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- 886 *Ar<sup>+</sup> FIB Milling and Measurement of FIB Damage in Silicon*; B Van Leer, H Cheng, M Dutka
- 888 *Characterization of Materials for Energy Storage and Production by Helium Ion Microscopy Coupled to Secondary Ion Mass Spectrometry*; J-N Audinot, J Lovric, T Wirtz
- 890 *Analytics on the FIB: ORION-SIMS and the Discovery of a Unique Chondrite-like, Precambrian Impactor*; MR Ball, RJM Taylor, JF Einsle, J-N Audinot, RJ Harrison
- 892 *Understanding Microstructural Evolution in ZrC Inoculated Zr<sub>47.5</sub>Cu<sub>45.5</sub>Al<sub>5</sub>Co<sub>2</sub> Via High Resolution SIMS*; B Lewis, MMA Rafique, F Khanom
- 894 *Semi-Inverted Sample Preparation of Meteorites for High Resolution Analytical Electron Microscopy Using Correlative Raman Spectroscopy and Xe Plasma FIB*; S Vitale, A Steele, LG Benning, R Wirth
- 896 *Novel FIB Torus Milling on Diamond Anvils with FIB Gasket Fabrication Enabling 5+ Megabar High Pressures Studies*; NE Teslich, Z Jenei, EF O'Bannon
- 898 "Stand-Out": *A Novel Approach for Preparing Sub-100 nm Samples Through in situ Ion Induced Bending*; V Garg, S Zhang, RG Mote, Y Chen, L Cao, J Fu
- 900 *Detailed Investigation of Silicon Nitride Phase Plates Prepared by Focused Ion Beam Milling*; A Müller, DB Durham, KC Bustillo, FI Allen, AM Minor, C Ophus
- 902 *Application of Ar Ion Beam Milling on Sectioning of Cells for SEM Observations*; S Tanaka, Y Ohmi
- 904 *Xe Plasma vs Gallium FIB Delayering*; S Sharang, P Anzalone, JV Obona
- 906 *Light Ion Beams Interacting with Thin Films*; D Xia, J Notte
- 908 *Helium Ion Microscopy Imaging of Bottlebrush Copolymers*; N Borodinov, D Chang, A Trofimov, K Hong, B Sumpter, OS Ovchinnikova, A Belianinov
- 910 *A Method for FIB Liftout of Particles in Epoxy Resin*; WL York, D Robinson, JD Sugar
- 912 *3D-Printed Lift Outs For EXLO and INLO Practice and Training*; ZA Giannuzzi, KA Gehoski, WJ Mahoney, LA Giannuzzi



- 914 *FIB Sample Preparation for In Depth EDS Analysis*; R Garcia, FA Stevie, L Giannuzzi
- 916 *In situ Analysis of Cryoformed Metals by STEM*; RS Namur, DE Huber, AJ Ramirez, OM Cintho
- 918 *A Fast and Accurate Workflow for Analytic 3D FIB-SEM Tomography*; T Volkenandt, F Pérez-Willard, F Bauer, N Stephen, J Goulden, P Trimby, K Larsen
- 920 *Microstructural and Defect Characterization of Al-Si Alloy Using PFIB and EMPAD*; REA Williams
- 922 *Demonstration of High Efficiency Diffractive Optics for Electrons Fabricated with Ion Beam Gas-Assisted Etching*; C Johnson, B McMorran
- 924 *Channeling Contrast Simulation of Secondary Electron Images in Scanning Ion Microscopes*; K Ohya
- 926 *Using Plasma Focused Ion Beam Microscopy to Characterize 3D Structure and Porosity of OPC Mortar*; P Dong, A Allahverdi, H Yuan, ND Bassim

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- 928 *Emerging Microscopy for Quantum Information Sciences*; Q Qiao, L Wu, J Li, S Cheng, MG Han, JA Garlow, SD Pollard, X Fu, J Tao, J Wall, Y Zhu
- 930 *Atomic Resolution CryoSTEM Across Continuously Variable Temperatures*; BH Goodge, E Bianco, HW Zandbergen, LF Kourkoutis
- 932 *New Advanced Electron Microscopy to Discover New Quantum Materials*; DC Bell, C Ozsoy-Keskinbora, F VonCube, J Checkelsky, RM Westervelt
- 934 *Low Temperature Electron Microscopy of "Charge-Ordered" Phases*; I El Baggari, DJ Baek, BH Savitzky, MJ Zachman, R Hovden, LF Kourkoutis
- 936 *In situ Materials Characterization of 2-Dim Materials at High Energy and Spatial Resolution*; X Hu, JR Jokisaari, S Ogut, RF Klie
- 938 *Electron-Beam Manipulation of Lattice Impurities in Graphene and Single-Walled Carbon Nanotubes*; T Susi, M Tripathi, K Mustonen, A Markevich, C Mangler, C Su, J Li, JC Idrobo, J Meyer, J Kotakoski
- 940 *Towards Atomic Scale Quantum Structure Fabrication in 2D Materials*; O Dyck, A Lupini, M Ziatdinov, X Li, SV Kalinin, S Jesse
- 942 *Atomic-Scale Study of Intrinsic Defects Suppressing the Thermal Conductivity of Boron Arsenide*; Q Zheng, CA Polanco, M-H Du, LR Lindsay, M Chi, J Yan, BC Sales
- 944 *Double-Slit Electron Interference Experiment with Zero Propagation Distance Using Electron Biprism*; K Harada, T Kodama, T Akashi, Y Takahashi, K Shimada, YA Ono, D Shindo, H Shinada, S Mori

- 946 *High Spatial and Energy Resolution Analytical Scanning Transmission Electron Microscopy for Quantum Materials*; D Kepaptsoglou, K Holsgrove, F Azough, B Kuerbanjiang, V Lazarov, R Freer, M Arredondo, Q Ramasse
- 948 *Microstructure Effect on LaPtBi Superconductivity*; C Ozsoy-Keskinbora, Y Ou, D Nandi, K Huang, S Kraemer, P Kim, A Yacoby, J Moodera, D Bell
- 950 *Correlating Atomic-Scale Lattice and Nanoscale Structural Dynamics with Ultrafast Electron Microscopy*; SA Reisbick, DJ Flannigan
- 952 *Tracking Quantum Effects at the Nanometer Scale with EELS and Cathodoluminescence*; M Kociak, LH Galvao-Tizei, H Lourenço-Martins, A Campos, S Meuret, R Bourrellier, A Zobelli, M Hillenkamp, D Blazit, M Tencé, O Stéphan
- 954 *Advanced Scanning Transmission Electron Microscopy as a Tool for Direct Real-Space Visualization and Artificial Control of Quantum Spin Textures*; T Matsumoto, Y Ikuhara, N Shibata
- 956 *STEM Study of Structure and Local Short-Range Orders in the  $Fe_{5-x}GeTe_2$  Crystals with Ferromagnetism Near Room Temperature*; Q Zheng, MA McGuire, AF May
- 958 *Investigation of Spin Manipulation in  $Pt/CoFe_2O_4$  via Scanning Transmission Electron Microscopy*; AH Trout, IV Pinchuk, W Amamou, REA Williams, RK Kawakami, DW McComb
- 960 *Mapping Local Structural and Electronic Properties of 2D Materials by Multi-dimensional STEM*; MJ Zachman, M Chi
- 962 *Structure-Property Relationships of Topological Insulator Nanomaterials*; P Liu, JJ Cha
- 964 *Aberration-corrected STEM Observations on the Interfacial Structure and Strain Fields of Patterned  $SrRuO_3$  Artificial Atoms*; H Wang, V Srot, G Laskin, H Boschker, J Mannhart, PA van Aken
- 966 *Structural and Compositional Effects in Epitaxially-Strained Vanadate Thin Films*; DTL Alexander, H Meley, B Mundet, J-M Triscone, S Gariglio
- 968 *Pushing the Limits of Absolute Scale Energy Dispersive X-ray Quantification*; KE MacArthur, SM Collins, HG Brown, SD Findlay, LJ Allen
- 970 *Study of Sub-atomic Channeling in  $SrTiO_3$  Crystal Along  $\langle 100 \rangle$  Direction Using Multislice Simulations*; JS Jeong, KA Mkhoyan
- 972 *A Versatile Common Platform for Quantum Transport Measurements in Fluidic, Cryogenic, and in situ Electron Microscopy Environments*; JL Swett, II Kravchenko, OE Dyck, S Jesse, JA Mol
- 974 *Rapid Fourier Masked Domain Mapping to Reveal Head to Head Charged Domain Walls in Lead Titanate*; K Moore, U Bangert, M Conroy, E O'Connell, JM Gregg
- 976 *Probing the Local Lattice Distortions in Doped  $SrTiO_3$  Using Quantitative STEM*; S Salmani-Rezaie, H Kim, K Ahadi, S Stemmer

- 978 *Metal Thio/Selenophosphates: A Novel Two-Dimensional Materials System*; M Cheng, R do Reis, D Chica, M Kanatzidis, VP Dravid
- 980 *Visualization of Misfit Dislocation Network at the BaSnO<sub>3</sub>-LaAlO<sub>3</sub> Interface*; H Yun, A Prakash, B Jalan, JS Jeong, KA Mkhoyan

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- 984 *Optimizing the Electron Energy for Cryomicroscopy*; M Peet, R Henderson, CJ Russo
- 986 *TOPAZ: A Positive-Unlabeled Convolutional Neural Network CryoEM Particle Picker that Can Pick Any Size and Shape Particle*; T Bepler, A Morin, M Rapp, J Brasch, L Shapiro, AJ Noble, B Berger
- 988 *Development of Rapid Tilt-Series Collection for Electron Cryo-Tomography*; G Chreifi, S Chen, LA Metskas, M Kaplan, CM Oikonomou, GJ Jensen
- 990 *Streptavidin Affinity Grids for Single-particle Cryo-EM*; RM Glaeser, B-G Han
- 992 *Exploiting the Dose-Rate Dependence of Radiolysis – A Future for Cryo-STEM?*; RF Egerton, H Qian
- 994 *Chameleon: Next Generation Sample Preparation for CryoEM Based on Spotiton*; MC Darrow, JP Moore, RJ Walker, K Doering, RS King
- 996 *Investigation of the Effects of Low-Energy Plasma Treatment on Amorphous Carbon and Graphene Support Films for Cryo-Electron Microscopy*; MJ Campin, MW Stumpf, PE Fischione
- 998 *CryoTEM with a Cold Field Emission Gun That Moves Structural Biology into a New Stage*; T Kato, F Makino, T Nakane, N Terahara, T Kaneko, Y Shimizu, S Motoki, I Ishikawa, K Yonekura, K Namba
- 1000 *Initial Results from the CryoARM300 and DE-64 Counting*; B Bammes, M Spilman, J Streetley, D Bhella
- 1002 *Scorpion: Facilitating High Throughput Electron Microscopy*; VP Dandey, P Kahn, H Wei, B Carragher, CS Potter
- 1004 *Charging Dynamics in Low-Dose Cryo-TEM Imaging*; MT Schreiber, A Maigné, M Wolf
- 1006 *Cryo-EM Study of Chaperonin Mm-Cpn's Conformational Heterogeneity under Different ATP Conditions*; Y Zhao, W Chiu
- 1008 *The NCI National Cryo-EM Facility*; U Baxa, TJ Edwards, AD Wier, H Wang, TM Hutchison, JE Finney, S Subramaniam
- 1010 *Spotiton and Chameleon Vitrification Robots*; H Wei, VP Dandey, M Kopylov, ET Eng, P Kahn, CS Potter, B Carragher

- 1012 *Advances in Single Particle Analysis Data Acquisition*; S Konings, M Kuijper, J Keizer, F Grollios, T Spanjer, P Tiemeijer
- 1014 *Determining the Differences in Image-resolutions of Single-particle CryoTEM Datasets Acquired with Indirect-electron and Direct-electron CMOS Cameras*; DH Anjum, MA Sobhy, AR Behzad, F Rashid, R Sougrat, SM Hamdan
- 1016 *Cryo-FIB Workflow for Fabricating Thin Lamellae Using TESCAN S8000G*; S Záchej, T Heuser, Z Hovádková, J Havrankova, K Rosíková, R Váňa

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### ***Multi-Modal, Large-Scale and 3D Correlative Microscopy***

- 1018 *Smart Microscopy: Automation of CLEM Using in situ Fluorescence Detection*; LM Collinson
- 1020 *Automatic Registration of Correlative Microscopies with Error Assessment and Applications for the Optimization of Multimodal Acquisitions*; G Potier, R Capoulade, J Mérot, F Lavancier, X Heiligenstein, J Salamero, P Paul-Gilloteaux
- 1022 *Synapse to Circuit – Correlative Microscopy Workflows for Functional Analysis of the Brain*; N Kamasawa, CI Thomas, MA Ryan, D Guerrero-Given
- 1024 *Spectral Map Reconstruction Using Pan-Sharpening Algorithm: Enhancing Chemical Imaging with AFM-IR*; N Borodinov, N Bilkey, M Foston, AV Ievlev, A Belianinov, S Jesse, RK Vasudevan, SV Kalinin, OS Ovchinnikova
- 1026 *In situ Correlative Helium Ion Microscopy and Secondary Ion Mass Spectrometry for High-Resolution Nano-Analytics in Life Sciences*; J Lovric, J-N Audinot, T Wirtz
- 1028 *Correlative Live-Cell, Electron Microscopy and Nanoscale Secondary Ion Mass Spectrometry Elucidates the Mechanism for the Release of Cholesterol-Rich Particles from the Plasma Membrane of Macrophages*; TA Weston, X Hu, C He, RS Jung, LG Fong, H Jiang, SG Young
- 1030 *Correlative X-ray Ptychographic and Fluorescence Imaging at the Advanced Photon Source*; J Deng, S Chen, Q Jin, E Vacek, C Jacobsen, B Lai, S Vogt
- 1032 *Using 3D X-ray Microscopy to Study Crown Root Development and Primary Root Tip Growth in Diverse Maize (*Zea mays L.*) Lines*; KE Duncan, AL Bray, TG Dowd, CN Topp
- 1034 *A Dedicated Multi-Beam SEM for Transmission Imaging of Thin Samples*; P Kruit, W Zuidema
- 1036 *Using MicroCT to Evaluate Stain Penetration and Establish Fiducial Marks for High Throughput Electron Microscopy*; J Buchanan, MM Takeno, AL Bodor, DJ Bumbarger, E Froudarakis, J Reimer, AS Tolia, RC Reid, NM da Costa
- 1038 *Integrated Array Tomography for High Throughput Electron Microscopy*; R Lane, P de Boer, BNG Giepmans, JP Hoogenboom

- 1040 *Multi-order Scaling of High-throughput Transmission Electron Microscopy*; CS Own, T DeRego, LS Own, G Weppelman, AA Wanner, S Ströh, E Hammerschmith, A Vishwanathan, HS Seung
- 1042 *New Molecular Tools for Protein Detection and Dynamics in Electron Microscopy*; D Boassa, JT Ngo, MR Mackey, R Ramachandra, TJ Deerinck, MH Ellisman, SR Adams
- 1044 *FIB-SEM 3D CLEM of Cultured Cells*; Y Wu, S Yu, P De Camilli, T Melia, X Liu
- 1046 *A Versatile En Bloc Staining Procedure for Large Volume Sample Imaging*; GM Alexandra, T Benjamin, G Christel
- 1048 *Improved Ultrastructural Preservation of the Drosophila Neuromuscular Junction by a Combination of Chemical Fixation, High Pressure Freezing and Freeze Substitution*; NA Iyer, PK Rivlin
- 1050 *Use of Negative Bias Potential for High Throughput Array Tomography in an Integrated Light-Electron Microscope*; R Lane, Y Vos, P de Boer, BNG Giepmans, JP Hoogenboom
- 1052 *Correlative Synchrotron Micro-CT and FIB-SEM Imaging for the Analysis of Multifocal Pathologies*; P Parlanti, R Rigolio, G Tromba, C Manzini, A Popratiloff, V Cappello
- 1054 *Correlative Light and Electron Microscopy Technique Using Commercially Available Reagents to Facilitate Immunolocalization via Epi-fluorescence*; L Cummins, V Tu, LM Weiss, FP Macaluso
- 1056 *High-Contrast Imaging of Nanodiamonds in Cells by Energy Filtered and Correlative Light-Electron Microscopy: Towards a Quantitative Nanoparticle-Cell Analysis*; S Han, M Raabe, L Hodgson, J Mantell, P Verkade, T Lasser, K Landfester, T Weil, I Lieberwirth
- 1058 *Studying the Bioactivity of Tissue Engineering Scaffolds Derived from Egg and Sea Shell Waste Using SEM, EDS, & TEM*; V Hembrick-Holloman, VK Rangari, T Samuel, S Jeelani
- 1060 *Multi-Color Electron Microscopy of Cellular Ultrastructure Using 4D-STEM*; B Bammes, R Ramachandra, MR Mackey, R Bilhorn, M Ellisman
- 1062 *Characterization of Biogenic Nanoparticles Via in-situ Correlative Secondary Electron Helium Microscopy and Secondary Ion Mass Spectrometry*; C Guillermier, D Medina Cruz, J-N Audinot, T Wirtz
- 1064 *Photoinduced Thermal Desorption on an Atomic Force Microscope Platform Coupled with Mass Spectrometry for Multimodal Imaging*; M Lorenz, R Wagner, R Proksch, OS Ovchinnikova
- 1066 *Advancing TEM Based Biomedical Nanoparticle Characterization: GMP Compliant TEM Workflow in a BSL2 Environment and Automation Using MiniTEM*; M Colomb-Delsuc, J Härmark, B Eriksson, R Nordström, V Carvalho, G Kylberg, I-M Sintorn

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- 1068 *X-ray Microscopy and Spectroscopy Combine to Probe Selenium Biology*; HH Harris, MJ Ceko, CM Weekely, PK Witting, RJ Rodgers

