

Electron Microscopy  
Facility Dedication

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Technical Symposium on  
Electron Microscopy and  
its Applications

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*Friday, February 13, 2004*

Introducing and celebrating the establishment  
of a state-of-the-art electron microscopy facility  
at Portland State University

**Presented by**

*College of Liberal Arts and Sciences  
College of Engineering and Computer Science  
Office of Research and Graduate Studies  
Office of the President*

**Greetings:**

Welcome to the dedication event for the state-of-the-art Electron Microscopy Facility at Portland State University. This facility brings the region into a new era for research and development in the sciences and nanotechnology.

Portland State professors and students in physics, chemistry, geology, mechanical and electrical engineering, biology, and other life-sciences will have access to the finest and most advanced teaching and research instruments. I believe that Portland State's motto of "Let Knowledge Serve the City" now resonates more fully, as this multimillion dollar facility will be available not only to the academic researcher, but also to the regional high-tech and bio-science industry for research and technology development.

The most significant element of the facility is the new Tecnai F-20 transmission electron microscope, manufactured by FEI-Philips. Portland State is proud to be the only university in the Pacific Northwest to have this advanced research tool.

Along with Robert Dryden, dean of the College of Engineering and Computer Science, and on behalf of the scientists, engineers and researchers at Portland State University, I want to thank the M.J. Murdock Charitable Trust for making the facility a possibility. Also, thanks to FEI Company, Intel Corporation, Gatan, Inc., and the Pacific Northwest National Laboratory for their support.

Thank you for joining us today as we open a new chapter at Portland State University.

Best Regards,

**Marvin Kaiser**

*Dean, College of Liberal Arts and Sciences*

## **Friday February 13, 2004**

- 10:00 a.m.      **Dedication**      *107 Science Building 1*  
Marvin Kaiser, *Dean, College of Liberal Arts and Sciences*  
Daniel O. Bernstine, *President*  
William Feyerherm, *Vice Provost for Research*  
Jun Jiao, *Director, Electron Microscopy Facility*
- 10:45 a.m.      **Tour**      *Lower level, Science Building 1*  
Faculty members and grad students by each microscope
- 11:45 a.m.      **Lunch**      *212 Shattuck Hall*  
Available for those who have reserved in advance
- 12:15 p.m.      **Technical Symposium on**      *212 Shattuck Hall*  
**Electron Microscopy and its Applications**  
Introduction  
Gordon Hoffman, Northwest Technology Ventures  
**“A Window on the Nanoworld—Electron Microscopy  
in Science and Technology”**  
Ulrich Dahmen, National Center for Electron Microscopy  
**“Electron Microscopy Development and Application  
at PSU: Past, Present, and Future”**  
Jun Jiao, Portland State University
- 1:45 p.m.      **“Atomic-Scale Characterization**      *107 Science Building 1*  
**of Semiconductor Heterostructures**  
**and Nanostructures”**  
David Smith, Arizona State University
- 2:15 p.m.      **“Nanometer-scale Analysis**      *107 Science Building 1*  
**of Grain Boundary Segregation in**  
**Metals and Alloys”**  
David C. Williams, Lehigh University
- 3:00 p.m.      **“The Study of Nanoparticles**      *107 Science Building 1*  
**Using Advanced TEM Techniques”**  
Miguel Jose-Yacamán, University of Texas
- 3:30 p.m.      **“Combined research, education**      *107 Science Building 1*  
**and outreach at the University of**  
**Arizona using Electron Microscope Facilities”**  
Supapan Seraphin, University of Arizona

**Gordon Hoffman**

*Managing Director, Northwest Technology Ventures*

Gordon Hoffman is a managing director of Northwest Technology Ventures, a venture capital fund focused on seed investments in Oregon companies that commercialize technology from university and other research institutions. He was director of Technology Commercialization at the Oregon Graduate Institute for the two years prior to its merger with OHSU, and is an angel investor in the Portland area.

In 1997 he sold a software company he co-founded, Eagle Design Automation, in Beaverton, his second venture-capital-funded software startup. He's started several other ventures as well, including an intrapreneurial new division within United Technologies Corporation, United Technologies Microelectronics Center.

