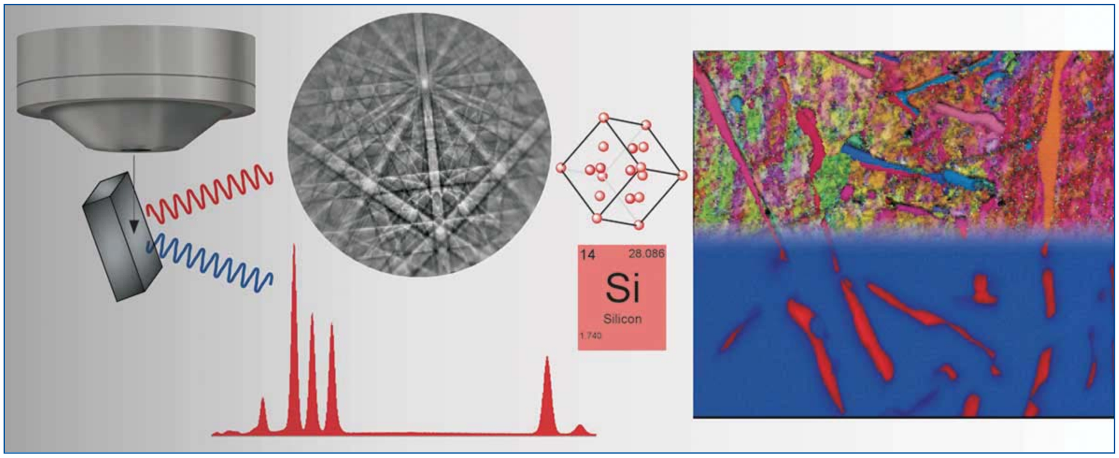
EDAX FOCUS

EDAX Launches the New TEAM™ Pegasus Analysis System



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EBSD joins the TEAM™

EDAX introduces TEAM™ Pegasus, a world-class materials characterization system providing users with both elemental composition and crystal structural results in one easy-to-use package. Pairing the new TEAM™ EBSD with our world-class TEAM™ EDS product in a clean, seamless interface, TEAM™ Pegasus enables users to focus their efforts on understanding their materials, rather than collecting data, proving once again that EDAX is the leader in providing cutting edge solutions to materials science problems.

Intuitive and Easy-to-use Interface

Building on the successful foundation of TEAM™ EDS, TEAM™ Pegasus incorporates the same three-click workflow that maximizes productivity and produces results quickly. The user can move from the start of analysis to a final report in three clicks of the mouse.

This efficiency is made possible by the analytical intelligence of the software and the further development of EDAX's Smart Features. Smart Features optimize the system setup, data collection, analysis, and reporting, ensuring high quality data along with industry best speed!

The new TEAM™ Pegasus Analysis System takes advantage of Smart Features to streamline difficult tasks that previously stood between EBSD users and their results.

Smart Camera, Smart Background Collection, and Smart Indexing apply the ease-of-use design philosophy of TEAM™ to the power of EDAX's OIM™ product, making EBSD data collection and analysis straightforward for users at any level.

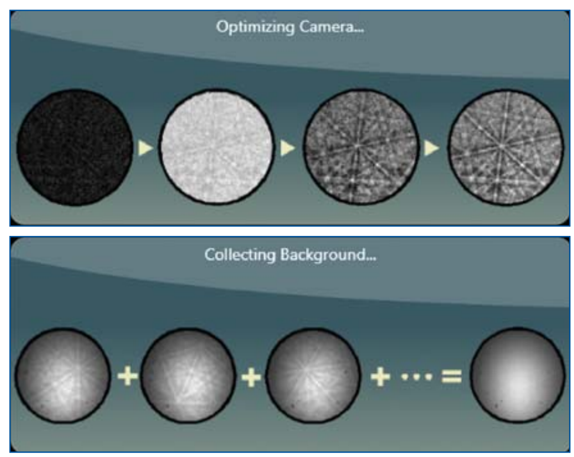


Figure 1: TEAM™ Pegasus uses Smart Features to setup and optimize the camera for best EBSD results.

