EDAX FOCUS

Inside This Issue

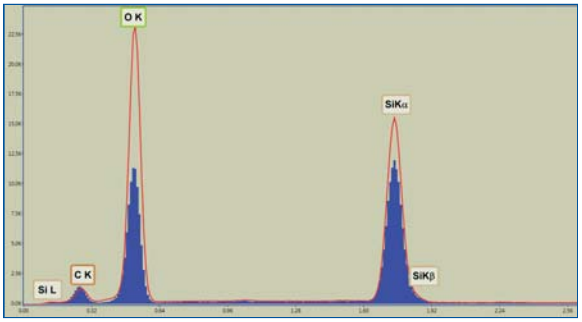
TEAM™ EDS System for the TEM

EDAX's TEAM™ EDS system featuring the new Apollo XLT Silicon Drift Detector (SDD) Series provides the ultimate analytical solution for Transmission Electron Microscope (TEM) applications. The series includes the Apollo XLT with a Supra Thin Window (SUTW) and a windowless version, the Apollo XLTW.

EDAX is the first microanalysis company to introduce a windowless detector version. The Apollo XLTW provides optimum light element performance with complete transmission of low energy X-rays. When compared to an SUTW detector, the light element sensitivity is improved up to 500% and the count rate is increased by 30% for heavy elements. As a result, the mapping speed and light element detection in low concentrations are greatly enhanced with the Apollo XLTW.

Apollo XLT SDD Series incorporates data acquisition and signal processing electronics into the detector to simplify installation and to eliminate the need for a separate data acquisition enclosure. The integrated detector presents an elegant design that improves performance and offers easy remote access via Ethernet from virtually any computer. Signal distortion and loss due to cable length have been eliminated. The PC can be located up to 100 meters away from the detector without affecting the performance.

TEAM™ EDS system for the TEM with the Apollo XLT Silicon Drift Detector.



Spectra of SiO_2 collected with the Apollo XLTW (red) compared to a SiLi detector (blue) have been normalized to the highest energy part of the spectrum. The Apollo XLTW detector significantly improves the low energy sensitivity. The Si K intensity is improved by 30% and the O K by 150%.

TEAM™ EDS with Apollo XLT for TEM

Smart Features are at the core of our new TEAM™ EDS system with Apollo XLT for TEM. Intelligence is built into the detector to provide the best protection against harmful conditions. The detector automatically retracts to a safe position when high energy electrons are detected. User intervention is not required, providing safe operation only achieved with Apollo XLT detectors. If maintenance is needed, superior remote support is achieved with the detector's logging capability. The performance history recorded in the detector can be accessed remotely for a quick and accurate evaluation.

TEAM™ EDS is built with a modern interface equipped with Smart Features that are automated to simplify analysis and provide quick results. Regardless of the skill of the operator, consistent and accurate results are achieved effectively and efficiently every time. TEAM™ EDS automatically determines the elements in your sample, monitors the count rate and magnification, collection time, as well as numerous other parameters used for optimum system performance. Interactive review allows users to preview the results in a unique way before the completion of analysis.

(Cont'd on Pg. 2)

Vol.9 No.1

TEAM™ EDS System for the TEM

(Cont'd. from Pg. 1)

The TEM quantification algorithm for thin material is now available in TEAM™ EDS. The quantification model is based on the Cliff-Lorimer method for fast and accurate analysis. The user has the flexibility to work in conjunction with standards to determine one's own Cliff-Lorimer factors and theoretical methods.

Features and Benefits

- All electronics are built into the detector to facilitate remote access, installation, service, and calibration
- Automated calibration algorithm for fast, repeatable, and accurate setup. Calibration data resides in the detector, eliminating the need to recalibrate when accessing remotely
- Compact detector system provides flexibility for each TEM installation
- 30mm^2 SDD chip technology optimized for solid angle
- SUTW and windowless detectors are offered for superior light element performance with resolutions typically better than 59eV for Carbon
- Better than 129eV resolution for Manganese
- Resolution stability of < 1eV up to 100 kcps
- Peak shift of < 1eV up to 250 kcps
- Available amp times from 120 ns to 7.68 μs for optimal collection
- Fast Ethernet communication
- Motorized slide automatically retracts in response to excessive backscatter electrons
- TEM quantification algorithm for thin materials is available in TEAM™ EDS

