Education

Undergraduate Opportunities
K-12 Science Activities
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Education Contacts
News

Cooperative International Science and Engineering Internships

Cooperative International Science and Engineering Internships(CISEI)
Summer 2006 - Student Projects

Student/School	Mentor	Faculty Sponsor	Department	Student Project
Maartje Bastings Biomedical Engineering / Technical University Eindhoven, Netherlands	Ben Messmore	Craig Hawker	Chemistry	Nanocylinders via the self-assembly and covalent capture of triblock copolymers
Kanghee Cho Chemistry / KAIST, Korea	April Sawvel	Songi Han	Chemistry & Biochemistry	Monitoring foreign surface/blood interface using protein labeling and magnetic resonance imaging
Sander Duijnhoven Biomedical Engineering / Technical University Eindhoven, Netherlands	Kim Weirich	Debra Fygensen	Physics	Real-time detection of the orientation of a sub-resolution DNA nanotube
Michael Ford Materials / Oxford, UK	Anderson Janotti	Christian Van de Walle	Materials	The development of OpenDX as visualization software for electronic structure calculations
Elmar Kroner Materials / University of Stuttgart, Germany	Peter Lowenhielm	Craig Hawker	Chemistry	Robust and high refractive encapsulations for solid state lightening devices
David Lee Materials / Oxford, UK	Kevin Boulware	Patrick Daugherty	Chemical Engineering	Cellular Libraries of Peptide Substrates (CLiPS)
Martijn Lijbers Biomedical Engineering / Technical University Eindhoven, Netherlands	Wei Tang	Eric McFarland	Chemical Engineering	Methanol coupling through doped and mixed metal oxide catalysts
Zeynep Nerghiz Sabanci University,	Sean	Susanne	Materials	$Bi_2Ti_2O_7$ thin film deposition by magnetron

Turkey	Keane	Stemmer		sputtering for tunable microwave capacitor applications
Lina Persechini Physics / Trinity College, Ireland	Dan Allen	Mark Sherwin	Physics	A 25ns free space delay line
Monika Rawolle Physics / University of Stuttgart, Germany	Nick Finstrom	Susanne Stemmer	Materials	X-ray diffraction characterization of heteroepitaxial $SrTiO_3$ thin film
Karen Young Exp Physics / Trinity College, Ireland	Kinson Kam	Tony Cheetham	Materials	Synthesis and characterization of nanoporous materials

Return to the CISEI homepage

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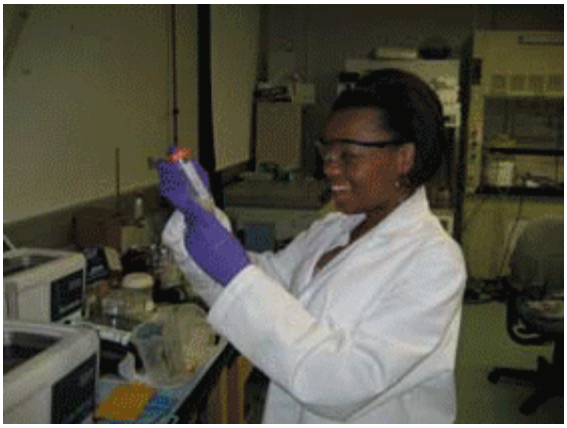
Undergraduate Research Opportunities



Research Interns in Science and Engineering (RISE)
Students from UCSB and other colleges and universities around the country pursue research projects under the supervision of MRL faculty and researchers. Both summer and school year internships are available.

California Alliance for Minority Participation (CAMP)
UCSB science undergraduates from under-represented groups participate in summer and school year research projects.

Cooperative International Science and Engineering Internships (CISEI)
The MRL and the International Center for Materials Research host an NSF REU site to send US undergraduate science and engineering majors to 10-week summer internships at our international partner institutions. Students from our international partner institutions complete research internships at UCSB; international students should apply through their home university.

Partnership for Research and Education in Materials (PREM)
Students from Jackson State University and other Minority Serving Institutions participate in mentored research internships at UCSB through this NSF-funded partnership. The PREM and RISE internship programs are run concurrently and PREM interns should apply through the **RISE** program.

Community College Interns in Materials Science (CCIMR)
Students from community colleges in southern California participate in an 8-week summer research internship program at UCSB. Interested students should apply through the INSET program of the **California NanoSystems Institute**.

Return to **MRL home** or **MRL Education Programs**

K-12 Science Activities

Resources and Activities for Students and Educators

UCSB ScienceLine

MRL's "Ask-a-Scientist" project enables K-12 students to directly ask expert UCSB researchers their science questions. Topics include astronomy, marine biology, physics, computers, materials science, and earth science, among many others!

MRL Multimedia Highlights

New MRL educational videos explain the excitement and central role of Materials Science and other science topics. MRL's "Meet a Scientist" program, an extension of ScienceLine in which elementary school students interview UCSB scientists, and other videos presenting fun topics in Materials Science. For more information, please contact **Claudia G. Mazzotti** or **Martina Michenfelder**

"Build a Buckyball" Workshop

Students, ranging from elementary to early high school, are given a brief introduction focused on Materials science and the scale of the nanometer, different forms of carbon and the relationship between molecular structure and material properties. Afterward, each student builds his own six-inch carbon-60 molecule. For more information, please contact our education director **Dotti Pak**.

It's a Material World!

This program is available for elementary school science nights. Children are naturally curious about science. These hands-on activities inspire inquiry into Materials Science related topics and emphasize the fascinating nature of science! For more information, please contact **Julie Standish** .

Return to **MRL home** or **MRL Education Programs**

Opportunities for Teachers

Research Experience for Teachers (RET)

Secondary school teachers participate in laboratory research, under the mentorship of graduate, post-doctoral and faculty researchers. During their second summer in the program, teachers work collaboratively to translate their research experiences into curriculum resources. All of the curriculum projects are archived on our website in a database.

Models and Materials

This teacher professional development program brings together teams of art and science teachers from local junior high and high schools to work together on developing curriculum projects that are in line with the state standards for art and science.

Workshops

The MRL hosts workshops and symposia on a variety of topics related to science education, outreach and teacher professional development.
Our next workshop for science teachers will be in March 2012.

Return to **MRL home** or **MRL Education Programs**

Education Programs Staff and Contact Information

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Education Programs Coordinator
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Ms. Lindsey Kasenhagen
Programs Assistant
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(805) 893-5850

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News

CAMP Program Provides Mentorship and Research Opportunities for Undergraduates

This summer marked the eighteenth year of the University of California CAMP (California Alliance for Minority Participation) program. Funded by the National Science Foundation's LSAMP program, CAMP is a UC system-wide alliance dedicated to improving access and participation by underrepresented minority students in science, math and engineering fields. This summer, ten UCSB undergraduates, ranging from sophomores to seniors, participated in mentored research projects through the CAMP program..

read more

Undergraduates Present Summer Research at UCSB

Nearly a hundred students from ten different campus intern programs gathered in Elings Hall on August 13 to present their summer research findings in the annual UCSB Summer Research Colloquium. Co-sponsored by the Materials Research Laboratory and California NanoSystems Institute, the colloquium featured student researchers from the Bio-Image Informatics, CAMP, CENTC, CISEI, CNS, ICB, INSET, McNair Scholars, RISE and UCLeads programs.

