X-ray Liquid-Surfaces Diffractometer at the Advanced Photon Source

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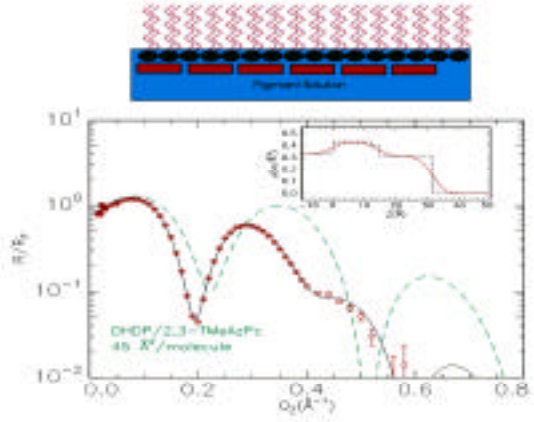
A novel X-ray liquid-surfaces diffractometer, recently commissioned on the 6-ID beamline at the Advanced Photon Source at Argonne National Laboratory, offers unique research opportunities of interfacial phenomena. The diffractometer with its auxiliary peripherals enables the structural investigations of free liquid-gas, liquid-liquid, and liquid-solid interfaces. The structural determination of the interface between two mediums (imiscible liquid-liquid, for instance) is of considerable importance in a range of areas, such as friction and lubrication, phase transfer catalysis, solvent extraction of metals and as model systems for biological membranes. The apparatus can operate with X-ray incident beam energies in the range of 4-40 keV providing a unique opportunity to locate the positions of interfacial ions using the anomalous diffraction techniques. In the near future the diffractometer will be employed for a wide range of investigations including electrochemical, photochemical, and biological effects in interfacial phenomena.

Using the Langmuir-Blodgett technique, we have recently constructed two-dimensional arrays of phthalocyanine pigments on solid support for potential use as light harvesting antenna in artificial photosynthetic devices[1]. The two-dimensional pigment array was formed on a negatively charged template of dihexadecyl phosphate (DHDP) monolayer that was spread on the pigment solution. The complexed film (DHDP-pigment) was subsequently transferred to solid support by the LB technique for photo-absorption studies. To examine the feasibility of the process and the quality of the 2D pigment array, X-ray reflectivity and grazing incidence diffraction have been employed on the liquid surface reflectometer on the X-22B beamline at the National Synchrotron Light Source, at Brookhaven National Laboratory. Recently, we have employed a similar approach to form a monomolecular magnetic layer contigouous to a charged lipid monolayer at the air/water interface. In another study we found that certain magnetic molecules spontaneously form monolayers at the air-water interface and can be transferred directly to solid support for further studies and applications. The apparatus at the APS will enable determination of the structure and organiztion of a wide variety of 2D arrays of magnetic molecules, liquid crystals, biomemebranes, and many others; information that is pivotal for the basic research of these systems and for their potential apllications.



Normalized reflectivities from a DHDP monolayers on pigment solution demonstrating the formation a single pigment layer contiguous to the lipid. Diffraction studies from the film show that the pigments form 2D crystals. The dashed green line is the reflectivity of DHDP on pure water. The inset shows the electron densitv across the interface.

[1] B. W. Gregory, D. Vaknin, et al, *J. Phys. Chem.* **101**, 2006 (1998); B. W. Gregory, D. Vaknin, et al, *J. Phys. Chem*. **103**, 502 (1998)