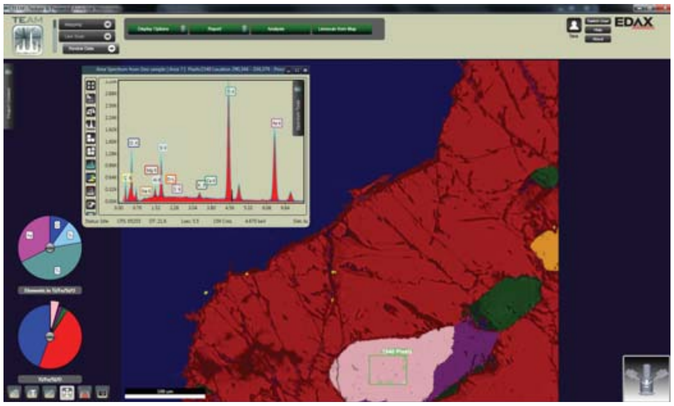
TEAM™ Smart Features Include:

Smart Track

Smart Track is built into the Environment Panel to quickly and easily ensure the optimal working conditions upon setup. The Panel monitors system status and relays information about the operating conditions for the detector, column, and more.

Smart Phase Mapping

Smart Phase Map collection can be started immediately with no setup required. Neither mapping setup parameters nor prior peak identification need to be defined before collection. Simply find the area of interest and begin the collection. TEAM™ EDS Smart Phase Mapping will automatically determine the best mapping resolution, collection time required, and identify all the elements present. The user can work interactively with the dataset during collection and the results are automatically saved for future analysis and report generation.



TEAM™ EDS is built with a modern interface that maximizes the display area for the results and allows quick access to all features.

Smart EXpert ID

EDAX's one step EXpert ID is a revolutionary peak identification program, combining traditional peak ID routines with real world analysis techniques, to provide the most accurate method for a user to solve qualitative analysis problems. Complex overlaps are deconvoluted and trace peaks are identified, resulting in the best automatic peak identification available.

Smart Drift

Smart Drift automatically monitors and dynamically adjusts the parameters to account for drift changes.

Smart Data Management

TEAM™ EDS increases the ease of use and provides organization through simplified file management. Data is saved as a project and presented in a project tree for interactive review and archiving of images, maps, spectra, and reports.

The Apollo XLT SDD Series offers fully integrated data acquisition and signal processing electronics. Coupled with TEAM™ Smart Features, the system is the most intuitive and easy to use analytical tool available for the TEM. The Series offers a windowless version to further maximize collection efficiency and light element performance. TEAM™ Smart Features automate the workflow and revolutionize the way EDS analysis is done. Regardless of the skill of the operator, TEAM™ Smart Features provide exceptional results every time. The Apollo XLT SDD Series, in combination with TEAM™ EDS, provides the user with the most advanced EDS system for the TEM.

Copyright© 2011 All rights reserved EDAX Inc.

TEAM - A New Generation for EDS Phase Mapping

The new TEAM™ EDS Analysis System features an innovative approach to mapping to rapidly generate results with greater flexibility. The Smart Phase Mapping can automatically collect spectra, elemental maps, and phase maps with elemental distributions without any user setup. The built-in analytical intelligence in Smart Phase Mapping, automatically assigns various phases based on differences in spectra. Smart Phase Mapping can also collect with added flexibility to provide the users with greater analysis control.

TEAM™ EDS software offers three different methods to generate phase maps. Each method has been evaluated with the same acceleration voltage of 20 kV and a resolution of 512x400 pixels. The SEM image of the sample is shown in Figure 1.

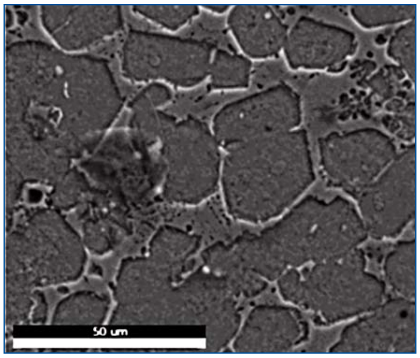


Figure 1: SEM image of a mineral sample.

