

Spring 2004



University of Colorado at Boulder



ChBE Alumni Newsletter

From the Chair

The more things change, the more they stay the same. Over the last few years, the Department of Chemical and Biological Engineering at the University of Colorado has seen dramatic changes; however, its commitment to excellence in education and research and to preparing students for a diverse range of outstanding careers has not faltered. As we approach the 100th Anniversary of the origins of Chemical Engineering at the University of Colorado (see the other information contained within this newsletter), the future prospects for our students and our department appear as bright as ever. It is an absolute delight to be Chair in such an outstanding department in which faculty, students, and staff are committed to excellence.

The last year has involved many highlights for both faculty and students. Kristi Anseth was selected to receive the 2003 American Society for Engineering Education Curtis W. McGraw Award and the 2003 AIChE Allan P. Colburn Award – both presented to a single individual each year. As an example of our faculty being well-rounded and excelling in numerous areas, Ted Randolph was selected last year to receive the CU Boulder Faculty Assembly's Outstanding Research and Creative Work Award while also receiving the College of Engineering's Outstanding Service Award. Our two newest faculty, Will Medlin and Ryan Gill, have also been recognized for excellence with an NSF CAREER

Award (Medlin) and the Subaru Educator Spotlight Award (Gill), both of which require combined excellence in both teaching and research. Our students have also had an outstanding year (see “An Update on the Achievements of our Students” on page 6). In fact, with this long list of accomplishments as a background, our department was ranked 18th in this year’s U.S. News and World Report rankings of the top chemical engineering programs in the nation. This achievement is the first time that our department has ever been ranked in the top 20 departments in the country. Congratulations to all department affiliates, past and present, that enabled this achievement.



In the last five years we have added five new faculty to our department, representing nearly one-third of our current faculty, and we plan on hiring at least two more new faculty this year. An article on Will Medlin, our newest faculty member, and his selection for an NSF CAREER Award is presented on page 4. These individuals have brought expertise in a wide variety of chemical and biological engineering fields, ranging from materials science to biological systems to surface and interfacial science to reaction engineering and modeling. With the change in our name last July to the Department of Chemical and Biological Engineering, we are also planning on several of our new faculty hires in areas that would build on our strengths in biological engineering. These new faculty hires will help our department to implement its plan for a second undergraduate degree – a B.S. in Chemical and Biological Engineering. This degree plan is currently being formulated and we hope to begin the approval process this fall. This program will enable our department to appeal to a broader range of students and improve the future prospects for undergraduate students graduating from our program. An article on page 4 addresses some of the specific changes that will be occurring in this area.

INSIDE

◆ News from Alumni.....	2
◆ Bridging the Past with the Future.....	2
◆ Controlling the Surface Chemistry of Nanoparticles.....	3
◆ CO-OP Program.....	3
◆ Biological Engineering Has Arrive at CU.....	4
◆ Will Medlin's Research.....	4
◆ Plans for the Undergraduate Laboratory.....	5
◆ Patten Distinguished Lecturer 2004.....	6
◆ An Update on the Achievements of our Students.....	6

Contact Information:

Department of Chemical and Biological Engineering, University of Colorado, 424 UCB, Boulder, CO 80309-0424; phone 303-492-7471; email: chemeng@spot.colorado.edu; web: <http://www.colorado.edu/che/>

Over the course of the last year, our department has had numerous opportunities (and obligations!) to be reflective and to consider both where the department is and where it would like to move. In this academic year, the department is going through its program review as required by the University every seven years. As a part of this review and as required by the Dean of our College, the department developed a Strategic Plan for the next five years (see http://www.colorado.edu/strategic_plan03.pdf) and assessed where we are as a department. Some striking information and plans came from these assessment activities. In the planning stage, three distinct strategic objectives were identified: have outstanding faculty and students and educate students to be leaders in the chemical and biological engineering field; develop outstanding discovery-based and service-based learning programs for undergraduate and graduate students; and raise sufficient resources to enable excellence in the first two activities. A variety of goals and plans have been formulated around these objectives, and involvement of our alumni in these activities and in the training of our students is always welcome and beneficial. Future directions highlighted in this newsletter relating to the Undergraduate Laboratory Renovation and the Biological Engineering efforts arose out of this planning and assessment activity. I hope that you will find ways to interact with our department and its current students. We are constantly looking for volunteers to help with design projects, undergraduate laboratories, career planning, cooperative education experiences, and internships. Please feel free to contact me or the department if you would like to participate in one of these programs or if you have other ideas of how you would like to interact.

