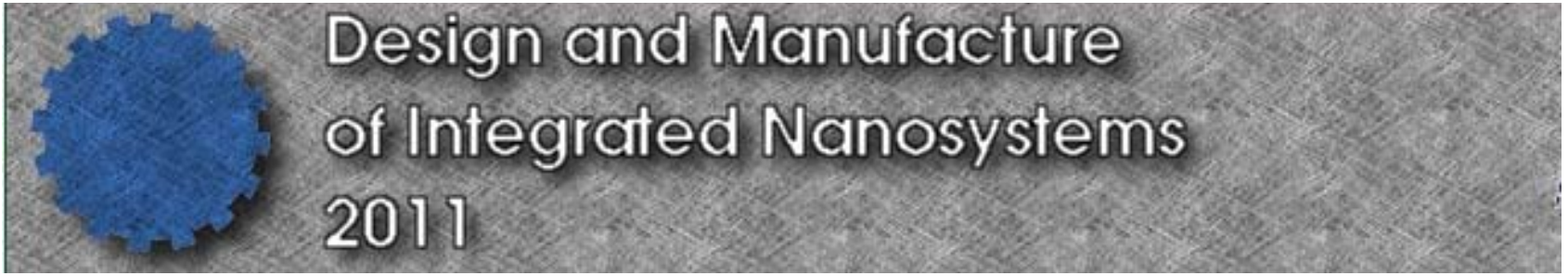


NSF-NNI Workshop: Design and Manufacture of Integrated Nanosystems

Arlington VA, March 2-3, 2011

Welcome!

National Nanomanufacturing Network

Supported by the
NSF CMMI-0531171

National Nanomanufacturing Network

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

- Cooperative activities (*real-space*) *workshops and more*
- Information and informatics (*cyber-space*) *InterNano*

Mission: A catalyst to support and develop communities of practice in nanomanufacturing. A partnership between academia, industry and government.

www.nanomanufacturing.org

Nanomanufacturing Infrastructure: Physical and Intellectual

Information • Tools • Know-how • Roadmaps

Information - ***enabling product design and manufacturing design***

- Nanomanufacturing process-property relationships
- Nanomaterial properties data - with statistics and metadata
- Experts and facilities
- Suppliers of materials and tools
- Documentary standards
- Data curation
- Federation of data and information

National Nanomanufacturing Network

continued

Tools - ***enabling commercial scale production***

- Scalable tool development for emergent nanomfg processes
- Nanomfg process control technology - measurement & control
- A high level of automation
- Standard reference materials
- Nanoinformatics tools - search, model, design, evaluate

Know-how - ***enabling manufacturing craftsmanship and innovation***

- Training of students in nanomanufacturing science and engineering
- Professional development of technicians and engineers
- Innovation and technology management best practices

Roadmaps - ***enabling the way forward by pooling resources and expertise***

- Topical clusters/Industry clusters -- "all politics is local"
- SEMATECH-like model for other nanomanufacturing cluster areas
- Communicating industry needs to academic and government scientists
- Culture of sustainable manufacturing

National Nanomanufacturing Network

NNN: Nanomanufacturing Research Centers

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

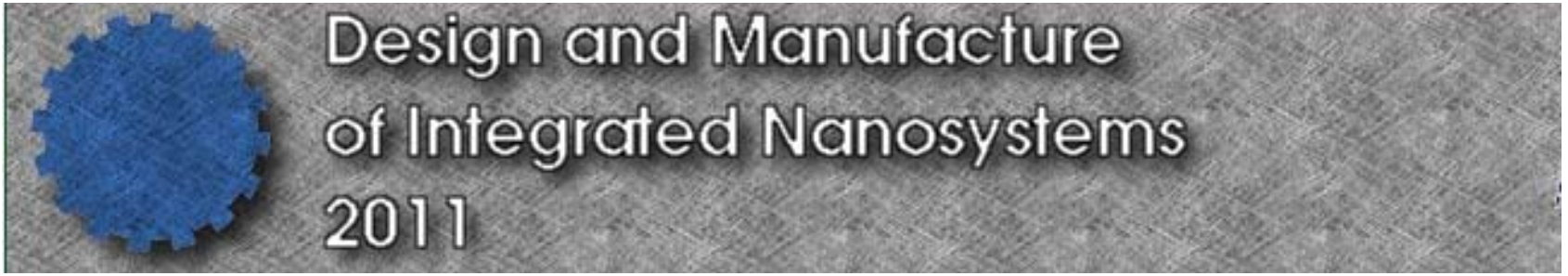
- **Center for High-Rate Nanomanufacturing** (CHN)
  - Northeastern/UMass Lowell/UNH

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

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

- **Center for Integrated Nanotechnologies** (CINT)
  - Sandia National Laboratories

- **Center for Nanoscale Science and Technology** (CNST)
  - NIST



The Nanosystems Workshop

We have *purposely* brought together:

- Scientists and engineers
- Expertise across disciplines
- Experts from universities, companies, and government labs

