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Catalysis and life-cycle-analysis of current and future industrial routes to CO₂ utilization**Thomas E Müller**

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The utilization of carbon dioxide (CO₂) as an inexpensive and renewable C1 feedstock is of strategic importance for decreasing our dependence on fossil based raw materials (Ref. 1). In this context, the direct build-up of fuels, chemicals and polymers, at least partially, from CO₂ is of particular interest. Various technologies are being discussed for implementation in the industry (Figure 1). The lecture will compare the current status of these technologies, the changes effected upon introducing CO₂ as feedstock and evaluate the CO₂ reduction potential based on the currently available life-cycle-analyses. One recently commercialized process that involves the direct use of carbon dioxide as a feedstock is the production of organic carbonates by reaction of CO₂ with epoxides (Ref. 2-4). Indirect routes for CO₂ utilization are of equal relevance. Formaldehyde, commercially attained by partial combustion of methanol that, in a future economy, may be obtained from CO₂, is a promising feedstock. Thus, oligomeric poly (acetalester) is generated readily from formaldehyde. Such poly (acetalester) has intriguing properties rendering them inspiring compounds for fuel and polymer applications. Motivated by the goal of expanding the CO₂ technologies to further application fields, it seems essential to unravel highly effective strategies for activating the carbon dioxide molecule. The energy needed to overcome the thermodynamically low energy level of CO₂ is thereby a crucial factor. Only when the energy level of the resulting intermediates is appropriate, the subsequent reaction of the activated CO₂ molecule with the co-reagents will take place. The right choice of the catalyst is thus the key to CO₂ conversion and directs the reaction pathway to the desired target products. The lecture concludes with discussing some of the most intriguing approaches for activating CO₂.

Biography

Thomas E Müller is working as a Lecturer at RWTH Aachen University, Germany. He has received a PhD in Chemistry (1995) from Imperial College London. After positions at University of Sussex and TU Munich and Visiting Professor position at NUS Singapore (2005) and University of Tokyo (2005), he accepted a position at Covestro in 2007. Since 2015, he has been concentrating on taking innovation to the chemical industry. He is Associate Editor of JCOU. His achievements include 80 papers and 75 patent applications, mainly in the fields of CO₂ chemistry, catalyst development, and materials. His vision is to bridge the gap between fundamental research and industrial application.

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