FROM NATURAL TO ARTIFICIAL METALLOPROTEINS – CHALLENGES AND OPPORTUNITIES

Johannes Schiffels, Institute of Biotechnology, RWTH University, Aachen, Germany
j.schiffels@biotec.rwth-aachen.de
Daniel F. Sauer, Institute of Biotechnology, RWTH University, Aachen, Germany
Jun Okuda, Institute of Inorganic Chemistry, RWTH University, Aachen, Germany
Ulrich Schwaneberg, Institute of Biotechnology & DWI-Leibniz Institute, RWTH University, Aachen, Germany

Key Words: Biohybrid catalysts, cascade reactions, biocatalysis, catalyst immobilization

Organometallic catalysts are used in a wide range of industrially important reactions. By immobilizing such catalysts to a protein (Fig. 1), we can bring them into aqueous media, fine-tune activities and selectivities and overcome the challenges associated with trace metal removal in the product fraction [1, 2]. Trace metal removal is particularly important for the synthesis of pharmaceutical compounds. Typically, the transition metal content should be below 10 ppm. We have employed two types of metal catalysts, a Ru-based Grubbs-Hoveyda-type catalyst for olefin metathesis and a Rh-catalyst for phenylacetylene polymerization. These catalysts were covalently attached to either nitrobindin (NB) [3] or *ferric hydroxamate uptake protein component: A* (FhuA) [4] β-barrel proteins, yielding biohybrid catalysts (also denoted artificial metalloproteins) that can be immersed in aqueous reaction media either in their free form or immobilized to bacterial cells. Moreover, we could show that the metal catalysts can be immobilized on surfaces consisting of silica or polypropylene via peptide-based adhesion promoters, thereby enabling “green” surface immobilization strategies with the potential of catalyst recycling [5]. Either strategy yielded highly active catalysts that show great promise for single or sequential one-pot reactions. Separation of products and the catalysts was readily achieved by extraction. With the potential to tune reaction efficiencies and selectivities by modifying either the metal catalyst or the protein surrounding, biohybrid catalysts bear great potential to amend or even substitute the repertoire of reactions available by organic synthesis and, likewise, biocatalysis.

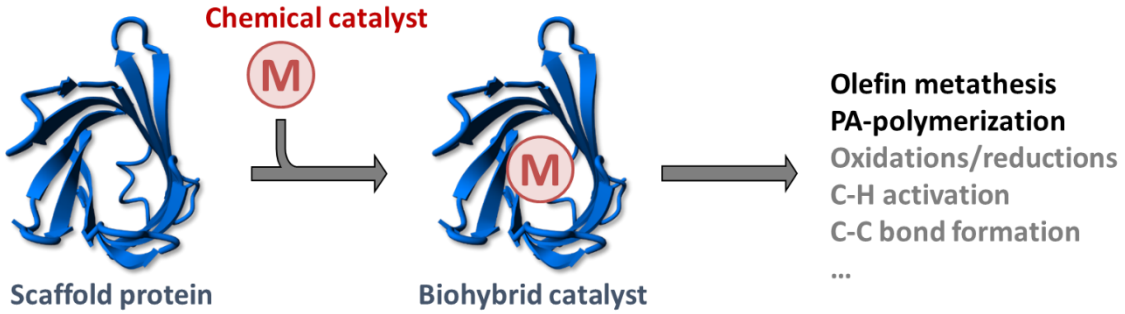

Figure 1 – Generation of Biohybrid catalysts by incorporating a metal catalyst into a protein scaffold.

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