Nanotechnology Research & Manufacturing Infrastructure Development

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Nanotechnology Research & Manufacturing Infrastructure Development

- **What improvements or additions to U.S. R&D infrastructure would catalyze nanotechnology innovation? What presently unavailable (or underavailable) facilities, tools, or services are most urgently needed?**

- **What should be done in the immediate future to meet these needs, and by whom? What roles should federal, regional, state, or local entities take in infrastructure development? What are the roles of government, academia, and industry, as developers and as users?**

Nanotechnology Research & Manufacturing Infrastructure Development – Mike Postek, NIST

Accuracy is telling the truth, Precision is telling the same lie over and over again

- **Development of an accurate measurement support infrastructure.**
  - **Nanomaterial Database development relies on the quality of the data submitted**
    - **Nano-risk Framework (DuPont and Environmental Defense Fund)**
    - **NIH NanoHealth Initiative**
    - **EPA – Nanoscale Materials Stewardship Program**
  - **Standards and procedures for instrument performance and calibration essential**
    - **SEM Calibration study 10-60% calibration error**
- **Development of a unifying industrial consortium (SEMATECH) for nanotechnology capable of developing and maintaining a nanotechnology roadmap (ITRS-like).**
  - **SEMATECH began as a Federal/State/government/industry partnership**
  - **Pre compeditive issues; Guide instrument manufacturers**
  - **Ensure tools are available when needed**
    - **Instrumentation and Metrology for Nanotechnology** http://www.nano.gov/NNI_Instrumentation_Metrology_rpt.pdf
    - **Instrumentation, Metrology and Standards for Nanomanufacturing** http://www.manufacturing.gov

Nanotechnology Research & Manufacturing Infrastructure Development – Mike Postek, NIST

- **What should be done in the immediate future to meet these needs, and by whom? What roles should federal, regional, state, or local entities take in infrastructure development? What are the roles of government, academia, and industry, as developers and as users?**
- **Follow the models demonstrated by Oklahoma Nano and Albany Nanotech where the states had the vision to work together with industry to significantly seed fund the nano-activities. Because of investments in New York significant economic benefits realized:**
    - **Convinced SEMATECH to move to Albany**
    - **Developed state-of-the-art fabrication facilities ($XB+)**
    - **Developed strong collaborations with instrument companies to put equipment into the fabs**
    - **Fostered economic development by facilitating the move of AMD (and others) to the area.**
    - **Similar successes were reported by Oklahoma Nano**
- **Explore development of a unifying organization or consortium to assist in solving of pre-competitive research issues and problems.**
    - **Nano-consortium (Predictive Modeling)**
- **Understand and promote the need for accuracy of nanomaterial characterization**

Dave Arthur, SWeNT

SWeNT
SouthWest NanoTechnologies

"making single-wall nanotubes a commercial reality"

Supply

Applications

Infrastructure

Metrology

HSE

Nanotechnology Research & Manufacturing Infrastructure Development – Marty Fritts, NIH

U.S. R&D infrastructure to catalyze nanotechnology innovation.

- **The capability to intelligently design nanomaterials. This requires**
  - Sufficient data characterizing nanomaterial **structures** in the design space of interest,
  - Sufficient data characterizing their **activity** in the design space of interest,
  - **Structure-activity** relationships (models at many levels, but especially at the molecular level),
  - Computation to supplement characterization.
- **Data gathered using standard protocols (for both structure & activity) for meaningful data exchange, collaboration and training**
- **Commonality in instrumentation available for research, scale-up and manufacture**
- **Databases and Collaboratories to accelerate (precompetitive) research/engineering**

Most urgently needed unavailable (or underavailable) facilities, tools, or services.

- **Formation of and support for <u>Communities Of Interest</u> – remove silos and collaborate**
- **PPPs for development of: instrumentation; metadata, ontologies and infrastructure; computation (code sharing/collaboration); characterization; standards.**
- **New mechanisms to accelerate research, scale-up, manufacture and regulation: remote access to national facilities for structure determination (SSRL, APS, ORNL Neutron Spallation Source, UTalca); expanded services for characterization (e.g. NCL); new services for scale-up of nano concepts (e.g. BDP); a separation science initiative.**

Nanotechnology Research & Manufacturing Infrastructure Development – Marty Fritts, NIH

Federal, regional, state, or local roles in infrastructure development?

Roles of government, academia, and industry as developers and as users?

Assumption. Roles designated are for establishing <u>pilot projects</u> only: The pilot projects will determine stakeholder requirements, and realistic follow-on program goals, plans and stakeholder roles based on experience and lessons learned.

- **Example. Provide thorough characterization using standard protocols for a small number of specific nanomaterials; use national state-of-the-art facilities to determine their structure (initiating user service for sample prep and remote access); develop SARs using resultant data and computation; and evaluate if all stakeholder requirements have been met and if new requirements are needed.**
- **Emphasize the science; involve collaborations among a large number of stakeholders, entities and disciplines to provide robust initial requirements for the pilots, as well as evaluate the pilot results prior to initiating the next stage.**
- **Informatics should federate existing databases, concentrating on common metadata and ontologies; use examples of shared (pre-competitive) data to show the utility in developing SARs. Systems should be built to provide secure storage of private data for limited sharing; sharing public data developed using government funds; and exploring the use of anonymous data. Regulators must be involved.**
- **PPPs should be used for broad involvement in development of instrumentation, standard software and standards for software as well as above projects.**

Nanotechnology Research & Manufacturing Infrastructure Development – Mark Tuominen, NNIN

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

Nanotechnology Research & Manufacturing Infrastructure Development – Mark Tuominen, NNIN

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