Supporting Information

Selective Long-Distance Isomerization of Terminal Alkenes via Nondissociative Chain Walking

Yuya Yamasaki, Takaaki Kumagai, Shota Kanno, Fumitoshi Kakiuchi, and Takuya Kochi*

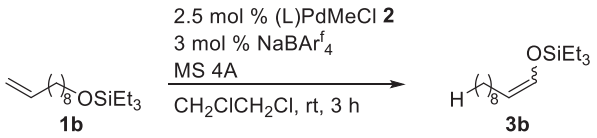
Department of Chemistry, Faculty of Science and Technology, Keio University, 3-14-1 Hiyoshi, Kohoku-ku, Yokohama, Kanagawa 223-8522, Japan.

kochi@chem.keio.ac.jp

Table of Contents

I. Optimization of the Reaction Conditions

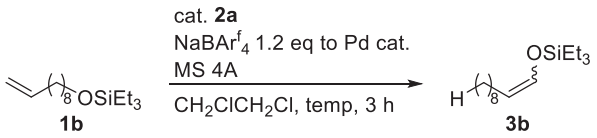
Table S1 Screening of Complexes



entry	complex [L]	GC yield (%)	*E*/*Z*
1	**2a** [1,10-phenanthroline]	77	34/66
2	**2b** [3,4,7,8-tetramethylphenanthroline]	70	34/66
3	**2c** [2,2'-bipyridine]	63	35/65
4	**2d** [2,9-dimethylphenanthroline]	73	34/66

[a]Reaction conditions: **1b** (0.1 mmol), **2** (0.0025 mmol), NaBAr$^f_4$ (0.003 mmol), CH_2ClCH_2Cl (5 mL), rt.

Table S2 Screening of the Reaction Conditions

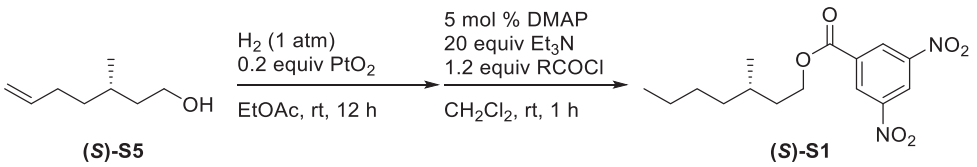


Entry	**2a** (mol %)	CH_2Cl_2 (mL)	temp (°C)	GC yield (%)	*E*/*Z*
1	2.5	5	rt	77	34/66
2	1.0	5	rt	71	35/65
3	5.0	5	rt	65	33/67
4	2.5	3	rt	69	34/66
5	2.5	10	rt	66	35/65
6	2.5	5	40	55	36/64
7	2.5	5	0	80	27/73
8	2.5	5	-5	64	20/80
9	2.5	5	-20	20	32/68
10[b]	2.5	5	-20	60	18/82

[a]Reaction conditions: **1b** (0.1 mmol). [b]24 h

II. Determination of Enantiomeric Excess of 1q and 3q

The enantiomeric excess for the substrate (*S*)-**1q** was determined by HPLC analysis of the derivative, dinitrobenzoate (*S*)-**S1**, which was derived in the following procedure from the esterification of the corresponding alcohol (S)-S5 before the silylative protection.



To a Schlenk flask charged with (*S*)-**S5** (27.8 mg, 0.217 mmol) were added EtOAc (2 mL) and platinum oxide (9.1 mg, 0.040 mmol) to form a suspension. A balloon filled with hydrogen gas was attached to the flask, which was then briefly evacuated and backfilled with hydrogen gas three times. The mixture was stirred at room temperature for 12 h. The resulting mixture was filtered through a pad of Celite and concentrated.

The residue was dissolved in CH_2Cl_2 (15 mL), and DMAP (1.2 mg, 0.098 mmol), 3,5-dinitrobenzoyl chloride (60.6 mg, 0.260 mmol), and Et_3N (0.6 mL, 4.2 mmol) were added to the solution at room temperature. After stirring for 1 h, the mixture was diluted with dichloromethane and washed twice with brine. The combined organic portions were dried over $MgSO_4$, filtered, and concentrated. Silica gel column chromatography (hexane:EtOAc = 10:1) of the crude material afforded dinitrobenzoate **S1** (23.3 mg, 33% yield, 97% ee) as a colorless oil.

The enantiomeric excess was determined by chiral HPLC analysis (Daicel Chiralpak AY-H column, column temperature: 25 °C, eluent; *n*-hexane:EtOH = 98:2, flow rate: 1.0 mL/min, λ = 254 nm; t_R = 15.1 and 16.3 min).

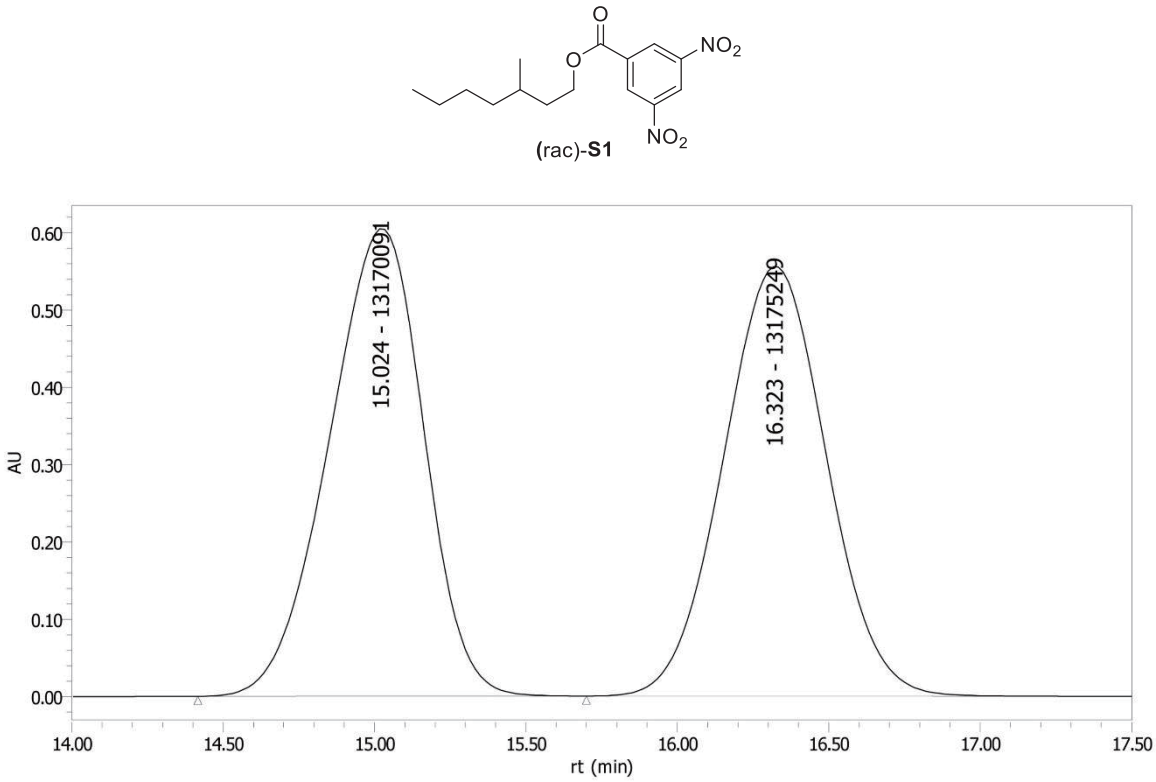


Figure S1. HPLC Analysis of (rac)-**S1**

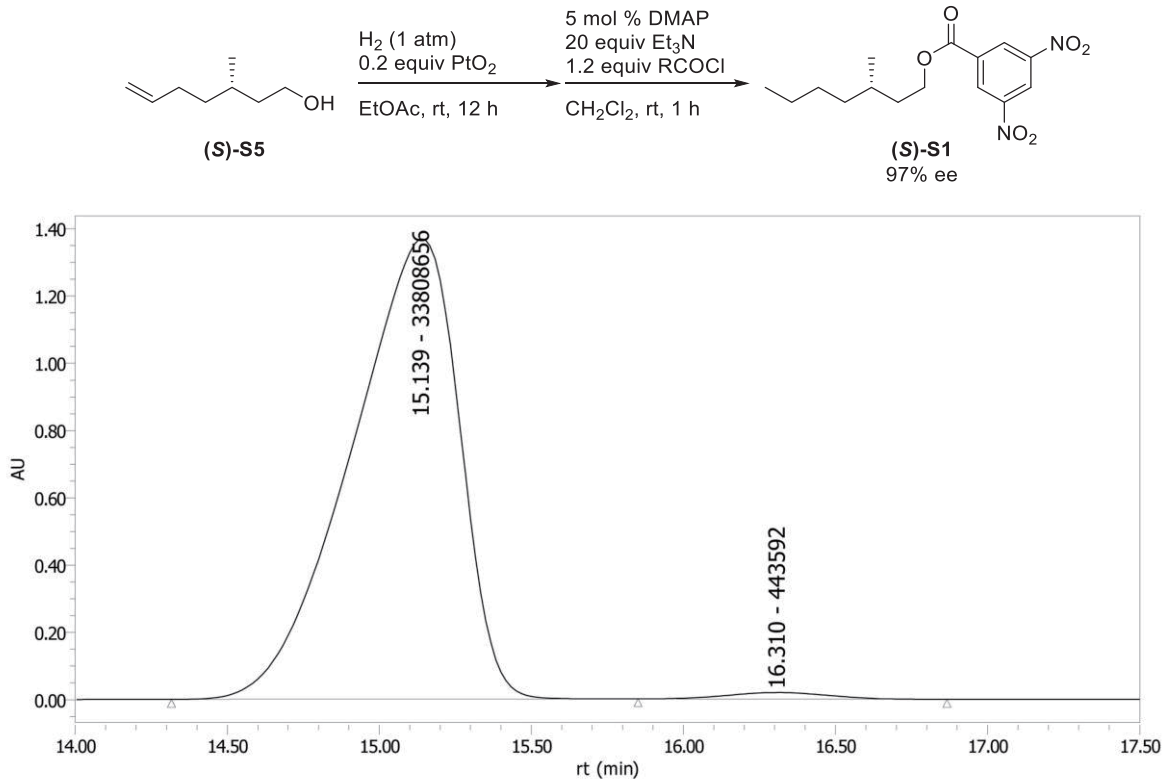
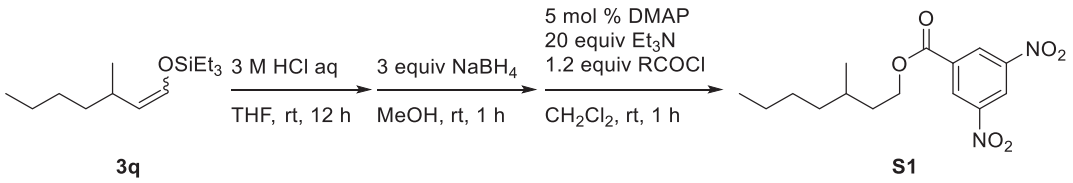


Figure S2. HPLC Analysis of (*S*)-**S1** derived from (*S*)-**S5**

The enantiomeric excess for **3q** was determined by HPLC analysis of the corresponding esterification product **S1**, which was obtained through the following procedure.



3q **S1**

To a solution of **3q** (16.2 mg, 0.067 mmol) in THF (3 mL) was added 3 M hydrochloric acid (2 mL). After stirring for 12 h at room temperature, a saturated aqueous solution of $NaHCO_3$ was added to the mixture, which was then extracted three times with Et_2O. The combined organic layers were washed with brine, dried over Na_2SO_4, and filtered. Volatile materials was removed carefully by distillation at 60 °C under ambient pressure. The residue was dissolved in MeOH (5 mL), and $NaBH_4$ (7.6 mg, 0.201 mmol) was added to the solution at 0 °C. The reaction mixture was stirred at room temperature for 3 h. Water and diethyl ether were added to the mixture and the organic layer was collected. The aqueous layer was extracted three times with diethyl ether. The combined organic portions were dried over $MgSO_4$, filtered, and concentrated. The residue was dissolved in CH_2Cl_2 (5 mL), and DMAP (0.4 mg, 0.003 mmol), 3,5-dinitrobenzoyl chloride (18.4 mg, 0.080 mmol), and Et_3N (0.2 mL, 1.3 mmol) were added to the solution at room temperature. After stirring for 1 h, the mixture was diluted with dichloromethane and washed twice with brine. The combined organic portions were dried over $MgSO_4$, filtered, and concentrated. Silica gel column chromatography (hexane:EtOAc = 10:1) of the crude material afforded dinitrobenzoate **S1** (6.0 mg, 0.018 mmol, 28% yield) as a colorless oil: IR (neat): 3105 w, 2960 m, 2930 m, 2872 w, 2858 w, 1740 s, 1735 m, 1731 m, 1628 w, 1550 s, 1545 s, 1544 s, 1542 s, 1541 s, 1462 w, 1344 s, 1282 s, 1170 m, 1076 w, 921 w, 730 m, 721 m cm^{-1}; ^1H NMR (400 MHz, $CDCl_3$): δ 0.91 (t, J = 7.2 Hz, 3H), 0.98 (d, J = 6.0 Hz, 3H), 1.20-1.42 (m, 6H), 1.59-1.69 (m, 2H), 1.83-1.91 (m, 1H), 4.45-4.54 (m, 2H), 9.16 (d, J = 2.4 Hz, 2H), 9.24 (t, J = 2.0 Hz, 1H); ^{13}C NMR (100 MHz, $CDCl_3$): δ 14.1, 19.6, 22.9, 29.1, 29.9, 35.4, 36.5, 65.7, 122.3, 129.4, 134.1, 148.6, 162.5; HRMS (DART-TOF) m/z: $[M+H]^+$ Calcd for $C_{15}H_{21}N_2O_6$ 325.1400; Found 325.1394.

The enantiomeric excess was determined by chiral HPLC analysis (Daicel Chiralpak AY-H column, column temperature: 25 °C, eluent: *n*-hexane:EtOH = 98:2, flow rate: 1.0 mL/min, λ = 254 nm; t_R = 15.0 and 16.3 min).

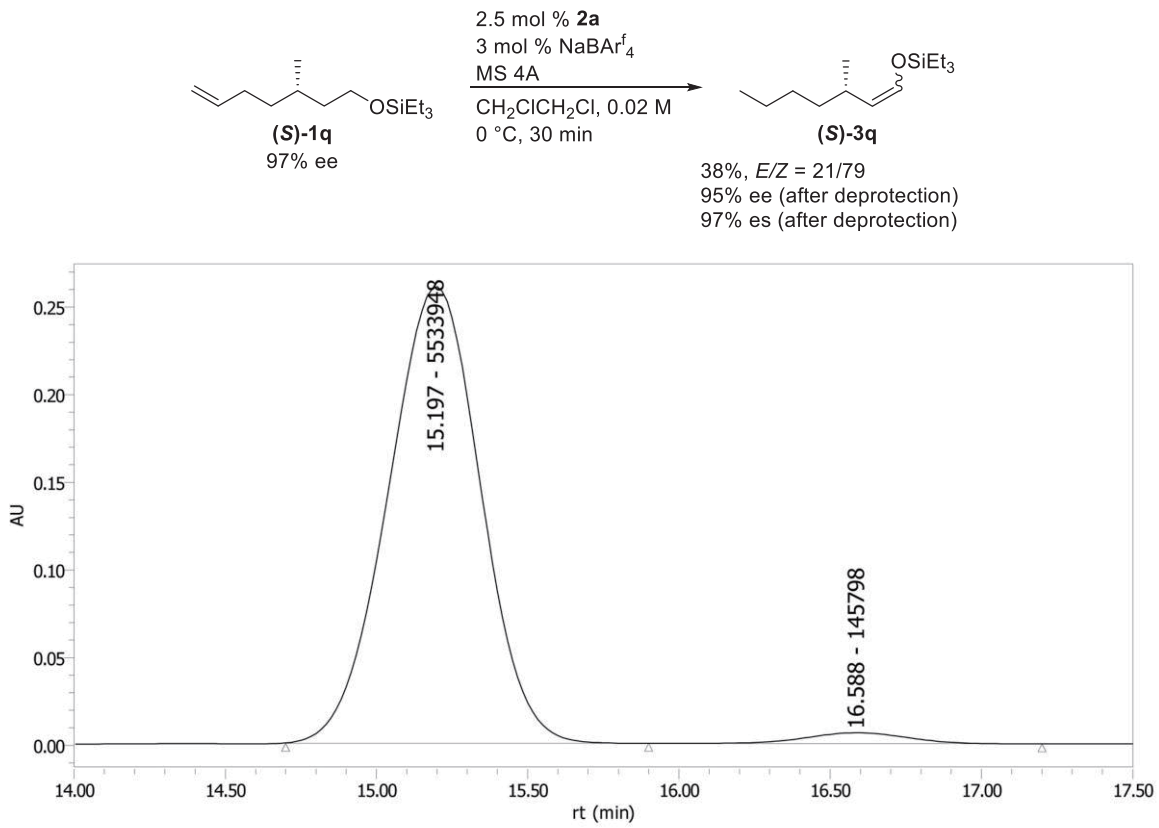


Figure S3. HPLC Analysis of (*S*)-**3q** (reaction conditions: standard)

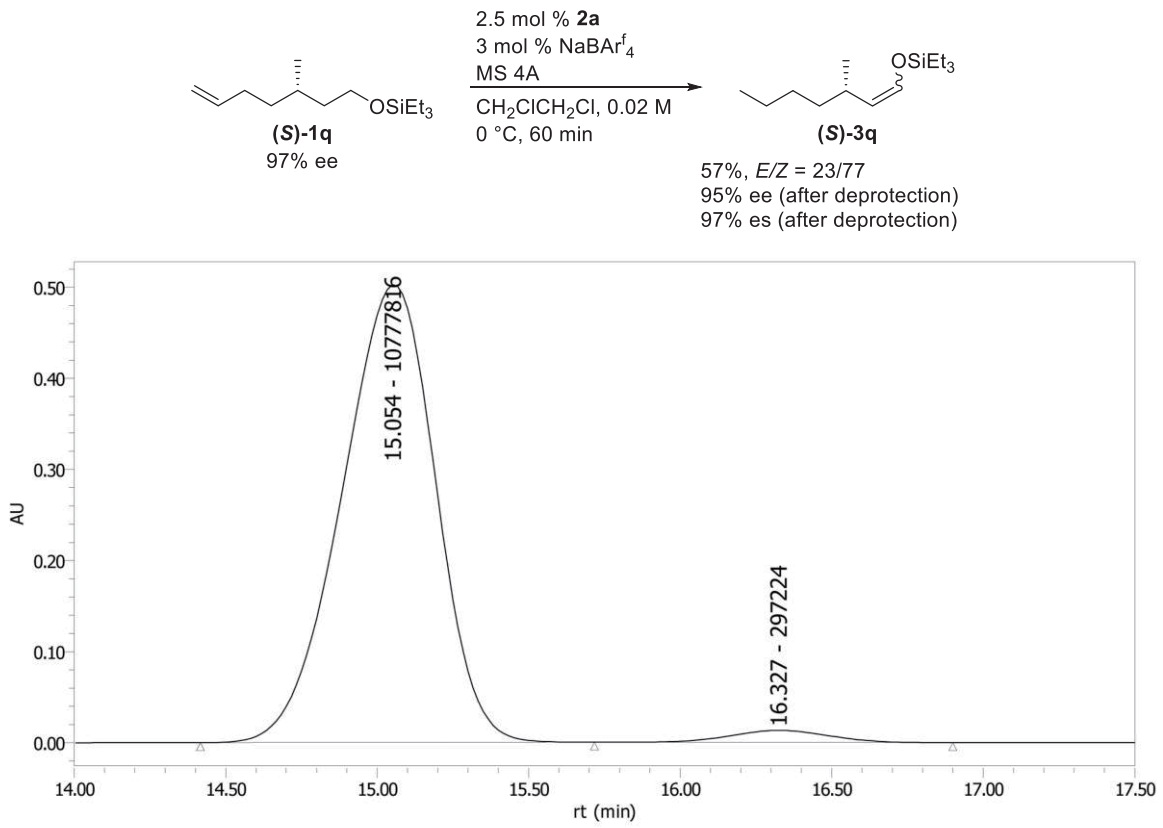


Figure S4. HPLC Analysis of (*S*)-**3q** (reaction conditions: standard except that the reaction time was 60 min)

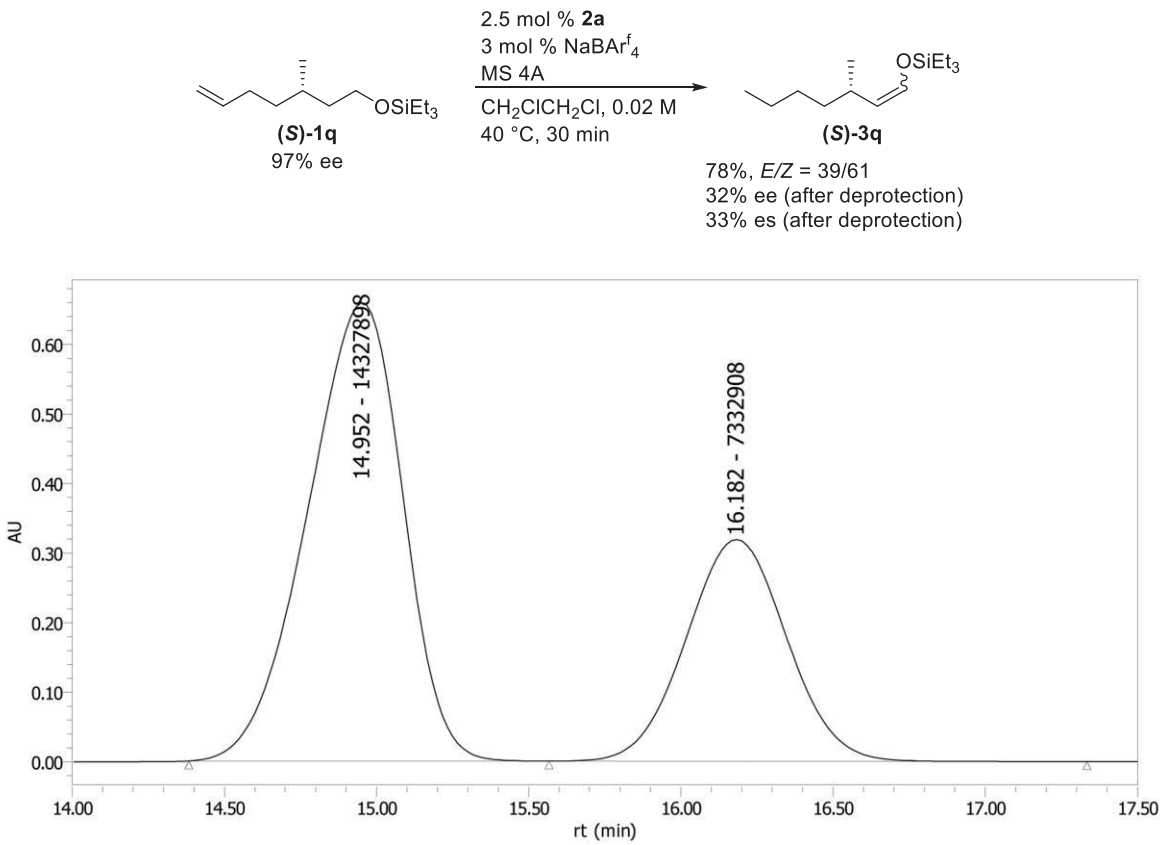


Figure S5. HPLC Analysis of (*S*)-**3q** (reaction conditions: standard except that the reaction temperature was 40 °C)

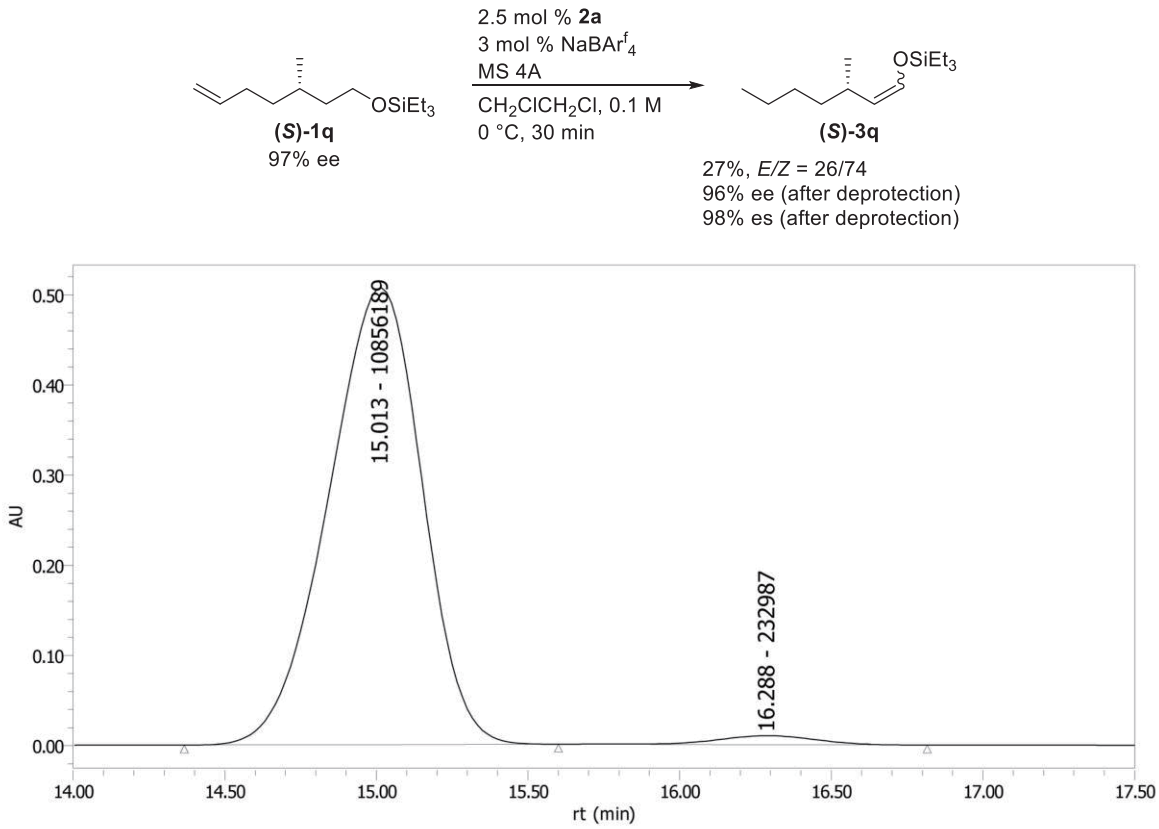
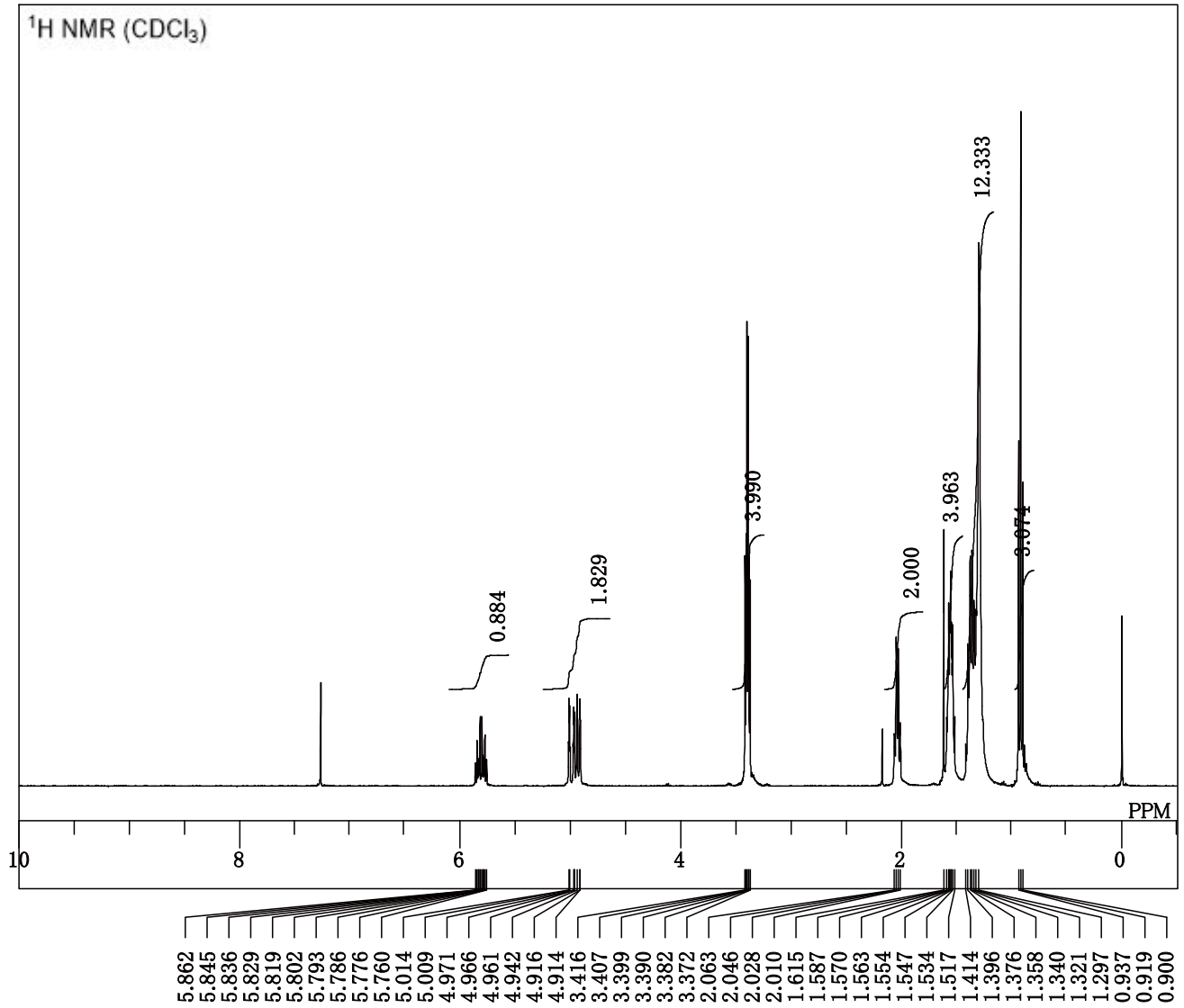
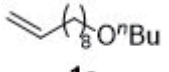
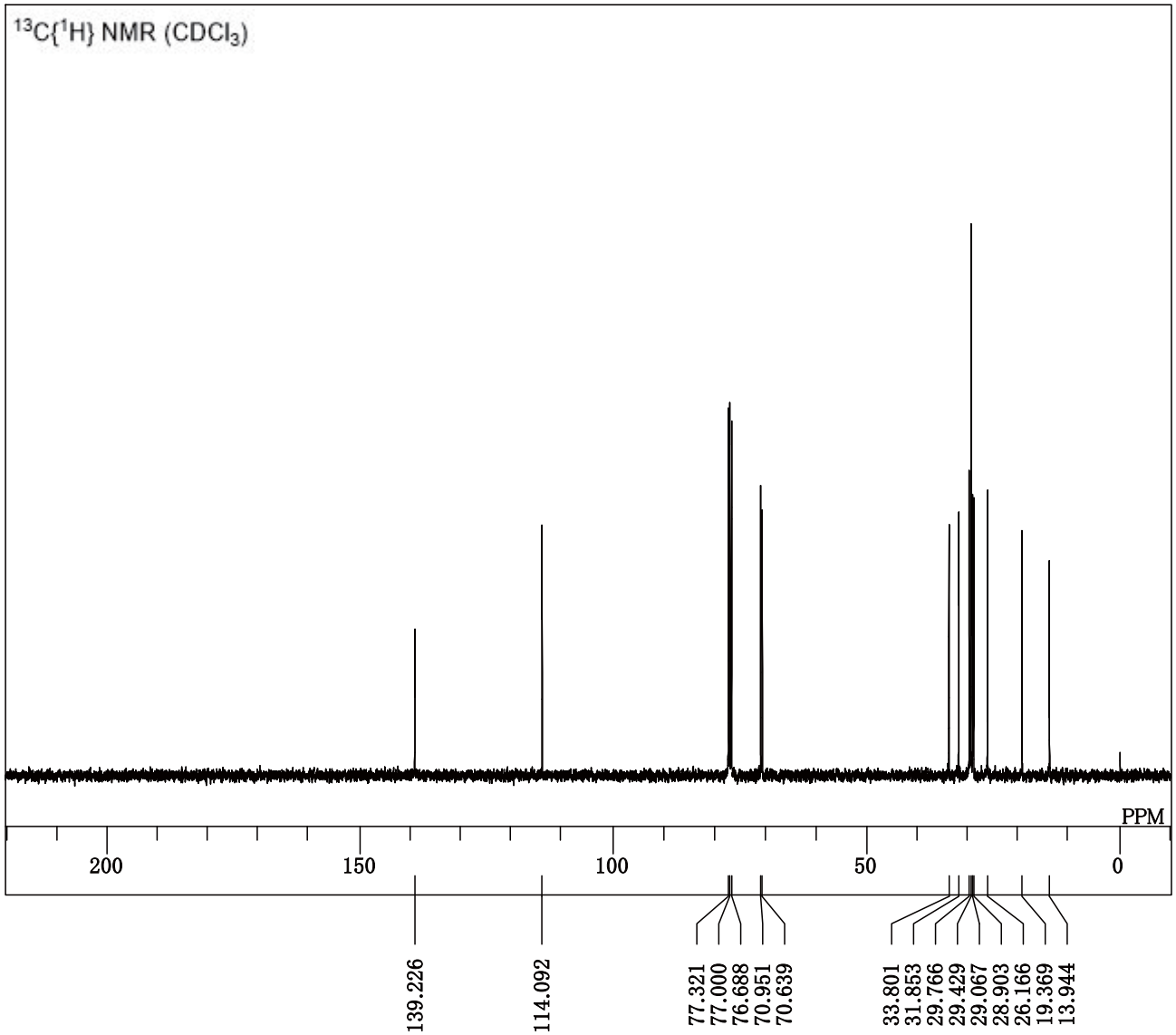


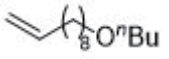
Figure S6. HPLC Analysis of (*S*)-**3q** (reaction conditions: standard except that the concentration was 0.1 M)


^{1}H NMR ($CDCl_3$)
0.884
1.829
3.990
2.000
3.963
12.333
3.074
PPM
10
8
6
4
2
0
5.862
5.845
5.836
5.829
5.819
5.802
5.793
5.786
5.776
5.760
5.014
5.009
4.971
4.966
4.961
4.942
4.916
4.914
3.416
3.407
3.399
3.390
3.382
3.372
2.063
2.046
2.028
2.010
1.615
1.587
1.570
1.563
1.554
1.547
1.534
1.517
1.414
1.396
1.376
1.358
1.340
1.321
1.297
0.937
0.919
0.900

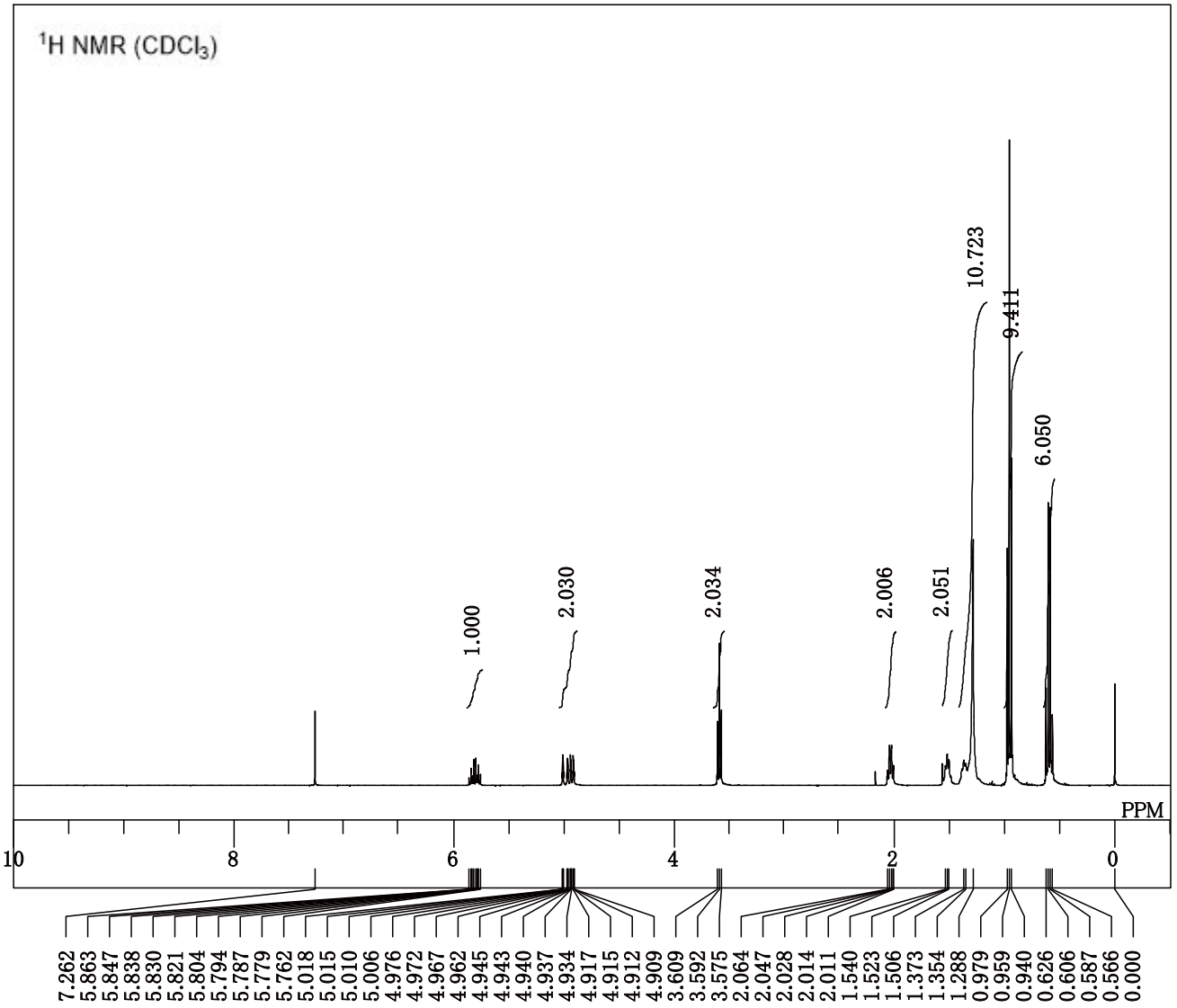

O^{n}Bu

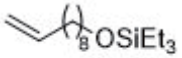
1a


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
139.226
114.092
77.321
77.000
76.688
70.951
70.639
33.801
31.853
29.766
29.429
29.067
28.903
26.166
19.369
13.944

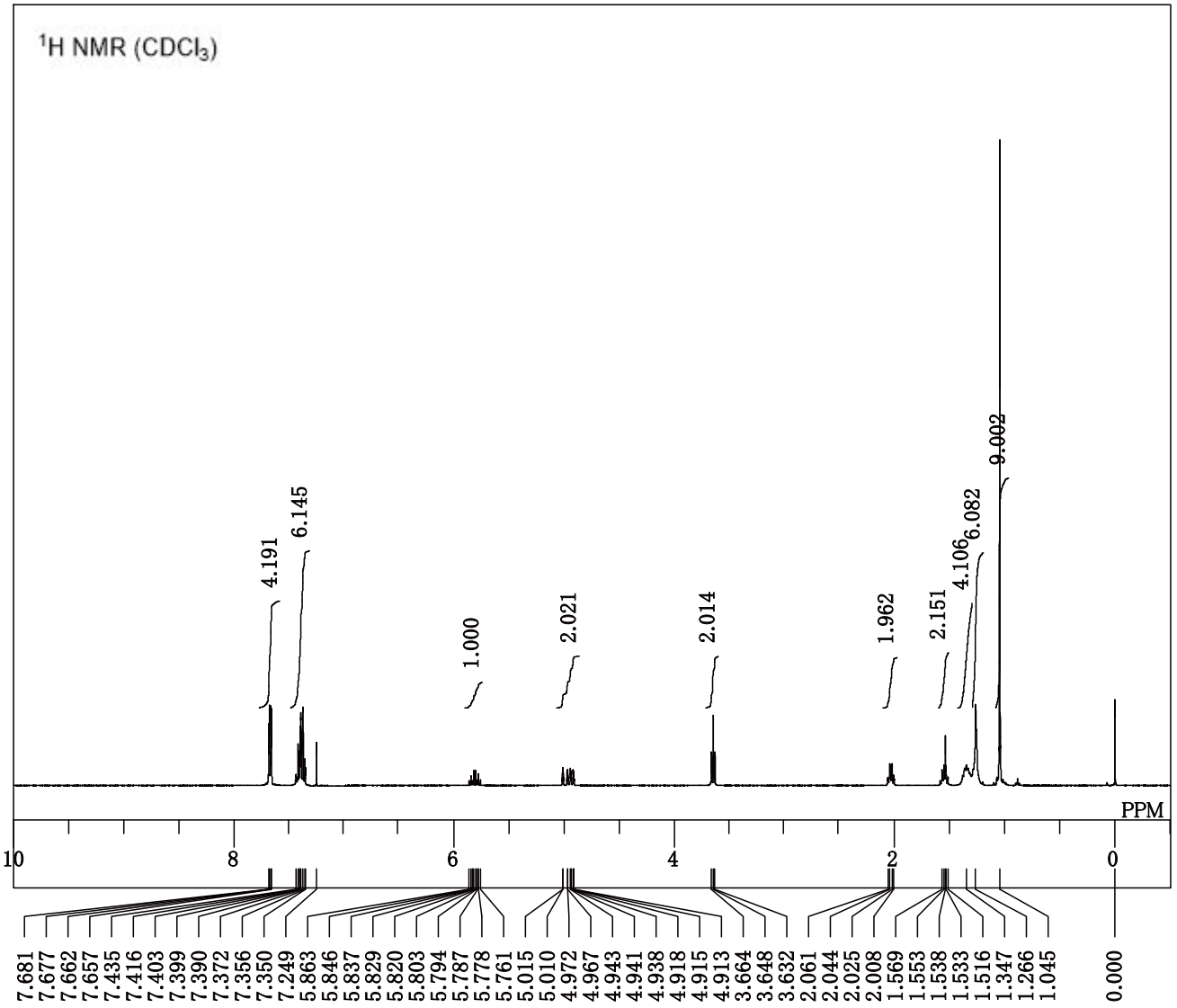

O^{n}Bu

1a


^{1}H NMR ($CDCl_3$)
1.000
2.030
2.034
2.006
2.051
10.723
9.411
6.050
PPM
10
8
6
4
2
0
7.262
5.863
5.847
5.838
5.830
5.821
5.804
5.794
5.787
5.779
5.762
5.018
5.015
5.010
5.006
4.976
4.972
4.967
4.962
4.945
4.943
4.940
4.937
4.934
4.917
4.915
4.912
4.909
3.609
3.592
3.575
2.064
2.047
2.028
2.014
2.011
1.540
1.523
1.506
1.373
1.354
1.288
0.979
0.959
0.940
0.626
0.606
0.587
0.566
0.000

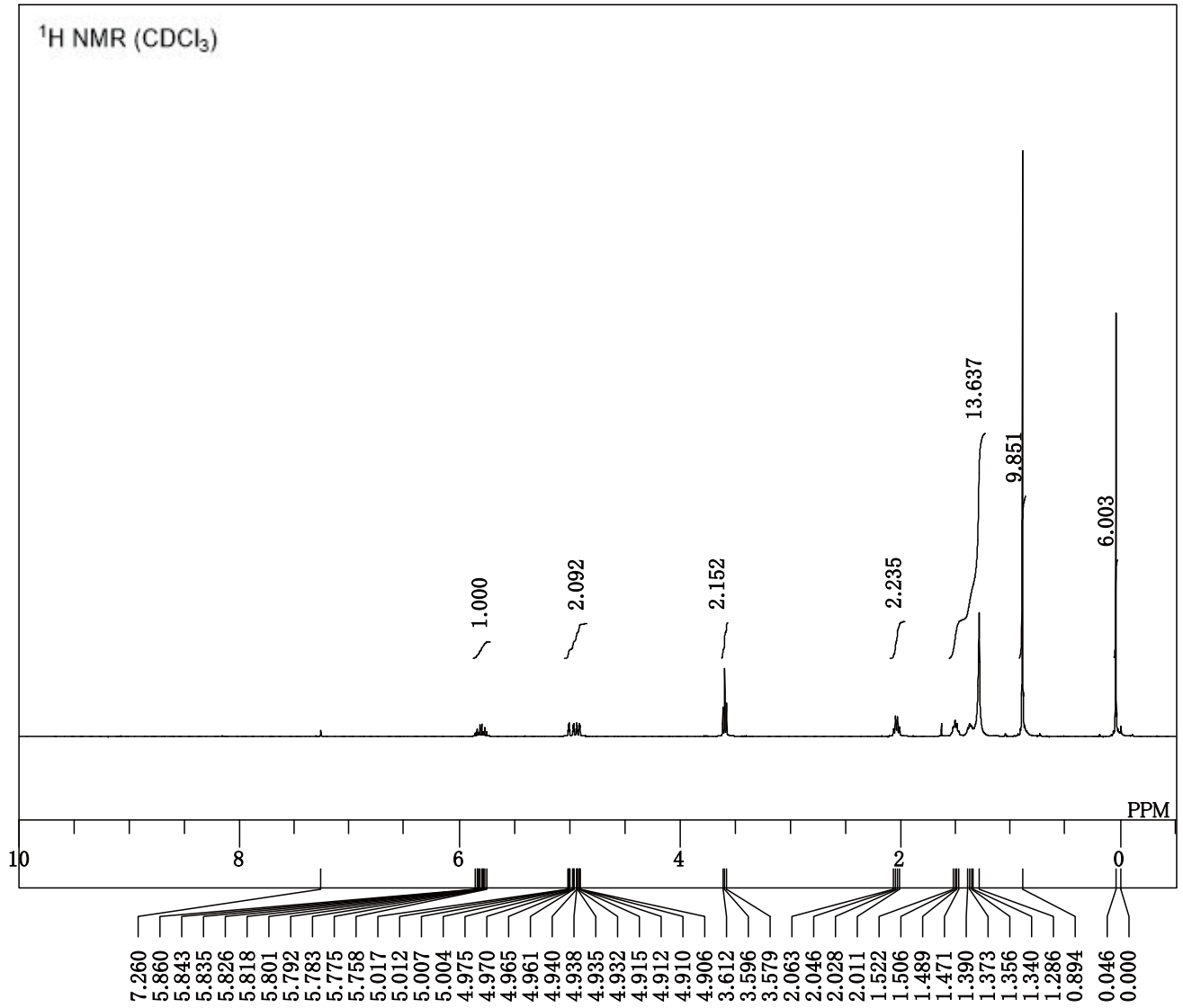

8
OSiEt3

1b


^{1}H NMR ($CDCl_3$)
4.191
6.145
1.000
2.021
2.014
1.962
2.151
4.106
6.082
9.002
PPM
10
8
6
4
2
0
7.681
7.677
7.662
7.657
7.435
7.416
7.403
7.399
7.390
7.372
7.356
7.350
7.249
5.863
5.846
5.837
5.829
5.820
5.803
5.794
5.787
5.778
5.761
5.015
5.010
4.972
4.967
4.943
4.941
4.938
4.918
4.915
4.913
3.664
3.648
3.632
2.061
2.044
2.025
2.008
1.569
1.553
1.538
1.533
1.516
1.347
1.266
1.045
0.000

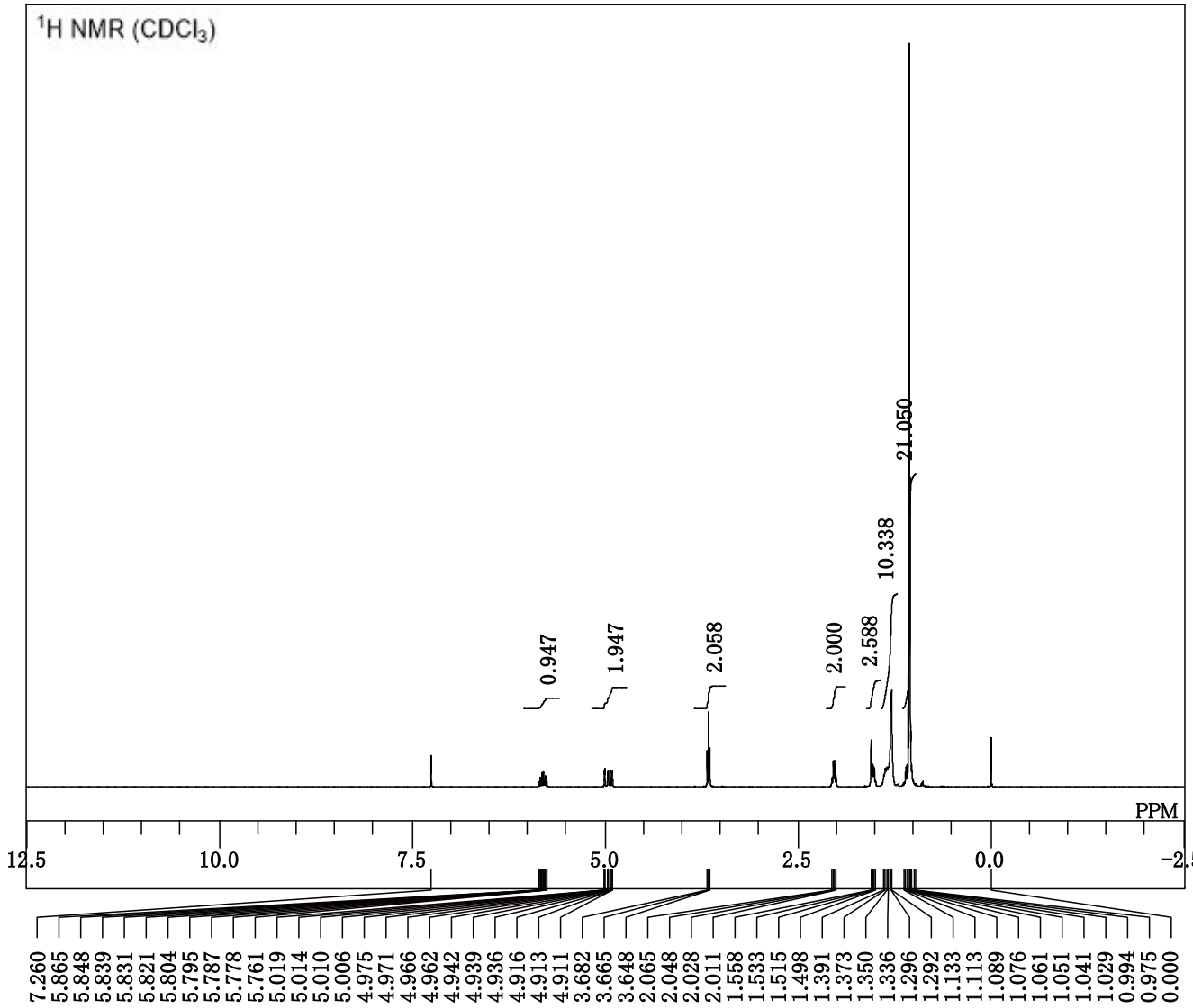

8
OSi^{t}BuPh$_2$

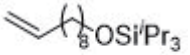
1c


1H NMR (CDCl3)
1.000
2.092
2.152
2.235
13.637
9.851
6.003
PPM
10
8
6
4
2
0
7.260
5.860
5.843
5.835
5.826
5.818
5.801
5.792
5.783
5.775
5.758
5.017
5.012
5.007
5.004
4.975
4.970
4.965
4.961
4.940
4.938
4.935
4.932
4.915
4.912
4.910
4.906
3.612
3.596
3.579
2.063
2.046
2.028
2.011
1.522
1.506
1.489
1.471
1.390
1.373
1.356
1.340
1.286
0.894
0.046
0.000

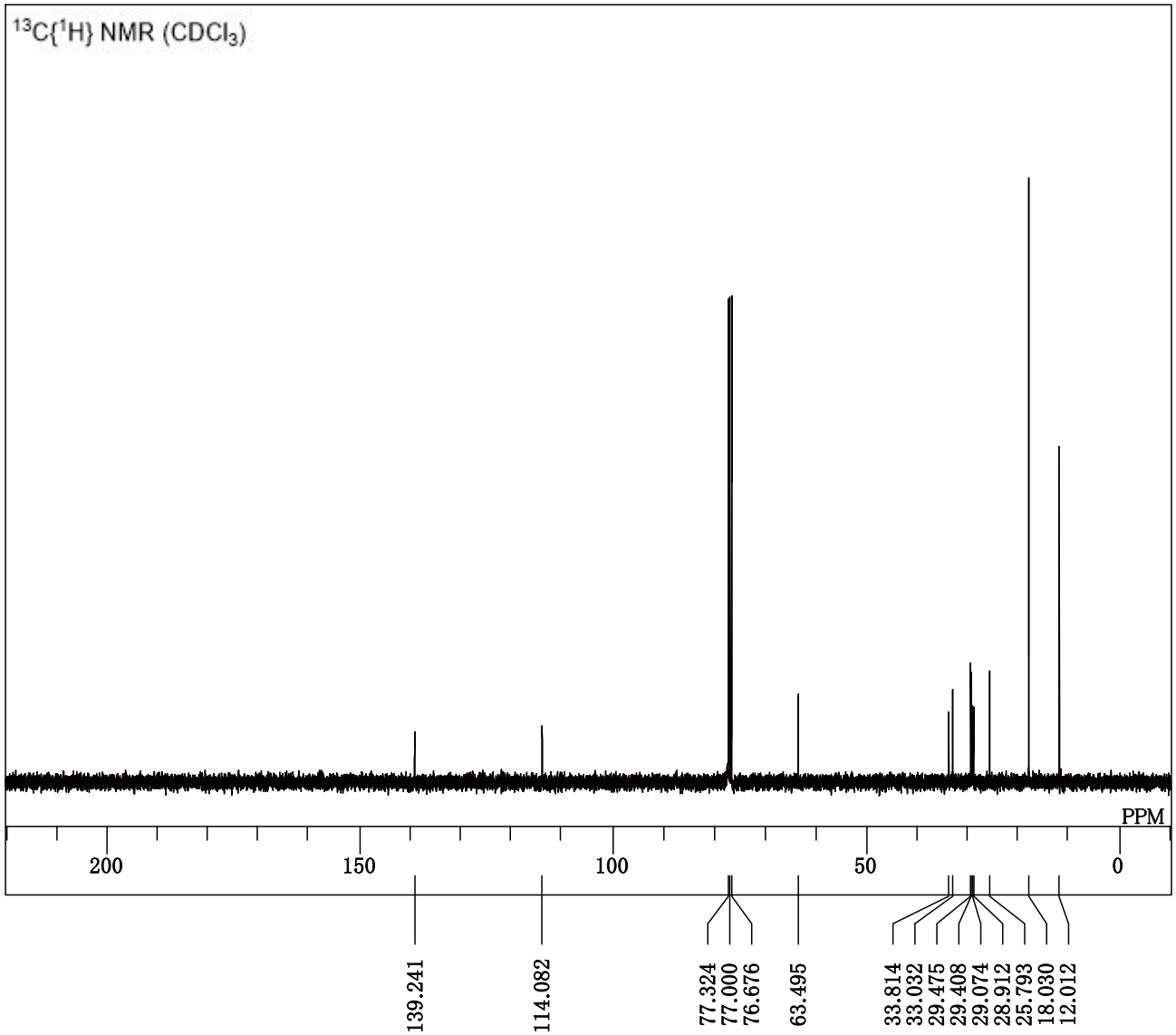

8
OSi^{t}BuMe$_2$

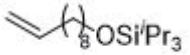
1d


^{1}H NMR ($CDCl_3$)
0.947
1.947
2.058
2.000
2.588
10.338
21.050
PPM
12.5
10.0
7.5
5.0
2.5
0.0
−2.5
7.260
5.865
5.848
5.839
5.831
5.821
5.804
5.795
5.787
5.778
5.761
5.019
5.014
5.010
5.006
4.975
4.971
4.966
4.962
4.942
4.939
4.936
4.916
4.913
4.911
3.682
3.665
3.648
2.065
2.048
2.028
2.011
1.558
1.533
1.515
1.498
1.391
1.373
1.350
1.336
1.296
1.292
1.133
1.113
1.089
1.076
1.061
1.051
1.041
1.029
0.994
0.975
0.000

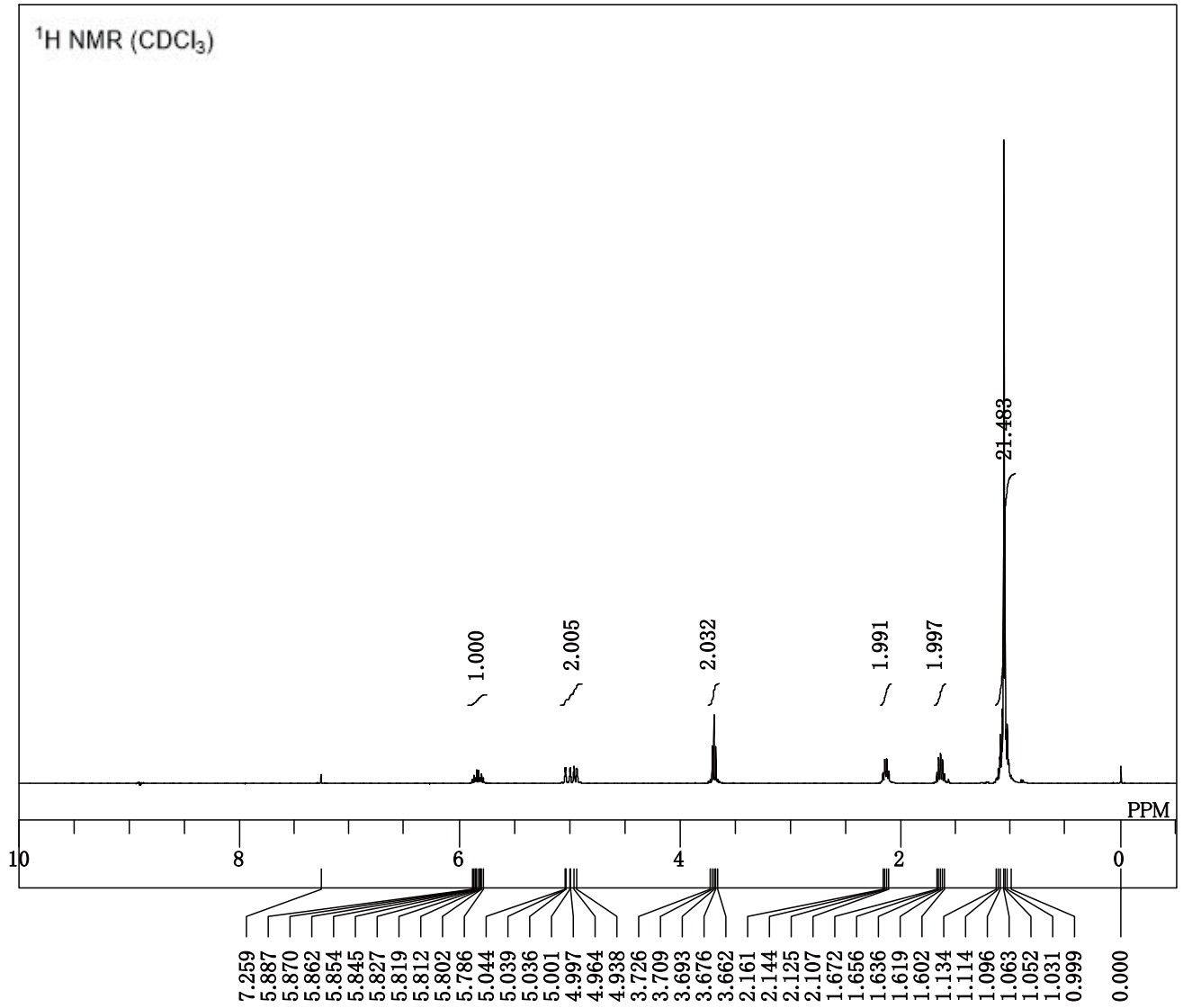

8
OSi^{i}Pr$_3$

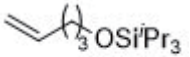
1e


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
139.241
114.082
77.324
77.000
76.676
63.495
33.814
33.032
29.475
29.408
29.074
28.912
25.793
18.030
12.012

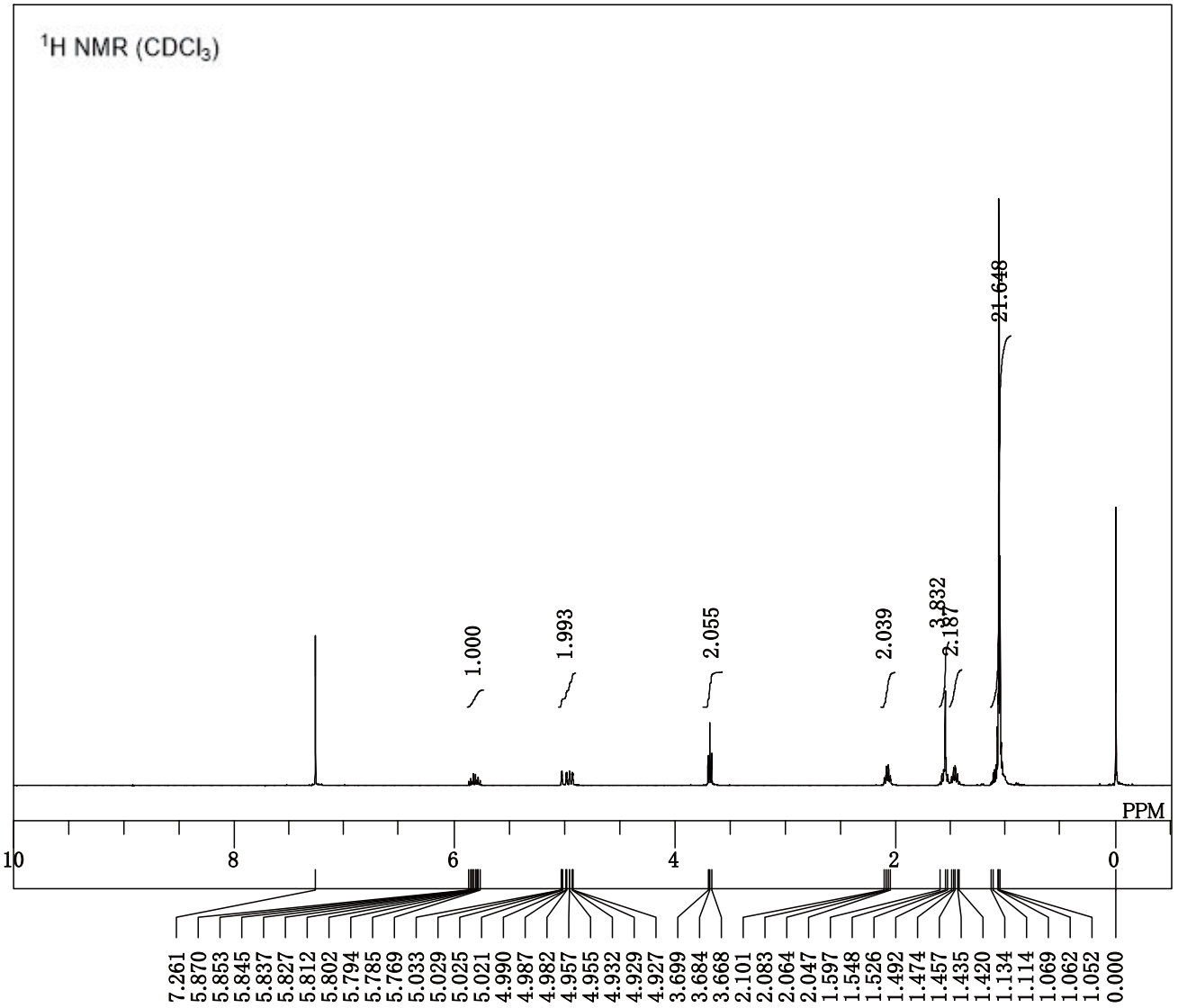

8
OSi^{i}Pr$_3$

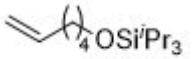
1e


1H NMR (CDCl3)
1.000
2.005
2.032
1.991
1.997
21.483
PPM
10
8
6
4
2
0
7.259
5.887
5.870
5.862
5.854
5.845
5.827
5.819
5.812
5.802
5.786
5.044
5.039
5.036
5.001
4.997
4.964
4.938
3.726
3.709
3.693
3.676
3.662
2.161
2.144
2.125
2.107
1.672
1.656
1.636
1.619
1.602
1.134
1.114
1.096
1.063
1.052
1.031
0.999
0.000

