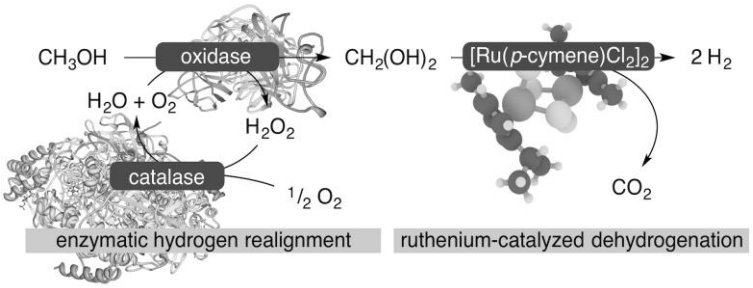
Towards a solution for the reversible C_1-reforming puzzle at near ambient conditions with a bio-inspired organometallic approach

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Our societies need novel energy storage systems owing the limited fossil fuels and the environmental disadvantages and limited efficiencies of current battery technologies. The latter ones are also not suitable to store energy in large amounts which is generated i. e. in wind power plants. The storage of hydrogen in its hydridic/protic form in small liquid organic hydrogen carriers (LOHC) offers a promising alternative that overcomes the obstacles which are present in known energy and H_2 storage systems in terms of safety issues and efficiencies.[1,2] Our research focusses on hydrogen generation at low temperature in water.[2-6] We showed that C_1-entities like hydrated formaldehyde (8.4 wt% H_2) is suitable for molecular H_2-storage as it can be easily and selectively dehydrogenated forming pure H_2 and CO_2.[2] The reaction runs on air using a novel water-stable molecular catalyst which is generated in situ using a commercial precursor under base-free conditions. This catalytic decomposition of H_2CO can be envisioned as novel approach for simultaneous H_2 production and decontamination treatment of wastewater with formaldehyde impurities a waste to value approach.[4,5] Moreover, we achieved the first room temperature reforming of methanol following a bio-inspired approach using multi-catalytic system consisting of enzymes and a biomimetic formaldehyde dehydrogenase (Figure).[6]



Our current studies include coupled conversion of the *in situ* generated H_2 and CO_2 towards a full/extended hydrogenation/ dehydrogenation cycle of the C_1-interconversion in between methanol, aq. formaldehyde, formic acid, carbon dioxide in water. Inspired by nature, where many organisms use C_1-molecules as hydride sources for the energy conversion/-transfer, we develop organometallic biomimetic catalysts exhibiting oxidoreductase-like reactivity applicable under ambient conditions for not well, respectively not yet, investigated C_1-interconversions.[6] Our model studies are of fundamental importance for the tailoring of artificial methylotrophic pathways and open new windows of opportunities towards an extended cycle of the not yet fully resolved C_1-interconversion network where we want to add important missing pieces to this C_1-puzzle.[7] Moreover, our bio-inspired approach is important for the general understanding of MeOH-based energy conversion systems which might lead to visionary enzyme-driven hydrogen fuel cells.

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