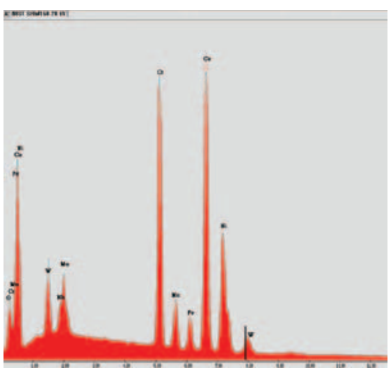
EDAX FOCUS

EDAX Introduces the Genesis Apex System - Accurate Results Start with Solid Foundations

In order to generate accurate X-ray microanalysis results, solid foundations are of the utmost importance. The foundations include the detector, the digital pulse processing electronics and the analytical software.

EDAX's Genesis Apex improves all aspects of these foundations, building on over 45 years of experience as the technology leader for EDS X-ray microanalysis.

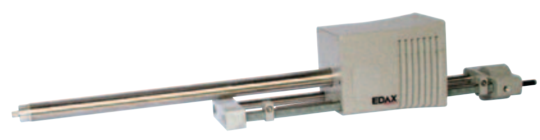
The Genesis Apex system is designed around the latest in SDD chip technology in the Apollo SDD series, new innovative digital pulse processing electronics, the DPP III, and the latest additions available in Version 6 of the market leading EDS software, Genesis, which includes the revolutionary new element identification routine, EXpert ID.



Example of EXpert ID, automatically and accurately identifying the peaks within the spectrum.

Apollo Silicon Drift Detector Series

- Utilizes the latest SDD chip technology
- Offers resolutions down to 125eV at MnKα and below 50eV at CKα
- First-in-class peak to background ratios up to 15,000:1
- Covers all applications from accurate quantitative analysis, fast X-ray mapping and superior particle analysis
- All SDD detectors are LN_2 free and vibration free, ensuring they have no effect on the SEM performance, even at ultra high resolutions



Apollo XV SDD provides high resolution and superb light element capabilities at high count rates.

DPP III Digital Pulse Processing Electronics Necessary for the SDD

- Improved performance at short shaping times to reduce dead time effects
- Capable of handling over 1,000,000 input counts to produce throughput exceeding 300,000 cps
- State of the art pulse pile up correction to minimize artifacts in the spectrum

EXpert ID (available in Genesis V6) – The revolutionary new standard for accurate element identification

- Founded on fundamental physics and a rules-based advanced algorithm
- Iterative process to produce the most accurate element identification in one simple step, ensuring that all peaks can be found and identified
- The most accurate results in the market, EXpert ID has been proven on the toughest spectra from the experts
- EXpert ID is available with all new Genesis Apex systems and via an upgrade for existing Genesis users

EDAX uses advancements in these three key components to improve the foundations for EDS X-ray microanalysis, enabling users to generate results with the greatest of confidence.

Inside This Issue

Vol.6 No.2

EDAX Introduces the DigiView IV EBSD Detector

EDAX introduces the DigiView IV EBSD detector into its EBSD detector family. The DigiView IV is a versatile detector satisfying many EBSD applications including orientation mapping data, using EDAX's OIM™ software, at rates up to 150 indexed patterns per second, Phase Identification using the Genesis and Delphi software applications and high-resolution (1392 x 1040 pixels) images.

Examples of data produced using the DigiView IV detector are shown in figures 1 and 2.

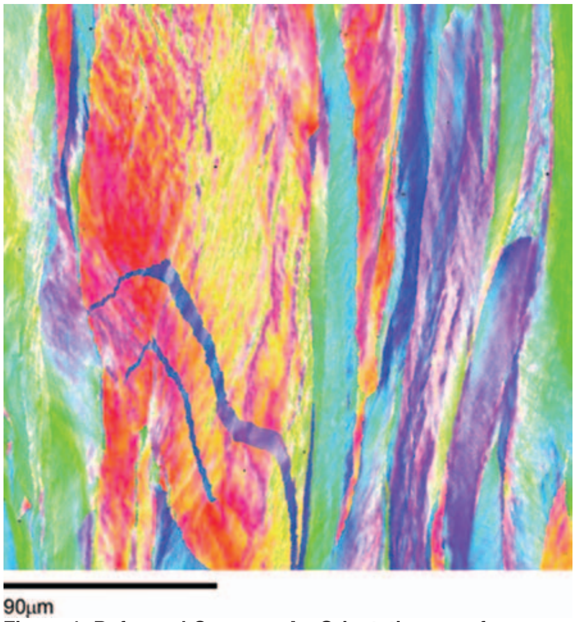


Figure 1: Deformed Copper – An Orientation map from a 75% cold rolled high purity copper sample. The large amount of deformation present produces significant orientation changes within parent grains. OIM can be used to investigate the correlation of orientation to deformation behavior.

