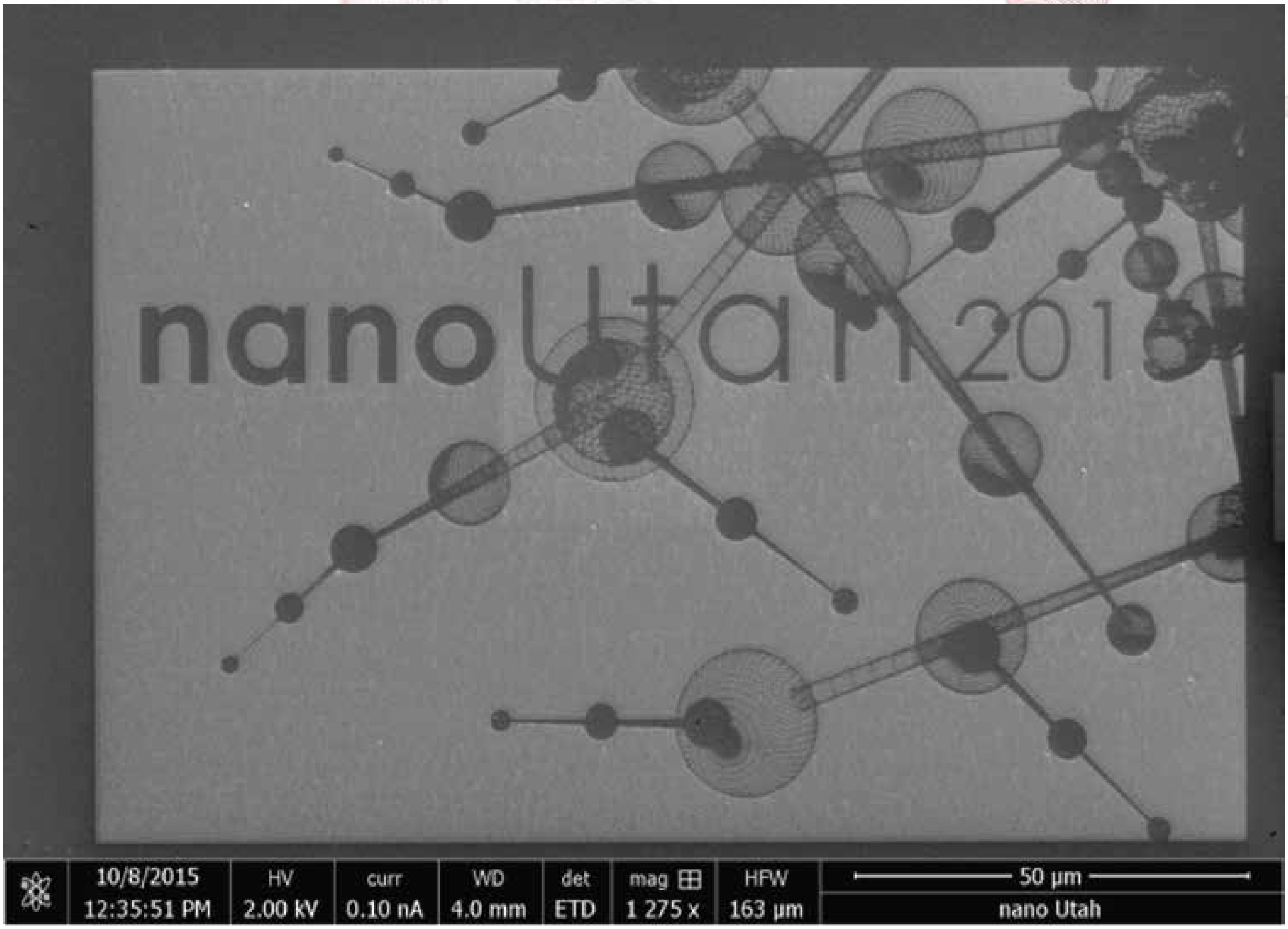
nanoUtah 2015

UTAH'S STATEWIDE NANOTECHNOLOGY GRANT COORDINATION WORKSHOP



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UTAH NANOFAB

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nanoUtah 2015

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Table of Contents

Instructions for use:

- click on blue underlined text for hot link
- click inside text boxes to edit and add your own notes

Welcome

Welcome nanoUtah '15 Participants!

Thank you for helping us celebrate the completion of the Utah Microfab / Nanofab move from the Merrill Engineering Building to the beautiful new Sorenson Molecular Biotechnology Building - A USTAR Innovation Center. We hope you will take time to visit with our staff at the various tour stations set up in the extended lunch hour. See the program guide for a map of tour stations.

Because of the coincident celebration, we have chosen to return to the roots of nanoUtah in developing and fostering collaborations in a workshop format. It was this format in 2004-2006 that really helped us attain a critical mass of statewide faculty and industry support leading to the inclusion of micro/nano into the USTAR program.

It is fitting then, to also announce the new USTAR subsidy program that makes it possible for all Utah-based academics and business users to access these facilities at the same low rates that were already being made possible to U of U faculty through VP and COE Dean subsidy.

Please see www.nanofab.utah.edu under the PI services menu and the Proposal Support button for a list of options that will help you truly make the Utah Nanofab an extension of your own labs!

This program is published in editable PDF form so that you can keep notes directly in the program and preserve your thoughts and notes as well as the abstracts of the talks in a search-able format. This helps you to maintain value from the experience and helps us save the cost of printing.

Many thanks to Dr. Greg Jones who is the University Liaison to the USTAR program (through the office of the VP-R), for making nanoUtah possible at no cost to the participants through the use of USTAR outreach funds. Also, thanks to our students and judges for participating in the poster session, organized by Prof. David Britt of USU and Ruby Steele of Prof. Ghandehari's group. Many, Many thanks to the Administrative Organizing Committee: Amy VanRoosendaal (Executive admin), Kayla Robinson (graphics, all things program), Deb Zemek (catering), Corinne Garcia (finance).

