Electronic supplementary information (ESI)

A facile synthetic strategy to polysiloxanes containing sulfonyl side groups with high dielectric permittivity

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c. *Swiss Federal Laboratories for Materials Science and Technology Empa, Laboratory of Materials for Energy Conversion, Überlandstr. 129, CH-8600, Dübendorf, Switzerland.*

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E-mail: dorina.opris@empa.ch

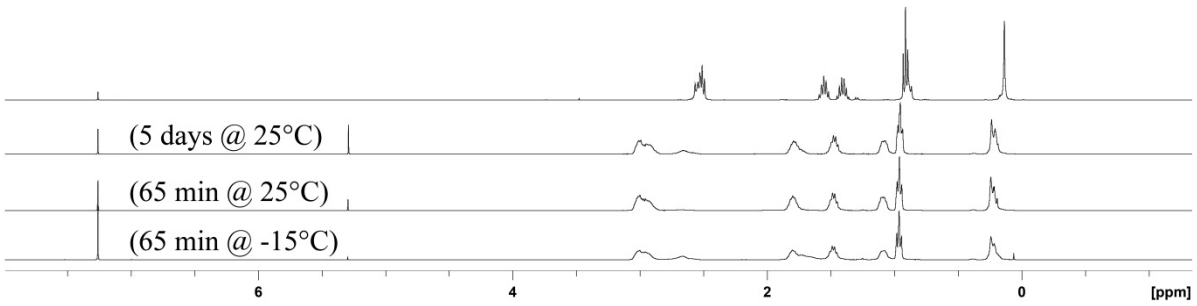


Fig. S1 ^{1}H NMR spectra of **P1** and of the polymer **P2** obtained at different reaction time and temperature.

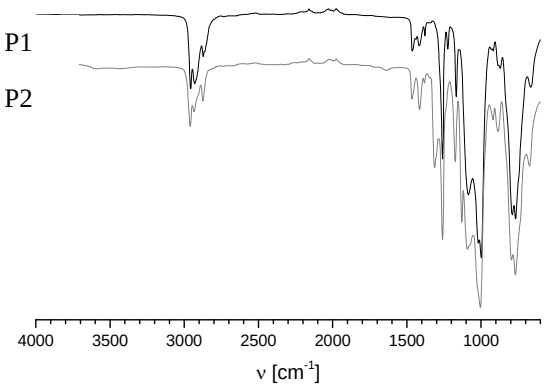


Fig. S2 IR spectra of **P1** and **P2**.

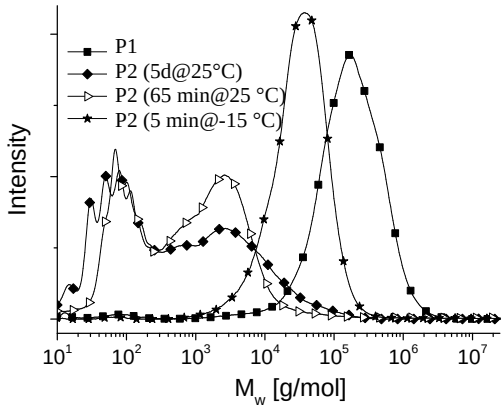


Fig. S3 GPC data of **P1** and the corresponding P2 prepared under different reaction conditions.

TGA Data

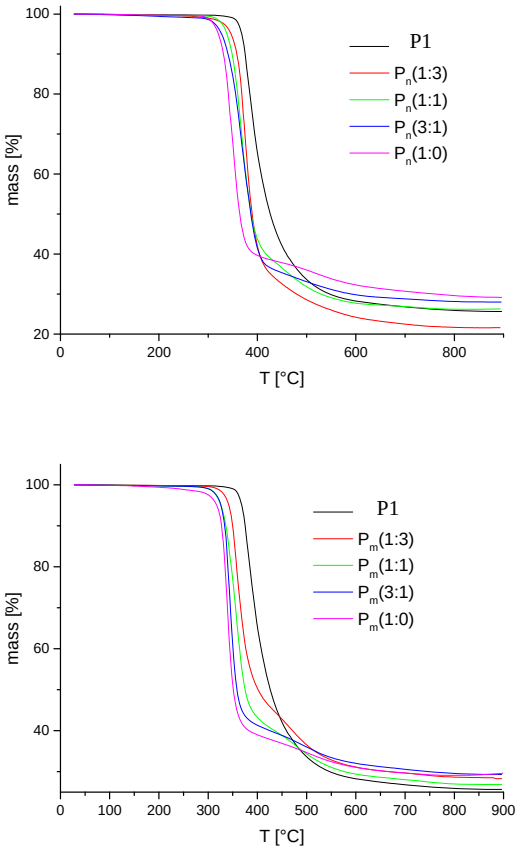
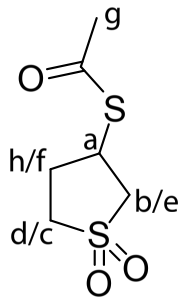
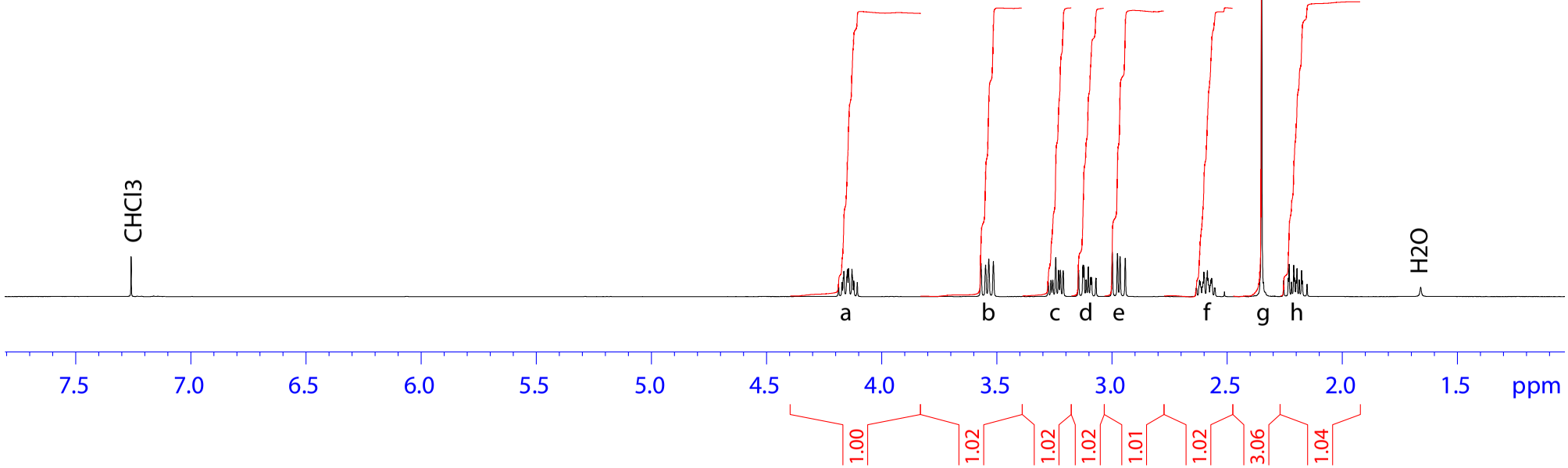


Fig. S4 TGA of $\mathbf{P_m(x:y)}$ and $\mathbf{P_n(x:y)}$.

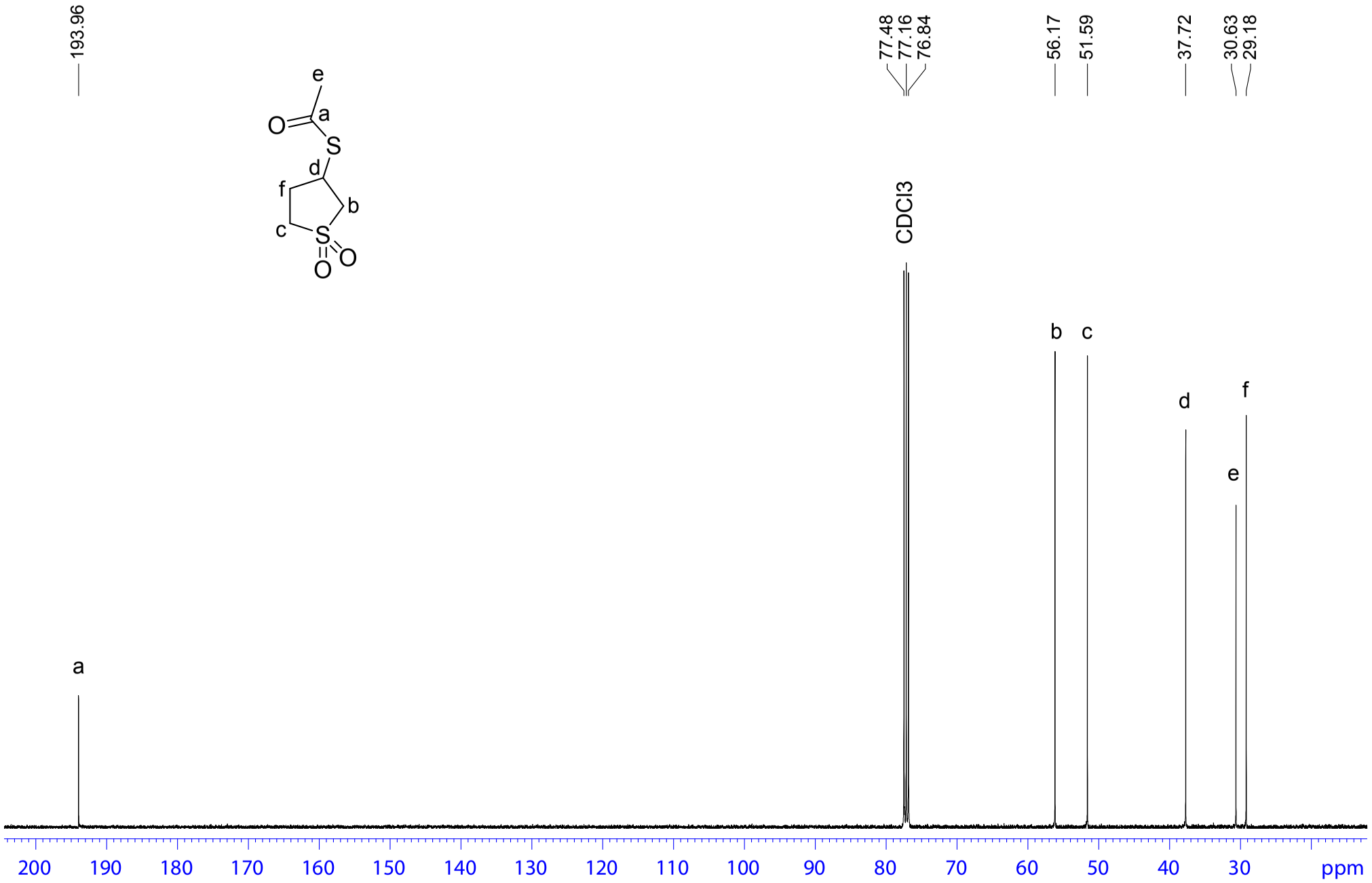
1H NMR of

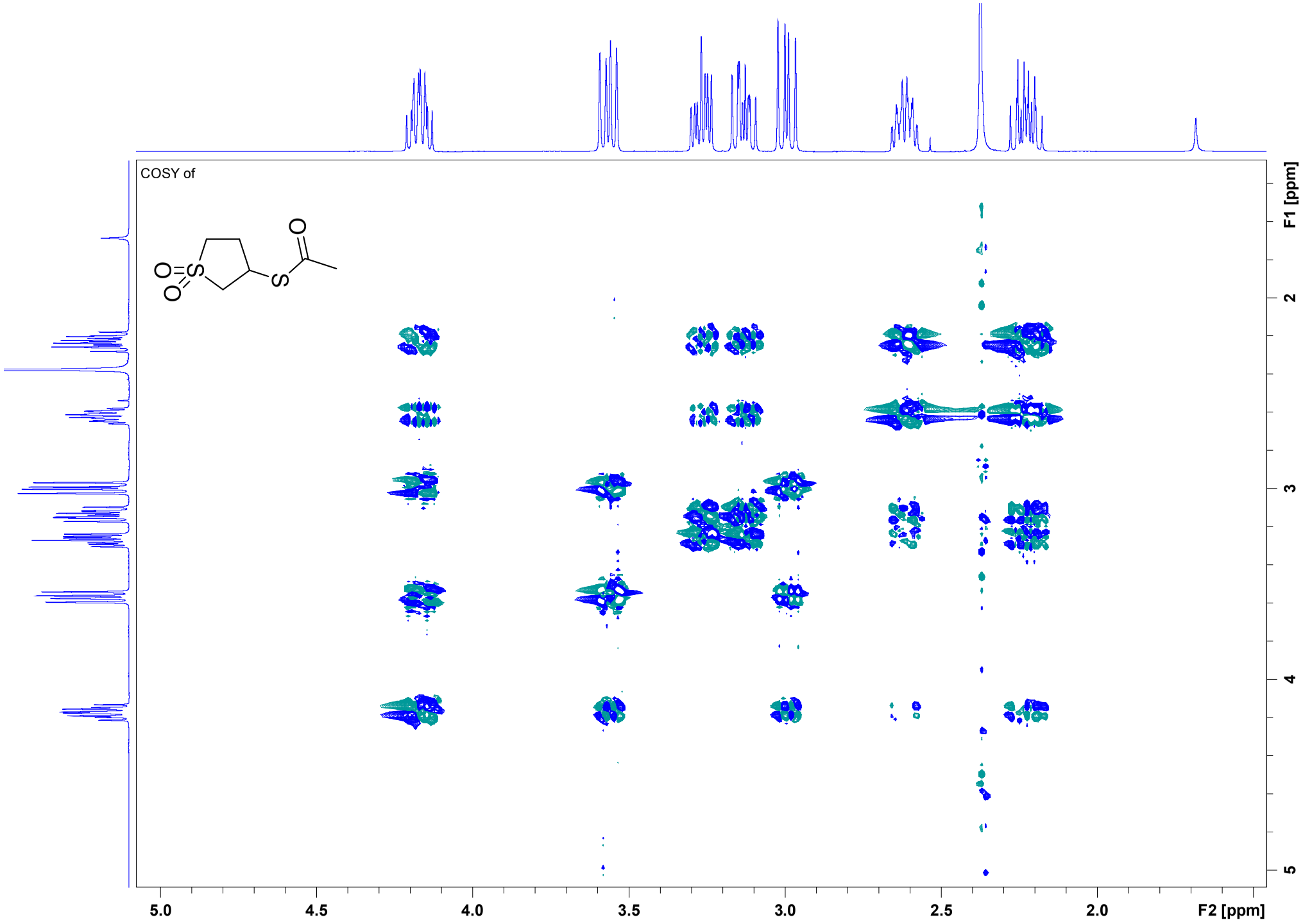

g
O
S
a
h/f
b/e
d/c
S
O
O

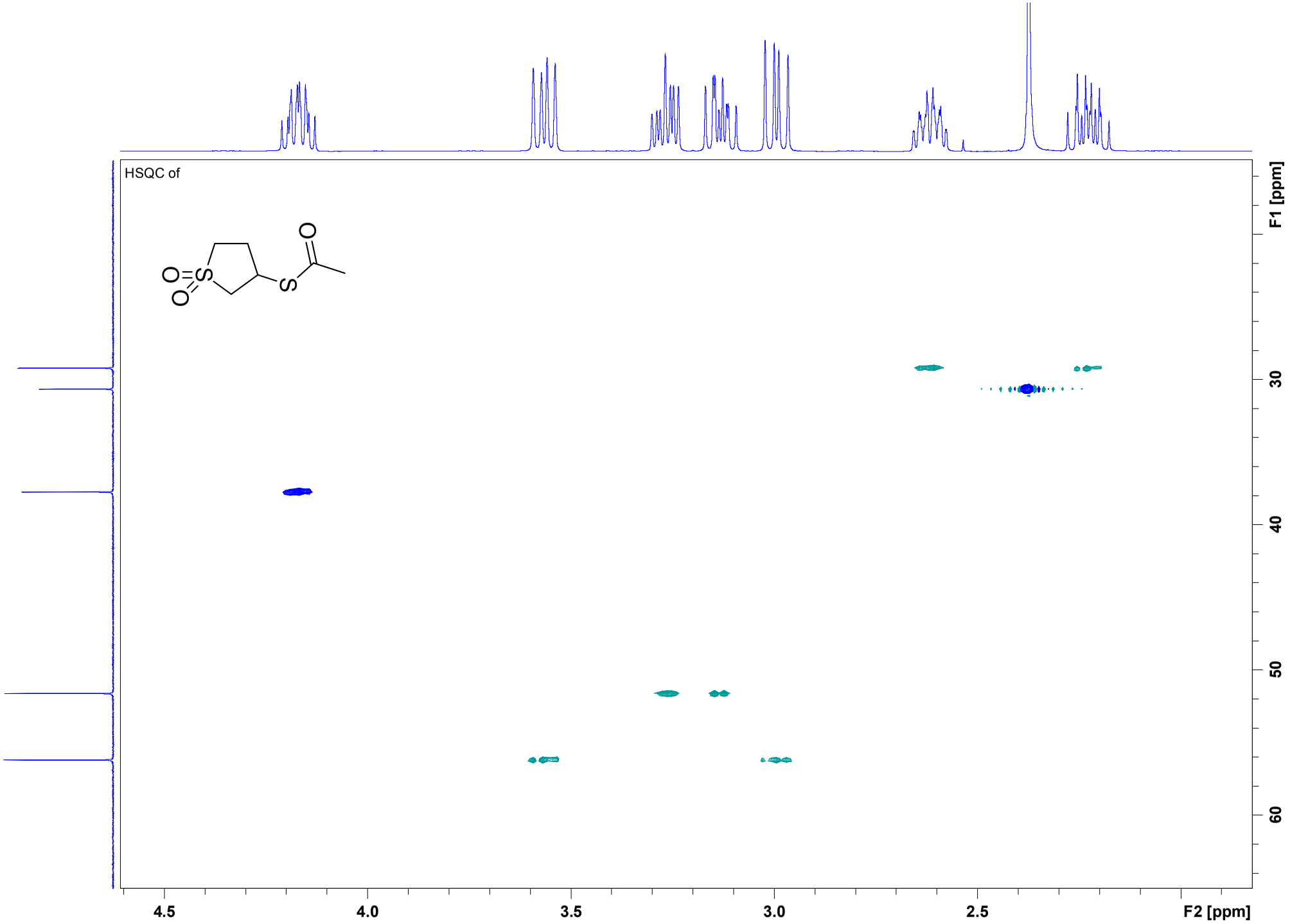
4.4
4.2
4.0
3.8
3.6
3.4
3.2
3.0
2.8
2.6
2.4
2.2
ppm

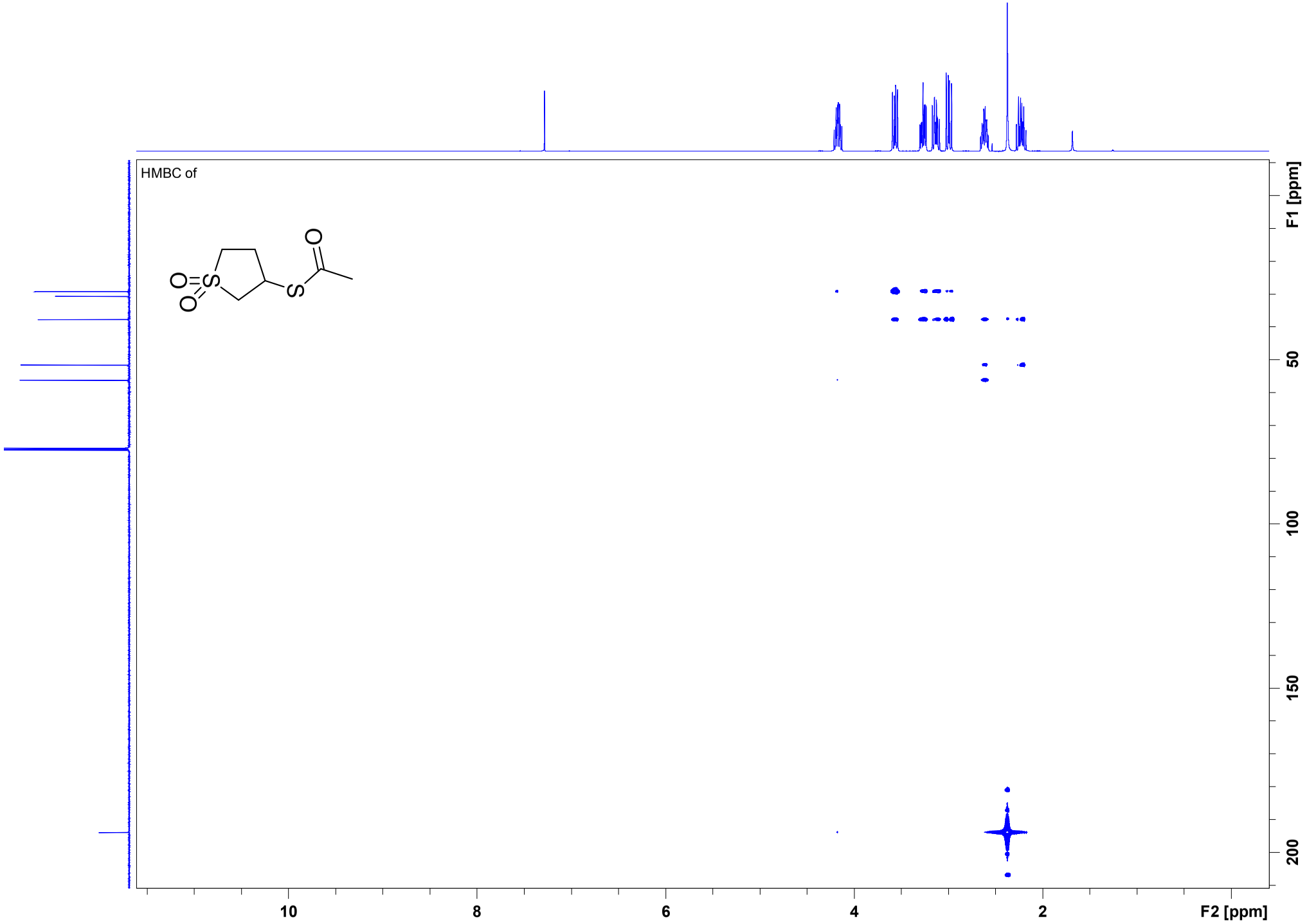

CHCl3
H2O
a
b
c
d
e
f
g
h
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
ppm
1.00
1.02
1.02
1.02
1.01
1.02
3.06
1.04

13C NMR of


193.96
77.48
77.16
76.84
56.17
51.59
37.72
30.63
29.18
CDCl3
a
b
c
d
e
f
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
ppm

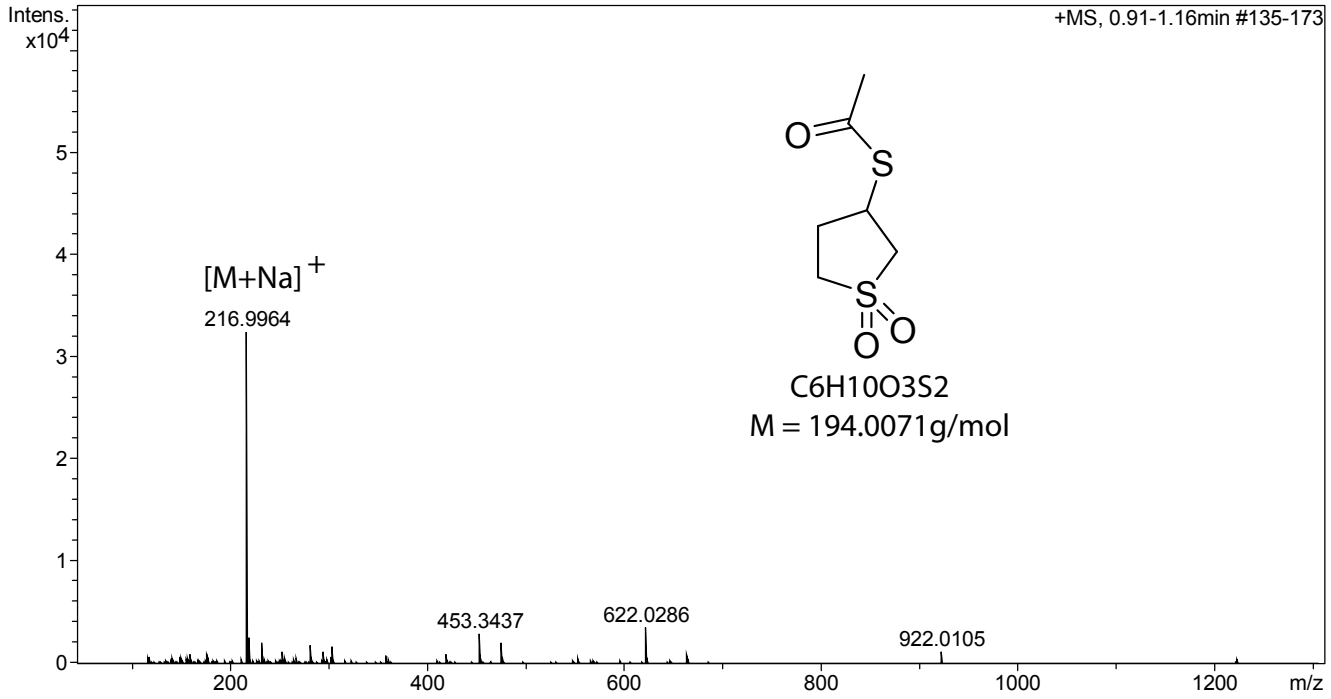

COSY of
F1 [ppm]
F2 [ppm]
5.0
4.5
4.0
3.5
3.0
2.5
2.0
2
3
4
5

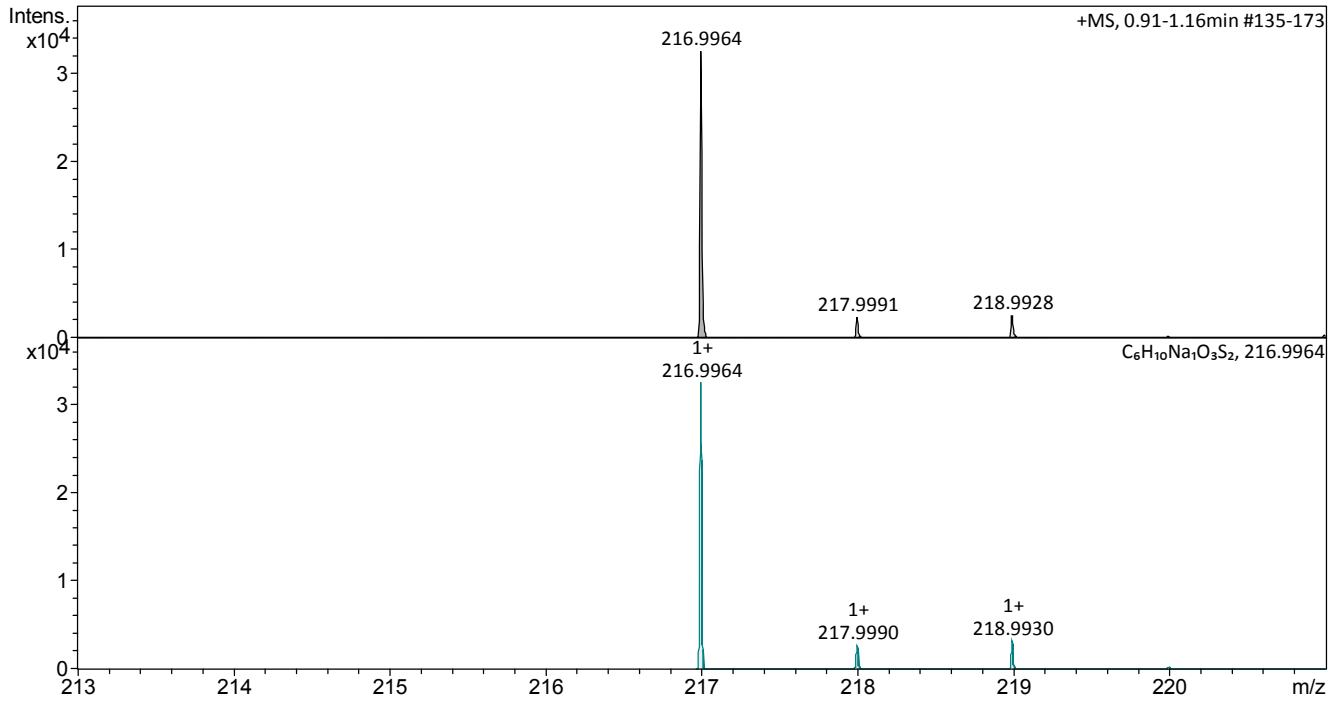

HSQC of
F1 [ppm]
30
40
50
60
4.5
4.0
3.5
3.0
2.5
F2 [ppm]

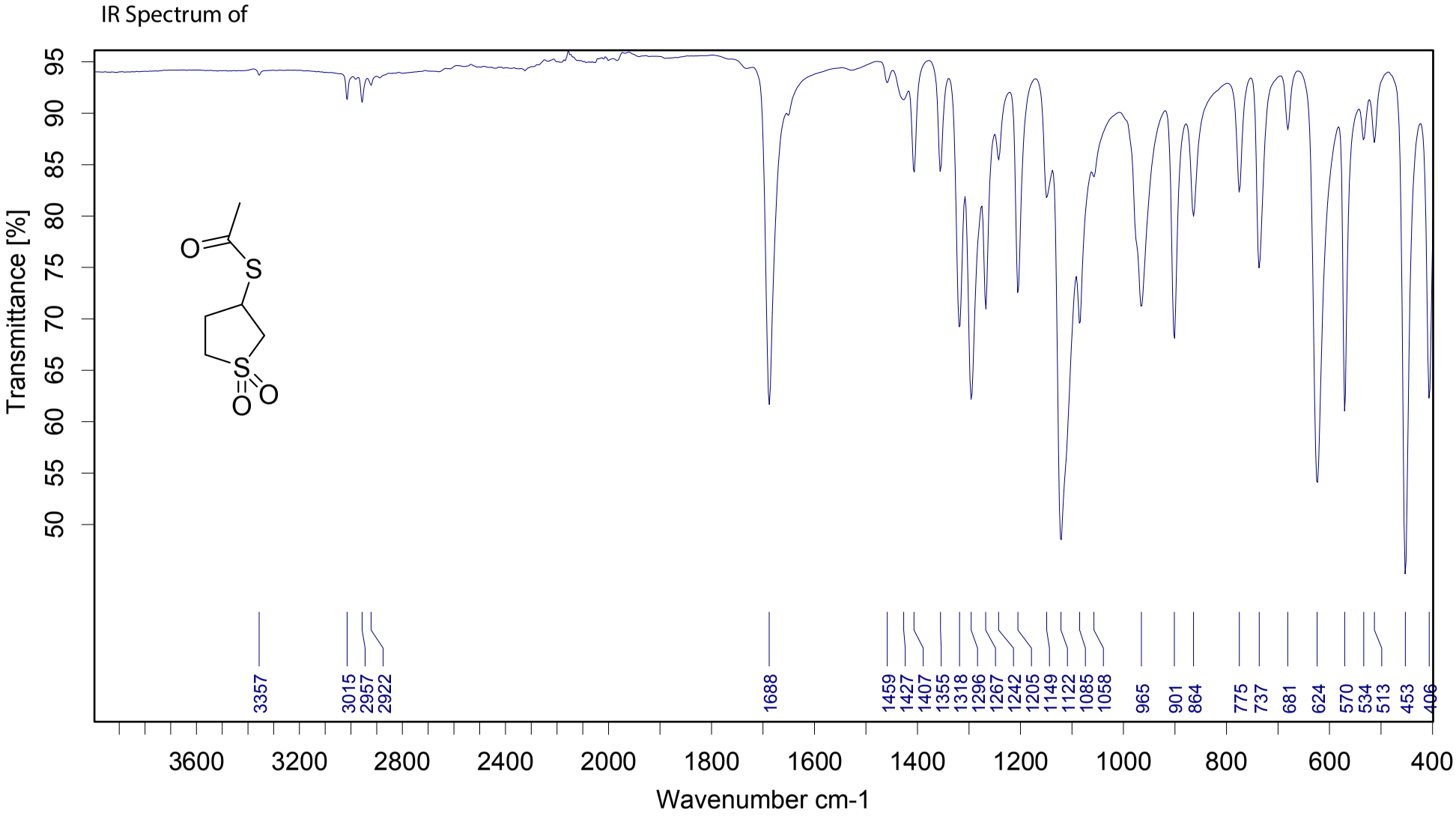

HMBC of
F1 [ppm]
50
100
150
200
10
8
6
4
2
F2 [ppm]

Acquisition Parameter

Source Type	ESI	Ion Polarity	Positive	Set Nebulizer	1.6 Bar
Focus	Not active	Set Capillary	4500 V	Set Dry Heater	200 °C
Scan Begin	50 m/z	Set End Plate Offset	-500 V	Set Dry Gas	8.0 l/min
Scan End	1300 m/z	Set Collision Cell RF	200.0 Vpp	Set Divert Valve	Source






IR Spectrum of
Transmittance [%]
95
90
85
80
75
70
65
60
55
50
O
S
S
O
O
3357
3015
2957
2922
1688
1459
1427
1407
1355
1318
1296
1267
1242
1205
1149
1122
1085
1058
965
901
864
775
737
681
624
570
534
513
453
406
3600
3200
2800
2400
2000
1800
1600
1400
1200
1000
800
600
400
Wavenumber cm-1

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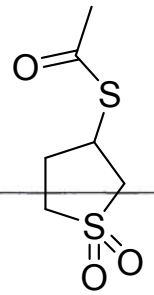
Mikroelementaranalyse



Molekularformel: C6 H10 O3 S2 Mr = 194.28g/mol

Schmelzpunkt: >100°C
gereinigt: UK aus Toluol getrocknet: 72h HV / 24h 40°C HV

Bestimmungen: C H O S

Eingang: 11.04.16 Ausgang: 22.04.16

M-161984 Operator: PK

Berechnete Gewichtsanteile:

[C] 37.09% [H] 5.19% [O] 24.71% [S] 33.01%

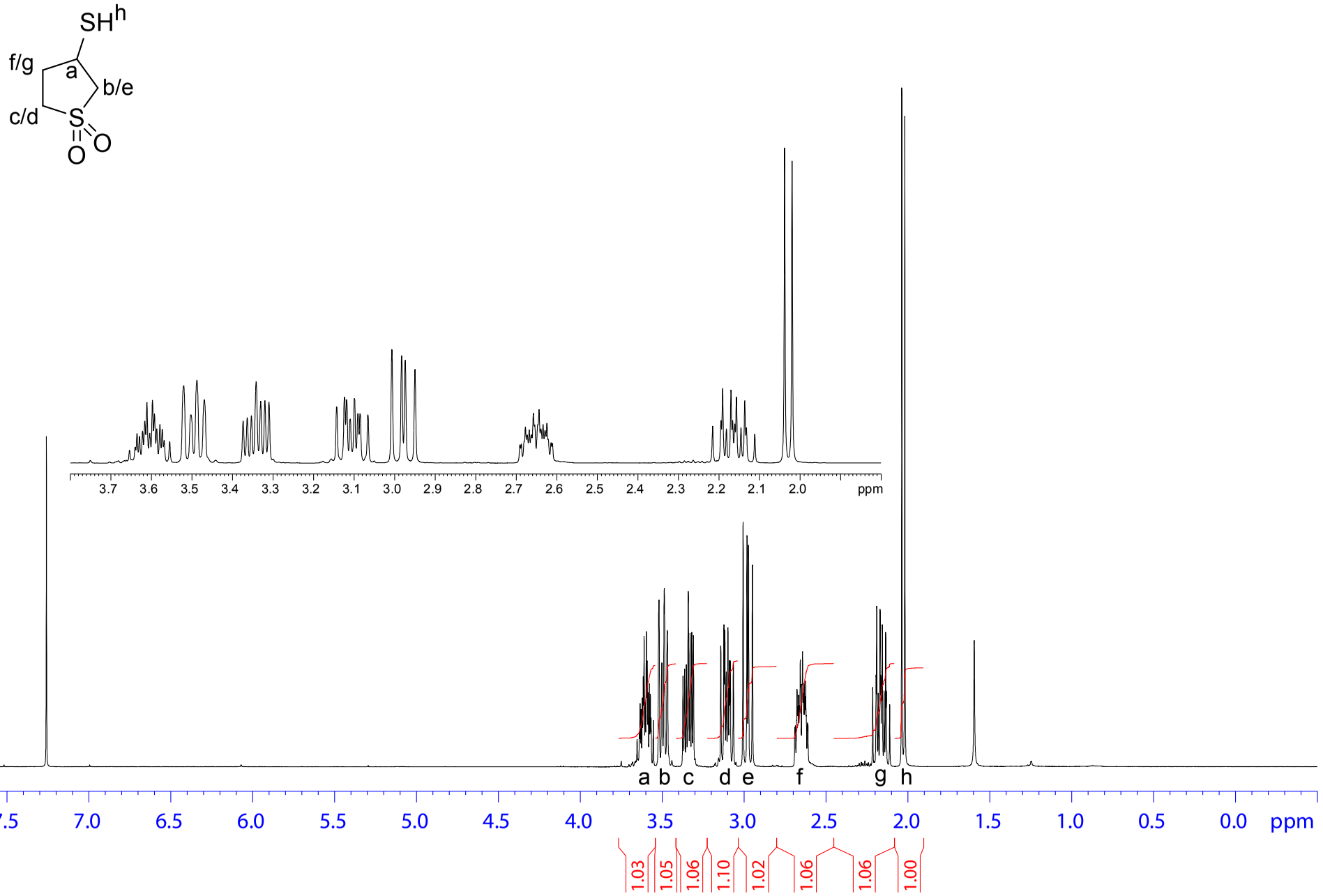
Gefundene Gewichtsanteile:

Einwaage: 0.922mg LECO TruSpec Micro
[C] 37.02% [H] 5.02% 12.04.16

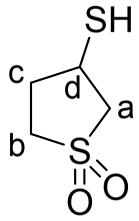
Einwaage: 2.306mg LECO RO-478
[O] 24.64% 22.04.16

