

CERSP News

University of North Carolina at Chapel Hill
North Carolina State University
University of Texas at Austin
North Carolina A&T State University
Georgia Institute of Technology

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**NCSU and UNC Open Doors to
Triangle National Lithography Center**

CERSP News

Center for Environmentally Responsible
Solvents and Processes

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About the CERSP

"We use CO₂ research to develop and share scientific knowledge profitably among:

- Students
- Scientists
- Industry
- and Society

for a cleaner environment."

Mission:

To identify and enable a generation of economical and energy-efficient, clean and safe processes, especially for improved products, by developing and exploiting a robust body of fundamental knowledge in CO₂-related science and technology.

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CORPORATE SPONSORS

As the major industrial outreach component of the CERSP, the Kenan Center for the Utilization of Carbon Dioxide in Manufacturing has the advantage of its industrially supported activities being highly leveraged by federal support for CERSP. This allows for a great deal of synergy between the more applied projects associated with the Kenan Center and the more fundamental and analytical research done by CERSP. The Kenan Center is comprised of chemists, chemical engineers, and materials scientists from the University of North Carolina at Chapel Hill and North Carolina State University as well as a team of corporate sponsors. Our laboratories are uniquely equipped to help industrial partners launch research programs in supercritical fluids R&D, as well as to assist in augmenting proprietary research programs within their corporate R&D laboratories.

Kenan Center for the Utilization of Carbon Dioxide in Manufacturing

Air Liquide	Micell Integrated Systems
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Website: www.ncsu.edu/champagne

COVER STORY

Triangle National Lithography Center Opens Its Doors

"... right now, we are leading the Nation in our capabilities to fabricate nanoscale devices with optical lithography. ... we have surpassed the capabilities of Cornell, MIT, and Stanford ...," says DeSimone in his opening remarks at the ribbon cutting ceremony. PAGES 6, 7



Photo by Roger Winstead

Cover: ASML executives pose with NC State and UNC Chancellors, TNLC officials, and science advisor to the Governor. Above: Chancellors Marye Anne Fox and James Moeser discuss the 193 nm scanner during a tour of the TNLC facilities.

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Leonard Uitenham

by Charles Jones
UNC-Chapel Hill

Dr. Leonard C. Uitenham, Professor and Chairman of the Mechanical and Chemical Engineering Department at North Carolina Agricultural and Technical State University in Greensboro, NC is one of the newer faculty members in the NSF-STC. He will serve as the new campus coordinator for NC A&T to focus the NC A&T program on research and education in Chemical Engineering.



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Dr. Uitenham obtained his bachelor, master, and doctoral degrees in chemical/polymer engineering from Case Western Reserve University. He also has a master degree in strategic studies and national security from the US Army War College.

Dr. Uitenham has over 20 years of industrial experience working for companies such as Diamond Shamrock, Diversitech General, The Sherwin Williams Company, and Pittsburgh Plate and Glass Industries. About half of this time was spent in R&D doing product and process development, designing, and building manufacturing plants while the other half was spent managing various manufacturing plants, some of which he built. Much of his industrial research experience has been in process control of various chemical processes and designing new processes. The processing research included new reactor designs, converting batch operations to continuous operations and developing new instrumentation to control processes. He

was involved in implementing innovative process research in real world applications, most of which was leading edge research. Due to the proprietary nature of the research and the decision by the company not to apply for patents, no external publications were allowed.

Overall, Dr. Uitenham has had a very interesting and sometimes demanding career applying the theoretical aspects of engineering design, research, unit operations, manufacturing, and business management. Currently as a professor of chemical and mechanical engineering, he is able to take his wide knowledge base into the classroom and use it as a tool to teach students how to use their intuition and engineering education to solve problems. This has been personally rewarding to him so far.

