

CERSP News

The Newsletter of the NSF Science and Technology
Center for Environmentally Responsible Solvents and Processes

August 2002

<http://www.nsfstc.unc.edu>

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

Research Notebook: A Highlight of Accomplishments

As a result of our strategic plan developed last year, thrust areas were reorganized into three “implementation domains”, including (1) Macromolecular Synthesis and Engineering; (2) Dissolution and Deposition; and (3) Small Molecule Systems. An overview of some research accomplishments is given below.

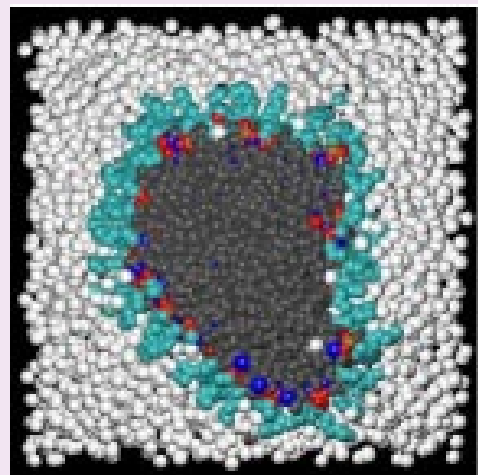
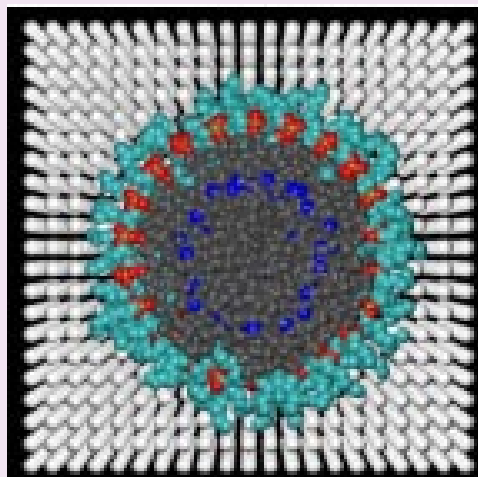
We prepared the following novel structures with significant potential applications:

- Cross-linked, CO₂-swellable resins have been identified as potential components for chemical mechanical planarization (CMP) for dry manufacturing of electronic components.
- Renewable CO₂-philic carbohydrate-based surfactants have been prepared with potential applications in separations, nanoparticle preparation and stabilization, pharmaceuticals, and viscosity enhancers.
- Micro and nanoporous thin films of multicomponent polymer systems were prepared containing either inorganic nanofiller or polymeric surfactant capable of self-organization.
- Nanocrystals were developed which exhibit unique size-dependent properties for potential use in medical, electronic, sensing and other applications.
- Hydrocarbon surfactant tails were identified to help facilitate microemulsions of H₂O and CO₂.

A 10-fold improvement in sensitivity of NMR measurements in CO₂ was achieved by utilizing a unique cell design, contributing directly to dynamic measurements of micelles and other micro- and nanostructures.

Taken with NMR and SANS data, a computational model describing the shape and dynamics of reverse micelles provides significant insight into their structure.

Sorption of CO₂ into PVDF was measured and modeled. Correcting to account for crystallinity, this model agreed quite well with literature data.



Snapshots of molecular dynamics simulations showing the cross section of a system containing water, supercritical CO₂ and double chain fluorosurfactant molecules at times 0 ns (top) and 4 ns (bottom).

(Senapati, S.; Keiper, J. S.; DeSimone, J. M.; Wignall, G. D.; Melnichenko, Y. B.; Frielinghaus, H.; Berkowitz, M. L.; *Langmuir*, **2002**, *18*(20), 7371-7376.)

Joseph M. DeSimone Director
Ruben Carbonell Co-Director
Everett Baucom Deputy Director

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.

