Issue 34/2016

umicore goldpost

The world of noble and functional surfaces

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Avoid Production Downtime
Hard chrome plating: minimise waiting times and decrease costs

umicore Electroplating

Dear readers,

We are happy to present new trends and developments in this edition of Goldpost. We've had a busy few months. As always, we value our close partnerships with our customers, which are our highest priority to ensure successful collaboration. In this issue, we will portray Thomas Sabo as a representative of all customers. The company is currently having great market success with its rose gold collection.

Let's not forget technical applications: we want to give you a short and sweet guide to market trends. This includes our story about nickel-free products, which have been a considerable feature of our portfolio for a few years already. A new EU regulation means that many companies now have to change their approach. We also have two more guide topics: tarnish protection and anodes. A tarnish protection especially for functional applications - the idea makes sense, even at first glance. Read about what makes our product so special. Finally, we tell you all about dimensionally stable, environmentally friendly anodes.

We hope our choice of topics will awaken your interest.
If you have any questions, suggestions or criticism, we'd be happy to hear from you. We always provide answers and never stop improving.

Warm wishes,

Thomas Engert
Senior Vice President
Business Unit Electroplating

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IMPRINT

Published by: Umicore Galvanotechnik GmbH, Klarenbergstraße 53-79, D-73525 Schwaebisch Gmuend

Editorial responsibility: Umicore Galvanotechnik GmbH

Design and layout: Umicore Galvanotechnik GmbH

Text: Umicore Galvanotechnik GmbH

Goldpost is available and can be downloaded as a pdf file from the Internet in German and English at ep.umicore.com.

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Umicore gets responsive

Umicore's New Website

Our new website is ready. The result is a site that perfectly fulfils the needs of our users: fast loading times, simple navigation and - most importantly - a 'responsive' design: whether you view via a laptop, smartphone or tablet, in portrait or landscape; all content, font sizes, menus and designs adapt to suit any device automatically to guarantee uninterrupted reading.

We've also made our content younger and more streamlined: the website offers an even more intuitive search function for users. Anyone looking for products, e.g. for smartcards, will find categories for the most relevant applications. There are also classic categories, such as for gold and silver electrolytes.
Try it out for yourself now! Remember: you'll only ever find a selection of our standard products.

An overview of the most important new features of our website:

+ Ideal for reading on a smartphone or tablet
+ List view of all products for important applications
+ Additional category search, e.g. all gold electrolytes
+ Clear contact area for branches and global representatives

The new Umicore website can be read perfectly on a mobile phone and tablet.

www.umicore-galvano.com
ep.umicore.com

News ticker

+++ Around 20 employees and friends of our company participated in the annual Umicore run over 10 kilometres at Schwaebisch Gmuend. The longest journey had our colleagues **Jean-Pierre Bize** and **Olivier Oblin** from Paris.

+++ Umicore is growing: A new three-storey **extension** is ready for occupation. At 400 square metres, it offers more room for measuring and monitoring devices, as well as office space for our laboratory workers.

+++ Umicore helps: Our employees donated **EUR 3,000** to the 'Bunter Kreis Schwäbisch Gmünd' association. The money came from bonuses for internal improvements. **Dr Norbert Sitte, Manuel Schwind** and **Thomas Kresbach** gave the money to the association, which supports families with sick children.

+++ Umicore shows a big heart: At **Christmas**, children from deprived families wrote their wishes on a piece of paper and hung them on a Christmas tree. Many of our employees made these dreams come true anonymously - from football shoes and clothing to a favourite CD.

+++ Umicore gets involved: **Erika Waibel** and **Dagmar Bürgel** took a group of **disabled people** to a high ropes course.

+++ Umicore celebrates: At the winter party, countless departments impressed as karaoke teams belting out the classics. Our yearly **ski trip** took place this January, and twelve members of staff enjoyed plenty of winter fun and après ski. In summer, three employees were honoured for **25 years** and one employee for **40 years with the company** in glorious sunshine.

At the moment, the jewellery brand THOMAS SABO is heavily relying on rose gold.

Portrait of a successful creative

Thomas Sabo

THOMAS SABO is one of the world's leading jewellery and watch companies designing and selling lifestyle products for men and women. Self-made man Thomas Sabo (55) has continued to build and expand his empire based in Lauf an der Pegnitz near Nuremberg (Germany/Bavaria) since 1984.