The DigiView IV is a versatile high resolution, high sensitivity digital camera utilizing a unique 1.4 Megapixel 2/3 inch interline progressive scan Charged-Coupled Device (CCD) sensor tailored to high-throughput scientific applications. The CCD sensor has a particularly high Quantum Efficiency (QE), peaking in the blue-green spectrum for use with an optimized phosphor screen coating resulting in higher sensitivity for EBSD applications. Noise is significantly reduced using a single stage Peltier cooling system that does not require a cooling fan.

Control of the DigiView IV is available through the software applications, with full control over the gain, black level, exposure time, and binning settings. Comprehensive image processing capability is also included for optimal image quality.

The DigiView IV detector fits seamlessly into the EDAX EBSD systems making it suitable for stand alone EBSD applications or for integration into the EDAX EDS systems to provide improved crystallography analysis. The detector operates with the latest version of OIM™ software and EDAX hardware to produce high quality EBSD data.

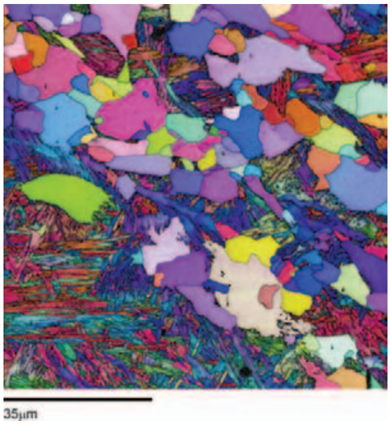


Figure 2: Ferrite Martensite – A combined Image Quality (IQ) and Orientation map from a dual-phase ferrite-martensite low carbon steel. The phase transformation from ferrite to martensite produces orientation, morphology, and image quality characteristic that can be used to differentiate and quantify the phases present, and to optimize processing parameters for optimal mechanical properties.

The specification of the DigiView IV detector is as follows:

- Data collection rates up to 150 indexing patterns per second
- High QE CCD: > 62% @ 500 nm
- 1.4 megapixel resolution: 1392 (H) X 1040 (V)
- 12 bit digitization
- Selectable on-chip binning modes: 1x1, 2x2, 4x4, 8x8, 10x10, 12x12, 13x13
- High signal to noise ratio
- Stage TE cooler
- Gigabit ethernet protocol
- No mechanical shutter
- CE certified
- RoHS compliant

Standardless Quantification

The standardless quantification algorithm is used by many customers as the preferred quantification method in Genesis software. Most important advantages are ease-of-use, fast method, and independence from beam current.

In this quantification routine, the k-ratio is calculated by dividing the measured peak intensity of the element of interest by the pure element intensity (calculated from first principles). Next, a correction is applied, necessary for the effect of other elements present in the unknown material (the so-called matrix correction method). Most often used is the ZAF matrix correction method.

The total composition is always normalized to 100%. This standardless method was first implemented 30 years ago and has been refined over time. It has proven to be a very robust and accurate method especially for analyses using K-lines.

Figure 1: Typing in the known element concentrations in the compound standard (in this case Fe_2O_3), the Genesis software is calculating the SEC factor by selecting the SEC button.

A disadvantage of this algorithm is that the detector efficiency can not be predicted with sufficient accuracy for X-ray lines below 1 keV. Small variations in detector parameters (thickness of detector window, metal contact layer, Si dead layer, etc.) cause small variations in measured intensity (due to absorption differences). To correct these, the Genesis software uses Standardless Element Coefficient factors, or SEC factors.

SEC factors are relative numbers (due to the normalization to 100%) and should be set up for light elements, i.e. B, C, N, O, and F, and measured using a standard for 100 live seconds and the known element weight percentages are input into the Genesis software.

For determining the SEC factor of oxygen, Fe_2O_3 could be used. See Figure 1 showing the setup.

In Table I standardless quant results for some standards, with and without, using SEC factors for oxygen are displayed. As shown in the table, when oxygen content is not corrected, (by applying a SEC factor), all other element concentrations as a consequence, are given incorrect values. This is due to the normalization to 100%.

