Southern California Society for Microscopy & Microanalysis

Full-Day Symposium

April 8, 2017

Microscopy Society of America President 2016 and Tour Speaker

Mike Marko
Wadsworth Center, NY

Location: California Nanosystems Institute (CNSI)
University of California Los Angeles

Dear SCSMM members:

Welcome to the SCSMM 2016/2017 program!

I am excited to announce that our full-day spring symposium is to be held on April 8th at the California Nanosystems Institute (CNSI) located in the beautiful UCLA campus. This event is co-sponsored by CNSI.

This year we will have a very strong scientific program featuring a list of excellent speakers in both life science and material science fields. They are: Mike Marko (2016 MSA president and tour speaker, Wadsworth Center, NY), Julie Schoenung (UCI), Hong Zhou (UCLA), Suveen Mathaudhu (UCR), Richard Kaner (UCLA), and Yi-Wei Chang (Caltech).

As a tradition, our spring symposium provides a platform for undergraduate and graduate students to present their work. Please encourage students to participate and submit their abstracts (see the student talk and image contest announcement).

Thanks to all our corporate sponsors, the SCSMM board has waived the 2016/2017 membership dues for regular and student members. Our 2016/2017 Gold and Silver level sponsors are listed on the first page and our corporate members are listed on the second last page. Please take time to visit the vendor booths and see their newest products.

Lastly I am announcing that our long-time Treasurer Mark Armitage resigned after ~19 years of service of our society. While we are extremely grateful to Mark's ~19 years' service, we are fortunate enough to have Sarah Dunn from Salk Institute to be our new Treasurer. Thank you Sarah for volunteering your time, wisdom and experience! By the way, we still have the Secretary position open, and we hope to find an enthusiastic, responsible volunteer to fill it too.

I am looking forward to seeing you all at our spring symposium!

