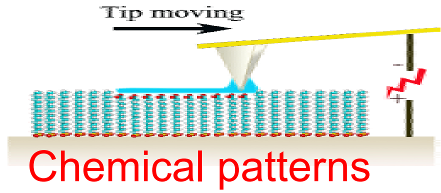
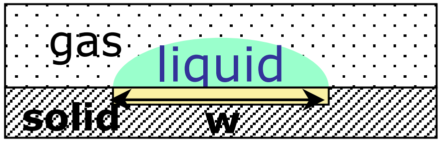
BNL Soft-Matter-- Liquids on the Nanoscale Highlight

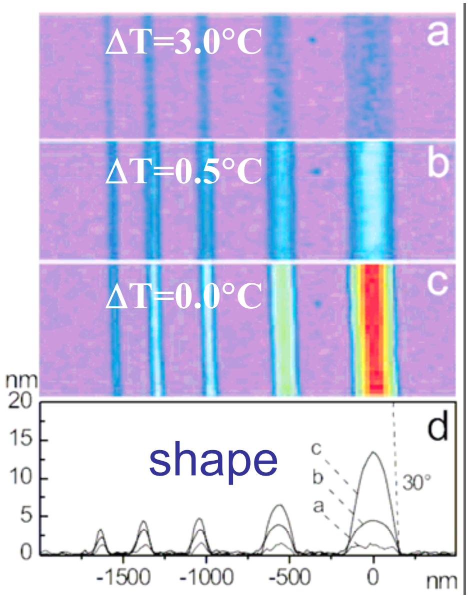
Liquid nanostripes





Nano stripe control

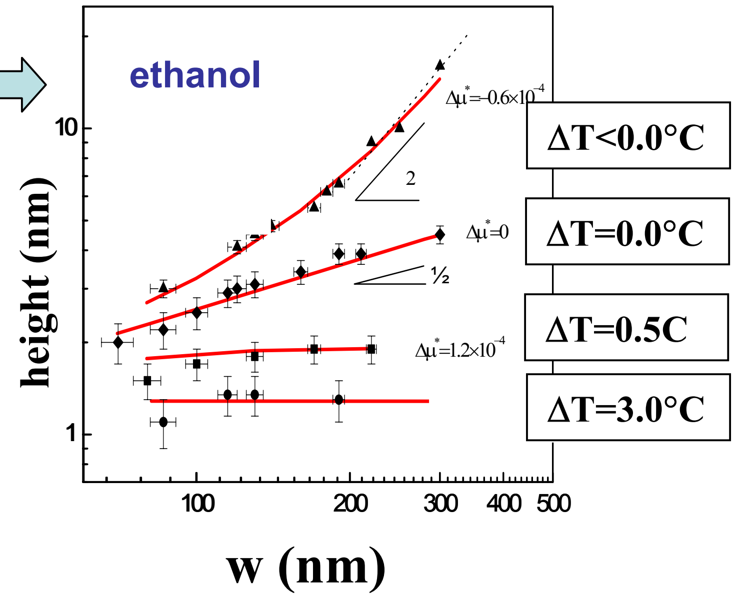
Non-contact AFM



ΔT is temperature difference between substrate and vapor.

Theoretical modelling

Drop height vs. width



Checco, Ocko, Gang, PRL *96*, 056104 (2006)

Impact

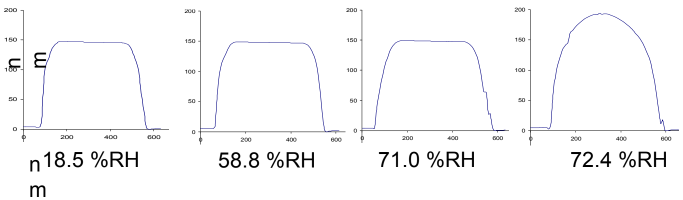
- **First detailed measurement of nanodrop shape.**
- **Observed height variation versus stripe width and height dependence agrees reasonably well with Density Functional Theory.**
- **Expected ½ power-law height dependence observed for ΔT =0, as predicted from dispersion forces.**
- **Model system for nanoliquid mediated self-assembly of nano-objects.**
- **Basic understanding vital to advances in nanofluidics.**

