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Outreach**Todd TeVogt, **Vendor Liaison**Amir Soleimanpour,  
**Communications and  
Newsletter****Upcoming Events in  
2016****Aug 24, 2016:****Dave Castner, University of  
Washington**Title: "Biomedical Surface  
Analysis: Impact, Challenges  
and Opportunities"**Buddy Ratner, University of  
Washington**Title: "Progress in  
Engineered Biomaterials and  
Understanding the  
Biointerface"**Sept 21, 2016:****Ian Gilmore, National  
Physical Laboratory, UK**Title: "Super-resolution Mass  
Spectrometry Imaging of  
Biomaterials with the New  
3D nanoSIMS"**5:30 PM at Buca di Beppo in  
St. Paul***For more information, Please  
visit our website***IN THIS ISSUE**

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**OPENING NOTE**

Dear MN-AVS Friends,

It's been a successful start to the year but there's plenty more to come this year! So far we've had well-attended short courses organized by Del Smith of Normandale Community College, an interesting dinner and discussion meeting with Valentina Pirro from Purdue University and our best attended social at Dangerous Man brewing. The student chapter has completed its first full year and an update on their activities and new leadership is provided by outgoing chair Chris Cheng in this newsletter.

The second half of the year promises additional opportunities for education and networking in fields of interest to AVS members. We anticipate having two dinner and discussion meetings near the early fall with Dave Castner from the University of Washington and Ian Gilmore of the UK's National Physical Laboratory. On October the 11<sup>th</sup> 2016 the annual Fall Symposium will be taking place and an announcement will be circulated shortly.

We look forward to seeing you at the upcoming events!

Sincerely,

**Ali Rafati****Chair**To subscribe, please contact [mnavs@avs.org](mailto:mnavs@avs.org)To advertise in this newsletter, please contact [todd.tevogt@gammavacuum.com](mailto:todd.tevogt@gammavacuum.com)<http://www.avs.org/chapters/minnesota>

# XPS SPECTROMICROSCOPY – GAINING LATERAL INFORMATION FROM SURFACES

Adam J. Roberts

Kratos Analytical Ltd, Wharfside, Trafford Wharf Road, Manchester, UK  
adam.roberts@kratos.co.uk

X-ray photoelectron spectroscopy is widely used in determining surface chemistry of materials. The assumption that the material and spectra are homogeneous over the area probed is often made although it may not be true. Information of the lateral distribution of elemental and chemical states on a surface can be probed using multispectral XPS imaging, also referred to as spectromicroscopy, where a series of images are acquired incremented in energy such that each pixel contains a spectrum. The great advantage of spectromicroscopy is that spectral information can be reconstructed from defined areas smaller than those possible with focused x-ray or virtual probe selected area XPS. This means that the reconstructed spectra are no longer averaged over the total area from which the image is acquired such that both sample and instrument dependent differences can be studied. The large spectromicroscopy data sets with over 65,000 spectra over the image field of view are ideally suited to multivariate analysis to analyse the information content and as a tool for noise reduction. Development of data processing to support spectromicroscopy data reduction has been necessary and a number of approaches have been successfully applied in the characterisation of model and real-world samples [1-3].

## References

- [1] E.F. Smith, D. Briggs and N. Fairley Surf. Interface Anal. 2005, 38, 69-75
- [2] J. Walton, N. Fairley Surf. Interface Anal. 2008, 40, 478 - 481

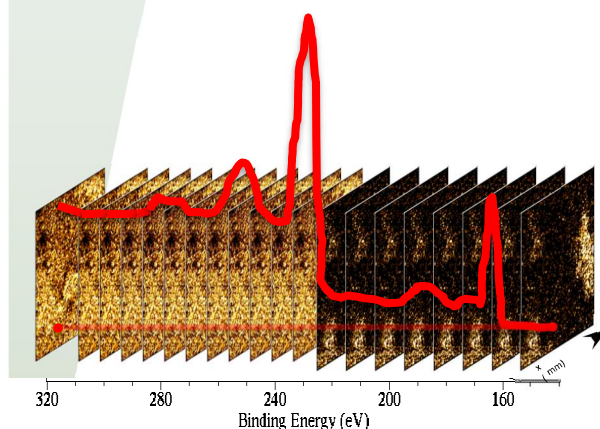


Figure 1) Schematic diagram for the concept of spectromicroscopy where series of images are acquired incremented in energy such that each pixel contains a spectrum.