- 1070 *Multiscale Multimodal Multicolor Microscopy*; BNG Giepmans
- 1072 *Selective Ion Accumulation in Biomineralizing Marine Acantharia*; V Merk, J Decelle, S Chen, A Lanzirotti, M Newville, O Antipova, D Joester
- 1074 *Visualization of the Ionome in Planktonic Symbioses*; J Decelle, G Veronesi, B Gallet, H Stryhanyuk, S Marro, R Tucoulou, N Musat
- 1076 *Challenges in Biological X-ray Microanalysis in the AEM*; NJ Zaluzec, J Seeler, R Bleher, T O'Halloran
- 1078 *Intracellular Elemental Mapping Using Simultaneous EELS and EDS: A Combined Approach to Quantifying Na, K and Ca*; AA Sheader, G Vizcay-Barrena, RA Fleck, SJL Flatters, PD Nellist
- 1080 *Analysing Cell Level Allocation of Calcium and Phosphorus in Leaves of Proteaceae from South-Western Australia*; PE Hayes, PL Clode, C Guilherme Pereira, H Lambers
- 1082 *Assessing Membrane Micro-domain Physiology from the Inside-Out Using Confocal Microscopy*; TR Cully, RM Murphy, I Jayasinghe, GG Rodney, BS Launikonis
- 1084 *Elemental Analysis and Cryo-STEM Tomography of Vitri-fied Cells*; SG Wolf, M Elbaum
- 1086 *Progress on Cryogenic Analytical STEM of Nanomaterials*; M Ilett, T Roncal-Herrero, R Brydson, A Brown, N Hondow
- 1088 *Damage-Free Nanoscale Isotopic Analysis of Biological Materials with Vibrational Electron Spectroscopy*; JA Hachtel, J Huang, I Popovs, S Jansone-Popova, JK Keum, J Jakowski, TC Lovejoy, N Dellby, OL Krivanek, JC Idrobo
- 1090 *Optimization of Sample Preparation Methods and SEM Imaging Conditions Enables High Resolution X-ray Mapping of Essential Elements in Biological Specimens*; L Hughes, P Trimby, J McKenna, C Hawes
- 1092 *Quick 3D Elemental Mapping of Biological Tissues Using Super High Solid Angle EDS*; Y Yamaguchi, H Nishioka, Y Moriya, C Nakayama, T Haruta, J Gilbert, S Asahina
- 1094 *Visualizing the Hyperaccumulation of Metals in Fucus gardneri from Howe Sound, British Columbia, Canada, Using Synchrotron X-ray Fluorescence Mapping*; LL Van Loon, NR Banerjee, D Mitchell, C Dunn
- 1096 *Investigation of Morphology and Surface Structure of Stenocara eburnea, Namib Desert Beetle*; JJ Lee, D-Y Kim
- 1098 *Determining and Characterizing if Deer Placenta Stem Cells are Present in Commercial Food Supplement Capsules: Utilizing Microscopy, Elemental Analysis, Cytology, Histology, Immunohistochemistry and Flow Cytometry*; LD Santos, S Gune, MC Killingsworth, T Cohen-Hyams, R Wuhrer, M Harvey, N McNamara, L Nguyen, S Sabapathy, C Evangelista, JLC Yong
- 1100 *AFM Structural Analysis of Colletotrichum gloeosporioides Interacting with ZnO Nanoparticles*; M Rodríguez-Nieto, NM Gomez-Ortiz, G Espinosa, P Martínez-Torres, JL Menchaca, SC De la Rosa-García, S Gomez-Cornelio

- 1102 *Green Synthesis and Characterization of Ag@Au Core-Shell Bimetallic Nanoparticles Using the Extract of Hamelia patens Plant*; K Chávez, G Rosas
- 1104 *The Application of SEM-Based EDS Microanalysis to the Study of Congenital Dyserythropoietic Anaemia Type-I (CDA-I)*; E Johnson, P Trimby, C Scott, J Brown, C Babbs, A-A Olijnik, V Buckle
- 1106 *Orientation of Organic Fibers and the Presence of Amorphous Calcium Phosphate in Elongated Crustacean Skeletal Elements*; M Vittori, V Srot, B Bussmann, F Predel, PA van Aken, J Štrus
- 1108 *Freezing and Sublimation Effects on Cryo-SEM Imaging and Microanalysis*; J Liang, X Xiao, T-M Chou, M Libera
- 1110 *Metallic Pollutants in Sargassum of Cancún, Quintana Roo, México Coast*; G González-Mancera, S Tehuacanero-Cuapa, E Chavira
- 1112 *SEM/EDS as a Tool to Investigate Pyrolysis Induced Transformations in Chicken Feather Fibers*; Z Mohammed, S Jeelani, V Rangari

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- 1116 *Isolation and Characterization of Cell- and Size-Specific Extracellular Vesicles by Nanoscale High Resolution Flow Cytometry*; TK Morgan
- 1118 *Scanning Electron Microscopy as a New Tool for Diagnostics in Pathology*; T Cohen Hyams, MC Killingsworth
- 1120 *Multi-Scale Imaging of Tissues and Organoid Models by Backscattered Electron Scanning Microscopy after Pre- and Post-Embedding Immuno-Labeling*; M Reichelt, D Mandikian, A Lopez, AK Katakam, D Smith, W Meilandt, J Imperio, M Sagolla
- 1122 *Real-time Observation of Ferritin Biomineralization Using Graphene Liquid Cells Electron Microscopy*; S Narayanan, R Shahbazian-Yassar, T Shokuhfar
- 1124 *Quantitative Anatomical Approaches to Examining Plasticity in Neural Circuits*; DM Hegarty, AE Gonzales, JH Harkness, BA Sorg, SA Aicher
- 1126 *Optical Clarity and Cataract: The Contributions of Intermediate Filaments to the Biology of the Ocular Lens*; P FitzGerald, B Shibata, N Sun
- 1128 *Investigating the Mucoïd Switch of Pseudomonas aeruginosa at Oil-Water Interfaces*; SD House, SR Balmuri, JC Yang, THR Niepa
- 1130 *Imaging Neuromodulatory Signaling Events at Single Cell Resolution in Behaving Animal*; L Ma, BC Jongbloets, W-H Xiong, H Zhong, T Mao

- 1132 *Utilizing Correlated Light and Electron Microscopy to Examine Alpha-Synuclein Pathology in a Mouse Model of Parkinson's Disease*; AJ Schaser, CS López, V Unni
- 1134 *A Correlative Imaging Approach for Extracellular Matrix Characterization in Mice*; Y Liu, Y-U Lee, T Yi, K Wu, C Bouchet-Marquis, H Chan, CK Breuer, DW McComb
- 1136 *Indirect CLEM Identifies Proarrhythmic Remodeling of Intercalated Disk Nanodomains in Murine Atria Following Acute VEGF Treatment*; L Mezache, H Struckman, A Greer-Short, TJ Hund, R Veeraraghavan
- 1138 *Segmentation, Modeling and Quantification of Electron Cryotomographic Datasets*; R Hylton, V Seader, MT Swilius
- 1140 *Microscopy Assists Understanding Important Aspects of Bioenergy Grasses*; G Sarath, LM Baird, H Chen, NA Palmer, SJ Edmé, RB Mitchell
- 1142 *Passion of a Different Kind: Working Career as an Electron Microscopist*; MB Ard
- 1144 *Histopathology and in situ Hybridization of Coatomer (CopI) Knockdown in Western Corn Rootworm (Diabrotica virgifera virgifera)*; AJ Bowling, HE Pence, E Fishilevich
- 1146 *Scanning Confocal Microscopy for Study of the Neuromuscular Junction (NMJ) Acetylcholine Receptors (nAChRs): One Model of the Peripheral Nerve Injury Recovered After Fibrin Sealant Use*; SMM Matheus, CG Pinto, APS Leite, AA Sartor, FC Tibúrcio, RS Ferreira Junior, AL Filadelpho, SC de Carvalho
- 1148 *The Examination on Corneal Nerve in Diabetic WBN/Kob Rat is Useful for Detecting Peripheral Sensory Neuropathy*; K Ozaki, Y Terayama, T Matsuura
- 1150 *The Role of Tyramine within the Mouse Ovary*; S Peck, SMB Obayomi, DP Baluch
- 1152 *Morphologic Analysis of Multiple Tissues in Caveolin-1 Null Mice*; B Qu, L Li
- 1154 *Correlative Structural, Biochemical and Behavioral Study in Neuroprotection with Palmitoylethanolamide after Perinatal Asphyxia in the Immature Brain*; MI Herrera, T Kobiec, LD Udovin, N Toro-Urrego, CF Kusnier, JP Luaces, R Kolliker, F Capani
- 1156 *Ultrastructural Modifications of the Mouse Uterus upon Biogenic Amine Stimulation*; SMB Obayomi, S Peck, DP Baluch
- 1158 *Transient Exposure to 450 nm Light Alters Phagocytosis by Retinal Pigment Epithelium Without Compromising Viability*; J Blaize, J Fabozzi
- 1160 *Chronic Oxidative Stress and Comorbidities in the HIV-1 Transgenic Rat*; F Denaro, M Worthington, F Benedetti, S Curreli, D Zella, J Bryant
- 1162 *Localization of the Herpesvirus Portal*; MHC Buch, JB Heymann, WW Newcomb, DC Winkler, AC Steven
- 1164 *Using Electron Microscopy to Enhance the Knowledge of Biological Systems*; K Ishikawa, Z Wang, C Burks, M Larion, N de Val, J Schneider



- 1166 *Microscopy Techniques Used to Visualize Immune-Labeled Chlamydial Inclusion Membrane Proteins in 2D and 3D*; B Crews, ER Fischer, F Hoyt, BT Hansen, T Hackstadt
- 1168 *Using Correlative Light and Electron Microscopy (CLEM) to Understand Ultrastructural Changes Induced by Salmonella typhimurium Infection in a Calf Ileum Loop Model*; S Antonioli-Schmit, A Chong, BT Hansen, M Pulliam, V Nair
- 1170 *Co-Registered Application of Matrix Assisted Laser Desorption/Ionization Mass Spectrometry and Time-of-Flight Secondary Ion Mass Spectrometry Images for Visualizing Signaling Molecules*; M Lorenz, ST King, N Borodinov, CA Steed, J Chae, AV Ievlev, OS Ovchinnikova
- 1172 *Vesicle Structural Changes Control Content Release of Transmitters and Hormones*; G Arpino, W Shin, O Shupliakov, L-G Wu
- 1174 *Use of Electron Microscopy for Detecting the Environmental Contamination by Asbestos: Analysis of Sentinel Animal Lung Tissue*; A Campopiano, A Cannizzaro, A Olori, F Angelosanto, MR Bruno, BM Bruni, F Casalnuovo, S Iavicoli
- 1176 *Identifying Artifacts from Real Changes in Electron Microscopy of Molecular Era*; G Ning
- 1178 *Phaechromocytoma Associated with Fatal Myocardial Infarction*; S Siew, J Richards
- 1180 *Scanning Electron Microscopy Preparation Method for Coolia sp., a Delicate Dinoflagellate*; LE Gómez-Lizárraga, LM Durán-Riveroll, HI Pérez-López
- 1182 *Rapid Automated Preparation for Serial Block Face Scanning Electron Microscopy*; SL Goodman, EK Benson, JM Campbell, GJ Kidd
- 1184 *Automated Preparation of Core Needle Biopsy Specimens for TEM Imaging*; TE Strader, BK August
- 1186 *Gold Nanorings Encapsulated in PNIPAM Nanoparticles*; SA Tovar-Cabrera, A Lucero-Acuña, R Esquivel
- 1188 *Novel Approaches for Treating Cardiac Disease*; A Kumar, D DiPette, JD Potts
- 1190 *Microlens Enhancement in Respiratory Infection Diagnosis*; F Teng, X Wu, T-M Chou, M Libera
- 1192 *Analysis of the Density and Distribution of HER2 in Breast Cancer Cell Subpopulations and Their Response to Anti-Cancer Drugs on the Single Cell Level Using Liquid-Phase Electron Microscopy*; P Blach, F Weinberg, D Peckys, N de Jonge

### ***Cutting-Edge Microscopy in the Pacific Northwest***

- 1194 *3DEM Data Collection of Cancer Biopsies: Comparing FIB-SEM and SBF-SEM*; JL Riesterer, K Loftis, K Stoltz, E Stempinski, M Williams, CS Lopez, G Thibault, JW Gray
- 1196 *Computer Vision Techniques for Cancerous Cells Analysis in FIB-SEM Images*; G Thibault, J Riesterer, K Stoltz, K Loftis, G Schau, E Stempinski, C López, YH Chang, JW Gray

- 1198 *Multiscale Cardiac Imaging: From Whole Heart Images to Cardiac Ultrastructure*; G Rykiel, CS López, JL Riesterer, M Williams, K Courchaine, A Maloyan, K Thornburg, S Rugonyi
- 1200 *ELVIS: A Correlated Light-Field and Digital Holographic Microscope for Field and Laboratory Investigations*; J Nadeau, M Schadegg, C Snyder, I Hanczarek
- 1202 *Simple Chemical Stains for Feature-Rich Super-Resolution and Cleared-Tissue Microscopy*; C Mao, MY Lee, J-R Jhan, JC Vaughan
- 1204 *VIPER: A Genetically-Encoded Tag for Fluorescence and Electron Microscopy*; JK Doh, JD White, HK Zane, YH Chang, CS López, CA Enns, KE Beatty
- 1206 *Antibody Conjugated Oligonucleotides as a Platform for Cyclic Immunofluorescent Staining*; N McMahon, J Jones, A Solanki, J Eng, S Kwon, Y-H Chang, G Thibault, K Chin, M Nederlof, J Gray, SL Gibbs
- 1208 *The Not-Boring Talk*; EC Humphrey
- 1210 *Seeing with Phase: Interferometric Electron Microscopy for Magnetic Materials and Biological Specimens*; BJ McMorran
- 1212 *HOTSPUR: A Real-time Interactive Preprocessing System for Cryo-EM Data*; J Elferich, R Posert, C Yoshioka, E Gouaux
- 1214 *Dual Native MS and Cryo-EM Approach to Resolve Heteromeric Protein Assemblies and Subunit Stoichiometry*; I Novikova, M Zhou, J Shaw, H Hellmann, JE Evans
- 1216 *Visualization of Protein-Lipid Interactions in Connexin-46/50 Intercellular Communication Channels at 2.1 Å Resolution*; JA Flores, KA Dolan, BG Haddad, JB Myers, CC Yoshioka, DM Zuckerman, SL Reichow
- 1218 *NMDA Receptors' Structural Asymmetry*; F Jalali-Yazdi, E Gouaux
- 1220 *Studying Ras Nanocluster Formation on the Cell Membrane with Correlative Superresolution and Electron Microscopies*; Y Zhang, K Tao, L Wu, Y Lee, YH Chang, X Nan
- 1222 *#Protein Lights Up in Cryo-EM*; JZ Chen
- 1224 *Structural Characterization of Immune Responses to HPV Infection and HPV Vaccination*; S Singh, J Carter, K Cohen, J McElrath, D Galloway, M Pancera

### ***Light and Fluorescence Microscopy for Imaging Cell Surface and Cell Structure***

- 1226 *Small Volumes in Biology*; D Axelrod, JJ Axelrod, RW Holz, NL Thompson
- 1228 *Generative Adversarial Networks Enable Cross-Modality Super-Resolution in Fluorescence Microscopy*; H Wang, Y Rivenson, Y Jin, Z Wei, R Gao, H Günaydin, LA Bentolila, C Kural, A Ozcan

- 1230 *Numerical Analysis of Tightly Focused Spot for Confocal Microscopy Illumination by a Real Lens System*; R Shi, S Zhang, C Hellmann, F Wyrowski
- 1232 *A Proposed Method for Optimizing the Spectral Discernibility of Engineered Point-spread Functions for Localization Microscopy*; JT Martineau, R Menon, EM Jorgensen, J Gerton
- 1234 *Using Advanced Differential Interference Contrast Microscopy for High-Resolution Mapping Two-Dimensional Phase Distribution in Cells and Tissue Structures*; M Shribak
- 1236 *Mechanism of Syntaxin Clustering Near Secretory Granules in Live Cells*; X Chen, L Wan, W Almers
- 1238 *Mapping Protein Dynamics During Exocytosis of Single Microvesicles in Neuroendocrine Cells with Evanescent Field Microscopy*; JW Taraska, KA Sochacki, A Somasundaram
- 1240 *Exchange Dynamics of Dynamin Measured in Living Cells During Endocytic Vesicle Formation*; L Claverie, M Rosendale, P Maschalchi, C Butler, N Retailleau, J-B Sibarita, D Choquet, D Perrais
- 1242 *Visualizing the Molecular Dynamics of Adaptive and Innate Immune Signaling at the Cell Surface*; Y Mun, F Gerpott, M Chupanova, A Schmidt, MJ Taylor
- 1244 *Fluorescence Polarization Microscopy Enables Spatial Mapping of the 3D Orientation of Piconewton Integrin Traction Forces*; JM Brockman, AT Blanchard, K Salaita, AL Mattheyses
- 1246 *A Novel Anisotropy Imaging Technique for NAD(P)H Autofluorescence*; JV Chacko, KW Eliceiri
- 1248 *Probing Membrane Nanodomain Organization with Single Particle Tracking via Photoactivated Localization Microscopy (spt-PALM)*; Y Lee, C Phelps, T Huang, B Mostofian, D Zuckerman, X Nan
- 1250 *High-Contrast Visualization of Endogenous Proteins for Live Imaging*; DA Fortin, JB Melander, BC Jongbloets, W-H Xiong, C Guo, T Mao, H Zhong
- 1252 *Immunoprofiling of Cell Wall Carbohydrate Modifications During Aerenchyma Formation in Fabaceae Roots*; TJ Pegg, RE Edelman, DK Gladish
- 1254 *Optimizing F-actin Labeling At the Leading Edge of Cells Using Multiple Actin Probes, Fixation Methods and Imaging Techniques*; V DesMarais, RJ Eddy, VP Sharma, O Stone, JS Condeelis
- 1256 *3D Confocal Fluorescence Microscopy Analysis of Skeletal Muscle Myogenesis in Self Assembled 3D Microtissues*; GP Ahnrud, J Morgan, K O'Fallon, P Marek
- 1258 *An Alpha-synuclein Overexpression Model of Vocal Symptoms in Parkinson's Disease*; A Badwal, CA Medina, SJ Munger, JE Miller
- 1260 *Multiplex Immunolabeling and Imaging of Functionally Essential Kidney Structures in X-CLARITY-Cleared Tissue*; P Mochama, R Tyshynsky, MA Sanders
- 1262 *Fluorescent Ligands on the Basis of Hongotoxin 1: eGFP-Hongotoxin 1*; MV Savelieva, K Kudryashova, OV Nekrasova, AV Feofanov

