

UNIVERSITY OF OREGON

Overview of Graduate Studies in Chemistry

What Sets Oregon Apart? Four distinguishing features:

- 1. World-class research and facilities
- 2. A multidisciplinary and collaborative approach
- 3. A student-centered graduate education program
- 4. Location: Eugene and the Pacific Northwest

Internationally Recognized Research

nature



ARTICLES Single-molecule FRET and linear dichroism studies of PUBLISHED ONLINE: 1 DECEMBER 2013 | DOL: DNA breathing and helicase binding at replication fork junctions Adaptive semiconductor/electrocatalyst junctions SNAS Carey Phelps^{a,b,c}, Wonbae Lee^{a,b,c}, Davis Jose^{b,c}, Peter H. von Hippel^{b,c,1}, and Andrew H. Marcus^{a,b,c,1} in water-splitting photoanodes regon Center for Optics, "Department of Chemistry and Biochemistry, and 'Institute of Molecular Biology, University of Oregon, Eugene, OR 97403 tributed by Peter H. von Hippel, August 19, 2013 (sent for review May 29, 2013) Fuding Lin and Shannon W. Boettcher* DNA "breathing" is a thermally driven process in which base-paired DNA sequences transiently adopt local conformations that interbase hydrogen bonds. Such fluctuations could be involved depart from their most stable structures. Polymerses and other in transition states leading to intercalation and base "flipping."

High-efficiency photoelectrochemical water-splitting devices require the integration of electrocatalysts (ECA) with light-absorbing semiconductors (SCA), but the encrepticas and drogs-transfer processes at SC/EC interfaces are popula-We fabricate model EC-coated single-crystal TO₂ electrodes and directly probe SC/EC interfaces in popular two working electrodes to independently monitor and control the potential and current at both the SC and the EC. We discover that

Ultralow Thermal Conductivity in Disordered, Layered WSe₂ Crystal

Source Control Arun Bodapati,³ Pawel Keblinski,³ Paul Zschack

The cross-plane thermal conductivity of thin films of WSe2 grown from alternating W and is as small as 0.05 watts per meter per degree kelvin at room temperature, 30 times s than the c-axis thermal conductivity of single-crystal WSe2 and a factor of 6 smaller th predicted minimum thermal conductivity for this material. We attribute the ultralow th conductivity of these disordered, layered crystals to the localization of lattice vibration by the random stacking of two-dimensional crystalline WSe2 sheets. Disordering of the structure by ion bombardment increases the thermal conductivity.

www.sciencemag.org SCIENCE VOL 315 19 JANUARY 2007

Understanding Hydrogen Sulfide Storage: Probing Conditions for Sulfide Release from Hydrodisulfides T. Spencer Bailey, Lev N. Zakharov, and Michael D. Pluth⁴

Department of Chemistry and Biochemistry, Institute of Molecular Biology, Material Science Institute, 1253 University of Oregon, European Oregon 97403, United States

(path be d

An Anion-Modulated Three-Way Supramolecular Switch that Selectively Binds Dihydrogen Phosphate, H₂PO₄^{-**}

Jesse V. Gavette, Nancy S. Mills, Lev N. Zakharov, Charles A. Johnson II, Darren W. Johnson,* and Michael M. Haley*

nature structural & molecular biology

week ending 19 OCTOBER 2012

Recent publications in world leading journals.