Einwaage: 1.564mg LECO CHNS-932
[S] 33.10% 20.04.16

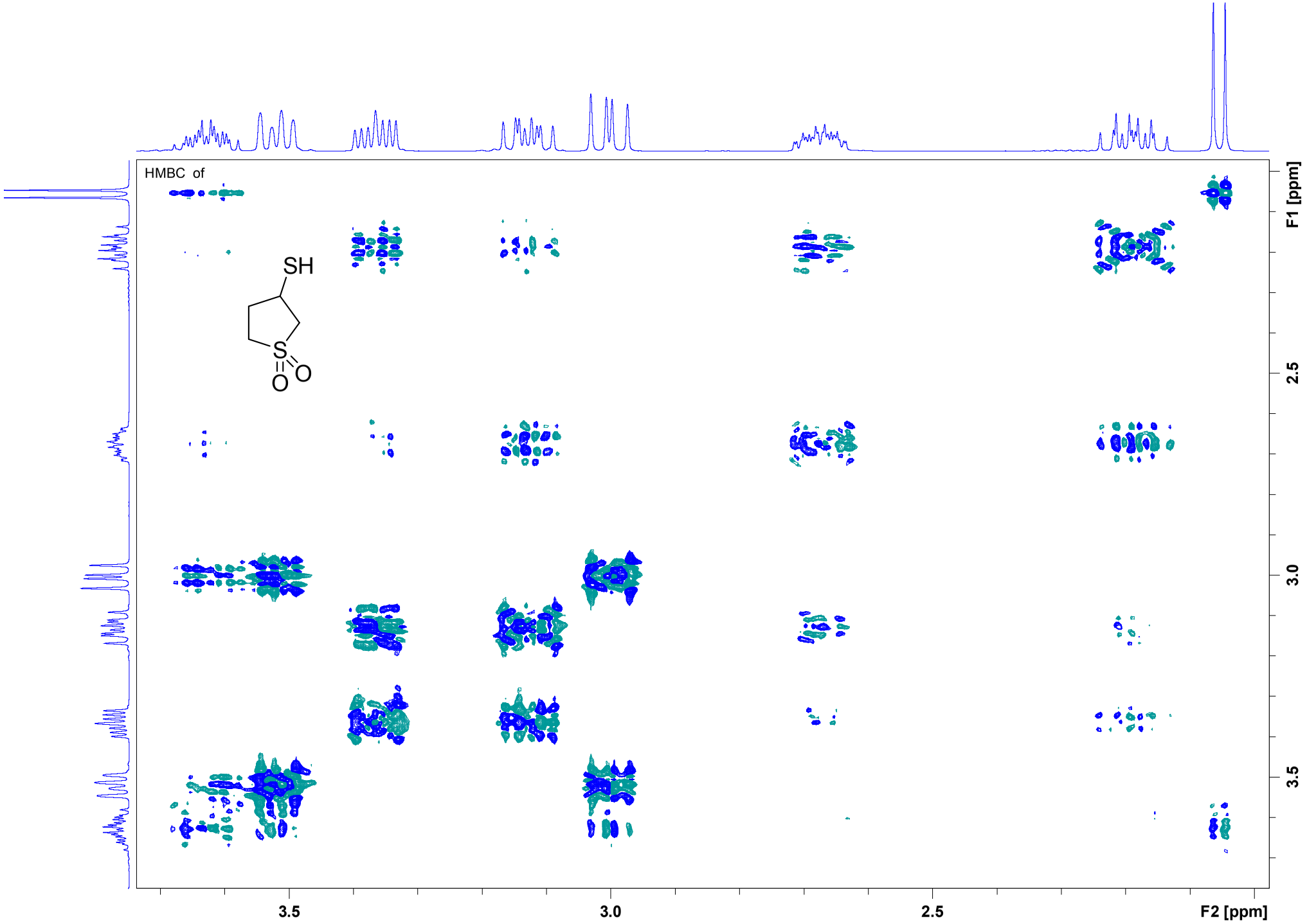
1H NMR of

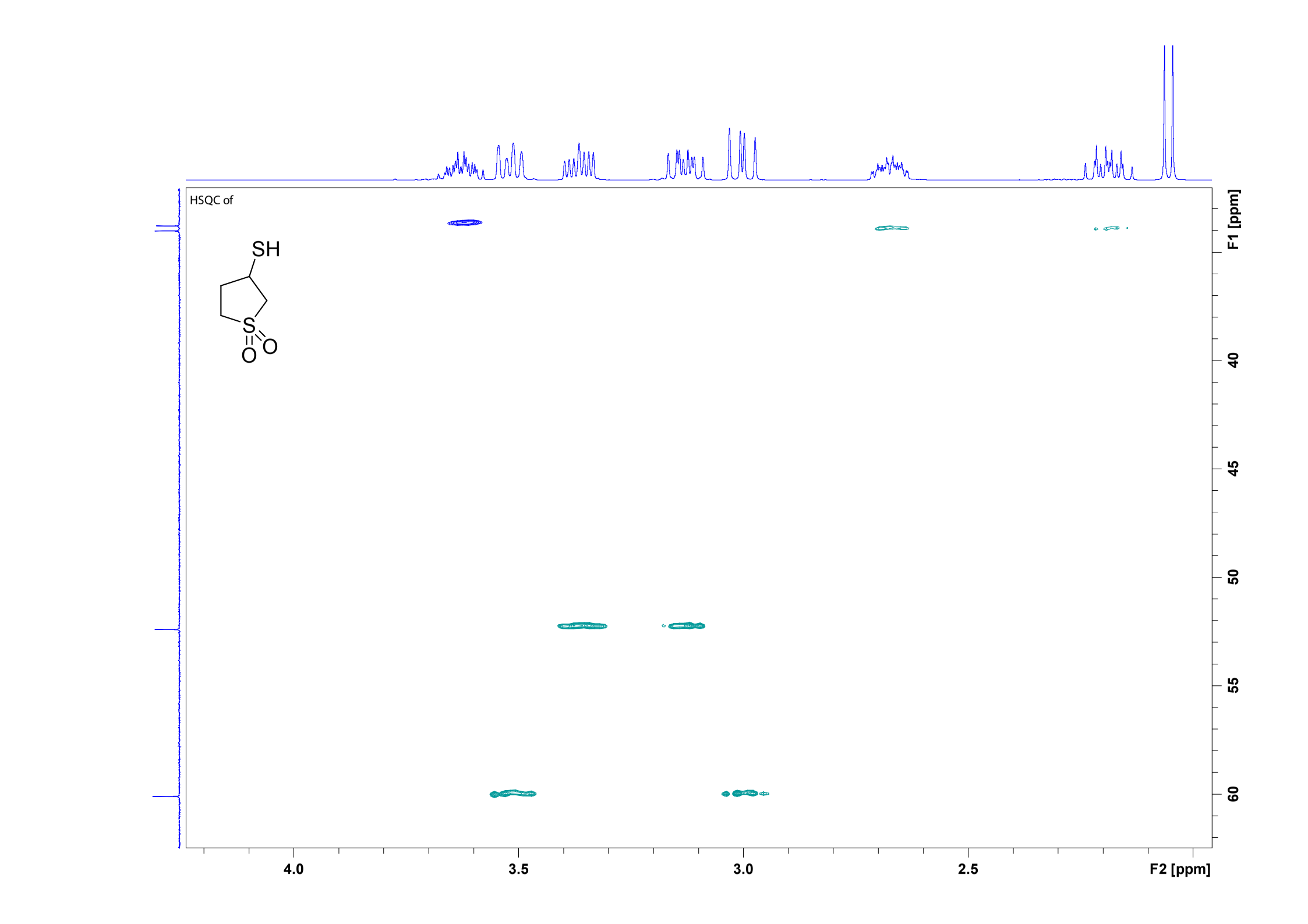

SH
h
f/g
a
b/e
c/d
S
O
O
3.7 3.6 3.5 3.4 3.3 3.2 3.1 3.0 2.9 2.8 2.7 2.6 2.5 2.4 2.3 2.2 2.1 2.0 ppm
a b c d e f g h
7.5 7.0 6.5 6.0 5.5 5.0 4.5 4.0 3.5 3.0 2.5 2.0 1.5 1.0 0.5 0.0 ppm
1.03 1.05 1.06 1.10 1.02 1.06 1.06 1.00

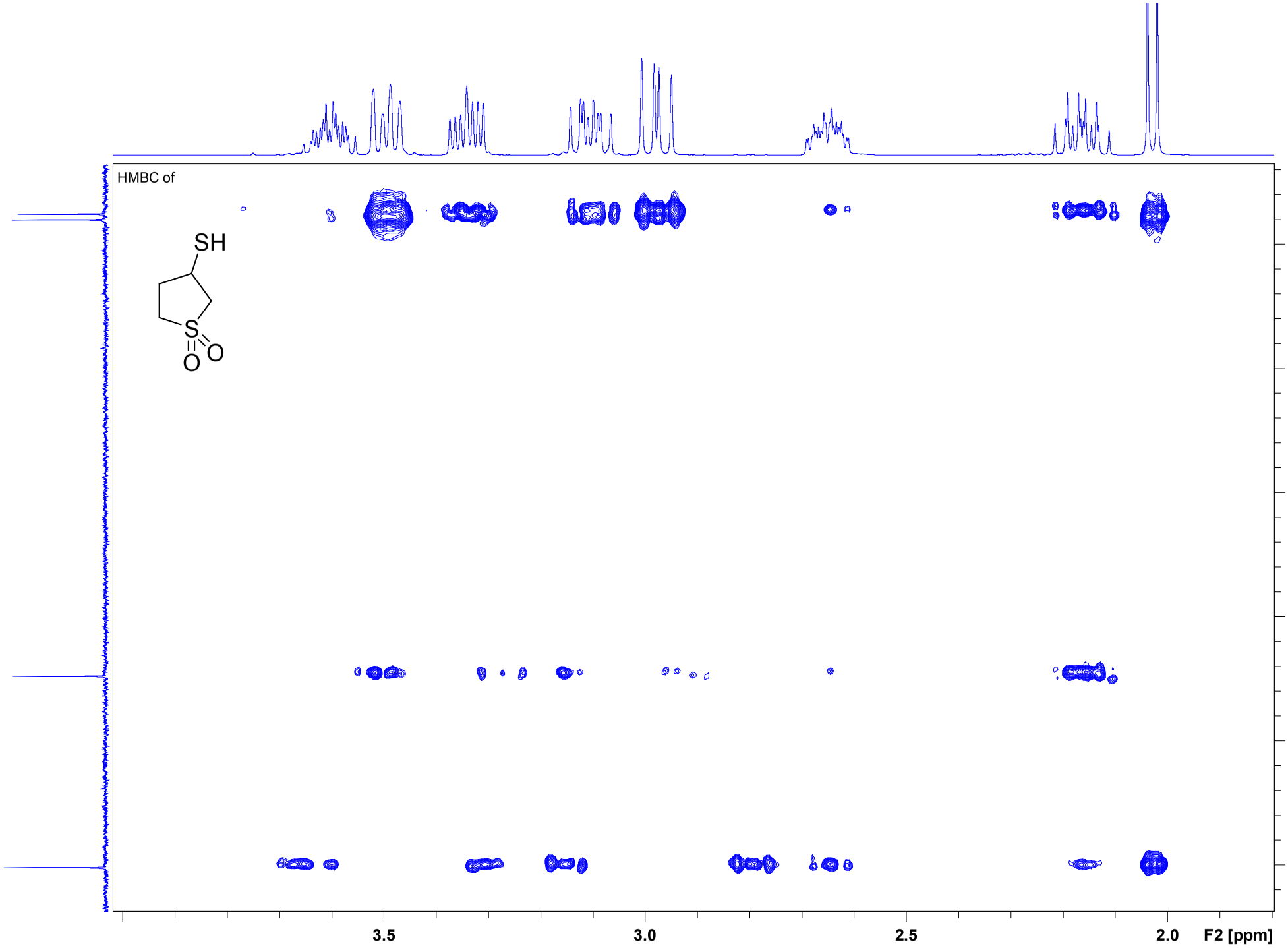
13C NMR of


SH
c
d
a
b
S
O
O

77.48
77.16
76.84
60.09
52.38
34.00
33.77
a
b
c
d
60
55
50
45
40
35
ppm
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

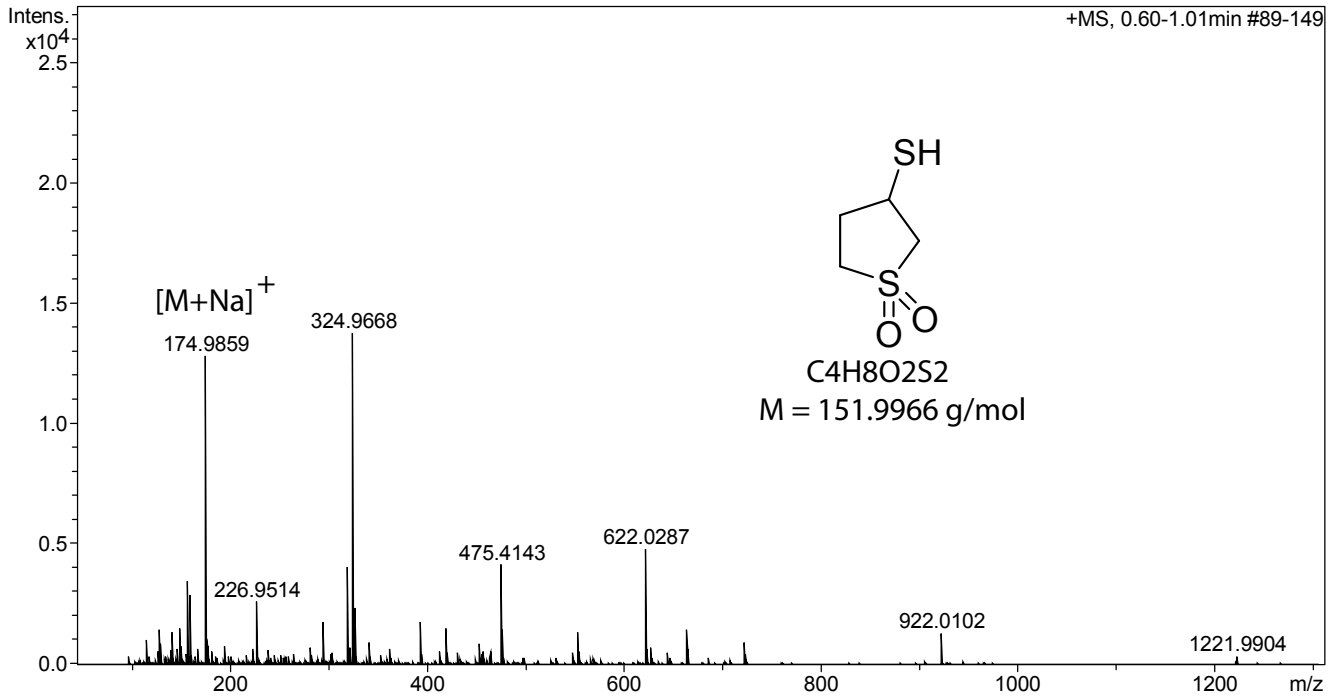

HMBC of
SH
S
O
O
F1 [ppm]
2.5
3.0
3.5
3.5
3.0
2.5
F2 [ppm]

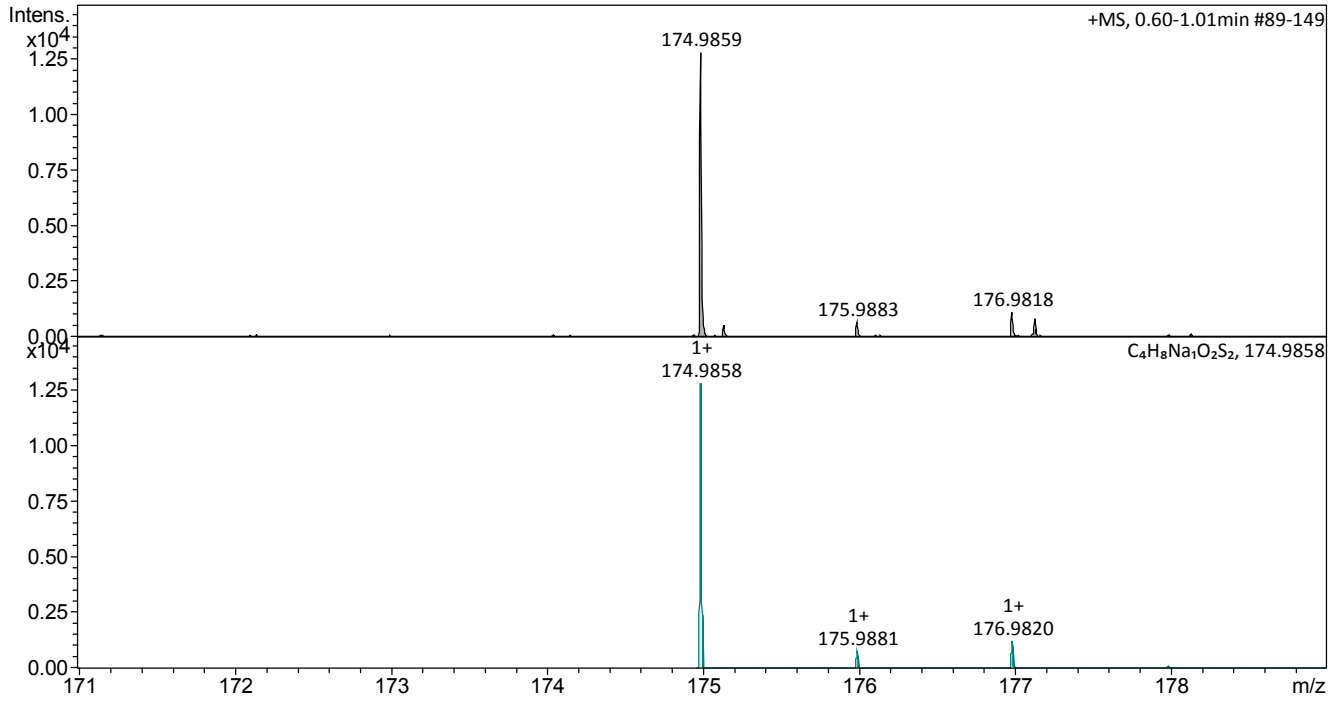

HSQC of
SH
S
O
O
F1 [ppm]
40
45
50
55
60
4.0
3.5
3.0
2.5
F2 [ppm]

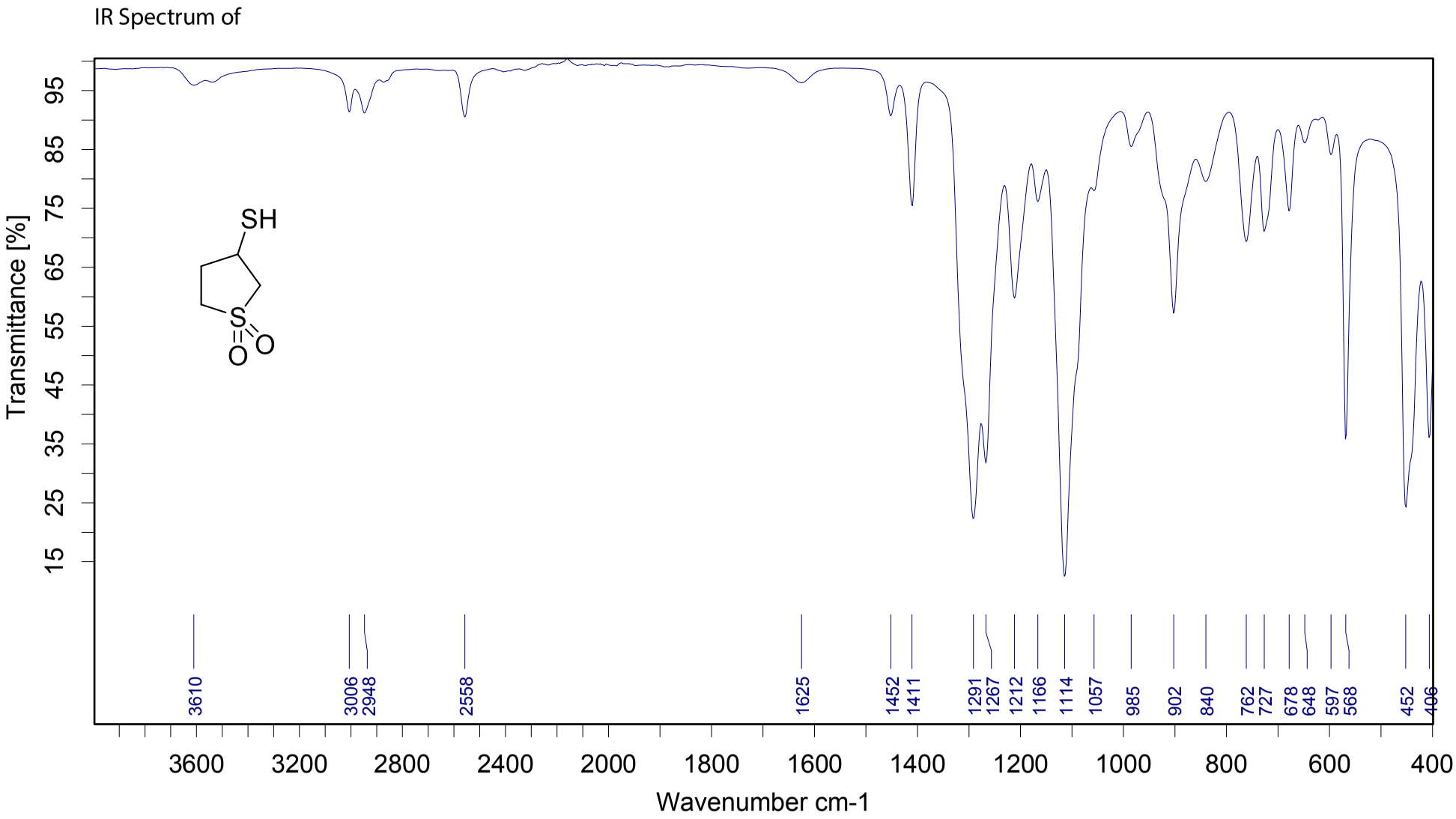

HMBC of
SH
S
O
O
F1 [ppm]
40
45
50
55
60
3.5
3.0
2.5
2.0
F2 [ppm]

Acquisition Parameter

Source Type	ESI	Ion Polarity	Positive	Set Nebulizer	1.6 Bar
Focus	Not active	Set Capillary	4500 V	Set Dry Heater	200 °C
Scan Begin	50 m/z	Set End Plate Offset	-500 V	Set Dry Gas	8.0 l/min
Scan End	1300 m/z	Set Collision Cell RF	200.0 Vpp	Set Divert Valve	Source






IR Spectrum of
Transmittance [%]
15
25
35
45
55
65
75
85
95
SH
S
O
O
3610
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2948
2558
1625
1452
1411
1291
1267
1212
1166
1114
1057
985
902
840
762
727
678
648
597
568
452
406
3600
3200
2800
2400
2000
1800
1600
1400
1200
1000
800
600
400
Wavenumber cm-1

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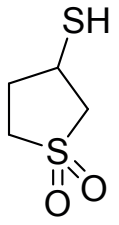
Mikroelementaranalyse



Molekularformel: C4 H8 O2 S2 Mr = 152.24g/mol

Siedepunkt: 182°C/1.2mbar
gereinigt: Dest. getrocknet: ????

Bestimmungen: C H O S

Eingang: 11.04.16 Ausgang: 22.04.16

M-161985 Operator: SM

Berechnete Gewichtsanteile:

[C] 31.56% [H] 5.30% [O] 21.02% [S] 42.13%

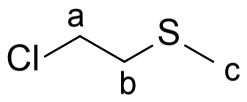
Gefundene Gewichtsanteile:

Einwaage: 2.415mg LECO CHNS-932
[C] 31.42% [H] 5.32% 12.04.16

Einwaage: 2.004mg LECO RO-478
[O] 21.25% 22.04.16

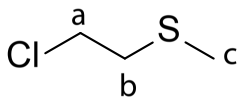
Einwaage: 1.890mg LECO CHNS-932
[S] 42.29% 20.04.16

1H NMR of


a
Cl
S
c
b

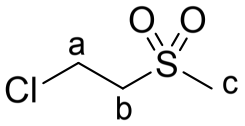
7.260
3.669
3.650
3.630
2.859
2.839
2.820
2.162
CHCl3
H2O
a
b
c
11
10
9
8
7
6
5
4
3
2
1
0
ppm
2.00
2.01
3.01

13C NMR of


a
Cl
S
c
b

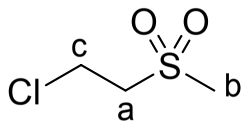
77.48
77.16
76.84
42.78
36.34
15.89
CDCl3
a
b
c
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm

1H NMR of

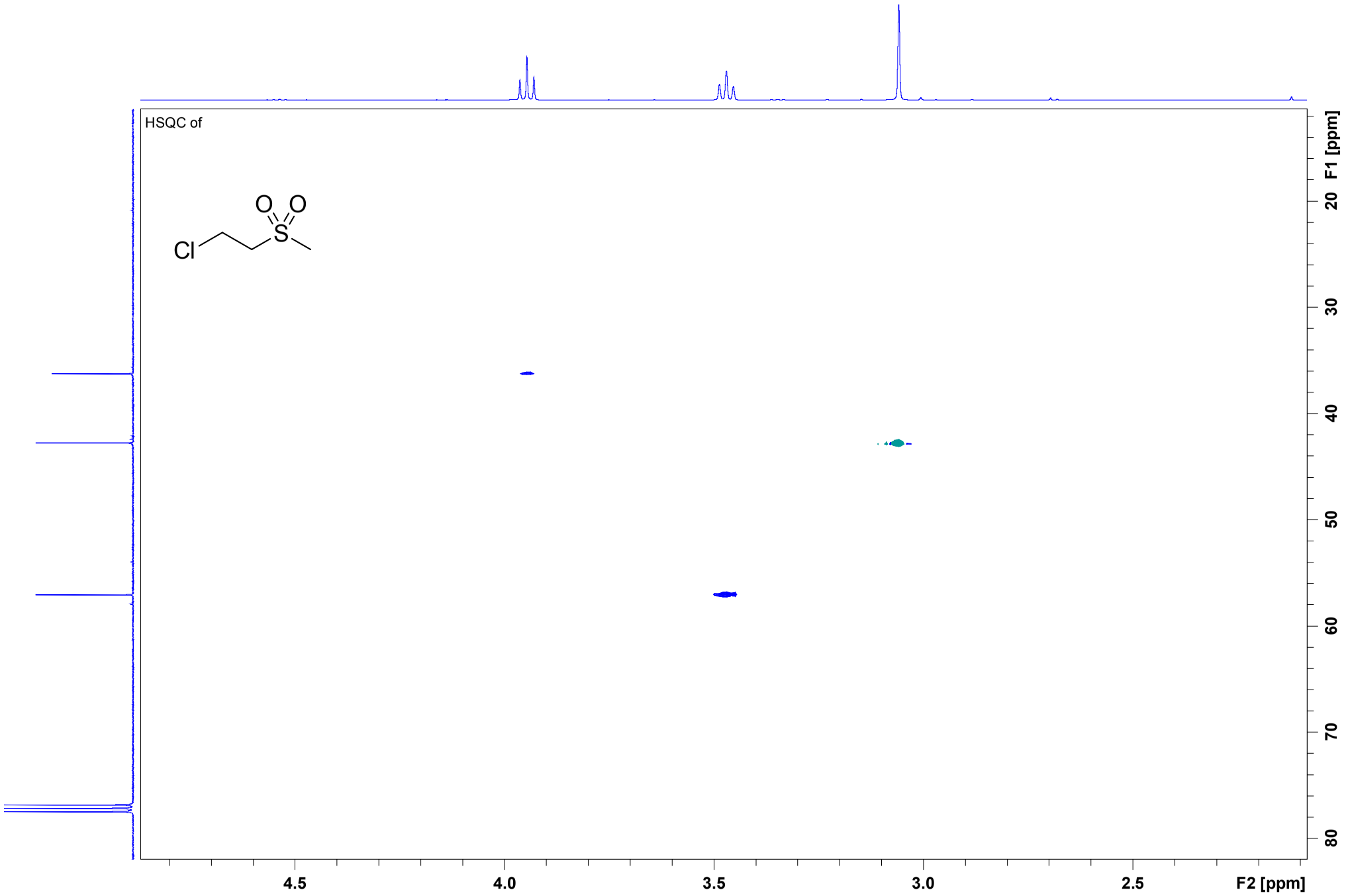

a
O
O
S
Cl
b
c

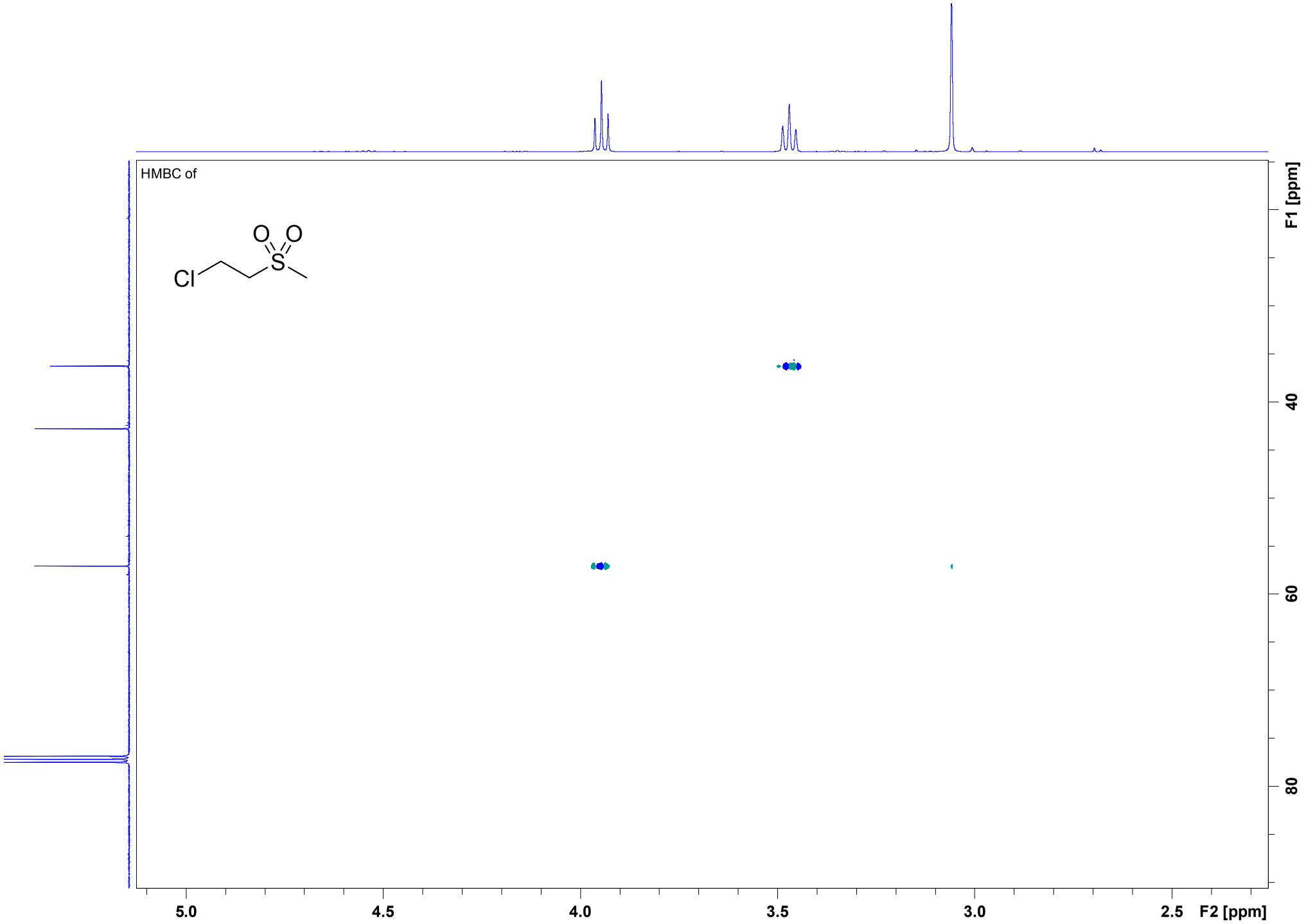
3.945
3.928
3.912
3.464
3.447
3.430
3.039
CHCl3
a
b
c
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
ppm
2.01
2.00
3.04

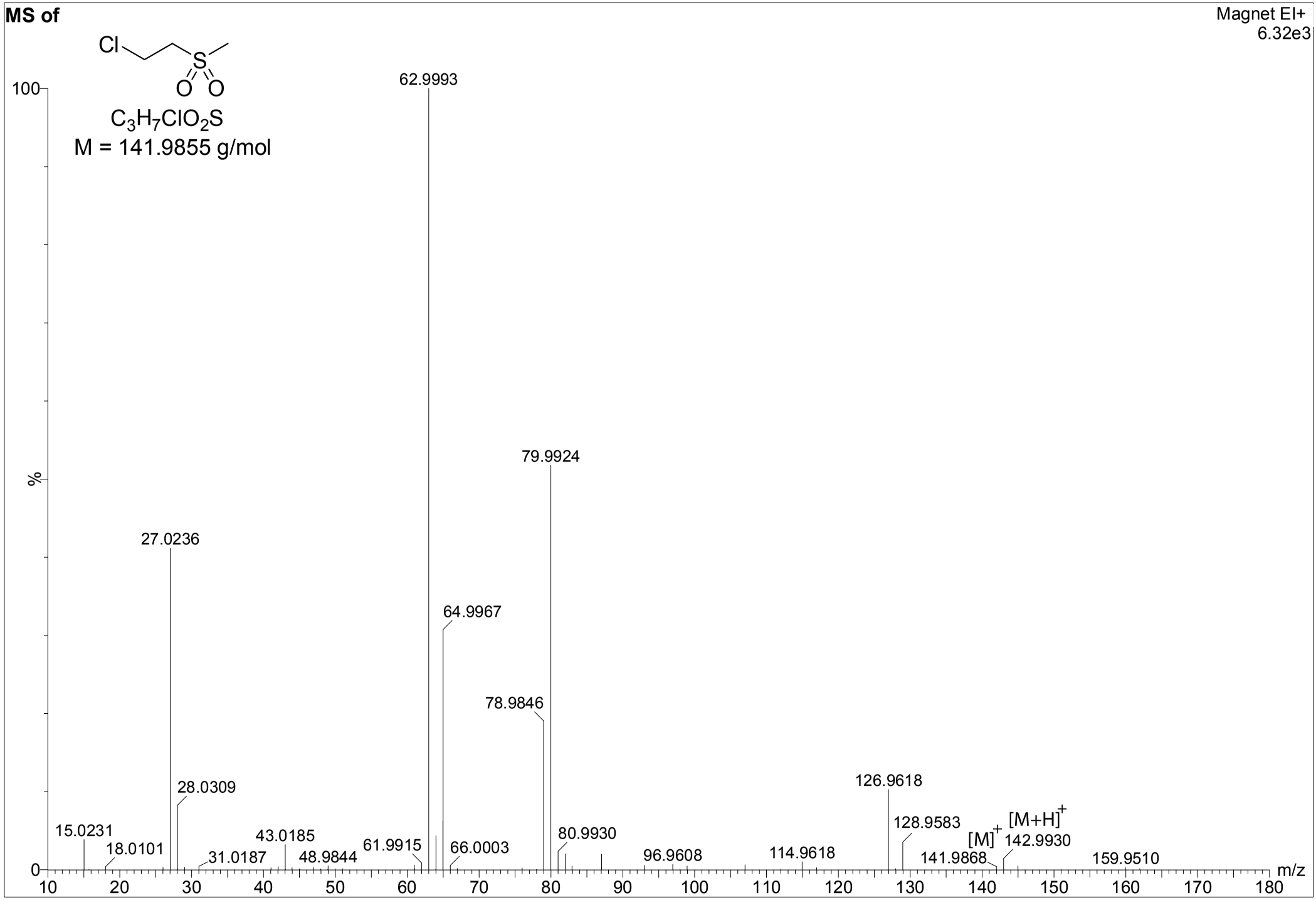
13C NMR of

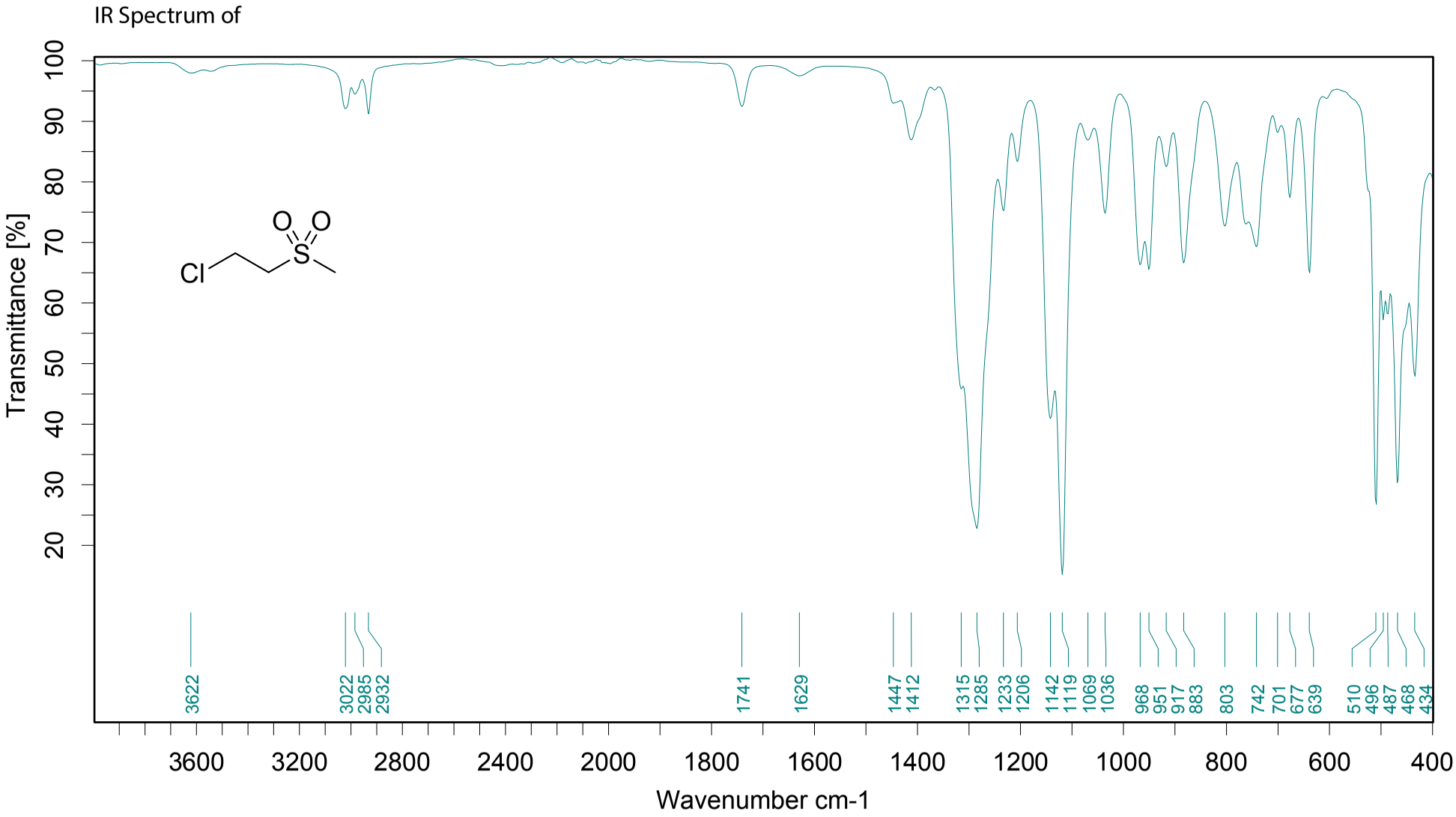

O
O
c
S
Cl
b
a

77.48
77.16
76.84
57.06
42.76
36.24
a
b
c
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
ppm


HSQC of
O
O
S
Cl
F1 [ppm]
20
30
40
50
60
70
80
4.5
4.0
3.5
3.0
2.5
F2 [ppm]


HMBC of
O
O
S
Cl
F1 [ppm]
40
60
80
5.0
4.5
4.0
3.5
3.0
2.5
F2 [ppm]


MS of
Magnet EI+
6.32e3
Cl
S
O O
$C_3H_7ClO_2S$
M = 141.9855 g/mol
100
%
0
62.9993
79.9924
27.0236
64.9967
78.9846
28.0309
126.9618
15.0231
18.0101
43.0185
31.0187
48.9844
61.9915
66.0003
80.9930
96.9608
114.9618
128.9583
[M]+
[M+H]+
142.9930
141.9868
159.9510
m/z
10 20 30 40 50 60 70 80 90 100 110 120 130 140 150 160 170 180


IR Spectrum of
Transmittance [%]
100
90
80
70
60
50
40
30
20
O
O
S
Cl
3622
3022
2985
2932
1741
1629
1447
1412
1315
1285
1233
1206
1142
1119
1069
1036
968
951
917
883
803
742
701
677
639
510
496
487
468
434
3600
3200
2800
2400
2000
1800
1600
1400
1200
1000
800
600
400
Wavenumber cm-1