			No SEC factor		SEC factor used	
	Element	wt% given	wt% determined	difference (%)	wt% determined	difference (%)
Jadeite (NaAlSi2O6)	O	47.4	40.4	-14.8	46.4	-2.1
	Na	11.2	12.0	7.1	11.0	-1.8
	Al	13.1	16.1	15.3	13.6	3.1
	Si	27.7	31.9	15.2	28.5	2.9
	Ca	0.55	0.64	16.4	0.57	3.6
Albite (NaAlSi3O8)	O	48.8	41.6	-14.8	47.8	-2.0
	Na	8.6	9.4	9.3	8.5	-1.2
	Al	10.3	12.3	19.4	11.1	7.8
	Si	32.0	36.7	14.7	32.6	1.9
Magnetite (Fe3O4)	O	27.7	22.5	-18.8	27.3	-1.4
	Fe	72.2	77.5	7.3	72.7	0.7
SEC factor for Oxygen: 0.74						

Table I: Standardless quantification, with and without, using SEC factor for oxygen. Analysis runs on Apollo 40 Silicon Drift Detector. Jadeite and Albite 10 kV was used and for Magnetite, 15 kV was used. All spectra were recorded for 100 live seconds. Results are averages from 3 runs/standard.

Using a SEC factor for oxygen gives results close to the given composition (note the much smaller differences in the percentage). This quantification routine is called the improved standardless quantification.

Table II shows quantification of samples with other light elements. If one uses very light elements like Boron and does not use SEC factors, bigger quantification errors can occur. SEC factors were determined for B, N, and F, using CaB_6, CrN, and CaF_2 as standards.

Advantages of the SEC method:

- SEC factors are independent of the SEM accelerating voltage. They only correct for variations in detector parameters thus, the accelerating voltage with which the X-rays were generated is irrelevant.
- SEC factors are matrix independent. A SEC factor for carbon calculated with SiC can be used for the carbon content in steel, ceramics, polymers, etc.

Recommendations:

- Although very stable over long periods of time, checking the SEC factors once a month is advised.
- When changes have been made to the detector (e.g. replacement of the window), the SEC factors have to be re-measured.
- For all elements > 1 keV, a user should not use SEC factors.

			No SEC factors		SEC factor used	
	Element	wt% given	wt% determined	difference (%)	wt% determined	difference (%)
Boron Nitride (BN)	B	43.6	53.9	23.6	44.7	2.5
	N	56.4	46.1	-18.3	55.3	-2.0
Apatite (Ca5(PO4)3F)	Ca	39.7	42.0	5.8	38.4	-3.3
	P	18.4	20.5	11.4	18.9	2.7
	O	38.1	34.4	-9.7	39.1	2.6
	F	3.8	3.1	-18.4	3.6	-5.3
SEC factors: Boron=0.89, Nitrogen=0.52 and Fluorine=0.89						

Table II: Standardless Quantification, with and without, using SEC factors for Apatite and Boron Nitride. Analysis runs on the Apollo 40 Silicon Drift Detector. Spectra run at 5 kV (BN) and 12 kV (Apatite) for 100 live seconds. Results are averages from 3 runs/standard.

Al 7075 Carabiner Analysis

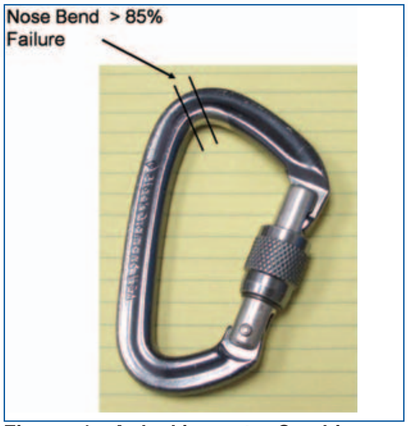


Figure 1: A locking-gate Carabiner. Greater than 85% of all failures occur at the nose bend.

Aluminum 7075 is an aluminum alloy with copper, magnesium, manganese, silicon, iron, chromium, zinc, and titanium. Al 7075 is best known as "aircraft aluminum" and sees usage in applications where a high-strength, low-density material is needed. The material is utilized in a high-stress environment, thus cracking behavior is of particular interest to engineers.

