COLLEGE OF SCIENCE

Winter 2012 Newsletter

Department of Chemistry

Dr. Burrows has an extensive background in sensitive fluorescence based measurement techniques for qualitative and quantitative analysis. His work primarily focuses on biological systems and analytical spectrochemistry. Dr. Burrows' research aims to create an interdisciplinary research program focused on developing unique analytical techniques to improve the selectivity and sensitivity of current cancer diagnostic instrumentation. The overall aim of his research is to bridge *chemistry, biology, and analytical instrumentation.* Currently, Dr. Burrows is interested in molecular pathways in biological systems. Biological systems are extremely complex with multiple processes working in concert. This complexity can be better elucidated with new and improved spectroscopic instrumentation. Dr. Burrows' interests lie in using multi-photon induced fluorescence and Surface Enhanced Raman Scattering as analytical signals to elucidate the molecular biology of aggressive cancers. His research will focus on the exploration of unique biosensing recognition and transduction technologies. Two biological mechanisms of interest to Dr. Burrows are the progression and/or metastasis associated with Epithelial to Mesenchymal Transition (EMT) and Mesenchymal to Epithelial Transition (MET). Evidence of messenger-RNA and micro-RNA expression coupled with other EMT and MET markers (*e.g.* proteins, morphology, *etc*.) will be used to study the EMT/MET mechanisms. By developing novel cellular and tissue imaging technology will allow improvements on the information content from *in vitro*, *in vivo,* and *ex vivo* studies. Dr. Burrows aims to contribute to society in three ways: (1) conducting research to illuminate what has never been, (2) igniting interest in science among the student body by mentoring, and (3) inspiring young scientists through community outreach. Dr. Burrows joined the department in September 2012.

David Xiulei Ji grew up in Jingyu, a town near the Changbai Mountain in Northeast of China. Jingyu is known for its high-quality mineral water and well-protected natural environment. It is at the same latitude as Corvallis but very much colder in winter with lots of snow. In his hometown, he enjoyed hiking across forest areas in mountains with friends. He loves exploring remote wildness where the untouched sites tell the history and the precipitation of time. David was interested in both ancient history and modern science during the school years at home. In 1999, he eventually chose to study chemistry in Jilin University where the chemistry program is one of the best in China. During his senior year, he worked with Professor Bai Yang, and realized that he could have much fun by exploring the unknown in nanochemistry.

From 2004 to 2010, David worked with Professor Linda F. Nazar for graduate studies at the University of Waterloo, Canada. In the Nazar's laboratory, David had the freedom to truly follow his curiosity and interests. He was fascinated by Li-ion batteries. In his research, he found that the nanochemistry can make a huge difference in terms of the performances of battery materials. He studied nanoporous materials and controlled properties of materials at nanometer scales for their applications in energy storage and conversion. He investigated this approach for Li-ion batteries, and fuel cell catalysts. Besides hard-working in the lab, David is a fan of skiing. It is speed and the control of the speed that are really exciting to him.

In 2010, David won the Innovation Challenge Award from Natural Sciences and Engineering Research Council of Canada (NSERC). He was also awarded the NSERC Postdoctoral Fellowship, and he joined the laboratory of Professor Galen D. Stucky at the University of California, Santa Barbara. At UCSB, David became interested in electrochemistry and band-gap engineering. He actively contributed in many projects, including water splitting, thermoelectric materials, inkjet printing of materials, and electrodeposition. He gained a wide view of research and deep understanding in the materials science and chemistry.

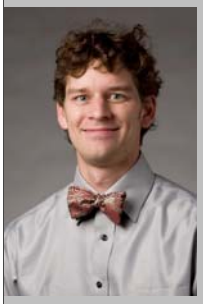
In September 2012, David started his own Materials Electrochemistry Laboratory at Oregon State University. His research interests are about increasing energy density and power density of energy storage devices for transportation purposes by innovative methods, and tailor-designed materials. To him, it is fascinating to apply electrochemical principles in the materials preparation and energy-device design.

In David's free time, he loves staying with his family, and reading poems for his daughter.

May Nyman, her husband and three children (Kaarina, 14; Flynn, 10; Devin, 5) moved to Corvallis in August 2012, where both elder Nymans joined the OSU faculty; May in Chemistry and Matt in Science, Math Education. Prior to this, the Nymans lived in Albuquerque, NM where May worked at Sandia National Laboratories for 14.5 years as a staff chemist, working on materials for energy and environmental applications. May's main scientific passion is polyoxmetalate chemistry; polyoxoniobates and tantalates in particular, as well as related oxide materials. These particular polyoxometalates and materials have properties useful for applications such proton

Oregon State UNIVERSITY

conductors, base catalysis, selective binding and precipitation or crystallization of bio-macromolecules, water splitting for hydrogen production, and anti-viral applications. The polyoxoniobates and tantalates are also very interesting for investigating the fundamentals of ion-pairing in solution. May chose this challenging mid-career change due to her interest in working with students and developing a focused research program centered around polyoxometalate chemistry.



Michael W. Burand attended the University of Minnesota–Duluth with a chemistry scholarship from the Swenson Family Foundation. He subsequently attended the University of Minnesota–Twin Cities, earning his M.S. in 2003 and his Ph.D. in 2006. His graduate research, conducted under the guidance of Professor Kent R. Mann, was in materials chemistry with a focus on the synthesis and characterization of organic materials for use in thin-film transistors. After completing his Ph.D., Michael worked as a postdoctoral fellow for Professor C. Daniel Frisbie in the Chemical Engineering and Materials Science Department at the University of Minnesota. Michael was also active in teaching as well during this time, teaching an introductory chemistry course at the University of Minnesota. In 2007, Michael began a position at Carleton College as a visiting assistant professor. At Carleton, Michael taught several different courses in the curriculum, including introductory chemistry, general chemistry, kinetics, spectroscopy, and materials chemistry. After this visiting position ended in 2012, Michael came to Oregon State University to begin a position as laboratory coordinator for the 2xx-level general chemistry laboratory courses, with the goal of enhancing the laboratory experience via guided inquiry-based learning, academic-civic engagement, and "green" chemistry procedures.