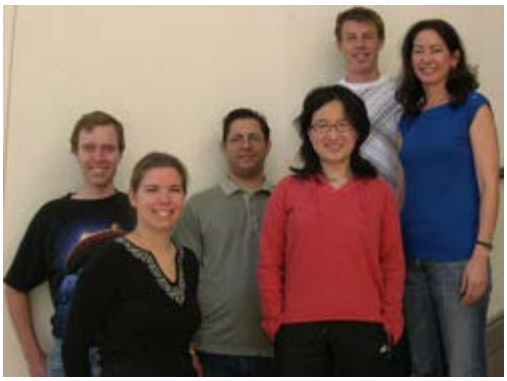
read more

It's a Material World

For many scientists, the thought of explaining their research to a seven year old fills them with trepidation. How do you explain complex scientific concepts to someone with little background in science and a limited attention span? The MRL's It's a Material World program attempts to do just that by bringing new materials to local elementary school students in an engaging, hands-on way.

read more

2008 Graduate Student Awards



MRL Education Programs are pleased to announce the following graduate students awards for 2008 for which each recipient will receive a certificate of appreciation and a cash prize: The MRL Education Programs Service Award is given to a graduate student who provides consistent support in multiple programs, including participation as an undergraduate intern mentor, a volunteer in our school programs and/or as a ScienceLine answerer. This year the award is shared by Alan Kleiman (Chemical Engineering) and Nick Strandwitz (Chemistry). The Excellence in Mentoring award is given to a graduate student who provides undergraduate mentoring above and beyond the call of duty. We are very pleased to present this award to Wei Tang (Chemical Engineering) and Aubrey Cano (Marine Science) for their dedicated support of undergraduate research. Finally, the ScienceLine Award is given to a student who provides consistent, reliable and thoughtful answers to our young ScienceLine users. This year our ScienceLine Award goes to Mark Wistey (Materials, Electrical and Computer Engineering).

2008 MRL Diversity Fellowship

Diversity is one of the key initiatives within the MRL and one way that the MRL supports these goals is through MRL Diversity Fellowships. These

QUICK LINKS

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WHERE DISCOVERIES BEGIN

SEARCH

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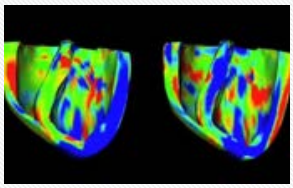
Advancing the Sciences | Funding & Supporting | Inspiring & Educating

HIDE

After Long-ago Mass Extinction, Global Warming Hindered Species' Recovery
November 5, 2012



Computational Medicine Enhances Way Doctors Detect, Treat Disease
November 1, 2012

Biofuel Breakthrough: Quick Cook Method Turns Algae Into Oil
October 31, 2012

Exhaustive Family Tree for Birds Shows Recent, Rapid Diversification
October 31, 2012

Far From Random, Evolution Follows a Predictable Genetic Pattern, Princeton Researchers Find
October 25, 2012

Robots in the Home: Will Older Adults Roll Out the Welcome Mat?
October 25, 2012

NSF Funding & Research Community

SPECIAL NOTICES

FUNDING OPPORTUNITIES

New NSF Proposal & Award Policies and Procedures Guide Issued, Effective for Proposals Submitted or Due On or After January 14, 2013

NSF Notice of Intent to Revise American Recovery and Reinvestment Act (ARRA) Award General Terms and Conditions to Ensure Project Completion by September 30, 2013

NSF Information Related to the American Recovery and Reinvestment Act of 2009

EVENT CALENDAR

07 NOV I/UCRC: Security and Software Engineering Research Center (S2ERC) IAB Meeting
PARTNERSHIP MEETING

07 NOV Directorate for Education and Human Resources Advisory Committee Meeting
ADVISORY COMMITTEE MEETING

07 NOV Center for Excellence in Logistics and Distribution (CELDi) Fall IAB Meeting
PARTNERSHIP MEETING

08 NOV NSF Day At The University of Nebraska-Lincoln
OUTREACH

08 NOV I/UCRC: Center for Pharmaceutical Development (CPD) IAB Meeting
PARTNERSHIP MEETING

VIEW ALL EVENTS

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Proposal and Award Policies and Procedures Guide
Prepare a Proposal
Upcoming Due Dates
Submit Proposal to FastLane

The National Science Foundation, 4201 Wilson Boulevard, Arlington, Virginia 22230, USA

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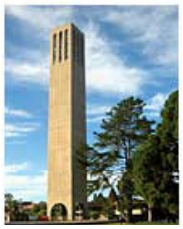
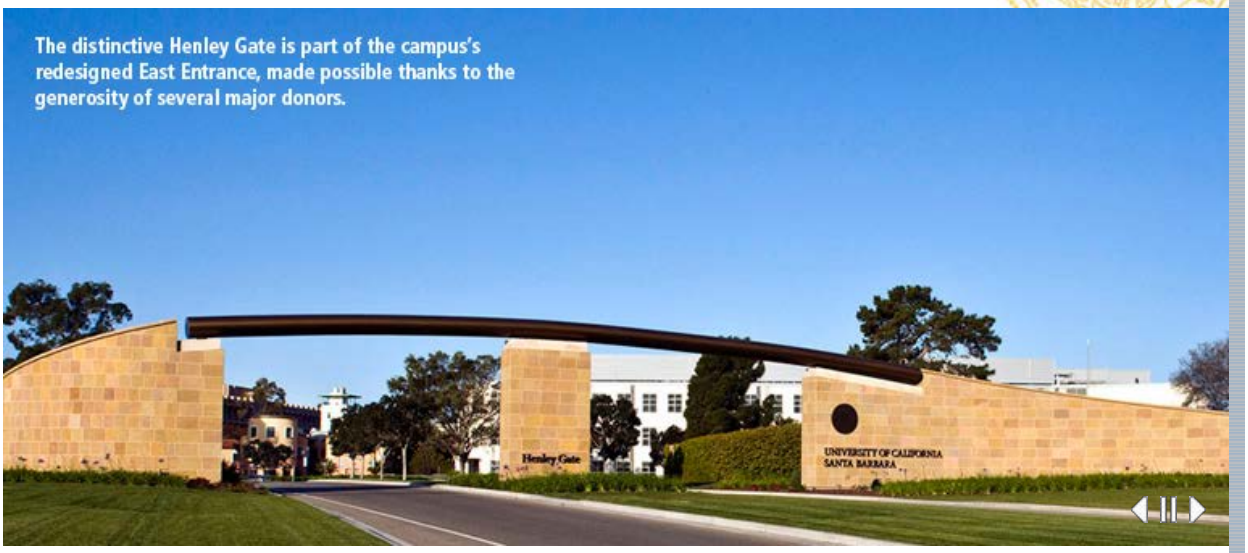
Text Only Version



UC SANTA BARBARA

UNIVERSITY OF CALIFORNIA



INFORMATION ABOUT
Academics
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Athletics
Giving to UCSB
Libraries
Our Campus
Research
UCSB Extension
Summer Sessions
Working at UCSB

INFORMATION FOR
Alumni
Current Students
Future Students
Parents & Friends
Visitors

Thursday, November 8

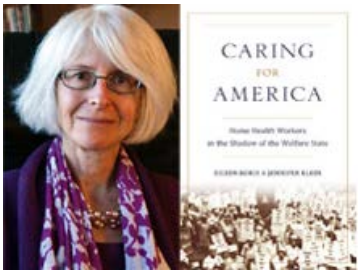
Weather

64°F / 18°C

FOLLOW US!

