SIMULTANEOUS MEASUREMENT OF THICKNESS AND REFRACTIVE INDEX OF LIPID BILAYERS BY INTERFEROMETRIC REFLECTOMETRY

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Measuring the thickness and refractive index of nanometre-scale layers with high lateral spatial resolution is challenging, yet it is of significant importance in many fields, including lipid membranes in the biosciences. We present an experimental technique and associated theoretical model to address this challenge.

Reflectometry is a technique that uses the intensity of the light reflected by a sample to determine properties of the sample. Interferometric reflectometry uses interference between two beams, only one of which is incident on —and reflected back by— the sample, to obtain the complex electric field rather than merely its intensity. This, in turn, allows us to obtain information about the sample's thickness and refractive index.

We have developed a confocal interferometric reflectometry (iRef) microscopy setup with which we can measure the amplitude and phase of the two perpendicular linear polarisation components of a light field reflected from a sample and reconstruct the sample's complex reflection coefficient. We have also developed a model to calculate the complex reflection coefficient of a sample consisting of an arbitrary number of parallel thin layers for arbitrary incident light and applied it to the case of a focussed beam's reflection collected by an objective of given numerical aperture.

We present our iRef results for heterogeneous lipid bilayers such as those found in cellular membranes. Our data allows the determination of the thermodynamic phase transitions of the bilayer in a label-free and nondestructive manner.

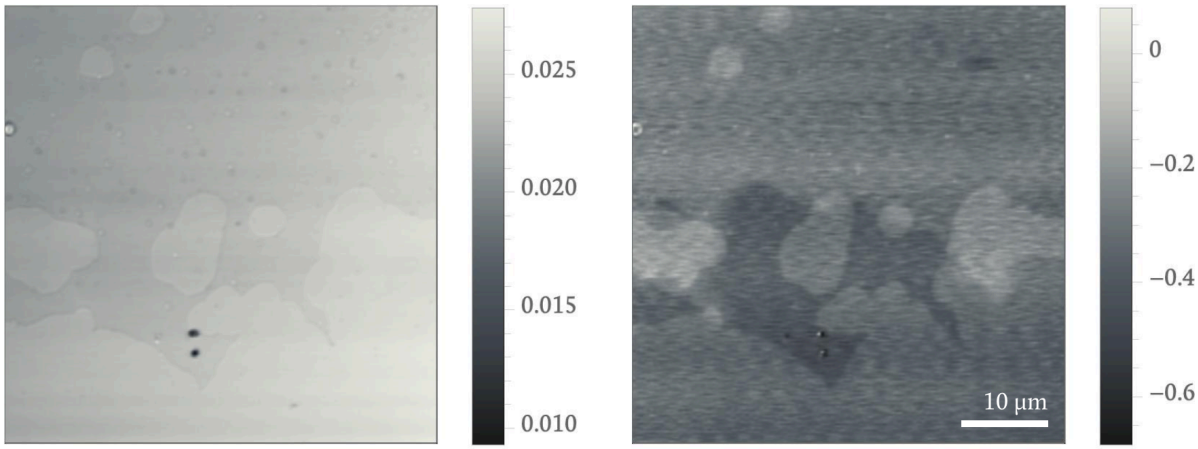

Figure 1: Amplitude (left) and phase (right) of the light reflected from a single lipid bilayer.