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Biological Sciences Tutorial: Biomedical Applications of Micro-CT in Hard and Soft Tissues—Going Beyond the Bone

1892 *Morphological Analysis of Laser Exposed Phenolic-based Nanocomposites*; S Young, H Aglan; Tuskegee University

1894 *Characterization of Novel Ceramic Composite Nanofibers by Electron Microscopy*; MT Janish, F Huang, L Zhang, V Rastegar, N Martin, J Chan; University of Connecticut; BB McKenzie, JR Michael; Sandia National Laboratories; C Cornelius, CB Carter; University of Connecticut

1896 *Diffusion Coating for Ni-Cr-Fe Alloy by the Pack Cementation Process*; AS Khalil; Tabbin Institute for Metallurgical Studies, Egypt

1898 *3D X-Ray Microscopy (XRM) Technique for Evaluating the Porosity of the 3D Ordered Macroporous Materials by Colloidal Crystal Templating*; H He; Carnegie Mellon University; J Gelb, N Kotwal, A Merkle; Xradia, Inc; K Matyjaszewski; Carnegie Mellon University

1900 *Diffuse Scattering in $Pb(In_{1/2}Nb_{1/2}O_3$-$Pb(Mg_{1/3}Nb_{2/3})O_3$ Relaxor Solid Solutions*; C-W Tai; Stockholm University, Sweden

1902 *Atomic Local Ordering in Amorphous InGaZnO*; T Suzuki, K Takayanagi; Tokyo Institute of Technology, Japan

1904 *Characterization of Heat Activated Minerals from Puturge (Malatya, Turkey)*; E Izci; Anadolu University, Turkey

1906 *Effect of Polymerization Kinetics in the Pore Distribution in Polyacrylamide*; E Rodriguez-Miranda; Universidad de Guanajuato, Mexico; EO Castrejón-González; Instituto Tecnológico de Celaya, Mexico; G Herrera-Pérez; Instituto Tecnológico Superior de Irapuato, Mexico

1908 *Microstructure Analysis of Electroplated Cr-Fe Alloy Deposits on Cu Substrate*; C-K Lin, C-A Huang; Chang Gung University, Taiwan; W-A Chiou; University of Maryland; C-Y Chen, C-Y Chen; Chang Gung University, Taiwan

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Advanced Atomic-Scale Imaging and Spectroscopy of Materials

1910 *The Effects of Annealing on the Inter-Diffusion of Cations across the $LaCrO_3/SrTiO_3(100)$ Interface, and the Formation of La Anti-Site Defect Clusters*; R Colby, H Zhang, S Chambers, B Kabius; Pacific Northwest National Laboratory

1912 *Quantification of Cation Ordering in La_{2-2x} $Sr_{1+2x}Mn_2O_7$ by STEM EELS*; MP Oxley; Vanderbilt University; MA Roland; Universidad Complutense de Madrid, Spain; M Varela, SJ Pennycook; Oak Ridge National Laboratory

1914 *Direct Observation of Polarization and Charge Transfer at the $BaTiO_3/SrTiO_3/GaAs$ Interfaces*; Q Qiao; University of Illinois, Chicago; R Contreras-Guerrero, R Droopad; Texas State University; RF Klie; University of Illinois, Chicago

1916 *Interface Magnetism in $LaMnO_3/SrTiO_3$ Superlattices: Influence of Oxygen Octahedral Tilts*; MA Roldan; Complutense University of Madrid, Spain; W Siemons; Oak Ridge National Laboratory; J Salafranca; Complutense University of Madrid, Spain; M Varela, AR Lupini, SJ Pennycook, HM Crishten; Oak Ridge National Laboratory

1918 *High-Precision Chemical Analysis and Structural Determination of Functional Oxides by STEM-EELS*; DM Kepaptsoglou; SuperSTEM, United Kingdom; F Azough; University of Manchester, United Kingdom; Q Ramasse; SuperSTEM, United Kingdom; B Schaffer, M Sarahan; Gatan; S Jackson, R Freer; University of Manchester , United Kingdom

1920 *Direct Observation of the Optical Response of Twisted Bilayer Graphene by Electron Energy Loss Spectroscopy*; LA Basile; Escuela Politecnica Nacional, Ecuador; W Zhou; Oak Ridge National Laboratory; J Salafranca; Universidad Complutense de Madrid, Spain; J-C Idrobo; Oak Ridge National Laboratory

1922 *Measuring Phase Transitions in $La_{1-x}Sr_xCoO_3$ Using* In Situ *Atomic-Resolution Z-Contrast Imaging and EELS*; A Gulec; University of Illinois, Chicago; RF Klie; University of Illinois, Chicago

1924 *Interplay of Octahedral Rotations, Magnetic and Electronic Properties in Epitaxial $LaCoO_3$ Thin Films*; JH Jang; Oak Ridge National Laboratory; Y-M Kim; Korea Basic Science Institute, South Korea; R Mishra; Vanderbilt University; L Qiao, MD Biegalski, Z Gai, AR Lupini; Oak Ridge National Laboratory; ST Pantelides; Vanderbilt University; SJ Pennycook, AY Borisevich; Oak Ridge National Laboratory

1926 *PFM and TEM Characterization of Polarization in Ferroelectric BFO under Changing Mechanical Constraints*; JR Jokisaari, P Gao, X Pan; University of Michigan

1928 *Atomic Structure of Surface Dielectric Dead Layer in $BiFeO_3$ Thin Film*; Y-M Kim; Korea Basic Science Institute, South Korea; AN Morozovska, EA Eliseev; National Academy of Sciences of Ukraine; AR Lupini; Oak Ridge National Laboratory; Y-H Chu; National Chiao Tung University, Taiwan; P Yu, R Ramesh; University of California-Berkeley; SJ Pennycook, SV Kalinin, AY Borisevich; Oak Ridge National Laboratory

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1934 *Quantitative Electron Diffraction of Graphene: Measurement of Mean-Square Atomic Displacement and Implications for Dark Field Imaging*; M Mecklenburg; The Aerospace Corporation; B Shevitski, W Hubbard, E White; University of California; B Dawson, M Lodge, M Ishigami; University of Central Florida; B Regan; University of California

1936 *Correlative Spectrum Imaging of Organic Photovoltaic Devices Using Energy Dispersive X-ray and Electron Energy-Loss Spectroscopy*; FJ Scheltens; The Ohio State University; MF Durstock, CE Tabor, BJ Leever, MD Clark, DP Butcher; Air Force Research Laboratory; DW McComb; The Ohio State University

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1958 *High Resolution Transmission Electron Microscopy and Selected Area Diffraction Study of Doped Zinc Oxide Thin Film*; L Fang, P Ricou, R Korotkov; Arkema Inc

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1970 *Galvanic Exchange on Reduced Graphene Oxide. Designing a Multifunctional Two-Dimensional Catalyst Assembly*; S Krishnamurthy, PV Kamat; University of Notre Dame

1972 *Conductivity Tuning of a Silver Nanowire Mesh Using an UV Light*; S Xu, G Poirier, N Yao; Princeton University

1974 *Structural and Spectroscopic Properties of* $MgTi_2O_5/MgTiO_3$ *Composite by Solid State Technique*; E Izci; Anadolu University, Turkey

1976 *Influence of Bismuth Additive on the Growth of ZnO Nanostructures*; J Xu, JY Liu; Arizona State University

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1980 *High Spatial Resolution CL Images of ZnO Nanostructures*; J Xu, D Convey, D Yuchi, J Liu; Arizona State University

Physical Sciences—Nanomaterials Characterization

1982 *Examining Atomistic Defect-Boundary Interactions Induced by Ion Irradiation Using Aberration Corrected Transmission Electron Microscopy*; JA Aguiar; Los Alamos National Laboratory; M Chi; Oak Ridge National Laboratory; P Kotula; Sandia National Laboratories; Z Bi, O Anderoglu, JK Baldwin, JA Valdez, A Misra, B Uberuaga; Los Alamos National Laboratory

