

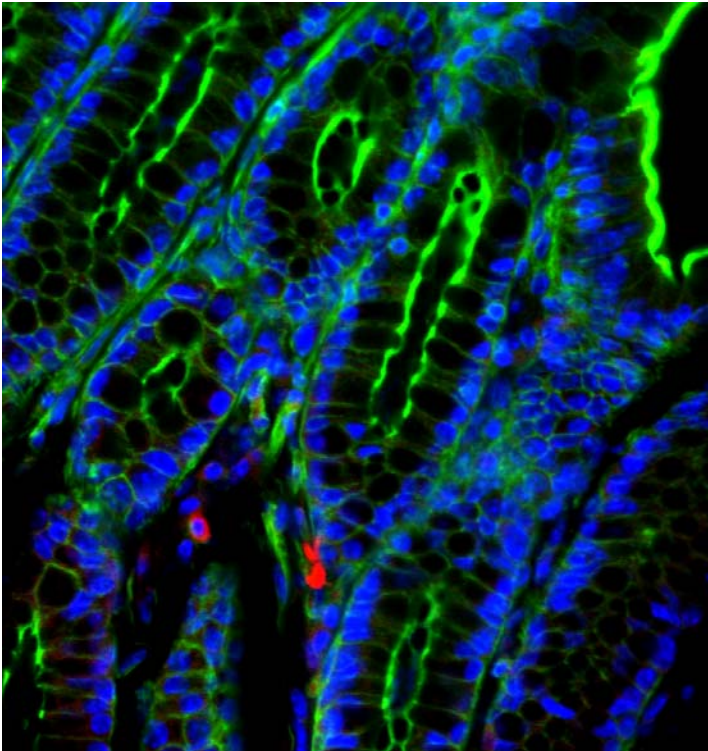
# Basic Confocal Light Microscopy

## Once More, Jay and Silent Bob do Basic Confocal Microscopy

Confocal microscopy has become a primary method for visualizing structure in three dimensions. The technology is rapidly evolving with new instruments, lasers, detectors, and spectral imaging capabilities. Bob and Jay will instruct beginning and intermediate researchers on carrying out successful biological confocal microscopy experiments. Emphasis will be on practical aspects of specimen preparation, instrument setup and operation and enhancement and analysis of the digital images collected by confocal microscopy. A general knowledge of optical microscopy is helpful, but no prior knowledge of confocal microscopy is necessary to benefit from the workshop.

### Topics to be covered:

- Introduction and overview: Resolution, basics of digital images, image formats
- Specimen fixation, processing and labeling
- Basics of microscopic fluorescence and dye characteristics
- Types and component parts of confocal microscopes; proper set up of operating parameters



Fluorescently labeled mouse small intestine

### Instructors (see next page for bios):

Jay Jerome: Associate Professor, Pathology and Cancer Biology, Vanderbilt University

Bob Price: Research Professor, Cell and Developmental Biology and Anatomy, and Director, Instrumentation Resource Facility, University of South Carolina School of Medicine.



**Bob Price** is Research Professor, Cell and Developmental Biology and Anatomy, and Director, Instrumentation Resource Facility, University of South Carolina School of Medicine  
<http://dba.med.sc.edu/price/irf/irf.htm>



**Jay Jerome** is Associate Professor, Pathology and Cancer Biology, Vanderbilt University  
[https://medschool.mc.vanderbilt.edu/facultydata/php\\_files/show\\_faculty.php?id3=1032](https://medschool.mc.vanderbilt.edu/facultydata/php_files/show_faculty.php?id3=1032)

