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# FALL NEWSLETTER

## Oklahoma Microscopy Society



## ABOUT THE COVER . . .

### **Hitachi TM 3000 from the University of Oklahoma at the tri-state junction of Oklahoma, Colorado, and New Mexico**

**T**he University of Oklahoma's Hitachi TM 3000 scanning electron microscope hits the road every spring to support the Oklahoma Microscopy Society's Ugly Bug Contest. This year one of the winning schools was Yarbrough Elementary located in the Oklahoma panhandle. A funny thing happened on the way to Yarbrough... the microscope visited the Santa Fe Trail and the tri-state area where Oklahoma, Colorado, and New Mexico all meet. The tri-state marker also known as the Preston monument (cover picture) is named after Levi S. Preston who surveyed a portion of the New Mexico—Colorado border. The two north facing sides of the monument are marked with "Colorado" while the south east side bears "Oklahoma" and the southwest side "New Mexico".





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# PRESIDENT'S LETTER



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Dear Oklahoma Microscopy Society Friends,

Thank you for allowing me to serve as president of the OMS for 2015-2016. I would like to thank Dr. Mark Curtis for serving as president for 2014-2015. We look forward to his continued involvement in the society and learning from his expertise as a geologist working with advanced microscopy techniques. This fall, our meeting is highlighted by speaker Dr. C. Barry Carter, world-class expert on TEM and accomplished author. Thanks to the Microscopy Society of America and their local affiliated society speaker program, we have opportunities at our fall and spring meetings to hear well-known microscopy experts speak right in our 'back yard'. At the November 13, 2015 meeting we will also hear students participating in the Timpano award competition, and vote on the state's ugliest bug for 2015.

The Oklahoma State University Microscopy Laboratory saw the end of an era with the retirement of both Dr. Charlotte Ownby and Terry Colberg in early 2015. Dr. Ownby founded the OSU Microscopy lab in 1977 and is a founding member of the Oklahoma Microscopy Society. Terry Colberg worked with Dr. Ownby since 1980 as a research lab manager and then as the OSU Microscopy facility manager. Luckily for us, they both still live in the area and are available for consultation! In May of 2015 we welcomed Brent Johnson to our facility. We are happy Brent has joined the team and we look forward to many years of working together. Brent brings many years of research experience to our facility and we are glad to have him.

OSU will host the spring OMS meeting in 2016. The last time that we hosted this meeting was 2008 so we hope to have a great workshop. Students have already expressed interest in attending so we anticipate having a good turnout. Plans are underway for the meeting and we hope to see you at the Spring Meeting in Stillwater in 2016!

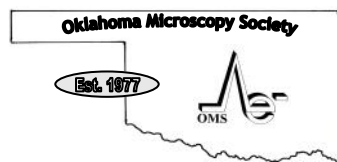
Sincerely,

A handwritten signature in blue ink that appears to read "L Whitworth".

Lisa Whitworth  
OMS President 2015-2016



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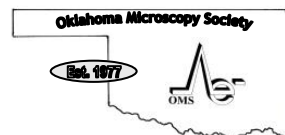
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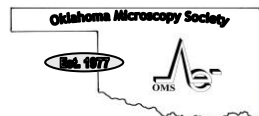
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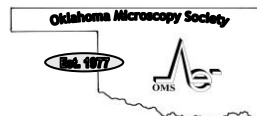
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**UPCOMING MICROSCOPY MEETINGS . . .**


# Oklahoma Microscopy Society

Spring 2016 OMS Workshop


## INTERNATIONAL Meetings




**ACMM**  
**24** Australian Conference on Microscopy & Microanalysis




MELBOURNE CONVENTION AND EXHIBITION CENTRE  
31 JAN - 4 FEB 2016



acmm2016.org



From 3D Light to 3D Electron Microscopy  
EMBL WORKSHOP



Heidelberg, Germany  
13 - 16 March 2016

## Microscopy and Microanalysis



**Columbus**  
**Ohio**  
**July 25 - July 28, 2016**



**St Louis**  
**Missouri**  
**July 23 - July 27, 2017**



**Baltimore**  
**Maryland**  
**August 5 - 9, 2018**



CITY OF BALTIMORE  
1797

## OMS MEMBER NEWS

### Brent Johnson Joins Microscopy Laboratory at Oklahoma State University



Brent Johnson recently joined the Oklahoma State University Microscopy Laboratory as a Research Specialist where he will assist Lisa Whitworth in operating the laboratories instrumentation suite on behalf of the university research community. Brent came to the OSU Microscopy Laboratory in May of this year from the Oklahoma Animal Disease Diagnostic Laboratory where he filled many positions during 25 years in the Analytical Toxicology and Histopathology laboratories. Brent earned a Bachelor degree in Microbiology ('88) and a Master of Science degree in Environmental Engineering ('92) from OSU. Brent spent his youth in the Lawton area and moved in 1983 to Stillwater where he settled down with his lovely wife in 1991.

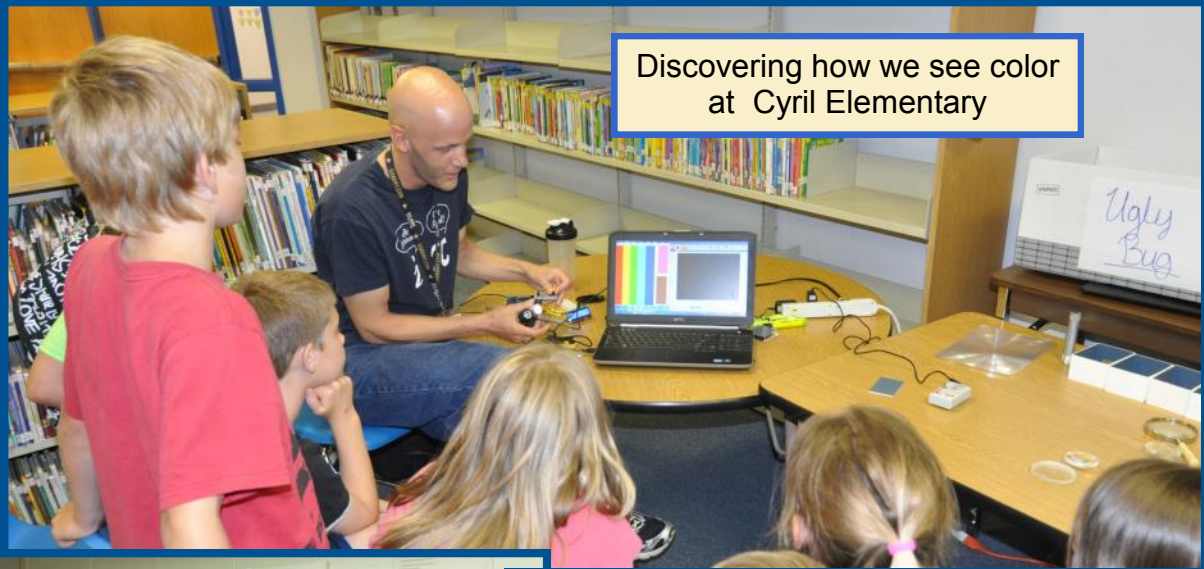


Welcome Brent!