1984 *Electric Field-Induced Point Defect Redistribution in TiO_2*; A Moballegh, EC Dickey; NC State University

1986 *Atomic-Scale Study of Grain Boundary Structures in Poly-Crystalline CdTe Solar Cells Using Abberation-Corrected STEM*; T Paulauskas, RF Klie, Z Guo, E Colegrove; University of Illinois, Chicago IL

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1992 *Structural Analysis of Sulfonated Mesoporous Silica*; T Maki; JEOL Ltd, Japan; Y Tominaga; Tokyo University of Agriculture and Technology, Japan

Advanced Atomic-Scale Imaging and Spectroscopy of Materials

1994 *Defects in Heavy-Ion Bombarded Compound Semiconductors Due to the Elastic and Inelastic Energy Loss Regimes*; AS Khalil; Tabbin Institute for Metallurgical Studies, Cairo, Egypt; LT Chadderton, AM Stewart, DJ Llewellyn, MC Ridgway, AP Byrne; Australian National University, Canberra

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2000 *On the Origin of Low Thermal Conductivity in High Thermoelectric Performance in n-type BiAgSeS*; H Wu; Xi'an Jiaotong University, China; Y-L Pei; Beihang University, China; J Li; Harbin Institute of Technology, China; J Sui; Harbin Institute of Technology; L Zhao; Beihang University, China; J He; South University of Science and Technology, China

2002 *SEM/EDS Characterization of Radioactive Particles in Samples of PM10*; R Ramirez-Leal, H Duarte-Tagles, M Burgos-Hernandez, C Chavez-Toledo; State University of Sonora, Mexico

2004 *Copper (II) Remediation Using Novel Iron-Phosphate Nanoparticles*; S Rouvimov; University of Notre Dame; N Adam; University of Wyoming; J Gates, B Beachel; East Central University

Plenary

2006 *The Long-Lasting Struggle to Achieve Atomic-Resolution Microscopy by Correcting the Aberrations of Electron Lenses*; HH Rose; Technical University Darmstadt

2008 *Looking Through Paintings*; J Dik; Delft University of Technology

Technologists' Forum Special Topic: EDS Revisited—Basics and Advances

2010 *Sample Preparation of "Soft" Matter Materials for EDS Analysis in Both SEM and TEM*; PF Lloyd; UES, Inc

2012 *Sample Preparation Considerations for X-ray EDS Analysis in the Physical Sciences*; S Walck; Army Research Laboratory

2014 *Preparation of Life Science Samples for Electron Dispersive X-ray (EDS) Analysis*; DM Sherman; DSimaging LLC

2016 *Everything You Always Wanted to Know about XES*; NJ Zaluzec; Argonne National Laboratory

2018 *Selecting a Silicon Drift Detector*; NW Ritchie; National Institute of Standards and Technology

2020 *Guidelines for Microanalysis Using the Energy-Dispersive Spectrometer*; PK Carpenter; Washington University

Technologists' Forum Roundtable: EDS Revisited—Basics and Advances

2022 *Technologists' Forum: Roundtable Discussion of Energy Dispersive Spectroscopy*; EA Ellis; Texas A&M University

2024 *Anhydrous (Non-Cryogenic) Specimen Preparation of Biological Samples for Energy Dispersive Spectroscopy in the Transmission Electron Microscope*; EA Ellis; Texas A&M University; L Blubaugh; Hitachi High Technologies America, Ltd.

2026 *Localization of a Short Peptide Anti-microbial (AMP) in* Staphylococcus aureus *by Diaminobenzidine-Eosin Photo-oxidation and Visualization with STEM EDS*; GA Johnson, EA Ellis, H Kim, J-P Pellois; Texas A&M University

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Physical Sciences Tutorial: Practical Processing of Spectrum Imaging Datasets by Multivariate Statistical Analysis: Advantages and Disadvantages

Physical Sciences Tutorial: State-of-the-Art Microanalysis at the nm-Scale and Smaller: Going from Pretty Pictures to Quantitative Analysis of Hyperspectral Data

Physical Sciences Tutorial: Practical Aspects of Atom Probe Tomography in Materials Science

Biological Sciences Tutorial: Correlative Imaging of Tissues, the Potential of Large Volume Array Tomography

Biological Sciences Tutorial: Biomedical Applications of Micro-CT in Hard and Soft Tissues—Going Beyond the Bone

Biological Sciences Tutorial: Bio-Imaging and Spectroscopy with Scanning Transmission X-ray Microscopy

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Welcome from the Society Presidents

On behalf of the Microscopy Society of America, the Microanalysis Society, and the International Metallographic Society, we welcome you to the Microscopy & Microanalysis 2013 meeting and its associated Exhibition in Indianapolis, IN. Once again this year, the meeting promises to be the premier opportunity in our field to learn, to connect, and to experience all the latest innovations in the world of microscopy and microanalysis.

We are very fortunate to have, as a part of our meeting, the largest and most diverse yearly exhibition of equipment, software, and other resources for microscopy and microanalysis. In our field, researchers from universities, government labs, and industry have a unique relationship with manufacturers and suppliers of our tools. Throughout the history of microscopy and microanalysis, these researchers have worked in close partnership with suppliers to create innovations and make those innovations available to everyone in the field. This partnership is never more evident, or more powerfully felt, than at the Microscopy and Microanalysis Exhibition. Whether in the exhibit hall, the poster and platform presentations, or the social events, all attendees connect in a powerful way that moves our technology and capabilities forward in what has been unprecedented growth over the years.

Over 100 exhibitors have come to display their products and capabilities at the 2013 Exhibition. We hope you will take the time to have a conversation with each of them and learn about what they have to offer and what's new. In many cases, we know you will be renewing old friendships and mutually beneficial relationships. Also, please be sure to take advantage of the Vendor Tutorials, which will be held on Monday, Tuesday, and Wednesday from 5:45 – 6:45 PM in the Exhibition Hall. These tutorials are special, small-group product demonstrations and related educational opportunities, held in the exhibitors' booths at a quiet time after the Exhibit Hall has closed. Please note that it is necessary to sign up for the Vendor Tutorials ahead of time, which can be done at the MSA Megabooth in the center of the Exhibit Hall. We would like to thank Andreas Holzenberg of the MSA Education Committee for organizing the Vendor Tutorials.

The Meeting and Exhibition could not take place without the extremely hard work and dedication of many people. We would like to particularly thank Nicole Guy, our Meeting Manager, and Doreen Bonnema, our Exhibition Manager. We would also like to thank our Editor, Richard Edelmann, who puts together the Official Exhibition & Meeting Guide.

It is our hope that you will find Microscopy & Microanalysis 2013 to be stimulating, informative, energizing, and fun. We know you will appreciate the excellent facilities that the Convention Center and hotels have to offer, and the proximity of many great restaurants and other attractions. Have a wonderful week, and we will see you next year in Hartford!

Ernie Hall
MSA President

Kristin Bunker
MAS President

Richard Blackwell
IMS President

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Welcome From the Program Committee

Welcome to the 71st Microscopy & Microanalysis meeting, M&M 2013 in Indianapolis, Indiana! The Microscopy Society of America, the Microanalysis Society, and the International Metallographic Society have excelled again bringing the latest and most innovative applications and instrumental developments from investigators in the biological and physical sciences using microscopy and microanalysis techniques. M&M 2013 features more than 35 symposia covering a broad range of topics, ample educational opportunities in the form of courses and tutorials and pre-meeting events including courses, a congress and a workshop.

