Model membranes of increasing complexity: structural highlights obtained by neutron reflection

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Biomembranes are complex objects composed of several different molecular species. One of their most significant complexities is compositional asymmetry. Regions exist where asymmetry, both lateral and transversal, is a key factor and is claimed to be associated to functional and structural roles. Nonetheless, membrane asymmetry is an often underestimated feature and is hard to reproduce in mimics. Experimental models, bearing forced membrane leaflets asymmetry in the form of disperse aggregates in solution or of single supported bilayers, have been developed and can be suitably investigated by neutron and x-ray scattering and reflectivity. These techniques allow access to the typical length scales of membranes, from the colloidal to the local, exploiting the specific advantages of the employed radiation. Neutron reflectometry and scattering allowed to access the cross structure of raft-mimes, assessing that the presence of a typical raft glycosphingolipid, GM1 ganglioside, forces asymmetry in cholesterol distribution, proving that a true coupling between the two molecules occurs. Similar results have been found in plant model membranes. Moreover, membranes are selective barriers and their selectivity depends on the local structure and specific composition. Multi-technique investigations allow to address the structural response of model membranes to approaching proteins and enzymes, such as Aβ peptides and ion channel proteins. The possibility to create and study customized membranes mimicking different membrane portions opens the way to the detailed investigation of a variety of specific molecule-membrane interactions.