SPATIAL COLOCALIZATION OF MULTIENZYMES BY POLYMER ASSISTED ORGANIC-INORGANIC NANOFLOWER COMPLEXES ENABLES ENHANCED CASCADE BIOCATALYSIS

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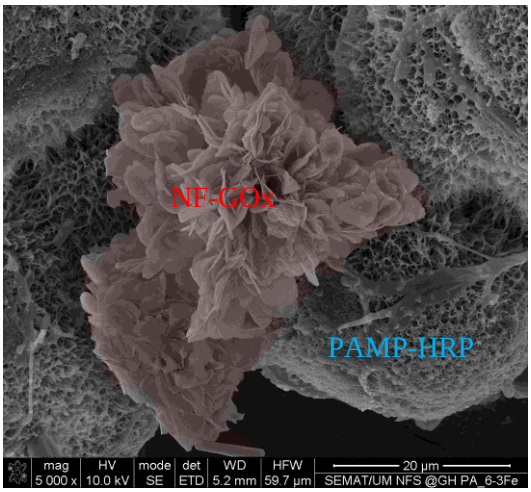
Abstract

Multienzyme complexes in which several enzymes are co-immobilized on the same support used to catalyze multistep or cascade reactions have recently received continuous interest. The major advantage of the multienzyme co-immobilization is that the enzymes´ active sites are in close proximity minimizing the diffusion of the intermediates, thereby enhancing the overall reaction efficiency. The spatial organization or compartmentalization of the multienzyme complex is crucial for its overall catalytic performance and efficiency [1]. One of the ways for effective single enzyme immobilization are the so-called "nanoflowers" (NFs) representing organic-inorganic conjugates of the enzyme with copper (II) ions. NFs have demonstrated enhanced enzymatic activity as compared to the free enzyme [2]. However, classic NFs are not very stable, they decompose easily over time, which makes their repeated use problematic. On the other hand, stable and robust polymeric micro-/nanostructured materials such as porous polyamide microparticles (PAMP) have also proven to be effective as protein/enzyme carriers [3]. Thus, we decided to combine the catalytic advantages of the NFs with the robustness and chemical stability of the PAMP creating hybrid PAMP-NF catalytic systems to be used as cascade biocatalysts.



In this work we present the synthesis and characterization of a series of bienzyme-NF-PAMP complexes with predefined spatial co-localization of the enzymes on a preliminary synthesized PA6MP. Glucose oxidase (GOx) and horseradish peroxidase (HRP) dyad was used as a model bi-enzyme enzyme system for cascade glucose oxidation. The morphology of the systems is a superposition of those of NF and PAMP (Figure 1). These hybrid GOx-HRP biocatalysts containing controlled amounts of the enzymes were more active than the traditional NFs and displayed good stability and reusability for up to 5 oxidation cycles.

Figure 1. SEM micrograph of a PAMP-NF system

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References

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