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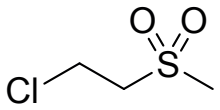
Laboratorium für Organische Chemie
ETH-Hönggerberg - HCI E304

Mikroelementaranalyse



Molekularformel: C3 H7 O2 S Cl Mr = 142.61g/mol

Siedepunkt: 110°C, 0.15mbar
gereinigt: Dest. getrocknet:

Bestimmungen: C H O S

Eingang: 14.06.16 Ausgang: 22.06.16

M-162423 Operator: PK

Berechnete Gewichtsanteile:

[C] 25.27% [H] 4.95% [O] 22.44% [S] 22.49% [Cl] 24.86%

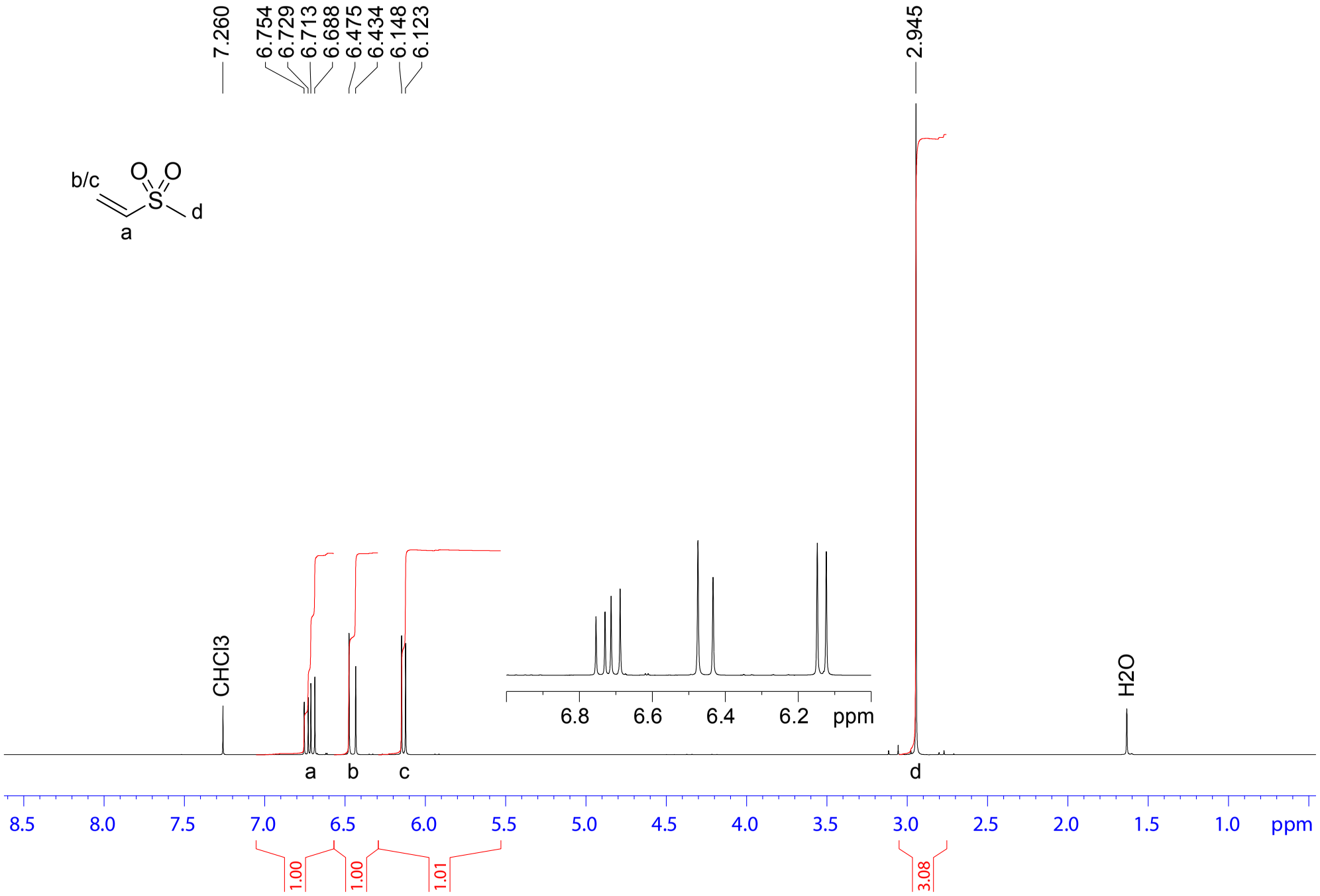
Gefundene Gewichtsanteile:

Einwaage: 1.022mg LECO TruSpec Micro
[C] 25.15% [H] 4.97% 14.06.16

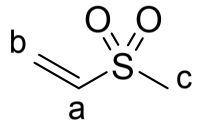
Einwaage: 1.732mg LECO RO-478
[O] 22.73% 22.06.16

Einwaage: 1.945mg LECO CHNS-932
[S] 22.20% 16.06.16

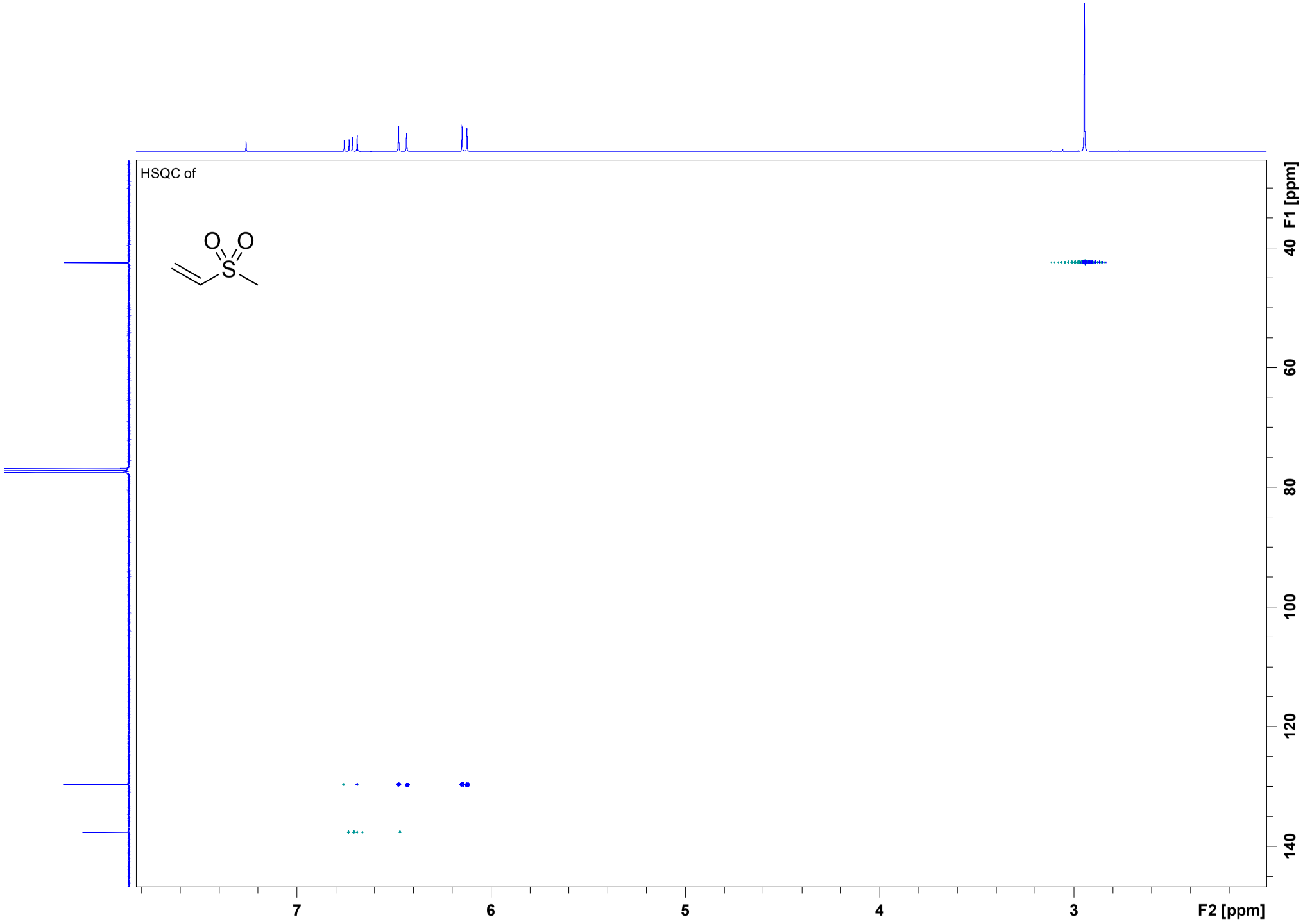
1H NMR of

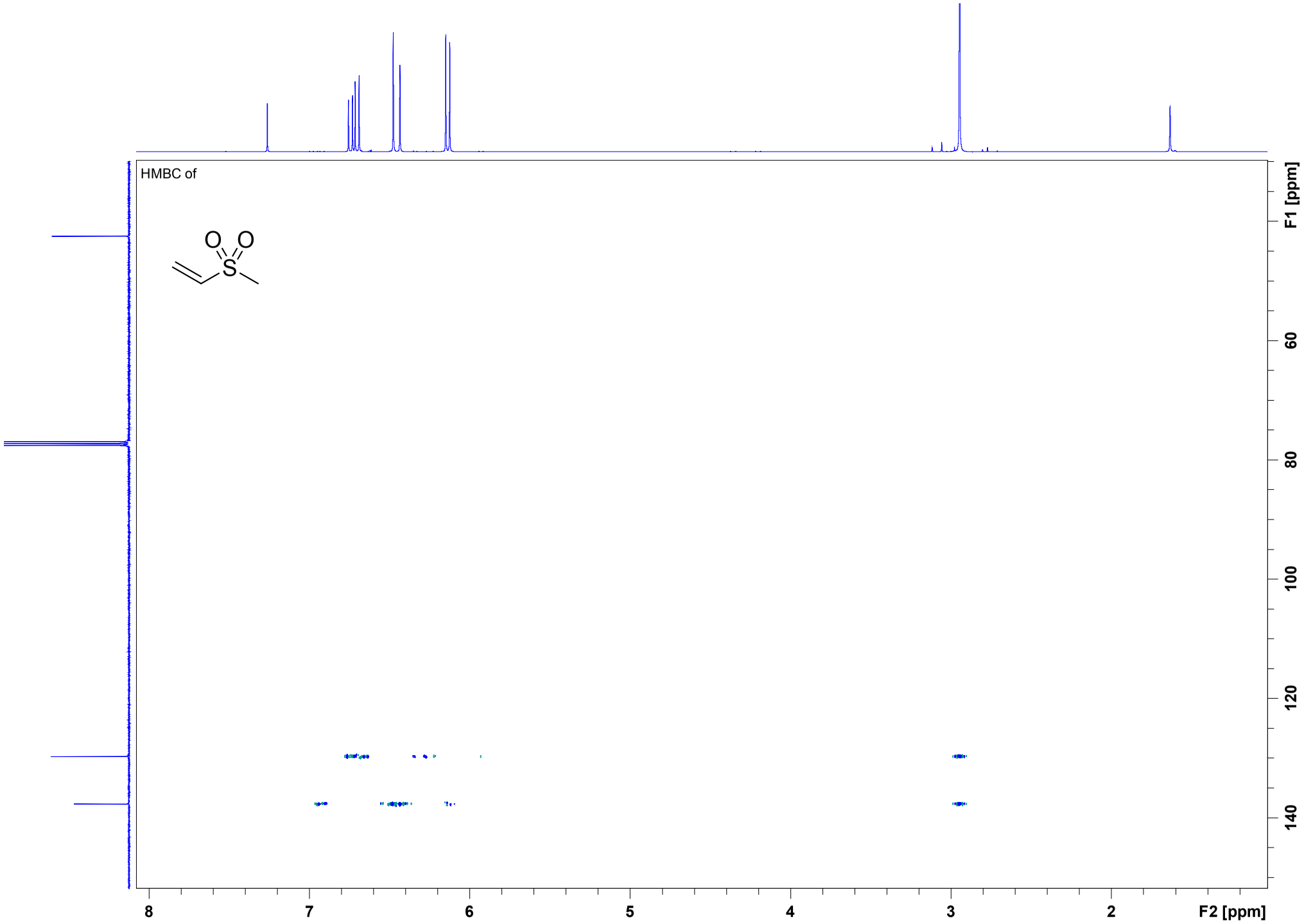

7.260
6.754
6.729
6.713
6.688
6.475
6.434
6.148
6.123
2.945
b/c
O
O
S
d
a
CHCl3
H2O
a
b
c
d
6.8
6.6
6.4
6.2
ppm
8.5
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
ppm
1.00
1.00
1.01
3.08

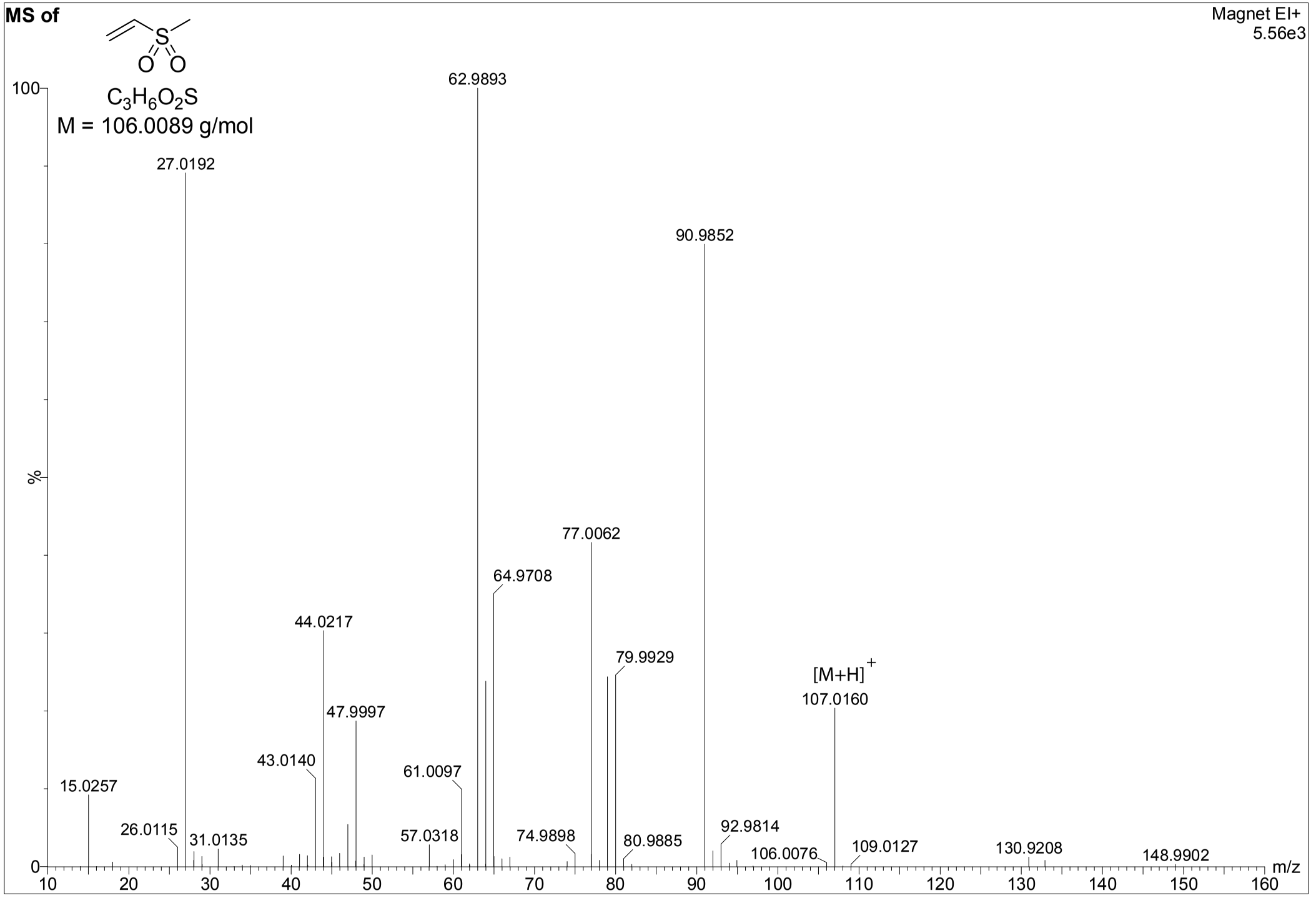
13C NMR of

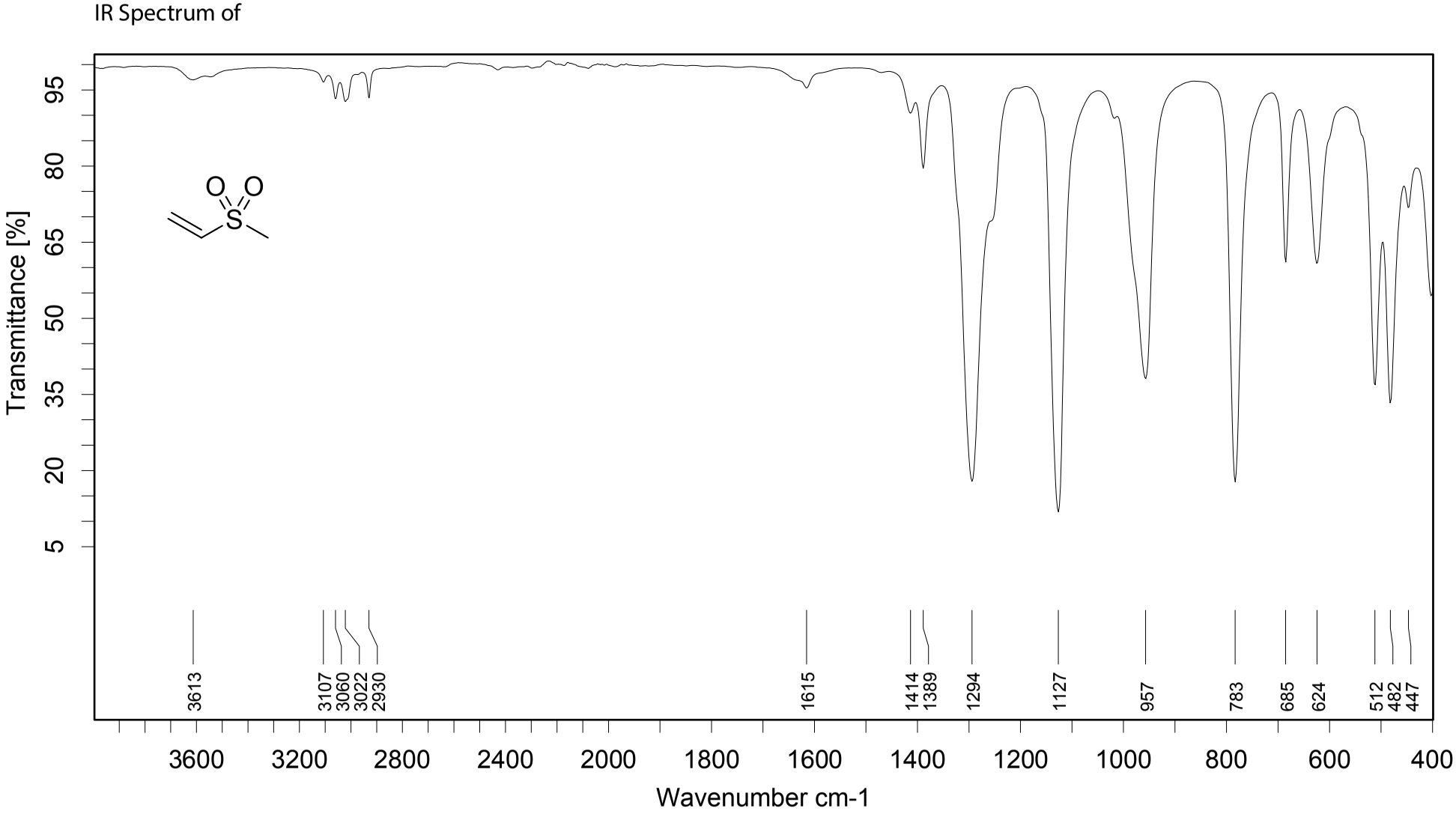

O
O
S
b
c
a

137.60
129.66
77.48
77.16
76.84
42.40
CDCl3
a
b
c
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm


HSQC of
O
O
S
F1 [ppm]
40
60
80
100
120
140
7
6
5
4
3
F2 [ppm]


HMBC of
O
O
S
F1 [ppm]
60
80
100
120
140
8
7
6
5
4
3
2
F2 [ppm]


MS of
Magnet EI+
5.56e3
$C_3H_6O_2S$
M = 106.0089 g/mol
100
%
0
62.9893
27.0192
90.9852
77.0062
64.9708
44.0217
79.9929
[M+H]+
107.0160
47.9997
43.0140
61.0097
15.0257
26.0115
31.0135
57.0318
74.9898
80.9885
92.9814
106.0076
109.0127
130.9208
148.9902
m/z
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160


IR Spectrum of
Transmittance [%]
95
80
65
50
35
20
5
O
O
S
3613
3107
3060
3022
2930
1615
1414
1389
1294
1127
957
783
685
624
512
482
447
3600
3200
2800
2400
2000
1800
1600
1400
1200
1000
800
600
400
Wavenumber cm-1

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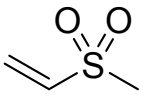


Mikroelementaranalyse

Molekularformel: C3 H6 O2 S Mr = 106.15g/mol

Siedepunkt: ?
gereinigt: Dest. getrocknet: 75°C, 0.15mbar

Bestimmungen: C H O S

Eingang: 14.06.16 Ausgang: 22.06.16

M-162424 Operator: SM

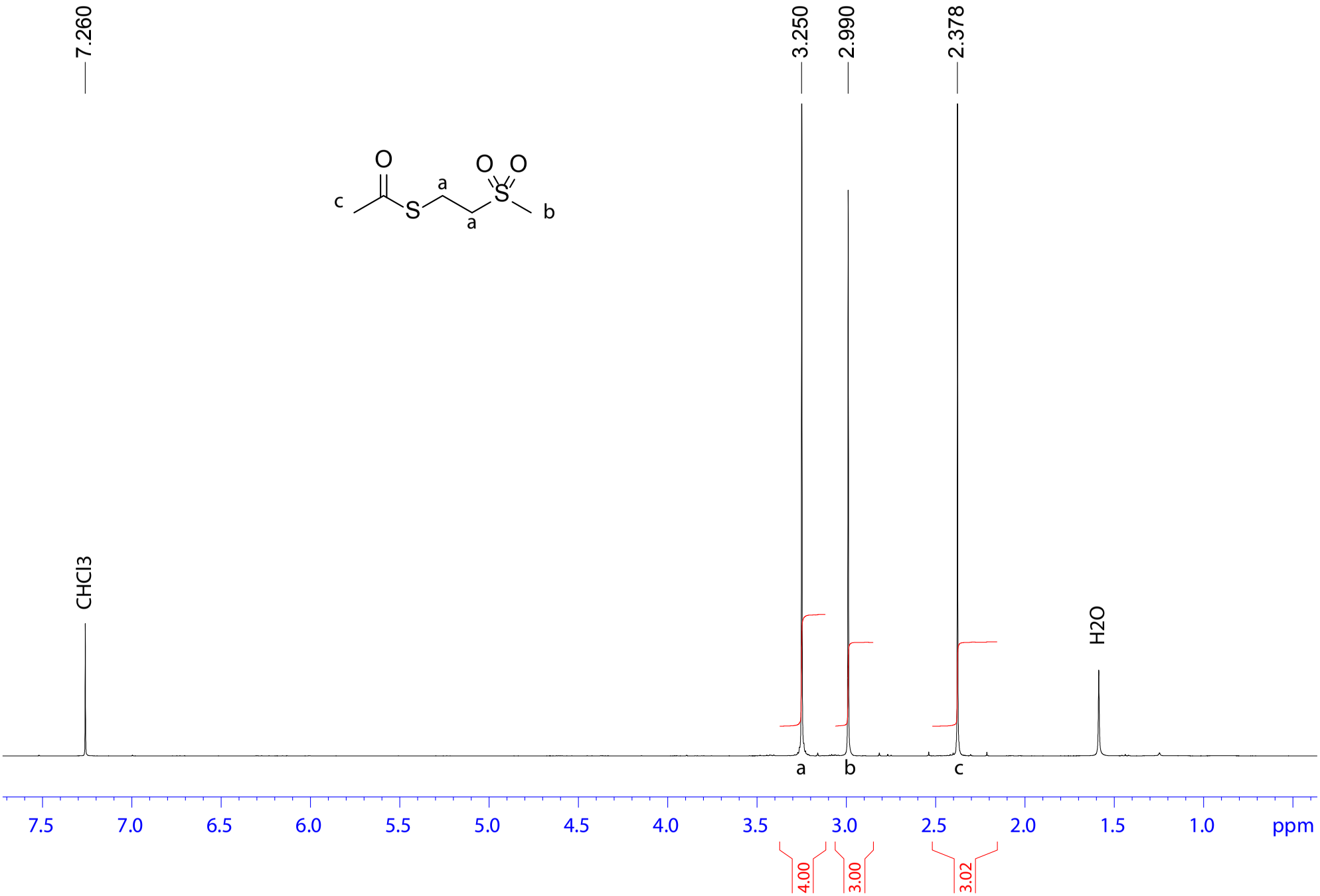
Berechnete Gewichtsanteile:

[C] 33.95% [H] 5.70% [O] 30.15% [S] 30.21%

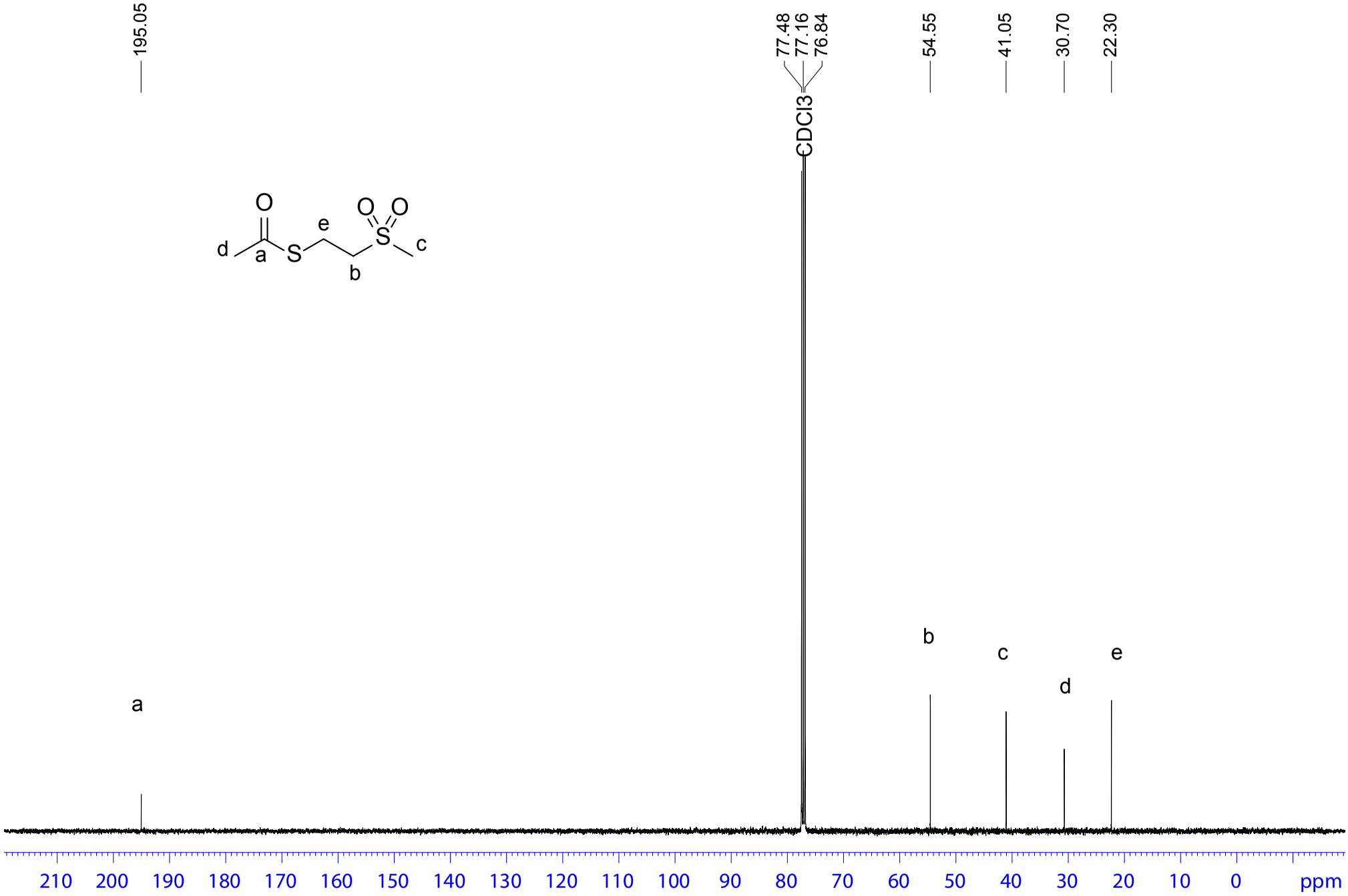
Gefundene Gewichtsanteile:

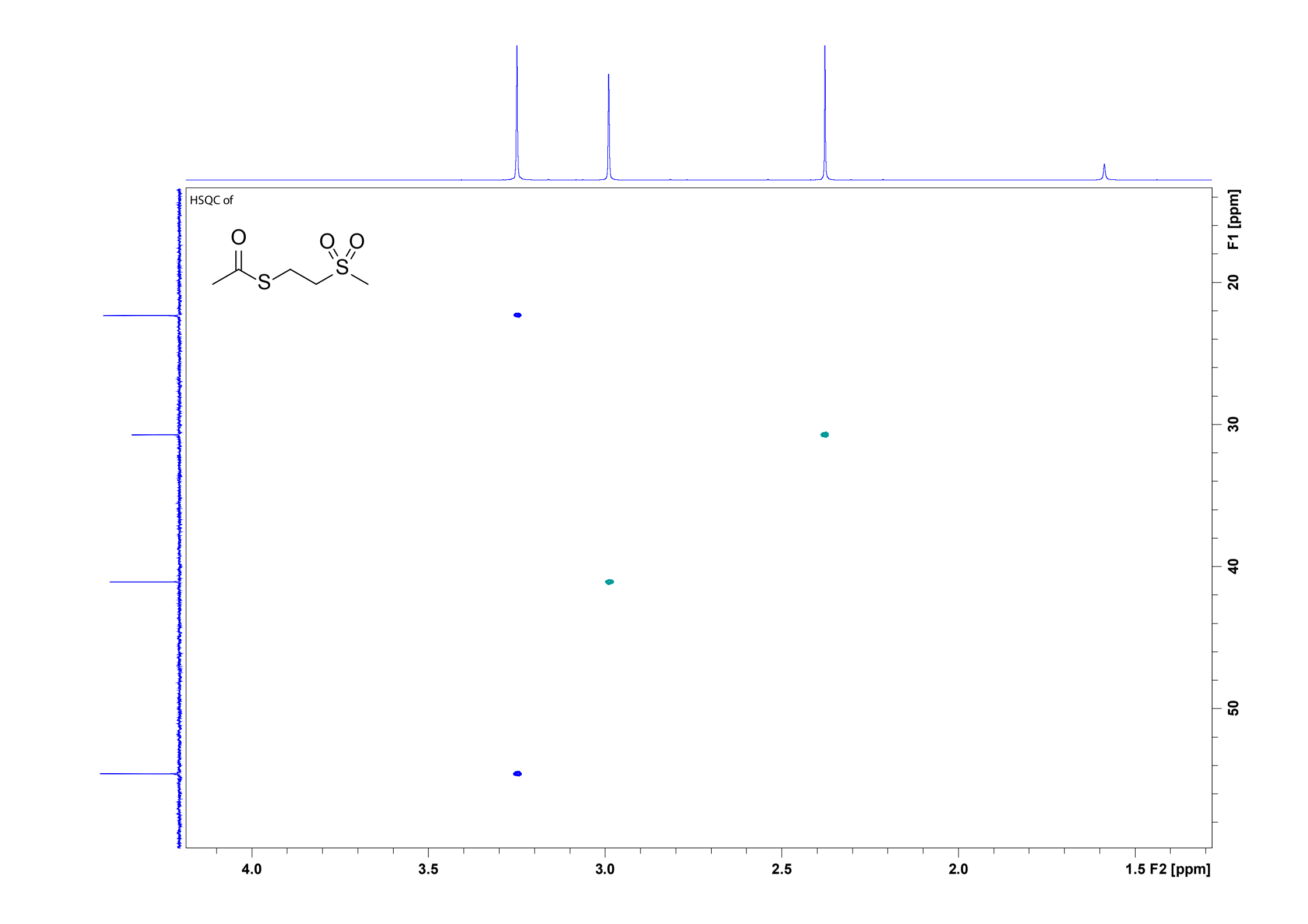
Einwaage: 1.897mg **[C] 32.98% [H] 6.16%**	LECO CHNS-932	14.06.16
Einwaage: 2.180mg **[C] 33.17% [H] 6.24%**	LECO CHNS-932	14.06.16
Einwaage: 2.103mg **[O] 30.74%**	LECO RO-478	22.06.16
Einwaage: 1.967mg **[O] 30.82%**	LECO RO-478	22.06.16
Einwaage: 1.341mg **[S] 29.79%**	LECO CHNS-932	16.06.16
Einwaage: 1.567mg **[S] 29.67%**	LECO CHNS-932	16.06.16

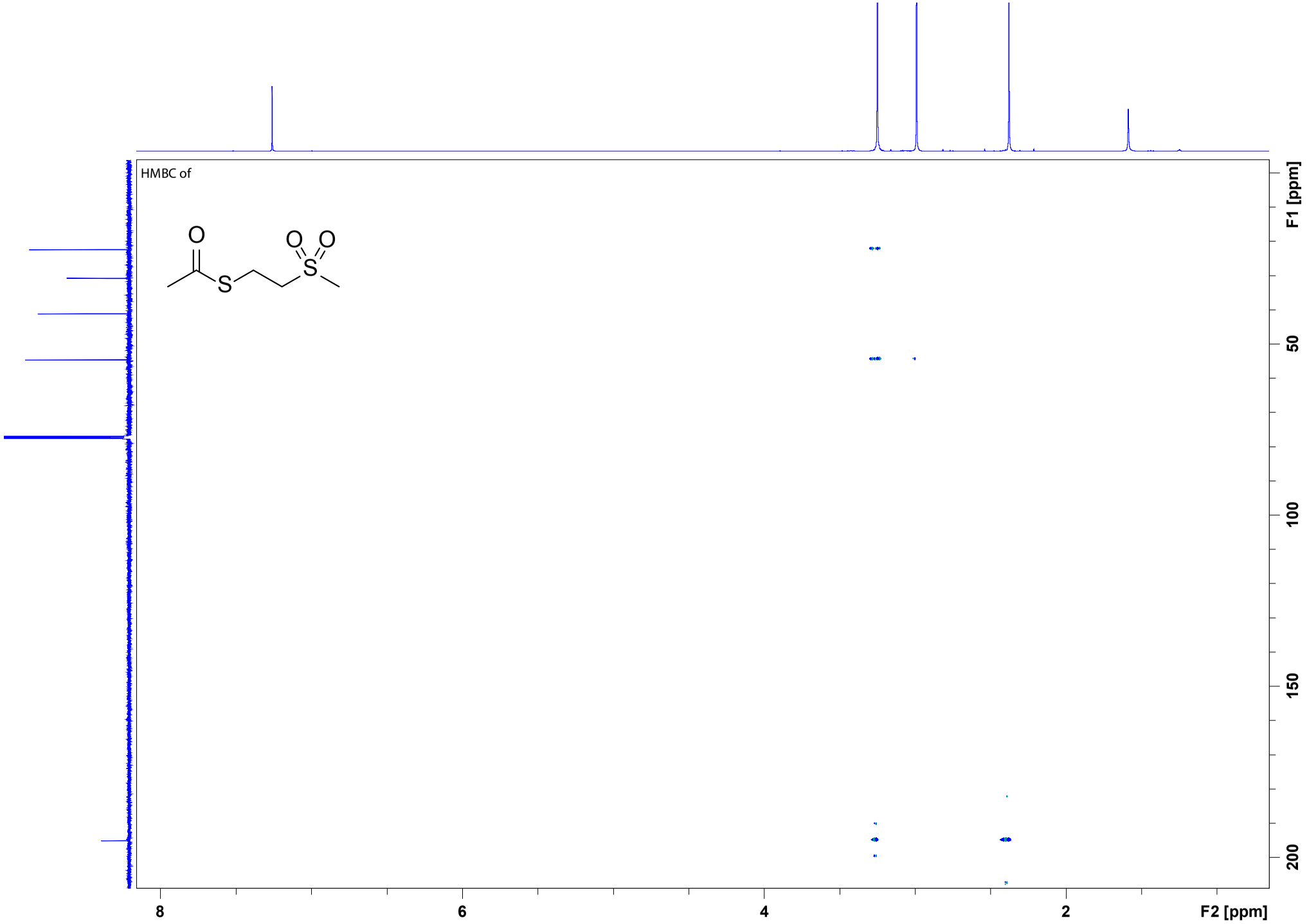
1H NMR of


7.260
3.250
2.990
2.378
CHCl3
H2O
a
b
c
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
ppm
4.00
3.00
3.02

13C NMR of

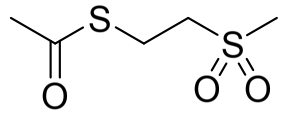

195.05
77.48
77.16
76.84
CDCl3
54.55
41.05
30.70
22.30
O
O
O
S
S
d
a
e
b
c
a
b
c
d
e
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm


HSQC of
O
S
O
O
S
4.0
3.5
3.0
2.5
2.0
1.5 F2 [ppm]
F1 [ppm]
20
30
40
50

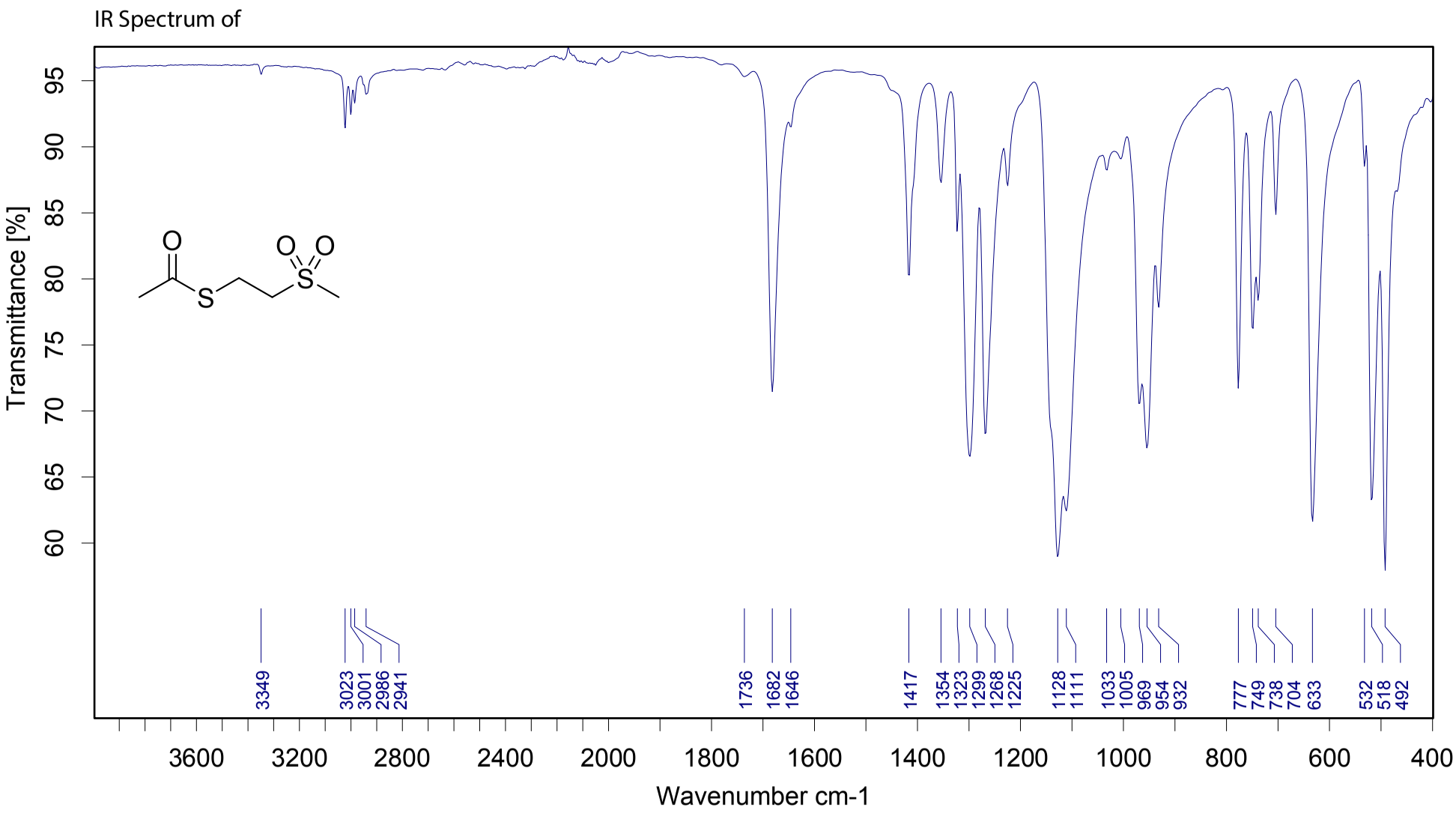

HMBC of
O
S
O
O
S
F1 [ppm]
50
100
150
200
8
6
4
2
F2 [ppm]

MS of

Magnet EI+
2.35e3



$C_5H_{10}O_3S_2$
M = 182.0071 g/mol


IR Spectrum of
Transmittance [%]
95
90
85
80
75
70
65
60
3349
3023
3001
2986
2941
1736
1682
1646
1417
1354
1323
1299
1268
1225
1128
1111
1033
1005
969
954
932
777
749
738
704
633
532
518
492
3600
3200
2800
2400
2000
1800
1600
1400
1200
1000
800
600
400
Wavenumber cm-1

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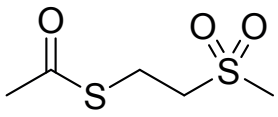


Mikroelementaranalyse

Molekularformel: C5 H10 O3 S2 Mr = 182.26g/mol

Schmelzpunkt: ?
gereinigt: chromat., UK getrocknet: 18h HV

Bestimmungen: C H O S

Eingang: 14.06.16 Ausgang: 22.06.16

M-162428 Operator: PK

Berechnete Gewichtsanteile:

[C] 32.95% [H] 5.53% [O] 26.33% [S] 35.19%

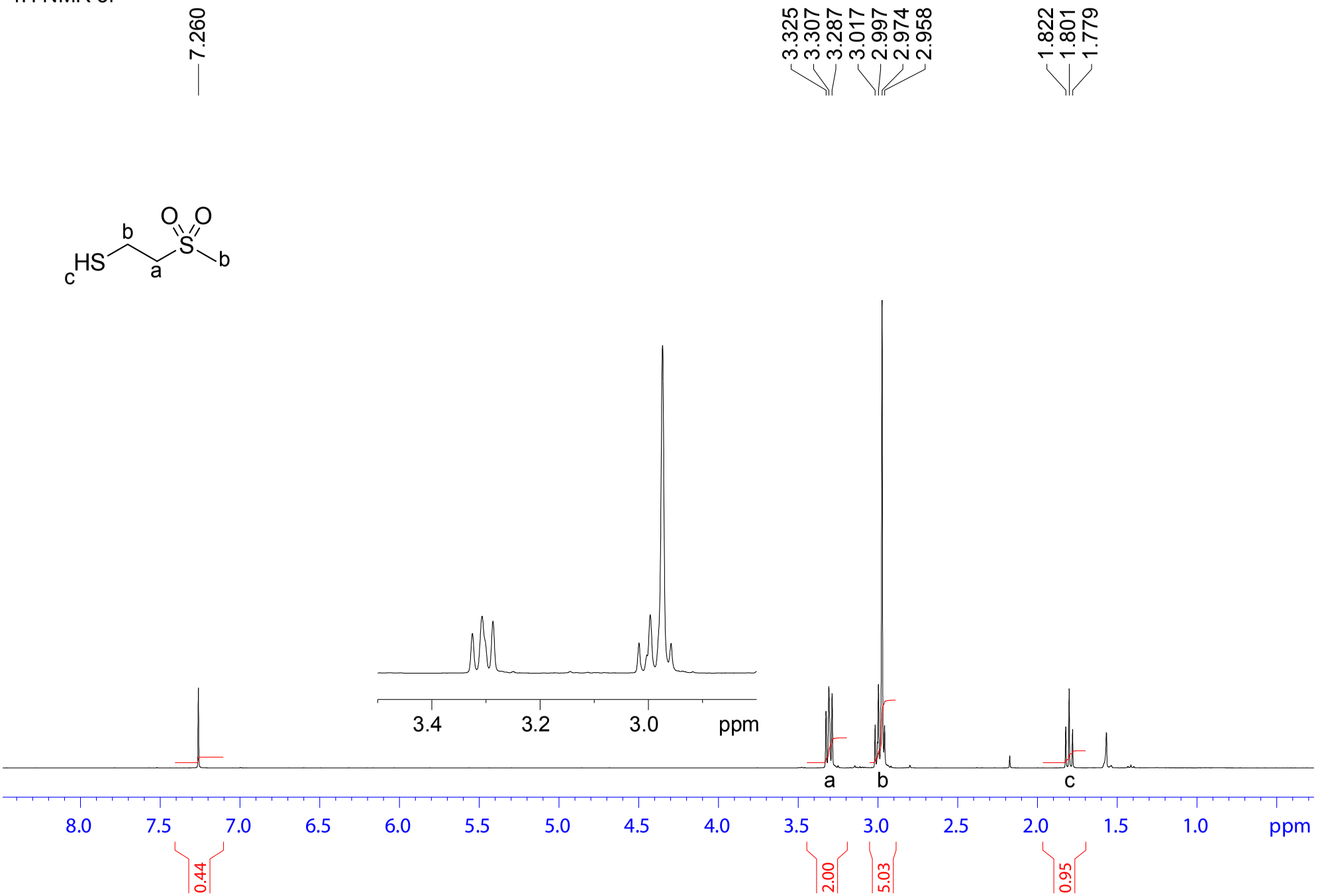
Gefundene Gewichtsanteile:

Einwaage: 0.938mg LECO TruSpec Micro
[C] 32.81% [H] 5.42% 15.06.16

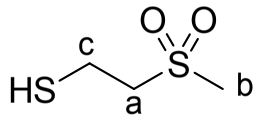
Einwaage: 1.983mg LECO RO-478
[O] 26.54% 22.06.16

Einwaage: 1.657mg LECO CHNS-932
[S] 34.89% 16.06.16

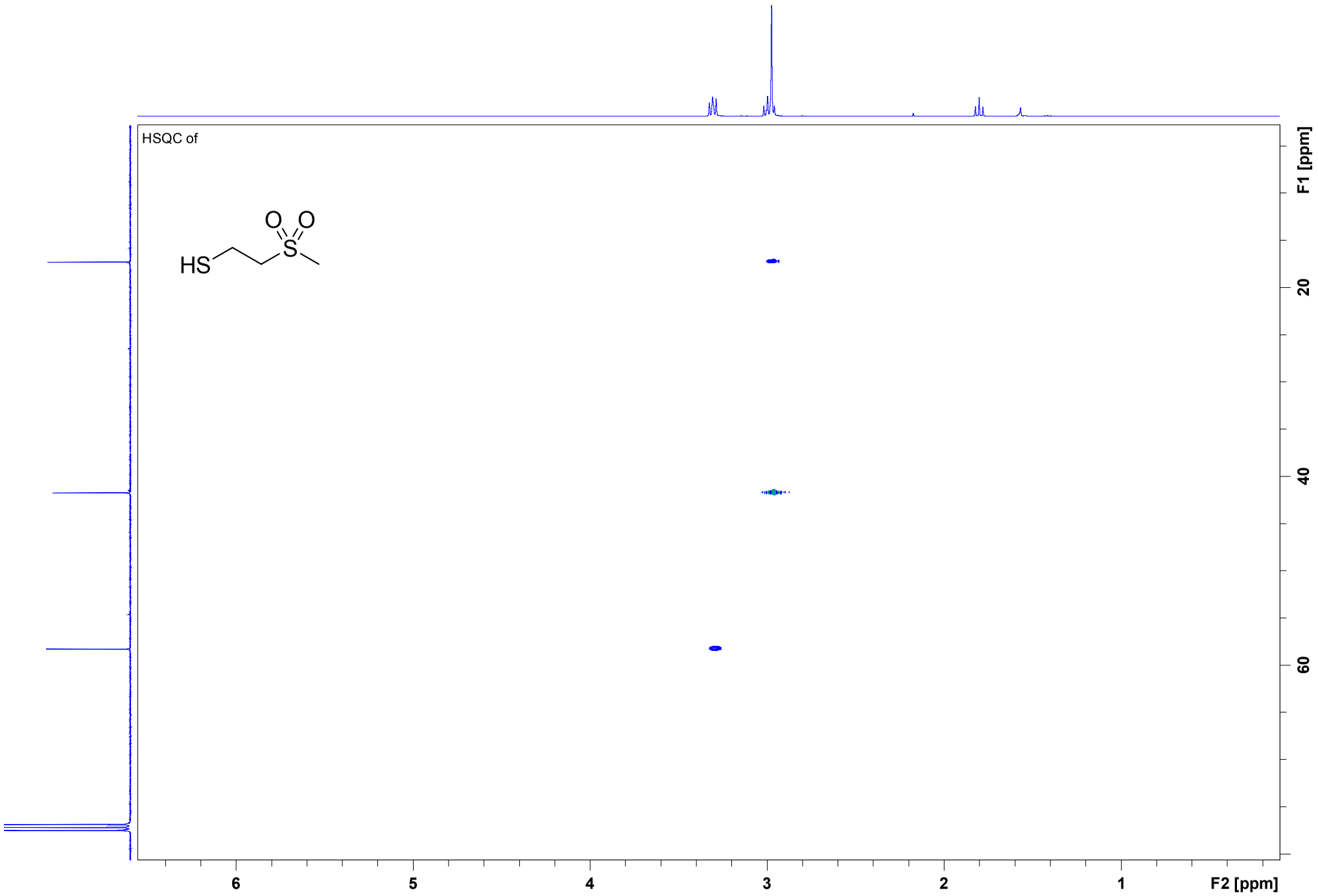
1H NMR of

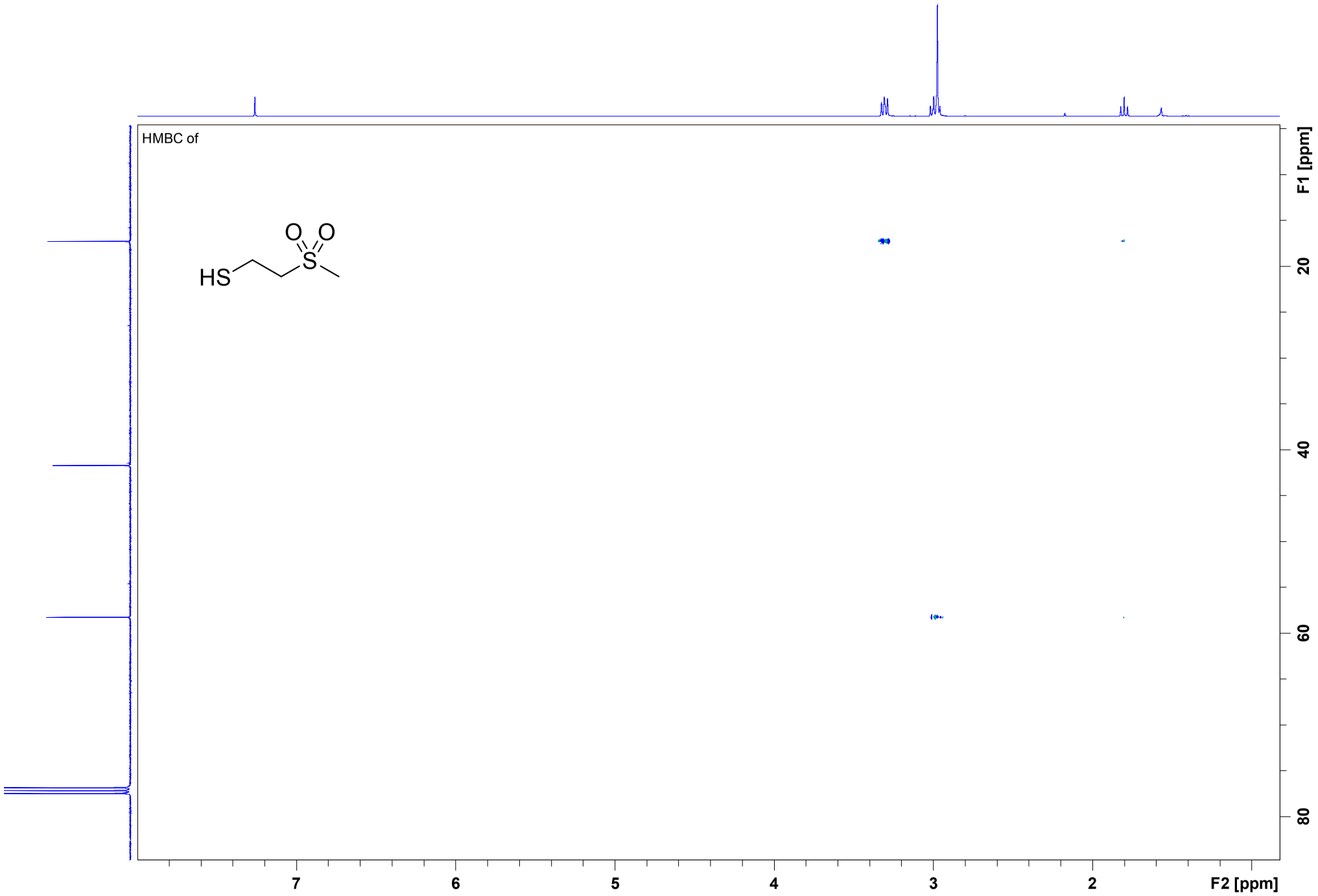

7.260
3.325
3.307
3.287
3.017
2.997
2.974
2.958
1.822
1.801
1.779
O
O
S
HS
a
b
b
c
3.4
3.2
3.0
ppm
a
b
c
8.0
7.5
7.0
6.5
6.0
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
ppm
0.44
2.00
5.03
0.95

13C NMR of

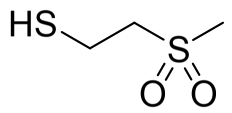

O
O
c
S
HS
a
b

77.48
77.16
76.84
58.26
41.71
17.26
a
b
c
210
200
190
180
170
160
150
140
130
120
110
100
90
80
70
60
50
40
30
20
10
0
ppm


HSQC of
HS
O
O
S
F1 [ppm]
20
40
60
6
5
4
3
2
1
F2 [ppm]


HMBC of
HS
O
O
S
F1 [ppm]
20
40
60
80
7
6
5
4
3
2
F2 [ppm]

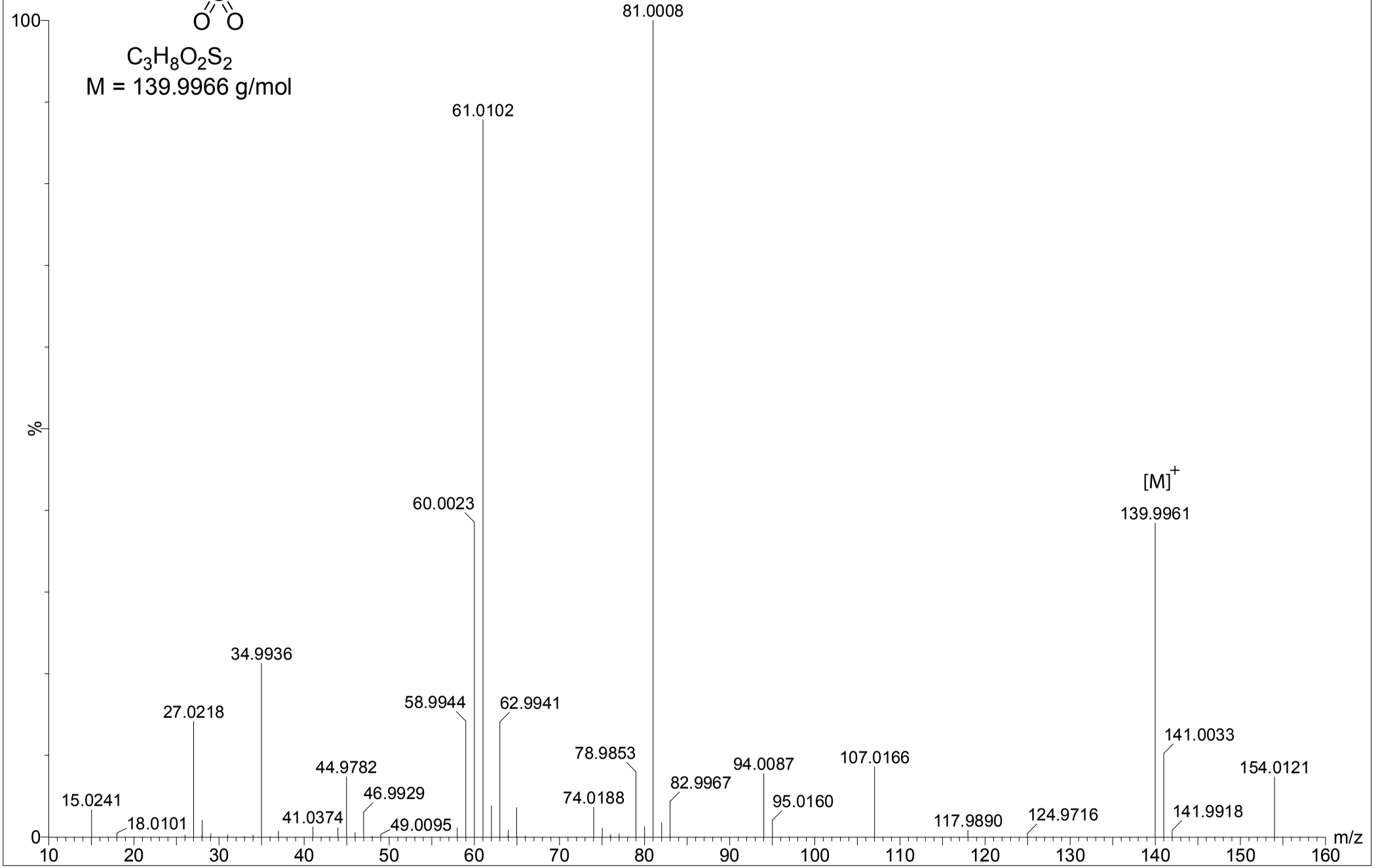
MS of

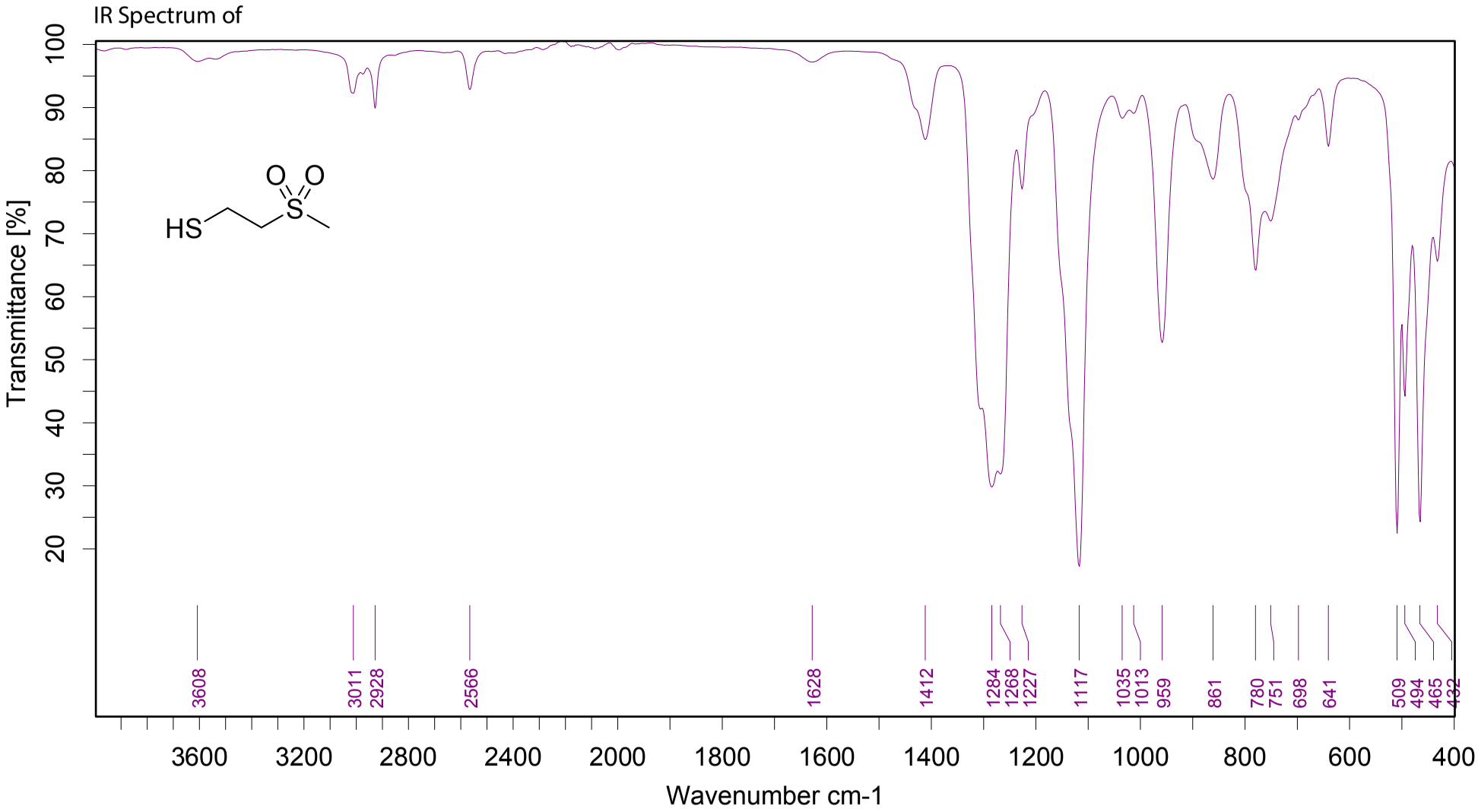


$C_3H_8O_2S_2$

M = 139.9966 g/mol

Magnet EI+
4.89e3




IR Spectrum of
Transmittance [%]
100
90
80
70
60
50
40
30
20
HS
O
O
S
3608
3011
2928
2566
1628
1412
1284
1268
1227
1117
1035
1013
959
861
780
751
698
641
509
494
465
432
3600
3200
2800
2400
2000
1800
1600
1400
1200
1000
800
600
400
Wavenumber cm-1

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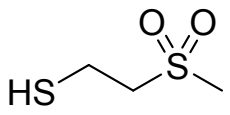


Mikroelementaranalyse

Molekularformel: C3 H8 O2 S2 Mr = 140.23g/mol

Siedepunkt:
gereinigt: chromat. getrocknet: 18h HV

Bestimmungen: C H O S

Eingang: 14.06.16 Ausgang: 22.06.16

M-162425 Operator: PK

Berechnete Gewichtsanteile:

[C] 25.70% [H] 5.75% [O] 22.82% [S] 45.73%

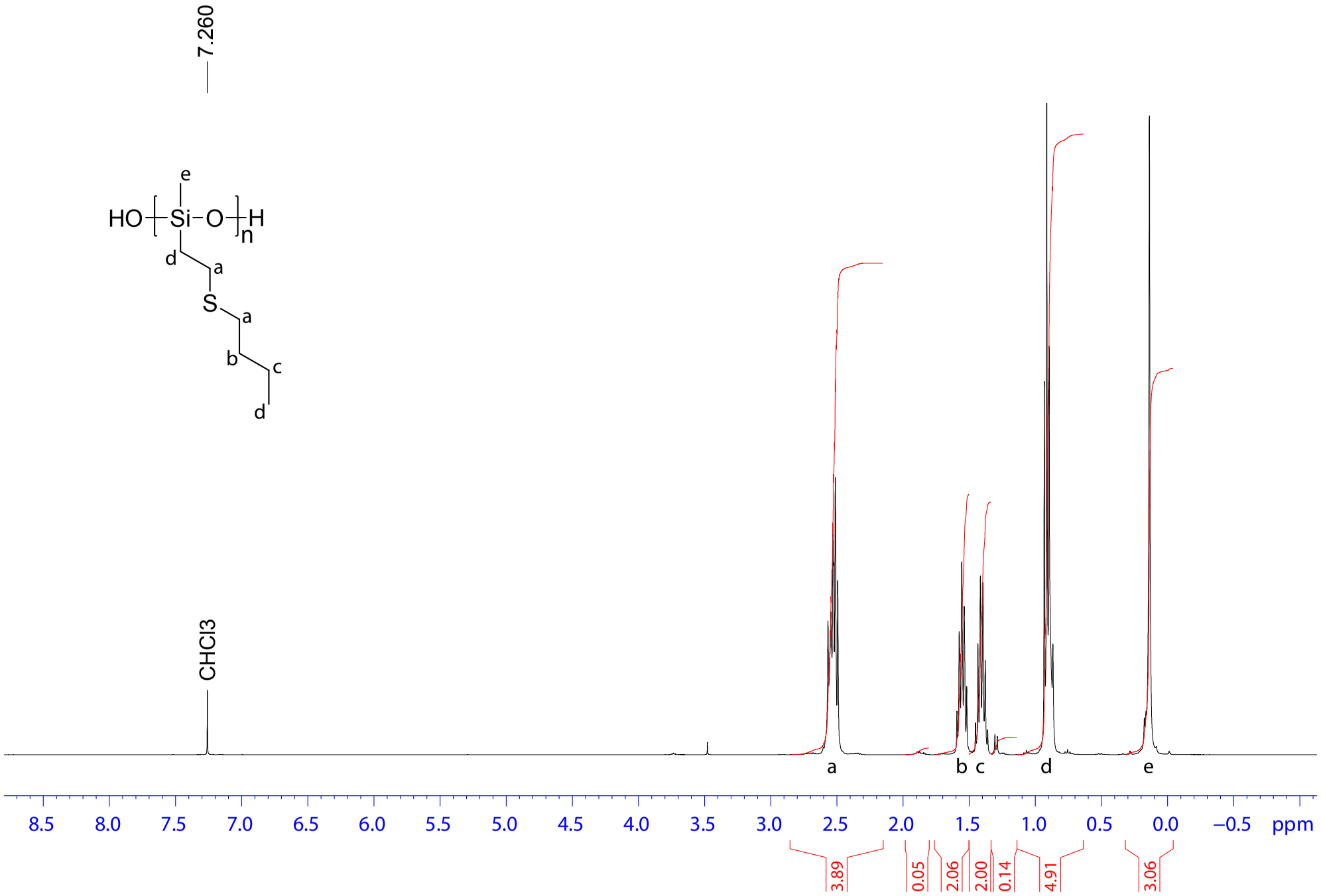
Gefundene Gewichtsanteile:

Einwaage: 1.000mg LECO TruSpec Micro
[C] 25.72% [H] 5.80% 14.06.15

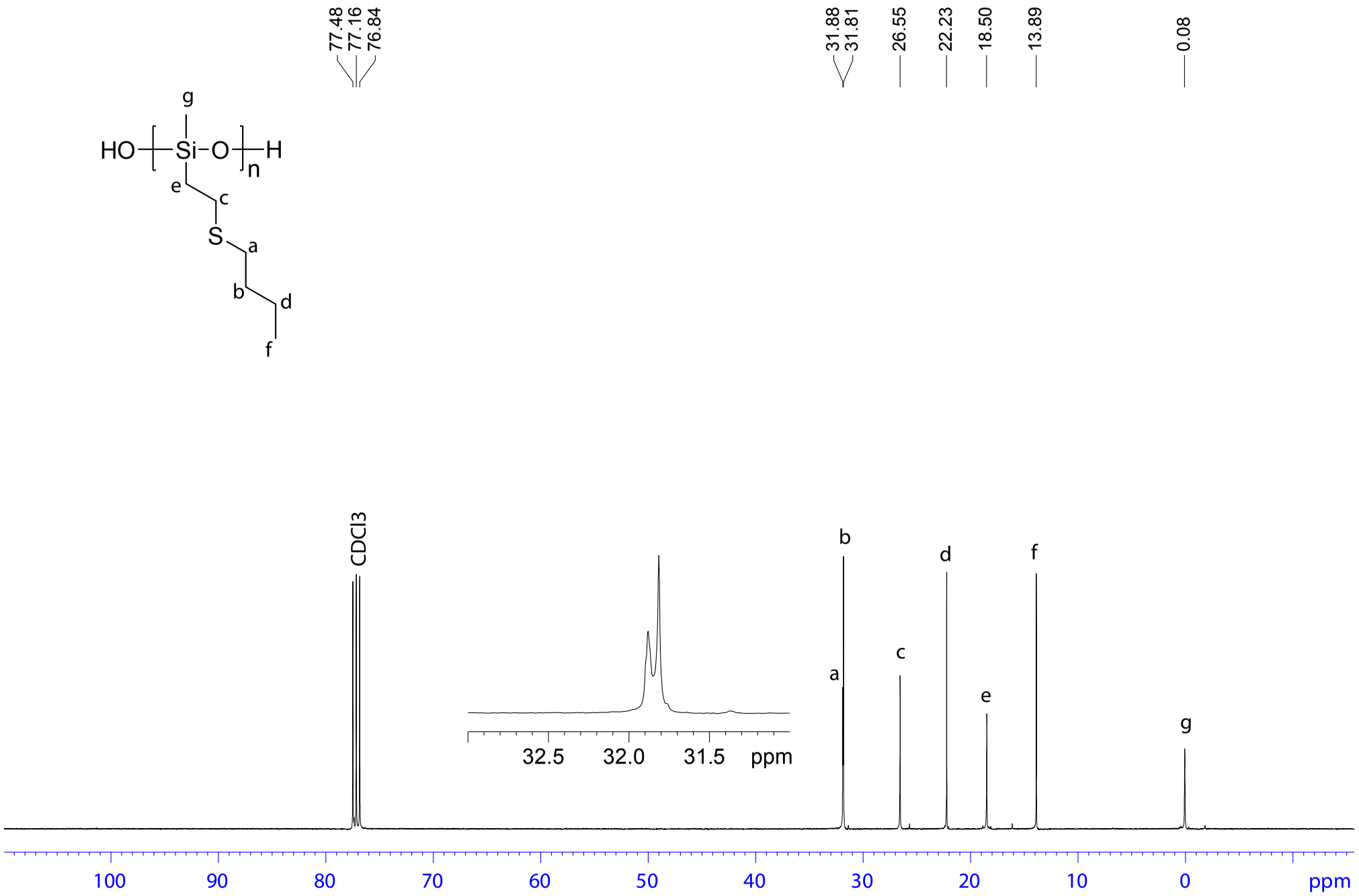
Einwaage: 1.831mg LECO RO-478
[O] 23.09% 22.06.16

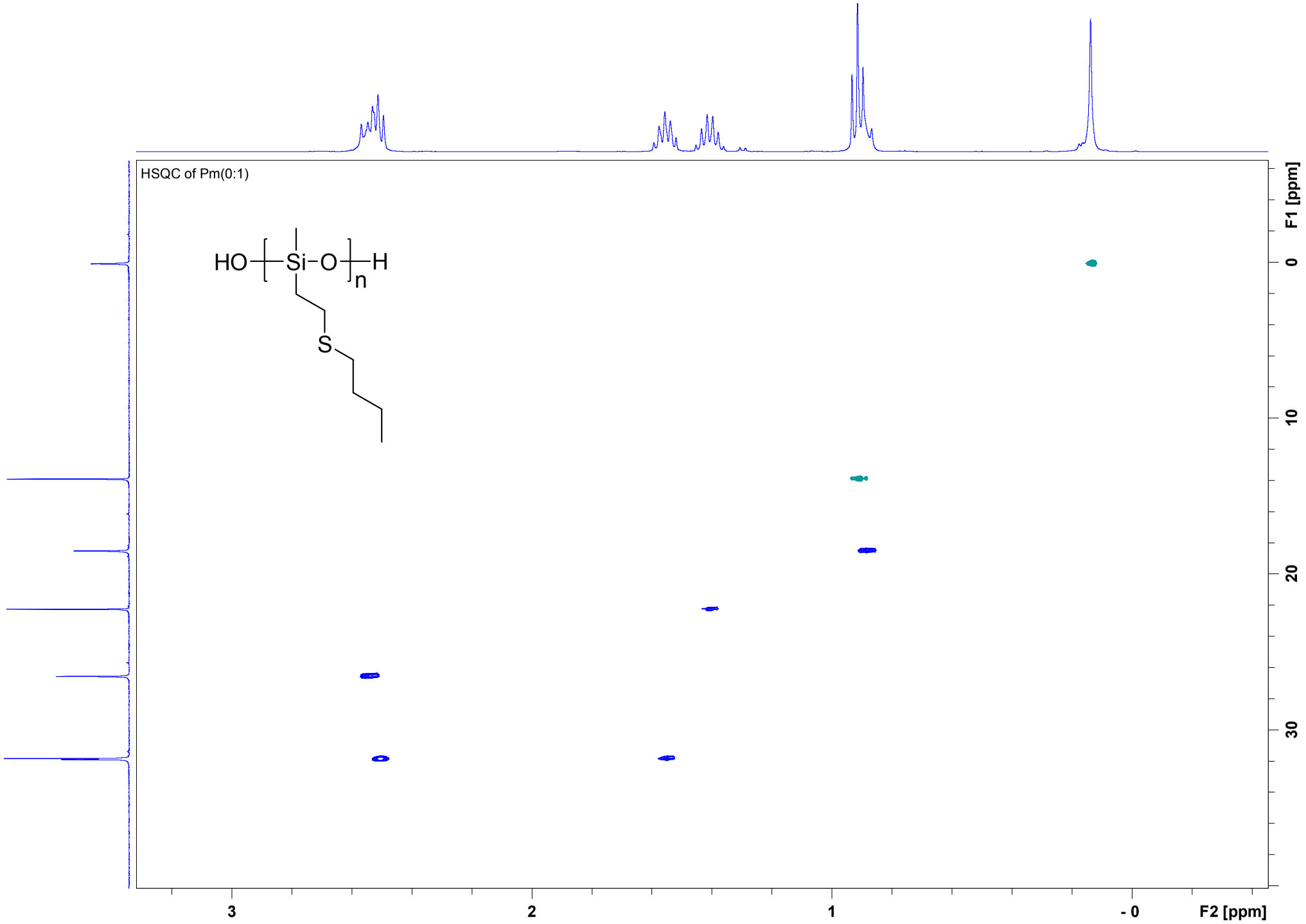
Einwaage: 1.209mg LECO CHNS-932
[S] 45.46% 16.06.16

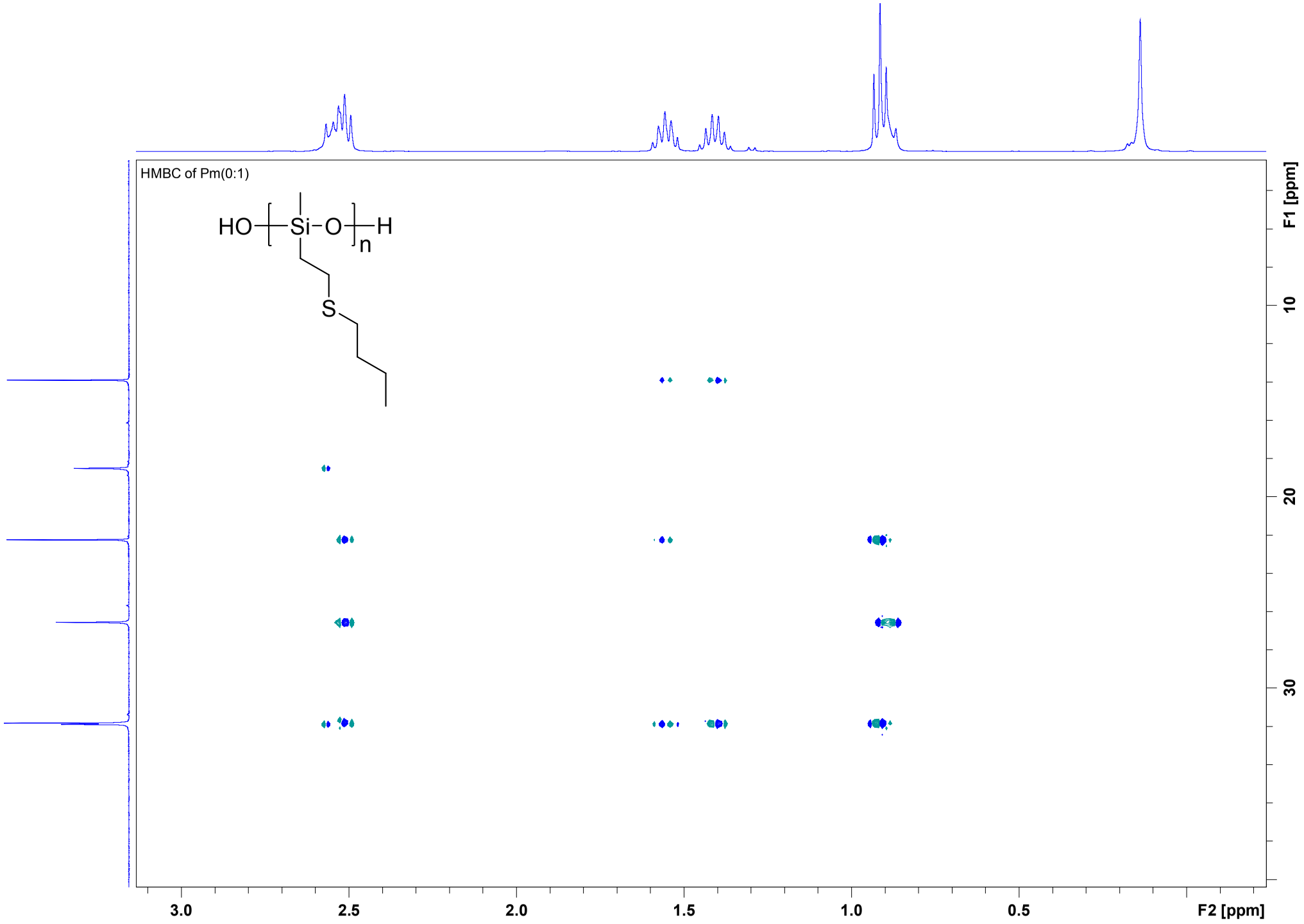
1H NMR of Pm(0:1)