He now has around 1,860 employees worldwide. The group has a sales network comprising around 300 shops on five continents, alongside roughly 2,800 retail partners, airlines (on board shops) and cruise ship operators, as well as its own online shop.

750 Rose Gold Jewellery as a Major Seller

Collections such as the well-known 'Sterling Silver' lines 'Glam & Soul', 'Rebel at Heart' and 'Karma Beads' as well as 'Charm Club' and 'Watches' have been major hits all around the globe. These collections all have different approaches and target groups, as well as complement each other beautifully: for young or old, to go with sophisticated or casual outfits, for a day at the office or a special evening event - this creative brand offers fascinating jewellery for men and women to complement any look, any style and any price category.

Who Is This Thomas Sabo and Why Does He Trust in 750 Rose Gold?

The man has obviously always had a sixth sense when it comes to trends: in the early 1980s, Thomas Sabo travelled across Asia. He was a layman back then, but was immediately fascinated by silver jewellery. Originally from Austria, Thomas Sabo brought an initial collection back to Europe in his rucksack. Even then, it was obvious he was onto something: his first collection sold out in a heartbeat.

In 1984, he founded his current company under his own name. Since the early 1990s, Sabo has been working closely with THOMAS SABO Creative Director Susanne Kölbli. This congenial duo always hits the mark, and has created one sales hit after the other - across all market segments, but especially when it comes to silver jewellery.

A Rebel Among Jewellery Designers

Thomas Sabo has long been a key feature in the jewellery design scene. At the end of 2014, his company launched the first THOMAS SABO Fine Jewellery Collection. In April 2016, his closest employee, THOMAS SABO Chief Brand Officer John Schlüter, said in an interview with the 'Wiener' magazine (Austria), that Thomas Sabo was 'unbelievably creative and, at the same time, an unbelievably good salesman. A very rare combination. And that's what makes the company what it is.'

And Thomas Sabo, the man with the long hair and leather trousers, added that creating a sustainable business is 'hard work'. This clearly pays off, as Thomas Sabo continues to run his business independently to this day. In his home town of Nuremberg, Thomas Sabo is also known as the main sponsor of the 'Nuremberg Ice Tigers'. He is a huge ice hockey fan, and can be often found at games cheering his team on.

Thomas Sabo showed his internal independence and his skills as a trendsetter in his new releases both this year and last. The businessman has been using rose gold-plated sterling silver since spring/summer 2013 to create a new global style. Once more, he had a hand in selecting only the best concepts from the babble of creative ideas. The result is the new THOMAS SABO 'Love Bridge' line, which is currently being intensively promoted worldwide.

'THOMAS SABO Love Bridge': Feelings instead of Rebellion

In contrast to the 'Rebel at Heart' collection with rebellious skull pendants and masculine signet rings made from blackened sterling silver, the new 'THOMAS SABO Love Bridge' collection in unisex sterling silver or feminine gold and rose gold is enchanting customers under its slogan of 'Make Memories Last'. The filigree bridge on the 925 sterling silver bracelet, with optional gold plating, is a creative stage for strong emotions and feelings that can be customised with a personalised engraving at no extra cost. Since July 2015, the line has been successfully expanded in THOMAS SABO stores on metropolitan boulevards from Hong Kong to New York and Sydney.

Thomas Sabo between fashion model Georgia Jagger (left), Mick Jagger's daughter, and Formula 1 driver Nico Rosberg (right).

The trend in THOMAS SABO shops' display cases has been clear for a few years now: sterling silver complemented by pieces with gold or rose gold plating - every customer is invited to create its own style, using bi-colour or tri-colour combinations.

One clue as to why rose gold has become the number one trend over night leads us back to Schwaebisch Gmuend. Here, Martin Stegmaier is responsible for the global jewellery market for Umicore Electroplating. Umicore has long been supporting THOMAS SABO in creating his collections. Now, they are also helping to create rose gold coatings. The colour is exceptionally popular in the USA and Arab countries, says Stegmaier. Up until now, it wasn't always easy to apply high-quality galvanic rose gold coatings. This has all changed thanks to a few new innovations, according to the Umicore expert (see interview).