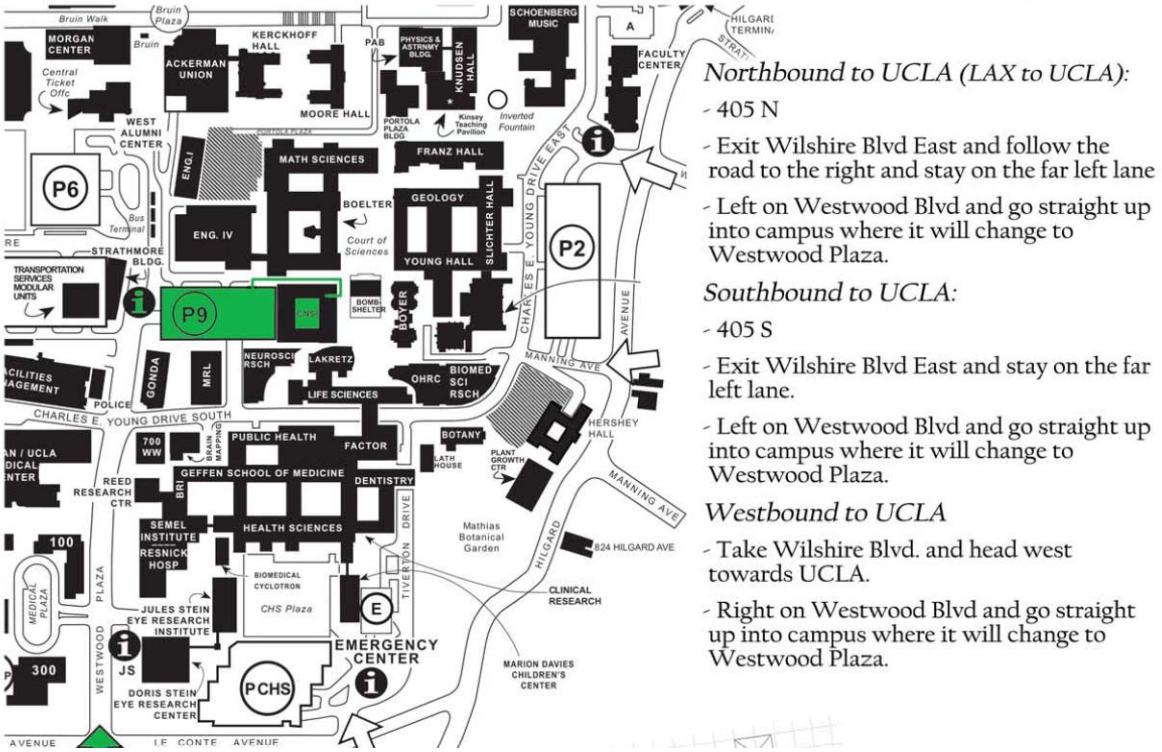
Zhuo Li

President, SCSMM

SCSMM 2017 Full-Day Symposium Schedule

08:00 – 8:50	Registration, continental breakfast
08:50 – 09:00	Welcome
09:00 – 9:40	Historical Perspectives on Biological EM Mike Marko, MSA President 2016 and tour speaker Wadsworth Center, NY
09:40 – 10:10	Application of HRTEM/In-situ TEM to Reveal Characteristics of Ceramic/Metal Interfaces Julie Schoenung, UCI
10:10 – 10:25	Microscopy at the Nanoscale and Beyond: Opportunities for Research, Education, and Collaboration in the CNSI at UCLA Adam Stieg, CNSI/UCLA
10:25 – 10:45	Coffee Break and Poster Set-up
10:45 – 11:15	Atomic cryoEM for proteins, nucleic acids and lipids Hong Zhou, UCLA
11:15 – 11:45	Why Interfaces Remind me of Aliens: Giger Boundaries in Mg-Gd-Y-(Ag)-Zr Alloys Suveen Mathaudhu, UCR
11:45 – 12:00	Title Vendor/Company
12:00 – 13:30	Lunch, CNSI lab tour, and Poster Session
13:30 – 13:40	Business Meeting
13:40 – 14:10	Exploring the Synthesis and Applications of Graphene Richard Kaner, UCLA
14:10 – 15:15	Student Presentations
15:15 – 15:30	Title Vendor/Company
15:30 – 16:00	Coffee Break and Poster Session
16:00 – 16:30	Architecture of the bacterial type IVa pilus machine by electron cryotomography of intact cells Yi-Wei Chang, Caltech
16:30 – 16:45	Title Vendor/Company
16:45 – 17:00	Student Awards and Closing Statement

Directions:
Get driving directions, campus map, and parking information here:
http://cnsi.ctrl.ucla.edu/file-sharing/publicview/facilities/DirectionsCNSI.pdf



- A parking permit may be obtained at the information kiosk towards the end of Westwood Plaza
- Parking Structure 9 is located on your right at the top level
- The CNSI building is built on the roof level of the parking structure. Use the walkway/bridge on the far left side to make your way around to the front entrance of the CNSI building.

Registration & RSVP

RSVP is required.

Please sign up on-line using the link here (http://www.imri.uci.edu/seminar-registration#overlay-context=seminar-registration) *no later than* 5 p.m. Friday, March 31.

For corporate members who haven't paid their membership dues, please fill the form on next page and bring along with your dues to the meeting or mail to:
SCSMM c/o Zhuo Li
City of Hope Electron Microscopy Core Facility
Furth Building Room 1118
1500 East Duarte Road
Duarte, CA 91010-3000

Southern California Society for Microscopy & Microanalysis

Membership Application 2016 - 2017

Name: _____

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Please check the appropriate membership category:

- ❑ Regular @ $25.00 (waived)
- ❑ Student @ $10.00 (waived)
- ❑ Corporate @ $100.00

Corporate Memberships are entitled to two individual member listings. If you have selected a Corporate Membership, please copy this form and provide details for the second listing. Write "**2nd Listing**" at top of form.

