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ChemChronicles

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BGSU Research Part of Photovoltaics Center

Photochemists at BGSU Want to Shed Light on the Future

The work of **Drs. Felix Castellano and Pavel Anzenbacher**, aimed at developing the next generation of photovoltaic materials much cheaper than today's technology, will be part of a newly established **Photovoltaics Innovation and Commercialization Center**, based at the University of Toledo.

This consortium has received $18.6 million in Wright Centers of Innovation funding from the state to create the center, part of Ohio's Third Frontier Project. **Photovoltaics deals with converting sunlight to electricity**, and research at the center will focus on advanced materials for use in constructing and developing solar cell arrays. Prototyping and demonstrating various photovoltaic system components, developing and installing a complete system, and graduate-level education and consumer awareness are also planned.

"It's quite a massive project," said Castellano, calling the center "a very broadly defined research program." It encompasses every facet of modern photovoltaic technology, and comprises 19 partners, also including Ohio State University—from higher education and the private sector.

Drs. Castellano and Anzenbacher became involved through their association with UT physics professors Alvin Compaan and Robert Collins, who is director of the project.

The two scientists "have established themselves as leaders in the field of molecular photonics," according to Dr. Heinz Bulmahn, vice provost for research. "BGSU's work in the photosciences has been recognized as a great strength for this institution and will contribute significantly to regional efforts to bring photovoltaics and photoscience-related research to an even higher level of prominence both nationally and internationally," he predicted.

While they may eventually lead to commercial products, which is a goal of the center and other Third Frontier programs, third-generation materials are still in the research and development phase, "holding promise but not proven," Castellano noted.

Crystalline silicon, he continued, is considered first generation, perhaps decades ahead of third-generation descendants such as the dye-sensitized solar cells that will be investigated further during the three-year project.

But he is optimistic about the future of those solar cells because of their efficiency and, especially, low expense.

Nanoparticles in paint are often titanium dioxide, which is readily available, cheap and a semiconductor that can be made into thin films with low processing costs, Castellano explained. "It's like dirt; you can do anything with it," he said about the compound. Attaching a dye sensitizer allows an onlooker to see the dye color in the films, he added, pointing out the potential use in architecture, for instance, of multicolored, photovoltaic (solar) panels on plastic.

Dr. Felix Castellano (left) and Dr. Pavel Anzenbacher

In addition, Castellano said, these materials—unlike silicon—work well in diffuse light, generating usable electricity earlier in the morning and later in the evening. The fact that it does not need direct illumination by the sun is one reason for this kind of panel's use, but more importantly, he said, it's inexpensive to produce.

Other possible uses of the technology are "where the military comes in," he said. Interest has been expressed, for example, in solar-powered tents that could be camouflaged with different combinations of dyes. Also, due to the flexibility and light weight of the films, they could be used to recharge batteries in the field and, because they're cheap, it wouldn't be a problem if a unit on the move had to leave them behind, according to Castellano.

Whatever the specific applications, the state is interested, through the center, in developing a comprehensive photovoltaics strategy and creating high-tech jobs that make Ohio a more desirable place to work, he said. "The expertise is in this region," he added, and the center's partners will be sharing theirs with each other during the project.

Dr. Ksenjia Glusac

Dr. Massimo Olivucci

Dr. H. Peter Lu

Dr. Alexander Tarnovsky

New Faculty
Join the Department

The Chemistry Department proudly welcomes four new faculty who have joined the department recently. Their area of research expertise will enhance and broaden the department's focus in photochemical sciences.

A specialist in physical chemistry, **Dr. H. Peter Lu** joins the department as an Ohio Board of Regents Eminent Scholar. Dr. Lu's research group centers on single-spectroscopy, studying the dynamics—or motions—of single molecules of proteins and enzymes as they conduct their biochemical functions.
(See more information about Dr. Lu's research on page 7.)

A graduate of Peking University in chemistry, Lu received master's and doctoral degrees in physical chemistry from Columbia University in 1987 and 1991, respectively. After working as a research associate at Northwestern University from 1991-95, he moved to the Pacific Northwest National Laboratory (Richland, Washington) where he became a chief scientist in the Chemical Sciences Division of the Fundamental Science Directorate.

