EDAX FOCUS

TEAM™ EDS Analysis System

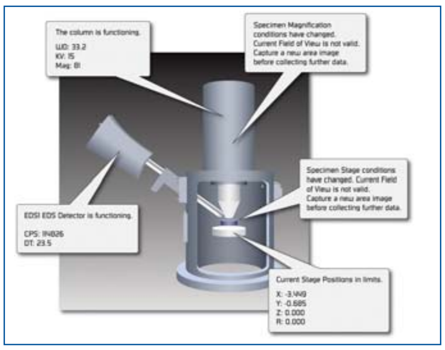
Vol.9 No.2

EDAX introduces the most advanced Energy Dispersive Spectroscopy (EDS) Analysis System with TEAM™ EDS. Ease of use, Smart Features, and a modern user interface make up the foundation of the new TEAM™ EDS. The software is available for new Apollo X series, EDS systems, as well as an upgrade to existing SDD systems.

The TEAM™ EDS Analysis System includes enhancements that streamline analysis and reporting workflow, boosting user productivity, reducing analysis time, and minimizing potential for errors. The intuitive and easy to use software assures consistent data collection, analysis and reporting, regardless of the experience level of the operator. Smart Features in Startup, Analysis, and Reporting are automated, integrating years of EDAX knowledge to provide the user with exceptional results.

Startup

TEAM™ EDS simplifies the setup and configuration for all analysis. In the User Profile, the system parameters and preferences can be configured specifically to a user account. EDAX technology automates routine tasks, permitting the user to collect data with minimal setup, predict or calculate optimal parameters, receive guidance on microscope parameter optimization, and dynamically adjust parameters during an analysis.



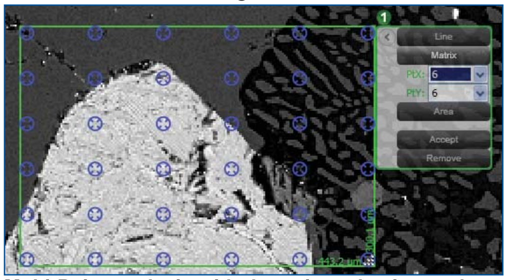
Environmental Panel with Smart Track.

Analysis

Whether the focus is phase mapping or spectra collection, the TEAM™ EDS system provides Smart Features that make analysis faster and easier.

Point Analysis and Line Scan

TEAM™ EDS Point Analysis utilizes EXpert ID for the fastest, most accurate EDS spectra collection. Whenever a spectrum is gathered, EXpert ID's element routine begins and automatically identifies elements present in the spectrum. Each peak will be labeled according to its energy line and transition. Spectra can be collected across the specimen's image area, using individual points, multiple points, freehand draw, and along a line.

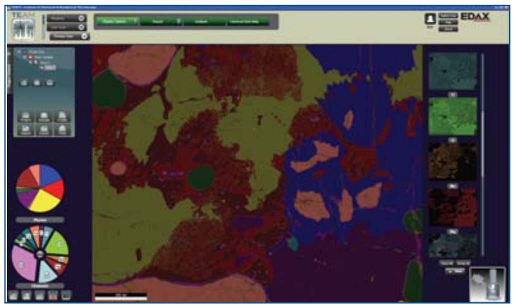


Multi-Point analysis with the point selection tool.

The line scans provide additional flexibility to customize the number of measurement points in a line. The line scan resolution can be selected from preset options or it can be customized for desired length and width.

Smart Phase Mapping

The new TEAM™ EDS Analysis System features an innovative approach to mapping to rapidly generate results with greater flexibility. User setup is no longer required. Smart Phase Mapping automatically collects spectra, elemental maps, and phase maps with elemental distributions. The user can choose the data quality required for the map or manually select the number of frames for collection.



Automated Smart Phase Mapping allows interactive review of phase, CPS and elemental maps during collection.

(Cont'd on page 2)

EDS NEWS

TEAM™ EDS Analysis System (Cont'd. from Pg. 1)

TEAM™ EDS operates as if an expert is inside the system, giving every level of operator an invaluable tool that rapidly generates results that can be trusted.

During and after collection the user can display:

- Phase to Element – Phase maps with supporting elemental information
- Element to Phase – Element maps and information with supporting phase data
- Counts Per Second (CPS) – A gray scale map for each frame showing total EDS counts per pixel

Smart Phase Mapping allows the element list to be modified to rebuild maps. After collection, TEAM™ EDS provides multiple tools to analyze data. Desired intensity range can be selected from the histogram window to highlight the area of interest and extract associated spectra.

