

Experimental results

In this document the experimental data for each experiment is listed.
Table 1 gives an overview of the experimental conditions.

Table 1: An overview over the experimental conditions during catalytic partial oxidation of methane

| Exp. | Catalyst T_{calc} | Reduction | GHSV $[\text{L}_{\text{CH}_4}/\text{g}_{\text{cat}} \cdot \text{h}]$ | T_{furnace} [K] |
|------|-------------------------------|---------------------|---|-----------------------------|
| 1 | 1273 K | 973 K, 10 K/min, 2h | 75 | 573/798/1023 |
| 2 | 1273 K | 973 K, 10 K/min, 2h | 75 | 923/1023 |
| 3 | 1173 K | 973 K, 10 K/min, 2h | 75 | 623/773/923 |
| 4 | 1473 K | 973 K, 10 K/min, 2h | 75 | 673/823/923 |
| 5 | 1373 K | 973 K, 10 K/min, 2h | 75 | 923 |
| 6 | 1273 K | 973 K, 10 K/min, 2h | 75 | 923/1023/1123 |
| 7 | 1173 K | 973 K, 10 K/min, 2h | 75 | 923/1023/1123 |
| 8 | 1273 K | 973 K, 10 K/min, 2h | 75 | 923/1023/1123 |
| 9 | 1273 K | No | 75 | 923/1023 |
| 11 | 1423 K | 973 K, 10 K/min, 2h | 75 | 923/1023/1123 |
| 12 | 1373 K | 973 K, 10 K/min, 2h | 75 | 923/1023/1123 |
| 13 | 1473 K | 973 K, 10 K/min, 2h | 75 | 923/1023/1123 |
| 14 | 1273 K | No | 250 | 923/1023/1123 |
| 15 | 1273 K | No | 500 | 923/1023/1123/1023 |
| 16 | 1273 K | No | 400 | 1023 |
| 17 | 1273 K | 973 K, 10 K/min, 2h | 150/250/350/ 400/450/250 | 1023 |
| 18 | Monolith | 973 K, 10 K/min, 2h | 8000 $[\text{h}^{-1}]$ | 1023 |
| 19 | 1273 K | 973 K, 10 K/min, 2h | 75 | 1023 |

Experiment 1

Catalyst: $\text{Co/CeO}_2\text{--Al}_2\text{O}_3$ (1173 K)

$m_{\text{catalyst}} = 0.0985 \text{ g}$

$\text{GHSV} = 75 \text{ L}_{\text{CH}_4}/\text{g}_{\text{cat}} \cdot \text{h}$

Reduction: 50 mL/min 50 vol.% H_2 in N_2 , 10 K/min, 973 K, 2h

Table 2: Exp. 1. Feed gas

| Compound | V [mL/min (STP)] | y [-] | F [mol/s] |
|-----------------|---------------------|----------|--------------|
| CH ₄ | 123.1 | 0.3010 | 0.0848 |
| O ₂ | 60.0 | 0.1468 | 0.0413 |
| N ₂ | 223.3 | 0.5459 | 0.1538 |
| Total | | 1.0000 | 0.2817 |

Table 3: Exp. 1. Product data, T_{furnace} = 573 K

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 28.54852 | 0.2855 | | | | | |
| H ₂ | | | | | | 12.3 | |
| O ₂ | 14.43481 | 0.1443 | 0.1448 | 0.0403 | | | |
| N ₂ | 55.08103 | 0.5508 | 0.5527 | 0.1538 | | | |
| CH ₄ (TCD) | 30.04694 | 0.3005 | 0.3015 | 0.0839 | 0.3 | | |
| CO ₂ | 0.0947167 | 0.0009 | 0.0010 | 0.0003 | | 100.0 | |
| H ₂ O | | | | | | 87.7 | |
| F _{H₂} /F _{CO} | - | | | | | | |
| F _{H₂O} /F _{CO₂} | 5.9 | | | | | | |
| ε _C | 0.7 | | | | | | |

Table 4: Exp. 1. Product data, T_{furnace} = 798 K

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 23.9060 | 0.2391 | | | | | |
| H ₂ | 1.6019 | 0.0160 | 0.0168 | 0.0040 | | 7.1 | |
| N ₂ | 61.7869 | 0.6179 | 0.6498 | 0.1538 | | | |
| CO | 1.3995 | 0.0140 | 0.0147 | 0.0035 | | 20.4 | |
| CH ₄ (TCD) | 24.8346 | 0.2483 | 0.2612 | 0.0618 | 21.7 | | |
| CO ₂ | 5.4647 | 0.0546 | 0.0575 | 0.0136 | | 79.6 | |
| H ₂ O | | | | 0.0520 | | 92.9 | |
| F _{H₂} /F _{CO} | 1.1 | | | | | | |
| F _{H₂O} /F _{CO₂} | 3.8 | | | | | | |
| ε _C | 6.9 | | | | | | |

Table 5: Exp. 1. Product data, $T_{\text{furnace}} = 1023 \text{ K}$

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{\text{norm.}}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 23.6024 | 0.2360 | | | | | |
| H ₂ | 1.7768 | 0.0178 | 0.0187 | 0.0044 | | 7.9 | |
| N ₂ | 61.5946 | 0.6159 | 0.6498 | 0.1538 | | | |
| CO | 1.5650 | 0.0157 | 0.0165 | 0.0039 | | 22.5 | |
| CH ₄ (TCD) | 24.4741 | 0.2447 | 0.2582 | 0.0611 | 22.1 | | |
| CO ₂ | 5.3797 | 0.0538 | 0.0568 | 0.0134 | | 77.5 | |
| H ₂ O | | | | 0.0519 | | 92.1 | |
| $F_{\text{H}_2}/F_{\text{CO}}$ | 1.1 | | | | | | |
| $F_{\text{H}_2\text{O}}/F_{\text{CO}_2}$ | 3.9 | | | | | | |
| ε_{C} | 7.5 | | | | | | |

Table 6: Exp. 1. Product data, $T_{\text{furnace}} = 1173 \text{ K}$

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{\text{norm.}}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 22.5090 | 0.2251 | | | | | |
| H ₂ | 2.5921 | 0.0259 | 0.0276 | 0.0066 | | 11.2 | |
| N ₂ | 60.8096 | 0.6081 | 0.6472 | 0.1538 | | | |
| CO | 2.2889 | 0.0229 | 0.0244 | 0.0058 | | 31.6 | |
| CH ₄ (TCD) | 23.3119 | 0.2331 | 0.2481 | 0.0589 | 23.7 | | |
| CO ₂ | 4.9504 | 0.0495 | 0.0527 | 0.0125 | | 68.4 | |
| H ₂ O | | | | 0.0519 | | 88.8 | |
| $F_{\text{H}_2}/F_{\text{CO}}$ | 1.1 | | | | | | |
| $F_{\text{H}_2\text{O}}/F_{\text{CO}_2}$ | 4.1 | | | | | | |
| ε_{C} | 8.9 | | | | | | |

Experiment 2

Catalyst: Co/CeO₂–Al₂O₃ (1273 K)

$m_{\text{catalyst}} = 0.0915 \text{ g}$

GHSV = 75 L_{CH₄}/g_{cat}·h

Reduction: 50 mL/min 50 vol.% H₂ in N₂, 10 K/min, 973 K, 2h.

Table 7: Exp. 2. Feed gas

| Compound | V [mL/min (STP)] | y [-] | F [mmol/s] |
|-----------------|---------------------|----------|---------------|
| CH ₄ | 114.4 | 0.3007 | 0.0787 |
| O ₂ | 55.9 | 0.1469 | 0.0385 |
| N ₂ | 207.8 | 0.5462 | 0.1430 |
| Total | 380.4 | 1.0000 | 0.2619 |

Table 8: Exp. 2. Product data, T_{furnace} = 923 K

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 6.8795 | 0.0688 | | | | | |
| H ₂ | 26.0824 | 0.2608 | | 0.0898 | | 81.3 | 57.0 |
| N ₂ | 43.5416 | 0.4354 | 0.6542 | 0.1430 | | | |
| CO | 14.6288 | 0.1463 | 0.2198 | 0.0481 | | 92.2 | |
| CH ₄ (TCD) | 7.1430 | 0.0714 | 0.1073 | 0.0235 | 69.0 | | |
| CO ₂ | 1.2408 | 0.0124 | 0.0186 | 0.0041 | | 7.8 | |
| H ₂ O | | | | 0.0207 | | 18.7 | |
| F _{H₂} /F _{CO} | 1.9 | | | | | | |
| F _{H₂O} /F _{CO₂} | 5.1 | | | | | | |
| ε _C | 4.0 | | | | | | |

Table 9: Exp. 2. Product data, T_{furnace} = 1023 K, (2 analyses)

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 5.0887 | 0.0509 | | | | | |
| H ₂ | 28.8761 | 0.2888 | | 0.1041 | | 85.7 | 66.1 |
| N ₂ | 41.9862 | 0.4199 | 0.6533 | 0.1430 | | | |
| CO | 16.4539 | 0.1645 | 0.2560 | 0.0561 | | 96.9 | |
| CH ₄ (TCD) | 5.3027 | 0.0530 | 0.0825 | 0.0181 | 76.2 | | |
| CO ₂ | 0.5225 | 0.0052 | 0.0081 | 0.0018 | | 3.1 | |
| H ₂ O | | | | 0.0173 | | 14.3 | |
| F _{H₂} /F _{CO} | 1.9 | | | | | | |
| F _{H₂O} /F _{CO₂} | 9.7 | | | | | | |
| ε _C | 3.6 | | | | | | |

Table 10: Exp. 2. Temperature data

| $T_{\text{furnace}} = 650\text{ }^{\circ}\text{C}$ | | $T_{\text{furnace}} = 750\text{ }^{\circ}\text{C}$ | | $T_{\text{furnace}} = 850\text{ }^{\circ}\text{C}$ | |
|--|-------------------------------|--|-------------------------------|--|-------------------------------|
| $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] | $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] | $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] |

Experiment 3

Catalyst: $\text{Co/CeO}_2\text{--Al}_2\text{O}_3$ (1173 K)

$m_{\text{catalyst}} = 0.0820\text{ g}$

$\text{GHSV} = 75\text{ L}_{\text{CH}_4}/\text{g}_{\text{cat}}\cdot\text{h}$

Reduction: 50 mL/min 50 vol.% H_2 in N_2 , 10 K/min, 973 K, 2h.

Table 11: Exp. 3. Feed gas

| Compound | V [mL/min (STP)] | y [-] | F [mmol/s] |
|---------------|-----------------------|------------|-----------------|
| CH_4 | 102.5 | 0.3018 | 0.0706 |
| O_2 | 49.8 | 0.1466 | 0.0343 |
| N_2 | 185.2 | 0.5453 | 0.1275 |
| Total | 339.6 | 1.0000 | 0.2338 |

Table 12: Exp. 3. Product data, $T_{\text{furnace}} = 623\text{ K}$

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{\text{norm.}}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|-----------------|------------|------------|------------|
| CH_4 (FID) | 28.1945 | | | | | | |
| H_2 | | | | 0.0039 | | 55.7 | 2.8 |
| O_2 | 14.0695 | 0.1418 | 0.1379 | 0.0322 | 6.0 | | |
| N_2 | 55.6415 | 0.5609 | 0.5453 | 0.1275 | | | |
| CH_4 (TCD) | 29.2761 | 0.2951 | 0.2869 | 0.0671 | 0.7 | | |
| CO_2 | 0.2167 | 0.0022 | 0.0021 | 0.0005 | | 100.0 | |
| H_2O | | | | 0.0031 | | 44.3 | |
| $F_{\text{H}_2}/F_{\text{CO}}$ | - | | | | | | |
| $F_{\text{H}_2\text{O}}/F_{\text{CO}_2}$ | 6.2 | | | | | | |
| ε_{C} | 4.2 | | | | | | |

Table 13: Exp. 3. Product data, $T_{\text{furnace}} = 773 \text{ K}$

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{\text{norm.}}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 24.3884 | 0.2439 | | | | | |
| H ₂ | | | | -0.0065 | | - | - |
| N ₂ | 60.4596 | 0.6046 | 0.6565 | 0.1275 | | | |
| CO | 0.703987 | 0.0070 | 0.0076 | 0.0015 | | 10.6 | |
| CH ₄ (TCD) | 25.0215 | 0.2502 | 0.2717 | 0.0528 | 20.9 | | |
| CO ₂ | 5.9111 | 0.0591 | 0.0642 | 0.0125 | | 89.4 | |
| H ₂ O | | | | 0.0421 | | 118.3 | |
| $F_{\text{H}_2}/F_{\text{CO}}$ | - | | | | | | |
| $F_{\text{H}_2\text{O}}/F_{\text{CO}_2}$ | 3.4 | | | | | | |
| ε_{C} | 5.5 | | | | | | |

Table 14: Exp. 3. Product data, $T_{\text{furnace}} = 923 \text{ K}$

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{\text{norm.}}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 23.8908 | 0.2389 | | | | | |
| H ₂ | 1.5216 | 0.0152 | | 0.0032 | | 8.4 | 2.3 |
| N ₂ | 60.8448 | 0.6084 | 0.6496 | 0.1275 | | | |
| CO | 1.0853 | 0.0109 | 0.0116 | 0.0023 | | 12.9 | |
| CH ₄ (TCD) | 24.4118 | 0.2441 | 0.2606 | 0.0512 | 25.6 | | |
| CO ₂ | 7.3235 | 0.0732 | 0.0782 | 0.0153 | | 87.1 | |
| H ₂ O | | | | 0.0356 | | 91.6 | |
| $F_{\text{H}_2}/F_{\text{CO}}$ | 1.4 | | | | | | |
| $F_{\text{H}_2\text{O}}/F_{\text{CO}_2}$ | 2.3 | | | | | | |
| ε_{C} | 2.6 | | | | | | |

Table 15: Exp. 3. Temperature data

| $T_{\text{furnace}} = 350\text{ }^{\circ}\text{C}$ | | $T_{\text{furnace}} = 500\text{ }^{\circ}\text{C}$ | | $T_{\text{furnace}} = 650\text{ }^{\circ}\text{C}$ | |
|--|-------------------------------|--|-------------------------------|--|-------------------------------|
| $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] | $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] | $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] |
| -3.0 | 349.9 | -3.0 | 506.2 | -3.5 | 600.6 |
| -2.5 | 350.8 | -2.5 | 509.2 | -3.0 | 602.8 |
| -2.0 | 352.2 | -2.0 | 515.2 | -2.5 | 606.0 |
| -1.5 | 353.3 | -1.5 | 529.0 | -2.0 | 610.4 |
| -1.0 | 355.9 | -1.0 | 552.0 | -1.5 | 620.3 |
| -0.5 | 360.8 | -0.5 | 615.9 | -1.0 | 643.3 |
| -0.2 | 364.5 | -0.2 | 694.8 | -0.5 | 684.0 |
| 0.0 | 366.1 | -0.1 | 706.7 | -0.3 | 712.0 |
| 0.2 | 365.5 | 0.0 | 737.6 | -0.2 | 747.6 |
| 0.5 | 363.5 | 0.1 | 747.0 | -0.1 | 761.0 |
| 1.0 | 359.8 | 0.2 | 741.6 | 0.0 | 797.0 |
| 1.5 | 357.8 | 0.3 | 696.0 | 0.1 | 806.0 |
| 2.0 | 356.8 | 0.5 | 683.6 | 0.2 | 788.0 |
| 2.5 | 355.8 | 1.0 | 585.1 | 0.4 | 757.0 |
| 3.0 | 354.0 | 1.5 | 566.5 | 0.5 | 757.0 |
| 3.5 | 352.5 | 2.0 | 550.3 | 1.0 | 674.0 |
| 4.0 | 351.4 | 2.5 | 533.3 | 1.5 | 647.0 |
| 4.5 | 349.8 | 3.0 | 520.8 | 2.0 | 630.5 |
| | | 3.5 | 514.7 | 2.5 | 620.6 |
| | | 4.0 | 508.0 | 3.0 | 613.0 |
| | | 4.5 | 502.7 | 3.5 | 606.3 |
| | | | | 4.0 | 603.4 |
| | | | | 4.5 | 600.0 |

Experiment 4

Catalyst: $\text{Co/CeO}_2\text{--Al}_2\text{O}_3$ (1473 K)

$m_{\text{catalyst}} = 0.0955\text{ g}$

$\text{GHSV} = 75\text{ L}_{\text{CH}_4}/\text{g}_{\text{cat}}\cdot\text{h}$

Reduction: 50 mL/min 50 vol.% H_2 in N_2 , 10 K/min, 973 K, 2h

Table 16: Exp. 4. Feed gas

| Compound | V [mL/min (STP)] | y [-] | F [mmol/s] |
|-----------------|---------------------|----------|---------------|
| CH ₄ | 119.4 | 0.3011 | 0.0822 |
| O ₂ | 58.2 | 0.1468 | 0.0401 |
| N ₂ | 216.4 | 0.5458 | 0.1490 |
| Total | 396.4 | 1.0000 | 0.2730 |

Table 17: Exp. 4. Product data, T_{furnace} = 673 K

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 28.2439 | 0.2824 | | | | | |
| H ₂ | | | | -0.0020 | | - | - |
| O ₂ | 13.2690 | 0.1327 | 0.1355 | 0.0361 | 9.8 | | |
| N ₂ | 54.7012 | 0.5470 | 0.5586 | 0.1490 | | | |
| CH ₄ (TCD) | 29.5247 | 0.2952 | 0.3015 | 0.0804 | 1.4 | - | |
| CO ₂ | 0.4248 | 0.0042 | 0.0043 | 0.0012 | | 100 | |
| H ₂ O | | | | 0.0055 | | 155.5 | |
| F _{H₂} /F _{CO} | - | | | | | | |
| F _{H₂O} /F _{CO₂} | 4.8 | | | | | | |
| ε _C | 0.8 | | | | | | |

Table 18: Exp. 4. Product data, T_{furnace} = 823 K

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 27.6996 | 0.2770 | | | | | |
| H ₂ | | | | -0.0066 | | - | - |
| O ₂ | 9.7005 | 0.0970 | 0.1000 | 0.0256 | 36.2 | | |
| N ₂ | 56.5232 | 0.5652 | 0.5824 | 0.1490 | | | |
| CH ₄ (TCD) | 28.8856 | 0.2889 | 0.2976 | 0.0761 | 6.3 | | |
| CO ₂ | 1.9434 | 0.0194 | 0.0200 | 0.0051 | | 100.0 | |
| H ₂ O | | | | 0.0187 | | 154.8 | |
| F _{H₂} /F _{CO} | - | | | | | | |
| F _{H₂O} /F _{CO₂} | 3.7 | | | | | | |
| ε _C | 1.1 | | | | | | |