Thank you for your previous support and interaction, and I look forward to meeting and working with you to make our department a better place for alumni, students, faculty, and staff.

– Chris Bowman, Chair

News from Alumni

We are starting a column called “News from Alumni.” If you have news to share with your classmates, you may go to <http://www.colorado.edu/che/alumni/forms/form.html> and enter your recent activities and/or general comments, which will be included in the next alumni newsletter.



**Bridging the Past
with the Future:
100 Years of
Chemical and
Biological
Engineering
at the University
of Colorado**

During the next academic year (2004-2005), we will be celebrating 100 Years of Chemical and Biological Engineering at the University of Colorado. The year-long celebration will be marked by two key events, namely a Centennial Scientific Workshop (February 3-4, 2005) and an Alumni Centennial Celebration weekend (April 15-16, 2005). *All alumni and friends of the department are invited to attend these events, so please mark your calendars accordingly!* The Centennial Celebration is intended to be just that – a big celebration! On Friday of that weekend, the department will host an Open House with a variety of activities intended to pay tribute to our past and present. The rest of the weekend will include a range of activities in and around the Boulder area, including a capstone dinner banquet. In addition, leading up to the event will be a year-long series of “class competitions” to find out which graduating class has the most class spirit, etc. As part of the Scientific Workshop, the department will host an internationally-renowned panel of scientists to discuss the past and future of the discipline. More detailed information will be sent in a separate mailing to alumni and friends in Spring 2004 (you may have already received it!), and will also be posted to the Centennial web site at http://www.colorado.edu/che/centennial_celebration.htm. The Centennial Celebration weekend is a great opportunity to return to Boulder in the Spring and reconnect with your CU family – don’t let it slide by! And just in case you are not convinced, here is what some of the nation’s leading periodicals are saying:

“Boulder has never been host to an event like this before. Our residents think the Nebraska game is a big deal – wait until they see this.” – Boulder Daily Camera

“This event has the hipness of New York City written all over it. Too bad we can’t bring it here.”
– The New Yorker

"If you're planning to attend, make sure you're ready for the paparazzi – it may just put the Oscars to shame."

– People Magazine

(If you would like more information on the Centennial events or would like to participate in planning activities, please contact Professor Christine Hrenya: hrenya@colorado.edu, 303-492-7689.)

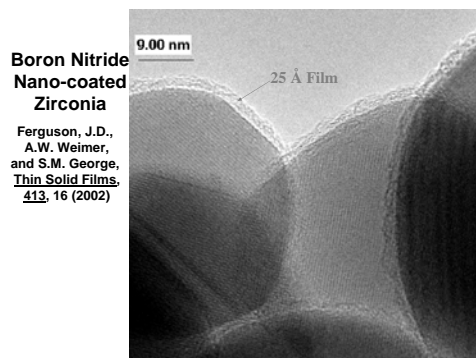
CU ChBE Alumni Website Launched

During the past summer, the Department launched a new website for ChBE alumni. The website, located at <http://www.colorado.edu/che/alumni/alumni.htm>, has a range of content targeted at alumni interests.

First, an "electronic guestbook" has been recently revived, in which you can read previous entries by colleagues and leave messages for others in your graduating class to read. Second, the site contains previous department newsletters, and also allows for electronic submission of news items to include in an upcoming newsletter. Finally, a listing of department graduates is also available on the site. The contents of this site will continue to be expanded during the course of the next year, so make sure to add this to your list of bookmarks!