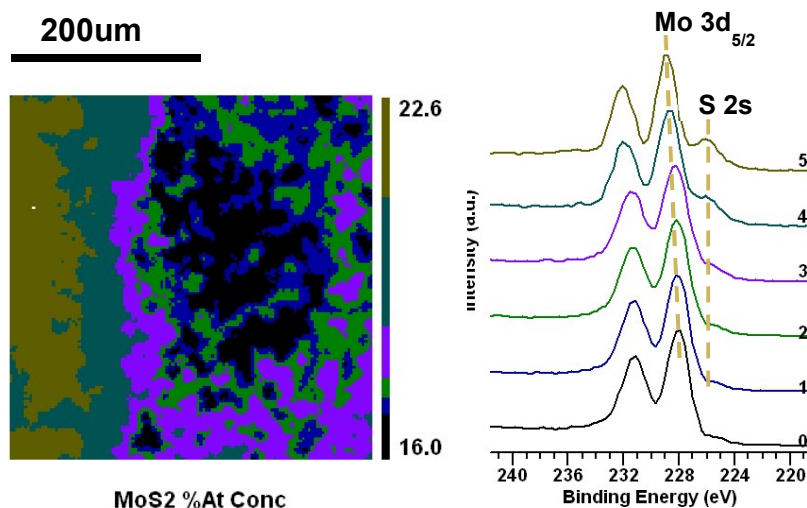


Figure 2a) A false colour image of Mo 3d intensity acquired from a sputter damaged MoS<sub>2</sub> specimen. b) Spectra were created by summing pixels defined by their colour in the image. The reduction of Mo to MoS<sub>2-x</sub> within the imaged field of view is easily observed in the reconstructed spectra as a reduction of the S 2s component and a shift of the Mo 3d components to lower binding energy.

# **A SUMMARY OF RECENT EVENTS**

## **March 15, 2016 - Event: MinnTS : 14<sup>th</sup> Annual Minnesota Technical Symposium**

Coordinated by 13 local technical societies

Invited Speaker:

"The internet of things (IoT)", Michael Finegan, Technical Design Consultant, Multi-Tech Systems, Inc.

"Recent trends in the cyber security threat landscape", Noah Korba  
Senior Manager, Global IT Security Infrastructure, Forensics and Incident Response teams General Mills

## **December 7, 2015 - Dinner and Discussion Event, Speaker: Luke Hanley, University of Illinois**

Title: "Mass spectrometry imaging using laser ablation: from ultrashort pulses to portable instruments"

## **October 1, 2015 - Dinner and Discussion Event, Speaker: Tyler Moersch, Tru Vue**

Title: "Exploring materials through combinatorial science: case studies on how chemistry influences the formation of thin films via atomic layer deposition and chemical vapor deposition"

## **September 9, 2015 - AVS MN Chapter Annual Symposium and Exhibition.**

Invited Speakers:

Morgan Alexander, University of Nottingham, "Biomaterials discovery using material microarrays: from polymer spots to devices via surface analysis"

Alex Shard, National Physical Laboratory, "Measuring organic shrunken on surfaces and nanoparticles"

Fred LaPlant, 3M, "The neglected vacuum – techniques that need vacuum but don't always get it"

Peter Ladwig, Hutchinson Technology, Inc., "Miniaturization of electromechanical medical devices using semi-additive photolithographic fabrication technologies"