In 2007 extended studies to other liquids, better temperature control, narrower and wider stripes

BNL Soft-Matter– Nanoliquids and Templates Highlight

Salt particles (related to Global Warming)

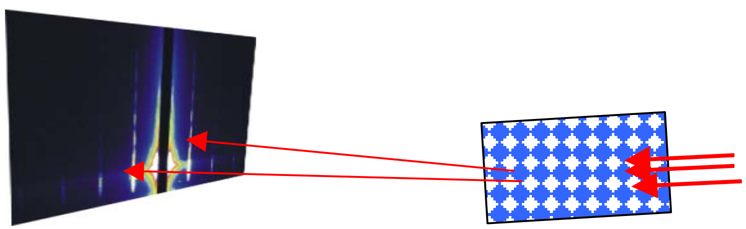
Aerosol particles (nano- and micron-sized particles suspended in air) affect atmospheric radiation and cloud microphysics. A correct description of their behavior is crucial to accurate climate modeling. We have started to study the size and shape of NaCl nanoparticles as a function of humidity. Clear changes of shapeand height are observed at the deliquescence point (75% RH) with the AFM.



Checco, Bruzewicz, Ocko, Oatis, Schwartz (Env. Dept.)

X-ray studies of wetting on physical patterns

The capillary wetting of small cavities is predicted to deviate from the macroscopic behavior. Previous studies were carried out in arrays of parabolic pits and where the phase behavior is in good agreement with recent simulations. We are extending our studies to well-ordered arrays of posts prepared using e-beam lithography.

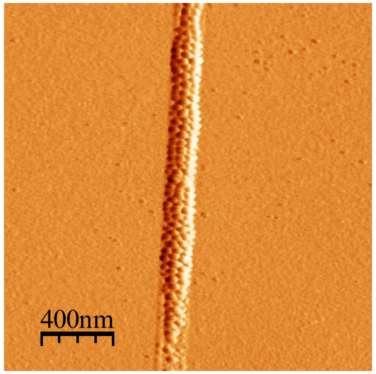


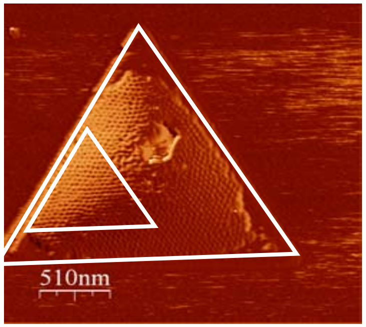
Hoffman, Ocko, Fukuto, Checco

Template directed assembly of diblock copolymers

Chemical patterns were used to direct the dewetting of polymer thin films into structures of complex shape. Here we study the effect of the lateral confinement on the spatial orientation of diblock copolymer microdomains. This process can be used to build polymer nanostructures with long-range order and this may provide a means of making ultra-small self-assembled arrays.

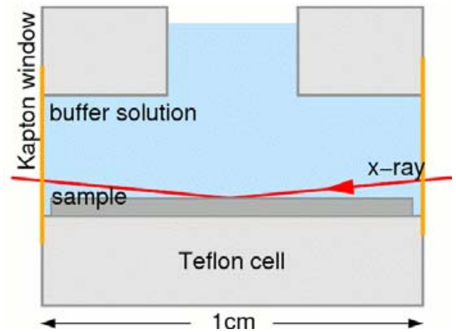
Checco, Ocko & Li, Russell (BNL, Univ. of Mass.)

