

## 8 Anhang

### 8.1 NMR-Spektren

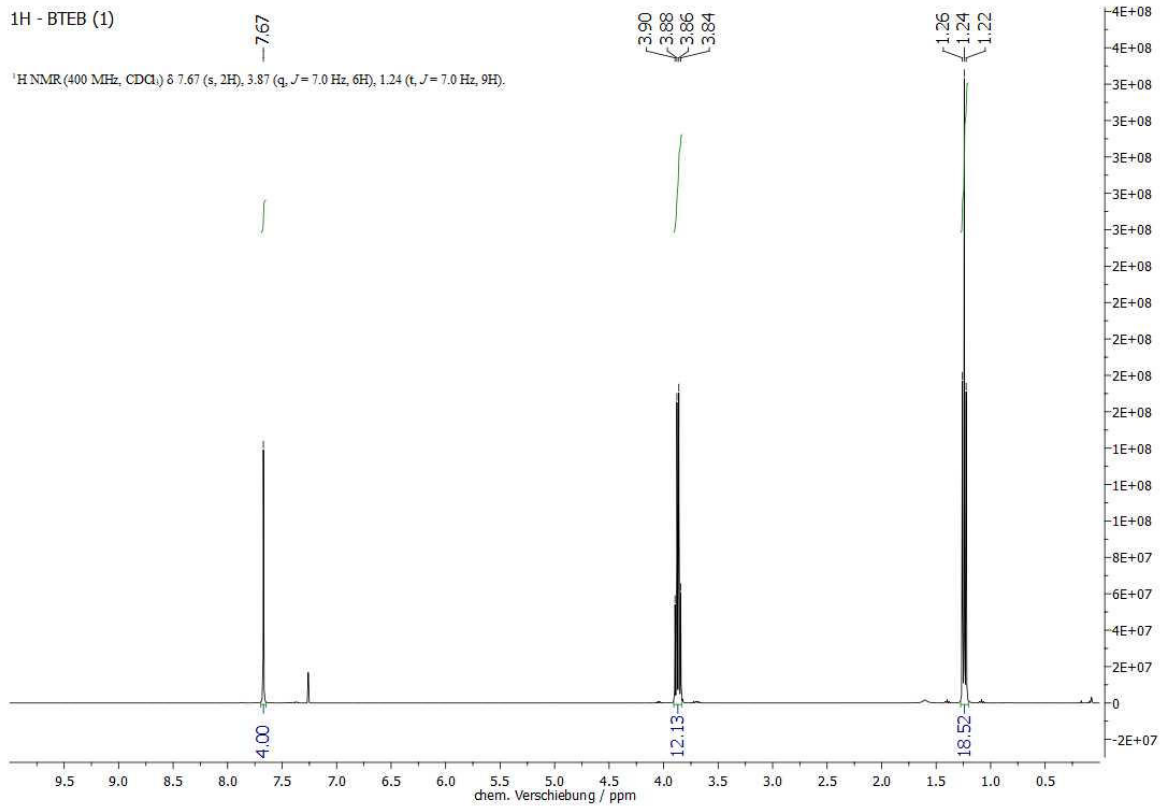


Abb. 8.1: <sup>1</sup>H-NMR-Spektrum (400 MHz, CDCl<sub>3</sub>, 298 K) von 1,4-Bis(triethoxysilyl)benzol (1).

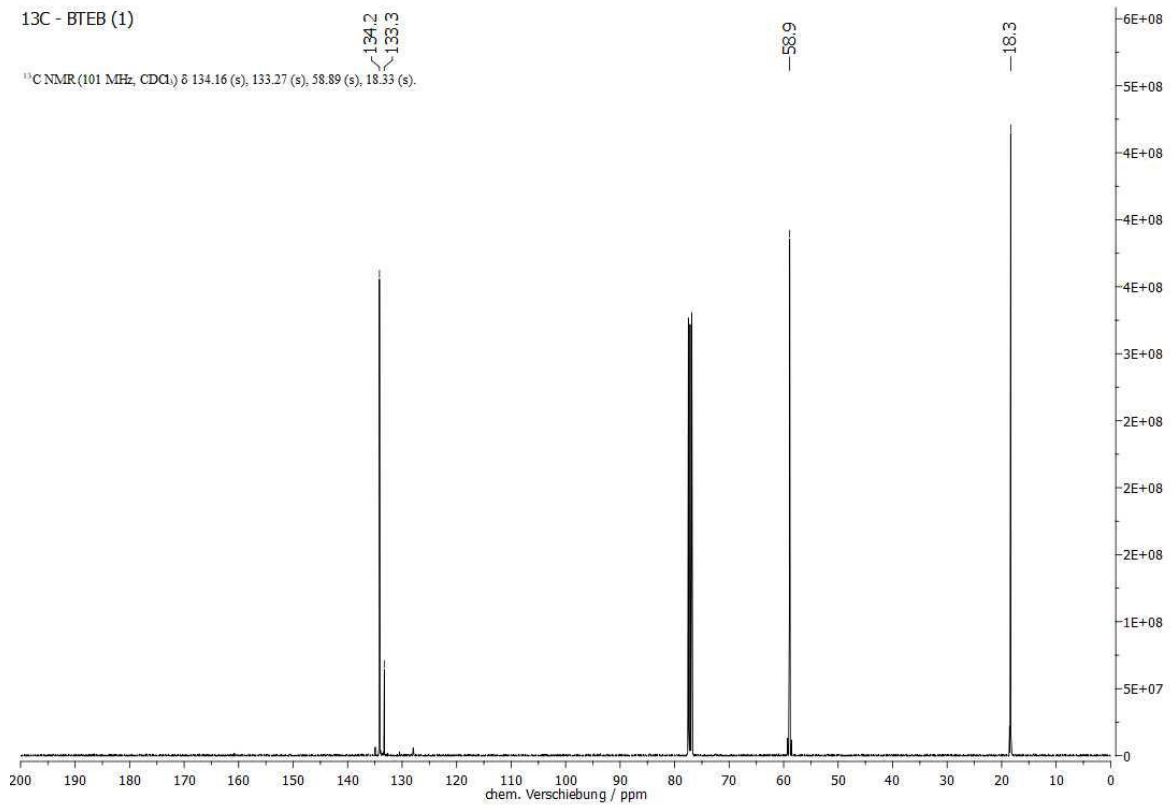


Abb. 8.2: <sup>13</sup>C-NMR-Spektrum (101 MHz, CDCl<sub>3</sub>, 298 K) von 1,4-Bis(triethoxysilyl)benzol (1).

# ANHANG

<sup>29</sup>Si - BTEB (1)

<sup>29</sup>Si NMR (80 MHz, CDCl<sub>3</sub>) δ -57.94 (s).

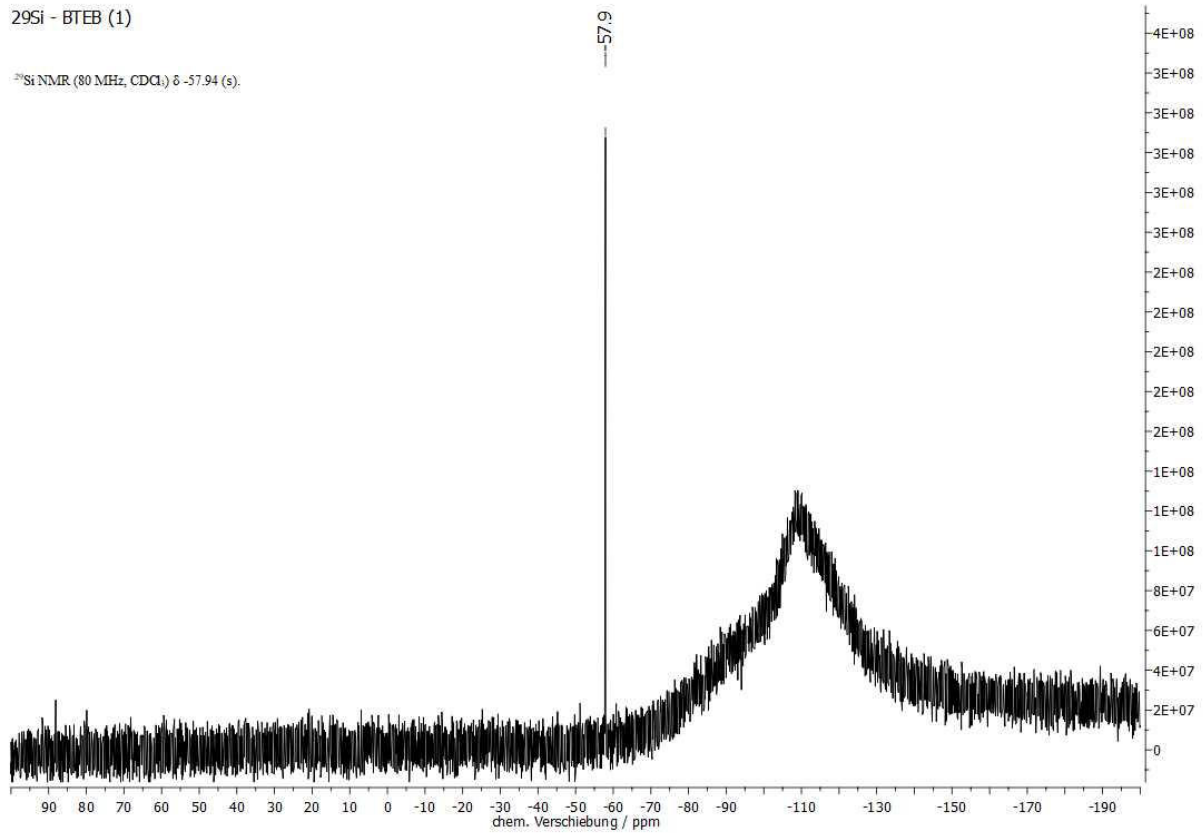


Abb. 8.3: <sup>29</sup>Si-NMR-Spektrum (80 MHz, CDCl<sub>3</sub>, 298 K) von 1,4-Bis(triethoxysilyl)benzol (1).

<sup>29</sup>Si - Cl-BTEB-PMO (5)

<sup>29</sup>Si NMR (99 MHz, ) δ -53.36 (s), -62.69 (s), -74.38 (s), -82.83 (s).

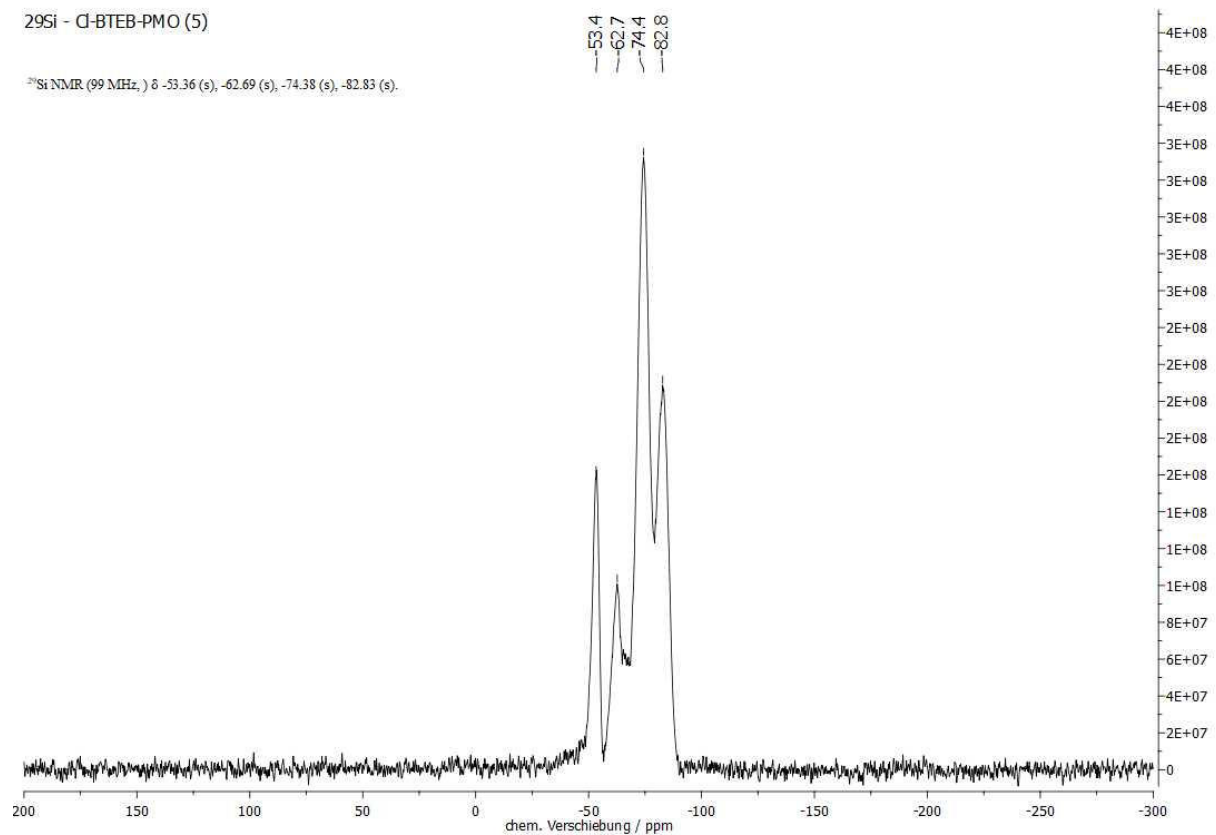


Abb. 8.4: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von Cl-BTEB-PMO (5).

# ANHANG

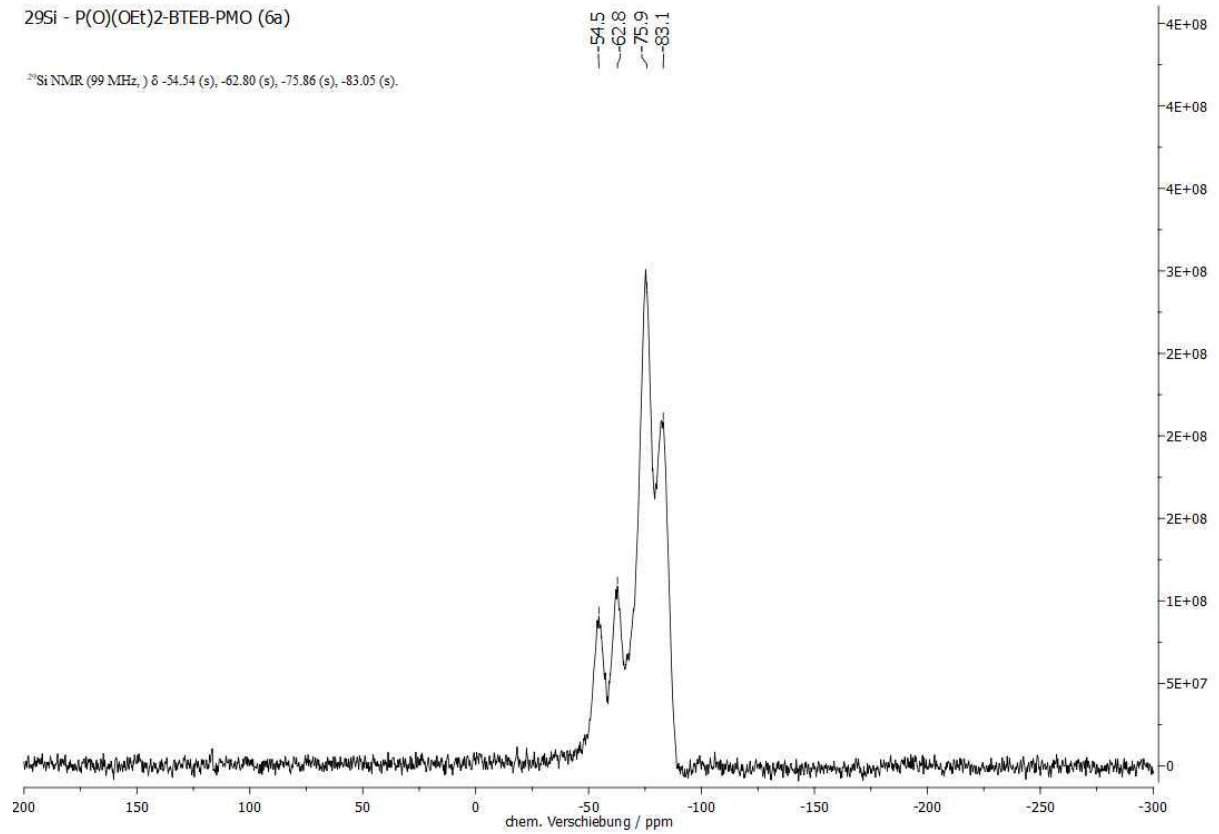


Abb. 8.5:  $^{29}\text{Si}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von P(O)(OEt)<sub>2</sub>-BTEB-PMO (6a).

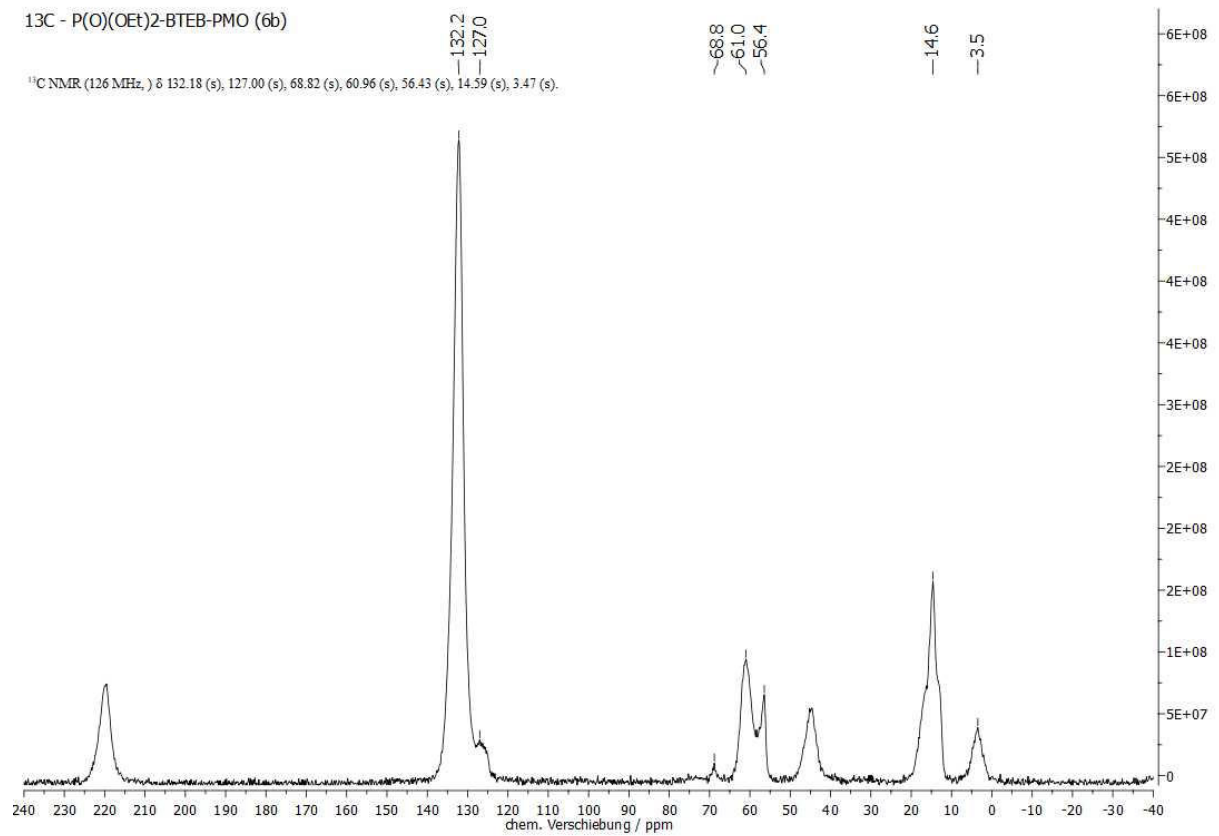


Abb. 8.6:  $^{13}\text{C}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von P(O)(OEt)<sub>2</sub>-BTEB-PMO (6b).

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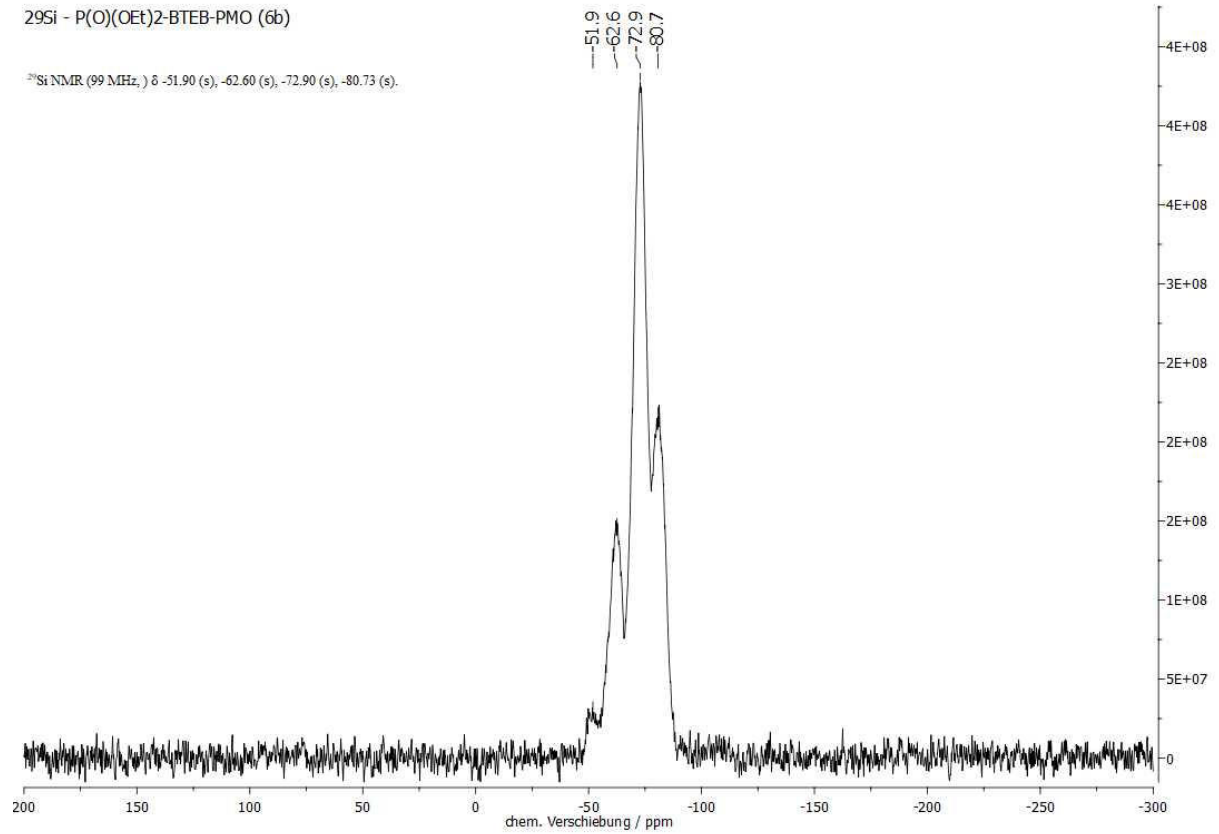


Abb. 8.7:  $^{29}\text{Si}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von P(O)(OEt)<sub>2</sub>-BTEB-PMO (6b).

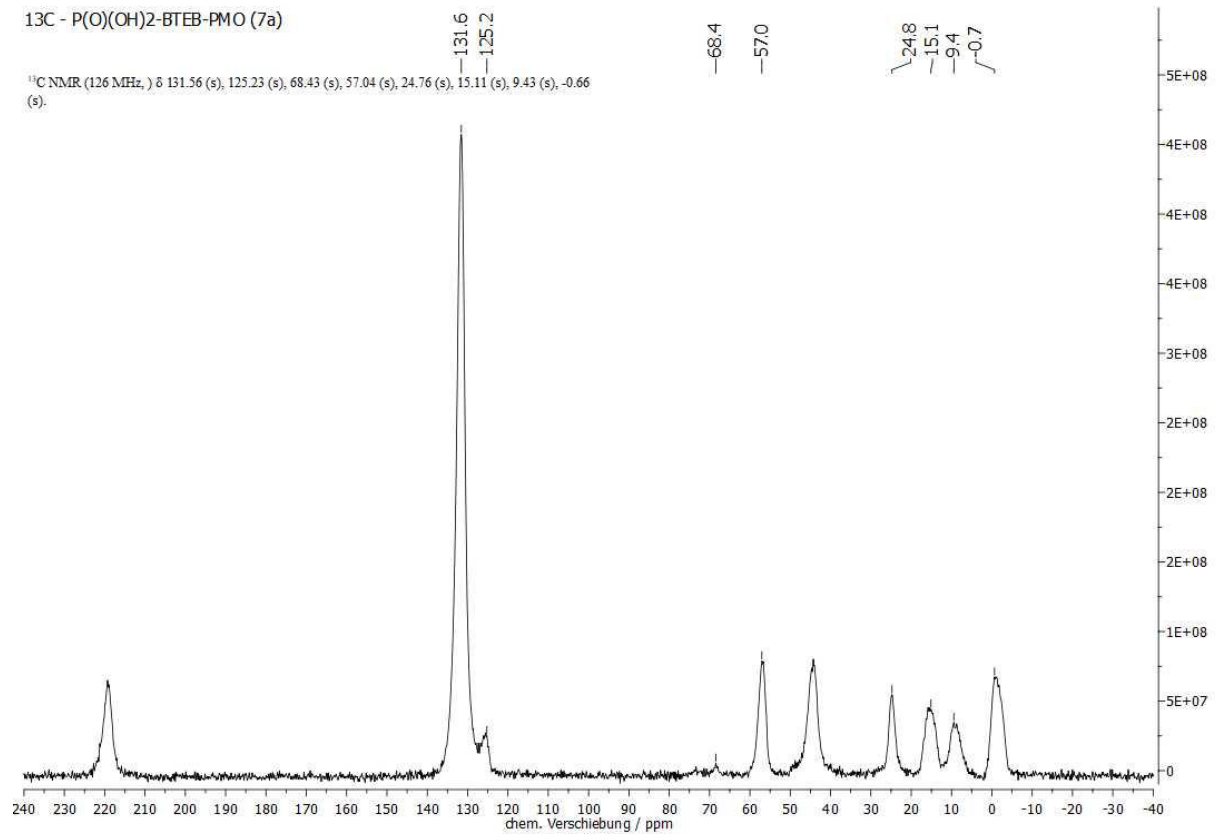


Abb. 8.8:  $^{13}\text{C}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von P(O)(OH)<sub>2</sub>-BTEB-PMO (7a).

ANHANG

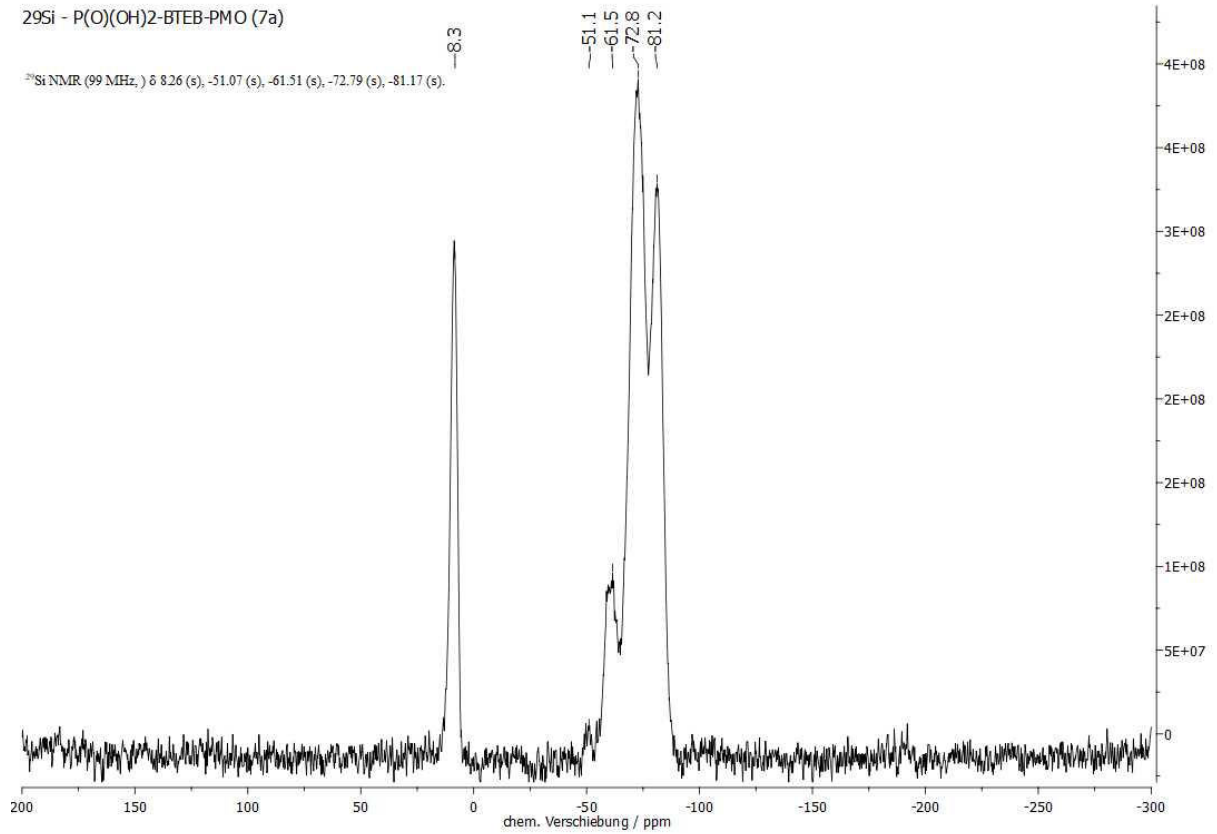


Abb. 8.9: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von P(O)(OH)<sub>2</sub>-BTEB-PMO (7a).

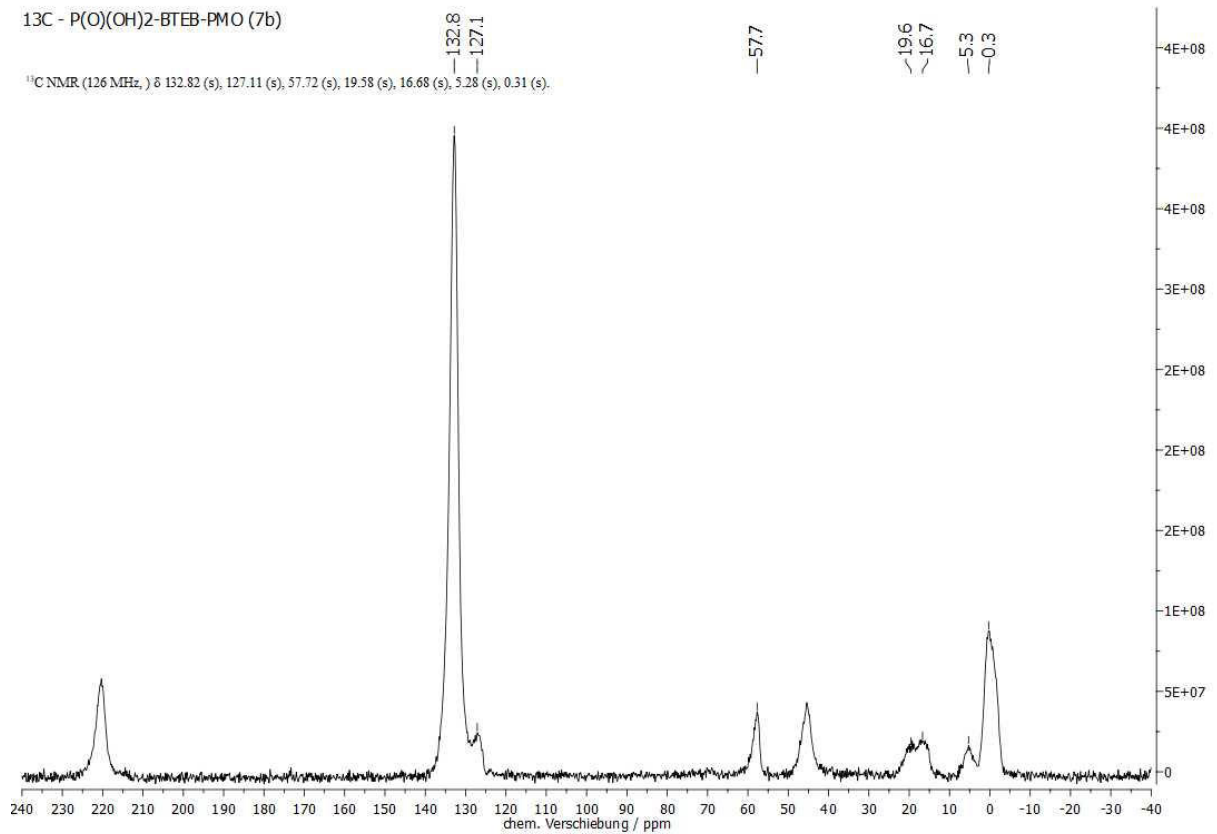


Abb. 8.10: <sup>13</sup>C-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von P(O)(OH)<sub>2</sub>-BTEB-PMO (7b).

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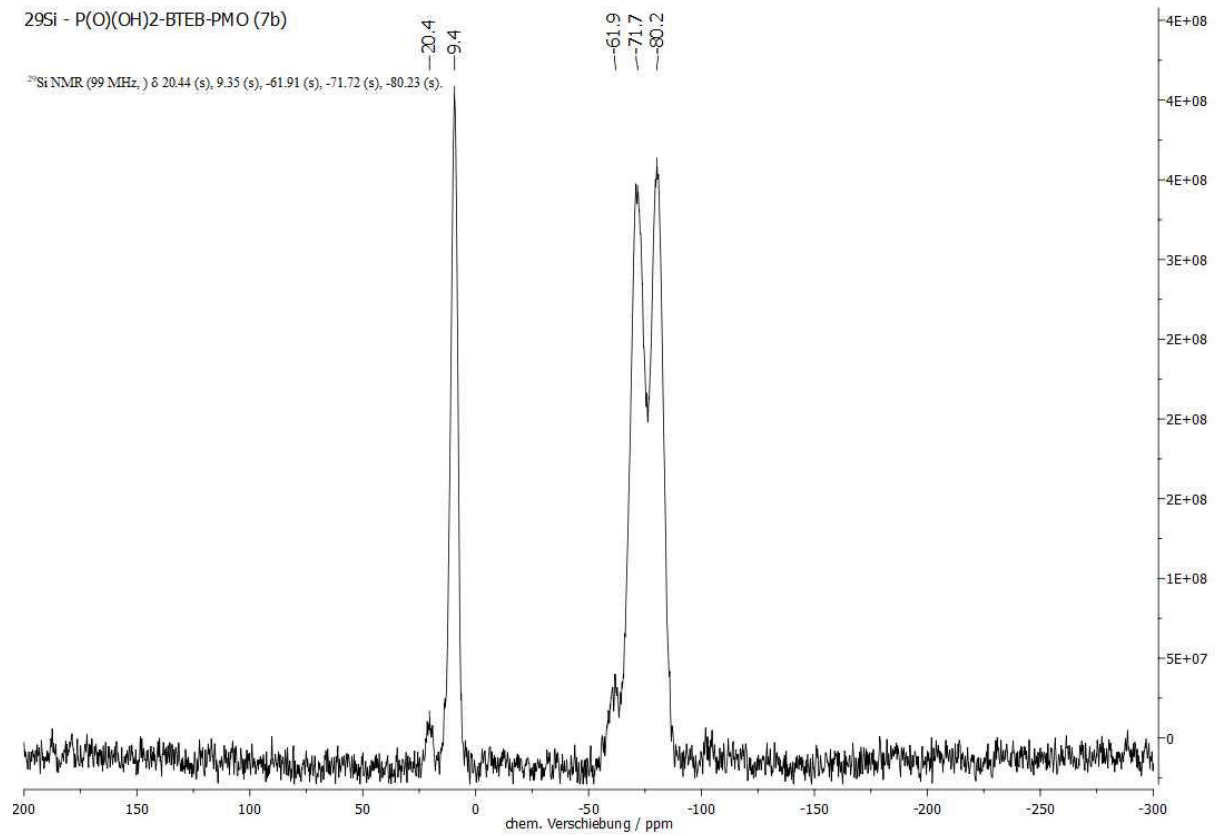


Abb. 8.11: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von P(O)(OH)<sub>2</sub>-BTEB-PMO (7b).

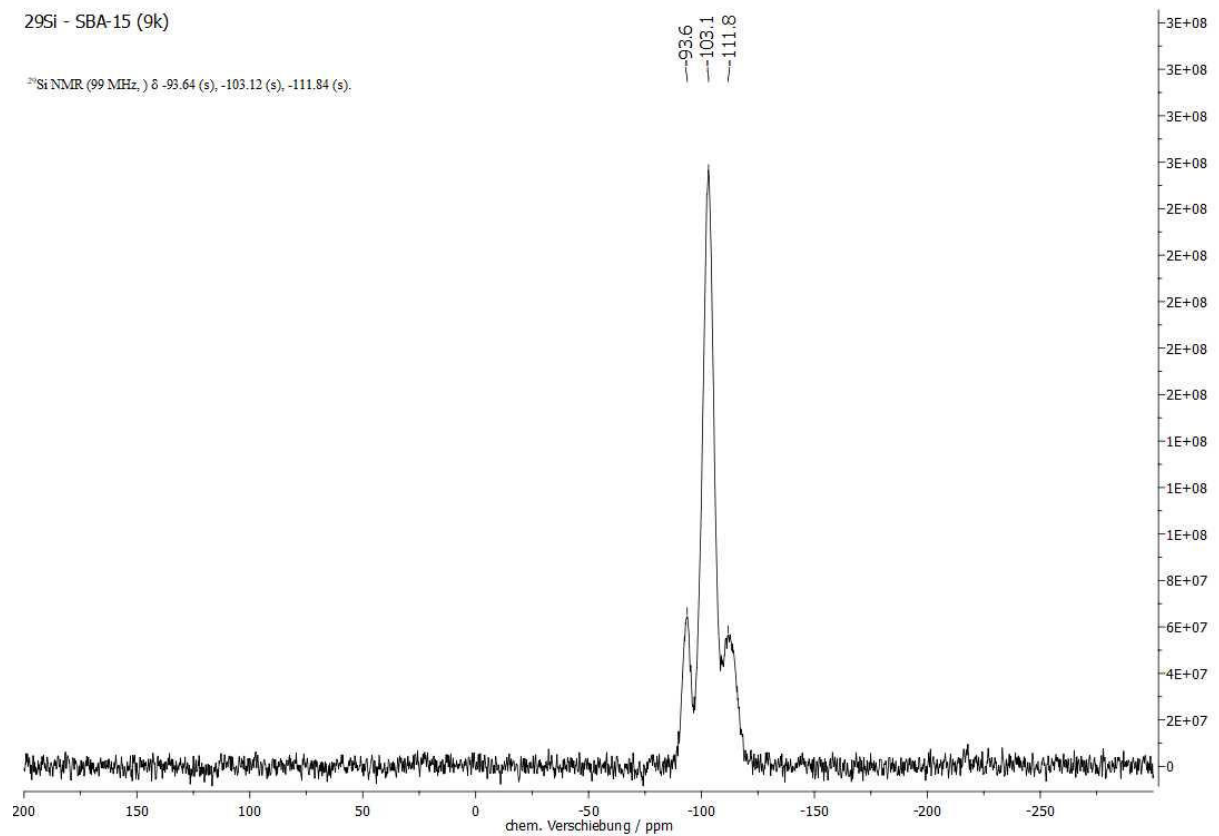


Abb. 8.12: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von SBA-15 (9k).

# ANHANG

<sup>13</sup>C - SH-SBA-15 (10k)

<sup>13</sup>C NMR (126 MHz, ) δ 45.93 (s), 23.51 (s), 7.44 (s).

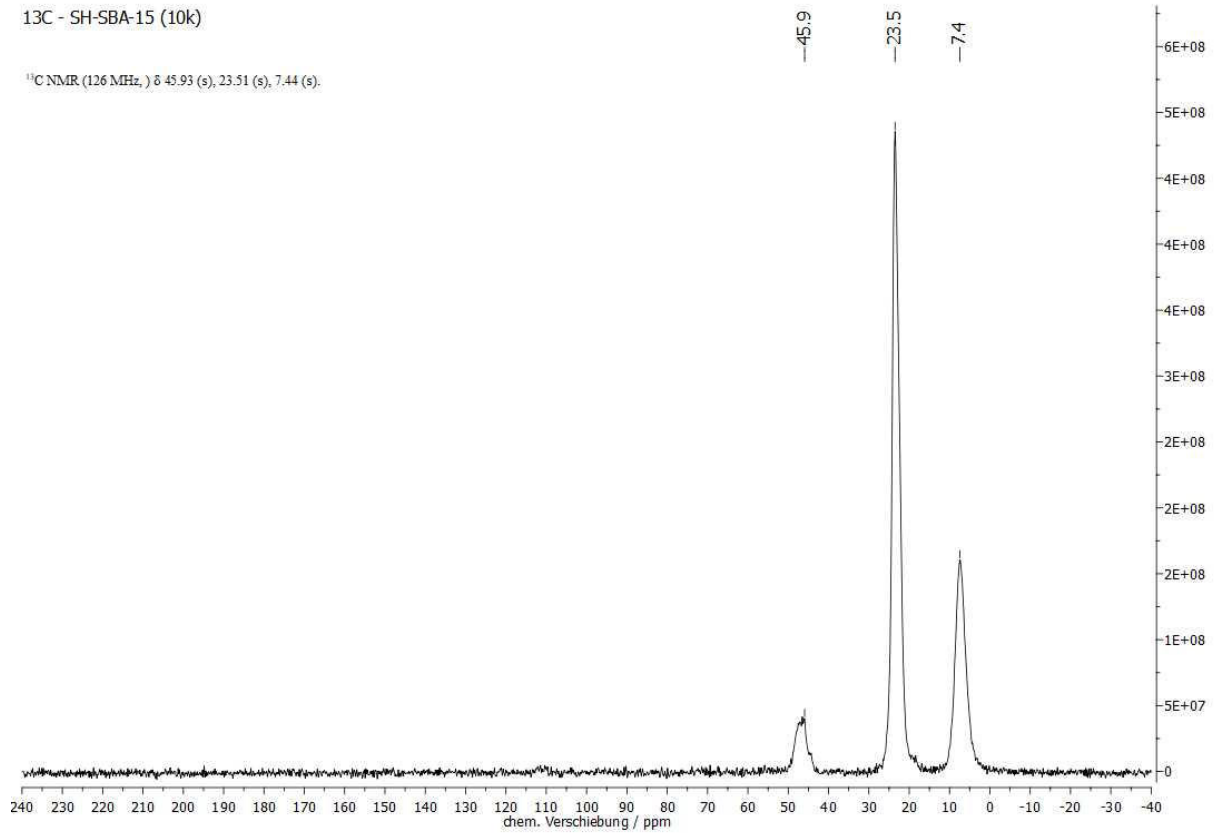


Abb. 8.13: <sup>13</sup>C-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von SH-SBA-15 (10k).

<sup>29</sup>Si - SH-SBA-15 (10k)

<sup>29</sup>Si NMR (99 MHz, ) δ -49.86 (s), -59.43 (s), -68.76 (s), -103.89 (s), -112.94 (s).

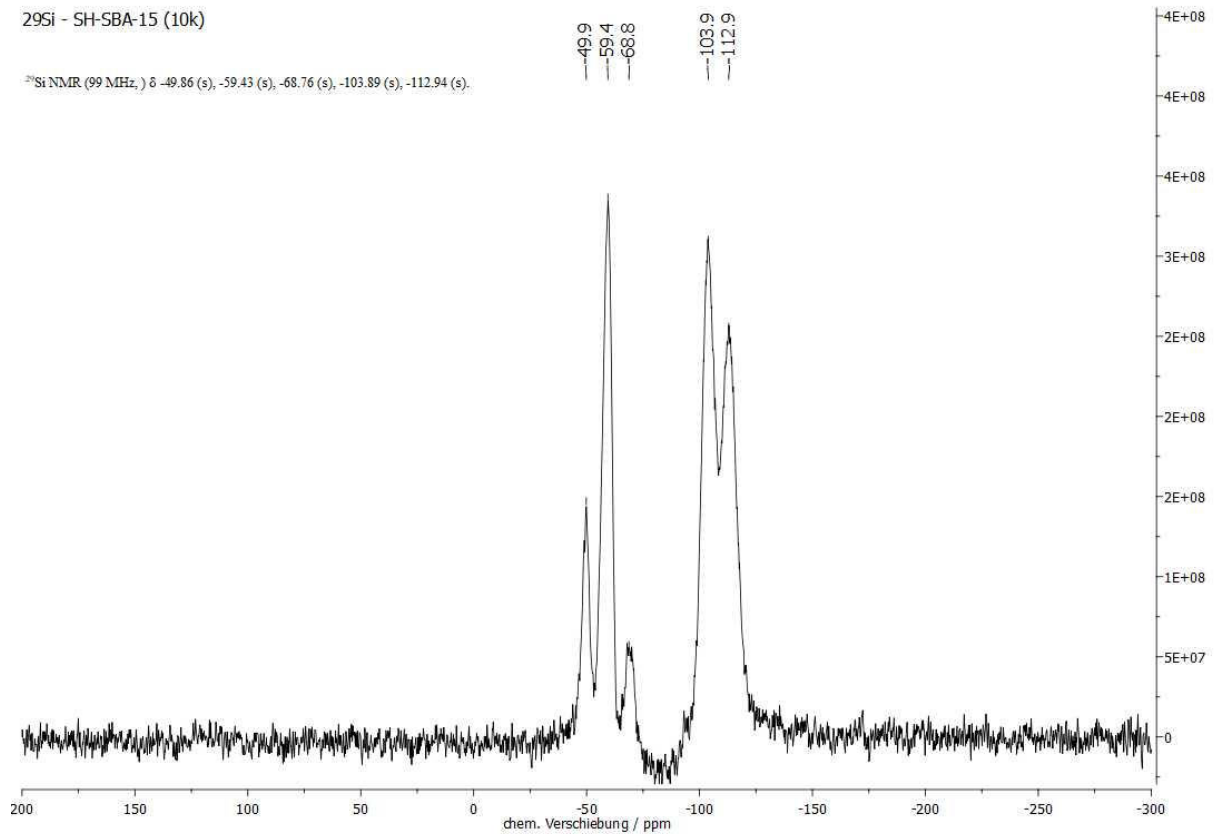


Abb. 8.14: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von SH-SBA-15 (10k).

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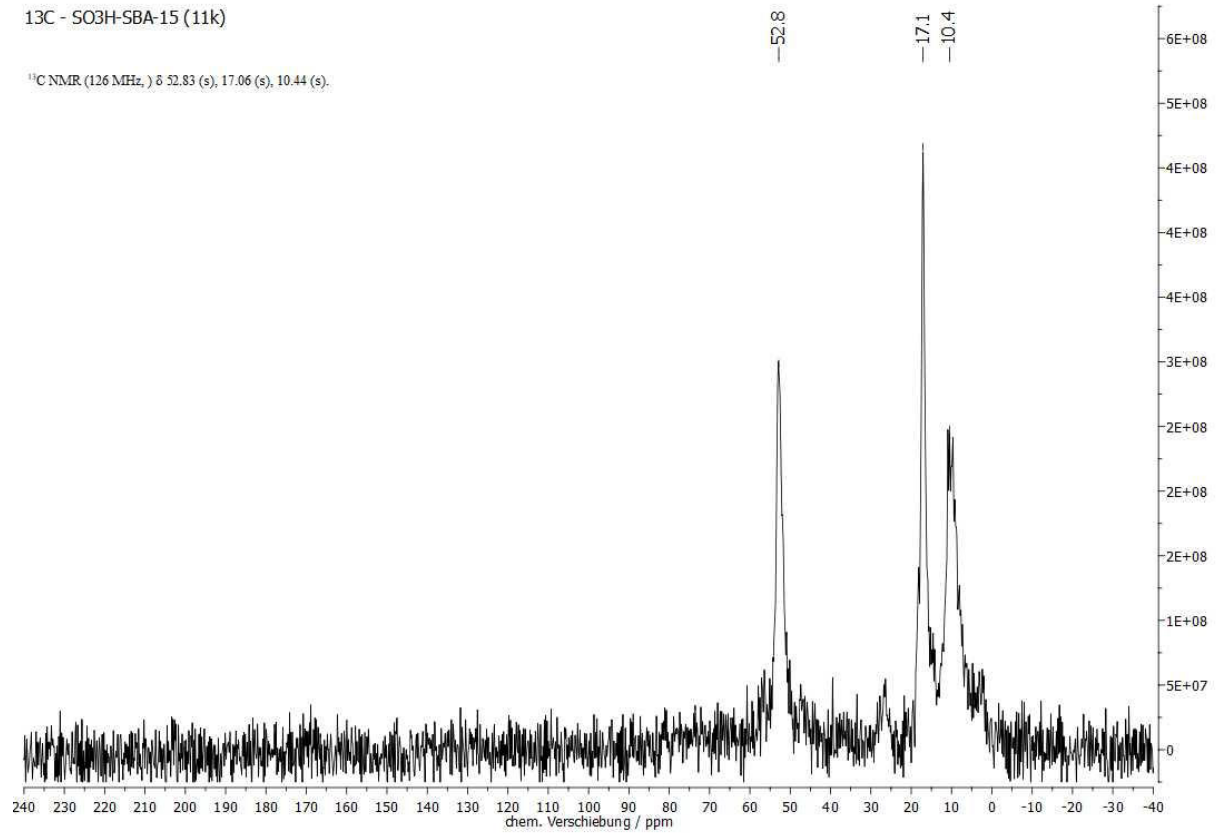


Abb. 8.15: <sup>13</sup>C-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von SO<sub>3</sub>H-SBA-15 (**11k**).

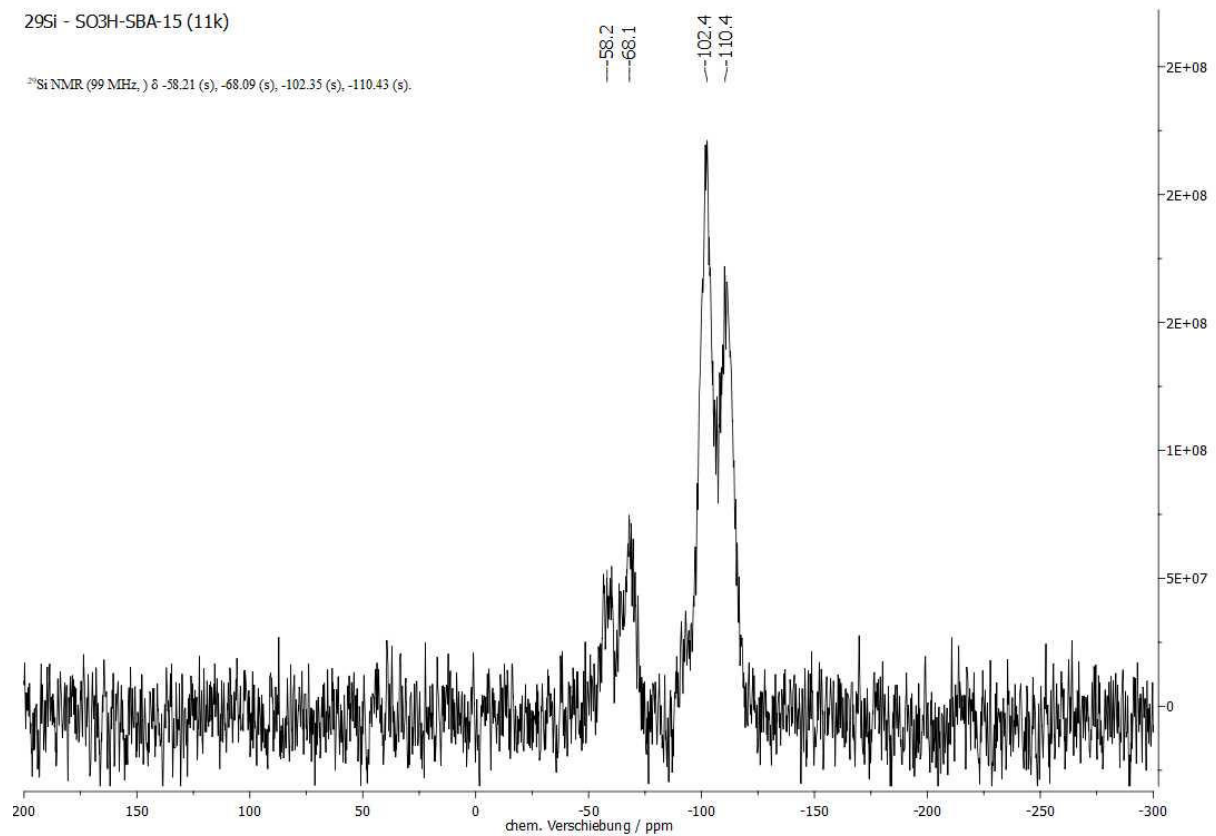


Abb. 8.16: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von SO<sub>3</sub>H-SBA-15 (**11k**).



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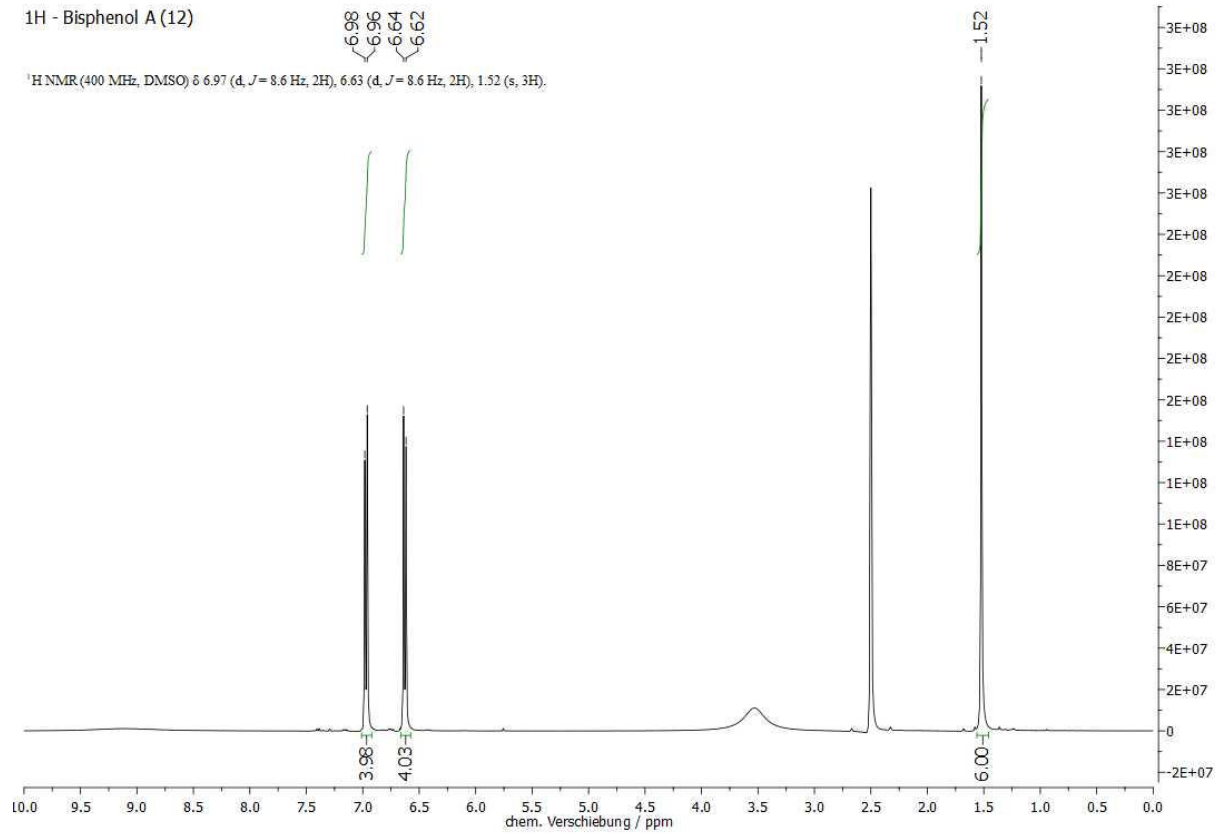


Abb. 8.17:  $^1\text{H-NMR}$ -Spektrum (400 MHz, DMSO- $d_6$ , 298 K) von Bisphenol A (12).

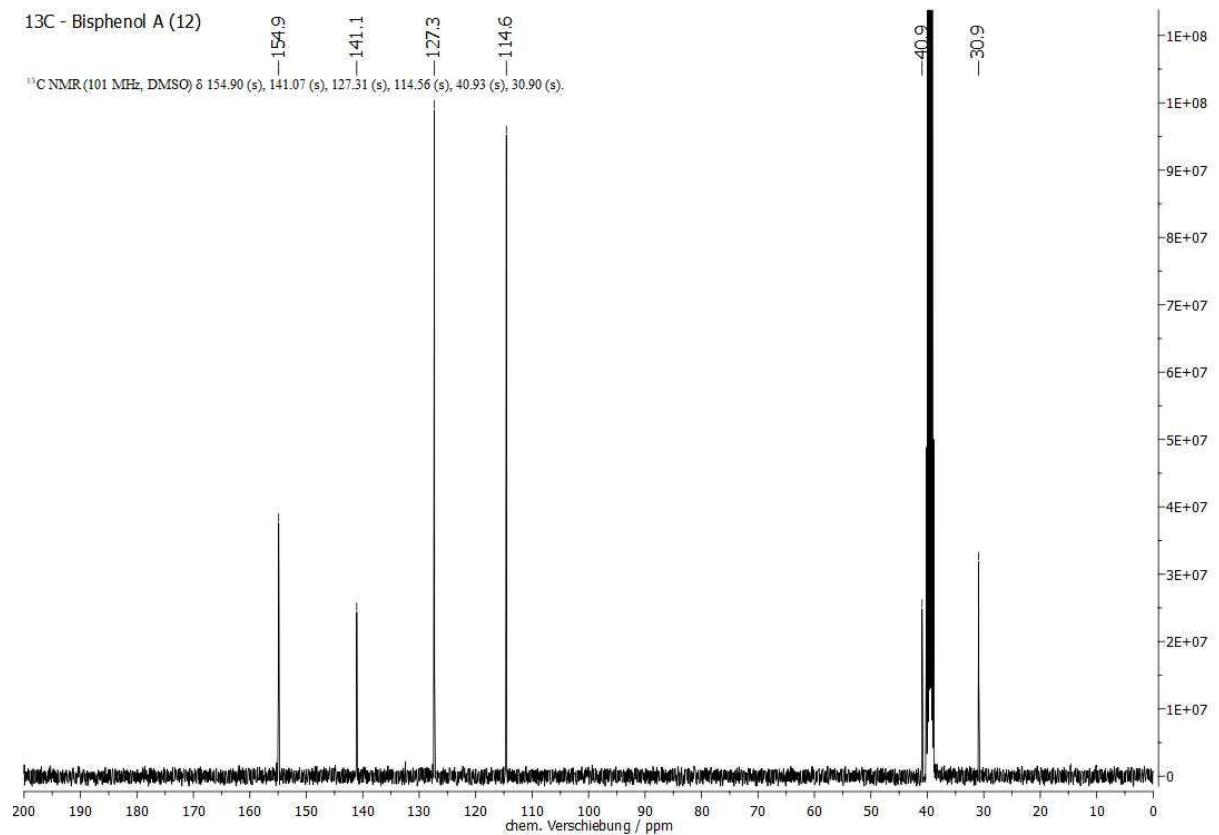


Abb. 8.18:  $^{13}\text{C-NMR}$ -Spektrum (101 MHz, DMSO- $d_6$ , 298 K) von Bisphenol A (12).

ANHANG

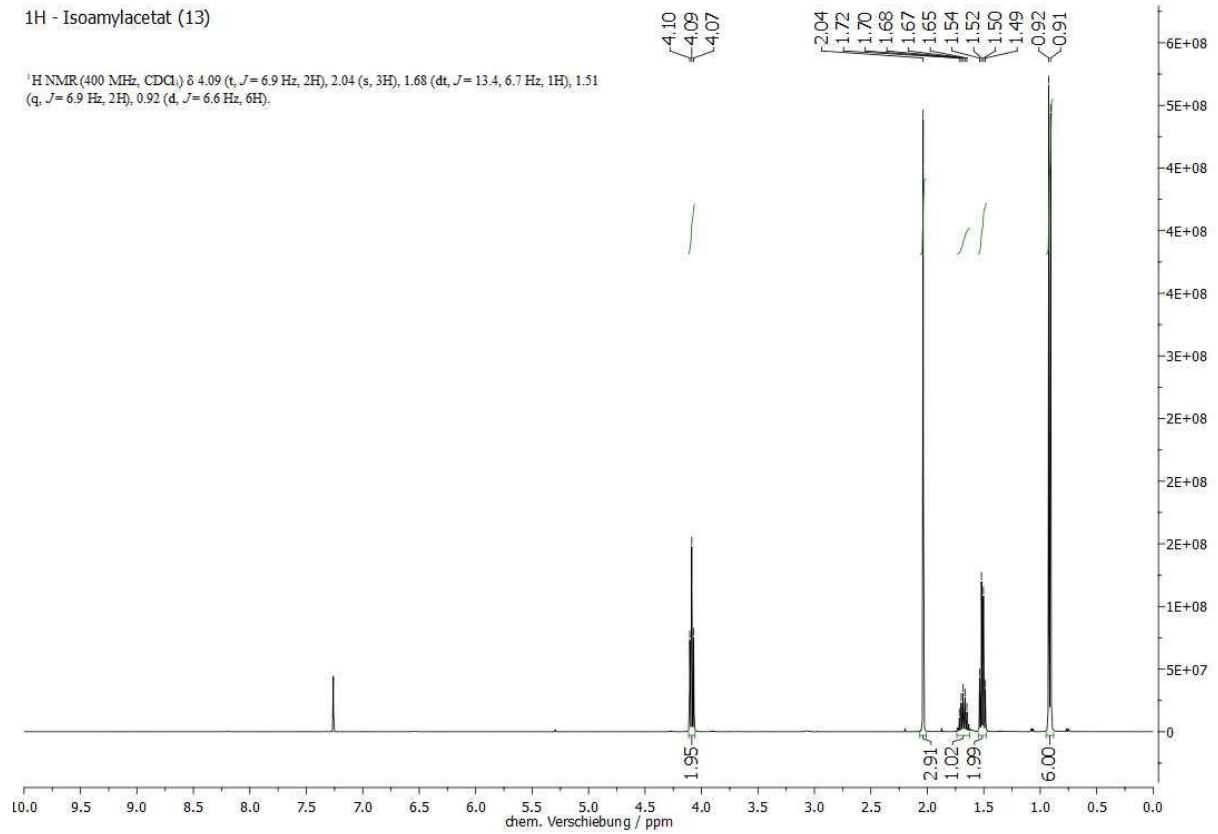


Abb. 8.19: <sup>1</sup>H-NMR-Spektrum (400 MHz, CDCl<sub>3</sub>, 298 K) von Isoamylacetat (**13**).

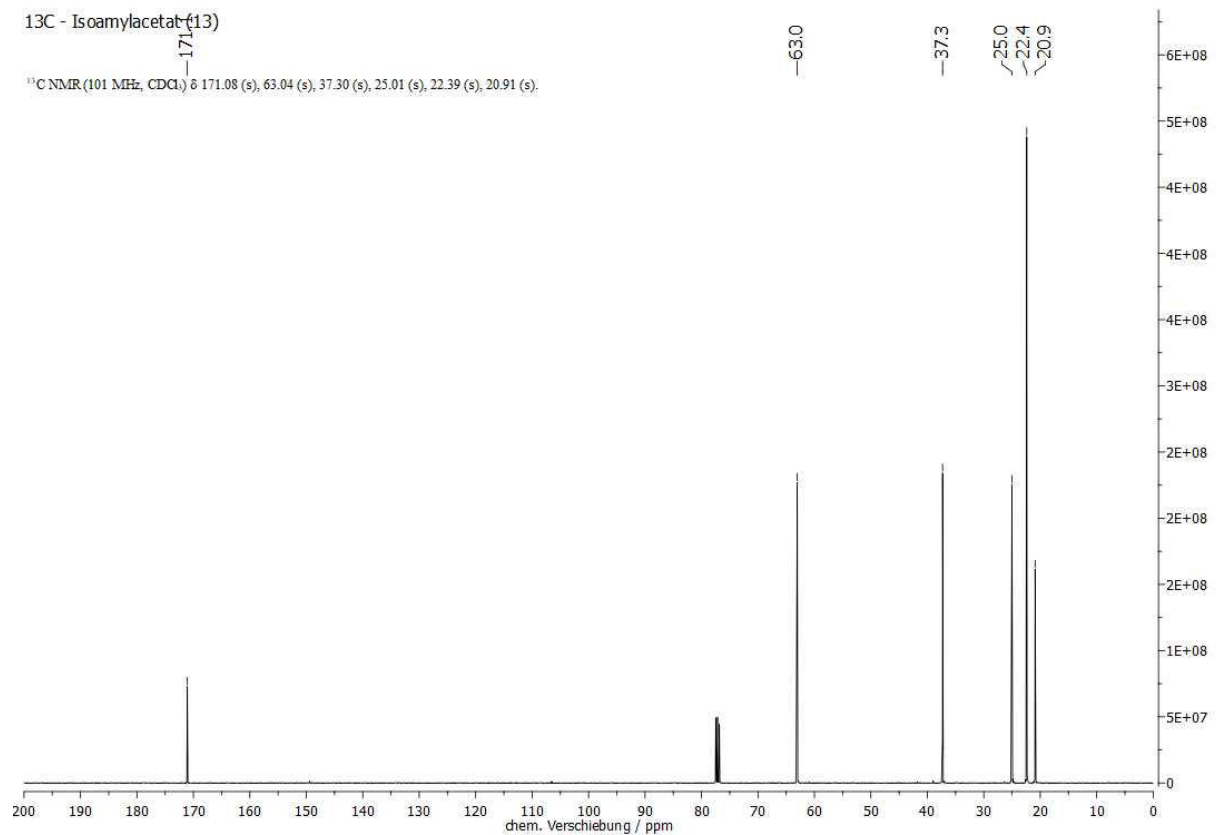


Abb. 8.20: <sup>13</sup>C-NMR-Spektrum (101 MHz, CDCl<sub>3</sub>, 298 K) von Isoamylacetat (**13**).

# ANHANG

## <sup>1</sup>H - Ölsäureethylester (14)

<sup>1</sup>H NMR (400 MHz, CDCl<sub>3</sub>) δ 5.34 (s, 4H), 4.12 (q, *J* = 7.1 Hz, 4H), 2.28 (t, *J* = 7.6 Hz, 4H), 2.00 (d, *J* = 5.9 Hz, 7H), 1.61 (d, *J* = 3.7 Hz, 5H), 1.37 – 1.19 (m, 47H), 0.87 (t, *J* = 6.8 Hz, 6H).

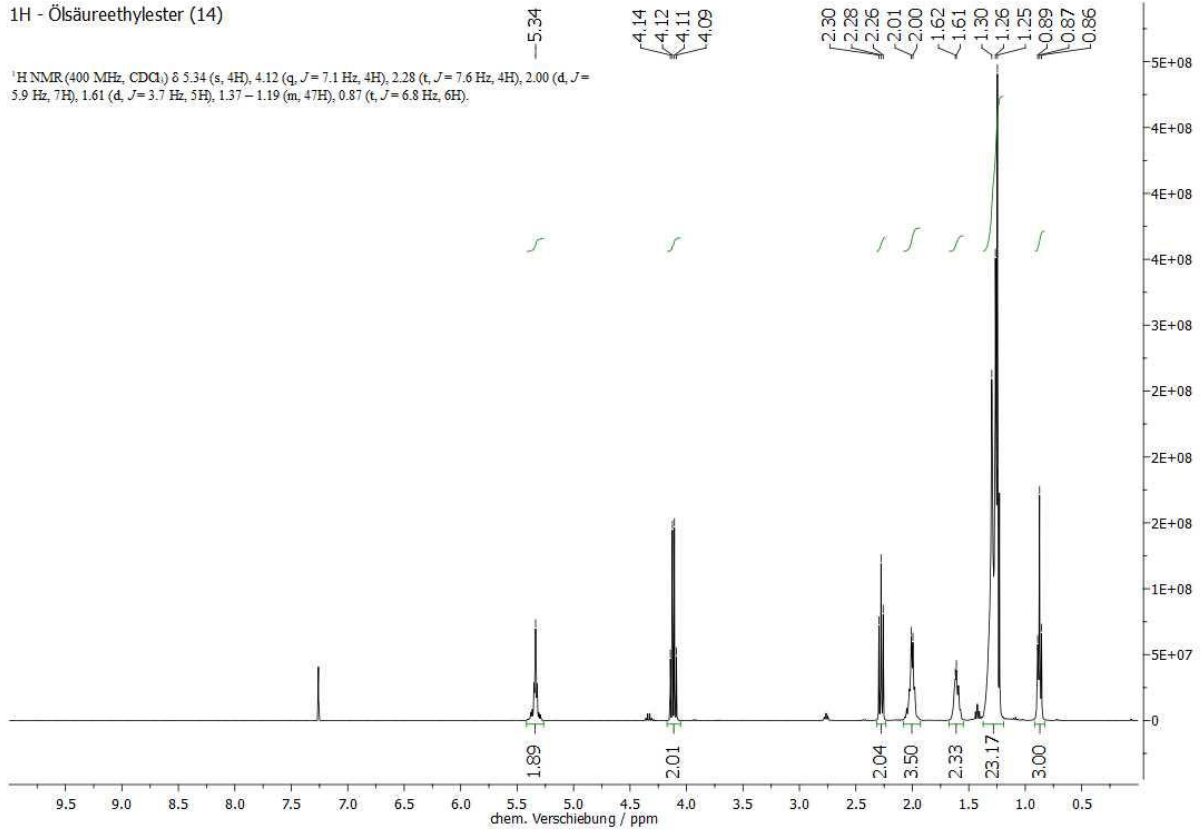


Abb. 8.21: <sup>1</sup>H-NMR-Spektrum (400 MHz, CDCl<sub>3</sub>, 298 K) von Ölsäureethylester (14).

## <sup>13</sup>C - Ölsäureethylester (14)

<sup>13</sup>C NMR (101 MHz, CDCl<sub>3</sub>) δ 174.04 (s), 130.13 (s), 129.89 (s), 60.28 (s), 34.52 (s), 32.04 (s), 29.91 (s), 29.83 (s), 29.79 (s), 29.66 (s), 29.46 (s), 29.31 (s), 29.26 (s), 29.24 (s), 27.35 (s), 27.30 (s), 25.11 (s), 22.82 (s), 14.39 (s), 14.25 (s).

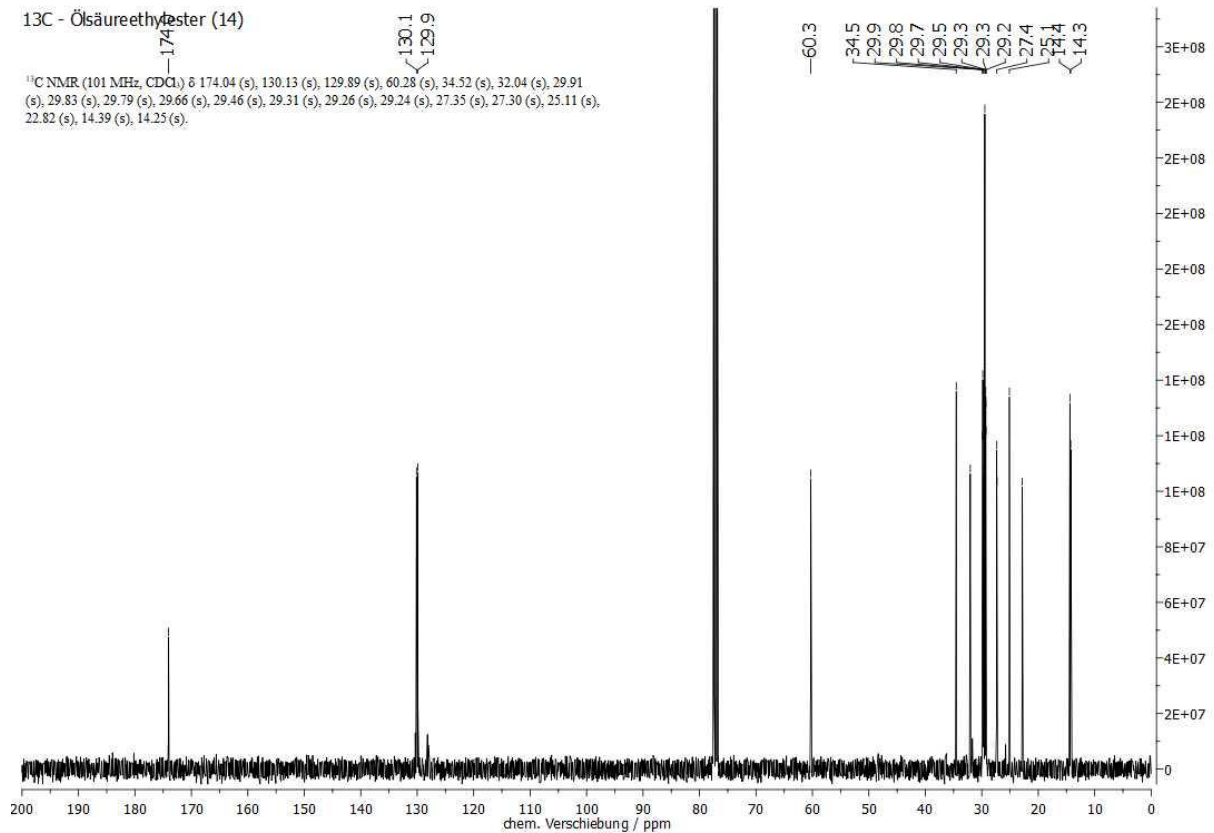


Abb. 8.22: <sup>13</sup>C-NMR-Spektrum (101 MHz, CDCl<sub>3</sub>, 298 K) von Ölsäureethylester (14).

# ANHANG

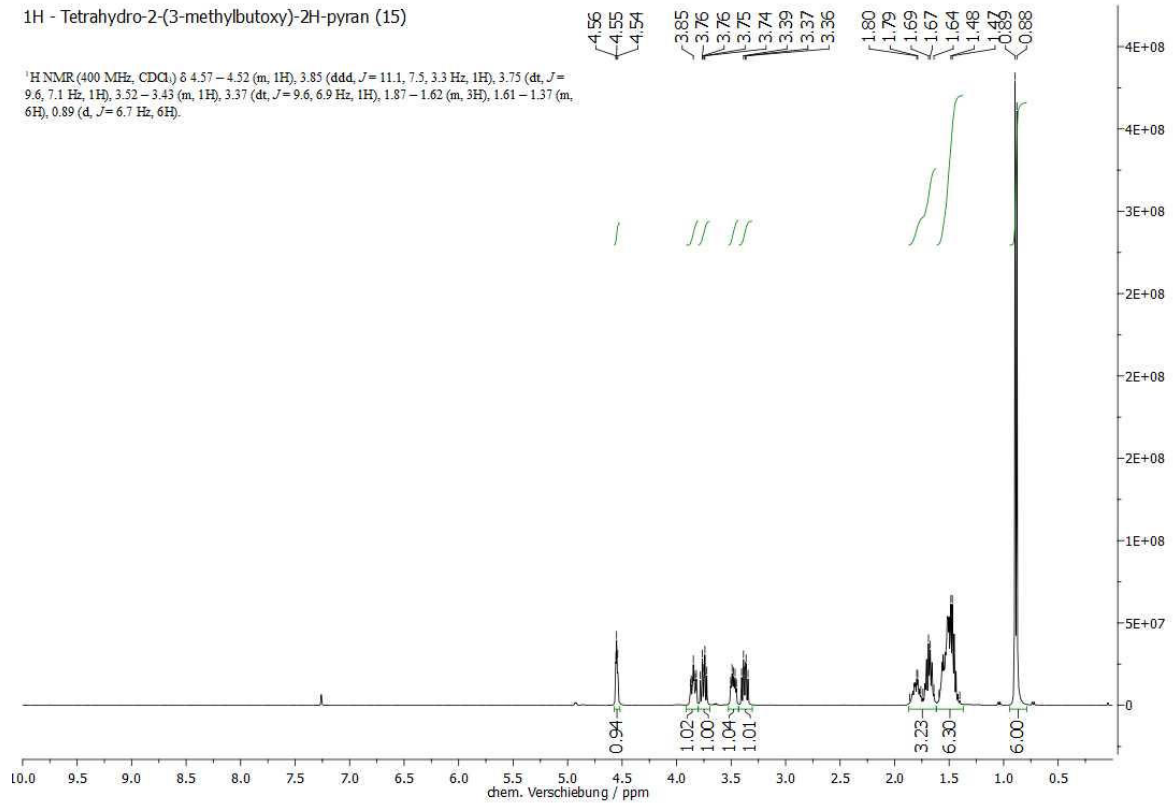


Abb. 8.23: <sup>1</sup>H-NMR-Spektrum (400 MHz, CDCl<sub>3</sub>, 298 K) von Tetrahydro-2-(3-methylbutoxy)-2H-pyran (15).

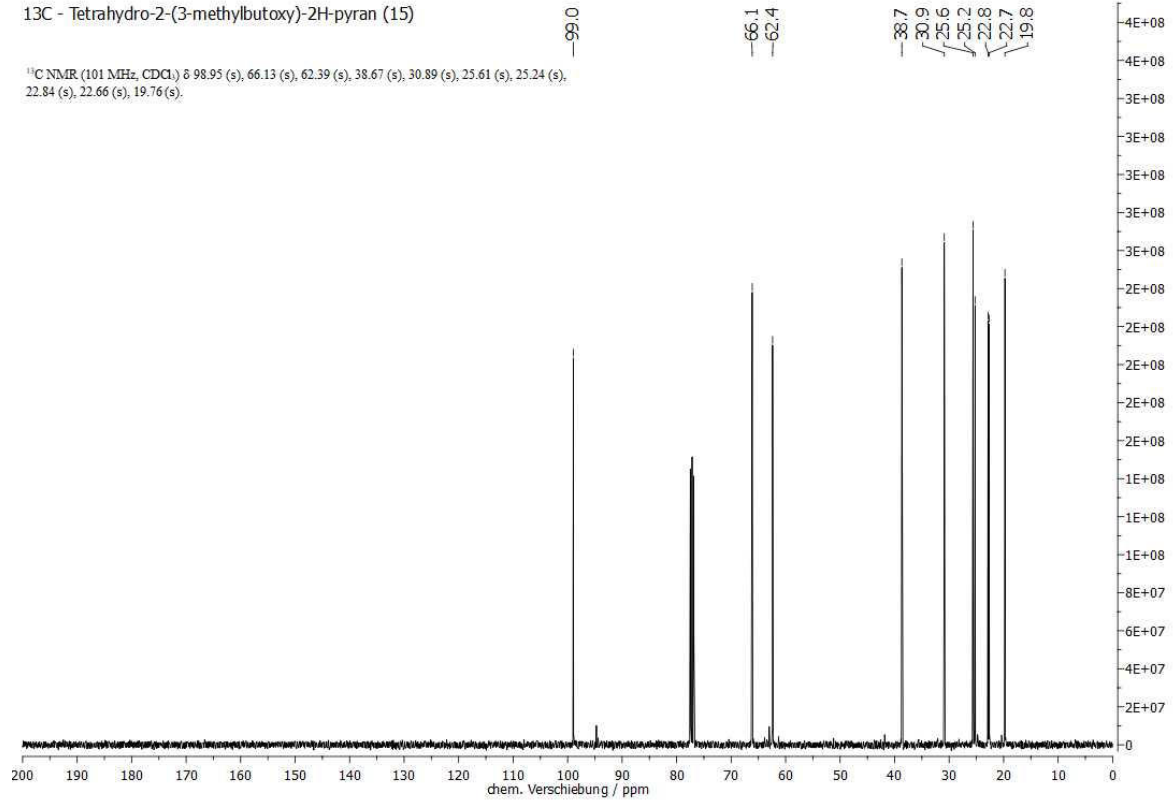


Abb. 8.24: <sup>13</sup>C-NMR-Spektrum (101 MHz, CDCl<sub>3</sub>, 298 K) von Tetrahydro-2-(3-methylbutoxy)-2H-pyran (15).

ANHANG

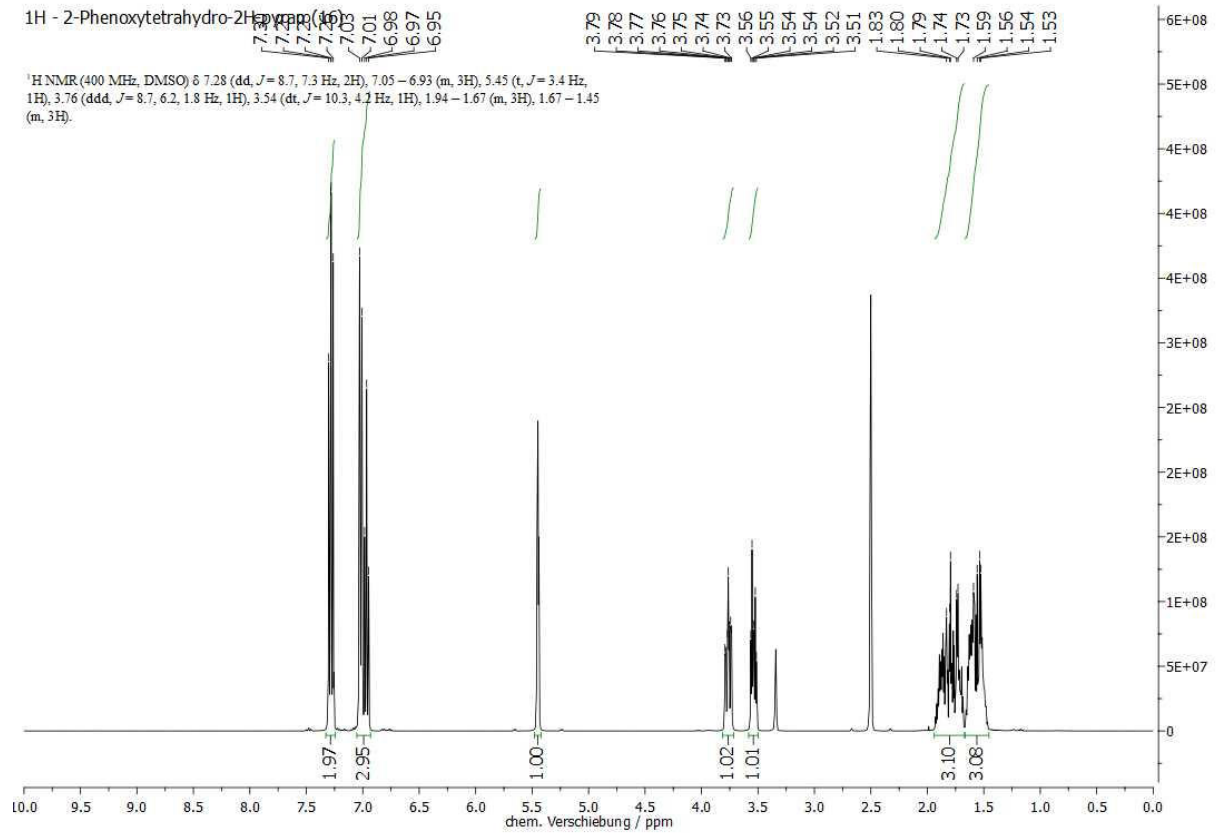


Abb. 8.25: <sup>1</sup>H-NMR-Spektrum (400 MHz, DMSO-d<sub>6</sub>, 298 K) von 2-Phenoxytetrahydro-2H-pyran (16).

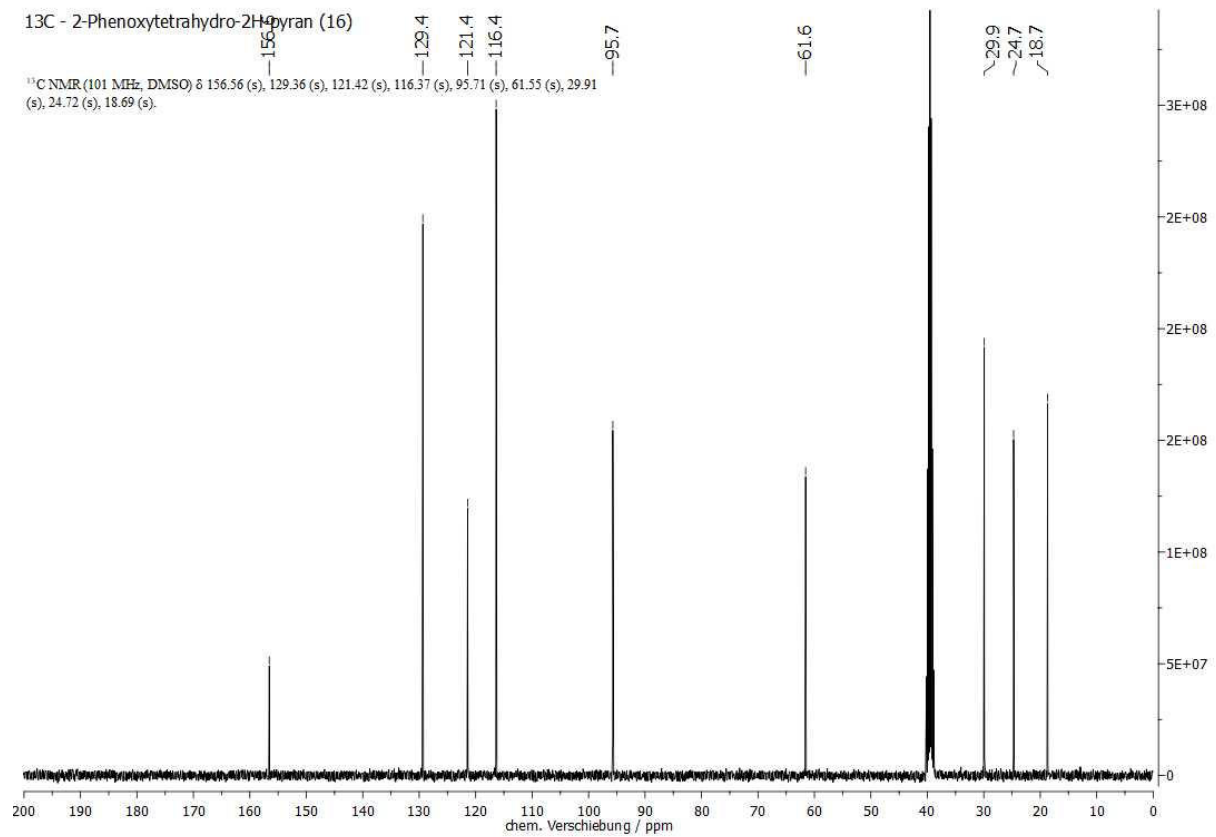


Abb. 8.26: <sup>13</sup>C-NMR-Spektrum (101 MHz, DMSO-d<sub>6</sub>, 298 K) von 2-Phenoxytetrahydro-2H-pyran (16).

ANHANG

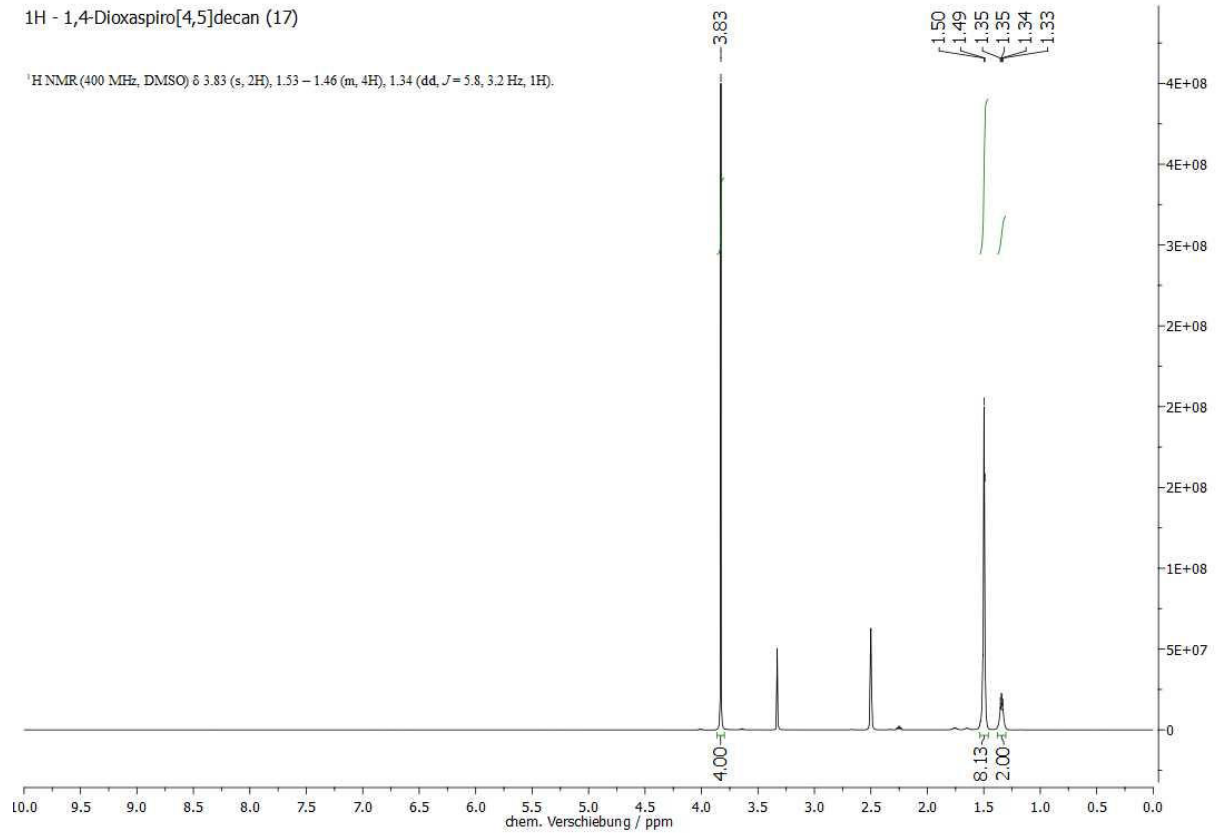


Abb. 8.27: <sup>1</sup>H-NMR-Spektrum (400 MHz, DMSO-d<sub>6</sub>, 298 K) von 1,4-Dioxaspiro[4,5]decan (**17**).

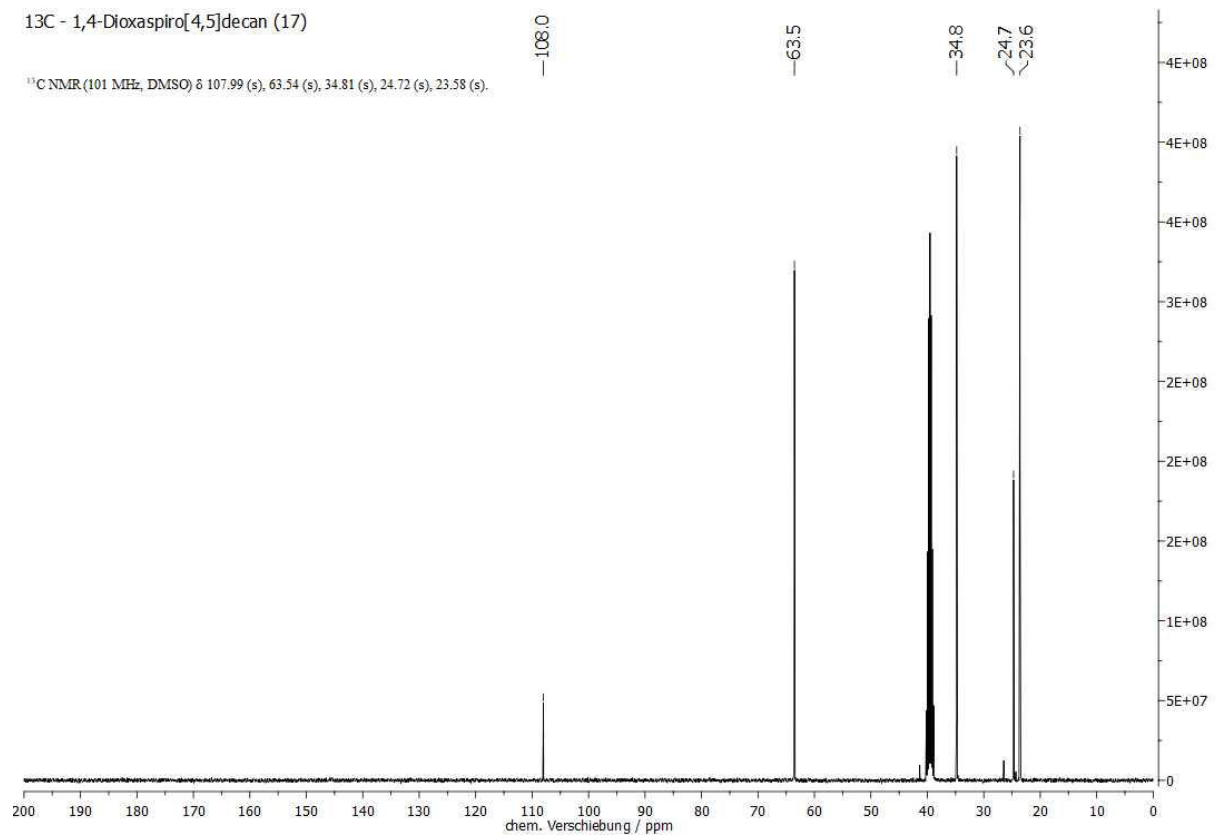


Abb. 8.28: <sup>13</sup>C-NMR-Spektrum (101 MHz, DMSO-d<sub>6</sub>, 298 K) von 1,4-Dioxaspiro[4,5]decan (**17**).

ANHANG

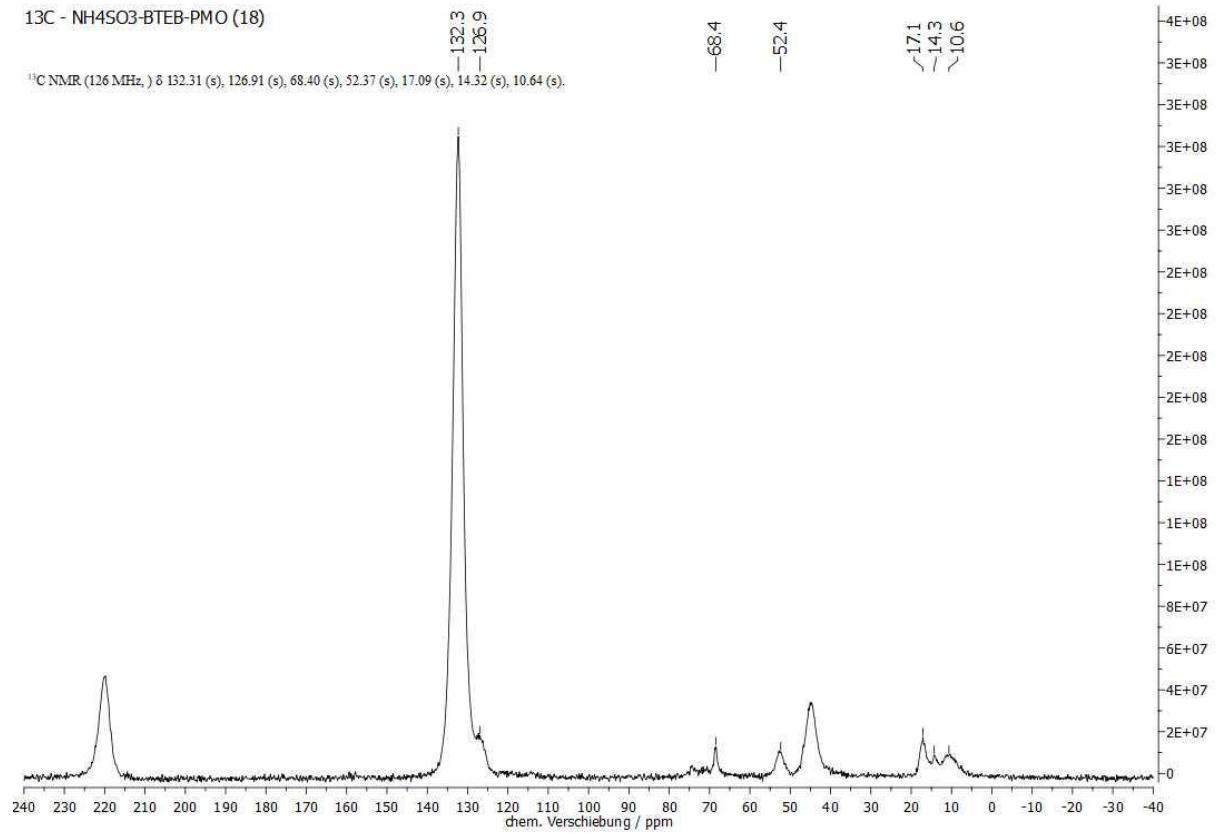


Abb. 8.29:  $^{13}\text{C}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von  $\text{NH}_4\text{SO}_3$ -BTEB-PMO (18).

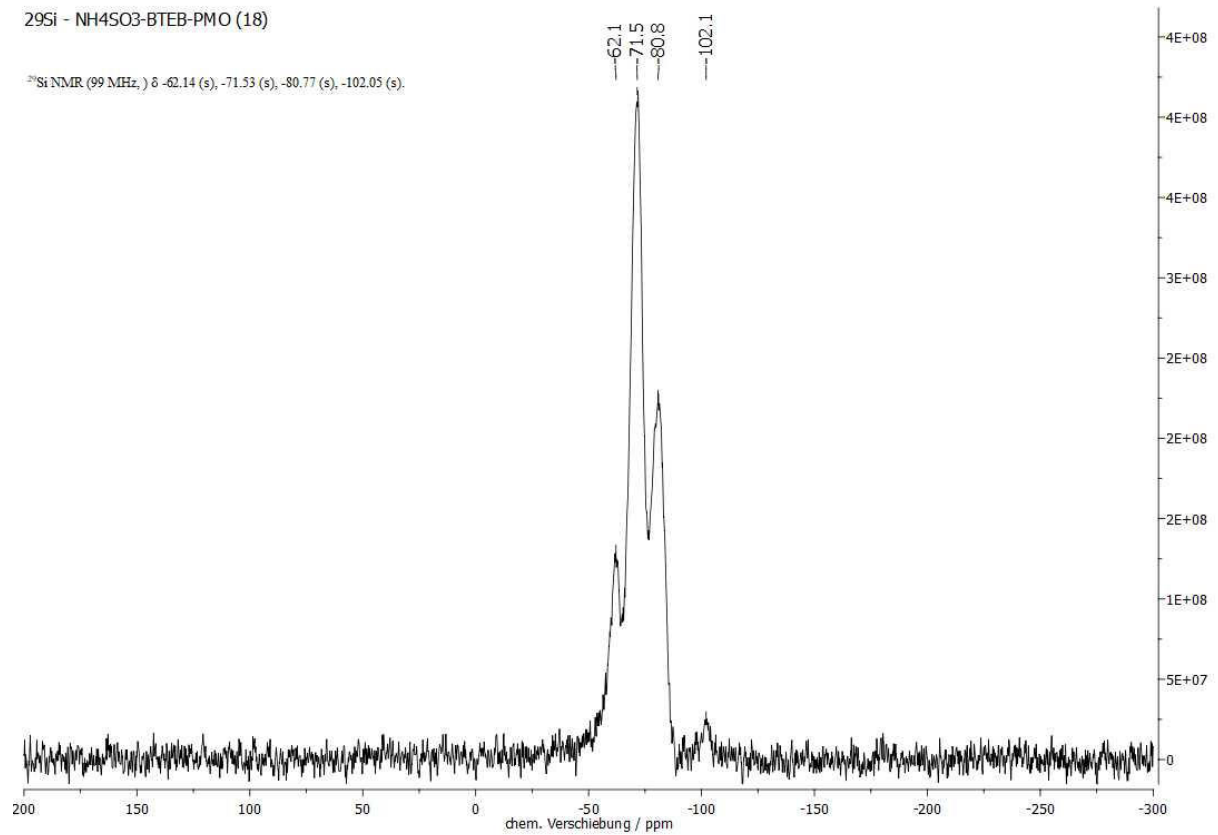


Abb. 8.30:  $^{29}\text{Si}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von  $\text{NH}_4\text{SO}_3$ -BTEB-PMO (18).

# ANHANG

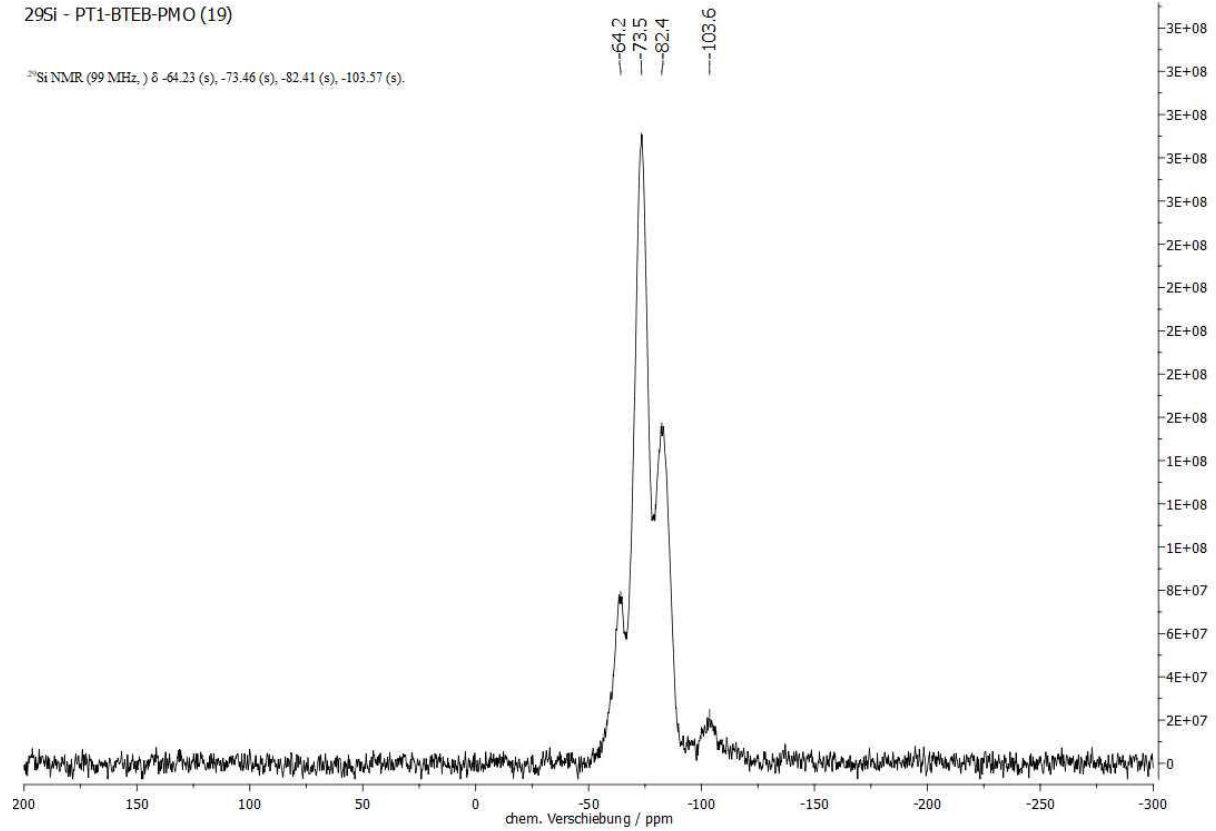


Abb. 8.31: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von PT1-BTEB-PMO (19).

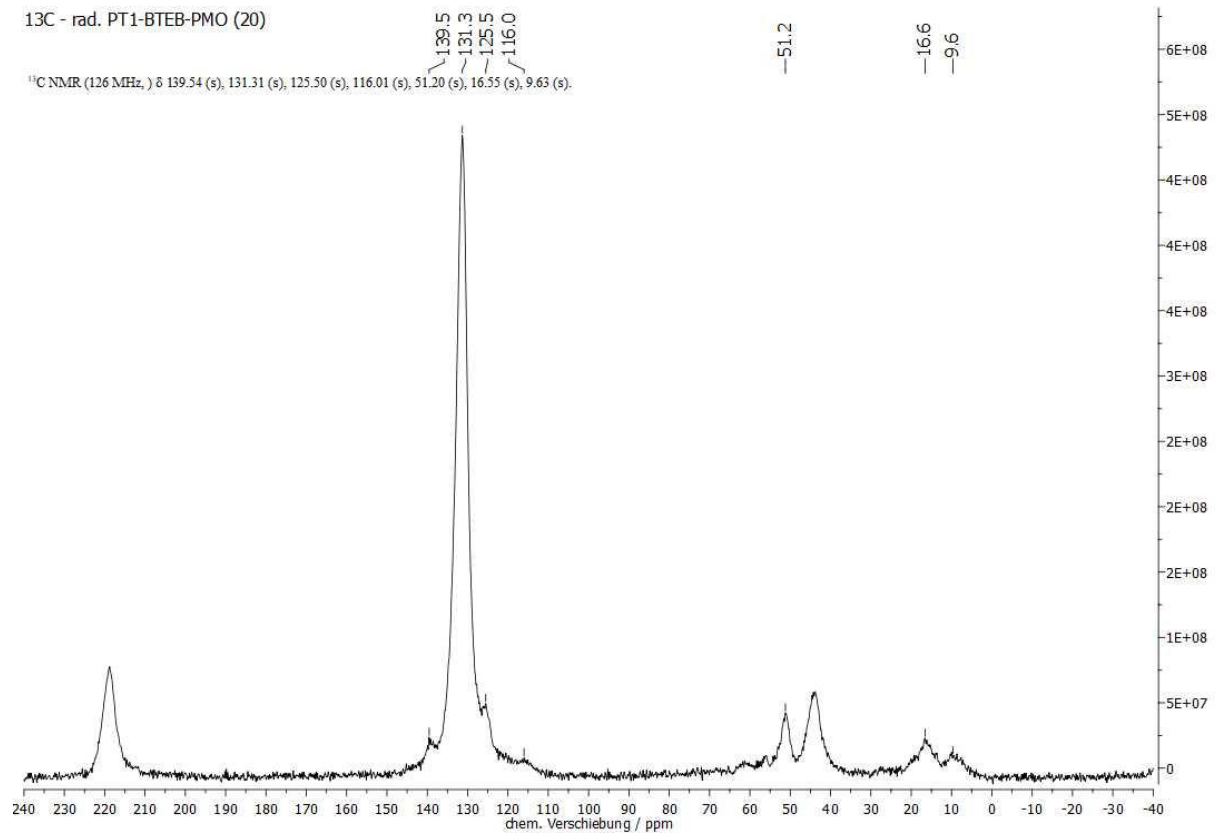


Abb. 8.32: <sup>13</sup>C-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von rad. PT1-BTEB-PMO (20).



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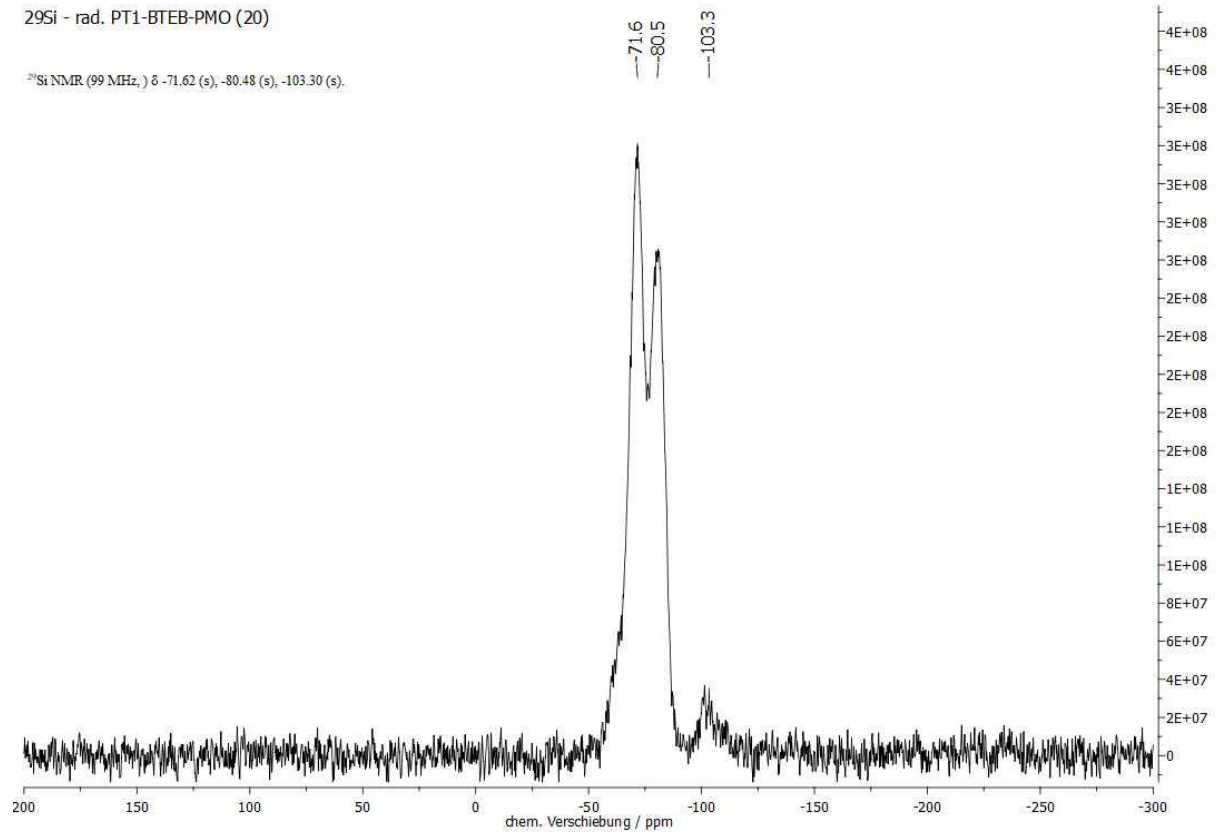


Abb. 8.33:  $^{29}\text{Si}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von rad. PT1-BTEB-PMO (20).

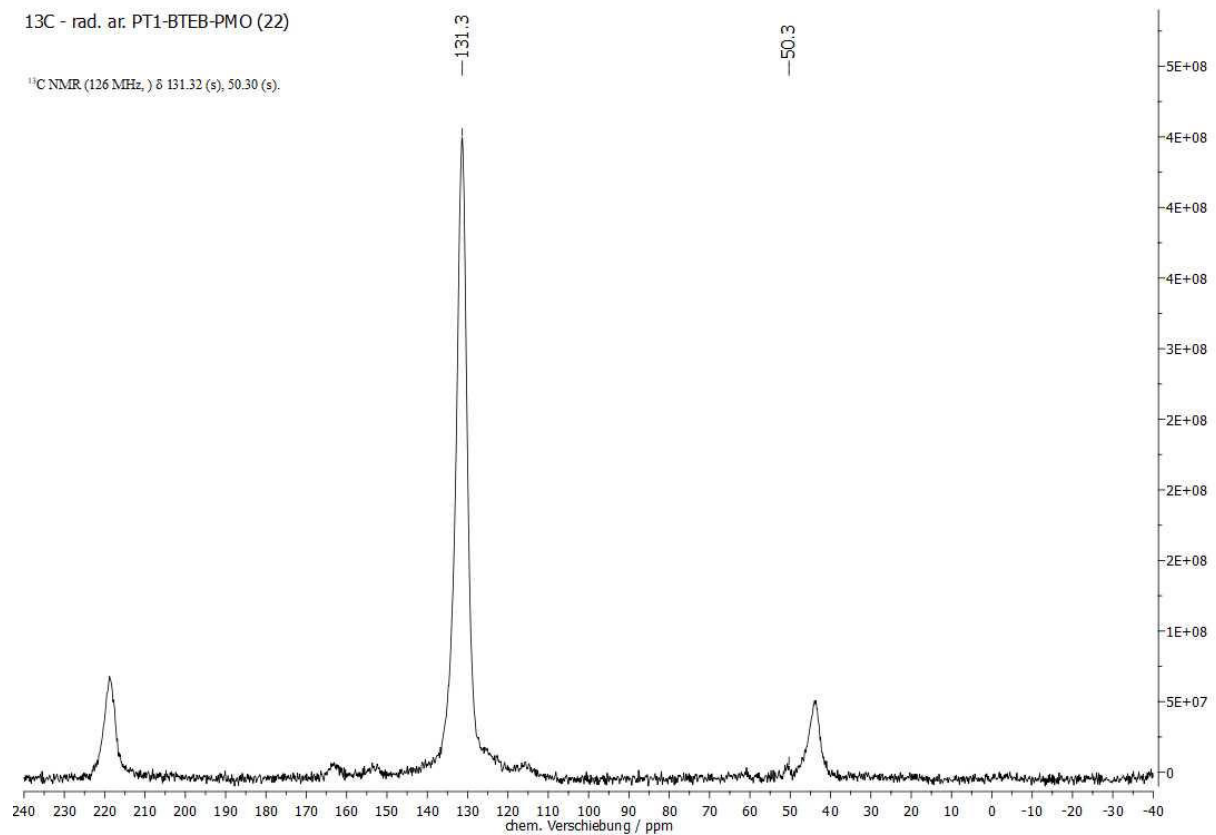


Abb. 8.34:  $^{13}\text{C}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von rad. ar. PT1-BTEB-PMO (22).

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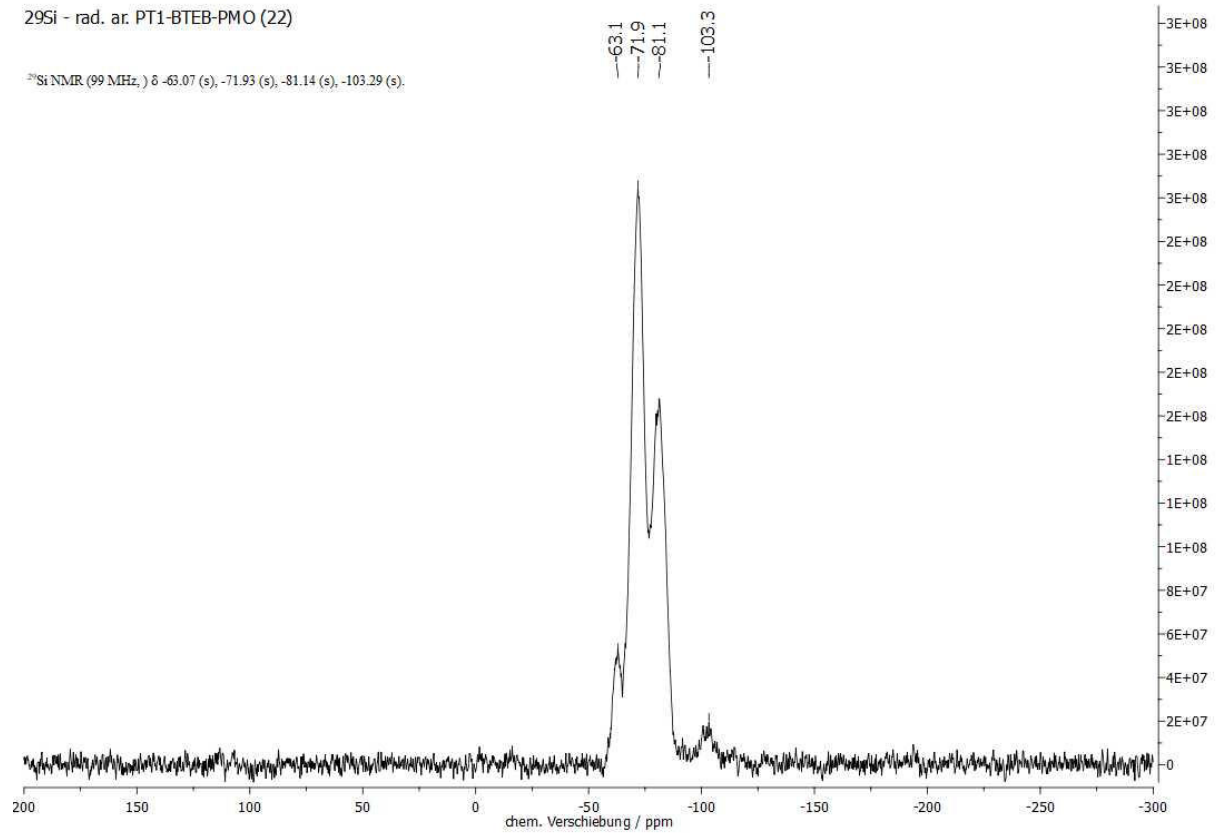


Abb. 8.35:  $^{29}\text{Si}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von rad. ar. PT1-BTEB-PMO (22).

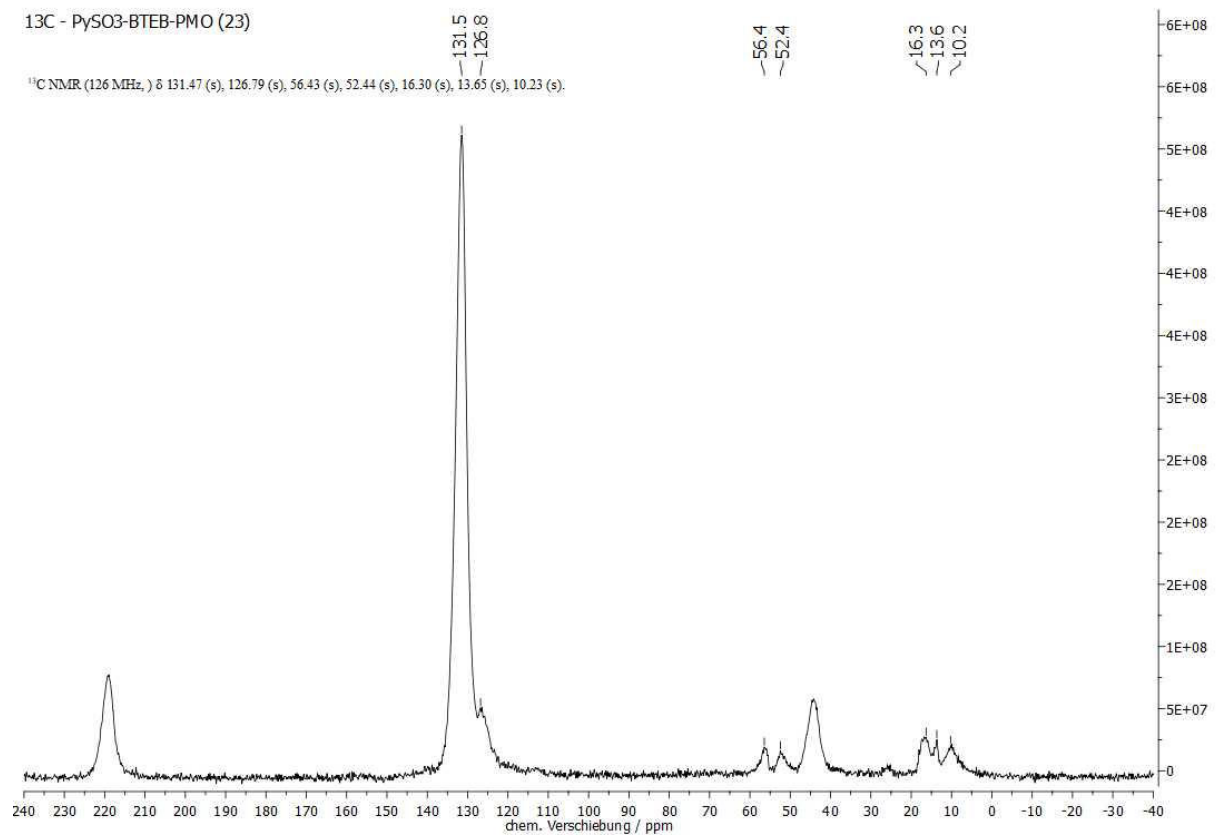


Abb. 8.36:  $^{13}\text{C}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von PySO<sub>3</sub>-BTEB-PMO (23).

# ANHANG

<sup>29</sup>Si - PySO<sub>3</sub>-BTEB-PMO (23)

<sup>29</sup>Si NMR (99 MHz, ) δ -62.74 (s), -72.36 (s), -80.55 (s), -92.45 (s), -101.33 (s).

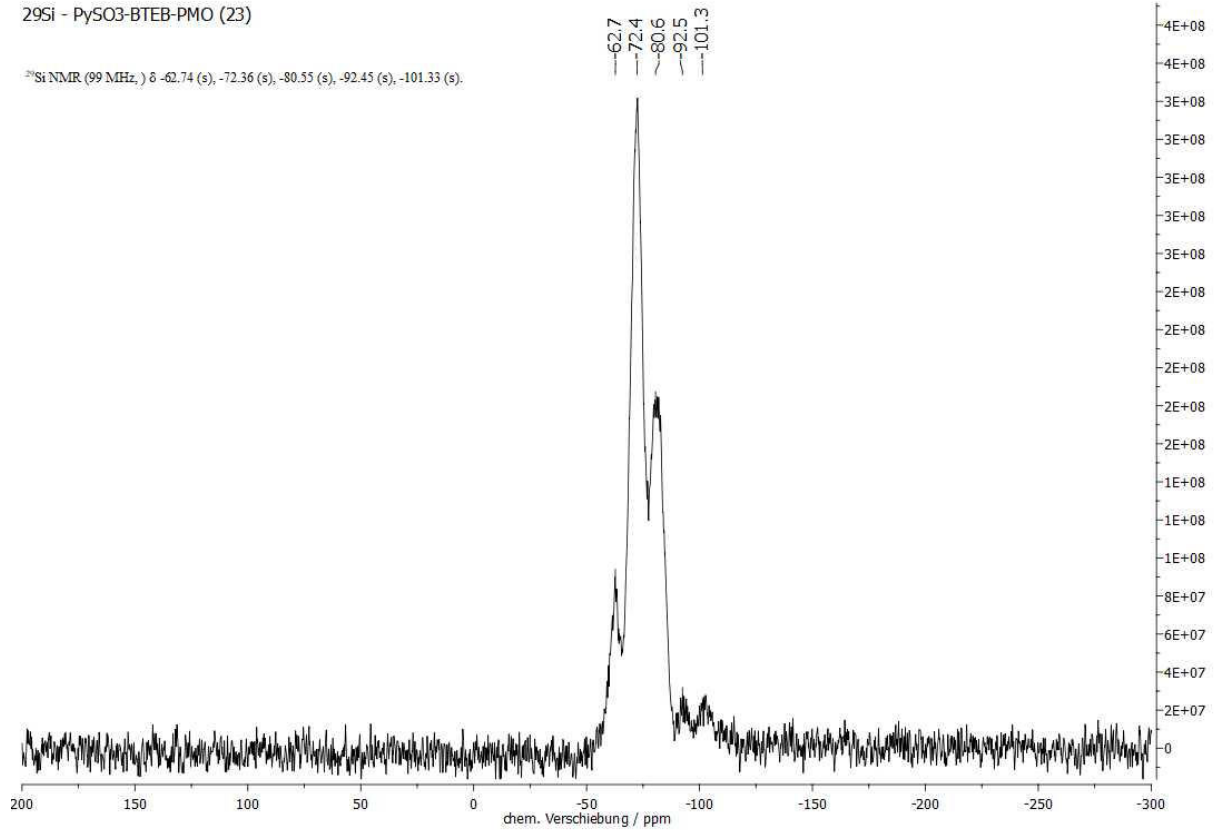


Abb. 8.37: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von PySO<sub>3</sub>-BTEB-PMO (**23**).

<sup>29</sup>Si - PT2-BTEB-PMO (25)

<sup>29</sup>Si NMR (99 MHz, ) δ -62.38 (s), -71.95 (s), -80.74 (s), -92.56 (s), -101.36 (s).

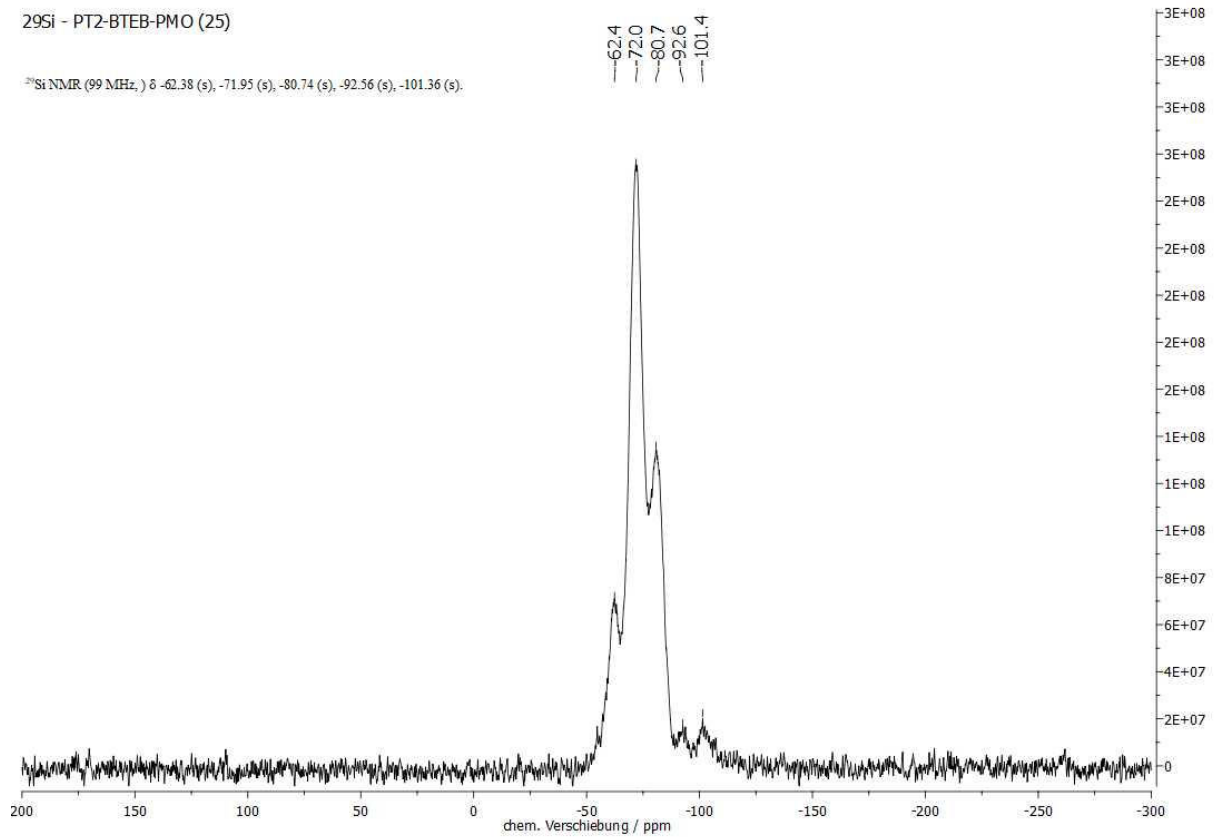


Abb. 8.38: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von PT2-BTEB-PMO (**25**).

# ANHANG

<sup>29</sup>Si - PT3-BTEB-PMO (26)

<sup>29</sup>Si NMR (99 MHz, ) δ -61.61 (s), -71.04 (s), -79.73 (s), -102.00 (s).

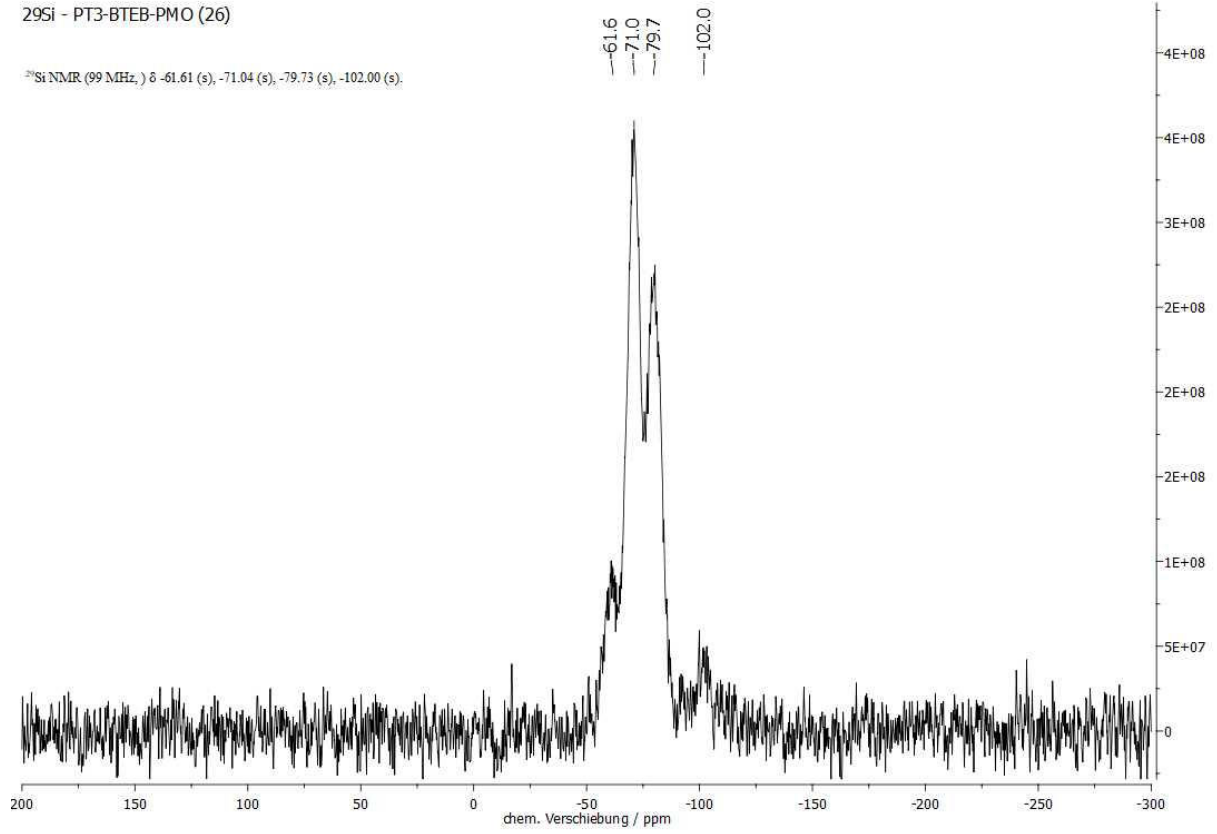


Abb. 8.39: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von PT3-BTEB-PMO (26).

<sup>29</sup>Si - PT4-BTEB-PMO (27)

<sup>29</sup>Si NMR (99 MHz, ) δ -62.27 (s), -71.71 (s), -80.54 (s), -102.25 (s).

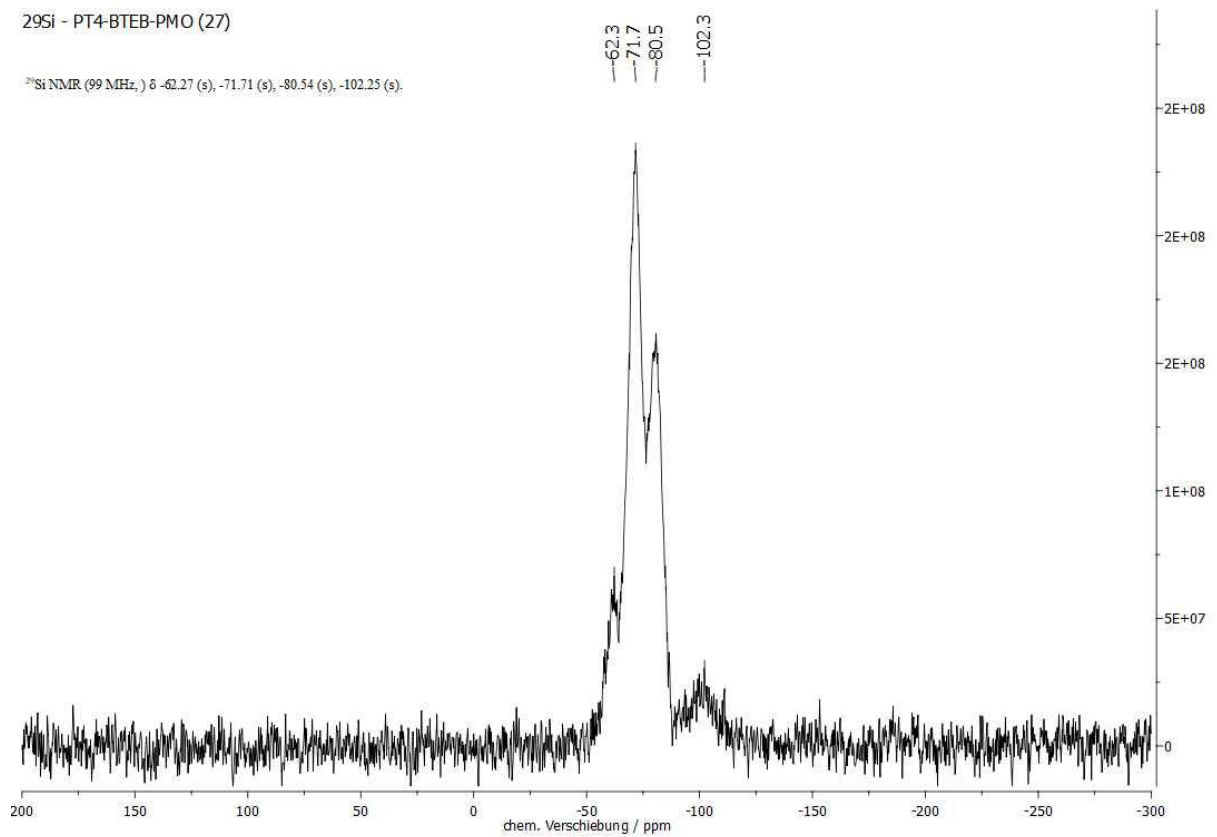


Abb. 8.40: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von PT4-BTEB-PMO (27).

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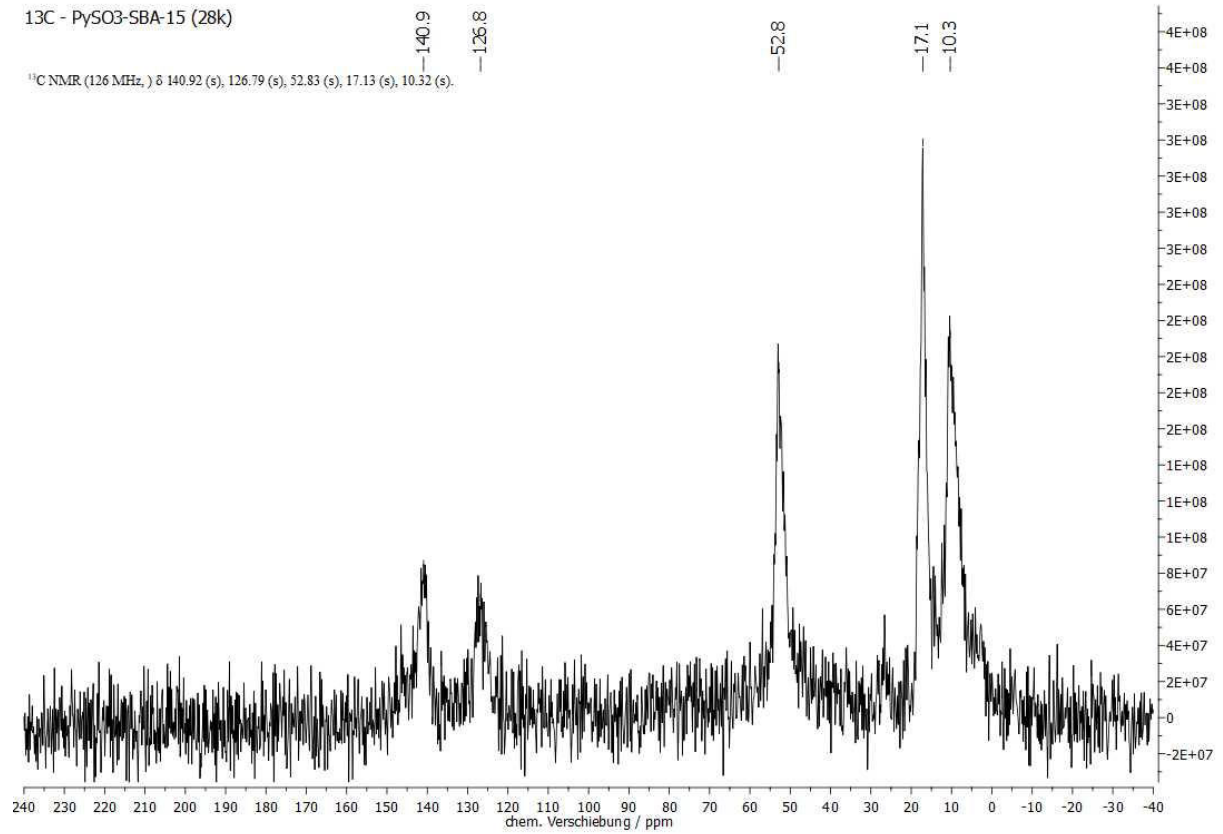


Abb. 8.41: <sup>13</sup>C-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von PySO<sub>3</sub>-SBA-15 (**28k**).

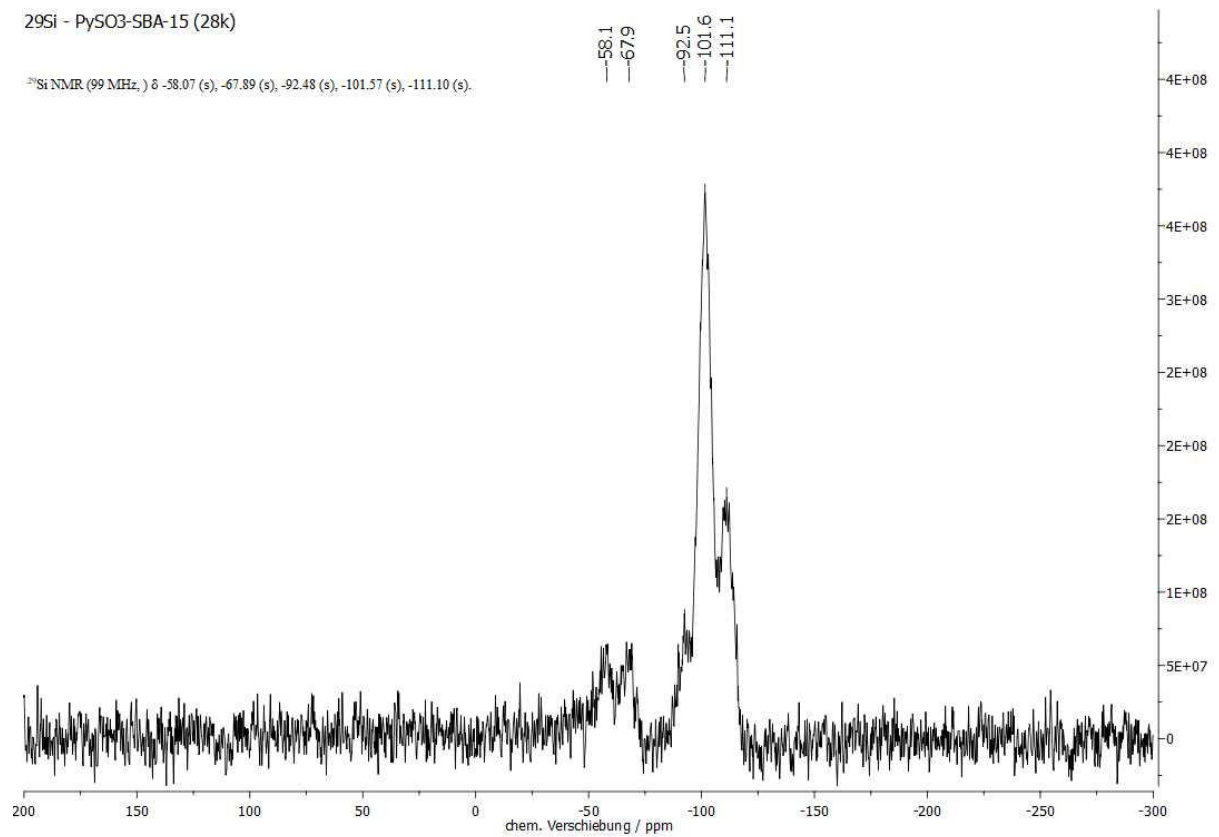


Abb. 8.42: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von PySO<sub>3</sub>-SBA-15 (**28k**).

# ANHANG

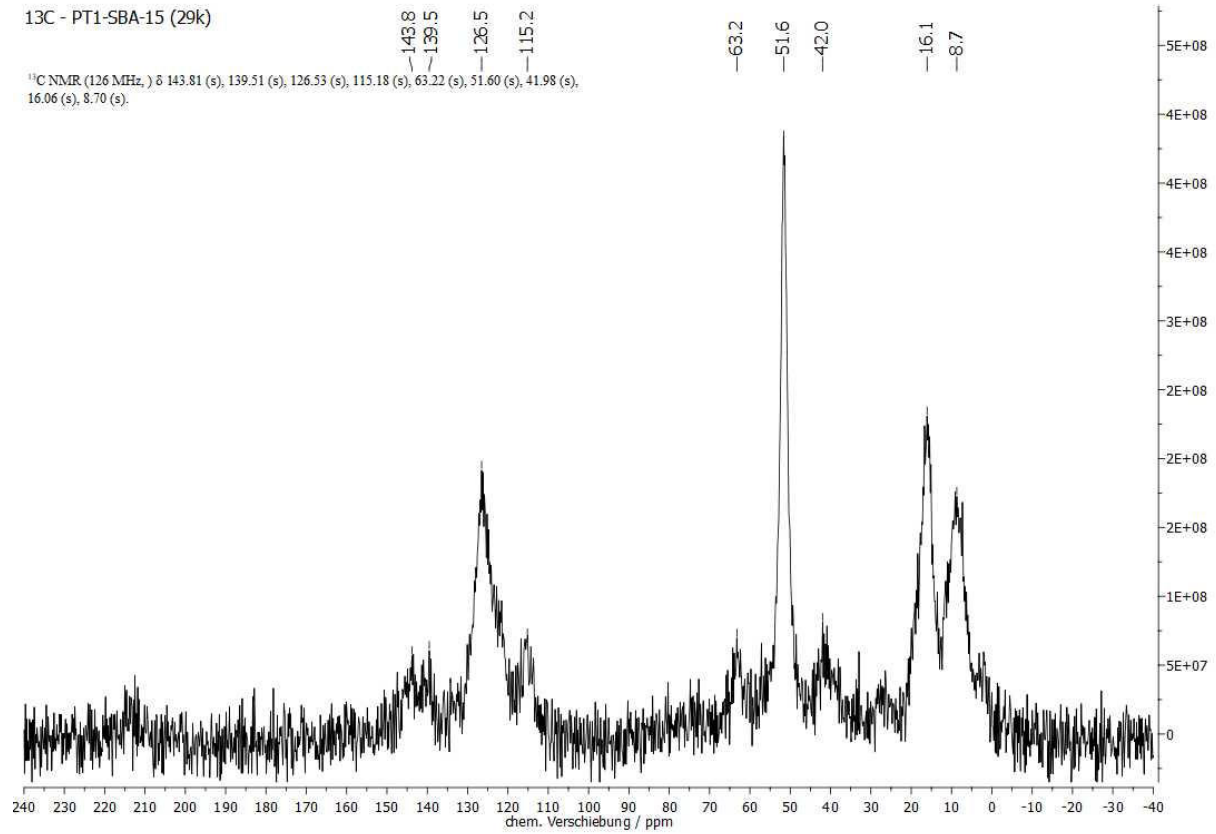


Abb. 8.43: <sup>13</sup>C-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von PT1-SBA-15 (**29k**).