Dr. Lu is eager to get back into a university environment where he can teach graduate students both in the classroom and the laboratory. "I really enjoy teaching, and I look forward to being able to make contributions to science and education."

Collaborating with him will be the renowned computational scientist **Dr. Massimo Olivucci** of Siena, Italy, recently hired by the department as an adjunct professor. Dr. Olivucci will divide his time between BGSU and the University of Siena and will be instrumental in developing a center for computational photochemistry at BGSU.

Dr. Olivucci received both his Ph.D. and M.S. degrees from the University of Bologna, Italy, and his research focuses primarily on investigating the reactivity of organic and biological molecules in their electronically excited states using conventional and novel computational tools. One major target of his work is mapping of the photon-induced "force field" which sets an equilibrium molecular structure into motion in realistic molecular environments.

Drs. Alexander Tarnovsky and **Ksenjia Glusac** joined the department as assistant professors and add a different dimension to the research already being performed in the department.

Dr. Glusac received her Ph.D. from the University of Florida followed by a postdoctoral fellowship at Stanford University. Dr. Glusac's research focuses primarily on photoinduced electron transfer in hydrogen-bonded donor-acceptor systems with the objective of determining how to control the electron flow in these systems by means of H-bond dynamics. Her aim is to discover new materials for solar cells and a new generation of photocatalysts.

Dr. Tarnovsky received his Ph.D. from S. I. Vavilov State Optical Institute in St. Petersburg, Russia, and his research targets two areas: developing a molecular-level understanding of the dynamics of chemical reactions occurring in solution as well as gaining a deeper and more detailed insight into the dynamics and mechanisms of ultrafast, photoinduced processes.

Welcome...

The Department of Chemistry is delighted that these outstanding researchers have joined our faculty and wish them a long and successful career at BGSU.

BGSU Team Turns Paint Into Marine Herbicide

By Jenni Laidman, Blade Science Writer, *The Toledo Blade*, Toledo, Ohio, April 2, 2007

What if you could turn one of the most popular liquid pesticides into a solid when you expose it to light?

Dr. Douglas Neckers and a team at the Center for Photochemical Sciences at Bowling Green State University did just that, **converting the active ingredient in Roundup into a light-curable coating that may keep boats from fouling with algae.**

Although this straightforward capability may add a long-lasting, potentially safe coating to the marine industry's resources, the invention has some interesting potential: It could allow technicians to imprint vegetation the way they imprint silicon chips.

Why would you want to print messages in algae? Dr. Neckers, director of the photochemical sciences center, doesn't know. But he figures someone could have a use for the invention, which he dubs "biophotoresists."

"Scientists worldwide will think of lots of other compounds they can make, and lots of real reasons to convert them to images," he said. "We have no pretense that it has any application at all, but the idea is there."

He said the familiar process by which computer chips are patterned was a similar trick without an application when it was created.

Dr. Neckers remembered his work 25 years ago on glyphosate, Roundup's active ingredient, when his lab received money from the Office of Naval Research to produce an herbicidal paint. His plan was to turn glyphosate into a complex of molecules called a polymer and used it as the anti-fouling coating.

It was no trivial task.
"I didn't have very high expectations," said Aneta Bogdanova, whose efforts created the polymer. "Just looking at the structure, I expected to have some difficulties."

Dr. Bogdanova was lead author on a paper on this work in the current issue of the journal *Biomacromolecules*. She is research and development director for Performance Coatings International in New Jersey.

The Office of Naval Research declined to comment on the research, saying it was too early to evaluate it, but BGSU is seeking a patent on the work.

Daniel Berger, a professor of chemistry at Bluffton University, also was involved with the research.

What is unique about this compound is that herbicide is actually bound into the polymer, and not simply a filler, and its release is "just barely detectable," he said.

Most marine anti-fouling paints work by slowly leaching chemicals that kill vegetation. Eventually, there is no herbicide left.

But this new material is a "very, very slow-release biocide," he said. "The release rate is just barely detectable. Yet it's herbicidal."