Gordon has worked in high-tech development for most of his career, spending 15 years in the semiconductor industry and 15 years in electronic-design-automation software. He has been actively involved in supporting higher education/industry cooperation, both in Oregon and in Colorado, and in supporting entrepreneurial and youth-directed science education. He is currently an instructor and advisory board chairman of Saturday Academy, a member of Portland State University's advisory council to its departments of Computer Science and Electrical Engineering, and a director of the PSU Foundation.

Gordon received his B.S.E.E. from the Illinois Institute of Technology, where he was a co-op student working at Argonne National Laboratory, and his M.S.E.E. from Stanford University.

## **Ulrich Dahmen**

*Director, National Center for Electron  
Microscopy, Lawrence Berkeley National  
Laboratory  
Berkeley, California*



Ulrich Dahmen obtained his Ph.D. in materials science from UC Berkeley in 1979, then joined Berkeley Lab in a postdoctoral position, and subsequently was named principal investigator and senior staff scientist. Since 1993, he has been head of the National Center for Electron Microscopy at Lawrence Berkeley National Laboratory. He also directs a research program on the crystallography of microstructures that uses transmission electron microscopy as a major tool for microstructural characterization. He has published extensively on the atomic structure of interfaces, phase transformations, the evolution of precipitate morphologies and the effects of size on the behavior of embedded particles. His activities on behalf of the materials and microscopy community include service on the editorial advisory board of several scientific journals, a term as director of physical sciences in the Microscopy Society of America, organization of numerous symposia at national and international meetings and the current scientific direction of the TEAM microscopy effort for the Department of Energy.

### ***Presentation: A Window on the Nanoworld—Electron Microscopy in Science and Technology***

As a key research tool in the discovery and development of new materials, electron microscopy plays an important role in science and technology. This talk will present a brief overview of the contribution that electron microscopy has made to materials science by exploring the fundamental relationship between atomic-scale structure and macroscopic properties. The importance of seeing and understanding microstructure will be highlighted with examples ranging from high-strength alloys to microelectronics to nanomaterials. Specific emphasis will be placed on the discovery of the nanotube by electron microscopy and the continuing exploration of novel materials with properties that depend on size and shape. This presentation will also give an outlook for future directions in electron microscopy, with a special focus on the TEAM project and the role of electron optical aberration correction. Using the experience of Berkeley Lab's National Center for Electron Microscopy, it will be pointed out that as instrumentation becomes more sophisticated and demanding, shared centralized facilities and high-level education become increasingly important.

## **Jun Jiao**

*Director, Portland State University Electron  
Microscopy Facility  
Portland, Oregon*



Jun Jiao holds an M.S. in Physics and a Ph.D. in Materials Science and Engineering from the University of Arizona. She joined Portland State University in 1999 and is currently an assistant professor in the Department of Physics. She has led the effort to establish the state-of-the-art electron microscopy facility at PSU and serves as the facility's director. Jiao's research interests focus on developing nanoscale materials, including carbon nanotubes, semiconductor nanowires and nanoparticles, as building blocks for electronic devices, as well as on the application of analytical techniques of electron microscopy and spectroscopy for materials characterization. She is currently the principal investigator for more than five multi-year research projects funded by the National Science Foundation, Petroleum Research Foundation and Intel Corporation. Her last 10 years' research accomplishments are documented in more than 60 publications in peer-reviewed journals. She has been invited to various national and international conferences and workshops to give keynote talks. In 2003 the United State Committee on Commerce, Science and Transportation invited her to testify in front of the full Committee at the Capitol on "The 21st Century Nanotechnology Research and Development Act." Her written testimony is in the United States Senate's permanent record and can be viewed at: [http://www.senate.gov/~commerce/hearings/testimony.cfm?id=745&wit\\_id=2013](http://www.senate.gov/~commerce/hearings/testimony.cfm?id=745&wit_id=2013)