We look forward to hearing back from you whether this is a useful format (even though in the future we will do it at a time other than fall break!) and whether someone else would like to step into the organizing role.

Please enjoy the program!

Program Chair:
Ian R. Harvey Associate Director, Utah Nanofab
Research Associate Professor
Department of Mechanical Engineering
Adjunct Associate Professor
Department of Electrical & Computer Engineering
University of Utah

Program Co-Chair:
Margit M. Janát-Amsbury
Research Assistant Professor
Research Director Division of Gynecologic Oncology
Dept. of Obstetrics and Gynecology
University of Utah

Organizing Committee

Technical Organizing Committee:
Hamid Ghandehari USTAR Professor,
Departments of Pharmaceutics &
Pharmaceutical Chemistry, and Bioengineering
Co-Director, Nano Institute of Utah
Director, Utah Center for Nanomedicine
University of Utah

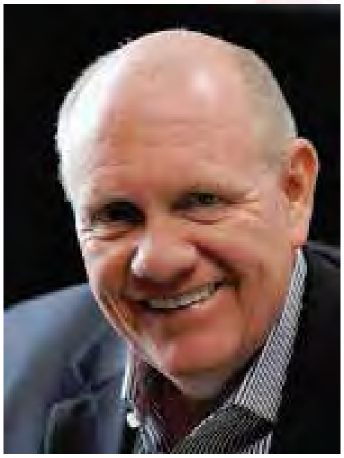
Technical Organizing Committee:
David Britt Associate Professor
Biological Engineering Department
Utah State University

Technical Organizing Committee:
Matthew Linford Associate Professor
Department of Chemistry and Biochemistry
Brigham Young University

Administrative Organizing Committee:
Amy VanRoosendaal
Utah Nanofab

Administrative Organizing Committee:
Kayla Robinson
Utah Nanofab

Keynote Address



Mr. Clayson has been a business owner, global strategic planning expert, financial and investment strategist and senior political advisor for the past 30 years. He currently serves as President and Chief Executive Officer of HzO Inc., A Salt Lake City-based startup with cutting-edge, breakthrough technology that makes electronic devices water resistant. He also serves as Chairman of the Board of Directors of Voyss Solutions, a North Carolina based cloud-computing company and as a member of the Board of Directors of Soligen, a California based solid-state drive manufacturer. Mr. Clayson previously served as Chairman and Chief Executive Officer of nCoat, Inc., an award winning nanotechnology materials development and manufacturing company, which he sold in 2010. He has served as President and COO of Sequoia Pacific Research Company.

Previously, Mr. Clayson managed congressional campaigns and served as Chief of Staff to two U.S. Congressmen. He served in the White House as a lead advance agent to two U.S. Presidents. Mr. Clayson served as senior management and operations officer for prominent institutional investment advisory and research firms in Portland, Oregon, growing assets under management from $400 million to over $2 billion. As a senior officer for a Utah-based publicly traded technology company, he developed global marketing, business, product development, and finance strategies and helped grow the company from an R&D base to a globally commercialized firm. Mr. Clayson has served in key positions in numerous charitable, civic and political—Chairman of the Utah Nanotechnology initiative, board member of the Utah Technology Industry Council, Chairman of the North Carolina WIRED Action Committee for Advanced Manufacturing, member of the Board of Directors of the Piedmont Triad Entrepreneurial Network. He currently serves as Chairman of the Industrial Advisory Board for the Engineering Resource Center at North Carolina A&T State University.

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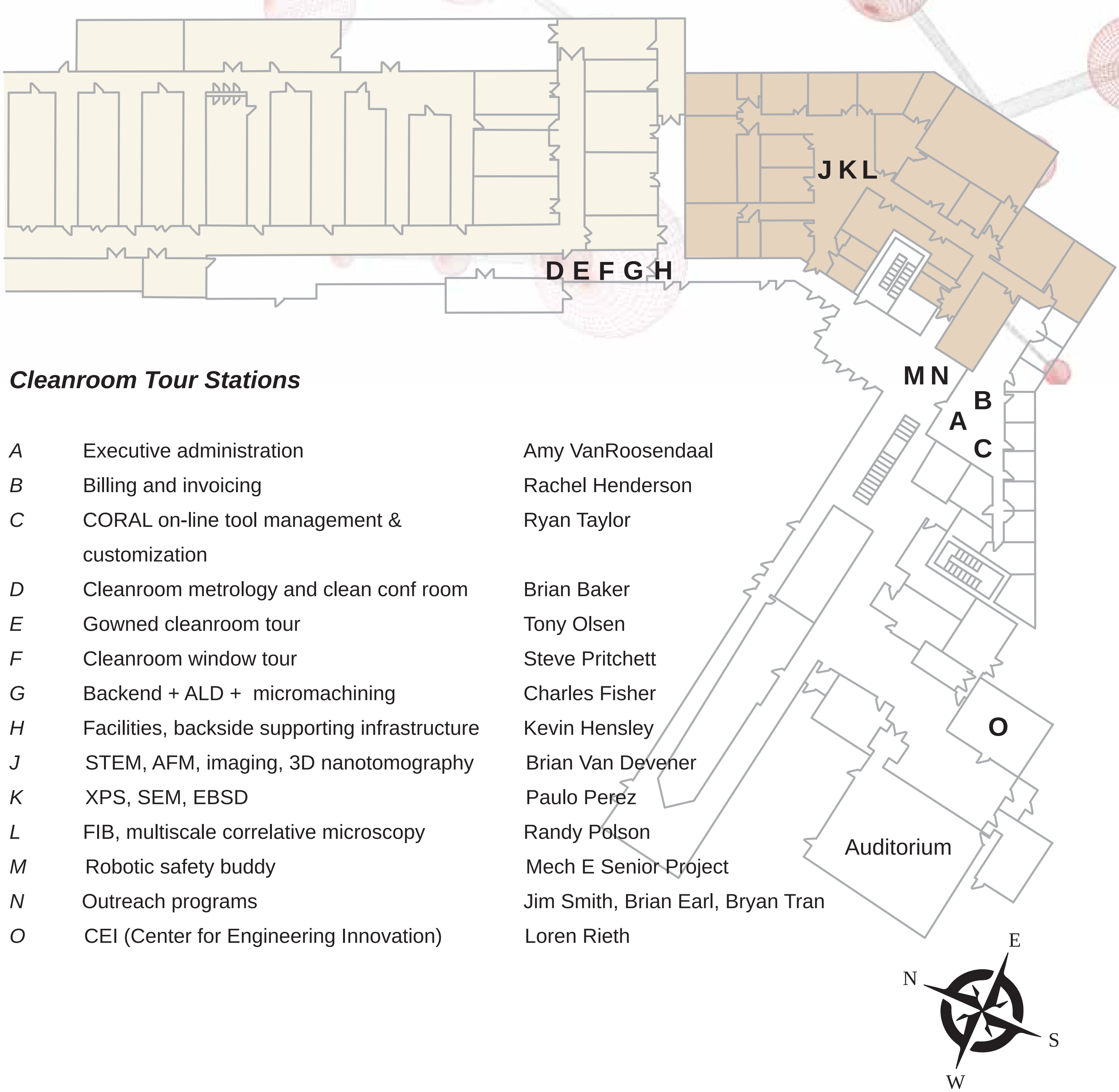
Tour Stations Map