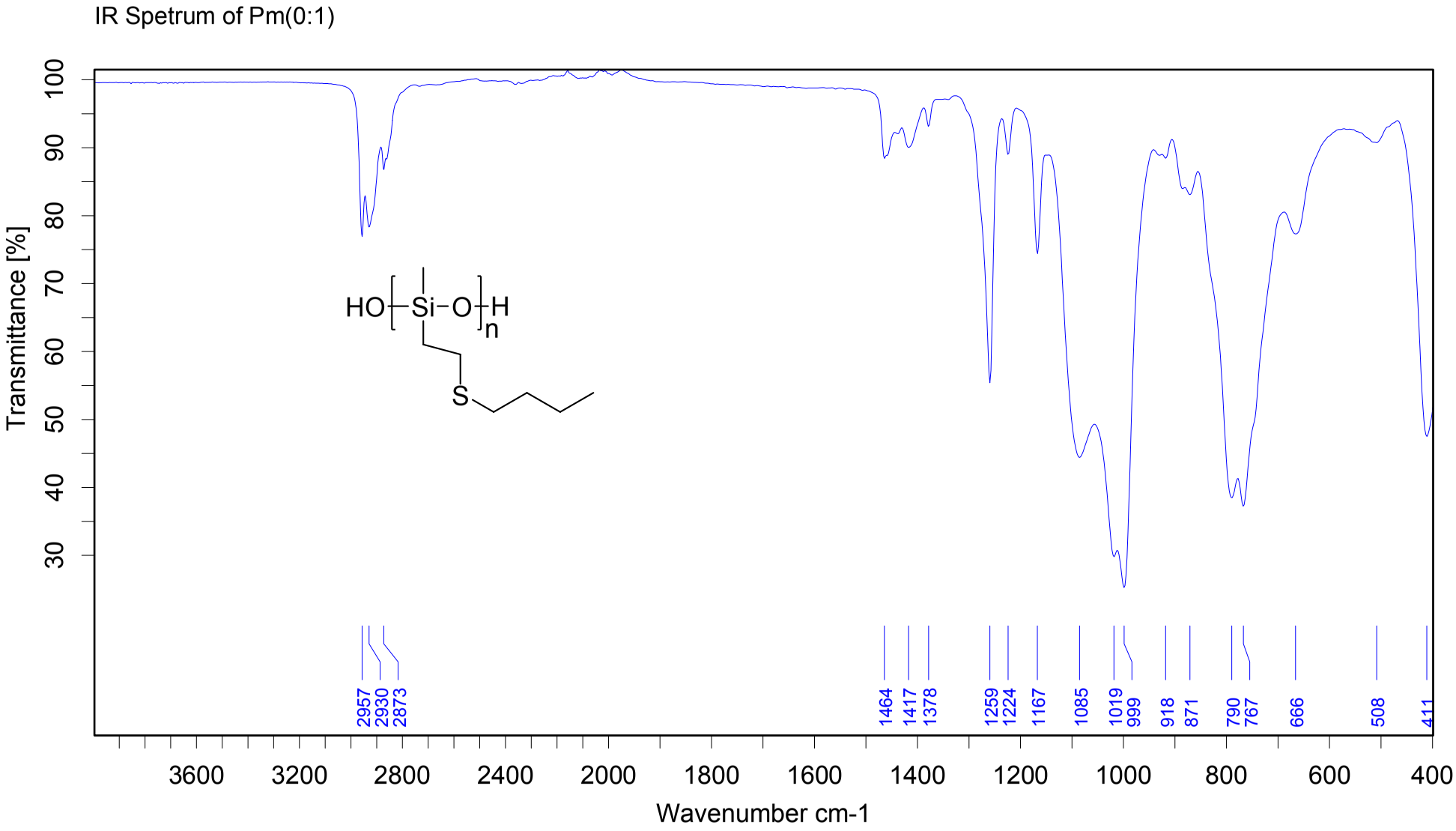


13C NMR of Pm(0:1)

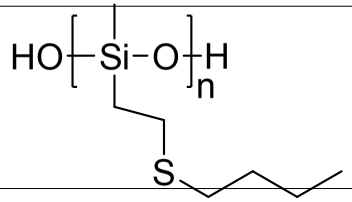



HSQC of Pm(0:1)
HO
Si
O
H
n
S
F1 [ppm]
0
10
20
30
3
2
1
- 0
F2 [ppm]


HMBC of Pm(0:1)
HO
Si
O
H
n
S
F1 [ppm]
10
20
30
3.0
2.5
2.0
1.5
1.0
0.5
F2 [ppm]


IR Spetrum of Pm(0:1)
Transmittance [%]
100
90
80
70
60
50
40
30
HO
Si
O
H
n
S
2957
2930
2873
1464
1417
1378
1259
1224
1167
1085
1019
999
918
871
790
767
666
508
411
3600
3200
2800
2400
2000
1800
1600
1400
1200
1000
800
600
400
Wavenumber cm-1

DSC of Pm(0:1)



Heat Flow Endo Up (mW) : Steps: 1-2
Heat Flow Endo Up (mW) : Step: 2
Heat Flow Endo Up (mW) : Step: 1

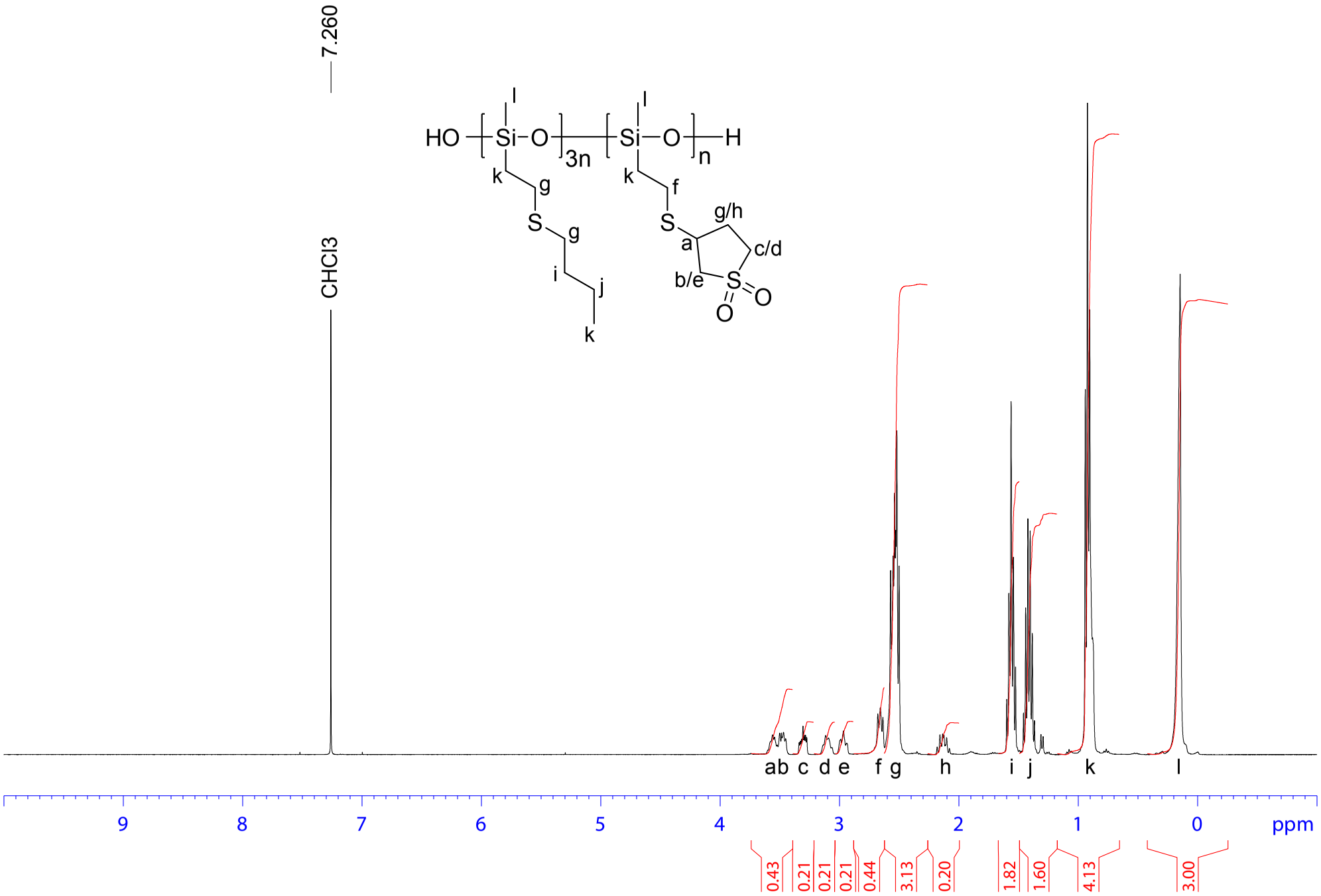
Funktionspolymere

Delta Cp = 0.371 J/g*°C
Delta Cp = 0.392 J/g*°C
Tg: Half Cp Extrapolated = -99.63 °C
Tg: Half Cp Extrapolated = -99.90 °C
Tg: Half Cp Extrapolated = -104.16 °C
Delta Cp = 0.602 J/g*°C

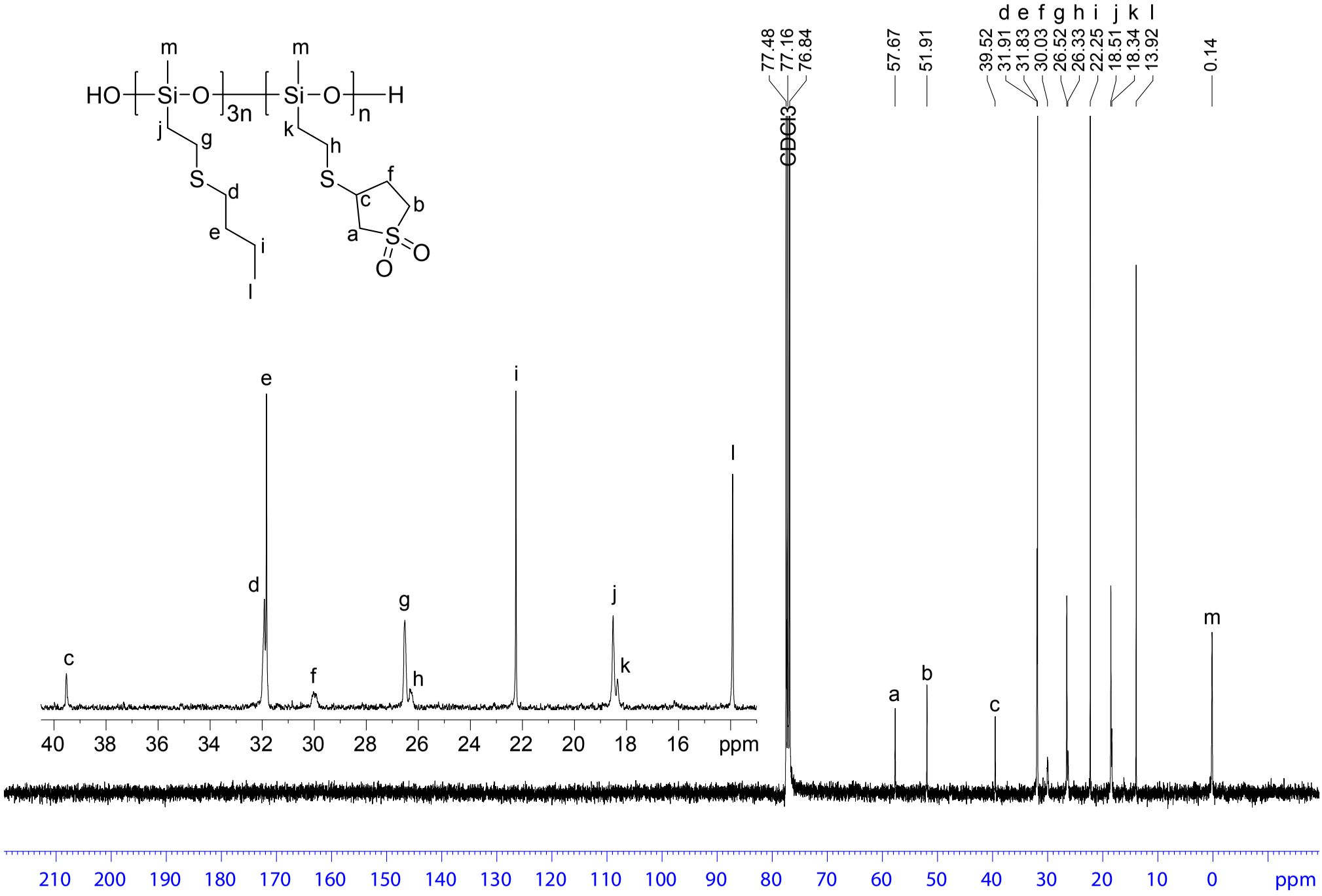
Heat Flow Endo Up (mW)
35
30
25
20
15
10
5
-120
-100
-80
-60
-40
-20
0
20
40
60
80
100
Temperature (°C)

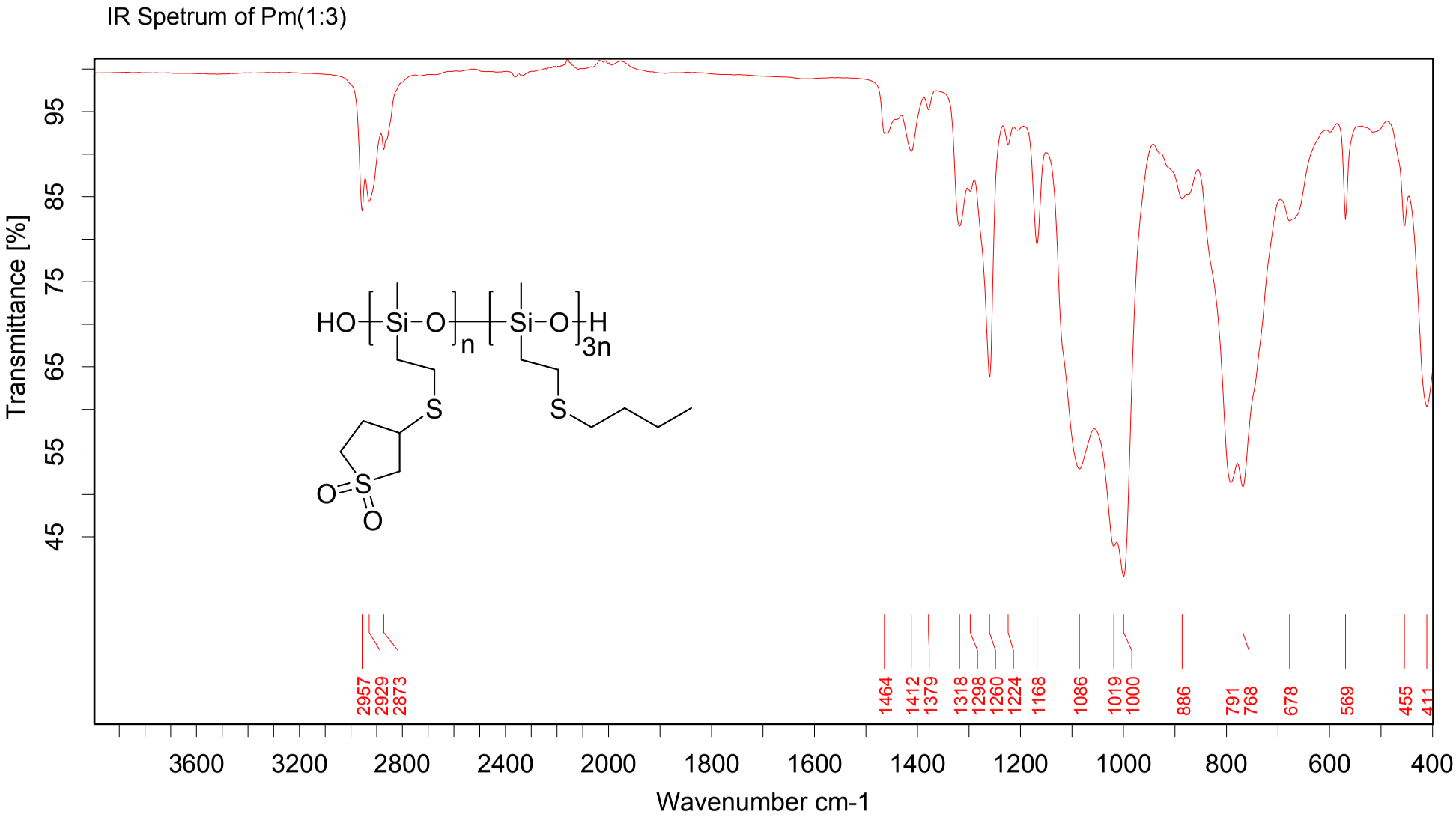
1) Heat from -120.00°C to 100.00°C at 20.00°C/min

1H NMR of Pm(1:3)

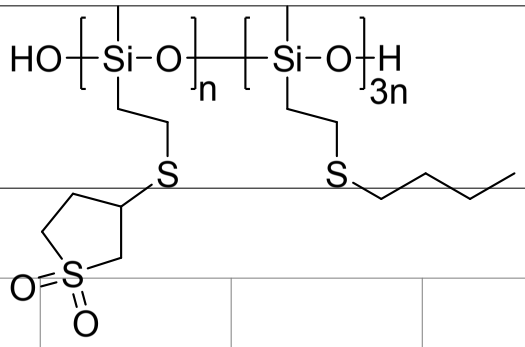


13C NMR of Pm(1:3)




IR Spetrum of Pm(1:3)
Transmittance [%]
95
85
75
65
55
45
HO
Si
O
n
Si
O
H
3n
S
S
O
S
O
2957
2929
2873
1464
1412
1379
1318
1298
1260
1224
1168
1086
1019
1000
886
791
768
678
569
455
411
3600
3200
2800
2400
2000
1800
1600
1400
1200
1000
800
600
400
Wavenumber cm-1

DSC of Pm(1:3)



Heat Flow Endo Up (mW) : Step: 1

Heat Flow Endo Up (mW) : Step: 2

Heat Flow Endo Up (mW) : Step: 1

Funktionspolymere

Delta Cp = 0.436 J/g*°C

Delta Cp = 0.397 J/g*°C

Tg: Half Cp Extrapolated = -71.37 °C

Tg: Half Cp Extrapolated = -72.87 °C

Tg: Half Cp Extrapolated = -103.03 °C

Delta Cp = 0.210 J/g*°C

Heat Flow Endo Up (mW)

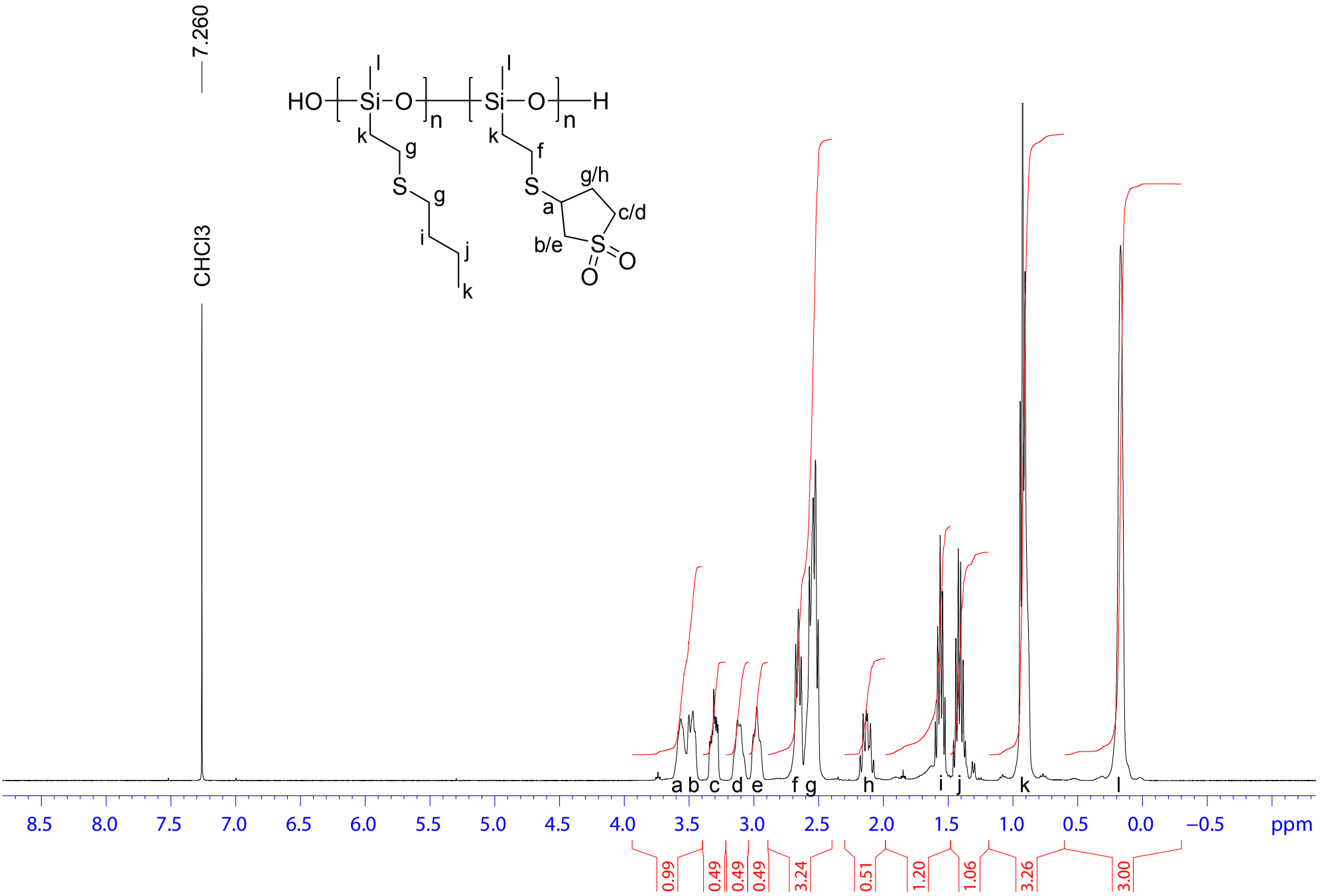
35
30
25
20
15
10
5

-120
-100
-80
-60
-40
-20
0
20
40
60
80
100

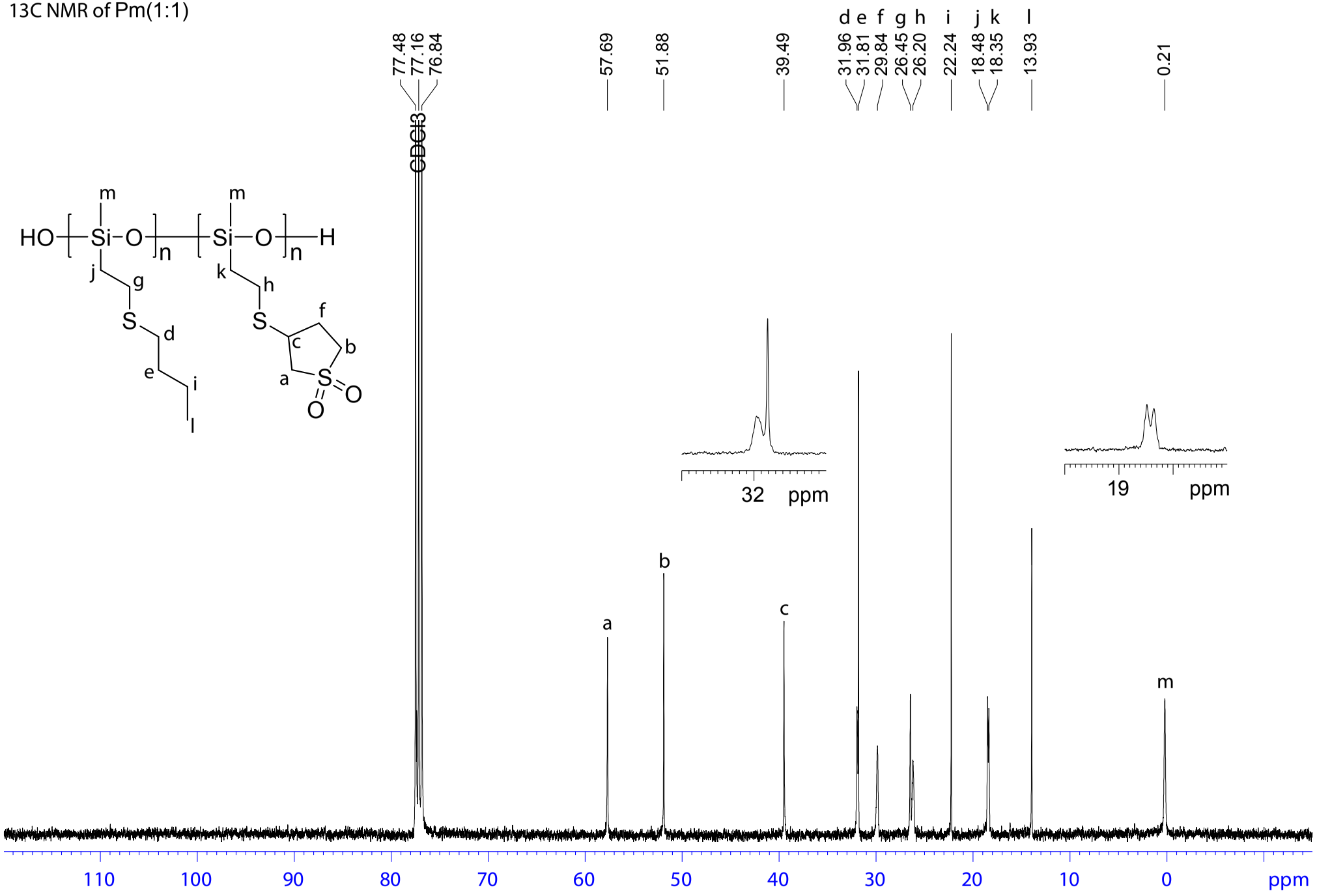
Temperature (°C)

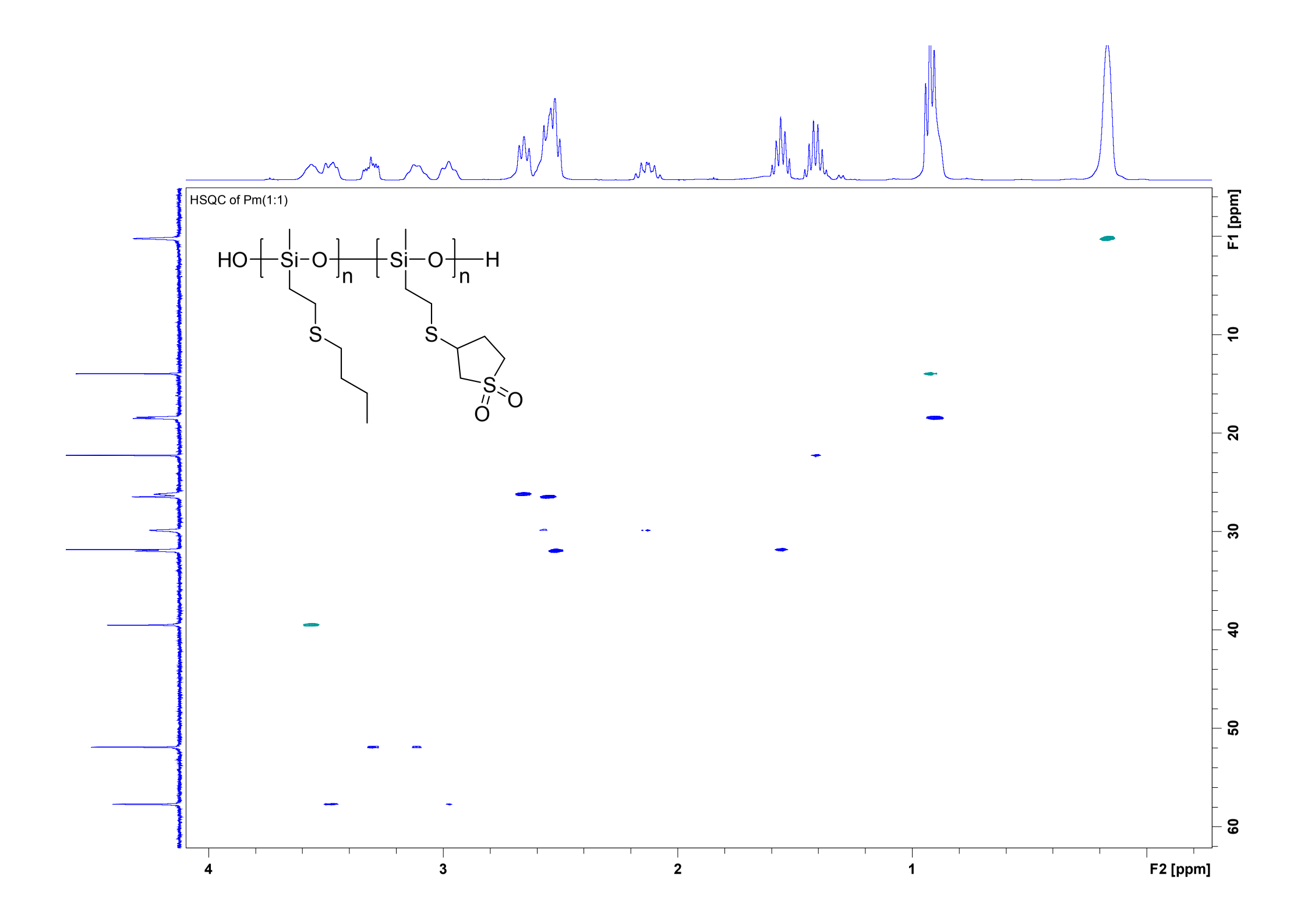
1) Heat from -120.00°C to 100.00°C at 20.00°C/min

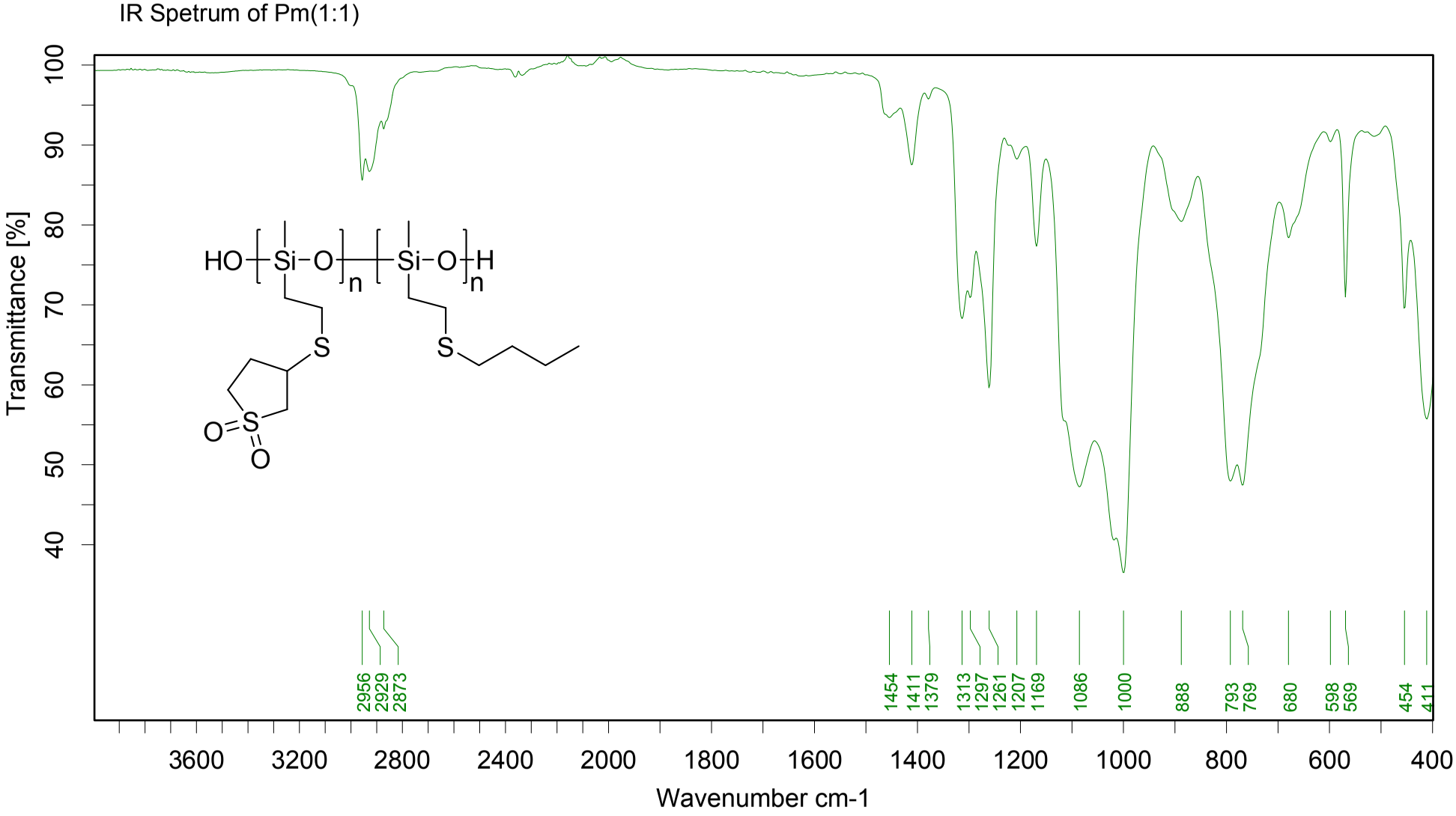
1H NMR of Pm(1:1)



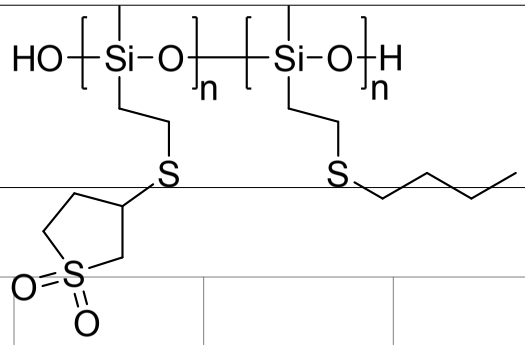
13C NMR of Pm(1:1)




HSQC of Pm(1:1)
HO
Si
O
n
H
S
O
F1 [ppm]
10
20
30
40
50
60
4
3
2
1
F2 [ppm]


IR Spetrum of Pm(1:1)
Transmittance [%]
100
90
80
70
60
50
40
HO
Si
O
n
Si
O
H
n
S
S
O
S
O
2956
2929
2873
1454
1411
1379
1313
1297
1261
1207
1169
1086
1000
888
793
769
680
598
569
454
411
3600
3200
2800
2400
2000
1800
1600
1400
1200
1000
800
600
400
Wavenumber cm-1

DSC of Pm(1:1)



Heat Flow Endo Up (mW) : Step: 1

Heat Flow Endo Up (mW) : Step: 2

Heat Flow Endo Up (mW) : Step: 1

Funktionspolymere

Delta Cp = 0.325 J/g*°C

Delta Cp = 0.314 J/g*°C

Tg: Half Cp Extrapolated = -35.79 °C

Tg: Half Cp Extrapolated = -34.51 °C

Tg: Half Cp Extrapolated = -41.12 °C

Delta Cp = 0.210 J/g*°C

Heat Flow Endo Up (mW)

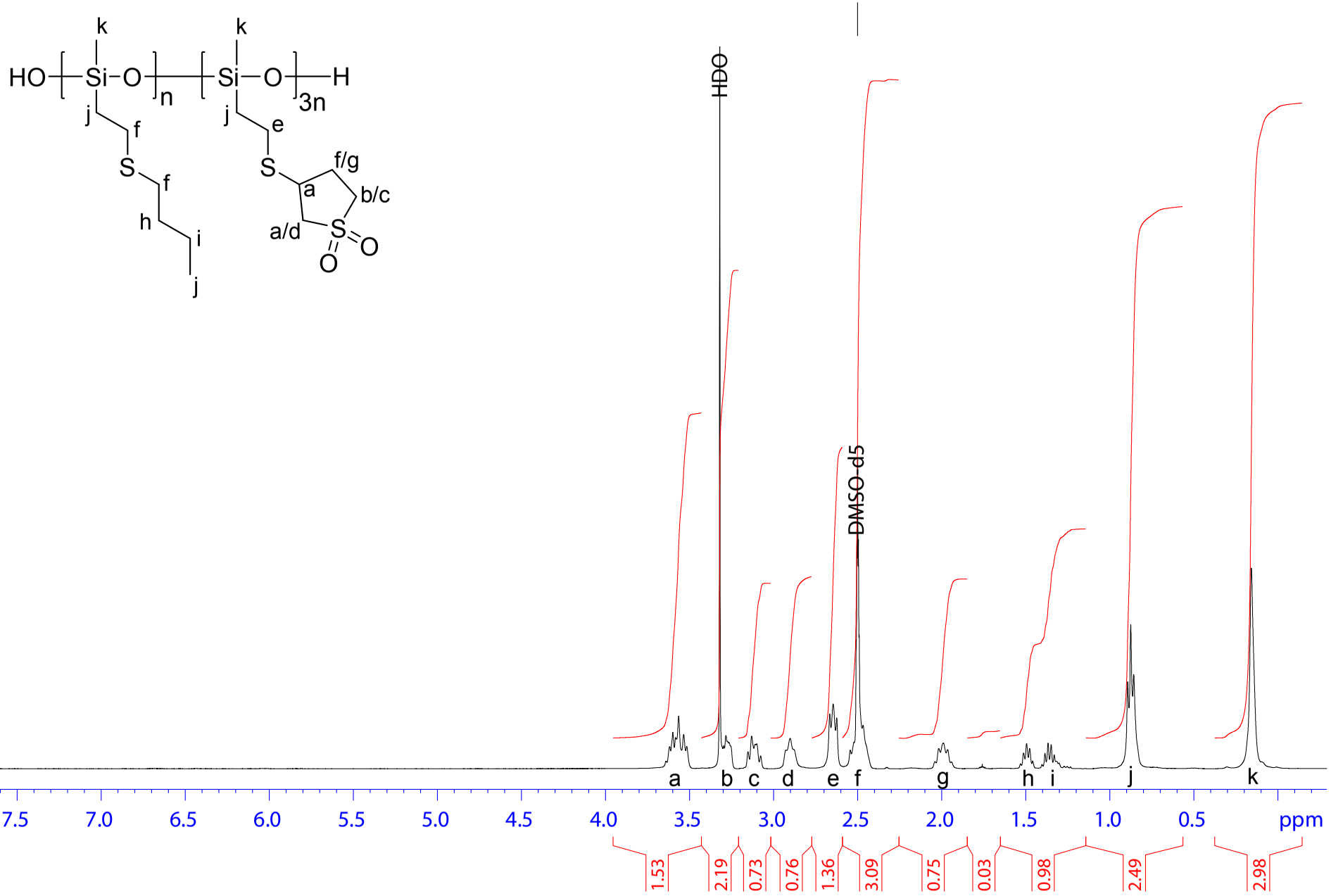
35 30 25 20 15 10 5

-120 -100 -80 -60 -40 -20 0 20 40 60 80 100

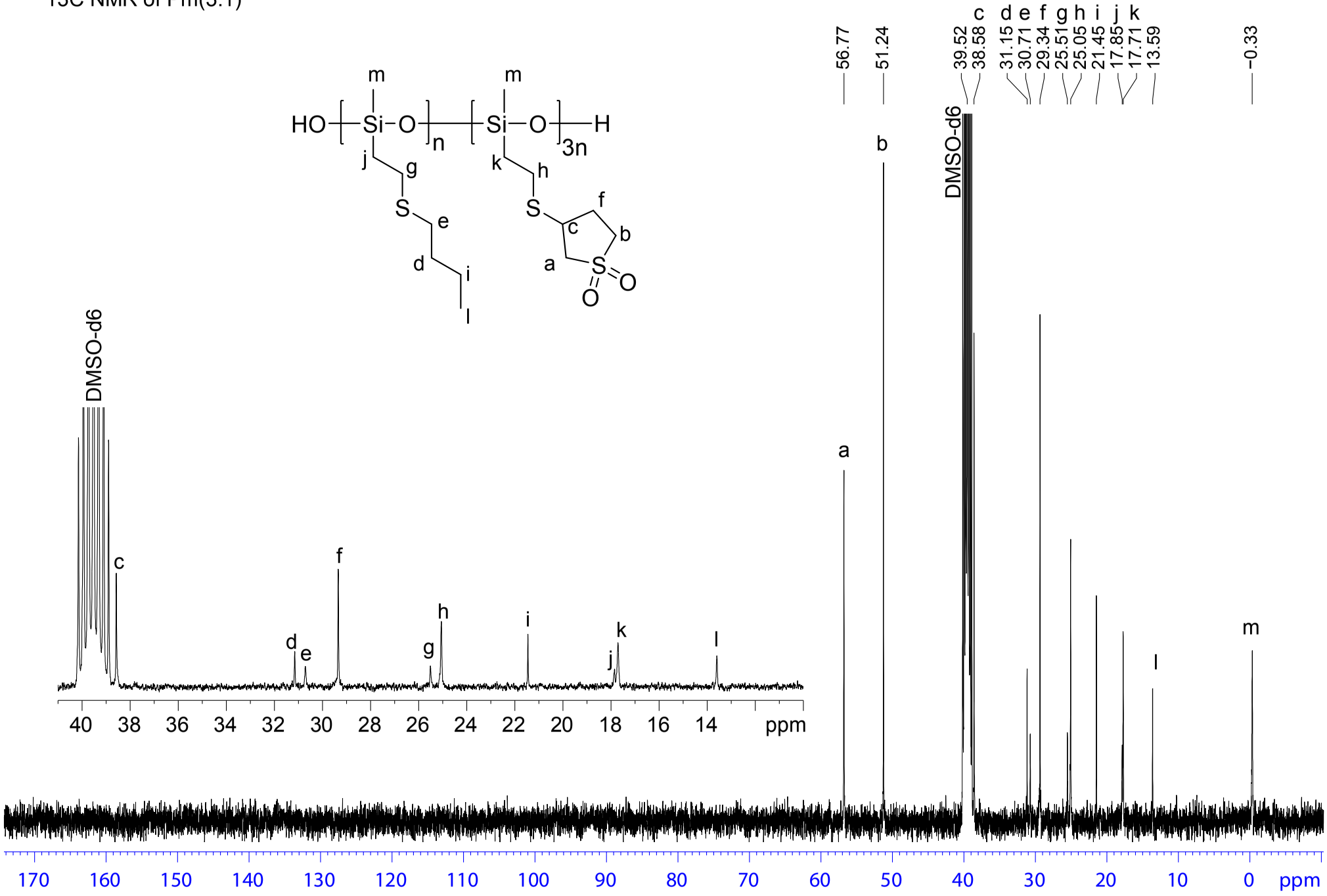
Temperature (°C)