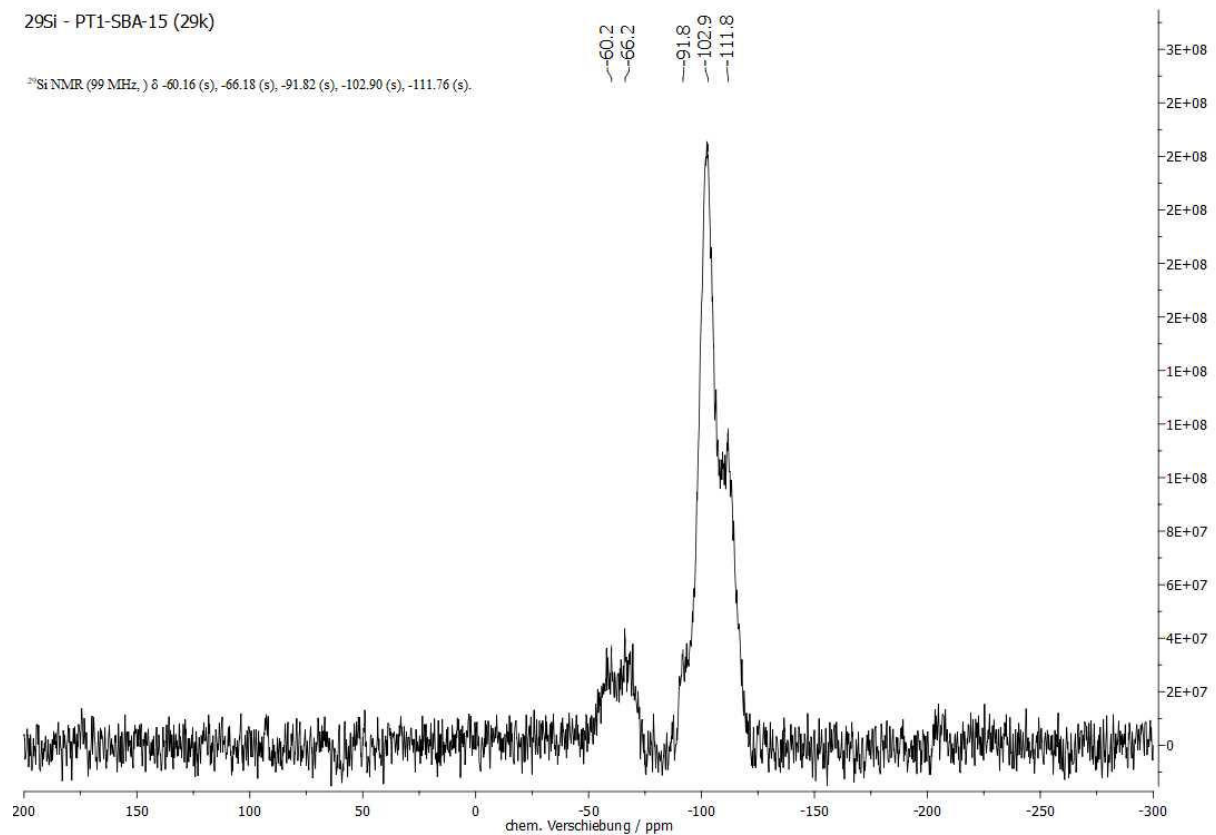


Abb. 8.44: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von PT1-SBA-15 (**29k**).

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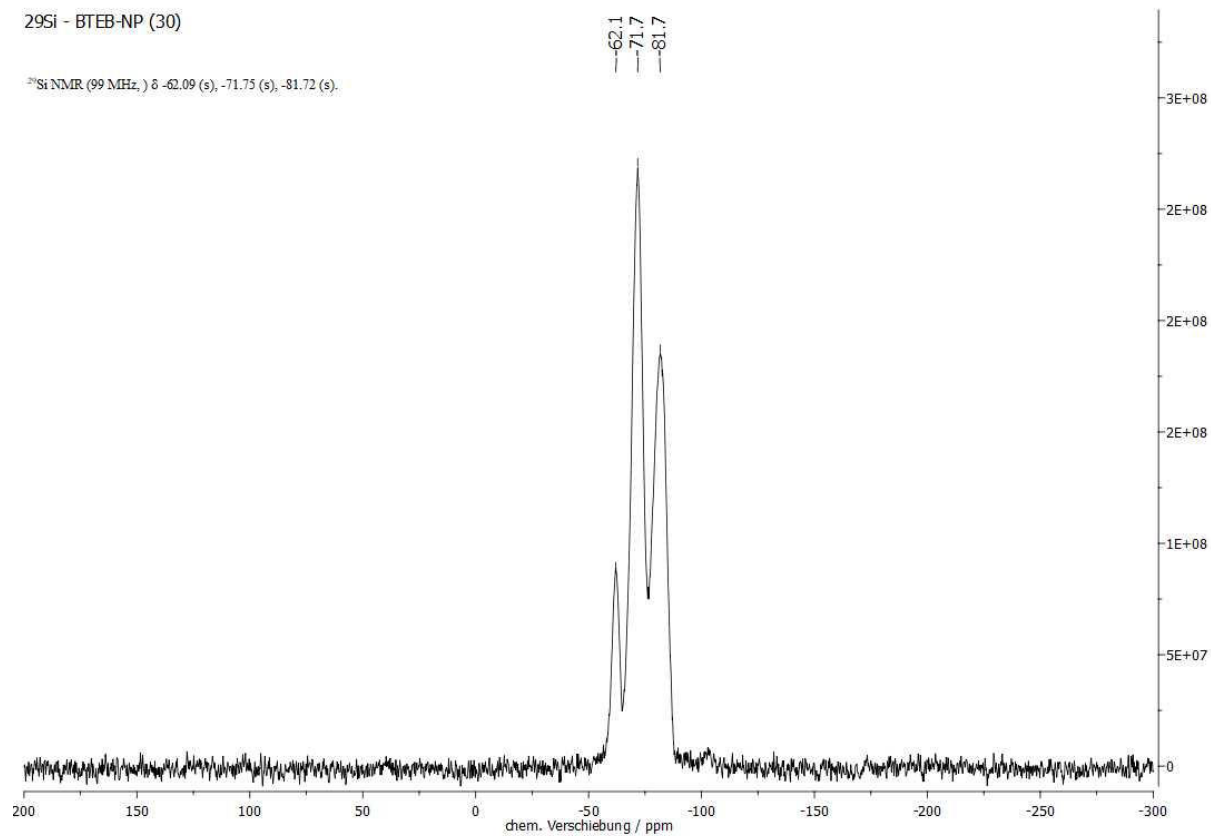


Abb. 8.45: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von BTEB-NP (30).

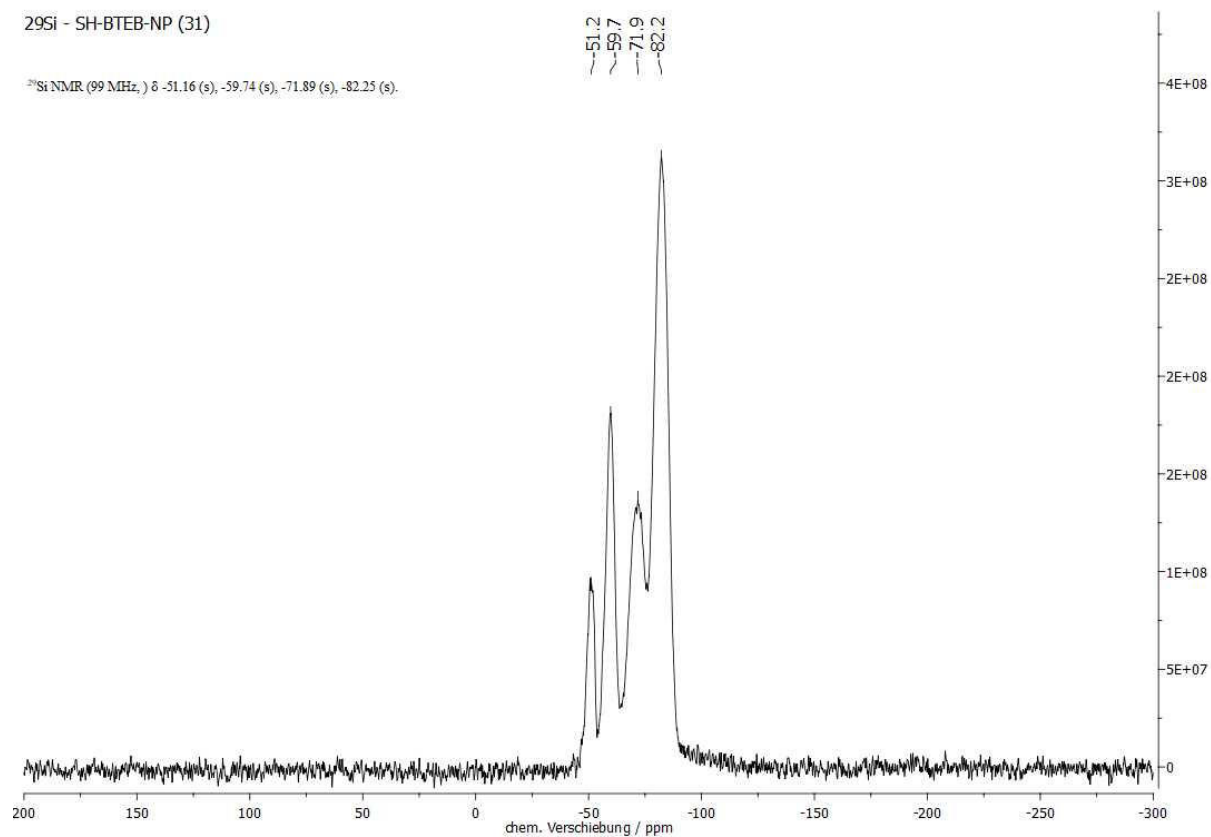


Abb. 8.46: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von SH-BTEB-NP (31).

# ANHANG

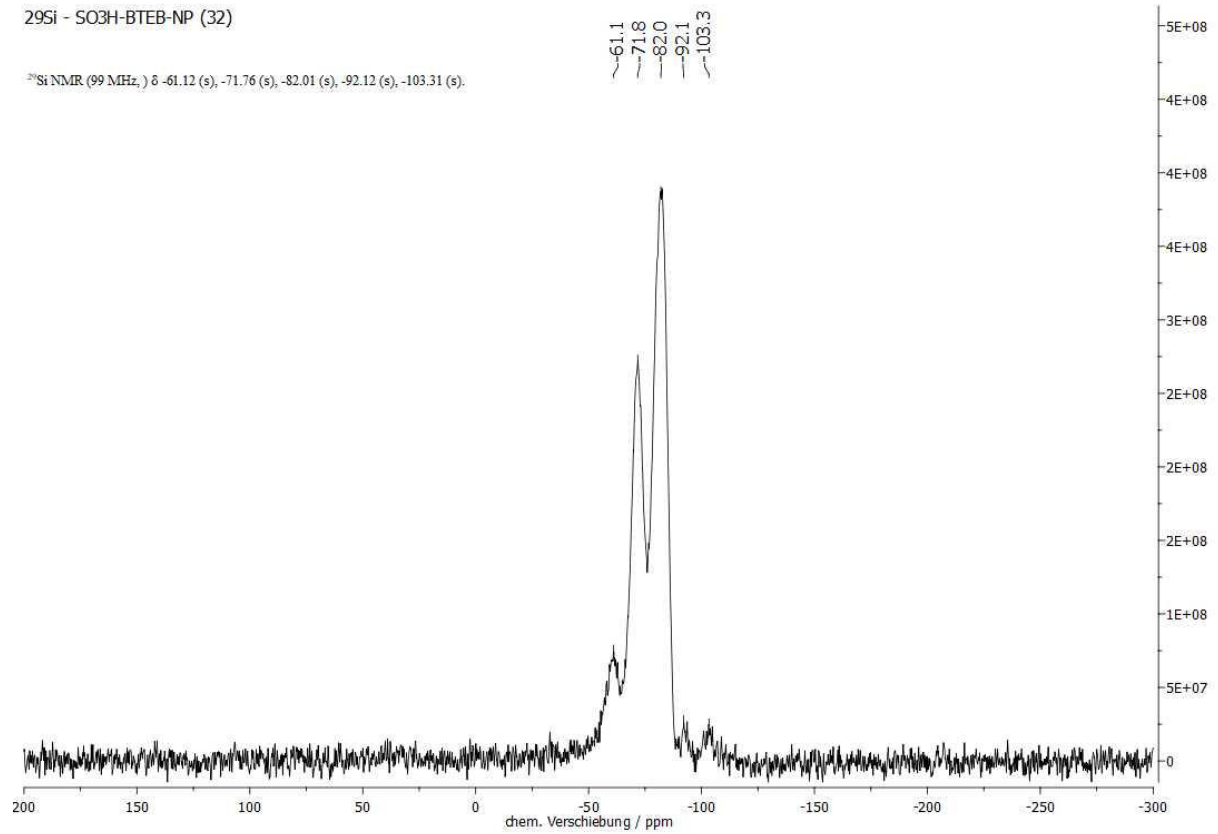


Abb. 8.47: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von SO<sub>3</sub>H-BTEB-NP (32).

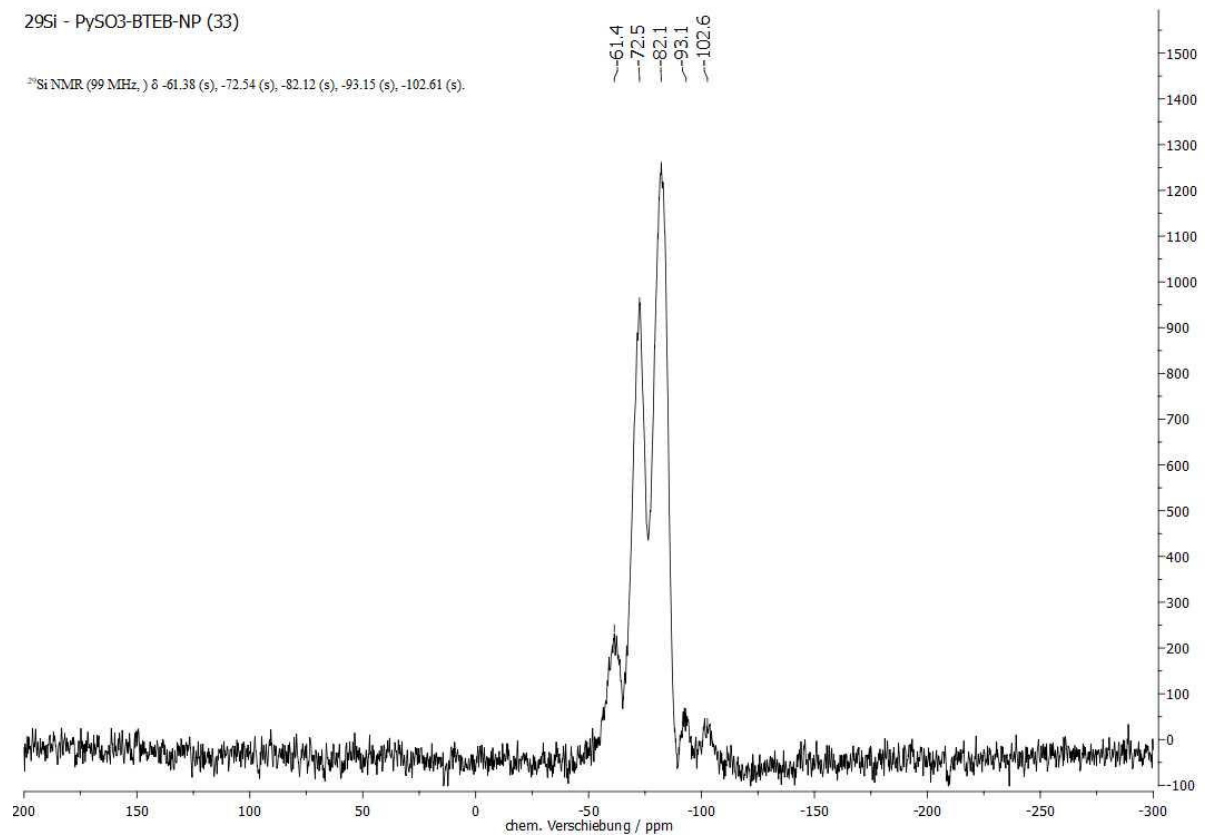


Abb. 8.48: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von PySO<sub>3</sub>H-BTEB-NP (33).



# ANHANG

<sup>29</sup>Si - PT5-BTEB-NP (34)

<sup>29</sup>Si NMR (99 MHz, ) δ -62.42 (s), -71.80 (s), -81.55 (s), -91.44 (s), -102.46 (s).

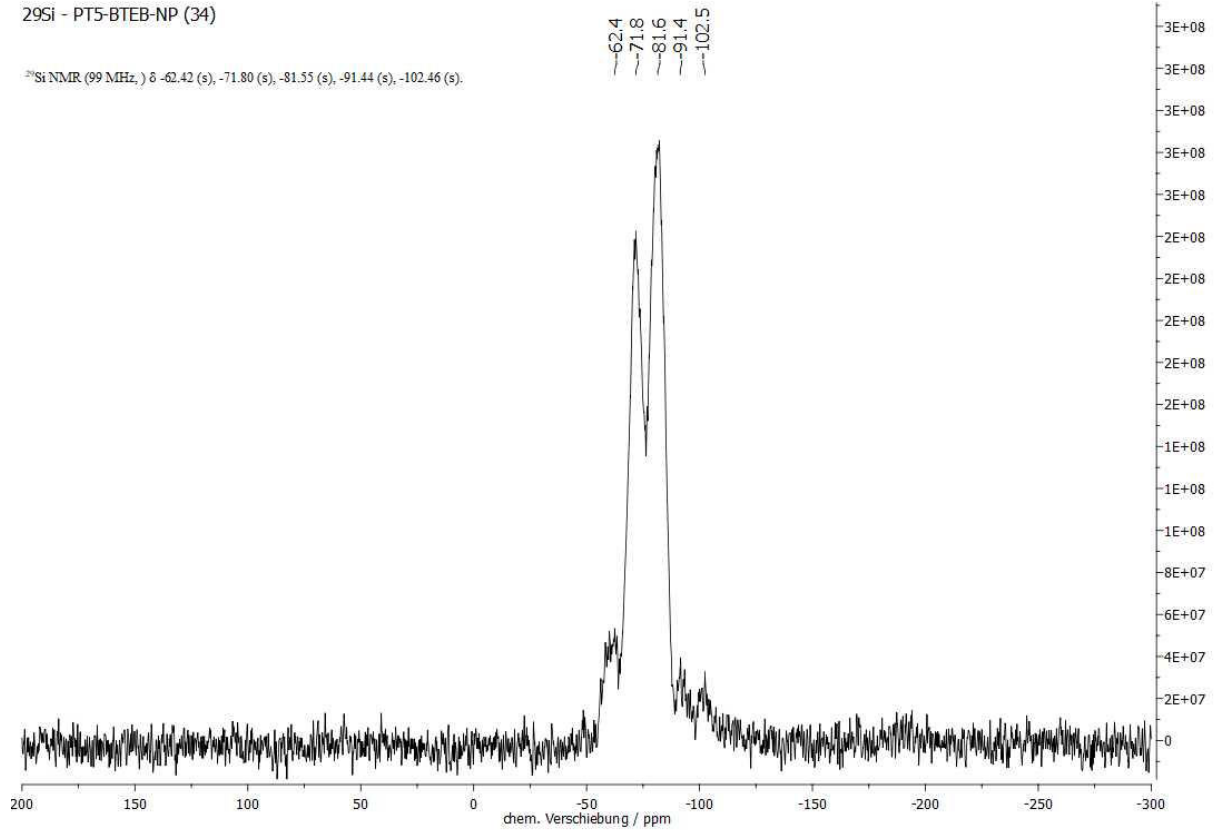


Abb. 8.49: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von PT5-BTEB-NP (34).

<sup>29</sup>Si - PT6-BTEB-NP (35)

<sup>29</sup>Si NMR (99 MHz, ) δ -61.46 (s), -71.64 (s), -81.14 (s), -92.16 (s), -102.34 (s).

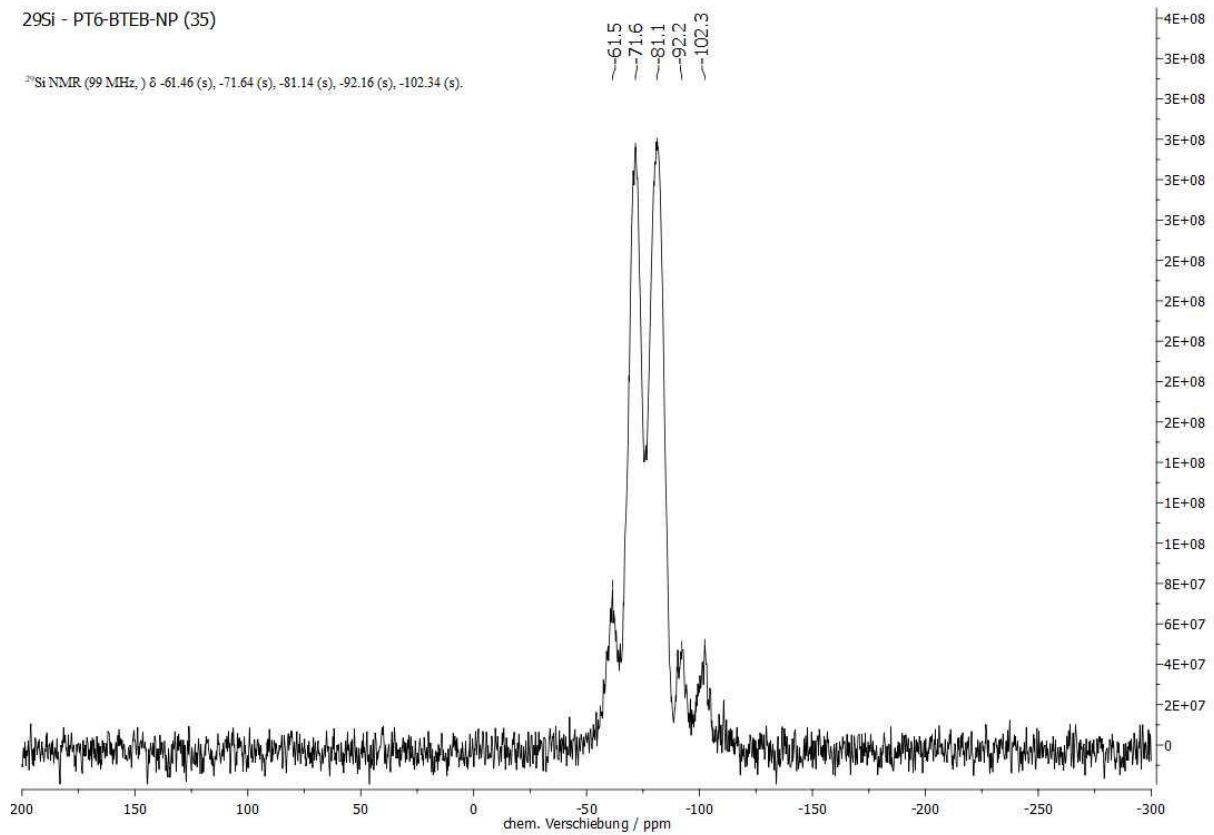


Abb. 8.50: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von PT6-BTEB-NP (35).

# ANHANG

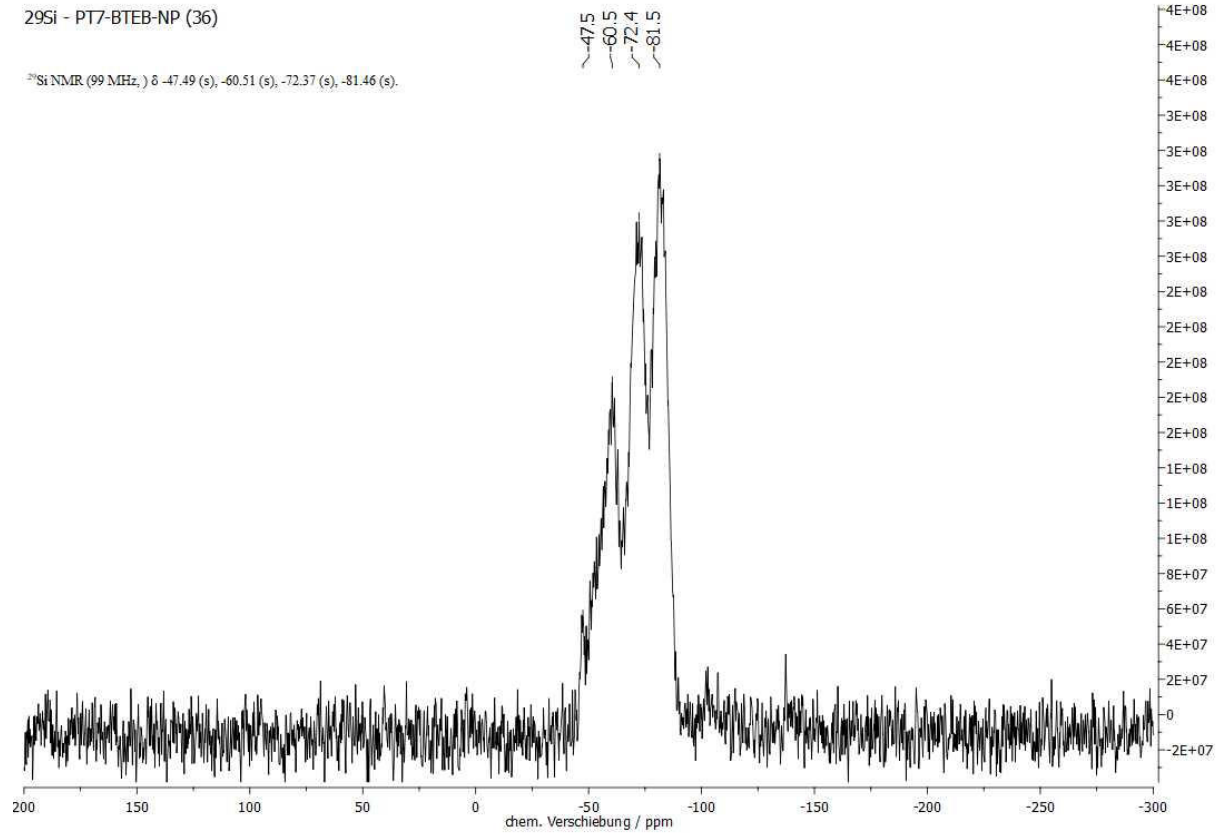


Abb. 8.51:  $^{29}\text{Si}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von PT7-BTEB-NP (36).

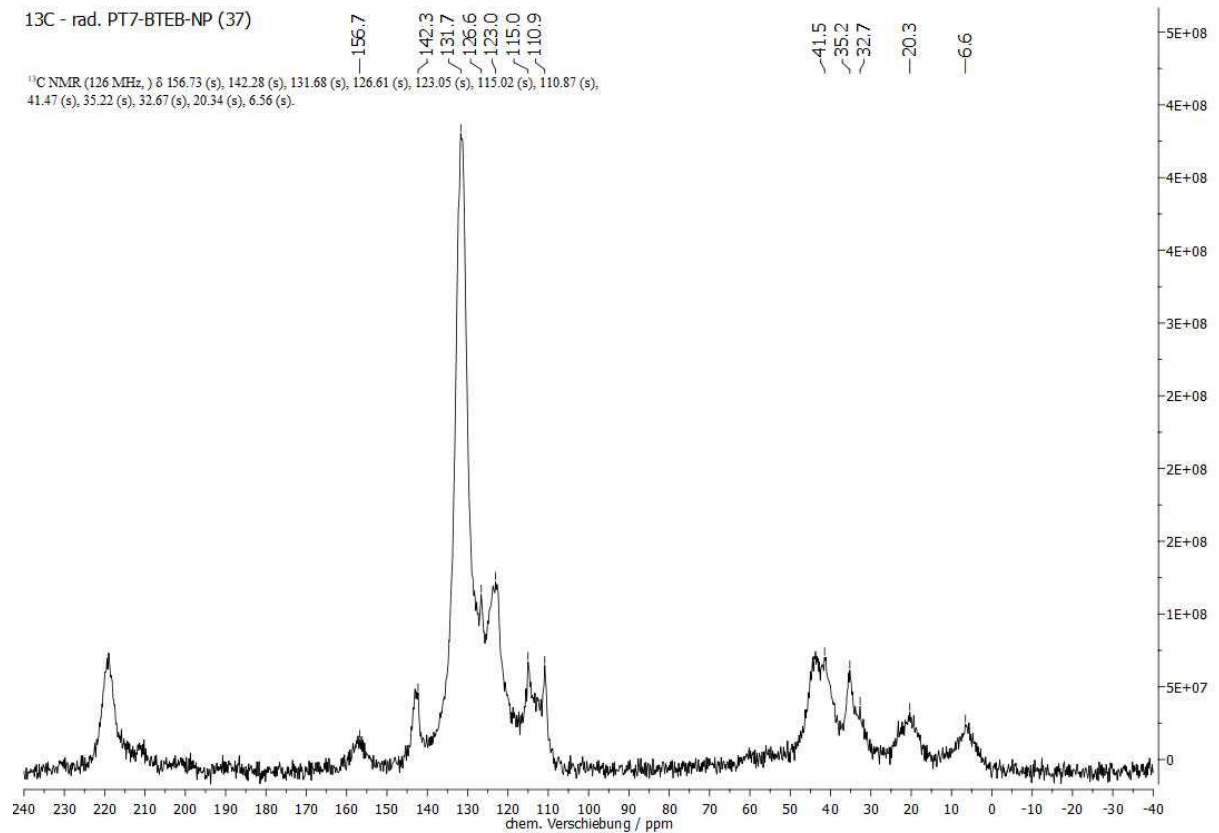


Abb. 8.52:  $^{13}\text{C}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von rad. PT7-BTEB-NP (37).

ANHANG

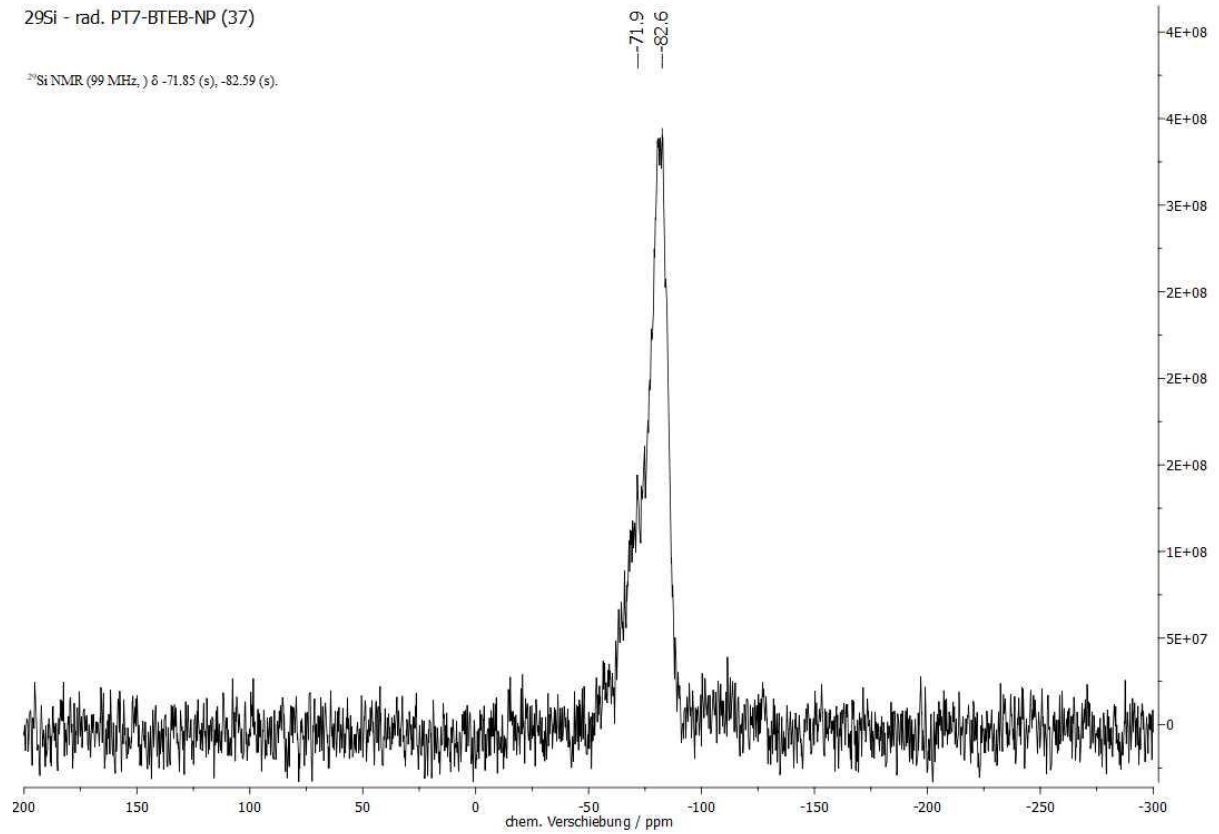


Abb. 8.53: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von rad. PT7-BTEB-NP (37).

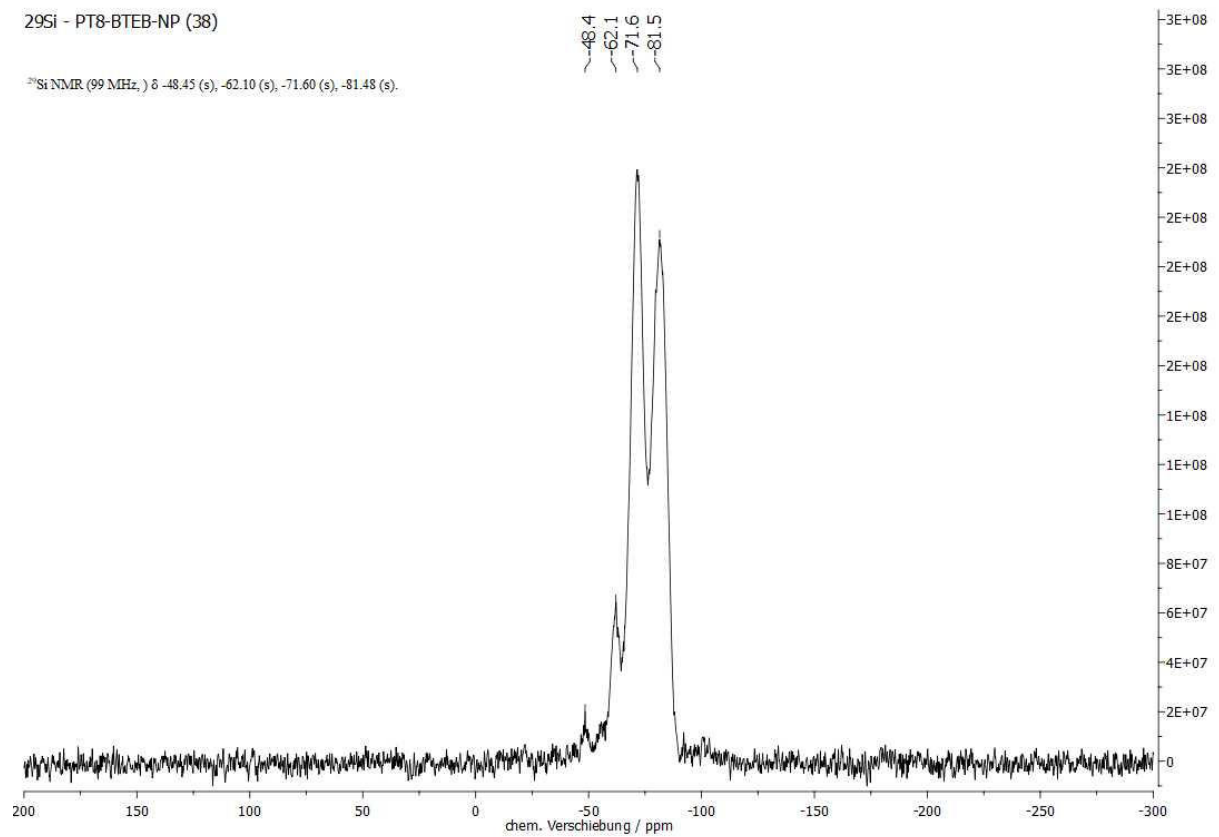


Abb. 8.54: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von PT8-BTEB-NP (38).

# ANHANG

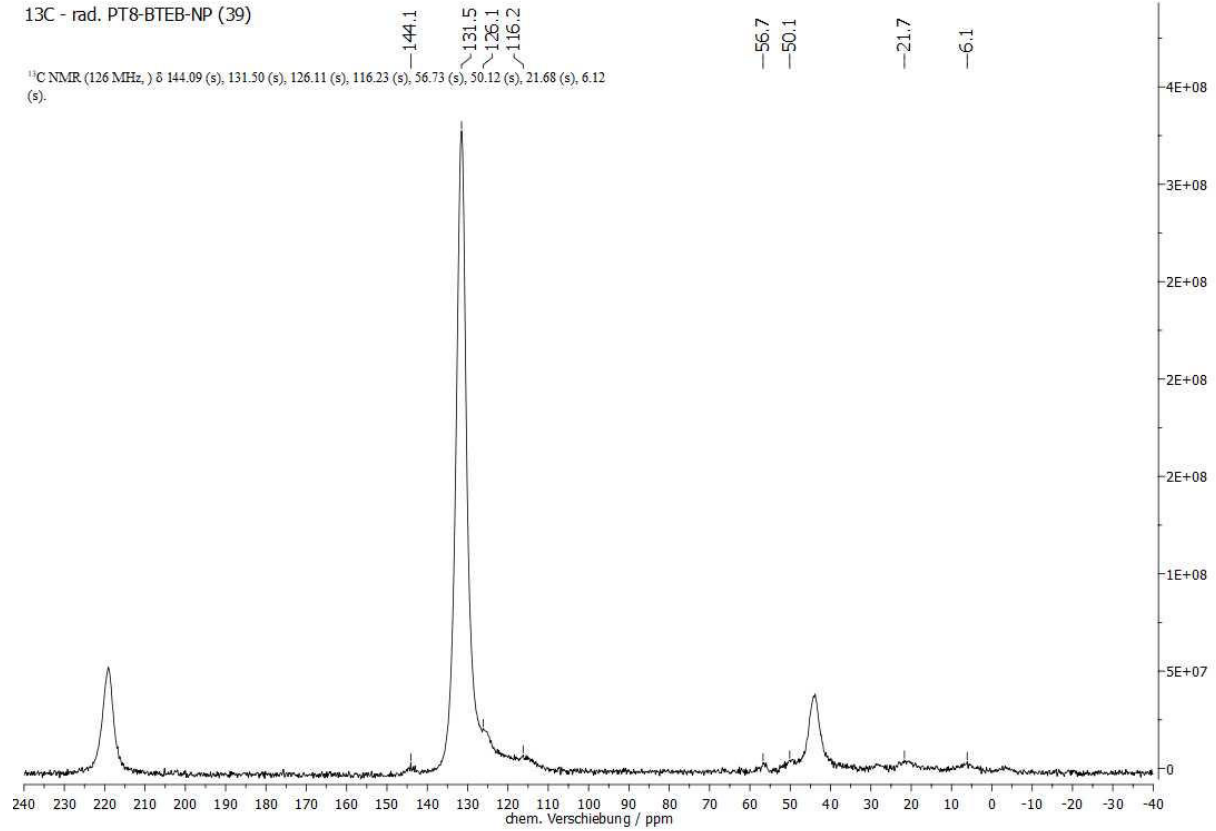


Abb. 8.55: <sup>13</sup>C-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von rad. PT8-BTEB-NP (39).

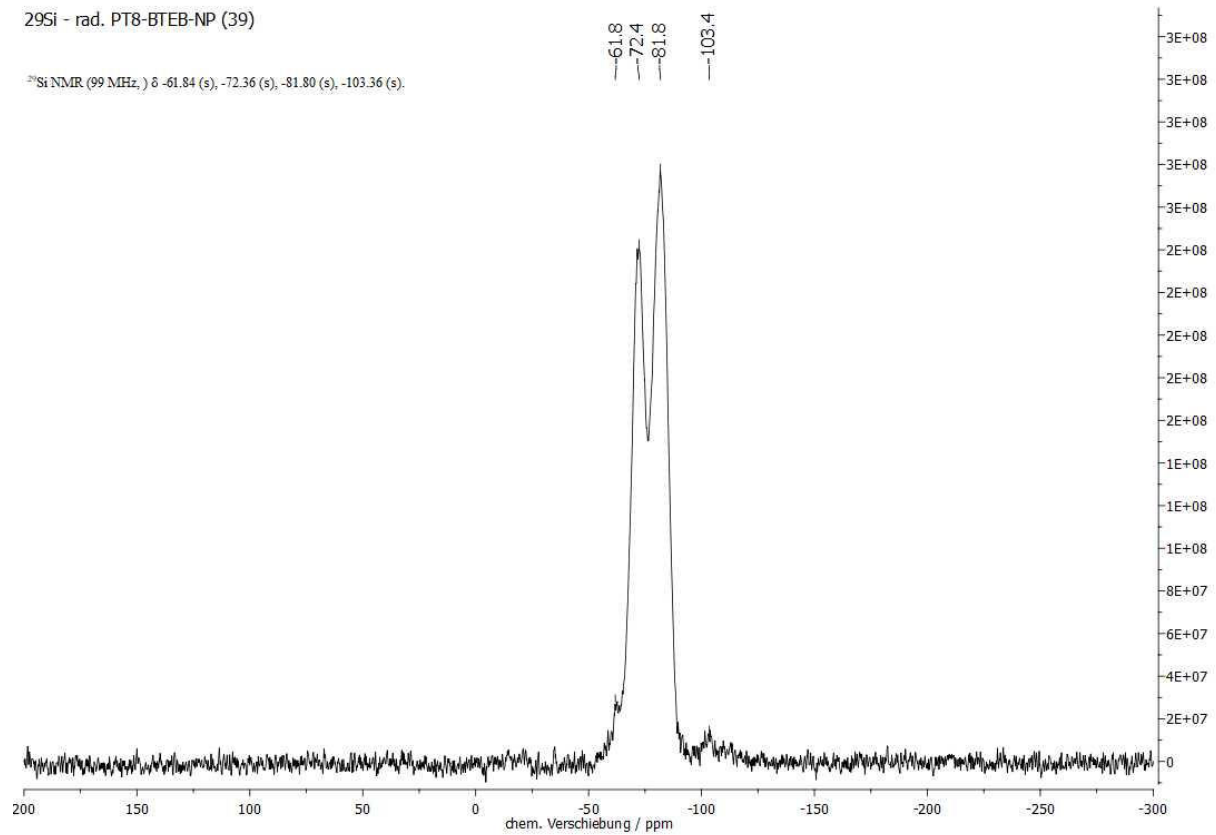


Abb. 8.56: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von rad. PT8-BTEB-NP (39).

ANHANG

<sup>1</sup>H - 3-(Triethoxysilyl)propylisothiocyanat (40)

<sup>1</sup>H NMR (400 MHz, CD<sub>3</sub>CN) δ 3.80 (q, J = 7.0 Hz, 6H), 3.53 (t, J = 6.6 Hz, 2H), 1.80 – 1.71 (m, 2H), 1.18 (t, J = 7.0 Hz, 9H), 0.66 (dd, J = 9.6, 7.1 Hz, 2H).

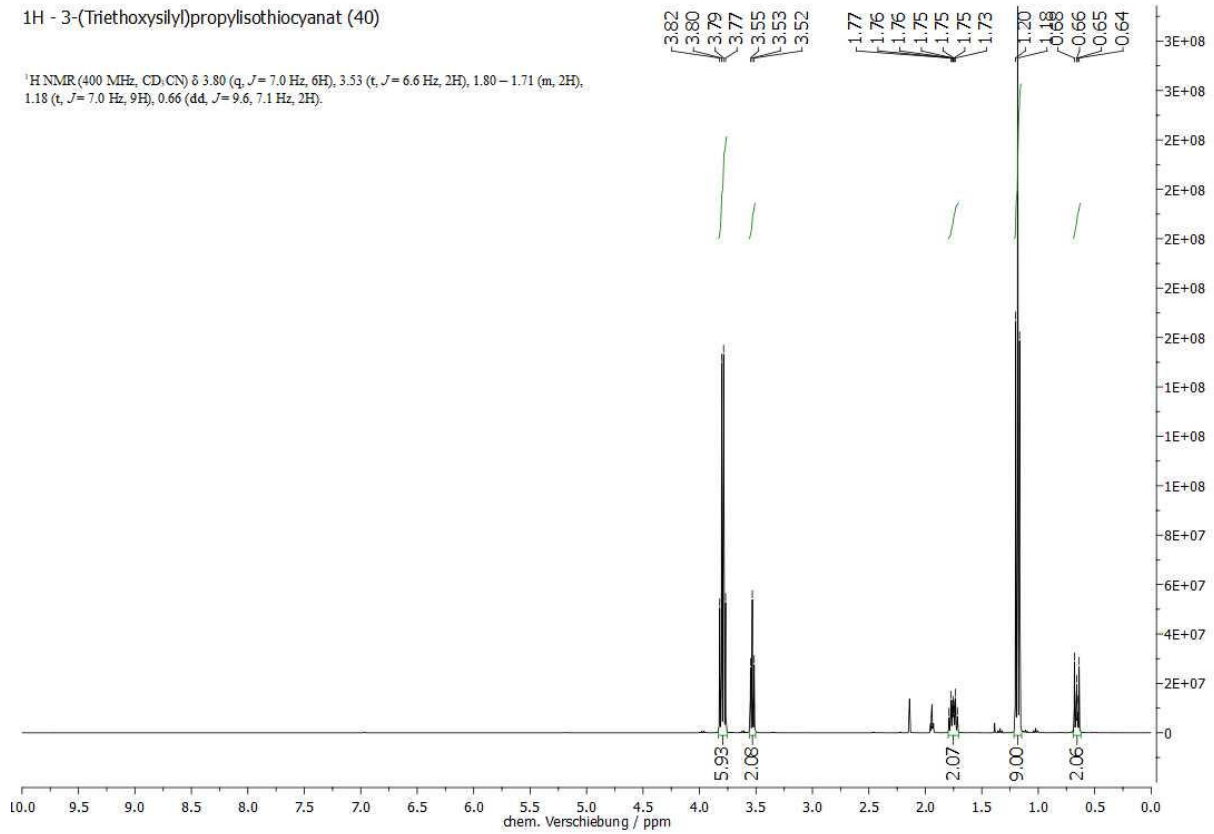


Abb. 8.57: <sup>1</sup>H-NMR-Spektrum (400 MHz, CD<sub>3</sub>CN, 298 K) von 3-(Triethoxysilyl)propylisothiocyanat (40).

<sup>13</sup>C - 3-(Triethoxysilyl)propylisothiocyanat (40)

<sup>13</sup>C NMR (101 MHz, CD<sub>3</sub>CN) δ 129.55 (s), 59.12 (s), 48.24 (s), 24.69 (s), 18.65 (s), 8.10 (s).

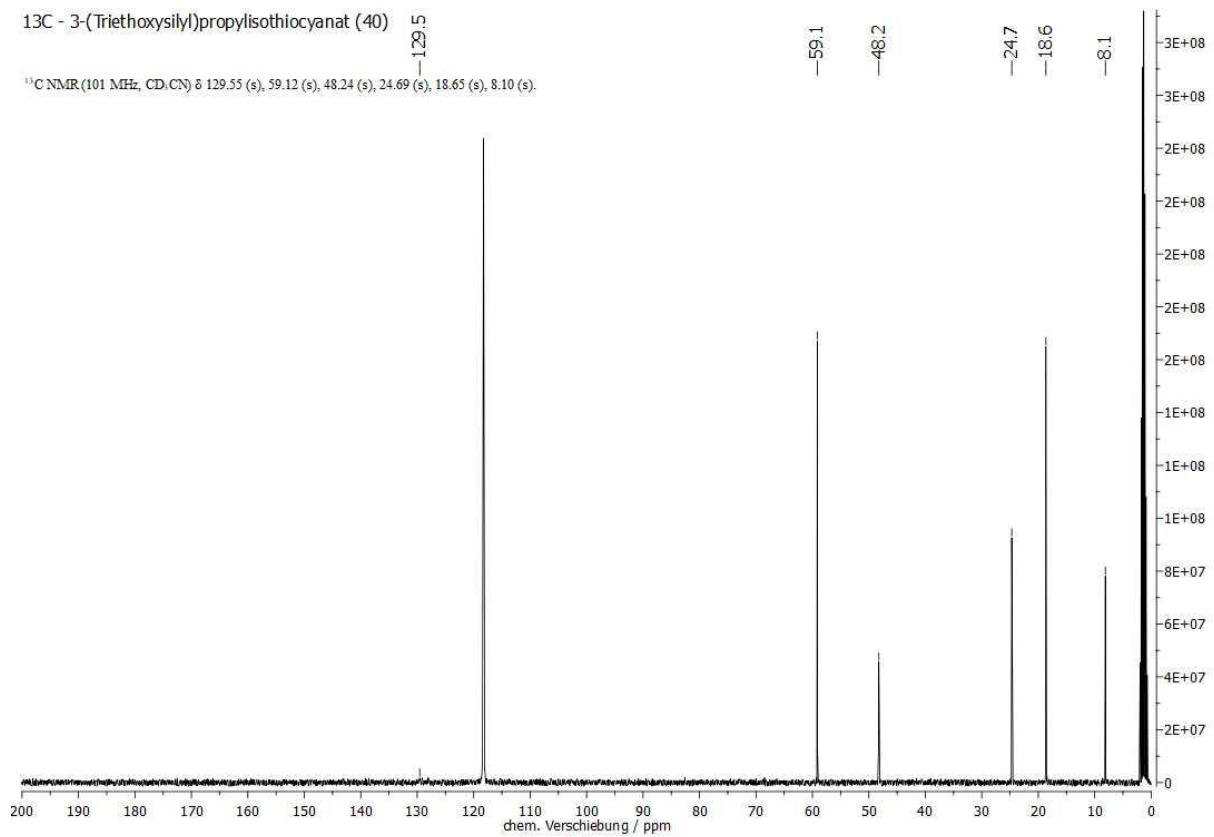


Abb. 8.58: <sup>13</sup>C-NMR-Spektrum (101 MHz, CD<sub>3</sub>CN, 298 K) von 3-(Triethoxysilyl)propylisothiocyanat (40).

ANHANG

$^{29}\text{Si}$  - 3-(Triethoxysilyl)propylisothiocyanat (40)

$^{29}\text{Si}$  NMR (80 MHz,  $\text{CD}_3\text{CN}$ )  $\delta$  -46.64 (s).

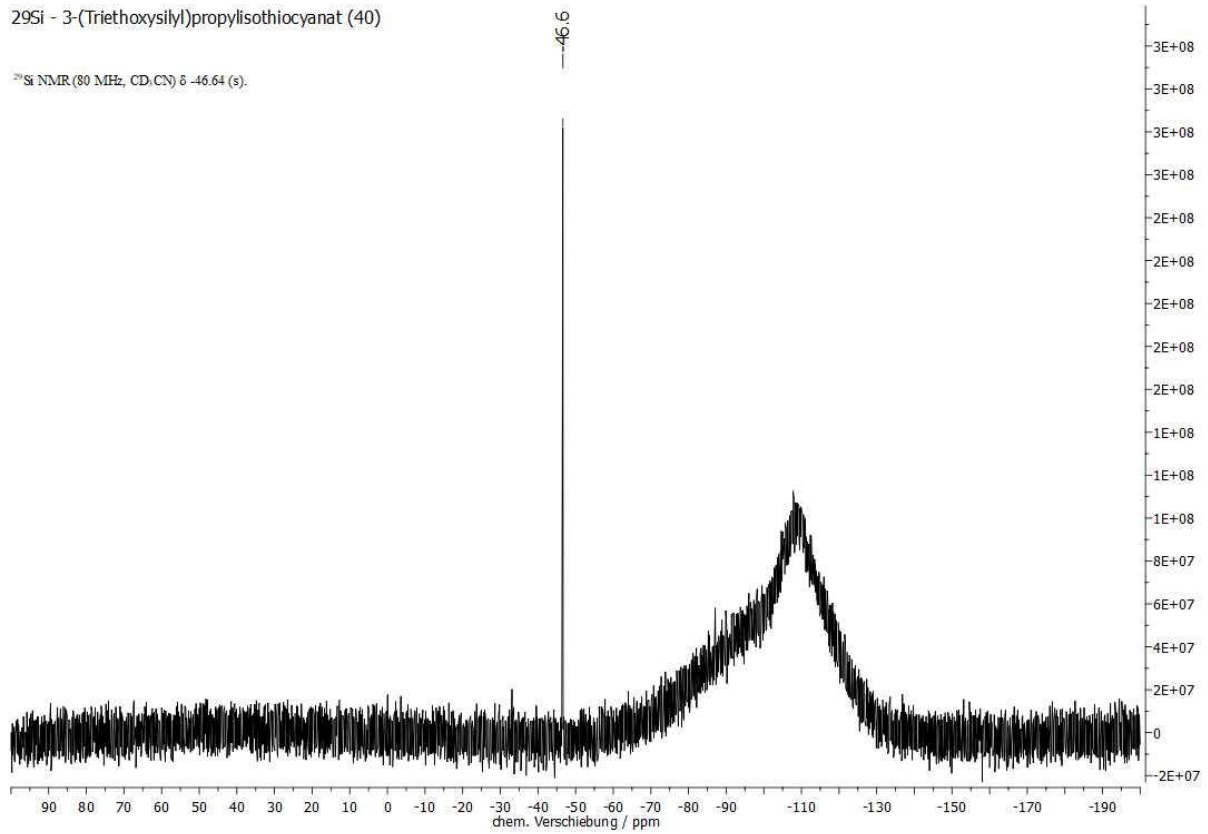


Abb. 8.59:  $^{29}\text{Si}$ -NMR-Spektrum (80 MHz,  $\text{CD}_3\text{CN}$ , 298 K) von 3-(Triethoxysilyl)propylisothiocyanat (40).

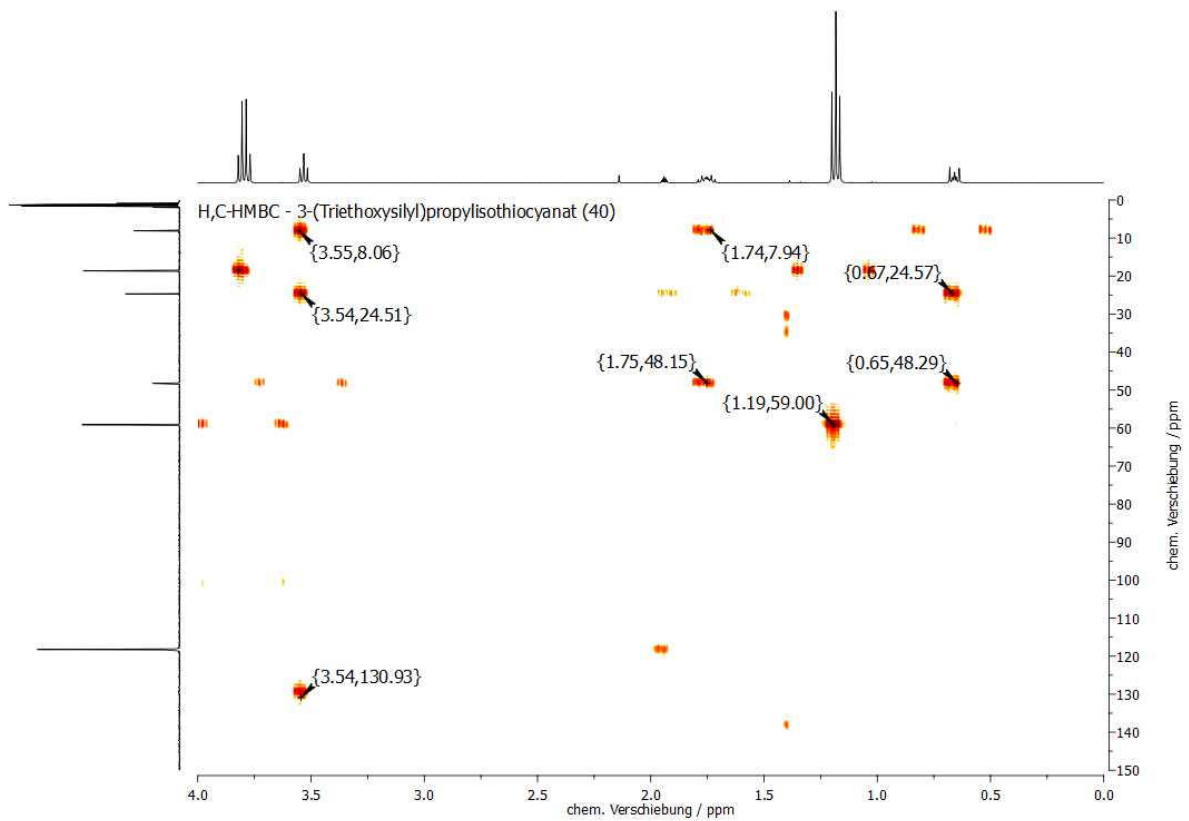


Abb. 8.60: H,C-HMBC-NMR-Spektrum ( $\text{CD}_3\text{CN}$ , 298 K) von 3-(Triethoxysilyl)propylisothiocyanat (40).

ANHANG

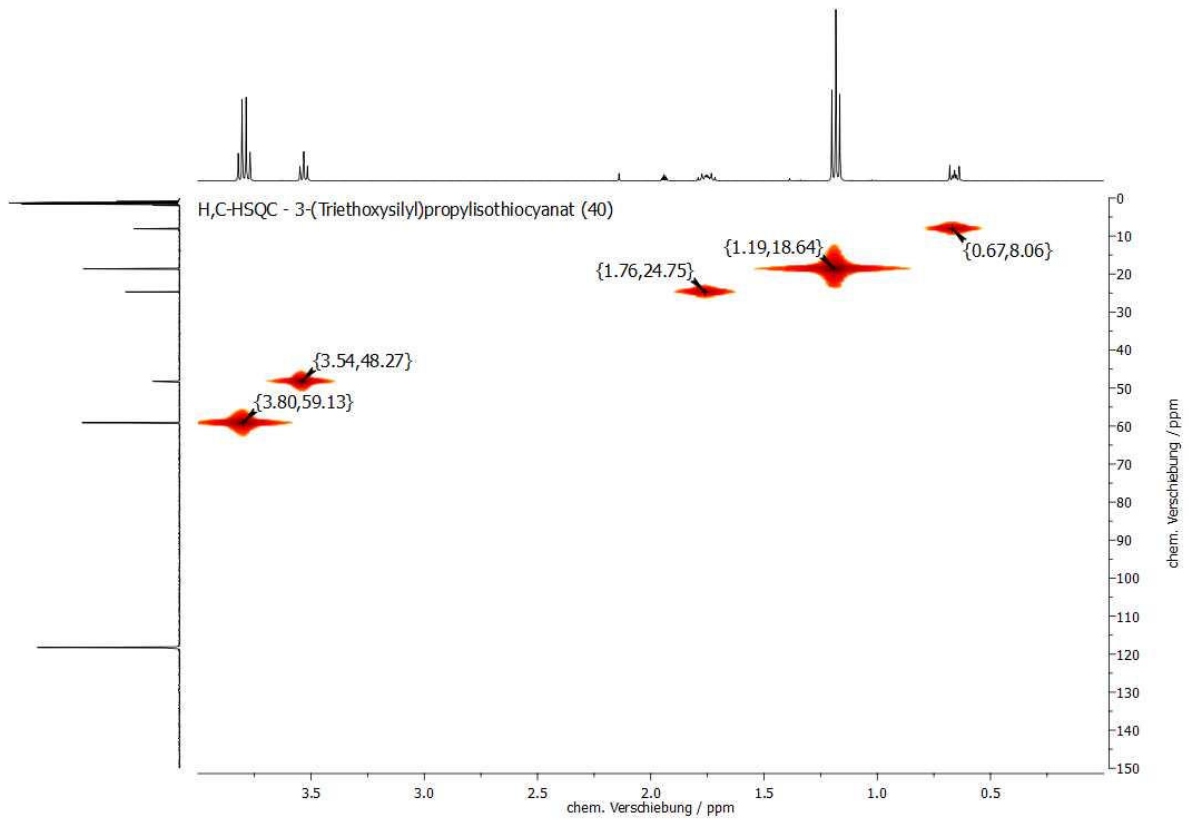


Abb. 8.61: H,C-HSQC-NMR-Spektrum (CD<sub>3</sub>CN, 298 K) von 3-(Triethoxysilyl)propylisothiocyanat (40).

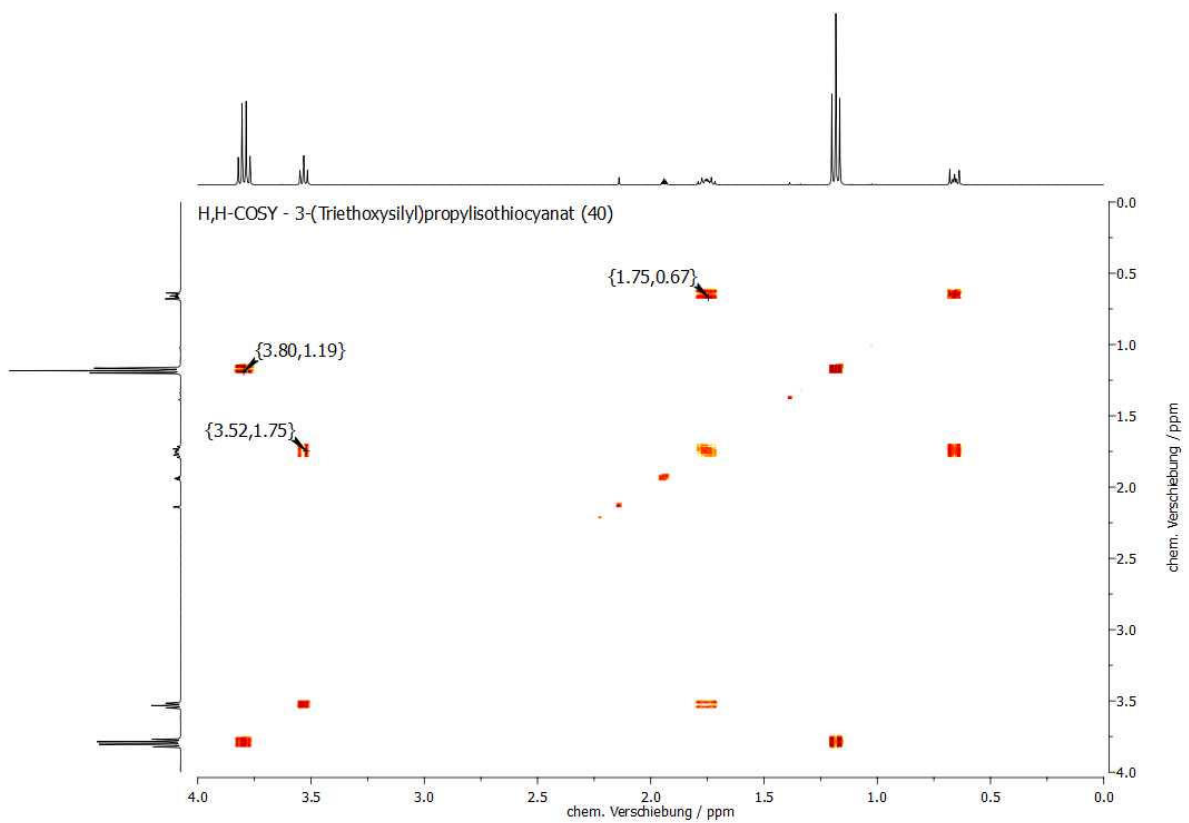


Abb. 8.62: H,H-COSY-NMR-Spektrum (CD<sub>3</sub>CN, 298 K) von 3-(Triethoxysilyl)propylisothiocyanat (40).

# ANHANG

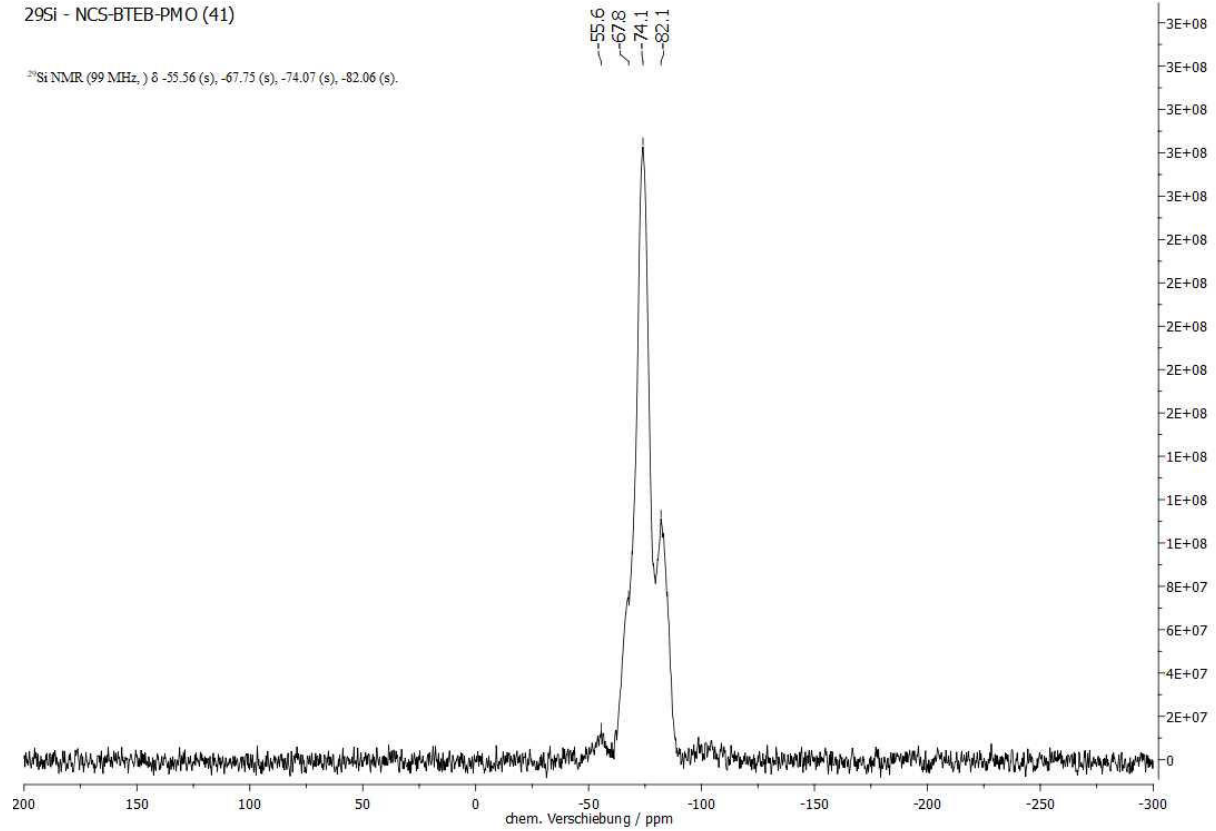


Abb. 8.63: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von NCS-BTEB-PMO (41).

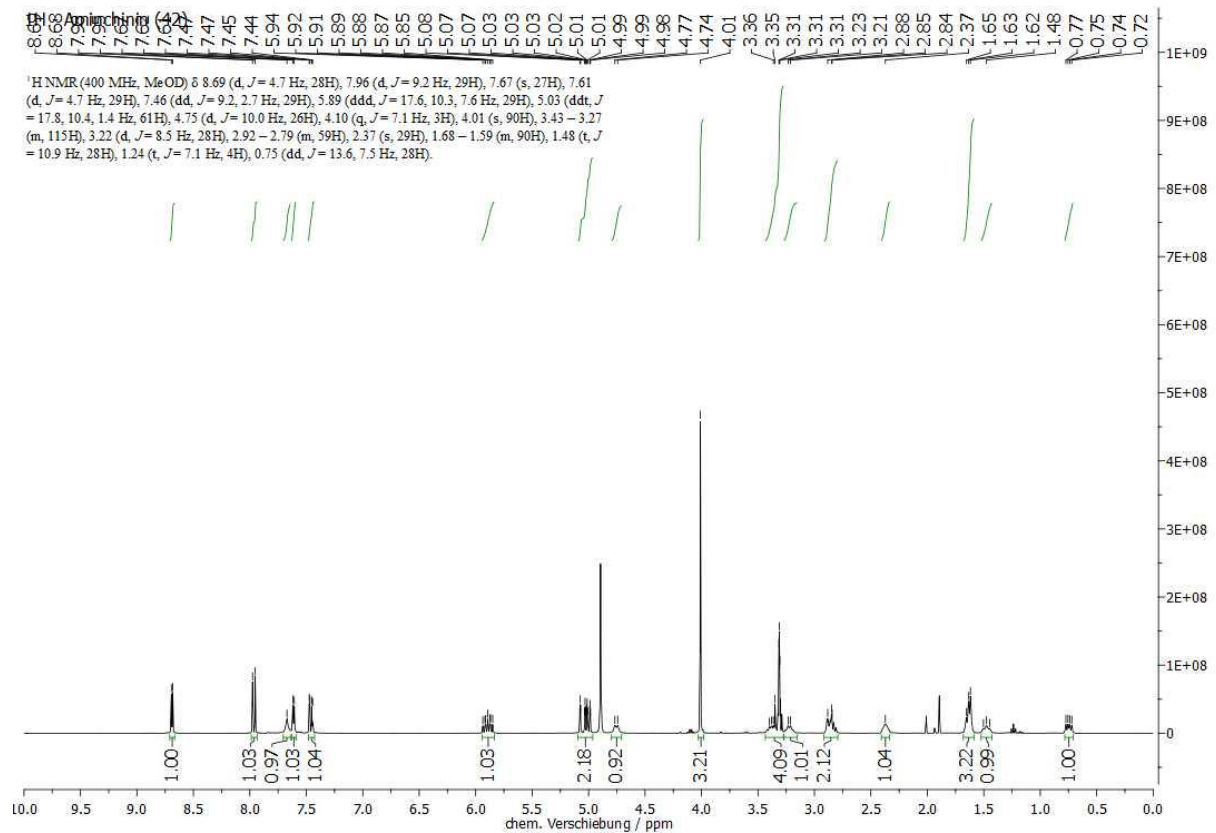


Abb. 8.64: <sup>1</sup>H-NMR-Spektrum (400 MHz, MeOH-d<sub>4</sub>, 298 K) von Aminichinin (42).



ANHANG

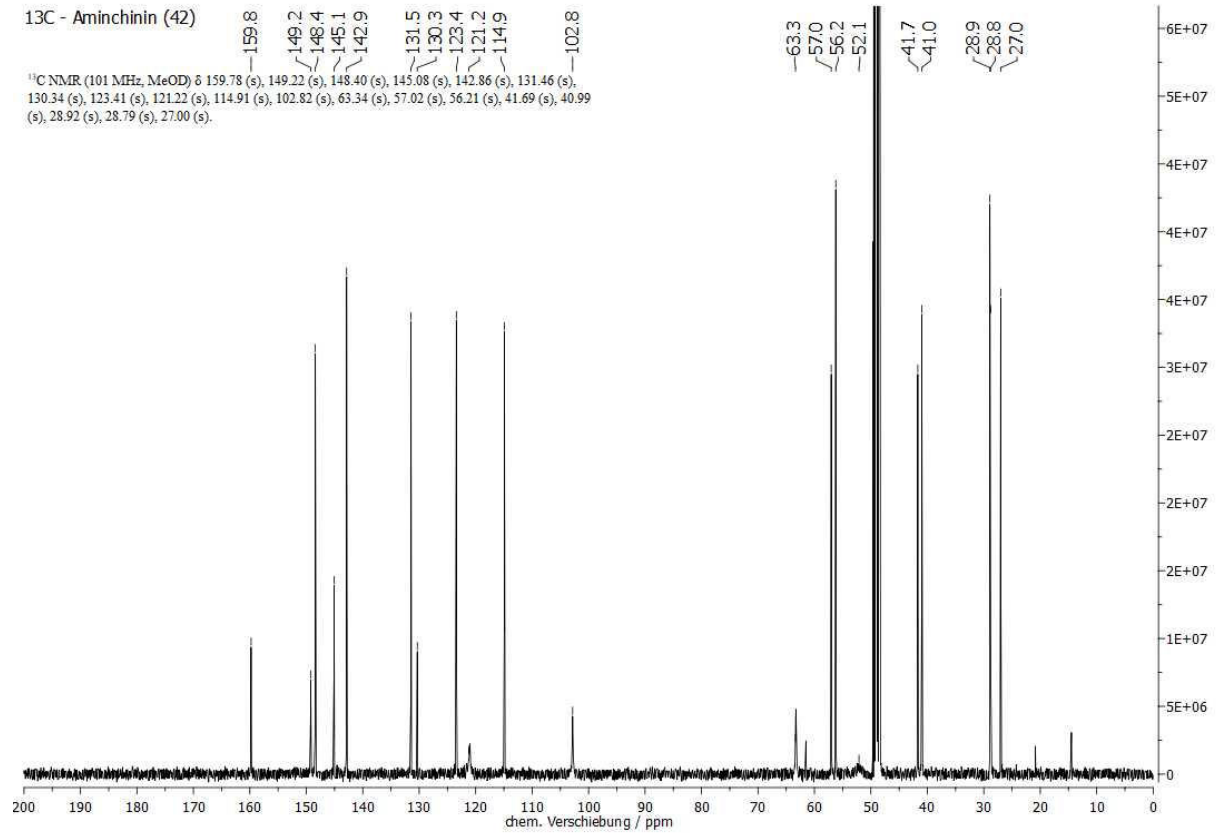


Abb. 8.65: <sup>13</sup>C-NMR-Spektrum (101 MHz, MeOH-d<sub>4</sub>, 298 K) von Aminchinin (42).

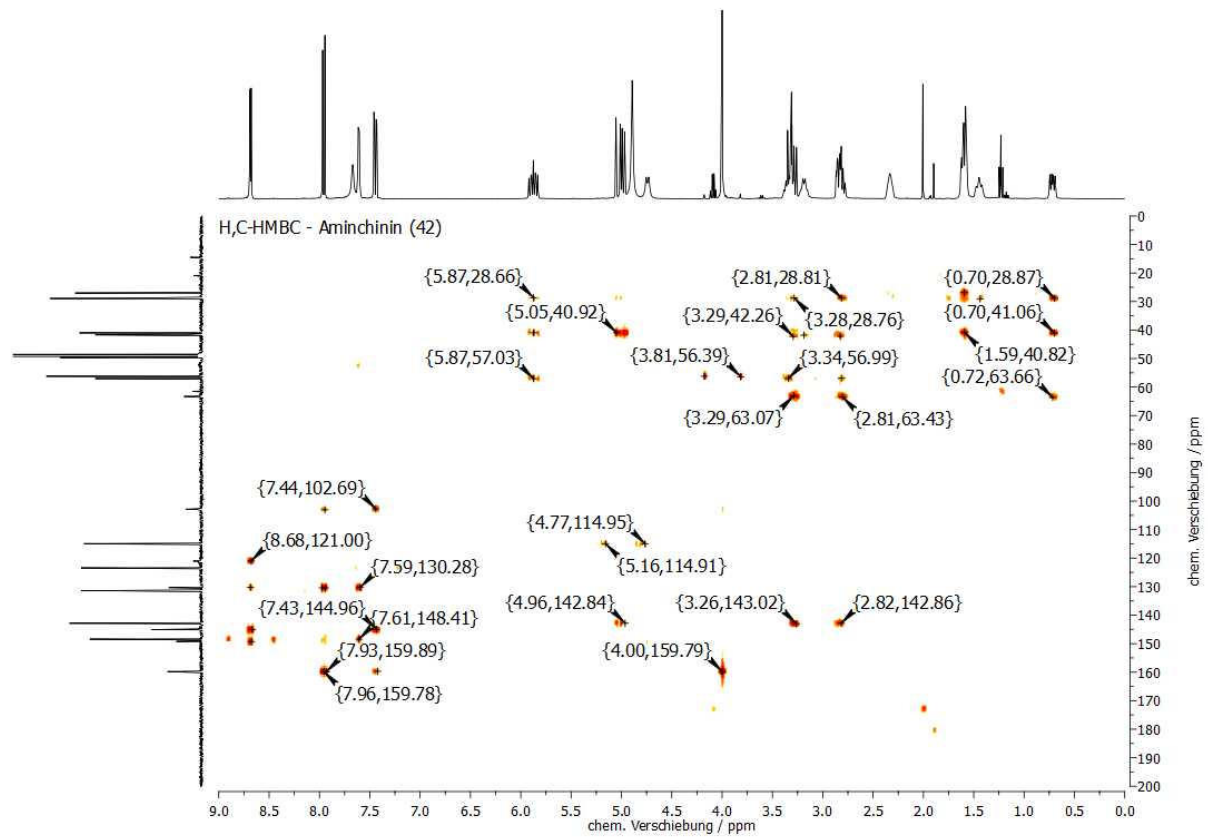


Abb. 8.66: H,C-HMBC-NMR-Spektrum (MeOH-d<sub>4</sub>, 298 K) von Aminchinin (42).

ANHANG

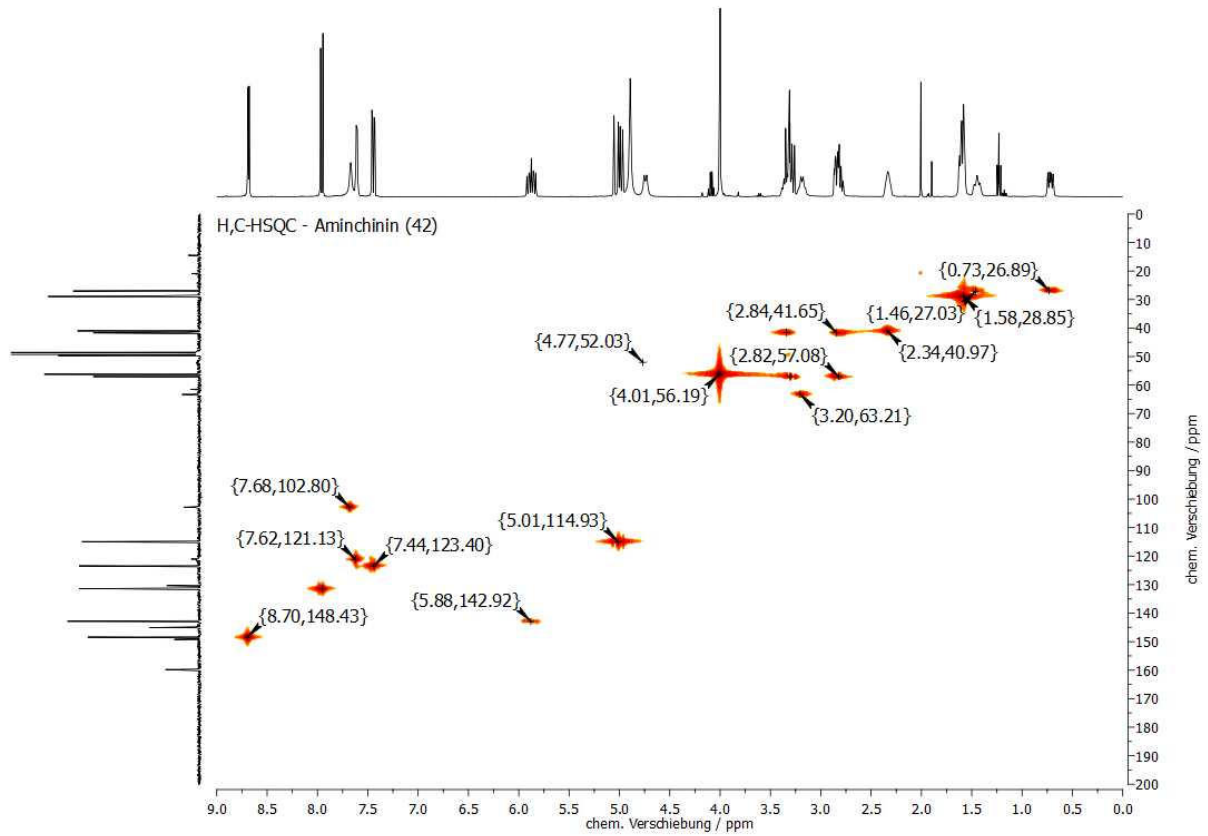


Abb. 8.67: H,C-HSQC-NMR-Spektrum (MeOH-d<sub>4</sub>, 298 K) von Aminichinin (42).

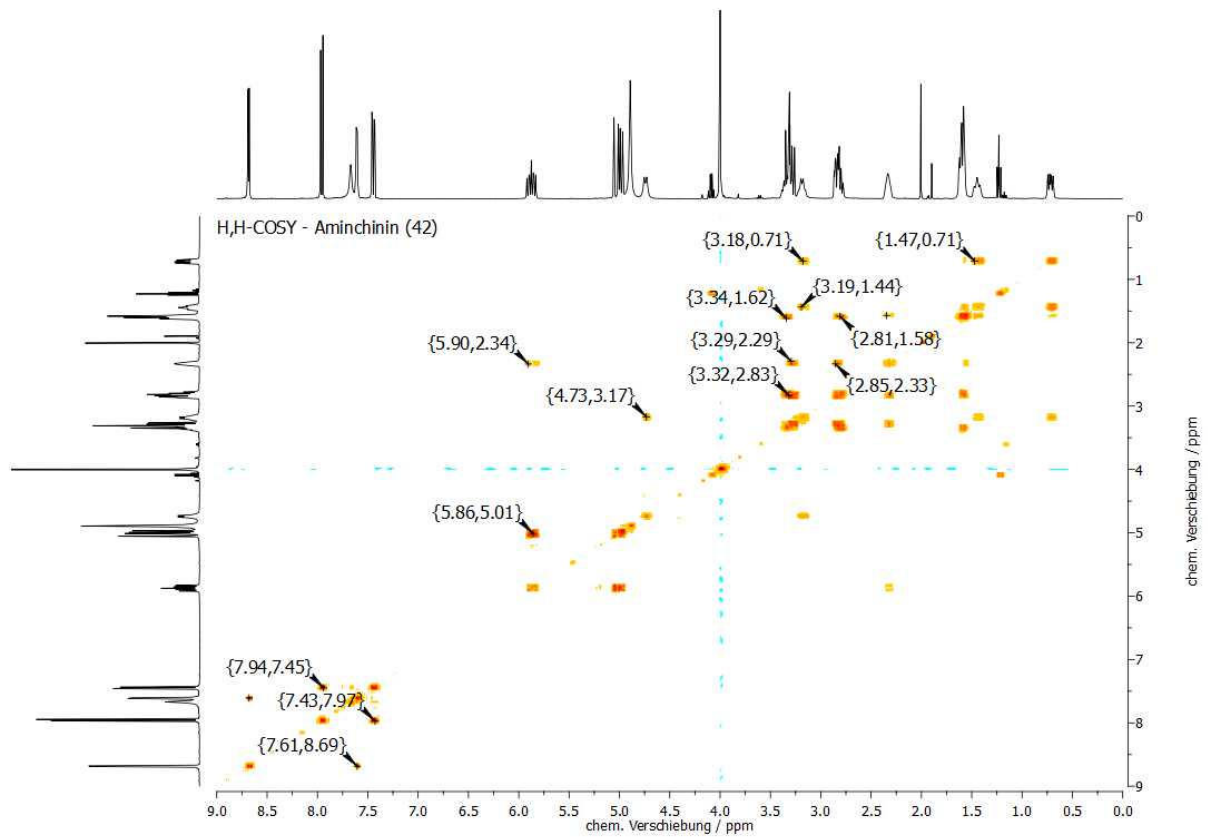


Abb. 8.68: H,H-COSY-NMR-Spektrum (MeOH-d<sub>4</sub>, 298 K) von Aminichinin (42).

ANHANG

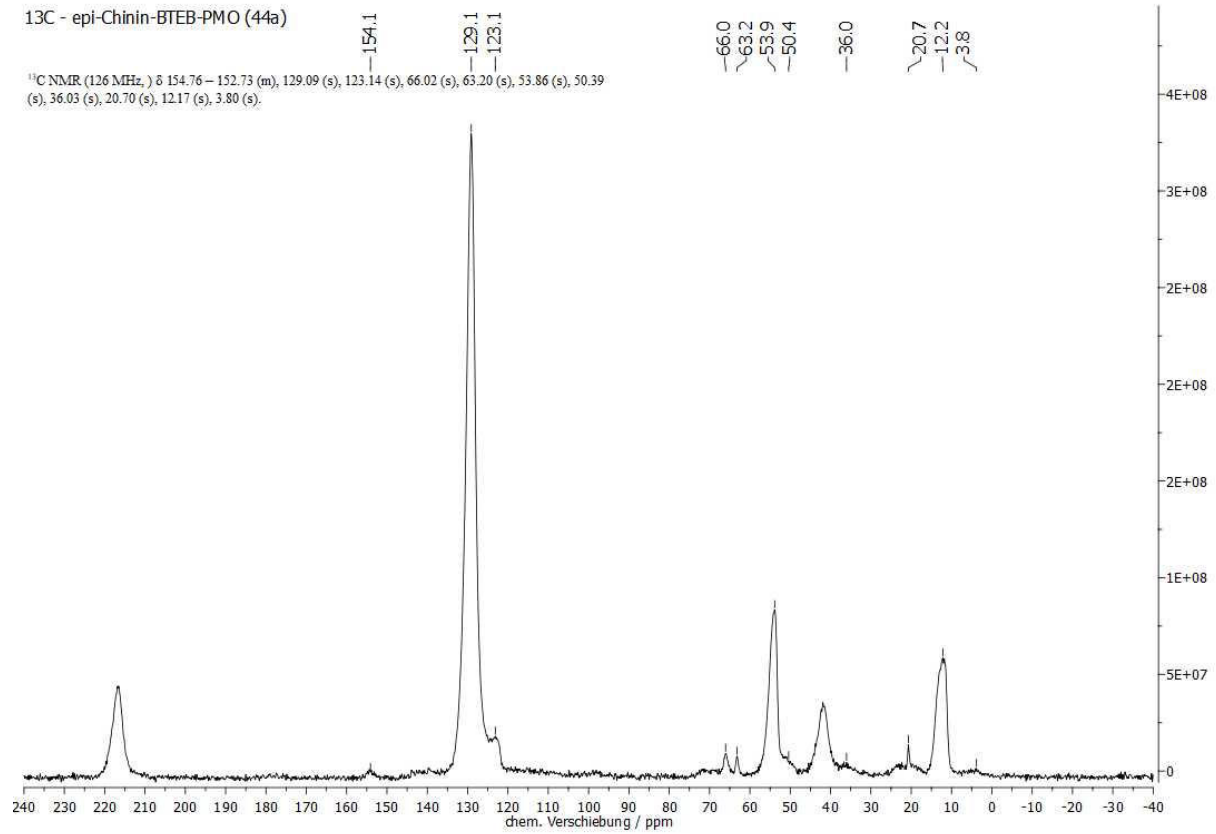


Abb. 8.69: <sup>13</sup>C-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von *epi*-Chinin-BTEB-PMO (**44a**).

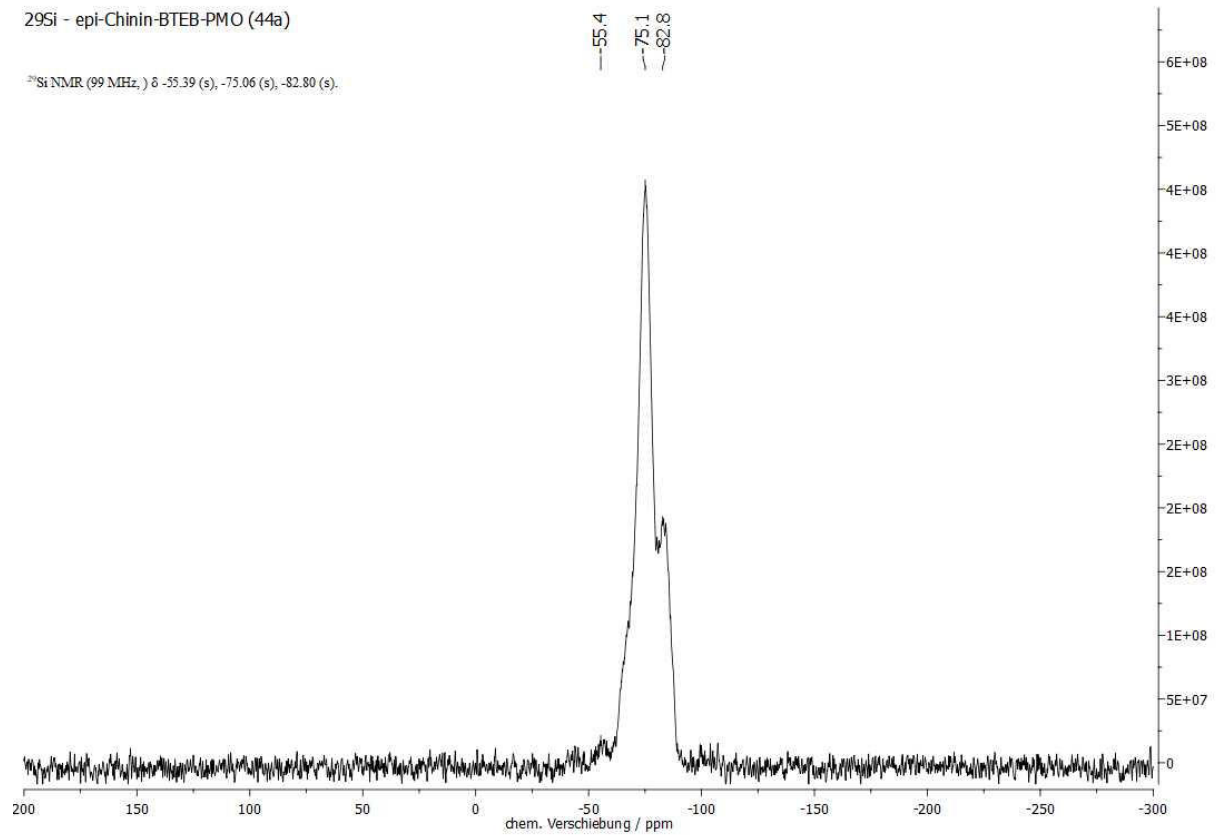


Abb. 8.70: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von *epi*-Chinin-BTEB-PMO (**44a**).

# ANHANG

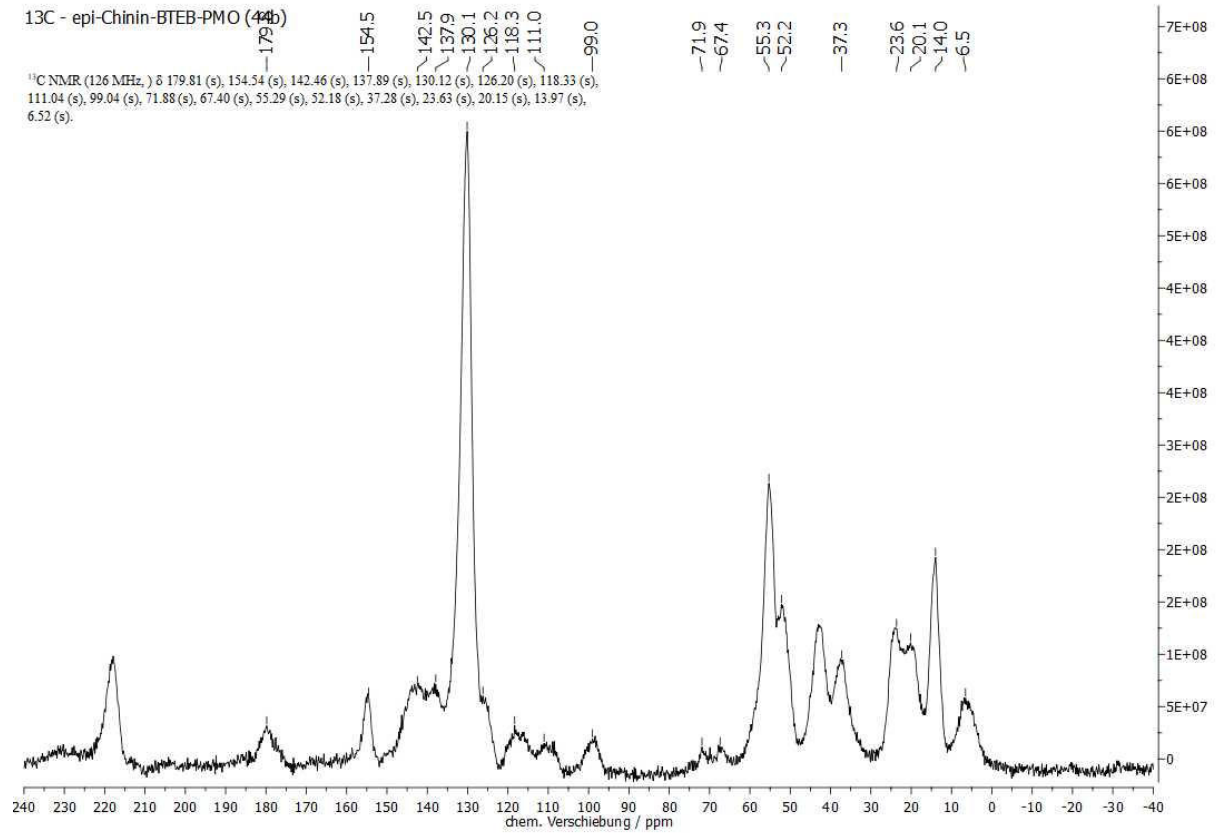


Abb. 8.71: <sup>13</sup>C-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von *epi*-Chinin-BTEB-PMO (**44b**).

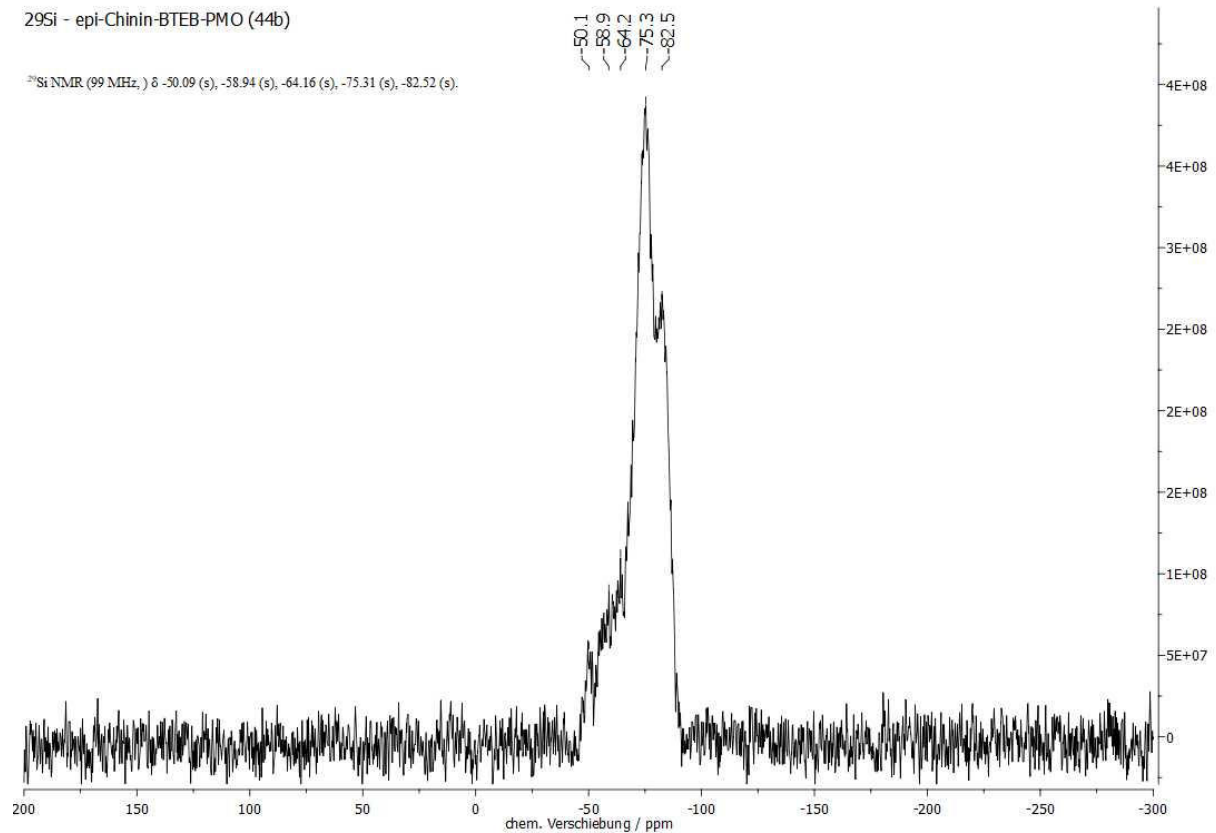


Abb. 8.72: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von *epi*-Chinin-BTEB-PMO (**44b**).

ANHANG

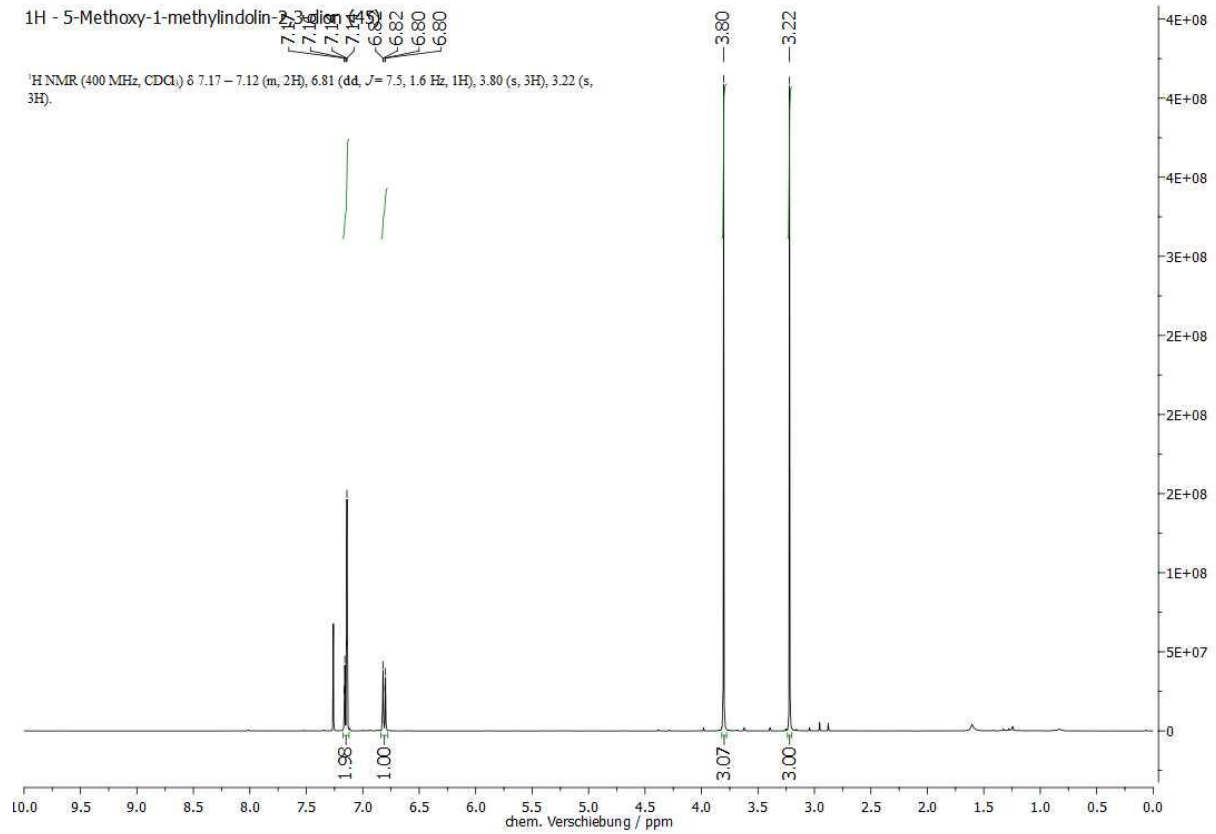


Abb. 8.73: <sup>1</sup>H-NMR-Spektrum (400 MHz, CDCl<sub>3</sub>, 298 K) von 5-Methoxy-1-methylindolin-2,3-dion (45).

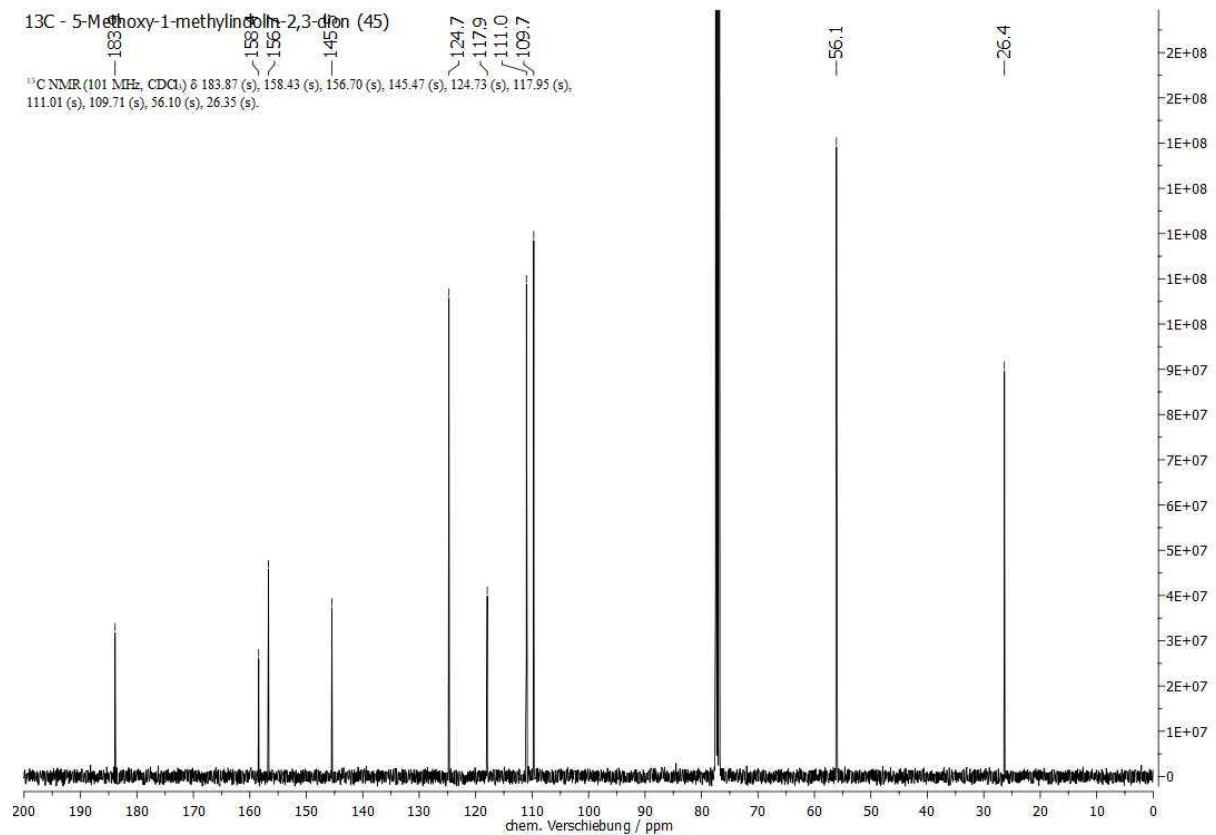


Abb. 8.74: <sup>13</sup>C-NMR-Spektrum (101 MHz, CDCl<sub>3</sub>, 298 K) von 5-Methoxy-1-methylindolin-2,3-dion (45).

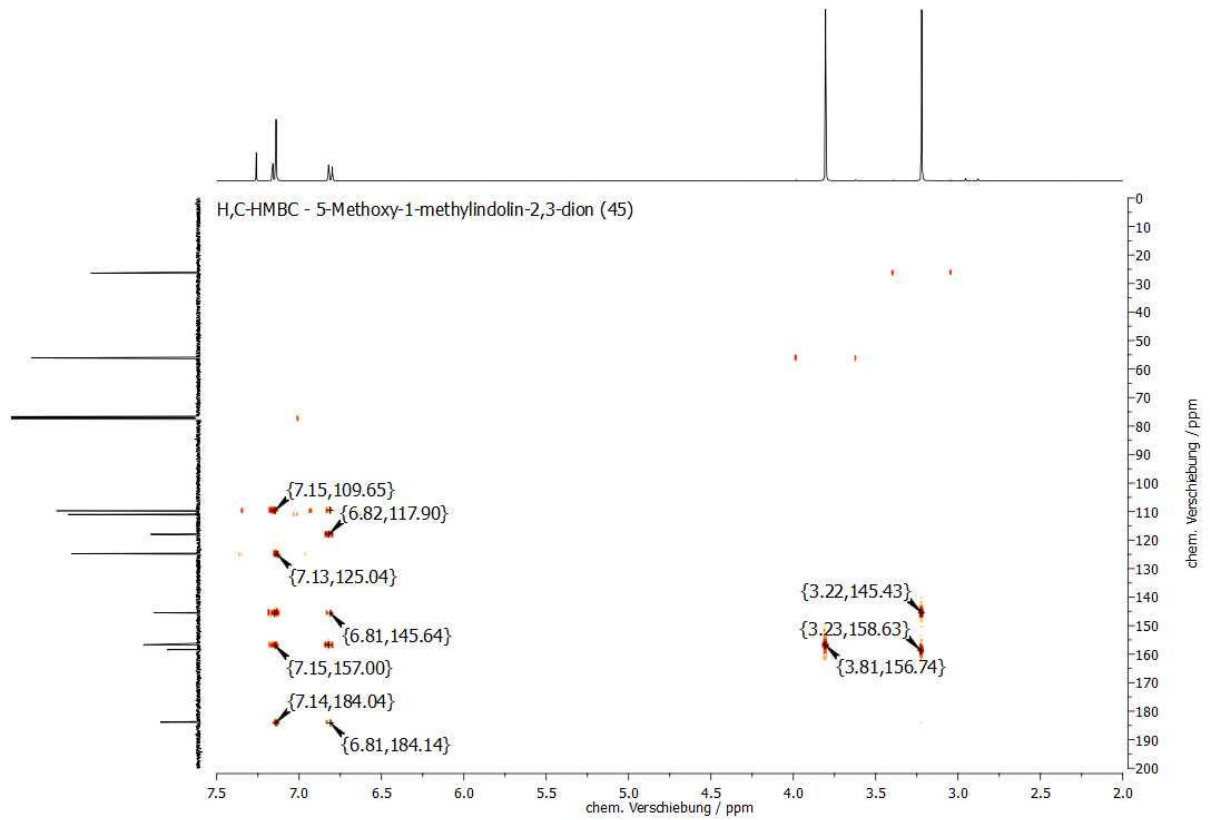


Abb. 8.75: H,C-HMBC-NMR-Spektrum (CDCl<sub>3</sub>, 298 K) von 5-Methoxy-1-methylindolin-2,3-dion (45).

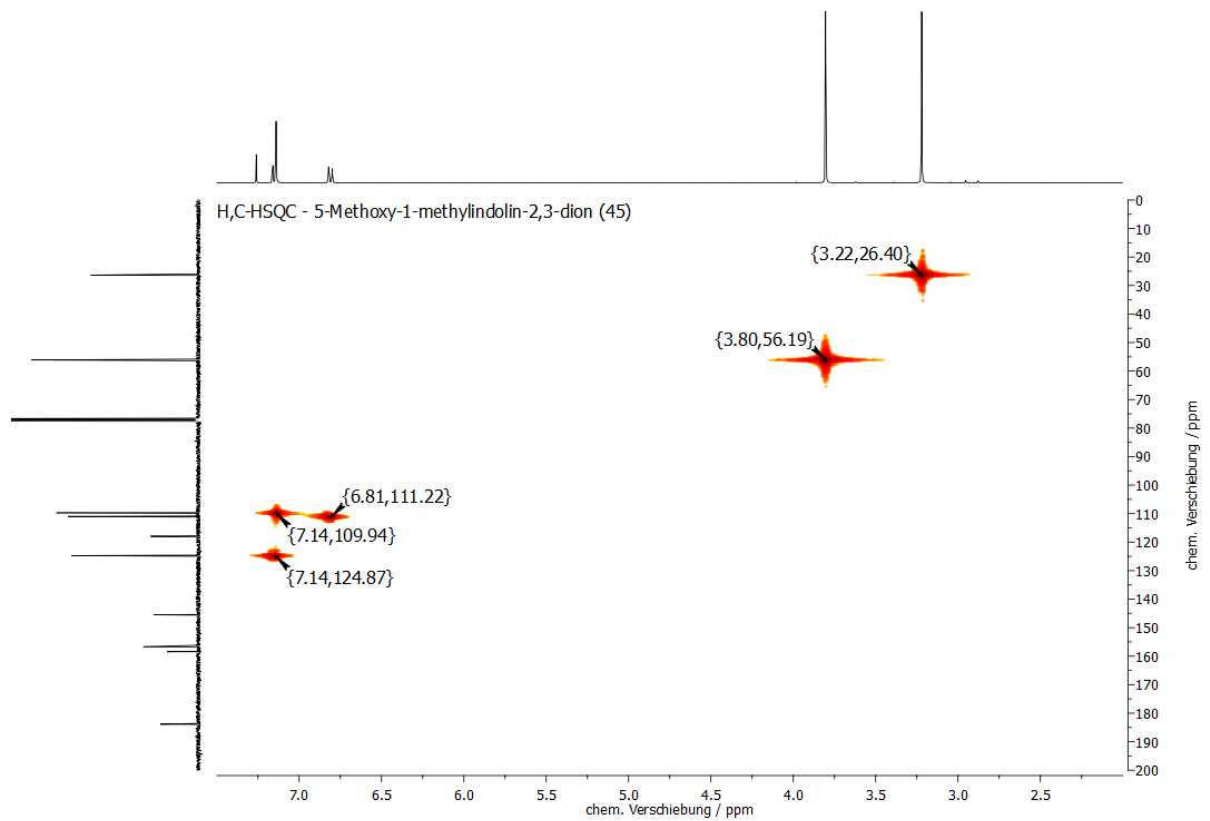


Abb. 8.76: H,C-HSQC-NMR-Spektrum (CDCl<sub>3</sub>, 298 K) von 5-Methoxy-1-methylindolin-2,3-dion (45).

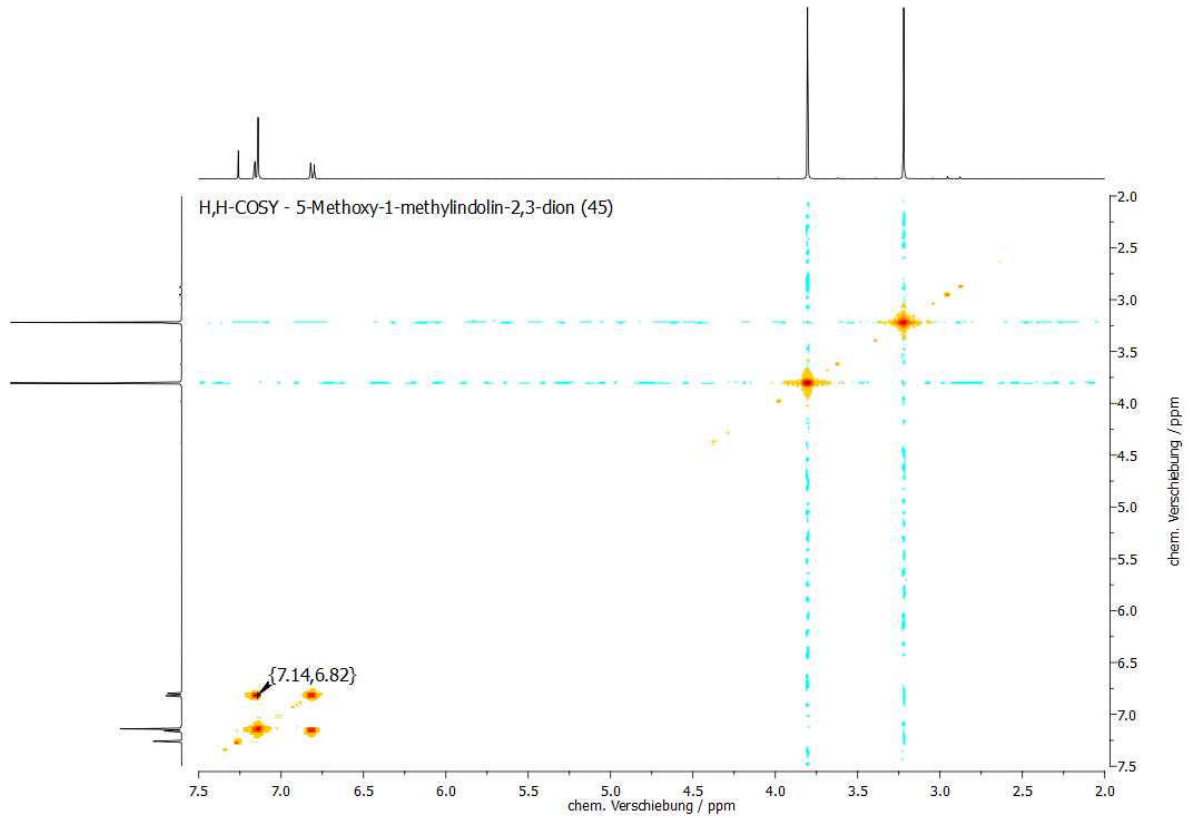


Abb. 8.77: H,H-COSY-NMR-Spektrum (CDCl<sub>3</sub>, 298 K) von 5-Methoxy-1-methylindolin-2,3-dion (**45**).

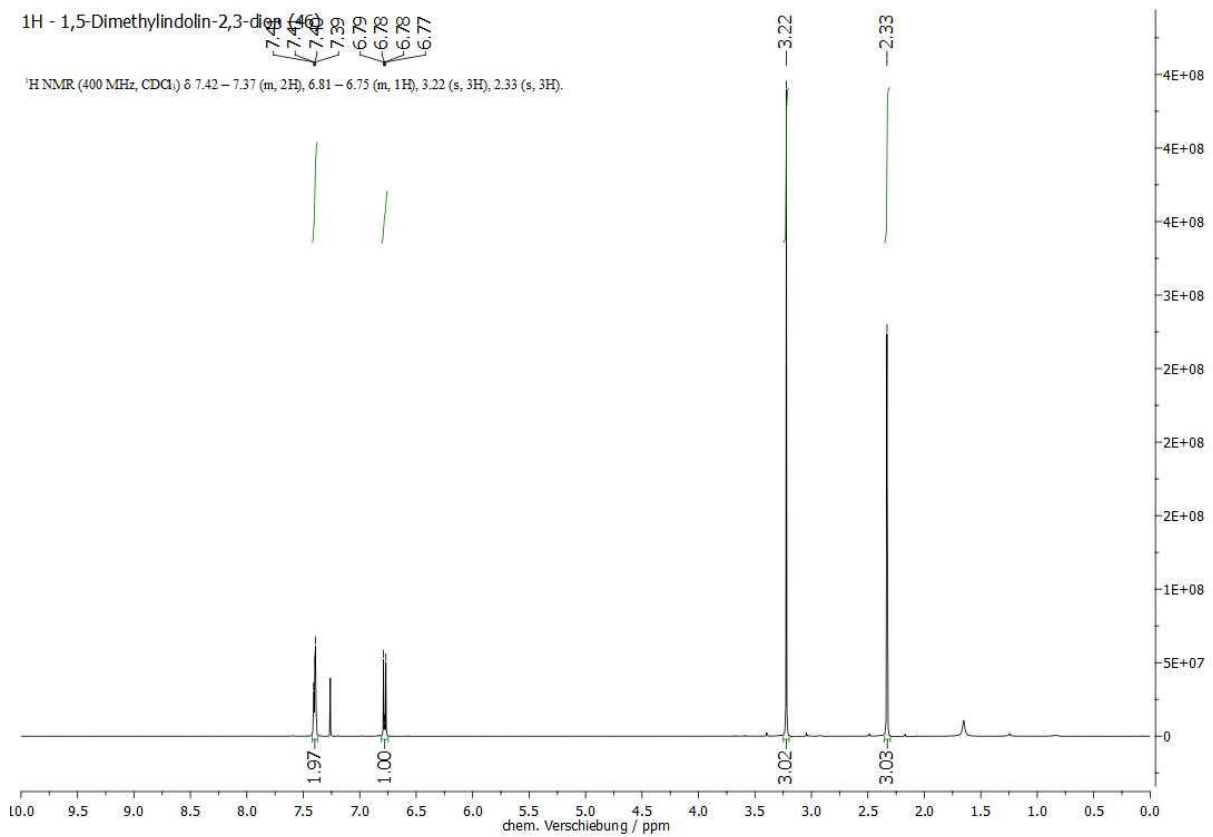


Abb. 8.78: <sup>1</sup>H-NMR-Spektrum (400 MHz, CDCl<sub>3</sub>, 298 K) von 1,5-Dimethylindolin-2,3-dion (**46**).

ANHANG

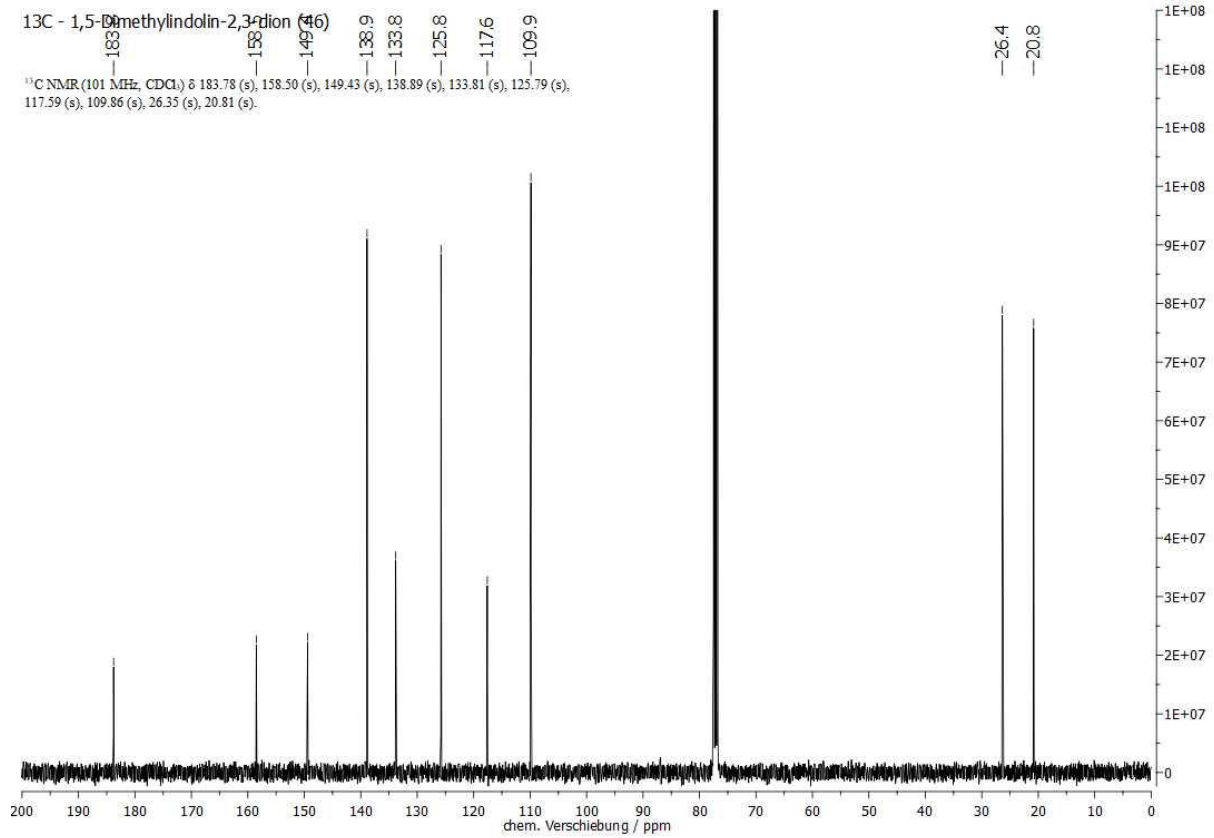


Abb. 8.79: <sup>13</sup>C-NMR-Spektrum (101 MHz, CDCl<sub>3</sub>, 298 K) von 1,5-Dimethylindolin-2,3-dion (46).

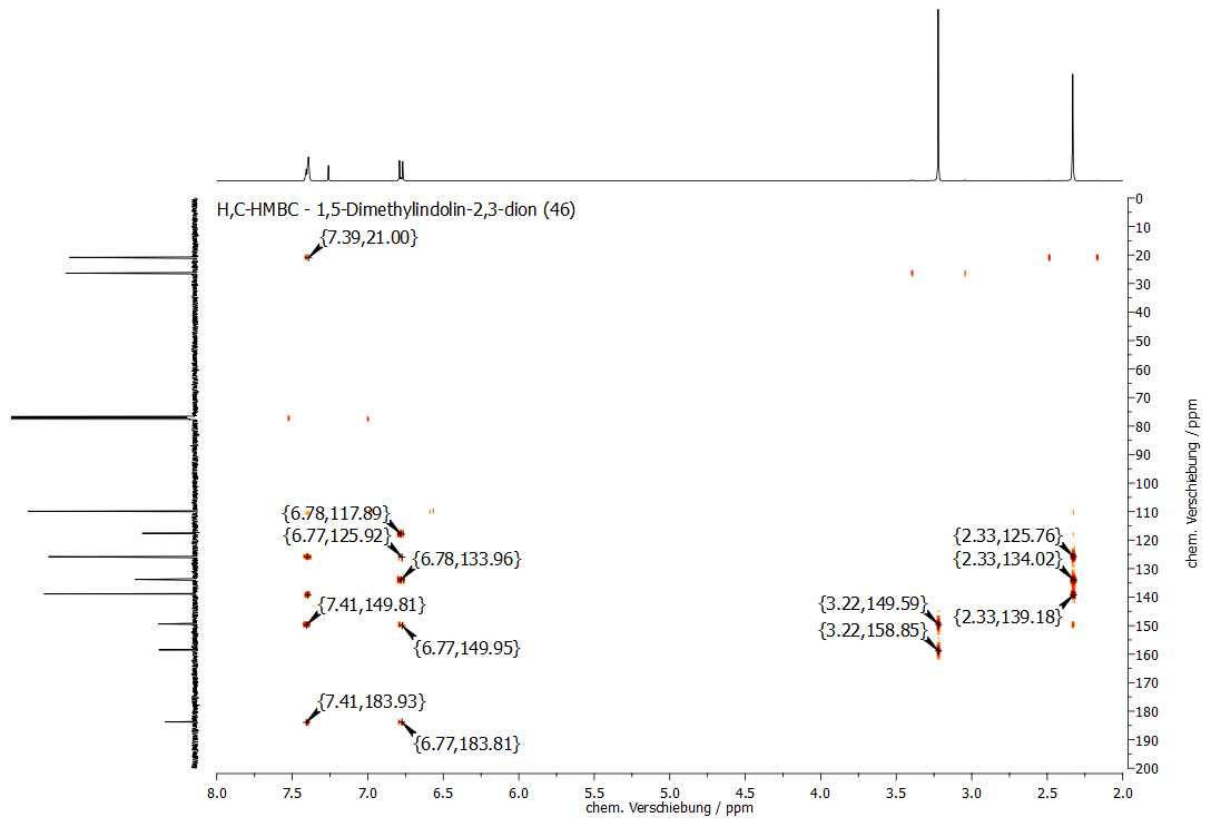


Abb. 8.80: H,C-HMBC-NMR-Spektrum (CDCl<sub>3</sub>, 298 K) von 1,5-Dimethylindolin-2,3-dion (46).



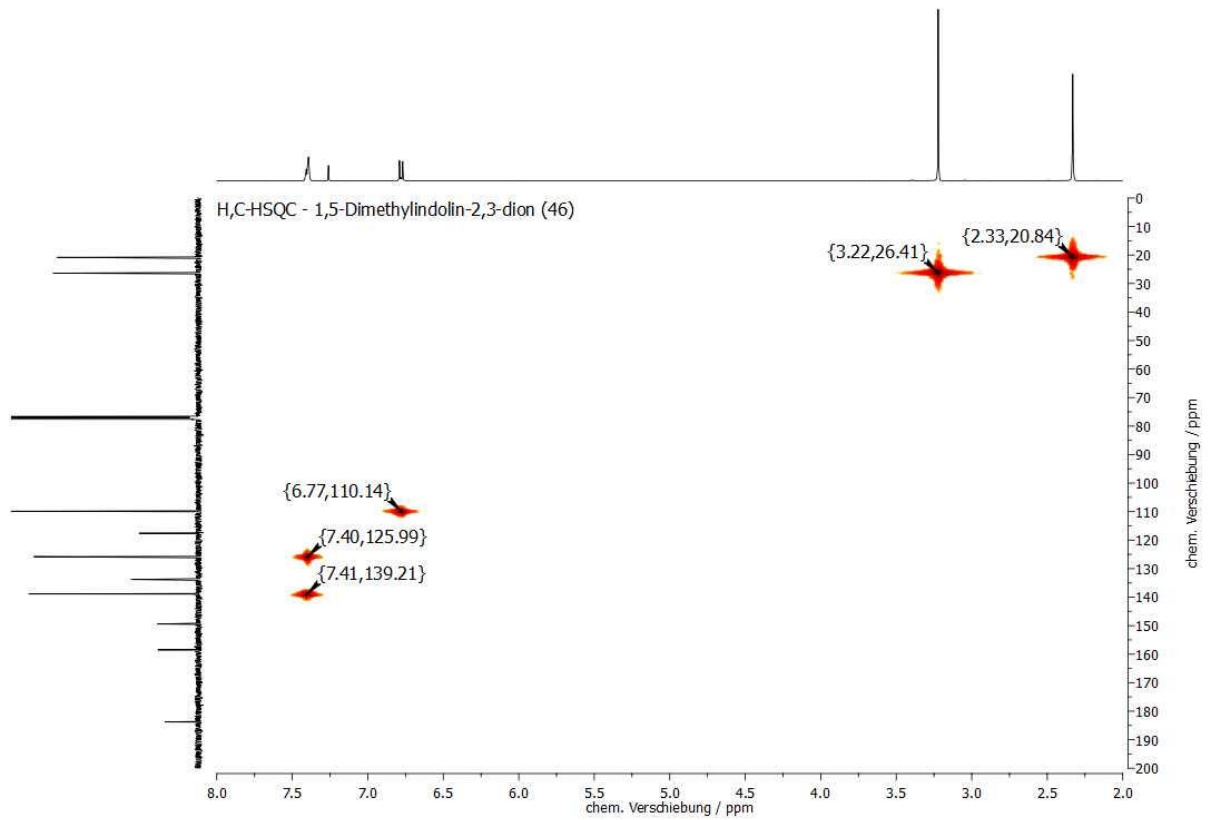


Abb. 8.81: H,C-HSQC-NMR-Spektrum (CDCl<sub>3</sub>, 298 K) von 1,5-Dimethylindolin-2,3-dion (46).

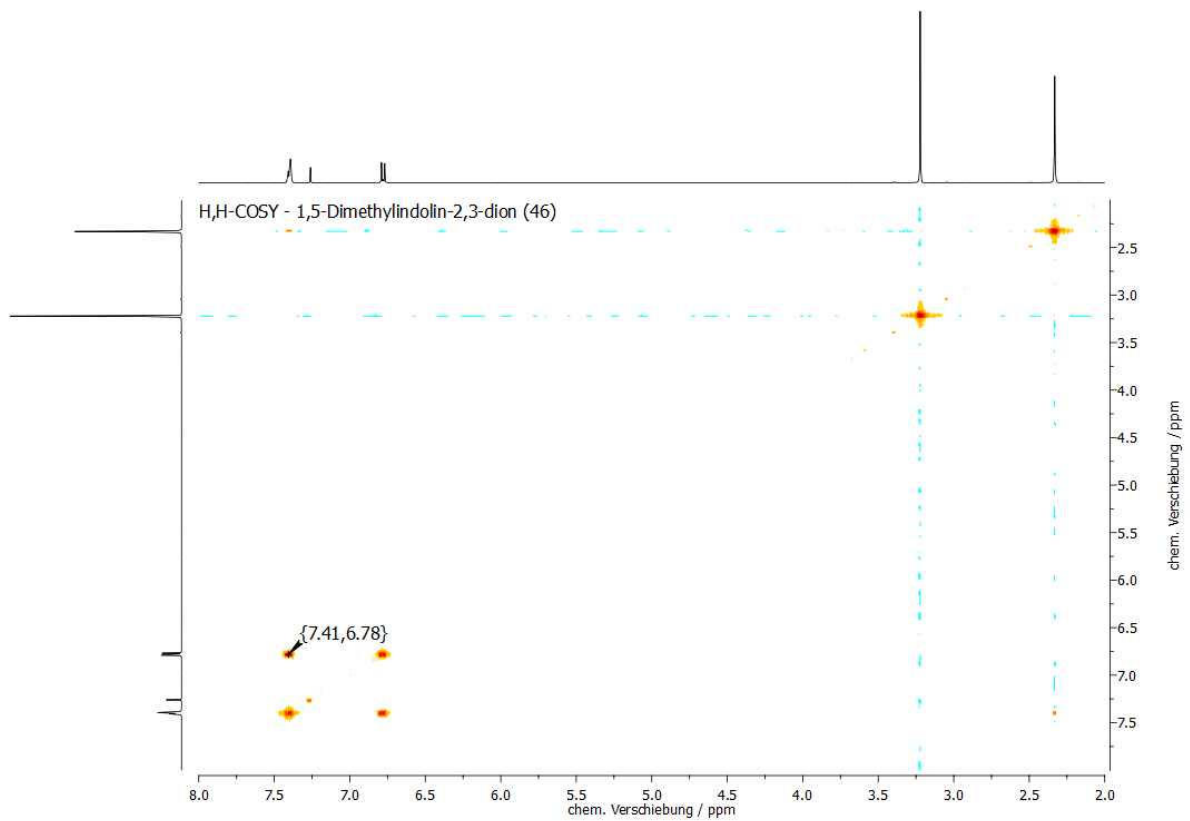


Abb. 8.82: H,H-COSY-NMR-Spektrum (CDCl<sub>3</sub>, 298 K) von 1,5-Dimethylindolin-2,3-dion (46).

ANHANG

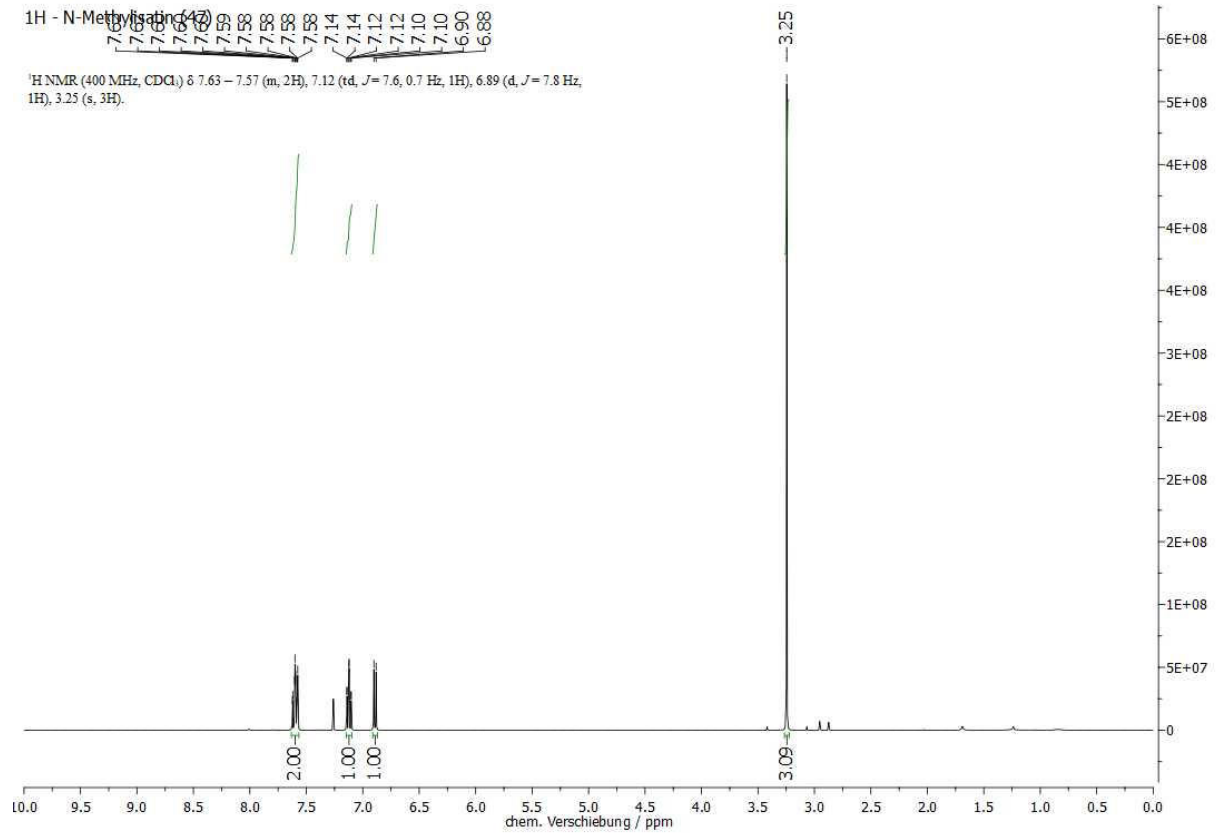


Abb. 8.83: <sup>1</sup>H-NMR-Spektrum (400 MHz, CDCl<sub>3</sub>, 298 K) von *N*-Methylisatin (47).

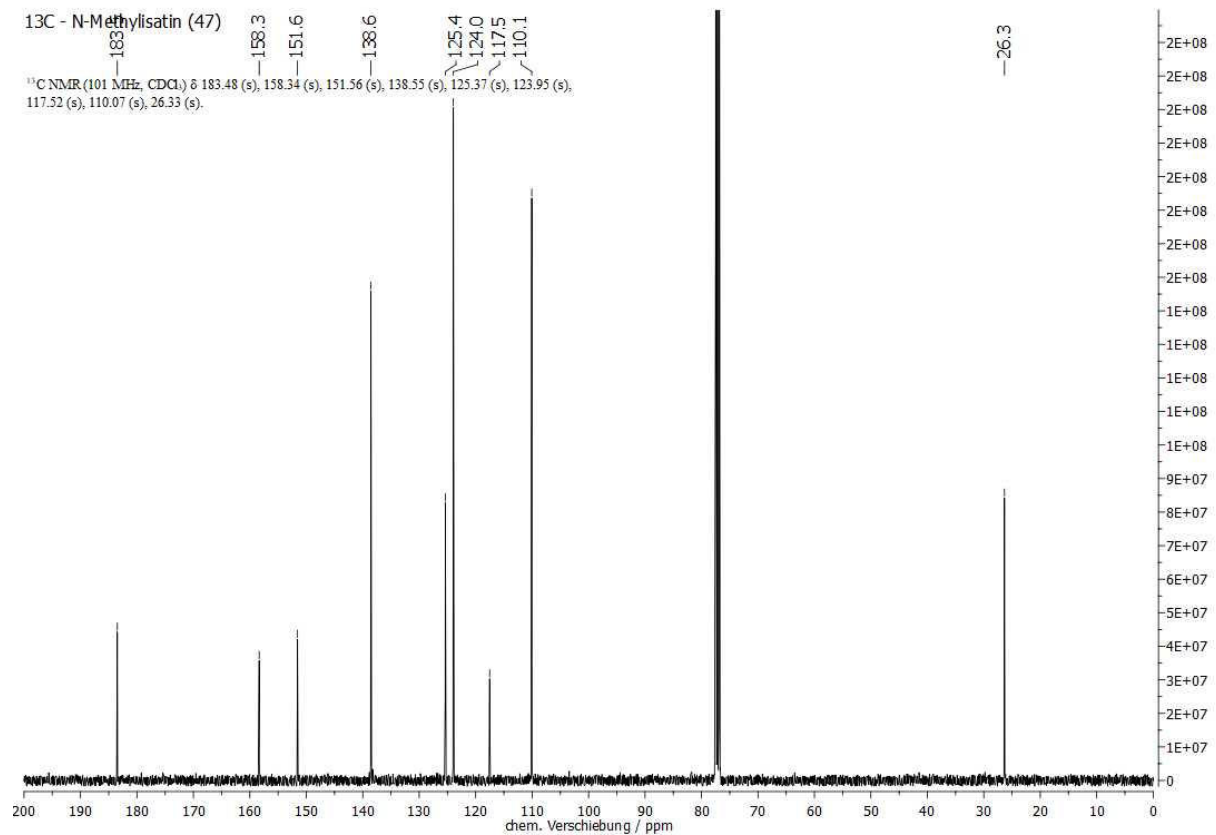


Abb. 8.84: <sup>13</sup>C-NMR-Spektrum (101 MHz, CDCl<sub>3</sub>, 298 K) von *N*-Methylisatin (47).

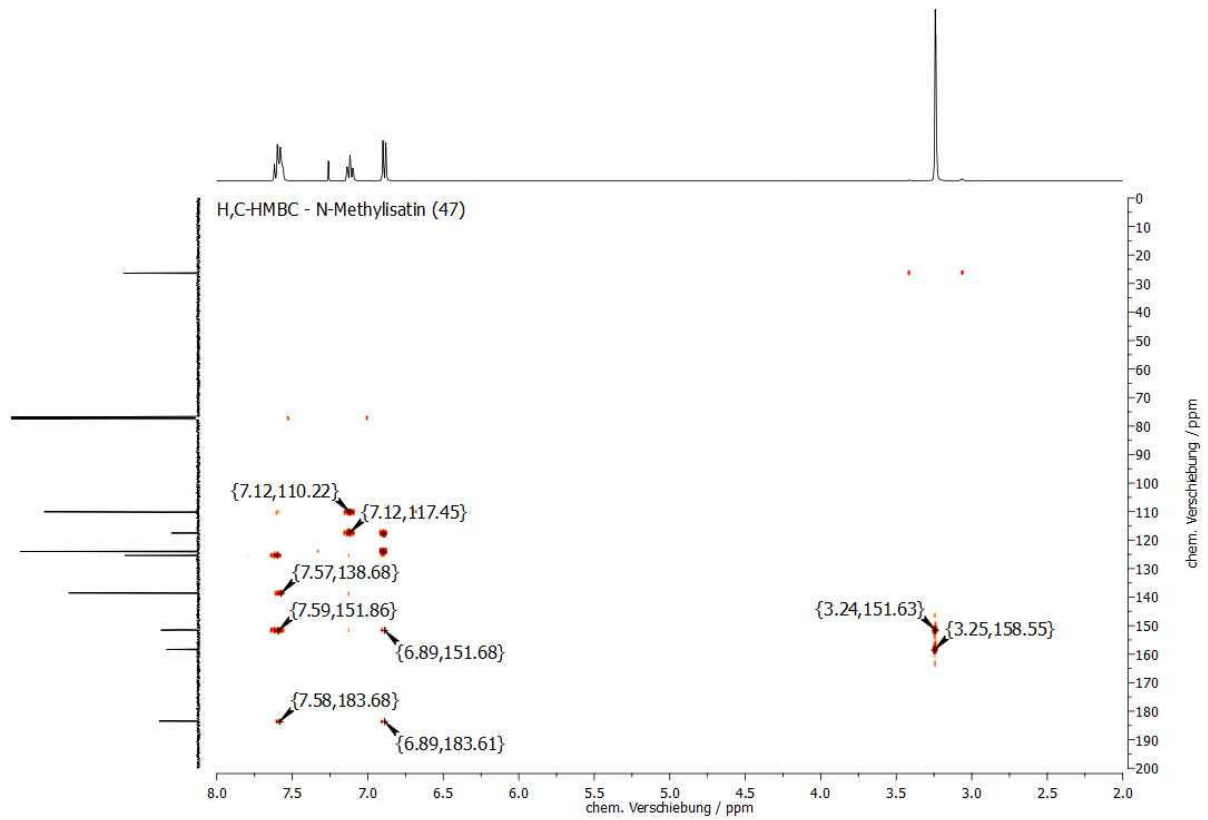


Abb. 8.85: H,C-HMBC-NMR-Spektrum (CDCl<sub>3</sub>, 298 K) von *N*-Methylisatin (**47**).

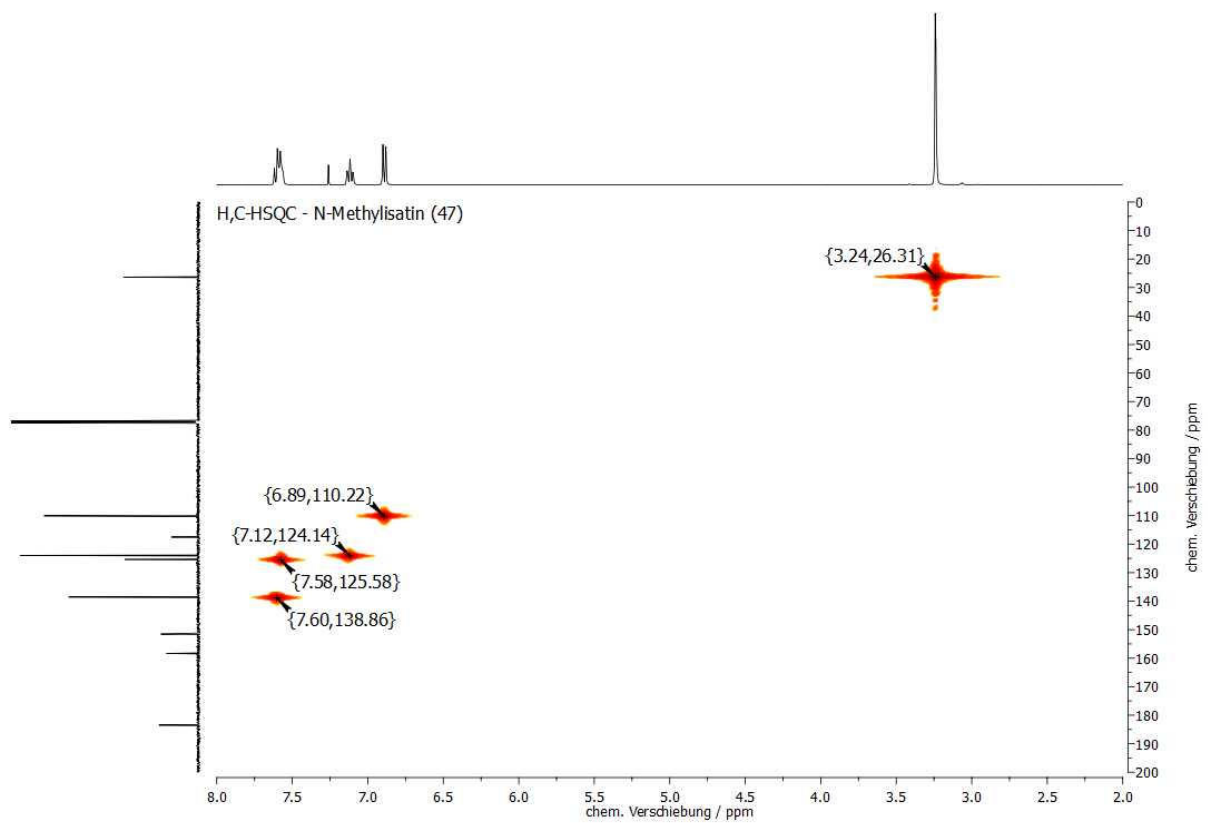


Abb. 8.86: H,C-HSQC-NMR-Spektrum (CDCl<sub>3</sub>, 298 K) von *N*-Methylisatin (**47**).