THE CAMPAIGN FOR THE University of California Santa Barbara

NEWS AND CAMPUS TOPICS



National Book Prize Eileen Boris, Hull Professor and chair of feminist studies at UC Santa Barbara, is the recipient of the 2012 Sara A. Whaley Prize for her book, "Caring for America: Home Health Workers in the Shadow of the Welfare State."

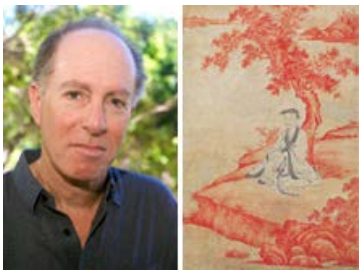
Using Analytical Tools, Scientists Report Discovery in Brain Research

Study on Destiny of Cells Could Lead to Engineering of New Organs

NSF Grant to Fund Candidates for Teachers in the Physical Sciences

Intertidal Network Program Receives National Conservation Partners Award

10 Faculty Members Named Fellows of American Mathematical Society

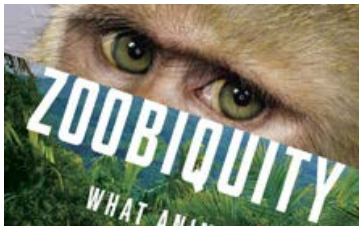


Partners in Art What began as an art history seminar at UCSB has evolved into a collaboration between the campus and the Santa Barbara Museum of Art. A new exhibit co-curated by Peter Sturman, professor of art history, features 17th-century Chinese paintings.

The Campaign for UC Santa Barbara

ALL NEWS & CAMPUS TOPICS

EVENTS



Zoobiquity, by a medical doctor and a science writer, introduces a unique, new approach to medicine, drawing on medical and veterinary science to inform human health and healing, Nov. 13.

Jeffrey Richman talks at Chancellor's Community Breakfast, Nov. 8.

Shakespeare's Globe Theatre in its acclaimed "Hamlet," Nov. 8 and 9.

Santa Barbara Geography, a look at area sea level rise and its effects, Nov. 9

Elizabeth Miller, of UCD, on socialist authors' use of print for politics, Nov. 9.

ALL EVENTS

MATERIALS RESEARCH LABORATORY AT UCSB: AN NSF MRSEC

Our Story

Widely recognized as one of the top five materials research facilities in the world, the MRL serves as the innovation engine for discoveries in new materials. The facility is home to a scientific and engineering community that creates new collective knowledge and fosters the next generation of scientific leaders. By enabling modern technological advances, the high-impact research conducted at the MRL and its affiliated centers has enormous societal impact, and is shaping the future of technology, the environment, and medicine.

News & Announcements

MRL Researchers Named Global School for Advanced Studies Scholars

MRL student, **Chris Liman**, and post-doc, **Bertrand Tremolet de Villers** were recently selected as Global School for Advanced Studies (GSAS)...

Bruker 300MHz Super-wide-bore MRI Up and Running

The MRL has added another unique and powerful instrument to its Central Facilities, augmenting an already impressive lineup of materials characterization equipment openly...

>>MORE NEWS

Support for this program is provided by the National Science Foundation, Division of Materials Research under the Materials Research Science & Engineering Centers Program

RISE Program

Application Information for School Year 2012-2013.

>> LEARN MORE

MROP 2013

We are pleased to announce that the Materials Research Outreach Program (MROP 2013) will take place February 5th & 6th in the UCSB Corwin Pavilion.

>> LEARN MORE

Our Brochure

The new MRL brochure is available now.

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UC Santa Barbara, Materials Research Laboratory

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MATERIALS RESEARCH LABORATORY at UCSB: an NSF MRSEC

the innovation engine for new materials

About

Widely recognized as one of the top five materials research facilities in the world, **The Materials Research Laboratory (MRL)** serves as the innovation engine for discoveries in new materials. The facility is home to a scientific and engineering community that creates new collective knowledge and fosters the next generation of scientific leaders.

By enabling modern technological advances, the high-impact research conducted at the MRL and its affiliated centers has enormous societal impact, and is shaping the future of technology, the environment, and medicine.

The Materials Research Laboratory (MRL) at the University of California, Santa Barbara, was established in September 1992 with funding from the National Science Foundation (NSF), and became an NSF Materials Research Science & Engineering

News

Frank Leibfarth has been awarded the DSM Polymer Technology Award 2012 for his PhD research in the field of functional polymeric materials at the recent American Chemical Society national meeting. Frank has developed a platform technology in polymer chemistry based on the ketene organic functional group. The versatility of this winning research allows discrete property changes of a material upon a simple heat treatment, providing on-demand access to robust and highly functional plastics in an operationally simple manner. Congratulations Frank!

Ania Bleszynski Jayich, an assistant professor in physics at UCSB and an MRL Seed Project PI, has been awarded the prestigious **Presidential Early Career Award for Scientists and Engineers (PECASE)**. The award is the highest honor the nation can bestow on a scientist or engineer at the beginning of his or her career. Prof. Jayich conducts experiments on a technique that may one day be used to image protein structures. More...

The MRL wishes to congratulate **Tresa Pollock** on having been awarded the **2012 ASM International Gold Medal**. The medal is the single highest honor bestowed by ASM on one of its members, for "outstanding knowledge and great versatility in the application of science to the field of materials science and engineering, as well as exceptional ability in the diagnosis and solution of diversified materials problems".

Congratulations to all our graduating seniors! 38 alumni of MRL's CAMP, RISE and CISEI programs are graduating from UCSB this spring and summer.

Center (MRSEC) in 1996. The MRL is supported by the MRSEC Program of the NSF under Award No. DMR-1121053. Click here to view our 2010-11 Annual Report.