Bharat Jalan, University of Minnesota, "Hybrid molecular beam epitaxy for functional oxide thin films and heterostructures"

Michael Kautzky, Seagate Technology, "Heat-assisted magnetic recording (HAMR): fundamentals, reliability, and the path to productization"

# **UPCOMING TALK IN MN AVS ON 24<sup>TH</sup> OF AUGUST**

## **Biomedical Surface Analysis: Impact, Challenges and Opportunities**

David G. Castner

National ESCA and Surface Analysis Center for Biomedical Problems

Molecular Engineering & Sciences Institute

Departments of Bioengineering and Chemical Engineering

University of Washington, Seattle, WA, 98195-1653 USA

Biomedical surface analysis has undergone significant and numerous advances in the past 40 years in terms of improved instrumentation, introduction of new techniques, development of sophisticated data analysis methods, and the increasing complexity of samples analyzed. Comprehensive analysis of surfaces and surface immobilized biomolecules (peptides, proteins, DNA, etc.) with modern surface analysis instrumentation provides an unprecedented level of detail about the immobilization process and the structure of the immobilized biomolecules. Results from x-ray photoelectron spectroscopy (XPS or ESCA), time-of-flight secondary ion mass spectrometry (ToF-SIMS), near edge x-ray absorption fine structure (NEXAFS), surface plasmon resonance (SPR) and quartz-crystal microbalance with dissipation (QCM-D) biosensing, atomic force microscopy, and sum frequency generation (SFG) vibrational spectroscopy provide important information about the attachment, orientation, conformation, etc. of biomolecules. However, even with the advances that have been achieved with these powerful surface analysis techniques, there still remain many significant challenges for biomedical surface analysis. These include characterizing the surface chemistry and structure of nanoparticles, determining the structure of protein bound to surfaces, 3D imaging of cells and tissue sections, and maintaining biomolecules and materials in a biological relevant state when using ultra-high vacuum based analysis techniques.

This talk will discuss the impact biomedical surface analysis has had, what the current challenges are, what is being done to address these challenges, and what some of the future opportunities are. Also discussed will be the role of well-defined standards to develop new biomedical surface analysis methods for characterizing more complex, biological relevant samples.



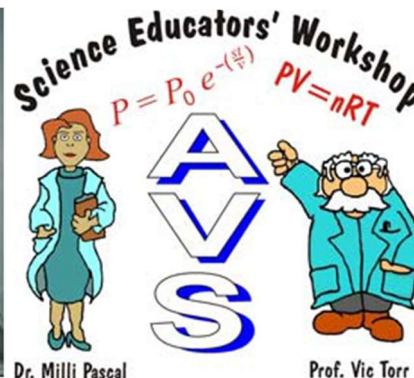
## SCIENCE EDUCATORS WORKSHOP PROGRAM BY AVS

The Minnesota chapter of AVS sends a teacher to the Science Educators Workshop held each year as part of the AVS Annual Symposium. The Minnesota Chapter will pay the costs for transportation and housing for the 2016 workshop to be held at Nashville, TN, Nov. 7-8, 2016.

This year, we plan to send two teachers. We have received a few applications and welcome additional applications. For more information, go to:

<http://avs.org/Education-Outreach/Science-Educators-Workshop>

If anyone knows of a secondary teacher who would benefit from attending this workshop, please pass this information along to them. The teachers who have attended have all given the workshop high marks.



AVS, a national scientific society with interests in vacuum sciences, would like to send two teachers to a two day workshop for high school science teachers.

**Date and location: Nashville, TN, November 7-8, 2016**

**Application Deadline: August 22, 2016**

Local AVS chapters typically pay travel and lodging costs to send a teacher from their region to this hands-on workshop. Teachers receive continuing education credit and their school will be eligible to receive an equipment grant including a new vacuum pump and vacuum jar.

Vacuum science is useful for demonstrating concepts in physics, chemistry, astronomy and engineering. For instance, you can demonstrate phase transitions under conditions that the students do not expect.