- 1264 *Method for Analysis of Excitation-Emission Spectral Scans to Characterize Fluorescent Probes in Confocal Microscopy*; V Cmiel, J Skopalik, L Baiazitova, I Provaznik
- 1266 *Strategy for Compositional Analysis of the Hair Cell Mechanotransduction Complex Using TIRF Microscopy*; S Clark, J Elferich, J Gai, A Goehring, J Mitra, T Ha, E Gouaux

### ***Pharmaceuticals FIG – Imaging, Analysis, and Regulation of Medical Products, Devices and Data Integrity***

- 1268 *Opportunities for Advanced Imaging Techniques in Pharmaceutical Formulation Development*; MS Lamm
- 1270 *Comprehensive Identification of the Particulate Matter Population Present in Medical Products and Their Manufacturing Processes*; X Gu, JR Mantei
- 1272 *Significance of Cryo-Scanning Electron Microscopy (Cryo-SEM) in Evaluating the Morphology of Multivesicular Liposomes*; S Manna, Y Wu, B Koo, X Xu, S Choi, Y Wang, D Kozak, J Zheng
- 1274 *Characterization of Encapsulated Liposomal Irinotecan*; JM Noble, L Chen, R Jog, D Kozak, J Zheng
- 1276 *The Use of ‘Live Chemical Imaging’ to Enhance and Increase Productivity in SEM/EDS Investigation of Pharmaceutical Samples, While Still Conforming to 21 CFR Part 11 Regulations*; A Hyde, S Burgess, J Goulden
- 1278 *Fluorescent Ligands of Kv1 Channels on the Basis of Hongotoxin: Atto488-Hongotoxin*; N Orlov, O Nekrasova, A Feofanov
- 1280 *Effect of Arginine and Lysine Substituents on Intracellular Localization and Photocytotoxicity of Dipropoxy-Bacterioporpurinimide*; E Dyakova, A Efremenko, P Ostroverkhov, M Grin, A Feofanov
- 1282 *7-Methylguanine Traps PARP-1 on Nucleosomes: spFRET Microscopy Study*; N Maluchenko, D Nilov, A Feofanov, A Lys, M Kutuzov, N Gerasimova, V Studitsky
- 1284 *Ultrastructure of Human Pancreatic Cancer Cells Treated with a TBK1 Inhibitor*; L Yasui, N Baker, H Savage, C Der
- 1286 *Application of Cryogenic-Electron Microscopy (Cryo-EM) for Morphological Characterization of Complex Drug Products*; J Zheng, Y Wu

### ***3D Structures: from Macromolecular Assemblies to Whole Cells (3DEM FIG)***

- 1288 *Towards a Mechanistic Understanding of P element Transposition Using Single-Particle Cryo-EM*; EH Kellogg, G Ghanim, E Nogales, DC Rio
- 1290 *Structural Analysis of Helicobacter pylori VacA Reveals Insights into Oligomerization*; AL Erwin, M Su, AM Campbell, DL Akey, DB Lacy, TL Cover, MD Ohi

- 1292 *Computational Methods to Process Highly Heterogeneous Cryo-EM Samples*; J Gomez-Blanco, S Kaur, J Ortega, J Vargas
- 1294 *Cryo-EM Reveals IMP Dehydrogenase I Filaments Adopt Diverse Architectures*; AL Burrell, M Said, C Nie, MC Johnson, JM Kollman
- 1296 *3-D Structure of Z-disks Isolated from the Flight Muscle of Lethocerus indicus*; F Abbasi Yeganeh, C Summerill, DW Taylor, H Rahmani, KA Taylor
- 1298 *CryoEM Reveals Multi-step Activation of  $\gamma$ Tubulin and Assemblies to Optimize Microtubule Nucleation*; AM Brilot, DA Agard
- 1300 *Structural Studies of Coronavirus Fusion Proteins*; AC Walls, MA Tortorici, X Xiong, J Snijder, B Frenz, B-J Bosch, F DiMaio, D Corti, FA Rey, D Veesler
- 1302 *Probing the Structural Organization of Virions and Genomic Ribonucleoprotein Complexes from Type B Influenza Virus by Cryo-electron Microscopy*; NM Gulati, JR Gallagher, DM McCraw, AK Harris
- 1304 *In situ Structure and Assembly of the Bacterial Multidrug Efflux Pump*; X Shi, M Chen, JM Bell, Z Yu, SJ Ludtke, Z Wang
- 1306 *Development of an Intact Mammalian System for High-resolution Imaging by Cryo-Electron Tomography*; X Li, D Park, Y Chang, A Radhakrishnan, H Wu, J Liu
- 1308 *Hunting for the Adhesion Molecule, Retinoschisin, in Retina Using CEMOVIS*; JB Heymann, CKE Bleck, RN Fariss, C Vijayasarathy, DC Winkler, R Huang, AD Dearborn, A Smirnov, PA Sieving, AC Steven
- 1310 *Customizable Cryo-EM Chips Improve 3D Analysis of Macromolecules*; AC Varano, N Alden, W Dearnaley, M Casasanta, J Damiano, J McConnell, M Dukes, DF Kelly
- 1312 *Structural Studies  $\alpha$ v $\beta$ 8 Integrin by Single Particle Cryo-EM*; MG Campbell, A Cormier, S Ito, S Wu, J Lou, J Marks, JL Baron, SL Nishimura, Y Cheng
- 1314 *Building Cryo-EM at Genentech to Enable Research and Drug Discovery*; A Estevez, C Arthur, L Rouge, M Kschonsak, A Rohou, C Ciferri
- 1316 *Imaging and Reconstructing Microglia in 3 Dimensions Using FIB-SEM*; JC Savage, SW Novak, M-E Tremblay
- 1318 *Structural Organization of the Guinea Pig  $\alpha$ A-Crystallin and  $\alpha$ A<sup>66-80</sup> Peptide Complex*; PK Yadav, M Su, S Jeyarajan, FJ Giblin, MD Ohi
- 1320 *Elucidating Molecular Mechanisms of Mitochondrial Fission Machinery via Helical Studies of Drp1 and its Partner Proteins*; KT Whiddon, RW Clinton, JA Mears
- 1322 *Determining the Solution Structure of the Drp1 and its Role in the Assembly of the Mitochondrial Fission Machinery*; K Rochon, JA Mears

- 1324 *Structure and Function of the Proteasome Activator PA28 of the Malaria Parasite Plasmodium falciparum*; R Metcalf, E Hanssen, SC Xie, D Gillett, A Leis, C Morton, MW Parker, W Wong, M Griffin, L Tilley
- 1326 *Structure of the Cyanobacterial NAD(P)H Dehydrogenase-Like Complex of Oxygenic Photosynthesis*; TG Laughlin, AN Bayne, J-F Trempe, DF Savage, KM Davies
- 1328 *Cryo-EM Structure of Nipah Virus Fusion Glycoprotein in Complex with a Monoclonal Antibody Reveals Mechanism of Neutralization*; HV Dang, Y-P Chan, Y-J Park, CC Broder, D Veesler
- 1330 *Three-Dimensional Reconstruction of Full-Length Tankyrase 1*; A Chemeris, AM Gautreau, OS Sokolova
- 1332 *The Three-Dimensional Structure of (+39) RNA-Polymerase Elongation Complex Determined by Cryo-Electron Microscopy*; OV Chertkov, MG Karlova, VM Studitsky, OS Sokolova
- 1334 *ATP-bound Conformation of OBP Chaperonin*; TB Stanishneva-Konovalova, EB Pichkur, PI Semenuyk, LP Kurochkona, OS Sokolova
- 1336 *Electron Microscopy of Yeast FACT Protein Complex*; MG Karlova, ME Valieva, Y Klein, AL Kozlova, VM Studitsky, OS Sokolova
- 1338 *SMA-based Extraction of the Yeast Cell Wall Integrity Sensor Mid2 from Native Membranes of Saccharomyces cerevisiae – Electron Microscopy Study*; N Voskoboynikova, M Karlova, R Kurre, J Heinisch, H-J Steinhoff, KV Shaitan, OS Sokolova
- 1340 *Interconnection of Actin-binding Proteins and Septins in Asymmetric Cell Division*; AV Vakhrusheva, TB Stanishneva-Konovalova, OS Sokolova
- 1342 *Atomic Force Microscopy Investigation of Influenza A Virus Nuclear Export Protein Aggregation*; EV Dubrovin, ON Koroleva, AO Golovko, NV Kuzmina, DV Klinov, VL Druitsa
- 1344 *Nanometer-Scale Structures of Neurons Differ Between Individuals and Those Differences Become Extraordinary in Schizophrenia*; R Saiga, V De Andrade, F De Carlo, A Takeuchi, K Uesugi, Y Terada, Y Suzuki, S Takekoshi, C Inomoto, N Nakamura, Y Torii, I Kushima, S Iritani, N Ozaki, K Oshima, M Itokawa, M Arai, R Mizutani
- 1346 *Hierarchical Spidroin Micellar Nanoparticles as the Precursors of Spider Silks*; LR Parent, D Onofrei, D Xu, D Stengel, JD Roehling, JB Addison, C Forman, SA Amin, BR Cherry, JL Yarger, NC Gianneschi, GP Holland
- 1348 *Hair-Structure Mystery Solved by Datamining Two Decades of Electron Tomograms*; DP Harland, V Novotná, M Richena, M Bostina, S Velamoor, AJ McKinnon

## ***Cryo-EM - from Physics to Cell Biology: Honoring the Remarkable Legacy of Ken Downing***

- 1350 *Taking the Road Less Travelled – The Downing Legacy*; SG Wolf

- 1352 *Microscale Fluid Mechanics of Making Thin Specimens for Cryo-EM*; RM Glaeser, M Armstrong, B-G Han, DA Fletcher
- 1354 *Cryo-EM Studies of Respiratory Complexes in a Hyperthermophilic Archaeon Pyrococcus furiosus Suggest an Evolutionary Path to Modern-Day Complex I*; H Yu, GJ Schut, C-H Wu, DK Haja, MW Adams, H Li
- 1356 *Imaging of Polypeptoid Nanosheets with Atomic Scale Precision (In Honor of Ken Downing)*; X Jiang, S Xuan, RK Spencer, RN Zuckermann, KH Downing, NP Balsara
- 1358 *Reconstitution of Tubulin Methylation by SETD2*; S Kearns, M Cianfrocco, K Verhey
- 1360 *Electron Microscopy of the Microtubule Framework in Primary Cilia*; S Sun, RL Fisher, BT Pentecost, H Sui
- 1362 *Severed Actin and Microtubules with Motors Walking All Over Them: Cryo-EM Studies of Seriously Perturbed Helical Assemblies*; G Debs, A Huehn, M Cha, X Liu, WA Elam, W Cao, E De La Cruz, CV Sindelar

### ***From Images to Insights: Working with Large Data in Cell Biological Imaging***

- 1364 *Automated Reconstruction of a Serial-Section EM Drosophila Brain with Flood-Filling Networks and Local Realignment*; PH Li, LF Lindsey, M Januszewski, M Tyka, J Maitin-Shepard, T Blakely, V Jain
- 1366 *Building a Data-driven Workflow to Streamline Cryo-EM Data Processing*; Y Li, MA Cianfrocco
- 1368 *A FAIR Principle Data Model for Focused Ion Beam Scanning Electron Microscopy (FIB-SEM) and the Frederick National Laboratory Data Coordinating Center*; P Aiyetan, K Narayan, D Mott, R Kuchipudi, C Zeitler, D Hope, U Mudunuri, A Quong
- 1370 *Scalable Imaging Science Tools to Support Increasingly Efficient Workflows for Research Tasks on Massive Images*; C Goetze, CT Zugates, T Ruth, P Boenisch, A Brady-Myerov
- 1372 *Harnessing the Power of the Crowd for Bioimage Analysis*; M Jones, H Songhurst, C Peddie, A Weston, H Spiers, C Lintott, LM Collinson
- 1374 *Visualizing and Interacting with Large Imaging Data*; E Perlman
- 1376 *Deep Learning Based Segmentation of Nuclei from Fluorescence Microscopy Images*; PR Gudla, G Zaki, S Shachar, T Misteli, G Pegoraro
- 1378 *Practices in Data Management Significantly Reduce Costs in Cryo-EM*; MJ Borgnia, A Bartesaghi
- 1380 *Maturation Times of Pancreatic Beta Cell Secretory Granules Estimated from Serial Block-Face Electron Microscopy*; RD Leapman, MA Aronova, A Rao, EL McBride, G Zhang, H Xu, AL Notkins, T Cai
- 1382 *Processing Volumetric Data for Correlative Analysis: An Anecdote from a Core Facility*; CI Thomas, N Kamasawa
- 1384 *Data Fabric Infrastructure for Heterogeneous Cell Biology Image Data*; JHJ Scott

- 1386 *Collaborative Editing and Distributing Large Image-Based Data for Connectomics*; WT Katz, SE Berg, SK Plaza
- 1388 *Workflow Automation and Portability Enable High Throughput Image Processing and Segmentation for Cell Biology Systems*; B Provencher, R Makovetsky, E Yen, N Piché, M Marsh
- 1390 *Large Data Considerations in Digital Holographic Microscopy*; C Snyder, D Cohoe, M Schadeegg, J Nadeau
- 1392 *Large Area SEM Backscatter Imaging of GABA Post-Embedding Immunogold, Web-Based Crowdsourcing Segmentation and Local Image Processing for Rigorous Quantification*; C Clarkson, CT Zugates, CA Brantner, M Rust, A Popratiloff
- 1394 *Strategies for Data Flow and Storage for High Throughput, High Resolution Cryo-EM Data Collection*; WJ Rice, A Cheng, S Dallakyan, S Bhatkar, S Krit, ET Eng, B Carragher, CS Potter

## Physical Science Symposia

### ***In situ TEM Characterization of Dynamic Processes During Materials Synthesis and Processing***

- 1396 *Mapping Electronic State Changes with STEM EBIC*; BC Regan, T Joshi, JJ Lodico, BT Zutter, HL Chan, M Mecklenburg, D Lederman, WA Hubbard
- 1398 *Atomic-scale Chemical Manipulation of Materials in the Scanning Transmission Electron Microscope Under Controlled Atmospheres*; GT Leuthner, C Mangler, JC Meyer, T Susi, J Kotakoski
- 1400 *Site Dependent Oxidation and Reduction Mechanisms in Nanoparticles Investigated via Environmental Scanning Transmission Electron Microscopy*; AP LaGrow, DC LLOYD, ED Boyes, PL Gai
- 1402 *Cryo-Focused Ion Beam Applications in High Resolution Electron Microscopy Studies of Beam Sensitive Crystals*; D Zhang, N Wei, L Liu, K Song, A behzad, A Genovese, Y Han
- 1404 *Colloidal Nanostructures: In-situ Electron Microscopy of Plasmon-Mediated Synthesis, Chemistry and Self-Assembly*; E Sutter
- 1406 *Liquid Pockets Encapsulated in MoS<sub>2</sub> Liquid Cells*; J Yang, MK Choi, P Ercius, H Zheng
- 1408 *Nucleation and Growth of Pharmaceutical Crystals in situ Using Liquid Cell Electron Microscopy*; J Cookman, V Hamilton, S Hall, U Bangert
- 1410 *Supercluster-Coupled Crystal Growth in Metallic Glass Forming Liquids*; Y Xie, S Sohn, M Wang, H Xin, Y Jung, MD Shattuck, CS O'Hern, J Schroers, JJ Cha
- 1412 *In situ TEM Etching of Gold Nanocrystals: Elucidating the Shape Transformation Mechanisms and Chemistry of the Graphene Liquid Cell*; MR Hauwiller, J Ondry, AP Alivisatos



- 1414 *Liquid-phase TEM Imaging of Self-assembly Pathways of Anisotropic Nanoparticles*; Z Ou, B Luo, C Liu, Q Chen
- 1416 *Real-time Investigation of Nanoparticle Self-assembly Mechanisms and Its Controlling Factors*; J Lee, E Nakouzi, J Chun, D Li
- 1418 *Radiation-induced Dissolution of a Recalcitrant Aluminum Oxyhydroxide in Liquid Cell TEM*; JA Soltis, TR Graham, X Zhang, GA Kimmel
- 1420 *Characterization and Modeling of Coarsening Mechanisms in Supported Nanoparticle Ensemble*; DN Zakharov, A Tkachenko, X Qu, H Wang, Y Lin, JP Horwath, S Yoo, EA Stach
- 1422 *Spatially Mapping Heterogeneous Nucleation Kinetics of Silver Nanocrystals with Liquid Cell Scanning Transmission Electron Microscopy*; M Wang, TU Dissanayake, C Park, TJ Woehl
- 1424 *In situ TEM Approaches to Controlling the Growth of Semiconductors on 2D Materials*; P Periwai, JD Thomsen, MC Reuter, D Zakharov, L Gignac, TJ Booth, S Hofmann, FM Ross
- 1426 *Using in situ Gas Heating TEM to Investigate Compound Nanowire Growth Mechanisms*; M Song, J Lee, D Li
- 1428 *Tracing Oxygen Transport Pathways with in-situ STEM and Theory*; AY Birenbaum, VR Cooper, A Borisevich
- 1430 *Composition Analysis by EDS at Elevated Temperatures and More*; M Falke, I Nemeth
- 1432 *In situ Heating to Investigate Phase Transformations in Individual Powder Particles of a Gas-Atomized Icosahedral-Phase-Strengthened Al Alloy*; HR Leonard, S Rommel, S Vijayan, TJ Watson, T Policandriotes, M Aindow
- 1434 *In-situ TEM Investigation on Reaction Mechanisms of Conversion Electrode Materials for Batteries*; D Su
- 1436 *Dynamic Observation of Li-Ion Movement in a Solid-State Li-Ion Battery*; Y Nomura, K Yamamoto, T Hirayama, E Igaki, K Saitoh
- 1438 *Operando Liquid-electrochemical TEM for Monitoring Growth and Dissolution Steps of NaO<sub>2</sub> Cubes in Na-O<sub>2</sub> Battery*; W Dachraoui, L Lutz, LR Johnson, PG Bruce, J-M Tarascon, A Grimaud, A Demortière
- 1440 *Can the Environmental TEM Confirm Atomistic Models of Adsorbed Molecules at Surfaces of Solids?;* M Bugnet, I Pershukov, O Matz, M Calatayud, T Epicier
- 1442 *The Utility of Xe-Plasma FIB for Preparing Aluminum Alloy Specimens for MEMS-based in situ Double-Tilt Heating Experiments*; LF Allard, DN Leonard, JD Poplawsky, MF Chisholm, BD Eckhart, A Shyam, FS Walden, BB Larson, R Kelley, A Stokes, WC Bigelow
- 1444 *Development of a Method to Characterize Active Sites in Photocatalysis Using operando Transmission Electron Microscopy*; N Glachman, N Geller, A Shea, VA Verret, K Karki, J Rodriguez-Manzo, NJ Salmon, DH Alsem, D Jariwala, E Stach