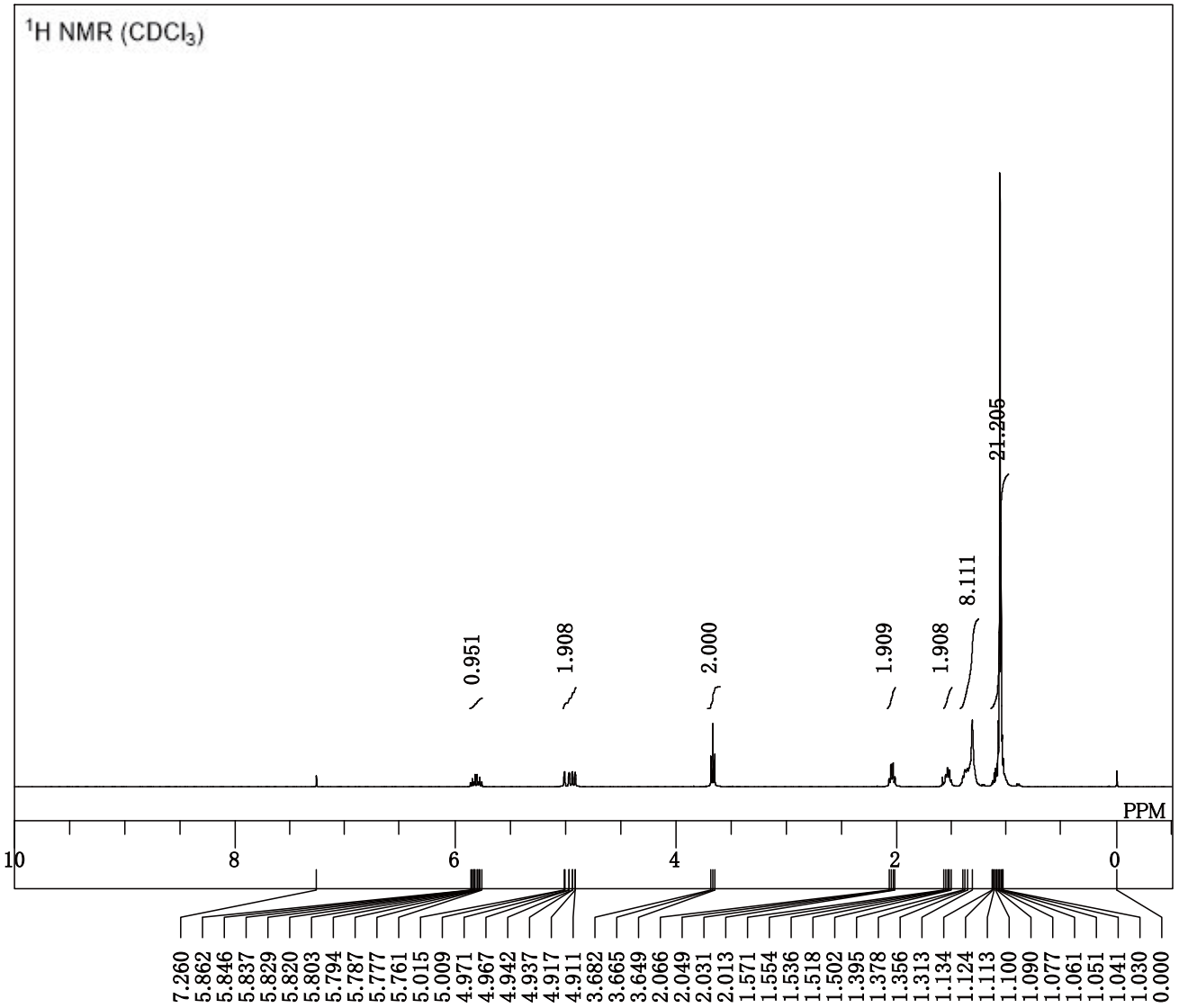

3
OSiiPr3

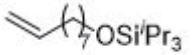
1f


1H NMR (CDCl3)
1.000
1.993
2.055
2.039
3.832
2.187
21.648
PPM
10
8
6
4
2
0
7.261
5.870
5.853
5.845
5.837
5.827
5.812
5.802
5.794
5.785
5.769
5.033
5.029
5.025
5.021
4.990
4.987
4.982
4.957
4.955
4.932
4.929
4.927
3.699
3.684
3.668
2.101
2.083
2.064
2.047
1.597
1.548
1.526
1.492
1.474
1.457
1.435
1.420
1.134
1.114
1.069
1.062
1.052
0.000

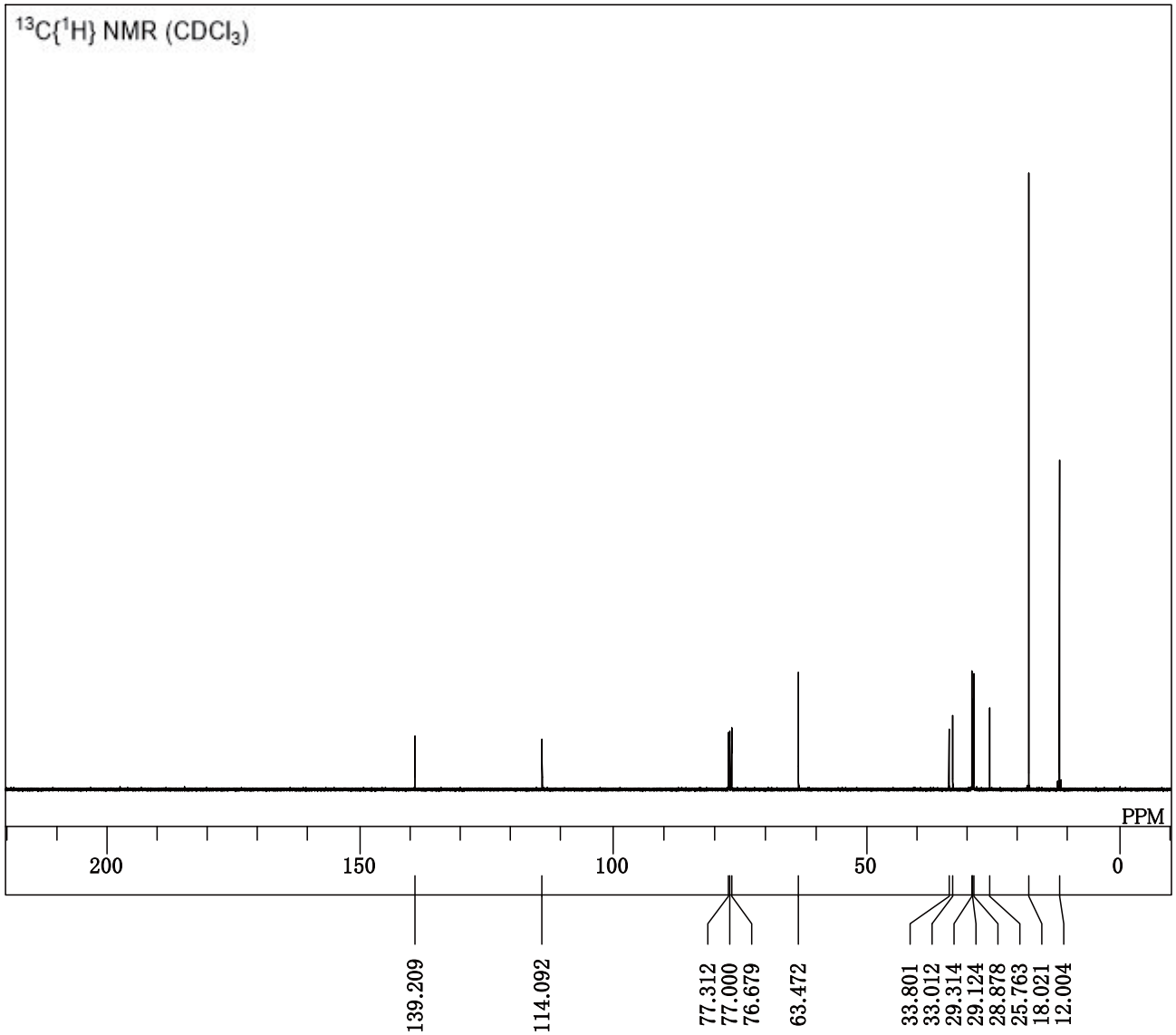

4
OSi^{i}Pr$_3$

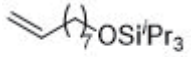
1g


1H NMR (CDCl3)
0.951
1.908
2.000
1.909
1.908
8.111
21.205
PPM
10
8
6
4
2
0
7.260
5.862
5.846
5.837
5.829
5.820
5.803
5.794
5.787
5.777
5.761
5.015
5.009
4.971
4.967
4.942
4.937
4.917
4.911
3.682
3.665
3.649
2.066
2.049
2.031
2.013
1.571
1.554
1.536
1.518
1.502
1.395
1.378
1.356
1.313
1.134
1.124
1.113
1.100
1.090
1.077
1.061
1.051
1.041
1.030
0.000

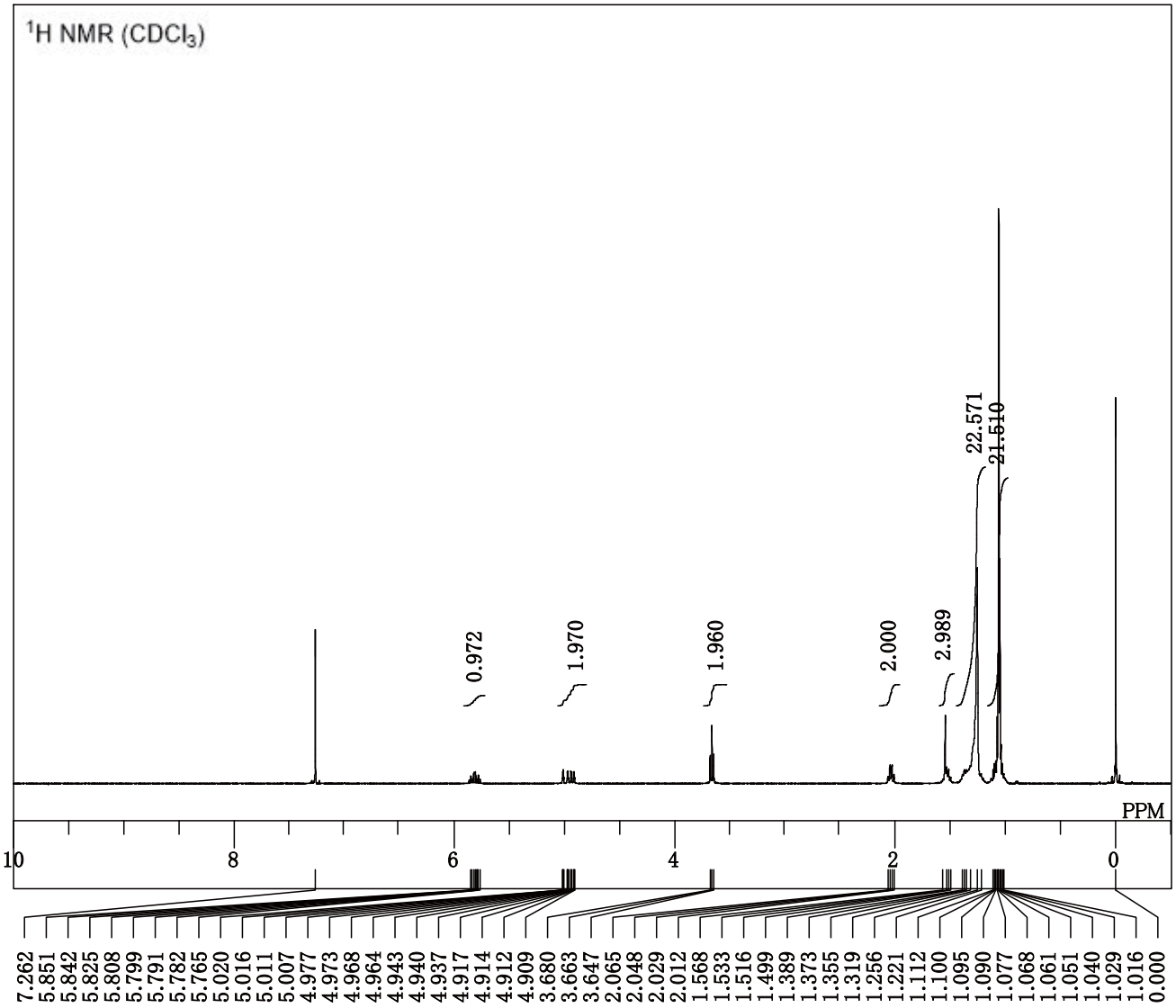

OSiiPr3

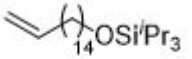
1h


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
139.209
114.092
77.312
77.000
76.679
63.472
33.801
33.012
29.314
29.124
28.878
25.763
18.021
12.004

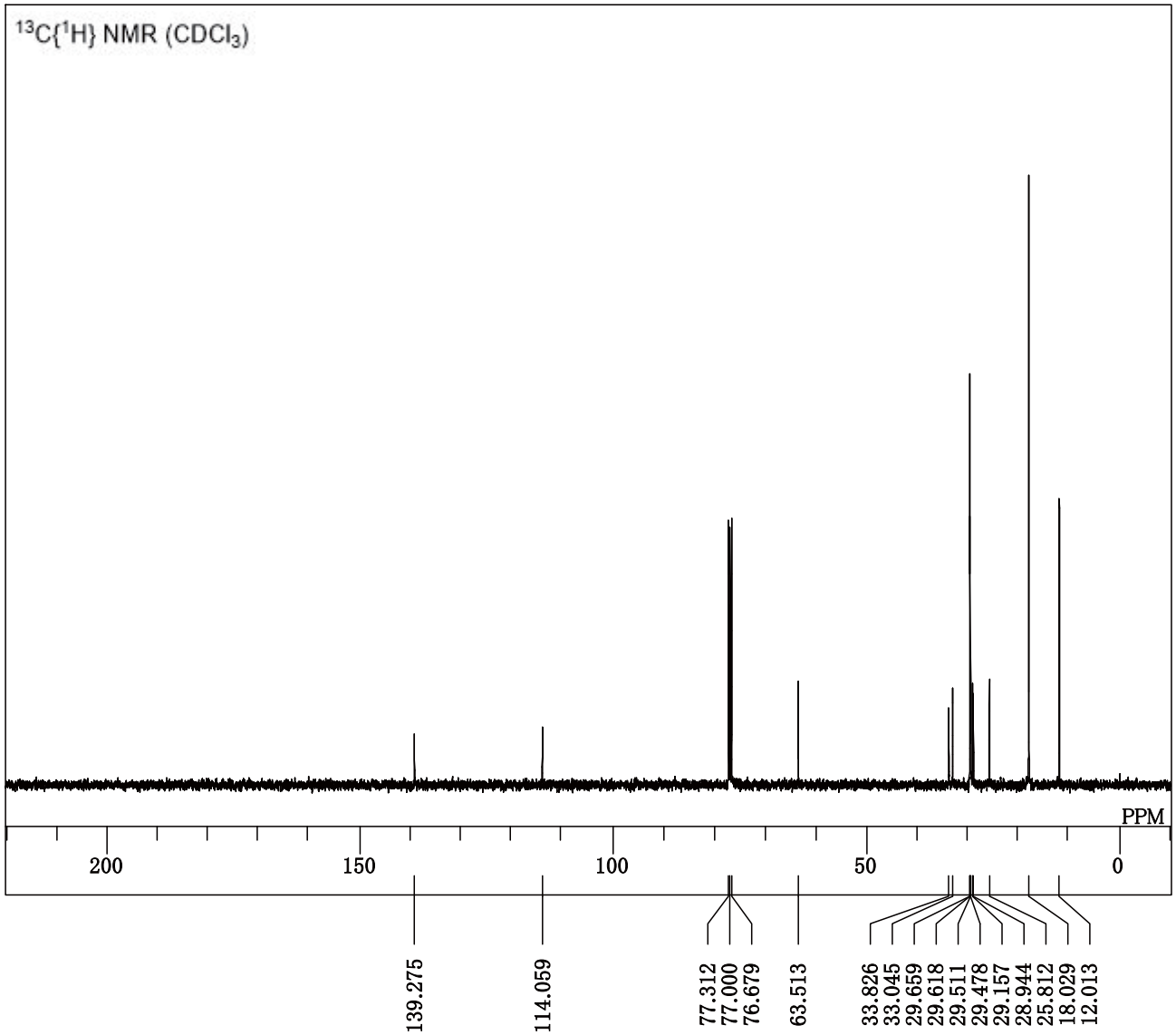

OSi^{i}Pr$_3$

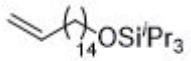
1h


^{1}H NMR ($CDCl_3$)
0.972
1.970
1.960
2.000
2.989
22.571
21.510
PPM
10
8
6
4
2
0
7.262
5.851
5.842
5.825
5.808
5.799
5.791
5.782
5.765
5.020
5.016
5.011
5.007
4.977
4.973
4.968
4.964
4.943
4.940
4.937
4.917
4.914
4.912
4.909
3.680
3.663
3.647
2.065
2.048
2.029
2.012
1.568
1.533
1.516
1.499
1.389
1.373
1.355
1.319
1.256
1.221
1.112
1.100
1.095
1.090
1.077
1.068
1.061
1.051
1.040
1.029
1.016
0.000

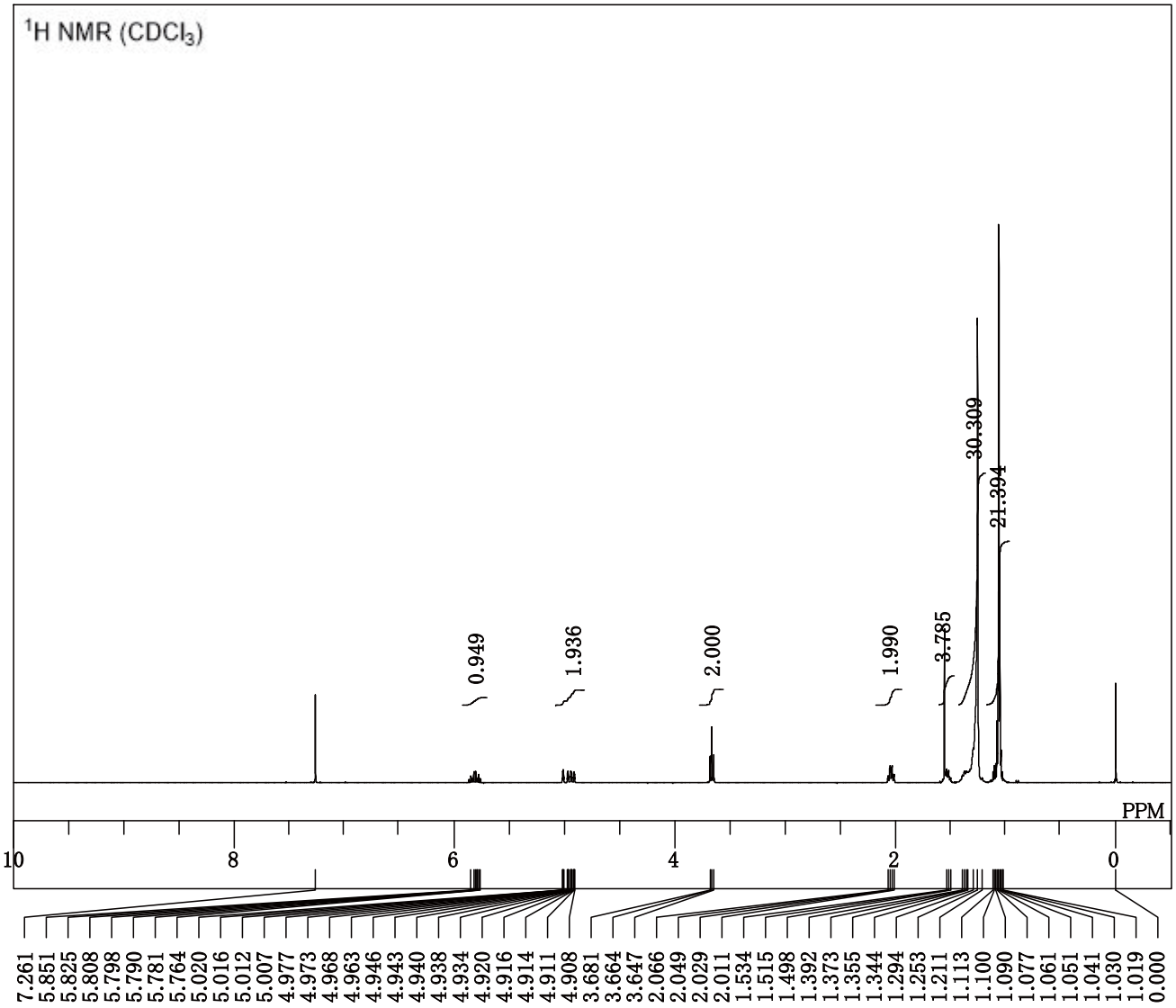

14
OSi^{i}Pr$_3$

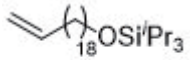
1i


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
139.275
114.059
77.312
77.000
76.679
63.513
33.826
33.045
29.659
29.618
29.511
29.478
29.157
28.944
25.812
18.029
12.013

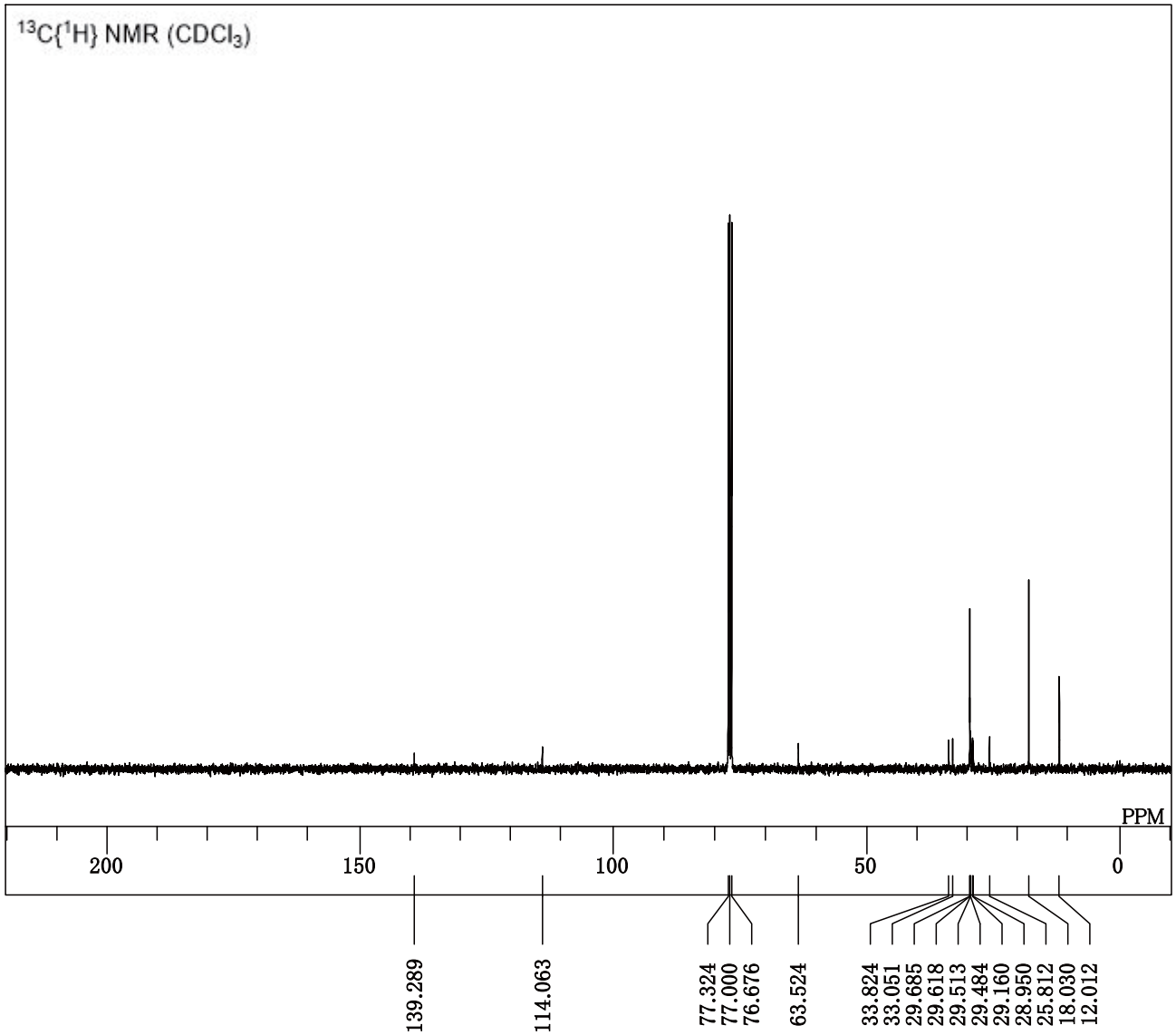

14
OSi^{i}Pr$_3$

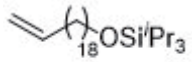
1i


^{1}H NMR ($CDCl_3$)
0.949
1.936
2.000
1.990
3.785
30.309
21.394
PPM
10
8
6
4
2
0
7.261
5.851
5.825
5.808
5.798
5.790
5.781
5.764
5.020
5.016
5.012
5.007
4.977
4.973
4.968
4.963
4.946
4.943
4.940
4.938
4.934
4.920
4.916
4.914
4.911
4.908
3.681
3.664
3.647
2.066
2.049
2.029
2.011
1.534
1.515
1.498
1.392
1.373
1.355
1.344
1.294
1.253
1.211
1.113
1.100
1.090
1.077
1.061
1.051
1.041
1.030
1.019
0.000

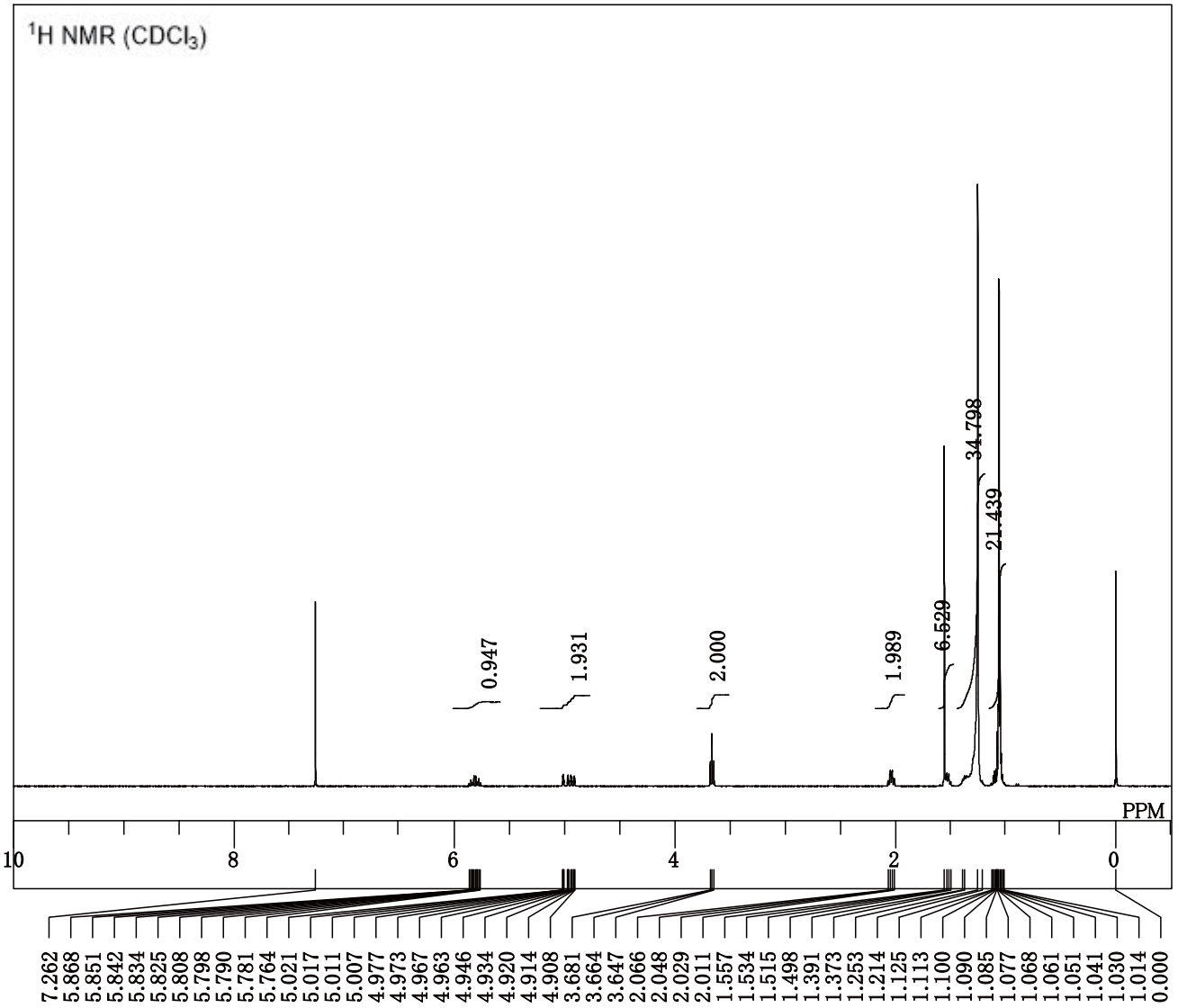

18
OSi^{i}Pr$_3$

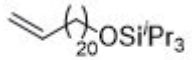
1j


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
139.289
114.063
77.324
77.000
76.676
63.524
33.824
33.051
29.685
29.618
29.513
29.484
29.160
28.950
25.812
18.030
12.012

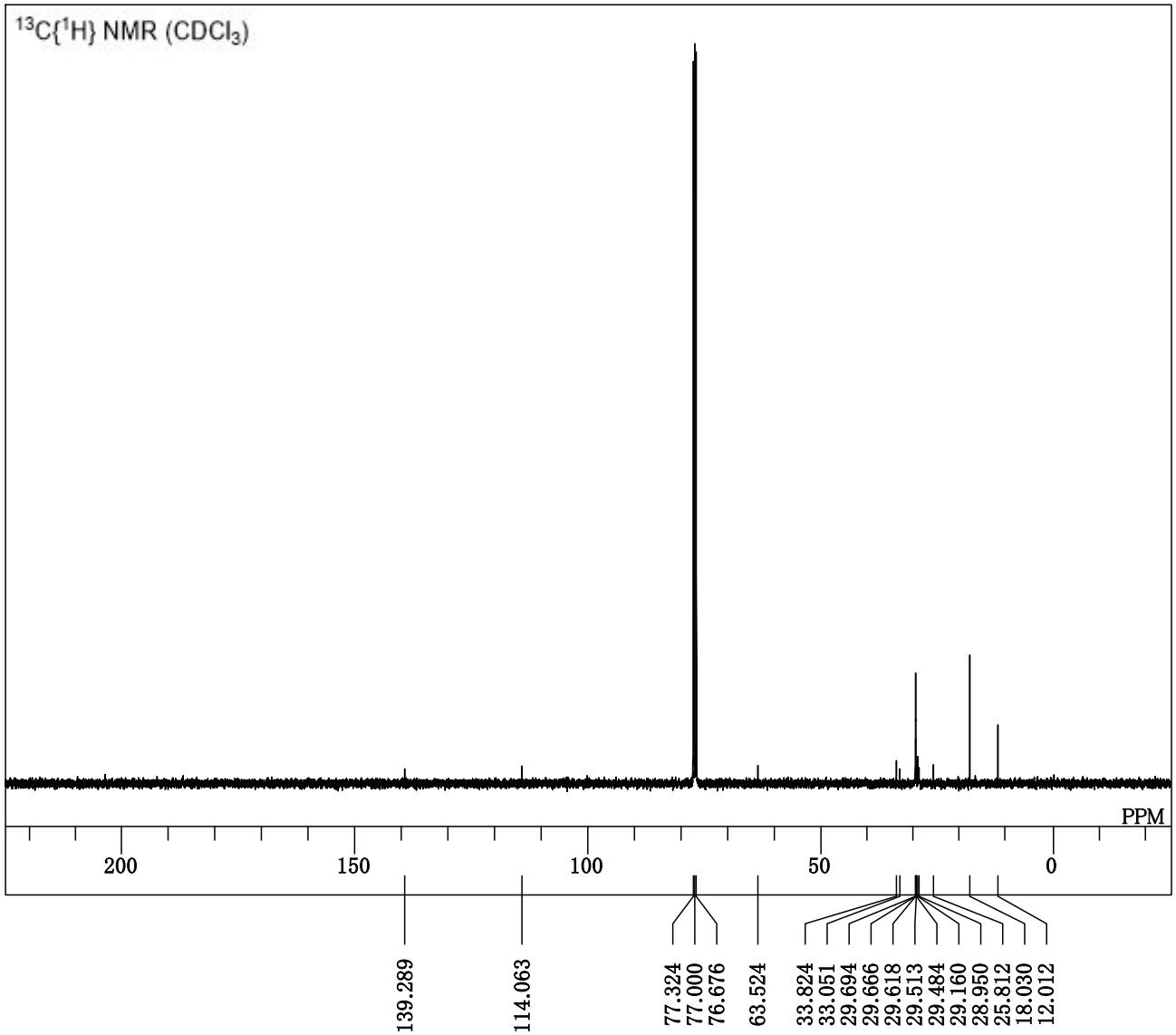

18
OSi^{i}Pr$_3$

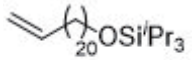
1j


^{1}H NMR ($CDCl_3$)
0.947
1.931
2.000
1.989
6.529
34.798
21.439
PPM
10
8
6
4
2
0
7.262
5.868
5.851
5.842
5.834
5.825
5.808
5.798
5.790
5.781
5.764
5.021
5.017
5.011
5.007
4.977
4.973
4.967
4.963
4.946
4.934
4.920
4.914
4.908
3.681
3.664
3.647
2.066
2.048
2.029
2.011
1.557
1.534
1.515
1.498
1.391
1.373
1.253
1.214
1.125
1.113
1.100
1.090
1.085
1.077
1.068
1.061
1.051
1.041
1.030
1.014
0.000

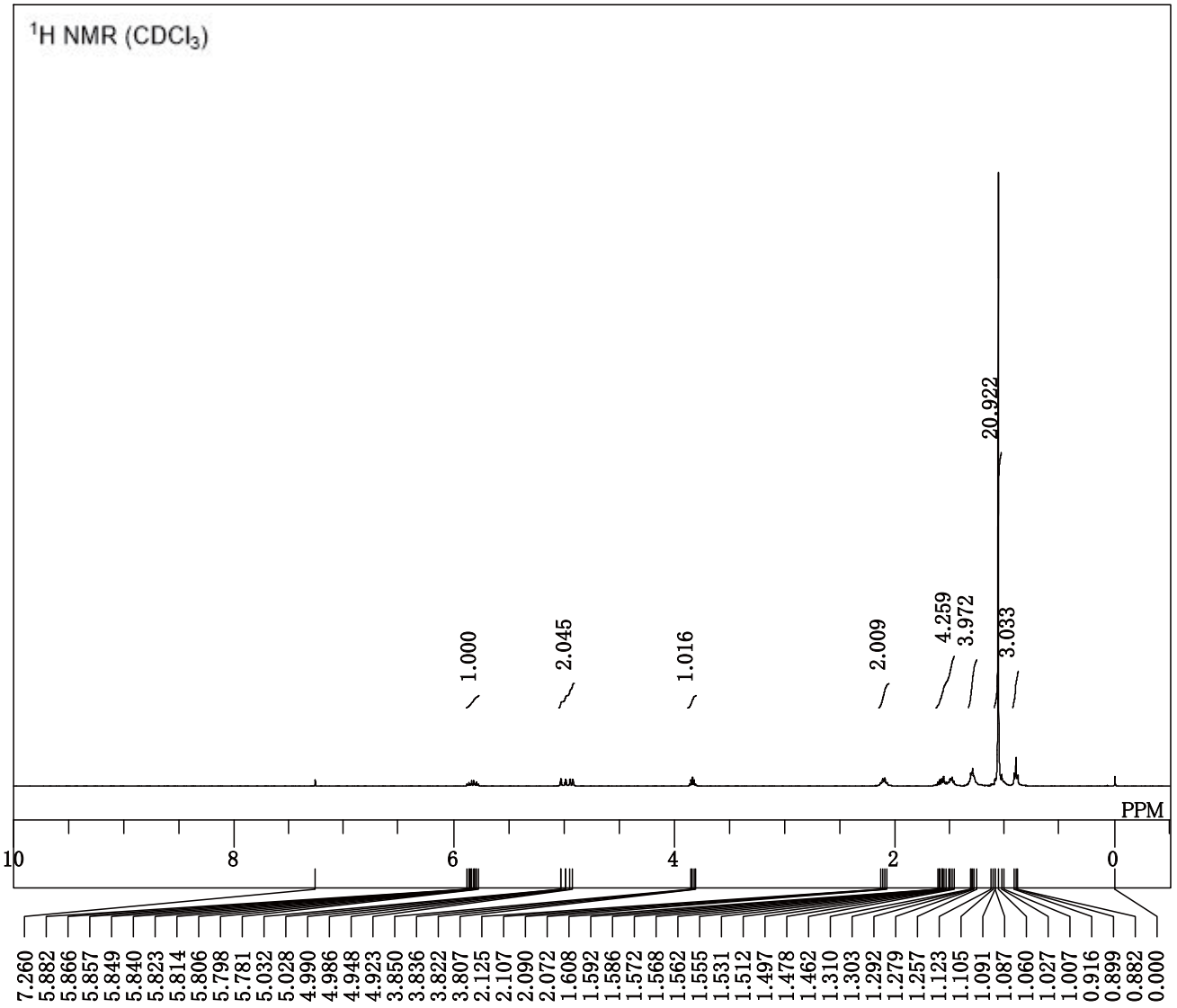

20
OSi^{i}Pr$_3$

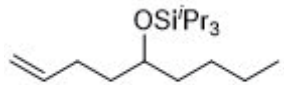
1k


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
139.289
114.063
77.324
77.000
76.676
63.524
33.824
33.051
29.694
29.666
29.618
29.513
29.484
29.160
28.950
25.812
18.030
12.012

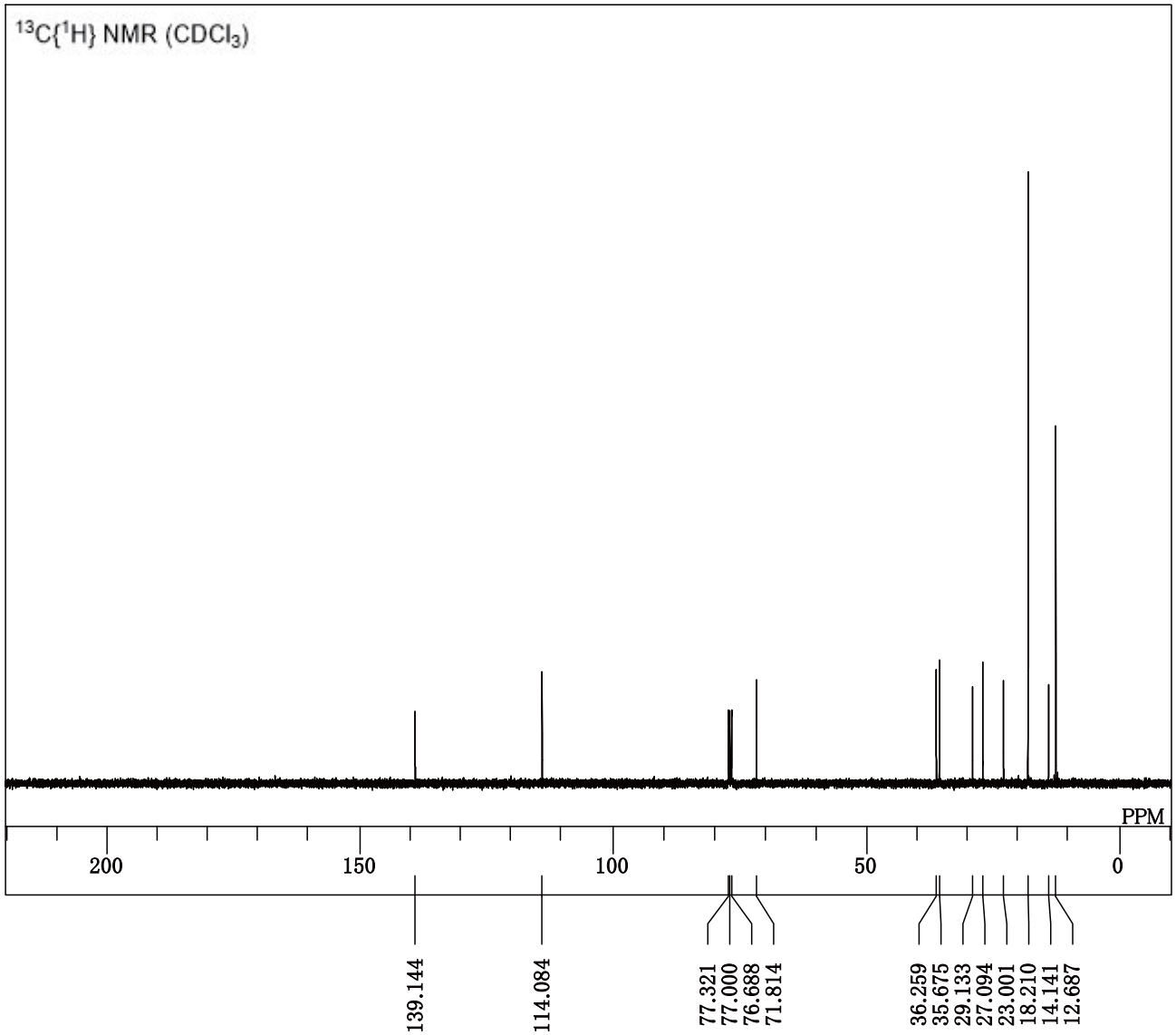

20
OSi^{i}Pr$_3$

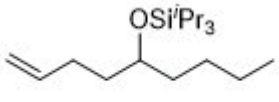
1k


^{1}H NMR ($CDCl_3$)
1.000
2.045
1.016
2.009
4.259
3.972
3.033
20.922
PPM
10
8
6
4
2
0
7.260
5.882
5.866
5.857
5.849
5.840
5.823
5.814
5.806
5.798
5.781
5.032
5.028
4.990
4.986
4.948
4.923
3.850
3.836
3.822
3.807
2.125
2.107
2.090
2.072
1.608
1.592
1.586
1.572
1.568
1.562
1.555
1.531
1.512
1.497
1.478
1.462
1.310
1.303
1.292
1.279
1.257
1.123
1.105
1.091
1.087
1.060
1.027
1.007
0.916
0.899
0.882
0.000

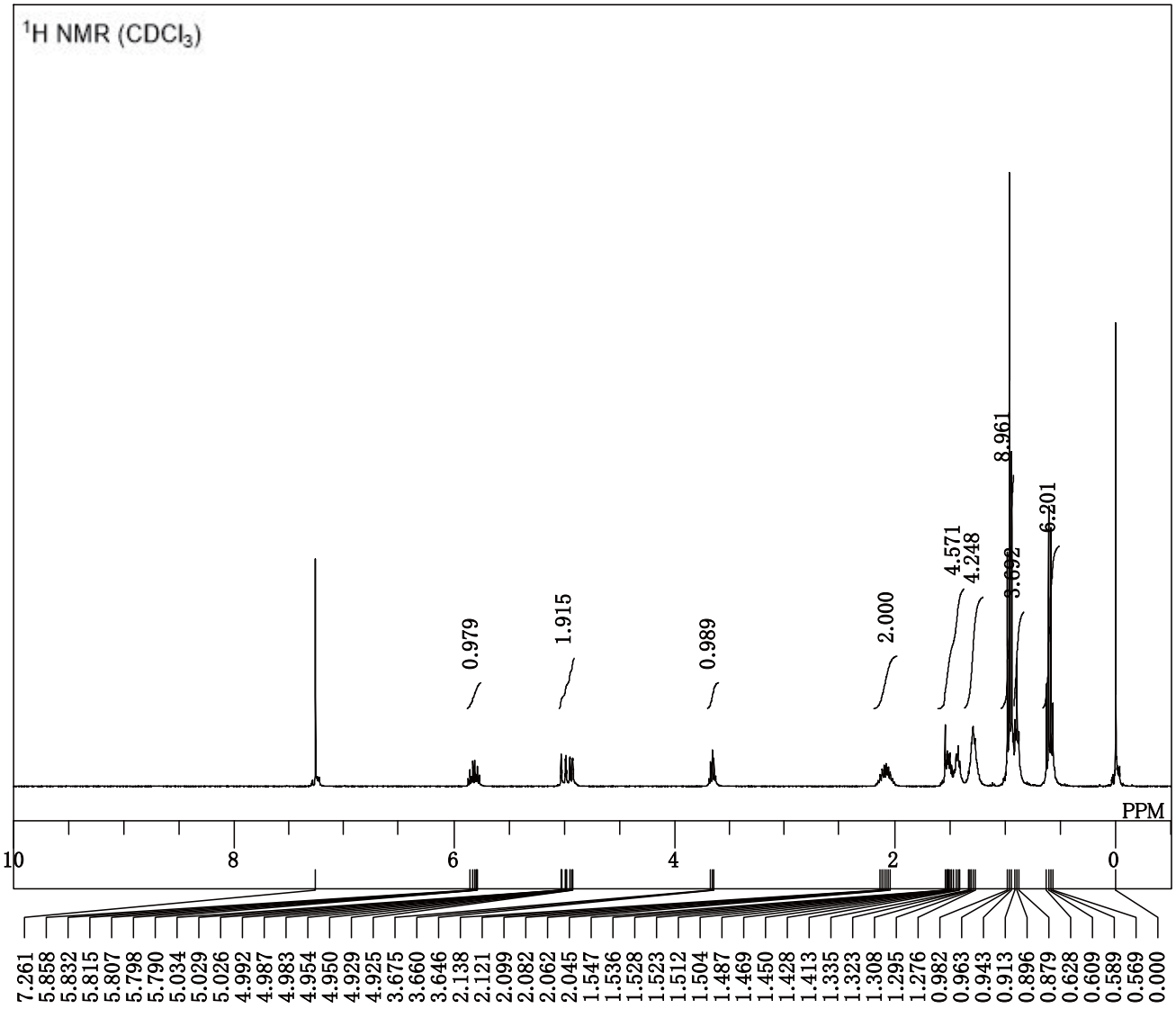

OSi^{i}Pr$_3$

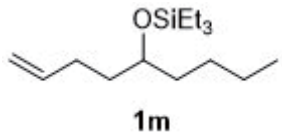
1l


13C{1H} NMR (CDCl3)
PPM
200
150
100
50
0
139.144
114.084
77.321
77.000
76.688
71.814
36.259
35.675
29.133
27.094
23.001
18.210
14.141
12.687

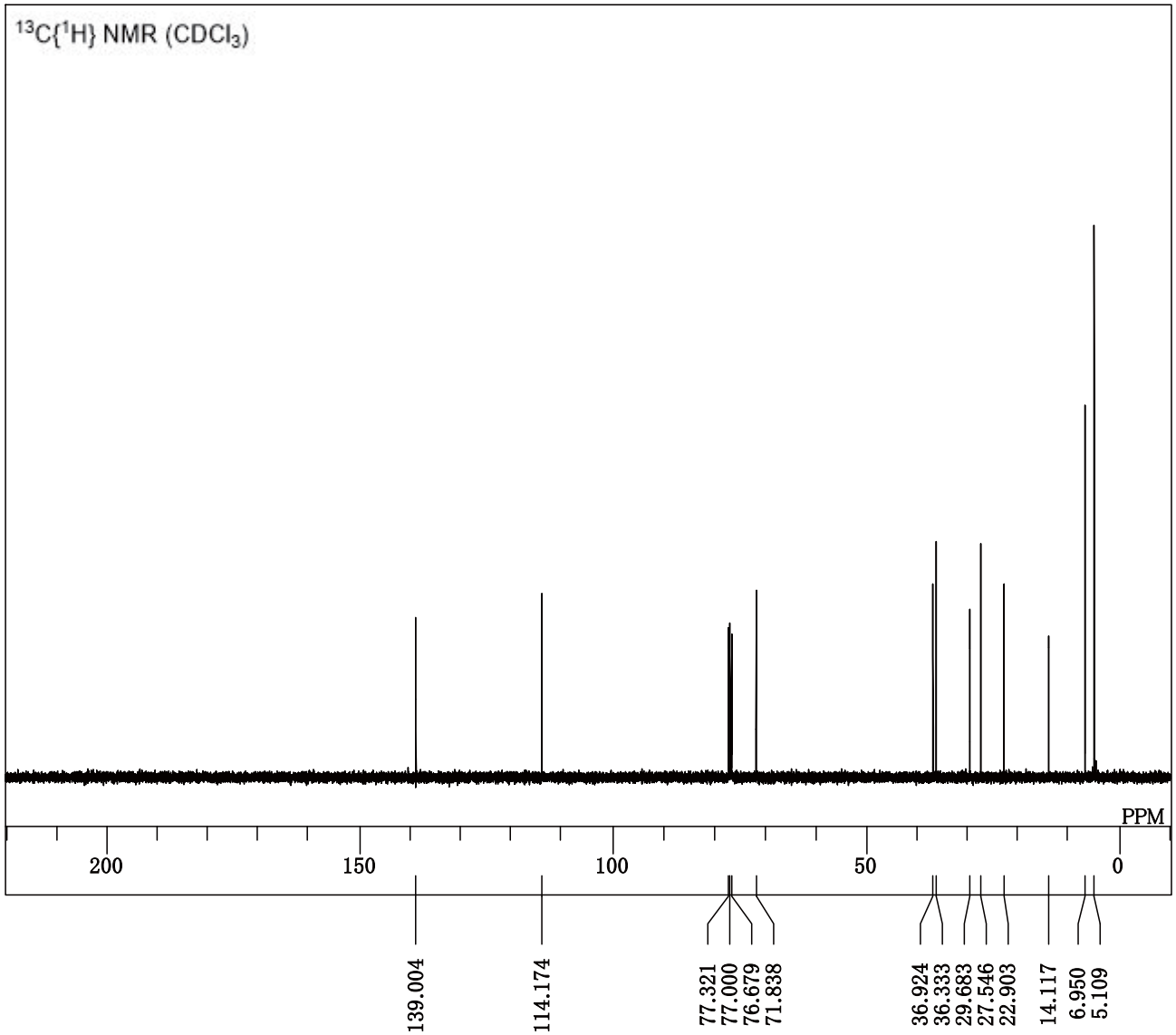

OSi^{i}Pr$_3$

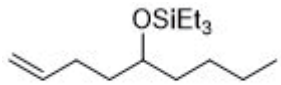
1l


^{1}H NMR ($CDCl_3$)
0.979
1.915
0.989
2.000
4.571
4.248
3.032
8.961
6.201
PPM
10
8
6
4
2
0
7.261
5.858
5.832
5.815
5.807
5.798
5.790
5.034
5.029
5.026
4.992
4.987
4.983
4.954
4.950
4.929
4.925
3.675
3.660
3.646
2.138
2.121
2.099
2.082
2.062
2.045
1.547
1.536
1.528
1.523
1.512
1.504
1.487
1.469
1.450
1.428
1.413
1.335
1.323
1.308
1.295
1.276
0.982
0.963
0.943
0.913
0.896
0.879
0.628
0.609
0.589
0.569
0.000

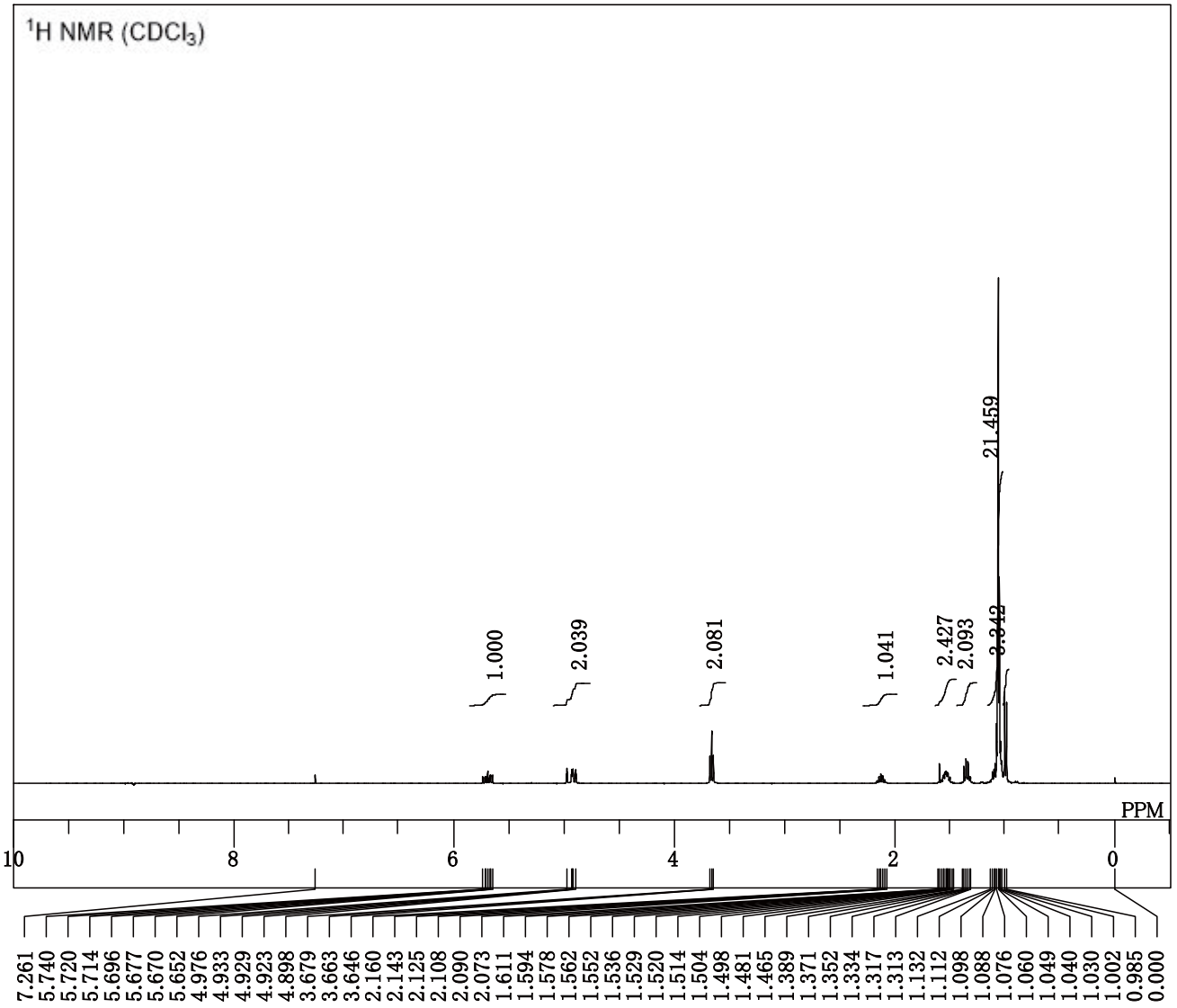

OSiEt$_3$

1m


13C{1H} NMR (CDCl3)
PPM
200
150
100
50
0
139.004
114.174
77.321
77.000
76.679
71.838
36.924
36.333
29.683
27.546
22.903
14.117
6.950
5.109

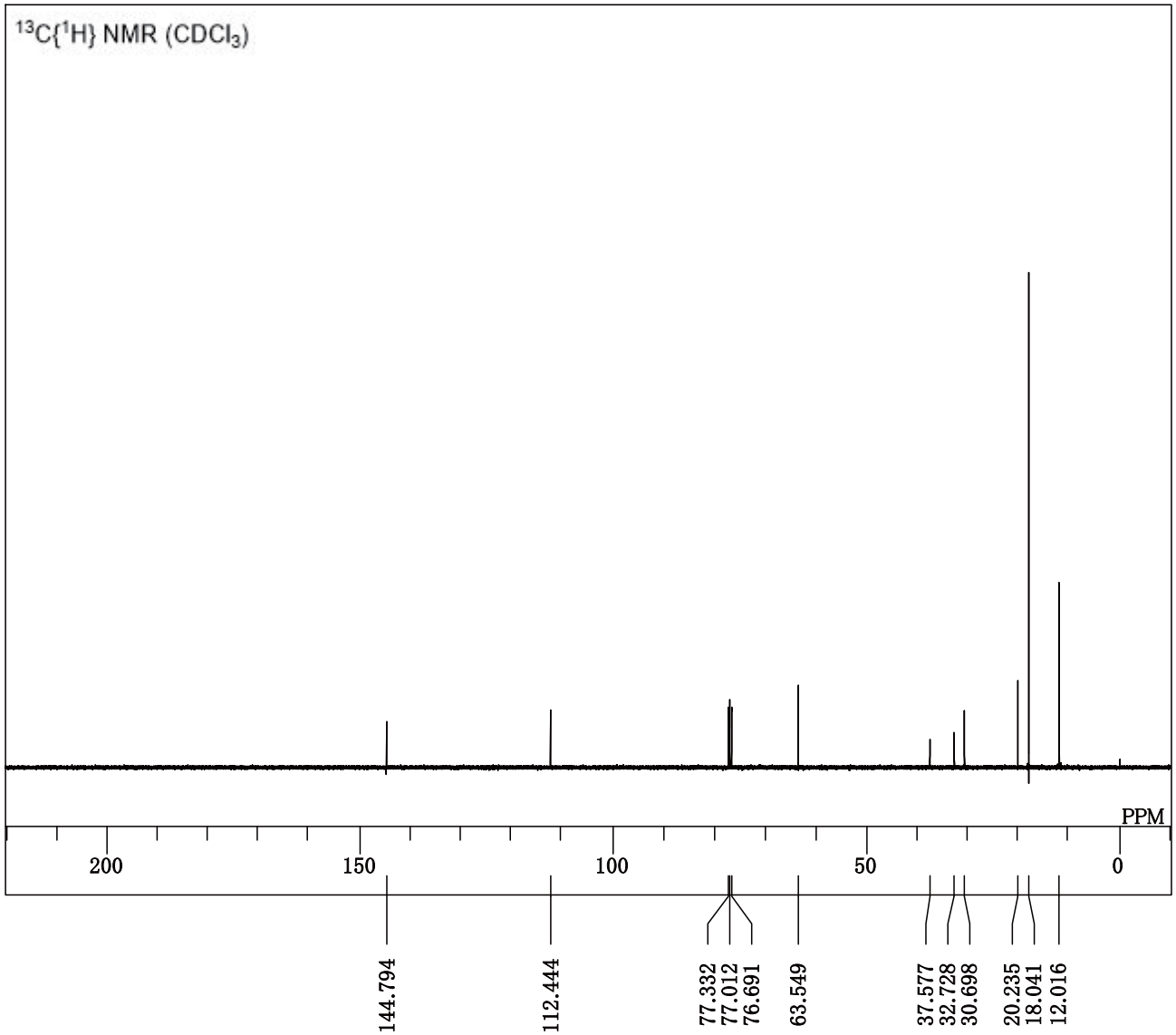

OSiEt3

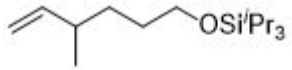
1m


^{1}H NMR ($CDCl_3$)
1.000
2.039
2.081
1.041
2.427
2.093
3.342
21.459
PPM
10
8
6
4
2
0
7.261
5.740
5.720
5.714
5.696
5.677
5.670
5.652
4.976
4.933
4.929
4.923
4.898
3.679
3.663
3.646
2.160
2.143
2.125
2.108
2.090
2.073
1.611
1.594
1.578
1.562
1.552
1.536
1.529
1.520
1.514
1.504
1.498
1.481
1.465
1.389
1.371
1.352
1.334
1.317
1.313
1.132
1.112
1.098
1.088
1.076
1.060
1.049
1.040
1.030
1.002
0.985
0.000