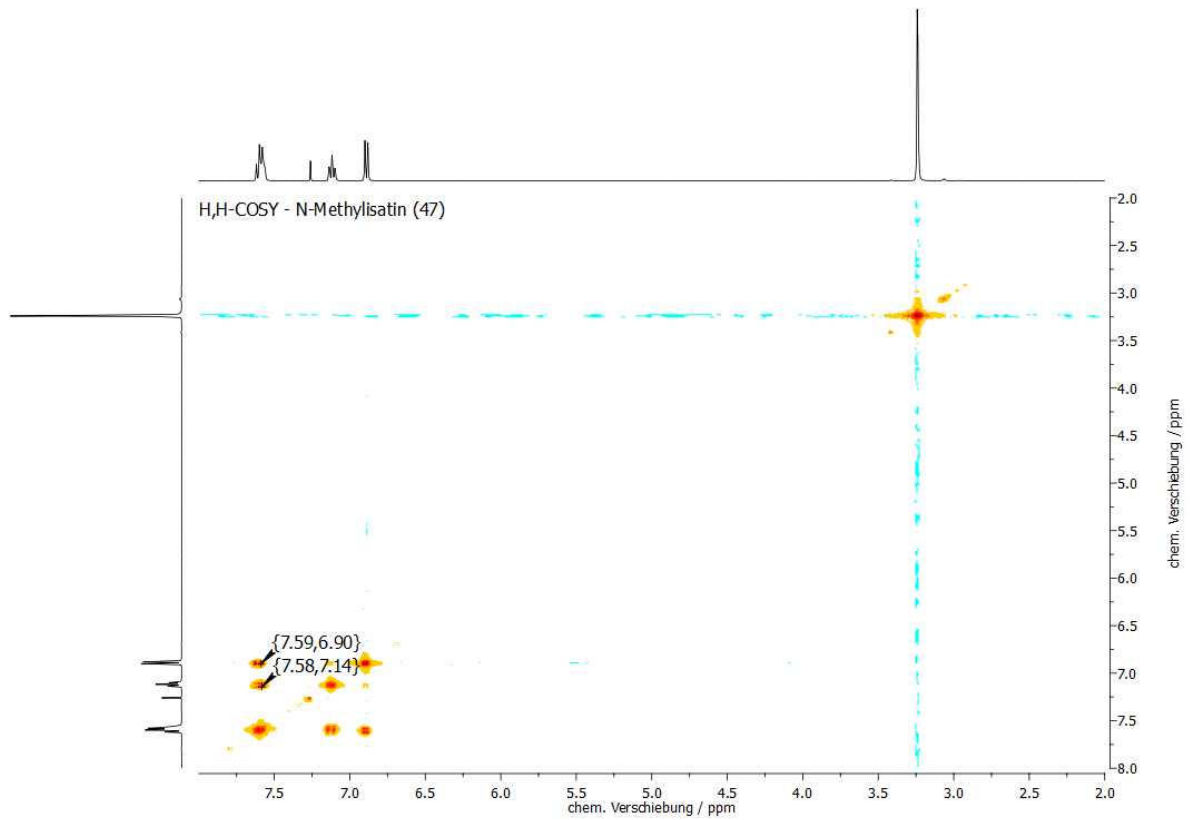


Abb. 8.87: H,H-COSY-NMR-Spektrum (CDCl<sub>3</sub>, 298 K) von *N*-Methylisatin (**47**).

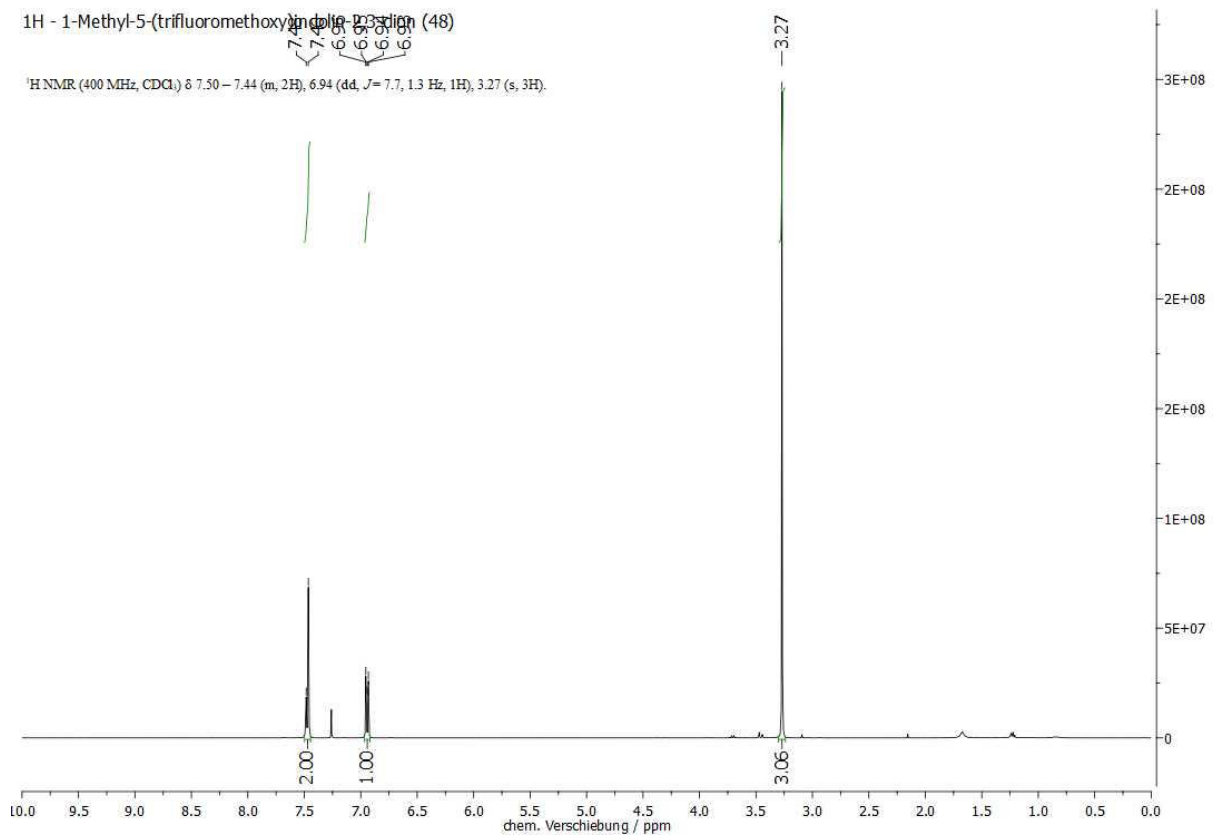


Abb. 8.88: <sup>1</sup>H-NMR-Spektrum (400 MHz, CDCl<sub>3</sub>, 298 K) von 1-Methyl-5-(trifluoromethoxy)indolin-2,3-dion (**48**).

ANHANG

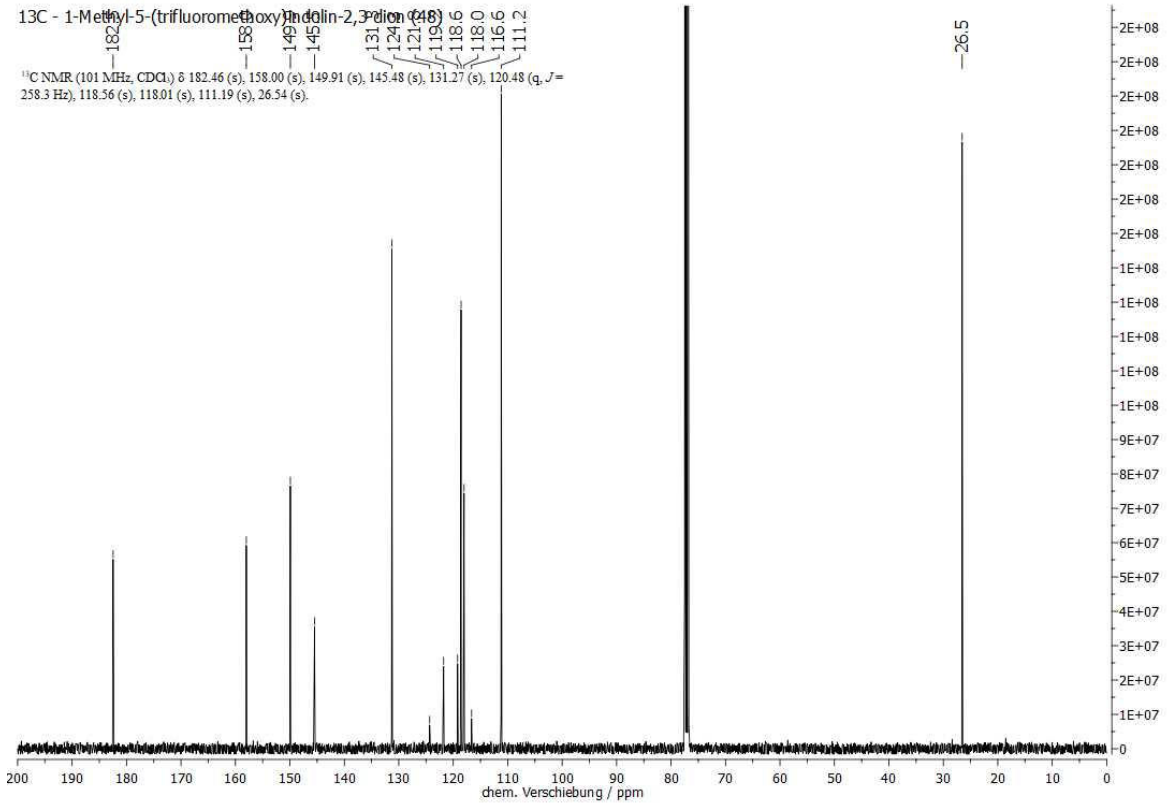


Abb. 8.89: <sup>13</sup>C-NMR-Spektrum (101 MHz, CDCl<sub>3</sub>, 298 K) von 1-Methyl-5-(trifluoromethoxy)indolin-2,3-dion (**48**).

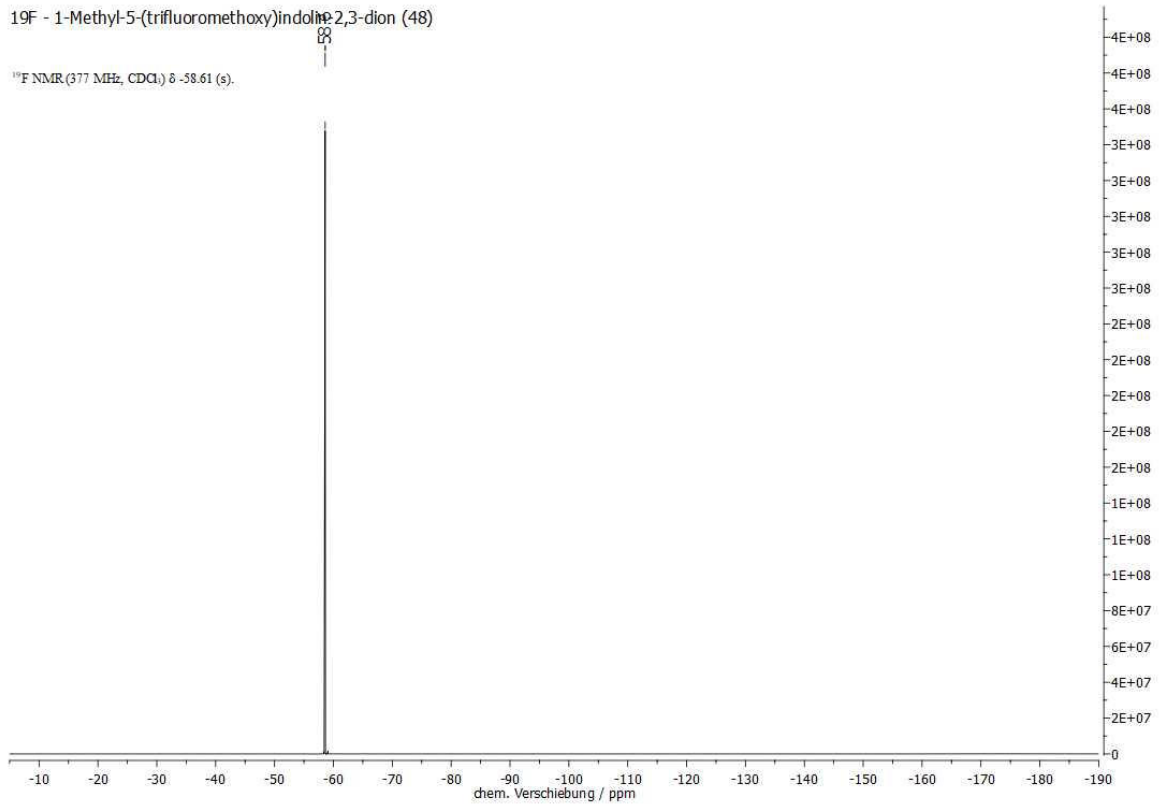


Abb. 8.90: <sup>19</sup>F-NMR-Spektrum (377 MHz, CDCl<sub>3</sub>, 298 K) von 1-Methyl-5-(trifluoromethoxy)indolin-2,3-dion (**48**).

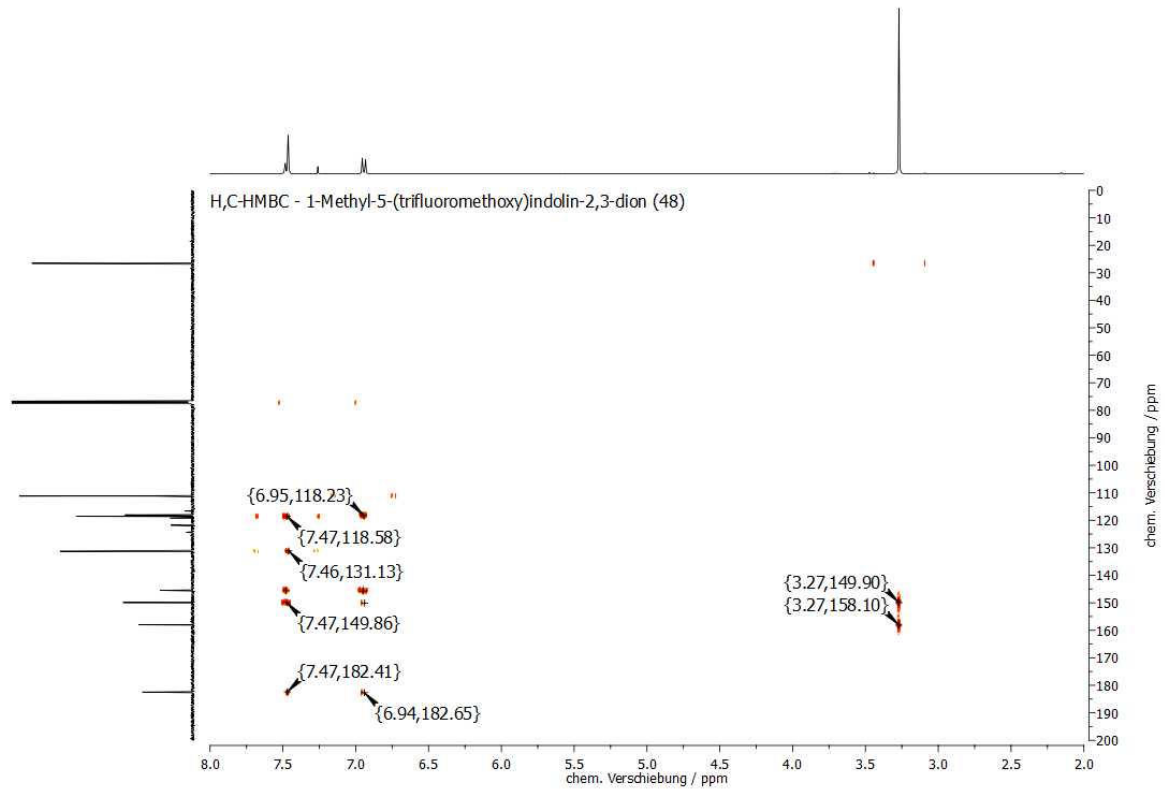


Abb. 8.91: H,C-HMBC-NMR-Spektrum (CDCl<sub>3</sub>, 298 K) von 1-Methyl-5-(trifluoromethoxy)indolin-2,3-dion (48).

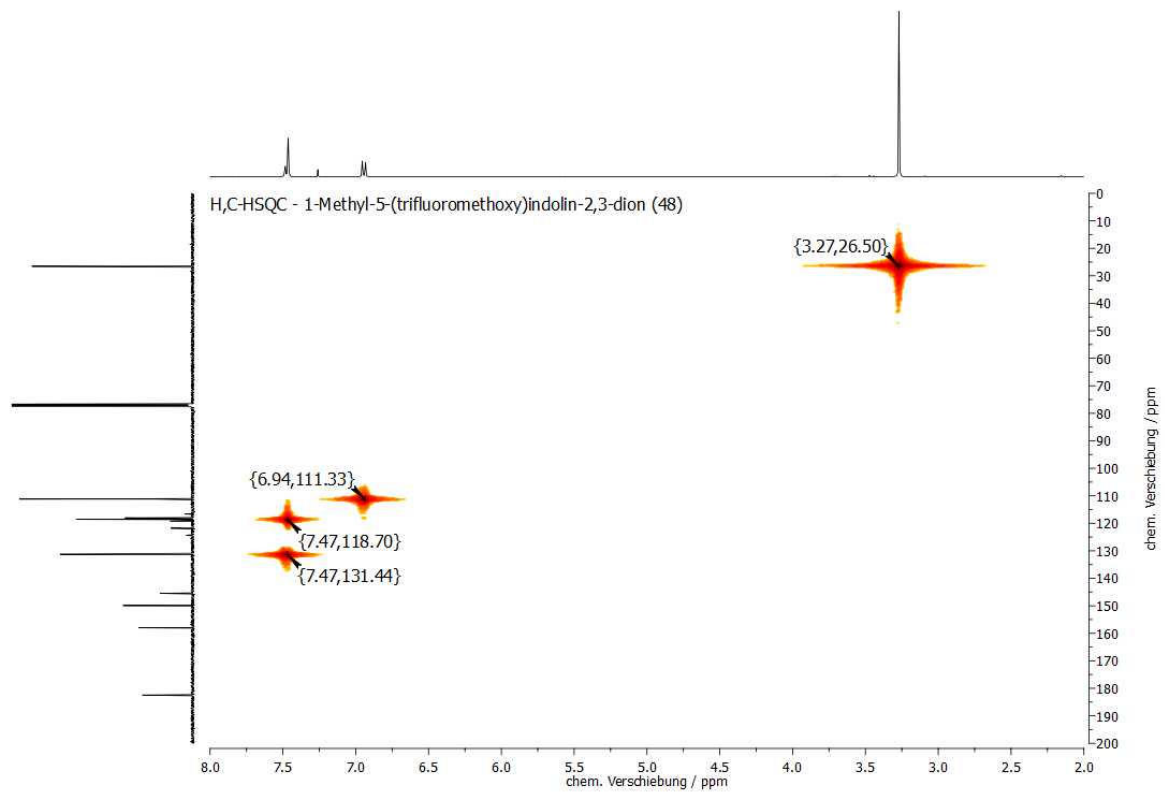


Abb. 8.92: H,C-HSQC-NMR-Spektrum (CDCl<sub>3</sub>, 298 K) von 1-Methyl-5-(trifluoromethoxy)indolin-2,3-dion (48).

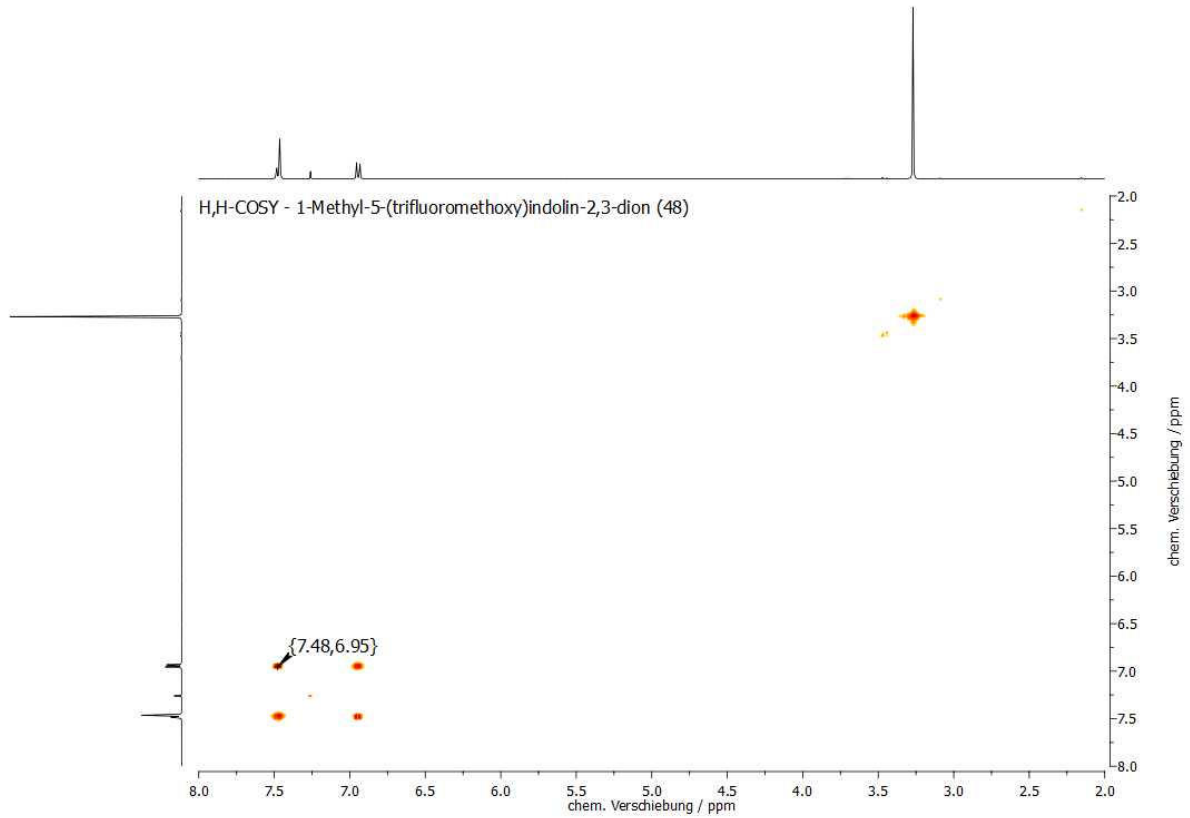


Abb. 8.93: H,H-COSY-NMR-Spektrum ( $\text{CDCl}_3$ , 298 K) von 1-Methyl-5-(trifluoromethoxy)indolin-2,3-dion (**48**).

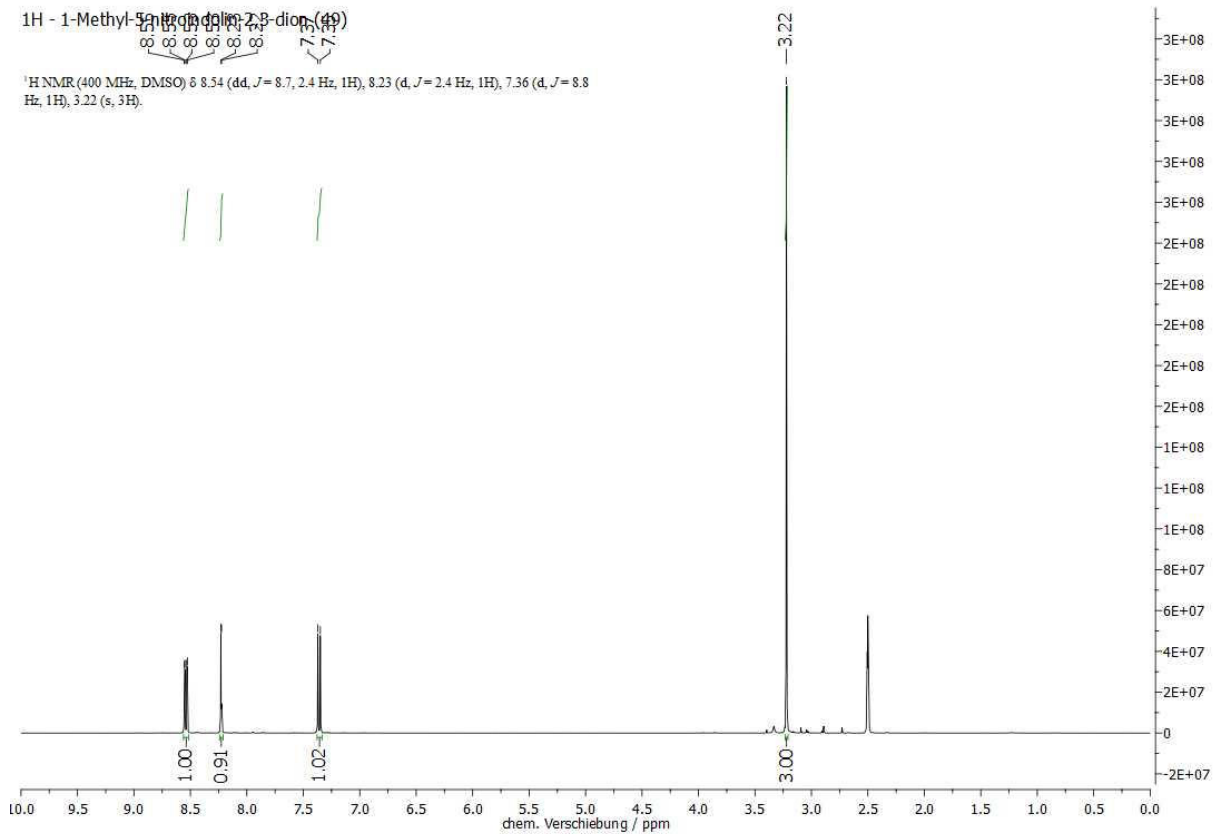


Abb. 8.94:  $^1\text{H-NMR}$ -Spektrum (400 MHz,  $\text{DMSO-d}_6$ , 298 K) von 1-Methyl-5-nitroindolin-2,3-dion (**49**).

ANHANG

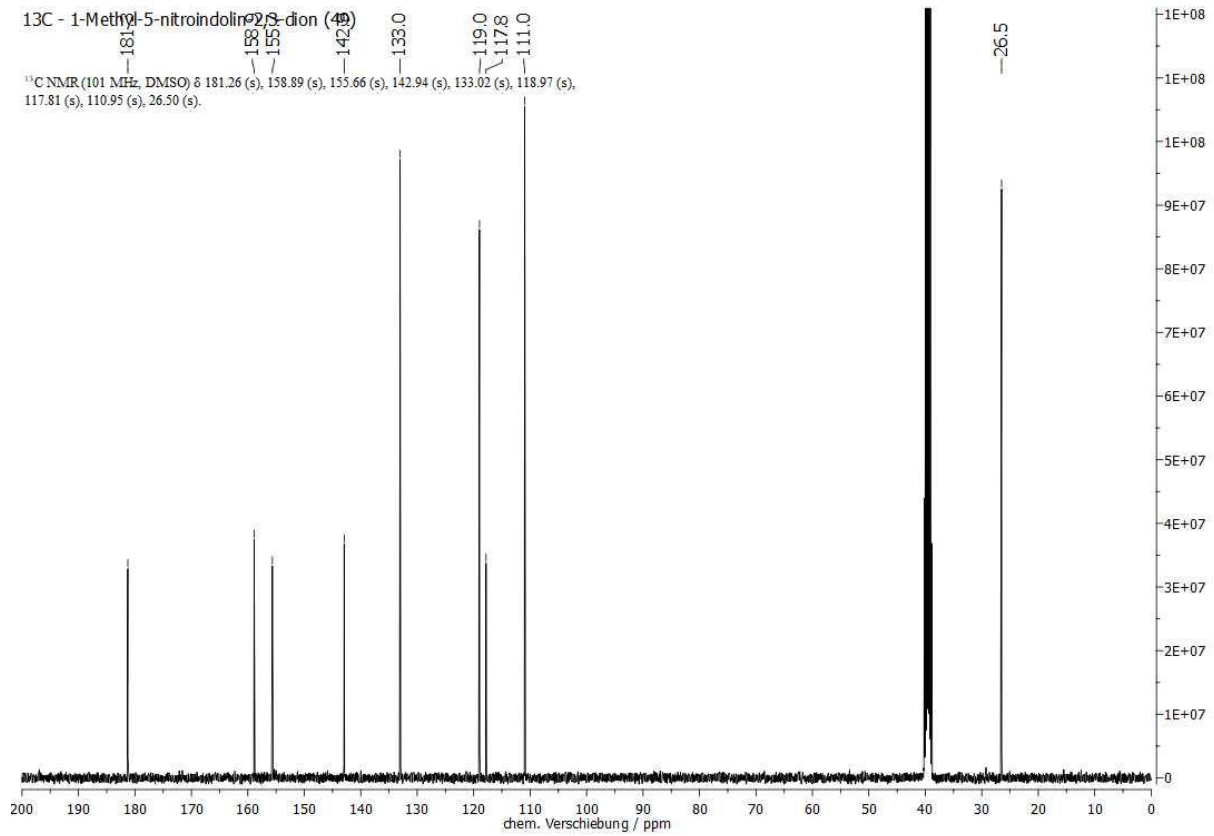


Abb. 8.95: <sup>13</sup>C-NMR-Spektrum (101 MHz, DMSO-d<sub>6</sub>, 298 K) von 1-Methyl-5-nitroindolin-2,3-dion (49).

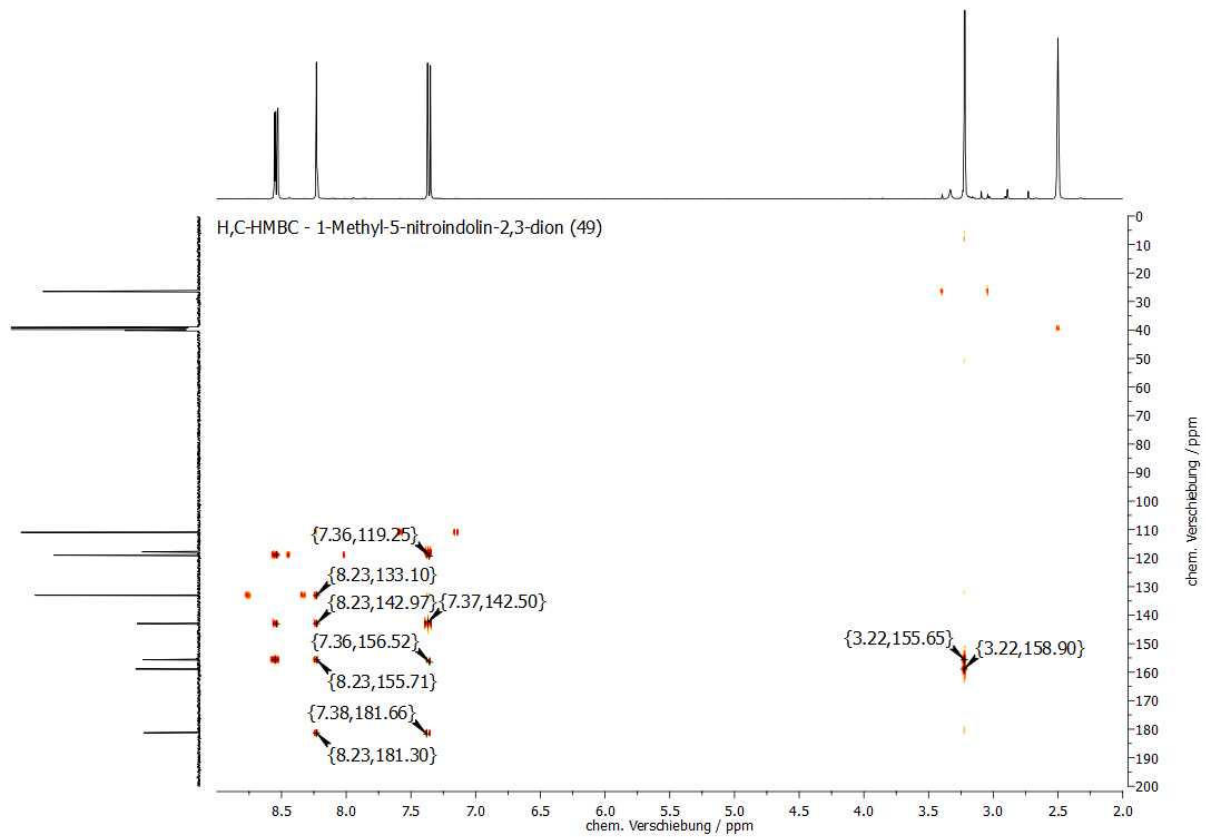


Abb. 8.96: H,C-HMBC-NMR-Spektrum (DMSO-d<sub>6</sub>, 298 K) von 1-Methyl-5-nitroindolin-2,3-dion (49).



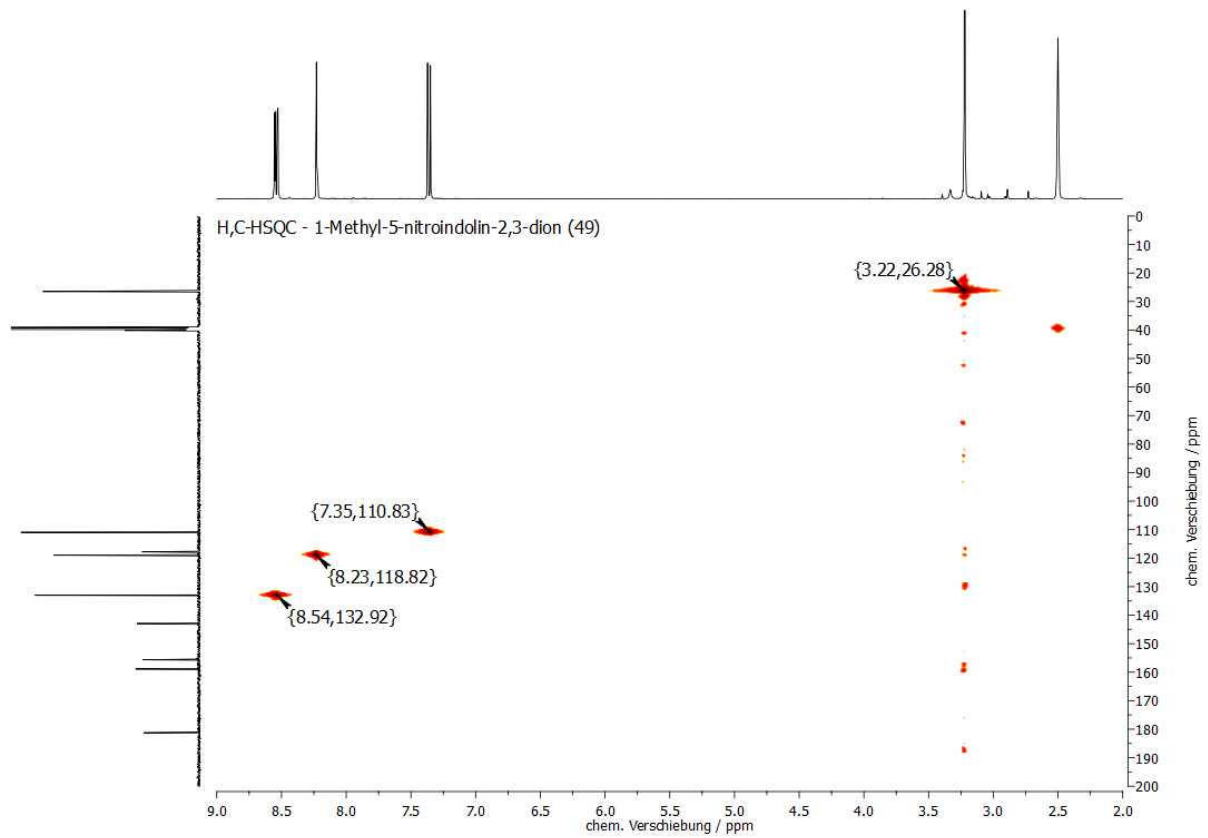


Abb. 8.97: H,C-HSQC-NMR-Spektrum (DMSO-d<sub>6</sub>, 298 K) von 1-Methyl-5-nitroindolin-2,3-dion (49).

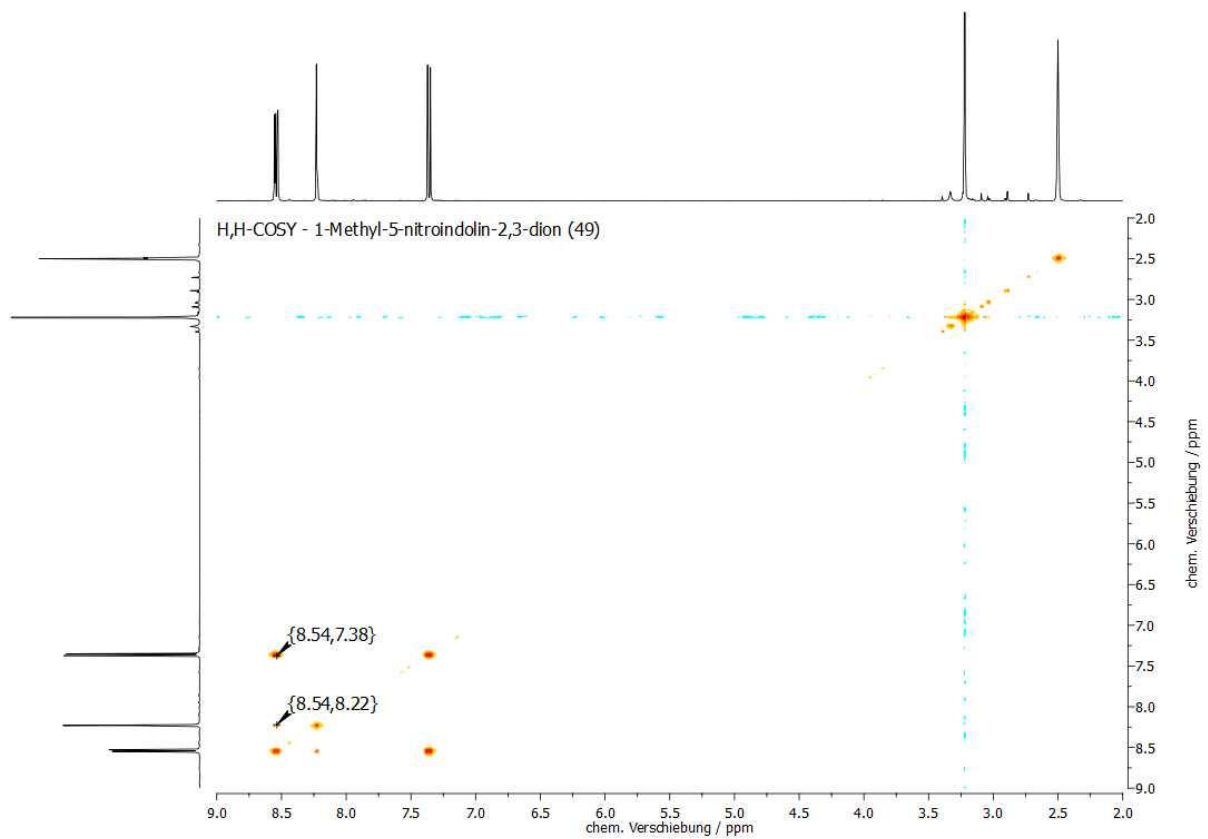


Abb. 8.98: H,H-COSY-NMR-Spektrum (DMSO-d<sub>6</sub>, 298 K) von 1-Methyl-5-nitroindolin-2,3-dion (49).

ANHANG

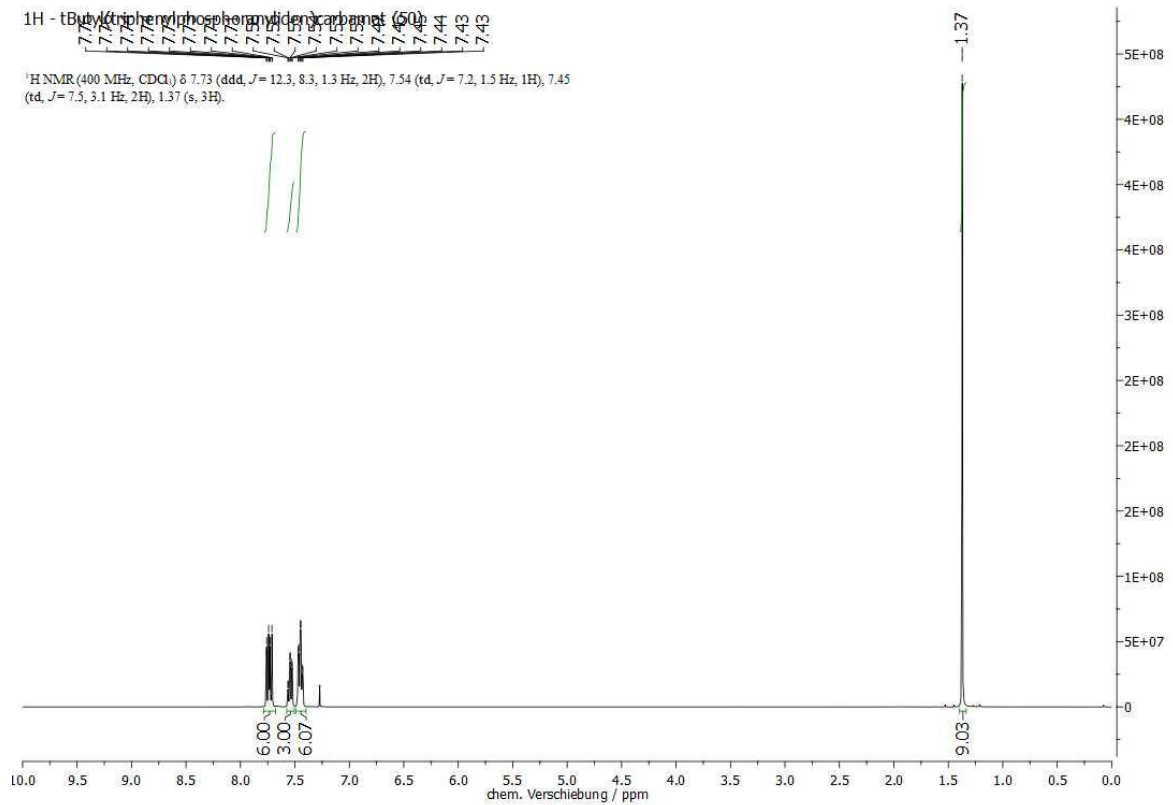


Abb. 8.99: <sup>1</sup>H-NMR-Spektrum (400 MHz, CDCl<sub>3</sub>, 298 K) von tButyl(triphenylphosphoranyliden)carbamat (50).

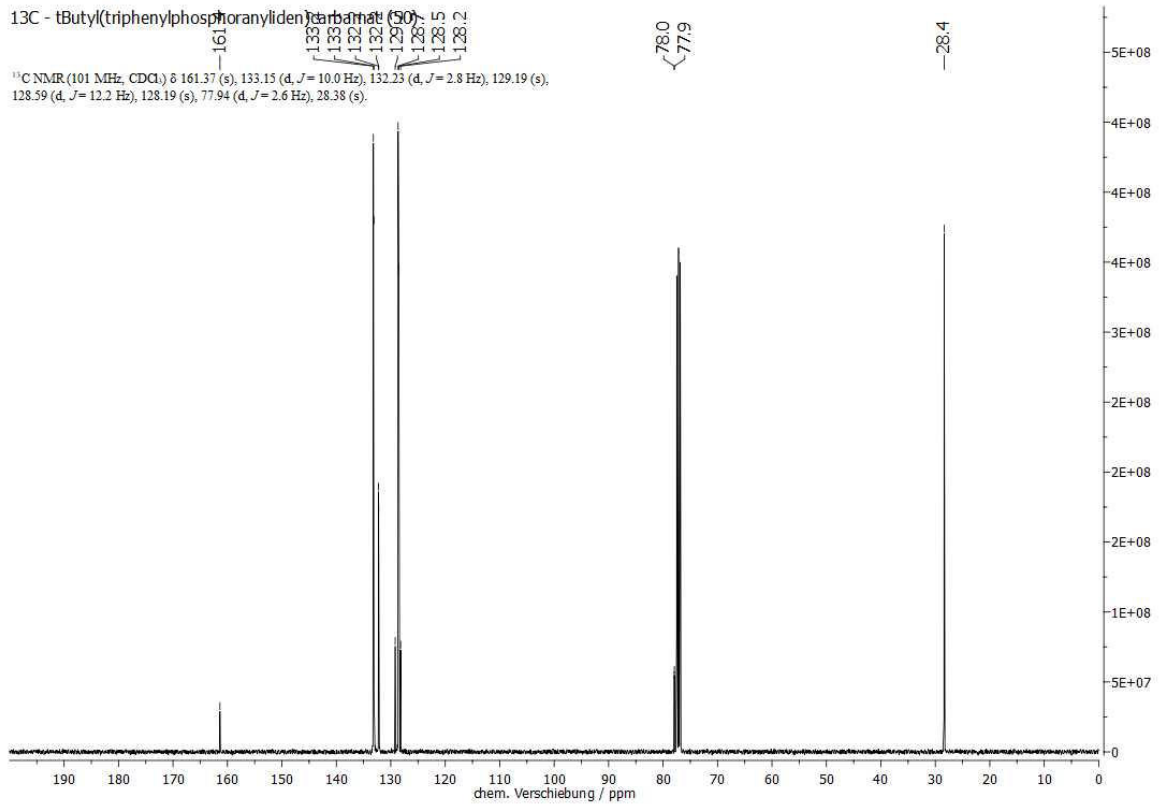


Abb. 8.100: <sup>13</sup>C-NMR-Spektrum (101 MHz, CDCl<sub>3</sub>, 298 K) von tButyl(triphenylphosphoranyliden)carbamat (50).

# ANHANG

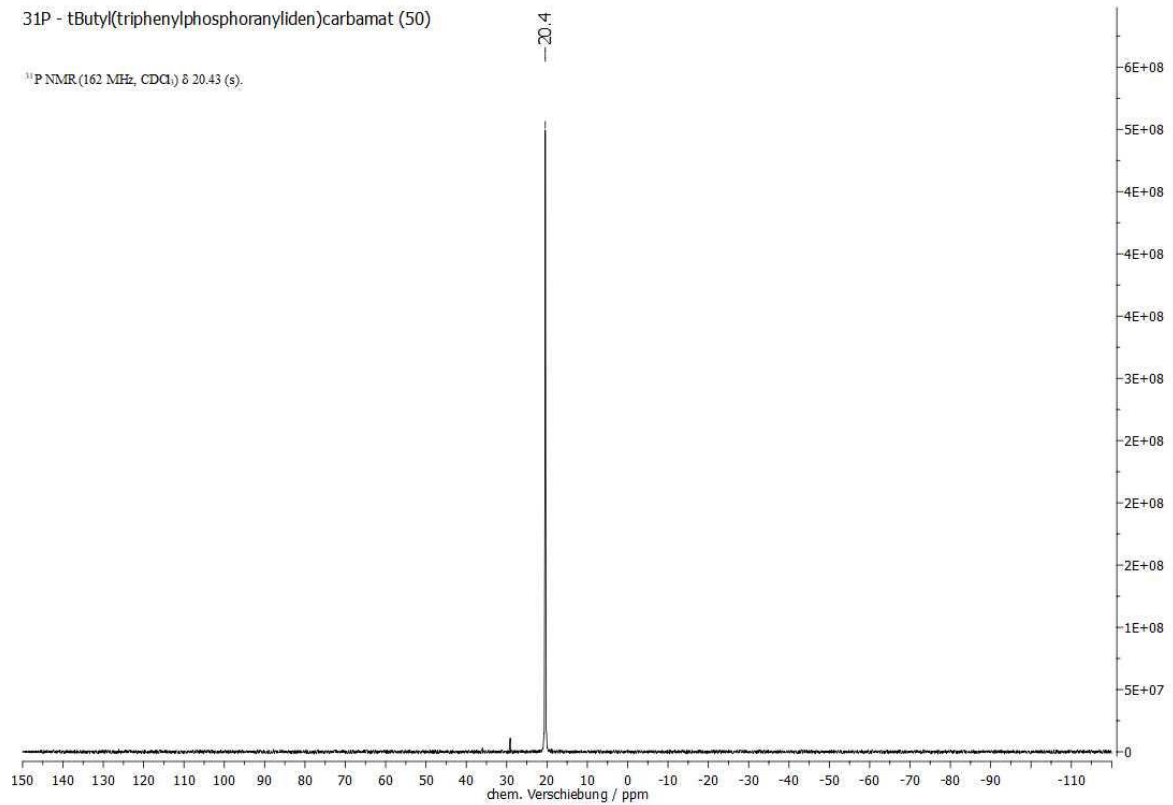


Abb. 8.101:  $^{31}\text{P}$ -NMR-Spektrum (162 MHz,  $\text{CDCl}_3$ , 298 K) von tButyl(triphenylphosphoranyliden)carbamat (50).

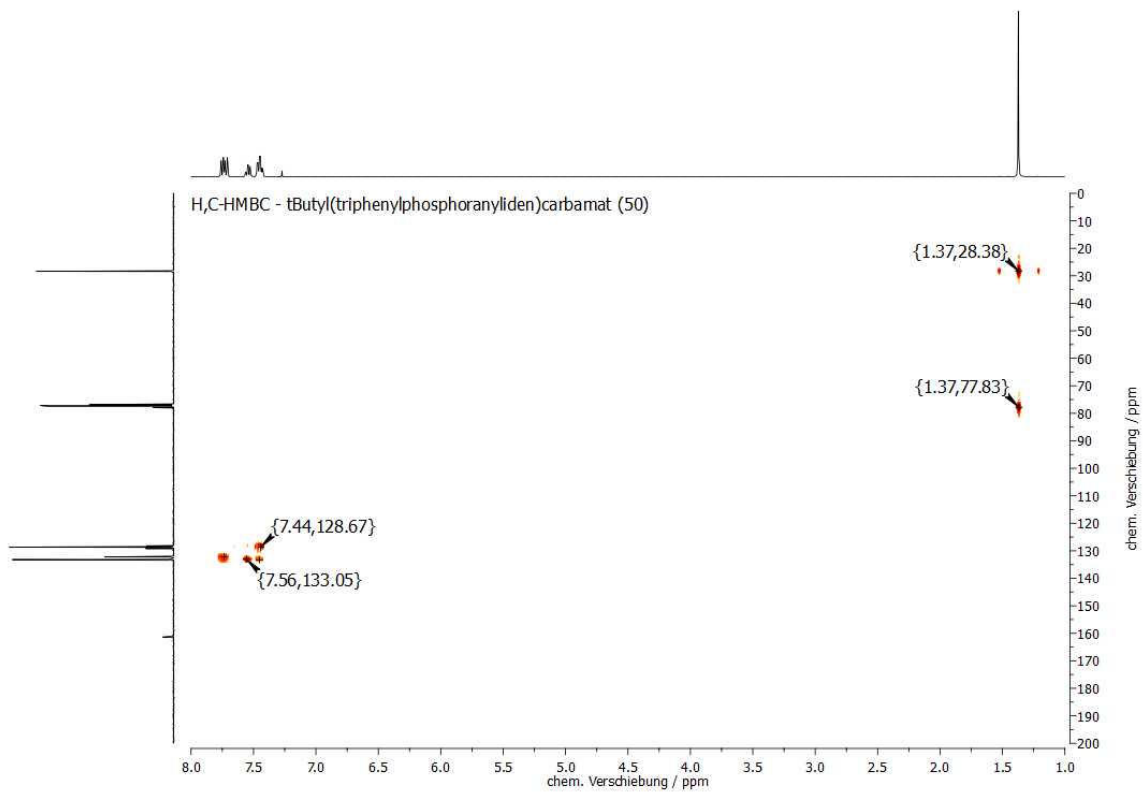


Abb. 8.102: H,C-HMBC-NMR-Spektrum ( $\text{CDCl}_3$ , 298 K) von tButyl(triphenylphosphoranyliden)carbamat (50).

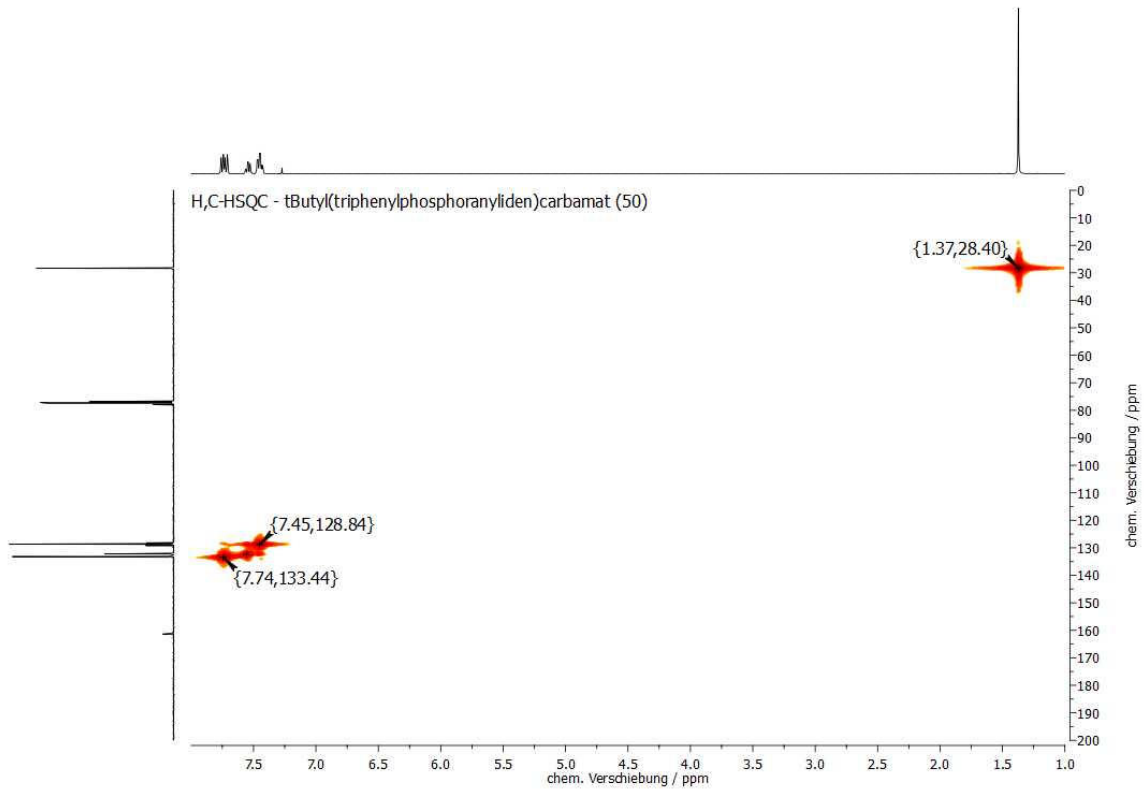


Abb. 8.103: H,C-HSQC-NMR-Spektrum (CDCl<sub>3</sub>, 298 K) von tButyl(triphenylphosphoranylidene)carbamate (**50**).

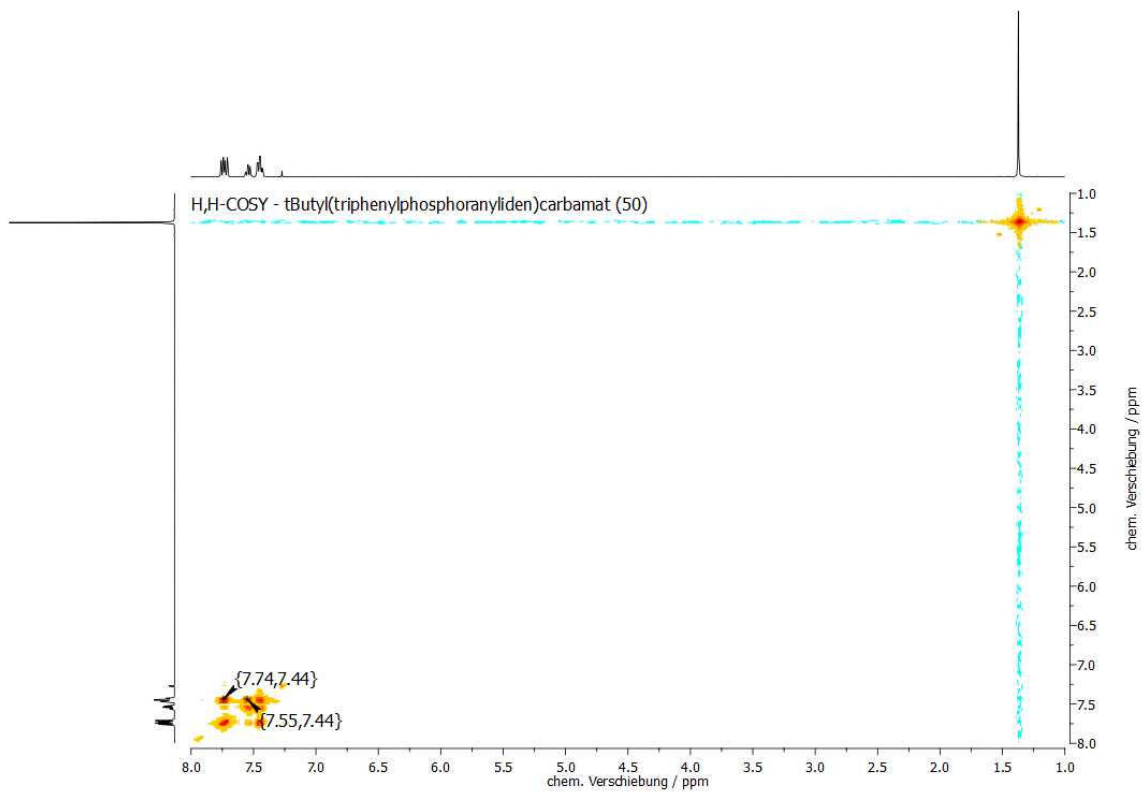


Abb. 8.104: H,H-COSY-NMR-Spektrum (CDCl<sub>3</sub>, 298 K) von tButyl(triphenylphosphoranylidene)carbamate (**50**).

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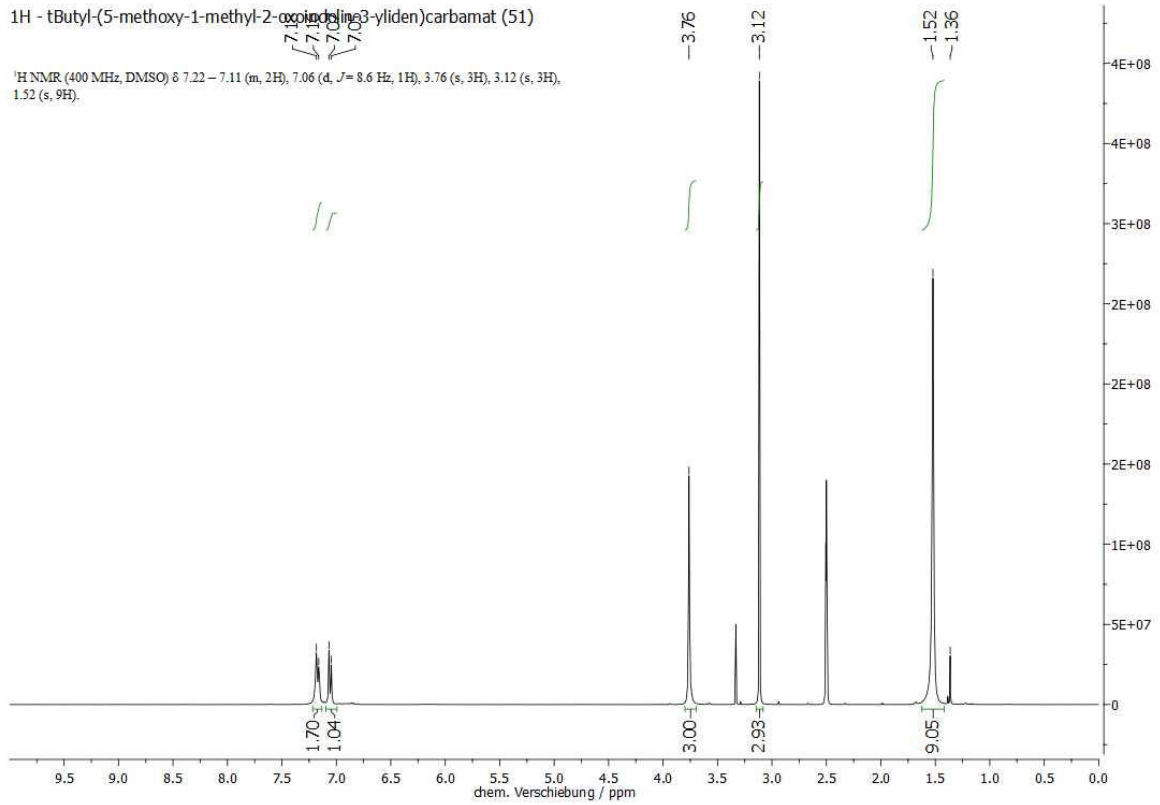


Abb. 8.105: <sup>1</sup>H-NMR-Spektrum (400 MHz, DMSO-d<sub>6</sub>, 298 K) von tButyl-(5-methoxy-1-methyl-2-oxoindolin-3-yliden)carbamate (**51**).

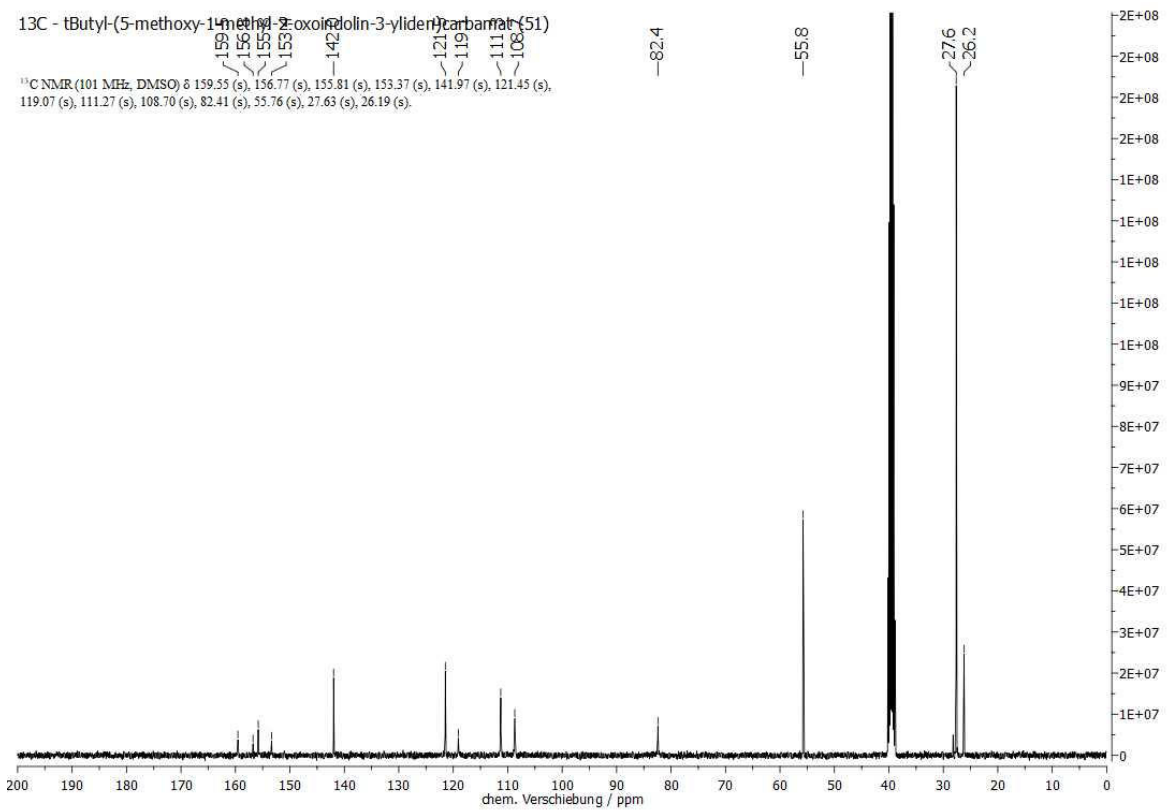


Abb. 8.106: <sup>13</sup>C-NMR-Spektrum (101 MHz, DMSO-d<sub>6</sub>, 298 K) von tButyl-(5-methoxy-1-methyl-2-oxoindolin-3-yliden)carbamate (**51**).

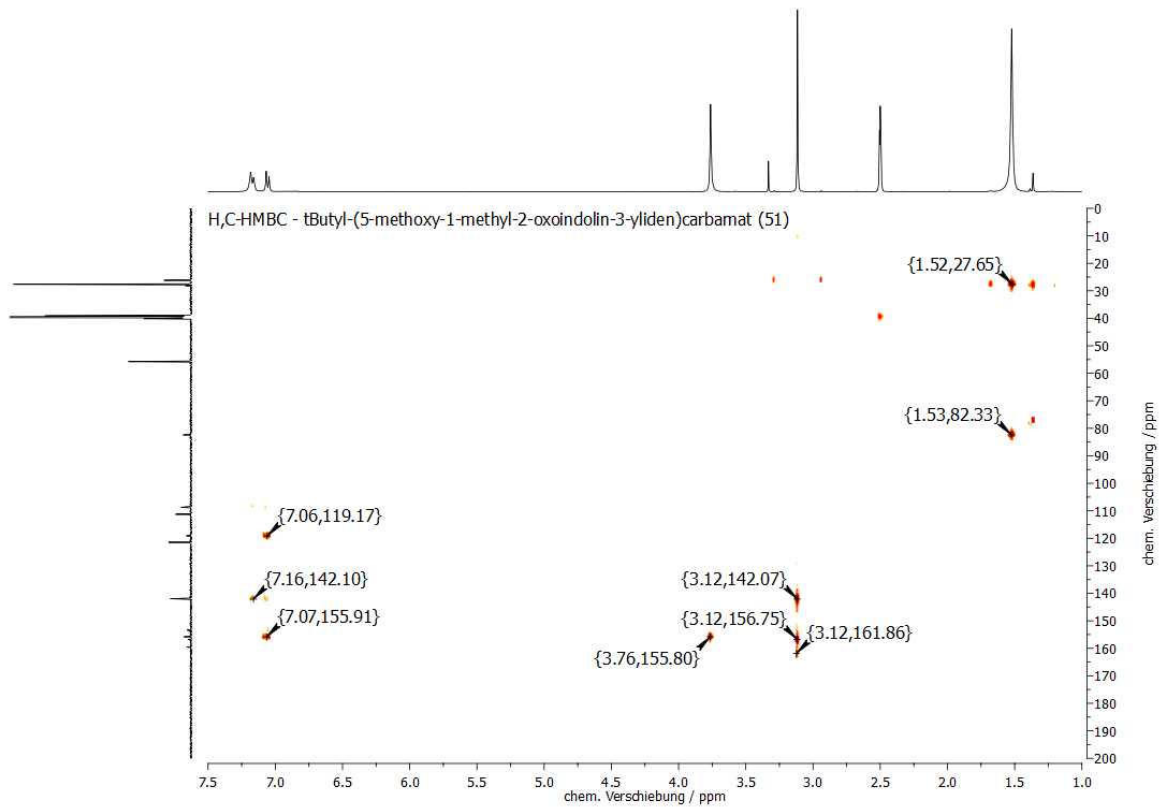


Abb. 8.107: H,C-HMBC-NMR-Spektrum (DMSO- $d_6$ , 298 K) von tButyl-(5-methoxy-1-methyl-2-oxoindolin-3-yliden)carbamate (**51**).

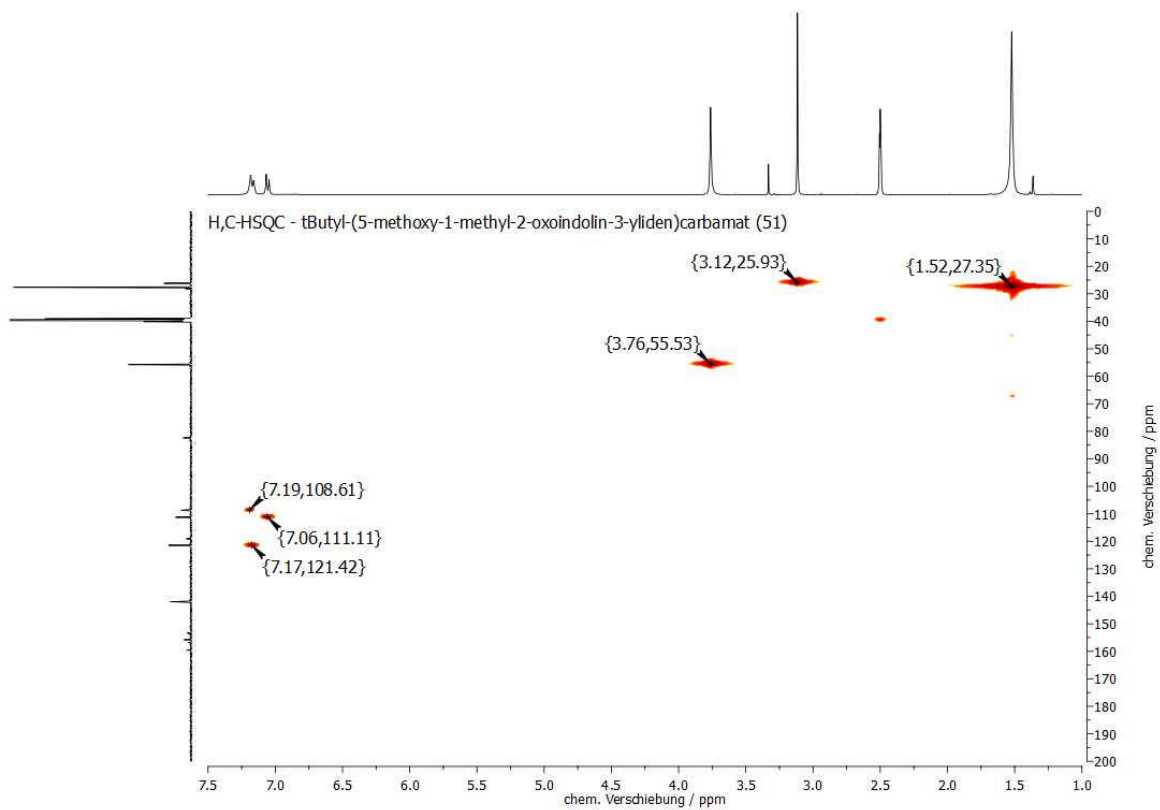


Abb. 8.108: H,C-HSQC-NMR-Spektrum (DMSO- $d_6$ , 298 K) von tButyl-(5-methoxy-1-methyl-2-oxoindolin-3-yliden)carbamate (**51**).

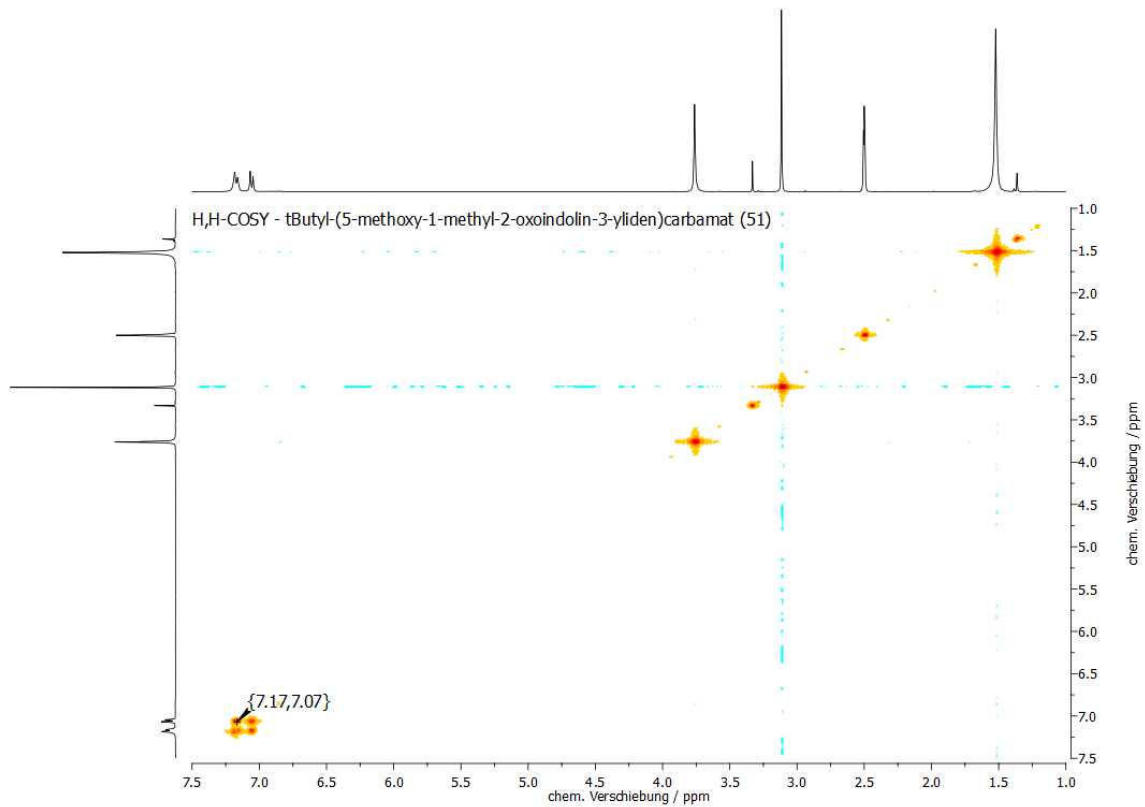


Abb. 8.109: H,H-COSY-NMR-Spektrum (DMSO-d<sub>6</sub>, 298 K) von tButyl-(5-methoxy-1-methyl-2-oxoindolin-3-ylidene)carbamate (**51**).

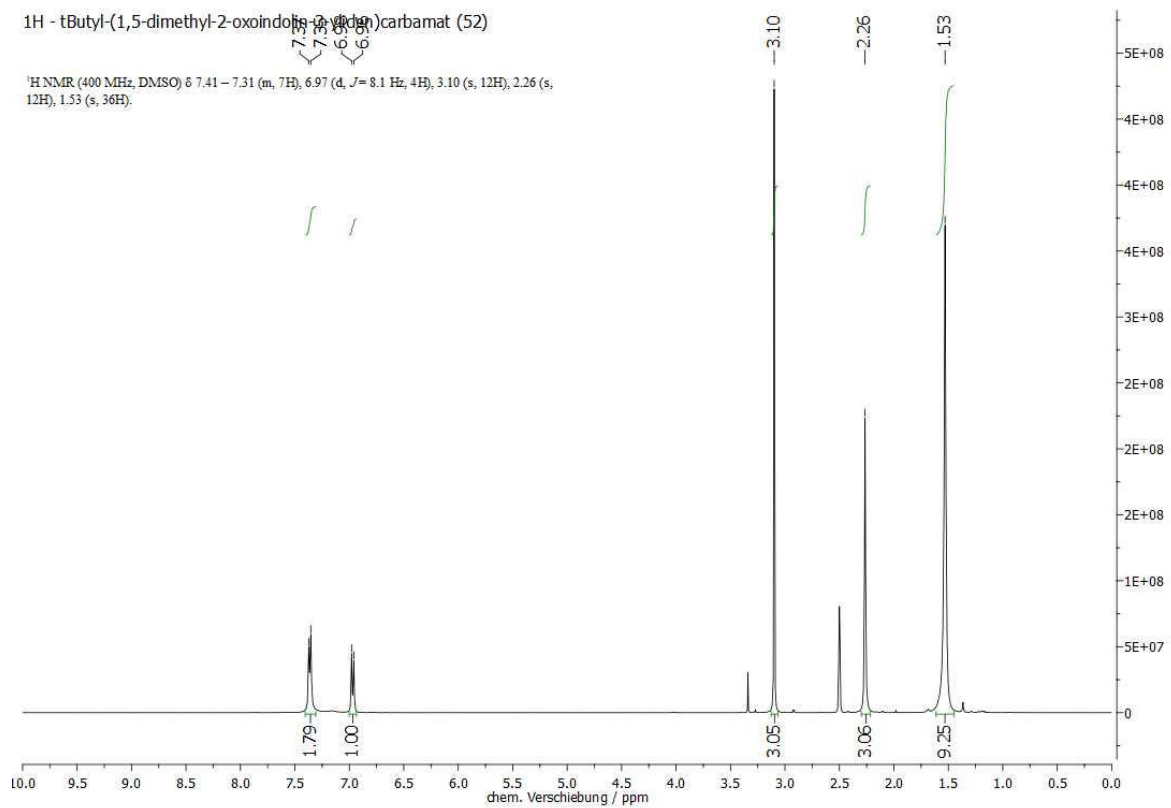


Abb. 8.110: <sup>1</sup>H-NMR-Spektrum (400 MHz, DMSO-d<sub>6</sub>, 298 K) von tButyl-(1,5-dimethyl-2-oxoindolin-3-ylidene)carbamate (**52**).

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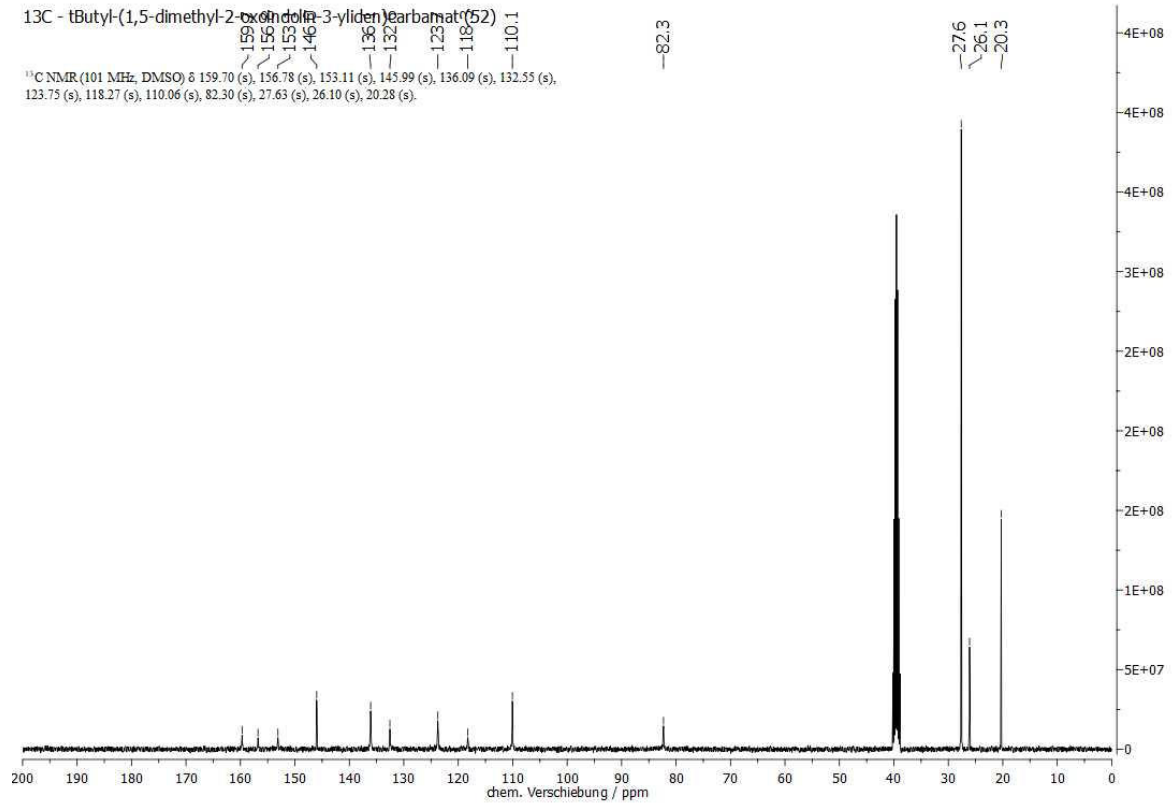


Abb. 8.111: <sup>13</sup>C-NMR-Spektrum (101 MHz, DMSO-d<sub>6</sub>, 298 K) von tButyl-(1,5-dimethyl-2-oxoindolin-3-yliden)carbamate (**52**).

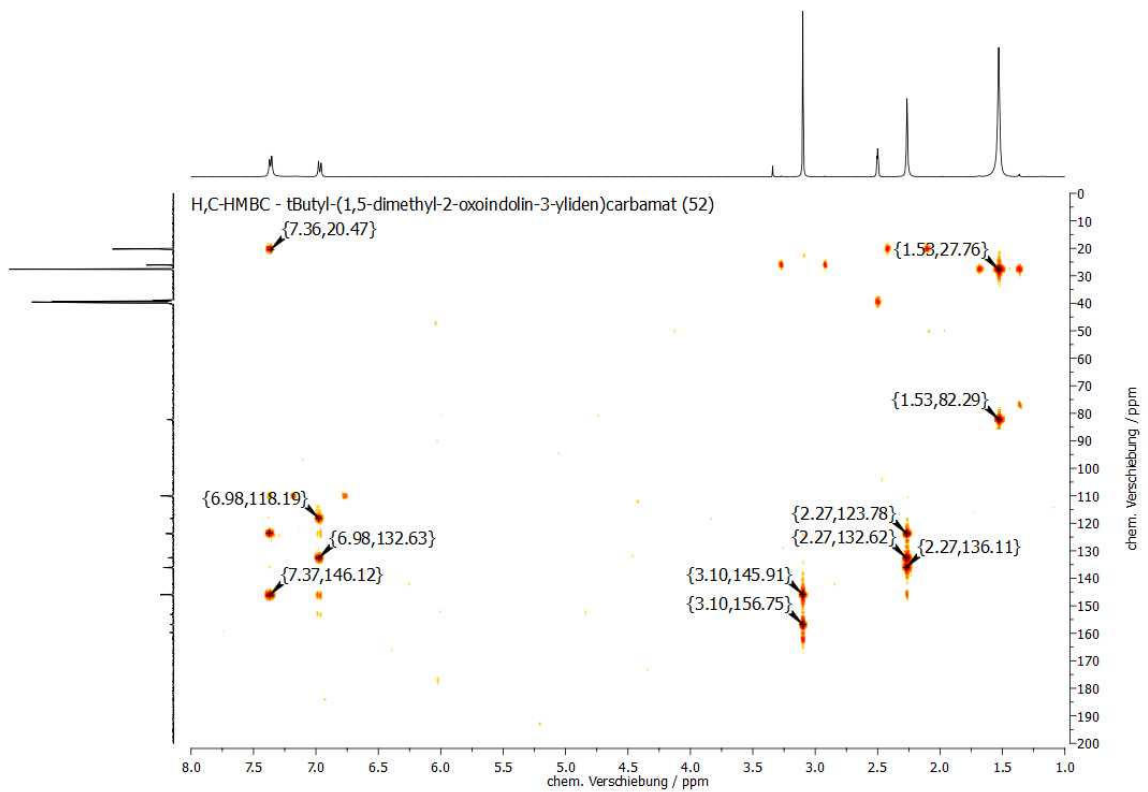


Abb. 8.112: H,C-HMBC-NMR-Spektrum (DMSO-d<sub>6</sub>, 298 K) von tButyl-(1,5-dimethyl-2-oxoindolin-3-yliden)carbamate (**52**).



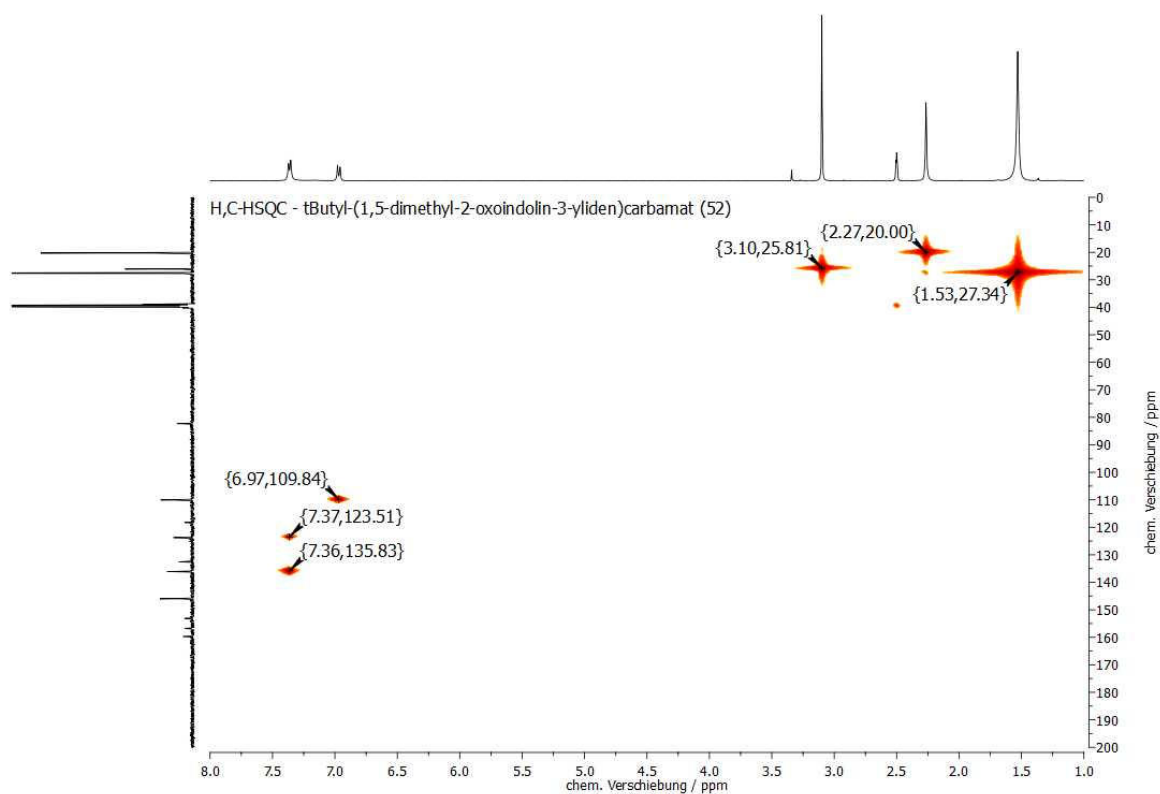


Abb. 8.113: H,C-HSQC-NMR-Spektrum (DMSO- $d_6$ , 298 K) von 'Butyl-(1,5-dimethyl-2-oxoindolin-3-yliden)carbammat (**52**).

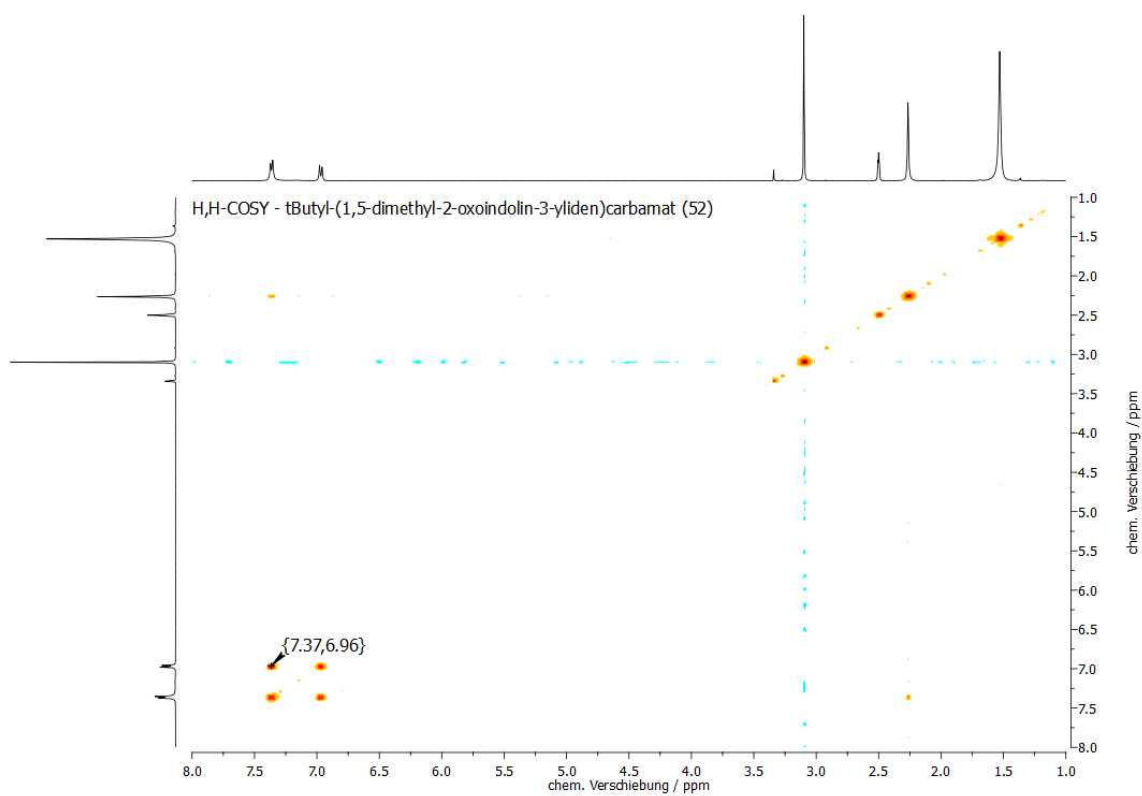


Abb. 8.114: H,H-COSY-NMR-Spektrum (DMSO- $d_6$ , 298 K) von 'Butyl-(1,5-dimethyl-2-oxoindolin-3-yliden)carbammat (**52**).

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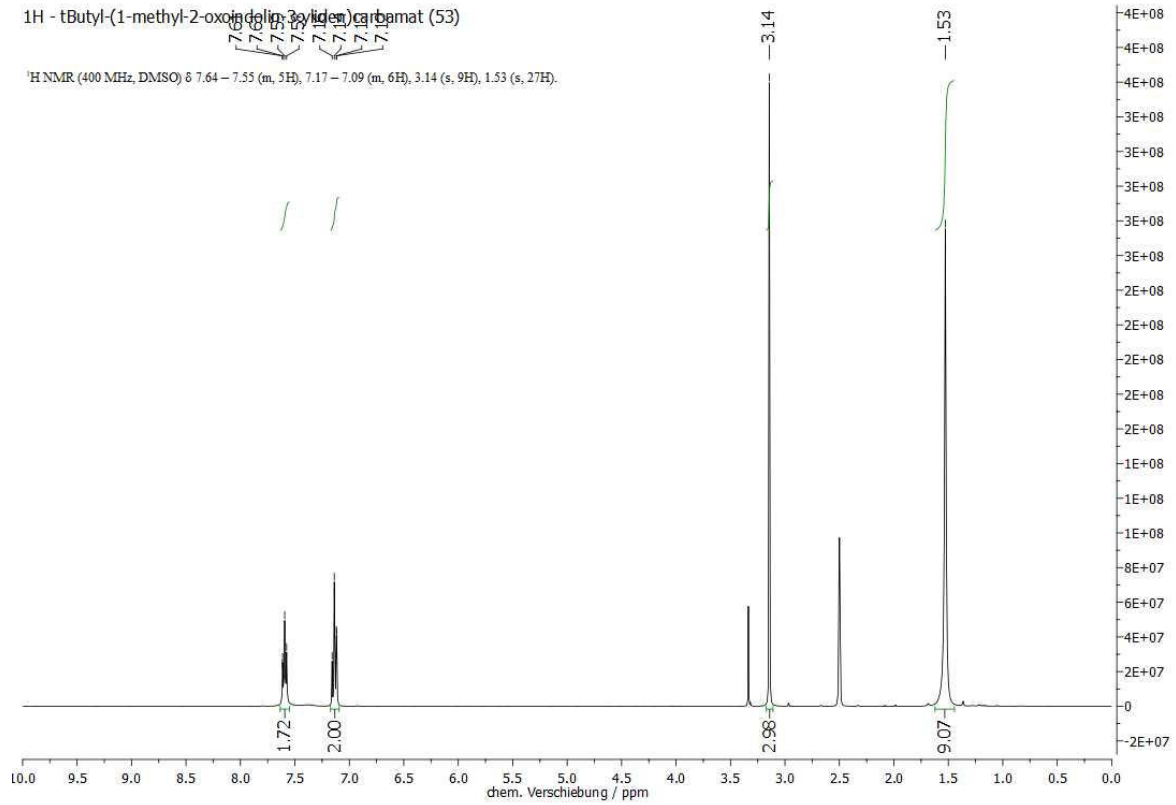


Abb. 8.115: <sup>1</sup>H-NMR-Spektrum (400 MHz, DMSO-d<sub>6</sub>, 298 K) von tButyl-(1-methyl-2-oxoindolin-3-yliden)carbamat (53).

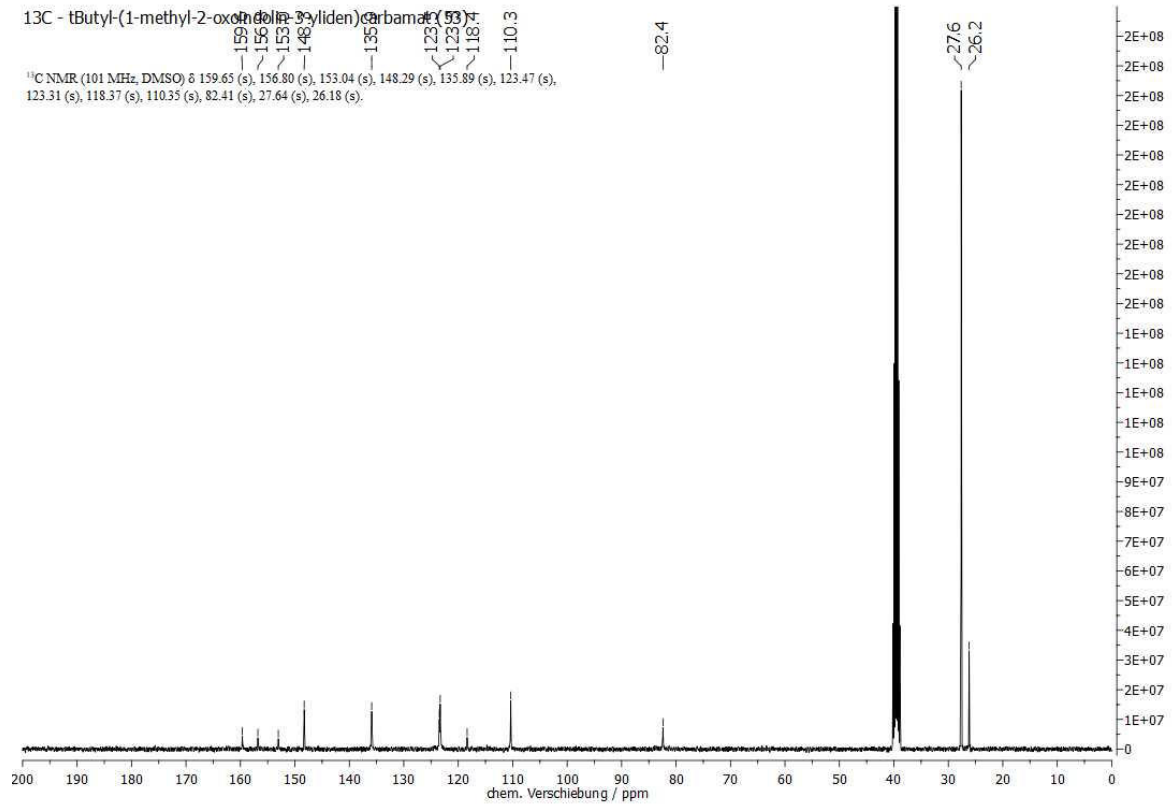


Abb. 8.116: <sup>13</sup>C-NMR-Spektrum (101 MHz, DMSO-d<sub>6</sub>, 298 K) von tButyl-(1-methyl-2-oxoindolin-3-yliden)carbamat (53).

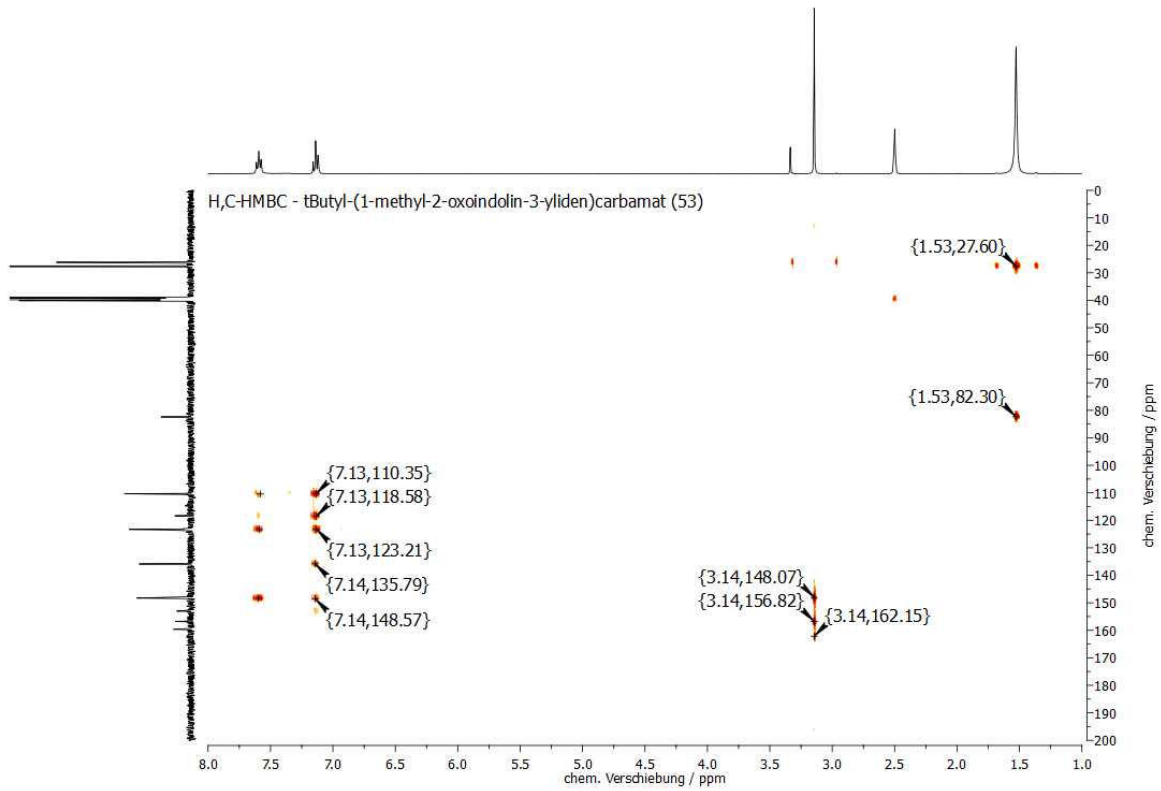


Abb. 8.117: H,C-HMBC-NMR-Spektrum (DMSO-d<sub>6</sub>, 298 K) von tButyl-(1-methyl-2-oxoindolin-3-yliden)carbamate (**53**).

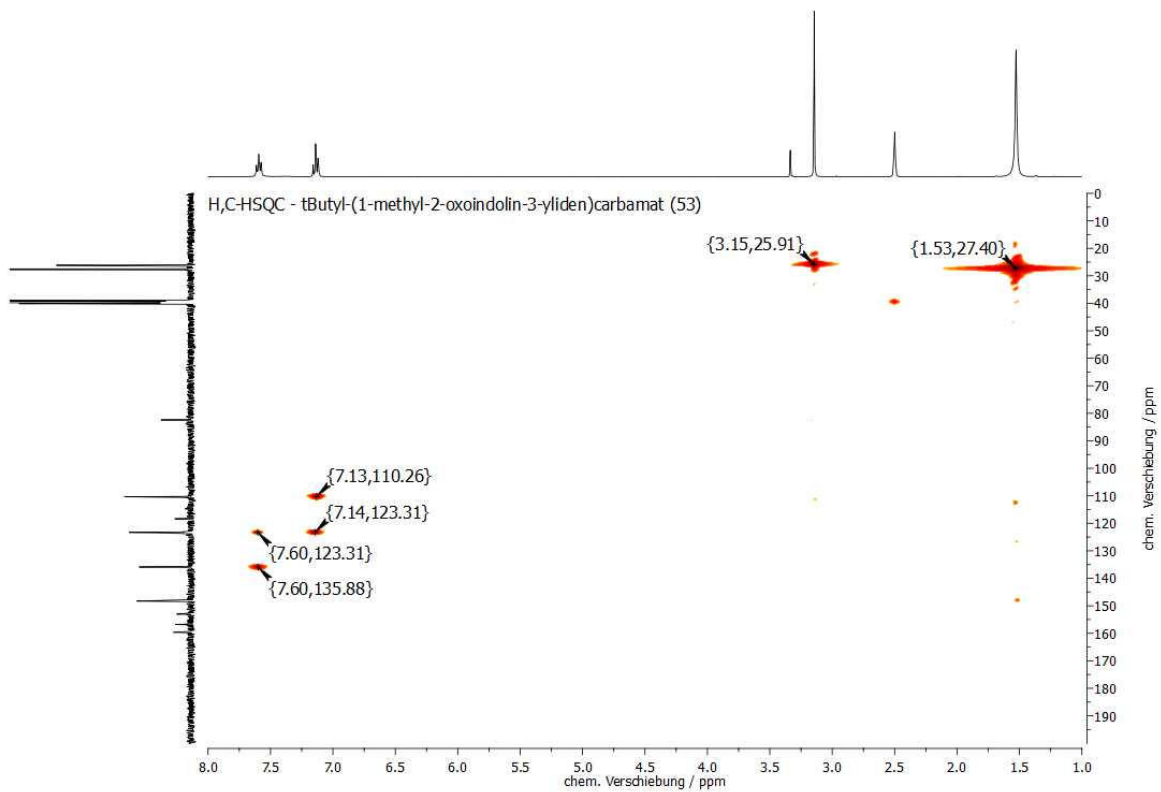


Abb. 8.118: H,C-HSQC-NMR-Spektrum (DMSO-d<sub>6</sub>, 298 K) von tButyl-(1-methyl-2-oxoindolin-3-yliden)carbamate (**53**).

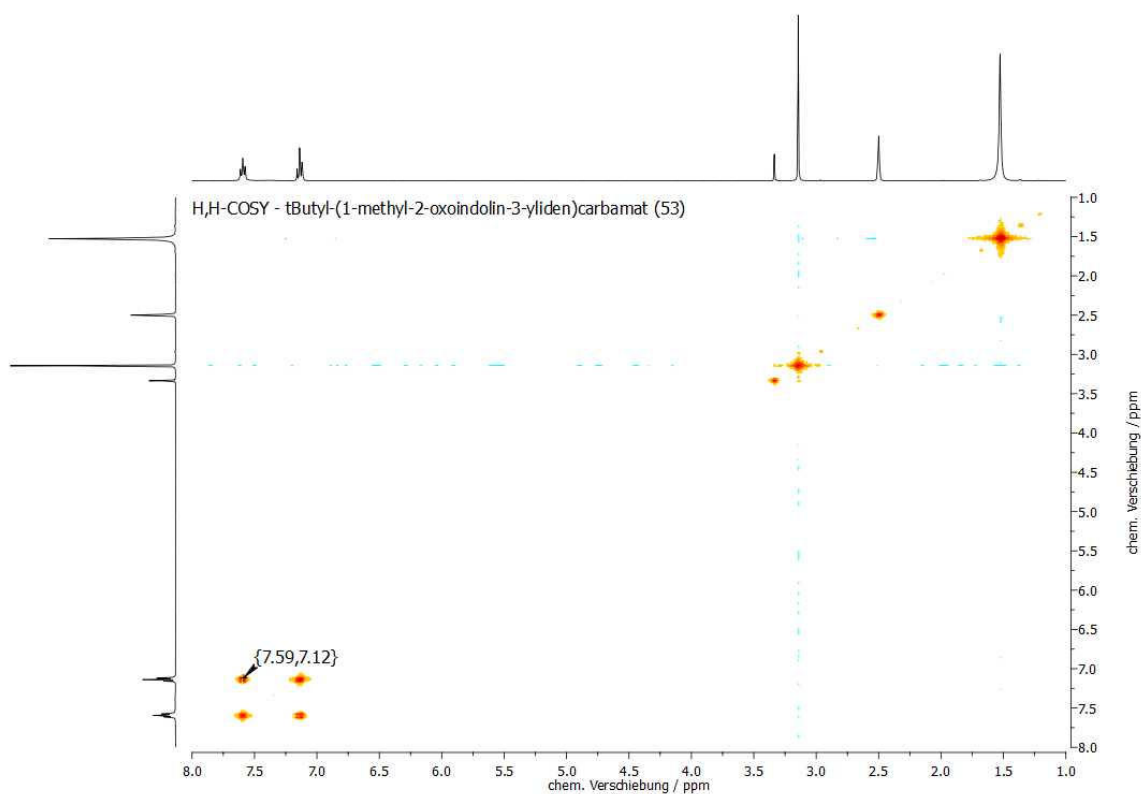


Abb. 8.119: H,H-COSY-NMR-Spektrum (DMSO- $d_6$ , 298 K) von tButyl-(1-methyl-2-oxoindolin-3-yliden)carbamat (**53**).

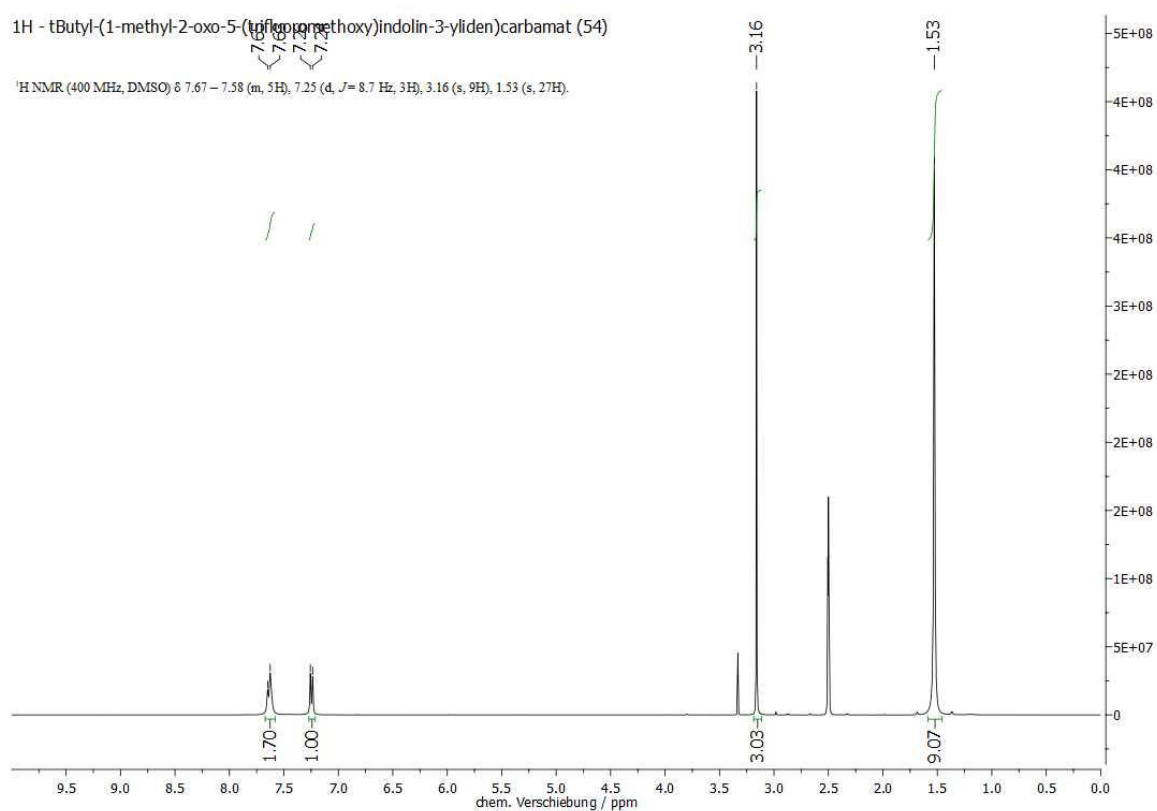


Abb. 8.120:  $^1\text{H-NMR}$ -Spektrum (400 MHz, DMSO- $d_6$ , 298 K) von tButyl-(1-methyl-2-oxo-5-(trifluoromethoxy)indolin-3-yliden)carbamate (**54**).

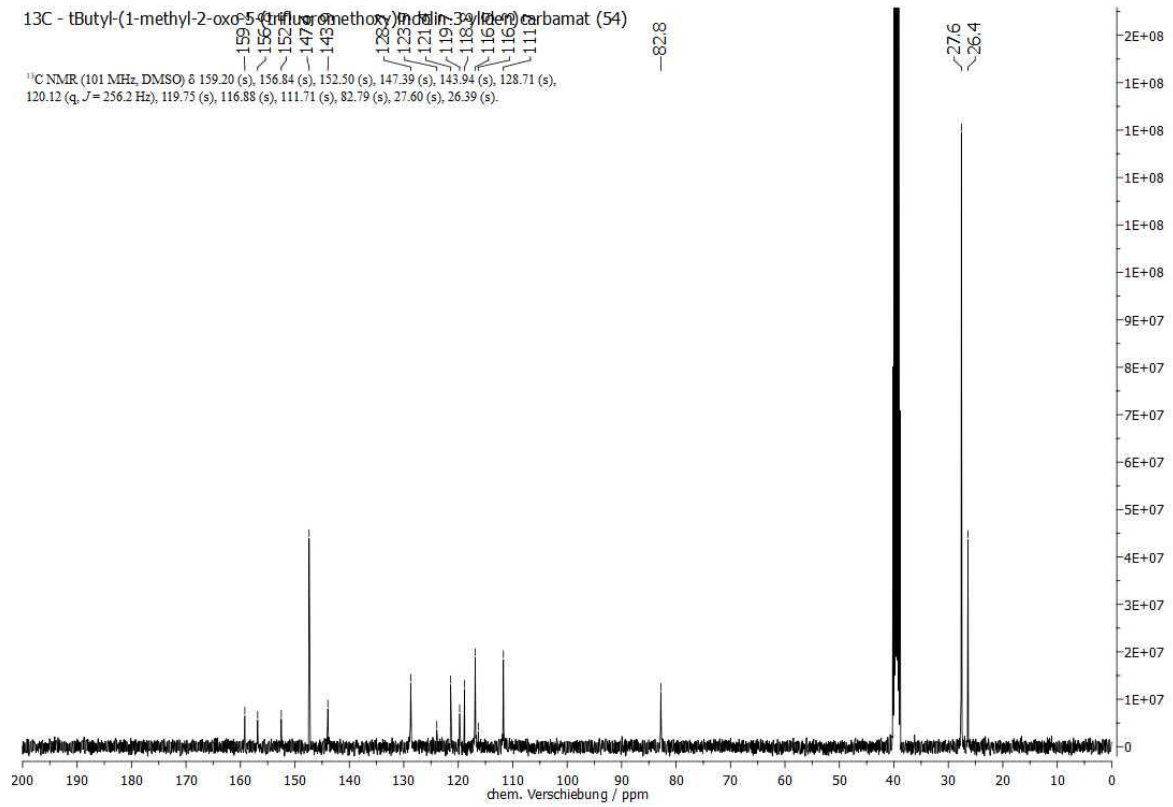


Abb. 8.121: <sup>13</sup>C-NMR-Spektrum (101 MHz, DMSO-d<sub>6</sub>, 298 K) von tButyl-(1-methyl-2-oxo-5-(trifluoromethoxy)indolin-3-yliden)carbamat (**54**).

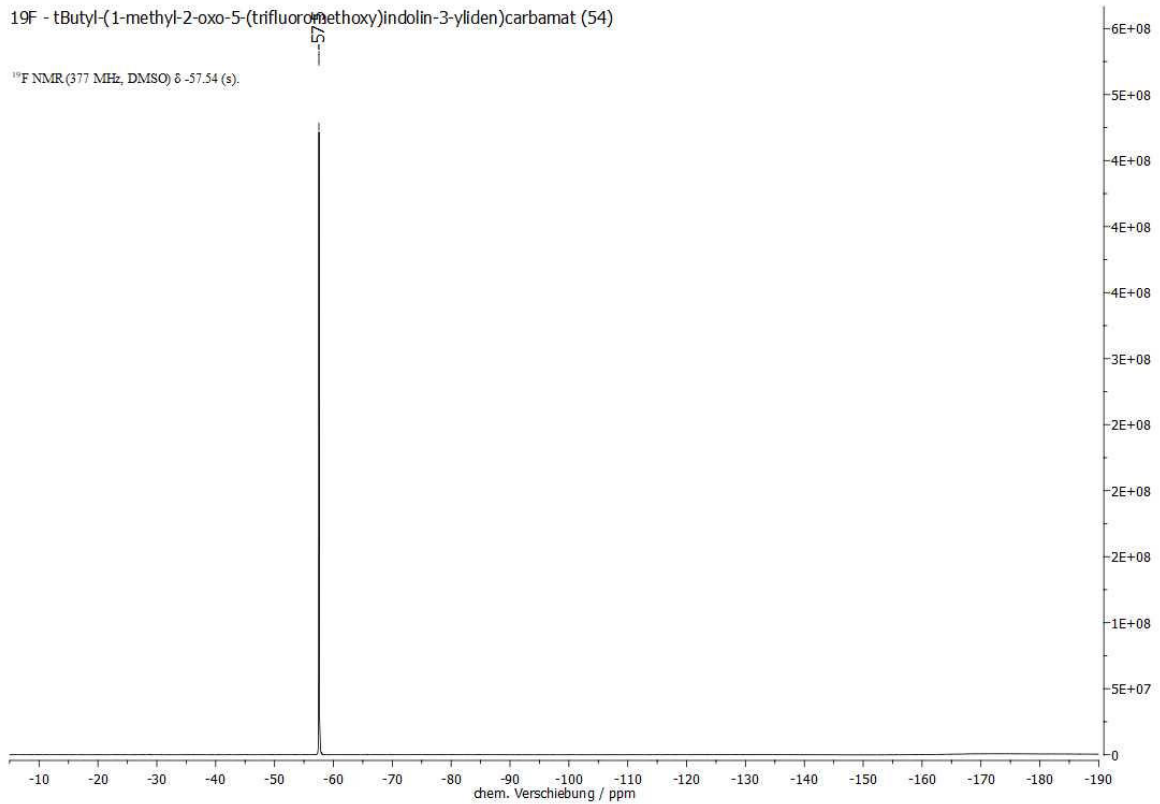


Abb. 8.122: <sup>19</sup>F-NMR-Spektrum (377 MHz, DMSO-d<sub>6</sub>, 298 K) von tButyl-(1-methyl-2-oxo-5-(trifluoromethoxy)indolin-3-yliden)carbamat (**54**).

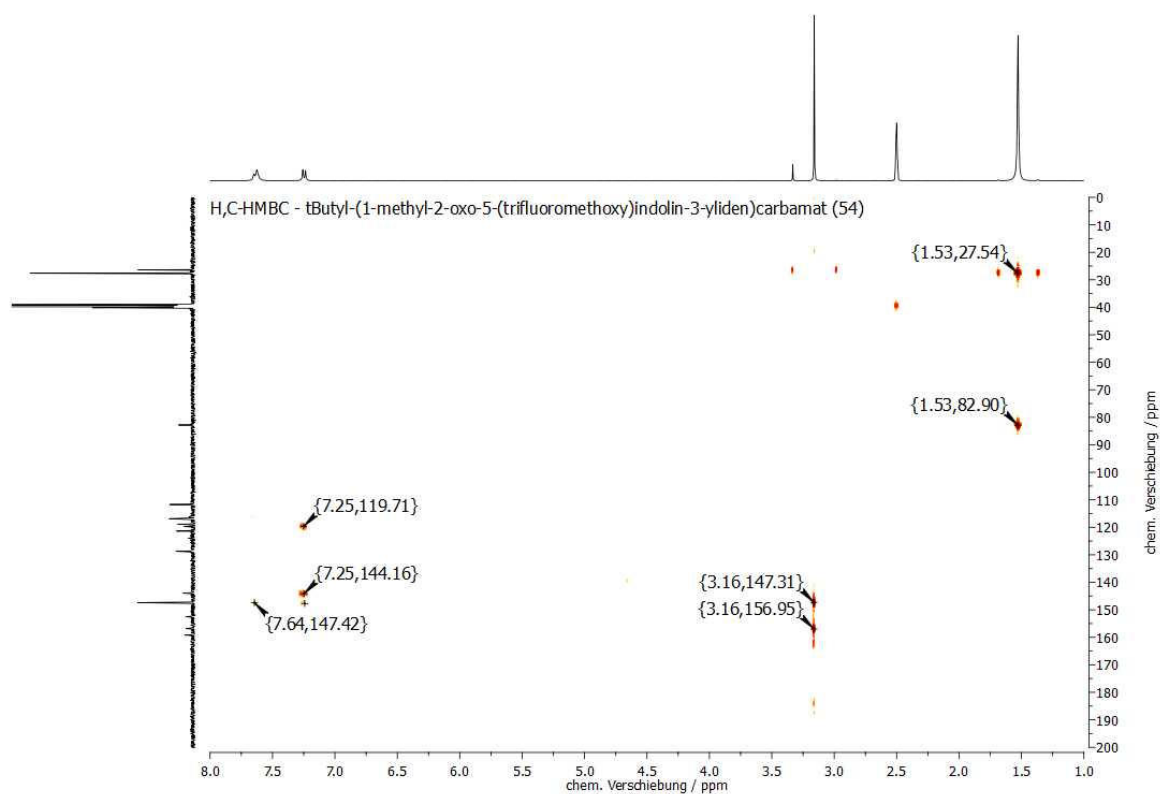


Abb. 8.123: H,C-HMBC-NMR-Spektrum (DMSO- $d_6$ , 298 K) von <sup>1</sup>Butyl-(1-methyl-2-oxo-5-(trifluoromethoxy)indolin-3-yliden)carbammat (**54**).

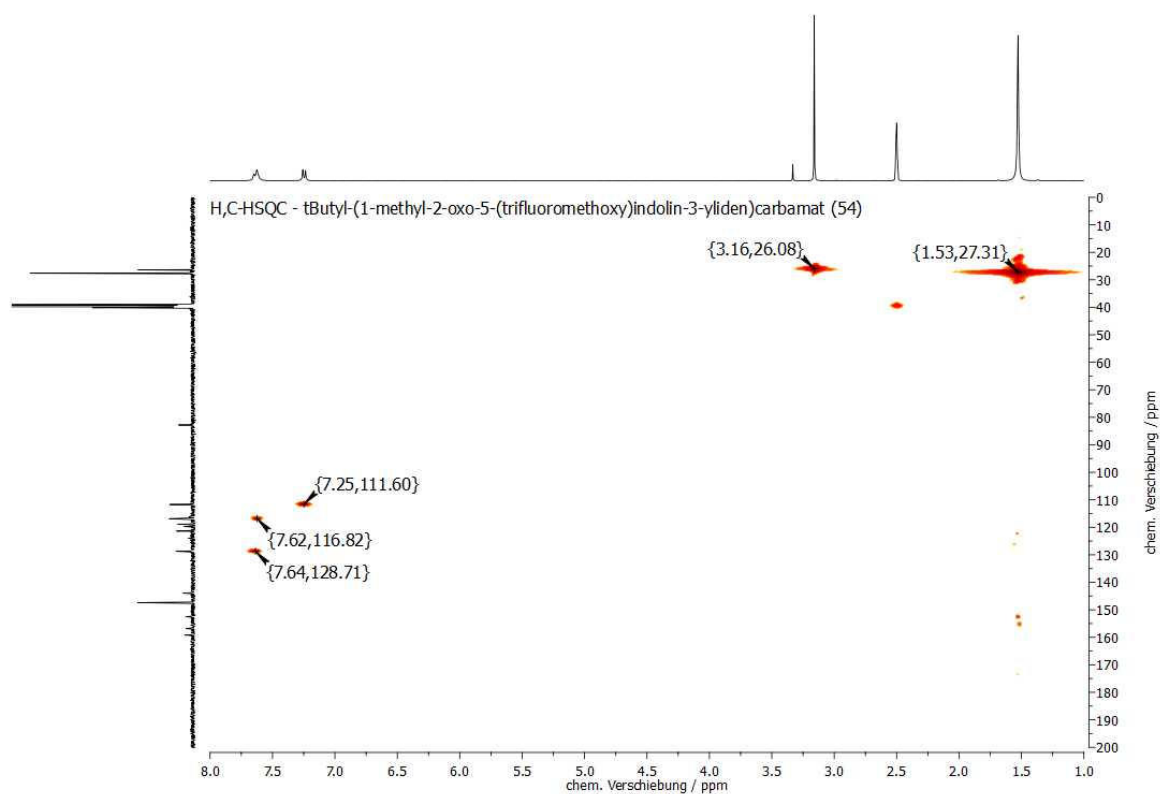


Abb. 8.124: H,C-HSQC-NMR-Spektrum (DMSO- $d_6$ , 298 K) von <sup>1</sup>Butyl-(1-methyl-2-oxo-5-(trifluoromethoxy)indolin-3-yliden)carbammat (**54**).

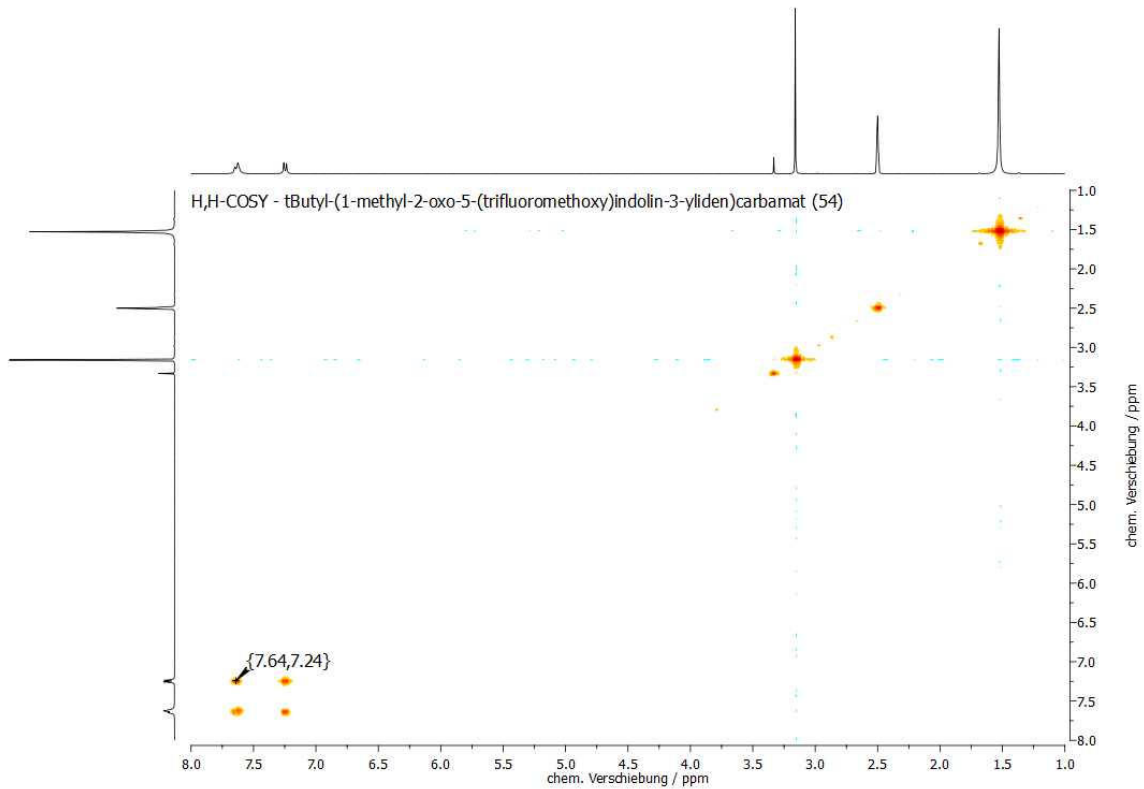


Abb. 8.125: H,H-COSY-NMR-Spektrum (DMSO-d<sub>6</sub>, 298 K) von tButyl-(1-methyl-2-oxo-5-(trifluoromethoxy)indolin-3-ylidene)carbamate (**54**).

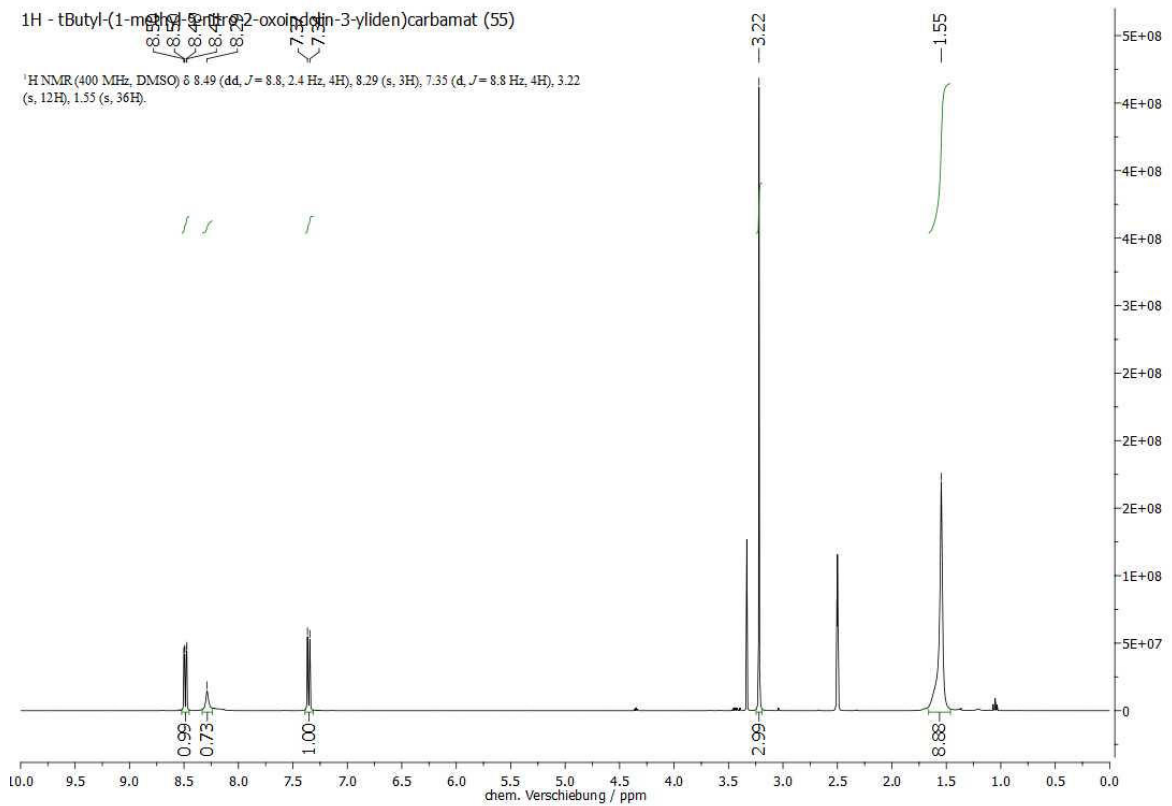


Abb. 8.126: <sup>1</sup>H-NMR-Spektrum (400 MHz, DMSO-d<sub>6</sub>, 298 K) von tButyl-(1-methyl-5-nitro-2-oxoindolin-3-ylidene)carbamate (**55**).

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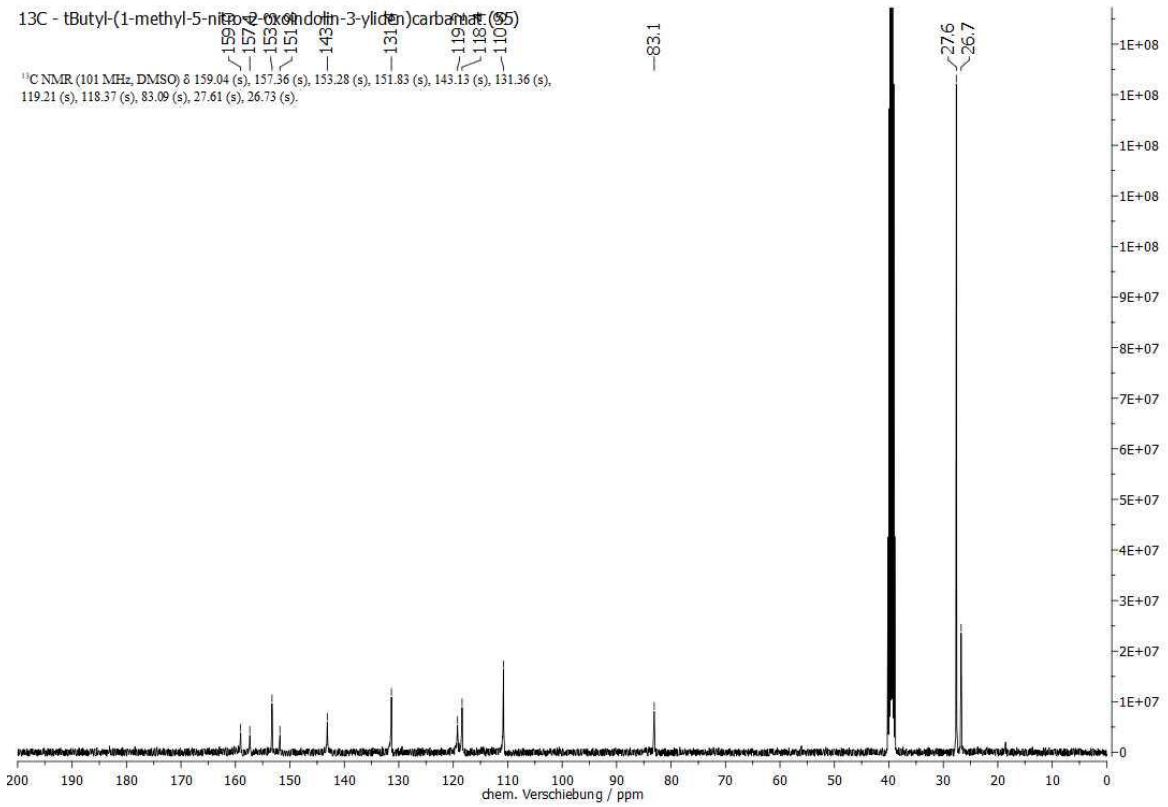


Abb. 8.127: <sup>13</sup>C-NMR-Spektrum (101 MHz, DMSO-d<sub>6</sub>, 298 K) von tButyl-(1-methyl-5-nitro-2-oxoindolin-3-yliden)carbamat (**55**).

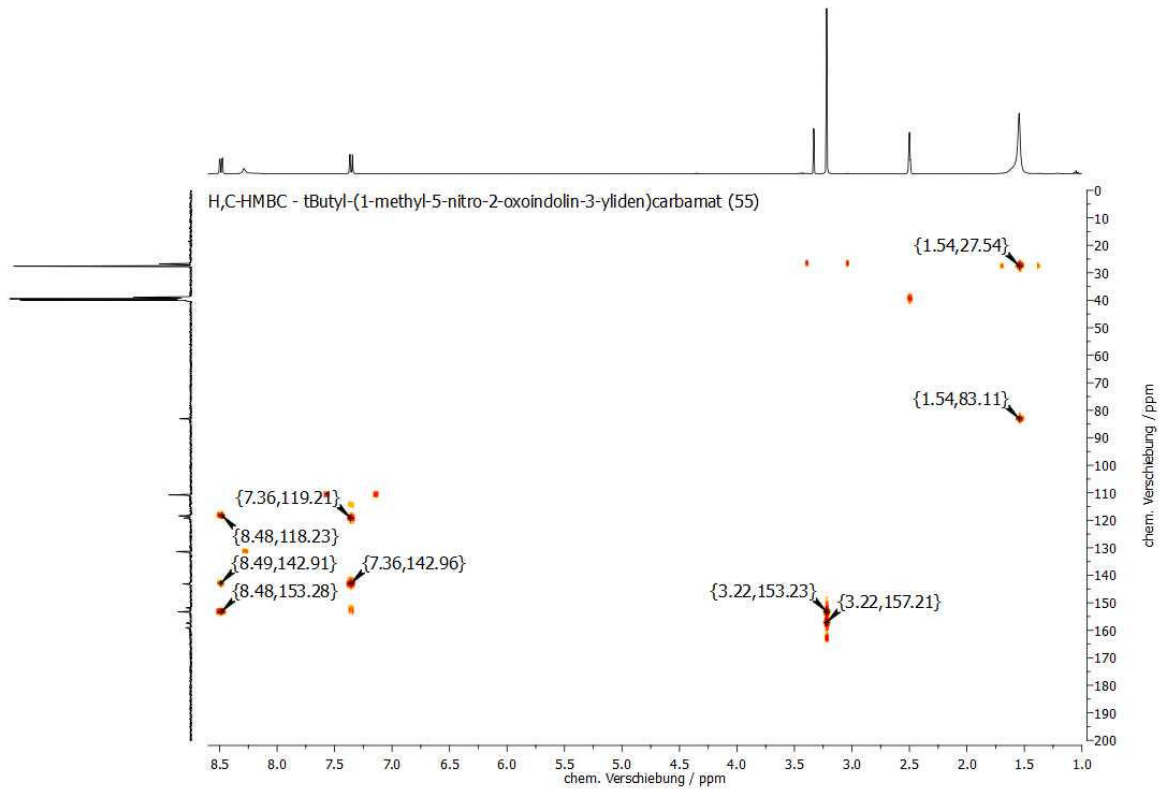


Abb. 8.128: H,C-HMBC-NMR-Spektrum (DMSO-d<sub>6</sub>, 298 K) von tButyl-(1-methyl-5-nitro-2-oxoindolin-3-yliden)carbamat (**55**).



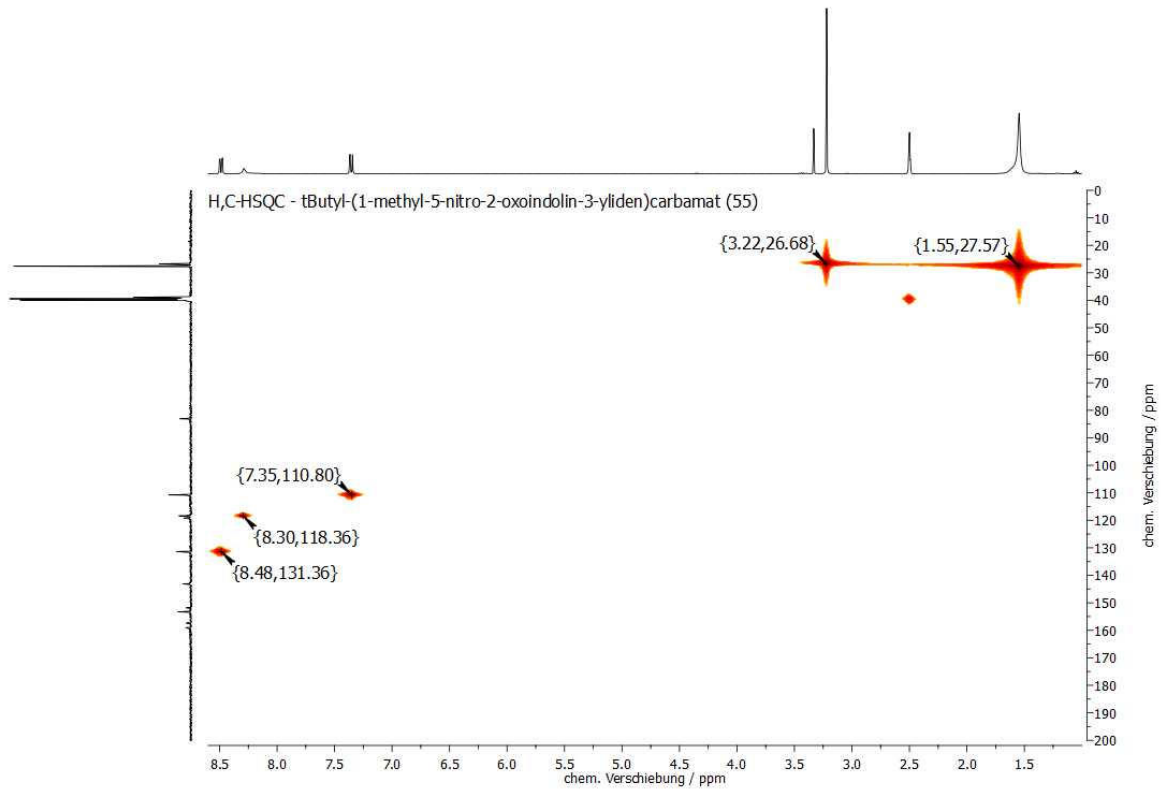


Abb. 8.129: H,C-HSQC-NMR-Spektrum (DMSO- $d_6$ , 298 K) von tButyl-(1-methyl-5-nitro-2-oxoindolin-3-yliden)carbamat (**55**).

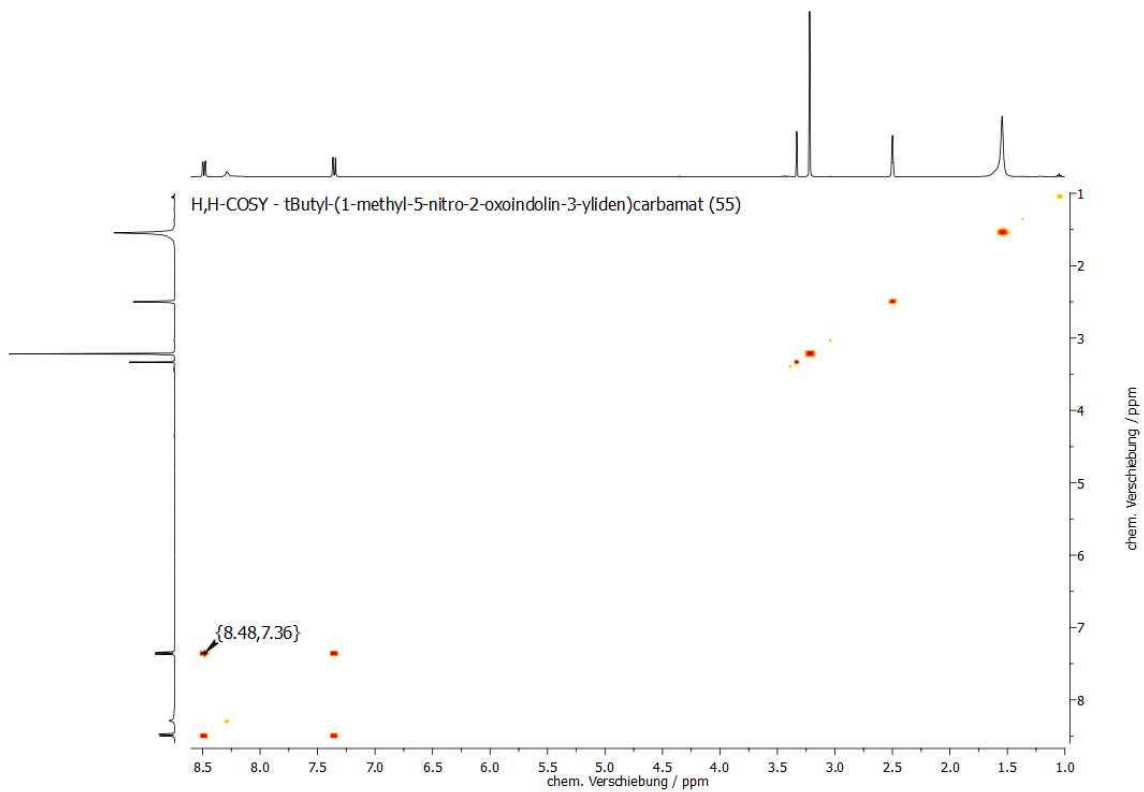


Abb. 8.130: H,H-COSY-NMR-Spektrum (DMSO- $d_6$ , 298 K) von tButyl-(1-methyl-5-nitro-2-oxoindolin-3-yliden)carbamat (**55**).

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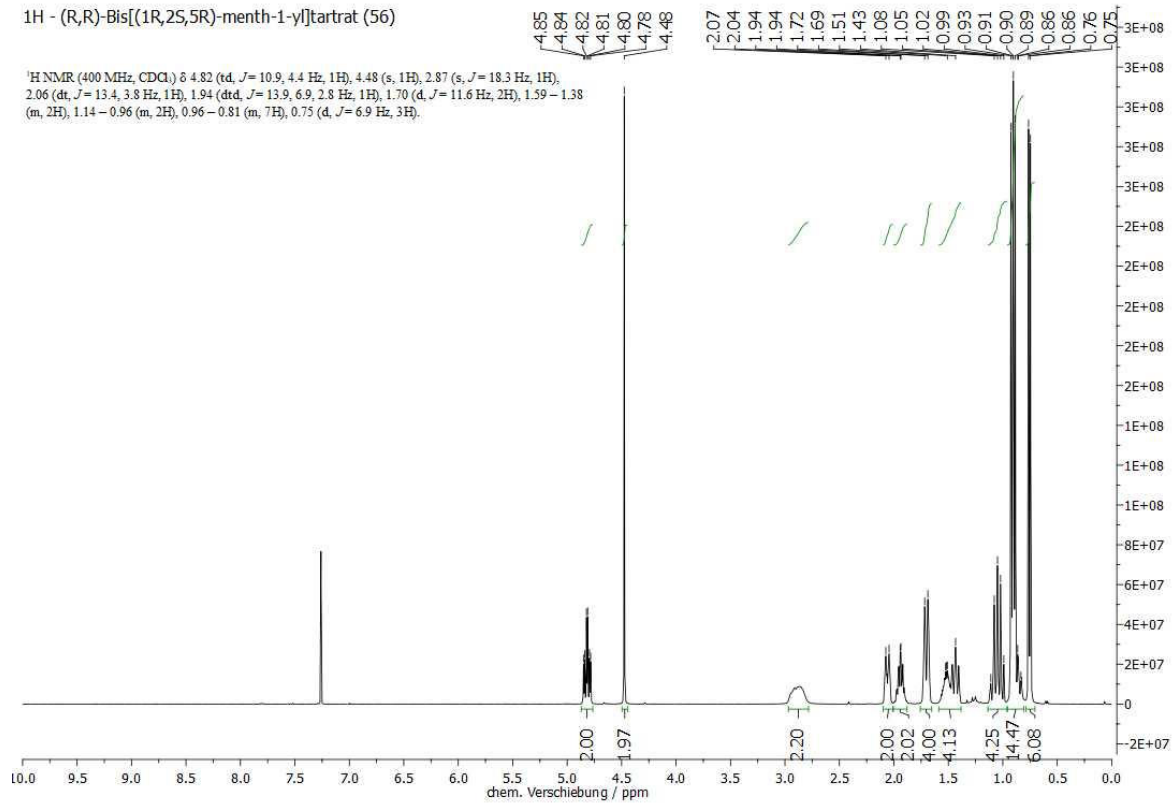


Abb. 8.131: <sup>1</sup>H-NMR-Spektrum (400 MHz, CDCl<sub>3</sub>, 298 K) von (R,R)-Bis[(1R,2S,5R)-menth-1-yl]tartrat (56).

