Editorial

Dear Readers,

Over the past year, FISCHER not only maintained a strong position in world markets, it even expanded its market penetration. A look at the industry as a whole reveals that this success cannot be taken for granted. Therefore, as a company with a global presence, it is all the more important that we remain true to our original values. We at FISCHER develop and manufacture clearly superior measuring instruments in our own factory in Germany.

Our newest and largest production facility in Sindelfingen/ Maichingen became fully operational during the second half of 2015. We have once again invested in the latest manufacturing technology for this facility and now benefit from even better product quality and higher productivity with which to serve our customers.

FISCHER has also re-oriented its corporate management. The future of Helmut Fischer AG is now in the competent hands of Bernhard Schuler, Dr Felix Lustenberger and Dr Wolfgang Babel.

Of course, this issue of FISCHERSCOPE once again presents you with interesting articles on current topics in measurement technology. Prepare to be surprised!

FISCHER INSTRUMENTATION ELECTRONIQUE:
40 years of success – and continuing!

March 2016 marks a significant milestone: Fischer Instrumentation Electronique (FIE) in France is celebrating its 40th anniversary. Like all success stories, it started small: in 1976 a single dealer was promoting and selling FISCHER instruments in France. However, the growing French market was so promising that it really deserved more. FISCHER Switzerland then took a far-reaching decision that would change the course of the company forever: it founded FIE as its first subsidiary. Right from the beginning, FIE proved prosperous and has since served as the model for establishing several other subsidiaries all around the world – now 14 in total.

In 1985, with the release of FISCHER’s revolutionary X-RAY product line, FIE left its initial offices in a residential building west of Paris for new premises near Versailles that offered the thriving operation more room to manoeuvre. And it was urgently needed, because the X-RAY instruments required advanced logistics and service concepts. Since then, FIE has sustained its growth and now occupies 425 m² of floor space, as well as a local office near Lyon that was also opened in 1976.

From its humble origins as a pioneering start-up FIE has developed into a premium-class enterprise. Over the years, FIE has continuously modernised its activities around a customer-centered approach. Thierry Vannier, General Director of FIE, explains: “Today, customer support is more important than ever. Like everywhere at FISCHER, we focus on premium services for our clients. In addition to our precise metrology instruments, providing excellent customer service is the key to our success.” FIE has also played a leading role within the company in realising innovative models for customer support.

The entire FISCHER Group wishes to congratulate FIE on its first 40 years of business. Now, let us tackle the next 40!
For centuries, gold and silver have played double roles as materials of outstanding beauty and value. Accordingly, besides industrial applications, the uses of gold and especially silver extend beyond jewellery to encompass everyday items such as cutlery, vases, tableware and cultural objects. Every year, thousands of tonnes of silver are processed for manufacturing a diverse array of decorative and useful items. Most used articles find their way back into the melting pot to be processed into new works of art.

This is one reason for the heterogeneous alloy landscape in Asia. While silver alloys with 80% or 92.5% silver (sterling silver) are typical in Europe, silver alloys with admixtures of copper, cadmium, tin, zinc and other elements are also used in Asia. Because of the value of silver, demand is high for determining its fineness as precisely and non-destructively as possible.

FISCHER accomplishes this task by combining a precise measurement procedure, such as X-ray fluorescence (RFA), with appropriate calibration standards that ensure the accuracy of the measured values. The catalogue of alloy standards has therefore been expanded to include 14 silver alloys and is consequently even more well-adapted than ever to the Asian market. The silver content of the alloys, which contain up to three additional elements, ranges from 25% to 99.5%.

Producing reference materials for the analysis of precious metals is challenging. The highly purified metals (purity ≥99.99%) are first alloyed at the desired composition for the new standards. FISCHER guarantees the accuracy of the certified values through a DIN EN ISO/IEC 17025 accredited procedure. These samples are initially analysed with RFA. As a surface-sensitive procedure, RFA is very sensitive to inhomogeneities in the material. Both the homogeneity along the surface and possible concentration gradients with depth are therefore recorded in a complex series of tests in the FISCHER calibration laboratory. In addition, micro-homogeneity is evaluated on the surface by means of electron microscopy and with energy-dispersive RFA. A portion of the samples is referenced for silver fineness through an independent, highly accurate procedure such as potentiometry. Thus the new standards achieve a very low uncertainty of less than 0.03% for the absolute silver content.
Determination of Mechanical Properties of Optical Lenses and Lens Coatings by Instrumented Indentation Testing

In combination with exacting calibration standards, the high degree of repeatability achieved by RFA ensures both trust in the analysis results and confidence in a sensitive area in which not only the beauty, but also the value of the material plays a role.