We are honored to have Professor Harald Rose from the University of Ulm and Professor Joris Dik from the Technical University of Delft as plenary speakers. Professor Harald Rose will open the meeting with an exciting and inspiring talk: "The long-lasting struggle to achieve atomic-resolution microscopy by correcting the aberrations of electron lenses". Professor Rose will take us on a journey from the development of early electron microscopes with nanometer resolutions to modern sub-Ångström instruments. Professor Rose was trained as a theoretical physicist in the group of Otto Scherzer and is now a leading expert in theoretical electron optics. He has contributed to advances in aberration correction of electron lenses, energy filters for electron microscopy, and the theory of image formation by inelastically scattered electrons important in low-voltage electron microscopy. During his long and fruitful career, Professor Rose received several international awards in recognition of his accomplishments, including the MSA Distinguished Scientist Award. He is a long-standing member of the Microscopy Society of America and was inducted as an MSA Fellow in 2009. Prof. Joris Dik will show us that microscopy and microanalysis can lead to amazing discoveries when applied to the arts and humanities. Professor Dik's lecture, "Looking through paintings," will examine how modern instrumentation can uncover art history mysteries using examples from van Gogh and Rembrandt. Professor Dik initially studied art history and classical archaeology at the University of Amsterdam. After a year internship at the J. Paul Getty Museum in Los Angeles, he returned to the Netherlands, where he completed a Ph.D in chemistry. In 2010, he was appointed to a prestigious Antoni van Leeuwenhoek professorship.

Our named symposium this year will honor the life and work of Professor Gertrude Rempfer who passed away in the Fall of 2011: "Gertrude Rempfer Memorial Symposium on Advances in Electron Optics and Aberration Corrected Electron Microscopy." After receiving her PhD in physics from the University of Washington in 1939, she worked both in industry and academia on electron optics and electron microscopy. Her efforts led to the development of the world's first ultra-high vacuum photoemission electron microscope. Gert Rempfer was a true role model for everyone, from her colleagues to students, especially female students. This symposium is intended to allure young scientists to some fast developing areas in electron microscopy.

The Executive Program Committee and the Symposia Organizers, planted the seed for M&M 2013, and we have all contributed to make it grow. Now it is time for all of us to enjoy the fruits of our efforts and actively participate in the meeting. It is also a great time to learn more about our three Societies and to inquire about possibilities of becoming a volunteer, since volunteers are the life-blood of each Society. And one day each of us might be able to say what our plenary speaker, Professor Harald Rose, said: "I consider MSA my scientific home and the home of many of my scientific friends".

The Executive Program Committee welcomes you to a celebration of microscopy and microanalysis in the city of Indianapolis, Indiana, August 4 – August 8, 2013.

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The Long-Lasting Struggle to Achieve Atomic-Resolution Microscopy by Correcting the Aberrations of Electron Lenses

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The correction of the aberrations of electron lenses is the long story of many seemingly fruitless efforts to improve the resolution of electron microscopes by compensating for aberrations of round electron lenses over a period of 50 years. The problem started in 1936 when Scherzer [1] demonstrated that the chromatic and spherical aberrations of rotationally symmetric electron lenses are unavoidable. Moreover, the coefficients of these aberrations cannot be made sufficiently small. As a result, the resolution limit of standard electron microscopes equals about one hundred times the wavelength of the electrons, whereas modern light microscopes have reached a resolution limit somewhat smaller than the wavelength. In 1947, Scherzer found an ingenious way for enabling aberration correction. He demonstrated in a famous article that it is in theory possible to eliminate chromatic and spherical aberrations by lifting any one of the constraints of his theorem, either by abandoning rotational symmetry or by introducing time-varying fields, or space charges [2]. Moreover, he proposed a multipole corrector compensating for the spherical aberration of the objective lens.

Starting in 1948, Seeliger built and tested the Scherzer corrector during a period of about five years. He aligned the constituent elements mechanically by means of adjustment screws. However, the experiments showed that this approach was a major obstacle due to insufficient stability of the mechanical alignment. As a result, the correction did not improve the resolution of the microscope because it was limited by mechanical and electromagnetic instabilities rather than by the static defects of the objective lens. Although Seeliger could not improve the resolution limit of the basic electron microscope, he could demonstrate that the corrector provided a negative spherical aberration, which could be adjusted to compensate for the spherical aberration of the objective lens [3]. In 1956, G. Moellenstedt first demonstrated experimentally the effective correction of spherical aberration by means of this corrector [4]. By employing critical illumination with a large cone angle of 2 10−2 × rad, he enlarged the spherical aberration to such an extent that it became by far the dominant aberration, which strongly blurred the image. After compensating for the spherical aberration by means of the octopoles, the resolution improved by a factor of about seven accompanied by a striking increase in contrast.

In 1964, Deltrap built a telescopic quadrupole-octopole corrector to eliminate the spherical aberration of a probe-forming lens. Although he nullified this aberration, he failed, like his predecessors, to improve the actual resolution of the uncorrected system because at that time the resolution was not limited by the spherical aberration of the objective lens. Moreover, all correctors known at that time introduce large off-axial coma and are not suitable for transmission electron microscopes (TEMs). In order to compensate for spherical aberration, chromatic aberration and off-axial coma, a novel aplanatic corrector utilizing symmetry properties was proposed [5]. This corrector was built and tested successfully in a test microscope within the frame of the so-called Darmstadt project and it demonstrated for the first time the simultaneous correction of chromatic and spherical aberrations [6]. Unfortunately, the project was abandoned after the death of O. Scherzer in 1982, although it was successful as far as it went.

In 1972, A. Crewe and V. Beck started at the University of Chicago another attempt to correct the spherical aberration of a scanning transmission electron microscope (STEM). They built and tested over a period of six years a magnetic quadrupole-octopole corrector consisting of a symmetric quadruplet with combined quadrupoles and octopoles. Because the corrector is aimed for the STEM, the difficulties to simultaneously compensate for the off-axial coma did not arise. Although Beck and Crewe incorporated several stigmator coils for producing weak dipole and hexapole fields, they were unable to find a suitable setting. Although all fruitless experimental attempts demonstrated that correction works in principle, none of them achieved an improvement in resolution. The main reasons for theses failures were: (a) the basic microscope was not stable enough, (b) the deleterious interference with the environment had been underestimated, (c) it was not possible to determine the state of alignment with the required precision, and (d) the resolution-limiting residual aberrations could not be measured with the required accuracy and eliminated within a period of time which must be shorter than the duration of the overall stability of the entire system. These obstacles were so severe that worldwide the granting agencies refused to fund the "fruitless correction projects" any longer.

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In 1990, the required technology and a new corrector design consisting of two sextupoles and two round lenses became available. Because this corrector is rather simple, Haider, Urban and the author were convinced that the successful correction of the spherical aberration in a 200 kV TEM equipped with a field emission gun should be feasible. Fortunately, the Volkswagen foundation was willing to take the risk and approved funding in 1991. In July 1997, the first atomic-resolution images of gallium-arsenide were obtained after the resolution limit of the microscope was reduced by the corrector from 0.24 nm to about 0.12nm [7]. Around 1995 O. Krivanek developed at the Cavendish Laboratory in Cambridge an improved version of the Deltrap quadrupole octopole corrector which he incoporated in his 100kV VG STEM. With this corrector he achieved, in 1998, the first genuine improvement of the resolution of a STEM [8]. Owing to the unexpected success of these correction efforts, the funding situation improved considerably.

In the US the Department of Energy (DOE) approved in 2003 funding of the TEAM (Transmission Electron Aberration-Corrected Microscope) project headed by U. Dahmen (LBNL Berkeley). The required resolution limit of 0.5Å was obtained in 2009 by means of an improved version of the hexapole corrector after the information limit of the basic 300 kV TEM was lowered to about 0.4Å [9].