Table 19: Exp. 4. Product data, $T_{\text{furnace}} = 923 \text{ K}$

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{\text{norm.}}$ [-] | \mathbf{F} [mmol/s] | \mathbf{X} [%] | \mathbf{S} [%] | \mathbf{Y} [%] |
|--|----------------------------|------------------------|---------------------------|--------------------------|---------------------|---------------------|---------------------|
| CH ₄ (FID) | 26.6912 | 0.2669 | | | | | |
| H ₂ | 0.1414 | 0.0014 | 0.0015 | 0.0004 | | 1.2 | 0.3 |
| O ₂ | 4.0852 | 0.0409 | 0.0426 | 0.0116 | 80 | | |
| N ₂ | 59.4204 | 0.5942 | 0.6200 | 0.1692 | | | |
| CO | 0.0867 | 0.0009 | 0.0009 | 0.0002 | | 2.0 | |
| CH ₄ (TCD) | 27.7898 | 0.2779 | 0.2900 | 0.0791 | 13.7 | | |
| CO ₂ | 4.3134 | 0.0431 | 0.0450 | 0.0123 | | 90.0 | |
| H ₂ O | | | | 0.0320 | | 98.8 | |
| $F_{\text{H}_2}/F_{\text{CO}}$ | 1.6 | | | | | | |
| $F_{\text{H}_2\text{O}}/F_{\text{CO}_2}$ | 2.6 | | | | | | |
| ε_{C} | 1.8 | | | | | | |

Table 20: Exp. 4. Temperature data

| $T_{\text{furnace}} = 400\text{ }^{\circ}\text{C}$ | | $T_{\text{furnace}} = 550\text{ }^{\circ}\text{C}$ | |
|--|-------------------------------|--|-------------------------------|
| $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] | $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] |
| -4.2 | 386.5 | -4.2 | 537.3 |
| -3.7 | 388.7 | -3.7 | 540.9 |
| -3.2 | 390.4 | -3.2 | 543.7 |
| -2.7 | 393.0 | -2.7 | 546.9 |
| -2.2 | 395.0 | -2.2 | 549.5 |
| -1.7 | 396.7 | -1.7 | 552.0 |
| -1.2 | 399.9 | -1.2 | 555.6 |
| -0.7 | 403.3 | -1.0 | 556.7 |
| -0.2 | 415.6 | -0.7 | 561.3 |
| 0.1 | 424.5 | -0.2 | 580.0 |
| 0.2 | 424.7 | 0.1 | 587.3 |
| 0.3 | 427.0 | 0.3 | 598.7 |
| 0.5 | 424.6 | 0.5 | 592.9 |
| 0.8 | 418.3 | 0.8 | 582.4 |
| 1.3 | 412.3 | 1.3 | 569.6 |
| 1.8 | 409.2 | 1.8 | 562.3 |
| 2.3 | 407.2 | 2.3 | 559.0 |
| 2.8 | 404.8 | 2.8 | 557.0 |
| 3.3 | 403.4 | 3.8 | 553.0 |
| 3.8 | 402.6 | | |

Experiment 5

Catalyst: $\text{Co/CeO}_2\text{--Al}_2\text{O}_3$ (1373 K)

$m_{\text{catalyst}} = 0.1085\text{ g}$

$\text{GHSV} = 75\text{ L}_{\text{CH}_4}/\text{g}_{\text{cat}}\cdot\text{h}$

Reduction: 50 mL/min 50 vol.% H_2 in N_2 , 10 K/min, 973 K, 2h

Table 21: Exp. 5. Feed gas

| Compound | V [mL/min (STP)] | y [-] | F [mmol/s] |
|-----------------|---------------------|----------|---------------|
| CH ₄ | 135.5 | 0.2958 | 0.0933 |
| O ₂ | 67.8 | 0.1479 | 0.0466 |
| N ₂ | 252.0 | 0.5500 | 0.1735 |
| Total | 458.1 | 1.0000 | 0.3154 |

Table 22: Exp. 5. Product data, T_{furnace} = 923 K

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 23.1104 | 0.2311 | | | | | |
| H ₂ | 1.6622 | 0.0166 | 0.0180 | 0.0048 | | 7.7 | 2.6 |
| N ₂ | 60.1900 | 0.6019 | 0.6501 | 0.1735 | | | |
| CO | 1.1465 | 0.0115 | 0.0124 | 0.0033 | | 16.8 | |
| CH ₄ (TCD) | 23.8933 | 0.2389 | 0.2581 | 0.0689 | 22.2 | | |
| CO ₂ | 5.6897 | 0.0569 | 0.0615 | 0.0164 | | 83.2 | |
| H ₂ O | | | | 0.0572 | | 92.3 | |
| F _{H₂} /F _{CO} | 1.4 | | | | | | |
| F _{H₂O} /F _{CO₂} | 3.5 | | | | | | |
| ε _C | 5.1 | | | | | | |

Experiment 6

Catalyst: Co/CeO₂–Al₂O₃ (1273 K)

m_{catalyst} = 0.0936 g

GHSV = 75 L_{CH₄}/g_{cat}·h

Reduction: 50 mL/min 50 vol.% H₂ in N₂, 10 K/min, 973 K, 2h

Table 23: Exp. 6. Feed gas

| Compound | V [mL/min (STP)] | y [-] | F [mmol/s] |
|-----------------|---------------------|----------|---------------|
| CH ₄ | 117.0 | 0.2958 | 0.0806 |
| O ₂ | 58.5 | 0.1479 | 0.0403 |
| N ₂ | 217.6 | 0.5500 | 0.1498 |
| Total | 395.6 | 1.0000 | 0.2724 |

Table 24: Exp. 6. Product data, $T_{\text{furnace}} = 923 \text{ K}$

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{\text{norm.}}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 6.9452 | 0.0695 | | | | | |
| H ₂ | 25.1032 | 0.2510 | | 0.0891 | | 79.7 | 55.3 |
| N ₂ | 43.9294 | 0.4393 | 0.6595 | 0.1498 | | | |
| CO | 13.9534 | 0.1395 | 0.2095 | 0.0476 | | 90.3 | |
| CH ₄ (TCD) | 7.2277 | 0.0723 | 0.1085 | 0.0246 | 68.1 | | |
| CO ₂ | 1.5036 | 0.0150 | 0.0226 | 0.0051 | | 9.7 | |
| H ₂ O | | | | 0.0227 | | 20.3 | |
| $F_{\text{H}_2}/F_{\text{CO}}$ | 1.9 | | | | | | |
| $F_{\text{H}_2\text{O}}/F_{\text{CO}_2}$ | 4.4 | | | | | | |
| ε_{C} | 4.0 | | | | | | |

Table 25: Exp. 6. Product data, $T_{\text{furnace}} = 1023 \text{ K}$

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{\text{norm.}}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 5.5711 | 0.0557 | | | | | |
| H ₂ | 27.5647 | 0.2756 | | 0.1009 | | 83.5 | 62.6 |
| N ₂ | 42.9165 | 0.4292 | 0.6585 | 0.1498 | | | |
| CO | 15.6373 | 0.1564 | 0.2399 | 0.0546 | | 94.8 | |
| CH ₄ (TCD) | 5.7636 | 0.0576 | 0.0884 | 0.0201 | 74.1 | | |
| CO ₂ | 0.8581 | 0.0086 | 0.0132 | 0.0030 | | 5.2 | |
| H ₂ O | | | | 0.0200 | | 16.5 | |
| $F_{\text{H}_2}/F_{\text{CO}}$ | 1.8 | | | | | | |
| $F_{\text{H}_2\text{O}}/F_{\text{CO}_2}$ | 6.7 | | | | | | |
| ε_{C} | 3.6 | | | | | | |

Table 26: Exp. 6. Product data, $T_{\text{furnace}} = 1123 \text{ K}$

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{\text{norm.}}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 4.1391 | | | | | | |
| H ₂ | 30.1935 | | | 0.1134 | | 87.0 | 70.4 |
| N ₂ | 42.0717 | | 0.6580 | 0.1498 | | | |
| CO | 17.2125 | | 0.2692 | 0.0613 | | 98.1 | |
| CH ₄ (TCD) | 4.3258 | | 0.0677 | 0.0154 | 80.2 | | |
| CO ₂ | 0.3308 | | 0.0052 | 0.0012 | | 1.9 | |
| H ₂ O | | | | 0.0169 | | 13.0 | |
| $F_{\text{H}_2}/F_{\text{CO}}$ | 1.8 | | | | | | |
| $F_{\text{H}_2\text{O}}/F_{\text{CO}_2}$ | 14.4 | | | | | | |
| ε_{C} | 3.3 | | | | | | |

Table 27: Exp. 6. Temperature data

| $T_{\text{furnace}} = 650\text{ }^{\circ}\text{C}$ | | $T_{\text{furnace}} = 750\text{ }^{\circ}\text{C}$ | | $T_{\text{furnace}} = 850\text{ }^{\circ}\text{C}$ | |
|--|-------------------------------|--|-------------------------------|--|-------------------------------|
| $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] | $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] | $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] |
| -1.8 | 667 | -1.8 | 776 | -4.8 | 868 |
| -1.3 | 670 | -1.3 | 777 | -4.3 | 875 |
| -0.8 | 677 | -0.8 | 779 | -3.8 | 880 |
| -0.3 | 700 | -0.3 | 781 | -3.3 | 880 |
| -0.1 | 710 | -0.1 | 778 | -2.8 | 880 |
| 0.0 | 713 | 0.0 | 775 | -2.3 | 880 |
| 0.2 | 704 | 0.1 | 766 | -1.8 | 878 |
| 0.7 | 681 | 0.2 | 757 | -1.3 | 878 |
| 1.2 | 670 | 0.5 | 745 | -0.8 | 878 |
| 1.7 | 666 | 0.7 | 746 | -0.3 | 874 |
| 2.2 | 662 | 0.8 | 748 | -0.2 | 869 |
| 2.7 | 660 | 1.0 | 751 | -0.1 | 871 |
| 3.2 | 658 | 1.2 | 754 | 0.1 | 839 |
| | | 1.7 | 757 | 0.2 | 834 |
| | | 2.2 | 757 | 0.4 | 818 |
| | | 2.7 | 758 | 0.5 | 817 |
| | | | | 0.7 | 822 |
| | | | | 0.9 | 833 |
| | | | | 1.2 | 840 |
| | | | | 1.7 | 851 |
| | | | | 2.2 | 855 |
| | | | | 2.7 | 857 |
| | | | | 3.2 | 857 |

Experiment 7

Catalyst: $\text{Co/CeO}_2\text{--Al}_2\text{O}_3$ (1173 K)

$m_{\text{catalyst}} = 0.1016\text{ g}$

$\text{GHSV} = 75\text{ L}_{\text{CH}_4}/\text{g}_{\text{cat}}\cdot\text{h}$

Reduction: 50 mL/min 50 vol.% H_2 in N_2 , 10 K/min, 973 K, 2h

Table 28: Exp. 7. Feed gas

| Compound | V [mL/min (STP)] | y [-] | F [mmol/s] |
|-----------------|---------------------|----------|---------------|
| CH ₄ | 127.0 | 0.2958 | 0.0874 |
| O ₂ | 63.5 | 0.1479 | 0.0437 |
| N ₂ | 236.2 | 0.5500 | 0.1626 |
| Total | 429.4 | 1.0000 | 0.2956 |

Table 29: Exp. 7. Product data, T_{furnace} = 923 K

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 6.2668 | | | | | | |
| H ₂ | 26.4901 | | | 0.1031 | | 81.6 | 59.0 |
| N ₂ | 43.4140 | 0.4341 | 0.6593 | 0.1626 | | | |
| CO | 14.7596 | 0.1476 | 0.2241 | 0.0553 | | 92.5 | |
| CH ₄ (TCD) | 6.4840 | 0.0648 | 0.0985 | 0.0243 | 71.1 | | |
| CO ₂ | 1.1956 | 0.0120 | 0.0182 | 0.0045 | | 7.5 | |
| H ₂ O | | | | 0.0232 | | 18.4 | |
| F _{H₂} /F _{CO} | 1.9 | | | | | | |
| F _{H₂O} /F _{CO₂} | 5.2 | | | | | | |
| ε _C | 3.9 | | | | | | |

Table 30: Exp. 7. Product data, T_{furnace} = 1023 K

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 4.4867 | 0.0449 | | | | | |
| H ₂ | 29.4058 | 0.2941 | | 0.1196 | | 86.1 | 68.4078 |
| N ₂ | 41.8423 | 0.4184 | 0.6584 | 0.1626 | | | |
| CO | 16.6102 | 0.1661 | 0.2614 | 0.0645 | | 97.3 | |
| CH ₄ (TCD) | 4.6314 | 0.0463 | 0.0729 | 0.0180 | 78.7 | | |
| CO ₂ | 0.4684 | 0.0047 | 0.0074 | 0.0018 | | 2.7 | |
| H ₂ O | | | | 0.0193 | | 13.9 | |
| F _{H₂} /F _{CO} | 1.9 | | | | | | |
| F _{H₂O} /F _{CO₂} | 10.6 | | | | | | |
| ε _C | 3.5 | | | | | | |

Table 31: Exp. 7. Product data, $T_{\text{furnace}} = 1123 \text{ K}$

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{\text{norm.}}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 3.4414 | 0.0344 | | | | | |
| H ₂ | 31.3216 | 0.3132 | | 0.1301 | | 88.7 | 74.4 |
| N ₂ | 41.0886 | 0.4109 | 0.6580 | 0.1626 | | | |
| CO | 17.6576 | 0.1766 | 0.2828 | 0.0699 | | 99.3 | |
| CH ₄ (TCD) | 3.5694 | 0.0357 | 0.0572 | 0.0141 | 83.3 | | |
| CO ₂ | 0.1255 | 0.0013 | 0.0020 | 0.0005 | | 0.7 | |
| H ₂ O | | | | 0.0166 | | 11.3 | |
| $F_{\text{H}_2}/F_{\text{CO}}$ | 1.9 | | | | | | |
| $F_{\text{H}_2\text{O}}/F_{\text{CO}_2}$ | 33.4 | | | | | | |
| ε_{C} | 3.4 | | | | | | |

Table 32: Exp. 7. Temperature data

| $T_{\text{furnace}} = 650\text{ }^{\circ}\text{C}$ | | $T_{\text{furnace}} = 750\text{ }^{\circ}\text{C}$ | | $T_{\text{furnace}} = 850\text{ }^{\circ}\text{C}$ | |
|--|-------------------------------|--|-------------------------------|--|-------------------------------|
| $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] | $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] | $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] |
| -4.8 | 676.0 | -5.8 | 771.9 | -5.8 | 869.8 |
| -4.3 | 678.0 | -5.3 | 773.0 | -5.3 | 871.4 |
| -3.8 | 678.8 | -4.8 | 774.0 | -4.8 | 872.5 |
| -3.3 | 679.0 | -4.3 | 775.0 | -4.3 | 874.0 |
| -2.8 | 679.8 | -3.8 | 776.0 | -3.8 | 875.2 |
| -2.3 | 680.3 | -3.3 | 777.0 | -3.3 | 876.0 |
| -1.8 | 681.3 | -2.8 | 777.5 | -2.8 | 876.3 |
| -1.3 | 685.0 | -2.3 | 778.2 | -2.3 | 876.6 |
| -0.8 | 692.6 | -1.8 | 779.0 | -1.8 | 877.2 |
| -0.6 | 699.0 | -1.3 | 780.5 | -1.3 | 877.0 |
| -0.5 | 706.0 | -0.8 | 784.0 | -0.8 | 877.0 |
| -0.3 | 716.8 | -0.6 | 786.4 | -0.6 | 877.8 |
| -0.1 | 725.5 | -0.3 | 792.4 | -0.3 | 878.6 |
| 0.0 | 728.2 | -0.1 | 796.0 | -0.1 | 875.4 |
| 0.2 | 718.2 | 0.1 | 790.0 | 0.2 | 862.0 |
| 0.3 | 708.6 | 0.5 | 771.0 | 0.3 | 854.0 |
| 0.4 | 703.2 | 0.7 | 766.5 | 0.4 | 851.5 |
| 0.5 | 693.4 | 1.2 | 764.8 | 0.5 | 849.5 |
| 0.7 | 688.2 | 1.7 | 763.7 | 0.6 | 849.0 |
| 1.2 | 674.7 | 2.2 | 760.7 | 0.7 | 851.5 |
| 1.7 | 670.7 | 2.7 | 758.0 | 0.9 | 854.0 |
| 2.2 | 664.8 | 3.2 | 755.5 | 1.2 | 857.4 |
| 2.7 | 661.3 | 3.7 | 751.5 | 1.7 | 860.0 |
| 3.2 | 657.6 | 4.2 | 748.3 | 2.2 | 859.0 |
| | | | | 2.7 | 857.0 |
| | | | | 3.2 | 854.0 |
| | | | | 4.2 | 850.0 |

Experiment 8

Catalyst: $\text{Co/CeO}_2\text{--Al}_2\text{O}_3$ (1273 K)

$m_{\text{catalyst}} = 0.0990\text{ g}$

$\text{GHSV} = 75\text{ L}_{\text{CH}_4}/\text{g}_{\text{cat}}\cdot\text{h}$

Reduction: 50 mL/min 50 vol.% H_2 in N_2 , 10 K/min, 973 K, 2h

Table 33: Exp. 8. Feed gas

| Compound | V [mL/min (STP)] | y [-] | F [mmol/s] |
|-----------------|---------------------|----------|---------------|
| CH ₄ | 123.8 | 0.2958 | 0.0852 |
| O ₂ | 61.9 | 0.1479 | 0.0426 |
| N ₂ | 230.1 | 0.5500 | 0.1584 |
| Total | 418.4 | 1.0000 | 0.2881 |

Table 34: Exp. 8. Product data, T_{furnace} = 923 K

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 5.8532 | 0.0585 | | | | | |
| H ₂ | 26.8539 | 0.2685 | | 0.1036 | | 82.7 | 60.8 |
| N ₂ | 42.5829 | 0.4258 | 0.6589 | 0.1584 | | | |
| CO | 14.9109 | 0.1491 | 0.2307 | 0.0555 | | 93.3 | |
| CH ₄ (TCD) | 6.0558 | 0.0606 | 0.0937 | 0.0225 | 72.5 | | |
| CO ₂ | 1.0761 | 0.0108 | 0.0167 | 0.0040 | | 6.7 | |
| H ₂ O | | | | 0.0217 | | 17.3 | |
| F _{H₂} /F _{CO} | 1.9 | | | | | | |
| F _{H₂O} /F _{CO₂} | 5.4 | | | | | | |
| ε _C | 3.7 | | | | | | |

Table 35: Exp. 8. Product data, T_{furnace} = 1023 K

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 4.1392 | 0.0414 | | | | | |
| H ₂ | 30.0136 | 0.3001 | | 0.1197 | | 87.0 | 70.2 |
| N ₂ | 41.4887 | 0.4149 | 0.6582 | 0.1584 | | | |
| CO | 16.8765 | 0.1688 | 0.2677 | 0.0644 | | 97.8 | |
| CH ₄ (TCD) | 4.2971 | 0.0430 | 0.0682 | 0.0164 | 80.1 | | |
| CO ₂ | 0.3735 | 0.0037 | 0.0059 | 0.0014 | | 2.2 | |
| H ₂ O | | | | 0.0179 | | 13.0 | |
| F _{H₂} /F _{CO} | 1.9 | | | | | | |
| F _{H₂O} /F _{CO₂} | 12.6 | | | | | | |
| ε _C | 3.4 | | | | | | |

