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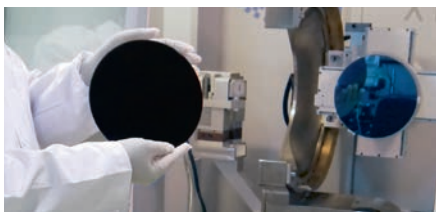
10 years



The Analytical X-ray Company

PANalytical software –

heart and soul of our analytical X-ray systems

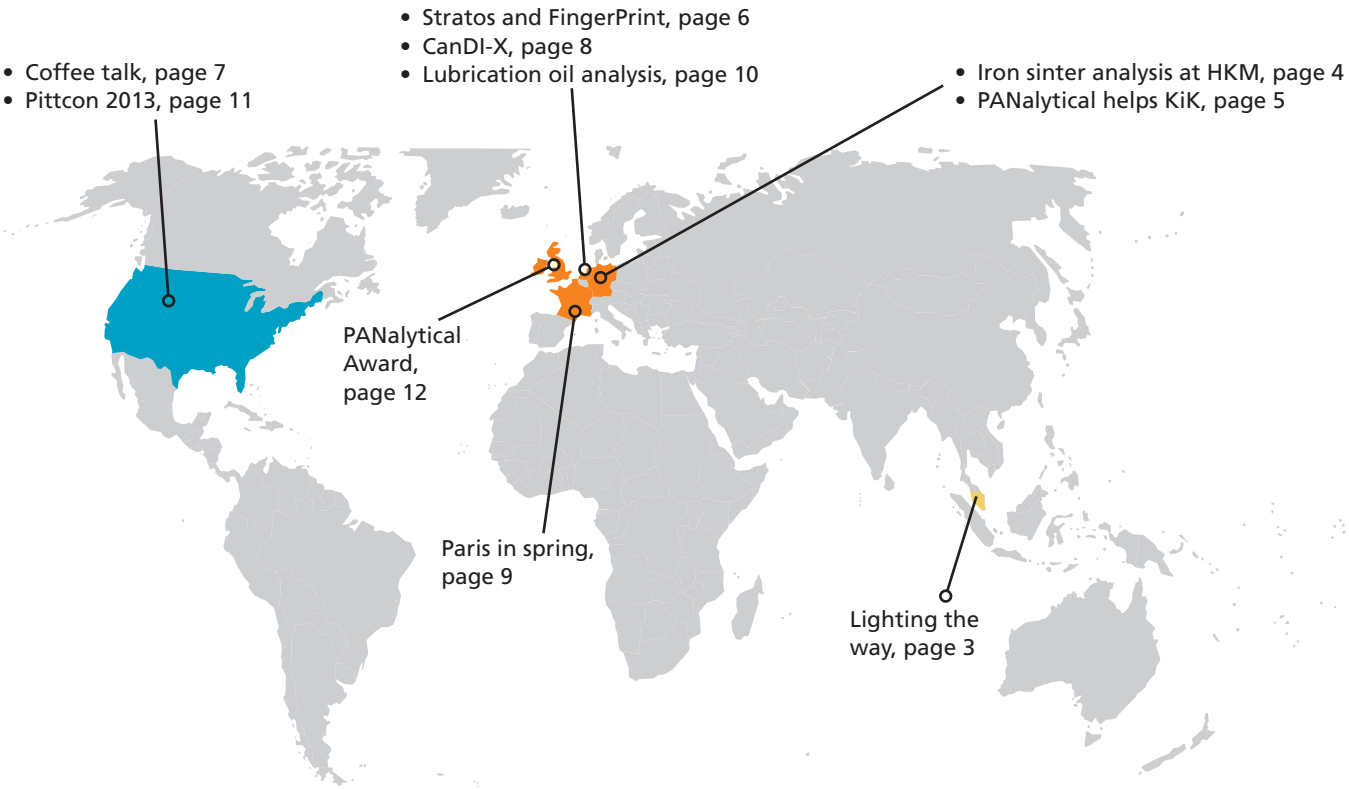
Welcome to this latest issue of X'Press

In today's environment without software even the most advanced technology effectively is quite useless. Hidden inside every PANalytical instrument is multi-layered advanced software for mechanical and radiation safety and for instrument operation and control; this software, although very important for the instrument behavior, usually is not much visible to the end user. The user software, on the other hand, is not only the main interface between the instrument and its user but also to a large extent determines the user experience, the processed analytical results and thus the overall satisfaction with our solutions and services.

Since the early days PANalytical has recognized the importance of software for its instruments. Already in the 1970s we were the first to launch a system with a microprocessor, enabling an online data processing unit. Nowadays we offer with all our instruments software that is simple and easy to use, features built-in intelligence, automation possibilities and convenient navigation, while also providing you best-in-class analytical results. The vast majority of our software is programmed and tested in-house by dedicated specialists, combining our in-depth analytical expertise and latest software technology into the ultimate user experience.
In this issue of X'Press we focus on a number of software applications and new releases such as Stratos for multilayer analysis and FingerPrint for fast determination of substances. Prof. Chuck Taylor of Pomona College in Claremont (USA) describes how he uses principal component analysis for a very practical course about XRF analysis, applying the fingerprinting technique to various brands of coffee for identification. X-ray diffraction on the other hand enables rapid identification of complex street drugs by employing the new CanDI-X database together with the HighScore software.