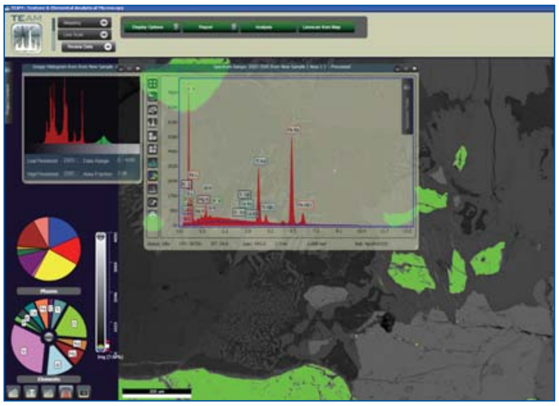
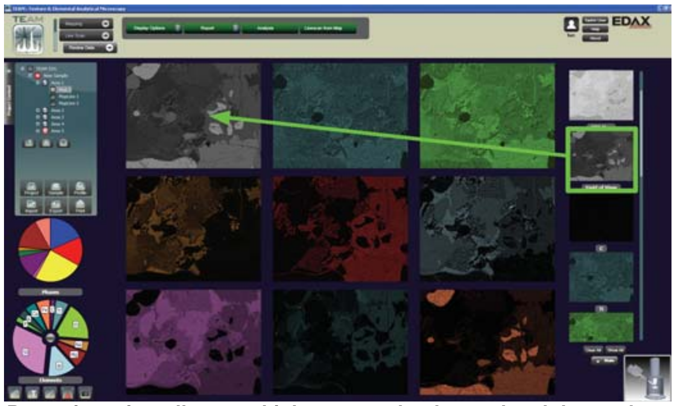


Image area highlighted in green are the pixels matching the intensity within the selected histogram range. The sum of the spectra from the highlighted area is extracted with the histogram tool.

Collected element maps can be processed with Quant Maps for further analysis and comparison with original data. Spectra can also be extracted from phase maps using many flexible methods including free hand draw.

Dynamic Review

TEAM™ EDS makes it easy to quickly compare the collected maps using the Dynamic Review. Just click and drag multiple maps to the display area and they are ready for review.

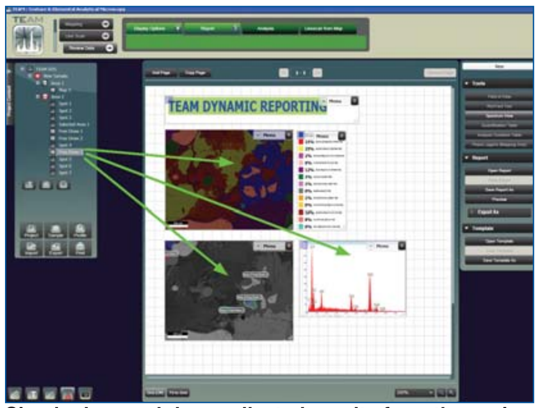


Dynamic review allows multiple maps to be dragged and dropped from the scroll list of maps to the display area for a quick and easy review.

Reporting

Smart Data Management

Data is handled in the project tree for interactive review and archiving of images, maps, and spectra. Data can be automatically loaded as a report into the Report Viewer by pressing a single button.



Simply drag and drop collected results from the project tree to create a customized report with TEAM™ EDS Dynamic Report.

TEAM™ EDS's dynamic reporting capabilities represent a newer, better, and smarter way to perform data management. The software permits template customization, allowing the operator to lay out the report with a few easy mouse clicks. The template can be applied over and over again, eliminating the need to create a new version for each report. Dynamic data editing enables rapid report construction and achieves a new level of simplicity in managing and formatting information.

For additional information on TEAM™ EDS Analysis System, contact us at info.edax@ametek.com

Spectral Overlay in TEAM™

Spectrum overlay provides a quick and easy way to visualize spectral peak intensity and chemistry differences from different areas on a sample. The areas can come from a single field of view, different image areas, and from different samples.

How to perform a series of spectral overlays:

- Double click on a spectrum in the project tree to activate that spectrum in review mode. See Figure 1.

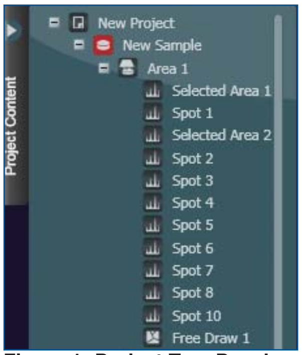


Figure 1: Project Tree Panel.