Combined with the current TEAM™ EDS Smart Features like EXpert ID, Smart Tracking, and Smart Data Management, the result is an incredibly intuitive and user friendly interface that guides the user to great results.

(Cont'd on page 2)

EDAX Launches the New TEAM™ Pegasus Analysis System (Cont'd. from Pg. 1)

Integrated Collection

TEAM™ Pegasus seamlessly integrates EDS and EBSD into a single application. Users can easily switch between EDS, EBSD and simultaneous EDS/EBSD acquisition as required by their sample needs. Collection of a full spectral map simultaneously with OIM™ provides complete characterization of the sample.

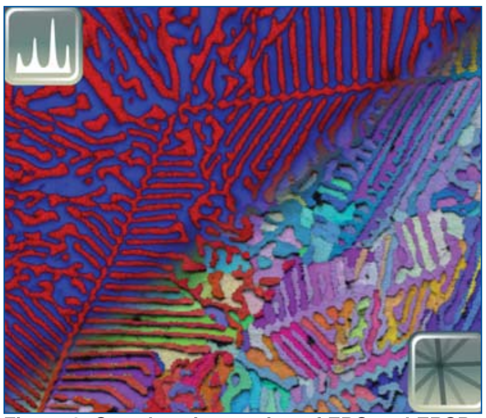


Figure 2: Seamless integration of EDS and EBSD.

Dynamic Mapping

TEAM™ Pegasus provides many mapping options to help in understanding the full nature of the material structure and composition. The user can choose from a variety of EDS and EBSD maps, as well as overlaying the SEM image with the maps. Choices include elemental maps, orientation maps, count per second (cps) maps, and phase maps. The maps can be selected and combined interactively in real time, allowing the user to see the results during data collection.

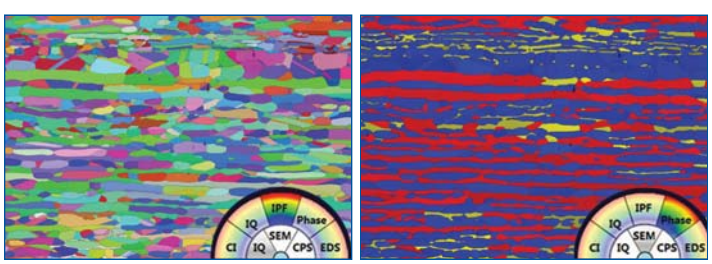
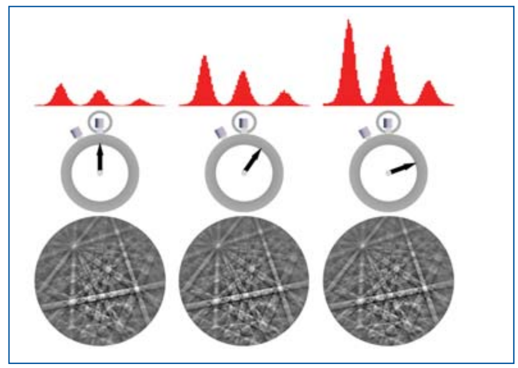


Figure 3: Combined Image quality and orientation map and combined Phase Map and SEM Image.

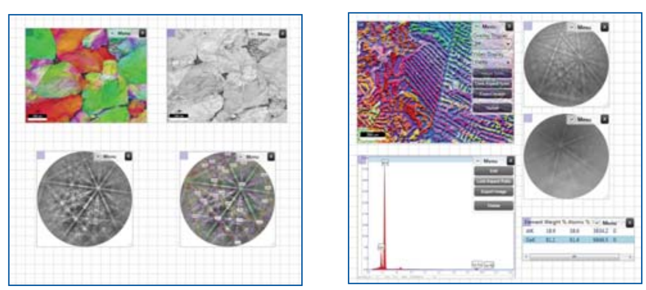
Time Machine (patents pending)

As a novel approach to dealing with beam sensitive samples, drift and contamination, EDAX has developed a new feature, Time Machine, which time stamps simultaneous EDS-EBSD data as it is collected. This unique feature allows the user to "go back in time" and select the optimal data before the change in the sample conditions.



