Phospholipid Bilayer Functionalized Membrane for Immobilized Enzymatic Catalysis

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Enzymes, immobilized within membrane pores, offer improved kinetics due to pressure driven convective flow. On the other hand, phospholipid bilayer (PLB), owing to its fluidity and native "cell-membrane" environment, facilitates the activity and stability of enzymes. In this study, we integrate the advantages of biomimetic characteristics of PLB and convective flow through microporous membrane within the same configuration. We report development of a novel bioinspired membrane by incorporating PLB within membrane pores using two different approaches – (i) direct deposition of lipid bilayer within bare membrane pores, and (ii) immobilization of a polymer cushion prior to lipid bilayer within membrane pores. Developed PLB functionalized membrane pores were examined for enzymatic catalysis by electrostatically immobilizing glucose oxidase (GOx) enzyme. In-depth activity study revealed that the bioinspired membrane containing polymer cushion supported PLB and operating under convective mode of flow exhibited benefits in terms of activity, stability and operating range of pH. We also report the reusability of the membrane matrix as well as the PLB by exploiting the reversible attachment-detachment sequence of the functional moieties. Characterization of the detached phospholipid confirmed retention of the original structural and functional properties as exhibited before attachment. To the best of our knowledge, this is the first study that investigates the advantages of incorporation of PLB within membrane pores for immobilized enzymatic catalysis.