Selective catalytic oxidation of residual ammonia for purification of green hydrogen from ammonia cracking

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Abstract

The Federal Government of Germany assigns hydrogen in its national hydrogen strategy a "[…] central role in the further development and completion of the energy transition" [1] while acknowledging that "[…] the greater part of demand will have to be covered permanently by imports of hydrogen and its derivatives." [2] Green ammonia as a hydrogen carrier will play a significant role and the Federal Ministry for Economic Affairs and Climate Action recently signed the first delivery contract for green ammonia starting 2027. [3]
To use the hydrogen after importing, the ammonia must be cracked. Due to the thermodynamic equilibrium of the reaction, the resulting product gas contains a residual amount of ammonia that must be removed for further gas separation and usage. For the operation parameters of the used industrial ammonia cracker in this project (T: 750 °C – 850 °C, p: 10 bar) the resulting product gas contains between 850 and 1500 ppm residual ammonia. One possible technology for the purification of the product gas is selective catalytic oxidation of the residual ammonia in a second reactor after the cracker.
In this study the usability and feasibility of this technology shall be determined. The first step is the identification of fitting catalysts regarding three target dimensions, maximum conversion of ammonia, maximum selectivity to nitrogen and no catalytic effects on hydrogen oxidation. A catalyst screening using commercial catalysts and catalysts produced in the laboratory will determine the best candidates for further kinetic experiments and up-scaling to a pilot reactor. The chosen commercial catalysts are either universal, pellet-based systems with single-metal loadings or SCR-/SCO-catalysts used in exhaust gas treatment systems. The catalysts produced in the laboratory for this study are based on past references for selective ammonia oxidation to nitrogen with promising performances regarding the three desired target dimensions.

References

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