Development of novel, highly active, and selective multifunctional carbon nanotube-supported catalysts for the chemical hydrogenolysis of glycerol to 1,2-propanediol

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Introduction: The aim of the CRC 1615 SMART-reactors is to build a reactor that converts renewable resources, which are more sustainable, into different products (multipurpose) and that are autonomously (self-adaptive), which will lead to more resilient processes that are better transferable between scales and locations. Designing tailor-made bi- or tri-metallic catalysts for the selective hydrogenolysis of glycerol, to 1,2-PD under mild reaction conditions is a key challenge for the project. Since the catalyst wettability should be switchable to make the catalyst more resilient against catalyst poisons, carbon nanotubes seem to be a promising support. Finding the optimal CNT support and the ideal combination of transition and noble metals is a key step in the development of the catalyst.

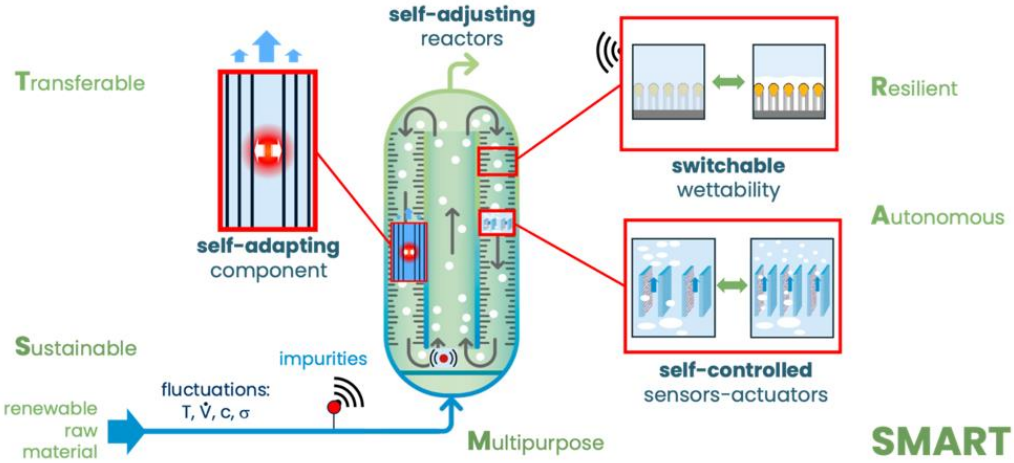

Figure 1: Overview over the CRC 1615: SMART-reactors.

Results and discussion: In our initial approach, we selected four different commercially available single and multi-wall CNTs, which we tested with the most promising metal combination RuCu2 from the literature[1] in an 8-fold hydrogenation screening plant. We compared those results with special tailor-made CNTs for the CRC, designed to have excellent properties for catalysis as well as the ability to have a switchable surface. After finding the ideal support with the highest selectivity and activity for our catalyst, we tested several transition metals like Cu, Fe, Co, and Ni, as well as Ru and Ag as noble metals to achieve the ideal metal combination. Using ICP-OES, we confirmed the targeted metal loading and ratio. For each of the catalysts, we were able to perform TPR measurements to find a tailored reduction program.

Conclusion: We could successfully develop a bimetallic catalyst supported by CNTs. We are confident that we can further improve the activity and selectivity of our catalysts by optimizing the synthesis procedure through varying the impregnation method, solvent, metal precursors, and temperature pretreatment program. Ultimately, our goal is to transfer our insights from the powder catalyst and begin working on a catalyst supported by a grown CNT forest.

References

[1] J. Albert *et al.*, *Catalysis Science and Technology* **2021**, 11., 6649-6653.