Darlene K. Taylor Newsletter Editor,
R.I.C.H.E.S. Leader

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	Nomacorc
Air Products	Oak Ridge National Lab
Atofina	Praxair
Daikin	Rohm & Haas
DuPont	Sandia National Labs
MICELL Technologies	Solvay
Michelin	Thar Design
Mitsubishi	Troxler
Nalco	UHDE



Website: ww2.ncsu.edu/champagne



In keeping with our vision to enable a revolution in green chemistry through cutting-edge physical science/engineering, social science and education programs, CERSP is once again changing components and emphasis of its organization. We would like to welcome several new principal investigators to CERSP. Professor Marcey Waters comes to UNC-CH following a NIH Postdoctoral Fellow at Columbia University. Her role in CERSP will concentrate on determining the effect of supercritical CO₂ on the thermodynamics of folding of β -hairpin peptides. Professor Sheyko joins the faculty at UNC-CH following his doctoral work at the Institute of Chemical Physics of the Russian Academy of Sciences and his Postdoctoral Fellowship at the University of Twente, The Netherlands. He will focus on investigating the structure and properties of CO₂-born polymer films using atomic force microscopy. Professor Orlin Velev joined the faculty at NCSU after his Post-doctoral appointment at the University of Delaware in 1998. Prior to that, Professor Velev received his Masters and doctorate degrees from the University of Sofia, Bulgaria in 1989 and 1996 respectively. His research interests within the CERSP will focus on investigating the potential of liquid CO₂ as a medium for the assembly of colloidal crystals and related nanostructured and photonic materials. Professor Brian Korgel is another new PI in CERSP who joined the faculty at UT-Austin after his post-doctoral appointment at the University College Dublin (1997-1998). He received his doctoral degree from the University of California at Los Angeles (1997). Within CERSP, Professor Korgel will investigate silver and gold nanoparticles sterically stabi-

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Scott Wallen Makes Sugar Dissolve in CO₂

by Ginger Denison and Mick Hurrey



Background:
B.S. Chemistry, 1988
University of Illinois at Urbana-Champaign

Ph.D. Chemistry, 1994
University of Illinois at Urbana-Champaign

Postdoctoral fellow, 1994-1997
Pacific Northwest National Laboratory

Dr. Scott Wallen has built a strong research program at UNC-CH, components of which he has lead as a principal investigator within the CERSP. Within CERSP, Dr. Wallen has also led efforts to track shared instrumentation equipment.

Scott Wallen started off his undergraduate career as a mathematician. However, as his math classes moved more towards abstract theory, he began reassessing his career goals; he knew he didn't want to remain an employee of UPS, where he worked as a loader during college. Dr. Wallen found his niche in chemistry at Illinois and went on to complete his Ph.D. in 1994. His

success as an analytical chemistry professor at UNC shows he made a wise decision.

For Dr. Wallen, going into academia was never a question. Even during his post doc appointment at Pacific Northwest National Laboratory, he taught chemistry classes at a community college. He accepted a job offer in 1997 from the analytical division of the UNC chemistry department, currently ranked first in the nation. Being a good advisor is very important to him; his favorite part of being a professor is watching his students develop as scientists, creating their own solutions to problems rather

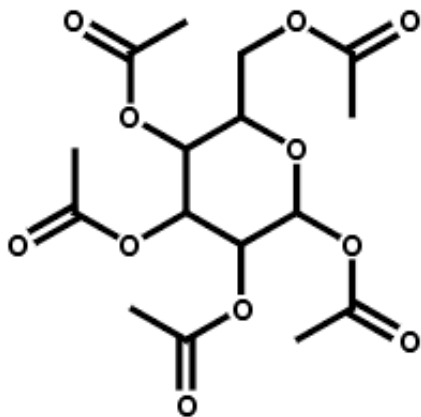
than just reading methods. His group presently consists of two post docs, six graduate students and three undergraduate researchers. Dr. Wallen also teaches the introductory analytical chemistry class at UNC.

In the last few years, Dr. Wallen's research has focused on supercritical fluid interactions and macromolecular structure and stability at high temperature and pressure. His group utilizes molecular spectroscopy, primarily Raman and NMR, to study these systems.

Recent work in the laboratory of Scott Wallen at UNC-CH by postdoctoral associate Raveendran Poovathinthodiyil has resulted in the development of the first renewable CO₂-philic molecules based on carbohydrates. These novel systems have the highest reported solubility of a nonvolatile solid in CO₂. An important aspect of this work is the discovery of a cooperative C-H...O interaction as a stabilizing force in the solvation of these materials by CO₂. The work has been extended toward the design of functional CO₂ soluble amphiphiles for applications ranging from CO₂ viscosity enhancement to use in products consumed by humans since the materials are nontoxic. The fact that these materials are renewable and derived from agricultural sources presents opportunities for truly sustainable solvent systems in CO₂ applications. The carbohydrate, β -1, 2, 3, 4, 6-pentaacetyl D-glucose (glucose pentaacetate), has a melting point of 132°C under ambient pressure conditions, however, it undergoes deliquescence (solid-to-liquid transition) at 23.0°C in contact with 56 bar of CO₂. This molecule and other carbohydrate analogs form the basis for a new class of renewable, CO-philic systems for use in CO₂ solvents. The work was recently reported in *J. Am. Chem. Soc.*, ASAP and highlighted in *Science*.