For this case study we selected rock-climbing carabiners from a local retail store. One goal in designing a carabiner is to maximize strength and minimize weight. The way in which this is accomplished is unique to each manufacturer. Due to the fact that there is no variation in the material selection and the material itself is homogeneous, Orientation Image Mapping (OIM™) is ideal to evaluate the microstructures introduced by the processing.

The scans are all collected from the interior of the carabiners' nose bend. It is at this point on the carabiner that 85% of all failures originate.

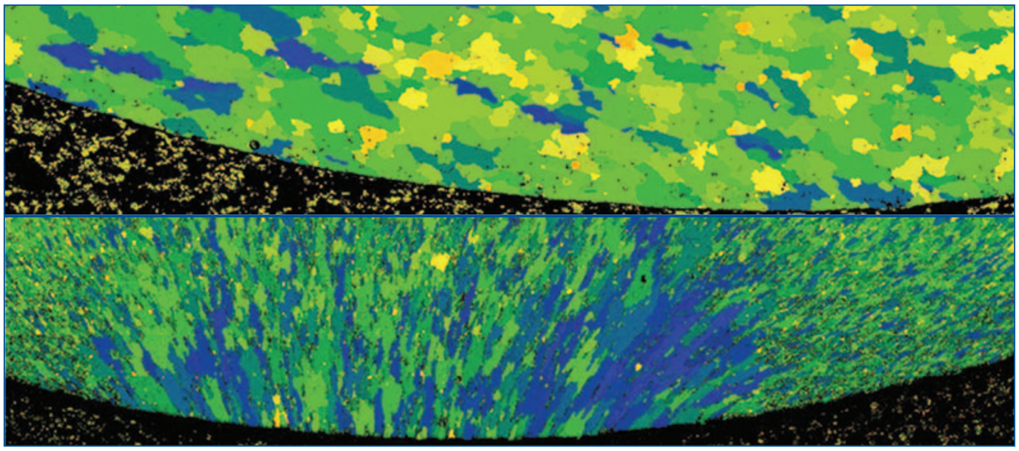


Figure 2: Carabiner A (top) shows nearly equiaxial grains and Carabiner B (bottom), meanwhile, shows greater elongation in the grain structure.

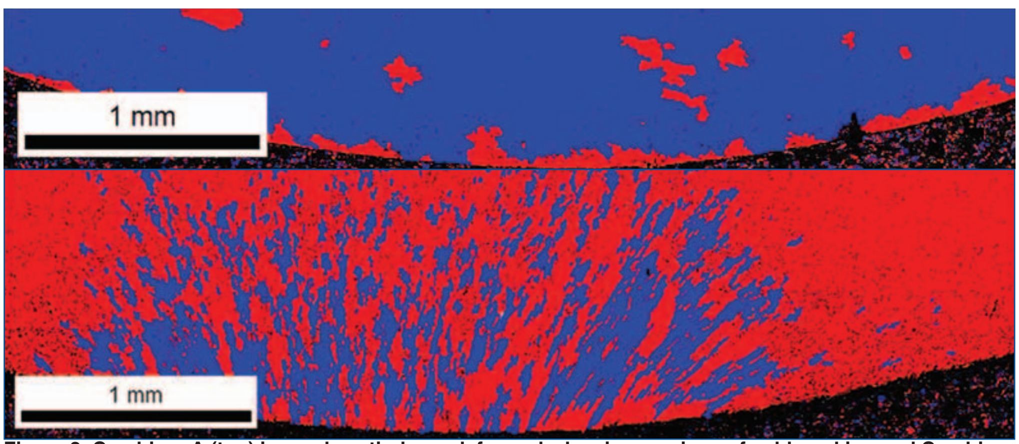


Figure 3: Carabiner A (top) is nearly entirely un-deformed, showing no signs of cold-working and Carabiner B (bottom) displays partial recrystallization near the center of the nose bend, where strain was the greatest prior to annealing.

