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Dynamics of photoinduced bidirectional phase transitions in phospholipid membranes

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Lipid membranes are the backbone for biologicals cells and to understand intercellular, and cell-cell interaction is of fundamental interest. The lipid molecules within the membrane define the cell properties and mesophase, and influence the functionality and efficiency of membrane proteins. [1,2,3] Therefore, controlled interaction between proteins and lipids in the biological membrane yields high potential for efficient drug transportation and release of pharmaceuticals. We want to present a model system consisting of DPPC and photoswitchable azobenzene amphiphiles [4] that induced structural changes of the membrane morphology upon isomerisation of the azobenzene mimetics by illumination with 365 nm and 455 nm to switch between the cis and trans isomer. In-situ X-ray and neutron reflectivity studies on Langmuir monolayers containing 5% [5] and 10% azobenzene amphiphiles at the water-air interface revealed an additional phase transition and light induced bidirectional, repeatable and fully reversible structural changes of the layer thickness and surface pressure. Further studies on liquid crystals containing DPPC and different percentages of azobenzene amphiphiles showed light-induced mesophase transitions between multilamellar (MLV) and bicontinuous cubic Pn3m structure at room temperature as visualised exemplarily in Figure 1 [6]. Recent times resolved SAXS measurements allowed to investigate the kinetics and dynamics of the mesophase transition for liquid crystals in dependence of the chemical composition of different azobenzene amphiphiles and identify transition times of up to several minutes. In addition to the scientific results we will also present the FAIR data handling and usage of data repositories and sample identifiers following the FAIR standards proposed by DAPHNE4NFDI [7] for an example SAXS data set.

Figure 1. Small angle X-ray scattering data of mixed DPPC and azobenzene mimetics for the cis (upper curve) and trans (lower curve) state and the fit (in grey) for the mesophases shown schematically on the right. [6]

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