



**National
Nanomanufacturing
Network**

www.nanomanufacturing.org



Mark Tuominen, CHM, UMass Amherst

NSF NSE December 5, 2007



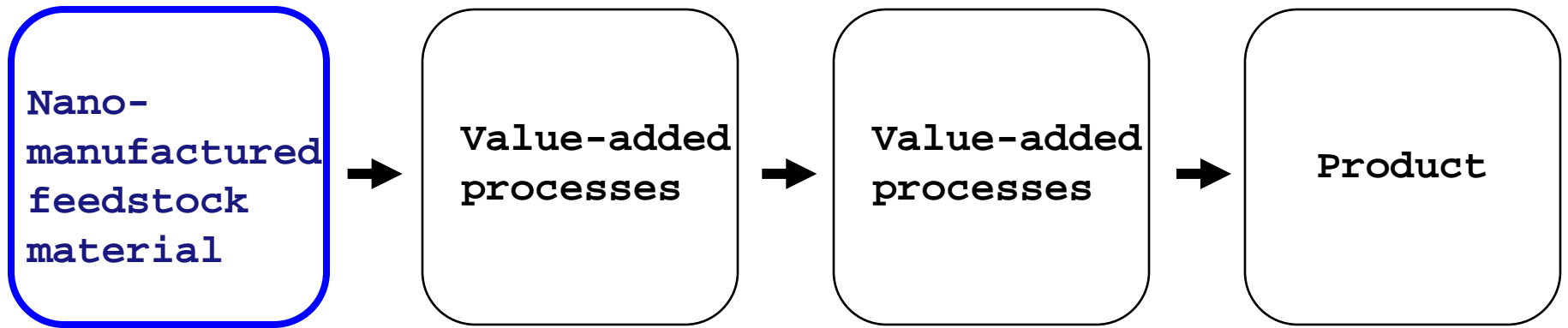
An open access network for the advancement of ***nanomanufacturing*** R&D and education

- Cooperative activities (*real-space*)
- Information clearinghouse (*cyber-space*)

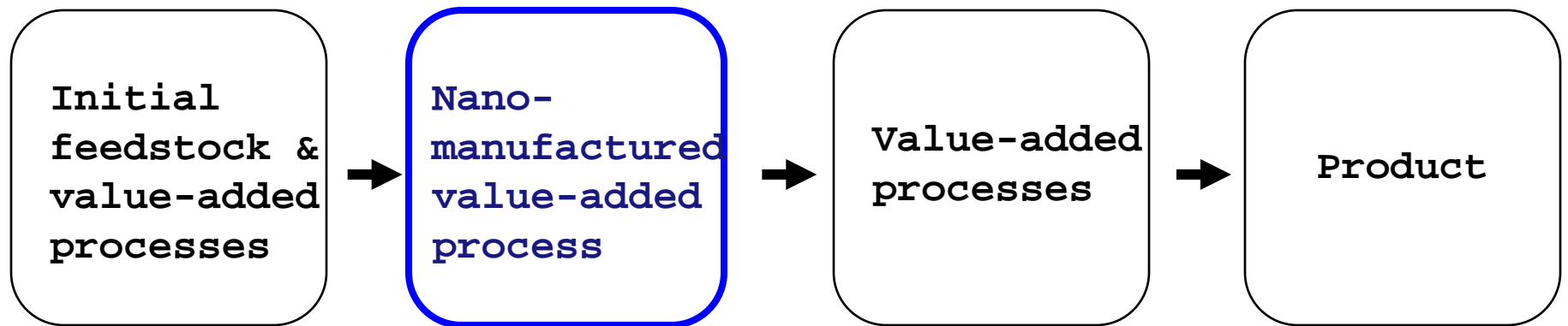
To develop and support communities of practice in nanomanufacturing