Its ability to operate as a "biophotoresist" is based on the fact that it is light curable. A surface covered with this compound could be etched with laser light. Or it could be covered with a template with a pattern cut in and then exposed to light. The exposed portions would become polymer, the remainder would wash away.
"What the end application of the technology would be is anybody's guess," Dr. Neckers said. "That's the way science works."

Dr.Tom Kinstle's 70th Birthday Celebration

Dr. Tom Kinstle celebrating with Doug Balogh (left) and Upali Weerasooriya (second from right) and his wife Vanitha.

BGSU Chemistry alumni Douglas Balogh and Upali Weerasooriya hosted a symposium honoring Dr. Tom Kinstle's 70th birthday—over a half a century of being both a student and educator of chemistry. The symposium was held on September 30, 2006, at the Bowen-Thompson Student Union and had over 100 attendees.

The day began with talks by friends and former students and concluded with a social hour and dinner recognizing Dr. Kinstle's accomplishments as an educator, a mentor, a scientist, and a friend.

A scholarship was established in honor of Dr. Kinstle. The scholarship exceeded its endowment goal of $25,000 and its first $1,000 scholarship was awarded last May to a chemistry major who had financial need and demonstrates academic excellence.

Thank you from Dr. Kinstle...

A sincere thanks to all of you who attended my birthday celebration and/or donated toward the scholarship fund. A special thank you to **Doug Balogh** and **Upali Weerasoooriya**. It was a great time. I'm sorry many of you could not attend. However, if you would like to make a donation to the scholarship fund or are interested in receiving one of the special coffee mugs that were distributed at the dinner, or if you just want to update me, please drop me a line or send me an e-mail (tkinstl@bgsu.edu).

Thanks again for your support and generosity!

— Dr. Tom Kinstle

Neocles Leontis Receives 2006 Olscamp Award for RNA Research

Dr. Neocles Leontis, professor of chemistry, has received the BGSU Olscamp Research Award for 2006. Given annually to a BGSU faculty member for outstanding scholarly or creative accomplishments during the previous three years, the award includes a $2,000 cash prize and a reserved parking spot for a year.

Leontis, who has been at BGSU since 1987, **has devoted his career to studying the very building blocks of life: DNA (deoxyribonucleic acid) and RNA (ribonucleic acid)—their structures, functions and interactions.** Using physical, chemical, biological and theoretical methods, he has not only made significant discoveries himself, but his work has helped other researchers around the world classify and integrate the knowledge they are producing.

"He is an acknowledged expert in nucleic acid structure," wrote nominator and research collaborator Dr. Helen Berman, a professor of chemistry and chemical biology at Rutgers University and director of the Protein Data Bank. "His very careful analysis of the available data has led to novel representations of RNA structures."

Leontis is particularly well known for the development of an RNA base-pair classification system that has been adopted by the Nucleic Acid Database, the international repository for RNA 3-dimensional structures. Developed in collaboration with Dr. Eric Westhof, director of the Institut Universaire de France, the classification is one of the building blocks for creating an RNA ontology, or naming system, according to chemistry department chair Dr. Michael Ogawa.

In recognition of his work in developing a nomenclature for RNA structures, the international RNA Society selected Leontis to lead the RNA Ontology Consortium. Begun in 2005, the five-year project is funded by a $500,000 National Science Foundation grant and is one of its Research Coordination Networks, whose goals are to "encourage and foster interaction among scientists" and to facilitate "innovative ideas for implementing novel networking strategies."

The ontology consortium is developing a common vocabulary and scientific concepts relating RNA structure and function to allow RNA scientists worldwide to communicate with one another and to integrate different kinds of information they obtain about RNA molecules. That will make it easier to turn molecular information into useful knowledge that can help scientists understand how different cells grow and develop as they do.

While some researchers focus on the sequences of RNA molecules, others study their 3-D structures. A major focus of the project will be to integrate the databases of RNA sequences and 3-D structure.

"Since the start of the grant, several meetings have been held in various parts of the world and, now, several laboratories are working together on the RNA ontology, each taking charge of an aspect of RNA structure," wrote Westhof. "This is a complex and delicate enterprise for which Neocles is gaining further respect and reputation."

Added Berman, "Much of the success of this effort is due to the leadership, energy, vision and intellectual contributions of Neocles Leontis."