Dr. Jeff Gautschi recently joined OSU in a joint appointment between OSU-Cascades and OSU Ecampus as an instructor of Organic Chemistry courses. Jeff brings an industry perspective, and a deep set of biotech and pharmaceutical contacts, to bear on the position. Over the last 8 years, he has held director level positions in Bend, Oregon at Agere Pharmaceuticals and Bend Research, where he gained expertise in drug development, drug formulation research, and clinical trial material manufacturing.

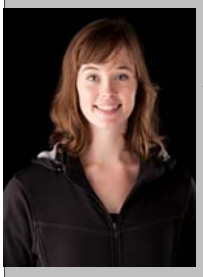
Jeff's doctorate work in Marine Natural Products with renowned Professor Philip Crews at the University of California, Santa Cruz provided the opportunity to pioneer the exploration of secondary metabolites from fungi cultured from sediment obtained from deep-water (i.e., greater than -1000 feet deep). It also allowed him to developed his NMR and Mass Spectrometry skills to perform structure-elucidation and bioassay guided isolation of biologically active compounds. Jeff currently teaches the newly implemented Organic Chemistry CH331, 332, 337 series at OSU-Cascades, and the CH130 course for Ecampus.

Kristin's interest in the biological mechanism of antisense-based therapeutics led her to pursue graduate research in biochemistry. She entered the Ph.D. chemistry program at the University of California – Davis, as a Bradford Borge Fellow. Mentored by Prof. Michael Toney, she investigated the catalytic mechanisms of four structurally similar enzymes. Each enzyme performs a substitution reaction on a common substrate, but only two employ water as a nucleophile. One major finding of Kristin's graduate work was to elucidate the subtle structural and biochemical forces responsible for the observed nucleophile selectivity.

After earning a Ph.D. in chemistry in 2010, Kristin began work as an NIH postdoctoral fellow at the University of California – San Francisco, in the laboratory of Prof. Brian Shoichet. At UCSF, Kristin investigated the enzyme inhibition properties and pharmacology of small molecules that form colloidal aggregates when dissolved in simulated gastrointestinal fluids.

During the years spent in California, Kristin developed a passion for teaching, and it became apparent that this would be a rewarding career. She had excellent mentors in teaching, many of whom offered opportunities that allowed her to explore and develop this craft. She has held positions at Sacramento City College and the University of California – Davis, teaching courses in organic chemistry, biochemistry and biophysical chemistry. Kristin was thrilled to return to Oregon State in September 2012 as an Instructor teaching General and Organic Chemistry. She hopes to give back what she received in mentoring and instruction as an OSU undergraduate to current OSU students.

Outside of work, Kristin can be found cheering for the Beaver football team, playing tennis, exploring the Oregon Cascades, and enjoying the company of friends and family.



Jenna Moser is originally from Philomath, Oregon. She attended Western Oregon University and received a BS in Chemistry with a minor in Forensics as well as a BA in German Language. She currently works as a lab assistant for the Department. When she's not at work she enjoys doing ballet, spending time with friends and family, snowboarding, geocaching and playing Guitar Hero!

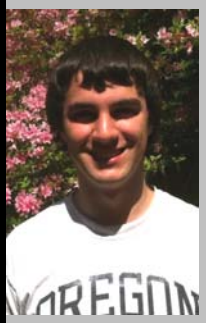
Chemistry now has a Facebook page. We're using this page to network with new incoming grad students, spread the word about things happening in the department and share some of the fun stuff we do. Feel free to pop over and "Like" us!

http://www.facebook.com/OSUChemistry

Chemistry

Undergraduates of the Quarter

Sam Bartlett – Undergraduate of the Quarter, Spring 2012



Sam was born in Sunnyside, WA but was raised in Lake Oswego, OR until 4th grade when he moved to Corvallis. He attended Crescent Valley High School. Sam picked OSU because of its strong reputation, the in-state tuition costs and wanting to stay close to home. He initially was a biology major, but the first term of Organic Chemistry from Dr. Daniel Myles showed him that his real interests were in Chemistry. Sam cites Prof. Carter (for CH 336) and Chris Beaudry (for his instruction in CH 471 and CH 535) as his two favorite professors. Sam conducted extensive undergraduate research during his time at OSU. In fact, Sam and Professor Beaudry published a paper on his research in the Journal of Organic Chemistry – a major accomplishment for an undergraduate student. Sam is very grateful for this experience – particularly commenting that Professor Beaudry's insights were valuable and he is very grateful for his help in getting into grad school. Sam has really enjoyed the community in the Department – feeling that it is like a close knit family. Sam started graduate school this summer in Organic Chemistry at the University of North Carolina at Chapel Hill with Professor Jeff Johnson. UNC-Chapel Hill is regarded as one of the top programs in his field and we congratulate Sam on all his accomplishments to date. It is students like Sam that make OSU Chemistry as strong as it is today!!

Matthew Stolt - Undergraduate of the Quarter, Spring 2012.

Matt was born and raised in Oregon – growing up in the Beaverton area. He attended Jesuit High School. He cites his big brother as a significant influence in his life including encouraging him to attend Jesuit High School as well as Oregon State University. While he came to OSU initially to be a Chemistry Engineering major, one of his friends, Evan, got him interested in becoming a Chemistry major. Matt has been conducting undergraduate research with Mas Subramanian since his sophomore year. He initially worked closely with senior graduate student Geneva Laurita-Plankis; however, he is now working on an independent project within Professor Subramanian's lab. He specifically mentioned emeritus professor Glenn Evans as his favorite teacher. He described Dr. Evans has "unbelievably challenging," but he did a wonderful job of making sure that the students really "know" the material. Matt plans to continue his education after graduation – likely getting a PhD in materials / inorganic chemistry. He would like to thank all the faculty and students he has worked with during his time here as well as his study group and friends for their support. We congratulate Matt on all his accomplishments to date and he is a wonderful part of the Chemistry program at OSU!