Dr Jörg Leske

Scratch-resistant protective coatings are important for plastic lenses (image courtesy of Rodenstock).

The demands on the surface properties of optical components have increased significantly in recent years. Highly complex coating systems have been developed in order to produce scratch-resistant, stain-resistant, anti-static or reflective surfaces. Quality control for these coatings requires correspondingly high-performance measurement procedures and systems.

Both in the development phase and during the subsequent quality control phase of the manufacturing process, these coatings can be optimally characterised with the PICODENTOR® HM500. Material parameters such as the Martens hardness, Vickers hardness or penetration modulus can be determined in conformance with standards. Even thin coatings of less than 1 micrometre can be measured accurately with instrumented indentation.

In the following account, the scratch resistance of coated optical lenses was determined on four samples from different production batches by means of instrumented indentation. The lenses were measured in 10 places with a maximum test load of 15 mN and a total time of 30 seconds. The usual hardness for these protective layers is approximately 50 N/mm², which corresponds to a penetration depth of about 4 µm for a 15 mN test load.

RFA results of an alloy containing 66.36% silver and 25.00% cadmium, which has been calibrated with the new standards, exhibit excellent agreement.

Scratch-resistant protective coatings are important for plastic lenses (image courtesy of Rodenstock).

**Table:**

<table>
<thead>
<tr>
<th>Measurement No.</th>
<th>Ag [%]</th>
<th>Cd [%]</th>
<th>Cu [%]</th>
<th>Zn [%]</th>
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<tr>
<td>1</td>
<td>66.66</td>
<td>24.91</td>
<td>6.93</td>
<td>1.50</td>
</tr>
<tr>
<td>2</td>
<td>66.24</td>
<td>24.87</td>
<td>7.07</td>
<td>1.81</td>
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<td>3 – 8</td>
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<td>9</td>
<td>66.53</td>
<td>24.94</td>
<td>6.97</td>
<td>1.56</td>
</tr>
<tr>
<td>Average</td>
<td>66.38</td>
<td>25.04</td>
<td>7.00</td>
<td>1.59</td>
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<tr>
<td>Std dev.</td>
<td>0.16</td>
<td>0.21</td>
<td>0.12</td>
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</table>

PICODENTOR® HM500 with optional AFM.
The coefficient of variation for the Martens hardness results ranged between 0.2% and 0.8%. This attests to both the homogeneity of the coatings and the excellent repeatability of the measurement system.

Minimal differences in properties can be easily verified by means of instrumented indentation testing. The production process can be adjusted as necessary.

Various hardening processes play an important role in the production of optical coatings. The decisive factor is a good balance between hardness and the elastic properties of the coating. Two plastic lenses with an identical coating but different lengths of hardening time with UV light were also subjected to a test of the Martens hardness. In this case as well, a coefficient of variation of less than 1.7% also demonstrates the accuracy of the measurement.

Whereas the measurement of the Martens hardness with the standard measurement procedure is already depth dependent, the depth-dependent determination of additional properties such as the Vickers hardness or the indentation modulus can be carried out by using the Enhanced Stiffness Procedure (ESP) with partial loading and unloading. Beyond a certain penetration depth, one starts to see the influence of the substrate. In order to measure the coating independently, the depth of penetration must not exceed 1/10 of the coating thickness.

By generating forces down to a few micronewtons and performing high-precision distance measurements in the picometre range, the PICO Paul Hartmann can measure the hardness of even very thin coatings. The extremely sensitive placement of the indenter enables precise zero point determination and avoids damaging the sample surface before testing.

In particular, due to the specific structure of the PICO Hartmann HM500, the ease of sample preparation and the speed of measurement, the system is suitable not only for the laboratory but also for quality and process control during production.

Dr Bernd Binder
Gottfried Bosch, MSc Physics

Analysing Samples with Unknown Matrix: The New Automatix Function of the WinFTM® Software (Part 1)

For many years, X-ray fluorescence equipment by FISCHER has been used successfully for various applications in industry, research and technology. It can determine both the coating thickness of single or multiple systems and the composition of a wide variety of samples accurately, quickly and non-destructively.

The measurement principle of X-ray fluorescence analysis is essentially based on the photoelectric effect, which leads to the emission of fluorescence radiation. Scattering, which is manifested in

Spectra of ABS, Si and Pb, taken using the XUV 773 with a rhodium tube. The ratio of inelastically- to elastically-scattered radiation changes with increasing atomic number. Therefore, the average atomic number of the sample can be determined by calculating the scattering substrate.
the spectral substrate, represents another interaction between X-rays and matter. Conclusions about the average atomic number of the sample can be drawn from the ratio of Compton (inelastically scattered) to Rayleigh radiation (elastically scattered). Various materials such as ABS plastic, silicon and lead have been tested with the FISCHERSCOPE® X-RAY® XUV® 773 equipped with a rhodium X-ray tube. The spectra clearly show how the scattering substrate and the ratio of inelastically- to elastically-scattered radiation changes with increasing atomic number.