New Head Office

Meanwhile, in Lauf an der Pegnitz, the creatives behind THOMAS SABO are already on the look-out for the next big trend. And they now have a brand new company head office to do this in. In Schwaebisch Gmuend, Martin Stegmaier's team is already working on improving galvanic processes. In the little town on the Rems River, black is currently a hot topic. More importantly, a very rich, intense black (see page 8).

A custom engraving makes the gem truly unique.

Martin Stegmaier
Tel.: +49 7231 776 93 84
martin.stegmaier@eu.umicore.com

Interview with Martin Stegmaier

What is the main challenge when creating a rose gold electrolyte?
Previously, it was incredibly costly to deposit tarnish-resistant coatings of up to five micrometres. It's easy to understand what happens with thin layers: one small scratch and the base substrate is exposed. The customer is disappointed. Manufacturers either had to deal with high numbers of returns or avoided using rose gold altogether.

What changed?
We managed to use additives to considerably improve separation behaviour. Now, five micrometre layers aren't a problem. Also, the electrolyte is easy to apply. This is especially important for producers in Asia that manufacture products as sub-contractors. Simply put: good quality rose gold was traditionally a real challenge, but now our AURUNA® 502 electrolyte makes it easy. It can easily tackle layers up to five micrometres thick, is free of cyanide and cadmium. It creates hardness levels of up to 400 HV.

How long will this rose gold trend last?
That's difficult to say. I'm no market researcher. My gut feeling tells me that rose gold will be a long-term feature alongside traditional gold and white surfaces. Jewellery is all about change and variety. And we're prepared for that.

Martin Stegmaier is the Division Manager Decorative Precious Metals at Umicore Electroplating.

Research & Development: how we invent at Umicore

50 Colleagues, 50 Patents

Umicore is innovative. And has been for more than 125 years. Each day, our Research & Development staff are faced with new challenges for electrolytes. They adapt electrolytes to suit many customers' needs. Or invent new ones. To this end, we use the most up-to-date technology available. What is the approach of our researchers?

1 Is there a suitable solution within our range of 17 product families and more than 200 electrolytes?

2 Is there one particular product to be adapted?

3 No. Okay, now it's getting serious.

4 We plan a complex roadmap to the product with you. You decide the costs, as well as the electrolyte and coating properties.

5 We check several basic initial compositions. Are we heading in the right direction? We use analysis devices such as HPLC, CE and ICP.

6 Okay. So, we're on the right path.

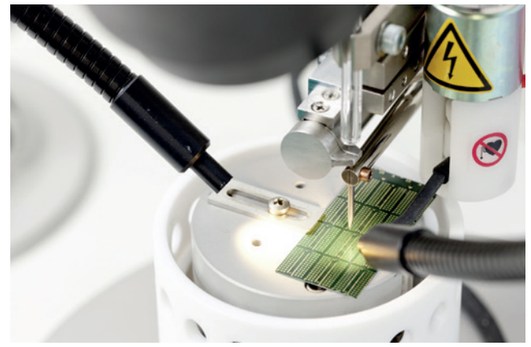
7 We are supported by design of experiment. We pay close attention. Our software recognizes dependencies and trends.

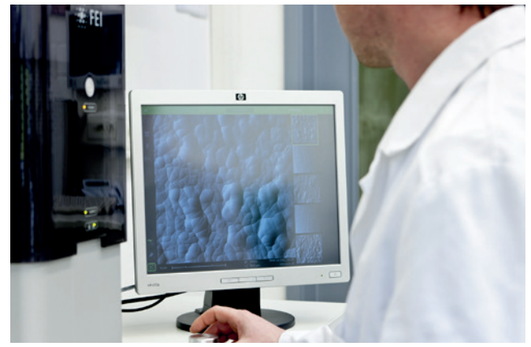
8 Now it's time for our laboratory robot to come into play. It performs test series after test series with the utmost precision.

9 Great! The results look good. We examine everything carefully.

10 We use our nanoindenter UNAT to determine hardness and wear resistance. Another system, our KOWI machine, measures the surface's contact resistance. We perform NSS and Kesternich tests to check corrosion resistance and protective properties of our anti-tarnish products using the K_2S test. We also measure the CIEL*a*b* colour values of decorative coatings.

11 Done. We've developed another new electrolyte.





Electroforming on the rise in Asia

Comeback of a Classic

The boom may have been unexpected, but it cannot be denied: hollow jewellery is enjoying a revival, especially in Asia, and is becoming ever more popular - some are even using it as financial investment.