Controlling the Surface Chemistry of Nanoparticles

Professors Steve George and Alan Weimer started collaborating five years ago to develop Atomic Layer Deposition (ALD) methods to place nanofilms controlled to within 1 Å on the surface of nanoparticles. Such technology was unheard of and would allow the functionalization of nanoparticles by allowing the surface chemistry to be modified while such particles maintained their bulk properties. This enabling processing capability has improved the usefulness of both oxide and non-oxide nanoparticles. Nanoparticles can now be passivated, activated, or functionalized for specific design considerations. The ALD processing has numerous advantages over state-of-the-art Chemical Vapor Deposition (CVD) and plasma enhanced CVD (i.e. PE-CVD) coating of particles. Particle nanocoating is conformal and non-granular with thickness controlled using "forgiving" self-limiting sequential surface chemistry. ALD processing is also independent of line of sight, thus, allowing the nanocoating of unexposed surfaces. The two faculty members developed a fluidized particle bed reactor process to demonstrate the technology in a scaleable process, providing for a commercial path to large scale production. They have published a number of papers and filed a number of International PCT Patents for the process and are expecting broad based coverage for their intellectual property. The method has significant application in the biomaterials, defense, microelectronics packaging, consumer products, construction, and other businesses. The adjacent figure shows a 2.5 nanometer thick film of boron nitride conformally and chemically bonded to a 50 nanometer zirconia particle. Individual nanoparticles can be nanocoated as there is no physical method for deposition. The entire process is controlled using sequential surface chemistry.



CO-OP Program

Four students will graduate this spring with a Certificate of Cooperative Education from the Chemical and Biological Engineering Department alongside the more traditional Bachelor of Science degree. They are among the first students to earn the certificate in the groundbreaking program in the College of Engineering and Applied Science at CU-Boulder.

Cooperative Education is a formal plan of education in which students alternate sessions of full-time work with sessions of full-time study. It is a five-year professional development experience, designed to combine practical on-the-job experiences with the classroom training of a four-year college curriculum. It

helps students integrate theory and practice, confirm career choices, investigate potential job opportunities, and become better graduates. At the same time, it allows students to earn money and help finance their education.

Students must write a report that documents their work assignments – ranging from laboratory experiments, facilities and pilot plant work - as well as provide information about the company history and organization. Companies that have participated include Roche Colorado, Amgen, Equistar Chemicals, Baxter, Chevron Phillips, Bend Research, Dow Chemical and 3M. Please contact Professor Bev Louie at 303-492-4967 or the department to learn more about this extraordinary opportunity for students and employers alike.

Biological Engineering has Arrived at CU

To address the dynamic changes that are occurring at the interface of biology and engineering, our department has not only changed its name to Chemical and Biological Engineering, but the faculty are working vigorously to build an educational infrastructure that will serve as a center of excellence for educating our students and integrating education and visionary research in areas that marry biology and engineering principles. We aim to become the leading department for the CU-Boulder campus, CU-system, and nation in building educational and research bridges for the molecular and chemical aspects of biology and the engineering disciplines. Our department has a long history of strong interactions and interdisciplinary graduate educational programs with Biochemistry and Molecular, Cellular, and Developmental Biology. The time has now arrived to focus on our undergraduate curriculum, and we are extremely excited to report on our recent progress. Chaired by Prof. Kristi Anseth, the Biological Engineering committee has been working on a new B.S. degree in Chemical and Biological Engineering, and Dr. Janet de Grazia, Prof. Kristi Anseth, Prof. Ted Randolph, Prof. Dhinakar Kompala, and Prof. Ryan Gill received \$100K from the National Science Foundation in September 2003 to develop a unified plan for our biological engineering educational curriculum reform. Led by Dr. de Grazia, a \$1M implementation proposal has been submitted, and our proposal objectives are to:

- ◆ establish a new B.S. degree in Chemical and Biological Engineering that will integrate biology, biochemistry, and biological engineering core courses and laboratories into this curriculum. In addition to directly serving the needs of students in our department, this program will serve as a model for other departments in the College that may wish to develop similar, parallel degree tracks in the future.
- ◆ use biological engineering as a vehicle to reform our curriculum by creating new courses and enhancing our core curriculum. Courses will be created that will serve the entire college as well as those that will improve chemical engineering students' experiences. The core curriculum will be completely updated by replacing traditional teaching methods with more progressive techniques.
- ◆ integrate biological research into undergraduate education so that every undergraduate has the opportunity to explore the laboratory experience and students graduate fully prepared to pursue further academic endeavors or employment. An

essential part of an engineer's education is the chance to perform research with some of the top professors in the field; this proposal will insure that all undergraduates get the opportunity. In addition, experience with modern lab techniques and experimental methods will increase the marketability for undergraduates seeking jobs or going on to graduate school.