- Left mouse click and hold on the next desired spectrum in the project tree. Hold and drag onto the already open first spectrum and release over the first spectrum. You are able to see both spectra overlaid.

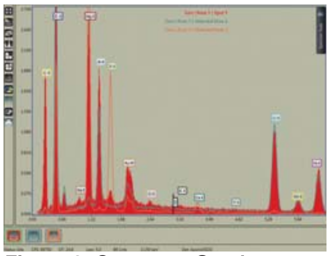


Figure 2: Spectrum Overlay.

- Overlay any number of desired spectra from the same field of view, another area or another sample, as found in the project tree. See Figure 2.

- If spectra from different users or projects are desired to be overlaid, save them in the spectrum tools from that user or project then open the project with the next desired spectrum. Select load from the spectrum tools area. See Figure 3. You are able to send multiple spectra to the active project panel. See Figure 4.

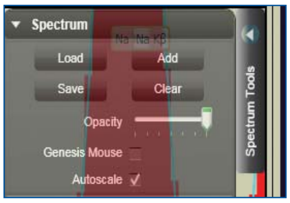


Figure 3: Spectrum Tools.

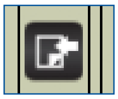


Figure 4: Send to Project.

- Use the autoscale feature in the spectrum tools to display all spectra on the same Y scaling (count intensity). If not used, all spectra will maintain their original count scale.

- Click on the colored spectrum icons beneath the spectra to toggle the spectrum between solid, outline, and off modes to select the desired view.

- To save overlaid spectra, activate the screen capture icon and either click once anywhere on the spectrum or left click and drag to define the desired area. Copy to clipboard or save to file with the prompt.

Spectrum overlay is also a valuable tool for reviewing the quantitative results in a multipoint analysis.

- Simply perform a spectral overlay as described.

- Select the quant icon while the multi spectra are displayed. See Figure 5.

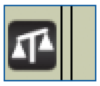


Figure 5: Quant.

- The quant results of all selected spectra will be displayed in one spreadsheet, which can then be saved as an Excel or spreadsheet format useful for further statistical or graphical analysis.

TIP! Use the spectral overlay image from a screen capture to insert or paste into the spreadsheet for a complete spreadsheet containing data and images, which can easily be shared and viewed by others!

Dynamic Reporting uses both spectral overlay and multi area overlay for reporting with multiple views. Build a manual report using field of view and spectrum containers. Simply click, drag, and release as with multi spectral overlay.

EBSD NEWS

Characterization of Thermoelectric Materials with EBSD and EDS

Thermoelectric efficiency is an important performance metric for system designers. Improved efficiency is key to opening large new market applications including automotive, waste heat recovery, and refrigeration. EBSD is a valuable characterization tool for understanding and exploiting the relationship between thermoelectric microstructure and device performance. EBSD provides unrivaled information on the orientation and grain boundary character of materials quickly and easily.

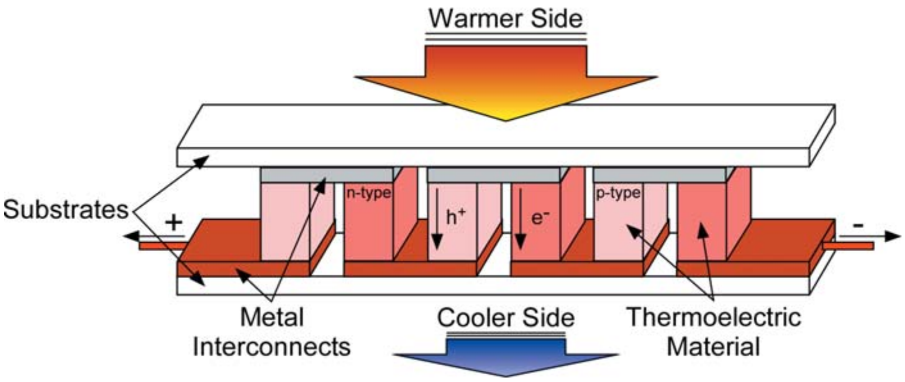


Figure 1: Schematic of a Thermoelectric Device.

