SÉMINAIRE
MATIÈRE MOLLE ET COMPLEXE

Liquid Crystalline Nanoassemblies for Delivery of Bioactive Molecules towards Neuroregeneration.

Angelina Angelova

Institut Galien Paris-Sud, CNRS UMR 8612, Université Paris-Saclay, France

Self-assembled nanomaterials are attracting considerable interest in therapeutic innovation. Our research on lipid-based nanocarriers of liquid crystalline inner organization has been inspired by the compartmentalization of biological systems and the formation of cubic and tubular membrane architectures in diverse cells and organelles. Self-assembly of lipid mixtures in aqueous medium may generate a variety of mesophases (lamellar, inverted hexagonal, bicontinuous cubic, sponge, and intermediate type of structures). The topology of the liquid crystalline nanoassemblies governs their controlled release properties for encapsulated drugs. We designed self-assembled mesoporous type carriers with incorporated functionalities in view of the necessity of targeting of receptor proteins implicated in neurodegenerative diseases. Our research aims at understanding of the mechanism and dynamics of formation of the nanocarriers generated by amphiphilic building blocks and time-resolved structural studies of the assembly and loading of therapeutic biomacromolecules [1-6]. It is of interest that the lipid bilayer building blocks impart biocompatible properties and low toxicity of the resulting nanoassemblies, which should provide minimal side effects in clinical applications. Moreover, liquid crystalline assemblies generated by functionalized lipid systems display stimulus-responsive properties, which may expand the possible therapeutic approaches. Loading of guest biomacromolecules (peptide, proteins, or DNA) is associated with concentration-dependent lyotropic phase transitions in the host lipid systems. High resolution SAXS structural analysis was employed to monitor these effects. Upload of the neurotrophic protein BDNF (brain-derived neurotrophic factor) into lipid membrane nanoassemblies yielded multicompartment nanoparticles with a dense core and a porous periphery of aqueous channels. Synergistic activities of nanodrugs and interaction of nanocarriers with a chosen cellular model was studied in relation to receptor targeting and intracellular signaling pathways in neurodegeneration/neuroregeneration.

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