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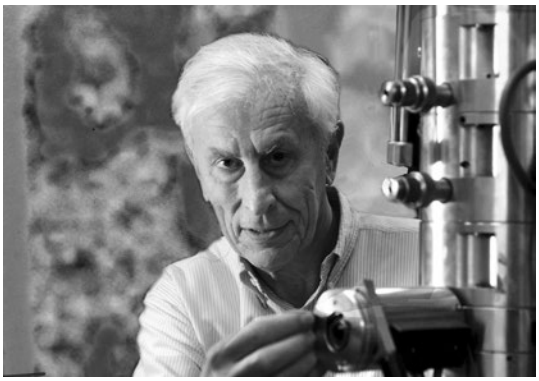

Harald Rose

Harald Rose is an Emeritus Professor of the Technical University of Darmstadt and since 2009 holds a Carl Zeiss funded Senior Professorship at the University of Ulm. He received his Ph. D. for his investigation of the imaging properties of arbitrary multipole systems in the laboratory of Otto Scherzer who was a professor of Theoretical Physics at the University of Darmstadt. He continued his studies in the development of electron optical components and in the theoretical aspects of image formation by scattered electrons, holding positions at the University of Darmstadt and The New York State Department of Health and spent sabbaticals at the Fermi Institute and Cornell University. After returning to Germany in 1980, he held a professor position at the University of Darmstadt for 20 years where, in collaboration with Joachim Zach, he developed the first aberration corrector for a scanning electron microscope. Throughout his expansive scientific carrier, he has investigated means to bring the experimental resolution of electron microscopes closer to the theoretical limit. Among his developments are: the Omega energy filter; an aberration corrector for a Low Energy Electron Microscope (LEEM) using a versatile beam splitter; and an ultra-corrector that corrects all primary chromatic and geometrical aberrations. He has published more than 200 reviewed articles in scientific journals and is the inventor of 105 patents on instruments and electron optical components. His work has been recognized internationally and he is the recipient of numerous awards including the Distinguished Scientist Award of the Microscopy Society of America; the Karl Heinz Beckurts Prize; the Honda Prize and the Wolf Prize for Physics.

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Looking Through Paintings

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Paintings are windows into the history of human kind, our history. None of us can claim never to have set foot in a museum to appreciate these beautiful works of art. The magnificent brushwork of Velazquez, the vivid colors and light effects of el Greco, the fine and detailed work of Rembrandt; and the emotional honesty and bold colors of Van Gogh are characteristics to be admired. They are all indications of the time, place and specific cultural moment in which the artists lived. Historians have been using this information in combination with correspondence and narrative accounts to reconstruct the moments of history in which the works came to light.

For hundreds of years the public has only seen the surface of famous masterpieces by artists such as Van Gogh and Rembrandt. Now, through a melding of innovative scientific techniques and art connoisseurship, completely different paintings and important clues about the artists themselves can be uncovered one layer at a time using non-invasive technologies. Researchers can calculate how and when an artist first began working on their composition by tracing fingerprints, brushstrokes and analyzing different layers of paint pigments. Art historians are increasingly turning to particle physics to authenticate masterpieces by artists like Rembrandt and Van Gogh, as well as to explore mysterious artworks lying beneath surface paintings.

Just microns below their paint surface lay a wealth of information on Old Master Paintings. Hidden paint layers can include underdrawing, underpainting or compositional alterations by the painter, or even younger layers related to later restorations. All too often artists simply re-used their canvases and painted a new composition on top. Thus, a look through the paint layer provides a look over the painter's shoulder. These elements, once fully uncovered, sometimes reveal completely different works of art underneath the surface that were abandoned by these great artists and painted over.

Nondestructive imaging of hidden paint layers is usually realized by means of tube-based X-ray radiation transmission radiography (XRR). The absorption contrast in these images is mostly caused by the heavy metal components of pigments employed, such as lead in lead white or mercury in vermillion. Conventional XRR, however, has a number of important limitations. First of all, the observed X-ray absorbance is a summation of all element-specific absorbancies, which reduces the contrast of weakly absorbing elements. Second, lead white primer raises the overall background of the absorption image derived from the paint layers. Finally, the polychromatic character of an X-ray tube further reduces the contrast in radiographic images. As a result, conventional XRR imaging of paintings frequently provides only a fragmentary view of their substructure, which can severely hamper the readability of hidden compositions [1]. In addition to using the absorption of primary X-rays as an imaging method, one can also record the intensity of secondary radiation, emitted by the atoms in the painting while a pencil beam of energetic X-rays is scanned over the surface. This X-ray radiation fluorescence (XRF) technique has the added advantage that the emitted X-ray radiation is element specific. The covering surface layers will not significantly attenuate the high-energy fluorescence signals from heavy elements in the hidden layers; in this manner, the distribution of both minor and major components in the painting can be visualized. The use of high intensity X-ray beams, coupled with high count rate detectors, reduces the dwell time for data acquisition to such an extent that large, decimeter sized areas can be scanned in a reasonable time frame. In order to learn about the chemical binding of a specific element, X-ray absorption near edge structure (XANES) measurements can be performed at either the element's K- or L-edge at the most interesting points of the hidden layer.

The application of this technology to work "Patch of Grass" by Van Gogh has revealed the head of a woman in a hidden paint layer [2]. We succeeded in visualizing the hidden face with unprecedented detail. In particular, the distribution of Hg and Sb in the red and light tones, respectively, enabled an approximate color reconstruction of the flesh tones. This reconstruction proved to be the missing link for the comparison of the hidden face with Van Gogh's known paintings.

The research into the painting "Old Man with Beard" to determine its attribution determined that the small panel was painted by Rembrandt around 1630, at the end of his time in Leiden. In addition, a self-portrait was revealed when the painting was scanned at the European Synchrotron Radiation Facility (ESRF) in Grenoble and at the Brookhaven National Laboratory (BNL) in New York using Macro-scanning X-Ray Fluorescence spectrometry (MA-XRF). The presence of the self-portrait of Rembrandt aided the authentication process [3].

These microscopy and microanalysis techniques have also found a niche in the art conservation field. Over the past years a number of studies have described the instability of the pigment cadmium yellow (CdS). We have shown how cadmium sulfide on paintings by James Ensor oxidizes to CdSO4·H2O [4]. The degradation in the painting "Flowers in a blue vase"

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by Vincent van Gogh was initially caused by oxidation of the original CdS pigment, similar as Ensor's paintings. However, additional degradation occurs due to the presence of an overlying varnish. The resulting opaque anglesite compound in the varnish, in combination with the underlying CdC2O4 layer at the paint/varnish interface, account for the orange-gray crust that is disfiguring the painting on a macroscopic level [5].

This presentation will show past successes, present developments and the future potential of these techniques in the realm of art conservation, preservation, authentication and discovery.

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Joris Dik

Joris Dik holds an Antoni van Leeuwenhoek chair at the Dept. of Materials Science and Engineering at the Delft University of Technology since 2011. He studied art history and classical archaeology at the University of Amsterdam and obtained his Masters of Arts in 1997. After spending a year as a graduate intern at the Paul Getty Museum in Los Angeles, he returned to Holland, where he joined the laboratory of Henk Schenk in the University of Amsterdam Chemistry department. He received his Ph. D. in 2003 for his studies of Naples yellow, a pigment that has existed for thousands of years. He joined the Delft University of Technology leading a research group in Materials in Art and Archaeology and is a member of the Young Academy of the Royal Netherlands Academy of Arts and Sciences (KNAW). Initially, he focused on the authentication and conservation of paintings and worked for auction houses such as Christie's. Currently, his research interest is the study of materials relating to cultural heritage, their origin and conservation, and the development of new analysis methods, including new visualization techniques to study 17th century paintings. He brings a unique perspective to the study of paintings and masterworks, combining insights from both the science and the art worlds. The transportable atomic particle accelerator, he recently developed, will permit many of the world's great masterworks to be examined in situ, without having to be transported to public laboratories.