Until recently, the ability to study an interface was limited to systems in UHV environments because interfacial measurements at ambient conditions were complicated by

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large contributions due to the bulk. With the advent of sum frequency generation vibrational spectroscopy (SFG), any interface of two bulk centrosymmetric media can be probed providing conformational, orientational, and vibrational information that is truly interface specific. The recent acquisition of an EKSPLA SFG system allows CERSP researchers to examine interfaces in CO₂ environments *in situ*. Studies are currently focused on the interfaces of CO₂ processed systems under ambient conditions while a specialized high-pressure cell is un-

der development.

Dr. Wallen is strongly devoted to chemistry; the website he visits most often is the ACS journals. When he's not working with his students, Dr. Wallen can be found at home playing with his two daughters Abbey and Ramey, ages 12 and 8. He says the hardest part of being a young professor is not having enough time to spend with his family.

Given the choice to be any per-

son in the world, Dr. Wallen selected P.W. Bridgeman, a famous scientist who performed high pressure experiments in the early 1900's and received the Nobel Prize for Physics in 1946. Dr. Bridgeman is also well known for his strong opinions regarding the scientific method, which can apply to us all as scientists: "The scientific method, so far as it is a method, is nothing more than doing one's damndest with one's mind, no holds barred."



A group of students from around the world attending YES2000 conference in Switzerland. Karen Kennedy (fourth person from the left seated on second row) was awarded \$1,000 USD to represent CERSP at this conference.



Bellamy and Haase Lead Efforts to Reach K-12 Teachers and Students



Joseph DeSimone at the Green Chemistry Student Research program.

In the past year, the Center carried out a coordinated K-12 education outreach program. Through teacher workshops and student presentations, this program directly reached 576 teachers and 1358 students in North Carolina and Texas. Through distribution of exemplary learning materials, this program indirectly reached an estimated additional 1800 teachers and 234,000 students in these states through July 2002. Through the end of fiscal 2002 some 4000 teachers and 500,000 students will have been directly or indirectly reached since program inception. Among the exemplary learning materials being distributed is a new Environmental Science laboratory book for middle school grades, aligned with the North Carolina and Texas state science curricula. Center faculty and staff participated in numerous teacher and

student programs. Through the distribution of educational materials, teacher training programs and an educational web site, the Center K-12 outreach is achieving national visibility. The Center has partnered with several other education organizations to increase its reach and, especially, to increase access to students from underrepresented groups.

A middle school laboratory manual was prepared and published in the fall of 2001. This laboratory manual serves as a supplement to the high school manual, published in December 2000. In addition, a series of workshops based on the high school lab manual is being implemented for high school environmental science teachers in North Carolina and Texas. Each workshop participant receives a free copy of the lab manual.

A web page has been developed that is devoted exclusively to the Center's K-12 outreach activities. All Center-related teacher workshops, educational publications, and other educational initiatives are being advertised on this web page. This page includes links to various carbon dioxide related educational materials, and teachers can easily access activities that use CO₂ in the classroom. Correlations are being made with these CO₂ activities and National Science Education Standards, North Carolina Science Education Standards, and Texas Science Education Standards. These correlations have been placed on the web site; they make the activities more useful for teachers across the country, as well as those in North Carolina and Texas. Terrell Russell, a Center graduate student, worked with Science House staff to design and construct an innovative, interactive database of K-12 outreach programs from NC State University. Through web access, any K-12 outreach program on the campus may register its teacher training or student programs or learning materials on the database. Any teacher, student or parent can query the database to find K-12 resources appropriate to time, grade level and subject area. The database has been publicized widely to the NC State and external communities.

