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

NanoFab News

Volume 2, Issue 1 February 2010

Center for Nanoscale Science and Technology

The NIST NanoFab offers:

- A streamlined project application process designed to get you into the cleanroom in a few weeks;
- A professional staff with over 200 years of collective experience and available for expert consultation;
- Hands-on training for all tools and processes.

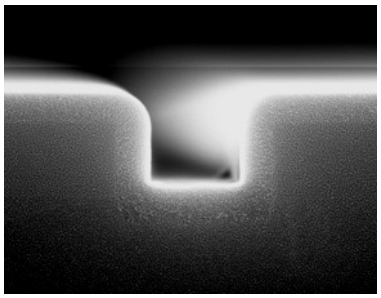
Inside this issue:

Welcome to the February 2010 Issue of the *NanoFab News*

We are pleased to distribute the *NanoFab News* for current and potential users of the NanoFab at the NIST Center for Nanoscale Science and Technology (CNST). This quarterly newsletter is intended to keep users up to date on our fabrication process development, tool installations, safety and access policies, and other notable news. This newsletter is for you, so if you have suggestions, please let us know at nanofab@nist.gov.

Oxford ALD System Now Available in the NanoFab

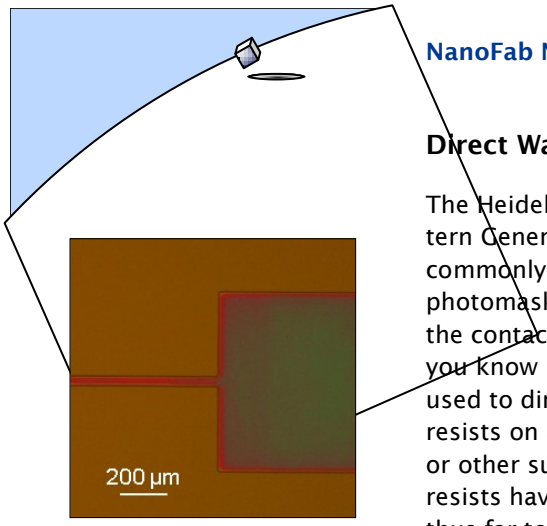
The NanoFab has installed a new Atomic Layer Deposition (ALD) tool inside the clean room. ALD can be used to deposit a conformal thin film onto a wide range of substrate materials via a self-limiting sequential surface chemical reaction process that enables the thickness and composition to be controlled at the atomic scale. ALD is considered to have the greatest utility for producing thin conformal films on non-planar structures. Unlike CVD and PVD, which deposit films "top-down," ALD grows "bottom-up," atomic-layer-by-atomic-layer. Currently, the NanoFab ALD is loaded with precursors for silicon, aluminum and hafnium.



A conformal layer of SiO_2 deposited by ALD onto a Si substrate with a 300 nm-wide trench.

Processes have been developed for SiO_2, HfO_2, Al_2O_3 and AlN, and the tool can now be reserved in CORAL.

Contact Lei Chen for additional information: 301-975-2908, lei.chen@nist.gov.



A negative tone resist pattern created by the LPG.

Direct Wafer Writing with the Heidelberg LPG

The Heidelberg Laser Pattern Generator (LPG) is commonly used to expose photomasks for use on the contact aligners. Did you know it can also be used to directly pattern resists on a silicon wafer or other substrate? Two resists have been used thus far to expose patterns in the tool, maN-490 negative tone resist and Shipley 1813 positive tone resist. The exposure conditions for each write-head have been added to the parameters text file which all users should reference prior to running their exposures. In addition to handling wafers up to 150 mm in diameter, the tool can also be used to expose small substrate pieces.