Will Medlin's Research

Will Medlin, who started his career at CU a little over a year ago, has received a 2004 CAREER award from the National Science Foundation to study the surface chemistry of functional materials using a combination of experimental methods and quantum chemical calculations. Experiments are conducted under conditions of ultrahigh vacuum (less than one-trillionth of atmospheric pressure), where powerful spectroscopic techniques can characterize surface processes. In conjunction with these experiments, molecular models based on quantum chemical methods are used to understand measured results at the atomic scale. The initial aim of the group's research is to develop an improved fundamental understanding of surface chemical processes important for a variety of applications. The broader goal of this work, however, is to develop the capability to design functional surfaces based on a molecular-level understanding of these processes. Several applications are being considered as part of this effort. For example, we are working on a project with researchers at Sandia National Laboratories to develop rational design approaches for metal-insulator-semiconductor (MIS) chemical sensors. These sensors—which offer the advantages of being small, cheap, and easy to distribute around an application environment—are being explored for use as H₂ leak detectors and electrical power station reliability monitors. Sandia's capability for fabrication of novel devices is being combined with fundamental studies at Colorado aimed at identifying structural characteristics that may lead to improved sensor performance.



The Medlin group is also using a combined experimental/theoretical approach to investigate the mechanism of electrocatalytic oxygen reduction in fuel cells. The low oxygen reduction rates and high costs

associated with the present platinum-based catalysts substantially hinder the overall efficiency of fuel cell engines. Recent improvements have been made in catalyst performance by alloying platinum with other metals; however, the reasons for these enhancements are not known, making further rational design improvements difficult. The Medlin group uses a variety of “non-situ” experimental and theoretical methods to simulate the electrochemical environment of a fuel cell catalyst under ultrahigh vacuum conditions in order to study the oxygen reduction reaction on platinum and platinum-alloy catalysts. Once the detailed mechanism for reduction is understood, explanations for the improved

performance of certain classes of catalysts may be identifiable. This identification can help in focusing design efforts on the catalyst properties likely to have the greatest influence over the fuel cell efficiency.

Other projects in the group focus on diverse applications including hydrogen-permeable membrane design, the tailoring of metal-insulator interfaces for microelectronic devices and catalysts, and the design of photocatalytic systems for remediation of waste streams. Nevertheless, all these projects focus on a common theme: the complementary use of experiment and theory in generating a platform for rational design of functional materials.

Plans for the Undergraduate Laboratory

The Department of Chemical and Biological Engineering has initiated a coordinated and multi-faceted effort to dramatically improve the undergraduate laboratory experience. The overall objectives of this effort are to (i) develop a variety of flexible laboratory modules that enable student-directed learning to foster skills used in today’s chemical and biological engineering workforce; (ii) upgrade the laboratory setting to an environment that fosters interaction among students and faculty, enhances the incorporation of new and industrially relevant technologies, and improves the integration of classroom-taught theory with laboratory experiments; and (iii) provide training, support, and guidance for faculty involved in teaching undergraduate laboratory courses. Our efforts towards achieving these objectives have included the development and submission of an NSF Course, Curriculum, and Laboratory Improvement (CCLI) proposal (\$100,000), a state proposal to the Colorado Institute of Technology (\$300,000), a CU-Engineering Excellence Fund proposal (\$50,000), and an ongoing effort to establish a laboratory endowment. The overarching goal of the NSF CCLI proposal is to reform and enhance the undergraduate laboratory experience so that students and faculty alike will feel that it is a worthwhile experience. The specific plan is to create two new experimental modules that involve student construction and testing of the actual experimental modules, add a trouble-shooting and critical thinking element to the curriculum, and improve training of faculty and teaching assistants. As a complement, the Engineering Excellence Fund proposal is focused on creating a dedicated undergraduate laboratory space that is modern, well-equipped, and safe, upgrading the current laboratory classroom, and integrating the laboratory and classroom through permanent infrastructure modifications as conceived in figure 1. If you would like to help in this effort, please contact the department.