Tours will be held from 11:55 - 1:45

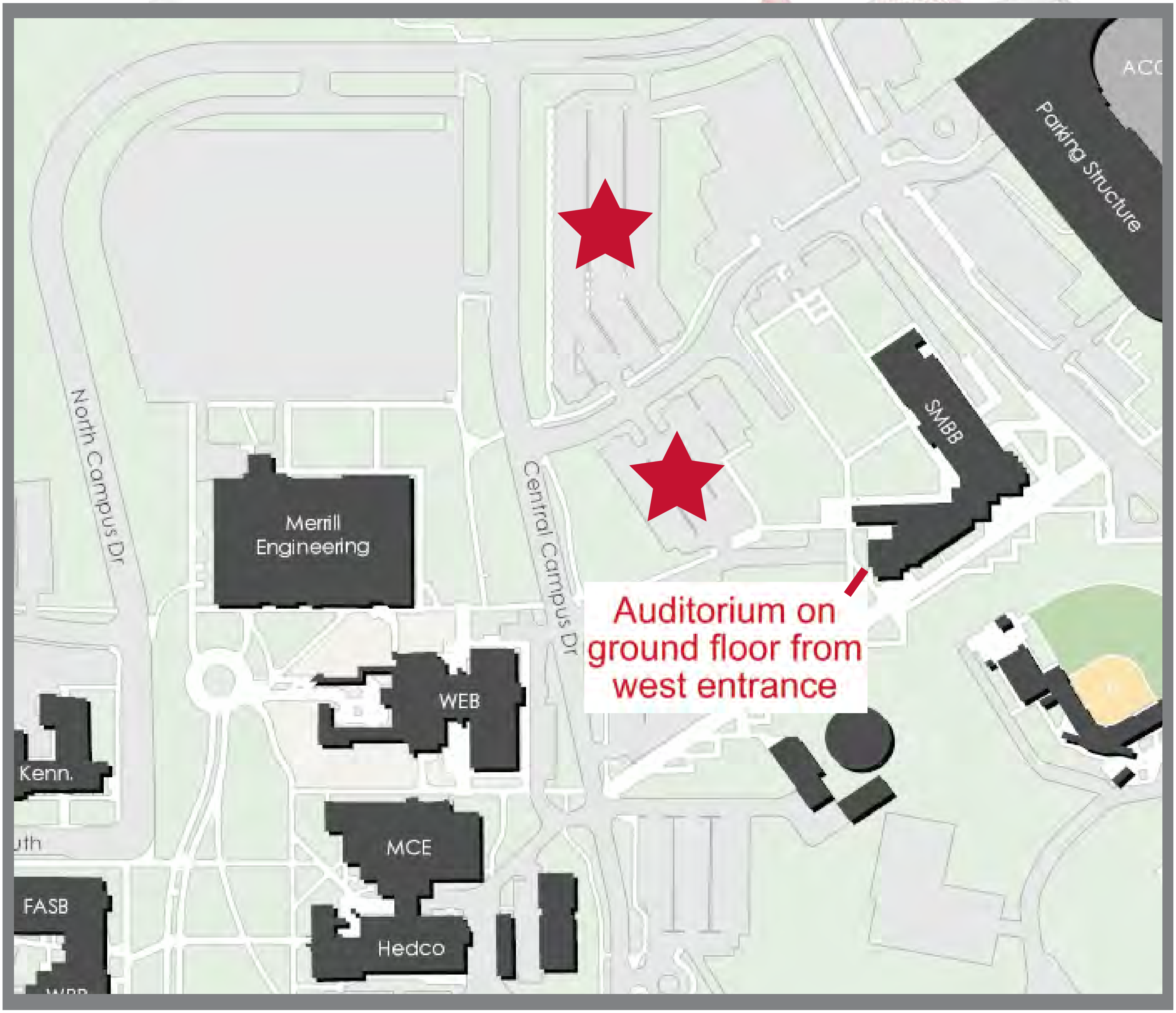


Cleanroom Tour Stations

A	Executive administration	Amy VanRoosendaal
B	Billing and invoicing	Rachel Henderson
C	CORAL on-line tool management & customization	Ryan Taylor
D	Cleanroom metrology and clean conf room	Brian Baker
E	Gowned cleanroom tour	Tony Olsen
F	Cleanroom window tour	Steve Pritchett
G	Backend + ALD + micromachining	Charles Fisher
H	Facilities, backside supporting infrastructure	Kevin Hensley
J	STEM, AFM, imaging, 3D nanotomography	Brian Van Devener
K	XPS, SEM, EBSD	Paulo Perez
L	FIB, multiscale correlative microscopy	Randy Polson
M	Robotic safety buddy	Mech E Senior Project
N	Outreach programs	Jim Smith, Brian Earl, Bryan Tran
O	CEI (Center for Engineering Innovation)	Loren Rieth

