Opportunities of Synchrotron Light Sources for Sustainable Chemistry

Jan-Dierk Grunwaldt

Abstract: Heterogeneous catalysis is the key for the sustainable production of chemicals, clean air and energy conversion technologies. This is also closely related to minimizing CO2-emissions and the energy transition which is a major challenge and cannot be achieved with the current catalytic processes. New catalyst materials need to be discovered and developed in a knowledge-based way. However, the structure of catalysts steadily changes, especially under working conditions, and usually the active site is part of a complex environment. The latter requires a hierarchical characterization approach. Synchrotron light is essential for a rational design and has given crucial impetus to catalysis.

Examples from chemical energy storage, such as methanation, methanol-synthesis, Firscher-Tropsch-synthesis and electrocatalysis, and related areas will be presented that demonstrate that the present and upcoming X-ray sources with their complementary portfolio of techniques are required. They allow to cover better and better the various complexity scales in terms of time and length (atomic scale information to mm/cm/m-scale). Hence, both time-resolved, new spectroscopic and new microscopic techniques are required. The understanding of working catalysts can be especially furthered with X-ray techniques due to their high penetration length.

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