

2015 Ph.D. Dissertations

Materials Research Updates

Electronic & Photonic Inorganic Macromolecular & Biomolecular Structural

New Faculty

Professor Rachel Segalman Assistant Professor Stephen Wilson Associate Professor Daniel Gianola

Department Life: Annual Tony Evans Memorial Run



A Note from the Department Chair

Dear Materials Alumni and Friends,

Welcome to the inaugural issue of the Materials Department Newsletter. As Department Chair, I want to take this opportunity to share with you a few of the many achievements of our graduate students and faculty. Along with this are some updates on the Materials Department infrastructure and some highlights on current research initiatives.

The Department is very proud of the accomplishments of our outstanding graduate students, which in recent years have hovered between a total of 140 - 150. Many of them hold prestigious national fellowships, including National Science Foundation Fellowships, the National Defense Science and Engineering Fellowships and a variety of UC Fellowships. Recent graduates have academic positions at top-ranked universities, have received prestigious international research fellowships, started their own companies and are providing leadership within a broad array of high-tech industries. We celebrate the successes of all of our alums and if you check our new web page, you will see the beginning of our efforts to profile these success stories.

Because our students and faculty are at the forefront of materials, we need the best facilities. We have invested substantially in our state-of-the-art Microscopy and Microanalysis Facility, Materials Processing Facilities and currently the Materials Research Lab is expanding to add a new wing for advanced characterization equipment. Staying at the forefront of advanced instrumentation is an ongoing challenge.

Our faculty continue to have high impact and our numbers continue to grow. Over the past 18 months we have welcomed three new faculty members to the department: Rachel Segalman, Stephen Wilson, and Daniel Gianola. We are fortunate to have strong support from the university to continue to search for additional outstanding faculty to join our ranks.

Great things are happening in the Materials Department at UCSB and we are looking forward to sharing more information about that in this inaugural newsletter and in newsletters to come. Please stay in touch and visit us on campus when you can.

Best regards,

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Tresa M. Pollock UCSB Materials Department Chair

2015 Ph.D. Dissertations

"Electron Emission Spectroscopy of InGaN/GaN Light Emitting Diodes" by Justin Iveland

"Effects of Molecular Structure and Processing on Morphology and Performance of Small Molecule Solar Cells" by John Love

"Loss Mechanisms in Solution-Processed Small Molecule Bulk Heterojunction Solar Cells" by Chris Proctor

"Improving Efficiency of III-N Quantum Well Based Optoelectronic Devices through Active Region Design and Growth Techniques" by Nathan Young

"III-Nitride Blue Laser Diode with Photoelectrochemically Etched Current Aperture" by Ludovico Megalini

"Growth and Carrier Transport Studies of III-Nitride Alloys by Ammonia Molecular Beam Epitaxy" by David Browne

"Phosphors for Solid-State Lighting: New Systems, Deeper Understanding" by Kristin Denault

"Modulation-Doped SrTiO3/SrTi1-xZrxO3 Heterostructures" by Adam Kajdos

"Characterizing Structure and Properties of Woven Ceramic Matrix Composites" by Michael Rossol

"Thermoelectric Properties of Complex Oxide Heterostructures" by Tyler Cain

"Growth and Electonic Structure of Heusler Compounds for Use in Electron Spin Based Devices" by Sahil Patel

"High Temperature Deformation Mechanisms of L12-Containing Co-Based Superalloys" by Michael Titus

"Structure-Property Relationships in Semiconducting Polymers and Small Molecules Probed by Synchrotron X-ray Method" by Gregory Su

"High Active Nitrogen Flux Growth of GaN/InGaN by Plasma Assisted Molecular Beam Epitaxy" by Brian McSkimming

The Leading Edge: Materials Research Updates

Electronic & Photonic

Prof. Chris Palmstrøm was named a National Security Science and Engineering Faculty Fellow by the Department of Defense, receiving a grant to study Heusler compounds. **Prof. Michael Chabinyc** is developing nextgeneration organic solar cells with a gift from a German commercial real estate developer, generating awareness of modern needs in the building industry and opening doors for future nontraditional funding opportunities.

Inorganic

Prof. Anton Van der Ven and **Prof. Ram Seshadri** are initiating collaborations in the area of electrochemical energy storage (i.e. secondary batteries) that emphasize sulfide-based electrode materials that operate in hybrid conversion/intercalation mode. They are also coordinating broader energy storage expertise across UCSB and neighboring universities for improved and new modalities of electrochemical energy storage.

TODAY'S **LEADERS** FOR Tomorrow's **Materials**

Macromolecular & Biomolecular

Prof. Craig Hawker was named a fellow of the American Association for the Advancement of Science "for revolutionizing materials research through the development of powerful synthetic methods and strategies for molecularly engineering functional macromolecules, inspiring scientists across multiple disciplines," and, most recently, Prof. Hawker was elected to the National Academy of Inventors in recognition of his "highly prolific spirit of invention."

