Title: A multiscale Catalysis and Engineering Approach to CO2-to-X

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In the Paris Agreement the IPCC determined that the release of greenhouse gases in our atmosphere must be reduced, with CO2 being the most important one. Since the start of the industrial revolution in the 19th century the CO2 concentration in ambient air has increased from 280 ppm to more than 400 ppm. Large amounts of CO2 are emitted by sectors such as the cement and coal industry, where CO2 is emitted in concentrations of 10 – 30 %. Using the CO2 emitted at such point sources, e.g. by catalytic conversion with renewable energy, as carbon feed can result in the synthesis of CO2 neutral, or better yet, negative, products and fuels. This comes with considerable challenges in terms of (combining) purification, capture and conversion of the CO2 feed. In this project, we aim to develop new (integrated) catalytic conversion and reactor technology for the conversion of CO2 to chemical building blocks. The usage of both conventional and novel scrubbing agents in novel combinations with homogeneous and heterogeneous catalysts will be researched in combination with the appropriate reactor design. Target molecules in the aforementioned processes are e.g. methanol and formates, which can be used both as chemical building blocks and as hydrogen carriers for renewable fuels. A second approach is the combination of the capture and conversion functions in one material with e.g. triazine based solid chemicals. During this project the effect of the concentration and purity of the gas stream on the process efficiency will be determined, as well as the possibility to operate the system in continuous flow using e.g. microfluidics or bubble reactors.