The first method uses the TEAM™ EDS Smart Phase Mapp-ing without any user setup. In less than 30 seconds, a spectrum is automatically collected to determine the elements present in the sample to begin the mapping process. During col-lection, the spectrum collected from each pixel is evaluated for proper phase color assignment. Figure 2 shows the completed phase map collected without any user setup.

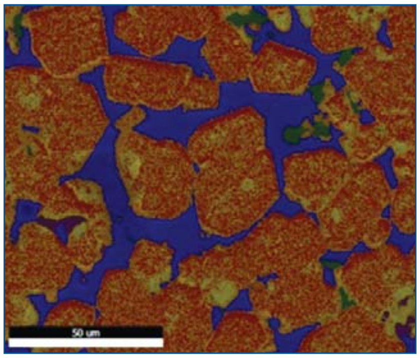


Figure 2: Phase Map collected without user setup.

The second method provides the user with the ability to define and lock the phase list for mapping. Available in the mapping advanced options, the user can control the boundaries for finding different phases. Spectra can be collected from different areas, then included in the phase list, and the phases can be locked for mapping. No additional phases are added to the phase list even if new phases are found during mapping. The spectrum collected from each pixel is evaluated for proper phase color assignment using only the locked phases. Figure 3 shows areas in gray, representing pixels that do not fit with any of the phases locked in the list.

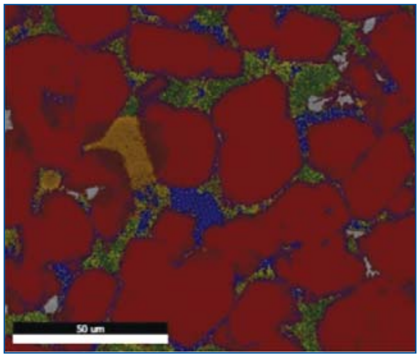


Figure 3: Phase Map collected with locked phases.

The third method is an extension of the second method, and includes the ability to add discovered phases. Also available as a selection in the mapping advanced options and similar to the second method, spectra can be collected from different areas to be included in the phase list. In contrast to the second method, any new phases that are discovered during collection are added to the phase list. In this example, four phases have been initially defined with the colors blue, green, red, and yellow. Figure 4 shows additional phases that have been added to the initial four phases to complete the phase map.

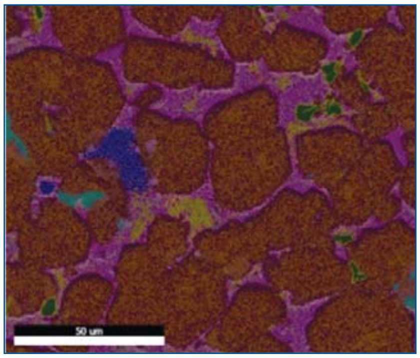


Figure 4: Phase Map collected with adding phases.

Conclusion:

The TEAM™ EDS software provides the user with added flexibility to obtain results with various collection methods. The Smart Phase Mapping can be customized to enhance the analysis of desired phases. Regardless of the experience of the user, Smart Phase Mapping assists the user to discover and explore the materials for exceptional results every time.

Copyright© 2011 All rights reserved EDAX Inc.

Particle Applications in the Hard Disk Industry

Hard disk drives are one of the essential components of personal computers and continue to be a rapidly evolving technology. These drives have achieved higher capacities, and continue to become faster and less expensive. Inside the disk drive (figure 1) is one or more platters that moves at a high speed (commonly 7200 rpm or 120 revolutions per second). At the edge of the platter the motion exceeds 75 miles per hour (120 km per hour) and the read-write head has a gap above the platter that is just a few tens of nanometers. This means that the platter must be ultra flat and smooth and the tolerance for particles is extremely low. The types and sizes of particles within the drive assembly and from key components must be monitored and characterized at various steps during the manufacturing process. The particle characterization is typically done in a scanning electron microscope using automated particle analysis with the chemical characterization of the particles by energy-dispersive x-ray spectroscopy. The hard disk industry is one of the largest application areas for particle analysis and the EDAX Particle Analysis software is well suited to this application.

