The MMS Scope

Minnesota Microscopy Society

Local affiliate of the **Microscopy Society of America** and the **Microanalysis Society**

april 2019

In this Issue:

Spring Symposium: Join us for an exciting Spring Symposium focused on *Non-Traditional and Emerging Microscopy Techniques.* Register by Tuesday, Apr. 23 to reserve your spot.

Remember to vote! Election of next year's officers will take place during the business meeting at the Spring Symposium.

MMS Dues: Please remember to pay your 2019 membership dues.

MAS Conference: Check out the four-day Quantitative Microanalysis conference at the University of Minnesota from June 24-27.

Photo Album: See photo memories from Project MICRO's busy early 2019 presenting at area elementary schools.

MINNESOTA MICROSCOPY SOCIETY SPRING SYMPOSIUM

FRIDAY, MAY 3, 2019

SCHEDULE on MAY 3RD

7:30 – 8:15 a.m.	Registration, continental breakfast, vendor displays
8:15 – 8:30 a.m.	Welcome
8:30 – 9:30 a.m.	**Stuart McKernan, retired microscopist** *Electron Beam-Sample Interactions*
9:30 – 10:30 a.m.	**Sören Eyhusen, Carl Zeiss Microscopy** *Helium Ion Microscopy: Imaging and Nanofabrication with Inert Ions*
10:30 – 11:00 a.m.	Break and vendor displays
11:00 – 12:00 p.m.	**Muhammad Nazir, Bruker** *Modern Imaging Technologies in Fluorescence Microscopy*
12:00 – 1:30 p.m.	Lunch and vendor displays
1:30 – 1:45 p.m.	Business meeting
1:45 – 2:45 p.m.	**Liang Gong, 3M** *AFM-IR Studies of Individual Electrospun Nanofibers*
2:45 – 3: 45 p.m.	**Tyler Blum, NSF Postdoctoral Fellow, Univ. of Wisc.** *Nanoscale Characterization by Atom Probe Tomography, and Applications in Studying the Early Earth and Moon*

LOCATION

Minnesota Science Museum
Discovery Hall (*one floor down)*
St. Paul, MN **map it**
Parking: Science Museum or River Centre parking ramps

120 W. Kellogg Blvd. | 55102

RESERVATIONS

Member: $75 **Student/K-12 teacher:** $20 **Deadline:** Tuesday, Apr. 23
Reserve a spot via PayPal by going to the **MMS events page**. Fee includes the meeting, buffet lunch, breakfast, coffee breaks and a free pass to Science Museum exhibits.

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Non-Traditional and Emerging Microscopy Techniques

continued

SPEAKER BIOS and ABSTRACTS

Stuart McKernan

Stuart McKernan is a retired electron microscopist. He was born in Birmingham, England, in 1956 and studied physics at Bristol University in the UK. After his B.Sc., he continued at Bristol, obtaining M.Sc. and Ph.D. degrees and completing a postdoctoral fellowship using electron microscopy (EM) as his main research tool. In 1986, he migrated to Professor C. B. Carter's group at Cornell University and became involved in HREM, image processing and image simulation. In 1991, along with the Carter group, he moved to the University of Minnesota and became an adjunct professor teaching electron microscopy in the instrumentation facility known as the Characterization Facility. For the last 10 years of his career, Stuart applied his EM expertise as a Research Scientist in the Corporate Research Analytical Lab (CRAL) of 3M.

Electron Beam-Sample Interactions

In the electron microscope, understanding the interaction of the incident electron beam with the specimen being examined is fundamental to our ability to interpret the images we collect. The energy and intensity of the incident electron, the interaction that electron has with the structure of the sample material, and the type of detector we are using, all play a part in our ability to work backwards from our observations and deduce something useful about the sample. With the advanced specification of modern microscopes, the range of operating conditions at our disposal is much larger than it once was and being able to adjust these conditions to optimize the information gathered from the specimen is both a blessing and a potential headache.

In parallel with the electron optic improvement of the instruments and the resultant resolution improvements, we are now able to examine ever smaller features in the samples. This frequently means that where we once treated the sample as a homogeneous block, we now need to carefully consider this inhomogeneity and its effect on the production and absorption of the signals being collected. This assessment may lead to changes in the operating conditions of the instrument to maximize the opportunity to collect meaningful data.

