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

The CNST News

SUMMER 2011 WWW.NIST.GOV/CNST

INSIDE THIS ISSUE:

From the Director

We are excited about the many new tools that have recently arrived or will soon be available in the CNST NanoFab. This equipment brings a range of new capabilities for lithography, metrology, and processing as part of our mission to provide our users with a state-of-the-art tool set for cutting-edge nanotechnology development.

We are significantly upgrading our lithography capabilities with a suite of new tools to make patterning more repeatable and user friendly, with automated resist coaters and developers recently installed, and a new automated tool for solvent lift-off coming later this year. This fall brings the installation of one of the most advanced i-line steppers available (from ASML), which will provide NanoFab researchers with a much-needed option for rapid, wafer-scale patterning of features from micrometers to nanometers.

In metrology, we have enhanced our capabilities with a new FEI Titan transmission electron microscope well equipped for nanoscale structural and chemical characterization of a wide range of materials. This critical addition to our tool set will be complemented by two FEI Helios NanoLab focused ion beam systems expected to be available in August for fast, precise, and reliable milling, patterning and ion imaging.

Finally, in our efforts to improve the overall customer experience, we have added wireless internet throughout the NanoFab and CNST common areas.

I look forward to seeing the great work enabled by our ongoing investments in new and improved capabilities in the CNST.

–Robert Celotta

CNST Center for Nanoscale Science & Technology

A High Bandwidth Nanomechanical Sensor for Atomic Force Microscopy

The atomic force microscope (AFM) is an important tool for nanoscale surface metrology. Typical AFMs map local tip-surface interactions by scanning a flexible cantilever probe over a surface. They rely on bulky optical sensing instrumentation to measure the probe's motion, which limits the sensitivity, stability, and accuracy of the microscope and precludes the use of probes much smaller than the wavelength of light. Recently, CNST researchers have fabricated a novel integrated sensor combining a nanomechanical cantilever with a high sensitivity nanophotonic interferometer as a unit on a single silicon chip. The sensor is compact, self-aligned, and stable. Replacing the laser detection system allowed them to build cantilevers orders of magnitude smaller than those used in conventional AFMs. The cantilever's small effective mass dramatically increases the detection bandwidth, reducing the system response time to a few hundred nanoseconds. While probe stiffness was kept comparable to conventional microcantilevers to maintain high mechanical gain, the probe size was reduced to a mere 25 µm × 260 nm × 65 nm (length × thickness × width). Readout relies on "cavity optomechanics", with the probe fabricated adjacent to a microdisk optical cavity at a gap of less than 100 nm. The cavity's high optical quality factor (Q) allows the light to make tens of thousands of round-trips before leaking out of it, all the time accumulating information about the probe's position.

The device sensitivity to probe motion is less than 1 fm/√Hz and the cavity can sense changes in probe position with high bandwidth. Fiber optic waveguides couple light to the sensor, allowing it to interface with standard optical sources and detectors.

Scanning electron micrograph of the cantilever – microdisk device.

Optomechanical transduction of an integrated silicon cantilever probe using a microdisk resonator, K. Srinivasan, H. Miao, M. T. Rakher, M. Davanco, and V. Aksyuk, *Nano Letters* **11**, 791-797 (2011).

In the effort to find ways to more efficiently store the world's information, CNST researchers have recently turned to vortices in magnetic disks to enable new domain arrangements for smaller and faster magnetic memory.