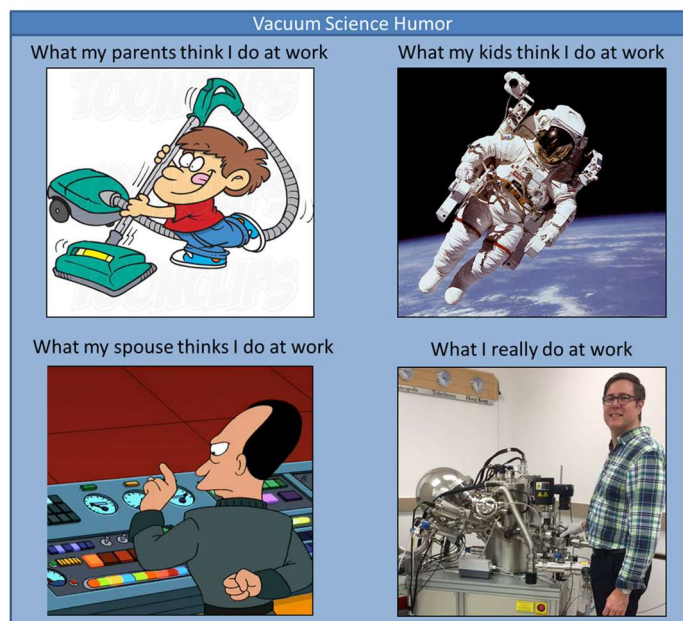
**Many examples are available at**

<http://www.avs.org/Education-Outreach/Science-Educators-Workshop/Demos-Experiments>

Teachers may apply on-line at the national AVS web site:

<http://www.avs.org/Education-Outreach/Science-Educators-Workshop/SEW-Application-Form>

## CARTOONS FROM MEMBERS



Cartoons are welcome from members

Please send your cartoons to [mnavs@avs.org](mailto:mnavs@avs.org)

## **NEWS OF OUR PAST CHAIR**

### **ELECTION OF ANNA BELU INTO MEDTRONIC BAKKEN SOCIETY**



Anna Belu a Senior Principal Scientist and Technical Fellow in the Corporate Science & Technology group at Medtronic was elected into the Medtronic Bakken Society. The Bakken Society is the highest technical honor at Medtronic. Members of the Bakken Society are nominated by colleagues and approved by the Medtronic board of directors. The Medtronic Bakken Society is designed to recognize employees who have made multiple, significant contributions to patients, physicians, and the biomedical industry in total. The Bakken Society was founded in 1979 with Medtronic founder Earl Bakken as the first member. Members are thought leaders, they raise emerging technical issues, and they have distinguished themselves in furthering the technical and scientific progress of Medtronic. They are futurists in the spirit of Earl Bakken. They work hard to perpetuate technical connections within Medtronic across functions, businesses, geographies and beyond. It is this technical excellence, combined with multiple business connections that drive results and help to solve the future's unmet medical needs.

Anna Belu is an internationally recognized expert in surface analysis and biomaterials. When she joined Medtronic 15 years ago, she established the first XPS instrument and later added the first TOF-SIMS instrument to Medtronic's surface analysis portfolio. Belu has helped solve critical materials problems for all of Medtronic's businesses in the areas of new market releases, intellectual property and patent infringement disputes. She was involved with the CardioVascular Complete SE Nitinol Stent evaluation, the polyimide coating on conductor wires in MRI-safe Brady leads and many more. Belu leads one of the most comprehensive labs for understanding surface chemistry in medical development activities around the world. She has developed a high-functioning team that is nimble, empowered and capable of solving a variety of problems. Belu also shares her knowledge with her colleagues by participating in technical organizations. She has served as President of the Medtronic Technical Forum and has led several Forum and MIX Communities including Laboratory Testing, Microscopy and Surface Analysis, and Technical Business Leadership. Belu has held leadership positions with several international technical organizations including the American Vacuum Society, the Surfaces in Biomaterials Foundation, and the International Conference on Secondary Ion Mass Spectrometry. Currently, Belu is Editor of the American Institute of Physics Journal Biointerphases and serves on the Advisory Board for the Characterization Facility at the University of Minnesota. She has authored more than 46 publications. She holds a B.S. in chemistry from Denison University, a Ph.D. in analytical chemistry from the University of North Carolina at Chapel Hill, and was a postdoctoral associate at the University of Washington.

