



NEW FACULTY FOR CHEMISTRY



Malika Jeffries-EL
Assistant Professor of Chemistry
Organic and Polymer Chemistry

Dr. Malika Jeffries-EL joined the faculty in August 2005 as an Assistant Professor. She received her Ph.D. from The George Washington University in 2002 and was a Postdoctoral Associate at Carnegie Mellon University from 2002-2005.

Since their discovery over 30 years ago conjugated polymers have been heralded as futuristic materials that will lead to the development of "plastic electronics". In order to realize the full potential of these materials, they must be engineered at the molecular level allowing for optimization of materials properties, leading to enhanced performance in a variety of applications.

As an organic chemist her approach to materials begins with small molecules. The lab will investigate the design and synthesis of novel pi-conjugated polymers and the study of their properties in order to develop an understanding of the relationship between polymer structure and its properties. She is primarily interested in the design and synthesis of new monomers, leading to the development of novel polymers. She is also interested in the development of new approaches toward materials synthesis such as applying combinatorial chemistry toward conjugated materials synthesis and the creation of new polymer architectures.

This research involves a number of inter-related projects, The first is the synthesis of a small library of functionalized 3-alkylthiophene monomers, which will be used as building blocks in the solution phase parallel synthesis of random poly (3-alkylthiophene) copolymers. *Continued on page 3...*



Aaron Sadow
Assistant Professor of Chemistry
Organometallic Chemistry,
Catalysis and Mechanism,
Chirality, C-H Bond Activation

Dr. Aaron Sadow joined the faculty in August 2005 as an assistant professor. He earned his Ph.D. from the University of California, Berkeley under the guidance of Professor T. Don Tilley, and then moved to Zurich, Switzerland for a postdoctoral position with Professor Antonio Togni at the Swiss Federal Institute of Technology (ETH Hnggerberg).

Chirality, which is defined by the nonsuperimposability of an object and its mirror image, is central to the chemistry of our three dimensional world. Biological molecules such as DNA and amino acids, pharmaceuticals such as L-DOPA, and many inorganic complexes are a few general examples of areas in which the asymmetry of a molecule or material is critical to its particular function. Thus, chirality will be a central theme in his investigations, and he intends to develop new organometallic catalysis involving this concept.

The research efforts of Sadow's group are directed toward the synthesis of new chiral ligands for the preparation of asymmetric organometallic compounds. The targeted chiral species are structurally or electronically related to known achiral compounds that have been shown to be effective in organometallic chemistry, especially as reactive complexes and useful in catalytic transformations. Thus, these ligands have been designed to incorporate features amenable to both asymmetric catalysis and classical organometallic chemistry. One of the proposed ligands is the anionic tridentate tris(oxazoline)borate. This ligand contains the popular and effective chiral oxazoline motif *Continued on page 11...*

EMILY SMITH TO JOIN THE DEPARTMENT OF CHEMISTRY FACULTY IN 2006

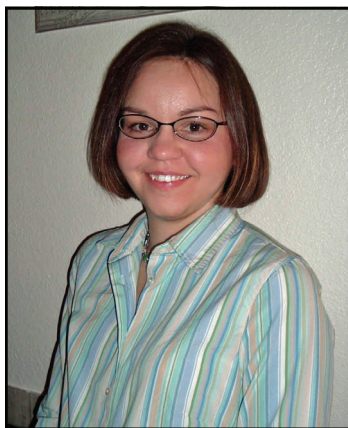
Dr. Smith will join the faculty in August 2006 as an Assistant Professor. She received her Ph.D. from the University of Wisconsin in 2003, and she was a Postdoctoral Associate at the University of Delaware and the University of Arizona from 2003 to 2006.

She is developing fluorescence and vibrational imaging techniques that can be used to study biomolecular processes in cells and tissue. The clustering of cell membrane proteins, the interaction of cell membrane proteins with extracellular and cytosolic proteins, and the post-translational modification of proteins are studied. The aim of this work is to further the understanding of molecular interactions *in vivo*, to provide insight into how cellular processes are altered in certain disease states, and to develop methods for screening potential therapeutic compounds.

Protein-Protein Interactions.

In vivo labeling techniques, such as the use of fluorescent proteins, enables the study of protein-protein interactions in living cells and tissue using fluorescence microscopy. Fluorescence resonance energy transfer is a distance-dependent fluorescent technique used to measure the interactions of proteins on a scale lower than the resolution of an optical microscope (below 200 nm). Fluorescence recovery after photobleaching is used to measure the diffusion of receptors within the membrane. She is using these techniques to study the aggregation of membrane proteins after exposure to UV light, and to study the clustering of a class of cell membrane proteins that contribute to cancer metastasis.

Post-translational Modification of Proteins. Fourier transform infrared (FTIR) and Raman microscopy, in contrast to vibrational spectroscopy, provide spatially correlated chemical composition data. These methods are suited to study covalent modifications of biological molecules within cells and tissue. The resolution of an FTIR microscope is on the order of the dimensions of a typical mammalian cell, enabling single cells to be probed and heterogeneous changes in protein, nucleic acid, or lipid content and composition to be studied. Vibrational microscopy is used to study post-translational modifications such as protein glycosylation in a hyperglycemic environment and protein phosphorylation after exposure to UV radiation. These modifications affect the chemical and physical properties of the protein, and it is important to identify these modifications to understand how the protein functions.



Emily A. Smith
Assistant Professor of Chemistry

Bioanalytical, Fluorescence & Chemical Imaging

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ANDREJA BAKAC RECEIVES ADJUNCT APPOINTMENT

Andreja Bakac received her B.S. from the University of Zagreb and her Ph.D. also from the University of Zagreb in 1976. Following postdoctoral work at Iowa State University with Prof. Jim Espenson, she joined the staff of the Ames Laboratory as a scientist where she currently is a Senior Scientist. Dr. Bakac currently serves on the editorial board of the following science publications—*Inorganic Chemistry*, *Inorganic Reaction Mechanisms*, and *Dalton Transactions*. She is a member of the American Chemical Society, American Association for the Advancement of Science, Sigma Xi, and the Iowa Academy of Science.

Andreja Bakac
Adjunct Professor of Chemistry

**Transition Metal Catalysts,
Mechanisms & Applications**



MALIKA JEFFRIES-EL *Continued from cover...*

The use of combinatorial synthesis will allow for the rapid synthesis of the large variety of polymers required for a sensor array. Such sensors could be used as chemoresistors, transistors, and chromic sensors. In the second project she will synthesize polythiophenes with terminal thiol groups to bind to gold surfaces and derivatize the other end

with groups suitable for interaction with biological moieties. Materials of this type will serve as an interface between biological and mechanical systems, consequently allowing for a flow of electrons between them. In the last project she will explore the incorporation of conjugated chromophores into non-conjugated matrixes. The chromophores will

determine the optical properties of the material, whereas the polymer component will determine the physical properties of the material allowing for the optimization of these parameters independently. These properties of these materials will be optimized for performance in organic light-emitting diodes (OLEDs).

AMES LAB RESEARCH ON MAGAZINE COVER



Jim Espenson, Yang Cai, and Jan Weedman pose with the Feb. 7, 2005 issue of *Inorganic Chemistry* that features Ames laboratory research on the cover.

cules and ions involved give these results.

The europium reaction was studied in detail by means of chemical reaction kinetics, revealing a multistep process characterized in terms of the chemical species involved. The step at which H_2 is produced is the last; it utilizes a rhenium hydride and can be represented by the chemical equation $HReMeO_2 + H^+ ReMeO_2 + H_2$.

Equally important, the question naturally arose as to why Cr^{2+} does not react analogously. The catalytic scheme becomes frozen midway for Cr, however, because it was discovered that the substance first formed has an electronic configuration that forbids Re and Cr from separating. Thus they cannot react further, and no hydrogen is produced.

www.chem.iastate.edu

A technical drawing by Janice Weedman, graphic designer, was selected for the cover of the Feb. 7th, 2005 issue of *Inorganic Chemistry*. Weedman created the drawing titled "Reactions that Evolve Hydrogen from Solutions" from pencil sketches developed by Yang Cai. Cai is a Ph.D. student working with senior chemist James Espenson.

Espenson explains the research as follows: Thermodynamic analysis indicates that metal ions such as europium(II) and chromium(II) will evolve molecular hydrogen in solutions containing acid. In spite of the thermodynamics, these reactions do not occur in practice at any measurable rate:

that is to say, there is a large kinetic barrier to be overcome. In such circumstances, the reaction can possibly be brought about with the aid of a catalyst, a substance that enters the reaction cycle but ultimately emerges unchanged.