I hope you enjoy the variety of applications in this latest issue of X'Press. For more information, application notes and other support you are welcome on our website, www.panalytical.com

With best regards,
Peter van Velzen



PANalytical

Lighting the way:

XRD helps IMRE to develop cost-effective GaN-on-silicon LEDs

LED lightbulbs are central to modern lighting, with a lifetime of up to 50,000 hours and far higher efficiency than compact fluorescent bulbs. However, LEDs are relatively expensive, due to the high cost of the gallium nitride (GaN) based chips inside each bulb. To address this pricing problem, extensive research is being undertaken into the way that GaN epitaxial layers are grown, with the aim of replacing the sapphire substrates widely used at present with silicon substrates. XRD technology from PANalytical is playing a crucial role in this process at one institute in Singapore.

A*STAR Institute of Materials Research and Engineering

Using silicon substrates in place of sapphire will significantly reduce LED production costs, due in part to the much lower price of this material. Moreover, silicon substrates can produce large scale 200 mm wafers, which may then be processed cheaply in the many under-utilized 200 mm foundries around the world. However, the commercialization of this alternative method has been hindered by the considerable challenges presented by growing GaN on silicon. A significant mismatch between the lattice constants and thermal expansion coefficients of the two materials create a strain which can make the GaN epitaxial wafer crack and bow, producing an unusable result.

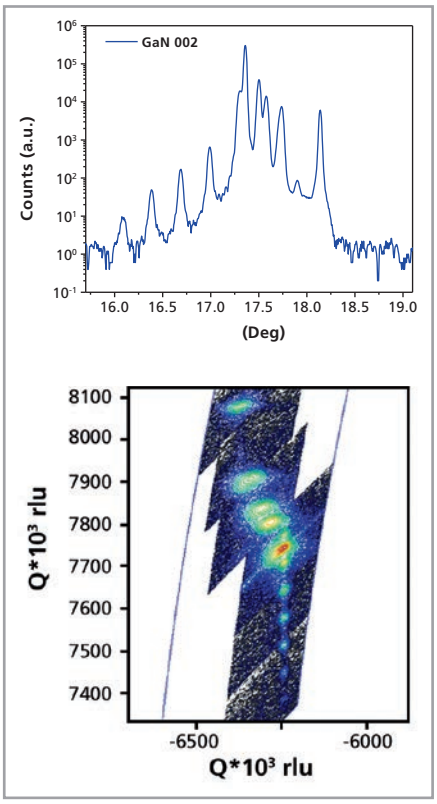
LED chipmakers around the world are attempting to improve the epitaxial quality on large silicon areas, focusing on the addition of an exceptional AIN nucleation layer and a combination of buffer and interlayers. The Institute of Materials Research and Engineering (IMRE), which operates under the umbrella of the Agency for Science, Technology and Research (A*STAR) in Singapore, has made significant progress in this field. IMRE researchers have successfully grown and characterized GaN-based blue LED structures on 200 mm diameter (111)-oriented silicon substrates.

In order to monitor the crystalline quality of LED epiwafers during the growth process, IMRE use PANalytical's X'Pert PRO MRD XL, an advanced X-ray diffractometer. The MRD XL is perfectly suited for this analytical challenge, delivering complete 200 mm high-resolution XRD wafer mapping and fast reciprocal space mapping (less than 30 minutes) with the high-end solid-state PIXcel detector. These maps indicate the uniformity of both substrate wafers and the hetero-epitaxial layers grown upon them, by measuring substrate and layer peak position, width and intensity, composition and strain.

Additionally their MRD XL has been equipped with X-ray reflectivity capabilities to measure the thickness, roughness and densities of epitaxial layers. XRD measurement spots may be varied to obtain a clear picture of crystal quality anywhere from the center to the edge of the 200 mm wafer.

Dr. Sudhiranjan Tripathy at IMRE says, "*The XRD equipment from PANalytical is vital to our work. The highly accurate data that the MRD XL provides has helped us to address the key problems in using silicon substrates. The flexibility of the XRD system has also been extremely helpful throughout this process, and should continue to help us in our efforts to develop a stable and reproducible mass manufacturing of GaN on silicon process.*"

The MRD XL plays a crucial role in current production, and is also prepared for future trends; for instance, its large sample stage is already equipped to handle the current shift towards 300 mm wafers.



Top: HRXRD omega/2theta scan of a full InGaN/GaN LED structure on a 200 mm diameter silicon wafer
Bottom: The XRD reciprocal space map around the (1-1-4) GaN Bragg point of the full LED structure showing high-quality multi-quantum well interfaces

PANalytical's Epitaxy software for the analysis of thin layers

Iron sinter analysis at HKM (Germany)

Hüttenwerke Krupp Mannesmann

HKM (Hüttenwerke Krupp Mannesmann GmbH) is one of the biggest German steelwork companies and is located in Duisburg, the steelmaking heart of Germany's industrial Ruhr region. With its 3,200 employees, the company produces more than five million tons of steel each year. This is nearly 1/8 of all crude steel produced in Germany. HKM's portfolio includes more than 1000 different steel types. Their special focus lies on environmentally conscious production processes.

