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Ammonia Sorbents for Novel Ammonia Synthesis Routes studied using in situ neutron imaging

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In 2021, ammonia was second most produced chemical in the world. Among different ammonia synthesis routes, the most prevalent is the Haber-Bosch process. However, it has been recently demonstrated that with new types of catalysts, ammonia can be synthesized at lower pressures and temperatures. To unlock the potential of this mild condition ammonia synthesis, it is necessary to find an alternative to ammonia condensation. A promising solution is ammonia absorption by metal halides, as these materials can efficiently and selectively remove ammonia down to ppm level, even at elevated temperatures. Within the framework of the ARENHA project (Horizon 2020, No 862482), we develop manganese chloride-silica gel sorbents to promote novel ammonia production paths.

In this work, the manganese chloride-silica gel sorbents were studied using in-situ radiography at the NEUTRA beamline (SINQ, PSI). Two-dimensional neutron radiography images of the sorbent bed were taken during breakthrough tests, during which a gaseous mixture of ammonia and nitrogen was passed through the bed at a controlled flowrate. During the tests, we could observe ammonia uptake and release within the sorbents. The results of the image analysis are discussed with respect to the homogeneity of the ammonia sorption over the volume of the reactive bed and how it is affected by manganese chloride loading in the sorbents. Changes in the sorbent bed dimensions and sorbent morphology during cycling are also reported.

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