Besides a civilian career, Dr. Uitenham is enlisted as a Colonel in the United States Marine Corps. He has served in the Marine Corps for 29 years (7 years active duty and 22 years reserve

duty). After being an infantry officer for 2 years, he went to military flight school, flew tactical military jet aircraft for 16 years, and spent 10 years in military intelligence. Dr. Uitenham is currently the Commander of the Marine Corps Reserve Southeast region. He has 41 units under his command in 9 states including Puerto Rico. And if you want to learn how to fly, Dr. Uitenham might be able to help. He is an Airline Transport Pilot rated in Boeing 727 and a FAA Certified Flight instructor qualified to teach instruments, single engine, and multi-engine airplanes. He has even served as flight instructor at the Naval Flight School. During most of his military career he has been involved in aircraft accident investigations. The structural integrity of both military and civilian airplanes has always been of great interest to him. Dr. Uitenham and his wife of 32 years currently live in McLeansville, NC. They have two adult children and three grandchildren.

Bothun cont'd from page 10

quiring development of fundamental data is the membrane area. Geoff can use his undergraduates to develop data supporting his own research with Ilias and Koros. In facilitating the Ilias-Koros collaboration, he will contribute to filling a CERSP need. And by increasing

the involvement of NCA&T undergraduates in research and the number attending graduate school, he will be helping increase the profile and stature of NCA&T as a technical university. Finally, by increasing the number of NCA&T undergraduates attending graduate school he will be contributing to a key CERSP

goal.

Geoff will start in May 2004 so that programs can be fully defined and operational by the Fall 2004 term. We have applied for a supplemental grant from NSF that will allow us to evaluate thoroughly the success of this type of non-classical post-doctoral associate position.

Making a Big Deal about Small Things

We are on our way to our exciting final five years of operation for CERSP with many of our planned initiatives well under way. We are developing new collaborations to strengthen our technical abilities in new areas such as microelectronics and nanoscience and technology. Ironically, as our collaborations grow internally, nationally, and internationally, the Center as a whole is thinking about how to make things smaller — as small as the nanoscale. And we are investing heavily in nanoscale research.

The doors to the Triangle National Lithography Center (TNLC) were officially opened during a ribbon cutting ceremony and dedication on January 20, 2004. The TNLC represents an unprecedented collaboration between



the University of North Carolina at Chapel Hill and North Carolina State University and the entire CERSP family including GA Tech, UT-Austin and NC A&T. TNLC will provide academic and industrial researchers from CERSP and around the world a state-of-the-art multi-user lithography facility to fabricate nanoscale structures using optical lithography. The facility will further the understanding of matter and processes at the nanometer length scale with unmatched capabilities to advance nanofabrication equipment and expertise. In addition, it will provide local industrial partners the infrastructure necessary to compete on the international stage in advanced application in microelectronics, lab-on-a-chip and the nanoscale technology. With a mission grounded in exploring, collaborating, educating, and

leading, the TNLC will be a magnet serving to elevate the capabilities of our universities, our state, our country, and our local economy. The details of the dedication ceremony are given in the feature article on pages 6 and 7.

We are giving a strong focus to microelectronics in the final phases of CERSP operation. Under the Kenan Center a new consortium has been launched with a "microelectronics-only" focus. The reorganization accommodates new research opportunities for CO₂-based technologies and the evolving interest of our corporate members. The new effort will be called the "Consortium for Integrated CO₂ Technologies in Microelectronics" (see article on page 5). Our goal is to form a consortium which has the requisite membership necessary to give advice, counsel, input and in-kind support that will ultimately allow the science and technology of the CO₂ platform to move forward in the microelectronics industry. In addition to running the Consortium, the Kenan Center will also serve as a conduit for individual research grants outside of the microelectronics field with corporations, federal and state agencies. This re-organization will also allow us to more easily work on a one-on-one basis with companies in specific areas outside of the microelectronics field.

Even in the areas of education and outreach, our "nano" thoughts (i.e. targeting the one-to-one relationship) are reaping big payoffs in training for effective collaborations, increasing diversity in the Center, stimulating an interest in mentoring. We have launched a brand new collaboration workshop that has been revamped under the direction of Dr. Russell Osmond. The workshop is a continuous, semester-long program that provides students with an understanding of their own personal style and the implications of that style. This knowledge is supplemented with skills in interpersonal relationships and tools to facilitate conflict resolution. See the article entitled "A Personality Profile Test That's Useful" on page 8 for a personal testimony about the impact of this workshop. We launched a nation-wide search to identify a post-doctoral candidate to work at NC A&T State University and we eagerly anticipate the stronger relationship between A&T and the sister CERSP universities. This postdoc will be collaborating with Professors Iliias and Koros to explore new high pressure membranes compatible with the CO₂-technology. In addition, he will be managing the new NC A&T Undergraduate Program of Excellence that was highlighted in our June/July 2003 CERSP News.