Measurements and reporting by PANalytical's Industry software, automatic phase refinements by RoboRiet

HKM uses two blast furnaces to produce the hot metal (liquid iron) for the steel shop. Iron ore input materials for these blast furnaces are sinter, pellets and lump ore. Sinter is produced from fine ores, coke breeze, recycled materials (as BF top dust) and fluxes like limestone or olivine. The sinter process takes place on a sinter strand where the mix is piled in a layer of 500-600 mm of height. The top layer is heated to more than 1350 °C and ignited.

Air is sucked through the sinter mix by a low-pressure system and simultaneously the burning coke breeze front moves through the sinter mix from top to bottom, delivering the necessary energy for sintering. The input materials are heated close to their melting points. The outside of the different particles and agglomerates melts and porous lumpy chunks are formed after cooling, the so called sinter.

HKM produces 4.9 million tons of sinter each year. With an average coke breeze consumption of 48.1 kg/t of sinter during the last years, even a slight overdosing of coke breeze is very costly. Furthermore, the quality of the sinter is decreasing if coke breeze is over- or under-dosed.

A well-known parameter to determine the right amount of coke breeze in the sinter mix is the Fe_3O_4 content (simplified Fe^{2+} or FeO content) in the sinter produced. Traditionally, wet-chemical analysis is used to determine the Fe^{2+} content. At HKM, hourly analyses were performed with a less accurate magnetic scale, which was calibrated once per day by wet chemistry. Nevertheless, the results were not always satisfying and HKM decided to use the advanced method of today: sample analysis by X-ray diffraction.
This method does not only reveal the amounts of all existing phases in the mixture but also the exact concentrations of Fe^{2+} and Fe^{3+}. Figure 1 shows the development of the FeO content during 9 sinter samples. The wet-chemical analysis corresponds well with the XRD results, while the magnetic scale shows some outliers.

Therefore HKM has recently invested in a fully automated laboratory provided by FLSmidth and is now equipped with a brand-new CubiX^3 XRD system and an Axios XRF spectrometer including applications for the automatic analysis of their sinter material.

Samples are automatically taken every 30 minutes from the sintering plant. They are transported by an air tube, prepared for X-ray analysis and finally entered into a PANalytical CubiX^3 Iron system for a scan. Subsequent Rietveld analysis delivers the Fe^{2+}/Fe^{3+} results within minutes without further operator intervention, indicating very precisely the quality of the actual sinter material without the delay of the traditional methods. The automated sample taking, transport and the subsequent sample preparation, including fully automated sample handling, in the Robolab has been delivered by FLSmidth Wuppertal GmbH.

Now coke breeze addition is much more accurate and a better sinter quality with much lower coke breeze consumption are achieved.

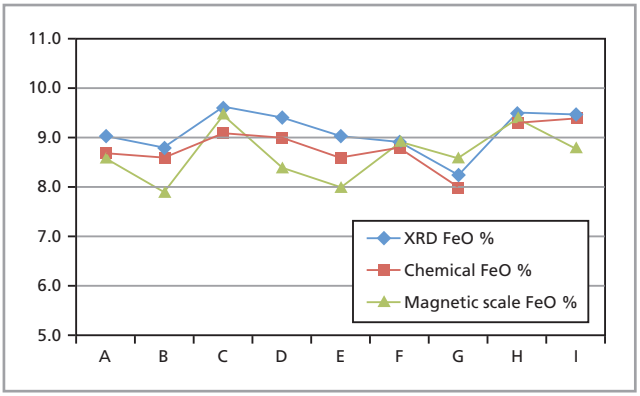


Figure 1.
Comparison of the FeO content determined by XRD, wet chemistry and magnetic scale

Figure 2.
Hot sinter is transported into the sinter coolers.

PANalytical helps KiK to maintain exceptional quality with the Epsilon 3

KiK is a German-based clothing provider, which also offers a wide range of gifts, household textiles, accessories, toys and stationery. KiK ranks among the top ten largest suppliers in the national retail sector with around 3,200 branches in Europe and over 20,000 employees.

A combination of high-quality products and attractive prices is the secret to KiK's success. Products are constantly evaluated to ensure the highest possible standard of quality.

Customer safety is central throughout the manufacturing process. It includes obligatory quality specifications agreed with the supplier, quality control undertaken during production by externally accredited testing institutes and the final chemical and physical spot checks completed by the KiK central lab in Germany.

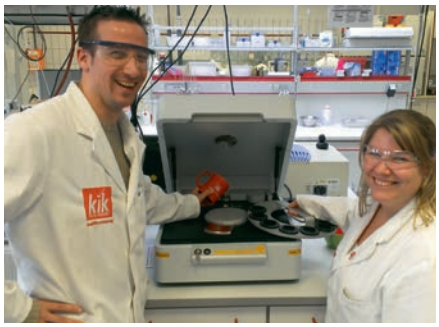
In addition to physical tests, the products are put through a range of checks to ensure that they do not contain any chemicals that might be harmful to human health or the environment. For example, all items are screened for metals, such as nickel, and other toxic elements.