Josh Holmes—Undergraduate of the Quarter, Fall 2012

Josh was born in Weymouth, Massachusetts, but grew up in Wilton, New Hampshire. Josh took a non-traditional path to OSU. While excelling in math throughout high school, he was unsure what career path to take. Consequently, he decided to work in the construction industry after graduating from high school in 2002. During that time, he became interested in snow skiing and began working as a ski lift operator. His interest in skiing ultimately brought him to the west coast (California) were he met his wife. In 2008, his wife enrolled in graduate school at OSU in geology. Josh took the opportunity to re-engage with his education and starting taking classes at LBCC in 2009. Within a year, he had matriculated to OSU where he has excelled ever sense. He enjoyed taking math classes at OSU, but it was his General Chemistry course with Dr. Phil Watson that really caught his attention – commenting that he was "blown away by it." His interest in the fundamental aspects of chemistry drove him to work for emeritus Professor Ken Hedberg because he "wants to known deep down inside what is happening" in chemistry. Josh has enjoyed the personal attention and friendly attitude that OSU offers – providing easy access to faculty. Both of those attributes he associates with the Experimental Chemistry courses run by Emile Firpo, John Loeser and Chris Pastorek. He is unsure exactly what he wants to do after graduation, but he feels that he would like to teach in some capacity. Josh still likes to snow ski and is an accomplished musician – playing guitar in the band called the Psych Country Revue (rock and roll with a country twist). Our Department is lucky to have wonderful students like Josh who will surely inspire the next generation of chemists through their passion and enthusiasm about science!

Monica Best—Undergraduate of the Quarter, Fall 2012

Monica grew up in Portland, OR and attended La Salle High School. Her junior and senior-year chemistry courses in high school solidified her interest in Chemistry. When she visited OSU, she was impressed with the Chemistry Department and specifically credits Chris Pastorek with telling her all the great things going on here. She is in her junior year right now – working in Adjunct Chemistry faculty member Jennifer Field's laboratory. She is unsure if she plans to attend graduate school, but hopes to stay in Oregon (or the Northwest) after she graduates. She is a fan of the TV crime dramas such as NCIS (particularly the lab tech Abby Sciuto) which has inspired her interest in the forensic science-chemistry option (with a toxicology minor). She has enjoyed participating in the Chemistry Club within the Department – particularly the laid back feel and the expectation that the students do the work. Her favorite courses so far have been Experimental Chemistry (continued on page 13)

Chemistry

Dear Alumni,

The Department continues to make great strides in its education, research and service missions. As a unit, the Chemistry Department taught over 50,000 student credit hours last academic year (second largest on campus). Our e-campus program continues to grow rapidly – increasing the education impact of our talented faculty across the United States and beyond. Central to our education mission, the Department graduated 28 students with BS in Chemistry, 5 students with MS in Chemistry and 14 students with PhD in Chemistry in June 2012. Our students have also been honored with numerous awards from the University and beyond. You can read more about our successful students on pages 3 and 12-13.

During the past academic year, our Department also grew significantly – adding six faculty members (see pages 1 & 2 for more details). Assistant Professor **Xiulei "David" Ji** intends will work to understand and tackle challenges in strategic materials and key electrochemical processes for energy storage and conversion devices. Dr. Ji was a NSERC postdoctoral associate at the University of California at Santa Barbara prior to joining us at OSU. Associate Professor **May Nyman's** research focuses on transition metal and actinide polyoxometalates (POMs), as well as their related functional materials. Prior to her arrival at OSU, Dr. Nyman was a Principal Member of the Technical Staff at Sandia National Laboratories. The overall aim of Assistant Professor **Sean Burrows'** research is to develop an interdisciplinary research program bridging chemistry, biology, and analytical instrumentation. Prior to his arrival at OSU, Dr. Burrows postdoctoral associate at Duke University. Dr. **Michael Burand** joined OSU this fall as an Instructor and Laboratory Coordinator for the 200-level General Chemistry sequence. Previously, Dr. Burand was a Visiting Assistant Professor at Carleton College. Dr. **Jeff Gautschi** became the first Chemistry instructional faculty member at the OSU Cascades campus this fall where he teaches Organic Chemistry and e-campus courses for the OSU-main campus. Dr. Gautschi was Director of Formulations and Analytical Development at Agere Pharmaceuticals prior to joining OSU. Dr. **Kristin Ziebart** returned to OSU this fall as an Instructor currently teaching in the General Chemistry sequence. Dr. Ziebart (a 1999 OSU alumni with a BS Chemistry) was most recently a Lecturer at the University of California at Davis.

Our existing faculty continue to have major impact. Distinguished Professor **Doug Keszler** successfully obtained a 5-year, $20 million Phase II Center award from the National Science Foundation. Milton Harris Professor of Materials Science **Mas Subramaniam** continues to make major advances in the area of new pigments (see page 7). Senior Instructor **Margie Haak** oversaw the 19th edition of OSU Discovery Days. Assistant Professor **Chong Fang** is making important advances in the area of laser spectroscopy (see page 6). Dr. **Daniel Myles** was promoted to Senior Instructor in June 2012 (see page 10). Professor **Vince Remcho** was selected as Interim Dean of the College of Science (see page 10). Professor **Kevin Gable** was elected Faculty Senate President for 2013 (see page 13).

Thank you for your continued interest in and support of OSU Chemistry. It is because of our amazing alumni that the Department continues to grow and succeed. We wish you a successful 2013!

Sincerely,

Rich G. Carter
Professor and Chair

Chemistry

Memories from Kyoto By: Mike Lerner

My family and I spent much of the summer 2012 in Kyoto. I was working with Professor Rika Hagiwara's group on their new methods to reversibly electroplate metals from ionic liquid electrolytes. Developed in the past 2-3 years by Hagiwara's group, this chemistry can be applied as the negative electrode (anode) chemistry in new batteries. Removing the organic solvent results in safer devices, and these cells can operate are much lower temperatures than was previously possible. I was very impressed by their innovative approach; not to mention the superb students, staff and facilities at Kyoto University.

Of course, visiting Kyoto was also a great experience for all of us. Rika and his family were wonderful hosts.

What to report? Kyoto is a tourist magnet; most visitors are Japanese. There are dozens of amazing temples and other sights, of which we saw only a small fraction. People are polite, friendly, and understanding of sometimes-rule-breaking foreign visitors. We discovered (or rediscovered) that high summer humidity is not nice, but the tasty tofu ice cream helped. We wanted to stay longer.