Structural basis for regulation of Arp2/3 complex by GMF

DOI: 10.1002/anie.201302929

eins of genome expression require access to single-stranded More-complex breathing fluctuations could be described a

PHYSICAL REVIEW LETTERS

Thermodynamic Consistency in Variable-Level Coarse Graining of Polymeric Liquids

A. J. Clark, J. McCarty, I. Y. Lyubimov, and M. G. Guenza* ent of Chemistry and Institute of Theoretical Science, University of Oregon, Eugene, Oregon 97403, USA (Received 16 May 2012; published 15 October 2012)

Numerically optimized reduced descriptions of macromolecular liquids often present thermodynamic

nconsistency with atomistic level descriptions even if the total correlation function, i.e. the structure, appears to be in agreement. An analytical expression for the effective potential between a pair of coarse-

Assembly and molecular order of two-dimensional

Peptoid nanosheets are a recently discovered data of 20 nano-material that from from the self-assembly of a sequence specific peptoid polymer at an alr-water interface. Nanosheet formation, cours first treough the assembly of a peptoid monolayer and as-cours first treough the assembly of a peptoid monolayer and as-

Ellen J. Robertson^{4,1}, Gloria K. Olivier^{b,1}, Menglu Qian^b, Caroline Proulx^b, Ronald N. Zuckermann^{b,2}, and Geraldine L. Richmond^{b,2}

*Department of Chemistry, University of Onegon, Eugene, OR 97403; and *Molecular Foundry, La

Contributed by Geraldine L. Richmond, August 5, 2014 (sent for review March 25, 2014)

peptoid nanosheets through the oil-water interface

Qing Luan^{1,2} & Brad J Nolen^{1,2}

PRL 109, 168301 (2012)

ned units

where each cha

 n_b , of size N_b . exponent of N_b^{l}

larger than the p

ANG

model to corre

DOI: 10.1103 U

pubs.acs.org/JACS

men Access on 07/10/201

The Arp2/3 complex mediates formation of complex cellular structures such as lamellipodia by nucleating branched actin filaments. Arp2/3-complex activity is precisely controlled by over a dozen regulators, yet the structural mechanism by which regulators interact with the complex is unknown. GMF is a recently discovered regulator of the Arp2/3 complex that can inhibit nucleation and disassemble branches. We solved the structure of the 240-kDa assembly of Mus musculus GMF and Bos taurus Arp2/3 complex and found that GMF binds the barbed end of Arp2, overlapping with the proposed binding site of WASP-family teins. The structure suggests that GMF can bind branch junctions in the manner that cofilin binds filament sides, consistent

Geri Richmond, *spectroscopy*. Pioneering studies of molecular structure and interactions at surfaces and interfaces.

2011 inductee into the <u>National</u> <u>Academy of Sciences</u> <u>President Elect – AAAS; Obama</u> <u>Science Envoy</u>

COACh founder, National Science Advisory Board

Mike Haley, Organic Chemistry, Leader in small molecule organic electronic materials, molecular anion sensing

See numerous publications in Ang. Chemie, JACS, ...

R = Mesityl, 3,5-(CF₃)₂C₆H₃, CCSi*i*-Pr₃

Marina Guenza, *Theoretical Chemistry*, develops new models for describing dynamics of macromolecules (polymers, proteins) important for understanding biological and materials

A. Clark, J. McCarty, I. Y. Lyubimov, M. G. Guenza "Thermodynamic consistency in variable-level coarsegraining of polymeric liquids" Physical Review Letters 109, 168301-5 (2012).

Ken Prehoda, *biochemistry*. regulation of stem cell division cellular signal transduction

Recent publications in Nature, PNAS, etc.

Award-winning young faculty

Mike Pluth – Organic, Chemical Biology

Started 2011 **NSF CAREER, Sloan Fellow, NIH** pathway to independence awards

Cathy Wong – Physical, Solar/electronic materials

Starting 2015

Mike Harms, 2013 Protein evolution biophysics **Sloan Fellow** Jim Prell – Physical, analytical, and biophysical

Started 2014

Started 2010: NSF CAREER, ACS PRF. **NSF-MRI** STM

George Nazin – Physical,

Started 2010

Shannon **Boettcher**

- Materials **DuPont Young** Professor, Cottrell Scholar. Sloan Fellow

Cathy Y. Wong

Postdoc: UC Berkeley PhD: University of Toronto BSc: McMaster University

Notable publications:

Exciton dynamics reveal aggregates with intermolecular order at hidden interfaces in solution-cast organic semiconducting films. *Nature Comm.* (2015) 6, 5946.