Obtaining quantitative information about the materials in KiK's products is problematic, particularly since they range from baking pans to intricate T-shirt prints. Because the products vary significantly in size, KiK must screen both small and large samples on a daily basis.

X-ray fluorescence spectrometry (XRF) offers the ideal testing solution for KiK's requirements. Sample preparation is very straightforward, as samples only have to fit in the sample chamber, and quantitative results are delivered by a standardless program.
The Epsilon 3 XRF spectrometer offers additional advantages: its small size is of particular value to KiK, because of the limited lab space available.
The Epsilon 3 can also accommodate a whole range of sample sizes, including whole coffee cups, in its large sample mode.

The Omnian standardless software program allows an increase of performance by using customized or reference materials such as plastics. This provides a better idea of the real chemical environment of each sample leading to better (semi)-quantitative results. Every item is pre-checked for relevant candidate elements. If any banned substances are detected their solubility will be tested using product-specific given methods.

The rigorous quality control testing that KiK conducts on a daily basis presents a tough analytical challenge, but the advanced Epsilon 3 makes life much easier for their lab.



PANalytical's Omnian software - the benchmark for standardless analysis

Stratos and FingerPrint:

new software modules designed with the user in mind

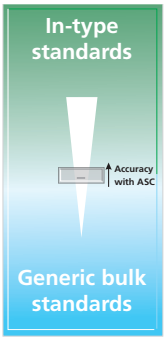
PANalytical has recently launched Stratos and FingerPrint, advanced software modules specifically designed to make users' lives easier. Stratos and FingerPrint complement the Axios and Epsilon 3 XRF spectrometer ranges, matching advanced hardware with powerful software. Both modules have been tailor-made for particular application areas, and, together with an XRF spectrometer system, combine sophisticated analysis with simple operation.

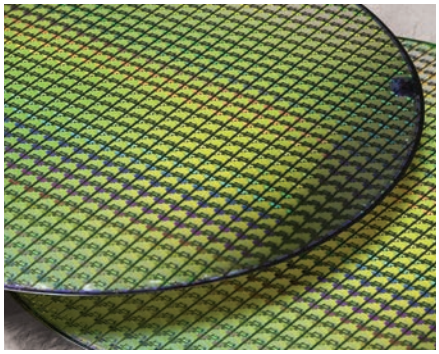
STRATOS

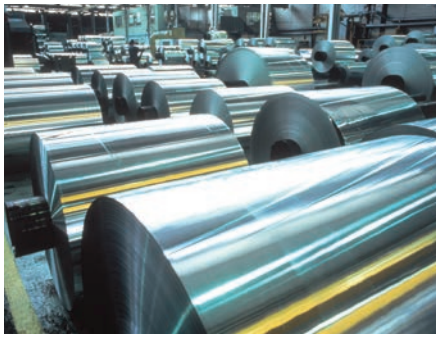
The Stratos software module enables simultaneous determination of the chemical composition and thickness of layered materials. In combination with the Axios and Epsilon 3 ranges of spectrometers, Stratos provides the rapid, non-destructive analysis of coatings, surface layers and multi-layered structures. This is ideally suited to applications ranging from measuring aerospace coatings to the thickness of gold plating on jewelry.

With Stratos, accurate results can be obtained using only conventional bulk standards as reference samples, eliminating the expense of acquiring costly certified multi-layer standards. Moreover, accuracy can be further improved by adding in-type standards to the main calibration using adaptive sample characterization (ASC).

The Stratos module combines this superior performance with ultimate ease of use. Operators do not need XRF expertise, thanks to the unique Virtual Analyst tool which uses a given sample structure to calculate the optimal conditions for XRF analysis. This avoids time-consuming trial and error experiments to set up complicated applications. Stratos is able to analyze more than 16 layers, depending on their composition.



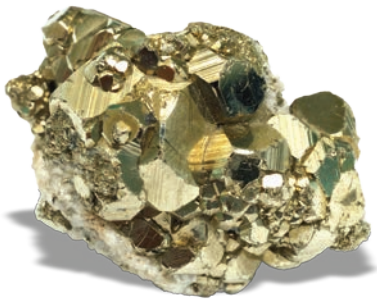




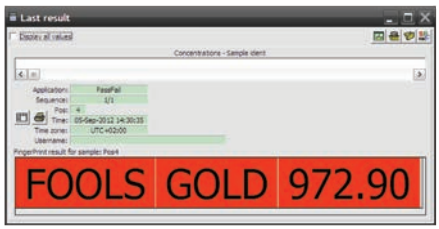
FINGERPRINT

The FingerPrint software module has been updated to closely match users' needs. Operating with the Epsilon 3 EDXRF system, the FingerPrint program is ideal for material testing where the actual composition is not of importance, but analysis speed is vital. The system delivers simple PASS/FAIL reporting, eradicating the need for review by an XRF expert. FingerPrint offers total analytical flexibility, as users may select principal components analysis (PCA) or spectrum- or concentration-based analysis. Any further review of results can be conducted using PCA and cluster analysis, which can be used to generate 3D graphic visualizations of the data set.