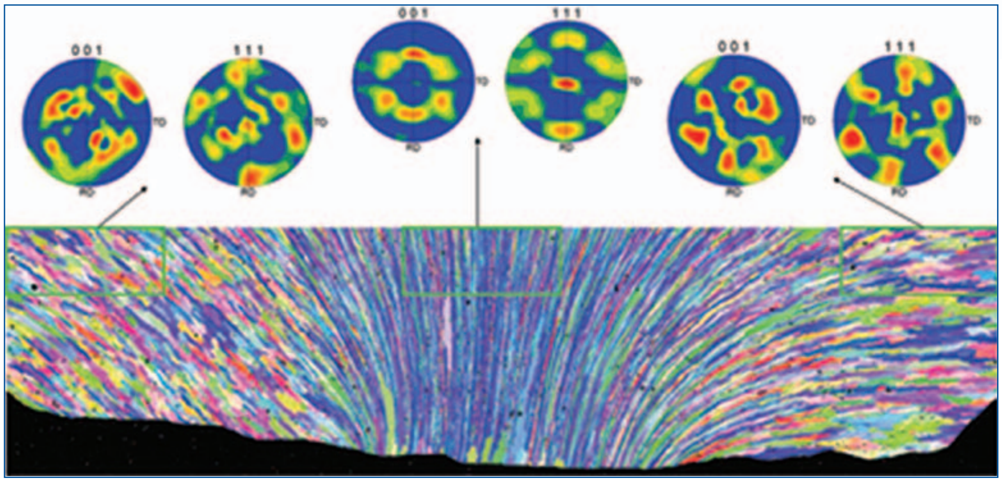
Using OIM™, grain orientation and deformation can be quantified. The grain orientation shows the flow texture of the material from the forging process.

The deformation in the grains shows the extent to which the heat treating process works. OIM™ can quantify the misorientations within a single grain, thus, thresholds can be set to classify particular regions as "deformed" and "recrystallized," allowing for a quantification of the extent of recrystallization during the heat treating process.

Carabiner A is a cold-forged carabiner (top). This processing imparts a more equiaxial structure with much less deformation (recrystallized grains in blue, deformed in red). Carabiner B (bottom) is forged, while held at a high temperature, allowing for more dramatic microstructural changes. The microstructure of Carabiner B shows a more elongated structure with deformation to reflect those stresses.

Al 7075 Carabiner Analysis (Cont'd from Pg. 4)

Figure 4: The flow texture of the grains is reflected in the rotation of the crystal lattice.



Carabiner C contains the most dramatic flow structure and the local textures reflect the rotation evident in the orientation map. The center of Carabiner C displays a strong <111> orientation. On the left, we see it rotated counterclockwise. One the right, it is rotated clockwise. In a scan with over 2.5 million data points, the cropped regions contain over 100,000 points to ensure accurate statistics.

For the final sample, a combination stage and beam scan allows 3.2 million data points in over 1600 fields to be stitched together to show the flow structure and texture of the heavily deformed Al 7075 in Carabiner D.

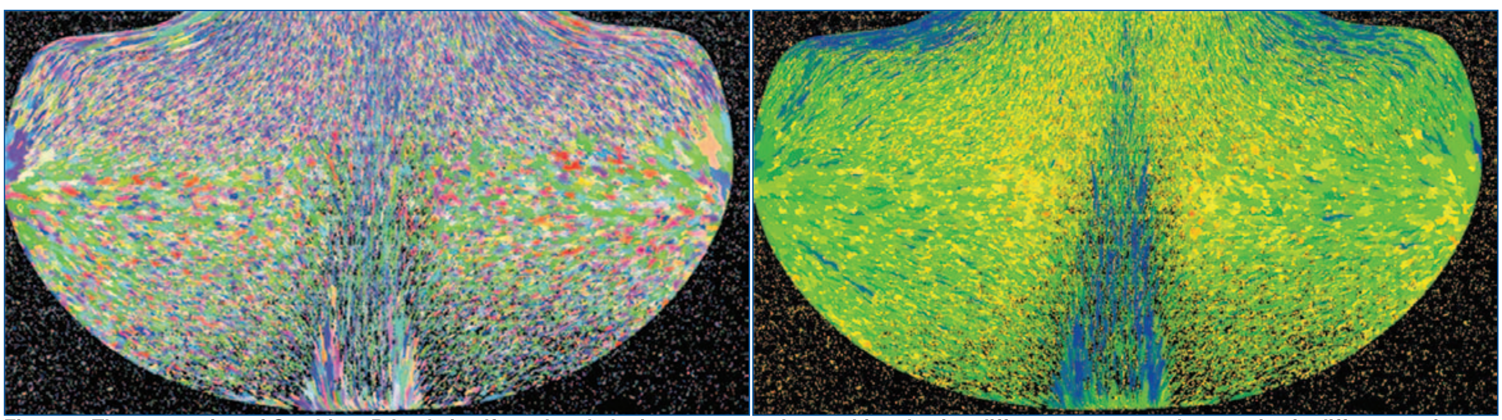


Figure 5: The processing of Carabiner D lends itself to a banded microstructure; the carabiner having different textures and properties in different regions and Carabiner D is the most dramatic example of flow texture, with the grains very elongated and following the pear-like shape of the piece.

