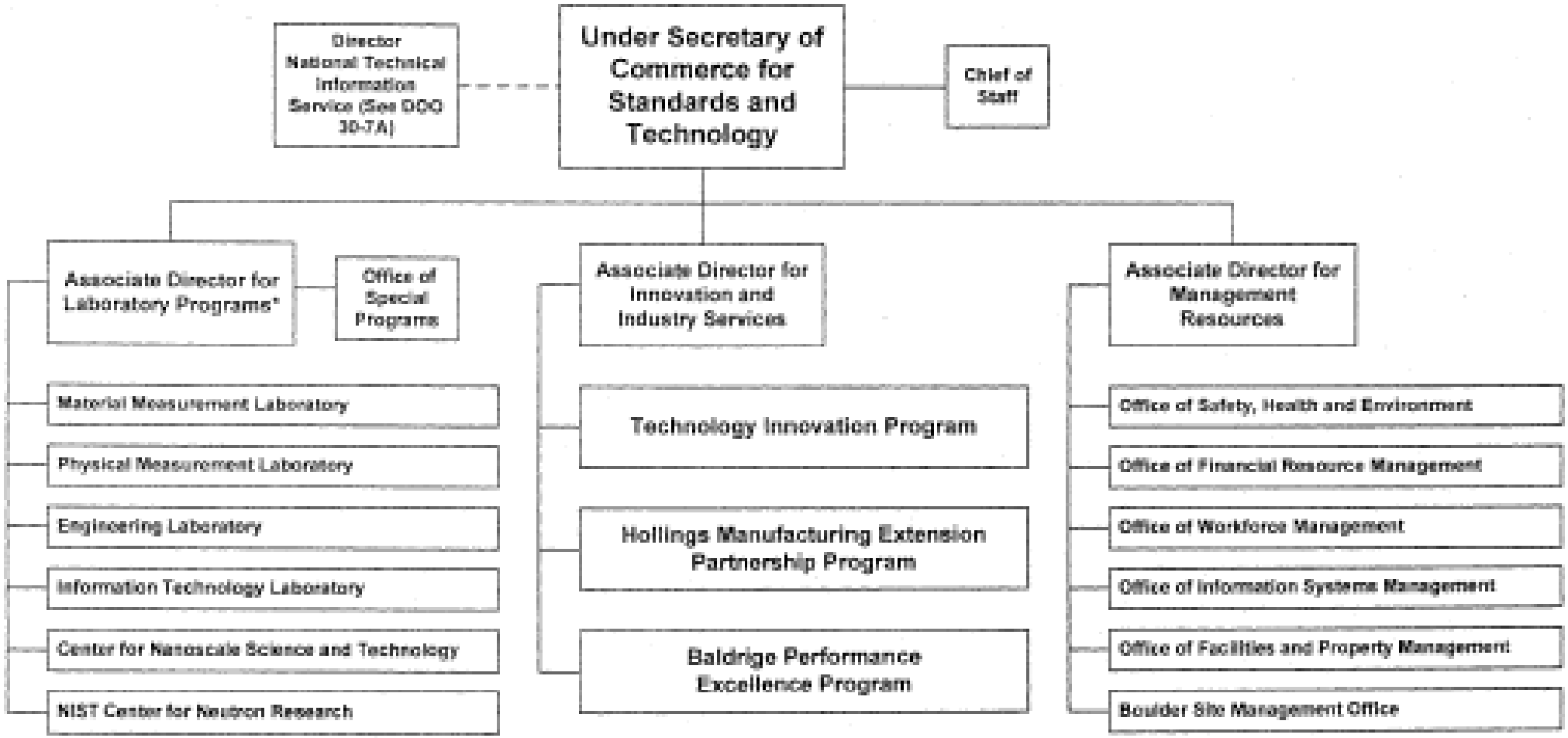
Measurement Science, Standards & Technology at The National Institute of Standards and Technology (NIST)