It was discovered that methyltrioxorhenium, $ReMeO_3$, catalyzes hydrogen evolution for the reaction of Eu^{2+} , but not for Cr^{2+} , despite their nearly identical thermodynamics. The objective of the research was to learn how the mole-

The research by Cai and Espenson addresses the ques-

TURNING PLANT CELLS INTO TINY FACTORIES

METABOLOMICS GETS \$1 MILLION JUMPSTART

Imagine if you could manipulate a potato plant to produce tubers that were high in insulin instead of starch. Or a cotton plant that produced natural fibers that were as strong as nylon.

Those and millions of other possibilities may someday prove feasible if the research efforts of Ames Laboratory's Ed Yeung and a team of Ames Lab and Iowa State University scientists can make inroads to understanding plant metabolism. Yeung received notice in August that his proposal in the fledgling field of plant metabolomics would receive \$1.02 million from the Department of Energy over the next two years with additional money coming in 2007 and possibly beyond.

"We know a lot about the genetic makeup of many plants, but we know very little about the chemical changes that take place within plant cells that eventually produce sugars, fibers or waxes," says Yeung, program director of Chemical and Biological Sciences and principle investigator on the project. "If we can understand metabolism, then ideally, all the materials a plant produces can be controlled."

The project, "Mass Spectrometric Imaging of Plant Metabolites," combines the analytical chemistry expertise of Ames Laboratory with the strength of ISU's Plant Sciences Institute. Yeung, who is also a Distinguished Professor of chemistry at ISU, is internationally recognized for his work in developing separation and detection technologies. He has also won four R&D 100 awards.

Also working on the project are Sam Houk, an Ames Lab senior chemist who specializes in identifying trace elements using inductively couple plasma-mass spectrometry, and associate scientist and ISU chemistry professor Ethan Badman, who specializes in mass spectrometry and gas-phase methods of analysis for biological molecules. Rounding out the team is Basil Nikolau, director of the

Plant Sciences Institute's Center for Designer Crops and a specialist in biochemistry and functional genomics of plant metabolism.

Funding from the Chemical Sciences, Geosciences and Biosciences Division of the DOE's Office of Basic Energy Sciences provides \$340,000 for operation and equipment this year and another \$680,000 in 2006. Additional money is expected in 2007 and could continue if the program receives good marks during a peer review scheduled for 2008.

Before they can study the chemical makeup within plant cells, the team must construct new analytical instruments capable of identifying molecules in such minute quantities.

"Developing the instrumentation is a large part of the proposal and we're building a special, high-resolution mass spectrometer," Yeung says, "because there's nothing available commercially that meets our needs." He adds that the equipment will be housed in the Roy J. Carver Co-Laboratory on the ISU campus.

Mass spectrometry works by measuring the mass of individual ions - molecules that have been electrically charged. Plant material is ionized into a gas, sorted in an analyzer chamber according to the mass-to-charge ratios, and collected by an ion detector.

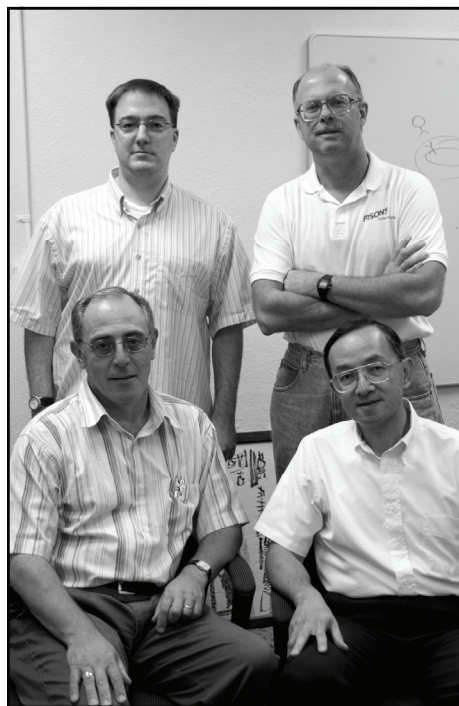
The detector converts ion flux into a proportional electrical current. Finally, the magnitude of the electrical signals is recorded and plotted as a mass spectrum.

The ability to sort and detect these ions at cellular-scale quantities is where the team hopes to fine-tune the instrumentation.

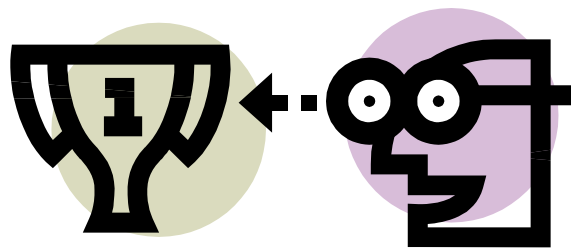
Once the equipment is ready, the team will look at the chemical content in the cells of *Arabidopsis thaliana*, a small flowering plant that is widely used as a model organism in plant biology. *Arabidopsis* is a member of the mustard (Brassicaceae) family, which

includes cultivated species such as cabbage and radish.

"*Arabidopsis* is not a major crop like corn and soybeans," Yeung says, "but because so much is already known about it genetically, we can hopefully begin to draw correlations between the chemical and genetic makeup. We hope that such fundamental research will be applicable to other plants as well."



(Clockwise from front right) Ed Yeung, Basil Nikolau, Ethan Badman, and Sam Houk will be working on developing new analytical equipment as the first step in a project to study plant metabolomics. The mass spectrometry equipment will be sensitive enough to distinguish the chemicals found within individual plant cells.



FACULTY HONORS

DANIEL ARMSTRONG

- Dal Nogare Award from the Chromatography Forum of Delaware Valley

MEI HONG

- Promoted to Professor

NICOLA POHL

- Alfred P. Sloan Fellow

JOHN CORBETT

- Spedding Award

MALIKA JEFFRIES-EL

- Gregory L. and Kathleen C. Geoffroy Faculty Fellow

KLAUS SCHMIDT-ROHR

- Promoted to Professor

MARK GORDON

- LAS Award for Excellence in Research/Artistic Creativity for 2005
- LAS Master Teacher 2005-2006

GEORGE KRAUS

- Distinguished Service Award for the Midcontinent Region of the Federal Laboratory Consortium (FLC)
- LAS Award for Outstanding Graduate Teaching

PATRICIA THIEL

- Honorary Ph.D. (Doctor Honoris Causa) from the Institute National Polytechnique de Lorraine, France
- Elected a Fellow of the Institute of Physics, London

TOM GREENBOWE

- ISU Foundation Academic Advising Award
- LAS Ruth Swenson Award for Academic Advising

VICTOR LIN

- Promoted to Associate Professor
- Outstanding Technology Development Award for the Midcontinent Region of the Federal Laboratory Consortium

EDWARD YEUNG

- Ralph N. Adams Award in Bionalytical Chemistry (first recipient)

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ANNOUNCEMENTS

SEE ANOTHER ANNOUNCEMENT ON PAGE 19...



Stephanie A. Burns, Ph.D. 1982
President and CEO

Dow Corning CEO Stephanie Burns assumes the additional role of chairman of the board as of January 2006 upon the retirement of Gary E. Anderson, the current chairman.



Charles Reese
Electrical Engineer

Chuck received his degree in 1975 from University of Illinois at Urbana/Champaign and began working in electrical design. He began his current position in the ISU Chemical Instrumentation Facility in August of 2005.



Steve Walstrum
Lecturer

Steve Walstrum received his degree from Cornell in 1983. Originally from Michigan, Steve has been teaching full-time for 18 years at institutions such as Waldorf College, University of Wisconsin, University of Iowa and Iowa State University.

THANK YOU

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LONGTIME CHEMIST ADOLF VOIGT DIES

Adolf Frank Voigt, emeritus professor of chemistry at Iowa State University, died Friday, March 11, 2005. He was 91.

Adolf Voigt was born on January 31, 1914, in Upland, California, the son of Adolf and Marie Hirschler Voigt. He graduated from Pomona College, earned his master's degree from Claremont College and a Ph.D. in chemistry from the University of Michigan in 1941. After teaching for a year at Smith College in Northampton, Massachusetts, and marrying Mary London, he was hired to work on plutonium separation for the Manhattan Project housed at Iowa State University. At the end of World War II he remained at Iowa State as a chemistry professor, teaching radiation and nuclear chemistry and es-

tablishing a research group. He was appointed assistant director of the Institute for Atomic Research and Ames Laboratory in 1959 and chief of the Reactor Division in 1968. He was instrumental in the planning and design of the research reactor at Iowa State, which was active from 1965 to 1978. He was also in charge of decommissioning the reactor and retired when that project was finished in 1981, having worked at Iowa State for 39 years.

Dr. Voigt's other interests included classical music and travel; he was an officer of the Town and Gown Chamber Music Association for a number of years, served in various capacities at Collegiate Presbyterian Church and traveled to continental Europe, Japan,

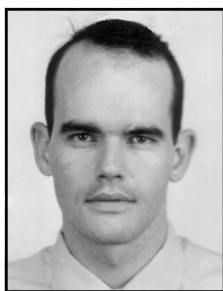
Kenya and England, as well as all over the western United States. His last years were spent in quiet retirement at Green Hills Retirement Community.



