Master Matière Condensée et Nanophysique

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Electroporation of model lipid membranes

Electroporation consists into creating pores in a membrane under the action of an electric field. Our research project concerns the physical properties of membranes of phospholipids, with the aim of understanding some of the complex properties of cell membranes.
Measuring the behavior of a membrane submitted to an electric field enables to get informations about the cohesion between the membrane constituants. Recent experiments have for example shown a big difference in such electric properties for membranes of POPC, a common unsaturated lipid in cell membranes, and POPC-OOH membranes, the oxidized version of the latter (Figure 1). The present study aims at finding out some of the possible effects of oxidation, a permanent chemical process in living cells, on the overall properties of lipid membranes.
Our aim is to finely measure the behavior of model membranes submitted to low electric fields; membranes with oxidized lipids will first be compared to their non oxidized counterpart. The study can be broadened to more complex systems, like membranes with some cholesterol, or others exhibiting phase separation due to the presence of saturated lipids as well.
This work is mainly of experimental nature, but it will incorporate a theoretical part, since the future results will need to be interpreted in terms of the physical mechanisms at play in the observed behaviors. The student will work in contact and collaboration with other students of the team, whose thematics concern other aspects of model lipid membranes.

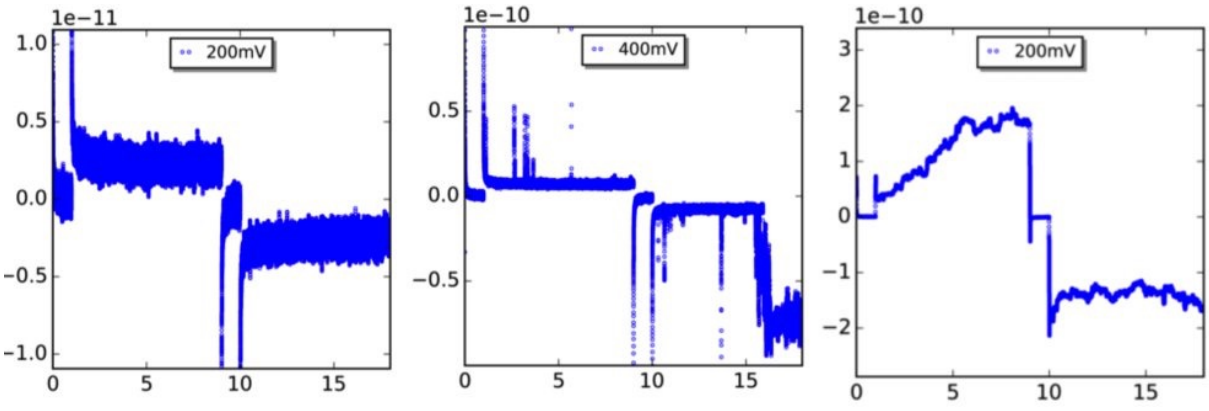

Figure 1 : Electric Current (Amperes) as a function of time (seconds) for different membranes. Left: membrane of POPC submitted to a 200 mV field; the current plateau value indicates that the membrane remains stable in this condition. Centre : same membrane submitted to a tension of 400 mV : pics appear, corresponding to temporary, short lifetime pores. Right : POPC-OOH membrane under a 200 mV tension; here the curve appears very different, since a higher, non stable current crosses the membrane over seconds, while the membrane does not break.