

Directed Self-Assembly of Block-Copolymer Nanostructures for Nanomanufacturing

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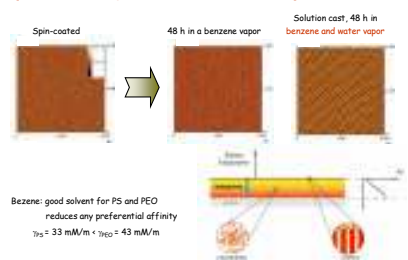
Oriented Block Copolymer (BCP) Phases : tools for creating nanoscale templates as well as high-density functional nanomaterials

- Primary driving forces for achieving highly oriented phases
 - Use of **confinement** such as in a thin film or within a channel
 - Control of the type and path of **annealing**
- Major barrier to application for nanomanufacturing
 - Controlling the long-range order and registry with other nanofabricated components

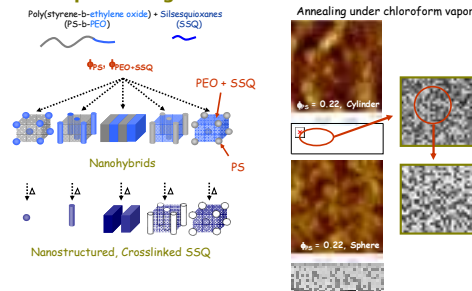
Tasks:

Remove and characterize defects in vertically oriented cylindrical BCP thin films

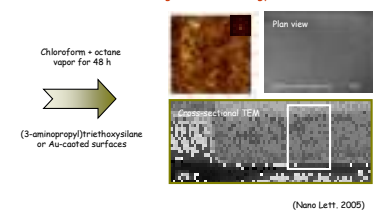
Highly Oriented and Ordered Arrays (TP Russell et al, Adv. Mater 2002 and 2004)



BCP Templated Organosilicate Thin Films



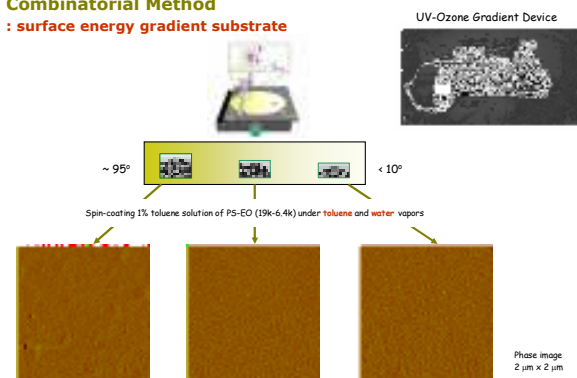
Normal orientation of cylindrical pores by tuning interfacial energy at both interfaces



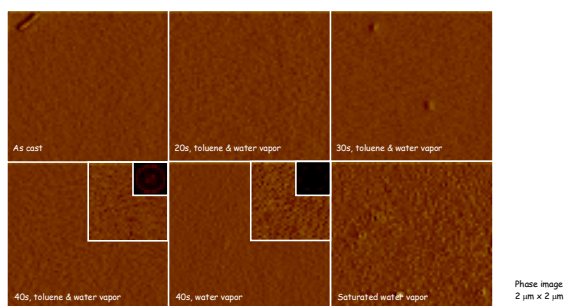
- Understand role of interfacial energy in orientation
- Characterize orientation of nanostructures

Combinatorial Method

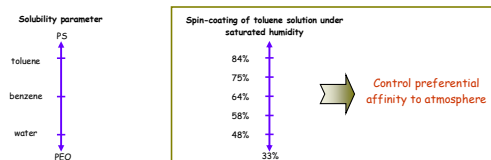
: surface energy gradient substrate



Vapor Controlled Spin Coating

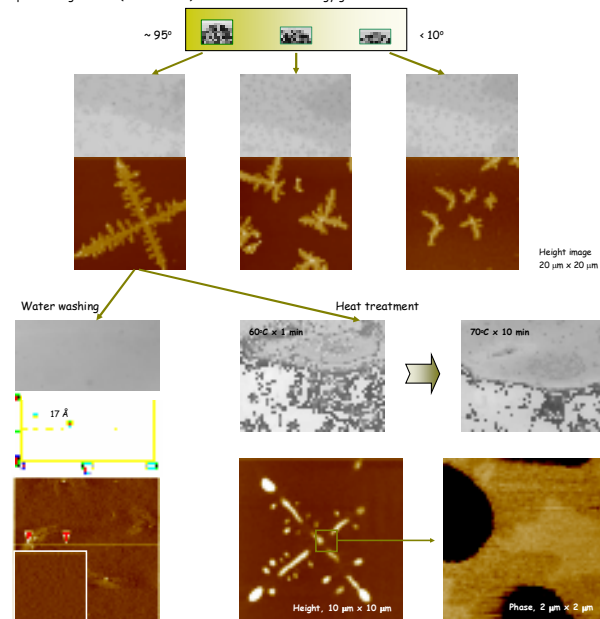


Saturated Humidity Control



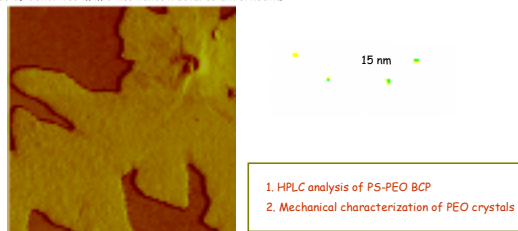
Integrity and Long-Term Reliability of BCP Nanostructures

Spin-coating toluene (PS-selective) solution on surface energy gradient substrate

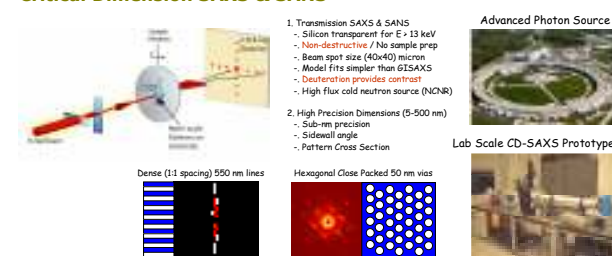


Crystallization of PEO on top of BCP Nanostructures

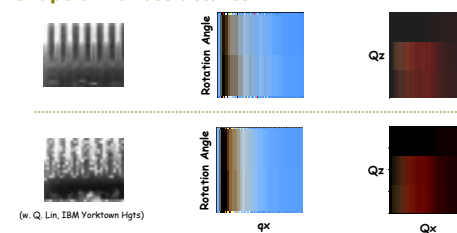
- Dendrites
- The surface of dendrites mimic the nanostructures underneath.



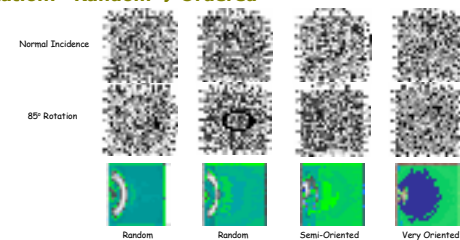
Critical Dimension SAXS & SANS



3-D Shape of Nanostructures



Orientation: Random → Ordered



CD-SAXS & CD-SANS

- Non-destructive measure of 3-D shape and size of an array of nanostructures
- Provides average
- Precision of sub-nm possible
- Line/spaces, contact holes, squares, more complex shapes possible
- Probes internal morphology/interfaces within nanostructures
- Probes buried and 3-D stacked structures

