ABSTRACT OF PHD THESIS

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"Photoregeneration of cofactor molecules through non-enzymatic methods"

Due to the high efficiency and great specificity of enzymatic reactions, together with environmentally friendly conditions biocatalysis has become a powerful, green tool in synthetic chemistry. Oxidoreductases are among the most industrially applied enzymes but their large scale applications are significantly limited by the high cost of specific cofactors, especially their reduced forms serving as electron donors.

The stoichiometric consumption of cofactors such as NADH (nicotinamide adenine dinucleotide) in the enzymatic process creates the need for their regeneration, that is recuperation of the reduced form. As the conventional enzymatic regeneration approach suffers from numerous drawbacks, the development of alternative, sustainable non-enzymatic methods for cofactor regeneration has become one of the goals of modern catalysis.

The present dissertation aims at the development of photocatalytic methods for heterogeneous regeneration of NADH as a model cofactor. The goal was achieved by following two approaches: proposing new materials as photocatalysts and, on the other hand, in-depth studies of the photocatalytic reactions themselves.

The results of the experimental research were presented in two chapters. The first chapter is devoted to the improvement of the water oxidation process in the context of its prospective implementation into cofactor regeneration systems. It was shown that cobalt oxide as a surface co-catalyst improves photocatalytic water oxidation and decreases organic dye degradation catalyzed by silver phosphate. In the second chapter the mechanism of typical photocatalytic NADH regeneration on semiconductor material using triethanolamine (TEOA) as an electron donor was revisited. It was concluded that glycolaldehyde arising from the photooxidation of TEOA is an actual reducing agent that can reduce NAD^+, also in the dark and in the absence of the photocatalyst.