Adolf F. Voigt

Emeritus Professor of Chemistry

GOOD-BYE HARVEY BURKHOLDER



Harvey Burkholder

Harvey Burkholder, of Ames, died on October 31, 2004 after a year-long struggle with ALS. Harvey Ralph Burkholder was born April 18, 1932 to Harvey and Jessie (Dayton) Burkholder in Rock Lake, N.D. After graduating from high school in Langdon, N.D., he attended college at the University of North Dakota where he was a member of the varsity basketball team. In 1954, he married Kathryn Mott of Rolla, N.D., and they moved to Ames. He was a research chemist at the Ames Laboratory for 28 years and then worked in the analytical chemistry

department at ISU until his retirement in 1997.

He was very involved locally and generously donated his time and energy to many activities. He ran the Ames Duplicate Bridge Club for 30 years and taught bridge at the Octagon and College for Seniors. He started the Ames Lab golf league and was secretary of the faculty bowling league for 33 years.

He was an active member of the Collegiate Presbyterian Church for 50 years, serving as deacon, elder and trustee.

A Farewell To:

William Adams, B.S., 1943	Daniel Grantham, Ph.D., 1962	Samuel P. Massie Jr., Ph.D, 1946	Gerrish Severson, Ph.D. 1936
Warren F. Bartz, Ph.D., 1939	Robert Greene, M.S., 1971	Charles Moss, M.S. 1940	Marion Shepard, Ph.D. 1965
Harvey Burkholder, Staff	George S. Hammond, Faculty	Philip Nordin, Ph.D, 1953	Alexis Svigoon, M.S. 1939
Orville Chapman, Faculty	Wayne R. Hansen, Ph.D., 1972	John H. Pazur, Ph.D. 1950	Harry Tennant, B.S. 1939
Nathan Crouse, B.S. 1938	Fred Hoyt, Ph.D, 1940	Philip Pratt, B.S., 1935	Thomas Tesdahl, B.S. 1947
Larry Gaffin, B.S., 1970	Sigmund H. Jaffe, Ph.D. 1953	John Priesthoff, M.S. 1953	Adolf Voigt, Faculty
Lewis Gidez, B.S. 1948	James R. Johnson, Ph.D., 1965	John Richard, M.S. 1959	Joe Woods, Ph.D., 1954
Richard D. Gorsich, Ph.D. 1957	Clarence Lovell, B.S., 1943	Willard Ruby, Ph.D. 1936	

"RADICAL" MEANS RESEARCHERS SOLVE CENTURY-OLD CHEMISTRY CONUNDRUM

For close to a century, chemists debated the nature of the mechanism that triggers the Fenton reaction, one of the most powerful oxidizing reactions available for breaking apart organic compounds. Back and forth the controversy persisted, generating a profusion of professional articles that supported either one or the other of the likely candidates - short-lived, difficult-to-measure hydroxyl radicals or the extremely rare iron(IV), or Fe(IV). Which one was the highly reactive Fenton intermediate that could initiate the oxidations of countless substances, from biomolecules, such as proteins, sugars, fatty acids and nucleic acids to the pollutants found in smog and industrial wastes?

Decades passed, and the identity of the elusive Fenton intermediate remained a mystery. Now, however, Ames Lab senior chemist Andreja Bakac and assistant chemist Oleg Pestovsky have generated, characterized and ruled out iron(IV) as the Fenton intermediate. Their irrefutable research results tip the balance heavily toward hydroxyl radicals, or OH radicals, as the crucial

intermediate - the means by which the Fenton reaction is carried to completion.

Fenton facts

Discovered in 1894 by H. J. H. Fenton, the Fenton reaction is the oxidation of aqueous iron(II), or Fe(II), with hydrogen peroxide, a versatile, safe and effective oxidant. (An oxidant is a substance containing oxygen that reacts chemically with other materials to produce new substances.)

The pervasive nature of the Fenton reaction accounts for scientists' longstanding efforts to unravel the century-old mystery surrounding the famous Fenton intermediate. And no wonder - the reaction operates or is employed almost everywhere, with both good and not-so-good effects. It's critical in the treatment of organic pollutants that are introduced into the environment by the uncontrolled use of such things as pesticides and herbicides, among many other man-made contaminants. It's vital within the industrial chemistry arena, where researchers investigate catalysts with the goal of making various chemical proc-

esses go faster and in a more selective and efficient manner. In contrast, the Fenton reaction plays not-so-benign roles in the biology of aging and disease, contributing to certain types of DNA damage that may not self-repair and accumulate with age.

Closing in on the chemistry

"Knowing the nature of the intermediate is crucial to understanding the role of Fenton chemistry in issues related to environmental and atmospheric chemistry, as well as human health and aging," says Bakac, who is also an Iowa State University adjunct professor of chemistry. "The fact that we have now eliminated iron(IV) in Fenton reaction and confirmed it in ozone reaction, may provide a foundation for the development of new and useful catalytic reactions based on iron(IV)."

Andreja's idea

"Iron(IV) was not a totally unknown species when we started looking at it," says Bakac. A research group in Denmark had done the reaction of iron(II) with ozone and proposed that iron(IV) was produced," she explains. "That was about a decade ago, and the work kind of went unnoticed."

While reviewing the literature relating to iron(IV), Bakac

came across the Dutch papers again. "As I read those papers, I figured if that was iron(IV), then there ought to be much more chemistry there, some of it potentially important in both catalytic and biological contexts," she says. "Of course, nobody knew whether iron(IV) was really involved. It was some sort of intermediate that hadn't been characterized. This is where Oleg and I got involved."

Bakac and Pestovsky set out to generate this species from iron(II) and ozone and look at its chemistry. "All along we were hoping to find that this really was aqueous iron(IV), a simple but probably extremely reactive species," Bakac says. The initial reactivity data were truly exciting and consistent with an iron(IV) species, but still we had no proof," she adds.

Mössbauer "magic"

"We saw some beautiful chemistry, but we definitely needed to identify this species," says Bakac, "so we got in touch with Eckard Münck at Carnegie Mellon. He's the world expert in Mössbauer spectroscopy, which is considered to be the most definite of spectroscopic methods when working with iron."

Continued on page 9...



Preserving a life: Andreja Bakac demonstrates the device that allows her and Oleg Pestovsky to generate and freeze iron(IV) in less than a second, preserving the fragile sample, which would otherwise live only 10 seconds at room temperature. The innovative apparatus was the brainchild of both Carnegie Mellon's Eckhard Münck, who came up with the idea, and the Ames group, who built and perfected the device.

“RADICAL” MEANS *Continued from page 8...*

Bakac explains that iron(IV) is a short-lived species, lasting about 10 seconds at room temperature. Although that is orders of magnitude more than some intermediates she works with that live only milliseconds or microseconds, Bakac notes that the 10-second life of iron(IV) did present a problem. “It was a lot to deal with when we were producing the material here and the group that was analyzing it was in Pittsburgh,” she says. Fortunately, the two research teams collaborated and found a way to get a sample from Ames to Pittsburgh before it “died.”

“We designed and built a device that allows us to generate iron(IV) and immediately cool it down to liquid nitrogen temperature and freeze it in a fraction of a second,” says Bakac. “We then packed the solid into a liquid-nitrogen-cooled dewar and shipped it overnight, as quickly as Fedex would go, to Pittsburgh. There, the Carnegie Mellon team collected the Mössbauer spectrum at liquid helium temperature.”

Mössbauer studies of the Ames samples done under Münck’s direction by Carnegie Mellon research associate Emile Bominaar and graduate student Sebastian Stoian proved the intermediate generated by Bakac and Pestovsky was exactly what they were hoping for - the iron(IV) species.

In addition to the Carnegie Mellon work, contributions by Lawrence Que and his postdoctoral associate, Xiaopeng Shan, at the University of Minnesota further confirmed the iron(IV) species. “They took our sample to Stanford University to get an X-



Very “cool” stuff: Although you can’t see it in this photo, a delicate spray of newly generated iron(IV) has frozen instantly to the inner walls of this copper cylinder that has been cooled to liquid-nitrogen temperature (77 Kelvin, or minus 321 degrees Fahrenheit). The frozen solid sample can be packed in a liquid-nitrogen-cooled dewar and shipped overnight to Carnegie Mellon in Pittsburgh for Mössbauer analysis.

ray absorption spectrum, or XAS, and that spectrum was consistent with the oxidation state of iron (IV),” says Bakac.

The Mössbauer and XAS analyses, combined with all the chemistry carried out at Ames Lab, told Bakac and Pestovsky what iron(IV) looks like and what it does. “For the first time we knew what both iron(IV) and OH radicals would do and could figure out which one is involved in the Fenton reaction,” says Bakac. “Nobody knew how to make iron(IV) or look at it before so that we could distinguish between the two.”