Compiled by

Dr. Lynnette D. Madsen

Exhibit 2

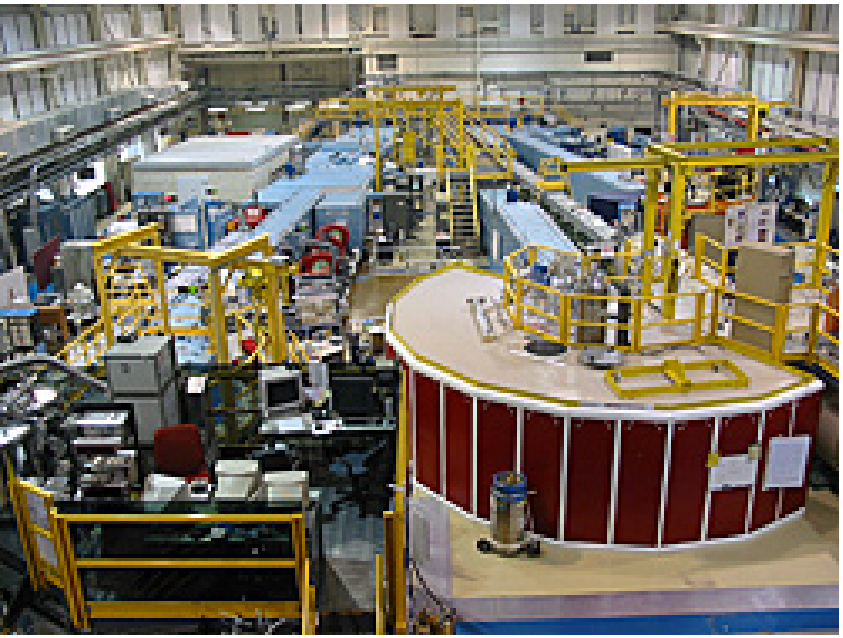
U.S. DEPARTMENT OF COMMERCE
National Institute of Standards and Technology



*The Associate Director for Laboratory Programs serves as the Principal Deputy for NIST.

User Facilities

NIST Center for Neutron Research (NCNR) is a national user facility that provides cold and thermal neutron measurement capabilities to researchers from academia, industry, and other government agencies.



Center for Nanoscale Science and Technology (CNST) supports the development of nanotechnology from discovery to production. The Center operates a national shared-use nanofabrication and measurement facility, the NanoFab, complemented by a multidisciplinary research staff creating the next generation of tools needed to advance nanotechnology.

Materials Science Portal - Overview

Plastics, carbon nanotubes, high-strength alloys, artificial bone and joint replacements are just some of the emerging materials for which the National Institute of Standards and Technology (NIST) develops testbeds, defines benchmarks, and develops formability measurements and models...

Material Measurement Laboratory>>

Subject Areas

Advanced Materials
Biomaterials
Ceramics
Evaluation
Hybrid Materials
Inorganic Materials
Metals
Nanomaterials
Polymers
Semiconductor Materials

Materials Science Ceramics Portal

Subject Areas

Electronics
Nanometrology
Properties
Structures
Synchrotron Methods

NIST Organizational Structure

MATERIAL MEASUREMENT LABORATORY

TURNING IDEAS INTO INNOVATIONS

MEASUREMENT SCIENCE AND TECHNOLOGY FOR THE NATION AND INDUSTRY

NIST
National Institute of Standards and Technology
U.S. Department of Commerce

MML DIVISIONS & GROUPS

Materials Science and Engineering (642)
Eric Lin, Chief
Sustainable Polymers, Kate Beers
Energy & Electronic Materials, Chris Soles
Complex Fluids, Kalman Migler
Thin Film and Nanostructure Processing, John Bonevich*
Magnetic Materials, Robert Shull
Materials Performance, Tim Foecke
Thermodynamics and Kinetics, James Warren

