Improving biocatalytic membranes for broader and better applications

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INTRODUCTION

Enzymes catalyze more than 5.000 biochemical reactions and provide efficient and low waste reactions. Due to enzymes specificity, selectivity and low energy use they are a green alternative to ordinary chemical catalyst or simply chemical reactions and are already used in a wide range of applications.
One of the applications is biocatalytic membranes where enzymes are immobilized on a membrane surface creating a selective bioreactor that runs under mild reaction conditions leading to a green process.

Immobilization of enzymes is a profitable process in regards to improving process economics by enabling reuse and providing enhanced robustness and overall productivity of the enzymes. Membranes are increasingly used as support for enzyme immobilization as this enables the integration of biocatalysis and separation by using the membranes in reactors.
Therefore an improvement of the biocatalytic membranes could both improve existing productions using biocatalytic membranes and also enable the production of some products to be made with biocatalytic membranes that could not be made before because of the instability of the enzymes.

THE PROJECT

As an example the enzyme alcohol dehydrogenase, ADH, could be an essential part of a environmental friendly process where CO_2 is reduced to methanol, which is an alternative method for removing CO_2 that also produces a useful end product. But ADH degrades too quickly for industrial applications and it is important to stabilize the enzyme in order to facilitate its application in bio-catalytic membranes.

In this project we seek to modify a simple cellulose membrane so that it accommodates the requirements for preserving the enzyme activity while keeping the rate of degradation low and simultaneously maintaining the permeability and selectivity of the membrane.

Using a well-known method for graft polymerization of monomers onto cellulose of the cellulose membranes and using this to improve immobilization by several immobilization techniques. The grafted monomer changes the properties of the surface and forms a protective layer where the enzymes are entrapped and/or covalently bound preventing leakage of enzyme. In this project the influence the specific monomers on enzyme stability and entrapment of ADH is investigated.

So far the grafting of the monomers has been confirmed, but the immobilization is still being researched.

The idea/concept will in the future make it possible to design better biocatalytic membranes with a broader range of enzymes.