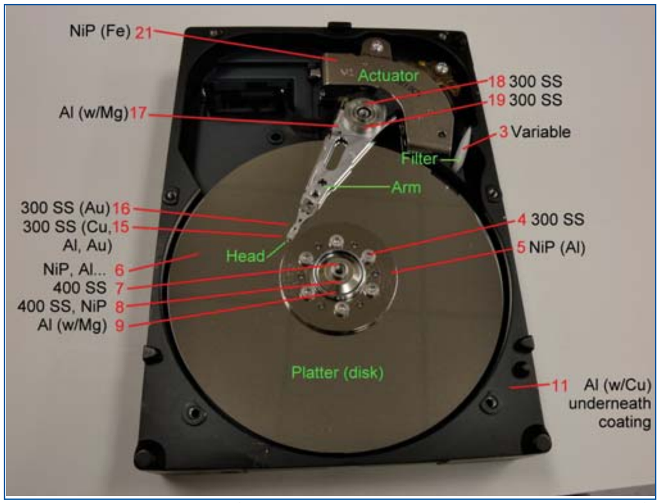


Figure 1 – The interior of a hard disk drive is shown with several of the key components labeled in green text. Some of the different compositions are shown.

There is a very thin (less than 20 nm) magnetic layer on the disk platter that is used for data storage and the life of the drive is shortened by hard abrasive particles which can damage this layer. Many of the components of the disk drive assembly are polished or machined using extremely hard abrasive materials and it is essential that these particles are not found inside the drive as free or loose particles. These abrasive materials and particles of all types are searched during the automated analysis. A variety of materials are used for the disk drive components (figure 1) and, at a minimum, these include 300 and 400 series stainless steels, several varieties of aluminum alloys, copper and gold wires, magnetic materials (rare earth magnets in the actuator as well as the magnetic layer of the platter). Many of these parts have been coated with a nickel phosphide. Many other compositions are possible due to the presence of dust impurities or environmental particles.

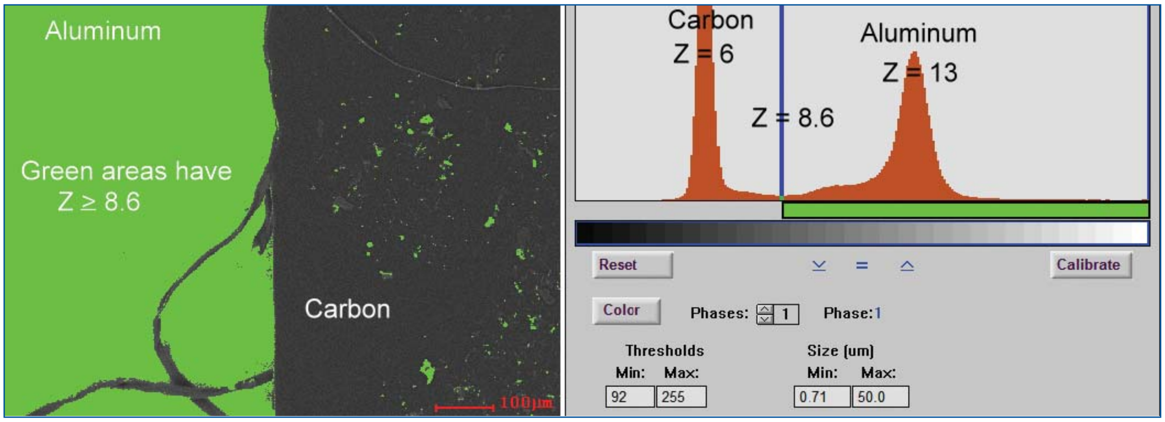
There are several key setup parameters that must be optimized to assure good-quality, reproducible results. These parameters will be discussed in more detail as Particle Notes on the EDAX website (www.edax.com). One of the more important setup parameters is how the backscattered electron (BSE) image is thresholded to select particles. The BSE image provides an image where the brighter particles have a higher atomic number. Particle analysis commonly looks for particles which can be isolated as bright areas on a darker background although there are also application areas where the particles can be dark areas against a brighter background (e.g. inclusions in steel). To eliminate possible variations in how particles are selected during automated analysis, a known area is commonly used as a brightness standard. This standard area is visited on a frequent basis and a threshold is set at a fixed percentage between the modes of the image histogram (figure 2). This method for determining which types of particles are analyzed allows an operator to be certain that they are finding a comparable variety of particles from day to day and will allow the results to be compared between operators, and different laboratories. The frequent re-visiting of the standard area will also allow for consistent collection of data even if the electron beam intensity varies over the course of the analysis.

