# Enzyme immobilization: rational basis for turning an enzyme into an efficient biocatalyst

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In the last decades, the use of biocatalysis for performing new, efficient, selective, cost effective and greener technologies, are related to new strategies in chemistry and represent an important tool for the progress of human civilization. More and more enzymes were identified, isolated, purified, characterized and used in their native or engineered form, increasing their performance in various applications, including synthetic processes. Enzymatic catalysis offers several cumulative advantages: mild conditions reaction, substrate specificity a high degree of chemo-, regio-, and enantioselectivity, use of a small amount of biocatalyst, the possibility of reuse of biocatalysts, reduction or elimination of by -products, performing reactions that conventionally require several steps in a single process without the need for protection / deprotection steps.
For synthetic and industrial purpose, the biocatalyst stability and reusability are important requirements which can be achieved by immobilization, improving also their activity and selectivity. Prevention of protein contamination is another motivation that induces pharma and cosmetic sectors to employ immobilized biocatalysts. The science of enzyme immobilization requires a multidisciplinary focus that involves several areas of knowledge such as, material science, surface chemistry, protein chemistry, biophysics, molecular biology, biocatalysts, and chemical engineering. Recent advances in the design of materials with tailorable characteristics suitable for immobilization, had an important impact for the development of robust immobilized enzymes with higher catalytic activity and stability.
An immobilized enzyme is adaptable for several type of industrial processes because: has convenient handling, provides easier product separation, has reusability, higher stability under extreme physical and chemical conditions and is suitable for all types of reactors (e.g., continuous, fixed-bed). Moreover, enzyme immobilization is useful for multienzyme and chemoenzymatic cascade processes. In such cases a controlled immobilization can become not only a solution to improve the stability of the enzyme, but may also reduce inhibition and improve the selectivity or specificity of the enzyme.
The aim of the lecture is to offer a general perspective concerning enzyme stabilization through immobilization by discussing the most important criteria and steps for the rational robust catalysts development completed by an overview of immobilized enzymes applications in chemical and cosmetic industry.

Lecture proposed topics:

1. Introduction (Enzymes as industrial biocatalysts, immobilization for enzymes stabilization, advantages/disadvantages of immobilization).
2. Supports for enzyme immobilization (Organic supports: natural and synthetic polymers; Inorganic supports: minerals and synthetic supports).
3. Methods for enzymes immobilization (Immobilization by binding to a support: adsorption, ionic binding, covalent binding, entrapment, microencapsulation; Cross-linking); Comparative evaluation of the immobilization techniques.
4. Enzyme immobilization for solvent free and non-conventional reaction media systems.
5. Immobilized enzymes for polymer synthesis.
6. Industrial applications of immobilized enzymes in the chemicals and cosmetics industries.