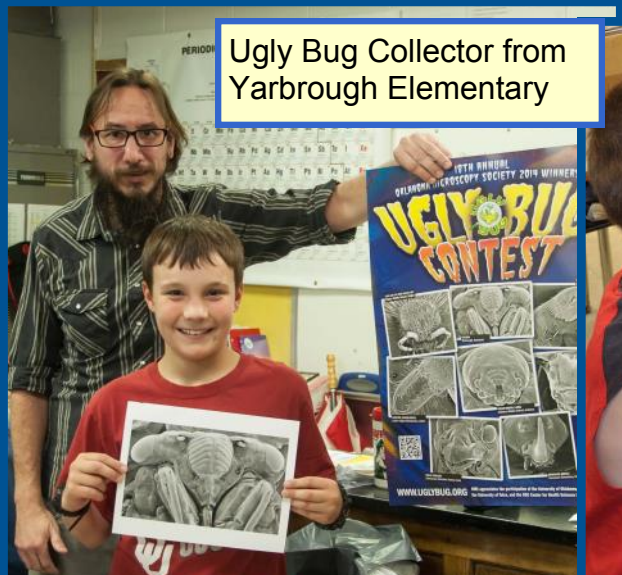
From the Oklahoma Microscopy Society



# OMS UGLY BUG SCOPE DELIVERIES



Discovering how we see color at Cyril Elementary



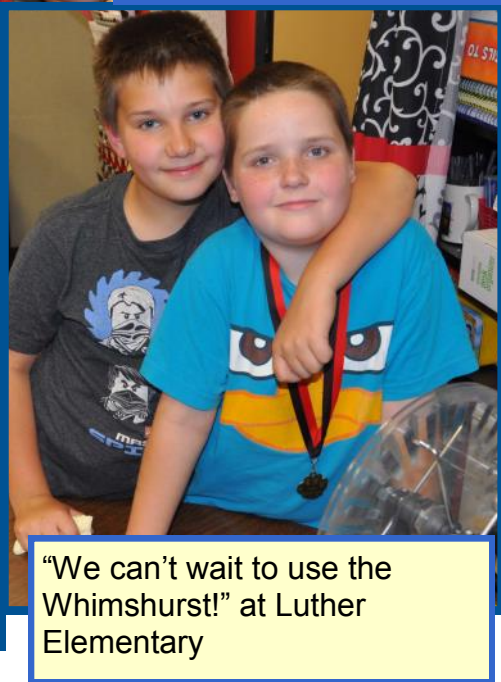
Ugly Bug Collector from Yarbrough Elementary



Investigating fingerprints at Luther Elementary



Using the new microscope at Cyril Elementary



"We can't wait to use the Whimshurst!" at Luther Elementary



## THANKS...

A special thanks to the following for their unflagging support of the Ugly Bug Contest...

**Phillips 66**



For providing grants to fund the contest and printing of posters delivered to classrooms



**Justin Meek**

For his work designing the beautiful OMS Ugly Bug Contest logo

**Leica**



For providing generous subsidies toward the purchase of stereomicroscopes given away to schools as a part of the contest and

**the Microscopists**

who make the images that are the heart of the contest

Phillips 66 — Matt Lundwall  
Oklahoma State University—Lisa Whitworth  
University of Oklahoma—Preston Larson

## Transmission Electron Microscopy Sample Preparation using a dual Column FIB/SEM with Kleindiek Micromanipulator

M. B. Johnson, J. C. Keay, H. Ye, R. Q. Yang, T. D. Mishima, M. B. Santos, C. Corrège  
and P. R. Larson

The Microscopy Lab at the University of Oklahoma has had a Zeiss Neon EsB dual beam SEM/FIB microscope for approximately 3 years which allows us to modify and image a wide range of specimens with excellent resolution. In addition, we have purchased an accessory for this microscope, a Kleindiek Micromanipulator, a necessary component along with the dual beam SEM/FIB to allow *in situ* site specific TEM preparation of semiconductors and related materials. This short article attempts to explain the progress we are making and some of the pitfalls we have encountered as we attempt to learn how to routinely fabricate these samples.

The first step is to locate the area for the TEM thin section using the SEM. In the particular example shown below, we were interested in investigating an oval hillock defect with a polyhedral

pit in an InAs semiconductor sample. Figure 1 (a) is a top down SEM image showing the defect along with a FIB-deposited platinum (Pt) strip over the desired defect as a means to prevent etching or damage in the ensuing FIB etching steps. Next, two trapezoidal trenches were etched on either side of the defect, followed by further etching below and on the sides of the defect sample area to create a thin section that is attached to the bulk substrate only by a small tab

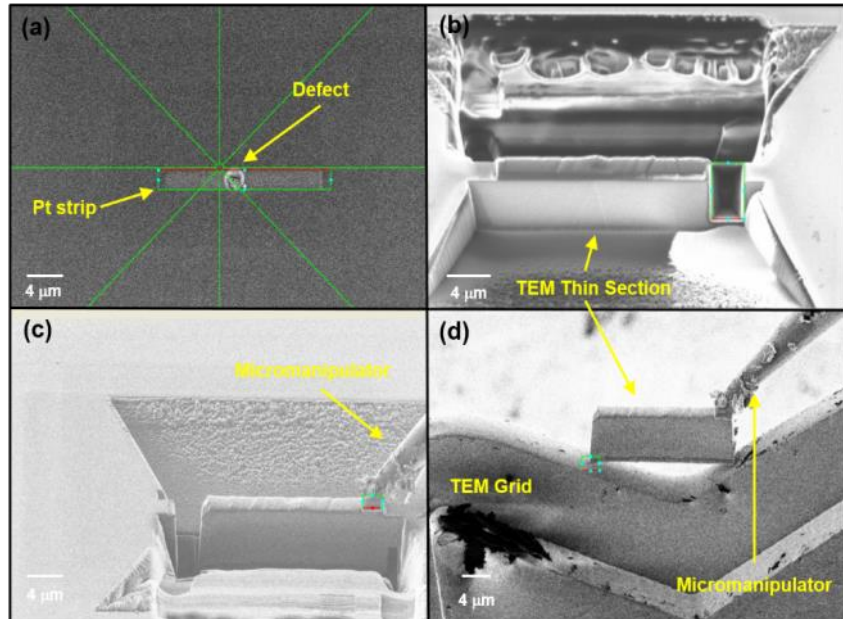


Figure 1 (a) Top down SEM image showing semiconductor defect with FIB-deposited Pt strip (b) Tilted SEM image showing FIB-etched trapezoids and further etching to produce a TEM thin section (c) Tilted SEM image showing removal of the TEM thin section with the micromanipulator (d) Tilted SEM image showing the placement of the TEM thin section onto a specialized TEM grid.

area to create a thin section that is attached to the bulk substrate only by a small tab

for TEM analysis. The sample, now attached to the TEM grid, can be removed from the dual beam SEM/FIB and analyzed or imaged in the TEM. Figure 2 (a) is a low magnification TEM image showing the TEM grid along with the attached sample while Figure 2 (b) shows a close up TEM image of the thin section.