The Effects of Disorder on Magnetic Vortex Gyration

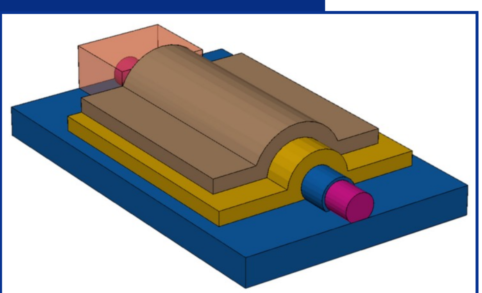
In the effort to find ways to more efficiently store the world's information, researchers have recently begun to exploit magnetic domain pattern dynamics in order to create smaller and faster magnetic memory. To better understand the results of recent CNST calculations on the dynamics of magnetic vortices in prototype information storage devices, Hongki Min of the CNST and the University of Maryland, Mark Stiles and Robert McMichael of the CNST, and Jacques Miltat of the University of Paris-South have investigated how disorder in magnetic disks might confound energy loss measurements. In thin disks of magnetic material, the magnetization finds its ground state configuration to be a vortex with magnetization in a swirl pattern around a central core. When the magnetization is excited, the vortex core gyrates around the center of the disk. Since this motion is relatively easy to measure, it has been the subject of substantial recent attention; in particular, recent measurements have studied the effect of disorder in the disk on this motion. As described in their recent publication in *Physical Review B*, the CNST researchers find only small disorder-induced changes in the effective damping in vortex gyration and then only for small amplitude precession when the vortex core is pinned by the disorder potential. This result is an important contribution to understanding how to correctly interpret measurements on magnetic materials and devices being considered for future high-density information storage applications.

Effects of disorder on magnetic vortex gyration, H. Min, R. D. McMichael, J. Miltat, and M. D. Stiles, *Physical Review B* **83**, 064411 (2011).

Nanowire-based charge-trapping memory devices could enable portable computers that can operate for days between charges.

Nanowire Measurements Aim to Improve Computer Memory

Researchers from NIST's Physical Measurement Laboratory may have revealed the optimal characteristics for a new type of computer memory now under development. The work, performed in collaboration with researchers from George Mason University, aims to optimize nanowire-based charge-trapping memory devices, potentially illuminating the path to creating portable computers that can operate for days between charging sessions.



Schematic showing a silicon nanowire-based memory device consisting of a nanowire surrounded by a stack of thin layered dielectrics.

The nascent technology is based on silicon formed into tiny wires, approximately 20 nanometers in diameter. These nanowires form the basis of memory that is non-volatile, holding its contents even while the power is off—just like the flash memory in USB thumb drives and many portable music players. Such nanowire devices are being studied as the possible basis for next-generation computer memory because they hold the promise to store information faster and at lower voltage.

Nanowire memory devices also hold an additional advantage over flash memory, which despite its uses is unsuitable for one of the most crucial memory banks in a computer: the local cache memory in the central processor. Cache memory stores the information a microprocessor is using for the task immediately at hand, and has to operate very quickly; flash memory just isn't fast enough. If a fast, non-volatile form of memory can be developed to replace what chips currently use as cache memory, computing devices could gain even more freedom from power outlets. The research team believes it has found the best way to help silicon nanowires do the job.

The researchers used the CNST NanoFab for all their processing, except for the deposition of the high-*k* dielectric layers. The NanoFab work included growth of the silicon nanowires in predefined locations by low pressure chemical vapor deposition, and growth of a tunnel oxide using rapid thermal annealing. Combining software modeling and electrical device characterization, the team explored a wide range of dielectric structures. Based on the understanding they gained, the researchers believe an optimal device can now be designed.

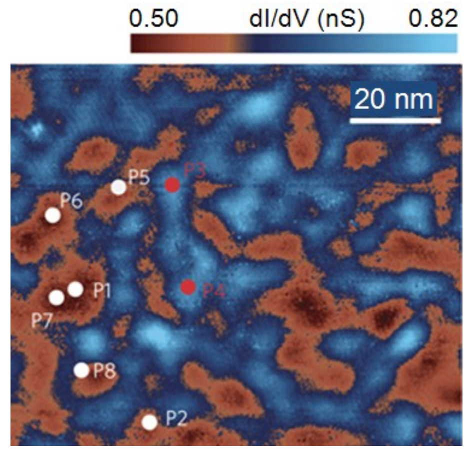
Fabrication, characterization and simulation of high performance Si nanowire-based non-volatile memory cells, X. Zhu, Q. Li, D. Ioannou, D. Gu, J.E. Bonevich, H. Baumgart, J. Suehle, and C. A. Richter, *Nanotechnology* **22**, 254020 (2011).

Electron Puddles Point a Path to Graphene Based Transistors

A research team from the CNST and NIST's Physical Measurement Laboratory has shown that the electronic properties of two layers of graphene on a substrate vary on the nanometer scale. Their surprising new results, reported in Nature Physics [1], reveal that the electric potential between the two graphene layers varies in magnitude and sign on the nanometer scale. The new measurements bring graphene a step closer to being used in practical electronic devices.

