Neutron-based static and dynamic biomembrane studies enabled by deuterium

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The plasma membrane is a thin, two-dimensional semi-permeable structure encapsulating the cell's machinery. It gives structure, regulates cell growth, and enables communication. It is also widely accepted that the plasma membrane is chemically asymmetric and laterally heterogeneous, containing nanoscopic regions enriched in certain types of lipids. These domains are functional and are commonly referred to as "lipid rafts".

Neutron scattering is a nondestructive, probe-free technique used to study the structure/dynamics of hydrogen-rich materials (e.g., biomembranes) over extended scales of length (angstroms to microns) and time (picoseconds to milliseconds). However, its full power can only be realized with the availability of selectively deuterated samples – this is because it is differentially sensitive to hydrogen's stable isotopes, namely protium (H) and deuterium (D). By selectively substituting D for H, parts of complex materials can be studied without altering their physical properties. Deuteration thus enables otherwise impossible studies, uniquely revealing relationships between molecular structure (static) and function (dynamics) in biomembranes. The talk will summarize recent results where deuterium was used to elucidate the static and dynamic structures of model and real biological membranes.