11th International Conference
on Advanced Materials

ICAM2009

Rio de Janeiro Brazil
September 20 - 25

Biosensing applications of multifunctionnal nanosized biomolecular devices

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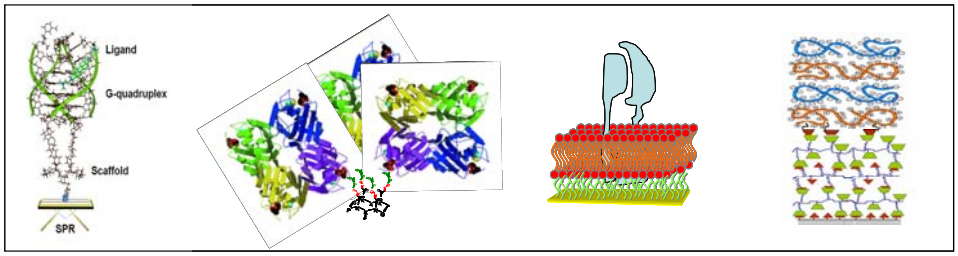
Abstract – Biologically programmed molecular recognition provides the basis of all natural systems and supplies evolution of optimized functional materials from self-assembly of a limited number of molecular building blocks. Biomolecules such as peptides, nucleic acids and carbohydrates represent a diverse supply of structural building blocks for the chemist to design and fabricate new functional nanostructured architectures. Using a chemoselective ligation methodology, we have prepared new integrated functional systems exhibiting designed properties in the field of nanovectors, biosensors as well as controlled peptide self-assembly. Thus this molecular engineering approach allows for the rational design of systems with integrated tailor-made properties for applications by bottom-up design in the domain of nanobiosciences.

Molecular recognition is a key feature used by nature for the design and the manufacture of biomaterials that exhibit highly developed nanostructures with tailor-made properties. Biological assemblies are highly interesting for nanosciences and nanotechnologies since they raise a number of questions to be addressed by nm-scaled probes or devices; they also provide source of inspiration for the design of nanodevices, nanostructures with new types of functions, and perhaps even components for new types of devices. Biomolecules such as peptides, nucleic acids and carbohydrates exhibit intrinsically structural and functional encoded recognition properties in living systems, which represent a tremendous source of inspiration for the creation of nano-sized molecular systems. Nano-constructs formed from combinations of such molecular building blocks opens up a wide and diverse field of research, from the construction of smart drugs that can selectively target diseased tissue to the understanding of nature's fascinating principles. Further, nano-sized biomolecular devices composed of protein or nucleic acid building blocks have the advantages of a broad spectrum of functionalities and binding interactions. Combining these properties with modern synthetic strategies allows for the design and preparation of elaborate nanomaterial with multiple embedded functions. Here, nano-constructs are referred to as artificially made structures possessing sizes between one to tens of nanometers. A key factor in the preparation of such elaborate devices is the precise control by which the different building blocks are conjugated together both chemically and directionally.

In this presentation, we summarize the research performed in our laboratory concerning the use of multifunctionnal biomolecular nanoconstructs for the development of biofunctionnal interfaces and sensing devices. Different approaches will be illustrated by several examples focusing on the impact of ligands multivalent presentation on several molecular recognition processes such as glycoside cluster effect or cell adhesion processes. Other examples will concerns the development of tethered lipid bilayers for studying protein-ligands interactions or the use of pegylated surfaces and click chemistry for assembling stimuli responsive biomaterials.

This work also belongs to the Nanobio* pole in Grenoble which promotes, thanks to local communities' supports, research in the field of nanobiosciences. Support from Nanosciences Fondation** is also aknowledged.



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