Angie dressed as a maiko with the Kinkakuji (Golden) Temple behind

(L-R) Rika Hagiwara, his daughter Yuka, Mike, Angie, Kimi, Cari and Ning in the Gion district of Kyoto

Fang Group Research Highlight: The Quest for a "Molecular Movie"

By: Breland Oscar, Weimin Liu and Chong Fang

The Fang research group at OSU Chemistry specializes in using ultrafast spectroscopic techniques to probe the atomistic motions of molecules on their intrinsic timescales in order to describe how microscopic structural interactions impact macroscopic function. Vibrational spectra are intimately related to the molecular structure of interest, so each time-resolved spectrum that we measure after perturbation at time zero is like a snapshot of the molecule at a certain time during a certain reaction; acquire enough snapshots and a "molecular movie" becomes a tangible goal. This quest can be quite challenging, however, since molecular vibrations occur with frequencies ranging from 10^{11}—10^{14} Hz! Luckily, the continuing development of solid-state femtosecond (10^{-15} s) lasers has led to rapid advancement of ultrafast spectroscopy with much improved temporal and spatial resolution.

Our lab is quite unique in that we implement both femtosecond stimulated Raman (FSRS) and two-dimensional infrared (2D-IR) spectroscopies. Having both state-of-the-art systems in one lab situated in Linus Pauling Science Center at OSU is advantageous since we can study vibrational modes of molecular systems, whether they are IR or Raman active, in order to paint a more complete picture of the underlying molecular conformations that facilitate function. For example, the vibrations associated with protein backbones are rather straightforward to observe in the 2D-IR setup, whereas electronically excited fluorescent chromophores in solution or protein environments are typically studied with FSRS, which can specifically excite the chromophore and is also intrinsically faster (ca. 6 orders of magnitude) than fluorescence that occurs on the nanosecond (10^{-9} s) timescale. The truly exciting thing about ultrafast vibrational spectroscopy is that it is an incredibly versatile and widely applicable technique: the projects in our lab range from purely optical phenomena to biological imaging!

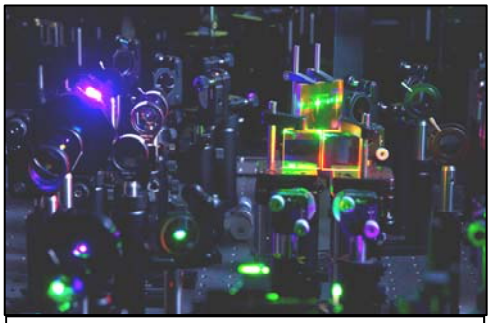


Fig. 1. The wavelength-tunable femtosecond stimulated Raman setup showcases the forest of optics with colorful lasers travelling through them to reveal atomistic motions of functional biomolecules. This is where the magic happens as we capture the molecular structural snapshots and make the real-time "molecular movies" with unprecedented spatial and temporal resolution!

Recently Dr. Weimin Liu, Liangdong Zhu (grad. student in physics), and Dr. Chong Fang published a paper in *Optical Letters* reporting a new cascaded four-wave mixing phenomenon that has led to a patent application for a new type of FSRS setup, and Liu and Fang also published a paper in *The Journal of Physical Chemistry B* with Fangyuan Han (grad. student in chemistry) and Connor Smith (undergrad with double major in physics and mathematics) about the conformational dynamics of the photoacid pyranine (HPTS) during excited state proton transfer (ESPT). ESPT is a very fast reaction that is ubiquitous in both fundamental chemistry and living systems, making it of particular interest in our research. Chemistry graduate student Yanli Wang is preparing to publish her work on ESPT dynamics of the photoacid HPTS in methanol, Breland Oscar spent her summer as an Arnold Johnson, Jr. fellow researching ESPT processes in Ca^{2+}-sensing green fluorescent protein (GFP) derivatives, and Longteng Tang has been studying the photoswitchable monomeric teal fluorescent protein (mTFP) for bioimaging applications!

There are also many exciting collaborative projects taking place between the Fang group and researchers here at OSU and abroad, making our ultrafast spectroscopic lab a nexus for interdisciplinary discoveries. Recent collaborations have featured photonic crystals for surface-enhanced Raman spectroscopy with the OSU School of Electrical Engineering and Computer Science, HIV envelope glycoprotein gp120 as a vaccine target with OSU Veterinary School, FSRS studies on the specification of aluminum-water complexes with the Center for Sustainable Materials Chemistry in Eugene, and the mechanism or ratiometric dual-emission in fluorescent protein chimeras for Ca^{2+} detection in live cells with the Campbell group at the University of Alberta in Canada. Further development of ultrafast laser sources has made the present a very exciting time to conduct novel research with ultrafast spectroscopy, and we hope to use both FSRS and 2D-IR to answer questions about how subtle structural changes on their intrinsic timescales influence the overall behavior of molecules, whether they are small drug molecules, cellular machineries or very large biological complexes. A better understanding of the intimate structure-function relationship will aid rational design of molecules engineered for specific purposes. With spectroscopic setups like the one photographed in Fig. 1, we may be able to make a vibrant "molecular movie" one day and truly visualize the atomic choreography!

Chemistry

Blues Standard

27 September 2012 Philip Ball
Royal Society of Chemistry, ChemistryWorld: http://www.rsc.org/chemistryworld/2012/09/blue-pigment-paint-chemistry

Kind of Blue

Blue has always been a problem for artists. One of the first synthetic pigments, Egyptian blue (calcium copper silicate), was pale. The best mineral alternative to ultramarine, called azurite (hydrous copper carbonate), was more readily accessible but is greenish rather than having ultramarine's glorious purple-reddish tinge. Around 1704, a misconceived alchemical experiment yielded Prussian blue (iron hexacyanoferrate), which is blackish, prone to discolour and decomposes to hydrogen cyanide under mildly acidic conditions. The discovery of cobalt blue (cobalt aluminate) in 1802, followed by a synthetic route to ultramarine in 1826, seemed to solve these problems of hue, stability and cost, but even these 'artificial' blues have drawbacks: cobalt is rather toxic and ultramarine is sensitive to heat, light and acid.