This presentation will give an overview of many of these electron beam-sample interactions, including methods to model them, and illustrate the differences that can be observed with some specific examples.

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Non-Traditional and Emerging Microscopy Techniques

continued

SPEAKER BIOS and ABSTRACTS

Söeren Eyhusen

Söeren Eyhusen is a business development manager at Carl Zeiss Microscopy. After receiving a Ph.D. in physics from Goettingen University, Germany, he joined Carl Zeiss's electron microscopy division in Germany where he primarily worked on electrons optics and system integration for electron microscopes and focused ion beam instruments. In 2012, Söeren moved to the United States and joined the product marketing management team, focusing on FE-SEMs, FIB-SEMs, and helium ion microscopes. He currently lives in the San Francisco Bay Area..

Helium Ion Microscopy: Imaging and Nanofabrication with Inert Ions

Helium ion microscopy is a relatively young and emerging technique that traces its history back to the 1950s when Professor Erwin Muller invented the Gas Field Ion Microscope at Pennsylvania State University. This remarkable instrument uses a very sharp, cryogenically cooled tip surrounded by a gas to produce an image of the atomic arrangement at the surface of the tip and allowed humans, for the first time, to "see" individual atoms directly. Further research over the years then led to the development of a commercially viable helium ion microscope, the ORION, by the company ALIS (now ZEISS) some 12 years ago.

ORION NanoFab, the current, third generation helium ion microscope, is still based on the gas field ion source technology, and is capable of producing both helium and neon ion beams. Due to the small probe size and the high precision of the ion beam, sub-10 nm structures can be routinely fabricated even in very sensitive materials such as graphene or other 2D materials. In contrast to focused gallium ion beams, helium and neon are inert ion species and leave no chemical contamination in the processed sample. Additionally, the beam-sample interaction dynamics of helium/neon ion beams offer unique contrast and stunning surface detail at sub 0.5nm lateral resolution.

In this presentation, we will provide an overview of helium/neon ion beam microscopy, its history and applications as well as report on new innovations.

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continued

SPEAKER BIOS and ABSTRACTS

Muhammad Nazir

Muhammad Nazir received his Ph.D. in biomedical engineering from University of Wisconsin, Madison, in 2007. His work was related to FLIM (fluorescence lifetime imaging) as a TCSPC technique. He joined Prairie Technologies in 2007 as a laser microscopy engineer and worked on multi-photon and confocal systems. Muhammad joined the Applications team in 2012. Bruker acquired Prairie Technologies in 2013 and Muhammad joined Bruker's sales team in 2018. He is currently the sales representative for the Midwest for Bruker's fluorescence microscopy products which include multiphoton, confocal, super-resolution and light-sheet technologies.

Modern Imaging Technologies in Fluorescence Microscopy

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Non-Traditional and Emerging Microscopy Techniques

continued

SPEAKER BIOS and ABSTRACTS

Liang Gong is a Senior Research Scientist in the Corporate Research Analytical Lab (CRAL) of 3M. She was born in Luoyang, China, in 1988. Liang received her B.S. degree in polymer science and engineering from Donghua University, Shanghai, in 2010, and her Ph.D. degree in materials science and engineering from University of Delaware, Newark, in 2016. Liang's current research interests include nanoscale characterization of macromolecular behaviors under extreme conditions, bio-based polymers, energy storage and conversion via polymeric media.

Liang Gong

AFM-IR Studies of Individual Electrospun Nanofibers of Bio-based Poly[(R)-3-hydroxybutyrate-co-(R)-3-hydroxyhexanoate] (PHBHx)

Bacterially-produced Poly [(R)-3-hydroxybutyrate-co-(R)-3-hydroxyhexanoate) (PHBHx) is a new type of bioplastic with excellent biocompatibility, biodegradability and processing properties. Electrospinning was used as the processing technique to fabricate PHBHx nanofibers. For the first time, the strain-induced metastable β-form crystal structure, with the extended chains adopting a planar zig-zag conformation, was discovered in the macro-scopically aligned PHBHx nanofibers collected with a high-speed rotary disk. In addition, this β-form crystal structure was confirmed to coexist with the thermodynamically-stable α-form crystal structure, in which the polymer chains adopting a 21-helical conformation. Due to the fact that the α- and β-form crystal structure of PHBHx have significantly different chemical and physical properties, it would be intriguing to investigate the spatial distribution of the two polymorphs in the nanofibers, providing insights into the internal structure of the fibers, with the ultimate goal of precise control of the macroscopic properties of the material.