Resources For:

Teachers

Undergraduates

K-12 Students

Giving to the MRL

The MRL and ScienceLine would like to congratulate and acknowledge seven students who in 2011-2012 have excelled as contributors to ScienceLine. Thank you for your great work!
Peter St. John from the Department of Chemical Engineering
Sean Paradiso from the Materials Research Laboratory
Sebastian Fischetti from the Department of Physics
Michael Gaultois from the Materials Research Laboratory
Jonathan Harvey from the Department of Earth Science
Graham A. Hagen-Peter from the Department of Earth Science
Darcy Bradley from Bren School of Environmental Science & Management (not in the picture)

The MRL would like to congratulate and acknowledge five students who in 2011-2012 have excelled at mentoring, general program service and as contributors to ScienceLine. Thank you for your hard work!
Outstanding Overall Service to Education Programs: **Frank Leibfarth**
Outstanding Mentor: **Justin Cochran**
Outstanding Service to K-12 Programs: **Brian Stahl**
Outstanding Service to K-12 Programs: **Moureen Kemei**
Outstanding Service to ScienceLine: **Mike Gaultois**
The MRL would also like to thank the Dow Materials Institute for financially co-sponsoring the awards.

The MRL is proud to announce that the National Science Foundation (NSF) has awarded $3.3 million for the establishment of a collaborative research and education program between The University of Texas at El Paso and UCSB. As part of the national **Partnerships for Research and Education in Materials** (PREM) grant program, this award establishes a long-term partnership between UTEP and the MRL in materials research. More...

A number of MRL students and faculty members are travelling to Chalmers Technical University, Goteborg, Sweden, to attend and speak at a bilateral workshop on **Materials for Catalysis and Energy Applications** in June 2012. On the UCSB side, the workshop is co-sponsored by MRL's International Programs, the ConvEne IGERT Program, and the International Center for Materials Research. The Chalmers Technical University is one of Sweden's leading Universities in the Materials area, and this is the second bilateral workshop (2011 at UCSB) between the MRL and Chalmers

We are delighted to announce that MRL Director **Craig Hawker** has been awarded the **2012 Centenary Prize of the Royal Society of Chemistry**. The Centenary prize was founded in 1947 to commemorate the centenary of the Chemical Society's founding in 1841, and is awarded to outstanding international chemists, who are also exceptional

communicators. The award honors Craig for his outstanding creative development of new strategies for the design of novel polymers which has revolutionized the field of polymer synthesis and influenced a generation of chemists. More...

We are also delighted to share the information that former MRL Director, and Emeritus Professor **Tony Cheetham** has been awarded the **2012 Nyholm Prize for Inorganic Chemistry**, also from the Royal Society of Chemistry, for his contributions to the structural characterization of new and useful mixed metal oxide and framework materials.

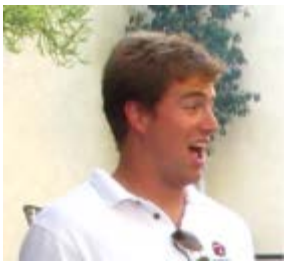
The MRL and Dow Materials Institute are proud to partner with the Technology Management Program at UCSB in support of the 2012 New Venture Competition. The 2012 competition was the biggest yet and we are thrilled to announce that **James Rogers** (PhD student in the Materials Department and MRL) together with **Zubin Kuvidia** (PhD student in Chemical Engineering) were awarded both the NVC's Grand Prize and Best Tech Push Award for their start-up aPEEL Technology. Selected from 140 competitors on 46 teams that started the competition, we look forward to James and Zubin joining past winners in creating successful Santa Barbara-based companies.

The MRL wishes to congratulate **Jason Kawasaki**, **Seung Soo Oh**, and **Neil Treat** on their recent awards at the **Materials Research Society's** Spring Meeting. Jason Kawasaki of the Palmstrom group was presented with a GOLD award. Seung Soo Oh of the Soh group and Neil Treat of the Chabinyc and Hawker groups were presented with SILVER awards. Congratulations!

MRL REU students **Lucy Darago** and **Katelyn Cahill-Thompson** are recipients of 2012 NSF Graduate Research Fellowships. Lucy (UCSB CCS Chemistry 2012) has participated in the RISE and CISEI programs and currently does undergraduate research in Ram Seshadri's group. Katelyn (UC Davis, Biomedical Engineering 2010) completed a RISE internship in the Safinya group in 2008 and a CISEI internship to Trinity College Dublin in 2009 and is currently a graduate student at Stanford in bioengineering.

Congratulations also to **Stephanie Moffitt** (UCSB Chemistry 2012) and **Charlotte Osborne** (Willamette University, Chemistry 2011) who received NSF GRF Honorable Mentions.

The MRL and the Center for Scientific Computing are pleased to announce the **Southern California Simulations in Science Conference** to be held **April 16**. Speakers from industry will talk about how they use simulations and high performance computing in their research and a lunchtime poster session will feature UCSB HPC research. For information and registration, please click here.



James Rogers has won the **Frank J. Padden award** of the Division of Polymer Physics of the American Physical Society. Out of 28 nominations he was selected as one of 7 PhD candidate finalists whose oral presentations were judged by a committee of senior physicists in the Division. His paper "Imaging three dimensional bicontinuous networks in bulk heterojunction solar cells" was selected as the best of an excellent set of presentations.

MRL undergraduate interns **Christina Rodriguez** (Hawker group, mentored by Nate Lynd) and **Maia Kinnebrew** (Han group, mentored by Sunyia Hussain) have won Special Merit Awards for their research presentations at the California Alliance for Minority Participation (CAMP) Statewide Symposium in Irvine, CA. CAMP provides research and program support for University of California undergraduate students in science, engineering and math fields. The CAMP Statewide Symposium brings together over 100 undergraduate researchers from the nine UC campuses.

Researchers in the Computational Materials Group at the University of California, Santa Barbara (UCSB) have uncovered the fundamental limits on optical transparency in the class of materials known as transparent conducting oxides. Their discovery will support development of energy efficiency improvements for devices that depend on optoelectronic technology, such as light- emitting diodes and solar cells. More...

The **Dow Chemical Company** has awarded UC Santa Barbara up to $15 million to establish a collaborative research initiative that will help shape the future of technology in areas that will benefit society. The Dow Materials Institute at UCSB will educate future scientists and engineers and advance the discovery of revolutionary new materials with applications that range from novel polymers to next-generation microelectronics. More...

The MRL is pleased to announce that **Song-i Han** has been awarded a 2011 **NIH Director's New Innovator Award**. These very prestigious and highly sought after awards are designed to support exceptionally creative investigators and highly innovative projects that have the potential for unusually high impact. Song-i will receive $1.5 million dollars to support her research.

MROP 2012 & CFDC Meeting Dates Announced: The Materials Research Outreach Program Symposium 2012 (MROP 2012) will take place on January 31 & February 1, 2012 in the UCSB Corwin Pavilion. The Annual Meeting of the Complex Fluids Design Consortium (CFDC) will be held on the preceding Monday, January 30th in the Room 2053. Further details on both meetings can be found here.

