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Unifying Concepts in Catalysis

Vortragsankündigung

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Zeit: **Mittwoch, 06. Mai 2009** 17:15 Uhr

Ort: **TU Berlin**
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Thema: **Enzyme Engineering of Hydrogenase: A Key for BioHydrogen**

Abstract: An attractive option to replace advantageously greenhouse gas-producing fossil fuels in the future is molecular hydrogen, provided that it is produced under a clean and renewable way. Development of new biotechnological processes, designed to meet the future energy demand, may take advantage of microbes that have been using H_2 from very early in the evolution of life. In order to match technological requirements, the use of hydrogenases for hydrogen production will imply enzyme function optimization, such as improving electron transfer from reducing donor (i.e. improving kinetic parameters of the enzyme) or improving O_2 tolerance. At present, structure function relationship studies in hydrogenases have mainly remained in the basic research realm, aimed at understanding the enzyme catalytic mechanism. In this talk, structure-function relationship studies will be reviewed in which new properties of modified enzymes might serve as an inspiration source for hydrogenase rational optimisation with biotechnological interest.

Respiratory [NiFe]-hydrogenases are involved in the cell in the uptake of hydrogen. It is interesting to note that the two peculiar features of the electron transfer chain, which are the high potential of the medial cluster and the histidine ligation of the distal cluster, are crucial elements of the enzyme physiological role. Indeed, any modification impairs H_2-uptake reaction and has low influence on the H_2-production reaction. It is therefore possible to engineer hydrogenase in order to modify the enzyme bias in such a way that it mainly functions in the direction of hydrogen production, which is the main goal of most biological hydrogen applications.

Among the strategies that have been developed through evolution to allow [NiFe]-hydrogenases to be catalytically active in the presence of oxygen, one of them consists in reducing the gas channel size at the interface with the active site cavity. At the end of the hydrophobic channel, near the active site, two hydrophobic residues, usually a valine and a leucine that are conserved in oxygen-sensitive hydrogenases, are respectively replaced by larger residues respectively isoleucine and phenylalanine in the oxygen-tolerant H_2-sensors. Thus, as a first approximation, increasing the bulk of residues occupying these two positions may reduce the channel diameter at that point, thereby preventing efficient dioxygen access to the active site. Recent results suggest that this might not be so simple.

Organisator: PD Dr. Michael Haumann (TUB)

Gäste sind herzlich willkommen!

Prof. Dr. Matthias Drieß
Sprecher des Exzellenz-Clusters UniCat