(Cont'd on Pg. 5)

Copyright© 2011 All rights reserved EDAX Inc.

Particle Applications in the Hard Disk Industry

(Cont'd. from Pg. 4)



Phases: 1 Phase: 1

Thresholds		Size (um)	
Min:	Max:	Min:	Max:
92	255	0.71	50.0

Figure 2 – The image with image histogram is provided for an area that can be used as a standard for how a sample is thresholded. The image consists of approximately equal areas of carbon tape and aluminum. The thresholds are given by two blue lines or cursors –one is at the extreme right and one is between the two peaks or modes of the histogram. The range of brightness values selected with these threshold cursors insures that particles having an average Z of 10 (Al2O3, SiO2, SiC, etc.) will be highlighted and within the brightness range to be analyzed.

In automated particle analysis, the electron beam is placed on each particle in an image area and a spectrum is collected (figure 3), quantified and classified against a library of compositions. When all particles in an image area have been collected, the stage may be moved to an adjacent field and the process of image collection, thresholding and particle spectrum collection is repeated. Automated analyses will commonly collect data from several thousand fields on overnight procedures which can analyze and classify thousands of particles. An example of a summary table is shown in figure 4.

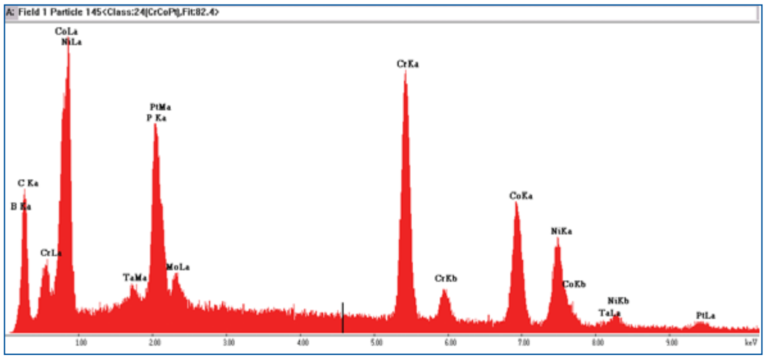
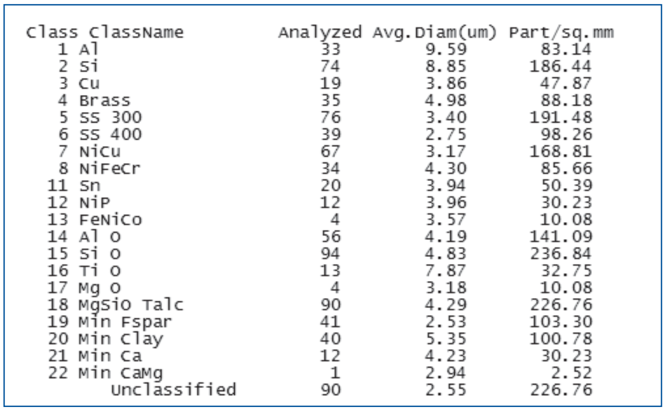


Figure 3 – A spectrum collected in Particle Analysis that shows the magnetic material from a disk platter (Co, Cr, Pt) with some of the substrate (Ni, P).



```
Class ClassName          Analyzed Avg.Diam(um) Part/sq.mm
   1 Al                      33         9.59        83.14
   2 Si                      74         8.85       186.44
   3 Cu                      19         3.86        47.87
   4 Brass                   35         4.98        88.18
   5 SS 300                  76         3.40       191.48
   6 SS 400                  39         2.75        98.26
   7 NiCu                    67         3.17       168.81
   8 NiFeCr                  34         4.30        85.66
  11 Sn                      20         3.94        50.39
  12 NiP                     12         3.96        30.23
  13 FeNiCo                   4         3.57        10.08
  14 Al O                    56         4.19       141.09
  15 Si O                    94         4.83       236.84
  16 Ti O                    13         7.87        32.75
  17 Mg O                     4         3.18        10.08
  18 MgSiO Talc              90         4.29       226.76
  19 Min Fspar               41         2.53       103.30
  20 Min Clay                40         5.35       100.78
  21 Min Ca                  12         4.23        30.23
  22 Min CaMg                 1         2.94         2.52
          Unclassified       90         2.55       226.76
```

Figure 4 – Summary table of the results of an analysis is shown. The summary is also available in more detail in a spreadsheet.

