Electronic Supplementary Material (ESI) for RSC Advances.

Synthetic approach towards 'Click' modified chalcone based organotriethoxysilanes; UV–Vis study

Gurjaspreet Singh,* Jandeep Singh, Satinderpal Singh Mangat, Aanchal Arora

Department of Chemistry and Centre of Advanced Studies, Panjab University, Chandigarh, 160014, India.

*Corresponding Author

Email: gjpsingh@pu.ac.in, Phone: +91-0172-2534428

Experimental

Caution! *Azide compounds are explosive to heat and shock. Great care and protection is required for handling of these compounds.*

5.1. General material and methods: All the syntheses were carried out under dry nitrogen atmosphere using vacuum glass line. The organic solvents used were dried and purified according to the standard procedure and stored under dry nitrogen atmosphere. bromotris(triphenylphosphine)copper(I) (Aldrich), γ-chloropropyltriethoxysilane (ClPTES) (Aldrich), propargyl bromide (80% wt. solution in toluene) (Aldrich), sodium azide (SDFCL), potassium carbonate (THOMAS BAKER), N,N-dimethylformamide (SDFCL), were used as supplied. Acetophenone (SDFCL), 2-hydroxyacetophenone (SDFCL), 3-hydroxyacetophenone (SDFCL), 4-hydroxyacetophenone (SDFCL), salicylaldehyde (Aldrich), 3-hydroxybenzaldehyde (SDFCL), 4-hydroxybenzaldehyde (SDFCL), p-methoxyacetophenone (HIMEDIA), 2,4-dimethoxyacetophenone (HIMEDIA) were used as supplied for synthesis of terminal alkynes **3a–3i** and **5a–5i**.

Infrared spectrum was obtained neat on a Thermo Scientific Fischer spectrometer. Multinuclear NMR (^{1}H, ^{13}C) spectra were recorded on a Bruker advance II 400 spectrometer (in $CDCl_3$) at 25 °C. HRMS data of all synthesized compounds **4a–4i** and **6a–6i** was recorded on Waters QQ–TOF micro Mass Spectrometer. UV–Vis spectra were recorded on JASCO V–530 UV–Vis spectrophotometer. The elemental data were obtained on Thermo Scientific flash 2000 organic elemental analyzer.

AzPTES was synthesized according to known procedure in literature.[20]

Synthesis of compounds 2a(i–iii) and 2b(i–iii)

To a uniformly stirred solution of **1a/1b** (2g, 16.40 mmol, 1 equiv) in 15 ml of DMF cooled in ice bath, added K_2CO_3 (6.76 g, 47.2 mmol, 3 equiv) and propargyl bromide (2.15 g, 1.61 ml, 18.06 mmol, 1.1 equiv) dropwise within 5 min. After complete addition of reactants, the temperature of reaction mixture was slowly raised to 30 °C and stirred for 14 h. The reaction was then quenched by addition of ice cold water and filtered the solid product (in case of **2a**(**i**, **iii**); **2b**(**i–iii**)). In case of low melting solids **2a**(**ii**), extraction was carried out with ethyl acetate.

The combined organic layers were dried over anhydrous $MgSO_4$ and vacuum evaporation of solvent resulted into the formation of desired compound. The solid alkynes were recrystallized by dissolving in minimum amount of ethanol.

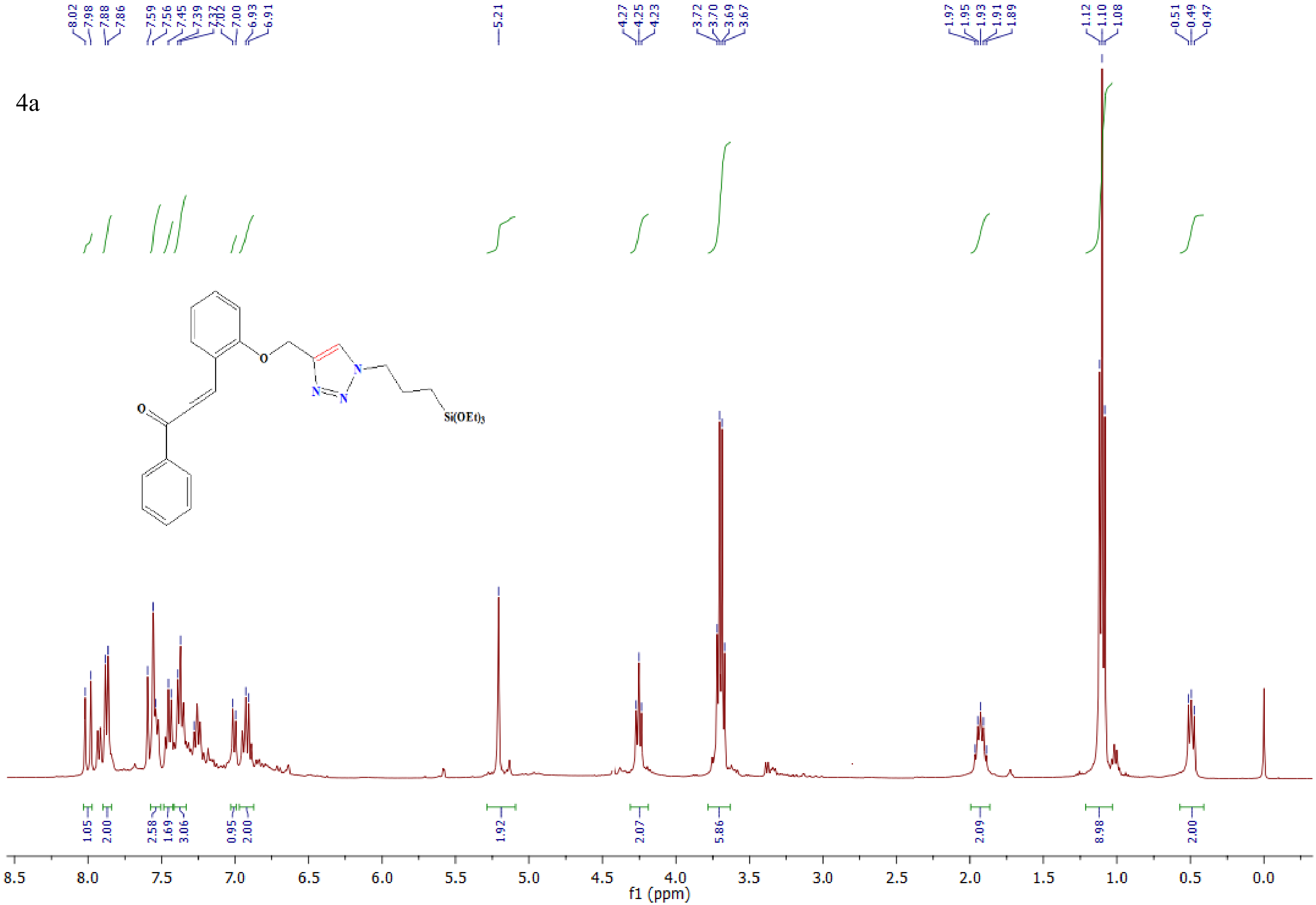
Synthesis of compounds 3a–3i/5a–5i

To a uniformly stirred solution of **2a** (1 equiv) and KOH (0.02 g, 0.36 mmol) in 15 ml of ethanol, ethanolic solution of substituted acetophenone **1c**(**a–c**) or **2b** (1 equiv) was added slowly within 10 min. The reaction was stirred for 4 h and monitored the end point using TLC (hexane:ethyl acetate (8:2)). On completion, the reaction was quenched by ice cold water, extracted with methylene chloride and washed twice with brine solution. The combined organic phases were dried over anhydrous $MgSO_4$ and vacuum evaporation afforded the desired product.

Synthesis of compounds 4a–4i/6a–6i

In a 25 ml two neck round bottom flask, to stirred solution of alkyne **3a–3i/5a–5i** in 1:1 solution of THF:TEA (3ml), added AzPTES (1 equiv for **3a–3i** and 2 equiv for **5a–5i**) followed by catalyst (0.02 mmol for **3a–3i** and 0.04 mmol for **5a–5i**) loading under inert atmosphere. Slowly the temperature of reaction mixture was raised to 65 ℃ and stirred vigorously for 3 h. After completion of reaction, it was cooled to room temperature, filtered and vacuum evaporation of solvent resulted in desired nPTES **4a–4i/6a–6i**.

4a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7.02
7.00
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6.91
5.21
4.27
4.25
4.23
3.72
3.70
3.69
3.67
1.97
1.95
1.93
1.91
1.89
1.12
1.10
1.08
0.51
0.49
0.47
O
O
N
N
N
Si(OEt)3
1.05
2.00
2.58
1.69
3.06
0.95
2.00
1.92
2.07
5.86
2.09
8.98
2.00
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
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3.5
3.0
2.5
2.0
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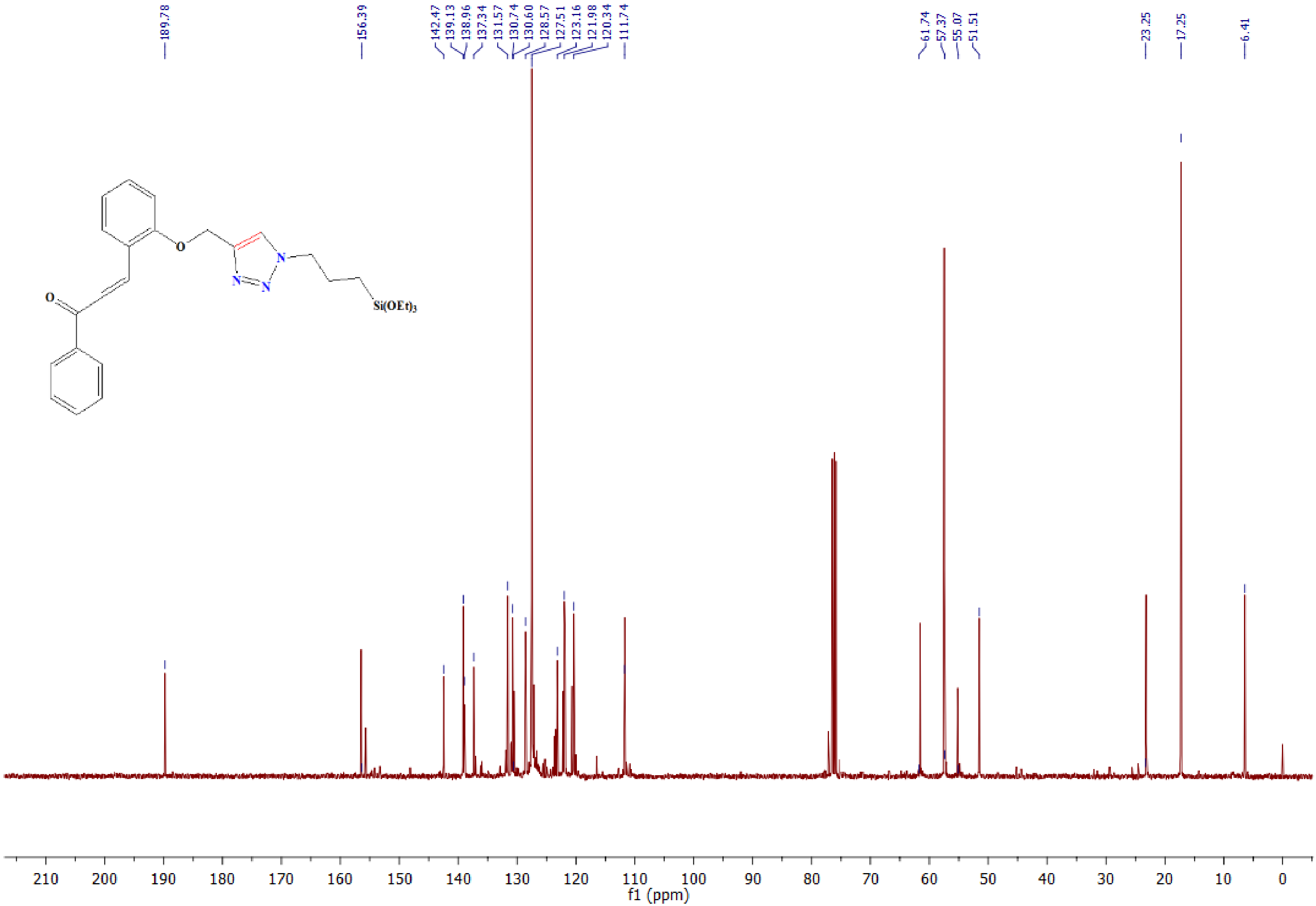
1.0
0.5
0.0
f1 (ppm)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137.34
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128.57
127.51
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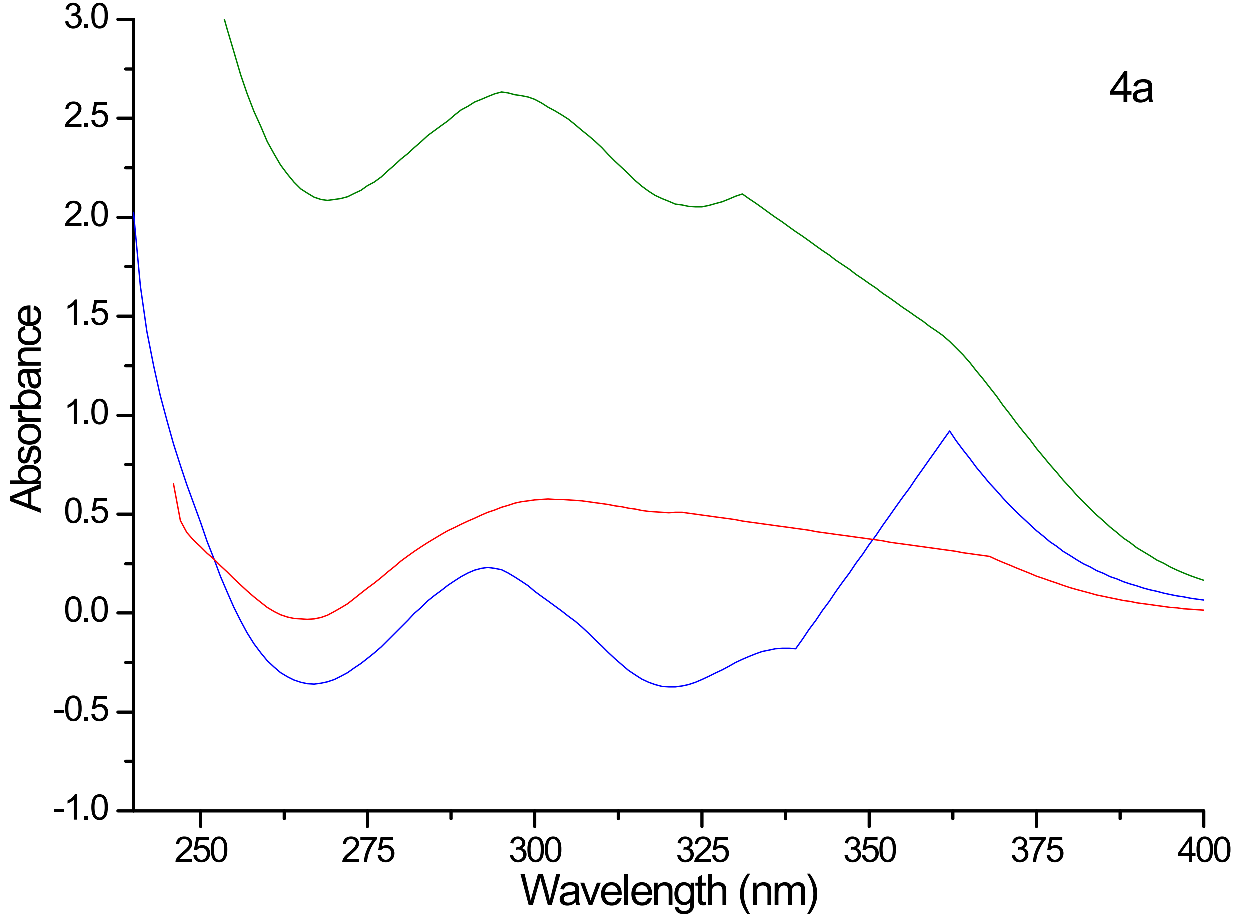
121.98
120.34
111.74
61.74
57.37
55.07
51.51
23.25
17.25
6.41
O
O
N
N
N
Si(OEt)3
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)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Absorbance
Wavelength (nm)
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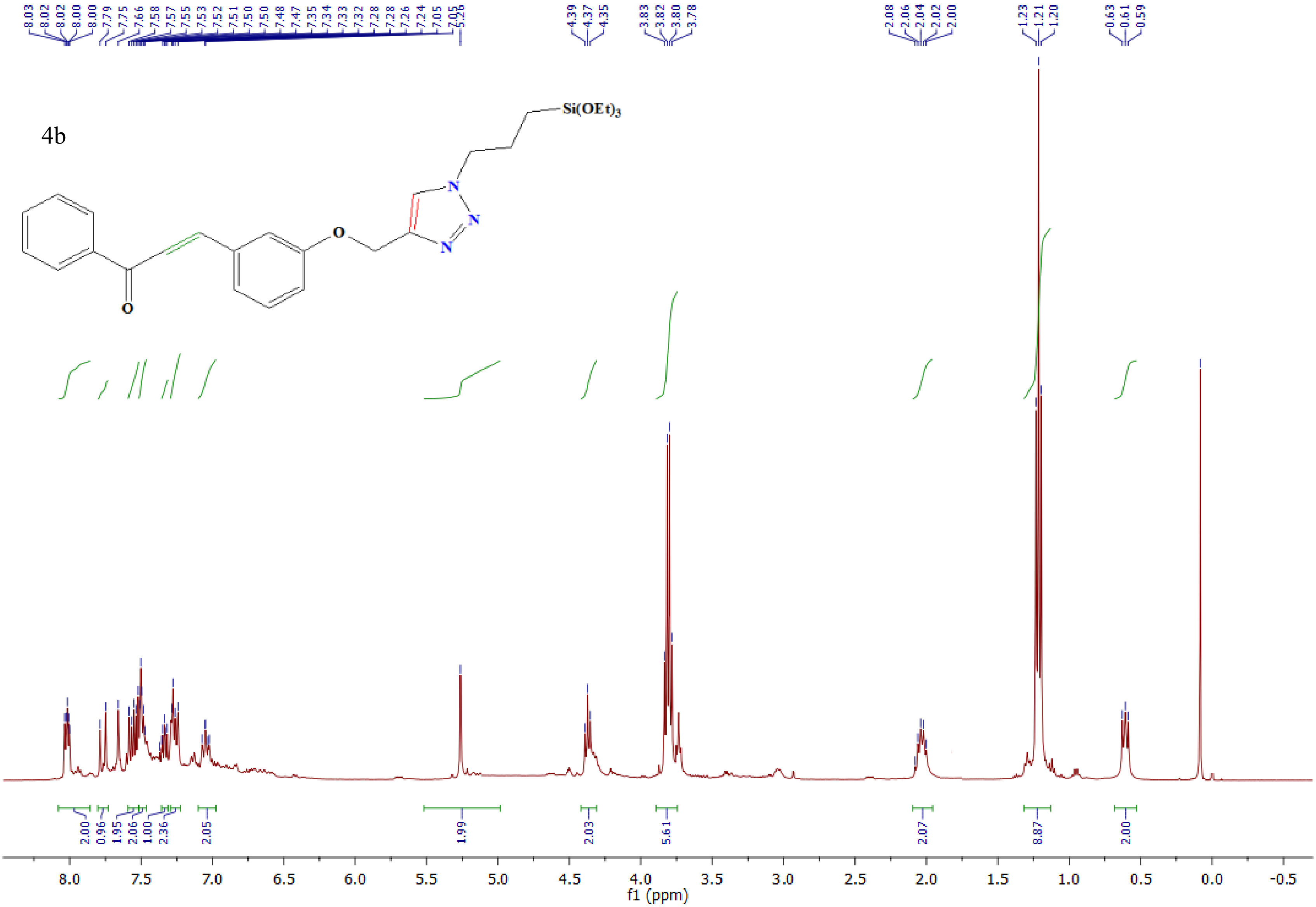
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
250
275
300
325
350
375
400

4b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8.02
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8.00
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7.55
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7.52
7.51
7.50
7.50
7.48
7.47
7.35
7.34
7.33
7.32
7.28
7.28
7.26
7.24
7.05
7.05
5.26
4.39
4.37
4.35
3.83
3.82
3.80
3.78
2.08
2.06
2.04
2.02
2.00
1.23
1.21
1.20
0.63
0.61
0.59
Si(OEt)3
N
N
N
O
O
2.00
0.96
1.95
2.06
1.00
2.36
2.05
1.99
2.03
5.61
2.07
8.87
2.00
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
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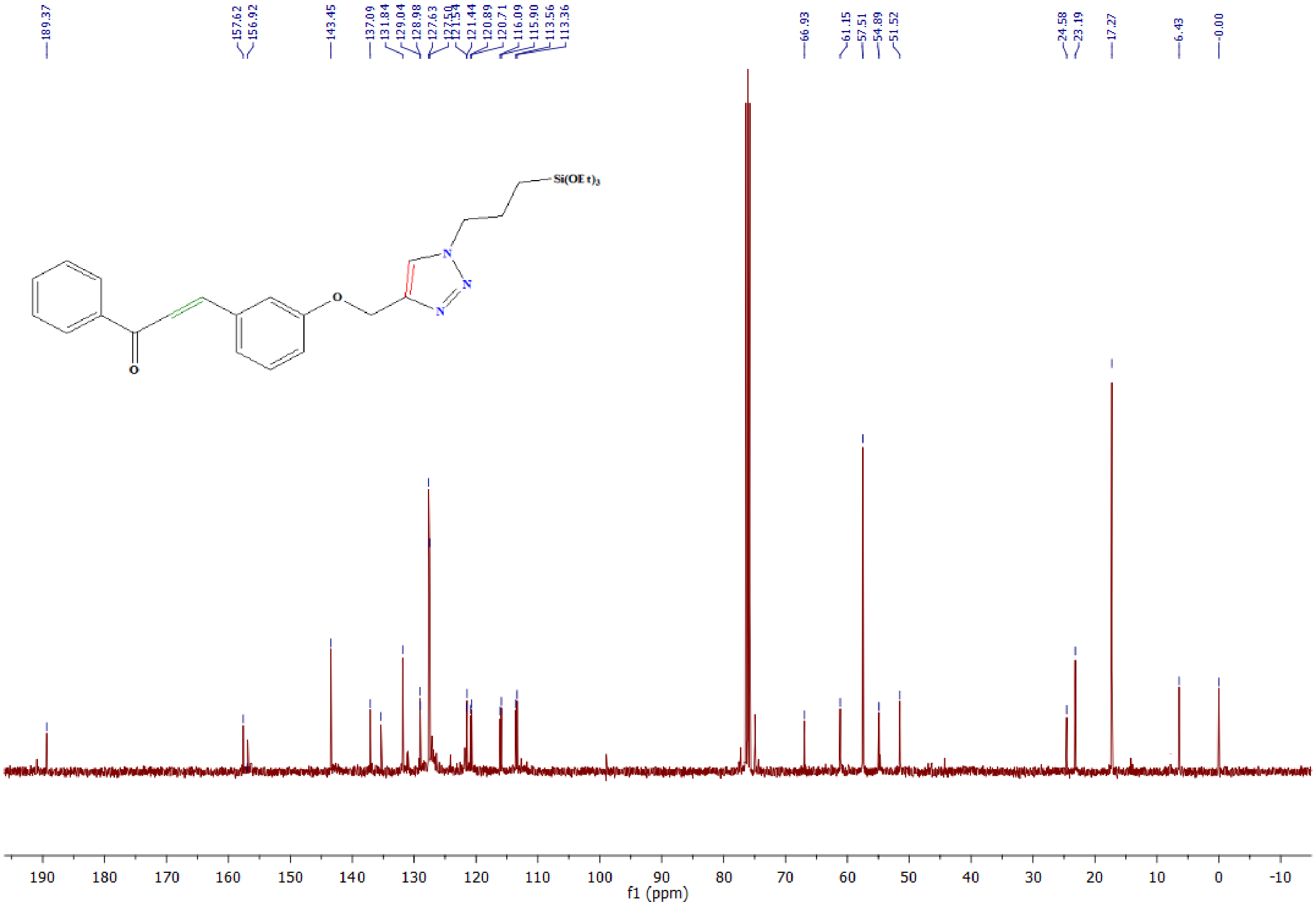
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)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129.04
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121.54
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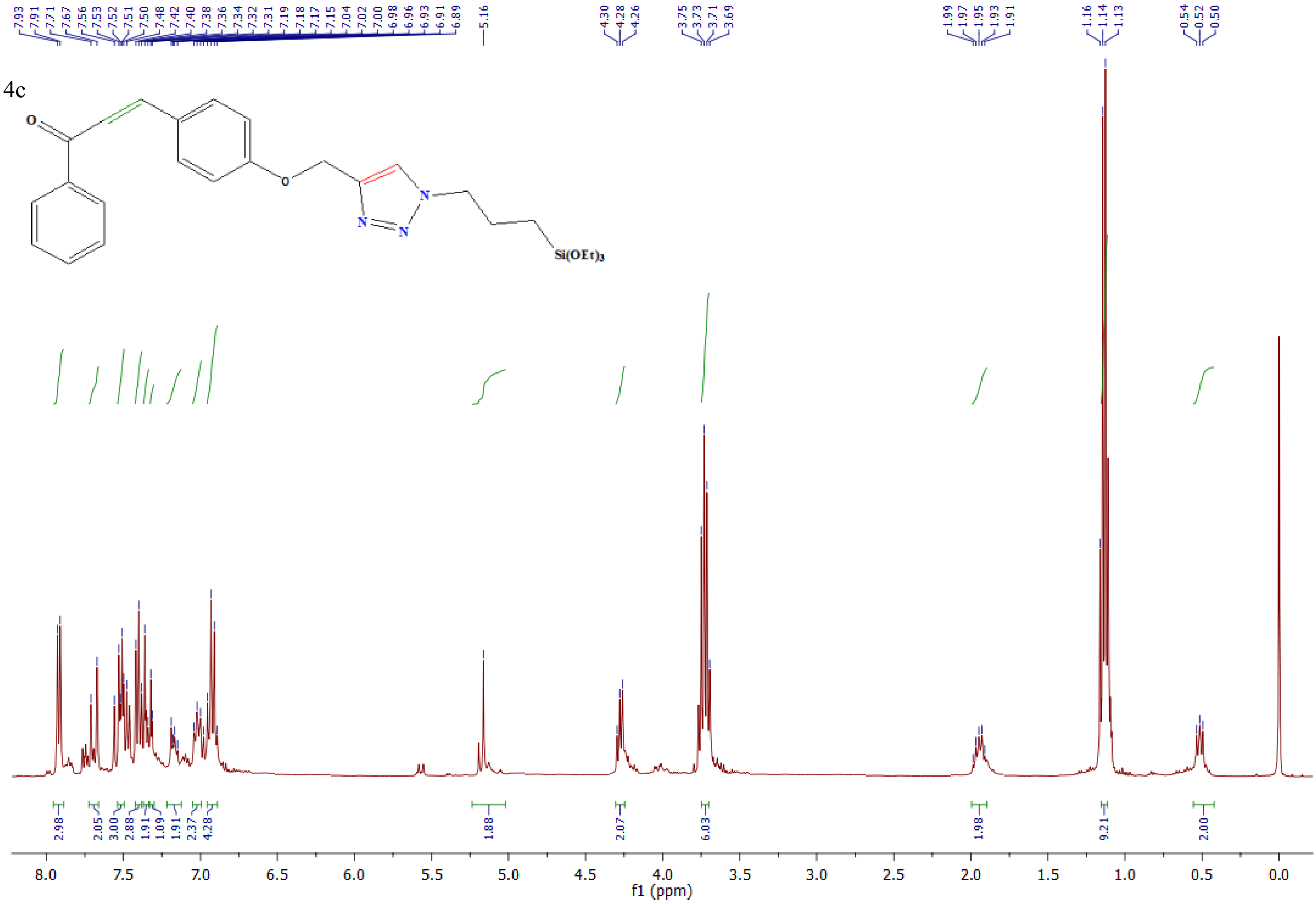
120.89
120.71
116.09
115.90
113.56
113.36
66.93
61.15
57.51
54.89
51.52
24.58
23.19
17.27
6.43
0.00
Si(OEt)3
O
O
N
N
N
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