Recent UCSB graduate, **Daniel P. Shoemaker**, a postdoctoral fellow at Argonne National Laboratory, is the winner of the 23rd Rosen Prize. The prize, established in honor of Louis Rosen, the father of Los Alamos Neutron Science Center (LANSCE), is awarded for the most outstanding doctoral or master's thesis based on experimental or theoretical research performed at LANSCE. Criteria include the originality and scientific impact of the research and the student's contribution to the research.

Ram Seshadri, Dotti Pak and Julie Standish have been awarded a UCSB Faculty Outreach Grant to develop curriculum materials for the MRL's Solar Car Workshop. The workshop links UCSB's research strength in photovoltaics with eighth and ninth grade science and math standards through hands-on building of a solar car kit.

The Technology Management Program and the MRL are proud to acknowledge the **2011 New Venture Competition Finalists** - Athlete Performance Data Systems, WageCraft, Aptitude Medical Systems, SyncIn, GigaMesh, and DermaTex - the final presentation round is May 11 at 3 PM in Corwin Pavillion, everyone is welcome.

MRL faculty members **Gary Leal** and **Glenn Fredrickson** have been elected as Fellows of the American Academy of Arts and Sciences, one of the nation's most prestigious honorary societies and a leading center for independent policy research.

Moureen Kemei, a first-year Materials Department Graduate Student in **Ram Seshadri's group,** was selected as a **Schlumberger Foundation Fellow**. The fellowship is endowed by the **Faculty of the Future Program** which funds graduate study throughout the world. The MRL is honored to have a Schlumberger Foundation Fellow here at UCSB and provide recognition of Moureen's outstanding work.

Faculty for the Future is the flagship program of the Schlumberger Foundation. The program, now in its seventh year, is devoted to bringing about long-term social advancement through the empowerment of women by generating conditions that result in more women pursuing scientific disciplines. The community has grown to become a close-knit group of 194 pioneering women from 54 countries. **More.....**

Maartje's Project Page - CISEI summer 2006

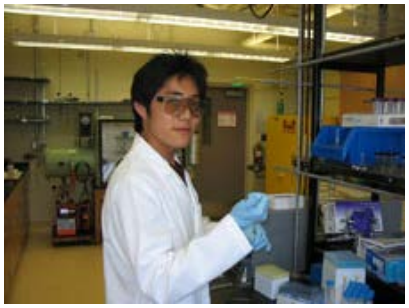
Intern: Maartje Bastings, Technical University Eindhoven, Netherlands
Mentor: Ben Messmore
Faculty Supervisor: Craig Hawker
Department: Chemistry

Nanocylinders via the self-assembly and covalent capture of triblock copolymers

The self-organization of single molecules or polymers into supramolecular objects through non-covalent interactions is a simple and versatile route to form nanostructured materials. These nanostructures may offer substantial benefits in various fields, ranging from molecular electronics to molecular imaging due to their well defined and precisely controlled structure. Using the self-assembly of block-copolymers to form hexagonal structure is one example of self-organizing materials. We developed novel triblock copolymers with amphiphilic character and cross-linking function to enable the fabrication of covalently captured cylindrical nano-objects. Polymers were synthesized using nitroxide mediated polymerization (NMP) and reversible addition fragmentation chain transfer (RAFT) polymerization. Three different crosslinking monomers were synthesized, a cinnamoyl, a dimethyl maleic anhydride, and a protected thiol crosslinker, and incorporated in the polymers. The path towards lift-off of the nanocylinders includes spin coating, annealing in benzene/water vapor environment overnight, UV irradiation or oxidation for crosslinking and solvation in THF for lift-off. 1H-nuclear magnetic resonance spectroscopy, gel permeation chromatography, ellipsometry, atomic force microscopy and dynamic light scattering were used for analysis. Lift-off of nanocylinders of the dimethyl maleic anhydride polymer has been achieved, as well as length control from 20 to 80nm.

Return to the CISEI 2006 project list

Kang Hee's Project Page - CISEI summer 2006



Intern: Kang Hee Cho, KAIST, South Korea
Mentor: April Sawvel
Faculty Supervisor: Songi Han
Chemistry & Biochemistry

Monitoring foreign surface/blood interface using protein labeling and magnetic resonance imaging

QuikClot™ is a zeolite based material used in the United States Military to stabilize battlefield injuries. This inorganic material is a good hemostatic agent (HA) because it offers a negatively charged surface for clotting factor adhesion, has a large hydration capacity, and it releases heat upon hydration which increases the clotting rate. The heat of hydration for QuikClot, however, is so high that there is a risk of causing third degree burns at the injury site upon application. A better understanding of the blood response to QuikClot, as well as other inorganic oxides, will allow for the rational design of the next generation of HA's. These experiments were focused on using nuclear magnetic resonance spectroscopy (NMR) and magnetic resonance imaging (MRI) to monitor the interaction of High Molecular Weight Kininogen (HMWK) (a protein involved in the initiation of the intrinsic pathway) with inorganic materials. HMWK was spin labeled with a TEMPO radical and detected using T1 relaxation measurements. The T1 relaxation constant of sodium bicarbonate buffer decreased with the addition of spin-labeled HMWK and then increased after the HMWK was exposed to QuikClot, indicating that a small fraction of the protein was binding to the surface of the material.

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Sander's Project Page - CISEI summer 2006

Intern: Sander van Duijnhoven Biomedical Engineering, University of Technology Eindhoven, Netherlands
Mentor: Kim Weirich
Faculty supervisor: Deborah Fygenson
Department: Physics

Real-time detection of the orientation of a sub-resolution DNA nanotube

Studying the orientation of biological molecules can give us deeper insight into molecular processes. To study the orientation of these molecules an orientation sensitive probe is needed. In this project we wanted to make such an orientation sensitive probe by using DNA nanotubes as scaffold. DNA nanotubes are self-assembled scaffolds that are about 10nm wide and anywhere from 0.1 to 100 microns long. Certain fluorescent dyes (called intercalating dyes) lodge themselves between the DNA bases and become organized with all their emission dipole monuments pointing in the same direction. The fluorescence intensity generated by such aligned fluorophores is predicted to have distinct out-of-focus pattern that depends on their orientation with respect to the optical axis. The main aim of this project was to find out if it is possible to determine the orientation of a fluorescently labeled DNA nanotube that is shorter than the diffraction limit (<0.2 microns) by imaging the fluorescence in real time. To determine the orientation we extended the model for determination of the orientation of a single dye molecule to a model for multiple fluorophores and compared this model with the out-of-focus pattern of the synthesized DNA nanotubes.