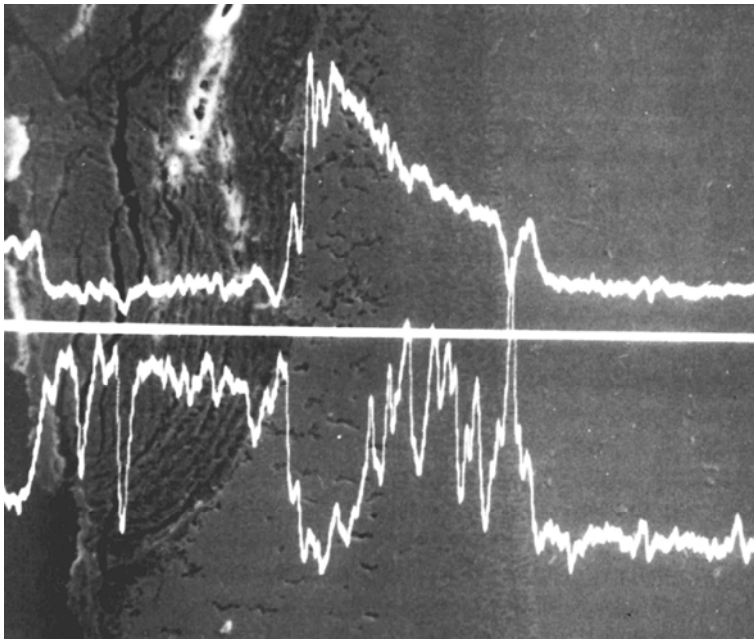
Drs. Price and Jerome have been teaching variations of the Basic Confocal Microscopy Workshop for the past 10 years for the Microscopy Society of America and its Local Affiliate Societies, The Australian Microscopy and Microanalysis Society, and on site courses for Universities. The Microscopy Society of America has also produced their lectures on the use of confocal microscopy as instructional videotapes.

## Introduction to SEM Imaging and X-ray Compositional Analysis

This introductory level workshop will involve classroom lectures and live demonstrations. The SEM topics will be taught by David Joy and will cover basic instrument operation and imaging modes. The EDS topics will be taught by Nicholas Ritchie and will cover basic compositional analysis using an SEM with energy dispersive x-ray spectrometer. The lessons in the lectures will be complemented with hands on demonstrations of SEM operation and x-ray microanalysis by John Mansfield. Demonstrated topics will include the effects of working distance, accelerating voltage, probe size, imaging detector, detector bias, probe current, dead time, detector choice, sample geometry, etc.

### Topics to be covered:

- Instrument features
- Operation basics
- Spectral optimization
- Sample preparation



Co (top) and Cr (bottom) X-ray line scans across an oxidized alloy. From the Goldstein et al. textbook.

### Instructors (see next page for bios):

David Joy: Distinguished Professor, University of Tennessee, Knoxville and Distinguished Scientist, Oak Ridge National Laboratory.

Nicholas Ritchie: Microanalysis Research Group, National Institute of Standards and Technology.

John Mansfield: Associate Research Scientist & Manager of the North Campus Electron Microbeam Analysis Laboratory, University of Michigan.

## David C. Joy



David Joy has joint appointments as a Distinguished Professor at the University of Tennessee, Knoxville and as Distinguished Scientist at Oak Ridge National Laboratory. He has written and edited nine books and 400 papers in the areas of Scanning Electron Microscopy, X-ray microanalysis, Monte Carlo modeling of electron interactions with solids, and associated topics. He has lectured at the Lehigh Electron Microscopy Schools every year since 1975 and conducted short courses in SEM in more than a dozen countries world wide. He is a past-President of MSA, and is current Editor in Chief of SCANNING.

## Nicholas Ritchie



Nicholas Ritchie specializes in the x-ray microanalysis of particles at the National Institute of Standards and Technology, Gaithersburg, MD. For about a decade after graduate school, he worked for an instrument vendor developing automated SEM-based particle analysis systems. Here he developed an interest in high throughput microanalysis techniques (~1000 spectra per hour) and data mining, computer assisted searching large data sets for patterns. Since joining NIST in 2005, Nicholas has expanded his interests to include spectrum simulation and the microanalysis of complex samples. Nicholas is the author of DTSA-II, a freely available software application for x-ray spectrum simulation and analysis. Nicholas has a doctorate in Physics from Rice University, Houston TX.

