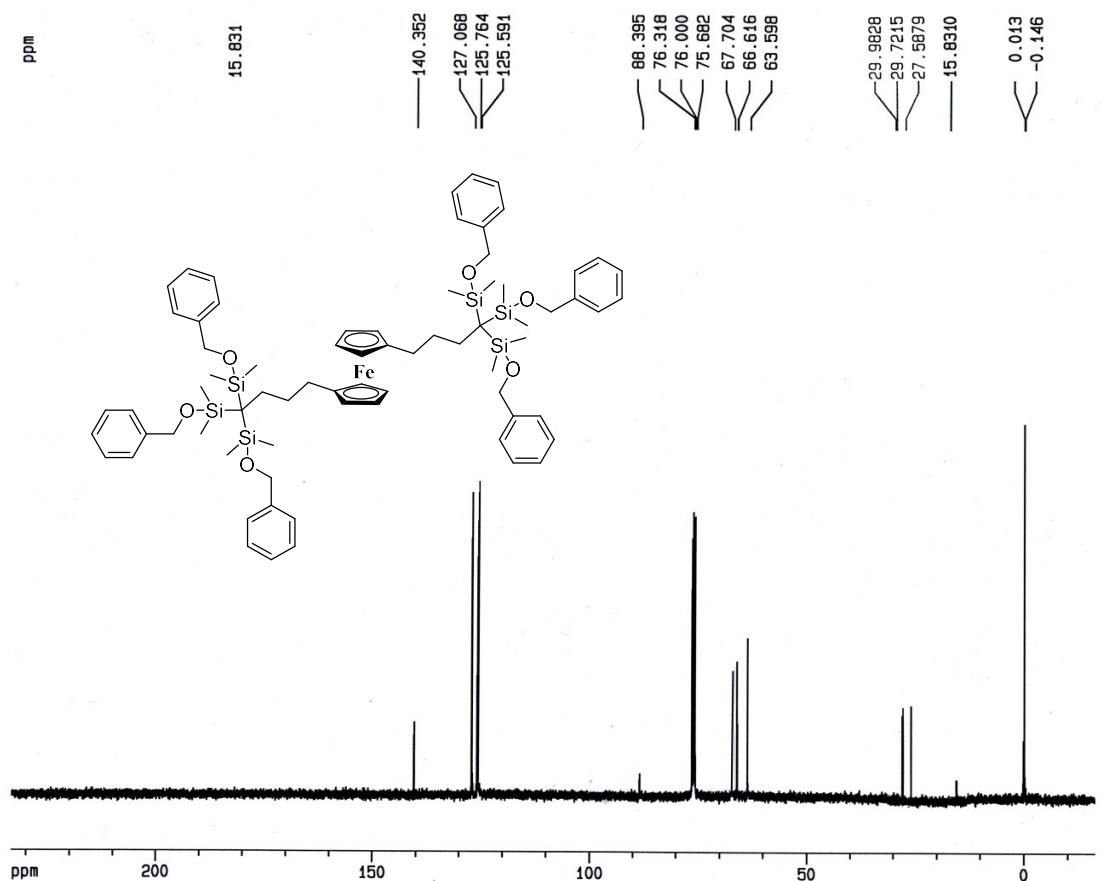


Fig. 30.  $^{13}\text{C}$  NMR spectrum of (8e) (100 MHz,  $\text{CDCl}_3$ )

