

Nanotechnology Subcommittee

Paul Fleury, Elsa Reichmanis, Bob Williams, John Cassidy,

-Summary of NSC points from March 07

-CNST Progress [Celotta]

-Additional Recommendations from NSC

Nanotechnology Subcommittee

March 2007

**Paul Fleury, Elsa Reichmanis, Bob Williams, John Cassidy,
David Sprong
Bob Celotta, Mike Postek, John Small, Eric Steel**

NIST in the National Nanotech Context

- PCA overlaps
- Funding levels- highest per capita of all fed agencies

NIST Nano programs

- CNST & seven UO's
- Synergy with NCNR and JILA user facilities

NIST MISSION and NNI Missions- Intersections and Opportunities

NIST PLAYS ACROSS THE BOARD

- **Strong overlap of NIST programs with NNI Program Component Areas**
- **NIST key roles and possibilities**
 - **Metrology**
 - **Standards**
 - **Environmental and health impacts**

Next Steps

- **Better understanding of SP process in three key areas of metrology, standards, ESH**
- **CNST as focal point for NIST Nano**
- **Responsible development of Nano**

Program Review - The Center for Nanoscale Science and Technology



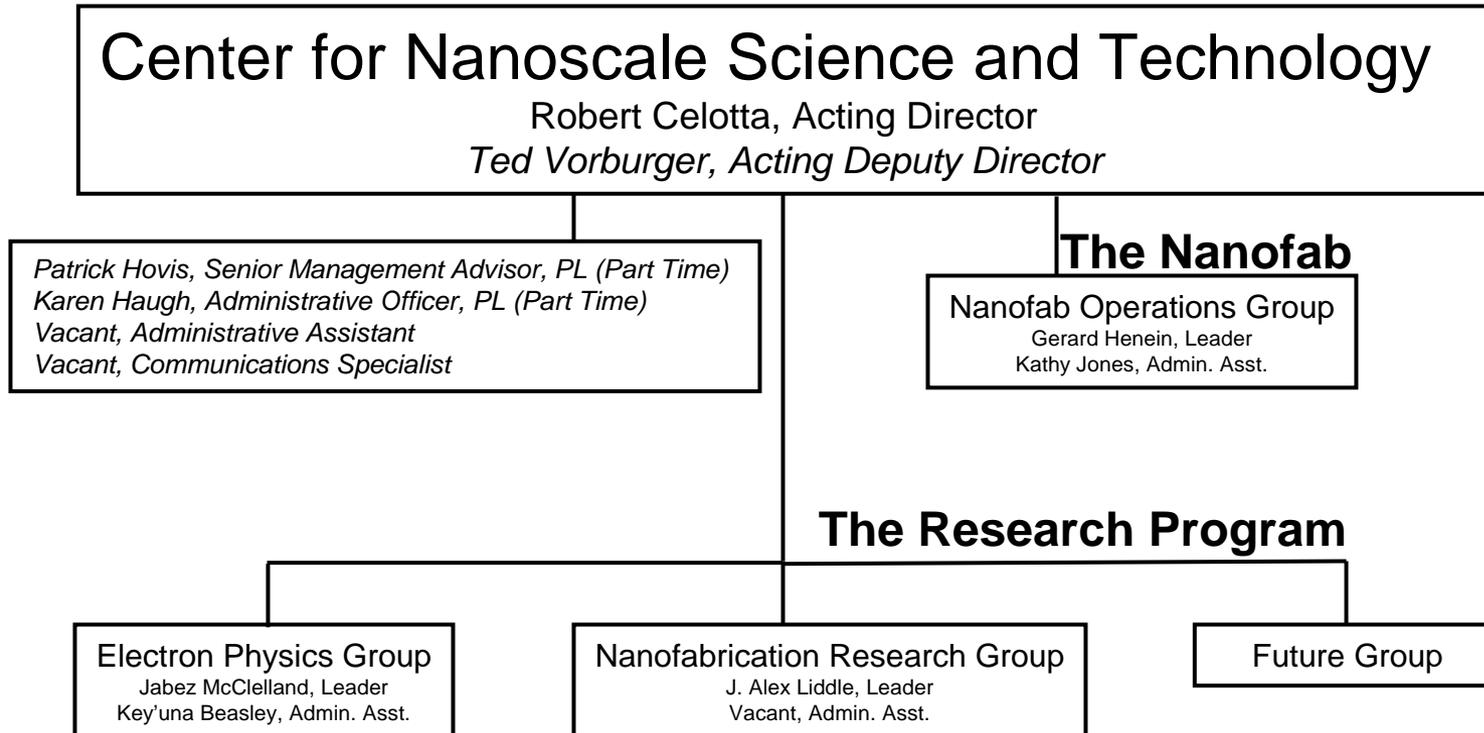
Robert Celotta, Acting Director

July 19, 2007

(For information see: <http://cnst.nist.gov>)