— Mary Louise Bellamy

Students Recognized for Outreach Activities

Faculty and students affiliated with CERSP are very active in K-12 outreach activities. After a unanimous decision from the management team, the Director of CERSP presented three awards in honor of those students who have been particularly active in outreach while maintaining competitive and successful research activities. Karen

Kennedy received the YES2002 Fellowship Award accompanied with \$1,000.00 USD that allowed her to attend the Youth Environmental Summit Conference in Braunwald/Switzerland. The YES Conference is organized by The Alliance of Global Sustainability consisting of research teams from 4 of the world's foremost research universities including the Swiss Federal Institute of Technology Zurich – ETH, the Massachusetts Institute of Technol-

ogy, the University of Tokyo, and Chalmers University of Technology. Youth from all over the world come together to study large-scale, multidisciplinary environmental problems that are faced by the world's ecosystems, economies, and societies. Kennedy attended the conference from August 17 - August 31, 2002. Devin Flowers and Shilpa Damle were also presented certificates for their outreach activities.

— Darlene K. Taylor

Videoconferenced Innovation Seminars

What's the big deal about the innovation process? Apparently, quite a bit and Professor Denis Gray hopes to drive this point home to CERSP affiliates by exposing them to a series of lectures on the innovation process given by social scientists, management scientists, and industrial representatives. Interest in this topic is growing among corporate, governmental, educational and other sectors partly because of the realization that modern societies rely on their ability to innovate, including their ability to create, deploy, implement, and anticipate and/or control new technologies. Technology is one of the key elements in defining a society or civilization and it has significant effect on our ability to meet many of the challenges confronting modern society (e.g., global competition; flat or shrinking resource bases; a variety of social and environmental problems; demands for increased productivity and effectiveness).

With this in mind, Professor Gray has lead efforts to design an innovation seminar series that will pro-

vide students, faculty and industrial participants involved in the CERSP with an understanding of how the innovation process works, highlight aspects of the innovation process that are relevant to their experience, and stimulate interest in and discussion about innovation and its management. The seminar series, jointly sponsored and coordinated by CERSP, Center for Innovation Management Studies (CIMS) and the Kenan Institute for Engineering, Technology and Science, began in August 2001, with Professor Denis Gray providing an overview lecture/discussion of the innovation process for non-social scientists. The series continued in February 2002, with Dr. Paul Anastas, advisor with the White House Office of Science and Technology Policy, who presented a lecture on "Green Chemistry: A View from the White House Office of Science & Technology Policy". Dr. Louis Tornatzky, Senior Scholar at the Tomas Rivera Policy Institute, lectured on June 6, presenting a synopsis of the book he co-authored with Denis Gray, "Innovation U: New

University Roles in a Knowledge Economy". On July 18, Dr. Irwin Feller, Director of the Institute of Policy Research and Evaluation at Penn State University, spoke on the topic "Performance Criteria for Basic Research." The series will continue through the Fall of 2003 involving four more guest lecturers and one final overview presentation from Prof. Gray. A total of eight lectures will be given during the seminar series and continue thereafter on an annual basis.

Each seminar is delivered from a teleconferencing classroom at one of the participating universities and broadcast to classrooms at the other institutions. They are also available in streaming format over the Internet for Kenan Center industrial sponsors and academic partners around the world. Presentations last for about one hour with time allotted afterwards for questions and discussion. Time is also scheduled before or after for refreshments and mingling at the delivery site. Seminars are videotaped for those who cannot attend and for future use.

— Darlene K. Taylor

Conference Room Inhibits Collaboration

Previous research into innovation processes indicates that various factors – i.e. research groups, organizational context, etc. – affect innovation. Among these, increased access to information resources is identified as a major facilitator. Communication of information through face-to-face interaction is underlined as a vital information resource that

significantly facilitates innovation.

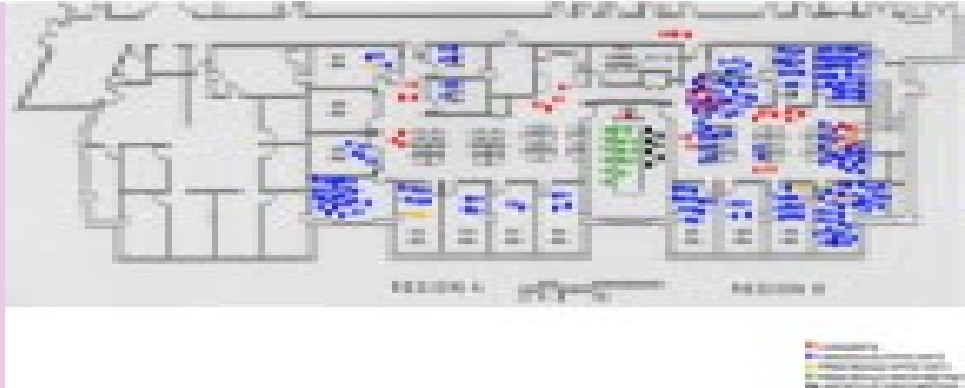
Previous research in architecture indicates that space (i.e. spatial organization, plan layout), as a framework for human encounters can significantly influence face-to-face interactions. Therefore, space exists as an important precursor of innovation, via its effects on interaction behavior. However, although innovation processes have been studied extensively in social sciences, the potential influences of space on in-

novation processes have not been studied.