Coherently wired light-harvesting in photosynthetic marine algae at ambient temperature. *Nature* (2010) 463, 7281.

Biexcitonic fine structure of CdSe nanocrystals probed by polarization-dependent 2D photon echo spectroscopy. *J. Phys. Chem. A* (2010) 115, 3797.

Single-shot ultrafast spectroscopies for non-equilibrium systems

Watch electronic structure and exciton dynamics change during materials formation

Tailor materials processing for designer excitonic properties

Prell Group: Native Mass Spectrometry for Nanoscale (Bio)assemblies

Topology, shape/conformation, and structure-function relationships for **macromolecular assemblies** with chemical specificity and sub-nanometer resolution **Instrument development** and **computational modeling**

Projects:

What protein-lipid interactions allow anthrax toxin to hijack the endocytosis pathway?

What chemical principles govern lipid "raft" composition, size, and organization in membranes?

Current projects:

- Evolution of allostery in S100A5
- Co-evolution of a new protein-protein interface in S100A8/S100A9

o mM Ca2+

Spectroscopy and Microscopy with a Scanning Tunneling Microscope (STM)

Nazin Lab

Single-molecule visualization of the actin binding protein, Cortactin: *Nolen Lab*

TIRF Microscope Setup

Total Internal Reflection Fluorescence microscopy (TIRF) excites fluorophores within 100 nm from the slide surface. 488 nm ex: Actin 561 nm ex: Cortactin

New Methods for H₂S Detection (Pluth Lab)

H₂S Fluorescent Probes

H₂S Quantification Methods

"Chemists moving forward with tool to detect hydrogen sulfide" Phys.org Jun 24, 2013

Colorimetric H₂S Detection

14th International Symposium on Novel Aromatic Compounds

ISNA-14

Eugene, Oregon | 24 - 29 July 2011

Major international conferences in your own backyard...

7th International Conference on Coherent Multidimensional Spectroscopy

Call for Abstracts and Second Announcement For the 7th International Conference on Coherent Multidimensional Spectroscopy, CMDS 2014 Hosted in Eugene, Oregon, July 13-16, 2014

http://cmds2014.org/

CURO-π Eugene, Oregon, USA

2nd International Symposium on the Synthesis and Application of Curved Organic π-Molecules and Materials

Non-planar aromatic compounds exhibit unique properties as a direct result of their novel architectures. The premier conference on this growing area of science will take place September 12, 2016 in Eugene.

What Sets Oregon Apart? Four distinguishing features:

- 1. World-class research and facilities
- 2. A multidisciplinary and collaborative approach
- 3. A student-centered graduate education program
- 4. Location: Eugene and the Pacific Northwest

O RESEARCH FACILITIES

Chemistry Instrumentation

Shared Laser Facility Larry Scatena, Ph.D.

Crystallography Lev Zakharov, Ph.D.

NMR Spectroscopy Mike Strain, Ph.D.

World Class Facilities for Advanced and Sustainable Materials

> \$35M in shared instrumentation

High Resolution and Analytical Facility

Microanalytical Facility

Imaging Facility

NMR Spectroscopy Facility

Polymer Characterization and Thermal Analysis Laboratory

Surface Analytical Facility

SuNRISE Facility

X-Ray Diffraction Lab

High Performance Cloud Computing

Cloud computing could provide faster and cheaper solutions to some problems,

By Elizabeth K. Wilson

What Sets Oregon Apart? Four distinguishing features:

- 1. Outstanding research and facilities
- 2. A multidisciplinary and collaborative approach
- 3. A student-centered graduate education program
- 4. Location: Eugene and the Pacific Northwest