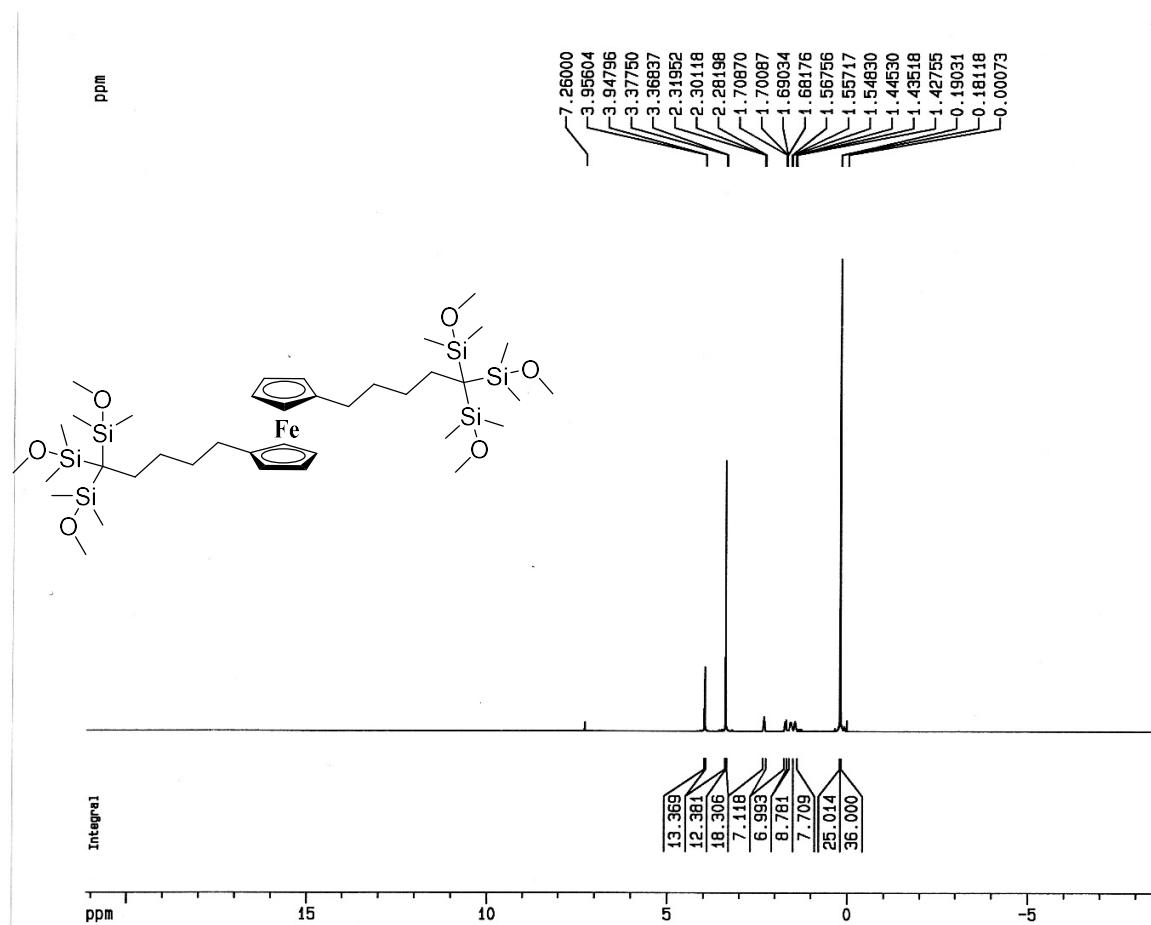
**5-6- 1,1'- Bis[4-(tris(methoxydimethylsilyl)methyl)butyl]ferrocene (8g)**

Fig. 31. <sup>1</sup>H NMR spectrum of (8g) (400 MHz, CDCl<sub>3</sub>)