www.nanomanufacturing.org

You cannot have nanotech products without manufacturing



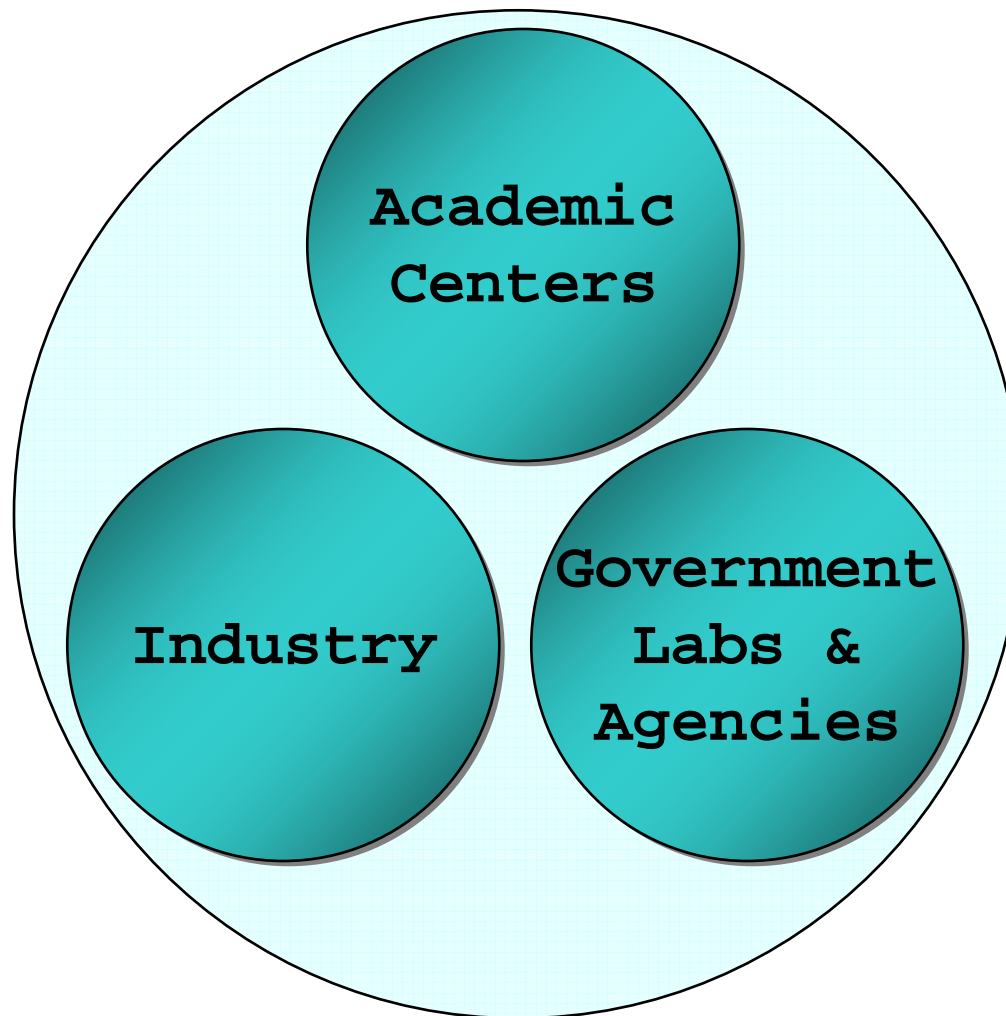
or



Factors influencing the implementation of an emergent nanomanufacturing process

- Built on robust science and technology
- Value of physical properties and impact on performance
- Statistical distributions of properties
- Knowledge of process-property relationships (model & design)
- Reproducibility and reliability
- Availability of process and metrology tools
- Compatibility of NM process with surround mfg processes
- Trained workforce
- Manufacturing cost and mode (in-house or outsource)
- EHS throughout life cycle
- Scalability and extensibility
- Current NM technologies are at various levels of maturity
- Many at infancy, information is sparse

Nanomanufacturing Stakeholders



NNN Origins: The Four Nanomanufacturing NSECs

- **Center for Hierarchical Manufacturing (CHM)**
- UMass Amherst/UPR/MHC/Binghamton



- **Center for High-Rate Nanomanufacturing (CHN)**
- Northeastern/UMass Lowell/UNH



- **Center for Scalable and Integrated Nanomanufacturing (SINAM)**
- UC Berkeley/UCLA/UCSD/Stanford/UNC Charlotte



- **Center for Nanoscale Chemical-Electrical-Mechanical Manufacturing Systems (Nano-CEMMS)**
- UIUC/CalTech/NC A&T