4c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7.36
7.34
7.32
7.31
7.19
7.18
7.17
7.15
7.04
7.02
7.00
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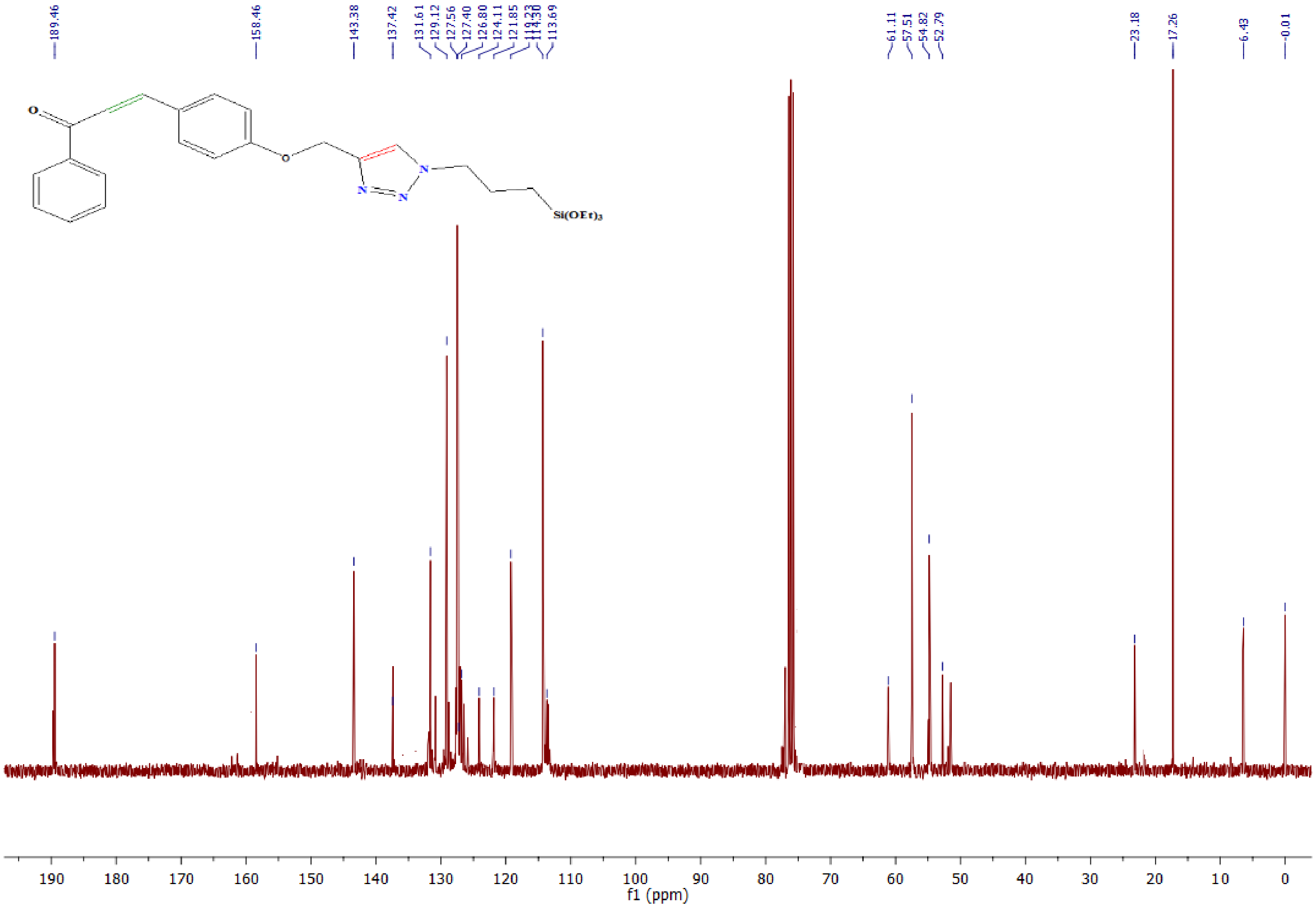
6.96
6.93
6.91
6.89
5.16
4.30
4.28
4.26
3.75
3.73
3.71
3.69
1.99
1.97
1.95
1.93
1.91
1.16
1.14
1.13
0.54
0.52
0.50
O
O
N
N
N
Si(OEt)3
2.98
2.05
3.00
2.88
1.91
1.09
1.91
2.37
4.28
1.88
2.07
6.03
1.98
9.21
2.00
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)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114.30
113.69
61.11
57.51
54.82
52.79
23.18
17.26
6.43
0.01
O
O
N
N
N
Si(OEt)3
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

WATERS, Q-TOF MICROMASS (LC-MS)
JANDEEP 4b 20 (0.251) Cm (10:30)

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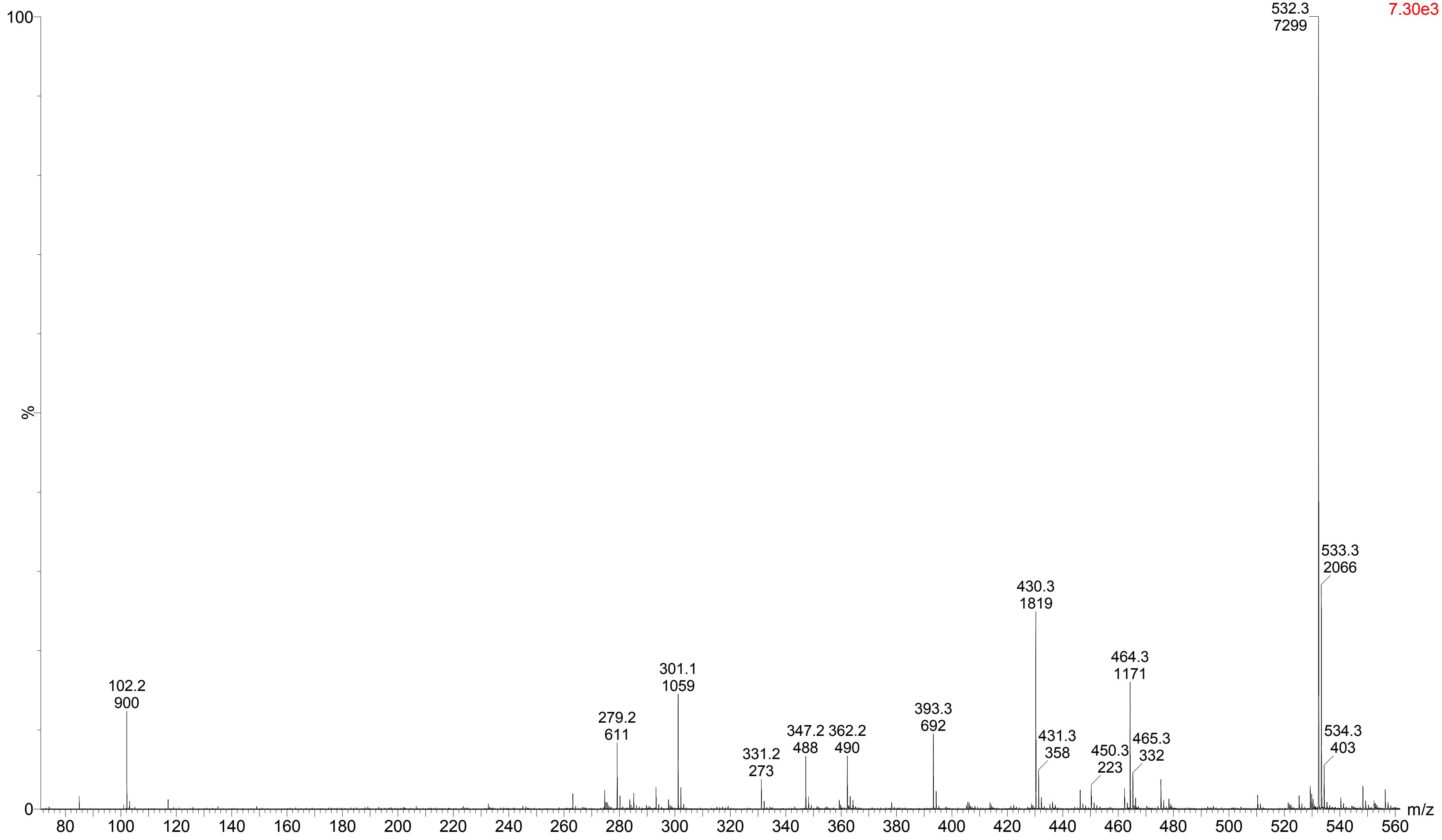
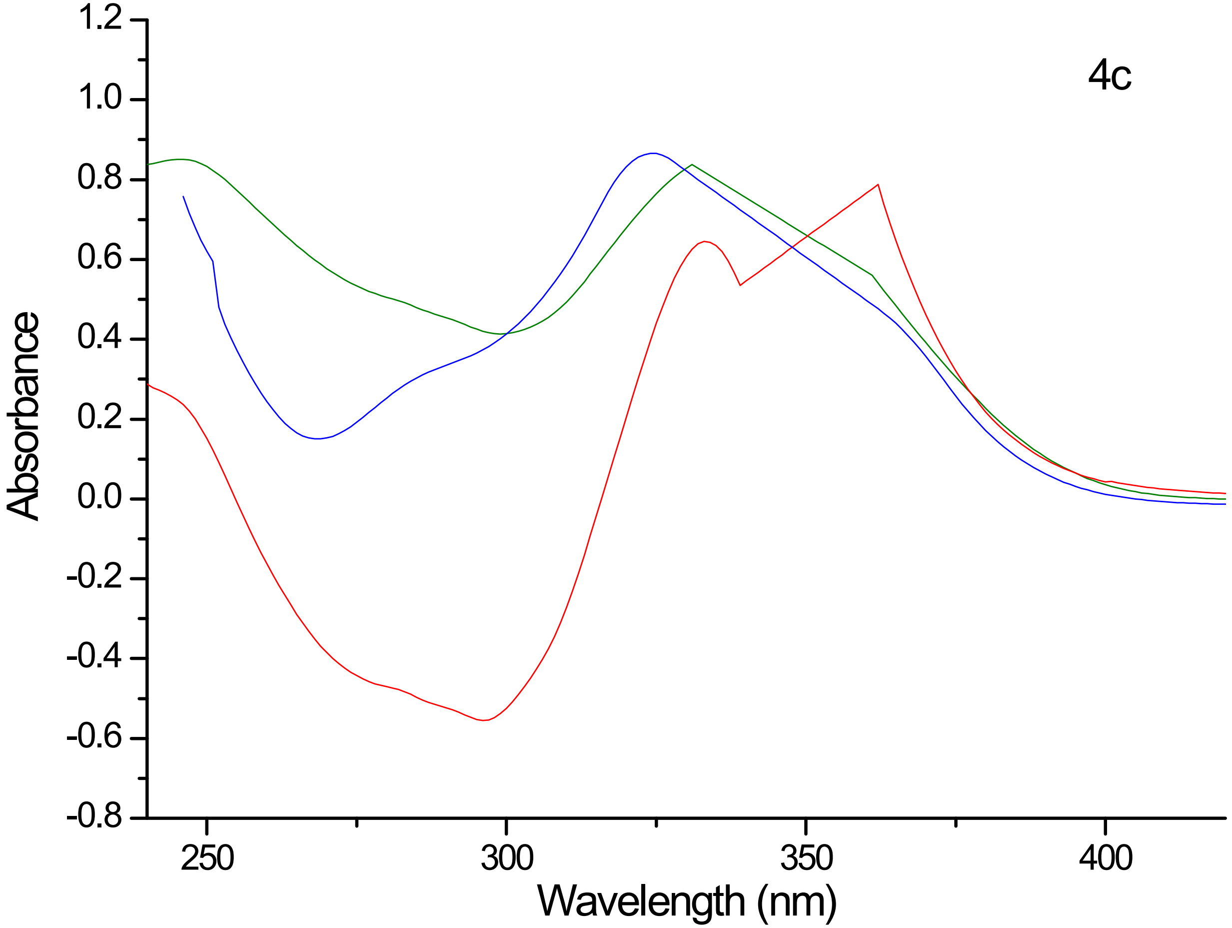
TOF MS ES+
7.30e3




4c
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0.8
0.6
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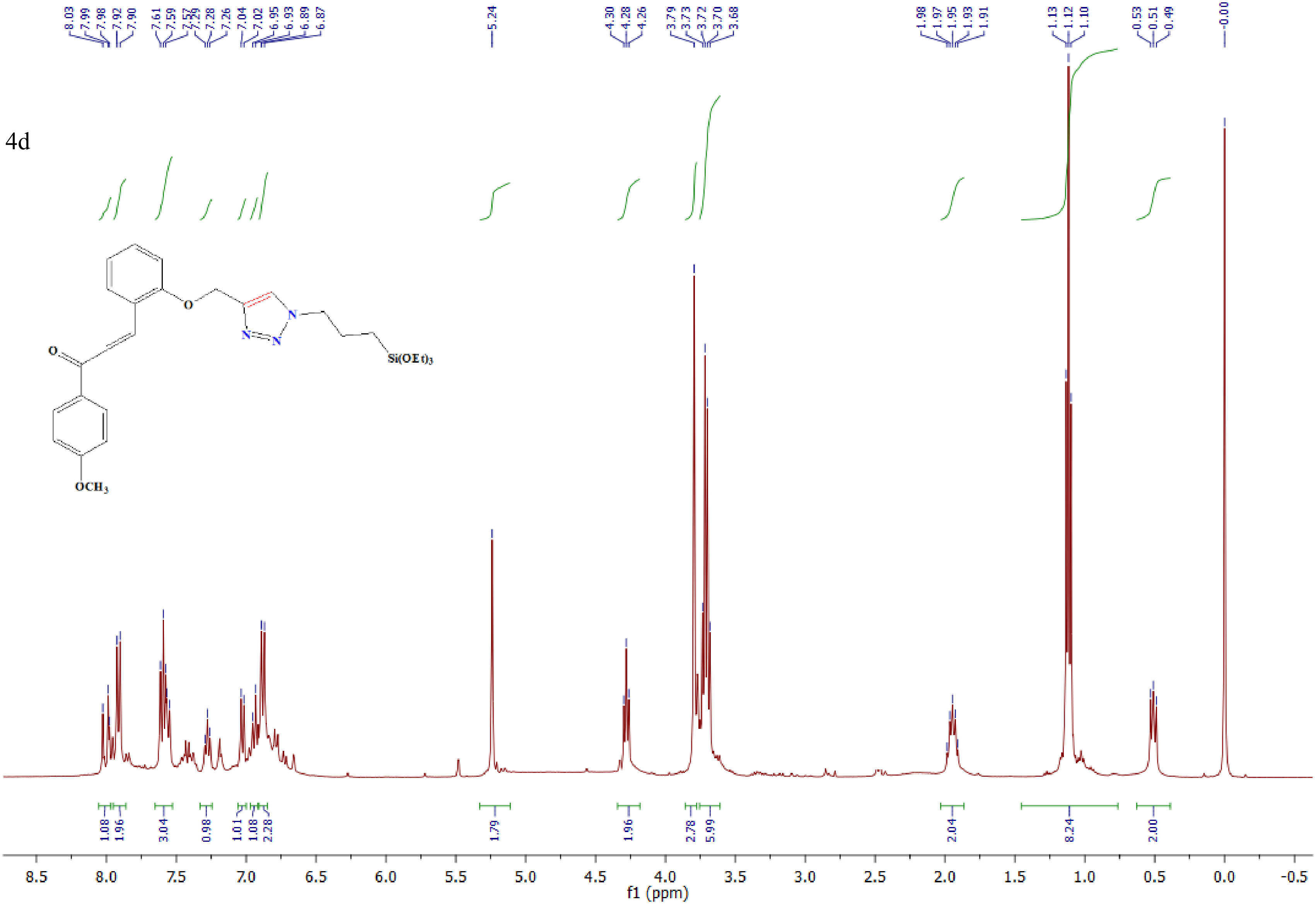
-0.8
250
300
350
400
Wavelength (nm)

4d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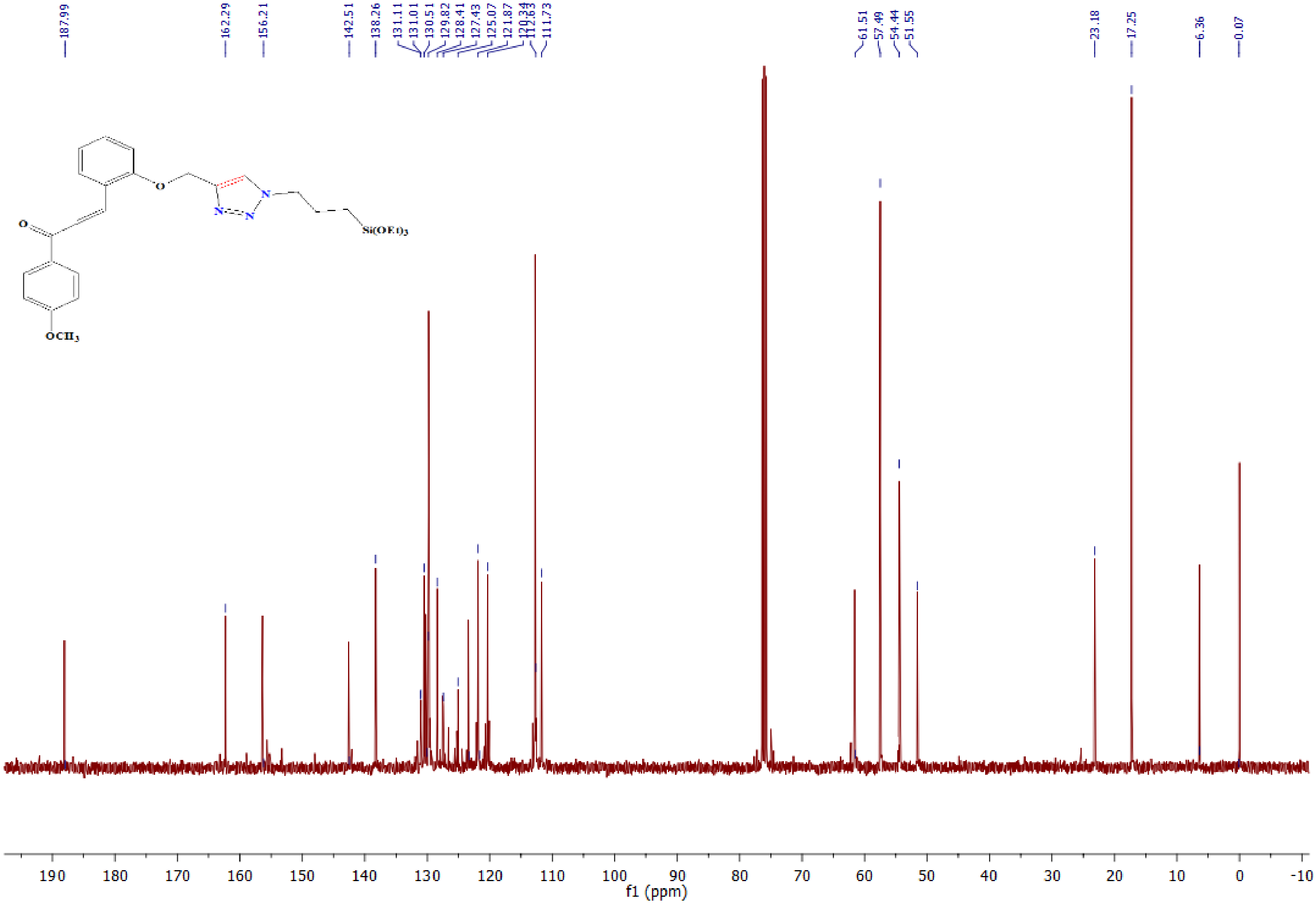
7.02
6.95
6.93
6.89
6.87
5.24
4.30
4.28
4.26
3.79
3.73
3.72
3.70
3.68
1.98
1.97
1.95
1.93
1.91
1.13
1.12
1.10
0.53
0.51
0.49
-0.00
O
O
N
N
N
Si(OEt)3
OCH3
1.08
1.96
3.04
0.98
1.01
1.08
2.28
1.79
1.96
2.78
5.99
2.04
8.24
2.00
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)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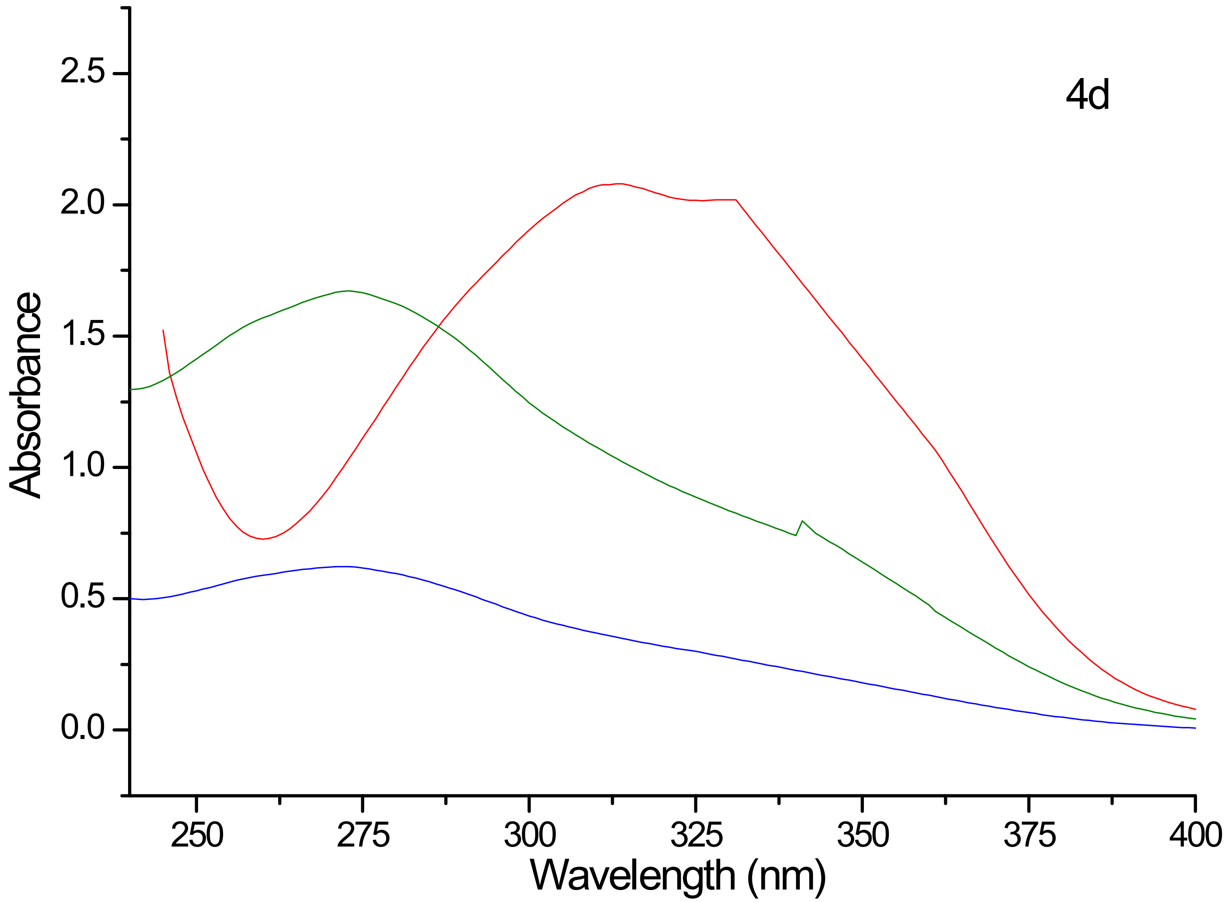
121.87
120.34
112.63
111.73
61.51
57.49
54.44
51.55
23.18
17.25
6.36
0.07
O
O
N
N
N
Si(OEt)3
OCH3
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


4d
Absorbance
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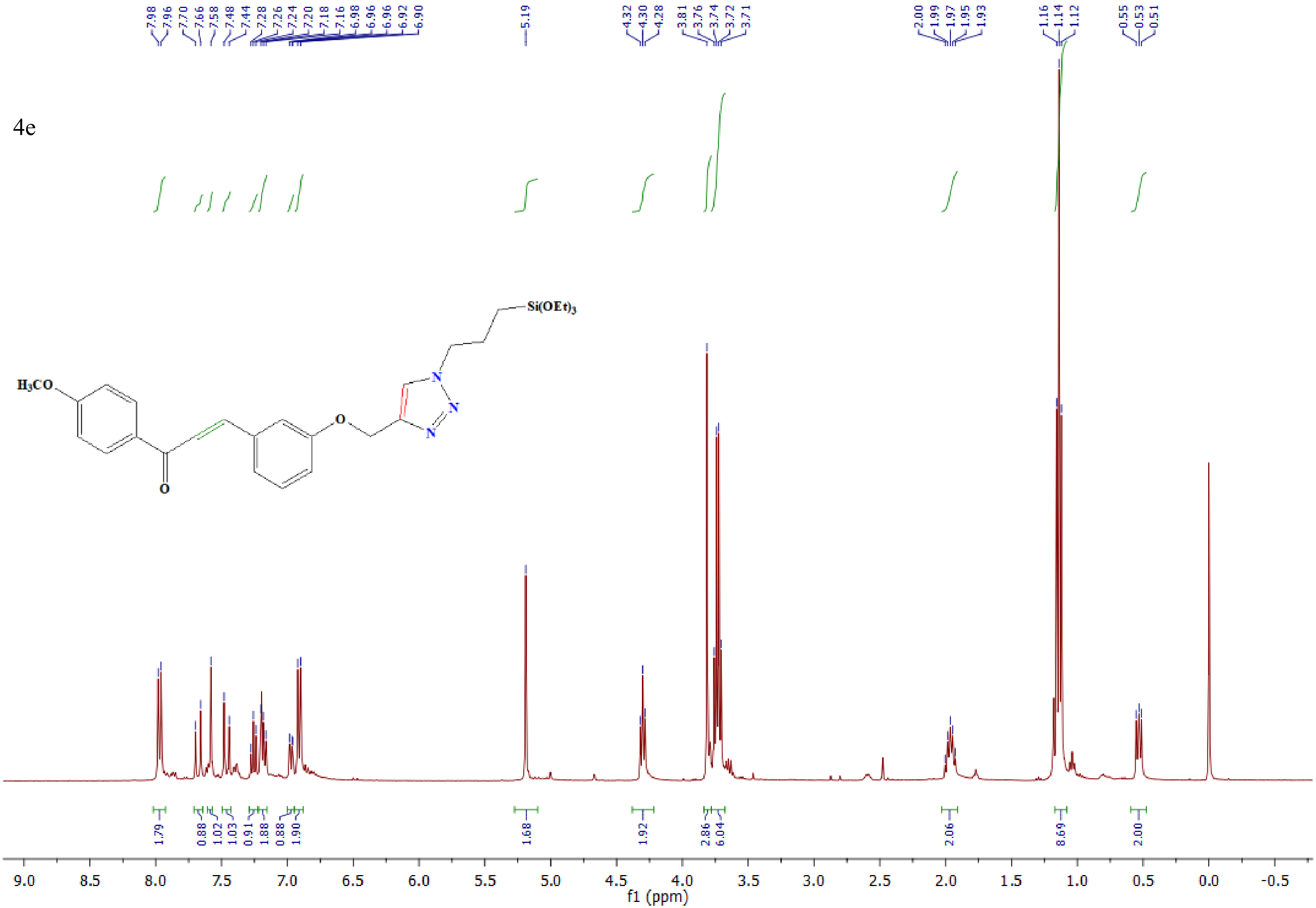
2.0
1.5
1.0
0.5
0.0
250
275
300
325
350
375
400
Wavelength (nm)