A basic description of particle analysis was given in a previous issue of the EDAX Focus (Vol.4, No.3, which can be downloaded at http://www.edax.com/press/newsletter.cfm) and in Microscopy Today (September, 2006; also available as a download at http://www.edax.com/press/paper.cfm). Particle Analysis is discussed in detail in a three day training course (information on this and other courses is provided at http://www.edax.com/service/A_particle.cfm).

Copyright© 2011 All rights reserved EDAX Inc.

TRAINING AND EVENTS

World-Wide Events

EDAX is pleased to announce that we are now on LinkedIn. View our page for new product information, software updates, training, News & Events, and much more. If you not have not already done so, join LinkedIn to get the latest up-to-date EDAX information. http://www.linkedin.com/company/edax?goback=%2Ecps_1288809548767_1&trk=co_search_results

May 15-19	EMAS (European Microbeam Analysis Society)	Angers, France
May 16-18	Japanese Society of Microscopy 2011	Fukuoka, Japan
May 22-27	IUMAS 5 (Instrumental Developments - SEM)	Seoul, Korea
June 8-10	Scandem	Oulu, Finland
July 12-14	Intersolar	San Francisco, CA
August 7-11	M&M (Microscopy & Microanalysis)	Nashville, TN
August 28 - September 2	EM-Conference	Kiel, Germany

***Please see our website www.edax.com for a complete list of our tradeshows

World-Wide Training

To help our present and potential customers obtain the most from their equipment and to increase their expertise in EDS microanalysis, WDS microanalysis, EBSD/OIM™ and Micro-XRF, we organize a number of Operator Courses at the EDAX facilities in North America; Tilburg, NL; Wiesbaden, Germany; and Japan.

Europe

Tilburg = (T) (in English)
Wiesbaden = (W) (in German unless stated otherwise):

EDS Microanalysis: (Genesis)
- May 10-12 (T)
- June 28-30 (T)
- November 22-24 (T)

EDS Microanalysis: (TEAM)
- May 23-25 (W)
- September 27-29 (T)
- Nov. 1-Dec. 29 (W)

EDS Microanalysis: (Short)
- June 23-24 (T)
- September 27-29 (T)
- November 10-11 (T)

EBSD:
- June 20-22 (T)
- September 19-21 (T)
- November 7-9 (T)

WDX TEXS:
- May 25-26 (W)

WDS LEXS:
- April 12-14 (T)
- October 11-13 (T)

Orbis:
- May 9-11 (W)
- October 26-28 (W)

Pegasus (TEAM/EBSD):
- October 17-21 (W)

Japan

Microanalysis Courses:

◆ April 13-15	Osaka
◆ June 8-10	Tokyo
◆ July 6-8	Osaka
◆ October 5-7	Tokyo
◆ November 9-11	Osaka

New European support email address for service and application issues for EDS/EBSD/WDS, and µ-XRF is:
edax.support@ametek.nl

For more information on our training classes, please visit our website at:
www.edax.com/service/user.cfm

North America

EDS Microanalysis:

◆ May 2-6	Mahwah, NJ
◆ June 21-23	Mahwah, NJ
◆ July 12-14	Draper, UT
◆ October 10-14	Mahwah, NJ
◆ November 8-10	Mahwah, NJ

EBSD :

◆ May 10-12	Mahwah, NJ
◆ August 20 - Sept. 1	Mahwah, NJ
◆ September 27-29	Draper, UT

EDS Particle Analysis:

◆ April 12-14	Mahwah, NJ

WDS:

◆ June 7-9	Mahwah, NJ

Micro-XRF:

◆ October 4-6	Mahwah, NJ

Copyright© 2011 All rights reserved EDAX Inc.

EMPLOYEE SPOTLIGHT

Matt Chipman has been with EDAX for over 13 years and is currently the Senior Regional Sales Manager responsible for much of the Southwestern United States. His office is located in EDAX's Draper, UT applications laboratory.

Matt is a graduate of the University of Utah where he earned a bachelor's degree in materials science and engineering. He first became interested in materials science after learning about the technology that goes into his bicycles and ski equipment.