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DISTINGUISHED SCIENTIST AWARDS

Biological Sciences
David DeRosier

Dr. DeRosier's interest in macromolecular complexes began while a graduate student with Bob Haselkorn at the University of Chicago. He studied two icosahedral plant viruses and then decided to try his hand at X-ray crystallography of viruses with Aaron Klug at the MRC-LMB (Cambridge, England). He soon found himself deeply involved in the development of 3D reconstruction from electron micrographs. Four years later, Dr. DeRosier moved to the University of Texas at Austin began structural studies of pyruvate dehydrogenase, a multienzyme complex. He continued this work after moving to Brandeis but was lured away to studies of the actin cytoskeleton with Lewis G. Tilney and the bacterial flagellum with Lucy Shapiro and Bob Macnab. After retiring, Dr. DeRosier returned as a postdoc in the neuroscience laboratory of Gina Turrigiano at Brandeis University. There they continue to develop super-resolution light microscopy at cryogenic temperatures to look at the organization of synaptic proteins.

Physical Sciences
C. Barry Carter

C. Barry Carter is a Professor at the University of Connecticutt. He has a B.A., M.A. and Sc.D. from Cambridge University, an M.Sc. from Imperial College and a D. Phil. From Oxford University. He was a full Professor at Cornell (until 1991) and the 3M Endowed Multidisciplinary Chair at U. Minnesota (until 2007). He is a CINT Distinguished Affiliate Scientist at Sandia National Lab, NM. He has received a Guggenheim Fellowship and the Alexander von Humboldt Senior Award. He is a Fellow of AAAS, MRS, MSA, ACerS and RMS and an elected Member of CASE. He was the 1997 President of MSA and the 2003-2010 General Secretary of IFSM. He is now the 2011-14 President of IFSM. He has co-authored 700 articles plus ***Transmission Electron Microscopy: A Textbook for Materials Science***, with Dave Williams and ***Ceramic Materials: Science and Engineering*** with Grant Norton. He is the Editor-in-Chief of the Journal of Materials Science.

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Burton Medal Award

John L. Rubinstein

John Rubinstein is a Senior Scientist at the Research Institute of the Hospital for Sick Children and an Associate Professor in the Departments of Biochemistry and Medical Biophysics at the University of Toronto. A native of Toronto, Canada, John received his BSc in Physical Sciences from the University of Guelph, Canada in 1998, and his PhD from Cambridge University in 2002 working in Medical Research Council laboratories with Dr. Richard Henderson and Sir John E. Walker. He was a Postdoctoral Research Associate at the MRC Laboratory of Molecular Biology before returning to Canada for a National Cancer Institute of Canada (NCIC) postdoctoral fellowship at the Banting and Best Department of Medical Research. He joined the Research Institute of The Hospital for Sick Children in 2006. John has received a New Investigator Award from the Canadian Institutes of Health Research and an Early Researcher Award from the government of Ontario.

Albert Crewe Award

Lena F. Kourkoutis

Lena F. Kourkoutis received a Diploma in Physics from the University of Rostock, Germany in 2003. Her career as an electron microscopist started shortly after, when she joined the electron microscopy group lead by David A. Muller at Cornell University. Her work focused on interface phenomenon in complex oxide heterostructures studied by advanced electron microscopy and spectroscopy methods. She was awarded a PhD from Cornell University in 2009. As a Humboldt Research Fellow Kourkoutis spent 2011-2012 exploring cryo-electron microscopy in the Molecular Structural Biology Group lead by Wolfgang Baumeister at the Max Planck Institute of Biochemistry in Martinsried, Germany. She returned to Cornell as a Postdoctoral Associate in 2012 and joined the Applied and Engineering Faculty in 2013.

Morton D. Maser Distinguished Service Award

Caroline Miller

Caroline Miller has been involved with microscopy for 44 years and is currently the Assistant Director and Manager of the Electron Microscopy Center for the Indiana University School of Medicine. The Center is a full service research facility and is in its 7th year as an International Research Core for the Polycystic Kidney Disease Foundation.

Caroline has been MSA certified and member since 1985. As a MSA Biological Director from 2008-2010, she also served on the fellowship and nomination committees and was liaison to the Educational Committee. Since finishing her term on MSA Council in 2010, she has been the Chair of the Education Committee.

She helped establish FIGs for Cryo Preparation and Diagnostic Imaging, is currently on the Editorial Board for Microscopy Today in Specimen Preparation and has co-chaired several symposiums. She is especially proud to have co-chaired the George E. Palade Memorial Symposium. She has been involved with the Sunday short courses and has chaired- the Short Course in Immunolabeling Technology for Light and Electron Microscopy for the last 4 years. Caroline has also served at the Local level in 2 different LAS's, was a Charter member of the Indiana Microscopy Society from 2004-2010 and is now the President-Elect of the Microscopy Society of the Ohio River Valley.

MSA 2013 Society Awards

Hildegard H. Crowley Outstanding Technologist Award for Biological Sciences

Robyn Roth

Robyn Roth received training in electron microscopy at Southwest Missouri State University. Following graduation in 1980, Mrs. Roth began work with the Electron Microscopy Center for Basic Cancer Research, at Washington University School of Medicine in St. Louis (WUSM). In 1981, Mrs. Roth transferred into the lab of Dr. John Heuser, inventor of techniques related to Quick Freeze Deep-etch Electron Microscopy (DEEM), Department of Cell Biology and Physiology, WUSM. She currently continues the Heuser Lab mission, "Visualization of everything from whole cells to individual molecules by DEEM", as a service for investigators at WUSM and throughout the country. Her DEEM micrographs appear widely in journals and textbooks.

Chuck Fiori Outstanding Technologist for Physical Sciences

K. Shawn Reeves

Shawn Reeves is a Master Technician in the Microscopy Group in the Materials Science and Technology Division at the Oak Ridge National Laboratory (ORNL). Shawn has been at ORNL for 20 years - she started her career as a student intern from the Tennessee Technological University, where she studied Chemistry. After completing her bachelor's degree, Shawn went on to graduate school in the Materials Science and Engineering Department at North Carolina State University, where she qualified for the Ph.D. program, and returned to Oak Ridge to conduct her Ph.D. research at ORNL on a DOE fellowship. During Shawn's career at ORNL, she has developed and demonstrated unmatched skills related to the innovative preparation of difficult materials for TEM and STEM. Shawn has gained an international reputation in the "niche field" of microscopy of materials for polymer electrolyte membrane fuel cells (PEMFCs), where she has trained and mentored students and other senior technicians. Shawn is internationally known for integrating ultramicrotomy as the primary preparation method for characterizing fuel cell membranes and membrane electrode assemblies.

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A. Klug
O. L. Krivanek
M. C. Ledbetter
D. McMullan
J. R. Michael
S. E. Miller
T. E.Mitchell
T. Mulvey
D. E. Newbury
G. Rempfer
J-P. Revel
H. Rose
F. O. Schmitt
C. Schooley
R. Shimizu
J. Silcox
R. Sinclair
S. J. Singer
F. Sjostrand
K. C.A. Smith
A. V. Somlyo
J. C.H. Spence
A. Steven
P. R. Swann
G. Thomas
K. Tokuyasu
N. Unwin
J. S. Wall
O. Wells
M. J. Whelan
N. J. Zaluzec
E. Zeitler
Y. Zhu

2010

R. M. Albrecht
L.F. Allard, Jr.
K. H. Downing
E. A. Ellis
J. I. Goldstein
M.S. Isaacson
M. K. Miller
G. Pappas
S. J. Pennycook
J. P. Petrali
Z. L. Wang
D. B. Williams

2011

P.E. Batson
P.G. Calarco
P.A. Crozier
J.A. Eades
B.J. Griffin
W.T. Gunning III
W.G. Jerome
R.D. Leapman
C.E. Lyman

2012

U. Dahmen
M.A. Goldstein
M.J. Kim
W. Landis
J. Liu
B. Maleeff
R. L. Price
F.M. Ross
D.N. Seidman

2013

N.D. Browning
H.L. Fraser
D. A. Muller
M. Radermacher
D.J. Smith
E.A. Stach

Microanalysis Society

Established 1968

Officers 2013

Executive Council

President	Kristin L. Bunker
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Past President	John F. Mansfield
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Treasurer	Daniel T. Kremser
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	Rhonda M. Stroud
	Patrick P. Camus
	Elaine F. Schumacher
	Jeffrey M. Davis
	Brian P. Gorman

