Cold plasma technology for fast immobilization of enzymes

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Over the years, the immobilization of enzyme molecules onto solid support gave rise to a wide range of analytical or industrial applications. Today, following the fast evolution of microfluidics and nanotechnology, the elaboration of efficient enzyme immobilization processes is becoming of great interest for the development of new and original analytical tools or microreactors. The immobilization of biologically active species constitutes therefore a crucial step in the fabrication of bio/chemical microelectromechanical systems (BioMEMS) for which the potential application fields may concern biological and medical analysis, environmental investigations or clinical diagnosis.

Recently, cold plasma polymerization of 1,1,3,3,tetramethyldisiloxane (TMDSO) has been successfully used for the simple fabrication of microchannels [1]. In the context of BioMEMS manufacturing, we present a fast, innovative, and biocompatible method for the rapid fabrication of bioactive coatings using this plasma polymerized 1,1,3,3,tetramethyldisiloxane (ppTMDS) as carrier matrix. Using β-galactosidase as enzyme, we aim to develop a one-step immobilization procedure in order to fabricate a bio-functionnal layer where the enzymes are expected to be entrapped into the polymer matrix while preserving their native structure and their activity. Following one remote afterglow plasma enhanced chemical vapor depositions (RPECVD) experiment and several washing sequences of the sample, enzyme activity and stability was determined through studying the enzymatic hydrolysis of *ortho*-nitrophenyl-β-galactoside (*o*-NPG) in *ortho*-nitrophenol (*o*-NP) by spectrophotometry. Furthermore, different deposited coatings were analyzed by imaging techniques (SEM, AFM) in order to obtain information about the surface, before and after exposition to activity tests for different coating thicknesses. Finally, we investigated the diffusional limitation after several activity assays and also as function of the thickness of the coatings.

The results greatly reveal the feasibility of this non-conventional immobilization procedure: a single step technology allows fast immobilization of enzyme while retaining their bioactivity after several assays. Further investigations and optimizations of the technological process will certainly enable the development of new biofunctional coatings for specific applications.

References

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