Lipidic Mesophases: fundamentals and applications

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Amphiphilic lipids aggregate in aqueous solution into a variety of structural arrangements. Among the plethora of ordered structures that have been reported, many have also been observed in nature. In addition, due to their unique morphologies, the hydrophilic and hydrophobic domains, very high internal interfacial surface area, and the multitude of possible order−order transitions depending on environmental changes, very promising applications have been developed for these systems in recent years. These include crystallization in inverse bicontinuous cubic phases for membrane protein structure determination, generation of advanced materials, sustained release of bioactive molecules, and control of chemical reactions. The outstanding diverse functionalities of lyotropic liquid crystalline phases found in nature and industry are closely related to the topology, including how their nanoscopic domains are organized. This leads to notable examples of correlation between structure and macroscopic properties, which is itself central to the performance of materials in general. The physical origin of the formation of the known classes of lipidic lyotropic liquid crystalline phases, their structure, and their occurrence in nature are described, and their application in materials science and engineering, biology, medical, and pharmaceutical products, and food science and technology are exemplified.

In this lecture I will illustrate the fundamentals of lipid self-assembly into mesophases, their analogies and differences with block copolymers, their physical properties and their range of applications from food to water crystallization nanoconfinement and cryo-enzymatic reactions.

References

R Mezzenga, JM Seddon, CJ Drummond, BJ Boyd, GE Schröder-Turk, and L Sagalowicz. Nature-Inspired Design and Application of Lipidic Lyotropic Liquid Crystals. *Adv. Mater*. 2019, **31**, 1900818