So the identification of a new inorganic blue pigment in 2009 looked very promising. **Mas Subramanian** and coworkers at Oregon State University, US, found that manganese ions produce an intense blue colour, with the prized 'reddish' shade of ultramarine, when they occupy a trigonal bipyramidal site in metal oxides. The researchers substituted Mn^{3+} for some indium ions in yttrium indium oxide, forming a solid solution of $YInO_3$ and $YMnO_3$, which has a blue colour even though the two oxides themselves are white and black, respectively. The depth of the colour varies from pale blue to virtually black as the manganese content is increased. Inserting manganese into other metal oxides with the same coordination geometry also offers strong blues. Meanwhile, similar substitutions of iron(III) and copper(II) generate bright orange and green pigments. Those are traditionally less problematic, however, and while the materials may prove to have useful magnetic properties, it's the blue that has attracted colour manufacturers.

But producing a commercially viable pigment is much more than a matter of finding a strongly coloured substance. It must be durable, for example. Although ultramarine is now made industrially from cheap ingredients in quantities that would have staggered Titian and Michelangelo, it fades in direct sunlight because the sodalite framework is degraded and the sulfur chromophores are released and decompose – a process only recently understood. This rules out many uses for exterior coatings. In contrast, the manganese compound has good thermal, chemical and photostability.

Cool Blues

One of the key advantages of the new compound over traditional blues, however, is strong reflectivity in the near-infrared region. Many other pigments, including cobalt blue and carbon black, have strong absorption bands here. This means that surfaces coated with these pigments heat up when exposed to strong sunlight. Building roofs coloured with such materials become extremely hot and can increase the demand of air conditioning in hot climates; instrument panels and steering wheels of cars may become almost too hot to touch. That's why there is a big demand for so-called 'cool' pigments, which retain their absorbance in the visible region but have low absorbance in the infrared.

This aspect in particular has motivated the Ohio-based pigment company Shepherd Color to start exploring the commercial potential of the new blue pigment. One significant obstacle is the price of the indium oxide starting material. It is produced (mostly in China) primarily for the manufacture of the transparent conductive material indium tin oxide to be used in electronic displays and other optoelectronic applications. Those uses demand that the material be made with extremely high purity (around 99.999%), which drives up the cost. In principle, low-purity In_2O_3 would suffice for making the new colourant, but there is no market demand for this so it is not currently made.

That's why Subramanian and his colleagues are now trying to find a way of eliminating the indium from their manganese compounds – to find a cheaper host that can place the metal atoms in the same coordination environment. If they succeed, it's possible we'll see yet another revolution in the chemistry of the blues.

'Two women sitting at a bar', from Picasso's blue period (The Gallery Collection/Corbis)

A New Activity to Enhance the General Chemistry Laboratory Experience

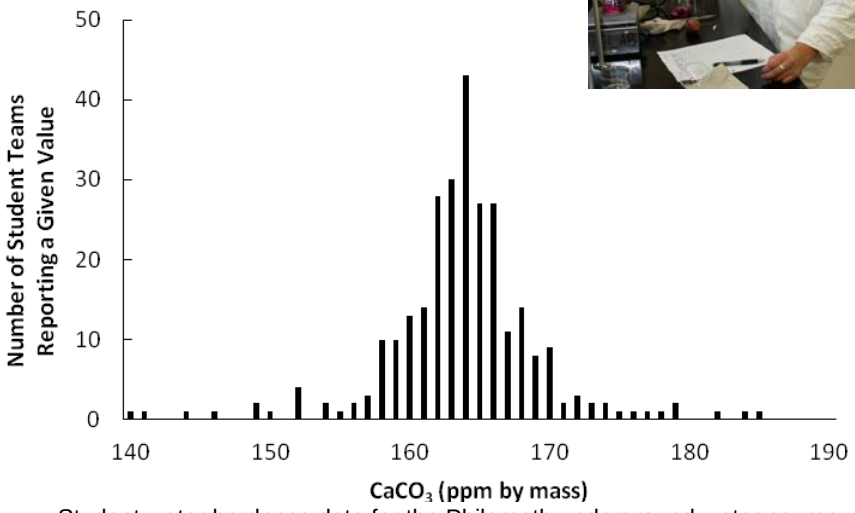
By: Michael W. Burand

In the LPSC general chemistry laboratories, our goals include making the laboratory experience more akin to what a chemist would encounter in a professional laboratory environment, implementing academic-civic engagement, improving "green" chemistry practices, and finding ways to take advantage of the fact that over 1000 students do a given laboratory activity every week. To this end, a new laboratory activity was introduced this fall in which general chemistry students analyzed the hardness of drinking water samples. Instead of simply testing an "unknown" prepared specifically for them, students tested real samples ranging from bottled water to water from the city of Philomath. Members of the Philomath Water Department were generously willing to work in cooperation with the Department of Chemistry and provide samples of water directly from their municipal well. Once the students complete their analysis, the results are sent back to the Philomath Water Department. This is a step towards increasing community involvement and showing that even a beginning chemistry student's results can go beyond the teaching laboratory. Since the "right" answer is not necessarily known for this type of analysis, students are evaluated on their technique and presentation of their results. Our hope is that this takes some of the pressure off the students and allows them to focus on the underlying theory and therefore attain a deeper understanding of the chemistry involved.

Students are also making use of the new technologies available in the LPSC teaching laboratories as well: As students obtain titration data, their results are projected on the display screens via the laboratory section's main computer. In this way, students can see the results of their labmates in real time, and teaching assistants can lead discussions about the results and any discrepancies. Later, a file with combined data from all sections—representing over 1500 titrations for each sample—is then posted for students to access online and use to conduct a statistical analysis.

Special thanks to Dr. Todd Jarvis (Oregon State University Institute for Water and Watersheds), Garry Black and James Winge (Philomath Public Works), the LPSC Issue Room staff, and the CH 261 teaching assistants for their valuable contributions to the development of this laboratory activity.

James Winge of Philomath Public Works (above) and **Michael Burand** (above left) obtaining water for student testing from the city's underground source in Philomath.



Student water hardness data for the Philomath underground water source.

