Integration of lipid assemblies with nanocomposite silica films

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Laboratory Overview

The nanoscale self-assembly labs at the CINT gateway facility are set up for the preparation and characterization of nanostructured materials, including nanostructured silica films and silica-based nanoparticles. These materials are prepared from a solution-based, bottom-up assembly process which allows for the integration of molecular or biomolecular components for binding/sensing studies. The lab is also equipped to perform a variety of synthetic chemistry processes, for example, preparation and chemical modification of self-assembled monolayers on metal or oxide surfaces. In addition, materials and equipment are available to prepare and manipulate assemblies that mimic biological systems, such as supported lipid membrane architectures, which mimic cellular membrane structures, by liposome formation or Langmuir-Blodgett techniques. The labs house equipment for spatially patterning nanostructured films, SAMs, or lipid bilayers using masked deep-uv exposure. Manipulation of biological materials may also be carried out in a bio-safety hood located in the labs.

Associated Capabilities

Sol-gel chemistry

Self-assembled monolayers

Fluorescence Microscopy and Spectroscopy

Spectroscopic Ellipsometry (with a liquid cell)

Langmuir-Blodget Techniques

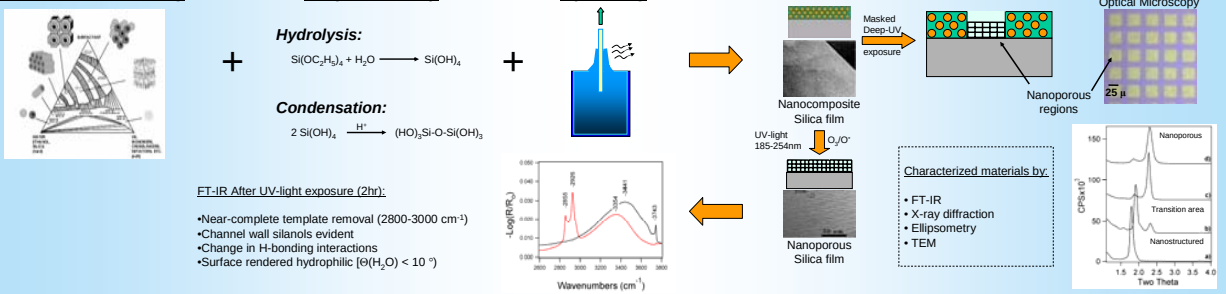
Surface assisted mass spectrometry

Powder X-ray diffraction

Access to a variety of other microscopy techniques including TEM, SEM and AFM

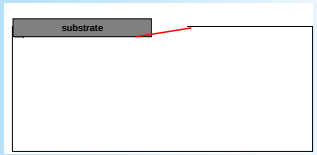
Science Examples

Preparation and Patterning of Ordered Nanocomposite Silica Thin Films



Parikh, *et al.* Chem. Mater. **2000**; Dattelbaum, *et al.* J. Phys. Chem., B, **2005,** Dattelbaum, *et. al. Nano letters*, **2003**.

Membrane Assemblies on Nanocomposite Silica Thin Films



Nanoporous silica can serve as:
- An ionic reservoir
- A base for membrane proteins
- A functional material separated from ambient by bilayer

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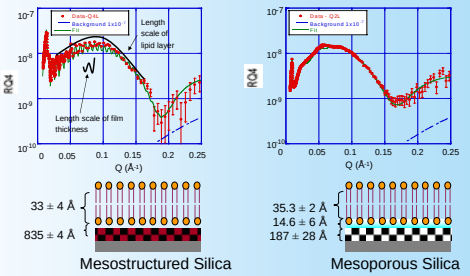
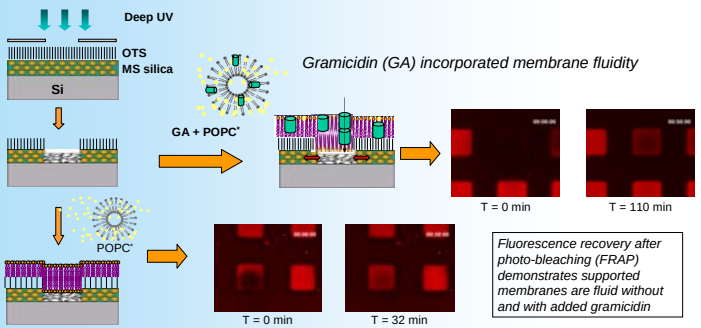
Preparation by Vesicle Fusion

- Phospholipid vesicles (with ≤1% fluorescently labeled lipid) are prepared by extrusion at controlled ionic strength and pH
- Vesicle solution contacted with supported thin film
- Incubate ≥15 minutes
- Exhaustively rinsed with water
- Store under buffer solution

Membrane structure determined by Neutron Reflectivity

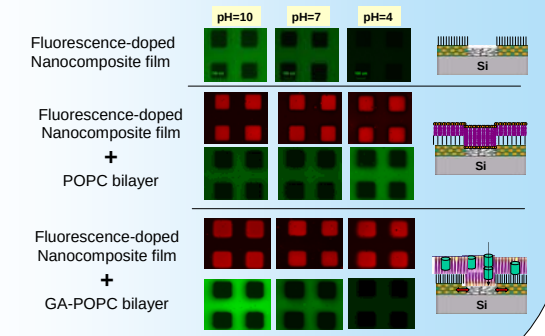


Membrane Fluidity on Patterned Films



Fluorescence recovery after photo-bleaching (FRAP) demonstrates supported membranes are fluid without and with added gramicidin

Functional Nanocomposite/membrane Materials



Demonstrates access to functionalized nanocomposite films may be regulated by lipid membrane architectures