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Michael's Project Page - CISEI summer 2006

Intern: Michael Ford, Oxford University, England
Mentor: Anderson Janotti
Faculty Supervisor: Chris van de Walle
Department: Materials

The development of OpenDX as visualization software for electronic structure calculations

Ab initio quantum mechanical calculations are important for understanding the electronic properties of many technologically useful materials. One such modeling technique is Density Functional Theory, which avoids the complexities of a many-body wave function and uses only the charge density and the atomic coordinates in its approach. The goal of this research was to develop user-friendly visualization tools based on OpenDX for imaging calculated electronic structures. 14 such tools were created, superimposing a plot of charge density onto an atomic structure. The charge densities can be viewed as either isosurfaces or contour lines plotted on arbitrary cross-sectional planes in colour or black-and-white. Simplified master control panels were developed for each tool, containing all the necessary imaging parameters. A further goal was to use unit-cell data to render a larger supercell image. Due to the lack of connections data in its inputs, OpenDX could not be used for such a translation to form a continuous image. However, progress has been made in developing a program which can translate the atomic structure into an arbitrary number of unit cells whilst preserving intercellular bonding, though further work is required to translate the charge density data.

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Michael's Project Page - CISEI summer 2006

Intern: Elmar Kroner Materials / University of Stuttgart, Germany
Mentor: Peter Lowenhielm
Faculty Supervisor: Craig Hawker
Department: Chemistry

Robust and high refractive encapsulations for solid state lighting devices

High Power LEDs have the capability to replace lighting devices such as light bulbs. To improve the lifetime of these LEDs, the conventional epoxy-based encapsulations have to be replaced because of their poor thermal stability. An LED lamp consists of a semiconductor chip (LED), which is located in a composite or metal cup. This cup is filled with a polymer to protect the chip from external damage and increase light extraction. In additio to functioning as protection, the polymer must not decrease the efficiency of the LED. In order to fulfill these requirements, the thermal stability, the adhesion, the mechanical and optical properties have to be optimized. Therefore silicones are investigated, which have a good thermal stability and can easily be modified by functionalizing of the silicones to fit the other requirements. The optical transmission was quantified by UV-VIS Spectroscopy. Adhesion tests such as peel-off tests and tensile tests to determine the mechanical properties were performed. It was possible to synthesize silicones that were colorless and showed good adhesion and the bulk properties were improved. The most promising samples were filled into the LED-cups and those packages subjected to LED application tests.

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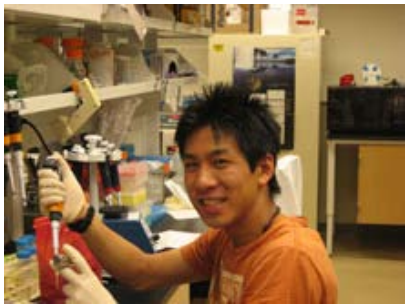
David's Project Page - CISEI summer 2006



Intern: David Lee, University of Oxford, England
Mentor: Kevin Boulware
Faculty Supervisor: Patrick Daugherty
Chemical Engineering

Cellular Libraries of Peptide Substrates (CLiPS)

Proteases are a particular group of enzymes which cleave peptides, and play an important role in many biological processes, such as digestion or cellular growth. By better understanding the cleavage characteristics of a protease, we can go on to improve disease identification or drug development. The method used during this internship is called cellular libraries of peptide substrates (CLiPS), which determines the optimum substrate sequences for a protease. Peptide substrates consist of a chain of amino acids and based on the particular sequence of the amino acids, a protease under investigation will be able to break apart the sequence at varying rates. This means that if the substrate sequence of the peptide is more optimal than another, then the protease will cleave more substrates of that particular sequence in a given time. To prepare the samples, bacteria cells that contain a plasmid which encode a substrate sequence are grown and are treated so that the substrates are displayed on its cell surface. The cells are then treated with the protease for a specific period of time. Finally, the cells are labeled with a fluorescent probe, and depending on whether there has been cleavage or not, the probe will attach itself to the end of the substrate. The samples are then run through a Fluorescent-Activated Cell Sorter (FACS), which will determine the amount of cleavage based upon the amount of fluorescence exhibited by each cell population. Therefore, to achieve a comprehensive analysis, conversion calculations need to be made for a variety of time points, and a time-dependent conversion graph can be constructed. This is then used to identify and rank the optimum substrates. This summer, as well as characterizing a protease, the CLiPS method was also developed, and it was found that complete growth media removal during sample preparation is essential for repeatable results.

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Martijn's Project Page - CISEI summer 2006

Image

Unavailable

Intern: Martijn Lijbers, Technical University Eindhoven, Eindhoven, Netherlands
Mentor: Wei Tang
Faculty Supervisor: Eric McFarland
Department: Chemical Engineering

Methanol coupling through doped and mixed metal oxide catalysts

The methanol-to-olefin (MTO) process has relied on using highly porous acidic aluminosilicate zeolites as catalysts. In addition to light olefins, large olefins and aromatic compounds (coke) are formed. Because the coking products can block the relative small pores and deactivate the MTO process, the goal for this project was to change the morphology of the catalyst into non-porous structure with comparable high surface area and density of active acid sites, which possesses a high methanol coupling selectivity for light olefins with minimum coke formation. With the sol-gel procedure, doped and mixed zinc aluminum oxide (ZnAlOx) were synthesized. The catalysts were tested using a continuous flow Packed Bed Reactor (PBR) and the reaction products were analyzed by a mass spectrometer on-line and by NMR off-line. The mixed metal oxides produce syn-gas starting at 200°C and heavy hydrocarbons and coke at 400°C.

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Zeynep's Project Page - CISEI summer 2006

Intern: Saide Zeynep Nerghiz, Sabanci University, Turkey
Mentor: Sean Keane
Faculty Supervisor: Susanne Stemmer
Department: Materials

$Bi_2Ti_2O_7$ thin film deposition by magnetron sputtering for tunable microwave capacitor applications

Tunable microwave capacitors are used in many wireless communication systems which have gained importance recently. The required dielectric properties for tunable capacitor applications are high permittivity, tunability and low loss. Besides ferroelectric thin films such as barium strontium titanate that exhibit the necessary dielectric properties, non-ferroelectric bismuth zinc niobate (BZN) thin films have been investigated for tunable capacitor applications, but the relationship between the cubic pyrochlore phase and the dielectric properties of BZN is not yet understood. We will investigate whether a new bismuth titanate, $Bi_2Ti_2O_7$, thin film with a cubic pyrochlore phase is capable of high permittivity, tunability and low losses. $Bi_2Ti_2O_7$ thin films will be deposited by rf magnetron sputtering and different process parameters and post-deposition annealing treatments will be investigated in order to optimize the dielectric properties for use in microwave tunable capacitor applications. Rutherford backscattering spectrometry and x-ray powder diffraction techniques will be used to investigate the composition and the degree of crystallinity of the sputtered thin films. Dielectric measurements will be conducted using planar Al_2O_3/Pt/$Bi_2Ti_2O_7$/Pt capacitor structures to investigate if the sputtered thin films possess high permittivity, tunability and low losses to make them desirable for use in microwave applications.

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General Program - Craig Hawker, Director

What's New

2010/2011 Annual Report

The Materials Research Laboratory (MRL) at the University of California, Santa Barbara, was established in September 1992 with funding from the National Science Foundation (NSF), and became an NSF Materials Research Science & Engineering Center (MRSEC) in 1996. Its primary role is to support interdisciplinary research, training and education through the study of materials with chemical and structural complexity. These materials range from self-assembling polymers to atomically layered semiconductor materials and have the common theme that multiple length-scales play an important role in their physical properties.