With FingerPrint, there is no need to purchase expensive standards, as typical samples will work, and setup is faster and easier than conventional calibrations.



The FingerPrint module has applications in many areas, including quality control of both incoming goods and final products, the monitoring of heavy machinery to anticipate equipment failure and the identification of authentic and counterfeit materials.



PANalytical's Stratos software for layer thickness and composition analysis
FingerPrint software for instant material identification

Coffee talk

Pomona College in Claremont, CA, 35 miles east of downtown Los Angeles, is one of the pre-eminent liberal arts colleges in the United States, with a world-class faculty and a student body drawn from across the nation and around the world. Known for academic innovations, Pomona emerged as an early leader among liberal arts colleges in preparing students to excel in the natural sciences. Today, Pomona continues to innovate with a range of interdisciplinary programs that bridge the traditional boundaries between academic fields.

Chuck Taylor, associate professor of chemistry at Pomona, continues this tradition of preparing students to excel. In his analytical chemistry class, his students perform research using a wide variety of analytical instrumentation, including X-ray fluorescence on a 3 kW PANalytical Axios sequential XRF spectrometer. The course includes statistics and chemometrics, enabling students to analyze and observe correlated variables in large data sets. In one such experiment, students analyzed 40 samples taken from 10 different types of coffee, to determine whether the trace elements could be used to identify coffees' origins.

In addition to learning about the XRF technique and sample preparation, the experiment also showed the power of elemental analysis combined with chemometrics to potentially be employed as a tool to verify product authenticity. "We prepared the samples like soil samples, oven drying at 85 °C and mixing five grams of finely ground coffee with one gram cellulose binder and pressed in aluminium sample cups. Each can of coffee was assigned a different number" described professor Taylor. Once collected, the data were then analyzed using principal component analysis (PCA) to determine if the four replicates of each coffee would form unique, discernible clusters in principal component space.

The plots below are the summary output for the PCA and include the scores and loadings plots for the ten roasted coffees. Professor Taylor explained "prior to filtering out the trace elements that were scattered around the method's detection limits for those elements, PC-1 explained about 59% of the variation and PC-2 explained 19% so it was instructive (and analytically beneficial) for the students to take the lower limits of detection into account. "Removing the data without valid information content greatly improved the clustering in principal component space, causing all ten samples to be clearly grouped and the overlap between different coffee samples was no longer present. Also based on the analysis, the three most important elements used to distinguish the coffee samples are Mn, Rb and Br.

Professor Taylor noted that this experiment was "a nice demo application for people interested in food analysis by XRF. The down side was that the lab smelled like coffee." I don't know, that actually sounds pretty good …

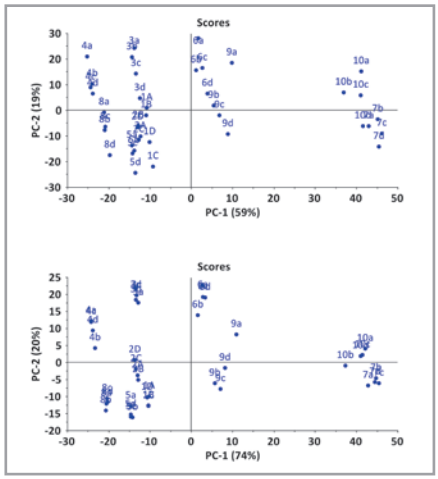


Figure 1. Plots of PC-1 vs. PC-2 before (top) and after (bottom) removing elements below method LLDs

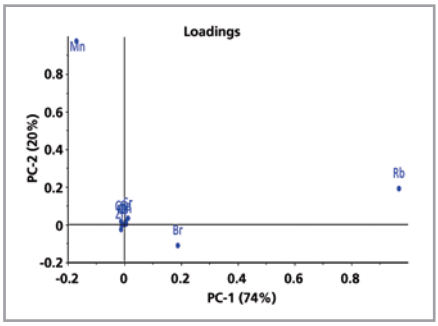


Figure 2. Loadings of plot for PC-1 vs. PC-2 and after removing elements below method LLDs

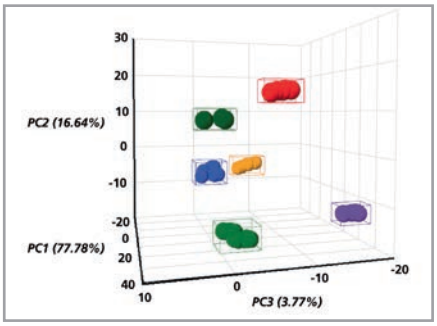


Figure 3. PCA plot in FingerPrint showing six distinct clusters

Principal component analysis is available in three of PANalytical's analysis software packages:

- **HighScore** and **HighScore Plus** – software for XRD data analysis, and also for data from many other types of instrumentation (e.g. Raman spectroscopy, XRF, NIR, etc.) for cluster analysis with PCA plotting capability
- **FingerPrint** – this software, available for Epsilon 3 range systems and MiniPal systems, now includes PCA plotting in the latest version released in 2013.