Graphene, a single layer of carbon atoms, is prized for its remarkable properties, including high speed electron conduction. Unfortunately, it is ill-suited for fabricating the traditional transistors required for digital electronic applications because it lacks a band gap. However, in bilayer graphene, consisting of two stacked graphene layers, a band gap may form when a perpendicular electric field is applied to the device. Using scanning tunneling spectroscopy measurements, the researchers have shown that interactions with the disordered insulating substrate material causes puddles of electrons and electron holes to form in the graphene layers. Both types of carriers are found close to the substrate, and the differences in the puddle depths, or charge density, between the layers creates a random pattern of alternating dipoles and a spatially varying band gap. The researchers hope that manipulating the purity of the substrate will allow for fine control of graphene's band gap, and may eventually lead to the fabrication of graphene-based transistors that can be turned on and off like a semiconductor device. Noting that their previous work [2] has shown that these substrate interactions lower the electron speed, they believe this problem can be addressed through clever engineering of graphene/substrate interactions.

The NIST team plans to test different substrate materials to explore the role that substrates play in forming and controlling band gaps in graphene. If the substrate interactions can be reduced enough, bilayer graphene may be used to create a new quantum field effect transistor.



Spatial distribution of the disorder potential in bilayer graphene. Different measurement points, six for electron puddles (white circles) and two for hole puddles (red circles) are indicated.

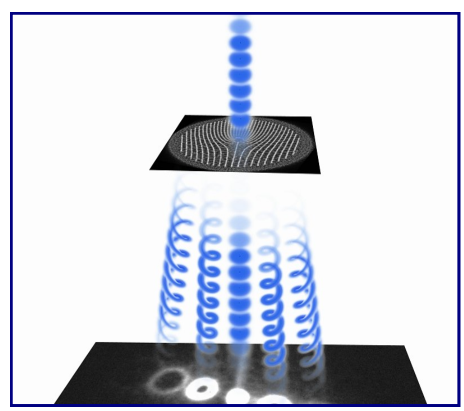
[1] Microscopic polarization in bilayer graphene, G. M. Rutter, S. Jung, N. N. Klimov, D. B. Newell, N. B. Zhitenev, and J. A. Stroscio, *Nature Physics*, advance online publication, 24 April 2011 (doi:10.1038/nphys1988).

[2] Evolution of microscopic localization in graphene in a magnetic field from scattering resonances to quantum dots, S. Jung, G. M. Rutter, N. N. Klimov, D. B. Newell, I. Calizo, A. R. Hight-Walker, N. B. Zhitenev, and J. A. Stroscio, *Nature Physics* **7**, 245-251 (2011).

Creating Electron Vortex Beams with Quantized Angular Momentum

Researchers in the CNST and MML have demonstrated electron vortex beams – coherent electron beams with helical wavefronts and quantized electron orbital angular momentum. Electron vortex beams with up to 100 ħ of orbital angular momentum per electron were demonstrated using nanofabricated diffraction holograms in a transmission electron microscope (TEM). The imaging optics of the TEM were used to witness the evolution of these electron orbital states in free space, confirming the high angular momentum of the beam, and demonstrating that a charged massive particle can exhibit stable orbital motion in the absence of any confining potential, external field, or surrounding medium. The researchers showed that the beams can be approximated as a superposition of classical electrons traveling in straight trajectories.

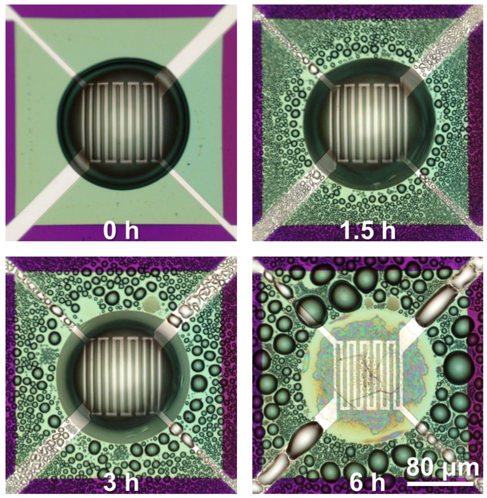
The electron vortex beams have several immediate applications. For example, transfer of quantized angular momentum from the electron beam to magnetic atoms could be exploited to provide magnetic contrast, which in principle could be used to image magnetic materials in a TEM with atomic resolution. The beams also hold promise for imaging electron-transparent materials in a TEM, such as biological specimens and other carbon-based samples, by implementing recent phase contrast techniques developed in light microscopy. The team is currently working on implementing these two applications.