Identical experiments, different products

At that point, knowing the nature of the intermediate, Bakac and Pestovsky decided to carry out some very specific experiments. In one set of experiments, they oxidized a substance with iron(IV), and in a parallel series of experiments with an identical substrate and under identical conditions, they oxidized the substrate using the Fenton reaction.

“The products were different,” says Bakac. “And more than that, the products generated from the Fenton reaction were identical to those known to be formed from reactions involving OH radi-

cals. So we both ruled out iron (IV) as the intermediate and indirectly confirmed OH radicals,” she says.

Bakac and Pestovsky’s work took about a year, and not every sample was good. “There were times when we thought our samples weren’t surviving the trip, so on one occasion Oleg actually traveled to Pittsburgh with all of our equipment to make the sample there,” recalls Bakac. “It’s been rocky at times, but we knew we had something special, and that kept us going.”

In addition to ruling out iron (IV) and indirectly establishing OH radicals as the Fenton intermediate, Bakac and Pestovsky’s research shows iron(IV) to be a very useful chemical species. “The fact that iron(IV) is very short-lived doesn’t matter because in catalytic reactions you make it *in situ* and use it immediately,” says Bakac. “There are certainly situations in chemistry and biology where various iron (IV) complexes, including our aqueous iron(IV), may be involved,” she suggests, then adds, “just don’t go searching for iron (IV) anymore in Fenton chemistry.”

“WE DESIGNED AND BUILT A DEVICE THAT ALLOWS US TO GENERATE IRON(IV) AND IMMEDIATELY COOL IT DOWN TO LIQUID NITROGEN TEMPERATURE AND FREEZE IT IN A FRACTION OF A SECOND.”

AMES LAB AND ISU HOST 9TH INTERNATIONAL CONFERENCE ON QUASICRYSTALS

Spin a globe and most people could quickly point to Beijing, Tokyo and Zürich and could probably locate Stuttgart and Bangalore, India, without too many problems. Okay, now how about finding Ames, Iowa?

Fortunately, Ames is as well known as the rest of those cities among quasicrystal researchers, thanks to the leading research that's taken place at Ames Laboratory over the past two decades. And that's why Ames played host to the Ninth International Conference on Quasicrystals last May. More than 150 researchers from 22 countries were on hand for the event, May 22-26.

This was the premier conference for this field, and it is only held every two to three years," says conference co-chair and materials chemist Cynthia Jenks. "The only other U.S. site was St. Louis in 1992, so we feel quite honored to serve as hosts. Ames Lab and Iowa State are internationally recognized for work in the field, and we hosted the conference based on that strength."

The focal point of the conference, quasicrystals, are metallic alloys that defy conventional rules of crystallography because the atoms are well-ordered, but not in a typical periodic manner. First discovered in 1982, quasicrystals were met with skepticism early on, but doubt has largely been displaced due to advances on many fronts to decipher these mysterious materials.

The conference looked at all aspects of quasicrystals," says Jenks. "We accepted 215 abstracts in more than a dozen areas of study. And for the first time, we also invited scientists working in the broader area of complex intermetallic alloys."

Another first for the conference was the awarding of the inaugural Jean-Marie Dubois Award, named for one of the key researchers in the field. Dubois, director of research at the Centre National de la Recherche Scientifique in Paris, was a presenter at the conference and was recently named as the 2007 winner of The Minerals, Metals & Materials Society's (TMS's) prestigious Robert Franklin Mehl Award.



Jean-Marie Dubois
Director of Research
Centre National de la Recherche

"We created the Dubois Award as a way to honor Jean-Marie for his many contributions to the field and at the same time recognize others who are making a sustained effort in quasicrystal research," says Pat Thiel, conference co-chair, Ames Lab senior chemist and ISU Distinguished Professor of chemistry. "His career has been an amazing blend of science and engineering, and he has the rare ability to speak across disciplines, bringing new insights and deeper understanding to the many researchers he has worked with over the years."

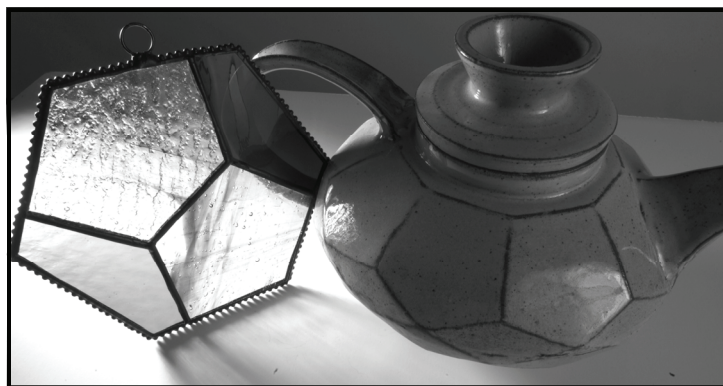
Dubois' ties to Iowa State go beyond the award bearing his name. He has worked closely with Thiel's research group and was awarded an Honorary Doctorate of Science degree from ISU in 2000. The Dubois award, which includes a plaque and a monetary prize, was administered by the ISU Foundation. Joining Dubois on the conference program were several other key figures in quasicrystal research. Dan Shechtman, Denis Gratias and Alan Goldman opened the conference on May 22 with a special session on the discovery of quasicrystals, including little-known history. Shechtman, of the Technion in Israel, discovered the materials and worked with Gratias and others to announce the discovery in 1984. If Shechtman's name sounds familiar to Lab employees, it's because he was on site as a visiting scientist since the first of the year.

Goldman, Ames Lab's division director for Science and Technology and a senior physicist, talked about his theoretical debate with Nobel Prize-winning scientist Linus Pauling over the existence of quasicrystals, and Dubois talked about the future of the materials.

Another highlight of the conference was a May 25 panel discussion on stabilization of quasicrystals. Led by Walter Steurer, Marc de Boissieu, Michael Feuerbacher, and Chris Henley, the session specifically addressed thermodynamics, cluster stability, and the role of defects and disorder, including vacancies and phasons.

The goal of this session was to take a broad look at this controversial area, identify common ground and terminology, and describe

Continued on page 11...



Conference Glassware

ICQ9 even has its own glassware. On the left is a sun-catcher, inspired by a dodecahedron quasicrystal grown by Ames Lab's Paul Canfield. At right is a teapot designed by English potter David Warrington, who produces pots with a symmetry to match the year of the conference. This conference's pot has nine-sided symmetry and was available to conference participants by special order.

QUASICRYSTALS *Continued from page 10...*

any consensus that might emerge within the group,” Jenks says. “We also worked to define the open problems and then identify specific experiments or calculations that are needed to help solve those problems.”

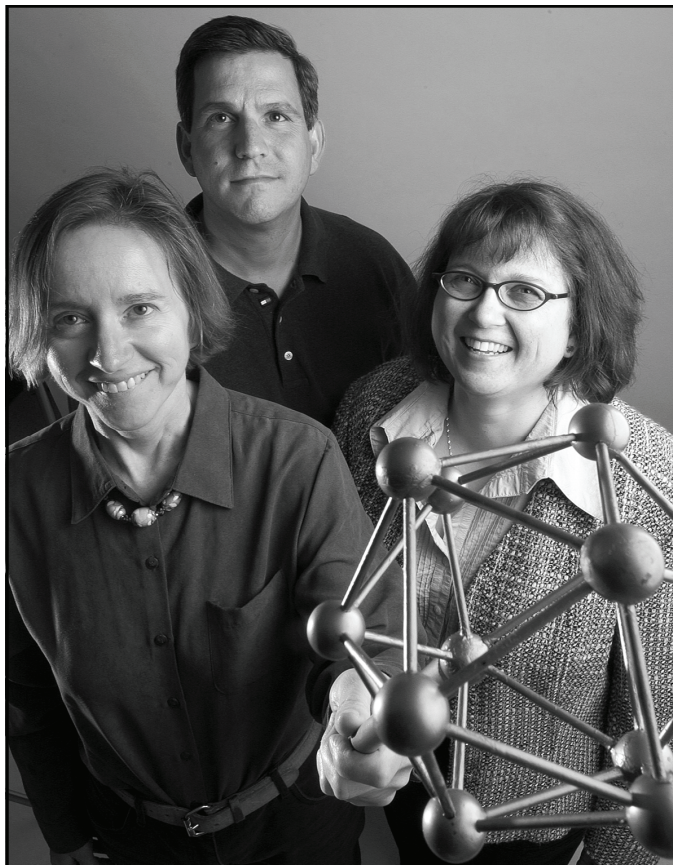
Jenks added that the results of the panel discussion were summarized as part of the conference proceedings, published in *Philosophical Magazine*.