Parking Map

★ = free parking for nanoUtah attendees



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Agenda Summary

TUESDAY, OCTOBER 13, 2015
UNIVERSITY OF UTAH
USTAR Atrium & Auditorium
Sorenson Molecular Biotechnology Building (SMBB)

7:30 a.m.	Check-in, poster set-up
8:00 a.m.	Welcome: Bruce Gale, Ian Harvey
8:15 a.m.	Paul Clayson: Father of Utah Nano Initiative (precursor to USTAR): Where we've come from, where we are going

Morning Session: Large, multi-PI proposals

8:30 a.m.	Dawn Porter: Collaborative research support
8:45 a.m.	M. Janat-Amsbury and H. Ghandehari: Cancer Nanotechnology and Nanotoxicology: Response to NIH RFAs
9:00 a.m.	Bryony Richards-McClung: EGI/SCII collaboration
9:15 a.m.	Deepankar Pal: The future of 3D metal printing
9:30 a.m.	Scott L. Anderson: I/UCRC
9:45 a.m.	Will Rankin: EFRC RFP 2D materials
10:00 a.m.	Morning break

Late morning Session: Infrastructure and Instrumentation proposals - Wish lists

10:20 a.m.	Ian Harvey: Nanofab update and designing new device functionality with hard-to-handle materials
10:35 a.m.	David Belnap: 300 KeV Cryo TEM
10:45 a.m.	Scott Anderson: eTEM at the U
10:55 a.m.	Shad Roundy: Advanced materials MRI: Thick AIN for piezoelectric and thermal conductivity
11:05 a.m.	Steve Blair: Advanced 3D nanomanufacturing nanoscribe
11:15 a.m.	Mike Czabaj: X-Ray nanoCT (5µm voxel resolution on 3-5" specimens, 500nm resolution on 1mm specimens)
11:25 a.m.	Raheel Samuel: Raman nano spectroscopy for biomed imaging applications
11:35 a.m.	Will Rankin: Imaging EELS NSF/MRI
11:45 a.m.	Ross Walker: Electrical Characterization user lab
11:55 a.m.	**Student poster session** Working lunch: Topics by table Nanofab tours
1:45 p.m.	Debriefing session: Facilitators summarize topics from tables, including action items
1:50 p.m.	Andy Buffmire: Utah Advanced Materials and Manufacturing Initiative. Benefits of the recent preferred designation of IMCP by the SBA and how to take advantage of this.

Afternoon Session: Smaller multi-PI grants and support resources

2:05 p.m.	Rapid-fire intros for tech push and market pull, see back for details
3:22 p.m.	Afternoon break
3:40 p.m.	Rapid-fire intros for tech push and market pull, see back for details
5:00 p.m.	Conclusion

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TUESDAY, OCTOBER 13, 2015
UNIVERSITY OF UTAH
USTAR Atrium & Auditorium
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Afternoon Rapid Fire Presentations

The following are participating in the rapid-fire intros:
Market Pull = MP
Tech Push = TP

2:05 p.m. *TP* **Mary Cardon -** Utah's SBIR/STTR Assistance Program: USTAR small business resource center

2:12 p.m. *TP* **Amy Arkwright -** State Science Olympiad Coordinator: Science Olympiad as a drop-in program for NSF Broader Impact outreach, with self-selection of students with interest in your discipline from all over the state, and self-assembly on our campus

2:19 p.m. *MP* **Kirk Schmierer** - CEO Total Quality Systems, Inc: SBIR/STTR plans and soliciting participation. Also participating in the lunch discussion on nXCT

2:26 p.m. *TP* **Tom Whitworth** - Synchronicity Microfluidics: CD style bio-reader test platform

2:33 p.m. *TP* **Tom Whitworth** - Synchronicity Microfluidics: 250nm full-wafer lithography here in SL Valley

2:40 p.m. *TP* **Jim Smith** - SLCC, U of U Course Instructor: Course offerings in the Utah Nanofab

2:47 p.m. *TP* **Brian Baker** - Utah Nanofab Staff Engineer: Keyence 3D microscopy

2:54 p.m. *TP* **Matt Linford** - BYU: TOF - SIMS

3:01 p.m. *MP* **Almut Vollmer** - USU: Potential use of nXCT in food science

3:08 p.m. *TP* **Aaron Smith -** SpectraSymbol: Flexible circuits as an alternative to traditional PCB's

3:15 p.m. *TP* **Shawn Averett -** BYU: NDE using second harmonic generation spectroscopy

3:22 p.m. Afternoon break

3:40 p.m. *TP* **Brian Van Devener** - U of U Surface Analysis Lab: 3D tomographic elemental mapping at the nanometer scale

3:47 p.m. *TP* **Randy Polson -** U of U Surface Analysis Lab: Multi-scale correlative microscopy: ways to image and visualize the same sample location from the mm scale to the Å scale

3:54 p.m. *TP* **Loren Rieth** - U of U Center for Engineering Innovation: Tools and resources to help engineer at the microscale when you do not understand the thin film tools

4:01 p.m. *TP* **Bruce Gale -** Director, Utah Nanofab: Microfluidics prototyping labs

4:08 p.m. *TP* **Michael Granger** - U of U: What a Vibrating Sample Magnetometer VSM in the Nanofab can do for you

4:15 p.m. *TP* **Paulo Perez** - U of U Surface Analysis Lab: New SEM techniques available

4:22 p.m. *TP* **David Petrucci** - Hydrogena: Evolving H_2 gas from inexpensive renewable sources

4:29 p.m. *TP* **Zhiheng Liu** - U of U: Nanoscale characterization available through SEM/CL and nanoRaman

4:36 p.m. *TP* **Taylor Sparks** - U of U: Resources at the MSE Materials Characterization Lab