Easy and fast analysis of complex street drugs

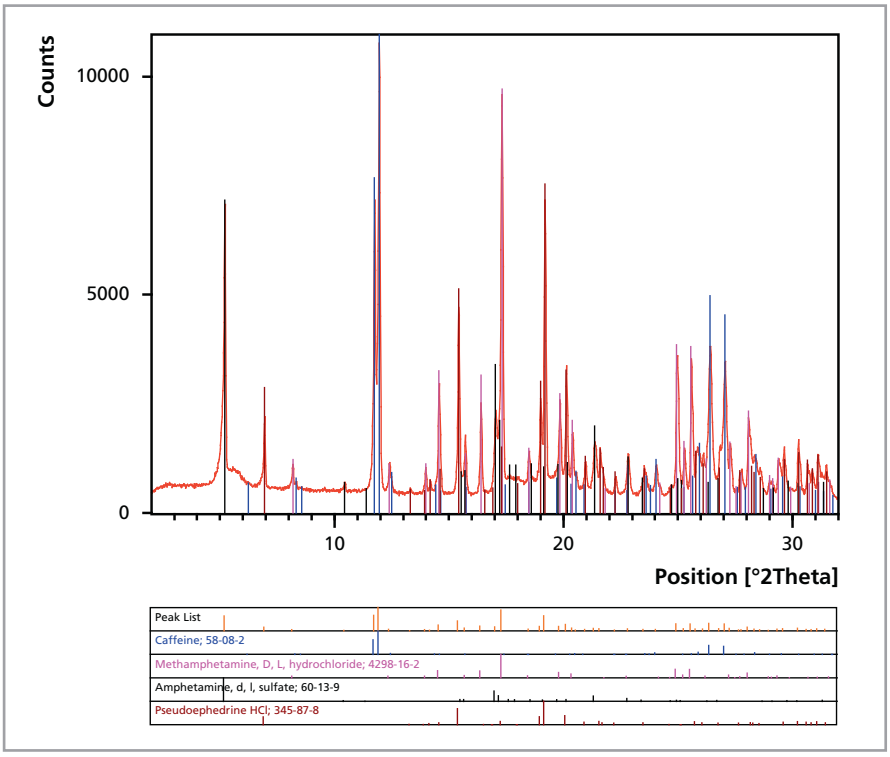
CanDI-X, PANalytical's database for controlled-substance and drug identification by XRD, was presented to the public at Pittcon 2013. It is the world's first XRD database dedicated to controlled substances and contains more than 550 substances for forensic criminal drug analysis.

X-ray diffraction (XRD) is an established analysis technique to confirm the identity of crystalline materials and it is widely accepted by courts of law. A growing number of institutions is using the technique as a class A method for controlled substances identification. These substances come in various forms, as powders, tablets or emulsions. XRD allows the analysis of the crystalline components even in difficult matrix types, for example cocaine blended in a cream.

Even multiple active ingredients in complex drug mixtures can automatically be identified. It is only a matter of recording the X-ray diffraction spectrum of the mixture in transmission geometry. Subsequent analysis of the resulting pattern with the search-match routine of PANalytical's HighScore software, together with the CanDI-X database delivers the result within minutes. An additional advantage is the fact that the sample material is not altered by XRD analysis and can still be used as evidence in court. Usually milligram quantities are needed and the time for a scan is typically 5 to 15 minutes.

All reference patterns were recorded at a regulated professional lab (Drug Analysis Services Health Care Canada) and reviewed by a team of crystallographers resulting in high-quality entries with supporting information.

CanDI-X (Controllled substances **and** Drug Identification by **X**-rays**) runs exclusively under PANalytical's HighScore (Plus) software, version 3.0e or higher.**



Each of the phases in a complex mixture provides a unique fingerprint and can thus be identified by XRD (methamphetamine•HCl, amphetamine•SO_4 and pseudoephedrine•HCl, together with a large amount of caffeine). These substances would normally cause interferences in standard chromatography.

With the aid of the PANalytical CanDI-X, it is possible to positively identify controlled substances, their precursors and additives nondestructively, within minutes. See how it works in our data sheet 'Easy and fast analysis of complex street drugs'.

Paris in spring - Epsilon 3 visits the Paris coin museum

An Australian team exploring the origins of the silver used to produce ancient Greek coins has taken a PANalytical Epsilon 3 EDXRF spectrometer to one of the most famous numismatic collections in the world, housed in Paris at the Bibliothèque nationale de France. Professors Damian Gore, Kenneth Sheedy and Dr. Gil Davis, all from Macquarie University in Sydney, are using the Epsilon 3 EDXRF to measure the silver and trace elements, particularly gold and bismuth, in Athenian coins made during the 6th and 5th centuries BC.