There was also an introductory session on Sunday, May 22, prior to the actual opening of the conference. Walter Steurer from the ETH- Zürich, presented a tutorial entitled “Quasicrystals - The Crystallographer’s Point of View.”

Ames Lab was well represented on the scientific program with two speakers, Matt Kramer and YaQiao Wu, and 13 poster presenters. Besides presentations, poster sessions and discussions, all of which took place at the Scheman Building, conference participants had opportunities to sample Iowa and American culture. The group visited Living History Farms in Des Moines and also attended an Iowa Cubs minor league baseball game.

Pulling together an event of this magnitude was no small task. Jenks, Thiel and fellow co-chair, senior scientist Dan Sordelet, relied on a local organizing committee to carry out the leg work. That committee included researchers Jim Anderegg, Matt Besser, Joe Burnett, Alan Goldman, Matt Kramer, Tom Lograsso, Shechtman, and Dong Mei Wu.

Program assistant Stacy Joiner served as the conference “quasi-secretary.” The conference logo, drawn by former ISU student



Melissa Meyers, showed two types of quasicrystals grown at the Lab, but that can also be interpreted to represent grain silos and corn. Besides the logo, a quasicrystal-inspired, stained-glass suncatcher was designed for the conference and was presented to each attendee.

Pat Thiel, left, holds the International Conference on Quasicrystals “official sceptor,” which has been passed from one conference organizing committee to the next since 1986. Thiel, Dan Sordelet and Cynthia Jenks co-chaired the conference, which brought more than 150 researchers from 22 countries to Ames.

Visit: www.ameslab.gov

AARON SADOW *CONTINUED FROM COVER...*

that has been shown to give effective stereochemical selectivity for a range of ligands in a large host of asymmetric catalyses. Furthermore, the ligand is isoelectronic with the ubiquitous cyclopentadienide ligand (Cp) and tris(pyrazolyl)borate (Tp) ligands. As a monoanionic tridentate C_3 -symmetric ancillary ligand, its geometry creates an asymmetric pocket for a reactive metal center to promote interesting transformations and catalyses. Thus, it is expected that complexes containing this ligand will afford asymmetric variants of the prominent chemistries developed with Cp, Tp and their derivatives as well as new transformations.

Using this ligand class, Sadow will synthesize complexes of the lanthanide and transition-metal series and attempt to develop new catalytic asymmetric transformations. In particular, he is focusing on catalytic chemistries based on C–H activation and insertion steps. This work will include traditional preparative organometallic chemistry, detailed mechanistic investigations, development of new methods in asymmetric catalyses, and the application of these reactions toward important problems in science.

ALUMNI AWARDS

Michael P. Doyle, Ph.D., 1968

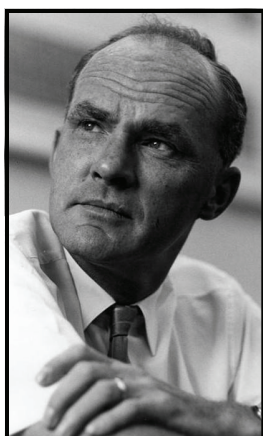
University of Maryland Professor and chair of the department of chemistry and biochemistry Michael P. Doyle will be the recipient of the 2006 Harry & Carol Mosher Award of the ACS Santa Clara Valley Section.

The Mosher Award recognizes outstanding work in chemistry, advancing chemistry as a profession, and service to ACS. Doyle, who is active in ACS, has long-standing recognition as an educator and scientist. He received the society's highest award in chemical education, the George Pimentel Award, in 2002, and has been the recipient of several awards for his research.

He also received the American Chemical Society's Arthur C. Cope Scholar Award, sponsored by the Arthur C. Cope Fund. The Cope Scholar Awards recognize excellence in organic chemistry and are considered to be one of the most prestigious awards in the field of chemistry.



Michael P. Doyle
Professor and Chair
University of Maryland



George S. Hammond
Distinguished Professor of Chemistry

George S. Hammond

(1921—2005)

George Hammond received the 2003 Othmer Gold Medal. He "is widely credited with creating the discipline of organic photochemistry, which laid the groundwork for the photochemical production of immensely complex computer chips. As an educator, he was a major innovator in the teaching of chemistry. After three decades in academe, Hammond led research and development at Allied Signal for nearly a decade. He has received many honors, including the very rare honor of lending his name to an important milestone in chemical discovery — the Hammond postulate."

Bruce D. Roth, Ph.D., 1981

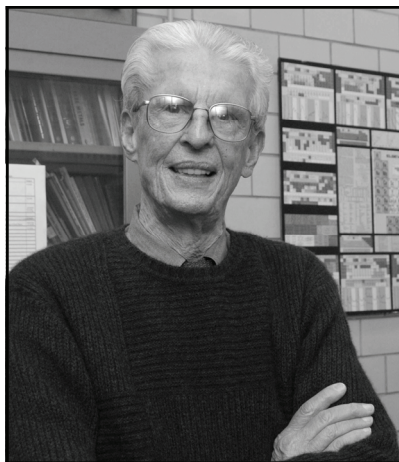
Bruce Roth of Plymouth, Michigan, received Iowa State's Distinguished Achievement Award. Bruce has made many significant discoveries in a stellar research career that spans 22 years, but one stands out more than the others. Roth invented atorvastatin, better known as *Lipitor*, which has become the largest selling drug in pharmaceutical history. More important than its sales records — more than \$10 million in 2004 for Pfizer — is the fact that *Lipitor* is used by 45 million people throughout the world to lower cholesterol levels, improve their quality of life and significantly reduce the risk of life-threatening cardiovascular conditions and diseases.



Bruce D. Roth
Vice President of Chemistry
Pfizer Global Research
and Development

FULL-TIME PART-TIMER

EVEN AFTER 52 YEARS ON CAMPUS, CHEMIST JOHN CORBETT ISN'T SLOWING DOWN



John Corbett
Distinguished Professor
of Chemistry

John Corbett scoffs when anyone suggests he should slow down.

"Why should I do that?" he asks. "I'm having so much fun. What else would I do?"

For the past 52 years, Corbett has been a chemist at Iowa State University and the Department of Energy's Ames Laboratory. His only concession to slowing down is moving to half-time.

"I'M HAVING
SO MUCH
FUN. WHAT
ELSE WOULD
I DO?"

But even at half-time there is no such thing as a 40-hour week for Corbett, Distinguished Professor of Liberal Arts and Sciences, Professor of Chemistry and Senior Chemist with the Ames Laboratory.

He continues to receive funding from the Department of Energy and recently had his grant from the National Science Foundation renewed. Four "top-notch" postdocs work in his lab, with another coming to campus soon.

He travels to meeting after meeting and has several talks scheduled. Two international organizations have invited Corbett to speak later this year, one each in the Ukraine and India, and he continues to publish around 12 articles a year.

Doesn't sound much like someone that's slowing down any time soon.

"There's nothing else I like as much as what I'm doing here," Corbett said. "If you enjoy what you're doing why do anything else? Continuing my work is my own doing. No one is pushing me. I push myself."

Pushing himself is something Corbett has done since he came to Iowa State as an assistant professor in 1952. He says that his success has had a lot to do with "imagination, luck and serendipity."

"There are times when we (his research group) do something, we find something new and unexpected," he said. "We're still exploring. That's the secret to our success."

Almost since the day Corbett stepped foot on campus he has had success. His research interests have revolved around inorganic solid-state chemistry emphasizing strong metal-metal bonding.

"If we didn't have a lot of successes I would probably be doing something else," he said. "I have been able to obtain funding for

our research every year that I have been at Iowa State, including the past 20 years from NSF.

"That has made me pretty independent."

It has also made Corbett highly recognizable in his field. A member of the National Academy of Sciences since 1992, Corbett has received just about every award his profession offers. He has received both awards in inorganic chemistry given by the American Chemical Society, including the Award for Distinguished Service in the Advancement of Inorganic Chemistry.

He is a fellow of the American Association for the Advancement of Science, has received a Senior Scientist Award from the Humboldt Foundation, and he has two DOE Awards, for Outstanding Scientific Accomplishments and Sustained Research in Materials Chemistry.

This summer, he will add another honor to his resume when he receives the prestigious Spedding Award in rare-earth science research at the 24th Rare Earth Research Conference. During the proceedings, he will present an awards lecture on his many years of reduced rare-earth metal compounds. Rare earth elements on the periodic table include cerium, gadolinium and ytterbium and lie between lanthanum and lutetium.

Corbett is the 11th recipient of the Spedding Award, which is given in recognition of excellence and achievement in research centered on the science and technology of rare earths. Former Iowa State colleague Karl A. Gschneidner was the sixth recipient.

The Spedding Award honors Frank Spedding, a long-time Iowa State chemistry professor and one of the nation's leading atomic scientists. Spedding was a pioneer researcher with rare earths and organized and directed the chemistry phase at Iowa State of the historic Manhattan Project.