During the formation of electron vortices, a spatially coherent plane wave of electrons illuminates a nanofabricated hologram. It then diffracts into multiple electron vortex beams which are imaged using a charge-coupled device.

Electron vortex beams with high quanta of orbital angular momentum, B. J. McMorran, A. Agrawal, I. M. Anderson, A. A. Herzing, H. J. Lezec, J. J. McClelland, and J. Unguris, *Science* **331**, 192 -195 (2011).

Drop-casting Sol-gel on Membrane Microhotplates

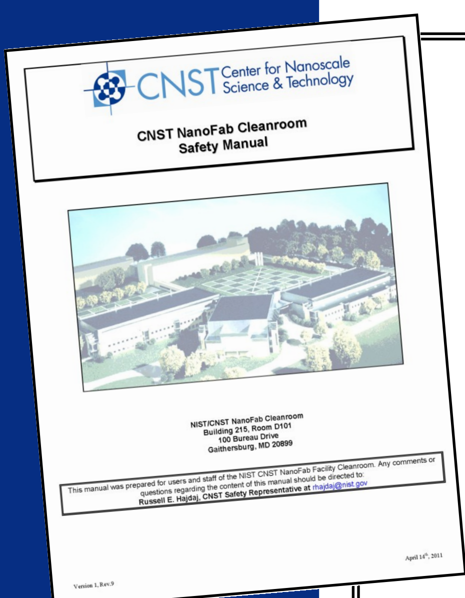


Microhotplate driven drying of a $Cu(OH)_2$ sol-gel film over six hours.

Thermoresistive elements are found in a broad range of microdevices that rely on rapid thermal modulation and fine temperature control. In an effort to improve one particularly important application, chemical microsensors that use temperature modulation for sensitive and selective target recognition, researchers Phillip Rogers and Michael Carrier from NIST's Material Measurement Laboratory have designed and built prototype microhotplate (MHP) devices. Working in the NanoFab, the researchers developed a protocol for low-stress sputter deposition of platinum layers on thin film membranes of CNST developed, low-stress silicon nitride. The resulting heating electrode allows for better device performance than traditional evaporated platinum.

The device takes advantage of the microhotplate membrane's low tensile stress to position deposited thin films. A microcapillary is used to pipette 500 pL to 800 pL of sol-gel drop-casting solution onto the membrane, which warps slightly due to its low tensile stress. This centers the droplet and the resulting thin film on the microhotplate. A current is then applied to the platinum heater to slowly evaporate the solvents and leave behind $Cu(OH)_2$, a metal-hydroxide film. This film can be calcified and annealed *in-situ* by reheating the microhotplate, which has a stable thermal range from room temperature to 600 °C, a 100 °C increase over earlier devices. According to Rogers, while MHP devices have been in use for decades, increased interest in these devices as "electronic nose" platforms for extraterrestrial exploration, biomedical screening, and national security applications is driving advances in their performance and robustness. The researchers are working on applying these material deposition techniques in a variety of other chemical sensor platforms.

Feedback-enabled discrimination enhancement for temperature-programmed chemiresistive microsensors, P. H. Rogers, S. Semancik, *Sensors and Actuators B: Chemical* **158**, 111-116 (2011).