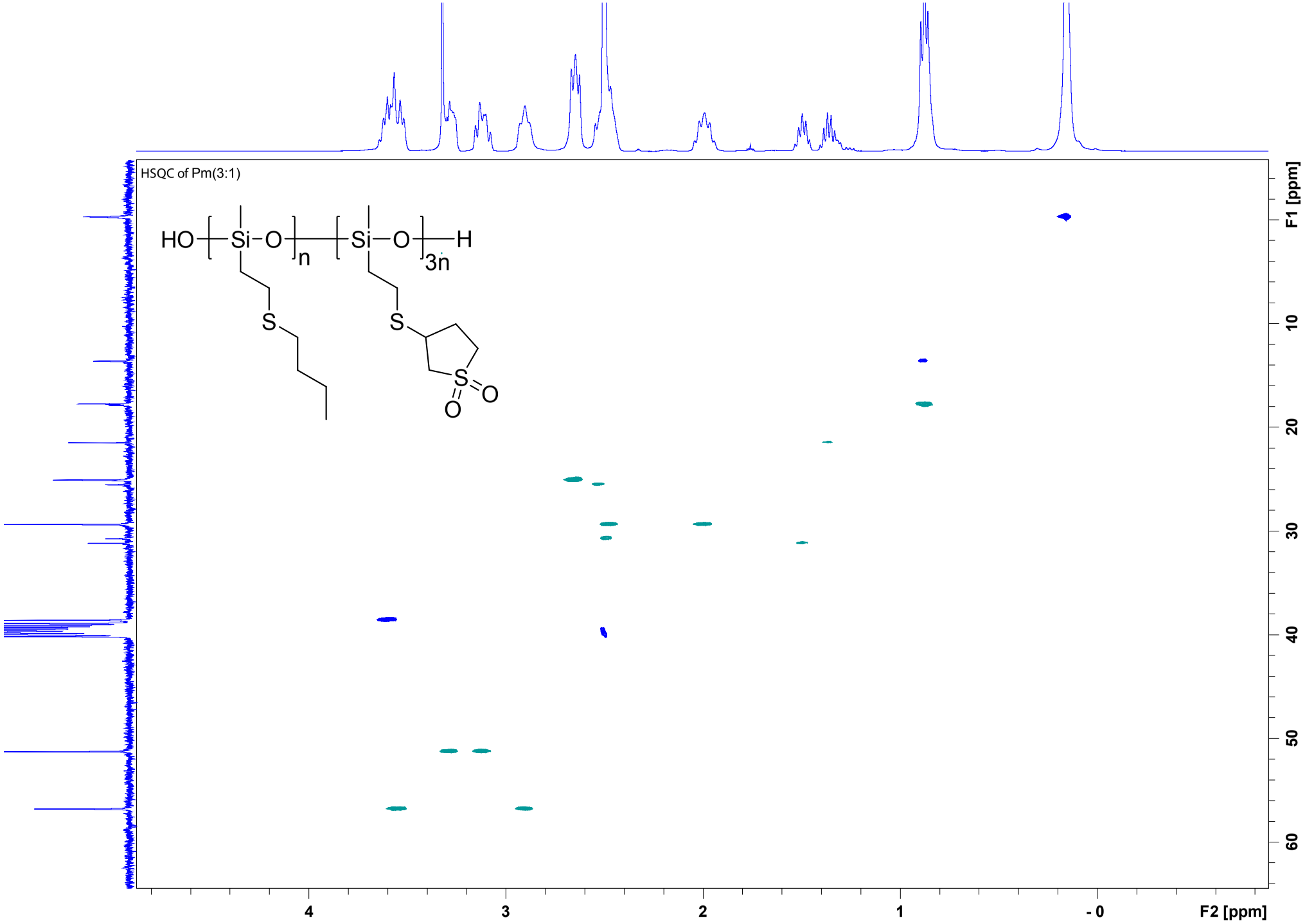
1) Heat from -120.00°C to 100.00°C at 20.00°C/min

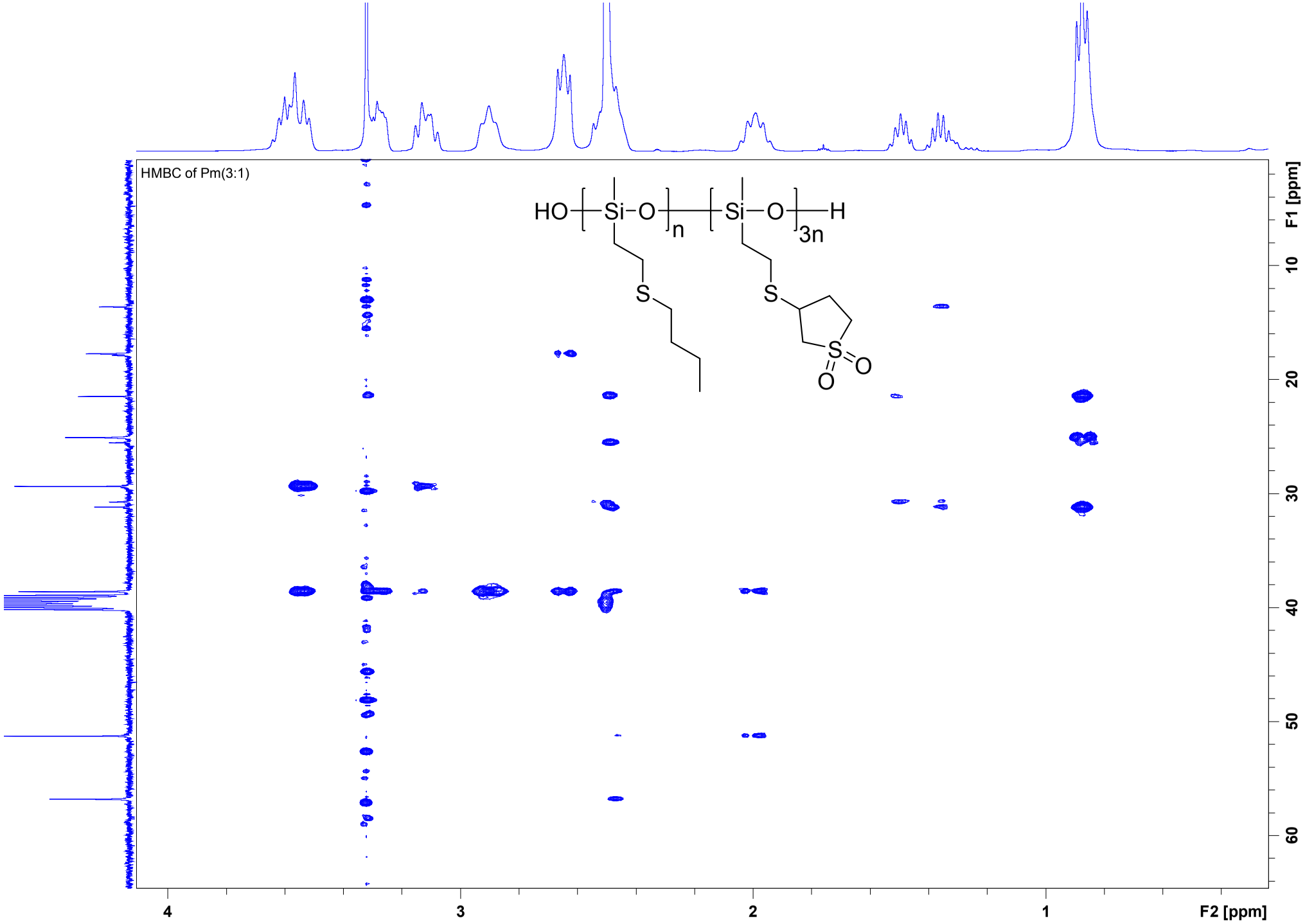
1H NMR of Pm(3:1)

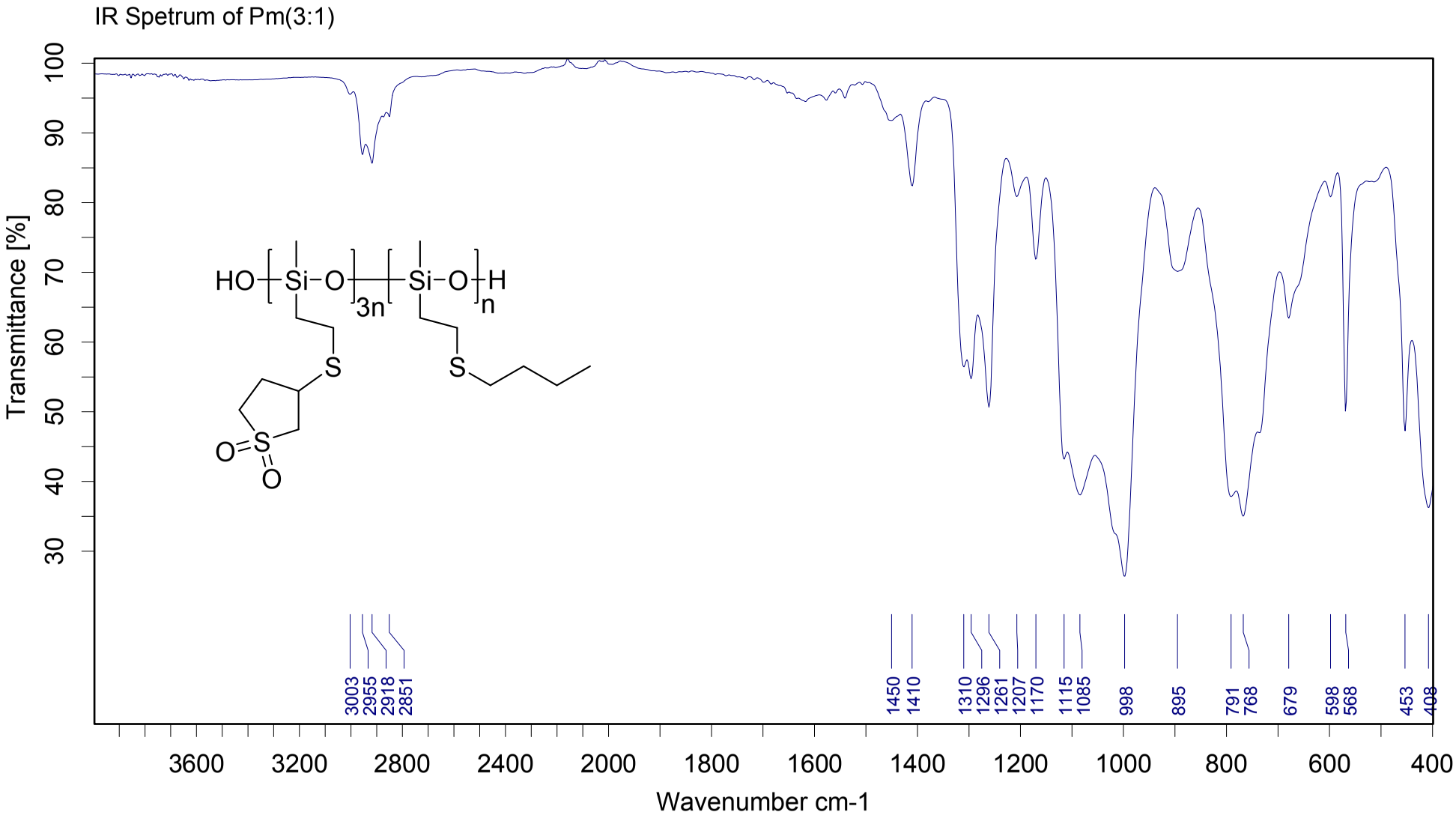


13C NMR of Pm(3:1)

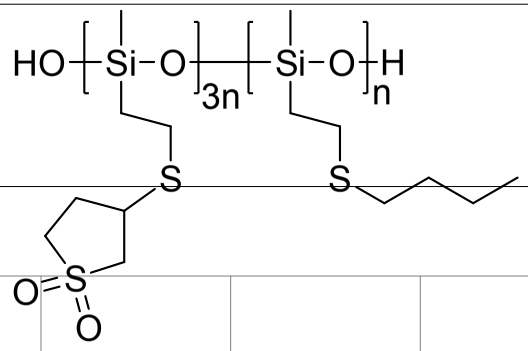



HSQC of Pm(3:1)
HO
Si
O
n
Si
O
3n
H
S
S
S
O
O
F1 [ppm]
10
20
30
40
50
60
4
3
2
1
- 0
F2 [ppm]


HMBC of Pm(3:1)
HO
Si
O
n
Si
O
3n
H
S
S
S
O
O
F1 [ppm]
10
20
30
40
50
60
4
3
2
1
F2 [ppm]


IR Spetrum of Pm(3:1)
Transmittance [%]
100
90
80
70
60
50
40
30
HO
Si
O
3n
Si
O
H
n
S
S
O
S
O
3003
2955
2918
2851
1450
1410
1310
1296
1261
1207
1170
1115
1085
998
895
791
768
679
598
568
453
408
3600
3200
2800
2400
2000
1800
1600
1400
1200
1000
800
600
400
Wavenumber cm-1

DSC of Pm(3:1)



Heat Flow Endo Up (mW) : Step: 1

Heat Flow Endo Up (mW) : Step: 2

Heat Flow Endo Up (mW) : Step: 1

Funktionspolymere

Delta Cp = 0.293 J/g*°C

Delta Cp = 0.274 J/g*°C

Tg: Half Cp Extrapolated = -5.55 °C

Tg: Half Cp Extrapolated = -5.71 °C

Tg: Half Cp Extrapolated = -11.92 °C

Delta Cp = 0.193 J/g*°C

Heat Flow Endo Up (mW)

35 30 25 20 15 10 5

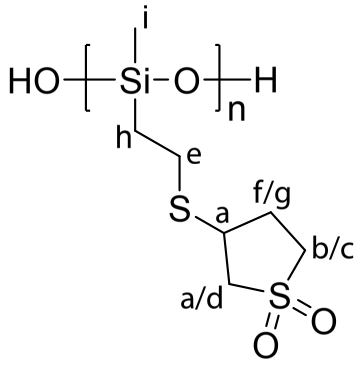
-120 -100 -80 -60 -40 -20 0 20 40 60 80 100

Temperature (°C)

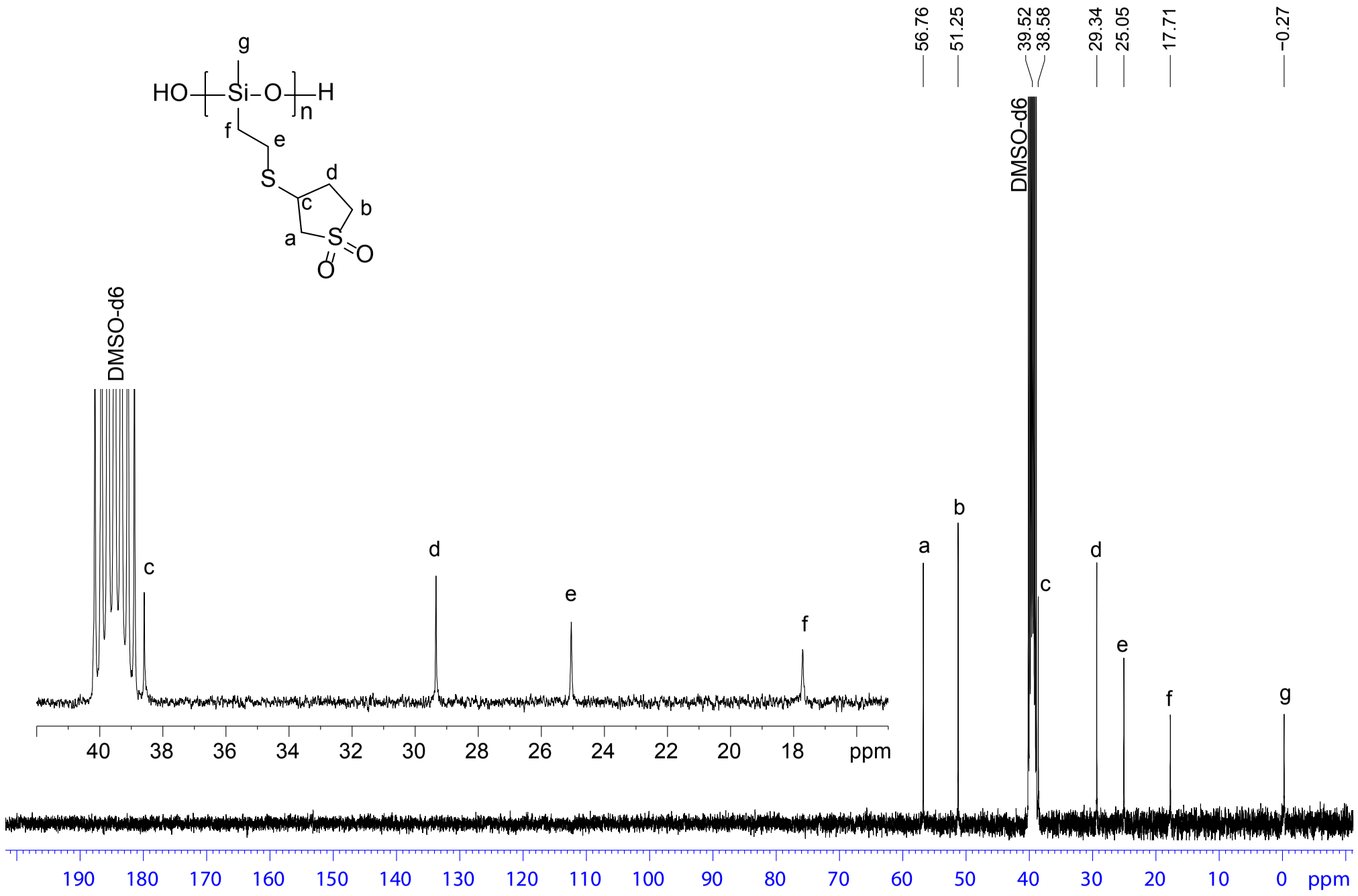
1) Heat from -120.00°C to 100.00°C at 20.00°C/min

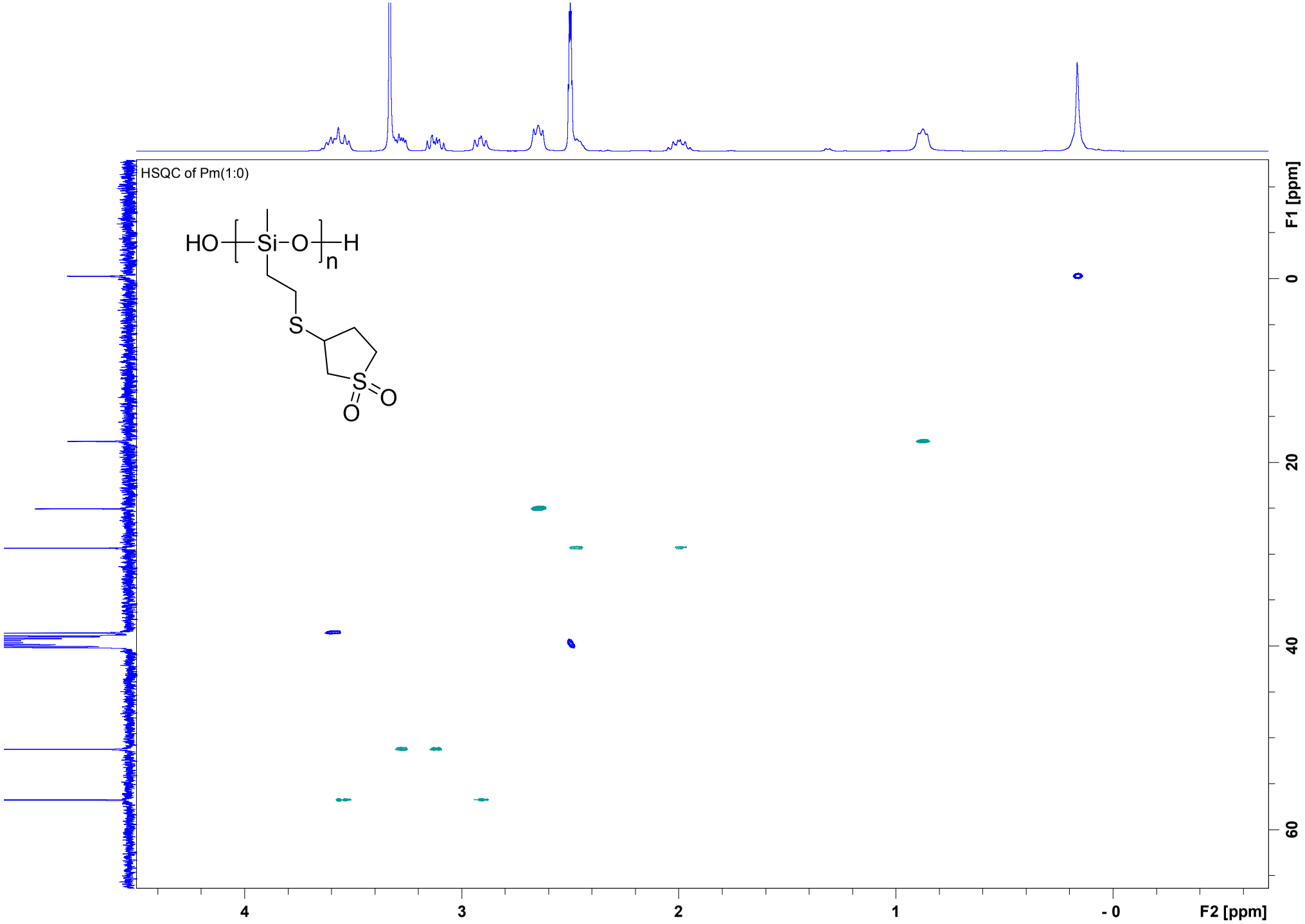
2) Cool from 100.00°C to -120.00°C at 20.00°C/min

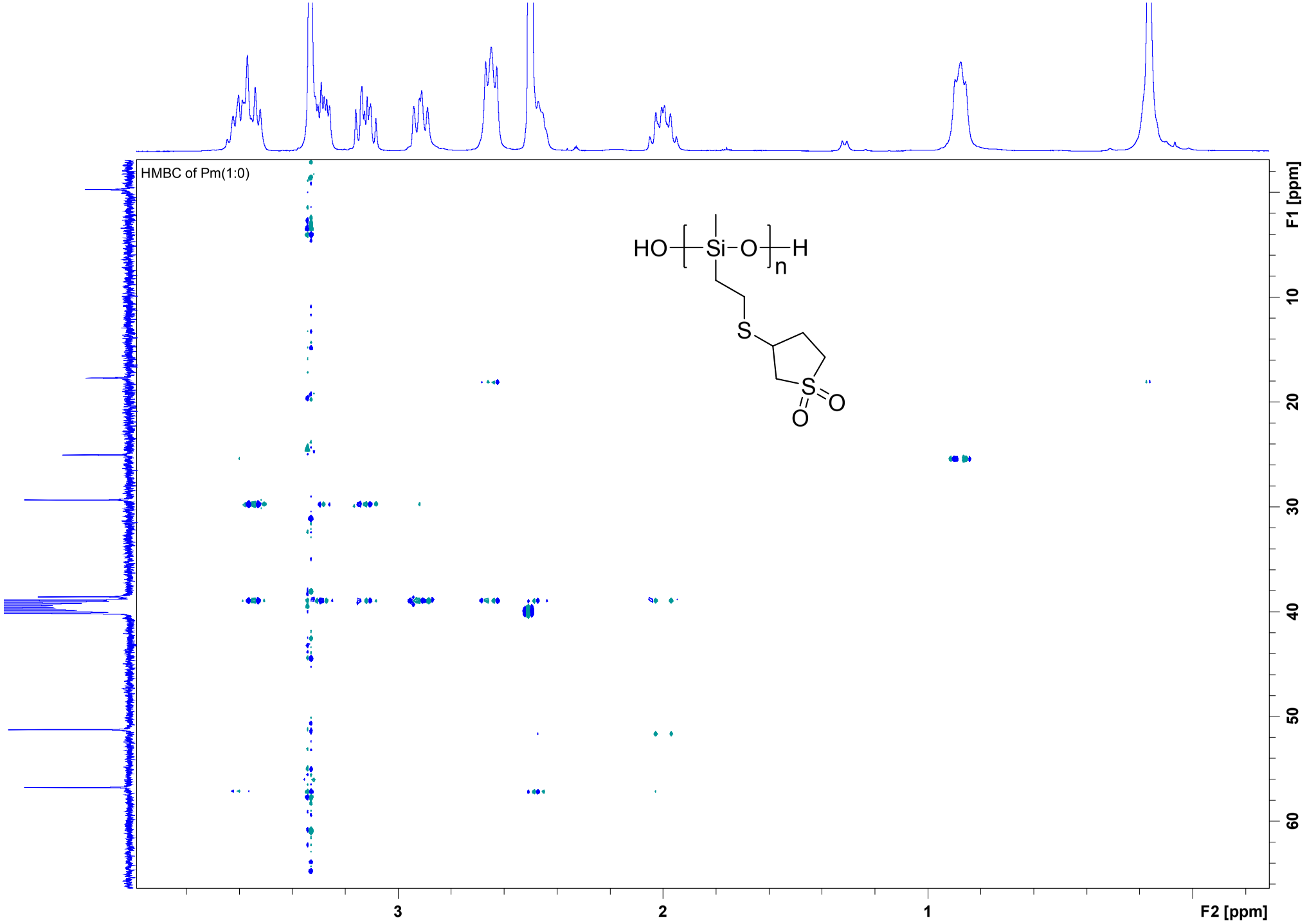
1H NMR of Pm(1:0)

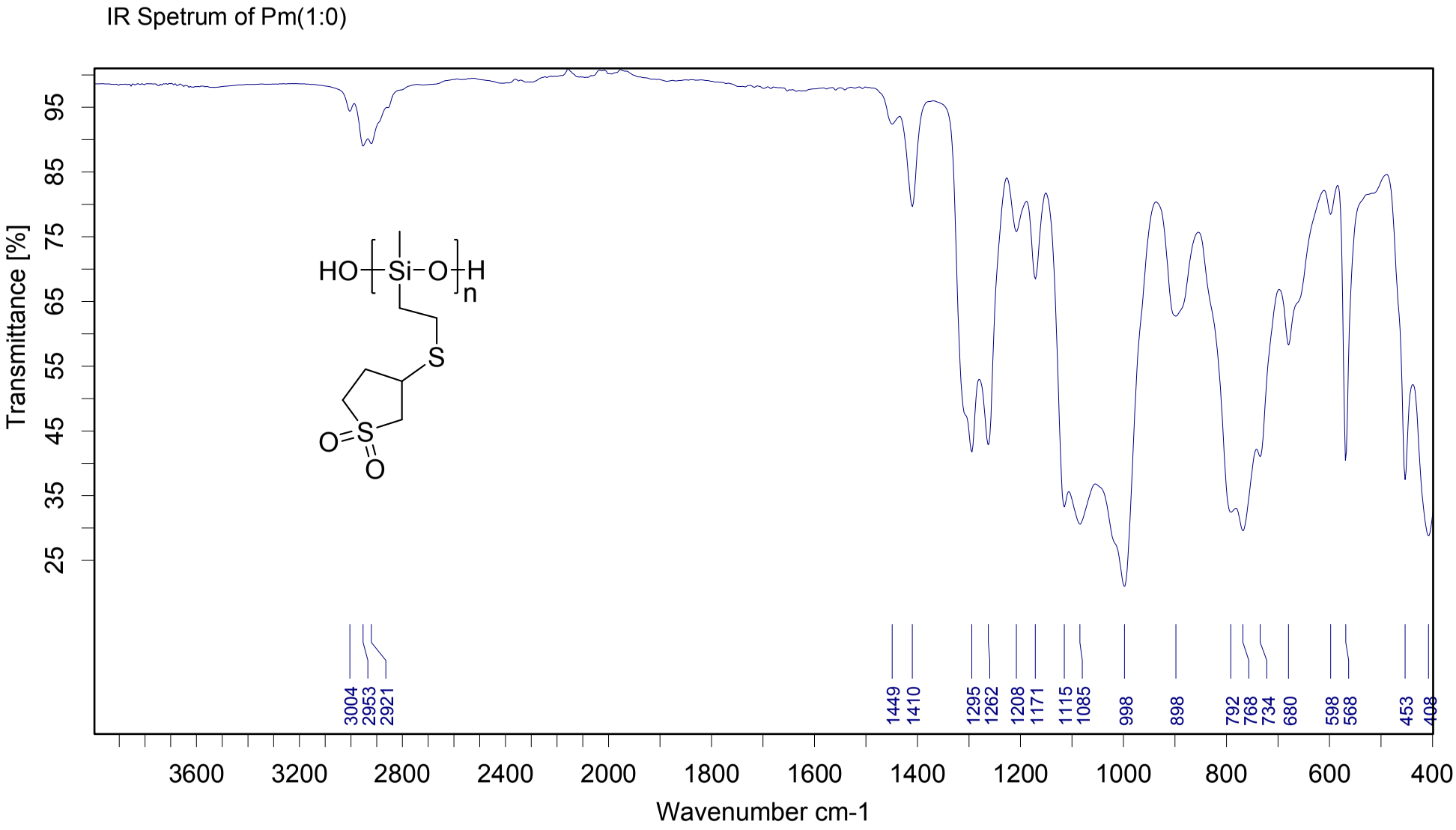


13C NMR of Pm(1:0)

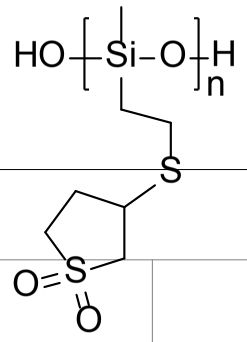



HSQC of Pm(1:0)
HO
Si
O
n
H
S
S
O
O
F1 [ppm]
0
20
40
60
4
3
2
1
- 0
F2 [ppm]


HMBC of Pm(1:0)
HO
Si
O
n
H
S
S
O
O
F1 [ppm]
10
20
30
40
50
60
3
2
1
F2 [ppm]


IR Spetrum of Pm(1:0)
Transmittance [%]
95
85
75
65
55
45
35
25
HO
Si
O
H
n
S
O
S
O
3004
2953
2921
1449
1410
1295
1262
1208
1171
1115
1085
998
898
792
768
734
680
598
568
453
408
3600
3200
2800
2400
2000
1800
1600
1400
1200
1000
800
600
400
Wavenumber cm-1

DSC of Pm(1:0)



Heat Flow Endo Up (mW) : Step: 1
Heat Flow Endo Up (mW) : Step: 2
Heat Flow Endo Up (mW) : Step: 4

Funktionspolymere

Delta Cp = 0.274 J/g*°C
Delta Cp = 0.284 J/g*°C
Tg: Half Cp Extrapolated = 7.92 °C
Tg: Half Cp Extrapolated = 9.34 °C
Delta Cp = 0.208 J/g*°C
Tg: Half Cp Extrapolated = 1.39 °C

Heat Flow Endo Up (mW)

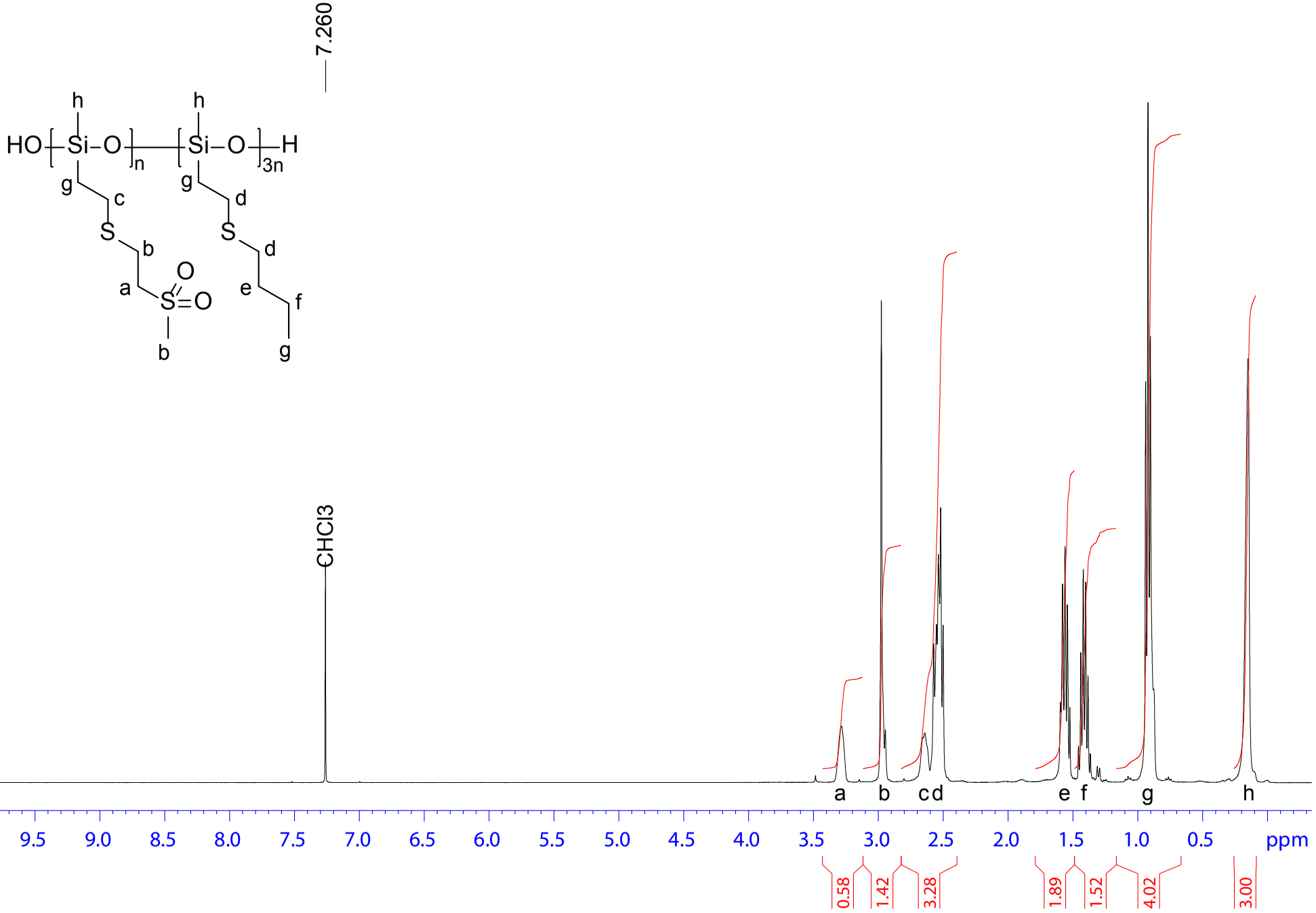
30
28
26
24
22
20
18
16
14
12
10

-90 -80 -60 -40 -20 0 20 40 60 80 100

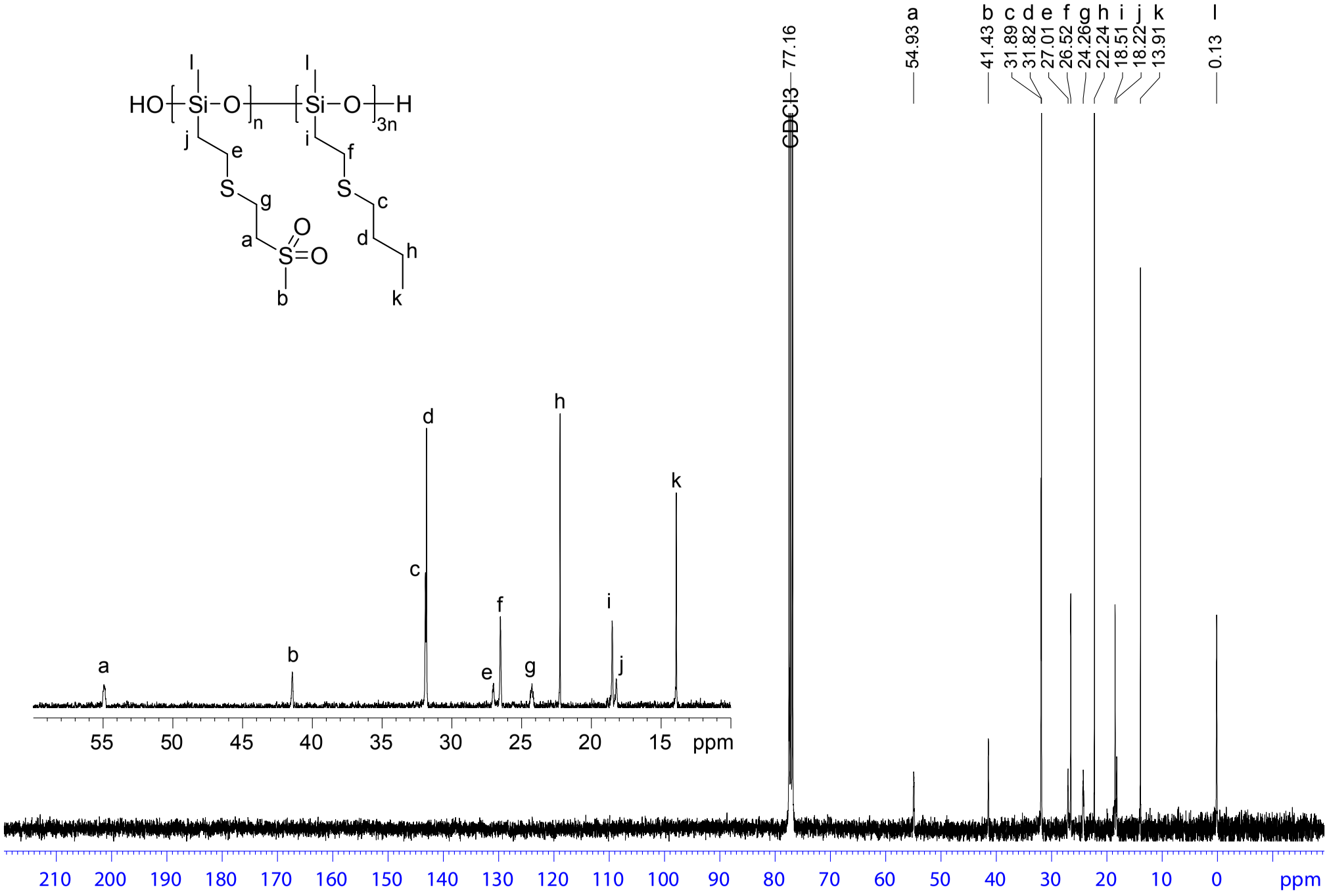
Temperature (°C)

