Structural and dynamic changes in photo-oxidized membranes: insights from a coarse-grained model, and a kinetic puzzle

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A few years ago, the in-situ photo-oxidation of POPC and DOPC vesicles brought a proof of the stability of fully peroxidized lipid bilayers and provided an estimate of their relative increase in area per lipid [1,2]. These results were comforted by self-consistent mean-field Monte-Carlo simulations. A coarse-grained model was then introduced, which reproduces semi-quantitatively the experimental findings [3]. We will review the main predictions of this model in terms of membrane structure and mechanics.

When photo-oxidation is not restricted to peroxidation, irreversible damages to the bilayer occur. Different experiments point to a non trivial relationship between the rate of lipid alteration and the time of occurrence of the damages in DOPC bilayers, as inferred from the sudden increase in membrane porosity [4,5]. We argue that a lateral lipid separation mechanism could account for this non-trivial kinetics of the membrane degradation.

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[3] Y.Guo et al, Soft Matter, 12, p263 (2016).
[4] O. Mertins et al., Biophysical Journal, 106, 162–171 (2014)
[5] I.O.L. Bacellar et al., BBA, 1860, p2366 (2018)