### **Presentation: *Electron Microscopy Development and Application at PSU: Past, Present, and Future***

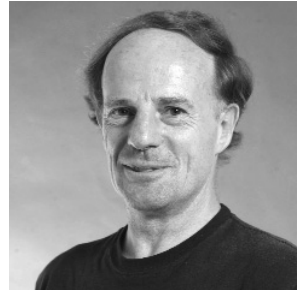
Electron microscopy and spectroscopy are indispensable to materials research on the nanoscale and in related disciplines including physics, chemistry, geology, mechanical and electrical engineering, biology and in several other life-science areas. The establishment of the state-of-the-art electron microscopy facility opened a new chapter at PSU for development and application in these areas. The new Tecnai TEM facility is the first of its type among universities in the Pacific Northwest region. It allows for the support of the current expansion of research at PSU as well as providing services for nearby institutions and many semiconductor and high-technology companies located in the greater-Portland area. It is expected that the enhanced research infrastructure will elevate PSU to the next level in scientific research and education. In this presentation, the development and application of electron microscopy at PSU is reviewed.

**David J. Smith**

*Regents' Professor of Physics*

*Director, John M. Cowley Center for High Resolution Electron Microscopy and the Center for Solid State Science*

*Arizona State University  
Tempe, Arizona*



David J. Smith's long-term research interests have centered on atomic-resolution electron microscopy, especially instrumentation, and applications to metals, oxides, and semiconductors. More recently, he has focused on characterization of magnetic thin films and multilayers, as well as semiconductor heterostructures and nanostructures. He is a member of the Materials Research Society, and the Microscopy Society of America, and he is a fellow of the Institute of Physics (U.K.) and the American Physical Society. He has co-chaired MRS, MSA and RMS symposia, and co-organized several Arizona State University Winter Workshops as well as Lawrence Symposia on Critical Issues in Epitaxy.

**Presentation: *Atomic-Scale Characterization of Semiconductor Heterostructures and Nanostructures***

The fabrication of semiconductor heterostructures and nanostructures based on two (or more) dissimilar materials offers many challenges. Lattice mismatch leads to strain and possible defect formation, while valence mismatch and differences in thermal expansion can seriously impact the final material quality. Microstructural characterization using electron microscopy methods plays a crucial role in understanding, controlling and optimizing the materials' properties. This talk will describe recent atomic-resolution studies of several important systems: (a) Group III-nitrides for high-temperature, high-power devices; (b) HgCdTe/HgTe alloys and superlattices for infrared detectors; (c) self-assembled silicide nanowires for possible nanoscale electrical interconnects; and (d) Ge/Si(100) nanoscale islands. The close interplay between synthesis, processing and microstructure will be emphasized.

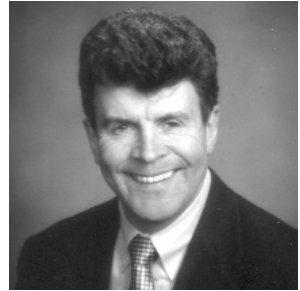
## **David B. Williams**

*Harold Chambers Senior Professor of Materials Science and Engineering*

*Vice Provost for Research*

*Lehigh University*

*Bethlehem, Pennsylvania*



David B. Williams obtained his B.A. (1970), M.A. (1974) Ph.D. (1974) and Sc.D. (2000) from Cambridge University. From 1974 to 1976 he was a science research council fellow at the Department of Metallurgy and Materials Science in Cambridge. In 1976 he moved to Lehigh as an assistant professor, becoming associate professor in 1979 and professor in 1983. He directed the electron optical laboratory at Lehigh from 1980 to 1998 and chaired the Department of Materials Science and Engineering from 1992-2000. He has co-authored and edited 10 textbooks and conference proceedings, and is the author or co-author of more than 200 journal publications in the general area of AEM and TEM and the application of these techniques to studies of precipitation and segregation. He is a fellow of TMS, ASM International and the Royal Microscopical Society (UK).