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Affiliated Regional Societies and Tour Speaker	Valerie Woodward
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MicroNews Editor	Heather A. Lowers
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Sustaining Members Chair	Lucille A. Giannuzzi
Topical Conferences Chair	Paul K. Carpenter

MAS Past Presidents

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

MAS Sustaining Members

Advanced MicroBeam, Inc.
Bruker Nano
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EDAX, Inc.
Electron Microscopy Sciences/DiATOME
FEI Company
Gatan, Inc.
Geller MicroÅnalytical Laboratory, Inc.
Hitachi High Technologies America, Inc.
Hysitron, Inc.
IBSS Group
IXRF Systems, Inc.
JEOL USA, Inc.
L.A. Giannuzzi & Associates, LLC
Lehigh University
Leica Microsystems, Inc.
Materials Analytical Services, LLC
Micron, Inc.
Oxford Instruments, Inc.
Probe Software, Inc.
PulseTor, LLC
SEMTEC Laboratories, Inc.
SEMTech Solutions, Inc.
South Bay Technology, Inc.
SPI Supplies/Structure Probe, Inc.
Ted Pella, Inc.
Thermo Fisher Scientific, Inc.

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MAS Awards

All MAS awards are recommended by the Awards Committee for approval by either the President or Council.

Peter Duncumb Award for Excellence in Microanalysis
Sponsored by Bruker Nano. The Duncumb Award recognizes outstanding achievement over a sustained period of time in the field of microanalysis through technical accomplishment, leadership, and educational and professional activities. The award winner is chosen through nomination by the MAS membership and selection by vote of MAS Council.

Presidential Service Award
This award honors a member of MAS for outstanding volunteer service to the society over a sustained period of time. The award winner is chosen annually by the MAS President.

Presidential Science Award
This award honors a senior scientist for outstanding technical contributions to the field of microanalysis over a sustained period of time. The award winner is chosen annually by the MAS President.

K. F. J. Heinrich Award
This award honors a scientist under the age of forty for distinguished technical contributions to the field of microanalysis. The award winner is chosen annually by the MAS President.

M&M Student Awards
These awards are presented annually to students presenting high quality technical papers with significant microanalysis content at the annual meeting. The award is comprised of meeting registration and up to $1,000 to defray travel expenses to attend the meeting. Application is accomplished by requesting consideration for a student award during the paper submission process. Qualified applicants must be full-time students at an accredited educational institution, must be first author of the paper submitted for consideration, and must present the paper in person at the meeting. M&M Student Award winners receive invitations to attend MAS-sponsored functions throughout the week of the annual meeting, including the Presidents' Reception and the MAS Social. The award winners are chosen annually by the MAS President.

MAS Outstanding Paper Awards

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

- Birks Award, for best contributed paper – Sponsored by JEOL USA. Inc.
- Macres Award, for best instrumentation or software paper – Sponsored by Oxford Instruments, Inc.
- Cosslett Award, for best invited paper – Sponsored by MAS
- Castaing Award, for best student paper. – Sponsored by CAMECA Instruments, Inc.

Candidates for the MAS Outstanding Paper Awards are nominated, through consultation with symposium organizers and the MAS membership, by the MAS Directors in their final year of service at the time of the meeting, then approved by vote of MAS Council.

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2013 Society Awards

Previous Winners

Presidential Science

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
1991 J.I. Goldstein
1992 G.W. Lorimer & G. Cliff
1993 D.E. Newbury
1994 D.C. Joy
1995 G. Bastin
1996 A.V. Somlyo & A.P. Somlyo
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 M. 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

Presidential Service

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

K.F.J. Heinrich

1986 P.J. Statham
1987 J.T. Armstrong
1988 D.B. Williams
1989 R.D. Leapman
1990 R.W. Linton
1991 A.D. Romig, Jr.
1992 S.J. Pennycook
1993 P.E. Russell
1994 J.R. Michael
1995 E.N. Lewis
1997 R. Gauvin
1998 V.P. Dravid
1999 J. Bruley
2000 H. Ade
2001 C. Jacobsen
2002 D.A. Wollman
2005 M. Watanabe
2006 M. Toth
2007 G. Kothleitner
2008 P.G. Kotula
2009 Dominique Drouin
2010 H. Demers
2011 L.N. Brewer
2012 E.A. Marquis
2013 J.M. LeBeau

Peter Duncumb Award for Excellence in Microanalysis

2007 D.B. Williams
2008 J.I. Goldstein
2009 D.E. Newbury
2010 D.C. Joy
2011 J.R. Michael
2012 J. Bentley
2013 E. Lifshin

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MAS 2013 Awards

Duncumb Award for Excellence in Microanalysis
Eric Lifshin

Eric Lifshin is currently a full professor at the College of Nanoscale Science and Engineering (CNSE), University at Albany, State University of New York. He had a long career at GE Global Research starting in 1963 where he served in various positions including Manager of the Characterization and Environmental Technology Laboratory which he held for 25 years prior to his retirement in 2000.

Throughout his career he has been extensively involved with research relating to many aspects of electron microprobe analysis and scanning electron microscopy. Some of these activities included early work on microprobe automation for the analysis of diffusion couples, specimen current imaging in the SEM, Monte Carlo calculation to better understand spatial resolution for chemical analysis, and he was one of the first people to interface an energy dispersive spectrometer to an SEM. He used the latter to both measure absolute x-ray production efficiencies and determine the shape of the x-ray continuum and thus develop models needed for background subtraction.

He is most appreciative of the many colleagues at GE who worked with him over the years. In his current work he is developing advanced deconvolution techniques for image restoration in the SEM and various types of microanalysis.

Eric Lifshin has published dozens of papers over the course of his career and has received various awards from MAS as well as from elsewhere including two IR100 awards and a best paper award from ISTFA. He also served as Past-President of MAS and as a national tour speaker. He currently teaches courses in microscopy and microanalysis at CNSE and has been a lecturer at the Lehigh SEM courses since their founding more than 40 years ago. Eric is a co-author of the popular text developed for the general SEM course.

W.F.J. Heinrich Award
James LeBeau

James LeBeau earned his B.S. in Materials Science & Engineering from Rensselaer Polytechnic Institute in 2006. Then, working with Prof. Susanne Stemmer, he received his Ph. D. from the University of California Santa Barbara in 2010. After his graduate work, he joined the Department of Materials Science and Engineering at North Carolina State University as a faculty member in January 2011. His research focuses on applying and developing transmission electron microscopy techniques to determine the atomic structure and chemistry of material defects. Having shown that HAADF images from experiment agree quantitatively with simulations, the LeBeau group is interested in exploring details in the image intensities to provide information about materials without the need for calibration standards. The materials currently being investigated cover a range of topics including advanced thermoelectrics, topological insulators, and materials for high temperature applications.

For his research, James has been honored with numerous awards. He was presented a MAS Distinguished Scholar award and the MAS Birks Award for Best Contributed Paper at M&M 2008 in Albuquerque, NM. In 2010, he received the Oak Ridge Associated Universities Ralph E. Powe Junior faculty award, and the Appalachian Regional Microscopy Society's Young Investigator Award in 2012. Since 2006, he has co-authored 26 journal articles and has given numerous invited talks in the United States and around the world.

MAS 2013 Awards

2013 Presidential Science Award
Patrick Echlin

Patrick Echlin was a lecturer in the Department of Plant Sciences and Director of the Multi-Imaging Centre, School of Biological Science, University of Cambridge until he retired in 1999. He has taught for more than thirty-five years at the Lehigh University Microscopy School and is the author and co-author of eight books on scanning electron microscopy and x-ray microanalysis. He was Editor in Chief for the Journal of Microscopy, reviving the journal after years of neglect. He is Past President, an elected Fellow, and an Honorary Fellow of the Royal Microscopical Society and received the Distinguished Scientist Award in Biological Sciences from the Microscopy Society of America in 2001. He was made a Fellow of the Microscopy Society of America in 2009. His research has focused on imaging and microanalysis of biological materials at cryogenic temperatures, spanning important aspects of specimen handling, preparation, and artifacts as well as instrumentation including the scanning electron microscope and scanning transmission electron microscope equipped with energy-dispersive x-ray spectrometers.