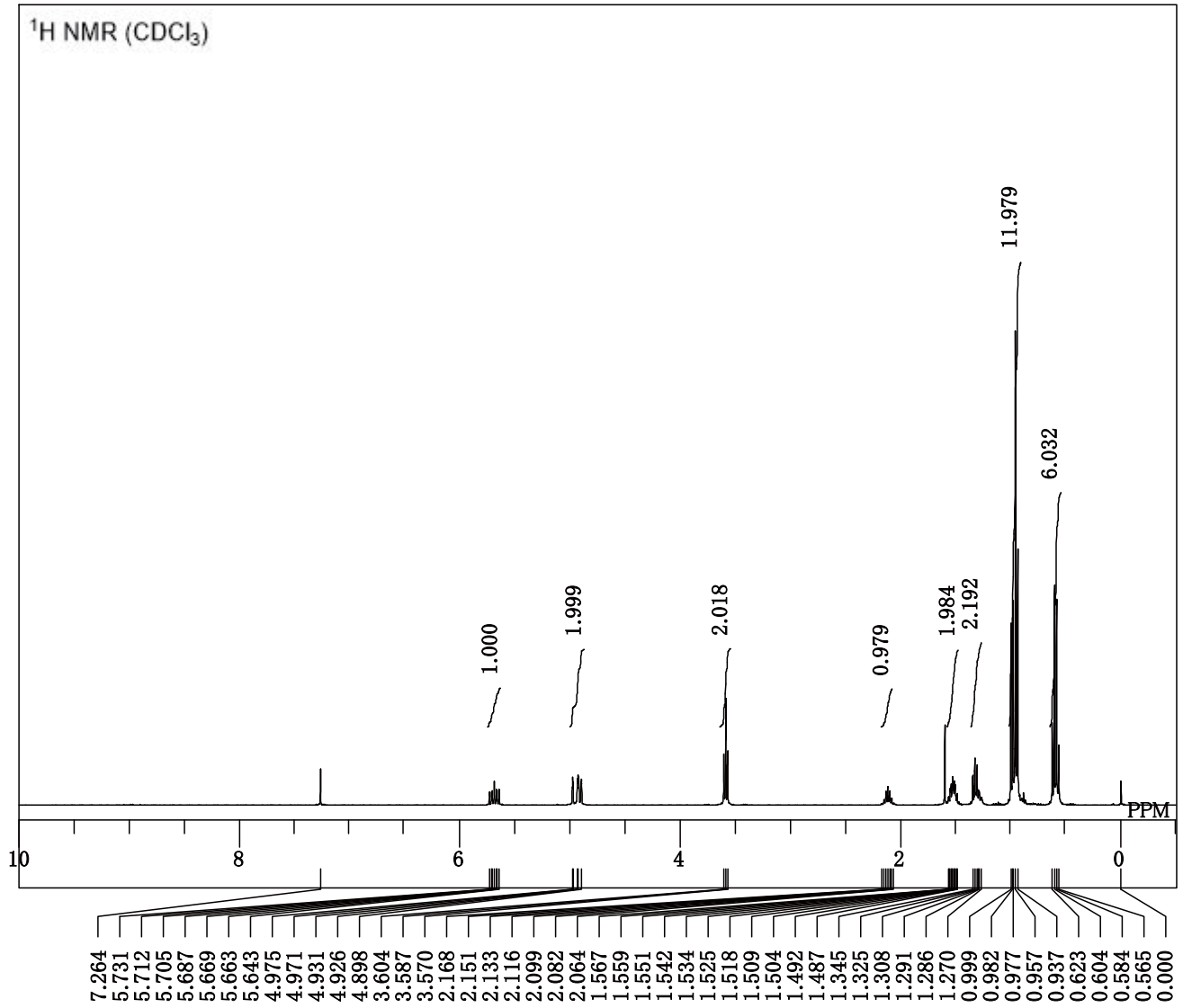

OSi^{i}Pr$_3$

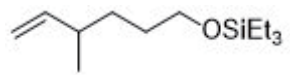
1n


13C{1H} NMR (CDCl3)
PPM
200
150
100
50
0
144.794
112.444
77.332
77.012
76.691
63.549
37.577
32.728
30.698
20.235
18.041
12.016

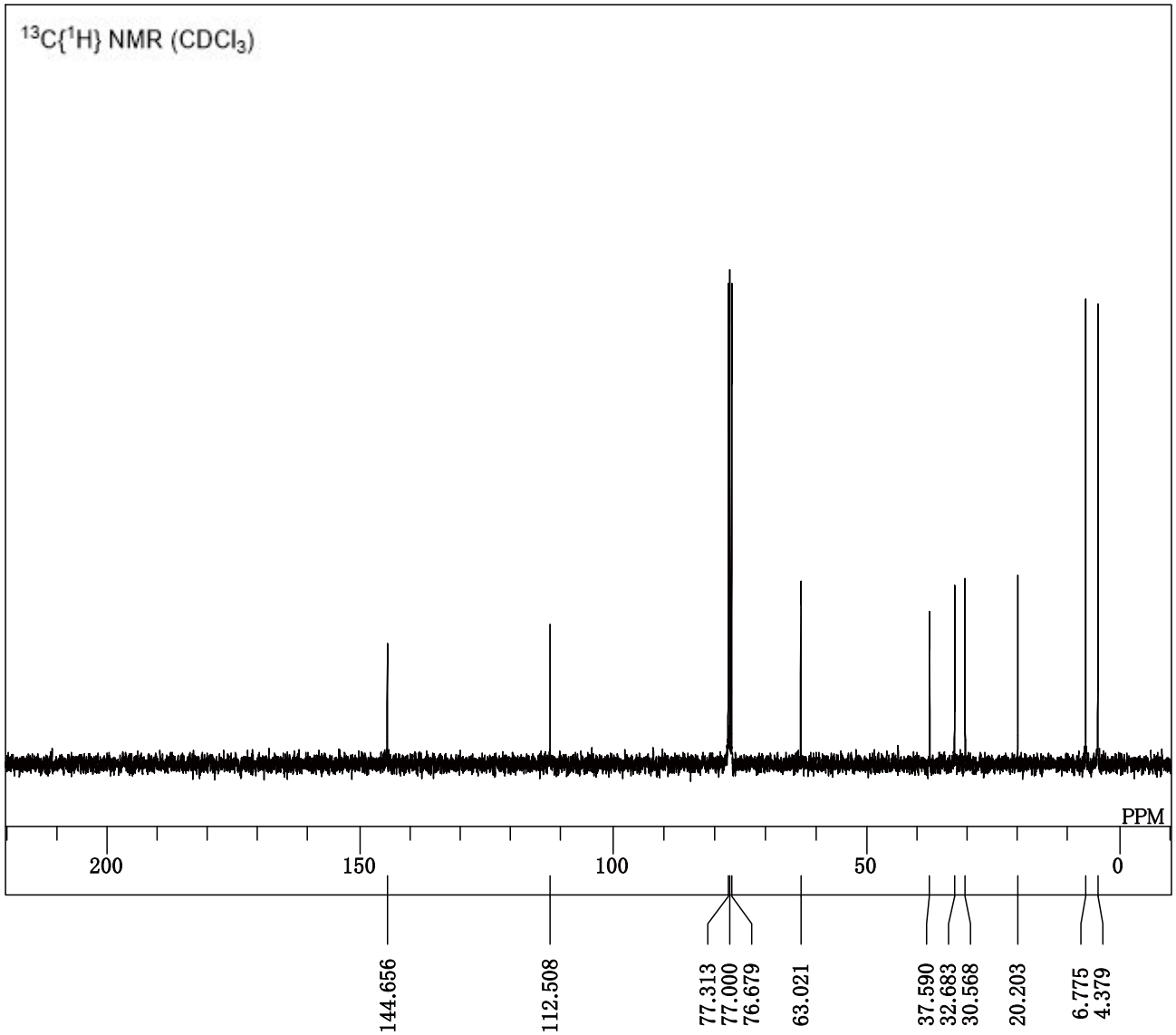

OSi^{i}Pr$_3$

1n


^{1}H NMR ($CDCl_3$)
1.000
1.999
2.018
0.979
1.984
2.192
11.979
6.032
PPM
10
8
6
4
2
0
7.264
5.731
5.712
5.705
5.687
5.669
5.663
5.643
4.975
4.971
4.931
4.926
4.898
3.604
3.587
3.570
2.168
2.151
2.133
2.116
2.099
2.082
2.064
1.567
1.559
1.551
1.542
1.534
1.525
1.518
1.509
1.504
1.492
1.487
1.345
1.325
1.308
1.291
1.286
1.270
0.999
0.982
0.977
0.957
0.937
0.623
0.604
0.584
0.565
0.000

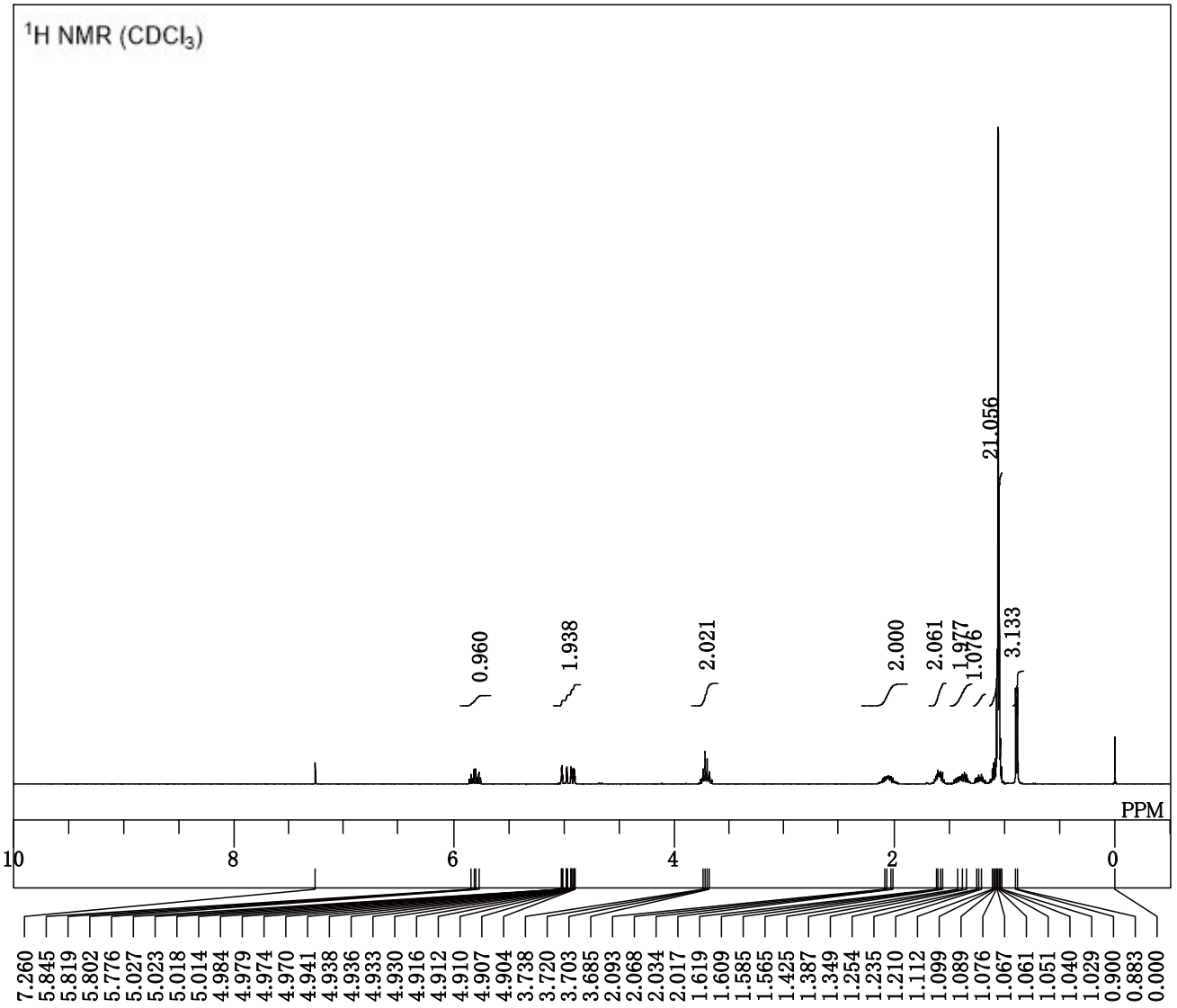

OSiEt$_3$

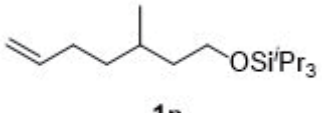
1o


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
144.656
112.508
77.313
77.000
76.679
63.021
37.590
32.683
30.568
20.203
6.775
4.379

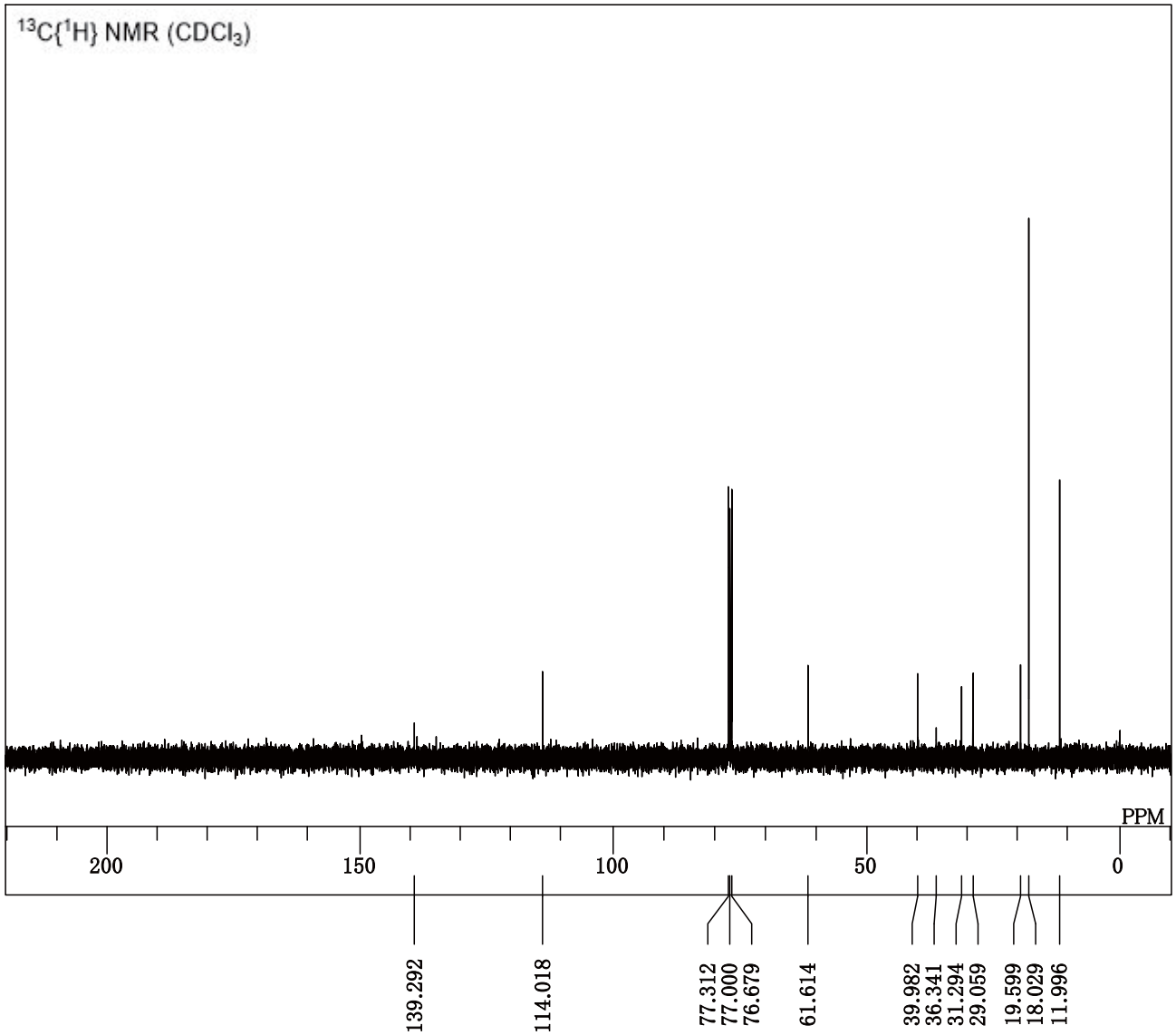

OSiEt3

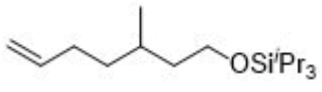
1o


^{1}H NMR ($CDCl_3$)
0.960
1.938
2.021
2.000
2.061
1.977
1.076
21.056
3.133
PPM
10
8
6
4
2
0
7.260
5.845
5.819
5.802
5.776
5.027
5.023
5.018
5.014
4.984
4.979
4.974
4.970
4.941
4.938
4.936
4.933
4.930
4.916
4.912
4.910
4.907
4.904
3.738
3.720
3.703
3.685
2.093
2.068
2.034
2.017
1.619
1.609
1.585
1.565
1.425
1.387
1.349
1.254
1.235
1.210
1.112
1.099
1.089
1.076
1.067
1.061
1.051
1.040
1.029
0.900
0.883
0.000

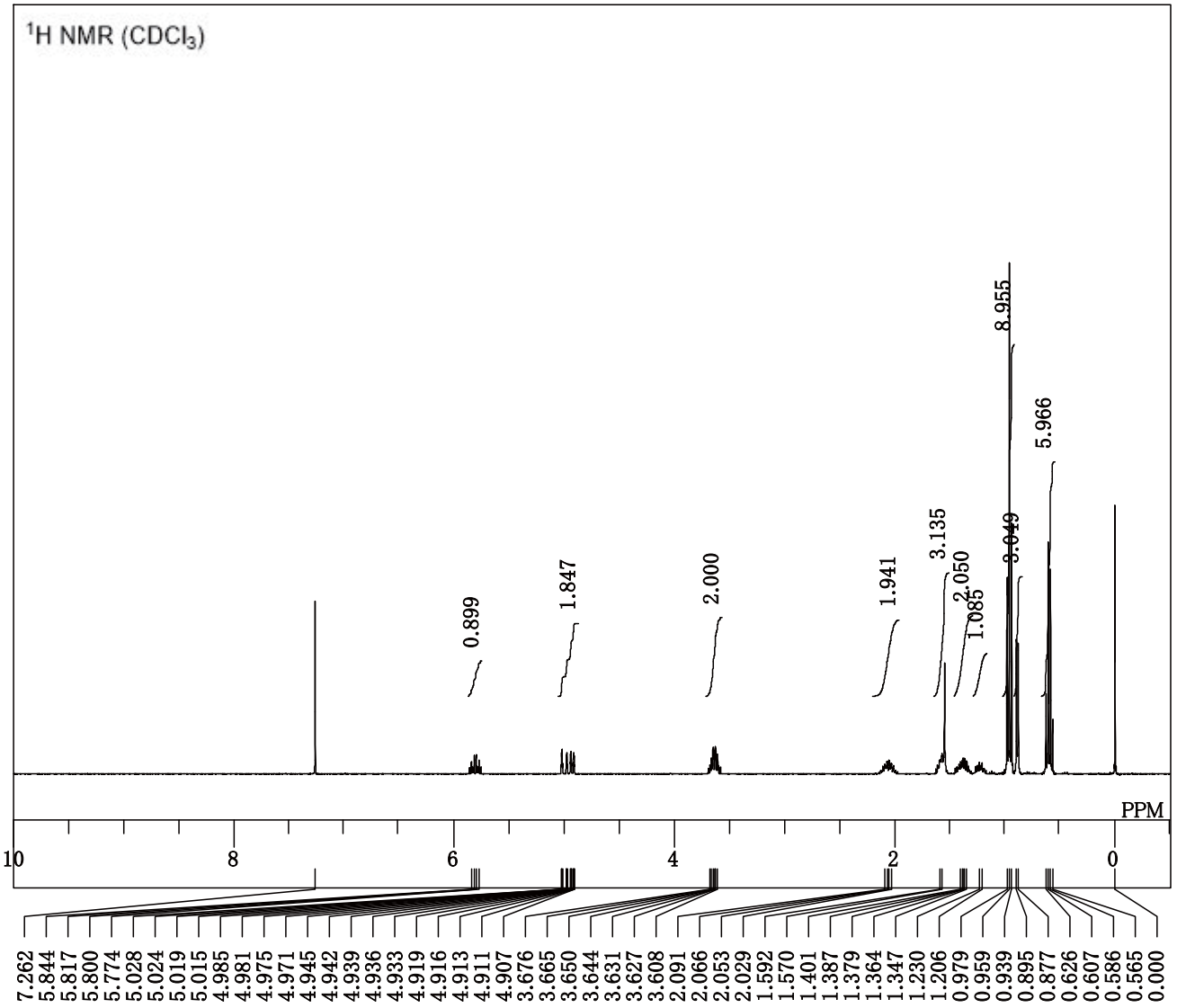

OSi^{i}Pr$_3$

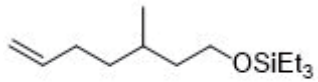
1p


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
139.292
114.018
77.312
77.000
76.679
61.614
39.982
36.341
31.294
29.059
19.599
18.029
11.996

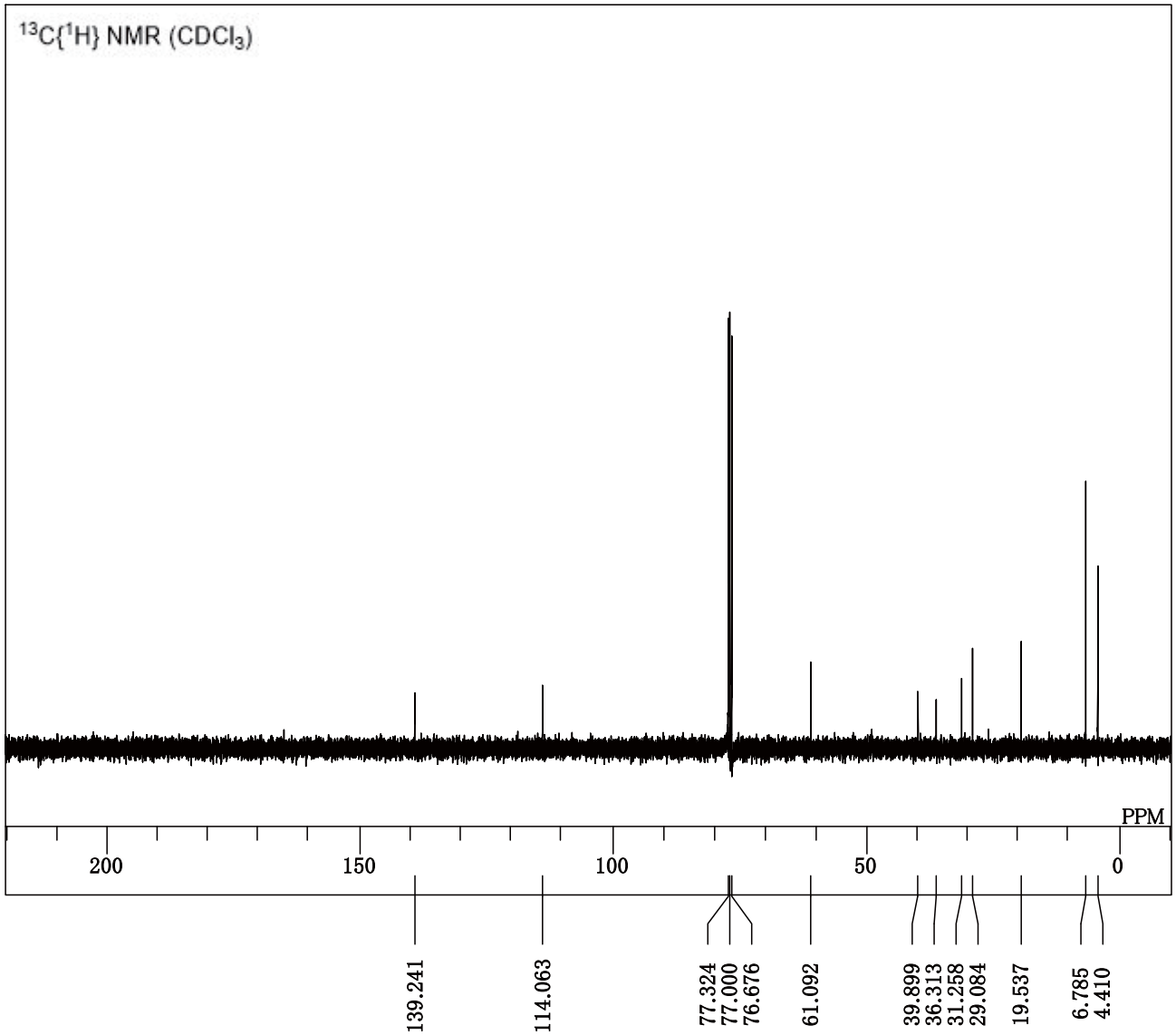

OSi^{i}Pr$_3$

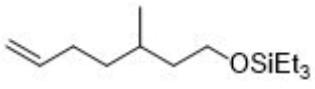
1p


^{1}H NMR ($CDCl_3$)
0.899
1.847
2.000
1.941
3.135
2.050
1.085
3.049
8.955
5.966
PPM
10
8
6
4
2
0
7.262
5.844
5.817
5.800
5.774
5.028
5.024
5.019
5.015
4.985
4.981
4.975
4.971
4.945
4.942
4.939
4.936
4.933
4.919
4.916
4.913
4.911
4.907
3.676
3.665
3.650
3.644
3.631
3.627
3.608
2.091
2.066
2.053
2.029
1.592
1.570
1.401
1.387
1.379
1.364
1.347
1.230
1.206
0.979
0.959
0.939
0.895
0.877
0.626
0.607
0.586
0.565
0.000

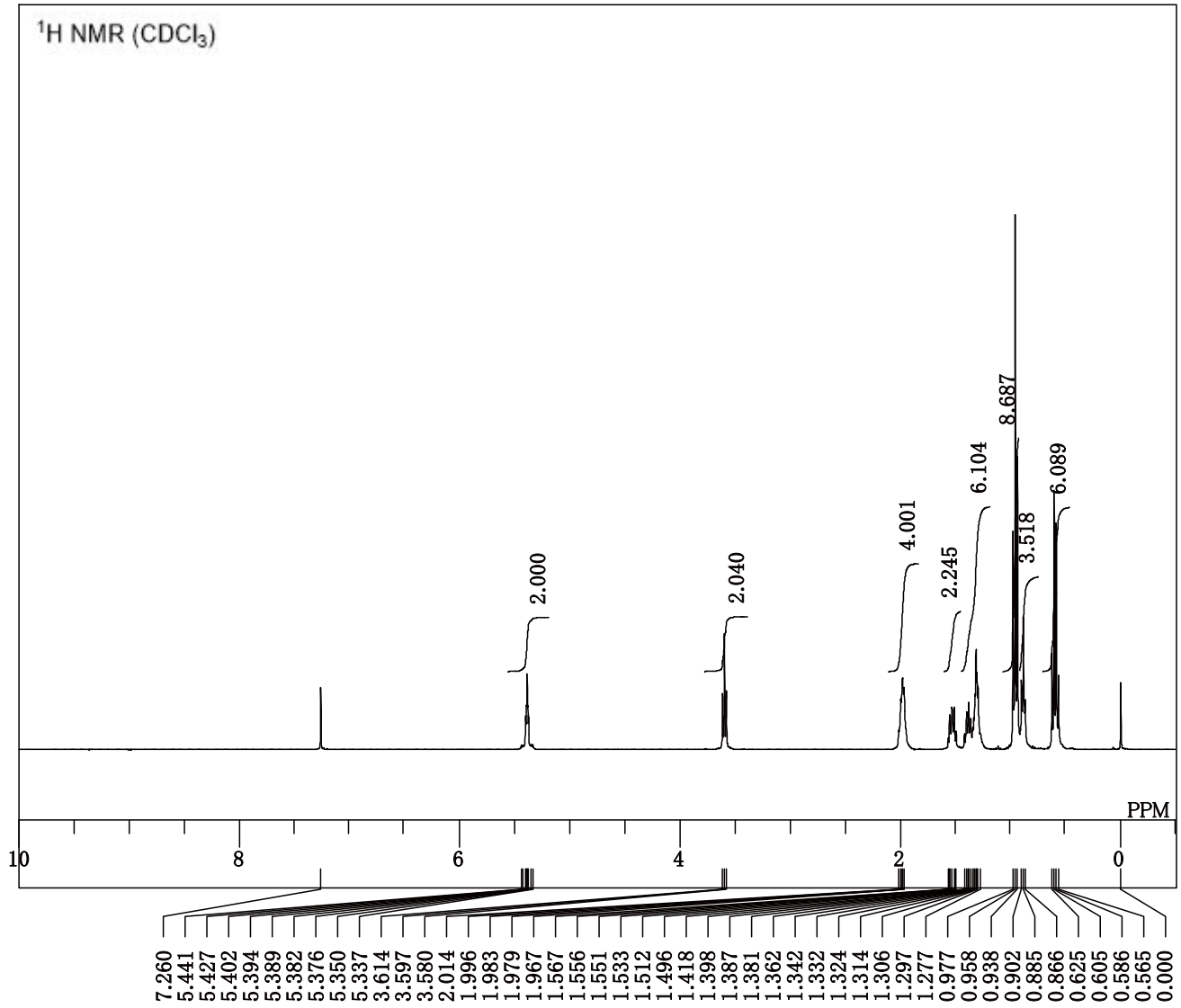

OSiEt$_3$

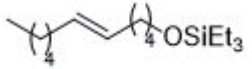
1q


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
139.241
114.063
77.324
77.000
76.676
61.092
39.899
36.313
31.258
29.084
19.537
6.785
4.410

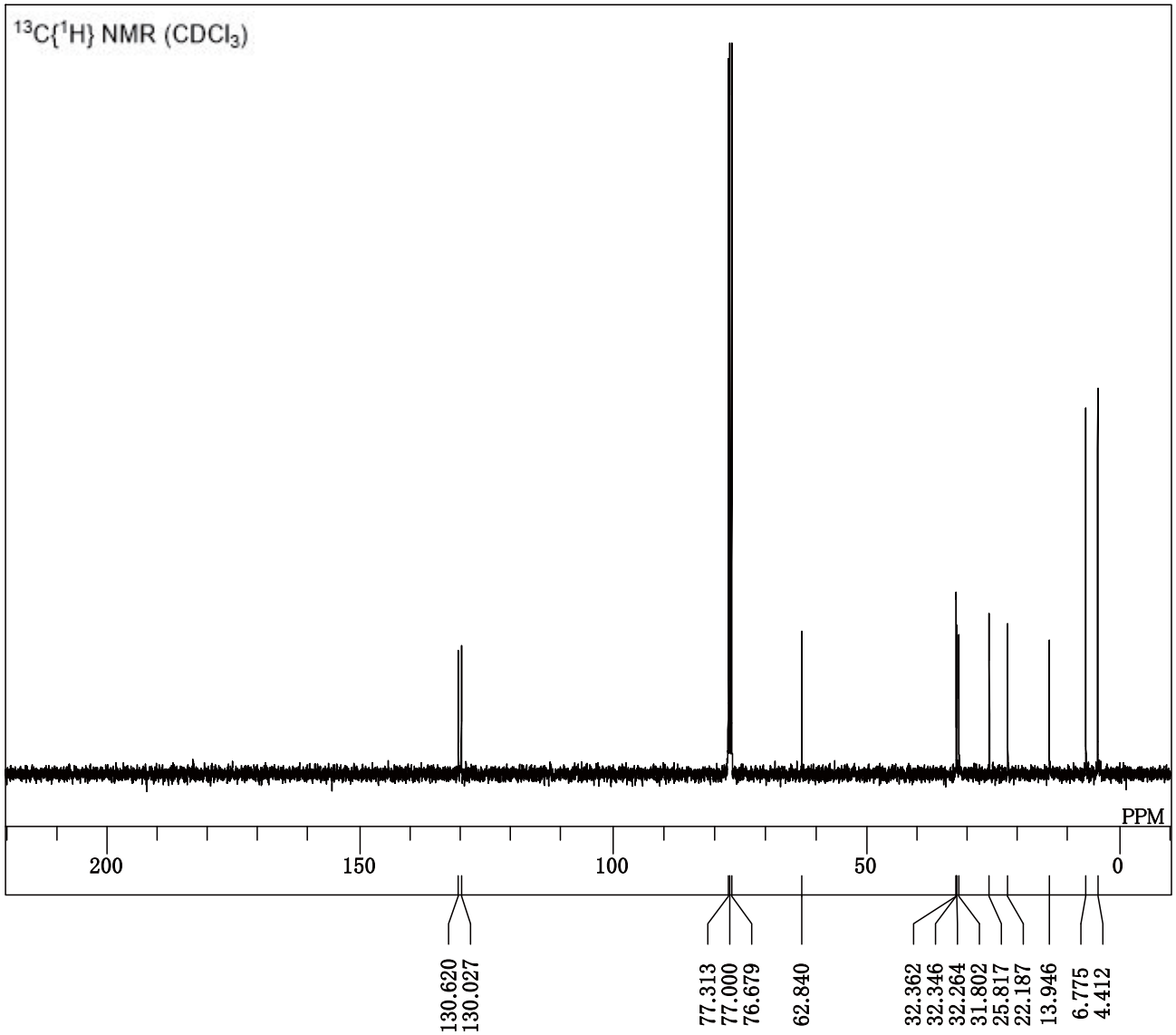

OSiEt3

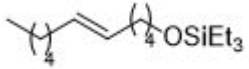
1q


^{1}H NMR ($CDCl_3$)
2.000
2.040
4.001
2.245
6.104
8.687
3.518
6.089
PPM
10
8
6
4
2
0
7.260
5.441
5.427
5.402
5.394
5.389
5.382
5.376
5.350
5.337
3.614
3.597
3.580
2.014
1.996
1.983
1.979
1.967
1.567
1.556
1.551
1.533
1.512
1.496
1.418
1.398
1.387
1.381
1.362
1.342
1.332
1.324
1.314
1.306
1.297
1.277
0.977
0.958
0.938
0.902
0.885
0.866
0.625
0.605
0.586
0.565
0.000

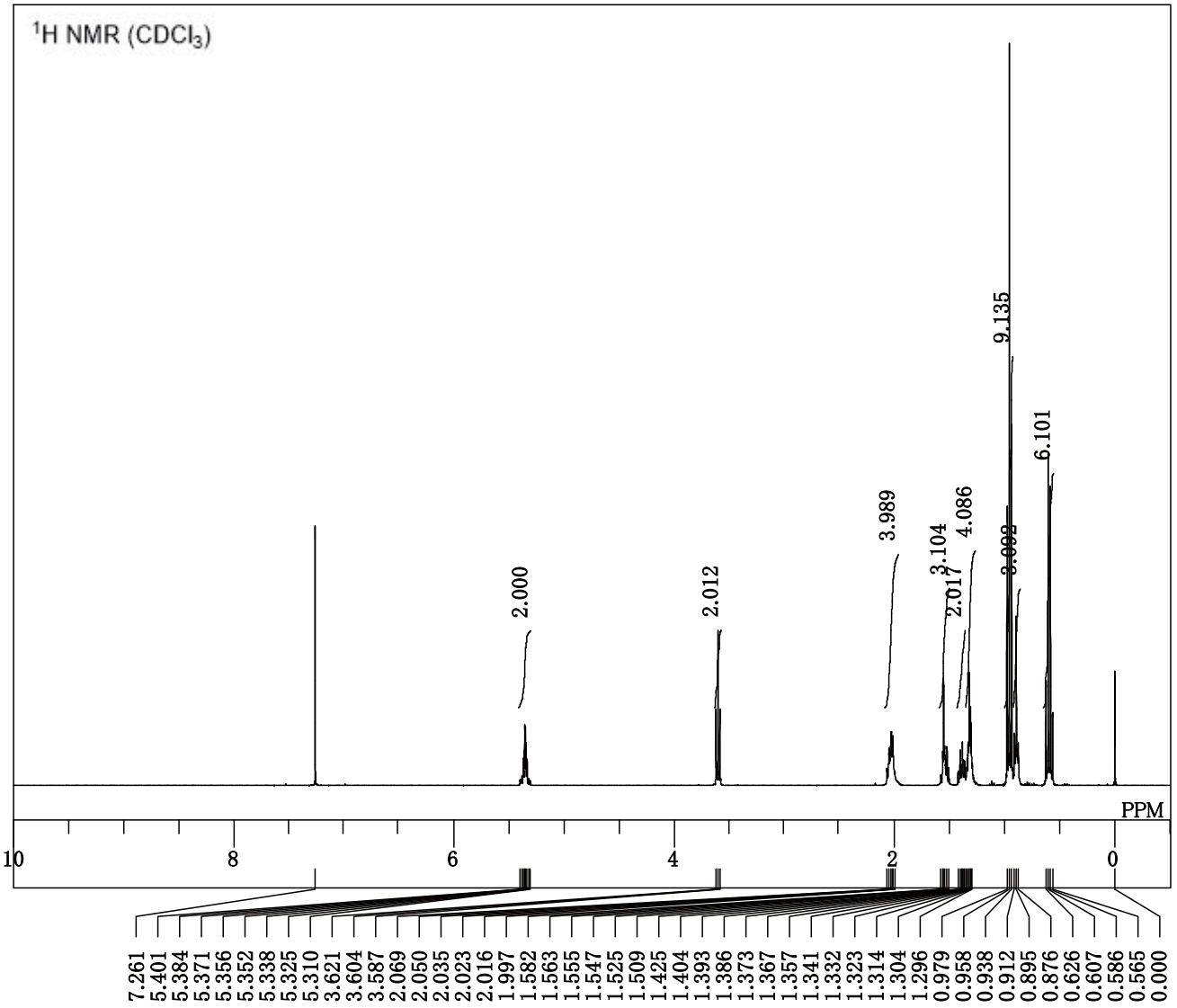

4
4
OSiEt$_3$

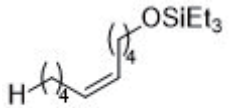
(*E*)-**1r**


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
130.620
130.027
77.313
77.000
76.679
62.840
32.362
32.346
32.264
31.802
25.817
22.187
13.946
6.775
4.412

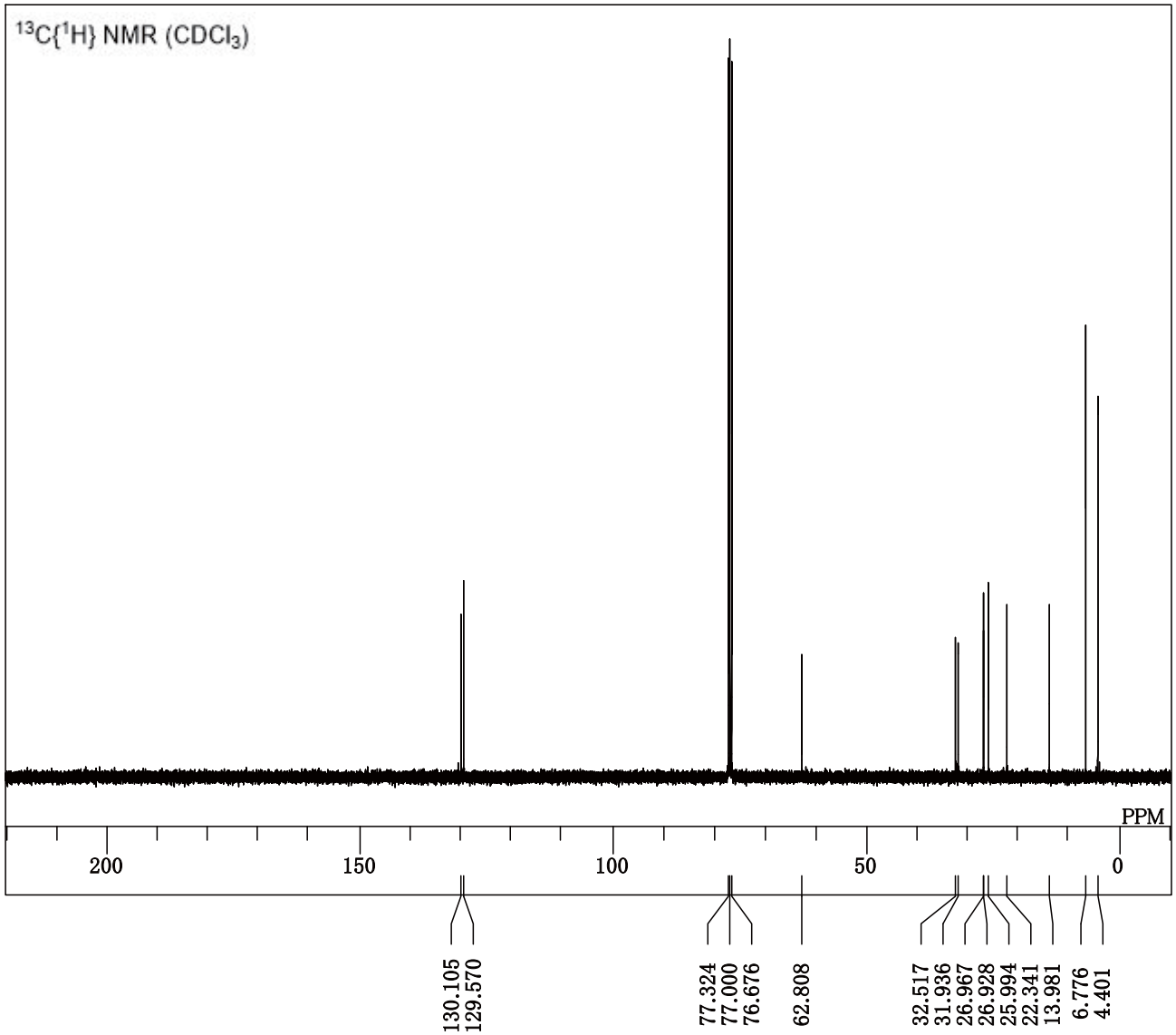

OSiEt3

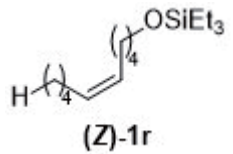
(*E*)-**1r**


^{1}H NMR ($CDCl_3$)
2.000
2.012
3.989
3.104
2.017
4.086
3.002
9.135
6.101
PPM
10
8
6
4
2
0
7.261
5.401
5.384
5.371
5.356
5.352
5.338
5.325
5.310
3.621
3.604
3.587
2.069
2.050
2.035
2.023
2.016
1.997
1.582
1.563
1.555
1.547
1.525
1.509
1.425
1.404
1.393
1.386
1.373
1.367
1.357
1.341
1.332
1.323
1.314
1.304
1.296
0.979
0.958
0.938
0.912
0.895
0.876
0.626
0.607
0.586
0.565
0.000

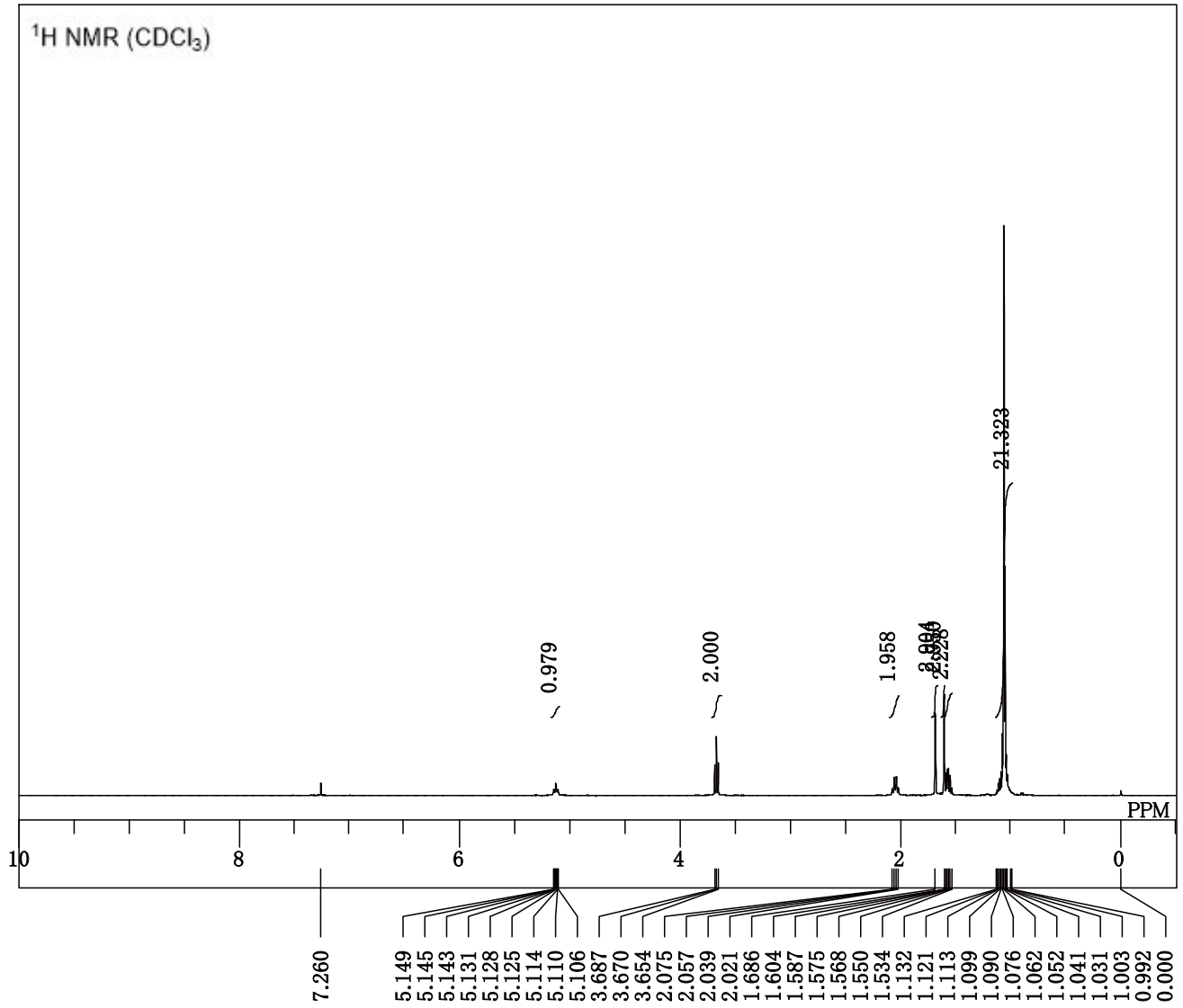

OSiEt$_3$
4
4
H

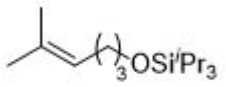
(*Z*)-**1r**


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
130.105
129.570
77.324
77.000
76.676
62.808
32.517
31.936
26.967
26.928
25.994
22.341
13.981
6.776
4.401

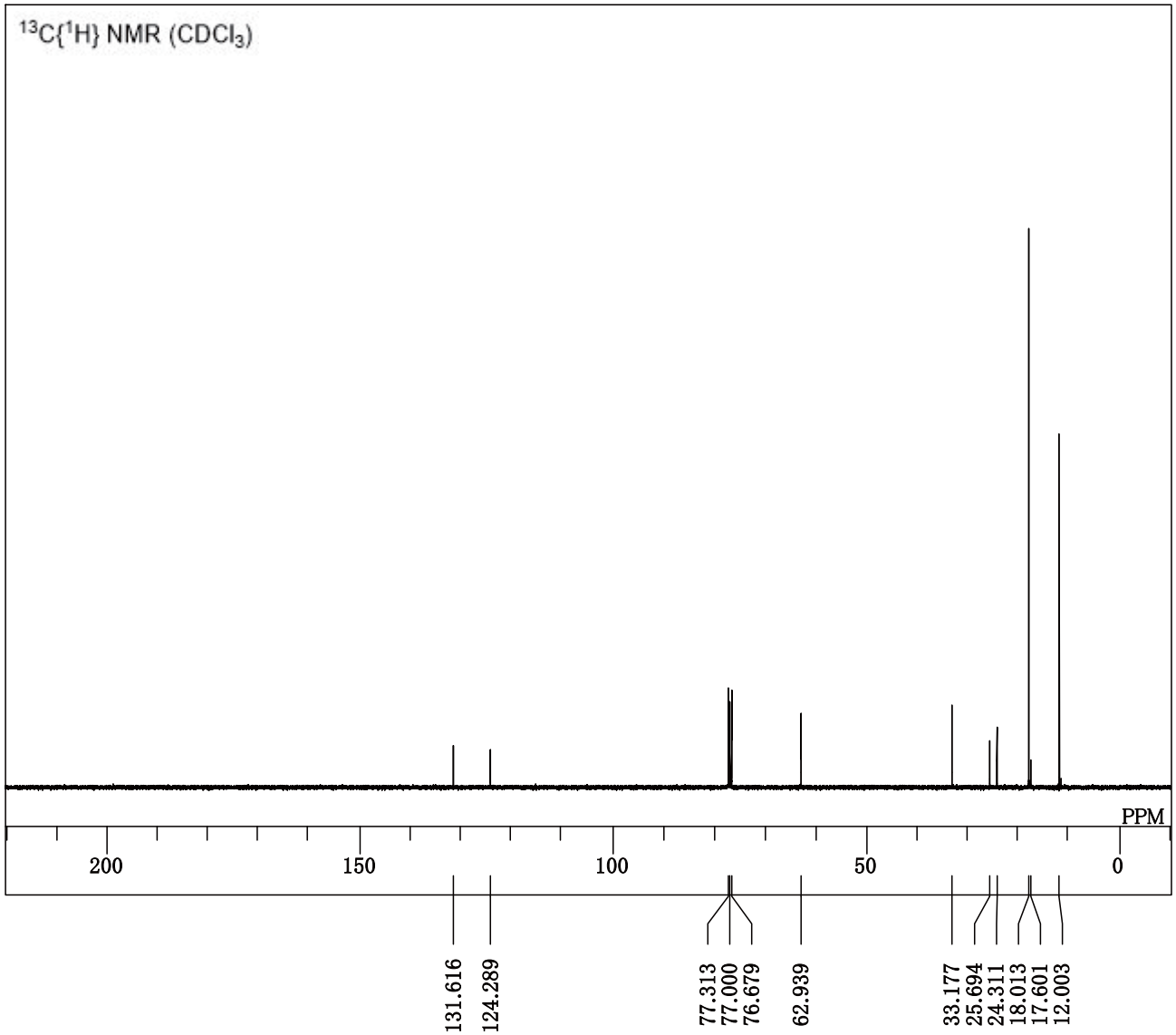

OSiEt3
H
4
4

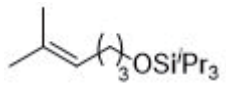
(Z)-1r


1H NMR (CDCl3)
0.979
2.000
1.958
21.323
PPM
10
8
6
4
2
0
7.260
5.149
5.145
5.143
5.131
5.128
5.125
5.114
5.110
5.106
3.687
3.670
3.654
2.075
2.057
2.039
2.021
1.686
1.604
1.587
1.575
1.568
1.550
1.534
1.132
1.121
1.113
1.099
1.090
1.076
1.062
1.052
1.041
1.031
1.003
0.992
0.000

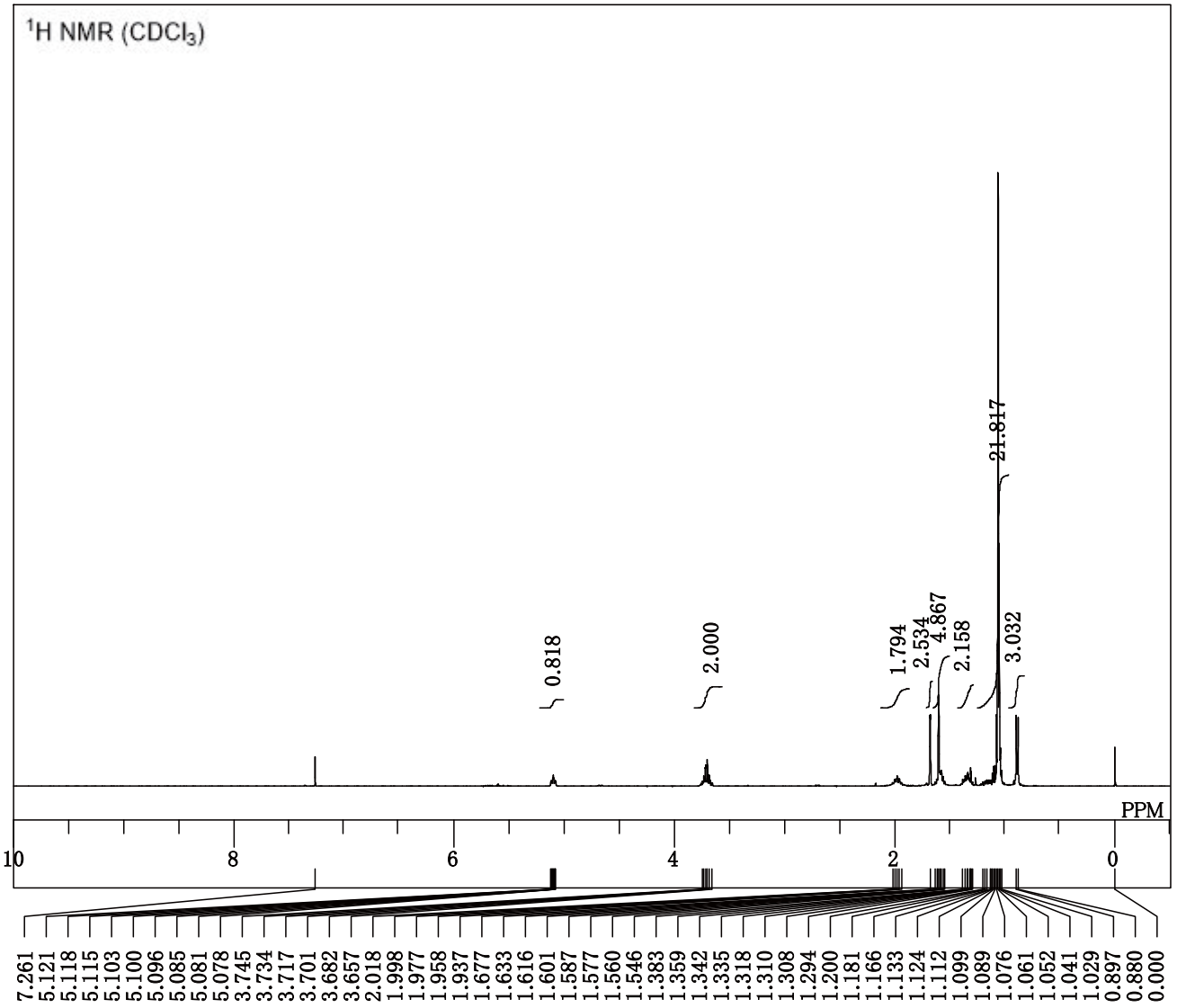

3OSi^{i}Pr$_3$

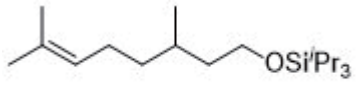
1s


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
131.616
124.289
77.313
77.000
76.679
62.939
33.177
25.694
24.311
18.013
17.601
12.003

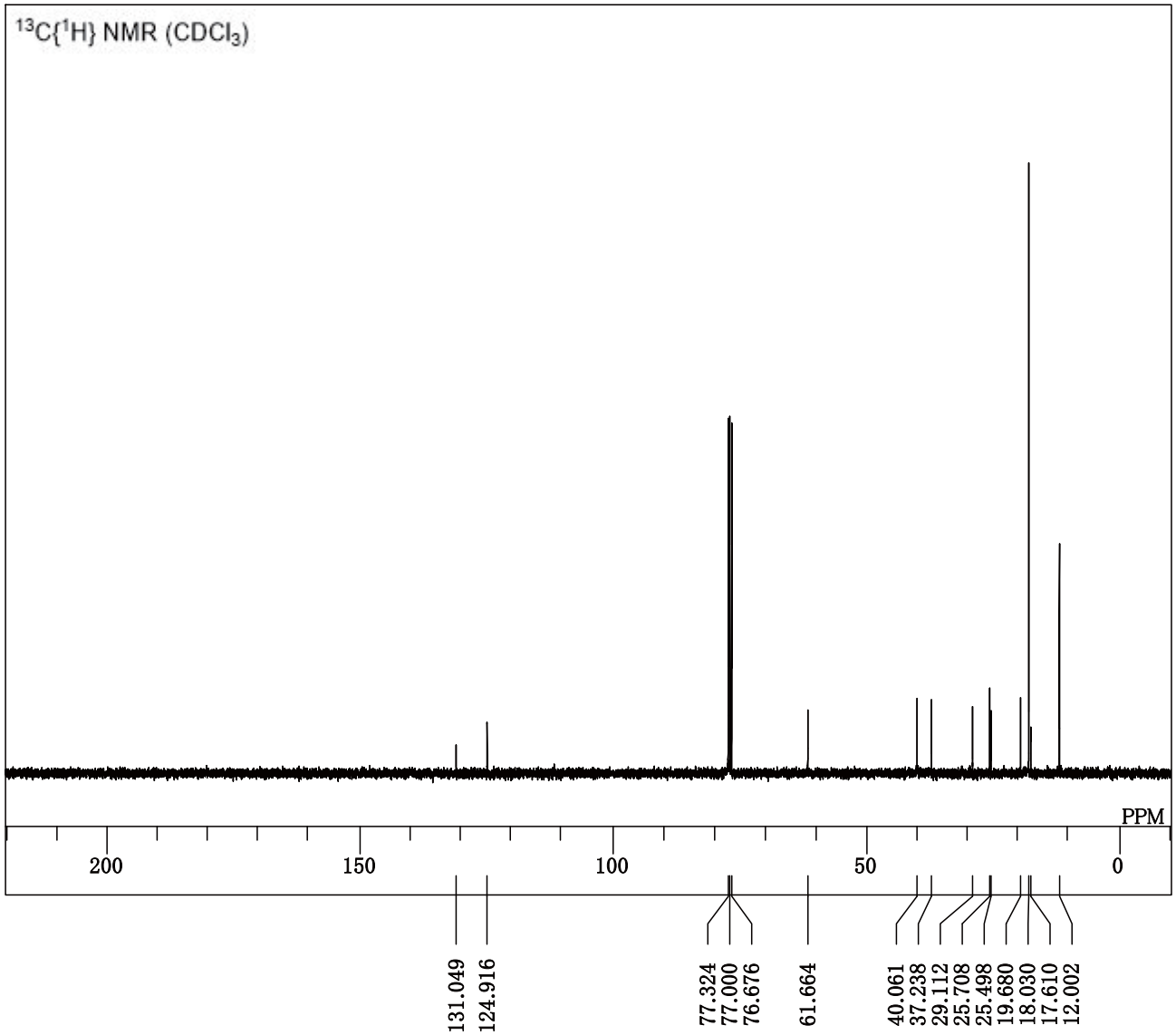

$_3OSi^iPr_3$

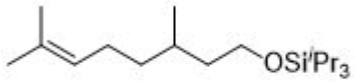
1s


^{1}H NMR ($CDCl_3$)
0.818
2.000
1.794
2.534
4.867
2.158
21.817
3.032
PPM
10
8
6
4
2
0
7.261
5.121
5.118
5.115
5.103
5.100
5.096
5.085
5.081
5.078
3.745
3.734
3.717
3.701
3.682
3.657
2.018
1.998
1.977
1.958
1.937
1.677
1.633
1.616
1.601
1.587
1.577
1.560
1.546
1.383
1.359
1.342
1.335
1.318
1.310
1.308
1.294
1.200
1.181
1.166
1.133
1.124
1.112
1.099
1.089
1.076
1.061
1.052
1.041
1.029
0.897
0.880
0.000

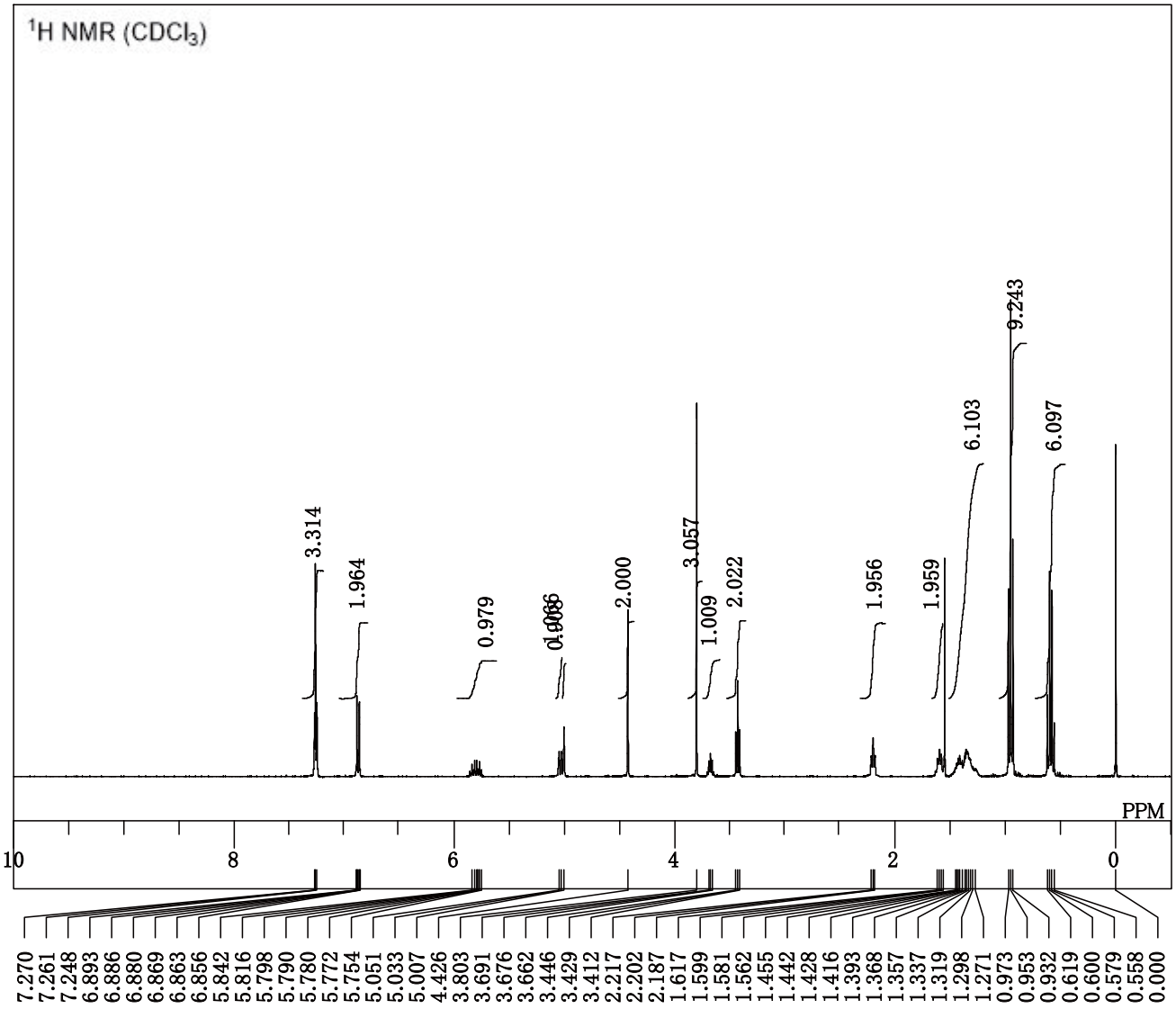

OSi^{i}Pr$_3$

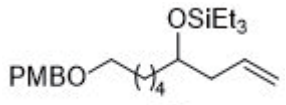
1t

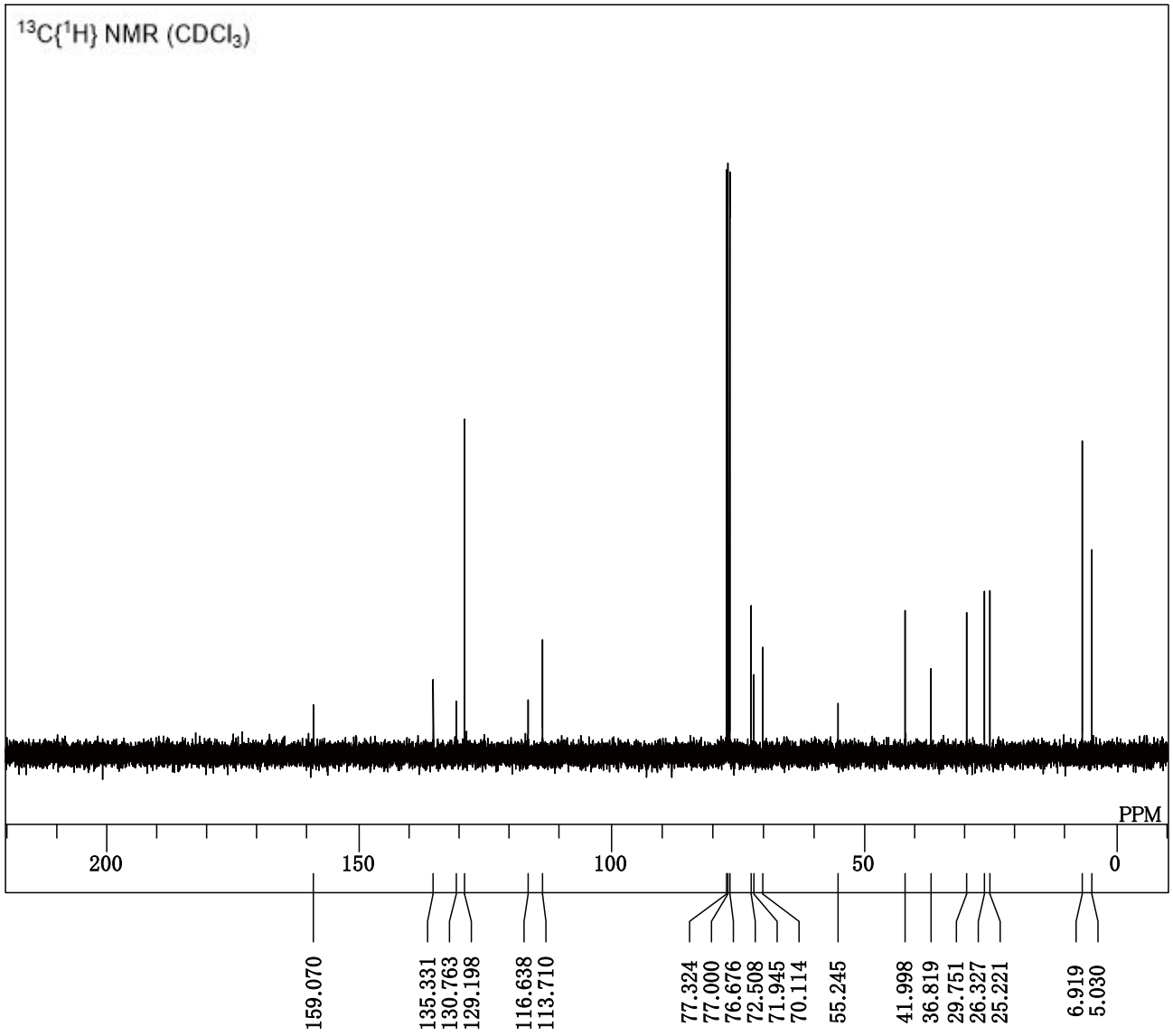

$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
131.049
124.916
77.324
77.000
76.676
61.664
40.061
37.238
29.112
25.708
25.498
19.680
18.030
17.610
12.002

