Surfaces based on amino acid functionalized polyelectrolyte films towards active surfaces for enzyme immobilization

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Surface based on polyelectrolytes functionalized with amino acids onto amino-terminated solid surfaces of silicon wafers was prepared, with the purpose of evaluate the chemical functionality of the polyelectrolyte films in adsorption and catalytic activity of an enzyme. In this work, the adsorption of the enzyme glucose 6-phosphate dehydrogenase from Leuconostoc mesenteroides (LmG6PD) was studied as model. The polyelectrolytes were obtained from poly (maleic anhydride-alt-vinylpyrrolidone) [poly(MA-alt-VP)] and functionalized with amino acids of different hydropathy index: glutamine (Gln), tyrosine (Tyr) and methionine (Met). The polyelectrolytes were adsorbed onto the amino-terminated silicon wafer at pH 3.5 and 4.5 and at low and high ionic strength. At low ionic strength and pH 3.5, the largest quantity of adsorbed polyelectrolyte was on the films containing glutamine moiety as the most hydrophilic amino acid in the side chain of polymer chain (5.88 mg/m2), whereas at high ionic strength and pH 4.5, the lowest quantity was in films containing tyrosine moiety in the side chain (1.88 mg/m2). The films were characterized by ellipsometry, contact angle measurements and atomic force microscopy (AFM). The polyelectrolyte

films showed a moderate degree of hydrophobicity, the methionine derivative being the most hydrophobic film. With the aim of evaluate the effect of the amino acid moieties on the ability of the surface to adsorb enzymes, we study the activity of the enzyme on these surfaces. We observed that the polarity of the side chain of the amino acid in the polyelectrolyte affected the quantity of LmG6PD adsorbed, as well as its specific activity, showing that films prepared from poly(MA-alt-VP) functionalized with Met provide the best enzymatic performance. The results obtained demonstrated that the surfaces prepared from polyelectrolytes functionalized with amino acids could be an attractive and simple platform for the immobilization of enzymes, which could be of interest for biocatalysis applications.

Amino acid functionalization

Enzyme adsorption

Glucose 6-phosphate dehydrogenase

Polyelectrolytes

Surfaces

Adsorption

Atomic force microscopy

Catalyst activity

Contact angle

Enzyme activity

Enzyme immobilization

Film preparation

Glucose

Hydrophobicity

Ionic strength

Polyelectrolytes

Polymer films

Silicon wafers

Surfaces

Chemical functionality

Enzyme adsorption

Functionalizations

High ionic strength

Leuconostoc mesenteroides

Low ionic strength

Polyelectrolyte films

Specific activity

Amino acids

amino acid

glucose 6 phosphate dehydrogenase

immobilized enzyme

nicotinamide adenine dinucleotide

polyelectrolyte

adsorption

biosynthesis

carbon nuclear magnetic resonance

chemistry

enzymology

infrared spectroscopy

Leuconostoc

metabolism

wettability

Adsorption

Amino Acids

Carbon-13 Magnetic Resonance Spectroscopy

Enzymes, Immobilized

Glucosephosphate Dehydrogenase

Leuconostoc

NAD

Polyelectrolytes

Spectroscopy, Fourier Transform Infrared

Wettability