Mentoring is still viewed as a valuable experience for our graduate students. Ginger Denison, winner of the 2003 RICHES Award of Excellence for exemplary activity in CERSP related outreach, gives her personal remarks about the importance of working with an undergraduate student one-on-one (see page 9).

Looking at all areas of CERSP activities, we can be proud of our accomplishments. For the first five years of funding, many of our goals were met and some even surpassed our expectations. As for the future, many of the activities we talked about initiating during our renewal visit with NSF have already been implemented. Nanoscale devices fabricated in part with the aide of CO₂-based technology are high on our list of goals. Carbon dioxide has shown superior qualities as a solvent for critical cleaning and drying of nanoscale devices. While the final chapter has not been written for the role of the CO₂-technology platform in microelectronics, we expect there will be a significant relationship.

Joseph M. DeSimone
CERSP Director

Our Visits to K-12 Schools



Students from a local school participate in experiments from the Fun with Carbon Dioxide kit.

Mary Louise Bellamy
CERSP K-12 Program Coordinator

Jamila Simpson and Julie Beier are NC State graduate students whose sole responsibility to CERSP is to work with pre-college (K-12) students and teach-



NC State graduate students Jamila Simpson and Julie Beier lead science demonstrations for CERSP at local schools.

ers. Since September 2003, Jamila and Julie have been visiting K-12 schools, within easy driving distance of Raleigh and Chapel Hill, North Carolina, to perform hands-on science activities with students. Two hands-on science activity kits have been developed and are available on most CERSP campuses. The kits, "Fun with Polymers!" and "Fun with Carbon Dioxide!" include activities that are easy and safe, such as "Oobleck," "Silly Putty," and "Dancing Spaghetti."

Students in the schools have really enjoyed working with Julie and Jamila. Here are some of the things they have told us: "Thank you for teaching us about carbon dioxide and liquids and solids. It was

fun."

"It was cool learning what carbon dioxide was."

"I learned a lot of things about science...when I got home I couldn't wait to tell my mom and dad and my big sister."

"I loved all the experiments."

"I didn't like when it was over."

"That was the best time in my whole life."

"I liked the Oobleck because...we got to make a mess."

"I learned dry ice is very cold."

"Science is fun!"

These educational outreach opportunities for elementary, middle, and high school (K-12) teachers and students in North Carolina and Texas are made possible through the pre-college program of CERSP. Our outreach activities include hands-on science classes for K-12 students, workshops for teachers, and the development of new curriculum materials and classroom science kits.

The K-12 outreach activities from CERSP endeavor to help K-12 students and teachers become more knowledgeable about science and engineering and to show how these fields contribute to a cleaner environment. The outreach activities involve CERSP scientists in K-12 education (1) to recruit future scientists and engineers, and (2) to enhance K-12 education. So far, over 80 CERSP faculty members, students, postdocs, and research assistants have participated in K-12 outreach. More than 4000 K-12 teachers and 480,000 K-12 students have been reached through CERSP educational outreach in North Carolina and Texas.

For more information about the CERSP K-12 program, visit our web sites, www.nsfstc.unc.edu or www.science-house.org/CO2/. To learn more about the CERSP K-12 Outreach Program and how you can get involved, contact Dr. Mary Louise Bellamy, CERSP K-12 Outreach Coordinator, mlbellam@unity.ncsu.edu.

Dr. Geoffrey Bothun to Coordinate CERSP Undergraduate Research at NCA&T

by Everett Baucom
CERSP Deputy Director

In the latest CERSP Newsletter, a plan was outlined to hire a post-doctoral associate to coordinate CERSP undergraduate research at NCA&T State University. That plan is being implemented. Following a national search, Dr. Geoffrey Bothun, a recent PhD from Prof. Barbara Knudson's group at the University of Kentucky, will join CERSP in May 2004 for a planned 24-month appointment. Geoff's background includes several aspects of research involving supercritical CO₂, most notably membrane separations. Geoff's position in

the STC will be as a non-classical post-doctoral fellow at NC A&T. In this position, he will help initiate three specific program elements of critical importance to CERSP. Firstly, Bothun will implement a multi-year program aimed at enhancing undergraduate education and increasing the number of underrepresented students (specifically NCA&T students) entering graduate school. Secondly, he will evaluate needs of CERSP researchers for fundamental data and to design and implement undergraduate research projects at NCA&T to address these key needs. Lastly, Bothun will develop and jointly execute a research program with

Professors Shamsuddin Ilias and Vinayak Kabadi of NCA&T and Professor William Koros of Georgia Tech in the area of membrane separations involving CO₂.