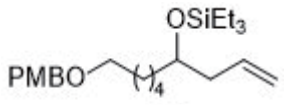

OSi^{i}Pr$_3$

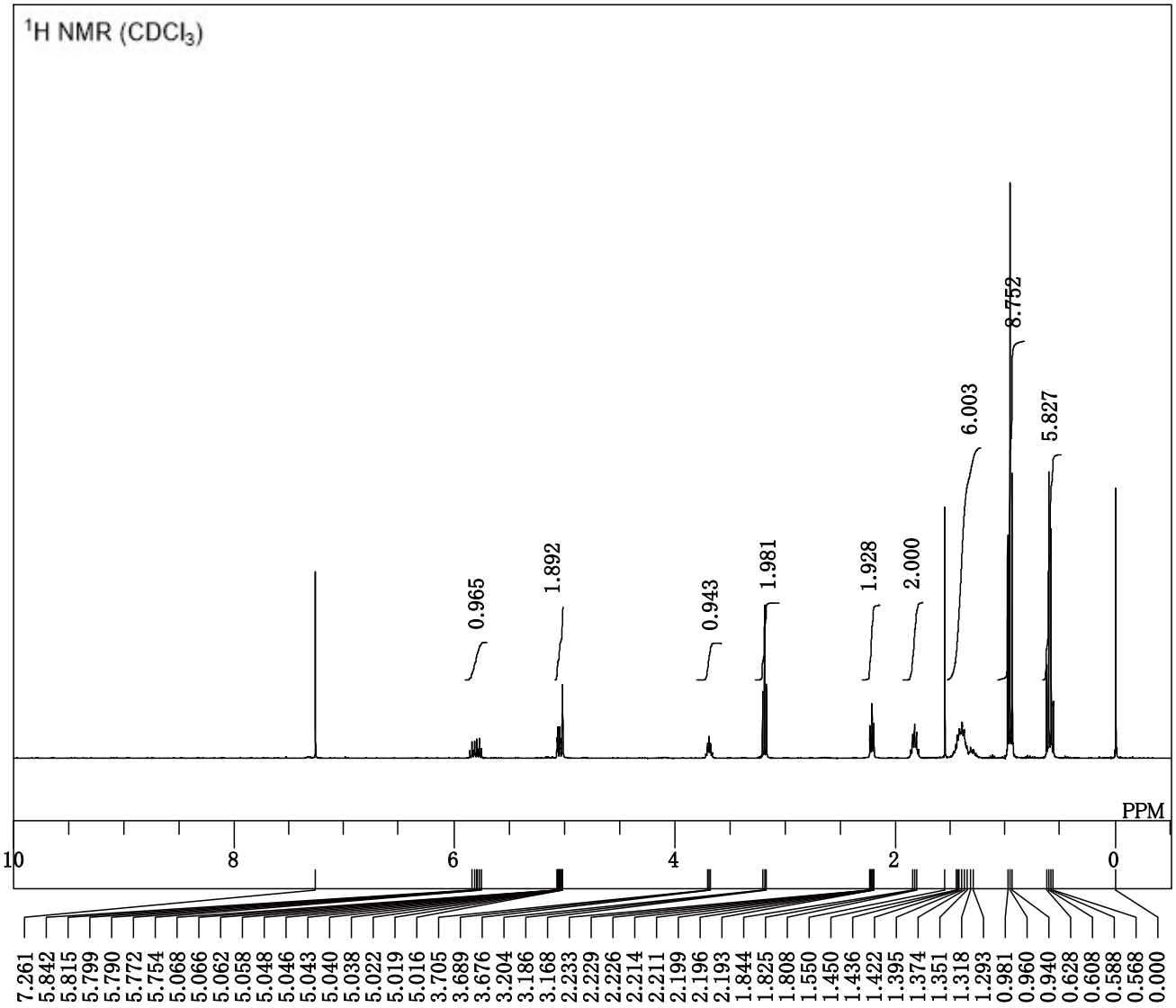
1t

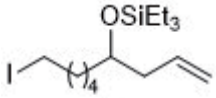

^{1}H NMR ($CDCl_3$)
3.314
1.964
0.979
2.000
3.057
1.009
2.022
1.956
1.959
6.103
9.243
6.097
PPM
10
8
6
4
2
0
7.270
7.261
7.248
6.893
6.886
6.880
6.869
6.863
6.856
5.842
5.816
5.798
5.790
5.780
5.772
5.754
5.051
5.033
5.007
4.426
3.803
3.691
3.676
3.662
3.446
3.429
3.412
2.217
2.202
2.187
1.617
1.599
1.581
1.562
1.455
1.442
1.428
1.416
1.393
1.368
1.357
1.337
1.319
1.298
1.271
0.973
0.953
0.932
0.619
0.600
0.579
0.558
0.000

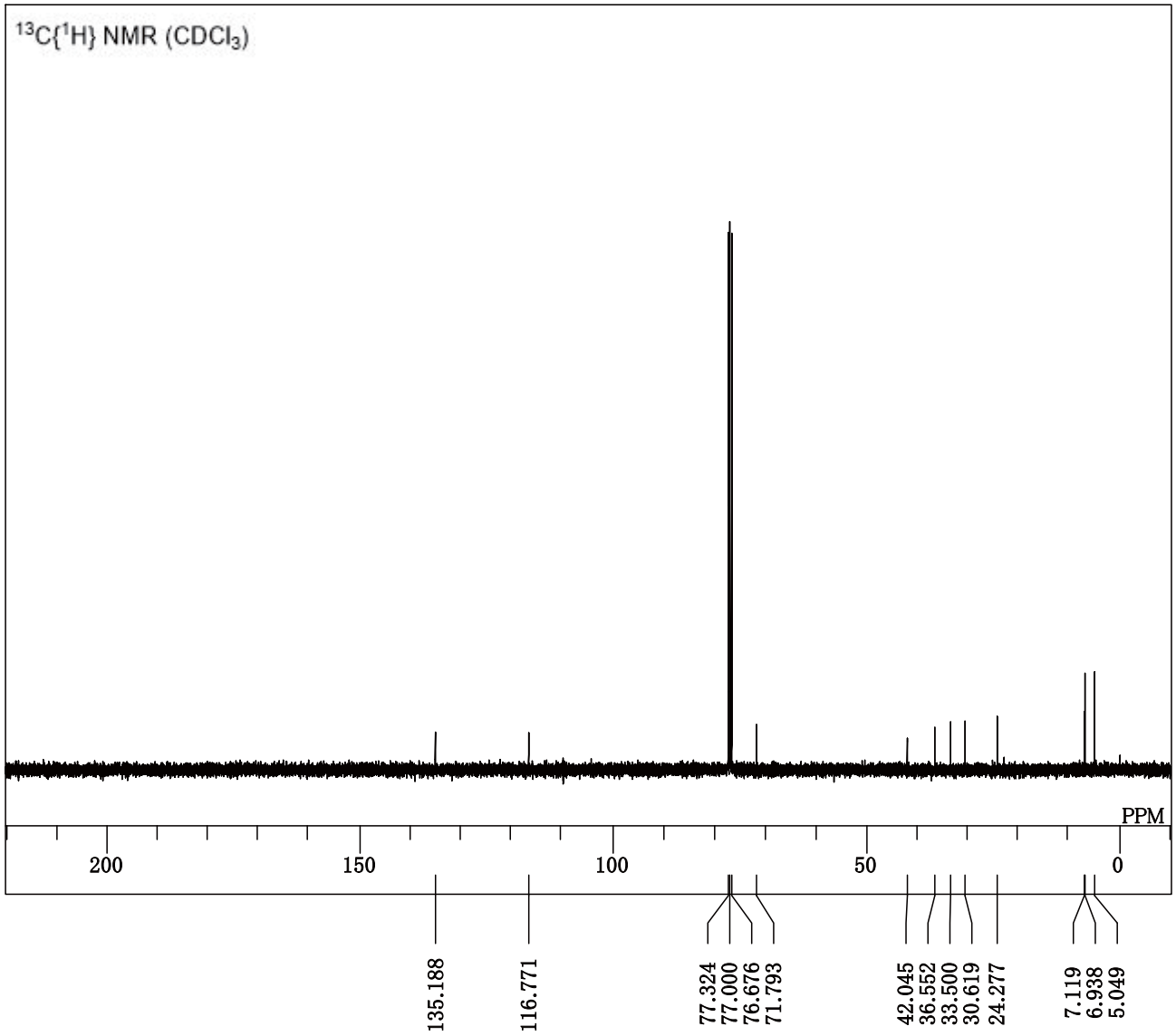

OSiEt$_3$
PMBO
4

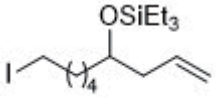

13C{1H} NMR (CDCl3)
PPM
200
150
100
50
0
159.070
135.331
130.763
129.198
116.638
113.710
77.324
77.000
76.676
72.508
71.945
70.114
55.245
41.998
36.819
29.751
26.327
25.221
6.919
5.030

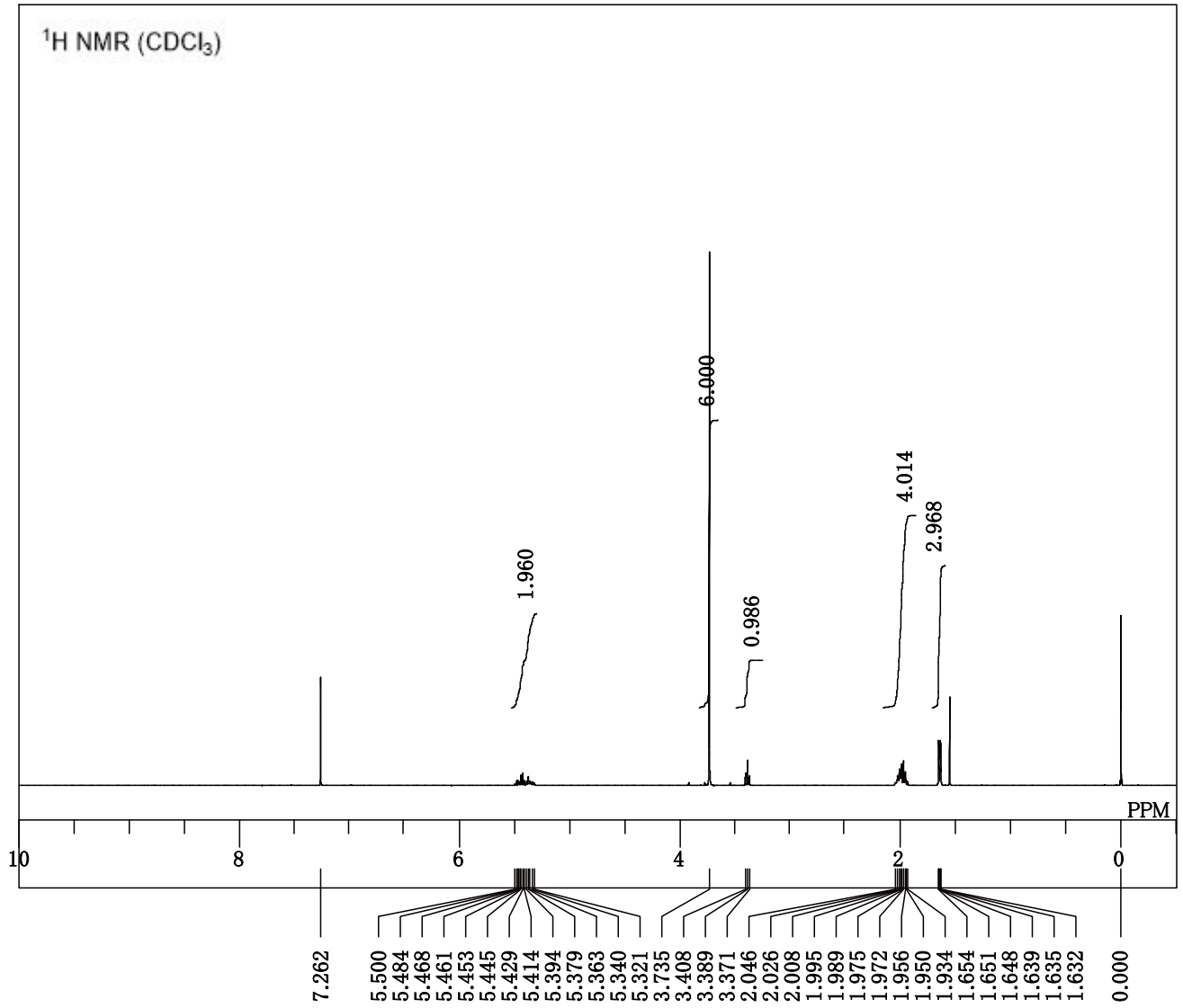

OSiEt3
PMBO
4

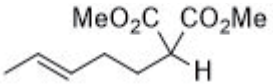

^{1}H NMR ($CDCl_3$)
0.965
1.892
0.943
1.981
1.928
2.000
6.003
8.752
5.827
PPM
10
8
6
4
2
0
7.261
5.842
5.815
5.799
5.790
5.772
5.754
5.068
5.066
5.062
5.058
5.048
5.046
5.043
5.040
5.038
5.022
5.019
5.016
3.705
3.689
3.676
3.204
3.186
3.168
2.233
2.229
2.226
2.214
2.211
2.199
2.196
2.193
1.844
1.825
1.808
1.550
1.450
1.436
1.422
1.395
1.374
1.351
1.318
1.293
0.981
0.960
0.940
0.628
0.608
0.588
0.568
0.000


OSiEt$_3$
I
4

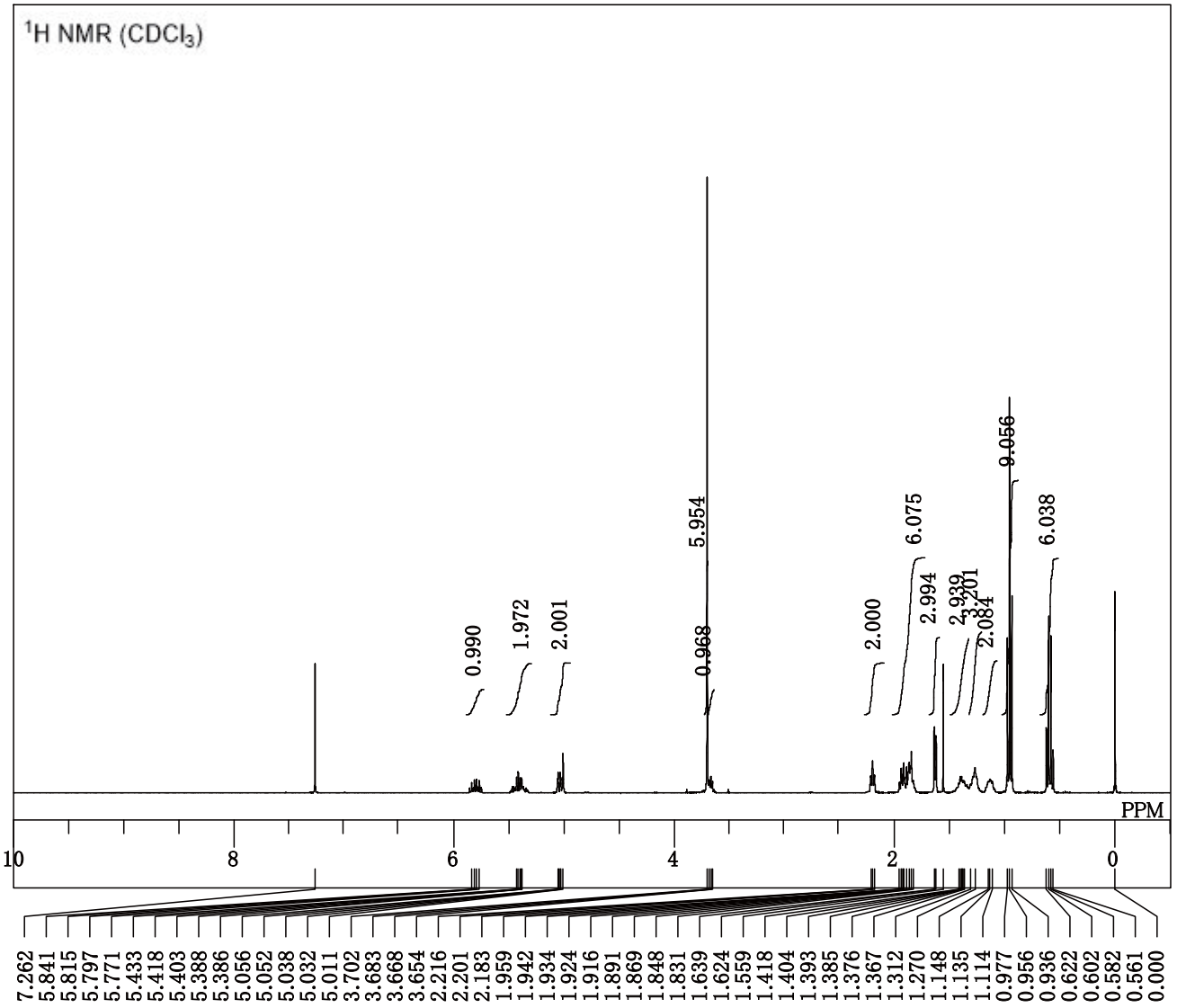

$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
135.188
116.771
77.324
77.000
76.676
71.793
42.045
36.552
33.500
30.619
24.277
7.119
6.938
5.049

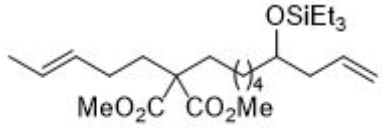

OSiEt3
I
4



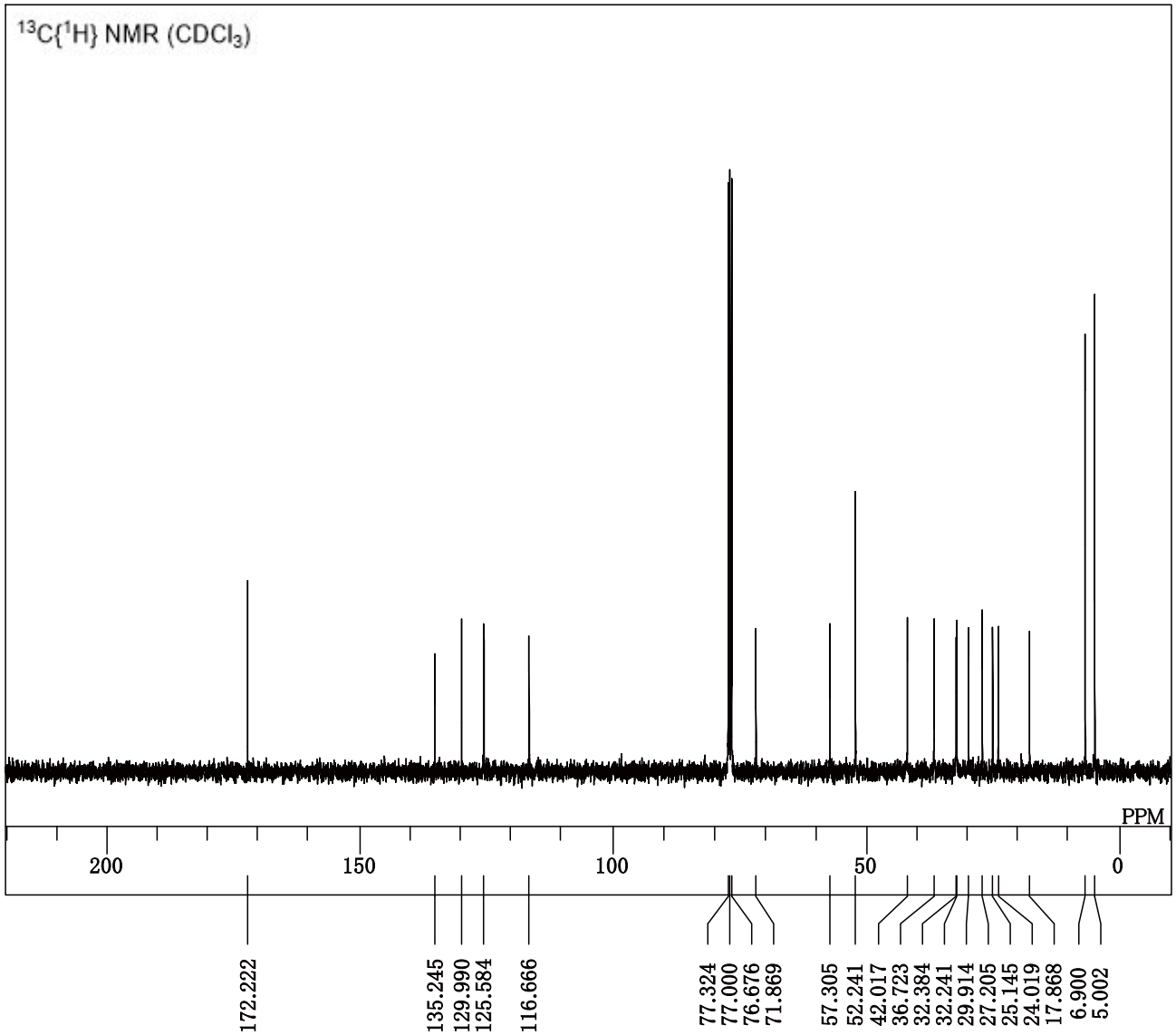


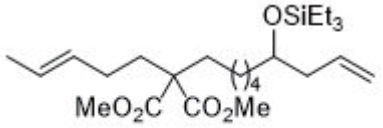
Dimethyl (*E*)-2-(3-penten-1-yl) malonate


^{1}H NMR ($CDCl_3$)
0.990
1.972
2.001
5.954
0.968
2.000
6.075
2.994
2.939
3.201
2.084
9.056
6.038
PPM
10
8
6
4
2
0
7.262
5.841
5.815
5.797
5.771
5.433
5.418
5.403
5.388
5.386
5.056
5.052
5.038
5.032
5.011
3.702
3.683
3.668
3.654
2.216
2.201
2.183
1.959
1.942
1.934
1.924
1.916
1.891
1.869
1.848
1.831
1.639
1.624
1.559
1.418
1.404
1.393
1.385
1.376
1.367
1.312
1.270
1.148
1.135
1.114
0.977
0.956
0.936
0.622
0.602
0.582
0.561
0.000

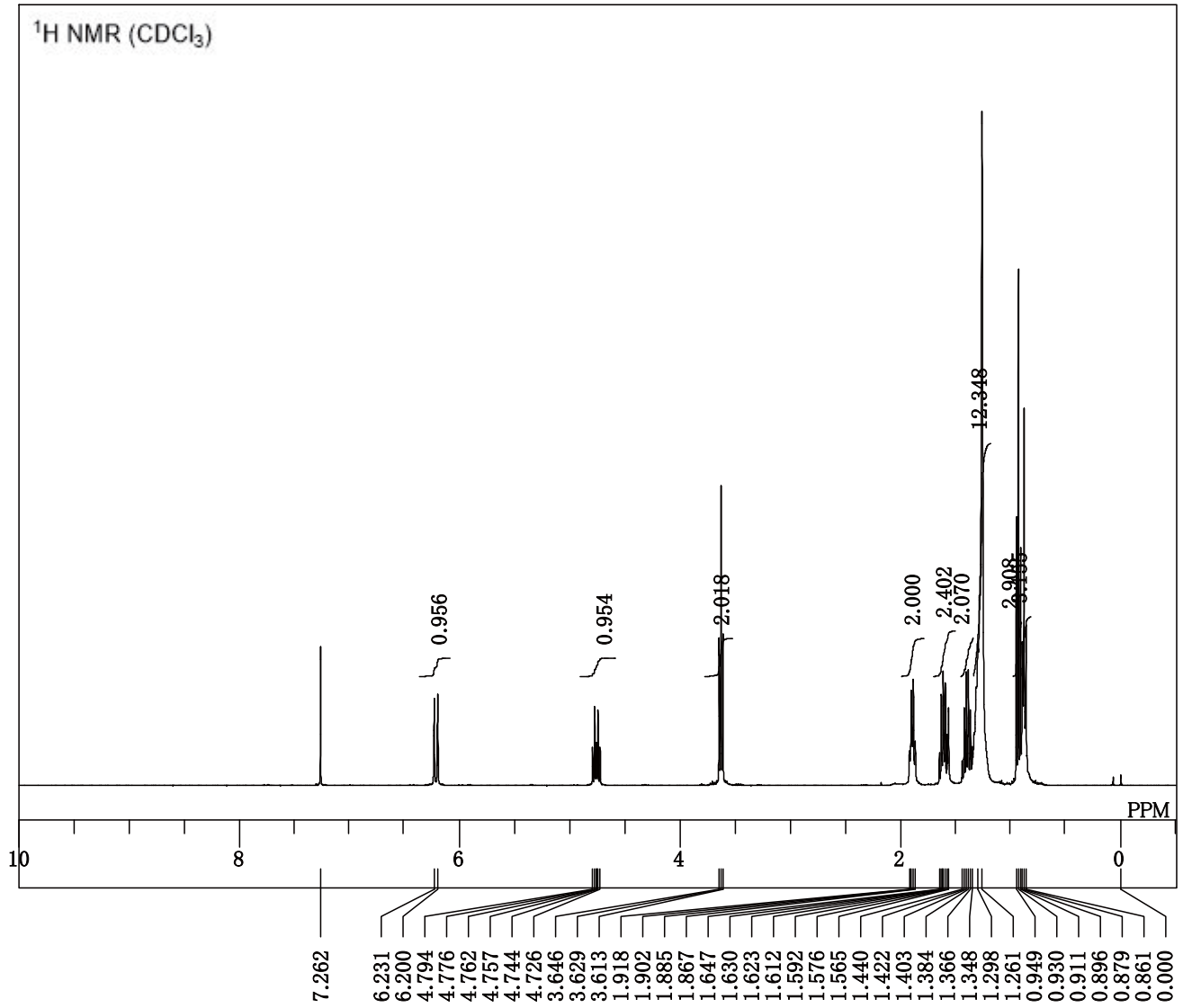

OSiEt$_3$
4
MeO$_2$C
CO$_2$Me

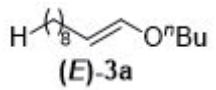
1u


13C{1H} NMR (CDCl3)
PPM
200
150
100
50
0
172.222
135.245
129.990
125.584
116.666
77.324
77.000
76.676
71.869
57.305
52.241
42.017
36.723
32.384
32.241
29.914
27.205
25.145
24.019
17.868
6.900
5.002

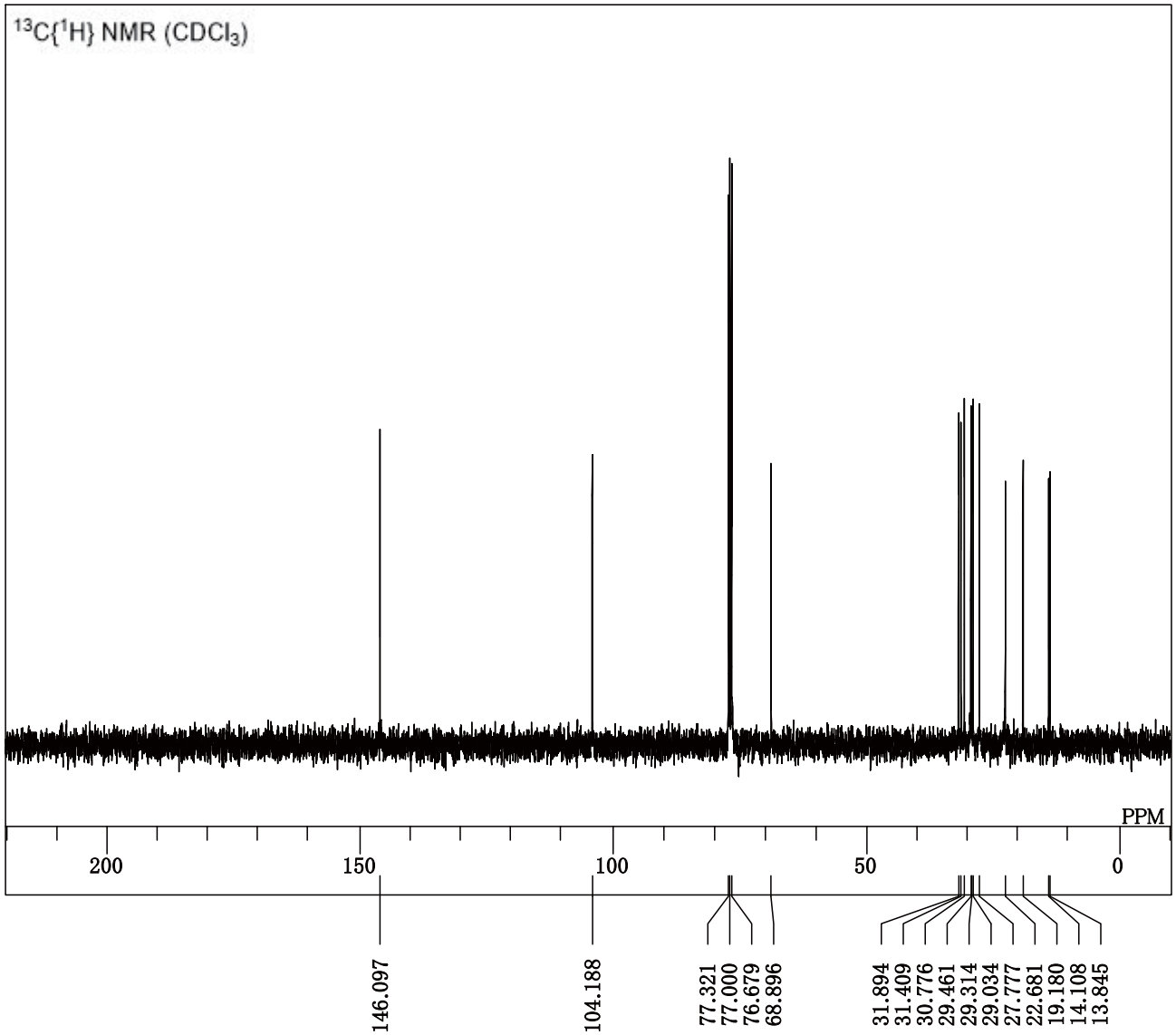

OSiEt3
MeO2C
CO2Me
4

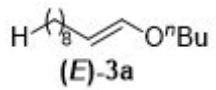
1u


^{1}H NMR ($CDCl_3$)
0.956
0.954
2.018
2.000
2.402
2.070
12.348
2.908
PPM
10
8
6
4
2
0
7.262
6.231
6.200
4.794
4.776
4.762
4.757
4.744
4.726
3.646
3.629
3.613
1.918
1.902
1.885
1.867
1.647
1.630
1.623
1.612
1.592
1.576
1.565
1.440
1.422
1.403
1.384
1.366
1.348
1.298
1.261
0.949
0.930
0.911
0.896
0.879
0.861
0.000

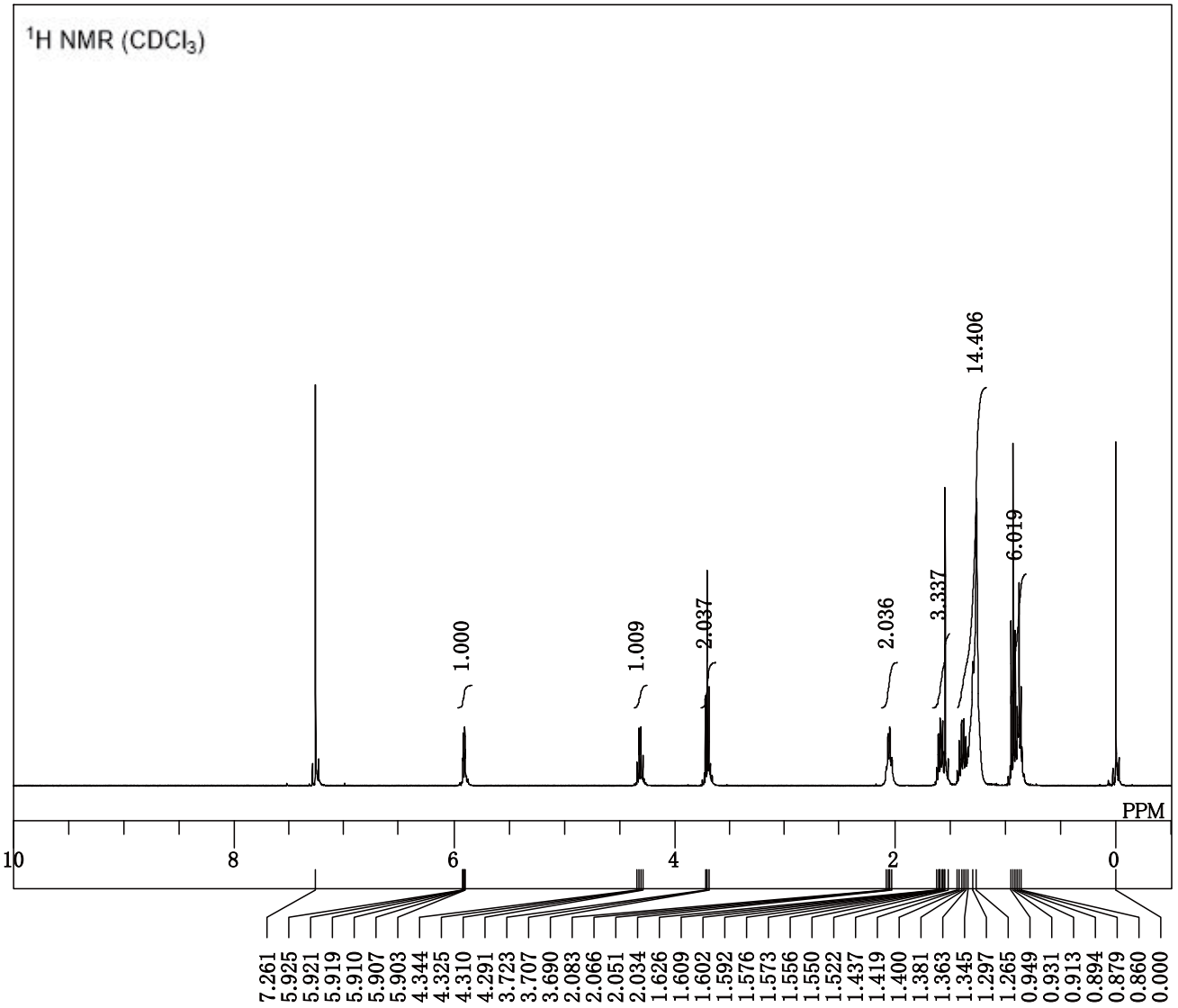

H
O^{n}Bu

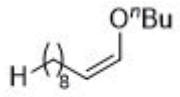
(*E*)-3a


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
146.097
104.188
77.321
77.000
76.679
68.896
31.894
31.409
30.776
29.461
29.314
29.034
27.777
22.681
19.180
14.108
13.845

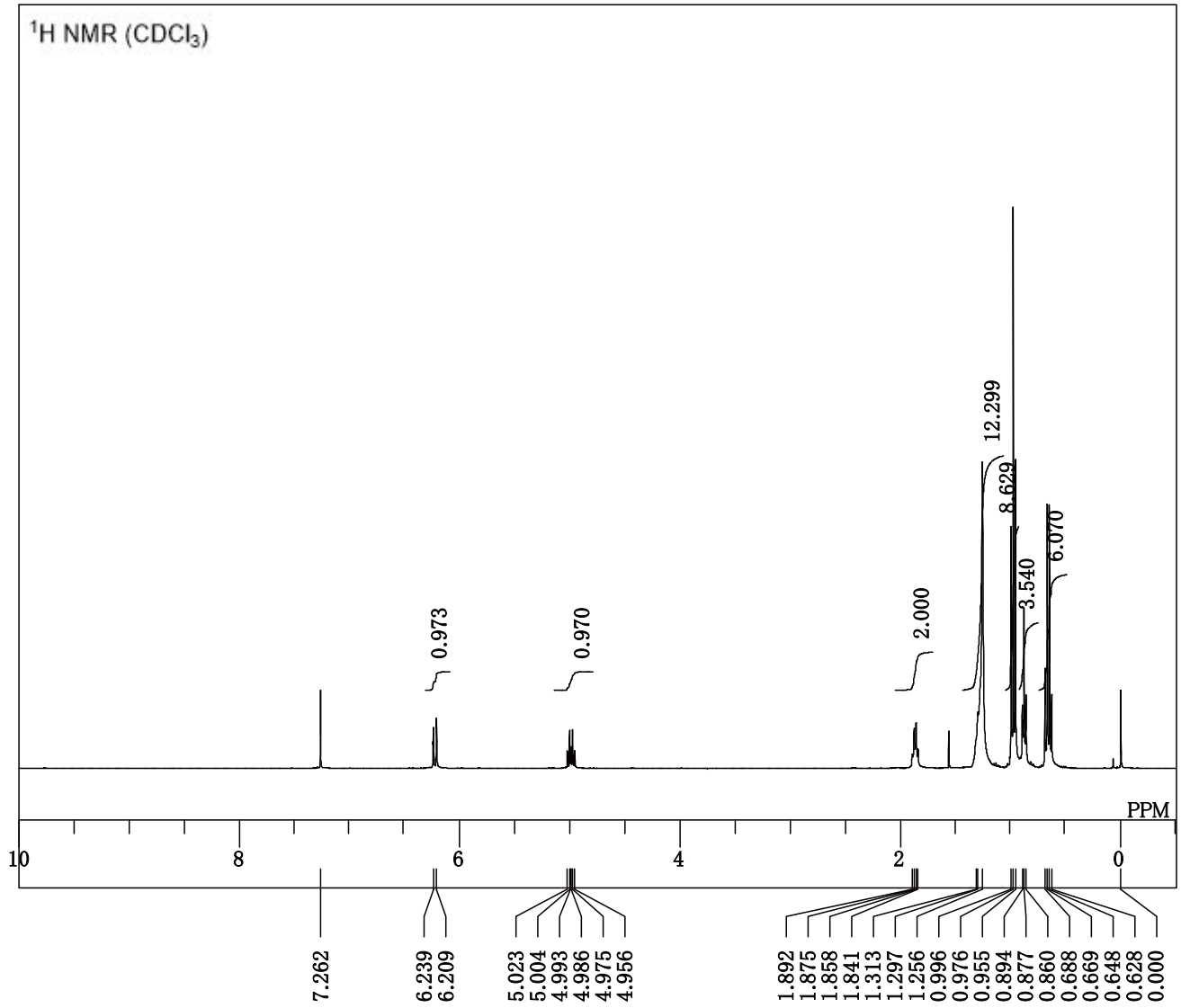

H
8
O^{n}Bu

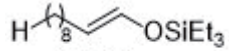
(*E*)-3a


^{1}H NMR ($CDCl_3$)
1.000
1.009
2.037
2.036
3.337
14.406
6.019
PPM
10
8
6
4
2
0
7.261
5.925
5.921
5.919
5.910
5.907
5.903
4.344
4.325
4.310
4.291
3.723
3.707
3.690
2.083
2.066
2.051
2.034
1.626
1.609
1.602
1.592
1.576
1.573
1.556
1.550
1.522
1.437
1.419
1.400
1.381
1.363
1.345
1.297
1.265
0.949
0.931
0.913
0.894
0.879
0.860
0.000

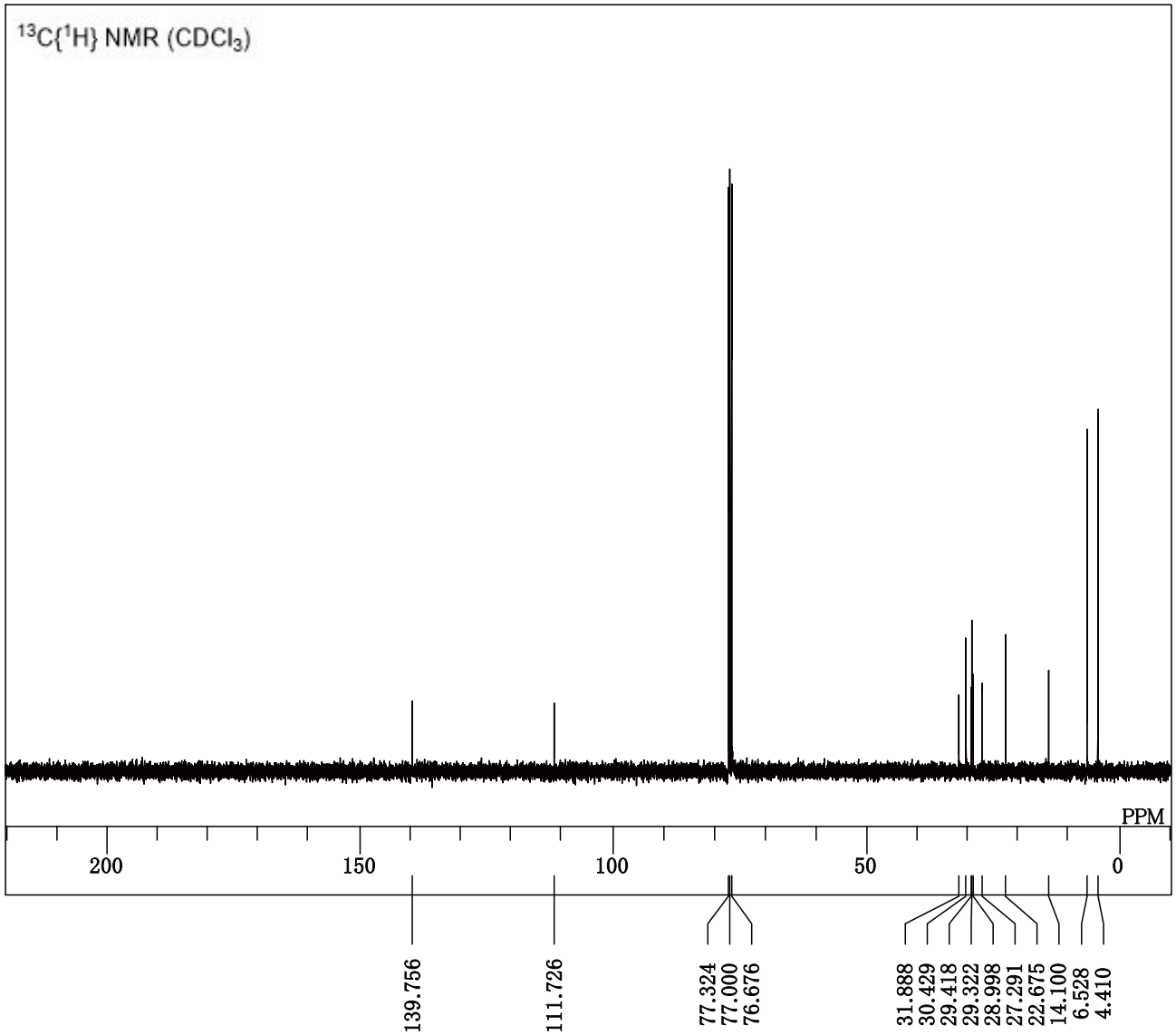

O^{n}Bu
H
8

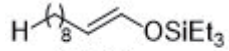
(Z)-3a


^{1}H NMR ($CDCl_3$)
0.973
0.970
2.000
12.299
8.629
3.540
6.070
PPM
10
8
6
4
2
0
7.262
6.239
6.209
5.023
5.004
4.993
4.986
4.975
4.956
1.892
1.875
1.858
1.841
1.313
1.297
1.256
0.996
0.976
0.955
0.894
0.877
0.860
0.688
0.669
0.648
0.628
0.000

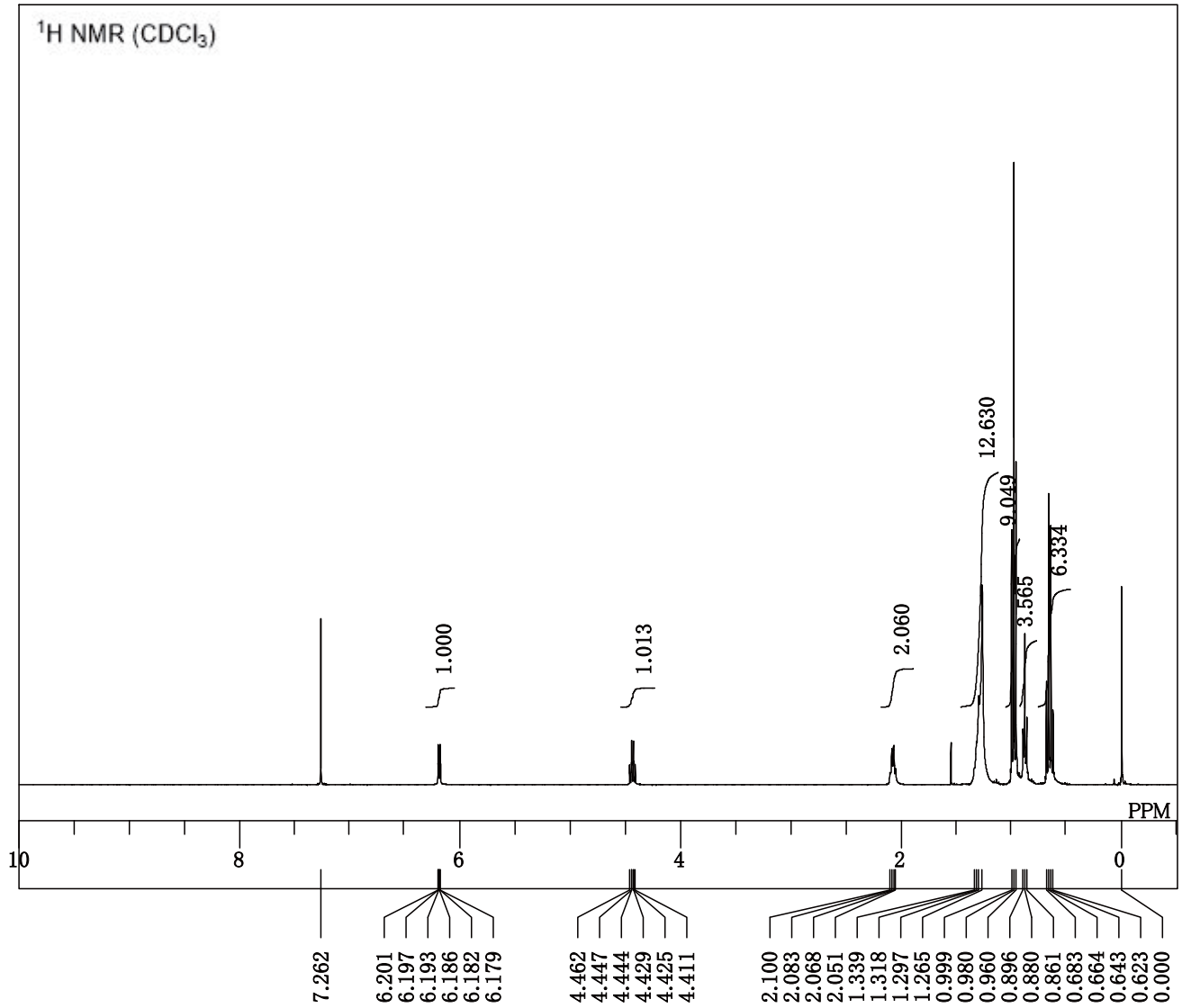

H
8
OSiEt3

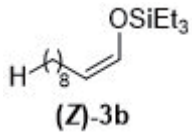
(*E*)-3b


13C{1H} NMR (CDCl3)
PPM
200
150
100
50
0
139.756
111.726
77.324
77.000
76.676
31.888
30.429
29.418
29.322
28.998
27.291
22.675
14.100
6.528
4.410

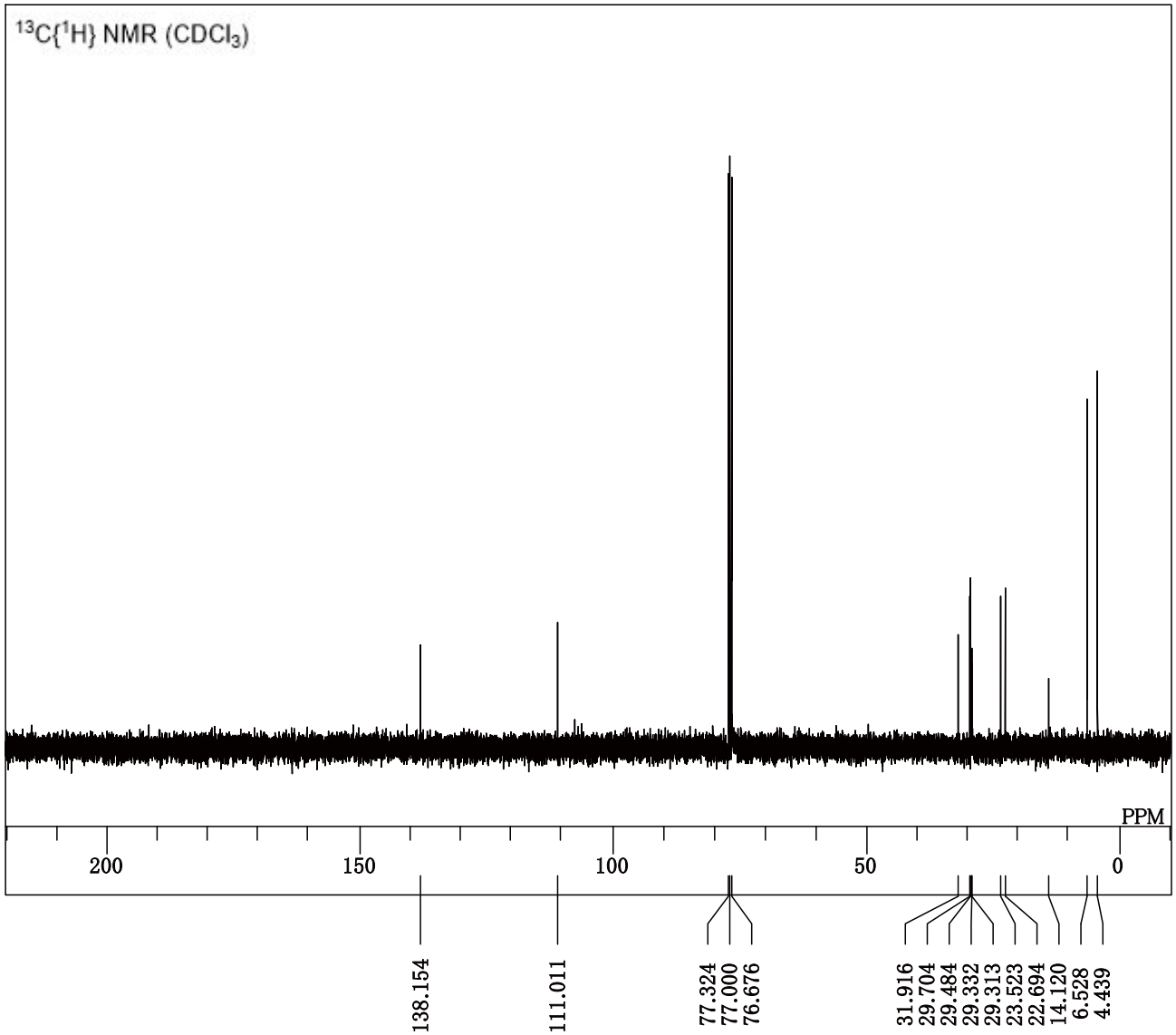

H
8
OSiEt3

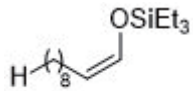
(*E*)-3b


^{1}H NMR ($CDCl_3$)
1.000
1.013
2.060
12.630
9.049
3.565
6.334
PPM
10
8
6
4
2
0
7.262
6.201
6.197
6.193
6.186
6.182
6.179
4.462
4.447
4.444
4.429
4.425
4.411
2.100
2.083
2.068
2.051
1.339
1.318
1.297
1.265
0.999
0.980
0.960
0.896
0.880
0.861
0.683
0.664
0.643
0.623
0.000

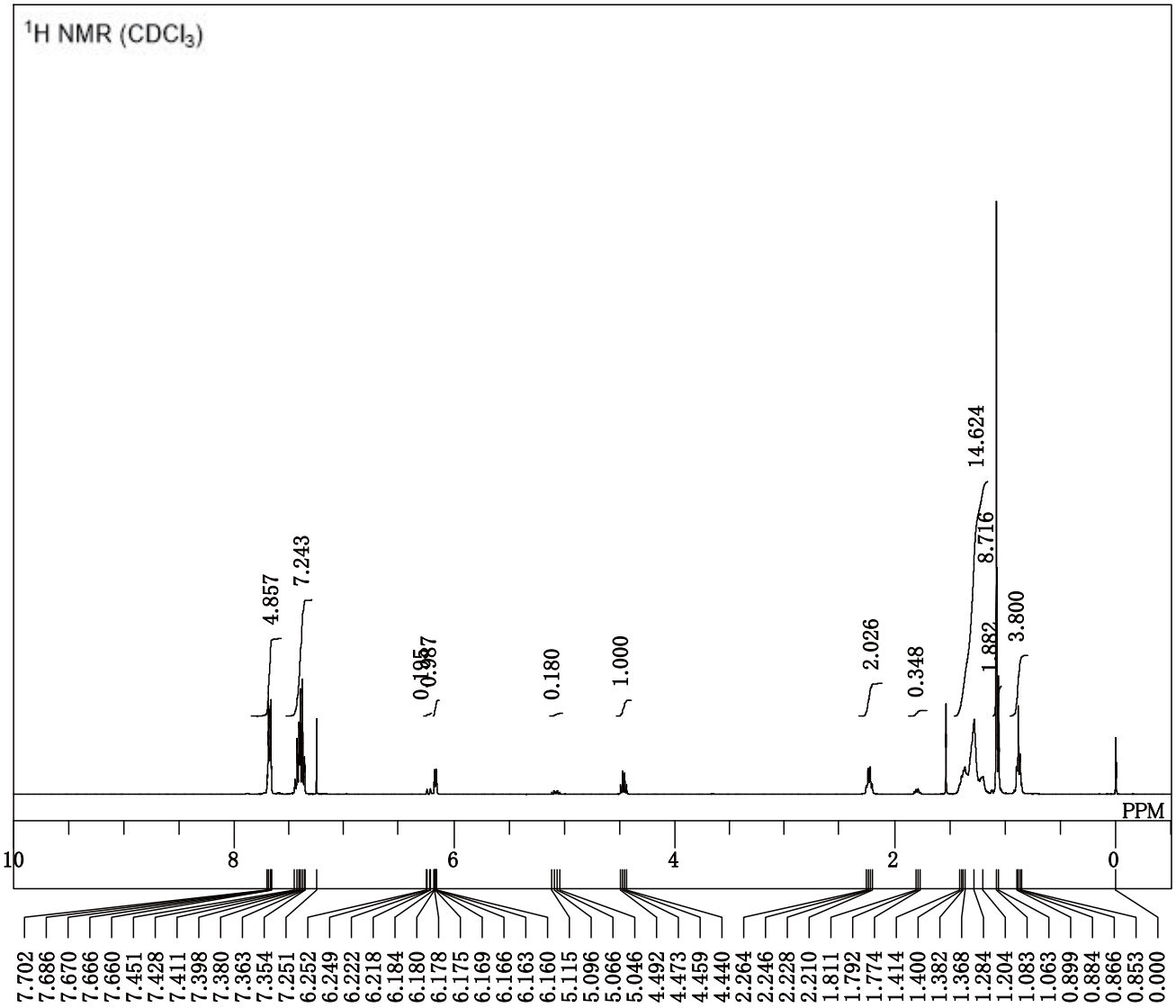

OSiEt$_3$
H
8

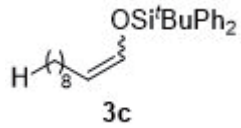
(Z)-3b


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
138.154
111.011
77.324
77.000
76.676
31.916
29.704
29.484
29.332
29.313
23.523
22.694
14.120
6.528
4.439

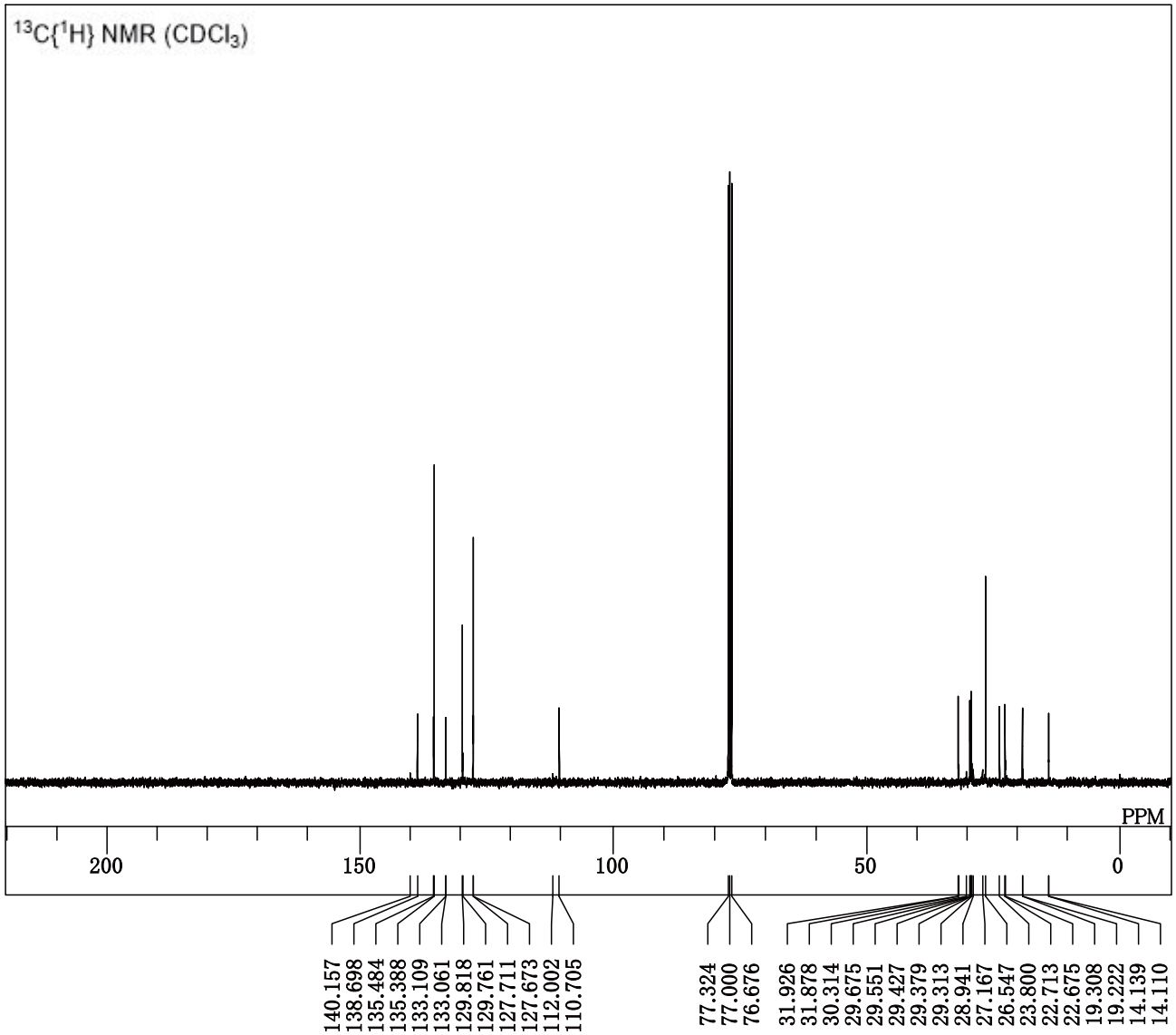

OSiEt3
H
8

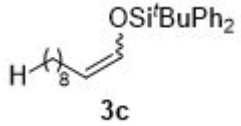
(*Z*)-3b


^{1}H NMR ($CDCl_3$)
4.857
7.243
0.195
0.987
0.180
1.000
2.026
0.348
14.624
8.716
1.882
3.800
PPM
10
8
6
4
2
0
7.702
7.686
7.670
7.666
7.660
7.451
7.428
7.411
7.398
7.380
7.363
7.354
7.251
6.252
6.249
6.222
6.218
6.184
6.180
6.178
6.175
6.169
6.166
6.163
6.160
5.115
5.096
5.066
5.046
4.492
4.473
4.459
4.440
2.264
2.246
2.228
2.210
1.811
1.792
1.774
1.414
1.400
1.382
1.368
1.284
1.204
1.083
1.063
0.899
0.884
0.866
0.853
0.000