4e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7.28
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7.24
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7.16
6.98
6.96
6.96
6.92
6.90
5.19
4.32
4.30
4.28
3.81
3.76
3.74
3.72
3.71
2.00
1.99
1.97
1.95
1.93
1.16
1.14
1.12
0.55
0.53
0.51
H$_3$CO
O
O
N
N
N
Si(OEt)$_3$
1.79
0.88
1.02
1.03
0.91
1.88
0.88
1.90
1.68
1.92
2.86
6.04
2.06
8.69
2.00
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
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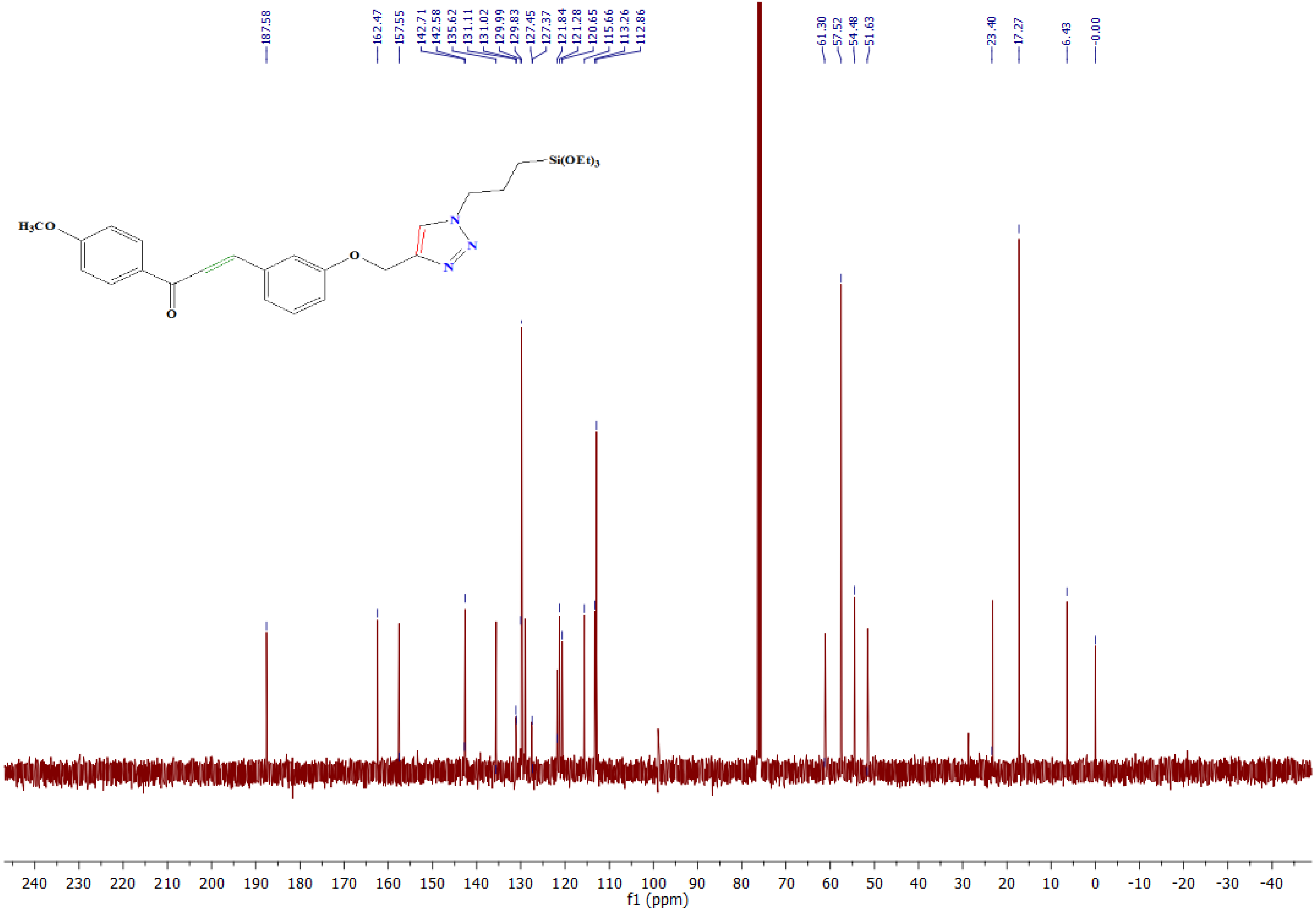
-0.5
f1 (ppm)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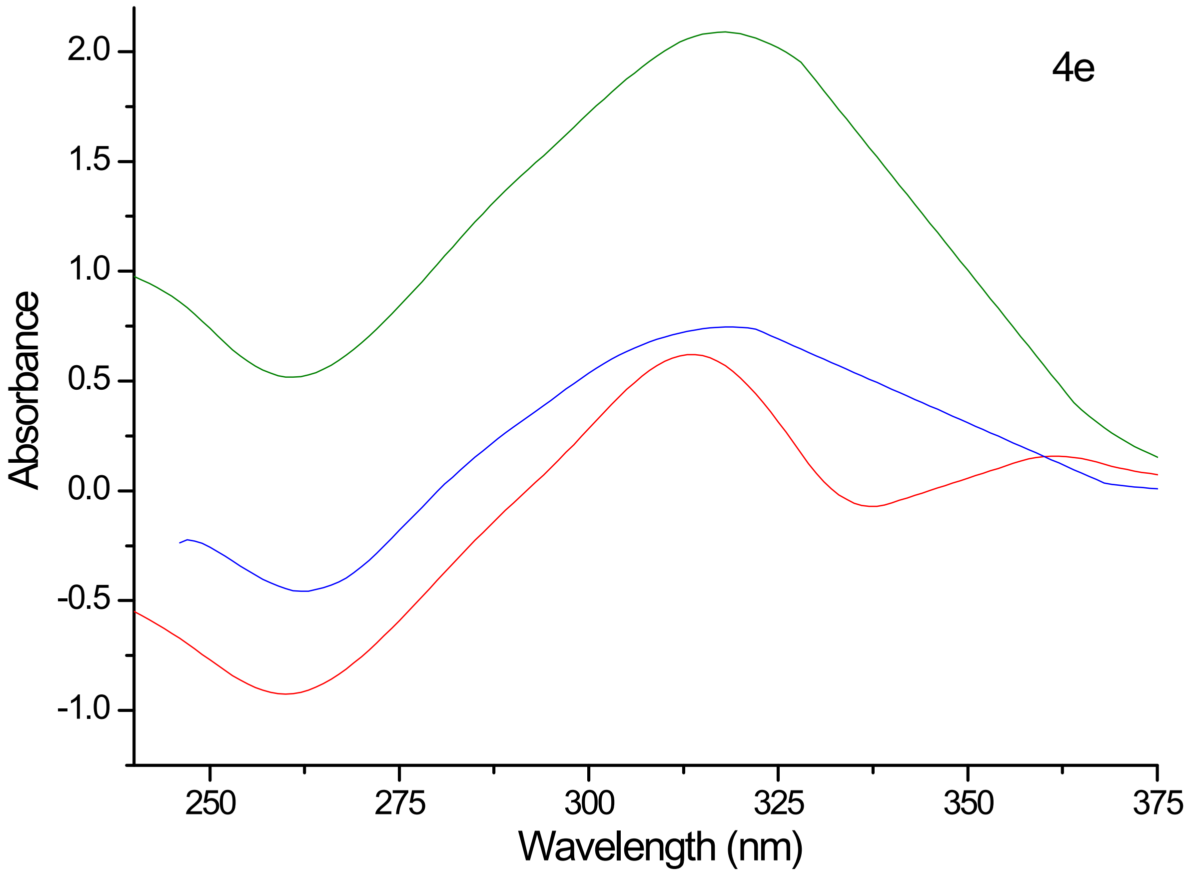
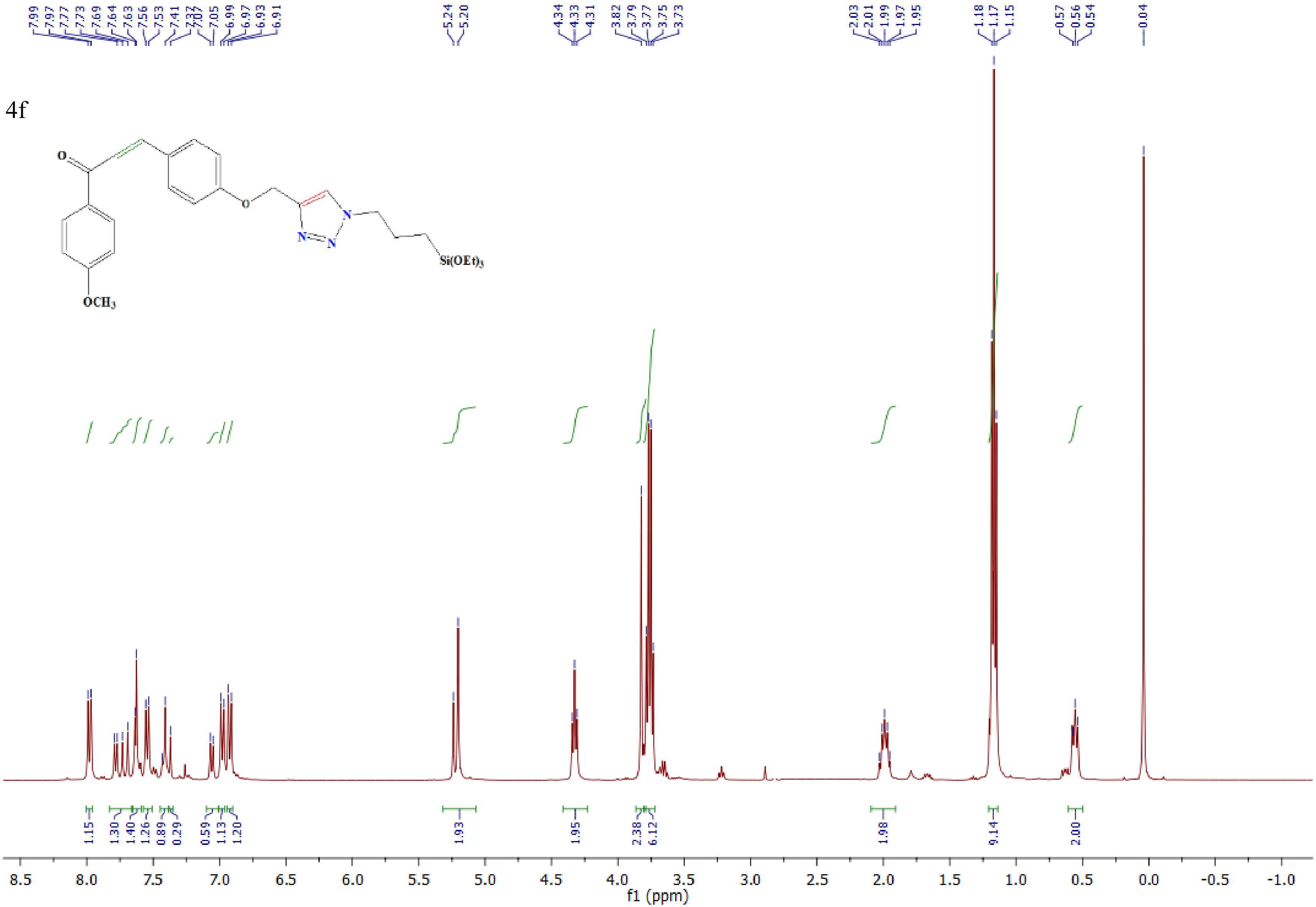
121.28
120.65
115.66
113.26
112.86
61.30
57.52
54.48
51.63
23.40
17.27
6.43
0.00
H3CO
O
O
N
N
N
Si(OEt)3
240 230 220 210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 -10 -20 -30 -40
f1 (ppm)


4e
Absorbance
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
250
275
300
325
350
375
Wavelength (nm)

4f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7.05
6.99
6.97
6.93
6.91
5.24
5.20
4.34
4.33
4.31
3.82
3.79
3.77
3.75
3.73
2.03
2.01
1.99
1.97
1.95
1.18
1.17
1.15
0.57
0.56
0.54
0.04
O
O
N
N
N
Si(OEt)3
OCH3
1.15
1.30
1.40
1.26
0.89
0.29
0.59
1.13
1.20
1.93
1.95
2.38
6.12
1.98
9.14
2.00
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
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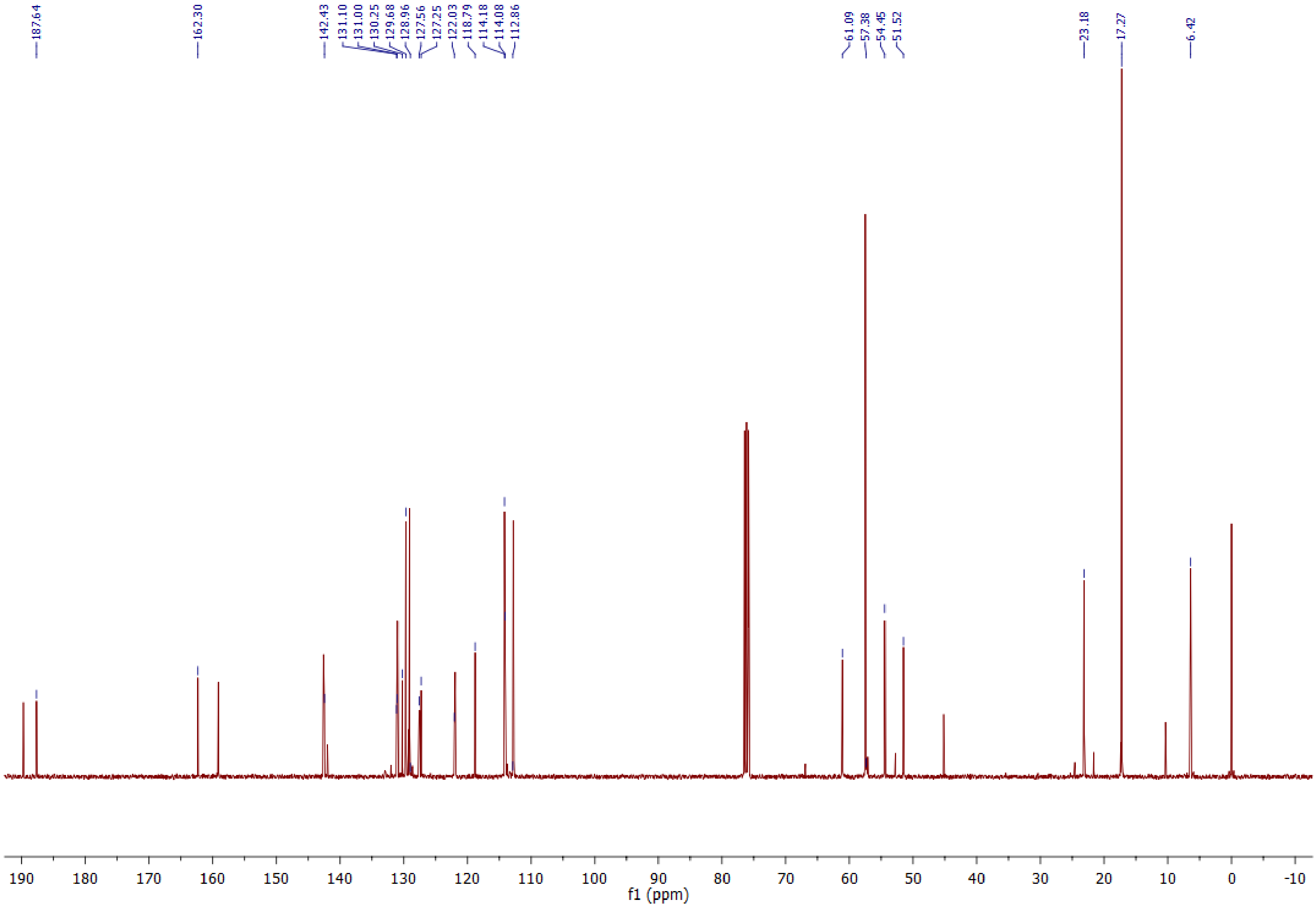
-0.5
-1.0
f1 (ppm)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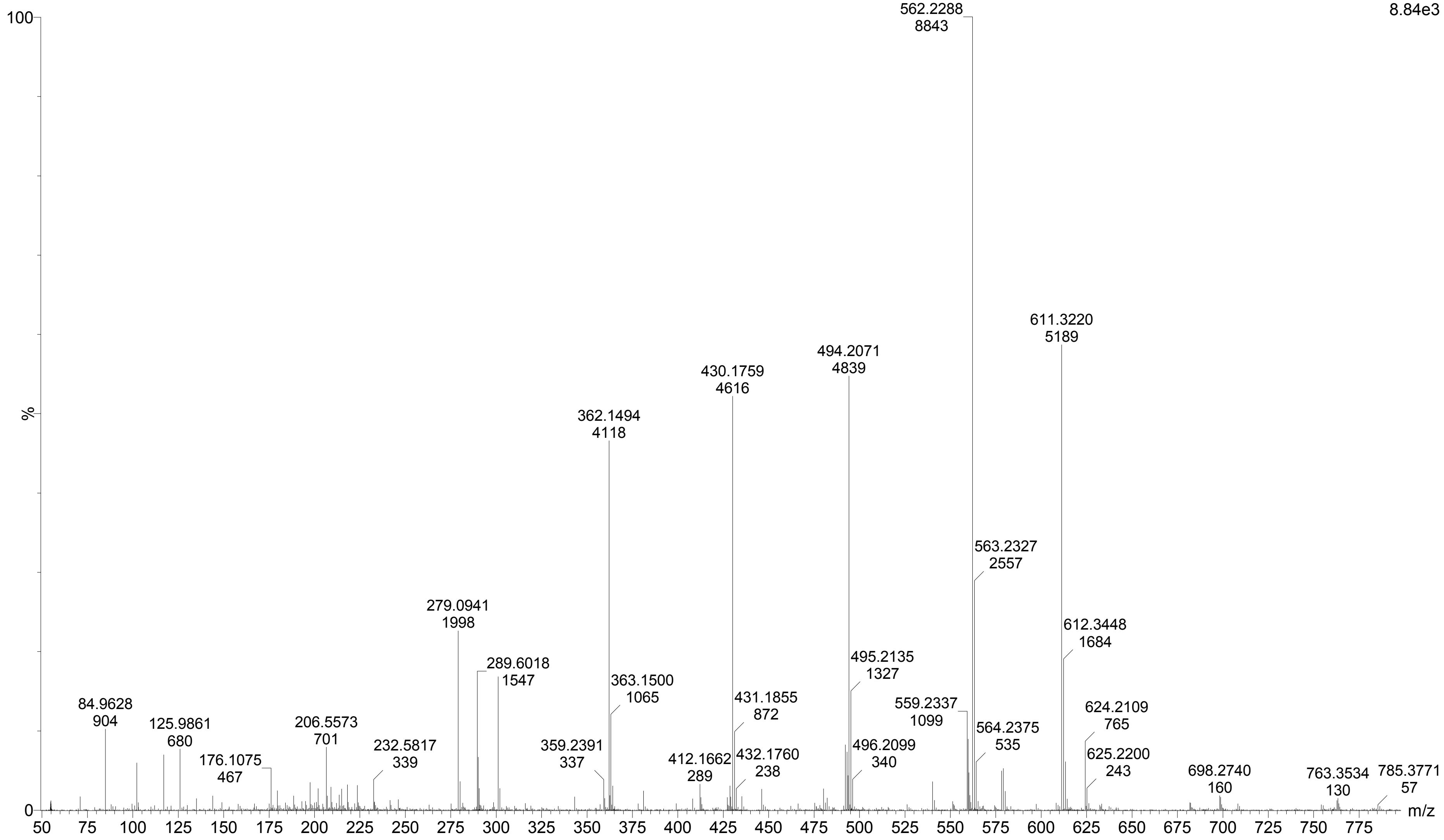
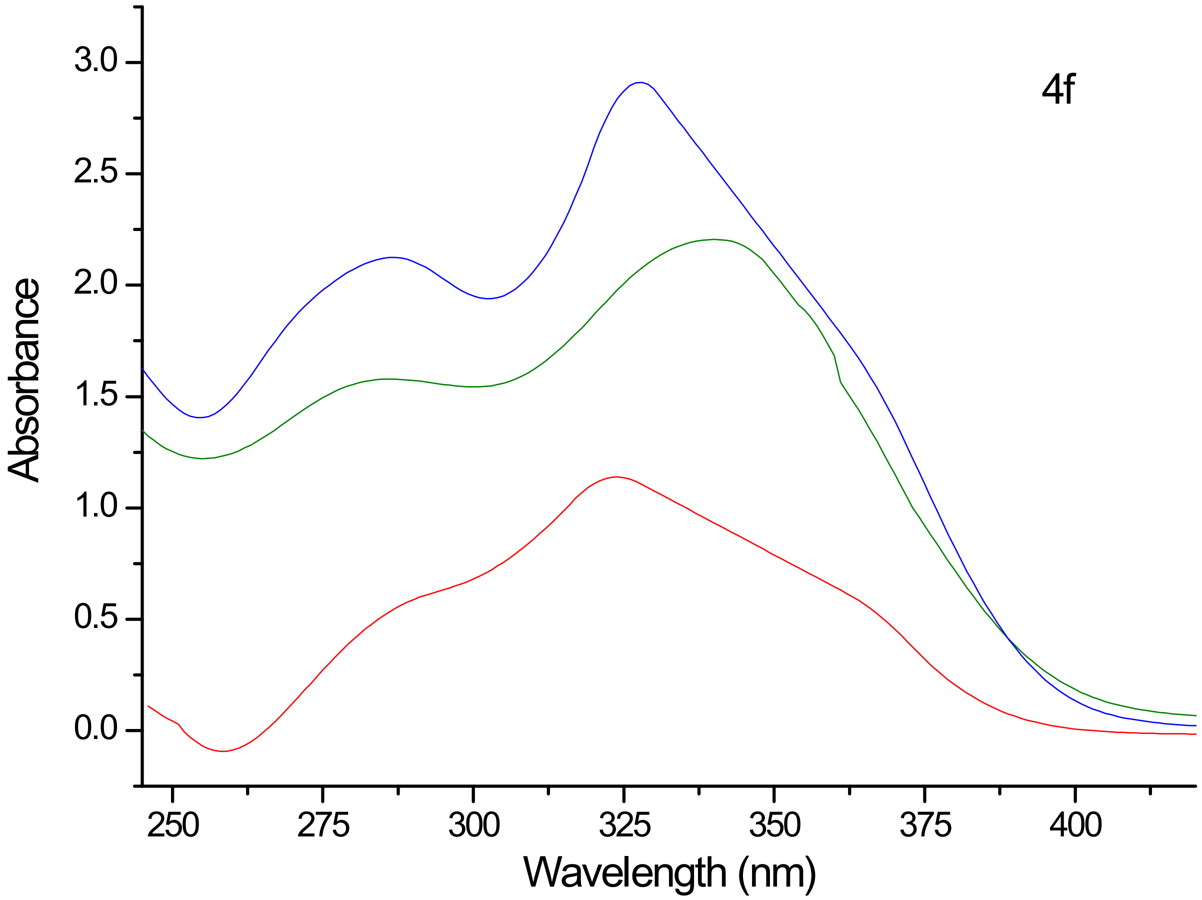
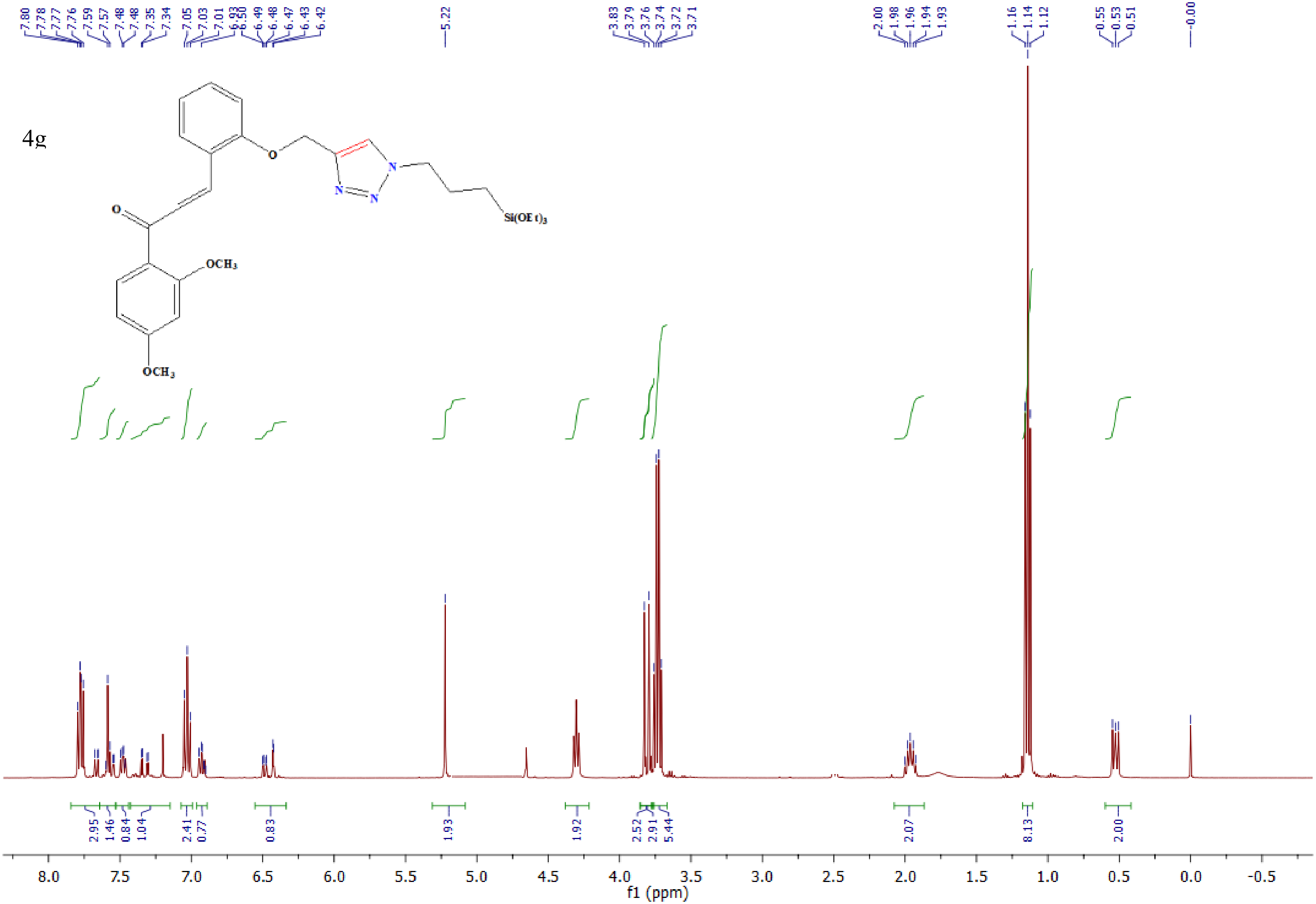
114.18
114.08
112.86
61.09
57.38
54.45
51.52
23.18
17.27
6.42
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)

WATERS, Q-TOF MICROMASS (LC-MS) **SAIF/CIL,PANJAB UNIVERSITY,CHANDIGARH**

JANDEEP 4f 21 (0.303) AM (Top,4, Ar,5000.0,556.28,0.70,LS 10); Sm (Mn, 2x3.00); Sb (1,40.00); Cm (21:24) 1: TOF MS ES+




4f
Absorbance
3.0
2.5
2.0
1.5
1.0
0.5
0.0
250
275
300
325
350
375
400
Wavelength (nm)