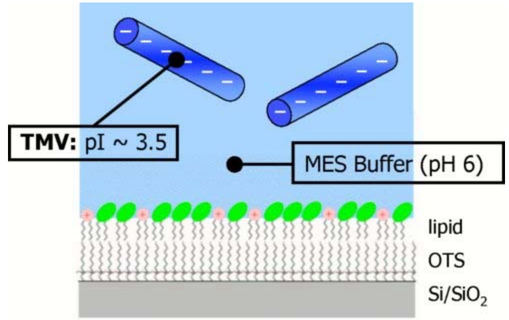




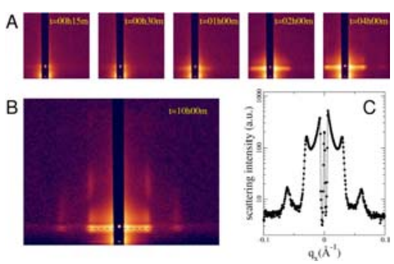
BNL Soft-Matter-- Biomolecular Materials Highlight #1

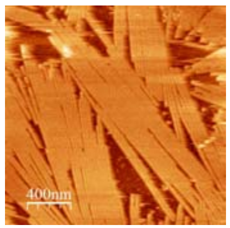
Ordered 2D Self-Assemblies of TMVs



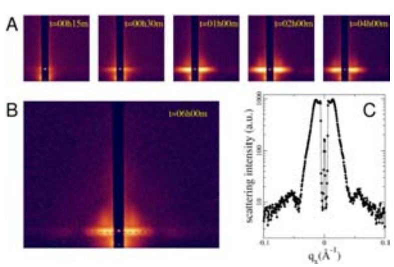


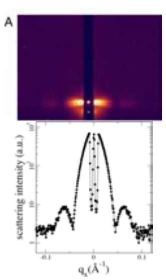
Tobacco Mosaic Viruses (TMVs) assembled on a substrate-supported lipid monolayer submerged in a buffer solution

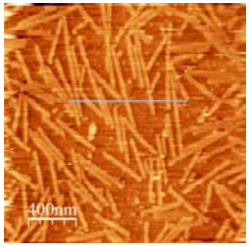




Well-ordered structures on a fluid lipid layer, Ca^{2+} presence in buffer solution





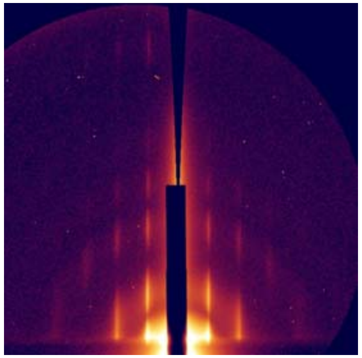


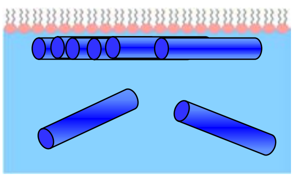
Poorly-ordered structures on a fluid lipid layer, Ca^{2+}-free buffer solution

Disordered structures on a solid substrate

Impact

- In-situ monitoring of structural order in a buried film (under water) using GISAXS for the first time
- Observed dependence of degree of order and the rate of its development on particle mobility, particle geometry and chemical environment (pH, ionic strength, type of ions, …)
- Nano-scale model system for self-assembly in two dimensions
- Possible application in structural biology as a 2D analog of protein solution scattering