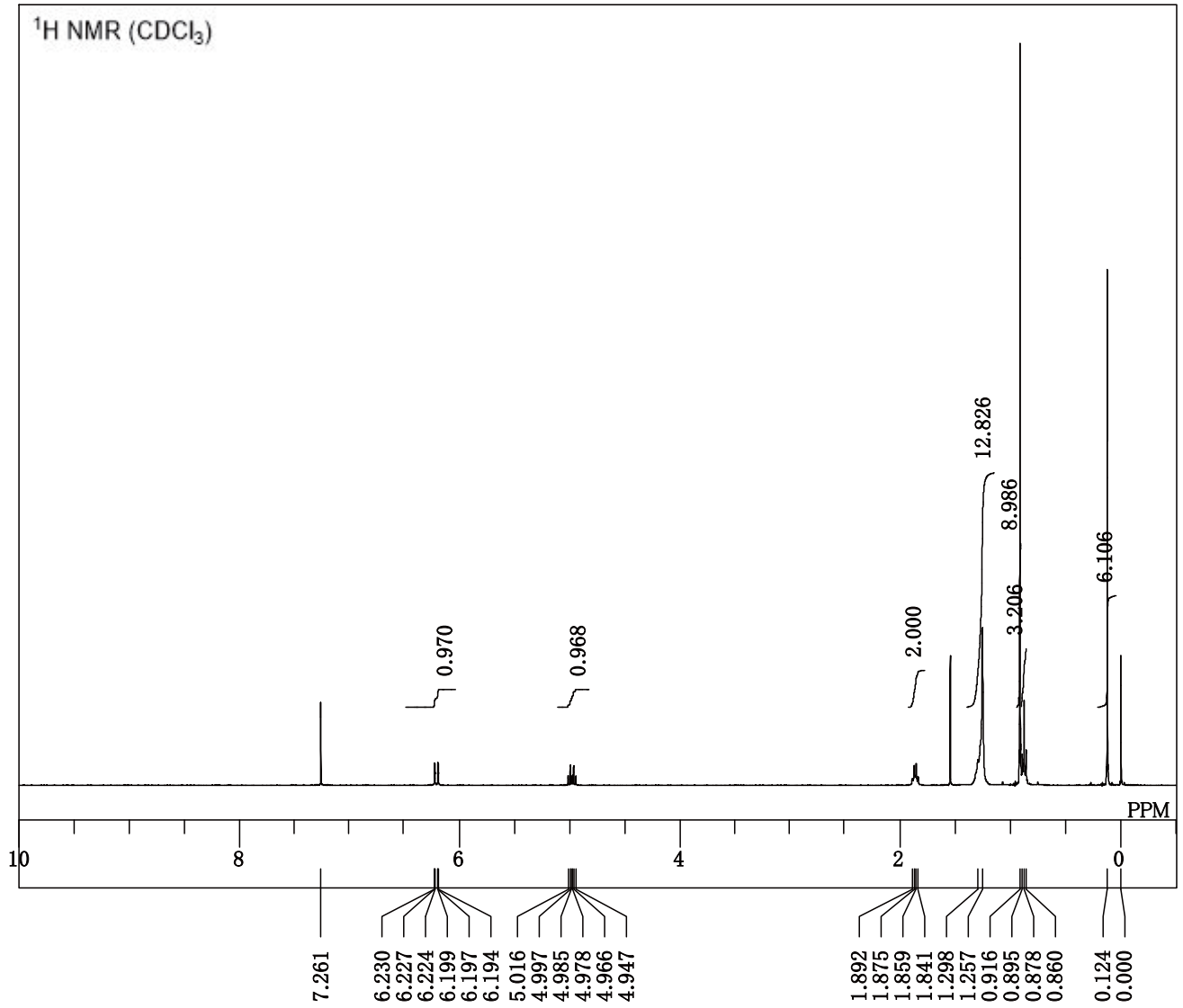

OSi^{t}BuPh$_2$
H
8

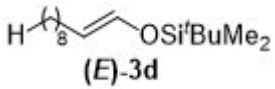
3c


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
140.157
138.698
135.484
135.388
133.109
133.061
129.818
129.761
127.711
127.673
112.002
110.705
77.324
77.000
76.676
31.926
31.878
30.314
29.675
29.551
29.427
29.379
29.313
28.941
27.167
26.547
23.800
22.713
22.675
19.308
19.222
14.139
14.110

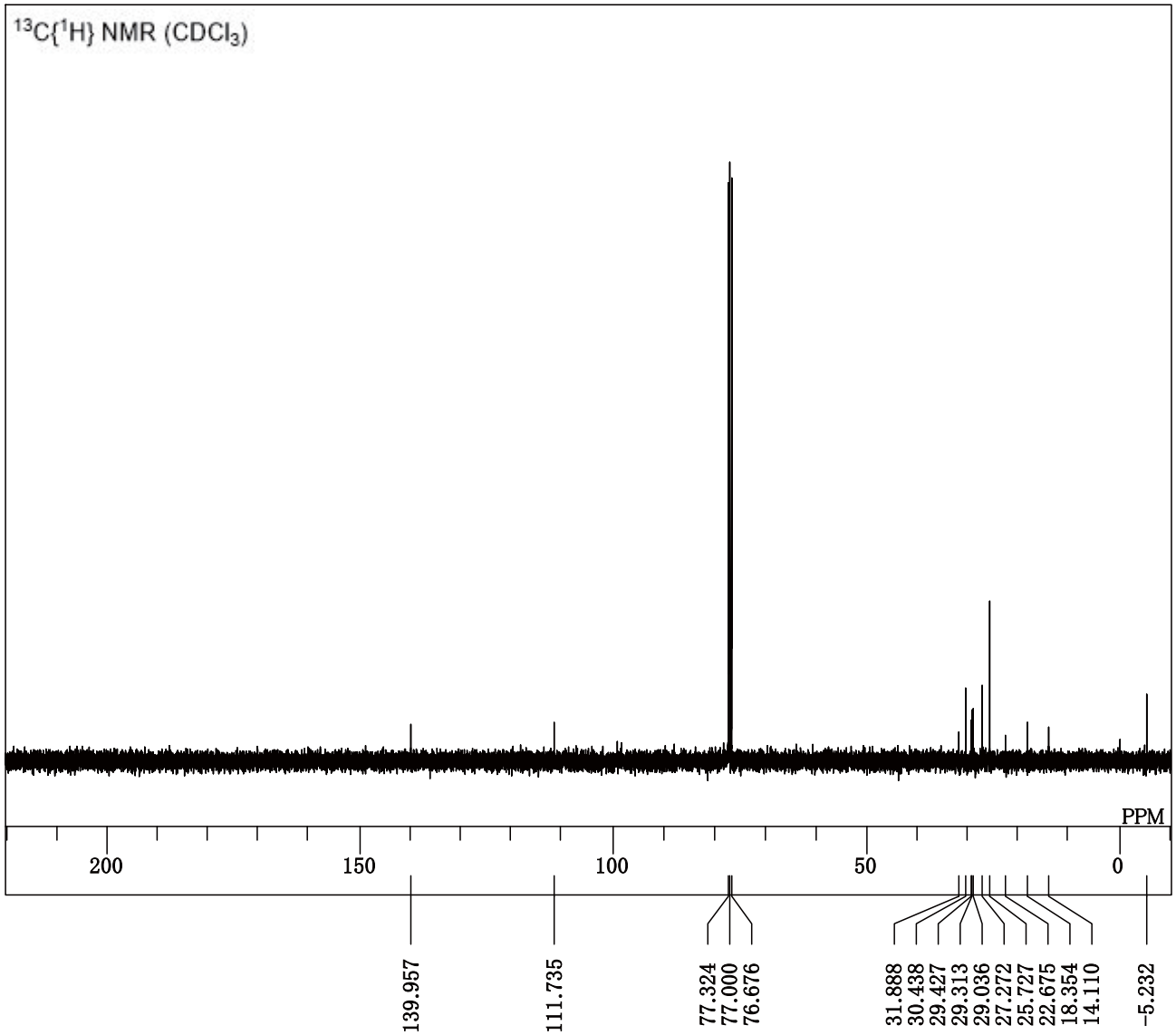

OSi^{t}BuPh$_2$
H
8

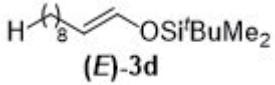
3c


^{1}H NMR ($CDCl_3$)
0.970
0.968
2.000
12.826
8.986
3.206
6.106
PPM
10
8
6
4
2
0
7.261
6.230
6.227
6.224
6.199
6.197
6.194
5.016
4.997
4.985
4.978
4.966
4.947
1.892
1.875
1.859
1.841
1.298
1.257
0.916
0.895
0.878
0.860
0.124
0.000

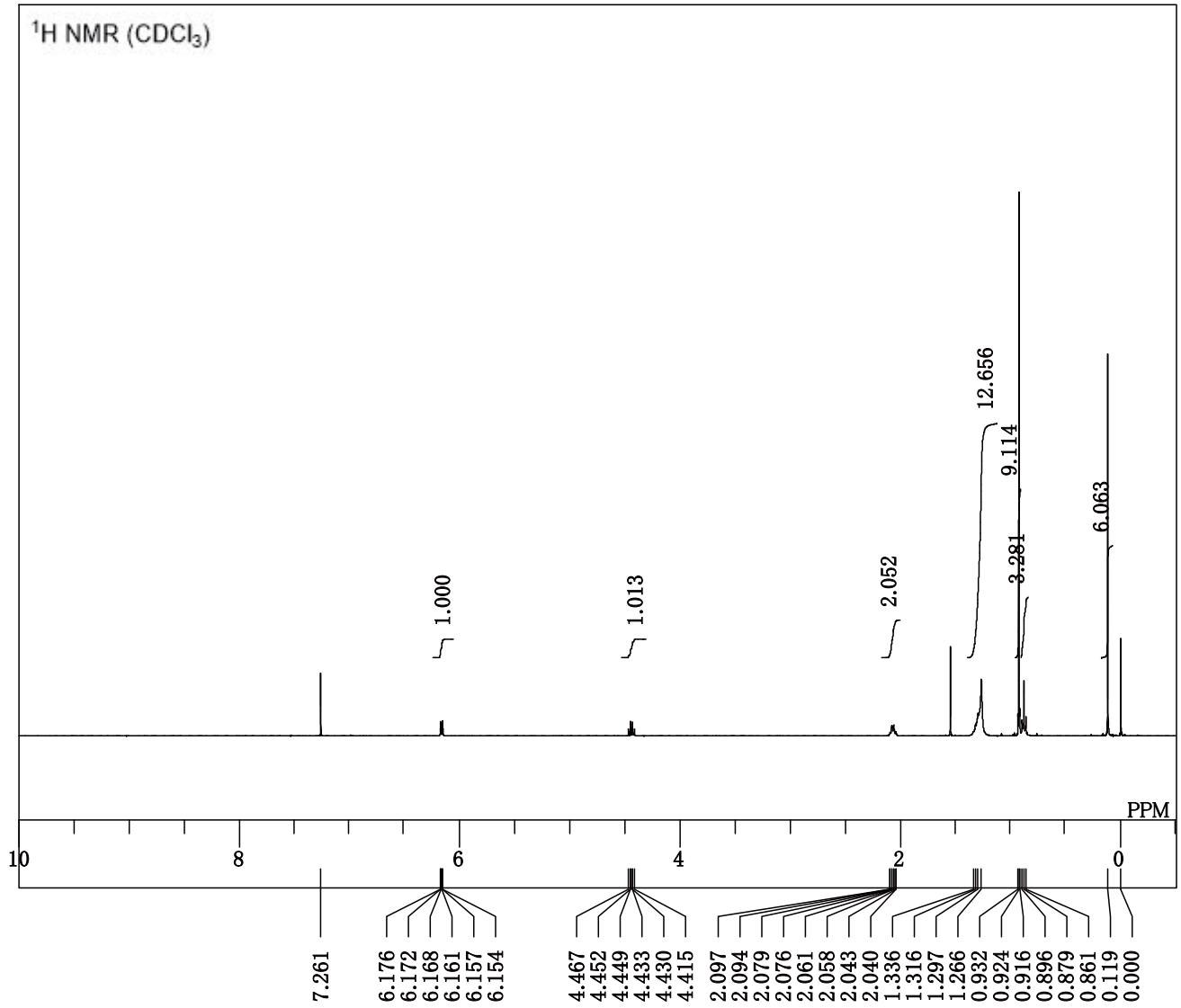

H
8
OSi^{t}BuMe$_2$

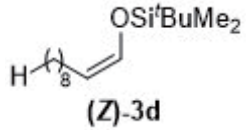
(*E*)-3d


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
139.957
111.735
77.324
77.000
76.676
31.888
30.438
29.427
29.313
29.036
27.272
25.727
22.675
18.354
14.110
-5.232

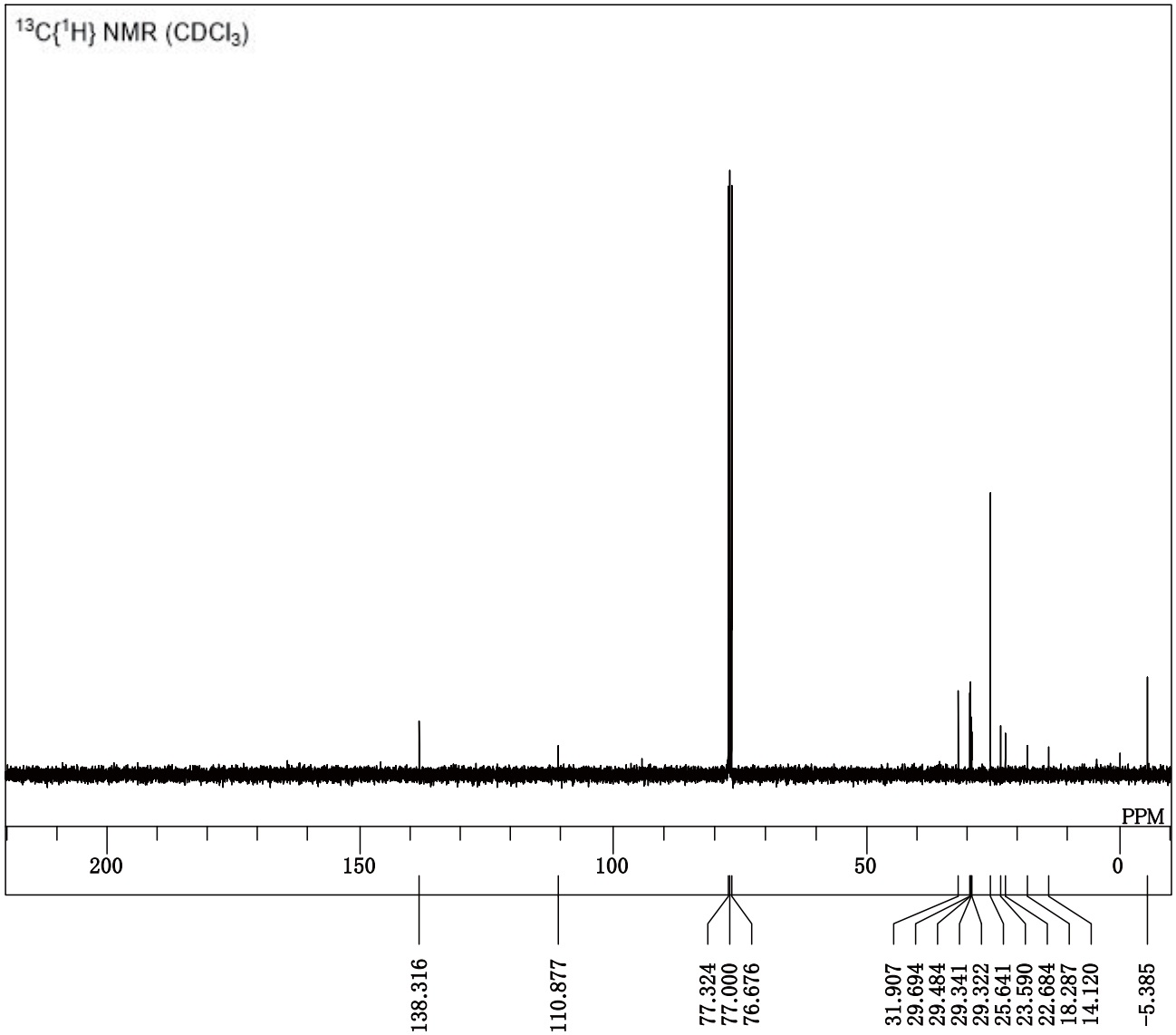

H
8
OSi^{t}BuMe$_2$

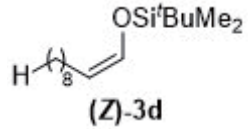
(*E*)-3d


1H NMR (CDCl3)
1.000
1.013
2.052
12.656
9.114
3.281
6.063
PPM
10
8
6
4
2
0
7.261
6.176
6.172
6.168
6.161
6.157
6.154
4.467
4.452
4.449
4.433
4.430
4.415
2.097
2.094
2.079
2.076
2.061
2.058
2.043
2.040
1.336
1.316
1.297
1.266
0.932
0.924
0.916
0.896
0.879
0.861
0.119
0.000

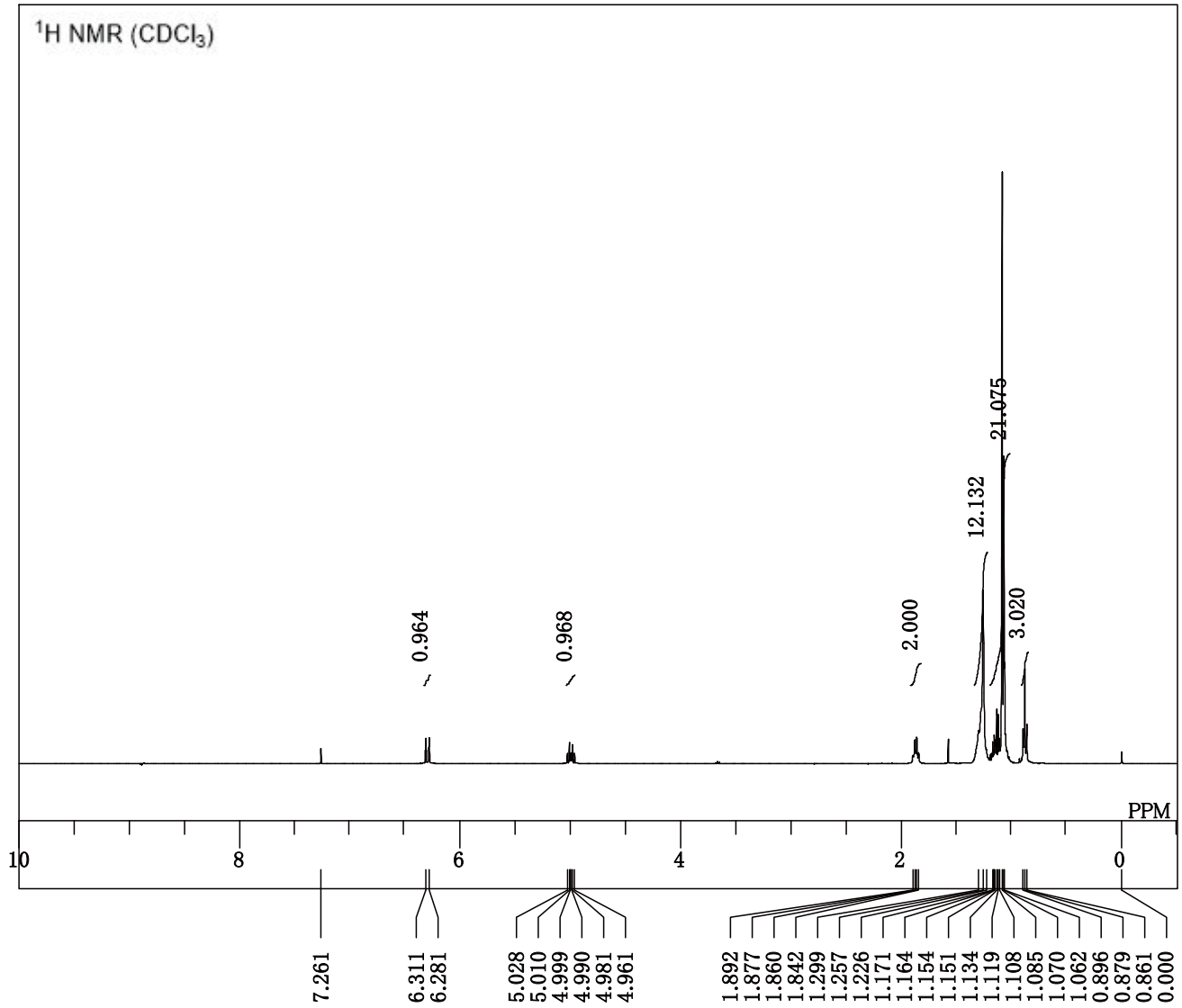

OSi^{t}BuMe$_2$
H
8

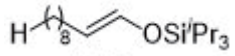
(*Z*)-3d


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
138.316
110.877
77.324
77.000
76.676
31.907
29.694
29.484
29.341
29.322
25.641
23.590
22.684
18.287
14.120
-5.385

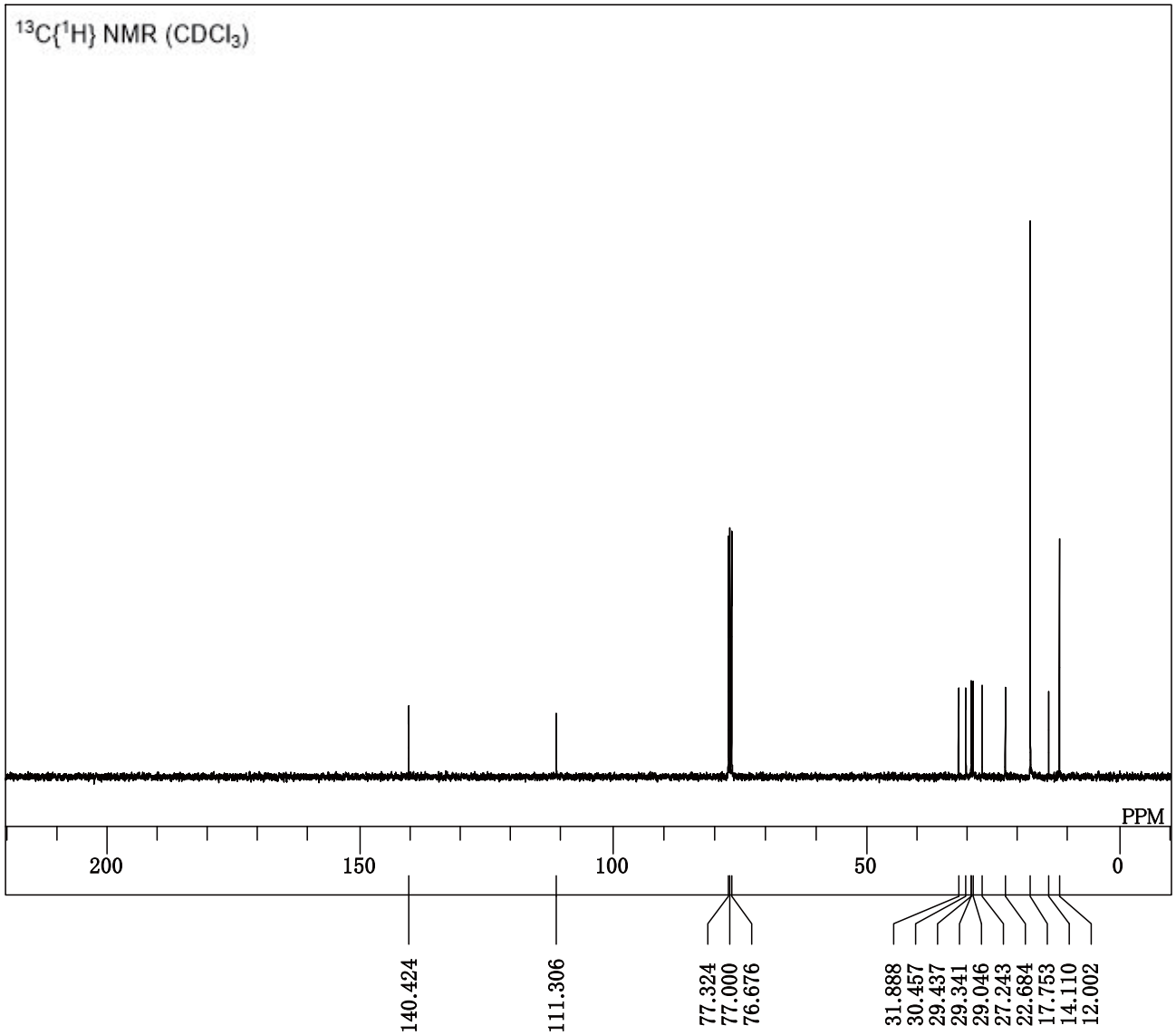

OSi^{t}BuMe$_2$
H
8

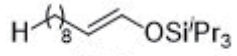
(*Z*)-3d


^{1}H NMR ($CDCl_3$)
0.964
0.968
2.000
12.132
21.075
3.020
PPM
10
8
6
4
2
0
7.261
6.311
6.281
5.028
5.010
4.999
4.990
4.981
4.961
1.892
1.877
1.860
1.842
1.299
1.257
1.226
1.171
1.164
1.154
1.151
1.134
1.119
1.108
1.085
1.070
1.062
0.896
0.879
0.861
0.000

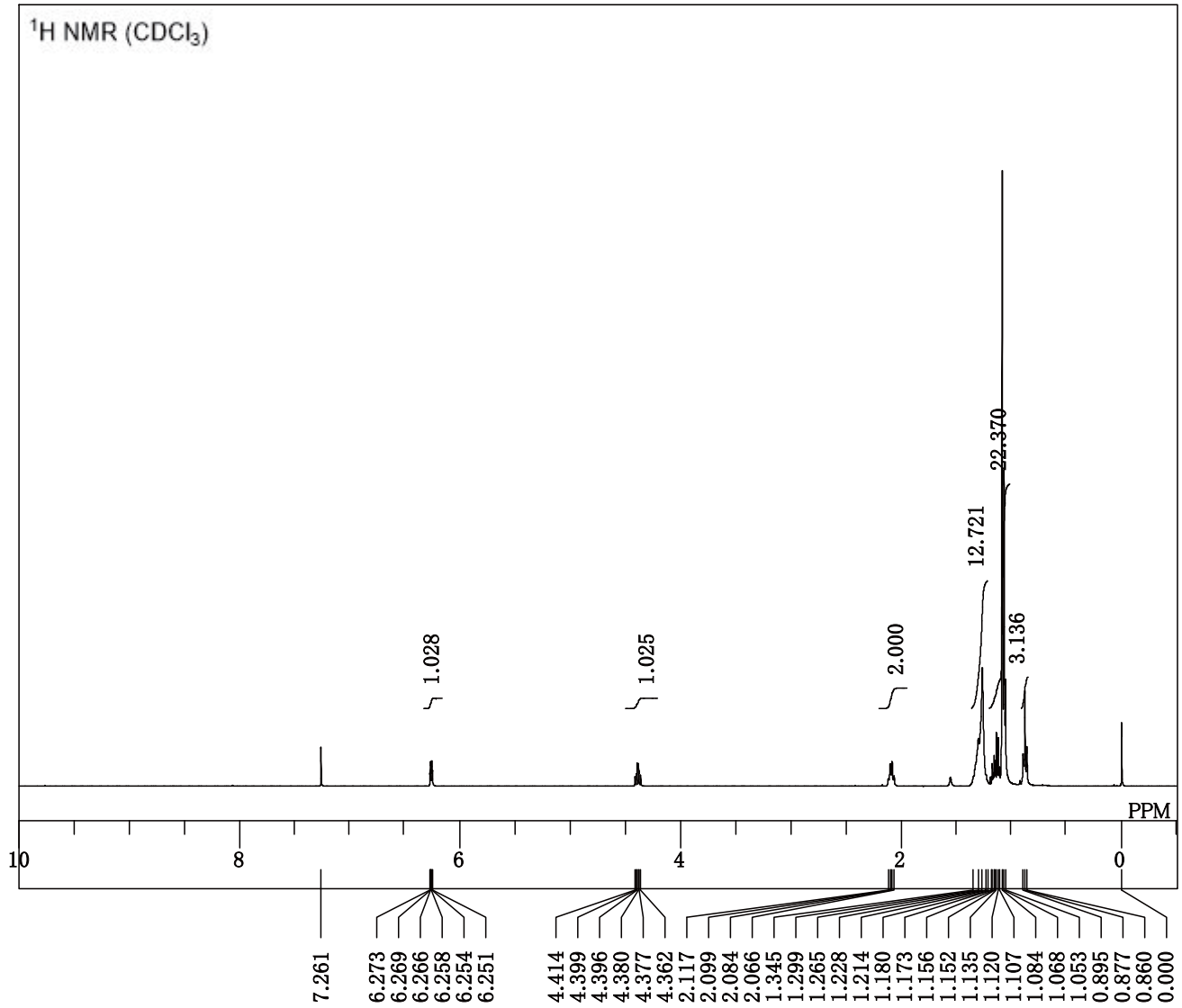

H
8
OSi^{i}Pr$_3$

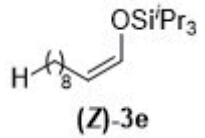
(*E*)-3e


13C{1H} NMR (CDCl3)
PPM
200
150
100
50
0
140.424
111.306
77.324
77.000
76.676
31.888
30.457
29.437
29.341
29.046
27.243
22.684
17.753
14.110
12.002

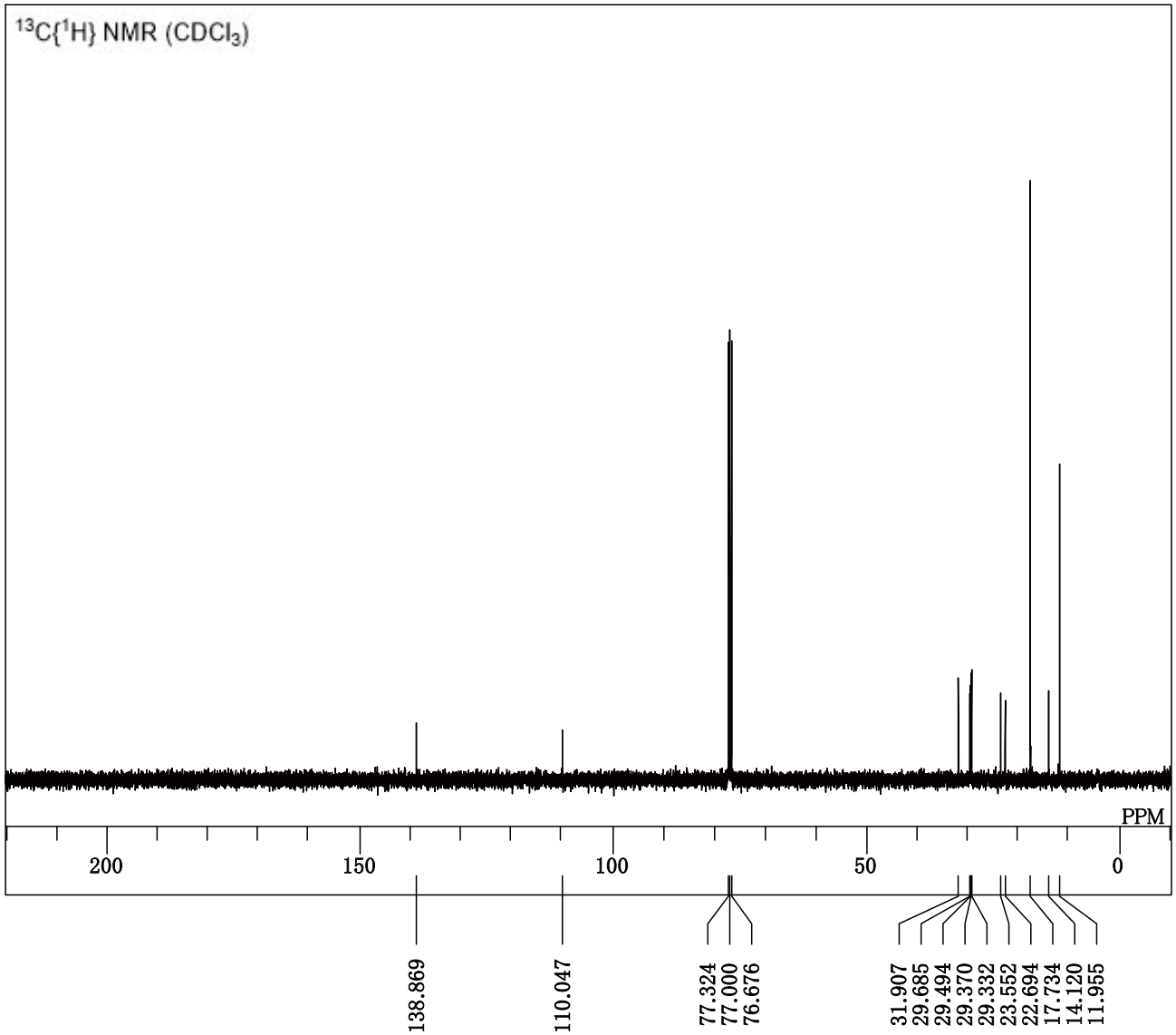

H
8
OSiiPr3

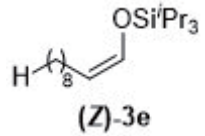
(*E*)-3e


^{1}H NMR ($CDCl_3$)
1.028
1.025
2.000
12.721
22.370
3.136
PPM
10
8
6
4
2
0
7.261
6.273
6.269
6.266
6.258
6.254
6.251
4.414
4.399
4.396
4.380
4.377
4.362
2.117
2.099
2.084
2.066
1.345
1.299
1.265
1.228
1.214
1.180
1.173
1.156
1.152
1.135
1.120
1.107
1.084
1.068
1.053
0.895
0.877
0.860
0.000

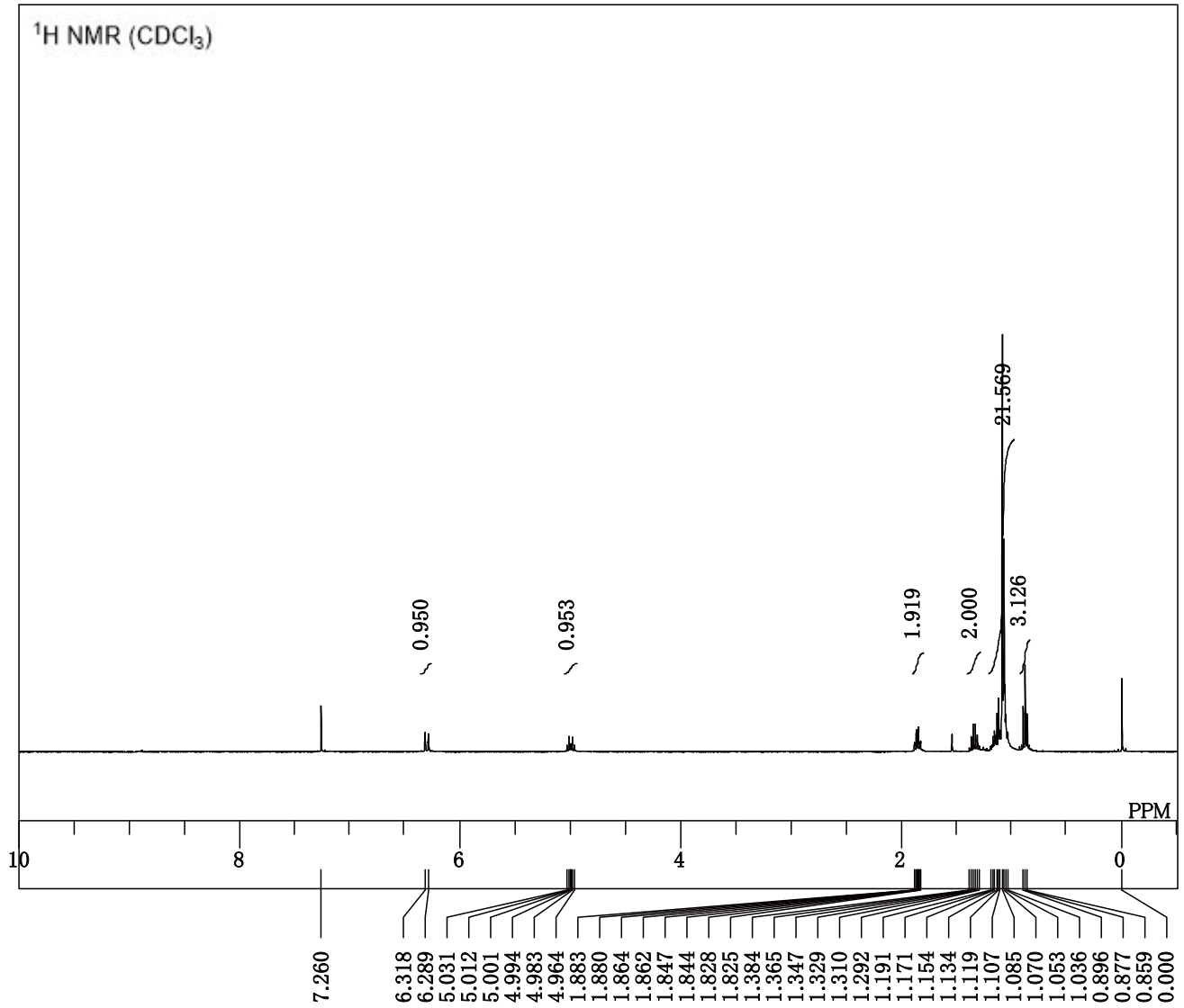

OSi^{i}Pr$_3$
H
8

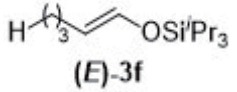
(*Z*)-3e


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
138.869
110.047
77.324
77.000
76.676
31.907
29.685
29.494
29.370
29.332
23.552
22.694
17.734
14.120
11.955

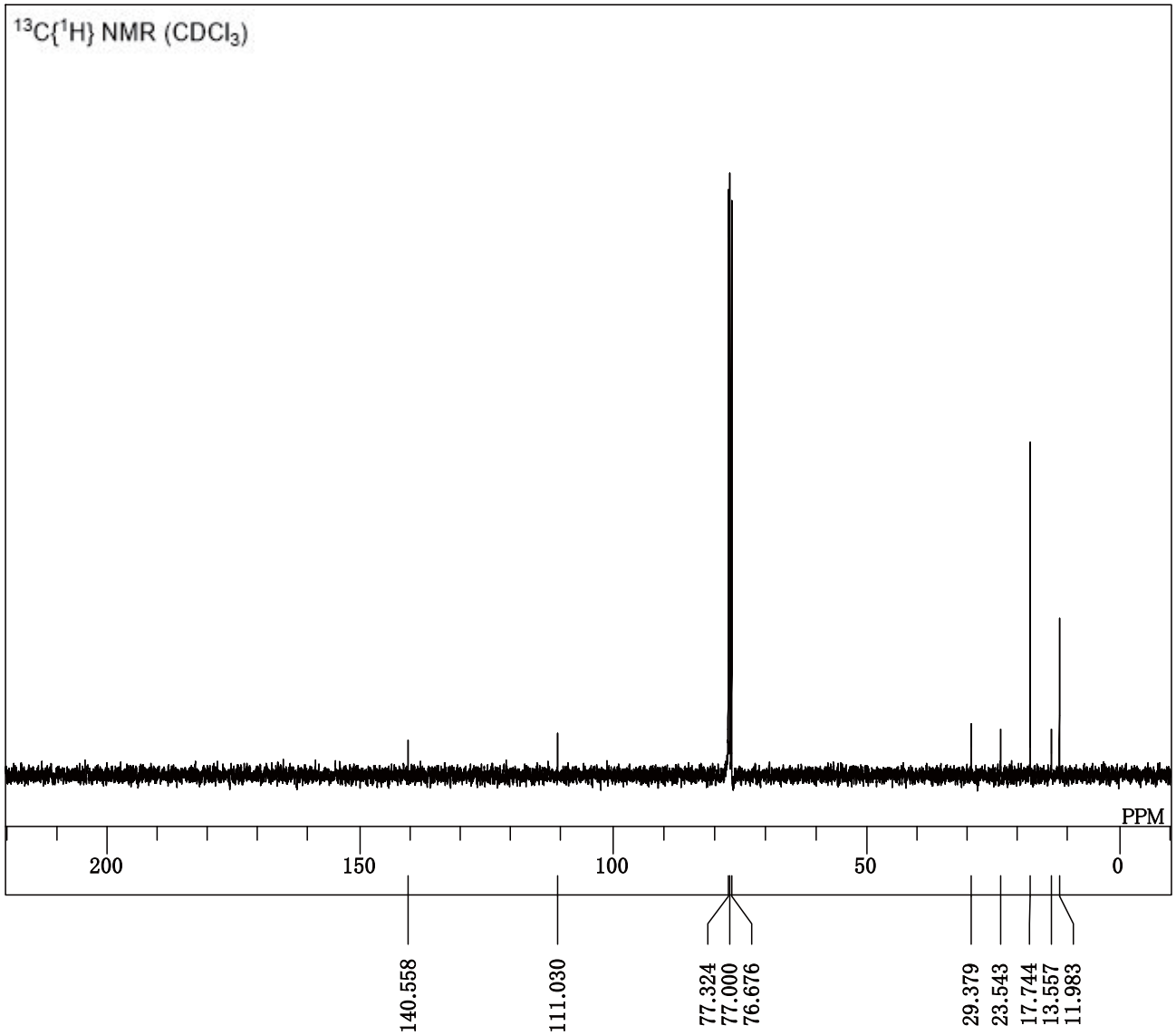

OSi^{i}Pr$_3$
H
8

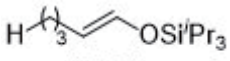
(*Z*)-3e


1H NMR (CDCl3)
0.950
0.953
1.919
2.000
21.569
3.126
PPM
10
8
6
4
2
0
7.260
6.318
6.289
5.031
5.012
5.001
4.994
4.983
4.964
1.883
1.880
1.864
1.862
1.847
1.844
1.828
1.825
1.384
1.365
1.347
1.329
1.310
1.292
1.191
1.171
1.154
1.134
1.119
1.107
1.085
1.070
1.053
1.036
0.896
0.877
0.859
0.000

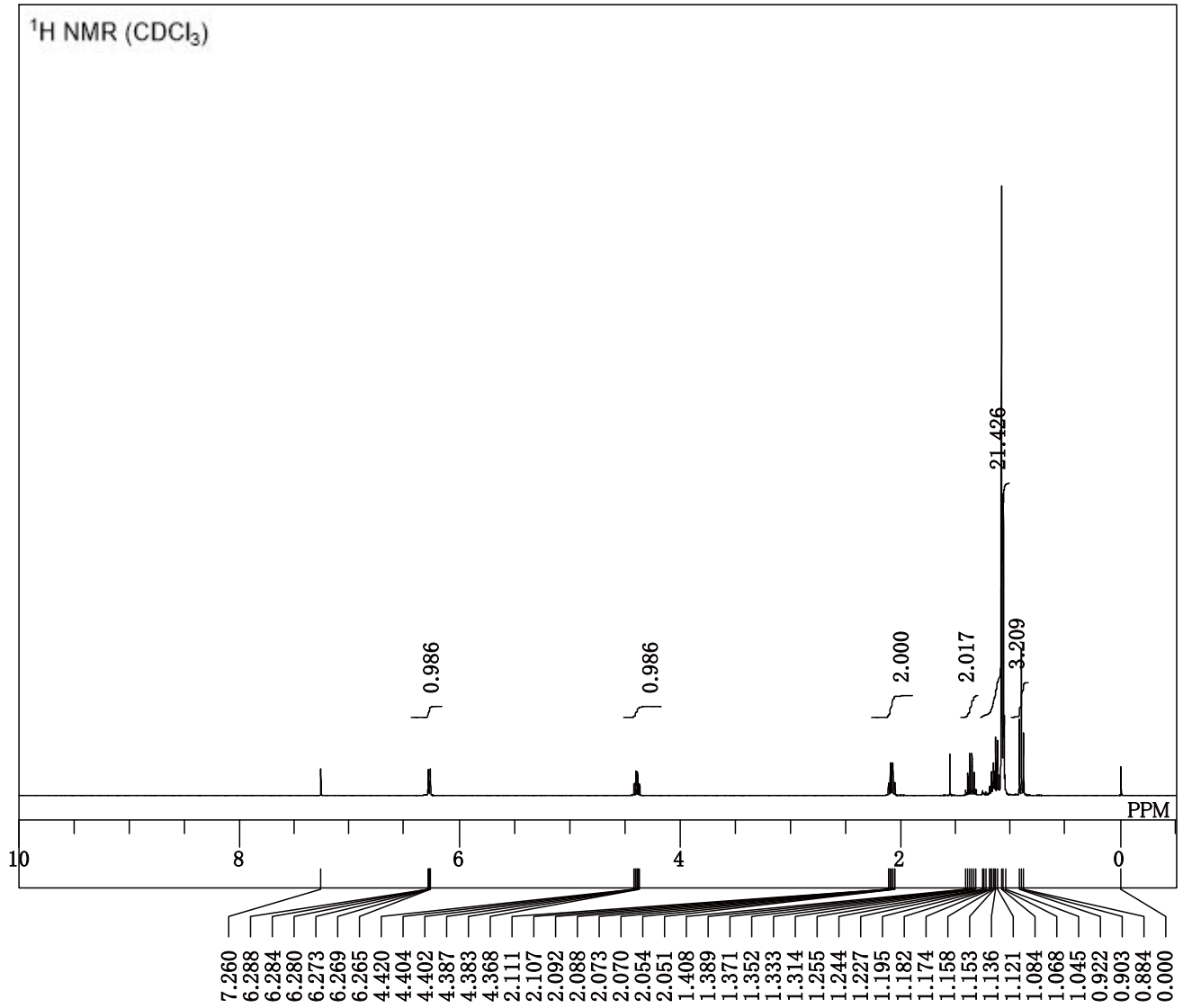

H
3
OSiiPr3

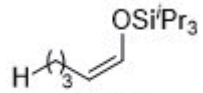
(*E*)-3f


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
140.558
111.030
77.324
77.000
76.676
29.379
23.543
17.744
13.557
11.983

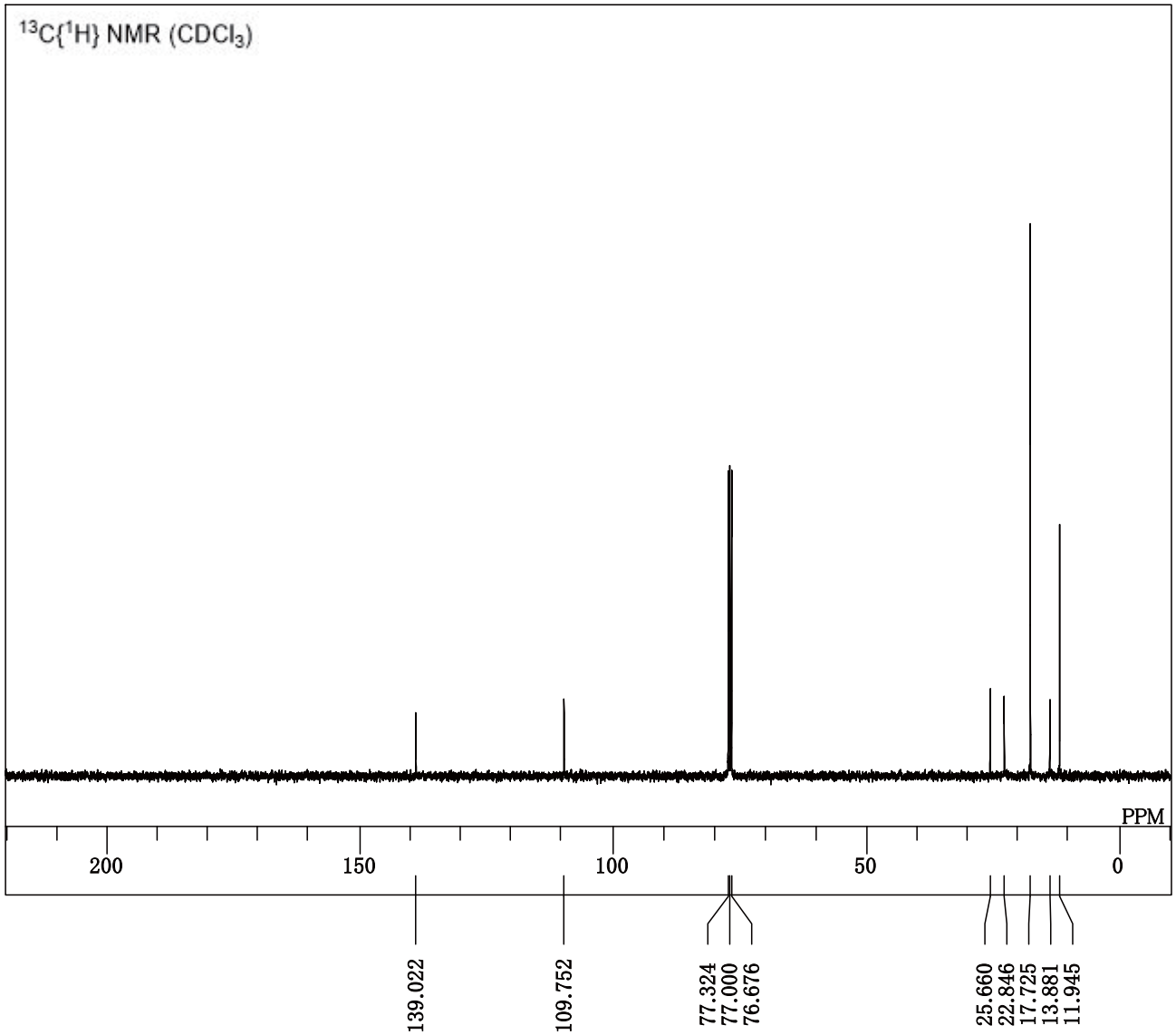

H
3
OSi^{i}Pr$_3$

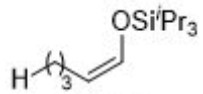
(*E*)-3f


^{1}H NMR ($CDCl_3$)
0.986
0.986
2.000
2.017
3.209
21.426
PPM
10
8
6
4
2
0
7.260
6.288
6.284
6.280
6.273
6.269
6.265
4.420
4.404
4.402
4.387
4.383
4.368
2.111
2.107
2.092
2.088
2.073
2.070
2.054
2.051
1.408
1.389
1.371
1.352
1.333
1.314
1.255
1.244
1.227
1.195
1.182
1.174
1.158
1.153
1.136
1.121
1.084
1.068
1.045
0.922
0.903
0.884
0.000

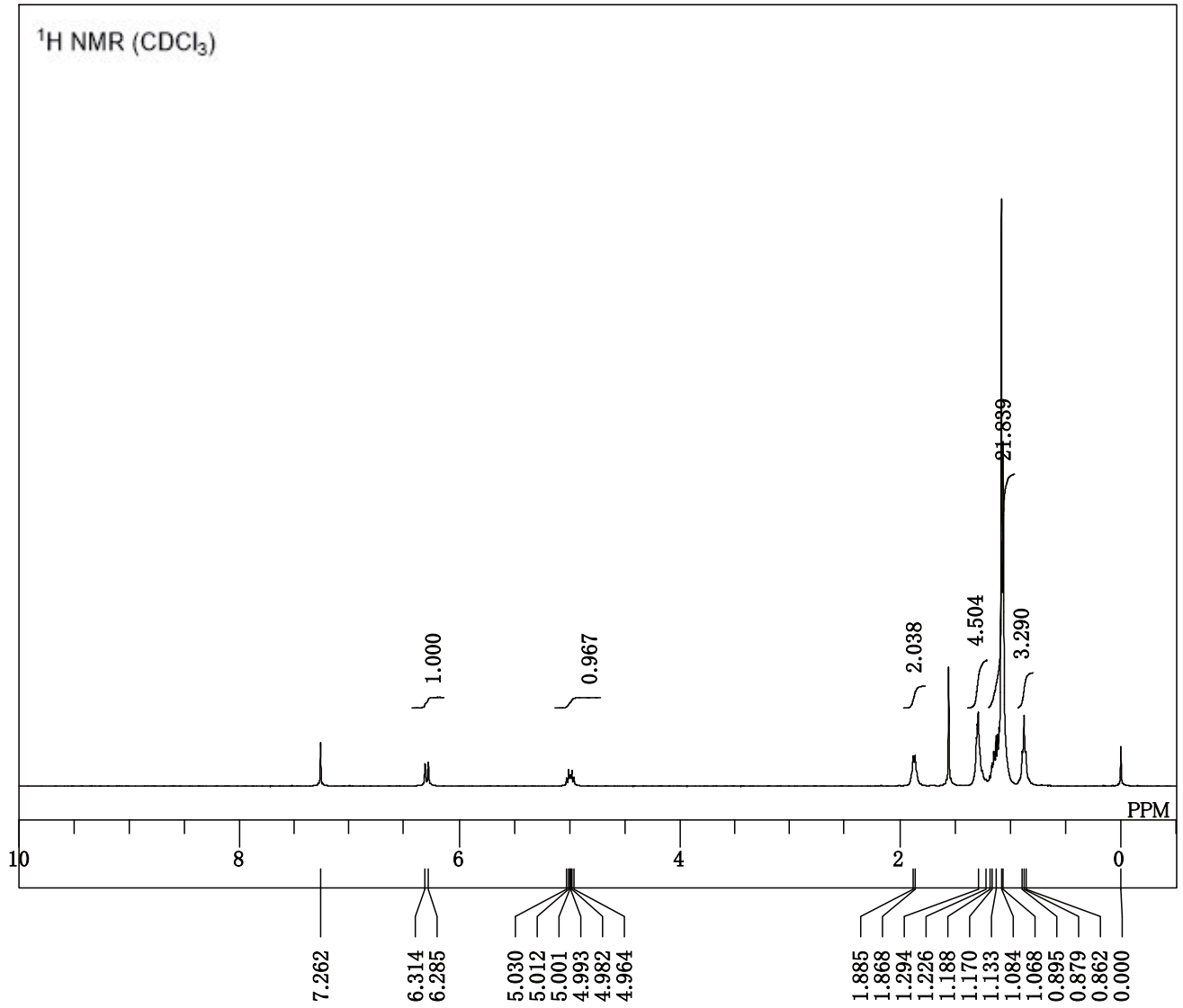

OSi^{i}Pr$_3$
H
3

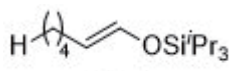
(*Z*)-3f


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
139.022
109.752
77.324
77.000
76.676
25.660
22.846
17.725
13.881
11.945

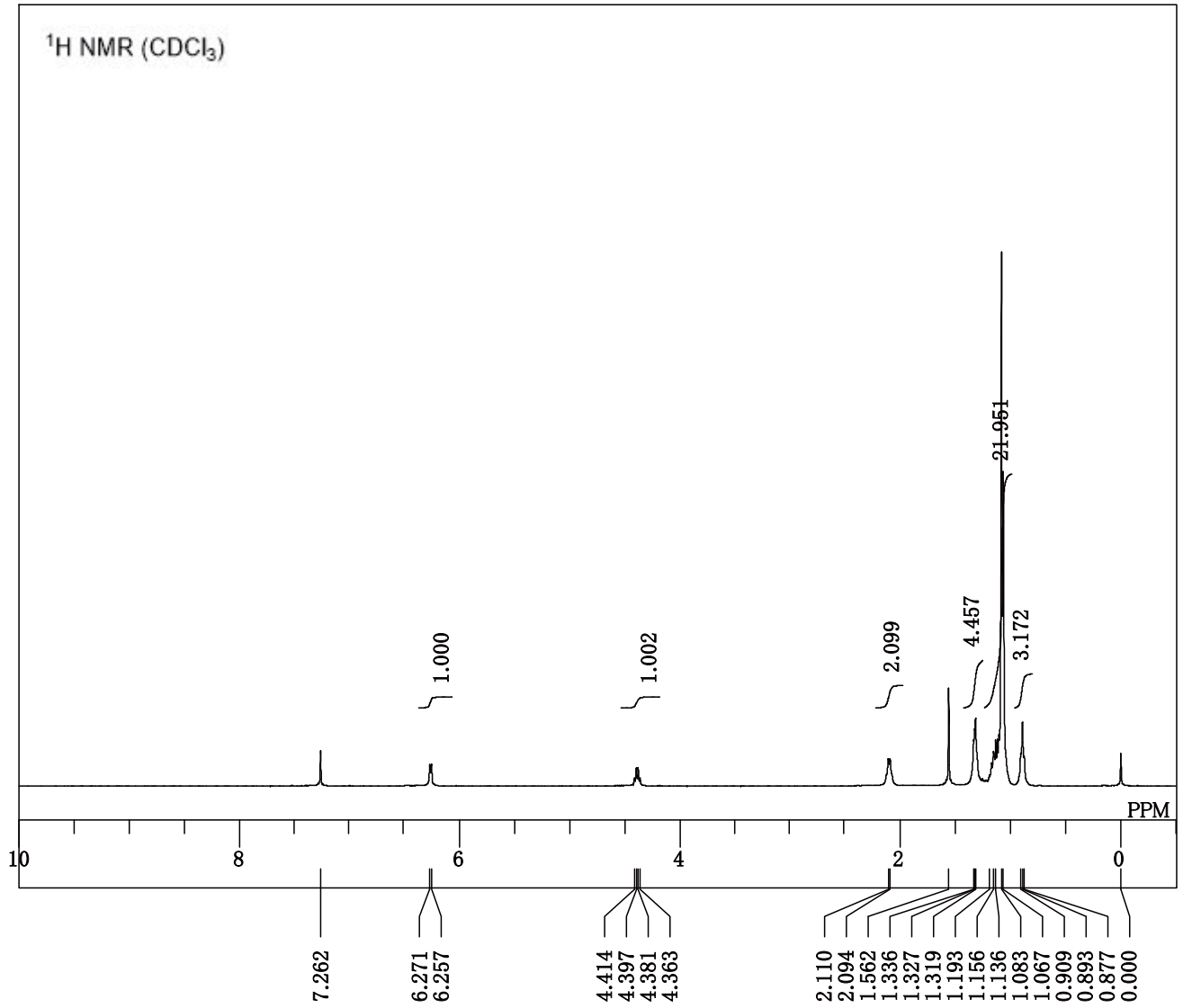

OSi^{i}Pr$_3$
H
3

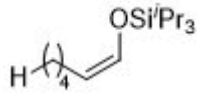
(*Z*)-3f


1H NMR (CDCl3)
1.000
0.967
2.038
4.504
21.839
3.290
PPM
10
8
6
4
2
0
7.262
6.314
6.285
5.030
5.012
5.001
4.993
4.982
4.964
1.885
1.868
1.294
1.226
1.188
1.170
1.133
1.084
1.068
0.895
0.879
0.862
0.000

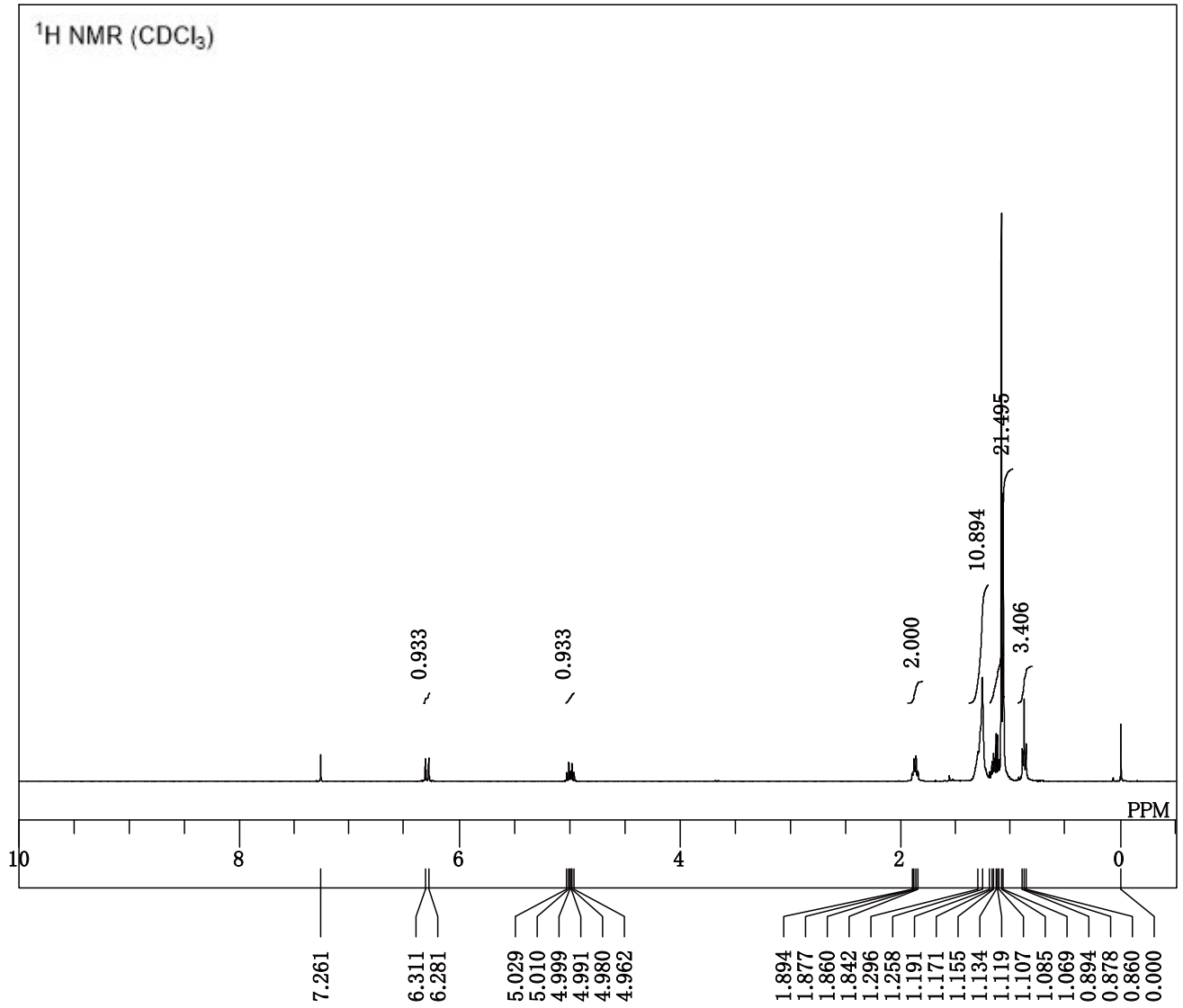

H
4
OSiiPr3

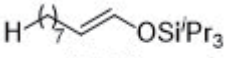
(*E*)-3g


1H NMR (CDCl3)
1.000
1.002
2.099
4.457
21.051
3.172
PPM
10
8
6
4
2
0
7.262
6.271
6.257
4.414
4.397
4.381
4.363
2.110
2.094
1.562
1.336
1.327
1.319
1.193
1.156
1.136
1.083
1.067
0.909
0.893
0.877
0.000