These three program elements are fully integrated with one another as well as being integrated into CERSP and NCA&T programs. For example, a key part of the mentoring and recruiting program is to give undergraduates meaningful research projects (and provide scholarships to support them) as a means of exciting them about science. Those projects will derive from an analysis of CERSP basic data needs. One area re

see Bothun onpage 11

Enabling Tomorrow's Nanoscale Devices

by Carlton Osburn

Director

Triangle National Lithography Center

In basic optical lithography, light shines through a patterned mask (Chrome on glass), exposing a photosensitive polymer (photoresist), which is subsequently developed to leave either a positive or a negative image of the mask pattern. Since diffraction of light limits resolution, the most advanced lithography tools employ very short wavelength light (193 nm) and high numerical aperture optics to project, and reduce, images on wafers.

The ASML 550/950B system, pictured here, uses an ArF excimer laser as a light source and CaF optical elements (since quartz is not sufficiently transparent at this wavelength) to produce images that are only about 100 nm in size. To reduce the overall size of the projection lens, a narrow arc of light is scanned across the exposure field, and the process is repeated as fields are stepped across the wafer. To increase photon sensitivity, chemically amplified resists are employed, where photo acids created by light exposure catalyze additional reactions during post exposure bake of the resist.

Because the photo acid concentration is critical, exposure of wafers to trace amines in the cleanroom must be avoided, and the scanner is equipped with special air filters which reduce background amine levels to the part-per-billion level. State of the art semiconductor chips require 20-30 different levels of lithography; each of these levels must be precisely aligned to the others. The ASML 550.950B offers two methods for alignment, depending on the underlying substrate and alignment requirements: one method involves through the lens alignment with sensors located along the optical path length; the other system senses high-order diffraction pat-



The ASML 550/950B scanner is demonstrated during a recent tour of the facilities (above). Staff members utilize the hoods in the clean room facilities of the TNLC (below).

terns obtained from off axis illumination using red and green lasers.

The scanner is currently being used to evaluate and optimize resist processes. Potential users are making plans now so that substrates and reticles will be avail-

able when needed. Please contact Dr. Carlton Osburn or Joan Osullivan for information about using the scanner at osburn@eos.ncsu.edu and jno@eos.ncsu.edu respectively.

Enriched Through Mentoring

by Ginger Denison,
UNC-Chapel Hill

Having role models and guidance can help students become successful leaders in any field. Studies have shown that mentoring relationships are valuable for those involved, enhancing career success and providing support to future scientists. At some point, you may have considered being a mentor but dismissed it, thinking it wasn't worth the time and energy. I believe that you should reconsider it, because in my experience, the commitment I've given to a professional relationship has returned in the form of personal development and job satisfaction.

In general, a mentor is someone who has personal and professional experiences that they are willing to share with someone having less experience. It involves giving insight, developing counseling skills, and generally broadening the perspective of the mentee. While the primary objective of the relationship is to provide support and direction for the mentee, the mentor also gains considerable experience:

Personal Development: Working with a younger student has helped me to develop effective communication, listening skills, and organization. I've learned methods, through trial and error, to convey my ideas and concerns in a manner that is easy to understand and encourages my student to develop their own line of reasoning. Mentoring has allowed me to improve my coaching and leadership skills by working with people from different backgrounds, which is a valuable skill considering the diverse workplace today. I have been motivated to work harder in order to be an effective role model, and I've become more organized and focused on my project. I also believe that I have created a strong network with a new professional that may be useful in the future.

Fresh Perspectives: Students interested in being mentored are motivated to contribute to research. The questions they ask have caused me to think critically about my work in order to explain my methods, and identify areas that need improvement. Additionally, bringing

other people into my project has added new perspectives. I've found that all of my student's past experiences are different, and thus they've contributed many new creative ideas.