To help understand metal usage in ancient Greece, the archaic Athenian coins held in the world's major museums (estimated to be well over 1,000 coins) are analyzed. The earliest Greek coins, the Wappenmünzen (or 'shield coins', so named because of the shield-like pattern on one side) are recognized to be of rather variable metal quality as the silver came from a number of sources. As the ancient Greeks discovered then exploited the incredibly rich Laurion silver deposit close to Athens, the quality of the coin metal improved and became very consistent, with very little gold, lead or bismuth.

The question is how much precious metal came from the Laurion mines, and where else did the Greeks get their silver? What role did the Laurion mines play in the development of the ancient Greek state, and thus modern democracy?

The critical advantage of PANalytical's Epsilon 3 EDXRF spectrometer for this research is that it is high power yet still transportable, allowing high-resolution, non-invasive measurements to be made at the collections.
It would not be permitted for these irreplaceable coins to leave the security of the museums to travel for any type of analysis elsewhere.

The Cabinet des Médailles, now a department of the national library but recognized as the oldest museum in France, is the repository of the French national numismatic collection. Among its vast and exceedingly rich holdings are an estimated 110,000 ancient Greek coins. Permission to undertake the XRF analyses of over 180 coins in the Cabinet was generously given by the Chief curator, Professor Michel Amandry and by the Curator of the Cabinet's Greek Collection, Dr. Frédérique Duyrat.

The research is showing that the ancient Greeks were exceptional metallurgists for their time with quite pure coins and consistent quality. Initial interpretations show that many of the coins being measured have probably come from the Laurion mines near Athens with only a minority coming from other sources.

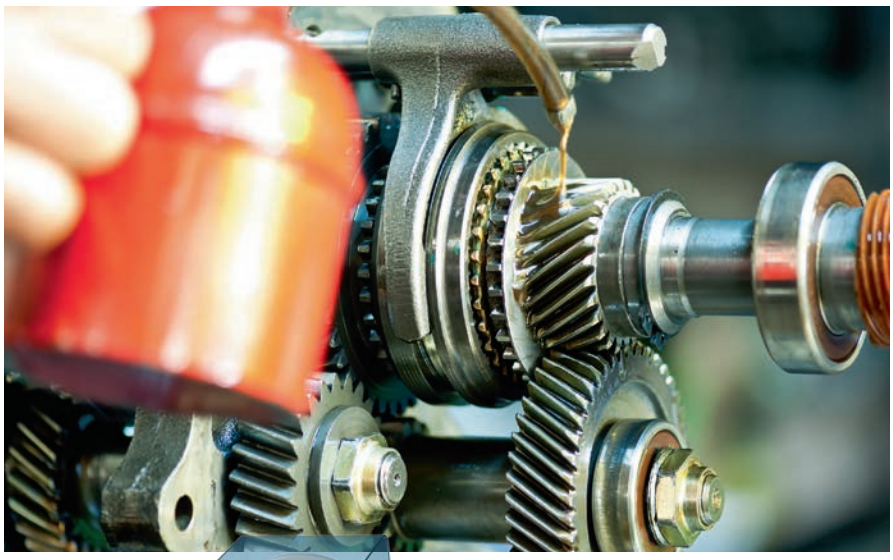
However, a relatively high bismuth concentration is a good indicator of coins having metal sourced further east into Asia, and coins with greater gold content are believed to have metal sourced from other mines closer to Athens. The research is ongoing to help define these patterns further.

Ancient Greek Wappenmünzen coins, like those tested in Paris. These 6th-5th century BC coins are amongst the earliest silver coins known. (Image: BnF, Paris)

From left to right: Prof. Michel Amandry, Dr. Frédérique Duyrat and Dr. Louis Brousseau with Epsilon 3 in Paris

Compliant and beyond: lubrication oil analysis from PANalytical

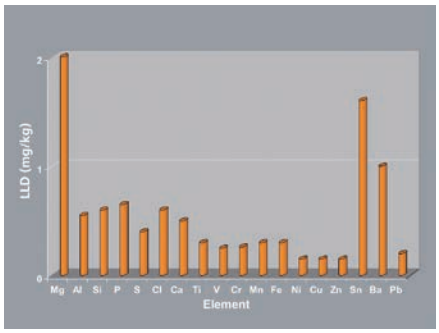
Lubricants are substances interposed between two moving surfaces in order to reduce the friction between them. Lubricants are usually liquids, consisting of 90% base oil and 10% chemical additives, which enhance lubricant properties by improving viscosity or resistance to corrosion. The most common lubricants are petroleum-based, but vegetable oils and even non-liquid substances such as grease, air cushions and powders are also used.



The largest application area for lubricants is powered machinery. By separating moving parts, lubricants reduce friction and surface fatigue to protect components and allow machines to operate effectively for an extended period. Lubrication oils also provide crucial information about the condition of machinery, through the wear metals that they contain. Wear metals are minute particles of metal suspended within the lubricant, formed by friction, abrasion or corrosion. Analyzing the quantity and type of wear metals allows users to determine the condition of individual components and to act ahead of any breakdown, saving downtime and money.