Chemistry

Amphidinolide F

29 August 2012 Paul Docherty
Royal Society of Chemistry, ChemistryWorld: http://www.rsc.org/chemistryworld/2012/08/amphidinolide-f

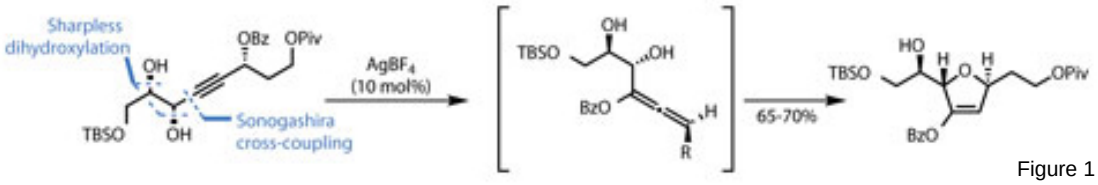


Figure 1

Amphidinolide F was first isolated in 1991, but as yet remains unconquered territory in synthetic laboratories.[1,2] However, new ground has been broken by a pair of chemists from Oregon State University, US, led by Rich Carter.[3] Their key insight was that hidden symmetry exists in the complex tetrahydrofuran (THF) regions. Although these two regions are not identical, the team considered that enough chemistry was in common that a mutual precursor might be used.

Eager to test their hypothesis, the team targeted the tetrahydrofuran precursor from the off, building a linear fragment based around an acetylene. The chains to either side of the acetylene are heavily oxygenated, with one set of hydroxyls installed using the ever-reliable Sharpless asymmetric dihydroxylation chemistry and the other half derived from malic acid. Treating the alkyne with a relatively strong Lewis acid prompted cyclisation of the nearer of the two unprotected hydroxyl groups onto an intermediate allene, neatly preparing the five-membered THF ring and avoiding a potential six-membered tetrahydropyran by-product (figure 1). Importantly, the team performed this chemistry repeatedly on multi-gram scale to supply their synthetic forays.

Their next task was to differentiate the common intermediate into the two subtly different portions of the target. The first job was to add a methyl group to the five-membered ring. The team hoped to do this by simply trapping the enolate of the remaining carbonyl functionality with methyl iodide (figure 2). However, they found that the intrinsic stereochemistry of the substrate favoured addition of the methyl group to the wrong face of the ring. Switching tack, the team overcame this problem by installing a C=C double bond, then harnessing that controlling stereochemistry to direct hydrogenation of the prevailing face and leave the correctly configured mthyl group.

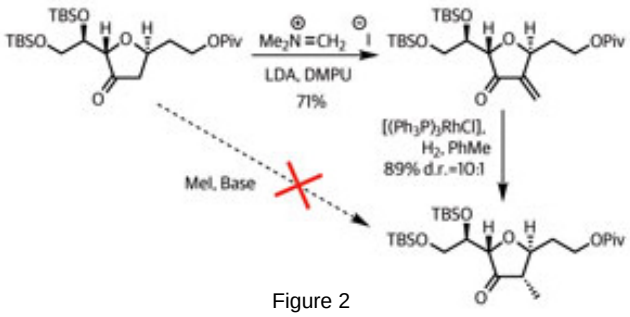


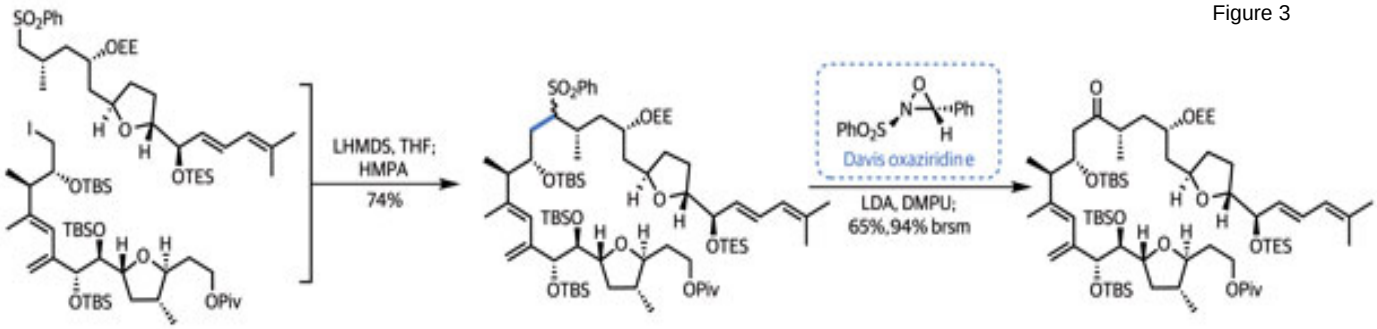
Figure 2

The team plugged away at elaborating the common THF cores across an array of relatively uncomplicated chemistry, taking 11 steps to get to their first cyclisation intermediate, and 15 steps to get to its partner. Then came the critical coupling of these fragments. The team decided to connect them by forming a C–C bond between a carbon destined to become a ketone in the final target and its neighbour. Carbonyl carbons are classically thought of as electrophilic or cationic in character, but the team needed an anion to react with the iodide in the other fragment.

To bring about this reversal of reaction polarity, or umpolung, the chemists made a sulfone and deprotonated it with a strong base. This anion swiftly displaced the alkyl iodide to generate the required C–C bond in good yield. Of course, the team no longer required the sulfone group, so a little base, followed by the exotic-looking Davis oxaziridine provided the desired ketone (figure 3).[4]

The strategy here seems to have paid off handsomely, finally completing a target that has been taunting chemists for over 20 years. Although the diversification of the common intermediate was somewhat lengthy, the effort saved in its synthesis looks worthwhile!

Figure 3



Chemistry

The Cutting Edge of Science

Story by: Jolene Guzman, Polk County Itemizer-Observer.
Picture by: Pete Strong

Dallas High School science teacher Lee Jones' last experience with organic chemistry was in college. But this summer, he is conducting research that may speed the development of new prescription drugs.

Jones is part of the M.J. Murdock Charitable Trust Partners in Science Program, which offers grants for high school science teachers to assist scientists on basic research over two summers.

He is working with **Rich Carter**, a professor and chairman of the Department of Chemistry at Oregon State University. Together, they are refining the process for developing a catalyst to create amino acids used in the production of pharmaceuticals.

Jones and Carter are coordinating the process with Synthetech, an Albany-based firm that assists in the development of new drugs.