4g
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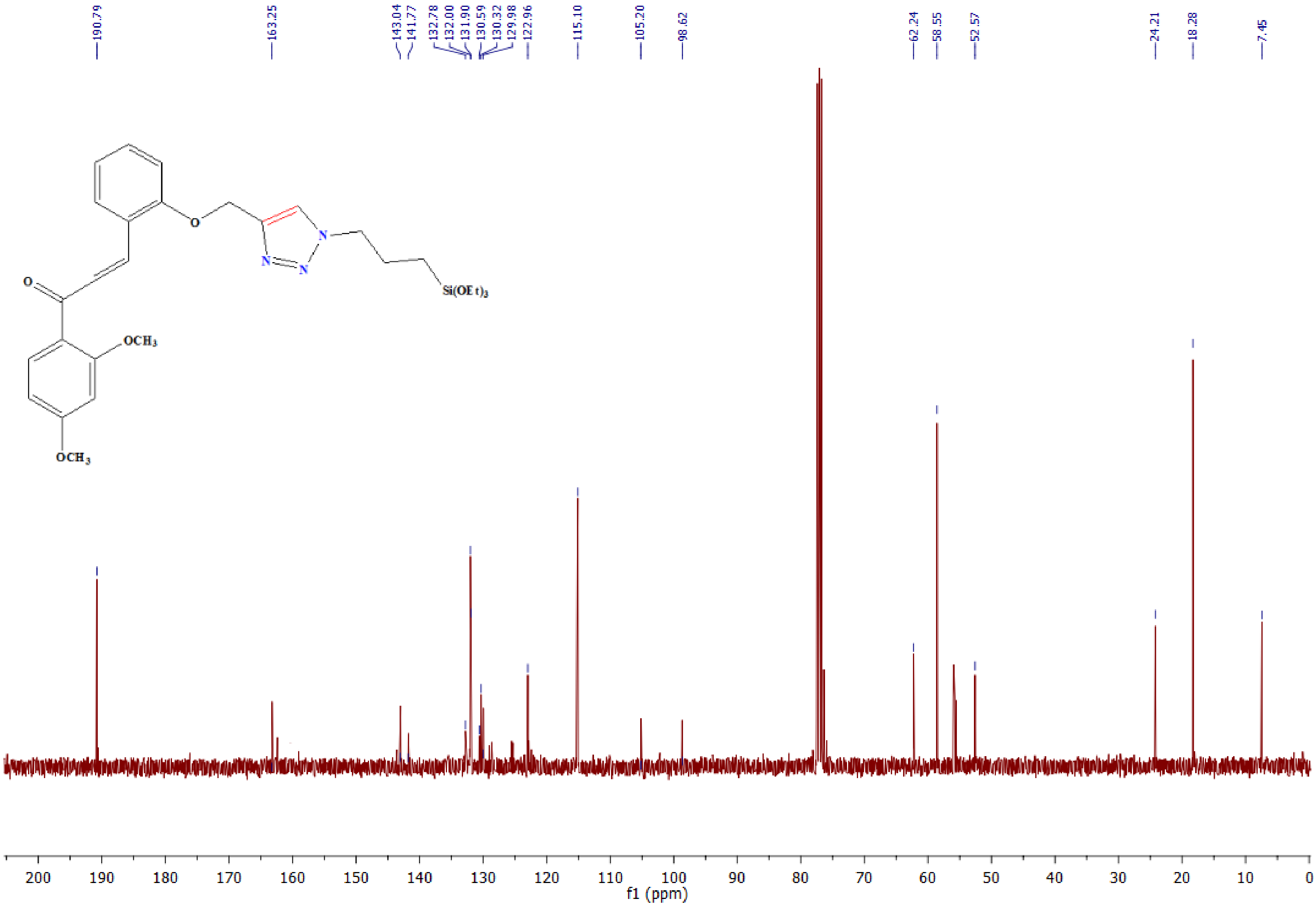
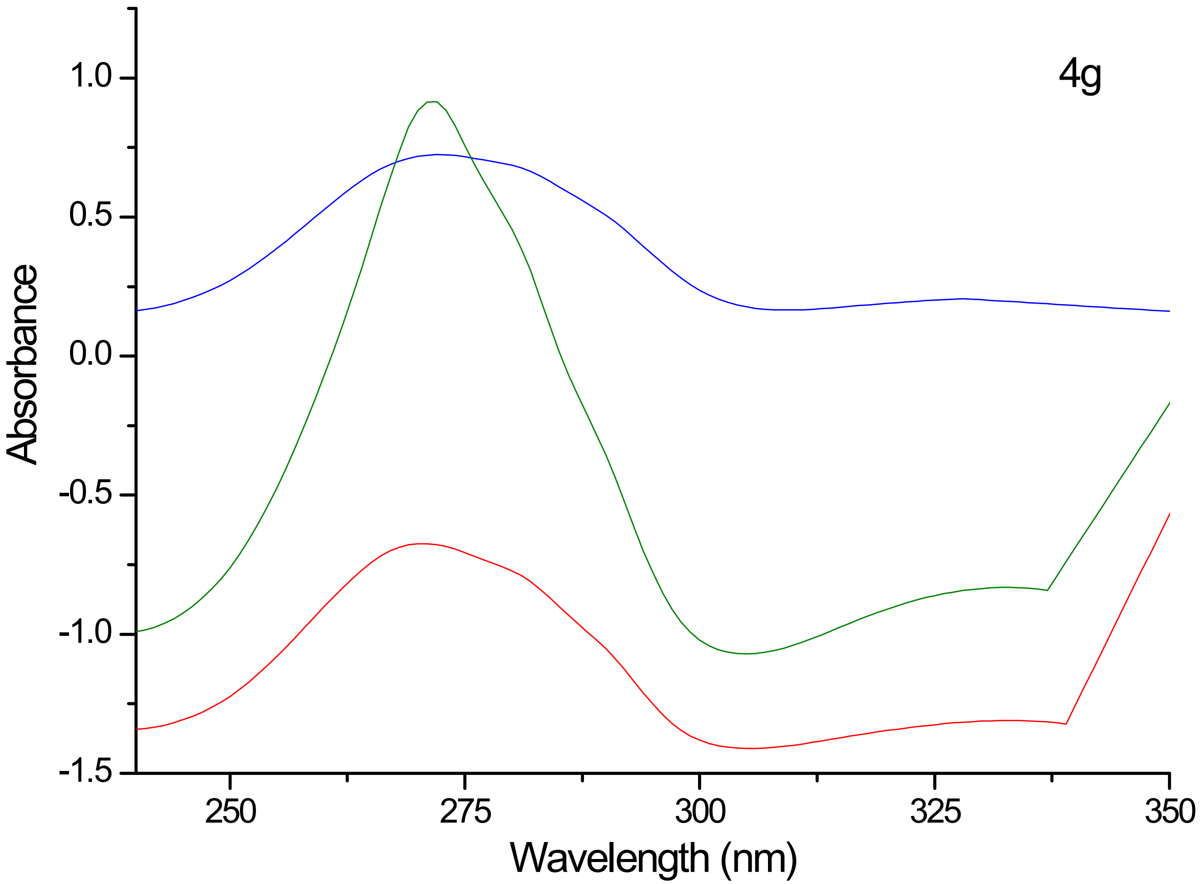
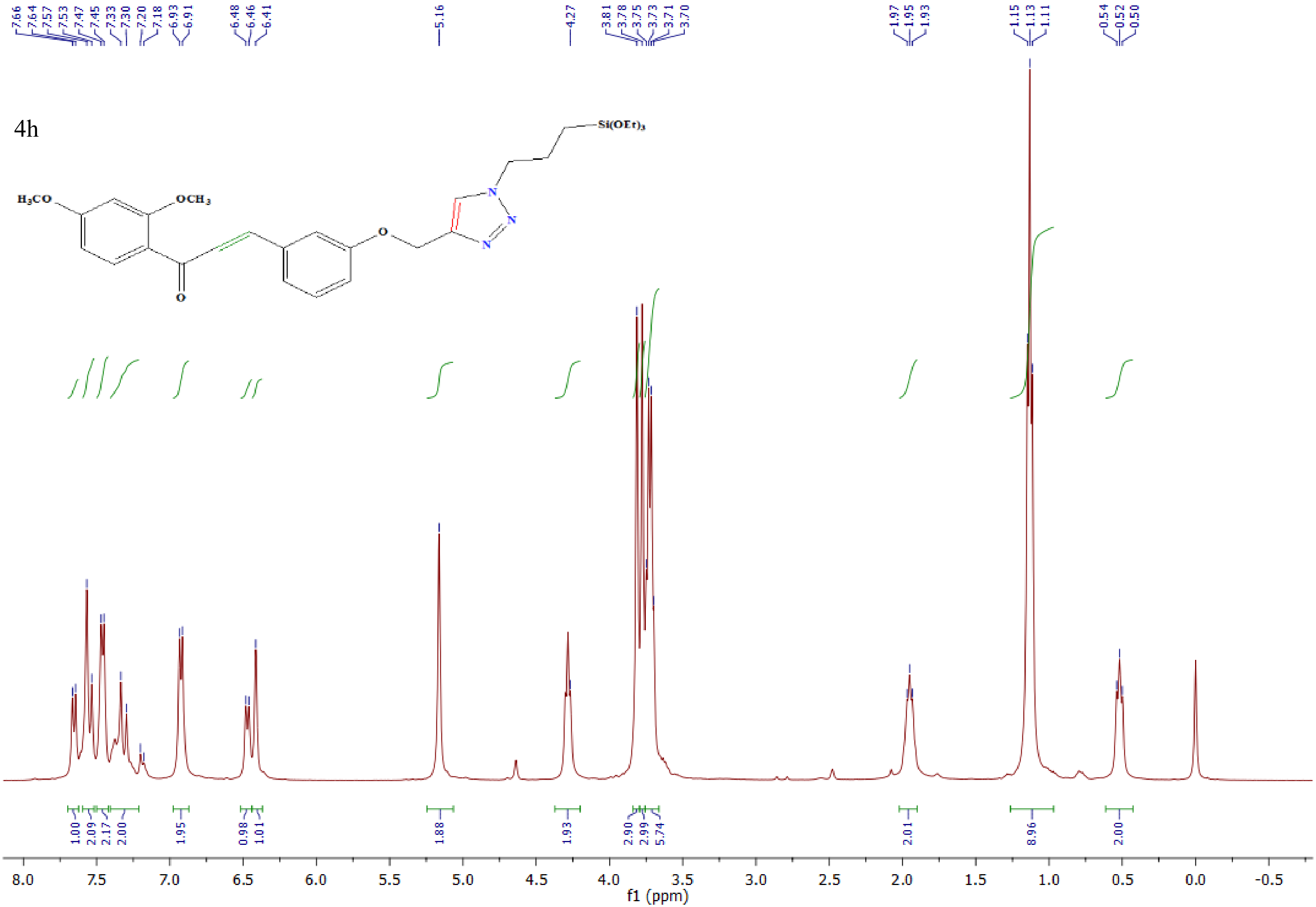
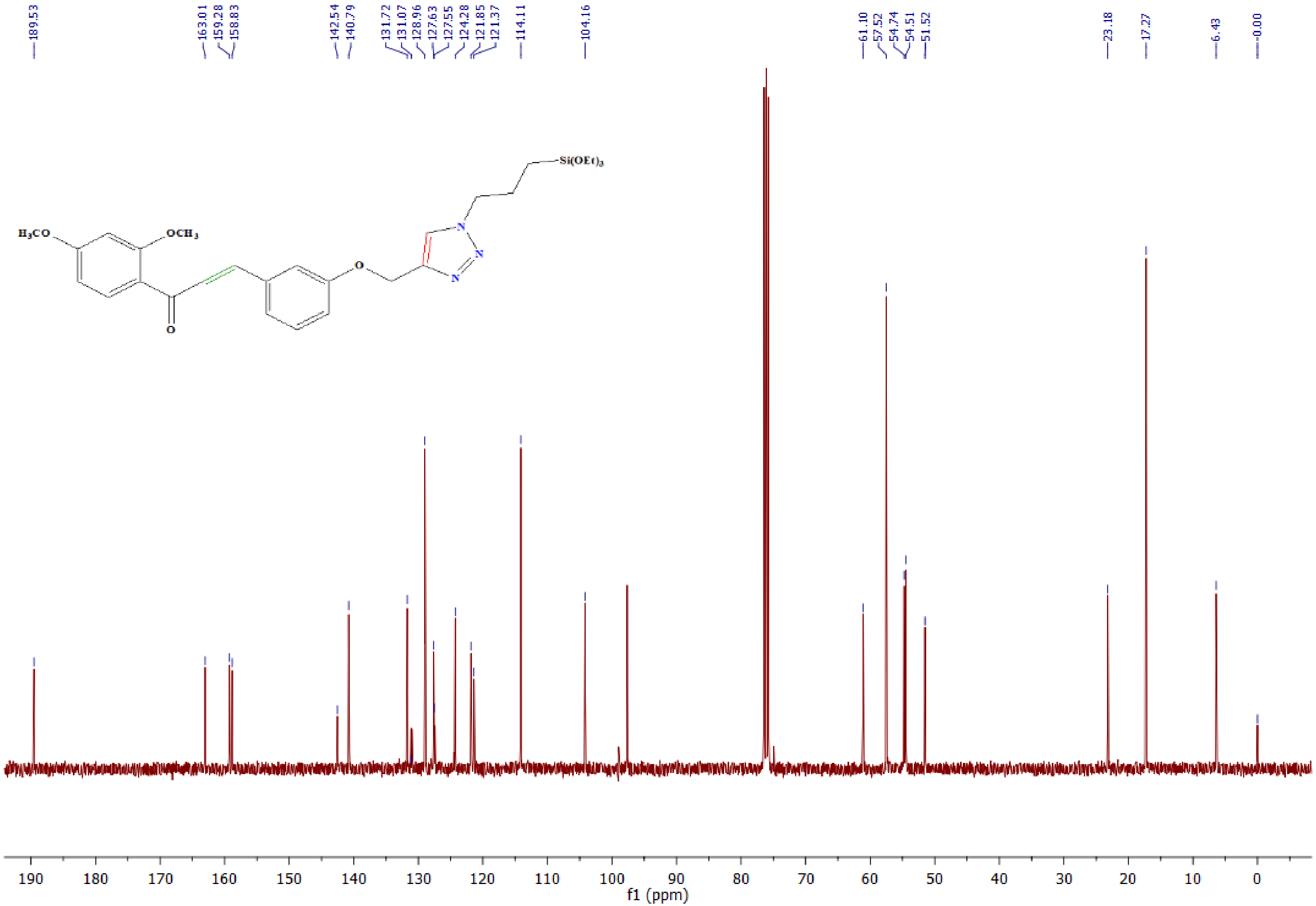
7.01
6.93
6.50
6.49
6.48
6.47
6.43
6.42
5.22
3.83
3.79
3.76
3.74
3.72
3.71
2.00
1.98
1.96
1.94
1.93
1.16
1.14
1.12
0.55
0.53
0.51
0.00
O
O
N
N
N
OCH3
OCH3
Si(OEt)3
2.95
1.46
0.84
1.04
2.41
0.77
0.83
1.93
1.92
2.52
2.91
5.44
2.07
8.13
2.00
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

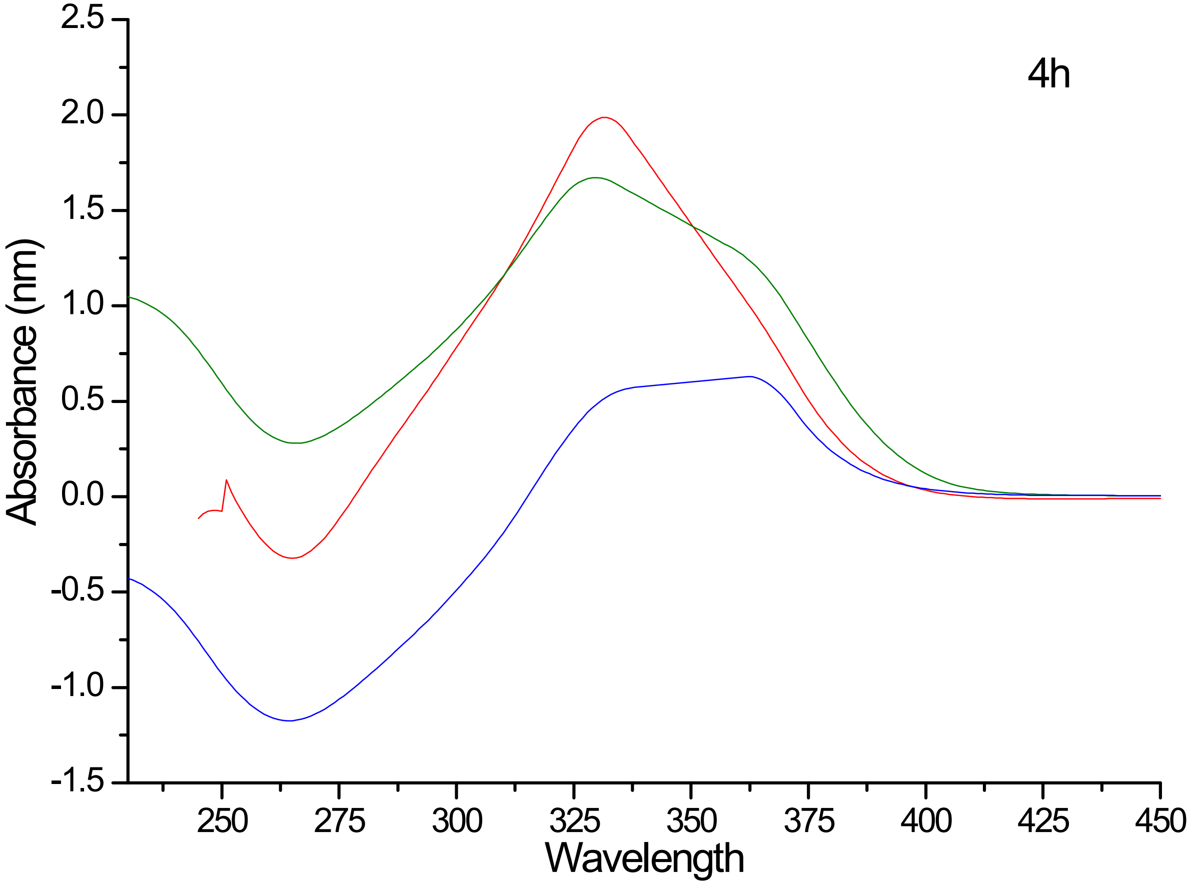

190.79
163.25
143.04
141.77
132.78
132.00
131.90
130.59
130.32
129.98
122.96
115.10
105.20
98.62
62.24
58.55
52.57
24.21
18.28
7.45
O
O
OCH3
OCH3
N
N
N
Si(OEt)3
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


4g
Absorbance
1.0
0.5
0.0
-0.5
-1.0
-1.5
250
275
300
325
350
Wavelength (nm)

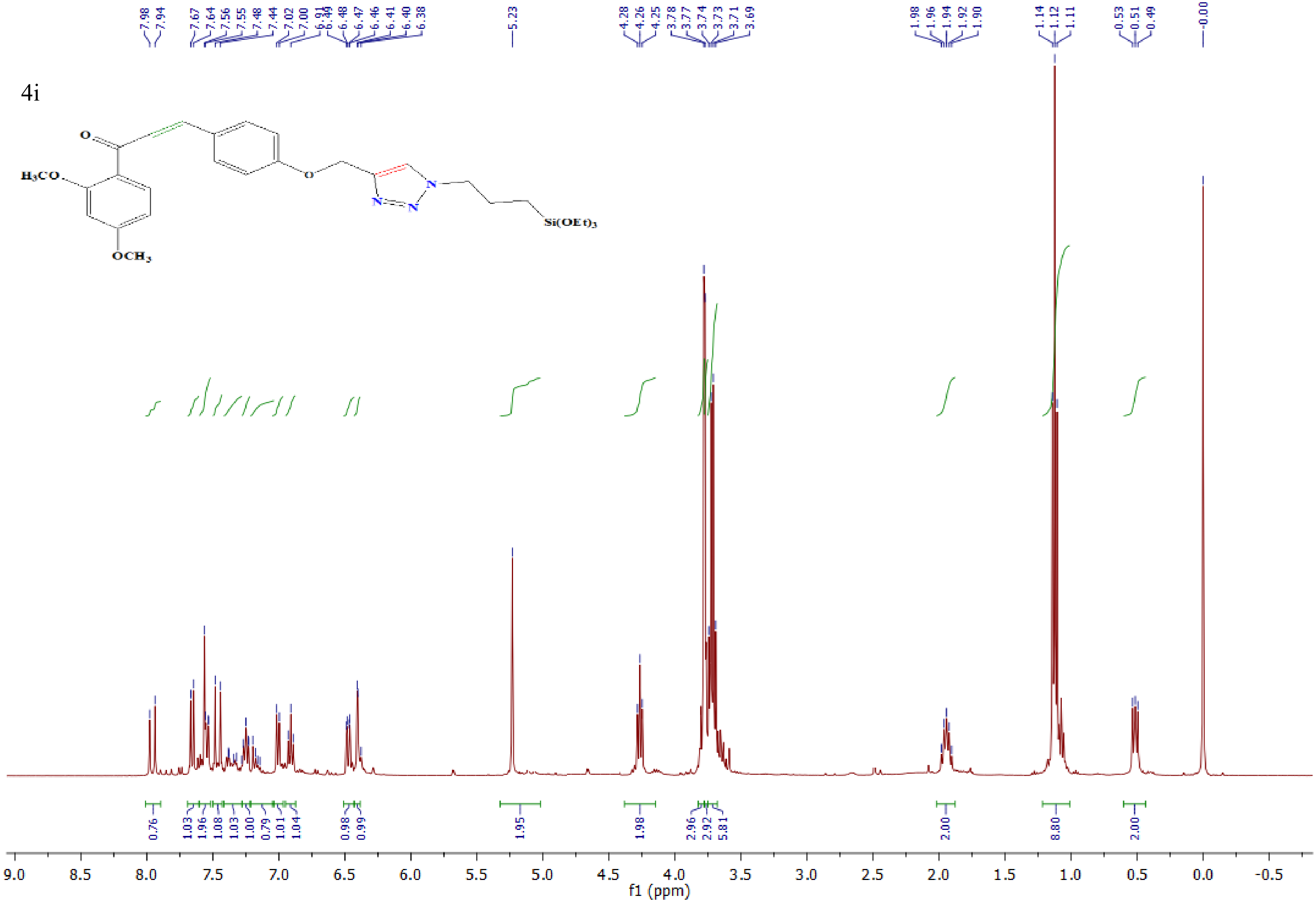
4h


7.66
7.64
7.57
7.53
7.47
7.45
7.33
7.30
7.20
7.18
6.93
6.91
6.48
6.46
6.41
5.16
4.27
3.81
3.78
3.75
3.73
3.71
3.70
1.97
1.95
1.93
1.15
1.13
1.11
0.54
0.52
0.50
H₃CO
OCH₃
O
O
N
N
N
Si(OEt)₃
1.00
2.09
2.17
2.00
1.95
0.98
1.01
1.88
1.93
2.90
2.99
5.74
2.01
8.96
2.00
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

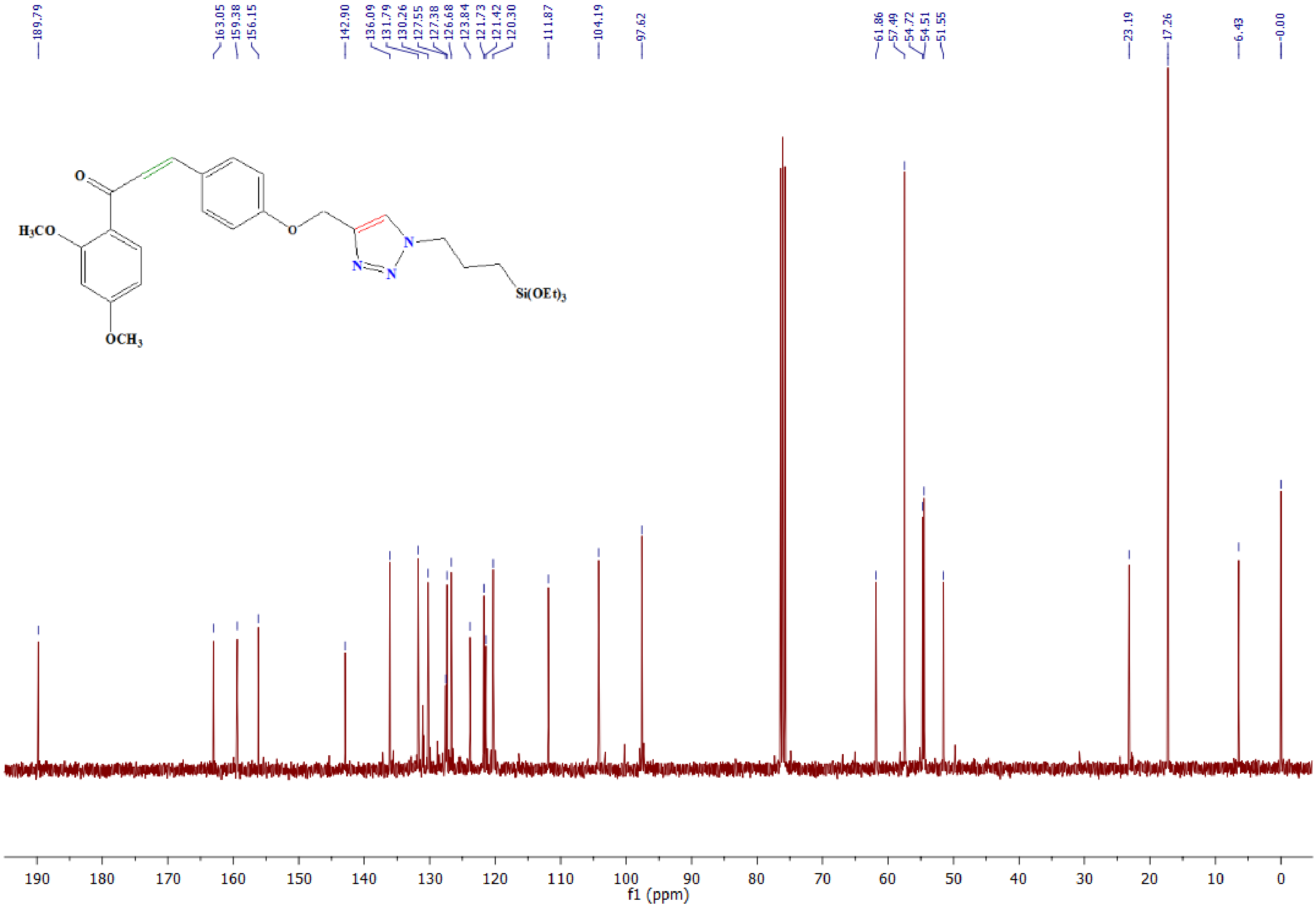

189.53
163.01
159.28
158.83
142.54
140.79
131.72
131.07
128.96
127.63
127.55
124.28
121.85
121.37
114.11
104.16
61.10
57.52
54.74
54.51
51.52
23.18
17.27
6.43
0.00
H$_3$CO
OCH$_3$
O
O
N
N
N
Si(OEt)$_3$
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

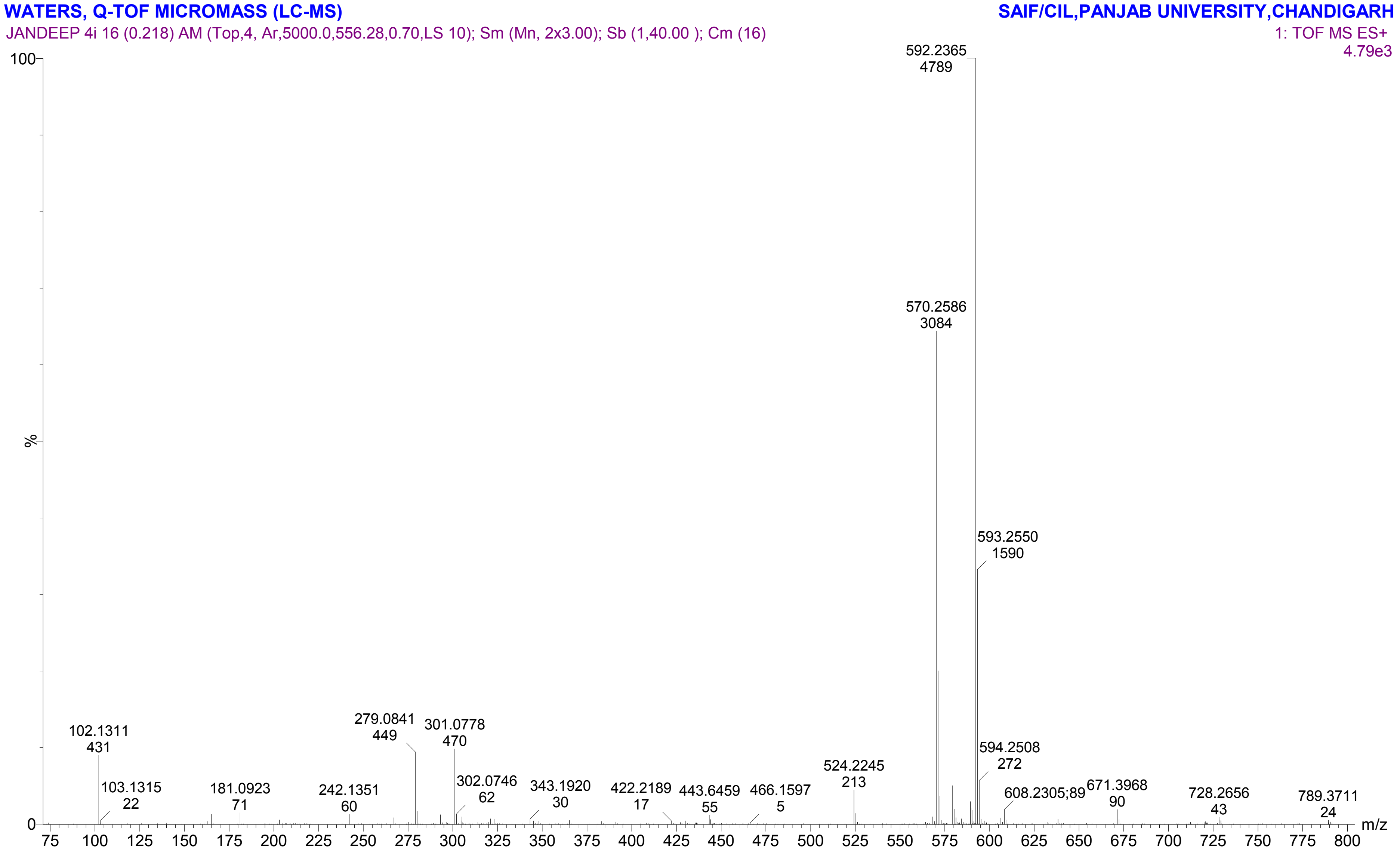

4h
Absorbance (nm)
Wavelength
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
250
275
300
325
350
375
400
425
450

