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„Langmuir monolayers of ferroelectric and bolaamphiphilic liquid crystals at the air–water interface"

Abstract

For over a century, Langmuir films have served as excellent two-dimensional model systems for studying the conformation and ordering of amphiphilic molecules at the air-water interface. With Wilhelmy plate technique, Brewster angle microscopy (BAM), and surface potential measurements, the interfacial phase and rheological behavior of Langmuir films can be investigated. In my dissertation, these techniques are employed to examine Langmuir films of ferroelectric and bolaamphiphilic liquid crystals.

In the first part of my experiment work I present the results of the monolayers behavior of four ferroelectric liquid crystals spread on water surface. The chiral molecules with tilted orientation to the surface create textures of circular stripe. These patterns arise from collective rotation of molecules driven by water evaporation through the monolayer. The rate of rotation was examined under variety of water temperatures. As it is shown, the rotation frequency depends on subphase temperature and at low temperature, when the driving force for rotation is reduced, the speed of collective rotation decreases. Typical time of rotation of a single molecule is in the range 10^{-12} – 10^{-9} s.[3] I observed in Langmuir monolayer the time of rotation up to 500 seconds, fourteen orders of magnitude slower than the one for a single molecule.

In the second part of my work I present the studies of 11 compounds from the group of specific surfactants known as bolaamphiphiles. The molecules of different shape (X-, T-, and anchor shaped) were studied. Some of these compounds have a fluorinated lateral chains and some are non-fluorinated. The research shows that the bolaamphiphiles create on water surface stable and well organized Langmuir monolayers and multilayers. The most interesting feature of the compounds is that partially fluorinated bolaamphiphiles exhibit an unusual reversibility and reproducibility of Langmuir isotherms in spite of the compression to complete collapse of the film.