Table 36: Exp. 8. Product data, $T_{\text{furnace}} = 1123 \text{ K}$

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{\text{norm.}}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 3.2316 | | | | | | |
| H ₂ | 31.7275 | | | 0.1289 | | 89.3 | 75.6 |
| N ₂ | 40.7684 | | 0.6577 | 0.1584 | | | |
| CO | 17.8063 | | 0.2873 | 0.0692 | | 99.6 | |
| CH ₄ (TCD) | 3.3484 | | 0.0540 | 0.0130 | 84.2 | | |
| CO ₂ | 0.0630 | | 0.0010 | 0.0002 | | 0.4 | |
| H ₂ O | | | | 0.0155 | | 10.7 | |
| $F_{\text{H}_2}/F_{\text{CO}}$ | 1.9 | | | | | | |
| $F_{\text{H}_2\text{O}}/F_{\text{CO}_2}$ | 63.3 | | | | | | |
| ε_{C} | 3.2 | | | | | | |

Table 37: Exp. 8. Temperature data

| $T_{\text{furnace}} = 650\text{ }^{\circ}\text{C}$ | | $T_{\text{furnace}} = 750\text{ }^{\circ}\text{C}$ | | $T_{\text{furnace}} = 850\text{ }^{\circ}\text{C}$ | |
|--|-------------------------------|--|-------------------------------|--|-------------------------------|
| $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] | $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] | $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] |
| -3.4 | 664.0 | -3.4 | 760.0 | -3.4 | 856.7 |
| -2.9 | 665.0 | -2.9 | 761.5 | -2.9 | 858.2 |
| -2.4 | 666.5 | -2.4 | 762.8 | -2.4 | 859.8 |
| -1.9 | 668.3 | -1.9 | 764.0 | -1.9 | 860.4 |
| -1.4 | 671.3 | -1.4 | 765.0 | -1.4 | 861.2 |
| -0.9 | 678.5 | -0.9 | 767.5 | -0.9 | 862.2 |
| -0.7 | 689.3 | -0.4 | 779.0 | -0.6 | 863.7 |
| -0.4 | 703.5 | -0.2 | 786.0 | -0.4 | 866.0 |
| -0.3 | 706.5 | -0.1 | 788.5 | -0.3 | 867.0 |
| -0.1 | 719.0 | 0.0 | 790.3 | -0.1 | 868.0 |
| 0.0 | 726.0 | 0.1 | 786.5 | 0.0 | 866.0 |
| 0.1 | 729.0 | 0.2 | 782.3 | 0.1 | 862.0 |
| 0.3 | 707.2 | 0.3 | 770.2 | 0.2 | 858.0 |
| 0.6 | 690.0 | 0.5 | 767.0 | 0.4 | 846.0 |
| 1.1 | 673.4 | 0.6 | 766.0 | 0.5 | 847.0 |
| 1.6 | 668.0 | 1.1 | 760.7 | 0.6 | 848.0 |
| 2.1 | 665.0 | 1.6 | 760.2 | 1.1 | 852.8 |
| 2.6 | 661.6 | 2.1 | 759.0 | 1.6 | 855.9 |
| 3.1 | 659.0 | 2.6 | 757.5 | 2.1 | 855.6 |
| 3.6 | 657.0 | 3.1 | 755.5 | 2.6 | 855.0 |
| 4.1 | 654.3 | 3.6 | 754.0 | 3.1 | 854.3 |
| 4.6 | 651.5 | 4.1 | 751.5 | 3.6 | 852.0 |
| | | 4.6 | 750.0 | 4.1 | 850.0 |

Experiment 9

Catalyst: $\text{Co/CeO}_2\text{--Al}_2\text{O}_3$ (1273 K)

$m_{\text{catalyst}} = 0.0977\text{ g}$

$\text{GHSV} = 75\text{ L}_{\text{CH}_4}/\text{g}_{\text{cat}}\cdot\text{h}$

No reduction

Table 38: Exp. 9. Feed gas

| Compound | V [mL/min (STP)] | y [-] | F [mmol/s] |
|-----------------|---------------------|----------|---------------|
| CH ₄ | 122.1 | 0.2958 | 0.0841 |
| O ₂ | 61.1 | 0.1479 | 0.0420 |
| N ₂ | 227.1 | 0.5500 | 0.1564 |
| Total | 412.9 | 1.0000 | 0.2843 |

Table 39: Exp. 9. Product data, T_{furnace} = 923 K

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 22.4295 | 0.2243 | | | | | |
| H ₂ | 2.2853 | 0.0229 | 0.0248 | 0.0060 | | 10.5 | 3.6 |
| N ₂ | 59.4908 | 0.5949 | 0.6457 | 0.1564 | | | |
| CO | 2.0085 | 0.0201 | 0.0218 | 0.0053 | | 27.6 | |
| CH ₄ (TCD) | 23.0762 | 0.2308 | 0.2505 | 0.0606 | 24.0 | | |
| CO ₂ | 5.2717 | 0.0527 | 0.0572 | 0.0139 | | 72.4 | |
| H ₂ O | | | | 0.0511 | | 89.5 | |
| F _{H₂} /F _{CO} | 1.1 | | | | | | |
| F _{H₂O} /F _{CO₂} | 3.7 | | | | | | |
| ε _C | 5.1 | | | | | | |

Table 40: Exp. 9. Product data, T_{furnace} = 1023 K

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 22.2832 | | | | | | |
| H ₂ | 2.4485 | 0.024484767 | 0.0265 | 0.0064 | | 11.1 | 3.8 |
| N ₂ | 59.7620 | 0.597620167 | 0.6464 | 0.1564 | | | |
| CO | 2.2679 | 0.022678533 | 0.0245 | 0.0059 | | 30.7 | |
| CH ₄ (TCD) | 22.8401 | 0.228401067 | 0.2471 | 0.0598 | 24.5 | | |
| CO ₂ | 5.1310 | 0.051309867 | 0.0555 | 0.0134 | | 69.3 | |
| H ₂ O | | | | 0.0513 | | 88.9 | |
| F _{H₂} /F _{CO} | 1.1 | | | | | | |
| F _{H₂O} /F _{CO₂} | 3.7 | | | | | | |
| ε _C | 5.1 | | | | | | |

Table 41: Exp. 9. Temperature data

| $T_{\text{furnace}} = 650\text{ }^{\circ}\text{C}$ | | $T_{\text{furnace}} = 750\text{ }^{\circ}\text{C}$ | |
|--|-------------------------------|--|-------------------------------|
| $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] | $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] |
| -3.8 | 664.2 | -3.8 | 763.3 |
| -3.3 | 665.2 | -3.3 | 765.2 |
| -2.8 | 668.5 | -2.8 | 766.9 |
| -2.3 | 671.5 | -2.3 | 769.2 |
| -1.8 | 676.0 | -1.8 | 772.0 |
| -1.3 | 685.9 | -1.3 | 779.9 |
| -1.0 | 702.5 | -0.8 | 797.0 |
| -0.8 | 711.2 | -0.5 | 827.6 |
| -0.5 | 739.2 | -0.3 | 857.0 |
| -0.3 | 775.8 | -0.1 | 884.3 |
| -0.1 | 816.6 | 0 | 893.0 |
| 0.0 | 830.5 | 0.1 | 904.7 |
| 0.1 | 840.0 | 0.2 | 903.6 |
| 0.2 | 836.5 | 0.7 | 833.0 |
| 0.5 | 810.0 | 1.2 | 786.0 |
| 0.7 | 757.5 | 1.7 | 772.5 |
| 1.2 | 700.0 | 2.2 | 767.2 |
| 1.7 | 681.7 | 2.7 | 764.0 |
| 2.2 | 673.5 | 3.2 | 760.0 |
| 2.7 | 670.0 | 3.7 | 755.4 |
| 3.2 | 664.8 | 4.2 | 752.2 |
| 3.7 | 660.0 | | |
| 4.2 | 655.0 | | |

Experiment 10

Catalyst: $\text{Co/CeO}_2\text{--Al}_2\text{O}_3$ (1473 K)

$m_{\text{catalyst}} = 0.1021\text{ g}$

$\text{GHSV} = 75\text{ L}_{\text{CH}_4}/\text{g}_{\text{cat}}\cdot\text{h}$

Reduction: 50 mL/min 50 vol.% H_2 in N_2 , 10 K/min, 973 K, 2h

Table 42: Exp. 10. Feed gas

| Compound | V [mL/min (STP)] | y [-] | F [mmol/s] |
|-----------------|---------------------|----------|---------------|
| CH ₄ | 127.6 | 0.2958 | 0.0879 |
| O ₂ | 63.8 | 0.1479 | 0.0439 |
| N ₂ | 237.3 | 0.5500 | 0.1634 |
| Total | 431.5 | 1.0000 | 0.2971 |

Table 43: Exp. 10. Product data, T_{furnace} = 923 K

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 12.7788 | 0.1278 | | | | | |
| H ₂ | 16.3545 | 0.1635 | | 0.0517 | | 58.0 | 29.4 |
| N ₂ | 49.3853 | 0.4939 | 0.6591 | 0.1634 | | | |
| CO | 9.6428 | 0.0964 | 0.1287 | 0.0319 | | 77.5 | |
| CH ₄ (TCD) | 13.0991 | 0.1310 | 0.1748 | 0.0433 | 48.7 | | |
| CO ₂ | 2.8061 | 0.0281 | 0.0374 | 0.0093 | | 22.5 | |
| H ₂ O | | | | 0.0374 | | 42.0 | |
| F _{H₂} /F _{CO} | 1.6 | | | | | | |
| F _{H₂O} /F _{CO₂} | 4.0 | | | | | | |
| ε _C | 3.8 | | | | | | |

Table 44: Exp. 10. Product data, T_{furnace} = 1023 K

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 11.1783 | 0.1118 | | | | | |
| H ₂ | 18.4134 | 0.1841 | | 0.0626 | | 64.2 | 35.6 |
| N ₂ | 47.8535 | 0.4785 | 0.6596 | 0.1634 | | | |
| CO | 10.9479 | 0.1095 | 0.1509 | 0.0374 | | 82.7 | |
| CH ₄ (TCD) | 11.4587 | 0.1146 | 0.1579 | 0.0391 | 53.6 | | |
| CO ₂ | 2.2863 | 0.0229 | 0.0315 | 0.0078 | | 17.3 | |
| H ₂ O | | | | 0.0349 | | 35.8 | |
| F _{H₂} /F _{CO} | 1.7 | | | | | | |
| F _{H₂O} /F _{CO₂} | 5.1 | | | | | | |
| ε _C | 5.2 | | | | | | |

Table 45: Exp. 10. Product data, $T_{\text{furnace}} = 1123 \text{ K}$

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{\text{norm.}}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 10.1443 | 0.1014 | | | | | |
| H ₂ | 19.5515 | 0.1955 | | 0.0701 | | 67.5 | 39.9 |
| N ₂ | 47.2799 | 0.4728 | 0.6623 | 0.1634 | | | |
| CO | 11.7911 | 0.1179 | 0.1652 | 0.0407 | | 85.9 | |
| CH ₄ (TCD) | 10.3914 | 0.1039 | 0.1456 | 0.0359 | 56.9 | | |
| CO ₂ | 1.9290 | 0.0193 | 0.0270 | 0.0067 | | 14.1 | |
| H ₂ O | | | | 0.0338 | | 32.5 | |
| $F_{\text{H}_2}/F_{\text{CO}}$ | 1.7 | | | | | | |
| $F_{\text{H}_2\text{O}}/F_{\text{CO}_2}$ | 4.5 | | | | | | |
| ε_{C} | 4.0 | | | | | | |

Table 46: Exp. 10. Temperature data

| $T_{\text{furnace}} = 650\text{ }^{\circ}\text{C}$ | | $T_{\text{furnace}} = 750\text{ }^{\circ}\text{C}$ | | $T_{\text{furnace}} = 850\text{ }^{\circ}\text{C}$ | |
|--|-------------------------------|--|-------------------------------|--|-------------------------------|
| $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] | $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] | $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] |
| -3.5 | 669.0 | -3.5 | 768.7 | -3.5 | 869.7 |
| -2.5 | 671.8 | -3.0 | 770.0 | -3.0 | 870.7 |
| -2.0 | 673.9 | -2.5 | 771.5 | -2.5 | 871.5 |
| -1.5 | 676.2 | -2.0 | 773.0 | -2.0 | 872.3 |
| -1.0 | 680.0 | -1.5 | 774.2 | -1.5 | 872.5 |
| -0.5 | 697.0 | -1.0 | 776.8 | -1.0 | 872.5 |
| -0.3 | 707.3 | -0.5 | 785.0 | -0.5 | 875.8 |
| -0.1 | 728.9 | -0.2 | 800.0 | -0.2 | 880.9 |
| 0.0 | 744.3 | -0.1 | 806.0 | 0.0 | 887.1 |
| 0.1 | 750.2 | 0.0 | 819.5 | 0.1 | 890.4 |
| 0.3 | 766.5 | 0.1 | 824.3 | 0.2 | 893.0 |
| 0.5 | 753.7 | 0.3 | 830.0 | 0.3 | 890.3 |
| 1.0 | 711.0 | 0.5 | 813.5 | 0.5 | 875.5 |
| 1.5 | 690.2 | 1.0 | 779.0 | 0.7 | 860.0 |
| 2.0 | 676.8 | 1.5 | 771.0 | 1.0 | 857.0 |
| 2.5 | 670.0 | 2.0 | 766.0 | 1.5 | 860.0 |
| 3.0 | 664.8 | 2.5 | 764.0 | 2.0 | 860.0 |
| 3.5 | 660.0 | 3.0 | 761.0 | 2.5 | 860.0 |
| 4.5 | 655.6 | 3.5 | 759.0 | 3.0 | 859.0 |
| | | 4.5 | 755.0 | 3.5 | 858.0 |
| | | | | 4.5 | 855.0 |

Experiment 11

Catalyst: $\text{Co/CeO}_2\text{--Al}_2\text{O}_3$ (1423 K)

$m_{\text{catalyst}} = 0.0948\text{ g}$

$\text{GHSV} = 75\text{ L}_{\text{CH}_4}/\text{g}_{\text{cat}}\cdot\text{h}$

Reduction: 50 mL/min 50 vol.% H_2 in N_2 , 10 K/min, 973 K, 2h

Table 47: Exp 11. Feed gas

| Compound | V [mL/min (STP)] | y [-] | F [mmol/s] |
|-----------------|---------------------|----------|---------------|
| CH ₄ | 118.5 | 0.2958 | 0.0816 |
| O ₂ | 59.3 | 0.1479 | 0.0408 |
| N ₂ | 220.4 | 0.5500 | 0.1517 |
| Total | 400.6 | 1.0000 | 0.2758 |

Table 48: Exp. 11. Product data, T_{furnace} = 923 K

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 7.1244 | 0.0712 | | | | | |
| H ₂ | 24.4586 | 0.2446 | | 0.0889 | | 79.1 | 54.5 |
| N ₂ | 43.9491 | 0.4395 | 0.6610 | 0.1517 | | | |
| CO | 13.5938 | 0.1359 | 0.2044 | 0.0469 | | 89.4 | |
| CH ₄ (TCD) | 7.3408 | 0.0734 | 0.1104 | 0.0253 | 67.4 | | |
| CO ₂ | 1.6082 | 0.0161 | 0.0242 | 0.0056 | | 10.6 | |
| H ₂ O | | | | 0.0236 | | 20.9 | |
| F _{H₂} /F _{CO} | 1.9 | | | | | | |
| F _{H₂O} /F _{CO₂} | 4.2 | | | | | | |
| ε _C | 4.6 | | | | | | |

Table 49: Exp. 11. Product data, T_{furnace} = 1023 K

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 4.8543 | 0.0485 | | | | | |
| H ₂ | 28.4612 | 0.2846 | | 0.1081 | | 85.0 | 66.3 |
| N ₂ | 42.4264 | 0.4243 | 0.6599 | 0.1517 | | | |
| CO | 16.1667 | 0.1617 | 0.2515 | 0.0578 | | 96.1 | |
| CH ₄ (TCD) | 5.0345 | 0.0503 | 0.0783 | 0.0180 | 77.0 | | |
| CO ₂ | 0.6610 | 0.0066 | 0.0103 | 0.0024 | | 3.9 | |
| H ₂ O | | | | 0.0190 | | 15.0 | |
| F _{H₂} /F _{CO} | 1.9 | | | | | | |
| F _{H₂O} /F _{CO₂} | 8.1 | | | | | | |
| ε _C | 4.2 | | | | | | |

Table 50: Exp. 11. Product data, $T_{\text{furnace}} = 1123 \text{ K}$

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{\text{norm.}}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 3.7521 | | | | | | |
| H ₂ | 30.5797 | | | 0.1185 | | 87.8 | 72.6 |
| N ₂ | 41.7166 | | 0.6595 | 0.1517 | | | |
| CO | 17.4012 | | 0.2751 | 0.0633 | | 98.6 | |
| CH ₄ (TCD) | 3.8813 | | 0.0614 | 0.0141 | 82.0 | | |
| CO ₂ | 0.2543 | | 0.0040 | 0.0009 | | 1.4 | |
| H ₂ O | | | | 0.0165 | | 12.2 | |
| $F_{\text{H}_2}/F_{\text{CO}}$ | 1.9 | | | | | | |
| $F_{\text{H}_2\text{O}}/F_{\text{CO}_2}$ | 17.8 | | | | | | |
| ε_{C} | 4.0 | | | | | | |

Table 51: Exp. 11. Temperature data

| $T_{\text{furnace}} = 650 \text{ }^\circ\text{C}$ | | $T_{\text{furnace}} = 750 \text{ }^\circ\text{C}$ | | $T_{\text{furnace}} = 850 \text{ }^\circ\text{C}$ | |
|---|----------------------------------|---|----------------------------------|---|----------------------------------|
| $d_{\text{bed entrance}}$ [cm] | T [$^\circ\text{C}$] | $d_{\text{bed entrance}}$ [cm] | T [$^\circ\text{C}$] | $d_{\text{bed entrance}}$ [cm] | T [$^\circ\text{C}$] |
| -3.9 | 666.0 | -3.9 | 766.5 | -3.9 | 868.9 |
| -3.4 | 667.3 | -3.4 | 767.5 | -3.4 | 869.8 |
| -2.9 | 668.0 | -2.9 | 768.2 | -2.9 | 870.0 |
| -2.4 | 669.0 | -2.4 | 769.0 | -2.4 | 870.0 |
| -1.9 | 670.0 | -1.9 | 769.5 | -1.9 | 870.0 |
| -1.4 | 673.3 | -1.4 | 770.2 | -1.4 | 869.4 |
| -0.9 | 679.9 | -0.9 | 772.5 | -0.9 | 869.0 |
| -0.5 | 688.0 | -0.5 | 775.5 | -0.5 | 867.6 |
| -0.4 | 693.8 | -0.4 | 778.0 | -0.4 | 865.5 |
| -0.2 | 706.5 | -0.2 | 779.9 | 0.0 | 851.5 |
| 0.0 | 713.3 | 0.0 | 778.5 | 0.2 | 846.5 |
| 0.2 | 713.0 | 0.2 | 773.0 | 0.5 | 827.0 |
| 0.5 | 690.0 | 0.5 | 759.0 | 0.7 | 833.5 |
| 0.7 | 683.4 | 0.7 | 757.5 | 1.2 | 848.8 |
| 1.2 | 672.3 | 1.0 | 758.6 | 1.7 | 854.3 |
| 1.7 | 667.5 | 1.2 | 759.0 | 2.2 | 855.0 |
| 2.2 | 665.2 | 1.7 | 759.0 | 2.7 | 855.0 |
| 2.7 | 663.0 | 2.2 | 759.0 | | |
| 3.2 | 660.8 | 3.2 | 757.5 | | |
| 4.2 | 656.0 | | | | |