Congratulations Anna!



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vacuum  
environments  
on Earth*



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# UPDATES FROM MINNESOTA AVS STUDENT CHAPTER



The American Vacuum Society (AVS) at UMN student chapter, in its very first year, had produced significant milestones. For instance, the AVS hosted a networking event consisting of 50+ students and local company employers (such as 3M) to help out job-seeking students. Moreover, the student group received sponsorship from both the College of Science & Engineering as well as the state and national AVS chapters.

Most importantly, the group was not afraid of collaboration. In its beginning, the AVS team worked with Materials Advantage, co-hosting meetings to spread word about events and ideas. The biggest significance was in collaborating with the American Institute of Aeronautics and Astronautics (AIAA) UMN student chapter to compete in the National Hyperloop Competition (sponsored by SpaceX); the goal was to design and build a subscale prototype transport vehicle that can operate in a partial vacuum. The AVS student group worked the AIAA sub-teams to design the vehicle's air bearings, and again demonstrated the desire to learn/collaborate by going to multiple professors of all disciplines, from Chemistry to Materials Science to the Minnesota Nano Center staff. The design was approved by SpaceX out of more than 1,000 applicants, and the team along with the UMN AIAA student chapter was invited to present at the final stage of the competition. Moreover, importance was laid in setting the stage for next year; a collaboration with the LPRD Rocketry group is underway to build a vacuum chamber for future outreach programs. The elections for next year's officer board for the student chapter have taken place, with the results yielding:

- **President:** Karsten Poulsen
- **Vice President:** Benjamin Siers
- **Secretary:** Alexandra Khlyustova
- **Treasurer:** Michael Ho
- **Outreach Officer:** Vamsi Bhadriraju

## JOB OPPROTUNITY

**Title:** Scientist, Microscopy & Surface Analysis at Medtronic

**Position Description:** The successful candidate will apply microscopy and surface analysis methods for problem solving of materials issues. The person will work in a creative, dynamic R&D environment solving problems across all Medtronic business units. The position is a contractor role with flexible daytime hours, open to 30-40 hours per week. The start date is anticipated to be Aug 15, 2016.

**Required Qualifications:** Expert in operation and interpretation of data from one or more of the following techniques: SEM, EDS, IR, Raman microscopy, XPS, TOF-SIMS. Demonstrated expertise in materials related problem solving or failure analysis. BS degree in materials science, physics, chemistry or related field.