- 1446 *Environmental TEM Study of Oxidation Processes of Catalytic Nanoparticles*; L Kovarik, Z Wei, CHF Peden, J Szanyi
- 1448 *Multimodal Operando Electron Microscopy Approach to Study Pt Catalyst During CO Oxidation Reaction*; M Plodinec, E Stotz, L Sandoval-Diaz, R Schlögl, T Lunkenbein
- 1450 *Application of Electron-Beam-Excited Localized Surface Plasmon Resonance to Unveil Catalytically Active Sites on Au Nanoparticles*; W-CD Yang, C Wang, LA Fredin, PA Lin, L Shimomoto, HJ Lezec, R Sharma
- 1452 *In-situ Measurements of Single Walled Carbon Nanotube Growth Reveal the Structures of Active and Inactive Catalyst Nanoparticles*; H-Y Chao, H Jiang, J Cumings, R Sharma
- 1454 *Low-Dose and High-Speed Observations of Battery Processes by Operando STEM*; BL Mehdi, ND Browning, J Lee, H Amari, N Johnson, D Nicholls, AJ Stevens
- 1456 *Surface Topotactic Growth of Edge-Terminated MoS<sub>2</sub> Catalysts*; C Dahl-Petersen, M Saric, M Brorson, LP Hansen, PG Moses, J Rossmeissl, JV Lauritsen, S Helveg
- 1458 *Environmental TEM Studies Reveal Catalyst/Support Registry on 2D Zeolites*; J Carpena-Núñez, D Zakharov, R Rao, D Kim, JA Boscoboinik, EA Stach, M Tsapatsis, D Stacchiola, B Maruyama
- 1460 *In situ S/TEM Reactions of Ag/ZrO<sub>2</sub>/SBA-16 Catalysts for Single-Step Conversion of Ethanol to Butadiene*; KA Unocic, V Lebarbier Dagle, RA Dagle, EC Wegener, J Kropf, TR Krause, DA Ruddy, LF Allard, SE Habas
- 1462 *Influence of Water Vapor on NiAl Oxidation Using in situ STEM*; KA Unocic, FS Walden II, LF Allard
- 1464 *Dynamic Restructuring during Processing: Approaches to Higher Temporal Resolution*; PA Crozier, EL Lawrence, JL Vincent, BDA Levin
- 1466 *Subsampled Acquisition to Increase Speed and Reduce Data Size for in situ TEM*; B Bammes, H Amari, BL Mehdi, R Bilhorn, ND Browning
- 1468 *Electrostatic Subframing and Compressive Sensing Video in in situ Transmission Electron Microscopy*; BW Reed, AA Moghadam, RS Bloom, ST Park, AM Monterrosa, PM Price, CM Barr, SA Briggs, K Hattar, DJ Masiel
- 1470 *Four Dimensional Scanning Transmission Electron Microscopy during the in situ Annealing of a CuZrAl Bulk Metallic Glass*; TC Pekin, C Gammer, C Ophus, RO Ritchie, AM Minor
- 1472 *Environmental TEM Study of NiMoO<sub>4</sub> Nanorods Undergoing Thermal Reduction: Observing the Formation of a Ni-Mo Alloy@oxide Core-shell Catalyst*; SD House, RB Patil, A Mantri, JC Yang, JR McKone
- 1474 *Engineering and Modifying Two-Dimensional Materials via Electron Beams*; X Zhao, J Dan, W Zhou, KP Loh, SJ Pennycook
- 1476 *Quantifying Structural Transformations from Redox Reactions in TiO<sub>2</sub>*; B Shindel, P Haluai, Q Liu, BDA Levin, T Boland, PA Crozier

- 1478 *A Scanning Tunneling Microscopy Study on Surface-Supported Imine-Based Covalent Organic Frameworks: A New Design for Robust 2D Materials*; N Bilbao, D Waghray, T Janssen, S De Feyter
- 1480 *Electron-Beam-Induced Nucleation in an Antisolvent*; T Yamazaki, Y Kimura
- 1482 *In situ Negative Cs HRTEM Imaging of Topotactic Phase Transformation from Perovskite SrFeO<sub>3</sub> to Brownmillerite SrFeO<sub>2.5</sub>*; YL Xing, B Park, Z Wang, KT Kang, J Seo, JC Kim, HY Jeong, WS Choi, SH Oh
- 1484 *In situ TEM Investigation on Rotation and Coalescence Behaviors of Au Nanoparticles on h-BN Substrate*; B Song, Y Yuan, R Rojaee, R Shahbazian-Yassar
- 1486 *In situ Observations of Abnormal Pore Size Changes of a Zirconium-Based Metal-Organic Framework Using High Resolution S/TEM and EELS*; P Tieu, C Gadre, W Gao, X Yan, M Li, Z Xu, X Pan
- 1488 *Quantifying the Atomic Ordering of Binary Intermetallic Nanocatalysts Using in situ Heating STEM and XRD*; Y Yang, Y Xiong, E Padgett, H Joress, V Yarlagadda, A Kongkanand, JD Brock, FJ DiSalvo, HD Abruña, DA Muller
- 1490 *In situ Analysis of nm-Scale Alpha Formation in Titanium Alloys*; AK Ackerman, C Ophus, M Danaie, P Karamched, AJ Knowles, A Wilkinson, D Rugg, D Dye
- 1492 *In-situ Liquid Phase Transmission Electron Microscopy Study for Phase Evolution of  $\alpha$ -Fe<sub>2</sub>O<sub>3</sub> Nanorods upon Lithiation/delithiation Process*; MW Pin, Y Kim, SJ Ahn, J-H Kwon
- 1494 *Atomic Scale Dynamic Process of Cu Oxidation Revealed by Correlated in situ Environmental TEM and DFT Simulations*; M Li, MT Curnan, MA Cresh-Sill, SD House, WA Saidi, JC Yang
- 1496 *Observation of Void Formation in Cubic NaYF<sub>4</sub> Nanocrystals Using in situ Heating Transmission Electron Microscopy*; AB Bard, MB Lim, X Zhou, JA Rodríguez Manzo, DH Alsem, PJ Pauzauskie
- 1498 *Real-time Electron Microscopy of Protein Nanodiscs in Graphene Liquid Cells*; JW Smith, LN Carnevale, A Das, Q Chen
- 1500 *Liquid-Phase STEM-EDS in Graphene and Silicon Nitride Cells*; DJ Kelly, N Clark, M Zhou, M Lindley, EA Lewis, MG Burke, RV Gorbachev, SJ Haigh
- 1502 *In situ Liquid Cell Transmission Electron Microscopy Study of Hydroxyapatite Mineralization Process*; K He, C Liu, Y Yuan, B Song, Y-P Lu, T Shokuhfar, R Shahbazian-Yassar
- 1504 *Liquid Phase Electron Microscopy Study on the Growth Mechanism of Gold Nanoparticles: In Scanning Electron Microscope*; IH Kang, MD Kim, YH Kim
- 1506 *Exploring the Link Between Amorphous Structure and Crystallization Behavior of Titania Thin Films by Electron-Based Pair Distribution Functions and in-situ TEM*; JS Mangum, LM Garten, V Jacobson, DS Ginley, BP Gorman
- 1508 *Operando Insight into Oxygen Transfer at Pt/CeO<sub>2</sub> Interfaces during CO Oxidation*; JL Vincent, PA Crozier
- 1510 *Probing the Functional Activity Limits of Biomolecules Under Electron Irradiation*; T Moser, J Evans

- 1512 *In-situ Heating TEM Study of Phase Change Material*; J Li, L Hong, H Wang
- 1514 *Live EDS Mapping of the Precipitation and Annealing Cycle of Alloys in the TEM Generated Through in situ Heating*; S Marks, P Pinard, H Kotadia, G West
- 1516 *Lattice Registry and Evidence for Surface Reconstructions of Metal Films on Suspended 2D Membranes Following Annealing*; TH Brintlinger, JF Vega, JC Culbertson, M Zalalutdinov, RM Stroud, JT Robinson
- 1518 *Initiation of Grain Growth Observed Using Electrostatic-Subframing*; BW Reed, AM Monterrosa, AA Moghadam, RS Bloom, ST Park, SA Briggs, PM Price, CM Barr, JT McKeown, DJ Masiel, K Hattar
- 1520 *Electron Correlation Microscopy for Studying Fluctuating Systems in situ*; D Chatterjee, P Zhang, PM Voyles
- 1522 *In situ Transmission Electron Microscopic Investigation of Coalescence Dynamics of Au Nanoparticles Embedded in Solid Potassium Bromide*; W Xin
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- 2442 *Hayabusa2: Sample Acquisition at a Near-Earth C-type Asteroid Ryugu and Analysis Plan of Returned Samples*; S Tachibana
- 2444 *Evaluation of Various Methods for Determining Bulk Compositions of Chondrules and Other Objects in Petrographic Thin Sections*; DK Ross, JI Simon
- 2446 *Space Rocks and Optimizing Scanning Electron Channeling Contrast*; TB Britton, D Goran, VS Tong
- 2448 *A Nanoscale Record of Impact-Induced Pb Mobility in Lunar Zircon*; TB Blum, DA Reinhard, MA Coble, MJ Spicuzza, Y Chen, AJ Cavosie, L Nasdala, C Chanmuang N, TJ Prosa, DJ Larson, JW Valley



- 2450 *Structure Determination of Donwilhelmsite by Electron Diffraction Tomography*; M Klementova, L Palatinus, J Fritz, A Greshake, R Wirth, V Assis Fernandes, L Ferrière
- 2452 *Amorphous and Nano-Crystalline Materials in Pristine Carbonaceous Chondrite Meteorites*; NM Abreu, CM Corrigan, DC Hezel, LP Keller, KT Howard, BT De Gregorio, KL Crispin, J Gray, H Wang
- 2454 *In situ Ion Irradiation and Heating Experiments in the Transmission Electron Microscope: Simulations of Dust Processing in Circumstellar Environments*; P Haenecour, MS Thompson, TJ Zega, JY Howe, W-Y Chen
- 2456 *Analysis of in situ Nanodiamonds in Organic Matter from Primitive Meteorites with Electron Energy-Loss Spectroscopy and Energy Dispersive X-ray Spectroscopy*; BT De Gregorio, CMOD Alexander, RM Stroud
- 2458 *Understanding the Origin and Evolution of Meteoritic Refractory Minerals Through Transmission Electron Microscopy*; T Ramprasad, P Haenecour, L Seifert, TJ Zega
- 2460 *Non-invasive 3D Crystallography of Geological Media in the Laboratory*; M Andrew, H Bale, N Gueninchault, J Sun, R Hanna, J Maisano, R Ketcham, M Pankhurst, M Zolensky
- 2462 *Three-Dimensional Rock Microstructure Modeling Using Two-Dimensional SEM Micrographs*; CCY Zhang
- 2464 *Mineral Surface Transformations by Ice Nucleation*; D Veghte, R Lybrand, S China, D Zaharescu, O Qafoku
- 2466 *Correlative Microscopy of Diverse Filamentous Microfossils from 850 Ma Rocks*; D Wacey, M Saunders, A McPherson, S Gain, E Sirantoine, K Eiloart
- 2468 *Automated Feature Analysis of Complex Geological Materials*; M Hiscock, S Burgess, J Zhang, A Stavropoulou
- 2470 *Microanalytical Characterization of REE Phases in a Glauconitic Sandstone*; J Yang, C Verba, S Montross, J Moore, R McDowell, M McKoy
- 2472 *Low-dose HRTEM Study of Interstratified Clay Minerals*; G Wang, H Wang, L Zhang, H Dong, KM Kemner, J Wen
- 2474 *STEM EDS/EELS for Phase Analysis of Deep-Mantle Rock Assemblages Supported by Machine Learning*; H Chen, F Nabiei, J Badro, DTL Alexander, C Hébert
- 2476 *Addressing the Difficulties of Differentiating Members of the Feldspar Solid Solution Series via Electron Backscatter Diffraction*; SW Wallace, S Wright
- 2478 *Application of Combined Mean Atomic Number Backgrounds and Blank Corrections to EPMA Trace Element Measurements: Successes and Challenges*; OK Neill, NL La Cruz, D Hernández Uribe, JSR Jolles, JR Boro, JJ Donovan
- 2480 *Can the Source Location of a Coloured Quartz Gemstone Be Determined from Non-Destructive Chemical Analysis?*; A Halfpenny

- 2482 *Examination of Heritage and Geological Materials Using Correlated Electron- and X-ray-Beam Microanalysis in the SEM*; EP Vicenzi, T Lam
- 2484 *Chromium in Corundum: Ultra-high Contents Under Reducing Conditions*; SEM Gain, WL Griffin, M Saunders, V Toledo
- 2486 *A Showcase of Analytical Techniques: Native V in Hibonite*; SEM Gain, WL Griffin, M Saunders, J Shaw, V Toledo
- 2488 *Putting Stars in the Gap: In situ Irradiation and Heating of Synthetic SiC and Implications for the Origins of C-rich Circumstellar Materials*; TJ Zega, J Bernal, JY Howe, P Haenecour, S Amari, LM Ziurys
- 2490 *Coordinated Analyses of a Supernova Polycrystalline Olivine Aggregate in the CO Chondrite Dominion Range 08006*; L Seifert, P Haenecour, T Zega, T Ramprasad
- 2492 *SEM-based Quantitative Analysis of Lunar Meteorite Northwest Africa 2727*; SM Seddio, SN Valencia

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- 2494 *Correlative UHV-Cryo Transfer Suite: Connecting Atom Probe, SEM-FIB, Transmission Electron Microscopy via an Environmentally-Controlled Glovebox*; JM Cairney, I McCarroll, Y-S Chen, K Eder, T Sato, Z Liu, A Rosenthal, R Wepf
- 2496 *Local Electrode Atom Probe Tomography of Carbon Fibre*; RKW Marceau, AS Taylor, T Sato, SP Ringer, BL Fox, N Stanford, LC Henderson
- 2498 *New Applications to Atom Probe Tomography: Insights on Trace Element Diffusion in Naturally Deformed Minerals*; R Dubosq, B Gault, A Rogowitz, K Schweinar, S Zaefferer, D Schneider
- 2500 *Three-Dimensional Microstructural Characterization of Novel Chalcogenide Nanocomposites for Gradient Refractive Index Applications*; H Francois-Saint-Cyr, M Kang, I Martin, S Antonov, TJ Prosa, K Richardson
- 2502 *Correlative Analysis in the Semiconductor Industry*; DJ Larson, TJ Prosa, I Martin, A-S Robbes, A Merkulov, N Bernier, V Delaye, P van der Heide, O Dulac, D Reinhard, RM Ulfig
- 2504 *APT Tip Shape Modifications During Analysis, Its Implications, and the Potential to Measure Tip Shapes in Real Time via Soft X-Ray Ptychography*; P van der Heide, I Mathotkin, W Vandervost, C Fleischmann
- 2506 *Hydride Growth Mechanism in Zircaloy-4: Investigation of the Partitioning of Alloying Elements*; I Mouton, Y Chang, S Wang, AJ Breen, A Szczepaniak, LT Stephenson, D Raabe, TB Britton, B Gault
- 2508 *Understanding the Growth Mechanism of  $\beta$ -(Al<sub>x</sub>Ga<sub>1-x</sub>)<sub>2</sub>O<sub>3</sub> by Atom Probe Tomography*; J Sarker, Y Zhang, M Zhu, S Rajan, J Hwang, B Mazumder
- 2510 *Multimodal Atomic Scale Characterization of Structural and Compositional Changes During Shear Deformation of Materials*; B Gwalani, EJ Kautz, T Kaspar, L Kovarik, VV Joshi, S Mathaudhu, A Rohatgi, P Sushko, A Devaraj

