

## **Catalyst study for selective catalytic oxidation of residual ammonia for purification of green hydrogen from ammonia cracking**

A. Sack<sup>1,2,3</sup>, A. Gradel<sup>1</sup>, H.-P. Schmid<sup>4</sup>, J. Wünnig<sup>4</sup>, T. Plessing<sup>1</sup>, A. Jess<sup>2,3</sup>

<sup>1</sup>Institute for hydrogen and energy technology, University of Applied Sciences Hof

<sup>2</sup>Chair of Chemical Engineering, University of Bayreuth

<sup>3</sup>Center of Energy Technology, University of Bayreuth

<sup>4</sup>WS GmbH, Renningen

### **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 different catalysts were used in ammonia oxidation experiments to determine their usability and performance for the proposed process. Two sets of experiments for ammonia oxidation in nitrogen and cracking gas atmosphere were undertaken to be able to compare the catalysts in the three target dimensions: maximum conversion of ammonia, maximum selectivity to nitrogen and least catalytic effects on hydrogen oxidation. While the experimental results in nitrogen fit well with literature, the results in cracking gas (75 Vol.-% H<sub>2</sub>, 25 Vol.-% N<sub>2</sub>, 1500 ppm NH<sub>3</sub>) with stoichiometric oxygen addition shows no ammonia conversion independent of reaction temperature (200 °C – 350 °C). A third study with a variation of the added oxygen amount showed promising ammonia conversion results for further use.

### **References**

[1] Bundesministerium für Wirtschaft und Klimaschutz (BMWK), „Die Nationale Wasserstoffstrategie“, BMWi, Berlin, 2020

[2] Bundesministerium für Wirtschaft und Klimaschutz (BMWK), „Fortschreibung der Nationalen Wasserstoffstrategie“, BMWK, Berlin, 2023

[3] Bundesministerium für Wirtschaft und Klimaschutz, „Wichtiger Schritt für globalen Wasserstoffhochlauf – Deutschland importiert ab 2027 mit H2Global grüne Wasserstoffprodukte im großen Umfang“, 11.07.2024. [Online] Available: <https://www.bmwk.de/Redaktion/DE/Pressemitteilungen/2024/07/20240711-h2global.html>.