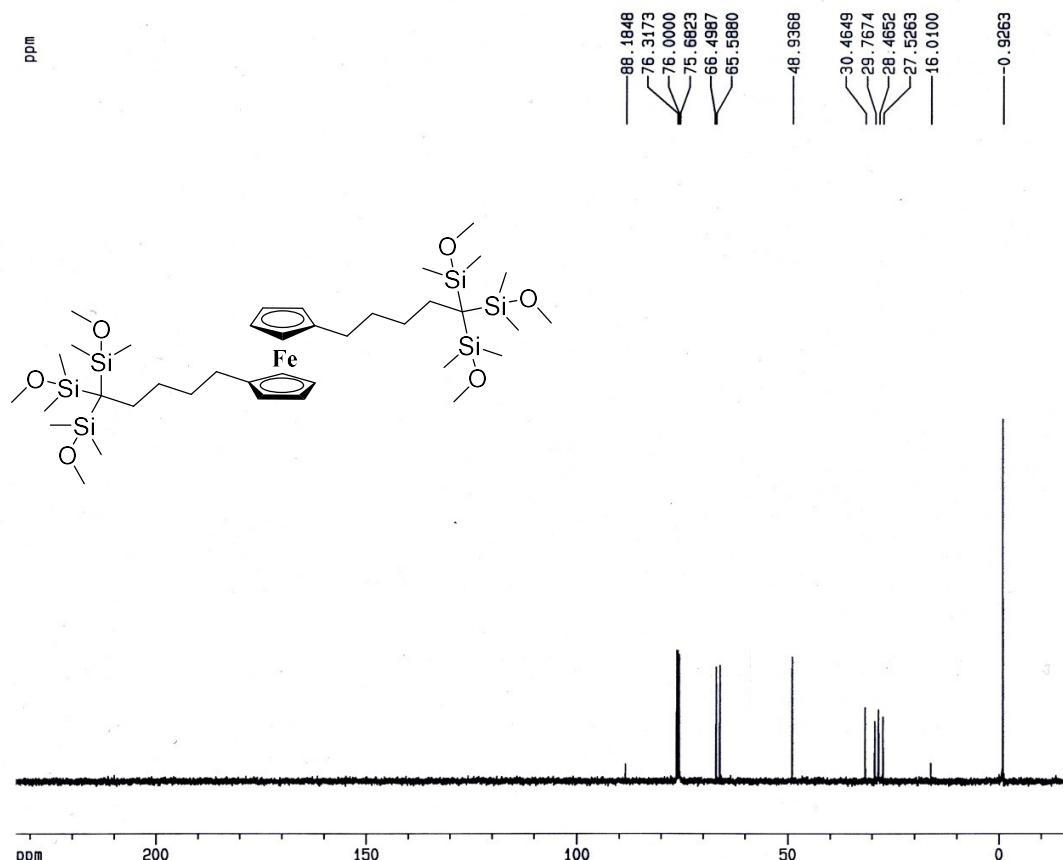
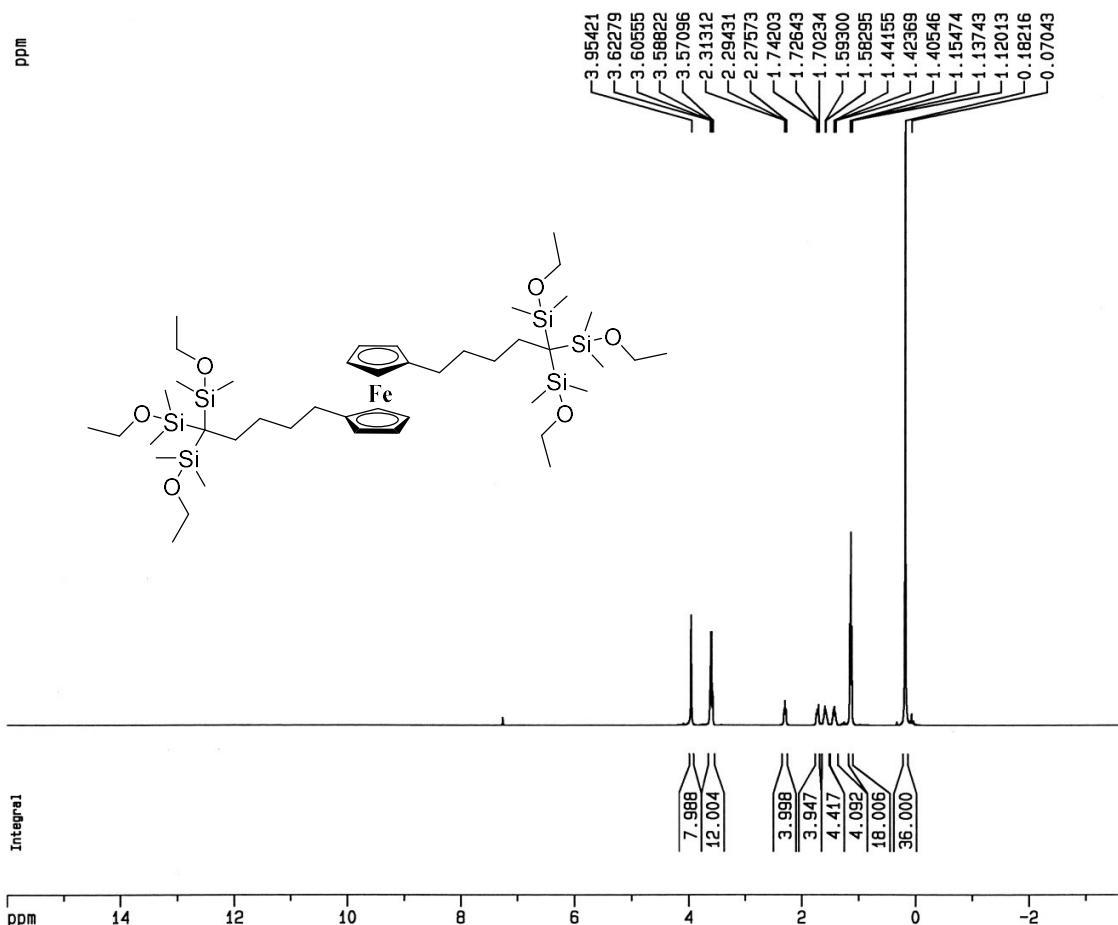


Fig. 32.  $^{13}\text{C}$  NMR spectrum of (8g) (100 MHz,  $\text{CDCl}_3$ )

**5-7- 1,1'- Bis[4-(tris(ethoxydimethylsilyl)methyl)butyl]ferrocene (8h)**Fig. 33.  $^1\text{H}$  NMR spectrum of (8h) (400 MHz,  $\text{CDCl}_3$ )