Materials Measurement Science (643)
John Small, Chief
Microanalysis Research, Keana Scott
Surface and Interface Research, Steve Buntin
Functional Properties, Marty Green
Analytical Microscopy, Greg Gillen
Synchrotron Methods, Daniel Fischer
Structure Determination Methods, Terrell Vanderah
Nanomechanical Properties, Richard Gates*
Security Technologies Group, Nick Paulter‡

Biosystems and Biomaterials Science (644)
Anne Plant, Chief
Bioassay Methods, Steve Choquette
Biomaterials, Sheng Lin-Gibson
Cell Systems Science, Anne Plant
Multiplexed Biomolecular Science, Marc Salit

Biomolecular Measurement (645)
Michael Tarlov, Chief
Macromolecular Structure & Function, John Marino
Chemical Reference Data, Steve Stein
Applied Genetics, John Butler
BioProcess Measurements, Dean Ripple
Bioanalytical Science, Karen Phinney

Chemical Sciences (646)
Carlos Gonzalez, Chief
Inorganic Chemical Metrology, Greg Turk
Organic Chemical Metrology, Lane Sander
Gas Metrology, Frank Guenther
Chemical Informatics Research, Bill Wallace†
Chemical Process Measurements, Roger van Zee†

Applied Chemicals and Materials (647)
Stephanie Hooker, Chief
Thermodynamics Research Center, Michael Frenkel
Structural Materials, Jim Fekete
Materials for Biological Environments, Tim Quinn†
Nanoscale Reliability, Vinod Tewary
Experimental Properties of Fluids, Thomas Bruno
Theory and Modeling of Fluids, Marcia Huber

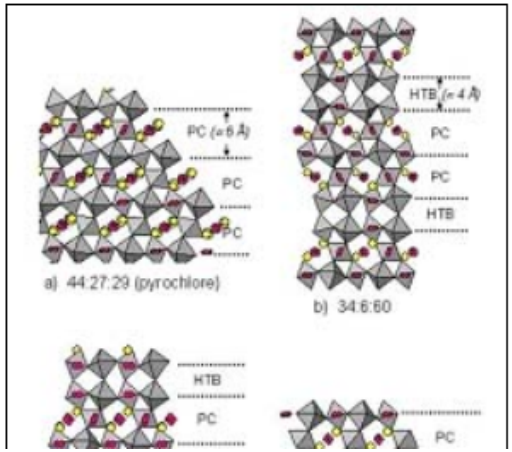
*New group leader
†New group name
‡New group

Dr. Terrell A. Vanderah

Supervisory Research Chemist
Materials Measurement Science Division, Structure Determination Methods Group

Research Interests

- Phase equilibrium relationships in technically important ceramic oxide systems for communications, energy, medical, and optoelectronic applications
- Inorganic non-molecular solid-state chemistry with emphasis on crystal chemistry and the interdependence of crystal structure, chemical composition, and physical properties



Position:

Supervisory Research Chemist
Materials Measurement Science Division
Structure Determination Methods

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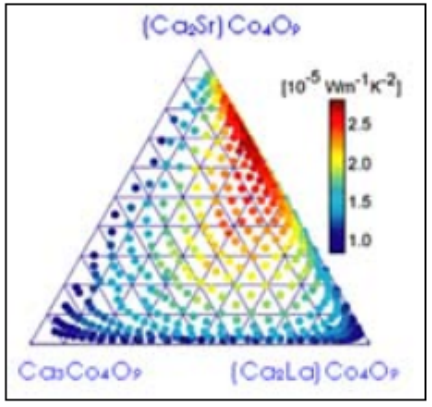
Dr. Winnie Wong-Ng