The main difficulties we have been confronted with in regards to a routine successful TEM sample preparation are primarily two fold. First, it is very easy to lose the section when transferring from the bulk sample to the TEM grid using the micromanipulator. We expect this can be solved with more practice and a skilled operator. The second issue is FIB etching artifacts that can occur.

Figure 2 (c) shows a high magnification TEM image of the defect illustrating some of the artifacts produced from specimen preparation including damage to the crystalline structure due to FIB etching and contrast effects due to specimen bending. It is well known that FIB etching can often induce amorphization effects in a crystalline lattice alt-

hough a diffraction pattern taken from the semiconductor crystal (Figure 2 (d)) showed no obvious amorphization regardless of the FIB induced damage seen in Figure 2 (c). Regardless, we hope to overcome these artifacts with gentler final FIB etching (*i.e.* lower accelerating voltages and currents) or maybe a final etching step in a low energy Ar ion mill.

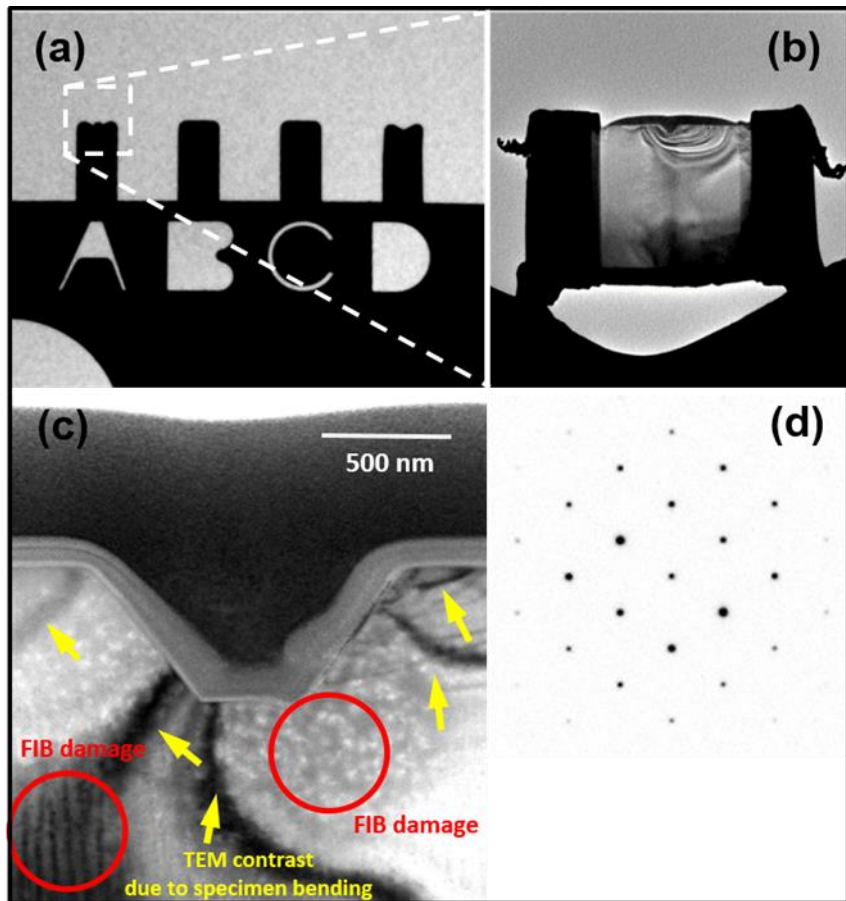


Figure 2 (a) Low magnification TEM image showing thin section attached to TEM grid (b) Close up TEM image showing thin section attached to TEM grid (c) High resolution TEM image showing semiconductor defect along with sample preparation artifacts (FIB damage and specimen bending effects) (d) Diffraction pattern taken from crystal showing no obvious amorphization regardless of FIB damage

## OMS 2015 FALL TECHNICAL MEETING

In conjunction with the 104th Annual Technical Meeting of the Oklahoma Academy of Science

Oklahoma City University  
2501 N Blackwelder Ave  
Oklahoma City, OK  
Friday, November 13, 2015