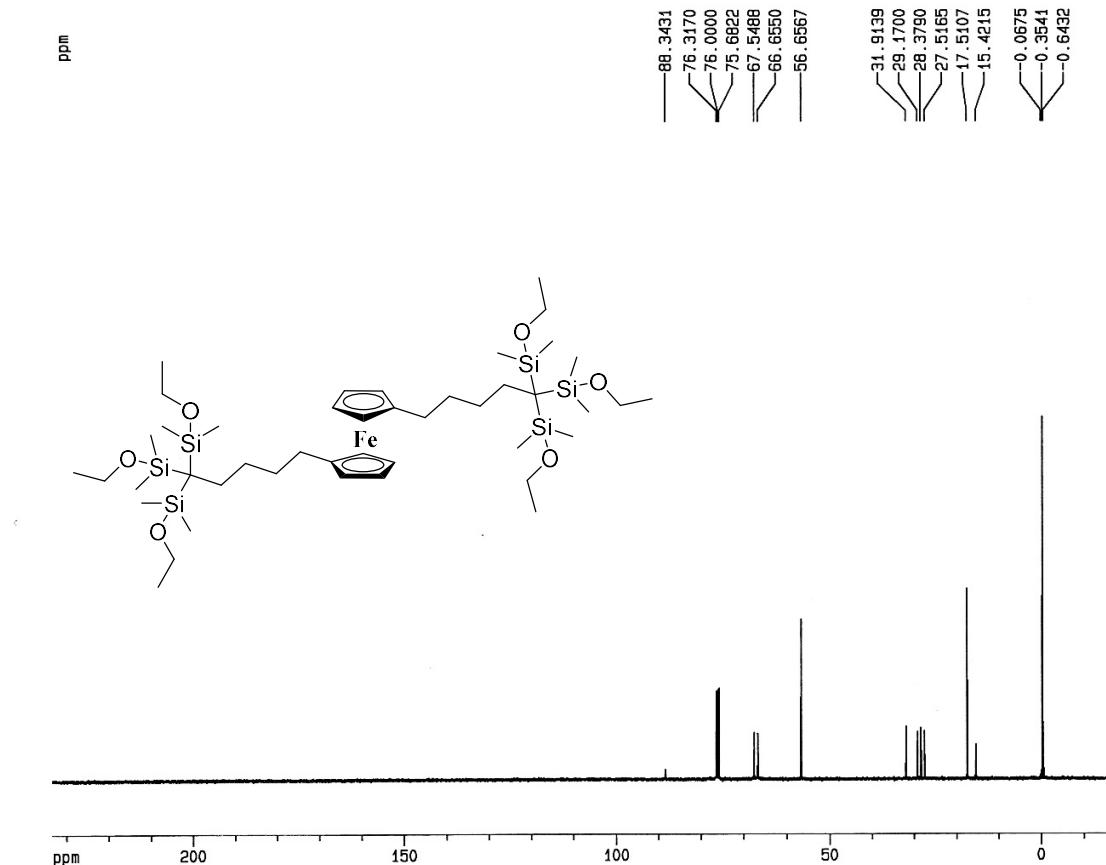


Fig. 34.  $^{13}\text{C}$  NMR spectrum of (8h) (100 MHz,  $\text{CDCl}_3$ )