A specialist workshop in Hong Kong brought users together with lab experts and engineers from Umicore. The debate was extremely productive and resulted in new knowledge on both sides.

The jewellery manufacturers were especially interested in the wide range of products that Umicore can provide - including electrolytes for hollow silver jewellery and, of course, environmentally friendly gold processes. For example, Umicore has been using a cadmium-free gold-silver electrolyte for 18 carat coatings for over 30 years. As cadmium is also prohibited in the jewellery industry, more and more manufacturers are placing their trust in this approved and tested Umicore product.

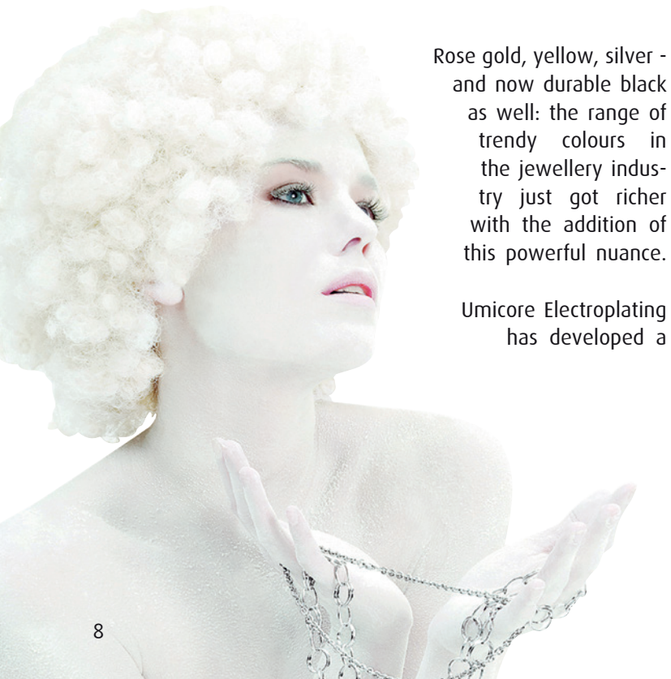
Especially in China, companies are increasingly using cyanide-free processes for electroforming. Umicore also has suitable solutions for this challenge.

Many visitors seemed very impressed that Umicore is one of only a few manufacturers offering processes that can be used with wax as well as metal cores.

Martin Stegmaier
Tel.: +49 7231 776 93 84
martin.stegmaier@eu.umicore.com

RHODUNA® 470 Black & RHODUNA® Diamond Bright: a perfect duo

Brilliant Black & White



Rose gold, yellow, silver - and now durable black as well: the range of trendy colours in the jewellery industry just got richer with the addition of this powerful nuance.

Umicore Electroplating has developed a new black rhodium electrolyte, RHODUNA® 470 Black. It offers a dark shade never before possible on jewellery. Up to now, an L-value of 65 in the CIEL*a*b* colour spectrum was the darkest shade possible using black rhodium, but now values below 40 are achievable. Another benefit compared to the proven black ruthenium: coatings are considerably more wear resistant.
But we can also do light and bright: RHODUNA® Diamond Bright produces brilliant radiance.

Martin Stegmaier
Tel.: +49 7231 776 93 84
martin.stegmaier@eu.umicore.com

The EU is promoting nickel-free commodities. What do you need to do?

REACH as a Challenge

What's it all about?

Nickel can damage people's health. That's why regulations are becoming more and more strict. Meanwhile, nickel-free earrings and piercings have become obvious.
Now, any object that could come into prolonged contact with human skin is supposed to be nickel-free.

What are the regulations?

REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) gives a clear direction: Annex XVII requires that consumers have even less contact with nickel. The text outlines that objects that are intended to have prolonged, direct contact with human skin must be free of nickel. 'Prolonged contact' is defined as more than ten minutes on three or more occasions within two weeks or one thirty-minute period within two weeks. The European Chemicals Agency (ECHA) defined this in a document from 2nd April 2014 ('Prolonged Contact with Skin'), which is currently available as a PDF by searching the term 'nickel' on www.echa.europa.eu.

Who will the new regulations affect?

The regulations don't name any specific objects; they only formulate general regulations. This means that manufacturers are obliged to make arrangements themselves: the now exact definition of 'prolonged' could apply to objects that only briefly come into contact with human skin. This could include writing instruments, tools for handicraft, scissors and kitchen gadgets.