SURFACE PATTERNING

Although the application of microarray chip technology to the study of carbohydrates is relatively new, it holds great promise for disease detection and vaccine development in animals and humans.

A research team led by Nicola Pohl, assistant professor of chemistry, has developed a new surface patterning method to make carbohydrate chips for bioscreening.

"The success of DNA and protein microarrays in chip format for biosample screening using small sample volumes has led to a variety of technologies that diagnose many diseases," Pohl said. "Extending this concept to other biomolecules has been challenging."

The new method developed by Pohl and graduate students Kwang-Seuk Ko and Firoz Jaipuri is based on a fluororous TeflonB.-pan like surface interacting with fluororous-tagged compounds. Unlike most other molecules, these fluororous-tailed sugars stick to the Teflon-type surface, which allows the tagged carbohydrates to be immobilized in a microarray format on standard glass microscope slides.

"The surprising part was that this fluororous interaction was strong enough to allow standard bioassays on the chips without rinsing away the sugars," Pohl said.

The Teflon-like tail also can be used to speed up the synthesis of complex carbohydrates. The fluororous-based microarray method should rival the speed and ease of solid-phase synthesis currently used for the commercial production of DNA and peptides, Pohl said.

"It will allow a whole range of carbohydrate chips to be produced, including chips that contain sugars of particular interest to plant scientists," said Pohl, a researcher associated with the Plant Sciences Institute.

The method should also work with other molecules, such as peptides, on the same chip to screen for antibodies correlated with diseases such as bacterial or fungal infections and diseases with known biomarkers (molecular indicators) such as cancer. And the new chips can help screen new biocatalysts that act on carbohydrates and discover new proteins, such as plant lectins, that

bind to specific carbohydrate sequences.

The researchers' initial work demonstrating the fluororous-based carbohydrate chip method was published in the Sept. 2 online edition of the *Journal of the American Chemical Society*. The research showed how two plant proteins (from jack beans and a bushy plant) only bind to specific sugar structures.

"The same principle can be used to screen for antibodies that bind to certain sugar structures on pathogens to let us know that that person or animal has come in contact with the pathogen and to let us know which carbohydrates the person or animal generates an immune response against in order to develop carbohydrate-based human and animal vaccines," Pohl said.

Nicola Pohl is the recipient of a \$45,000 Alfred P. Sloan Research Fellow award for 2005.

Pohl was awarded one of the 116 fellowships given annual by the Alfred P. Sloan Foundation in one of seven academic fields. She is the only recipient at Iowa State.

Nicola Pohl
Assistant Professor



"THE SUCCESS OF DNA AND PROTEIN MICROARRAYS IN CHIP FORMAT FOR BIOSAMPLE SCREENING USING SMALL SAMPLE VOLUMES HAS LED TO A VARIETY OF TECHNOLOGIES THAT DIAGNOSE MANY DISEASES"

RENEE HARRIS RECEIVES PROFESSIONAL AND SCIENTIFIC OUTSTANDING NEW PROFESSIONAL AWARD



Renee Harris, Program Coordinator in the department of chemistry, is pictured with Iowa State's President, Gregory Geoffroy

Renee Harris has been instrumental in revitalizing and improving many areas in the department of chemistry, including graduate student recruitment and retention, faculty recruitment and alumni relations. She also provides exceptional support for the department's National Science Foundation-funded Research Experiences for Undergraduates project and for a privately funded program that matches graduate student mentors with undergraduate students.

To contact Renee with alumni news and updates, please email her at rmharris@iastate.edu.

EXCERPTS FROM “*THE GILMAN PIPELINE*” A HISTORICAL PERSPECTIVE OF AFRICAN AMERICAN PH.D. CHEMISTS FROM IOWA STATE UNIVERSITY BY DR. SIBRINA COLLINS

As an undergraduate chemistry major at Wayne State University (Detroit, Michigan), I began to recognize early that very few African Americans pursued graduate degrees in chemistry. There were many of us pursuing undergraduate chemistry degrees at WSU, but I noticed there were few pursuing Ph.D.s. And I didn't quite understand why.

I first became aware of Professor Henry Gilman while pursuing my Postdoc at Louisiana State University. I had the opportunity to coauthor a paper focusing on the successes of the LSU Chemistry Department with my Postdoc advisers Isiah M. Warner, George Stanley and Steve Watkins. I was absolutely amazed and thrilled to learn of Gilman's efforts so many years ago. To my surprise, a survey of the literature indicated that very little attention had focused on Gilman's recruitment and retention efforts of African Americans in chemistry. From that moment, I decided that I wanted to tell this story...

The 1920s and 1930s were tumultuous times in our nation's history. The Jim Crow segregation laws were well established in the southern states, lynchings were common occurrences, and the organizations such as the NAACP and the National Urban League worked tirelessly to achieve equal rights for African Americans. In addition, very few African Americans had the opportunity to pursue a higher education – in any discipline — during this time period. Despite facing insurmountable social and economic challenges, some African Americans were able to pursue graduate degrees in various fields.

Iowa State University has a very interesting and remarkable

history producing African American chemists, beginning with George Washington Carver, an agricultural chemist. He earned his M.S. degree from Iowa State in 1896, and later invented hundreds of products from peanuts and sweet potatoes. He spent the remainder of his very successful career on the faculty at Tuskegee Institute (now Tuskegee University).

In the 1930s, Henry Gilman, an organic chemistry professor at ISU began a remarkable legacy producing African American Ph.D. chemists from ISU. Gilman was opposed to racial discrimination against African Americans and frequently had African American students in his research group at ISU. Considering only 42 Black Americans earned a doctorate in chemistry in 2003, Gilman's efforts are truly remarkable. In fact, in the 1950s, ISU had at least 16 African Americans enrolled in the Department of Chemistry. This “critical mass” of students served as a key retention factor for the success of these students in the department.

The story of the “Gilman Pipeline” begins with Nathaniel Oglesby Calloway. Calloway attended Iowa State as an undergraduate and earned a B.S. degree in 1930. Three years later, Calloway earned a Ph.D. in organic chemistry under the direction of Gilman.

Samuel Procter Massie is arguably one of the most celebrated chemists of the modern era. Originally from Arkansas, Massie earned his undergraduate degree from the Agricultural Mechanical & Normal (AMN) College of Arkansas (now the University of Arkansas at Pine Bluff). He earned his master's degree in

chemistry from Fisk University in 1940, and was encouraged by his professor, Nathaniel Calloway, to pursue a doctorate at Iowa State University. Gilman was Massie's graduate adviser, and he earned his Ph.D. in chemistry from Iowa State in 1946. Massie's research efforts focused on many aspects of synthetic organic chemistry, including the chemistry of phenothiazines.

Dr. Massie was indeed a catalyst holding several key positions throughout his celebrated career including Professor and Chairman of the Department of Chemistry at Langston University, President of the Oklahoma Academy of Science, Chairman of the Department of Chemistry at Fisk, Professor of Chemistry at the United States Naval Academy and Associate Program Director at the National Science Foundation.

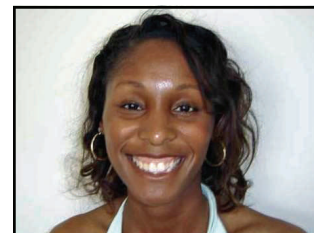
Sadly, Dr. Samuel P. Massie passed away April 10, 2005. He received numerous awards over his career including the NOBCCChE Henry A. Hill Award and the White House Lifetime Achievement Award for Contributions to Science and Technology and Community Service in 1988. In 1998 he was named as one of the Top 75 Distinguished Contributors to the Chemical Enterprise by *Chemical and Engineering News*.

Increasing the number of African American Ph.D. chemists remains a serious problem, and Gilman's efforts to improve these statistics is truly remarkable for his time. Gilman had at least eight African American students earn Ph.D.s from his laboratory over the course of his remarkable career. His efforts ultimately touched the lives of thousands of students. Dr. Costello Brown

fittingly summarizes Gilman's efforts by stating the following, “It should be noted that Gilman had the courage to recruit Black students long before it was the generally accepted thing to do. He established a strong pipeline to HBCUs (Historically Black Colleges) and sent his Ph.D. graduates back to these institutions to teach. These professors had a major impact on the lives of thousands of Black students attending HBCUs. In fact, Gilman served on the Board of Trustees of Tuskegee University for several years.”

Today, there are many “Henry Gilmans” or “human catalysts” who are working tirelessly to populate the proverbial pipeline of African American chemistry graduates. But ultimately more “human catalysts” and more departments of chemistry across the nation will need to make more of an effort to create a diverse scientific workforce. Not only because it is the politically correct thing to do, but because like Gilman it is simply the *right* thing to do.