# Plenary Speaker

**Dr. C. Barry Carter**

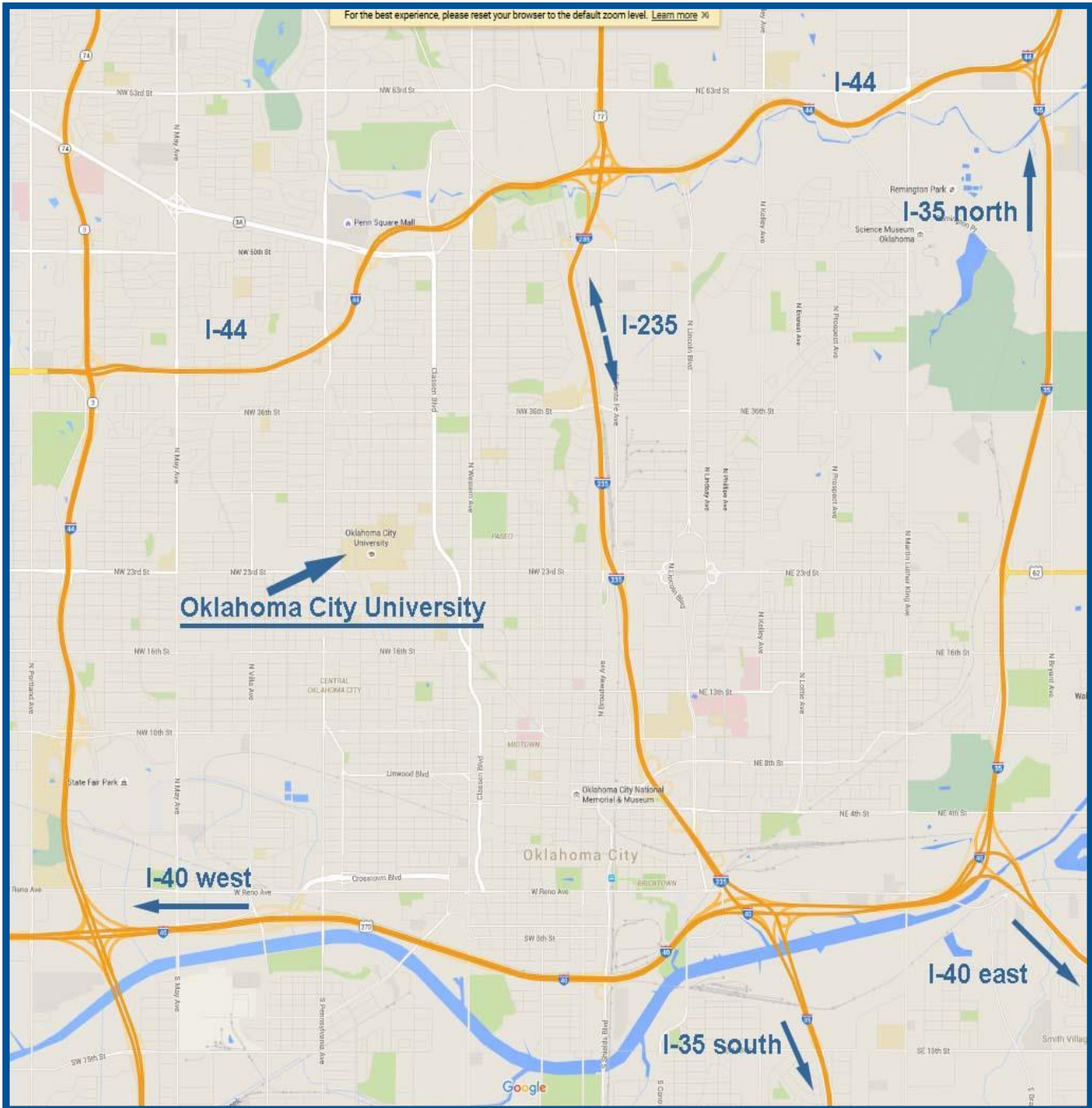
Professor,  
Dept. Chemical & Biomolecular Eng.,  
Dept Materials Sci. & Eng.  
Institute of Materials Science,  
University of Connecticut, Storrs, CT

**"The Future of TEM and why  
we must Remember the Past"**

# DIRECTION TO FALL MEETING

## Oklahoma City University Area Map

2501 N Blackwelder Ave,  
Oklahoma City, OK 73106



# TIMPANO COMPETITION...

## *OMS Best Student Paper Award:*

### THE TIMPANO AWARD

This Award, commemorating the late Dr. Peter Timpano, is based on student presentations at the Fall OMS meeting, which is held annually in conjunction with the meeting of the Oklahoma Academy of Science (OAS). All applicants for the Timpano Award must be members of OMS at the time that they declare themselves as candidates for the Award and must be enrolled in a degree program in an institution of higher learning in Oklahoma.

**First Prize:** All-expense-paid trip for the first place winner to the national meeting of the Microscopy Society of America (MSA) or Microbeam Analysis Society (MAS) to present a paper or poster on his or her research. The total travel allowance (including MSA or MAS contribution, if any) will be \$1,100.00, with all reasonable expenses reimbursed upon presentation of receipts. In addition, a \$100.00 cash scholarship to be used toward the student's research career will be awarded. (If the student is selected as a finalist in the MSA Presidential Student Awards Competition, then MSA will provide registration and airfare, and OMS will provide an additional \$200.00 bonus.)

**Second Prize:** A \$100.00 cash scholarship will be awarded to the second place winner for use toward the student's educational/research expenses. This and the above award are tax exempt if used for educational/research expenses.

*The best student paper will be evaluated on the basis of the following criteria:*

1. Quality of presentation
2. Quality of slides and micrographs
3. Scientific approach
4. Materials and methods
5. Value of contribution to scientific knowledge
6. Merit of microscopic work
7. Quality of submitted abstract

**Rules for the Competition:** This competition shall be judged by a committee of at least 3 OMS members appointed by the OMS Executive Board; those having a conflict of interest will be excluded. Votes shall be cast by secret-ballot and will be accepted by the Secretary-Treasurer (or designated OMS Officer) after the final competing presentation. (OMS reserves the right to set minimum standards for the best paper and may choose to select a second place winner without selecting a first place winner, at its discretion.)

**Conditions of Award:** Upon winning first place, the awardee must, by December 15 of the current year, submit a letter of intent or declination regarding attendance at the MSA or MAS meetings. If the awardee notifies OMS that he or she declines to attend MSA or MAS for any reason, a \$100 prize will be awarded in lieu of the trip to the meeting, provided that *the declination is received within the stated time limit*. If the winner declines the first place prize, the second place winner will be offered the opportunity to attend the meeting and present a paper as provided above. A student may compete for the Timpano Award throughout his or her career, but may attend an MAS or MSA meeting at OMS expense only once. Students winning additional Timpano competitions will receive a \$ 100 cash scholarship.

# OMS FALL MEETING PROGRAM

## SECTION K: MICROSCOPY

Building  
Room

Moderator: **Scott Russell**  
University of Oklahoma

- 8:30      **Pectic Polysaccharide Cell Wall Compositional Alterations during Lateral Root Emergence in *Oryza sativa*.** Timothy Pegg, Laura Bartley. University of Oklahoma.
- 8:45      **Crystalline Defect Characterization Using Field-Emission Scanning Electron Microscopy.** Joseph N. Tessmer, P.R. Larson, J.C. Keay, E.S. Sanchez, M.B. Johnson. University of Oklahoma.
- 9:00      **The Future of TEM and Why We Must Remember the Past.** C. Barry Carter, University of Connecticut.
- 9:45      Break
- 10:00     **Characterization and Failure Analysis of Interband Cascade (IC) Structures and Devices Using a Zeiss Neon 40 Cross-Beam Microscope.** S.M. Shazzad S. Rassel, H. Ye, J.C. Keay, L. Li, H. Lotfi, R.Q. Yang, M.B. Santos, P.R Larson, M.B. Johnson. University of Oklahoma.
- 10:15     **Three-Dimensional Imaging and Quantitative Analysis of Dispersion and Mechanical Failure in Filled Nanocomposites.** Benjamin E. Smith, Hessam Yazdani, Kianoosh Hatami. University of Oklahoma.
- 10:30     **Synthesis of Hydrophobic Carbon Nanomaterials on Stainless Steel Substrates in a Diffusion Biodiesel Flame.** Ethan Murphy, June Hua, Steve Zhang, Jesse Yue, Wilson Merchan-Merchan. University of Oklahoma.
- 10:45     **Immunolocalization of Ferulic Acid Ester Linked Arabinoxylans in *Oryza sativa* Throughout Pre-Emergent Lateral Root Primordia Development.** Thomas, David; Pegg, Timothy; Bartley, Laura. University of Oklahoma.
- 11:00     **Focused Ion Beam to Mill Organic-Walled Fossils at the Micro- and Nanoscale.** Nathan C. Sheely, P.R Larson, M.B Johnson, R.A Lupia. University of Oklahoma.
- 11:15     **Characterization of High-Density Arrays of Self-Assembled InAs/GaAs<sub>1-x</sub>Sb<sub>x</sub> Quantum Dots.** Cédric Corrège, P.R. Larson, M.C. Debnath, M.B. Santos, and M.B. Johnson. University of Oklahoma.
- 11:30     **Section K Business Meeting**