Data Management

TEAM™ Pegasus offers great flexibility in the management of data and preparation of reports from one-click Quick Reports to completely user-customized reports. The data can be presented with the necessary content and layout to meet specific analytical needs.



Conclusion

Powerful, innovative, and easy to use, TEAM™ Pegasus is the answer to **your** difficult materials characterization problems.

TIPS & TRICKS

EBSD Sample Preparation - the Basics

With the introduction of TEAM™ Pegasus, the collection of Electron Backscatter Diffraction (EBSD) patterns and Orientation Imaging Microscopy (OIM™) maps has never been easier. The Smart Features within the TEAM™ software automate EBSD camera optimization and background collection and make the collection of either EBSD or combined EDS-EBSD data routine with just a few clicks. However, due to the small volume of material from which patterns are generated, EBSD is sensitive to surface conditions and often requires sample preparation to make sure this surface volume produces useable EBSD patterns. The key to EBSD sample preparation is producing a representative analytical surface while minimizing deformation during the preparation procedure.

In our laboratories, the majority of EBSD sample preparation is done with three primary sample preparation tools: an automatic mounting press to encapsulate the samples, a grinding/polishing machine with an automated power head, and a vibratory polisher for final polishing. Approximately 90% of the samples we analyze can produce great EBSD results when prepared with these tools.

The mounting press is used to produce a sample that can be used with our polishing machine. We use an automatic press where the time, temperature, and pressure are all controlled. This allows for fast mounting under reproducible conditions. We also use a conductive thermoset resin to help improve conductivity and minimize potential charging/drifting issues. Cold epoxy mounts have also been used for pressure or temperature sensitive samples when hardening times are not an issue. Conductive fillers can also be added to these epoxy formulas to address potential charging/drifting issues. This is particularly useful if the area of interest is at the edge of a sample, where imaging a non-conductive epoxy could cause these issues.

Polishing is generally performed with the procedure listed in the table (Figure 1). Note that for the Silicon Carbide papers (SiC Paper), polishing time is one minute for each abrasive size, but often we use two papers in this time frame (30 seconds each) to maximize effectiveness. Also note that the pressure listed is based on a single sample for a 1 inch diameter mount. Pressure on the sample can be calculated by multiplying the applied force by the sample surface area, and corresponding forces selected for any number of samples of differing sizes.

Step	Abrasive Size	Cloth	Time	Force
1	240 Grit	SiC Paper	1 Minute	10lbf
2	320 Grit	SiC Paper	1 Minute	10lbf
3	400 Grit	SiC Paper	1 Minute	10lbf
4	600 Grit	SiC Paper	1 Minute	10lbf
5	800 Grit	SiC Paper	1 Minute	10lbf
6	1200 Grit	SiC Paper	1 Minute	10lbf
7	1 μm Al_2O_3	Synthetic Rayon	10 Minute	9lbf
8	0.03 μm Al_2O_3	Synthetic Rayon	10 Minute	9lbf

Figure 1:

Final polishing is typically performed using a vibratory polisher with 0.05 μm colloidal silica suspension. This does an excellent job of removing the final deformation layer in many materials. Polishing times vary from 15 minutes to more than two hours. The polishing wheel can also be used for shorter time periods with this polishing suspension.

Our standard EBSD sample preparation procedure as outlined above works well for many materials. For additional information or with questions on specific samples, please contact us at edax.applications@ametek.com.

Using TEAM™ Pegasus to Characterize Intermetallic Phases in Duplex Steel Alloys

Duplex steels have a two phase microstructure consisting of ferrite and austenite and generally have about twice the strength of both ferritic and austenitic stainless steels and better toughness than ferritic stainless alloys. Duplex steels also have similar corrosion resistance behavior to common austenitic stainless grades. Because of the lower alloying element requirements for duplex steels, they are often lower in cost than traditional stainless alloys and because of the higher strength, thinner sections of duplex steel may be used, reducing both cost and weight. However, duplex steels are more susceptible to the precipitation of intermetallic phases due to their higher chromium and molybdenum content. In particular, the sigma phase is a hard phase which negatively affects toughness and corrosion resistance. If an excess of the sigma phase is present, the alloy properties are reduced below values which are practical for use.