2013 Presidential Service Award
James J. McGee

James McGee received a B.S. in Geology from University of Notre Dame and a M.S. in Geochemistry from SUNY-Stony Brook. Jim was a Research Geologist at the U.S. Geological Survey (USGS) for 18 years, specializing in lunar sample studies and microanalysis of geologic materials, and served as Chief of the Electron Microprobe Project at the USGS-Reston, VA headquarters. Jim then joined the University of South Carolina's Geosciences Department, continuing research on lunar samples and revitalizing the Electron Microprobe facility. Jim then joined the Knolls Atomic Power Laboratory in Schenectady NY, where he carried out material characterization and laboratory/project management.

Jim joined the Microbeam Analysis Society in 1979, co-organized the Fifty years of Electron Probe Microanalysis Symposium and its Microscopy and Microanalysis special issue. He served as MAS Director (2003–2005) and Treasurer (2007-2010). As Treasurer, he redefined the Treasurer, business office, and accounting functions, thereby reducing Society operating expenses. He also helped define the funding procedures for MAS Topical Workshops and M&M Meeting co-sponsor funding, simplified/clarified financial reporting to the membership, and helped channel more funds for student support.

Jim considered it a privilege and very rewarding to be able to serve MAS in these capacities in order to aid in advancing the Society's promotion of scientific/technical knowledge for its members and for the entire microanalysis community.

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International Metallographic Society

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	Brian J. Joyce
	Gabriel M. Lucas
	James E. Martinez
	Coralee McNee
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1968–1971	John H. Bender Jr.	1981–1983	George Vander Voort	1993–1995	Japnell D. Brown	2003–2005	Allan J. Lockley
1971–1973	Arthur E. Calabra	1983–1985	James E. Bennett	1995–1997	E. Daniel Albrecht	2005–2007	Dennis W. Hetzner
1973–1975	E. Daniel Albrecht	1985–1987	William E. White	1997–1999	Mahmoud T. Shehata	2007–2009	David J. Fitzgerald
1975–1977	James H. Richardson	1987–1989	M.R. Louthan, Jr.	1999–2001	Elliot A. Clark	2009–2011	Frauke Hogue
1977–1979	Robert J. Gray	1989–1991	Donald W. Stevens	2001–2003	Richard K. Ryan	2011–2013	Natalio T. Saenz
1979–1981	P.M. French	1991–1993	Ian LeMay				

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2013 IMS Society Awards

President's Award (Service to IMS)

1977 Carus K.H. DuBose
1978 Richard D. Buchheit
1979 Arthur E. Calabra
1980 James L. McCall
1981 E. Daniel Albrecht
1982 James H. Richardson
1983 Robert J. Gray
1984 Japnell D. Braun
1986 P. Michael French
1987 George F. Vander Voort
1988 Robert S. Crouse
1989 Ian Le May
1990 William E. White
1991 Chris Bagnall
1992 Gary W. Johnson
1993 Donald W. Stevens
1994 MacIntyre R. Louthan, Jr.
1995 Gunter Petzow
1996 James Nelson
1997 John Wylie
1998 John W. Simmons
1999 William Forgeng, Jr.
2000 Nat Saenz
2001 William W. Scott, Jr.
2002 George Blann
2003 Jeff Stewart
2004 Elliot A. Clark
2005 Chris Bagnall
2006 Art Geary
2007 Richard K. Ryan
2008 Thomas S. Passek
2009 David & Dale Fitzgerald
2010 Jaret J. Frafjord
2011 Donald F. Susan

Henry Clifton Sorby Awards

1976 Georg L. Kehl
1977 Cyril Stanley Smith
1978 Adolph Buehler
1979 Frederick N. Rhines
1980 Len E. Samuels
1981 Robert J. Gray
1982 Gunter Petzow
1983 William D. Forgeng
1984 Ervin E. Underwood
1985 Alan Price
1986 Robert W. K. Honeycombe
1987 Gareth Thomas
1988 Franz Jeglitsch
1989 Tanjore R. Anantharaman
1990 E. Daniel Albrecht
1991 W. C. Leslie
1992 Charles S. Barrett
1993 Raimond B. Castaing
1994 F. Brian Pickering
1995 Erhard Hornbogen
1996 Peter Duncumb
1997 Robert T. DeHoff
1998 Kay Geels
1999 Joseph Goldstein
2000 Hans Eckhart Exner
2001 Brian Ralph
2002 Walter Mannheimer
2003 Enrica Stagno
2004 George F. Vander Voort
2005 Iain LeMay
2006 Arlan Benscoter
2007 McIntyre R. Louthan, Jr.
2008 Lawrence E. Murr
2009 Chris Bagnall
2010 Albert C. Kneissl
2011 David B. Williams
2012 Michael Pohl

Jacquet-Lucas Award For Excellence in Metallography

1946 G.R. Kuhn
1947 R.H. Hays
1948 E.C. Pearson
1949 D.H. Rowland
1950 S.O. Modin
1951 H.P. Roth
1952 H. Griffin
1953 B.C. Leslie, R.J. Gray
1954 R.D. Buchheit, J.E. Boyd, A.A. Watts, F.C. Holden
1955 F.M. Cain, Jr.
1956 D. Mannas
1957 T.K. Bierlein, B. Mastel
1958 J.C. Gower, E.P. Griggs, W.E. Denny, J.E. Epperson, R.J. Gray
1959 F.M. Beck
1960 G.C. Woodside
1961 J.F. Radavich, W. Couts, Jr
1962 D. Medlin
1963 W.C. Coons
1964 B.C. Leslie, R.J. Gray
1965 W.C. Coons, A. Davinroy
1966 D.M. Maher, A. Eikum
1967 J.F. Kisiel
1968 R.M.N. Pelloux, Mrs. H. Wallner
1969 R.H. Beauchamp, R.P. Nelson
1970 D.R. Betner, W.D. Hepfer
1971 R.J. Gray
1972 C.J. Echer, S.L. Digiallonardo
1973 M.S. Grewal, B.H. Alexander, S.A. Sastri
1974 M.P. Pinnel, D.E. Heath, J.E. Bennett, G.V. McIlharagie
1975 W.C. Coons
1976 L.E. Soderqvist
1977 R.H. Beauchamp, D.H. Parks, N.T. Saenz, K.R. Wheeler
1978 C. Bagnall, R. Witkowski
1979 M.J. Bridges, S.J. Dekanich
1980 R.H. Beauchamp, K. Fredriksson
1981 F. Kurosawa, I. Taguchi, H.G. Suzuki
1982 M.J. Carr, M.C. Mataya, T.O. Wilford, J.L. Young
1983 V. Carle, E. Schmid
1984 R.H. Beauchamp, N.T. Saenz, J.T. Prater
1985 U. Taffner, R. Telle
1986 N.T. Saenz, C.A. Lavender, M.T. Smith, D.H. Parks, G.M. Salazar

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2013 IMS Society Awards

Jacquet-Lucas Award For Excellence in Metallography- (continued)

1987 S.A. David, J.M. Vitek, C.P. Haltom, A.G. Barcomb
1988 A. David, J.M. Vitek, A. Boatner, G.C. Marsh, A.B. Baldwin
1989 G. Hoerz, M.C. Kallfass
1990 A. David, J.M. Vitek, A.B. Baldwin
1991 M.R. Jones
1992 G.F. VanderVoort
1993 T. Leonhardt, F. Terepka, M. Singh, G. Soltis
1994 J.W. Simmons, B.S. Covino, Jr., S.D. Cramer, J.S. Dunning
1995 Kamal, K. Soni, R. Levi-Setti, S. Shah, S.J. Gentz
1996 R.L. Bodnar, S.J. Lawrence
1997 J. Yewko, D.L. Marshall
1998 R. Pereyra, E.G. Zukas
1999 K.R. Luer
2000 D.J. Lewis, S. Allen
2001 D. Chakrapani
2002 F.F. Noecker, II
2003 F.F. Noecker, II
2004 R. Unocic, P.M. Sarosi, M.J. Mills
2005 K. Kimura, S. Hata, S. Matsumura, T. Horiuchi
2006 R. Deacon
2007 K.A. Unocic, G.S. Daehn
2008 T. Nizolek
2009 B. Gerard
2010 C. Roberts, H. Colijn
2011 Christopher Marvel, Will Lenthe, John Logan
2012 Zhiping Luo

History of the IMS Awards

HENRY CLIFTON SORBY AWARD—The Sorby Award was established to recognize outstanding contributions to the field of metallography by an internationally recognized senior figure in the field of metallography. This award is a personalized plaque, and the recipient is honored during the M&M Conference Sorby Lecture and at the IMS Annual Meeting banquet.