Jones is relishing the experience of working with organic chemistry again.

"It's neat … the possibility of getting that one flow set up this summer and having that be my contribution to the world of chemistry," he said.

Full story at: http://www.polkio.com/archives/Story.aspx/23645/the-cutting-edge-of-science

SRP Recognizes Carlos Monzano

Carlos Monzano, graduate student in Dr. Staci Simonich's laboratory was recognized by NIEHS on the SRP webpage for receiving the highly prestigious 2012 Student Paper Award from the American Chemical Society (ACS), which he presented during the 244th ACS National Meeting in Philadelphia. Carlos received the award for his research developing different gas chromatography (GC) techniques to separate and identify mixtures of polycyclic aromatic hydrocarbons (PAHs). The announcement is located on the SRP homepage (http://www.niehs.nih.gov/research/supported/srp/index.cfm) and the rest of the story is on the news page (http://www.niehs.nih.gov/research/supported/srp/news/index.cfm). Congratulations to Carlos and Staci!

Chem Major Researching in New Zealand Blogs Experiences

Jackson Olson Dougan, is conducting research in New Zealand for the summer. He's put together a travel blog to document his summer and is sharing it with us.
http://jacksoninnewzealand.tumblr.com/

Arsalan Zolfaghari Wins Summer 2011-12 URISC

We're sending a congratulatory shout-out to **Arsalan Zolfaghari** (Student Researcher for Dr. Paul Blakemore) for winning a 2011-12 Summer URISC for his proposal entitled, "Investigation of a Novel

Chemistry

Class of 2012

Adamic, Michael J (BS) Adv Chemistry
Bartlett, Samuel L (BS) Adv Chemistry
Blackburne, Andrew Chandler (BS) Pre-Med
Brewer, Ben Daniel (BS) Business
Cadotte, Andy (BS) Chem Education
Chart, Trevor Lance (BS) Chem Engineering
Ferrall, Alaina Louise (BS) Forensic Science
Hawks, Kathryn Ann (HBS) Adv Biochem
Hoffman, Alexandra (BS) Env Chemistry
Jenson, Peter Jeremiah (BS) Pre-Medicine
Mangum, Brent Allen (BS) Biochem
Marshall, Brittany Lana (HBS) Adv Biochem
Megowan, Meghan (BS) Forensic Science
Milbrat, Daniel R (BS) Adv Chemistry
O Neil, James Hugh (BS) Pre-Medicine
Perry, Theodore (BS) Env Chemistry
Porter, Jeffrey Scott (BS) Materials Science
Rau, Derek Dale (BS) Chem Education
Rogers, Jonathan M (BS) Business
Rose, Ben Allen (BS) Adv Chemistry
Sardari, Sardar (BS) Chem Engineering
Schardt, Jenna Lynn (BS) Pre-Medicine
Selvey, Natasha Yvonne (BS) Env Chemistry
Tanabe, Courtney Keiko (BS) Forensic Science
Tscheu, Sarah Rose (BS) Forensic Science
Wagner, Lindsay (HBS) Pre-Med
Williams, Brendan (BS) Materials Science
Wright, Corey (BS) Adv Chem & PreMed
Betterton, Sharon A (MS)
Harthcock, Colin (MS)
Lee, Kyoungyim (MS)
Pylypiuk, Nataliia (MS)
Su, Dong (MS)
Bychkova, Valeriya (PhD)
Chatterjee, Esha (PhD)
Eilertsen, James Scott (PhD)
Emerson, Christopher R (PhD)
Jana, Somnath (PhD)
Juniku, Rajan (PhD)
Kim, Tae-Hyeong (PhD)
Knutson, Christopher C (PhD)
Li, Yang (PhD)
Maluangnont, Tosapol (PhD)
Muir, Sean William (PhD)
Siritanon, Theeranun (PhD)
Telecky, Alan J (PhD)
Wang, Jing (PhD)

Chemistry

Congratulations to **Daniel Myles** for being promoted to Senior Instructor as of June 2012.

Congratulations to **Vince Remcho** for being selected as Interim Dean of the College of Science.

Congratulations **Kevin Gable** for being elected Faculty Senate President 2013.

Congratulations to Professor **Kevin Gable** who was awarded the 2012 Loyd Carter Award for Outstanding and Inspirational Teaching at the Graduate Level!

Spring Award Winners

Amanda Abbott – Hach Scientific Foundation Scholarship
Amanda Abbott is an undergraduate student entering her senior year in Chemistry. Over the summer, she has been working with the Paradigms in Physics program, which involves analyzing classroom video and updating the website for use by instructors across the country. After graduation, she plans on pursuing a Master's in Education, which will allow her to go on and teach Chemistry and Physics at the high school level.

Paul Bluhm – Milton Harris Scholarship
Paul Bluhm is a sophomore from Portland, Oregon. A chemistry major with a pre-med option. He is also enrolled in the international degree program, and hopes to study abroad in Spain in the future. Currently, he is an intern at a company called Cooper Environmental Services, LLC. He does research for various projects as defined by his boss (a non-disclosure agreement prevents him from being more specific). He also helps to clean and organize the lab when needed. After graduation, his goal to get into medical school. His dream school is OHSU, where he would become a doctor. He is not totally set on what type yet, but is interested in general pediatrics, pediatric rheumatology, and cardiology.

Elise Cowley – ACS Analytical Chemistry Award
Elise Cowley is in her fourth and final year at OSU. She is double majoring in Bioresource Research and Chemistry. Both of these degrees have fostered research opportunities. For the past three years, she has been working on isolating and characterizing secondary metabolites in a particular Red Sea cyanobacteria in Dr. Kerry McPhail's lab group. After graduation, she plans to be happy and pursue a PhD after taking a bit of time off.

Lauren DeSantis – Hach Science Foundation Scholarship
Lauren DeSantis, is a sophomore at OSU. After graduation, she's planning on becoming a high school chemistry teacher.

Jackson Olson-Dougan – Colleen Spurgeon Scholarship
Jackson Olson Dougan has elected majors chemistry, biology, and international studies through the Honors College and College of Science at Oregon State University. His undergraduate research in bat zoogeography has taken him to New Zealand on full scholarship and resulted in increased professional ties between Oregon State University and University of Auckland. Following his undergraduate studies, Jackson hopes to complete a Ph.D. (or M.D./Ph.D.) program in the quantitative sciences. He later plans to work internationally influencing environmental policy using informed and reasoned scientific decisions.