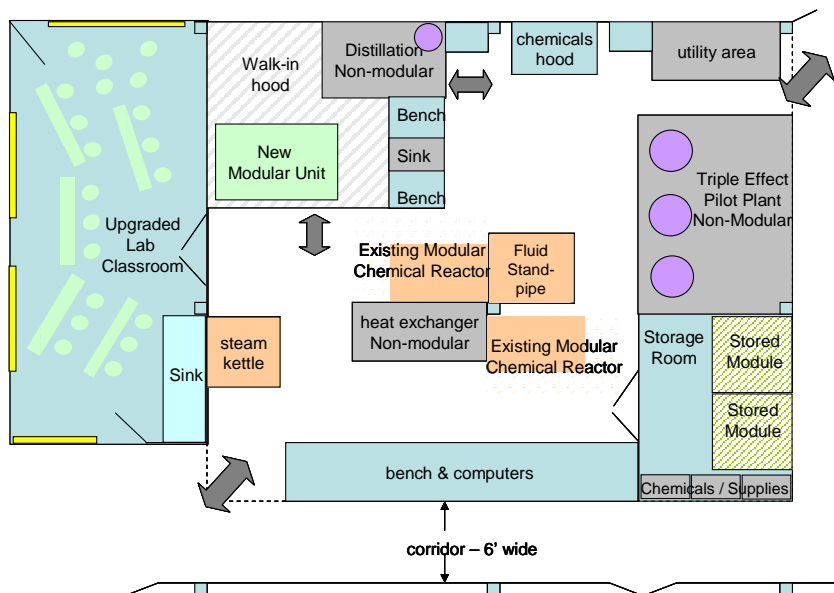


Figure 1. Preliminary Layout of Undergraduate Laboratory.

Design accommodates fixed non-modular equipment plus existing and new modular units. The classroom will be upgraded and a storage facility will be added. Added ventilation will be provided in a “walk-in hood” area.

Patten Distinguished Patten Lecturer 2004

On March 1, 2004, the department was honored to have Professor David Tirrell from the California Institute of Technology present the fifth annual Patten Distinguished Lecture. Professor Tirrell is currently the Ross McCollum–William H. Corcoran Professor of Chemical Engineering and also Chairman of the Division of Chemistry and Chemical Engineering at Caltech. Professor Tirrell's research is at the interface of polymer science, biology, and chemical engineering. His contributions to these three areas have been recognized by a number of prestigious awards, including a Sloan Research Fellowship, an NSF Presidential Young Investigator, a Fulbright Senior Scholar Award, the Carl S. Marvel Creative Polymer Chemistry Award of the American Chemical Society, the Harrison Howe Award of the Rochester Section of the ACS, the ACS Award in Polymer Chemistry, and a *Doctor honoris causa* degree from the Technical University of Eindhoven. He has also served as Editor of the *Journal of Polymer Science, Part A: Polymer Chemistry* from 1988 until 1999, and has served on the editorial boards of ten other journals, including *Macromolecules*, *Biopolymers*, *Accounts of Chemical Research*, and *Chemical & Engineering News*.



Professor Tirrell's Distinguished Patten Lecture was entitled "Novel Macromolecules via Alternative Translations of the Genetic Code." It focused on the use of biological machinery to create novel polypeptide polymers containing unnatural amino acids for promising biomedical engineering applications. His lecture highlighted the opportunities in using both chemical and biological tools to create new engineering materials. This lecture topic was particularly fitting this year, in light of the recent name change in the department from Chemical Engineering to Chemical and Biological Engineering.

In addition to his seminar, Professor Tirrell also met with faculty and students during his two-day visit to the department. After his lecture, he enjoyed an honorary dinner with the faculty at the Chautauqua Dining Hall. In his after dinner speech, Professor Tirrell noted that the field of biological engineering is still in its infancy, and that a department like ours could play a major role in defining and pioneering the area. Overall, Professor Tirrell's visit was thoroughly enjoyed by everyone in the department.