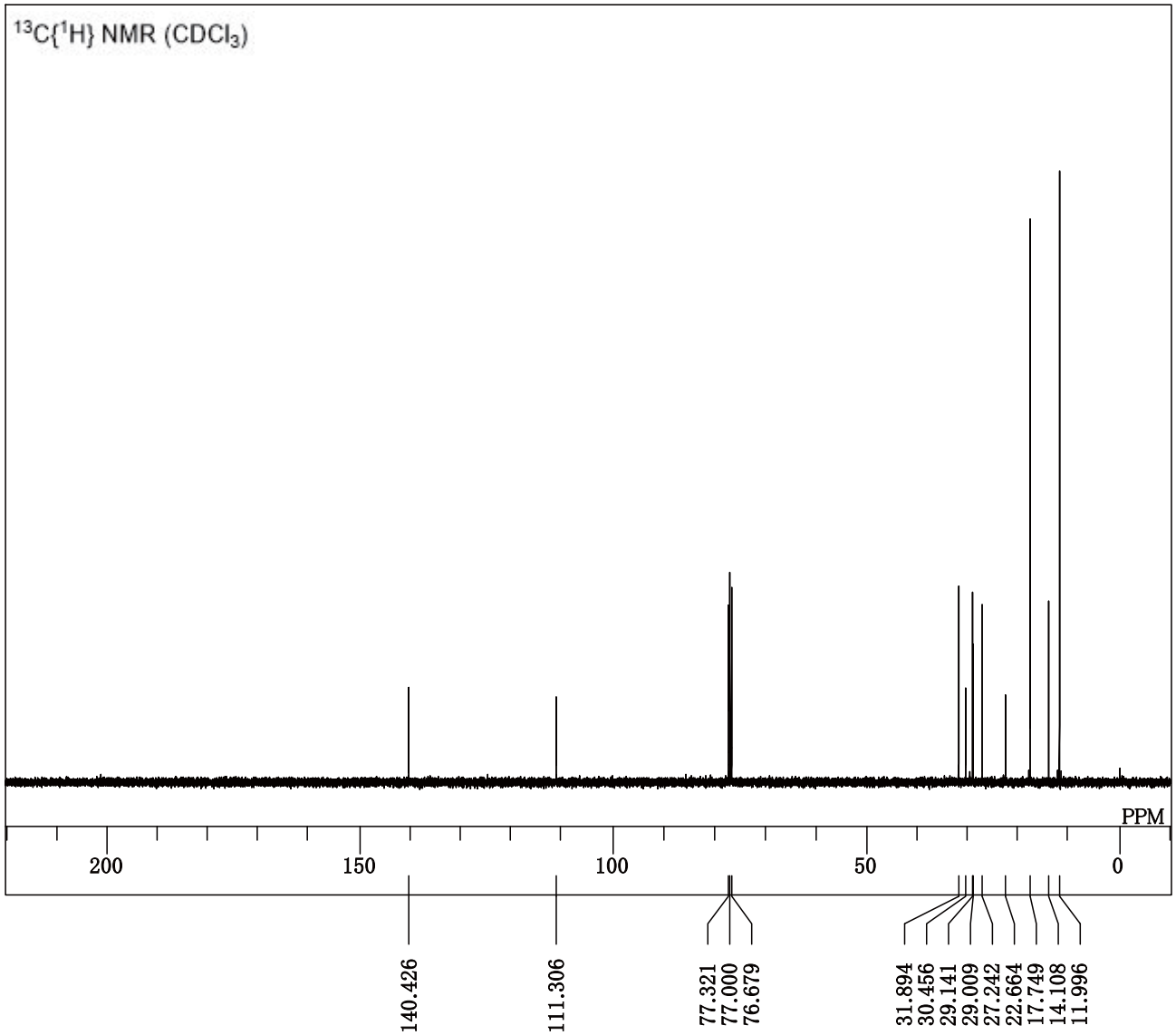

OSi^{i}Pr$_3$
H
4

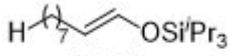
(Z)-3g


^{1}H NMR ($CDCl_3$)
0.933
0.933
2.000
10.894
21.495
3.406
PPM
10
8
6
4
2
0
7.261
6.311
6.281
5.029
5.010
4.999
4.991
4.980
4.962
1.894
1.877
1.860
1.842
1.296
1.258
1.191
1.171
1.155
1.134
1.119
1.107
1.085
1.069
0.894
0.878
0.860
0.000

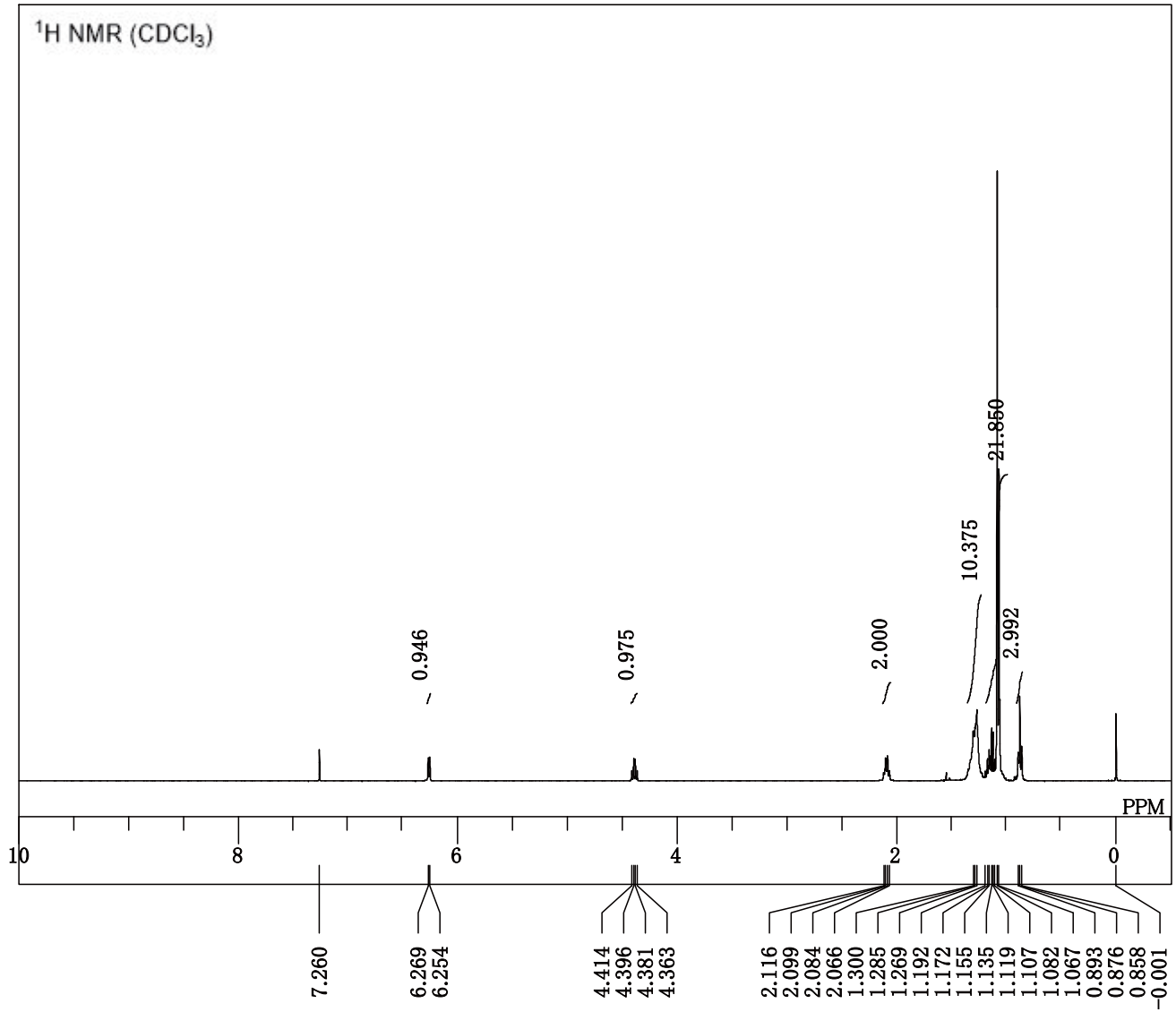

H
7
OSi^{i}Pr$_3$

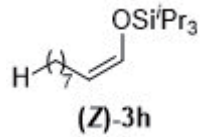
(*E*)-3h


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
140.426
111.306
77.321
77.000
76.679
31.894
30.456
29.141
29.009
27.242
22.664
17.749
14.108
11.996

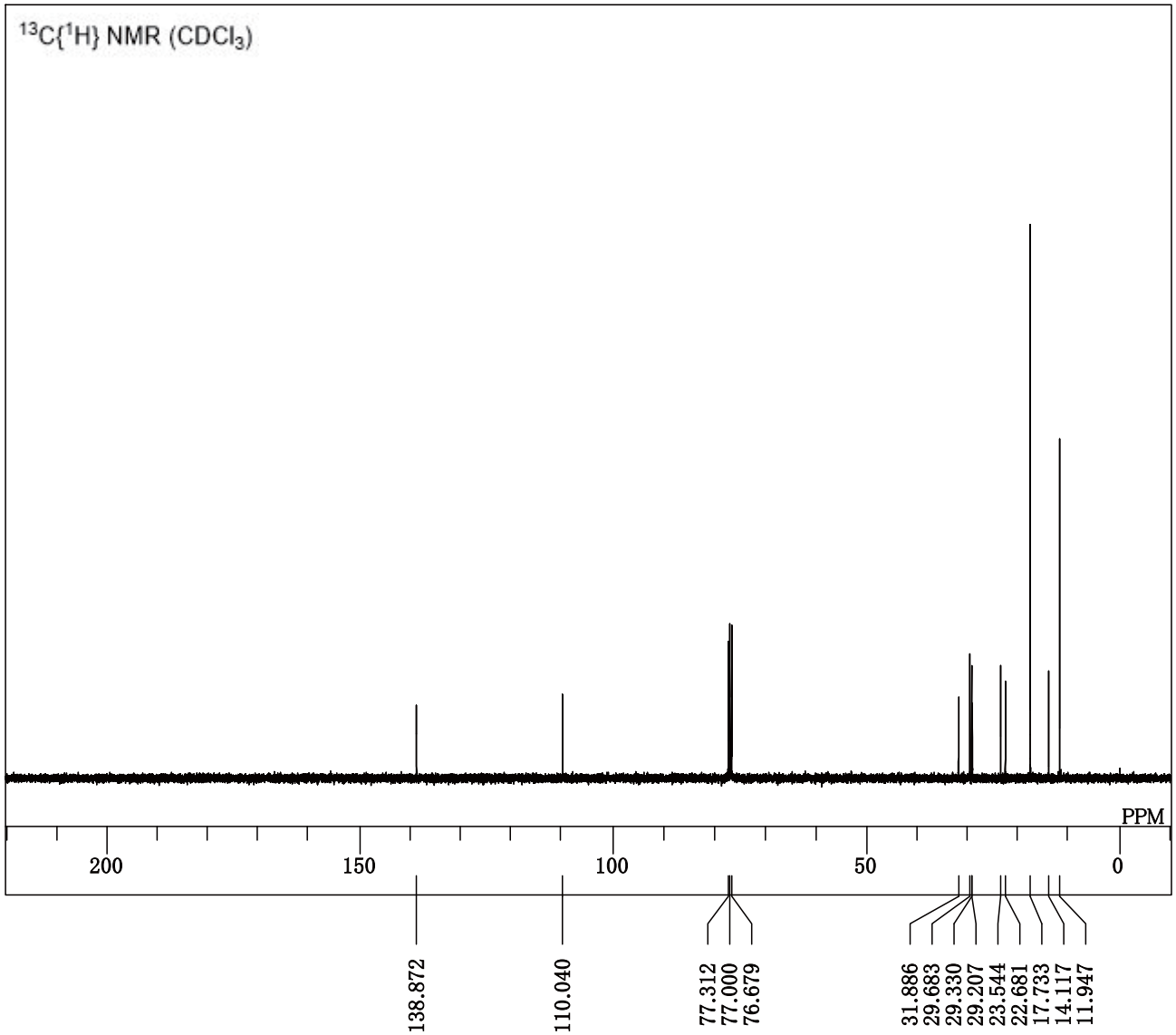

H
7
OSi^{i}Pr$_3$

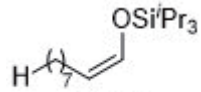
(*E*)-3h


^{1}H NMR ($CDCl_3$)
0.946
0.975
2.000
10.375
2.992
21.850
PPM
10
8
6
4
2
0
7.260
6.269
6.254
4.414
4.396
4.381
4.363
2.116
2.099
2.084
2.066
1.300
1.285
1.269
1.192
1.172
1.155
1.135
1.119
1.107
1.082
1.067
0.893
0.876
0.858
-0.001

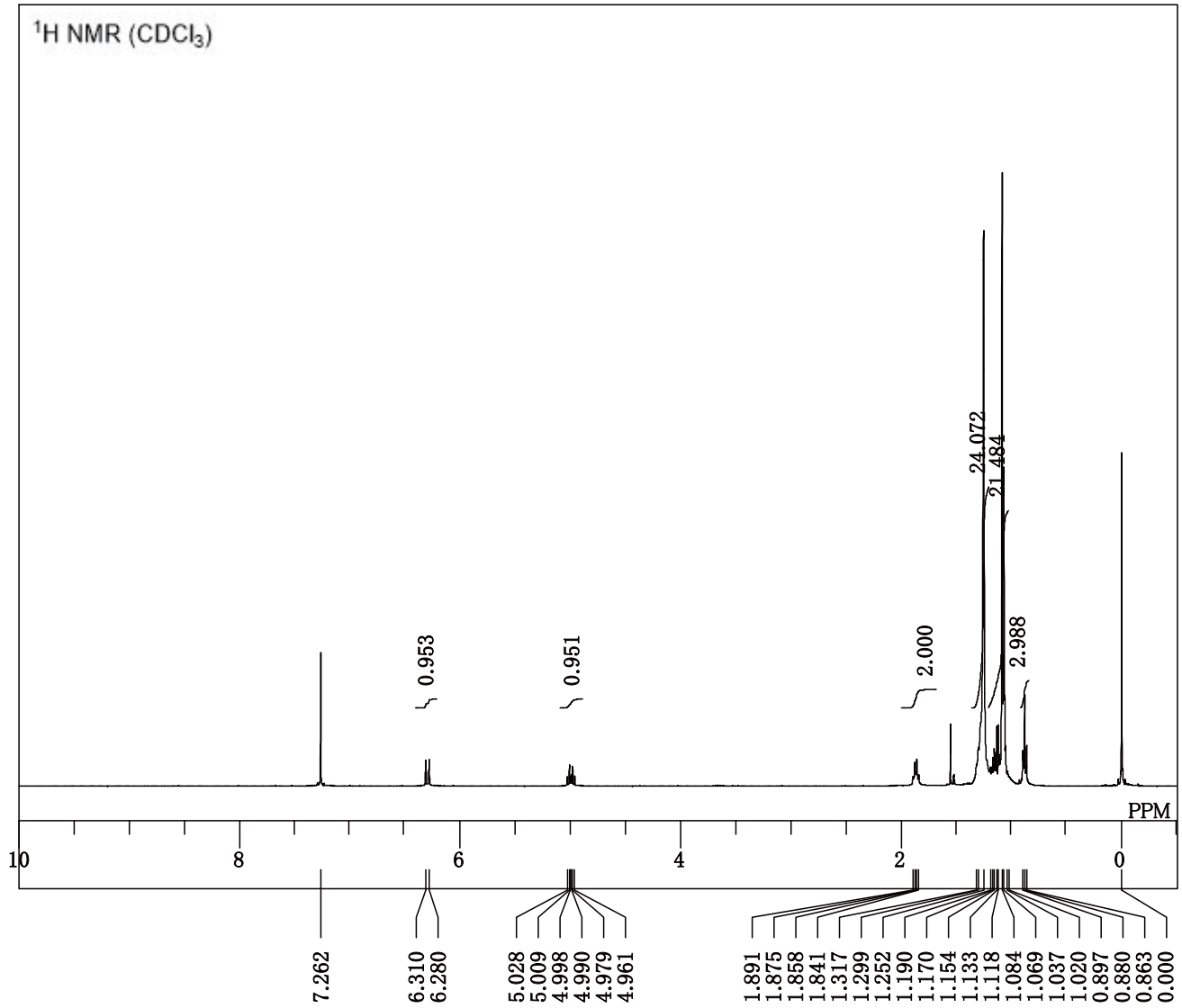

OSi^{i}Pr$_3$
H
7

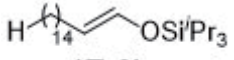
(Z)-3h


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
138.872
110.040
77.312
77.000
76.679
31.886
29.683
29.330
29.207
23.544
22.681
17.733
14.117
11.947

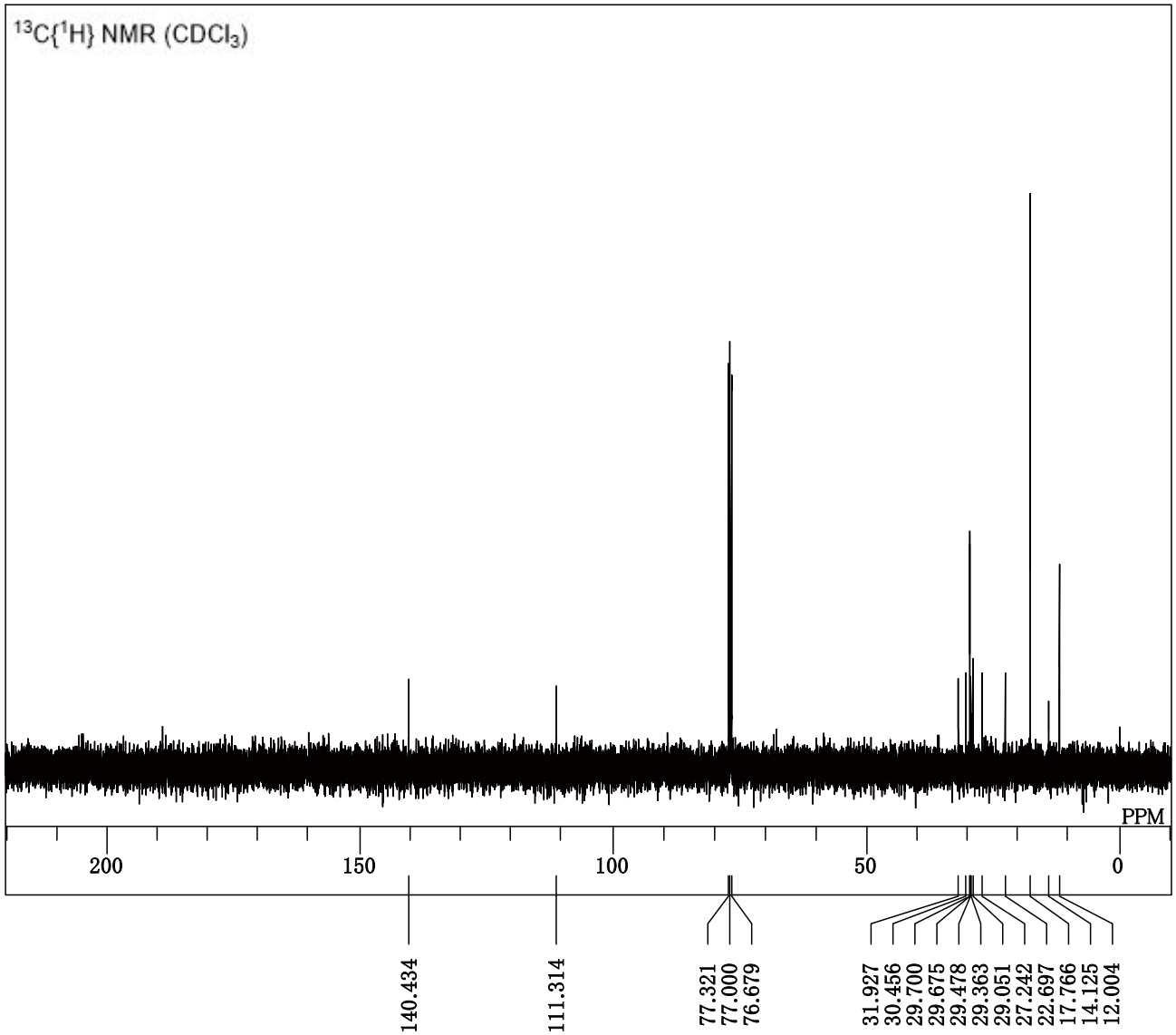

OSi^{i}Pr$_3$
H
7

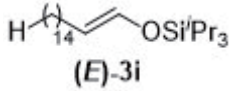
(Z)-3h


^{1}H NMR ($CDCl_3$)
0.953
0.951
2.000
24.072
21.484
2.988
PPM
10
8
6
4
2
0
7.262
6.310
6.280
5.028
5.009
4.998
4.990
4.979
4.961
1.891
1.875
1.858
1.841
1.317
1.299
1.252
1.190
1.170
1.154
1.133
1.118
1.084
1.069
1.037
1.020
0.897
0.880
0.863
0.000

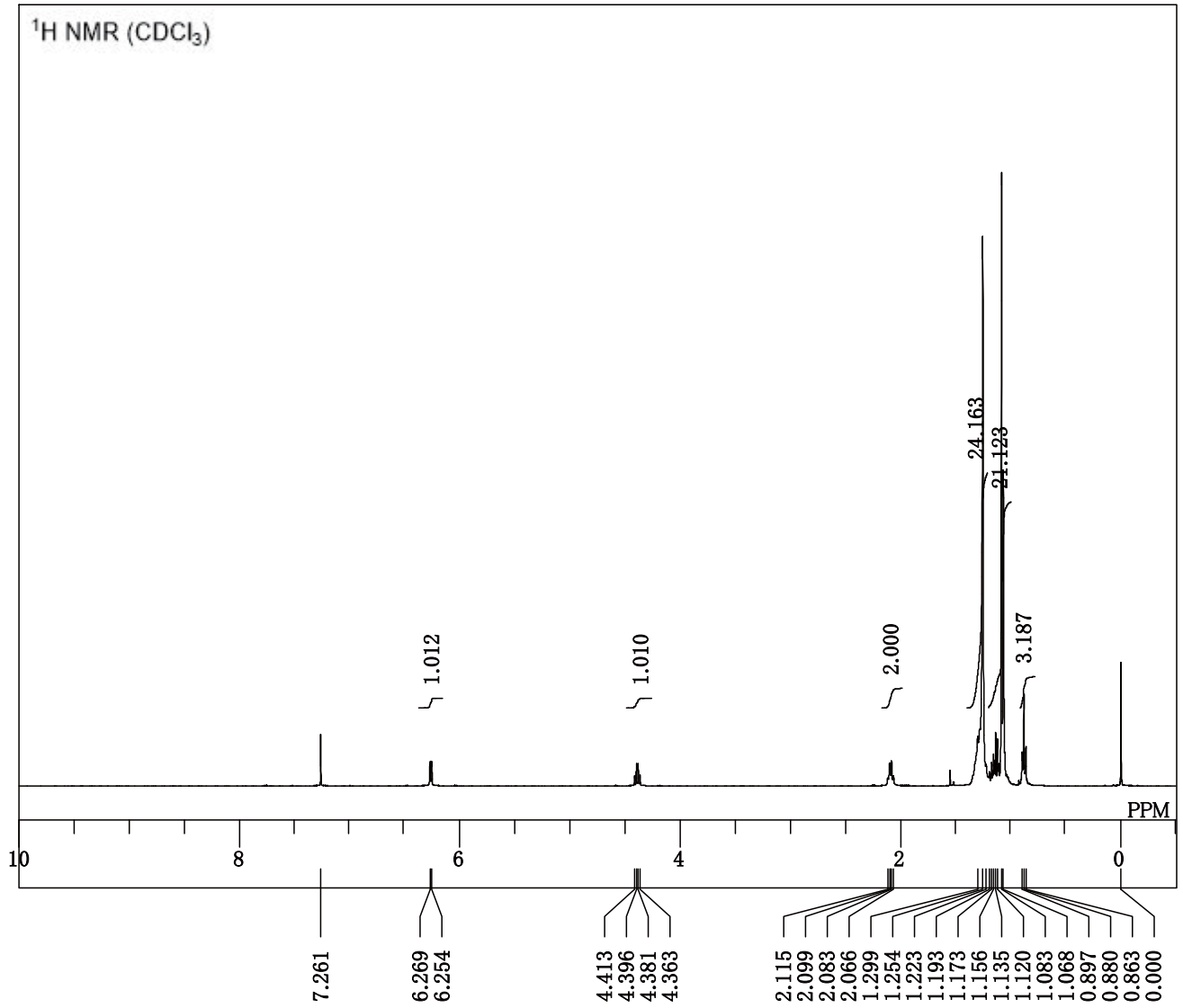

H
14
OSi^{i}Pr$_3$

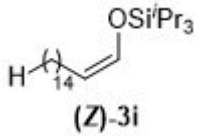
(*E*)-3i


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
140.434
111.314
77.321
77.000
76.679
31.927
30.456
29.700
29.675
29.478
29.363
29.051
27.242
22.697
17.766
14.125
12.004

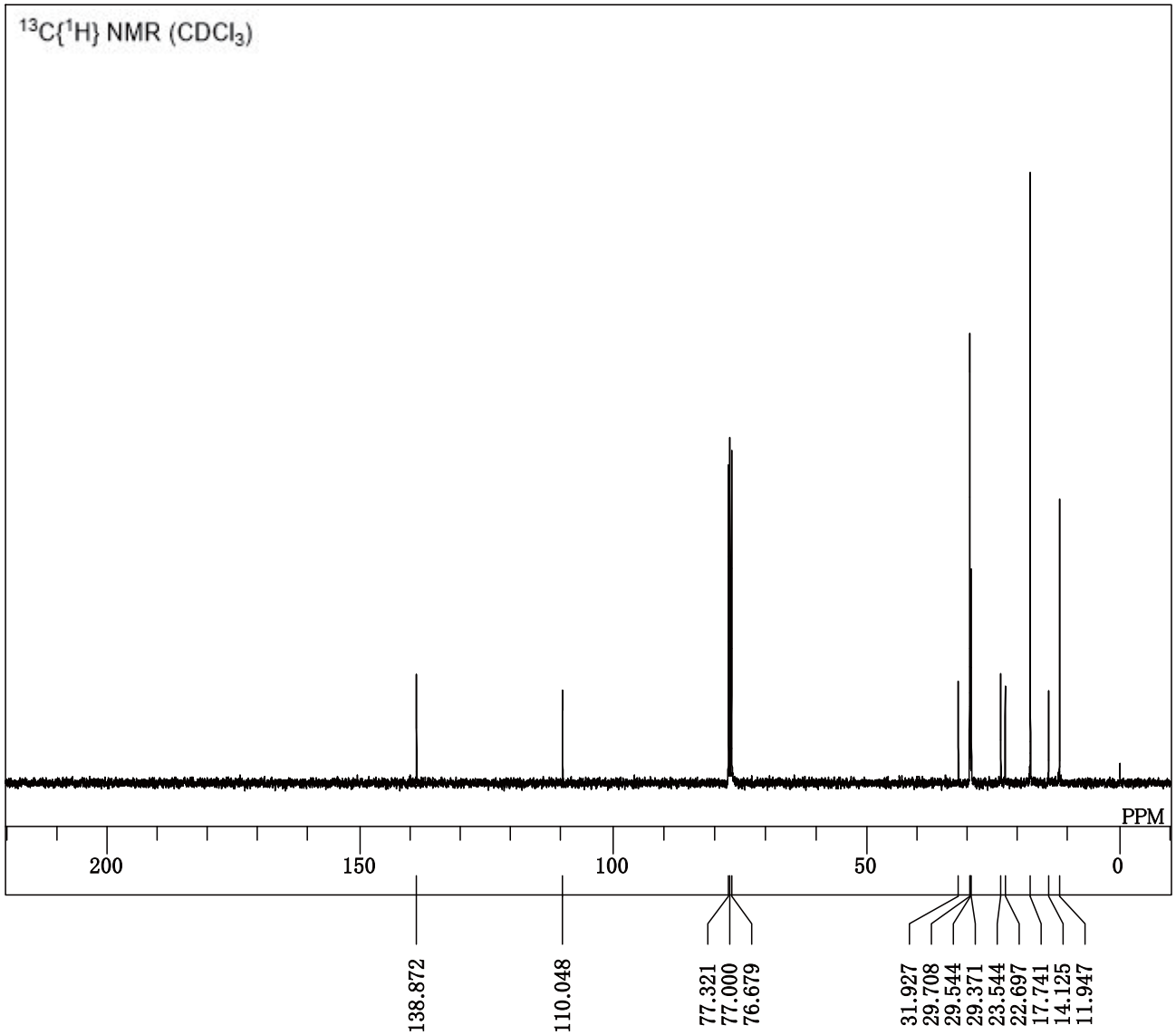

H
14
OSi^{i}Pr$_3$

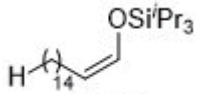
(*E*)-3i


1H NMR (CDCl3)
1.012
1.010
2.000
24.163
21.123
3.187
PPM
10
8
6
4
2
0
7.261
6.269
6.254
4.413
4.396
4.381
4.363
2.115
2.099
2.083
2.066
1.299
1.254
1.223
1.193
1.173
1.156
1.135
1.120
1.083
1.068
0.897
0.880
0.863
0.000

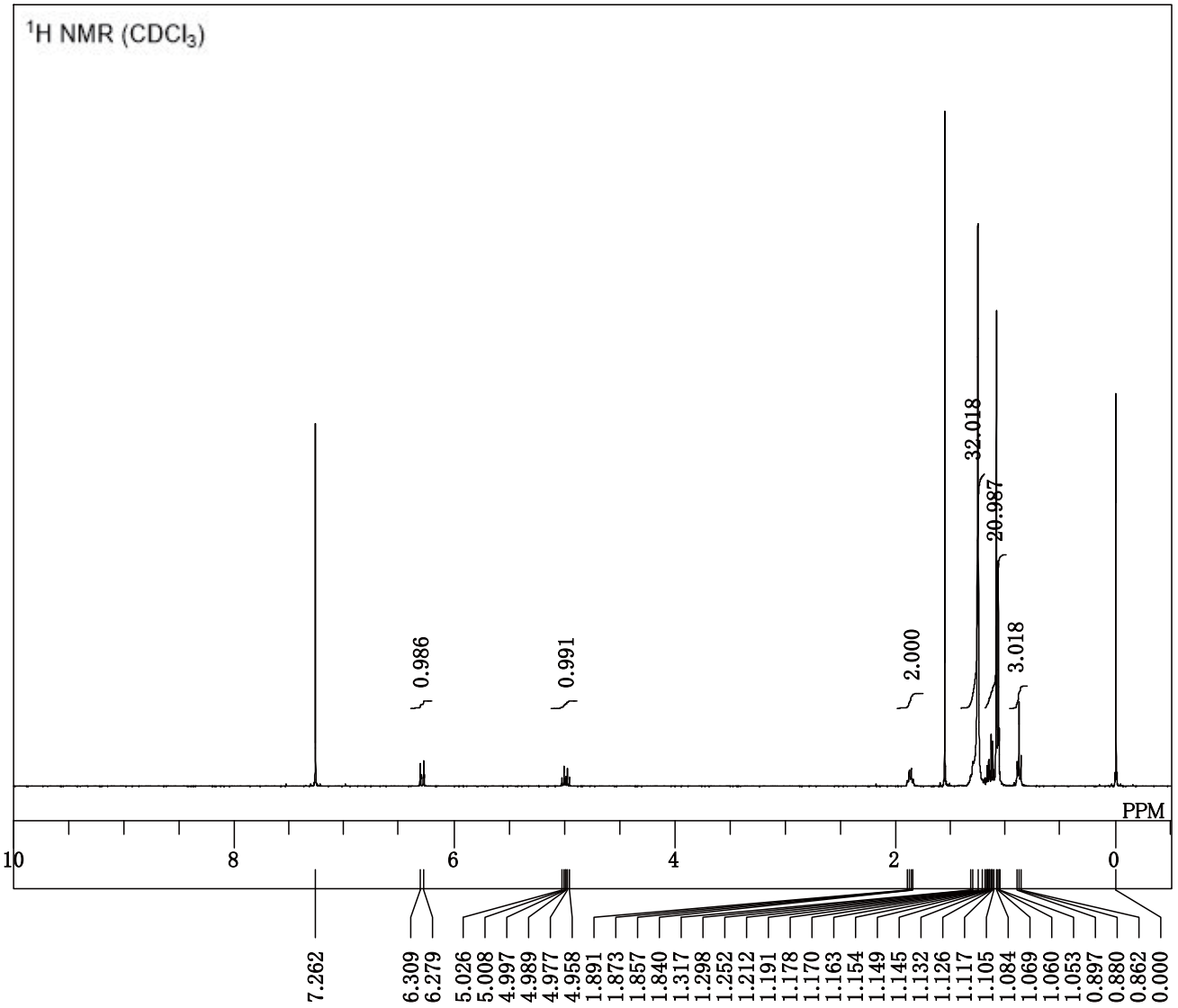

OSi^{i}Pr$_3$
H
14

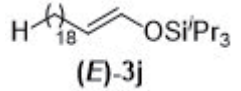
(*Z*)-3i


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
138.872
110.048
77.321
77.000
76.679
31.927
29.708
29.544
29.371
23.544
22.697
17.741
14.125
11.947

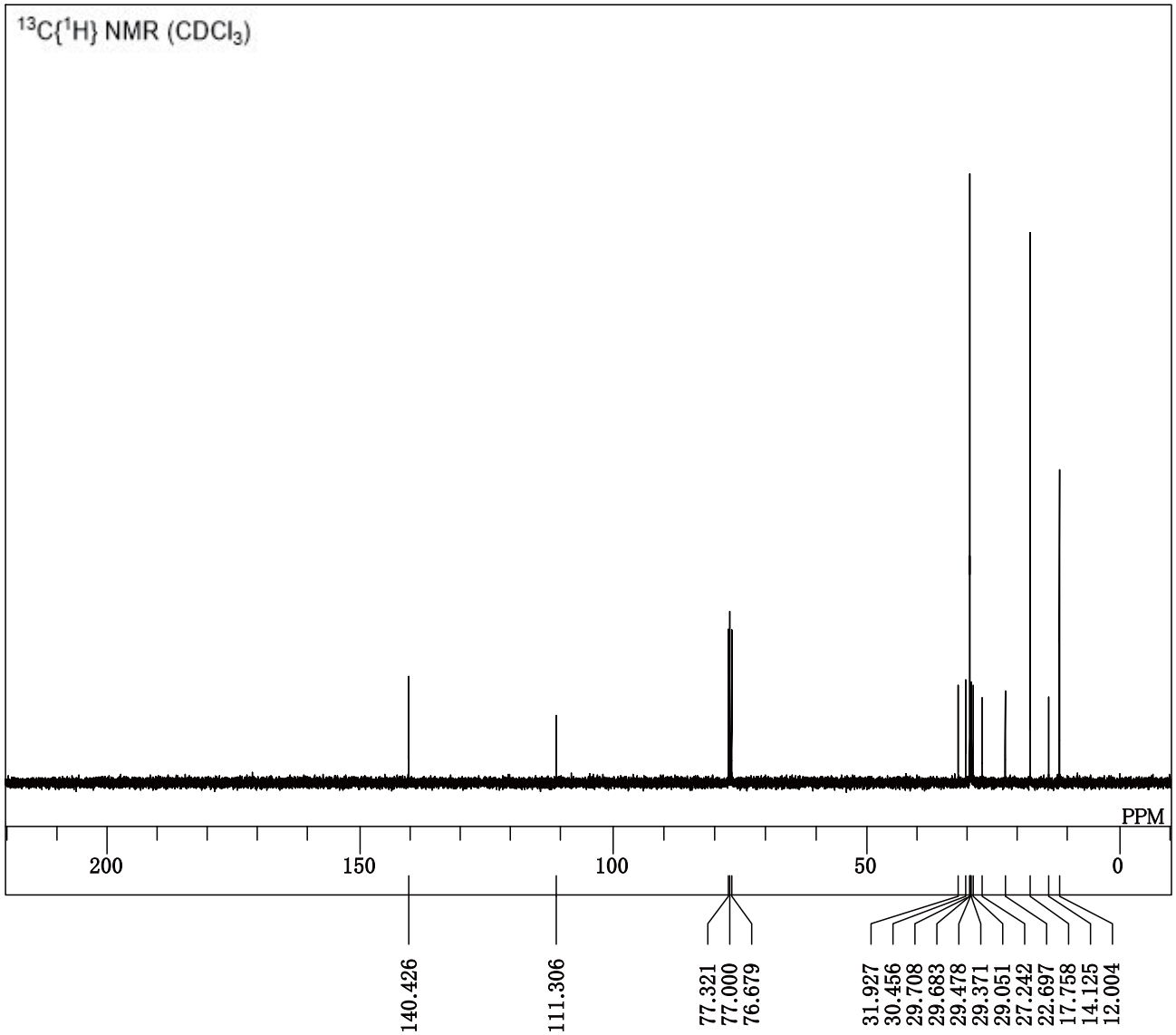

OSi^{i}Pr$_3$
H
14

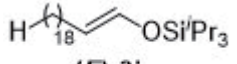
(*Z*)-3i


^{1}H NMR ($CDCl_3$)
0.986
0.991
2.000
32.018
20.987
3.018
PPM
10
8
6
4
2
0
7.262
6.309
6.279
5.026
5.008
4.997
4.989
4.977
4.958
1.891
1.873
1.857
1.840
1.317
1.298
1.252
1.212
1.191
1.178
1.170
1.163
1.154
1.149
1.145
1.132
1.126
1.117
1.105
1.084
1.069
1.060
1.053
0.897
0.880
0.862
0.000

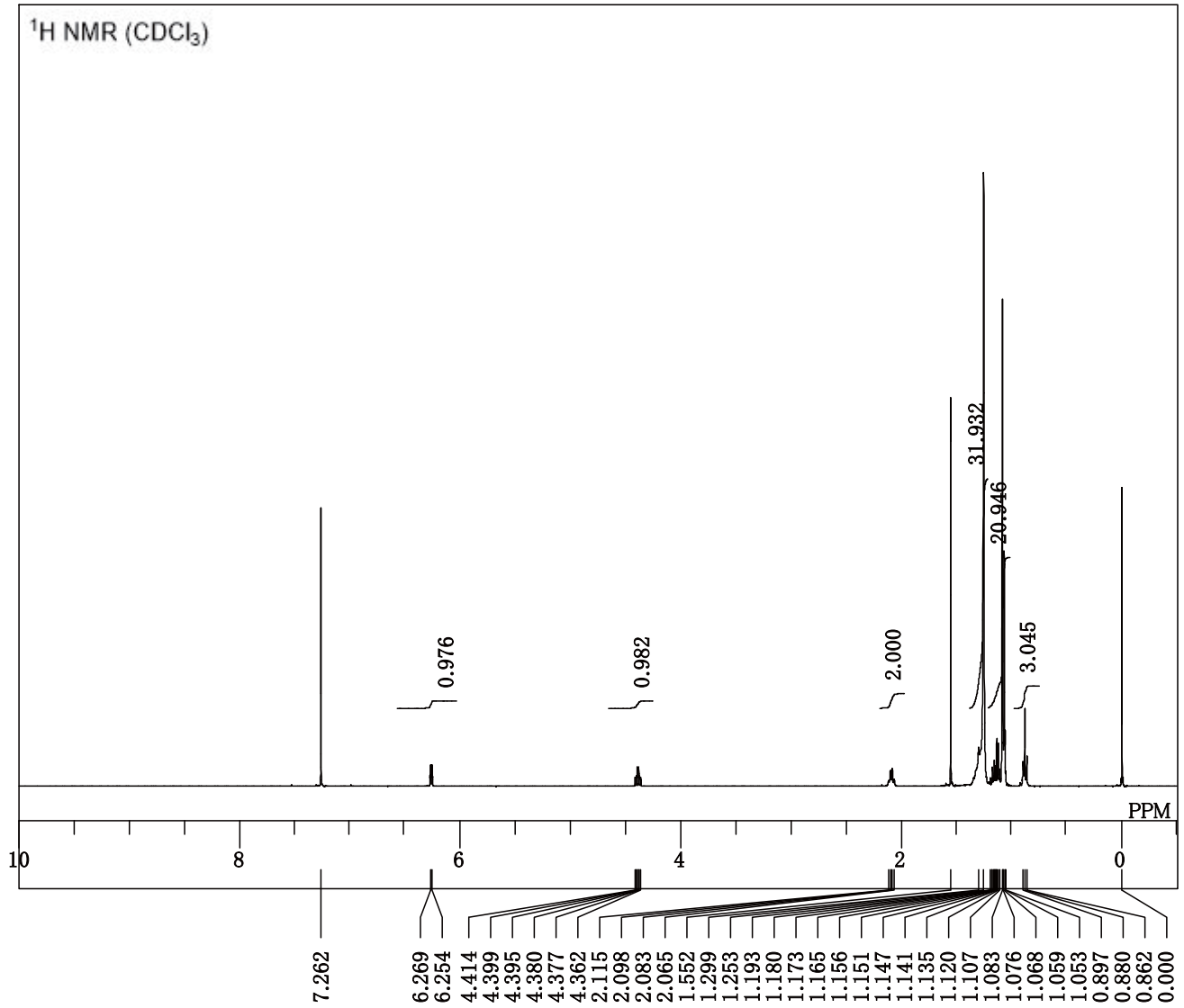

H
18
OSi^{i}Pr$_3$

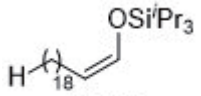
(*E*)-3j


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
140.426
111.306
77.321
77.000
76.679
31.927
30.456
29.708
29.683
29.478
29.371
29.051
27.242
22.697
17.758
14.125
12.004

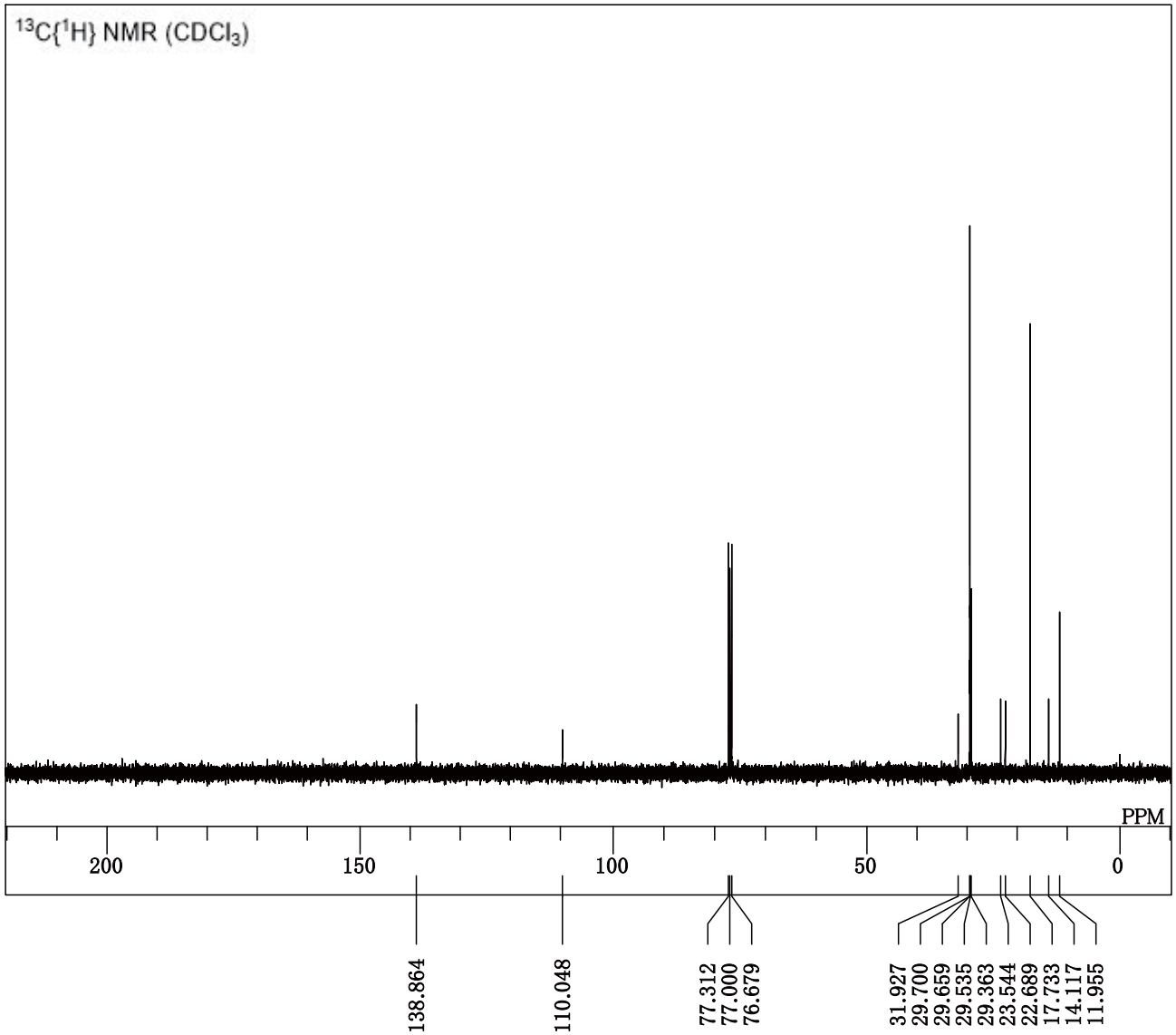

H
18
OSi^{i}Pr$_3$

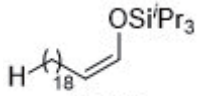
(*E*)-3j


^{1}H NMR ($CDCl_3$)
0.976
0.982
2.000
31.932
20.946
3.045
PPM
10
8
6
4
2
0
7.262
6.269
6.254
4.414
4.399
4.395
4.380
4.377
4.362
2.115
2.098
2.083
2.065
1.552
1.299
1.253
1.193
1.180
1.173
1.165
1.156
1.151
1.147
1.141
1.135
1.120
1.107
1.083
1.076
1.068
1.059
1.053
0.897
0.880
0.862
0.000

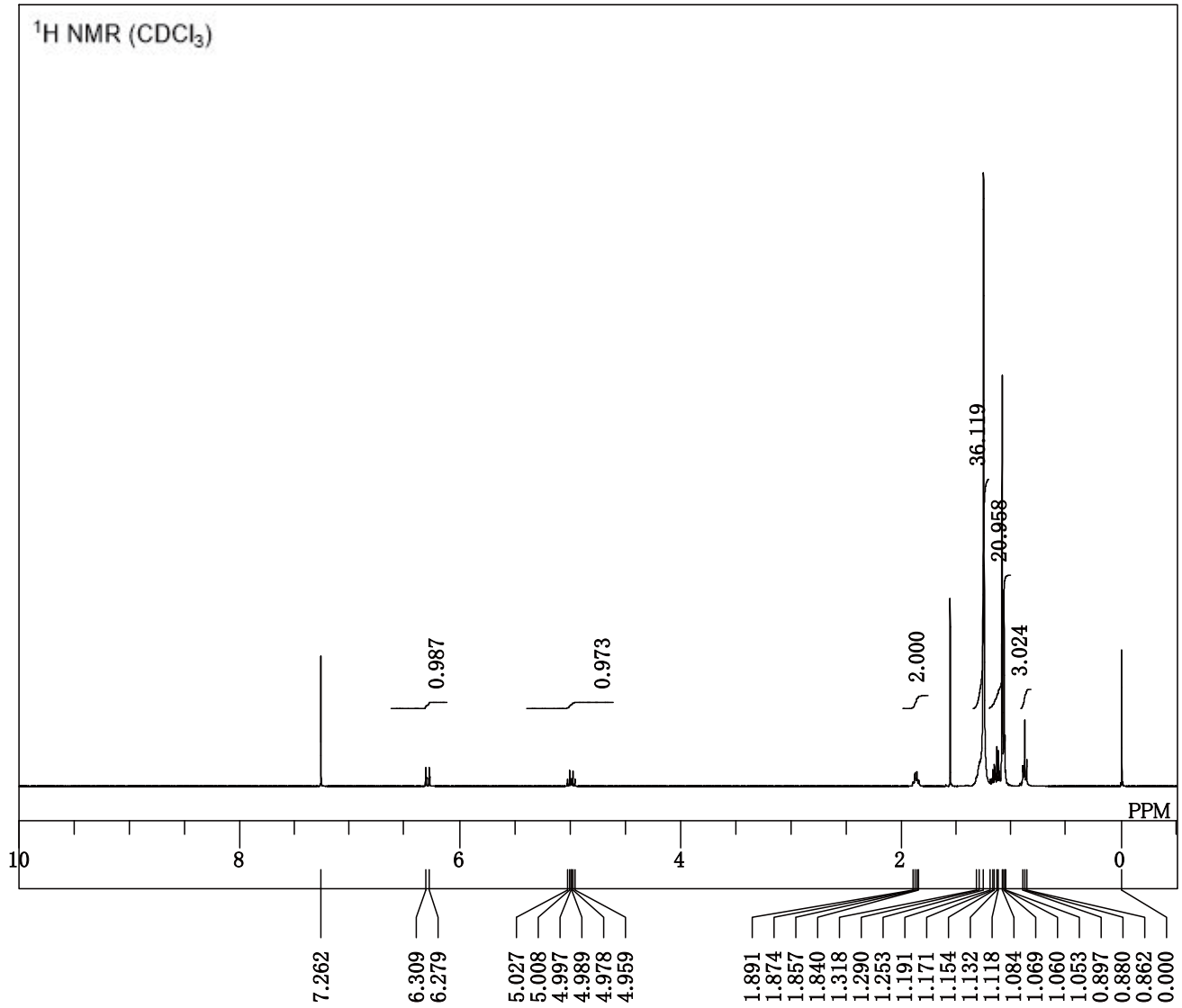

OSi^{i}Pr$_3$
H
18

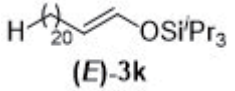
(Z)-3j


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
138.864
110.048
77.312
77.000
76.679
31.927
29.700
29.659
29.535
29.363
23.544
22.689
17.733
14.117
11.955

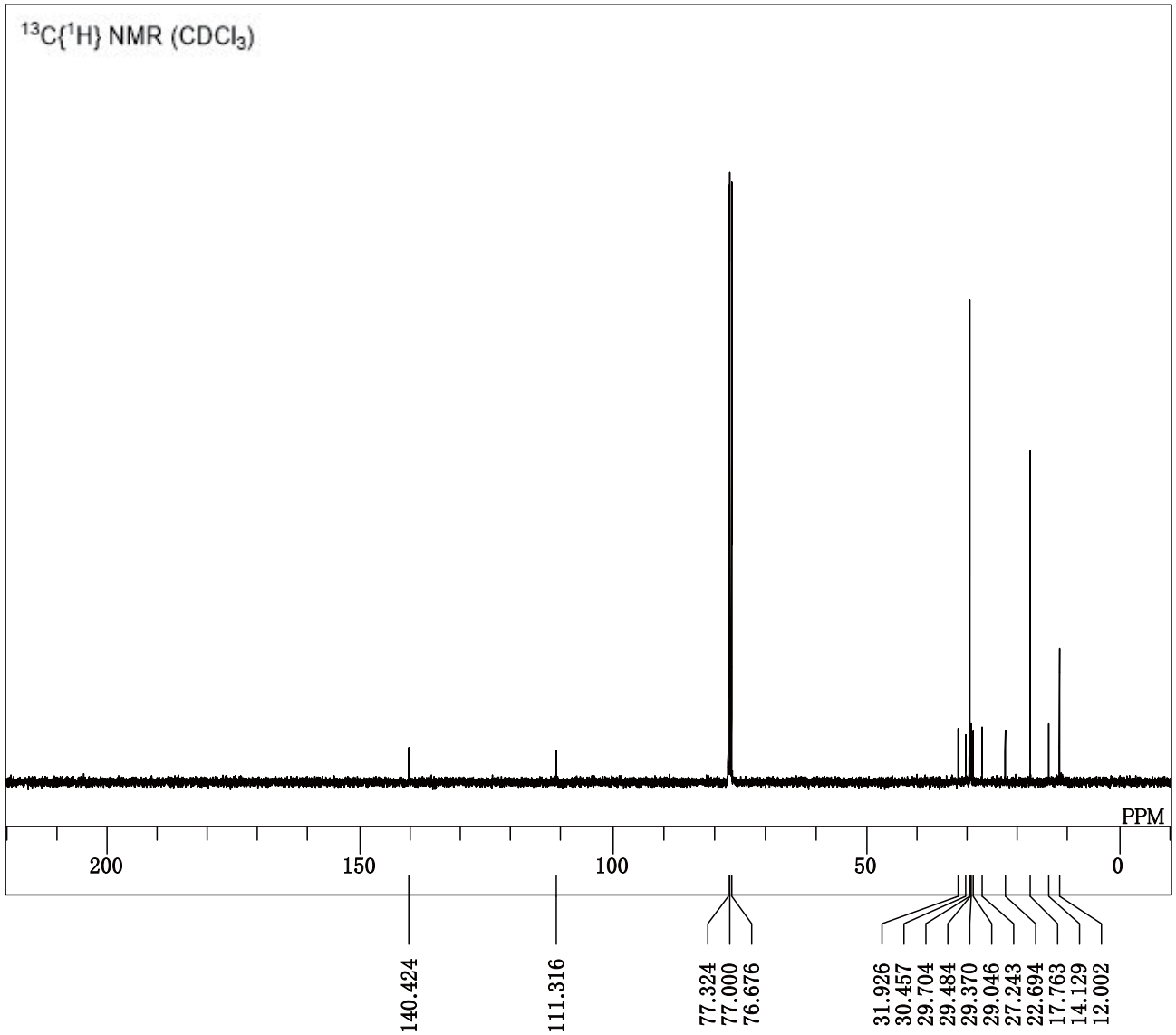

OSi^{i}Pr$_3$
H
18

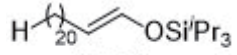
(Z)-3j


1H NMR (CDCl3)
0.987
0.973
2.000
36.119
20.958
3.024
PPM
10
8
6
4
2
0
7.262
6.309
6.279
5.027
5.008
4.997
4.989
4.978
4.959
1.891
1.874
1.857
1.840
1.318
1.290
1.253
1.191
1.171
1.154
1.132
1.118
1.084
1.069
1.060
1.053
0.897
0.880
0.862
0.000

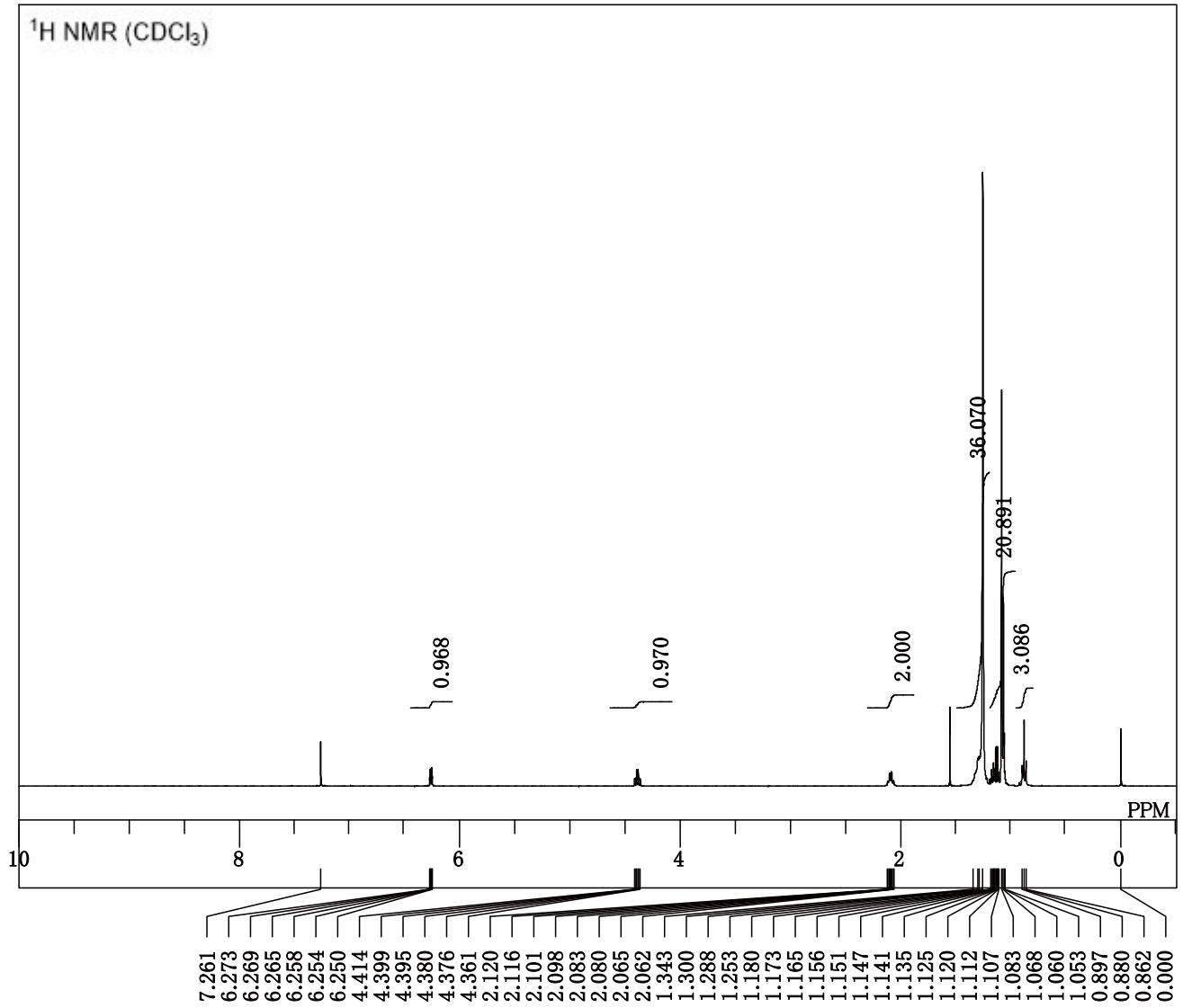

H
20
OSi^{i}Pr$_3$

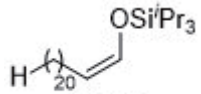
(*E*)-3k


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
140.424
111.316
77.324
77.000
76.676
31.926
30.457
29.704
29.484
29.370
29.046
27.243
22.694
17.763
14.129
12.002

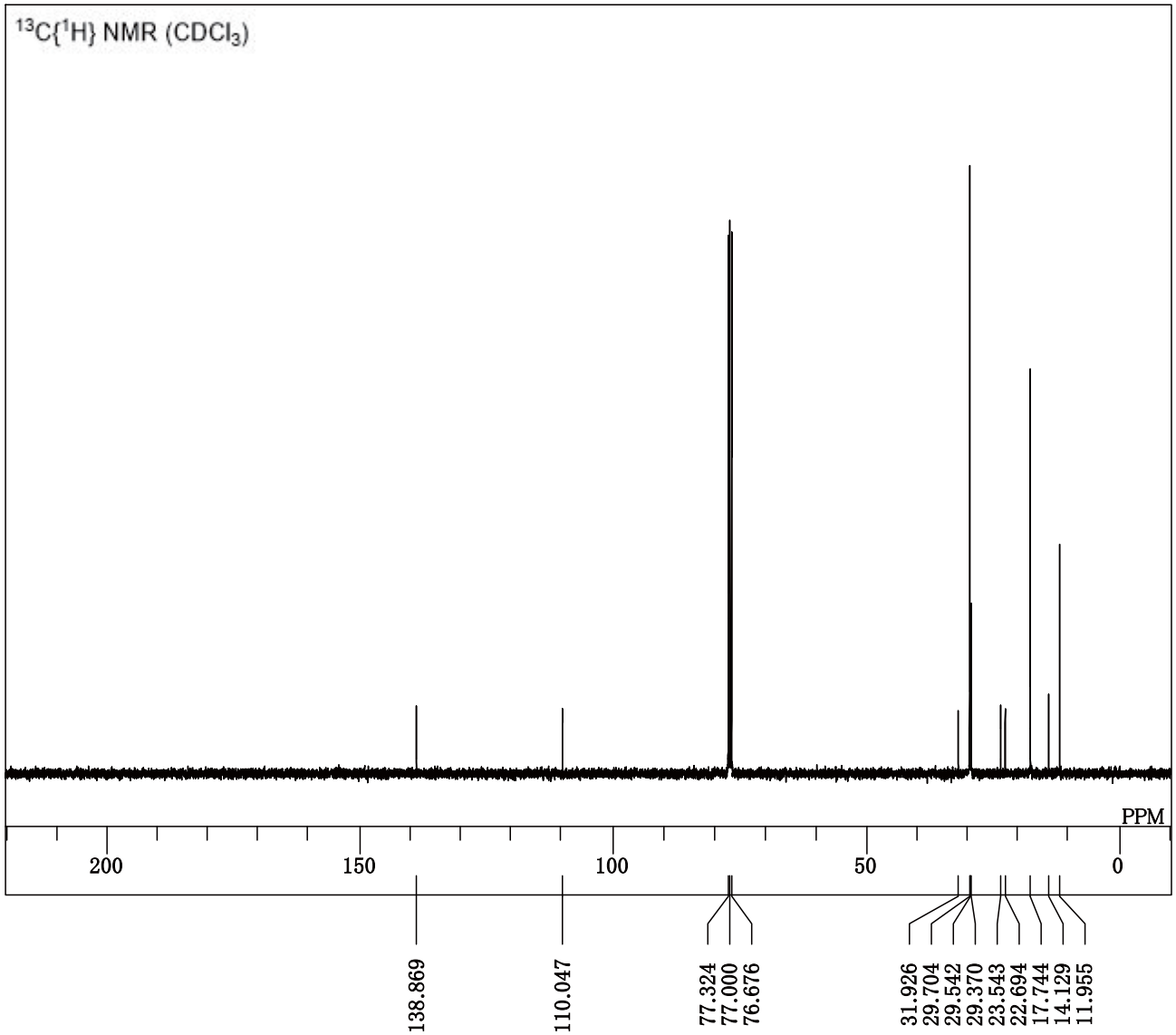

H
20
OSi^{i}Pr$_3$

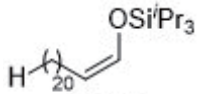
(*E*)-3k


^{1}H NMR ($CDCl_3$)
0.968
0.970
2.000
36.070
20.891
3.086
PPM
10
8
6
4
2
0
7.261
6.273
6.269
6.265
6.258
6.254
6.250
4.414
4.399
4.395
4.380
4.376
4.361
2.120
2.116
2.101
2.098
2.083
2.080
2.065
2.062
1.343
1.300
1.288
1.253
1.180
1.173
1.165
1.156
1.151
1.147
1.141
1.135
1.125
1.120
1.112
1.107
1.083
1.068
1.060
1.053
0.897
0.880
0.862
0.000