Nanomanufacturing Portfolio

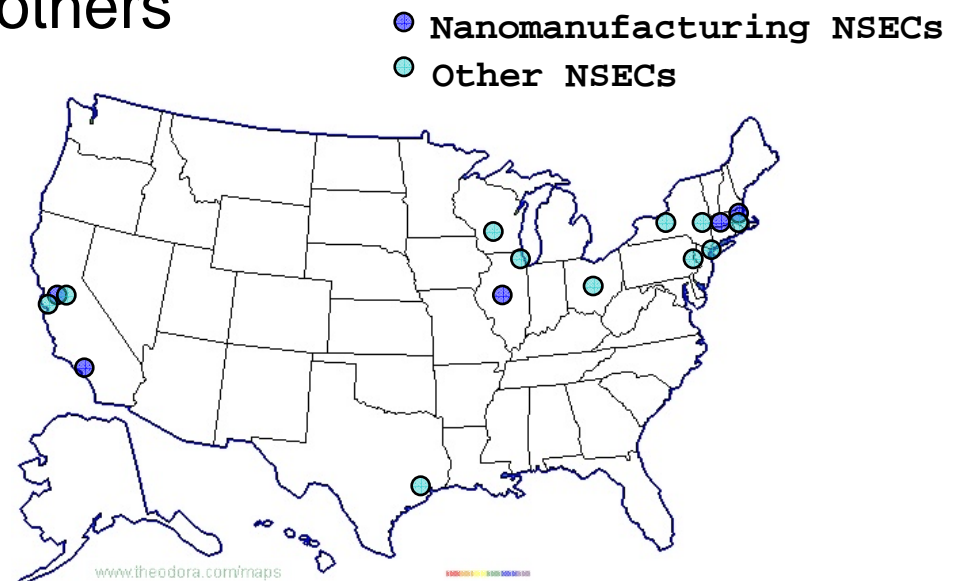
CHM - CHN - SINAM - Nano-CEMMS

Processes, expertise and facilities for:

- Materials and patterning via self-assembly
- Micro/nanofluidic fabrication
- Advanced nanoscale lithographies
- High-rate, high-volume bottom-up assembly
- Synthesis for bionanotechnology
- Nano deposition and etching process
- Nanoscale integration
- Systems engineering and scale-up
- Machine tool approaches

Expanding the NNN Base

- Other NSECs with nanomanufacturing activities
- Other academic research centers and networks (e.g., MRSECs, components within NNIN, NCN)
- Industry & industry associations - multiple sectors
- NIST - metrology, processes, materials informatics
- DOD - MURI, SBIRs, ManTech, Nanomaterials
- NIOSH, NASA, NIH, DOE, others



Nanomanufacturing Workshops

Thematic workshops, targeting priority challenges in nanomanufacturing

- NNN-DOD roundtable workshop in nanomanufacturing (Oct. 2006)
- CHM Nano for Solar Energy Workshop (May 18, 2007)
- NNN Nanoinformatics Strategic Workshop (June 12-13, 2007)
- CHN 5th New England Conference on Nanomanufacturing (June 19-20, 2007)
- AVS Nanomanufacturing Symposium (2007, 2008, NNN promoted)
- CHM Workshop on Nanomanufacturing Systems (Feb. 2008)
- Symposium at Nanomaterials for Defense conference (April 2008)
- Future NNN workshops on timely themes (steered by needs of the nanomanufacturing community)

Other NNN Target Activities

- R & D **collaboration** (developing and integrating technologies)
- Complementary portfolio of nanomanufacturing **education** and **training** activities
- Share and disseminate **best practices** (process implementation, tech transfer, EHS, others)
- Assist technology **visioning** and **roadmapping** activities (via **workshops** and **working groups**)
- **Economic analyses** of emerging nanomanufacturing processes
- Guide the development, implementation and growth of the **InterNano** NM information clearinghouse