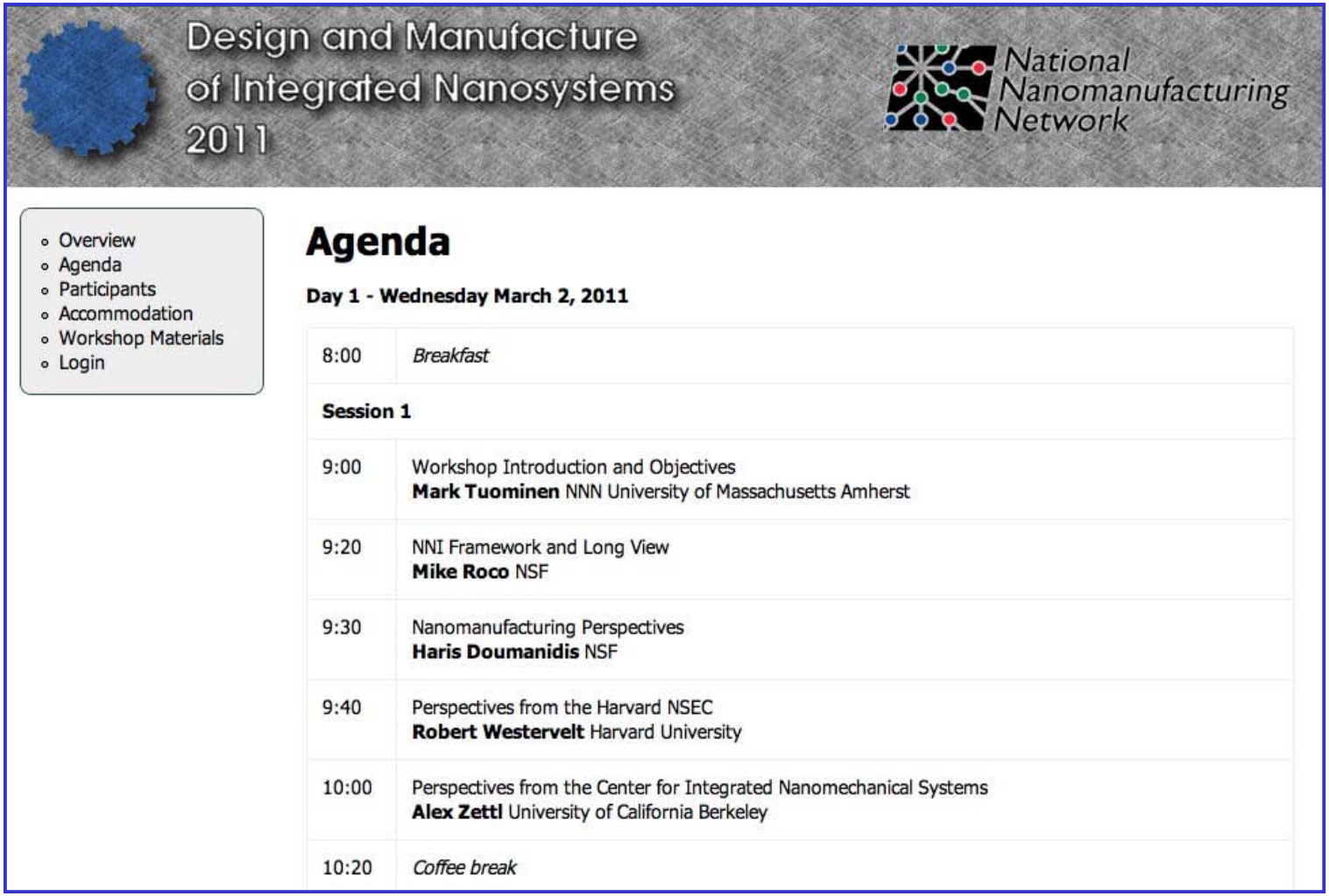
Workshop Objectives

• Envision ***Integrated Nanosystems*** — how we will design them and manufacture them
• Disseminate recent progress in R & D
• Discuss scientific and engineering challenges and opportunities — bold ideas
• Identify thematic priorities for focused research activity
• Strategies to strengthen and fill gaps in the *design* and *nanomanufacturing* value chain

• *Report out to broader nano R&D community and agencies. (via presentations and report)*

Workshop Website

www.internano.org/nanosystems/



- Workshop details
- Password protected area for workshop participants
- Dissemination (subsequent to report)

A few simple thoughts to seed discussion

Integrated Nanosystem

- Necessarily heterogeneous
- Does something (function), by design
- Achieved with interacting components
- If active, needs energy source
- Perhaps does several somethings (functions) - complex, active, intelligent
- Utilizes nanoscale phenomena or properties
- In ambitious limit, functions with some autonomy
- In extreme limit, achieves complex functions entirely from nanoscale components

Thoughts...

Fundamental Science

- What scientific principles can we use for operational mechanisms?
- At the nanoscale, interactions with the environment are strong — this can assist or hinder function
- Biology is existence proof of nanosystem feasibility: What can we adopt or adapt from nature?
- Recognize the importance of non-linear interactions, collective phenomena, stochasticity, quantum effects, and other unconventional features and utilize them in design
- Sustainable nanomanufacturing principles await discovery

Thoughts...

Systems Engineering

• Cost matters — new cost-efficient manufacturing designs are warranted and possible at the nanoscale (eg, modes of directed self-assembly)

• Is a nano-assembly line to integrate nanoscale devices and systems a viable paradigm? Sequential chain or parallel manufacturing processes?

• In design-for-nanomanufacturing, how to accomplish the process engineering and scale up?

• What new integration issues occur for functional nanosystems?

A frontier area

Design and Manufacture of Integrated Nanosystems

- What can we achieve in 5 years?
- What might be possible in 20-30 years?

Thank you for your participation!