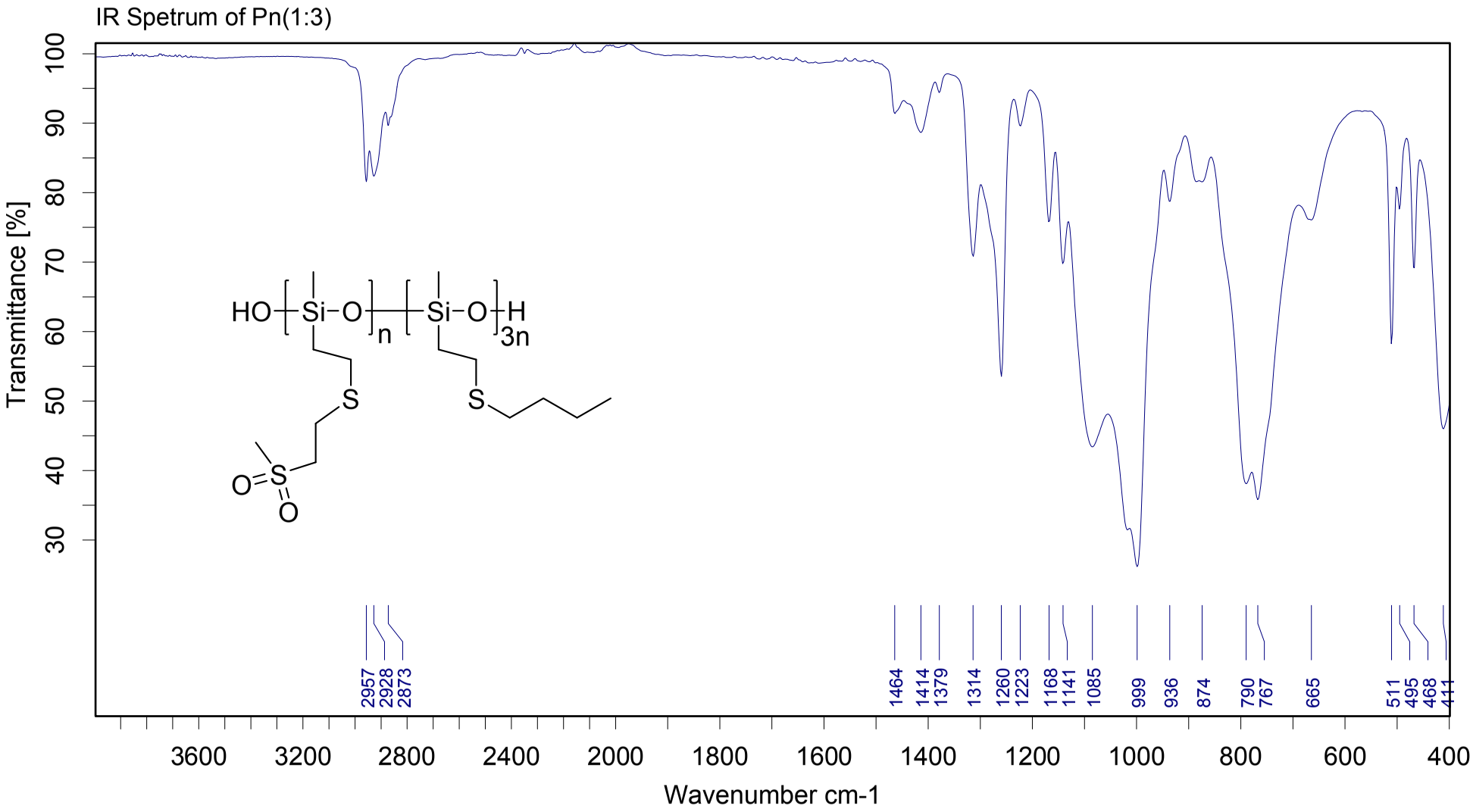
1) Heat from -90.00°C to 100.00°C at 20.00°C/min
2) Cool from 100.00°C to -90.00°C at 20.00°C/min
3) Hold for 5.0 min at -90.00°C
4) Heat from -90.00°C to 100.00°C at 20.00°C/min

1H NMR of Pn(1:3)

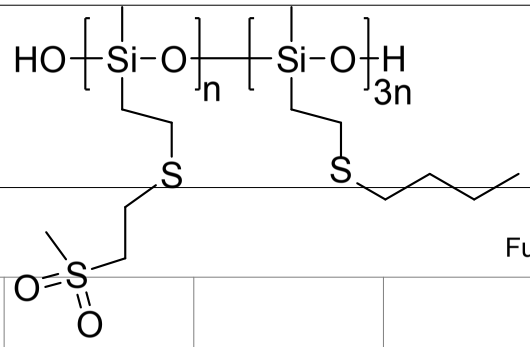


13C NMR of Pn(1:3)




IR Spetrum of Pn(1:3)
Transmittance [%]
100
90
80
70
60
50
40
30
HO
Si
O
n
Si
O
H
3n
S
S
O
S
O
2957
2928
2873
1464
1414
1379
1314
1260
1223
1168
1141
1085
999
936
874
790
767
665
511
495
468
441
3600
3200
2800
2400
2000
1800
1600
1400
1200
1000
800
600
400
Wavenumber cm-1

DSC of Pn(1:3)



Heat Flow Endo Up (mW) : Step: 1
Heat Flow Endo Up (mW) : Step: 2
Heat Flow Endo Up (mW) : Step: 4

Funktionspolymere

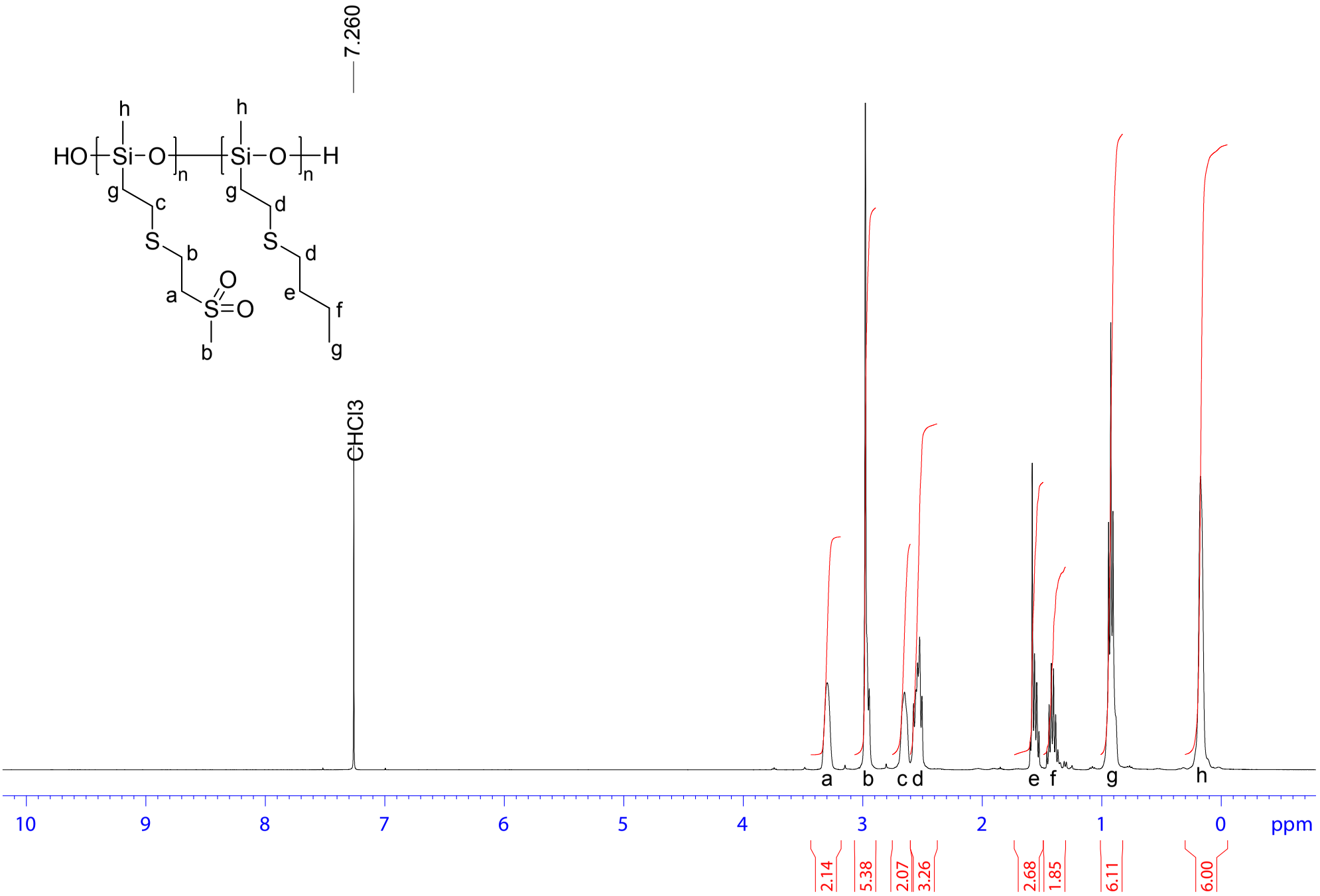
Delta Cp = 0.438 J/g*°C
Delta Cp = 0.410 J/g*°C
Tg: Half Cp Extrapolated = -71.35 °C
Tg: Half Cp Extrapolated = -72.64 °C
Tg: Half Cp Extrapolated = -73.39 °C
Delta Cp = 0.315 J/g*°C

Heat Flow Endo Up (mW)
30
28
26
24
22
20
18
16
14
12
10

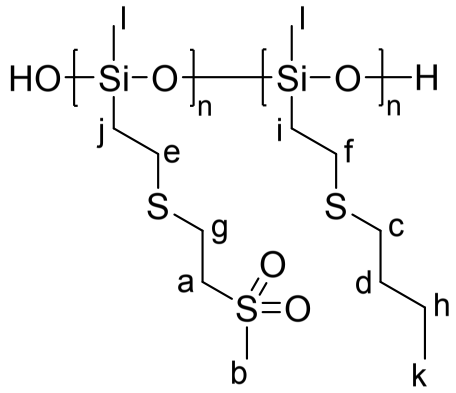
-120 -100 -80 -60 -40 -20 0 20 40 60 80 100
Temperature (°C)

1) Heat from -120.00°C to 100.00°C at 20.00°C/min
2) Cool from 100.00°C to -120.00°C at 20.00°C/min
3) Hold for 5.0 min at -120.00°C
4) Heat from -120.00°C to 100.00°C at 20.00°C/min

1H NMR of Pn(1:1)

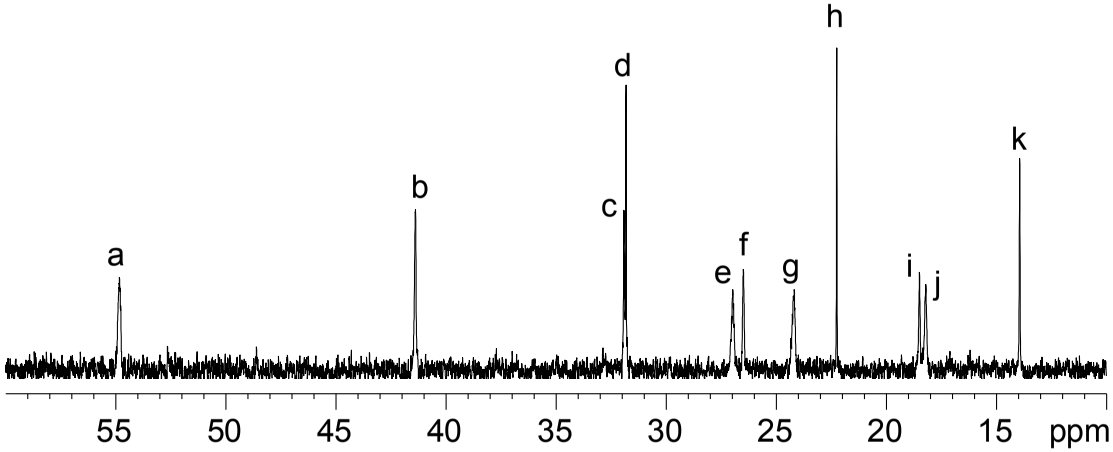


13C NMR of Pn(1:1)

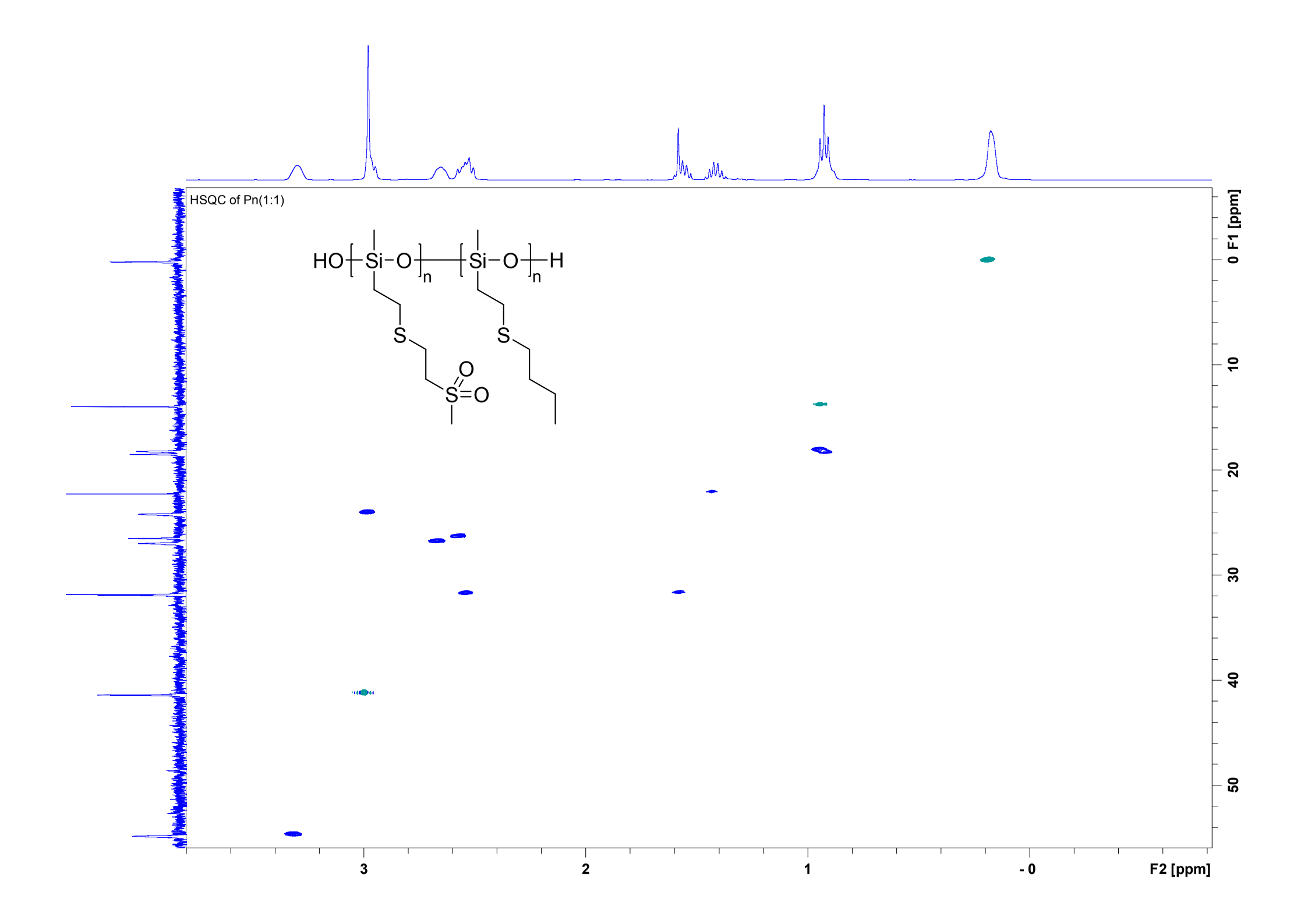


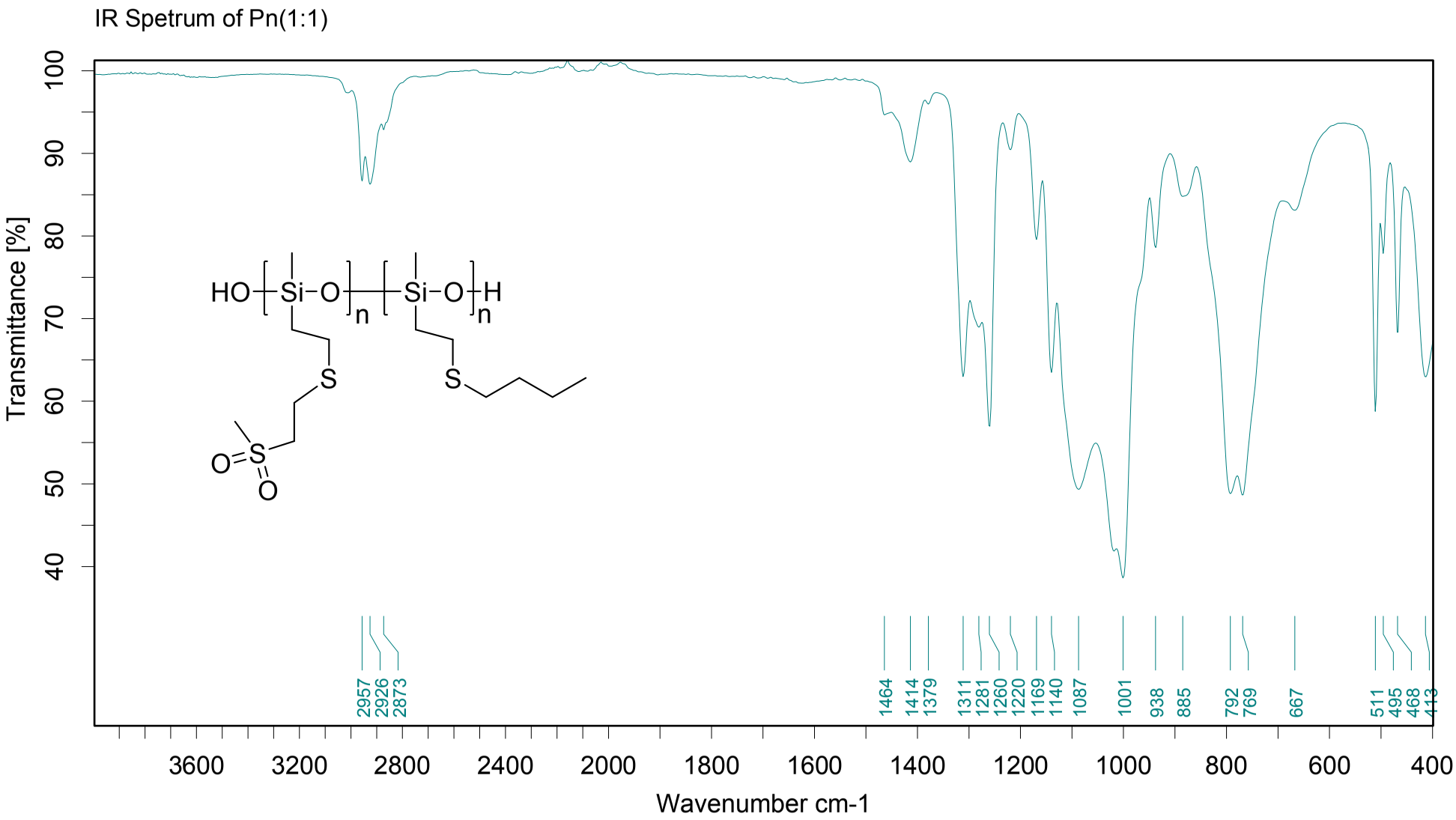
77.16 CDCl3

a 54.83 | b 41.38 | c 31.91 | d 31.82 | e 26.97 | f 26.49 | g 24.18 | h 22.25 | i 18.49 | j 18.21 | k 13.94 | l 0.19

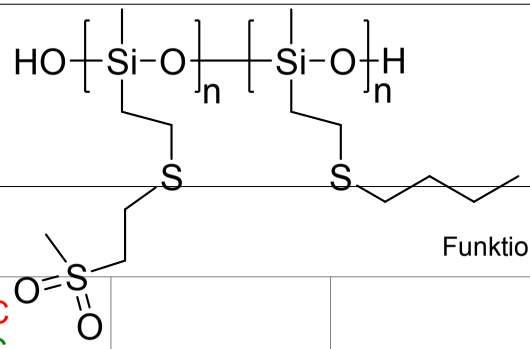


210 200 190 180 170 160 150 140 130 120 110 100 90 80 70 60 50 40 30 20 10 0 ppm


HSQC of Pn(1:1)
HO
Si
O
n
Si
O
n
H
S
S
O
S
O
0
10
20
30
40
50
F1 [ppm]
3
2
1
- 0
F2 [ppm]


IR Spetrum of Pn(1:1)
Transmittance [%]
100
90
80
70
60
50
40
HO
Si
O
n
Si
O
H
n
S
S
O
S
O
2957
2926
2873
1464
1414
1379
1311
1281
1260
1220
1169
1140
1087
1001
938
885
792
769
667
511
495
468
413
3600
3200
2800
2400
2000
1800
1600
1400
1200
1000
800
600
400
Wavenumber cm-1

DSC of Pn(1:1)



Heat Flow Endo Up (mW) : Step: 1
Heat Flow Endo Up (mW) : Step: 2
Heat Flow Endo Up (mW) : Step: 4

Funktionspolymere

Delta Cp = 0.373 J/g*°C
Delta Cp = 0.374 J/g*°C
Tg: Half Cp Extrapolated = -44.07 °C
Tg: Half Cp Extrapolated = -43.12 °C
Delta Cp = 0.283 J/g*°C
Tg: Half Cp Extrapolated = -48.38 °C

Heat Flow Endo Up (mW)

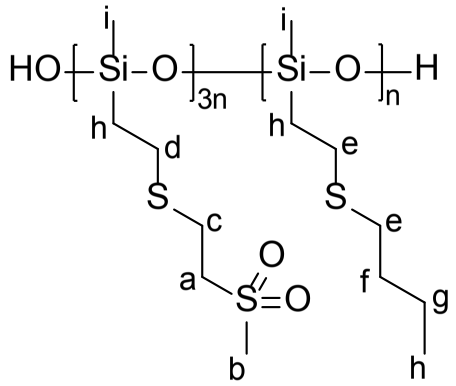
30
28
26
24
22
20
18
16
14
12
10

-90 -80 -60 -40 -20 0 20 40 60 80 100

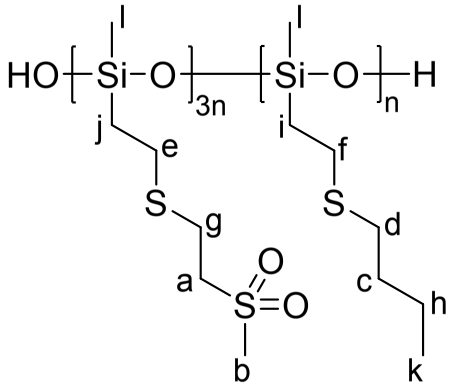
Temperature (°C)

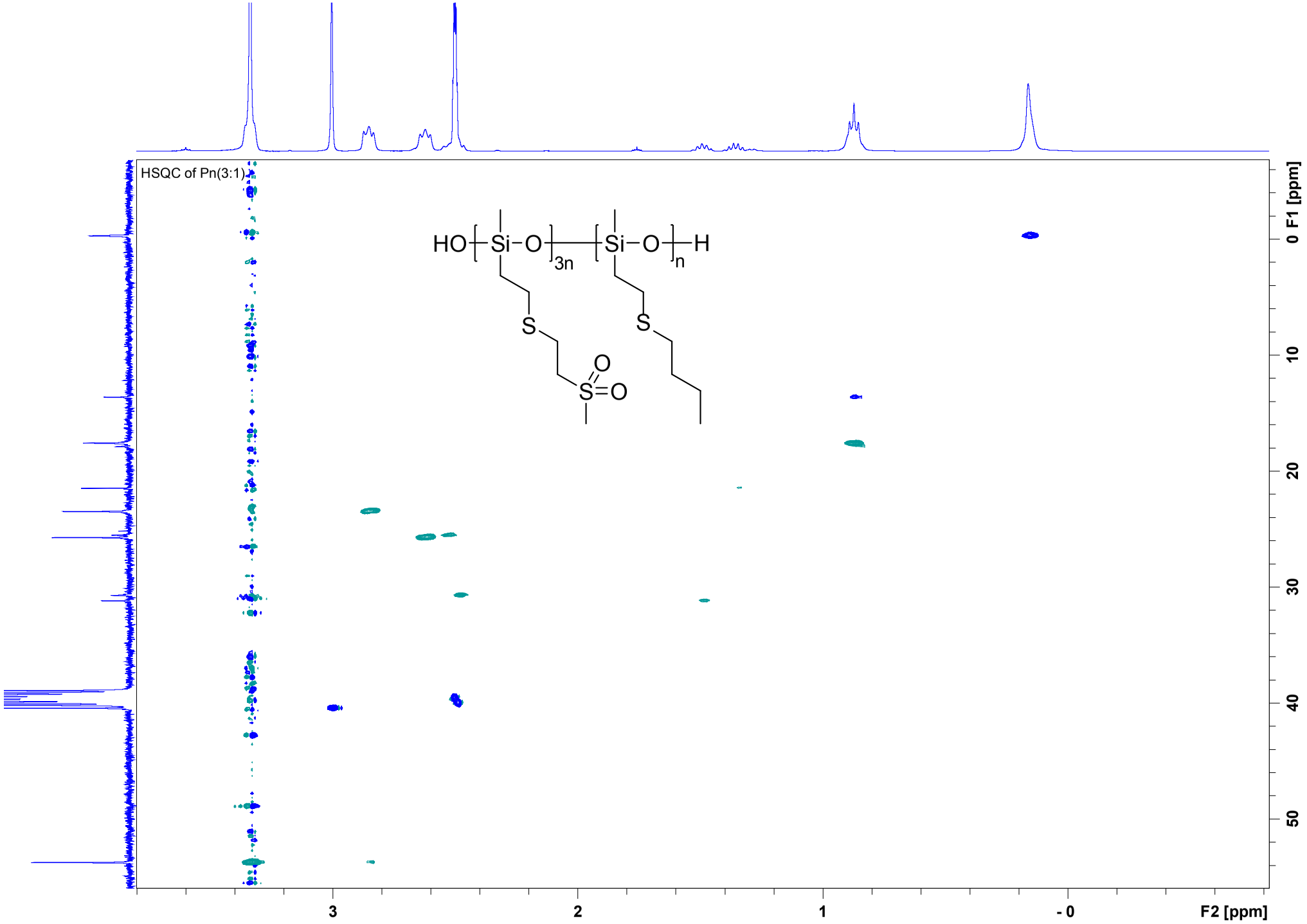
1) Heat from -90.00°C to 100.00°C at 20.00°C/min
2) Cool from 100.00°C to -90.00°C at 20.00°C/min
3) Hold for 5.0 min at -90.00°C
4) Heat from -90.00°C to 100.00°C at 20.00°C/min

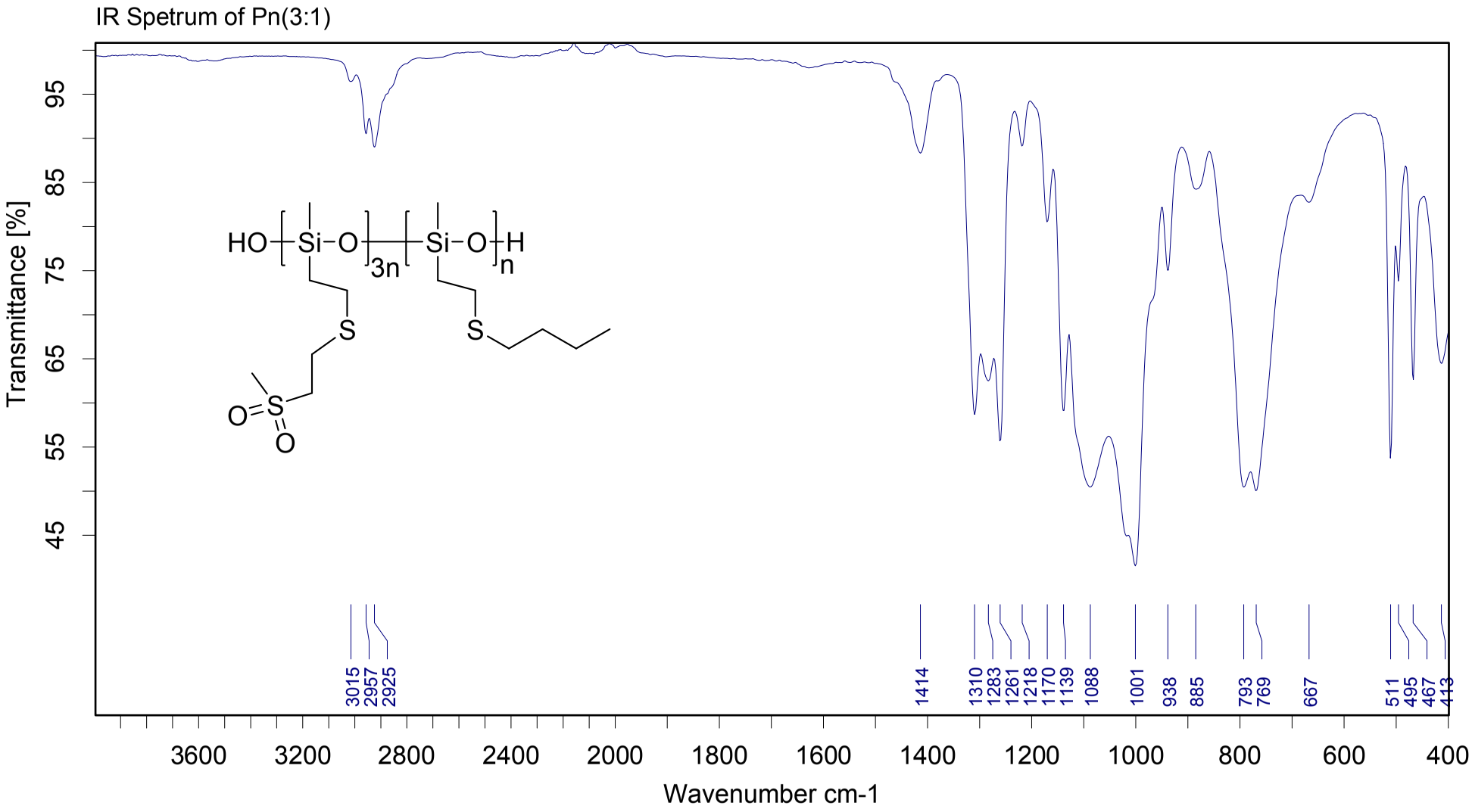
1H NMR of Pn(3:1)



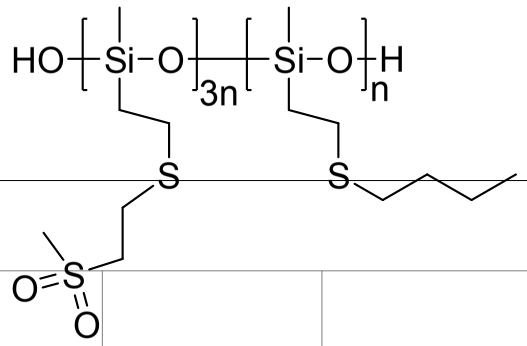
13 C NMR of Pn(3:1)




HSQC of Pn(3:1)
HO
Si
O
3n
Si
O
n
H
S
S
O
S
O
0
F1 [ppm]
10
20
30
40
50
3
2
1
- 0
F2 [ppm]


IR Spetrum of Pn(3:1)
Transmittance [%]
95
85
75
65
55
45
HO
Si
O
3n
Si
O
H
n
S
S
O
S
O
3015
2957
2925
1414
1310
1283
1261
1218
1170
1139
1088
1001
938
885
793
769
667
511
495
467
413
3600
3200
2800
2400
2000
1800
1600
1400
1200
1000
800
600
400
Wavenumber cm-1

DSC of Pn(3:1)



Heat Flow Endo Up (mW) : Step: 1
Heat Flow Endo Up (mW) : Step: 2
Heat Flow Endo Up (mW) : Step: 4

Funktionspolymere

Delta Cp = 0.410 J/g*°C
Delta Cp = 0.428 J/g*°C
Tg: Half Cp Extrapolated = -27.86 °C
Tg: Half Cp Extrapolated = -26.31 °C
Delta Cp = 0.332 J/g*°C
Tg: Half Cp Extrapolated = -33.53 °C

Heat Flow Endo Up (mW)

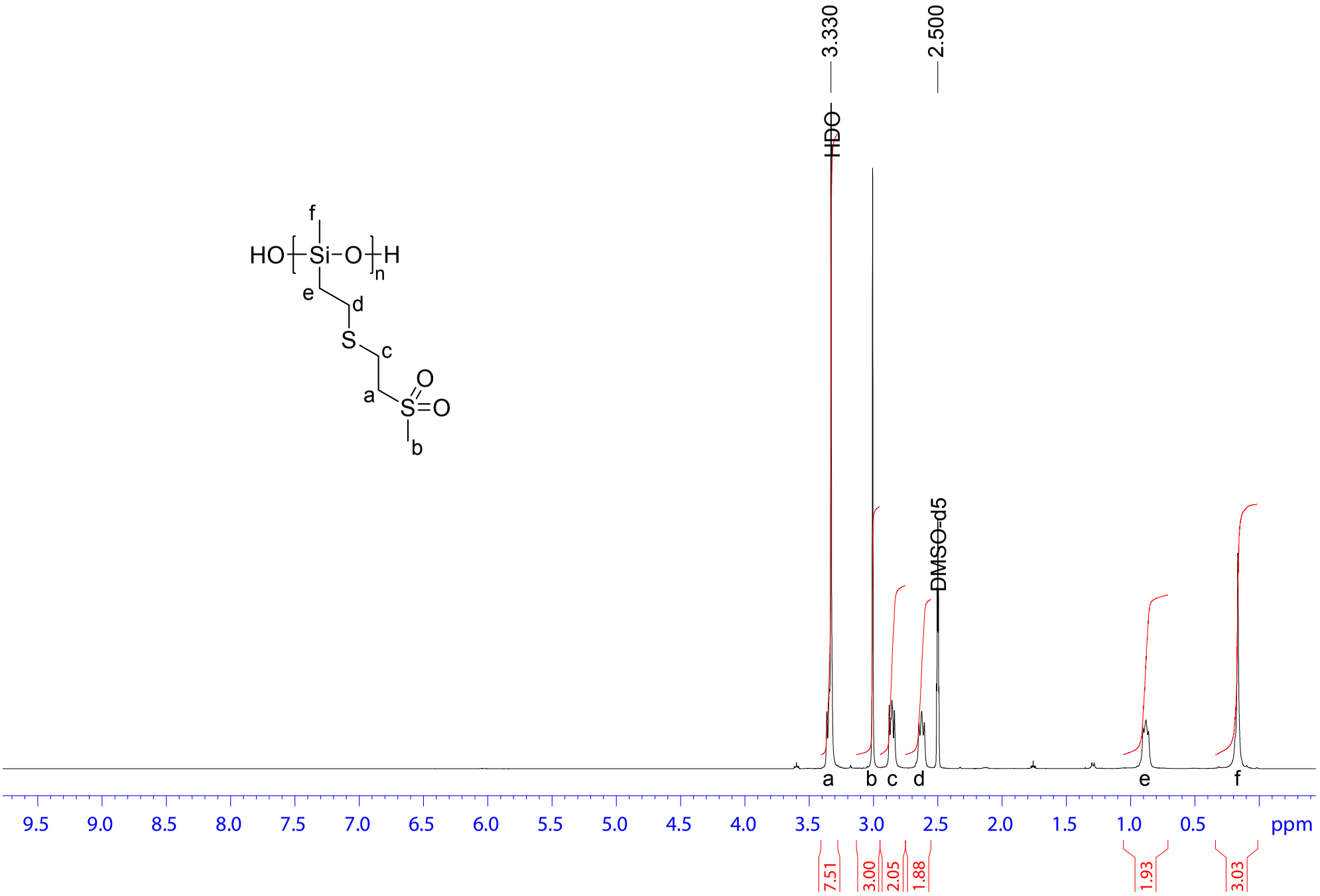
30
28
26
24
22
20
18
16
14
12
10

-90 -80 -60 -40 -20 0 20 40 60 80 100

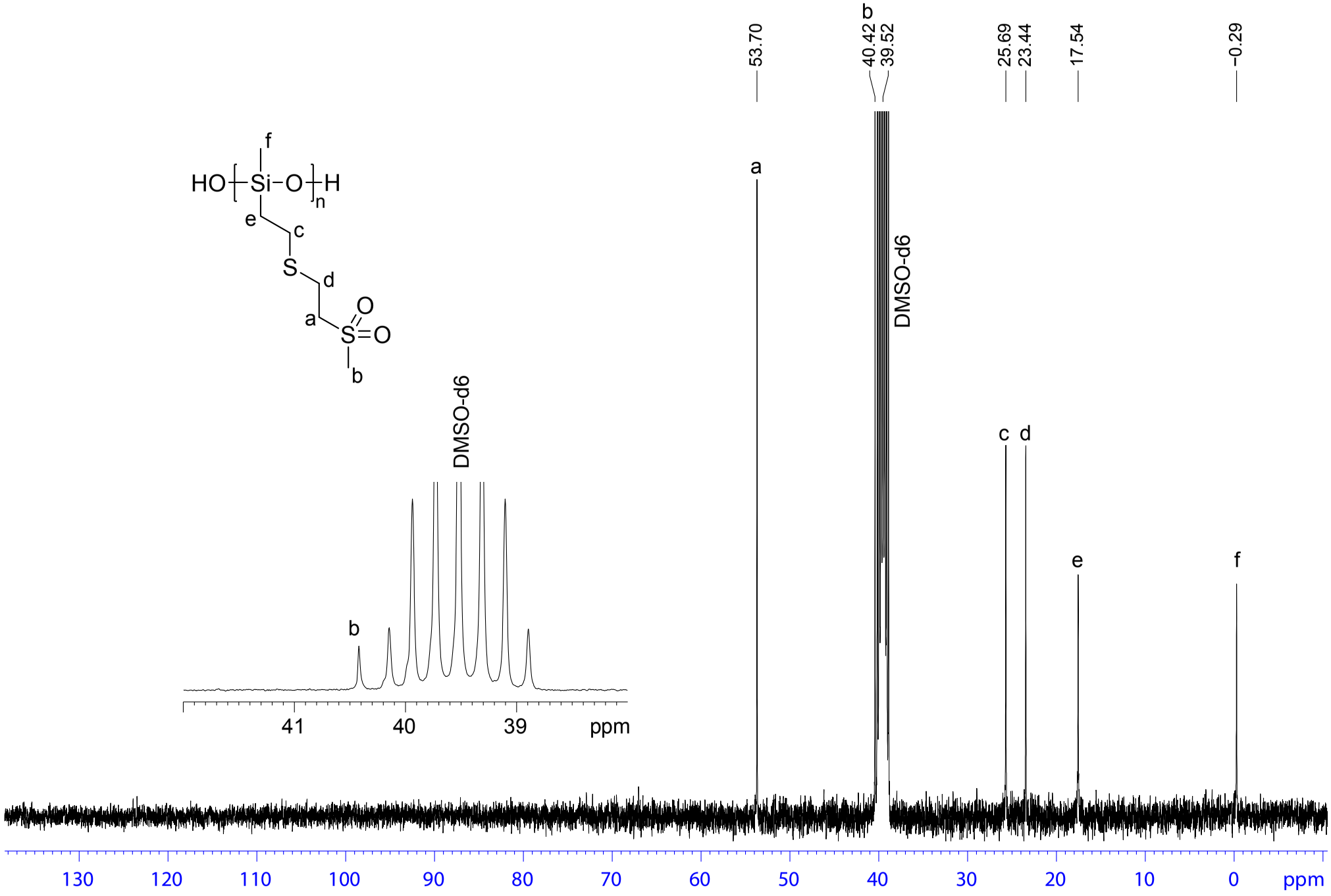
Temperature (°C)