# OMS FALL MEETING ABSTRACTS

## OMS 2015 Fall Meeting Key Note Speaker

### **The Future of TEM and why we must Remember the Past**

C. Barry Carter, Department of Chemical & Biomolecular Engineering,  
University of Connecticut



<http://cbarrycarter.com/group.html>

#### **Abstract**

The subject of this talk concerns the future of TEM. TEM is facing many challenges including the fact that the top-of-the-line microscopes are becoming more expensive and more complex even when they seem simpler because of the increasing use of computers and a clear affordable textbook. The techniques used by the different communities (physical sciences and life sciences) are also often converging especially for those specializing in 3D imaging, spectral imaging, low-dose imaging (we all should be) and aberration-corrected imaging. (Who is specializing in non-aberration-corrected imaging?)

I'll illustrate the talk with some examples of work from my group and from friends. My field of research is Ceramic Materials so I'll use my crystal ball to suggest some potential directions that TEM as a whole might follow in the next few years, and in so doing explain the title.

#### **Bio**

I began in 1971 at Imperial College with a study of the intercalation of layer materials - using the tape-peeling technique to make TEM specimens. The main feature of my D.Phil. thesis at Oxford was the use of the weak-beam technique for studying defects in metals. Key papers from this time are those on the stacking-fault energies of copper alloys and Ni, those on in-situ observations of the climb and formation of jogs on dissociated dislocations, faulted dipoles (they are much more numerous than people knew before WB) and double ribbons (which tell us both the intrinsic *and* extrinsic stacking fault energies of a material. At Cornell my research emphasized the application of diffraction techniques to grain boundaries, solid-state reactions in oxides and defects in semiconductors. At Minnesota, the latter two topics were continued and nanoparticle research added. I now started to use in-situ studies to understand the behavior of nanoparticles and have continued this at UConn. At UConn I have collaborated with colleagues on energy materials, fibers, biomimetics for ceramics and more nanoparticles.



# OMS FALL MEETING ABSTRACTS

## **PECTIC POLYSACCHARIDE CELL WALL COMPOSITIONAL ALTERATIONS DURING LATERAL ROOT EMERGENCE IN *ORYZA SATIVA***

**Timothy Pegg and Laura Bartley**

Department of Microbiology and Plant Biology, University of Oklahoma, Norman, OK 73019

Lateral roots (LRs) represent the horizontal component of plant root systems and provide structural stability, increased nutrient uptake, and water absorption via extension of root system boundaries. In rice seedlings, lateral roots initiate through cellular division of the pericycle and develop through several layers of extant tissues, including cortex, sclerenchyma, exodermis, and the epidermis. Comprehension, and future regulation, of cell wall changes that occur during lateral root emergence (LRE) may lead to optimization of root cell architecture for improved rice biofuel feedstock saccharification. This study seeks to characterize the cell wall compositional changes in cells adjacent to the lateral root primordium with respect to modification of pectic polysaccharides. Preliminary data from immunofluorescence with primary antibodies targeting the cell wall matrix homogalacturonan (HG) epitopes suggests de-methyl esterification (DME) of HG is abundant in cell walls located between rice LR primordia and adjacent tissue in an 180° forward arc. Cell wall digestive enzyme treatment of root tissue before primary antibody binding suggests chemically significant relationships between cellulose and DME homogalacturonan in cells in front of the developing LRP. In addition, 3D-rendered, confocal focus series of lateral root primordia provides standard cellular dimensions per tissue type, and demonstrates significant cell wall deformation in cortex cells similarly adjacent to the LR primordium. This data suggests loss of cellular adhesion and primary cell wall integrity due to pectin modification and pectin/cellulose interaction may be required for the proper extension of LR primordia through the various rice root tissue layers.

## **CRYSTALLINE DEFECT CHARACTERIZATION USING FIELD-EMISSION SCANNING ELECTRON MICROSCOPY**

**Joseph N. Tessmer<sup>1</sup>, P.R. Larson<sup>2</sup>, J.C. Keay<sup>1</sup>, E.S. Sanchez<sup>1</sup>, and M.B. Johnson<sup>1</sup>**

<sup>1</sup> Homer L. Dodge Department of Physics and Astronomy, University of Oklahoma. Norman, OK 73019

<sup>2</sup> Samuel Roberts Noble Microscopy Laboratory, University of Oklahoma, Norman, OK 73019

The development of new materials for use in electronic and photonic devices hinges upon the quality of the grown material. Of particular interest are crystalline defects, as these can strongly affect device operation. Traditionally, these defects are identified and characterized by Atomic Force Microscope (AFM) or Transmission Electron Microscope (TEM). However, new SEM techniques such as Angular sensitive Backscatter (AsB) and Electron Channeling Contrast Imaging (ECCI) allow these features to be viewed in the Field Emission Scanning Electron Microscope (FE-SEM). The FE-SEM has several advantages over the more commonly used methods: compared to the TEM, which requires extensive sample preparation, the SEM requires virtually no sample preparation; and compared to AFM, which can often take large amounts of time to produce high quality images, the SEM can quickly image an area at the desired magnification, then proceed to another area of interest on the sample. Additionally, the SEM grants access to complementary techniques like Energy Dispersive x-ray Spectroscopy (EDS) that are not available in the AFM. In this talk, we will show examples of our recent results using our FE-SEM and we will compare these results to AFM and TEM studies wherever possible. Our results focus on InSb- through GaN-related semiconductor structures as well as flat gold nanoparticles.