Personal Satisfaction: As a mentor, I have been rewarded by knowing I am making a difference in someone's life. I think a mentor's personal and professional expertise is valuable as they teach others to self-reflect on their own life choices and create a well-balanced lifestyle. I think that students I've worked

with have really gotten into their projects and gained satisfaction by understanding the concepts and obtaining useful results. I also hope that they've learned that involvement in activities outside of lab is equally important.

Mentoring is a very satisfying personal experience as well as making you more attractive for new hires and promotions. However, mentoring is not a decision to be taken lightly; it does involve time and dedication. But for those who choose this endeavor, the rewards are countless.



Ginger Denison is a third year analytical graduate student advised by Professor Joseph M. DeSimone. Her research interest is copper surface analysis and slurry development for a carbon dioxide based chemical mechanical planarization. Above, Ginger demonstrates a new technique to Renee Smith and Aaryn Jones.



Kenan Center Consortium Focuses on Microelectronics

by Everett Baucom
CERSP Deputy Director

A new joint R&D program is being established at NC State and UNC-CH, called the "Consortium for Integrated CO₂ Technologies in Microelectronics" (CICTIM). CICTIM is being launched in partnership with the NSF Science & Technology Center for Environmentally Responsible Solvents and Processes (<http://www.nsfstc.unc.edu>). This new industrial consortium will have the requisite membership to give advice, counsel, input, and in-kind support to allow the CO₂ platform to move forward in the microelectronics industry. Membership is being sought from all key sectors of the microelectronics industry, including:

- End users
- Original Equipment Manufacturers (OEMs)
- Chemical suppliers
- Industrial gas suppliers
- CO₂ technology providers

CICTIM seeks to become the largest, most comprehensive, university-based research program in the world for the emerging dry CO₂-based technology platform. Membership will allow participating companies to stay abreast of this fast

moving field in a cost effective manner. In addition, participants will have access to important new IP and know-how that emerges, access to state-of-the-art equipment in this field, and the opportunity to guide and influence the direction of the research program. There are also opportunities for technical sabbaticals at our facilities and access to university faculty involved in Consortium projects.

Membership fees are heavily leveraged by the \$36 million investment by NSF in our CO₂-based Science and Technology Center. This STC is funded through 2009. In addition, members will have preferred access and preferred rates to use our new ASML 193nm 5500 950B scanner, with 0.63 numerical aperture (<http://www.tnnc.ncsu.edu>). This stepper and the associated CO₂-based lithography track modules constitute the newest additions to our extensive suite of CO₂-based equipment and processes which include:

- Cleaning chambers and chemistries
- Etchant chambers and chemistries
- Interfaced analytical measurement tools including *in situ* ellipsometry, quartz crystal microbalance, x-

ray/light scattering/reflectometry, NMR, UV/VIS spectroscopy, FTIR, etc

- Spin coating and development chambers
- CMP prototype tool (under development)
- Metal deposition/removal chemistries.

More information will be provided about the new CICTIM program at the next Kenan Center Meeting to be held April 14-15, 2004. At this time the agenda is tentative, but should include tours of the facilities beginning at 3:00 PM on Wednesday. A relaxed social event will follow the tours starting at 6:00 PM at the Carolina Club at UNC-Chapel Hill. Research Review by students and an introduction meeting for potential new Kenan Center Members will be held during the April 15th sessions from 8:00 a.m. - 4:00 p.m. The Dogwood Rooms A&B at the Friday Center have been reserved to host the Thursday sessions.

Please feel free to contact Dr. Joseph M. DeSimone or Dr. Ruben G. Carbonell about any questions pertaining to the new microelectronics focus of the Kenan Center or the April Meeting.

ABC's of Laboratory Safety Emphasized for the Center

by Everett Baucom
CERSP Deputy Director

One of the most important aspects of any research organization is safety. Although we have an excellent safety record to date, our STC has embarked upon a rededication to safety. In order to minimize the probability of any safety disaster accident developing, we have moved to improve safety in all of our operations.