CNST Mission

- CNST:
 - provides **measurement methods**, standards and technology to support all phases of nanotechnology development from discovery to production,
 - develops and maintains a national shared use facility, **the Nanofab**, with state-of-the-art, nanoscale fabrication and measurement capabilities
 - applies a **multidisciplinary** approach to problem solving that involves partnering with industry, academia, and other government agencies,
 - serves as a hub to **link the external nanotechnology community** to the vast measurement expertise that exists within the NIST Laboratories, and
 - helps to **educate** the next generation of nanotechnologist.



Administrative hires currently posted for:

Director

Deputy Director

Senior Management Advisor

Administrative Officer

Administrative Assistant (2)

July 19, 2007

Strategic Planning - Goals

- Nanofab
 - Establish Nanofab as a world-class facility
 - Greatly broaden the scope and capabilities of the Nanofab
 - Expand the Nanofab user base
- Research Program
 - Determine measurement needs
 - Determine major program areas
 - Determine core competence requirements
 - Recruit the best and the brightest (*who are enthused by our mission*)
 - Establish strategic partnerships
- Infrastructure
 - Establish an administrative staff configured for efficiency and agility
 - Establish and provide for continuous refinement of operational policies
 - Acquire and provision the space necessary to operate

Strategic Planning and Actualization – Research Program

- Collect Needs
 - Direct input from
 - NIST Staff
 - Direct requests for input from entire staff
 - Continuous staff interactions
 - Industrial Community
 - Had multiple interactions with Intel, IBM, Seagate, Nanoelectronics Research Initiative (NRI), Motorola, Texas Instruments, Zyvex, FEI Inc., Semiconductor Research Corporation, Telecommunications Industry Association (TIA), Agilent, etc.
 - Meetings
 - Professional society conferences: e.g., AVS, EPIBN, NRI Program Reviews, Gordon Research Conferences, Nanoforum Europe, ICN+T, APS March Meeting, etc.
 - Workshops, e.g., NIST & NNI Workshops on Nanotechnology/Nanomanufacturing, Vision2020 Workshops, etc.
 - Government Reports
 - NNI, Europe (NanoStrand), Asia
 - US Measurement System Survey
 - CNST Research Staff
 - Leading experts in their fields
 - Additional continuous expert advice is being obtained
 - VCAT Nanotechnology Subcommittee
 - External individual experts, e.g., a committee is being formed including:

Strategic Planning and Actualization – Research Program

- Recruit Project Leaders
 - Ads on website, at meetings, in Science, IEEE Spectrum, Chemical & Engineering News, etc.
 - Personal outreach
 - More than 350 resumes reviewed to date
- Recruit the best and the brightest
 - Kartik Srinivasan; CalTech
 - 27 publications, 1 patent; <1 year postdoctoral experience
 - Nikolai Zhitenev; Institute of Solid State Physics (Chernogolovka); Max Plank Institute (with von Klitzing); MIT; Bell Labs (H. Stormer)
 - Notable Publications
 - Henri Lezec; MIT, CNRS (Strasbourg), CalTech
 - Recent publications
 - **The ability to work with excellent people has been our most effective attractor of the best and the brightest**

CNST Technical Hires

- Andrew Berglund. Physics, Ph.D. Caltech
- Marc Cangemi* Process Engineering, B.S. RIT; Photonics
- Kenneth Chau Elect. & Comp. Eng., Ph.D. University of Alberta
- Paul Carmichael Bio-Chemistry UCSD; UT Austin
- Lei Chen* Polymer Sci. & Eng., Ph.D. Nanjing Univ.; Princeton; NanoOpto
- Seok-Hwan Chung Physics, Ph.D. University of Maryland; ANL
- Nathan Guisinger Physics, Ph.D. University of Illinois
- Paul Haney Physics, Ph.D. University of Texas, Austin
- James Hanssen Physics, Ph.D. Rice University
- Christian Heiliger Physics, Ph.D. Martin Luther University, Halle
- Emily Jarvis Chemistry, Ph.D. UC Los Angeles
- Richard Kasica* Material Science, M.S. Bell Labs; Oak Ridge NL
- Henri Lezec Electrical Engineering, Ph.D. MIT; CNRS (Strasbourg); CalTech
- Alex Liddle Materials Science, Ph.D. Oxford; Lawrence Berkeley NL
- Matthew McMahon Physics, Ph.D. Vanderbilt University
- Gregory Rutter Physics, Grad Student, B.S. Georgia Tech
- Young Jae Song Physics, Ph.D. Seoul National University, Seoul
- Kartik Srinivasan Physics, Ph.D. CalTech
- Gila Stein Chemical Engineering, Ph.D. UC Santa Barbara
- Nikolai Zhitenev Physics, Ph.D. Institute of Low Temperature Physics;
Max-Planck-Institute Stuttgart; Bell Labs

