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Measuring lipid order to assess lipid nanoparticle stability, cell membrane permeability and membrane drug interaction

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We here report on reversible and irreversible changes of the lipid order in synthetic and biological systems that open up new applications. First, the lipid order within lipid nanoparticles changes as function of time during storage indicating irreversible structural changes. This allows for assessing in-situ the temperature stability in drying processes such as spray drying but also the long-time storage stability of formulations. Second, the permeability of cellular membranes is directly related to the plasma membrane order. This can facilitate permeabilization and transfection protocols. Third, we found that lipid phase transitions of cellular membranes are strongly influenced by short and long-time exposure of the breast cancer drug tamoxifen. These results might yield a different view on working mechanisms and long-time adaptation effects of membrane targeted drugs. All observations were obtained using the same measurement principle: The fluorescent analysis of solvatochromic dyes over wide temperature ranges. We are convinced that these observations will inspire researchers across different working fields in biophysics to include lipid order measurements in their studies. For this we provide detailed insight into the measurement procedure and introduce a custom-made device that facilitates this kind of studies.