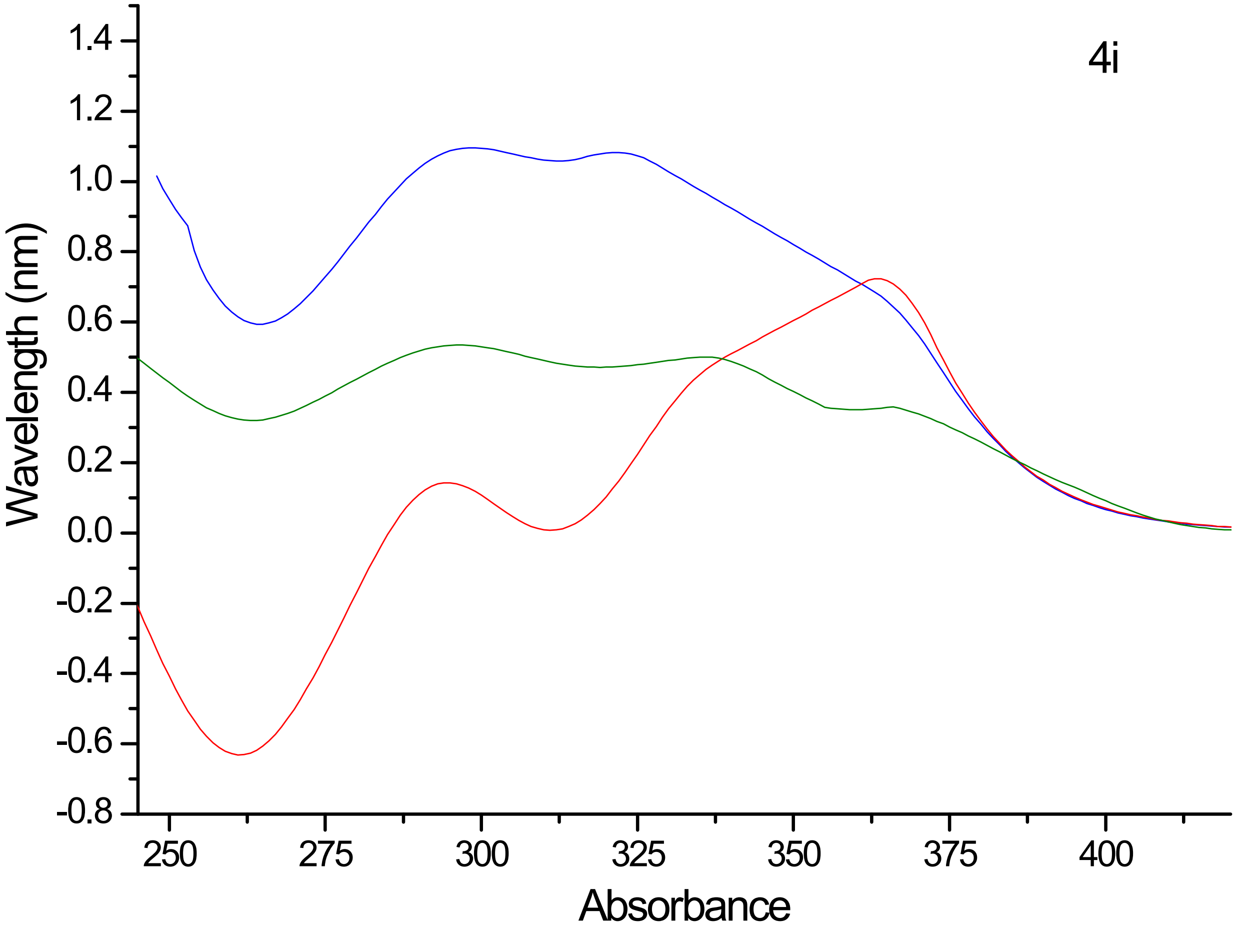
4i



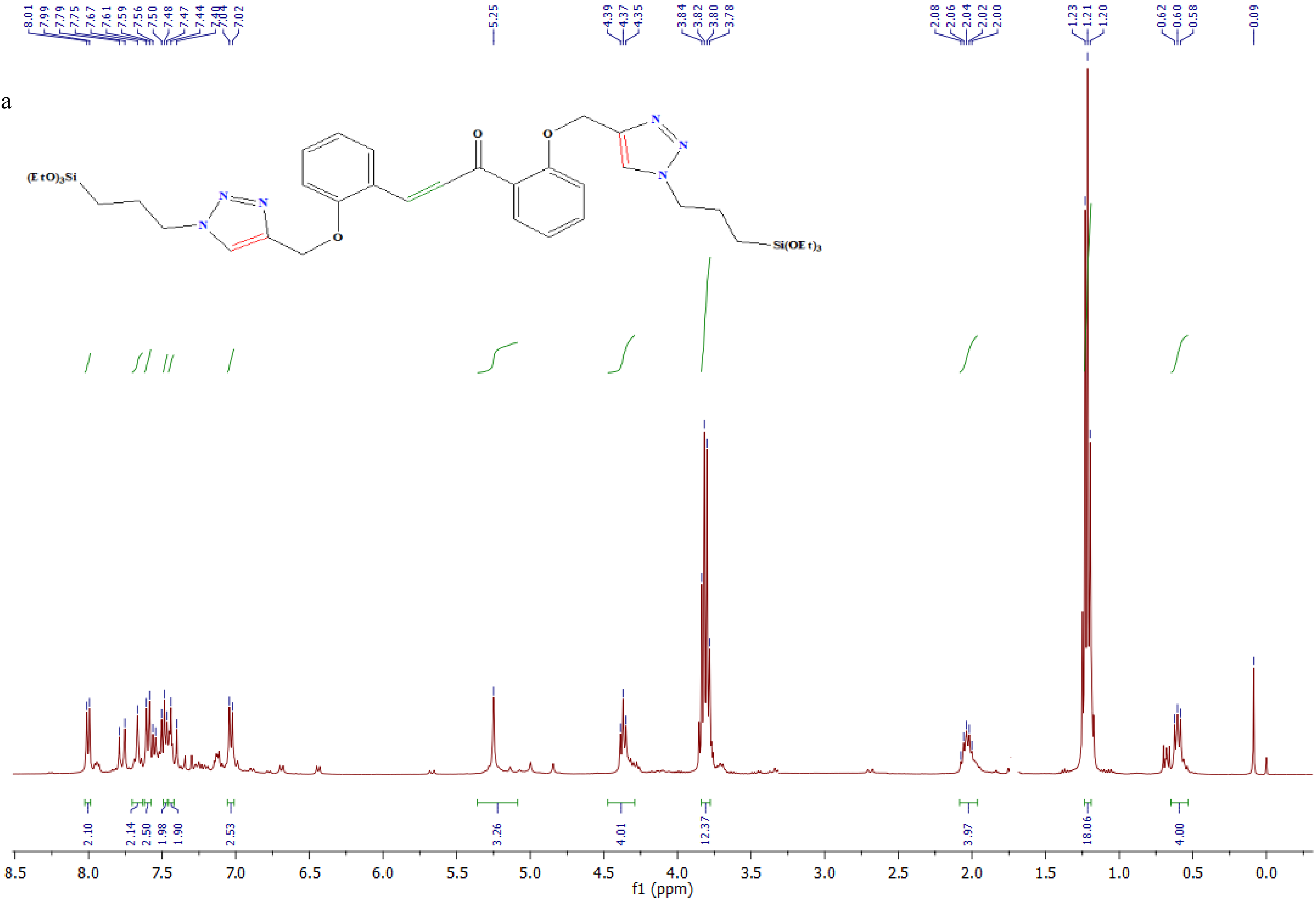
O
H₃CO
OCH₃
O
N
N
N
Si(OEt)₃
7.98
7.94
7.67
7.64
7.56
7.55
7.48
7.44
7.02
7.00
6.91
6.89
6.48
6.47
6.46
6.41
6.40
6.38
5.23
4.28
4.26
4.25
3.78
3.77
3.74
3.73
3.71
3.69
1.98
1.96
1.94
1.92
1.90
1.14
1.12
1.11
0.53
0.51
0.49
0.00
0.76
1.03
1.96
1.08
1.03
1.00
0.79
1.01
1.04
0.98
0.99
1.95
1.98
2.96
2.92
5.81
2.00
8.80
2.00
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

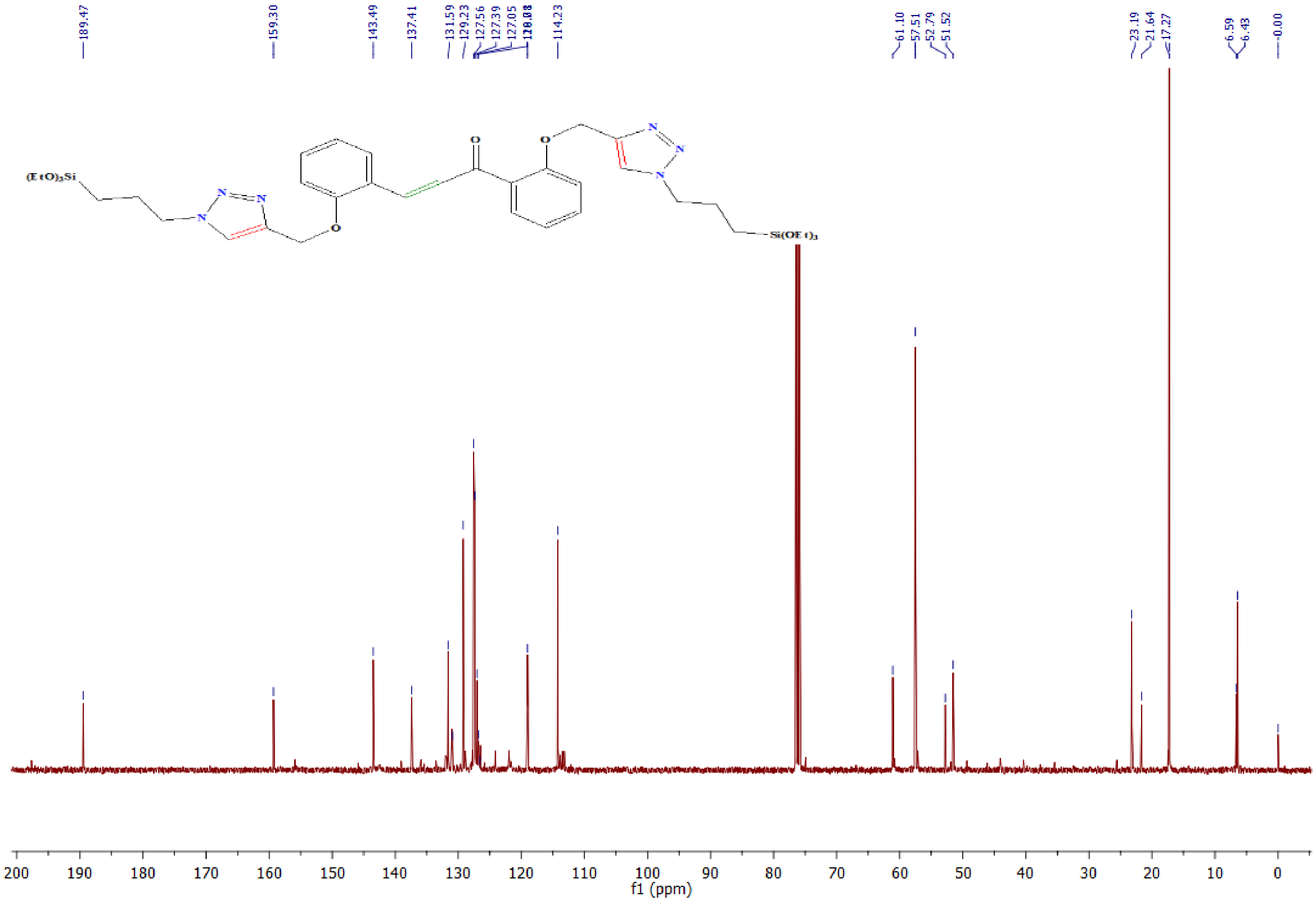

189.79
163.05
159.38
156.15
142.90
136.09
131.79
130.26
127.55
127.38
126.68
123.84
121.73
121.42
120.30
111.87
104.19
97.62
61.86
57.49
54.72
54.51
51.55
23.19
17.26
6.43
0.00
O
H3CO
OCH3
O
N
N
N
Si(OEt)3
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

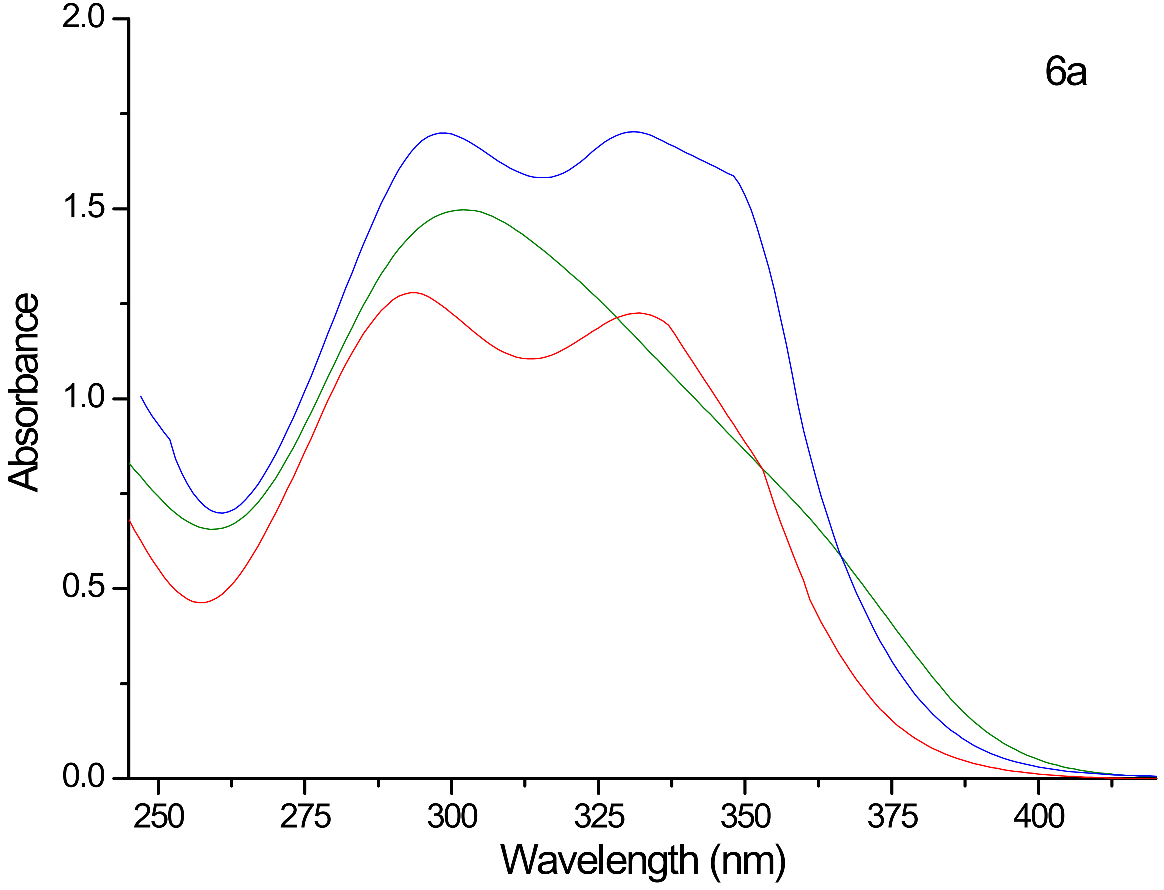

WATERS, Q-TOF MICROMASS (LC-MS)
SAIF/CIL,PANJAB UNIVERSITY,CHANDIGARH
JANDEEP 4i 16 (0.218) AM (Top,4, Ar,5000.0,556.28,0.70,LS 10); Sm (Mn, 2x3.00); Sb (1,40.00); Cm (16)
1: TOF MS ES+
4.79e3
100
%
0
592.2365
4789
570.2586
3084
593.2550
1590
594.2508
272
524.2245
213
102.1311
431
103.1315
22
181.0923
71
242.1351
60
279.0841
449
301.0778
470
302.0746
62
343.1920
30
422.2189
17
443.6459
55
466.1597
5
608.2305;89
671.3968
90
728.2656
43
789.3711
24
75
100
125
150
175
200
225
250
275
300
325
350
375
400
425
450
475
500
525
550
575
600
625
650
675
700
725
750
775
800
m/z


4i
Wavelength (nm)
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
-0.2
-0.4
-0.6
-0.8
250
275
300
325
350
375
400
Absorbance

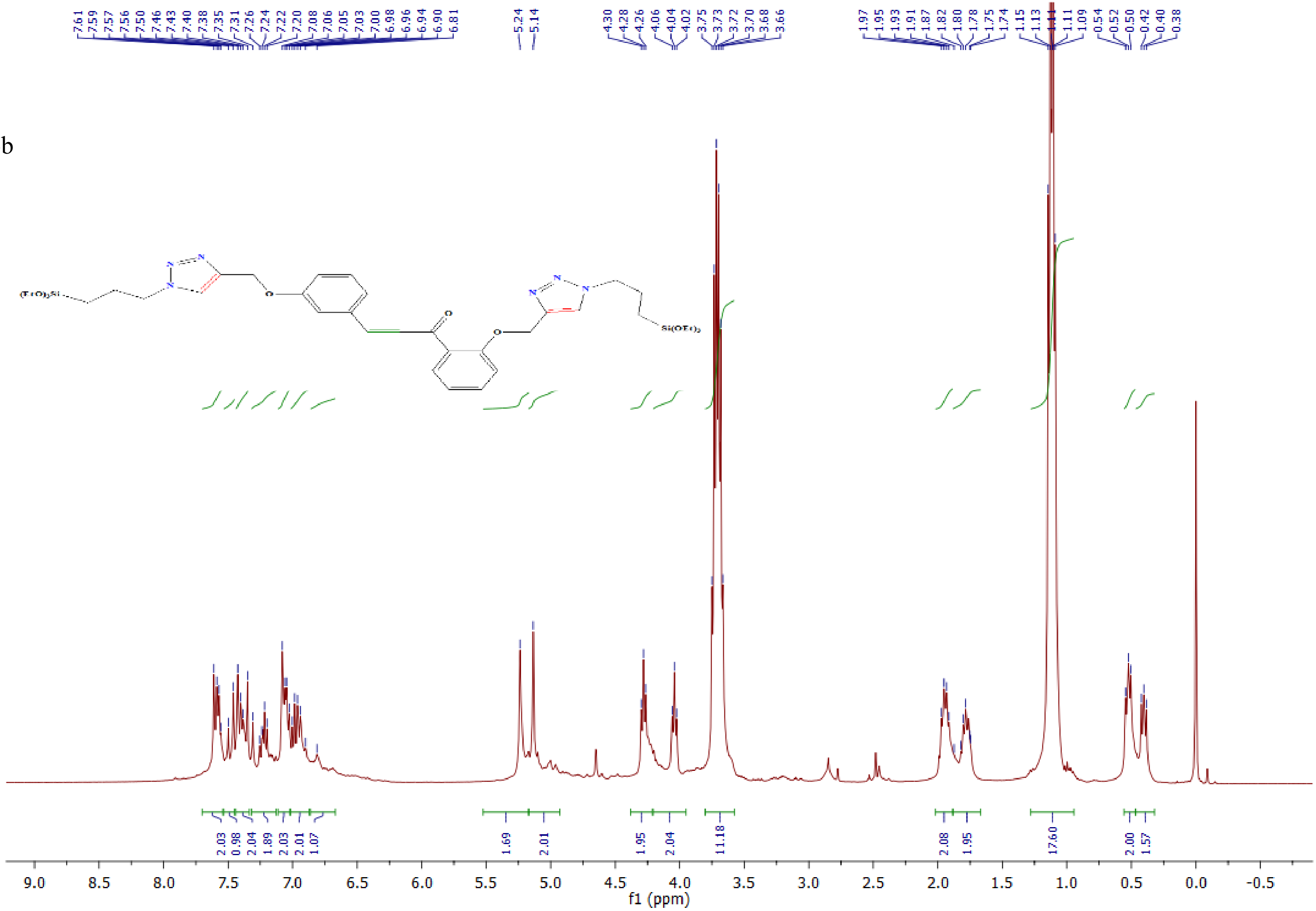
6a

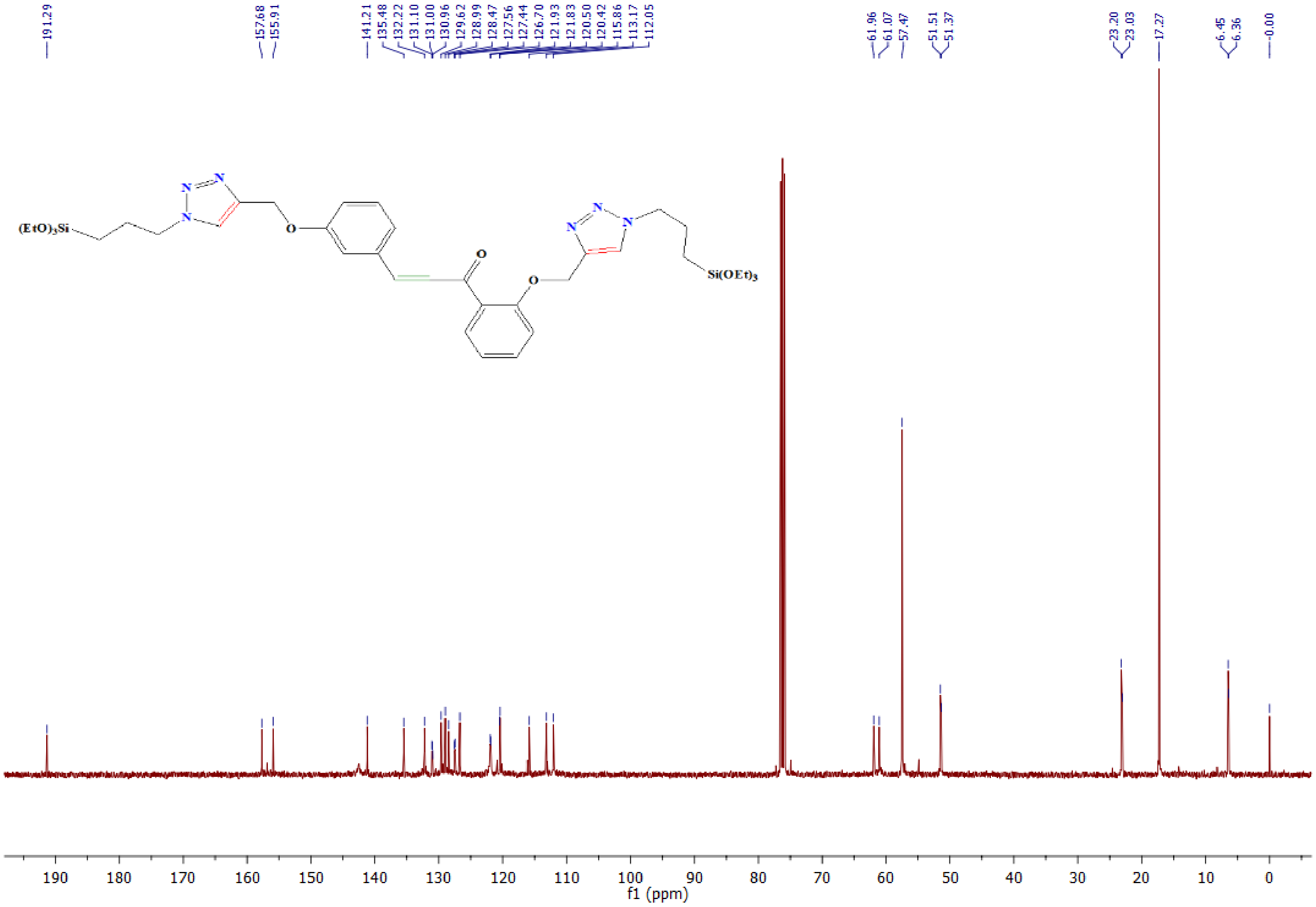

8.01
7.99
7.79
7.75
7.67
7.61
7.59
7.56
7.50
7.48
7.47
7.44
7.40
7.04
7.02
5.25
4.39
4.37
4.35
3.84
3.82
3.80
3.78
2.08
2.06
2.04
2.02
2.00
1.23
1.21
1.20
0.62
0.60
0.58
0.09
(EtO)$_3$Si
N
N
N
O
O
O
N
N
N
Si(OEt)$_3$
2.10
2.14
2.50
1.98
1.90
2.53
3.26
4.01
12.37
3.97
18.06
4.00
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
f1 (ppm)

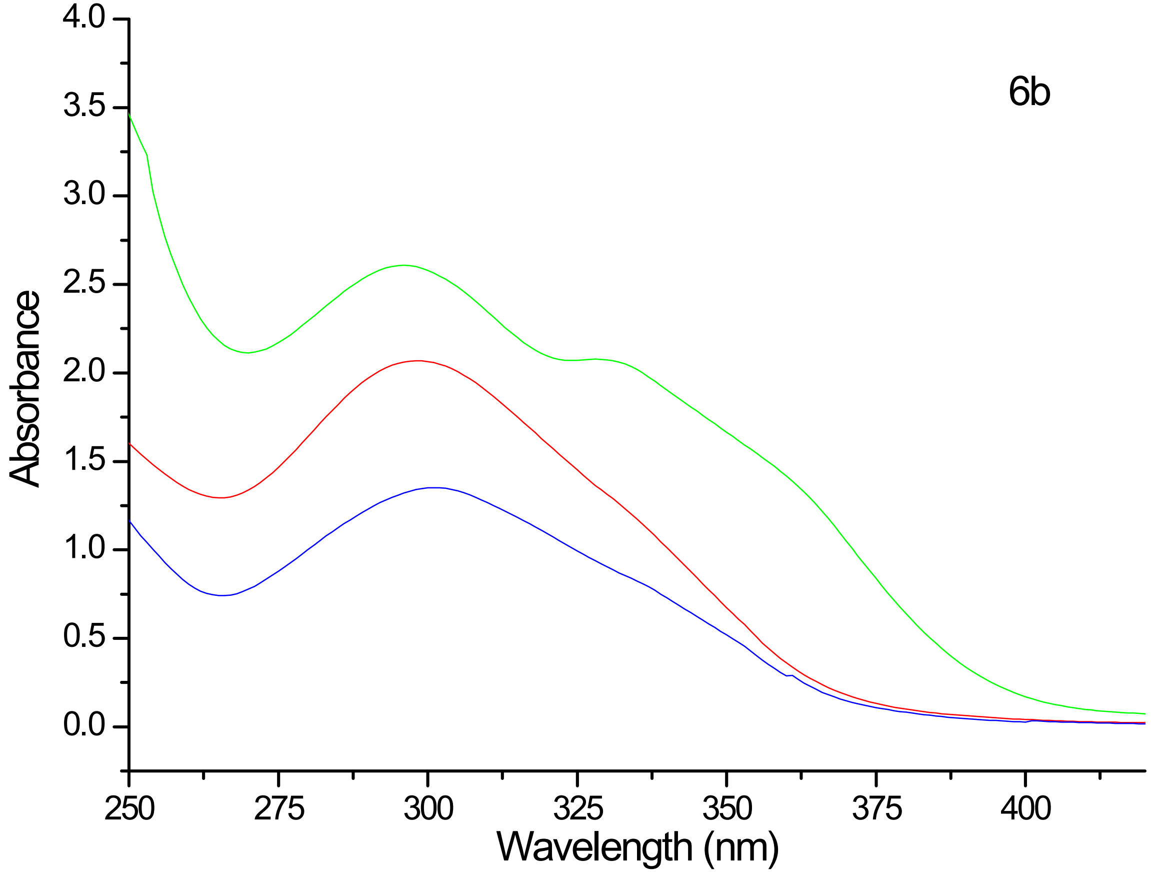

189.47
159.30
143.49
137.41
131.59
129.23
127.56
127.39
127.05
119.08
114.23
61.10
57.51
52.79
51.52
23.19
21.64
17.27
6.59
6.43
0.00
(EtO)3Si
N
N
N
O
O
O
N
N
N
Si(OEt)3
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


2.0
1.5
1.0
0.5
0.0
Absorbance
6a
250
275
300
325
350
375
400
Wavelength (nm)

