

Lipid Membranes in an Electric Field

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Electric fields have a strong influence on lipid membrane behavior and are used in many applications in cell biology, biotechnology and pharmacology [1]. High electric field can lead to cell hybridization, electroporation, electrofusion and electropermeabilization, opening wide applications in tissue ablation and gene therapy. Lower electric fields can also induce shape deformation of the lipid bilayer and under certain conditions its destabilization. This electroformation process has become one of the classical methods to form large unilamellar vesicles. The effect of electric fields on membrane elasticity has been investigated using synchrotron grazing incidence x-ray scattering [2]. Using a recently developed method, we are able to precisely determine membrane tension, rigidity and interaction potentials. We show that membrane tension is decreased, possibly down to negative values and that the membrane rigidity is increased. A full analysis of our data as a function of applied potential and frequency shows that it is possible to decouple simple electrokinetic effects from the bilayer elasticity which is affected by the local electric field. The effects on the membrane itself and Debye electrical double bilayer could be fully analysed leading to a fine understanding of AC fields effects.

[1] U. Zimmermann. Electrical breakdown, electropermeabilization and electrofusion. In Reviews of Physiology, volume 105, pages 175-256. Springer Berlin Heidelberg, 1986.

[2] A. Hemmerle, G. Fragneto, J. Daillant and T. Charitat, Physical Review Letters, 116, 228101 (2016).

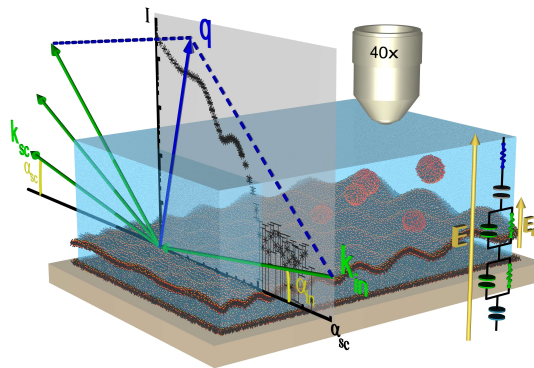


Figure 1: Schematic view of a model supported double bilayers under an electric field investigated by x-rays off-specular reflectivity.