A pilot study within the CERSP was focused on understanding innovation process relationships in basic science and research settings. The findings indicate that factors such as centrality, visibility, as well as perceived quality of spaces significantly affect interaction behavior, such as coincidental interactions or unscheduled office visits among researchers.

— Umut Toker

A centrally located conference room causes the formation of two "regions", and influences the number of trips from each "region" to the other for unscheduled office visits and coincidental interactions.



Videoconferencing Capabilities Maximize Collaboration



Student presenters at a small group meeting (top). Clarence Murray answers questions from a remote CERSP scientist at large group meeting (bottom).

W eekly interactive videoconference sessions are common practice for students and faculty associated with CERSP. During the videoconferences, students present and discuss their research with others across distances using state-of-the-art technology, e.g., electronic whiteboards, very large screen displays and advanced audio systems. In addition, students and faculty from each university have the opportunity to ask questions and make suggestions. Although most videoconferences focus on student work, several have been organizational in nature, discussing the vision, goals and management within the center. In addition, specific topics, such as safe laboratory practices, are covered as appropriate.

Students have been involved, through these videoconferences, in the strategic planning process of the Center. Participating in these exercises in research planning offers an unusual educational experience for the students. Student leaders now manage each videoconference session, e.g., arranging for student presentations, introducing each presenter and handling the Q&A period. The videoconference seminars have been listed as a graduate course for credit in the curriculum at NCSU, UNC-CH and UT-A.

In addition to weekly large group videoconference meetings, a number of students at UNC and NCSU gather weekly for a more focused and in-depth discussion of their research. The weekly small group meetings are facilitated by a 42" plasma screen. These screens are also utilized for management meetings and small collaborative meetings. We anticipate that this use will expand to include wider collaboration with other groups.

— Darlene K. Taylor

reaching industry

Snapshots of the March and September 2002 Technical Review Meetings

The Fall 2001 KCUCDM meeting (scheduled for September 18th) was cancelled due to the events of September 11th. Students and post-doctoral associates presented 53 posters at the KCUCDM meeting held March 25, 2002. Approximately 23 representatives from fourteen companies attended the meeting. In addition, CD-ROMs containing the posters were distributed. Kenan Center members were encouraged to fill out a feedback questionnaire. KCUCDM members expressed strong interest in areas of CERSP focus, whereas in last year's survey, members expressed lukewarm support for several key CERSP areas. This change of priorities indicates that CERSP has had significant influence in shaping industry thinking and confirms the direction in which the CERSP plans to move. In addition, we received a number of suggestions concerning ways in which we can better communicate results and increase our usefulness. We will include these suggestions in our plans.

Our most recent Kenan Center meeting held on September 16, 2002 featured 66 posters and six oral presentations by students and postdoctoral fellows. We took the recommendation made by our corporate sponsors on the their response to the questionnaire and extended the hours of the poster session. Approximately 19 representatives from ten companies attended the meeting. As usual, CD-ROMS containing the meeting proceedings were distributed.

— Darlene K. Taylor



Poster session at the September 2002 Kenan Center Technical Review Meeting.



Kenan Center Members Respond to Questionnaire

Interest in polymers remains very high among respondents to the questionnaire distributed at the March 2002 KCUCDM meeting. Among current polymerization studies, fundamental studies are most favored although there is some interest in doing work in the area of equipment design. Two applications stand out as being strongly favored above all others: microelectronics and coatings. In addition, we are encouraged by some to seek new opportunities in nano- and biotechnology.

Areas of most interest include: 1) photoresist/microelectronics materials (24), 2) polymer fundamentals (16), and 3) encapsulation and coatings (9). The numbers in parentheses show the number of "votes". Of 72 possible responses (3 areas x 2 centers x 12 respondents) there were 55 responses. All other areas combined received only six votes. Responses regarding both Kenan Center and STC projects were combined in several related categories.