- 2512 *Quantification of Solute Deuterium in Titanium Deuteride by Atom Probe Tomography with Both Laser Pulsing and High-Voltage Pulsing: Influence of the Global and Local Surface Electric Field*; YH Chang, I Mouton, L Stephenson, M Ashton, GK Zhang, A Szczepaniak, D Ponge, D Raabe, B Gault
- 2514 *Application of Atom Probe Tomography to Complex Microstructures of Laser Additively Manufactured Samples*; P Kürnsteiner, A Hariharan, HY Jung, N Peter, MB Wilms, A Weisheit, P Barriobero-Vila, B Gault, D Raabe, EA Jäggle
- 2516 *Combined APT, TEM and SAXS Characterisation of Nanometre-Scale Precipitates in Titanium Alloys*; FF Dear, P Kontis, B Gault, J Ilavsky, H Gardner, PAJ Bagot, MP Moody, D Rugg, D Dye
- 2518 *Nanoscale Spatially Resolved Mapping of Uranium Enrichment in Actinide-Bearing Materials*; E Kautz, T Lach, D Reilly, V Joshi, C Lavender, A Devaraj
- 2520 *Atom Probe Tomography Analyses of Solute Segregation in Self-Ion Irradiated Electron-Beam Welded SA508 Grade 3 Reactor Pressure Vessel Steels*; JO Douglas, PAJ Bagot, MG Burke, MP Moody
- 2522 *Direct Observation of Hydrogen in Cold-Drawn Pearlitic Steel Wires Using Cryogenic Atom Probe Tomography*; AJ Breen, Y Li, L Stephenson, B Gault, M Herbig
- 2524 *Isotopic Composition and Origin of Meteoritic Nanodiamonds Studied by Atom-Probe Tomography and Complementary Techniques*; JB Lewis, C Floss, D Isheim, TL Daulton, DN Seidman, RC Ogliore
- 2526 *Novel Synthesis and Multi-technique Characterisation of Au-Cu Nanoparticles*; Q Yang, M Danaie, N Young, V Broadley, DE Joyce, TL Martin, E Marceau, MP Moody, PAJ Bagot
- 2528 *Atomic-scale Observation of Hydroxyapatite Nanoparticle*; Y-S Chen, DS Mosiman, L Yang, TH Pham, B Hawkett, BJ Mariñas, JM Cairney
- 2530 *Atomic-scale Characterisation of Catalyst Nanoparticles in Ionic Liquids by Atom Probe Tomography*; T Li, H Meyer, A Ludwig
- 2532 *Atom Probe Tomography of Oxidised Grain Boundaries in Highly Irradiated SS316*; K Lindgren, A Jenssen, O Tengstrand, P Ekström, P Efsing, M Thuvander
- 2534 *Nanoindentation, EPMA and Atom Probe Tomography Characterisation of Oxygen-rich Layer Formed on a Titanium Jet Engine Component*; HM Gardner, A Radecka, D Rugg, DEJ Armstrong, MP Moody, PAJ Bagot
- 2536 *Spatial Reconstruction of Atom Probe Data from Zircon*; DW Saxey, D Fougereuse, WDA Rickard, SM Reddy
- 2538 *Deformation of Borides in Nickel-based Superalloys: a Study of Segregation at Dislocations*; L Lilensten, S Antonov, D Raabe, S Tin, B Gault, P Kontis
- 2540 *Characterization of p-type Doping in Silicon Nanocrystals Embedded in SiO<sub>2</sub>*; R Demoulin, M Roussel, S Duguay, D Muller, D Mathiot, P Pareige, E Talbot

- 2542 *Influence of Composition and Structure on Measured H Concentration in beta-Ti Alloys via Atom Probe Tomography*; J Ballor, E Kautz, B Gwalani, C Boehlert, A Devaraj
- 2544 *Complementary SEM-EDS / FIB-SEM Sample Preparation Techniques for Atom Probe Tomography of nanophase-Fe<sup>0</sup> in Apollo 16 Regolith Sample 61501,22*; P Gopon, JO Douglas, J Wade, MP Moody
- 2546 *Atom Probe Tomography Investigation on the Effect of Ni Additions on the Site Occupation and Partitioning Behavior in Co-Based Superalloys*; S Antonov, A Day, H Francois Saint Cyr, S Lu, W Li, Q Feng
- 2548 *In situ Crystallization of Metallic Glass in an Atom Probe Instrument*; DR Diercks, R Jha, CV Ciobanu, AP Stebner
- 2550 *Performance of Ultra-Violet Laser Pulsing with a Wire-Geometry, Moderately Focused Atom Probe System (EIKOS)*; RM Ulfig, J Bunton, D Lenz, Y Chen, KP Rice, TJ Prosa, PH Clifton, DJ Larson
- 2552 *An Atom-probe Tomography Study of the Stability of Oxide-dispersion Strengthening Particles in 14YWT Exposed to Neutron Irradiation*; K Kruska, DJ Edwards, J Wang, T Yamamoto, CH Henager, RJ Kurtz, GR Odette
- 2554 *Post-FIB Specimen Preparation of Atom Probe Specimens under Controlled Environments for Correlative Microscopy*; CS Bonifacio, P Nowakowski, K Costello, ML Ray, R Morrison, PE Fischione

### ***Advanced Characterization of Components Fabricated by Additive Manufacturing***

- 2556 *Porosity Formation and Meltpool Geometry Analysis Using High-speed, in situ Imaging of Directed Energy Deposition*; S Webster, S Wolff, J Bennett, T Sun, J Cao, K Ehmann
- 2558 *High Resolution X-ray Microscopy for 3D Characterization and Qualification of AM Materials*; WM Harris, H Bale, ST Kelly
- 2560 *Understanding the High Strength of L-PBF Metals Using in and ex situ Characterization by TEM and Synchrotron XRD*; T Voisin, JB Forien, JT McKeown, MJ Matthews, YM Wang
- 2562 *Melt Pool and Microstructure Characterization for AM Model Development*; JT McKeown, JD Roehling, A Perron, J-L Fattebert, JMK Wieszorek, AJ Clarke, DJ Bober, JN Florando, M Kumar, SA Khairallah, MJ Matthews
- 2564 *Rapid Analysis as an Integral Part of Additive Manufacturing*; J Goulden, P Trimby, J Porter, M Hiscock
- 2566 *In situ Characterization of Laser Powder Bed Fusion Using High-Speed Synchrotron X-ray Imaging Technique*; N Parab, C Zhao, R Cunningham, LI Escano, K Fezzaa, A Rollett, L Chen, T Sun
- 2568 *Effect of Cyclic Thermal Loadings on the Microstructural Evolution of a Cantor Alloy in 3D Printing Processes*; H Wang, ZG Zhu, HS Chen, SM Nai, XH An, RK Zheng, S Primig, SP Ringer, XZ Liao
- 2570 *Microstructural Analysis of Additively Manufactured Corrosion Resistant Duplex Stainless Steel Clads on Carbon Steel Substrate*; P Murkute, S Pasebani, OB Isgor

- 2572 *Effect of Part Placement Strategy on the Microstructure of Additively Manufactured 17-4PH Stainless Steel Thin-Wall Parts*; Y Sun, M Aindow, RJ Hebert
- 2574 *Contribution of Microstructural Features at Various Length Scales to the Strength of Additively Manufactured Austenitic Stainless Steels*; JD Sugar, TR Smith, CS Marchi
- 2576 *Microstructural Evolution during Heat Treatment of 3D Printed Maraging Steel*; F Tetteh, S Boakye-Yiadom
- 2578 *Additive Manufacturing of Ni-Mn-Cu-Ga: Influence of Sintering Temperature on Magnetocaloric Effect and Microstructure*; E Stevens, D Salazar, K Kimes, RR de Vecchis, V Chernenko, M Chmielus
- 2580 *Corrosion-resistance Microstructure Design Using Mesoscale Modeling Environment for Additive Manufacturing for Co-Cr Alloys*; X Yan, A Samei, B Mercer, P Priyia, S Chaudhuri
- 2582 *Processing-Microstructure Relationships From 3D Characterization of Additively Manufactured Metals*; AT Polonsky, N Raghavan, MP Echlin, WC Lenthe, MM Kirka, RR Dehoff, TM Pollock
- 2584 *2D/3D Characterization of AM IN625 For Calibrating and Validating AM Modelling Techniques*; MG Chapman, MD Uchic, MA Groeber, EJ Schwalbach, SP Donegan, ME Cox
- 2586 *Multiscale Characterization of Microstructure and Residual Strain Distribution in Additively Manufactured Inconel 625*; KA Small, ML Taheri
- 2588 *TEM Study of Additively Manufactured Metallic Alloys: Nickel Aluminum Bronze*; BS Amirkhiz, D Chalasani, M Mohammadi
- 2590 *Using Microscopy and Image Analysis to Show Density and Property Variations in Additive Manufactured Ti-6Al-4V*; E Stevens, S Schloder, E Bono, D Schmidt, M Chmielus
- 2592 *Identification of Twin Formation in Additively Manufactured Stainless Steel by in-situ EBSD*; SM Dickens, PJ Noell, JM Rodelas, D Wilson
- 2594 *Microstructural Analysis of Additively Manufactured 304L Stainless Steel Oxide Dispersion Strengthened Alloy*; M Ghayoor, K Lee, Y He, C-H Chang, BK Paul, S Pasebani
- 2596 *Understanding Microstructural Properties of  $Al_xCrCoFeNiCu$  High Entropy Alloy by Advanced Scanning Transmission Electron Microscopy*; P Lu, A Kustas, N Argibay, M Chandross, S Whetten
- 2598 *Quantitative Study on the Effect of Thermal Gradients on the Microstructure of Additively Manufactured Ti-6Al-4V Builds*; M Shao, C Blackwell, S Vijayan, S Kumar, SS Babu, JR Jinschek
- 2600 *Binder Jet 3D Printing of 316L Stainless Steel: Effects of HIP on Fatigue*; K Kimes, K Myers, A Klein, M Ahlfors, E Stevens, M Chmielus
- 2602 *Hardness Variation of Microstructural Heterogeneities in Directed Energy Deposited 304L Stainless Steel*; H Vega, TR Smith, CS Marchi, RW Friddle, JD Sugar
- 2604 *Microstructural Characterization of WC-Co Cemented Carbide Processed Using Selective Laser Sintering*; J Agyapong, A Czekanski, S Boakye-Yiadom

2606 *Materials Characterization of Thin Films Printed with Ge<sub>20</sub>Se<sub>80</sub> Ink*; A-A Ahmed Simon, SM Rahmot Ullah, B Badamchi, H Subbaraman, M Mitkova

2608 *Studies and Analysis of Ge<sub>x</sub>Se<sub>100-x</sub> Based Spin Coated Chalcogenide Thin Films*; SMR Ullah, A-A Ahmed Simon, M Mitkova

## ***Microstructural and Mechanical Characterization of Metallic Alloys***

2610 *Characterization of Misfit Dislocations at Heterovalent II-VI/III-V Interfaces*; BS McKeon, X Liu, JK Furdyna, DJ Smith

2612 *Structure, Morphology and Coarsening Behavior of MX (NbC) Nanoprecipitates in Fe-Ni-Cr Based Alloys*; M Heczko, BD Esser, R Gröger, L Feng, V Mazánová, Y Wang, MJ Mills

2614 *Characterization of Complex Retained Austenite on a TRIP800 Automotive Steel*; NI Makris, S Deligiannis, A Alexandratou, P Tsakiridis, G Fournalis

2616 *Effect of High Temperature Impact on The Formation of Adiabatic Shear Bands*; A Eliasu, S Boakye-Yiadom

2618 *Ternary Fe-Al-Si Alloys Prepared by Mechanical Alloying and Spark Plasma Sintering*; J Kopeček, F Laufek, M Karlík, P Haušild, J Čech, A Školáková, K Nová, B Severa, J Šesták, P Novák, F Průša

2620 *Effect of Ni Addition and T6 Heat Treatment on Microstructure and Microhardness of Hot Plastic Deformed (Al-Si-Mg) Alloys*; HM Medrano-Prieto, CG Garay-Reyes, I Estrada-Guel, JM Mendoza-Duarte, JC Guía-Tello, JS Castro-Carmona, H Camacho-Montes, MC Maldonado-Orozco, R Martínez-Sánchez

2622 *Improvement of Mechanical Properties of an Aluminum Alloy 7075 by Adding Reduced Graphene Oxide Through Mechanical Milling*; E Cuadros-Lugo, I Estrada-Guel, JM Herrera-Ramirez, C López-Meléndez, C Carreño-Gallardo

2624 *Exploring the Reinforcing Effect of Ag<sub>c</sub>NP and Al<sub>2</sub>O<sub>3</sub>NP in Aluminum Alloy 2024 Matrix Composites*; C Carreño-Gallardo, E Cuadros-Lugo, I Estrada-Guel, C López-Meléndez, JM Herrera-Ramirez

2626 *Effect of the Age-hardening Time on the Microstructure of Cold Rolled Al<sub>2024</sub> Alloy*; JC Guía-Tello, CG Garay-Reyes, HM Medrano-Prieto, MA Ruiz Esparza-Rodriguez, MC Maldonado-Orozco, G Rodriguez-Cabriaes, R Martínez-Sánchez

2628 *Wear Behavior in Al-Cu-Mg Alloy Reinforced with WC Particles Fabricated by Mechanical Alloying*; G Rodriguez-Cabriaes, CG Garay-Reyes, I Estrada-Guel, MC Maldonado-Orozco, R Martínez-Sánchez

2630 *Scanning Electron Microscopy of the Electrochemical Corrosion Products of a Titanium based Metallic Foam*; L Béjar, E Huape, A Medina, AA Mejía, C Aguilar, I Alfonso

2632 *Evaluation of Mechanical Properties of Ti/Al/Zr-N and Zr/Al/Ti-N Thin Films*; CD Gómez-Esparza, RP Talamantes-Soto, A Duarte-Moller

2634 *Microstructural Evolution of Cold-Rolled  $\beta$  Metastable Ti-29Nb-2Mo-6Zr Alloy*; AR Vieira Nunes, S Borborema, L Malet, J Dille, LH de Almeida

- 2636 *A Comparative TEM Study of Nanoprecipitate Formation in Waspaloy® Welds*; A Alexandratou, S Deligiannis, NI Makris, P Tsakiridis, G Fourlaris
- 2638 *Rationalization of Thermo-Mechanical Instabilities in Transient Additive Manufacturing of Ni-based Superalloys*; B Lim, XY Cui, S Ringer
- 2640 *Microstructural Behavior of AA319 Aluminum Alloy Modified with Nickel*; J Camarillo-Cisneros, R Martinez-Sanchez, H Arcos-Gutierrez, IE Garduño-Olvera, R Pérez-Bustamante
- 2642 *Microstructural and Hardness Behavior of AlCoCuFeNi and AlCoCuFeNiCr High-Entropy Alloys Synthesized by Milling and Arc Melting*; CD Gomez-Esparza, M Hernandez-Hernandez, VH Mercado-Lemus, R Pérez-Bustamante
- 2644 *Densification, Microhardness and Microstructural Evolution by Fast Low-Temperature Consolidation of Al<sub>x</sub>CoCrFeMnNi High Entropy Alloy*; MA Ruiz-Esparza-Rodriguez, CG Garay-Reyes, JM Mendoza-Duarte, I Estrada-Guel, R Martinez-Sanchez
- 2646 *Microstructural Study and Antibacterial Response of an AlCoCrCuFeMoNi High-Entropy Alloy*; CD Gómez-Esparza, CA Ramírez-Valdespino, I Estrada-Guel, A Duarte-Moller
- 2648 *Microstructural Study of Fe-Cr-Al-X (X=Nd,Pr) Alloys for High Temperature Structural Applications*; MA Encinas Ocejo, O Hernández-Negrete, G Tiburcio Munive, F Brown, A Valenzuela Soto, HE Esparza Ponce
- 2650 *Discontinuous Precipitation of  $\alpha$ -Cr Phase in Alloy 33 (Cr-Fe-Ni-N)*; JC Spadotto, MG Burke, IG Solórzano
- 2652 *Influence of the Powder Pack Boriding Mixture on the FeB and Fe<sub>2</sub>B Layers*; M Ortiz-Domínguez, G Ares de Parga, A Arenas-Flores, I Morgado-Gonzalez, OA Gómez-Vargas, J Zuno-Silva, A Cruz-Avilés
- 2654 *Investigation of Digital Imaging Processing in Determining Nano-Particle Size Distribution Based on Scanning Electron Microscopic Image*; BC Park, MJ Kwak
- 2656 *Effect of Finishing and Coiling Temperatures on the Nanoprecipitate Dispersion in Novel HSLA Steels*; S Deligiannis, A Alexandratou, NI Makris, P Tsakiridis, G Fourlaris

## Technologist Forum, Tutorials, and Outreach Symposia

### ***Tech Forum Session: Utilization of the National NIH-Funded Cryo-EM Centers: Transformative High Resolution Cryo-Electron Microscopy***

- 2658 *Stanford-SLAC Cryo-EM Center (S<sup>2</sup>C<sup>2</sup>)*; W Chiu, YT Li, D Bushnell, MF Schmid, G Skiniotis, B Hedman
- 2660 *Introducing The Pacific Northwest Center for Cryo-EM*; C Yoshioka
- 2662 *Best Practices at the National Center for CryoEM Access and Training*; ET Eng, WJ Rice, A Cheng, B Carragher, CS Potter

## ***Technologists' Forum Roundtable: Technical Careers in Microscopy – For the Love of Microscopy***

2664 *Career Advancement: Microscopy Technician to Core Facility Director*; FP Macaluso

2666 *My Life as a Microscopist; Two Dual Beams and an Atom Probe*; RL Martens, TF Kelly, GB Thompson

2668 *A Career with Passion in The Sciences*; T Nylese

2670 *The MSA Certification Program for Biological Electron Microscopy*; L Cohen-Gould

2672 *A Review of Fifty Years of Light and Electron Microscopy at a Two-Year Community College*; F Villalovoz, C Davis

## ***Tech Forum Session: Imaging Resin Embedded Samples for Serial Block Face Imaging or Array Tomography***

2674 *Essentials of Specimen Preparation for High Performance Volume Imaging by SEM*; TJ Deerinck

2676 *Tools for 3D Electron in Life Sciences – Generate Meaningful Statistics from 3DEM Data Microscopy*; J Mancuso, K Czymmek, AF Elli

2678 *Correlation Of Imaging Technologies: Methodologies*; CS López, K Loftis, G Thibault, S Kwon, E Stempinski, JL Riesterer, JW Gray

## ***Following the Electrons: Simulation for High-Resolution STEM and CBEDs***

2680 *Following the Electrons: Simulation for High-Resolution STEM and CBED*; MP Oxley

## ***Entrepreneurship in the Microscopy Community***

2682 *Entrepreneurship in Microscopy: Identifying and Addressing Needs in the Microscopy Market*; D Masiel

## ***Efficient Phase Contrast Imaging via Electron Ptychography***

2684 *Efficient Phase Contrast Imaging via Electron Ptychography, a Tutorial*; TJ Pennycook, GT Martinez, CM O'Leary, H Yang, PD Nellist

## ***Expanding the Computational Toolbox for CryoEM***

2686 *Expanding the Computational Toolbox for Single-Particle Cryo-Electron Microscopy*; A Bartesaghi

## ***Electron Optics for CryoEM: Facts and Myths***

2688 *High-End Data Collection for Single-Particle Cryo-EM*; F Weis



## ***Biological Sciences Tutorial: Tips and Tricks for High-Pressure Freezing / Freeze Substitution***

2690 *Biological Sciences Tutorial: Tips and Tricks for High-Pressure Freezing / Freeze Substitution*; M Schauflinger

## ***Microscopy Explorations***

2692 *Suitability of Martian Regolith as Material for Future Dwellings—An Investigation by Middle School Students in Collaboration with MIT and JEOL, USA*; N Miller, M Richmond, B Meagan, S Richardson, O Akubude, W Bao, R Li, K Dinner, H Griffin, D Shattuck, FM Martinez, Z Qin, M Buehler, K Kupwade-Patil, V Robertson

2694 *The Morgan University STEM EXPO: A STEM Microscopy Workshop Offered at the Community Level*; F Denaro, L Givens, D Hill-Bartlett, J Ross, C Sampson, S Sampson, S E Sampson, T Smarton, S Nyaga

# Welcome from the Society Presidents



On behalf of the Microscopy Society of America, the Microanalysis Society, and the International Field Emission Society, we welcome you to Microscopy & Microanalysis 2019 at the Oregon Convention Center in Portland, Oregon. It's an excellent venue with wonderful restaurants, lots of activities for the family, and a comfortable climate.

