

Investigation of the Kinetic of the Selective CO Methanation

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Abstract

The concept of “Green Technology” has become increasingly popular when looking for environmentally friendly residential electric power generation systems. Thus, fuel cells are of great interest not only in vehicles, but also in homes and businesses; in particular, small, multipurpose fuel cell systems are well suited for combined heat and power supply in households. Proton exchange membrane fuel cells (PEMFC) can be operated with hydrogen already at temperatures of 60-80°C and allow simultaneous production of electricity and heat from a single fuel source. However, these stationary fuel cell systems contain heterogeneous catalysts vulnerable to catalyst poisoning; thus, pure operating gas has to be supplied. Hydrogen produced from natural gas is the first choice because of its high availability due to the already existing (natural) gas grids. However, operating gas from methane always includes impurities of CO (0,5 - 2 vol.%) [1,2] poisoning the PEMFC catalyst which has a CO tolerance of only ca. 100 ppm [1,3,4]; as a result, the fuel cell will be damaged gradually during operation.

Thus, the carbon monoxide concentration in operating gas has to be reduced down to threshold values at which CO poisoning is omitted. Here, selective CO methanation is an attractive technique to remove CO below acceptable concentrations to guarantee the long term stability of polymer electrolyte fuel cell systems.

The objective of this work is the synthesis of a catalyst suitable to meet these very low amounts of carbon monoxide selectively since CO₂ methanation as well as reverse water-gas shift reaction also run under the reaction conditions of the CO methanation. Both reactions are undesired as methanation of CO₂ consumes valuable hydrogen and the reverse water-gas shift reaction yields CO.

For this purpose, in-house manufactured Ru catalysts supported on Al₂O₃ were applied in experiments for the examination of their selectivity. For a better understanding of the system, the methanation of CO and CO₂ were individually investigated. Finally, the selective CO methanation including CO₂ in the feed gas was investigated and compared. Furthermore a kinetic approach of the system is investigated.

References

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