Collaborative research is a signature aspect of Oregon Chemistry

INSTITUTE OF MOLECULAR BIOLOGY

UNIVERSITY OF OREGON The Institute of Molecular Biology at the University of Oregon is an interdisciplinary research community, founded in 1959, dedicated to investigating biological questions at the molecular level. Our collaborative and interactive Institute brings together—from the Departments of Biology, Chemistry and Biochemistry, and Physics—scientists using diverse approaches and state-of-the-art facilities. The rich research environment provides exceptional training opportunities for young scientists. To join the IMB as a graduate student, see th

World class ground-breaking research for over 50 years:

Green fluorescent protein

The Institute of Theoretical Science is a center for research in several interrelated disciplines that encompass mathematics, theoretical chemistry, and theoretical physics.

Quantum optics Condensed matter physics Theoretical quantum chaos and semiclassical physics Optical devices Ultracold atoms and atom optics Fluorescence fluctuation and ultrafast laser spectroscopy Quantum information Quantum control Semiconductor optical physics Nonlinear optics and lasers Biophysics

SM51 materials science institute University of Oregon Founded in 1985 as a State Center of Excellence, the purpose of the Institute is to study the structure and properties of materials, to educate in the sciences of materials, and to serve Oregon as a resource in these sciences.

summer immersion coursework (polymers, optics, semiconductors, bioinfo.)

Graduate Internships – Relationships with over 150 companies nationwide (incl. IBM, Intel, FEI, Nike,) REU programs for undergraduates

Center for Sustainable Materials Chemistry

Dave Johnson

Darren Johnson

NSF Phase II Center for Chemical Innovation

\$20 Million 5-year grant awarded in 2011. renewable until 2021

Collaborative effort with Oregon State University.

CSMC () center for sustainable materials chemistry

- A 5-Year, \$20M NSF Center for Chemical Innovation (awarded 2011)
 - Mission: To conduct curiosity-driven and use-inspired research to enhance the green chemistry toolbox with new methods and new techniques that will advance the scientific enterprise and transform the next generation of products
- Immersion CSMC Lab Class
 - Introduces students to CSMC chemistry in Fall term
- **Transition Fellowships** for students to transfer from Graduate Internship Program after Masters degree
- Center Fellows: outreach in the community and highs schools
- Graduate Workshops to enhance career opportunities
 - Entrepreneurship, project management, ethics, teamwork, mentoring
 Proposal writing, scientific writing, analytical methods, interviewing

A partnership between UO and OSU!

The Thin-Film Challenge

Metal Oxide Clusters as Precursors to Thin Films

- Ultra smooth, large area, films, and functional multi layers
- -Basic chemistry of clusters, and cluster-to-
- -film transformation
- Applications in energy, electronics

Collaboration

Prof. Alán Aspuru-Guzik (Harvard)

ultrafast spectroscopy, quantum chemistry

Prof. Mike Raymer (UO Physics)

multi-dimensional spectroscopy with quantum light Prof. Mark Lonergan (UO Chemistry)

Andy Marcus

(University of Oregon,

Physical Chemistry)

solar devices

biological molecules in membranes

protein-

interactions

DNA

Prof. Pete von Hippel (UO, Institute of Molecular Biology)

Prof. Ted Molinski (UC San Diego)

What Sets Oregon Apart? Four distinguishing features:

- 1. Outstanding research and facilities
- 2. A multidisciplinary and collaborative approach
- 3. A student-centered graduate education program
- 4. Location: Eugene and the Pacific Northwest

O STUDENT-CENTERED GRADUATE STUDIES

- Research rotations allow you to make an *informed* choice
- Targeted coursework to accelerate your research
- Close community of graduate students, postdocs and faculty
- Professional development towards your goals IDP
- Opportunities for Internships that (*ex.* Intel, Proton OnSite, PNNL, College teaching) *launch your career* after graduate school

Organizations to foster your success:

National Organization of Black Chemists and Chemical Engineers

- NOBBChE chapter at the University of Oregon.
- The first in the Pacific Northwest.

