Visualization and characterization of domains in model membranes

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Supported lipid bilayers can be regarded as simple models for biological membranes. In particular, bilayers composed of lipid mixtures containing cholesterol have provided notable insight in the phase-behavior of such systems. This is particularly interesting, since specific interactions between cholesterol and sphingolipids are thought to induce the formation of biologically functional domains, also referred to as rafts. Such domains have been found to be present in model systems and there are several techniques at hand to visualize them. We have used Atomic Force Microscopy (AFM), Fluorescence Microscopy (FM) and Coherent Anti-Stokes Raman Scattering (CARS) Microscopy to try and visualize domains in supported model membranes. These techniques were chosen because they are suitable for imaging supported systems and because they provide complementary information. AFM yields height profiles of the scanned samples, and thus in the case of model membranes the contrast is based on differences in bilayer-thickness; FM visualizes probe-partitioning in different lipid phases; multiplex CARS provides direct information on the phase of lipid bilayers by yielding Raman spectra of every single measured point of the bilayer. We present images obtained with AFM and FM and discuss the effect of lipid-composition, temperature and substrate properties. Apart from domains induced by lipid-lipid interactions, we also studied domain formation induced in supported bilayers by peptide-lipid interactions (Figure 1). Currently we are attempting to obtain images of both systems using multiplex CARS microscopy.

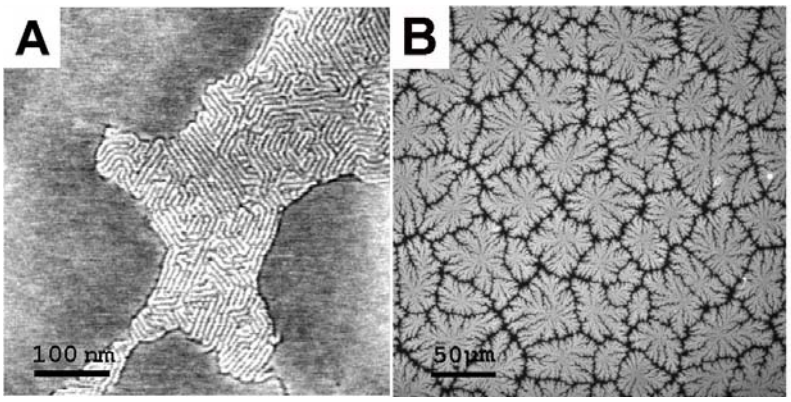

Figure 1: model peptides incorporated in DPPC bilayers, A: on the nanometer scale, imaged with Atomic Force Microscopy and B: on the micrometer scale imaged with Fluorescence Microscopy.