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

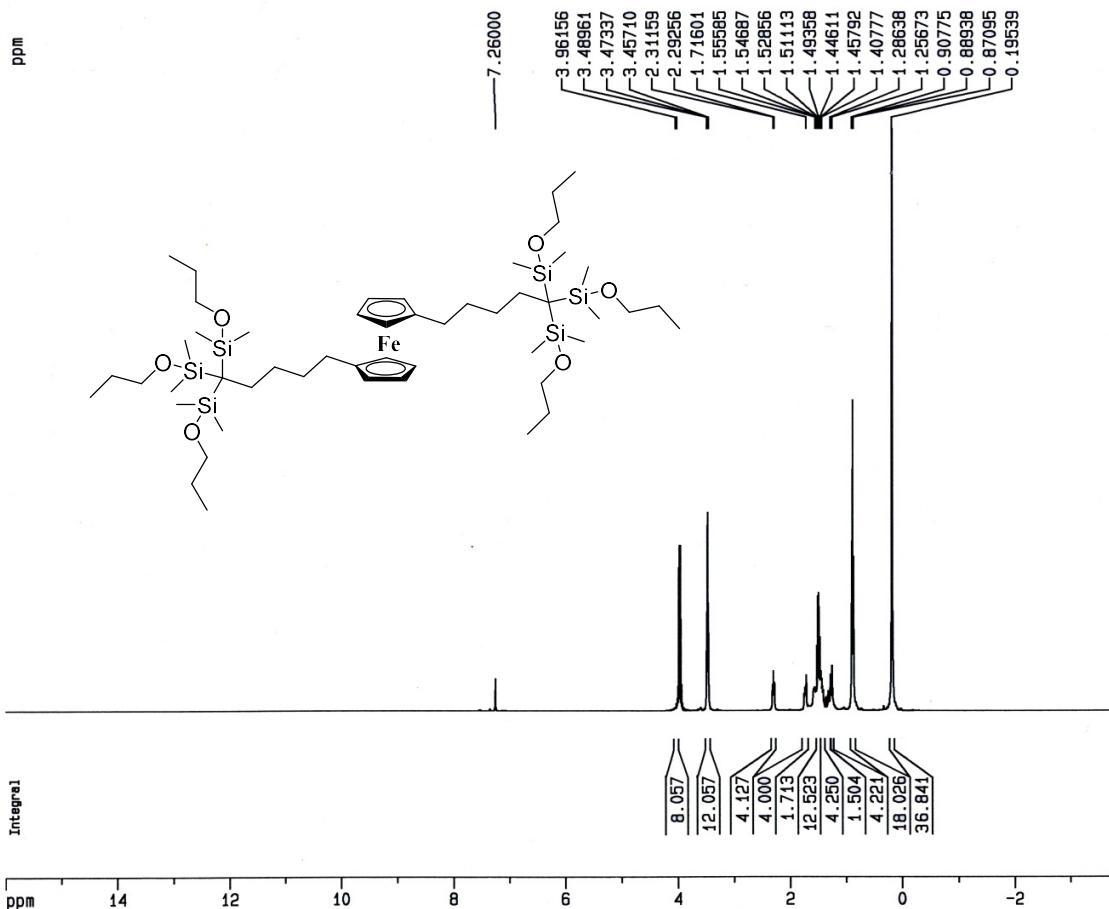


Fig. 35. <sup>1</sup>H NMR spectrum of (8i) (400 MHz, CDCl<sub>3</sub>)

