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The development of transportation fuels from sustainable resources requires new and better production paths. One approach involves the use of biogas to create alcohol for fuel. Higher alcohols are favorable due to their high energy density and ease of use in current internal combustion engines. However, the yield of higher alcohols in such reactions is poor, resulting in a demand for better catalysts [1].

Transmission electron microscopy is a powerful tool for characterizing catalysts. However, conventional TEM does not provide dynamic information about catalysts in their working state.

We have recently installed an environmental transmission electron microscope (ETEM), which is equipped with an inlet system for introducing reactive gases. In combination with a use of a heating holder, this microscope allows catalysts to be studied using a variety of TEM techniques at close to working conditions. [2,3].

The CAtalysis for Sustainable Energy Project (CASE) at the Technical University of Denmark aims at predicting new catalysts using density functional theory and then testing the chemical reactivity of the most promising candidates experimentally.

Here, we present recent ETEM studies of newly synthesized catalysts for alcohol synthesis. We focus on structural changes of these catalysts with bright-field, EELS, EDX and HAADF investigations and relate that to tests concerning the catalysts' chemical activity. Some of these systems are e.g. CuSn supported on Alumina and Co on MoS$_2$.

a) b)

Fig.1: Representative bright-field images of a CuSn catalyst supported on Al$_2$O$_3$, acquired a) at high vacuum conventional TEM mode and b) in ETEM mode in 1.2 mbar H$_2$ at 600K.


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