PIERRE JACQUET-FRANCIS F. LUCAS AWARD—The Jacquet-Lucas Award is given each year to the International Metallographic Contest entry judged "Best in Show" by a panel of judges. This is a joint IMS/ASM award with origins dating back to 1946, and has been endowed by Buehler since 1976. The winners receive the Jacquet Gold Medal, the ASM Lucas Award, a cash award, and are honored at banquets at both the IMS Annual Meeting and the ASM Annual Event.

The 2012 International Metallographic Contest Judging Team

Chair: Alice Kilgo, Sandia National Laboratories
Local Chair: Mitch Witkowski, W.L. Gore & Associates
Brian Rose, EMCON Technologies
Coralee McNee, IMR Test Labs
Lee Garrett, Buehler
Andrea McMartin, Buehler
Ikaros Kayafas, Product Evaluation Systems, Inc.
Chris Bagnall, Product Evaluation Systems, Inc.
Amber Trees, SEMTEC Laboratories, Inc.
Steven Gentz, NASA Langley Research Center

PRESIDENT'S AWARD—This award is presented to an individual deemed deserving of special recognition by the Society. This award is a plaque personalized for the recipient.

BUEHLER TECHNICAL PAPER MERIT AWARD—This award shall be given annually to the authors of the technical paper published that year in the journal Materials Characterization that was determined most outstanding by a panel of IMS judges. A plaque and cash award is given to the recipients each year by Buehler.

PAST-PRESIDENTS AWARD—This award shall be presented by the Board of Directors to the out-going Past-President in recognition of their contributions to the Society. This award is a plaque personalized for the recipient.

PRESENTATION OF THE IMS AWARDS—The awards are presented at the annual banquet on Wednesday, August 1, 2012, at 6:30 PM.

We would like to thank the IMS Members who helped organize the M&M 2013 Conference

Jaret Frafford, *M&M 2010 IMS Co-Chair*
Don Susan, *M&M 2011 IMS Co-Chair*
Dustin Turnquist, *M&M 2012 IMS Co-Chair*
Coralee McNee, *M&M 2013 IMS Co-Chair*
Alice Kilgo, *International Metallographic Contest Chair*
Brian Rose, *International Metallographic Contest Local Chair*
James Martinez, *Symposia Co-Chair*
George Vander Voort, *Symposia Co-Chair*
Daniel Dennies, *Symposia Co-Chair*
Brett Miller, *Symposia Co-Chair*
John Sauer, *Symposia Co-Chair*
Richard Chinn, *Symposia Co-Chair*
Gabriel Lucas, *Symposia Co-Chair*

2013 IMS Awards

President's Award
Sarina Pastoric

Sarina Pastoric is currently serving as Affiliates Administrator for ASM International's five Affiliate Societies: International Metallographic Society, Electronic Device Failure Analysis Society, Heat Treating Society, Thermal Spray Society and International Organization on Shape Memory and Superelastic Technologies. Her role includes administration of all governance and protocol activities including budgets, strategic plans, board and committee meetings, and numerous volunteer programs. She works closely with the Board of Directors, committees and volunteers.

She has been with ASM International her entire career and has served in numerous positions which included responsibility for several activities including events, awards, committees, education services, and customer service.

Jacquet-Lucas Award
Zhiping Luo

Dr. Zhiping Luo is an Associate Professor of the Department of Chemistry and Physics, and Manager of the Electron Microprobe Facility, Fayetteville State University, North Carolina. He received his Ph.D. from the Chinese Aeronautical Establishment in 1994, and then worked as a Principle Investigator at Beijing Institute of Aeronautical Materials, China. From 1996-1997, he spent two years in Okayama University of Science, Japan, as a postdoctoral researcher studying electron microscopy with Professor Hatsujiro Hashimoto. In 1998, he moved to Materials Science Division, Argonne National Laboratory, as a Visiting Scholar and was then promoted to Assistant Scientist. From 2001-2012 he worked at Texas A&M University as a Research Scientist of the Microscopy and Imaging Center, and a Graduate Faculty member of the Materials Science and Engineering Program.

Dr. Luo's research interest is mainly in the field of metallurgy, focusing on the novel nanostructured materials with enhanced performance, material structures revealed through electron microscopy, and material structure-property correlations. He has published over 130 papers on peer-reviewed journals, and over 60 papers on conference proceedings and book chapters. As community service, he served as a reviewer for over 30 journals and some grant agencies, and an editorial board member of several journals. He received the DuBose-Crouse Award from the International Metallographic Society and ASM International, and the Professional Technical Staff Award from the Microscopy Society of America in 2008. He has made a wide range of collaborations with other investigators to study the material structures using electron microscopy.

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2013 IMS Awards

Henry Clifton Sorby Award
Arun M. Gokhale

Dr. Arun M. Gokhale
Professor of Materials Science and Engineering
Georgia Institute of Technology

Professor Gokhale received his B Tech (1970) and M Tech (1972) in Metallurgical Engineering from Indian Institute of Technology, Kanpur, and PhD (1977) in Materials Science from University of Florida. He is internationally renowned for his contributions in the development and applications of quantitative metallography, stereology, and digital image processing for mathematical representation of materials and biological microstructures; modeling and simulations of microstructures for materials design, and applications of quantitative fractography for characterization of fracture.

Professor Gokhale has been an active member in the metallurgical community as Vice President, International Society for Stereology (1992-1995), the Vice Chair (2005-2006), and Chair (2006-2007), Materials Characterization Committee (EPD Congress) of TMS. He was an Invited Member of the US delegation to Germany to participate in NATO Science Forum meetings on research partnerships (2000). He has also Served on the Editorial Boards of three international journals, namely, Metallurgical and Materials Transactions, Journal of Microscopy (Oxford), and Materials Characterization.

Professor Gokhale has received many awards including Fellow of American Society for Metals (ASM) International, Sustained Research Award from Sigma Xi Society (2000), Research Leadership Award from American Foundry Society (2000), Twice received Special Creativity Based Research Award from National Science Foundation (1996 and 2001), ASM-IIM Distinguished Visiting Lecturer Award (2002), and the Kamani Gold Medal by Indian Institute of Metals (1985). Professor Gokhale has published more than 200 scientific research papers in archival journals and conference proceedings, written chapters in ASM Metals Handbook Vol. 9 (Failure Analysis and Prevention, 2002 edition), and Vol. 11 (Metallography and Microstructures, 2004 edition), and has Co-edited conference proceedings for TMS.

He continues to improve and promote the metallurgical community by teaching more than 25 continuing education short courses, contributing to outreach through organization (as Co-PI) of National Science Foundation sponsored Summer Undergraduate Research Fellowship (SURF), Research Experience for School Teachers (RET) and International Research Experience (IRE) programs at Georgia Tech for more than 10 years.