### **Presentation: *TEM Techniques in Understanding Grain Boundary Chemistry***

Grain boundaries play a major role in determining the properties of almost all engineering materials. Very often the boundary is the source of brittle or premature failure and, therefore, its characteristics limit the performance of the material. In particular, intergranular failure is a widespread fracture mode including such undesirable phenomena as hydrogen embrittlement, temper embrittlement and liquid-metal embrittlement. A common factor in such failures is the presence of elements that segregate to the grain boundary. To understand grain boundary chemistry and its role in intergranular failure, we need to be able to characterize the boundaries in detail.

Characterization can take many forms but, for a full comprehension of the problem, it is necessary to understand the crystallographic structure, the elemental chemistry and the local bonding at the boundary, often down to the nanometer level or below. Transmission electron microscopy (TEM is unique in its ability to determine all these characteristics in a single instrument, using diverse techniques such as imaging, diffraction, X-ray and electron spectrometry) thus permitting correlation of the structure, chemistry and properties of grain boundaries. This talk will describe the application of these various TEM techniques to grain boundary segregation in a range of metals and alloys.

## **Miguel Jose-Yacamán**

*Reese Endowed Professor in Engineering  
University of Texas  
Austin, Texas*



Miguel Jose-Yacamán has served as the Reese Endowed Professor in Engineering at University of Texas since 2002. Prior to University of Texas, he was general director of the National Institute of Nuclear Research in Mexico City. He earned his Ph.D. in materials science from the National University of Mexico, followed by postdoctoral work at Oxford, followed by the NASA-Ames Research Center at Moffat Field, California. His primary research interest for more than 25 years has been the structure and properties of nanoparticles including metals, semi-conductors, and magnetic materials.

### **Presentation: *Formation of Bimetallic Nanoparticles***

The aim of Jose-Yacamán's work is to contribute in the understanding of the formation of bimetallic nanoparticles by colloidal chemistry, either with a surface modifier or without it. This knowledge supports the design of the reaction paths to generate new materials with tailored properties and characteristics. The cases of study will be focused of new catalytic materials. The work starts by the study of the mechanism of reaction, analyzing the intermediaries formed in the process of synthesis such as coordination of the metallic species with the surface modifiers, the thermodynamics of the reaction, affinity between the metals in study and effect of alloying different metals in a low dimensional material.

In this work, bimetallic nanoparticles based on different metals as Au, Pd, Pt, Rh, and Cu are to systematically synthesized by a colloidal chemistry approach, which has been proven to yield better control on the reaction conditions in the synthesis of the metallic nanoparticles than the physical methods, either with surface modifiers to stabilize them (PVP, thiol molecules, solvents and other surfactants) or with a free surface stabilized only by the presence of the double electric layer. The information concerning the reactivity, size, shape and structure of alloyed bimetallic nanoparticles, as a function of the growth method and conditions was obtained. This provided valuable information to further understand the chemistry and physics of nanoparticles for the case of multi-component systems, and to solve important questions, which will contribute to the development of new materials.

## **Supapan Seraphin**

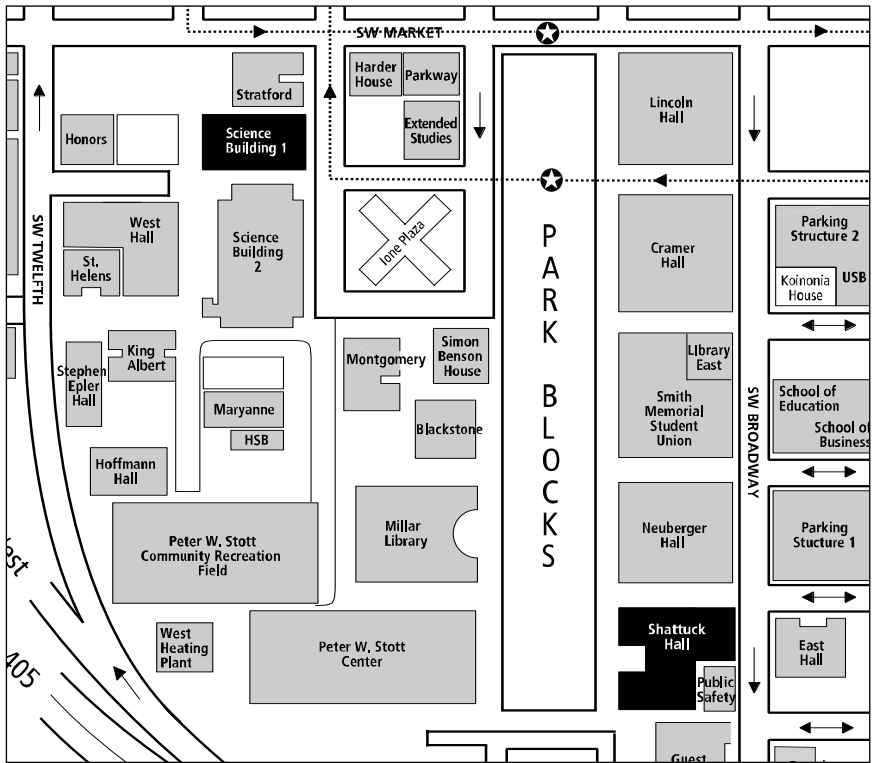
*Director, Electron Microscopy Facilities  
University of Arizona  
Tucson, Arizona*