4:43 p.m. *TP* **Steve Pritchett** - Utah Nanofab Staff Engineer: Techniques for wafer thinning, controlled reactive thin film sputter deposition

Large multi-PI Proposals

8:00 a.m. Welcome: Bruce Gale, Ian Harvey
click below to add your own notes

8:15 a.m. Paul Clayson: Father of Utah Nano Initiative (precursor to USTAR): Where we've come from, where we are going
click below to add your own notes

8:30 a.m. Dawn Porter: Collaborative research
click below to add your own notes

Large multi-PI Proposals

8:45 a.m. M. Janat-Amsbury and H. Ghandehari: Cancer Nanotechnology and Nanotoxicology: Response to NIH RFAs

9:00 a.m. Bryony Richards-McClung: EGI/SCII collaboration

9:15 a.m. Deepankar Pal: The future of 3D metal printing

Large multi-PI Proposals

9:30 a.m. Scott L. Anderson: I/UCRC

Abstract: NSF funds an "Industrial University Cooperative Research Program", that provides seed NSF funding to help organize and facilitate cooperative research on problems of mutual interest to companies and universities. Prof. Shelley Minteer (U of U) is organizing a proposal for an I/UCRC center in the general area of bio-inspired electrocatalysis for energy applications, with participation from research groups at the U and USU. This talk will discuss potential benefits to participation and research areas of interest.

9:45 a.m. Will Rankin: EFRC RFP 2D materials

Infrastructure and Instrumentation

10:20 a.m. Ian Harvey: Nanofab update and designing new device functionality with hard-to-handle materials

Abstract: An introduction to the Utah Nanofab, setting context for some of the other presentations throughout the day describing new instruments and capabilities, as well as targets for acquisition. One acquisition target is the need to develop safe thin film handling capabilities so that exotic materials can be incorporated into new microsystems device design. The Premise is that our ability to create new sensory, actuation and control micro devices is severely restricted if we limit ourselves to design tricks and scaling effects alone. Therefore we have to be able to add to that NEW MATERIALS such as PXT and VO2.

Our approach is to dedicate a controlled space for that purpose. Build in specially filtered corrosive and solvent handling hoods, place tools in the hoods to safely manage PVD, litho and etch, then train specific people to use these systems safely. Our pending proposal to the VP's (with cost sharing by three faculty and the Utah Nanofab) includes:

Phase-I (a) design of a currently unused class 10,000 space inside the cleanroom to be optimized for use with these materials and to minimize risk of contaminating the rest of the cleanroom. Phase-I will also (b) acquire and install the fume hood in which the sputtering will take place; (c) acquire and install the second fume hood for solvent use, which will involve capture of all solvents, developers and rinse effluent for EHS removal. There will be no running water or drain at this hood, in order to prevent unlawful discharges of toxic materials; (d) acquire the hardware for sputter deposition of the materials. (this item will consume the cost-share funds)

Phase-II, Spring '16 RIF application, will (a) acquire and install tools for complementary use in thin film processing such as etch and photoresist application and development, device singulation, and supporting tools used to minimize risk of contamination during alignment/exposure steps, such as backside taping.

10:35 a.m. David Belnap: 300 KeV Cryo TEM

Abstract: Cryogenic transmission electron microscopy has made possible the imaging of many macromolecular complexes. With great effort during the past, a few of these structures were solved to near atomic resolution. During the last three years, a revolution has occurred. This fantastic revolution was made possible by the invention of a new electron-imaging detector, the direct electron detector. This new detector is making the determination of near-atomic resolution structures considerably easier. The University of Utah purchased one of these expensive detectors in 2014, and it is in use on our 200 kV instrument. We would like to complement that technology with the latest in microscope technology. The state-of-the-art transmission electron microscope is currently the FEI Titan Krios. Advantages of this microscope include 300 kV acceleration of electrons, constant power lenses, and cryo-specimen holder completely inside the microscope (i.e. disconnected from the warm room outside). Plans and funding are underway to build a room for this instrument in the new Crocker Science Center. The room should be ready in about two years.

Infrastructure and Instrumentation

10:45 a.m. Scott Anderson: eTEM at the U

Abstract: Advances in microfabrication have enabled a new generation of TEM sample holders that allow nanoscale imaging and elemental mapping on samples under reaction conditions, which include gases at pressures to 1 atm and temperatures to 1000 K, and liquid environments, including reactions with solutions under electrochemical potentials. Efforts are underway to acquire both liquid and gas cell TEM sample holders, and this talk will discuss potential applications and opportunities.

10:55 a.m. Shad Roundy: Advanced materials MRI: Thick AlN for piezoelectric and thermal conductivity

Abstract: Aluminum Nitride (AlN) is a non-ferroelectric, piezoelectric material with very high thermal conductivity. Thinfilm aluminum nitride has been used commercially to make bulk acoustic resonators which are used as filters in communications applications. Because of its high thermal conductivity, bulk aluminum nitride is used a substrate for very high power electronic devices. The material's piezoelectricity, its stability at high temperatures, and its high thermal conductivity make it an interesting material for a variety of MEMS research directions.

AlN has been used for MEMS scale vibration energy harvesting (i.e. converting vibrations to electricity to replace batteries for small wireless devices). However, the power outputs are generally too low to be useful for a variety of reasons. One limitation is that power output scales with material volume, and typical AlN films have been 1 um or less in thickness. Power output also scales with the energy harvesting material figure of merit which is given by the material coupling coefficient and the elastic constant (FOM = k2cE). Although the coupling coefficient for AlN is not very high, its figure of merit compares very well to alternative materials.

Thick, high quality AlN films could also benefit research on ultrasonic power transfer for bio-medical implants, which has recently begun to receive research attention as the size of implants decreases. At very small sizes (<= 1 mm3) and large implant depths, the efficiency of ultrasound power transfer exceeds that of near field electromagnetic or RF power transfer. MEMS scale piezoelectric power transducers for such applications do not exist, making this a fertile area for investigation. There are several other research directions that AlN could enable. High Q, high frequency oscillators can be used for a variety of communications applications. Surface Acoustic Wave (SAW) based resonators can be used as completely untethered passive devices for sensing chemicals, strain, pressure, acceleration, and host of other signals. Furthermore, because the material retains its piezoelectric properties up to at least several hundred degrees Celsius, it enables sensing and energy harvesting in very harsh environments.