Where does Umicore fit in?

We support manufacturers in producing nickel-free jewellery and consumer goods. We offer suitable electrolytes and processes, support with intensive consultation about process optimization and conversion, and provide technical user services, e.g. laboratory analyses.

Info online:

www.echa.europa.eu
www.bfr.bund.de
www.nickelfrei.de

Dr. Klaus Leyendecker
Tel.: +49 7171 607-223
klaus.leyendecker@
eu.umicore.com

How you can protect your functional surfaces

Tarnish Protection 4.0

Umicore Electroplating has developed a new anti-tarnish process - particular for functional applications. We tell you why it's high time for you to take a closer look at this product.

The Idea

Decorative surfaces come with a different set of challenges for tarnish protection than functional ones. As precious metal layers get thinner, resistance to corrosion and tarnishing gets more important, and a simple tarnish protection will no longer be sufficient.

We took this to the next level, and are offering now processes for decorative applications, such as jewellery, but also highly efficient solutions for technical components, such as connectors or smartcards. They enable fast deposition of compact and dense protection layers.

The Product

Umicore Sealing 691 offers the best protection without changing technical properties of the functional surfaces. Self-organising molecules create strong protective layers rapidly. Applied and supported by electric current, very dense and compact protection layers are formed in a very short time span. This is important in continuous plating lines.

Corrosion and tarnish protection improve considerably. Contact resistance as well as solderability and bondability are not changed. The coefficient of friction decreases demonstrably. Therefore, the sliding properties are improved. Optical properties such as color and reflectivity remain preserved.

The Result

Umicore Sealing 691 delivers impressive results in the following tests, among others:

- K_2S test: resistance increases two to three times.
- Coefficient of Friction: decreases under test conditions by up to 95 percent.
- Zero-cross time remains explicitly under one second, and the gold wire bonding specification is exceeded significantly.
- NSS test: even thin gold layers show a considerably improved resistance to tarnishing. They keep up to 72 hours without discolouration or corrosion.

5 Seconds:

That fast the new antitarnish process can be applied in a continuous plating line and the protective layer is fully grown.

Interview with Friedrich Talgner and Robert Ziebart

What's so special about Umicore Sealing 691?
For us, it's definitely the deposition speed powered by electricity. The customer will benefit from the fact that the post-treatment process only takes five seconds.

What changes are you seeing on the market in general?
Many users still apply solvent-based antitarnish processes. Our system is aqueous based. This will generally increase. In Asia, this is already the case.

Are there already user for this new process?
Yes, of course - and on a global scale. We have a growing customer base from Asia to Europe and North America. There's a lot of interest - from subcontractors up to OEMs.

Friedrich Talgner is the Division Manager Technical Precious Metal at Umicore Electroplating.
Robert Ziebart, Sales Manger, serves clients in electronic manufacturing by technical consultation.

5 applications for which Umicore Sealing 691 is perfect:

1. Connectors
The corrosion resistance is improved and insertion forces are reduced.

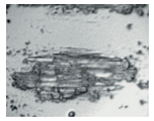
2. Smartcards
The product protects palladium, palladium-nickel and gold surfaces and increases the corrosion resistance, especially for thin layers.

3. LED
During LED production, Umicore Sealing 691 protects reflective surfaces reliable between the process steps.

4. Sliprings
The tarnish protection initially reduces the friction forces and avoids, for example, damage to the sensitive surfaces during transport.

5. PCB
Sensitive surfaces of printed circuit boards, such as ENIG, are vulnerable to corrosion. Umicore Sealing 691 improves the corrosion resistance also in this application area.

Friction marks on the silver surface show a clear improvement of the wear resistance

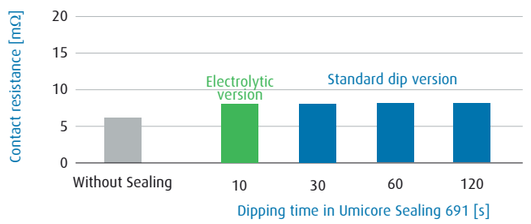


Pure silver without Umicore Sealing 691
Surface destroyed after 500 cycles
*COF: 0.76

Pure silver with Umicore Sealing 691
Surface intact after 500 cycles
*COF: 0.04

* Coefficient of Friction

Stable contact transition resistance



Friedrich Talgner
Tel.: +49 7171 607-322
friedrich.talgner@eu.umicore.com

Nickel-free processes - a hot topic

Umicore: PCB System Specialist with Strong Partners

Nickel-free final finishes and copper plating technologies for filling of through holes and blind micro vias are hot topics, according to Umicore Electroplating's printed circuit board experts. Read on to find out what other news the system specialist for PCBs has to tell.