Structural

Prof. Matthew Begley is currently developing novel approaches to threedimensional printing of composites; the goal is to be able to fabricate complex shapes with reinforcements (whiskers) aligned with structural features. His research has shown that one can use standing acoustic waves to align and pack particles in the printing direction, opening new avenues to rapidly synthesize multifunctional materials that exploit long range ordering of embedded features.

New Faculty Please welcome...

Professor Rachel Segalman joined the Materials Department, with a joint appointment in Chemical Engineering, in July of 2014. Prof. Segalman's research focuses on the self-assembly of functional polymer systems. Since structure control over soft matter on a molecular through nanoscopic lengthscale is a vital tool to optimizing properties for applications ranging from energy (solar and thermal) to biomaterials, Prof. Segalman studies the likes of how molecular structure affects the electronic properties of semiconducting polymers, the crystal and grain structure greatly affect bulk conductivity, and nanometer lengthscale pattern of internal interfaces is vital to charge separation and recombination in photovoltaic and light emission effects. She also researches how biological materials gain functionality from structures ranging from monomeric sequence through chain shape through



self-assembly. Prof. Segalman works to both understand the effects of structure on properties and gain pattern control in these inherently multidimensional problems. She is particularly interested in materials for energy applications such as photovoltaics, fuel cells, and thermoelectrics. Prof. Segalman was recently elected Fellow of the American Physical Society for "pioneering contributions to the understanding of conjugated, polypeptoid, and ion-containing polymers and co-polymers."

Professor Stephen Wilson joined the Materials Department in July of 2014. Current research interests of Prof. Wilson include studying of phase behavior in strongly correlated electron/quantum materials, new states in spin orbit coupled matter, and harnessing many-body electronic states in functional materials. Specific examples of his research are studies of relativistic Mott materials, unconventional superconductivity, quantum criticality, and new approaches to controlling magnetocaloric and cathode materials. Experimental techniques include neutron and x-ray scattering, bulk electronic properties characterization (e.g. charge transport, heat capacity, magnetic susceptibility, etc.), and bulk single crystal growth. Prof. Wilson recently won a Keck Foundation Grant to grow new exotic materials capable of driving technological and scientific advances to new levels in the semiconductors of today's electronics. He was also recently named a 2015-2016 Hellman Fellow and



will receive support from the Hellman Fellows Fund for new research addressing the role of electronic correlations in transition metal oxides being explored as battery materials.



Professor Daniel S. Gianola is the newest member of the Materials faculty, joining us in November 2015. His research interests span the nanomechanical behavior of ultra-strong materials to the development of tunable energy conversion materials for applications in structural settings, micro- and nanoelectronics, robust thermal management, and waste heat collection. Prof. Gianola aims to understand and exploit the unique deformation mechanisms that govern mechanical response in nanoscaled materials at the extreme limits of strength. He is motivated by the opportunities to develop structural materials with unprecedented combinations of strength and damage tolerance, as well as to create a new paradigm for tunable functional properties via elastic strain engineering. Prof. Gianola possesses unique expertise in probing the behavior of individual nanostructures in situ, allowing him to directly observe materials mechanisms with atomic fidelity, while simultaneously performing quantitative measurements.



4th Annual Tony Evans 5k Memorial Run



On a Saturday morning in early October, the Materials family celebrated the life of Tony Evans in the 4th Annual Tony Evans 5K Memorial Run. Over 100 people gathered to honor Tony's memory and daily practice of running around the lagoon and back through campus. While not everyone present had met Tony, his indelible presence was felt by all.

After the run concluded, the group moved from the peace and respite of the lagoon to Goleta Beach, for food, more socializing, and a few games of beach volleyball.

Tony and his legacy are unique, and our annual tradition of remembering this great man with a run around the lagoon as a Materials family is our unique way of saying, Here's to you, Tony. Cheers!

Supporting UCSB Materials

Gifts to UCSB Materials allow us to deepen and broaden the scientific experience for our students. Please consider making a gift to Materials to allow us to continue to bring highly distinguished speakers to campus, provide even more research opportunities for our students, and strengthen our Materials family. To find out more, please visit materials.ucsb.edu/about/giving.

A Legacy of Excellence

UCSB Materials alumni lead exceptional careers as premier scientists, business leaders, and entrepreneurs, and recognizing the excellence of our alumni is a priority. To better leverage the power of the UCSB Materials network, we created a LinkedIn group – UCSB Materials Alumni – and we invite you to join. We also recently began highlighting the careers of our alumni on our website. We encourage you to submit names of alumni for us to feature by writing to **materials-alumni@engineering.ucsb.edu**. In fact, please write to us at any time - we want you to stay in touch!

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