InterNano

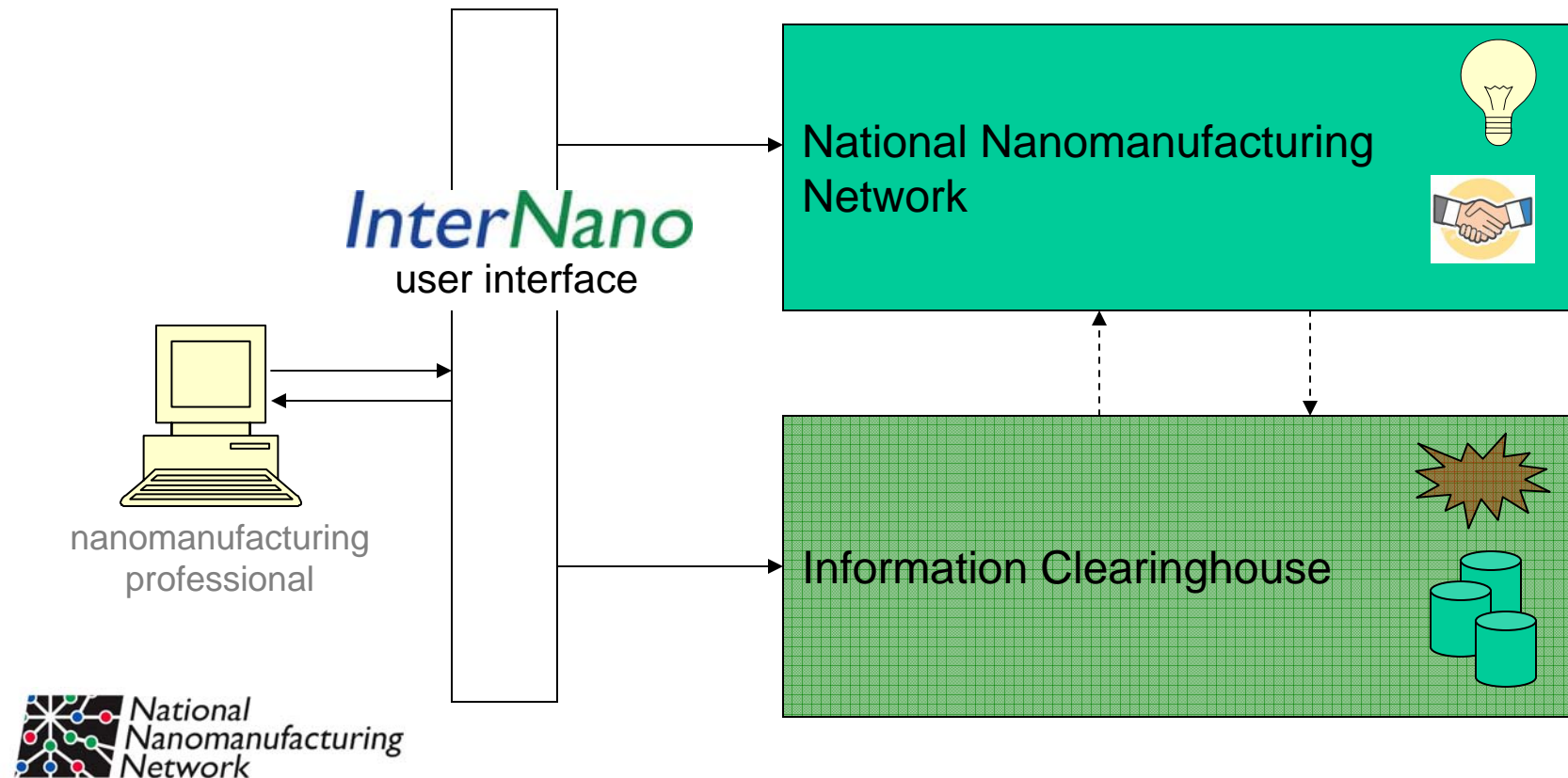
The information source for
nanomanufacturing



National
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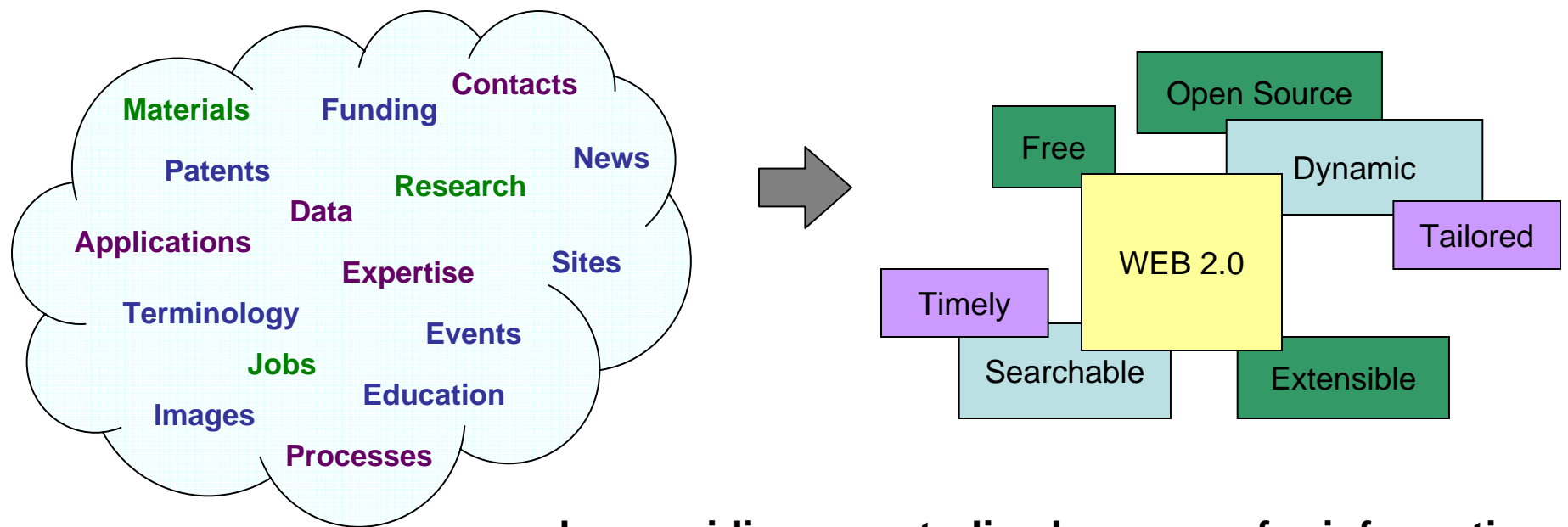
Information Arm of the National Nanomanufacturing Network

beta.internano.org





Increasing the efficiency of the nanomanufacturing community...