CNST Center for Nanoscale Science & Technology

CNST NanoFab Cleanroom Safety Manual

NIST/CNST NanoFab Cleanroom
Building 215, Room D101
100 Bureau Drive
Gaithersburg, MD 20899

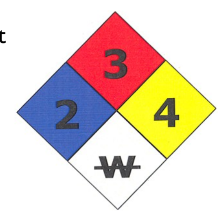
This manual was prepared for users and staff of the NIST CNST NanoFab Facility Cleanroom. Any comments or questions regarding the content of this manual should be directed to: Russell E. Hajdaj, CNST Safety Representative at rhajdaj@nist.gov

April 14th, 2011

Version 1, Rev.9

CNST Releases Updated NanoFab Safety Manual

The CNST has just released a new edition of the *CNST NanoFab Safety Manual*, a valuable source of operational and safety information about the NanoFab laboratories and cleanroom. The manual is designed to help researchers, visitors, managers and contractors use the NanoFab safely. It provides information about lab procedures, equipment use, chemical safety, and nanoscale specific material safety. It also includes staff contacts, a list of emergency services, and a copy of the CNST NanoFab incident reporting form. Since the NanoFab is continuously upgrading its equipment and updating its chemicals, its safety policies are evolving. The latest safety updates to the manual for 2011 include the following sections: Piranha Solution Safety, Pyrophoric Liquid and Organometallic Safety, and Chemical Waste Neutralization and Disposal. At the CNST, our goal is to ensure that our staff, guests, customers, and contractors are safe at all times and are provided with the most up to date safety information available. We encourage all users to read the safety manual, which is available at:



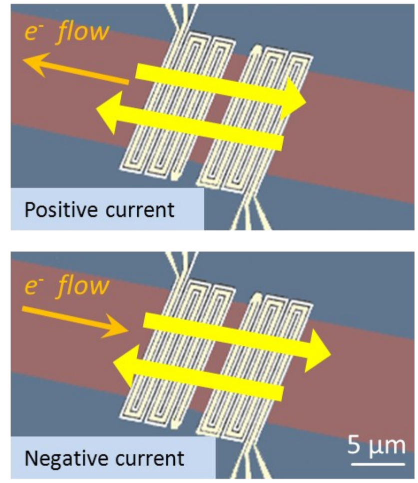
http://www.cnst.nist.gov/nanofab/pdf/cleanroom_safety_manual.pdf.

Spin Waves Used to Measure Magnetic Polarization of Electrical Current

The rapid growth of storage density in hard drives has been propelled in part by developments in the sensors used to read the magnetic "bits" on the disk. Recently, the use of giant magnetoresistance (GMR) in such sensors, with current flowing in the plane of a multilayer film, has given way to the use of tunneling magnetoresistance, where current flows perpendicular to the plane of the multilayer through a tunnel barrier. To avoid the prohibitively high resistance of smaller tunnel junction sensors, future miniaturization of the sensors is projected to again require the use of GMR in all-metal multilayers, but with current flowing perpendicular to the plane. In a collaboration with researchers at Hitachi Global Storage Technologies, CNST researchers used their recently developed spin wave Doppler technique to measure the current polarization in $(CoFe)_{1-x}Ge_x$ alloys being investigated for possible use in future disk drive read head sensors.

A critical parameter affecting the GMR of a multilayer sensor film is the current polarization, which is the degree to which the current in a magnetic metal is carried by electrons with spins either parallel or anti-parallel to the magnetization. The CNST researchers used nanostructured antennas to launch and detect spin waves in current-carrying $(CoFe)_{1-x}Ge_x$ stripes, allowing them to measure shifts in a resonant transmission frequency that revealed the current-induced drift velocity of the magnetization and the current polarization. The results indicate polarization up to 95 % in these alloys. Although comparable polarization values have been found in materials that require annealing at prohibitively high temperatures, these $(CoFe)_{1-x}Ge_x$ alloys are compatible with sensor manufacturing.

Enhanced magnetization drift velocity and current polarization in $(CoFe)_{1-x}Ge_x$ alloys, M. Zhu, B. D. Soe, R. D. McMichael, M. J. Carey, S. Maat, and J. R. Childress, *Applied Physics Letters* **98**, 072510 (2011).



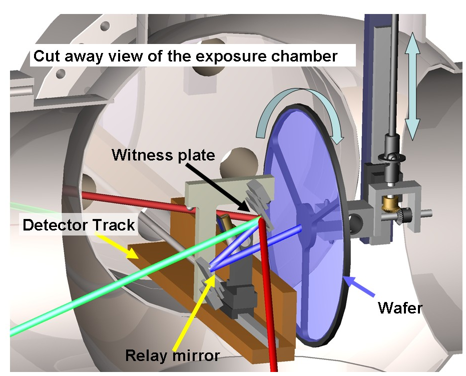
False-color scanning electron micrograph of a spin-wave Doppler device. Asymmetry in the spin wave velocity (yellow arrows) is used to measure the current polarization.