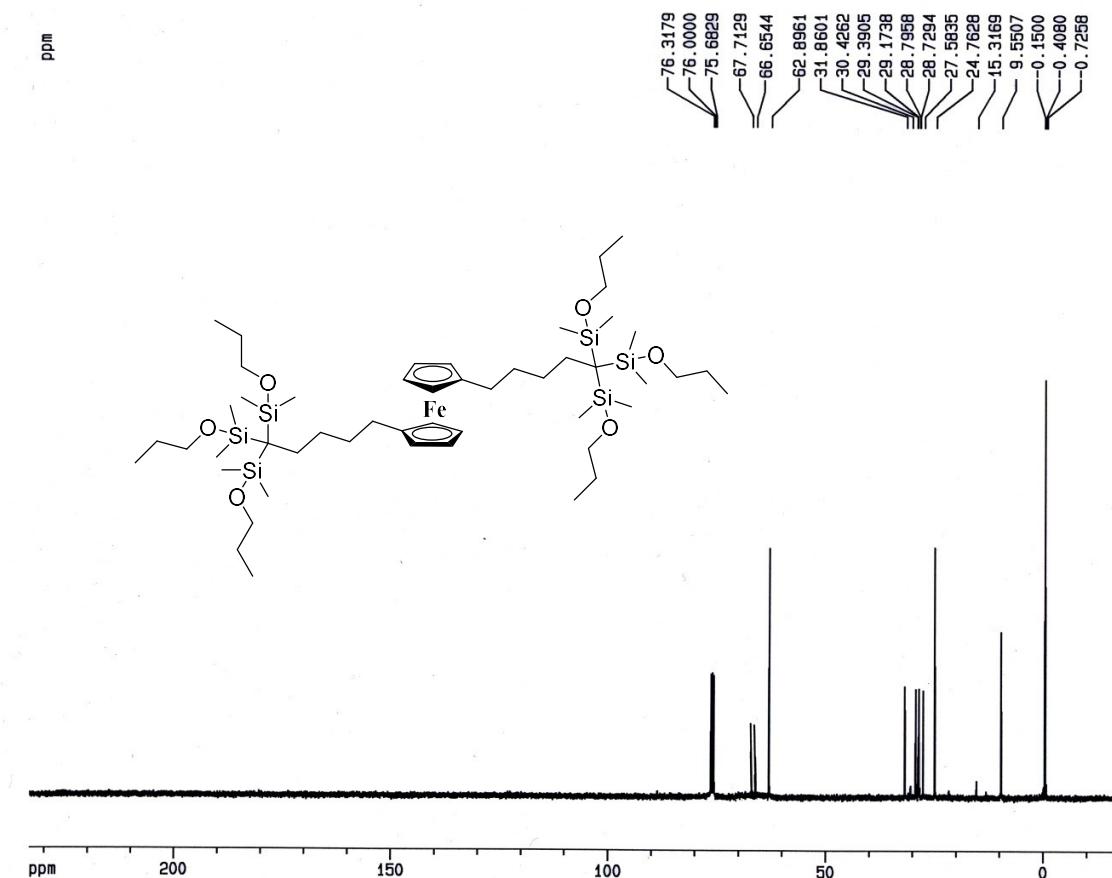
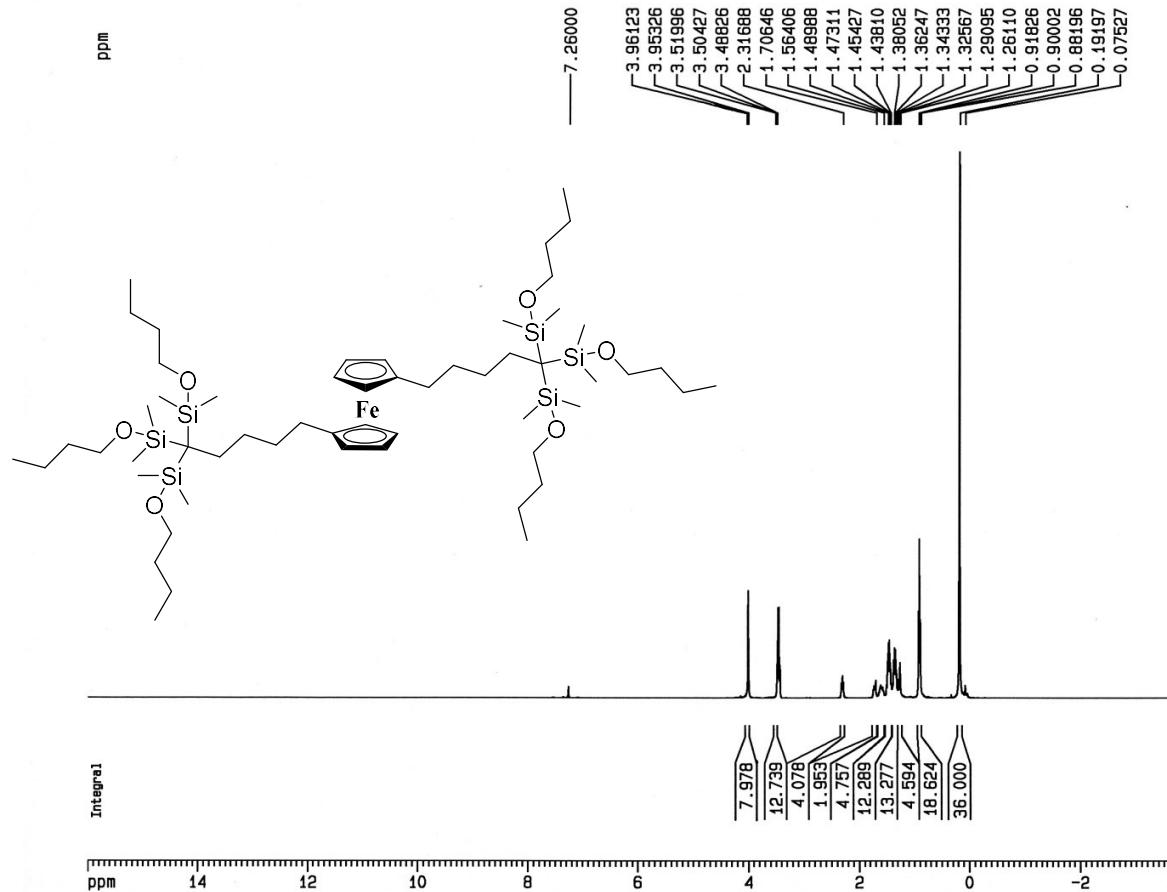


Fig. 36.  $^{13}\text{C}$  NMR spectrum of (8i) (100 MHz,  $\text{CDCl}_3$ )

**4-9- 1,1'- Bis[4-(tris(butoxydimethylsilyl)methyl)butyl]ferrocene (8j)**Fig. 37.  $^1\text{H}$  NMR spectrum of (8j) (400 MHz,  $\text{CDCl}_3$ )