Application of the diverse set of materials studied at the UC Santa Barbara MRL includes new semiconductors for microelectronics, novel nanostructures for high-speed communication devices and advanced polymeric materials. Active collaborations exist with a variety of small to large companies, which have a direct benefit to the region. In addition, the center directs pioneering education and international outreach programs, including undergraduate research opportunities, graduate training, outreach to K-12 students and teachers, and community outreach. Craig Hawker, a UCSB professor of chemistry and materials, is Director of the MRL.

The scientific and engineering activities of the UCSB-MRL focus on the following three major interdisciplinary research groups (IRGs):

- **Bio-Inspired Wet Adhesion**
- **Correlated Electronics**
- **Robust Biphasic Materials**

Details of the IRG's, activities and their participants can be found on their respective web-pages under Research Programs which also includes a description of the MRL Seed Programs.

In addition, the UCSB, MRL maintains state-of-the-art instrumentation in six central facilities: X-ray, Spectroscopy, Microscopy and Microanalysis, Computing, Polymer Characterization, and Chemistry. The MRL has a tradition of international collaborations and engages in a large number of individual and multi-investigator collaborations with overseas scientists. The MRL has especially been proactive in fostering special relationships with international centers-of-excellence in Materials research. As of 2005, our international workshops are held in partnership with the **International Center for Materials Research at UCSB.**

Research Programs

Research Programs

Research Programs

The research scientific and engineering activities of the Materials Research Laboratory focus on the following three major interdisciplinary research groups (IRGs):

- **Bio-Inspired Wet Adhesion**
- **Correlated Electronics**
- **Robust Biphasic Materials**

COMPLEX FLUIDS DESIGN CONSORTIUM brings together UCSB faculty with researchers from industry and national laboratories interested in the computational design and processing behavior of soft materials and complex fluids.

SEED PROJECTS

Central Facilities

We currently operate six laboratories within the MRL:

TEMPO, Extensive analytical instrumentation for characterization of all kinds of materials. Training is available for all instruments. Equipment includes: a PPMS that measures DC Resistivity, AC Transport (AC Resistivity, Hall Coefficient, I-V Curve, & Critical Current), and Heat Capacity for small samples under controlled magnetic field to 7 Tesla and temperature from 1.9 to 400 K; a SQUID Magnetometer is for measuring the magnetic properties of small samples to 5 Tesla between 1.7 and 400 K, with a sensitivity of 10 -9 emu; a TGA/DTA is used for quantitative thermo analysis of a sample to 1100° C, it requires as little as 5 mg of sample; MS Accessory to the TGA for Evolved Gas Analysis; a DSC for quantitative heat capacity, Transition Enthalpy, Glass Transition, and Crystallinity from room temperature to 1400° C; an ICP for elemental analysis which measures down to 10 PPB; an X-Ray Diffractometer that can measure powders and thin films in the theta theta configuration from room temperature to 1500° C; a UV-Vis-NIR Spectrometer that measures the of transmission, absorbance, and diffuse reflectance spectrum of powder, solid, liquid, and thin film samples over a range of 220 to 2600 nm; a Fluorimeter that measures fluorescence, phosphorescence, and chemiluminescence of solid, powder, liquid, or thin film samples over a range of 200 to 800 nm; two BET Porosimeters that measure the surface area, pore size, and pore size distribution of powder samples; a Pycnometer for very precise density measurements of small solid samples.

Computing, with Linux, Windows NT, and SGI workstations, a dedicated Beowulf computer cluster, and the campus SGI Origin 2000 supercomputer.

Microscopy and Microanalysis with (i) three FEI transmission electron microscopes (two Tecnai 200kV microscopes and a Titan 300kV one for high resolution TEM/STEM, and EDS/EELS analysis); (ii) three FEI SEMs (XL30FEG, XL40FEG and Inspect S for high resolution SEM imaging, EDS spectrum imaging and cathodluminescence measurement); (iii) a FEI focus ion beam microscope (Duel-beam, Pt-deposition and EDS); (iv) six AFMs (a Asylum MFP-3D SL, a Asylum MFP-3D Bio system, two Veeco Dimensions, and two Veeco Multimode AFMs); (v) a PHI dynamic SIMS and a Kratos XPS System for surface analysis.

Polymer Characterization, with equipment for the synthesis of polymers, and monomers (Schlenk lines) as well as polymer analysis equipment: Circular Dichroism (CD) used in the study of proteins, TA Differential Scanning Calorimeter (DSC) Q2000 temp. -90 °C to 400 °C, Dynamic Light Scattering (DLS) Brookhaven, Dynamic Mechanical Analyzer (DMA), Gel Permeation Chromatography (GPC) using chloroform with 0.25% TEA as a solvent (Analytical and Preparative), GPC using DMF with 0.1% of LiBr as a solvent, High Performance Liquid Chromatography (HPLC- Analytical and Preparative), Two Microwave Reactors (Biotage and CEM), Two Rheometers (with the oven and the water bath), Wyatt DynaPro NanoStar DLS, Wyatt Optilab rEX which can measure the absolute Refractive Index and the dn/dc which is specific refractive index increment, and Gas Chromatograph (GC).

Spectroscopy, housing three Bruker Avance NMR Spectrometers: a 500MHz SB for both solutions and solids, a 300MHz WB for solids, a 200MHz SB for solutions, a Nicolet-Magna 850 IR Spectrometer with a Raman module, and a Varian Cary Eclipse Fluorimeter.

X-ray facility, which houses three Rigaku rotating anode and three sealed tube x-ray sources supporting seven state-of-art x-ray spectrometers for (i) small and wide angle x-ray scattering and diffraction, (ii) thin-film characterization, (iii) in-situ powder diffractometry and (iv) small molecule x-ray crystallography. In addition, the facility has extensive optical imaging capabilities including a state-of-art laser scanning confocal microscope.

MRL Facilities Recharge Rates

Non-UCSB Use of MRL Facilities

FOR NON-UCSB USE OF MICROSCOPY & MICROANALYSIS FACILITY PLEASE CONTACT: Venissa Wilson 805-893-8885.

Education Programs

Mission Statement

MRL scientists and education staff are dedicated to improving access to science for diverse groups and to building a competent work force of scientists and engineers. Our education programs provide undergraduate research opportunities, graduate student training, outreach to K-12 students and teachers, and community outreach.

Undergraduate Research Opportunities

K-12 Science Activities

Opportunities for Teachers

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Distinguished Visitors
Students, Staff & Faculty

MRL People Frontpage

The MRL People Page (Under Construction)

Events

News/Seminars/Events

Seminars
Each IRG sponsors a seminar program, usually one seminar a week, which alternates between internal and external (invited) speakers.