For a copy of “The Gilman Pipeline” in its entirety, please contact rmharris@iastate.edu.



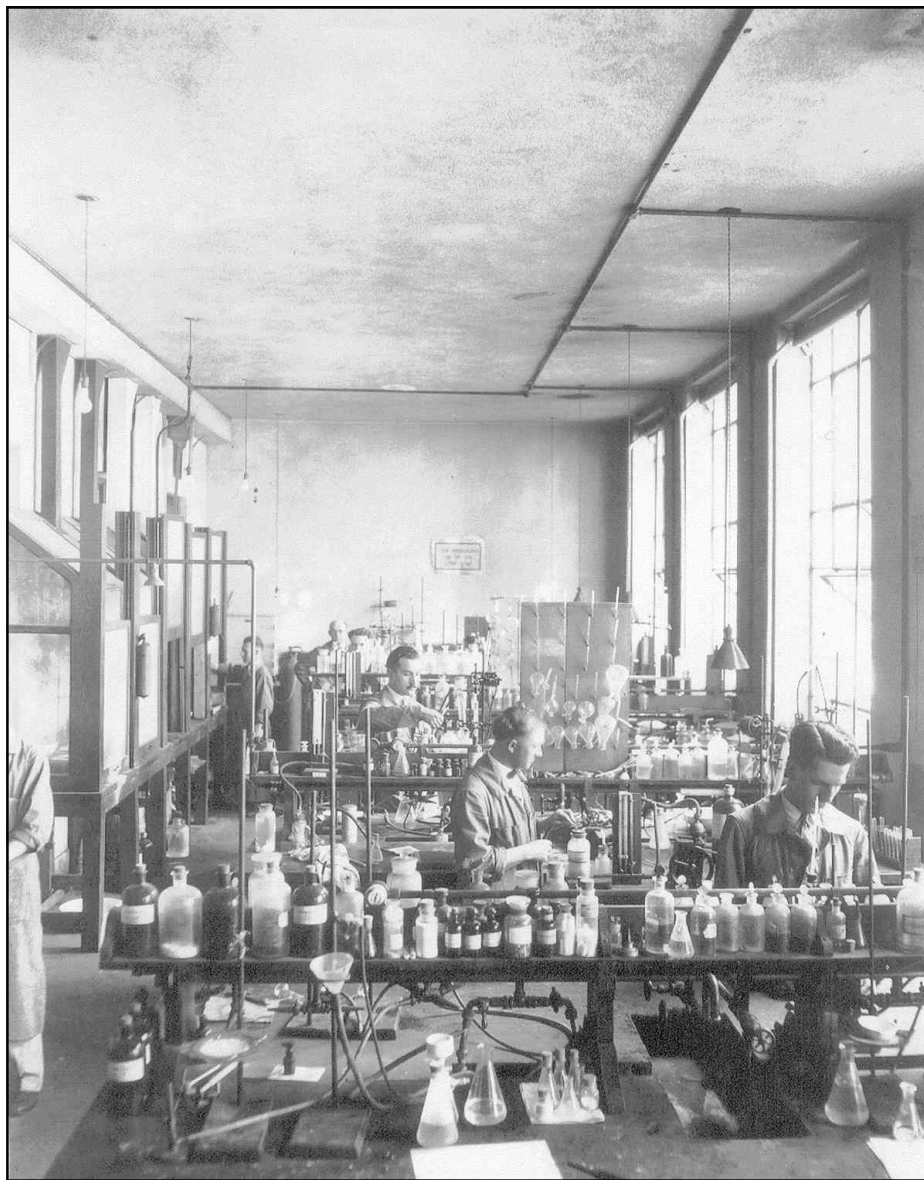
Sibrina N. Collins
Assistant Professor
Claflin University

FOR THE ARCHIVES

FROM INGO H. PETERSEN

Browsing through our collection of photographs recently, I came across a photograph of graduate students in Henry Gilman's research laboratory. Lloyd L. Heck is pictured in the photograph, third person from the left at the back of the laboratory. I thought you might like to have this for the department archives.

Lloyd was a student at Iowa State from 1926 through December 1930, when he graduated with his Ph.D. He had come to ISC with a Master's degree from Colorado State at Fort Collins, Colorado. Stanton Harris was one of the group at the same time and probably graduated when Lloyd did.



Lloyd had employment in several locations during the Depression years — with General Motors in Detroit; Standard Oil in New Jersey; Mississippi Women's College in Hattiesburg, Mississippi; Limestone College in Gaffney, South Carolina; and finally Merck and Company in Rahway, New Jersey. Until he died in October 1948, he was head of Factory Six at Merck's Rahway location, where he oversaw the manufacture of Vitamin B₆, B₁₂ and possibly sulfa drugs, among other products. Stanton Harris went first to Rockefeller Institute and then to Merck, where he spent his entire career in research labs.

At the back, first on the left is facing a hood, second from the left is facing the camera (this might be Gilman himself), and the third from the left also facing the camera, is Lloyd. The person in the center of the foreground, facing right at the second lab bench may be Stanton A. Harris. This photo was taken sometime between August 1926 and December 1930.

WHAT MAKES A FUEL MEMBRANE TICK? USING NMR TO PROBE NAFION®'S STRUCTURE

One of the keys to hydrogen fuel-cell technology is a thin, plastic film that “magically” separates water into its component parts of hydrogen and oxygen and at the same time releases electrons that generate power from the fuel cell. The membrane, known commercially as Nafion®, looks like a clear, heavy vinyl, but because of what it’s able to do, the material is more than worth its weight in gold.

Developed by DuPont, Nafion® has been around for roughly 30 years and is the commercial standard for the proton exchange membrane in fuel cells. Despite that history and commercial success, surprisingly little is known about its molecular structure or just how it works.

“It takes 24 of these to make a hydrogen fuel cell used in buses,” says Ames Laboratory chemist Klaus Schmidt-Rohr, as he held a roughly one-foot-square sheet of Nafion®, “so it costs several thousand dollars just for the membrane material. In order to develop more affordable alternatives, we need to understand the molecular structure of Nafion® and how it works.

NMR Probes Structure

Schmidt-Rohr has been studying the membrane material for about five years, primarily using a technique called nuclear magnetic resonance, or NMR. The spectroscopic technique basically involves placing the material within a magnetic field and measuring how energy levels of the atomic nuclei split as the material transitions from one energy state to another. In general, the more complex the structure of the material, the sharper or more distinctive its NMR signature will be.

“A material like polystyrene has a broad NMR signature because its structure is amorphous,” Schmidt-Rohr says. “Perfluorinated polymers such as Teflon® or Nafion® register these sharp peaks, indicating a surprising amount of order - in other words, a crystalline structure.”

According to Schmidt-Rohr, electron scattering techniques can provide an overall

view of the structure, while NMR allows “us to go segment-by-segment and look at the structure from the bottom up.”

Bent backbones

Previous studies of Teflon® show it has rod-like, helical structures that spin rapidly, about a million times a second. This “backbone” is hydrophobic - water hating - which helps explain its nonstick nature, and the rods pack neatly into parallel bundles.

In his study of Nafion®, Schmidt-Rohr saw a similar backbone pattern with some important differences. The signature line of the backbone showed up nicely, but it had “defects” along the chain approximately every 14 units.

“We thought now that we have these straight (backbone) elements, they’ll want to crystallize and pack nicely together,” he says. “We did one more experiment and looked at how one local piece is parallel to another. What we found really threw us off because they weren’t parallel. They weren’t random, but they weren’t nicely packed either.”

The literature on the structure of Nafion® proposed about a dozen different models, but none of them were consistent with the observations of Schmidt-Rohr’s NMR studies.

“We discovered these ionic sulfonate side groups with hair-like ends,” he says. “These structures are charged and are hydrophilic - they like water - while the backbone is hydrophobic.”

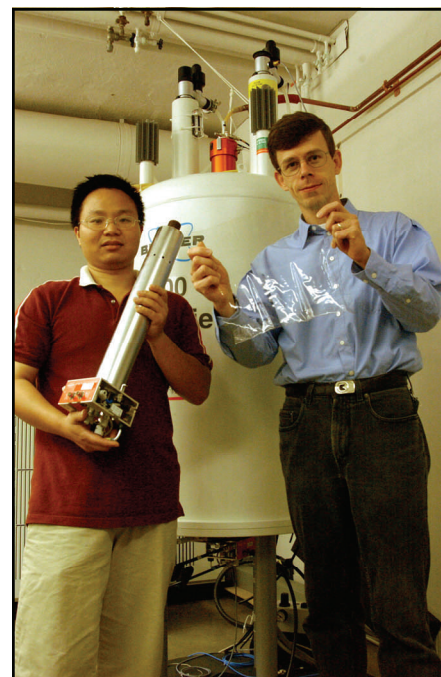
New model

Schmidt-Rohr developed what he calls an “alternating curvature model” that shows the backbones aligning along the bends and the hairlike structures clustering together. The material is crystalline in areas where the backbones align, roughly 10 percent of the overall structure. And in order for a polymer chain to have the required stiffness, the theory is that the density of the hairs matches the density of the backbone.