Umicore: System Specialist for PCBs

Copper plating technologies for through holes and blind vias are the focus of Umicore Electroplating's market activity in Europe.

The company offers precious metal processes, pre- and post-treatment processes, anodes and solder resists for the manufacture of circuit boards and electrical components, such as LEDs, smartcards and connectors.

Umicore Electroplating works closely with leading electronics producers worldwide, meaning that all processes for final finishes have been extensively tried and tested in large volumes by renowned printed circuit board producers and service providers all across Europe and Asia.

When it comes to PCBs, growing packing densities and the increasing complexity of HDI circuit boards are resulting in a need for new Cu plating technologies to fill through holes and blind vias of different dimensions.

Increased reliability requirements in the processing of PCBs with regard to solder joint reliability and wire bonding performance call for optimized and almost completely corrosion-free Ni-based depositions. Umicore provides therefore innovative solutions for market-proven processes, such as ENIG (electroless nickel + immersion gold plating) and ENEPIG (electroless nickel/electroless palladium + immersion gold plating) based on semi autocatalytic gold deposition using the proven electrolyte Gobright TWX-40.

Strong Partners: Umicore Electroplating, Uyemura and Taiyo

Uyemura and Taiyo have long been partners of Umicore Electroplating. These two Japanese companies are world market leaders for basic components and coating processes for the production of circuit boards and electronic components.

Umicore represents both of these companies in Europe. 'This cooperation has allowed us to take on a role as system specialists for circuit boards,' stated Thomas Engert, Head of the Umicore Group's Electroplating Business Unit. Umicore offers processes tested by Uyemura, such as ENEPIG, ENIG, EPIG and ISIG, Cu filling processes for through holes and blind micro vias, and solder resists from Taiyo.

New from Taiyo: CAD Printing

The Inkjet Soldermask IJSR-4000 is revolutionising solder resist processing: CAD/CAM data are sent directly to the inkjet printer. The machine precisely applies Taiyo ink to the defined areas on the circuit board. It is then fixed using UV light during the printing process, and then thermally hardened. The process can be used on both rigid and flexible boards.

This process significantly simplifies solder resist processing, which often involves more than six complex process steps. In future, only a maximum of three steps will be needed. Things that have previously been a challenge in solder resist processing, such as registry precision, through hole cleaning, and missing solderdams due to overdevelopment, are now a thing of the past. The process also impresses from an environmental point of view, as solvents are avoided. No waste water is generated, while less energy is required. The process even demands smaller amount of soldermask, only being used where it is really needed.

Info Sheet about Nickel-Free Products for PCBs

Umicore circuit board specialists see further growth in the need for high-quality processes with significantly improved ultra-fine conductivity. Nickel-free processes, such as EPIG (electroless palladium + immersion gold plating) and ISIG (immersion silver + immersion gold plating) are ideal for these purposes. Request information sheets and more via:

Andreas Gross
Tel.: +49 7171 607-358
andreas.gross@eu.umicore.com

Martin Mack
Tel.: +49 7171 607-332
martin.mack@eu.umicore.com

Continuous Improvment Process

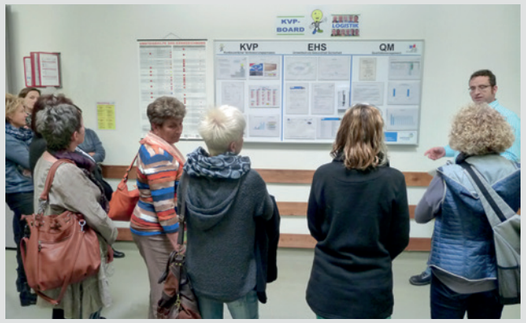
CIP

3 questions to Alexander Kurz, CIP coordinator at Umicore Electroplating

What is behind the term CIP?
Toyota was at the beginning of the 1960s in a major crisis. The management was looking for a way out and developed the concept of 'Kaizen', in Germany mostly known as 'Continuous Improvement Process' (CIP). Every detail was carefully checked, with each process analysed in order to avoid waste of resources. Umicore started with CIP in 2006.