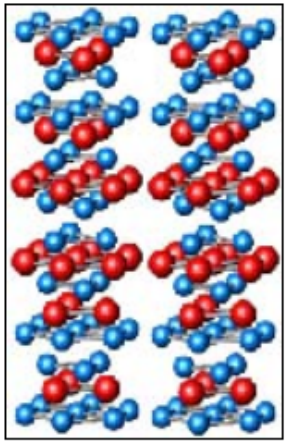
Research Chemist

Ceramics Division, Functional Properties Group

Research Interests

- Materials for energy applications
- Thermoelectric standards, metrology, data, and materials
- Crystallography, phase equilibria, and crystal chemistry of functional materials
- Sorbent materials for sustainability applications
- Measurements and standards for batery and supercapacitor materials





Position:

Research Chemist
Ceramics Division
Functional Properties Group

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William Luecke

Staff

Metallurgy, Materials Performance

Biography

William Luecke joined the Materials Science and Engineering Laboratory in 1991 as an NRC post-doctoral fellow working under NIST Fellow Sheldon Wiederhorn. For nearly six years he conducted research on high-temperature deformation models and standard test methods for structural ceramics, primarily silicon nitride, for gas turbine engines

In 1996 he joined the Ceramics division as a permanent staff member, where he moved into deformation of fuel cell ceramics and rolling-contact fatigue of silicon nitride.

In 2002 he transferred to the Metallurgy division, where he was part of the MSEL team assigned to the NIST World Trade Center collapse investigation. Since 2005 he has researched standard test methods and data for improved grades of fire-resistive steel, a project that grew out of the recommendations of the NIST WTC report.

Research interests

High-temperature mechanical testing of ceramics and metals. Standards and test methods to evaluate the fire resistance of structural steel

Position:

Staff
Metallurgy
Materials Performance

Employment History:

2005–2011: Group lead

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Albert Davydov

Metallurgy Division

Thin Film and Nanostructure Processing

Albert Davydov received the Ph.D. in Chemistry from Moscow State University (Russia) in 1989. He was an Assistant Professor of Chemistry at Moscow State University (1987-1993), an Assistant Research Scientist at the University of Florida (1993-1997), and a NIST Research Associate at the University of Maryland (1997-2005). He joined NIST fulltime in 2005 and is now active in wide bandgap nanowires.

He has more than 20 years experience with materials analysis, bulk crystal growth, thin film growth/deposition, and the fabrication, characterization, and processing of a wide range of nanostructured electronic and optical materials. He serves as the Head of the Semiconductor Task Group for the International Centre for Diffraction Data and is on the Editorial Board of the Journal of Mining and Metallurgy. Dr. Davydov has published/coauthored over 50 publications in peer-reviewed journals.

Research interests:
1) Fabrication, processing and characterization of semiconductor nanowires and thin films: GaN, SiC, ZnO, Si
2) Development of electrical contacts to semiconductor nanowires and thin films

Position:

Dr.
Metallurgy Division
Thin Film and Nanostructure Processing

Phone: 301-975-4916
Email: albert.davydov@nist.gov

Dr. Robert Cook

Physicist, Ceramics Division
Nanomechanical Properties Group

Research Interests

- Mechanical properties measurement tools, methods, standards, and data needed for materials and components in nanotechnology applications, including microelectronics, magnetic storage, microelectromechanical systems (MEMS), and nanoparticles
- Applications of advanced nanomechanical measurement tools, such as scanning probe microscopy, nanoindentation, and MEMS-based test vehicles, to solve commercial nanotechnology problems
- Fracture mechanics—particularly the effects of microstructure, residual stress distributions, and crystalline anisotropy on crack propagation, strength, and flaw tolerance in brittle materials, especially silicon
- Contact mechanics, including instrumented indentation testing—"nanoindentation"—for measurement of elastic, plastic, fracture, and viscous properties of all materials at ultra-small scales
- Adhesion mechanics, and the effects of interfacial surface forces, capillary menisci, and molecular layers on the mechanical and electrical properties of ultra-small contacts

Position:

NIST Fellow, Supervisory Physicist
Ceramics Division
Nanomechanical Properties G

Phone: (301) 975-3207
Email: robert.cook@nist.gov

Stephanie Hooker, Ph.D.