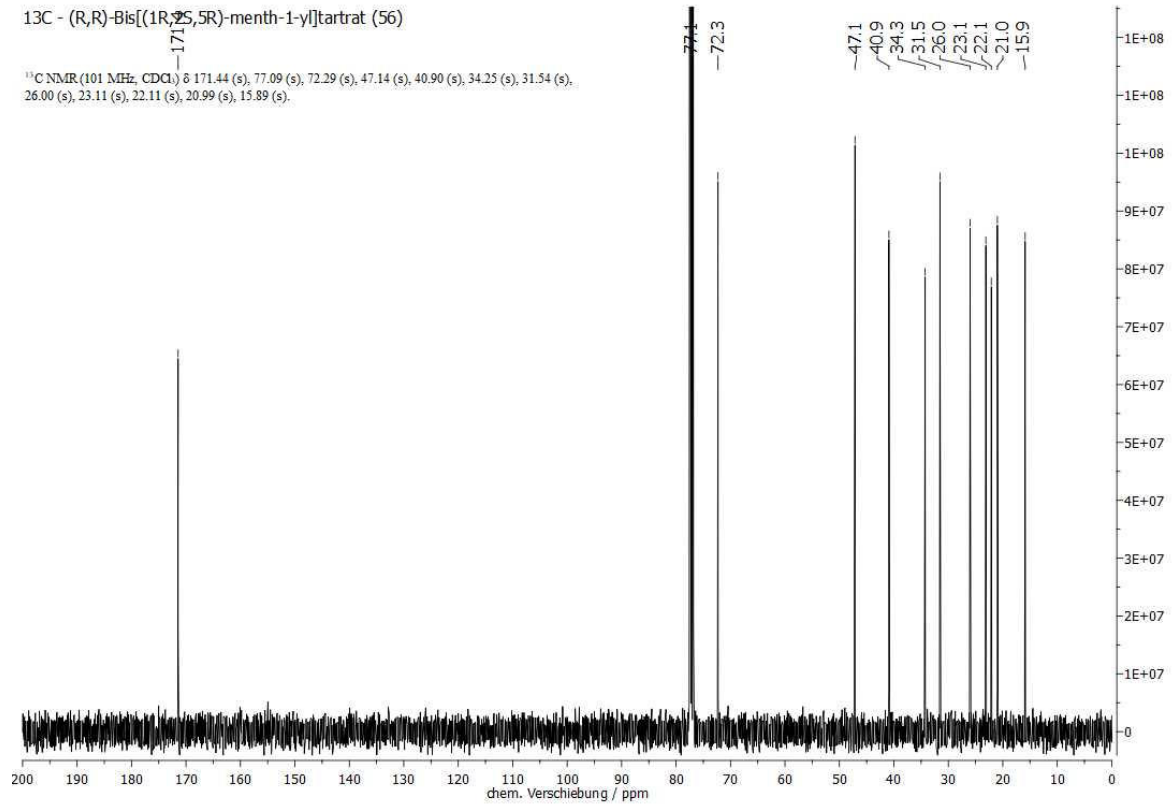


Abb. 8.132: <sup>13</sup>C-NMR-Spektrum (101 MHz, CDCl<sub>3</sub>, 298 K) von (R,R)-Bis[(1R,2S,5R)-menth-1-yl]tartrat (56).

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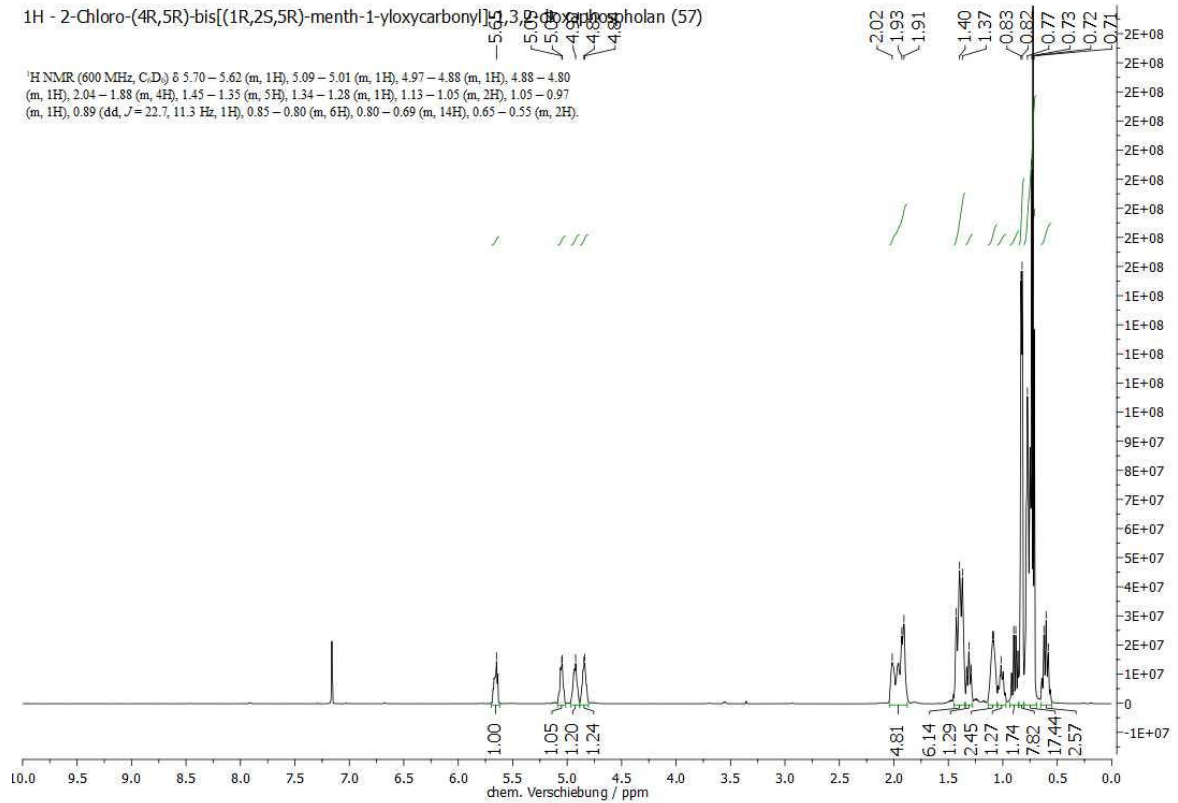


Abb. 8.133: <sup>1</sup>H-NMR-Spektrum (600 MHz, C<sub>6</sub>D<sub>6</sub>, 298 K) von 2-Chloro-(4*R*,5*R*)-bis[(1*R*,2*S*,5*R*)-menth-1-yloxy-carbonyl]-1,3,2-dioxaphospholan (**57**).

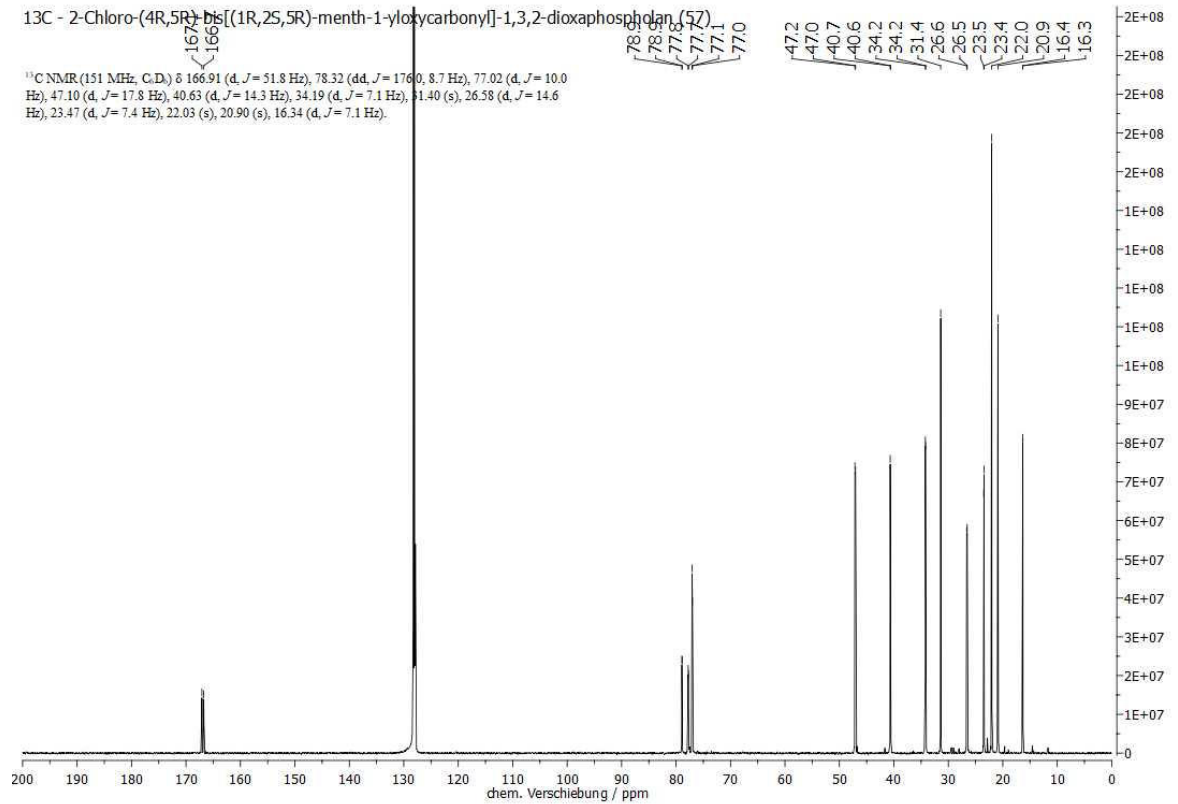


Abb. 8.134: <sup>13</sup>C-NMR-Spektrum (151 MHz, C<sub>6</sub>D<sub>6</sub>, 298 K) von 2-Chloro-(4*R*,5*R*)-bis[(1*R*,2*S*,5*R*)-menth-1-yloxy-carbonyl]-1,3,2-dioxaphospholan (**57**).

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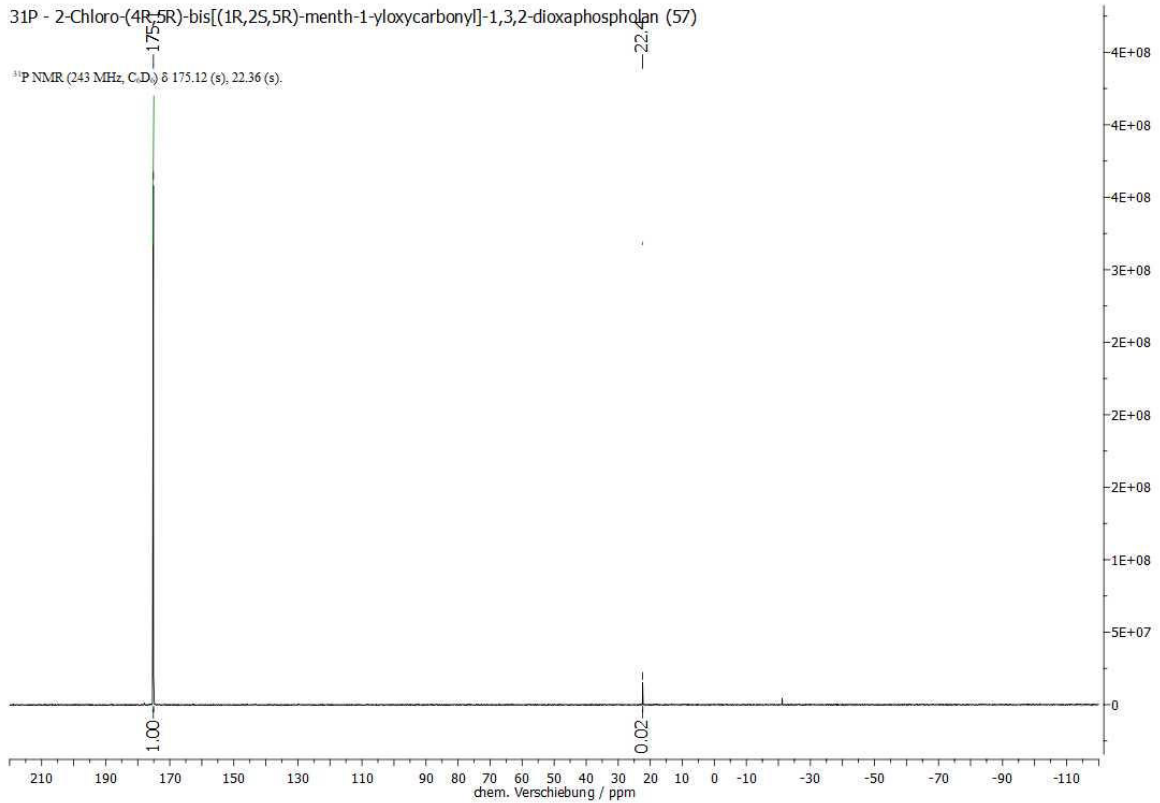


Abb. 8.135: <sup>31</sup>P-NMR-Spektrum (243 MHz, C<sub>6</sub>D<sub>6</sub>, 298 K) von 2-Chloro-(4*R*,5*R*)-bis[(1*R*,2*S*,5*R*)-menth-1-yloxy-carbonyl]-1,3,2-dioxaphospholan (**57**).

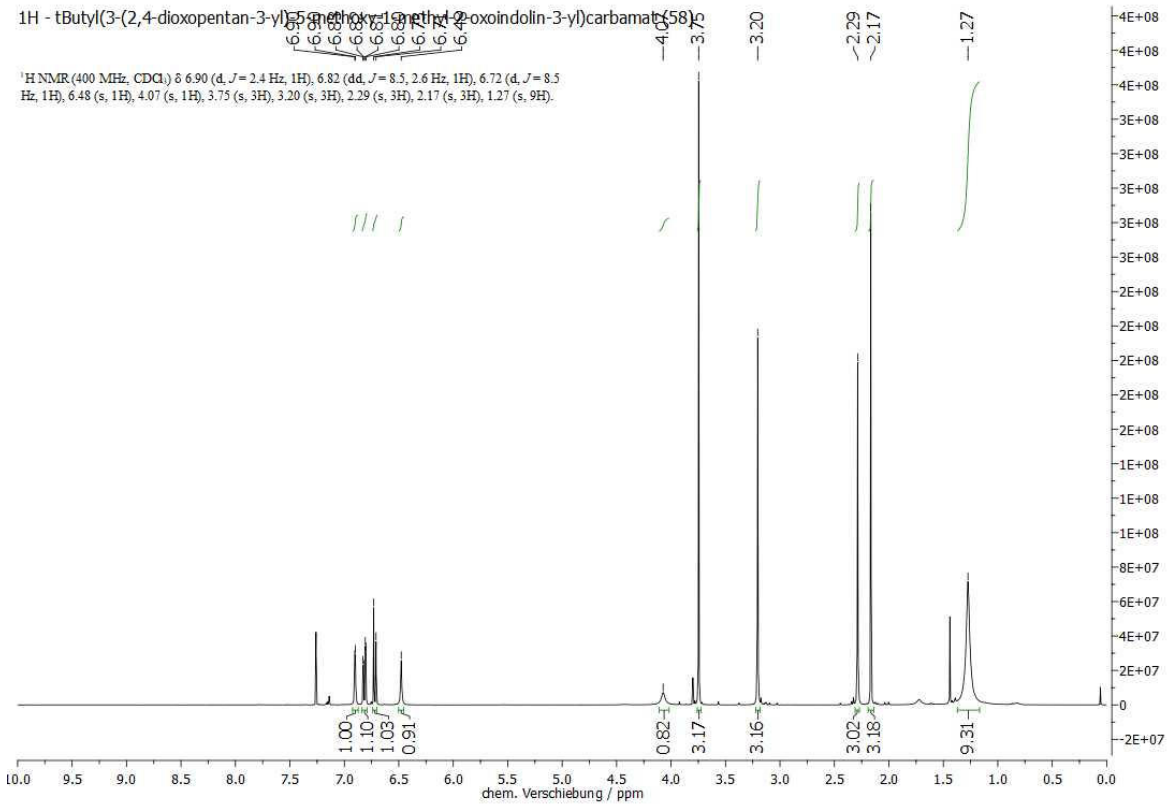


Abb. 8.136: <sup>1</sup>H-NMR-Spektrum (400 MHz, CDCl<sub>3</sub>, 298 K) von (*S*)-tButyl(3-(2,4-dioxopentan-3-yl)-5-methoxy-1-methyl-2-oxoindolin-3-yl)carbamate (**58**).

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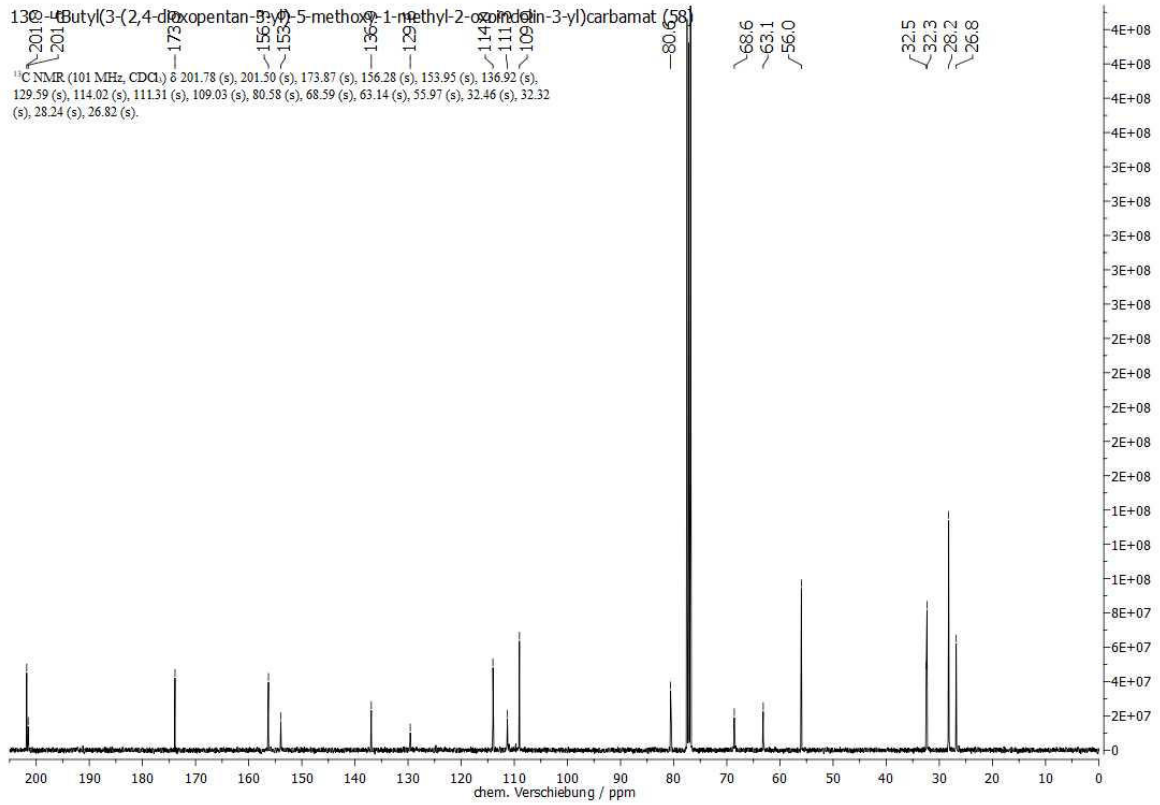


Abb. 8.137: <sup>13</sup>C-NMR-Spektrum (101 MHz, CDCl<sub>3</sub>, 298 K) von (*S*)-Butyl(3-(2,4-dioxopentan-3-yl)-5-methoxy-1-methyl-2-oxoindolin-3-yl)carbamate (**58**).

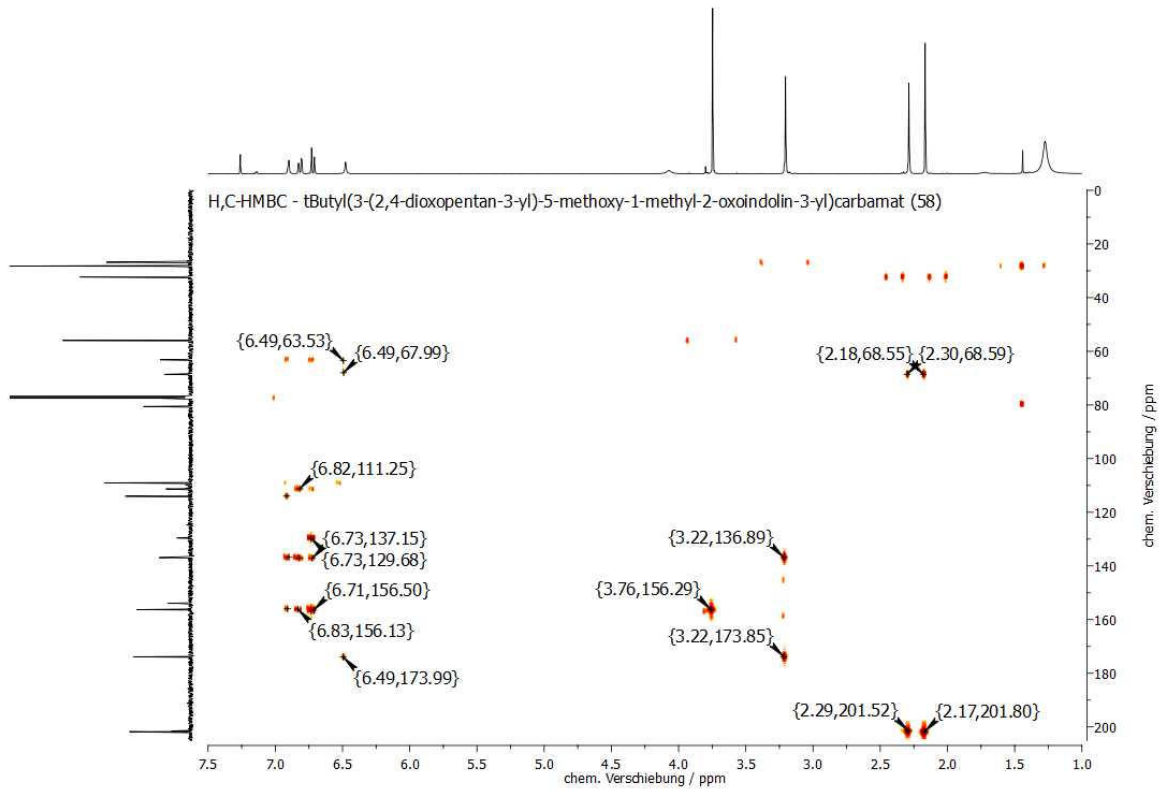


Abb. 8.138: H,C-HMBC-NMR-Spektrum (CDCl<sub>3</sub>, 298 K) von (*S*)-Butyl(3-(2,4-dioxopentan-3-yl)-5-methoxy-1-methyl-2-oxoindolin-3-yl)carbamate (**58**).

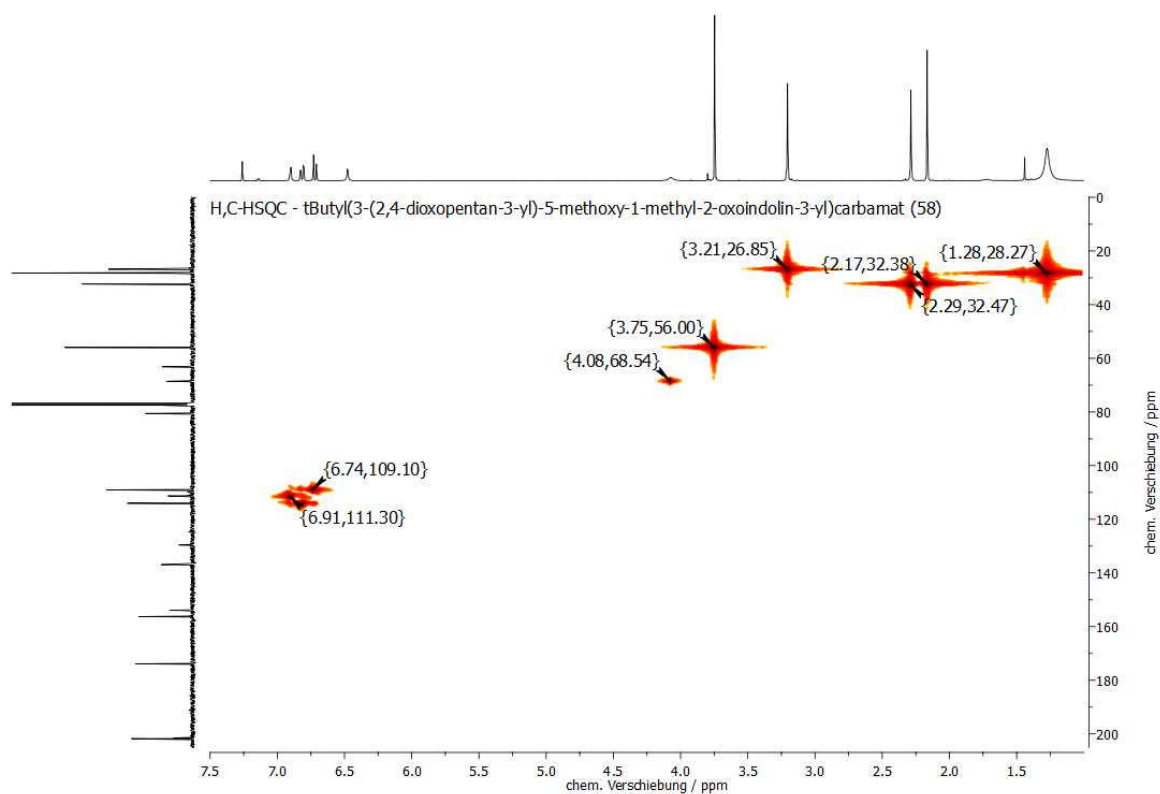


Abb. 8.139: H,C-HSQC-NMR-Spektrum ( $\text{CDCl}_3$ , 298 K) von (*S*)-tButyl(3-(2,4-dioxopentan-3-yl)-5-methoxy-1-methyl-2-oxoindolin-3-yl)carbamate (**58**).

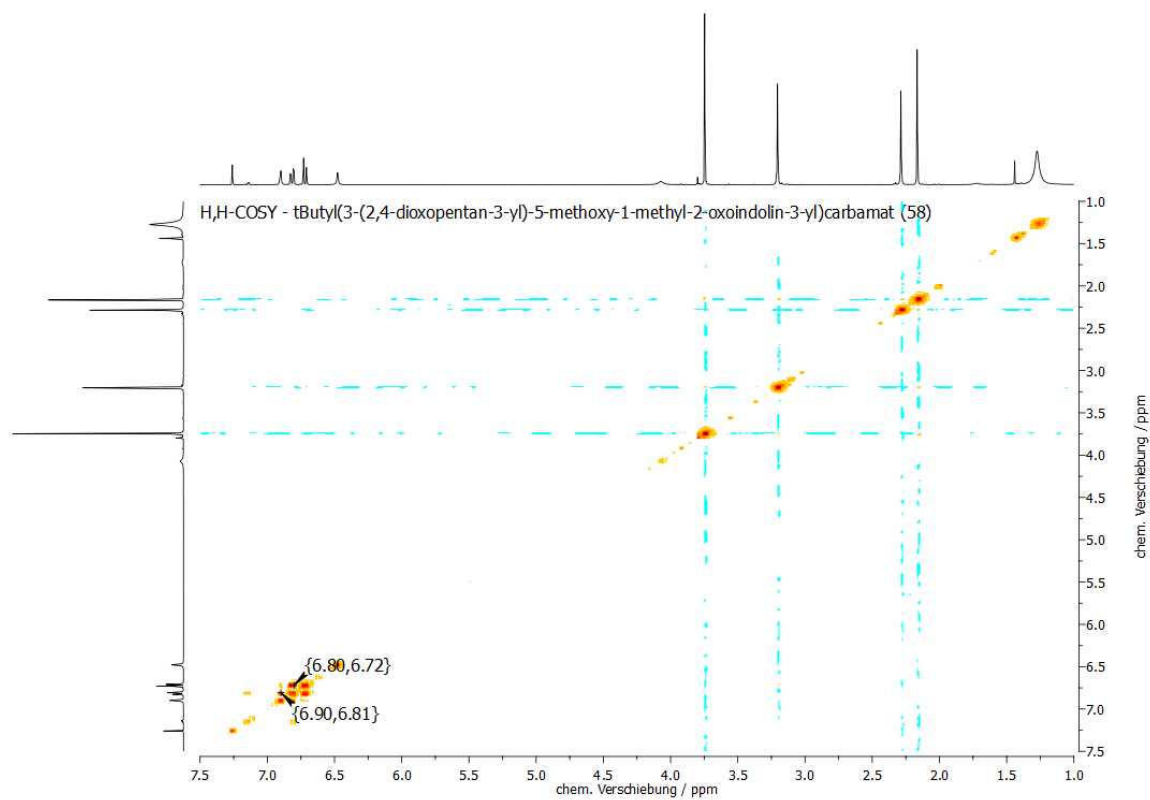


Abb. 8.140: H,H-COSY-NMR-Spektrum ( $\text{CDCl}_3$ , 298 K) von (*S*)-tButyl(3-(2,4-dioxopentan-3-yl)-5-methoxy-1-methyl-2-oxoindolin-3-yl)carbamate (**58**).

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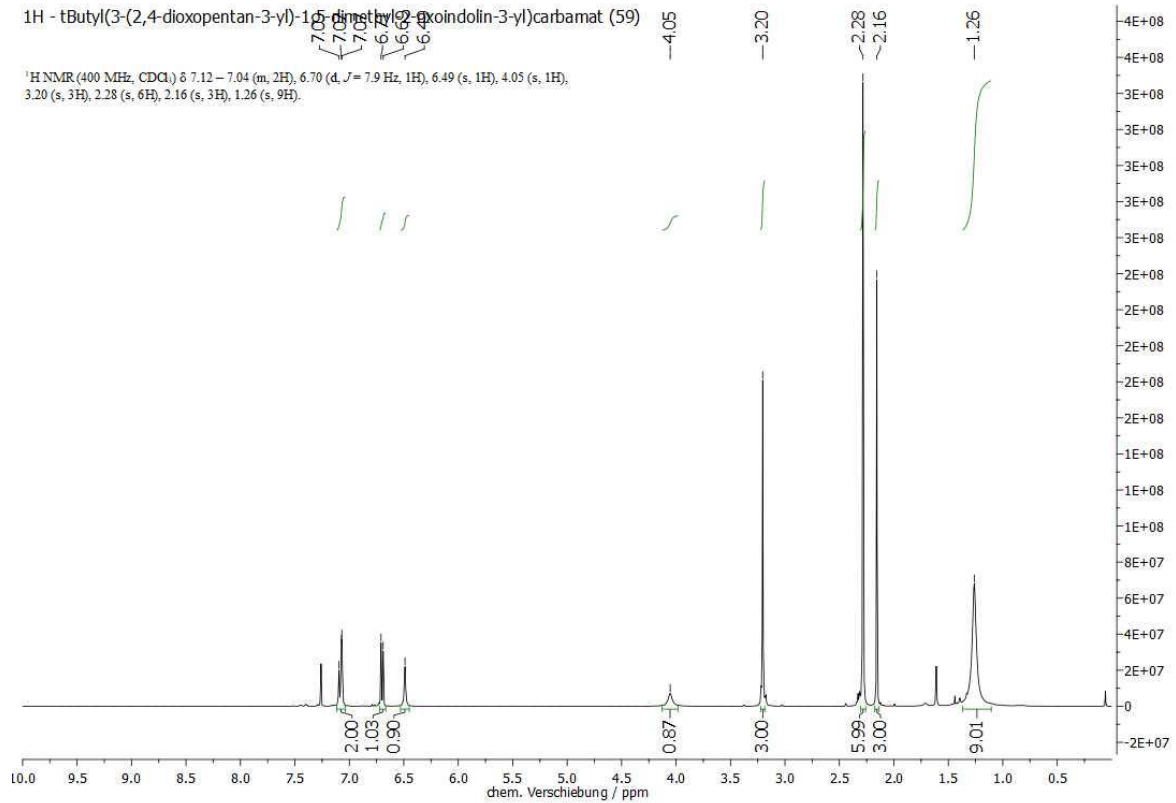


Abb. 8.141: <sup>1</sup>H-NMR-Spektrum (400 MHz, CDCl<sub>3</sub>, 298 K) von (*S*)-tButyl(3-(2,4-dioxopentan-3-yl)-1,5-dimethyl-2-oxoindolin-3-yl)carbamate (**59**).

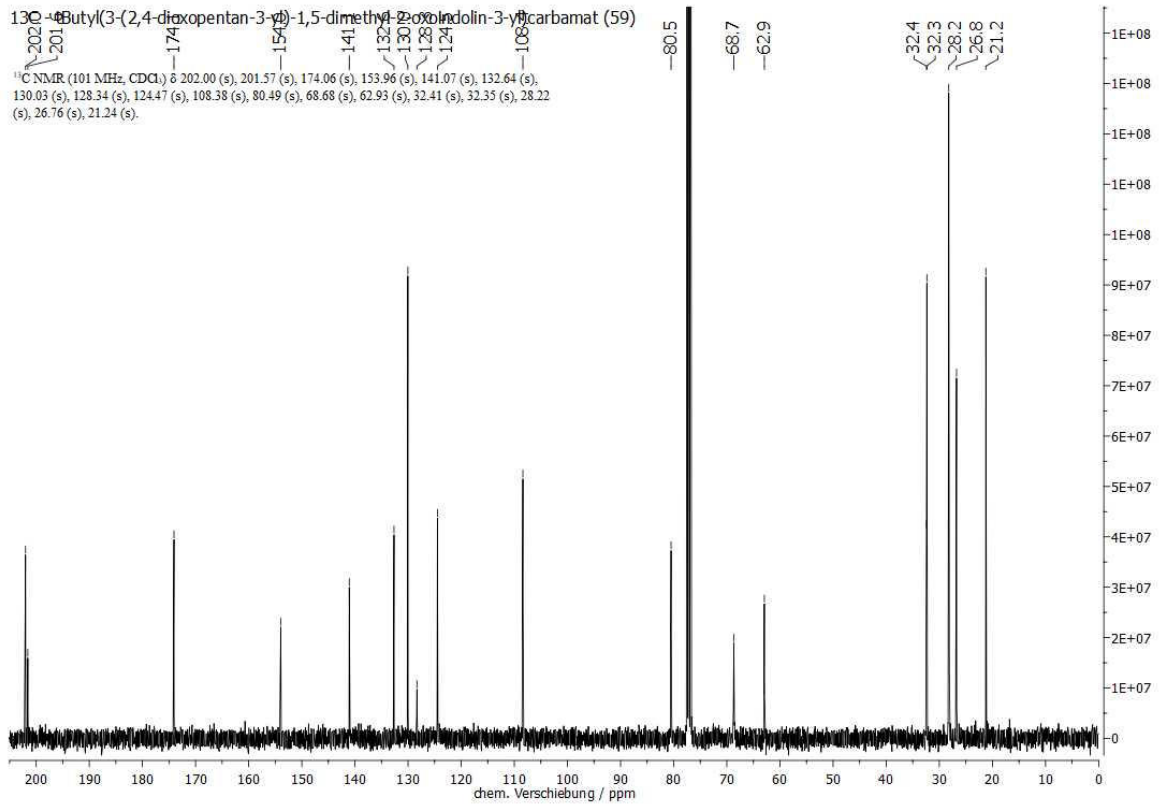


Abb. 8.142: <sup>13</sup>C-NMR-Spektrum (101 MHz, CDCl<sub>3</sub>, 298 K) von (*S*)-tButyl(3-(2,4-dioxopentan-3-yl)-1,5-dimethyl-2-oxoindolin-3-yl)carbamate (**59**).

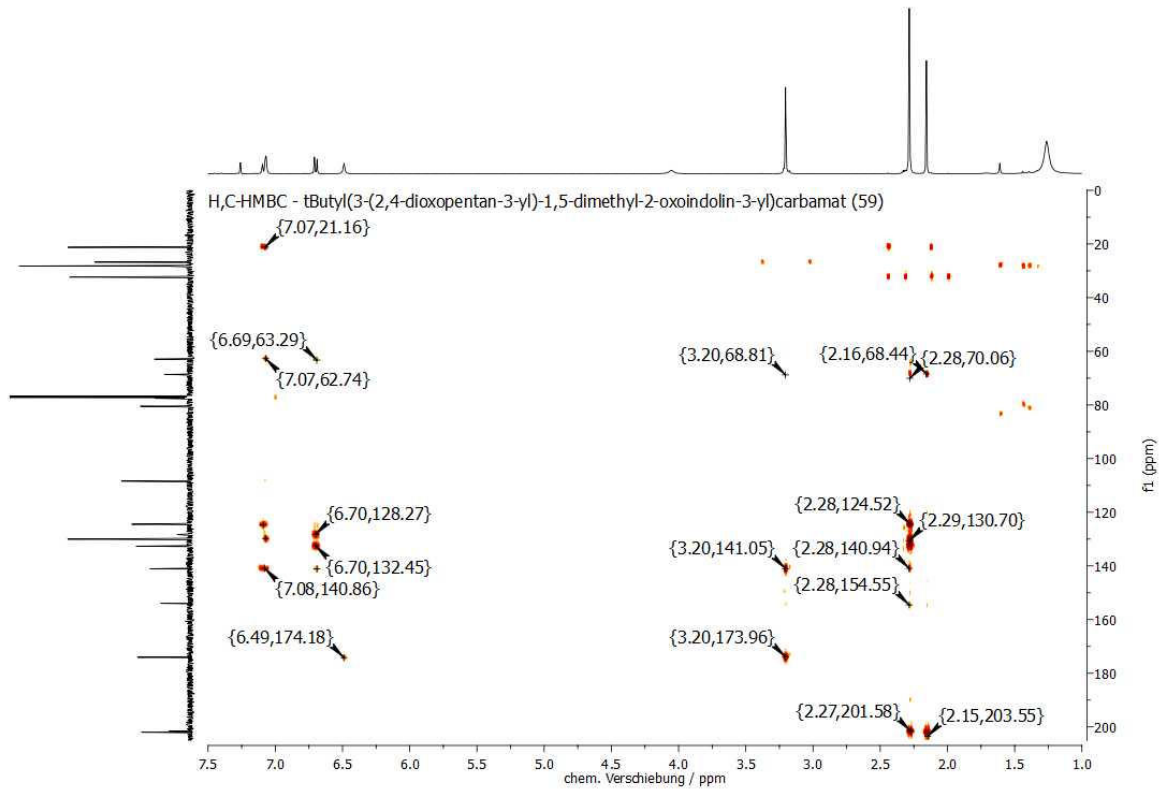


Abb. 8.143: H,C-HMBC-NMR-Spektrum ( $\text{CDCl}_3$ , 298 K) von (*S*)-*t*-Butyl(3-(2,4-dioxopentan-3-yl)-1,5-dimethyl-2-oxoindolin-3-yl)carbamate (**59**).

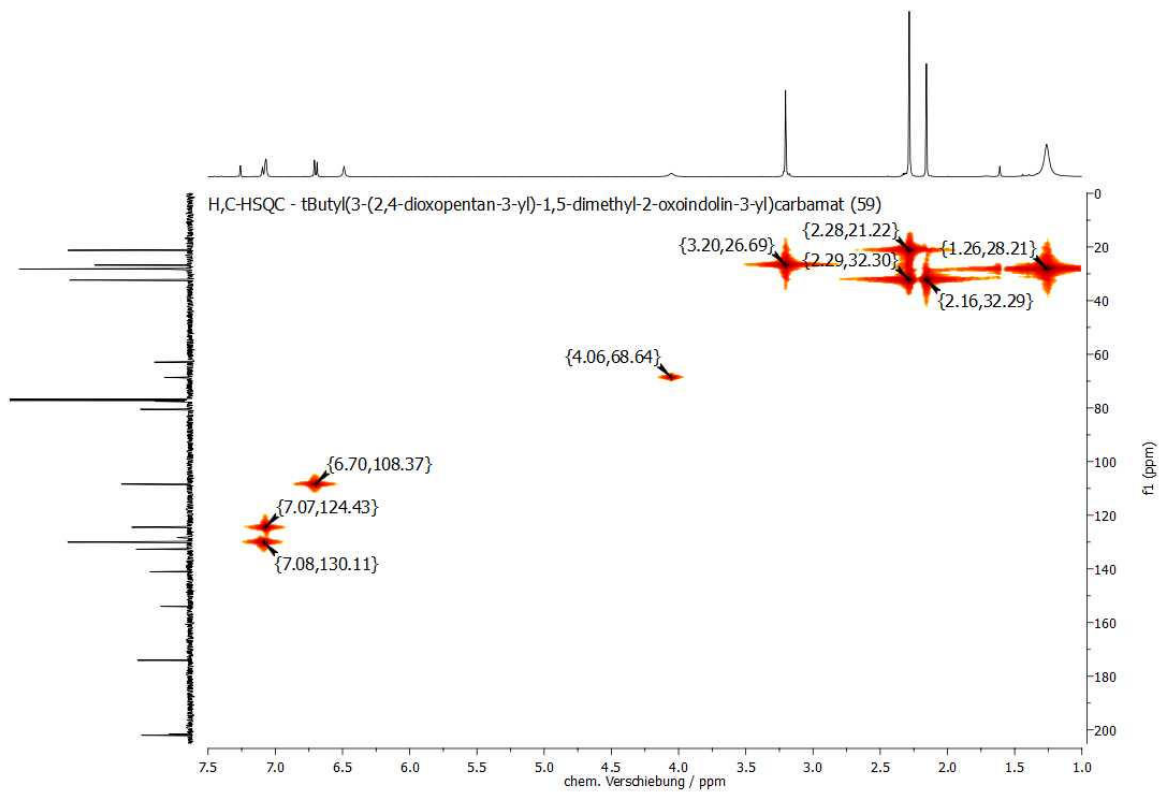


Abb. 8.144: H,C-HSQC-NMR-Spektrum ( $\text{CDCl}_3$ , 298 K) von (*S*)-*t*-Butyl(3-(2,4-dioxopentan-3-yl)-1,5-dimethyl-2-oxoindolin-3-yl)carbamate (**59**).



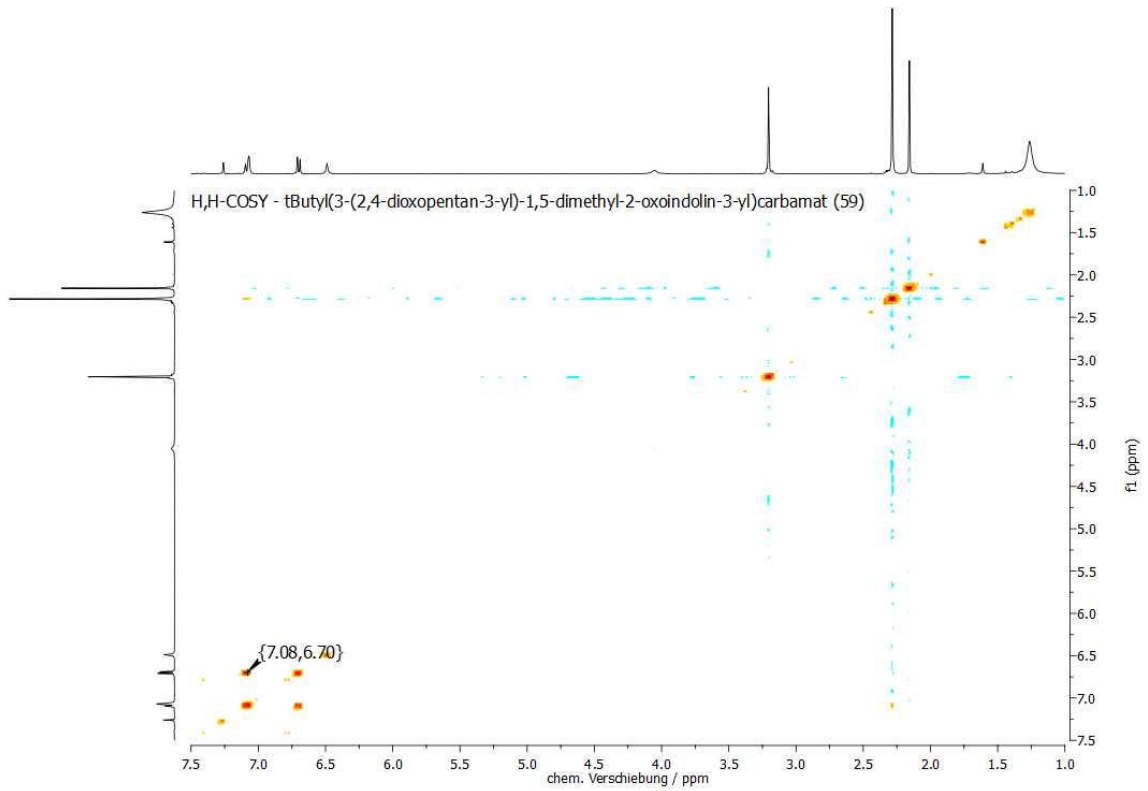


Abb. 8.145: H,H-COSY-NMR-Spektrum ( $\text{CDCl}_3$ , 298 K) von (*S*)-Butyl(3-(2,4-dioxopentan-3-yl)-1,5-dimethyl-2-oxoindolin-3-yl)carbamat (**59**).

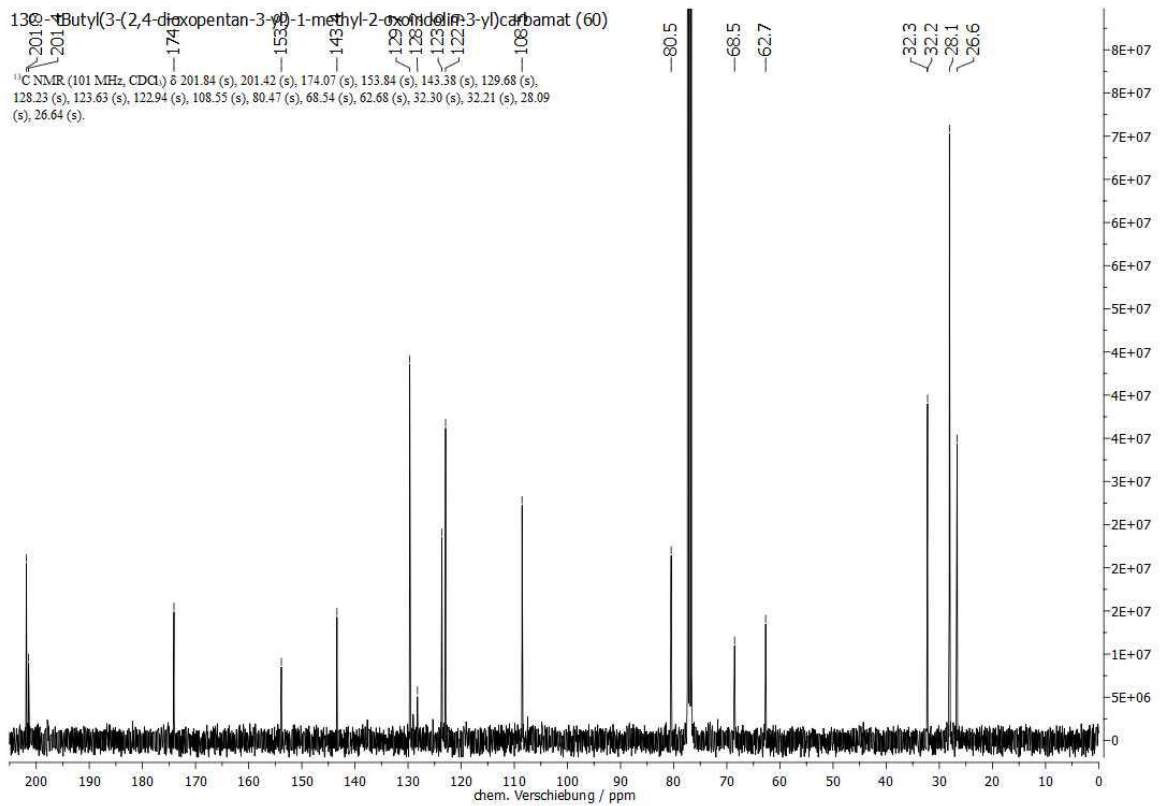


Abb. 8.146:  $^{13}\text{C}$ -NMR-Spektrum (101 MHz,  $\text{CDCl}_3$ , 298 K) von (*S*)-Butyl(3-(2,4-dioxopentan-3-yl)-1-methyl-2-oxoindolin-3-yl)carbamate (**60**).

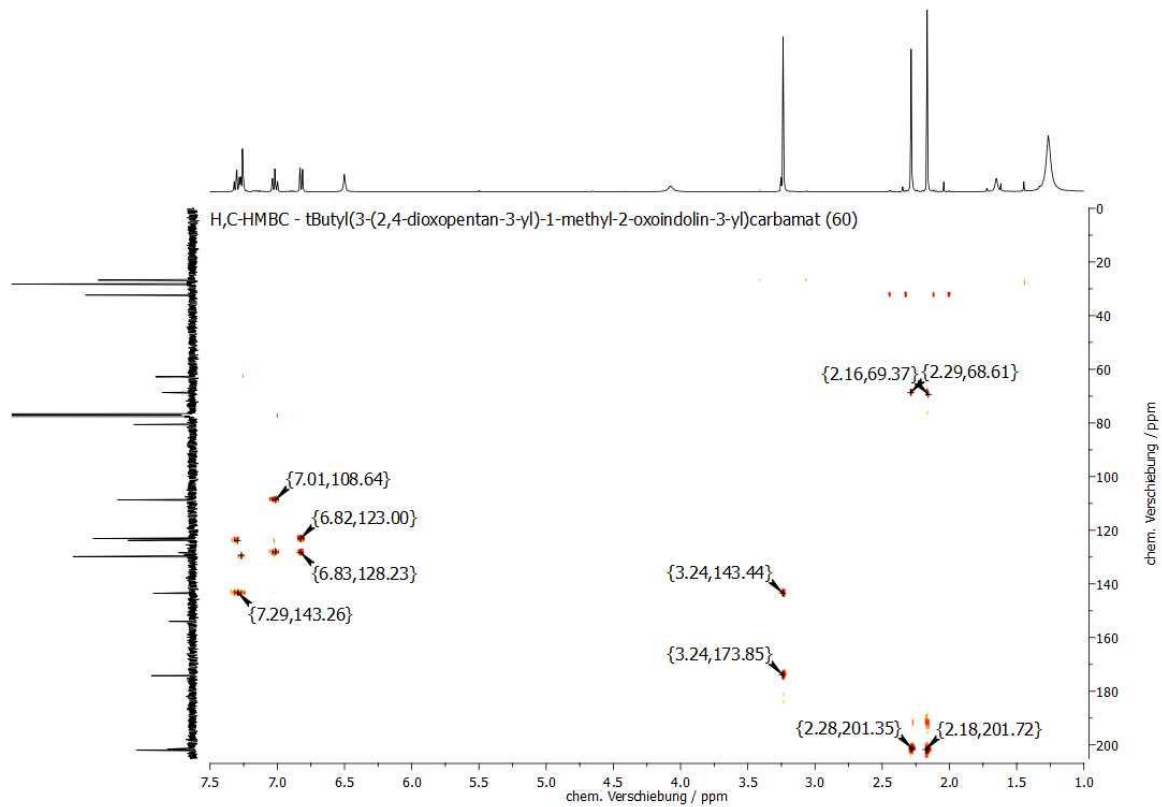


Abb. 8.147: H,C-HMBC-NMR-Spektrum (CDCl<sub>3</sub>, 298 K) von (*S*)-tButyl(3-(2,4-dioxopentan-3-yl)-1-methyl-2-oxoindolin-3-yl)carbamate (**60**).

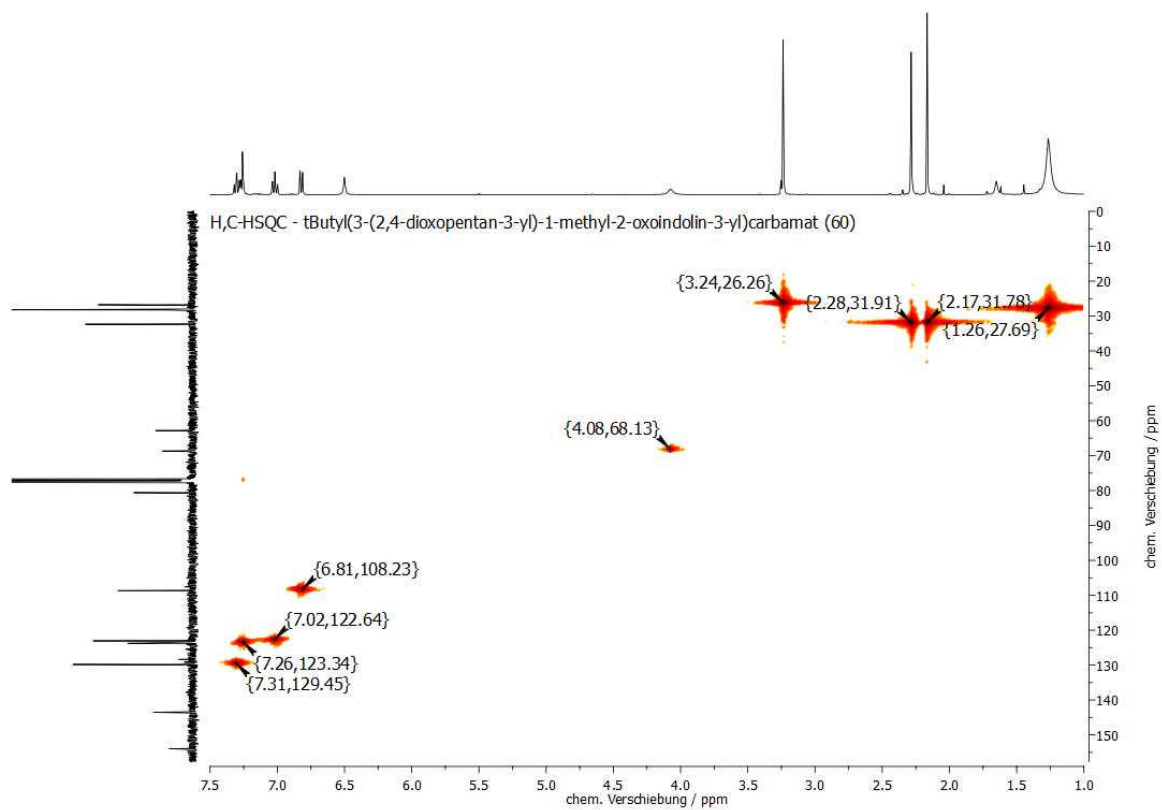


Abb. 8.148: H,C-HSQC-NMR-Spektrum (CDCl<sub>3</sub>, 298 K) von (*S*)-tButyl(3-(2,4-dioxopentan-3-yl)-1-methyl-2-oxoindolin-3-yl)carbamate (**60**).

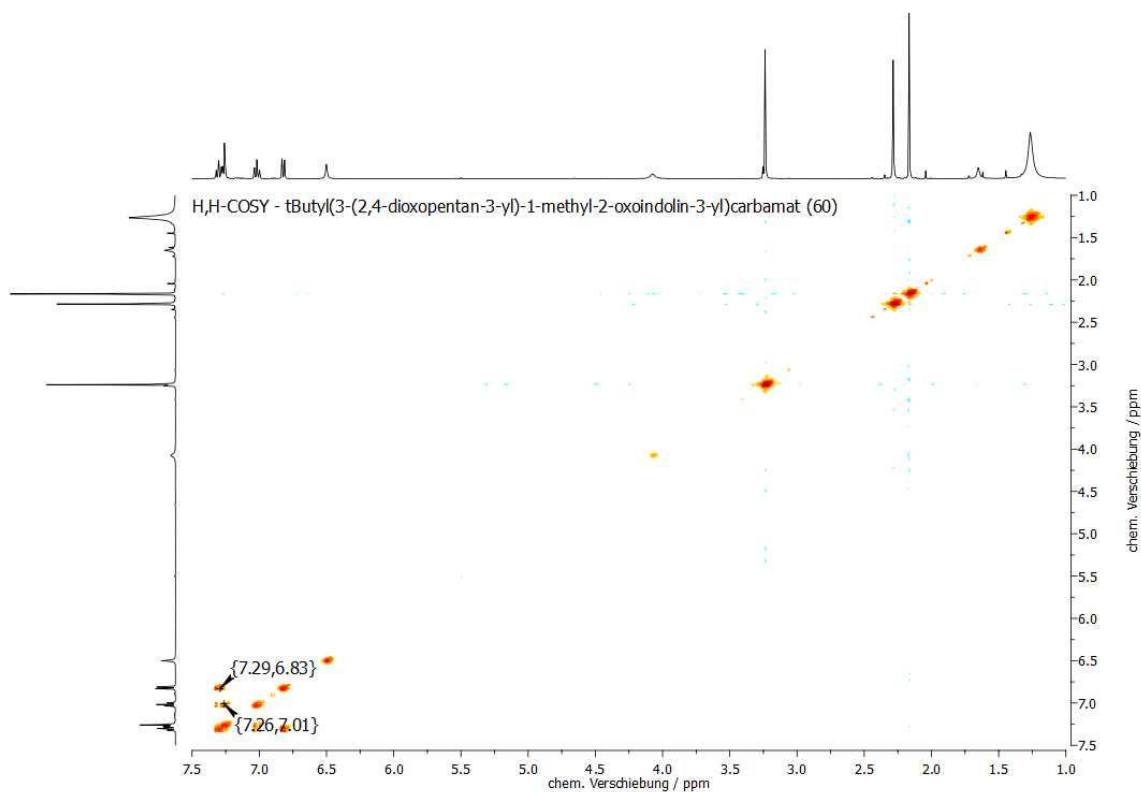


Abb. 8.149: H,H-COSY-NMR-Spektrum (CDCl<sub>3</sub>, 298 K) von (*S*)-*t*-Butyl(3-(2,4-dioxopentan-3-yl)-1-methyl-2-oxoindolin-3-yl)carbamat (**60**).

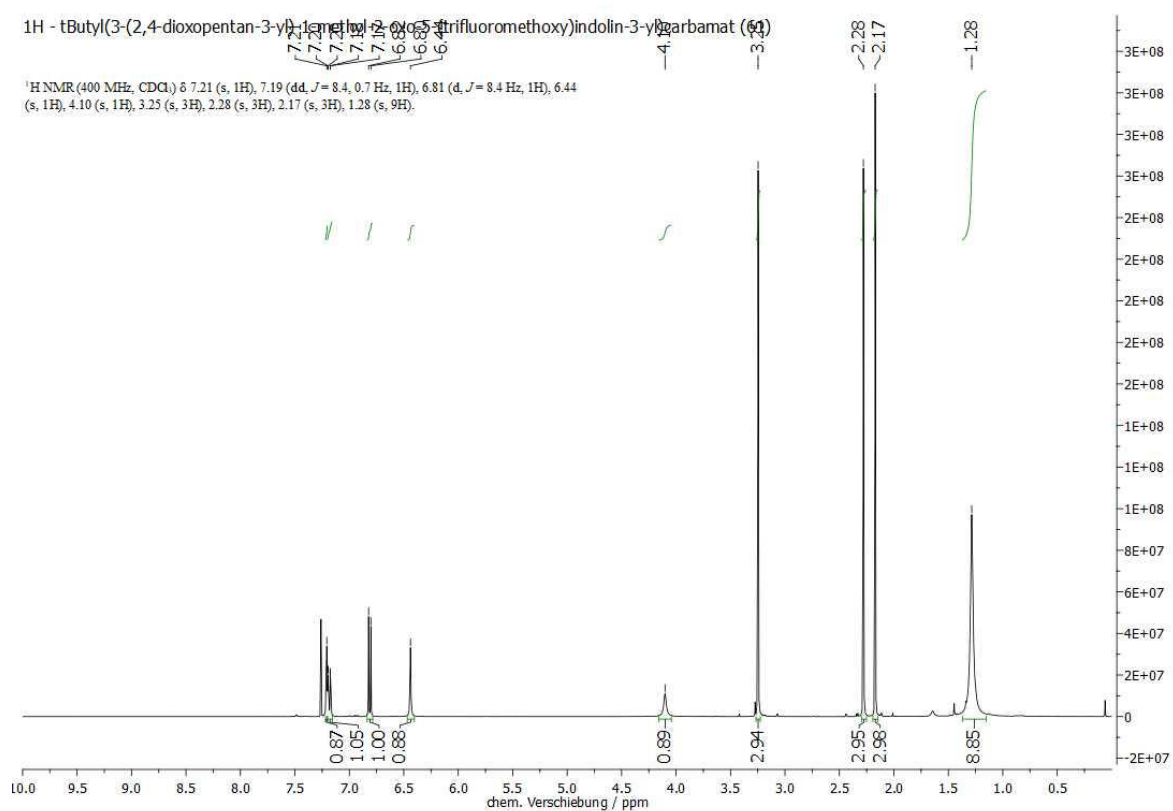


Abb. 8.150: <sup>1</sup>H-NMR-Spektrum (400 MHz, CDCl<sub>3</sub>, 298 K) von (*S*)-*t*-Butyl(3-(2,4-dioxopentan-3-yl)-1-methyl-2-oxo-5-(trifluoromethoxy)indolin-3-yl)carbamat (**61**).

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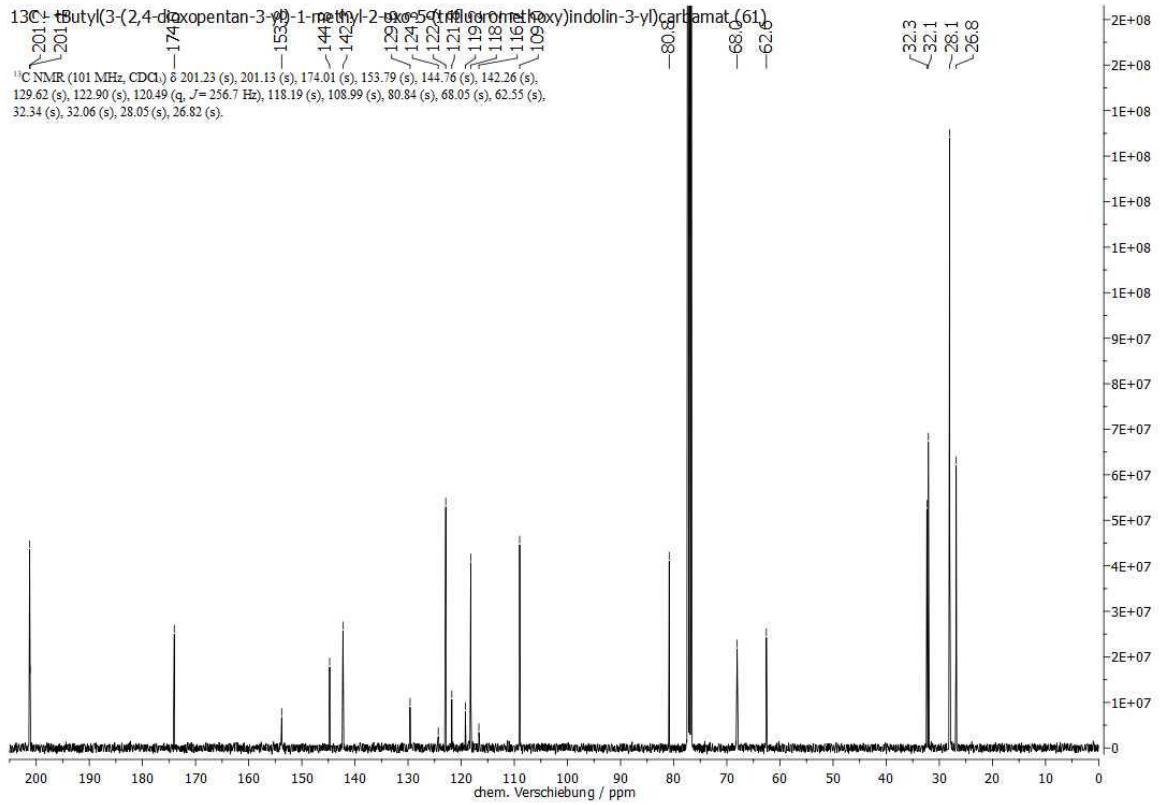


Abb. 8.151: <sup>13</sup>C-NMR-Spektrum (101 MHz, CDCl<sub>3</sub>, 298 K) von (*S*)-'Butyl(3-(2,4-dioxopentan-3-yl)-1-methyl-2-oxo-5-(trifluoromethoxy)indolin-3-yl)carbammat (**61**).

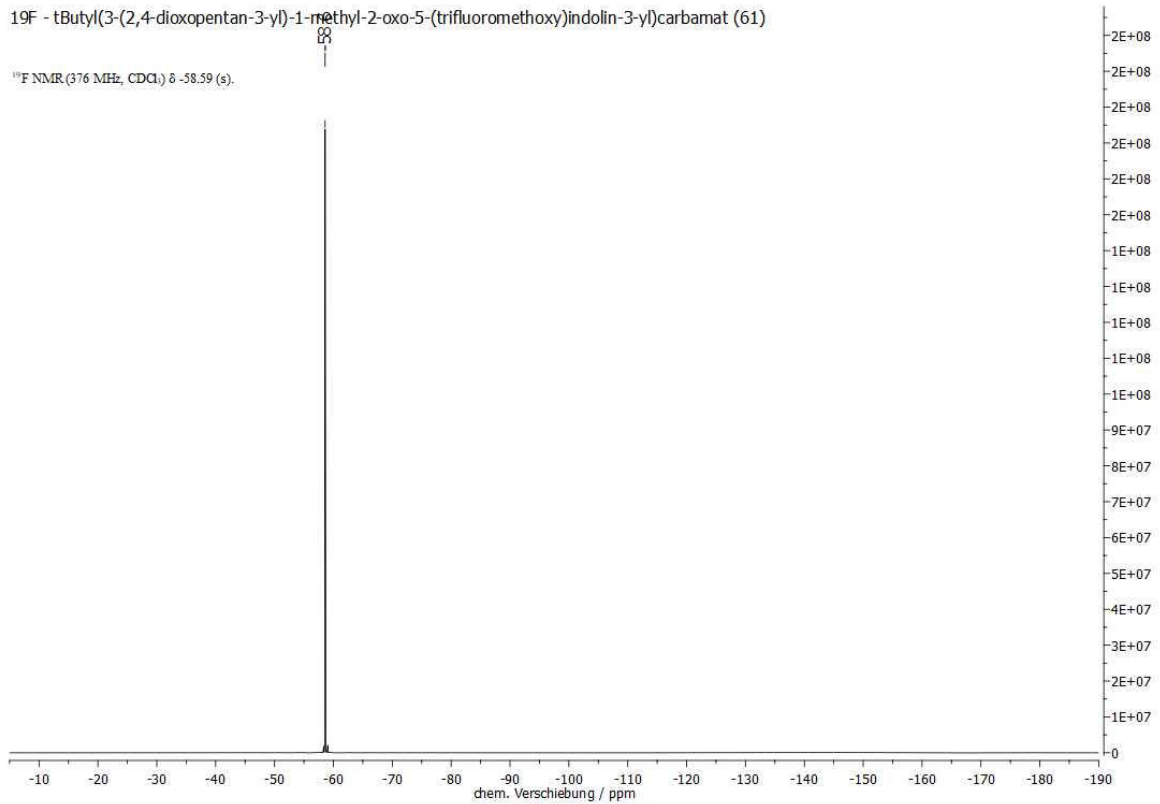


Abb. 8.152: <sup>19</sup>F-NMR-Spektrum (376 MHz, CDCl<sub>3</sub>, 298 K) von (*S*)-'Butyl(3-(2,4-dioxopentan-3-yl)-1-methyl-2-oxo-5-(trifluoromethoxy)indolin-3-yl)carbammat (**61**).

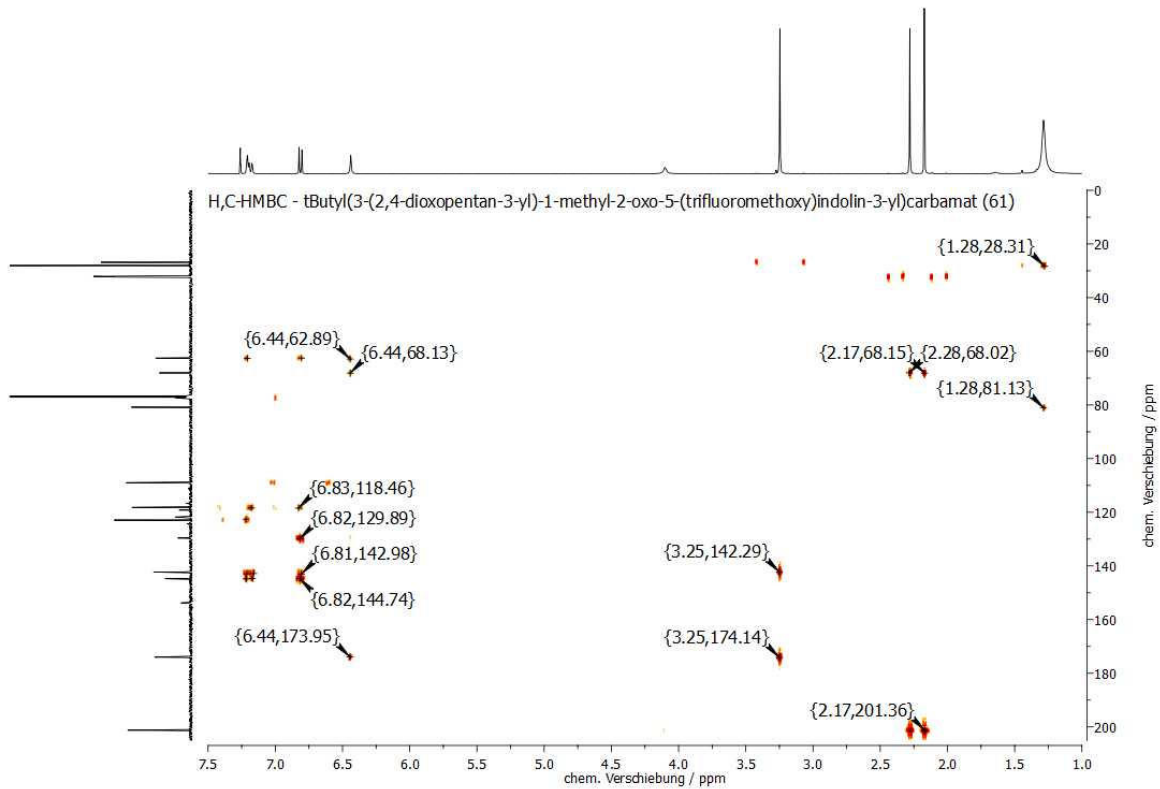


Abb. 8.153: H,C-HMBC-NMR-Spektrum (CDCl<sub>3</sub>, 298 K) von (*S*)-tButyl(3-(2,4-dioxopentan-3-yl)-1-methyl-2-oxo-5-(trifluoromethoxy)indolin-3-yl)carbamate (**61**).

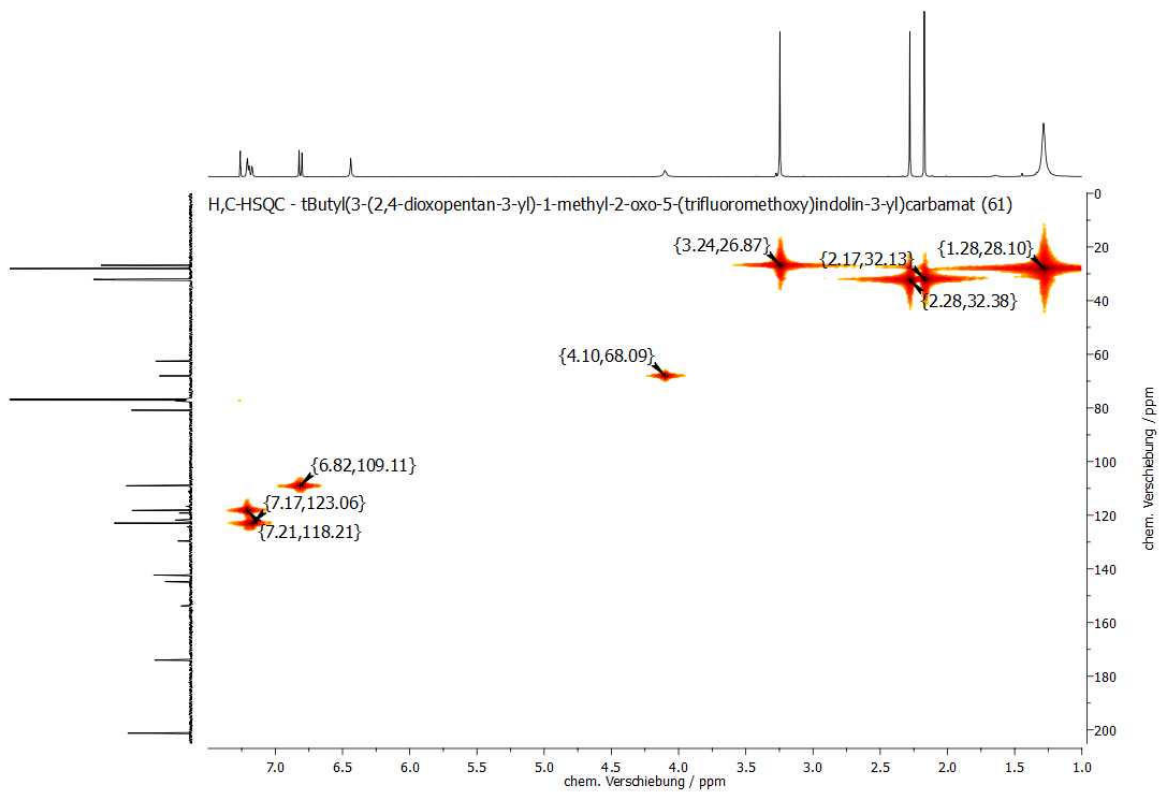


Abb. 8.154: H,C-HSQC-NMR-Spektrum (CDCl<sub>3</sub>, 298 K) von (*S*)-tButyl(3-(2,4-dioxopentan-3-yl)-1-methyl-2-oxo-5-(trifluoromethoxy)indolin-3-yl)carbamate (**61**).

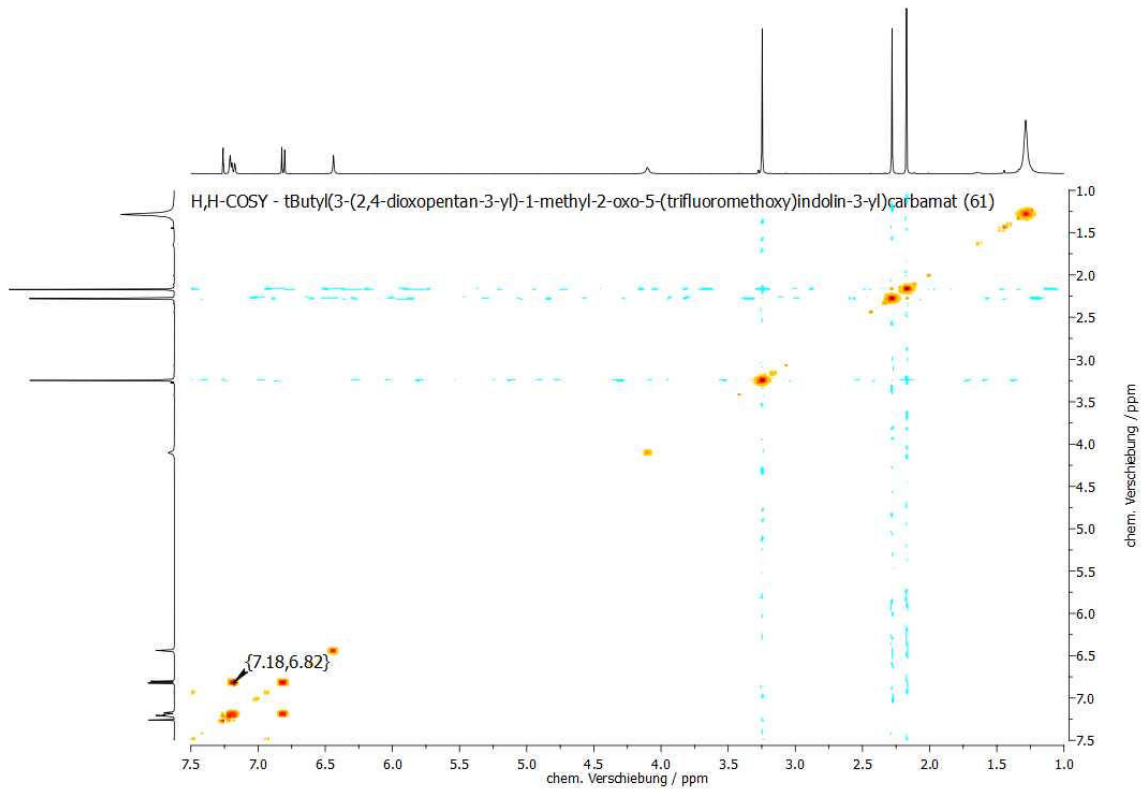


Abb. 8.155: H,H-COSY-NMR-Spektrum (CDCl<sub>3</sub>, 298 K) von (*S*)-Butyl(3-(2,4-dioxopentan-3-yl)-1-methyl-2-oxo-5-(trifluoromethoxy)indolin-3-yl)carbammat (**61**).

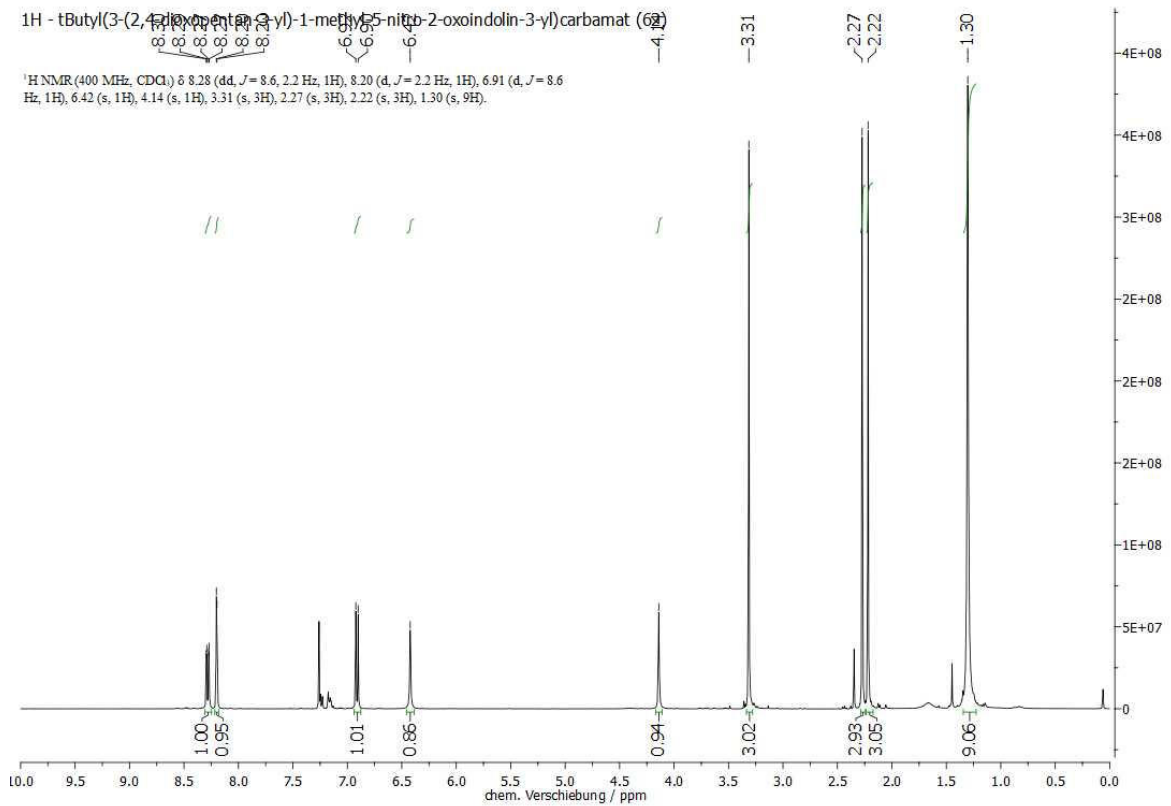


Abb. 8.156: <sup>1</sup>H-NMR-Spektrum (400 MHz, CDCl<sub>3</sub>, 298 K) von (*S*)-Butyl(3-(2,4-dioxopentan-3-yl)-1-methyl-5-nitro-2-oxoindolin-3-yl)carbammat (**62**).

ANHANG

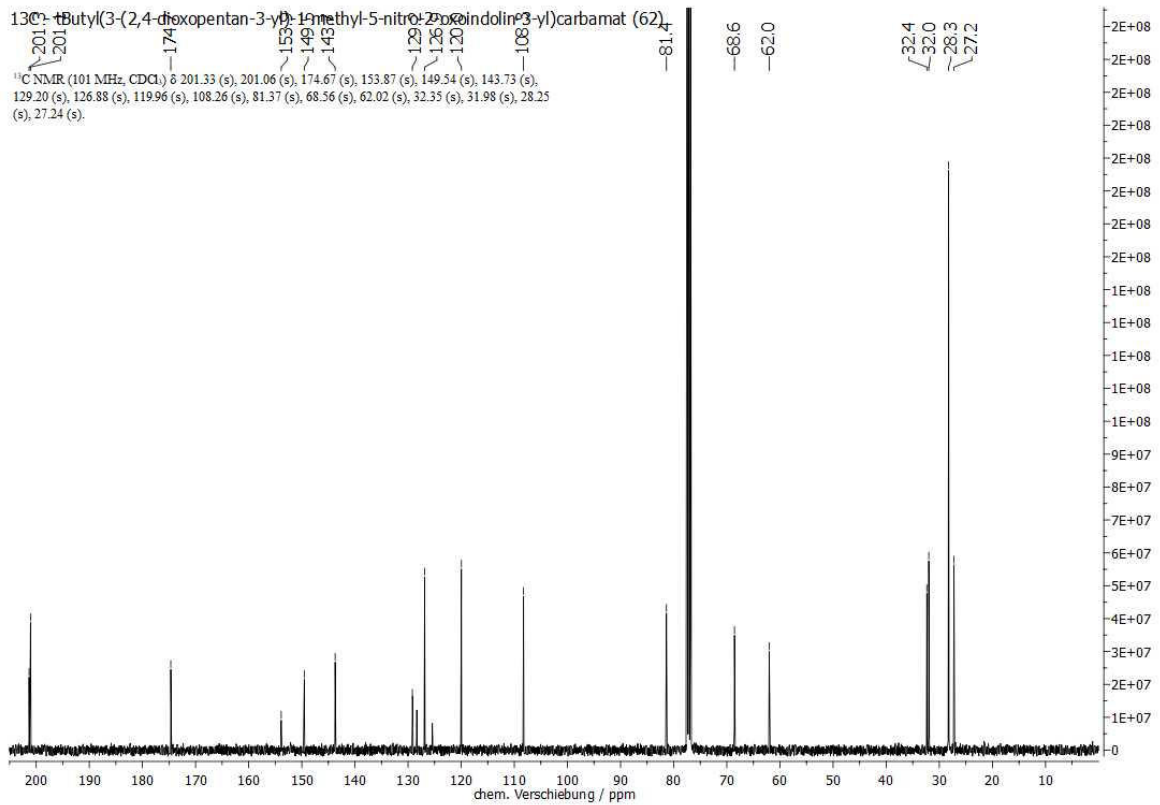


Abb. 8.157: <sup>13</sup>C-NMR-Spektrum (101 MHz, CDCl<sub>3</sub>, 298 K) von (*S*)-Butyl(3-(2,4-dioxopentan-3-yl)-1-methyl-5-nitro-2-oxoindolin-3-yl)carbamate (**62**).

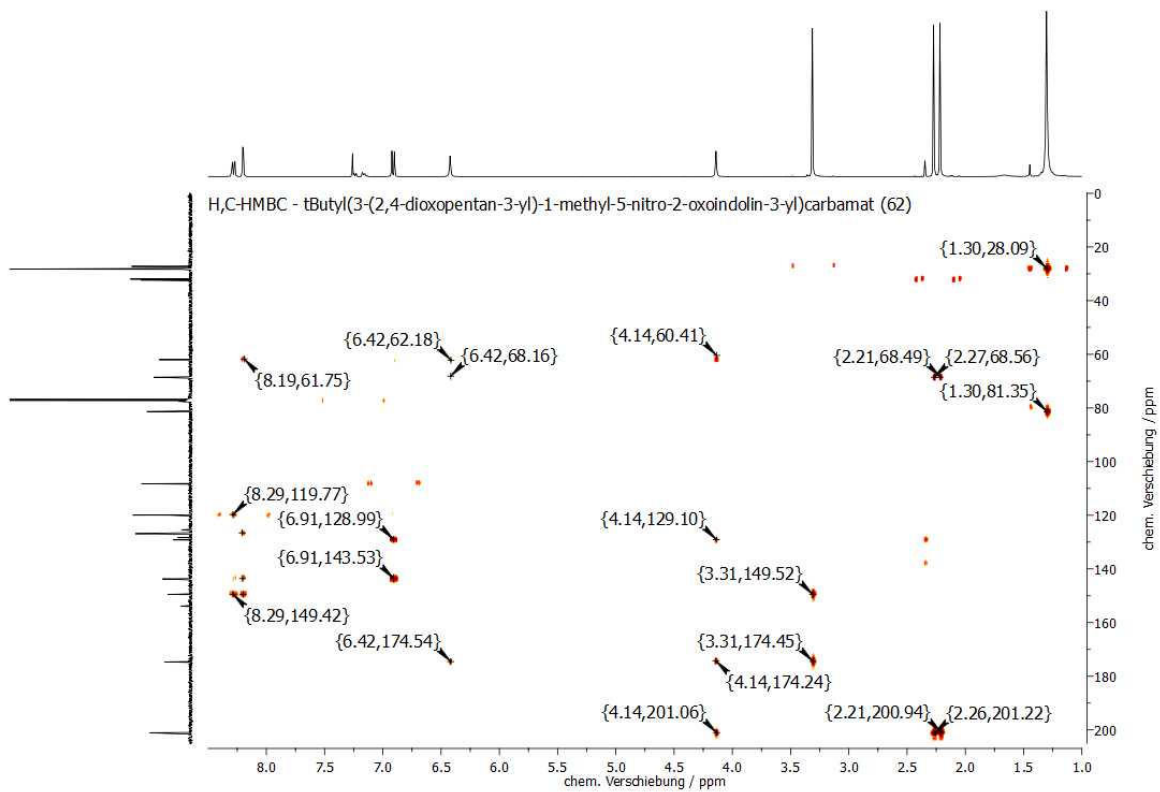


Abb. 8.158: H,C-HMBC-NMR-Spektrum (CDCl<sub>3</sub>, 298 K) von (*S*)-Butyl(3-(2,4-dioxopentan-3-yl)-1-methyl-5-nitro-2-oxoindolin-3-yl)carbamate (**62**).

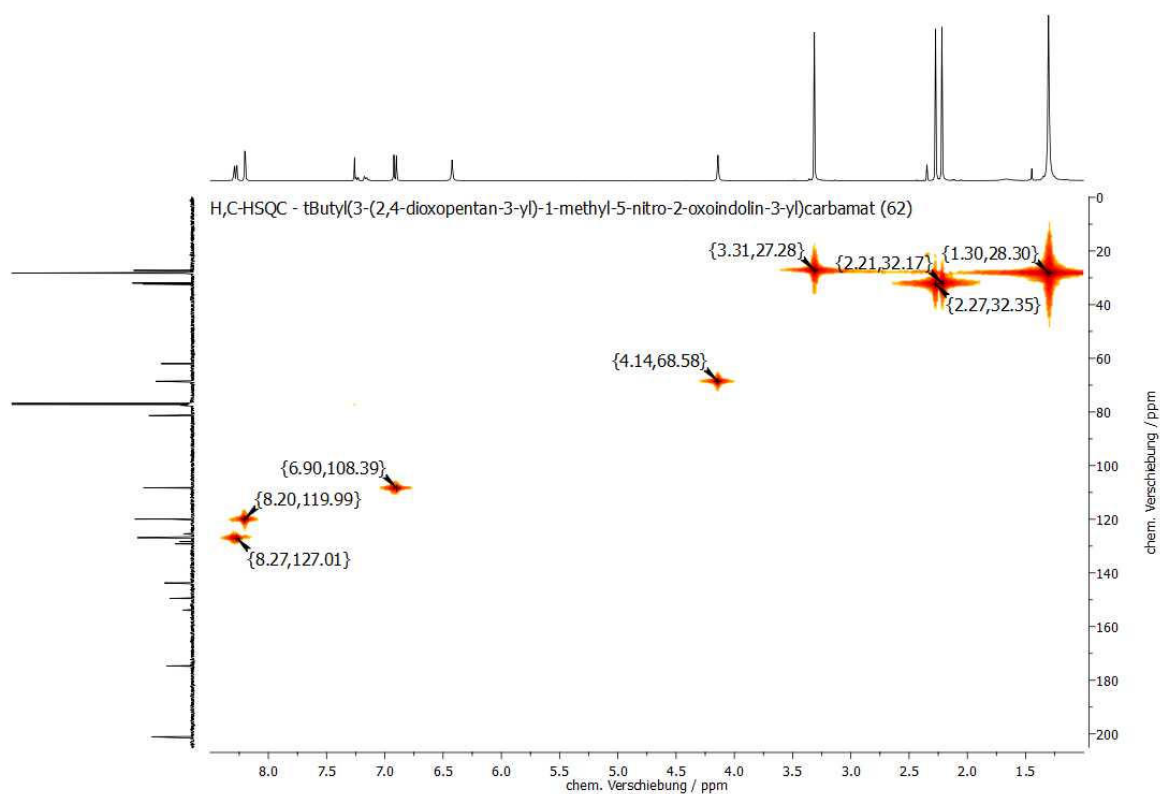


Abb. 8.159: H,C-HSQC-NMR-Spektrum (CDCl<sub>3</sub>, 298 K) von (*S*)-*t*-Butyl(3-(2,4-dioxopentan-3-yl)-1-methyl-5-nitro-2-oxoindolin-3-yl)carbammat (**62**).

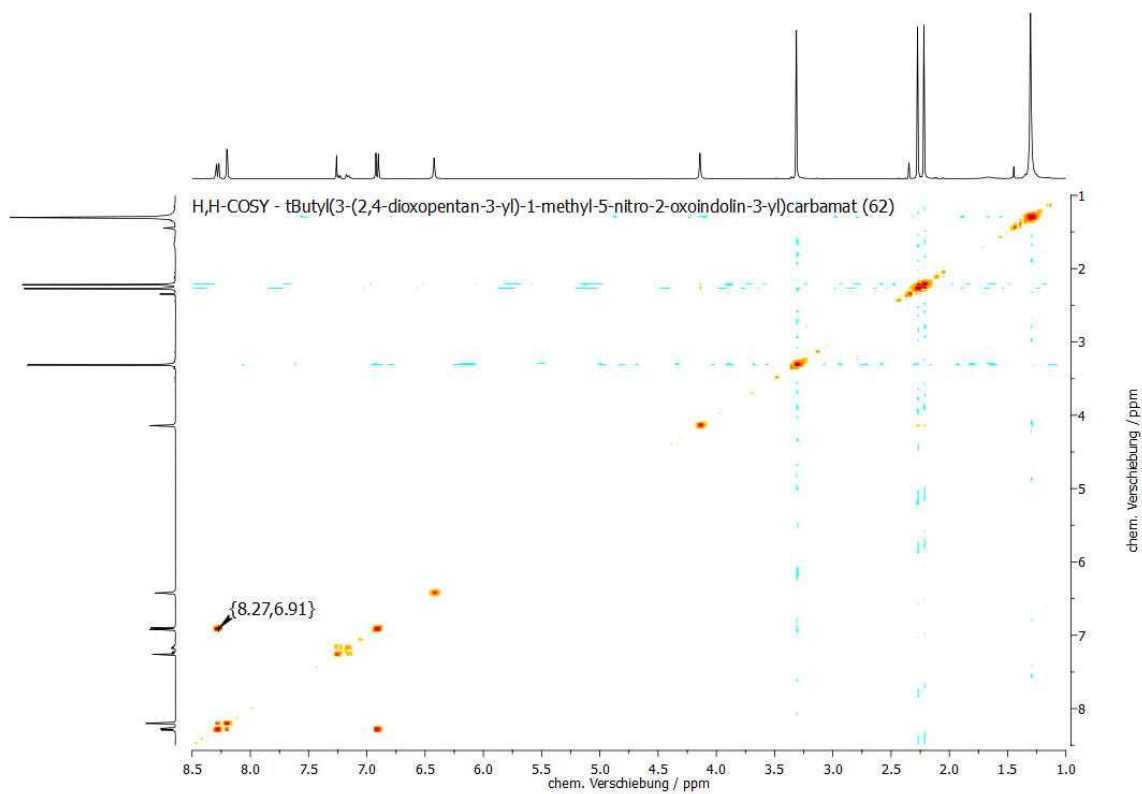


Abb. 8.160: H,H-COSY-NMR-Spektrum (CDCl<sub>3</sub>, 298 K) von (*S*)-*t*-Butyl(3-(2,4-dioxopentan-3-yl)-1-methyl-5-nitro-2-oxoindolin-3-yl)carbammat (**62**).



ANHANG

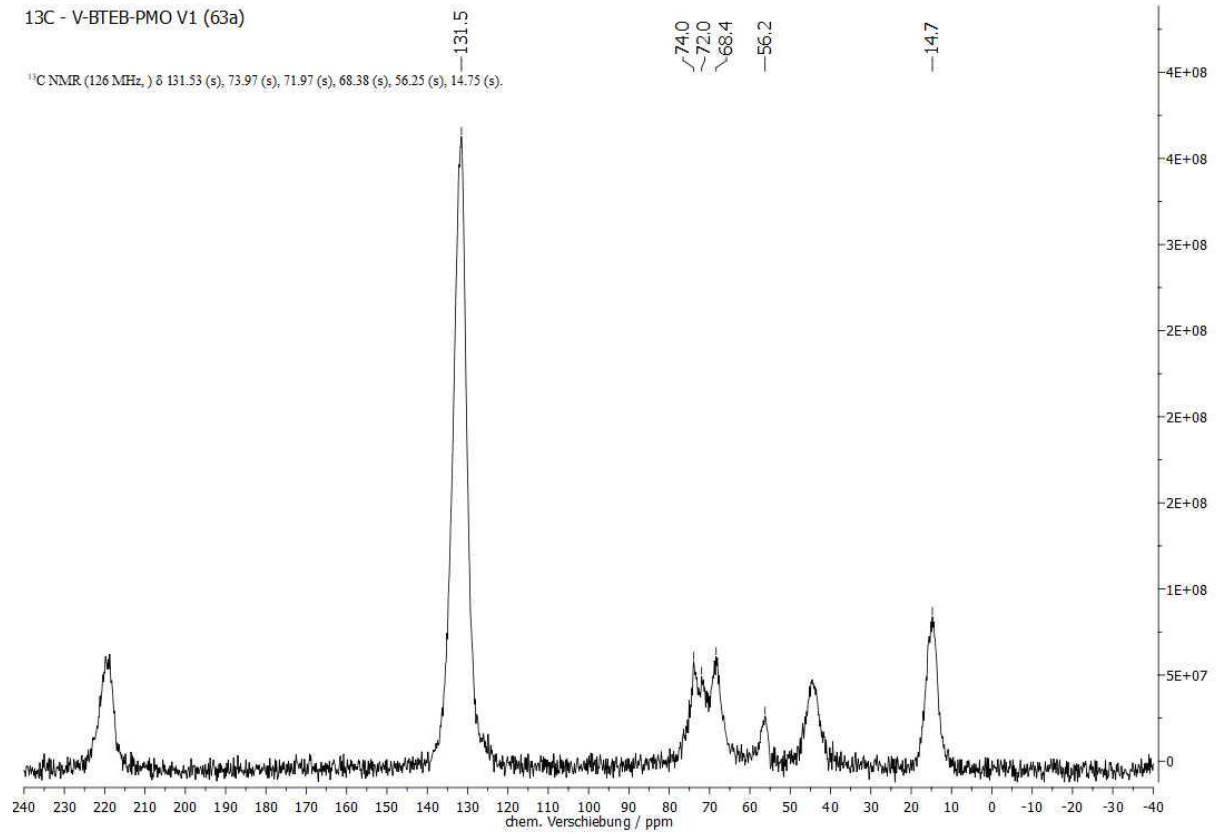


Abb. 8.161:  $^{13}\text{C}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von V-BTEB-PMO V1 (**63a**).

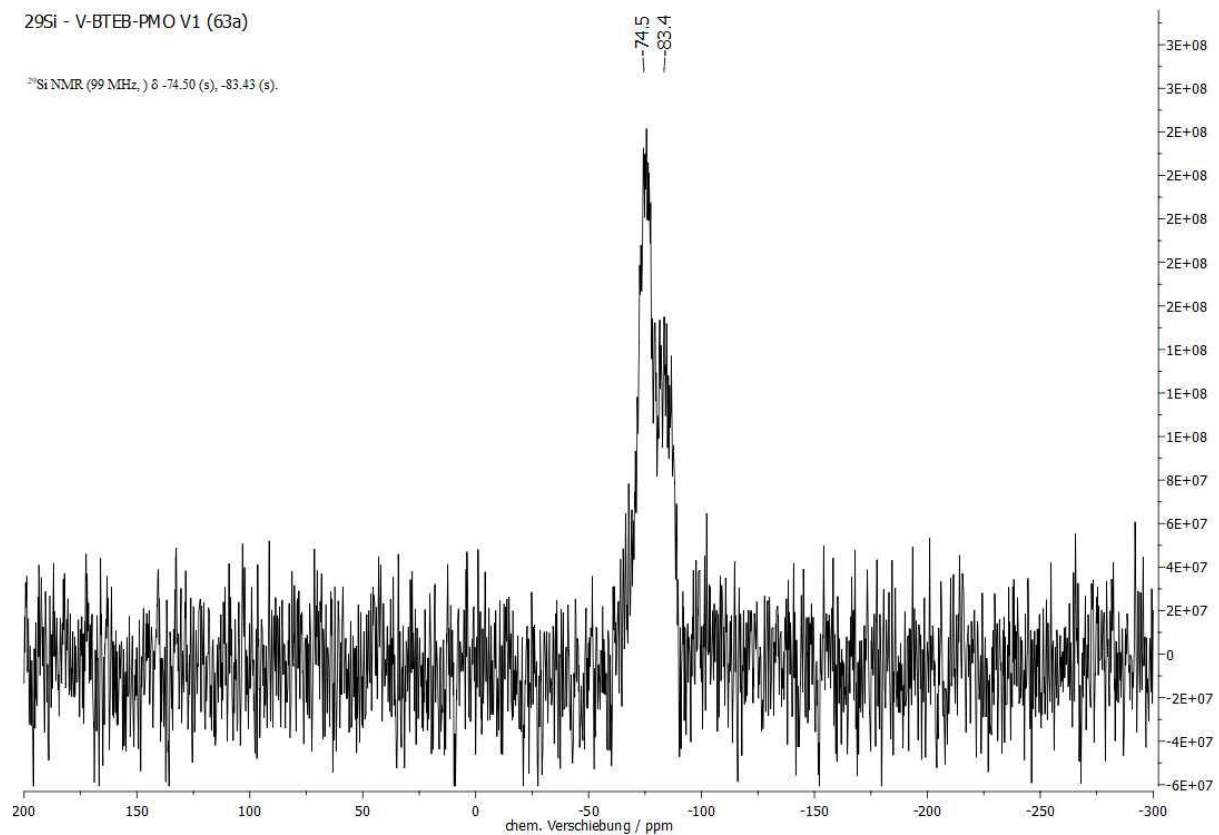


Abb. 8.162:  $^{29}\text{Si}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von V-BTEB-PMO V1 (**63a**).

ANHANG

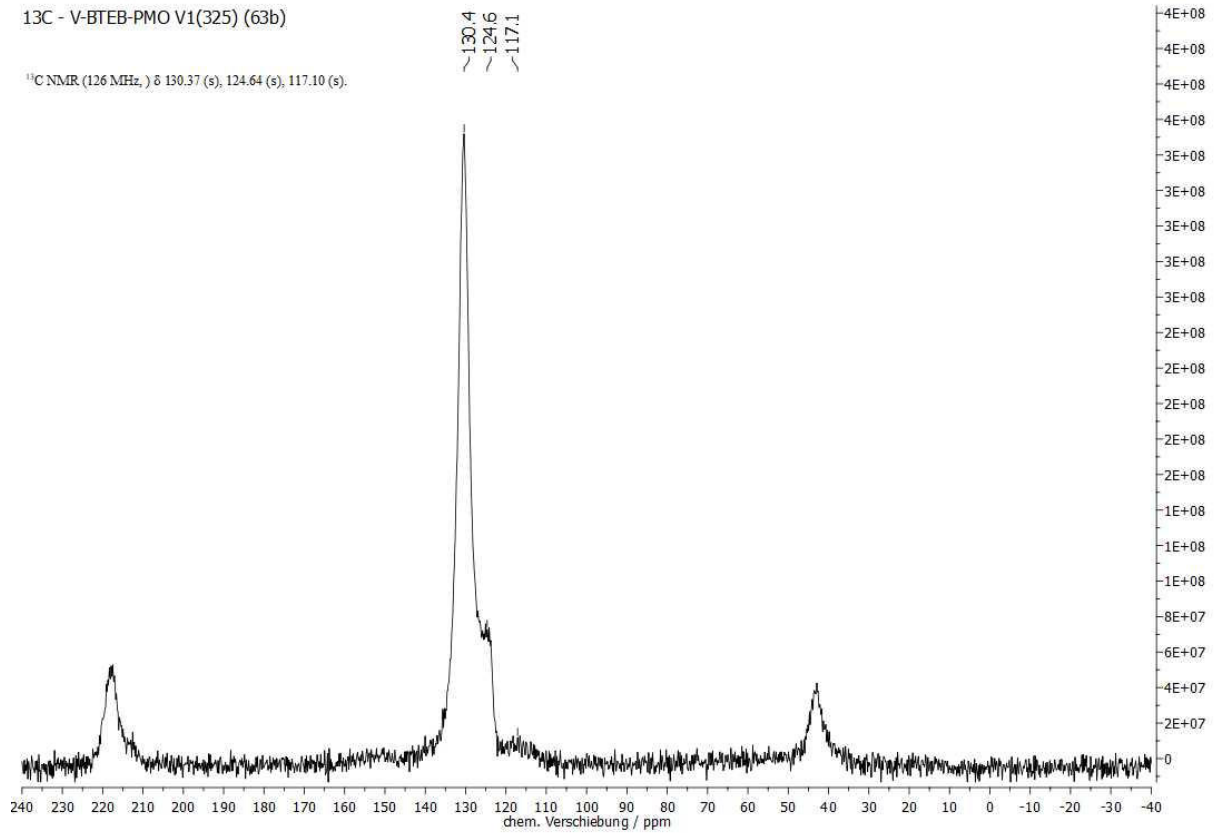


Abb. 8.163: <sup>13</sup>C-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von V-BTEB-PMO V1 (325) (**63b**).

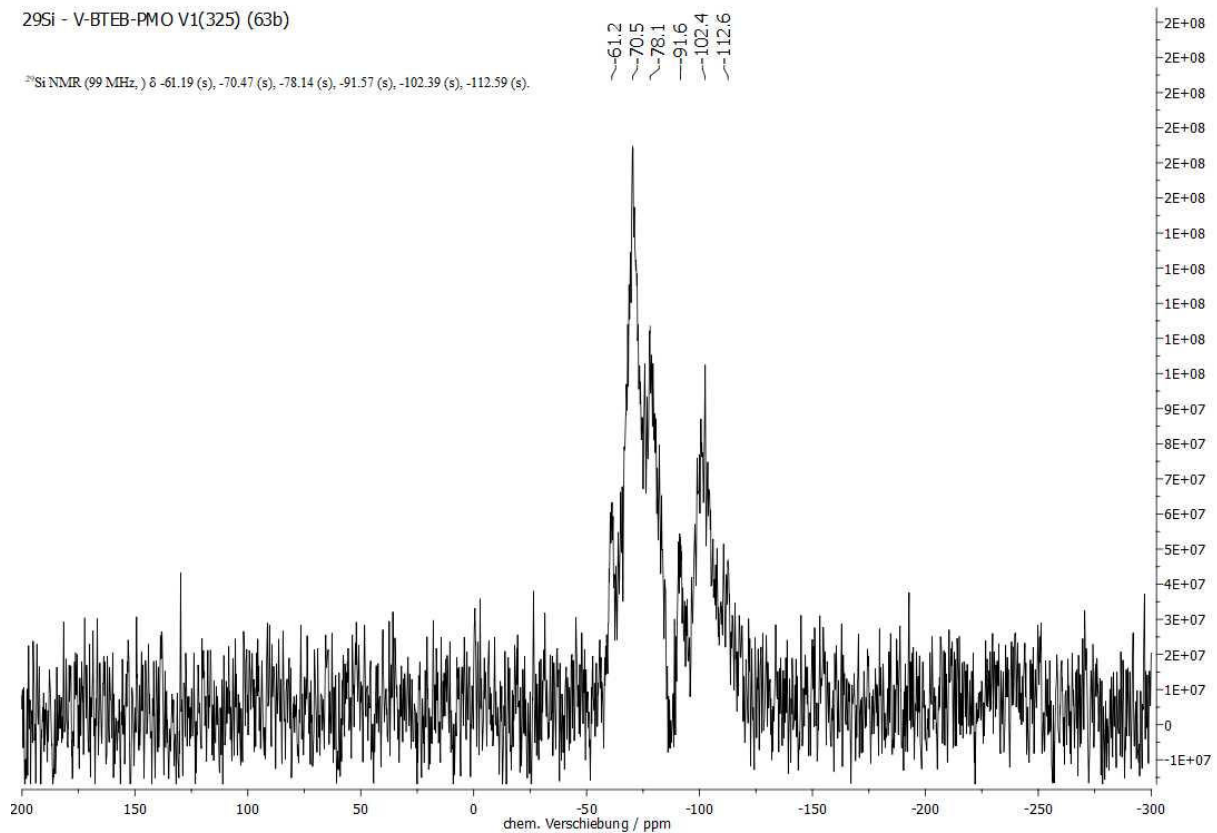


Abb. 8.164: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 2.5 mm) von V-BTEB-PMO V1 (325) (**63b**).

# ANHANG

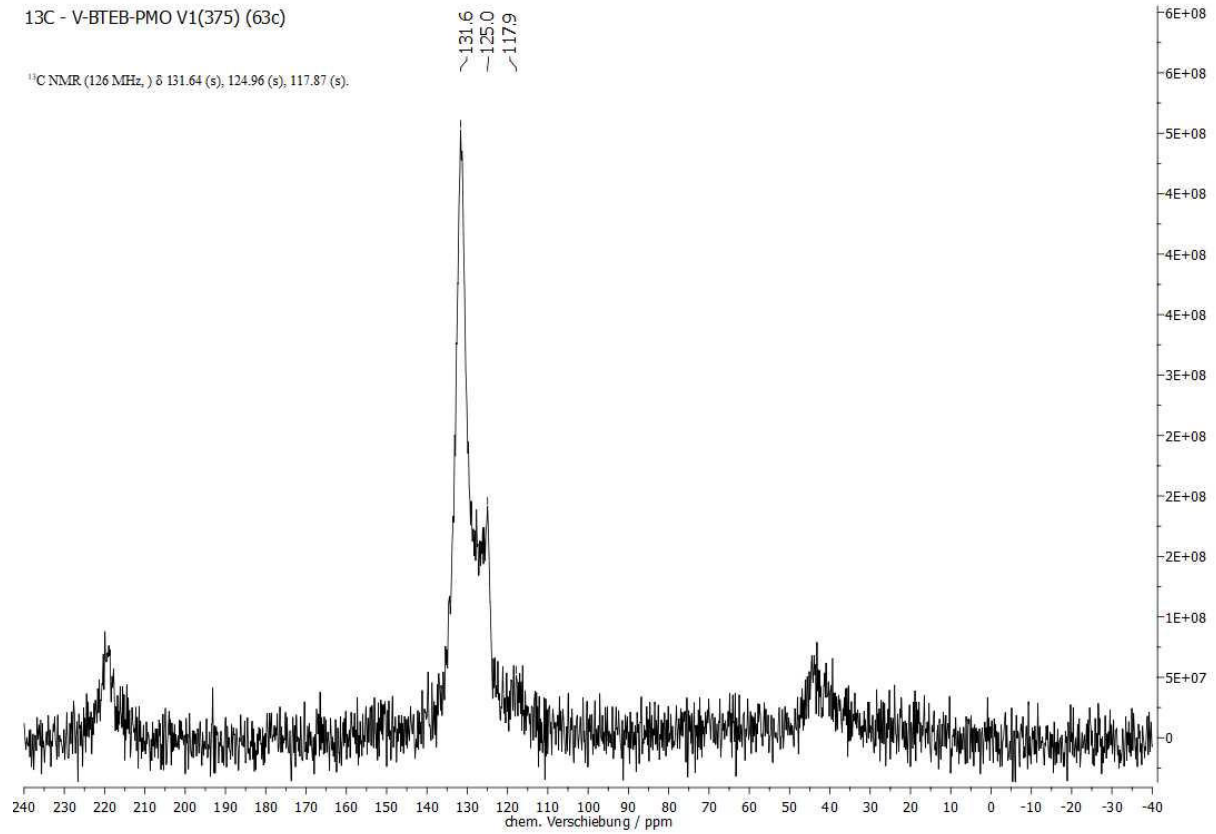


Abb. 8.165:  $^{13}\text{C}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von V-BTEB-PMO V1 (375) (**63c**).

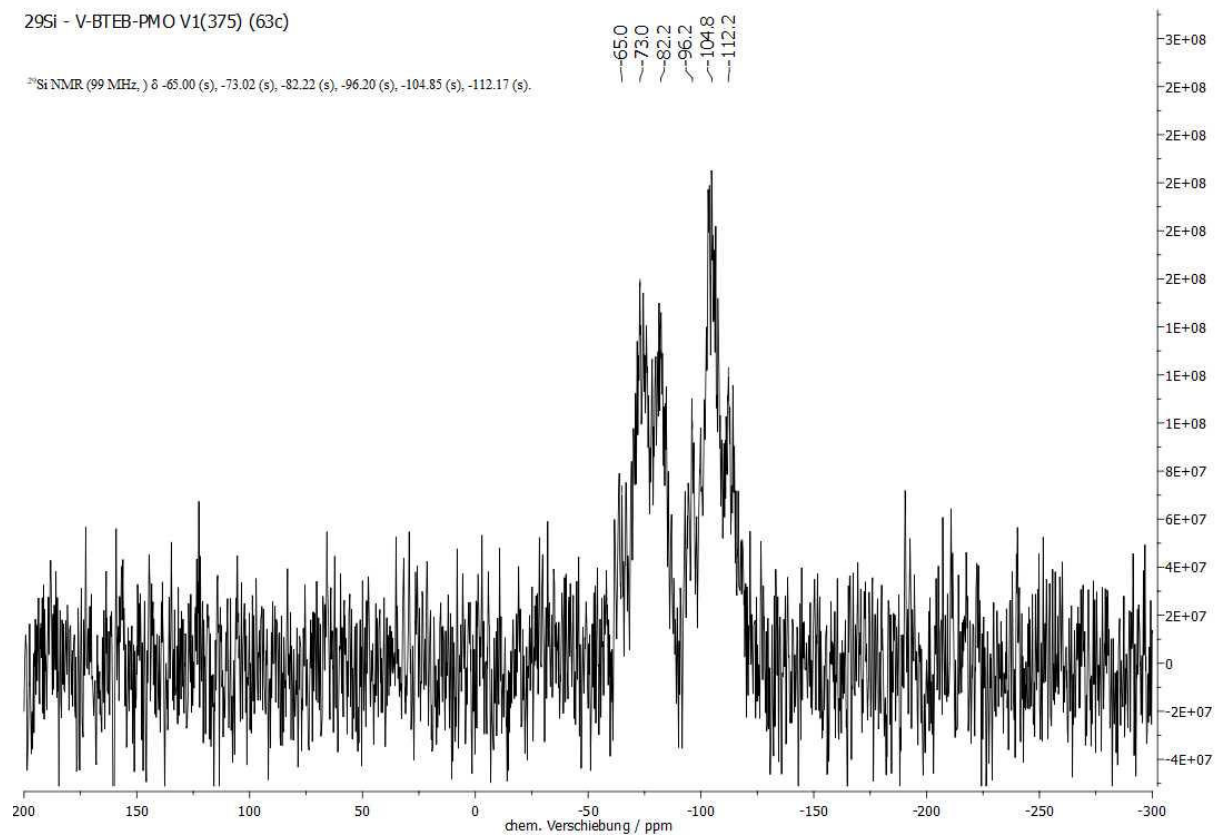


Abb. 8.166:  $^{29}\text{Si}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von V-BTEB-PMO V1 (375) (**63c**).

# ANHANG

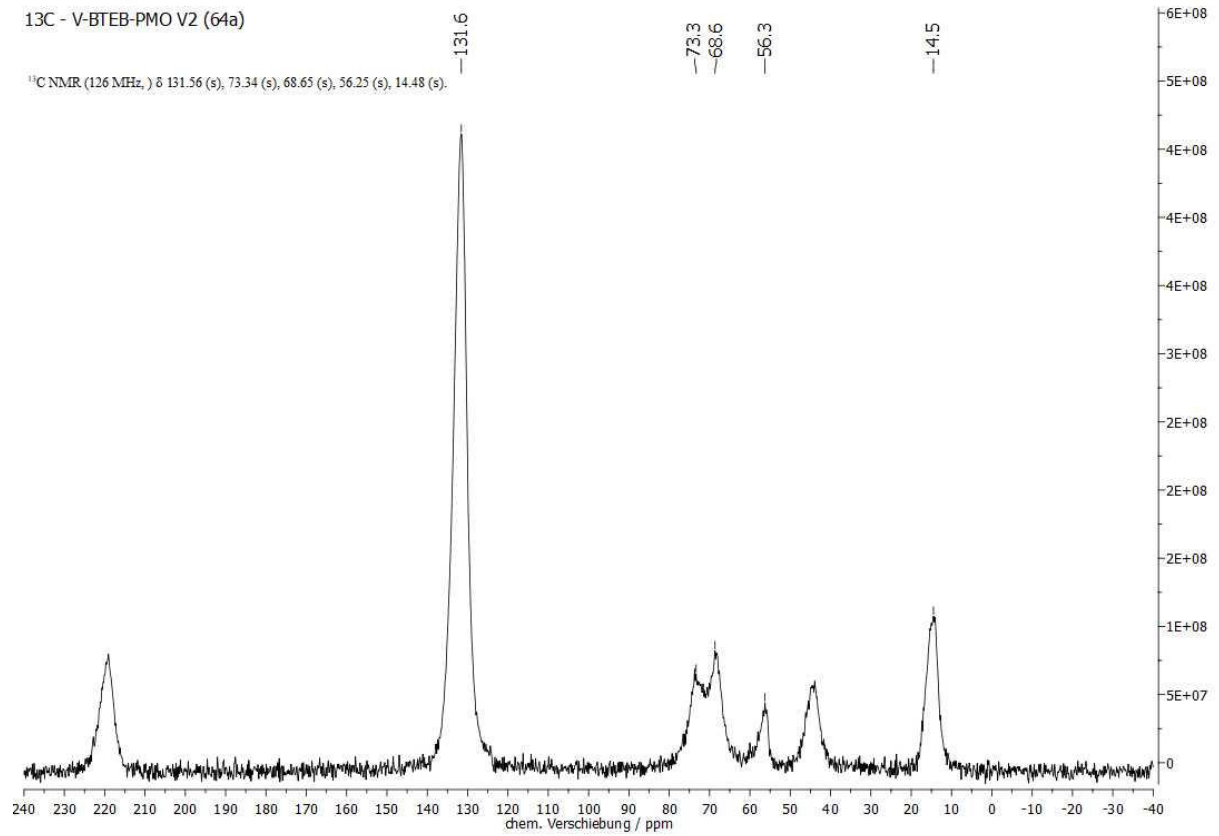


Abb. 8.167:  $^{13}\text{C}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von V-BTEB-PMO V2 (**64a**).

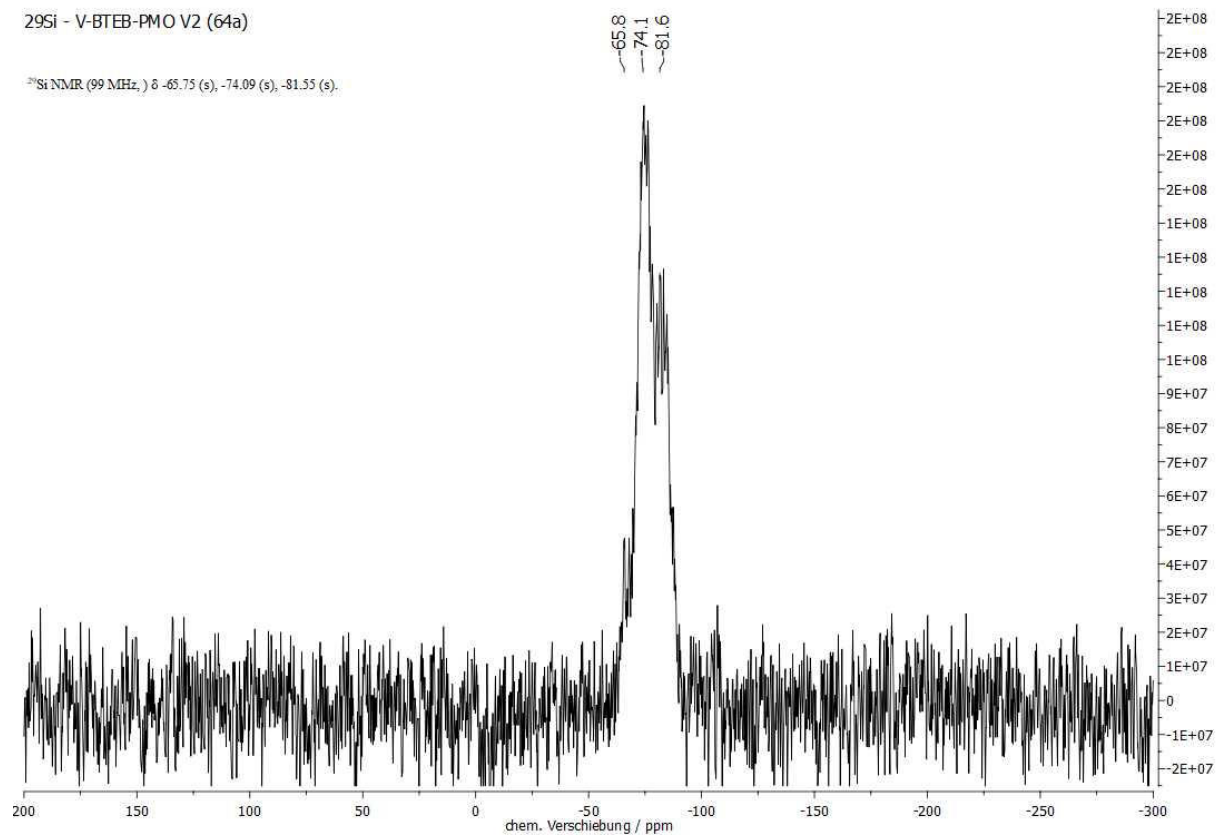


Abb. 8.168:  $^{29}\text{Si}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von V-BTEB-PMO V2 (**64a**).

ANHANG

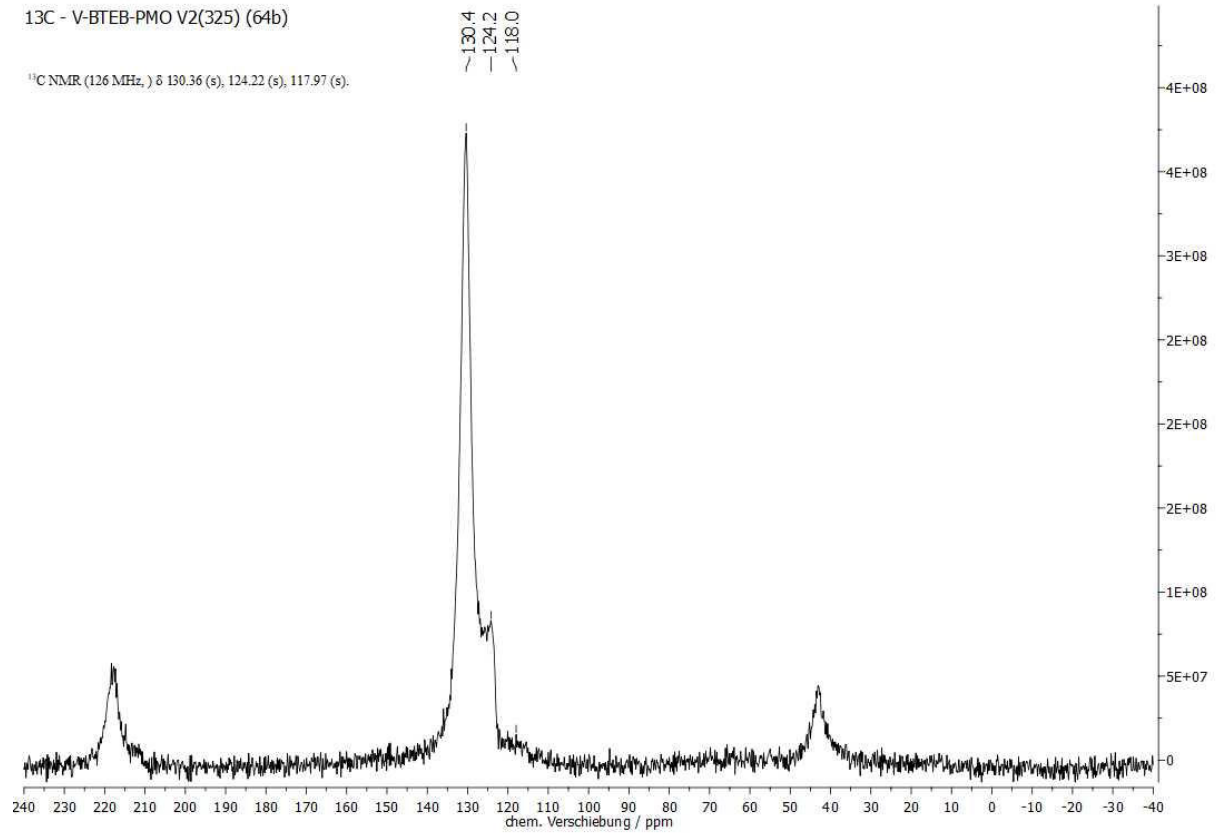


Abb. 8.169: <sup>13</sup>C-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von V-BTEB-PMO V2 (325) (64b).

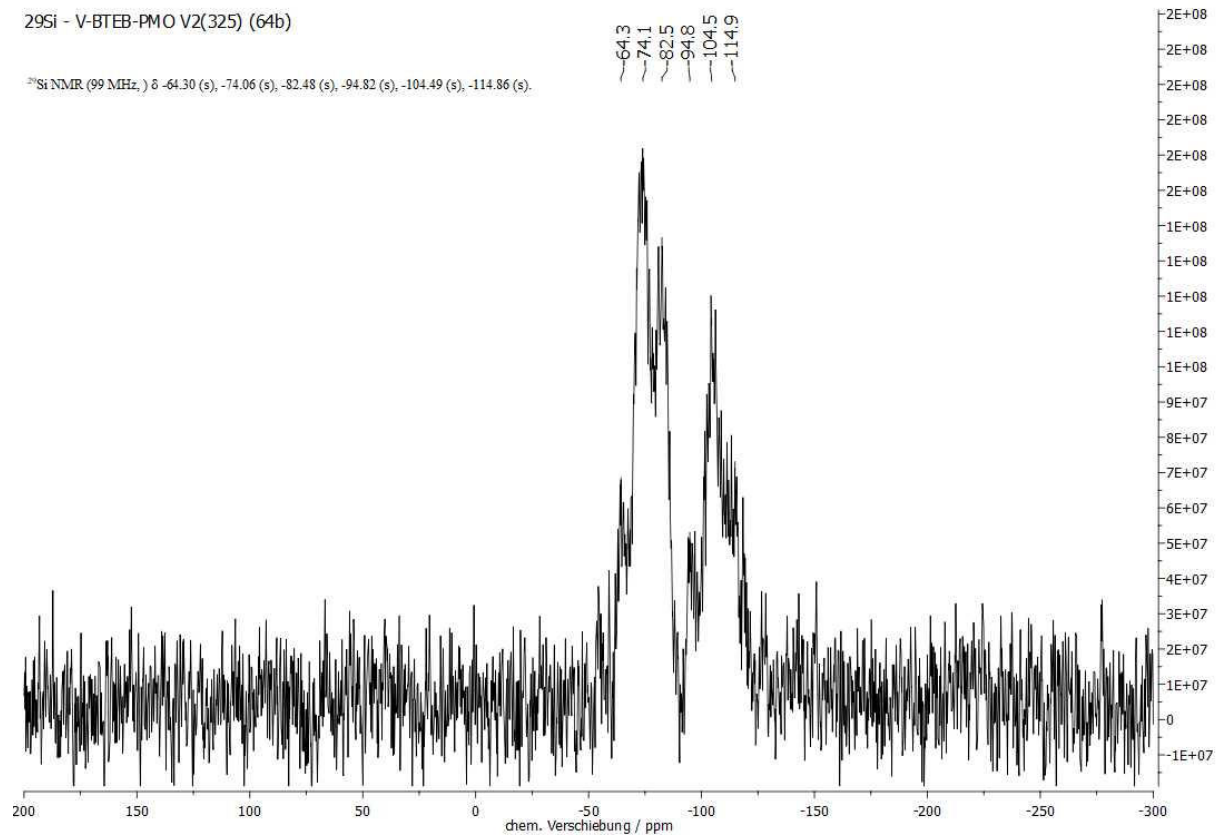


Abb. 8.170: <sup>29</sup>Si-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von V-BTEB-PMO V2 (325) (64b).

ANHANG

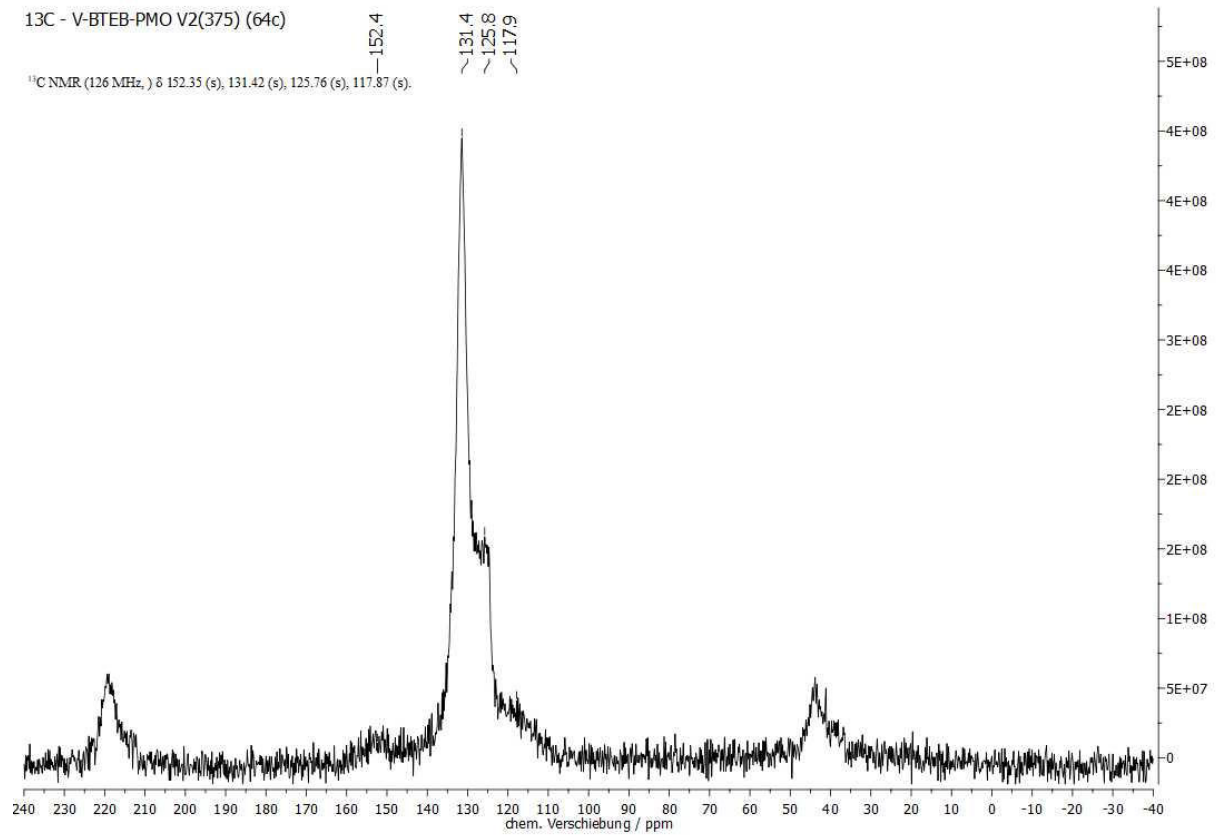


Abb. 8.171:  $^{13}\text{C}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von V-BTEB-PMO V2 (375) (64c).

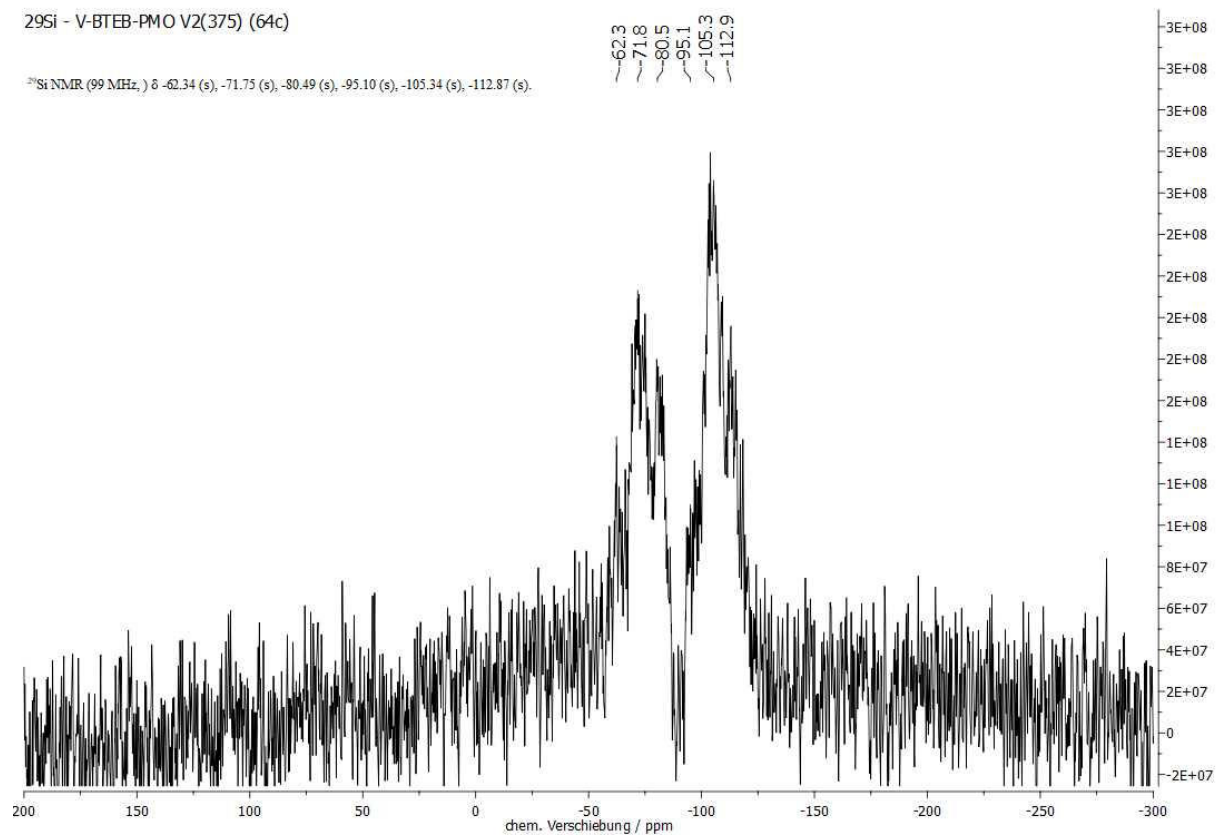


Abb. 8.172:  $^{29}\text{Si}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von V-BTEB-PMO V2 (375) (64c).

# ANHANG

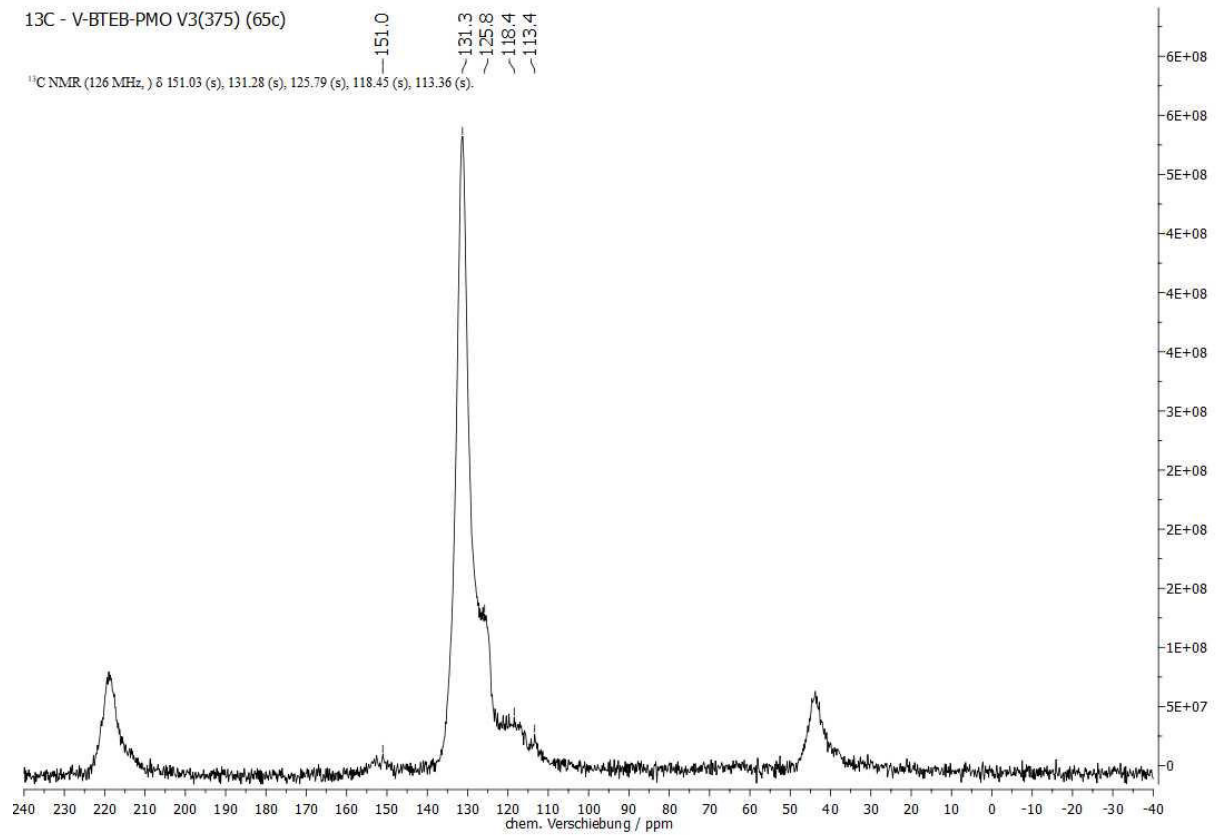


Abb. 8.173:  $^{13}\text{C}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von V-BTEB-PMO V3 (375) (**65c**).

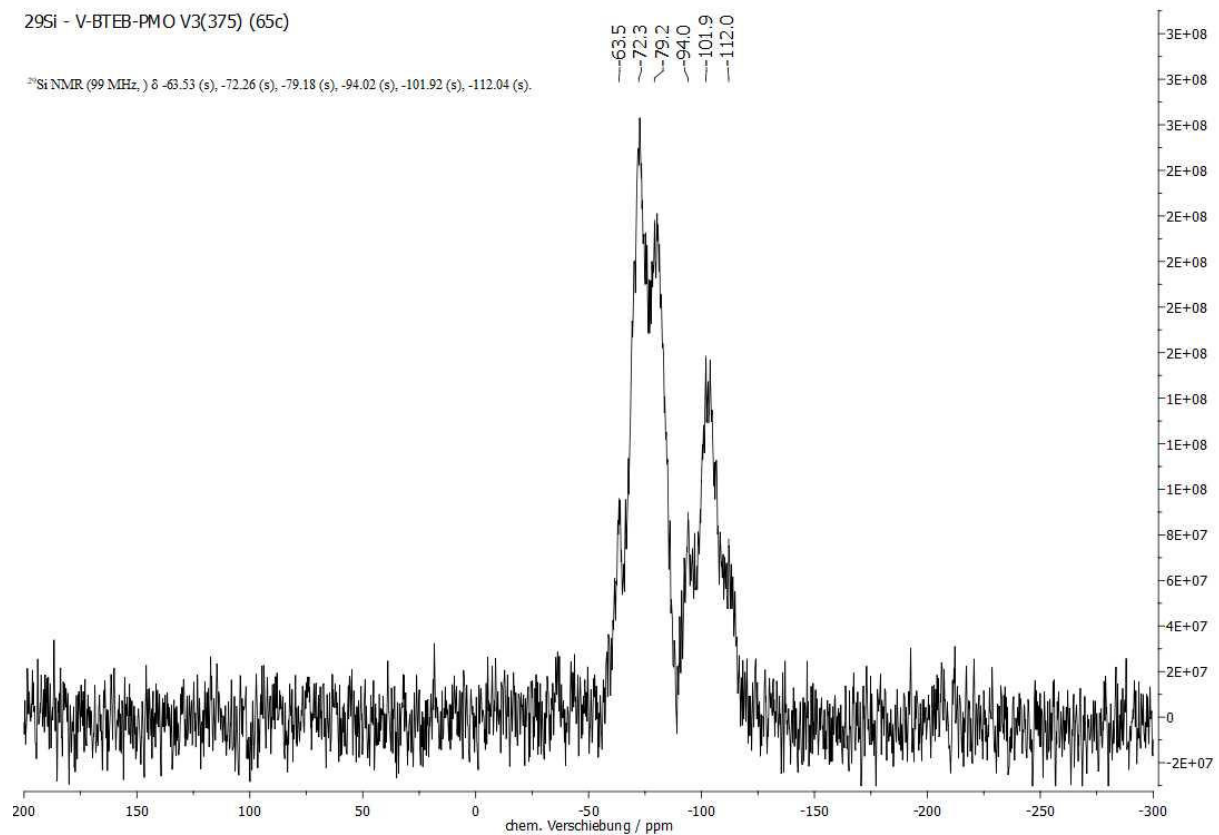


Abb. 8.174:  $^{29}\text{Si}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von V-BTEB-PMO V3 (375) (**65c**).

# ANHANG

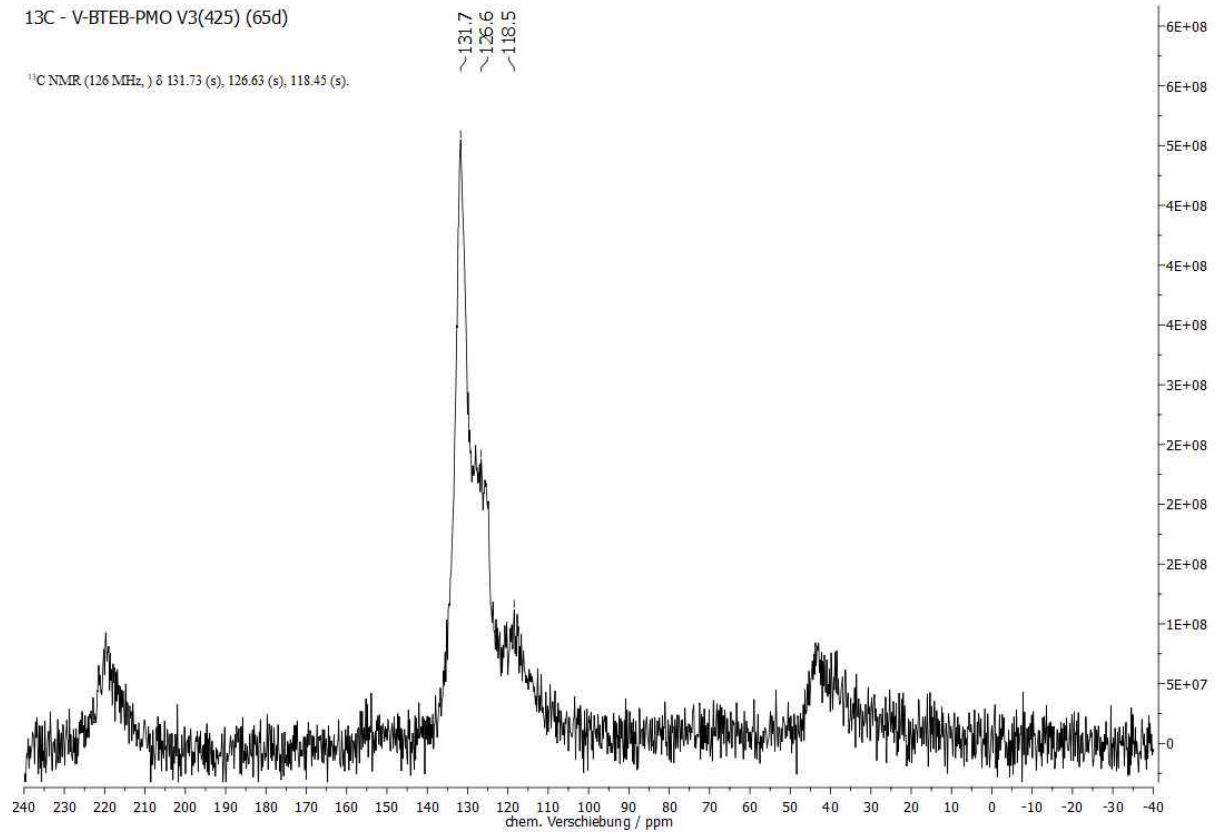


Abb. 8.175:  $^{13}\text{C}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von V-BTEB-PMO V3 (425) (**65d**).