Rosa Grajczyk – Milton Harris Chemistry Fellowship
Rosa Grajczyk is beginning her third year as a graduate student in Mas Subramanian's research lab. Her research has been focused on investigating the structure – property relationships of layered oxide compounds, in an effort to optimize the materials that are currently used in modern devices. In the future, she would like to hold a position as an educator so that she can use her solid state chemistry background to help more students become interested in the Materials and Inorganic Chemistry field."

Jeff Grell – David and Clara Shoemaker Memorial Fund
Jeff Grell was born and raised in Los Angeles. He graduated from the UC Berkeley College of Chemistry at the top of his class in 1999. Jeff immediately proceeded to earn a Master's degree in chemistry from UCLA. In the interim, he has tutored and taught chemistry, physics, and math at the high school and college levels. Other academic endeavors include co-authoring an MCAT reviewook and an AP Physics B review book. In 2011, he returned to graduate school at Oregon State University with the objective of obtaining a Ph.D. in nuclear chemistry under the guidance of Prof. Walter Loveland. At OSU, Jeff is carrying out experiments to verify theoretical predictions concerning the multinucleon transfer reaction. These experiments utilize the ATLAS accelerator at the Argonne National Laboratory. After graduation, Jeff intends to pursue research in a national laboratory, industrial setting, or academic institution.

Josh Holmes – Linda M Oleson Scholarship
Josh Holmes is a junior in advanced chemistry. He works in Dr. Ken Hedberg's lab studying physical chemistry via gas-phase electron diffraction. After graduation, I plan to pursue a master's degree. My interests are in research and teaching at the community college level.

David Schiedler – Tartar Resource Chemistry Fellowship Fund
David Schiedler was born and raised in Oregon. He earned a B.S. in chemistry from George Fox University in 2008, then earned a coursework M.S. in organic chemistry from the University of Oregon in 2009. He have been studying organic chemistry at OSU since fall of 2009 under the direction of Chris Beaudry. His research is focused on the development of new methods to form carbon -carbon bonds using radical intermediates. After graduation, he intends to pursue work in the pharmaceutical industry.

Brittany Johnston – Peter C Culter Memorial Scholarship
Brittany Johnston is a junior level chemistry undergrad. She has worked in Dr. Cheong's computational organic chemistry lab and also for VOC Technologies with Dr. O'Brien. She hasn't yet decided what the plan is for after graduation.

Jonathan Rogers – ACS Inorganic Chemistry
Jonathan Rogers is currently work-

ing at the Naval Nuclear Power School at Naval Nuclear Power Training Command in Charleston, SC. He teaches enlisted sailors nuclear reactor theory before they operate and learn the procedures for producing power and propulsion on naval submarines or surface carriers.

Quamar Salih – Milton Harris Chemistry Fellowship
Quamar Salih is a fourth year graduate student in Organic Chemistry. He specializes in Natural Product Synthesis. After graduation, he's thinking of doing some Post-Doctoral studies.

Shin-Cheng Tzeng – Milton Harris Chemistry Fellowship
Shin-Cheng Tzeng (aka Newcity) originally came from Taiwan. His research focuses on developing label-free quantitative techniques to monitoring changes of mitochondrial proteome by utilizing state-of-art mass spectrometers and affinity tagging. The goal is to develop a platform that can fast and reliably tell us how the whole or a subset of mitochondrial proteome change during the progress of a disease or other physiological conditions. After graduation, he would like to keep work in the field of proteomics either in academic or industry.

Jessica Vellucci – Tartar Resource Chemistry Fellowship
Jessica Vellucci is a fourth year graduate student in Organic Chemistry. She specializes in Aminal Radical Research. After graduate, she hopes to obtain a Postdoctoral Fellowship.

Lindsay Wills – Ken and Lise Hedberg Graduate Student Fund
Lindsay Wills graduated summa cum laude from the University of Oregon in 2011 with a B.S. in physics and chemistry. She then joined the Oregon State University community in September of 2011 and became a member of Dr. Paul Cheong's group. In the Cheong group, she has worked primarily with the computational aspects of projects within the Center for Sustainable Materials Chemistry. One of the key projects in the center is the discovery and characterization of metal hydroxide clusters. After graduation, she would like to continue with computational work, preferably in an academic setting. The field of computational materials chemistry is growing field, and I would like to stay on the cutting edge.

Undergrad of the Quarter: **(continued from page 3)** with Emile Firpo and John Loeser where she tells us that the student gets to be the "brain of it" – deciding what they are going to do. She is taking Physical Chemistry this term and really has enjoyed Professor Glenn Evans' passion and enthusiasm in the classroom. Outside of chemistry, she likes going to OSU football games, swimming and waterskiing in the summer time and crafting "everything" from picture frames to scrapbooks. She also recently joined the OSU Flying Club to learn how to fly. It is talented and diverse students like Monica that help to make the OSU Chemistry program so strong!

Discovery Days

The Chemistry Department has a very active outreach program encompassing a variety of events including Family Science & Engineering Nights, high school and middle school campus visits, and Discovery Days. For the last 10 years the department has been a part of Discovery Days, a science and engineering outreach event that takes place twice a year on the OSU campus. Discovery Days is a chance for K-12 students to explore science and engineering fields that they may not have exposure to at their schools. This is a major outreach event with approximately 2000 students, 60-70 teachers and hundreds of parent chaperones attending each event. Schools come from as far away as Roseburg to attend Discovery Days.

Discovery Days has provided a way to get our undergraduate majors involved with the department and with the community. The Chemistry Club (Student Affiliates of the American Chemical Society) has been very involved in volunteering at Discovery Days, staffing the chromatography activity as well as presenting demonstrations with liquid nitrogen, dry ice, and oscillating reactions. The students in the First Year Experience class for new chemistry majors, CH 220, also get involved with Discovery Days and this experience has been mentioned in class evaluations as an experience that helped them "feel like a chemist" as they explained the science behind the demonstrations and the chromatography activity.

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