Characterizing Photoresists for Next Generation Lithography

Extreme ultraviolet lithography has great potential to displace current 193 nm photolithography, but will require the development of new, well characterized, EUV sensitive photoresists. A new NIST resource operated at the Synchrotron Ultraviolet Radiation Facility (SURF III) provides data on the potential of the outgas products of candidate resists to contaminate EUV scanner optics by using a mirrored optical configuration to focus EUV radiation on a witness plate and on a nearby resist-coated wafer. The resulting contamination of the witness plate, where outgas products accumulate, can be analyzed by on-site EUV reflectometry as well as surface-sensitive probes, providing detailed real-time information on the rate of contamination. The system optics mimic an EUV stepper, where focusing mirrors are coated to protect against oxidation, but cannot be protected against deposition from residual organic molecules that are decomposed by high-intensity EUV radiation. The beamline includes an *in-situ* monochromatic ellipsometer for imaging. Samples are tested post-exposure using spectroscopic ellipsometry and x-ray photoelectron spectroscopy. Without changing the device configuration, the researchers can evaluate resist for sensitivity and can provide accurate dose-to-clear measurements of the exposure energy needed to clear resist in a large area. The NIST facility uses a metrology-dedicated synchrotron storage ring with a peak output near 13.5 nm, the wavelength anticipated for EUV lithography, as a high intensity radiation source for performing its witness sample testing.

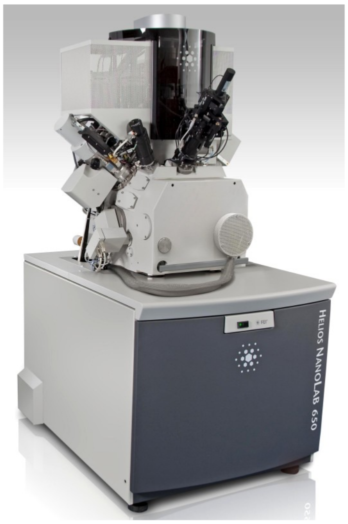
NanoFab technicians supported the SURF researchers by providing sample preparation for a range of different potential EUV photoresists. The work included 200 mm-diameter wafer cleaning, calibrated resist coating, resist soft baking, post-exposure baking, aqueous development, and film thickness measurements using spectroscopic ellipsometry. The researchers obtained the fabrication services as remote users, specifying the work to be performed by NanoFab staff at an hourly rate.

A synchrotron beamline for extreme-ultraviolet photoresist testing, C. Tarrio, S. Grantham, S. B. Hill, N. S. Faradzhev, L. J. Richter, C. S. Knurek, and T. B. Lucatorto, *Review of Scientific Instruments*, **82**, 073102 (2011).



Schematic of the sample chamber and beamline used to evaluate EUV resists.

NEW TOOLS IN THE NANOFAB



Applications for the two new FIBs include cross-sectioning, device modifications, TEM sample preparation, and XEDS analysis.

Analytical Transmission Electron Microscope (TEM) – The new FEI Titan 80-300 TEM in room 216/G115 provides nanoscale structural and chemical characterization of a variety of materials, including semiconductors, photovoltaics, quantum structures, and nanostructures. Its capabilities include high angle annular dark field scanning TEM imaging, x-ray energy dispersive spectroscopy (XEDS), electron energy loss spectroscopy, and sub-nanometer 3D imaging using electron tomography. Users can reserve time through the CORAL system. For more information, contact Alline Myers, 301-975-3775.

Focused Ion Beam (FIB) – The CNST is installing two FEI Helios NanoLab 650 DualBeam FIBs in room 216/G103. These FIBs allow for fast, precise, and reliable milling, patterning, and ion imaging, and deliver sub-nanometer resolution across a range of 1 kV to 30 kV. They will be available for use in August 2011. For more information, contact Alline Myers, 301-975-3775.