Strategic Planning and Actualization – Research Program

- Action: Establish strategic partnerships
 - NIST
 - MSEL (Nanomagnetics; thin film nanostructure)
 - MSEL (Bistable-switch)
 - EEEL (Nanomagnetics; low noise sensors)
 - EEEL (Theory; magnetization dynamics)
 - ITL (Nanomagnetics; domain properties, wall motion)
 - CSTL (Atomic Scale Measurement; atom switching dynamics)
 - MEL (Probe Measurements; beam probe analysis)
 - PL, MSEL (Nanofabrication; particle assembly)
 - PL, MSEL (Nanofabrication; edge roughness)
 - NIST (under consideration or development)
 - NCNR (Nanofabrication; edge roughness)
 - EEEL (Nanofabrication; Photonic couplers to bolometers)
 - EEEL, CSTL, PL (Optical communication; FY2009 initiative)
 - UMD (under consideration or development)
 - Aerospace Engineering (Control System Theory/Application)



Strategic Planning and Actualization – Research Program

- Action: Establish strategic partnerships
 - External (under consideration or development)
 - Industry consortia and partners
 - National Labs
 - Universities

Strategic Planning and Actualization – Reprogramming

- Action: Reprogramming experimental research
 - Room-temperature Scanning Tunneling Microscopy research → Development of the Next Generation Atomic Force Microscope (AFM)
 - Mature technology; resources better allocated elsewhere
 - Jason Crain, Project Leader → NextGen AFM Program as Project Leader
 - Dan Pierce, NIST Fellow → Nanomagnetism Project
 - STM Equipment → Routine analysis support of molecular beam epitaxy lab
 - Vibration controlled lab space → Refitting for NextGen AFM Project
 - International collaboration formed to provide needed skill set and supercritical mass
- Action: Reprogramming theoretical research
 - Theory of magnetic multilayers → Theory of proximal probe measurement
 - Essential physics appears captured; theory analysis better applied elsewhere
 - Mark Stiles, Project Leader → Proximal Probe, Project Leader
 - Post doctoral research focus changed at normal replacement cycle
 - Additional computer resources added to support the new task

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Challenges

Some of the things we will be working hard on this year

- Keeping move momentum going
 - About 15% of AML moving, but no swing space
 - Many different contracts, organizations
 - Any one of which can cause a major delay
- Outreach for optimal Nanofab utilization
 - NIST Staff
 - Outside Users
- Establishing equipment sharing paradigm at NIST
- Recruiting remaining research program staff
- Establishing an efficient team from newly hired administrative staff

Standards

NIST participation on US and Int'l standards bodies-

- Represented on 100 of 600 bodies**
- Key Chair Laurie Locascio of ANSI ESH Cmte.**
- Issue: how to influence standards [particularly internationally]**

ESH Measurements Science and Standards Research for Nanotechnology

- **Biggest under- exploited opportunity/need is in nano related ESH**
- **Locascio group impressive – just the tip of the iceberg [it's the right iceberg, though]**
- **US industry already becoming tentative**
- **If regulations precede science/data = trouble**
- **NIST uniquely qualified to develop standards for good and relevant data**
- **Greater role in orchestration with NIH, EPA, etc**
- **Impact both + and - largest of all- on industry in particular**
- **Window is finite and probably short**

NIST Workshops- promising steps

- “standards for ESH Research Needs for Engineered Nanoscale Materials”
- 9/12-13 initiative at NIST- Willie May presentation to VCAT on 8/14/07.
- Oct 2008 Symposium/Wkshop on measurements and standards- barriers to innovation in biosciences.
- Integration of SP with CNST?

NSC Observations

- Excellent progress on CNST
 - SP clarified and actionable
 - Examine SNL NINE approach to partners
 - ‘Acting’ Leadership?
 - MOU with 5 UMBI Centers- CNST role?
- Gap in role/participation in Nanotech ‘Responsible Development’
- Need for integration of ‘standards’ with technology focus