The combination of atomic force microscopy (AFM) and infrared (IR) spectroscopy has been shown with the ability to provide topographic information as well as chemical and structural information at a spatial resolution of 50-100 nm, well below the diffraction limit in the IR. Using an AFM-IR instrument, we explored the correlation between molecular orientation, crystalline structure and processing in electrospun PHBHx nanofibers at the single fiber scale and tested the hypothesis that different processing protocols can alter the concentration of the α- and β-form crystal structure. The ability to obtain IR spectra at high spatial resolutions allowed us to probe the crystalline populations as a function of nanofiber diameter and as a function of spatial location within the fiber. In addition, by utilizing the spectroscopic imaging capability of the AFM-IR instrument, we created a distribution map of the α- and β-form crystal structure in a single PHBHx nanofiber, which revealed the existence of a structure consisting of an α-form-rich core and a β-form-rich shell. According to the experimental results, a new generation mechanism of the β-crystalline form was proposed which is significantly different from those previously reported. The morphological and structural details of individual electro-spun PHBHx nanofibers provide us a deeper understanding of the structure/property/ processing relationships at the single fiber scale, facilitating the fine-tuning of nanofiber properties to meet the application needs.

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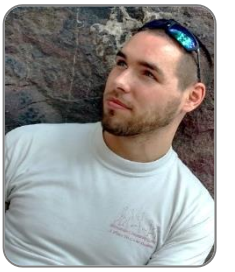
Non-Traditional and Emerging Microscopy Techniques

continued

SPEAKER BIOS and ABSTRACTS



Tyler B. Blum

Tyler B. Blum is a National Science Foundation Postdoctoral Fellow at the University of Wisconsin – Madison and Max-Planck-Institut fur Eisenforschung. Tyler's research focuses on high spatial resolution geochronology, and the study of the early Earth and Moon through isotopic and structural characterization of geomaterials. Tyler holds both an M.S. and Ph.D. from the University of Wisconsin – Madison.

Nanoscale Characterization by Atom Probe Tomography, and Applications in Studying the Early Earth and Moon

Atom probe tomography (APT) combines time-of-flight mass spectrometry and projection microscopy, enabling the three-dimensional reconstruction of material chemistry at the near atomic scale. APT is increasingly applied to both natural and engineered materials, due to the variety of materials it can analyze, and its ability to provide quantitative nanoscale descriptions of dopant distributions, precipitates, and interfaces. In the geosciences, the technique's high detection efficiency and spectral resolution enables measurement of isotope ratios at very high spatial resolution, providing a novel means to identify nanoscale heterogeneities, understand the scale dependence of isotope systematics, and ultimately quantify cryptic time and temperature relations. This is well illustrated in APT studies of zircon mineral grains ($ZrSiO_4$), the only minerals to be confidently dated to the first 500 million years of Earth history (>4.0 billion years ago). APT data sets document ~10 nm domains, rich in trace components including Y and lanthanides, as well as isotopes of Pb produced from the radioactive decay of $^{238}U \rightarrow {}^{206}Pb$ and $^{235}U \rightarrow {}^{207}Pb$. These clusters have been linked to high temperature periods in the zircon history, including magmatism, and basin-forming impacts. Combined with modeling of Pb isotope accumulation and migration, these types of APT data have enabled a new means to evaluate the fidelity of zircon ages measured at larger length scales, and understand the thermal state of the Earth's crust during the poorly sampled portion of Earth's history.

DON'T FORGET!

Election of MMS officers for 2019/2020 will be conducted during the business meeting following lunch.

Candidates proposed by the board:

- President Elect – Anette von der Handt
- Secretary – Patti Sanft
- Treasurer – Dave Burleson

* *Nominations will be accepted from the floor.*

MEMBER DUES

Please remember to pay your 2019 MMS membership dues.