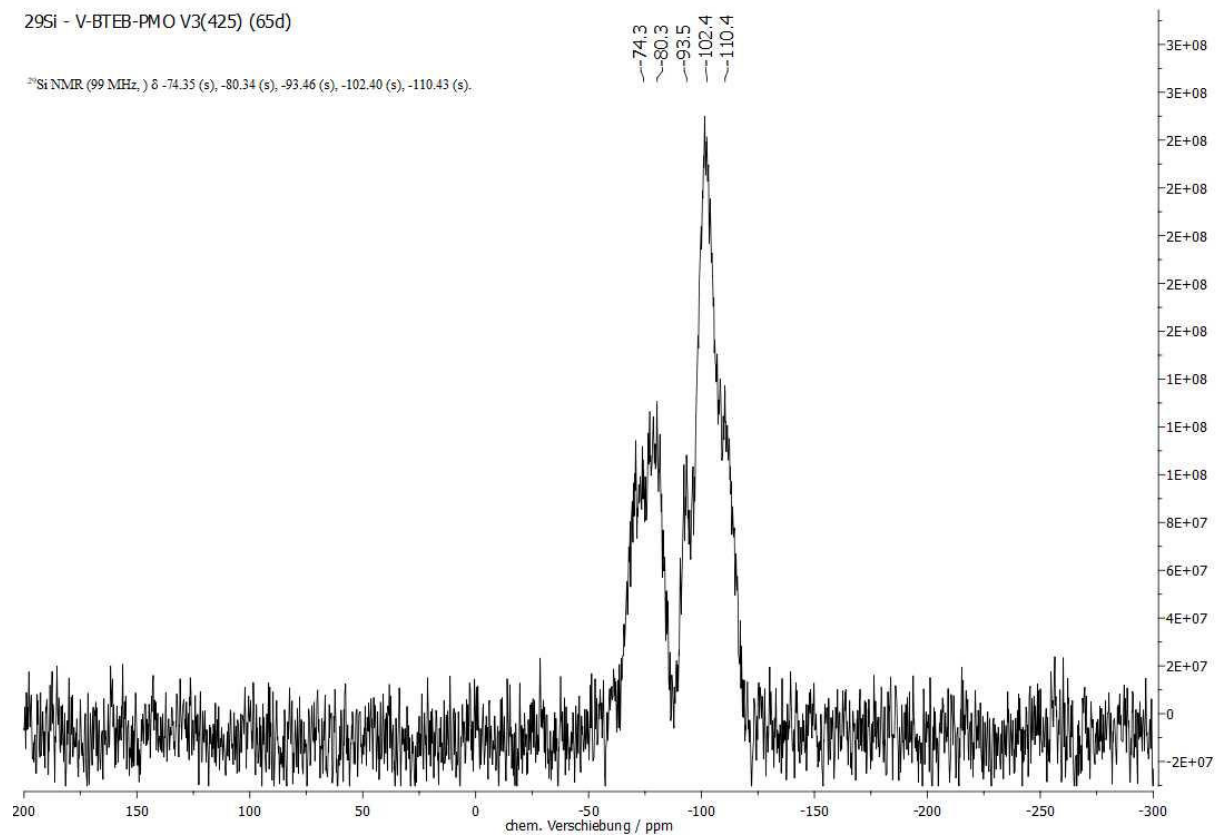


Abb. 8.176:  $^{29}\text{Si}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von V-BTEB-PMO V3 (425) (**65d**).



# ANHANG

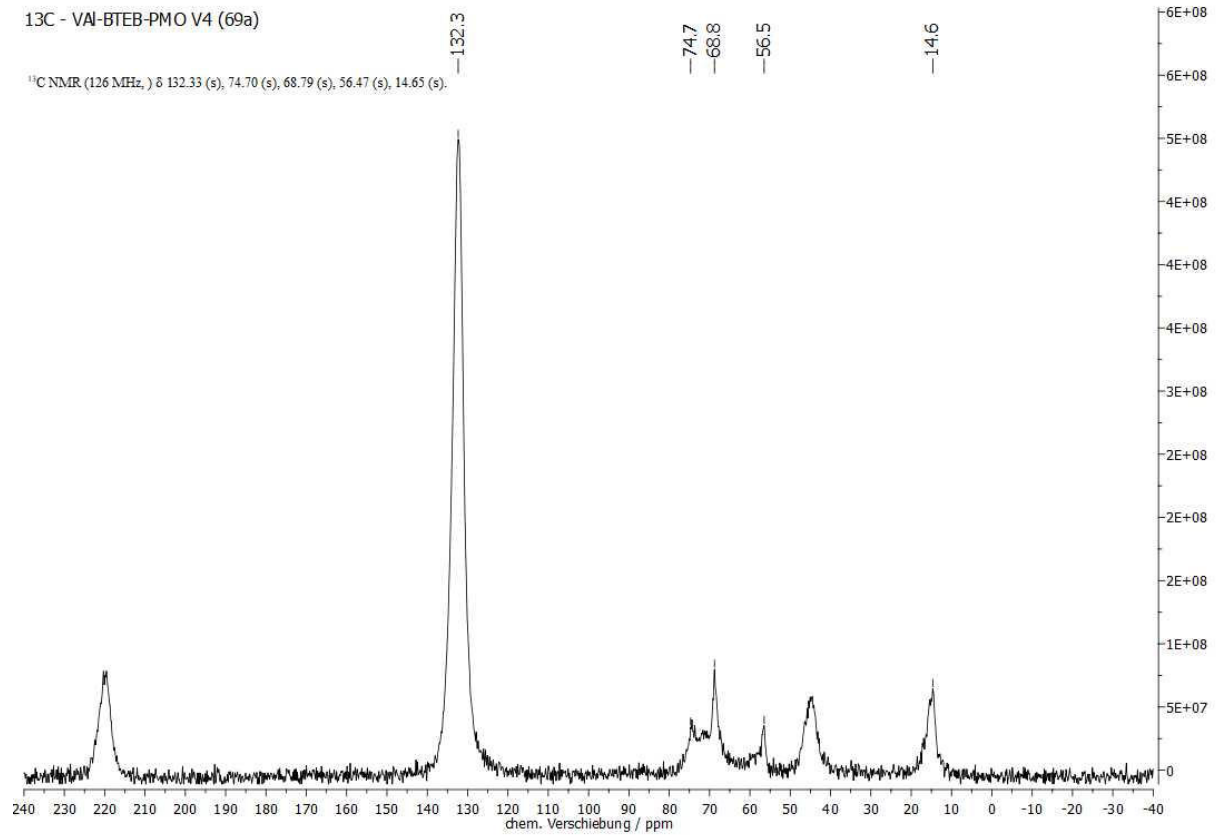


Abb. 8.177:  $^{13}\text{C}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von VAl-BTEB-PMO V4 (**69a**).

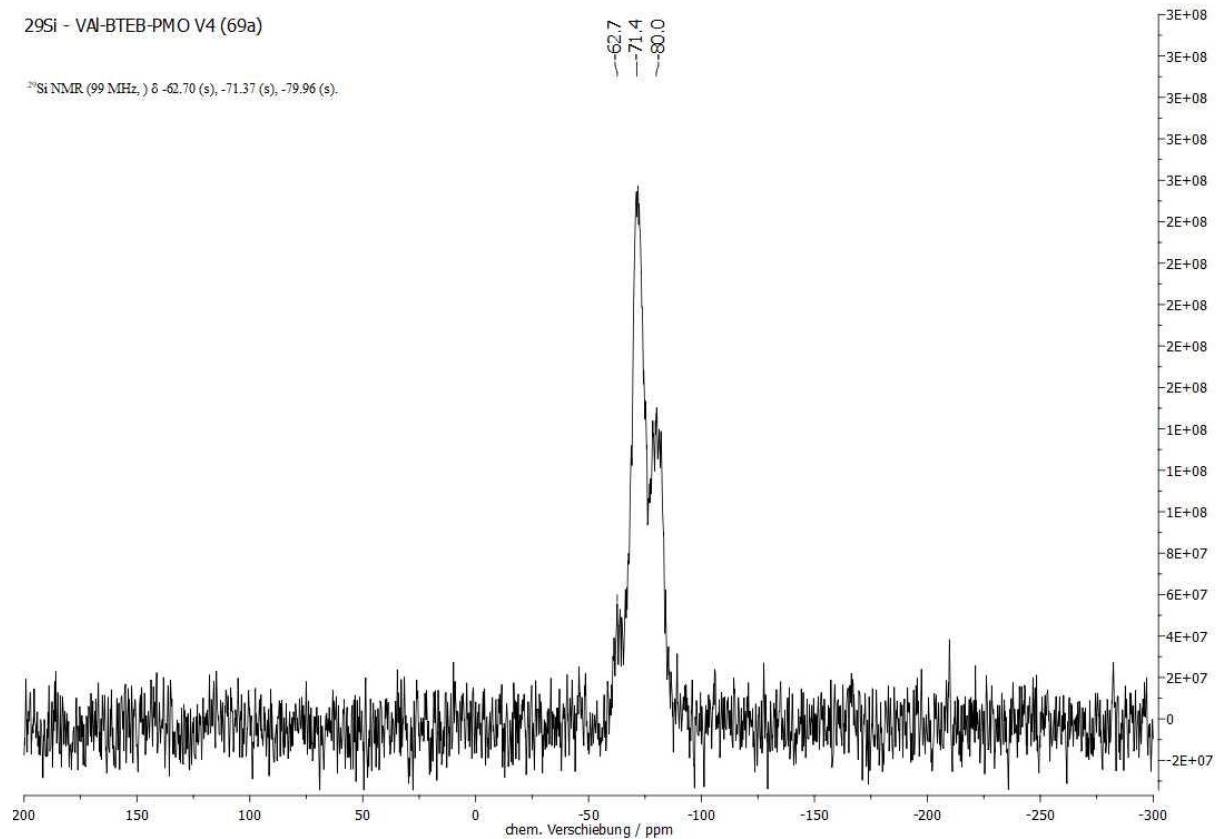


Abb. 8.178:  $^{29}\text{Si}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von VAl-BTEB-PMO V4 (**69a**).

ANHANG

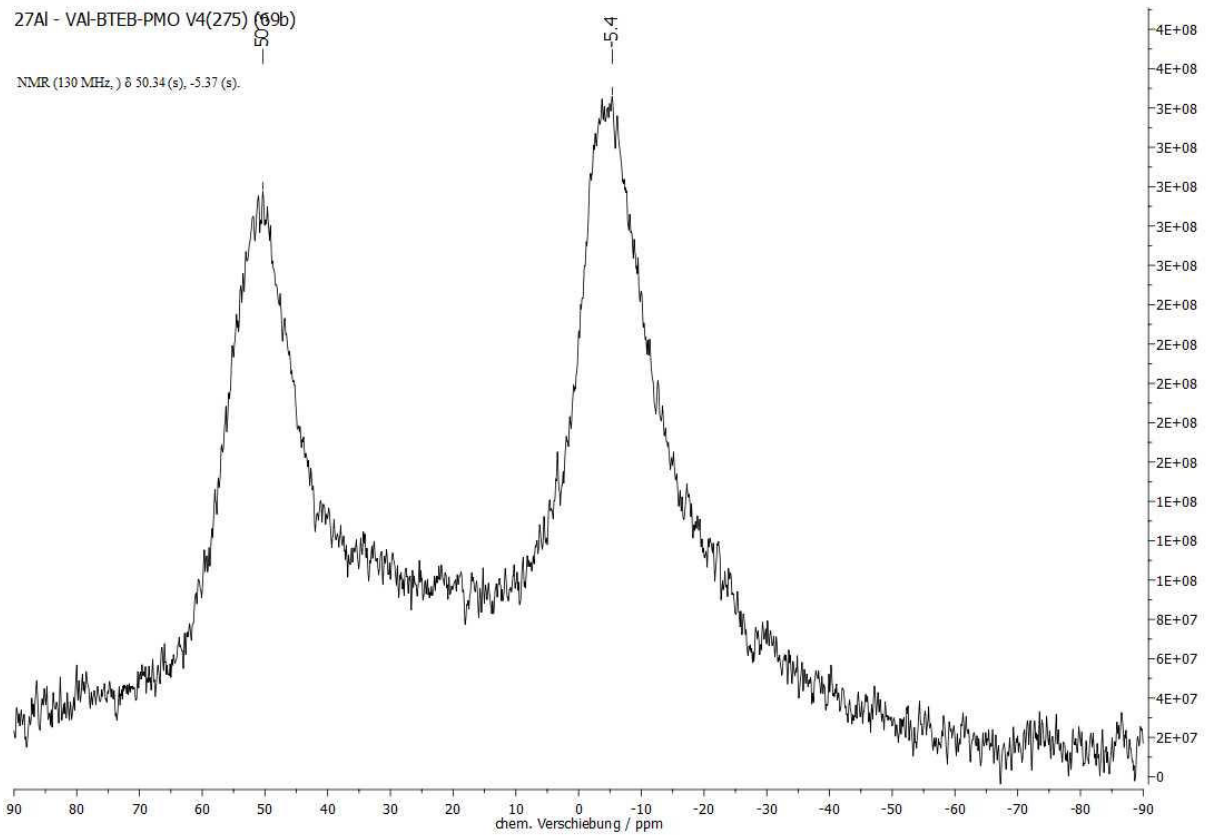


Abb. 8.179:  $^{27}\text{Al}$ -MAS-NMR-Spektrum (11000 Hz, 298 K, 2.5 mm) von VAl-BTEB-PMO V4 (275) (69b).

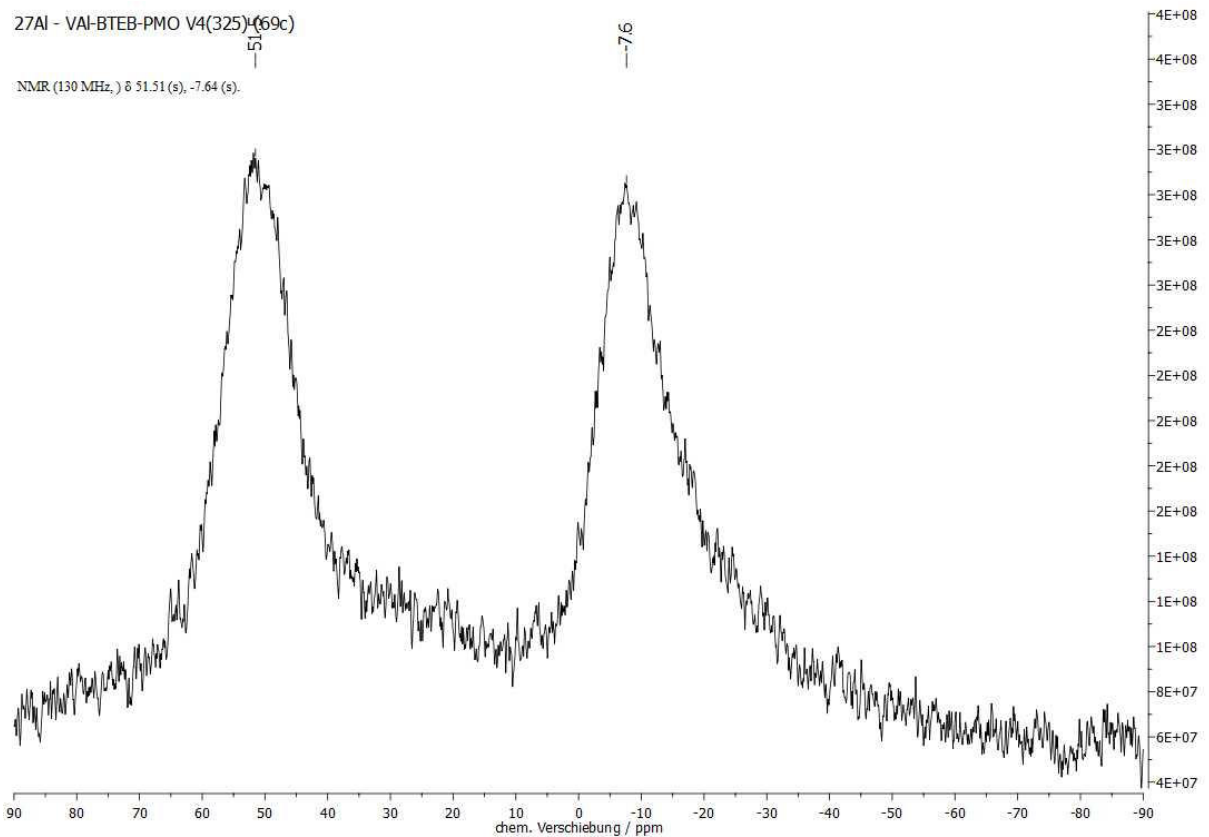


Abb. 8.180:  $^{27}\text{Al}$ -MAS-NMR-Spektrum (11000 Hz, 298 K, 2.5 mm) von VAl-BTEB-PMO V4 (325) (69c).

ANHANG

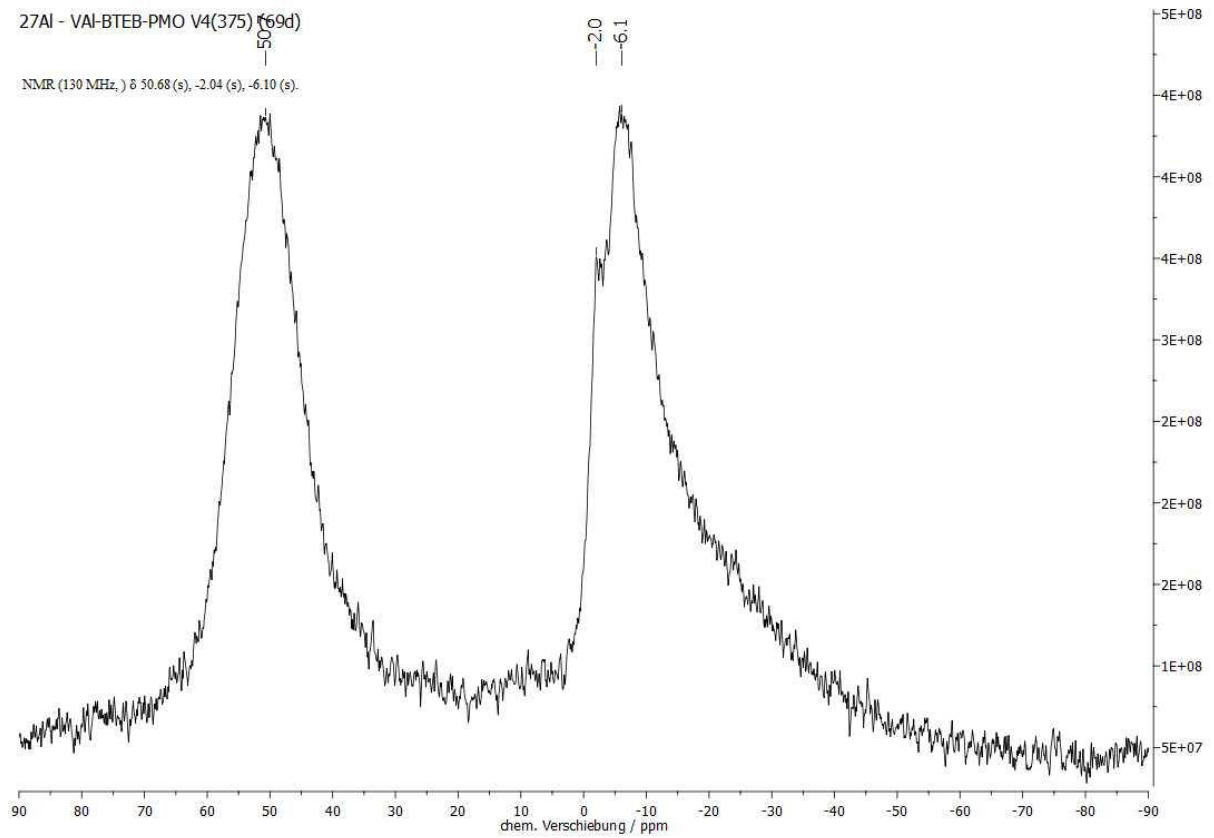


Abb. 8.181:  $^{27}\text{Al}$ -MAS-NMR-Spektrum (11000 Hz, 298 K, 2.5 mm) von VAl-BTEB-PMO V4 (375) (69d).

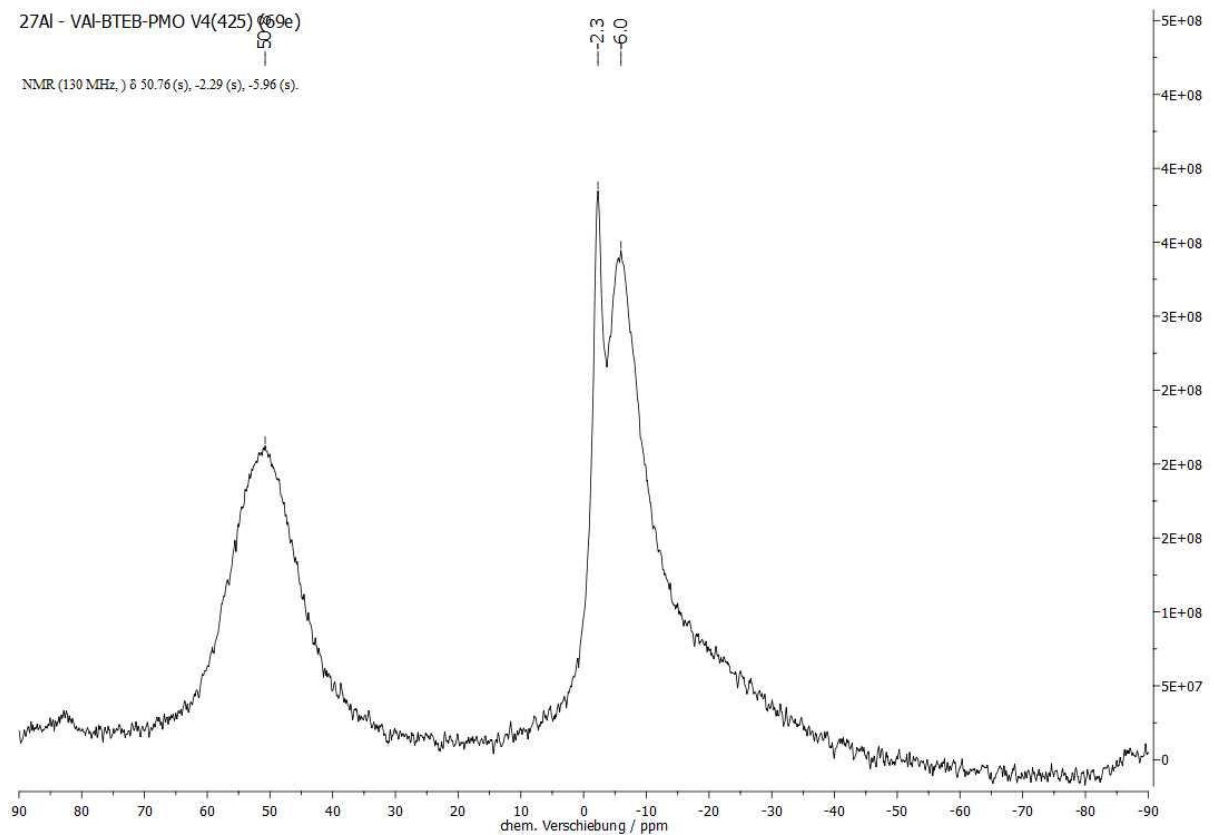


Abb. 8.182:  $^{27}\text{Al}$ -MAS-NMR-Spektrum (11000 Hz, 298 K, 2.5 mm) von VAl-BTEB-PMO V4 (425) (69e).

# ANHANG

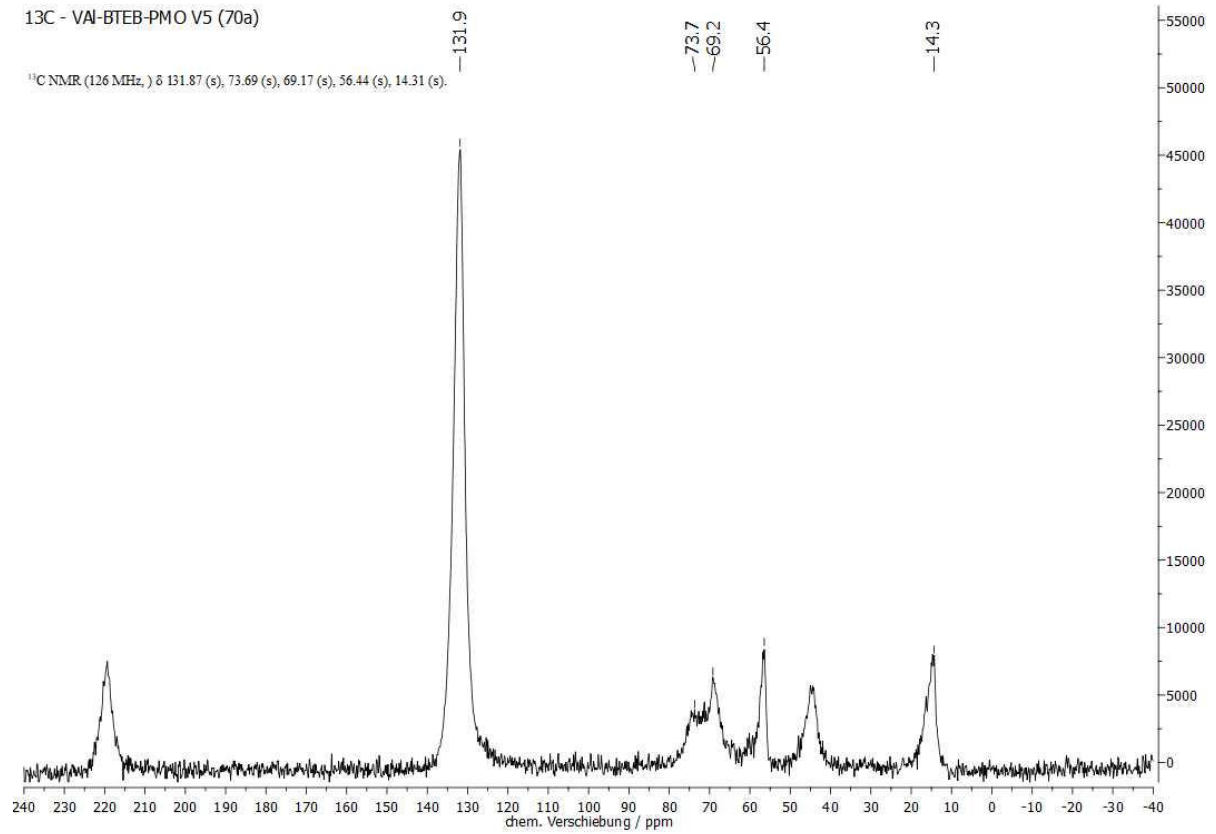


Abb. 8.183:  $^{13}\text{C}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von VAl-BTEB-PMO V5 (70a).

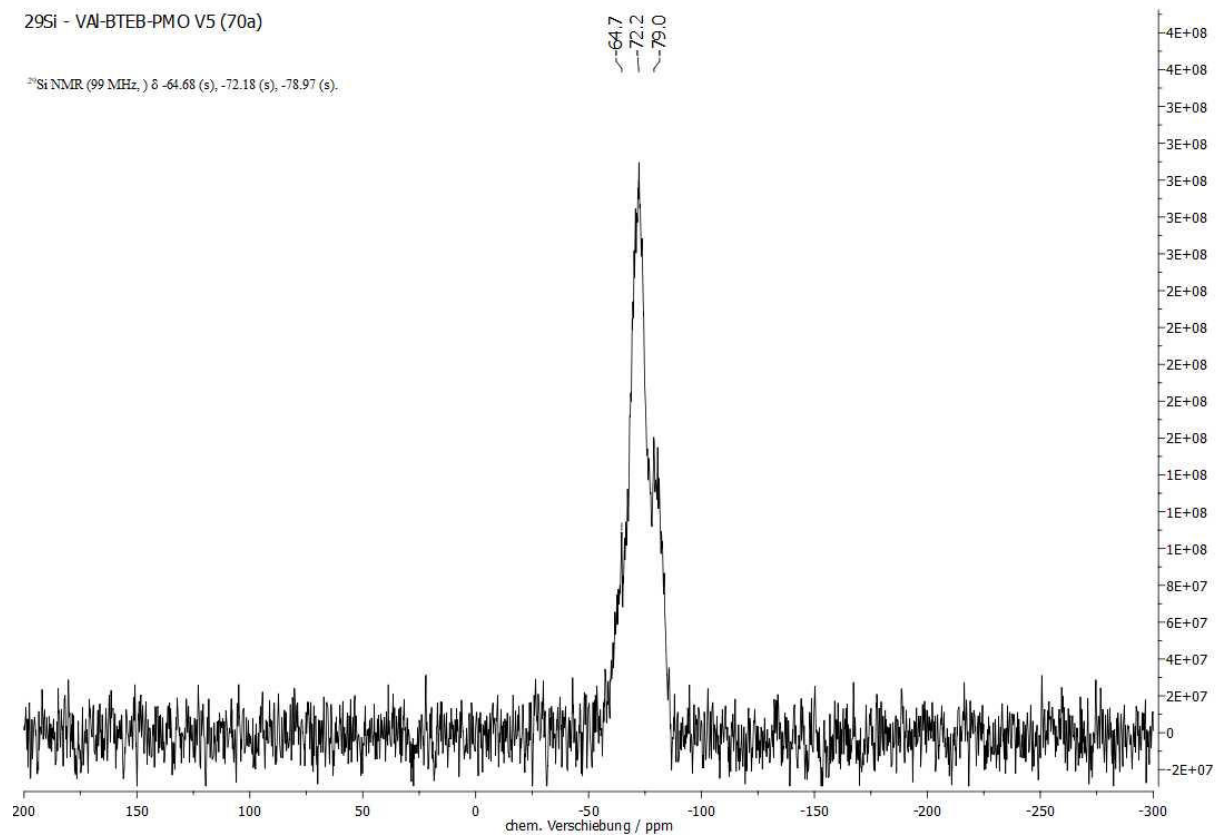


Abb. 8.184:  $^{29}\text{Si}$ -CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von VAl-BTEB-PMO V5 (70a).

ANHANG

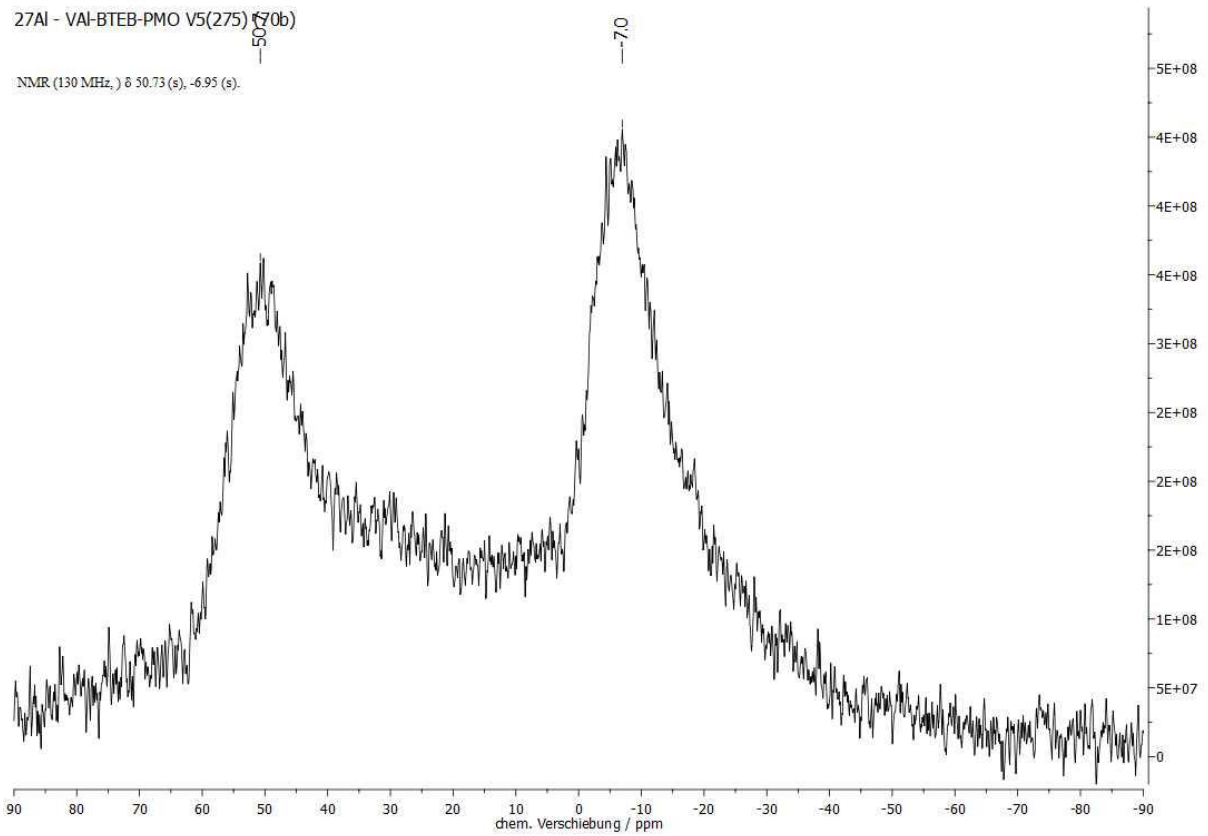


Abb. 8.185:  $^{27}\text{Al}$ -MAS-NMR-Spektrum (11000 Hz, 298 K, 2.5 mm) von VAl-BTEB-PMO V5 (275) (70b).

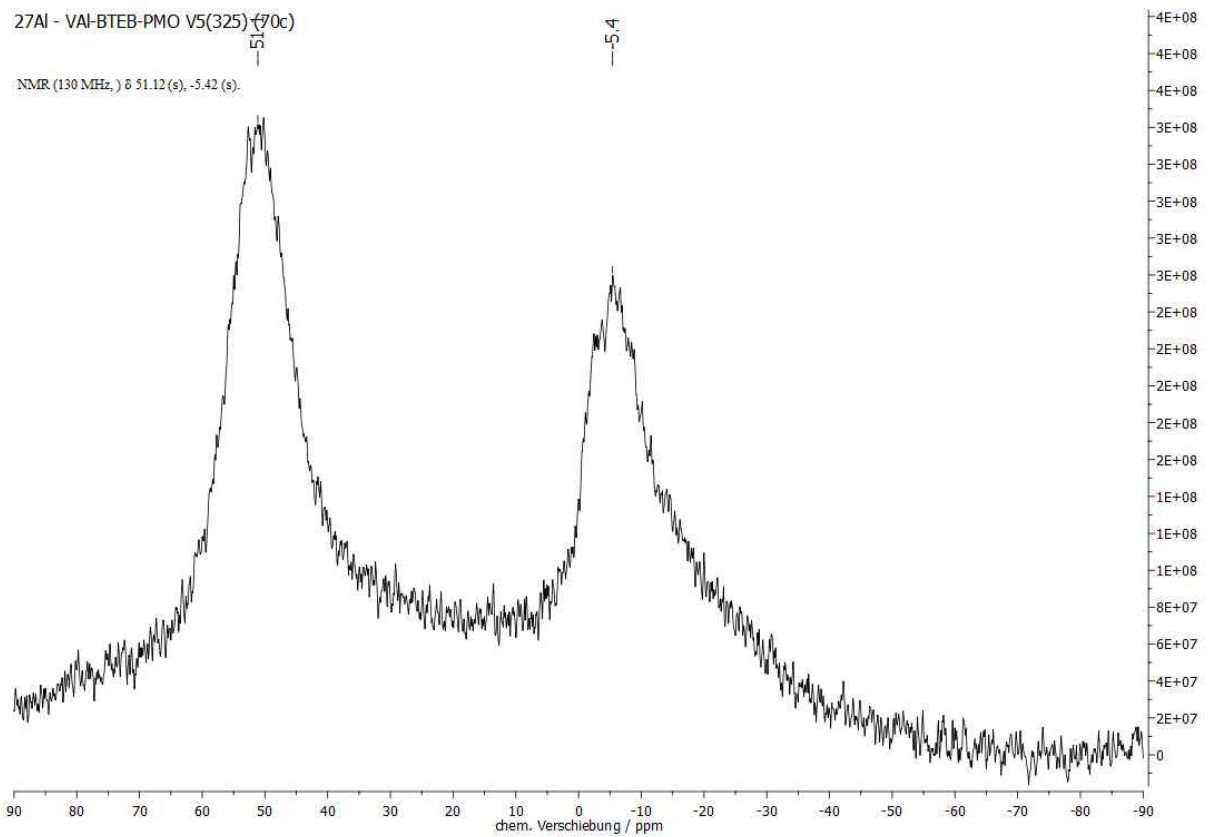


Abb. 8.186:  $^{27}\text{Al}$ -MAS-NMR-Spektrum (11000 Hz, 298 K, 2.5 mm) von VAl-BTEB-PMO V5 (325) (70c).

ANHANG

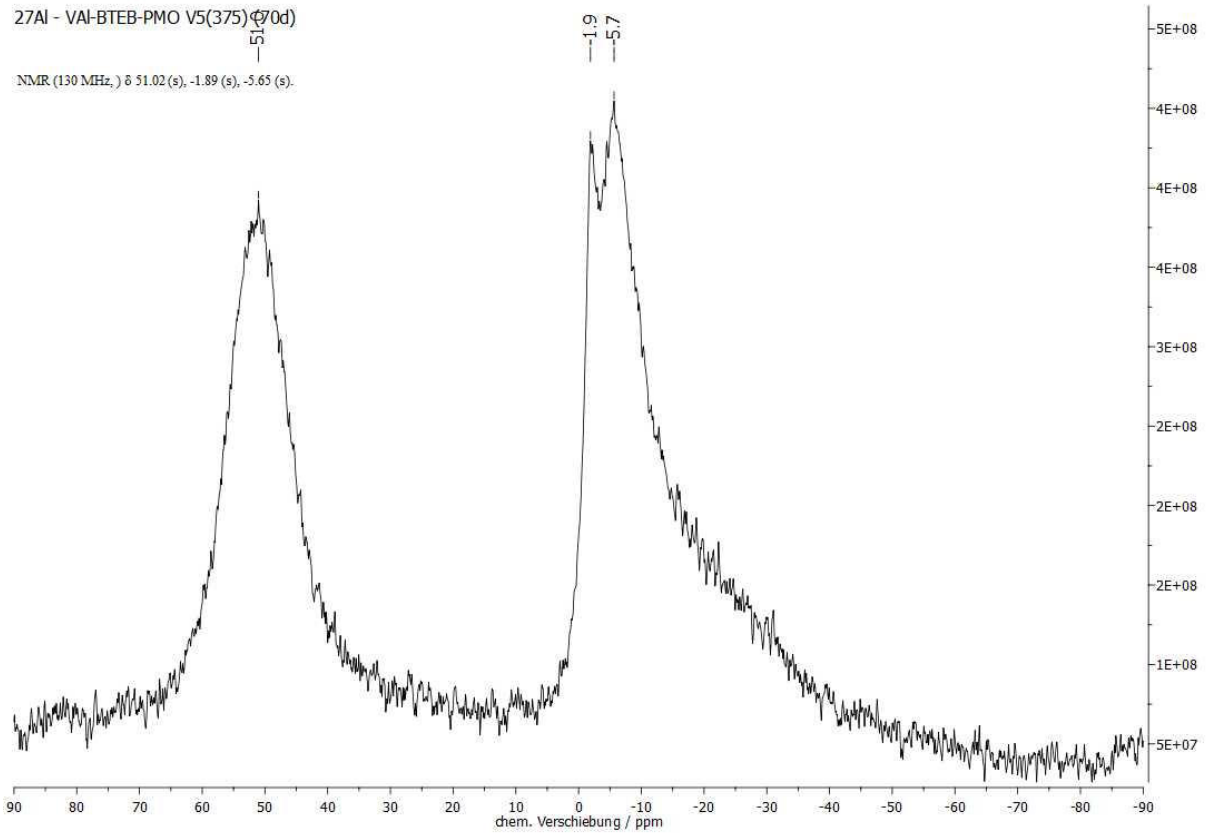


Abb. 8.187:  $^{27}\text{Al}$ -MAS-NMR-Spektrum (11000 Hz, 298 K, 2.5 mm) von VAl-BTEB-PMO V5 (375) (70d).

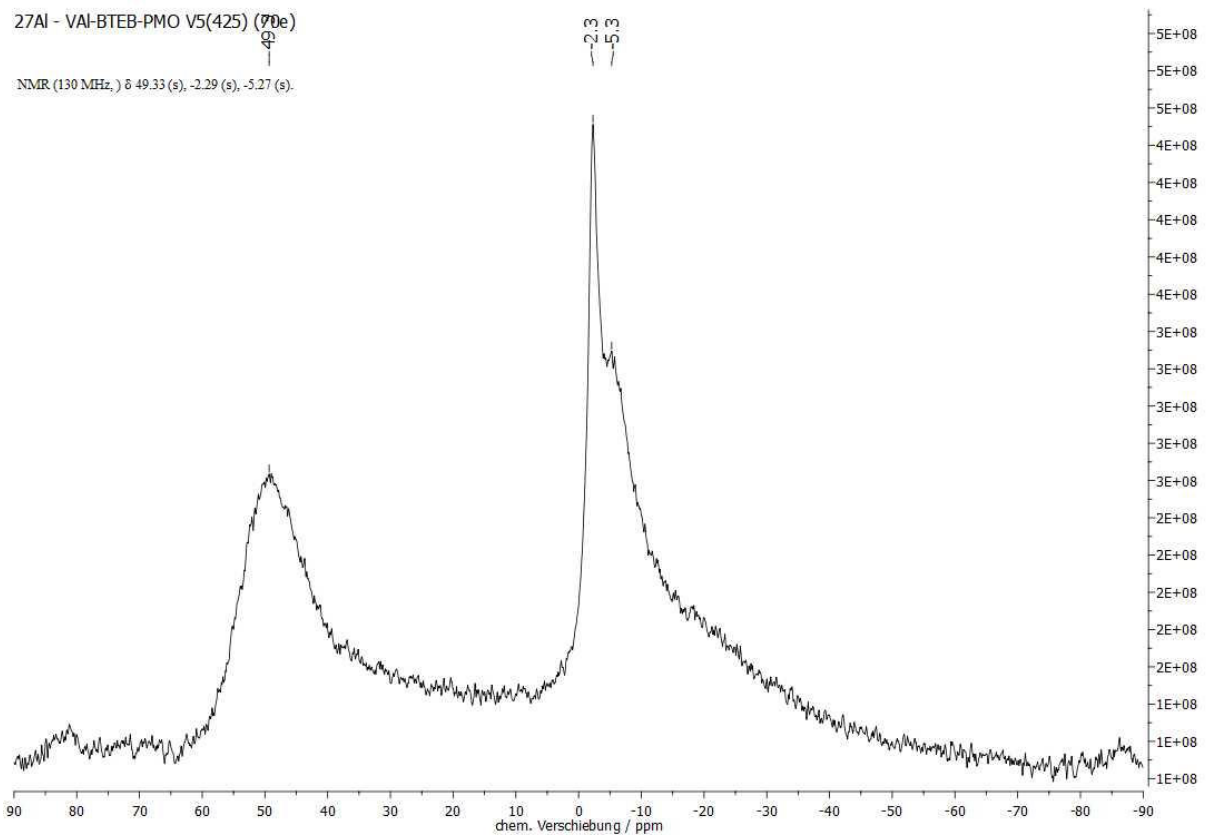


Abb. 8.188:  $^{27}\text{Al}$ -MAS-NMR-Spektrum (11000 Hz, 298 K, 2.5 mm) von VAl-BTEB-PMO V5 (425) (70e).

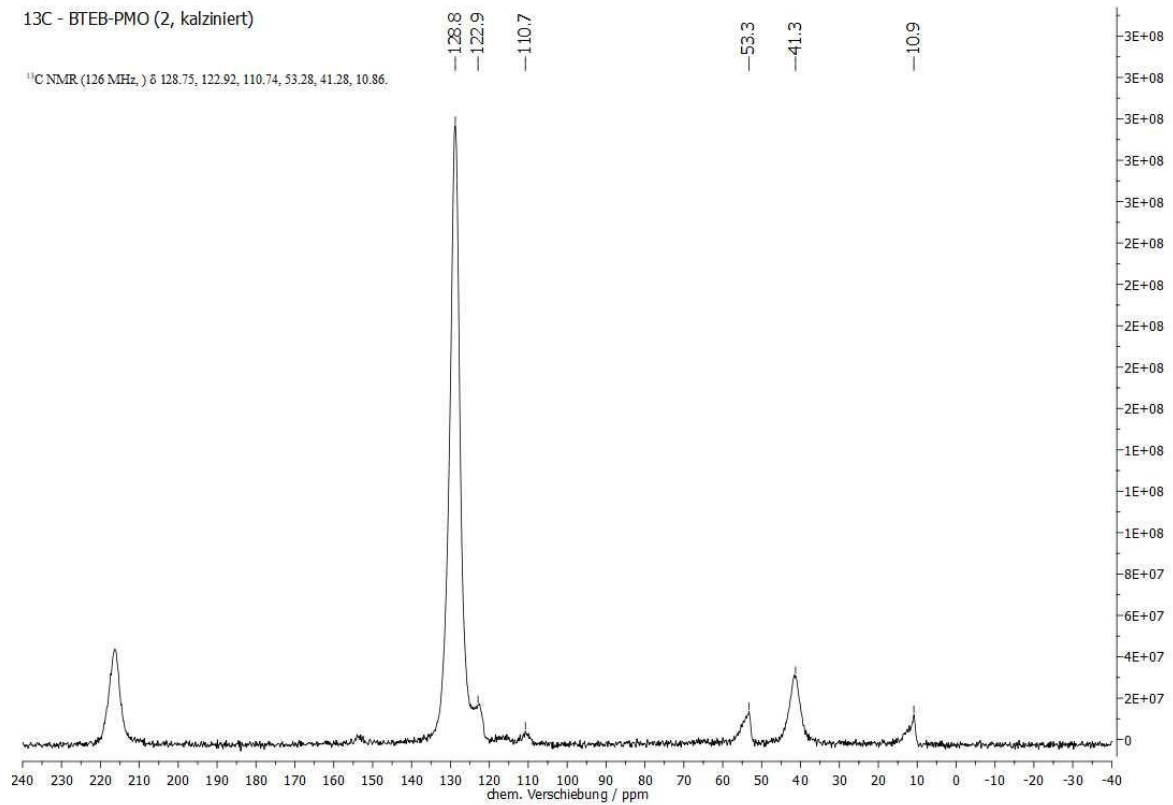


Abb. 8.189: <sup>13</sup>C-CP-MAS-NMR-Spektrum (11000 Hz, 298 K, 4 mm) von kalziniertem BTEB-PMO 2.

## 8.2 XRD-Spektren

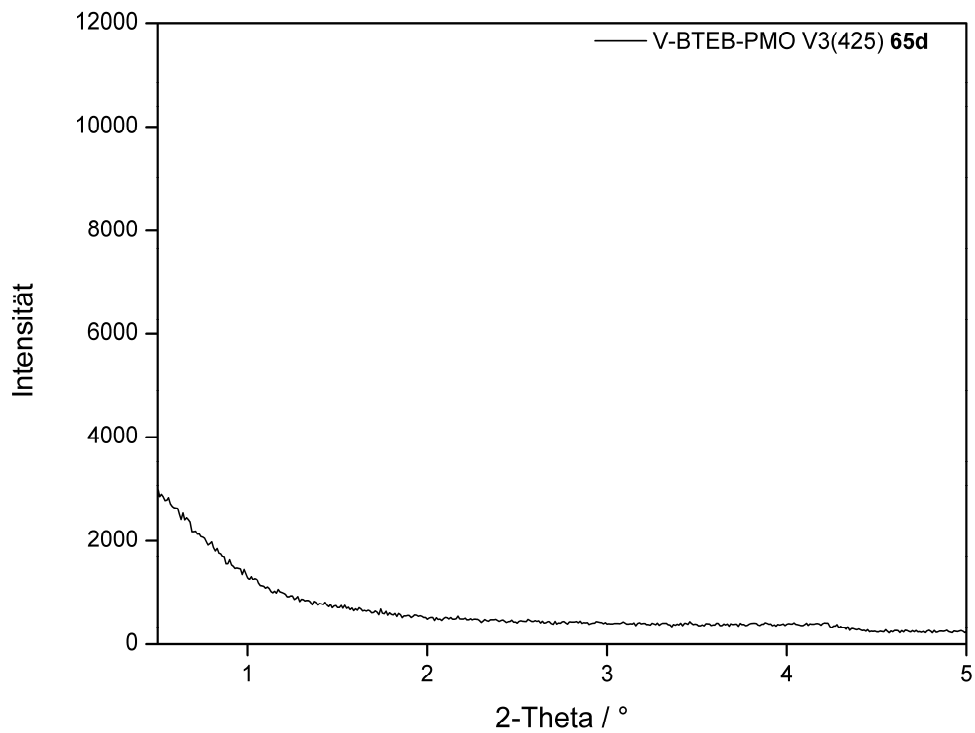


Abb. 8.190: XRD-Spektrum von V-BTEB-PMO V3 (425) (65d).

### 8.3 TGA-Messungen

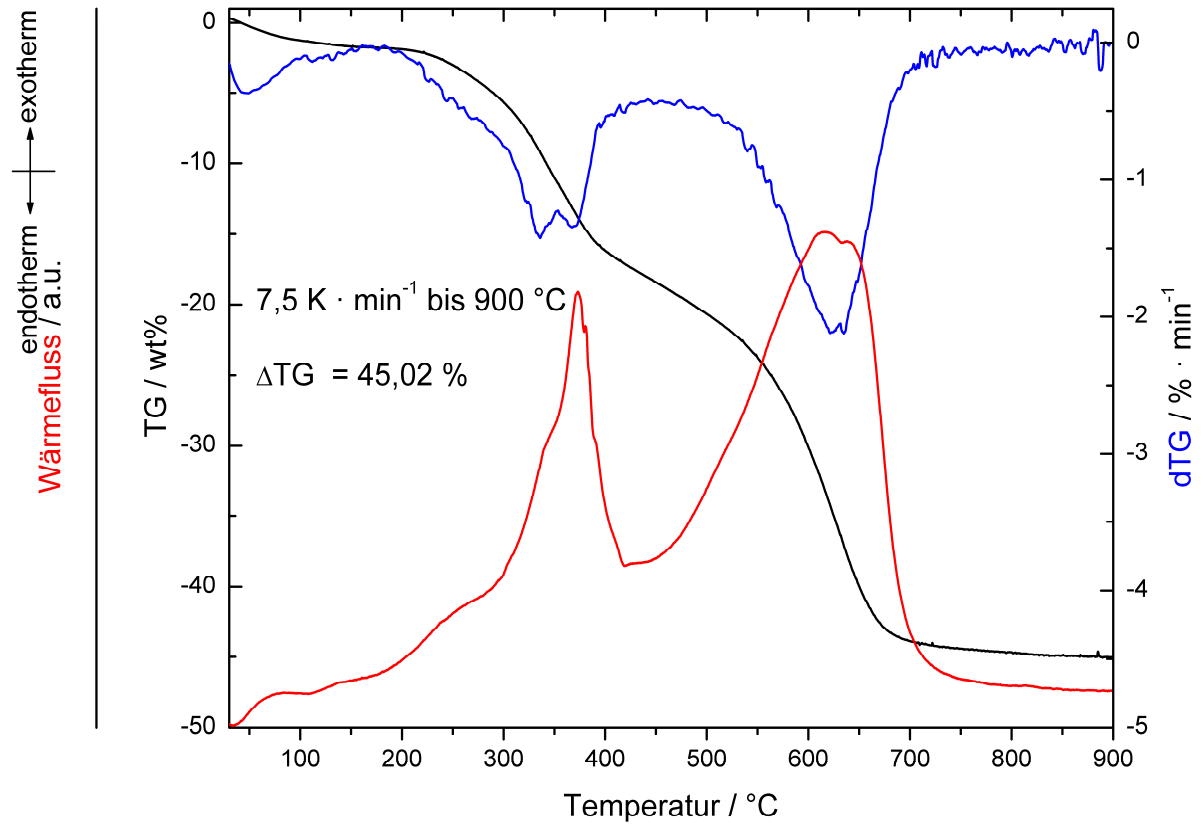


Abb. 8.191: TGA-Messung von SH-BTEB-PMO (3).

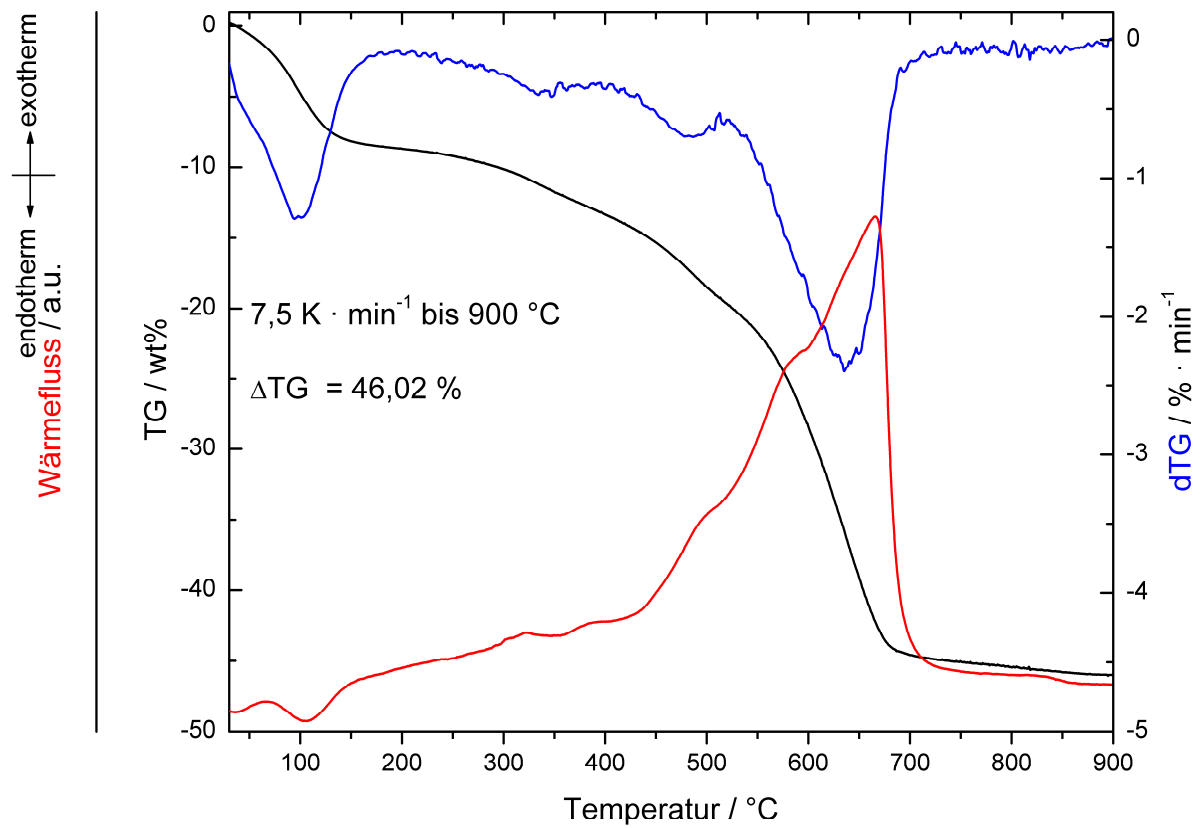


Abb. 8.192: TGA-Messung von SO<sub>3</sub>H-BTEB-PMO (4).



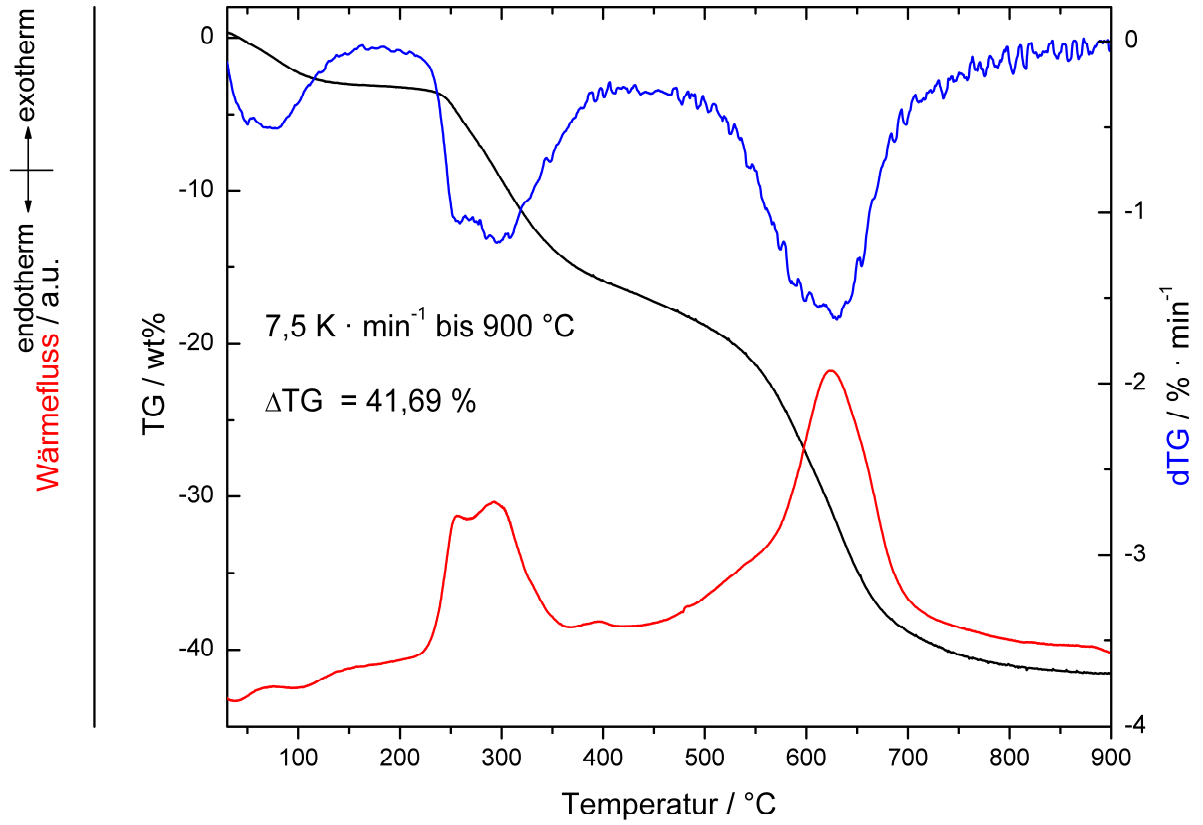


Abb. 8.193: TGA-Messung von P(O)(OEt)<sub>2</sub>-BTEB-PMO (**6b**).

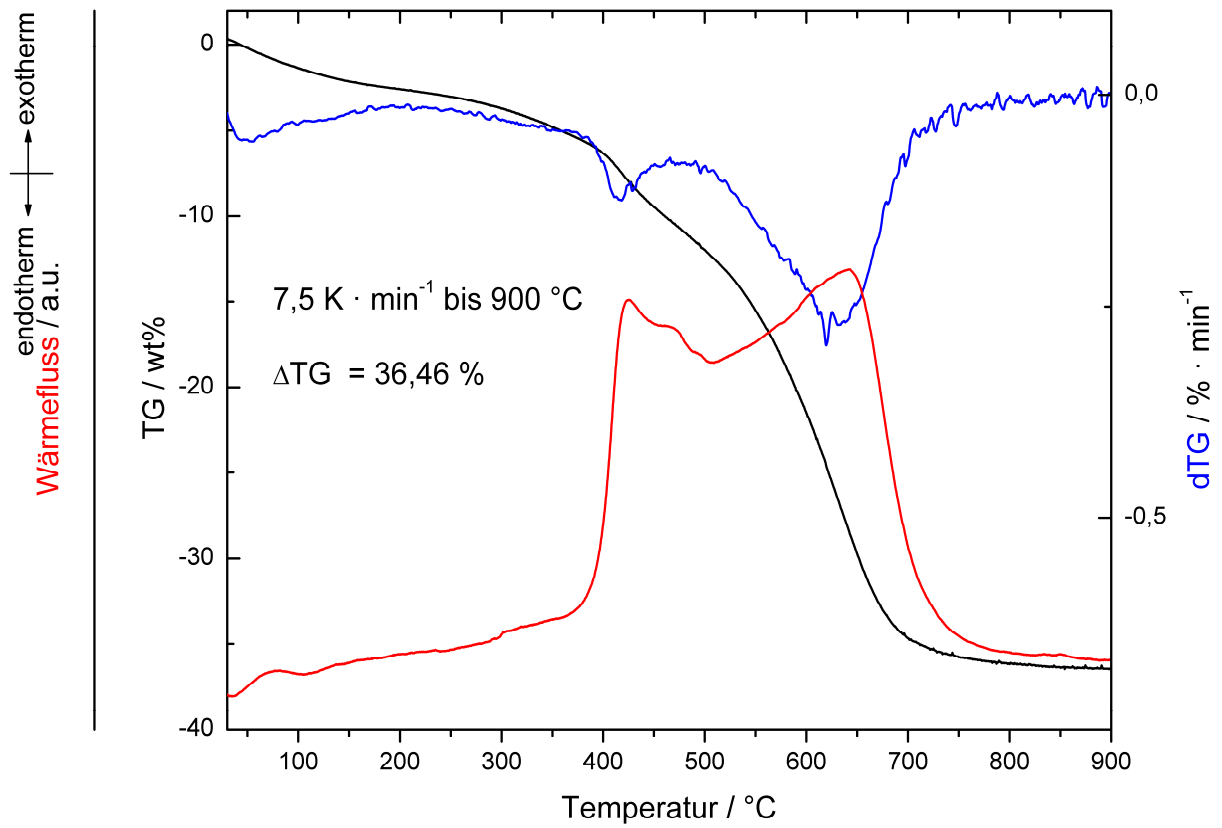


Abb. 8.194: TGA-Messung von P(O)(OH)<sub>2</sub>-BTEB-PMO (**7b**).

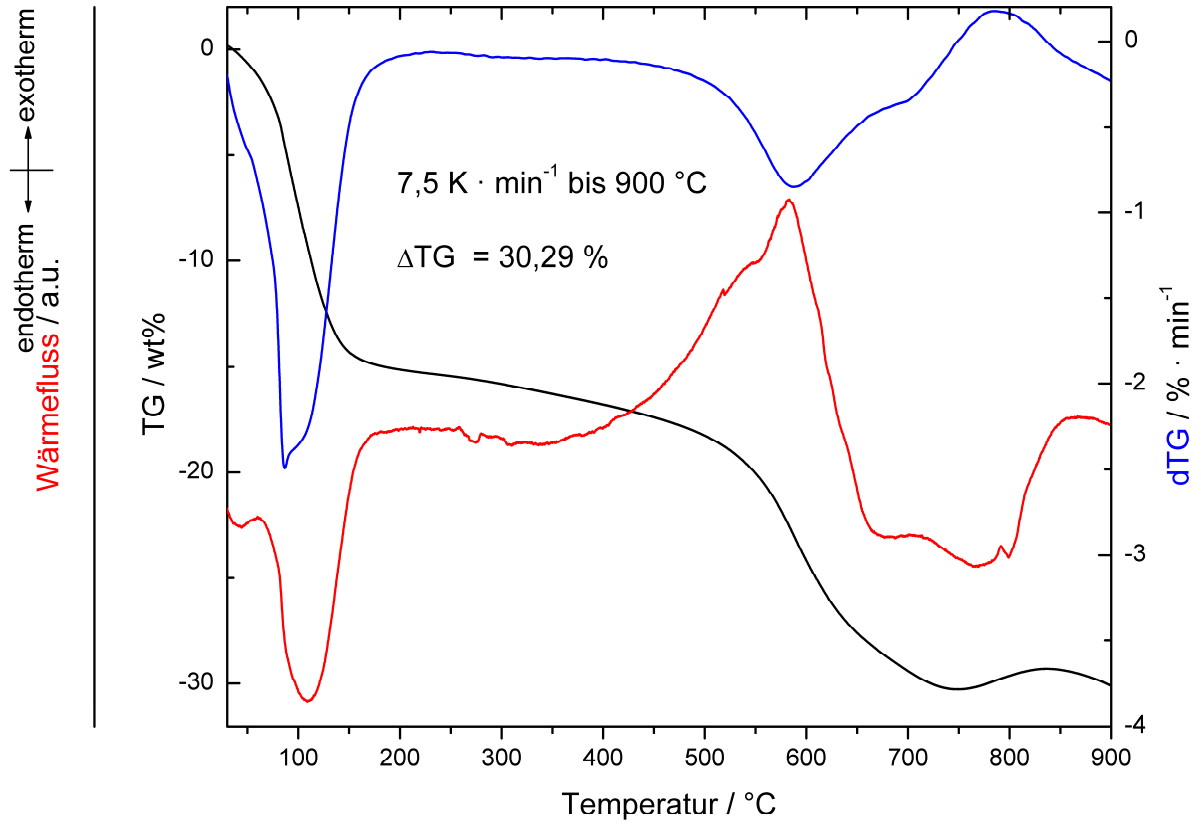


Abb. 8.195: TGA-Messung von ar. SO<sub>3</sub>H-BTEB-PMO (8).

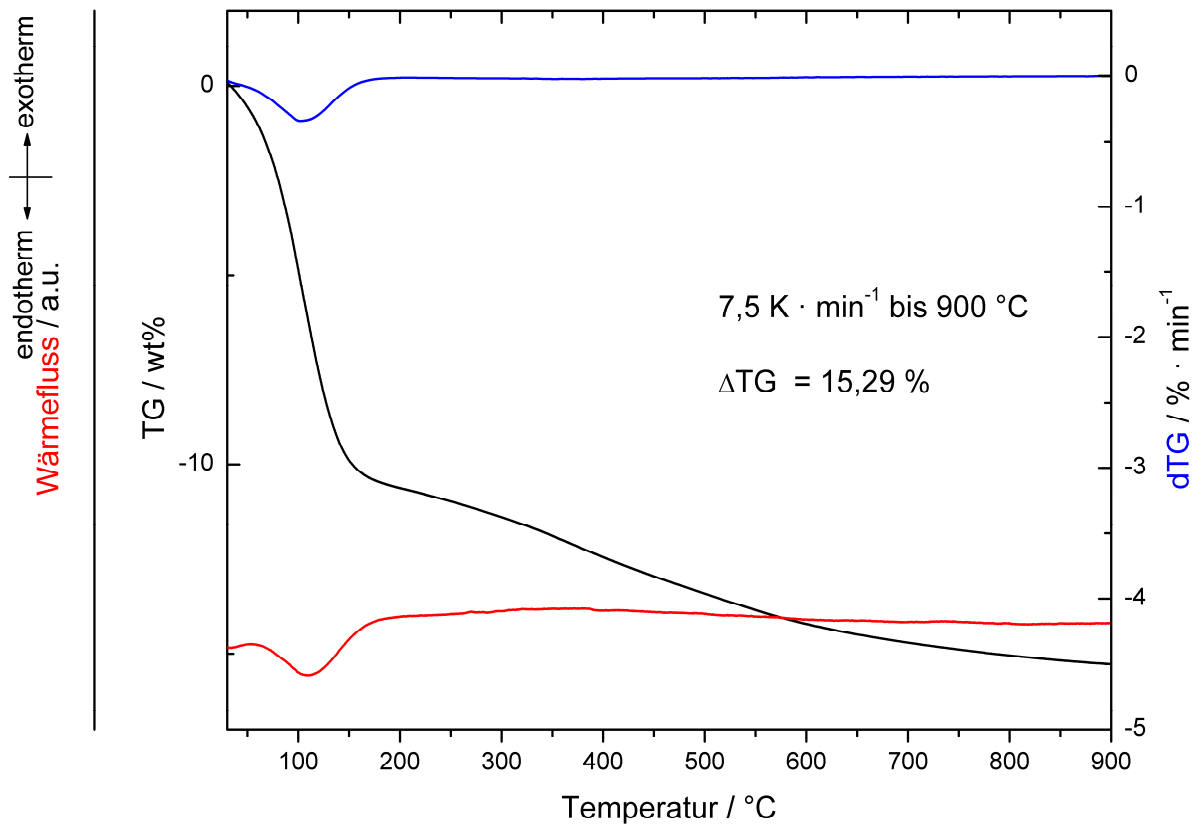


Abb. 8.196: TGA-Messung von SBA-15 (9k).

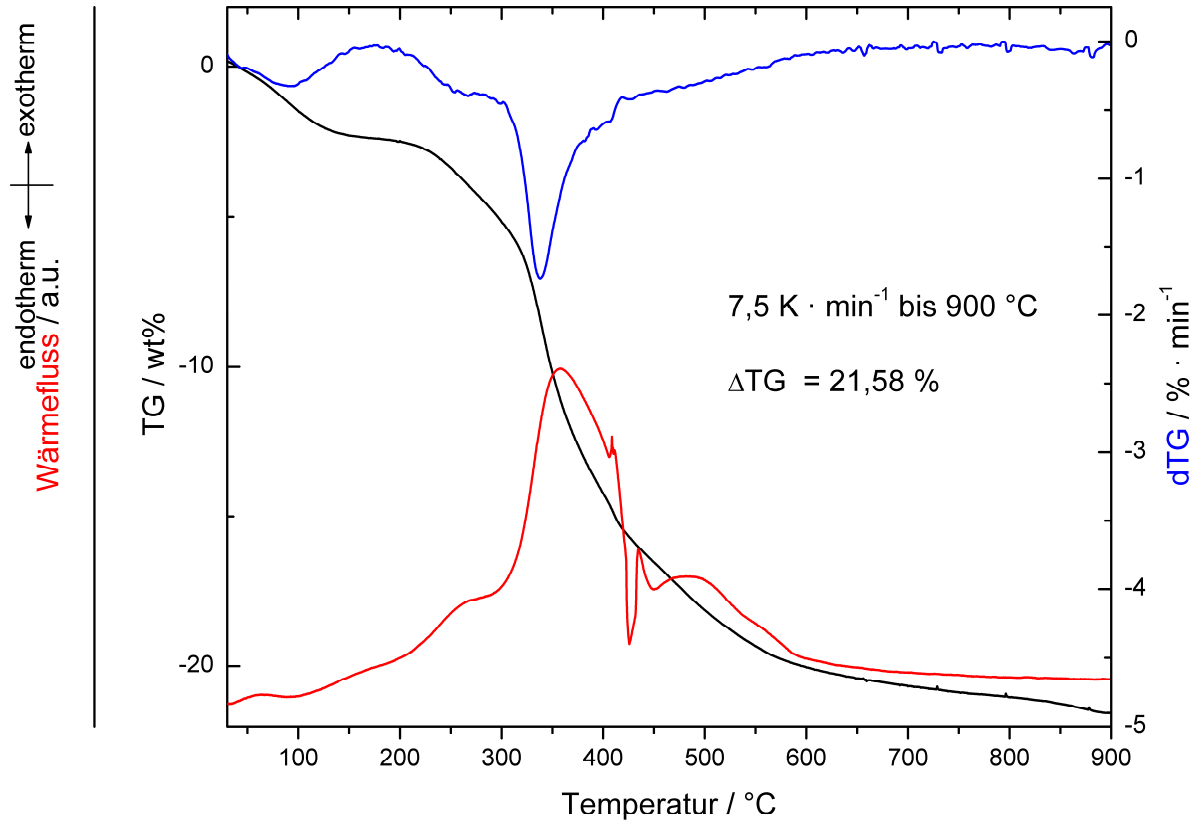


Abb. 8.197: TGA-Messung von SH-SBA-15 (10k).

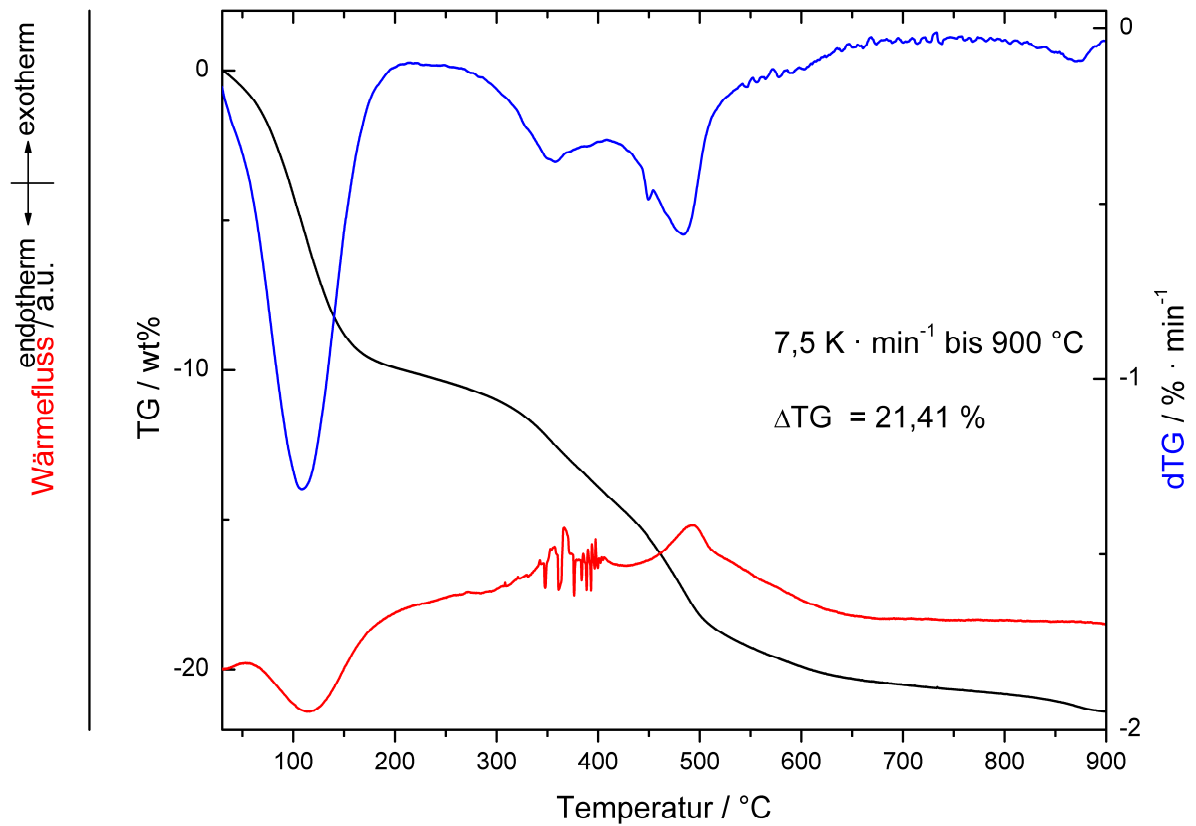


Abb. 8.198: TGA-Messung von SO<sub>3</sub>H-SBA-15 (11k).

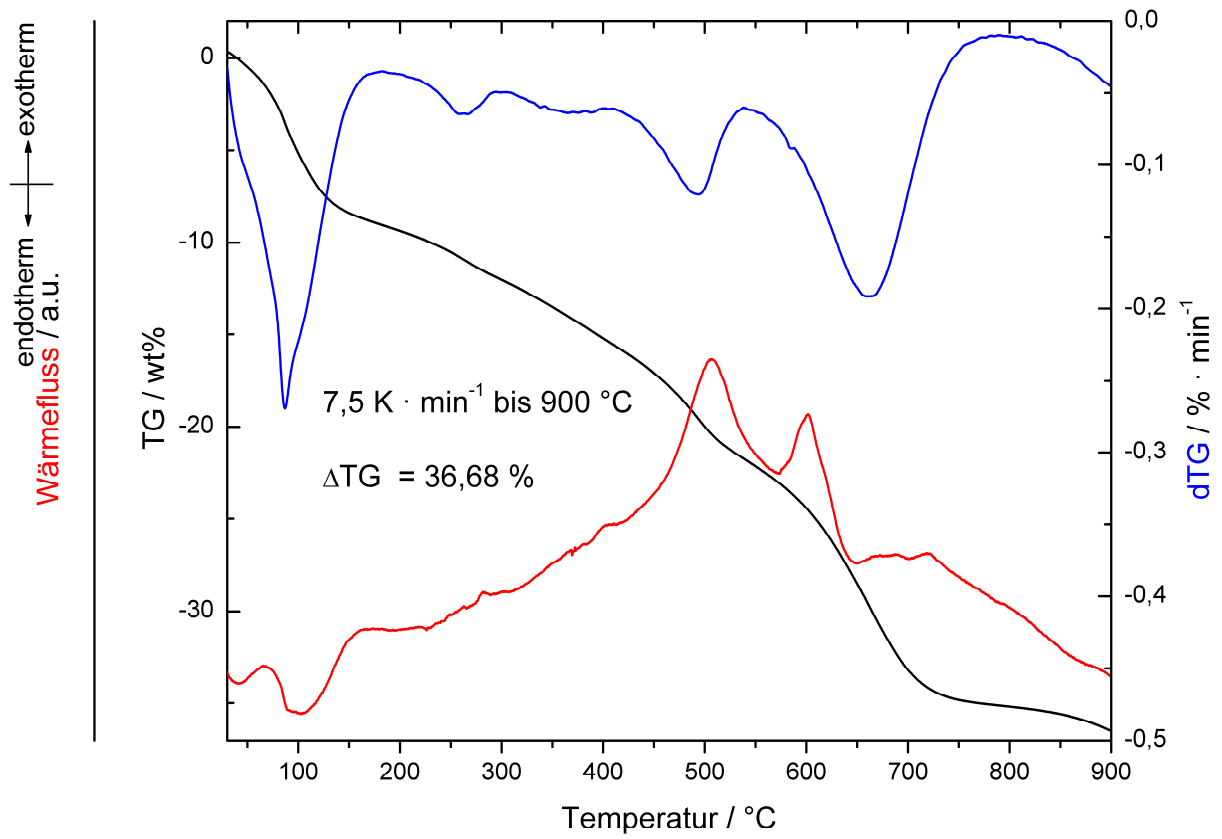


Abb. 8.199: TGA-Messung von NH<sub>4</sub>SO<sub>3</sub>-BTEB-PMO (18).

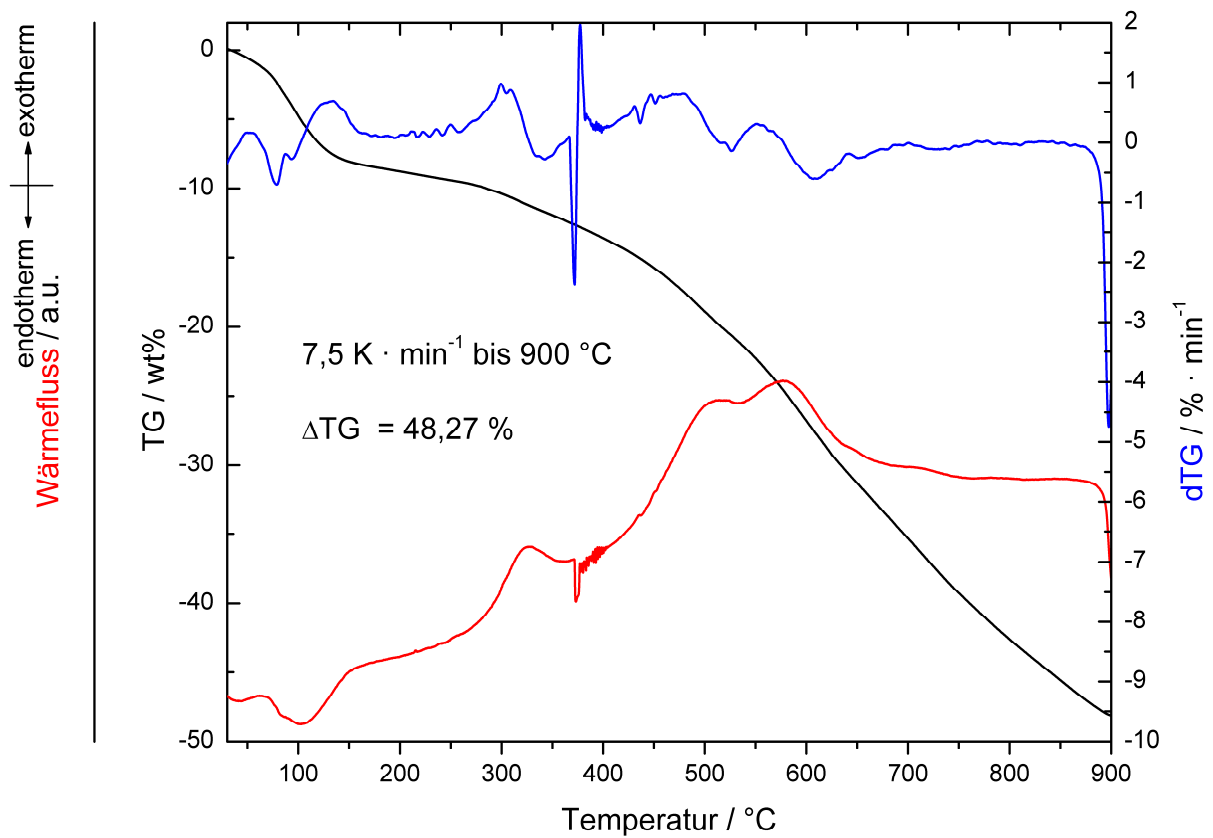


Abb. 8.200: TGA-Messung von PT1-BTEB-PMO (19).

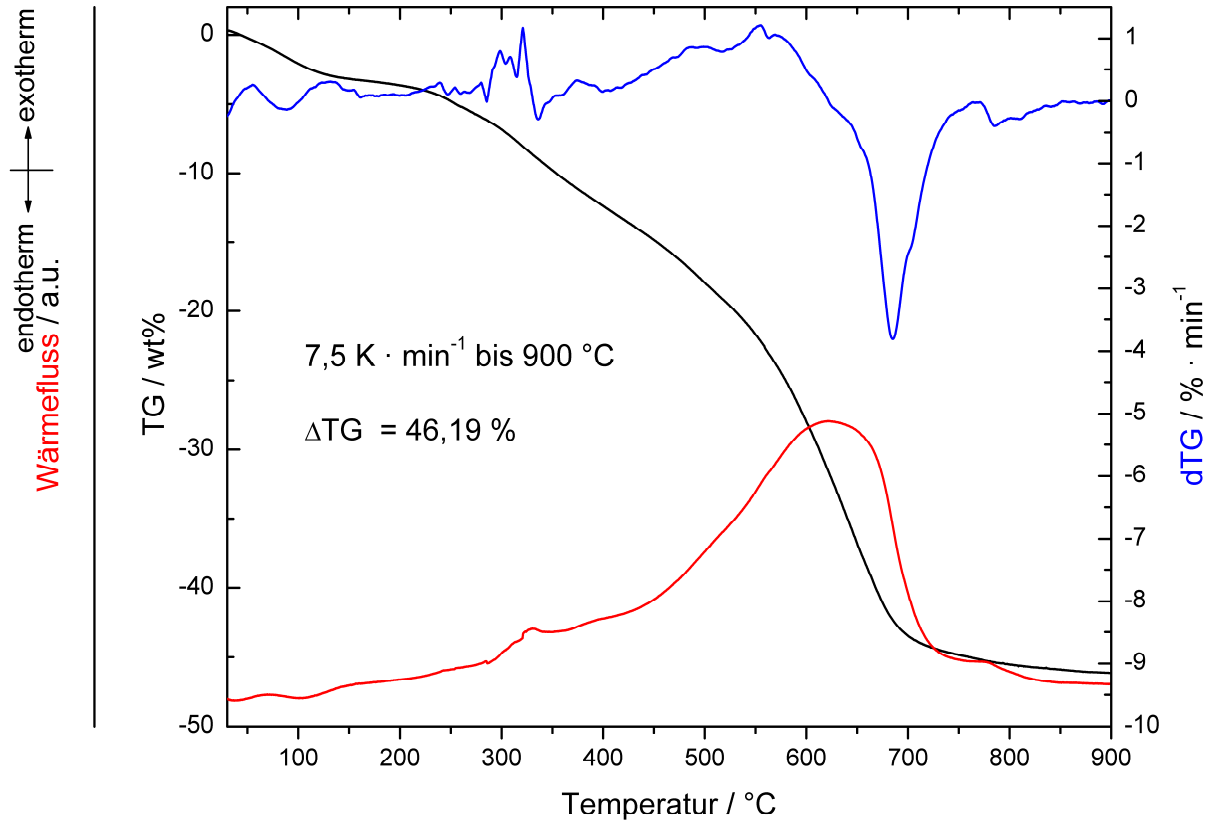


Abb. 8.201: TGA-Messung von rad. PT1-BTEB-PMO (20).

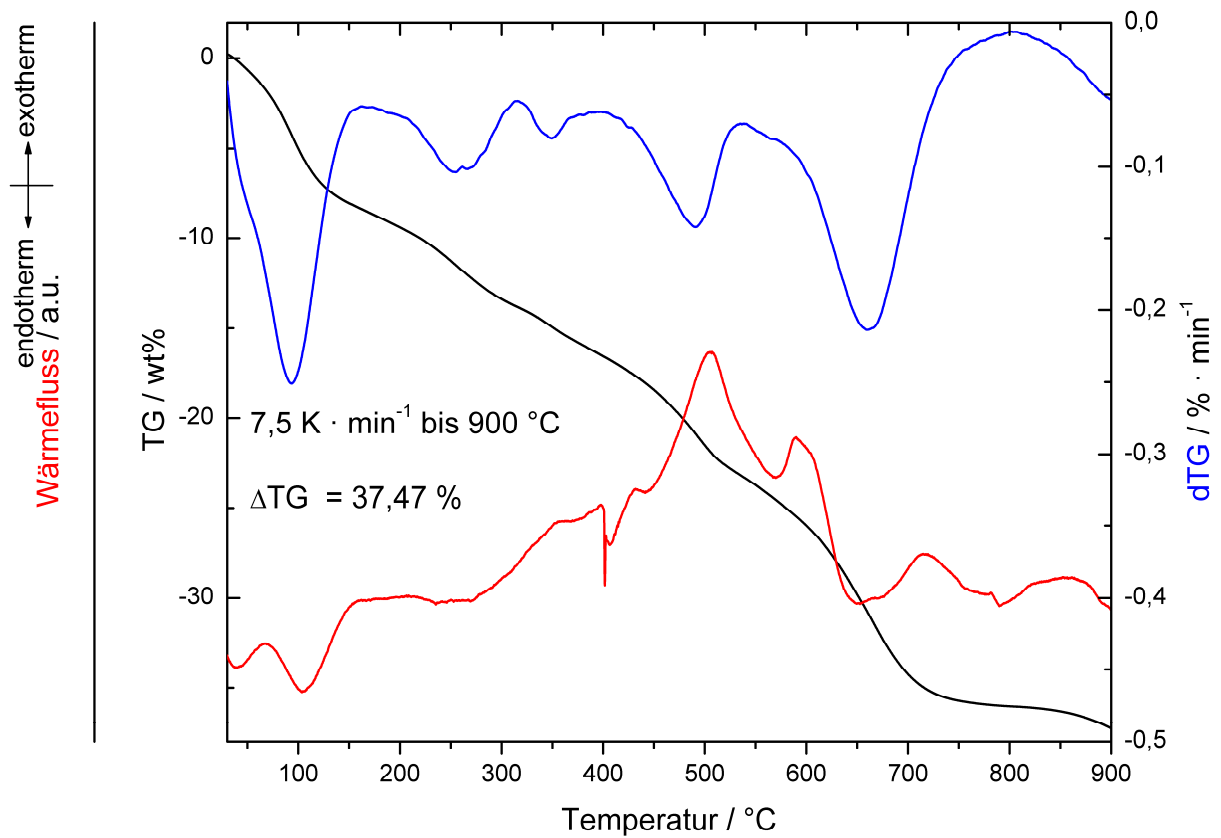


Abb. 8.202: TGA-Messung von PySO<sub>3</sub>-BTEB-PMO (23).

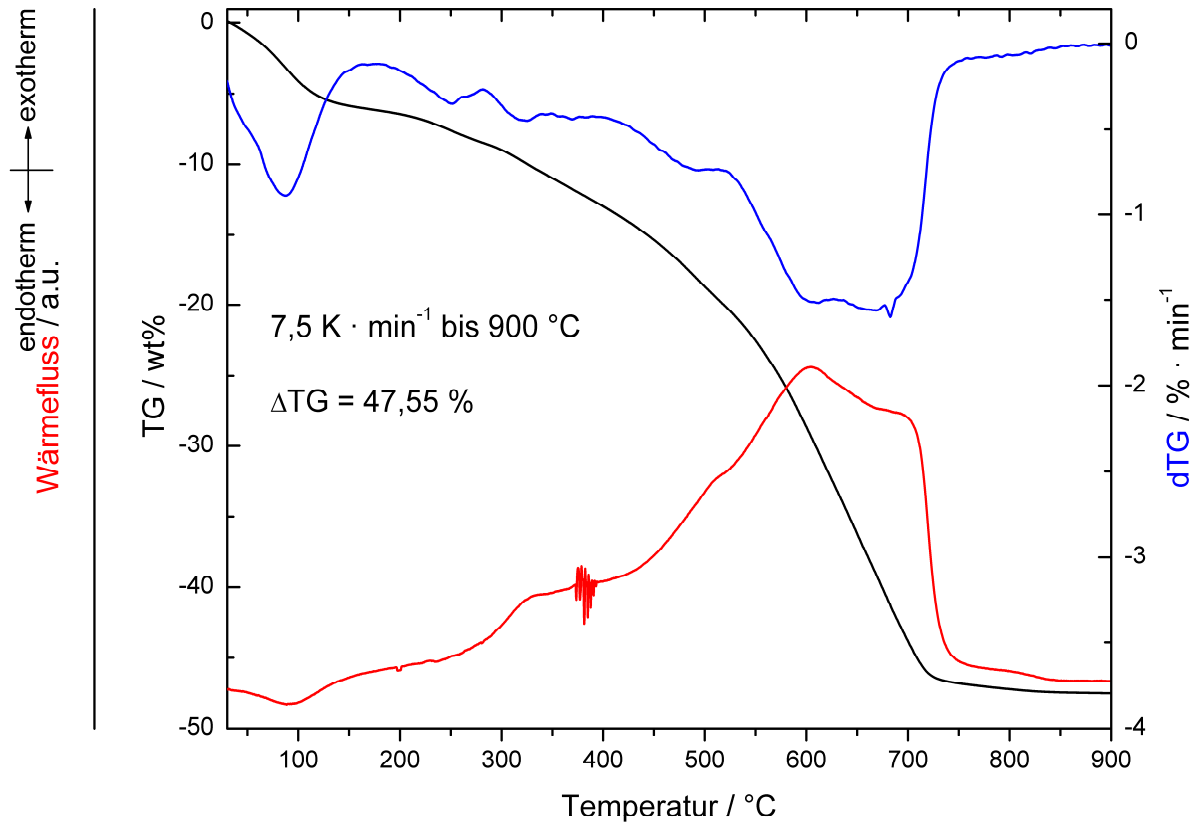


Abb. 8.203: TGA-Messung von PT1-BTEB-PMO (**24**).

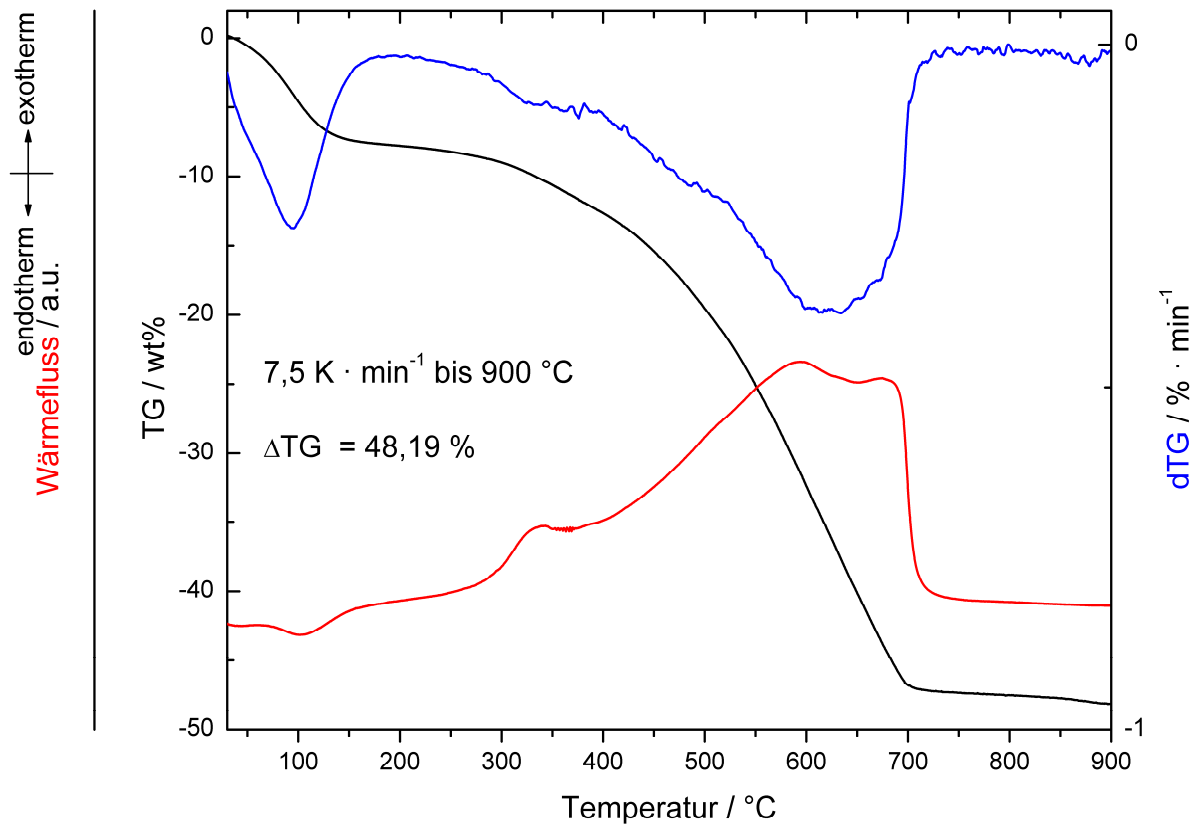


Abb. 8.204: TGA-Messung von PT2-BTEB-PMO (**25**).

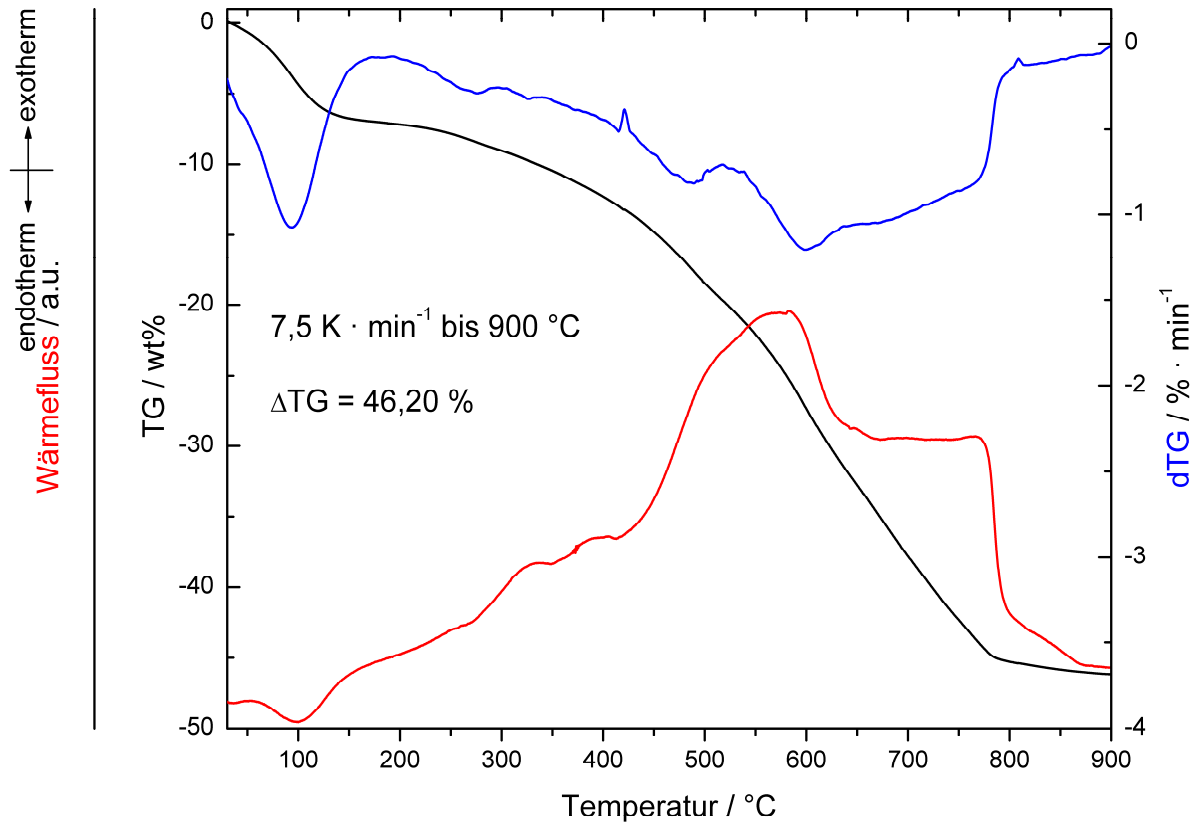


Abb. 8.205: TGA-Messung von PT3-BTEB-PMO (26).

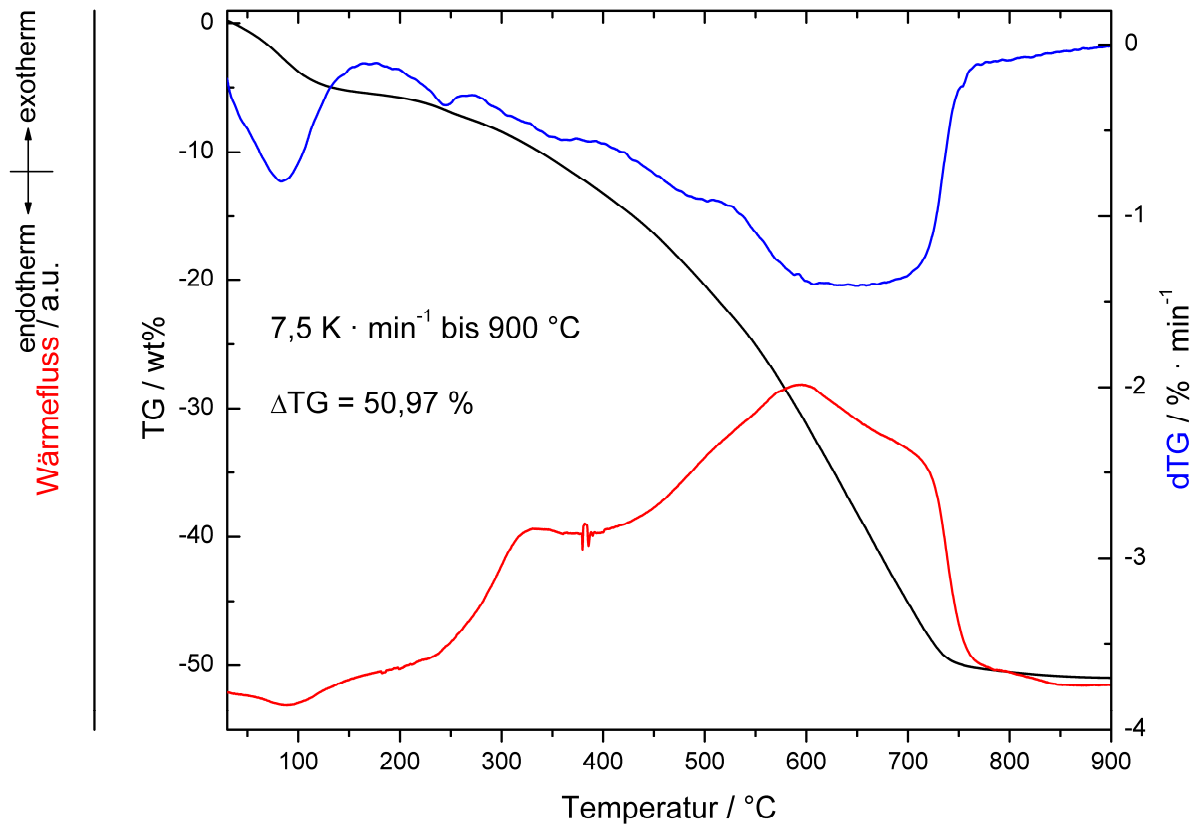


Abb. 8.206: TGA-Messung von PT4-BTEB-PMO (27).

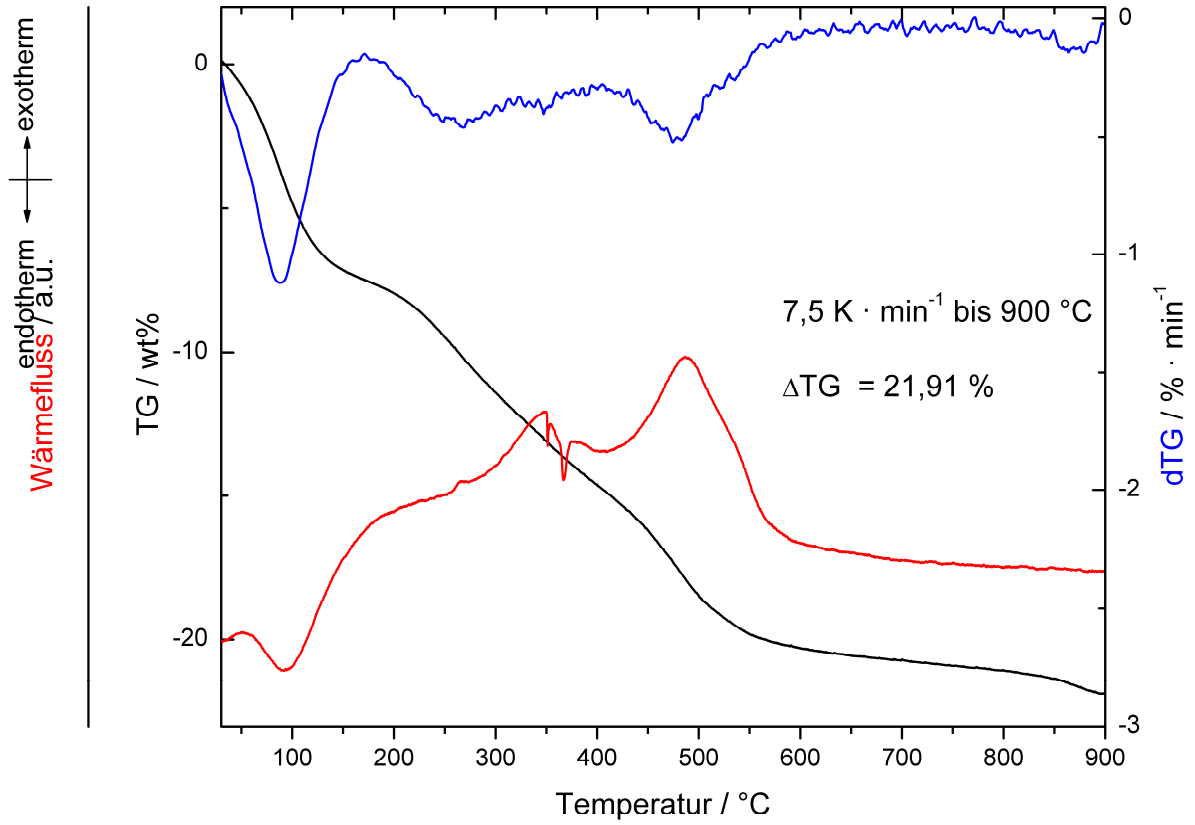


Abb. 8.207: TGA-Messung von  $\text{PySO}_3\text{-SBA-15}$  (28k).

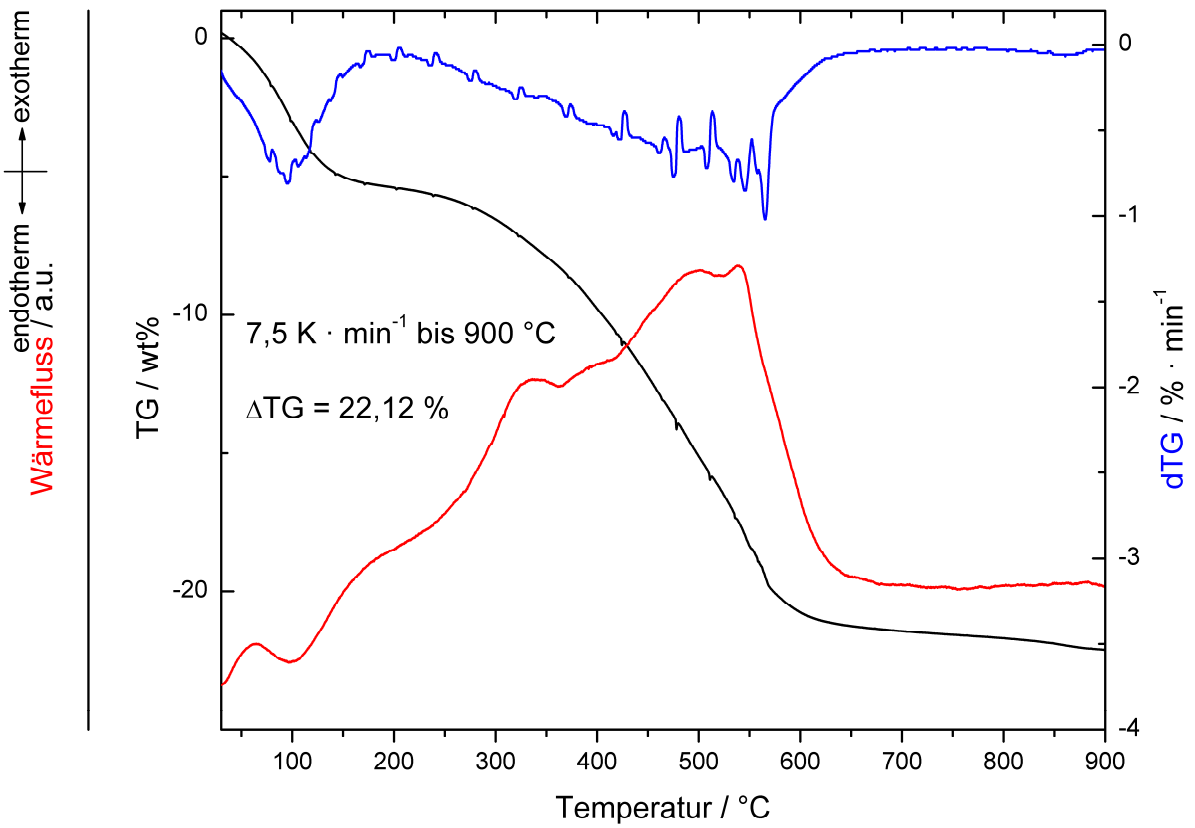


Abb. 8.208: TGA-Messung von  $\text{PT1-SBA-15}$  (29k).



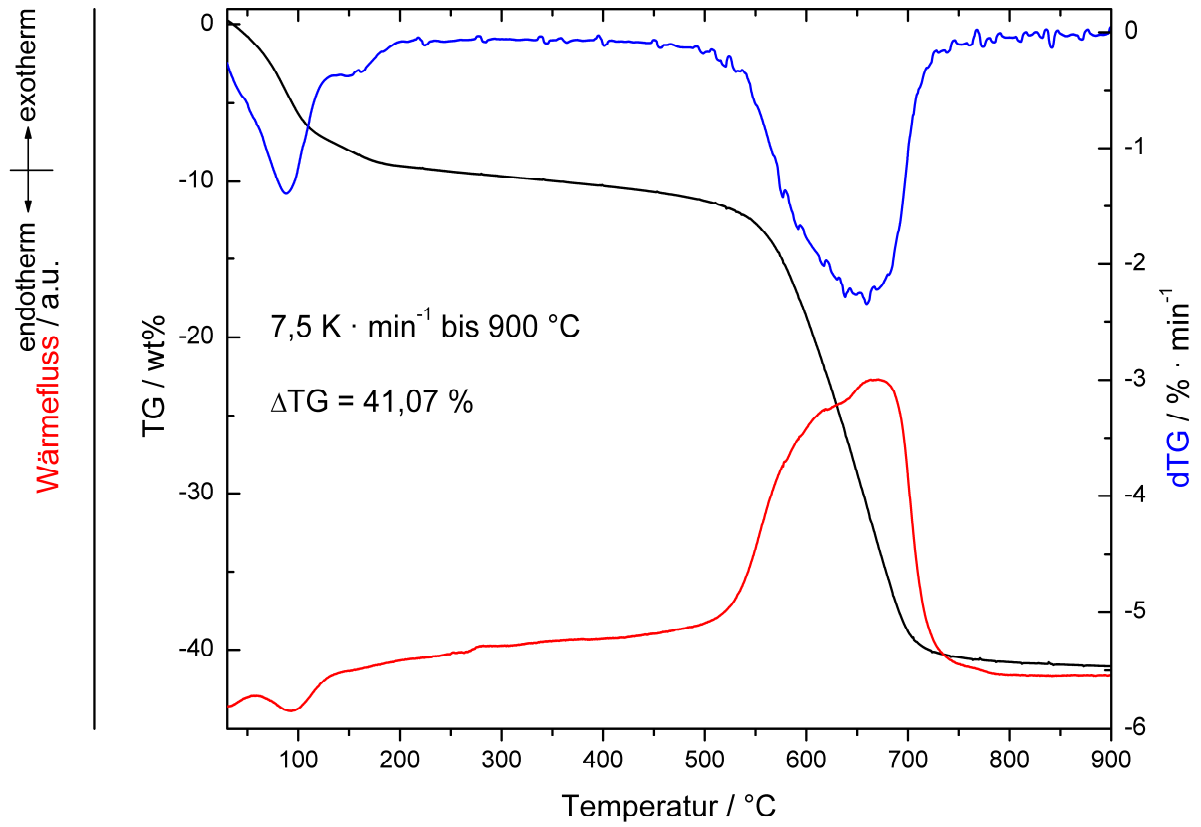


Abb. 8.209: TGA-Messung von BTEB-NP (30).

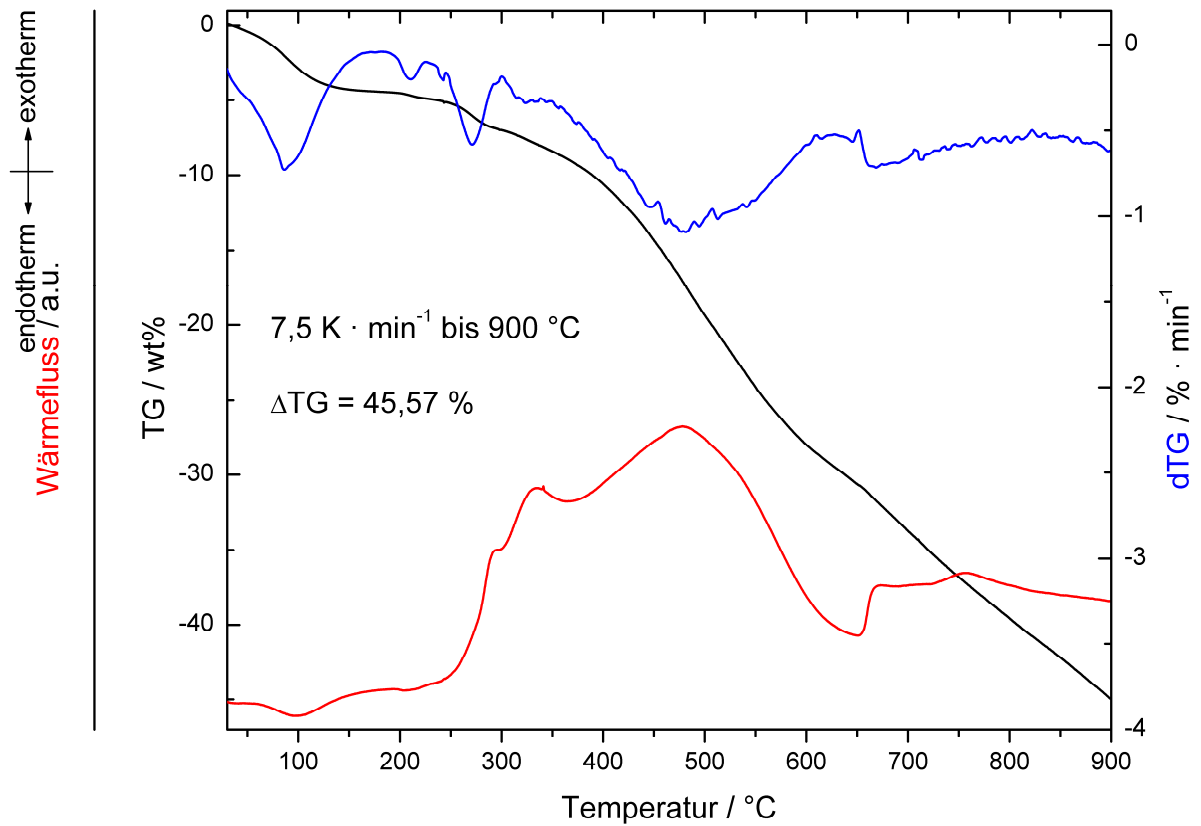


Abb. 8.210: TGA-Messung von PT5-BTEB-NP (34).

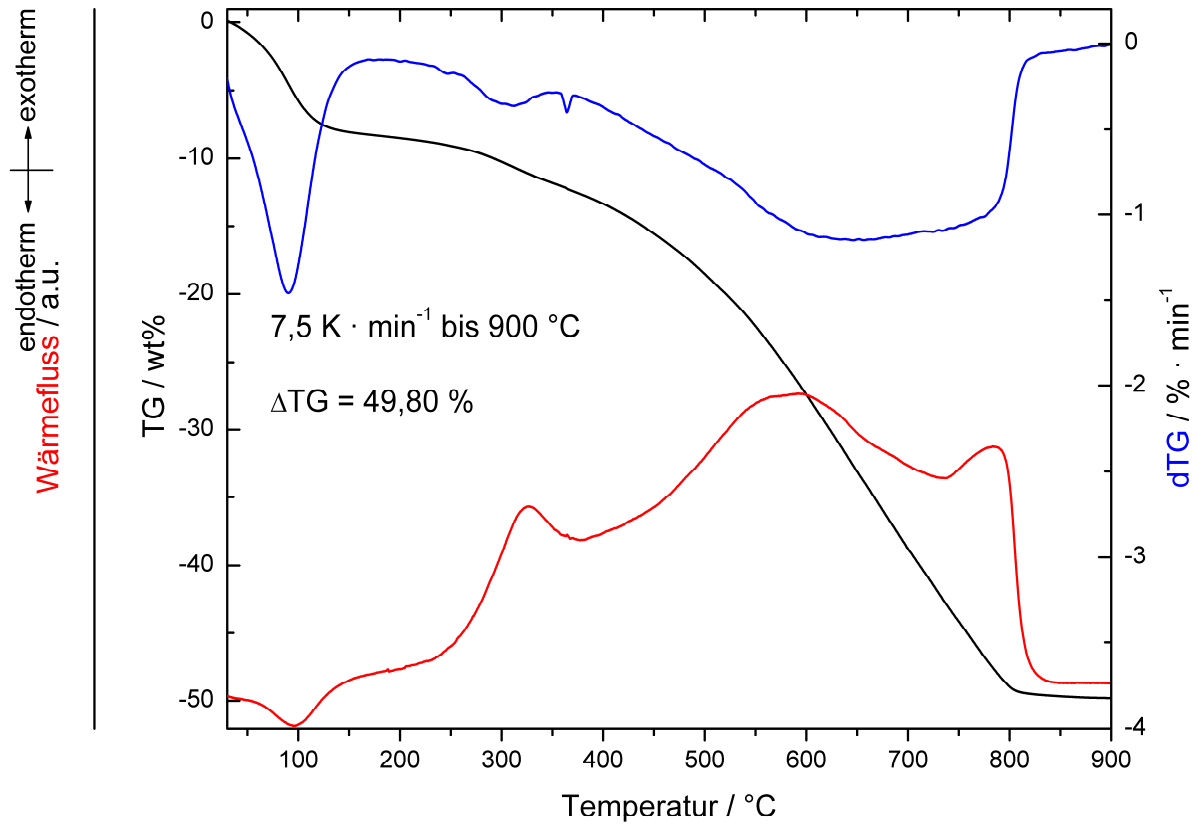


Abb. 8.211: TGA-Messung von PT6-BTEB-NP (35).

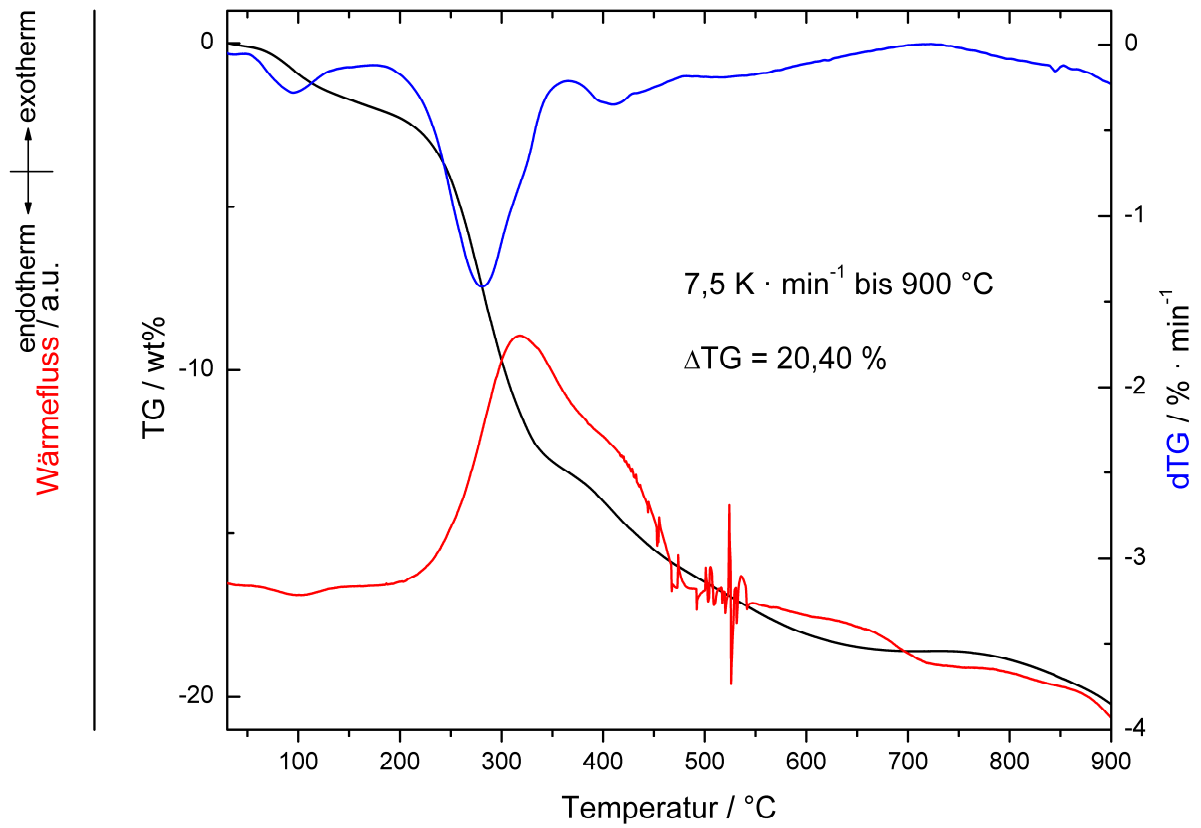


Abb. 8.212: TGA-Messung von PT7-BTEB-NP (36).

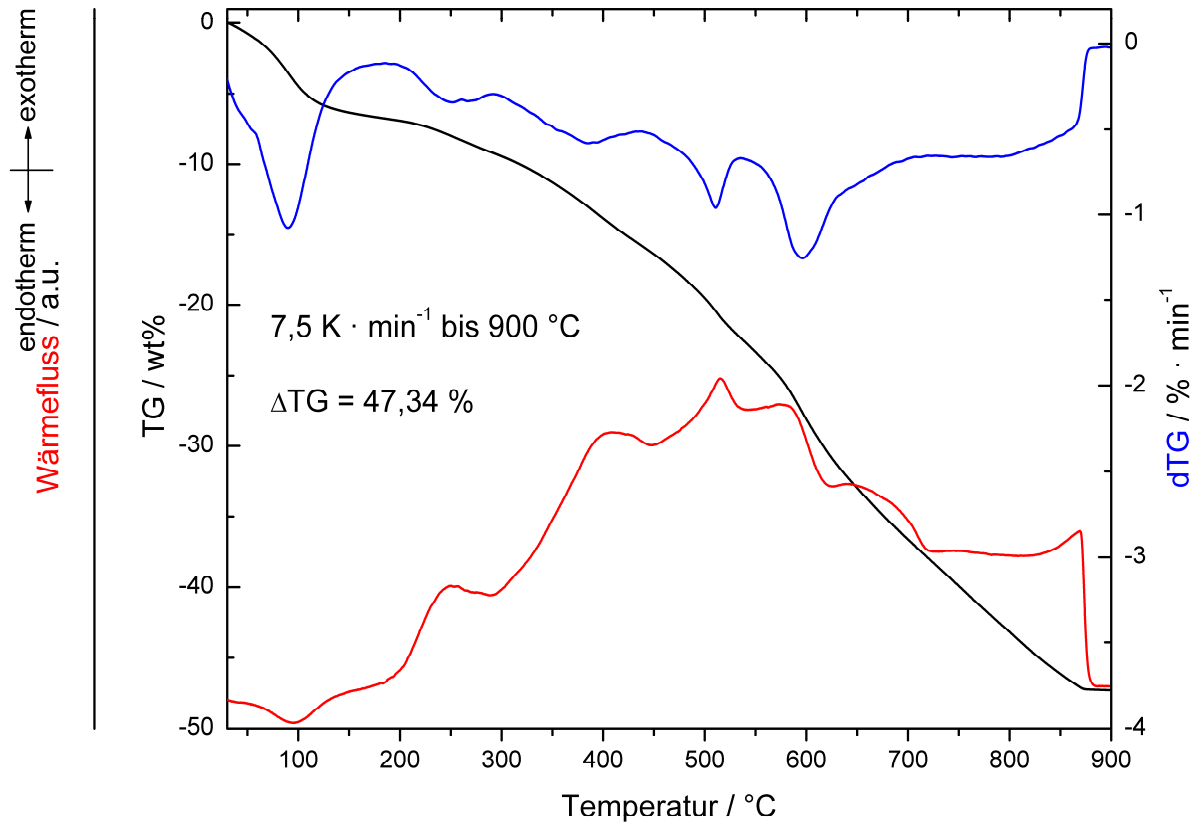


Abb. 8.213: TGA-Messung von PT8-BTEB-NP (38).

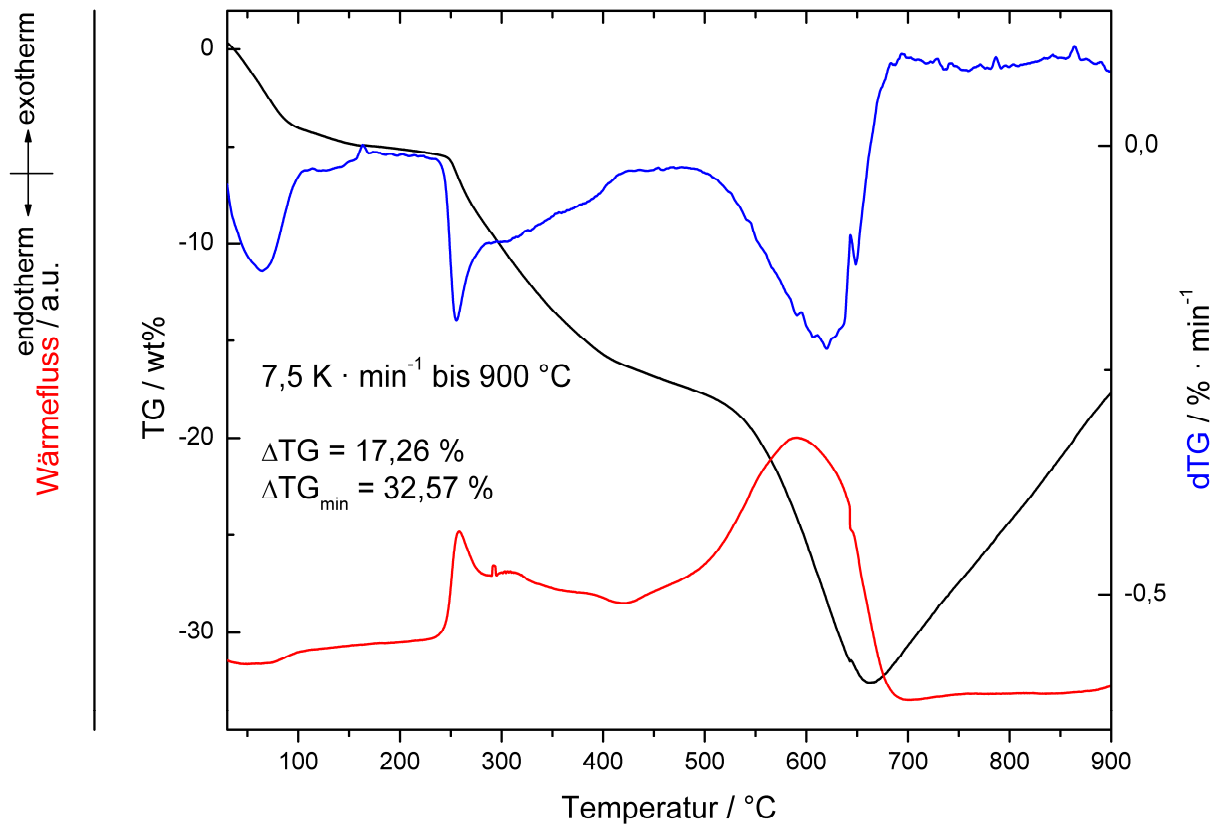


Abb. 8.214: TGA-Messung von NCS-BTEB-PMO (41).

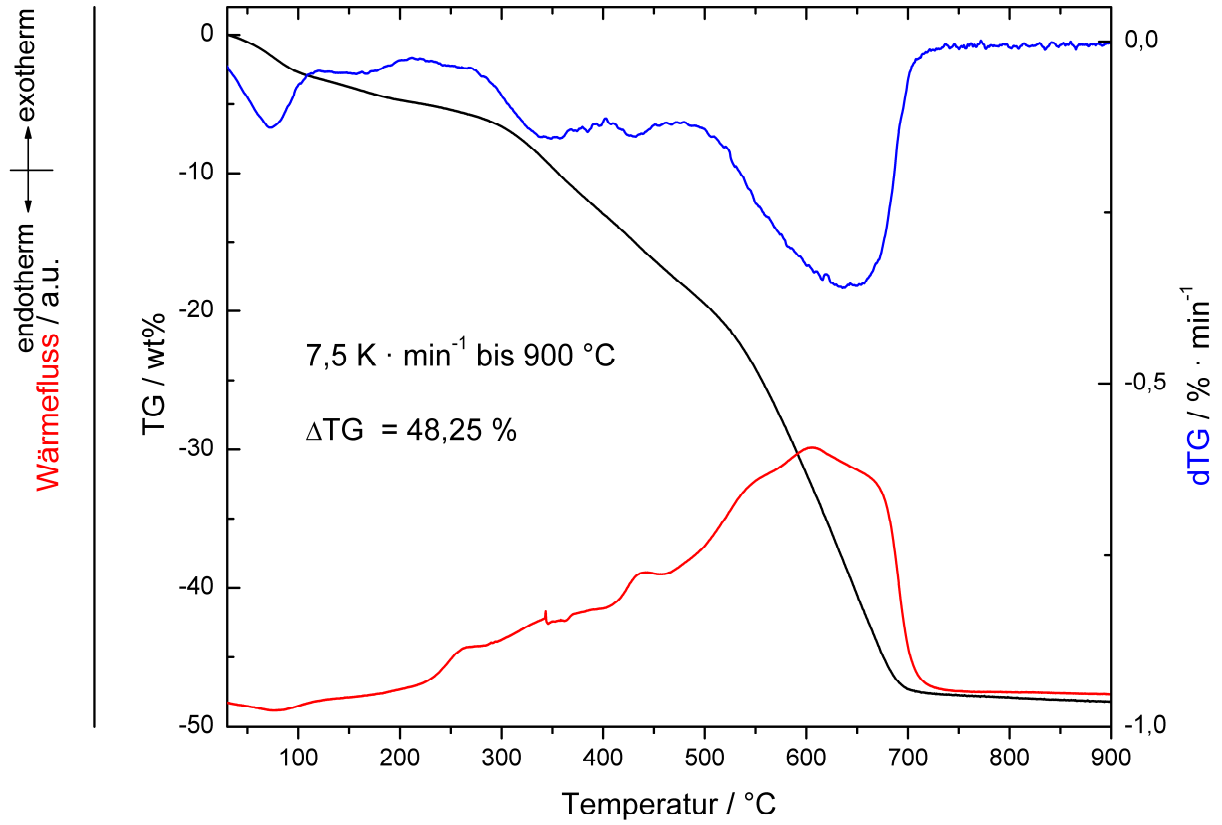


Abb. 8.215: TGA-Messung von *epi*-Chinin-BTEB-PMO (**44a**).

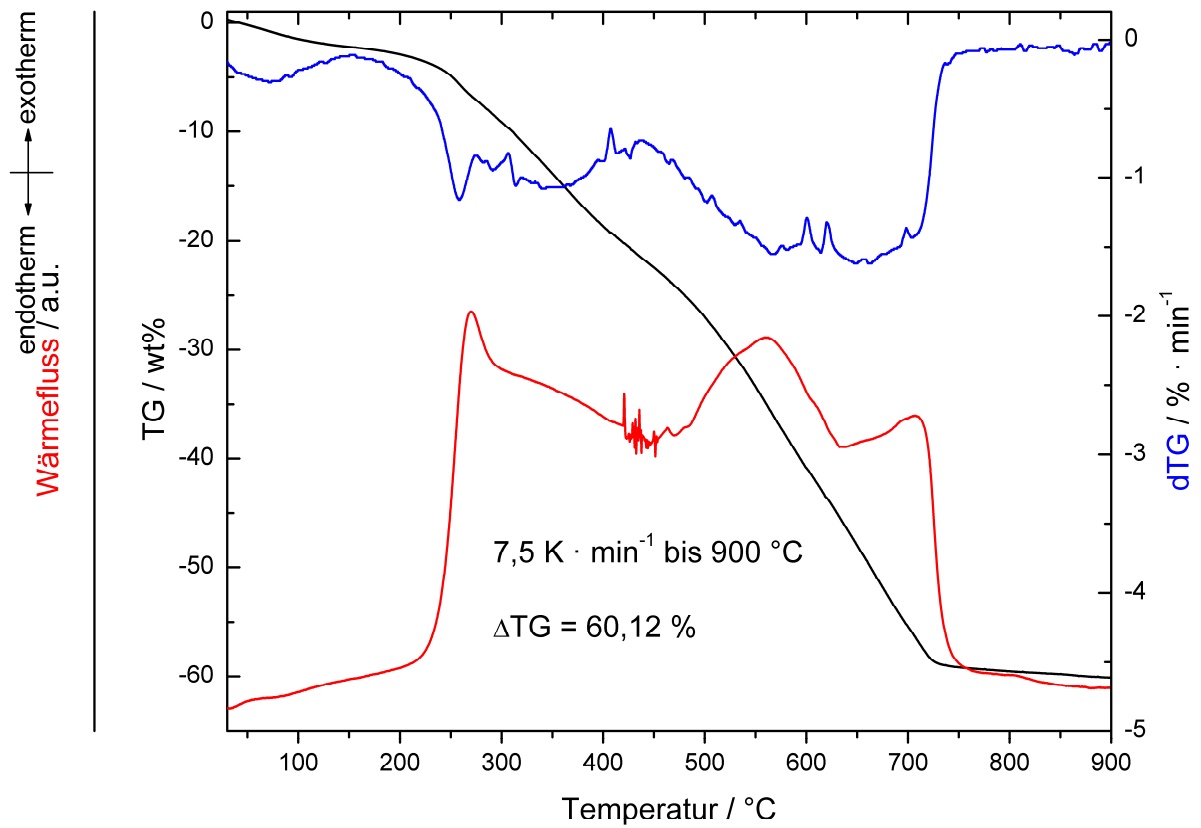


Abb. 8.216: TGA-Messung von *epi*-Chinin-BTEB-PMO (**44b**).

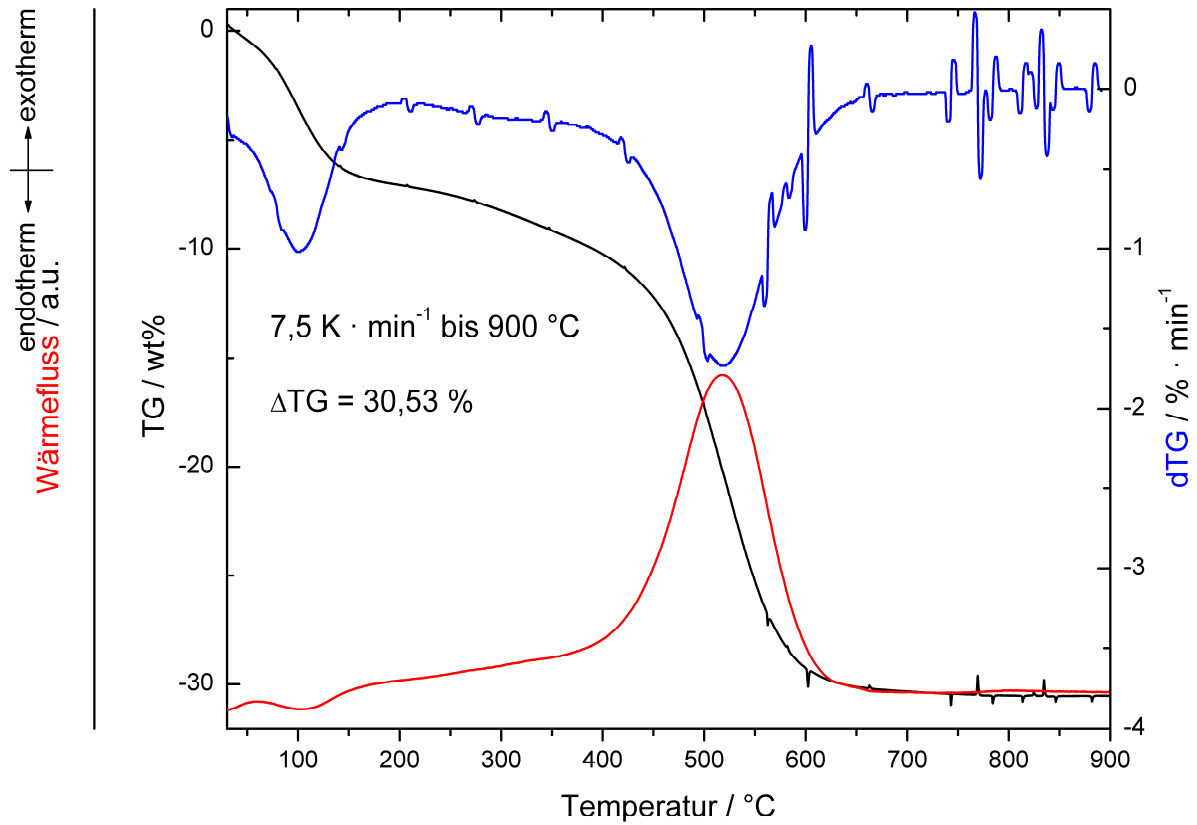


Abb. 8.217: TGA-Messung von V-BTEB-PMO V1 (325) (63b).

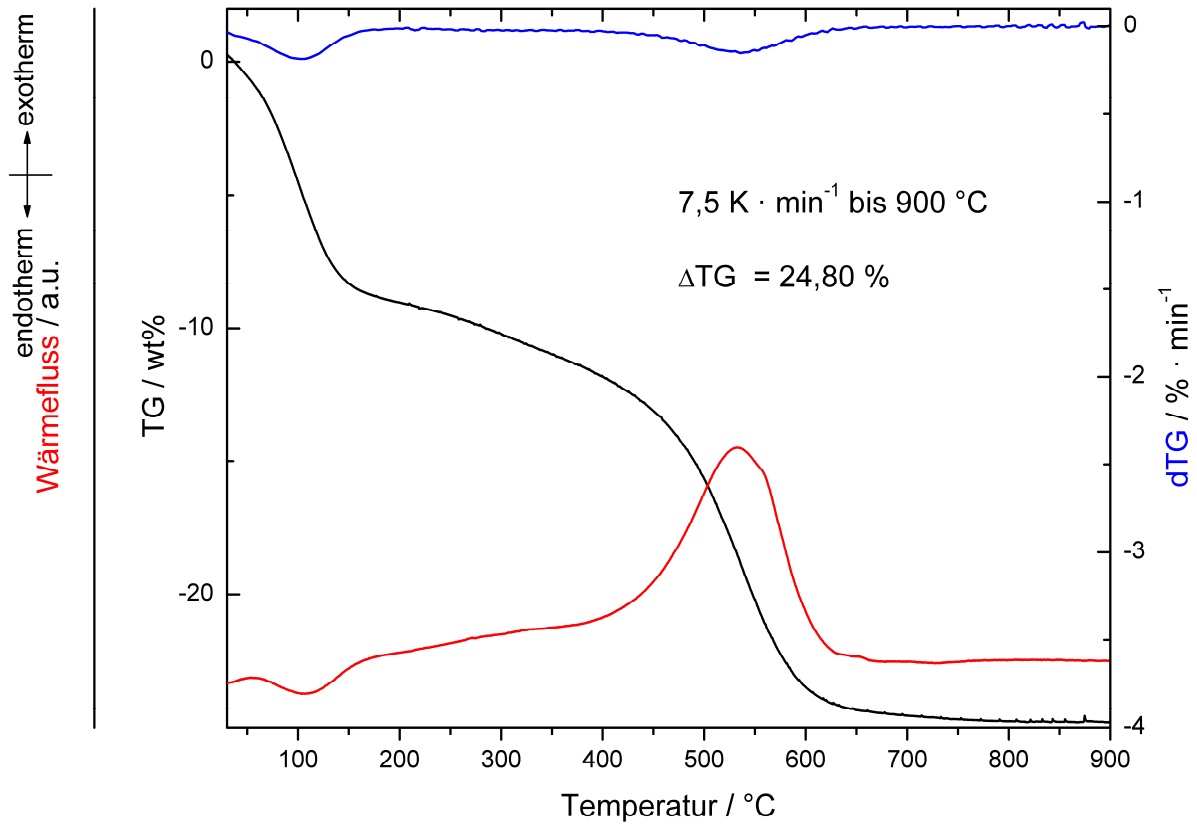


Abb. 8.218: TGA-Messung von V-BTEB-PMO V1 (375) (63c).

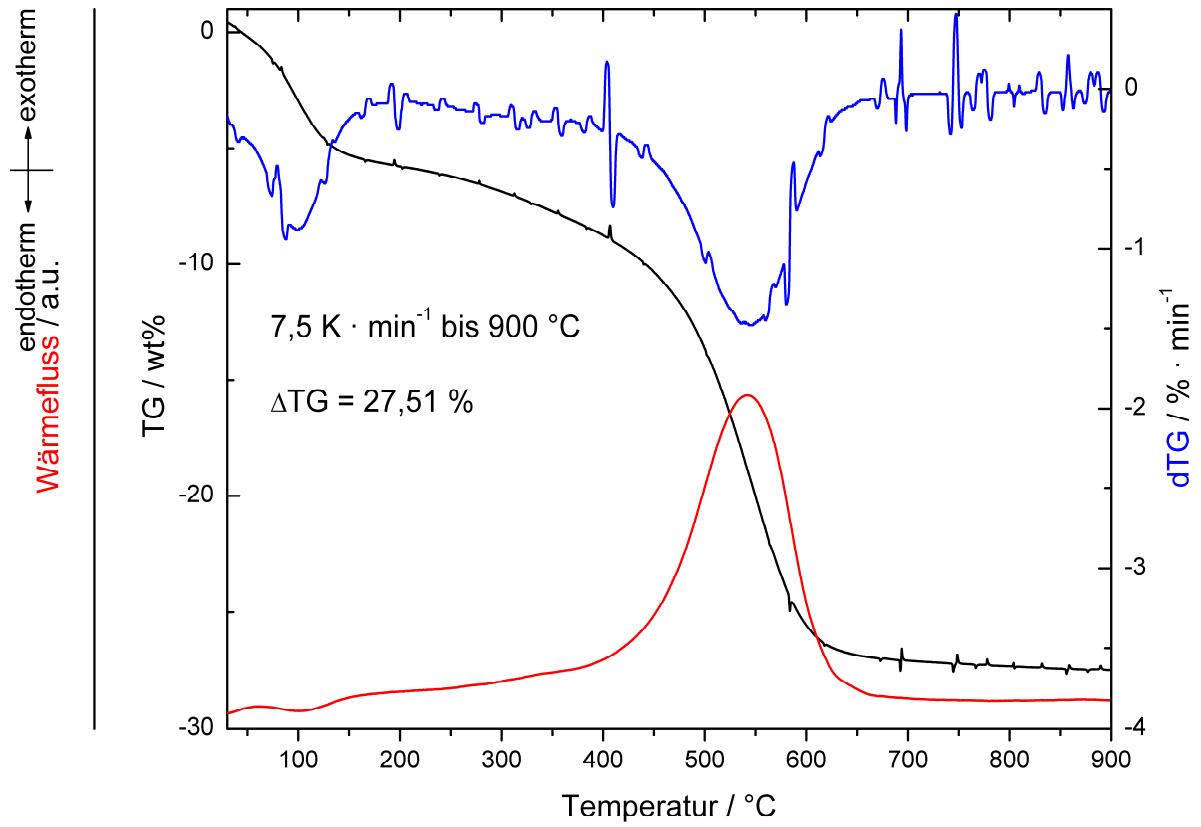


Abb. 8.219: TGA-Messung von V-BTEB-PMO V2 (325) (64b).

