

Label-free, real-time studies on intermolecular interactions at model membranes using surface vibrational spectroscopy

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Sum frequency generation (SFG) vibrational spectroscopy is a technique that provides the vibrational spectrum of the outermost monolayer of molecules at an interface. As such, it has proven itself to be a very powerful technique in the study of molecular structure of surfaces and interfaces in different chemical environments. It is particularly well-suited for the study of biomolecular interactions at model biological membranes. It provides information on the organization and confirmation of lipids, the water hydrating the lipids, and proteins embedded in, or interacting with the model membrane.

We have performed SFG studies on lipid monolayers, aimed at elucidating the intermolecular interactions that give rise to membrane functionality. We will report on the interaction of lipids with cholesterol and DNA, reveal the molecular signatures of an antimicrobial peptide destabilizing both the lipids and the membrane bound water, and report on the specific interactions between the large protein cholera toxin and GM1 lipids.

Molecular level details revealed by SFG in these studies show that SFG can provide unique insights on the interactions between lipid monolayers and DNA, peptides and proteins in real time, in situ, in an intrinsically label-free manner.