Division Chief

Applied Chemicals and Materials

Backround

I am a materials engineer whose diverse interests have kept me enthusiastic about science for 20+ years. From smart systems to nanotechnology, I am fascinated by how the right material can make virtually anything possible. I've been fortunate to have built space experiments to qualify new materials, helped grow a high-tech startup, and, for the last decade, managed and promoted research in applied materials and chemistry at NIST. My goal as a manager is to help our scientists pursue their passions and achieve great impact for the nation.

Current Areas of Interest

Water

Nearly 1 billion people around the world lack reliable access to clean water. Ensuring an adequate supply of clean water is essential for human health, agriculture, energy production, and manufacturing. NIST is enabling better measures of water quality, cost-effective approaches to treat contaminated water, and reliable infrastructure to deliver water for use.

Alternative Fuels

Successful implementation of alternative fuels is vital to ending our reliance on foreign oil. NIST is providing critical data on fuel chemistry, enabling optimized engine design and

Position:

Division Chief
Applied Chemicals and Ma

Employment History:

2012-Present: Chief, Appli
Chemicals and Materials D
MML, NIST

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Renu Sharma

Project Leader

CNST, Nanofabrication Research Group

Dr. Renu Sharma is a Project Leader in the Nanofabrication Research Group. She received a B.S. and B.Ed. in Physics and Chemistry from Panjab University, India, and M.S. and Ph.D. degrees in Solid State Chemistry from the University of Stockholm, Sweden, where she had a Swedish Institute Fellowship. Renu joined the CNST in 2009, coming from Arizona State University (ASU), where she began as a Faculty Research Associate in the Department of Chemistry and Biochemistry and the Center for Solid State Science, and most recently served as a Senior Research Scientist in the LeRoy Eyring Center for Solid State Science and as an affiliated faculty member in the School of Materials and Department of Chemical Engineering. Renu has been a pioneer in the development of environmental scanning transmission electron microscopy (E(S)TEM), combining atomic-scale dynamic imaging with chemical analysis to probe gas-solid reactions. She has applied this powerful technique to characterize the atomic-scale mechanisms underlying the synthesis and reactivity of nanoparticles (including catalysts), nanotubes, nanowires, inorganic solids, ceramics, semiconductors, and superconductor materials. Renu has received a Deutscher Akademischer Austauschdienst (DAAD) Faculty Research Fellowship, is a past President of the Arizona Imaging and Microanalysis Society, and has given over 70 invited presentations, and published 3 book chapters and over 160 research articles. At the CNST, Renu is establishing advanced E(S)TEM measurement capabilities for nanoscience research and contributing her research expertise to the operation of a new TEM facility in the NanoFab.

Position:

Project Leader
CNST
Nanofabrication Research Gr

Education:

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Dr. Kenneth A. Snyder

Acting Deputy Division Chief, & Group Leader
Materials and Structural Systems Division,
Inorganic Materials Group

Dr. Kenneth A. Snyder is the Acting Deputy Division Chief and Leader the Inorganic Materials Group, in the Materials and Structural Systems Division (MSSD) of the Engineering Laboratory (EL) at the National Institute of Standards and Technology (NIST). Dr. Snyder joined the Inorganic Materials Group in 1990 as a staff scientist and became the Group Leader in 2009.

Dr. Snyder's primary area of research has been the diffusive transport of ionic species through cement paste pore solution. His approach was to identify the essential physical and chemical phenomena involved. Because transport is a critical component of virtually all degradation mechanisms, these studies are the basis of reliable predictive models for the performance assessment of concrete structures exposed to the environment. Much of what has been learned has been incorporated into the 4SIGHT computer model that was sponsored by the Nuclear Regulatory Commission (NRC) for the assessment of underground concrete structures.