- UO hosted 2013 NOBBChE Western Regional Meeting

The Women in Graduate Science (UOWGS)

- professional development of women in all disciplines of science
- informative workshops, inspirational speakers
- community outreach program.

SACNAS 40 Years of Advancing Hispanics/Chicanos & Native Americans in Science

High-Impact Outreach and Educational Opportunities

STEM CORE: a UO Center Dedicated to Outreach and Education

"MAD DUCK" SCIENCE

UNIVERSITY OF OREGON Department of Chemistry & Biochemistry

Monthly hand-on science labs with local middle school students.

What Sets Oregon Apart? Four distinguishing features:

- 1. Outstanding research and facilities
- 2. A multidisciplinary and collaborative approach
- 3. A student-centered graduate education program
- 4. Location: Eugene and the Pacific Northwest

Eugene, Oregon

- "The Emerald City": top-ten college town, population ~ 155,000
- "Track Town USA" U.S. Track & Field Olympic Trials, NCAA's, Prefontaine Classic
- 157 city parks, more than 250 miles of paved bike paths, a host of hiking trails, and an outstanding bus system

Cultural

- Eugene symphony / Hult Center
- LA-SF-Seattle music axis
- wine region (famous Pinot Noirs)
- local/organic food year-round

The University of Oregon

- $\sim 24,000$ students
- \sim 4,000 graduate students
- One of 63 *AAU* universities nationwide
- Top performing NCAA college athletics

Examples of UO Graduates

O STUDENT PROFILE – DAN MOORE

Ph.D., Materials/Inorganic Chemistry, 2014 "Synthesis and characterization of rotationally disordered intergrowths containing PbX and TiX2 (X = Se and Te)"

Adviser: David Johnson

HIGHLIGHTS

- 7 publications; (Angewandte Chemie (cover), Chem Mat)
- Presentations at Materials Research Society, IEEE, etc.
- internships with Intel

AFTER OREGON

process engineer at Intel Corporation, 2014

O STUDENT PROFILE – ED SAMBRISKI

Ph.D., Physical Chemistry (Theory and Computation), 2006 "Theoretical Models for the Coarse Graining of Polymer Liquids"

, AC

Adviser: Marina Guenza a ground-state evolution, Relin

HIGHLIGHTS

- •5 publications; Physical Review Letters, J. Chem Phys. etc.
- NSF Graduate Research Fellow
- Travel Award 55th Lindau Meeting of Nobel Laureates and Students

AFTER OREGON

Postdoctoral Associate, University of Wisconsin – Madison

- •Tenure Track Professor since 2009 at Delaware Valley College
- •7 publications, 1 in Nature 4 grants

Fluorescent sensors enabling precision agriculture

Dr. Calden Carroll

President

Graduated 2011 7 papers **NSF IGERT** Fellow

- **NSF** icorp best-of-show

Co-Founders: Darren Johnson & Mike Haley

> **Co-Founder and Business Mentor: Bruce Branchaud**

Augie Sick Business Adviser, Entrepreneur-in-Residence

O STUDENT PROFILE – JULIA WIDOM

Ph.D., Chemistry and Biochemistry, 2013, "Local conformations and excited state dynamics of porphyrins and nucleic acids by two-dimensional fluorescence spectroscopy "

Adviser: Andrew H. Marcus

HIGHLIGHTS

- 9 papers including Nature Communications, Proc. Nat. Acad. Sci., Nucleic Acids Res., J. Phys. Chem. Lett., J. Chem. Phys., etc.
- Attended 4 professional meetings 1 poster, 2 contributed talks, and 1 30 minute invited talk.
- Rosaria Haugland Chemistry Graduate Research Fellowship, given to the top firstyear female graduate student.
- Peter H. von Hippel Graduate Scholar Award, given to a senior graduate student by the Institute of Molecular Biology

AFTER OREGON

- Postdoctoral Fellow at the University of Michigan
- Won NIH postdoctoral fellowship (one of top scores nationwide!)