CALENDAR of EVENTS

24-27 JUN 2019

Quantitative Microanalysis 2019 (QMA 2019)
University of Minnesota, Minneapolis, Minn.
(Tate Hall on the East Bank campus)
Costs: Professional: $400, Students: $100

The Microanalysis Society's (MAS) 2019 Topical Conference on Quantitative Microanalysis will follow a plenary structure format with presentations at the beginner, intermediate, and advanced level, with discussion appropriate for students, technical and professional personnel, scientists, and representatives from the vendor communities. QMA 2019 will include tutorials, presentation of wavelength-dispersive (WDS) and energy-dispersive (EDS) spectrometry, quantitative analysis, and other aspects of EPMA presented in invited and contributed presentations.

Learn more
Registration

THANK YOU, PROJECT MICRO

Project MICRO

Project MICRO has been busy presenting at elementary schools again this first half of 2019. We welcome new volunteers at any time. No experience necessary; training provided on site. Please contact Jeff Payne, Project MICRO Director (jjpayne@mmm.com) to join us.

Thank you, Project MICRO Volunteers!

On Thursday, February 21, Project MICRO participated in Echo Park Elementary School's Family Engineering Night from 5:30 to 7:30pm in Burnsville. This was our third consecutive year here. We served many students with their families non-stop, engaging them with our popular demonstrations of Fingerprints, Sand, Fabrics, and Everyday Cool Stuff viewed with our Leica and Dino-Lite stereoscopes. Thank you to volunteers **Muriel Gavin**, **Stuart McKernan**, **Ann Palmer** and **Jeff Payne**. Echo Park sent us a wonderful thank you note:

> *Thank you so much for volunteering your time at Family Engineering Night last night! Please send a big THANK YOU to all the volunteers that attended with you. It was such a fun event and the feedback from families has been amazing! This event could not have happened without all the volunteers like you. We really appreciate how interactive your station was at the event. Families loved checking out things in the microscopes and the fingerprinting was awesome! We hope you enjoyed your time at Echo Park and that you join us for future events. Thank you again for your support of all things Engineering and Tech at Echo Park.*
>
> Thank you,
> Rebecca Haehnel
> Echo Park Elementary School of Leadership,
> Engineering and Technology

SPRING SCHEDULE

Thurs., April 4 was **Hamilton Elementary School**'s Science Night from 5:30 - 7:30pm in Coon Rapids. This was our first time here!

Fri., April 5 was **Poplar Bridge Elementary School**'s STEAM Fundraiser Night from 6:00 - 8:30pm in Bloomington. (Thankfully, Project MICRO volunteers were not auctioned off as part of their fundraising – ha! 😁)

THANK YOU, PROJECT MICRO - 2

Project MICRO

Stuart McKernan magnifying money with the Dino-Lite digital microscope.
Jeff Payne magnifying mosquito larvae with the Leica stereoscope.

Our library room with **Muriel Gavin** (in red). Our kid-friendly microscopes are ready for visitors to view sand and fabrics.