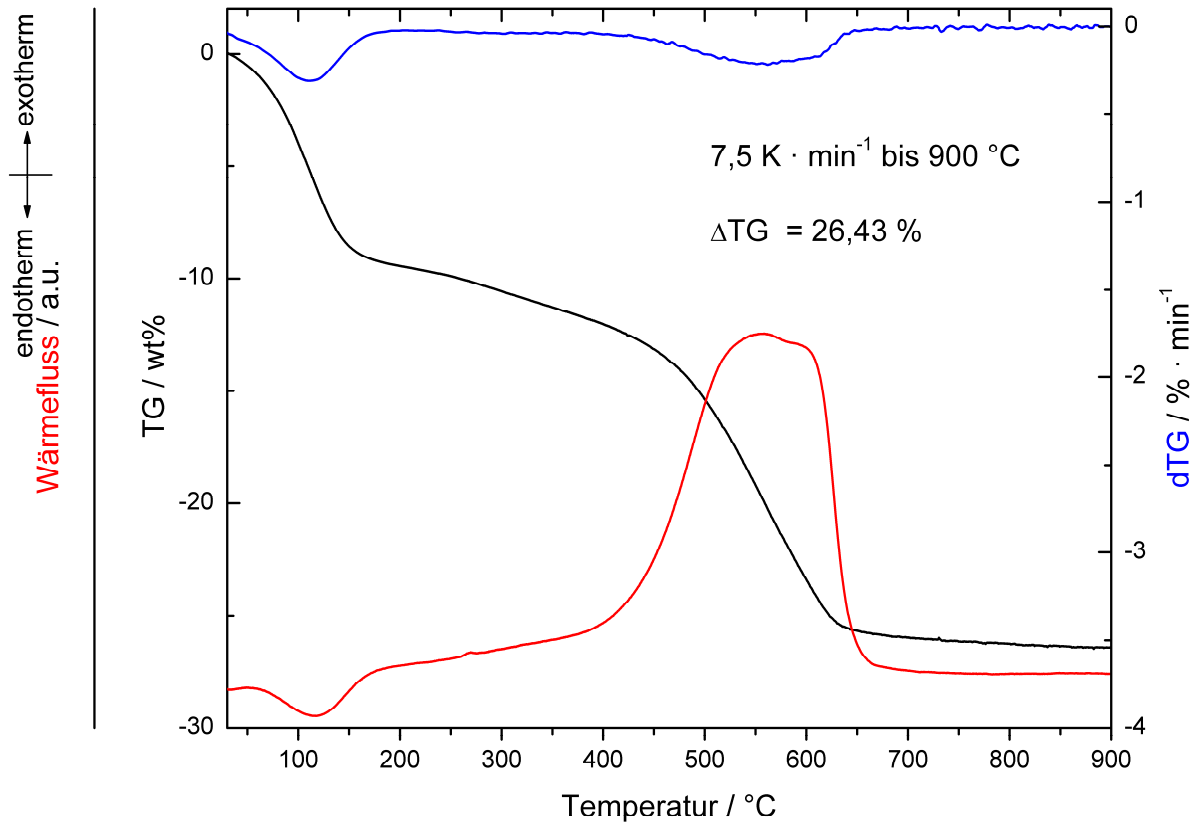


Abb. 8.220: TGA-Messung von V-BTEB-PMO V2 (375) (64c).

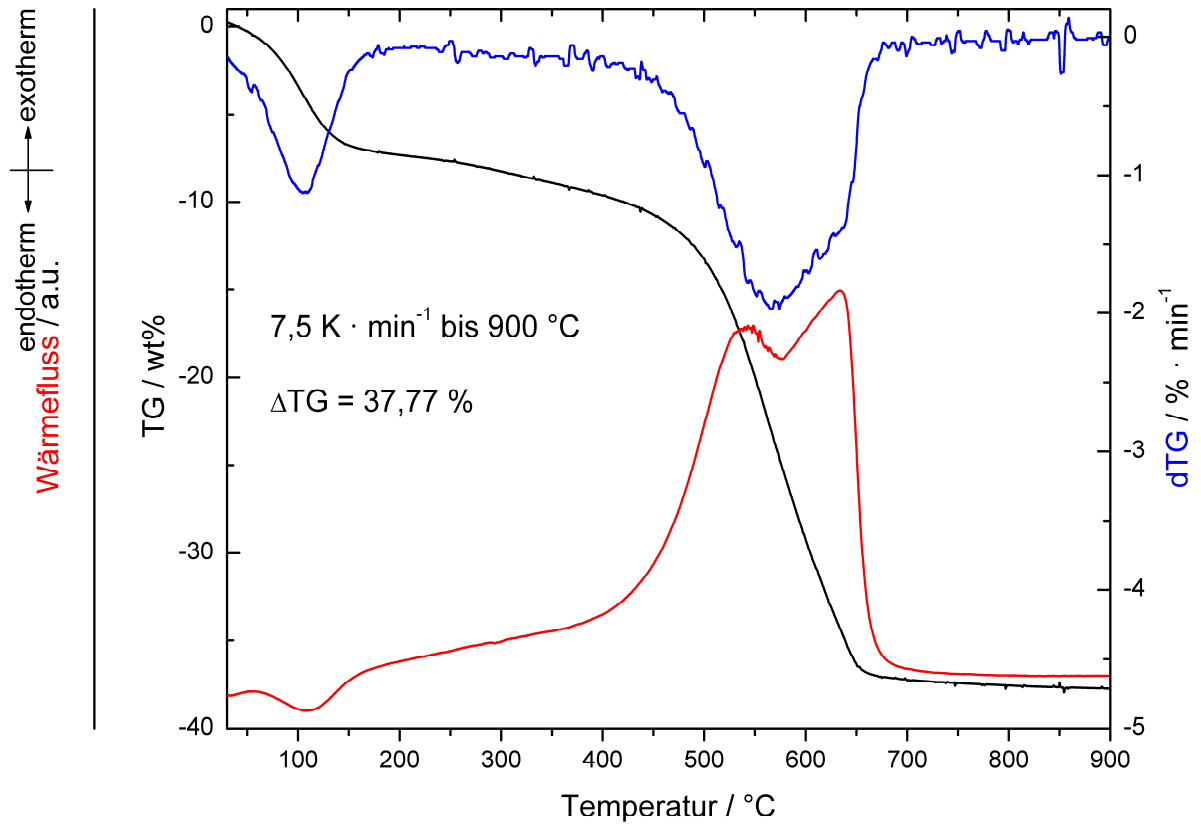


Abb. 8.221: TGA-Messung von V-BTEB-PMO V3 (325) (**65b**).

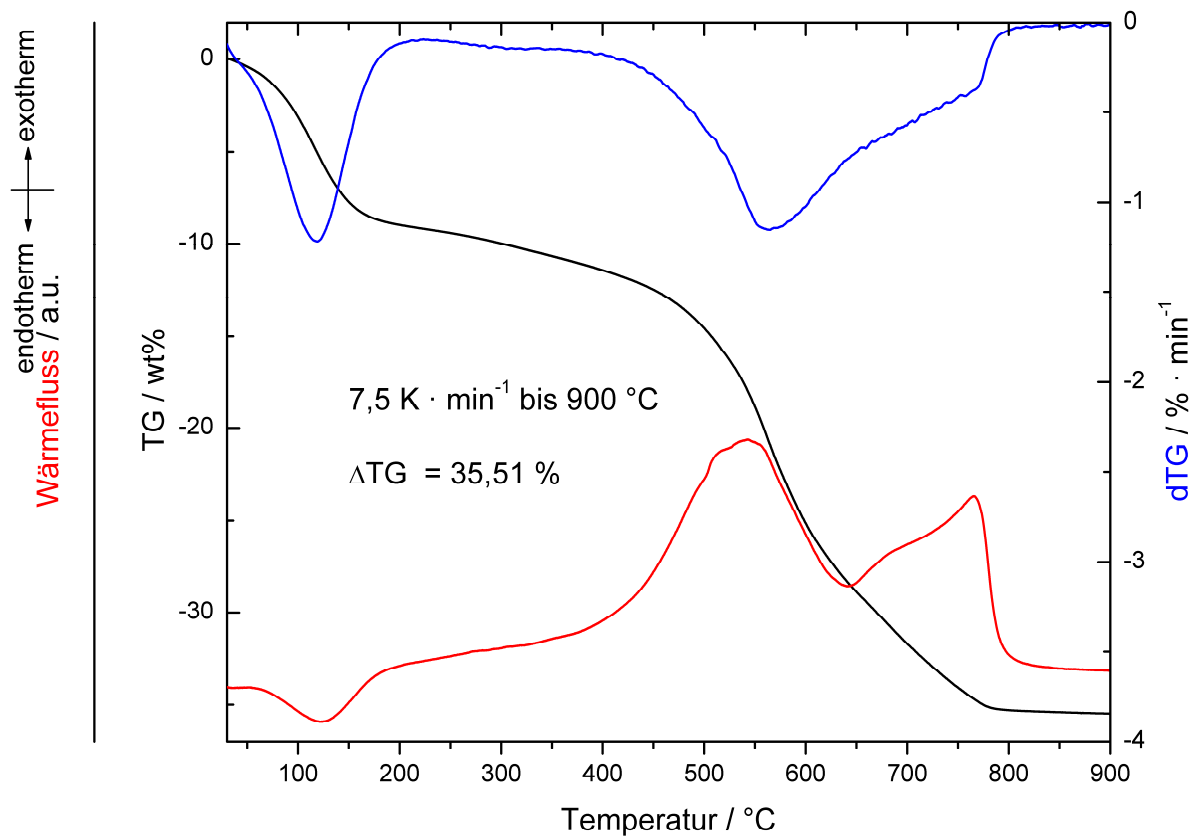


Abb. 8.222: TGA-Messung von V-BTEB-PMO V3 (375) (**65c**).

## 8.4 UV/Vis-Spektren

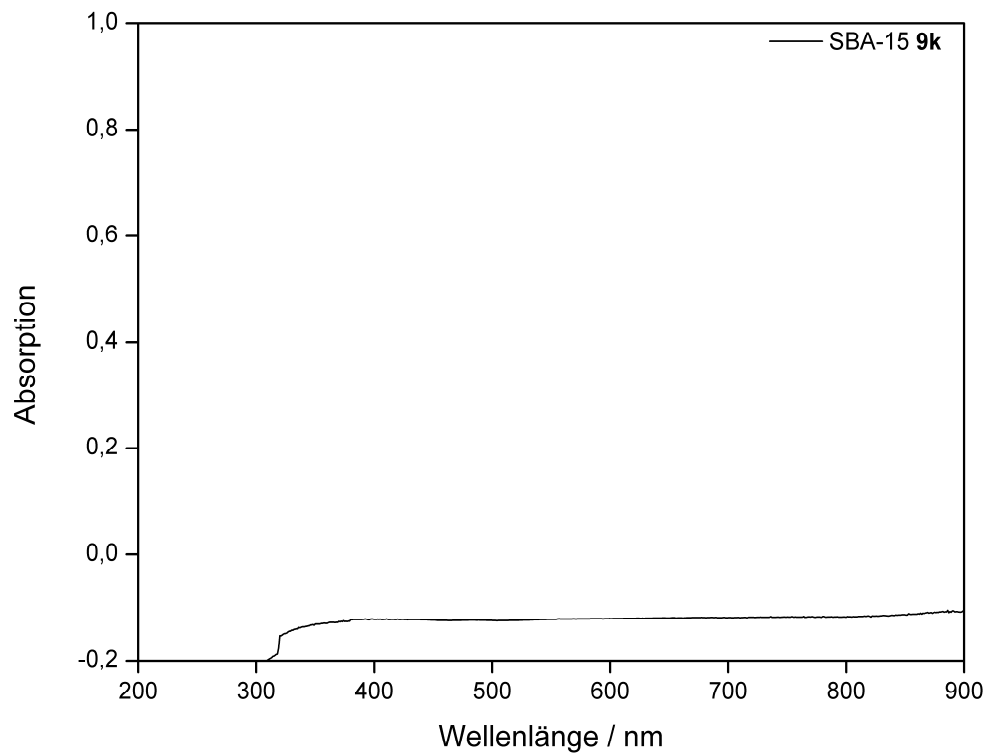


Abb. 8.223: UV/Vis-Spektrum von SBA-15 (9k).

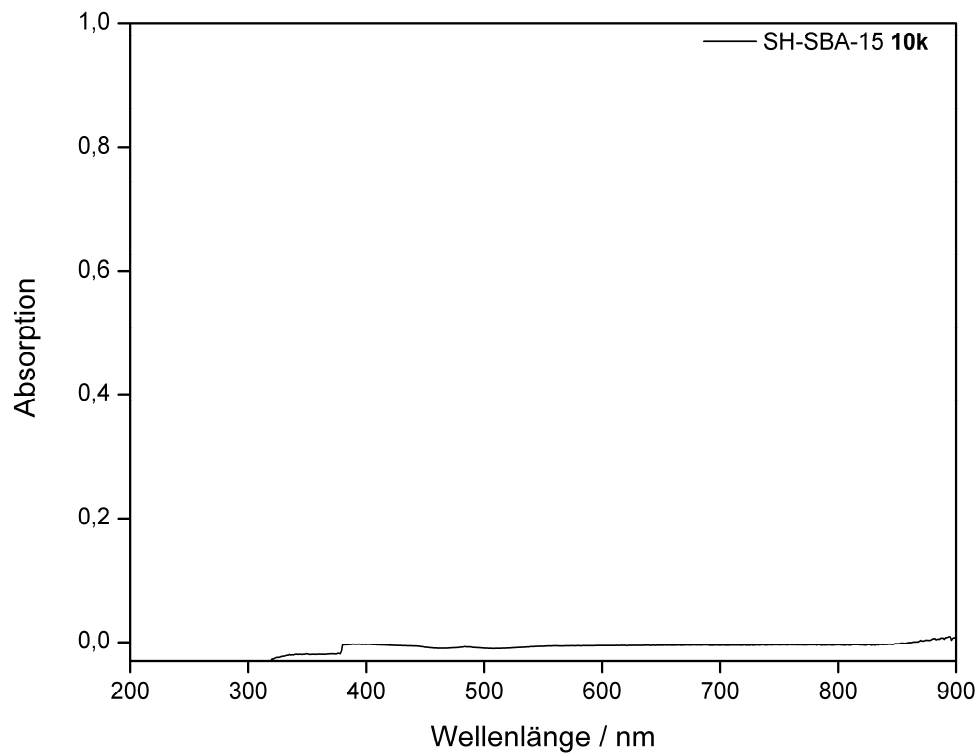


Abb. 8.224: UV/Vis-Spektrum von SH-SBA-15 (10k).



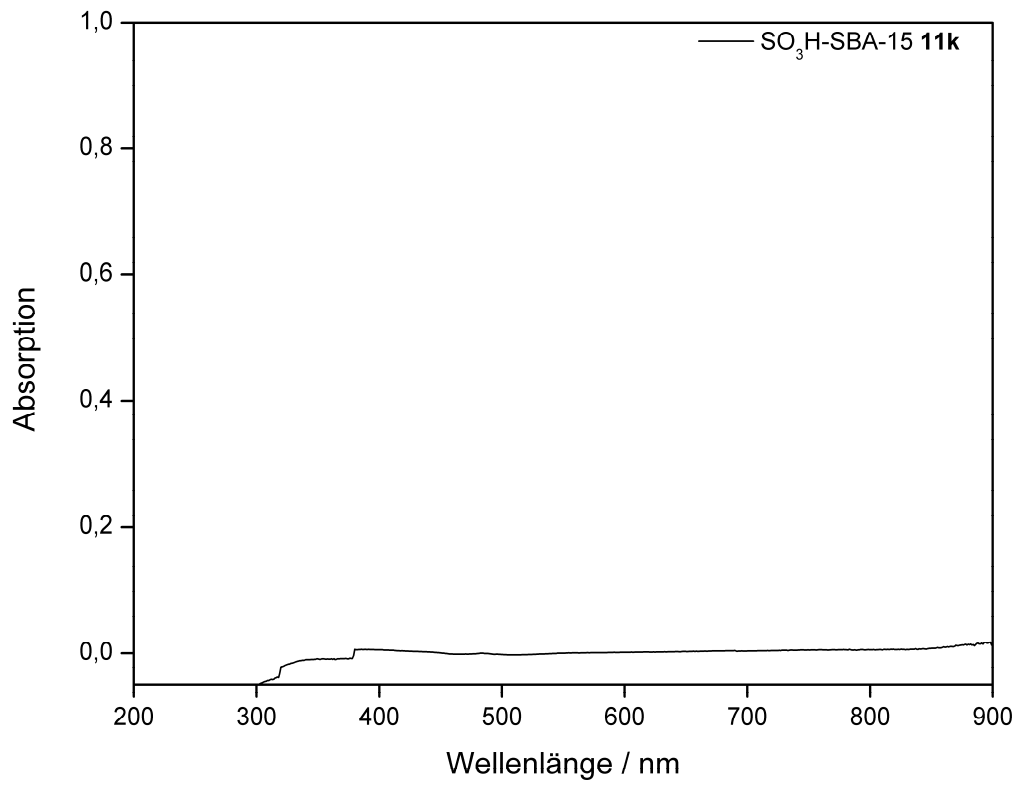


Abb. 8.225: UV/Vis-Spektrum von SO<sub>3</sub>H-SBA-15 (**11k**).

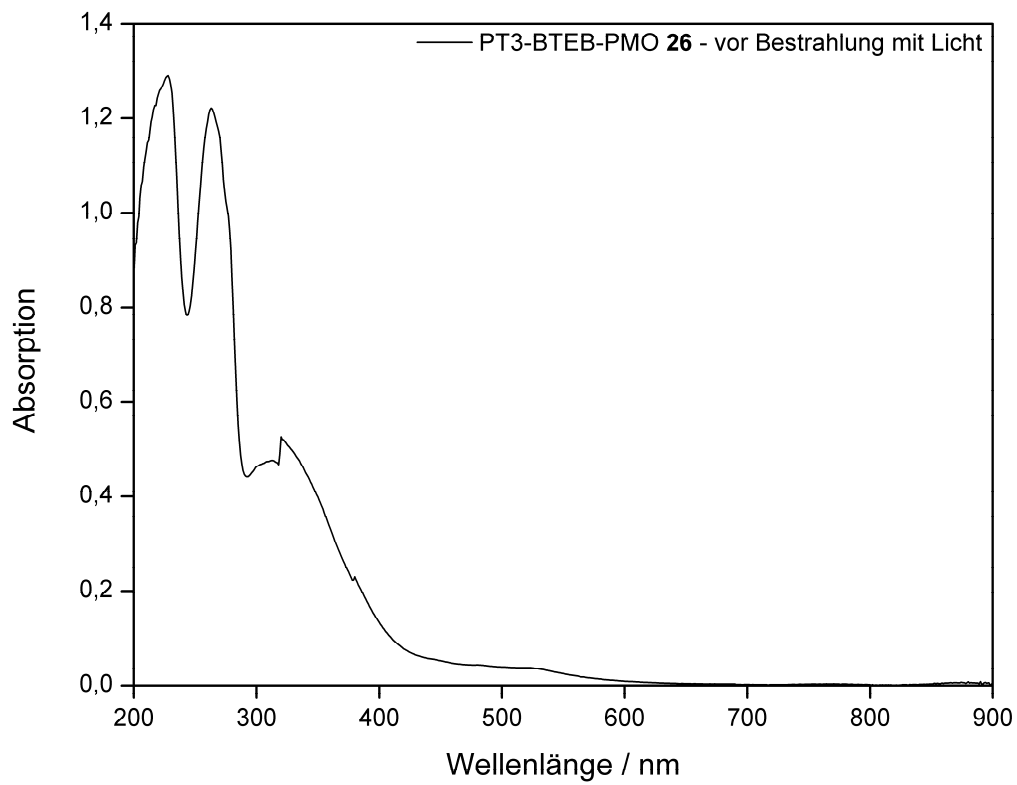


Abb. 8.226: UV/Vis-Spektrum von PT3-BTEB-PMO (**26**) vor Bestrahlung mit Licht.

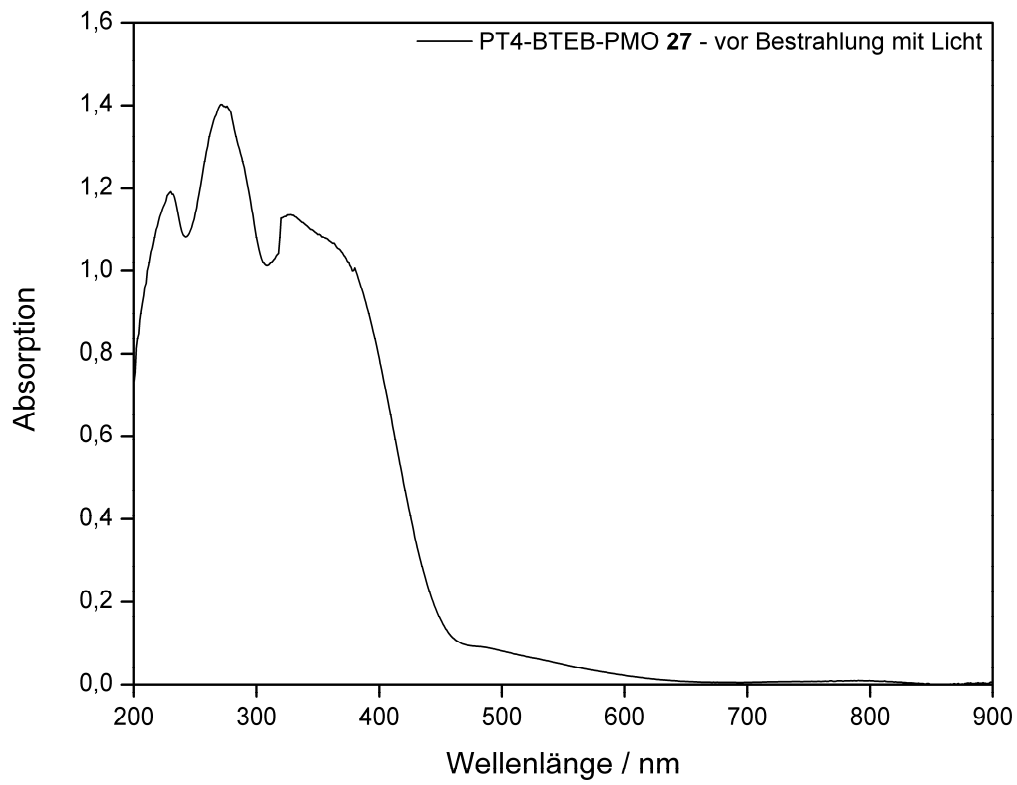


Abb. 8.227: UV/Vis-Spektrum von PT4-BTEB-PMO (27) vor Bestrahlung mit Licht.

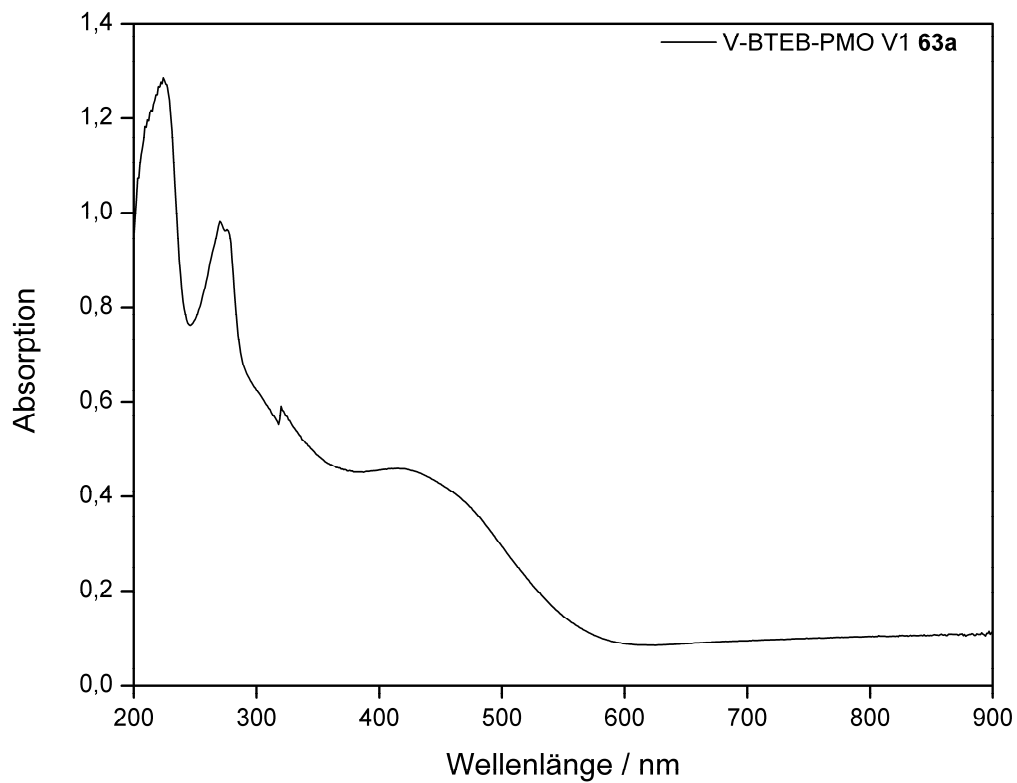


Abb. 8.228: UV/Vis-Spektrum von V-BTEB-PMO V1 (63a).

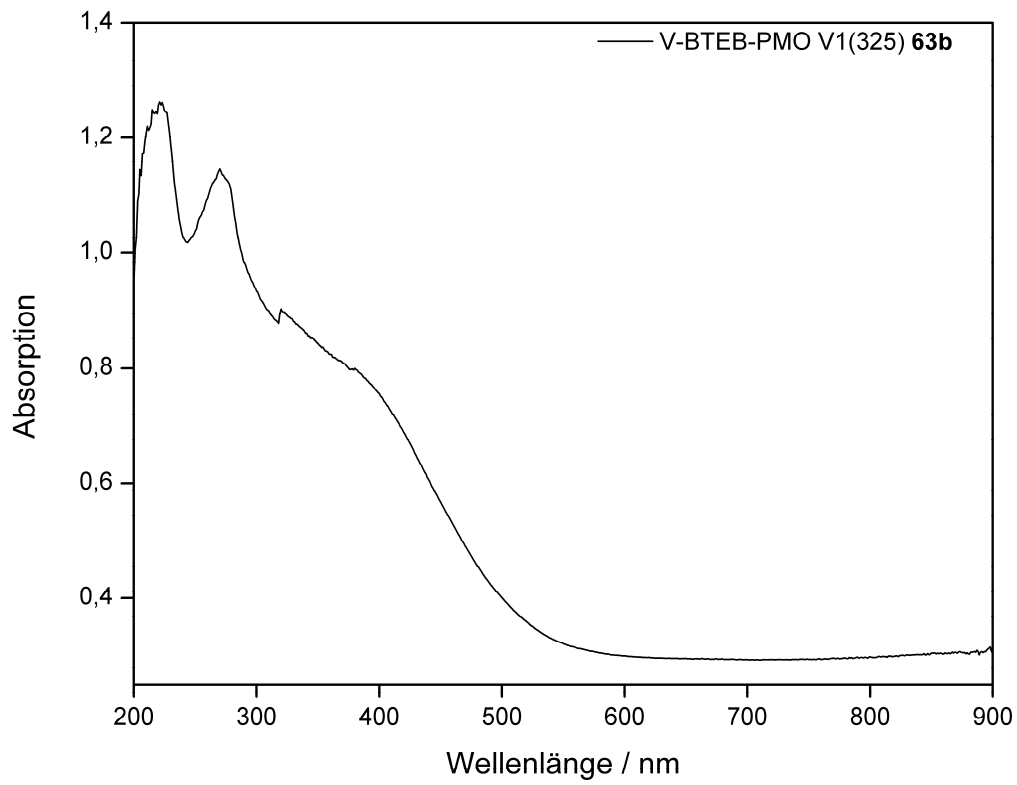


Abb. 8.229: UV/Vis-Spektrum von V-BTEB-PMO V1 (325) (**63b**).

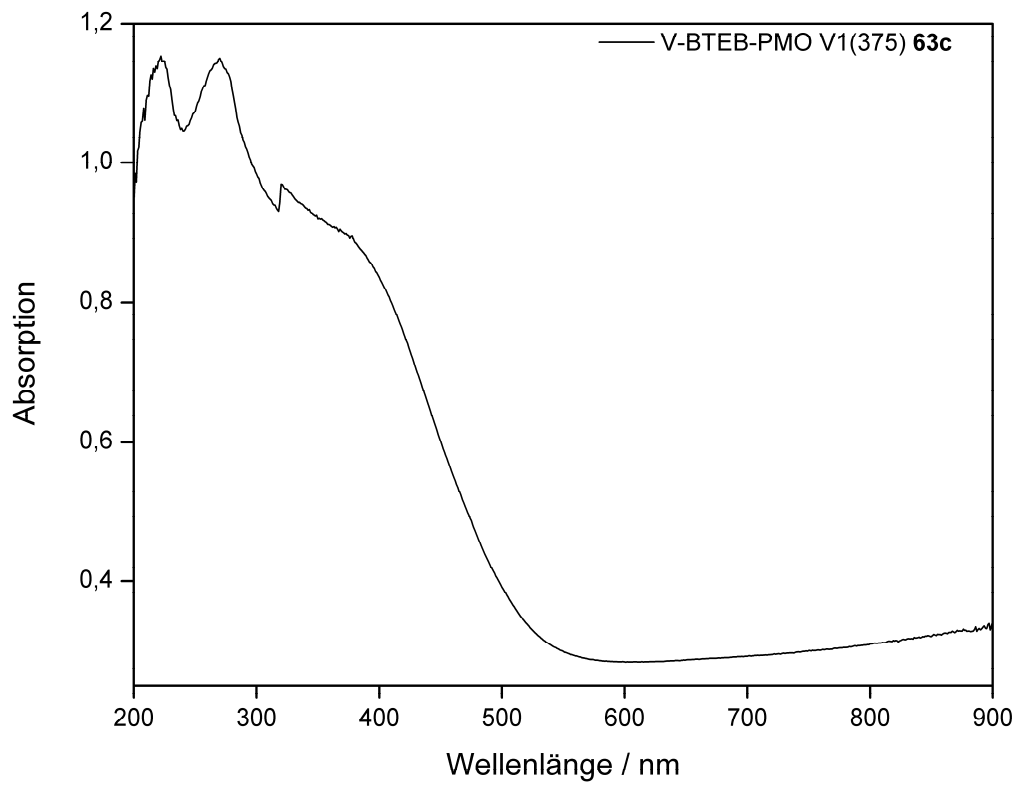


Abb. 8.230: UV/Vis-Spektrum von V-BTEB-PMO V1 (375) (**63c**).

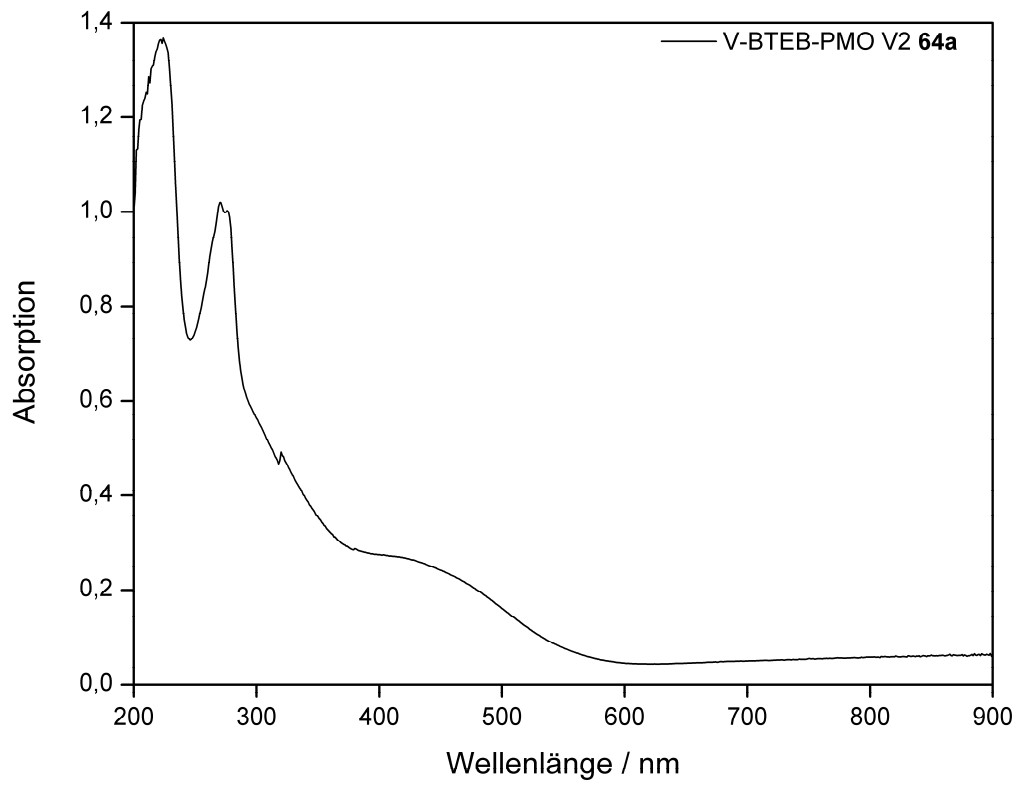


Abb. 8.231: UV/Vis-Spektrum von V-BTEB-PMO V2 (**64a**).

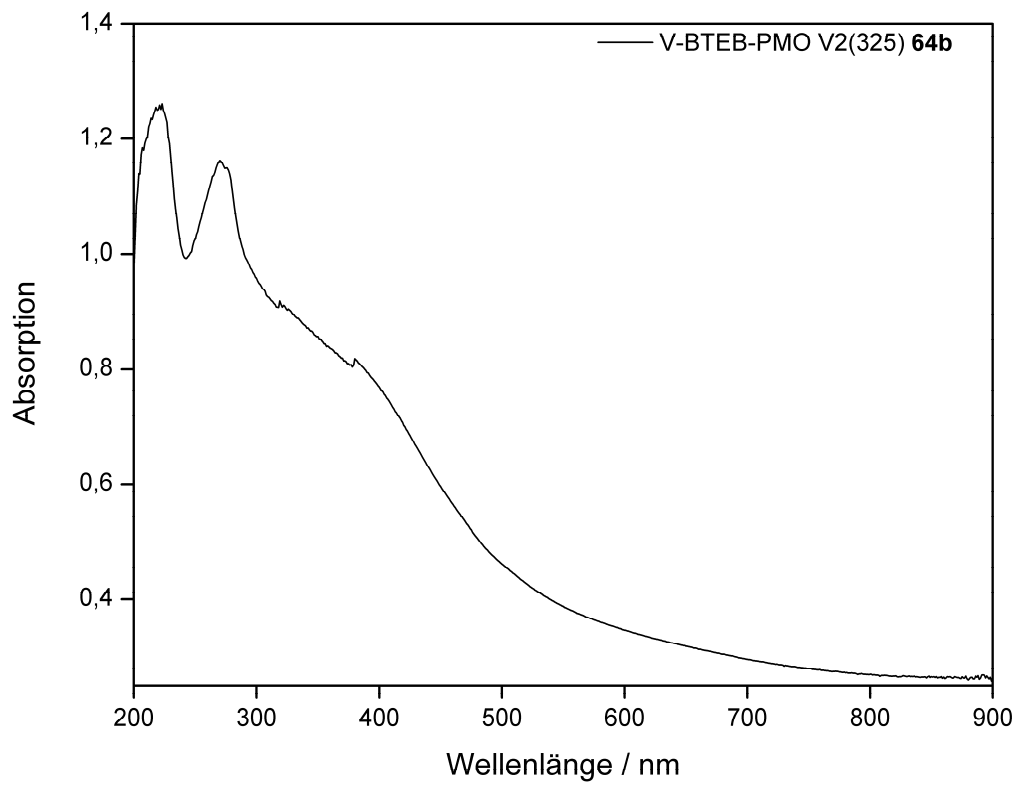


Abb. 8.232: UV/Vis-Spektrum von V-BTEB-PMO V2 (325) (**64b**).

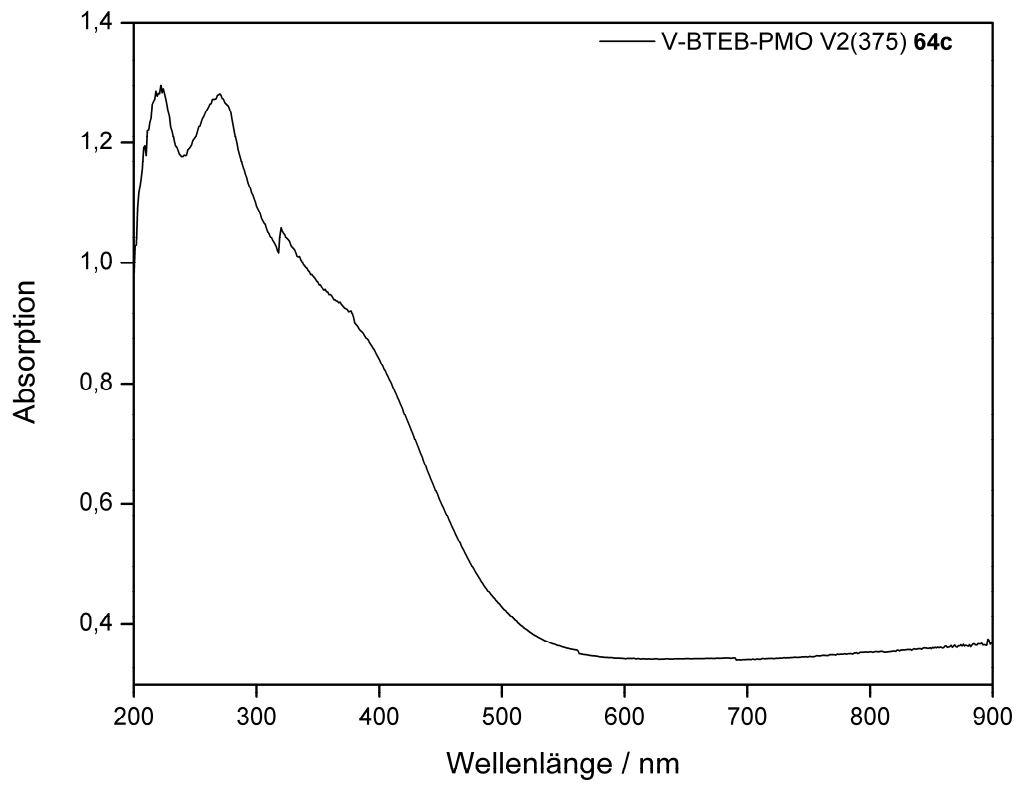


Abb. 8.233: UV/Vis-Spektrum von V-BTEB-PMO V2 (375) (**64c**).

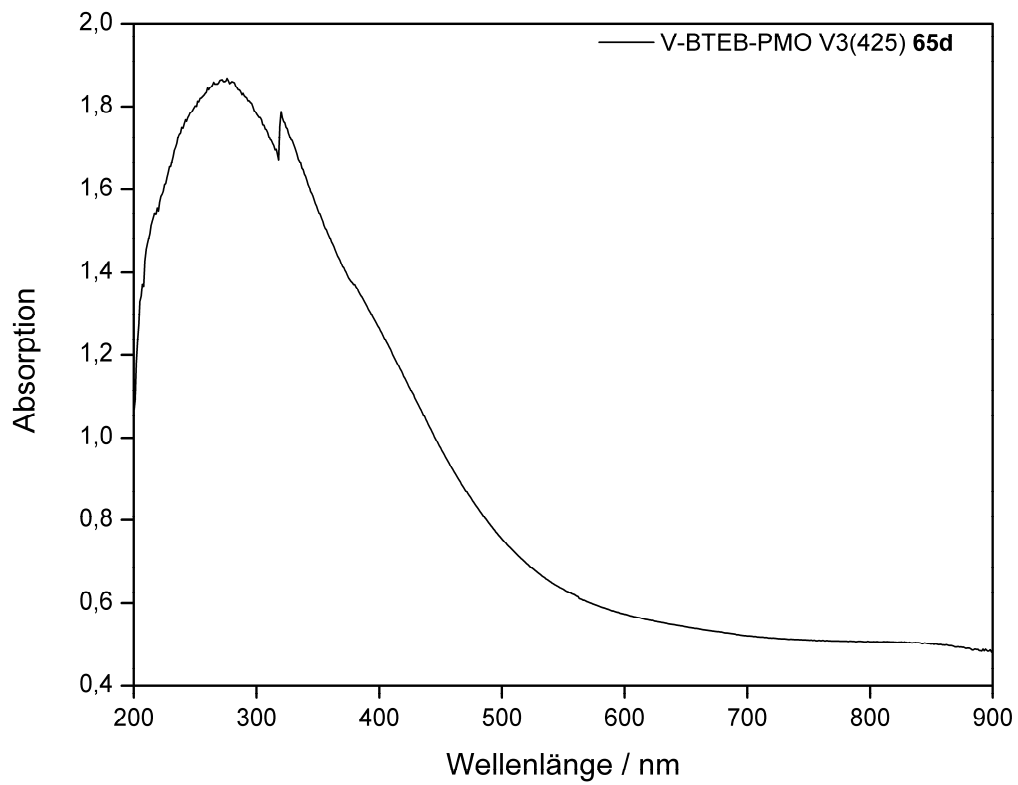


Abb. 8.234: UV/Vis-Spektrum von V-BTEB-PMO V3 (425) (**65d**).

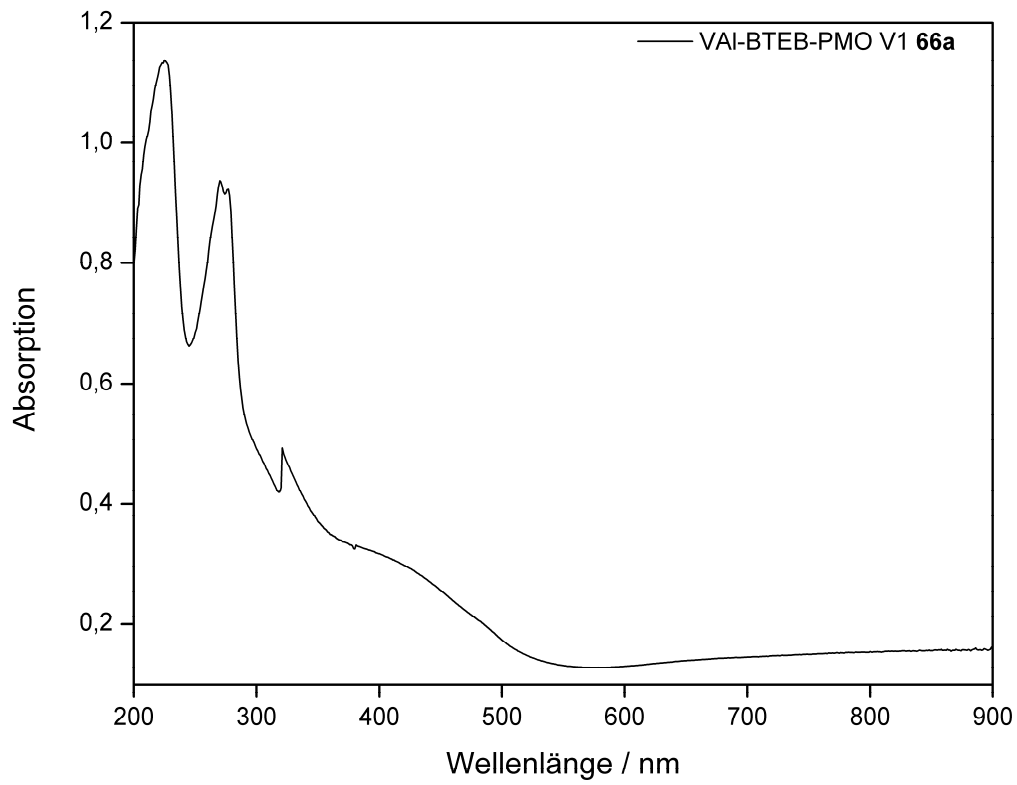


Abb. 8.235: UV/Vis-Spektrum von VAl-BTEB-PMO V1 (**66a**).

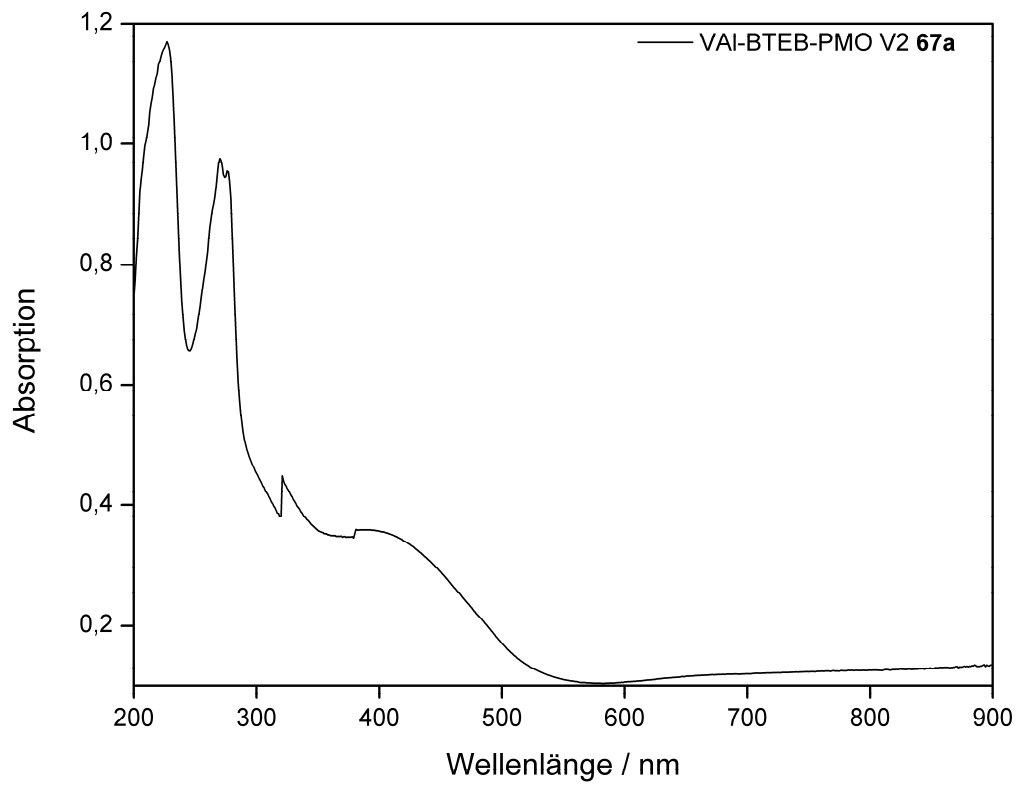


Abb. 8.236: UV/Vis-Spektrum von VAl-BTEB-PMO V2 (**67a**).

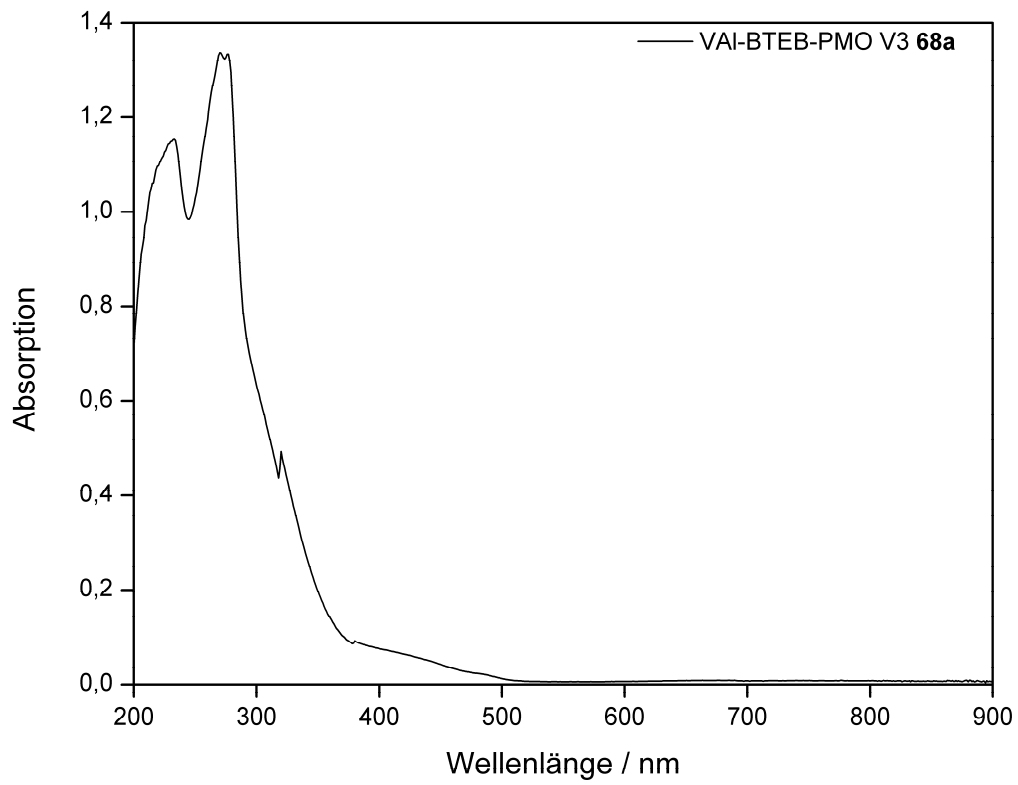


Abb. 8.237: UV/Vis-Spektrum von VAI-BTEB-PMO V3 (**68a**).

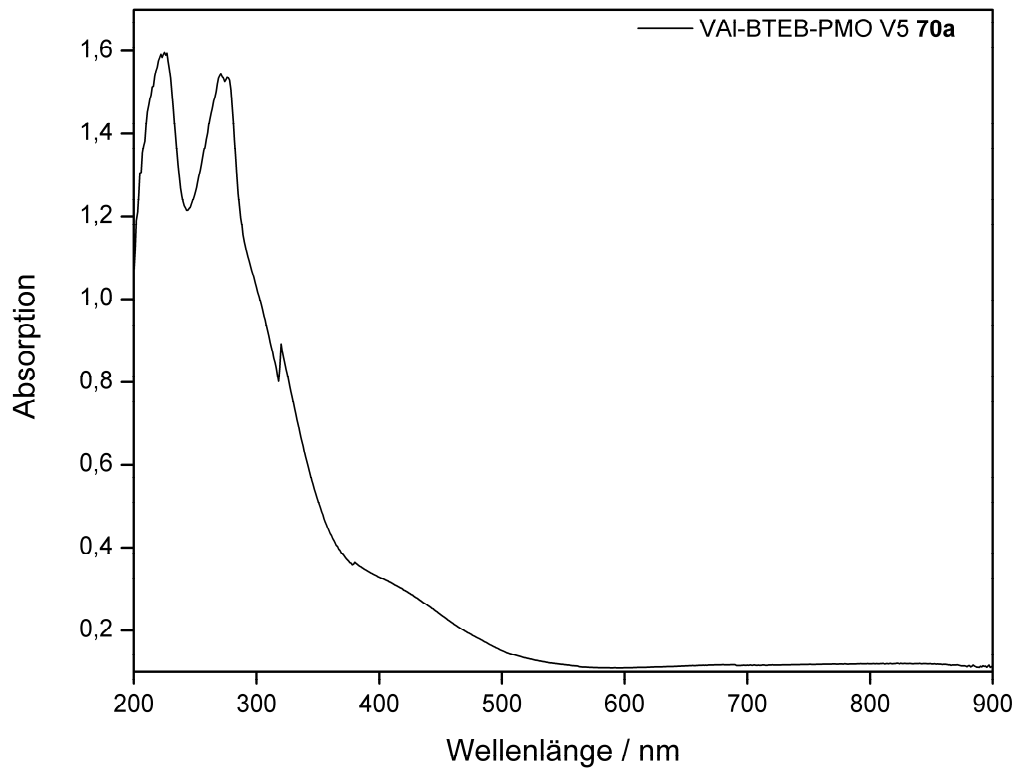


Abb. 8.238: UV/Vis-Spektrum von VAI-BTEB-PMO V5 (**70a**).

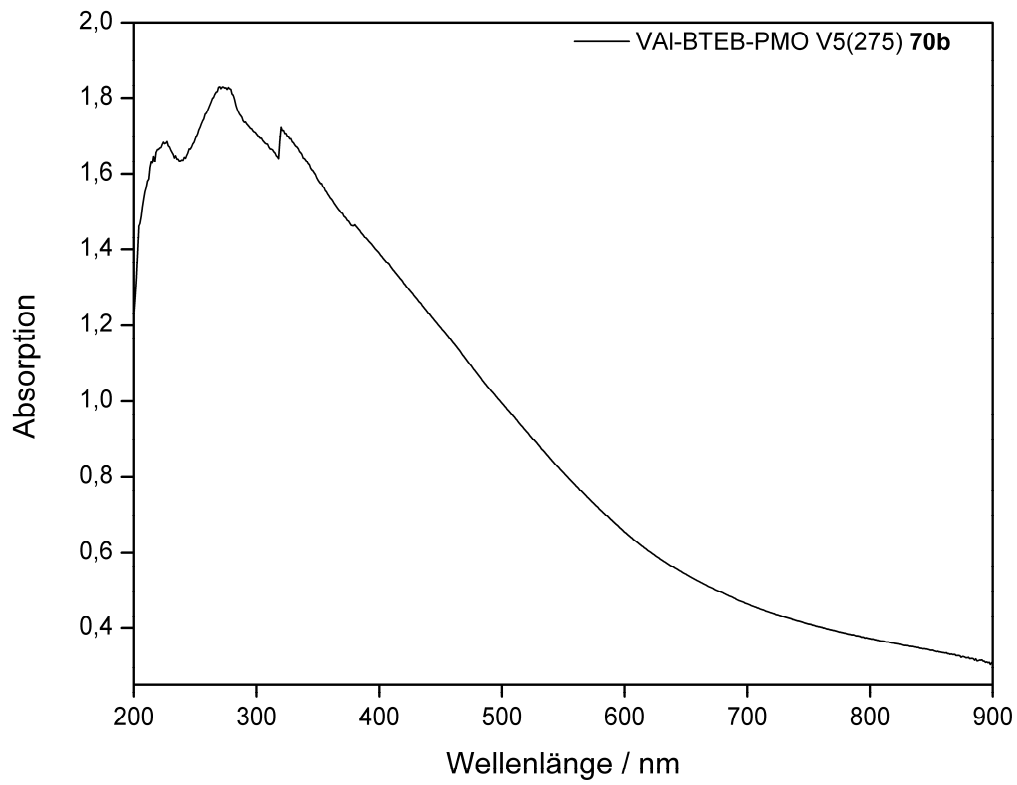


Abb. 8.239: UV/Vis-Spektrum von VAI-BTEB-PMO V5 (275) (**70b**).

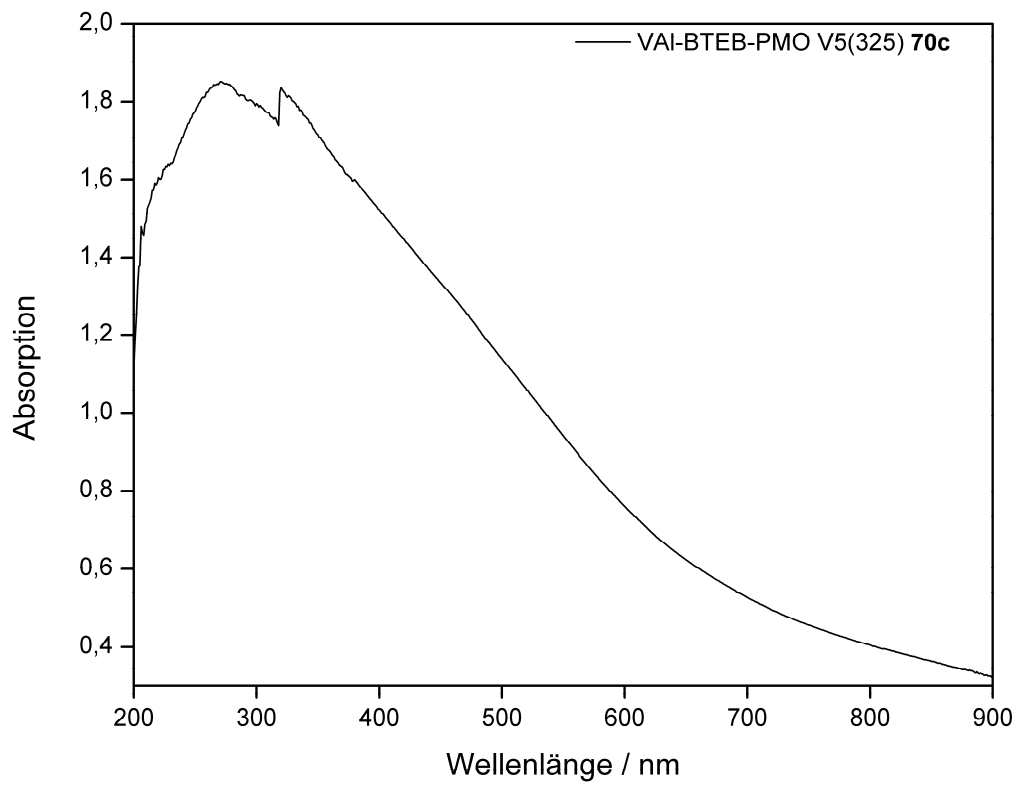


Abb. 8.240: UV/Vis-Spektrum von VAI-BTEB-PMO V5 (325) (**70c**).



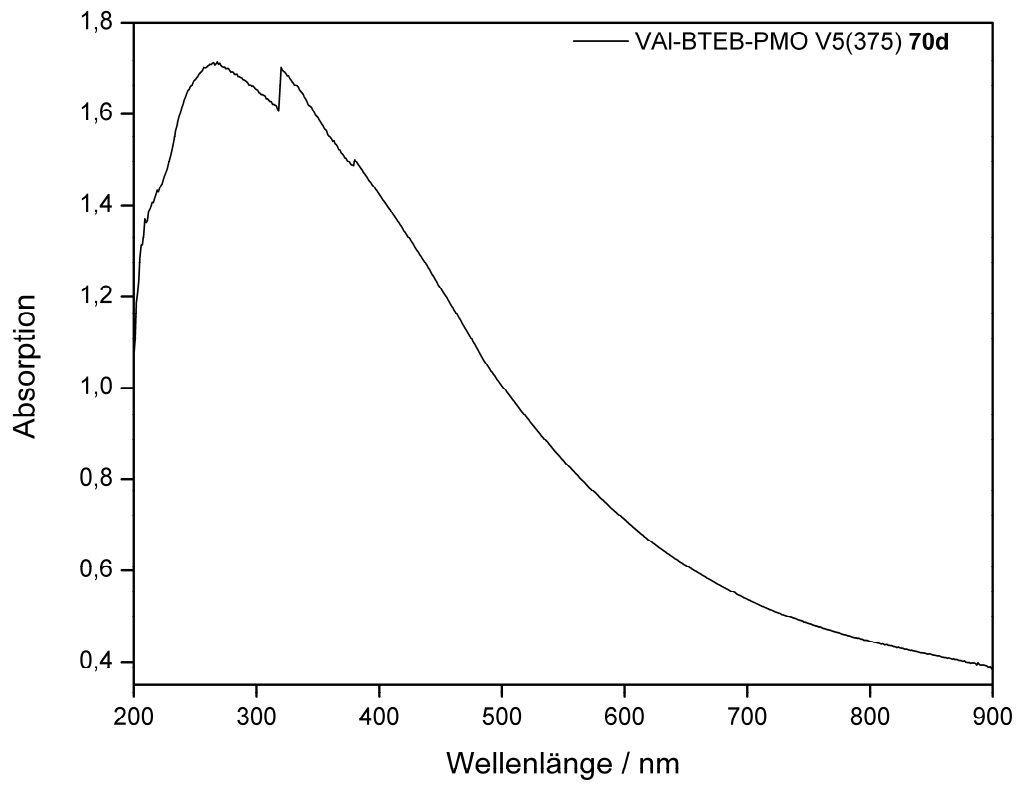


Abb. 8.241: UV/Vis-Spektrum von VAI-BTEB-PMO V5 (375) (70d).

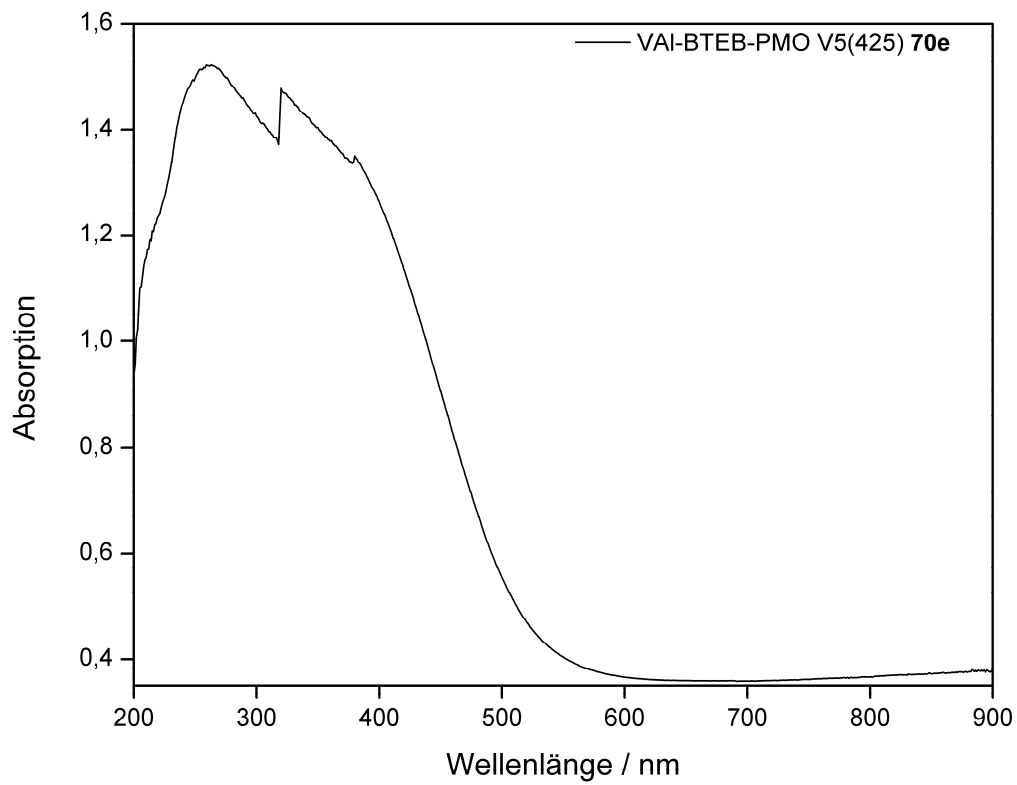


Abb. 8.242: UV/Vis-Spektrum von VAI-BTEB-PMO V5 (425) (70e).

## 8.5 ESR-Spektren

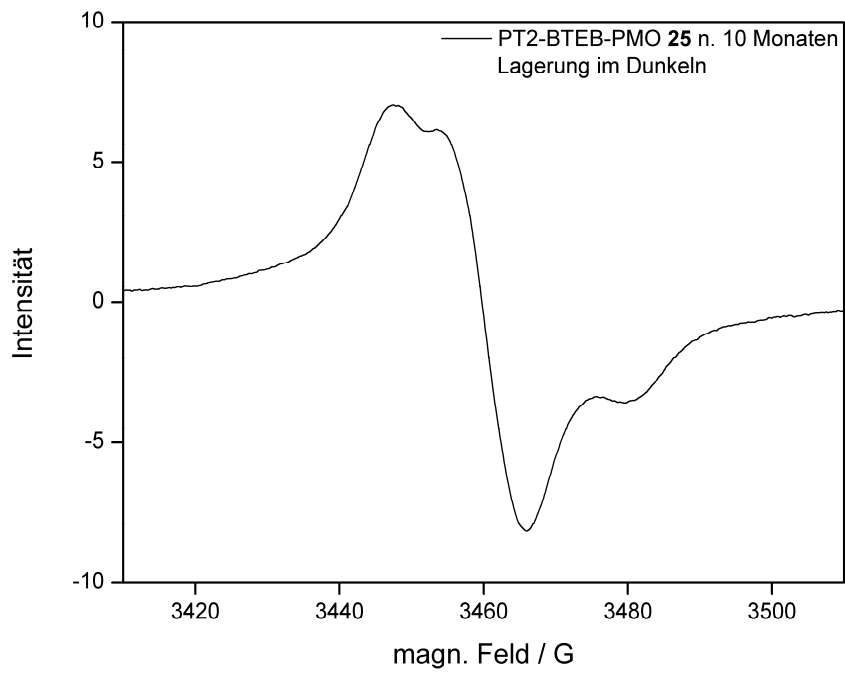


Abb. 8.243: ESR-Spektrum von PT2-BTEB-PMO (**25**) nach Lagerung für 10 Monaten im Dunkeln.

## 8.6 Voltammetrie-Messungen

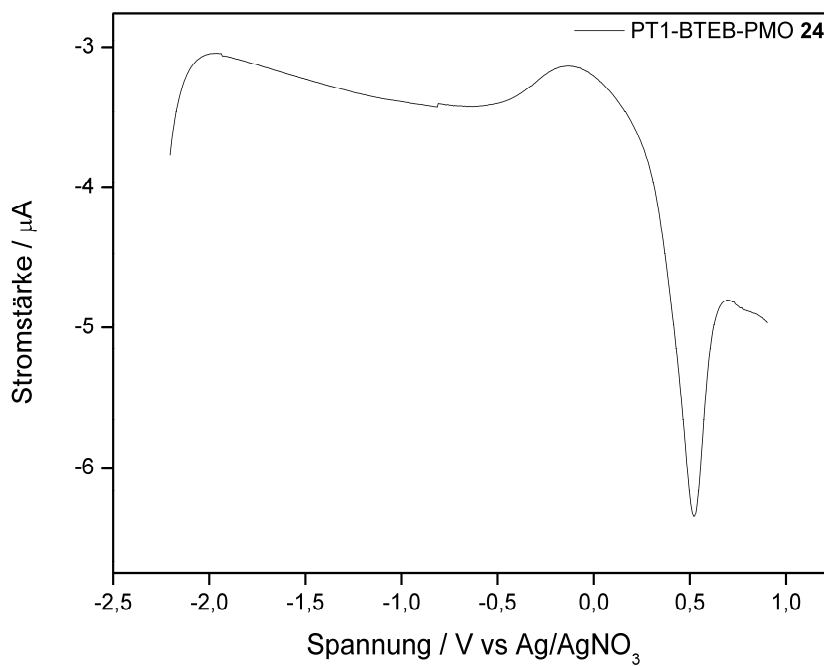


Abb. 8.244: Square-wave-Messung von PT1-BTEB-PMO (**24**).

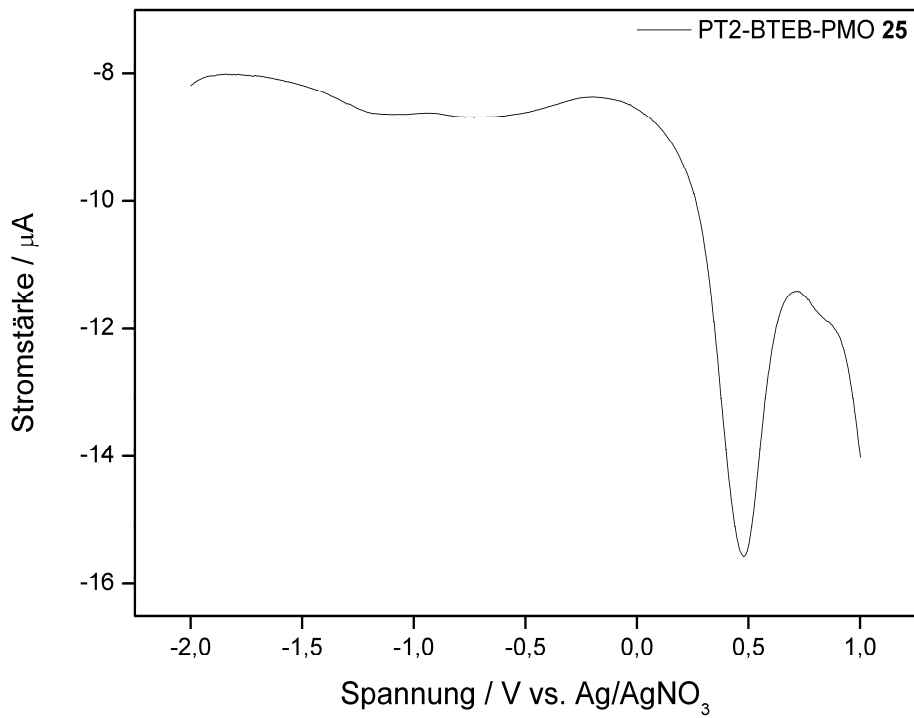


Abb. 8.245: Square-wave-Messung von PT2-BTEB-PMO (25).

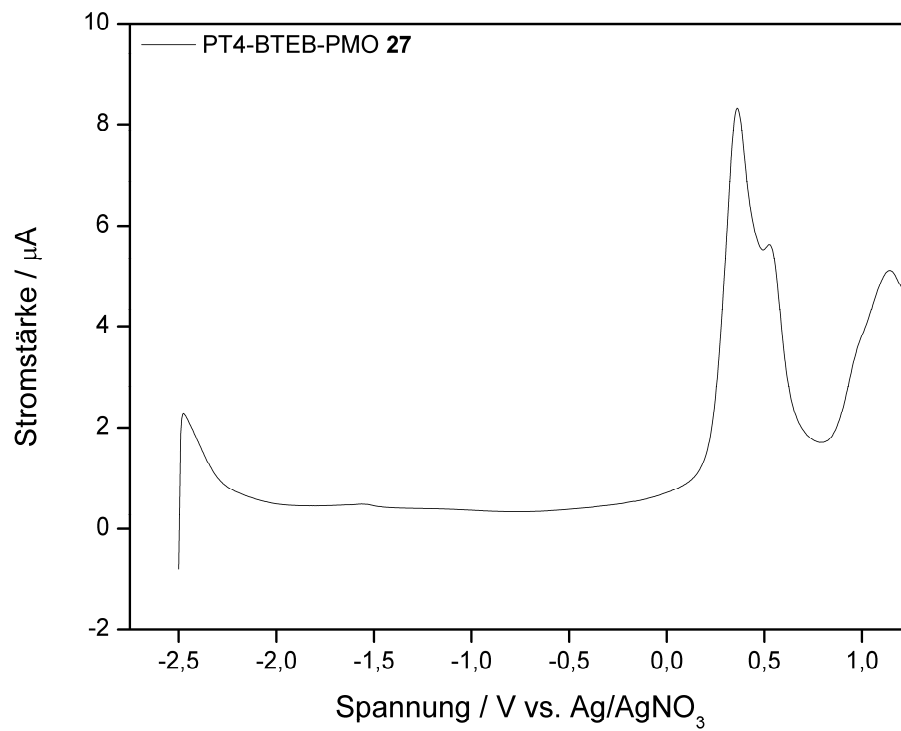


Abb. 8.246: Square-wave-Messung von PT4-BTEB-PMO (27).

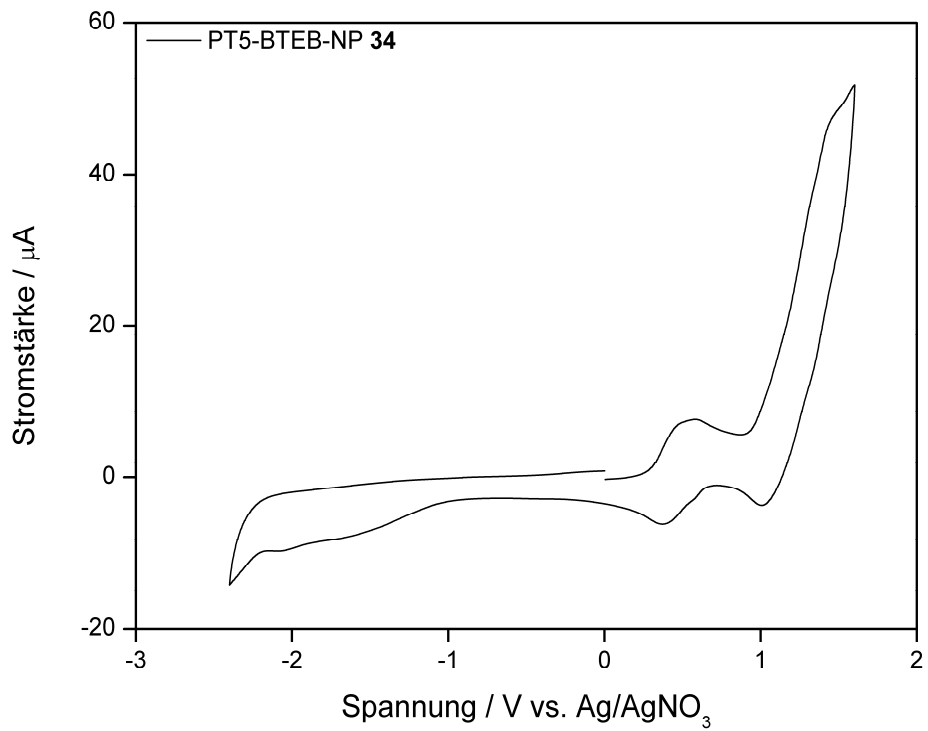


Abb. 8.247: CV-Messung von PT5-BTEB-NP (34).

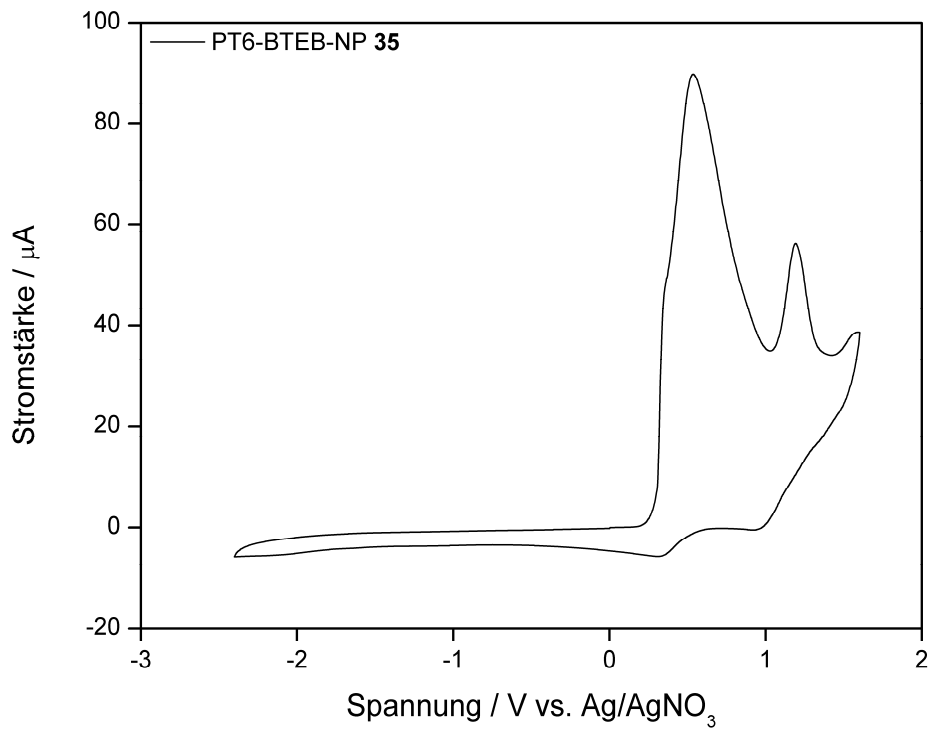


Abb. 8.248: CV-Messung von PT6-BTEB-NP (35).

## 8.7 IR-Spektren

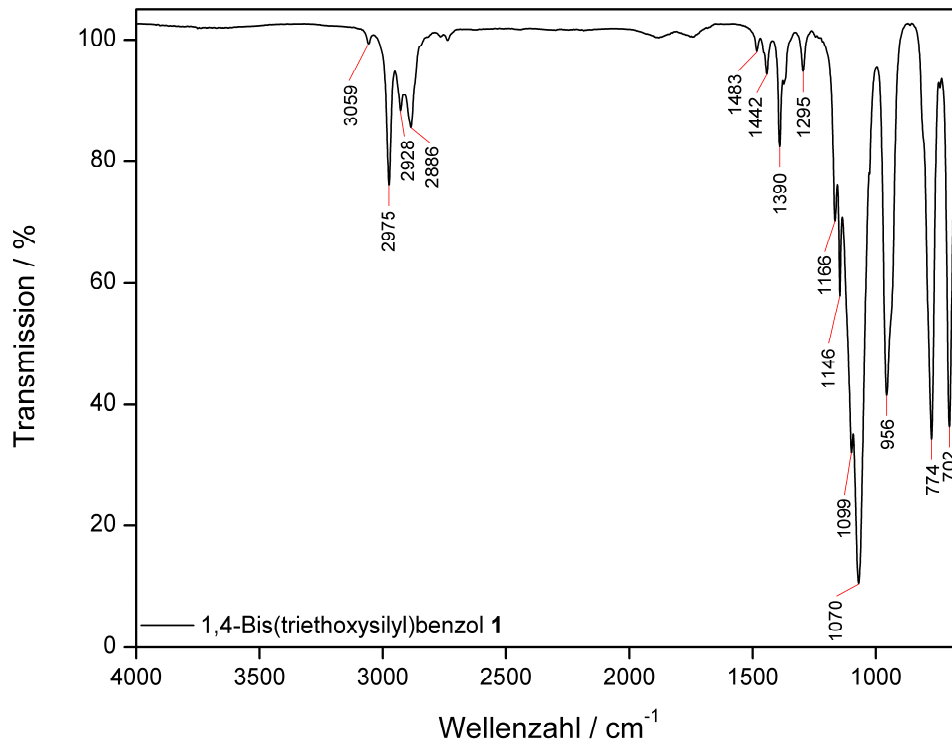


Abb. 8.249: ATR-IR-Spektrum von 1,4-Bis(triethoxysilyl)benzol (**1**).

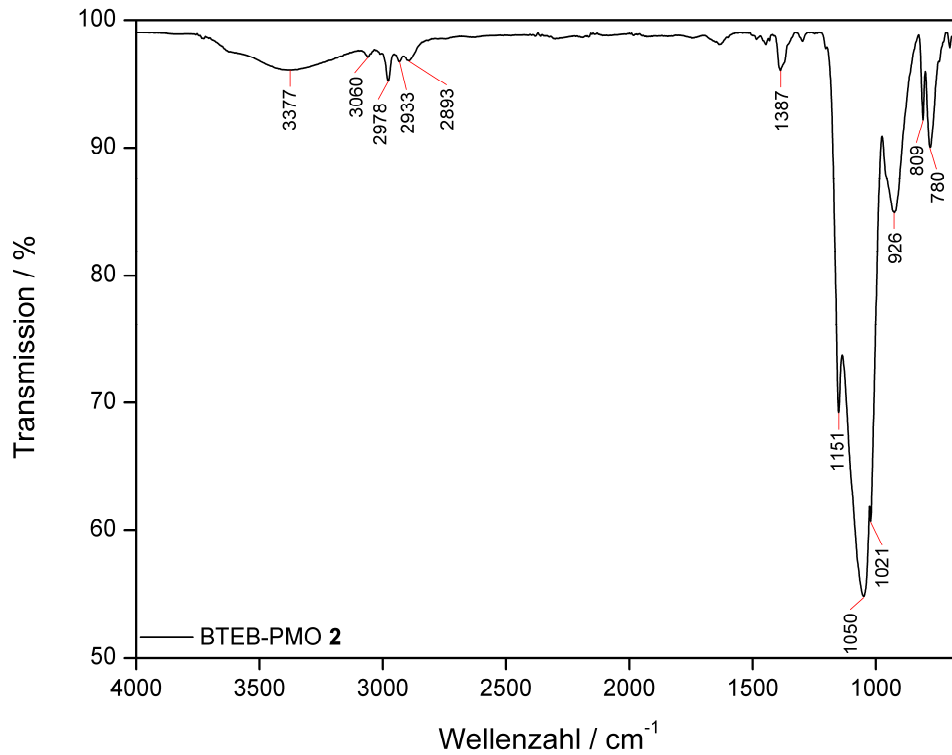


Abb. 8.250: ATR-IR-Spektrum von BTEB-PMO (**2**).

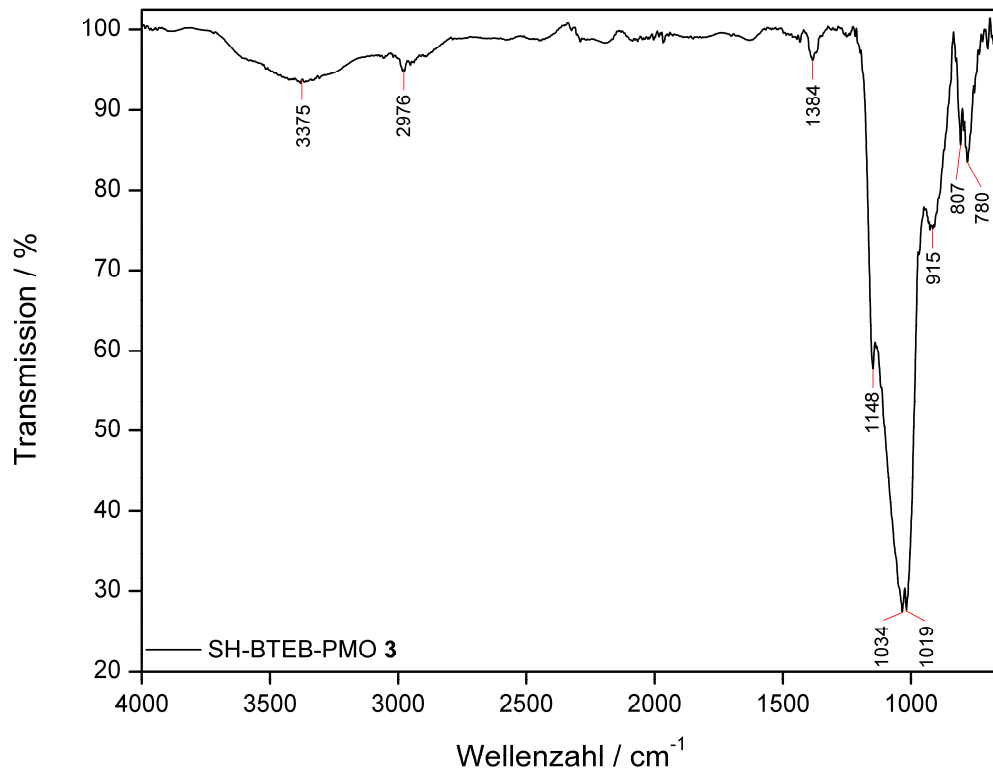


Abb. 8.251: ATR-IR-Spektrum von SH-BTEB-PMO (3).

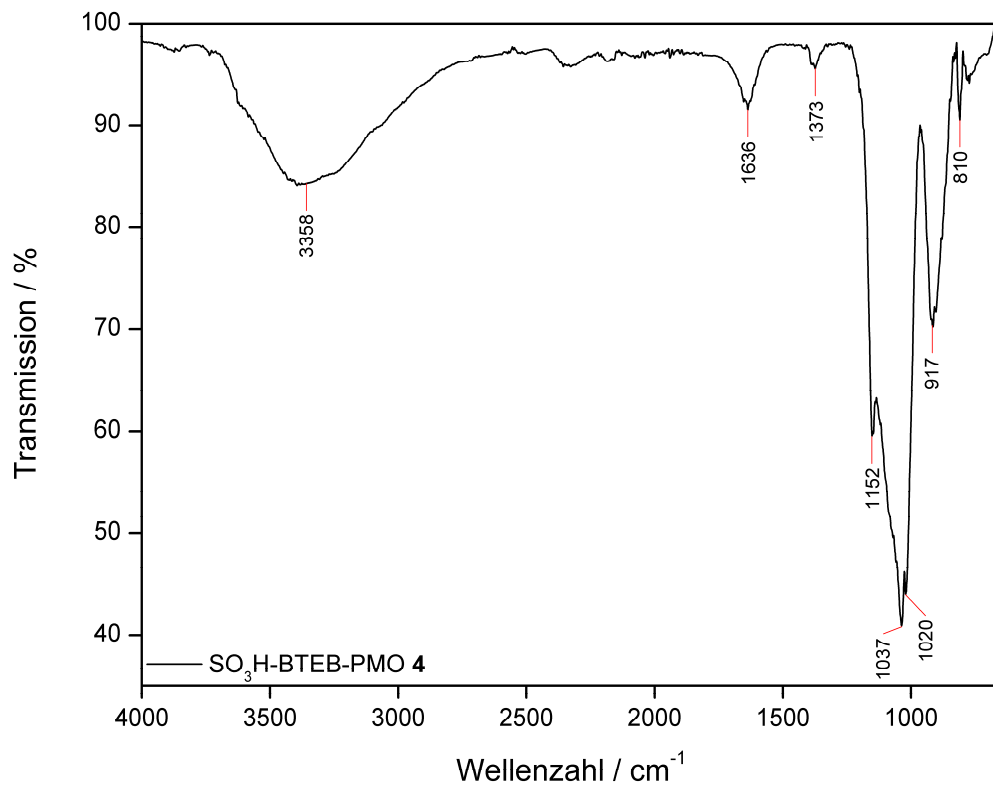


Abb. 8.252: ATR-IR-Spektrum von SO<sub>3</sub>H-BTEB-PMO (4).

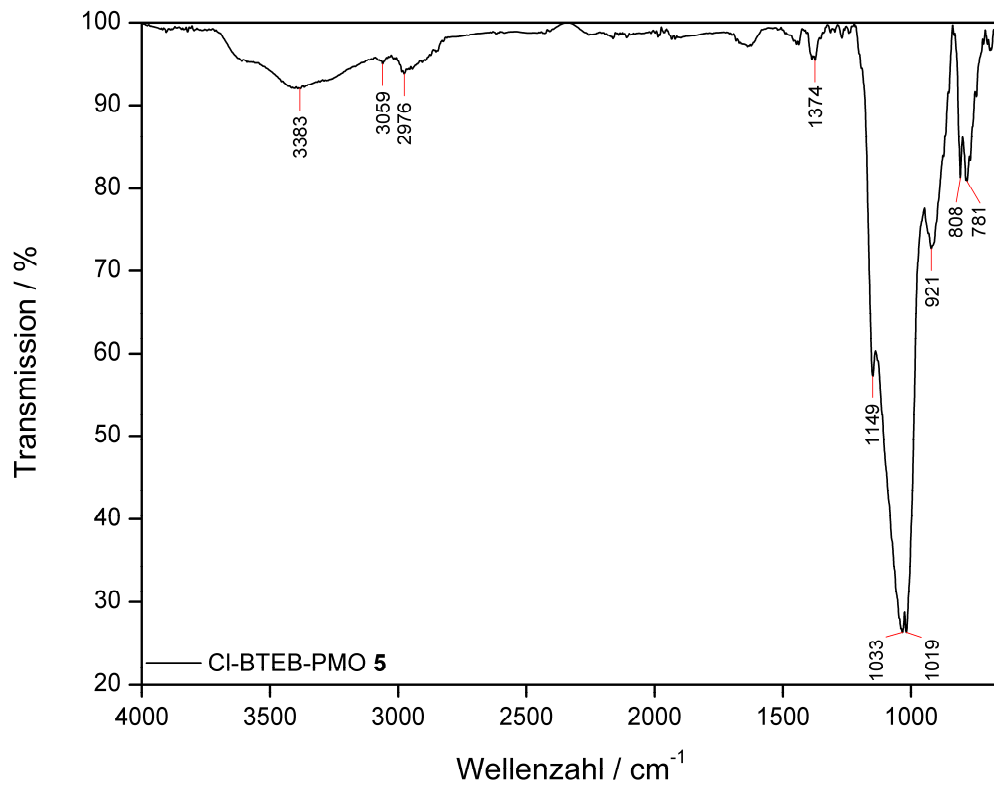


Abb. 8.253: ATR-IR-Spektrum von Cl-BTEB-PMO (**5**).

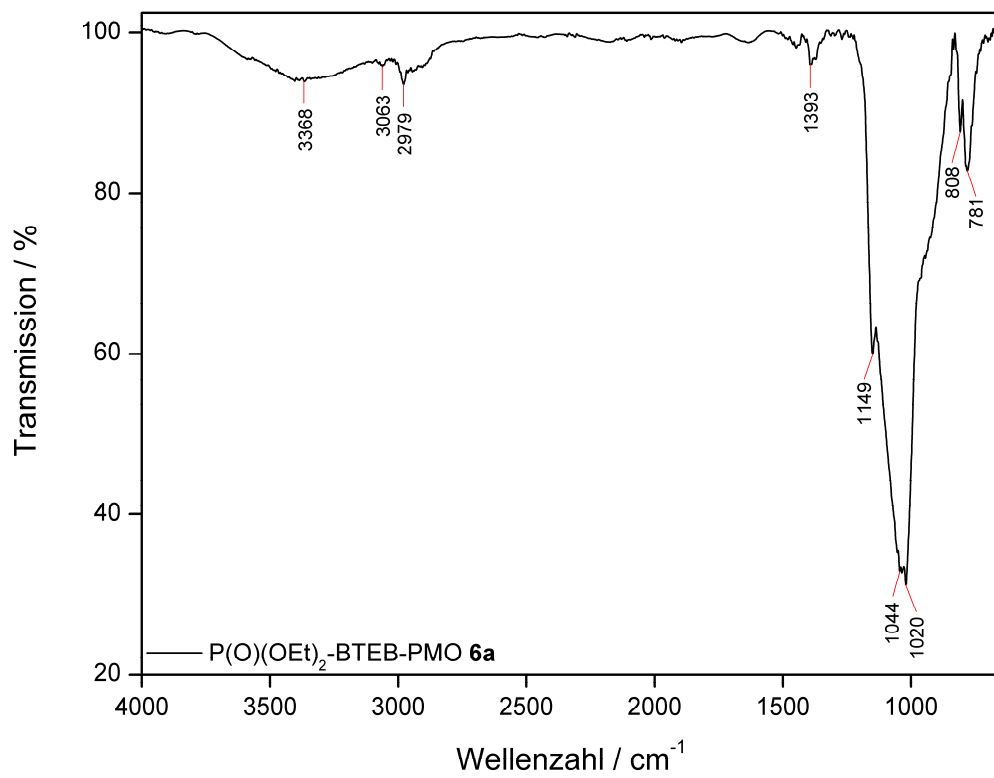


Abb. 8.254: ATR-IR-Spektrum von P(O)(OEt)<sub>2</sub>-BTEB-PMO (**6a**).

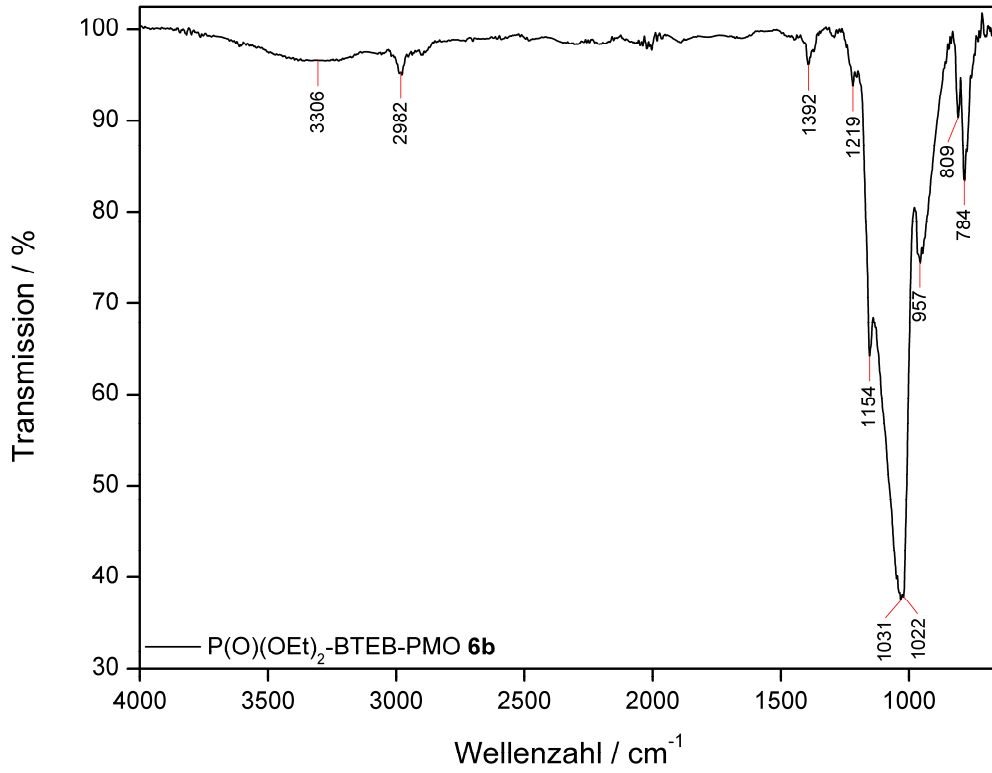


Abb. 8.255: ATR-IR-Spektrum von P(O)(OEt)<sub>2</sub>-BTEB-PMO (**6b**).

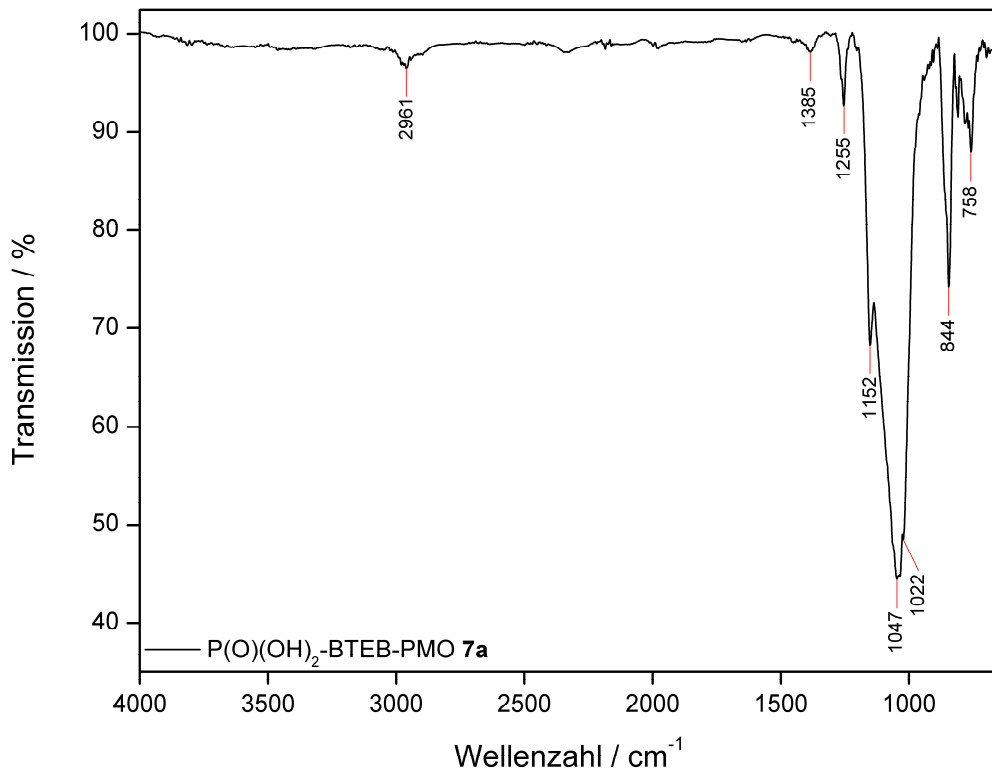


Abb. 8.256: ATR-IR-Spektrum von P(O)(OH)<sub>2</sub>-BTEB-PMO (**7a**).



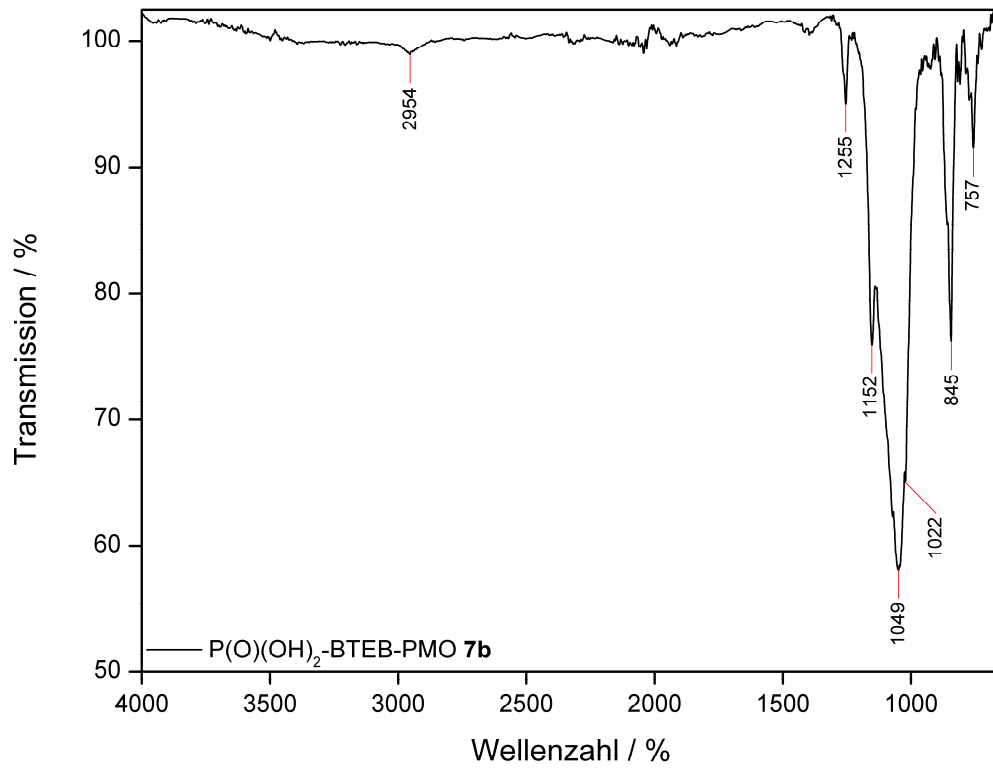


Abb. 8.257: ATR-IR-Spektrum von P(O)(OH)<sub>2</sub>-BTEB-PMO (**7b**).

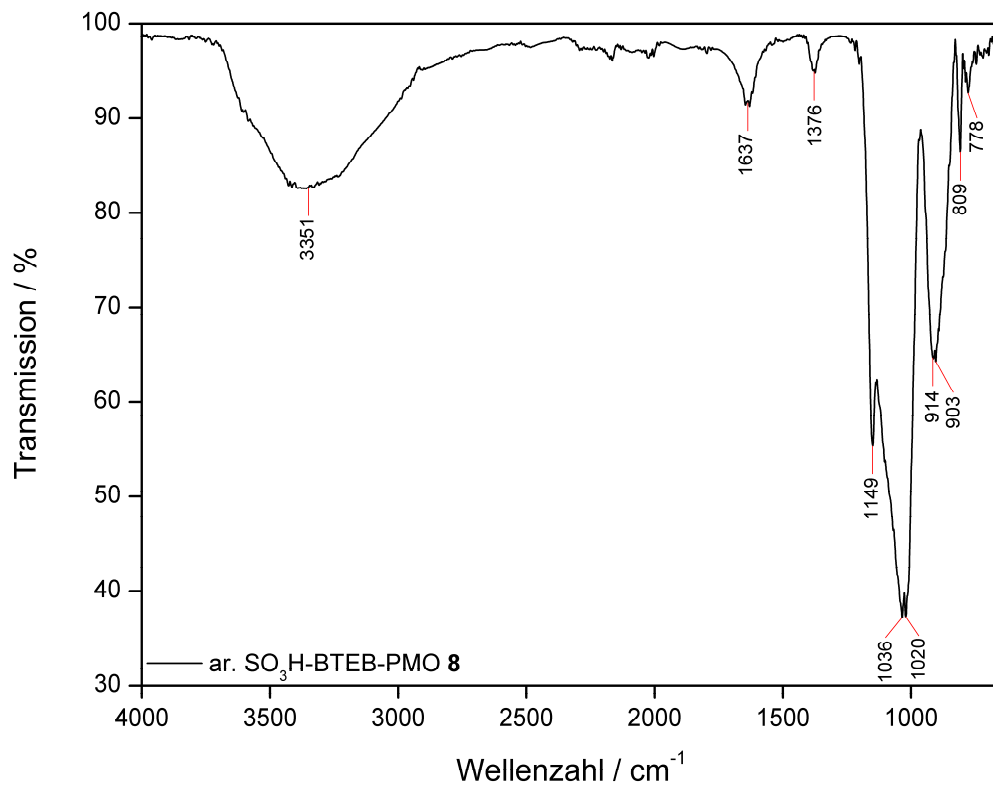


Abb. 8.258: ATR-IR-Spektrum von ar. SO<sub>3</sub>H-BTEB-PMO (**8**).

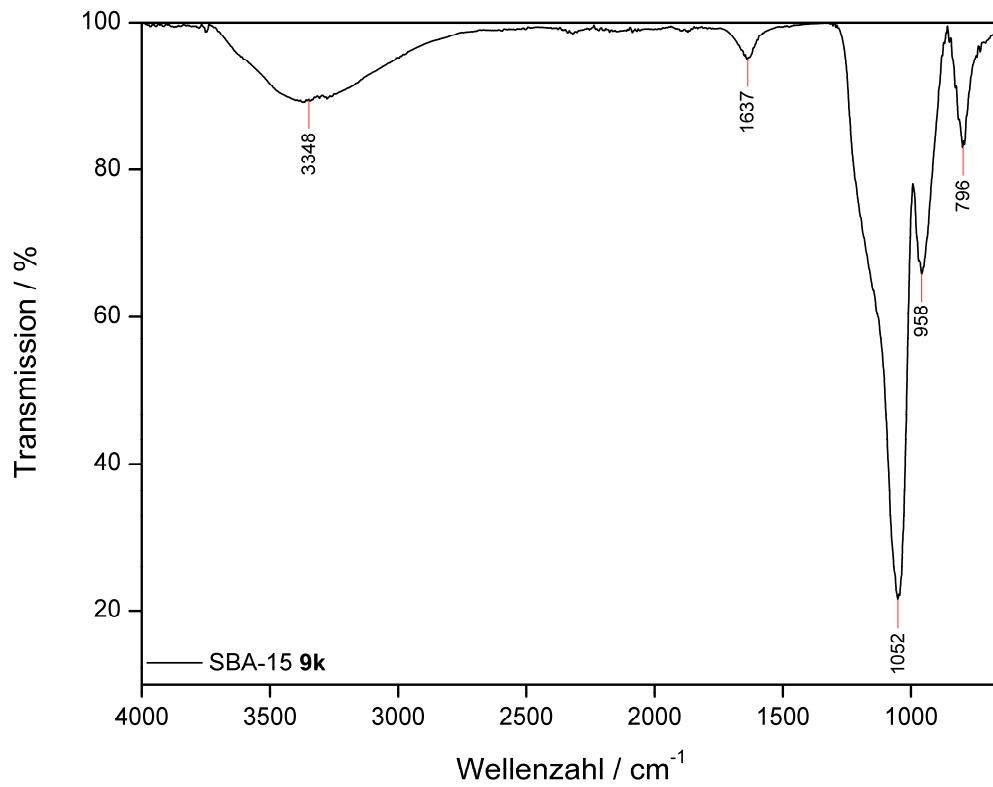


Abb. 8.259: ATR-IR-Spektrum von SBA-15 (9k).

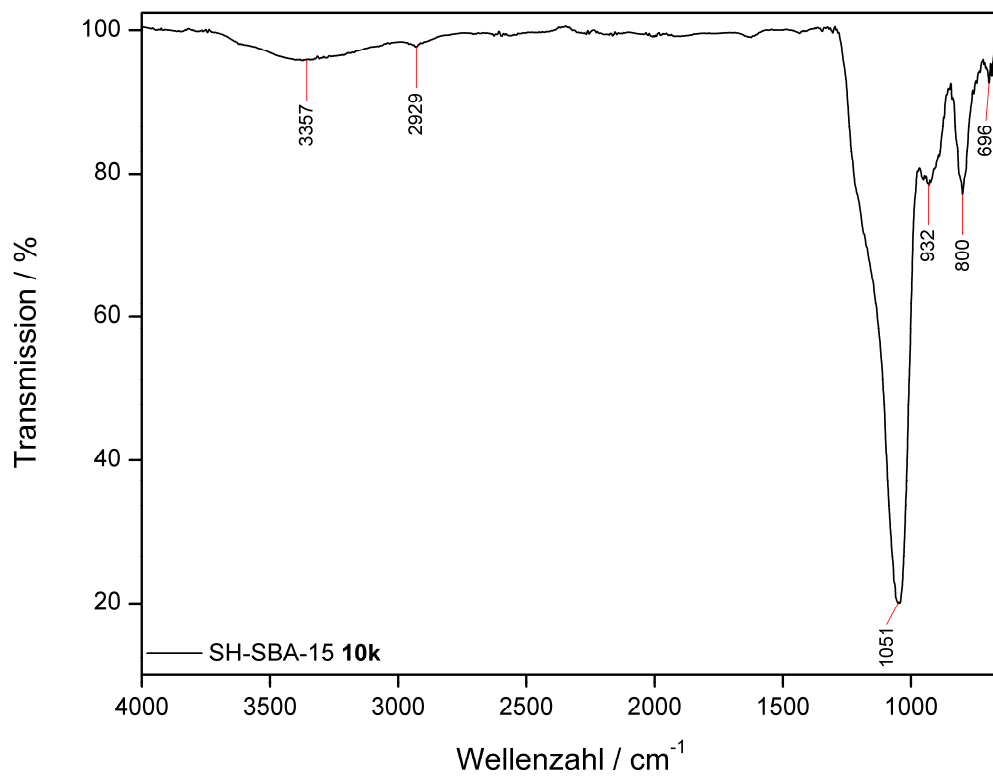


Abb. 8.260: ATR-IR-Spektrum von SH-SBA-15 (10k).

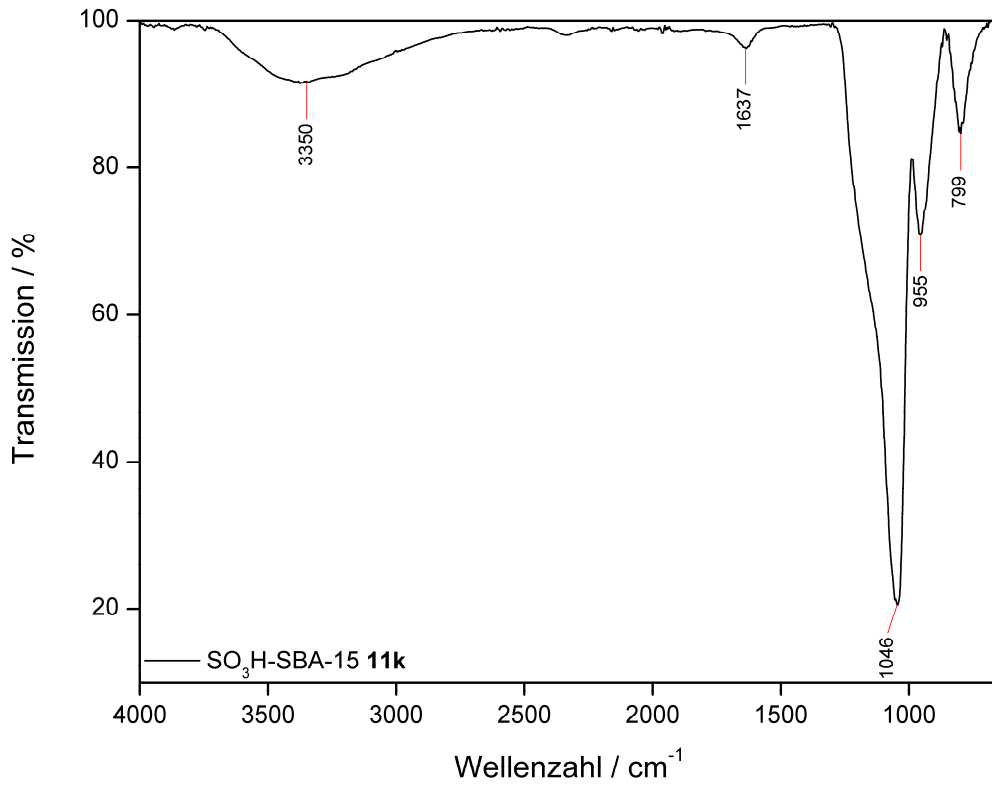


Abb. 8.261: ATR-IR-Spektrum von SO<sub>3</sub>H-SBA-15 (**11k**).

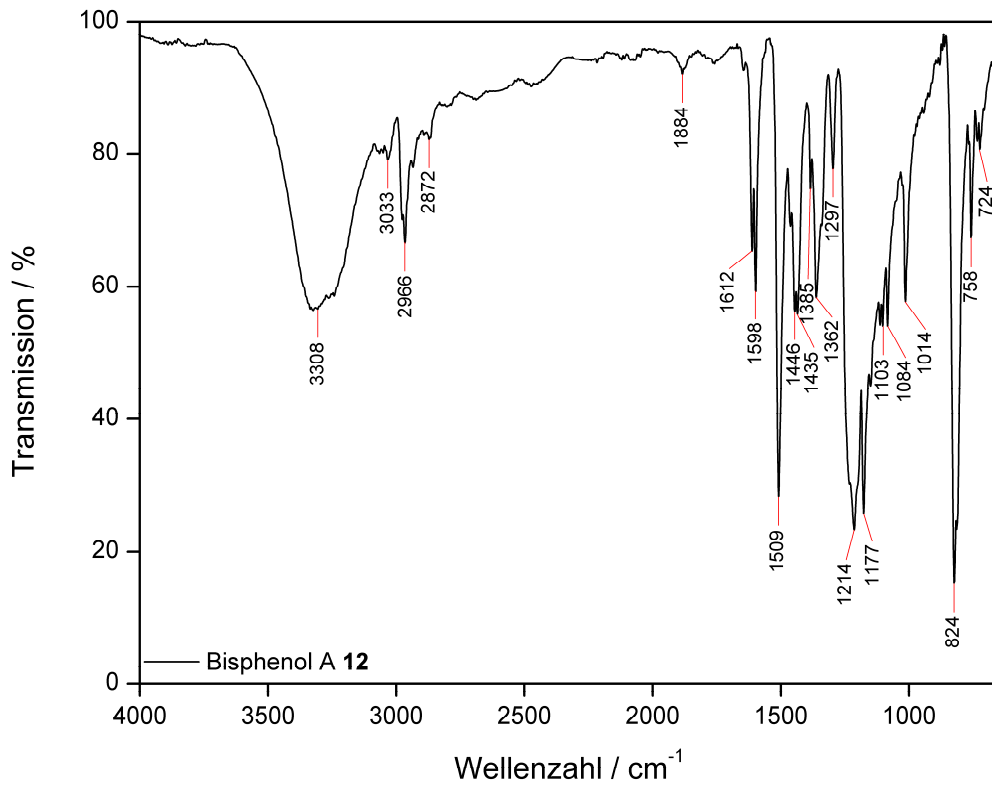


Abb. 8.262: ATR-IR-Spektrum von Bisphenol A (**12**).

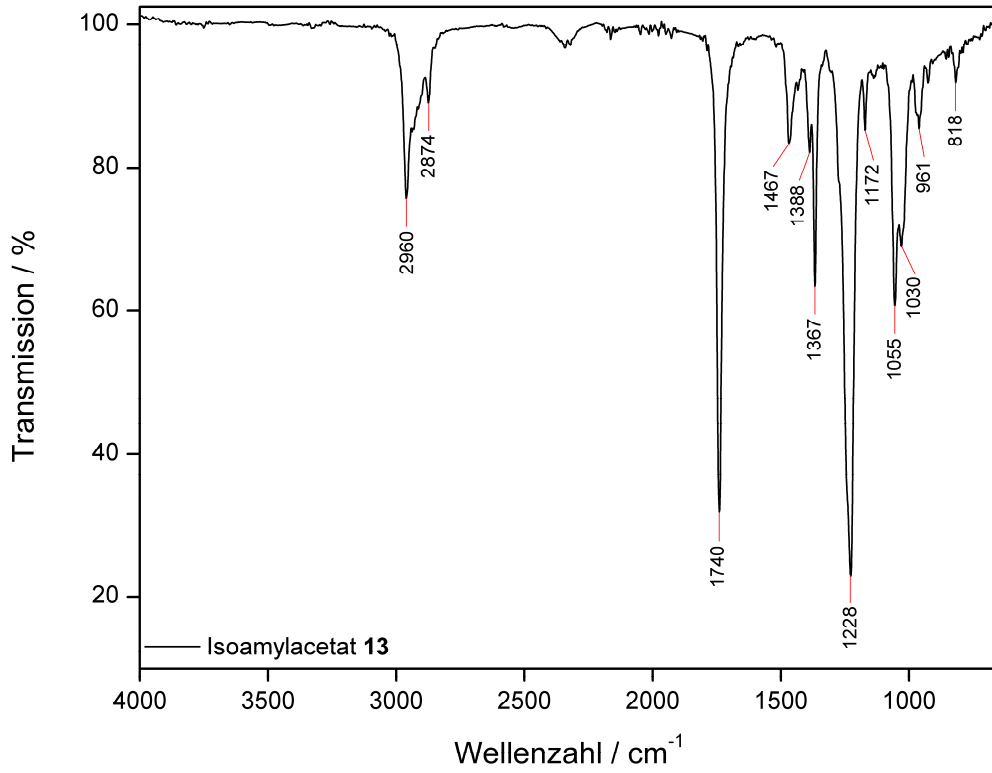


Abb. 8.263: ATR-IR-Spektrum von Isoamylacetat (13).

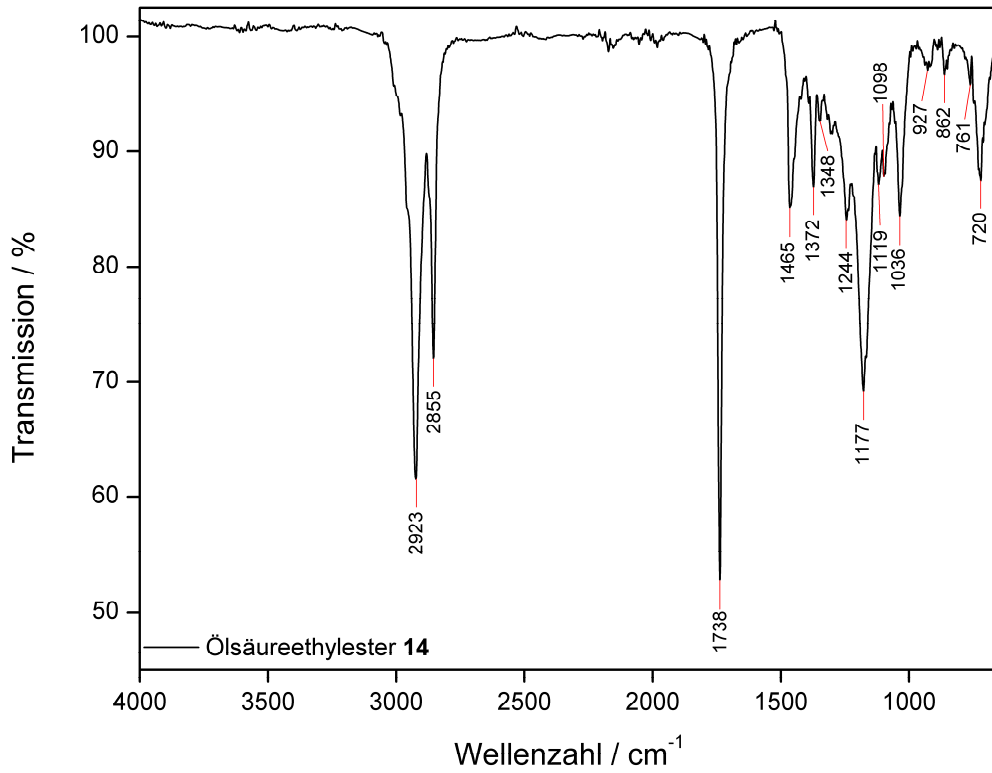


Abb. 8.264: ATR-IR-Spektrum von Ölsäureethylester (14).

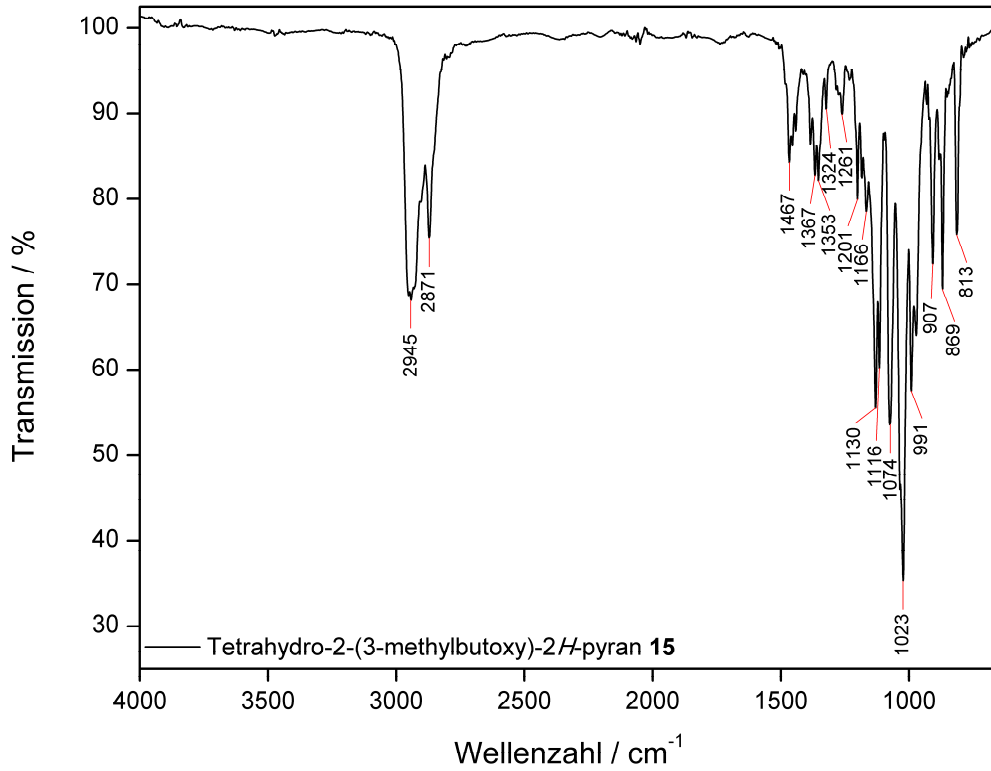


Abb. 8.265: ATR-IR-Spektrum von Tetrahydro-2-(3-methylbutoxy)-2H-pyran (**15**).

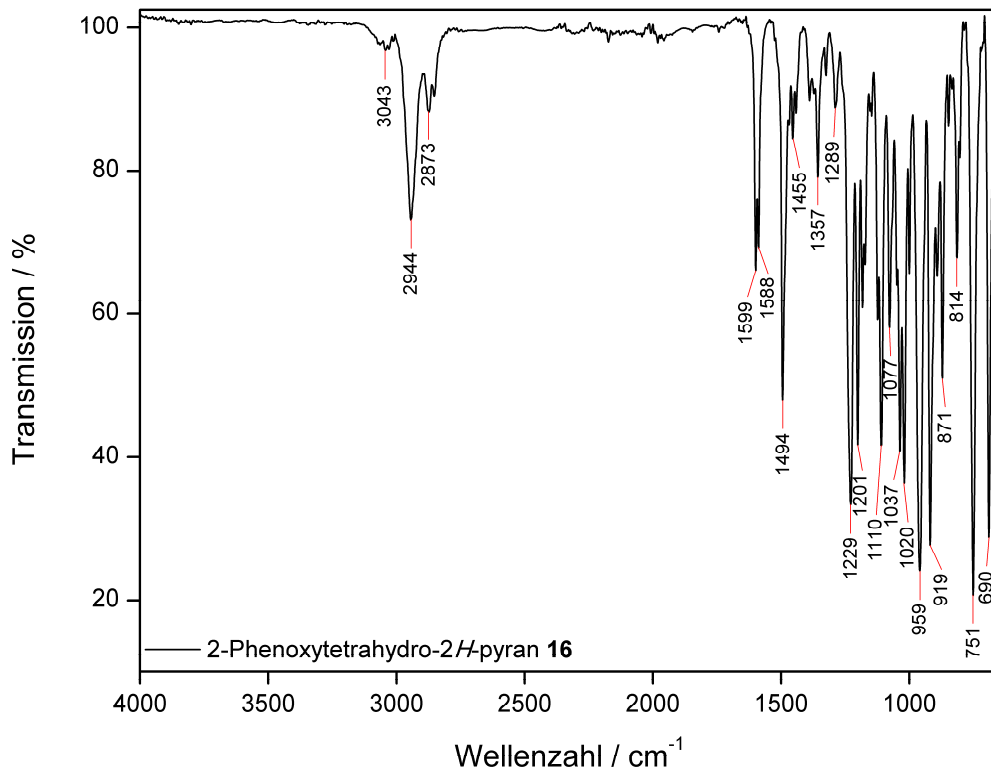


Abb. 8.266: ATR-IR-Spektrum von 2-Phenoxytetrahydro-2H-pyran (**16**).

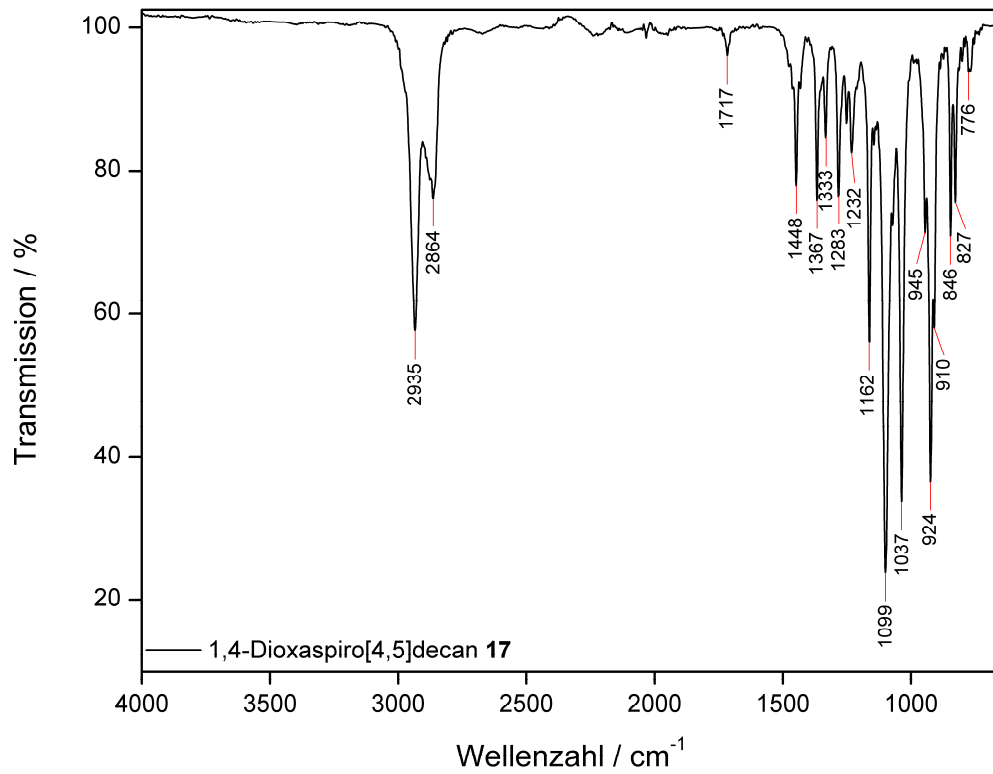


Abb. 8.267: ATR-IR-Spektrum von 1,4-Dioxaspiro[4,5]decan (**17**).

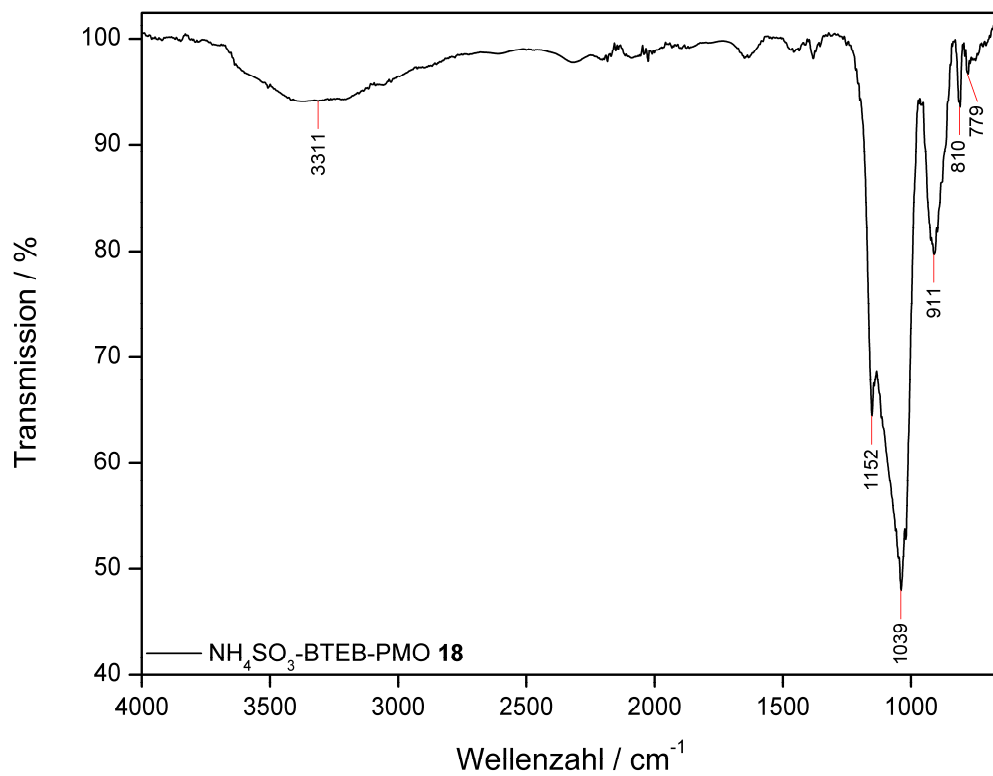


Abb. 8.268: ATR-IR-Spektrum von NH<sub>4</sub>SO<sub>3</sub>-BTEB-PMO (**18**).

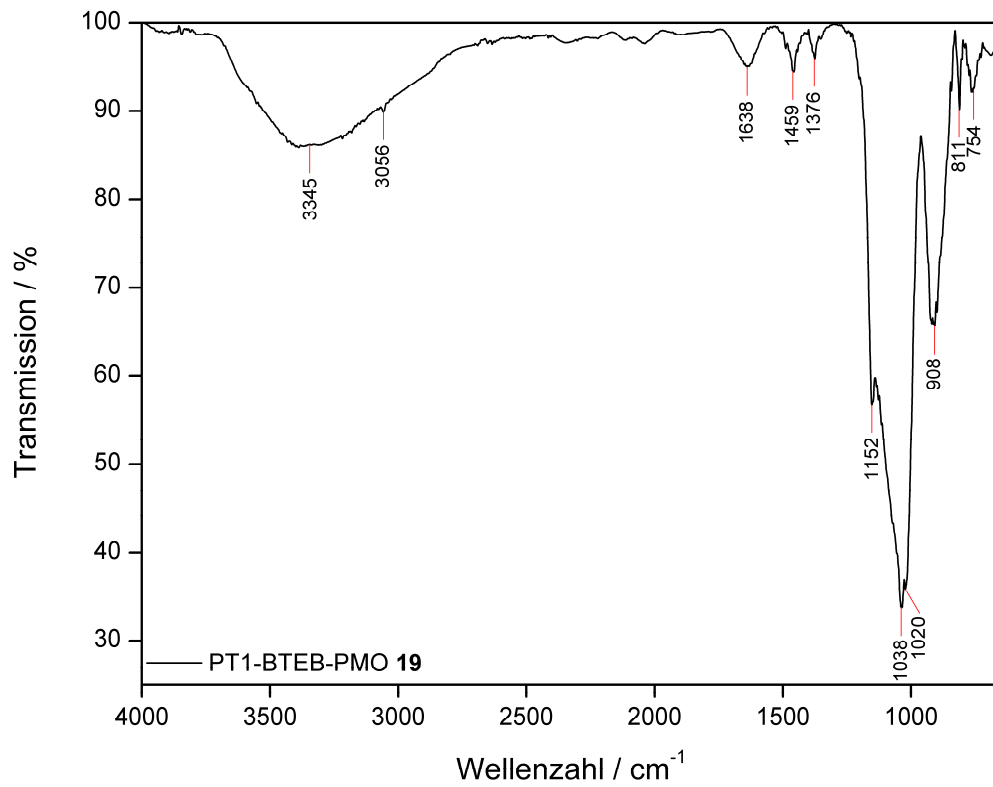


Abb. 8.269: ATR-IR-Spektrum von PT1-BTEB-PMO (**19**).

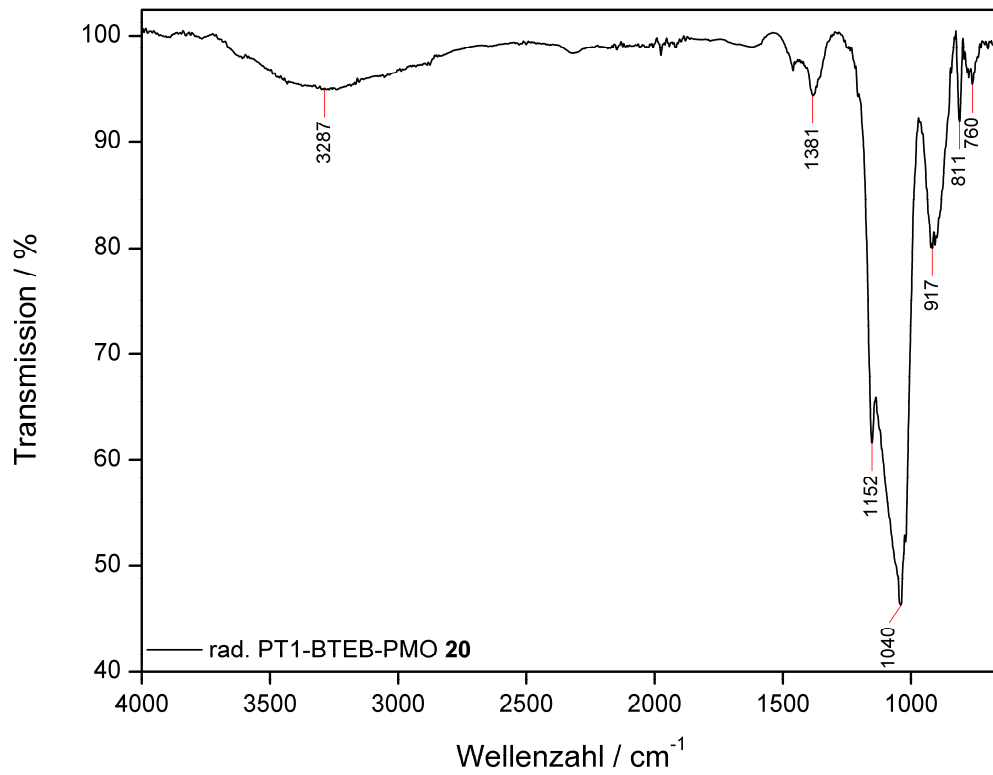


Abb. 8.270: ATR-IR-Spektrum von rad. PT1-BTEB-PMO (**20**).

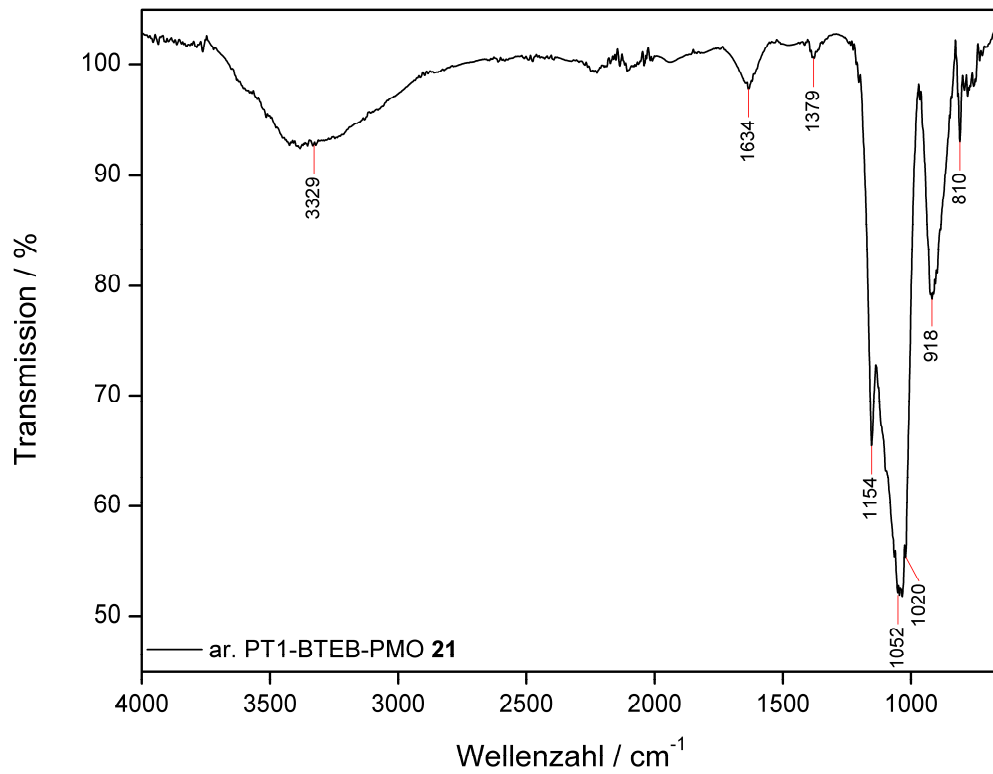


Abb. 8.271: ATR-IR-Spektrum von ar. PT1-BTEB-PMO (21).

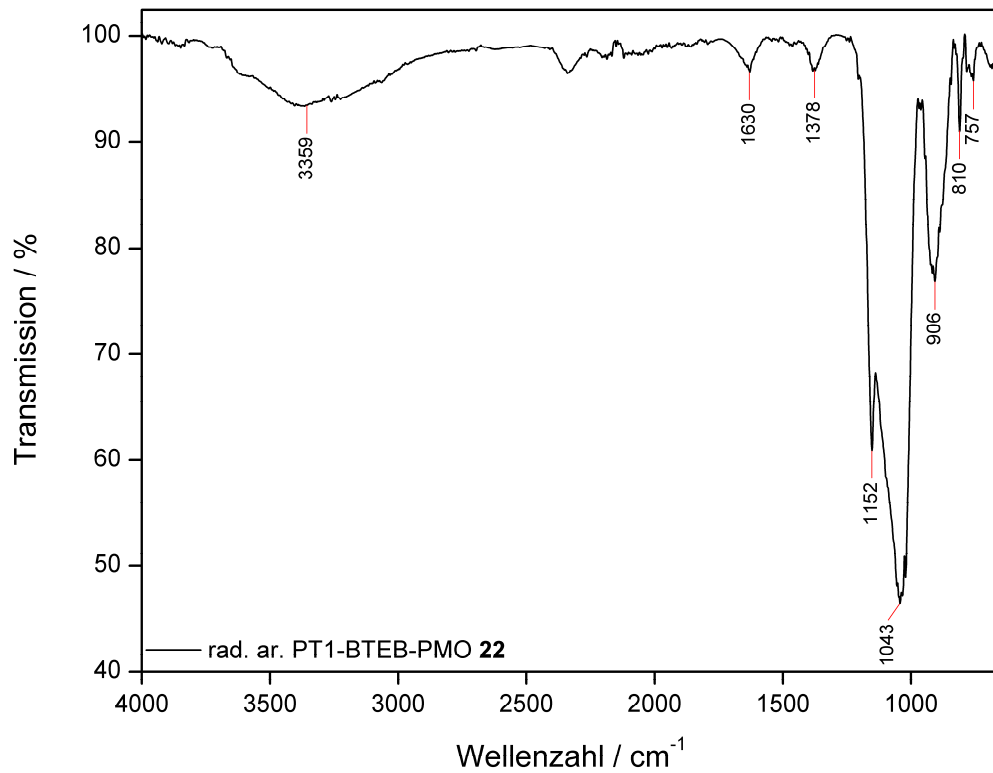


Abb. 8.272: ATR-IR-Spektrum von rad. ar. PT1-BTEB-PMO (22).



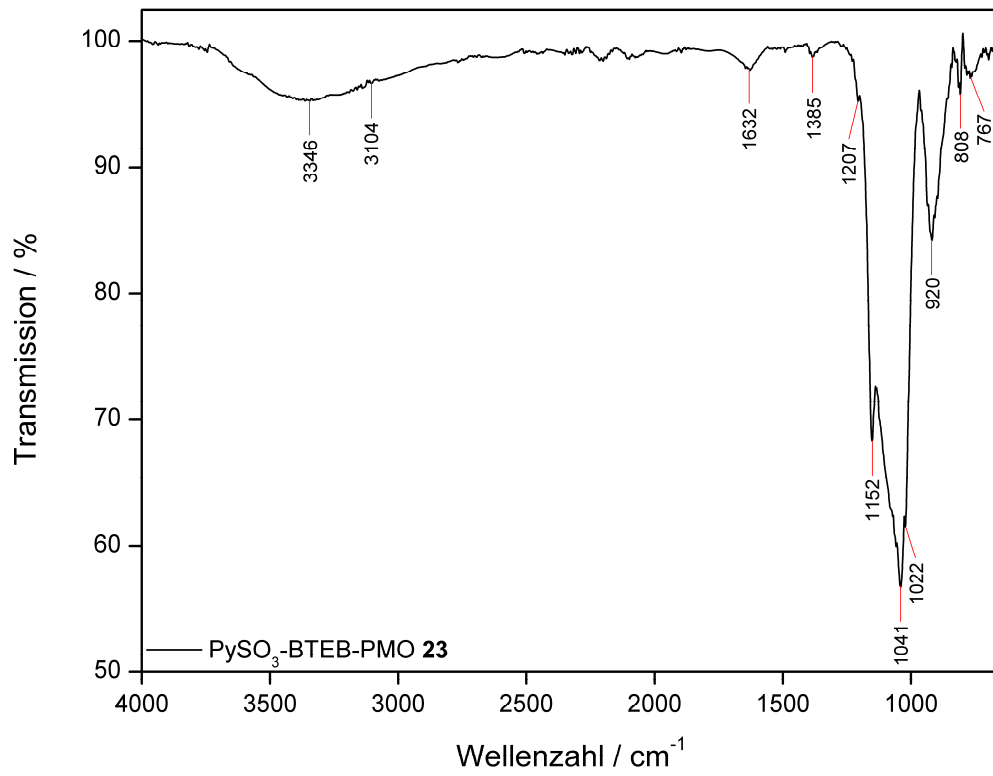


Abb. 8.273: ATR-IR-Spektrum von PySO<sub>3</sub>-BTEB-PMO (**23**).

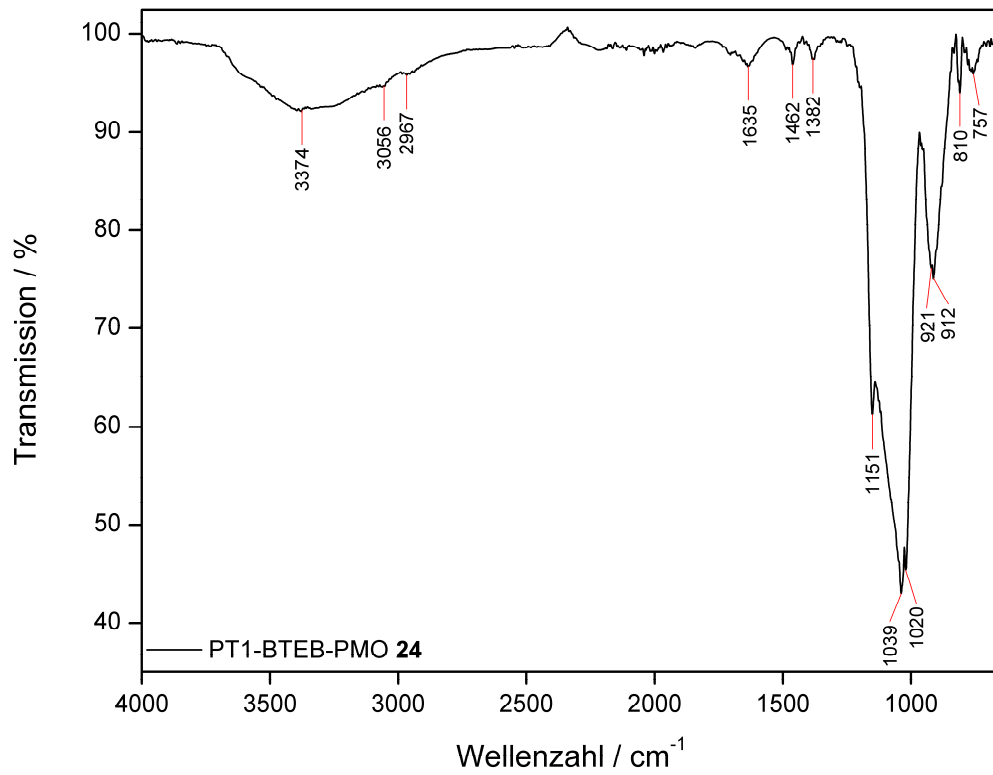


Abb. 8.274: ATR-IR-Spektrum von PT1-BTEB-PMO (**24**).

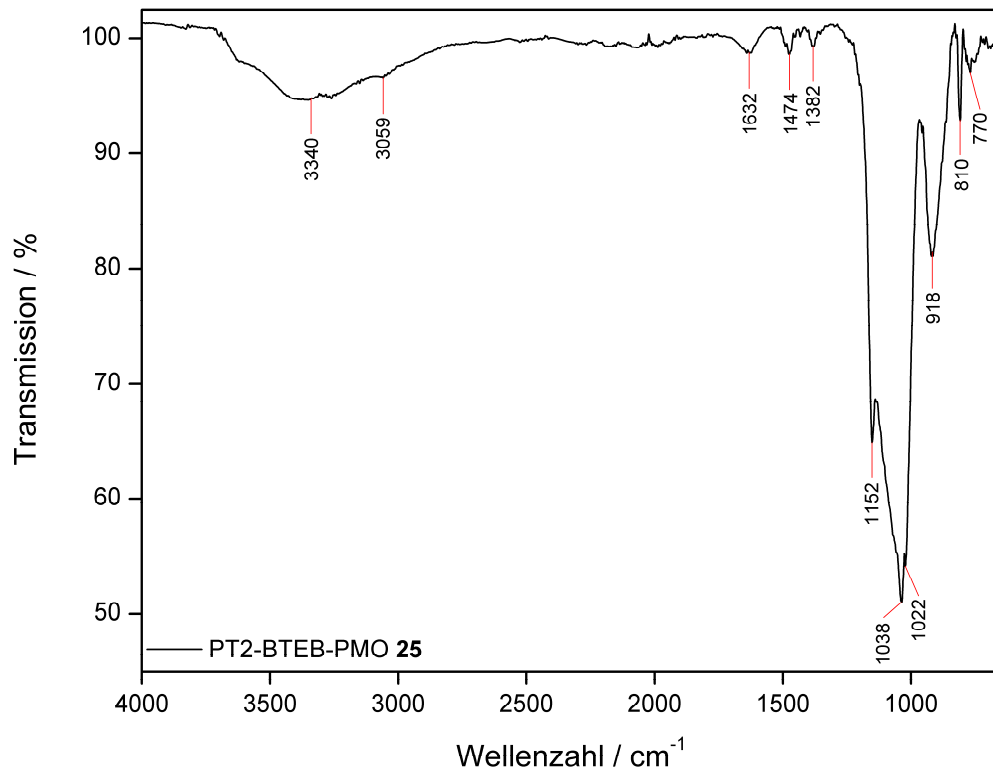


Abb. 8.275: ATR-IR-Spektrum von PT2-BTEB-PMO (**25**).