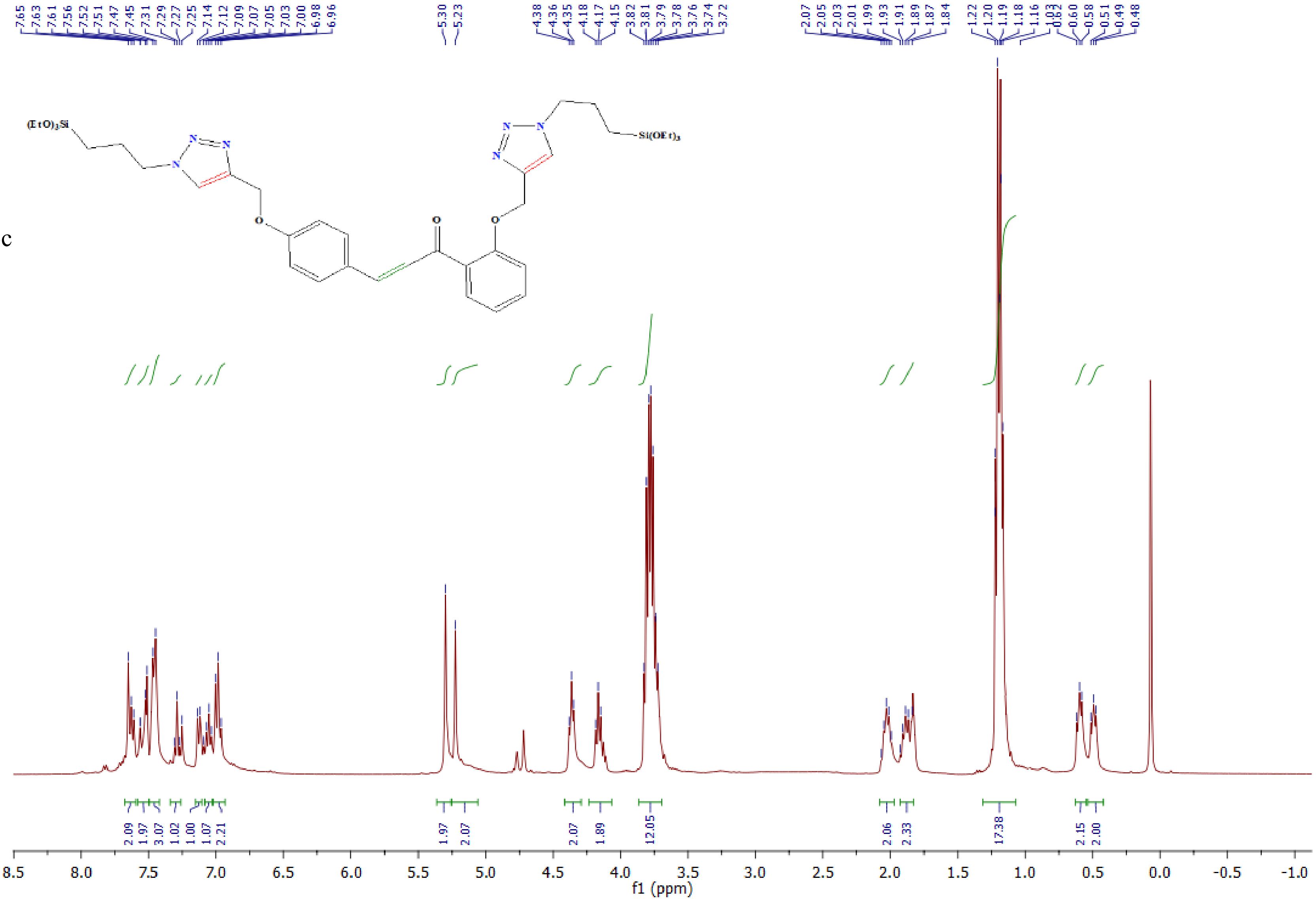
6b

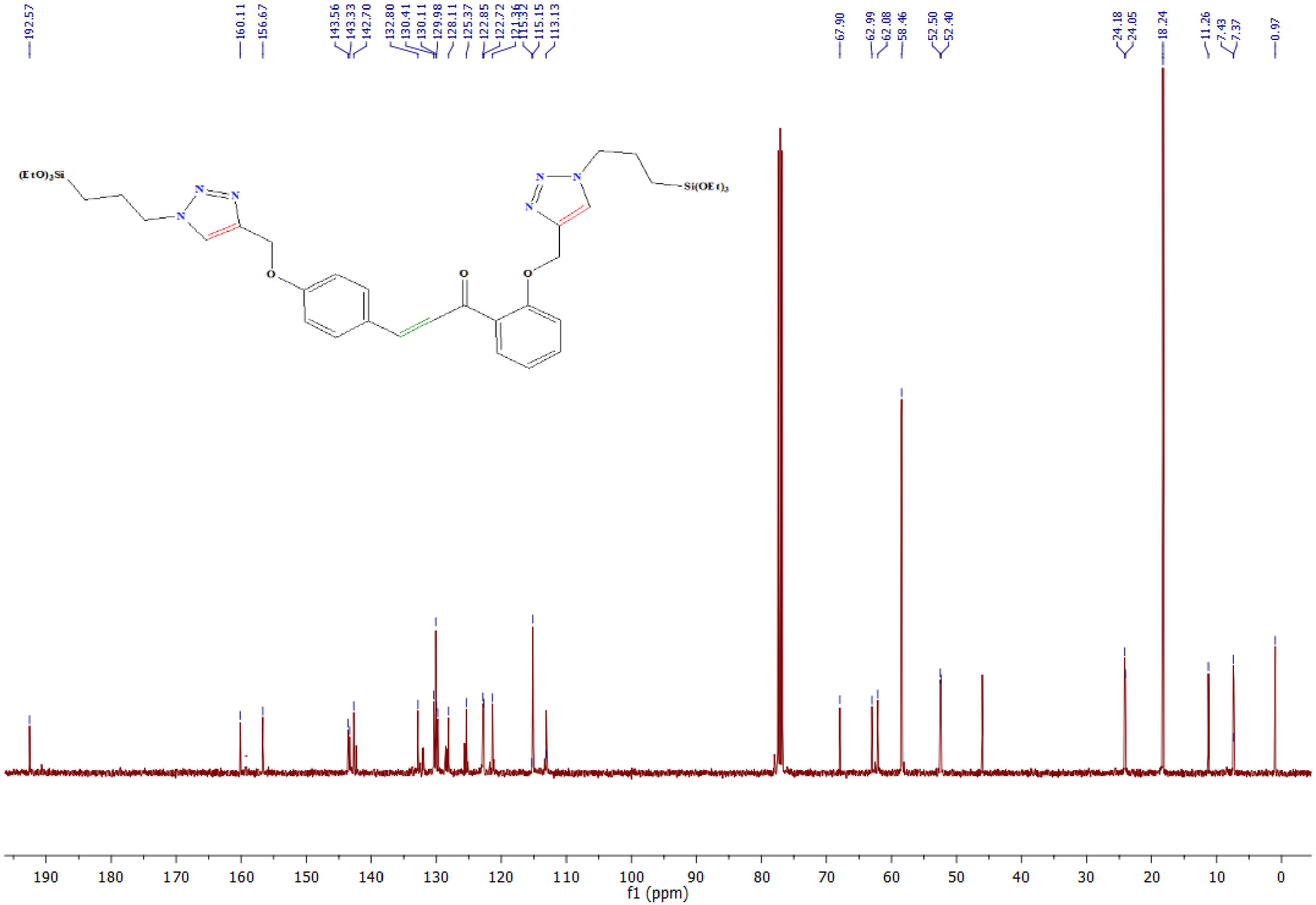

7.61
7.59
7.57
7.56
7.50
7.46
7.43
7.40
7.38
7.35
7.31
7.26
7.24
7.22
7.20
7.08
7.06
7.05
7.03
7.00
6.98
6.96
6.94
6.90
6.81
5.24
5.14
4.30
4.28
4.26
4.06
4.04
4.02
3.75
3.73
3.72
3.70
3.68
3.66
1.97
1.95
1.93
1.91
1.87
1.82
1.80
1.78
1.75
1.74
1.15
1.13
1.11
1.11
1.09
0.54
0.52
0.50
0.42
0.40
0.38
(EtO)3Si
N
N
N
O
O
O
N
N
N
Si(OEt)3
2.03
0.98
2.04
1.89
2.03
2.01
1.07
1.69
2.01
1.95
2.04
11.18
2.08
1.95
17.60
2.00
1.57
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)


191.29
157.68
155.91
141.21
135.48
132.22
131.10
131.00
130.96
129.62
128.99
128.47
127.56
127.44
126.70
121.93
121.83
120.50
120.42
115.86
113.17
112.05
61.96
61.07
57.47
51.51
51.37
23.20
23.03
17.27
6.45
6.36
0.00
(EtO)3Si
Si(OEt)3
N
O
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


6b
Absorbance
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
250
275
300
325
350
375
400
Wavelength (nm)

6c

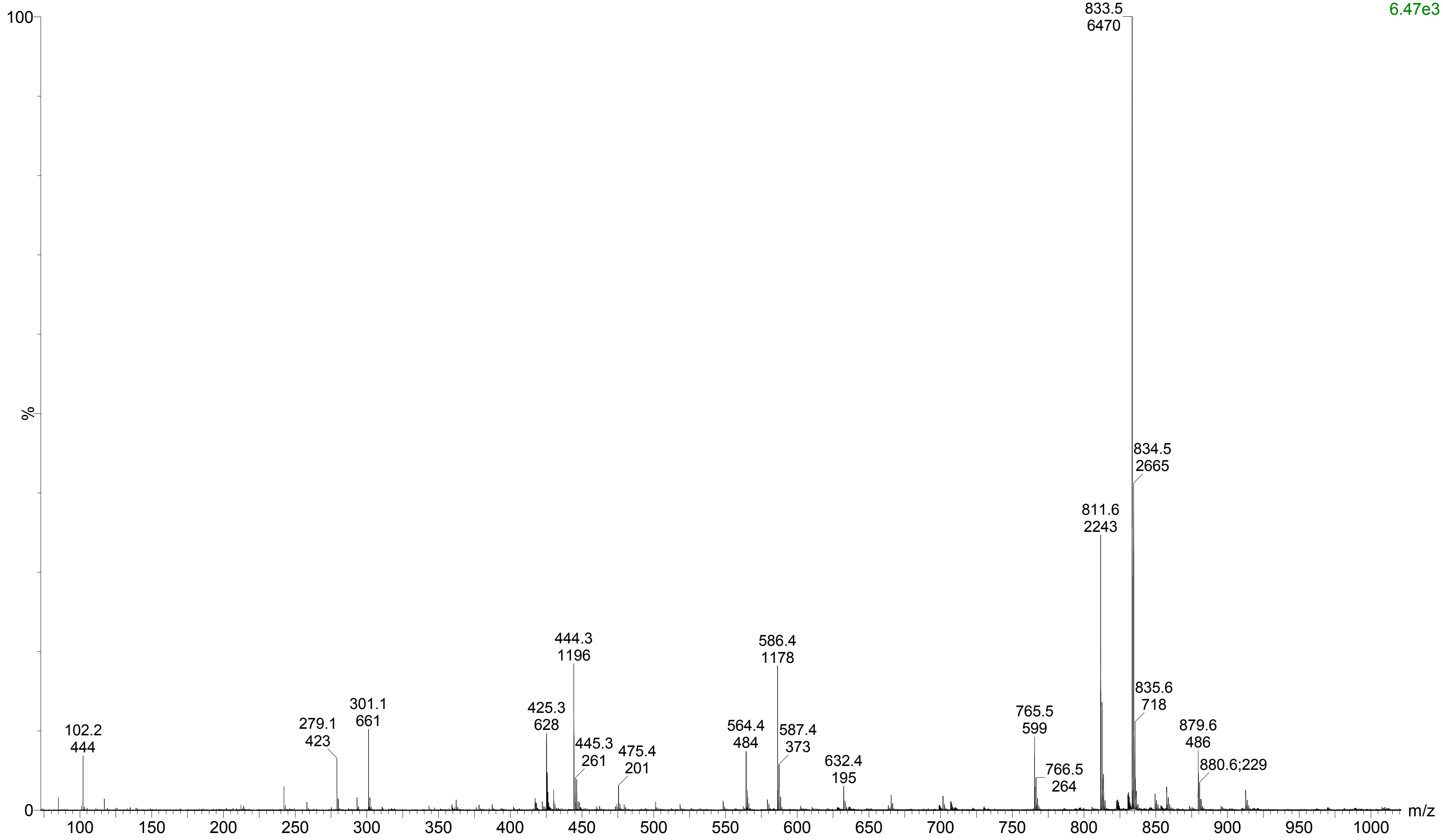

7.65
7.63
7.61
7.56
7.52
7.51
7.47
7.45
7.31
7.29
7.27
7.25
7.14
7.12
7.09
7.07
7.05
7.03
7.00
6.98
6.96
5.30
5.23
4.38
4.36
4.35
4.18
4.17
4.15
3.82
3.81
3.79
3.78
3.76
3.74
3.72
2.07
2.05
2.03
2.01
1.99
1.93
1.91
1.89
1.87
1.84
1.22
1.20
1.19
1.18
1.16
1.03
0.62
0.60
0.58
0.51
0.49
0.48
(EtO)3Si
N
N
N
O
O
O
N
N
N
Si(OEt)3
2.09
1.97
3.07
1.02
1.00
1.07
2.21
1.97
2.07
2.07
1.89
12.05
2.06
2.33
17.38
2.15
2.00
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
f1 (ppm)


192.57
160.11
156.67
143.56
143.33
142.70
132.80
130.41
130.11
129.98
128.11
125.37
122.85
122.72
121.36
115.32
115.15
113.13
67.90
62.99
62.08
58.46
52.50
52.40
24.18
24.05
18.24
11.26
7.43
7.37
0.97
(EtO)$_3$Si
N
N
N
O
O
O
N
N
N
Si(OEt)$_3$
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

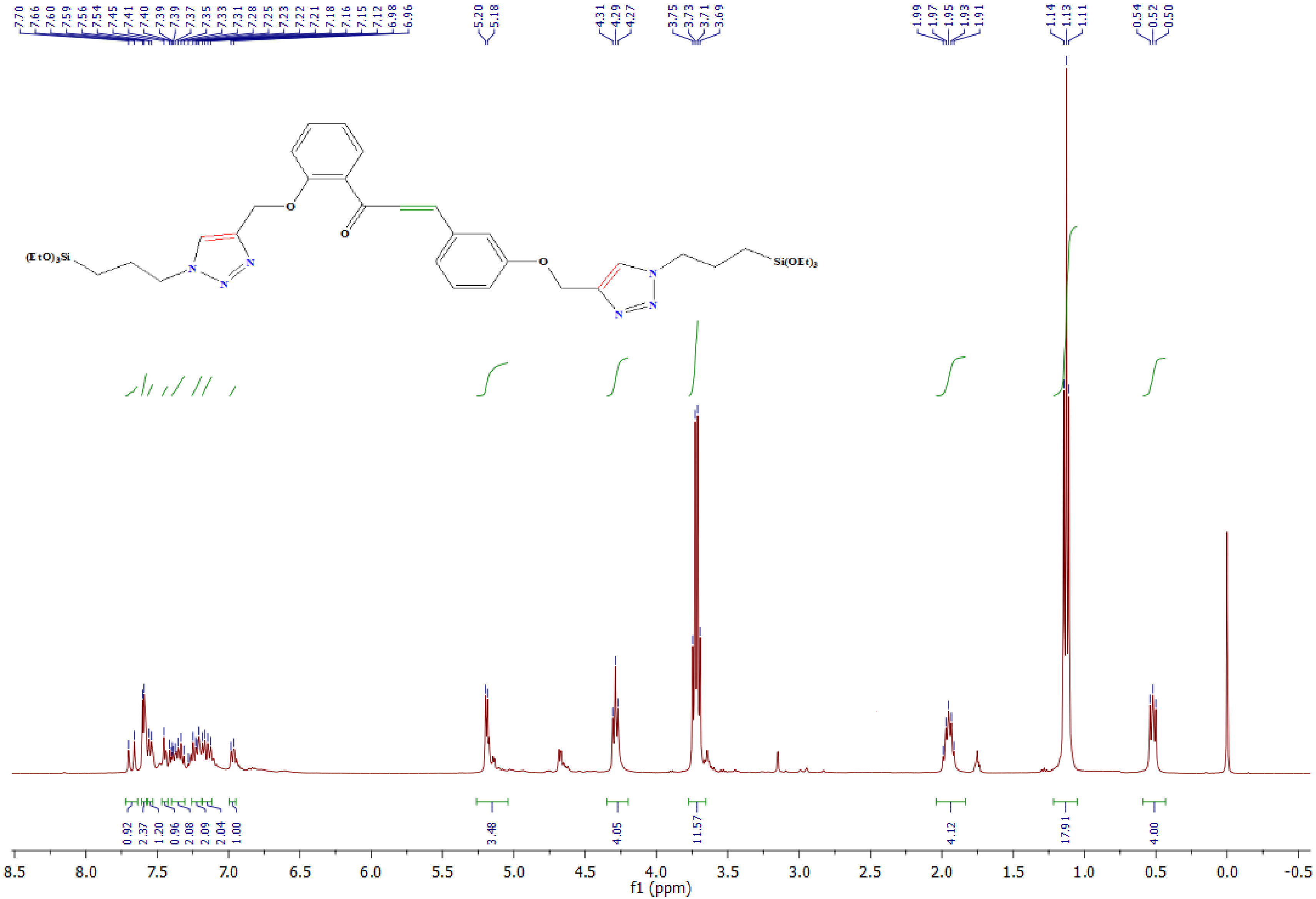
WATERS, Q-TOF MICROMASS (LC-MS) **SAIF/CIL,PANJAB UNIVERSITY,CHANDIGARH**

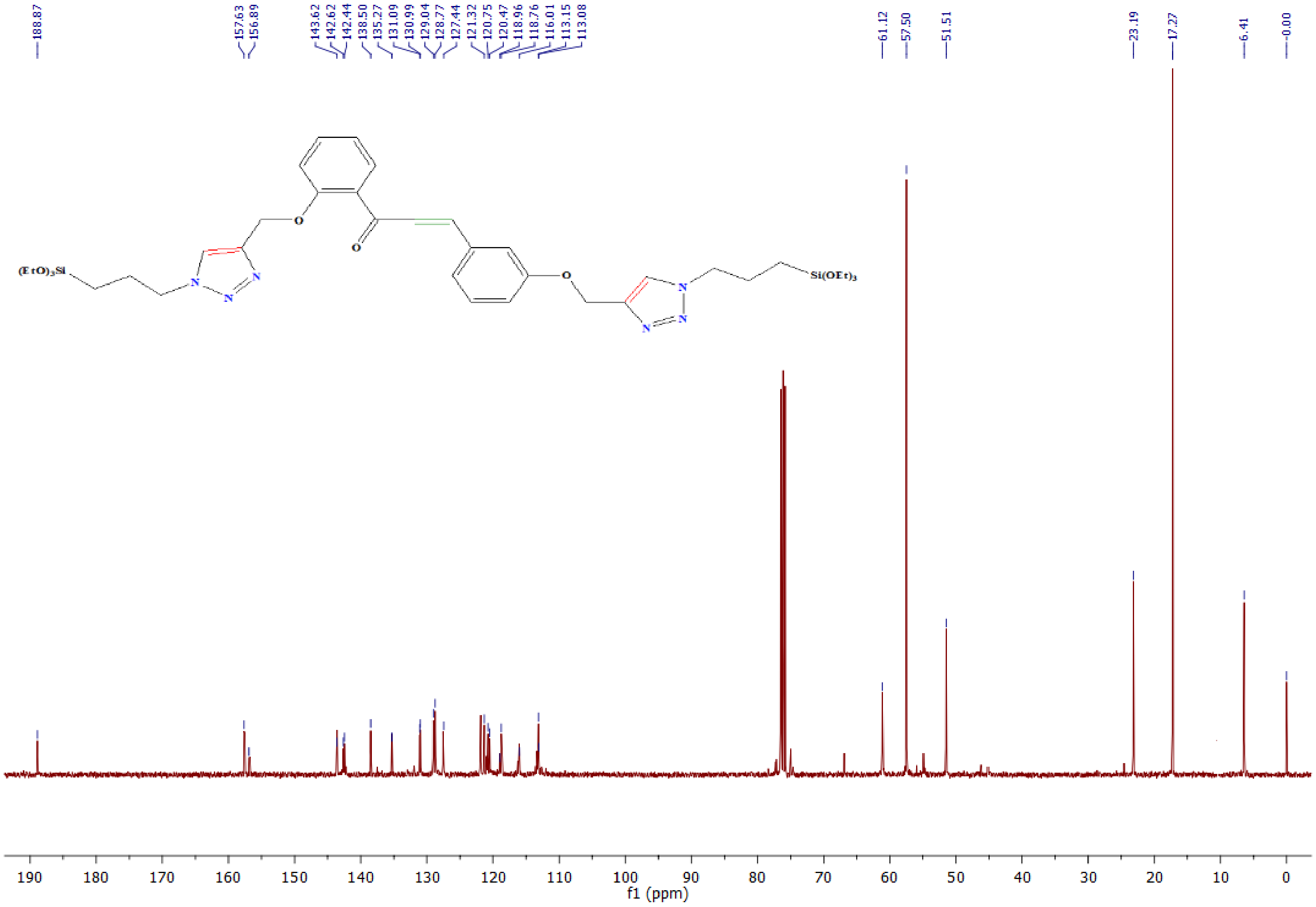
JANDEEP 6b 23 (0.288) Cm (7:30)

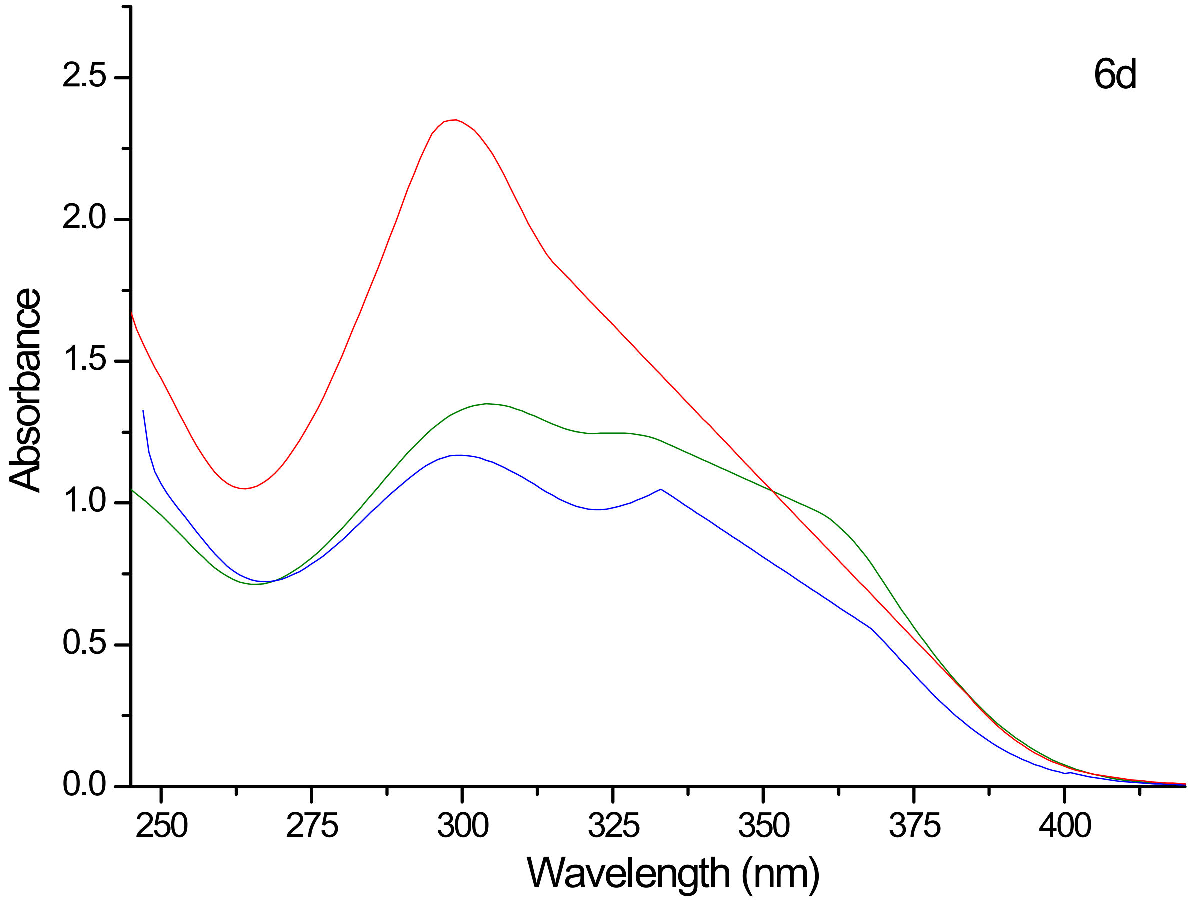
TOF MS ES+
6.47e3



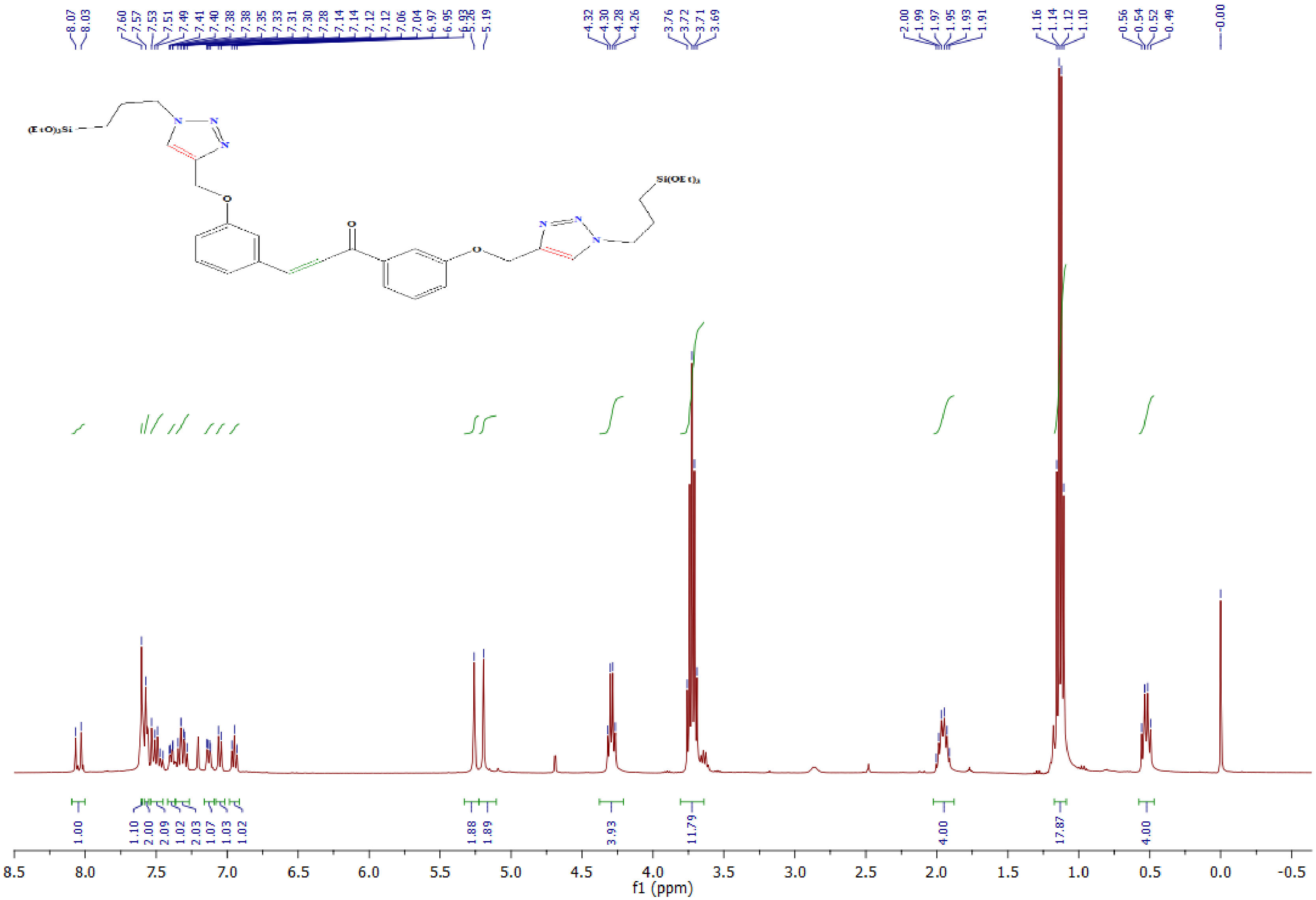
6d


7.70
7.66
7.60
7.59
7.56
7.54
7.45
7.41
7.40
7.39
7.39
7.37
7.35
7.33
7.31
7.28
7.25
7.23
7.22
7.21
7.18
7.16
7.15
7.12
6.98
6.96
5.20
5.18
4.31
4.29
4.27
3.75
3.73
3.71
3.69
1.99
1.97
1.95
1.93
1.91
1.14
1.13
1.11
0.54
0.52
0.50
(EtO)3Si
O
O
N
N
N
O
N
N
N
Si(OEt)3
0.92
2.37
1.20
0.96
2.08
2.09
2.04
1.00
3.48
4.05
11.57
4.12
17.91
4.00
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