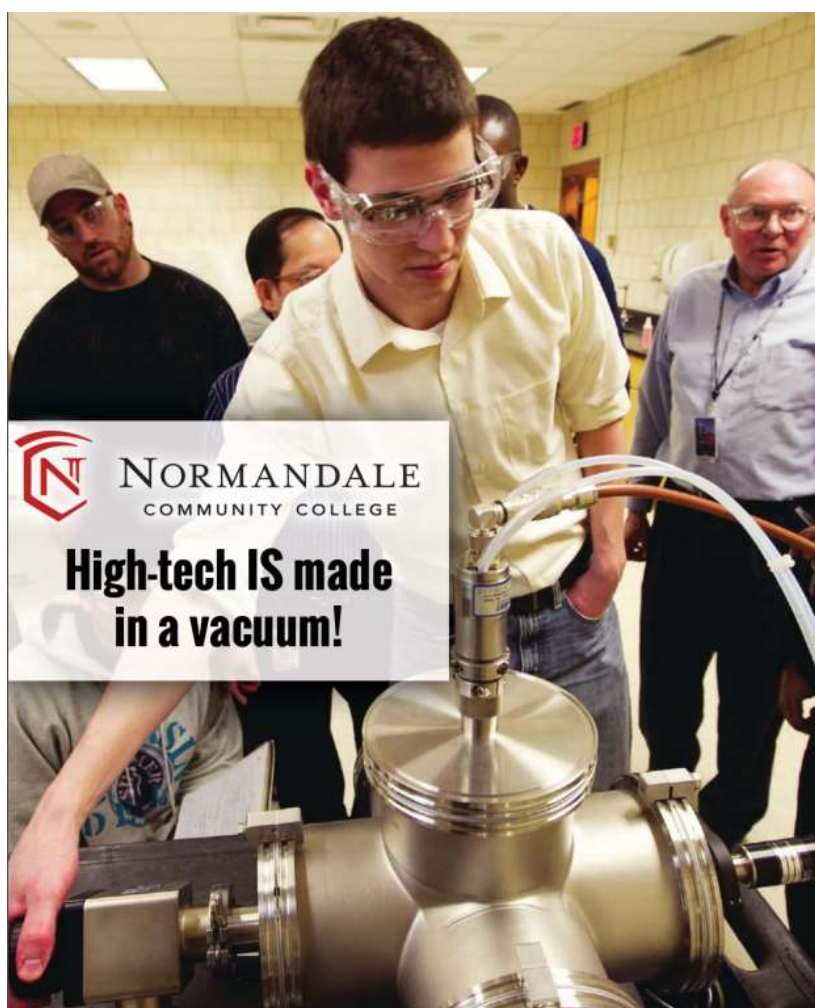
Please send your resume to **Anna Belu**, [anna.belu@medtronic.com](mailto:anna.belu@medtronic.com)



## UPCOMING CONFERENCES

Conference/Course	Date	Location
Biointerfaces International 2016	August 23-25	Zurich, Switzerland
SIMS Europe	September 18-20	Munster, Gmbh
SCIX	September 18-23	Minneapolis, MN
MD&M	September 21-22	Minneapolis, MN
WITec 11th Symposium Confocal Raman Imaging	September 26-28	Ulm, Germany
Surfaces in Biomaterials (Biointerface 2016)	October 3-5	Minneapolis, MN
Biomedical Engineering Society	October 5-8	Minneapolis, MN
MN-AVS Annual Symposium	October 11	Minneapolis, MN
AVS (American Vacuum Society)	November 6-11	Nashville, TN
WITec Raman instrument and software training	November 16-17	Knoxville, TN

To receive future newsletters, send your email address to [mnavs@avs.org](mailto:mnavs@avs.org)



### NORMANDEALE COMMUNITY COLLEGE'S VACUUM AND THIN FILM TECHNOLOGY PROGRAM

From the Hadron Collider to the fastest microprocessors, vacuum equipment systems make advances possible in much of today's cutting-edge science and manufacturing technology. Normandale Community College's Vacuum and Thin Film Technology program will give you a path to an exciting career in the world of high-tech.

Normandale's 2-year degree can lead to a career (with starting salaries ranging from \$40K-\$55K) as a maintenance technician, process technician, or research technician. Our certificates will enhance your credentials in science, engineering, or technology.

#### WHERE DO OUR GRADS WORK?

Industries that produce high speed memory devices, electronic parts for aerospace and automotive applications, guidance systems for aviation, wear-resistant tool coatings, and the ultra-high vacuum pumps used for leading-edge research in physics and medicine.

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Call 952-358-8200 (1-800-481-5412), or email program chair Nancy Louwagie at [Nancy.Louwagie@normandale.edu](mailto:Nancy.Louwagie@normandale.edu) or check us out at [www.normandale.edu/vactech](http://www.normandale.edu/vactech) or watch our program video at [www.normandale.edu/vacvideo](http://www.normandale.edu/vacvideo)