# OMS FALL MEETING ABSTRACTS

## CHARACTERIZATION AND FAILURE ANALYSIS OF INTERBAND CASCADE (IC) STRUCTURES AND DEVICES USING A ZEISS NEON 40 CROSS-BEAM MICROSCOPE

**S.M. Shazzad S. Rassel<sup>1</sup>, H. Ye<sup>1</sup>, J.C. Keay<sup>2</sup>, L. Li<sup>1</sup>, H. Lotfi<sup>1</sup>, R.Q. Yang<sup>1</sup>, M.B. Santos<sup>2</sup>, P.R. Larson<sup>3</sup> and M.B. Johnson<sup>2</sup>**

<sup>1</sup>School of Electrical and Computer Engineering, University of Oklahoma, Norman, OK 73019

<sup>2</sup>Homer L. Dodge Department of Physics and Astronomy, University of Oklahoma, Norman, OK 73019

<sup>3</sup>Samuel Roberts Noble Microscopy Laboratory, University of Oklahoma, Norman, OK 73019

Interband cascade (IC) devices include mid-IR lasers and detectors, as well as thermophotovoltaics (TPVs). Among these devices, IC lasers are the most mature and have demonstrated high performance. By engineering band-structure, IC lasers reuse injected [electrons](#) to emit multiple photons, which are generated by interband transitions. The cascade heterostructures are comprised about one thousand different epitaxial layers from group III-V materials, such as InAs, GaSb, AlSb, and their related alloys. At OU, we routinely grow these cascade devices by molecular beam epitaxy (MBE), often taking more than 20 hours of growth time. Compared to the complexity of MBE growth technique, the fabrication process of these samples into devices is simpler, however, complications arise due to the sophisticated nature of device structure and material issues associated with narrow bandgap semiconductors. In this talk, we will briefly describe the device fabrication process and then discuss the use of FIB/SEM cross-beam microscope to help characterize the MBE materials, to assess the quality of the device fabrication, and to do failure analysis on the final devices themselves. We will give examples of characterizing growth defects in the MBE materials; assessment of wet- and dry-etched mesa side wall profiles, and problems associated with sputter-deposited insulating layers.

## THREE-DIMENSIONAL IMAGING AND QUANTITATIVE ANALYSIS OF DISPERSION AND MECHANICAL FAILURE IN FILLED NANOCOMPOSITES

**Benjamin E. Smith<sup>1</sup>, Hessam Yazdani<sup>2</sup>, Kianoosh Hatami<sup>2</sup>**

<sup>1</sup>Samuel Roberts Noble Microscopy Laboratory, University of Oklahoma, Norman, OK 73019

<sup>2</sup>School of Civil Engineering and Environmental Science, University of Oklahoma, Norman, OK 73019

Characterizing filled nanocomposites is an active area of research in order to predictively modify their properties. The dispersion of nanofillers has a direct influence on these properties, and therefore the precise characterization of dispersion is essential in establishing a complete understanding of composite behavior. In this study, we have developed a methodology for using laser scanning confocal microscopy to quantitatively assess the three-dimensional dispersion of carbon nanotube bundles within a composite material in situ. Furthermore, we applied this methodology to directly visualize in real-time the subsurface mechanical failure of a carbon nanotube-filled composite.

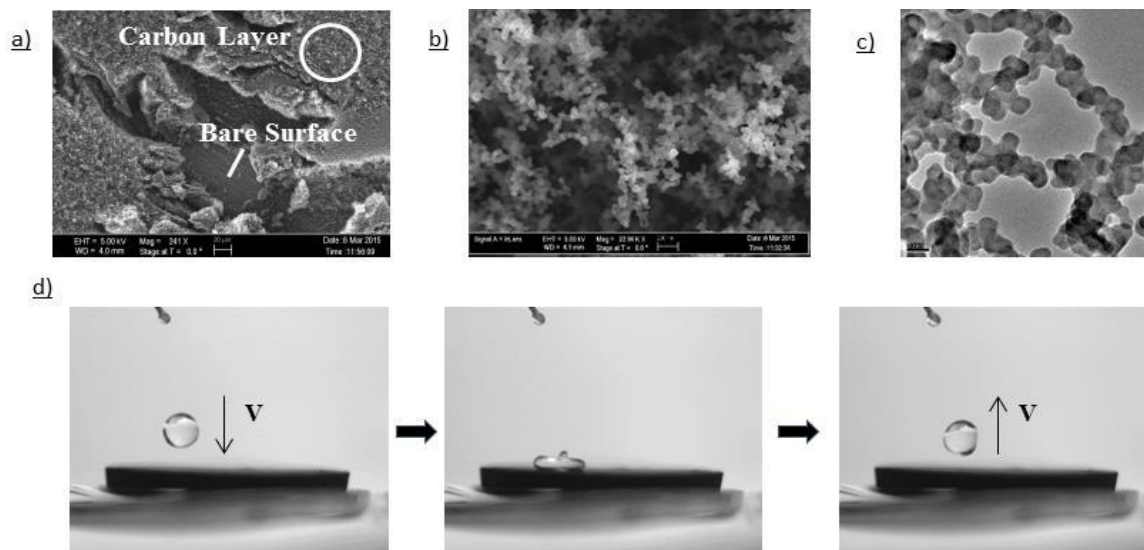
# OMS FALL MEETING ABSTRACTS

## SYNTHESIS OF HYDROPHOBIC CARBON NANOMATERIALS ON STAINLESS STEEL SUBSTRATES IN A DIFFUSION BIODIESEL FLAME

*Ethan Murphy, June Hua, Steve Zhang, Jesse Yue, Wilson Merchan-Merchan*

*School of Aerospace and Mechanical Engineering, University of Oklahoma, Norman, OK 73019, USA*

In this work we show that carbon particulates formed in a flame medium using a canola methyl ester (biodiesel) possess unique hydrophobic properties. Stainless steel (SS) disks of up to 19-mm-diameter are introduced in a co-flow flame formed using canola methyl ester (CME). Carbon layers of various thicknesses are formed on the surface of the SS disks depending on the flame position and residence time (Fig. 1a). The hydrophobicity of the formed layers is characterized by measuring the contact angle of water droplets deposited on the surface and the behavior of water droplets impacted upon the surface in a drop test (Fig. 1d). The surface morphology of the layers is studied using scanning electron microscopy (SEM) (Fig. 1a-b). The structure of the carbon particulates (particle diameter, degree of agglomeration, internal structure) is studied using transmission electron microscopy (TEM) (Fig. 1c). Analysis from SEM, TEM and contact angles is employed to find an ideal flame location and residence time for maximum hydrophobicity of the formed layers.