An unexpected outcome of this fundamental work was the realization, by his colleague Dale Bentz, that one could decrease the rate of diffusive transport by increasing the viscosity experienced by a diffusing ionic species. This insight has led to the identification of potential chemical admixture family that may dramatically increase the service life of most concretes, and also led to a patent application, by NIST, for this technology, referred to here as Viscosity Enhancers Reducing Diffusion in Concrete Technology (VERDiCT).

In 2009, Dr. Snyder and Dale Bentz were awarded a U.S. Department of Commerce Bronze

Position:

Acting Deputy Division Chief, & Group Leader

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Ron Goldfarb, and others in Boulder

Magnetics Group

Welcome

The Magnetics Group develops measurement technology for industries broadly concerned with magnetic information storage and biomagnetic imaging, spanning the range from practical engineering to theoretical modeling. The group disseminates the results of its research through publications in peer-reviewed journals, presentations at conferences and workshops, and participation in standards organizations.

Programs/Projects

Biomagnetic Imaging Standards and Microsystems—The Magnetics Group's program in biomagnetic imaging standards and microsystems develops calibration standards and new types of magnetic contrast agents for magnetic resonance imaging. Magnetic ...

Magnetodynamics and Spin Electronics—The Magnetics Group's program in magnetodynamics and spin electronics develops new measurement

Collaborations with NIST

- NIST seeks productive collaborations involving its world-class technical expertise & state-of-the-art user facilities. NIST researchers frequently collaborate informally with researchers at other organizations. Collaborations often result in joint peer-reviewed papers, short-term visits or tours of NIST, & sharing of research methods.
- NIST researchers may provide limited technical assistance of short-term duration (written response, telephone call, on-site discussions, visits to a non-NIST site, or a combination). Non-reimbursable services should not impede accomplishment of NIST objectives and may benefit and support NIST's mission. Such services are part of regular staff duties and subject to management approval.
- More extensive collaborations include: Cooperative Research and Development Agreements (CRADAs), Guest Researchers, Designated User Facilities
- **http://www.nist.gov/public_affairs/factsheet/workwithnist.cfm**

NSF-NIST DCL 11-066

- NSF-NIST Interaction in Basic and Applied Scientific Research in BIO, ENG & MPS (NSF-NIST)
- Supplement funding: travel & per diem costs associated with collaborative work at NIST. Support NSF-supported project participants (PIs, co-PIs, post-doctoral scholar, undergraduate and graduate students, and other personnel), not provided for NIST employees. Must not exceed $25,000.

SURFing the Material Measurement Laboratory (MML) – a NIST/NSF REU Partnership for Materials Science

Terrell Vanderah & Robert Shull
(National Institute of Standards and Technology, Gaithersburg, Maryland)
DMR-1060416

May 23 –Aug. 9, 2013,
190 undergraduate students from 86 different U.S. colleges and universities worked on projects with world-leading experts in all laboratories of NIST, Gaithersburg, MD.

Out of this group were 38 students from 22 different universities who participated in the Materials Science part of the Material Measurement Laboratory (MML)/NIST Center for Neutron Research (NCNR) Summer Undergraduate Research Fellowship (SURF) program partially supported by the NSF working on ceramic, metallic, polymeric, and biological materials.

MML/NCNR Students & PIs

Total NIST Program

In addition to living together and visiting each others' laboratories, these 190 students in all disciplines learned about other fields of science and presentation skills through a special weekly seminar and through staff interactions. Oral presentations at the conclusion of the summer to the NIST management and technical staff showed during the summer the students gained proficiency in areas as diverse as implant materials and miscellar gells, nanomechanical properties, spintronics, magnetic nanoparticles, non-linear coatings, carbon nanotubes, triple axis diffractometry, X-ray scattering, neutron reflectivity and radiography, and combinatorial research. Most plan to pursue graduate education afterwards. Afterwards, one student even stated "you changed my life."