While inductively coupled plasma (ICP) techniques are conventional for lubrication oil analysis, XRF offers significant time and cost savings. PANalytical has designed two advanced solutions to make the analysis of wear metals, and used and unused oils, as easy and cost-effective as possible: the compact, portable Epsilon 3 XL and the high-throughput Axios range, complete with large capacity sample changer. Norm compliancy is made easy, as both packages offer out-of-the-box ASTM compliance, with analysis templates, calibration standards and performance test samples. There is almost no sample preparation; oil is simply poured into pre-assembled PANalytical liquid cups, ensuring optimal reproducibility and repeatability. Moreover, XRF offers the advantage of non-destructive analysis without memory effects.

The powerful Axios range of spectrometers require minimal maintenance, with just one calibration lasting for months, thanks to the exceptionally stable proprietary SST and SST-mAX X-ray tubes from PANalytical. Oil-Trace software and standards provide highly accurate results for both used and unused oil using only one calibration, delivering a large reduction in investment in Certified Reference Materials.



Typical $LLD_{(100\ s)}$ for wear metals in oil using 6 µm polypropylene film

The rugged Epsilon 3 XL may be placed on the exact site of analytical need, as it weighs only 43 kg and meets the toughest safety regulations. This outstanding robustness is combined with exceptional analytical performance, with a detection limit of 10 ppm or better for common elements and a sophisticated FingerPrint software module. With the Epsilon 3 XL and the Axios range, PANalytical provides a lubrication oil analysis solution for all requirements.

Oil-Trace for universal elemental analysis of fuels, oils and their derivatives

One decade of BMA

10 years

2013 saw the 10th anniversary of the Building Materials Analysis (BMA) workshop, organized by the research group of Prof. Pöllmann together with PANalytical. This biannual, three-day event was organized for the 6th time at the Martin Luther University Halle-Wittenberg in Germany.

The 29 contributions covered topics such as: new applications for the analysis of normal and special cements; the importance of sample preparation for characterization; and sustainability, CO_2 reduction and the use of alternative fuels. Highlight was a practical session on the quantification of special cements using HighScore Plus, led by PANalytical's Dr. Füllmann and Dr. Witzke. Participants got instructions on how to set up a quantification of special cements in HighScore Plus all the way to a demonstration of a fully automated quantification solution for routine analysis in cement plants.

BMA 2013 was very successful again with fruitful discussions and information sharing between the participants working in the various areas of the building materials industry.
We are looking forward to BMA 2015!

78 participants from 12 countries out of 5 continents, coming from the cement industry, suppliers and academia, made the course an ideal platform to share information and new ideas.

Pittcon 2013

The Pittsburgh Conference, aka Pittcon took place in March 2013 at the Pennsylvania Convention Center in Philadelphia, PA.

PANalytical's new booth showcased an impressive number of instruments such as an Axios WDXRF spectrometer, the Eagon 2 fusion system, the Empyrean XRD platform as well as the X'Pert Powder and additionally ASD LabSpec4 NIR instruments.

Visitors were challenged to a Philadelphia beer tasting that demonstrated the FingerPrint software capabilities in conjunction with the Epsilon 3 XL EDXRF benchtop instrument. This was a welcome bit of constructive fun where several tasters stayed on to explore the further capabilities of the instrument.
The new controlled-substance database software package CanDI-X was presented at a general seminar on day 1 of the show. Later during the week a few in-booth seminars, e.g. about non-destructive XRF elemental analysis for pharmaceutical impurities in accordance with USP232, drew crowds of attendees and members of the press.

During the conference PANalytical was happy to welcome many loyal customers as well as new prospects - thanks for visiting! We hope to see you again at Pittcon Chicago 2014.

Events calendar 2013 Q2/Q3

You will find us at the following events during the upcoming period. If you attend any of these events, please pass by and visit us!

Date	Event	Location
June 23-26	EMC 2013	Weimar, Germany
June 24-27	IWPCPS	Philadelphia, PA, USA
June 30-July 5	ICMAT 2013	Suntec, Singapore
July 1-3	17. Tagung Festkörperanalytik	Chemnitz, Germany
July 9-11	Semicon West	San Francisco, CA, USA
August 5-9	62nd Denver X-ray Conference	Westminster, CO, USA
August 12-14	Iron Ore 2013	Perth, Australia
August 23-25	Dairy Tech India, 2013	Bangalore, India
August 25-29	ECM 28	Warwick, UK
September 4-6	JASIS 2013	Makuhari Messe, Japan
September 24-26	Analitica Latin America	São Paulo, Brazil

Please visit www.panalytical.com/events for more information.

PANalytical Award presented to Dr. Thomas Bennett

On 7 May 2013 the first PANalytical Award was presented to Dr. Thomas Bennett in Cambridge (UK) where he is on the research staff. The happy winner received a certificate, the trophy and a cheque of € 5000.- from the hands of PANalytical's Dr. Jan Gertenbach (right) in the presence of Prof. Christian Lehmann (left). Prof. Lehmann (Max-Planck-Institut für Kohlenforschung, Mülheim, Germany) was a member of the judging panel that scrutinized all of the submissions.

Dr. Bennett was acknowledged with the award for his publication 'Structure and Properties of an Amorphous Metal-Organic Framework' as reported in the last issue of X'Press.

Colophon

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