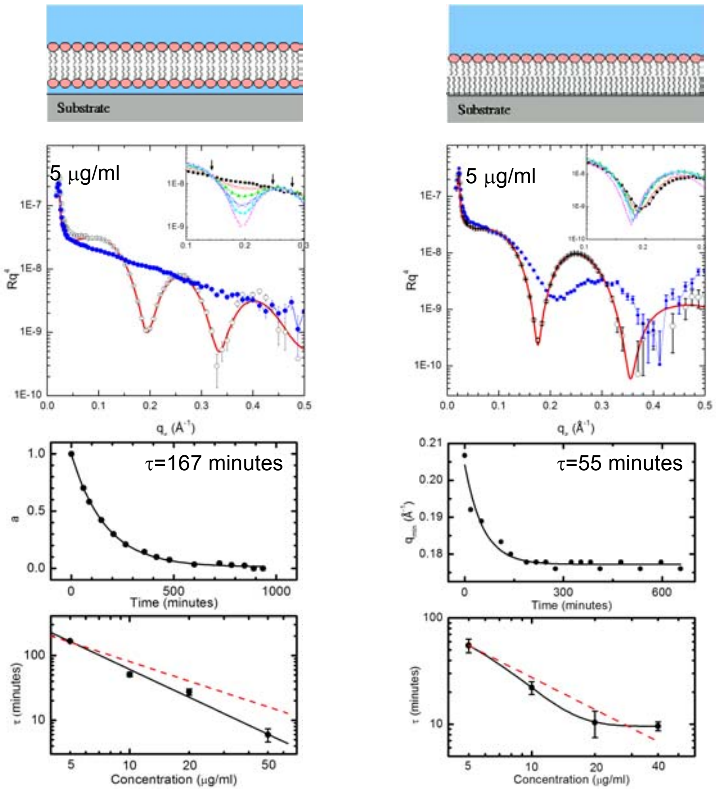


Higher mobility (Langmuir monolayer) improves order (tighter packing).

Fukuto, Checco, Wang, & Yang□

BNL Soft-Matter-- Biomolecular Materials Highlight #2

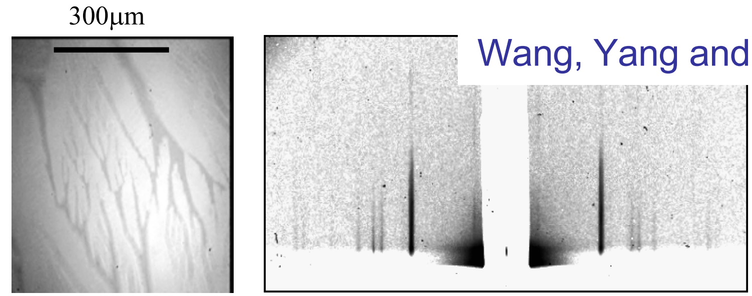
Formation of solid-supported lipid bilayers and monolayers



The formation of lipid bilayers is well described by lateral growth of bilayer islands while that of lipid monolayer on OTS-coated Si occurs through a relatively fast coverage of the entire interfacial area, followed by an increase in the monolayer thickness.

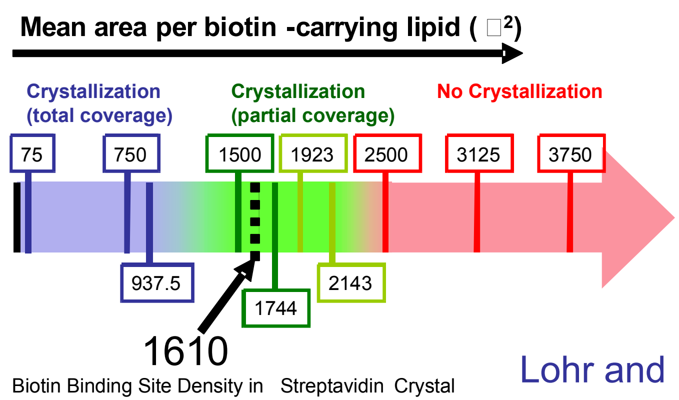
Wang, Fukuto and Yang

2D protein crystallization on a Langmuir lipid monolayer



Wang, Yang and Fukuto

2D crystals were formed from streptavidin (SA) bound to lipids that contain SA-binding biotin. The crystals were observed by BAM and area detector based-GID. The crystal structure was affected by the pH value of the buffer solution in the sub-phase.



Lohr and Fukuto

Crystal formation as a function of density of SA-binding sites was further studied. Optically visible crystals do not form if the density is below approximately 1 binding site per SA.