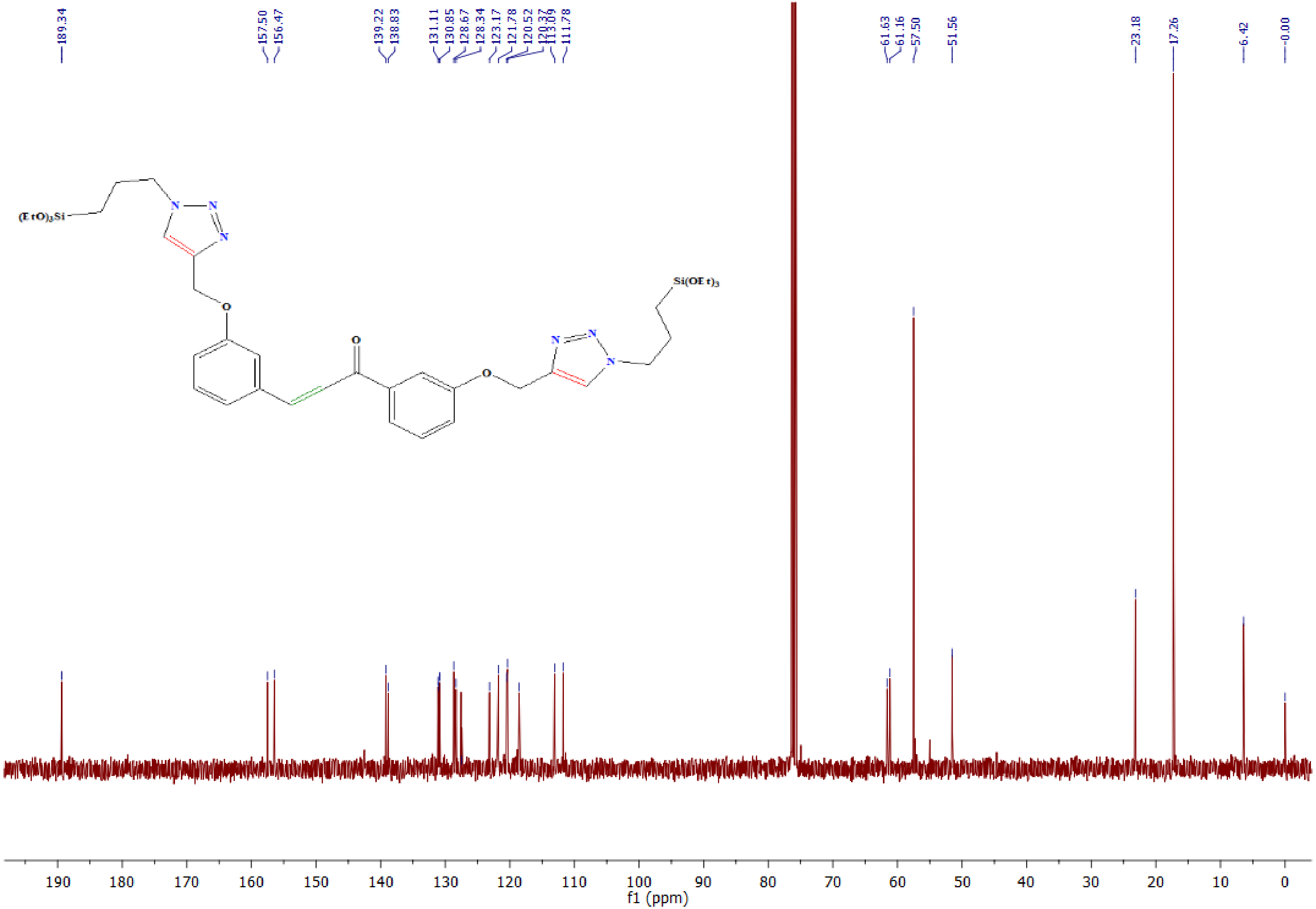

188.87
157.63
156.89
143.62
142.62
142.44
138.50
135.27
131.09
130.99
129.04
128.77
127.44
121.32
120.75
120.47
118.96
118.76
116.01
113.15
113.08
61.12
57.50
51.51
23.19
17.27
6.41
0.00
(EtO)$_3$Si
Si(OEt)$_3$
O
N
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

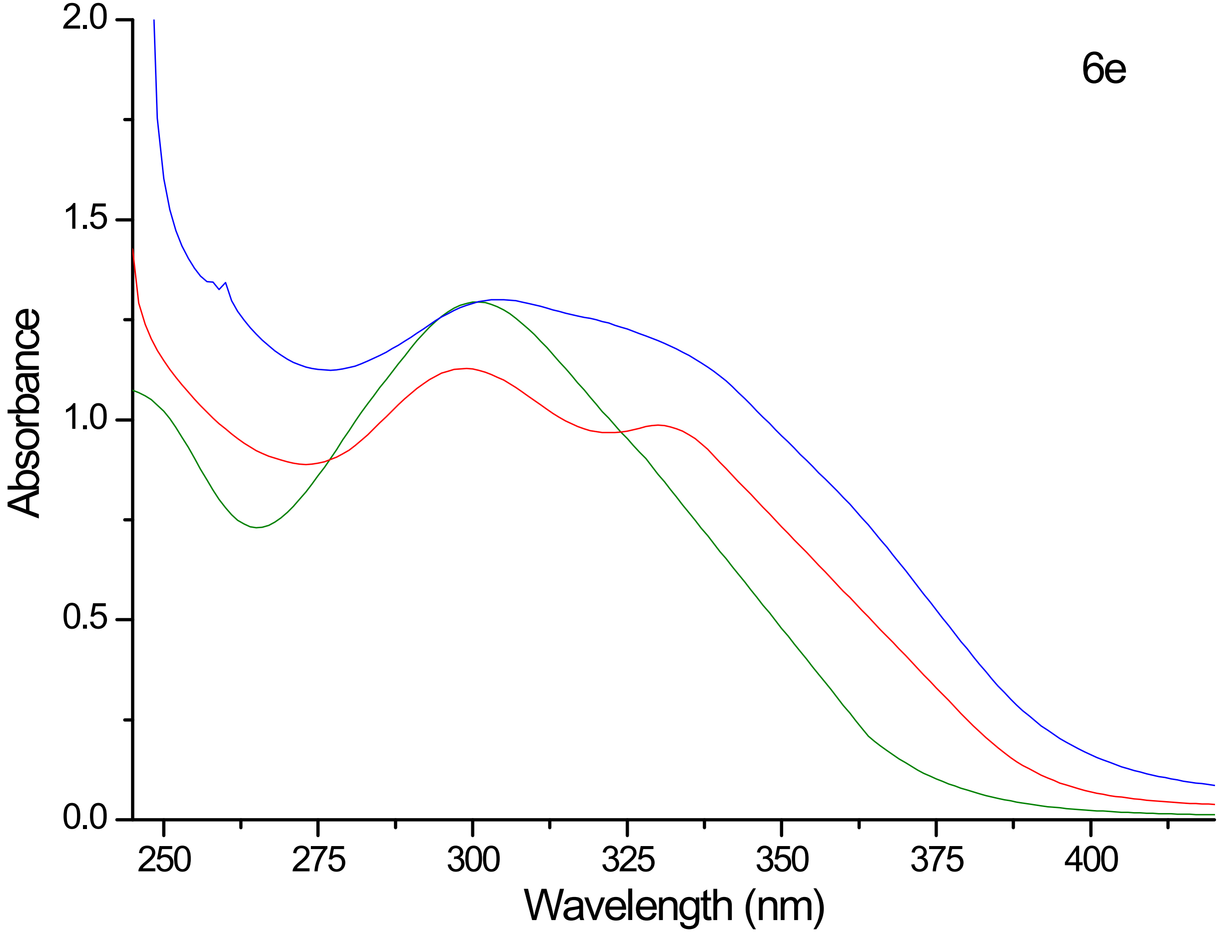

6d
Absorbance
0.0
0.5
1.0
1.5
2.0
2.5
250
275
300
325
350
375
400
Wavelength (nm)

6e

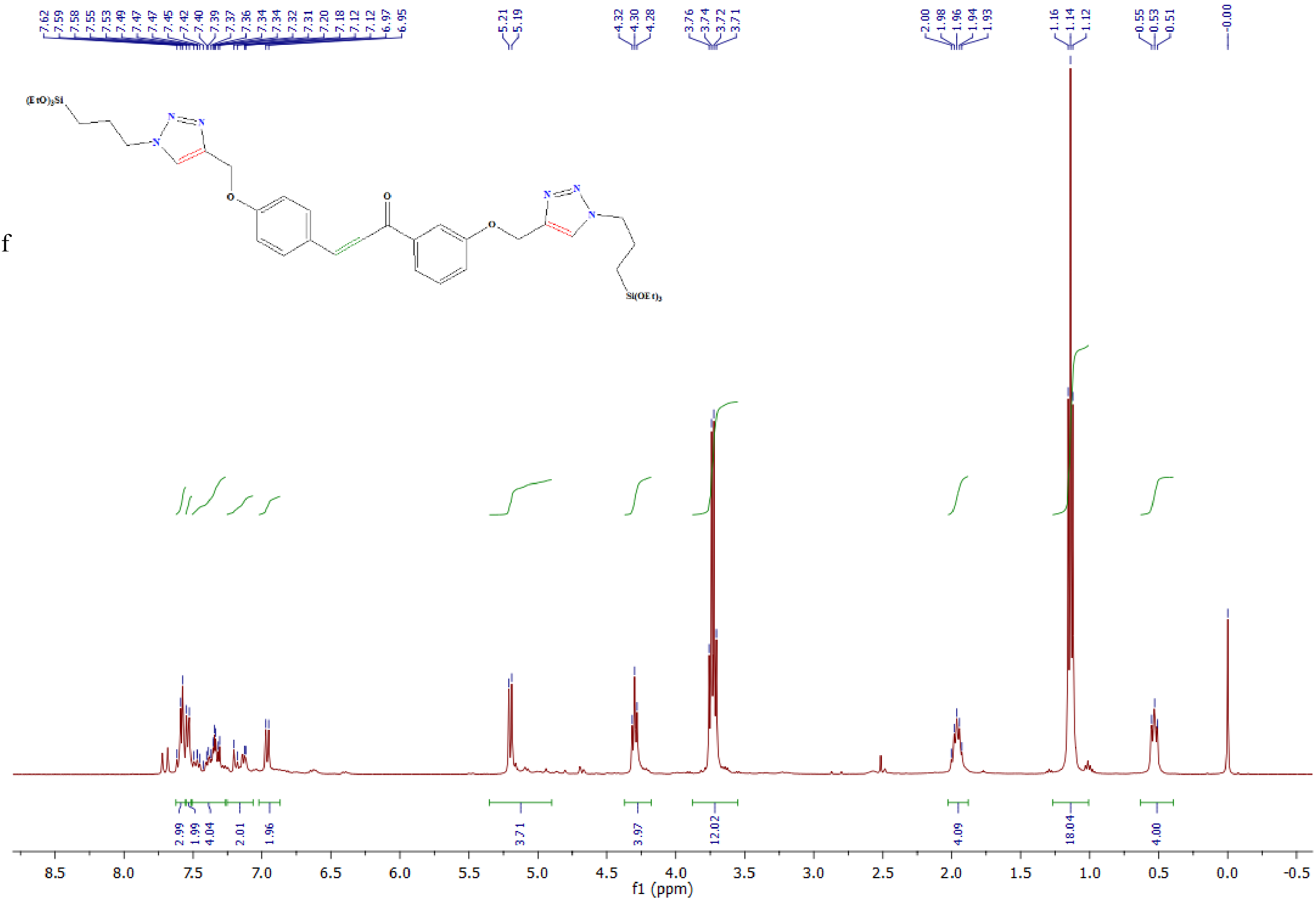


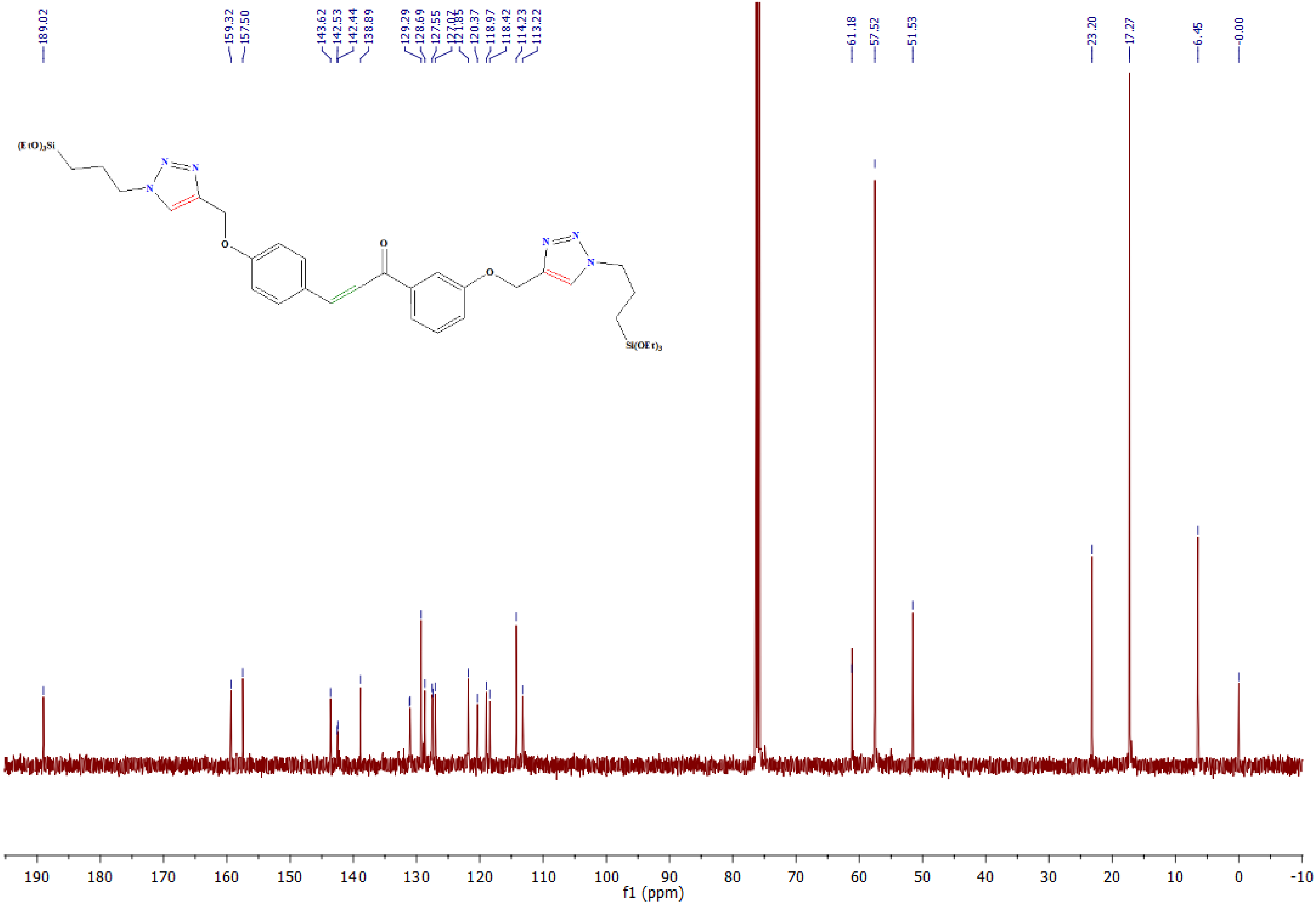
(EtO)3Si
N
N
N
O
O
O
N
N
N
Si(OEt)3
8.07
8.03
7.60
7.57
7.53
7.51
7.49
7.41
7.40
7.38
7.38
7.35
7.33
7.31
7.30
7.28
7.14
7.14
7.12
7.12
7.06
7.04
6.97
6.95
6.93
5.26
5.19
4.32
4.30
4.28
4.26
3.76
3.72
3.71
3.69
2.00
1.99
1.97
1.95
1.93
1.91
1.16
1.14
1.12
1.10
0.56
0.54
0.52
0.49
0.00
1.00
1.10
2.00
2.09
1.02
2.03
1.07
1.03
1.02
1.88
1.89
3.93
11.79
4.00
17.87
4.00
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

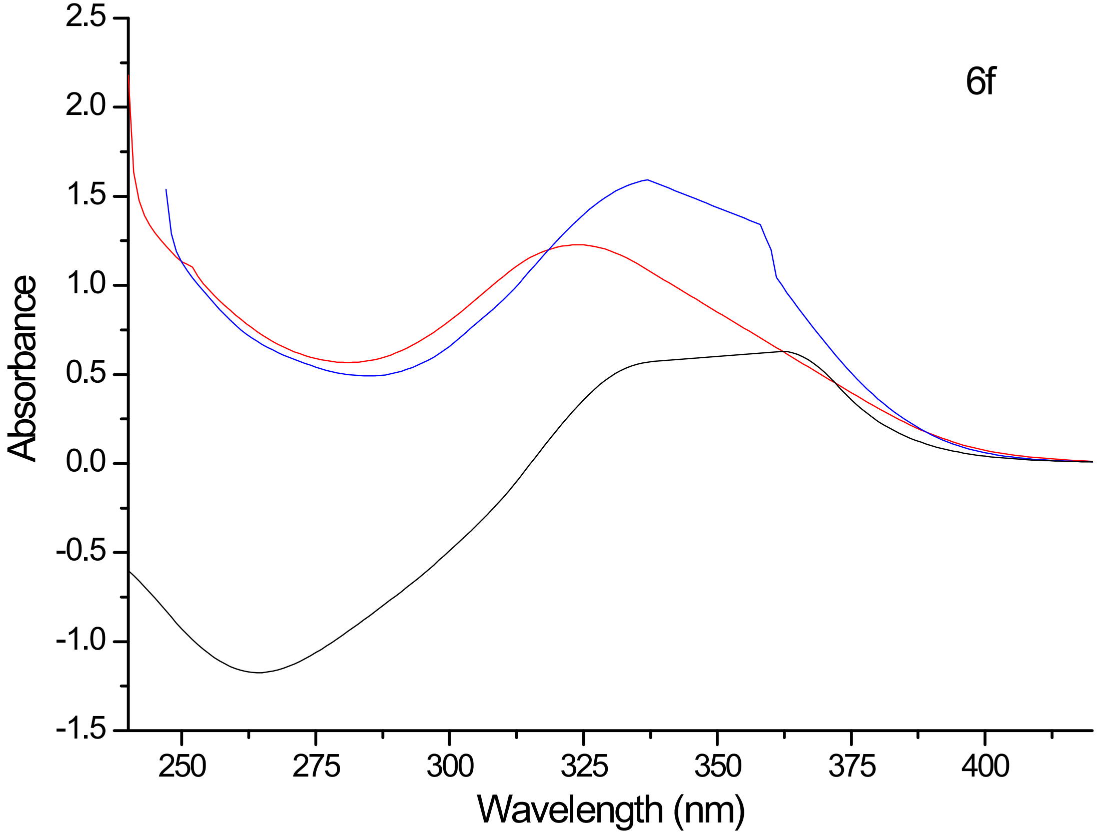

189.34
157.50
156.47
139.22
138.83
131.11
130.85
128.67
128.34
123.17
121.78
120.52
120.37
113.09
111.78
61.63
61.16
57.50
51.56
23.18
17.26
6.42
0.00
(EtO)3Si
N
N
N
O
O
O
N
N
N
Si(OEt)3
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


6e
Absorbance
2.0
1.5
1.0
0.5
0.0
250
275
300
325
350
375
400
Wavelength (nm)

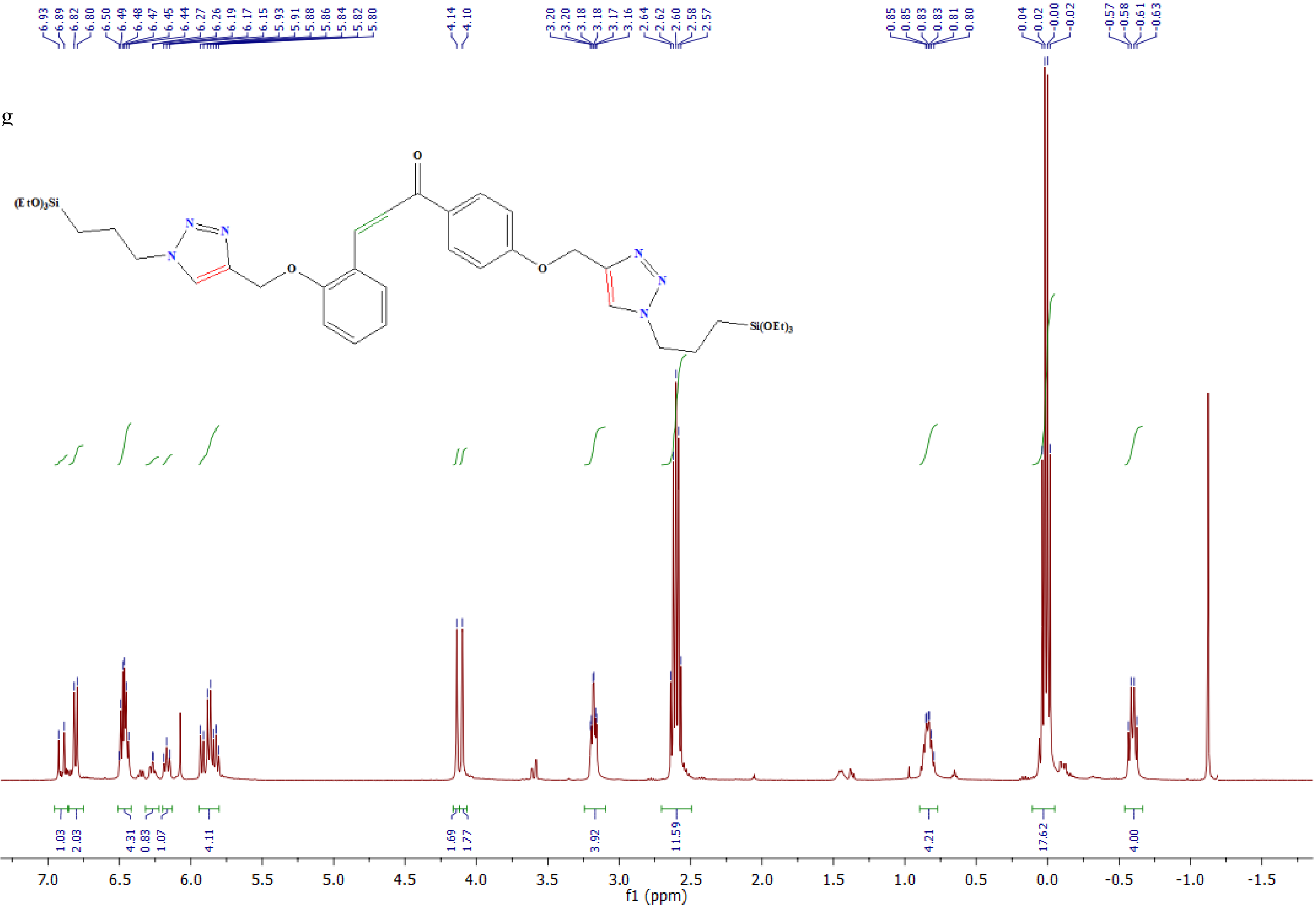
6f

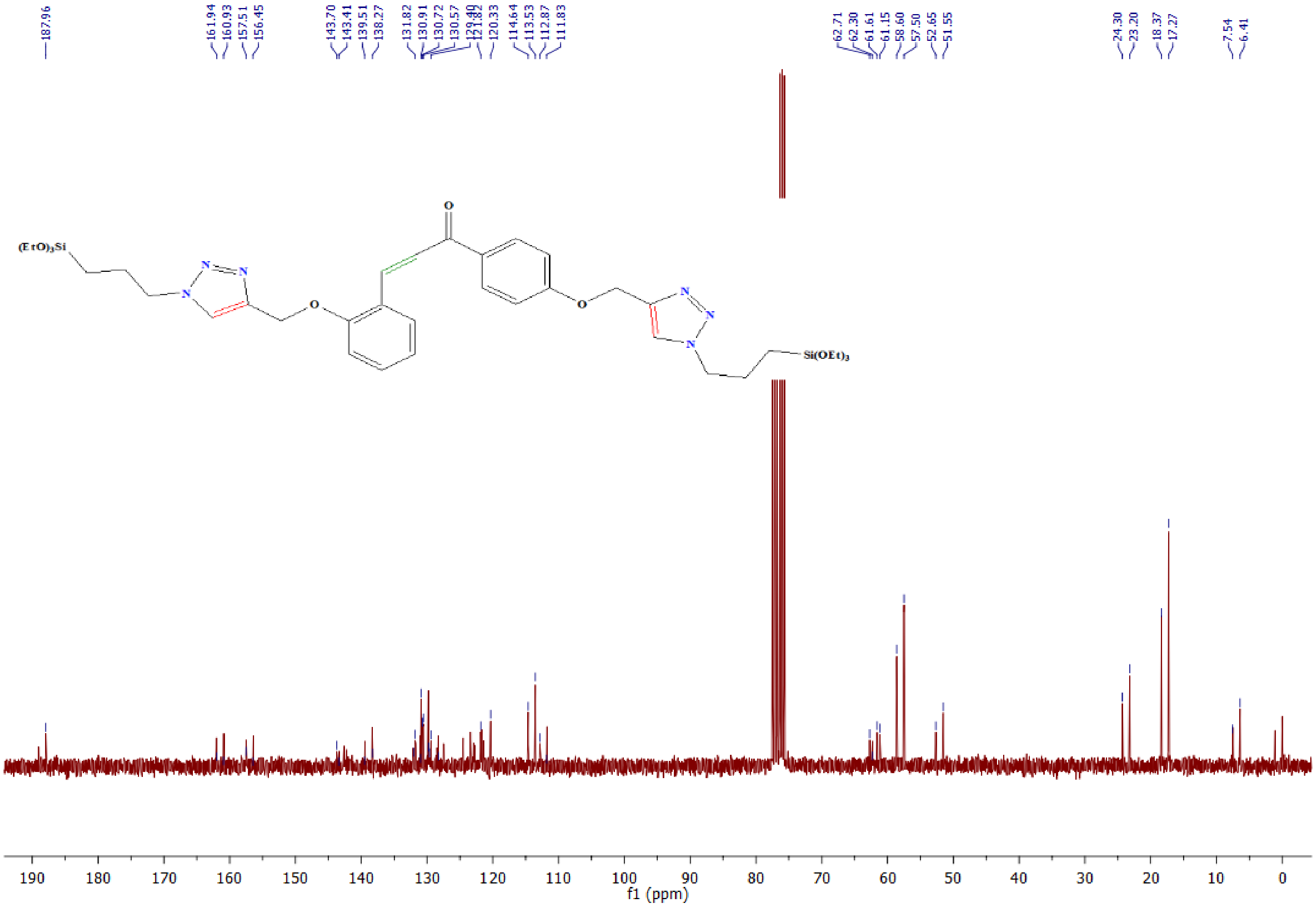

7.62
7.59
7.58
7.55
7.53
7.49
7.47
7.47
7.45
7.42
7.40
7.39
7.37
7.36
7.34
7.34
7.32
7.31
7.20
7.18
7.12
7.12
6.97
6.95
5.21
5.19
4.32
4.30
4.28
3.76
3.74
3.72
3.71
2.00
1.98
1.96
1.94
1.93
1.16
1.14
1.12
0.55
0.53
0.51
-0.00
(EtO)3Si
N
N
N
O
O
O
N
N
N
Si(OEt)3
2.99
1.99
4.04
2.01
1.96
3.71
3.97
12.02
4.09
18.04
4.00
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