Experiment 12

Catalyst: Co/CeO₂–Al₂O₃ (1373 K)

$m_{\text{catalyst}} = 0.0959 \text{ g}$

GHSV = 75 L_{CH₄}/g_{cat}·h

Reduction: 50 mL/min 50 vol.% H₂ in N₂, 10 K/min, 973 K, 2h

Table 52: Exp. 12. Feed gas

| Compound | V [mL/min (STP)] | y [-] | F [mmol/s] |
|-----------------|---------------------|----------|---------------|
| CH ₄ | 119.9 | 0.2958 | 0.0825 |
| O ₂ | 59.9 | 0.1479 | 0.0413 |
| N ₂ | 222.9 | 0.5500 | 0.1535 |
| Total | 405.3 | 1.0000 | 0.2790 |

Table 53: Exp. 12. Product data, T_{furnace} = 923 K

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 12.9794 | 0.1298 | | | | | |
| H ₂ | 26.8429 | 0.2684 | | 0.1001 | | 82.4 | 60.7 |
| N ₂ | 43.8678 | 0.4387 | 0.6600 | 0.1535 | | | |
| CO | 15.2555 | 0.1526 | 0.2295 | 0.0534 | | 93.2 | |
| CH ₄ (TCD) | 6.2280 | 0.0623 | 0.0937 | 0.0218 | 72.4 | | |
| CO ₂ | 1.1174 | 0.0112 | 0.0168 | 0.0039 | | 6.8 | |
| H ₂ O | | | | 0.0213 | | 17.6 | |
| F _{H₂} /F _{CO} | 1.9 | | | | | | |
| F _{H₂O} /F _{CO₂} | 5.5 | | | | | | |
| ε _C | 4.2 | | | | | | |

Table 54: Exp. 12. Product data, $T_{\text{furnace}} = 1023 \text{ K}$

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{\text{norm.}}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 4.0186 | 0.0402 | | | | | |
| H ₂ | 30.1648 | 0.3016 | | 0.1176 | | 87.3 | 71.2 |
| N ₂ | 42.2746 | 0.4227 | 0.6589 | 0.1535 | | | |
| CO | 17.3658 | 0.1737 | 0.2707 | 0.0630 | | 98.2 | |
| CH ₄ (TCD) | 4.1870 | 0.0419 | 0.0653 | 0.0152 | 80.9 | | |
| CO ₂ | 0.3272 | 0.0033 | 0.0051 | 0.0012 | | 1.8 | |
| H ₂ O | | | | 0.0171 | | 12.7 | |
| $F_{\text{H}_2}/F_{\text{CO}}$ | 1.9 | | | | | | |
| $F_{\text{H}_2\text{O}}/F_{\text{CO}_2}$ | 14.4 | | | | | | |
| ε_{C} | 3.8 | | | | | | |

Table 55: Exp. 12. Product data, $T_{\text{furnace}} = 1123 \text{ K}$

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{\text{norm.}}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 3.1549 | 0.0315 | | | | | |
| H ₂ | 31.7625 | 0.3176 | | 0.1259 | | 89.4 | 76.3 |
| N ₂ | 41.6465 | 0.4165 | 0.6587 | 0.1535 | | | |
| CO | 18.2467 | 0.1825 | 0.2886 | 0.0672 | | 99.7 | |
| CH ₄ (TCD) | 3.2891 | 0.0329 | 0.0520 | 0.0121 | 84.8 | | |
| CO ₂ | 0.0476 | 0.0005 | 0.0008 | 0.0002 | | 0.3 | |
| H ₂ O | | | | 0.0149 | | 10.6 | |
| $F_{\text{H}_2}/F_{\text{CO}}$ | 1.9 | | | | | | |
| $F_{\text{H}_2\text{O}}/F_{\text{CO}_2}$ | 85.1 | | | | | | |
| ε_{C} | 3.6 | | | | | | |

Table 56: Exp. 12. Temperature data

| $T_{\text{furnace}} = 650\text{ }^{\circ}\text{C}$ | | $T_{\text{furnace}} = 750\text{ }^{\circ}\text{C}$ | | $T_{\text{furnace}} = 850\text{ }^{\circ}\text{C}$ | |
|--|-------------------------------|--|-------------------------------|--|-------------------------------|
| $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] | $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] | $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] |
| -3.7 | 660.7 | -3.7 | 765.5 | -3.7 | 868.4 |
| -3.2 | 662.4 | -3.2 | 767.0 | -3.2 | 870.0 |
| -2.7 | 664.0 | -2.7 | 768.8 | -2.7 | 871.4 |
| -2.2 | 665.5 | -2.2 | 769.7 | -2.2 | 872.5 |
| -1.7 | 667.5 | -1.7 | 771.2 | -1.7 | 873.8 |
| -1.2 | 671.2 | -1.2 | 773.3 | -1.2 | 874.9 |
| -1.0 | 675.0 | -0.7 | 777.9 | -1.0 | 875.9 |
| -0.7 | 682.0 | -0.5 | 781.5 | -0.7 | 877.3 |
| -0.5 | 688.9 | -0.4 | 786.0 | -0.5 | 879.6 |
| -0.3 | 699.8 | -0.3 | 789.0 | -0.3 | 881.2 |
| -0.2 | 707.5 | -0.2 | 790.5 | -0.2 | 882.9 |
| -0.1 | 714.0 | -0.1 | 793.8 | -0.1 | 883.8 |
| 0.0 | 720.8 | 0.0 | 796.2 | 0.1 | 884.0 |
| 0.1 | 724.0 | 0.2 | 795.4 | 0.3 | 872.5 |
| 0.2 | 722.0 | 0.3 | 790.0 | 0.4 | 867.5 |
| 0.3 | 716.0 | 0.5 | 779.5 | 0.8 | 868.0 |
| 0.8 | 684.7 | 0.8 | 773.5 | 1.3 | 870.0 |
| 1.3 | 673.5 | 1.3 | 770.8 | 1.8 | 871.0 |
| 1.8 | 668.4 | 1.8 | 769.4 | 2.3 | 870.9 |
| 2.3 | 664.7 | 2.3 | 768.0 | 3.3 | 868.0 |
| 2.8 | 662.0 | 2.8 | 766.0 | | |
| 3.3 | 659.3 | 3.3 | 765.0 | | |

Experiment 13

Catalyst: Co/CeO₂–Al₂O₃ (1473 K)

$m_{\text{catalyst}} = 0.0953\text{ g}$

GHSV = 75 L_{CH₄}/g_{cat}·h

Reduction: 50 mL/min 50 vol.% H₂ in N₂, 10 K/min, 973 K, 2h

Table 57: Exp. 13. Feed gas

| Compound | V [mL/min (STP)] | y [-] | F [mmol/s] |
|-----------------|---------------------|----------|---------------|
| CH ₄ | 119.1 | 0.2958 | 0.0820 |
| O ₂ | 59.6 | 0.1479 | 0.0410 |
| N ₂ | 221.5 | 0.5500 | 0.1525 |
| Total | 402.8 | 1.0000 | 0.2773 |

Table 58: Exp. 13. Product data, T_{furnace} = 923 K

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|--------------|----------|----------|----------|
| CH ₄ (FID) | 8.2222 | 0.0822 | | | | | |
| H ₂ | 22.8772 | 0.2288 | | 0.0806 | | 75.7 | 49.1 |
| N ₂ | 45.1510 | 0.4515 | 0.6598 | 0.1525 | | | |
| CO | 12.8968 | 0.1290 | 0.1885 | 0.0436 | | 87.4 | |
| CH ₄ (TCD) | 8.5200 | 0.0852 | 0.1245 | 0.0288 | 63.4 | | |
| CO ₂ | 1.8633 | 0.0186 | 0.0272 | 0.0063 | | 12.6 | |
| H ₂ O | | | | 0.0259 | | 24.3 | |
| F _{H₂} /F _{CO} | 1.9 | | | | | | |
| F _{H₂O} /F _{CO₂} | 4.1 | | | | | | |
| ε _C | 4.1 | | | | | | |

Table 59: Exp. 13. Product data, T_{furnace} = 1023 K

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 5.9001 | 0.0590 | | | | | |
| H ₂ | 26.6775 | 0.2668 | | 0.0995 | | 82.2 | 60.7 |
| N ₂ | 43.4655 | 0.4347 | 0.6596 | 0.1525 | | | |
| CO | 15.4121 | 0.1541 | 0.2339 | 0.0541 | | 94.5 | |
| CH ₄ (TCD) | 6.1133 | 0.0611 | 0.0928 | 0.0215 | 72.7 | | |
| CO ₂ | 0.9047 | 0.0090 | 0.0137 | 0.0032 | | 5.5 | |
| H ₂ O | | | | 0.0216 | | 17.8 | |
| F _{H₂} /F _{CO} | 1.8 | | | | | | |
| F _{H₂O} /F _{CO₂} | 6.8 | | | | | | |
| ε _C | 4.0 | | | | | | |

Table 60: Exp. 13. Product data, $T_{\text{furnace}} = 1123 \text{ K}$

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{\text{norm.}}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 5.4248 | 0.0542 | | | | | |
| H ₂ | 27.6745 | 0.2767 | | 0.1036 | | 83.3 | 63.2 |
| N ₂ | 43.3825 | 0.4338 | 0.6592 | 0.1525 | | | |
| CO | 16.1483 | 0.1615 | 0.2454 | 0.0568 | | 96.2 | |
| CH ₄ (TCD) | 5.6418 | 0.0564 | 0.0857 | 0.0198 | 74.8 | | |
| CO ₂ | 0.6413 | 0.0064 | 0.0097 | 0.0023 | | 3.8 | |
| H ₂ O | | | | 0.0207 | | 16.7 | |
| $F_{\text{H}_2}/F_{\text{CO}}$ | 1.8 | | | | | | |
| $F_{\text{H}_2\text{O}}/F_{\text{CO}_2}$ | 9.2 | | | | | | |
| ε_{C} | 3.9 | | | | | | |

Table 61: Exp. 13. Temperature data

| $T_{\text{furnace}} = 650\text{ }^{\circ}\text{C}$ | | $T_{\text{furnace}} = 750\text{ }^{\circ}\text{C}$ | | $T_{\text{furnace}} = 850\text{ }^{\circ}\text{C}$ | |
|--|-------------------------------|--|-------------------------------|--|-------------------------------|
| $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] | $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] | $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] |
| -3.8 | 665.7 | -3.8 | 773.0 | -3.8 | 878.6 |
| -3.3 | 667.2 | -3.3 | 774.5 | -3.3 | 880.6 |
| -2.8 | 669.2 | -2.8 | 776.0 | -2.8 | 882.7 |
| -2.3 | 670.5 | -2.3 | 777.0 | -2.3 | 883.3 |
| -1.8 | 671.5 | -1.8 | 777.2 | -1.8 | 882.7 |
| -1.3 | 674.5 | -1.3 | 777.7 | -1.3 | 881.5 |
| -1.1 | 677.5 | -1.1 | 778.5 | -1.1 | 881.3 |
| -0.8 | 682.0 | -0.8 | 780.3 | -0.8 | 880.6 |
| -0.5 | 694.0 | -0.3 | 788.0 | -0.5 | 880.5 |
| -0.3 | 700.0 | -0.2 | 789.8 | -0.3 | 880.6 |
| -0.2 | 710.5 | -0.1 | 793.0 | -0.1 | 879.1 |
| -0.1 | 716.8 | 0 | 793.2 | 0 | 874.3 |
| 0 | 720.3 | 0.1 | 792.0 | 0.1 | 872.5 |
| 0.1 | 721.3 | 0.2 | 787.0 | 0.2 | 867.0 |
| 0.2 | 716.5 | 0.3 | 779.3 | 0.3 | 862.5 |
| 0.3 | 708.5 | 0.5 | 772.0 | 0.4 | 858.0 |
| 0.5 | 692.8 | 0.7 | 769.3 | 0.5 | 857.0 |
| 0.7 | 682.3 | 1.2 | 767.0 | 0.7 | 860.3 |
| 1.2 | 670.5 | 1.7 | 765.3 | 1.2 | 866.8 |
| 1.7 | 664.5 | 2.2 | 763.2 | 1.7 | 867.9 |
| 2.2 | 660.5 | 3.2 | 758.3 | 2.2 | 866.9 |
| 3.2 | 652.0 | | | 2.7 | 866.1 |
| | | | | 3.2 | 864.0 |

Experiment 14

Catalyst: $\text{Co/CeO}_2\text{--Al}_2\text{O}_3$ (1273 K)

$m_{\text{catalyst}} = 0.0266\text{ g}$

$\text{GHSV} = 250\text{ L}_{\text{CH}_4}/\text{g}_{\text{cat}}\cdot\text{h}$

No reduction

Table 62: Exp. 14. Feed gas

| Compound | V [mL/min (STP)] | y [-] | F [mmol/s] |
|-----------------|---------------------|----------|---------------|
| CH ₄ | 110.8 | 0.2958 | 0.0763 |
| O ₂ | 55.4 | 0.1479 | 0.0382 |
| N ₂ | 206.1 | 0.5500 | 0.1419 |
| Total | 374.7 | 1.0000 | 0.2580 |

Table 63: Exp. 14. Product data, T_{furnace} = 923 K

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 22.9558 | 0.2296 | | | | | |
| H ₂ | 1.7620 | 0.0176 | 0.0186 | 0.0041 | | 8.0 | 2.7 |
| N ₂ | 61.1847 | 0.6118 | 0.6460 | 0.1419 | | | |
| CO | 2.2789 | 0.0228 | 0.0241 | 0.0053 | | 30.3 | |
| CH ₄ (TCD) | 24.2383 | 0.2424 | 0.2559 | 0.0562 | 23.7 | | |
| CO ₂ | 5.2462 | 0.0525 | 0.0554 | 0.0122 | | 69.7 | |
| H ₂ O | | | | 0.0467 | | 92.0 | |
| F _{H₂} /F _{CO} | 0.8 | | | | | | |
| F _{H₂O} /F _{CO₂} | 3.8 | | | | | | |
| ε _C | 3.5 | | | | | | |

Table 64: Exp. 14. Product data, T_{furnace} = 1023 K

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 22.8079 | 0.2281 | | | | | |
| H ₂ | 1.7182 | 0.0172 | 0.0182 | 0.0040 | | 7.8 | 2.6 |
| N ₂ | 61.1525 | 0.6115 | 0.6485 | 0.1419 | | | |
| CO | 2.0917 | 0.0209 | 0.0222 | 0.0049 | | 28.5 | |
| CH ₄ (TCD) | 24.0970 | 0.2410 | 0.2555 | 0.0559 | 23.3 | | |
| CO ₂ | 5.2380 | 0.0524 | 0.0555 | 0.0122 | | 71.5 | |
| H ₂ O | | | | 0.0471 | | 92.2 | |
| F _{H₂} /F _{CO} | 0.8 | | | | | | |
| F _{H₂O} /F _{CO₂} | 3.9 | | | | | | |
| ε _C | 4.4 | | | | | | |

Table 65: Exp. 14. Product data, $T_{\text{furnace}} = 1123 \text{ K}$

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{\text{norm.}}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 22.1789 | 0.2218 | | | | | |
| H ₂ | 2.1116 | 0.0211 | 0.0226 | 0.0049 | | 9.4 | 3.2 |
| N ₂ | 60.8067 | 0.6081 | 0.6513 | 0.1419 | | | |
| CO | 2.3115 | 0.0231 | 0.0248 | 0.0054 | | 31.3 | |
| CH ₄ (TCD) | 23.0677 | 0.2307 | 0.2471 | 0.0538 | 24.2 | | |
| CO ₂ | 5.0704 | 0.0507 | 0.0543 | 0.0118 | | 68.7 | |
| H ₂ O | | | | 0.0473 | | 90.6 | |
| $F_{\text{H}_2}/F_{\text{CO}}$ | 0.9 | | | | | | |
| $F_{\text{H}_2\text{O}}/F_{\text{CO}_2}$ | 4.0 | | | | | | |
| ε_{C} | 6.9 | | | | | | |

Table 66: Exp. 14. Temperature data

| $T_{\text{furnace}} = 650\text{ }^{\circ}\text{C}$ | | $T_{\text{furnace}} = 750\text{ }^{\circ}\text{C}$ | | $T_{\text{furnace}} = 850\text{ }^{\circ}\text{C}$ | |
|--|-------------------------------|--|-------------------------------|--|-------------------------------|
| $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] | $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] | $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] |
| -3.0 | 660.2 | -3.0 | 765.0 | -3.0 | 870.1 |
| -2.5 | 661.2 | -2.5 | 766.7 | -2.5 | 871.5 |
| -2.0 | 663.5 | -2.0 | 768.3 | -2.0 | 872.5 |
| -1.5 | 668.0 | -1.5 | 771.3 | -1.5 | 874.7 |
| -1.0 | 680.5 | -1.0 | 778.5 | -1.0 | 879.7 |
| -0.5 | 717.0 | -0.5 | 801.0 | -0.5 | 896.5 |
| -0.3 | 741.5 | -0.4 | 817.5 | -0.4 | 900.9 |
| -0.2 | 764.5 | -0.3 | 820.2 | -0.3 | 910.8 |
| -0.1 | 781.0 | -0.2 | 832.5 | -0.2 | 916.6 |
| 0.0 | 800.0 | -0.1 | 850.0 | -0.1 | 928.4 |
| 0.2 | 835.6 | 0.0 | 874.7 | 0.0 | 933.7 |
| 0.3 | 839.5 | 0.1 | 891.6 | 0.2 | 968.8 |
| 0.5 | 799.2 | 0.2 | 903.8 | 0.3 | 977.8 |
| 0.7 | 745.5 | 0.3 | 905.5 | 0.4 | 978.2 |
| 1.0 | 726.0 | 0.4 | 908.0 | 0.5 | 970.0 |
| 1.5 | 693.4 | 0.4 | 903.5 | 0.6 | 947.4 |
| 2.0 | 672.7 | 0.5 | 879.0 | 0.7 | 935.4 |
| 2.5 | 663.5 | 0.7 | 832.8 | 1.0 | 899.7 |
| 3.0 | 655.0 | 1.0 | 816.0 | 1.5 | 883.5 |
| | | 1.5 | 784.0 | 2.0 | 874.0 |
| | | 2.0 | 773.1 | 2.5 | 868.0 |
| | | 2.5 | 765.0 | 3.0 | 863.0 |
| | | 3.0 | 759.0 | | |

Experiment 15

Catalyst: $\text{Co/CeO}_2\text{--Al}_2\text{O}_3$ (1273 K)

