In situ UV-vis characterization and activity testing of flat model catalysts in custom built micro reactors

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Catalysis research is complex and multidisciplinary in its nature. The performance of an industrially used catalyst is influenced by a multitude of factors, from material composition to oxidation state, support porosity, reactant and product distribution in the reactor as well as temperature gradients and local hot spots. Therefore, under “real” conditions, it is nearly impossible to learn which are the most important properties of a catalyst. By preparing simplified model systems, it is possible to eliminate some of the variables during catalyst testing and learn about the materials fundamental properties. We prepare flat model catalysts, consisting of merely a few µg of catalytically active material and test them in a custom made micro reactor with in-situ mass spectrometry and UV-vis spectroscopy.

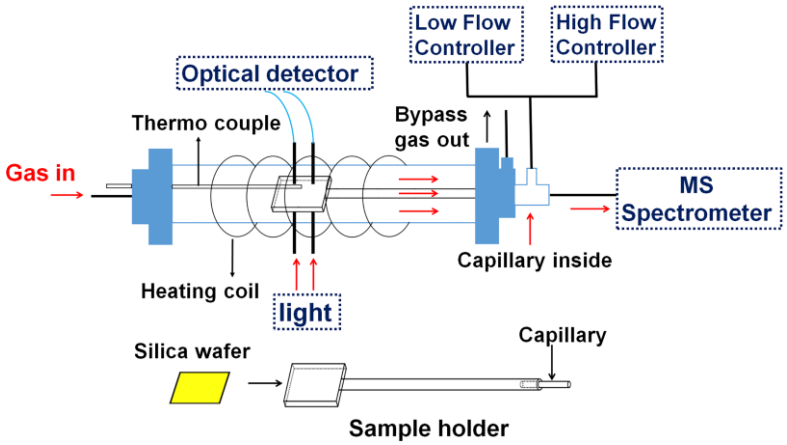

Figure 1 Custom made micro reactor for testing of flat model catalysts with in situ UV-vis spectroscopy and mass spectrometry.The design allows testing of catalysts with a total loading down to a few µg.

The flat model catalysts have the advantage that there are no hot spots or diffusion limitations in the gas phase that can obscure the findings and that all catalyst material is accessible to in-situ characterization. A range of model catalysts, from sub monolayer deposits of size selected nano clusters and thin particle films to nanoparticles supported on porous as well as non-porous 3D structures has been tested and various reactions such as Fischer-Tropsch synthesis, water-gas shift reaction, preferential oxidation of CO in H_2, NH_3 decomposition and catalytic combustion of volatile organic compounds has been addressed[1–3]. A few examples will be presented, where the importance of the oxidation state of the active material and the interaction between catalyst, support and promoter is elucidated.

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