The more deformed samples with strong flow structure will have a higher strength-to weight ratio by aligning the grain boundaries with the stresses imparted on the carabiner during loading.

Not surprisingly, Carabiner D had the highest strength-to-weight ratio of the test carabiners. However, this only holds true in one loading direction. The structure is optimized to withstand stresses loaded from the bottom of the maps, Carabiner D does not hold up to "cross-loading" or lateral stresses as well as the less-deformed Carabiner B shown earlier. Therefore, note: The microstructure has drastic effects on the performance of the piece, despite identical materials.

TRAINING AND EVENTS

World-Wide Events

July 23-25	MSSA (The 46th Annual Conference of the Microscopy Society of Southern African)	Botswana, Africa
August 4-7	M&M (Microscopy & Microanalysis)	Albuquerque, NM
August 4-8	Denver X-ray Conference	Denver, CO
August 18-22	NanoSPD4 (The 4th International Conference on Nanomaterials by Severe Plastic Deformation)	Goslar, Germany
September 1-5	EMC 2008 (14th European Microscopy Conference)	Aachen, Germany
September 3-5	JAIMA	Makuhari Messe, Japan
September 8-10	ICAM 2008 (9th International Congress for Applied Mineralogy	Brisbane, Australia
September 14-16	SIMS Europe 2008	Munster, Germany
September 14-17	86.Jahrestagung DMG 2008 Berlin	TU Berlin, Germany
September 17-19	42 Metallographie Tagung	Jena, Germany
September 22-24	ENFSI - European Paint and Glass Group	Delft, Netherlands
October 6-9	MS&T (The Materials Science & Technology Expo.) (Formerly called ASM)	Pittsburgh, PA
October 14-17	15th ENFSI EWG Firearms/GSR Meeting	Dubrovnik, Croatia
November 5-6	NWAFS Meeting	Boise, ID
December 2-4	MRS Fall 2008	Boston, MA

***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):

Microanalysis Courses:

3-4 Day

- ◆ August 25-28 (T)
- ◆ November 17-20 (T)
- ◆ November 25-28 (W)

2 Day

- ◆ September 4-5 (T)

LEX Course:

- ◆ October 7-9 (T)

TEX Courses:

- ◆ September 9-10 (W)
- ◆ September 23-24(W)

Pegasus Courses:

- ◆ October 20-24 (W)

OIM™(EBSD) Courses:

- ◆ September 8-10 (T)

Japan

Microanalysis Courses:

- ◆ October 1-3 Tokyo
- ◆ November 5-7 Osaka

For more information on our training classes, please visit our website at:

www.edax.com/service/user.cfm

North America

Microanalysis Courses:

- ◆ September 22-26 Mahwah, NJ
- ◆ October 27-31 Mahwah, NJ
- ◆ December 1-5 Mahwah, NJ

Particle Courses:

- ◆ November 11-13 Mahwah, NJ

WDS Courses:

- ◆ November 18-20 Mahwah, NJ

EBSD OIM™ Academy Courses:

- ◆ August 26-28 Mahwah, NJ
- ◆ October 14-16 Draper, UT

Micro-XRF Courses:

- ◆ October 7-9 Mahwah, NJ

Dianne Moncavage joined EDAX in July 1997 and is located in our Mahwah, NJ Corporate office. Dianne brings 20 years of accounting experience to EDAX. After her three daughters completed college, Dianne went back to school and received her associate degree in Accounting.

Dianne worked as an accounts payable specialist for Osicom Technologies in 1988 and when the company moved to California in 1992, she relocated with the company for a year to assist with hiring staff and setting up various departments.

When Dianne returned to New Jersey she began working for Philips Electronics in 1997 in the accounts payable department and was promoted to accounts payable/payroll manager. After Philips Electronics sold EDAX, Dianne was instrumental in setting up a variety of functions/processes for the newly independent company.

Dianne is currently the general accountant for EDAX and her responsibilities consist of inventory costing, tracking loan and demo inventory, fixed asset accounting, account analysis, and month-end closing.