$m_{\text{catalyst}} = 0.0169\text{ g}$

$\text{GHSV} = 500\text{ L}_{\text{CH}_4}/\text{g}_{\text{cat}}\cdot\text{h}$

No reduction

Table 67: Exp. 15. Feed gas

| Compound | V [mL/min (STP)] | y [-] | F [mmol/s] |
|-----------------|---------------------|----------|---------------|
| CH ₄ | 140.8 | 0.2958 | 0.0970 |
| O ₂ | 70.4 | 0.1479 | 0.0485 |
| N ₂ | 261.9 | 0.5500 | 0.1803 |
| Total | 476.2 | 1.0000 | 0.3278 |

Table 68: Exp. 15. Product data, T_{furnace} = 923 K

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 27.0779 | 0.2708 | | | | | |
| H ₂ | | | | 0.0003 | | 33.1 | 1.7 |
| O ₂ | 13.3902 | 0.1339 | 0.1377 | 0.0451 | 9.8 | | |
| N ₂ | 55.2062 | 0.5521 | 0.5676 | 0.1861 | | | |
| CO | 0.0863 | 0.0009 | 0.0009 | 0.0003 | | 17.6 | |
| CH ₄ (TCD) | 28.1831 | 0.2818 | 0.2897 | 0.0950 | 1.7 | | |
| CO ₂ | 0.4035 | 0.0040 | 0.0041 | 0.0014 | | 82.4 | |
| H ₂ O | | | | 0.0037 | | 66.9 | |
| F _{H₂} /F _{CO} | 11.5 | | | | | | |
| F _{H₂O} /F _{CO₂} | 5.0 | | | | | | |
| ε _C | 3.4 | | | | | | |

Table 69: Exp. 15. Product data, T_{furnace} = 1023 K

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 26.2148 | 0.2621 | | | | | |
| H ₂ | 0.4579 | 0.0046 | | 0.0008 | | 3.7 | 0.4 |
| O ₂ | 10.3365 | 0.1034 | 0.1072 | 0.0328 | 32.3 | | |
| N ₂ | 56.7924 | 0.5679 | 0.5889 | 0.1803 | | | |
| CO | 0.5129 | 0.0051 | 0.0053 | 0.0016 | | 25.1 | |
| CH ₄ (TCD) | 27.2707 | 0.2727 | 0.2828 | 0.0866 | 7.0 | | |
| CO ₂ | 1.5267 | 0.0153 | 0.0158 | 0.0048 | | 74.9 | |
| H ₂ O | | | | 0.0200 | | 96.3 | |
| F _{H₂} /F _{CO} | 0.5 | | | | | | |
| F _{H₂O} /F _{CO₂} | 4.1 | | | | | | |
| ε _C | 4.0 | | | | | | |

Table 70: Exp. 15. Product data, $T_{\text{furnace}} = 1123$ K. Analysis 1

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{\text{norm.}}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 22.1842 | 0.2218 | | | | | |
| H ₂ | 1.9308 | 0.0193 | 0.0207 | 0.0057 | | 8.7 | 3.0 |
| O ₂ | 0.4137 | 0.0041 | 0.0044 | 0.0012 | 97.5 | | |
| N ₂ | 60.9513 | 0.6095 | 0.6541 | 0.1803 | | | |
| CO | 2.4324 | 0.0243 | 0.0261 | 0.0072 | | 34.4 | |
| CH ₄ (TCD) | 22.8129 | 0.2281 | 0.2448 | 0.0675 | 23.7 | | |
| CO ₂ | 4.6391 | 0.0464 | 0.0498 | 0.0137 | | 65.6 | |
| H ₂ O | | | | 0.0599 | | 91.3 | |
| $F_{\text{H}_2}/F_{\text{CO}}$ | 0.8 | | | | | | |
| $F_{\text{H}_2\text{O}}/F_{\text{CO}_2}$ | 4.4 | | | | | | |
| ε_{C} | 8.8 | | | | | | |

Table 71: Exp. 15. Product data, $T_{\text{furnace}} = 1123$ K. Analysis 2

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{\text{norm.}}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 22.8577 | 0.2286 | | | | | |
| H ₂ | 1.5376 | 0.0154 | 0.0165 | 0.0046 | | 7.9 | 2.4 |
| O ₂ | 2.1271 | 0.0213 | 0.0228 | 0.0064 | 86.8 | | |
| N ₂ | 60.0886 | 0.6009 | 0.6436 | 0.1803 | | | |
| CO | 2.0697 | 0.0207 | 0.0222 | 0.0062 | | 34.2 | |
| CH ₄ (TCD) | 23.5427 | 0.2354 | 0.2522 | 0.0706 | 20.5 | | |
| CO ₂ | 3.99066 | 0.0399 | 0.0427 | 0.0120 | | 65.9 | |
| H ₂ O | | | | 0.0540 | | 91.1 | |
| $F_{\text{H}_2}/F_{\text{CO}}$ | 0.7 | | | | | | |
| $F_{\text{H}_2\text{O}}/F_{\text{CO}_2}$ | 4.5 | | | | | | |
| ε_{C} | 8.4 | | | | | | |

Table 72: Exp. 15. Product data, $T_{\text{furnace}} = 1123$ K. Analysis 3

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{\text{norm.}}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 24.3442 | 0.2434 | | | | | |
| H ₂ | 1.1247 | 0.0112 | 0.0118 | 0.0035 | | 9.1 | 1.8 |
| O ₂ | 6.8906 | 0.0689 | 0.0726 | 0.0215 | 55.7 | | |
| N ₂ | 57.8744 | 0.5787 | 0.6098 | 0.1803 | | | |
| CO | 1.3520 | 0.0135 | 0.0142 | 0.0042 | | 36.0 | |
| CH ₄ (TCD) | 25.2702 | 0.2527 | 0.2662 | 0.0787 | 12.9 | | |
| CO ₂ | 2.4016 | 0.0240 | 0.0253 | 0.0075 | | 64.0 | |
| H ₂ O | | | | 0.0349 | | 90.9 | |
| $F_{\text{H}_2}/F_{\text{CO}}$ | 0.8 | | | | | | |
| $F_{\text{H}_2\text{O}}/F_{\text{CO}_2}$ | 4.7 | | | | | | |
| ε_{C} | 6.7 | | | | | | |

Table 73: Exp. 15. Product data, $T_{\text{furnace}} = 1023$ K, cooled down

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{\text{norm.}}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 27.0542 | 0.2705 | | | | | |
| H ₂ | 0.1697 | 0.0017 | | 0.0033 | | 26.1 | 1.7 |
| O ₂ | 12.7996 | 0.1280 | 0.1319 | 0.0416 | 14.2 | | |
| N ₂ | 55.4980 | 0.5550 | 0.5720 | 0.1803 | | | |
| CO | 0.2228 | 0.0022 | 0.0023 | 0.0007 | | 27.5 | |
| CH ₄ (TCD) | 27.9187 | 0.2792 | 0.2877 | 0.0907 | 2.8 | | |
| CO ₂ | 0.5880 | 0.0059 | 0.0061 | 0.0019 | | 72.5 | |
| H ₂ O | | | | 0.0093 | | 73.9 | |
| $F_{\text{H}_2}/F_{\text{CO}}$ | 4.5 | | | | | | |
| $F_{\text{H}_2\text{O}}/F_{\text{CO}_2}$ | 4.8 | | | | | | |
| ε_{C} | 3.7 | | | | | | |

Table 74: Exp. 15. Temperature data

| $T_{\text{furnace}} = 650\text{ }^{\circ}\text{C}$ | | $T_{\text{furnace}} = 750\text{ }^{\circ}\text{C}$ | |
|--|-------------------------------|--|-------------------------------|
| $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] | $d_{\text{bed entrance}}$ [cm] | T [$^{\circ}\text{C}$] |
| -4.3 | 664.0 | -4.3 | 757.6 |
| -3.8 | 665.0 | -3.8 | 758.7 |
| -3.3 | 665.5 | -3.3 | 759.7 |
| -2.8 | 665.8 | -2.8 | 760.3 |
| -2.3 | 666.0 | -2.3 | 760.9 |
| -1.8 | 666.3 | -1.8 | 762.0 |
| -1.3 | 666.8 | -1.3 | 764.0 |
| -0.8 | 668.5 | -0.8 | 769.8 |
| -0.5 | 670.7 | -0.5 | 776.0 |
| -0.3 | 673.3 | -0.3 | 786.5 |
| -0.1 | 675.3 | -0.2 | 790.7 |
| 0.1 | 678.0 | -0.1 | 796.8 |
| 0.2 | 677.7 | 0.1 | 808.7 |
| 0.3 | 676.6 | 0.2 | 811.0 |
| 0.5 | 673.5 | 0.3 | 809.7 |
| 0.7 | 670.3 | 0.5 | 798.0 |
| 1.2 | 666.0 | 0.7 | 788.0 |
| 1.7 | 663.5 | 1.2 | 772.8 |
| 2.2 | 661.5 | 1.7 | 767.0 |
| 2.7 | 659.0 | 2.2 | 763.3 |
| | | 2.7 | 759.5 |

Experiment 16

Catalyst: $\text{Co/CeO}_2\text{--Al}_2\text{O}_3$ (1273 K)

$m_{\text{catalyst}} = 0.0264\text{ g}$

$\text{GHSV} = 400\text{ L}_{\text{CH}_4}/\text{g}_{\text{cat}}\cdot\text{h}$

No reduction

$T_{\text{furnace}} = 923\text{ K}$

Table 75: Exp. 16. Feed gas

| Compound | V [mL/min (STP)] | y [-] | F [mmol/s] |
|-----------------|---------------------|----------|---------------|
| CH ₄ | 176.0 | 0.2958 | 0.1212 |
| O ₂ | 88.0 | 0.1479 | 0.0606 |
| N ₂ | 327.3 | 0.5500 | 0.2253 |
| Total | 595.0 | 1.0000 | 0.4097 |

Table 76: Exp. 16. Product data, TOS = 0 min

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 21.55139 | 0.2155 | | | | | |
| H ₂ | 2.64148 | 0.0264 | 0.0286 | 0.0100 | | 11.7 | 4.1 |
| N ₂ | 59.66902 | 0.5967 | 0.6467 | 0.2253 | | | |
| CO | 3.34341 | 0.0334 | 0.0362 | 0.0126 | | 43.2 | |
| CH ₄ (TCD) | 22.20471 | 0.2220 | 0.2407 | 0.0839 | 25.9 | | |
| CO ₂ | 4.40388 | 0.0440 | 0.0477 | 0.0166 | | 56.8 | |
| H ₂ O | | | | 0.0753 | | 88.3 | |
| F _{H₂} /F _{CO} | 0.8 | | | | | | |
| F _{H₂O} /F _{CO₂} | 4.5 | | | | | | |
| ε _C | 6.7 | | | | | | |

Table 77: Exp. 16. Product data, TOS = 23 min

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 21.35387 | 0.2135 | | | | | |
| H ₂ | 2.59481 | 0.0259 | 0.0280 | 0.0097 | | 11.3 | 4.0 |
| N ₂ | 60.16038 | 0.6016 | 0.6500 | 0.2253 | | | |
| CO | 3.11277 | 0.0311 | 0.0336 | 0.0117 | | 41.0 | |
| CH ₄ (TCD) | 22.20943 | 0.2221 | 0.2400 | 0.0832 | 25.5 | | |
| CO ₂ | 4.47985 | 0.0448 | 0.0484 | 0.0168 | | 59.0 | |
| H ₂ O | | | | 0.0760 | | 88.7 | |
| F _{H₂} /F _{CO} | 0.8 | | | | | | |
| F _{H₂O} /F _{CO₂} | 4.5 | | | | | | |
| ε _C | 7.9 | | | | | | |

Table 78: Exp. 16. Product data, TOS = 46 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|-----------------|------------|------------|------------|
| CH ₄ (FID) | 21.6259 | 0.2163 | | | | | |
| H ₂ | 2.4328 | 0.0243 | 0.0262 | 0.0091 | | 11.0 | 3.8 |
| O ₂ | 0.5107 | 0.0051 | 0.0055 | 0.0019 | 96.8 | | |
| N ₂ | 60.0579 | 0.6006 | 0.6479 | 0.2253 | | | |
| CO | 2.9392 | 0.0294 | 0.0317 | 0.0110 | | 40.3 | |
| CH ₄ (TCD) | 22.3957 | 0.2240 | 0.2416 | 0.0840 | 24.6 | | |
| CO ₂ | 4.3565 | 0.0436 | 0.0470 | 0.0163 | | 59.7 | |
| H ₂ O | | | | 0.0736 | | 89.0 | |
| F_{H_2}/F_{CO} | 0.8 | | | | | | |
| F_{H_2O}/F_{CO_2} | 4.5 | | | | | | |
| ε_C | 8.1 | | | | | | |

Table 79: Exp. 16. Product data, TOS = 69 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|-----------------|------------|------------|------------|
| CH ₄ (FID) | 22.4115 | 0.2241 | | | | | |
| H ₂ | 2.0710 | 0.0207 | 0.0222 | 0.0078 | | 10.1 | 3.2 |
| O ₂ | 1.4562 | 0.0146 | 0.0156 | 0.0055 | 91.0 | | |
| N ₂ | 59.8564 | 0.5986 | 0.6429 | 0.2253 | | | |
| CO | 2.6536 | 0.0265 | 0.0285 | 0.0100 | | 39.6 | |
| CH ₄ (TCD) | 23.0163 | 0.2302 | 0.2472 | 0.0866 | 22.6 | | |
| CO ₂ | 4.0557 | 0.0406 | 0.0436 | 0.0153 | | 60.4 | |
| H ₂ O | | | | 0.0697 | | 89.9 | |
| F_{H_2}/F_{CO} | 0.8 | | | | | | |
| F_{H_2O}/F_{CO_2} | 4.6 | | | | | | |
| ε_C | 7.7 | | | | | | |

Table 80: Exp. 16. Product data, TOS = 92 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|-----------------|------------|------------|------------|
| CH ₄ (FID) | 22.9388 | 0.2294 | | | | | |
| H ₂ | 1.7279 | 0.0173 | 0.0185 | 0.0065 | | 9.1 | 2.7 |
| O ₂ | 2.3889 | 0.0239 | 0.0256 | 0.0090 | 85.1 | | |
| N ₂ | 59.5743 | 0.5957 | 0.6373 | 0.2253 | | | |
| CO | 2.3808 | 0.0238 | 0.0255 | 0.0090 | | 38.7 | |
| CH ₄ (TCD) | 23.6398 | 0.2364 | 0.2529 | 0.0894 | 20.7 | | |
| CO ₂ | 3.7715 | 0.0377 | 0.0403 | 0.0143 | | 61.3 | |
| H ₂ O | | | | 0.0656 | | 90.9 | |
| F_{H_2}/F_{CO} | 0.7 | | | | | | |
| F_{H_2O}/F_{CO_2} | 4.6 | | | | | | |
| ε_C | 7.0 | | | | | | |

Table 81: Exp. 16. Product data, TOS = 115 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|-----------------|------------|------------|------------|
| CH ₄ (FID) | 23.5955 | 0.2360 | | | | | |
| H ₂ | 1.4600 | 0.0146 | 0.0156 | 0.0056 | | 8.4 | 2.3 |
| O ₂ | 3.5023 | 0.0350 | 0.0373 | 0.0133 | 78.0 | | |
| N ₂ | 59.2006 | 0.5920 | 0.6307 | 0.2253 | | | |
| CO | 2.0974 | 0.0210 | 0.0223 | 0.0080 | | 37.8 | |
| CH ₄ (TCD) | 24.1538 | 0.2415 | 0.2573 | 0.0919 | 18.7 | | |
| CO ₂ | 3.4449 | 0.0344 | 0.0367 | 0.0131 | | 62.2 | |
| H ₂ O | | | | 0.0603 | | 91.6 | |
| F_{H_2}/F_{CO} | 0.7 | | | | | | |
| F_{H_2O}/F_{CO_2} | 4.6 | | | | | | |
| ε_C | 6.7 | | | | | | |

Table 82: Exp. 16. Product data, TOS = 138 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|-----------------|------------|------------|------------|
| CH ₄ (FID) | 23.8282 | 0.2383 | | | | | |
| H ₂ | 1.2979 | 0.0130 | 0.0138 | 0.0050 | | 8.3 | 2.1 |
| O ₂ | 4.5500 | 0.0455 | 0.0482 | 0.0174 | 71.2 | | |
| N ₂ | 58.8089 | 0.5881 | 0.6232 | 0.2253 | | | |
| CO | 1.8793 | 0.0188 | 0.0199 | 0.0072 | | 37.4 | |
| CH ₄ (TCD) | 24.6960 | 0.2470 | 0.2617 | 0.0946 | 16.9 | | |
| CO ₂ | 3.1408 | 0.0314 | 0.0333 | 0.0120 | | 62.6 | |
| H ₂ O | | | | 0.0550 | | 91.7 | |
| F_{H_2}/F_{CO} | 0.7 | | | | | | |
| F_{H_2O}/F_{CO_2} | 4.6 | | | | | | |
| ε_C | 6.0 | | | | | | |

Table 83: Exp. 16. Product data, TOS = 161 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|-----------------|------------|------------|------------|
| CH ₄ (FID) | 24.2242 | 0.2422 | | | | | |
| H ₂ | 1.0476 | 0.0105 | 0.0111 | 0.0040 | | 7.5 | 1.7 |
| O ₂ | 5.6216 | 0.0562 | 0.0595 | 0.0217 | 64.2 | | |
| N ₂ | 58.3188 | 0.5832 | 0.6172 | 0.2253 | | | |
| CO | 1.6592 | 0.0166 | 0.0176 | 0.0064 | | 37.6 | |
| CH ₄ (TCD) | 25.0921 | 0.2509 | 0.2656 | 0.0970 | 15.0 | | |
| CO ₂ | 2.7516 | 0.0275 | 0.0291 | 0.0106 | | 62.4 | |
| H ₂ O | | | | 0.0501 | | 92.5 | |
| F_{H_2}/F_{CO} | 0.6 | | | | | | |
| F_{H_2O}/F_{CO_2} | 4.7 | | | | | | |
| ε_C | 5.9 | | | | | | |

Table 84: Exp. 16. Product data, TOS = 184 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|-----------------|------------|------------|------------|
| CH ₄ (FID) | 25.2784 | 0.2528 | | | | | |
| H ₂ | 0.5900 | 0.0059 | 0.0062 | 0.0023 | | 5.5 | 1.0 |
| O ₂ | 7.7555 | 0.0776 | 0.0814 | 0.0304 | 49.9 | | |
| N ₂ | 57.5572 | 0.5756 | 0.6039 | 0.2253 | | | |
| CO | 1.1844 | 0.0118 | 0.0124 | 0.0046 | | 36.0 | |
| CH ₄ (TCD) | 26.1211 | 0.2612 | 0.2741 | 0.1023 | 11.2 | | |
| CO ₂ | 2.1036 | 0.0210 | 0.0221 | 0.0082 | | 64.0 | |
| H ₂ O | | | | 0.0393 | | 94.5 | |
| F_{H_2}/F_{CO} | 0.5 | | | | | | |
| F_{H_2O}/F_{CO_2} | 4.8 | | | | | | |
| ε_C | 5.0 | | | | | | |