The Program Committee, led by Alice Dohnalkova, Huolin Xin, Assel Aitkaliyeva, and Baptiste Gault, has developed an exciting group of symposia, spanning advances in instrumentation and techniques development, as well as applications in the analytical, biological, and physical sciences. A record number of paper submissions this year is sure to guarantee an exciting and robust program of cutting-edge research!

The main meeting starts with the Opening Welcome Reception on Sunday evening. The Sunday reception is a great place for all attendees to meet new colleagues and reconnect with old friends. On Monday morning, the Plenary Session kicks off the scientific program with two exciting plenary lectures from 2017 Nobel Prize in Chemistry co-winners, Professors Joachim Frank and Richard Henderson, the presentations of the M&M meeting awards, and awards from the sponsoring societies. Please join us in welcoming back these long-time MSA members and frequent M&M attendees as they discuss their groundbreaking work in cryo-electron microscopy.

In addition to the strong scientific program, what sets the M&M meeting apart is the Exhibit Hall, the world's largest annual microscopy exhibition, which showcases the latest in microscopy instrumentation and accessories. Don't miss the highly popular vendor tutorials, held Monday through Wednesday after hours in the Exhibit Hall. Other educational opportunities throughout the week include focused biological and physical science tutorials, educational outreach programs, and our Technologists' Forum special and roundtable sessions.

In short, M&M 2019 is an outstanding opportunity to stay abreast of the latest technologies, hear about new developments in applications across all areas of microscopy and microanalysis, and most importantly network with colleagues.

Welcome to Portland!

**Paul Kotula**  
Sandia National  
Laboratories  
President, Microscopy  
Society of America



**Rhonda Stroud**  
U.S. Naval  
Research Laboratory  
President,  
Microanalysis Society



**David Larson**  
AMETEK, Inc.  
President, International  
Field Emission Society



# WELCOME FROM THE PROGRAM CHAIRS

On behalf of the Microscopy Society of America (MSA), the Microanalysis Society (MAS), and the International Field Emission Society (IFES), we are excited to welcome you to Microscopy & Microanalysis 2019 in Portland, Oregon.



As many of you who have previously visited Portland know, this city is a terrific location for our meeting: set between Mt. Hood and the Pacific coast, Portland (PDX to locals) presents a variety of attractions for everybody. Infused with the awesome Pacific Northwest culture of environmental conservation and organic local food sourcing, you will find a lot of wonderful restaurants here, plus a myriad of microbreweries, distilleries and wineries! Don't forget to visit famous PDX staples like Powell's Books and the charismatic Voodoo Donuts. Don't forget your hiking shoes or beachwear if you're planning to explore the great outdoors like the Columbia Gorge area or the Oregon Coast beaches.

The meeting itself will be preceded by our usual array of Sunday Short Courses, two Pre-Meeting Congresses, and our Sunday evening Opening Welcome Reception. We will once again hold a Pre-Meeting Congress featuring outstanding work by students and early-career researchers.

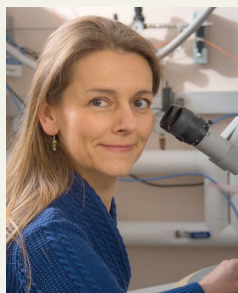
The technical program will kick off with our annual Monday morning plenary session, featuring the major awards ceremonies for the sponsoring societies, the M&M meeting awards, and two exciting plenary talks of the 2017 Nobel Prize laureates Joachim Frank and Richard Henderson.

Immediately following the plenary session, the largest microscopy/ microanalysis instrument exhibition in the world opens to participants. Plan to visit the more than 100 companies displaying their latest technology and services. The social activities of the opening reception, and daily "happy hours" accompanying each day's poster and awards sessions, have become "can't-miss" events of learning and fellowship.

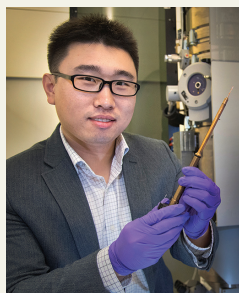
For a complete description of all the symposia, contributed sessions, educational opportunities and the multiple award possibilities from the three organizing societies, please visit:

<http://www.microscopy.org/MandM/2019/>.

Be sure to download the M&M 2019 mobile app! ("M&M Annual Meeting" in App Store or Google Play.)



**Alice Dohnalkova**  
PROGRAM CHAIR



**Huolin Xin**  
PROGRAM CO-CHAIR



**Assel Aitkaliyeva**  
MAS CO-CHAIR



**Baptiste Gault**  
IFES CO-CHAIR

## 2019 COUNCIL – OFFICERS & DIRECTORS

<b>President</b>	Paul Kotula
<b>Past President</b>	Robert L. Price
<b>President-Elect</b>	Esther Bullitt
<b>Secretary</b>	Pamela F. Lloyd
<b>Treasurer</b>	Peter A. Crozier
<b>Director</b>	Elizabeth A. Dickey
<b>Director (Local Affiliated Societies)</b>	Patricia Jansma
<b>Director</b>	Deborah F. Kelly
<b>Director</b>	Lena Kourkoutis
<b>Director</b>	Melanie Ohi
<b>Director</b>	Jay Potts
<b>Director</b>	Yimei Zhu

## APPOINTED OFFICERS

<b>Archives</b>	Michael Marko
<b>Awards Committee Chair</b>	Miaofang Chi
<b>Certification Board Chair</b>	Lee Cohen-Gould
<b>Educational Outreach Committee Chair</b>	Rengasayee (Sai) Veeraraghavan
<b>Educational Outreach Committee Vice Chairs</b>	Isabel Boona
<b>Educational Resources Chair</b>	Donovan Leonard
<b>Fellows Chair</b>	Esther Bullitt
<b>Finance</b>	Peter A. Crozier
<b>International Committee</b>	David C. Bell
<b>Membership Committee Chair</b>	James Kilcrease
<b>Nominating Committee Chair</b>	Robert L. Price
<b>Placement Office</b>	Katie Jungjohann
<b>Sustaining Members Chair</b>	Stephen E. Mick
<b>Standards Committee</b>	Nestor J. Zaluzec
<b>Student Council President</b>	A. Cameron Varano
<b>Technologists' Forum</b>	Janice Pennington

## FOCUSED INTEREST GROUPS

<b>Focused Interest Group Chair</b>	Andrew D. Vogt
<b>3D Electron Microscopy in the Biological Sciences</b>	Steven Ludtke
<b>Aberration-Corrected Electron Microscopy</b>	Juan Carlos Idrobo
<b>Atom Probe Field Ion Microscopy</b>	Arun Devaraj
<b>Cryo-preparation</b>	Kim Rensing
<b>Diagnostic Microscopy</b>	Greg Ning
<b>Electron Crystallography and Automated Mapping Techniques</b>	Alex Eggeman
<b>Electron Microscopy in Liquids and Gas (EMLG)</b>	Raymond R. Unocic
<b>Facilities Operation &amp; Management (FOM)</b>	Christine A. Brantner
<b>Focused Ion Beam</b>	Suzy Vitale
<b>Pharmaceuticals</b>	Jason Mantei
<b>MicroAnalytic Standards</b>	Anette von der Handt

## 2019 STUDENT COUNCIL

<b>President</b>	A. Cameron Varano
<b>Past President</b>	Janet Gbur
<b>President-Elect</b>	Erica Stevens
<b>Secretary</b>	Jackson Spurling
<b>Treasurer</b>	Kartik Venkatraman
<b>Program Chair</b>	Ethan L. Lawrence

## PUBLICATIONS

<b><i>Microscopy and Microanalysis</i> Editor in Chief</b>	John F. Mansfield
<b>Scientific Program Editor</b>	Richard L. Martens
<b>M&amp;M 2019 Proceedings Editor</b>	Gail J. Celio
<b><i>Microscopy Today</i> Editor-in-Chief</b>	Charles E. Lyman

## M&M 2019 ANNUAL MEETING PROGRAM CHAIR

Alice Dohnalkova

## SOCIETY & MEETING MANAGEMENT

<b>Association Management</b>	Virtual, Inc.
<b>Managing Director</b>	Ashley Carey
<b>Meeting Management</b>	Conference Managers
<b>Meeting &amp; Registration Managers</b>	Nicole Guy, Maeve Carey, Corey Siembieda
<b>Exhibition Management</b>	Corcoran Expositions, Inc.
<b>Exhibits &amp; Sponsorship Managers</b>	Doreen Bonnema, Mary Michalik

## MSA PAST PRESIDENTS

1942	G.L. Clark	1968	John H. Luft	1994	Robert R. Cardell
1943	R. Bowling Barnes	1969	Wilbur C. Bigelow	1995	Terence E. Mitchell
1944	R. Bowling Barnes	1970	Russell Steere	1996	Margaret Ann Goldstein
1945	James Hillier	1971	Robert M. Fisher	1997	C. Barry Carter
1946	David Harker	1972	Daniel C. Pease	1998	Ralph M. Albrecht
1947	William G. Kinsinger	1973	Benjamin Siegel	1999	David C. Joy
1948	Perry C. Smith	1974	Russell J. Barnett	2000	Kenneth H. Downing
1949	F.O. Schmitt	1975	Gareth Thomas	2001	Ronald M. Anderson
1950	Ralph W.G. Wyckoff	1976	Etienne de Harven	2002	Stanley L. Erlandsen
1951	Robley C. Williams	1977	Thomas E. Everhart	2003	J. Alwyn Eades
1952	R.D. Heidenreich	1978	Myron C. Ledbetter	2004	Sara E. Miller
1953	Cecil E. Hall	1979	John Silcox	2005	M. Grace Burke
1954	Robert G. Picard	1980	Michael Beer	2006	W. Gray (Jay) Jerome
1955	Thomas F. Anderson	1981	John J. Hren	2007	Michael A. O'Keefe
1956	William L. Grube	1982	Lee Peachey	2008	William T. Gunning
1957	John H.L. Watson	1983	David B. Wittry	2009	David J. Smith
1958	Max Swerdlow	1984	J. David Robertson	2010	David W. Piston
1959	John H. Reisner	1985	Dale E. Johnson	2011	Nestor J. Zaluzec
1960	D. Gordon Sharp	1986	Robert M. Glaeser	2012	Janet H. Woodward
1961	D. Maxwell Teague	1987	Linn W. Hobbs	2013	Ernest L. Hall
1962	Keith R. Porter	1988	Jean Paul Revel	2014	Jeanette Killius
1963	Charles Schwartz	1989	Ray W. Carpenter	2015	John F. Mansfield
1964	Sidney S. Breese	1990	Keith R. Porter	2016	Michael Marko
1965	Virgil G. Peck	1991	Charles E. Lyman	2017	Ian M. Anderson
1966	Walter Frajola	1992	Patricia Calarco	2018	Robert L. Price
1967	Joseph J. Comer	1993	Michael S. Isaacson		

## 2019

Wilbur C. Bigelow  
Edward D. Boyes  
Pratibha L. Gai  
Ronald Gronsky  
Maximilian Haider  
Michael Marko  
David W. McComb  
Karren L. More

## 2018

Wen-An Chiou  
Linn Hobbs  
Elaine Humphrey  
Kazuo Ishizuka  
David Larson  
Guillermo Solórzano-Naranjo  
Judy Yang  
Jian-Min Zuo

## 2017

David C. Bell  
Paul E. Fischione  
Christopher J. Kiely  
Jeanette Killius  
Laurence D. Marks  
Peter Rez  
Phillip E. Russell  
Heide Schatten

## 2016

Helmut Gnaegi  
Ernest L. Hall  
David N. Mastronarde  
Stuart McKernan  
Renu Sharma  
George D.W. Smith  
Kenneth A. Taylor  
James E. Wittig

## 2015

Rafal E. Dunin-Borkowski  
Michael E. Davidson  
E. Ann Ellis  
Peter W. Hawkes  
Miguel José-Yacamán  
Kent L. McDonald  
Stanley Frank Platek  
Michael T. Postek  
Susanne Stemmer  
Michael M.J. Treacy

## 2014

Gianluigi Botton  
Wah Chiu  
Abhaya K. Datye  
Marija Gajdardziska-Josifovska  
Lucille A. Giannuzzi  
Thomas F. Kelly  
John F. Mansfield  
Martha R. McCartney  
Xiaoqing Pan  
David W. Piston

## 2013

Timothy S. Baker  
Nigel D. Browning  
David J. DeRosier  
Hamish L. Fraser  
David A. Muller  
Michael Radermacher  
David J. Smith  
Eric A. Stach

## 2012

Ulrich Dahmen  
Margaret Ann Goldstein  
Moon Kim  
William J. Landis  
Jingyue Liu  
Beverly E. Maleeff  
Robert L. Price  
Frances M. Ross  
David N. Seidman  
Debra Sherman  
Nan Yao

## 2011

Ueli Aebi  
Philip E. Batson  
Patricia G. Calarco-Isaacson  
Peter A. Crozier  
J. Alwyn Eades  
Brendan J. Griffin  
William T. Gunning, III  
W. Gray Jerome  
Richard D. Leapman  
Hannes Lichte  
Charles E. Lyman  
Michael A. O'Keefe  
George Perry  
Robert B. Simmons  
Janet H. Woodward

## 2009 (Inaugural Class)

Marc Adrian	Myron C. Ledbetter
Ronald M. Anderson	Dennis McMullan
James Bentley	Joseph R. Michael
Mary Grace Burke	Sara E. Miller
Ray W. Carpenter	Terrence E. Mitchell
C. Barry Carter	Thomas Mulvey
Albert V. Crewe	Dale E. Newbury
Marc De Graef	Gertrude Rempfer
Vinayak P. Dravid	Jean-Paul Revel
Jacques Dubochet	Harald Rose
Patrick Echlin	F.O. Schmitt
Raymond F. Egerton	Caroline Schooley
Marilyn G. Farquhar	Ryuichi Shimizu
Don W. Fawcett	John Silcox
Joachim Frank	Robert Sinclair
Robert M. Glaeser	S.J. Singer
Audrey M. Glauert	Fritiof Sjostrand
Raymond Kenneth Hart	Kenneth C.A. Smith
Hatsujiro Hashimoto	Avril V. Somlyo
Richard Henderson	John C.H. Spence
Peter B. Hirsch	Alasdair C. Steven
Archibald Howie	Peter R. Swann
Hugh E. Huxley	Gareth Thomas
Takeo Ichinokawa	Kiyoteru Tokuyasu
Sumio Iijima	Nigel Unwin
Shinya Inoué	Joseph S. Wall
David C. Joy	Oliver C. Wells
Morris J. Karnovsky	Michael J. Whelan
Aaron Klug	Nestor J. Zaluzec
Ondrej L. Krivanek	Elmar Zeitler
	Yimei Zhu

## 2010

Ralph M. Albrecht  
Lawrence F. Allard, Jr.  
Kenneth H. Downing  
Joseph I. Goldstein  
Michael S. Isaacson  
Michael K. Miller  
George Pappas  
Stephen J. Pennycook  
John P. Petrali  
Zhong L. Wang  
David B. Williams

## PHYSICAL SCIENCES (2019)

### Philip E. Batson

Rutgers University, Department of Physics and Astronomy

Philip E. Batson is a Distinguished Research Professor at Rutgers University, with appointments in Physics, and Materials Science, since his retirement from the IBM Thomas J. Watson Research Center in 2009. After receiving a Ph.D. in Applied Physics in 1976 at Cornell University, he did post-doctoral work at the Cavendish Laboratory in Cambridge England, and then moved to IBM in 1978. During the 1980's he built high resolution EELS equipment there and used it to explore spatially resolved EELS in the STEM, with studies of surface plasmon scattering in metal nanoparticle systems. In 2002, he was the first to demonstrate sub-Angstrom imaging using aberration correction, for which he was recognized with a 2002-2003 Scientific American 50 Award for Leadership in Imaging Sciences. Currently, he is exploring phonon behavior in nanometer sized structures Using EELS with a 10 meV energy resolution. The NSF sponsored project in collaboration with Nion to improve EELS resolution was cited by the White House in 2010 as one of "100 Recovery Act Projects that are Changing America." He has authored about 210 publications and is a Fellow of the American Physical Society and the Microscopy Society of America.



