volks— hochschule beider basel

18./19.02.2019

Catalysis: the Miracle of Consumption and Regeneration!

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Zusammenfassung

A catalyst is a molecule that is capable of accelerating a chemical reaction from: **A** ➔ **B**. As a result, the energy required to carry out such a reaction is significantly reduced. A large portion of all (bio)chemical reactions carried out in industry and in Nature are performed in the presence of a catalyst. In the past twenty years, five Nobel prizes in chemistry have been awarded for contributions in the field of catalysis.[1-6]

Catalysts are typically classified according to their chemical composition. **Enzymes** consist of a large protein and, in some cases, require a vitamin to function. Such macromolecules are Mother Nature's catalysts: they operate in water, at body temperature and allow a cell to maintain its vital functions.[6] **Heterogeneous catalysts** typically consist of a metal finely dispersed on an inert support. These systems are insoluble and very stable, thus allowing to carry-out very challenging reactions at high temperature and pressure.[4, 7] **Homogeneous catalysts** are small, man-made molecules that are often used in the chemical industry to accelerate chemical transformations in organic solvents and at low temperature.[2, 3, 5]

This talk will present noteworthy examples of the three types of catalysts and highlight the impact of catalysis on society and its future development.

Examples will include: *i)* photosynthesis and the appearance of dioxygen on Earth and CO_2 fixation; *ii)* enzymes responsible for the digestion of food; *iii)* nitrogenase, the enzyme responsible for the production of ammonia from dinitrogen; *iv)* the Haber-Bosch process, the heterogeneous catalyst equivalent of the natural nitrogenase enzyme;[7] *v)* the car catalyst located in the exhaust pipe of cars that helps to eliminate toxic gases from the incomplete combustion of gasoline; *vii)* the homogeneous catalyst that was developed by Ciba Geigy for the large-scale production of Metolachlor, a herbicide.[8]

NB The presentation will be held in English; questions and answers will be either in English or German

Literatur und Internetlinks

1) https://cen.acs.org/articles/91/i36/Nobel-Prizes-Recognized-Notable-Developments.html
2) https://www.nobelprize.org/prizes/chemistry/2001/popular-information/
3) https://www.nobelprize.org/prizes/chemistry/2005/summary/
4) https://www.nobelprize.org/prizes/chemistry/2007/summary/
5) https://www.nobelprize.org/prizes/chemistry/2010/summary/
6) https://www.nobelprize.org/prizes/chemistry/2018/arnold/facts/
7) https://www.nobelprize.org/prizes/chemistry/1918/summary/
8) Blaser, Hans-Ulrich. "The chiral switch of (S)-metolachlor: a personal account of an industrial odyssey in asymmetric catalysis." *Advanced Synthesis & Catalysis* 344 (2002): 17-31.

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