Table 85: Exp. 16. Temperature data

| TOS = 15 min | | TOS = 120 min | | TOS = 150 min | | TOS = 205 min | |
|---------------------------|-----------|---------------------------|-----------|---------------------------|-----------|---------------------------|-----------|
| d _{b.e.} [cm] | T [°C] | d _{b.e.} [cm] | T [°C] | d _{b.e.} [cm] | T [°C] | d _{b.e.} [cm] | T [°C] |
| -3.5 | 750.0 | -3.5 | 755.0 | -3.5 | 758.0 | -3.5 | 759.3 |
| -3.0 | 751.7 | -3.0 | 757.9 | -3.0 | 759.8 | -3.0 | 761.6 |
| -2.5 | 754.8 | -2.5 | 760.9 | -2.5 | 762.0 | -2.5 | 763.8 |
| -2.0 | 757.8 | -2.0 | 763.5 | -2.0 | 764.5 | -2.0 | 765.9 |
| -1.5 | 762.8 | -1.5 | 766.9 | -1.5 | 767.5 | -1.5 | 768.5 |
| -1.0 | 775.0 | -1.0 | 776.8 | -1.0 | 776.0 | -1.0 | 774.5 |
| -0.5 | 812.0 | -0.5 | 804.5 | -0.5 | 799.8 | -0.5 | 790.0 |
| -0.2 | 875.0 | -0.2 | 848.0 | -0.2 | 841.7 | -0.2 | 812.3 |
| 0.0 | 912.0 | 0.0 | 882.5 | 0.0 | 865.2 | 0.0 | 839.5 |
| 0.1 | 959.9 | 0.1 | 905.5 | 0.1 | 886.2 | 0.1 | 858.7 |
| 0.2 | 976.0 | 0.2 | 923.9 | 0.2 | 906.5 | 0.2 | 873.4 |
| 0.3 | 972.0 | 0.3 | 927.2 | 0.3 | 911.8 | 0.3 | 880.0 |
| 0.4 | 950.0 | 0.4 | 921.6 | 0.4 | 904.0 | 0.4 | 873.8 |
| 0.5 | 925.0 | 0.5 | 900.8 | 0.5 | 884.8 | 0.5 | 864.3 |
| 0.7 | 880.0 | 0.7 | 859.6 | 0.7 | 853.5 | 0.7 | 831.5 |
| 1.0 | 825.0 | 1.0 | 824.0 | 1.0 | 825.0 | 1.0 | 816.3 |
| 1.5 | 795.0 | 1.5 | 799.0 | 1.5 | 797.5 | 1.5 | 795.0 |
| 2.0 | 782.5 | 2.0 | 784.0 | 2.0 | 784.5 | 2.0 | 781.5 |
| 2.5 | 771.0 | 2.5 | 775.0 | 2.5 | 774.0 | 2.5 | 775.0 |
| 3.0 | 762.0 | 3.0 | 767.3 | 3.0 | 768.0 | 3.0 | 768.0 |
| 3.5 | 755.0 | 3.5 | 760.0 | 3.5 | 761.0 | 3.5 | 762.5 |

Experiment 17

Catalyst: Co/CeO₂–Al₂O₃ (1273 K)

m_{catalyst} = 0.0196 g

Reduction: 50 mL/min 50 vol.% H₂ in N₂, 10 K/min, 973 K, 2h

T_{furnace} = 1023 K

Table 86: Exp. 17. Feed data, $\text{GHSV} = 150 \text{ L}_{\text{CH}_4}/\text{g}_{\text{cat}} \cdot \text{h}$

| Compound | V [mL/min (STP)] | y [-] | F [mmol/s] |
|-----------------|---------------------|----------|---------------|
| CH ₄ | 49.0 | 0.2958 | 0.0337 |
| O ₂ | 24.5 | 0.1479 | 0.0169 |
| N ₂ | 91.1 | 0.5500 | 0.0627 |
| Total | 165.7 | 1.0000 | 0.1141 |

Table 87: Exp. 17. Product data, $\text{GHSV} = 150 \text{ L}_{\text{CH}_4}/\text{g}_{\text{cat}} \cdot \text{h}$, TOS = 17 min. Analysis 1

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 4.1461 | 0.0415 | | | | | |
| H ₂ | 29.2200 | 0.2922 | | 0.0468 | | 85.9 | 69.3 |
| N ₂ | 41.4382 | 0.4144 | 0.6624 | 0.0627 | | | |
| CO | 16.4640 | 0.1646 | 0.2632 | 0.0249 | | 97.8 | |
| CH ₄ (TCD) | 4.2905 | 0.0429 | 0.0686 | 0.0065 | 79.7 | | |
| CO ₂ | 0.3694 | 0.0037 | 0.0059 | 0.0006 | | 2.2 | |
| H ₂ O | | | | 0.0077 | | 14.1 | |
| F _{H₂} /F _{CO} | 1.9 | | | | | | |
| F _{H₂O} /F _{CO₂} | 13.8 | | | | | | |
| ε _C | 5.2 | | | | | | |

Table 88: Exp. 17. Product data, $\text{GHSV} = 150 \text{ L}_{\text{CH}_4}/\text{g}_{\text{cat}} \cdot \text{h}$, TOS = 40 min. Analysis 2

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 4.29878 | 0.0430 | | | | | |
| H ₂ | 28.74706 | 0.2875 | | 0.0461 | | 85.4 | 69.3 |
| N ₂ | 41.37285 | 0.4137 | 0.6623 | 0.0627 | | | |
| CO | 16.23832 | 0.1624 | 0.2600 | 0.0246 | | 97.6 | |
| CH ₄ (TCD) | 4.44821 | 0.0445 | 0.0712 | 0.0067 | 78.9 | | |
| CO ₂ | 0.40681 | 0.0041 | 0.0065 | 0.0006 | | 2.4 | |
| H ₂ O | | | | 0.0079 | | 14.6 | |
| F _{H₂} /F _{CO} | 1.9 | | | | | | |
| F _{H₂O} /F _{CO₂} | 12.8 | | | | | | |
| ε _C | 5.2 | | | | | | |

Table 89: Exp. 17. Product data, GHSV = 150 L_{CH₄}/g_{cat}·h, TOS = 64 min. Analysis 3

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 4.53540 | 0.0454 | | | | | |
| H ₂ | 28.35036 | 0.2835 | | 0.0454 | | 85.1 | 67.3 |
| N ₂ | 41.49611 | 0.4150 | 0.6615 | 0.0627 | | | |
| CO | 16.07491 | 0.1607 | 0.2563 | 0.0243 | | 97.0 | |
| CH ₄ (TCD) | 4.66516 | 0.0467 | 0.0744 | 0.0071 | 78.0 | | |
| CO ₂ | 0.49140 | 0.0049 | 0.0078 | 0.0007 | | 3.0 | |
| H ₂ O | | | | 0.0079 | | 14.9 | |
| F _{H₂} /F _{CO} | 1.9 | | | | | | |
| F _{H₂O} /F _{CO₂} | 10.7 | | | | | | |
| ε _C | 4.9 | | | | | | |

Table 90: Exp. 17. Feed data, GHSV = 250 L_{CH₄}/g_{cat}·h

| Compound | V [mL/min (STP)] | y [-] | F [mmol/s] |
|-----------------|---------------------|----------|---------------|
| CH ₄ | 81.7 | 0.2958 | 0.0562 |
| O ₂ | 40.8 | 0.1479 | 0.0281 |
| N ₂ | 151.9 | 0.5500 | 0.1046 |
| Total | 276.1 | 1.0000 | 0.1901 |

Table 91: Exp. 17. Product data, GHSV = 250 L_{CH₄}/g_{cat}·h, TOS = 98 min. Analysis 1

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 6.40338 | 0.0640 | | | | | |
| H ₂ | 26.41300 | 0.2641 | | 0.0647 | | 80.6 | 57.5 |
| N ₂ | 43.11167 | 0.4311 | 0.6551 | 0.1046 | | | |
| CO | 15.35850 | 0.1536 | 0.2334 | 0.0372 | | 95.6 | |
| CH ₄ (TCD) | 6.63548 | 0.0664 | 0.1008 | 0.0161 | 70.8 | | |
| CO ₂ | 0.69982 | 0.0070 | 0.0106 | 0.0017 | | 4.4 | |
| H ₂ O | | | | 0.0156 | | 19.4 | |
| F _{H₂} /F _{CO} | 1.7 | | | | | | |
| F _{H₂O} /F _{CO₂} | 9.2 | | | | | | |
| ε _C | 2.1 | | | | | | |

Table 92: Exp. 17. Product data, GHSV = 250 L_{CH₄}/g_{cat}·h, TOS = 121 min. Analysis 2

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 6.89747 | 0.0690 | | | | | |
| H ₂ | 25.19463 | 0.2519 | | 0.0615 | | 78.9 | 54.7 |
| N ₂ | 43.11038 | 0.4311 | 0.6553 | 0.1046 | | | |
| CO | 14.78143 | 0.1478 | 0.2247 | 0.0359 | | 94.9 | |
| CH ₄ (TCD) | 7.09735 | 0.0710 | 0.1079 | 0.0172 | 68.7 | | |
| CO ₂ | 0.79919 | 0.0080 | 0.0121 | 0.0019 | | 5.1 | |
| H ₂ O | | | | 0.0165 | | 21.2 | |
| F _{H₂} /F _{CO} | 1.7 | | | | | | |
| F _{H₂O} /F _{CO₂} | 8.5 | | | | | | |
| ε _C | 2.2 | | | | | | |

Table 93: Exp. 17. Product data, GHSV = 250 L_{CH₄}/g_{cat}·h, TOS = 145 min. Analysis 3

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 7.45760 | 0.0746 | | | | | |
| H ₂ | 24.31932 | 0.2432 | | 0.0584 | | 77.1 | 51.9 |
| N ₂ | 43.65208 | 0.4365 | 0.6552 | 0.1046 | | | |
| CO | 14.39773 | 0.1440 | 0.2161 | 0.0345 | | 94.0 | |
| CH ₄ (TCD) | 7.65877 | 0.0766 | 0.1150 | 0.0183 | 66.7 | | |
| CO ₂ | 0.91477 | 0.0091 | 0.0137 | 0.0022 | | 6.0 | |
| H ₂ O | | | | 0.0174 | | 22.9 | |
| F _{H₂} /F _{CO} | 1.7 | | | | | | |
| F _{H₂O} /F _{CO₂} | 7.9 | | | | | | |
| ε _C | 2.2 | | | | | | |

Table 94: Exp. 17. Feed data, GHSV = 350 L_{CH₄}/g_{cat}·h

| Compound | V [mL/min (STP)] | y [-] | F [mmol/s] |
|-----------------|---------------------|----------|---------------|
| CH ₄ | 114.3 | 0.2958 | 0.0787 |
| O ₂ | 57.2 | 0.1479 | 0.0394 |
| N ₂ | 212.6 | 0.5500 | 0.1464 |
| Total | 386.6 | 1.0000 | 0.2661 |

Table 95: Exp. 17. Product data, GHSV = 350 L_{CH₄}/g_{cat}·h, TOS = 178 min. Analysis 1

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 9.30382 | 0.0930 | | | | | |
| H ₂ | 21.19302 | 0.2119 | | 0.0688 | | 71.4 | 43.7 |
| O ₂ | 0.293756 | 0.0029 | 0.0042 | 0.0009 | 97.6 | | |
| N ₂ | 45.98390 | 0.4598 | 0.6557 | 0.1464 | | | |
| CO | 13.04207 | 0.1304 | 0.1860 | 0.0415 | | 91.4 | |
| CH ₄ (TCD) | 9.59128 | 0.0959 | 0.1368 | 0.0305 | 59.8 | | |
| CO ₂ | 1.22345 | 0.0122 | 0.0174 | 0.0039 | | 8.6 | |
| H ₂ O | | | | 0.0275 | | 28.6 | |
| F _{H₂} /F _{CO} | 1.7 | | | | | | |
| F _{H₂O} /F _{CO₂} | 7.1 | | | | | | |
| ε _C | 3.5 | | | | | | |

Table 96: Exp. 17. Product data, GHSV = 350 L_{CH₄}/g_{cat}·h, TOS = 201 min. Analysis 2

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 10.01085 | 0.1001 | | | | | |
| H ₂ | 19.96280 | 0.1996 | | 0.0635 | | 68.8 | 40.4 |
| O ₂ | 0.36739 | 0.0037 | 0.0052 | 0.0012 | 97.1 | | |
| N ₂ | 46.65882 | 0.4666 | 0.6552 | 0.1464 | | | |
| CO | 12.47266 | 0.1247 | 0.1751 | 0.0391 | | 90.3 | |
| CH ₄ (TCD) | 10.36973 | 0.1037 | 0.1456 | 0.0325 | 57.1 | | |
| CO ₂ | 1.34352 | 0.0134 | 0.0189 | 0.0042 | | 9.7 | |
| H ₂ O | | | | 0.0289 | | 31.2 | |
| F _{H₂} /F _{CO} | 1.6 | | | | | | |
| F _{H₂O} /F _{CO₂} | 6.9 | | | | | | |
| ε _C | 3.6 | | | | | | |

Table 97: Exp. 17. Product data, GHSV = 350 L_{CH₄}/g_{cat}·h, TOS = 225 min. Analysis 3

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|-----------------|------------|------------|------------|
| CH ₄ (FID) | 10.79475 | 0.1079 | | | | | |
| H ₂ | 18.75379 | 0.1875 | | 0.0583 | | 65.8 | 37.0 |
| O ₂ | 0.416235 | 0.0042 | 0.0058 | 0.0013 | 96.7 | | |
| N ₂ | 47.40020 | 0.4740 | 0.6548 | 0.1464 | | | |
| CO | 11.94293 | 0.1194 | 0.1650 | 0.0369 | | 89.1 | |
| CH ₄ (TCD) | 11.16284 | 0.1116 | 0.1542 | 0.0345 | 54.6 | | |
| CO ₂ | 1.46237 | 0.0146 | 0.0202 | 0.0045 | | 10.9 | |
| H ₂ O | | | | 0.0302 | | 34.2 | |
| F_{H_2}/F_{CO} | 1.6 | | | | | | |
| F_{H_2O}/F_{CO_2} | 6.7 | | | | | | |
| ε_C | 3.6 | | | | | | |

Table 98: Exp. 17. Feed data, GHSV = 400 L_{CH₄}/g_{cat}·h

| Compound | V [mL/min (STP)] | y [-] | F [mmol/s] |
|-----------------|-----------------------|------------|-----------------|
| CH ₄ | 130.7 | 0.2958 | 0.0900 |
| O ₂ | 65.3 | 0.1479 | 0.0450 |
| N ₂ | 243.0 | 0.5500 | 0.1673 |
| Total | 441.8 | 1.0000 | 0.3042 |

Table 99: Exp. 17. Product data, GHSV = 400 L_{CH₄}/g_{cat}·h, TOS = 253 min. Analysis 1

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 9.30382 | 0.0930 | | | | | |
| H ₂ | 17.08852 | 0.1709 | | 0.0594 | | 62.2 | 33.0 |
| O ₂ | 0.589407 | 0.0059 | 0.0079 | 0.0020 | 95.5 | | |
| N ₂ | 48.63683 | 0.4864 | 0.6547 | 0.1673 | | | |
| CO | 11.16338 | 0.1116 | 0.1503 | 0.0384 | | 87.2 | |
| CH ₄ (TCD) | 12.25341 | 0.1225 | 0.1649 | 0.0421 | 51.1 | | |
| CO ₂ | 1.64425 | 0.0164 | 0.0221 | 0.0057 | | 12.8 | |
| H ₂ O | | | | 0.0362 | | 37.9 | |
| F _{H₂} /F _{CO} | 1.6 | | | | | | |
| F _{H₂O} /F _{CO₂} | 6.4 | | | | | | |
| ε _C | 4.2 | | | | | | |

Table 100: Exp. 17. Product data, GHSV = 400 L_{CH₄}/g_{cat}·h, TOS = 276 min. Analysis 2

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 12.86877 | 0.1287 | | | | | |
| H ₂ | 15.61770 | 0.1562 | | 0.0527 | | 58.3 | 29.3 |
| O ₂ | 0.712714 | 0.0071 | 0.0094 | 0.0024 | 94.7 | | |
| N ₂ | 49.55625 | 0.4956 | 0.6540 | 0.1673 | | | |
| CO | 10.45510 | 0.1046 | 0.1380 | 0.0353 | | 85.4 | |
| CH ₄ (TCD) | 13.25441 | 0.1325 | 0.1749 | 0.0447 | 48.0 | | |
| CO ₂ | 1.79420 | 0.0179 | 0.0237 | 0.0061 | | 14.7 | |
| H ₂ O | | | | 0.0377 | | 41.7 | |
| F _{H₂} /F _{CO} | 1.5 | | | | | | |
| F _{H₂O} /F _{CO₂} | 6.2 | | | | | | |
| ε _C | 4.3 | | | | | | |

Table 101: Exp. 17. Product data, GHSV = 400 L_{CH₄}/g_{cat}·h, TOS = 300 min. Analysis 3

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|-----------------|------------|------------|------------|
| CH ₄ (FID) | 14.06558 | 0.1407 | | | | | |
| H ₂ | 13.86766 | 0.1387 | | 0.0450 | | 53.3 | 25.0 |
| O ₂ | 0.867279 | 0.0087 | 0.0112 | 0.0029 | 93.6 | | |
| N ₂ | 50.68615 | 0.5069 | 0.6531 | 0.1673 | | | |
| CO | 9.61194 | 0.0961 | 0.1238 | 0.0317 | | 82.9 | |
| CH ₄ (TCD) | 14.46732 | 0.1447 | 0.1864 | 0.0478 | 44.5 | | |
| CO ₂ | 1.97986 | 0.0198 | 0.0255 | 0.0065 | | 17.1 | |
| H ₂ O | | | | 0.0394 | | 46.7 | |
| F_{H_2}/F_{CO} | 1.4 | | | | | | |
| F_{H_2O}/F_{CO_2} | 6.0 | | | | | | |
| ε_C | 4.4 | | | | | | |

Table 102: Exp. 17. Feed data, GHSV = 450 L_{CH₄}/g_{cat}·h

| Compound | V [mL/min (STP)] | y [-] | F [mmol/s] |
|-----------------|-----------------------|------------|-----------------|
| CH ₄ | 147.0 | 0.2958 | 0.1012 |
| O ₂ | 73.5 | 0.1479 | 0.0506 |
| N ₂ | 273.4 | 0.5500 | 0.1882 |
| Total | 497.0 | 1.0000 | 0.3422 |

Table 103: Exp. 17. Product data, GHSV = 450 L_{CH₄}/g_{cat}·h, TOS = 330 min. Analysis 1

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 15.73267 | 0.1573 | | | | | |
| H ₂ | 11.58552 | 0.1159 | | 0.0471 | | 47.7 | 23.3 |
| O ₂ | 1.39274 | 0.0139 | 0.0173 | 0.0045 | 91.2 | | |
| N ₂ | 52.34104 | 0.5234 | 0.6499 | 0.1673 | | | |
| CO | 8.43107 | 0.0843 | 0.1047 | 0.0269 | | 79.7 | |
| CH ₄ (TCD) | 16.22612 | 0.1623 | 0.2015 | 0.0519 | 39.5 | | |
| CO ₂ | 2.15099 | 0.0215 | 0.0267 | 0.0069 | | 20.3 | |
| H ₂ O | | | | 0.0516 | | 52.3 | |
| F _{H₂} /F _{CO} | 1.8 | | | | | | |
| F _{H₂O} /F _{CO₂} | 7.5 | | | | | | |
| ε _C | 15.3 | | | | | | |