## BIOLOGICAL SCIENCES (2019)

### Bridget Carragher

Simons Electron Microscopy Center, New York Structural Biology Center

Bridget Carragher received her Ph.D. in Biophysics from the University of Chicago in 1987. She then worked in a variety of positions, both in industry and academia until moving to the Scripps Research Institute in 2001. Since 2002 she has served, together with Clint Potter, as the Director of the National Resource for Automated Molecular Microscopy (NRAMM), an NIH funded national biotechnology research resource. The focus of NRAMM is the development of automated imaging techniques for solving three-Dimensional structures of macromolecular complexes using cryo-transmission electron microscopy (cryoEM). The overall goal is to develop new methods to improve the entire process, from specimen preparation to the generation of the final three-Dimensional map. In 2007 Bridget co-founded a new company, Nanolmaging Services, Inc., whose goal is to provide cryoEM and other microscopy services to the biopharmaceutical and biotechnology industry. She serves as Chief Technical Officer of Nanolmaging Services. In 2015 Bridget and Clint moved their academic lab from The Scripps Research Institute to the New York Structural Biology Center where they serve as Co-Directors of the Simons Electron Microscopy Center. In May 2018 they were awarded a U24 grant to build the National Center for CryoEM Access and Training (NCCAT).



	BIOLOGICAL SCIENCES	PHYSICAL SCIENCES
1975	Keith R. Porter	Robert Heidenreich
1976	L.L. Marton	Albert V. Crewe
1977	Robley C. Williams	James Hillier
1978	Thomas Anderson	Vernon E. Cosslett
1979	Daniel C. Pease	John M. Cowley
1980	George E. Palade	Gareth Thomas
1981	Sanford L. Palay	Vladimir K. Zworykin
1982	Richard M. Eakin	Benjamin M. Siegel
1983	Hans Ris	Otto Scherzer
1984	Cecil E. Hall	Charles W. Oatley
1985	Gaston Dupouy	Ernst Ruska
1986	F. O. Schmitt	Peter B. Hirsch
1987	Marilyn G. Farquhar	Jan B. LePoole
1988	Morris J. Karnovsky	Hatsujiro Hashimoto
1989	Don W. Fawcett	Elmar Zeitler
1990	Audrey M. Glauert	Gertrude F. Rempfer
1991	Hugh E. Huxley	Archibald Howie
1992	Fritiof Sjöstrand	Oliver C. Wells
1993	Jean-Paul Revel	Kenneth C.A. Smith
1994	Andrew P. Somlyo	Dennis McMullan
1995	Shinya Inoué	David B. Wittry
1996	Myron C. Ledbetter	John Silcox

	BIOLOGICAL SCIENCES	PHYSICAL SCIENCES
1997	S.J. Singer	Peter R. Swann
1998	Avril V. Somlyo	Michael J. Whelan
1999	Sir Aaron Klug	Takeo Ichinokawa
2000	K. Tokuyasu	S. Amelinckx
2001	Patrick Echlin	Thomas Mulvey
2002	Marc Adrian	Ryuichi Shimizu
2003	Joachim Frank	Harald Rose
2004	Robert M. Glaeser	Raymond F. Egerton
2005	Richard Henderson	Sumio Iijima
2006	Joseph S. Wall	John C.H. Spence
2007	Nigel Unwin	Terence E. Mitchell
2008	Alasdair C. Steven	Ondrej L. Krivanek
2009	Jacques Dubochet	Robert Sinclair
2010	George Papas	Michael S. Isaacson
2011	Ueli Aebi	Hannes Lichte
2012	Timothy S. Baker	Ulrich Dahmen
2013	David J. DeRosier	C. Barry Carter
2014	Wah Chiu	David J. Smith
2015	Michael W. Davidson	Peter W. Hawkes
2016	Kenneth H. Downing	George W. Smith
2017	David W. Piston	Nestor J. Zaluzec
2018	Richard Leapman	Yimei Zhu

## BURTON MEDAL AWARD (2019)

### Hari Shroff

National Institute of Health



Dr. Hari Shroff received a B.S.E. in bioengineering from the University of Washington in 2001, and under the supervision of Dr. Jan Liphardt, completed his Ph.D. in biophysics at the University of California at Berkeley in 2006. He spent the next three years performing postdoctoral research under the mentorship of Eric Betzig at the Howard Hughes Medical Institute's Janelia Farm Research Campus where his research focused on development of photactivated localization microscopy (PALM), an optical super-resolution technique. Dr. Shroff is now chief of NIBIB's Section on High Resolution Optical Imaging laboratory, where he and his staff are developing new imaging tools for application in biological research. Current research areas include further development of super-resolution microscopy, light-sheet microscopy, inverse imaging problems, deep learning for microscopy, and the study of neurodevelopment in *C. elegans*.

## MORTON D. MASER DISTINGUISHED SERVICE AWARD (2019)

No 2019 awardee.

### YEAR RECIPIENT

1975	James Lake
1976	Michael S. Isaacson
1977	Robert Sinclair
1978	David C. Joy
1979	Norton B. Gilula
1980	John C.H. Spence
1981	Barbara J. Panessa-Warren
1982	Nestor J. Zaluzec
1983	Ronald Gronsky
1984	David B. Williams
1985	Richard D. Leapman
1986	J. Murray Gibson
1987	Ron A. Milligan
1988	A.D. Romig, Jr.
1989	Laurence D. Marks
1990	W. Mason Skiff
1991	Joseph R. Michael
1992	Kannan M. Krishnan
1993	Joseph A.N. Zasadzinski
1994	Jan M. Chabala
1995	Joanna L. Batstone
1996	Vinayak P. Dravid

1997	P.M. Ajayan
1998	Ian M. Anderson
1999	Zhong Lin Wang
2000	Eva Nogales
2001	Jian Min Zuo
2002	Nigel D. Browning
2003	Frances M. Ross
2004	Z. Hong Zhou
2005	David J. Larson
2006	David A. Muller
2007	Peter D. Nellist
2008	Steven J. Ludtke
2009	Eric A. Stach
2010	Sergei V. Kalinin
2011	Radostin Danev
2012	David S. Ginger
2013	John L. Rubinstein
2014	Maria Varela
2015	Andrew M. Minor
2016	Miaofang Chi
2017	Christopher J. Russo
2018	Lena F. Kourkoutis

### YEAR RECIPIENT

1992	Ronald M. Anderson
	G. W. Bailey
	Frances L. Ball
	M. Blair Bowers
	Deborah L. Clayton
	Joseph Harb
	Kenneth R. Lawless
	Morton D. Maser
	Caroline Schooley
	John H.L. Watson
1993	E. Laurence Thurston
1994	Richard F.E. Crang
1995	Raymond K. Hart
1996	José A. Mascorro
1997	William T. Gunning III
1998	Nestor J. Zaluzec
1999	Charles E. Lyman
2000	Barbara A. Reine
	Hildegard H. Crowley

2002	Beverly E. Maleeff
2003	M. Grace Burke
2004	Ralph M. Albrecht
2005	W. Gray (Jay) Jerome
2006	Jeanette Killius
2007	Robert L. Price
2008	Stuart McKernan
2010	Pamela F. Lloyd
2011	Janet H. Woodward
2012	Gina E. Sosinsky
2013	Caroline A. Miller
2014	Michael Marko
2015	JoAn Hudson
2016	Amanda Lawrence
2017	David W. Tomlin
2018	Donovan N. Leonard

## ALBERT CREWE AWARD (2019)

### B. Layla Mehdi

University of Liverpool

Dr B. Layla Mehdi is currently an Assistant Professor and Associate Director of the Imaging Centre at the University of Liverpool (ICaL), UK. She received her Master's in Analytical Chemistry from the University of Warsaw, Poland and her Ph. D. in Chemistry from Miami University, USA working in the area of electrochemical detectors coupled with gas chromatography for cancer therapy. Following her Ph.D., in 2013 she joined the Physical Sciences Directorate at the Pacific Northwest National Laboratory (PNNL) as a postdoctoral research associate and in 2016 was promoted to Staff Scientist. Her work at PNNL involved the development of an In Situ stage to study dynamic processes in next generation batteries with applications to Li-Ion and beyond Li chemistries being supported as part of the Joint Centre for Energy Storage Research (JCESR) funded by the US Department of Energy. She has received numerous international awards for this work, including the 2015 MRS postdoctoral award, the 2015 Microscopy Society of America postdoctoral award and the 2014 Microscopy & Microanalysis Presidential award. In 2016 she also received JSPS Postdoctoral Fellowship to perform Research at Nagoya University, Japan in collaboration with TOYOTA Japan. She has over 20 publications in the development and application of low-dose methods to the operando and high resolution study of beam sensitive materials and processes. She has organized 4 international In Situ liquid TEM workshops, an international In Situ TEM symposium, has given over 25 invited talks at international meetings and institutions, and is the Associate Editor covering In Situ TEM for the SpringerNature journal, Advanced Structural and Chemical Imaging. Currently, her research group focuses on developing advanced new microscopy methods to generate an in depth understanding of reaction kinetics at solid/liquid and solid/gas interfaces in batteries, electrocatalysts and pharmaceuticals.



## GEORGE PALADE AWARD (2019)

### Alex Noble

New York Structural Biology Center

Alex Noble earned his BS in Physics and BA in Applied Mathematics from UC San Diego and his MS and PhD in Physics at Florida State University. He is currently an NIH Kirschstein Postdoctoral fellow in the laboratory of Bridget Carragher and Clint Potter at the Simons Electron Microscopy Center (SEMC) in the New York Structural Biology Center. He is broadly focused on developing, distributing, and applying methods that further the progress of the cryo-electron microscopy (cryoEM) field and individual cryoEM projects, along with applying those methods himself to specific biological systems. Each focus is driven by a motivation to make positive biomedical and thus humanitarian impacts. As a graduate student, he investigated a model of a coat protein complex II cage by combining cryoEM, hydrogen-deuterium exchange mass spectrometry, and molecular modelling. Beginning as a graduate student and continuing into his postdoctoral training, he develops and maintains software, Appion-Protomo, that enables researchers of all experience levels to process cryo-electron tomography (cryoET) images without the need for additional sample or imaging optimization. As a postdoctoral fellow in a highly-collaborative environment, he has illuminated and investigated a long-standing and widespread problem with single particle cryoEM sample preparation that has numerous broad implications – protein adsorption to the air-water interface. Through collaborative efforts internal and external to SEMC, he investigated solutions to this problem in the form of cryoEM grid freezing techniques (the Spotiton grid preparation robot) and sample detergent optimization. His postdoctoral fellowship, spurred by a fruitful cryoET collaboration, seeks to understand the structural behavior of type II cadherins on membranes, which are a set of cell adhesion molecules with several pathological implications if malformed. His current investigations and efforts also include several projects designed to obtain three-Dimensional cryoET structures of cellular interiors Using cryo-focused ion beam preparation, developing and overseeing deep learning applications in cryoEM/ET, assisting cryoET users at SEMC, and leading cryoET training workshops.



### YEAR RECIPIENT

2012	Wu Zhou
2013	Lena Fitting-Kourkoutis
2014	Jinwoo Hwang
2015	Meng Gu
2016	Ryo Ishikawa
2017	Pinshane Y. Huang
2018	Timothy Pennycook

### YEAR RECIPIENT

2012	Gabriel C. Lander
2013	Peng Ge
2014	Ricardo C. Guerrero-Ferreira
2015	Alexey Amunts
2016	Dmitry Lyumkis
2017	Rengasayee Veeraraghavan
2018	Not awarded



## HILDEGARD H. CROWLEY OUTSTANDING TECHNOLOGIST AWARD FOR BIOLOGICAL SCIENCES (2019)

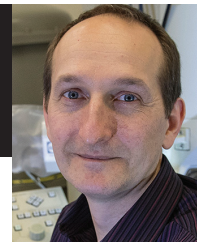


**Matthew S. Joens**

Washington University School of Medicine

Matthew is an analytical chemist by undergraduate training and has over 10 years of electron microscopy experience. His introduction into microscopy included internships at the University of California – San Diego (UCSD) with Dr. Timothy Baker, one of the founding fathers of cryo-electron microscopy, and with the National Center for Microscopy Imaging Research (NCMIR), a NIH funded lab headed by Dr. Mark Ellisman. Following these internships, he moved to the Salk Institute for Biological Studies where he worked with Dr. James Fitzpatrick to establish and grow the electron microscopy division of the Waitt Advanced Biophotonics Center. Matthew was later recruited by Dr. Fitzpatrick to help build the Center for Cellular Imaging at the Washington University School of Medicine in St. Louis. His background includes extensive experience with cryo sample preparation, immunolabeling, 3D electron microscopy, and selective staining chemistries. His main interests are in correlative sample preparation and imaging techniques, spanning light, X-Ray, ion, and electron microscopies.

## CHUCK FIORI OUTSTANDING TECHNOLOGIST AWARD FOR PHYSICAL SCIENCES (2019)



**Dmitri Zakharov**

Brookhaven National Laboratory

Dmitri N. Zakharov received his M.S. degree in Solid State Physics from Moscow State Engineering Physical Institute, Department of Theoretical and Experimental Physics in 1995, his Ph.D. in Solid State Physics from the Institute of Crystallography of the Russian Academy of Sciences in 2001, and postdoctoral trainings at Max Planck Institute of Microstructure Physics and Lawrence Berkeley National Laboratory. After spending 6 years as a Staff Scientist at Birk Nanotechnology Center at Purdue University, Dr. Zakharov joined the Center for Functional Nanomaterials at Brookhaven National Laboratory in 2012 in a Staff Scientist role. Dr. Zakharov's research interests include environmental scanning/transmission electron microscopy (ETEM) technique; automated low dose image acquisition of electron beam sensitive materials; Machine Learning algorithms and Big Data analysis for Real-Time image streams processing to extract quantitative information; operando experimental setup utilizing ETEM and the National Synchrotron Light Source II as two complimentary techniques; carbon nanotube nucleation, growth, termination and chirality control; 2D and III-Nitride materials and devices. Dr. Zakharov has over 150 journal and conference publications, which have been cited more than 3,200 times (h-index 33), and he has presented over 30 invited talks in the US and abroad. Dmitri was recipient of 2014 Spotlight Award by Brookhaven National Laboratory and Mikhail Teplov Scholarship in 2000. He also served as Graduate Faculty at the School of Materials Engineering at Purdue University.

### YEAR RECIPIENT

1993	Ben O. Spurlock
1994	<i>not awarded</i>
1995	Kai Chien
1996	<i>not awarded</i>
1997	John P. Benedict
1998	Hilton H. Mollenhauer
1999	John M. Basgen
2000	Nancy Crise Smith
2001	<i>not awarded</i>
2002	José A. Mascorro
2003	<i>not awarded</i>
2004	<i>not awarded</i>
2005	John J. Bozzola
2008	Thomas Deerinck
2009	Mary Morphew
2010	E. Ann Ellis
2011	Robert Grassucci
2012	Kunio Nagashima
2013	Robyn Roth
2014	Hong Yi
2015	Norman Olson
2016	Frank Macaluso
2017	Patricia S. Connelly
2018	Anchi Cheng

### YEAR RECIPIENT

1993	<i>not awarded</i>	2009	Lynne Gignac
1994	Bernard J. Kestel	2010	<i>not awarded</i>
1995	<i>not awarded</i>	2011	<i>not awarded</i>
1996	David W. Ackland	2012	<i>not awarded</i>
1997	Stanley J. Klepeis	2013	K. Shawn Reeves
1998	Charles J. Echer	2014	Eddy Garcia-Meitin
1999	John C. Wheatley	2015	Masahiro Kawasaki
2000	<i>not awarded</i>	2016	<i>not awarded</i>
2001	Conrad G. Bremer	2017	Richard L. Martens
2002	<i>not awarded</i>	2018	Chengyu Song
2003	Edward A. Ryan		
2004	Mark C. Reuter		
2005	Chris Nelson		
2008	<i>not awarded</i>		

## MAS 2019 COUNCIL – OFFICERS

### EXECUTIVE COUNCIL

<b>President</b>	Rhonda Stroud
<b>President-Elect</b>	Heather Lowers
<b>Secretary</b>	Chad Parish
<b>Treasurer</b>	Elaine Schumacher

### DIRECTORS

Andrew Herzing  
 Anette von der Handt  
 Emma Bullock  
 Roseann Csencsits  
 Abigail Lindstrom  
 Donovan Leonard  
 Patrick Camus (Commercial Director)

### COMMITTEE CHAIRS

<b>Archivist</b>	John H. Fournelle
<b>Affiliated Regional Societies &amp; Tour Speakers</b>	Kerry Siebein
<b>Awards Committee</b>	Andrew Herzing
<b>Computer Activities</b>	Nicholas W.M. Ritchie
<b>Education</b>	James LeBeau
<b>Fellows Committee</b>	Thomas F. Kelly
<b>Finance</b>	James McGee
<b>International Liaison</b>	Heather Lowers
<b>M&amp;M 2019 Co-Chair</b>	Assel Aitkaliyeva
<b>M&amp;M 2020 Co-Chair</b>	John Fournelle
<b>Membership Services</b>	Mike Nagorka
<b>MicroNews Editor</b>	Assel Aitkaliyeva
<b>Microscopy and Microanalysis Editorial Board</b>	Donovan Leonard
<b>Nominations</b>	Heather Lowers
<b>Social Media</b>	Daniel M. Ruscitto
<b>Strategic Planning</b>	Vincent S. (Vin) Smentkowski
<b>Sustaining Membership</b>	Pat Camus
<b>Topical Conferences</b>	Paul K. Carpenter

## PAST PRESIDENTS

1968	L.S. Birks
1969	K.F.J. Heinrich
1970	R.E. Ogilvie
1971	A.A. Chodos
1972	K. Keil
1973	D.R. Beaman
1974	P. Lublin
1975	J.E. Colby
1976	E. Lifshin
1977	J.I. Goldstein
1978	J.D. Brown
1979	D.F. Kyser
1980	O.C. Wells
1981	J.R. Coleman
1982	R.L. Myklebust
1983	R. Bolon
1984	D.C. Joy
1985	D.E. Newbury
1986	C.G. Cleaver
1987	C.E. Fiori
1988	W.F. Chambers
1989	D.B. Wittry
1990	A.D. Romig, Jr
1991	J.T. Armstrong
1992	D.B. Williams
1993	T.G. Huber
1994	J.A. Small
1995	J.J. McCarthy
1996	D.E. Johnson
1997	J.R. Michael
1998	R.B. Marinenko
1999	J.J. Friel
2000	C.E. Lyman
2001	R.W. Linton
2002	G.P. Meeker
2003	E.S. Etz
2004	P.K. Carpenter
2005	I.H. Musselman
2006	R. Gauvin
2007	P.G. Kotula
2008	I.M. Anderson
2009	C. Johnson
2010	E.P. Vicenzi
2011	J.H.J. Scott
2012	J.F. Mansfield
2013-14	K.L. Bunker
2015-16	T.F. Kelly
2017-18	M. Watanabe

## PETER DUNCUMB AWARD FOR EXCELLENCE IN MICROANALYSIS (2019)

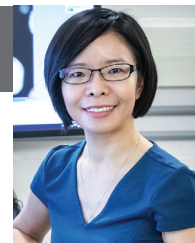


### David N. Seidman

Department of Materials Science & Engineering, Northwestern University

David Seidman is a Walter P. Murphy professor of materials science and engineering at Northwestern University, since 1996. He is a pioneer in the development and application of field-ion microscopy (FIM), atom-probe FIM and atom-probe tomography to a wide range of scientific and technological problems, which require spatial resolution at the subnanometer scale and chemical information at the same length scale. He received his Ph.D. degree from the University of Illinois at Urbana-Champaign, where he studied the kinetics of formation of vacancies in up-quenched gold: his advisor was Robert W. Balluffi. His current research interests are in atomistic mechanisms of phase-separation in multicomponent Ni-Based superalloys, development of high-temperature (greater than 723 K) Al-Based alloys, development of high-temperature Co-Based alloys, high-strength tough-steels with good blast and projectile resistance, and the use of silicon nanowires for sensors. Seidman is a member of the National Academy of Engineering, a fellow of the American Academy of Arts & Sciences, American Association for the Advancement of Science, American Physical Society, ASM International, John Simon Guggenheim Memorial Foundation, Materials Research Society, TMS (Minerals•Metals•Materials). Gold Medal Award and Albert Sauveur Achievement Award of ASM International, David Turnbull Lecturer Award of the Materials Research Society, Alexander von Humboldt Stiftung Prize, Max Planck Research Prize.