O STUDENT PROFILE – BRYAN WARF

Ph.D., Biochemistry, 2009, "The Regulation of Alternative Splicing Associated with Myotonic Dystrophy "

Adviser: Andy Berglund

HIGHLIGHTS

- NIH training grant appointee
- American Heart Association Graduate fellowship
- 5 publications
- Speaker at several national/international meetings
- Awarded the Myotonic Dystrophy Foundation Award for Excellence in Research
- Clarence and Lucille Dunbar Award
- Co-inventor on a patent

AFTER OREGON

- NIH Postdoctoral Fellow at the University of Utah
- Staff scientist at Myriad Genetics

O STUDENT PROFILE – NATE SZYMCZAK

Ph.D., Biochemistry, 2007, "Coordination chemistry of dihydrogen and dihydrogen hydrogen-bonding"

Adviser: David Tyler

HIGHLIGHTS

- 10 papers (incl. 2 in JACS)
- Discovered novel water soluble catalysts
- Internship at Pacific Northwest National Labs
- NSF IGERT Fellow
- Multiple national meeting presentations

AFTER OREGON

Postdoctoral Studies MIT/Caltech

•Tenure Track Faculty at University of Michigan (Sloan, NSF Career)

O STUDENT PROFILE – LENA TROTOCHAUD

Ph.D., Chemistry, 2014

"Structure-composition-activity relationships in transition-metal oxide and oxyhydroxide oxygen-evolution electrocatalysts "

Adviser: Shannon Boettcher

HIGHLIGHTS

- Discovered and characterized record-activity catalysts for water-splitting
- 7 total, 5 first-author papers including 3X J. Am Chem. Soc., Chem. Mat, J. Phys. Chem Lett. etc.
- Oral presentations at Materials Research Society, American Chemical Society, African MRS in Addis Abba, Ethiopia, Summer School on Materials for Energy
- CSMC Outreach Fellow
- Graduated in 4.5 years

AFTER OREGON

 Postdoctoral Fellow Berkeley, Joint Center for Artificial Photosynthesis

O STUDENT PROFILE – TRAVIS HUMBLE

Ph.D., Theoretical Chemistry, 2005 "Nonlinear wave-packet interferometry and molecular state reconstruction "

, AC

Adviser: Jeff Cina during ground-state evolution, Relin

HIGHLIGHTS

- •5 high profile publications (e.g., Physical Review)
- Internship at Los Alamos National Lab
- Presentation at ultrafast meeting in Okazaki, Japan
- Numerous other national and international meeting presentations
- Scholarship from Western Spectroscopy Society

AFTER OREGON

Permanent staff-scientist position at Oak Ridge National Lab

SCHEDUL

FRIDAY (today)

2:30-3:30 pm - Overview of graduate program 3:30-5:00 pm - Poster Session - Willamette Atrium - Integrated Science Complex Facilities Tour (3:30, 4:00 pm) 5:00 - 6:20 pm - Mixer in Lewis Atrium 6:30 pm - Dinner (Lillis Rotunda)

SCHEDUL

Saturday

9:00 - 12:00 pm – Faculty appointments and Degree requirements 12:00 - 1:00 pm – Catered lunch in Willamette Atrium 1:00 - 1:45 pm – Faculty appointments 1:50 - 2:00 pm – Closing remarks 2:00 - 2:30 pm – Institute open houses and informal meetings 2:30 – Free time / optional activities 5:30 – Shuttle starts to dinner 6:00 – Dinner at Geri Richmond's home

SUNDAY

8:30 am – Coast Trip 9:15 – Brunch at the Valley River Inn (optional river walk following brunch)

Outdoors

- running

- climbing (smith rock)
- kayaking/rafting
- biking (road, trail, commuting)
- skiing (mt. bachelor, backcountry)
- camping/hiking/fishing