News

Symposia, Workshops and **International Workshops**
The MRL will on an ongoing basis sponsor local (UCSB) Workshops and International Workshops (see also **International Programs**).

Research Highlights
We have collected a few of the high profile research highlights published under the auspices of the MRL.

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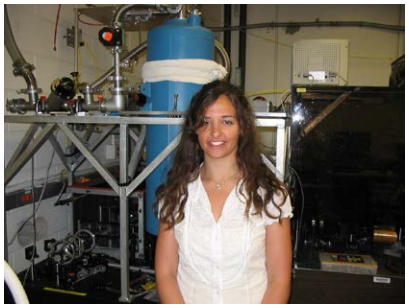
Lina's Project Page - CISEI summer 2006



Intern: Lina Persechini, Trinity College, Dublin, Ireland
Mentor: Dan Allen
Faculty Supervisor: Mark Sherwin
Department: Physics

A 25ns free space delay line

We built and tested a variable detour path for far infrared or Terahertz (THz) laser pulses. This scientific apparatus, called a delay line, can be used to divide an incoming laser pulse into three pulses of light delayed by a variable amount (0-25 ns). This will aid with the investigation of coherent quantum phenomena of localized electrons and electron spins in a previously inaccessible part of the electromagnetic spectrum. The THZ region lies between the well-developed microwave and infrared spectral ranges. We intend to use this delay line with THz pulses from the UCSB Free Electron Laser (FEL), an intense source of THz radiation, to perform quantum control experiments such as electron spin resonance (ESR) and photon echo from electrons bound shallow donors. This technology will enable studies of quantum information in materials, including measurements of dephasing times. Our unique design compensates for strong diffraction at these frequencies, and includes a desiccated enclosure to eliminate H2O absorption. The delay line will enable the highest frequency pulsed ESR measurements to date.

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Monika's Project Page - CISEI summer 2006

Intern: Monika Rawolle, Stuttgart University, Stuttgart, Germany
Mentor: Nick Finstrom
Faculty Supervisor: Susanne Stemmer
Department: Materials

X-ray diffraction characterization of heteroepitaxial $SrTiO_3$ thin films

$SrTiO_3$ is an oxide with the Perovskite structure. It is one of the best-characterized oxides because of its dielectric properties. The high dielectric constant and the non-linear dielectric permittivity that can be tuned with the applied electric field make thin films of SrTiO3 very interesting for applications such as capacitors or tunable microwave devices. The dielectric properties of a thin film are dependent on its microstructure, as well as other effects like strain or non-stoichiometry. By studying the microstructure and the dielectric properties on the same samples, the relationship between these two aspects can be found.

Two different types of substrates were studied: Pt that had been sputtered on a sapphire substrate and Pt that had been grown by Electron-Beam Deposition with a Ti adhesion layer on a sapphire substrate. $SrTiO_3$ was grown epitaxially by radio-frequency magnetron sputtering with a substrate temperature of about 700?C on both types of samples, resulting in different crystal growth directions. On both types of samples 5 different thicknesses, 60nm, 80nm, 100nm, 120nm and 140nm, were examined. Two aspects of the microstructure were studied, strain and mosaic. Strain evolves during the film growth when the lattice parameters of the substrate and the layer don't match completely. Mosaic describes the misorientation between substrate and layer subgrains. X-ray diffraction methods to determine mosaic in SrTiO3 on sputtered Pt and to determine the relaxed and strained lattice parameters were developed.

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Karen's Project Page - CISEI summer 2006

Intern: Karen Young, Trinity College, Dublin, Ireland
Mentor: Kinson Kam
Faculty Supervisor: Tony Cheetham
Department: Materials

Synthesis and characterization of nanoporous materials

Nanoporous materials are structures containing pores of diameter less than 100nm. The synthesis of nanoporous materials has sparked great interest over the past decade as they have many important applications such as ion exchange, separations, catalysis and gas storage. The focus of this project is to synthesise novel nanoporous materials using organic ligands as structural linkers and various metals. Each sample was characterised using powder x-ray diffraction, single crystal x-ray diffraction, and thermogravimetric analysis (TGA) for structure determination and thermal stability. We have successfully synthesised several novel metal containing coordination polymers under hydrothermal conditions with metal-to-ligand-to-metal (M-L-M) connectivity. Based on our structure determination results, various architectures can be prepared as a function of temperature. We found that denser and complex frameworks were formed at higher temperature than ones formed at lower temperature. Furthermore, by utilizing organic ligands with racemic and chiral moieties, chiral frameworks were synthesised with interesting structure and connectivity, both at low and high temperature. Our thermal stability shows that frameworks synthesised at higher temperature have less weight loss prior to heating at 300°C due to the amount of water present in the framework. Upon further heating, all structures decompose to its native oxide >400°C.

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Cooperative International Science and Engineering Internships

The CISEI Program is sponsored by the
Materials Research Laboratory,
International Center for Materials Research

Application for **Summer 2012 Internships**
(Deadline - February 17th, 2012)

The Cooperative International Science and Engineering Internships program, sponsored by the Materials Research Laboratory and the International Center for Materials Research, sends US science and engineering undergraduates to international partner institutions for a 10-week summer research experience. Internships are available at research centers in Santiago-Chile; Eindhoven-Netherlands; Dublin-Ireland; Cork-Ireland; Oxford-England; Shanghai-China; Saarbruecken-Germany and Goethenborg-Sweden.

2011 CISEI Exchange Students from UCSB

To see examples of what areas of research are explored by CISEI undergrads, see our listings of Student Project Titles:

- **Summer 2011**
- **Summer 2010**
- **Summer 2009**
- **Summer 2008**
- **Summer 2007**
- **Summer 2006**

Our partner institutions also send undergraduate students to participate in a 10 week summer internship program here at UCSB.

2011 CISEI Exchange Students from abroad

To see examples of what areas of research are explored by CISEI undergrads, see our listings of Student Project Titles:

- **Summer 2011**
- **Summer 2010**
- **Winter 2010**
- **Summer 2009**
- **Winter 2009**
- **Summer 2008**
- **Winter 2008**
- **Summer 2007**
- **Winter 2007**
- **Summer 2006**
- **Summer 2005**

For more information about our partner institutions click here:
Oxford-UK, **Dublin-Ireland**, **Cork-Ireland**, **Shanghai-China**, **Santiago-Chile**, **Eindhoven-Holland**, **Saarbruecken-Germany**, **Goethenborg-Sweden**

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MRL Sitemap

MRL - Web Site Privacy Notification Guideline

Current University Privacy Notification Guidelines

University of California at Santa Barbara websites that collect personal information are REQUIRED to contain a formal privacy notification statement. The WSG recommends that any UCSB sites collecting information from users include a link to this statement.

Access to the section of the UCSB Web Guide containing Privacy Notification information is available at this link: **Web Privacy Guide**

If you have any questions regarding UCSB's policies regarding the collection of data from visitors, please contact **webstandards@ucsb.edu**.