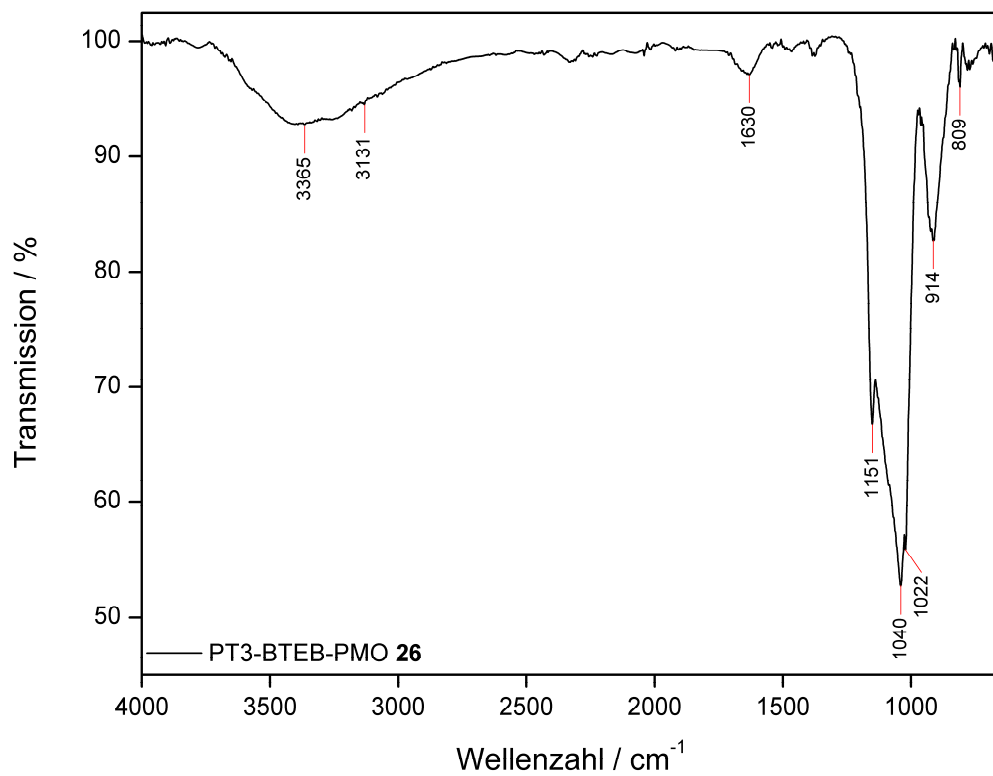


Abb. 8.276: ATR-IR-Spektrum von PT3-BTEB-PMO (**26**).

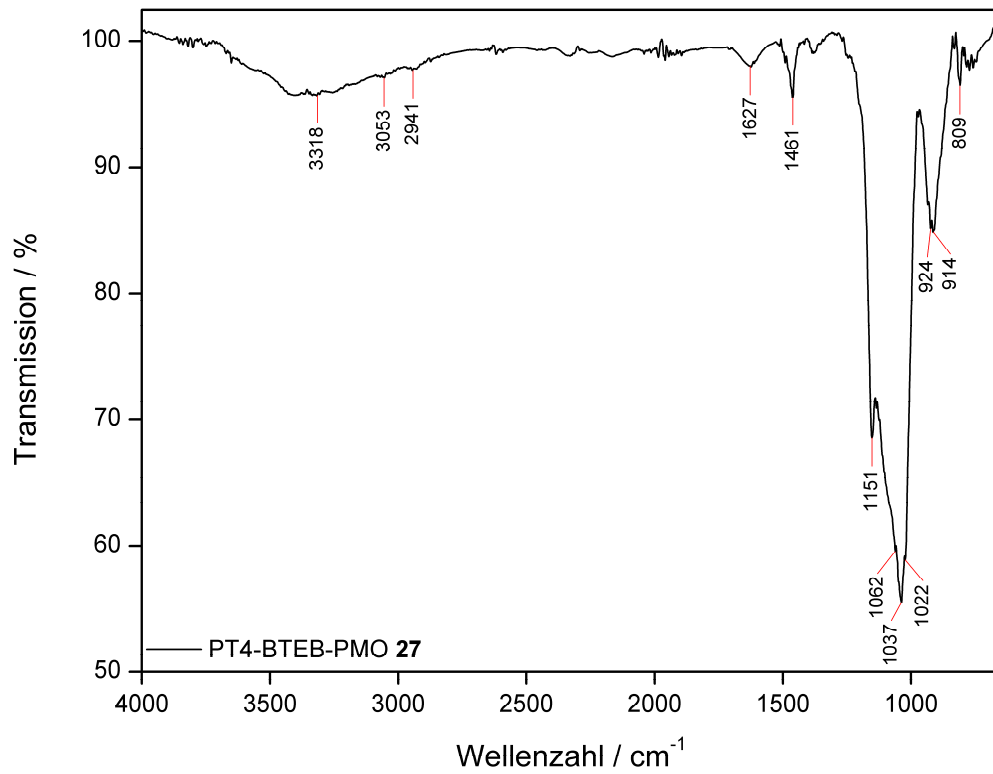


Abb. 8.277: ATR-IR-Spektrum von PT4-BTEB-PMO (**27**).

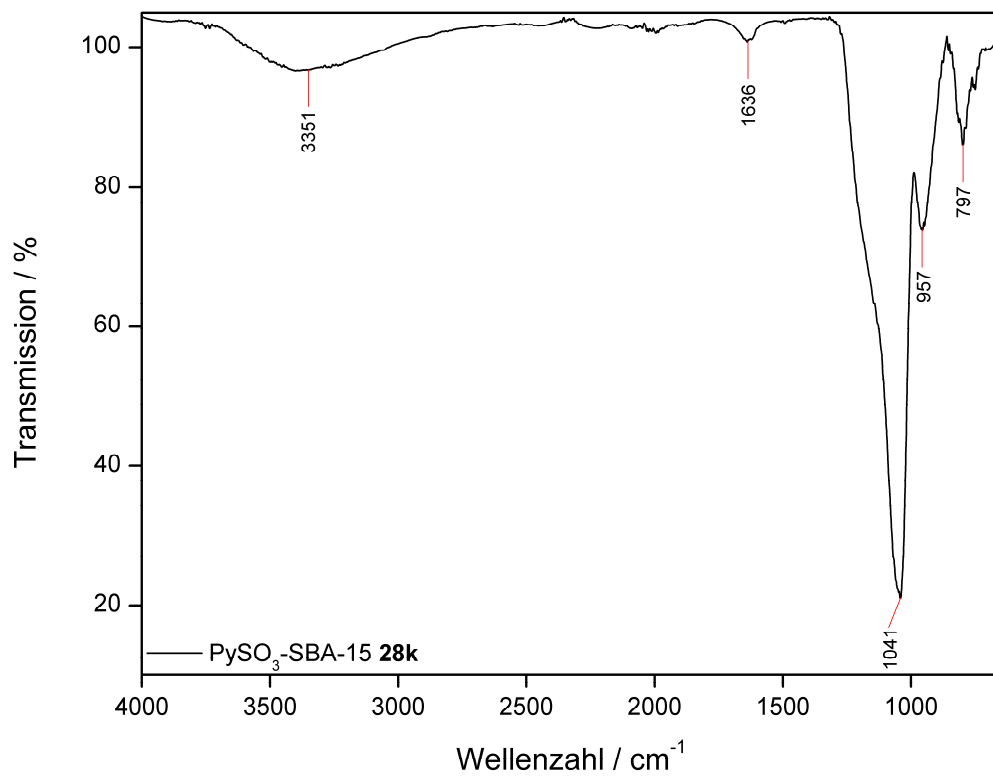


Abb. 8.278: ATR-IR-Spektrum von PySO<sub>3</sub>-SBA-15 (**28k**).

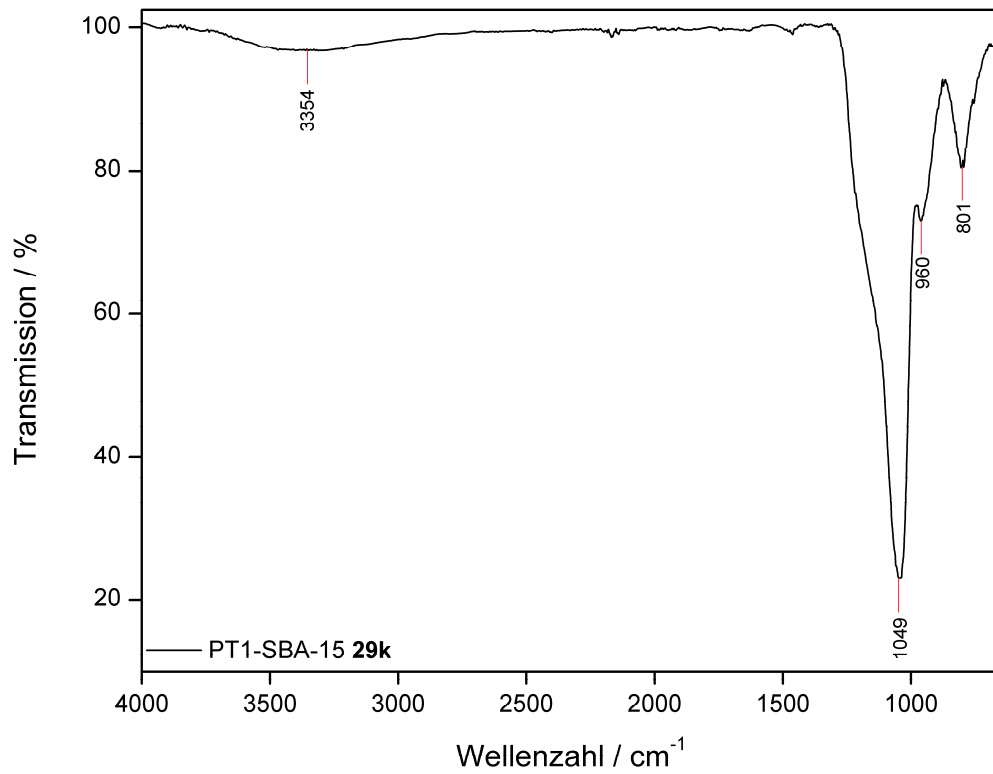


Abb. 8.279: ATR-IR-Spektrum von PT1-SBA-15 (**29k**).

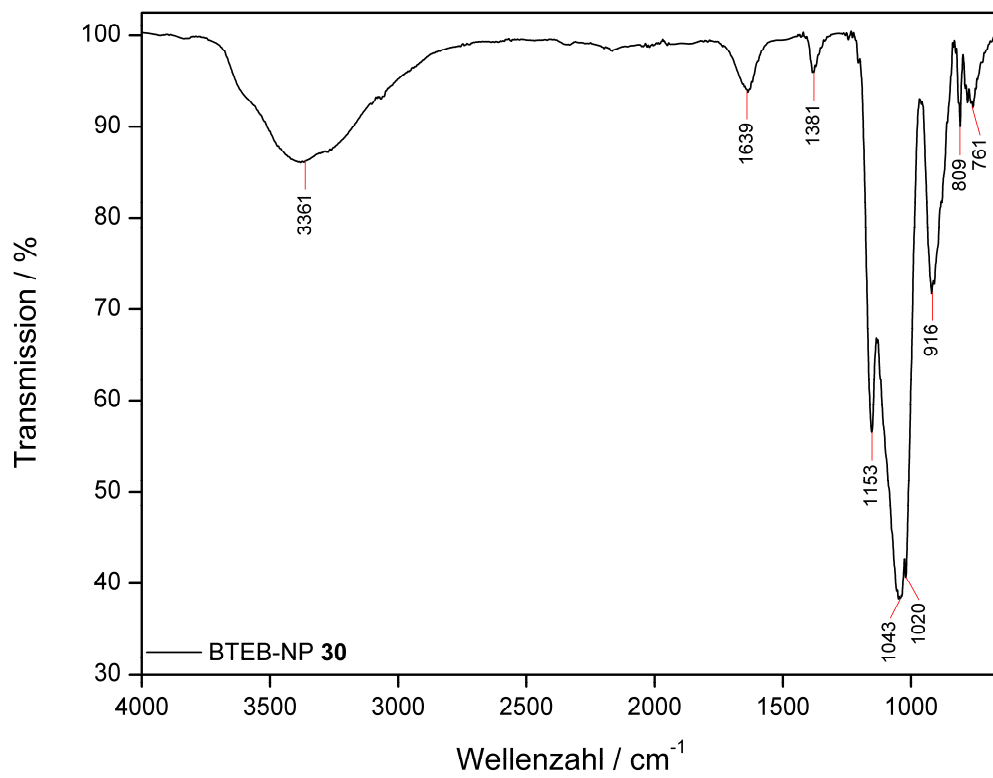


Abb. 8.280: ATR-IR-Spektrum von BTEB-NP (**30**).

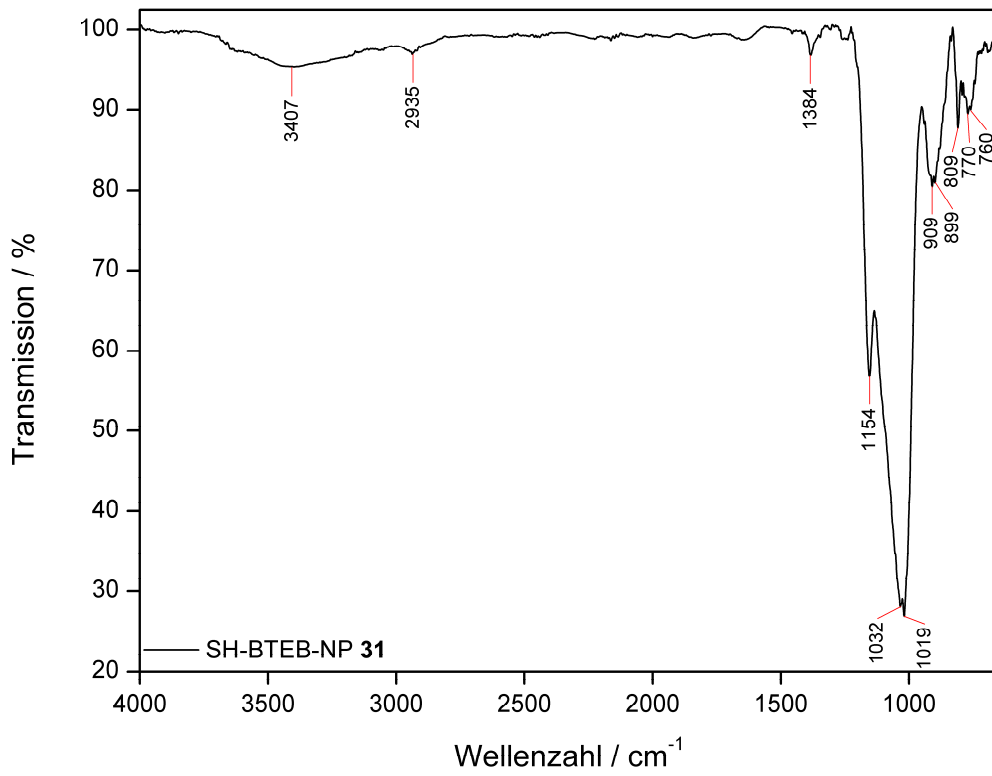


Abb. 8.281: ATR-IR-Spektrum von SH-BTEB-NP (31).

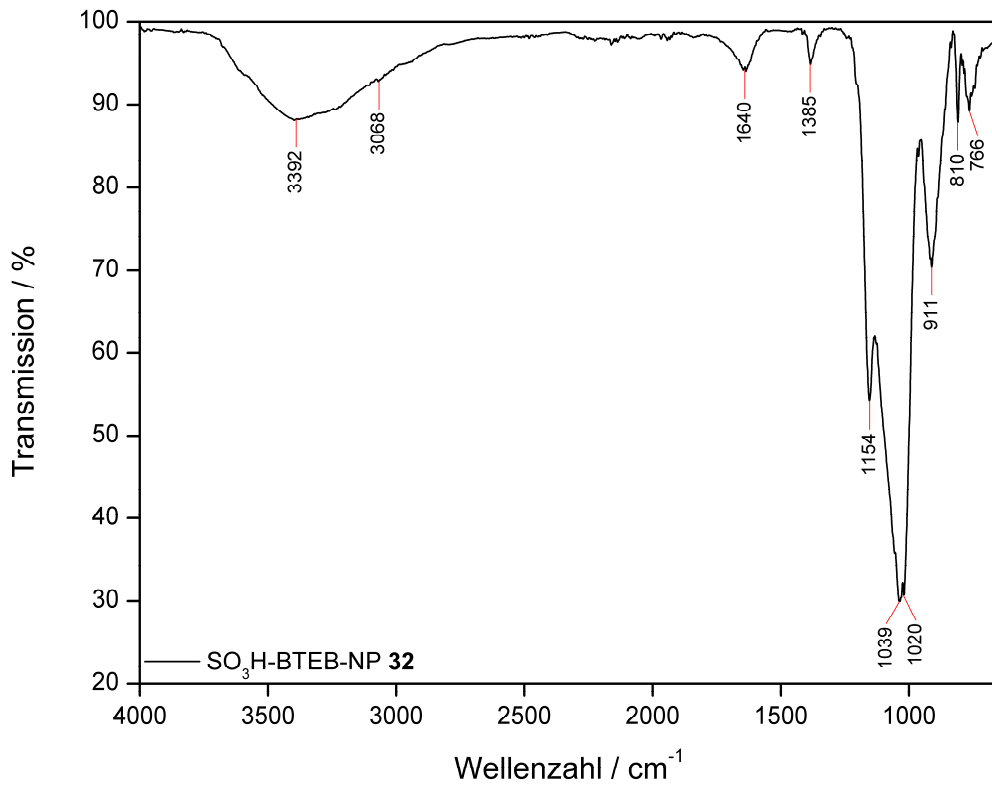


Abb. 8.282: ATR-IR-Spektrum von SO<sub>3</sub>H-BTEB-NP (32).

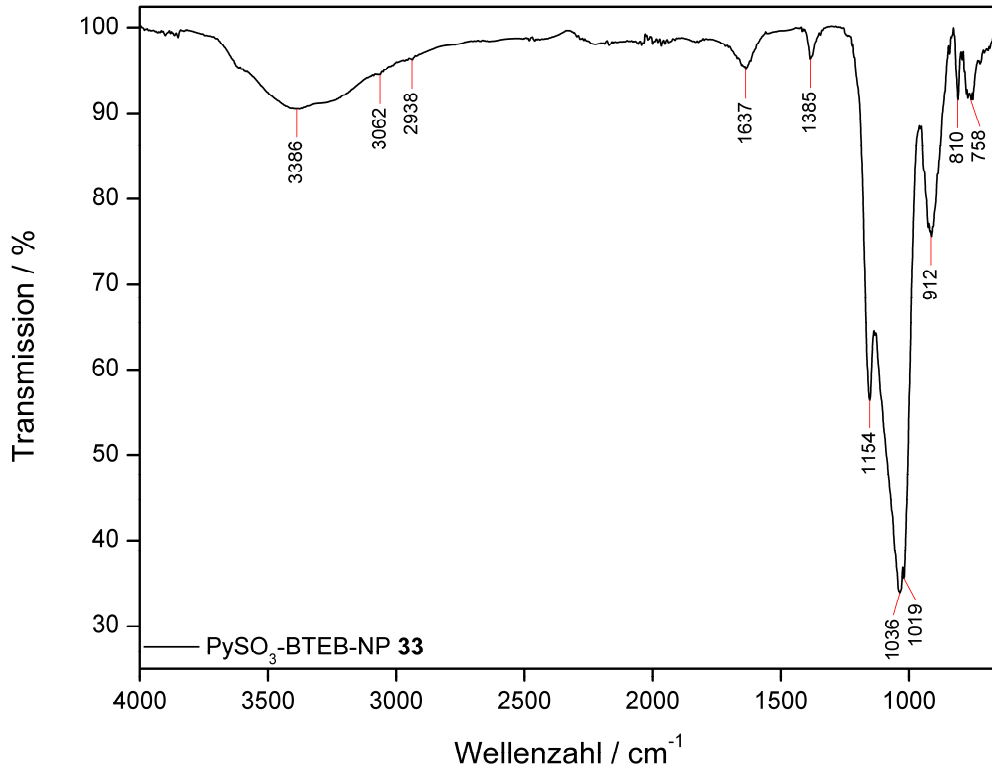


Abb. 8.283: ATR-IR-Spektrum von PySO<sub>3</sub>-BTEB-NP (**33**).

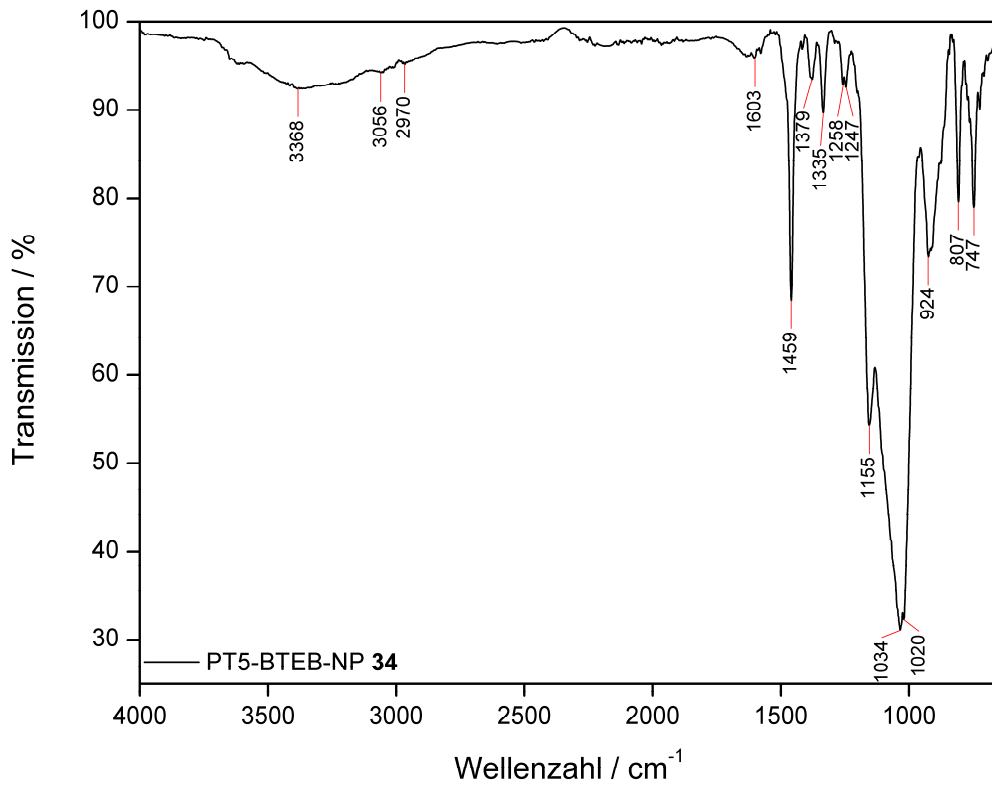


Abb. 8.284: ATR-IR-Spektrum von PT5-BTEB-NP (**34**).

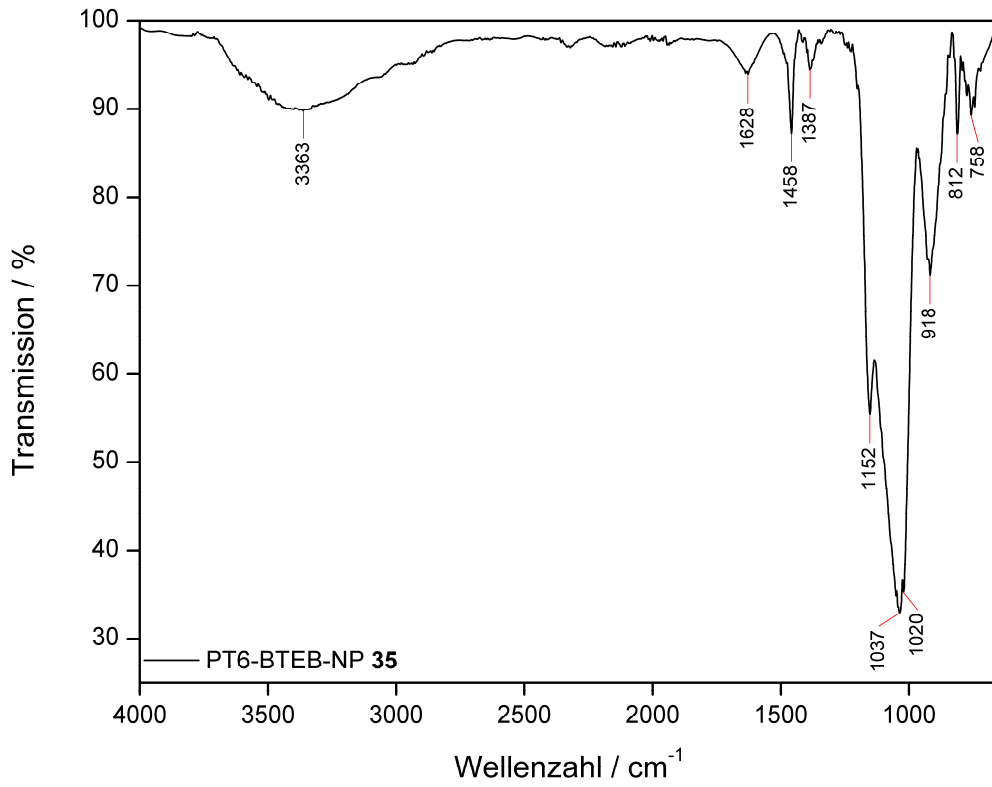


Abb. 8.285: ATR-IR-Spektrum von PT6-BTEB-NP (**35**).

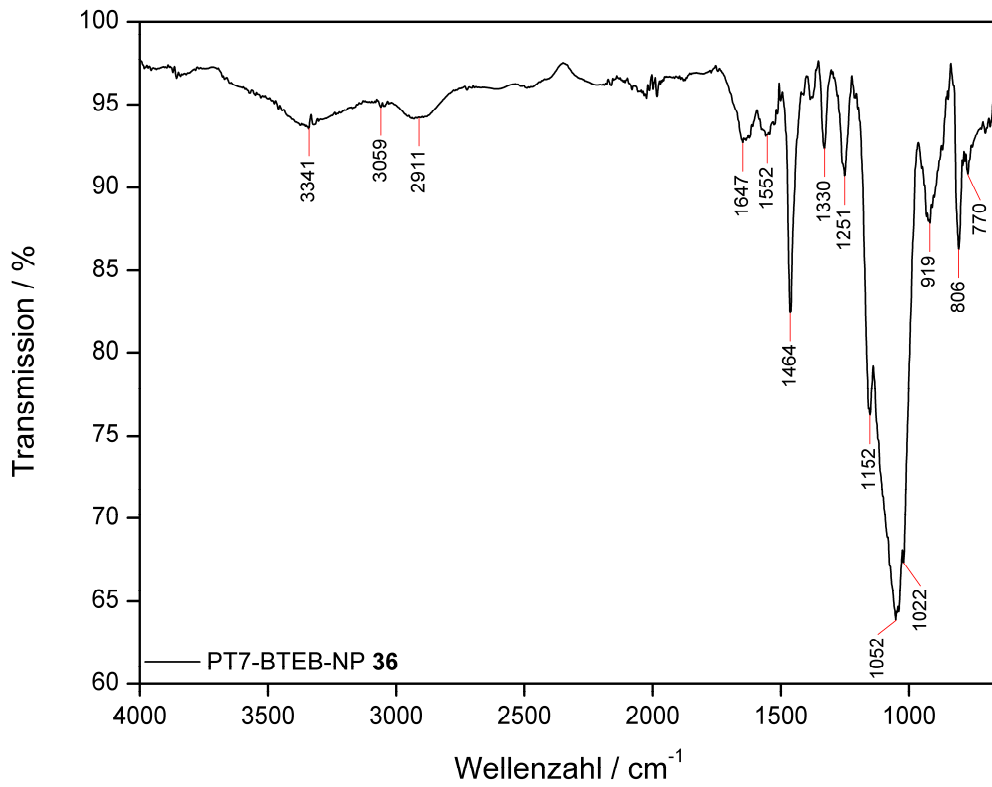


Abb. 8.286: ATR-IR-Spektrum von PT7-BTEB-NP (**36**).

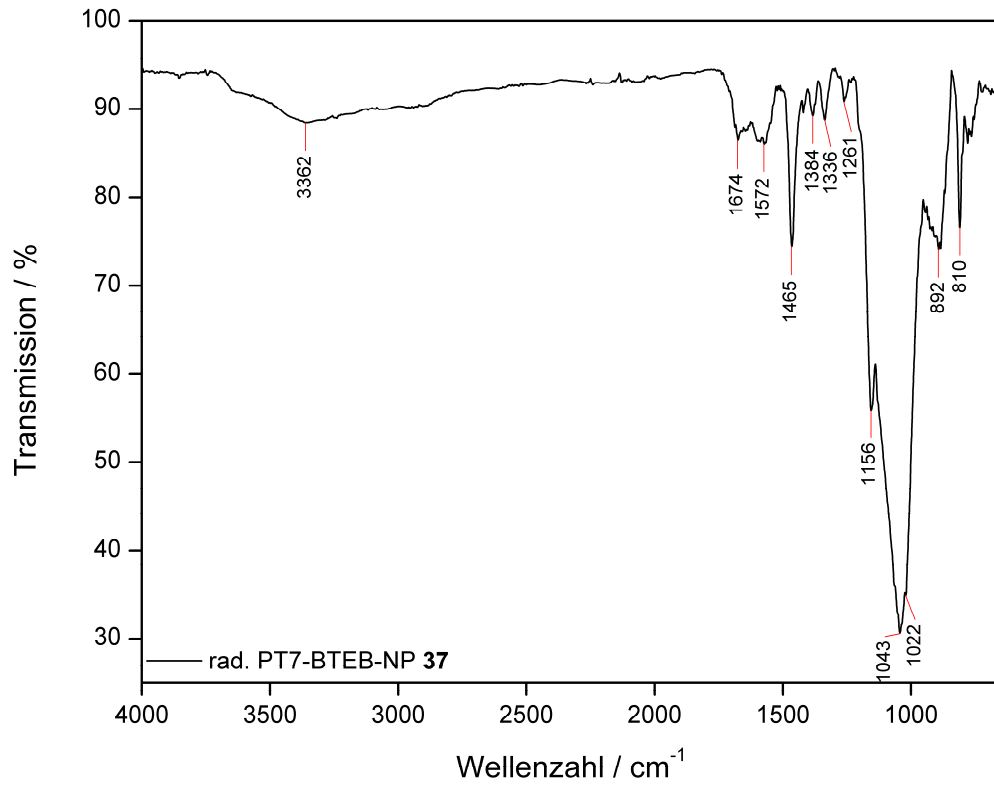


Abb. 8.287: ATR-IR-Spektrum von rad. PT7-BTEB-NP (**37**).

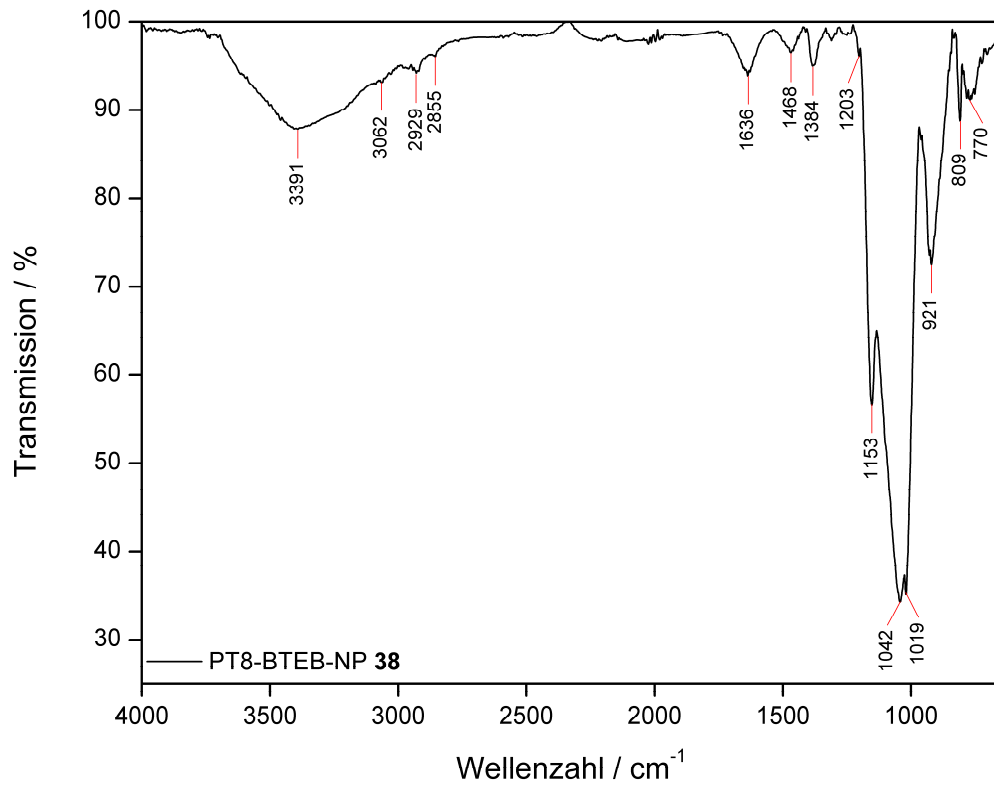


Abb. 8.288: ATR-IR-Spektrum von PT8-BTEB-NP (**38**).



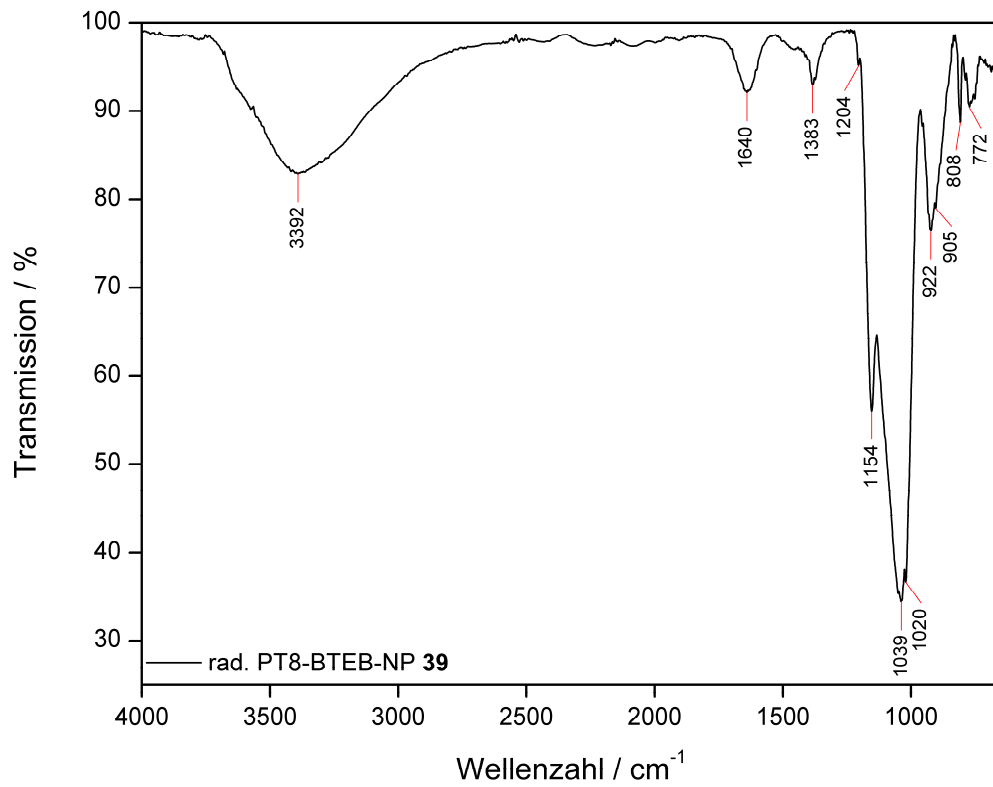


Abb. 8.289: ATR-IR-Spektrum von rad. PT8-BTEB-NP (**39**).

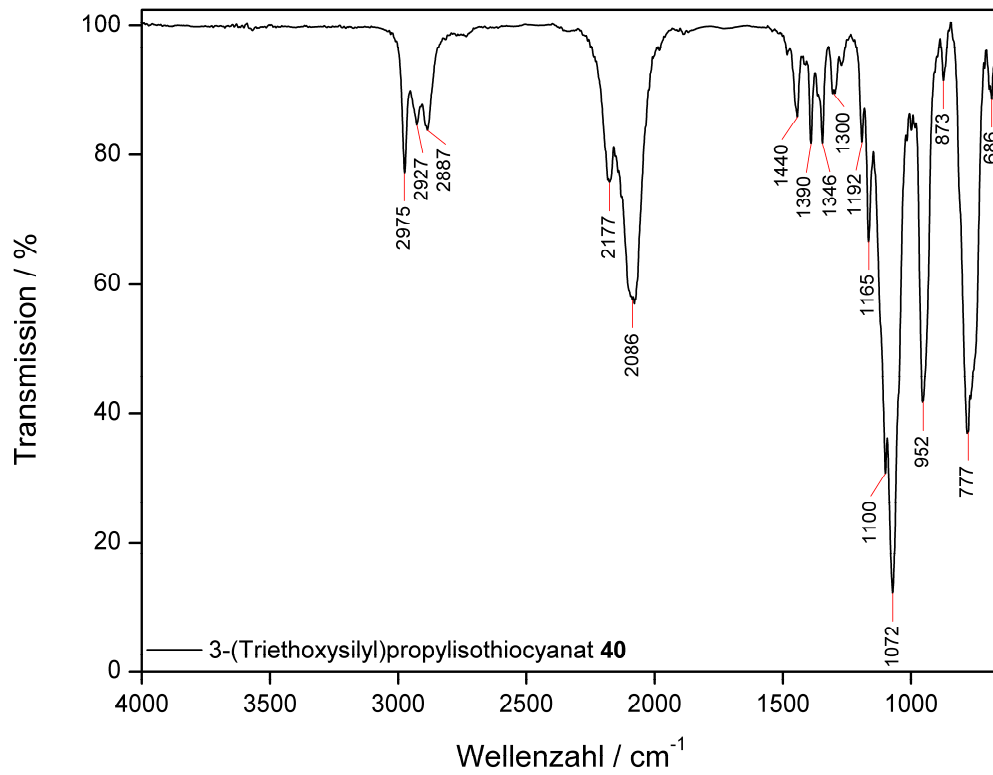


Abb. 8.290: ATR-IR-Spektrum von 3-(Triethoxysilyl)propylisothiocyanat (**40**).

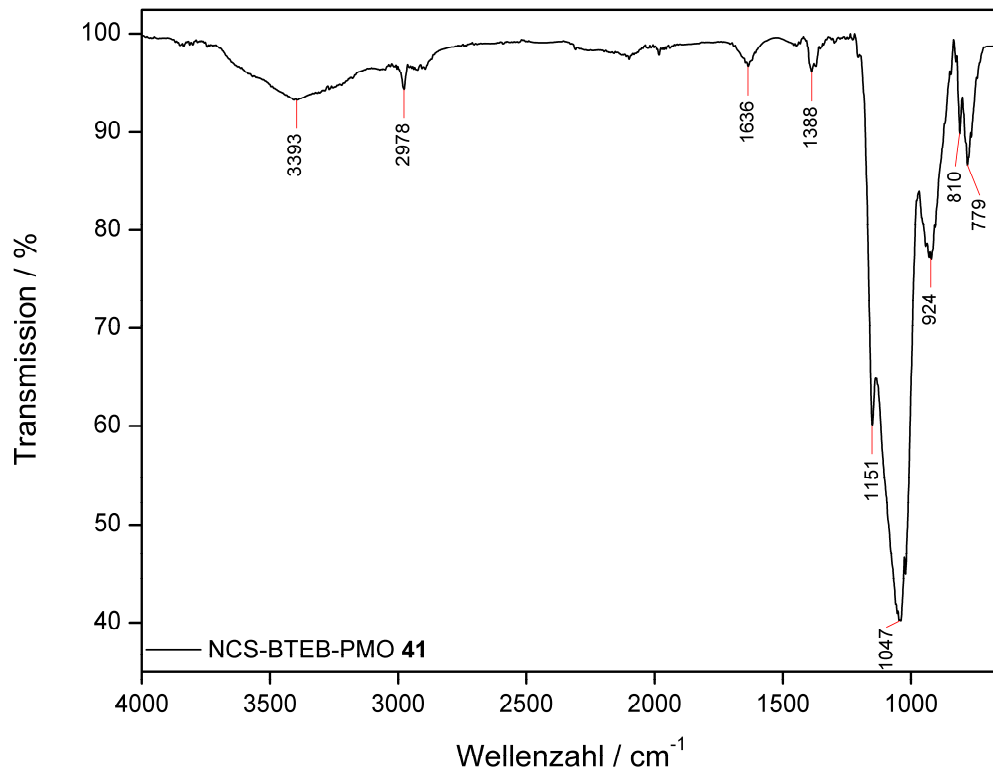


Abb. 8.291: ATR-IR-Spektrum von NCS-BTEB-PMO (**41**).

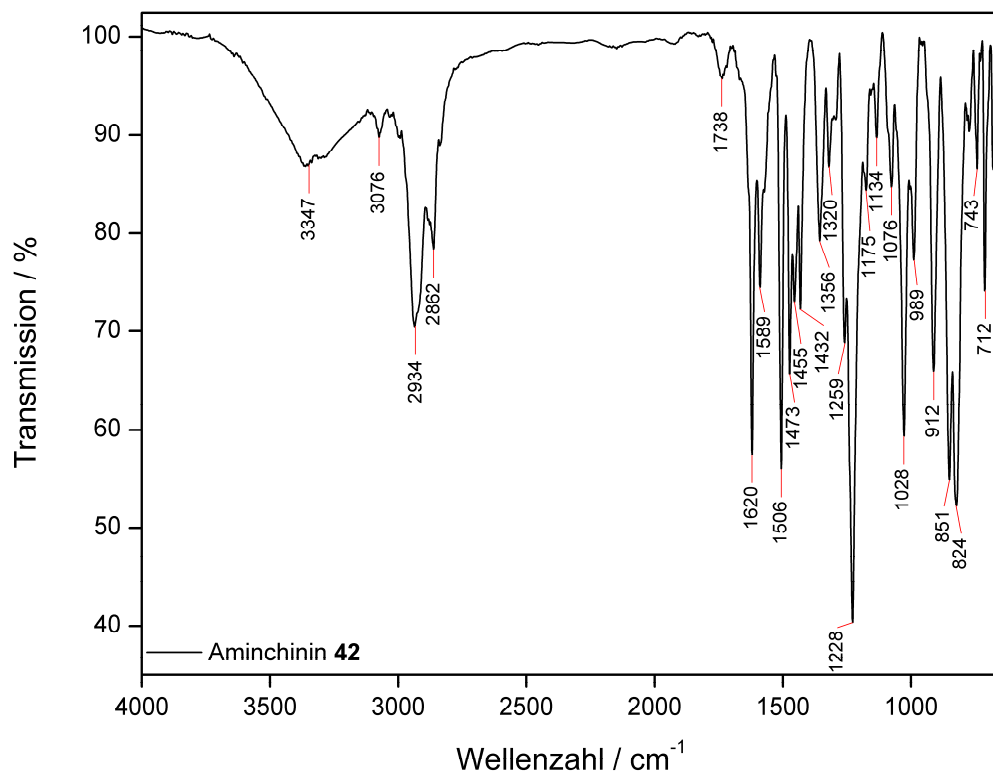


Abb. 8.292: ATR-IR-Spektrum von Aminichinin (**42**).

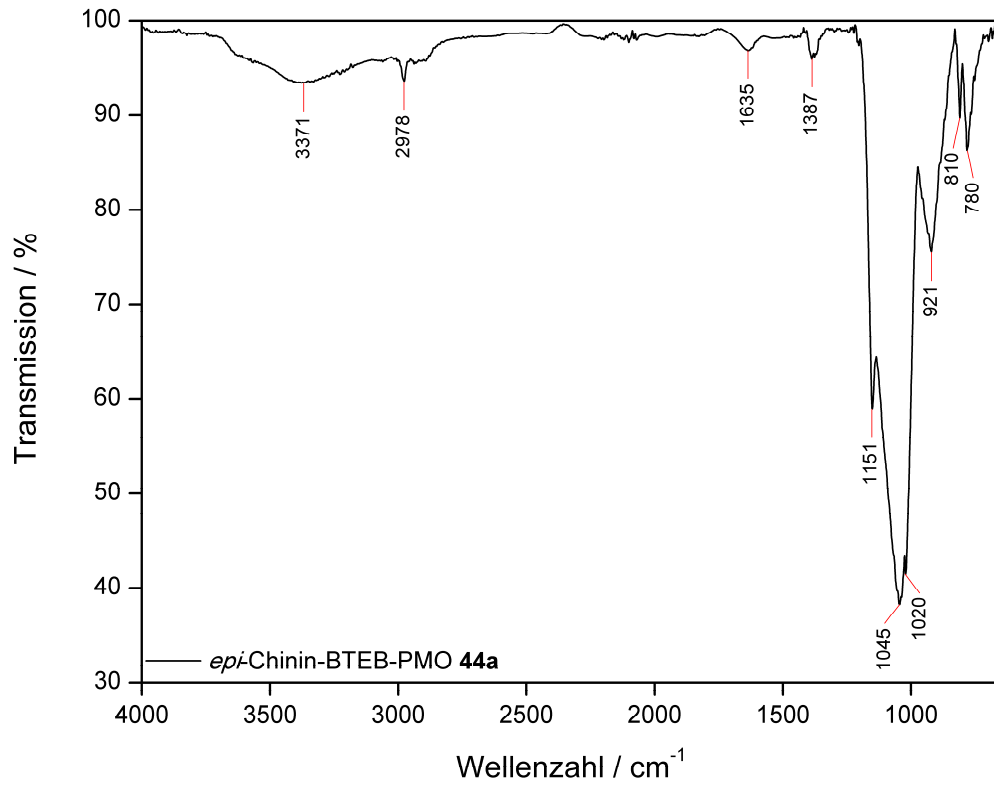


Abb. 8.293: ATR-IR-Spektrum von *epi*-Chinin-BTEB-PMO (**44a**).

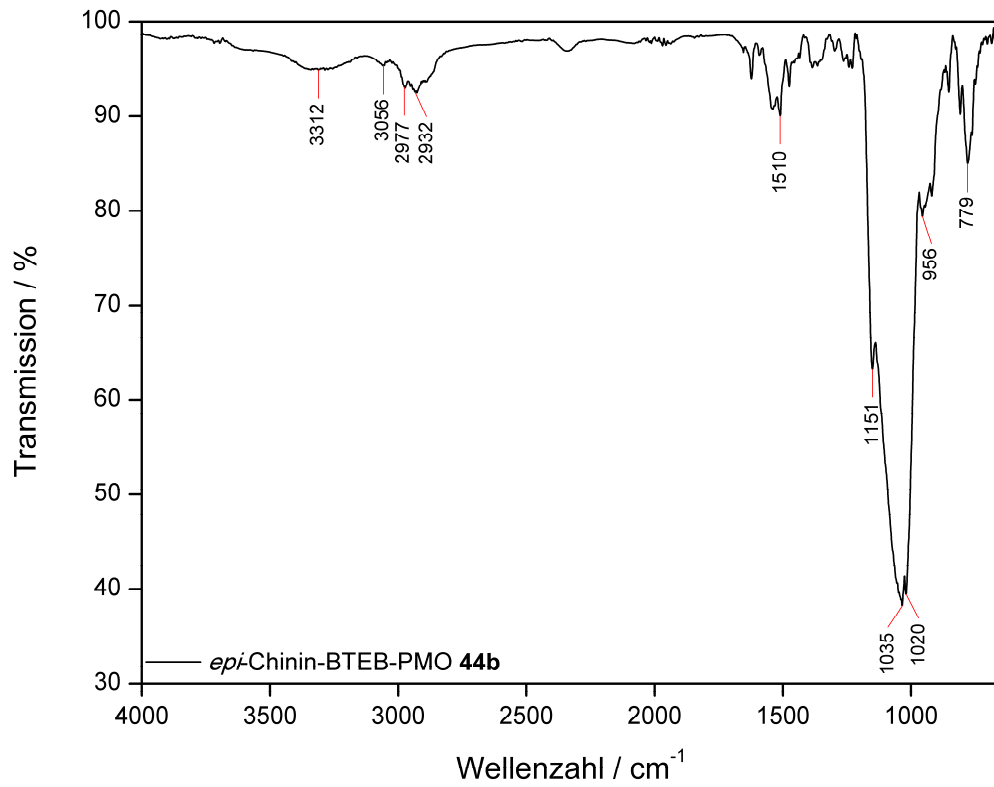


Abb. 8.294: ATR-IR-Spektrum von *epi*-Chinin-BTEB-PMO (**44b**).

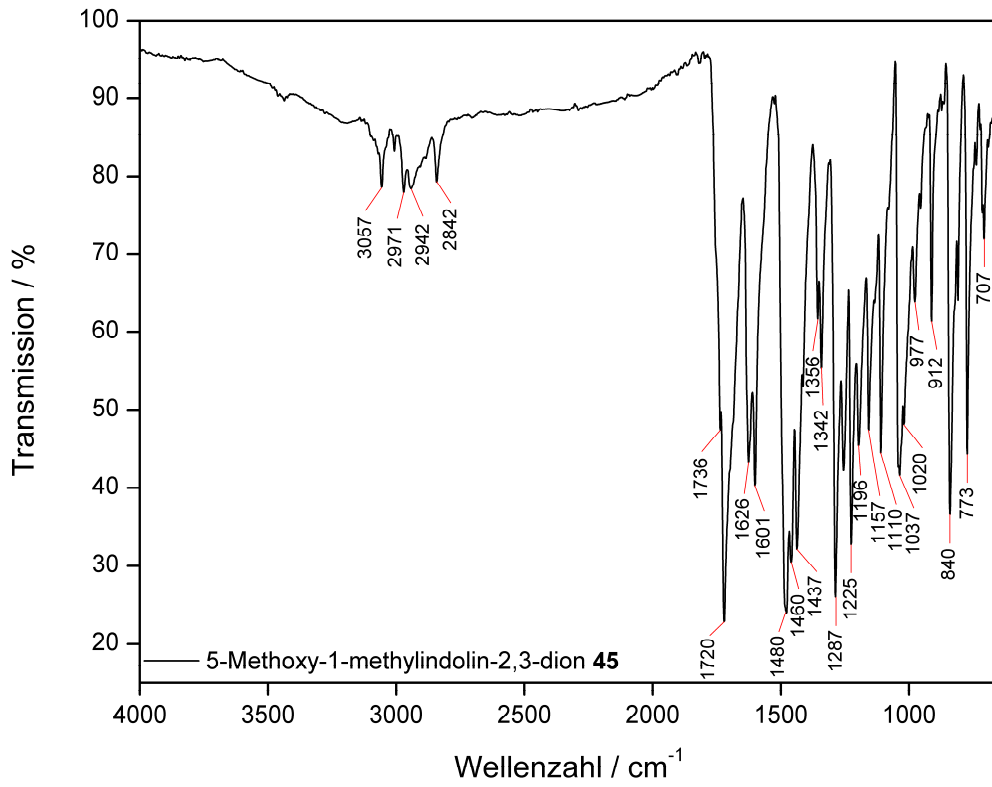


Abb. 8.295: ATR-IR-Spektrum von 5-Methoxy-1-methylindolin-2,3-dion (**45**).

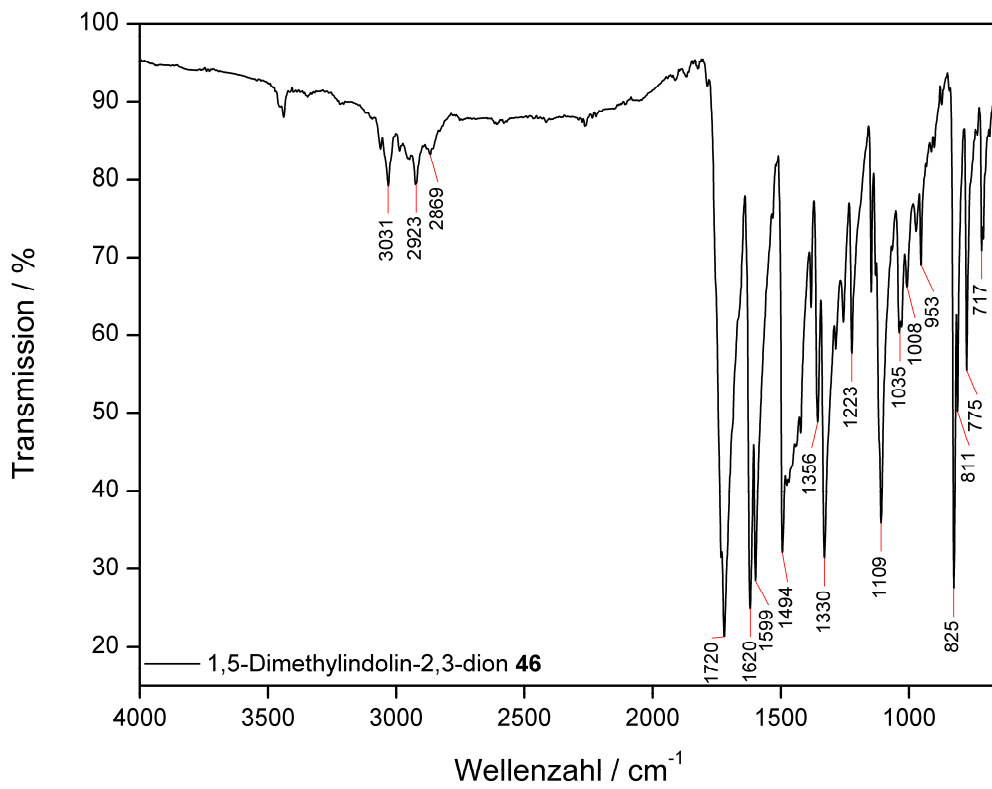


Abb. 8.296: ATR-IR-Spektrum von 1,5-Dimethylindolin-2,3-dion (**46**).

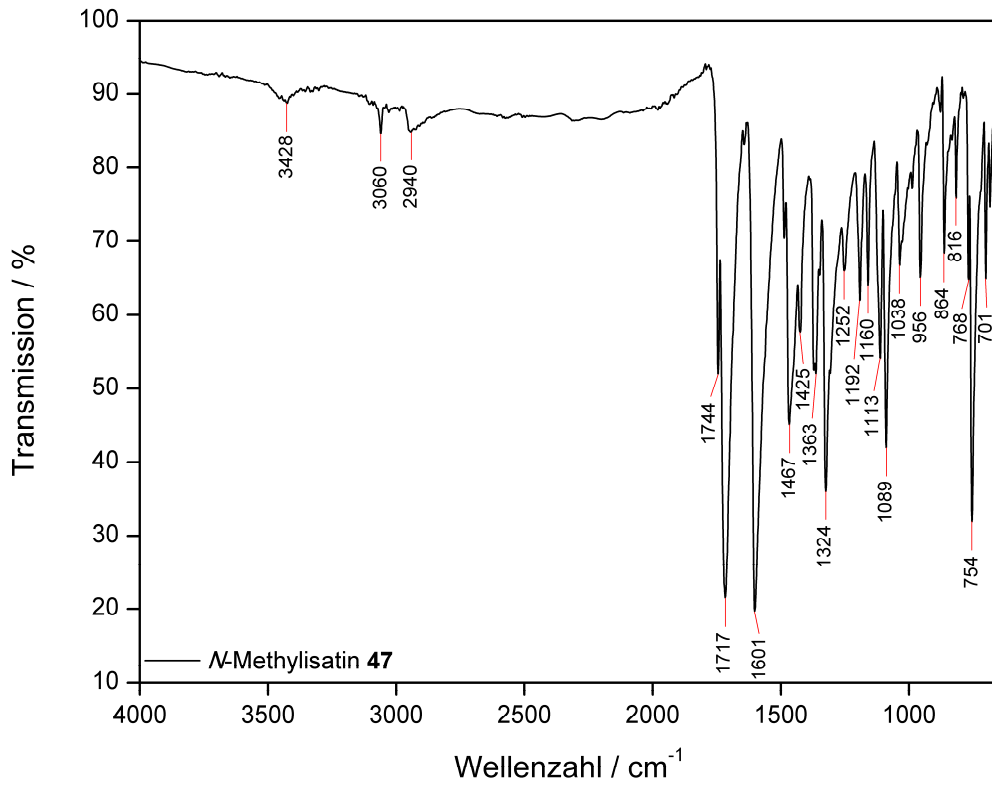


Abb. 8.297: ATR-IR-Spektrum von *N*-Methylisatin (**47**).

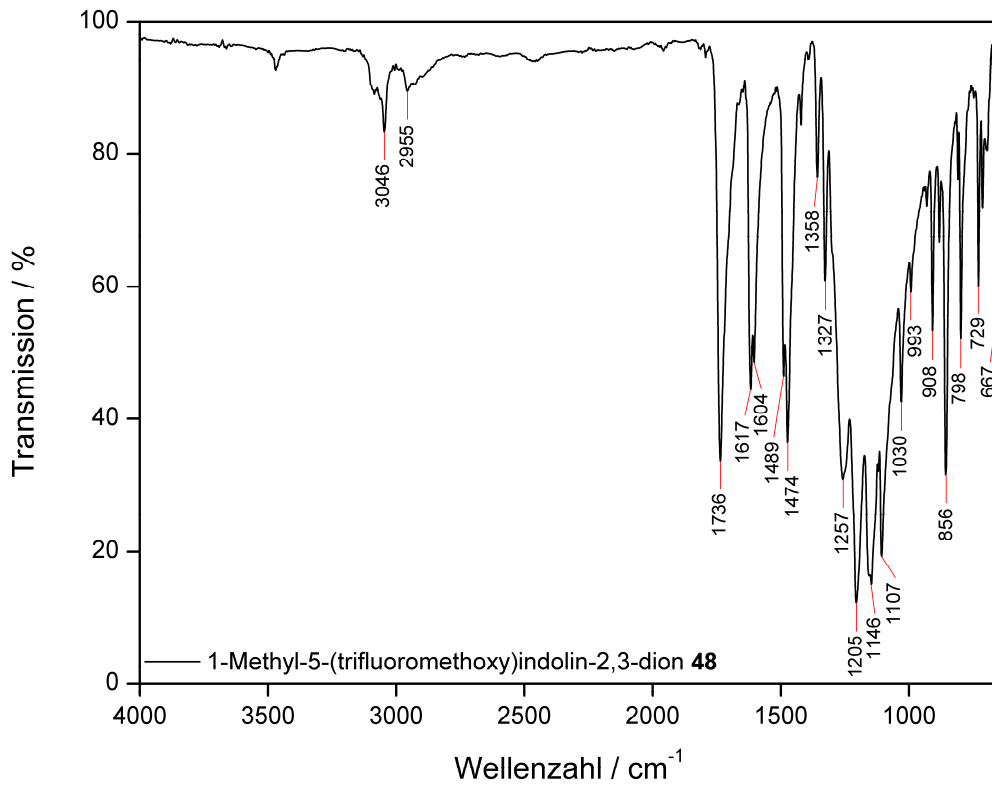


Abb. 8.298: ATR-IR-Spektrum von 1-Methyl-5-(trifluoromethoxy)indolin-2,3-dion (**48**).

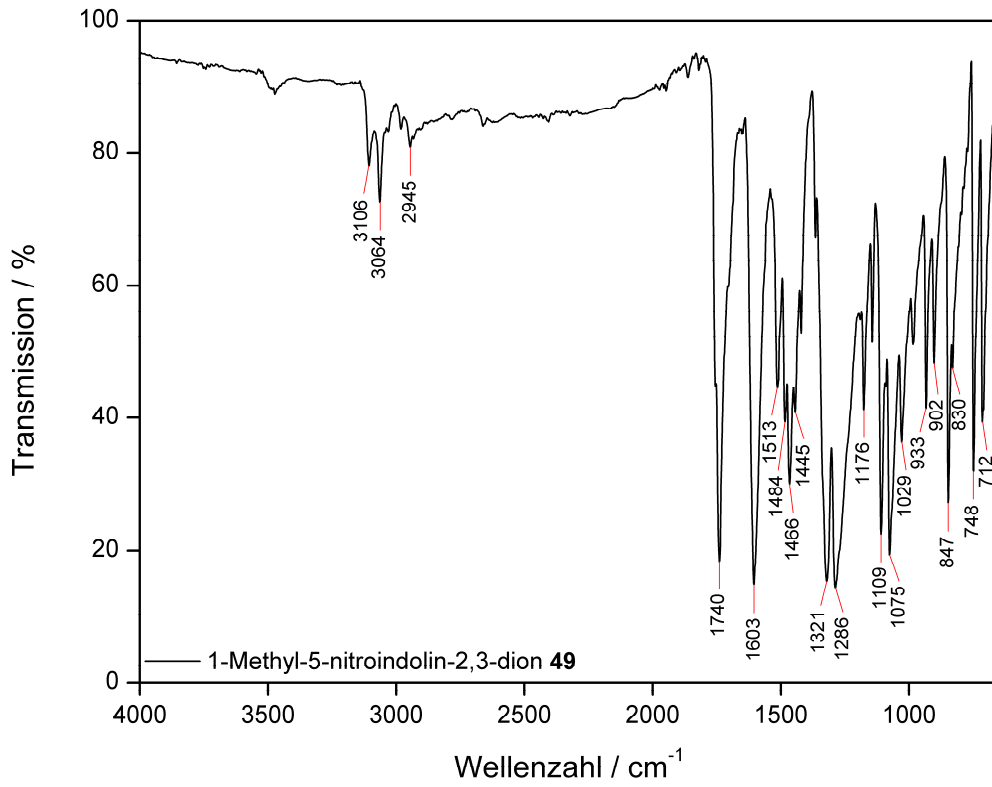


Abb. 8.299: ATR-IR-Spektrum von 1-Methyl-5-nitroindolin-2,3-dion (**49**).

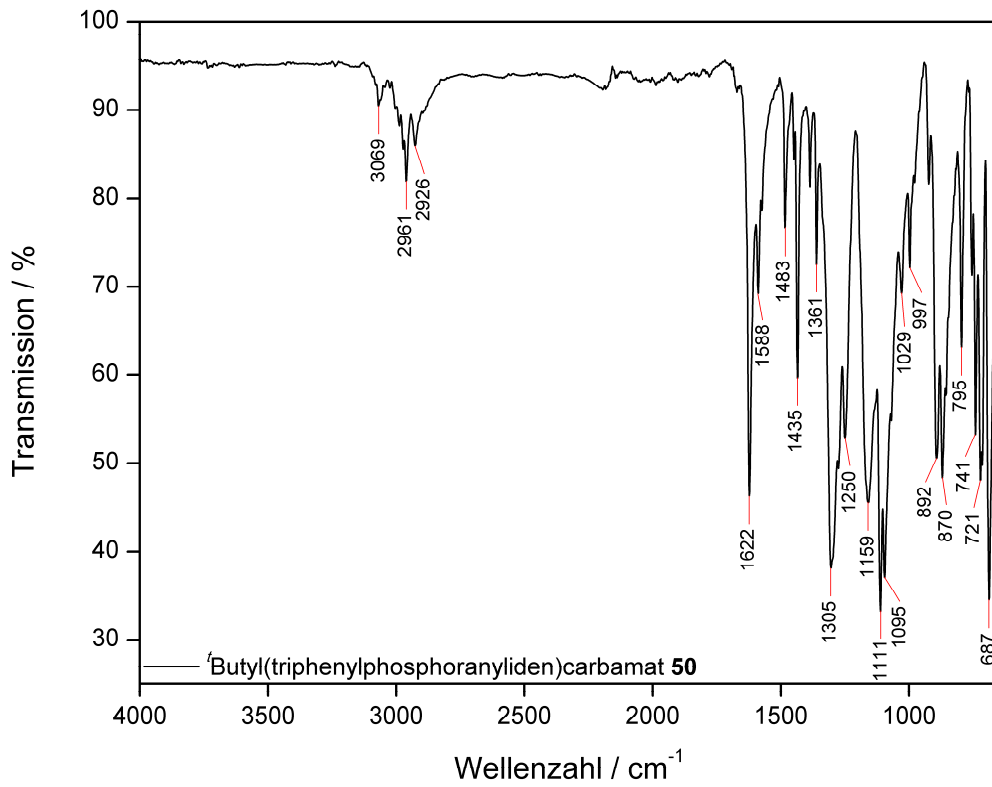


Abb. 8.300: ATR-IR-Spektrum von Butyl(triphenylphosphoranyliden)carbamate (**50**).

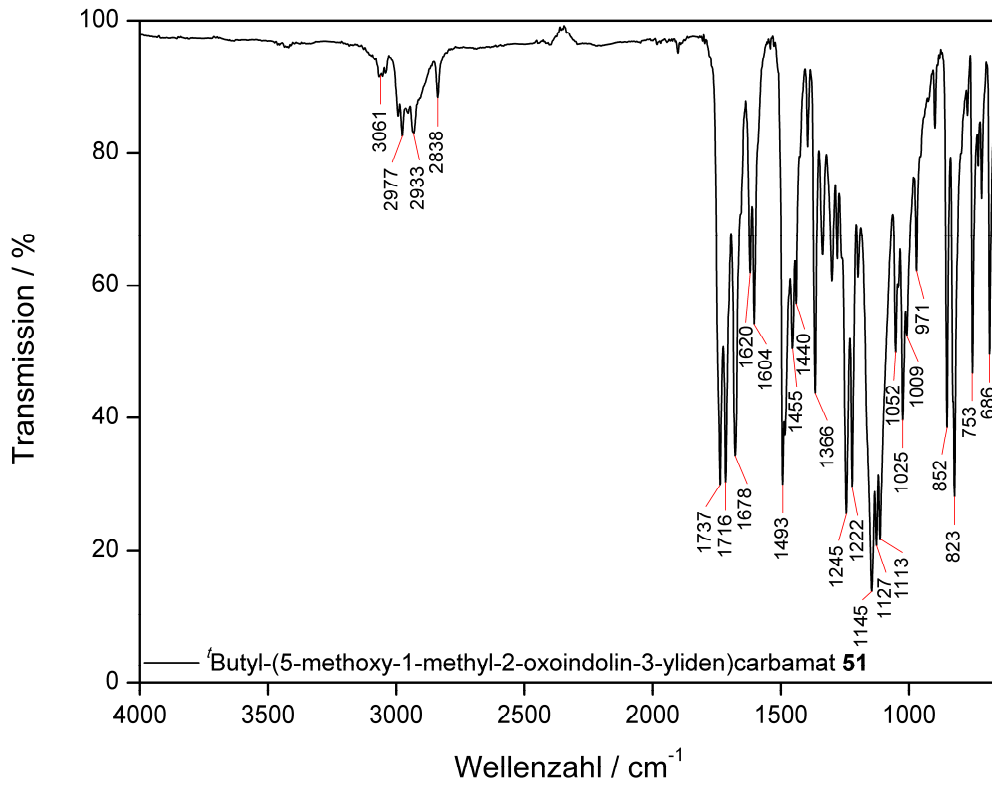


Abb. 8.301: ATR-IR-Spektrum von Butyl-(5-methoxy-1-methyl-2-oxoindolin-3-yliden)carbamate (**51**).

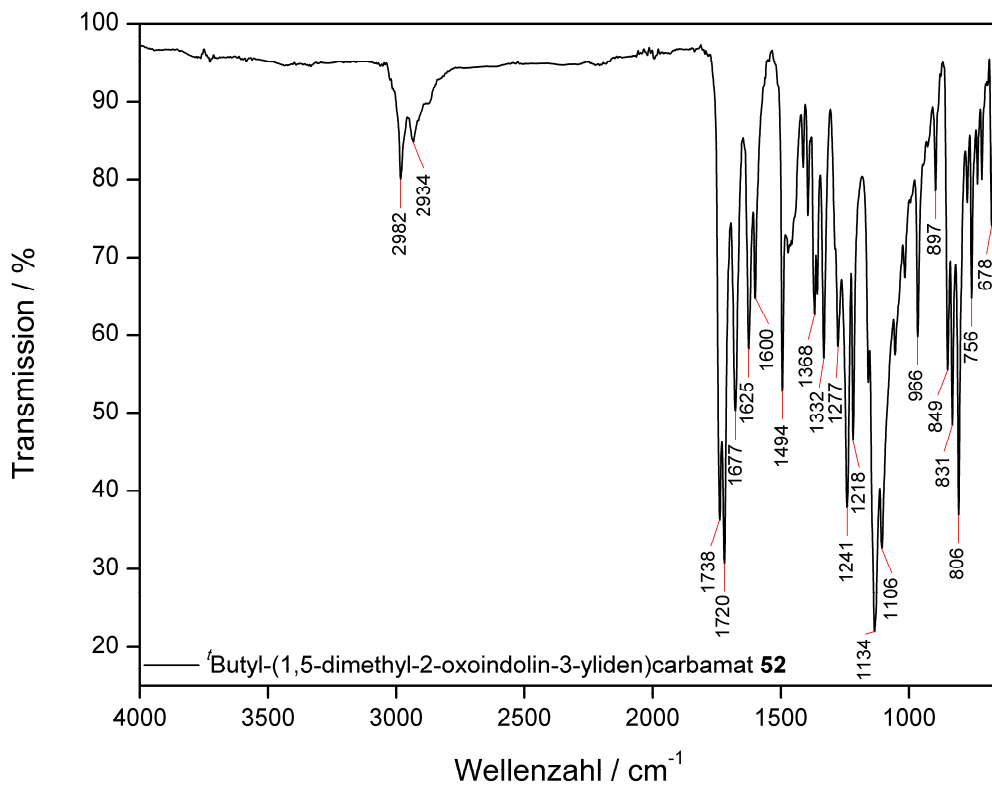


Abb. 8.302: ATR-IR-Spektrum von Butyl-(1,5-dimethyl-2-oxoindolin-3-yliden)carbamate (**52**).

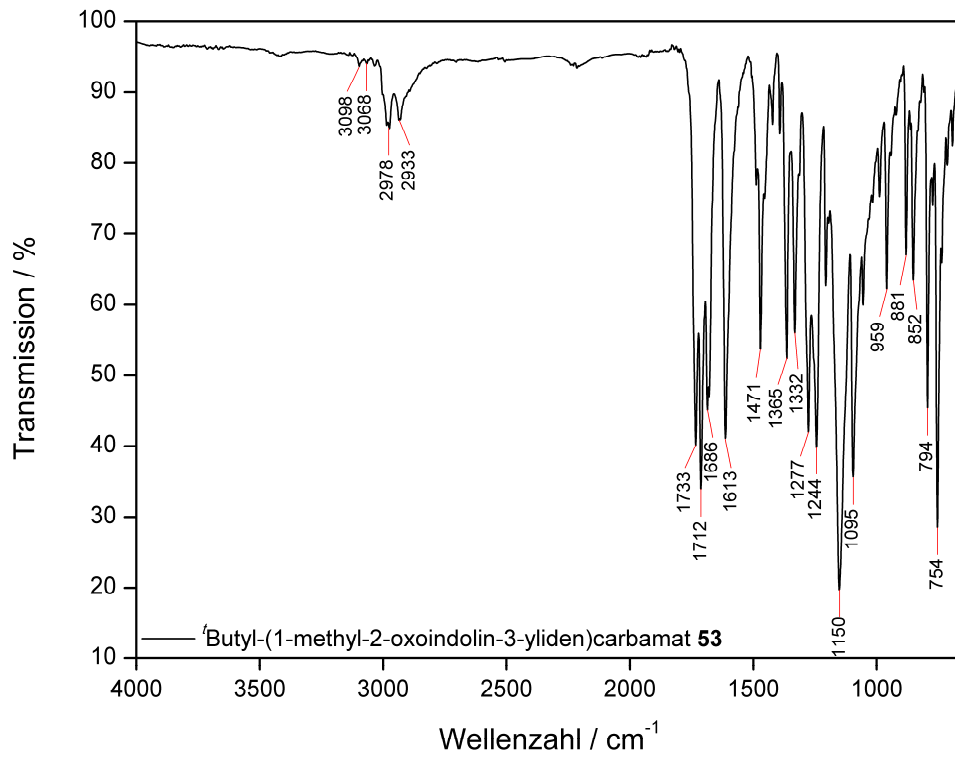


Abb. 8.303: ATR-IR-Spektrum von Butyl-(1-methyl-2-oxoindolin-3-yliden)carbamate (**53**).

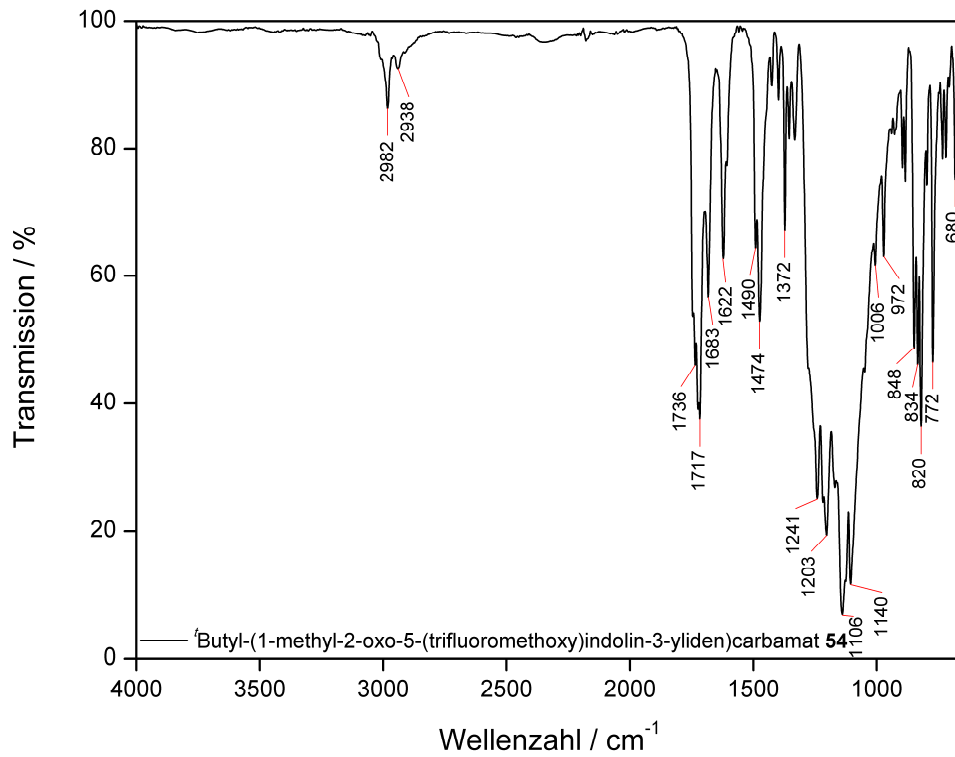


Abb. 8.304: ATR-IR-Spektrum von Butyl-(1-methyl-2-oxo-5-(trifluoromethoxy)indolin-3-yliden)carbamate (**54**).



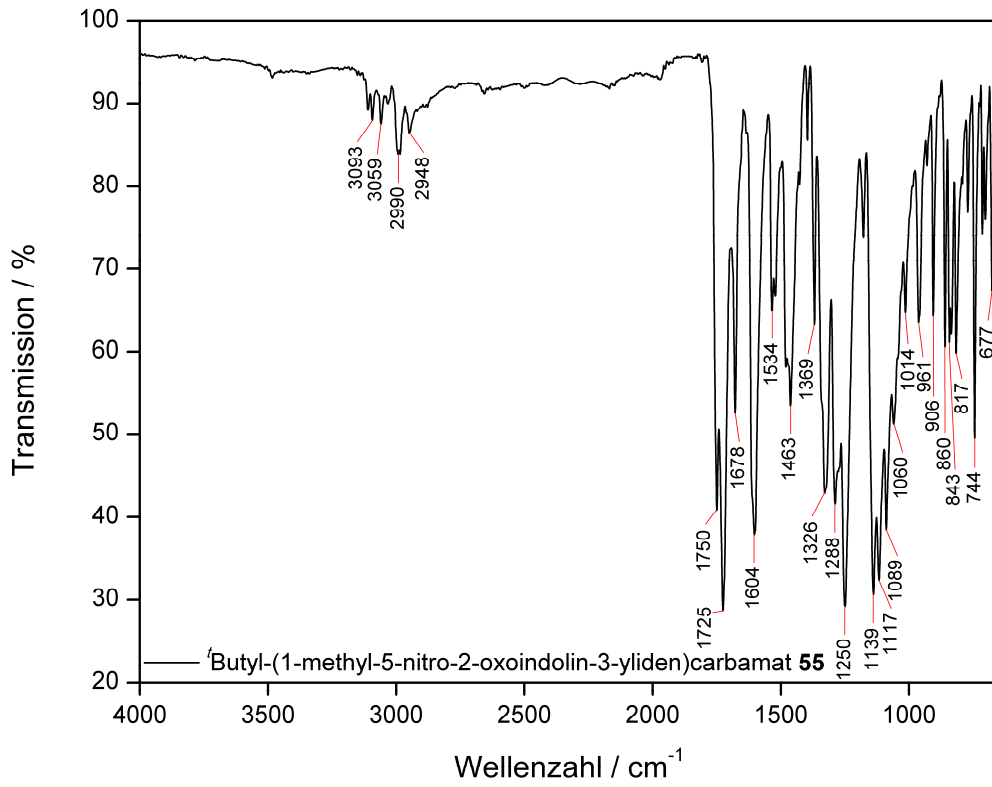


Abb. 8.305: ATR-IR-Spektrum von Butyl-(1-methyl-5-nitro-2-oxoindolin-3-yliden)carbamate (**55**).

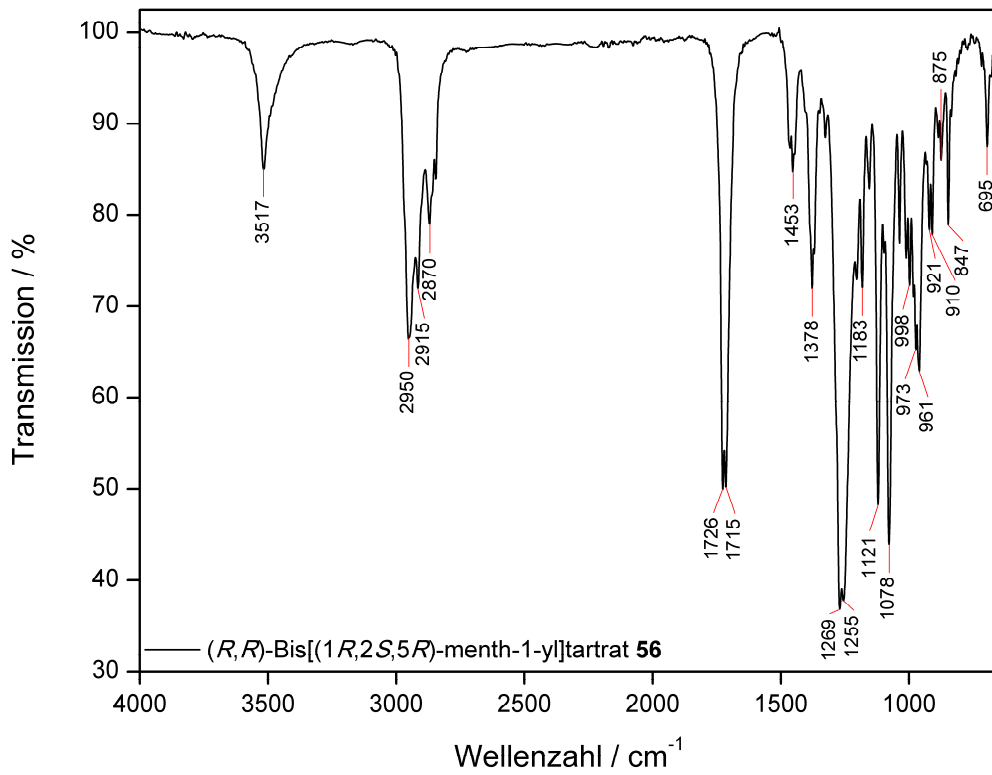


Abb. 8.306: ATR-IR-Spektrum von (*R,R*)-Bis[(1*R*,2*S*,5*R*)-menth-1-yl]tartrate (**56**).

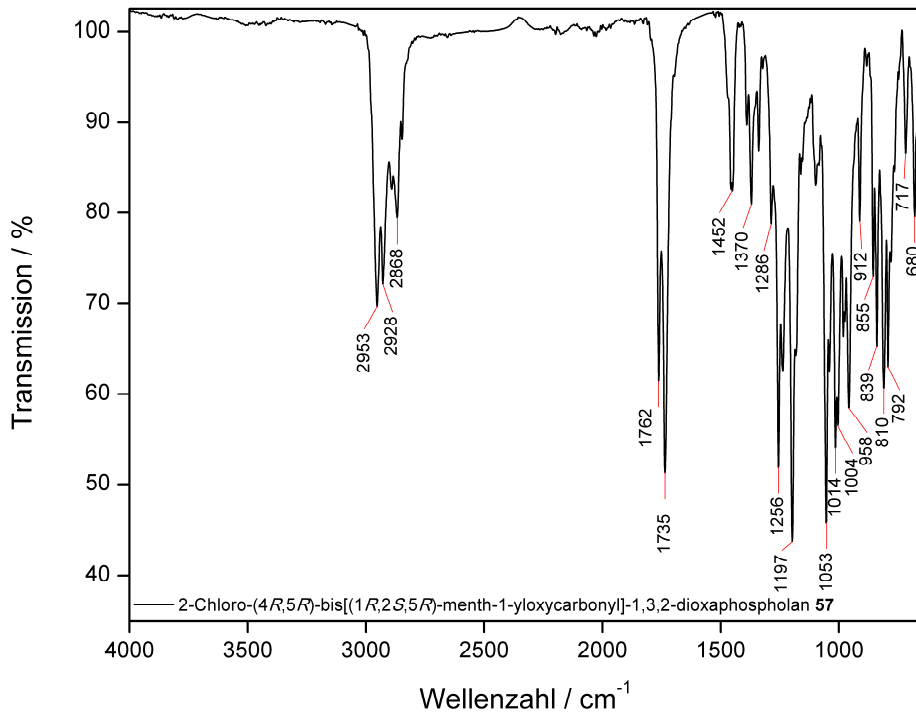


Abb. 8.307: ATR-IR-Spektrum von 2-Chloro-(4*R*,5*R*)-bis[(1*R*,2*S*,5*R*)-menth-1-yloxy-carbonyl]-1,3,2-dioxaphospholan (**57**).

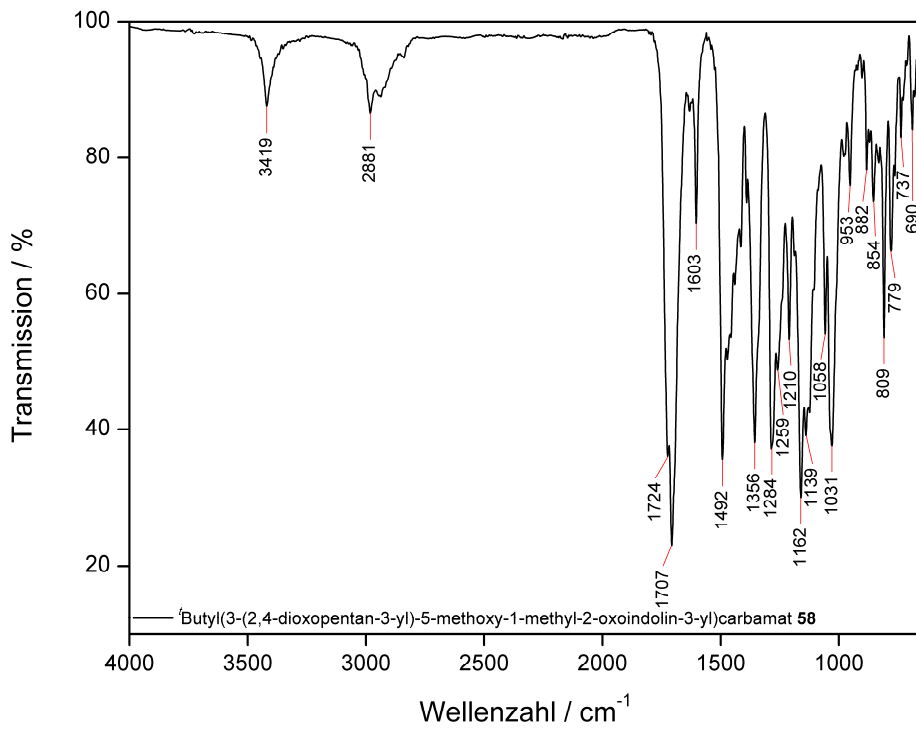


Abb. 8.308: ATR-IR-Spektrum von *t*-Butyl(3-(2,4-dioxopentan-3-yl)-5-methoxy-1-methyl-2-oxindolin-3-yl)carbamate (**58**).

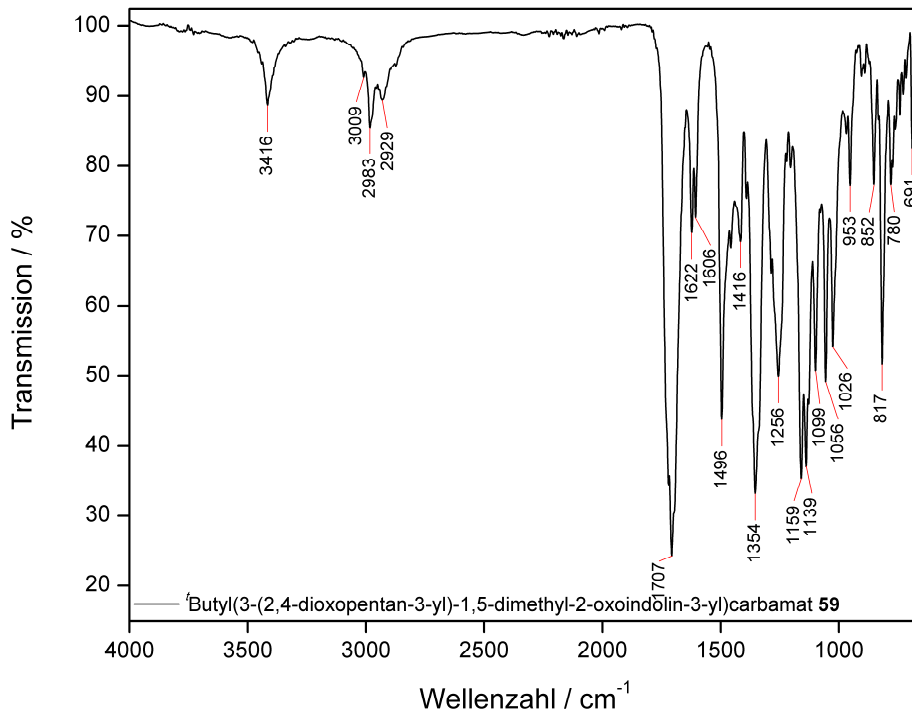


Abb. 8.309: ATR-IR-Spektrum von <sup>1</sup>Butyl(3-(2,4-dioxopentan-3-yl)-1,5-dimethyl-2-oxoindolin-3-yl)carbammat (**59**).

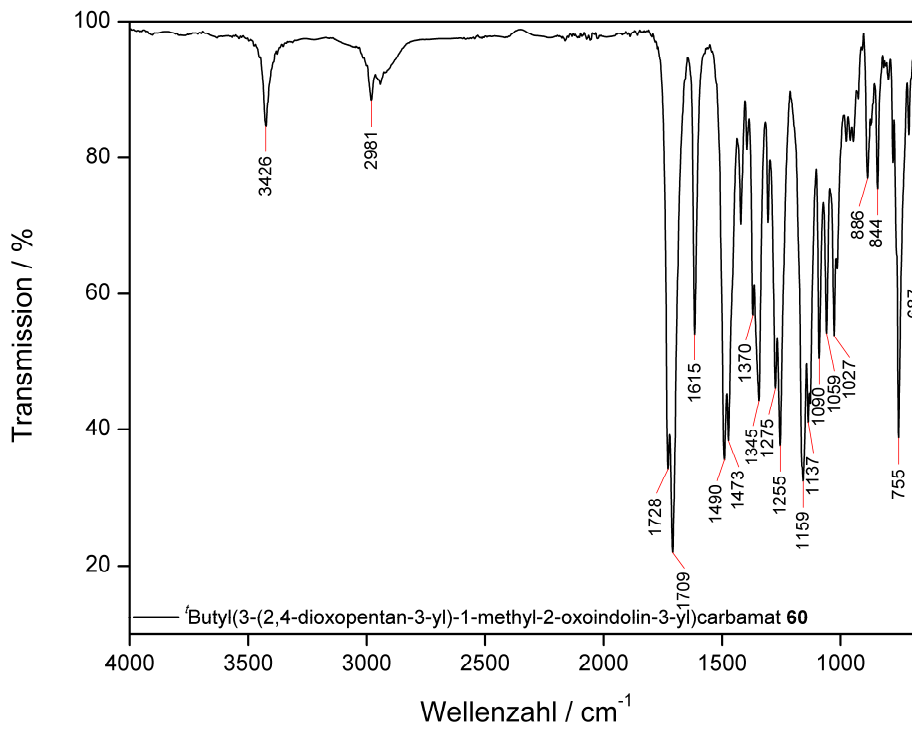


Abb. 8.310: ATR-IR-Spektrum von <sup>1</sup>Butyl(3-(2,4-dioxopentan-3-yl)-1-methyl-2-oxoindolin-3-yl)carbammat (**60**).

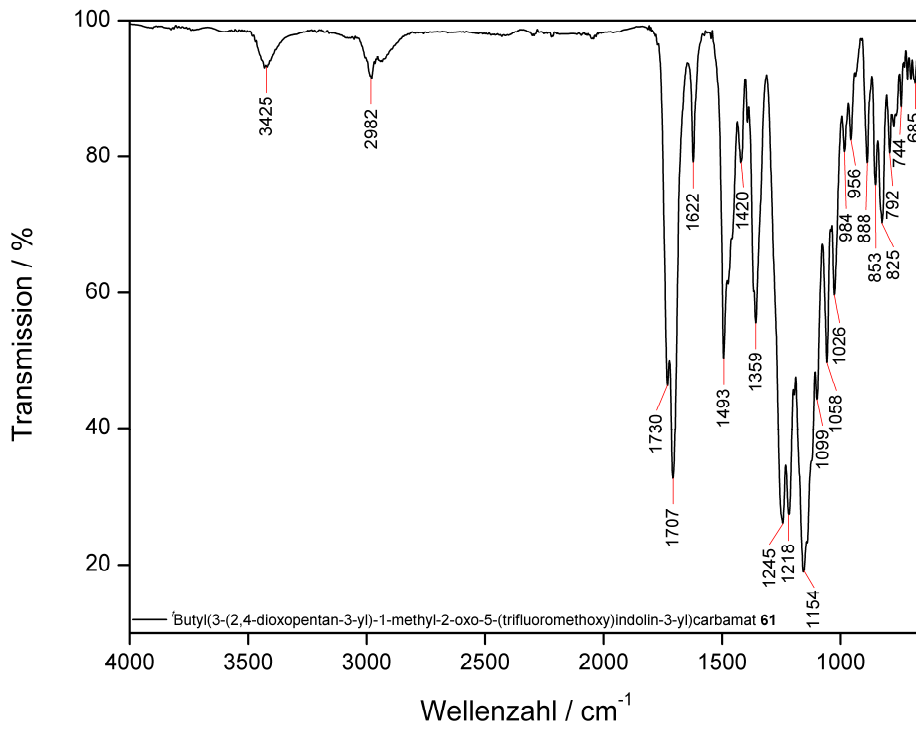


Abb. 8.311: ATR-IR-Spektrum von *Butyl(3-(2,4-dioxopentan-3-yl)-1-methyl-2-oxo-5-(trifluoromethoxy)indolin-3-yl)carbamate* (**61**).

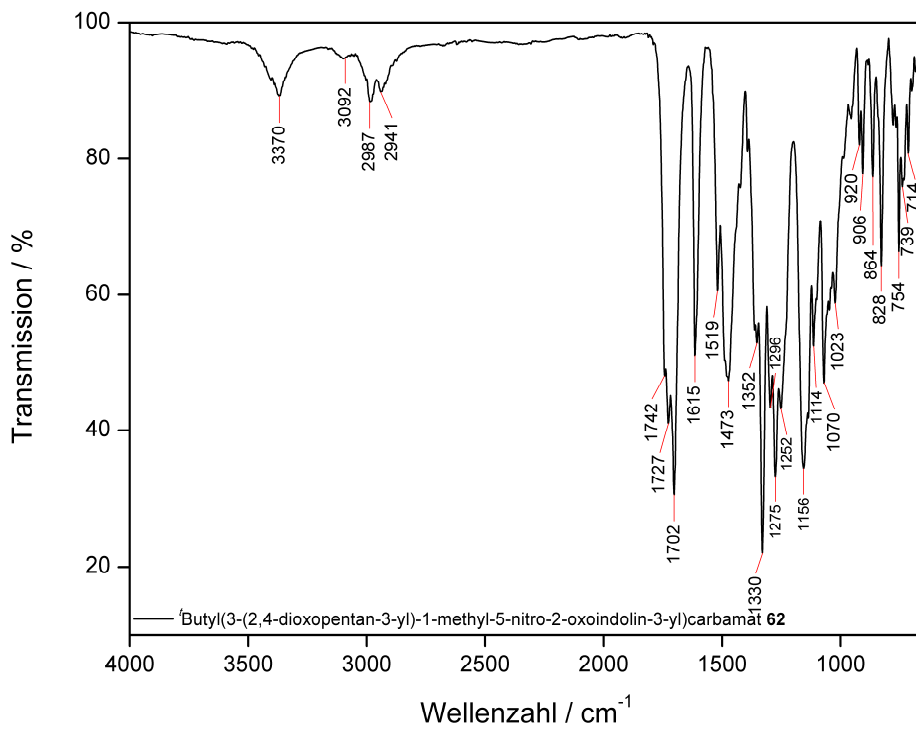


Abb. 8.312: ATR-IR-Spektrum von *Butyl(3-(2,4-dioxopentan-3-yl)-1-methyl-5-nitro-2-oxoindolin-3-yl)carbamate* (**62**).

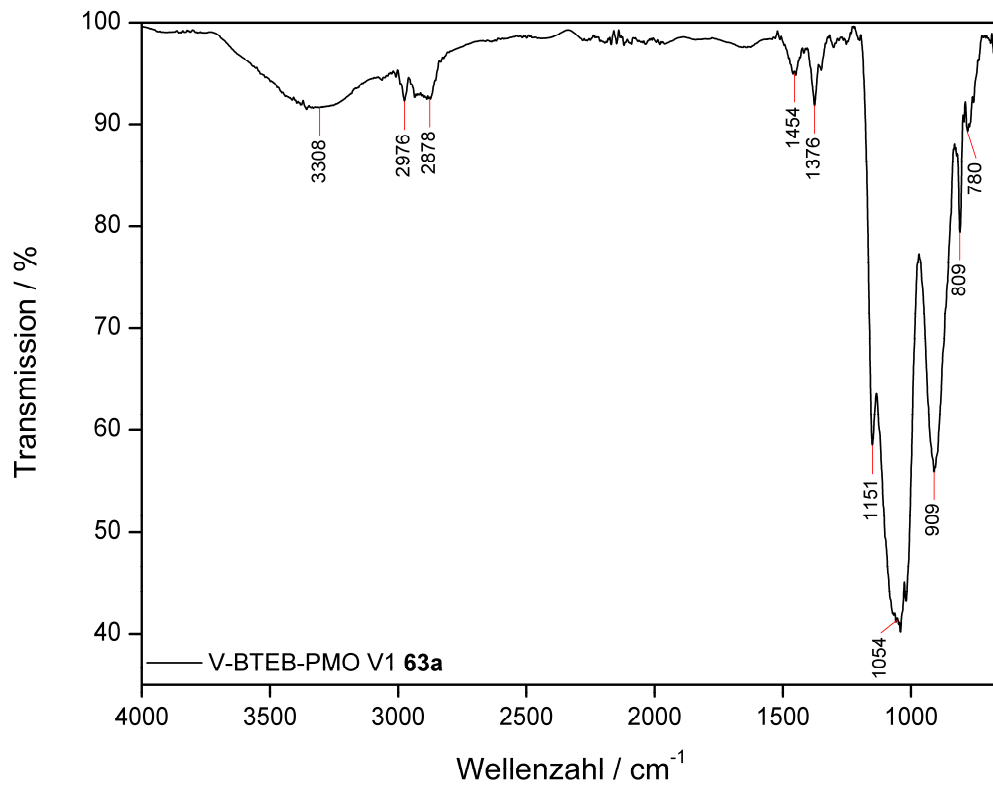


Abb. 8.313: ATR-IR-Spektrum von V-BTEB-PMO V1 (63a).

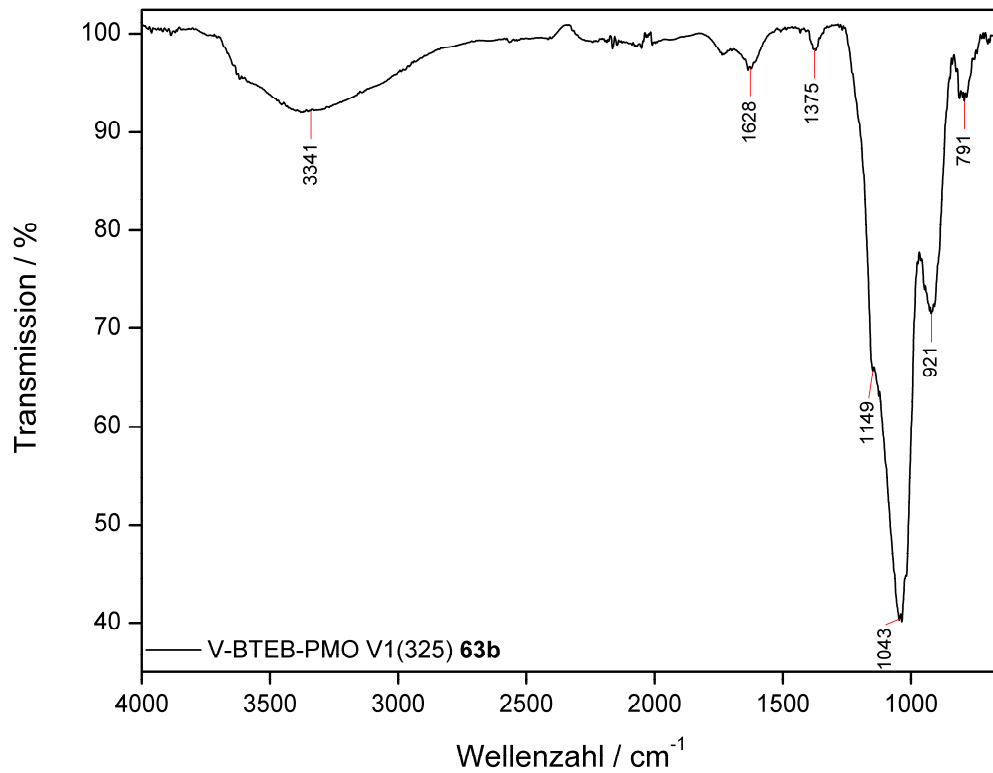


Abb. 8.314: ATR-IR-Spektrum von V-BTEB-PMO V1 (325) (63b).

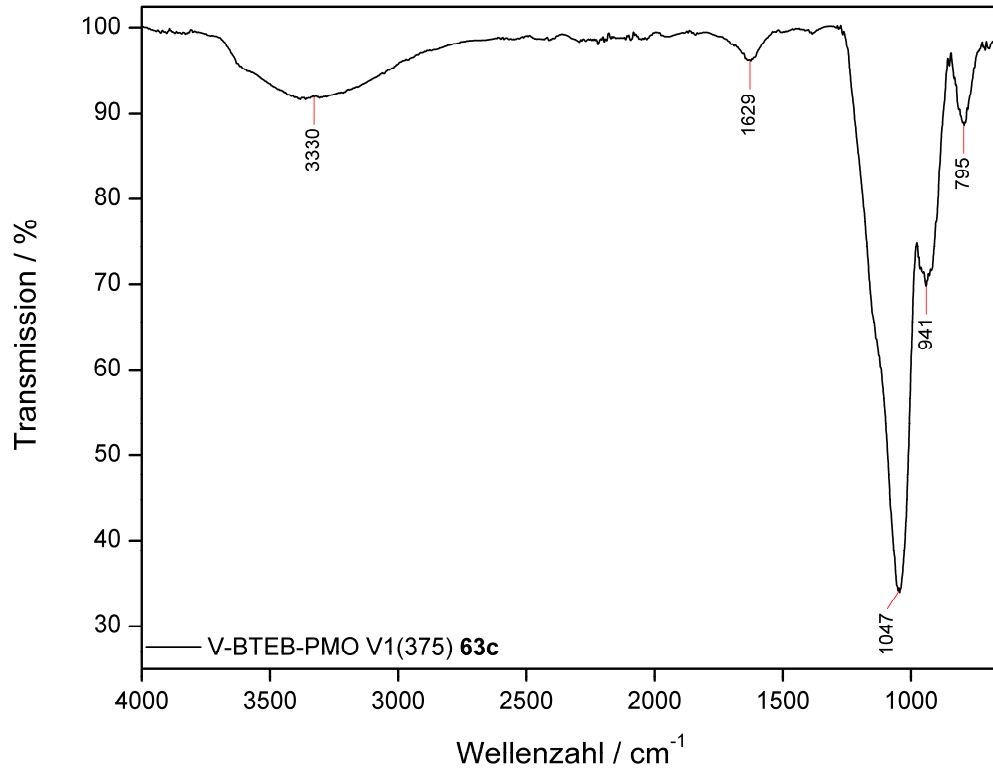


Abb. 8.315: ATR-IR-Spektrum von V-BTEB-PMO V1 (375) (**63c**).

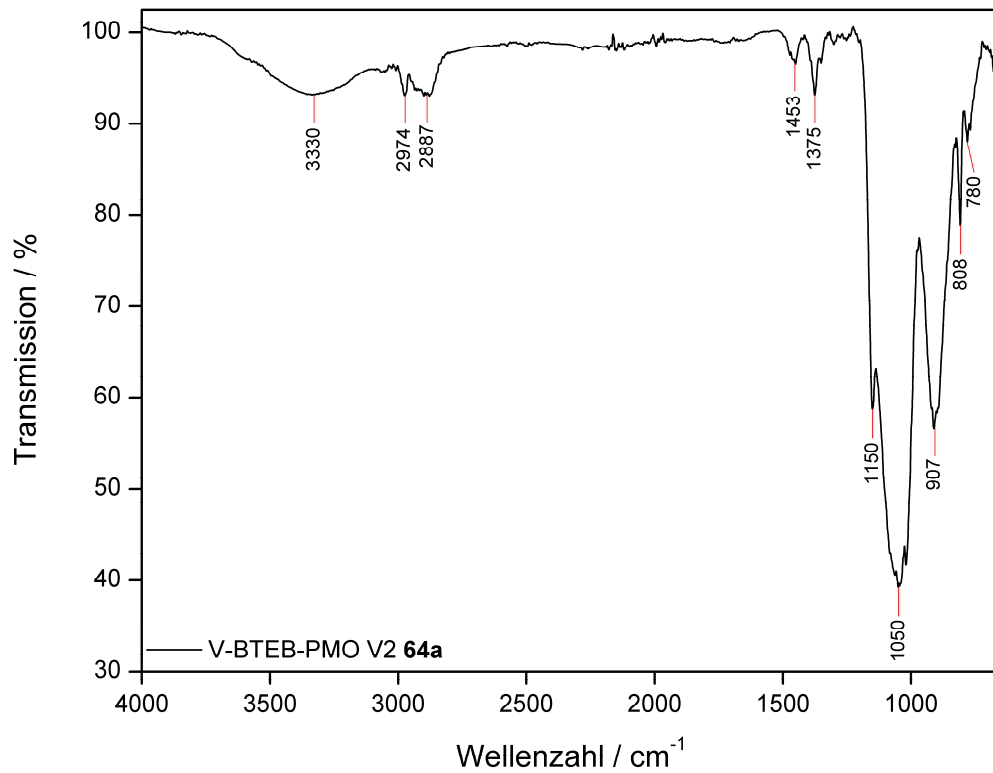
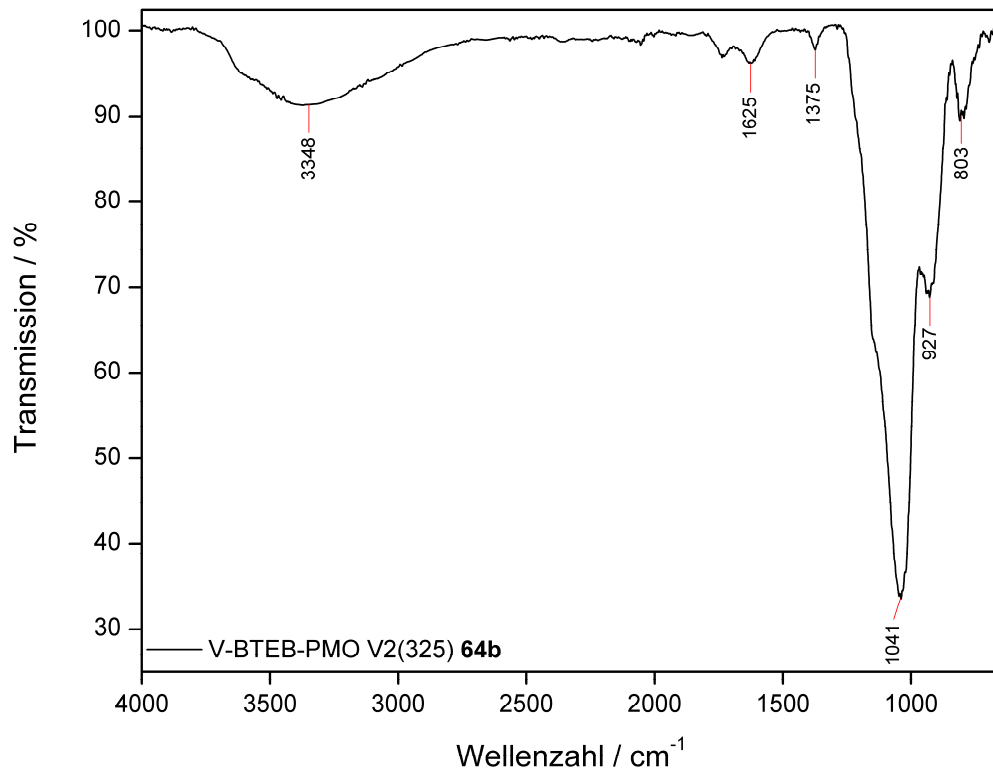
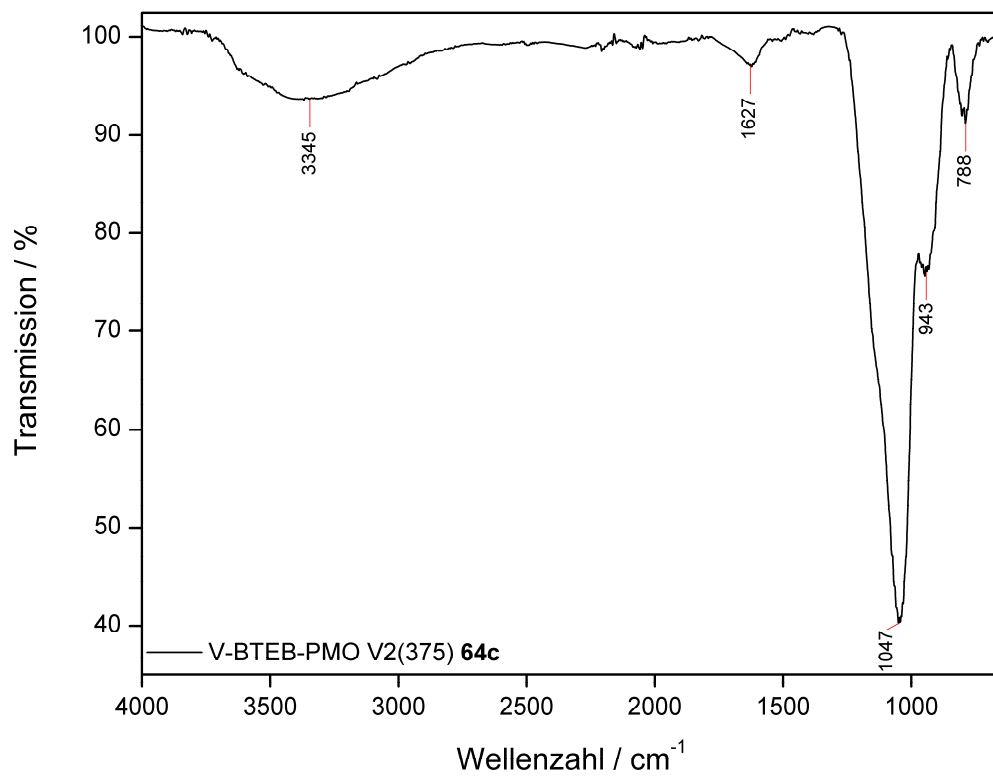


Abb. 8.316: ATR-IR-Spektrum von V-BTEB-PMO V2 (**64a**).

Abb. 8.317: ATR-IR-Spektrum von V-BTEB-PMO V2 (325) (**64b**).Abb. 8.318: ATR-IR-Spektrum von V-BTEB-PMO V2 (375) (**64c**).

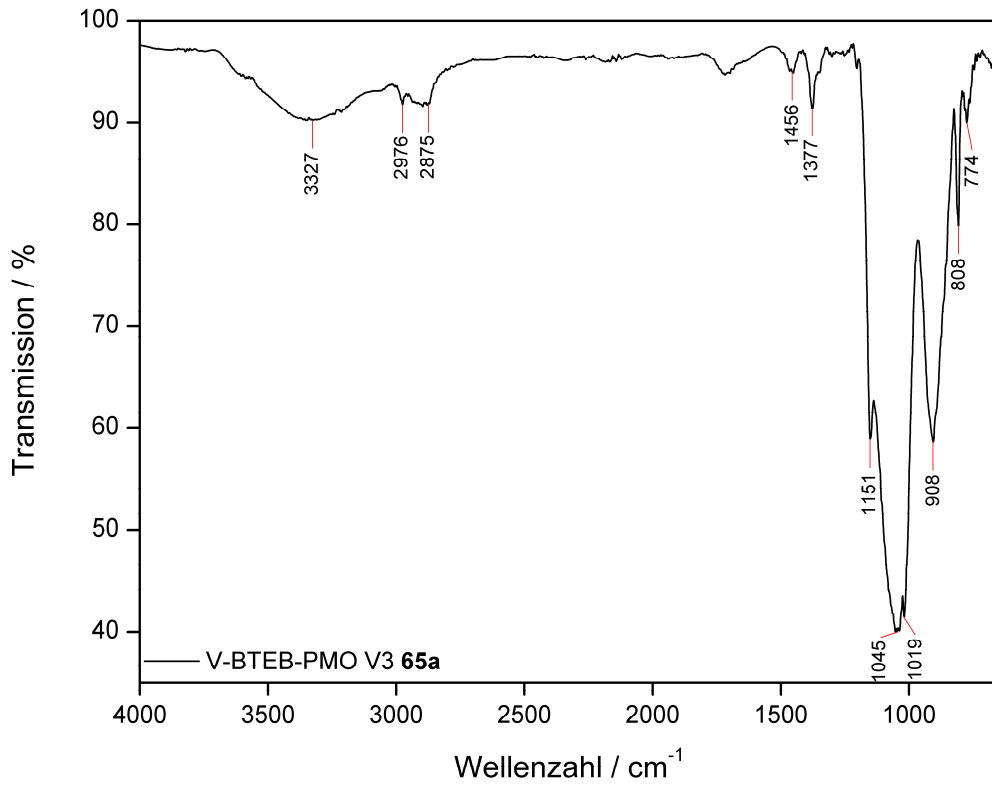


Abb. 8.319: ATR-IR-Spektrum von V-BTEB-PMO V3 (**65a**).

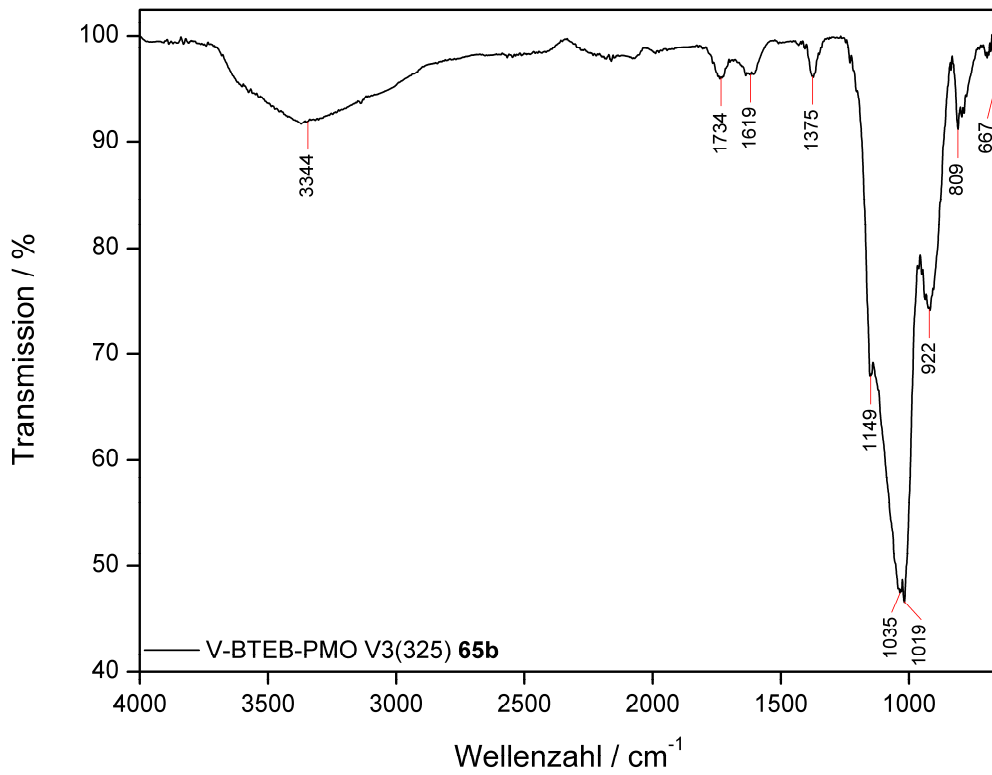


Abb. 8.320: ATR-IR-Spektrum von V-BTEB-PMO V3 (325) (**65b**).



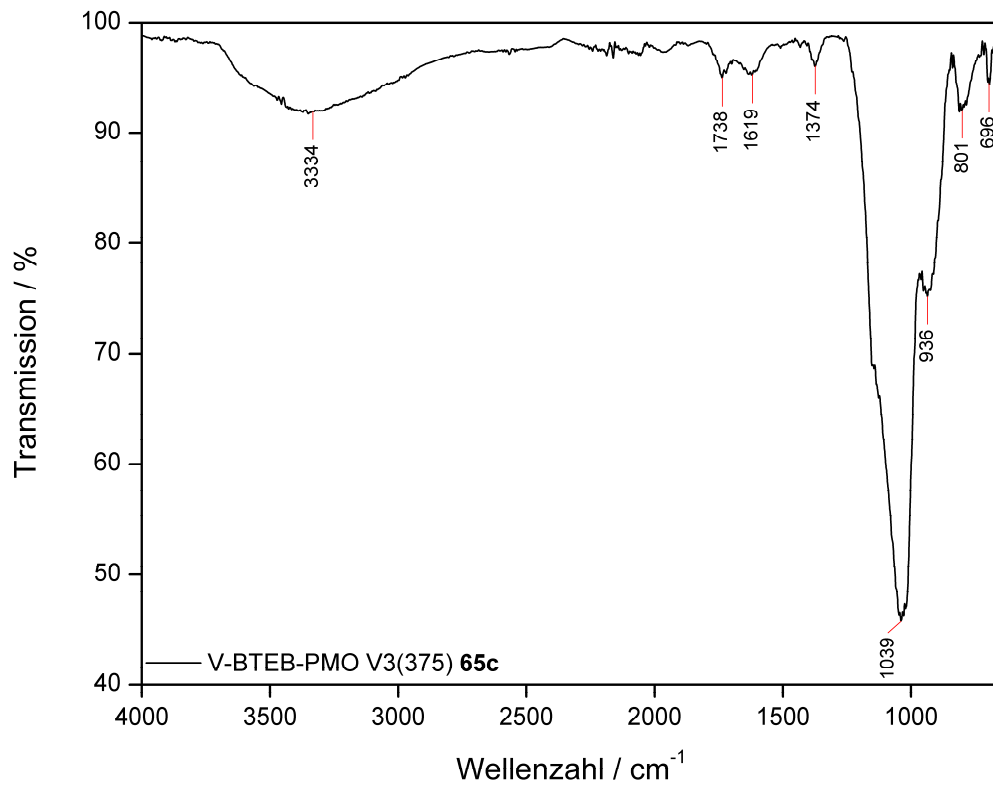


Abb. 8.321: ATR-IR-Spektrum von V-BTEB-PMO V3 (375) (**65c**).

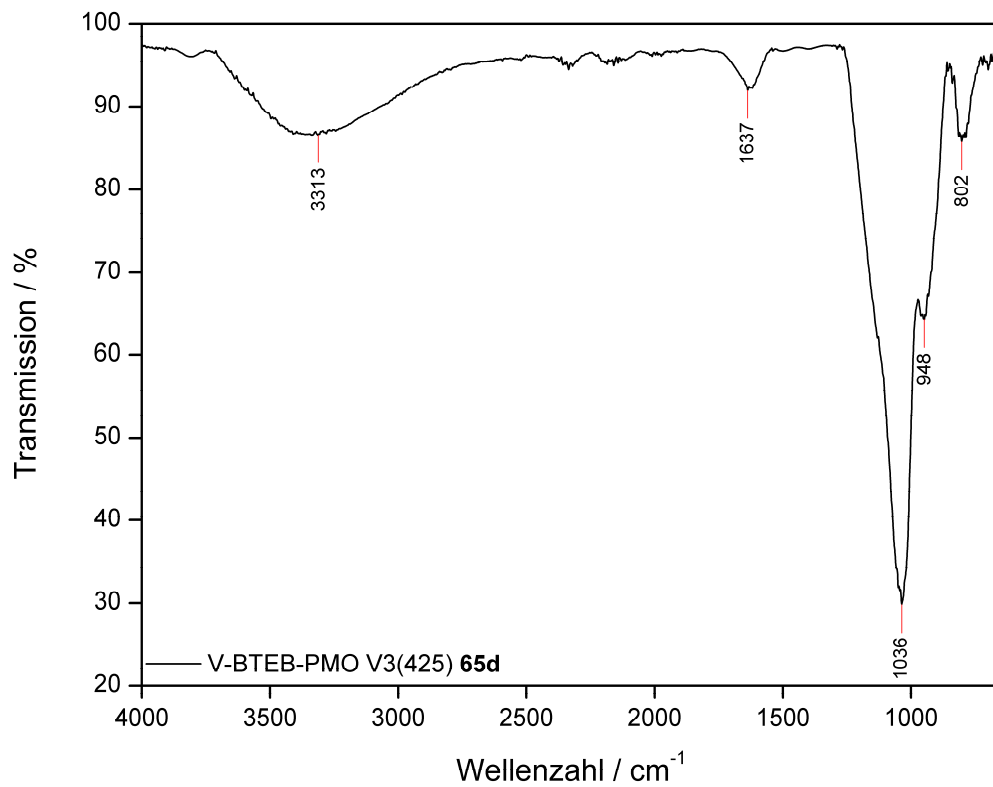


Abb. 8.322: ATR-IR-Spektrum von V-BTEB-PMO V3 (425) (**65d**).

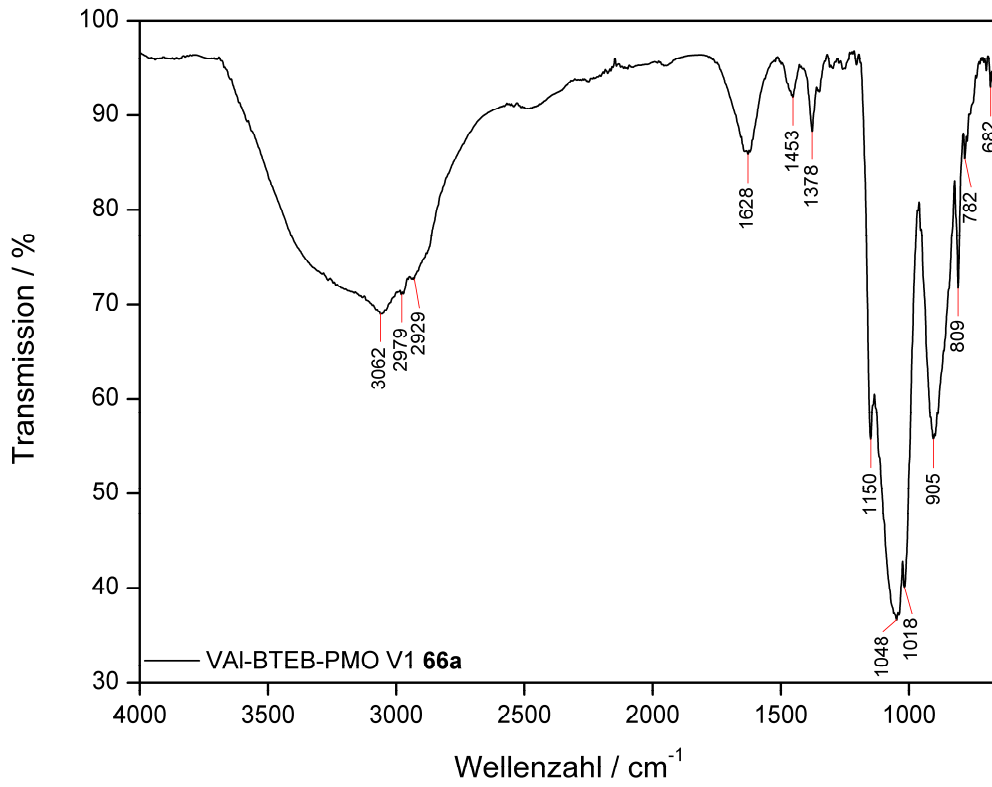


Abb. 8.323: ATR-IR-Spektrum von VAI-BTEB-PMO V1 (**66a**).

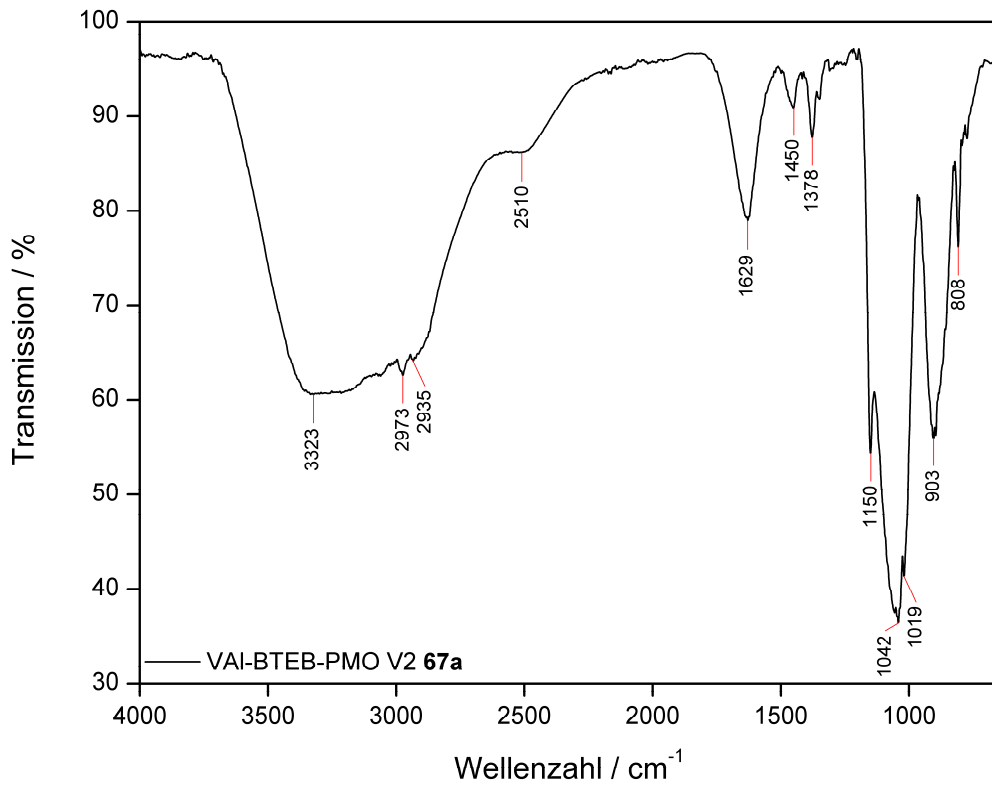


Abb. 8.324: ATR-IR-Spektrum von VAI-BTEB-PMO V2 (**67a**).

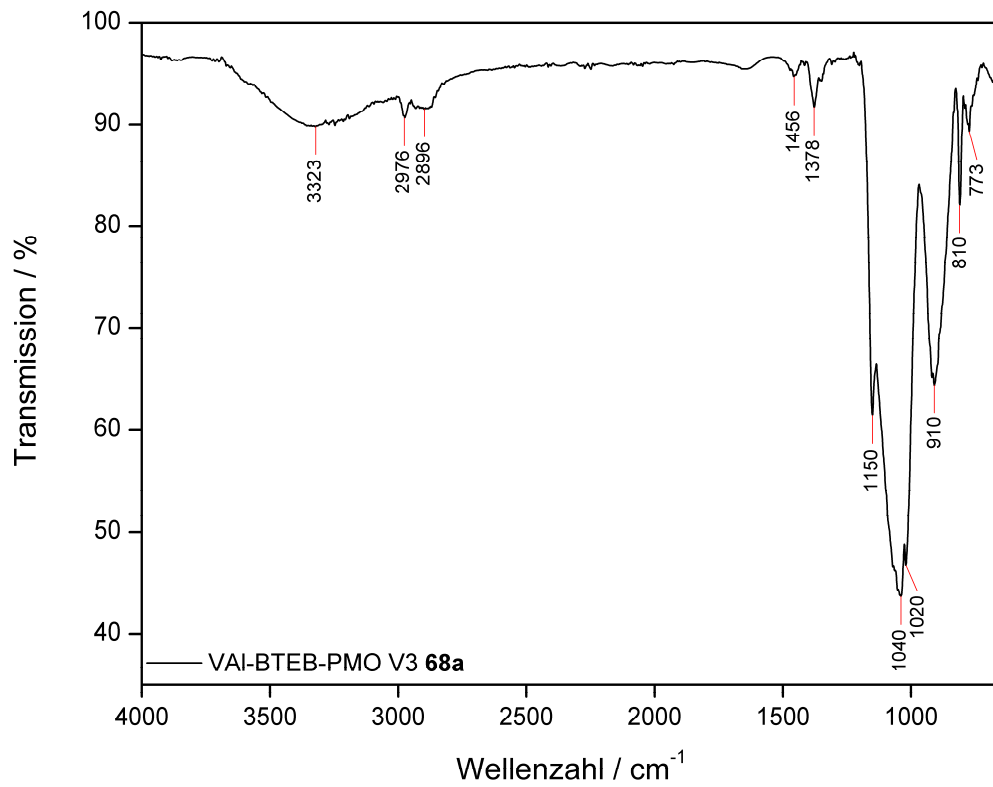


Abb. 8.325: ATR-IR-Spektrum von VAI-BTEB-PMO V3 (**68a**).

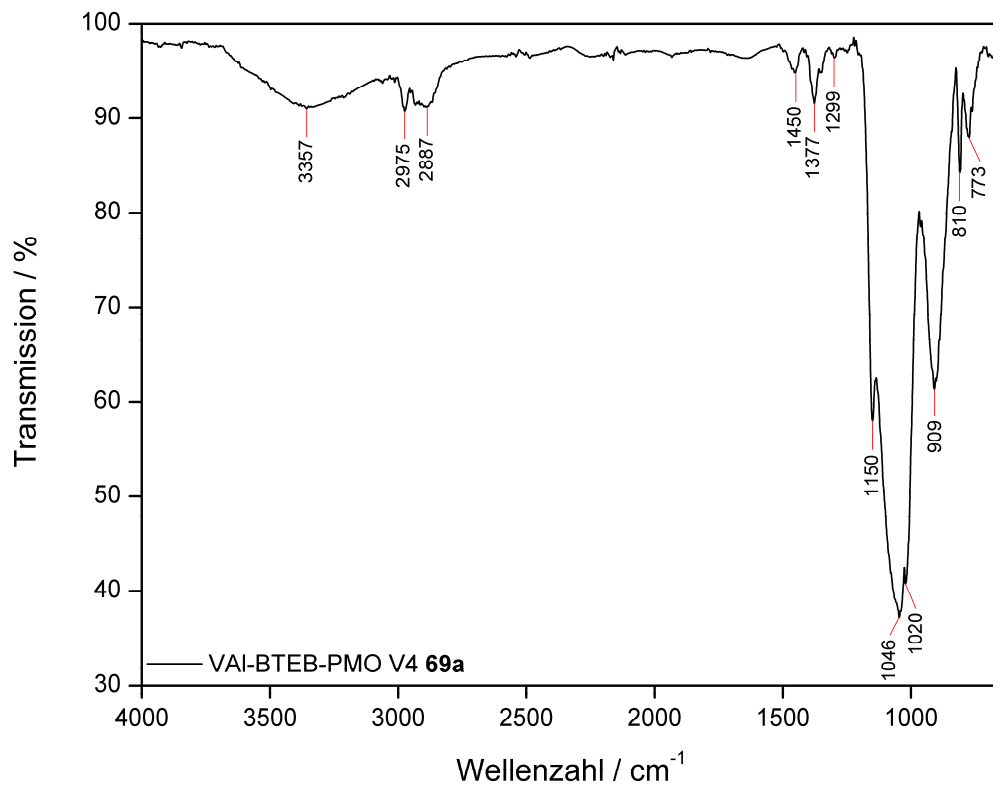


Abb. 8.326: ATR-IR-Spektrum von VAI-BTEB-PMO V4 (**69a**).

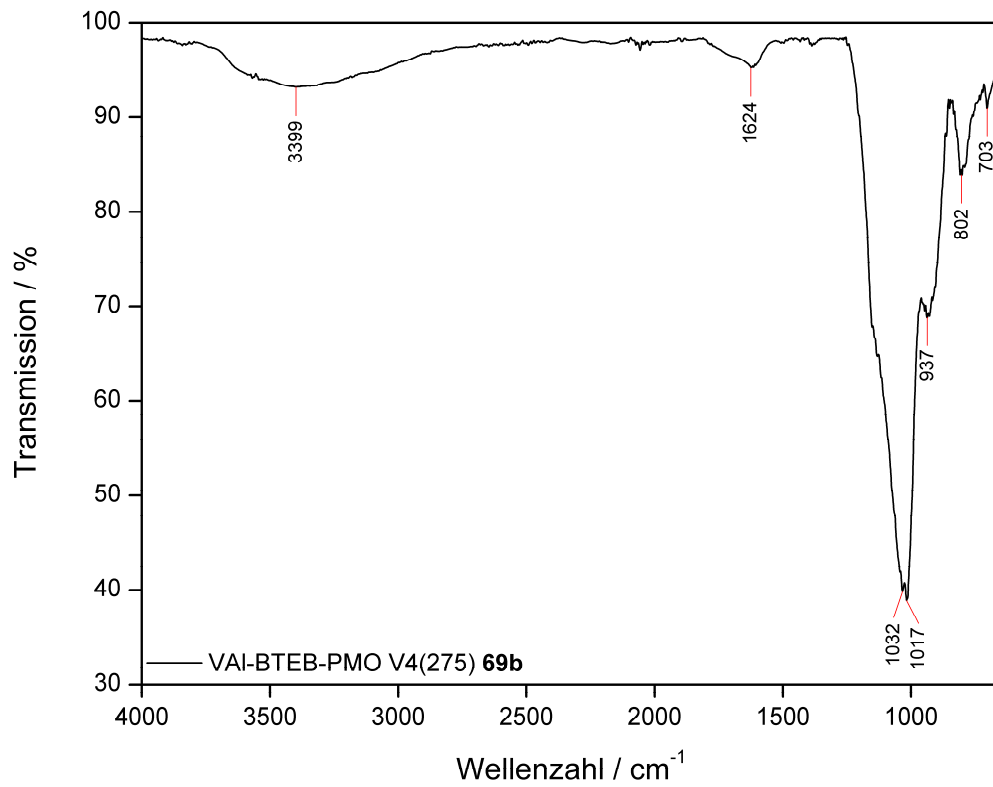


Abb. 8.327: ATR-IR-Spektrum von VAI-BTEB-PMO V4 (275) (**69b**).

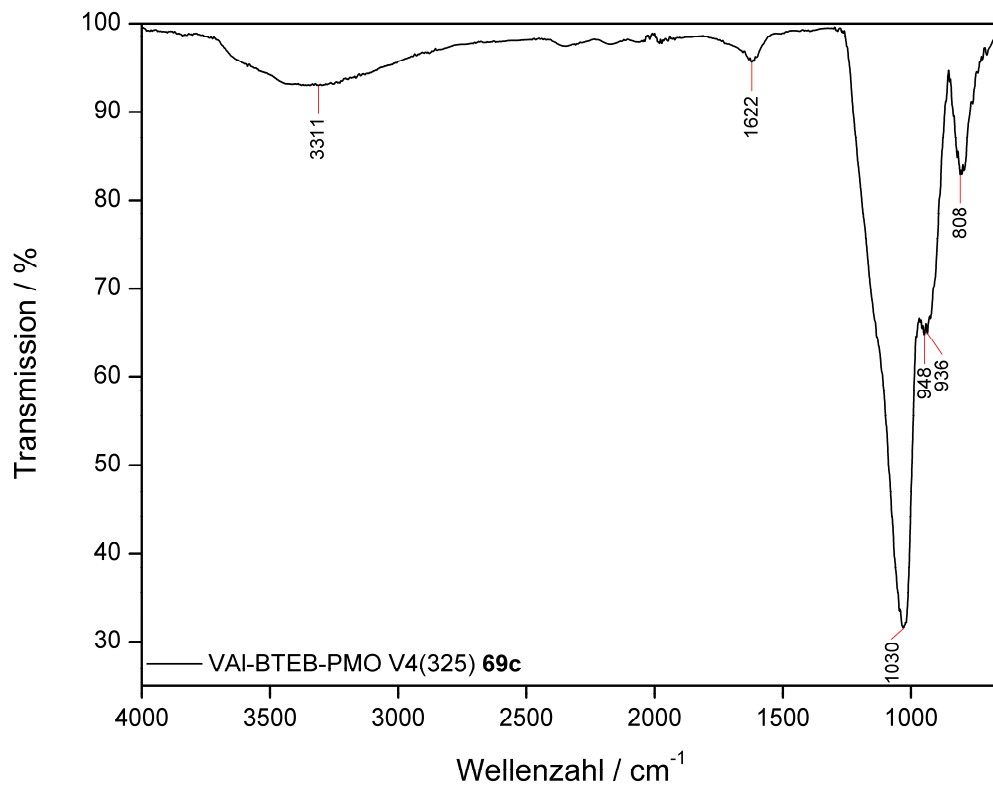


Abb. 8.328: ATR-IR-Spektrum von VAI-BTEB-PMO V4 (325) (**69c**).

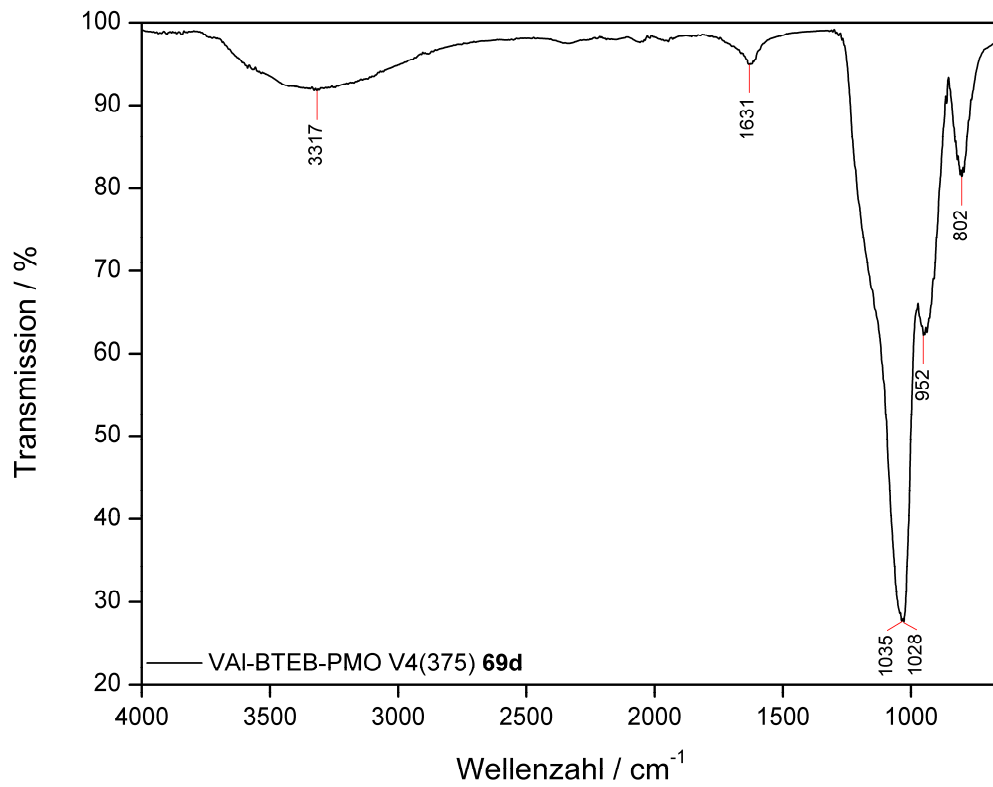


Abb. 8.329: ATR-IR-Spektrum von VAI-BTEB-PMO V4 (375) (**69d**).

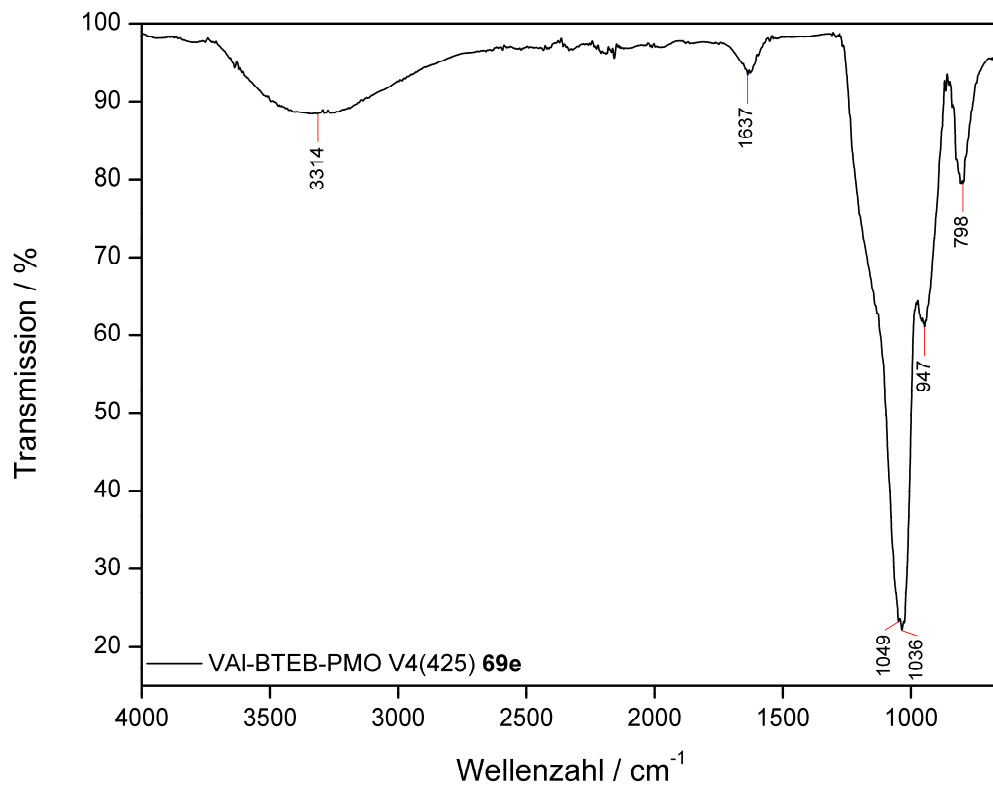


Abb. 8.330: ATR-IR-Spektrum von VAI-BTEB-PMO V4 (425) (**69e**).