**Figure 1: (a-b) SEM imaging on the surface of a stainless steel substrate coated with a film of material formed in a non-smoky biodiesel/air (CME/79%N<sub>2</sub>+21%O<sub>2</sub>) flame a) 241X and b) 33990X; (c) TEM analysis of the material forming the hydrophobic layer shows that it is composed of carbon particulates of nanometer size scale; (d) the set of photographs represents snapshots of a water droplet falling and impacting the surface of the coated SS substrate. The droplet deforms after impact then retracts its shape and bounces back into the air.**

# OMS FALL MEETING ABSTRACTS

## IMMUNOLOCALIZATION OF FERULIC ACID ESTER LINKED ARABINOXYLANS IN *ORYZA SATIVA* THROUGHOUT PRE-EMERGENT LATERAL ROOT PRIMORDIA DEVELOPMENT

David Thomas, T. Pegg and L. Bartley

Department of Microbiology and Plant Biology, University of Oklahoma, Norman, OK 73019

Lateral roots extending from crown roots expand total root system surface area to substantially increase nutrient and moisture uptake and to establish additional anchorage. Cell wall structural polymer lignin and associated matrix polysaccharides including ferulated arabinoxylan (FAX) are altered in an undetermined way to allow lateral root primordia (LRP) to extend from the center of the crown root through five different cell types. Ferulic acids (FA) cross link adjacent xylan strands to one another in type 2 cell walls of grasses and are proposed to be involved in nucleation of lignin polymerization. Localization of FAX is accomplished in agarose embedded *Oryza sativa* crown root cross sections employing the primary antibody 5-O-Fer-Ara with goat anti-rabbit IgG coupled Alexa Fluor 647 (ThermoFisher) fluorophore. Immunolocalization images produced with a Zeiss Apotome Fluorescence microscope and filter set 38 HE GFP provide a novel view of the changing cell wall matrix composition. Visualization of the sclerenchyma cell layer overlying the lateral root primordia show an apparent decrease in FAX binding compared to adjacent sclerenchyma cells as LRP development progresses. This decrease in FAX binding in cells that will be degraded supports the notion that FAX are involved in cell wall deformation resistance. An increased understanding of cell wall compositional changes during LRP development can lead to root function optimization with applications in food and feed agriculture. Additionally, further understanding of native targeted cell wall matrix polysaccharide degradation can be applied to increase biomass-processing efficiency in lignocellulosic biofuel production.

## FOCUSED ION BEAM TO MILL ORGANIC-WALLED FOSSILS AT THE MICRO- AND NANOSCALE

Nathan C. Sheely<sup>1</sup>, P.R Larson<sup>2</sup>, M.B Johnson<sup>1</sup> and R.A Lupia<sup>3</sup>

<sup>1</sup> Homer L. Dodge Department of Physics and Astronomy, University of Oklahoma. Norman, OK 73019

<sup>2</sup> Samuel Roberts Noble Microscopy Laboratory, University of Oklahoma, Norman, OK 73019

<sup>3</sup> Sam Noble Museum and School of Geology & Geophysics, University of Oklahoma, 2401 Chautauqua Ave, Norman OK 73072

Optical and electron microscopy are critical tools for the study of fossils organisms. Due to its early development and refinement, light microscopy has dominated the study of organic-walled fossils. Taxonomic (species) identification and discrimination is almost exclusively based on features visible under transmitted light. However electron microscopy, and in particular transmission electron microscopy (TEM), has been applied to investigations of the ultrastructure of the walls and ornament that are beyond the resolution of light microscopy. Hypotheses for the assembly of the walls have been formulated based on these data. Recently new techniques, such as focused-ion beam scanning electron microscopy and synchrotron radiation tomography, have expanded the boundaries of imaging fossils. In this talk we will describe our recent results in using the focused ion beam (FIB) scanning electron microscopy in our cross-beam Zeiss Neon 40 to cross-sectionally explore and characterize the features of the fern megaspore *Arcellites hexapartitus* and a previously unknown algal phycocyst preserved in Cretaceous sediments from Maryland (100-125 million years old).

# OMS FALL MEETING ABSTRACTS

## CHARACTERIZATION OF HIGH-DENSITY ARRAYS OF SELF-ASSEMBLED InAs/GaAs<sub>1-x</sub>Sb<sub>x</sub> QUANTUM DOTS

Cédric Corrège<sup>1</sup>, P.R. Larson<sup>2</sup>, M.C. Debnath<sup>1</sup>, M.B. Santos<sup>1</sup>, and M.B. Johnson<sup>1</sup>

<sup>1</sup> Homer L. Dodge Department of Physics and Astronomy, University of Oklahoma. Norman, OK 73019

<sup>2</sup> Samuel Roberts Noble Microscopy Laboratory, University of Oklahoma, Norman, OK 73019-6131

Third generation photovoltaics (PVs) seek to reduce the cost per watt of solar energy by increasing the efficiency of PV cells. One candidate to this third generation involves an intermediate energy band created by an array of quantum dots (QDs). This device, by better utilizing the solar spectrum, could theoretically increase the photovoltaic efficiency to >63% (under concentrated solar irradiation), well beyond the Shockley-Queisser efficiency limit for single-gap cells (~30%). However, the current results are far from the theoretical limit partly due to the material quality of the QDs structure. This project studies high-density arrays of self-assembled InAs/GaAs<sub>1-x</sub>Sb<sub>x</sub> QDs grown by molecular beam epitaxy at the University of Oklahoma (OU). Ultimately the size, shape, density, composition and crystalline quality of the QDs, as well as similar details for the matrix layer, play an important role in the PV efficiency. Hence, characterization of these properties is important. To best characterize multiple layers of QDs will ultimately require cross-sectional transmission electron microscopy, however, along the way, atomic force microscopy (AFM) and field-emission scanning electron microscopy (FE-SEM) can more easily yield details about the uncapped top QD layer. For example AFM measurements accurately determine the number of QDs per unit area, and quantitatively describe QD shape, but AFM is sensitive to tip/probe-shape artefacts. Cross-sectional FE-SEM can clear up some of these artefacts and indicate crystalline quality. In this talk we will describe AFM and cross-sectional FE-SEM studies of InAs/GaAs<sub>0.872</sub>Sb<sub>0.128</sub> QDs, including pitfalls with either method. Overcoming some of these pitfalls was quite a challenge that involved in situ plasma cleaning and Focus Ion Beam (FIB) etching. Ultimately cross-sectional FE-SEM was found to more easily give better lateral resolution than our typical AFM results. Finally, we will describe our progress in FIB lift out of cross-sectional QD layers using our Zeiss Neon-40 cross-beam FE-SEM *en route* to successful TEM observations.

# CONSTITUTION & BYLAWS OF THE OMS

## Article I. NAME

The name of this organization shall be the Oklahoma Microscopy Society. The acronym shall be OMS. OMS is a non-profit organization.

## Article II. PURPOSE

The purpose of OMS shall be the advancement of the science of microscopy in Oklahoma and nationally by:

encouraging the dissemination of knowledge of microscopy including its technology and instrumentation.

promoting the free exchange of ideas and data among interested individuals and

encouraging interdisciplinary interaction between microscopists.

## Article III. MEMBERSHIP

### Section 1. Types:

Regular membership shall be open to any person who has an interest in microscopy.

Corporate membership shall be open to any commercial or non-profit organization that has an interest in microscopy. A member organization may designate one representative to receive all privileges of membership. Other members of the same organization may become regular members.

Honorary membership may be given to a person named an Honorary member by vote of the Executive Committee.

Section 2. Enrollment: Any eligible person or organization may make application for membership to the Executive Committee of OMS. Completed application forms shall be submitted to the Secretary-Treasurer of OMS with one year's dues.

Section 3. Privileges: All members have the right to vote at any business meetings held by OMS and to hold elective office.