As calculation of the scattering substrate is included in the current WinFTM® software, the average atomic number of samples with an unknown lighter matrix can be determined with the new Automatrix function, enabling correction of matrix effects. When used in combination with the “Automatic Elements” search, widely varying unknown samples can be automatically measured, e.g. overnight. An application example use of the Automatrix function is the measurement of rhodium, palladium and platinum in recycled automobile catalytic converters with the FISCHERSCOPE® X-RAY® XDV®-SDD (50kV Al 1000 Filter, 10x50s). The BAM-certified reference material ERM-EB504 is used for the sample. Used catalytic converters from automobiles are crushed, annealed at 700°C and then ground to a particle size of less than 100µm.

If the wrong matrix is assumed, for example carbon, the measured values can deviate significantly from the reference value. Nominal values are very good with the Automatrix function. With the “Automatic Elements” function, Ce, Fe, Ni, Cu, Zn, Pb, Sr, Zr, Ba, Sn and Ag are also “found” in the samples and also considered in the analysis.

**Conclusion:** Applications for the Automatrix function can be found whenever the composition of the samples is not known to the user. Examples include recycling, the analysis of soil samples and electroplating sludges, and RoHS analysis.

More information about these applications awaits you in the next edition of FISCHERSCOPE.

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**Dr Simone Dill**

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<table>
<thead>
<tr>
<th>Element</th>
<th>Certified nominal value (u for K = 2)</th>
<th>Standard-free results assuming carbon as a matrix</th>
<th>Standard-free results with the Automatrix function in WinFTM 6.33</th>
<th>Relative deviation between the nominal value and the results of the Automatrix function</th>
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</thead>
<tbody>
<tr>
<td>Pt</td>
<td>1777 (15) ppm</td>
<td>620 (6) ppm</td>
<td>1731 (20) ppm</td>
<td>2%</td>
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<tr>
<td>Pd</td>
<td>279 (6) ppm</td>
<td>554 (9) ppm</td>
<td>292 (9) ppm</td>
<td>5%</td>
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<tr>
<td>Rh</td>
<td>338 (4) ppm</td>
<td>650 (9) ppm</td>
<td>375 (10) ppm</td>
<td>10%</td>
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Measurements for rhodium, palladium and platinum with the new Automatrix function in WinFTM® 6.33.
Helmut Fischer begins operations in new facility

Over 60 years after its founding, FISCHER has set a new course for the future. This summer in Sindelfingen, FISCHER commissioned a new factory building that substantially expands the company’s infrastructure. With it, FISCHER underscores its commitment to both innovation and the Sindelfingen location: premier-class measurement instruments, developed and built in Germany.

The company’s continuous and steady growth over the past several years had pushed the capacity of its physical plant to the limits. So, in order to remain responsive to increasing market demands, the production facility was enlarged with a new assembly building. This was not simply a decision about overall infrastructure, but also a clear continuation of its manufacturing strategy. Key components that are decisive for its instruments are built by FISCHER on the premises. Know-how stays in-house. Only then can FISCHER completely guarantee fulfilment of its high quality standards.

The new building is located directly across from the old location and nearly doubles the available work area. Approximately half of the 200 employees in Sindelfingen have moved into the new quarters, where one now finds the mechanical processing, assembly and logistics, as well as the calibration and DAkkS laboratory.

A core element of the building is the new logistics centre. A high rack storage area, designed for optimal goods flow, has been linked directly to the various departments. The routes are short, and the logistics and communications processes have been redefined and trimmed for efficiency.

On the whole, only the latest, most cutting-edge standards of plant engineering were employed during the conception of the new facility. For the departments involved, planning-phase tasks were met with enthusiasm: how often does one have the opportunity to optimise and reorganise one’s own department from the ground up?

Several limitations due to the increasingly cramped conditions in the old building have now been resolved. Finely-tuned workflows and an ideal layout have already led to significant increases in production capacity. And this can only be good for our customers!

The most important capital of any technology enterprise is its staff. For this reason, the workstations were designed according to the latest principles of ergonomy. Particular attention was paid to providing first-class spaces, well-lit with natural light and affording comfortable and efficient work movements. The result is a functional and aesthetic work ambience. But the employees in the new building are not the only ones to have benefitted: moving whole sections of the infrastructure over has freed up considerable room in the old areas. This has made it possible to re-envision the existing spaces, allowing for a more generous dimensioning of the workstations left behind.