Leontis has experience in both the sequences of RNA molecules and their 3-D structures. Methods he has developed for analyzing and classifying RNA structures have been adopted internationally to advance RNA structure prediction and simulation and RNA sequence analysis.

Another collaborator, Dr. Biao Ding of Ohio State University, wrote of Leontis's Isostericity Matrix that it "allows a researcher to predict the 3D structure of an RNA motif without experimentation." Leontis and Ding recently published results of a biological experiment testing Leontis's matrix in the prestigious *Journal of Virology*. The piece "received enthusiastic reviews for its novelty and expected high impact," said Ding. The two later presented the work at the American Society for Virology to great interest from both plant and animal virologists, Ding said, and several virologists have contacted Leontis for help investigating the 3-D structures of their viral RNA motifs.

Leontis is affiliated with the BGSU Center for Biomolecular Sciences and the Northwest Ohio Bioinformatics Consortium, and **is known internationally for his work on RNA structural bioinformatics** (the field of science in which biology, computer science and information technology merge). His work is supported by the National Institutes for Health and the American Chemical Society.

Students Introduced to **Forensics**

To help science come alive for students, BGSU has turned to the dead. Considering the popularity of the "CSI" television shows, the response hasn't disappointed.

Chemistry 177, Introduction to Forensic Science, was filled to the 30-student maximum virtually overnight when it was widely announced early last year and was full again last fall. The forensic science course is aimed at non-science majors, as is a course on "Life in Extreme Environments," which is being developed now for a planned debut next spring.

Both courses are part of an effort by the College of Arts and Sciences "to explore new and exciting curriculum offerings in the sciences," notes Dr. Roger Thibault, the college's executive associate dean for resources, planning, facilities and personnel.

"We have made it a high priority to enhance our non-major science courses that satisfy BG Perspective (general education) science credit with contemporary offerings that are attractive to students," according to Thibault. "We also hope that such offerings will encourage many students to consider majoring in science as well."

Dr. Stephania Messersmith, a visiting assistant professor of chemistry, was hired over a year ago to create and teach Chemistry 177, where students learn the nature of scientific evidence, how it's obtained and used in the scientific process, and how to solve problems using the scientific approach.

An analytical chemist, Messersmith points out that forensic science incorporates her specialty, along with many others in the sciences. Criminalistics, which she calls the primary textbook among the relatively few available in the field, was written by an analytical chemist, Richard Saferstein, she adds.

Mathematical and scientific concepts are kept on a fundamental level in her class, Messersmith says, but "we talk about a lot of the different facets" of forensic science, including basics of chemistry and analytical methods, DNA analysis, fingerprints, toxicological studies, document examination/authentication, and hair and fiber analysis.

"On 'CSI,' they say, 'Run it through the GC (Gas Chromatography) Mass Spectrometer,'" so the students talk about what that is and do some in-class projects analyzing data from it, she says.

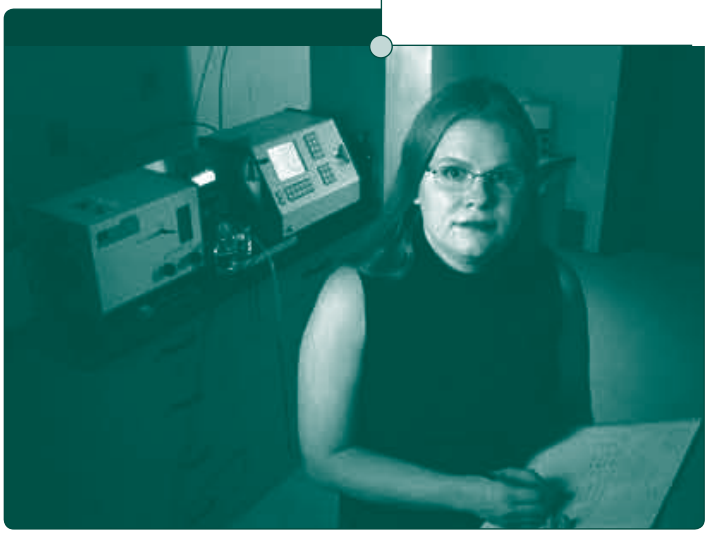
And is the stable of "CSI" shows to thank for the level of student interest? "I think that's a major reason why, but also the fact that forensic science has come a long way," Messersmith notes, elaborating that technology now affords the ability to perform complex analyses and provide considerable information.