Stepper – This fall, the NanoFab will install an ASML Aerial i-Line model PAS 5500/275D Stepper, significantly expanding its optical lithographic capabilities. This stepper can expose 80 – 120 wafers per hour. It provides front and backside alignment with resolution down to 280 nm and overlay accuracy of 40 nm. It can handle 200 mm-diameter wafers up to 1 mm thick, as well as small pieces. For more information, contact Rich Kasica, 301-975-2693.

Lift-off Tool – A new heated spray solvent metal liftoff tool will be installed in December, providing automatic recipe control and reducing liftoff time from hours to minutes. Its "dry in - dry out" processing will reduce user exposure to solvents, and provide cleaner finishing of samples ranging from 150 mm-diameter wafers down to 25 mm-on-a-side squares. For more information, contact Jerry Bowser, 301-975-8187.

Ion Milling System – In the next few months, the CNST will install a new 4W-LIBE ion mill system from 4Wave, Inc., capable of milling a wide variety materials, including Au, Co, Cu, Fe, Ir, Mn, Ni, Permalloy, Pd, Pt, Ta, W, AlN, Al_2O_3, SiO_2, Si_3N_4, Ta_2O_5, and TiO_2. A 200 mm-diameter argon ion gun provides broad beam, collimated, high-energy flux to mill with better than 2.5 % uniformity. Users can vary the substrate angle to tailor sidewall profiles with minimal sputtered redeposition on overlying masks. The device can prepare samples ranging from small pieces to 150 mm-diameter wafers for use in a TEM, a scanning electron microscope (SEM), or other devices. A secondary ion mass spectrometer (SIMS) for end-point detection and deposition capability for up to four materials at one time will be added in 2012. For more information, contact Gerard Henein, 301-975-5645.

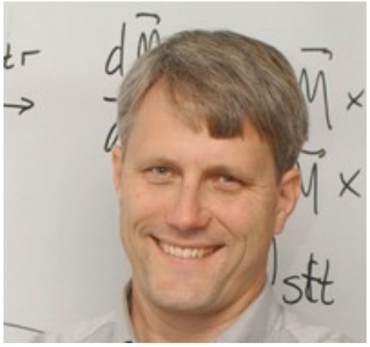
Chemical Mechanical Polishing/Planarization (CMP) System – The CNST has purchased a CETR model CP-4 CMP system that will be installed in August 2011. The CMP removes irregular topography, leaving samples planar, using a corrosive colloidal slurry and a dynamic polishing head with different nonconcentric rotation axes. It is typically used to polish copper, aluminum, tungsten, and SiO_2, and to remove excess conductors while stopping reliably at the top of an insulating layer. The CP-4 will handle samples ranging from small pieces up to 100 mm-diameter wafers. For more information, contact Gerard Henein, 301-975-5645.

The LPCVD furnace now allows *in-situ* doping of polysilicon.

LPCVD Now Allows *In-Situ* Doping of Polysilicon

The NanoFab has expanded its processing capability by adding *in-situ n*-type doping to the low pressure chemical vapor deposition (LPCVD) polysilicon furnace. The furnace uses an inherently safe phosphine sub-atmospheric delivery system as the doping gas. This source minimizes the possibility of leaks or accidental release of phosphine. The new process deposits doped polysilicon films with a resistivity of less than 0.002 Ω • cm on substrate sizes ranging from small pieces to 150 mm-diameter wafers. *In-situ* doping can prevent dopant punch-thru on thin gate CMOS devices and can relieve stress in polysilicon MEMS structures.

For more information, contact Jerry Bowser, 301-975-8187.



Mark Stiles Elected Vice-Chair of the American Physical Society Magnetism Topical Group

Mark Stiles, a NIST Fellow in the CNST Electron Physics Group, has been elected Vice-Chair of the American Physical Society (APS) Topical Group on Magnetism and its Applications (GMAG). As Vice-Chair, he will head the GMAG Fellowship Nomination Committee. Next year, he will become Chair Elect and, as Program Chair, will coordinate the GMAG program at the APS March Meeting. Finally, in 2013, he will rise to become Chair of the 800 member strong group. Stiles, who is a Fellow of the APS, previously served as a Member-at-Large of the GMAG Executive Committee, and has also served the APS on the Executive Committee of the Division of Condensed Matter Physics and as a Divisional Associate Editor at Physical Review Letters. At NIST, he leads multiple projects focused on the development of *ab initio* theoretical methods for understanding measurements and predicting the properties of magnetic nanostructures.