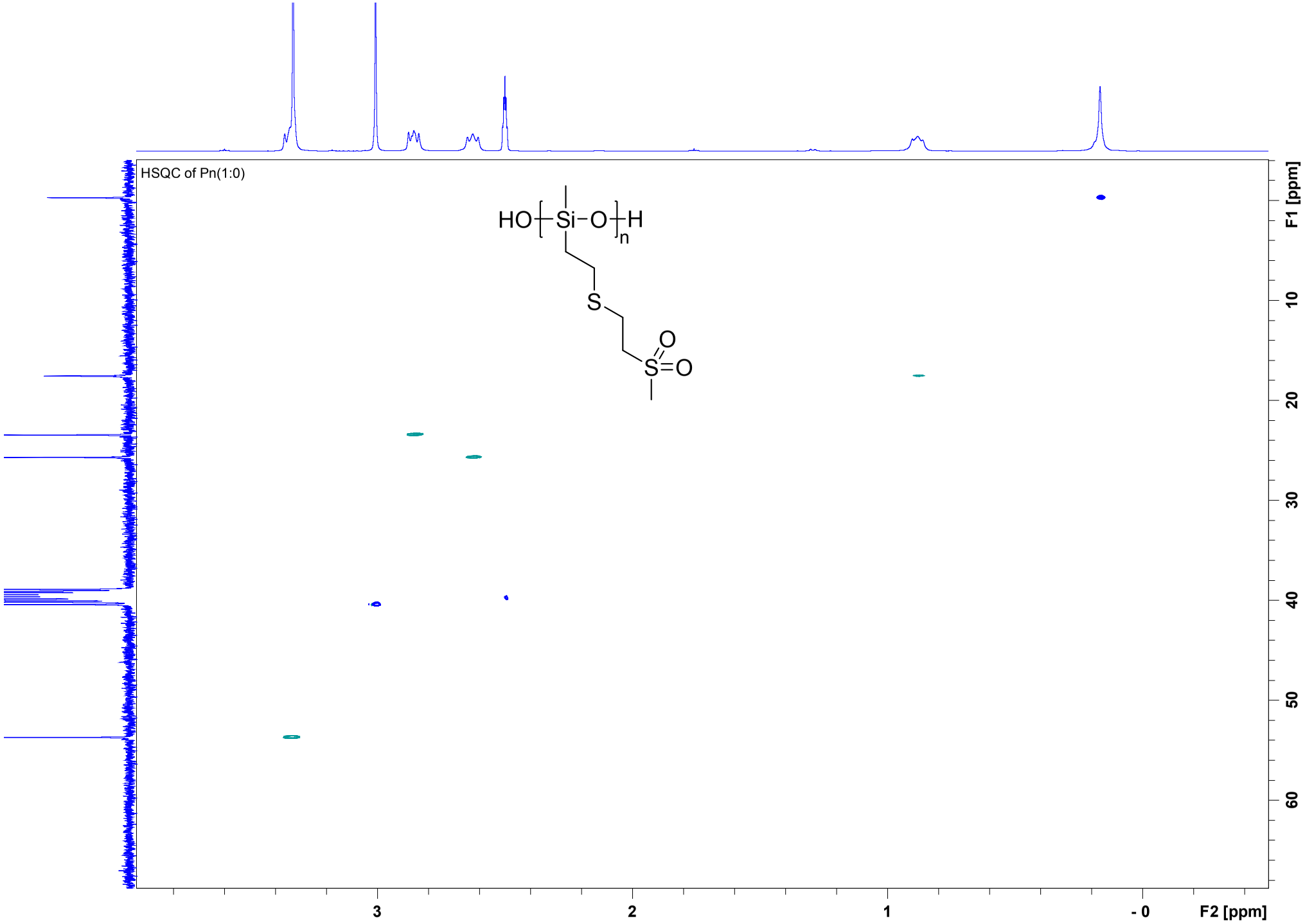
1) Heat from -90.00°C to 100.00°C at 20.00°C/min
2) Cool from 100.00°C to -90.00°C at 20.00°C/min
3) Hold for 5.0 min at -90.00°C
4) Heat from -90.00°C to 100.00°C at 20.00°C/min

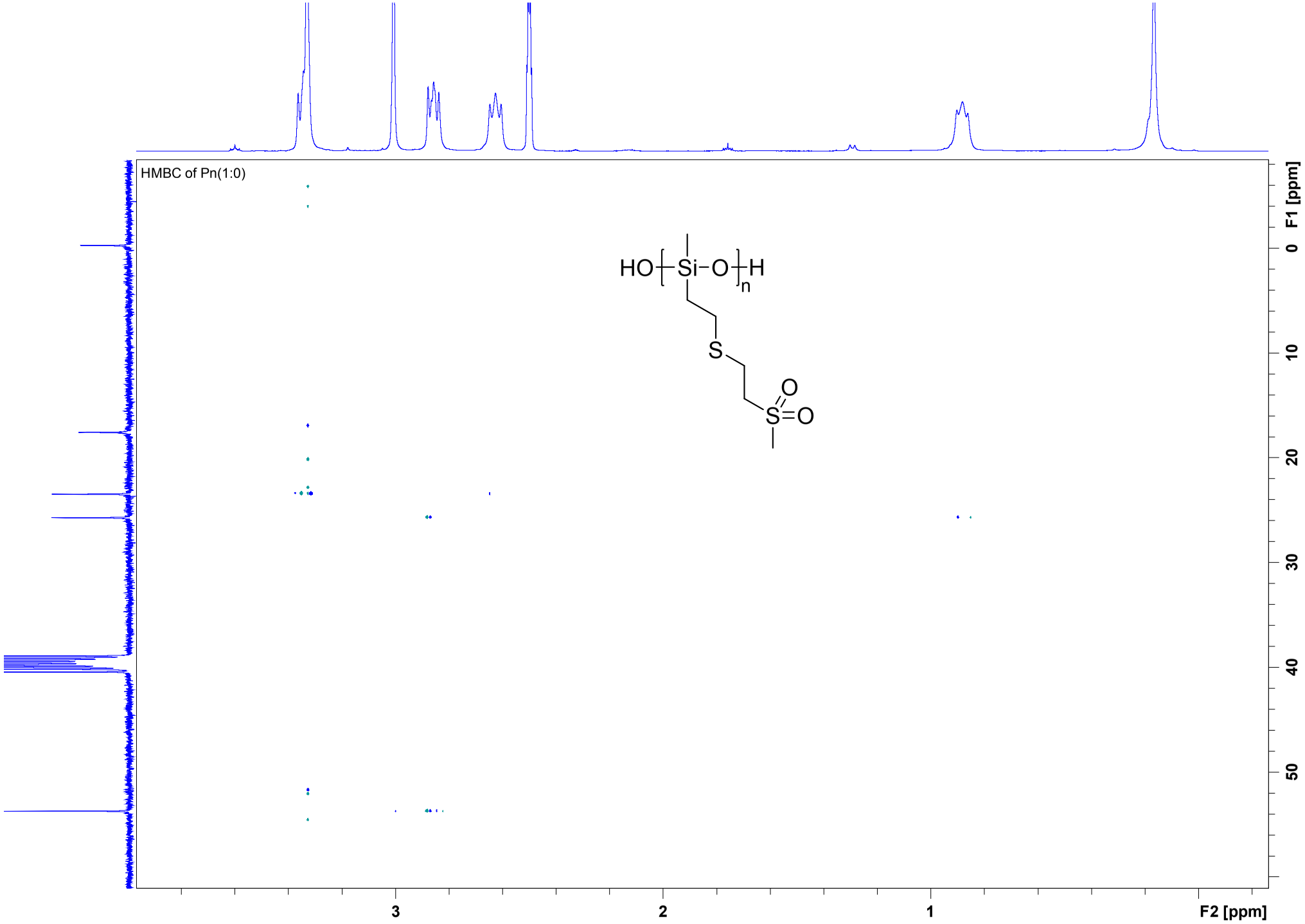
1H NMR of Pn(1:0)

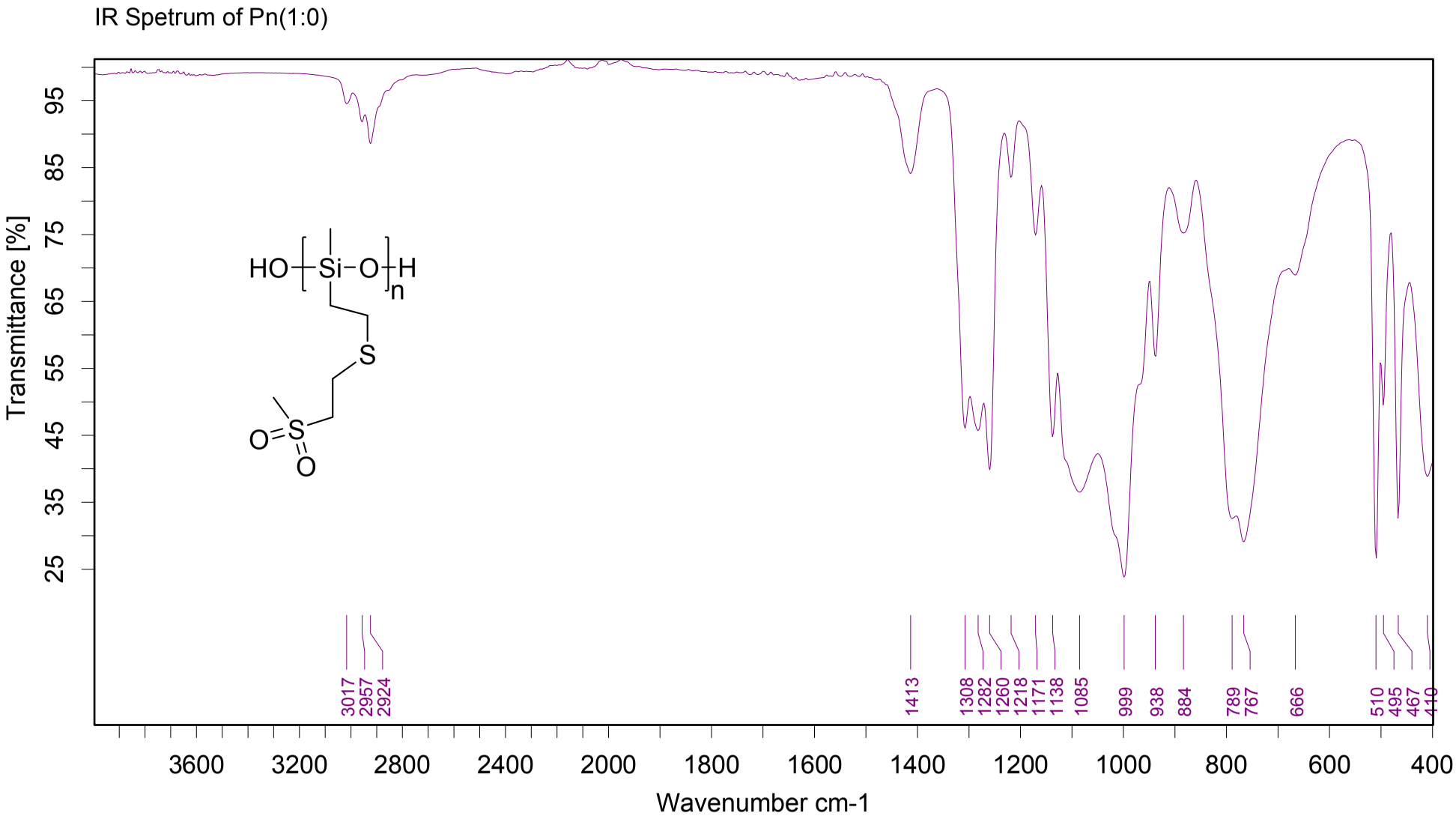


13C NMR of Pn(1:0)

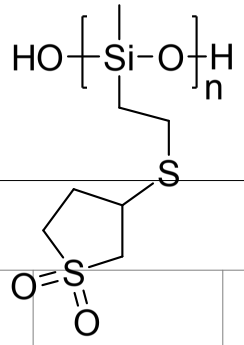



HSQC of Pn(1:0)
HO
Si
O
n
H
S
O
S
O
F1 [ppm]
10
20
30
40
50
60
3
2
1
- 0
F2 [ppm]


HMBC of Pn(1:0)
HO
Si
O
H
n
S
O
S
O
F1 [ppm]
0
10
20
30
40
50
3
2
1
F2 [ppm]


IR Spetrum of Pn(1:0)
Transmittance [%]
95
85
75
65
55
45
35
25
HO
Si
O
H
n
S
O
S
O
3017
2957
2924
1413
1308
1282
1260
1218
1171
1138
1085
999
938
884
789
767
666
510
495
467
410
3600
3200
2800
2400
2000
1800
1600
1400
1200
1000
800
600
400
Wavenumber cm-1

DSC of Pn(1:0)



Heat Flow Endo Up (mW) : Step: 1
Heat Flow Endo Up (mW) : Step: 2
Heat Flow Endo Up (mW) : Step: 4

Funktionspolymere

Delta Cp = 0.474 J/g*°C
Delta Cp = 0.471 J/g*°C
Tg: Half Cp Extrapolated = -20.47 °C
Tg: Half Cp Extrapolated = -19.19 °C
Tg: Half Cp Extrapolated = -24.93 °C
Delta Cp = 0.455 J/g*°C

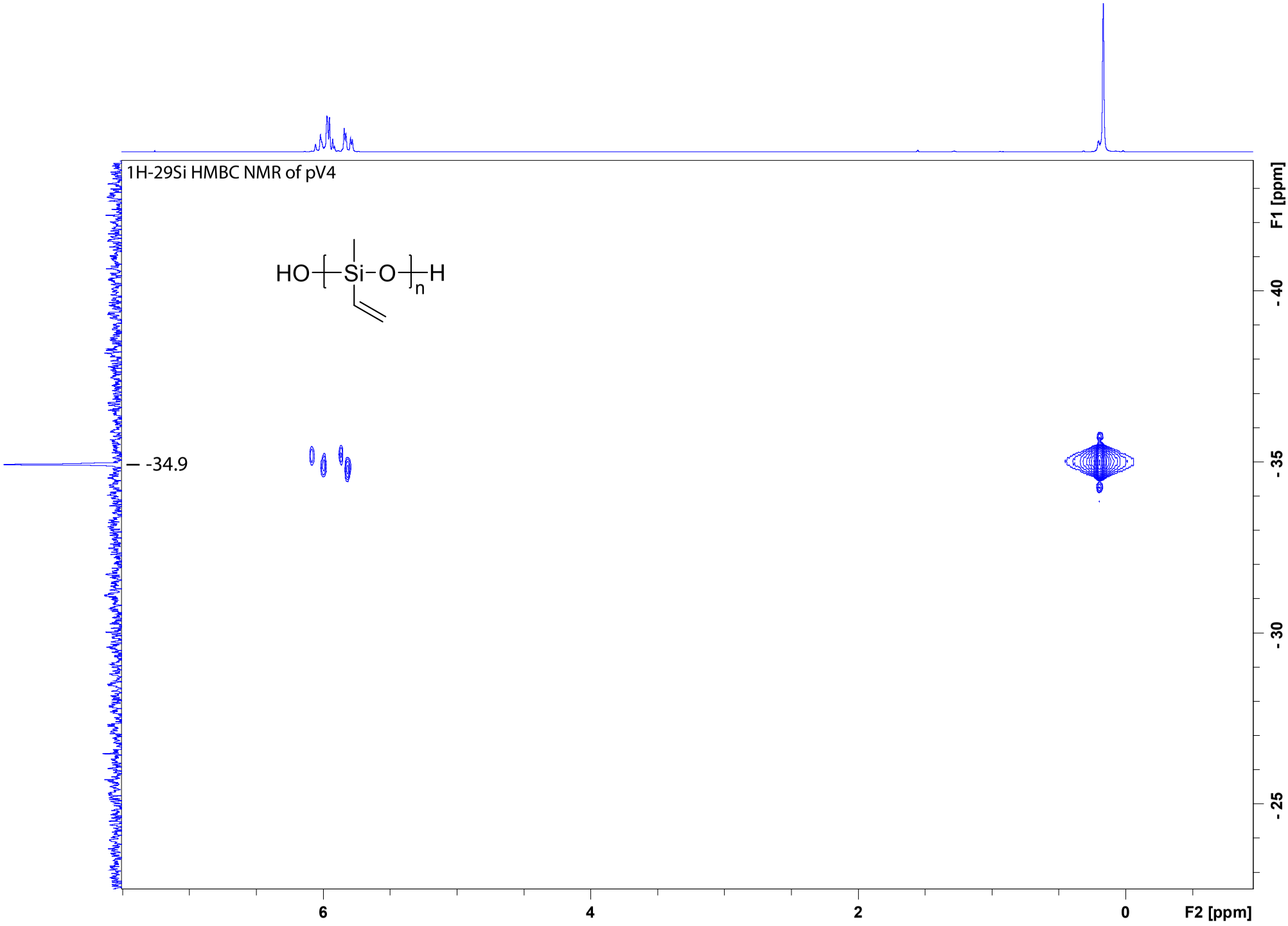
Heat Flow Endo Up (mW)

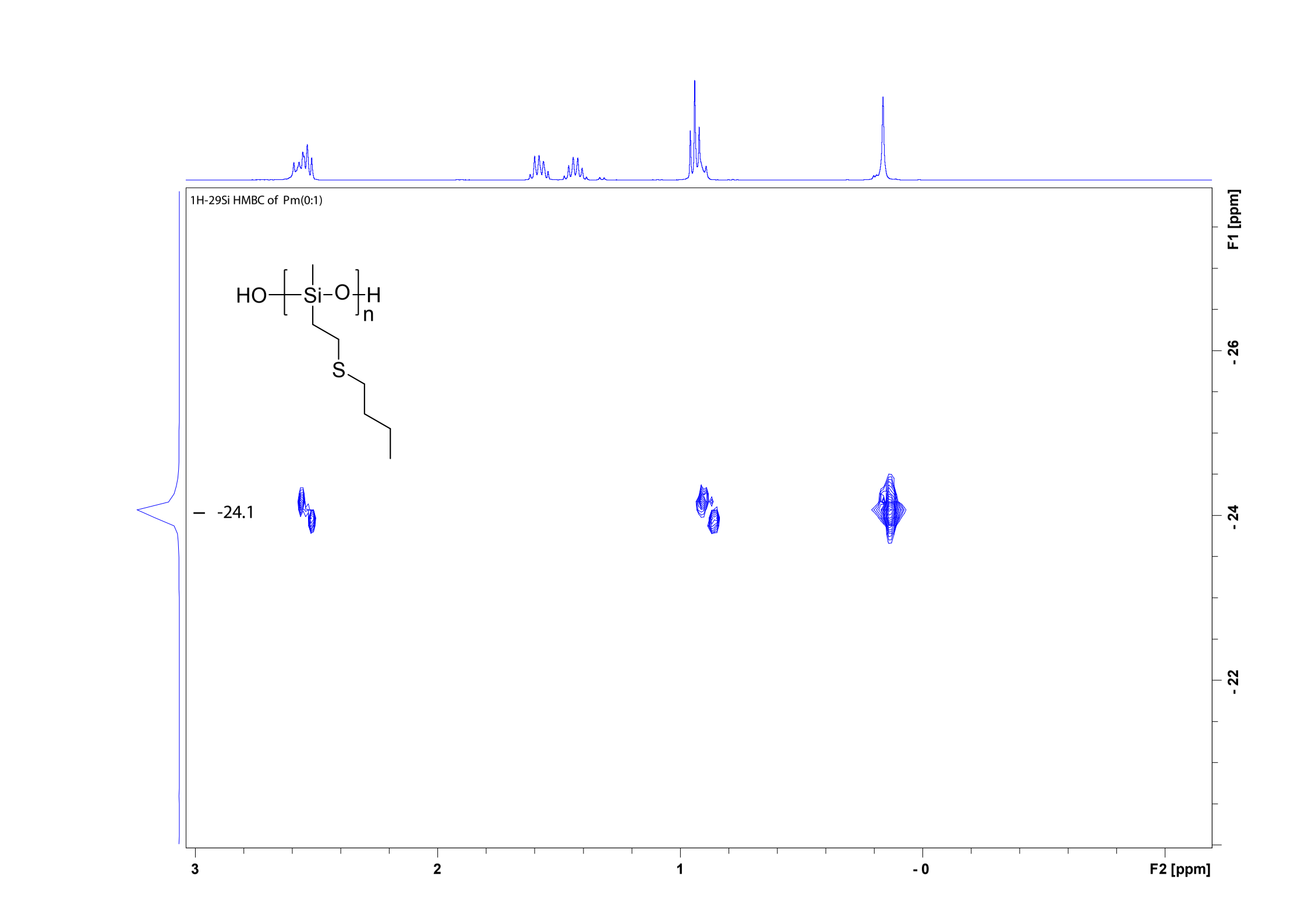
40
35
30
25
20
15
10
5
0

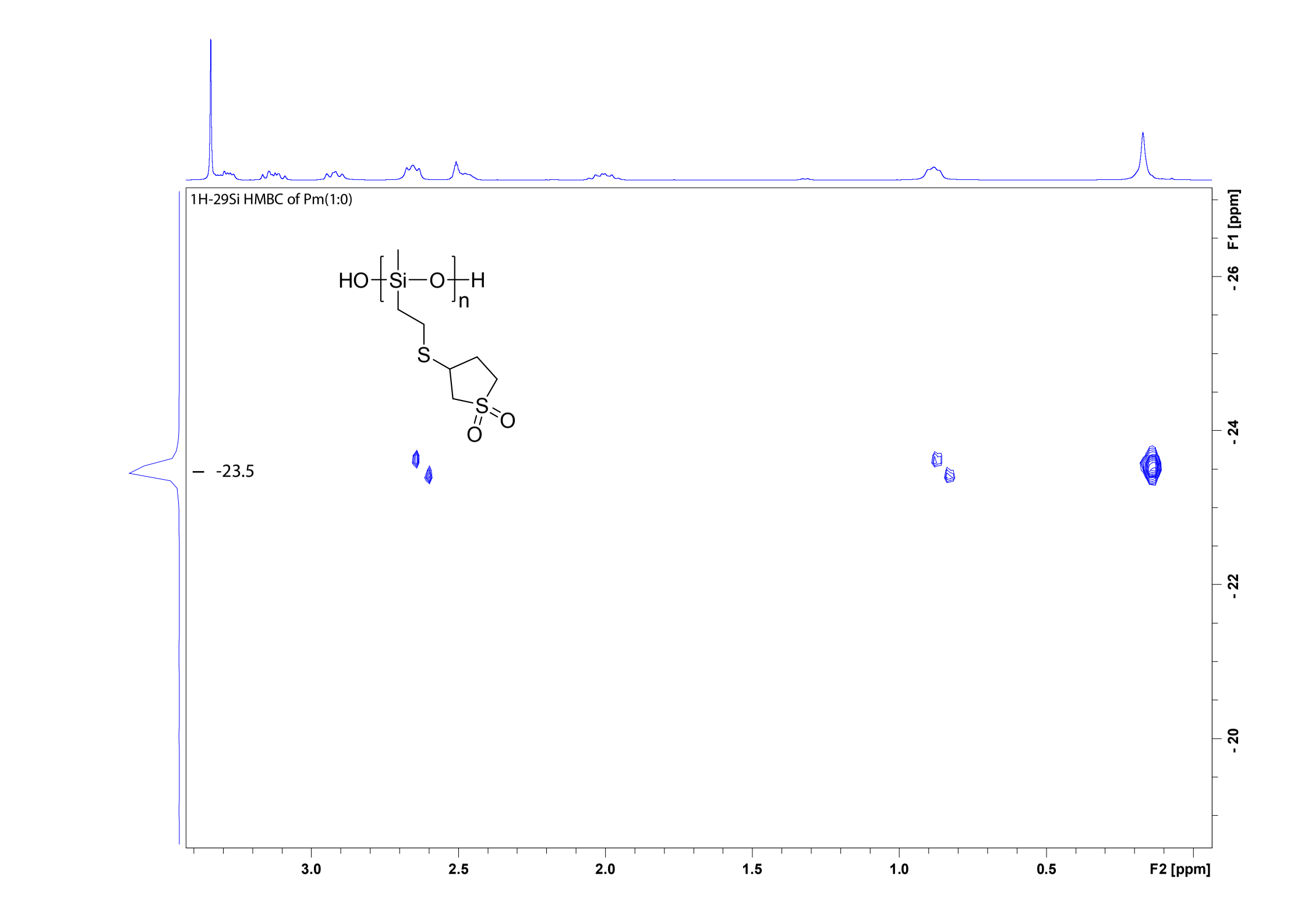
-120 -100 -80 -60 -40 -20 0 20 40 60 80 100

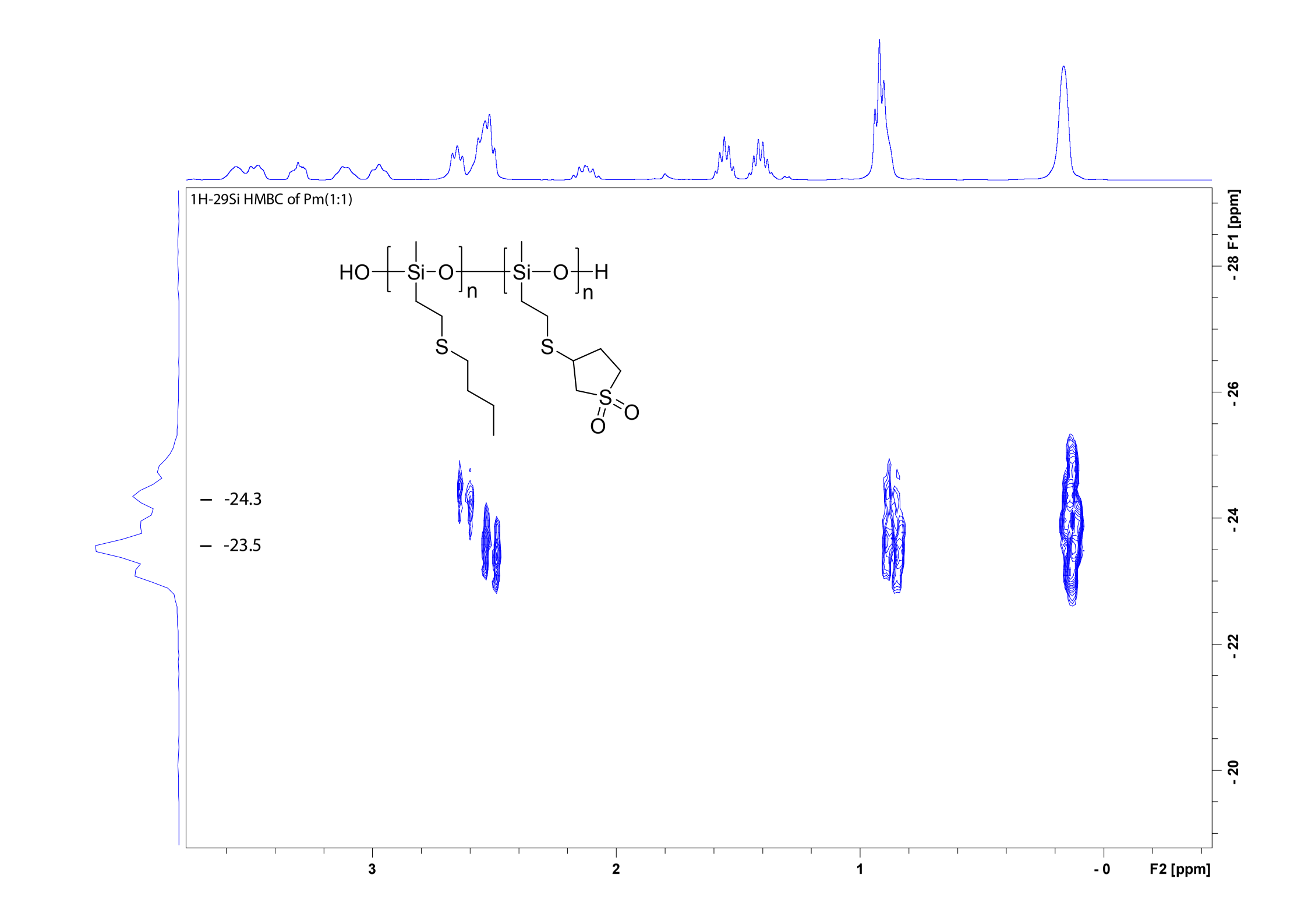
Temperature (°C)

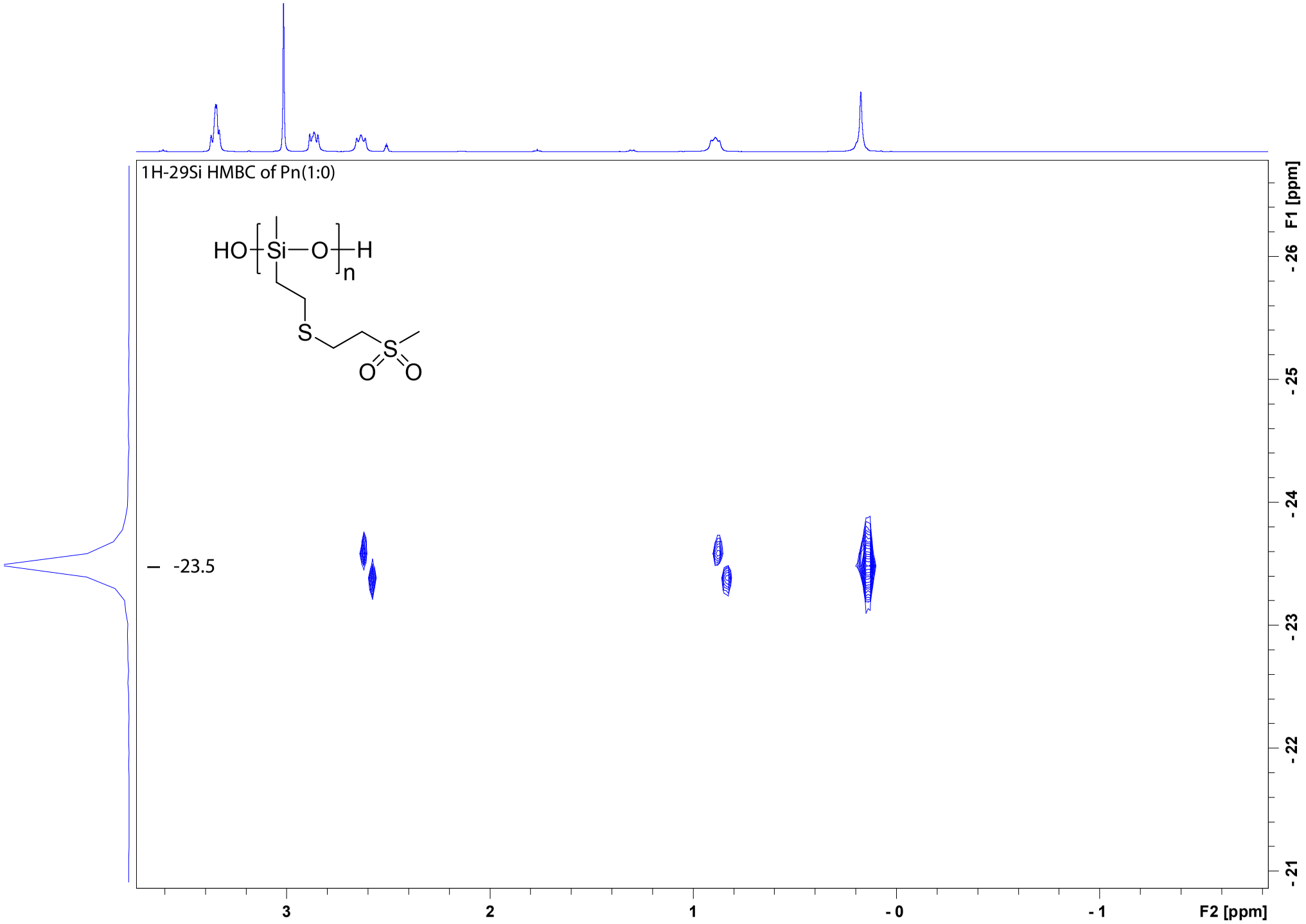
1) Heat from -120.00°C to 100.00°C at 20.00°C/min
2) Cool from 100.00°C to -120.00°C at 20.00°C/min
3) Hold for 5.0 min at -120.00°C
4) Heat from -120.00°C to 100.00°C at 20.00°C/min

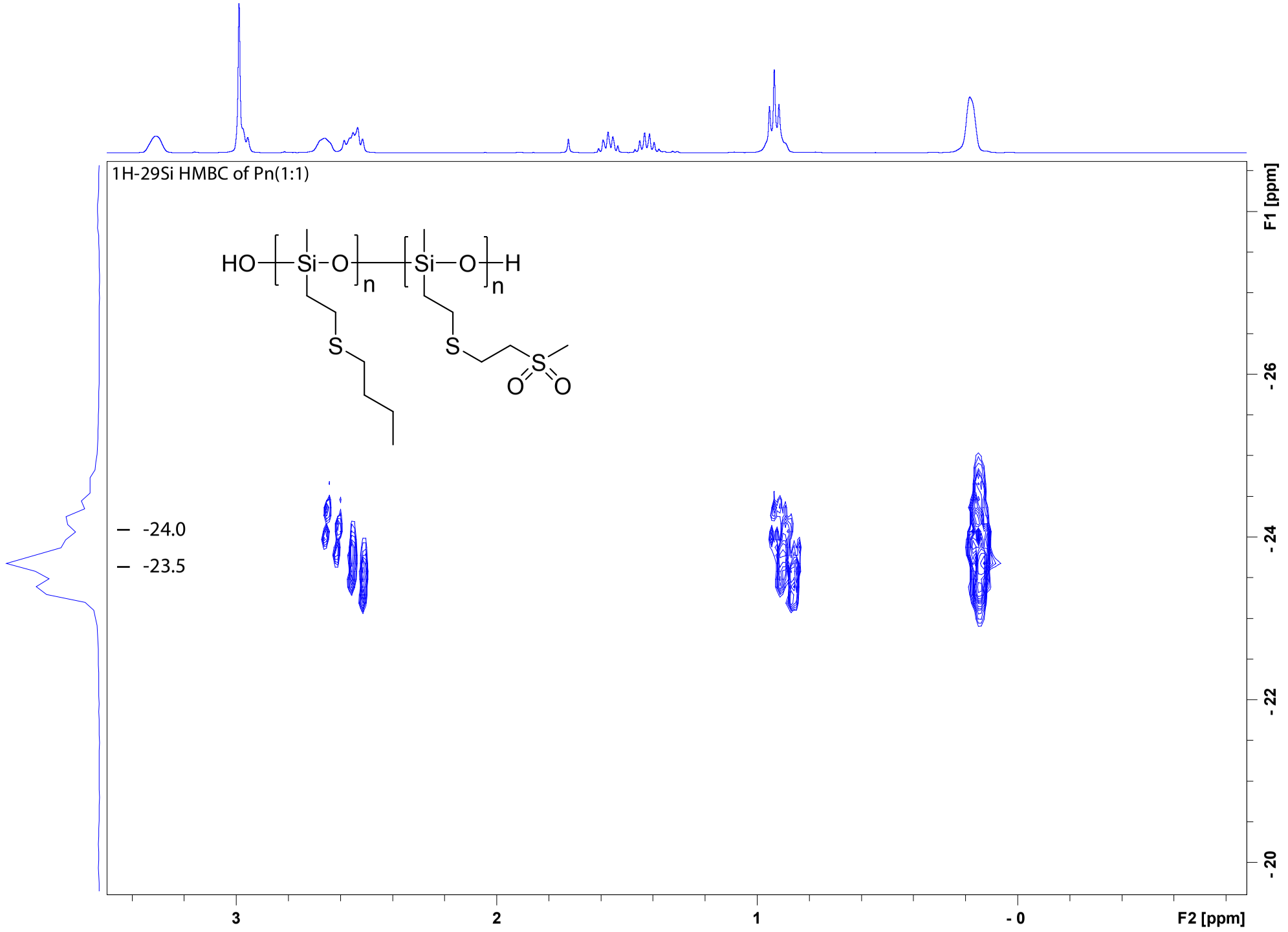

1H-29Si HMBC NMR of pV4
HO
Si
O
n
H
-34.9
6
4
2
0
F2 [ppm]
- 40
- 35
- 30
- 25
F1 [ppm]


1H-29Si HMBC of Pm(0:1)
HO
Si
O
H
n
S
-24.1
F1 [ppm]
- 26
- 24
- 22
3
2
1
- 0
F2 [ppm]


1H-29Si HMBC of Pm(1:0)
HO
Si
O
H
n
S
S
O
O
-23.5
F1 [ppm]
- 26
- 24
- 22
- 20
3.0
2.5
2.0
1.5
1.0
0.5
F2 [ppm]


1H-29Si HMBC of Pm(1:1)
HO
Si
O
n
Si
O
n
H
S
S
S
O
O
-24.3
-23.5
- 28 F1 [ppm]
- 26
- 24
- 22
- 20
3
2
1
- 0
F2 [ppm]


1H-29Si HMBC of Pn(1:0)
HO
Si
O
H
n
S
S
O
O
-23.5
F1 [ppm]
- 26
- 25
- 24
- 23
- 22
- 21
3
2
1
- 0
- 1
F2 [ppm]


1H-29Si HMBC of Pn(1:1)
HO
Si
O
n
Si
O
H
n
S
S
S
O
O
-24.0
-23.5
F1 [ppm]
- 26
- 24
- 22
- 20
3
2
1
- 0
F2 [ppm]