TEAM™ Pegasus is the ideal tool for using simultaneous EDS-EBSD to characterize the microstructure of duplex steels and to measure the phase fractions present to determine if a given alloy and heat treatment process produces a usable duplex steel product. TEAM™ is an acronym for Texture and Elemental Analytical Microscopy, with the name suggesting both techniques working together for improved characterization. In the analysis described in this application note, duplex steel alloy samples were subjected to heat treatments at one of three temperatures (800° C, 900° C, and 1000° C) for two hours then prepared for EBSD analysis. TEAM™ Pegasus was used to collect, manage, and analyze data from the three samples.

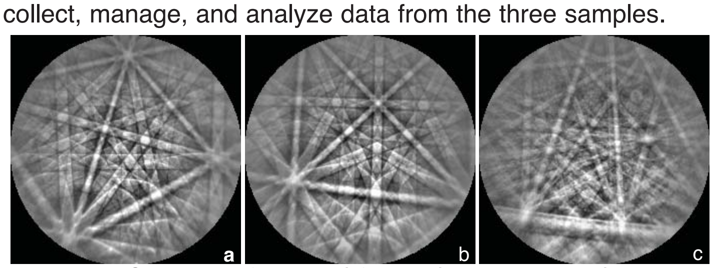


Figure 1: EBSD patterns from the a) ferrite, b) austenite, and c) sigma phases.

To collect the data, a TEAM™ Pegasus project was created. Ferrite (body-centered cubic), austenite (face-centered cubic), and sigma (tetragonal) structures were selected. Representative patterns are shown in Figure 1. The 3-Click workflow in TEAM™ was used to image the area of interest, collect the combined EDS-EBSD dataset, and review the data. When collecting a simultaneous TEAM™ map, a key Smart Feature is the auto-optimization of the EBSD camera. This optimization is content sensitive.

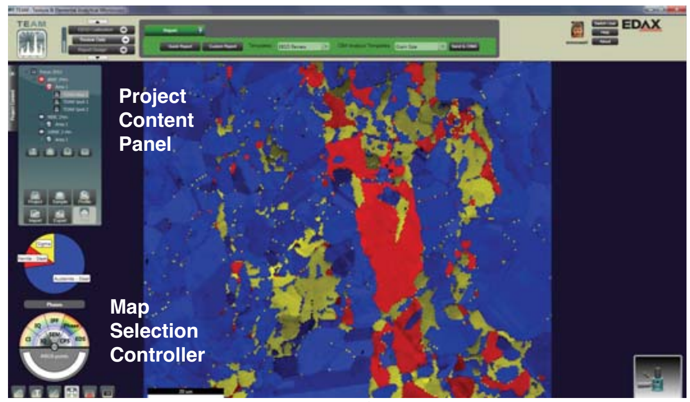


Figure 2: TEAM™ Pegasus User Interface showing project management and data review.

When collecting Point Analysis data, EBSD patterns are optimized for high-resolution and low noise while EDS spectra are collected for quantitative analysis. When collecting Mapping data, the EDS count rate is used to determine a dwell time that produces a statistically significant number of EDS counts per pixel. In turn the software then automatically sets the EBSD camera exposure to this dwell time to optimize the collection pattern quality. Optimization modes for EBSD-only mode are also available. A screenshot of the review mode is shown in Figure 2.

Note that the three datasets are easily accessible for review in the Project Content panel. The TEAM™ MASCOT (Map Selection Controller) is the selection tool in the lower left portion of the user interface where different map types can be selected, both in review mode and dynamically during data collection. In this example, a greyscale Image Quality (IQ) map is combined with a colored Phase map. Other map types are available. For example, Figure 3 shows a blended EDS map for each processing temperature, where molybdenum is shaded red, chromium is shaded blue, and iron is shaded green.

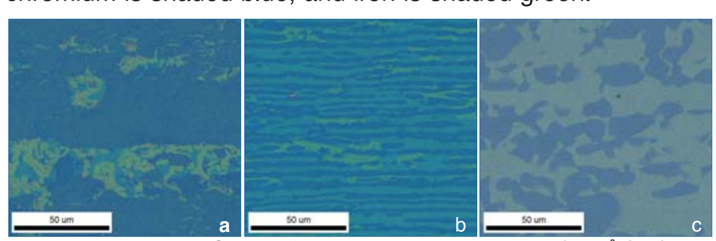


Figure 3: Blended EDS maps for samples heat treated at a) 800° C, b) 900° C, and c)1000° C where molybdenum is colored red, chromium is colored blue, and iron is colored green.