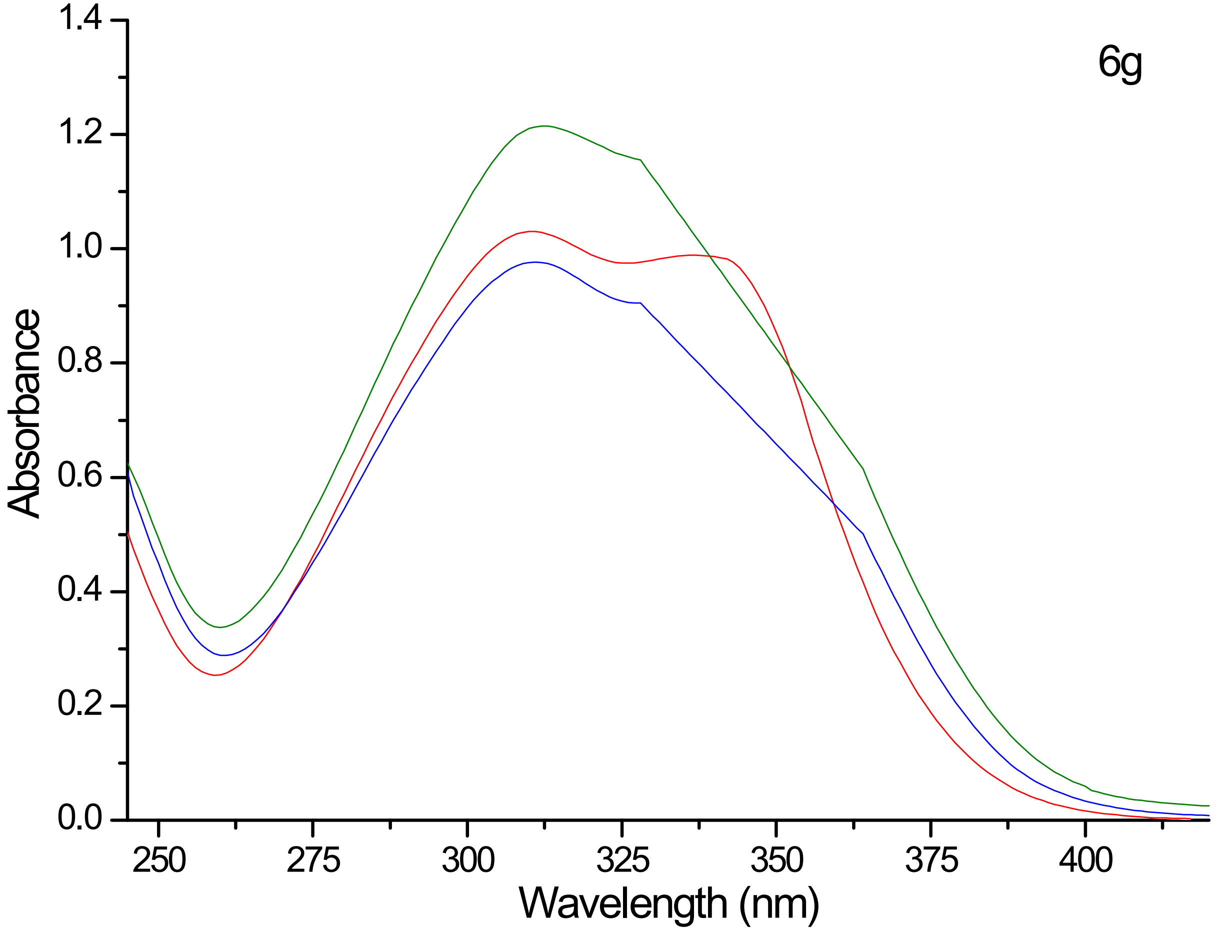

189.02
159.32
157.50
143.62
142.53
142.44
138.89
129.29
128.69
127.55
127.07
121.85
120.37
118.97
118.42
114.23
113.22
61.18
57.52
51.53
23.20
17.27
6.45
0.00
(EtO)3Si
N
N
N
O
O
O
N
N
N
Si(OEt)3
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
-10
f1 (ppm)


6f
Absorbance
Wavelength (nm)
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
250
275
300
325
350
375
400

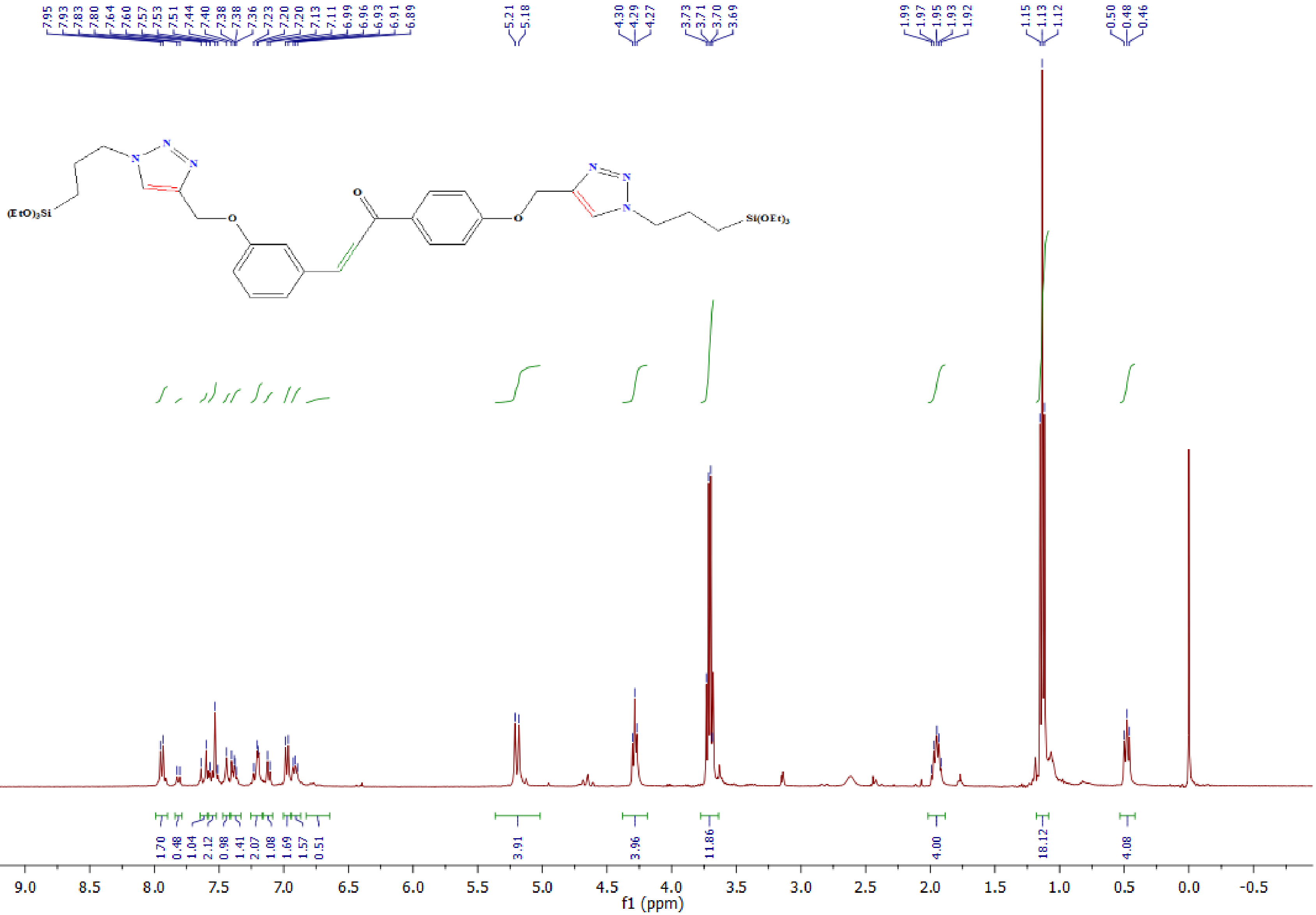
6g


6.93
6.89
6.82
6.80
6.50
6.49
6.48
6.47
6.45
6.44
6.27
6.26
6.19
6.17
6.15
5.93
5.91
5.88
5.86
5.84
5.82
5.80
4.14
4.10
3.20
3.20
3.18
3.18
3.17
3.16
2.64
2.62
2.60
2.58
2.57
0.85
0.85
0.83
0.83
0.81
0.80
0.04
0.02
0.00
-0.02
-0.57
-0.58
-0.61
-0.63
O
(EtO)3Si
N
N
N
O
O
N
N
N
Si(OEt)3
1.03
2.03
4.31
0.83
1.07
4.11
1.69
1.77
3.92
11.59
4.21
17.62
4.00
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
-1.0
-1.5
f1 (ppm)

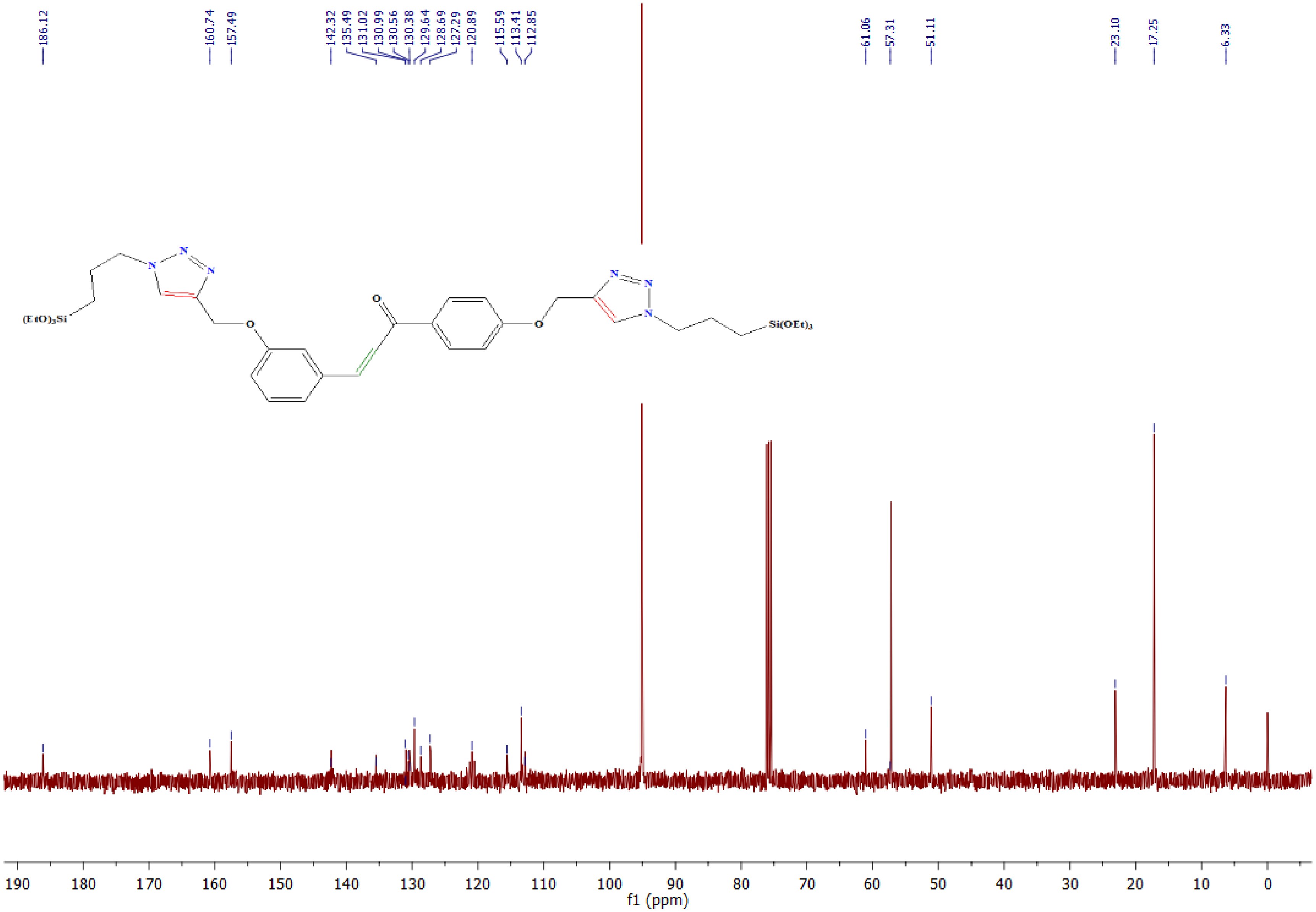

187.96
161.94
160.93
157.51
156.45
143.70
143.41
139.51
138.27
131.82
130.91
130.72
130.57
129.40
121.82
120.33
114.64
113.53
112.87
111.83
62.71
62.30
61.61
61.15
58.60
57.50
52.65
51.55
24.30
23.20
18.37
17.27
7.54
6.41
(EtO)3Si
N
N
N
O
O
O
N
N
N
Si(OEt)3
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

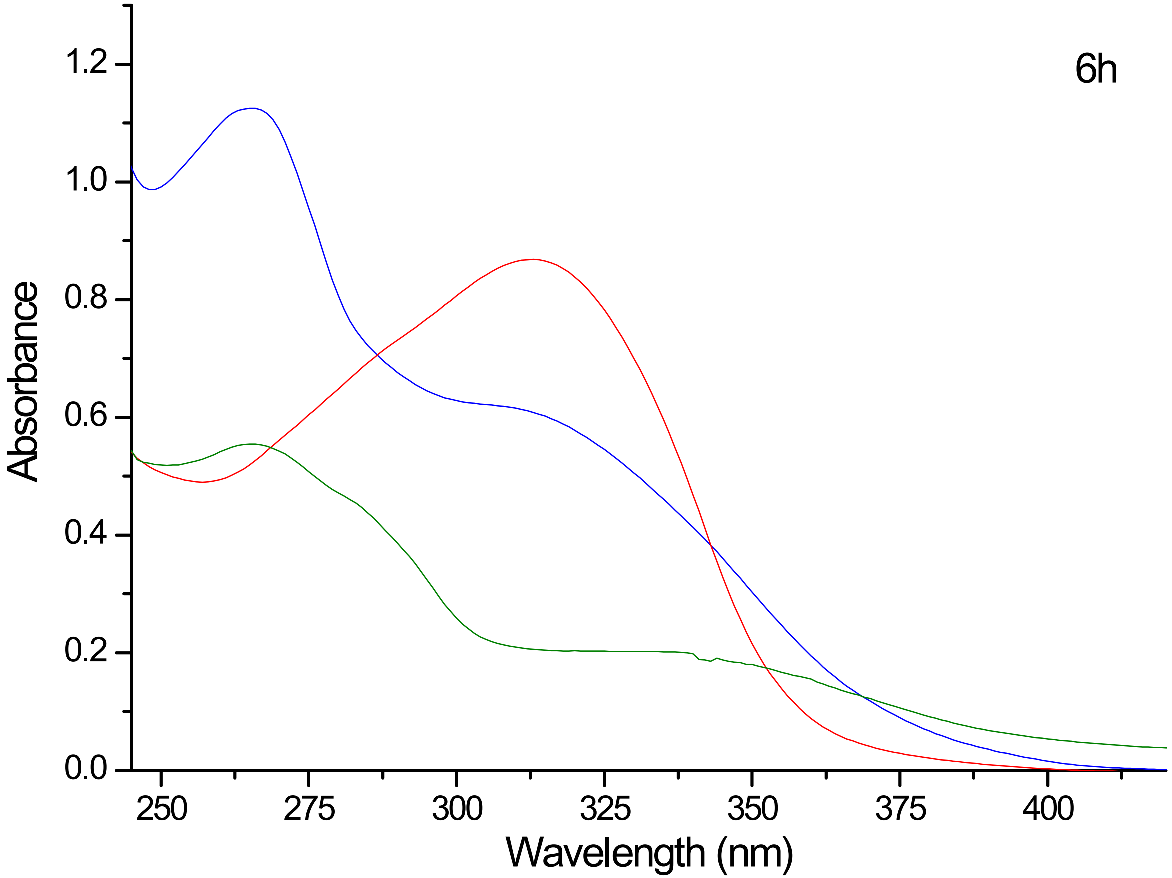

6g
Absorbance
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
250
275
300
325
350
375
400
Wavelength (nm)

6h

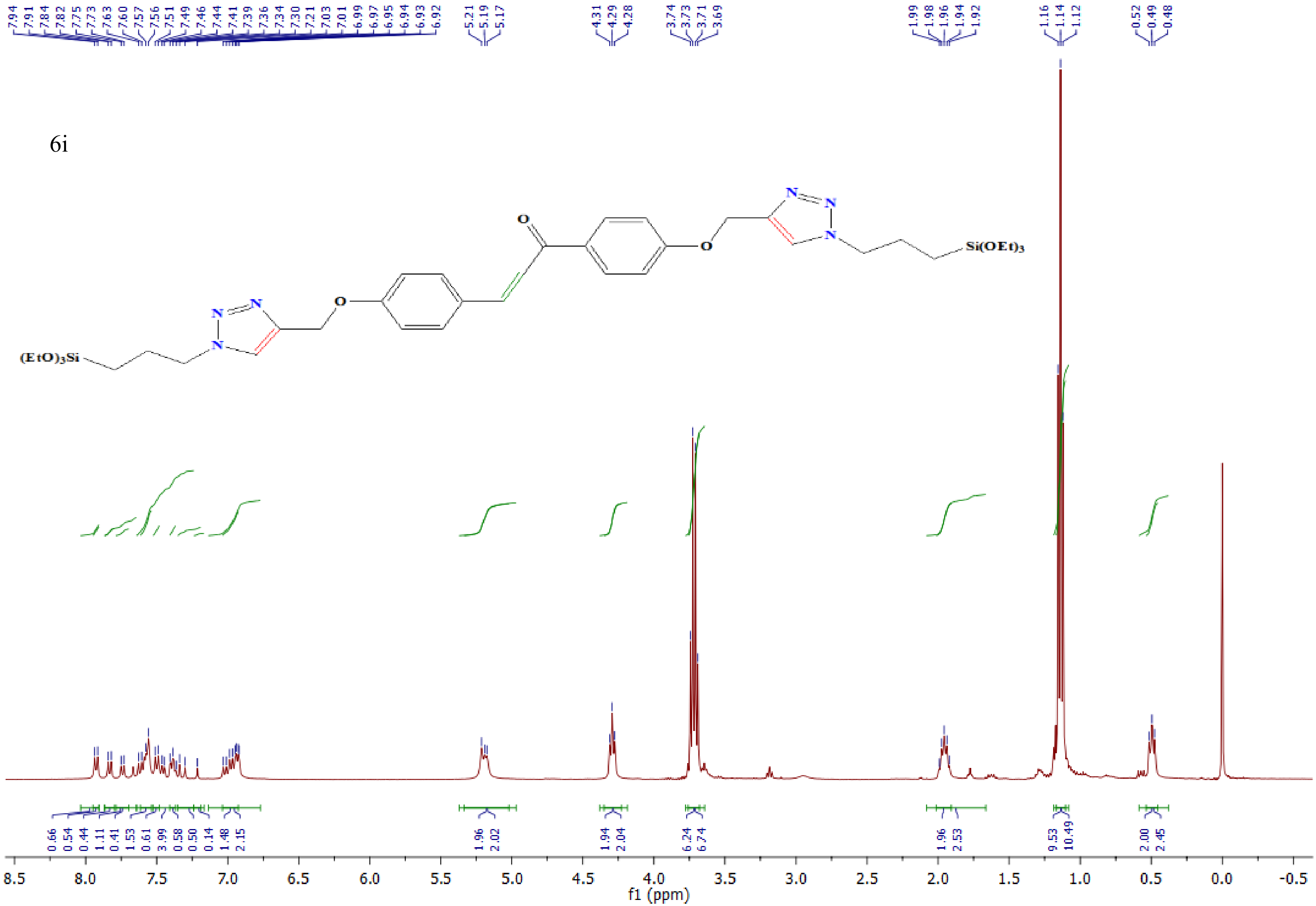


7.95
7.93
7.83
7.80
7.64
7.60
7.57
7.53
7.51
7.44
7.40
7.38
7.38
7.36
7.23
7.20
7.20
7.13
7.11
6.99
6.96
6.93
6.91
6.89
5.21
5.18
4.30
4.29
4.27
3.73
3.71
3.70
3.69
1.99
1.97
1.95
1.93
1.92
1.15
1.13
1.12
0.50
0.48
0.46
(EtO)3Si
N
N
N
O
O
O
N
N
N
Si(OEt)3
1.70
0.48
1.04
2.12
0.98
1.41
2.07
1.08
1.69
1.57
0.51
3.91
3.96
11.86
4.00
18.12
4.08
9.0
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
-0.5
f1 (ppm)

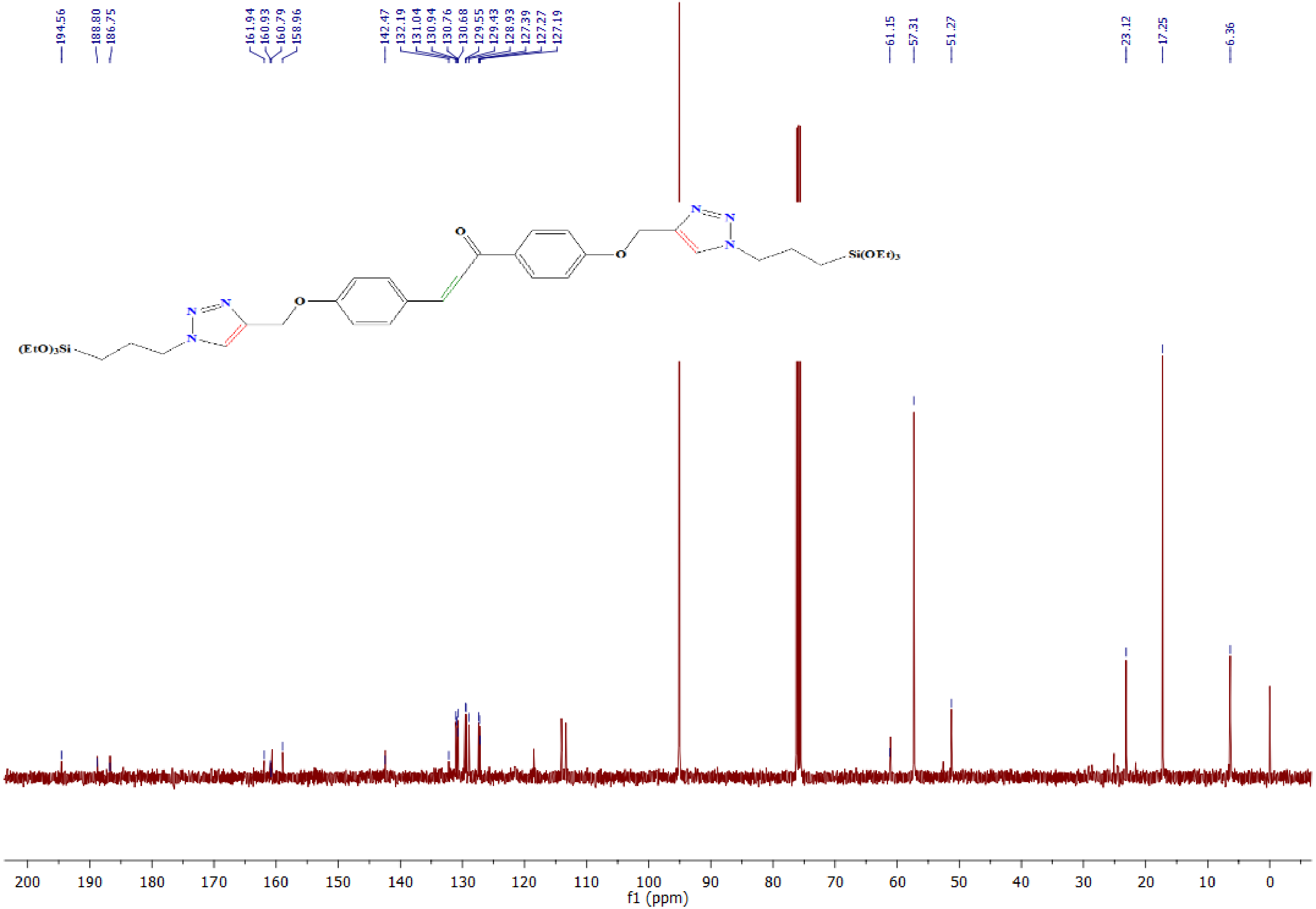

186.12
160.74
157.49
142.32
135.49
131.02
130.99
130.56
130.38
129.64
128.69
127.29
120.89
115.59
113.41
112.85
61.06
57.31
51.11
23.10
17.25
6.33
(EtO)$_3$Si
N
N
N
O
O
O
N
N
N
Si(OEt)$_3$
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)

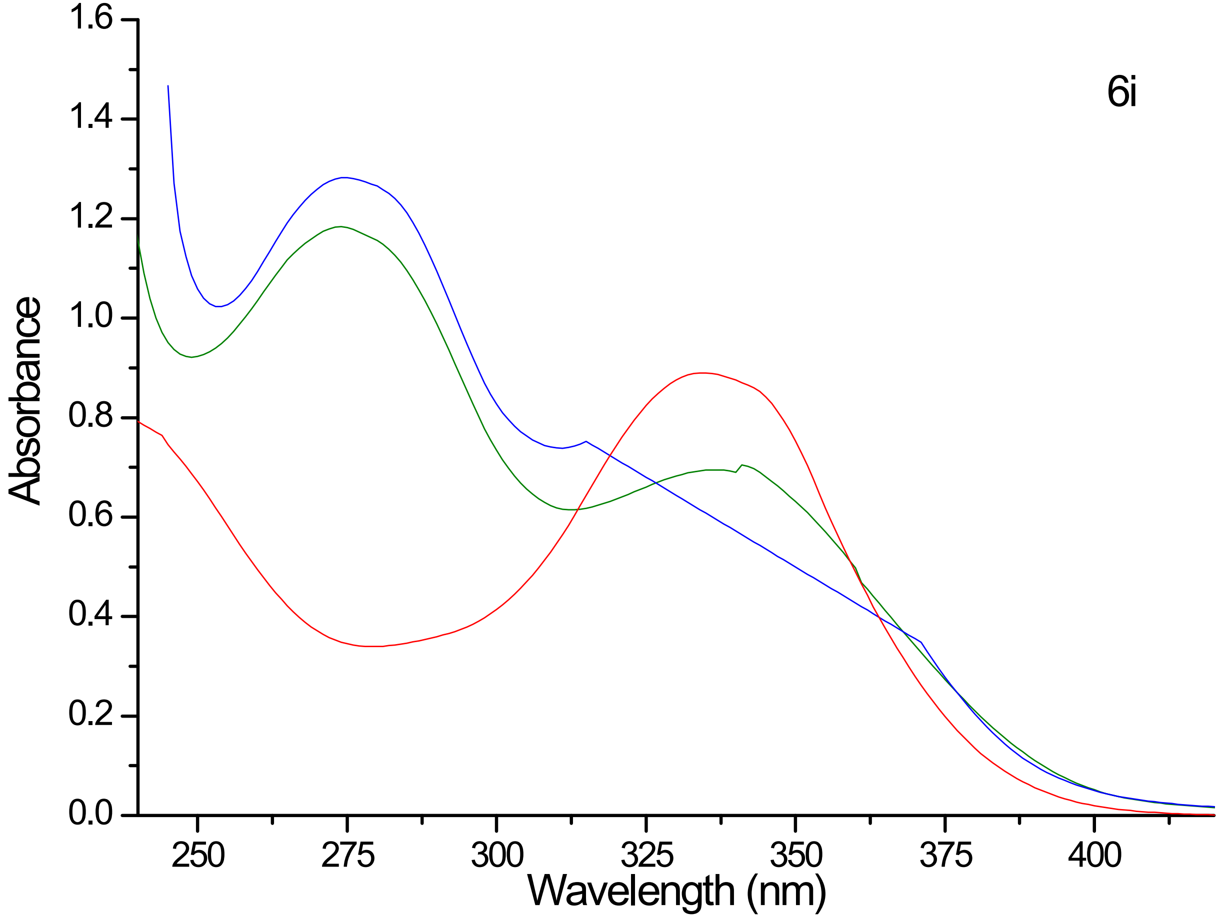

6h
Absorbance
Wavelength (nm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
250
275
300
325
350
375
400

6i



7.94 7.91 7.84 7.82 7.75 7.73 7.63 7.60 7.57 7.56 7.51 7.49 7.46 7.44 7.41 7.39 7.36 7.34 7.30 7.21 7.03 7.01 6.99 6.97 6.95 6.94 6.93 6.92
5.21 5.19 5.17
4.31 4.29 4.28
3.74 3.73 3.71 3.69
1.99 1.98 1.96 1.94 1.92
1.16 1.14 1.12
0.52 0.49 0.48
O
N
N
N
O
O
N
N
N
Si(OEt)3
(EtO)3Si
0.66 0.54 0.44 1.11 0.41 1.53 0.61 3.99 0.58 0.50 0.14 1.48 2.15
1.96 2.02
1.94 2.04
6.24 6.74
1.96 2.53
9.53 10.49
2.00 2.45
8.5 8.0 7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 -0.5
f1 (ppm)


194.56
188.80
186.75
161.94
160.93
160.79
158.96
142.47
132.19
131.04
130.94
130.76
130.68
129.55
129.43
128.93
127.39
127.27
127.19
61.15
57.31
51.27
23.12
17.25
6.36
O
O
O
N
N
N
N
N
N
Si(OEt)3
(EtO)3Si
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
f1 (ppm)


6i
Absorbance
Wavelength (nm)
0.0
0.2
0.4
0.6
0.8
1.0
1.2
1.4
1.6
250
275
300
325
350
375
400