Thermoelectric (TE) materials convert thermal gradients to useful electrical power or use electrical energy to manipulate thermal energy in cooling and heating applications. TE behavior is a function of the thermal and electrical conductivity of a material. These intrinsic properties are anisotropic or dependent on crystallographic orientation. Electron Backscatter Diffraction (EBSD) is a Scanning Electron Microscope (SEM) based characterization tool for determining the orientation, texture, grain boundary structure, and phase distribution comprising a material, and is therefore an ideal tool for analyzing and understanding thermoelectric materials and correlating their microstructure to the resultant performance.

Figure 1 shows a two-dimensional schematic of a thermoelectric device. When used for energy generation, the thermal gradient causes electrons in the n-type material and holes in the p-type material to diffuse away from the warmer side and creates an electric potential that can be used productively. In order to maximize thermoelectric performance, a material should have a low thermal conductivity, to preserve the thermal gradient, but a high electrical conductivity to facilitate current flow and use. As many materials are used to create a working TE device, combined analysis using EBSD and Energy Dispersive Spectroscopy (EDS) provides a comprehensive characterization of the device microstructure. Figure 2 shows a phase map derived from combined EBSD-EDS data using EDAX's patented ChI-Scan technology of a cross-sectioned thermoelectric device. In this example, the thermoelectric material is bismuth telluride (Bi_2Te_3). EDS is used to detect the alloying used to create n-type and p-type material. The characterization also highlights a defect that has occurred during device production as shown by the tin region in the right most p-type material.

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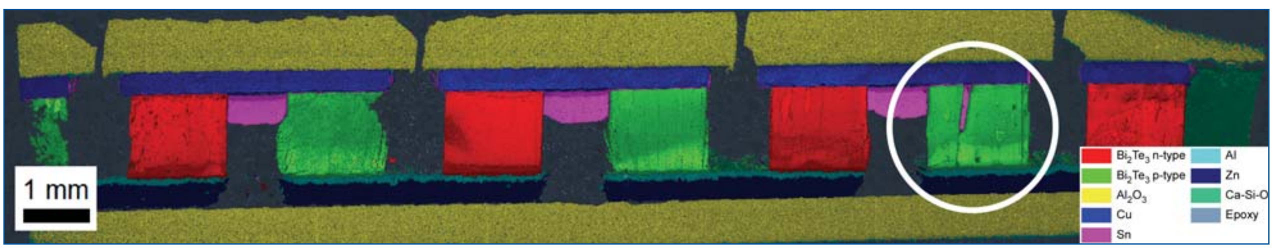

Figure 2: Phase map derived from simultaneously collected EBSD and EDS data with highlighted defect.

Characterization of Thermoelectric Materials with EBSD and EDS

(Cont'd. from Pg. 4)

Figure 3 shows a detailed characterization of this defect. The phase map shows that some of the interconnecting tin has impinged into the active Bi_2Te_3 material, which will reduce the efficiency of the device. The orientation map shows the crystallographic orientation of the corresponding phase for each pixel in the map. The thermoelectric Bi_2Te_3 is primarily a single orientation; however, the crystal is not orientated in a way that maximizes performance. The Local Orientation Spread (LOS) map shows some regions of higher plastic strain, primarily near phase interfaces. These regions could affect phonon propagation, decrease thermal conductivity, and increase device performance.

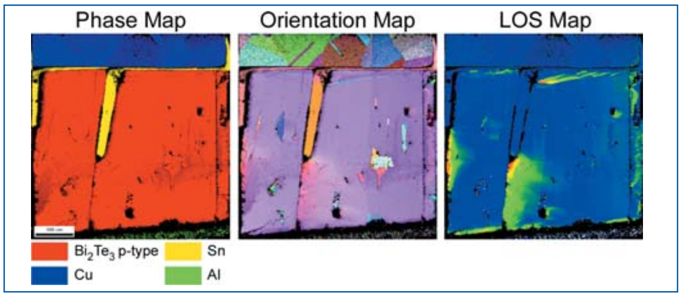

Figure 3: Highlighted region from p-type Bi_2Te_3 material.

One of the more popular methods to improve TE material efficiency is through nanostructuring. By reducing the grain size, the grain boundary density increases. With this comes a corresponding increase in phonon scattering and a decrease in thermal conductivity while minimizing the impact on electrical conductivity. Figure 4 shows an example of nanostructured Bi_2Te_3 produced by gas atomization and compacted using a high-pressure press at room temperature. It is observed that the particles used are polycrystalline with a wide range of grain sizes. Grains as small as 20nm have been observed in this material. The ability to characterize the microstructure of both the nanostructured particles and the consolidated material allows for the optimization of processing conditions to produce the best thermoelectric materials. Standard characterization techniques, such as X-ray diffraction, do not provide the visual information that is intuitively understood at a glance and reinforced with a quantitative description of the microstructure.