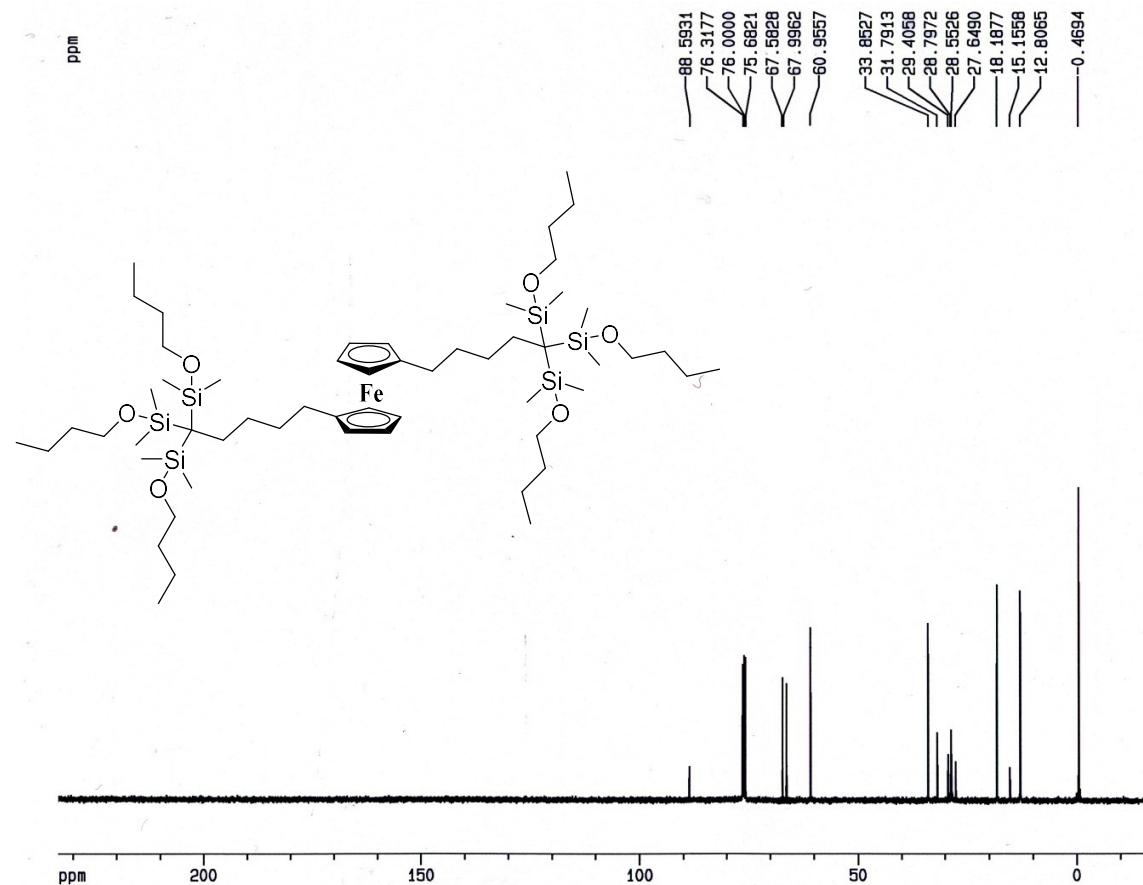


Fig. 38.  $^{13}\text{C}$  NMR spectrum of (8j) (100 MHz,  $\text{CDCl}_3$ )