This is a significant change from last year when microelectronic materials was rated sixth of nine categories. Coatings and encapsulation remain of high interest. The emergence of fundamental studies,

led by phase equilibria/behavior, suggests a shift in interest to more fundamental studies of polymerization from "standard" applications work.

Regarding future directions, the area of microelectronic materials is at the top, tied with several areas related to polymer processing. This is consistent with the vision that we presented last year, suggesting that our work in polymers would begin to focus on specific areas such as microelectronic materials with increasing emphasis on ways to process these new materials, such as spin coating from carbon dioxide.

A final point is in order. The results may be skewed by our selection of talks. Few of the posters not covered in the morning presentations were listed as being of highest interest.

Suggestions for improving quality/relevance of the Kenan Center are varied. Several comments appear to suggest that we need to work on communicating the "big picture". These improvements may also help to assure renewal. We clearly need to provide members with more "ammunition" of the sort handed out in the business session; e.g., a "communication document" showing tan-

gible benefits. All comments about making the STC more useful deal with improving communications as well. This will be a major focus of KCUCDM communications going forward.

Regarding ways to improve the meeting, we received positive comments about combining the two meetings. We need to find more time for both presentations and posters. Next time we will consider having the EAB session on the second day and spend a whole day communicating technical programs to Kenan Center members. The Thrust Area leaders could summarize key efforts in their areas with a few (3?) speakers from each area reported on completed projects. These comments by Area leaders might touch on "tangible benefits" and other relevant points. A Tuesday-Wednesday format was also suggested to avoid weekend travel. More time is needed for the poster session, which was impressive and well organized but too short.

A detailed analysis of feedback from the questionnaire was mailed to KCUCDM members. Many thanks to all who participated! Your feedback is valued and useful.

— Ev Baucom



Poster Session at the March 2002 Kenan Center Technical Review Meeting.



2002 MPS Fellows: Laura Berube, Samuel Wheeler, Pat Ligon, and Deborah Massengill(l-r).

communities

MPS Fellows Working with “Carbon Dioxide in Nature and Technology”

by Darlene K. Taylor

The Math and Physical Sciences-Internship in Public Science Education (MPS-IPSE) program began this summer the first of a three-year program for K-12 teachers. The program is a joint effort of the Kenan Institute for Engineering, Technology & Science at NC State University, CERSP, and the North Carolina Museum of Natural Sciences. MPS

Fellows selected from North Carolina’s brightest and most committed teachers will collaborate with the NC Museum of Natural Sciences staff and CERSP scientists and engineers to explore new ways of describing and teaching the natural role of CO₂ in our world and its application in technology. Significant leverage is provided through the recruit-

ment efforts of the Kenan Institute. For their first summer, MPS Interns participated in a lot of orientation and professional development activities as well as visited the lab facilities of CERSP at NCSU and received presentations by CERSP K-12 Outreach Director, David Haase.

Recent Updates to CERSP Website Available at www.nsfstc.unc.edu

We continue to add features to our website that (we hope) will be useful to those in the field of carbon dioxide research, especially those interested in the Science and Technology Center. Recent additions accessible from the homepage include:

1. On-line orientation of the STC: who we are, what we plan to accomplish and how
2. Shared experimental facilities: a guided tour of facilities available for use by researchers
3. Lab safety: a web-based summary of good laboratory safety practices, especially for high pressure operations, with many useful links

4. Our continuous improvement initiative: 2002 plans to upgrade our operations
5. On-line searchable carbon dioxide patents
6. Statistical analysis of carbon dioxide patents issued through March 2002
7. Summary charts of all STC research programs in these areas: macromolecular synthesis and engineering, dissolution and deposition, and small molecule systems

In the case of our research projects, clicking on the project title brings up a detailed description of each of our 42 projects. Clicking on the professor’s name takes you to

his/her homepage with research interests and contact info.

Finally, a reminder that our weekly seminars are available over the internet to members of the KCUCDM. Contact Ev Baucom at baucome@email.unc.edu for details. Abstracts are available on our website (click Group Meetings, then presenter) beforehand so you can decide if it’s worthwhile for you to participate. We also plan to make special presentations, such as our Innovation series, available on CD-ROM and as audio downloads on our website. As always, your input on how to improve is appreciated!