Actual forensic science isn't as glamorous as the TV version, she continues, saying it's "a little disappointing" to see a portrayal of one person doing everything from gathering evidence to trying the eventual case. Also, "in the shows, you have unlimited funding to pursue every case," she adds, citing that as another of the "media misconceptions" about the field.

But "CSI" producers get a number of scientific details right, too, including appropriate use of instruments, says Messersmith, who earned her Ph.D. in chemistry from the University of Toledo. They know they have to be more accurate, she believes, because of the increasing number of viewers interested in forensic science.

This course also incorporates discussion of values issues such as not discarding data if it's not scientifically sound to do so and not having preconceived notions based on someone's presumed guilt or innocence, she explains. Questions about the chain of custody of evidence are also among those addressed. As Messersmith points out, forensic scientists "have to constantly know who has the evidence," and that it's not been tampered with.

"The challenge in a 100-level course really is presenting that (information) at a level where students can understand it with their background, and not oversimplifying things to the point where they're not true," she says, adding that a companion course is also planned for science majors.



Dr. Stephania Messersmith with an atomic absorption spectrometer, an instrument used by forensic scientists to analyze samples for gunshot residues or revealing soil or toxicological matter.

> *"We talk about a lot of the different facets of forensic science, including basics of chemistry and analytical methods, DNA analysis, fingerprints, toxicological studies, document examination/authentication, and hair and fiber analysis."*
>
> *—Dr. Stephania Messersmith*

Dr. Heinz Bulmahn (left), Dean of the Graduate College, and Dr. D.C. Neckers (right), Executive Director for the Center for Photochemical Sciences, hooding Brigitte Wex, recent Ph.D. graduate

Recent BGSU **Graduates**

Ph.D. in Photochemical Sciences

Jing Hong
Design, Characterization and Electron Transfer Properties of Synthetic Metallopeptides (August 2006), Adviser: Dr. M. Y. Ogawa

Radiy Islangulov
Low Power Photoluminescence and Photochemical Upconversion (December 2006), Adviser: Dr. F. N. Castellano

Jinyue Jiang
Investigation of Polyene-Related Fluorophores as ICT Probes for Cationic Polymerization (August 2006), Adviser: Dr. D. C. Neckers

Grigori Karpov
Activation of Enediynes by Photochemical Ring Contraction: Design, Synthesis and Reactivity of Cyclic Enediynes (May 2006), Adviser: Dr. V. Popik

Olesya Kharenko
De novo Design of Rubredoxin-like Electron Transfer Proteins (December 2005), Adviser: Dr. M. Y. Ogawa

Anton Kulikov
Development of Photocleavable Linker Groups for the Preparation of Photocleavable Liposomes and Caging Alcohols and Carboxylic Acids (August 2006), Adviser: Dr. V. Popik

Andrei Moiseev
Synthesis and Photochemistry of 3,5-Dialkyl-3,5-Dihydro-3,5-Diphenyl-4H-Pyrazol-4-Ones (May 2006), Adviser: Dr. D. C. Neckers

Albert Okhrimenko
Ultrafast Excited State Relaxation Dynamics of Electron Deficient Porphyrins: Conformational and Electron Factors (December 2005), Adviser: Dr. Michael A. J. Rodgers

Dmitry Polyansky
Novel Radical Peroxyester Photoinitiators: Decomposition Mechanisms and Potential Applications (December 2005) Adviser: Dr. D. C. Neckers

Alexandra Soldatova
Photophysical Properties of Metallonaphthalocyanines: Experimental and Theoretical Investigations (December 2006), Adviser: Dr. M. A. J. Rodgers

Nurtay Urdabayev
Development of Photoreactive Organic Molecules with Large Two-Photon Absorption Cross Sections (August 2006), Adviser: Dr. V. Popik