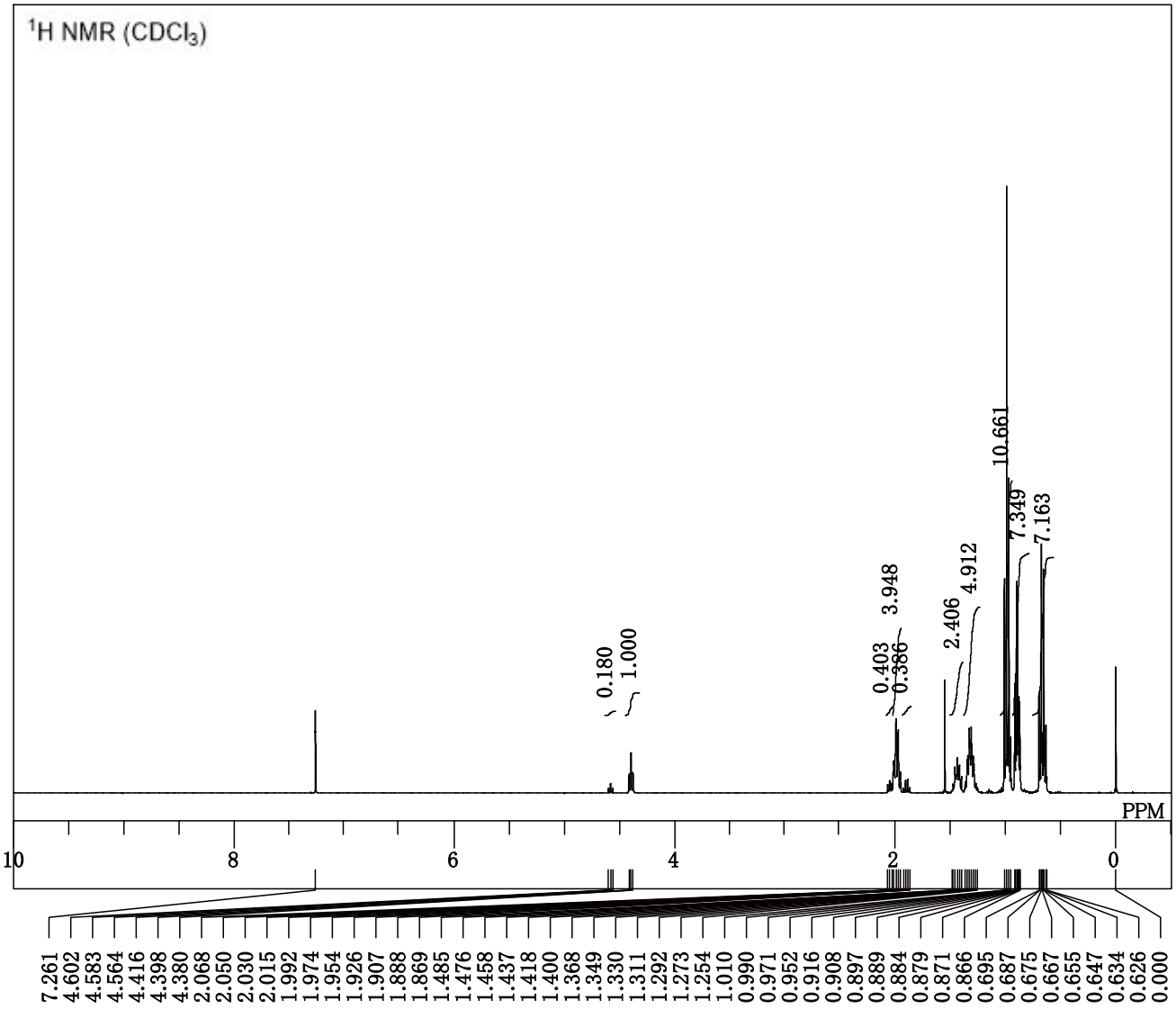

OSi^{i}Pr$_3$
H
20

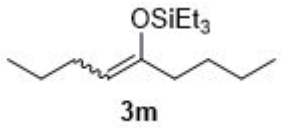
(Z)-3k


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
138.869
110.047
77.324
77.000
76.676
31.926
29.704
29.542
29.370
23.543
22.694
17.744
14.129
11.955

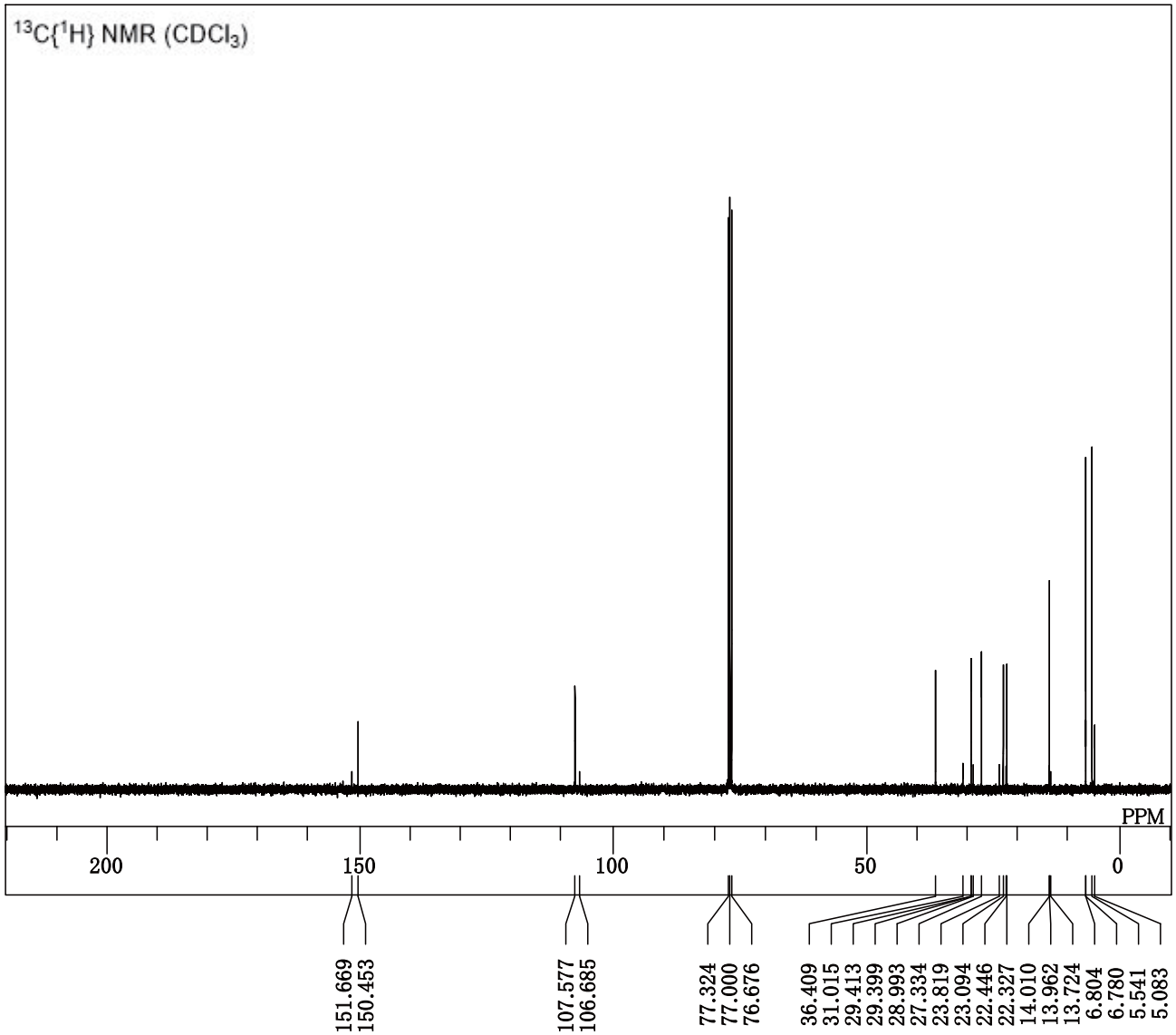

OSi^{i}Pr$_3$
H
20

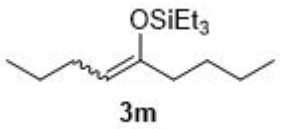
(Z)-3k


^{1}H NMR ($CDCl_3$)
0.180
1.000
0.403
0.386
3.948
2.406
4.912
10.661
7.349
7.163
PPM
10
8
6
4
2
0
7.261
4.602
4.583
4.564
4.416
4.398
4.380
2.068
2.050
2.030
2.015
1.992
1.974
1.954
1.926
1.907
1.888
1.869
1.485
1.476
1.458
1.437
1.418
1.400
1.368
1.349
1.330
1.311
1.292
1.273
1.254
1.010
0.990
0.971
0.952
0.916
0.908
0.897
0.889
0.884
0.879
0.871
0.866
0.695
0.687
0.675
0.667
0.655
0.647
0.634
0.626
0.000

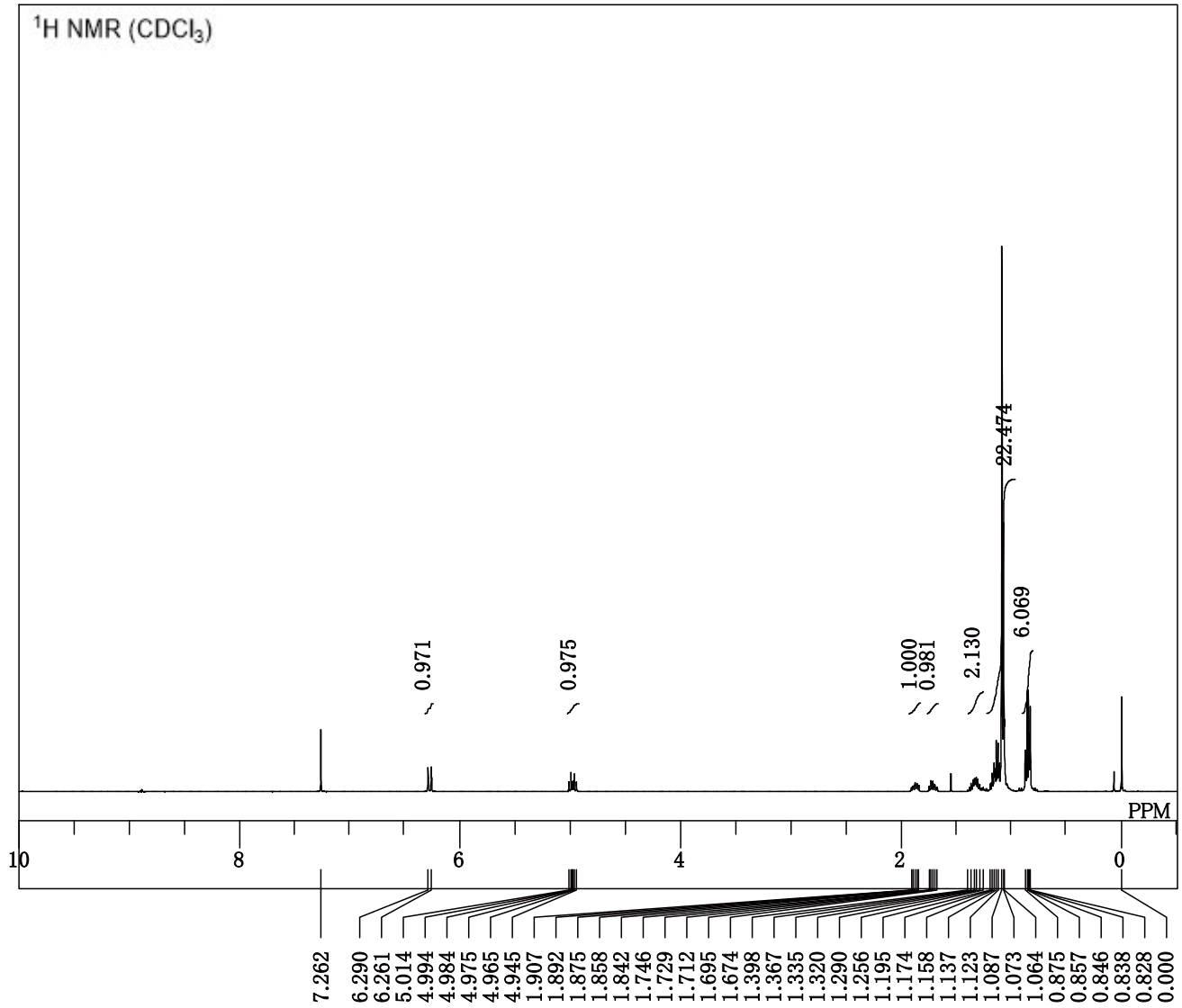

OSiEt$_3$

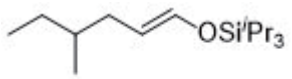
3m


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
151.669
150.453
107.577
106.685
77.324
77.000
76.676
36.409
31.015
29.413
29.399
28.993
27.334
23.819
23.094
22.446
22.327
14.010
13.962
13.724
6.804
6.780
5.541
5.083

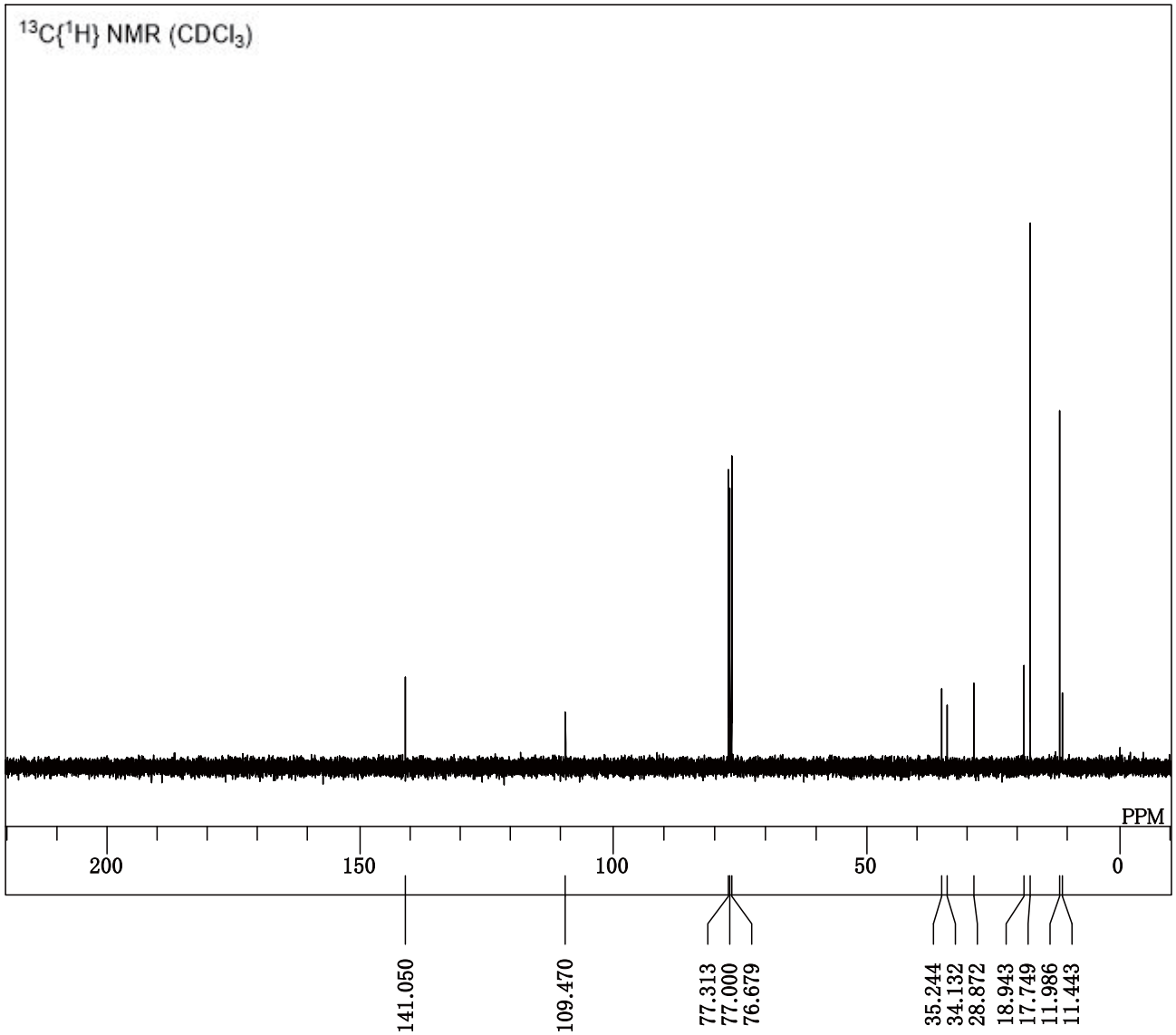

$OSiEt_3$

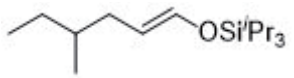
3m


^{1}H NMR ($CDCl_3$)
0.971
0.975
1.000
0.981
2.130
22.474
6.069
PPM
10
8
6
4
2
0
7.262
6.290
6.261
5.014
4.994
4.984
4.975
4.965
4.945
1.907
1.892
1.875
1.858
1.842
1.746
1.729
1.712
1.695
1.674
1.398
1.367
1.335
1.320
1.290
1.256
1.195
1.174
1.158
1.137
1.123
1.087
1.073
1.064
0.875
0.857
0.846
0.838
0.828
0.000

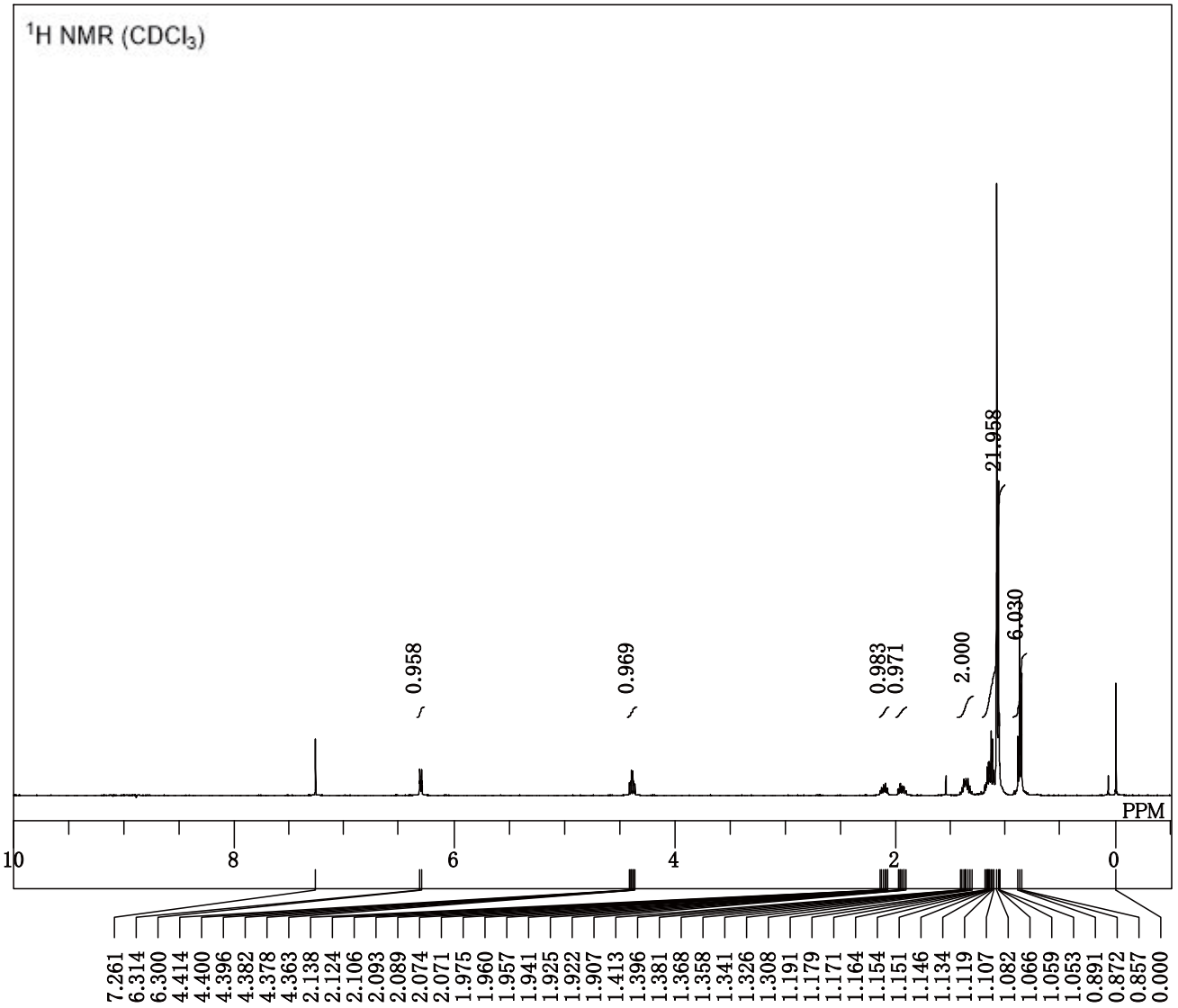

OSi^{i}Pr$_3$

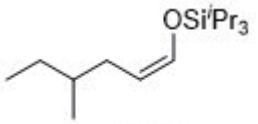
(*E*)-3n


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
141.050
109.470
77.313
77.000
76.679
35.244
34.132
28.872
18.943
17.749
11.986
11.443

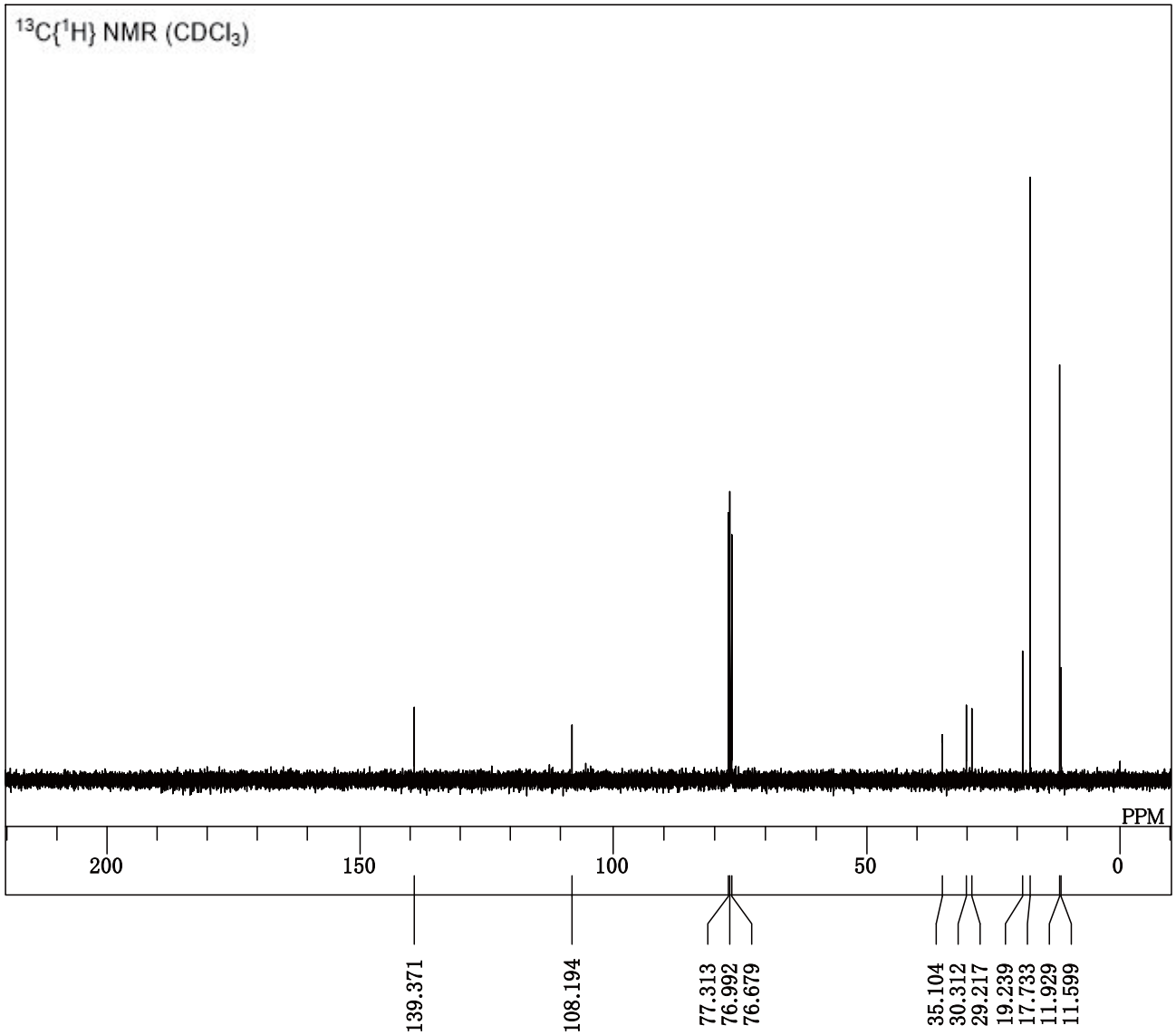

OSi^{i}Pr$_3$

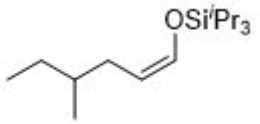
(*E*)-3n


^{1}H NMR ($CDCl_3$)
0.958
0.969
0.983
0.971
2.000
21.958
6.030
PPM
10
8
6
4
2
0
7.261
6.314
6.300
4.414
4.400
4.396
4.382
4.378
4.363
2.138
2.124
2.106
2.093
2.089
2.074
2.071
1.975
1.960
1.957
1.941
1.925
1.922
1.907
1.413
1.396
1.381
1.368
1.358
1.341
1.326
1.308
1.191
1.179
1.171
1.164
1.154
1.151
1.146
1.134
1.119
1.107
1.082
1.066
1.059
1.053
0.891
0.872
0.857
0.000

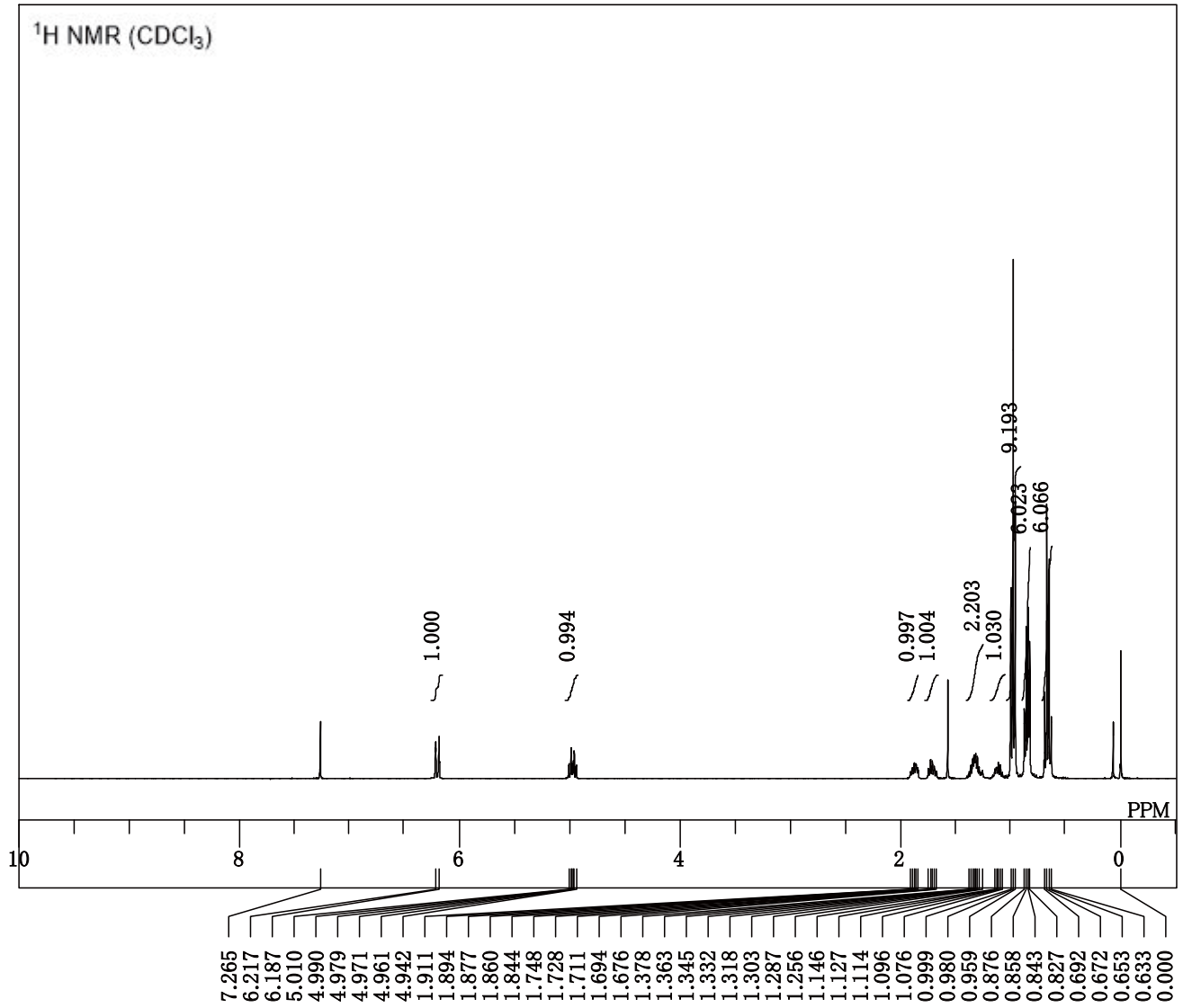

OSi^{i}Pr$_3$

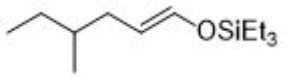
(Z)-3n


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
139.371
108.194
77.313
76.992
76.679
35.104
30.312
29.217
19.239
17.733
11.929
11.599

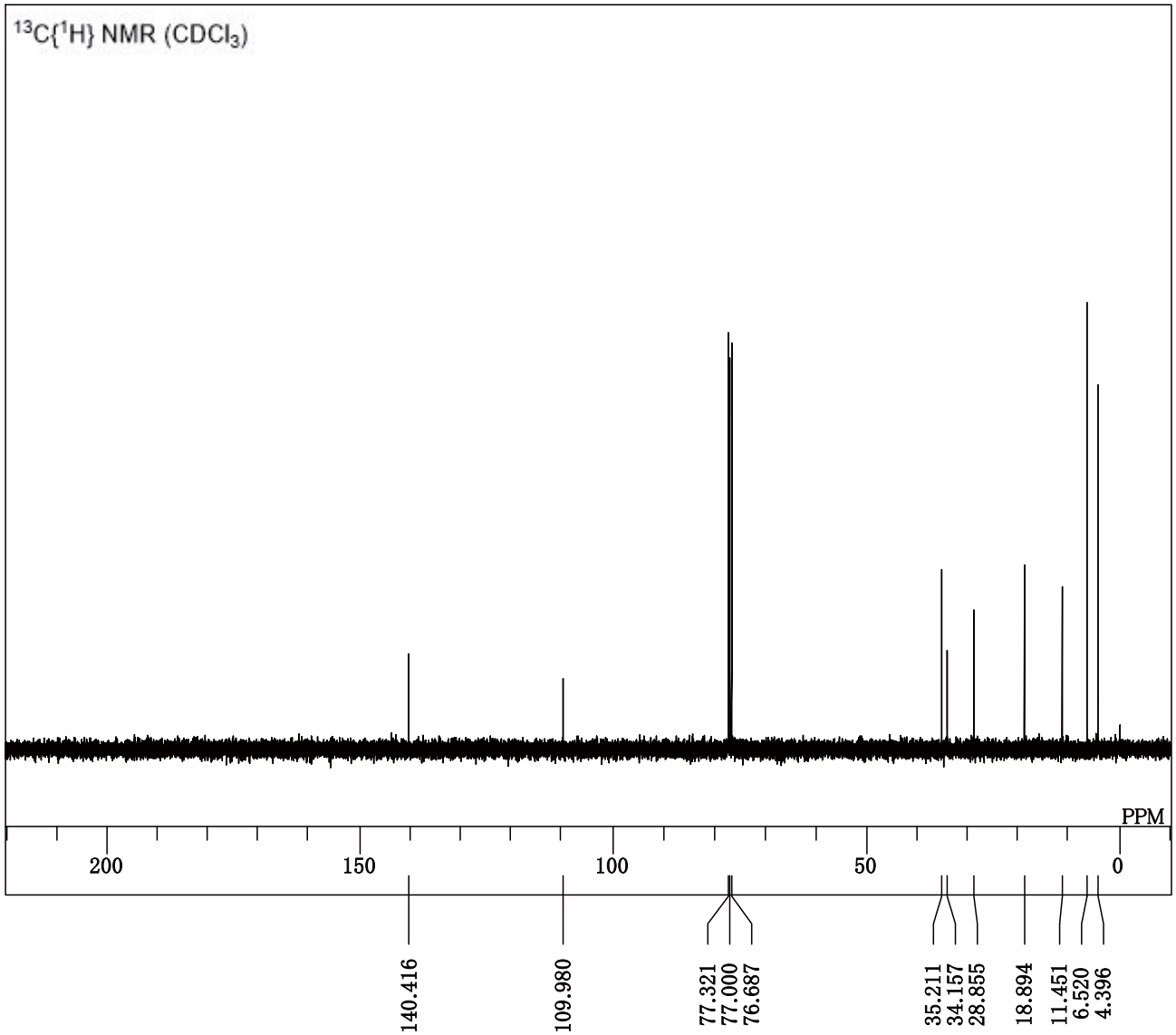

OSi^{i}Pr$_3$

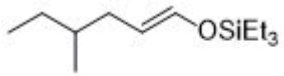
(Z)-3n


^{1}H NMR ($CDCl_3$)
1.000
0.994
0.997
1.004
2.203
1.030
9.193
6.023
6.066
PPM
10
8
6
4
2
0
7.265
6.217
6.187
5.010
4.990
4.979
4.971
4.961
4.942
1.911
1.894
1.877
1.860
1.844
1.748
1.728
1.711
1.694
1.676
1.378
1.363
1.345
1.332
1.318
1.303
1.287
1.256
1.146
1.127
1.114
1.096
1.076
0.999
0.980
0.959
0.876
0.858
0.843
0.827
0.692
0.672
0.653
0.633
0.000

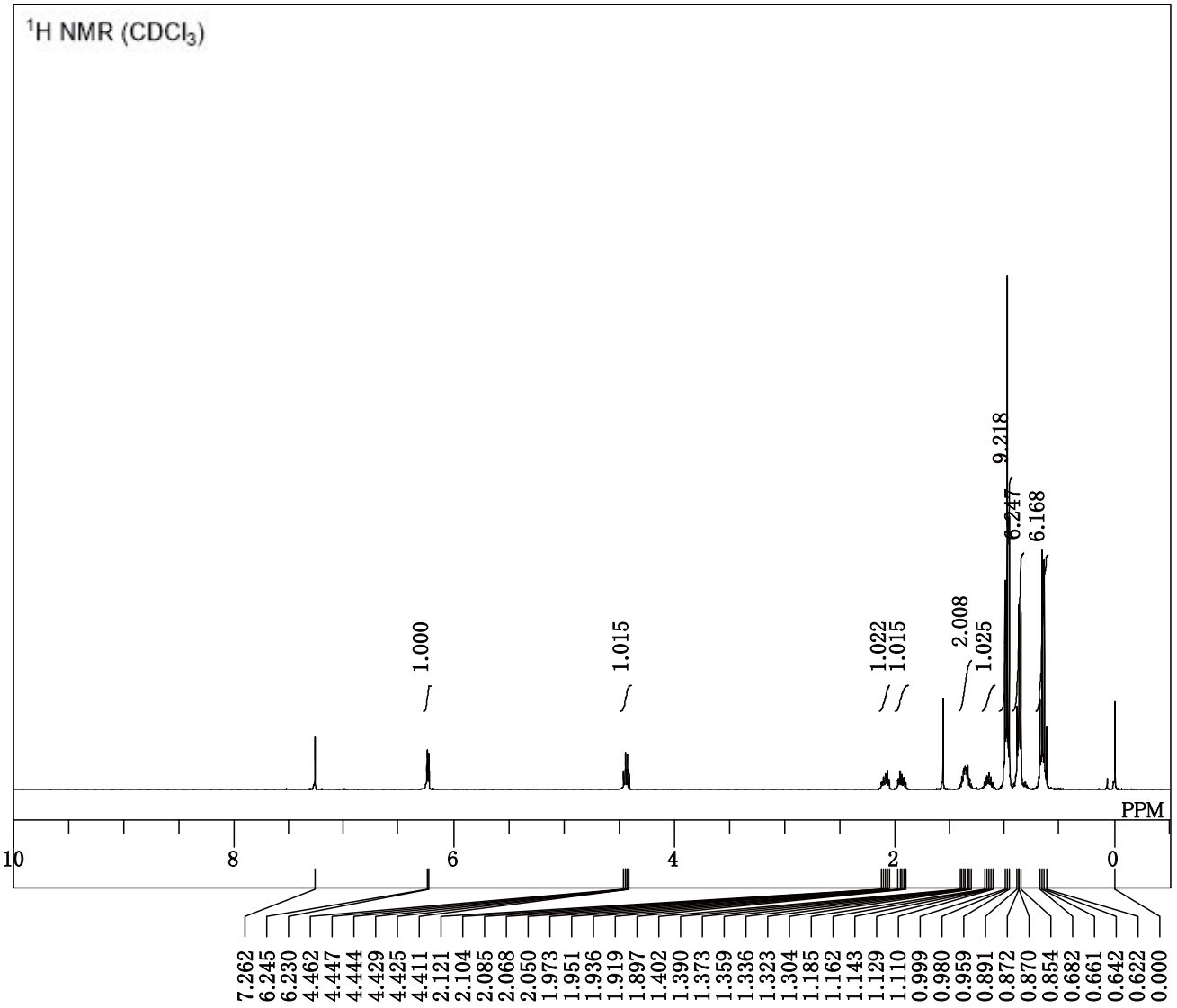

OSiEt$_3$

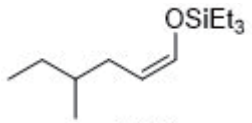
(*E*)-3o


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
140.416
109.980
77.321
77.000
76.687
35.211
34.157
28.855
18.894
11.451
6.520
4.396

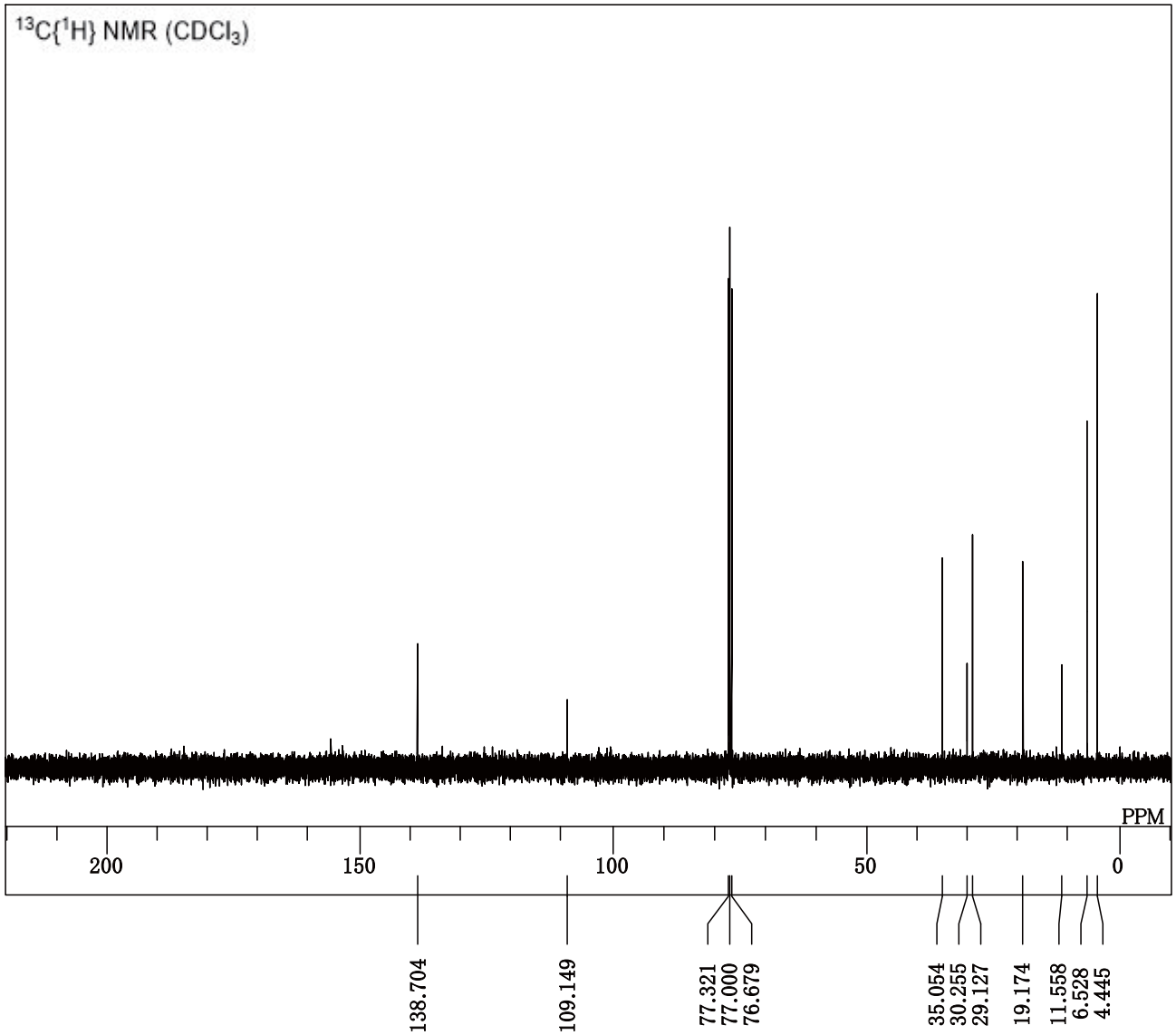

OSiEt3

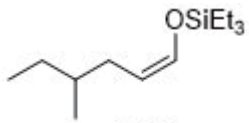
(*E*)-3o


^{1}H NMR ($CDCl_3$)
1.000
1.015
1.022
1.015
2.008
1.025
9.218
6.247
6.168
PPM
10
8
6
4
2
0
7.262
6.245
6.230
4.462
4.447
4.444
4.429
4.425
4.411
2.121
2.104
2.085
2.068
2.050
1.973
1.951
1.936
1.919
1.897
1.402
1.390
1.373
1.359
1.336
1.323
1.304
1.185
1.162
1.143
1.129
1.110
0.999
0.980
0.959
0.891
0.872
0.870
0.854
0.682
0.661
0.642
0.622
0.000

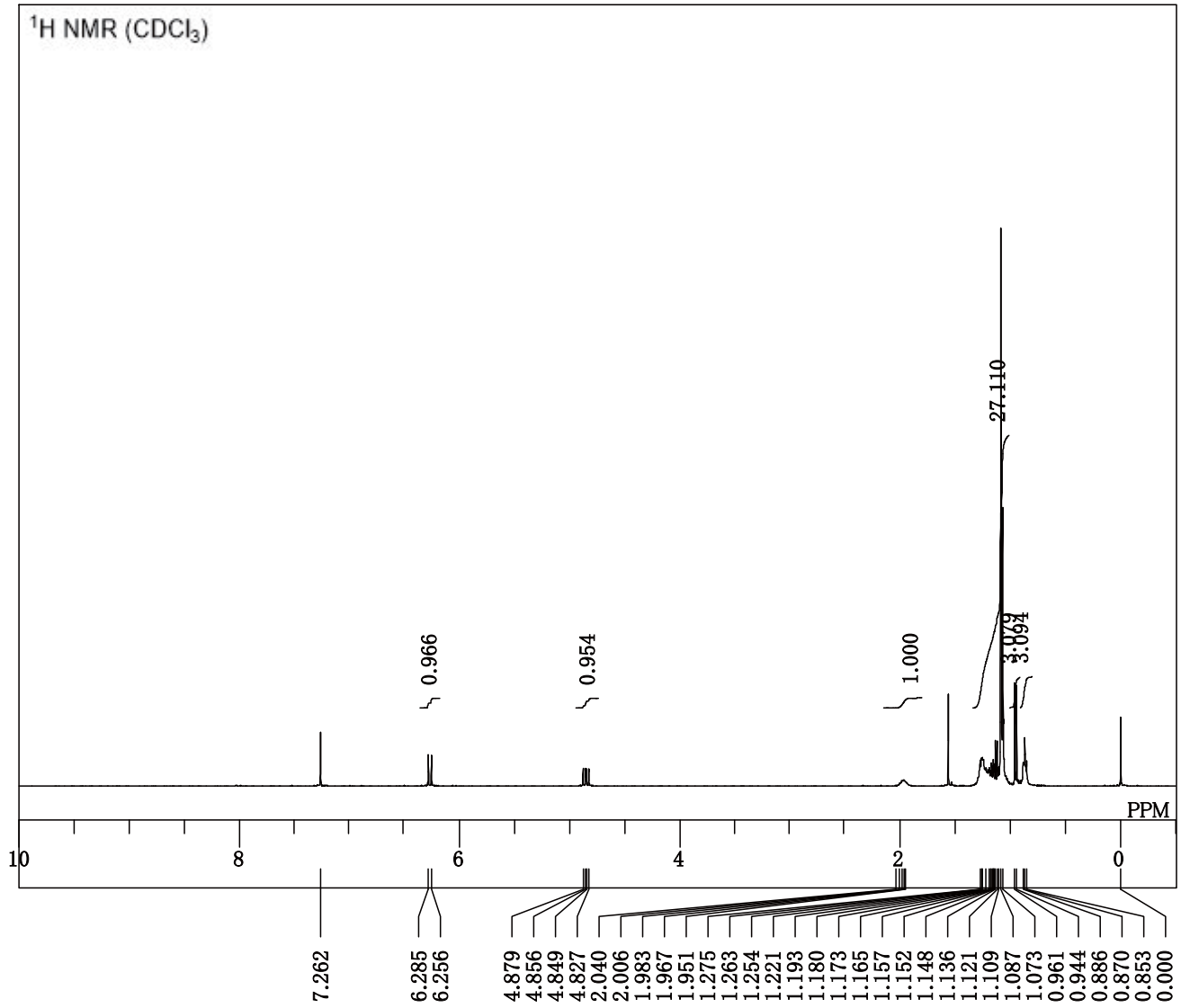

OSiEt$_3$

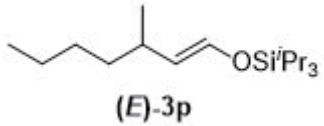
(*Z*)-3o


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
138.704
109.149
77.321
77.000
76.679
35.054
30.255
29.127
19.174
11.558
6.528
4.445

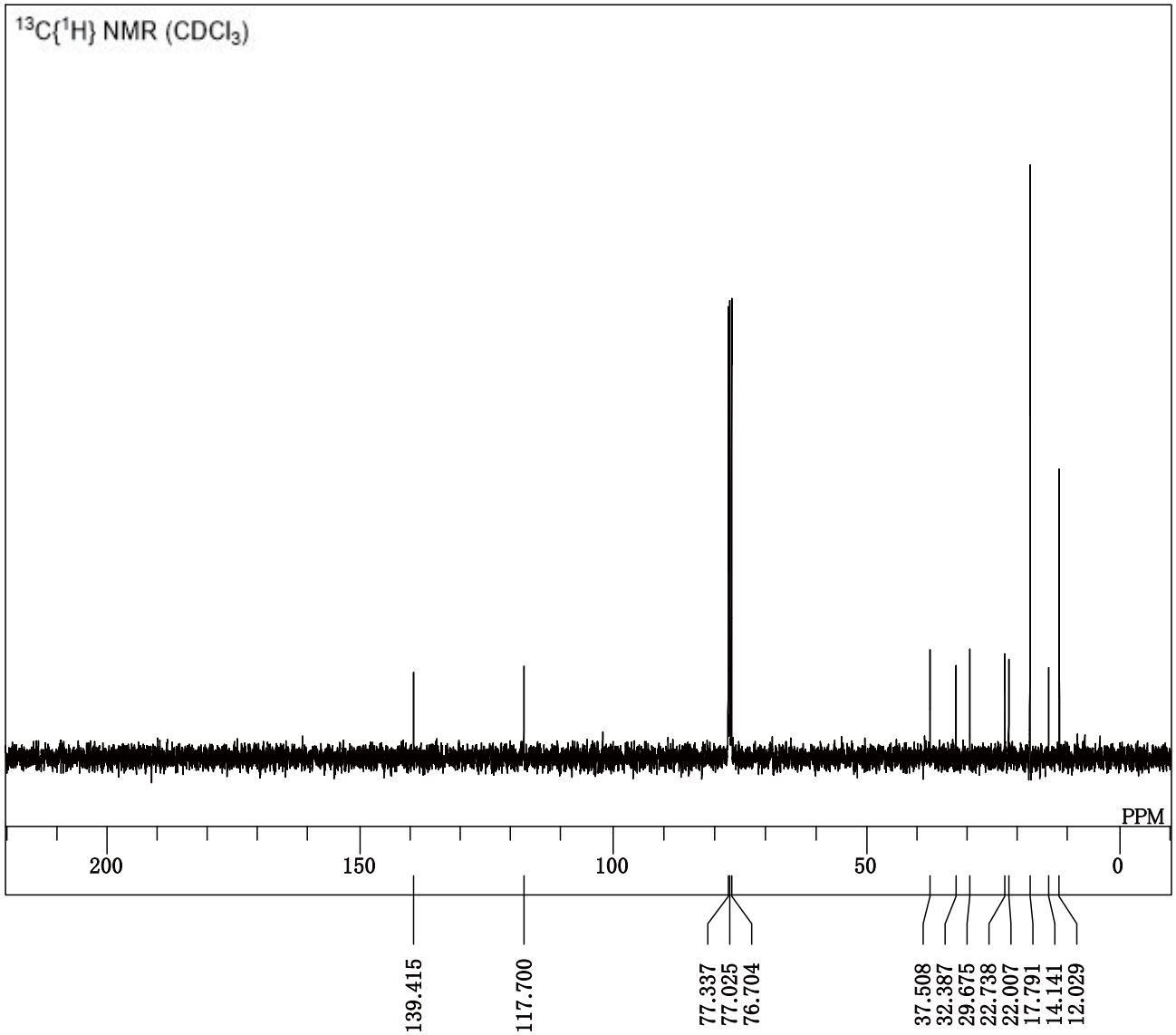

OSiEt3

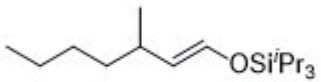
(Z)-3o


^{1}H NMR ($CDCl_3$)
27.110
3.079
3.054
1.000
0.966
0.954
PPM
10
8
6
4
2
0
7.262
6.285
6.256
4.879
4.856
4.849
4.827
2.040
2.006
1.983
1.967
1.951
1.275
1.263
1.254
1.221
1.193
1.180
1.173
1.165
1.157
1.152
1.148
1.136
1.121
1.109
1.087
1.073
0.961
0.944
0.886
0.870
0.853
0.000

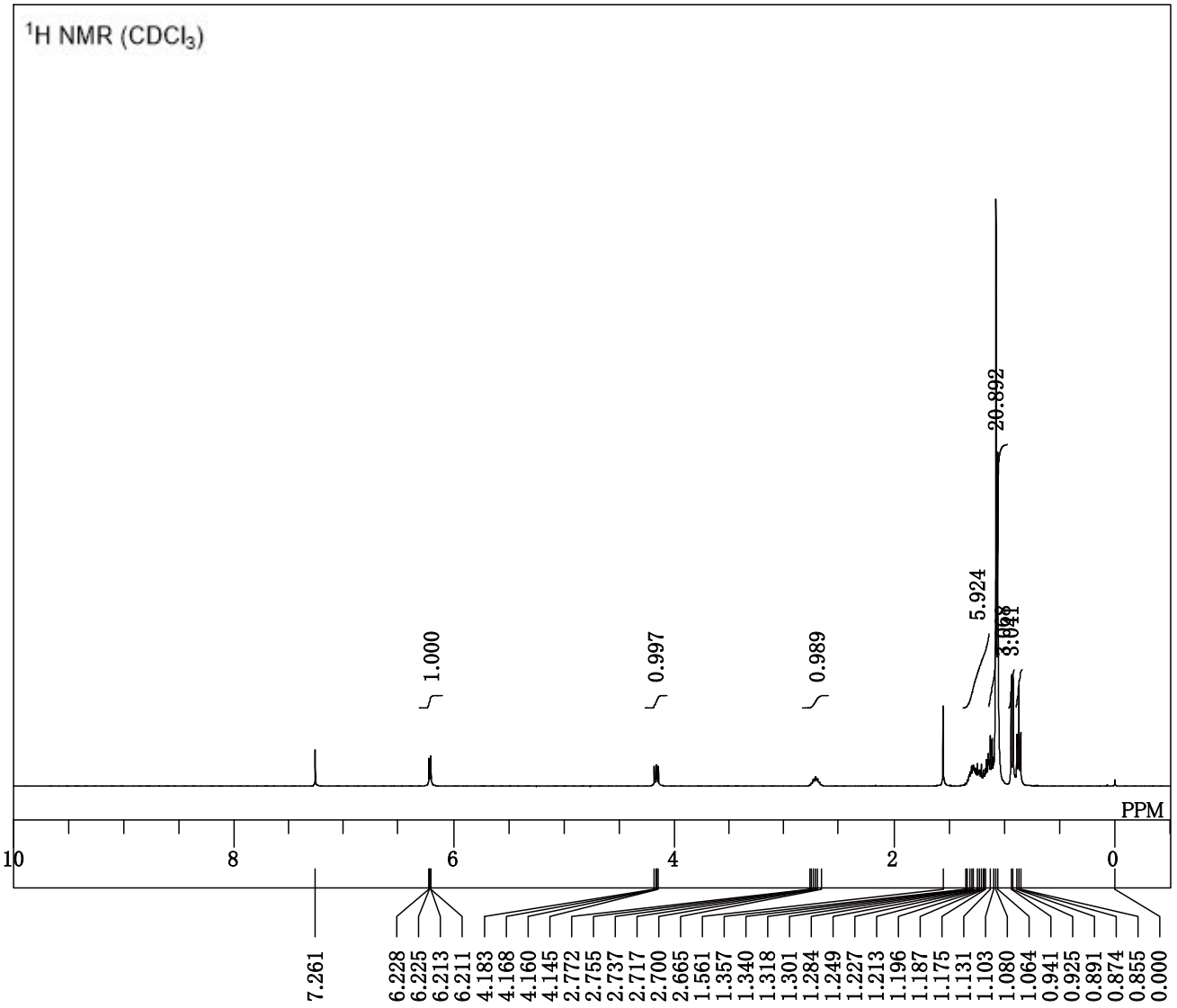

OSi^{i}Pr$_3$

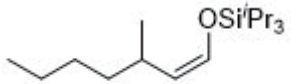
(*E*)-3p


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
139.415
117.700
77.337
77.025
76.704
37.508
32.387
29.675
22.738
22.007
17.791
14.141
12.029

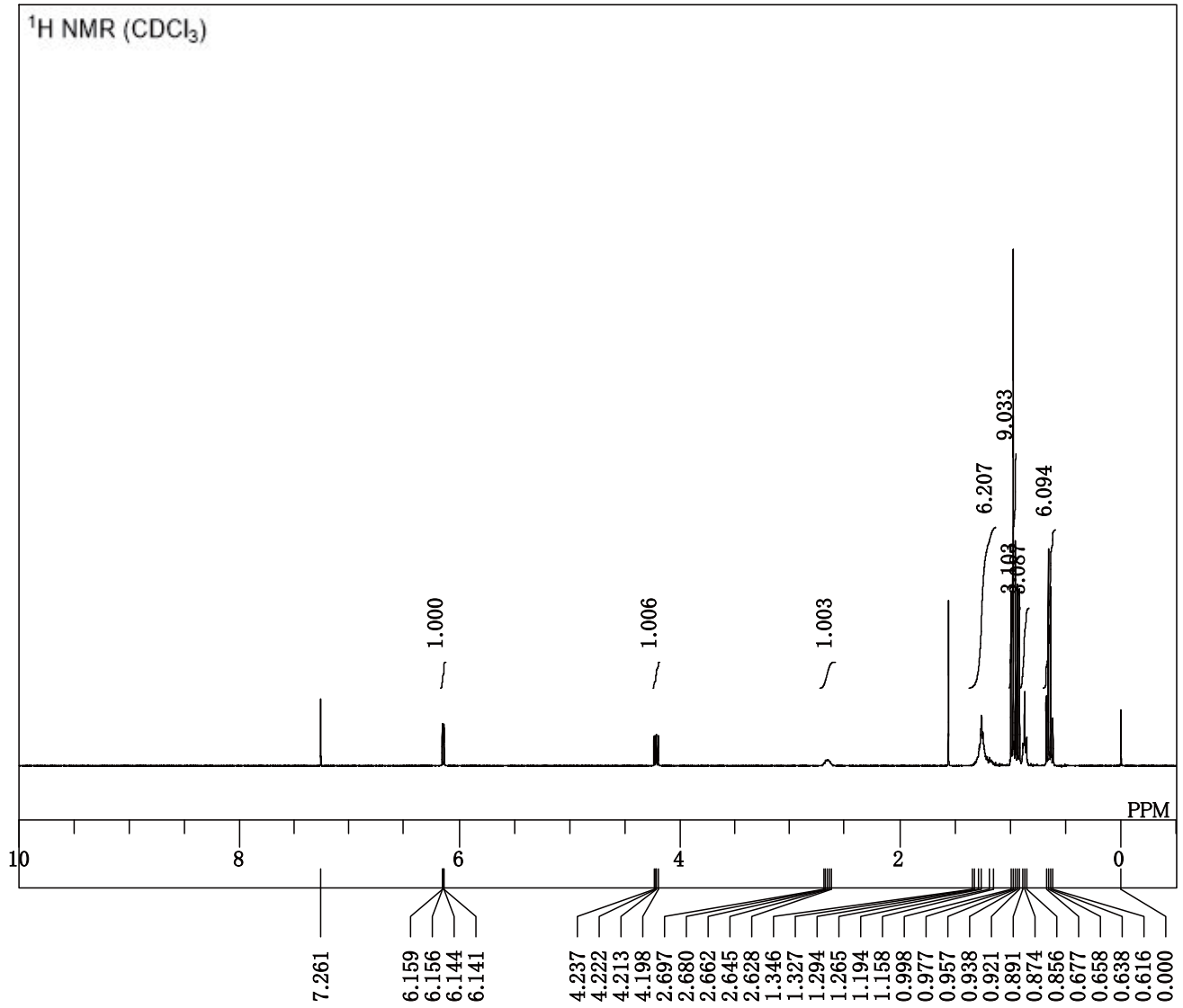

OSi^{i}Pr$_3$

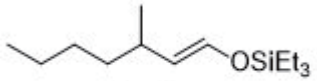
(*E*)-3p


^{1}H NMR ($CDCl_3$)
1.000
0.997
0.989
20.892
5.924
PPM
10
8
6
4
2
0
7.261
6.228
6.225
6.213
6.211
4.183
4.168
4.160
4.145
2.772
2.755
2.737
2.717
2.700
2.665
1.561
1.357
1.340
1.318
1.301
1.284
1.249
1.227
1.213
1.196
1.187
1.175
1.131
1.103
1.080
1.064
0.941
0.925
0.891
0.874
0.855
0.000

