Light-harvesting protein intermolecular order in the Langmuir-Blodgett (LB) nanofilms: characterization methods and applications.

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Proteins represent versatile building blocks for the realization of functional biomaterials based on nanotechnological approaches. Langmuir-Blodgett (LB) nanotechnology provides a path to hierarchical organization of protein molecules into functional biomaterials with applications in materials science and bioelectronics (e.g., biosensors, energy-conversion devices).

Phycocyanin (PC), a phycobiliprotein that forms part of the photosynthetic light harvesting phycobilisome complex in most cyanobacteria and red algae, has potentially many nanobiotechnological applications, e.g., in biological photovoltaic devices or as a natural photosensitizer for dye-sensitized solar cells. However, such applications often require specific operating conditions, and one of the most important is thermal stability.

Two emerging techniques: Cryo-electron Microscopy in microbeam electron diffraction mode and Nanobeam X-ray Diffraction in scanning mode were used for probing local temperature-induced self-assembly in thermally annealed PC LB multilayered nanofilm. Their close-packing and morphology were determined by Quartz Crystal Microbalance and Atomic Force Microscopy. The possible nanotechnological application of highly ordered PC LB nanofilms in terms of key enabling technologies, namely innovative, sustainable and clean energy as solar fuel generation by low-cost biomaterial such as cyanobacterial phycocyanin is discussed.

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