## John Mansfield



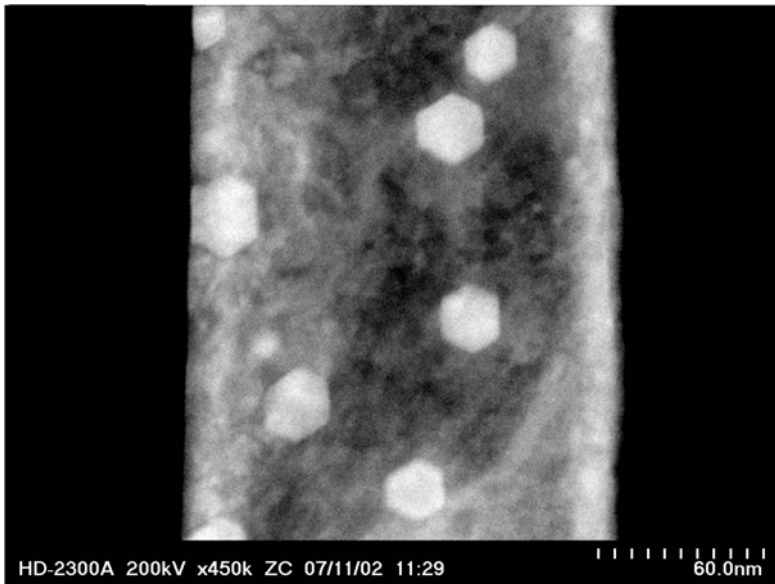
John Mansfield is Associate Research Scientist & Manager of the North Campus Electron Microbeam Analysis Laboratory, University of Michigan. After receiving Ph. D. in Physics (1983) from the University of Bristol, Bristol, UK (1983), he spent two and a half years as a post-doctoral fellow at Argonne National Laboratory and a year as a visiting scientist at the Microelectronics Center of North Carolina. Since 1987 he has been managing the North Campus Electron Microbeam Analysis Laboratory at the University of Michigan. John's interests include analytical electron microscopy (including convergent beam electron diffraction, X-ray energy dispersive spectrometry and electron energy loss spectroscopy), scanning electron microscopy environmental scanning electron microscopy, focused ion beam nanomachining of materials and the remote control of instrumentation for teaching and research, the last of which makes extensive use of Internet2.

# Nanomaterial Microscopy and Microanalysis: Tools and Preparation

With the wide variety of analytical instrumentation available, the selection of the correct “tool” for analysis of nanomaterials is critical. By introducing various microscopy and microanalysis methods this workshop should provide a solid foundation for nanomaterial characterization for the beginning to intermediate investigator. The importance of choosing the proper preparation technique, to minimize introduction of artifacts and ensure that representative samples are identified for subsequent analysis, will also be discussed.

## Topics to be covered:

- Choosing the proper preparation technique
- Minimizing the introduction of artifacts
- Ensuring that representative samples are identified for subsequent analysis
- Tools to be discussed:
  - SEM, ESEM, and EBSD; FESEM: X-ray Microanalysis
  - TEM and HRTEM; STEM/EELS: Nanoanalysis
  - FIB: Sample Prep and Nanofabrication
  - AFM: Imaging and Nanofabrication



Thin film of ZnO containing Au nanodots (bright contrast hexagons), prepared for 360° STEM Z-contrast imaging by FIB milling

## Instructors (see next page for bios):

Phillip E. Russell: Distinguished Professor of Science Education and Physics at Appalachian State University, a Director of MSA, Education Chair for MAS, and President of the Appalachian Regional Microscopy Society.

Donovan N. Leonard: Assistant Professor in the Dept. of Physics & Astronomy at Appalachian State University and an instructor for the Duke University Talent Identification Program.

## **Phillip E. Russell**



Phillip E. Russell is the Distinguished Professor of Science Education and Physics at Appalachian State University. He spent 21 years of his career at NC State University where he was Professor of Materials Science and Engineering, and funding Director of the Analytical Instrumentation Facility. He has been actively teaching both University and specialty short courses in microscopy and microanalysis for the past 25 years. He is a Director of MSA, Education Chair for MAS, and President of the Appalachian Regional Microscopy Society.