Brigitte Wex
Photochemical, Photophysical and Electronic Properties of Fused Ring Systems with Alternating Benzene and Thiophene Units (December 2005), Adviser: Dr. D. C. Neckers

Masters of Science Degree in Chemistry

Sergey Arutyunyan
Design of Multifunctional Molecules for Treatment of Acne: Synthesis of Skin Soluable Benzophenone Peroxyesters (December 2005), Adviser: Dr. D. C. Neckers

Dina Atoyan
Characterization of Zinc Telluride Thin Films on Glass Prepared by Low-Temperature Pulsed-Laser Deposition (August 2006), Advisers: Dr. B. Ullrich, Dr. M. A. J. Rodgers

Olga Katkova
Photochemical Isomerization and Stereoselective Thermal Cycloaddition Reactions of Conjugated Nitrones (December 2005), Adviser: Dr. T. Kinstle

Ekaterina Nikolaeva
Synthesis and Characterization of New Tetraalkyl Borate Initiators for Novel Polymerization Applications (August 2006), Adviser: Dr. D. C. Neckers

Victoria Piunova
Photopolymerizable "Roundup," Synthesis, Herbicidal Activity and Coating Formulation (August 2006), Adviser: Dr. D. C. Neckers

Udaya Rodrigo
Ultrafast Studies of Solvated Electrons in Liquid Media (December 2006), Adviser: Dr. M. A. J. Rodgers

Yaw Sarpong
The Binding of Estrogen, Progesterone and Glucocorticoid Receptors to Their Recognition Sites in a Nucleosome and the Effect of HMGB1 on the Binding Affinity (December 2006), Adviser: Dr. W. Scovell

Andrey Zamyatin -
Photophysical Investigation of Nickel Tetrapyrrole Macrocycles (May 2006), Adviser: Dr. M. A. J. Rodgers

James Zubricky -
Physical Models of Biochemically Important Molecules Using Rapid Prototyping Techniques (August 2006), Adviser: Dr. N. Leontis

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Faculty Research Focus

By H. Peter Lu, Ohio Eminent Scholar and Professor of Chemistry

Our research focus is on using single molecule approaches to understand molecular dynamic processes and the effects of the local environment on these processes in the condensed phase and at interfaces. Condensed phase chemistry is often dominated by special sites/structures and by sequences of reactions, both of which are difficult, if not impossible, to discern without an approach that avoids the averaging of time and local coordinates inherent in typical multiple-species, ensemble-averaged measurements. Single-molecule approaches are useful and unique in studying heterogeneous and complex systems because the inhomogeneity can be identified and/or removed by studying one molecule at a time. We have focused our research on two system classes: (1) reactions and conformational dynamics of proteins and protein complexes, and (2) electron transfer reactions on solid surfaces (interfaces) and across biological interfaces.

> *"One of the important discoveries we made is that interfacial electron transfer dynamics are highly inhomogeneous and fluctuate from molecule to molecule and from site to site."*

Single-molecule spectroscopy on protein conformational dynamics, including (i) combined approach on enzymatic reactions using single-molecule spectroscopy, MD simulation, and theoretical modeling; (ii) protein-protein interaction dynamics in cell signaling and protein-DNA interaction dynamics in DNA damage recognition; (iii) patch-clamp single-molecule spectroscopy and imaging, and (iv) photo-stamping studies of protein rotational diffusion from nanosecond to seconds. **The primary focus of this project is to understand the statically and dynamically inhomogeneous conformational dynamics that associate and regulate the complex protein reactions in biophysical systems that are extremely difficult to study using ensemble-averaged approaches.** We have demonstrated a systematic study of the dynamics of multiple-step and complex enzymatic reactions, revealing multiple intermediate conformational states and characteristics of the energy landscape. We reported a unique application of single-molecule imaging and ultrafast spectroscopy at sub-nanosecond to second time scale to probe the gramicidin ion channel conformational states correlated with single-molecule patch current recording in the lipid bilayers. Using this new approach, we have revealed a new multiple-state mechanism for gramicidin ion-channel dynamics. Our approach shows great promise for studying single-molecule ion channel protein conformational dynamics under active and "silent" states in living cells. Dynamic protein-protein and protein-DNA interactions involve significant conformational motions that initiate cascade interactions/reactions leading to specific cellular responses. Single molecule fluorescence intensity and polarization measurements have revealed the dynamic and inhomogeneous nature of protein-protein recognition/interactions. We have characterized the conformational fluctuation rates, and, for the first time, the fluctuating bound-unbound conformational states of the interactions.