Please attach a check for the appropriate amount made payable to SCSMM. You may bring this form along with your dues to any of our meetings or mail to:

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Scheduled (15 min) talk during spring or fall meeting
Announcement/acknowledgment from the stage as a Gold sponsor of SCSMM
Listing as a Gold sponsor in all press and media materials of the SCSMM
Invitation for two to attend the spring and fall meeting

$250 (Silver) level
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Invitation for two to attend the spring and fall meeting

$100 Regular Corporate membership
Listing as a Corporate Member in SCSMM spring and fall pre-meeting newsletters
Invitation for one to attend the spring and fall meetings

Vendors are also most welcome to sponsor with "in-kind" support of our meetings, such as providing wine with dinner (fall meeting) or a prize for a raffle or student talk/poster. Acknowledgements of such sponsorship will be made during the meeting and in the meeting announcement - and are always much appreciated!

Southern California Society for Microscopy & Microanalysis

Call for Student Talks and Posters

SCSMM Symposium, Saturday April 8, 2017
California NanoSystems Institute (CNSI), UCLA

All SCSMM members are invited to submit an abstract to present their work at the SCSMM All-day Symposium to be held at California NanoSystems Institute (CNSI), UCLA on Saturday April 8, 2017. Five submissions from students will be selected for a 15-minute platform talk. All others will be invited to present a poster.

Student platform talks and posters will be judged by the judging committee and the winners will get cash awards. Please submit abstracts to Zhuo Li (zhuoli@coh.org). The subject line should read "SCSMM Student Presentation". The content should include:

- Title
- Name, affiliation, and e-mail address
- Preference for platform talk or poster (5 platform talks will be selected)
- Abstract (in PDF or WORD format, no more than 2 pages including an optional image).

In order to be considered for platform talks, please submit your abstract by March 20, 2017. Notification of acceptance will be e-mailed by March 25, 2017

Image Contest Announcement

All SCSMM members are invited to submit their most visually stunning images from any types of microscopy for a chance to win a $50 gift card. The submitted images will be posted on the Wordpress website and the SCSMM Facebook page (See the 2016 images here: https://scsmmimages.wordpress.com/). The image with the most "likes" on Facebook will get an award of a $20 gift card. The winners will be announced at the SCSMM spring symposium held on April 8, 2017.

Please e-mail your images to Poorna Subramanian (poorna.physics@gmail.com). The images should be in the formats of TIFF, JPEG or PDF, with at least 300 dpi resolution. Please provide the author's name and affiliation, a title and brief description for each image. **The deadline for contest submission is March 31, 2017.**

ABSTRACTS

Historical Perspectives on Biological EM

Mike Marko,

Wadsworth Center, NY

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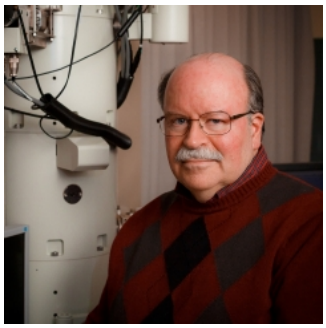
Biological EM began in 1934. The first challenge was radiation damage, but after fixation was established, production of thin samples became the central problem. As specimen preparation evolved, the challenge of radiation damage returned, and can now be dealt with. For decades, resolution was limited by metallic stains, but now near-atomic resolution is reached with unfixed, unstained specimens. Some of the key events and persons in the technical development of biological TEM will be described.



Mike Marko has been an electron microscopist for almost 50 years, witnessing its development "from the inside". He was a founding member of the HVEM lab at Albany and also his local microscopy society. He has been very involved with the Microscopy Society of America in several capacities, and has a particular interest in the history of TEM technology, as the Society's Archivist. He is currently funded to continue his work on his specialty, cryo-TEM instrumentation.