— Ev Baucom

higher education students

Summer Internship programs with a Green Chemistry Research Theme

Our most effective programs to date in reaching undergraduate students from underrepresented groups are the REU program sponsored by Prof. Christine Grant at NCSU, the SPGRE program sponsored by Prof. Henry Frierson at UNC-CH, and the programs led by Prof. Kenneth Roberts and Prof. Godfrey Uzochukwu

at NCA&T. During this year 30 undergraduate students received research experiences with guidance from graduate students, post-doctoral associates and professors. This number includes 24 from a combination of this summer's programs plus students who participated in various activities during the academic year.

The REU at NCSU is devoted to environmental (or "green") science and engineering. Prof. Christine Grant, Co-Director of the NSF Green Processing Undergraduate Research Program, is also a faculty member in the CERSP. As a result, there is a very close link between the REU program and those of the CERSP. This year the NSF Green Processing Undergraduate Research Program supported 19 students, six of whom worked

on topics of direct interest to and mentored by CERSP personnel. During their time at NCSU, the 19 REU participants attended ethics seminars, graduate school preparation events and professional development seminars (including the collaboration workshop) in addition to their research experiences. They also enjoyed socials, lunches and round-table discussions as well as the beaches of North Carolina.

The SPGRE Program is con-

ducted by UNC-CH and is partially funded by NSF. It offers students throughout the country the opportunity to work on research projects under the direction of UNC-CH faculty members. The program is designed for students sincerely interested in pursuing graduate studies, preferably the Ph.D. degree.

videoconference meeting. CERSP funding has enhanced the exposure of SPGRE participants to cutting-edge environmental science themes. We believe this exposure will be captivating and in turn encourage them to pursue graduate careers. One faculty members from the CERSP participated this year.

The NCA&T intern program provides undergraduates at NCA&T opportunities for supervised engineering research in Environmentally Responsible Carbon Dioxide Processes. Interns work with a faculty researcher/engineer (mentor) during the summer months. The intern and his/her faculty mentor develop an independent project to be carried out by the intern. This research continues throughout the academic year, leading to scientific reports and presentations. Faculty mentors work with each intern to supervise and assist with research, and advise interns on careers development and graduate training options. Interns are informed, but not proselytized, regarding the value of graduate training in green processes. The internship program, it is hoped, will inspire students

to become scientists and engineers and increase participation of minority students in science and engineering research.

All the summer interns working with CERSP faculty were exposed to two innovation seminars as well as the latest technology in videoconferencing. The interns at UNC presented their final results using the 42" plasma screen videoconference equipment.

— Darlene K. Taylor



SPGRE and Project Seed students from summer of 2001 (top) and the REU Green NProcessing Interns from class of 2002 (bottom).

SPGRE is one effort to address the obvious shortage of Ph.D. recipients from underrepresented groups particularly those from African-American, Native American, Mexican American, and Puerto Rican populations. The program is 10 weeks in duration, from the last full week of May to the last week of July. Students are involved in research on a full-time basis, prepare a paper as their finished product, and present their work at an end-of-program

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lized by ligands and dispersed in supercritical carbon dioxide. Finally, I would like to welcome Professor Peter Green to the CERSP. He received his Masters and doctoral degrees from Cornell University in 1983 and 1985 respectively. Professor Green joined the team at UT-Austin after his post-doctoral appointment at Sandia National Laboratories. His research in CERSP will focus on supercritical CO₂ polymer thin film systems. Welcome to all of you.

In our effort to have a vibrant and current relationship with our industrial sponsors in the Kenan Center, we have responded to comments from a questionnaire. The Spring 2002 Kenan Center Meeting was combined with the CERSP EAB Technical Meeting and this seemed to work well for everyone. The combined meeting format is likely to be a reoccurring theme for future meetings. Other responses from the questionnaire are elaborated on in one of the feature articles for this newsletter, but in general concerns about insufficient time allotted for presen-

tations and posters will be addressed in future meetings.

We welcome the Georgia Institute of Technology as the fifth academic member of the CERSP. The move of Professor Bill Koros from UT-Austin to Georgia Tech initiated the inclusion of this institution in the Center and we anticipate other new collaborations at Georgia Tech.

In closing, I would like to thank everyone for their enthusiastic participation in our Center activities, especially those of you who have given so much time and effort to our many outreach efforts. From my own experience and from talking to many of you who have participated, this effort has been a particularly satisfying experience. It is not often that we get the opportunity to help share the excitement of our work with others in a manner that can inspire others to choose careers that are influenced by science and technology.

Joseph M. DeSimone
CERSP Director

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