For more information contact:

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marc.cangemi@nist.gov;

Rich Kasica
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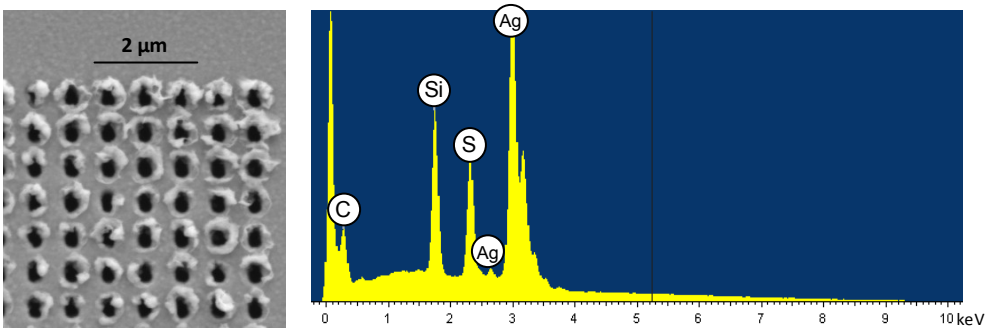
richard.kasica@nist.gov.

Did you know the Heidelberg Laser Pattern Generator can be used to directly pattern resists on a substrate?

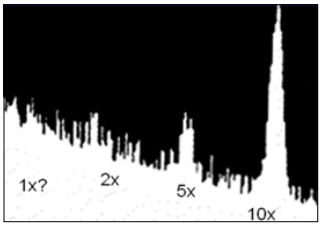
Energy Dispersive Spectroscopy Mapping Demonstrated

A silver film patterned on silicon was analyzed for its compositional distribution using the NanoFab's new Oxford EDS tool installed on the Zeiss Ultra60 SEM. After the SEM image was obtained, a spectrum showing all elements present was used to identify individual elements for mapping. For an X-ray line to be statistically valid, the signal-to-noise ratio should be at least 3:1. For EDS, the detection limit is typically in the range of 1-5%, depending on the overall count acquired in the spectrum and on the actual elements involved. Note that EDS is not a trace detection technique; its minimum detectable mass (MDM) is on the order of 10^{-12} to 10^{-15} g. The SEM image of the silver film and corresponding element maps are shown below.

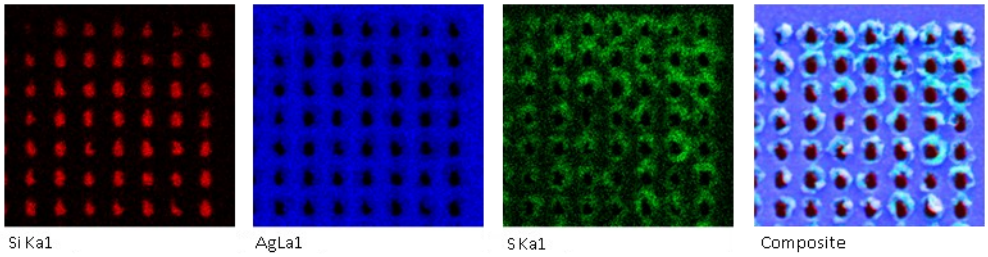
Contact Mike Hernandez for additional information: 301-975-4590, mikehern@nist.gov.



Secondary electron image and corresponding spectrum showing elements present.



Signal-to-noise criteria for determining EDS detection limit.



Element maps showing the spatial distribution of Si, Ag, S, and a composite of all three elements.

New E-beam Evaporator Installed and Available in Coral

A second Denton electron beam evaporator has been installed. Deposition recipes are currently being tested, with the tool expected to become available to the users by late February. This new tool should greatly ease the present bottleneck on the existing evaporator. The new chamber has a 6-pocket electron gun, two quartz crystal monitors for flux averaging, and an ion gun to densify refractory films and thereby obtain better control over their refractive indexes. The ion gun can also be used to clean the wafers prior to deposition. The wafers are mounted on a planetary fixture that undergoes a double rotation, yielding a thickness uniformity of 1-2% over 100 mm. The tool can accept four wafers (100 or 150 mm-diameter), eight wafers (75 or 50 mm-diameter) or wafer pieces. Source materials being given first consideration are Ti, Cr, Au, Permalloy, Ta, Pt, SiO_2, Al_2O_3, TiO_2, and MgO.

Contact Gerard Henein for additional information: 301-975-5645, gerard.henein@nist.gov.

The metal deposition bay in the NanoFab.