Application of HRTEM/In-situ TEM to Reveal Characteristics of Ceramic/Metal Interfaces

Julie M. Schoenung

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The microstructure and adhesion of heterophase interfaces is vital information in the design of structural composites, electroceramic devices, and environmental coatings, but has not yet been well understood due to the complexion in the heterophase interfaces, such as the presence of various types of atomic-scale elemental segregation layers and lattice distorted layers. When equipped with both high-speed cameras and holders with mechanical test units, transmission electron microscopy (TEM) has the capability to in-situ observe microstructure evolution over time under externally applied stress conditions and thus becomes a very promising microscopic tool to probe adhesion behavior of heterophase interfaces.

Here, we utilized advanced microscopy techniques to understand the interfacial behavior from two aspects. First, we studied the influence of length scale on the spatial distribution and characteristics of ceramic/metal interfaces in nanostructured composites. Specificly, the characteristics of the B_4C/Al

interface, namely the local chemistry and interfacial structure, were studied in detail using TEM and atom-probe tomography. Results reveal significant differences in these characteristics as a function of particle length scale. Mechanisms related to length scale effects on the formation of the corresponding structures and chemistries in the interfaces are discussed. Second, we implemented an in-situ TEM based approach to isolate an individual ceramic/metal interface and to evaluate its adhesion behavior at the nanoscale. A Hysitron PI-95 picoindenter was used to carry out in-situ TEM adhesion tests, for which a push-to-pull (PTP) device was utilized to transform the compression loading into a tensile force. The goal was to understand not only effects of "intrinsic microstructural features," but also of "extrinsic sample size" on the nanomechanical response at a ceramic/metal interface. The results indicate that ceramic/metal interfaces at the nanoscale are inherently tough and ductile, even though the metallic phase may be polycrystalline, and irrespective of whether the interfaces are subject to local segregation and chemical variation.

Julie M. Schoenung is a Professor of Materials Science and Engineering at the University of California, Irvine. She received her Ph.D. and M.S. degrees in materials engineering from the Massachusetts Institute of Technology, and a B.S. in ceramic engineering from the University of Illinois, Urbana-Champaign. Dr. Schoenung was recently selected to be the recipient of the 2018 ASM Edward DeMille Campbell Memorial Lectureship and the 2016 *Acta Materialia* Holloman Award for Materials & Society. She was recently appointed as an Editor-in-Chief for the *Journal of Sustainable Metallurgy*, and has served for many years as a Key Reader for *Metallurgical and Materials Transactions A*. In 2016, she was elected as a Fellow of Alpha Sigma Mu, the materials honor society. In 2012, she was elected as an ASM Fellow and selected as a recipient of the Chime Bell Award, Hubei Province, China. Dr. Schoenung's research activities seek to provide fundamental insight into structure-processing-property mechanistic relationships in various material systems. Innovative synthesis and consolidation processes are combined to fabricate materials that exhibit unique behavior, providing new knowledge into the mechanisms that govern the observed behavior. Of particular interest has been mechanical behavior, including novel work on the nanoindentation and nanoscratch behavior in ceramics and nanocomposites. Microstructural characterization studies and modeling efforts are critical components of these fundamental investigations.

Atomic cryoEM for proteins, nucleic acids and lipids

Z. Hong Zhou

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Cryo electron microscopy (cryoEM) has emerged as a tool of choice for

determining three-dimensional (3D) structures of macromolecular complexes or biological nano-machines (>50 kDa) in their native forms. When such complexes can be isolated in microgram quantities, atomic models can now be obtained by cryoEM single-particle analysis and model building. Comparisons of atomic models obtained for the same complex at different functional states provide mechanistic insights for its functions. For pleomorphic complexes, such as those in their cellular or tissue environments, molecular resolution structures can be reconstructed by cryo electron tomography (cryoET). Examples will be presented to illustrate the power of cryoEM in visualizing 3D structures of nano-scale biological machines containing proteins, nucleic acids or lipids to inform such fundamental biological processes as genome transcription, molecular translocation and infectious diseases.