Matt began his career with TexSEM Laboratories (TSL) before they were acquired by EDAX. He has previously held several EBSD positions with EDAX, including installations, training, technical support, and applications support. During that time, he enjoyed traveling to Japan, China, Korea, South Africa, Germany, Brazil, and Mexico. His primary responsibility was installing EBSD systems and training customers on the use of the system. Matt now enjoys selling all of the EDAX products, but still has a particular love for EBSD. Matt enjoys interfacing with customers and prospective customers and seeing them get excited about the microanalysis equipment that EDAX can offer them.

He currently resides in Alpine, Utah with his wife Jennifer and their three children, Jake 12, Hannah 9, and Seth 5. Matt enjoys living in Utah and spending time outdoors with his family in the mountains or at the lake. He is an avid sports enthusiast and enjoys water skiing, mountain biking, and snow skiing.

Mr. Koichi Shimamura joined EDAX September 1987. Shimamura-san is a Field Service Engineer located in the EDAX Japan Tokyo office. He is responsible for installations, repairs, and training.

Shimamura-san graduated from The University of Electro-Communications in Chofu-shi, Tokyo where he earned a Bachelor of Engineering degree.

Prior to joining EDAX Shimamura-san was employed at NTT (Nippon Telegraph and Telephone Corporation), Japan.

Shimamura-san and his wife Yasuko met at a company site while he was installing a PV980 system. They have a daughter, Hiromi 19, and two sons, Kazuya 17, and Tatsuya 14. Shimamura-san recently started running to stay in shape. His family is the owners of a batting center which is very popular in Japan. Having grown up with a batting center in his family, Shimamura-san would be expected to hit among the first three in the line-up if EDAX Japan ever put together a baseball team.

Copyright© 2011 All rights reserved EDAX Inc.

The University of Windsor – Ontario, Canada

The Great Lakes Institute for Environmental Research, located at the University of Windsor in Ontario Canada, serves as a central electron microscopy facility supporting an interesting variety of university groups. The main focus of the laboratories instrumentation and technology is geared towards environmental research but also supports several departments in the University, including engineering, earth & environmental sciences (geology), biogeochemistry, biology, chemistry, and physics.

Sharon Lackie has been the primary operator of the FEI Quanta 200 FEG Environmental SEM and EDAX Genesis EDS system for the past four years. She supports other users on the equipment either by training them to be competent on the tools to run them for their own analyses or by working side by side with them and performing their analysis using the skills she has acquired over the years working with the system.


Sharon Lackie, Electron Microscope Technician

As a multi-disciplinary facility, the University has supported many interesting projects over the years. Recently, the music department came to the EM facility to obtain electron images of one of their brass instruments at various magnifications. They took images at increasing magnifications, created a multi frame merged image set zooming in and out. During their concert event they projected the slideshow onto a giant screen during the performance.

There is also an automotive engineering group at the University that works with a local automotive manufacturer supplier to create and provide them with new or modified alloys which are then used in various auto components sent to major suppliers. Testing for this group can include quantitative alloy analysis showing elemental variations, and wear tests which show where and how much of each element or area are subject to the most functional wear. One of the recent problems solved for this group made use of the EDAX system to determine there was an increase in carbon concentration in the area of a cracked engine block. It was concluded that this elemental contamination contributed to the failure of the engine block.

Support for other groups, for instance a local museum, takes advantage of some of the more advanced EDAX techniques such as multi-field mapping of geological and fossil specimens. Particle analysis is yet another area of interest that will become one of the next set of capabilities the EDAX system will be used for in this multi-functional university center.

Art & Layout:
Beverlee Boddy
Christine Meehan

Contributing Writers:
Dr. Robert Anderhalt
Matthew Chipman
Tara Nylese
Sun Park
Felix Reinauer
Koichi Shimamura

Copyright 2011 EDAX Inc. No part of this publication may be reproduced, stored in a retrieval system, or transmitted in any form or by any means without prior written permission of EDAX Inc.

EDAX advanced microanalysis solutions

AMETEK MATERIALS ANALYSIS DIVISION

EDAX Inc. • 91 McKee Drive Mahwah, NJ 07430 • Phone: (201) 529-4880 • E-mail: info.edax@ametek.com • www.edax.com