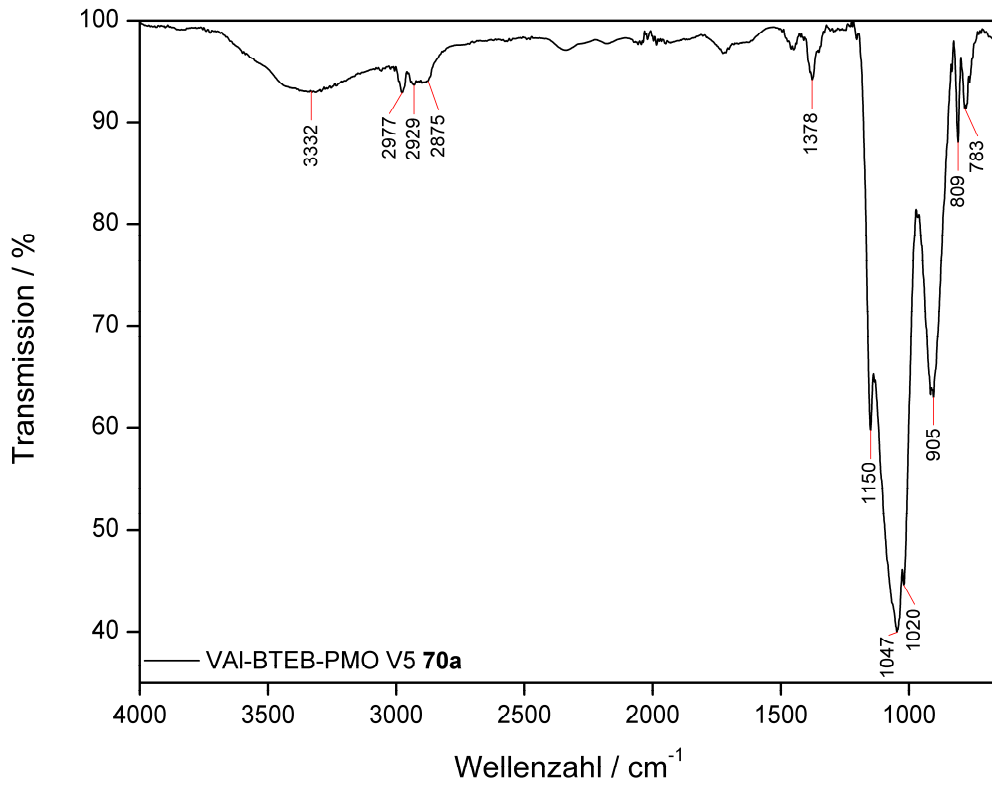


Abb. 8.331: ATR-IR-Spektrum von VAI-BTEB-PMO V5 (**70a**).

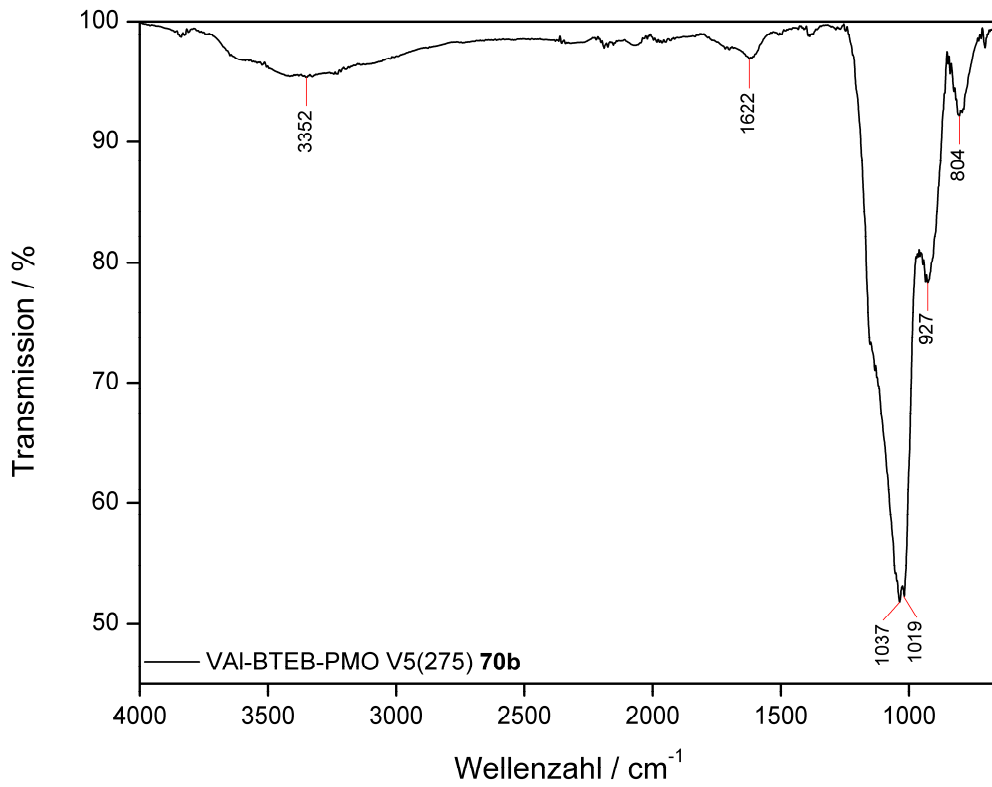


Abb. 8.332: ATR-IR-Spektrum von VAI-BTEB-PMO V5 (275) (**70b**).

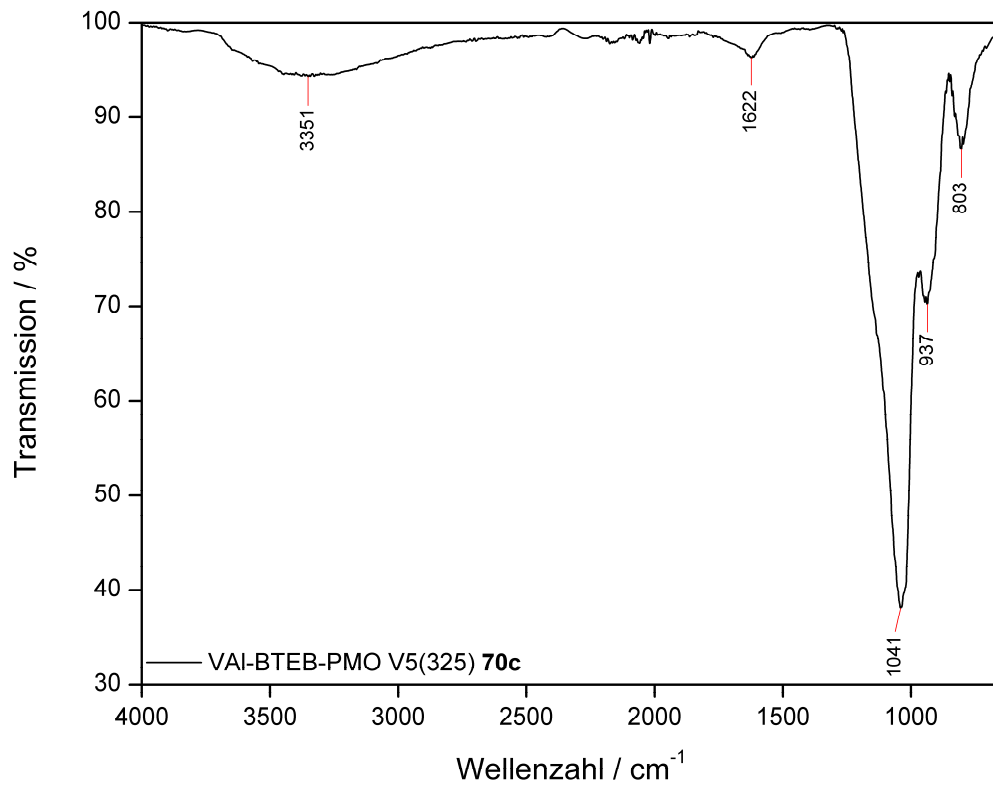


Abb. 8.333: ATR-IR-Spektrum von VAI-BTEB-PMO V5 (325) (**70c**).

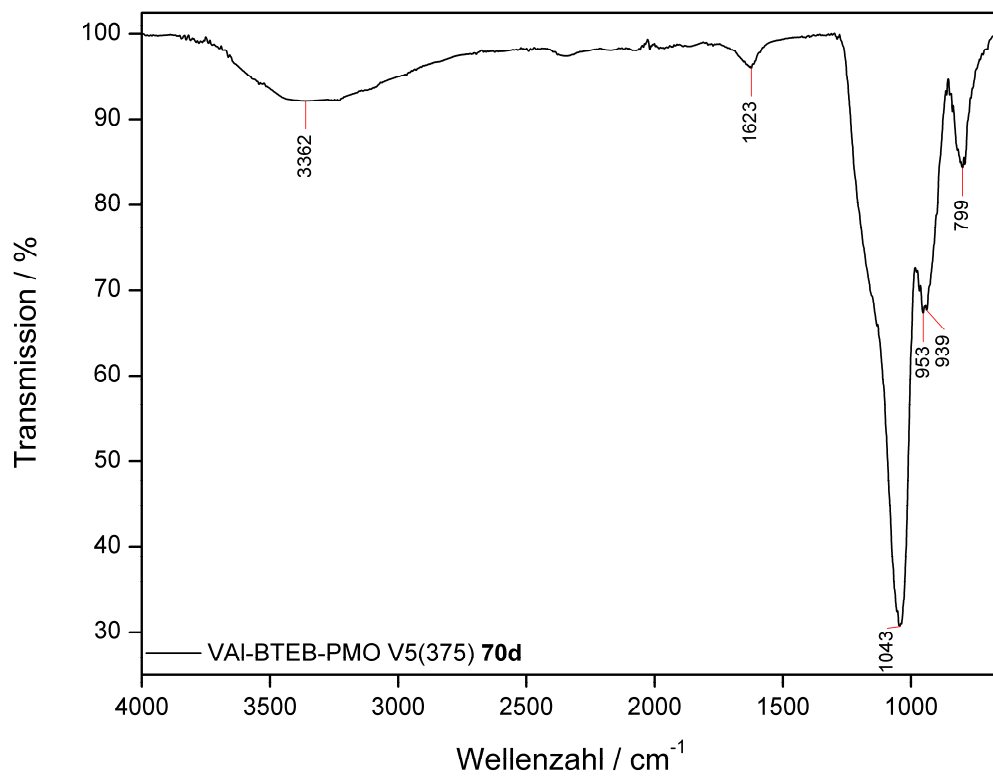


Abb. 8.334: ATR-IR-Spektrum von VAI-BTEB-PMO V5 (375) (**70d**).

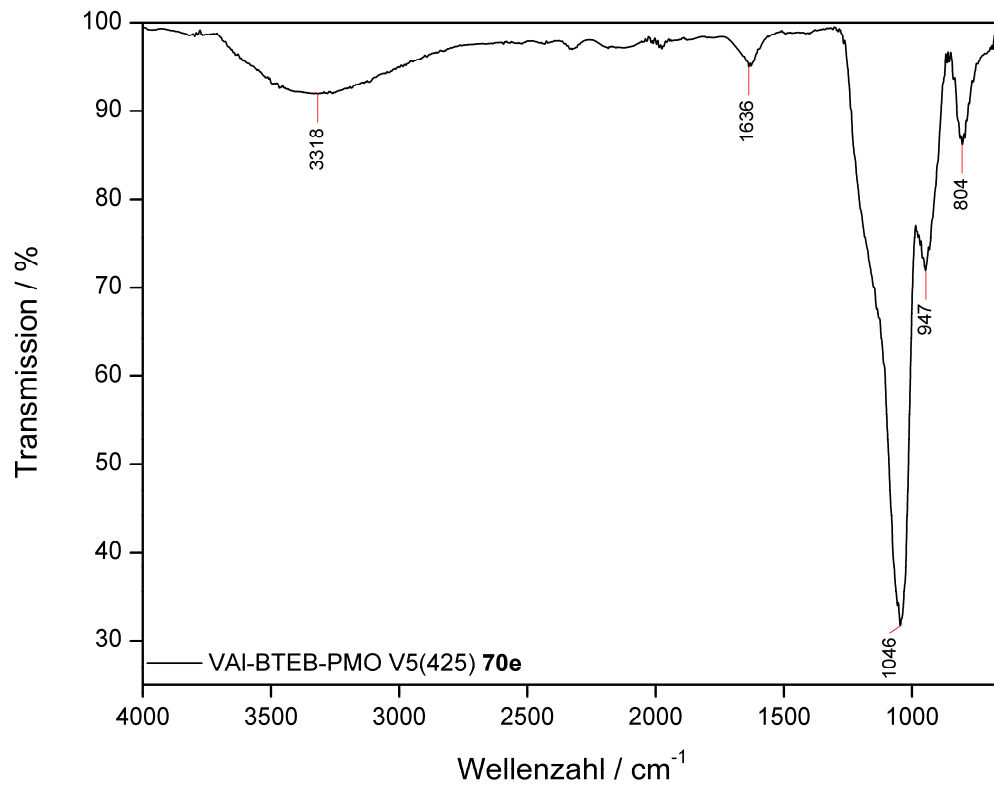


Abb. 8.335: ATR-IR-Spektrum von VAI-BTEB-PMO V5 (425) (**70e**).

## 8.8 REM-Aufnahmen

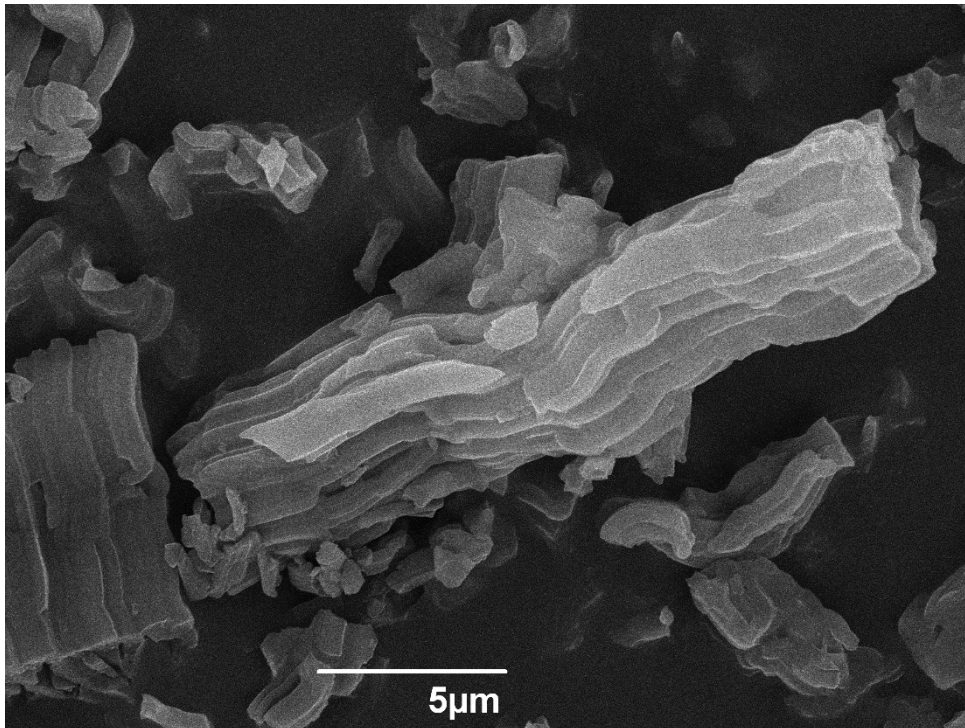


Abb. 8.336: REM-Aufnahme von SH-BTEB-PMO (**3**), 5000fache Vergrößerung.



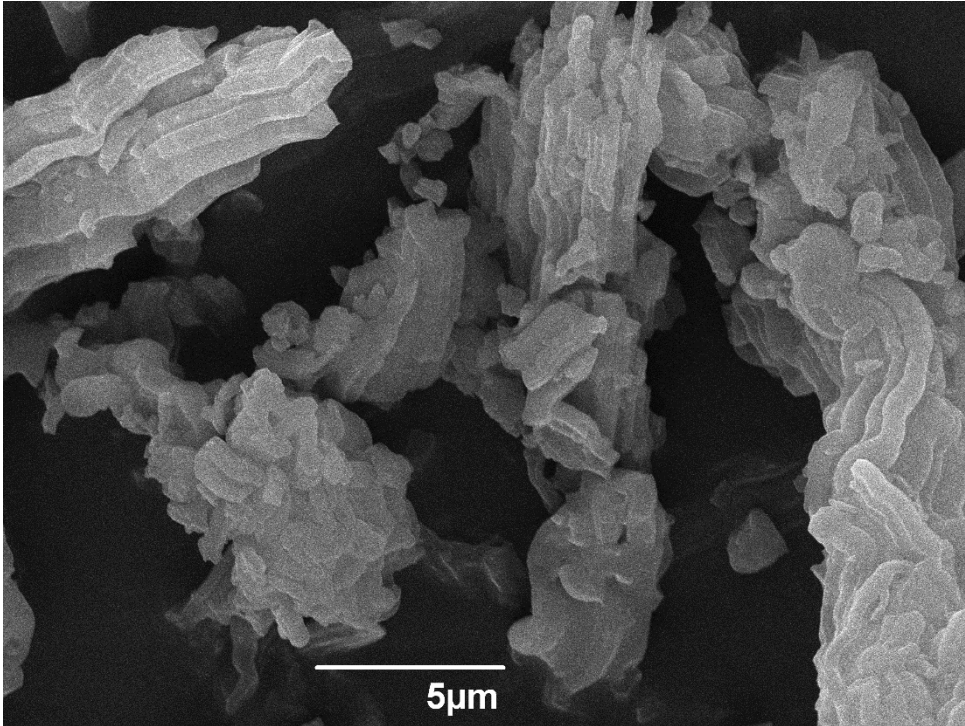


Abb. 8.337: REM-Aufnahme von SO<sub>3</sub>H-BTEB-PMO (4), 5000fache Vergrößerung.

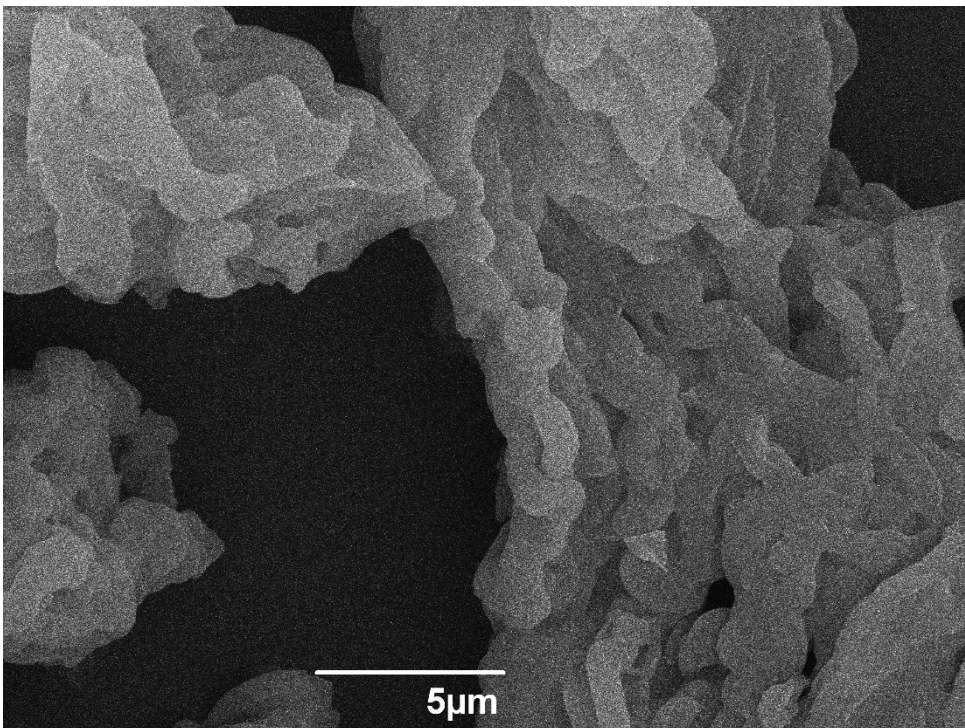


Abb. 8.338: REM-Aufnahme von Cl-BTEB-PMO (5), 5000fache Vergrößerung.

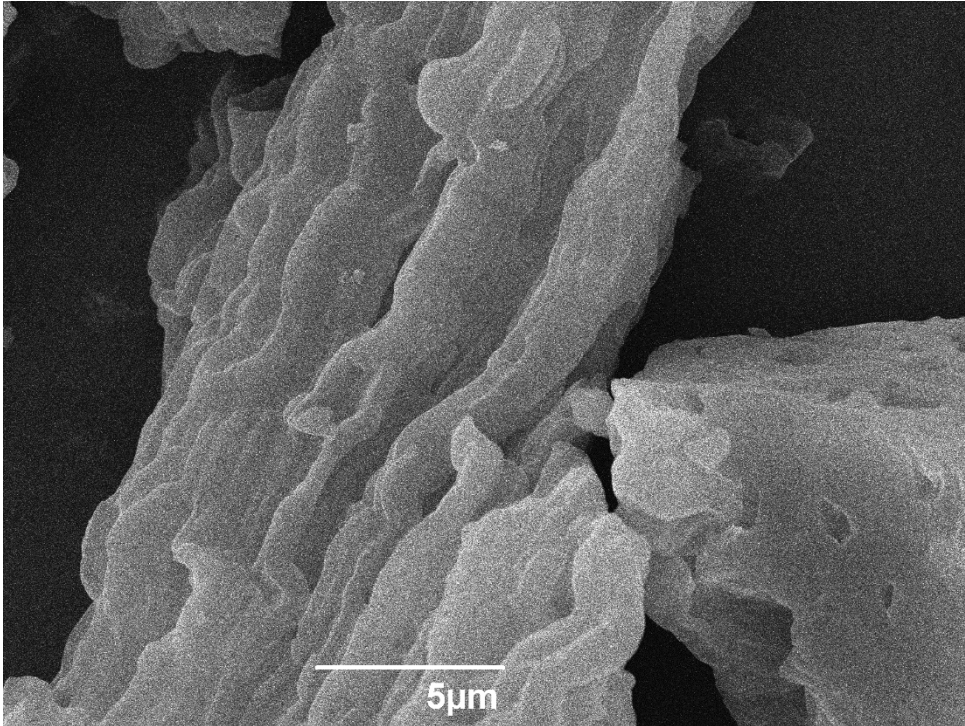


Abb. 8.339: REM-Aufnahme von P(O)(OEt)<sub>2</sub>-BTEB-PMO (**6a**), 5000fache Vergrößerung.

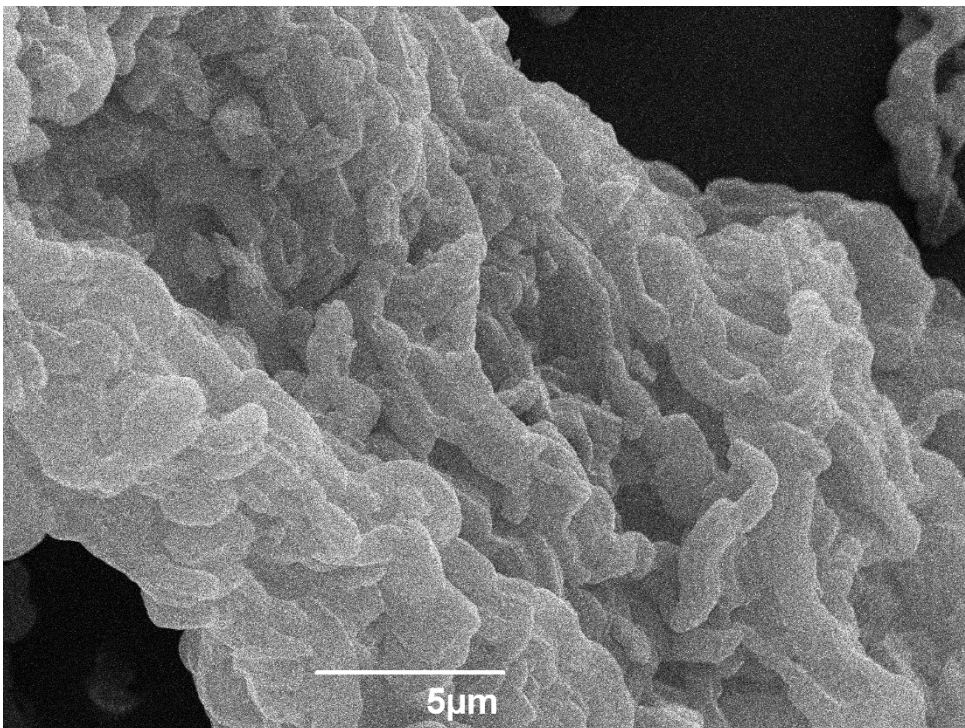


Abb. 8.340: REM-Aufnahme von P(O)(OEt)<sub>2</sub>-BTEB-PMO (**6b**), 5000fache Vergrößerung.

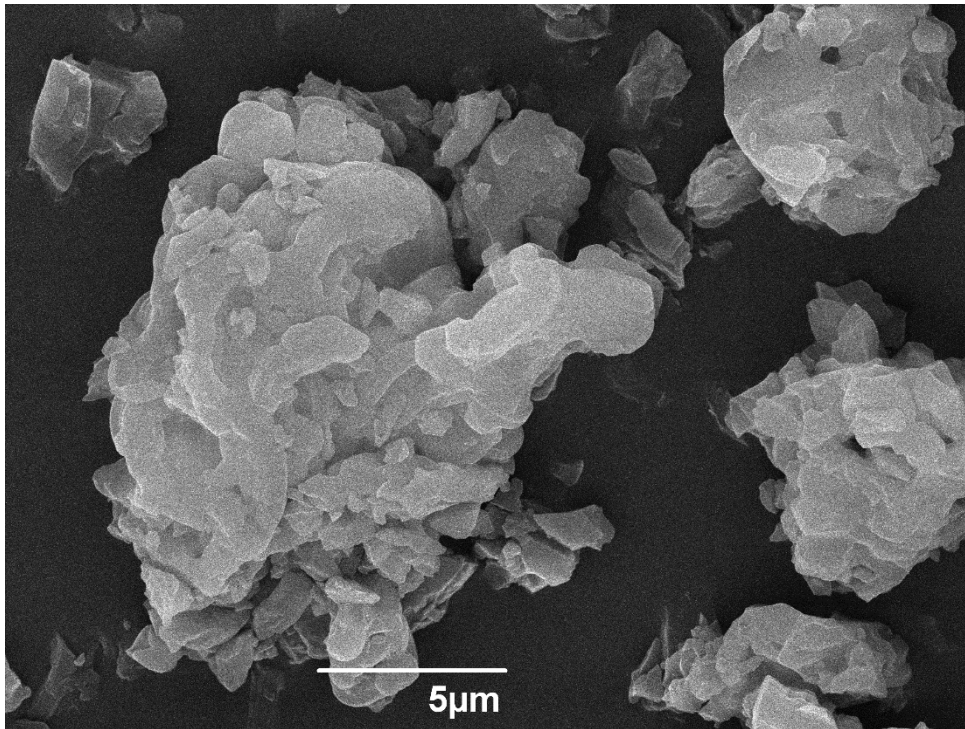


Abb. 8.341: REM-Aufnahme von  $\text{P(O)(OH)}_2\text{-BTEB-PMO (7a)}$ , 5000fache Vergrößerung.

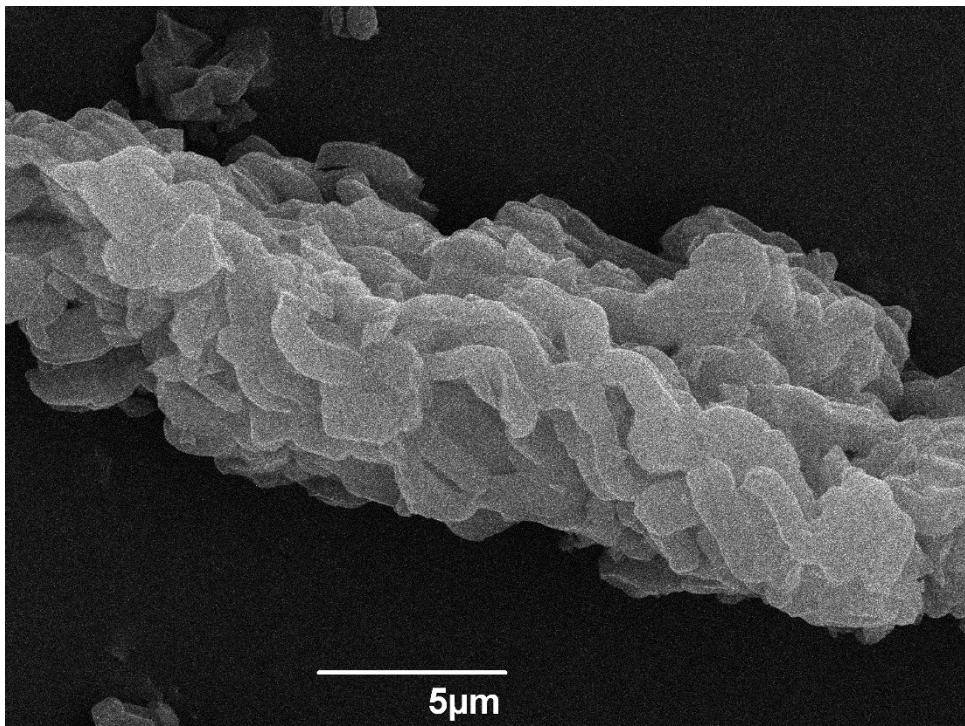


Abb. 8.342: REM-Aufnahme von  $\text{P(O)(OH)}_2\text{-BTEB-PMO (7b)}$ , 5000fache Vergrößerung.

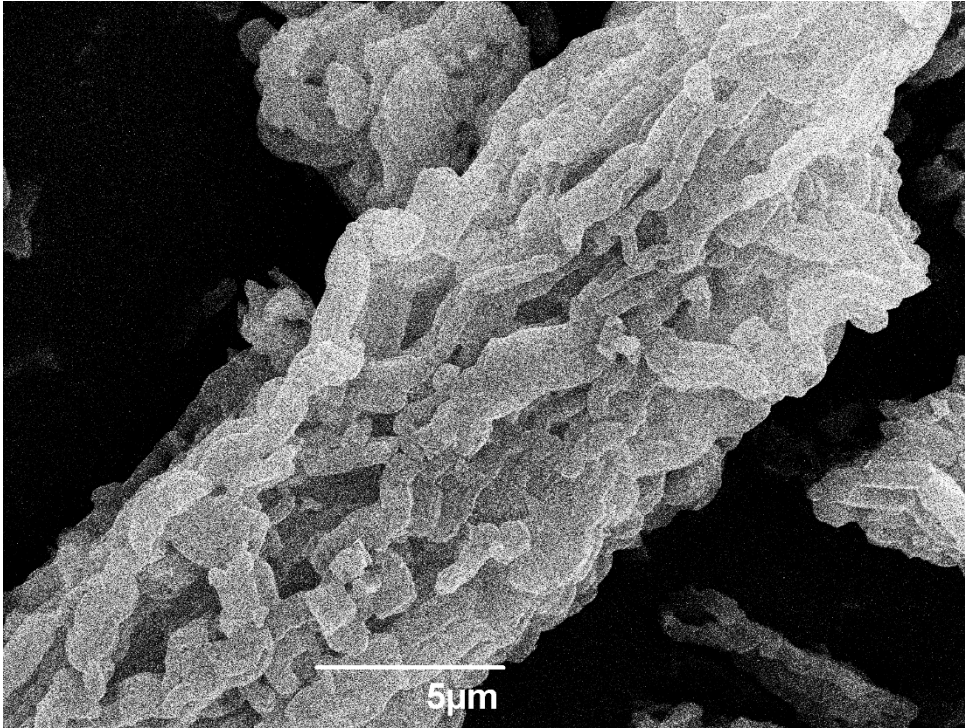


Abb. 8.343: REM-Aufnahme von ar. SO<sub>3</sub>H-BTEB-PMO (8), 5000fache Vergrößerung.

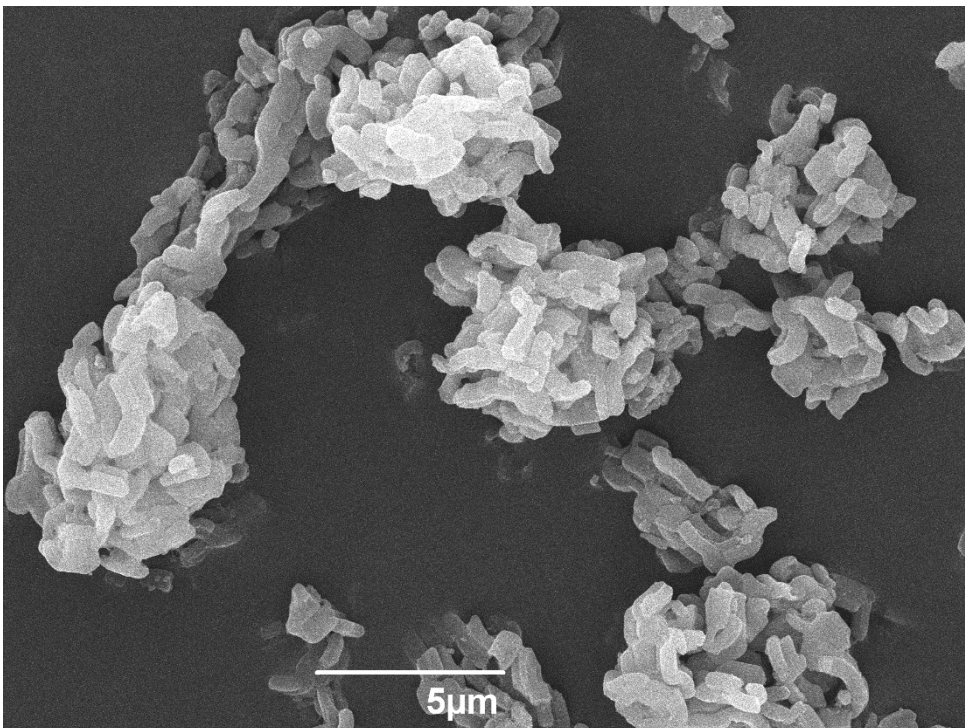


Abb. 8.344: REM-Aufnahme von SBA-15 (9k), 5000fache Vergrößerung.

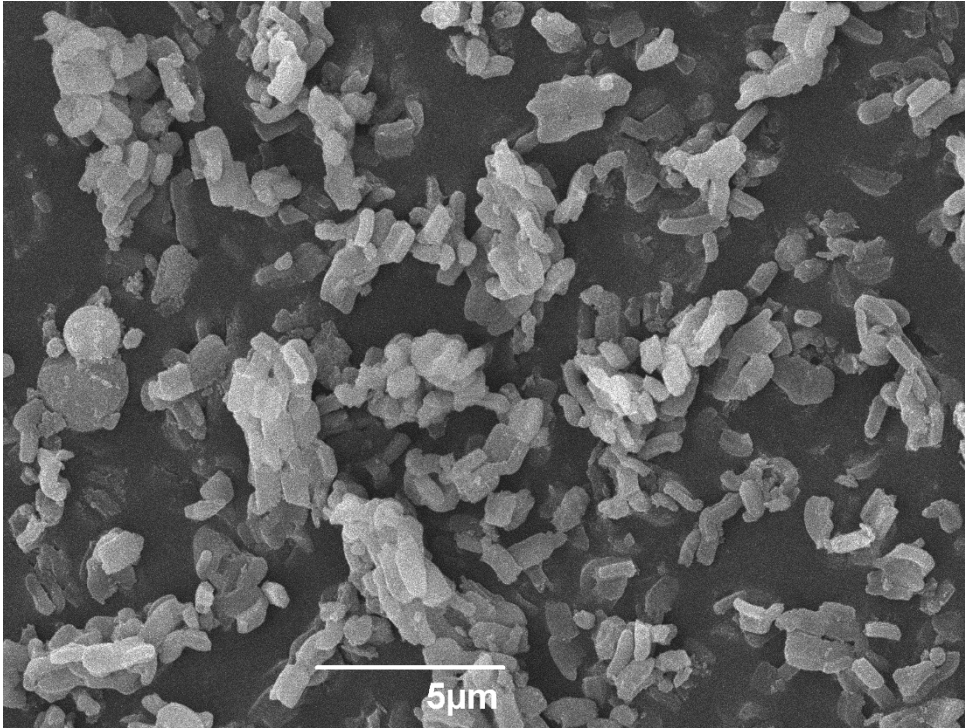


Abb. 8.345: REM-Aufnahme von SH-SBA-15 (10k), 5000fache Vergrößerung.

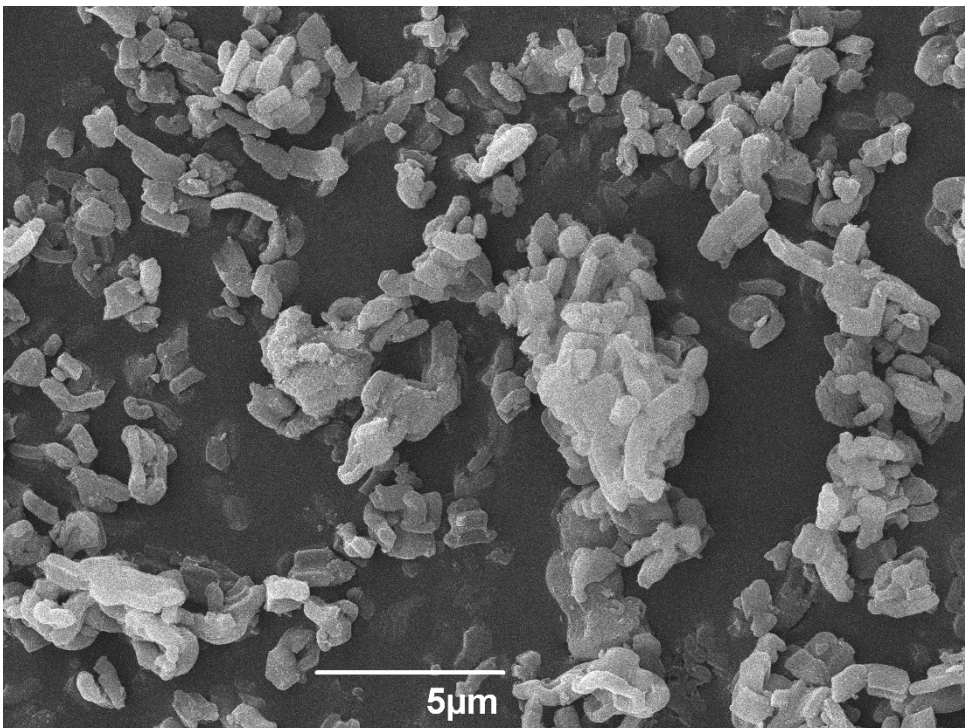


Abb. 8.346: REM-Aufnahme von SO<sub>3</sub>H-SBA-15 (11k), 5000fache Vergrößerung.

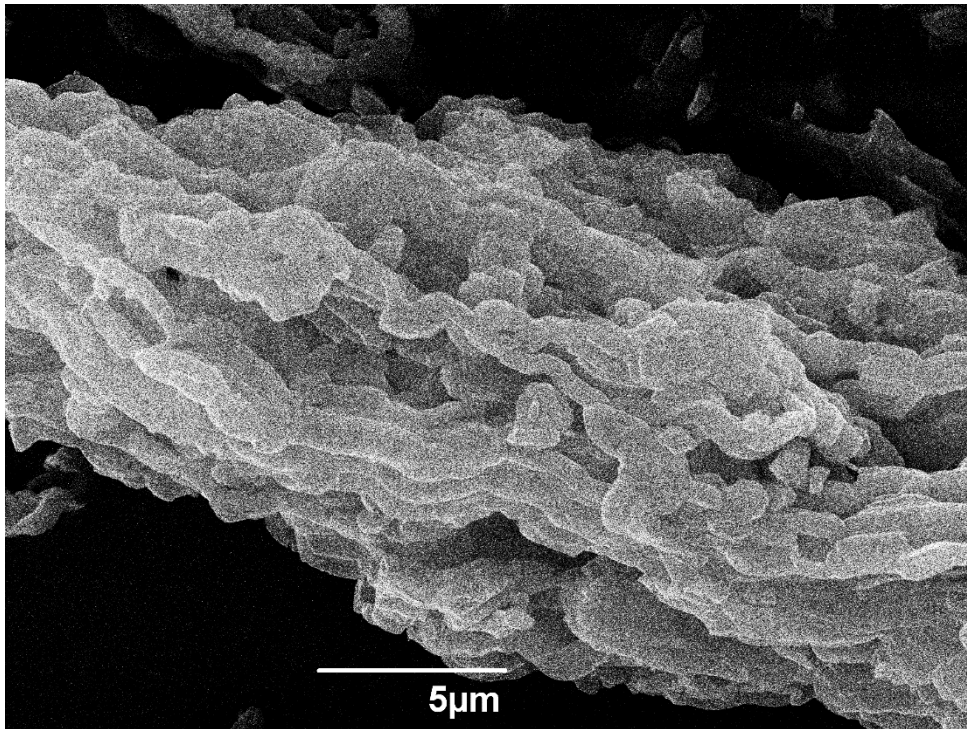


Abb. 8.347: REM-Aufnahme von NH<sub>4</sub>SO<sub>3</sub>-BTEB-PMO (18), 5000fache Vergrößerung.

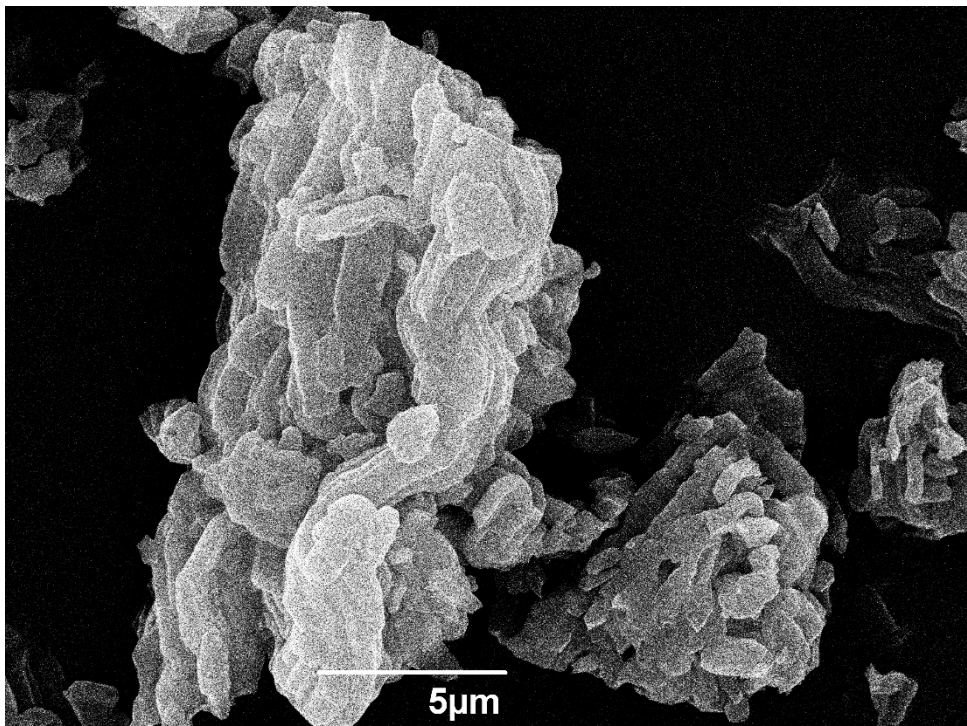


Abb. 8.348: REM-Aufnahme von PT1-BTEB-PMO (19), 5000fache Vergrößerung.

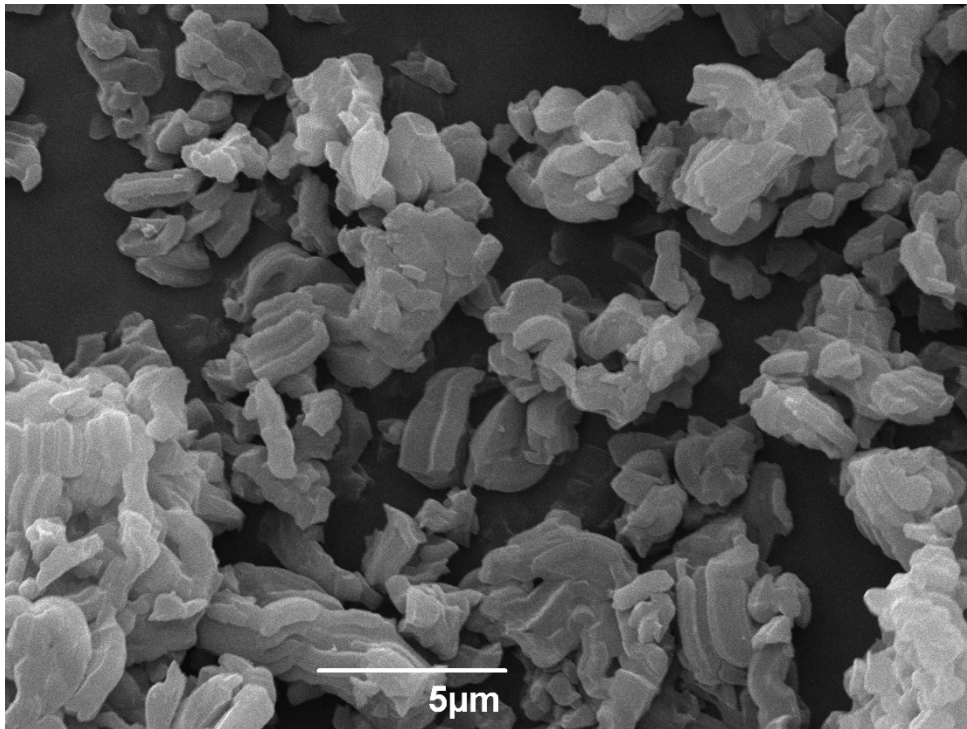


Abb. 8.349: REM-Aufnahme von rad. PT1-BTEB-PMO (20), 5000fache Vergrößerung.

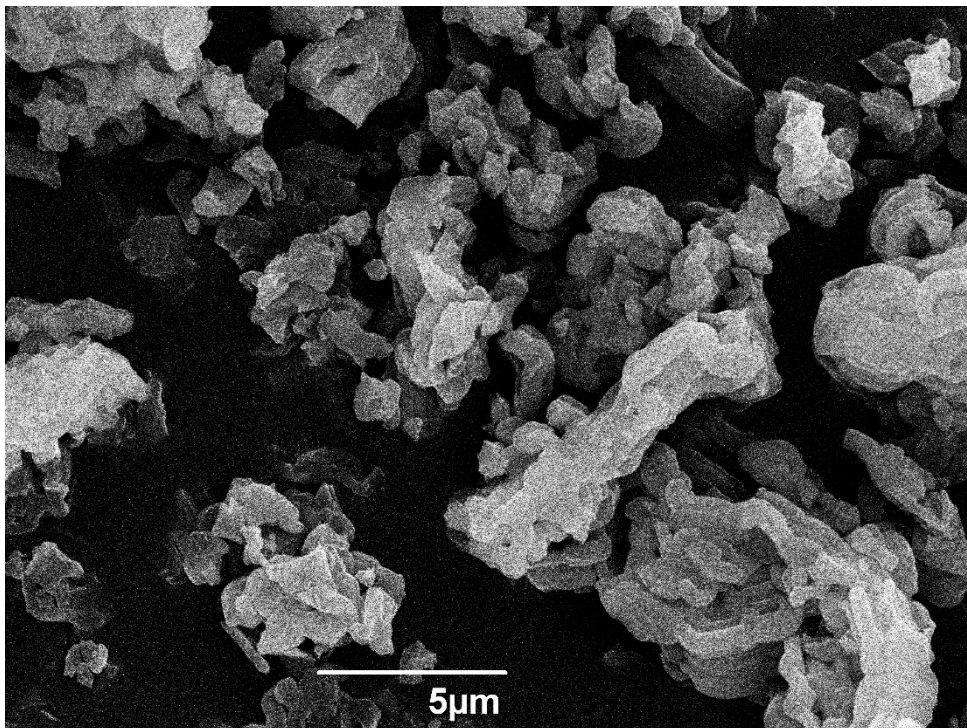


Abb. 8.350: REM-Aufnahme von ar. PT1-BTEB-PMO (21), 5000fache Vergrößerung.

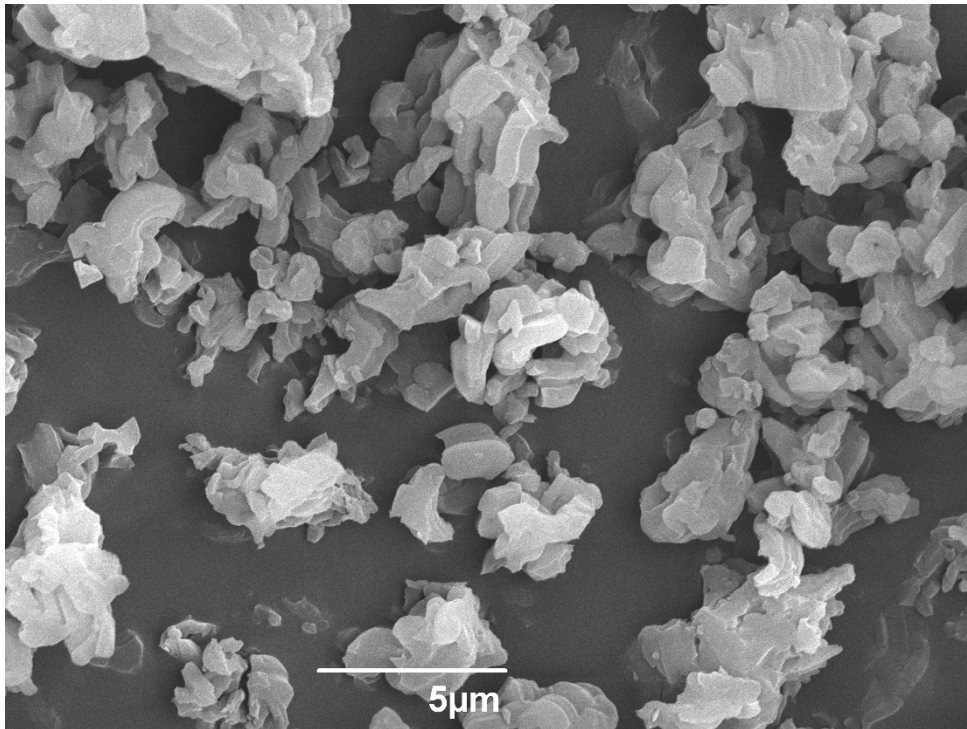


Abb. 8.351: REM-Aufnahme von rad. ar. PT1-BTEB-PMO (**22**), 5000fache Vergrößerung.

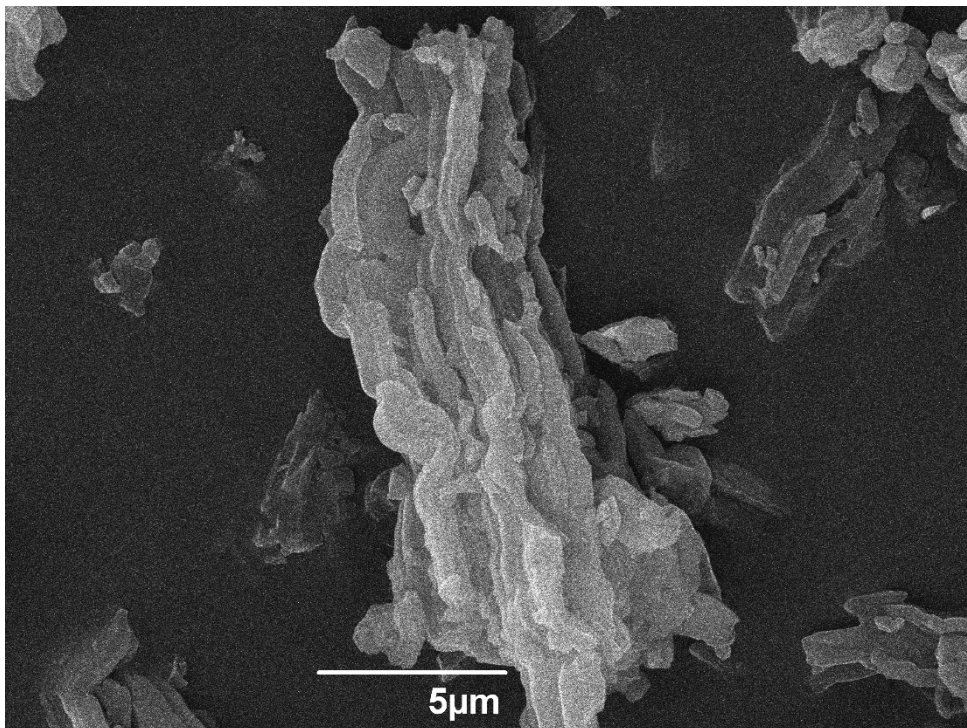


Abb. 8.352: REM-Aufnahme von PySO<sub>3</sub>-BTEB-PMO (**23**), 5000fache Vergrößerung.



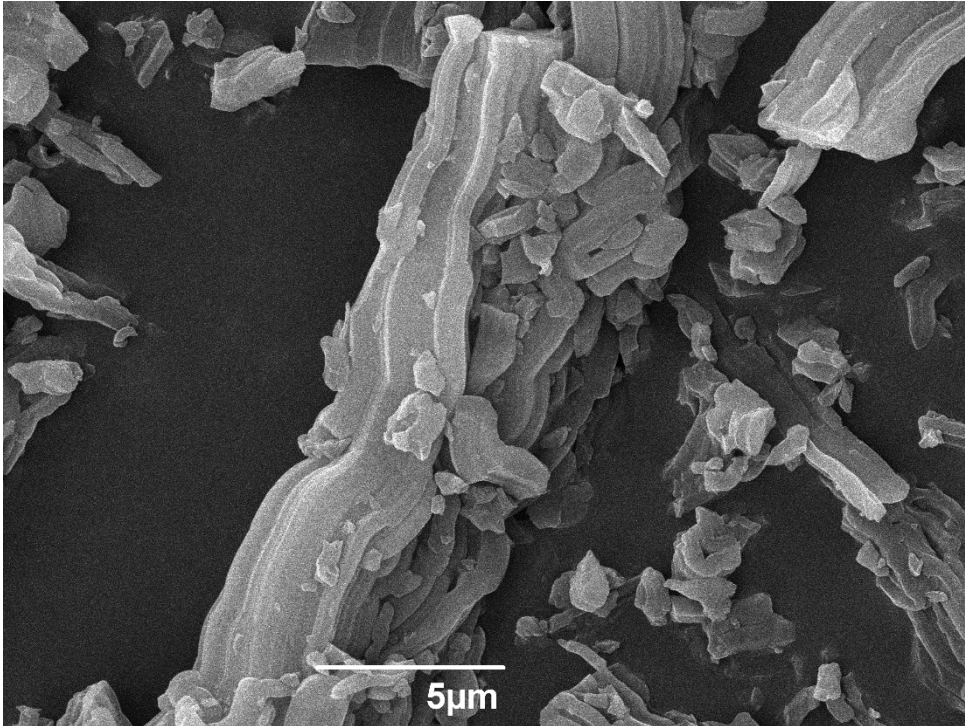


Abb. 8.353: REM-Aufnahme von PT1-BTEB-PMO (24), 5000fache Vergrößerung.

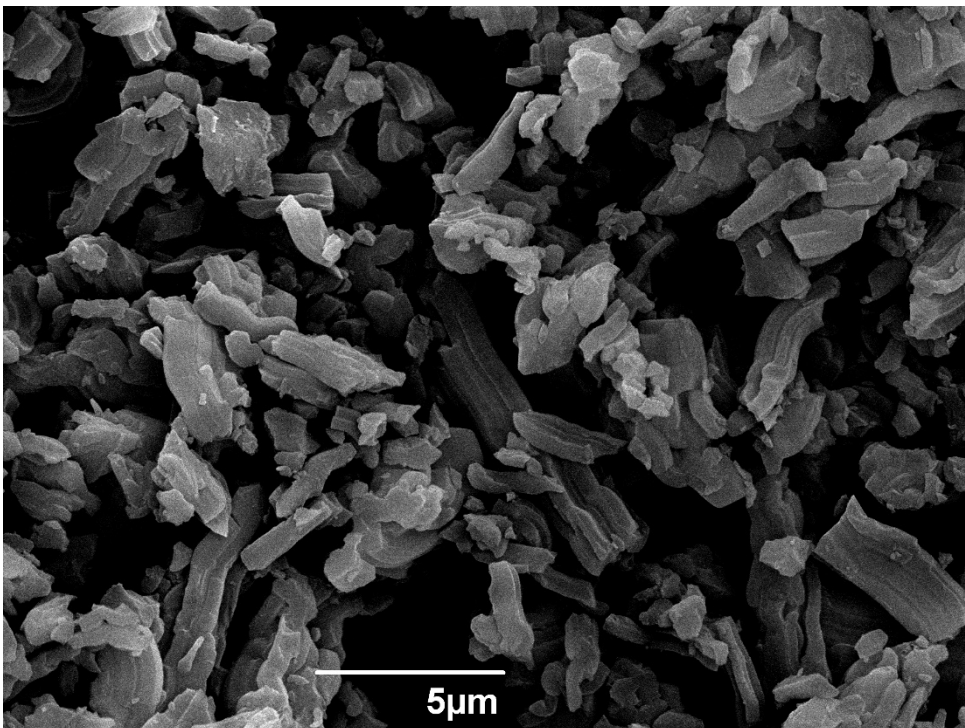


Abb. 8.354: REM-Aufnahme von PT2-BTEB-PMO (25), 5000fache Vergrößerung.

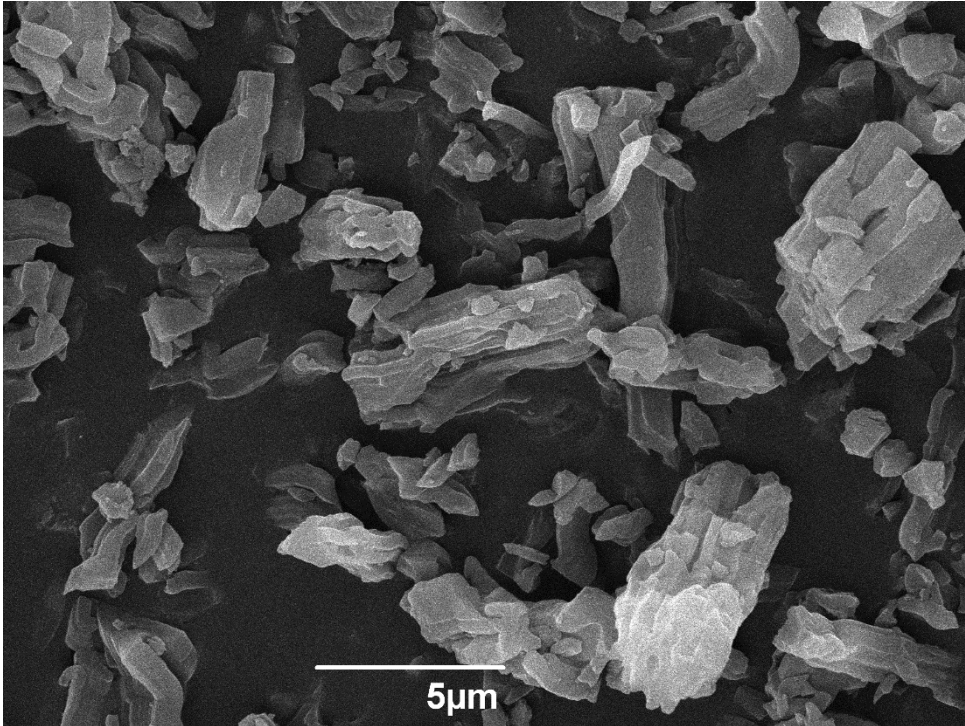


Abb. 8.355: REM-Aufnahme von PT3-BTEB-PMO (26), 5000fache Vergrößerung.

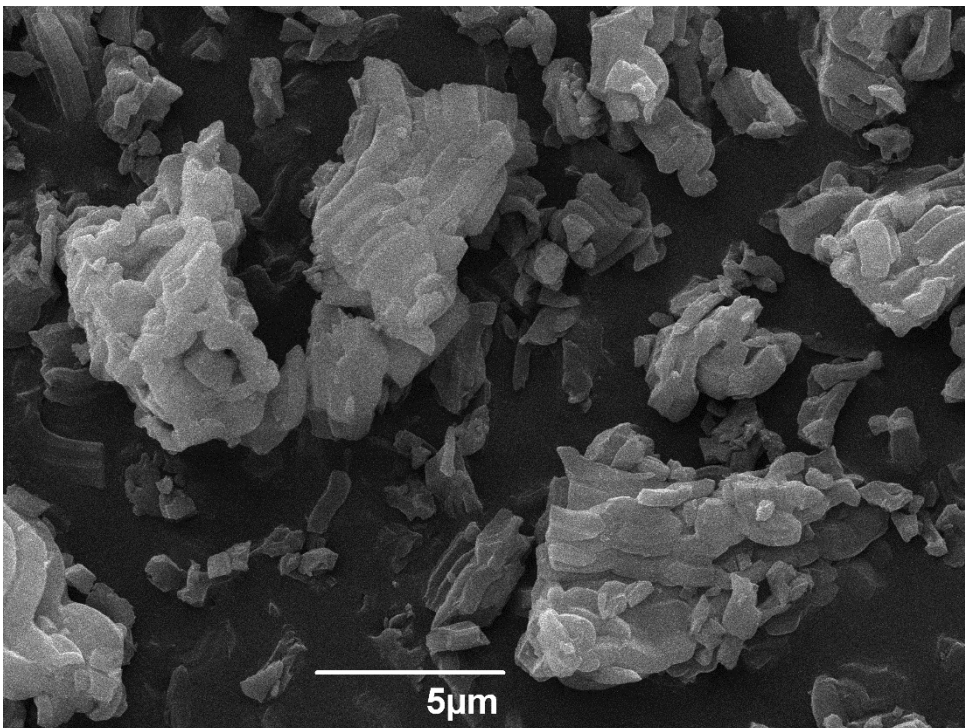


Abb. 8.356: REM-Aufnahme von PT4-BTEB-PMO (27), 5000fache Vergrößerung.

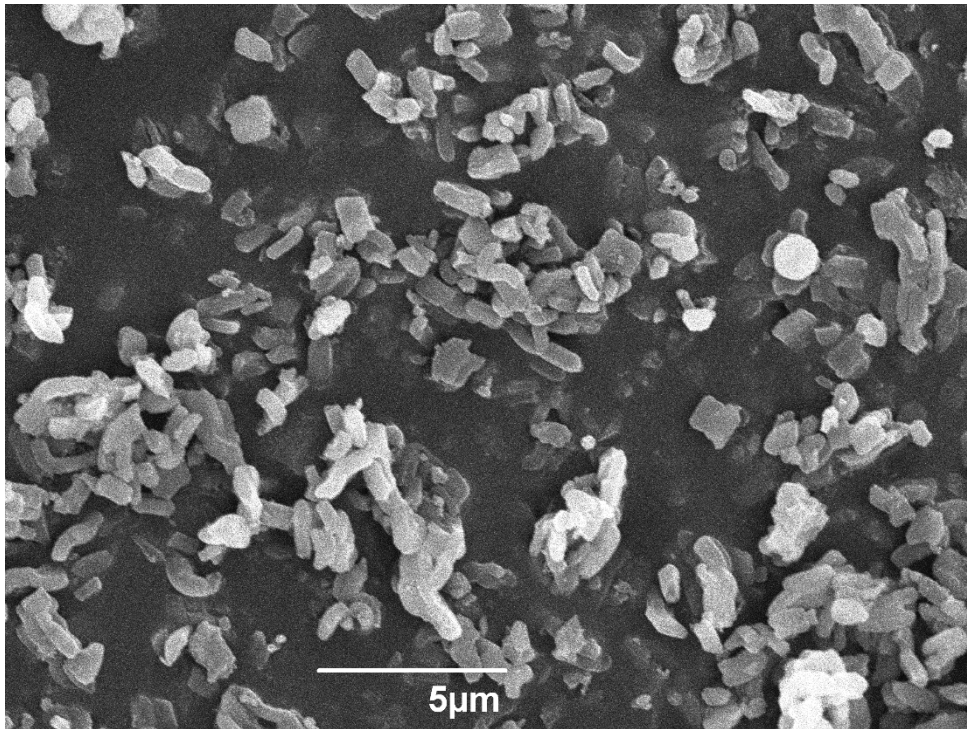


Abb. 8.357: REM-Aufnahme von PySO<sub>3</sub>-SBA-15 (28k), 5000fache Vergrößerung.

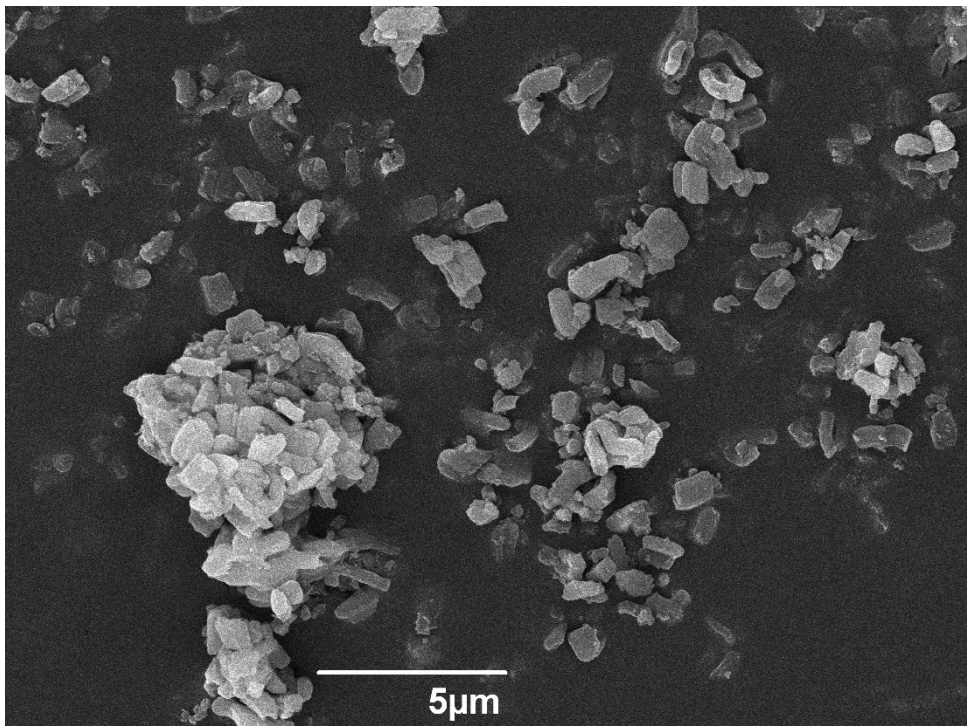


Abb. 8.358: REM-Aufnahme von PT1-SBA-15 (29k), 5000fache Vergrößerung.

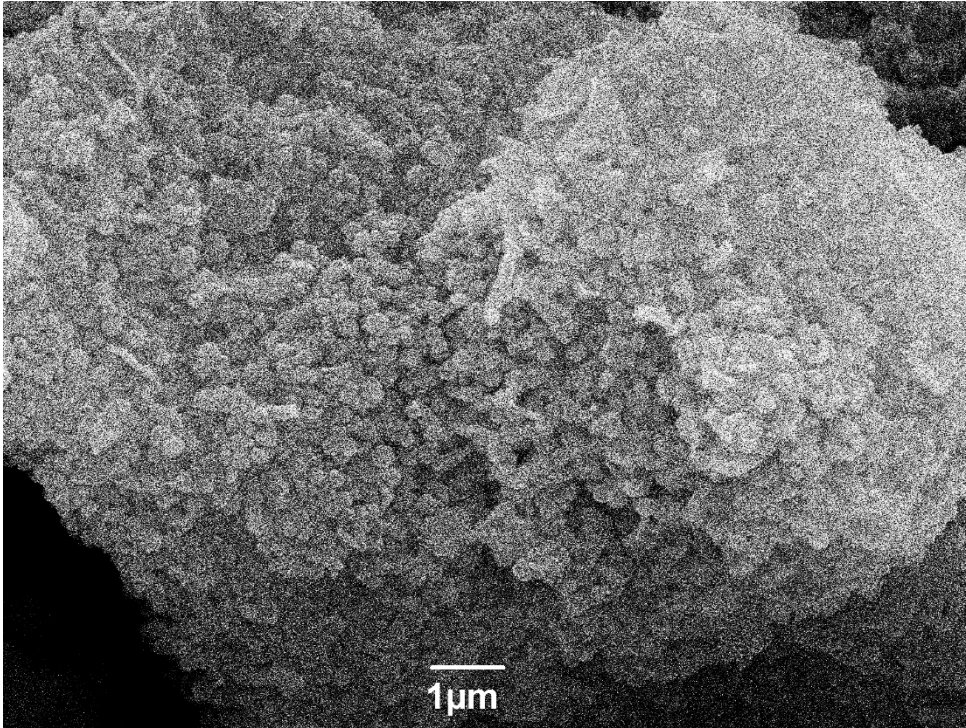


Abb. 8.359: REM-Aufnahme von rad. PT7-BTEB-NP (37), 10000fache Vergrößerung.

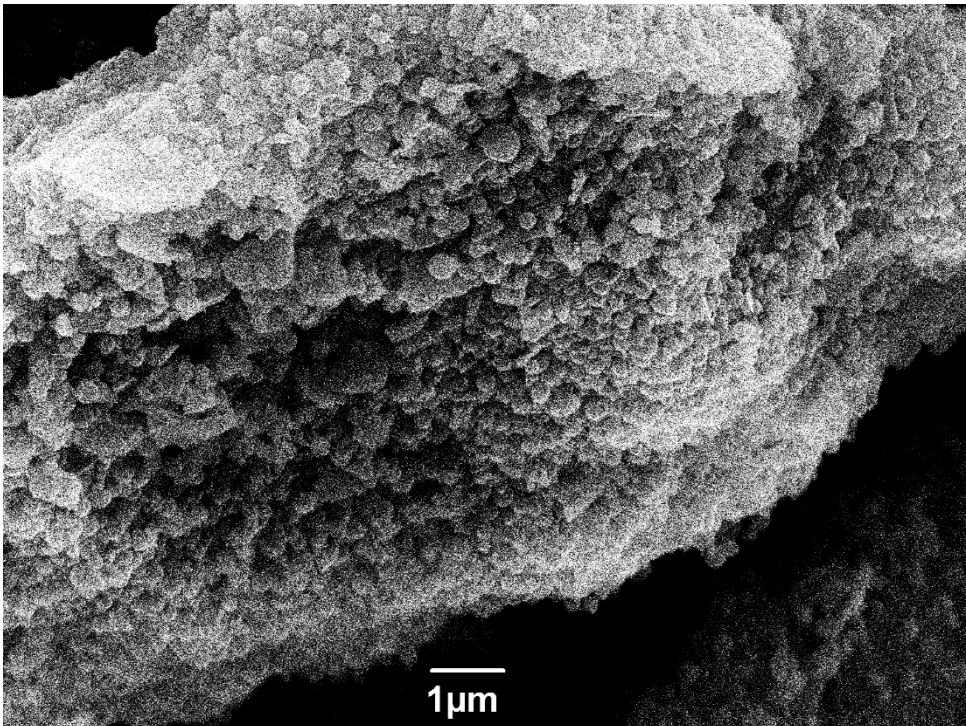


Abb. 8.360: REM-Aufnahme von rad. PT8-BTEB-NP (39), 10000fache Vergrößerung.

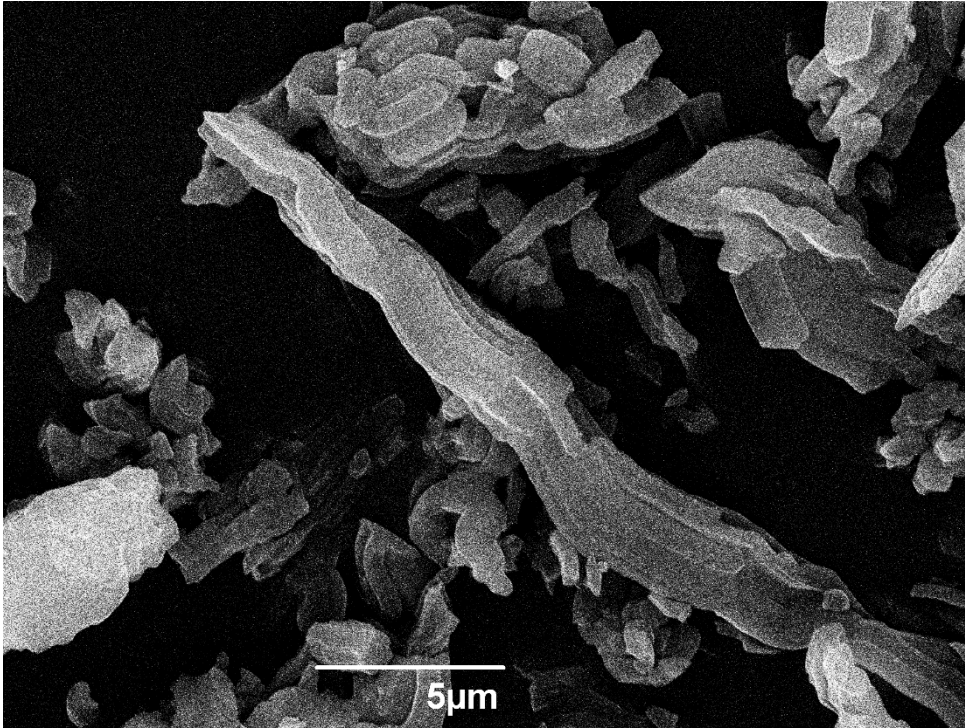


Abb. 8.361: REM-Aufnahme von NCS-BTEB-PMO (41), 5000fache Vergrößerung.

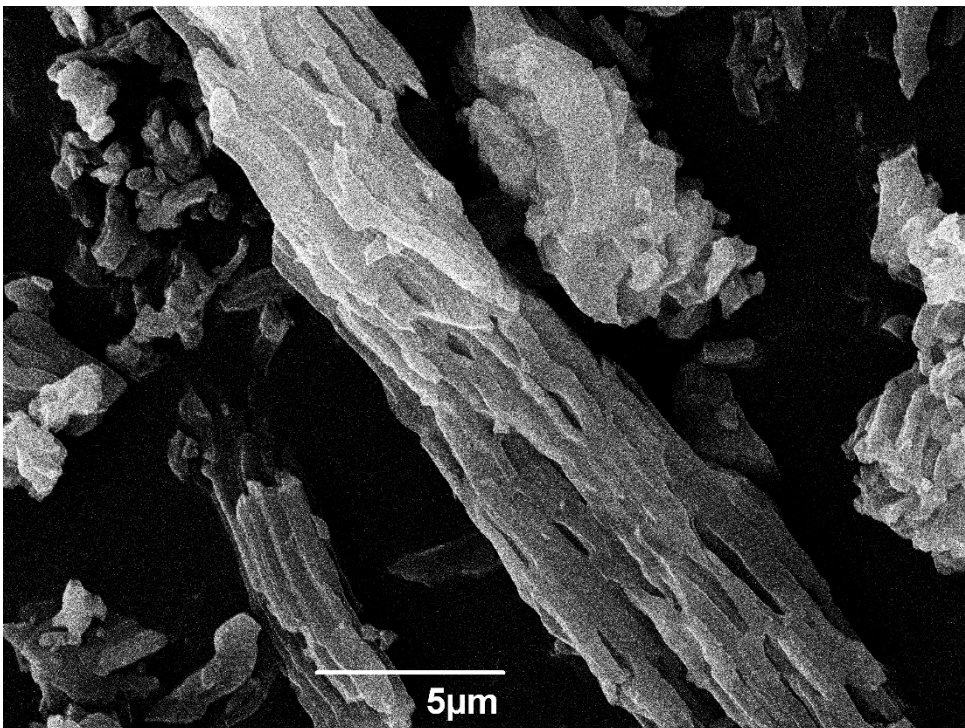


Abb. 8.362: REM-Aufnahme von *epi*-Chinin-BTEB-PMO (44a), 5000fache Vergrößerung.

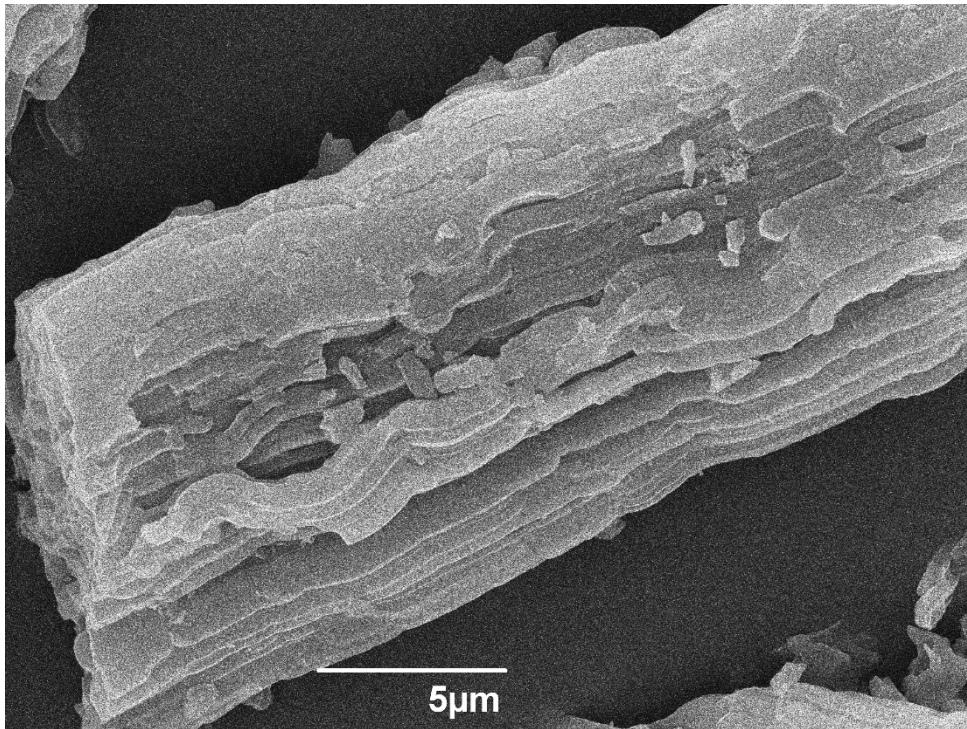


Abb. 8.363: REM-Aufnahme von *epi*-Chinin-BTEB-PMO (**44b**), 5000fache Vergrößerung.

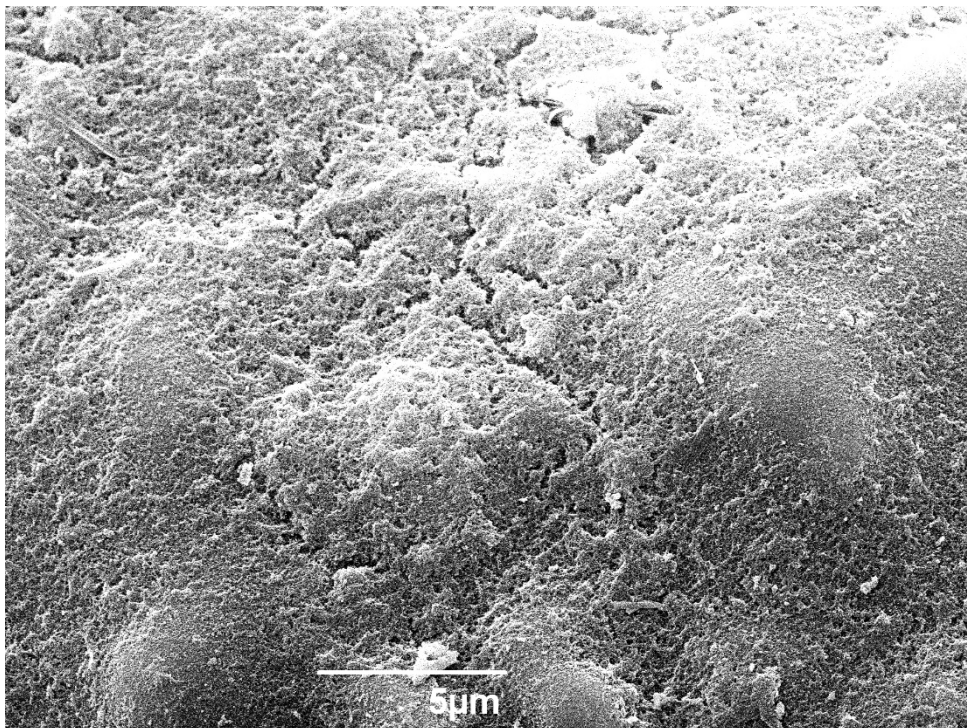


Abb. 8.364: REM-Aufnahme von V-BTEB-PMO V3 (**65a**), 5000fache Vergrößerung.

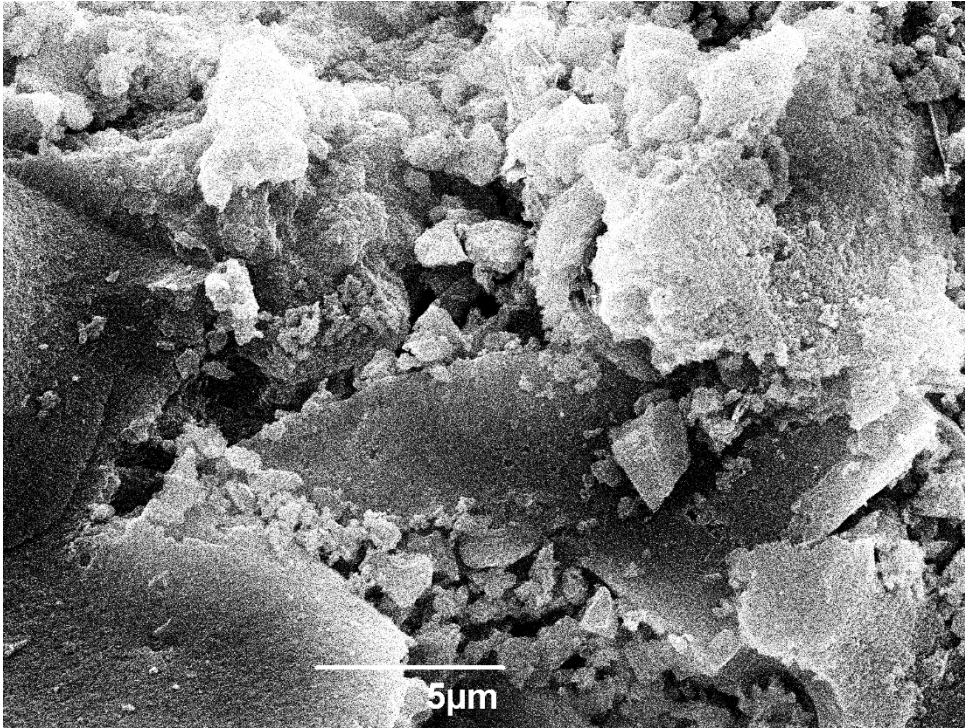


Abb. 8.365: REM-Aufnahme von V-BTEB-PMO V3 (325) (**65b**), 5000fache Vergrößerung.

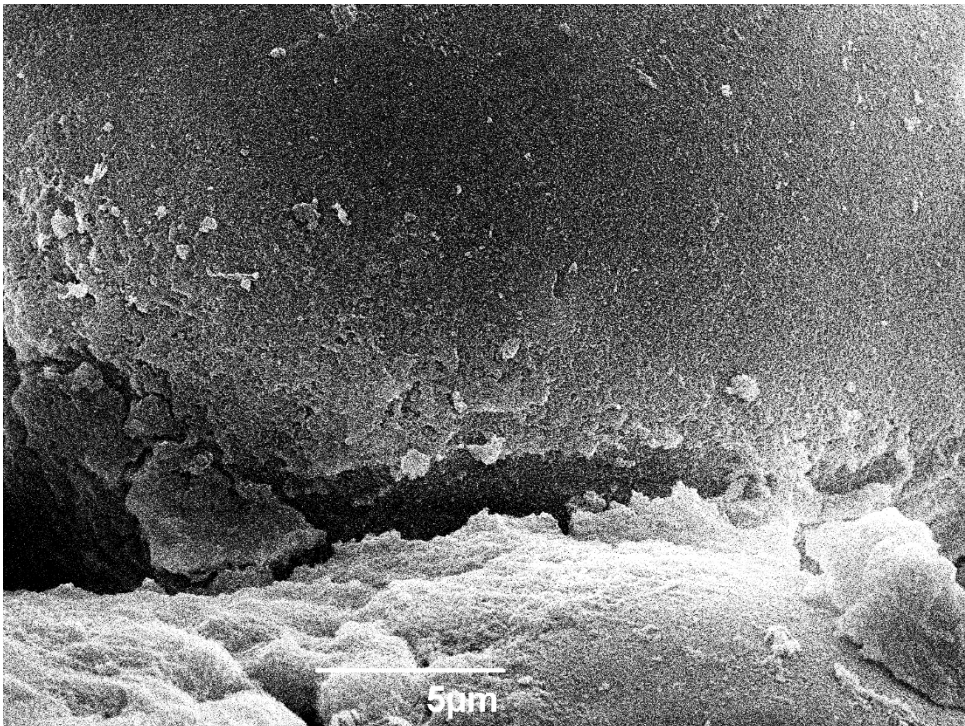


Abb. 8.366: REM-Aufnahme von V-BTEB-PMO V3 (375) (**65c**), 5000fache Vergrößerung.

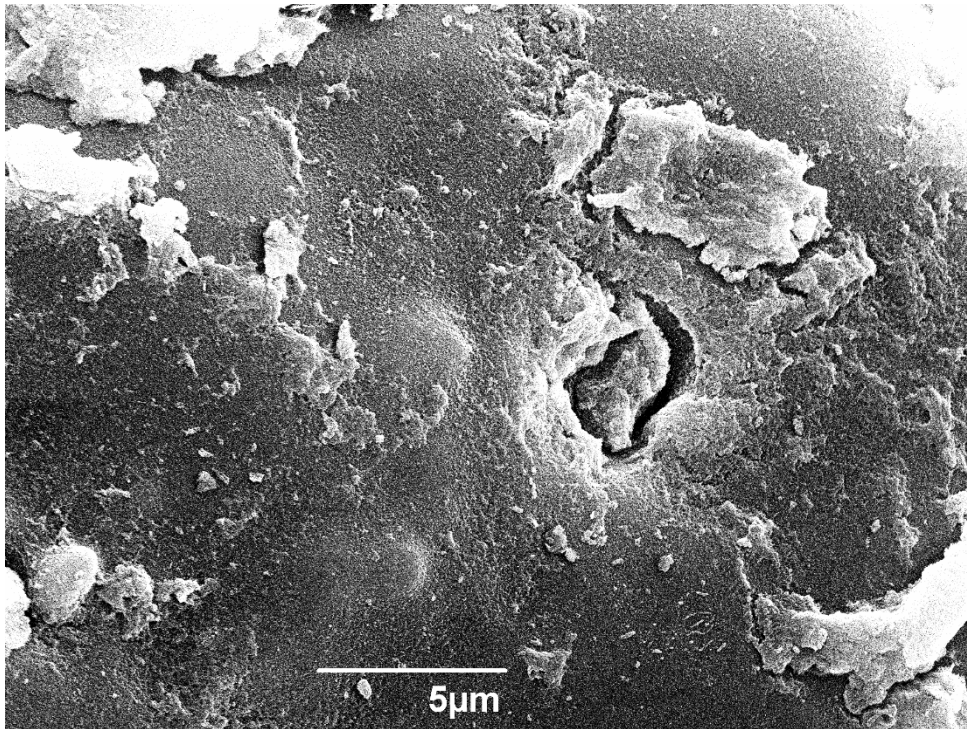


Abb. 8.367: REM-Aufnahme von V-BTEB-PMO V3 (425) (65d), 5000fache Vergrößerung.

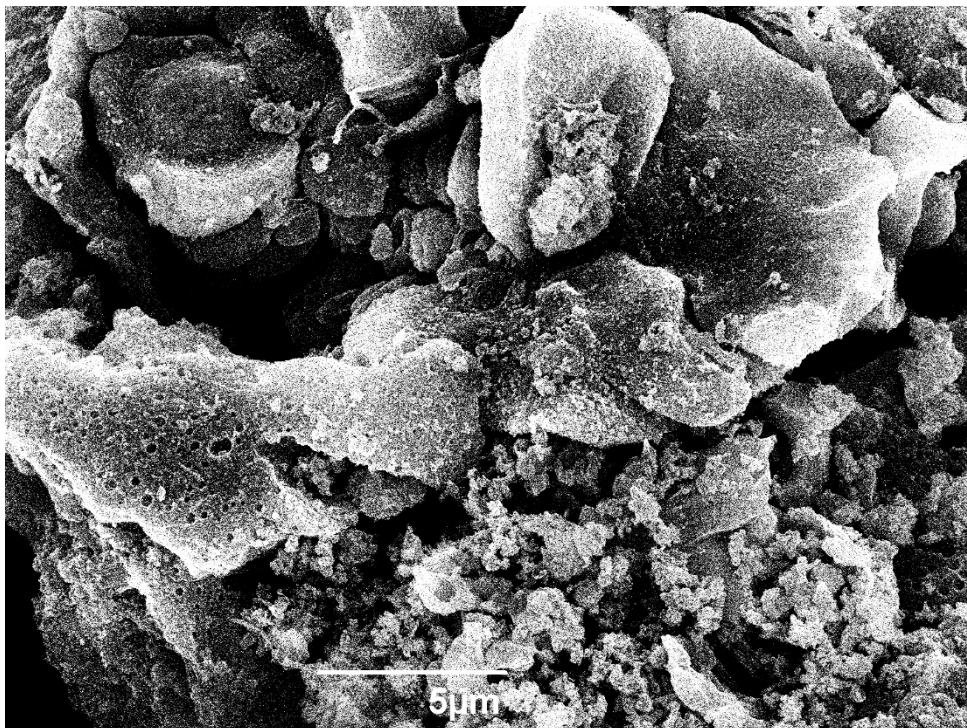


Abb. 8.368: REM-Aufnahme von VA1-BTEB-PMO V1 (66a), 5000fache Vergrößerung.



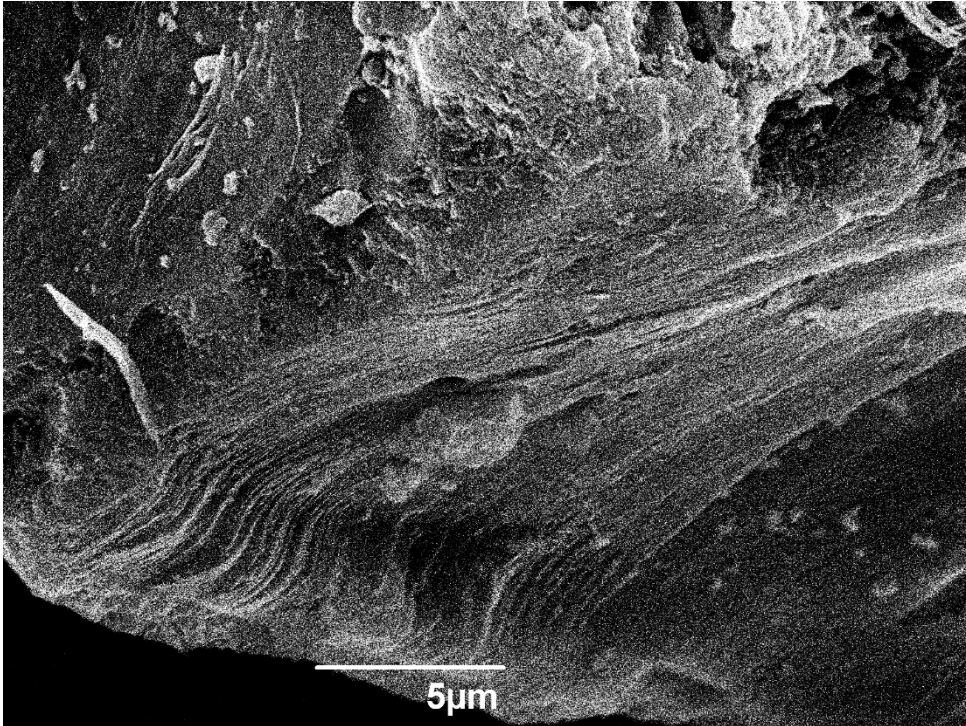


Abb. 8.369: REM-Aufnahme von VAl-BTEB-PMO V2 (67a), 5000fache Vergrößerung.

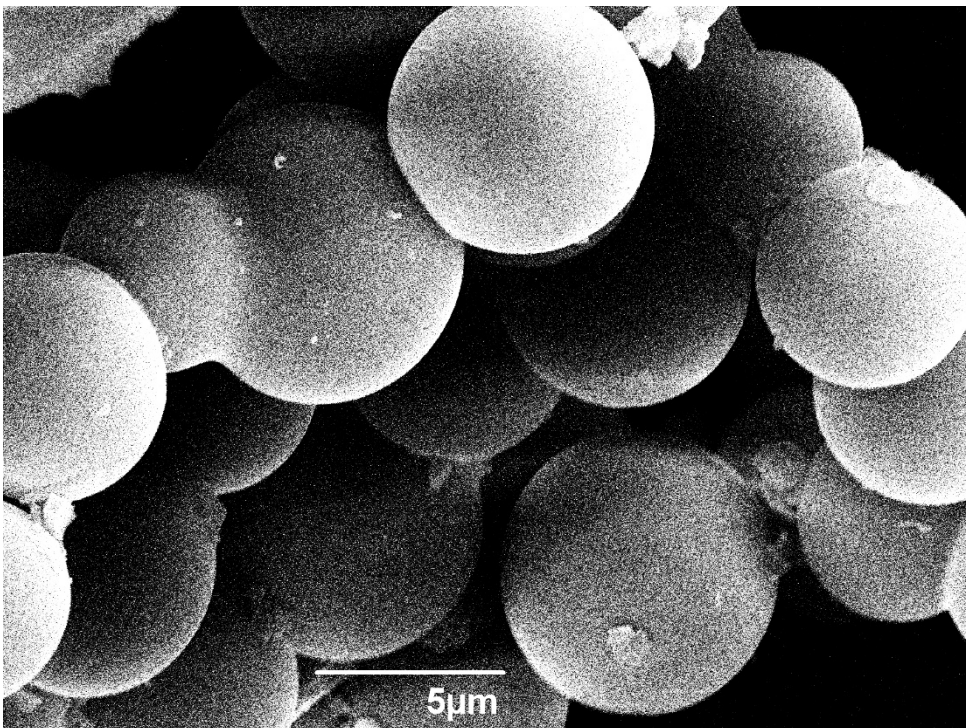


Abb. 8.370: REM-Aufnahme von VAl-BTEB-PMO V3 (68a), 5000fache Vergrößerung.

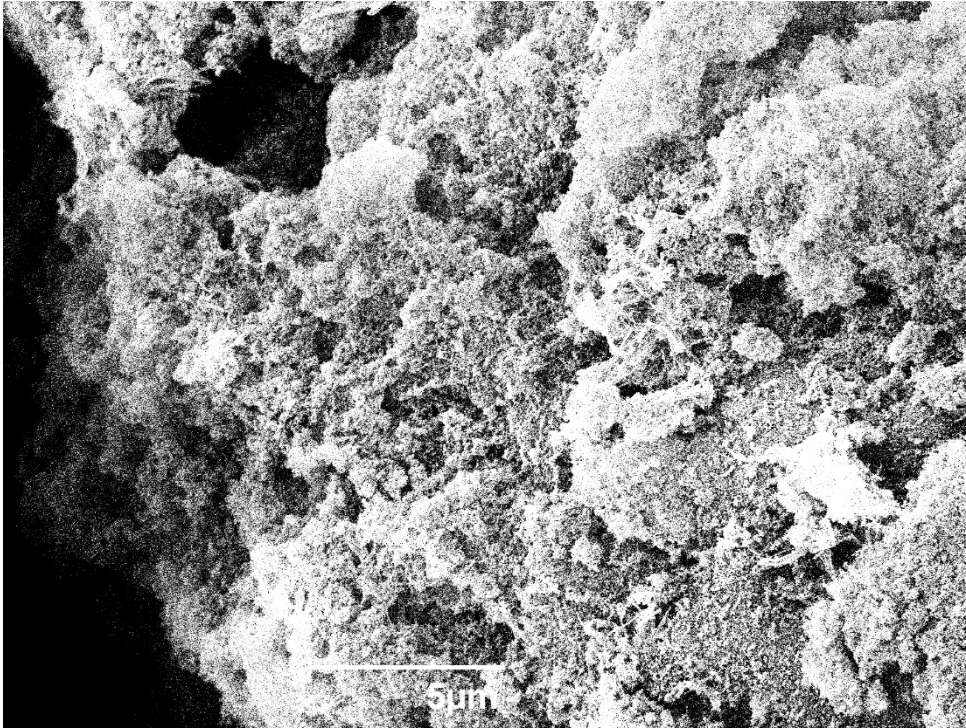


Abb. 8.371: REM-Aufnahme von VAl-BTEB-PMO V4 (**69a**), 5000fache Vergrößerung.

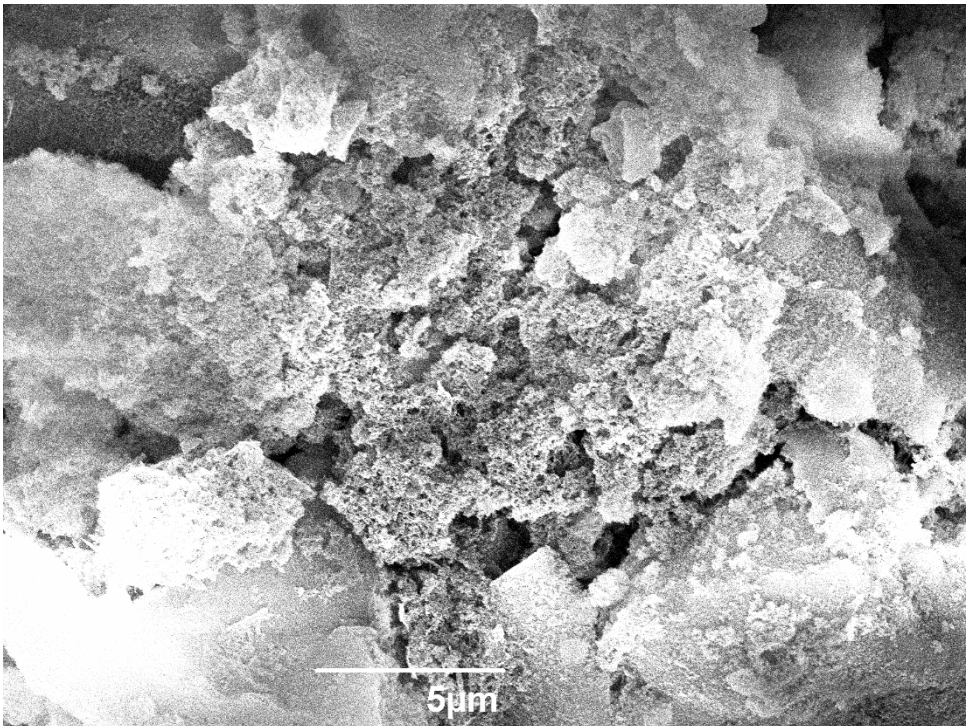


Abb. 8.372: REM-Aufnahme von VAl-BTEB-PMO V4 (275) (**69b**), 5000fache Vergrößerung.

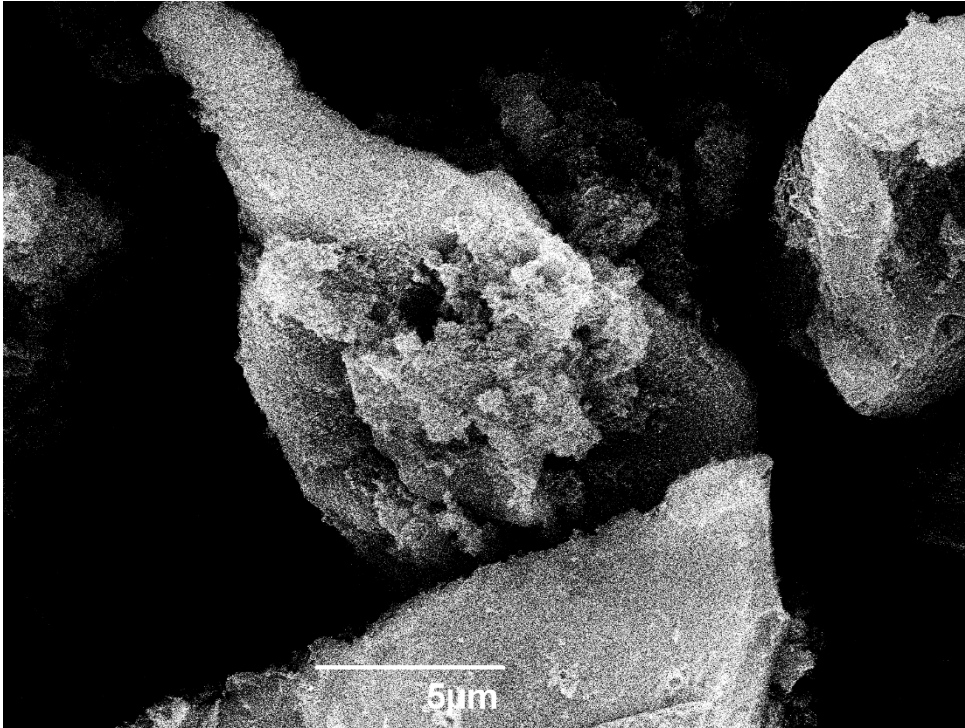


Abb. 8.373: REM-Aufnahme von VAl-BTEB-PMO V4 (325) (**69c**), 5000fache Vergrößerung.

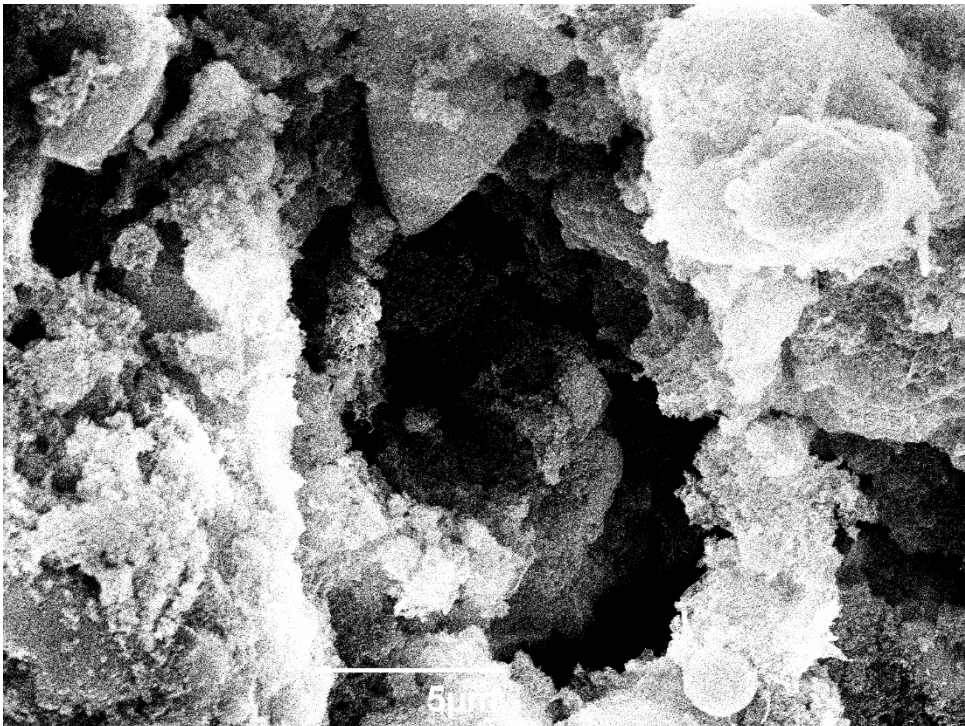


Abb. 8.374: REM-Aufnahme von VAl-BTEB-PMO V4 (375) (**69d**), 5000fache Vergrößerung.

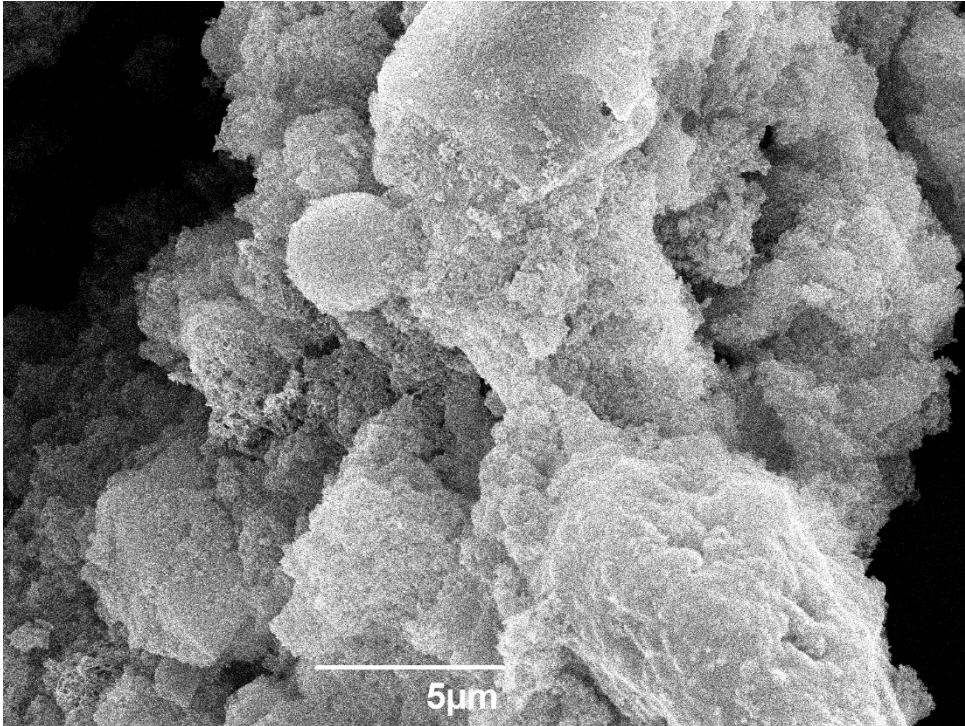


Abb. 8.375: REM-Aufnahme von VAl-BTEB-PMO V4 (425) (69e), 5000fache Vergrößerung.

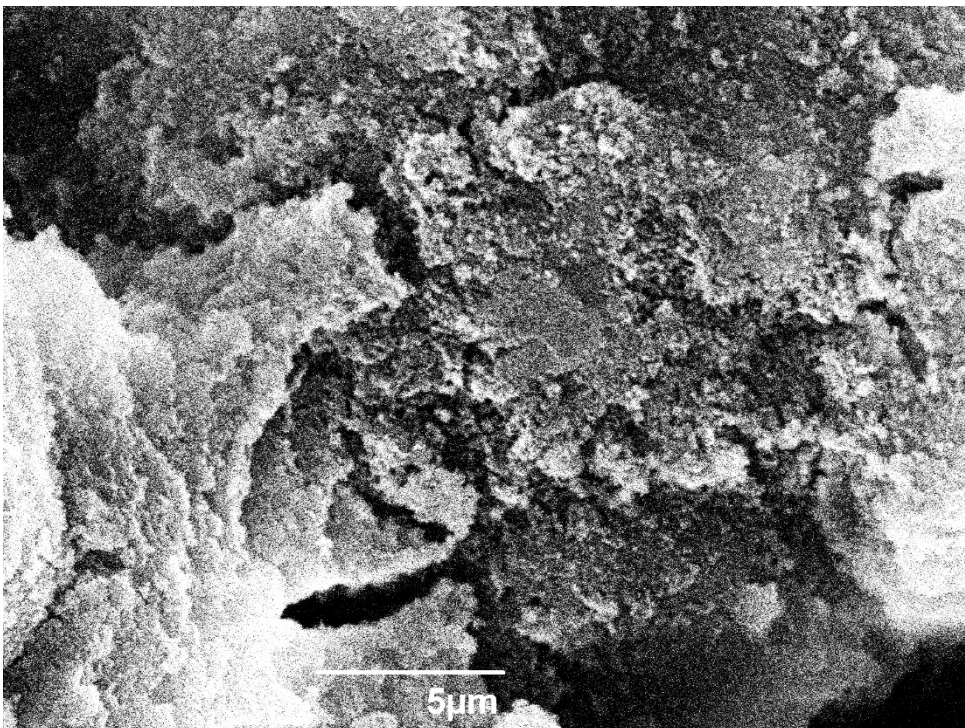


Abb. 8.376: REM-Aufnahme von VAl-BTEB-PMO V5 (70a), 5000fache Vergrößerung.

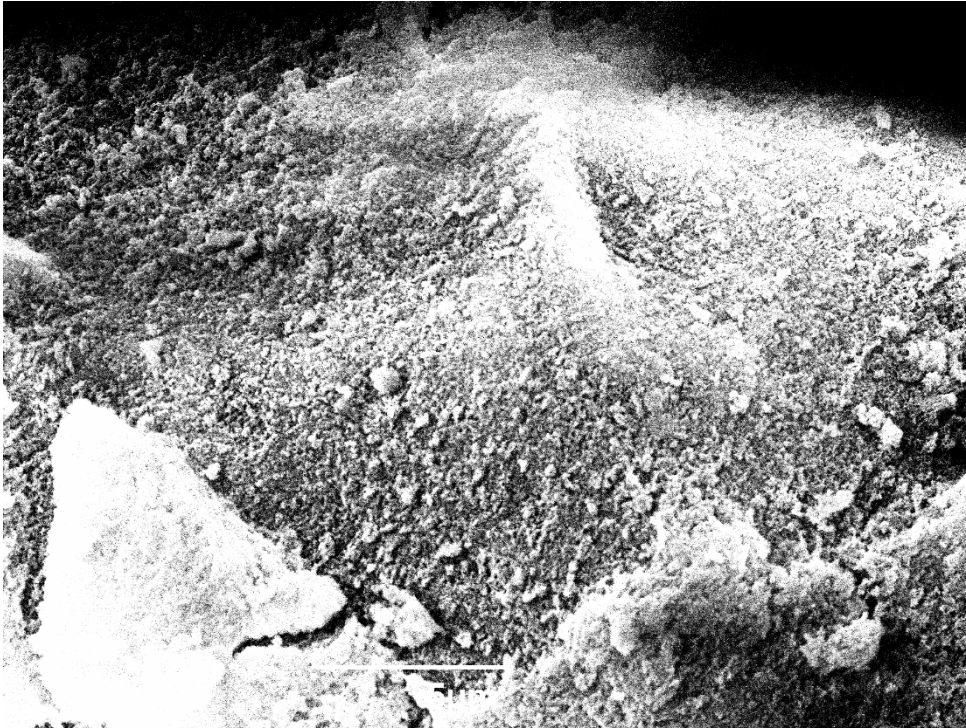


Abb. 8.377: REM-Aufnahme von VAl-BTEB-PMO V5 (275) (70b), 5000fache Vergrößerung.

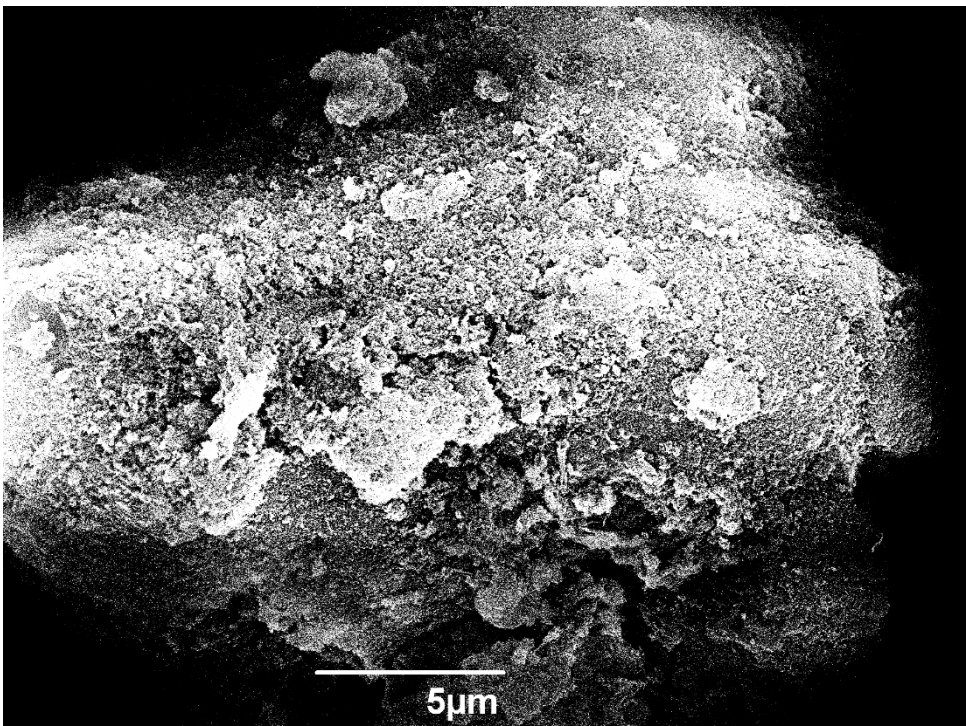


Abb. 8.378: REM-Aufnahme von VAl-BTEB-PMO V5 (325) (70e), 5000fache Vergrößerung.

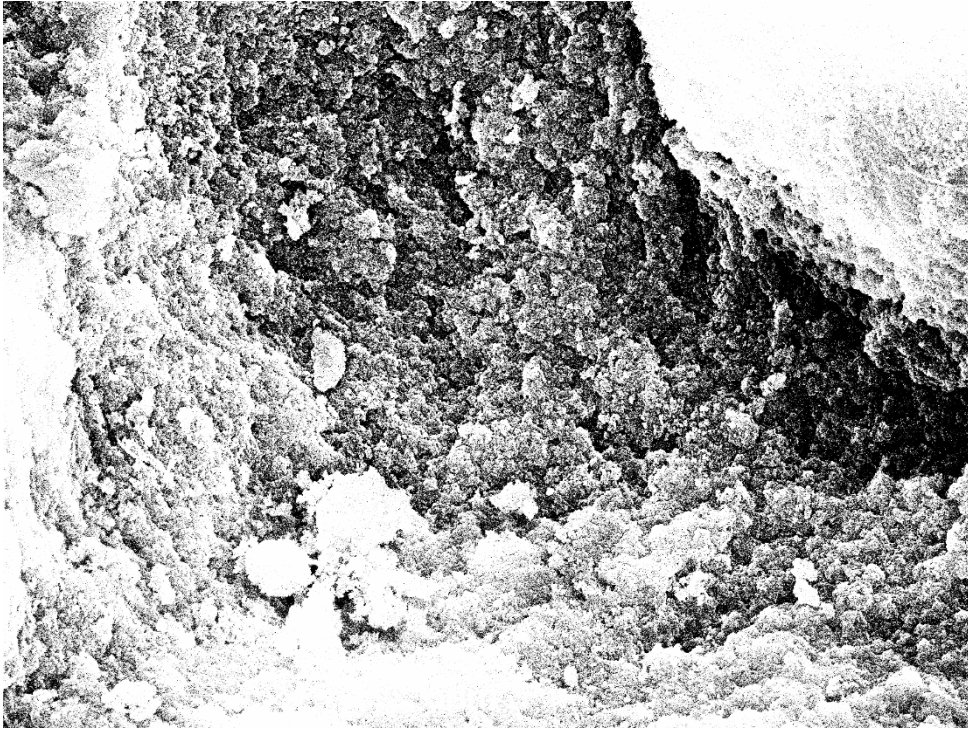


Abb. 8.379: REM-Aufnahme von VAl-BTEB-PMO V5 (375) (70d), 5000fache Vergrößerung.

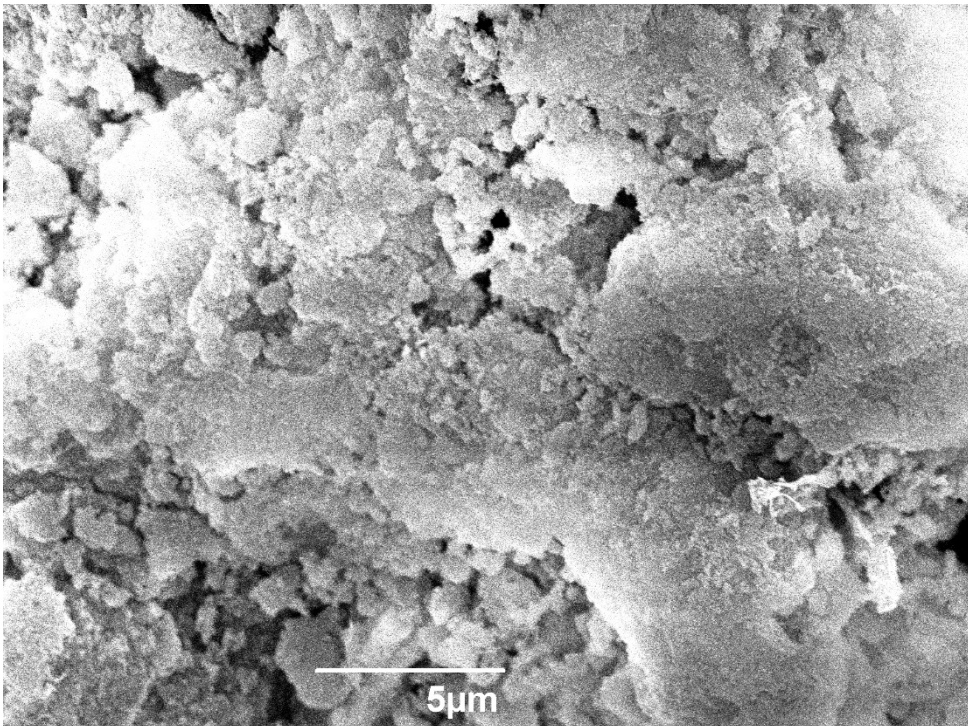


Abb. 8.380: REM-Aufnahme von VAl-BTEB-PMO V5 (425) (70e), 5000fache Vergrößerung.

## 8.9 EDX-Aufnahmen

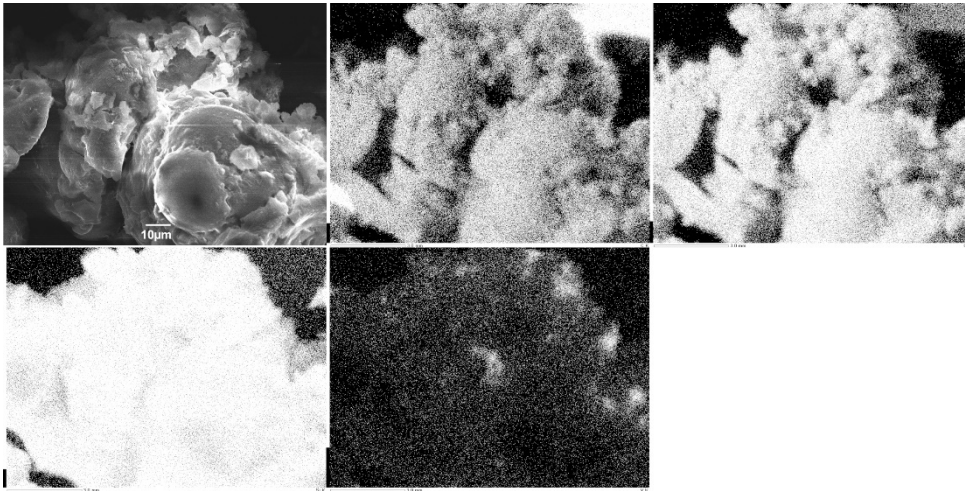


Abb. 8.381: REM- (oben links) & EDX-Aufnahme von V-BTEB-PMO V3 (**65a**), 1000fache Vergrößerung. Kohlenstoff oben Mitte, Sauerstoff oben rechts, Silizium unten links, Vanadium unten Mitte.

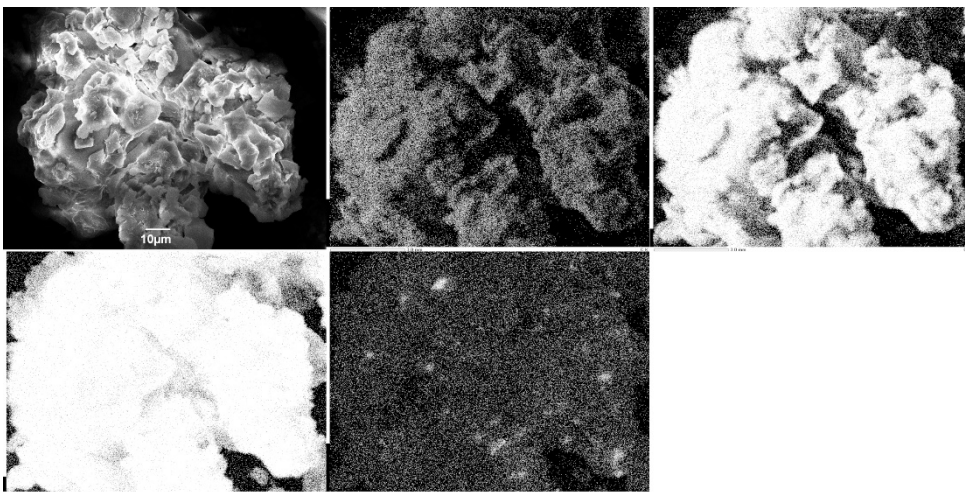


Abb. 8.382: REM- (oben links) & EDX-Aufnahme von V-BTEB-PMO V3 (425) (**65d**), 1000fache Vergrößerung. Kohlenstoff oben Mitte, Sauerstoff oben rechts, Silizium unten links, Vanadium unten Mitte.

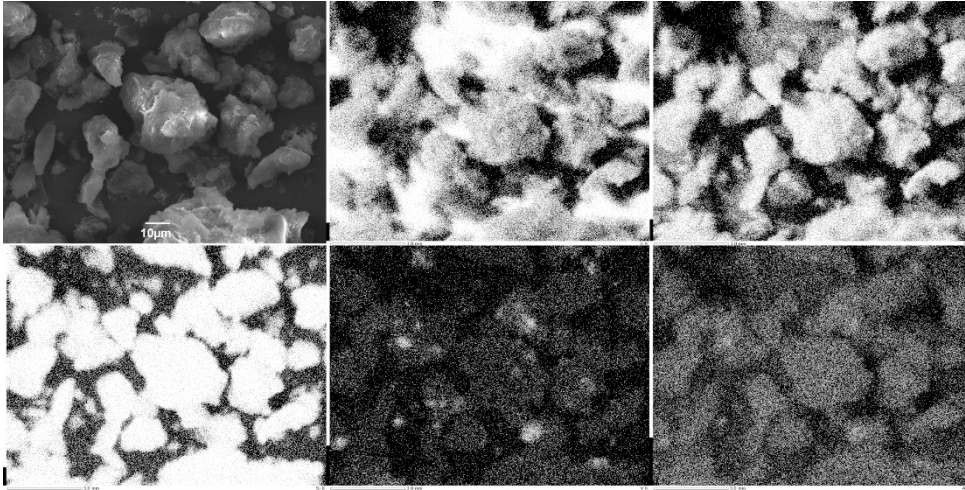


Abb. 8.383: REM- (oben links) & EDX-Aufnahme von VAl-BTEB-PMO (**69a**), 1000fache Vergrößerung. Kohlenstoff oben Mitte, Sauerstoff oben rechts, Silizium unten links, Vanadium unten Mitte, Aluminium unten rechts.

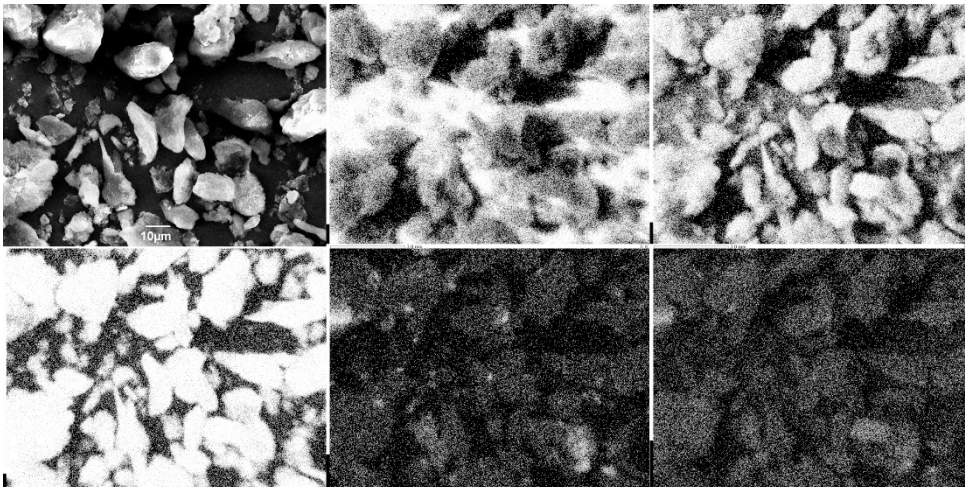


Abb. 8.384: REM- (oben links) & EDX-Aufnahme von VAl-BTEB-PMO (275) (**69b**), 1000fache Vergrößerung. Kohlenstoff oben Mitte, Sauerstoff oben rechts, Silizium unten links, Vanadium unten Mitte, Aluminium unten rechts.



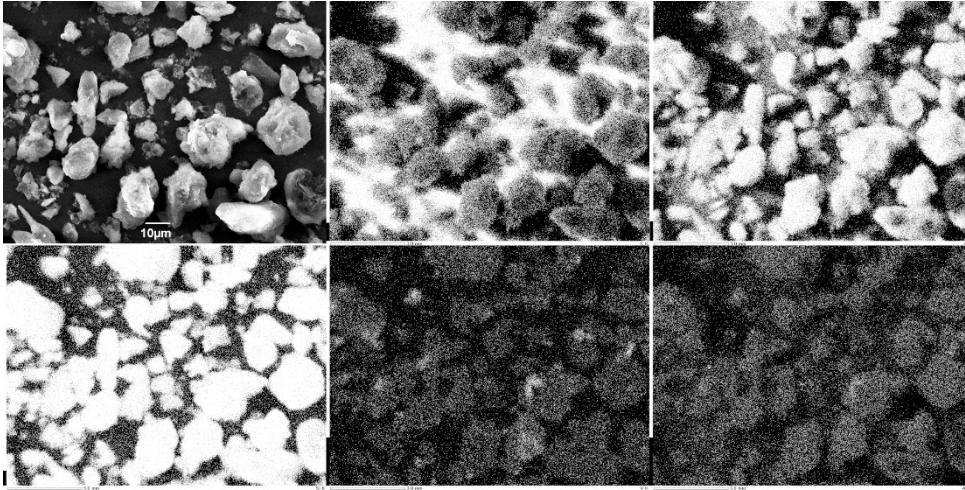


Abb. 8.385: REM- (oben links) & EDX-Aufnahme von VAl-BTEB-PMO (325) (**69c**), 1000fache Vergrößerung. Kohlenstoff oben Mitte, Sauerstoff oben rechts, Silizium unten links, Vanadium unten Mitte, Aluminium unten rechts.

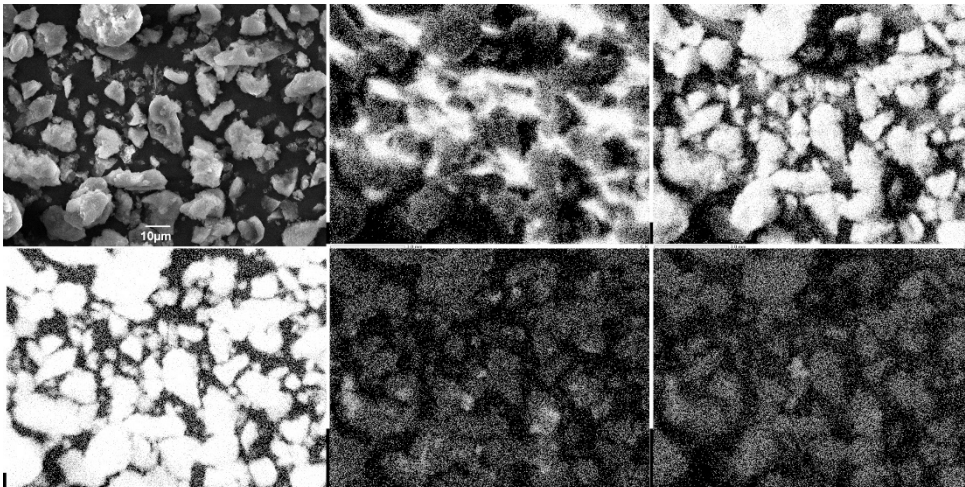


Abb. 8.386: REM- (oben links) & EDX-Aufnahme von VAl-BTEB-PMO (375) (**69d**), 1000fache Vergrößerung. Kohlenstoff oben Mitte, Sauerstoff oben rechts, Silizium unten links, Vanadium unten Mitte, Aluminium unten rechts.

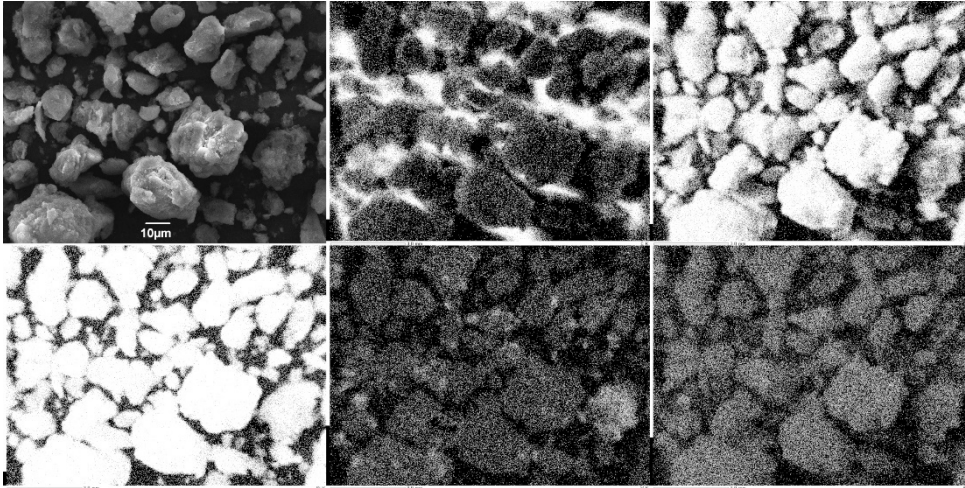


Abb. 8.387: REM- (oben links) & EDX-Aufnahme von VAl-BTEB-PMO (425) (**69e**), 1000fache Vergrößerung. Kohlenstoff oben Mitte, Sauerstoff oben rechts, Silizium unten links, Vanadium unten Mitte, Aluminium unten rechts.

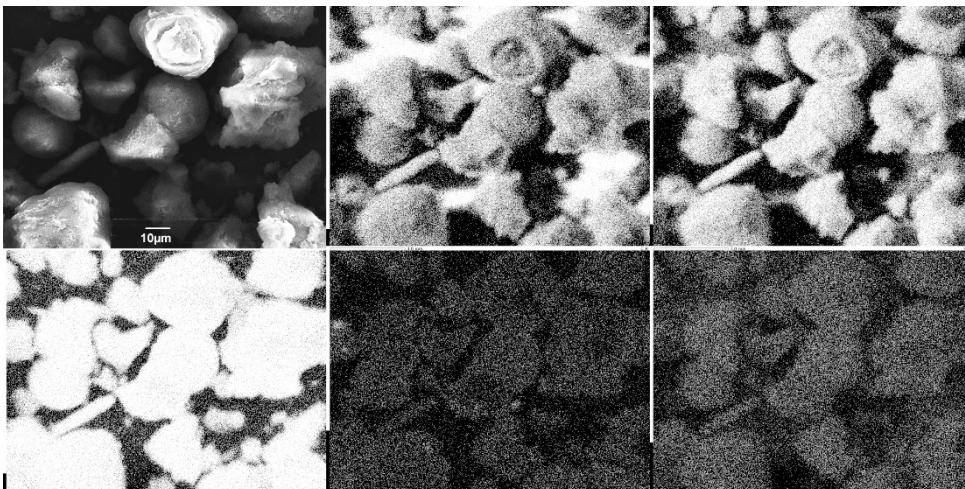


Abb. 8.388: REM- (oben links) & EDX-Aufnahme von VAl-BTEB-PMO (**70a**), 1000fache Vergrößerung. Kohlenstoff oben Mitte, Sauerstoff oben rechts, Silizium unten links, Vanadium unten Mitte, Aluminium unten rechts.

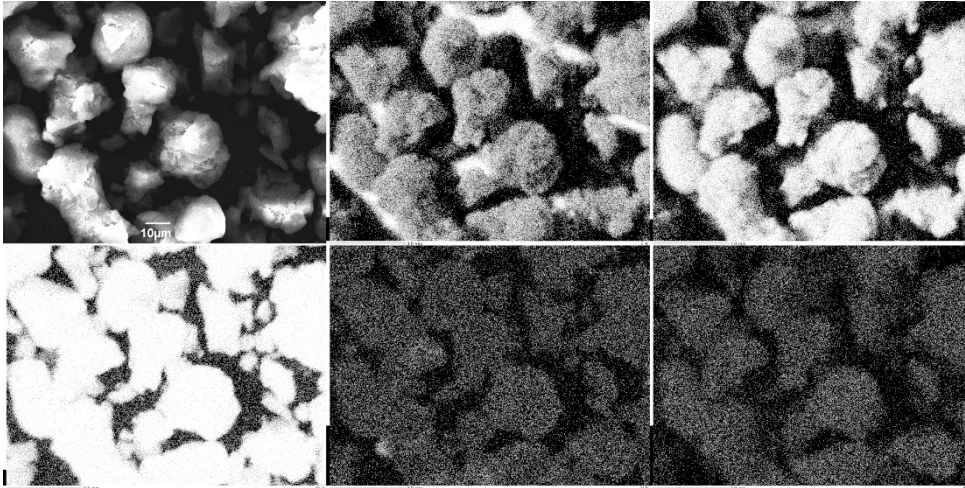


Abb. 8.389: REM- (oben links) & EDX-Aufnahme von VAl-BTEB-PMO (275) (**70b**), 1000fache Vergrößerung. Kohlenstoff oben Mitte, Sauerstoff oben rechts, Silizium unten links, Vanadium unten Mitte, Aluminium unten rechts.

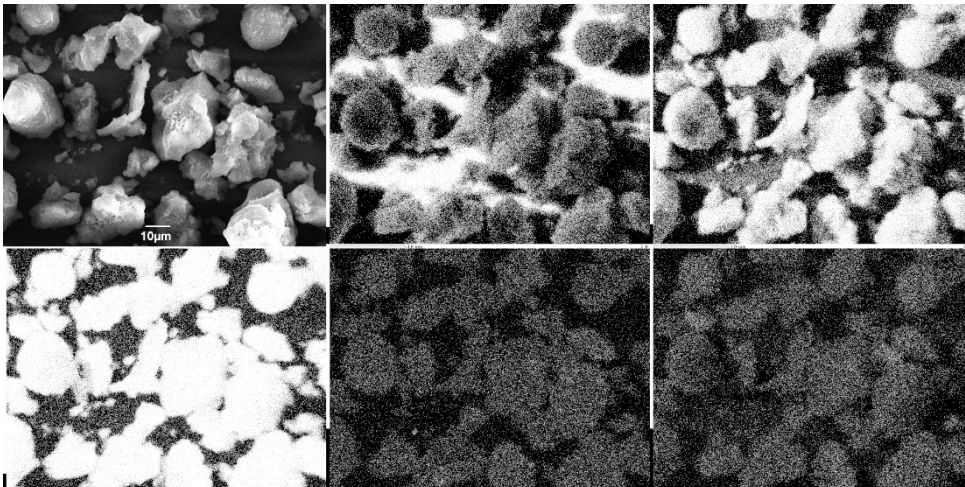


Abb. 8.390: REM- (oben links) & EDX-Aufnahme von VAl-BTEB-PMO (325) (**70c**), 1000fache Vergrößerung. Kohlenstoff oben Mitte, Sauerstoff oben rechts, Silizium unten links, Vanadium unten Mitte, Aluminium unten rechts.

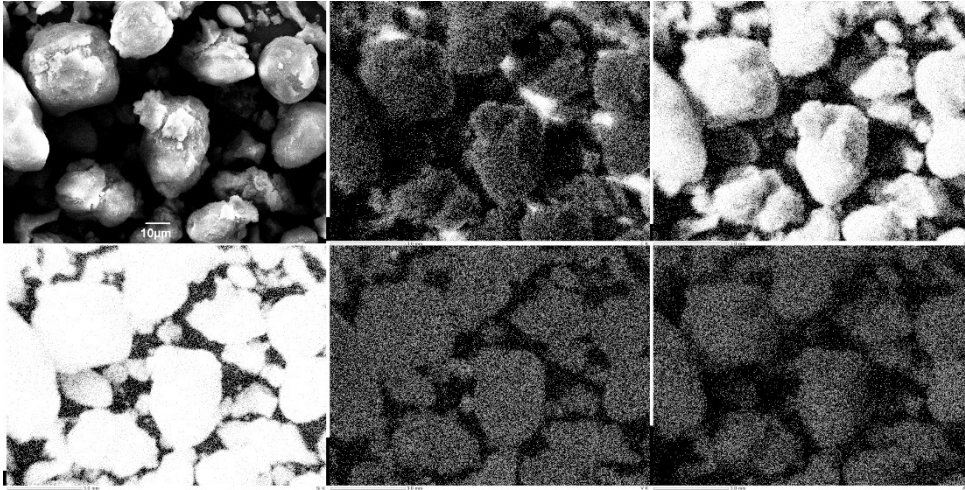


Abb. 8.391: REM- (oben links) & EDX-Aufnahme von VAl-BTEB-PMO (375) (**70d**), 1000fache Vergrößerung. Kohlenstoff oben Mitte, Sauerstoff oben rechts, Silizium unten links, Vanadium unten Mitte, Aluminium unten rechts.

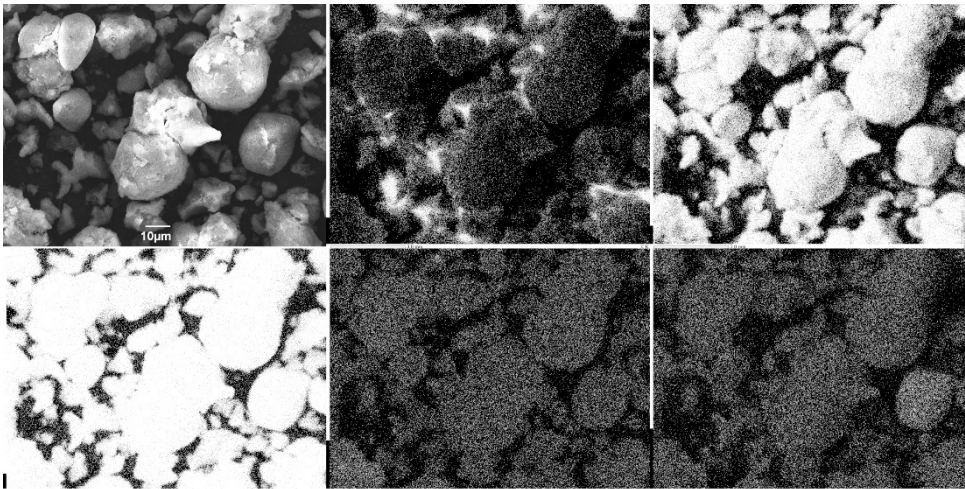


Abb. 8.392: REM- (oben links) & EDX-Aufnahme von VAl-BTEB-PMO (425) (**70e**), 1000fache Vergrößerung. Kohlenstoff oben Mitte, Sauerstoff oben rechts, Silizium unten links, Vanadium unten Mitte, Aluminium unten rechts.

### 8.10 Response Faktoren

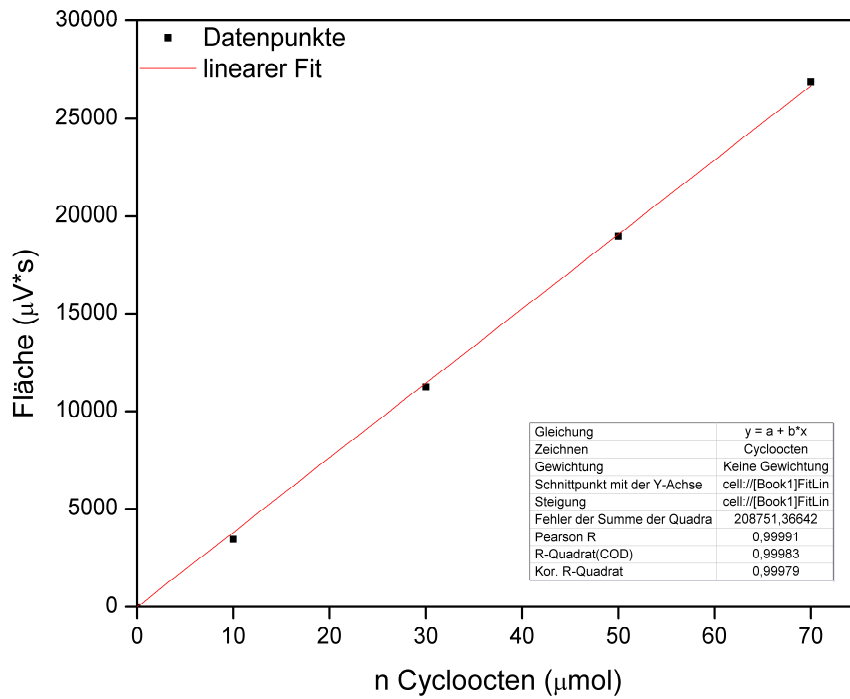


Abb. 8.393: Auftragung der GC-Werte bestimmter Stoffmengen von (Z)-Cycloocten zur Bestimmung des Response Faktors.

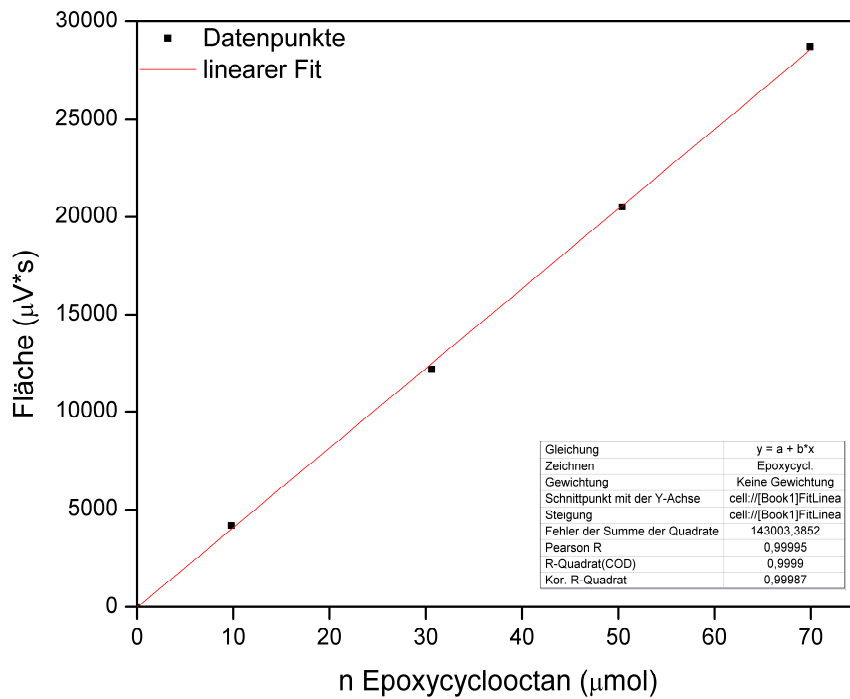


Abb. 8.394: Auftragung der GC-Werte bestimmter Stoffmengen von Epoxycyclooctan zur Bestimmung des Response Faktors.