Supapan Seraphin is a professor and faculty fellow in the Materials Science and Engineering Department, University of Arizona, Tucson, Arizona. She is the PI and co-PI of several research and education projects from NSF including Research Experience for Undergraduates and Teachers, Gender-Equity, and Graduate K-12 Fellowship grants. The most recent one is a NSF grant supporting undergraduate interns working with the Flandrau Science Center and the Arizona State Museum to bring science to general public. She serves as a role model for minorities and under-represented students. She received a Department Outstanding Teaching Award in 1997 for her dedication to undergraduate education and a 2001 and 2002 College of Engineering and Mines Award for Excellence at the Student Interface for making students feel they are an essential and valued part of the university community.

### ***Presentation: Combined research, education and outreach at the University of Arizona using Electron Microscope Facilities***

Our Electron Microscope Facilities for Materials Research in the Department of Materials Science and Engineering at the University of Arizona have served the campus, local, and national community in research, education, and outreach capacities. Over a decade ago, we pioneered an idea to interface electron microscopes with a computer network for teaching and training students at the university as well as K-12 science teachers. We established a laboratory, the Computer Network Laboratory for Microscopy Education, which captured a wide audience from fourth graders to graduate students, and science teachers to the general public. The laboratory is also a critical part of our successful NSF-supported programs—Research Experience for Undergraduates and Teachers (REU/RET). In research efforts, the facilities provide indispensable information and insight to various fields ranging from medical, environmental, hydrological, optical, archeological, conservation science, and many more. Our MSE alumni ranked their learning/research associations with the EM Facilities as one of their most valuable experiences at the University of Arizona. The presentation will highlight samples of activities and the EM Facilities impacts on students and users. One example will be a lesson plan for a blind student.



Portland State University is an affirmative action / equal opportunity institution.  
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**The Electron Microscopy Facility at Portland State University consists of the following equipment:**

- ◆ FEI Sirion ultra high-resolution field emission scanning electron microscope (FESEM)
- ◆ FEI Tecnai F-20 field emission transmission electron microscope (HRTEM) equipped with an energy dispersive x-ray spectrometer (EDS) and a Gatan imaging filter (GIF) system
- ◆ JEOL 2000FX transmission electron microscope (TEM) equipped with an Oxford EDS
- ◆ FEI 611 focused ion beam system equipped with secondary ion mass spectroscopy capability
- ◆ Sample preparation laboratory.

**Portland State University thanks the M.J. Murdock Charitable Trust, FEI Company, Intel Corporation, Gatan, Inc., and the Pacific Northwest National Laboratory for their support to this facility.**

*Portland State University, Oregon's only urban university, is the largest and most diverse in the state system. The University's position in Oregon's economic and cultural center allows for deep community engagement and the creation of partnerships with hundreds of organizations throughout the region—partnerships that give PSU students valuable learning opportunities as they solve real-world problems of business and community. Portland State offers more than 100 undergraduate, master's, and doctoral degrees, as well as graduate certificates and continuing education programs. PSU serves more students and confers more master's degrees annually than any other Oregon university.*

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