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

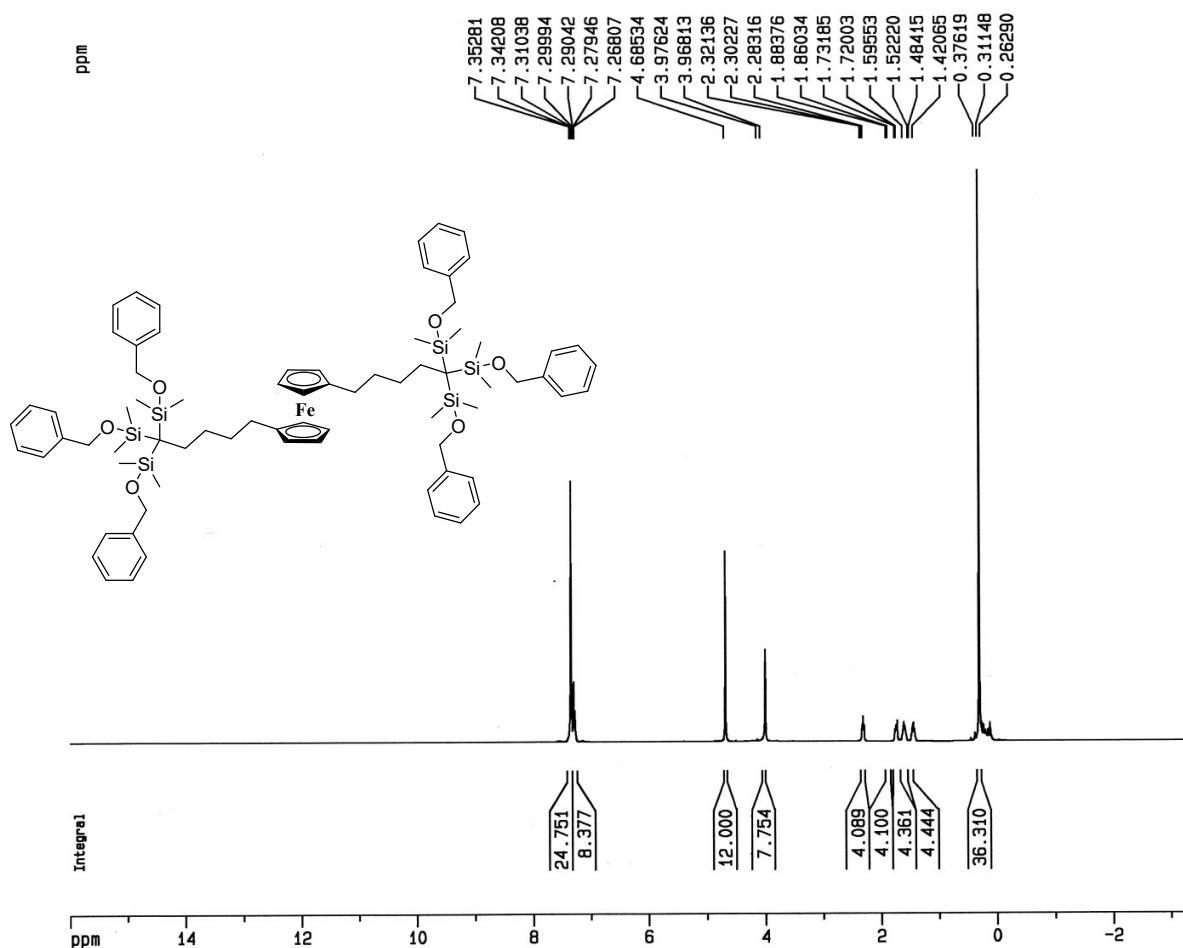


Fig. 39.  $^1\text{H}$  NMR spectrum of (8k) (400 MHz,  $\text{CDCl}_3$ )

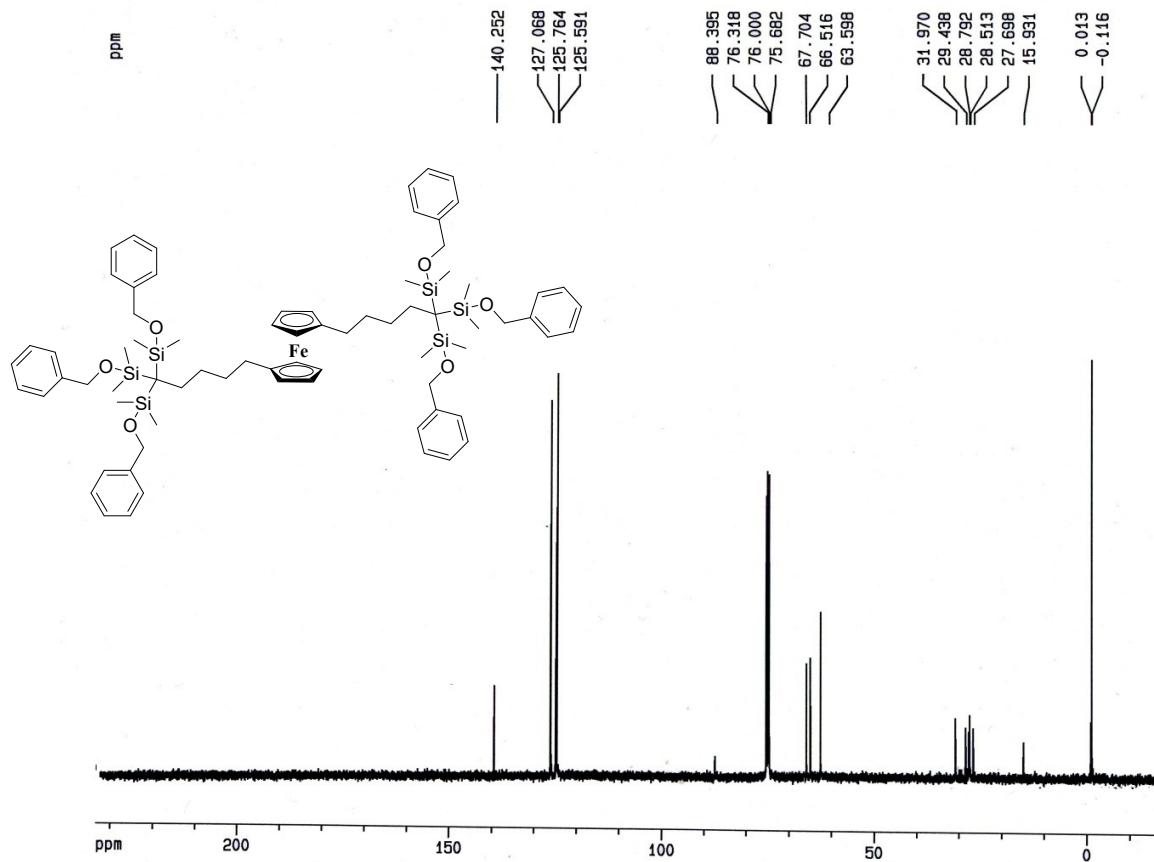


Fig. 40.  $^{13}\text{C}$  NMR spectrum of (8k) (100 MHz,  $\text{CDCl}_3$ )