She has three adult daughters, Doranne, Carissa, and Noelle. Dianne is looking forward to becoming a grandmother for the first time in July. In her spare time she enjoys gardening, reading, traveling, working on projects around her home, spending time with Gregg, her significant other, and her two cocker spaniel puppies, Jetzie and Bailee.

Dr. Yuntao Lei joined EDAX in November 2003 in the sales department. Dr. Lei is based in Beijing and covers North China. In 2006 he was promoted to the application department, responsible for EDAX's TSL product line for the entire EDAX China market.

Yuntao received a degree in Physics from Zhengzhou University China, an MS in Solid State Physics from the University of Science and Technology of China, and a PhD in Materials Physics from the University of Science and Technology Beijing. In 1991 Yuntao started his career as a materials research engineer in the Nuclear Power Institute of China in Chengdu, in the field of microstructural characterization with XRD and TEM, where he worked on an EDAX PV9100.

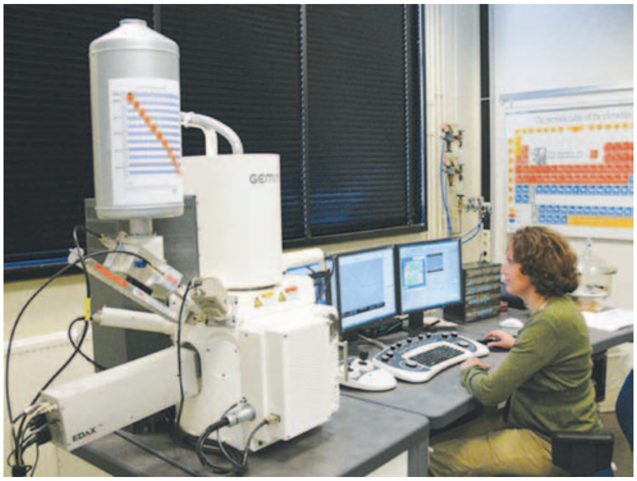
Prior to joining EDAX, Yuntao was a user of a Philips CM200 TEM with an EDAX DX-4 for approximately 8 years at the Luoyang Institute of Shipbuilding Materials.

Yuntao's physics background, his experience in electron microscopy and materials science, as well as his dedication have led him to the position of an application specialist for EBSD/OIM™. As a result, we see a significant pick-up on OIM™ related sales in China recently.

When Yuntao is not working, he enjoys running or playing badminton. He also enjoys spending time with his wife Pengling and their 16 year old daughter Wei who is attending high school in Beijing.

CUSTOMER NEWS

Corus Technology B.V., IJmuiden the Netherlands



Corus is an international company that manufactures, processes, and distributes metal products. They provide related services in design, technology, and consultancy. Corus has manufacturing operations in many countries with major plants located in the UK, the Netherlands, Germany, France, Norway, and Belgium. Corus is part of Tata Steel Group, the world's sixth largest and second most global steel producer.

The Metallography and Surface Analysis (MSA) group is part of Corus Research, Development and Technology and is located on the Corus IJmuiden site in the Netherlands. The group provides direct process and customer support to Corus Business Units and delivers solutions for advanced materials characterization to support research programs for both steel and aluminum. The research consists primarily of characterization of substrate and coatings as well as defect and failure analyses in relation to production or customer application issues.

Electron microscopy, in combination with EDX and EBSD, can be regarded as the key technique within the versatile range of analytical techniques available at MSA. The SEM facilities at MSA consist of a conventional LEO438VP W-SEM and a state-of-the-art ULTRA55 FEG-SEM. Both systems are equipped with an EDAX Pegasus system for X-ray micro-analysis and Electron Backscatter Diffraction (EBSD) analysis. The ULTRA55 FEG-SEM is equipped with a Hikari EBSD camera.

Typical EDAX applications for X-ray micro-analysis and Electron Backscatter Diffraction analysis at the MSA research group include:

- X-ray mapping and spot analysis for defect and failure analyses
- Automated Particle Analyses of steel inclusions
- OIM analyses to determine properties related to recovery, recrystallization, local deformation, texture, and identification of phase constituents

Marga Zuijderwijk, responsible for the SEM facilities at the Metallography and Surface Analysis group of Corus stated, "We are very pleased with the good integration between our ULTRA55 and EDAX Pegasus system. The automated overnight and over-weekend measurements for Particle Analyses and EBSD enable us to make optimal use of the system. The drift correction that is available in Genesis is excellent and has been used successfully during spectral mapping with mapping times over 60 hours."

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