

Research Project

Design of Nanoreactors and Artificial Organelles based on Polymer Supramolecular Assemblies

Third-party funded project

Project title Design of Nanoreactors and Artificial Organelles based on Polymer Supramolecular Assemblies

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Status Completed

Design of new materials and active assemblies by understanding the expression of nature's intelligence and mimicking its structures and functions is on focus today in various domains that include chemistry, medicine, electronics, and materials science. In this respect, a key strategy is to combine biomolecules that induce functionality through their specific biologic activity with synthetic structures with a variety of architectures (micelles, vesicles, tubes, particles). In this project, we plan to develop a platform of cascade reaction compartments at nanoscale for efficient and controlled production of molecules by a combination of physical chemistry, nanoscience and enzymatic reactions. Our aim is to encapsulate/insert biomolecules (proteins, enzymes) in synthetic compartments to create nanoreactors in which a cascade reaction is performed in situ inside one compartment, or it takes place between different compartments. The necessity to develop cascade reactions in compartments with nanometer sizes originates from the increasing evidence of uncontrolled release associated with the conventional drug delivery systems, and the aim to produce in a space- and time-controlled manner active molecules necessary for several severe pathological conditions, such as cancer, glycogen storage diseases, and infectious diseases. The project will evaluate the efficacy of cascade reactions in different topologic compartments in order to understand the conditions necessary to support a successful application, as for example introduction of artificial organelles as cellular implants mimicking natural ones. Our strategy to study cascade reactions inside confined space will provide structural and functional details to choose the type of cascade reaction space in a rational design by straightforward change of the biomolecules or the overall polymer assembly. The project will create the premises to use the platform of nanoreactors for applications in various domains, such as medicine, food science, environmental sciences, and technology.

Keywords cascade reactions, amphiphilic copolymers, self-assembly, enzymes, nanoreactors

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