(Cont'd on page 5)

Using TEAM™ Pegasus to Characterize Intermetallic Phases in Duplex Steel Alloys (Cont'd. from Pg. 4)

This provides some indication of phase distribution. These maps can be compared to the EBSD structural phase maps shown in Figure 4, where ferrite is colored blue, austenite is colored red, and sigma is colored yellow. In these maps, the colored phase information is again combined with the greyscale EBSD image quality contrast to reveal the grain structure within each phase.

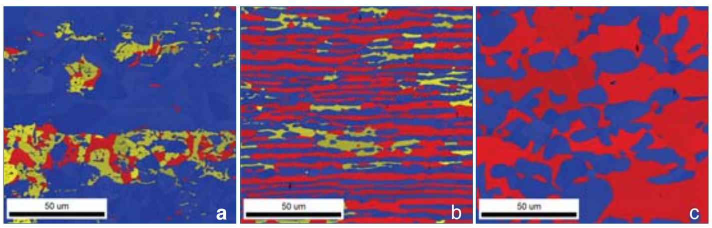


Figure 4: Colored phase maps combined with grey scale EBSD image quality for samples heat treated at a) 800° C, b) 900° C, and c)1000° C where ferrite is colored blue, austenite is colored red, and sigma is colored yellow.

The quantitative microstructural results are shown in Table 1. In this case, increasing the annealing temperature has decreased the percentage of sigma phase present but this has coincided with an increase of the average grain size. As increasing grain size often corresponds to a decrease in strength, two competing mechanisms must be controlled. In this case, the grain size needs to be small enough to provide strength high enough for a given application while the sigma fraction must be kept low enough to provide adequate toughness and corrosion resistance. TEAM™ Pegasus provides the characterization data necessary to understand and optimize the heat treating process in order to provide a material suitable for this application. TEAM™ Pegasus is compatible with Apollo Series SDD EDS detectors and both Hikari and DigiView EBSD cameras.

Annealing Temperature	% Sigma	% Ferrite	% Austenite	Ave Grain Size (μm)
800° C	14	6	80	1.37
900° C	9	38	53	1.85
1000° C	0	57	43	4.82

Table 1: Microstructural results vs. annealing temperature.

Also Available from AMETEK - Taylor Hobson

Our world-leading metrology tools use Coherence Correlation Interferometry (CCI) technology to generate high resolution 3D images for non-contact surface measurement.

Non-contact metrology plays an important role in the development and manufacture of many nanodevices. CCI is a modern non-contacting metrology tool with applications in the characterization of these devices.

The technique is capable of providing surface roughness and step height measurements with sub-nanometre precision. It is also capable of quantitatively measuring surface texture and surface form in three dimensions.

CCI is a scanning white light interferometry technique combining a coherence correlation algorithm with a high-resolution digital camera array to generate a 3D representation of a structure. Imaging the surface and then processing the information gives a quantitative 3D image with 0.01 nm vertical resolution.

It now has the capability to measure both thin film and thick film thickness, from 50 nm to around 10 μm. The ability to give sub-nanometre vertical resolution and ~1 μm lateral resolution allows precision measurement of thin films in applications like solar PV, displays, metal films, optics, polymer films, ophthalmic lens coatings, thick resists and semiconductors.