# CONSTITUTION & BYLAWS OF THE OMS

## Section 4. Dues:

Annual dues shall be five dollars for Regular membership for students, fifteen dollars for Regular membership for non-students, and fifty dollars for Corporate membership.

Dues shall become payable on July 1 of each year for the following twelve months.

Any member that is delinquent in payment of dues for a period of six months shall be dropped from membership. Members thus dropped may be reinstated thereafter by paying one year's delinquent dues and the current year's dues.

## Article IV. MEETINGS

At least one business meeting per year shall be held. The time(s) and place(s) of such meetings shall be designated by the Executive Committee and duly announced. Business meetings shall be conducted according to Robert's Rules of Order.

## Article V. OFFICERS

Section 1. The officers of OMS shall be a President, a President-Elect, a Secretary-Treasurer, a Member-at Large for Biological Sciences, a Member-at Large for Physical Sciences, and a Member-at Large for student members. These officers shall perform the duties prescribed by these bylaws and by the parliamentary authority adopted by the Society.

### Section 2. Duties:

- a. The President shall preside at all meetings of the Executive Committee and business meetings of the OMS and promote the interests of OMS both within the state and nationally.
- b. The President-Elect shall assist the President, substitute for him/her when necessary, perform any duties assigned by the President and be responsible for organizing the regular spring workshop/seminar.
- c. The Secretary-Treasurer shall maintain records of OMS and communicate with members. This officer shall be custodian of OMS funds, collect all dues, notify members delinquent in membership and account for OMS funds in accordance with accepted business practice.
- d. Members-at-Large shall represent their respective constituents.

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## Section 3. Term of Office:

The President, President-Elect, and Members-at-Large shall each serve for one year beginning July 1 and ending June 30 of the following year.

The Secretary-Treasurer shall serve for two consecutive years beginning July 1 and ending July 30 of the second following year.

## Section 4. Election: Officers shall be elected as prescribed in Article VII of these bylaws.

Section 5. Vacancies: If the President cannot serve, the President-Elect shall immediately succeed to that office. If the President-Elect or any other officer cannot serve for any reason, the Executive Committee shall appoint a person to serve pro tem in the vacant office. Any such appointed officer shall be replaced by one duly elected at the next annual election in May.

## **Article VI. EXECUTIVE COMMITTEE**

Section 1. Composition: The Executive Committee shall consist of the officers of OMS, plus the Newsletter Editor ex officio who shall be without vote.

## Section 2. Duties:

The Executive Committee shall conduct the business of OMS as specified herein and otherwise as necessary, and shall advise the membership on matters concerning the management of OMS. It shall appoint the Newsletter Editor.

The Executive Committee shall hold not fewer than two meetings annually, on call of the President or a majority of its members.

## **Article VII. ELECTIONS**

Section 1. Nominations of officers except the President shall be made by a nominating Committee appointed by the President and approved by the Executive Committee. This Committee shall consist of five persons, at least one of whom is from the field of Biological Sciences and one from the field of Physical Sciences. Nominations may be solicited from the membership at any time.

Section 2. The Nominating Committee shall present a slate of consenting candidates (two for each office) to the President prior to the spring general business meeting. The President and Secretary-Treasurer shall announce this list to the membership at the spring general business meeting. Additional nominations of persons willing to serve may be solicited from the floor at this time.



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Section 3. The Secretary-Treasurer shall prepare and mail ballots to all members by May 15 and shall accept ballots until May 31.

Section 4. Ballots shall be counted by at least two Executive Committee members and may be reviewed by the entire board if deemed necessary. In each case the candidate receiving the largest number of votes shall be declared elected. Any tie shall be resolved by vote of the combined Executive and Nominating Committees. Results shall be announced by the Secretary-Treasurer at the next business meeting or by mail to all members.

## **Article VIII. AD HOC COMMITTEE**

The President shall appoint ad hoc committees as necessary or helpful in managing affairs of OMS. Committee members shall be considered automatically discharged at the end of the appointing President's term of office unless the new President specifically requests that they continue. The committee itself shall continue until its purpose has been fulfilled or it is dissolved by vote of the executive board or the membership at large.

## **Article IX. AMENDMENTS**

Section 1. Amendments may be suggested at any OMS business meeting. However, amendments to these bylaws may be formally proposed in only two methods:

By the Executive Committee or

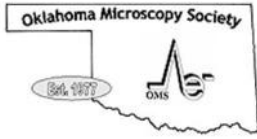
By petition of ten percent of the members.

Section 2. The proposed amendment shall then be promptly submitted by mail to the membership by the Secretary-Treasurer, along with the signed statement of reasons for support and/or opposition. Returned ballots shall be accepted by the Secretary-Treasurer for three weeks after the date of mailing. The Executive Committee shall count the ballots and the amendment(s) shall be declared ratified if a two-thirds majority of the votes cast is favorable.

Section 3. Any member who so desires may be present at the counting of such ballots.

## **Article X. DISSOLUTION**

In the event of the dissolution of the OMS, upon the discharge of all its debts and obligations, any remaining assets shall be given to such tax-exempt scientific organization as the Executive Committee may determine. In no case shall any assets be used for the direct benefit of any member of OMS.



**Oklahoma Microscopy Society  
Membership Application/Renewal Form  
for 2015-2016**



**NOTE:** For snailmail, please return this form with a check. (for Paypal option see bottom of page.)

Name: \_\_\_\_\_

Business Phone: \_\_\_\_\_

FAX: \_\_\_\_\_

Email: \_\_\_\_\_

Institution: \_\_\_\_\_

Address: \_\_\_\_\_

\_\_\_\_\_

\_\_\_\_\_

Check here if Address is New/Revised: \_\_\_\_\_

Membership in Affiliated Societies:

MSA \_\_\_\_\_

MAS \_\_\_\_\_

OAS \_\_\_\_\_

Microscopy Interests:

Physical Sciences \_\_\_\_\_

Biological Sciences \_\_\_\_\_

Other \_\_\_\_\_

Membership Dues:

Type:

Corporate (\$50.00) \_\_\_\_\_

Professional (\$15.00) \_\_\_\_\_

Student (\$5.00) \_\_\_\_\_

Amount Enclosed: \_\_\_\_\_

Please enclose a check for one year's dues (**July 1, 2015 - June 30, 2016**) made out to: "Oklahoma Microscopy Society" and mail to address below:

**Scott Russell, OMS Secretary-Treasurer**

Samuel Roberts Noble Microscopy Lab  
770 Van Vleet Oval, GLCH rm 136  
University of Oklahoma  
Norman, OK 73019

Email: [srussell@ou.edu](mailto:srussell@ou.edu) (use also for any address or membership information updates)

**NOTE:** You can pay by Paypal at:

<http://www.ou.edu/research/electron/oms/paypaldues.html>

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