

13.0 Graphoepitaxy of Colloidal Crystals

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13.1 Growth of Colloidal Crystals

Joint Services Electronics Program (Contract DAAL03-86-K-0002)

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The goal of this project is to use colloidal crystals of polystyrene latex spheres as models to study epitaxial growth on patterned substrates. Using lithographic techniques, it is possible to control the texture and patterns of the substrate precisely on the “atomic” scale of the model systems - which is about $0.1 \mu\text{m}$. Thus light scattering may be used to study ordering in these materials in a way analogous to the use of x-rays to study ordinary crystals, with the added advantage that dynamic information can be obtained.

A thin cell in which the ionic strength of the colloid can be reduced to the point where crystallization occurs has been constructed. Preliminary light scattering experiments of the freezing with smooth substrates are in progress. For analysis of the intensity of scattered light, we have developed computer codes based on the theory of interacting charged spheres; the code has been tested on data obtained by neutron scattering from micellar solutions and found to work well. It will be interesting to see how well this theory works near the “freezing” transition of the colloidal crystals.

13.2 Structure of Langmuir-Blodgett Films

Joint Services Electronics Program (Contract DAAL03-86-K-0002)

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This project aims to use surface sensitive x-ray scattering to study the surface of Langmuir-Blodgett films pulled in the standard way from monolayers on the surface of water. These films have potential for device applications and are also model systems for studying the structure of two-dimensional materials.

Initial experiments have been carried out on a Langmuir-Blodgett sample with 192 multilayers polymerized with a poly-diacetylene linkage. The layers were pulled from monomers of the cadmium salt of 10,12-nanacosa-diyonic acid dispersed on a substrate containing 10^{-2} M of CdCl_2 . Polymerization was done by ultraviolet irradiation after the films were pulled. X-ray scattering data for this film that were taken at our beam line

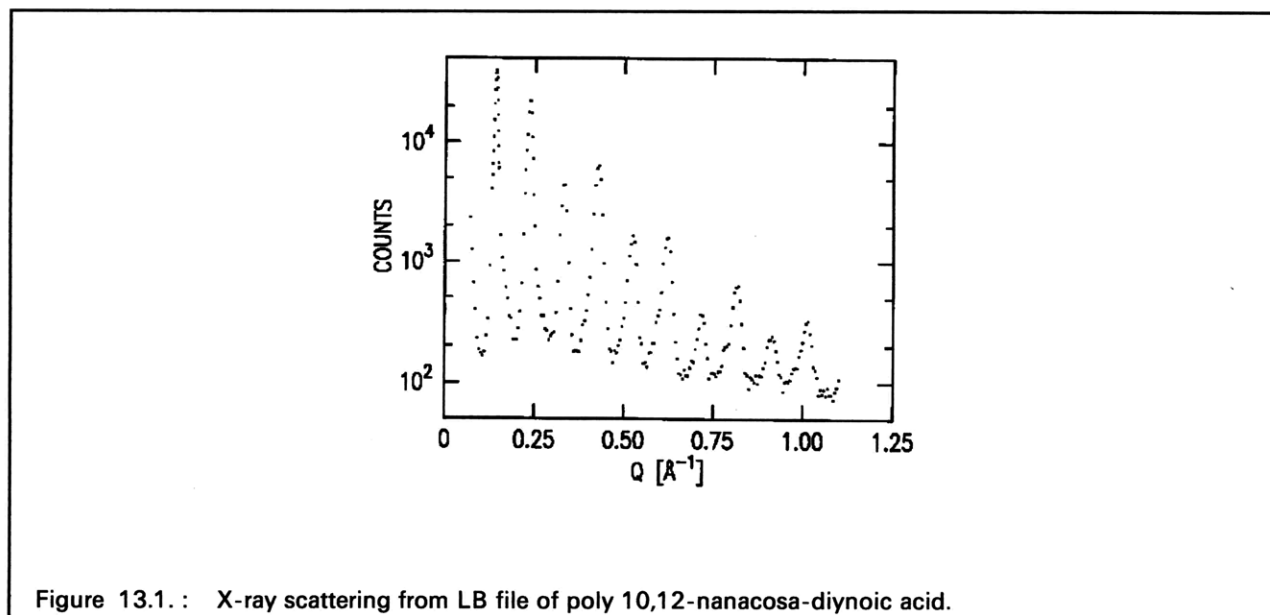


Figure 13.1. : X-ray scattering from LB file of poly 10,12-nanacosadiynoic acid.

at the Brookhaven National Synchrotron Light Source are shown in the accompanying figure; the momentum transfer was normal to the film and shows many harmonics with an interesting alternating intensity of the peaks. No structure could be detected in the plane of the film.