The Utah Nanofab currently does not have the capability to fabricate high quality AlN. The Endeavor AT sputter tool sold by OEM Group can deposit piezoelectric AlN films up to 6 um which could enable a wide range of energy harvesting and sensing research particularly for harsh environments.

Rapid Fire Intros

11:05 a.m. Steve Blair: Advanced 3D nanomanufacturing nanoscribe

11:15 a.m. Mike Czabaj: X-Ray nanoCT (5µm voxel resolution on 3-5" specimens, 500nm resolution on 1mm specimens)

11:25 a.m. Raheel Samuel: Raman nano spectroscopy for biomed imaging applications

Infrastructure and Instrumentation

11:35 a.m. Will Rankin: Imaging EELS NSF/MRI

11:45 a.m. Ross Walker: Electrical Characterization user lab

1:45 p.m. Debriefing session: Facilitators summarize topics from tables, including action items

Rapid Fire Intros

1:50 p.m. Andy Buffmire: Utah Advanced Materials and Manufacturing Initiative. Benefits of the recent preferred designation of IMCP

2:05 p.m. *TP* **Mary Cardon** - Utah's SBIR/STTR Assistance Program: USTAR small business resource center

Abstract: Mary Cardon leads the USTAR SBIR/STTR Assistance Program (SSAP), located at and operating in partnership with the Salt Lake Community College Miller Resource Center in Sandy, Utah. The center works with Utah's technology companies exclusively on SBIR/STTR grants and currently has a better than 25% success rate for grants they assist with.

2:12 p.m. *TP* **Amy Arkwright** - State Science Olympiad Coordinator: Science Olympiad as a drop-in program for NSF Broader Impact outreach, with self-selection of students with interest in your discipline from all over the state, and self-assembly on our campus

Rapid Fire Intros

2:19 p.m. *MP* **Kirk Schmierer** - CEO Total Quality Systems, Inc. SBIR/STTR plans and soliciting participation. Also participating in the lunch discussion on nXCT

Abstract: Total Quality Systems, Inc. (TQS) is a small business that provides engineering services to identify and resolve technical issues for the Department of Defense (DoD) in the area of sustainment engineering and repair. TQS is a Research and Development (R&D) company that has had many Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) project success stories to date. TQS would like to further our success by collaborating with the University of Utah to accomplish identified STTR projects using the U's research and nanoFab laboratory capabilities. This would be accomplished by funding research projects for students or professors, or by TQS using the nanoFab's laboratory facilities directly. The briefing provides general opportunities for future research, and two current STTR topics being reviewed for possible bid.

2:26 p.m. *TP* **Tom Whitworth** - Synchronicity Microfluidics: CD style bio-reader test platform

Abstract: Photolithography for solid state devices - The Microfluidic, Lab on a Chip (LOAC), and Liquid Biopsy markets must have clean, reliable and repeatable devices for diseases testing. The two major "pain" issues are:

- Quality - due to the availability of limited manufacturing processes, current options are micromachining, and photomask
- "Commercialization gap" - no simple, low cost process to ramp into production at high volumes

The market needs these devices in the field and labs to further disease diagnoses, air and water testing, and many other areas. The market goal is to achieve access to testing which aligns with the goals of the ACA (Obama Care)
In order to achieve this goal, there must be a low cost, high volume solution to get products distributed to market
We are a Microfluidic / Microarray / LOAC Mastering company. Our Process is a direct lithographic process. We use photo resist, directly expose the resist with a laser, develop the exposed resist and etch to the customers required depth. We work with companies and researchers when they need sub micron and larger features. We can provide Molds or Stamps for low and high volume reproduction. We can master on silicon. We receive from the customer a CAD type drawing usually as a GDSII, Oasis, or .DXF file. We convert it to a .BMP file and then we directly master this in the photo resist.
Our capability ranges are:

- Max. aspect ratio : 30:1 with or without draft angles
- Min. pattern width : 250nm
- Max. pattern depth : 10nm -400µm
- Multiple Depth capabilities 3D Mastering

We make these patterns on or in Silicon. We then transfer them to Nickel for injection molding, hot embossing, and roll to roll web manufacturing. For many years we have been the leader in Optical Disc mastering for CD/DVD masters. We have now translated this expertise into industries such as:

- Microfluidics / LOAC / Liquid Biopsy
- Single cell arrays
- Diffraction gratin
- Etc
- CD based microfluidics
- Optical Encoders
- Components in Solar Panels

Rapid Fire Intros

2:33 p.m. *TP* **Tom Whitworth** - Synchronicity Microfluidics: 250nm full-wafer lithography here in SL Valley

Abstract: CD spin-based lab-on-a-chip (LOAC) and bio-microfluidics

Many microfluidic / Bio-Mems devices require fluid / cell movement under pressure. Most often this has resulted in tubes and pumps to achieve this movement. By using a spinning disc you can eliminate these added assembly components using centrifugal and osmotic pressures to move fluids / cells out or in. CD/ DVD drives are one of the most common, underutilized products we all have everywhere in the world. This capability has been well documented, but under used. Our company Synchronicity Microfluidics has developed a process using a direct lithography mastering CD/DVD machine to make these devises directly on the disc format.

As Synchronicity Mastering Services we evolved from being the leading CD/DVD mastering facility in the Americas and beyond. So we have been sending nickel stampers to replicators that do not have mastering internally. This is the same model we are using for (LOAC) and bio-microfluidics. Through the use of very sophisticated optics, and formatter we can master any pattern device onto a spinning disc. We can also add CD/DVD start up content to keep the disc spinning. No other company in the world has developed this process. The result is multiple devices can be placed on a single CD or DVD for various diagnostics. We can then transfer the master to a nickel plate for replication in injection molds. Optical discs CD and DVD have been around for many years, as a result the manufacturing equipment for these discs has proliferated the world. Lately, much of this equipment is underutilized. The result is if you can get your device into the CD/DVD format you can get to manufacturing at a lower cost per unit.

