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SMART FUNCTIONAL NANOSYSTEMS: POLYMER MEMBRANES DECORATED WITH PROTEINS

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Summary: In a variety of domains, such as medicine, catalysis, environmental science, food science and technology, new concepts that combine multifunctional compounds with stable, safe carriers or membranes are required.¹ Suitable amphiphilic block copolymers can self-assemble into 3D supramolecular assemblies, such as nanocompartments, or planar membranes mimicking biological membranes. Such synthetic membranes based have advantages of superior stability, and robustness compared to the lipid based membranes, in addition to the possibility to tailor their physical and chemical properties. The properties of such membranes can be extensively controlled via chemical composition, molecular weight and the hydrophilic-to-hydrophobic block length ratio of the polymers. Smart behavior of polymer membranes is implemented either by using stimuli-responsive polymers, or by insertion of biopores, which possess an intrinsic responsive property. Other well-defined functions, such as molecular recognition, cooperation, and catalytic activity can be introduced by combining these polymeric membranes with suitable biological entities, e.g., by incorporating integral membrane proteins or by enzyme encapsulation in polymer compartments.²

Here, we present protein-polymer assemblies as compartments with triggered activity or as bilayers on solid support that provide distinct spaces for desired reactions at the nanometer scale.^{3,4} Biopores/channel proteins inserted into the polymer membrane selectively control the exchange of substrates and products with the environment of compartments, resulting in development of stimuli-responsive compartments, which preserve their architecture, while allowing specific in situ reactions. When inserted in solid supported membranes, channel proteins/biopores serve for a controlled transport of ions or molecules through the synthetic membrane. Protein-decorated synthetic membranes represent smart hybrid systems, which open new avenues in various domains, as for example protein therapy or biosensing approaches.

References

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