Table 104: Exp. 17. Product data, GHSV = 450 L_{CH₄}/g_{cat}·h, TOS = 353 min. Analysis 2

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 17.24136 | 0.1724 | | | | | |
| H ₂ | 9.35638 | 0.0936 | | 0.0381 | | 41.6 | 18.8 |
| O ₂ | 1.624 | 0.0162 | 0.0196 | 0.0051 | 90 | | |
| N ₂ | 53.70556 | 0.5371 | 0.6491 | 0.1673 | | | |
| CO | 7.17356 | 0.0717 | 0.0867 | 0.0223 | | 74.6 | |
| CH ₄ (TCD) | 17.78301 | 0.1778 | 0.2149 | 0.0554 | 35.1 | | |
| CO ₂ | 2.44935 | 0.0245 | 0.0296 | 0.0076 | | 25.5 | |
| H ₂ O | | | | 0.0535 | | 58.4 | |
| F _{H₂} /F _{CO} | 1.7 | | | | | | |
| F _{H₂O} /F _{CO₂} | 7.0 | | | | | | |
| ε _C | 15.7 | | | | | | |

Table 105: Exp. 17. Product data, $\text{GHSV} = 450 \text{ L}_{\text{CH}_4}/\text{g}_{\text{cat}}\cdot\text{h}$, $\text{TOS} = 377 \text{ min}$. Analysis 3

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{\text{norm.}}$ [-] | \mathbf{F} [mmol/s] | \mathbf{X} [%] | \mathbf{S} [%] | \mathbf{Y} [%] |
|--|----------------------------|------------------------|---------------------------|--------------------------|---------------------|---------------------|---------------------|
| CH_4 (FID) | 18.35337 | 0.1835 | | | | | |
| H_2 | 8.01167 | 0.0801 | | 0.0333 | | 38.6 | 16.4 |
| O_2 | 2.22649 | 0.0223 | 0.0264 | 0.0068 | 86.5 | | |
| N_2 | 54.47626 | 0.5448 | 0.6448 | 0.1673 | | | |
| CO | 6.43640 | 0.0644 | 0.0762 | 0.0198 | | 72.7 | |
| CH_4 (TCD) | 18.92726 | 0.1893 | 0.2240 | 0.0581 | 31.8 | | |
| CO_2 | 2.41810 | 0.0242 | 0.0286 | 0.0074 | | 27.3 | |
| H_2O | | | | 0.0529 | | 61.4 | |
| $F_{\text{H}_2}/F_{\text{CO}}$ | 1.7 | | | | | | |
| $F_{\text{H}_2\text{O}}/F_{\text{CO}_2}$ | 7.1 | | | | | | |
| ε_{C} | 15.7 | | | | | | |

Table 106: Exp. 17. Feed data, $\text{GHSV} = 150 \text{ L}_{\text{CH}_4}/\text{g}_{\text{cat}}\cdot\text{h}$

| Compound | \mathbf{V} [mL/min (STP)] | \mathbf{y} [-] | \mathbf{F} [mmol/s] |
|---------------|--------------------------------|---------------------|--------------------------|
| CH_4 | 49.0 | 0.2958 | 0.0337 |
| O_2 | 24.5 | 0.1479 | 0.0169 |
| N_2 | 91.1 | 0.5500 | 0.0627 |
| Total | 165.7 | 1.0000 | 0.1141 |

Table 107: Exp. 17. Product data, GHSV = 150 L_{CH₄}/g_{cat}·h, TOS = 404 min. Analysis 1

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 24.41721 | 0.2442 | | | | | |
| H ₂ | 1.01555 | 0.0102 | 0.0108 | 0.0011 | | 6.4 | 1.6 |
| O ₂ | 4.10695 | 0.0411 | 0.0435 | 0.0044 | 74.1 | | |
| N ₂ | 59.07316 | 0.5907 | 0.6261 | 0.0627 | | | |
| CO | 1.08690 | 0.0109 | 0.0115 | 0.0012 | | 22.1 | |
| CH ₄ (TCD) | 25.22214 | 0.2522 | 0.2673 | 0.0268 | 16.4 | | |
| CO ₂ | 3.84158 | 0.0384 | 0.0407 | 0.0041 | | 78.0 | |
| H ₂ O | | | | 0.0157 | | 93.6 | |
| F _{H₂} /F _{CO} | 0.9 | | | | | | |
| F _{H₂O} /F _{CO₂} | 3.9 | | | | | | |
| ε _C | 5.1 | | | | | | |

Table 108: Exp. 17. Product data, GHSV = 150 L_{CH₄}/g_{cat}·h, TOS = 427 min. Analysis 2

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 24.93293 | 0.2493 | | | | | |
| H ₂ | 0.95709 | 0.0096 | 0.0101 | 0.0010 | | 6.2 | 1.5 |
| O ₂ | 4.47949 | 0.0448 | 0.0474 | 0.0048 | 71.6 | | |
| N ₂ | 58.67799 | 0.5868 | 0.6208 | 0.0627 | | | |
| CO | 1.03185 | 0.0103 | 0.0109 | 0.0011 | | 21.9 | |
| CH ₄ (TCD) | 25.68872 | 0.2569 | 0.2718 | 0.0275 | 15.5 | | |
| CO ₂ | 3.68378 | 0.0368 | 0.0390 | 0.0039 | | 78.1 | |
| H ₂ O | | | | 0.0152 | | 93.7 | |
| F _{H₂} /F _{CO} | 0 | | | | | | |
| F _{H₂O} /F _{CO₂} | 0.6 | | | | | | |
| ε _C | 3.7 | | | | | | |

Table 109: Exp. 17. Temperature data

| GHSV = 0 | | GHSV = 150 | | GHSV = 250 | | GHSV = 350 | |
|---------------------------|-----------|---------------------------|-----------|---------------------------|-----------|---------------------------|-----------|
| d _{b.e.} [cm] | T [°C] | d _{b.e.} [cm] | T [°C] | d _{b.e.} [cm] | T [°C] | d _{b.e.} [cm] | T [°C] |
| -2.2 | 770.6 | -3.2 | 769.5 | -3.2 | 766.5 | -3.2 | 761.3 |
| -1.7 | 770.6 | -2.7 | 769.5 | -2.7 | 766.7 | -2.7 | 762.0 |
| -1.2 | 770.4 | -2.2 | 769.5 | -2.2 | 767.3 | -2.2 | 762.7 |
| -0.7 | 770.0 | -1.7 | 770.0 | -1.7 | 768.0 | -1.7 | 764.3 |
| -0.2 | 768.8 | -1.2 | 771.0 | -1.2 | 770.0 | -1.2 | 767.6 |
| 0.0 | 767.5 | -0.7 | 774.3 | -0.7 | 777.8 | -0.7 | 777.5 |
| 0.3 | 765.9 | -0.2 | 780.5 | -0.2 | 790.5 | -0.2 | 804.0 |
| 0.8 | 765.5 | -0.1 | 781.8 | -0.1 | 796.0 | -0.1 | 814.5 |
| 1.3 | 765.0 | 0.0 | 782.5 | 0.0 | 799.2 | 0.0 | 818.5 |
| 1.8 | 763.8 | 0.1 | 781.7 | 0.1 | 802.4 | 0.1 | 830.6 |
| 2.3 | 761.6 | 0.2 | 779.5 | 0.2 | 803.7 | 0.2 | 835.8 |
| 2.8 | 759.0 | 0.3 | 773.2 | 0.3 | 796.5 | 0.3 | 827.5 |
| | | 0.8 | 766.5 | 0.8 | 787.0 | 0.4 | 822.0 |
| | | 1.3 | 764.1 | 1.3 | 777.2 | 0.8 | 792.3 |
| | | 1.8 | 762.0 | 1.8 | 770.0 | 1.3 | 777.2 |
| | | 2.3 | 759.2 | 2.3 | 761.0 | 1.8 | 769.3 |
| | | 2.8 | 756.5 | 2.8 | 757.4 | 2.3 | 763.2 |
| | | | | | | 2.8 | 757.0 |
| | | GHSV = 400 | | GHSV = 450 | | GHSV = 150 | |
| | | d _{b.e.} [cm] | T [°C] | d _{b.e.} [cm] | T [°C] | d _{b.e.} [cm] | T [°C] |
| | | -3.2 | 754.8 | -3.2 | 740.3 | -3.2 | 753.0 |
| | | -2.7 | 756.0 | -2.7 | 741.8 | -2.7 | 753.5 |
| | | -2.2 | 757.0 | -2.2 | 743.2 | -2.2 | 754.0 |
| | | -1.7 | 759.0 | -1.7 | 745.7 | -1.7 | 755.3 |
| | | -1.2 | 764.4 | -1.2 | 751 | -1.2 | 758.5 |
| | | -0.7 | 777.8 | -0.7 | 766.6 | -0.7 | 766.8 |
| | | -0.2 | 813.4 | -0.2 | 818.2 | -0.2 | 793.0 |
| | | -0.1 | 830.0 | -0.1 | 832.7 | -0.1 | 797.0 |
| | | 0.0 | 847.5 | 0.0 | 853.5 | 0 | 805.5 |
| | | 0.1 | 858.3 | 0.1 | 866.8 | 0.1 | 809.5 |
| | | 0.2 | 866.8 | 0.2 | 879.5 | 0.2 | 812.6 |
| | | 0.3 | 862.3 | 0.3 | 877.8 | 0.3 | 809.5 |
| | | 0.8 | 806.0 | 0.8 | 813.3 | 0.8 | 772.2 |
| | | 1.3 | 784.5 | 1.3 | 780 | 1.3 | 758.3 |
| | | 1.8 | 773.2 | 1.8 | 768 | 1.8 | 750.7 |
| | | 2.3 | 764.0 | 2.3 | 758 | 2.3 | 745.3 |
| | | 2.8 | 757.0 | 2.8 | 751 | 2.8 | 741.0 |

Experiment 18

Catalyst: Monolithic Co/CeO₂–Al₂O₃

GHSV = 75 L_{CH₄}/g_{cat}·h

Reduction: 50 mL/min 50 vol.% H₂ in N₂, 10 K/min, 973 K, 2h

T_{furnace} = 1023 K

Table 110: Exp. 18. Feed data

| Compound | V [mL/min (STP)] | y [-] | F [mmol/s] |
|-----------------|---------------------|----------|---------------|
| CH ₄ | 166.7 | 0.2958 | 0.1148 |
| O ₂ | 83.3 | 0.1479 | 0.0574 |
| N ₂ | 309.9 | 0.5500 | 0.2134 |
| Total | 563.5 | 1.0000 | 0.3880 |

Table 111: Exp. 18. Product data, TOS = 20 min

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 5.65530 | 0.0566 | | | | | |
| H ₂ | 26.52139 | 0.2652 | | | | 82.7 | 61.8 |
| N ₂ | 42.35700 | 0.4236 | 0.6599 | 0.2134 | | | |
| CO | 15.23627 | 0.1524 | 0.2374 | 0.0768 | | 94.8 | |
| CH ₄ (TCD) | 5.76368 | 0.0576 | 0.0898 | 0.0290 | 73.6 | | |
| CO ₂ | 0.83066 | 0.0083 | 0.0129 | 0.0042 | | 5.2 | |
| H ₂ O | | | | | | 17.3 | |
| F _{H₂} /F _{CO} | 1.9 | | | | | | |
| F _{H₂O} /F _{CO₂} | 7.1 | | | | | | |
| ε _C | 4.2 | | | | | | |

Table 112: Exp. 18. Product data, TOS = 43 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 6.22378 | 0.0622 | | | | | |
| H ₂ | 25.85705 | 0.2586 | | | | 81.1 | 58.9 |
| N ₂ | 43.25364 | 0.4325 | 0.6601 | 0.2134 | | | |
| CO | 14.97149 | 0.1497 | 0.2285 | 0.0739 | | 94.1 | |
| CH ₄ (TCD) | 6.36192 | 0.0636 | 0.0971 | 0.0314 | 71.4 | | |
| CO ₂ | 0.94347 | 0.0094 | 0.0144 | 0.0047 | | 5.9 | |
| H ₂ O | | | | | | 18.9 | |
| F_{H_2}/F_{CO} | 1.8 | | | | | | |
| F_{H_2O}/F_{CO_2} | 6.8 | | | | | | |
| ε_C | 4.2 | | | | | | |

Table 113: Exp. 18. Product data, TOS = 66 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 6.67019 | 0.0667 | | | | | |
| H ₂ | 25.21102 | 0.2521 | | | | 79.7 | 56.7 |
| N ₂ | 43.78924 | 0.4379 | 0.6600 | 0.2134 | | | |
| CO | 14.70402 | 0.1470 | 0.2216 | 0.0717 | | 93.4 | |
| CH ₄ (TCD) | 6.81776 | 0.0682 | 0.1028 | 0.0332 | 69.8 | | |
| CO ₂ | 1.03211 | 0.0103 | 0.0156 | 0.0050 | | 6.6 | |
| H ₂ O | | | | | | 20.3 | |
| F_{H_2}/F_{CO} | 1.8 | | | | | | |
| F_{H_2O}/F_{CO_2} | 6.6 | | | | | | |
| ε_C | 4.2 | | | | | | |

Table 114: Exp. 18. Product data, TOS = 93 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|-----------------|------------|------------|------------|
| CH ₄ (FID) | 7.27604 | 0.0728 | | | | | |
| H ₂ | 24.32662 | 0.2433 | | 0.1237 | | 78.1 | 53.9 |
| N ₂ | 44.41157 | 0.4441 | 0.6601 | 0.2134 | | | |
| CO | 14.31895 | 0.1432 | 0.2128 | 0.0688 | | 92.5 | |
| CH ₄ (TCD) | 7.38795 | 0.0739 | 0.1098 | 0.0355 | 67.7 | | |
| CO ₂ | 1.16137 | 0.0116 | 0.0173 | 0.0056 | | 7.5 | |
| H ₂ O | | | | 0.0348 | | 22.0 | |
| F_{H_2}/F_{CO} | 1.8 | | | | | | |
| F_{H_2O}/F_{CO_2} | 6.2 | | | | | | |
| ε_C | 4.3 | | | | | | |

Table 115: Exp. 18. Product data, TOS = 117 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|-----------------|------------|------------|------------|
| CH ₄ (FID) | 7.62628 | 0.0763 | | | | | |
| H ₂ | 23.73046 | 0.2373 | | 0.1190 | | 76.7 | 51.9 |
| N ₂ | 44.92350 | 0.4492 | 0.6602 | 0.2134 | | | |
| CO | 14.07545 | 0.1408 | 0.2068 | 0.0669 | | 92.0 | |
| CH ₄ (TCD) | 7.81888 | 0.0782 | 0.1149 | 0.0371 | 66.2 | | |
| CO ₂ | 1.23165 | 0.0123 | 0.0181 | 0.0059 | | 8.1 | |
| H ₂ O | | | | 0.0362 | | 23.3 | |
| F_{H_2}/F_{CO} | 1.8 | | | | | | |
| F_{H_2O}/F_{CO_2} | 6.2 | | | | | | |
| ε_C | 4.3 | | | | | | |

Table 116: Exp. 18. Product data, TOS = 141 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|-----------------|------------|------------|------------|
| CH ₄ (FID) | 7.90545 | 0.0791 | | | | | |
| H ₂ | 23.25627 | 0.2326 | | 0.1159 | | 75.7 | 50.5 |
| N ₂ | 45.14907 | 0.4515 | 0.6601 | 0.2134 | | | |
| CO | 13.89302 | 0.1389 | 0.2031 | 0.0657 | | 91.7 | |
| CH ₄ (TCD) | 8.08638 | 0.0809 | 0.1182 | 0.0382 | 65.2 | | |
| CO ₂ | 1.26541 | 0.0127 | 0.0185 | 0.0060 | | 8.4 | |
| H ₂ O | | | | 0.0371 | | 24.3 | |
| F_{H_2}/F_{CO} | 1.8 | | | | | | |
| F_{H_2O}/F_{CO_2} | 6.2 | | | | | | |
| ε_C | 4.3 | | | | | | |

Table 117: Exp. 18. Product data, TOS = 165 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|-----------------|------------|------------|------------|
| CH ₄ (FID) | 8.20171 | 0.0820 | | | | | |
| H ₂ | 22.92471 | 0.2292 | | 0.1134 | | 75.0 | 49.4 |
| N ₂ | 45.43115 | 0.4543 | 0.6601 | 0.2134 | | | |
| CO | 13.76351 | 0.1376 | 0.2000 | 0.0646 | | 91.4 | |
| CH ₄ (TCD) | 8.33200 | 0.0833 | 0.1211 | 0.0391 | 64.4 | | |
| CO ₂ | 1.30269 | 0.0130 | 0.0189 | 0.0061 | | 8.7 | |
| H ₂ O | | | | 0.0379 | | 25.0 | |
| F_{H_2}/F_{CO} | 1.8 | | | | | | |
| F_{H_2O}/F_{CO_2} | 6.2 | | | | | | |
| ε_C | 4.2 | | | | | | |

Table 118: Exp. 18. Product data, TOS = 188 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 8.36258 | 0.0836 | | | | | |
| H ₂ | 22.58740 | 0.2259 | | 0.1112 | | 74.3 | 48.5 |
| N ₂ | 45.66332 | 0.4566 | 0.6601 | 0.2134 | | | |
| CO | 13.64696 | 0.1365 | 0.1973 | 0.0638 | | 91.1 | |
| CH ₄ (TCD) | 8.53496 | 0.0853 | 0.1234 | 0.0399 | 63.7 | | |
| CO ₂ | 1.33308 | 0.0133 | 0.0193 | 0.0062 | | 8.9 | |
| H ₂ O | | | | 0.0385 | | 25.7 | |
| F_{H_2}/F_{CO} | 1.7 | | | | | | |
| F_{H_2O}/F_{CO_2} | 6.2 | | | | | | |
| ε_C | 4.2 | | | | | | |

Table 119: Exp. 18. Product data, TOS = 212 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 8.51483 | 0.0851 | | | | | |
| H ₂ | 22.33921 | 0.2234 | | 0.1095 | | 71.8 | 47.7 |
| N ₂ | 45.80784 | 0.4581 | 0.6599 | 0.2134 | | | |
| CO | 13.56216 | 0.1356 | 0.1954 | 0.0632 | | 90.9 | |
| CH ₄ (TCD) | 8.69260 | 0.0869 | 0.1252 | 0.0405 | 63.2 | | |
| CO ₂ | 1.35101 | 0.0135 | 0.0195 | 0.0063 | | 9.1 | |
| H ₂ O | | | | 0.0390 | | 26.3 | |
| F_{H_2}/F_{CO} | 1.7 | | | | | | |
| F_{H_2O}/F_{CO_2} | 6.2 | | | | | | |
| ε_C | 4.2 | | | | | | |