## KURT F.J. HEINRICH AWARD (2019)



### Miaofang Chi

Oak Ridge National Laboratory

Miaofang Chi is a senior staff scientist at the Center for Nanophase Materials Sciences (CNMS) at Oak Ridge National Laboratory (ORNL). She received her Ph.D. in Materials Science and Engineering from University of California, Davis in 2008. Her primary research interest lies in the advancements and applications of novel electron microscopy techniques in energy and nanotechnology research, especially in the understanding of interfacial charge transfer behavior in energy storage and nanoelectronics systems. She was awarded the Burton Metal by the Microscopy Society of America (2016). She received the ORNL Director's Award for Outstanding Individual Accomplishment in Science and Technology (2015) and the ORNL's Early Career Research Award (2015). Miaofang is the author and co-author of more than 150 peer-reviewed journal articles. She was named to the Clarivate's 2018 list of Highly Cited Researchers.

### PREVIOUS AWARDEES

<b>2007</b>	D.B. Williams
<b>2008</b>	J.I. Goldstein
<b>2009</b>	D.E. Newbury
<b>2010</b>	D.C. Joy
<b>2011</b>	J.R. Michael
<b>2012</b>	J. Bentley
<b>2013</b>	E. Lifshin
<b>2014</b>	O.L. Krivanek
<b>2015</b>	P.J. Statham
<b>2016</b>	D. Muller
<b>2017</b>	T.F. Kelly
<b>2018</b>	R.D. Leapman

### PREVIOUS AWARDEES

<b>1986</b>	P.J. Statham
<b>1987</b>	J.T. Armstrong
<b>1988</b>	D.B. Williams
<b>1989</b>	R.D. Leapman
<b>1990</b>	R.W. Linton
<b>1991</b>	A.D. Romig, Jr.
<b>1992</b>	S.J. Pennycook
<b>1993</b>	P.E. Russell
<b>1994</b>	J.R. Michael
<b>1995</b>	E.N. Lewis
<b>1997</b>	R. Gauvin
<b>1998</b>	V.P. Dravid
<b>1999</b>	J. Bruley
<b>2000</b>	H. Ade
<b>2001</b>	C. Jacobsen

<b>2002</b>	D.A. Wollman
<b>2005</b>	M. Watanabe
<b>2006</b>	M. Toth
<b>2007</b>	G. Kothleitner
<b>2008</b>	P.G. Kotula
<b>2009</b>	D. Drouin
<b>2010</b>	H. Demers
<b>2011</b>	L.N. Brewer
<b>2012</b>	E.A. Marquis
<b>2013</b>	J.M. LeBeau
<b>2014</b>	B.P. Gorman
<b>2015</b>	P. Pinard
<b>2016</b>	J. Allaz
<b>2017</b>	A. Herzing
<b>2018</b>	Y.N. Picard

## PRESIDENTIAL SCIENCE AWARD (2019)



**Lawrence Allard**  
Oak Ridge National Laboratory

Dr. Larry Allard obtained all three of his degrees at the University of Michigan in (what is now the) Materials Science and Engineering Dept. He started his electron microscopy career in 1963 as a sophomore, learning theory and practice under Prof. Wilbur Bigelow. He is currently a Distinguished Research Staff Member in the Materials Science & Technology Division at Oak Ridge National Laboratory. His research involves ultra-high-resolution imaging and microanalysis in studies of precipitation processes in aluminum alloys and superalloys, catalytic materials (e.g. single-atom catalysts) for automotive exhaust after-treatment and other chemical processes, and instrumental developments involving in situ heating and operando gas-reactions electron microscopy used in those studies. He is the chief scientist in charge of the Aberration-Corrected Electron Microscope (ACEM) project at the High Temperature Materials Lab at ORNL; his JEOL 2200FS instrument is one of the first of the new generation of STEM/TEM instruments with sub-Ångström resolution to be installed in the US (2004). He is also the principal technical designer of ORNL's new Advanced Microscopy Laboratory, a facility currently housing 7 Aberration-Corrected microscopes. Dr. Allard has more than 300 cited scientific publications; he has been a co-organizer of more than a dozen workshops and symposia on advanced microscopy topics, and has co-edited several conference proceedings and books, including "Introduction to Electron Holography," the first definitive textbook on electron holography, published by Kluwer/Plenum in 1999. Dr. Allard was elected Fellow of the Microscopy Society of America in 2010. He is still collaborating closely with Prof. Bigelow, who at age 96 continues to contribute to the scientific capabilities provided by the microscopy group at ORNL and other institutions.

## PRESIDENTIAL SERVICE AWARD (2019)



**Lucille Giannuzzi**  
EXpressLO LLC

Dr. Lucille Giannuzzi holds a B.E. in Engineering Science and M.S. in Materials Science and Engineering from Stony Brook University. She received her Ph.D. from Penn State in Metals Science and Engineering and was a Post-Doc at the PSU Center for Advanced Materials. Prof. Giannuzzi was at the University of Central Florida for 10 years where she was a recipient of an NSF CAREER award. She joined FEI Company as a product marketing engineer for 7 years before founding her own consulting and product companies. She recently joined TESCAN USA. Dr. Giannuzzi has applied focused ion beam and electron microscopy techniques to study the structure/property relationships in metals, alloys, ceramics, composites, polymers, minerals, bone/dental implants, irradiated, inorganic, and biological materials. She maintains professional affiliations in several societies and is a Fellow of AVS, MSA, and MAS. Dr. Giannuzzi has over 125 (co)authored publications; several FIB-related patents, contributed to several invited book chapters, and is co-editor of a book entitled "Introduction to Focused Ion Beams."

### PREVIOUS AWARDEES

**1977** R. Castaing  
**1978** K.F.J. Heinrich  
**1979** P. Duncumb  
**1980** D.B. Wittry  
**1981** S.J.B. Reed  
**1982** R. Shimizu  
**1983** J. Philibert  
**1984** L.S. Birks  
**1985** E. Lifshin  
**1986** R.L. Myklebust  
**1987** O.C. Wells  
**1988** J.D. Brown  
**1989** J. Hillier  
**1990** T.E. Everhart  
**1997** D.B. Williams  
**1998** F.H. Schamber  
**1999** R.A. Sareen  
**2000** R.F. Egerton  
**2001** P.E. Batson

**2002** K. Keil  
**2003** P.E. Russell  
**2004** J.T. Armstrong  
**2005** G. Slodzian  
**2006** B.J. Griffin  
**2007** R.D. Leapman  
**2008** T.F. Kelly  
**2009** J.R. Michael  
**2010** J.J. Donovan  
**2011** P.J. Statham  
**2012** N.J. Zaluzec  
**2013** P. Echlin  
**2014** H.L. Fraser  
**2015** M.R. Keenan  
**2016** M. Jercinovic  
**2017** M.K. Miller  
**2018** M.G. Burke

### PREVIOUS AWARDEES

**1977** P. Lublin  
**1978** D.R. Beaman  
**1979** M.A. Giles  
**1980** A.A. Chodos  
**1981** R.L. Myklebust  
**1982** J. Doyle  
**1983** D.E. Newbury  
**1984** J.I. Goldstein  
**1985** M.C. Finn  
**1986** V. Shull  
**1987** D.C. Joy  
**1988** C.G. Cleaver  
**1989** W.F. Chambers  
**1990** C.E. Fiori  
**1991** T.G. Huber  
**1992** E.S. Etz  
**1993** H.A. Freeman  
**1994** J.L. Worrall  
**1995** R.W. Linton  
**1996** P.F. Hlava  
**1997** J.A. Small

**1998** J.J. McCarthy  
**1999** T.G. Huber  
**2000** R.B. Marinenko  
**2001** C.E. Lyman  
**2002** J.F. Mansfield  
**2003** I.H. Musselman  
**2004** J.R. Michael  
**2005** G.P. Meeker  
**2006** H.A. Freeman  
**2007** P.K. Carpenter  
**2008** L.M. Ross  
**2009** V. Woodward  
**2010** S.A. Wight  
**2011** D.T. Kremser  
**2012** C. Johnson  
**2013** J.J. McGee  
**2014** I.M. Anderson  
**2015** S. McKernan  
**2016** H. Lowers  
**2017** D. Kremser  
**2018** V. Robertson

## MAS OUTSTANDING PAPER AWARDS (2019)

These awards are presented annually to the authors of outstanding papers from the previous annual meeting in each of four categories.

### RAYMOND CASTAING – BEST STUDENT PAPER AWARD:

*Analysis of Redox Changes in Silicate Glasses Using EPMA and Raman Spectroscopy*

Ery Hughes, University of Bristol, United Kingdom

### V.G. MACRES – BEST INSTRUMENTATION/SOFTWARE PAPER AWARD:

*The MTF and DQE of Annular Dark Field STEM: Implications for Low-dose Imaging and Compressed Sensing*

Lewys Jones, Trinity College Dublin, Ireland

### L.S. BIRKS – BEST CONTRIBUTED PAPER AWARD:

*Low Energy STEM-EELS Characterization of Primitive Organic Matter and Silicates in the Meteorite LAP 02342*

Bradley De Gregorio, U.S. Naval Research Laboratory

### V.E. COSSLETT – BEST INVITED PAPER AWARD:

*Novel EELS Experiments in the Newly Opened Monochromatic Regime*

Jordan Hachtel, Oak Ridge National Laboratory

## 2019 MAS FELLOWS (INAUGURAL CLASS):

Ian Anderson	Cathy Johnson
Phil Batson	Thomas Kelly
Paul Carpenter	Paul Kotula
Bill Chambers	Charles Lyman
John Donovan	John Mansfield
Vinayak Dravid	Joseph Michael
Ray Egerton	Inga Musselman
John Fournelle	Nicholas Ritchie
Hamish Fraser	John Henry Scott
Raynald Gauvin	John Small
Paul Hlava	Ed Vicenzi
Thomas Huber	Masashi Watanabe
Michael Jercinovic	Valerie Woodward

## Current IFES Steering Committee

David J. Larson	<b>President</b>
Julie Cairney	<b>Vice-President</b>
Ross Marceau	<b>Secretary</b>
Paul Bagot	<b>Treasurer</b>
Mattias Thuvander	
Arun Deveraj	
Gang Sha	
David Saxey	
Baptiste Gault	

## IFES Past Presidents

2014 -present	D.J. Larson
2008 - 2014	N. Kruse
2006 – 2008	T.F. Kelly
2002 – 2006	R.G. Forbes
2000 – 2001	D.N Seidman
1996 – 2000	R.G. Forbes
1993 – 1996	M.K. Miller
1990 – 1993	G.D.W. Smith
1987 – 1990	J.H. Block

## IFES Fellows

Hans-Olof André	Michael Miller
Didier Blavette	Marwan Mousa
Alfred Cerezo	Osamu Nishikawa
Paul Cutler	John Panitz
Frédéric Danoix	Simon Ringer
Richard Forbes	Guido Schmitz
Georgiy Fursej	David Seidman
Robert Gomer	George Smith
Kazuhiro Hono	Krystyna Stiller
Gary Kellogg	Lyn Swanson
Thomas Kelly	Tien Tzou Tsong
Hans Juergen Kreuzer	Nelia Wanderka
Norbert Kruse	
Allan Melmed	

## E.W. Müller Young Scientist Award

<b>(1978)</b>	A.R. Waugh
<b>(1979)</b>	H.-W. Fink
<b>(1980)</b>	Y. Kuk
<b>(1981)</b>	S.J. Banard
<b>(1982)</b>	J.M. Derochette
<b>(1983)</b>	D.R. Kingham
<b>(1984)</b>	M.G. Hetherington
<b>(1985)</b>	M. Ahmad
<b>(1986)</b>	L. Karlsson
<b>(1987)</b>	P.P. Camus
<b>(1988)</b>	A. Cerezo
<b>(1989)</b>	J. Dirks
<b>(1990)</b>	J.E. Brown
<b>(1991)</b>	F. Danoix
<b>(1992)</b>	H. Schmid
<b>(1993)</b>	M.C. Reckzügel
<b>(1994)</b>	R.C. Thomson
<b>(1995)</b>	C. Voss
<b>(1996)</b>	L. Li
<b>(1997)</b>	C. Schmuck-Pareige
<b>(1998)</b>	K. Nagaoka
<b>(2001)</b>	Ch. Lang
<b>(2002)</b>	E.A. Marquis
<b>(2004)</b>	B. Cho
<b>(2006)</b>	W.M. Tsang
<b>(2008)</b>	M. Moors
<b>(2010)</b>	P. Stender
<b>(2012)</b>	M. Roussel
<b>(2014)</b>	C. Oberdorfer
<b>(2016)</b>	M. Dagan
<b>(2018)</b>	S. Lambeets

## 2019 IFES Travel Scholarship Awards

### Olivia G. Licata

University at Buffalo

*Multiplicity vs. Composition Study to Understand the Field Evaporation of Polar AlxGa1-xN Heterostructures: A New Approach*

### Yi-Sheng (Eason) Chen

The University of Sydney, Australia

*Atomic-Scale Observation of Hydroxyapatite Nanoparticle*

**M&M STUDENT SCHOLAR AWARDS—  
SPONSORED BY MSA**

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Fatemeh Abbasi Yeganeh, Florida State University  
Wah Chiu, Stanford University (Miller Award)  
Paul Cueva, Cornell University  
Ha Dang, University of Washington  
Julia Doh, Oregon Health & Science University  
Amanda Erwin, University of Michigan  
Alice Greenberg, University of Oregon  
Catherine Groschner, University of California-Berkeley  
Shen Han, Max Planck Institute for Polymer Research, Germany  
Daniel Kelly, Manchester University, United Kingdom  
Abinash Kumar, North Carolina State University  
Ethan Lawrence, Arizona State University  
Brandon McKeon, Arizona State University  
Arthur Moya, University of Oxford, United Kingdom  
Akshay Murthy, Northwestern University  
Colum O'Leary, University of Oxford, United Kingdom  
Will Parker, University of Oregon  
Timothy Pegg, Miami University  
Graham Rykiel, Oregon Health & Science University  
Jonathan Schwartz, University of Michigan  
Alexandra Sheader, University of Oxford, United Kingdom  
Michelle Smeaton, Cornell University  
Louisa Mezache, The Ohio State University  
Janis Wirth, Friedrich-Alexander University, Germany  
Yao Long Xing, Sung Kyun Kwan University, Korea  
Reed Yalisove, University of Michigan  
Hwanhui Yun, University of Minnesota  
Ruopeng Zhang, University of California-Berkeley

**M&M STUDENT SCHOLAR AWARDS—  
SPONSORED BY MAS**

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Kousuke Ooe, University of Tokyo, Japan  
Kevin Schweinar, Max Planck Institute for Iron Research, Germany  
Berit Goodge, Cornell University  
Brian Zutter, University of California-Los Angeles  
Charles Fletcher, The University of Oxford, United Kingdom  
Meredith Sharps, University of Oregon  
Heena Inani, University of Vienna, Austria  
Yichao Zhang, University of Minnesota  
Parivash Moradifar, Pennsylvania State University  
Yitian Zeng, Stanford University  
Komal Syed, University of California-Irvine

**M&M POSTDOCTORAL SCHOLAR AWARDS**

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Benjamin Apeleo Zubiri, Friedrich-Alexander University, Germany (APKARIAN AWARD—BIOLOGICAL SCIENCES)  
Axel Brilot, University of California-San Francisco (APKARIAN AWARD—PHYSICAL SCIENCES)  
Hamish Brown, Lawrence Berkeley Laboratory  
Michael Buch, National Institutes of Health  
Johannes Elferich, Oregon Health & Science University  
Wenpei Gao, University of California-Irvine  
Vivian Merk, Northwestern University  
Aubrey Penn, North Carolina State University (ERIC SAMUELS SCHOLARSHIP)  
Paul Smeets, Northwestern University  
Wei-Chang Yang, National Institute of Standards and Technology  
Andrew Yankovich, Chalmers University of Technology, Sweden

**M&M PROFESSIONAL TECHNICAL  
STAFF AWARDS**

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Leslie Cummins, Albert Einstein College of Medicine  
Pauline Mochama, University of Minnesota  
Sara Dickens, Sandia National Laboratories  
Ann Johnson, The Dow Chemical Company