## **Donovan N. Leonard**



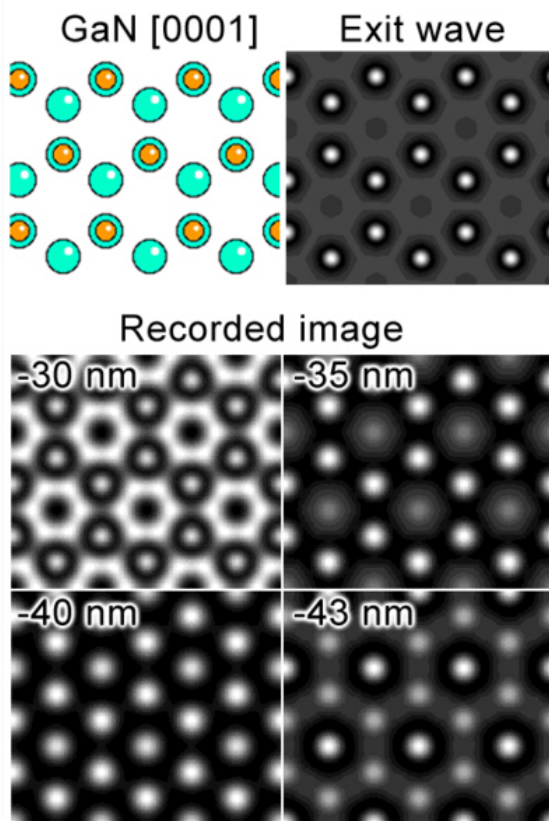
Donovan N. Leonard is an Assistant Professor in the Dept. of Physics & Astronomy at Appalachian State University in Boone, NC. He holds a Ph.D., M.S. and B.S. degree in Materials Science & Engineering from North Carolina State University in Raleigh, NC and researched bio-related nanotechnologies for his dissertation using state-of-the-art electron microscopy techniques. He is also currently an instructor for the Duke University Talent Identification Program and teaches both classroom and online Nanotechnology courses for high school students.

# High-resolution Transmission Electron Microscopy

Modern-day electron microscopes can routinely produce lattice fringes at the 1 Å level or better. However, obtaining *useful* structural information at similar length scales requires a basic understanding of imaging theory and a working knowledge of microscope operation and correct adjustment methods. The first part of the workshop will concentrate on these basic aspects of HRTEM. Later topics to be covered will include recent progress towards quantitative electron microscopy, an introductory overview of aberration-corrected electron microscopy using either hardware or software methods, and a brief review of related HRTEM methods.

## Topics to be covered:

- Basic theory for HRTEM
- Instrumentation and operation
- Steps towards quantitative electron microscopy
- Introduction to aberration-corrected electron microscopy
- Related HRTEM methods



Multislice simulation for GaN. Top: atomic model of GaN [0001] and the corresponding exit wave. Bottom: simulated images at indicated defoci. Courtesy of Til Bartel via Wikipedia.

## Instructors (see next page for bios):

David C. Bell: Lecturer in Applied Physics, Harvard University

Yimei Zhu: Senior Physicist, Dept. of Condensed Matter Physics and Materials Science, Center for Functional Nanomaterials, Brookhaven National Laboratory.

## David C. Bell



David C. Bell, is Lecturer in Applied Physics at Harvard University. His current research interests include; nanocomposites & nanowire materials properties and applications, investigating new mechanisms for materials imaging and analysis with charged particle beams, aberration determination, correction and measurements and the application with analytical microscopy methods for correlative electron microscopy, electron energy loss and x-ray spectroscopy. Dr Bell did his Postdoctoral studies at MIT, and received his Ph. D. from the University Of Melbourne. He is a Fellow of the Royal Microscopical Society, U.K.

## Yimei Zhu



Yimei Zhu is a Senior Physicist at Dept. of Condensed Matter Physics and Materials Science, and Center for Functional Nanomaterials, Brookhaven National Laboratory. He is also an adjunct professor at Dept. of Applied Physics and Mathematics, Columbia University, and Dept. of Physics at SUNY Stony Brook. His current research interests include advanced high-resolution electron microscopy in measuring atomic structure, electronic structure and electron density, and magnetic potential and field of functional materials as well as structure-properties of strongly correlated electron systems, multiferroics and nanomagnetism. Zhu received his Ph. D in Applied Physics and Materials Science from Nagoya University, Japan. He is a Fellow of American Physical Society.