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An Azidolipid Monolayer – Transitions, Miscibility, and UV Reactivity studied by Infrared Reflection Absorption Spectroscopy

We developed an azide-modified lipid with the potential to be used in photocrosslinking studies in lipid bilayers [1,2] or monolayers[3] with interaction partners, such as peptides or proteins. The UV-activatable lipid is a phosphatidylcholine (PC) and bears a terminal azide moiety in one of its hydrophobic tails (AzidoPC). Here, we present systematic monolayer studies of pure AzidoPC and its mixtures with the model lipid DPPC. Besides a thorough thermodynamic analysis with the Langmuir film balance technique, we performed infrared reflection-absorption spectroscopy (IRRAS) to get detailed insights in the organization of those (mixed) monolayers. Additionally, we applied high-resolution mass spectrometry (HRMS) to see effects of UV-irradiation on the lipids' chemical structure and organization. Our results suggest that in expanded monolayers of pure AzidoPC the azido terminated chain folds back towards the air-water interface. Conversely, in condensed monolayers, the chains stretch and the azide moiety detaches from the interface. For future applications as UV-activatable dopant, we studied the miscibility of the azide-modified lipid with DPPC and found a sufficient miscibility over all investigated mixing ratios. Finally, we showed photo-dissociation of AzidoPC upon irradiation with UV light at 305 nm, leading to chemical crosslinking with adjacent monolayer lipids. This shows the potential of AzidoPC to be used as crosslinking agent within self-assembled lipid or lipid/protein layers.

[1] S. Lindner et al.: Azide-Modified Membrane Lipids: Synthesis, Properties, and Reactivity, Langmuir 2017, 33 (20), 4960-73.
[2] S. Müller et al.: Azide-Modified Membrane Lipids: Miscibility with Saturated Phosphatidylcholines, Langmuir 2019, 35 (38), 12439-50
[3] M. Hoffmann et al.: An Azidolipid Monolayer – Transitions, Miscibility, and UV Reactivity studied by Infrared Reflection Absorption Spectroscopy, Langmuir 2020, 36, 12804-15

Session

Interaction lipids/polymers/membrane proteins

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