> *"Our approach shows great promise for studying single-molecule ion channel protein conformational dynamics under active and "silent" states in living cells."*

Single-molecule interfacial electron transfer dynamics by site-specific fluorescence and Raman spectroscopy. interfacial electron transfer dynamics is important for solar-energy, environmental, and catalytic reaction systems that involve broad inhomogenieties of reaction dynamics under heterogeneous local environments. We have studied the complex and inhomogeneous dynamics of the single-molecule interfacial electron transfer process of dye-sensitized TiO_2 nanoparticle systems. By conducting single-molecule spectroscopy experiments, one can avoid molecular aggregation, multiple electron injection to a single particle, and multiple electron-cation recombination at a single particle, so that the intrinsic interfacial electron transfer dynamics can be specifically characterized. One of the important discoveries we made is that interfacial electron transfer dynamics are highly inhomogeneous and fluctuate from molecule to molecule and from site to site. Combining site-specific Raman spectroscopy, time-dependent wave-packet scattering spectral analyses, and single-molecule fluorescence spectroscopy, we have demonstrated the inhomogeneous and site-specific molecule-nanoparticle vibrational coupling and vibrational reorganization energy distributions. **Our work has begun to define a new approach of a noninvasive, vibration-selective, and single-molecule sensitive spectroscopic methodology to study single-molecule dynamics and energetics in chemical and environmental reaction systems.**

Our work has been highlighted in the media and numerous journals, including *Nature*, *The Scientist*, *Biological Imaging and Microscopy,* and *Opto & Laser Europe*. Our contributions to the broader scientific field have also drawn great interest, evidenced by invited review articles (for example, *Acc. Chem. Res.* and *J. Physics: Condensed Matter*) and book chapters, and invited talks at scientific institutes as well as at international conferences.

ChemChronicles

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ChemChronicles Alumni News

Where Are They?

Jennifer (Huntley) Aurandt graduated from the University of Michigan in 2005 with a Ph.D. in biological chemistry and is an assistant professor of chemistry at Kettering University (Flint, Michigan).

Kestutis Beninskas is an associate professor of biochemistry at the State University of New York (Oswego).

Aneta Bogdanova is employed with Performance Coatings International (New Jersey) as director of research and development.

Anna Fedorova is a senior research associate with Genentech, Inc. in San Francisco.

Tatiana Golovkova is a product development chemist with the Euclid Chemical Company (Cleveland, Ohio).

After graduating with an M.S. in biochemistry, **Sandra Gruin** did cancer research at the University of Pennsylvania Medical School. She has recently retired from Dupont and is now teaching chemistry at Montgomery Community College (North Carolina).

Terry Hammond received a Ph.D. in chemistry from Case Western Reserve University in 1985 and has been at Ashland, Inc. (Dublin, Ohio) since 1989. He is currently a research fellow in the Platform Technologies group.

Priya Hewavitharanage has been appointed assistant professor at Ball State University (Indiana).

Anna Kornilova was recently promoted to senior research biochemist with Merck, Inc. (Pennsylvania).

Natalia Mitin is a research assistant professor in the Department of Pharmacology at the University of North Carolina at Chapel Hill.

Ali Mokdad is a post-doctoral associate at the University of California in San Francisco.

Albert Okhrimenko has been hired as a senior research chemist with PPG Industries (Pennsylvania).

Dmitry Polyansky is a chemist with Brookhaven National Laboratory (New York).

Eric Rader graduated with a doctor of osteopathy from Ohio University in June 2006.

Stephen H. Thong received his Ph.D. from Northwestern University in 1990 and is currently director of Global Oral Care Product Development at Church & Dwight Co. (New Jersey).

Brigitte Wex has been appointed as an assistant professor of the Lebanese American University in Lebanon.

James Zubricky is a visiting assistant professor of chemistry at the University of Toledo (Ohio).