A key step was to install safety guidelines prominently on the homepage of our website. (See www.nsfstc.unc.edu >Lab Safety.) Information on the website includes emergency numbers for each

site, links to useful safety information such as MSDS, our own guidelines and a tutorial from Lawrence Livermore on high pressure operations, etc. The attached figure shows a poster for use in the labs reminding students of the ABCs of high-pressure safety. Links on the

website give details. Recently, a video was made by CERSP starring Pamela Visintin as she demonstrated the safe operation of high-pressure cells in the laboratory. This video is also available on our website. We have begun what will be a

continuing process to review our laboratory manuals to assure that they are up-to-date and reflect recent procedures and chemical hazards.



A Personality Profile Test That's Useful



Mary Kate Boggiano is a fourth year organic graduate student. Her research interests are in the design of carbon dioxide based photoresist materials.

by Mary Kate Boggiano
UNC-Chapel Hill

I hate surveys. I hate social scientists who distribute surveys in an effort to categorize me according to my personality. This is the attitude I had coming into Russ Osmond's collaboration seminar last October. He started on a bad foot by giving us personality surveys before we even met with him. However, I was surprised by the complete change in my perspective during his seminar. Unlike the

well-known Briggs-Meyers test, the Hermann Brain Dominance model that Russ uses does not classify a person's personality as "either/or" (e.g., introvert or extrovert). Rather, a personality is described on a continuum. For example, I could be weak in organizational thinking, but that doesn't mean that I can't think that way. Similarly, if I'm strong in creative thinking, I do tend to think that way. The organization of the model does not pigeon hole a person into a certain classification. Instead,

it non-judgmentally recognizes a person's strengths and weaknesses.

During the presentation, it was apparent how Russ used the four quadrants of the Hermann Model to facilitate communication to his audience. Using a diversity of activities, Russ' "yellow dominance" (conceptual, creative), was apparent in the flow of his talk, how he frequently referred back to topics previously covered, in order to convey why the model is relevant. He covered the "blue

quadrant" (analytical, logical) by telling the audience specifically what we would learn from the seminar. The green quadrant (organization, planning) seemed to be weaker in the seminar, but Russ covered this by making lists and moderating discussion. The red quadrant (feelings, interpersonal) was presented as we worked in groups, and Russ encouraged candid discussion.

Russ Osmond's collaboration seminar made me aware of what I can learn about myself and how I can more effectively communicate with others. The information provided in the seminar was valuable both for personal development and collaborative development, whether in the NSF-STC ERSP, or in other environments.

Comments from the Editor: CERSP's strategy with the Communications and Collaboration workshop is to enhance students' education while providing tools that promote productive researchers while in the Center. This workshop is part of the Personal Development Program for Center students.

Undergraduates and their Mentors (clockwise). Five undergraduates participated in research activities under the guidance of their mentors during the Summer of 2003. Ijoema Amen and Darlene Taylor analyze data collected on the ReactIR. David Snead continues his research project during the academic year.



Photos by Marcus Donie



NCSU and UNC Open Doors to Triangle National Lithography Center



Joseph DeSimone, Ruben Carbonell, Chancellor James Moeser, Chancellor Marye Anne Fox, Robert McMahan, Russ Lea, and Rich Rogoff participated in the ribbon cutting ceremony.

by Darlene Taylor
Editor

Carolina blue and NC State red balloons decorated sign posts across Centennial campus on January 20. Their purpose was to guide visitors to a ribbon cutting ceremony, but symbolically they denoted a collaboration of unprecedented scale. On this occasion, The University of North Carolina at Chapel Hill and NC State University officially opened the doors to the Triangle National Lithography Center (TNLC). Leaders from the two universities, the University of North Carolina system, industry and government gathered to tour the new facility and view its high-tech gem – an ASML 193-nanometer lithography scanner. The event began at 2:00 PM and included remarks from Professor Joseph M. DeSimone, William R. Kenan Jr. Distinguished Professor of Chemistry and Chemical Engineering at UNC-Chapel Hill and NC-State; Dr. Russ Lea, Vice President for Research and Sponsored Programs of The University of North Carolina Office of the President; NC State's Chancellor Marye Anne Fox; UNC-Chapel Hill's Chancellor James Moeser; and Dr. Robert McMahan, Senior Advisor to the Governor for Science and Technology and Executive Director of the NC Board of Science and Tech-

nology.