2:40 p.m. *TP* **Jim Smith** - SLCC, U of U Course Instructor: Course offerings in the Utah Nanofab

Abstract: The Nanofab at the University of Utah has a number of educational opportunities for people at the University of Utah and neighboring colleges, universities, and businesses. These opportunities include formal courses, short courses, workshops, demonstrations, tours, and curriculum materials. A workforce development pipeline is being established which provides training from technician to engineer and scientist level through partnerships with other educational institutions. We are seeking industry involvement and cooperation at all levels of this process.

Contact: jim.smith@utah.edu

Rapid Fire Intros

2:47 p.m. *TP* **Brian Baker** - Utah Nanofab Staff Engineer: Keyence 3D microscopy

Abstract: A new high-resolution 3D optical microscope, the Keyence VHX-5000, is now available for use in the Utah Nanofab. The instrument includes automatic depth composition to capture full-focus color images and a tilting objective for angled views up to 90 degrees. Measurement capabilities include one-click 2D and 3D length, depth, area, radius, and angle, as well as particle counting and basic statistical analysis. The microscope is capable of capturing 54 megapixel, publication-worthy images of micromachined devices, tissue samples, microfluidics, microelectronics, cross-sections, and microoptics from 20x-5000x.

2:54 p.m. *TP* **Matt Linford** - BYU: TOF - SIMS

Abstract: I will discuss here the ToF-SIMS that is jointly owned by BYU and the University of Utah. ToF-SIMS is one of the most important techniques for chemical surface analysis. ToF-SIMS typically shows part per million sensitivities for most elements. The mass spectra it generates are often highly characteristic of the materials they come from. Our ToF-SIMS has two sources: Ga+ and Cs+. At present, both work in static mode. The instrument can also be used to image samples. There is the possibility of depth profiling with it. The mass resolution with the Ga+ source (typically ca. 5000) is higher than with the Cs+ source. The charge for the instrument is $25/hr plus analyst time. We have collected a significant amount of data with this instrument that has appeared in publications. I will show some of this data. We are interested in collaborations through which the instrument can be used to a greater extent and/or undergo additional upgrades.

3:01 p.m. *MP* **Almut Vollmer** - USU: Potential use of nXCT in food science

Abstract: Understanding the microstructure of dairy foods in general, and Mozzarella cheese in particular, is essential for understanding many of the functional properties of food. These are important for the large--scale production and marketing in the food industry. We accessed the Zeiss Xradia 520 Versa for analysis of native cheese and compared TEM--processed samples. The preliminary results were not conclusive, but are encouraging. More experiments will be pursued.

Rapid Fire Intros

3:08 p.m. *TP* **Aaron Smith** - SpectraSymbol: Flexible circuits as an alternative to traditional PCB's

Abstract: Printed Circuit Boards (PCBs) are a staple of the electronics industry, but customers push PCB's capabilities as they request smaller, flexible, and less expensive solutions for MEMS and nanotechnology based devices. Spectra Symbol's White Flex performs functions similar to a rigid PCB and provides lighter weight, bendable, and less expensive circuitry solutions. Although printed circuits on polyester are widely available, we have unique equipment and expertise in surface mounting components onto a polyester substrate. White Flex design can include a tail for connecting to external devices and circuitry, and the polyester may be any color of the rainbow.

Spectra Symbol's engineering services team will work with you on solving your micro and nanoscale integration challenges. Our team supports one-time engineering projects and full-scale production. Prototype services are available for quick iteration through full-scale production of tens of thousands of your flexible circuit design. Our 35,000 square foot facility offers in-house screen-printing, laser cutting, die cutting, electrical testing, and quality inspections. Spectra Symbol's automated production line provides Surface Mount Technology with solder printing, pick and place of multiple components, and encapsulant liquid dispense and cure.

Come visit Spectra Symbol at 3101 West 2100 South in Salt Lake.

Also available: potentiometers and membrane switches

Contact Information: Christine Drage cdrage@spectrasymbol.com
Aaron Smith aaron@spectrasymbol.com

3:15 p.m. *TP* **Shawn Averett -** BYU: NDE using second harmonic generation spectroscopy

Abstract: The U.S. Navy spends $66 million dollars a year repairing damage caused by aluminum sensitization. Naval grade aluminum becomes sensitized when magnesium in the alloy is concentrated at the metal grain boundaries, where it forms a new material called beta phase aluminum. When too much beta phase aluminum has formed, the material weakens and cracks. Currently there isn't a practical method to detect beta phase aluminum formation without damaging the material. We have found that second harmonic generation (SHG) can be used to detect how much beta phase aluminum is present, and are working to see if it is sensitive enough to be useful to the Navy.