Different material systems are needed to achieve high efficiencies at the different operating temperatures required for the wide variety of potential applications such as automotive and waste heat recovery. Figure 5 shows an example of a Co-based skutterudite TE material, where EBSD shows the regions of crystallographic material in color and amorphous regions in black. The crystalline-amorphous composite is thought to enhance Phonon Glass Electron Crystalline (PGEC) behavior and improve TE performance.

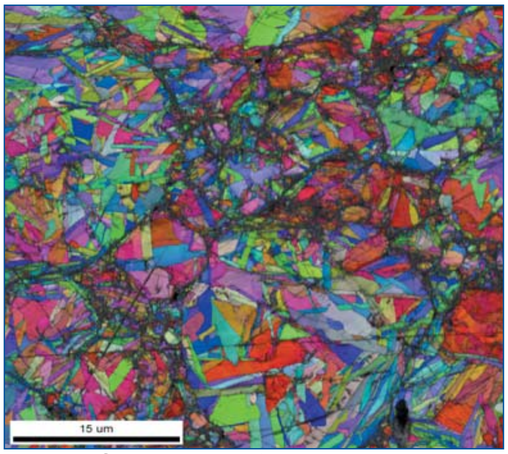

Figure 4: Orientation map from a compacted nanostructured Bi_2Te_3 material where the grain size and shape is easily seen.

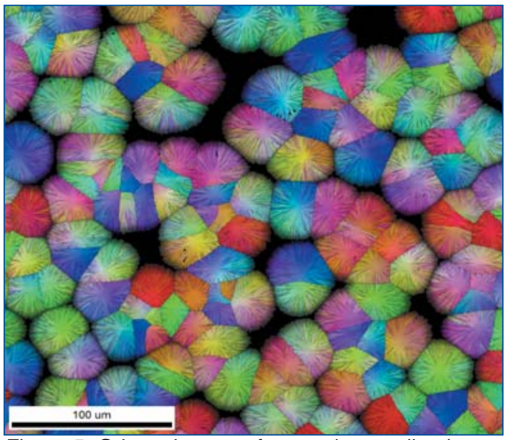

Figure 5: Orientation map from a skutterudite thermoelectric material.

EDAX's market leading microanalysis products provide superior data collection and analysis tools to better understand and improve your materials. For thermoelectric materials, EBSD provides insight into the orientation and grain boundary character that intrinsically affect performance and are not easily observable by other methods. Using these tools can help designers improve the efficiency and performance of their materials.

TRAINING AND EVENTS

World-Wide Events

August 28 - September 2	EM-Conference	Kiel, Germany
September 6-9	EMAG 2011 Conference (Electron Microscopy and Analysis Group)	Uni of Birmingham, UK
September 7-9	JAIMA EXPO 2011	Chiba, Japan
September 25-29	11th Interamerican Congress on Microscopy	Mexico (with SIPROA)
October 13-16	BCEIA (The 14th Beijing Conference and Exhibition on Instrumental Analysis)	Beijing, China
October 16-20	(MS&T) The Materials Science & Tech. Expo.	Columbus, OH
November 15-16	(ISTFA) International Symposium for Testing & Failure Analysis	San Jose, CA
December 12-17	ICOTOM 16	Mumbai, India

***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)
- November 22-24 (T)

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

EDS Microanalysis: (Short)
- September 15-16 (T)
- November 10-11 (T)

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

WDS LEXS:
- October 11-13 (T)

Orbis:
- October 26-28 (W)

Pegasus (TEAM/EBSD):
- October 17-20 (W)

Japan

Microanalysis Courses:
- 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:
- October 10-14 Mahwah, NJ

EBSD :
- September 27-29 Draper, UT

Micro-XRF:
- October 4-6 Mahwah, NJ

EMPLOYEE SPOTLIGHT

Tomas Vikström joined EDAX in May 2005 as the Field Service Engineer in northern Europe, located in Stockholm, Sweden. He graduated from the University of Stockholm with a Bachelor's degree in Electronics. Prior to joining EDAX, Tomas worked as a Field Service Engineer at LECO. In May 1981 Tomas began working for Philips Electron Optics. After servicing Philips SEM's and TEM's for the first few years he was introduced to the EDAX equipment. In 1986 he began producing software for the EDAX equipment. From 1992-1996 Tomas worked in Germany with service, as well as continuing to produce EDAX software. From 1996-2005 he held the position of M2 Engineering, working on CD/DVD production machinery and travelling all around the world.