...by providing a centralized resource for information.

Aggregation, Organization, Standardization, Access





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Topics

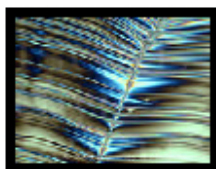
Headlines

Links

InterNano Processes

InterNano Galleries

Galleries



MATTs RIPPLES

Like ripples in the sand on a beach at low tide, similar patterns occur by solvent casting thin polymer films. As the film dries, the solution pulls b...

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1. Fabrication of a nanoporous template from a diblock copolymer film - electric field alignment

An applied electric field aligns a cylindrical-phase diblock copolymer perpendicular to a substrate. One polymer block is removed by UV exposure and a chemical rinse to yield a nanoporous polymer film. The porous film can be used as a template for electrodeposition of metal nanowires or as a mask for reactive ion etching.



3. Fabrication of a nanoporous template from a diblock copolymer film - neutral brush

A perpendicular orientation of cylindrical microdomains in diblock copolymer thin films is achieved by control over polymer-surface interactions. The block which forms cylindrical microdomains is removed by UV exposure and a chemical rinse to yield a nanoporous polymer film. The porous film can be used as a template for electrodeposition of metal nanodots or as a mask for reactive ion etching.



2. Fabrication of a nanoporous template from a diblock copolymer film - solvent annealing

An evaporation-induced flow in solvent cast block copolymer films can produce arrays of nanoscopic cylinders oriented normal to the surface and solvent annealing could markedly enhance the ordering of block copolymer microdomains in thin films. Without removing minor components, solvent-induced surface reconstruction can produce nanoporous structure in thin films. The porous film can be used as a template for deposition of quantum dots or as a mask for pattern transfer to the underneath substrates.

NNN Highlights

[SINAM Call for Proposals](#)

[InterNano Beta Launch](#)

Events

- 2008 Micro & Nanomanufacturing Conference
 April 22, 2008


[View Full Calendar](#)

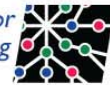
Industry News

- The World Economic Forum Announces Technology Pioneers 2008: SIGNa Chemistry Selected
 - Nanotechnology Now
 Recent News November 29, 2007
- NanoQuébec to receive \$11 million in Quebec government funding
 - Nanotechnology Now
 Recent News November 29, 2007
- 'High Q' Nanowires May be Practical Oscillators
 - Physics Org November 27, 2007
- New Flexible, Transparent Transistors made of Nanotubes



InterNano

The information source for nanomanufacturing

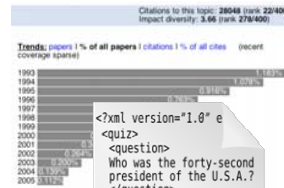


National Nanomanufacturing Network

Needs-Based, Statistics, Sustainable Model

Informatics Laboratory and Data Analysis, Partner on National Standards

Nanomanufacturing Process Databases, Enhanced Search, NM Subject Repository



Phase 4 : Evaluation, Strategic Planning 2010-2011

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    Who was the forty-second president of the U.S.A.?
  </question>
  <answer>
    William Jefferson Clinton
  </answer>
  <!-- Note: We need to add more questions later. -->
</quiz>
```

XML

Phase 3 : Research Components, Standards, Community Integration 2008-2010

InterNano Process Description

Fabrication of a nanoporous template from a diblock copolymer film

Production of Nanoporous Templates from Diblock Copolymers

InterNano: The online resource for the Nanomanufacturing and Biotechnology community

Phase 2 : Core Features, Collection- and Expertise-building 2007-2008

<http://beta.internano.org>



Phase 1 : Design/Framework 2006 – 2007

InterNano Timeline : 5 Year Plan (2006-2011)

Ongoing Goals of NNN

- Creating and providing value for industry, academic and government stakeholders – network value (real/cyber)
- Bolstering the development of specific emergent technologies – supporting NM communities of practice
- Informatics - serve focused NM domain
- Training of an innovative NM workforce
- Creating effective mechanisms for reaching out to under-represented stakeholders (e.g., industries without a clear roadmap)