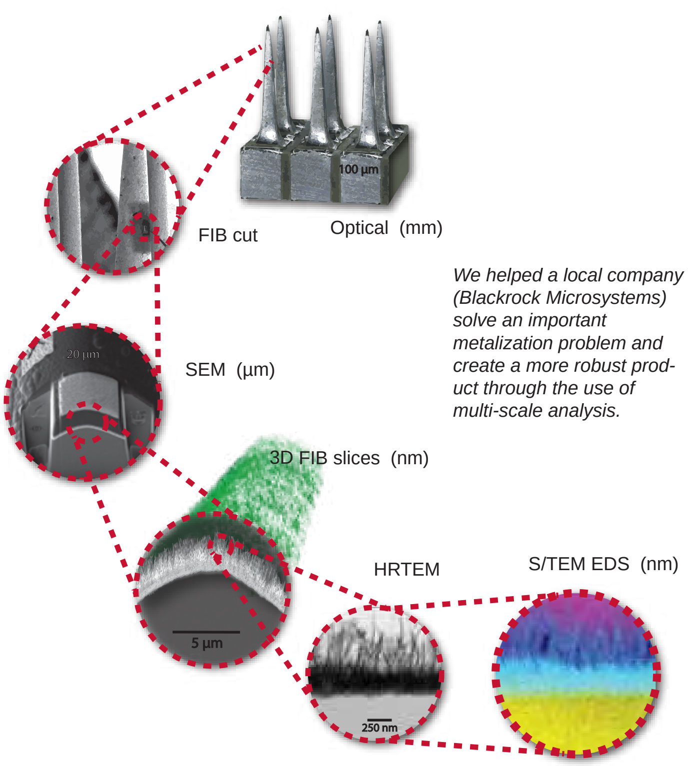
SHG occurs when two photons of the same energy combine on a material to form a single photon with twice the energy. More or less photons will combine depending on the material they hit. When beta phase aluminum is formed the amount of SHG photons produced goes up, thus by measuring the amount of SHG photons produced we can track the amount of beta phase aluminum formed. SHG is also sensitive to changes in the physical structure of a material. For example, we have used SHG to track the changes in aerospace grade aluminum as it undergoes mechanical deformation.

An SHG instrument is relatively simple and inexpensive to build; SHG signal can also be created and detected with fiber optics allowing for the testing of hard to reach parts such as pipes and turbines. The simplicity, sensitivity, and flexibility of SHG make it a promising entry into the $2.7 billion a year nondestructive testing industry. We have filed a patent on this technology and are looking for partners to help us bring it to market. We believe that the potential for SHG is much greater than we have outlined or even discovered yet and we are interested in ideas for further application.

Rapid Fire Intros

3:40 p.m. *TP* **Brian Van Devener** - U of U Surface Analysis Lab: 3D tomographic elemental mapping at the nanometer scale

3:47 p.m. *TP* **Randy Polson** - U of U Surface Analysis Lab: Multi-scale correlative microscopy: ways to image and visualize the same sample location from the mm scale to the Å scale



We helped a local company (Blackrock Microsystems) solve an important metalization problem and create a more robust product through the use of multi-scale analysis.

Rapid Fire Intros

3:54 p.m. *TP* **Loren Rieth** - U of U Center for Engineering Innovation: Tools and resources to help engineer at the microscale when you do not understand the thin film tools

4:01 p.m. *TP* **Bruce Gale** - Director, Utah Nanofab: Microfluidics prototyping labs

4:08 p.m. *TP* **Michael Granger** - U of U: What a Vibrating Sample Magnetometer VSM in the Nanofab can do for you

Abstract: Our Vibrating Sample Magnetometer (VSM; ±2 T applied field) is capable of measuring the magnetic moment of planar (up to 8-mm diam.) and powdered samples. Measurements can be performed at temperatures between -170°C and +720°C. The system provides the experimentalist the ability to acquire: Magnetic hysteresis loops; Virgin remanent magnetization; Saturation magnetization; Coercivity; DC-demagnetization remanence; angular remanence; AC-remanence; First-order-reversal curves; and Isothermal remanent magnetization. The system is also equipped with a linear 4-point probe for magnetoresistance measurements of thin films at temperatures between 0°C and +400°C.

Rapid Fire Intros

4:15 p.m. *TP* **Paulo Perez** - U of U Surface Analysis Lab: New SEM techniques available

4:22 p.m. *TP* **David Petrucci** - Hydrogena - Evolving H_2 gas from inexpensive renewable sources

Abstract: The world's energy demand is constantly increasing. Most of the energy supply comes from fossil fuels. Unfortunately, energy production from fossil fuels has a number of downfalls: the supply is limited and comes, for the most part, from politically unstable nations; furthermore, fossil fuels generate polluting wastes and greenhouse gasses.

Hydrogen could substitute, at least in part, the use of fossil fuels in many applications. Burning hydrogen produces only water vapor. Even though hydrogen is a "green" fuel, current methods for the production hydrogen are not so green. In fact, most of the hydrogen generated in our days comes from a fossil fuel, methane.

HYDROGENA, LLC has discovered a method to produce hydrogen from inexpensive, renewable sources, namely sun light together with citric, gluconic, or other naturally-occurring organic acids. Unlike other methods for hydrogen production, HYDROGENA's technique utilizes low cost, robust catalysts. We are looking for investors to help move our project from the bench top to production. We are also interested in creating ties with a research group working with UV lasers to assist us along the last steps of our research.

Contact Information:
O. David Petrucci, Ph.D. oscard.petrucci@gmail.com

4:29 p.m. *TP* **Zhiheng Liu** - U of U: Nanoscale characterization available through SEM/CL and nanoRaman

Abstract: We introduce some of the unique characterization capabilities of microscopy and spectroscopy in the Department of Physics and Astronomy of the University of Utah. The WiTec Micro-Raman system allows Raman spectroscopy and spectral imaging with a sub-micron spatial resolution. The FEI Nova NanoSEM is equipped with an attachment that measures cathodoluminescence microscopy and spectroscopy with a nanoscale spatial resolution provided by a high-resolution SEM.

Rapid Fire Intros

4:36 p.m. *TP* **Taylor Sparks** - U of U: Resources at the MSE Materials Characterization Lab

4:43 p.m. *TP* **Steve Pritchett** - Utah Nanofab Staff Engineer: Techniques for wafer thinning, controlled reactive thin film sputter deposition

Abstract: Overview of basic backgrinding process and list of several backgrinding service providers. Introduction of new Denton sputtering system, benefits are: 4" cathode/target for +/- 5% uniformity on 8" diameter area, 3" is +/- 5% on 6" diameter area; Heated stage, provides heating to 500°C for film property and stress modification; Water-cooled Rf biased stage, reduces substrate heating during process and/or allows surface back-sputter process for substrate pre-clean; RGA for base pressure gas composition evaluation; Reproducible deposition of reactively sputtered films with higher sputter rates

5:00 p.m. Conclusion - Margit Janat-Amsbury

Notes