The TNLC is a multi-user center that will provide academic and industrial researchers from the Triangle and around the world a state-of-the-art facility to fabricate nanoscale structures using optical lithography. The facility is expected to further the understanding of matter and processes at the nanometer length scale with unmatched capabilities to advance nanofabrication equipment and expertise. It is believed that no other institute of higher education has such a state-of-the-art tool for nanofabrication. "... right now, we are leading the Nation in our capabilities to fabricate nanoscale devices with optical lithography. . . we have surpassed the capabilities of Cornell, MIT, and Stanford . . .," says DeSimone in his opening remarks at the ribbon cutting ceremony.

"The theme 'Exploring, Collaborating, Educating, Leading. For Tomorrow's Nanoscale Devices' is an appropriate one for this new Triangle National Lithography Center and a wonderful example of the quality of our faculty and the combined strength of the universities in the greater University of North Carolina system," comments Lea.

Gaining experience with the stepper will give students a big advantage in the nanotechnology workforce. In addition,

it will provide local industrial partners the infrastructure necessary to compete on the international stage in advanced applications in microelectronics, lab-on-a-chip and the nanoscale technology. The TNLC is an affiliate of the National Nanofabrication Infrastructure Network (NNIN). NC State's Chancellor Marye Anne Fox commented, "As we open the doors to this new, world-class center, we open a new era in nanotechnology research in North Carolina."

The ASML 193 nm scanner has a market value of about \$12 million. NC State and UNC-Chapel Hill jointly invested about \$4 million in purchase and start-up costs. ASML essentially gifted to the Center the cost differential. As an outgrowth of the NSF Science and Technology CERSP, the stepper will also be used to support research in environmentally safe lithography, polymers and polymer processing as part of the "Dry Fab of the Future" research program. That program works to develop sustainable, "dry" manufacturing methods based on the carbon dioxide technology platform. UNC-Chapel Hill Chancellor James Moeser commented, "This innovative center shows just how powerful the partnerships between two great research universities can be on behalf of the people of North Carolina. The cutting-edge approach both campuses are taking with the center will help address practical environmental and economic issues facing our state and nation." "The opening of this facility is an important milestone for the nanotechnology research community and the state," said McMahan.

After an approximately 20 minute program in the auditorium of the Engineering Graduate Research Center (EGRC) on NC State's Centennial Campus, visitors were given an opportunity to tour the facilities. Light refreshments were served in EGRC Room 215. At the refreshment station, attendees were able to view a slide show of the stepper delivery and installation. In addition, a video tape supplied by ASML provided details of the scanner in operation.

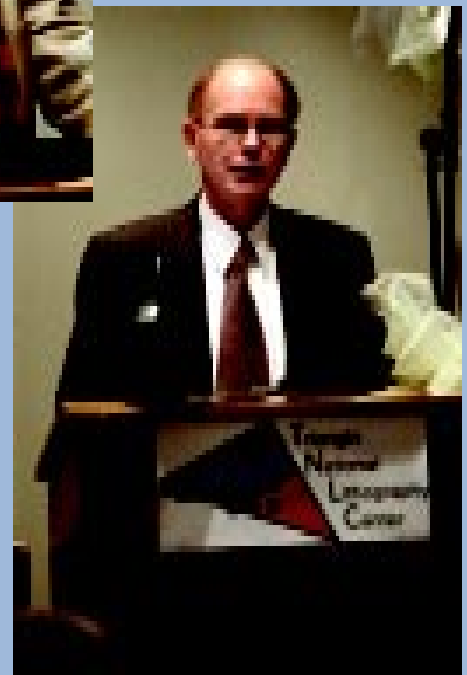


“As we open the doors to this new, world-class center, we open a new era in nanotechnology research in North Carolina.”

Chancellor Marye Anne Fox
NC State University

“The opening of this facility is an important milestone for the nanotechnology research community and the state”

Robert McMahan
Senior Science & Technology Advisor to the Governor



“... right now ... we have surpassed the capabilities of Cornell, MIT, and Stanford ...”

Joseph DeSimone
Director NSF S&T CERSP

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Chancellor James Moeser
UNC-Chapel Hill