Z. Hong Zhou is a Professor of Microbiology, Immunology and Molecular Genetics and the Director of the Electron Imaging Center for Nanomachines at University of California, Los Angeles (UCLA). He received his early education in physics at the University of Science and Technology of China and earned his PhD (in 1995) in biochemistry at the Baylor College of Medicine, in Houston, Texas, USA, under the supervision of Professor Wah Chiu. Zhou has published over 160 research articles and book chapters. He uses cryoEM to determine three-dimensional structures of molecular complexes near their native functional states at near atomic resolution. His research addresses both practical and fundamental biological questions, such as how viruses assemble and spread and how proteins and nucleic acids interact to store and release energy, to transduce signals, and to perform tasks of chemistry or functions of life. Zhou was a Pew Scholar in Biological Sciences and a Basil O'Connor Scholar of the March of Dimes Foundation. He is a recipient of a Burton Award and K. H. Kuo Distinguished Scientist Award**.**

Why Interfaces Remind me of Aliens: Giger Boundaries in Mg-Gd-Y-(Ag)-Zr Alloys

Suveen Mathaudhu

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Interfaces such as twin boundaries, stacking faults and grain boundaries often play an important role in controlling mechanical properties of metals through interaction with dislocations. Segregation of alloy elements and impurities to these interfaces can stabilize them and produce a large strengthening effect. Here we report the effect of Ag on segregation of alloy elements at twin boundaries, stacking faults and grain boundaries in the Mg-Gd system. Specifically, for the first time a spinal-shaped periodic segregation is observed at the extension twin boundary and high-angle lamellar grain boundary in a Mg-Gd-Y-Zr alloy due to the presence of the Ag addition. The segregation

consists of Gd- and Ag-rich columns. It appears that high Ag content in the spinal-shaped segregation induces fcc-like cell structures.

Prof. Mathaudhu serves as an Assistant Professor in the Mechanical Engineering Department and Materials Science and Engineering Program, where he studies the underpinning mechanisms that will make metallic materials and composites lighter and stronger. He received his Ph.D. in Mechanical Engineering from Texas A&M University in 2006. There, he studied "top-down" processing methods, such as severe plastic deformation, and "bottom-up" processing methods, such as powder consolidation to produce bulk nanoscrystalline and metastable metals for structural and defense applications. He subsequently served as an ORISE post-doctoral Fellow and then a Staff Scientist at the U.S. Army Research Laboratory from 2006-2010. From 2010 - 2014, he was the Program Manager for the Synthesis and Processing of Materials at the U.S. Army Research Office, and also, an Adjunct Assistant Professor in the Materials Science and Engineering Department at North Carolina State University. He is active in several technical societies, including the Minerals, Metals and Materials Society, the Materials Research Society and ASM International. He is also an expert on the science of superheroes as depicted in comic books and their associated movies, and frequently speaks and consults on this subject.

Exploring the Synthesis and Applications of Graphene

Richard B. Kaner

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Graphene is the ultimate two-dimensional material consisting of a single layer of sp^2 hybridized carbon. Here we explore different approaches to synthesize this carbon allotrope, ranging from chemical conversion to vapor phase deposition. Briefly, graphite can be converted into graphene oxide (GO) sheets, which readily disperse in water, and then can be reduced by various methods.[1-2] Due to its unique ability to be solution processed and patterned, GO and chemically converted graphene hold promise for applications ranging from sensors to transparent conducting electrodes.[3-4] Chemical vapor deposition onto metal substrates enables the growth of continuous, large-area graphene (Fig. 1). The challenges of growing graphene, controlling the number of layers, transferring graphene and some exciting uses such as laser scribed graphene for supercapacitors will be discussed.[5-6]

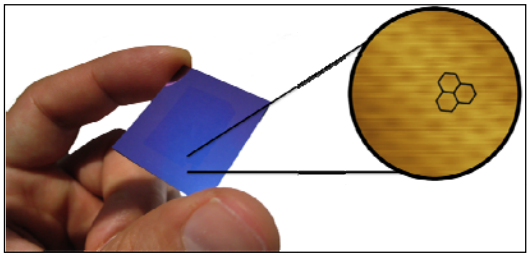

Fig. Large-area single layer graphene transferred onto a silicon substrate with a 300 nm oxide can be seen with the naked eye, while STM imaging enables seeing the honeycomb network of carbon that makes this material so robust.