In his spare time when Tomas is not scuba diving he enjoys refining his sound and video multimedia system, occasionally also using it for constructing electronic devices. Tomas is also planning to take up an old hobby, motorcycles.

Arie Zuidam joined EDAX in August 2006 as a field service engineer and is based in the EDAX Tilburg office in The Netherlands. As a new EDAX employee he attended the sales and service meeting in Phuket where EDAX introduced their first Silicon Drift Detector (SDD) the Apollo 40. Initially Arie was responsible for the installation, repairs, and training in the Netherlands and Belgium. He is now responsible for supporting EDAX customers in the rest of Europe as well. Arie enjoys working with the distributors and OEM´s for the European region. In 2009 Arie installed the first Orbis system at Naturalis in the Netherlands.

Arie was born in South Africa where he lived for 11 years. He was raised in the Netherlands where he obtained a degree in Electronics Engineering. Arie worked for Böwe Systec prior to joining EDAX.

Arie lives with his wife Ingrid in the picturesque village of Duiven near the German border. On Saturdays Arie supports his daughter Anniko (11) when she plays hockey and also his son Danick (8) when he plays a football match. In his spare time Arie enjoys running with friends and attends some running events during the weekends.

Zentraleinrichtung Elektronenmikroskopie (ZELMI), Berlin

The Zentraleinrichtung Elektronenmikroskopie (ZELMI) is the comprehensive service and user facility of the Technical University Berlin (TU Berlin), responsible for research and education in the fields of electron microscopy and related physical analytical methods. The combination of complementary methods for the analysis of varying samples from all the different research groups in the TU Berlin is their specialty. The team analyzes a great variety of samples, including metallic, ceramic, and organic materials, geological samples, building materials and catalytic and layered nano material. They also do environmental analysis and examine nanoscopic and microscopic components from research, semi-conductor technology, and (bio-) medical engineering.

ZELMI has four Scanning Electron Microscopes (SEM) each one dedicated to one speciality: high throughput, large samples, low voltage or ultra high resolution. For accurate analysis some SEMs are equipped with additional detectors like EBSD, STEM or 4-quadrant-BSE. Materials may be studied on an in situ tensile/compression stage with EBSD by EDAX. The highest resolution is obtained by a cold field emitter SEM and a conventional 200kV-Transmission Electron Microscope. For the elemental analysis with EDX, several microscopes are equipped with SDD-systems supplied by EDAX. High-resolution elemental analyses are carried out on a new field emission Electron Probe Micro Analyzer (EPMA) with five crystal WDX-spectrometer. The elemental analyses are added using analytical light microscopy and μ-X-ray fluorescence.

Additionally comprehensive preparation tools for nearly all organic and inorganic samples to be analyzed by light microscopy, SEM, EBSD, EPMA and TEM are available including a focused ion beam Nano-workbench (FIB).

All equipment is installed in appropriate laboratories. The high and ultrahigh resolution microscopes use a new building specifically designed to minimize electromagnetic stray fields and mechanical vibrations even though the laboratory is situated in the middle of Berlin.

The crew of ZELMI.

Facility staff perform customer's orders, train investigators in the use of the equipment, teach students, and are involved in scientific research. Presently seven staff members specialize in one of the methods mentioned. ZELMI is in close collaboration with the "Electron microscopy and holography" chair of Prof. Michael Lehmann, who fills the management position of ZELMI as well. Dr. Dirk Berger is the Controller of ZELMI.

One way ZELMI partners with other working groups is in the Cluster of Excellence "Unifying Concepts in Catalysis" (UniCat) founded in 2007 within the framework of TU Berlin's Excellence Initiative. More than 250 chemists, physicists, biologists and engineers from four universities and two Max Planck research institutes are involved in this research network. UniCat is working on future-related research topics ranging from energy supply, including natural gas and bio-hydrogen, to the development of new agents. All these processes use catalysts in nano scale dimensions, which also have to be analyzed by the ZELMI working group.

Another example of good interactive team play at the TU Berlin is in the Metallic Materials department of the Institute for Material Science and Technology. The characterization of the material microstructure, its defined optimization during the fabrication process (mainly hot extrusion) and the assessment of macroscopic properties are the focus of the research work, requiring analysis of the chemical composition by EDX and of the microstructure by EBSD measurements.

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