An Update on the Achievements of Our Students

With May 2004 commencement just behind us, it is appropriate to take note of awards garnered by our students.

Jeremiah Zartman (double degree with Engineering Physics) was recognized as the BS graduate with the highest grade-point average in the College of Engineering and Applied Science, receiving the College's Academic Achievement Award. He also won the Outstanding Graduate in Research Award and a Certificate of Merit from the Colorado Engineering Council. Jeremy was recognized by the Department of Chemical and Biological Engineering with our Outstanding Senior Award, presented in the photo by Prof. Chris Bowman. He will begin graduate studies at Princeton in the fall.



Steven Dahl received the award as the Outstanding Graduate Student in the department. Steve is completing his PhD under the supervision of Prof. Christine Hrenya. He is doing this at long distance, as he lives in Anchorage with his wife Jamie who received her doctorate in chemical engineering last year. Steve has previously received both NSF and Department of Education Fellowships.

Eric Beckel was recognized with the Graduate Student Faculty Leadership Award. Awards sponsored by the American Institute of Chemists were made at three levels: Post-doctoral: Brian Hutchison, Graduate: Eva Chi, and Undergraduate: Robert Dahl.

The Howard L. Anseth Outstanding Undergraduate Research Award was won by Joseph Spencer. Joe is in the combined BS/MS program and is a member of Prof. Al Weimer's research team. Leslie Morgret received the Undergraduate Student Faculty Recognition award, and the Clough-Weimer Most Improved Student award went to Kristil Grimsrud.

The department also recognizes outstanding students in our sophomore and junior classes. The Kazuko Boe Outstanding Junior Award was shared by Janna Martinek and Jeffrey Wyss. The Donald F. Othmer Sophomore Academic Excellence Award was presented to Nicholas Sandoval.

Two undergraduates, Melinda Channel and Brian Kay, were recognized for their contributions to our academic program with the Alan D. Randolph Outstanding Undergraduate Course Assistant Award.

Four students were recognized for completing the Cooperative Education Program, Robert Dahl, Jenna Estwin, Meghan Mallozzi and Adam York. They represent the first full generation of Co-Op Program graduates.

During the 2003-2004 academic year, seventy-seven undergraduate ChBE students were awarded undergraduate scholarships. Three students, Alexandra Halevi,

Sarah Recktenwall-Work and Joseph Schmidt, participated in the Undergraduate Research Opportunities Program, and last summer six students joined NSF Research Experiences for Undergraduates Programs around the country.

Our current and graduating students have continued the tradition of years past in being recognized as the brightest and best on the Boulder Campus.

CU-ChE ALUMNI RESPONSE FORM

Enclosed is my gift of: \$ _____

*(Please make your check payable to the CU Foundation
– Chemical and Biological Engineering)*

Please charge my gift of: \$ _____

mark one Visa MasterCard
 American Express Discover

Credit Card Number Expiration Date

Name as it appears on Credit Card (please print)

Authorized Signature

Please direct my Chemical and Biological Engineering New Millennium gift to:

- Max S. Peters Graduate Fund
 Ronald E. West Undergraduate Fund
 Clough Computer Instrumentation Fund
 Chemical Engineering Excellence Fund
 Chemical Engineering Laboratory Fund
 Other: _____

- Please mark if you would like to be contacted about establishing a HELP award or other naming opportunity.
 Please mark if you would like your gift to remain anonymous.

- Please mark if this is a recent address change.

Name(s) as you would like them to appear in donor acknowledgement listings

Address

City State Zip

Home Phone Business Phone

E-mail

Return to:

Stephanie Kellum
 Department of Chemical and
 Biological Engineering, 424 UCB
 University of Colorado
 Boulder, CO 80309-0424

- I would like to help with planning Chemical and Biological Engineering reunions and events
 I would like to help mentor a Chemical Engineering student
 I would be interested in giving a talk to Chemical Engineering students in a seminar class