References:

1. D. Li, M.B. Muller, S. Gilje, R.B. Kaner and G.G. Wallace, "Processable aqueous dispersions of graphene nanosheets", *Nature Nanotech* **3**, 101 (2008).
2. V. Strong, S. Dubin, M. El-Kady and R.B. Kaner, "Patterning and electronic tuning of laser scribed graphene for flexible all-carbon devices", *ACS Nano* **6**, 1395 (2012).
3. M.F. El-Kady, V. Strong, S. Dubin and R.B. Kaner, "Laser printing of flexible graphene-based supercapacitors with ultrahigh power and energy densities", *Science* **335**, 1326 (2012).
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6. M.F. El-Kady, Y. Shao, R.B. Kaner, "Graphene for batteries, supercapacitors and beyond", *Nature Review Materials*, **1**, 16033 (2016).

Richard Kaner received a Ph.D. from the University of Pennsylvania in 1984 working with Prof. Alan MacDiarmid (Nobel Laureate 2000, deceased). After postdoctoral research at Berkeley, he joined UCLA in 1987, earned tenure in 1991 and became a Distinguished Professor in 2012. He has published over 350 papers in top peer reviewed journals and holds 23 U.S. patents. According to the 2014, 2015 and 2016 Thomson-Reuters rankings, he is among the world's most highly cited authors. Professor Kaner has received awards from the Dreyfus, Fulbright, Guggenheim and Sloan Foundations along with the Materials Research Society Medal, the Buck-Whitney Research Award, the Tolman Medal and the Award in the Chemistry of Materials from the American Chemical Society for his work on refractory materials including new synthetic routes to ceramics, intercalation compounds, superhard metals, graphene and conducting polymers. He has been elected a Fellow of the American Association for the Advancement of Science (AAAS), the American Chemical Society (ACS), the Materials Research Society (MRS) and the Royal Society of Chemistry (FRSC).

Architecture of the bacterial type IVa pilus machine by electron cryotomography of intact cells

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Type IV pili machines (T4PMs) are part of a superfamily of bacterial and archaeal envelope-spanning multi-protein assemblies that also include type II secretion systems and archael flagella. T4PM involved in biofilm formation, motility, host adhesion, predation, DNA uptake, and protein secretion. Here, we

study the T4PM of *Myxococcus xanthus* responsible for pilus extension, attachment to surfaces, and retraction to move the cell. Using electron cryotomography to image intact cells, average structures of the T4PM *in situ* in both piliated and non-piliated states are produced to 2-3 nm resolutions. The locations of all ten T4PM components within the structure are identified by imaging mutants with individual proteins either missing or fused to tags. The resulting component map is tested by building hypothetical models of both piliated and empty forms which are seen to fit the EM maps well and satisfy all known connectivity and structural constraints. The architecture of the T4PM suggests new mechanistic insights into pilus extension and retraction and explains how the enigmatic switch from extension to retraction occurs.

Yi-Wei Chang obtained undergraduate training in mathematical engineering and received his PhD in macromolecular X-ray crystallography at National Tsing-Hua University, Taiwan. He is currently a research scientist in the Grant Jensen lab at California Institute of Technology/Howard Hughes Medical Institute. He has been actively developing methods to combine X-ray crystallography, electron cryotomography, and super-resolution microscopy for studying structure/function relationships of molecular machineries in vivo. His most recent interests are focused on bacterial motility nanomachines and effector secretion systems.

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