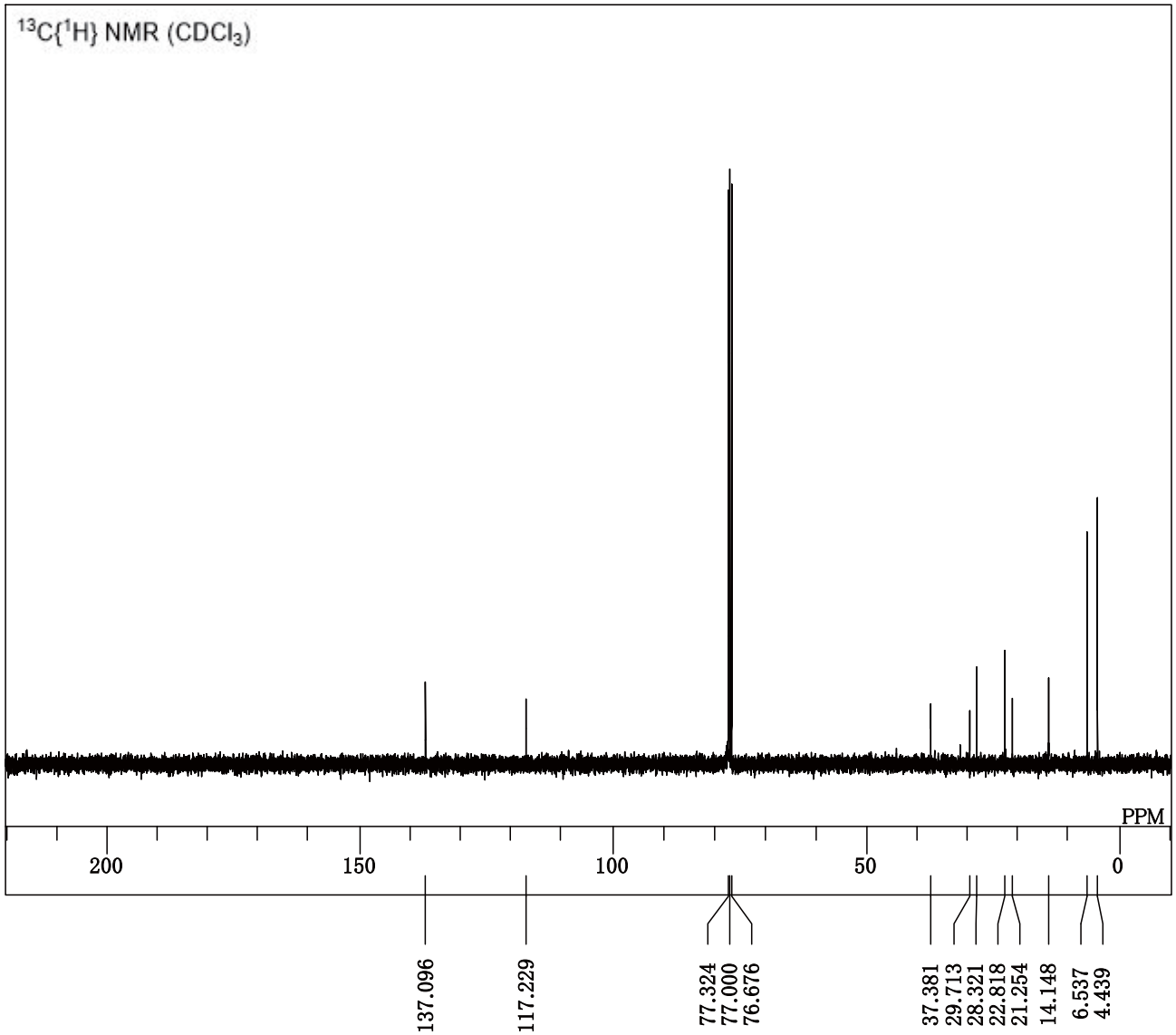

OSi^{i}Pr$_3$

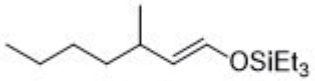
(Z)-3p


1H NMR (CDCl3)
1.000
1.006
1.003
6.207
9.033
6.094
PPM
10
8
6
4
2
0
7.261
6.159
6.156
6.144
6.141
4.237
4.222
4.213
4.198
2.697
2.680
2.662
2.645
2.628
1.346
1.327
1.294
1.265
1.194
1.158
0.998
0.977
0.957
0.938
0.921
0.891
0.874
0.856
0.677
0.658
0.638
0.616
0.000

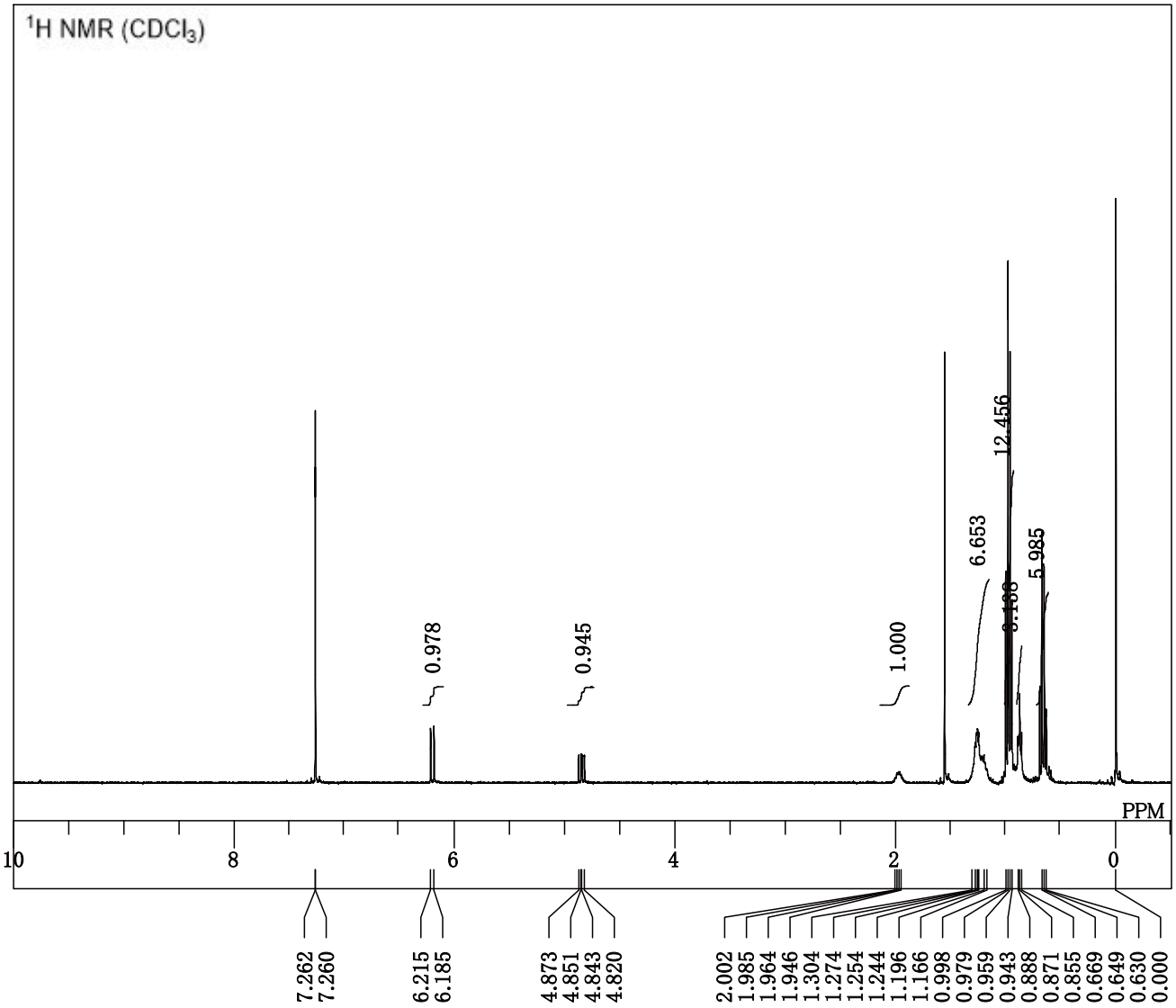

OSiEt3

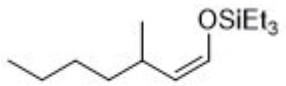
(*E*)-3q


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
137.096
117.229
77.324
77.000
76.676
37.381
29.713
28.321
22.818
21.254
14.148
6.537
4.439

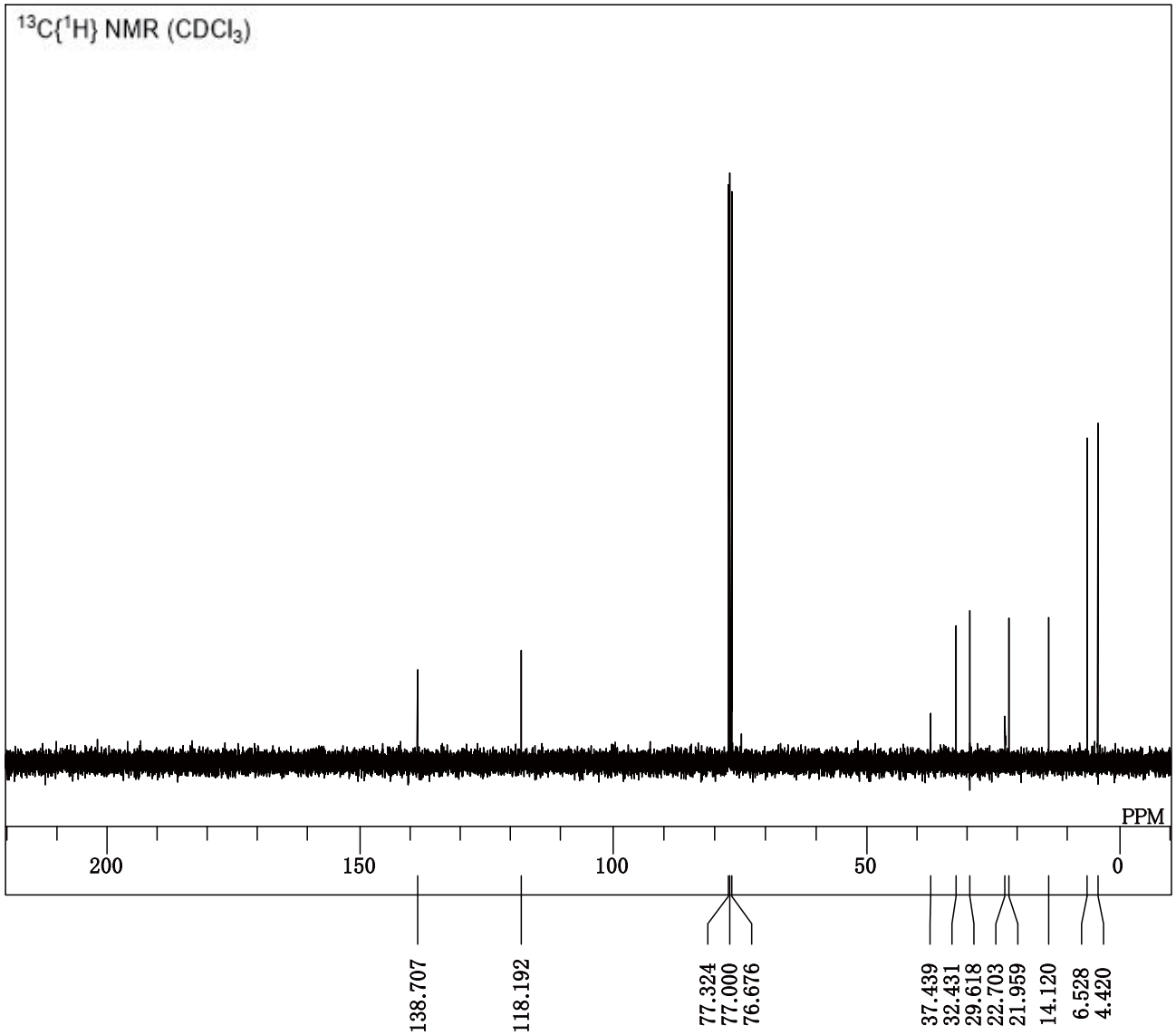

OSiEt$_3$

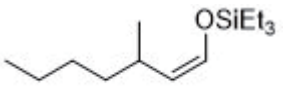
(*E*)-3q


^{1}H NMR ($CDCl_3$)
0.978
0.945
1.000
6.653
12.456
5.985
PPM
10
8
6
4
2
0
7.262
7.260
6.215
6.185
4.873
4.851
4.843
4.820
2.002
1.985
1.964
1.946
1.304
1.274
1.254
1.244
1.196
1.166
0.998
0.979
0.959
0.943
0.888
0.871
0.855
0.669
0.649
0.630
0.000

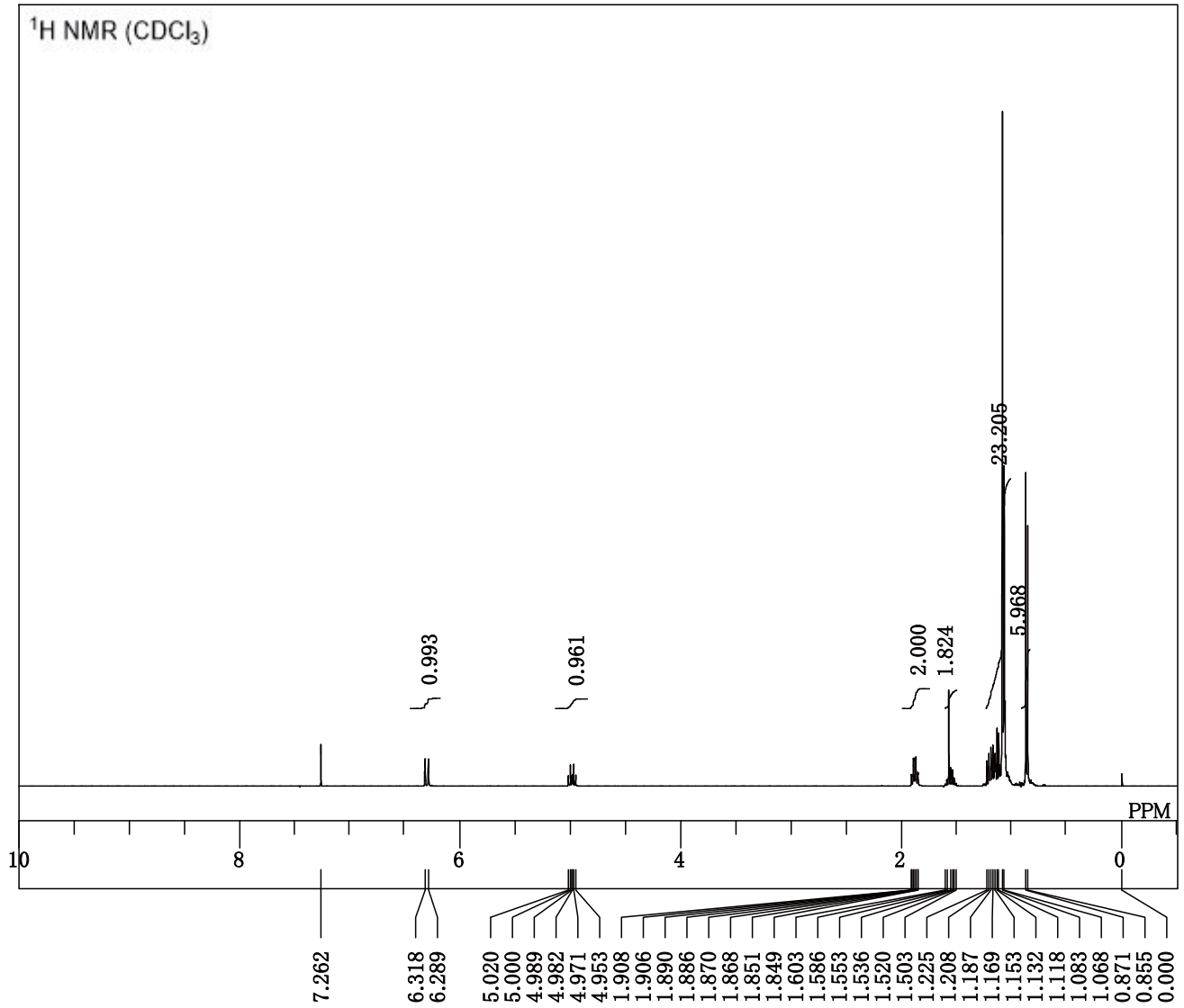

OSiEt$_3$

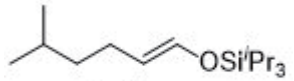
(Z)-3q


13C{1H} NMR (CDCl3)
PPM
200
150
100
50
0
138.707
118.192
77.324
77.000
76.676
37.439
32.431
29.618
22.703
21.959
14.120
6.528
4.420

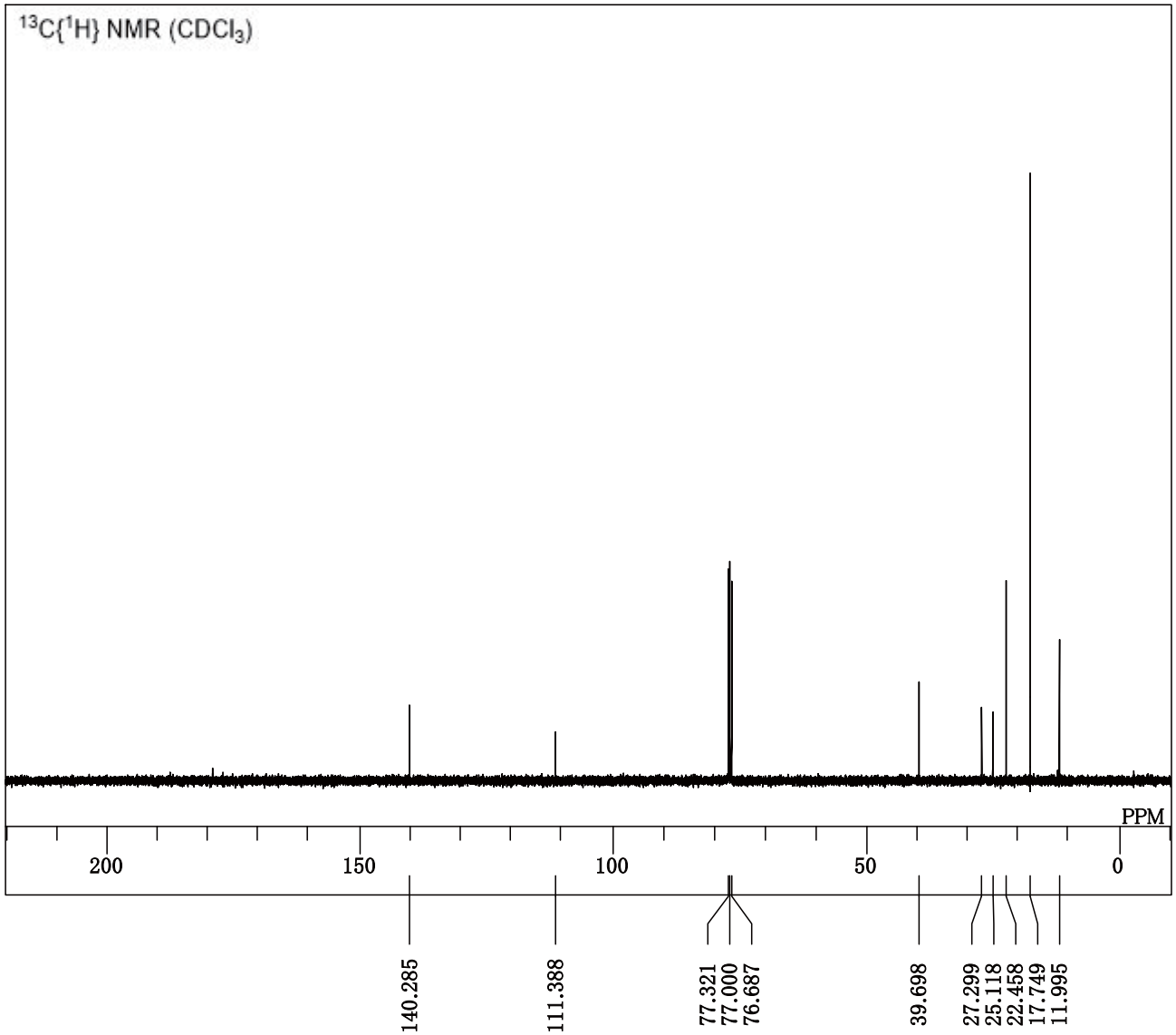

OSiEt3

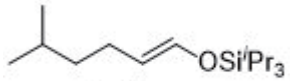
(Z)-3q


^{1}H NMR ($CDCl_3$)
0.993
0.961
2.000
1.824
5.968
23.205
PPM
10
8
6
4
2
0
7.262
6.318
6.289
5.020
5.000
4.989
4.982
4.971
4.953
1.908
1.906
1.890
1.886
1.870
1.868
1.851
1.849
1.603
1.586
1.553
1.536
1.520
1.503
1.225
1.208
1.187
1.169
1.153
1.132
1.118
1.083
1.068
0.871
0.855
0.000

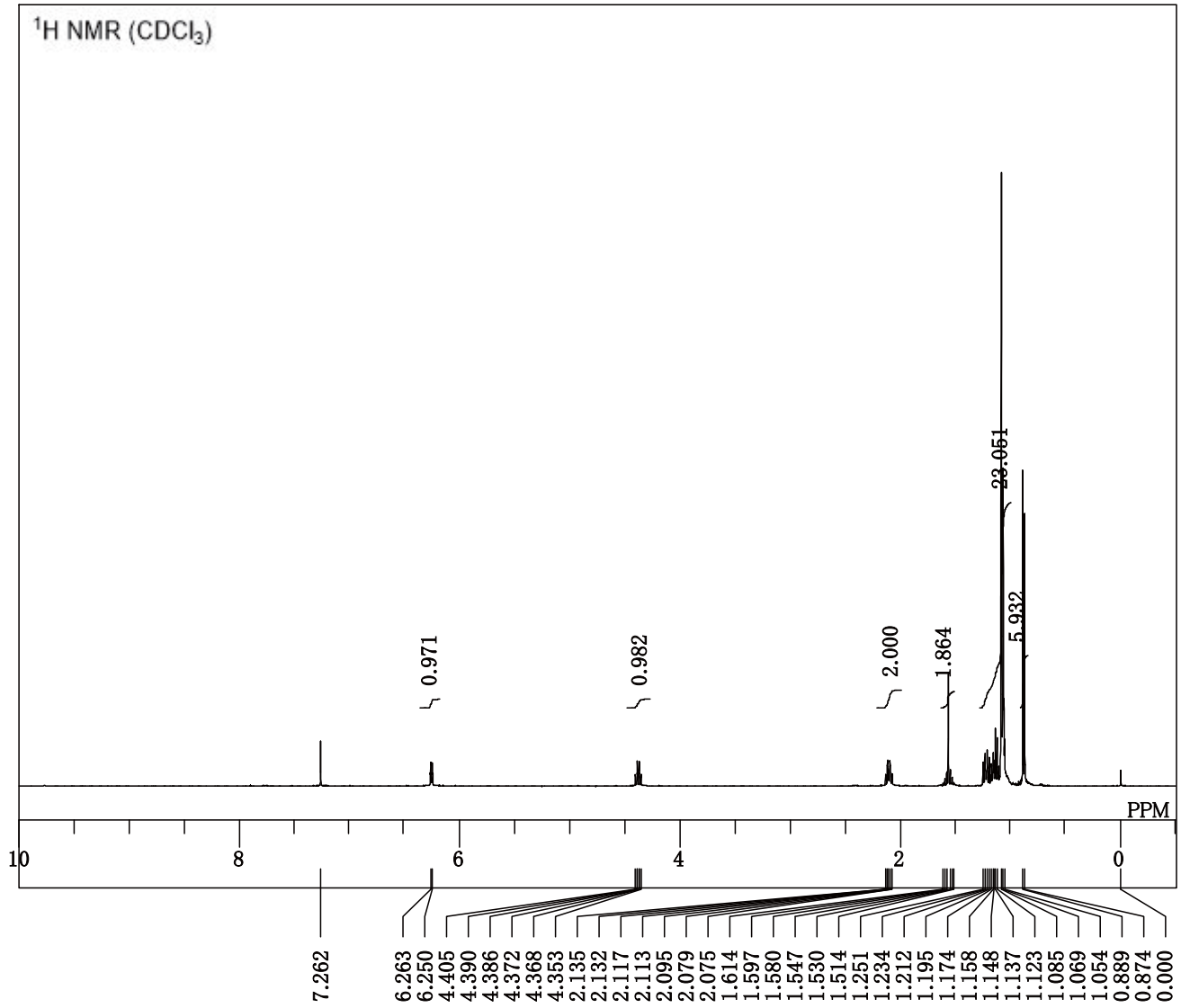

OSi^{i}Pr$_3$

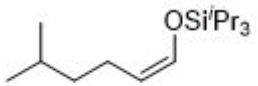
(*E*)-3s


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
140.285
111.388
77.321
77.000
76.687
39.698
27.299
25.118
22.458
17.749
11.995

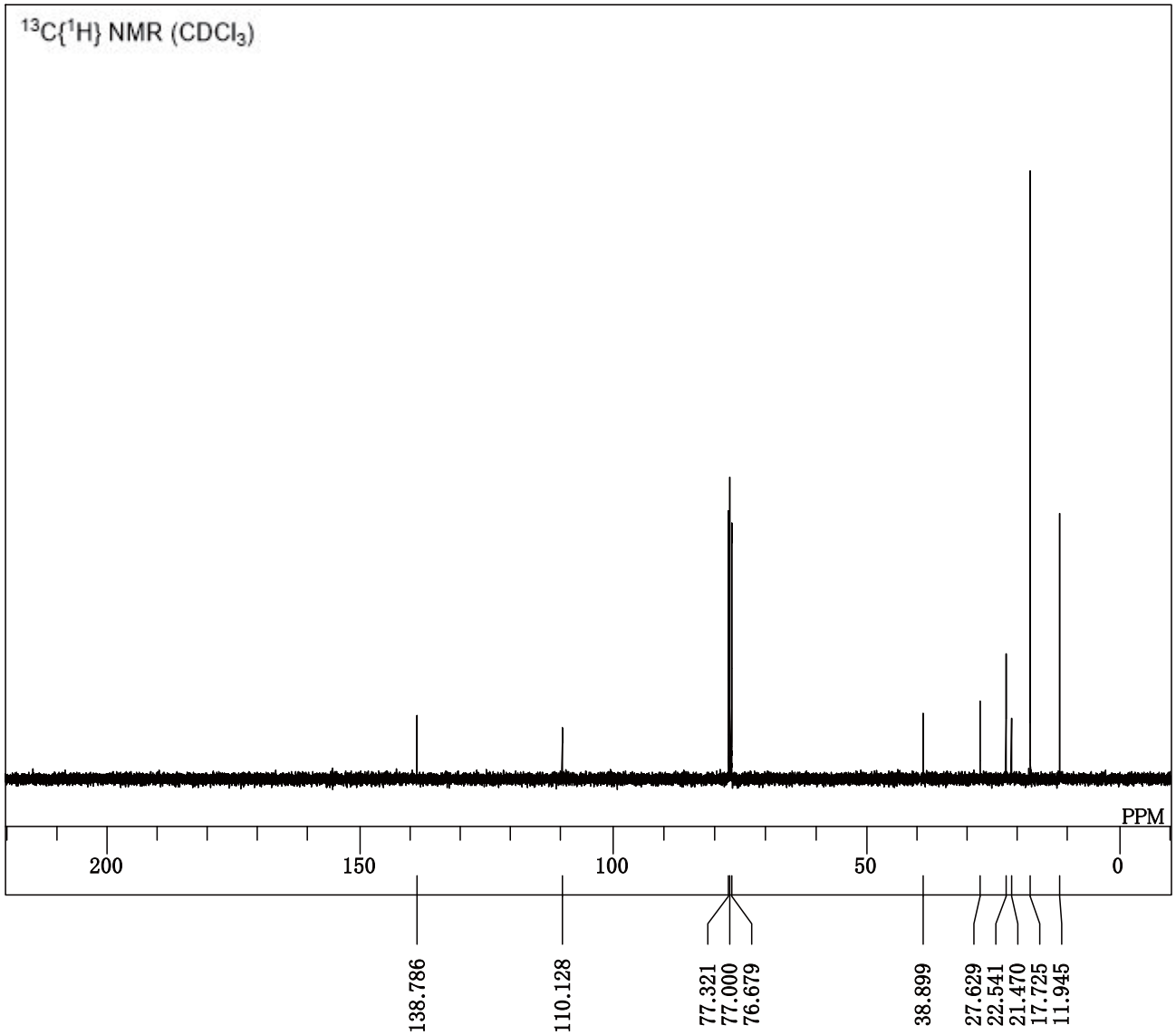

OSi^{i}Pr$_3$

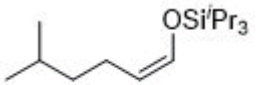
(*E*)-**3s**


^{1}H NMR ($CDCl_3$)
0.971
0.982
2.000
1.864
5.932
23.051
PPM
10
8
6
4
2
0
7.262
6.263
6.250
4.405
4.390
4.386
4.372
4.368
4.353
2.135
2.132
2.117
2.113
2.095
2.079
2.075
1.614
1.597
1.580
1.547
1.530
1.514
1.251
1.234
1.212
1.195
1.174
1.158
1.148
1.137
1.123
1.085
1.069
1.054
0.889
0.874
0.000

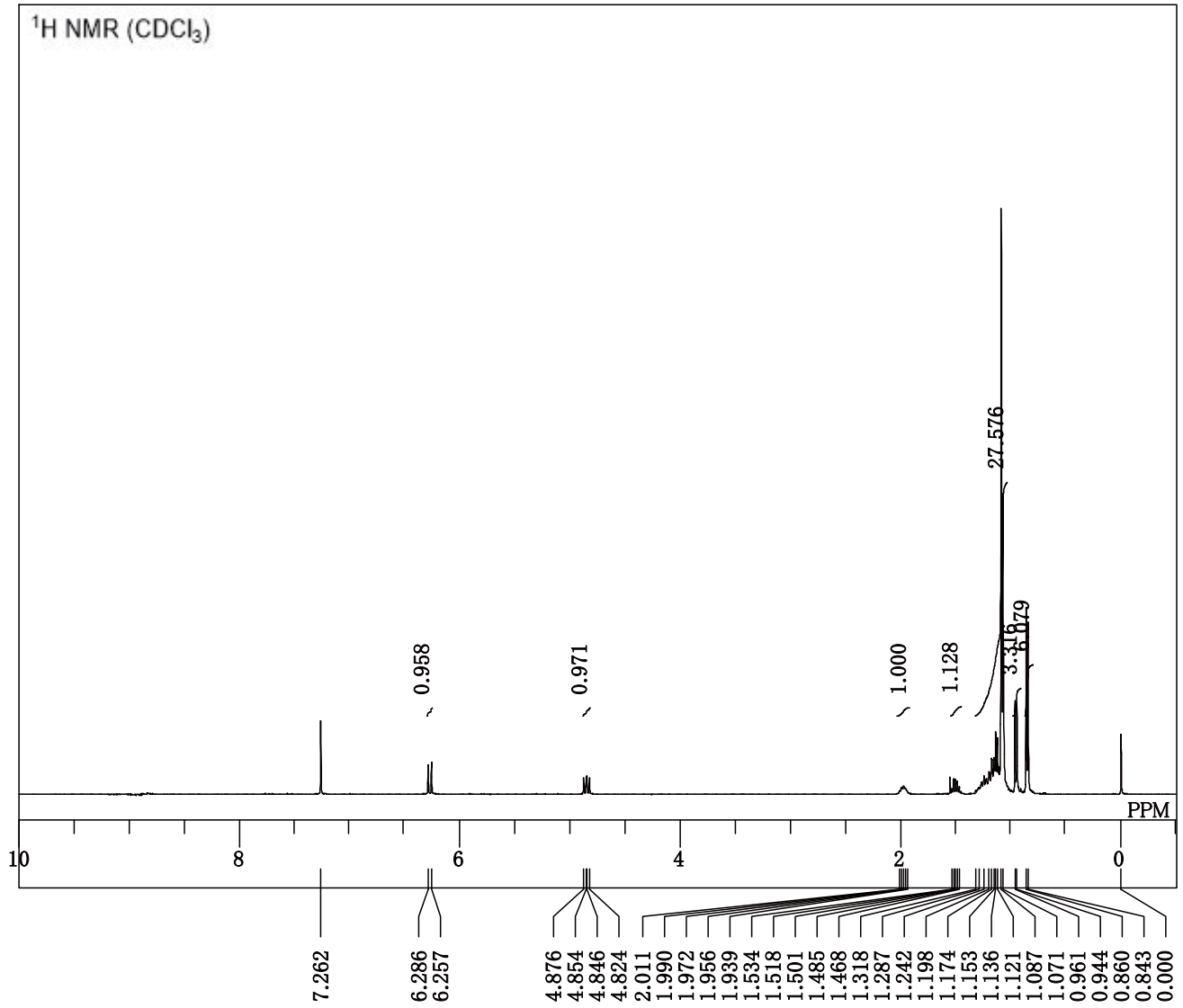

OSi^{i}Pr$_3$

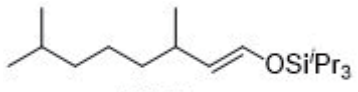
(*Z*)-3s


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
138.786
110.128
77.321
77.000
76.679
38.899
27.629
22.541
21.470
17.725
11.945

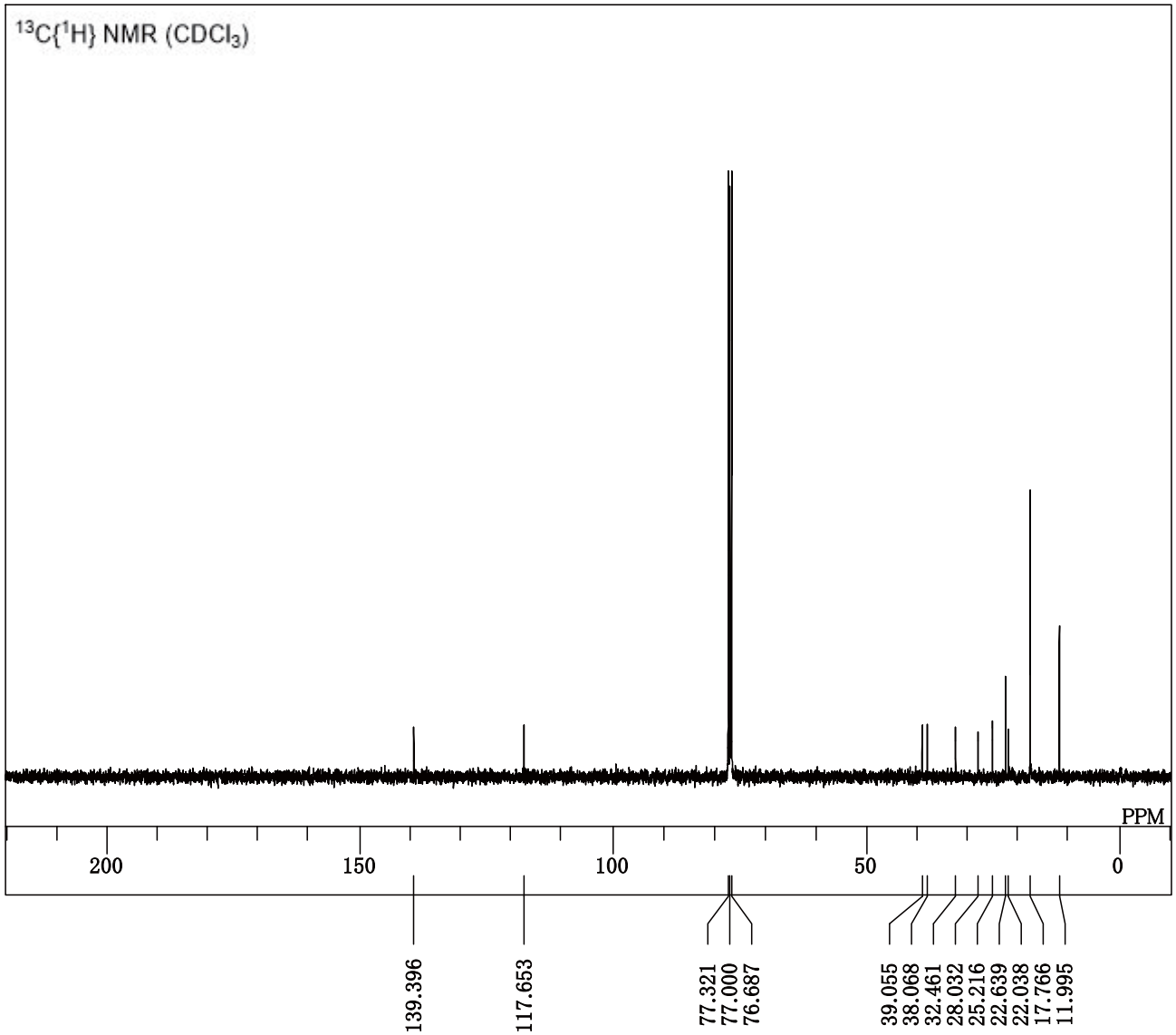

OSi^{i}Pr$_3$

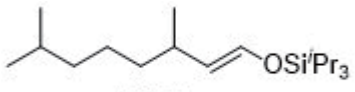
(*Z*)-3s


^{1}H NMR ($CDCl_3$)
0.958
0.971
1.000
1.128
27.576
3.316
6.179
PPM
10
8
6
4
2
0
7.262
6.286
6.257
4.876
4.854
4.846
4.824
2.011
1.990
1.972
1.956
1.939
1.534
1.518
1.501
1.485
1.468
1.318
1.287
1.242
1.198
1.174
1.153
1.136
1.121
1.087
1.071
0.961
0.944
0.860
0.843
0.000

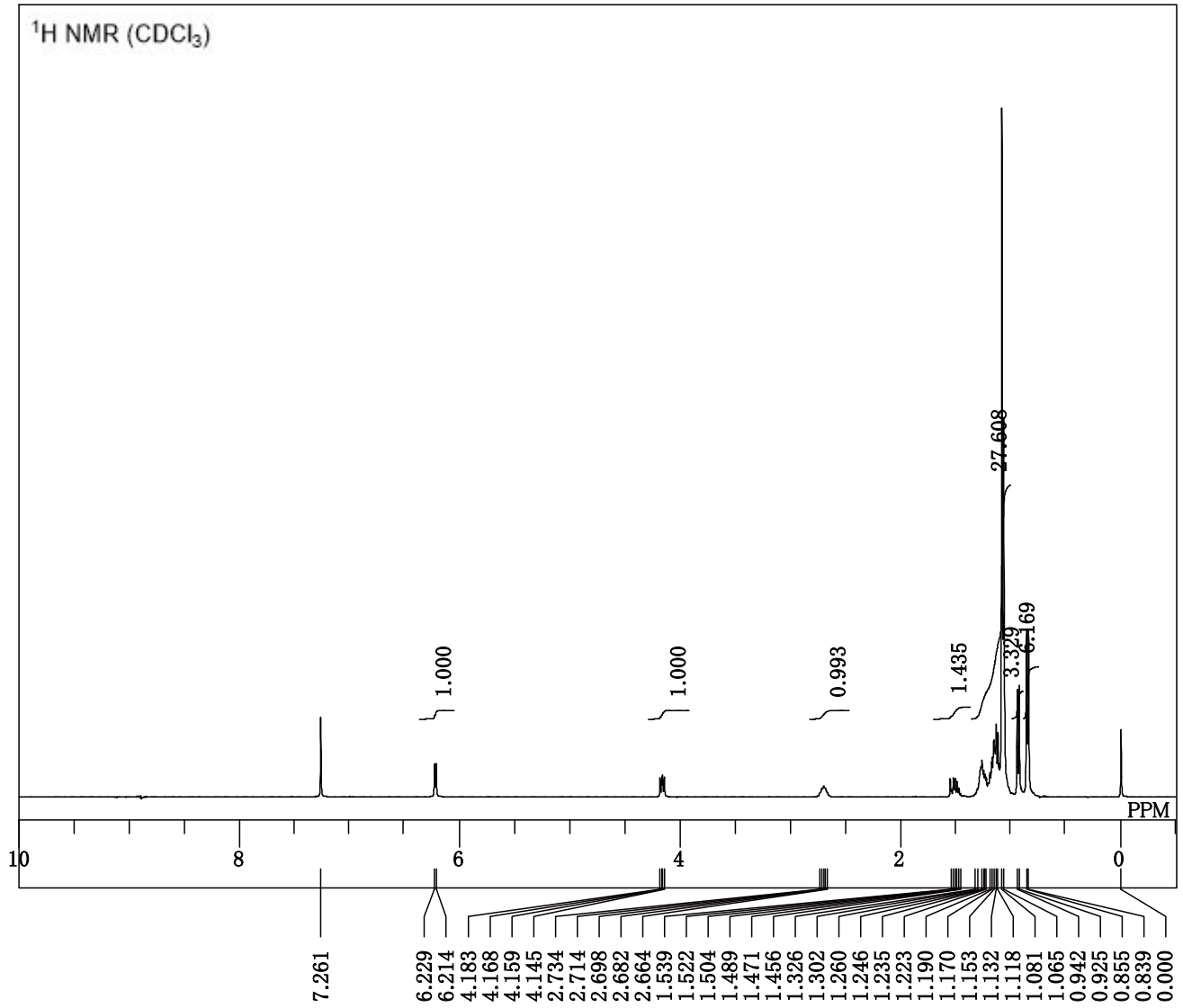

OSi^{i}Pr$_3$

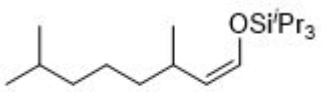
(*E*)-3t


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
139.396
117.653
77.321
77.000
76.687
39.055
38.068
32.461
28.032
25.216
22.639
22.038
17.766
11.995

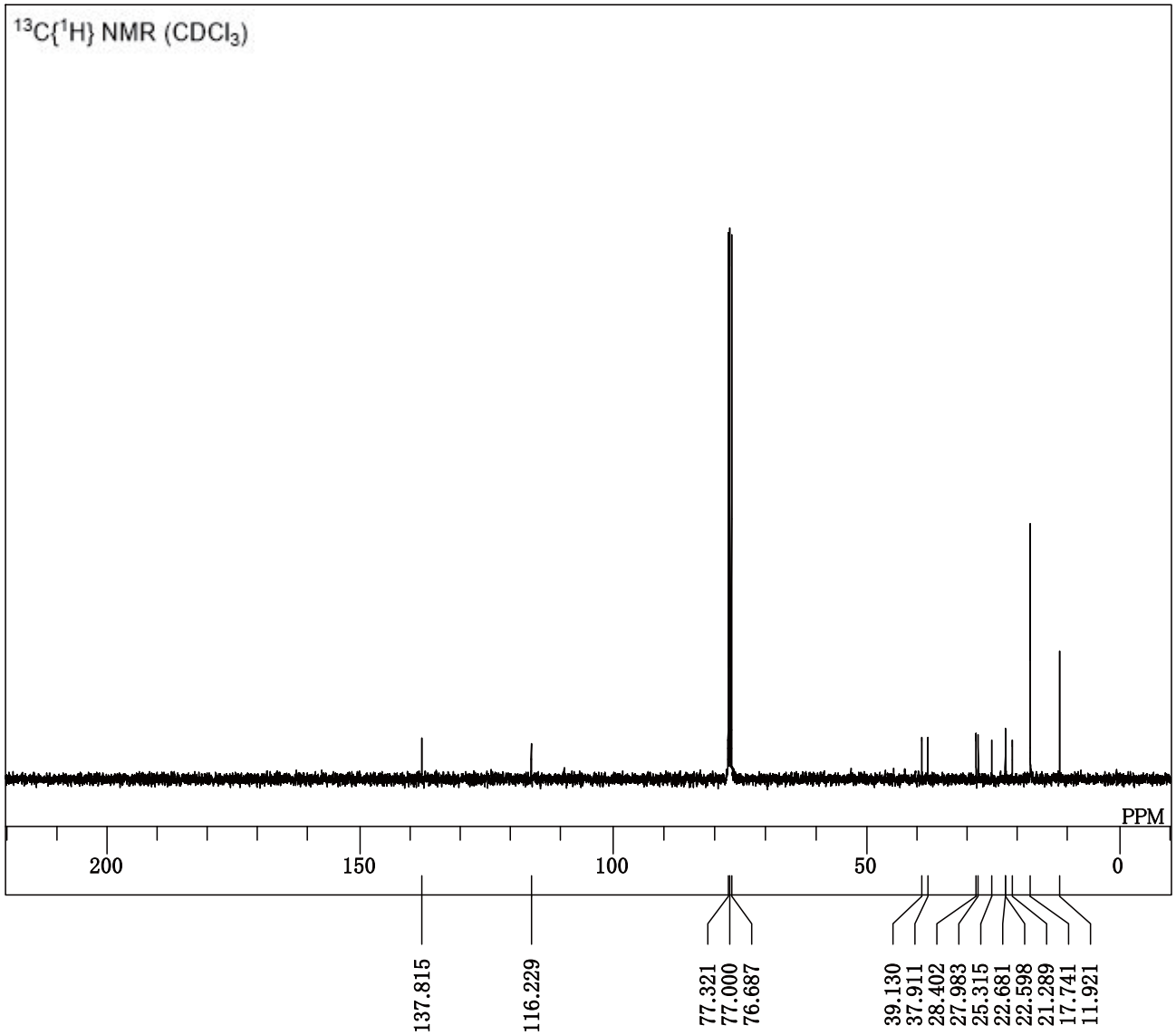

OSi^{i}Pr$_3$

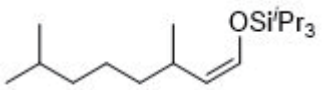
(*E*)-3t


^{1}H NMR ($CDCl_3$)
1.000
1.000
0.993
1.435
27.608
3.329
6.169
PPM
10
8
6
4
2
0
7.261
6.229
6.214
4.183
4.168
4.159
4.145
2.734
2.714
2.698
2.682
2.664
1.539
1.522
1.504
1.489
1.471
1.456
1.326
1.302
1.260
1.246
1.235
1.223
1.190
1.170
1.153
1.132
1.118
1.081
1.065
0.942
0.925
0.855
0.839
0.000

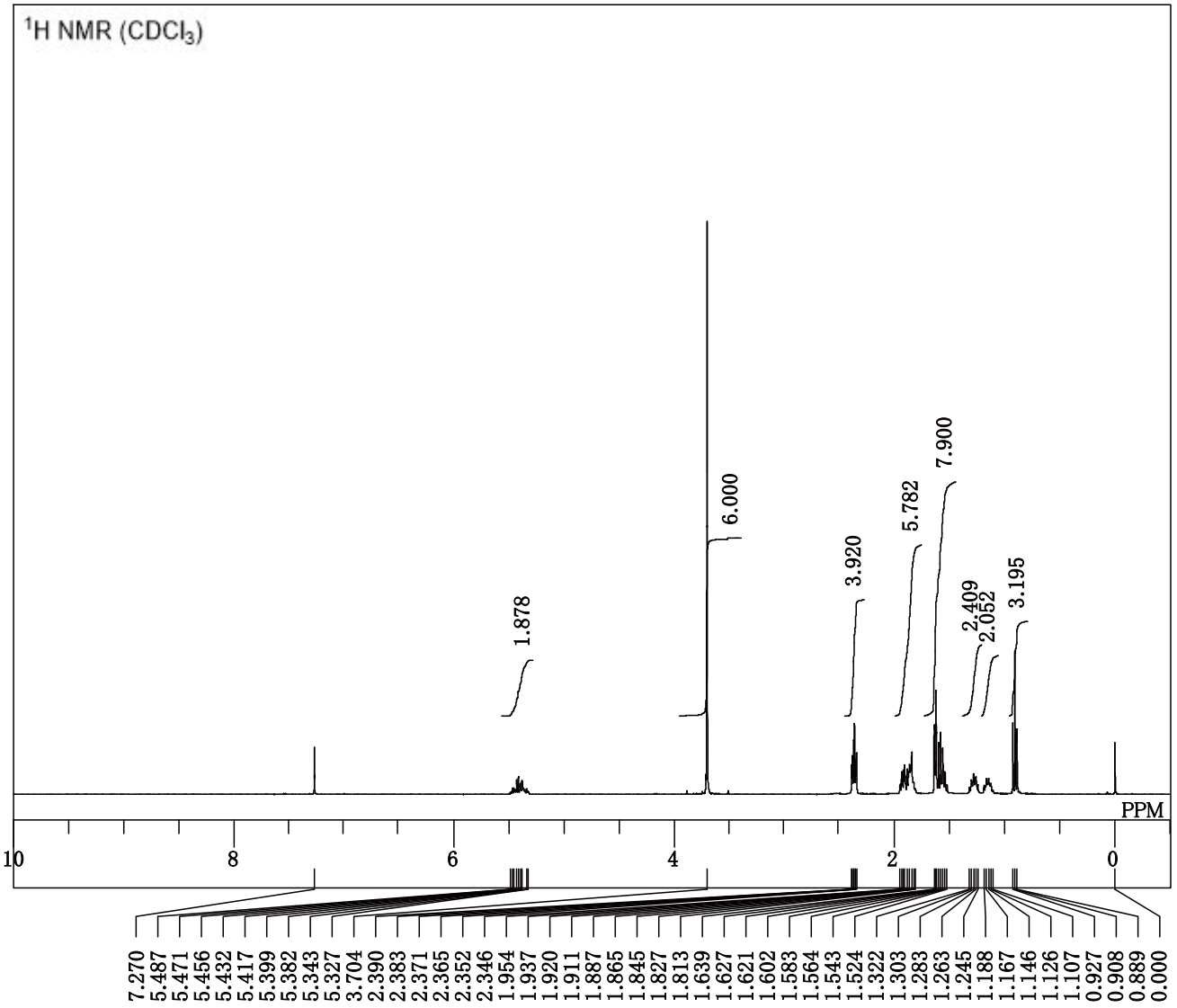

OSi^{i}Pr$_3$

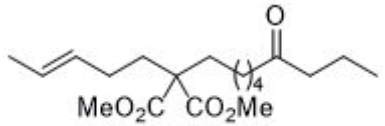
(*Z*)-3t


$^{13}C\{^{1}H\}$ NMR ($CDCl_3$)
PPM
200
150
100
50
0
137.815
116.229
77.321
77.000
76.687
39.130
37.911
28.402
27.983
25.315
22.681
22.598
21.289
17.741
11.921

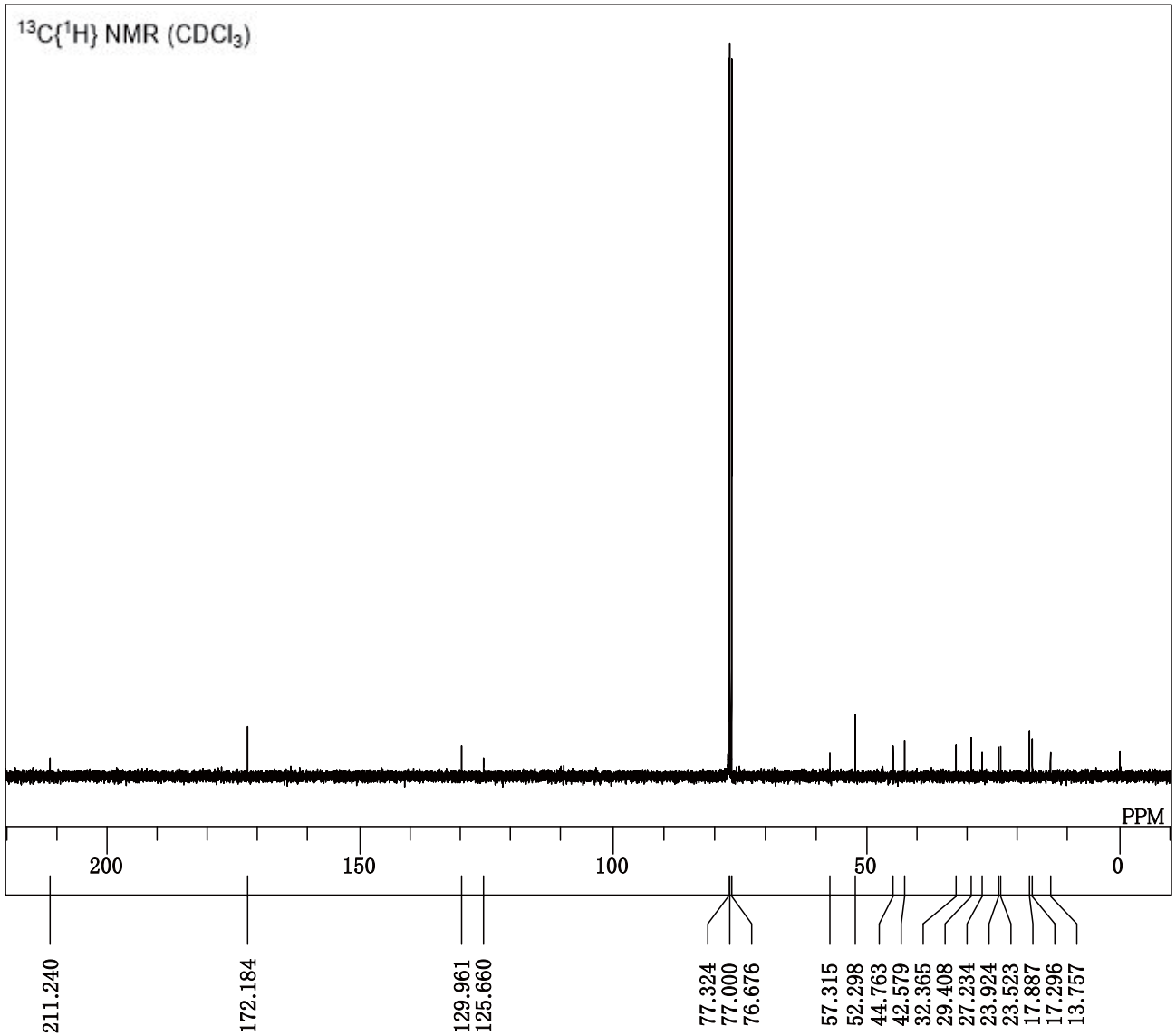

OSi^{i}Pr$_3$

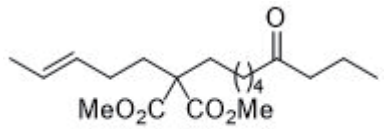
(*Z*)-3t


1H NMR (CDCl3)
1.878
6.000
3.920
5.782
7.900
2.409
2.052
3.195
PPM
10
8
6
4
2
0
7.270
5.487
5.471
5.456
5.432
5.417
5.399
5.382
5.343
5.327
3.704
2.390
2.383
2.371
2.365
2.352
2.346
1.954
1.937
1.920
1.911
1.887
1.865
1.845
1.827
1.813
1.639
1.627
1.621
1.602
1.583
1.564
1.543
1.524
1.322
1.303
1.283
1.263
1.245
1.188
1.167
1.146
1.126
1.107
0.927
0.908
0.889
0.000

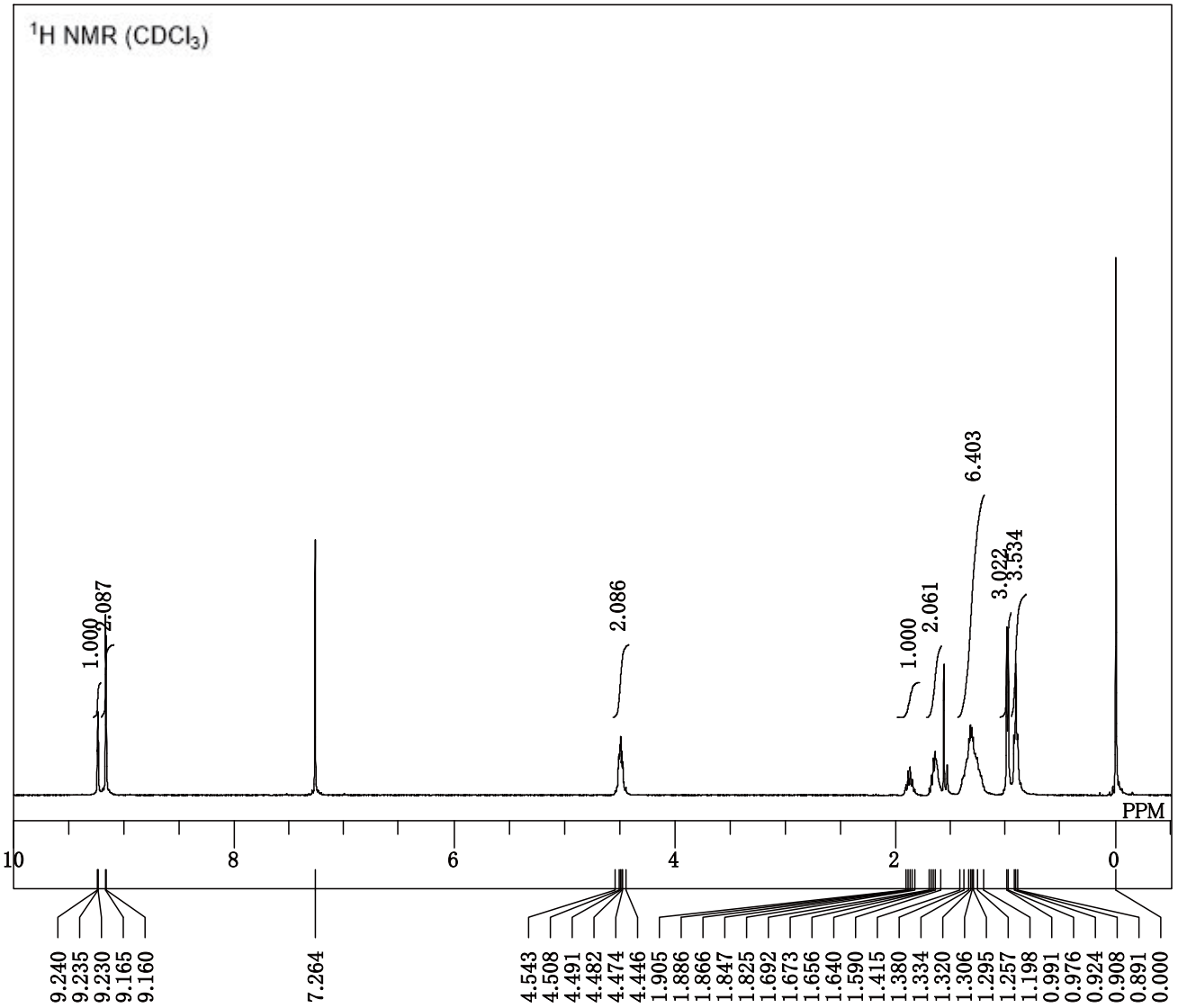

O
4
MeO2C
CO2Me

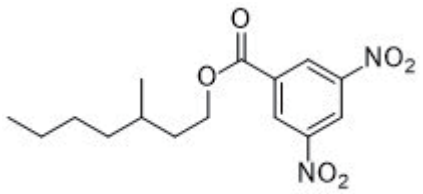
3u


13C{1H} NMR (CDCl3)
PPM
200
150
100
50
0
211.240
172.184
129.961
125.660
77.324
77.000
76.676
57.315
52.298
44.763
42.579
32.365
29.408
27.234
23.924
23.523
17.887
17.296
13.757

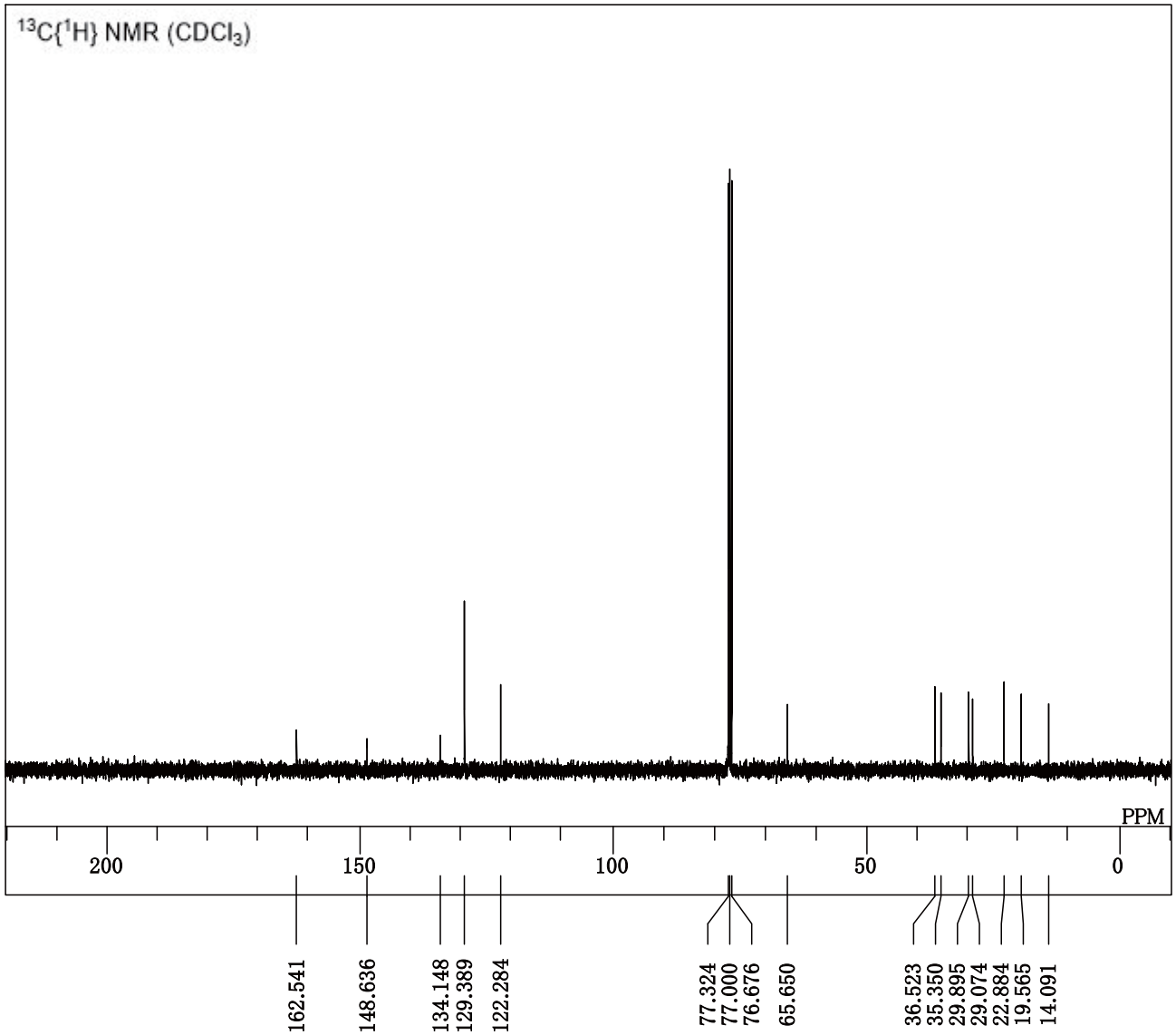

O
MeO2C
CO2Me
4

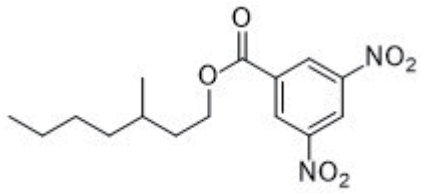
3u


1H NMR (CDCl3)
1.000
2.087
2.086
1.000
2.061
6.403
3.022
3.534
PPM
10
8
6
4
2
0
9.240
9.235
9.230
9.165
9.160
7.264
4.543
4.508
4.491
4.482
4.474
4.446
1.905
1.886
1.866
1.847
1.825
1.692
1.673
1.656
1.640
1.590
1.415
1.380
1.334
1.320
1.306
1.295
1.257
1.198
0.991
0.976
0.924
0.908
0.891
0.000


O
O
NO2
NO2

S1


13C{1H} NMR (CDCl3)
PPM
200
150
100
50
0
162.541
148.636
134.148
129.389
122.284
77.324
77.000
76.676
65.650
36.523
35.350
29.895
29.074
22.884
19.565
14.091


O
O
NO2
NO2

S1