Major advantages include:

- 3D surface information in HD gives better representation of the surface structure than 2D
- No risk of scratches from stylus, so fragile surfaces are not affected or damaged by contact
- High speed measurement saves time in manufacturing, leading to higher yields
- Easy to use, automatic measurement removes operator variability, with less training demands

For more information click here or visit www.cci-3d.com

TRAINING AND EVENTS

World-Wide Events

April 12-14	Texas Society of Microscopy (TSM)	Fort Worth, TX
April 27	Oklahoma Microscopy Spring Meeting (OMS)	Ardome, OK
June 5-7	Microscopical Society of Canada (MSC)	Halifax, Canada
June 4-8	Lehigh School	Bethlehem, PA
June 19-21	Electron Backscatter Diffraction Topical Conference (EBSD 2012)	Carnegie Mellon Univ., Pittsburgh, PA
July 29 - August 2	Microscopy & Microanalysis (M&M)	Phoenix, AZ
September 25-29	11th Interamerican Congress on Microscopy	Mexico

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

2012 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 systems, we organize a number of Operator Courses at the EDAX facilities in North America; Tilburg, NL, Wiesbaden, Germany, Japan, and China.

***Please visit our website **www.edax.com/support/training/index.aspx** for additional information on our training classes.

Europe

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

Tilburg

EDS Microanalysis:
- March 27-29, 2012
- April 16-18, 2012
- June 14-15, 2012
- September 13-14, 2012
- October 2-4, 2012
- November 8-9, 2012
- November 20-22, 2012

EBSD:
- April 18-20, 2012
- June 11-13, 2012
- September 10-12, 2012
- November 12-14, 2012

WDS LEXS:
- April 24-26, 2012
- October 23-25, 2012

Wiesbaden

EDS Microanalysis:
- June 12-14, 2012

Pegasus: (EDS/EBSD)
- November 5-9, 2012

EDS (TEAM™) & WDS TEXS
- May 8-11, 2012

Orbis: Course & Workshop Presented in English
- October 23-25, 2012

Japan

EDS Microanalysis:

April 12-13	Osaka
June 7-8	Tokyo
July 12-13	Osaka
October 11-12	Tokyo
November 8-9	Osaka

EBSD (OIM™):

May, 2012	Tokyo
June, 2012	Osaka
August, 2012	Tokyo
December, 2012	Tokyo

China

EDS:
- June 19-21, 2012
- September 4-6, 2012

Particle Analysis:
- December 4-6, 2012

North America

EDS Microanalysis:

April 23-27	Mahwah, NJ
May 22-24	Mahwah, NJ
July 10-12	Draper, UT
September 25-27	Mahwah, NJ

EBSD:

May 29-31	Draper, UT
October 23-25	Mahwah, NJ

Pegasus: (EDS/EBSD)

TBD	Mahwah, NJ

WDS:

November 13-15	Mahwah, NJ

Micro-XRF:

April 10-12	Mahwah, NJ
October 2-4	Mahwah, NJ

Orbis X-ray Optic Positioner Design Patent Awarded

Bob Westerdale, Dr. Joseph Nicolosi, and Dr. Bruce Scruggs

Microscopic X-ray analyzing devices typically combine an optical microscope with a micro-beam X-ray analyzer for non-destructive sample analysis. This arrangement allows for localized point analysis and elemental imaging analysis such as studying compositional homogeneity of samples.

Prior microscopic X-ray analyzers arrange the incident X-ray beam with an angular range of 45° - 70° to the sample and the camera perpendicular to the sample for best viewing. However, the positioning of the X-ray beam at an angle to the sample introduces some difficulties in the analysis, for example elliptical elongation and shadowing. Historically others have avoided this issue by using mirrors with an X-ray guide tube or by shuffling the sample between a viewing position and an analyzing position

In studying requirements for the Orbis Micro-XRF Analysis System, Dr. Bruce Scruggs and Sun Park provided important information regarding what functions and analyses customers needed to be able to perform. Dr. Joseph Nicolosi and Bob Westerdale studied mechanical and physical requirements, which ensure accurate qualitative / quantitative analysis and mapping capability. Accordingly, the requirements called for a microscopic X-ray analyzer that allows for coaxial viewing and analyzing of a sample. A further need existed for a microscopic X-ray analyzer that allows for multiple X-ray optics to quickly and easily be placed perpendicular to the sample for analysis without moving the sample. Together, the team developed the concept for an optical positioner assembly configured above the sample stage. The patent filing describes a rotary turret capable of selecting multiple X-ray optics and an optic viewing lens coupled to a camera. This invention enables undistorted microscopic viewing of the sample; unobstructured analysis of topographical samples and selection of multiple micro-X-ray beams each perpendicular to the sample surface.