The creation of a modern factory facility also requires taking other factors into account. Because the new factory was constructed in a densely populated region, it was important to integrate it appropriately into the existing landscape. For example, expansive plantings and green areas surround the building. The fire water reservoir – prescribed by law – is not just an underground tank but was built into the park-like landscape as a pond. And no shortcuts were taken on environmental protection. Extensive solar systems provide the plant with clean energy. This combined with its insulating, climate-stabilizing masonry ensures high sustainability.

With its newly-built facility, expanded capacity and higher efficiency, FISCHER is ready for the future. Now as much as ever, the goal remains to satisfy customers and partners and provide the very best quality.
Decorative chrome elements are indispensable to the design of most vehicles. Whereas with compact cars, the silvery shine is reserved primarily for the car maker’s logo, in upmarket vehicles other elements such as the grille or parts on the dashboard are often finished in chrome. In none of these applications is solid material used; rather, they are made from coated polymers, primarily ABS. The silvery surface is achieved by means of a multilayer system composed of various metals. After the component is activated, a 15 – 80 μm thick copper coating is applied; on top of that comes a 10 – 40 μm coating system of bright and semi-bright nickel, and finally a chrome coating with a thickness of less than 1 μm.

FISCHERSCOPE® X-ray instruments can be used for non-destructive determination of coating thickness using the X-ray fluorescence method. Depending on the exact measurement procedure and the combination of materials, overall coating thicknesses can be measured to approximately 100 μm. A coulometric measurement procedure by means of anodic dissolution with the COULOSCOPE® CMS2 offers one option for reliably determining the thickness of thicker layers. In this destructive measuring process, the individual coatings are successively removed. The coating thickness is calculated from the time taken for removal, the introduced current, the depleted area and the density of the material. To ensure the optimal removal of the different coatings, the ideal electrolyte is used for each individual coating as well as sealing rings of increasingly smaller size.

The redesigned V18 stand offers the usual FISCHER product precision for positioning specimens. Below, the coating thickness of an exterior trim strip was measured with the V18 stand and the CMS2. One of the measuring sites was then examined with a confocal microscope. There was good agreement between the measured values obtained with the two methods. These results can be used for purposes such as calibrating an X-ray instrument to conduct non-destructive quality checks on identical components.

Dr Benedikt Peter

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<td>Cr</td>
<td>F1</td>
<td>3.2</td>
<td>0.5</td>
<td>0.62</td>
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<tr>
<td>Ni</td>
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<td>39.9</td>
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<tr>
<td>Cu</td>
<td>F4</td>
<td>1.5</td>
<td>20</td>
<td>41.2</td>
<td>41.8</td>
<td>42.1</td>
</tr>
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</table>

Coating thickness measurements of a multilayer Cr/Ni/Cu system for automotive trim strips.

Confocal image of the removal site (etching hole).
A Behind-the-Scenes Look at Our Export and Logistics Department

As a globally active corporation, FISCHER provides measurement instruments and accessories in many countries and markets. As a result, FISCHER comes into contact with a wide range of customs and foreign trade regulations. These regulations must be scrupulously observed in order to deliver the instruments on time and intact. This requires experienced and qualified professionals. The team of foreign trade experts responsible for this function at FISCHER acts as a hub between the internal flow of goods and the export of measuring instruments. Although this may sound like a tedious job, it is actually very multifaceted and interesting: “The worldwide contact with subsidiaries and customers, as well as the widely varying mentalities of our contact persons, makes our job exciting and diverse,” say the team members.

Each member is assigned responsibility for specific countries. Responsibilities are divided so that all employees are always active in all areas of the logistics and export business, guaranteeing broad-based competence. This scheme is necessary because, unlike other areas, processes in the export business are subject to deadlines which can only be changed with considerable effort.

Each and every week, Helmut Fischer AG ships over three tonnes of material all over the world. This is quite a lot, considering that FISCHER manufactures high-precision measurement technology with no heavyweight components. Deliveries are first sent to Switzerland from the FISCHER factory in Germany. In Switzerland, they are processed by two logistics experts before being shipped to their ultimate destination. The entire spare parts management process is the responsibility of the logisticians. Excellent organisation and foresight are required to keep the right parts on hand so that components can be shipped as quickly as possible when needed.

The numerous new and spare parts deliveries are electronically registered with customs and logistics partners using internet-based systems. Because Helmut Fischer AG has acquired the status of Known Consignor for airfreight, packages from FISCHER do not require X-ray inspection. This reduces delivery time for the measuring instruments.

FISCHER’s Export and Logistics team is well-positioned to continue offering our clients the best possible service in future.

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