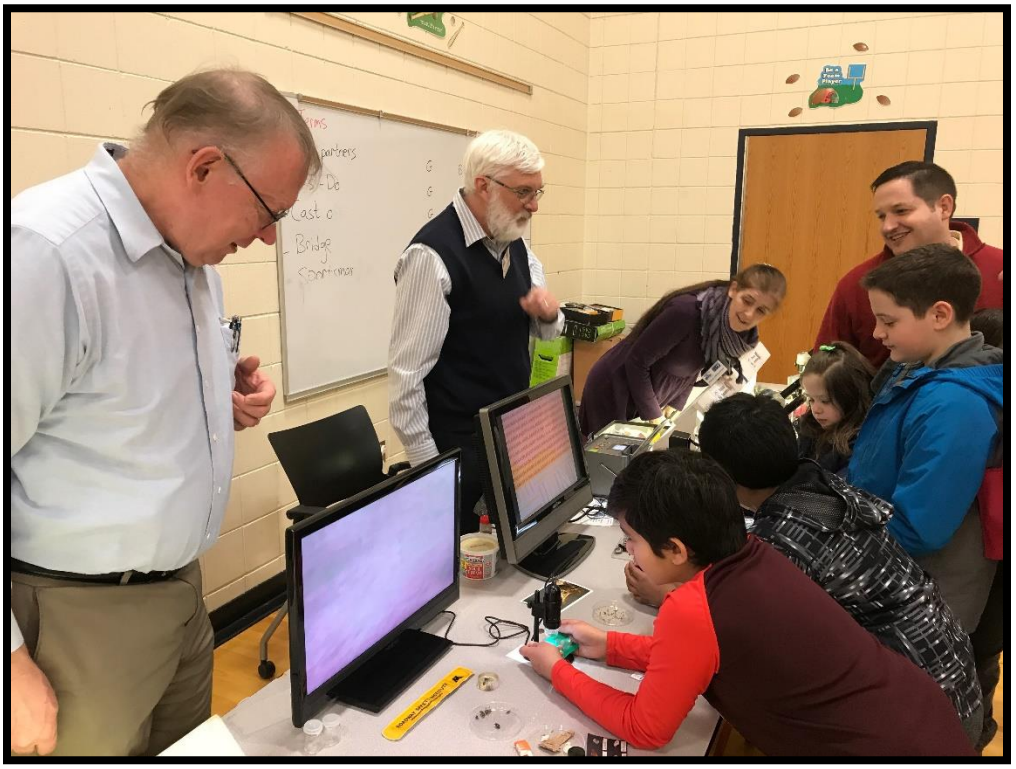
THANK YOU, PROJECT MICRO - 3

Project MICRO

Stuart McKernan, **Muriel Gavin**, **Jeff Payne**, and **Ann Palmer** are ready for visitors to arrive.

On Friday, March 15, we presented at Eagle Creek Elementary School's Science and Art Fair from 6:30 to 8:00pm in Shakopee. Our station was in the gymnasium, along with student science and art work displayed on many tables. At our station**, Janet McKernan** showed the details of fabrics with our kid-friendly Microscopes; **Stuart McKernan** showed the security details of MN driver's licenses and U.S. dollar bills with the Leica Stereoscope; **Steve Axdal** helped magnify slime that visitors made at another station with the Dino-Lite digital microscope; and **Ann Palmer** engaged visitors to see their fingerprint patterns and view sand differences. We served 70 excited family visitors with our demonstrations and this was our fourth consecutive year here.

THANK YOU, PROJECT MICRO - 4



Project MICRO

Steve Axdal magnifying visitors' slime on the Dino-Lite digital microscope. **Stuart** and **Janet McKernan** showing security details of MN driver's licenses on the Leica stereoscope.

Project MICRO station with **Steve Axdal** (in light blue), **Stuart** and **Janet McKernan**, and **Ann Palmer** taking the photo. Our kid-friendly microscopes are magnifying fabrics.

THANK YOU, PROJECT MICRO - 5

Project MICRO

Eagle Creek Science and Art Fair in the gymnasium showing students' science and art work.

MMS CORPORATE SPONSORS

Corporate Sponsors are the backbone of financial support for the Society. These members make it possible for the Society to support Project Micro and to cover many expenses of the regular meetings and the Spring Symposium. MMS gratefully acknowledges the corporate sponsorships provided by the following companies. To become a Corporate Sponsor, complete and return the MMS membership form at the end of the newsletter.

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If any sponsors are missing from this list, please contact Jason Heffelfinger (763-514-1021, jason.r.heffelfinger@medtronic.com).

MMS SUSTAINING & PATRON MEMBERS

The Minnesota Microscopy Society would like to express sincere thanks to our Sustaining and Patron Members. These members provide financial support to the organization above the standard membership fee. This additional support makes it possible for MMS to maintain its financial well being. To become a Patron or Sustaining Member, complete and return the MMS membership form at the end of the newsletter.

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MINNESOTA MICROSCOPY SOCIETY | MEMBER INFORMATION FORM

All microscopists are urged to support their Society at one of the membership levels offered below. Often, supervisors will support MMS memberships out of their project budget because they recognize that it is a very inexpensive way to maintain and increase the skills of their microscopists. If you have been a member over the years and recognize the value of MMS to the community of microscopists it serves, consider upgrading your membership this year to the Patron or Sustaining level. Thank you.

Dr ☐ Mr ☐ Mrs ☐ Ms ☐ First Name _____ Last Name _____

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Payment: Check ☐ PayPal ☐

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