Moreover, the clusters of hydrophilic hairs form pores 3-5 nanometers in size that hold water. The next step is to figure out how the water moves from one pore to the next.

Unlocking the structural secrets of Nafion® may help not only in development of materials for fuel-cell membranes but other purposes as well.

“The material has these 3-5 nanometer pores,” Schmidt-Rohr says, “so if we were able to fill those with other counter-ions, it could provide optical properties for a variety of nanoscale applications.”



Klaus Schmidt-Rohr, right, and graduate student Qiang Chen stand in front of the nuclear magnetic resonance chamber. Tiny samples of Nafion® membrane are placed in a probe, which Chen is holding, and lowered into the high magnetic field within the chamber.

INVESTING IN MALIKA JEFFRIES-EL



Malika Jeffries-EL
Assistant Professor of Chemistry

"I DON'T
WANT TO BE
THE ONE
THAT PEOPLE
DON'T TALK
ABOUT A FEW
YEARS FROM
NOW"

Raising funds for undergraduate scholarships, graduate fellowships and faculty support was one of President Gregory Geoffroy's first initiatives at Iowa State.

The initiative, called "Investing in People," was designed to enhance the university's quality and was announced by Geoffroy during his installation as Iowa State's 14th president in October 2001.

During his remarks that day, Geoffroy also took the lead in the initiative. He announced that he and his wife, Kathy, had established a \$150,000 endowment with the ISU Foundation, providing annual support for the teaching and research program of an assistant professor in the College of Liberal Arts and Sciences during the first three years of the professor's appointment.

"The difference between a good university and a truly great university is the people," Geoffroy said during his installation. "Increased support for scholarships, fellowships and professorships is the best way to attract and retain great students and faculty."

The increased support from the Gregory L. and Kathleen C. Geoffroy Faculty Fellowship was an added incentive for Malika Jeffries-EL when she decided to come to Iowa State this fall as an assistant professor of chemistry.

"I had my choice of jobs," Jeffries-EL said. "But the department here is great and the faculty and staff have made me not only feel welcome, but they were really glad that I am here on the faculty. I didn't get that feeling everywhere I interviewed.

"And the Geoffroy Fellowship was a great recruiting tool. I was reluctant to come to the Midwest having spent my entire life on the East Coast, but that added incentive made the choice a lot easier."

Jeffries-EL is the first Geoffroy Faculty Fellow, selected at the discretion of the LAS dean. She knows being the first will add additional pressure to her job. "I don't want to be the one (Geoffroy Fellow) that people don't talk about a few years from now," she said. "I intend to do good work here."

For her three years as the Geoffroy Faculty Fellow, Jeffries-EL will have an additional \$4000 to \$5000 in discretionary funds. And she already knows how she will use the first installment.

Next May, the organic chemist will travel to Osaka, Japan, for the Seventh International Symposium on Function Pi-Electron Systems. The symposium, held every two years, brings together chemists, physicists, biologists and engineers to discuss recent developments in the field of pi-conjugated materials.

"This is an excellent conference in my field," Jeffries-EL said. "At the (2004) Cornell symposium I had lunch with a chair from (University of California) Berkeley and we had a nice discussion. By attending the conference in Japan I hope to meet others that I can collaborate with."

For now, however, Jeffries-EL is focused on getting her feet on the ground at Iowa State. Currently she is rolling up her sleeves, cleaning up and getting organized.

"I have a slight advantage in that I was the first Ph.D. advisee of my adviser (at George Washington University)," she said. "I've built a lab as a Ph.D. student. I learned a lot of things - not only what to do, but what not to do."

The organic chemist will investigate the design and synthesis of novel pi-conjugated polymers and the study of their properties in order to develop an understanding of the relationship between polymer structure and its properties. In particular she is interested in flat panel displays and sensing technologies.

She hopes to collaborate with faculty members not only in chemistry, but physics and chemical engineering at Iowa State.

Malika Jeffries-EL is the first Gregory L. and Kathleen C. Geoffroy Faculty Fellow in the College of Liberal Arts and Sciences.

CONTRIBUTIONS



Alsatia Mellecker
Senior Director of
Development

To all alumni and friends who supported the Department of Chemistry in 2005, a big thank you. Your gifts and pledges have been very appreciated by the students and the faculty of the Department.

It is impossible to overstate the impact of personal contributions to the Department of Chemistry. As state support decreases, the cost of delivering a first class education increases. Students have

seen double digit increases in their tuition rates, but that is not enough to make up for the difference. It is becoming clear that we must look to our alumni and friends for support.

To illustrate the difference private support can make, let me tell you about the generous support the Department received from Fred (B.S. '50) and Wanda Plagens. The Plagens have established an endowment that has funded several innovative programs in the Department, primarily for undergraduate students.

*This past academic year the Department was able to start a new test program called the Plagens Mentoring Program. Graduate students served as mentors for undergraduate students in Chemistry meeting regularly to discuss graduate school, professional opportunities, and research experiences. In return, the graduate students who participated felt

they made a contribution to the program and were paid a stipend from a gift from the Plagens. This was just one of eight programs the Department was able to fund for the 2004-2005 academic year.

*This last fall four undergraduate Chemistry students received tuition assistance from the *Plagens Chemistry Scholarship Endowment*.

*Four undergraduate students in the spring and two this summer will be offered research fellowships from the *Plagens Chemistry Scholarship*. The research fellows will each receive a scholarship, be assigned to a research project in the lab, and receive a salary for their work. Each student will be assigned to a research advisor. Fellows will also have opportunities to attend professional conferences and take field trips to industrial research sites.

The programs I have described are only available to students

because of the generous support from Fred and Wanda Plagens. These are the kinds of programs that make the difference between a good department and a great department. The Plagens hear from their scholarship recipients and research fellows each year; and, I'm sure as they read letters from grateful students, they feel they have made a wise investment.

There are many investment opportunities for alumni and friends to consider, and if you would like to discuss how you can get involved please get in touch with me. I would be very pleased to work with you. You can call me at 515-294-6431 or 866-419-6768. My e-mail address is amelleck@iastate.edu.

ANNOUNCEMENTS *Continued from page 6...*

AMERICAN CHEMICAL SOCIETY MEETING & EXPOSITION
MARCH 26 - 30, 2006
ATLANTA, GA USA

Please reserve March 27th from 6:00-7:30 pm to join us at the Alumni and Friends of Iowa State University Chemistry Social. Watch for a postcard to be coming to shortly to give you more details of location and additional activities.



Photo courtesy of AOCVCB

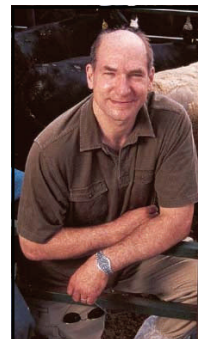


IOWA STATE UNIVERSITY

Chemistry Department
1605 Gilman Hall
Ames, IA 50011-3111

A NOTE FROM THE CHAIR

Jacob W. Petrich



Dear Friends of Chemistry and Iowa State University,

I wish you and your family the best of all good things for 2006.

As you may have noticed from the new photograph accompanying this letter, there has been a change in the Chairmanship of Chemistry. I am honored to assume this new responsibility and to follow in the steps of Gordie Miller, who served the Department tirelessly and selflessly with the utmost dedication and imagination for the past three years. He has provided an imposing standard to live up to and is now on a well-deserved sabbatical leave with his family in Germany.

The 2005-2006 academic year has erupted with an explosion of activity and excitement. Malika Jeffries-EL and Aaron Sadow arrived as new Assistant Professors in August. Emily Smith has agreed to join our faculty in August 2006. We are aggressively pursuing the hiring of other new faculty as this newsletter goes to press.

As we strive to build the ranks of our faculty by acquiring new energetic and imaginative scientists, we also strive to acquire a new Chemical Sciences Facility to complement Gilman Hall. A new Chemistry building is crucial to future growth and success of not only the Department but also the College and the University. At the November meeting of the Board of Regents, President Geoffroy eloquently and passionately stated that the acquisition of a new Chemistry building was the University's number-one priority. During the Regents' February meeting, the President will personally provide them with a tour of Gilman and again argue for our future needs.

Finally, we take time to remember Harvey Burkholder, Professor Adolf Voigt, and Professor George Hammond whose contributions have formed countless students and scientists.

If you have the opportunity to visit Ames, please stop by the Department. I welcome the occasion of meeting you and of showing you and talking to you about the exciting developments Chemistry is undergoing.

Yours sincerely,

A handwritten signature in cursive script that reads "Jacob W. Petrich".