Table 120: Exp. 18. Product data, TOS = 235 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 8.68445 | 0.0868 | | | | | |
| H ₂ | 22.09340 | 0.2209 | | 0.1077 | | 73.1 | 46.9 |
| N ₂ | 46.05902 | 0.4606 | 0.6602 | 0.2134 | | | |
| CO | 13.45982 | 0.1346 | 0.1929 | 0.0624 | | 90.7 | |
| CH ₄ (TCD) | 8.86859 | 0.0887 | 0.1271 | 0.0411 | 62.6 | | |
| CO ₂ | 1.37661 | 0.0138 | 0.0197 | 0.0064 | | 9.3 | |
| H ₂ O | | | | 0.0396 | | 26.9 | |
| F_{H_2}/F_{CO} | 1.7 | | | | | | |
| F_{H_2O}/F_{CO_2} | 6.2 | | | | | | |
| ε_C | 4.2 | | | | | | |

Table 121: Exp. 18. Product data, TOS = 258 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 8.83333 | 0.0883 | | | | | |
| H ₂ | 21.81531 | 0.2182 | | 0.1058 | | 72.5 | 46.1 |
| N ₂ | 46.22755 | 0.4623 | 0.6600 | 0.2134 | | | |
| CO | 13.36730 | 0.1337 | 0.1908 | 0.0617 | | 90.5 | |
| CH ₄ (TCD) | 9.05138 | 0.0905 | 0.1292 | 0.0418 | 62.0 | | |
| CO ₂ | 1.39815 | 0.0140 | 0.0200 | 0.0065 | | 9.5 | |
| H ₂ O | | | | 0.0401 | | 27.5 | |
| F_{H_2}/F_{CO} | 1.7 | | | | | | |
| F_{H_2O}/F_{CO_2} | 6.2 | | | | | | |
| ε_C | 4.2 | | | | | | |

Table 122: Exp. 18. Product data, TOS = 282 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 9.00413 | 0.0900 | | | | | |
| H ₂ | 21.57338 | 0.2157 | | 0.1039 | | 71.9 | 45.3 |
| N ₂ | 46.44846 | 0.4645 | 0.6598 | 0.2134 | | | |
| CO | 13.27724 | 0.1328 | 0.1886 | 0.0610 | | 90.3 | |
| CH ₄ (TCD) | 9.24096 | 0.0924 | 0.1313 | 0.0425 | 61.4 | | |
| CO ₂ | 1.42612 | 0.0143 | 0.0203 | 0.0066 | | 9.7 | |
| H ₂ O | | | | 0.0407 | | 28.1 | |
| F_{H_2}/F_{CO} | 1.7 | | | | | | |
| F_{H_2O}/F_{CO_2} | 6.2 | | | | | | |
| ε_C | 4.1 | | | | | | |

Table 123: Exp. 18. Temperature data

| $d_{\text{bed entrance}}$ [cm] | T [°C] |
|-----------------------------------|-----------|
| -2.6 | 753 |
| -2.5 | 754.7 |
| -2 | 760.5 |
| -1.5 | 767.5 |
| -1 | 786.8 |
| -0.5 | 832.3 |
| -0.3 | 874.2 |
| -0.1 | 888.2 |
| 0 | 896.6 |
| 0.1 | 897.2 |
| 0.2 | 891.6 |
| 0.3 | 880.6 |
| 0.4 | 868 |
| 0.5 | 857.2 |
| 0.6 | 843.5 |
| 0.7 | 832.4 |
| 0.8 | 814.8 |
| 0.9 | 799.2 |
| 1 | 795 |
| 1.5 | 771.5 |
| 2 | 762 |
| 2.5 | 759.8 |
| 3 | 758 |
| 3.5 | 757 |

Experiment 19

Catalyst: Co/CeO₂–Al₂O₃ (1273 K)

$m_{\text{catalyst}} = 0.0953 \text{ g}$

GHSV = 75 L_{CH₄}/g_{cat}·h

Reduction: 50 mL/min 50 vol.% H₂ in N₂, 10 K/min, 973 K, 2h

$T_{\text{furnace}} = 1023 \text{ K}$

Table 124: Exp. 19. Feed data

| Compound | V [mL/min (STP)] | y [-] | F [mmol/s] |
|-----------------|---------------------|----------|---------------|
| CH ₄ | 119.1 | 0.2958 | 0.0820 |
| O ₂ | 59.6 | 0.1479 | 0.0410 |
| N ₂ | 221.5 | 0.5500 | 0.1525 |
| Total | 402.8 | 1.0000 | 0.2773 |

Table 125: Exp. 19. Product data, TOS = 20 min

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 4.21818 | 0.0422 | | | | | |
| H ₂ | 29.07686 | 0.2908 | | 0.1139 | | 86.6 | 69.5 |
| N ₂ | 41.45171 | 0.4145 | 0.6582 | 0.1525 | | | |
| CO | 16.70295 | 0.1670 | 0.2652 | 0.0615 | | 97.6 | |
| CH ₄ (TCD) | 4.41949 | 0.0442 | 0.0702 | 0.0163 | 79.5 | | |
| CO ₂ | 0.40325 | 0.0040 | 0.0064 | 0.0015 | | 2.4 | |
| H ₂ O | | | | 0.0176 | | 13.4 | |
| F _{H₂} /F _{CO} | 1.9 | | | | | | |
| F _{H₂O} /F _{CO₂} | 11.9 | | | | | | |
| ε _C | 3.4 | | | | | | |

Table 126: Exp. 19. Product data, TOS = 43.5 min

| Compound | y _{GC} [vol.%] | y _{GC} [-] | y _{norm.} [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|----------------------------|------------------------|---------------------------|---------------|----------|----------|----------|
| CH ₄ (FID) | 4.23144 | 0.0423 | | | | | |
| H ₂ | 29.20115 | 0.2920 | | 0.1141 | | 86.7 | 69.6 |
| N ₂ | 41.44205 | 0.4144 | 0.6581 | 0.1525 | | | |
| CO | 16.72784 | 0.1673 | 0.2656 | 0.0616 | | 97.7 | |
| CH ₄ (TCD) | 4.40389 | 0.0440 | 0.0699 | 0.0162 | 79.6 | | |
| CO ₂ | 0.39950 | 0.0040 | 0.0063 | 0.0015 | | 2.3 | |
| H ₂ O | | | | 0.0175 | | 13.3 | |
| F _{H₂} /F _{CO} | 1.9 | | | | | | |
| F _{H₂O} /F _{CO₂} | 11.9 | | | | | | |
| ε _C | 3.4 | | | | | | |

Table 127: Exp. 19. Product data, TOS = 67 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 4.31026 | 0.0431 | | | | | |
| H ₂ | 29.83804 | 0.2984 | | 0.1141 | | 86.7 | 69.6 |
| N ₂ | 42.24395 | 0.4224 | 0.6579 | 0.1525 | | | |
| CO | 17.06227 | 0.1706 | 0.2657 | 0.0616 | | 97.7 | |
| CH ₄ (TCD) | 4.49619 | 0.0450 | 0.0700 | 0.0162 | 79.5 | | |
| CO ₂ | 0.40718 | 0.0041 | 0.0063 | 0.0015 | | 2.3 | |
| H ₂ O | | | | 0.0175 | | 13.3 | |
| F_{H_2}/F_{CO} | 1.9 | | | | | | |
| F_{H_2O}/F_{CO_2} | 11.9 | | | | | | |
| ε_C | 3.3 | | | | | | |

Table 128: Exp. 19. Product data, TOS = 90.5 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 4.32529 | 0.0433 | | | | | |
| H ₂ | 29.90699 | 0.2991 | | 0.1141 | | 86.7 | 69.5 |
| N ₂ | 42.30182 | 0.4230 | 0.6577 | 0.1525 | | | |
| CO | 17.09220 | 0.1709 | 0.2658 | 0.0616 | | 97.7 | |
| CH ₄ (TCD) | 4.51105 | 0.0451 | 0.0701 | 0.0163 | 79.5 | | |
| CO ₂ | 0.41037 | 0.0041 | 0.0064 | 0.0015 | | 2.3 | |
| H ₂ O | | | | 0.0174 | | 13.3 | |
| F_{H_2}/F_{CO} | 1.9 | | | | | | |
| F_{H_2O}/F_{CO_2} | 11.8 | | | | | | |
| ε_C | 3.2 | | | | | | |

Table 129: Exp. 19. Product data, TOS = 114 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|---------------------|-----------------|--------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 4.30727 | 0.0431 | | | | | |
| H ₂ | 29.91702 | 0.2992 | | 0.1141 | | 86.7 | 69.5 |
| N ₂ | 42.34386 | 0.4234 | 0.6578 | 0.1525 | | | |
| CO | 17.10200 | 0.1710 | 0.2657 | 0.0616 | | 97.6 | |
| CH ₄ (TCD) | 4.51677 | 0.0452 | 0.0702 | 0.0163 | 79.5 | | |
| CO ₂ | 0.41389 | 0.0041 | 0.0064 | 0.0015 | | 2.3 | |
| H ₂ O | | | | 0.0174 | | 13.3 | |
| F _{H₂} /F _{CO} | 1.9 | | | | | | |
| F _{H₂O} /F _{CO₂} | 11.7 | | | | | | |
| ε_C | 3.2 | | | | | | |

Table 130: Exp. 19. Product data, TOS = 137.5 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|---------------------|-----------------|--------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 4.33104 | 0.0433 | | | | | |
| H ₂ | 29.90007 | 0.2990 | | 0.1140 | | 86.7 | 69.5 |
| N ₂ | 42.33013 | 0.4233 | 0.6577 | 0.1525 | | | |
| CO | 17.09554 | 0.1710 | 0.2656 | 0.0616 | | 97.6 | |
| CH ₄ (TCD) | 4.51888 | 0.0452 | 0.0702 | 0.0163 | 79.5 | | |
| CO ₂ | 0.41572 | 0.0042 | 0.0065 | 0.0015 | | 2.4 | |
| H ₂ O | | | | 0.0174 | | 13.3 | |
| F _{H₂} /F _{CO} | 1.9 | | | | | | |
| F _{H₂O} /F _{CO₂} | 11.6 | | | | | | |
| ε_C | 3.2 | | | | | | |

Table 131: Exp. 19. Product data, TOS = 161 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|-----------------|------------|------------|------------|
| CH ₄ (FID) | 4.32335 | 0.0432 | | | | | |
| H ₂ | 29.85996 | 0.2986 | | 0.1138 | | 86.7 | 69.4 |
| N ₂ | 42.30262 | 0.4230 | 0.6575 | 0.1525 | | | |
| CO | 17.08043 | 0.1708 | 0.2655 | 0.0616 | | 97.6 | |
| CH ₄ (TCD) | 4.54312 | 0.0454 | 0.0706 | 0.0164 | 79.4 | | |
| CO ₂ | 0.41730 | 0.0042 | 0.0065 | 0.0015 | | 2.4 | |
| H ₂ O | | | | 0.0174 | | 13.3 | |
| F_{H_2}/F_{CO} | 1.9 | | | | | | |
| F_{H_2O}/F_{CO_2} | 11.6 | | | | | | |
| ε_C | 3.1 | | | | | | |

Table 132: Exp. 19. Product data, TOS = 184.5 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|-----------------|------------|------------|------------|
| CH ₄ (FID) | 4.31464 | 0.0431 | | | | | |
| H ₂ | 29.80962 | 0.2981 | | 0.1138 | | 86.7 | 69.4 |
| N ₂ | 42.29908 | 0.4230 | 0.6575 | 0.1525 | | | |
| CO | 17.07003 | 0.1707 | 0.2653 | 0.0615 | | 97.6 | |
| CH ₄ (TCD) | 4.54661 | 0.0455 | 0.0707 | 0.0164 | 79.4 | | |
| CO ₂ | 0.41874 | 0.0042 | 0.0065 | 0.0015 | | 2.4 | |
| H ₂ O | | | | 0.0175 | | 13.3 | |
| F_{H_2}/F_{CO} | 1.9 | | | | | | |
| F_{H_2O}/F_{CO_2} | 11.6 | | | | | | |
| ε_C | 3.1 | | | | | | |

Table 133: Exp. 19. Product data, TOS = 208 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 4.37308 | 0.0437 | | | | | |
| H ₂ | 29.86480 | 0.2986 | | 0.1137 | | 86.7 | 69.3 |
| N ₂ | 42.36307 | 0.4236 | 0.6575 | 0.1525 | | | |
| CO | 17.07712 | 0.1708 | 0.2650 | 0.0615 | | 97.6 | |
| CH ₄ (TCD) | 4.56366 | 0.0456 | 0.0708 | 0.0164 | 79.3 | | |
| CO ₂ | 0.42600 | 0.0043 | 0.0066 | 0.0015 | | 2.4 | |
| H ₂ O | | | | 0.0175 | | 13.3 | |
| F_{H_2}/F_{CO} | 1.9 | | | | | | |
| F_{H_2O}/F_{CO_2} | 11.4 | | | | | | |
| ε_C | 3.1 | | | | | | |

Table 134: Exp. 19. Product data, TOS = 231.5 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 4.38328 | 0.0438 | | | | | |
| H ₂ | 29.79834 | 0.2980 | | 0.1136 | | 86.7 | 69.2 |
| N ₂ | 42.32066 | 0.4232 | 0.6573 | 0.1525 | | | |
| CO | 17.06091 | 0.1706 | 0.2650 | 0.0615 | | 97.6 | |
| CH ₄ (TCD) | 4.57897 | 0.0458 | 0.0711 | 0.0165 | 79.3 | | |
| CO ₂ | 0.42731 | 0.0043 | 0.0066 | 0.0015 | | 2.4 | |
| H ₂ O | | | | 0.0175 | | 13.3 | |
| F_{H_2}/F_{CO} | 1.9 | | | | | | |
| F_{H_2O}/F_{CO_2} | 11.3 | | | | | | |
| ε_C | 3.0 | | | | | | |

Table 135: Exp. 19. Product data, TOS = 255 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|---------------------|-----------------|--------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 4.40805 | 0.0441 | | | | | |
| H ₂ | 30.09847 | 0.3010 | | 0.1135 | | 86.7 | 69.2 |
| N ₂ | 42.71077 | 0.4271 | 0.6572 | 0.1525 | | | |
| CO | 17.20940 | 0.1721 | 0.2648 | 0.0615 | | 97.5 | |
| CH ₄ (TCD) | 4.62761 | 0.0463 | 0.0712 | 0.0165 | 79.2 | | |
| CO ₂ | 0.43664 | 0.0044 | 0.0067 | 0.0016 | | 2.5 | |
| H ₂ O | | | | 0.0174 | | 13.3 | |
| F _{H₂} /F _{CO} | 1.9 | | | | | | |
| F _{H₂O} /F _{CO₂} | 11.2 | | | | | | |
| ε_C | 3.0 | | | | | | |

Table 136: Exp. 19. Product data, TOS = 278.5 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|--|---------------------|-----------------|--------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 4.33876 | 0.0434 | | | | | |
| H ₂ | 29.79069 | 0.2979 | | 0.1138 | | 86.7 | 69.4 |
| N ₂ | 42.40401 | 0.4240 | 0.6581 | 0.1525 | | | |
| CO | 17.04185 | 0.1704 | 0.2645 | 0.0613 | | 97.5 | |
| CH ₄ (TCD) | 4.54419 | 0.0454 | 0.0705 | 0.0163 | 79.4 | | |
| CO ₂ | 0.44277 | 0.0044 | 0.0069 | 0.0016 | | 2.5 | |
| H ₂ O | | | | 0.0175 | | 13.4 | |
| F _{H₂} /F _{CO} | 1.9 | | | | | | |
| F _{H₂O} /F _{CO₂} | 11.2 | | | | | | |
| ε_C | 3.4 | | | | | | |

Table 137: Exp. 19. Product data, TOS = 302 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 4.33656 | 0.0434 | | | | | |
| H ₂ | 29.76854 | 0.2977 | | 0.1138 | | 86.6 | 69.4 |
| N ₂ | 42.41900 | 0.4242 | 0.6581 | 0.1525 | | | |
| CO | 17.03341 | 0.1703 | 0.2643 | 0.0612 | | 97.4 | |
| CH ₄ (TCD) | 4.55159 | 0.0455 | 0.0706 | 0.0164 | 79.3 | | |
| CO ₂ | 0.44979 | 0.0045 | 0.0070 | 0.0016 | | 2.6 | |
| H ₂ O | | | | 0.0175 | | 13.4 | |
| F_{H_2}/F_{CO} | 1.9 | | | | | | |
| F_{H_2O}/F_{CO_2} | 10.9 | | | | | | |
| ε_C | 3.4 | | | | | | |

Table 138: Exp. 19. Product data, TOS = 325.5 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 4.34470 | 0.0434 | | | | | |
| H ₂ | 29.71357 | 0.2971 | | 0.1136 | | 86.6 | 69.2 |
| N ₂ | 42.42237 | 0.4242 | 0.6581 | 0.1525 | | | |
| CO | 17.01866 | 0.1702 | 0.2640 | 0.0612 | | 97.4 | |
| CH ₄ (TCD) | 4.57214 | 0.0457 | 0.0709 | 0.0164 | 79.3 | | |
| CO ₂ | 0.44919 | 0.0045 | 0.0070 | 0.0016 | | 2.6 | |
| H ₂ O | | | | 0.0176 | | 13.4 | |
| F_{H_2}/F_{CO} | 1.9 | | | | | | |
| F_{H_2O}/F_{CO_2} | 10.9 | | | | | | |
| ε_C | 3.4 | | | | | | |

Table 139: Exp. 19. Product data, TOS = 349 min

| Compound | y_{GC} [vol.%] | y_{GC} [-] | $y_{norm.}$ [-] | F [mmol/s] | X [%] | S [%] | Y [%] |
|-----------------------|---------------------|-----------------|--------------------|----------------------|-----------------|-----------------|-----------------|
| CH ₄ (FID) | 4.38009 | 0.0438 | | | | | |
| H ₂ | 29.66823 | 0.2967 | | 0.1134 | | 86.6 | 69.2 |
| N ₂ | 42.40797 | 0.4241 | 0.6580 | 0.1525 | | | |
| CO | 17.00164 | 0.1700 | 0.2638 | 0.0611 | | 97.4 | |
| CH ₄ (TCD) | 4.58597 | 0.0459 | 0.0712 | 0.0165 | 79.2 | | |
| CO ₂ | 0.45479 | 0.0045 | 0.0071 | 0.0016 | | 2.6 | |
| H ₂ O | | | | 0.0176 | | 13.4 | |
| F_{H_2}/F_{CO} | 1.9 | | | | | | |
| F_{H_2O}/F_{CO_2} | 10.8 | | | | | | |
| ε_C | 3.4 | | | | | | |

Table 140: Exp. 19. Temperature data

| TOS [min] | $T_{bed\ entrance}$ [°C] |
|--------------|-----------------------------|
| 20.0 | 769.0 |
| 43.5 | 772.0 |
| 67.0 | 773.7 |
| 90.5 | 775.0 |
| 114.0 | 775.7 |
| 137.5 | 776.4 |
| 161.0 | 777.0 |
| 184.5 | 777.5 |
| 208.0 | 777.8 |
| 231.5 | 778.0 |
| 255.0 | 778.7 |
| 278.5 | 779.2 |
| 302.0 | 779.5 |
| 325.5 | 780.0 |