Two New Staff Members Join the NanoFab Operations Group

Chet Knurek joined the NanoFab Operations Group as a Process Engineer in December 2009. Chet has a B.S. in Electronics Engineering from DeVry University in Chicago. Prior to joining NIST, he worked at AT&T Microelectronics/Lucent Technologies – Bell Labs on characterization and process development for next-generation lithography, including binary/phase-shift, point source X-ray and flood e-beam mask formats. Chet is responsible for training and process support for NanoFab users in various nanofabrication areas, including optical lithography and metrology.

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NanoFab User's Meeting

The next User's Meeting will be held Wednesday, Feb. 24 at 2 pm in the 215 Conf. Room.

Please attend!

Jerry Bowser joined the NanoFab Operations Group as an Engineering Technician in January 2010. Jerry has over 13 years of experience in semiconductor manufacturing engineering, focusing on process efficiency in the private sector. He worked for five years at Allied-Signal and eight at Covega, where he held both engineering and supervisory positions. He is proficient in electronics design, troubleshooting, and computer programming. Jerry will apply his process development expertise and Six-Sigma Greenbelt training in the NanoFab with CMOS diffusion/oxidation and chemical vapor deposition processes.

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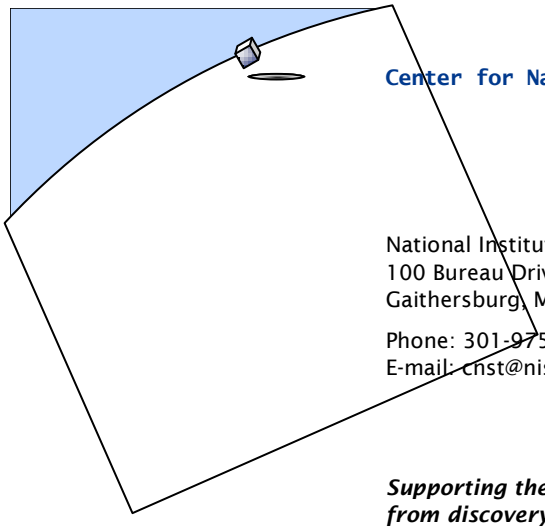
Disclaimer: Certain commercial equipment and software are identified in this documentation to describe the subject adequately. Such identification does not imply recommendation or endorsement by the NIST, nor does it imply that the equipment identified is necessarily the best available for the purpose.



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Supporting the development of nanotechnology from discovery to production.

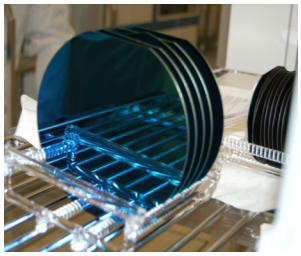
CNST Center for Nanoscale Science & Technology

www.nist.gov/cnst

The NIST Center for Nanoscale Science and Technology supports the development of nanotechnology through research on measurement and fabrication methods, standards and technology, and by operating a state-of-the-art nanofabrication facility, the NanoFab. The Center promotes innovation by using a multidisciplinary approach to research, maintaining a staff of the highest caliber, and leveraging our efforts by collaborating with others.

For information about becoming a NanoFab user, contact the NanoFab Manager:

Vincent Luciani
301-975-2886
vincent.luciani@nist.gov.



Supplies can now be purchased from the NanoFab.

NanoFab Supplies Now Available Through Coral

The NanoFab can now supply users with a selection of basic supplies for use in the NanoFab. We are currently offering silicon wafers, mask blanks, wafer tweezers, storage boxes, and single wafer trays. We can also charge for various precious metals. The supplies will be charged to your Coral account at the time of purchase.

To purchase items, or if you have any suggestions for stock items, contact Marc Cangemi: 301-975-5993, marc.cangemi@nist.gov.

Visit our Booth at these Upcoming Meeting Exhibits

March 1 – 4	PITTCON Conference & Expo	Orlando, FL
March 15 – 17	APS March Meeting	Portland, OR
March 16 – 17	WBT Showcase	Arlington, TX
April 6 – 8	MRS Spring Meeting	San Francisco, CA
May 4 – 6	BIO International Convention	Chicago, IL
June 22 – 23	Nanotech Conference & Expo	Anaheim, CA