Sun and Bob prepared breadboards and prototypes for testing functionality and accuracy. Bruce and Joe verified customer requirements for speed and accuracy of analysis. Subsequently, the United States Patent Office issued a patent for a unique X-ray optic positioning device used in EDAX's Orbis micro-XRF elemental analyzer. Utilizing this invention, Orbis has become the industry standard for micro-X-ray Fluorescence Spectrometers among Forensic and Research scientists.

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The Surface and Morphology Analysis Laboratory, Suwon

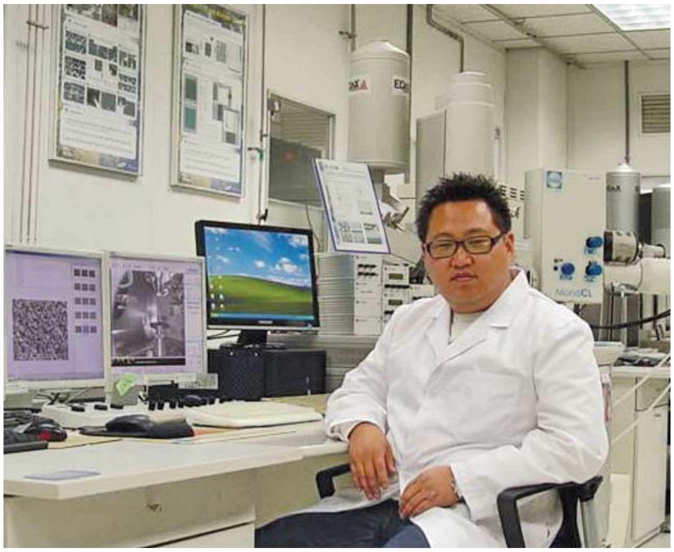
The Surface and Morphology Analysis Laboratory, Fundamental Technology Group, located at the Samsung Electro-Mechanics Company in Suwon, Republic of KOREA, serves as a central scanning electron microscopy (SEM) facility supporting failure analysis and new product Research & Development for various electronic devices such as Multi-Layer Ceramic Capacitors (MLCC), Printed Circuit Board (PCB) substrates, and power modules. The engineers at the laboratory perform general SEM analysis for surface and morphology, in addition to advanced SEM techniques for electrical, optical, and crystallographic characteristics and thermodynamics. The tools available in the analysis laboratory include Nano-Manipulator (NM), Cathodoluminescence (CL), Electron Beam Induced Current (EBIC), and Electron Back Scattered Diffraction (EBSD) techniques, as well as the microscope heating/cooling stage.

Mr. Yongchoon Park has been Principal Engineer at the Surface and Morphology Analysis Laboratory since 2005. He has worked for seven years on various scanning electron microscopes equipped with material analysis capability, such as the Hitachi S-4700 FEG SEM, the FEI Sirion 200 FEG SEM, the Nova NanoSEM 200 FEG SEM, the FEI Quanta 650 FEG Environmental SEM system, and the EDAX Genesis EDS system.

Lately, Mr. Park's main area of research has been focused on advanced SEM analysis techniques for a variety of electronic device applications. In addition, he has provided SEM and EDS training for Samsung Electro-Mechanics Company employees who need to understand microstructure analysis. About 150 employees have completed SEM and EDS training to date.

Mr. Park has been using the EDAX EDS system since 2005. In contrast with other EDS systems, which he used in his Bachelor and Master courses, he appreciates the user-friendly interface of the EDAX system. The EDAX system provides easy operation, simple results windows, and reporting to enable SEM and EDS training within a single day.

Recently, the EDAX EDS system has been improved with the introduction of SDD detectors together with software and hardware modifications. This allows a faster acquisition time for elemental line and map scanning analysis. Maintenance on the EDAX system is very easy and can be performed by anyone who operates the system. There are four SEMs in the Samsung Electro-Mechanics Company, all of which have been used with the EDAX EDS system. Mr. Park considers the EDAX EDS system to offer the best-performing analysis for a general nano/micro analysis researcher due to its versatile and combined system for chemical analysis such as line, mapping, and particle/phase over general qualitative/quantitative analysis.



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