”Active surfaces” formed by immobilization of enzymes on solid-supported polymer membranes

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In various domains ranging from catalysis to medical and environmental sciences, there is currently much focus on the design of surfaces that present active compounds at the interface with their environments. Here, we describe the design of ”active surfaces” based on solid-supported monolayers of asymmetric triblock copolymers, which serve as templates for the attachment of enzymes. A group of poly(ethylene glycol)-block-poly(gamma-methyl-epsilon-caprolactone)-block-poly[(2-di methylamino) ethyl methacrylate] amphiphilic copolymers, with different hydrophilic and hydrophobic domains (PEG(45)-b-PMCLx-b-PDMAEMA(y)) was selected to generate solid-supported polymer membranes. The behavior of the copolymers in terms of their molecular arrangements at the air-water interface was established by a combination of Langmuir isotherms and Brewster angle microscopy. Uniform thin layers of copolymers were obtained by transferring films onto silica solid supports at optimal surface pressure. These solid-supported polymer membranes were characterized by assessing various properties, such as monolayer thickness, hydrophilic/hydrophobic balance, topography, and roughness. Laccase, used as an enzyme model, was successfully attached to copolymer membranes by stable interactions as followed by quartz crystal microbalance with dissipation measurements, and its activity was preserved, as indicated by activity assays. The interaction between the amphiphilic triblock copolymer films and immobilized enzymes represents a straightforward approach to engineer ”active surfaces”, with biomolecules playing the active role by their intrinsic bioactivity.

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