Joseph Stroscio Named 2010 AAAS Fellow

Joseph Stroscio, a NIST Fellow in the CNST Electron Physics Group, has been named a Fellow of the American Association for the Advancement of Science (AAAS). Election as a Fellow is an honor bestowed upon AAAS members by their peers. Joe was elected as an AAAS Fellow as part of the Physics Section for his “distinguished contributions to the fields of surface and condensed matter physics, particularly for the development and application of scanning tunneling microscopy.” This year 503 members have been chosen for this honor by AAAS because of their scientifically or socially distinguished efforts to advance science or its applications. The new Fellows were presented with an official certificate and a rosette pin at the 2011 AAAS Annual Meeting in Washington, D.C.

Robert Celotta Elected Member-at-Large of the American Physical Society Forum on Industrial and Applied Physics

CNST Director Robert Celotta has been elected as a Member-at-Large of the American Physical Society (APS) Forum on Industrial and Applied Physics (FIAP). FIAP was formed in 1995 with the objective of enhancing the ability of the APS "to meet the needs of the industrial and applied physics community,” and help the APS to “take advantage of the evolving opportunities in the practice and application of physics.” It has since grown into the largest APS forum. During his term, which runs from 2011 to 2014, Celotta will serve as a member of the FIAP Executive and Fellowship Committees, and represent FIAP to the APS as a whole. Coming from NIST, a national laboratory that has always had a close connection to the nation’s industries, Celotta hopes to bring a different and helpful perspective to the Forum. He is particularly interested in “exploring and showcasing new promising, or older accomplished, ways that industrial, academic, and governmental organizations can work together.” He has also committed to working to “highlight the creative and important contributions of those working in areas of applied physics, particularly to younger scientists to inform their career choice.”

Center for Nanoscale Science and Technology

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Supporting the development of nanotechnology from discovery to production.

The CNST is a national user facility purposely designed to accelerate innovation in nanotechnology-based commerce. Its mission is to operate a national, shared resource for nanoscale fabrication and measurement and develop innovative nanoscale measurement and fabrication capabilities to support researchers from industry, academia, NIST, and other government agencies in advancing nanoscale technology from discovery to production. The Center, located in the Advanced Measurement Laboratory Complex on NIST's Gaithersburg, MD campus, disseminates new nanoscale measurement methods by incorporating them into facility operations, collaborating and partnering with others, and providing international leadership in nanotechnology.

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SPIE Optics and Photonics

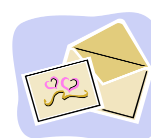
San Diego, August 23-25

Announcing the Next

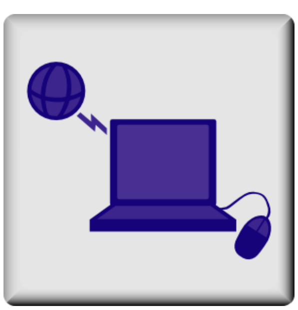
NanoFab Users Meeting

Friday, September 9, 2 pm to 4 pm

Building 215/C103



Current and potential NanoFab researchers and others interested in NanoFab operations are invited to the quarterly NanoFab Users meeting. Topics typically include safety, policy changes, new equipment purchases or upgrades, research highlights, and new standard processes. Every meeting also includes an open discussion to allow users to bring ideas and suggestions to our attention. Anyone wishing to have a specific item added to the agenda should contact Vincent Luciani at 301-975-2886, vincent.luciani@nist.gov.



CNST Offers Wireless Internet Access and Easier NanoFab Log-In Procedure

CNST visitors with laptops and smartphones can now access the internet wirelessly using the NISTnet system thanks to the installation of new wireless routers throughout building 215 and parts of building 216. Beginning this fall, NanoFab users will be automatically logged into the CORAL system when they enter a NanoFab laboratory using a NIST badge.

Disclaimer: Certain commercial equipment, and software, are identified in this documentation to describe the subject adequately. Such identification does not imply recommendation or endorsement by the National Institute of Standards and Technology, nor does it imply that the equipment identified is necessarily the best available for the purpose.

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