Which experience did Umicore Electroplating make?
Mainly positive. We have found and eliminated many areas of waste during the past decade. The central task has been, and remains, not finding ideas for improvements. The point is rather to develop better standards and then consistently comply with them. I like the image of a wheel, which is rotated uphill by joint forces. A wedge prevents it from rolling backwards.

Do you also train customers?
Every year we inform numerous colleagues from other companies. Many are surprised how complex the issue is. But, with backing from the executive board and consistently applied, CIP brings a company forward enormously and ensures competitive advantages.



A group of visitors from Thomas Sabo is informed at Umicore Electroplating about the topic CIP.

Alexander Kurz
Tel.: +49 7171 607-295
alexander.kurz@eu.umicore.com

Hard chrome plating: minimise waiting times and decrease costs

Avoid Production Downtime

Their many benefits are persuasive: platinized titanium and niobium anodes are taking the world by storm. We explain, when platinum-plated anodes pay off and why this will probably be the case for your hard chromium business.

Benefits of Platinized Titanium and Niobium Anodes

• **Dimensional stability**
Pt/Ti and Pt/Nb anodes are dimensionally stable. They don't change shape during their lifetime. This means the production downtime and replacements required by lead systems don't apply.

• **Lead-free**
Processes are almost completely lead-free nowadays, and therefore considerably more environmentally friendly. Lead chromate sludge is no longer created, which is both expensive and difficult to dispose off.

• **Uniform layer thickness**
The chromium layer thicknesses on the components are very even due to adapted anode shapes. Mechanical reworking is no longer needed.

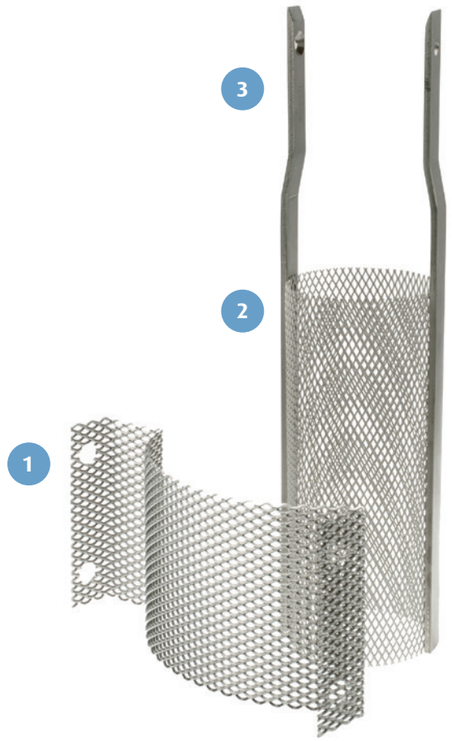
• **Energy saved**
Energy consumption is also considerably lower. In the long run, the voltage difference (between lead and platinum-plated anodes Δ = approx. minus 1 V) results in noticeable cost savings.

• **Components can be reused**
Components such as power supplies and framework constructions made from CuTi can be reused several times. This shortens amortisation time significantly in comparison to lead anodes.

• **Credits for the remaining platinum**
Credit for leftover platinum when recoating used anodes essentially decreases the initial precious metal costs.

• **Tailor-made construct**
The anodes are individual, tailor-made products. They are optimally adapted to the respective challenge after a lengthy consultation.

How Umicore Electroplating Produces Pt/Ti and Pt/Nb Anodes



Umicore Electroplating creates platinized titanium and niobium anodes in a 550 degree celsius water-free molten salt electrolyte. Expanded metal anodes (1) have different mesh sizes and can therefore be customized to work with different power loads and tailor-made to fulfil customer requirements. For example, the distance to the round materials, which have to be coated, can be adapted to suit the cylindric anode's diameter (2). For users, this means less energy consumption, increased current density and improved coating quality. Power supplies (3) conduct electrical energy to all areas of the anode without any drops in voltage. Correct anode construction is therefore very important for the anode lifetime.

Breaking Even: Calculated Using the Umicore Tool

Umicore has developed a calculation tool. It takes into account the most important parameters to compare actual costs for lead anodes, which are made using the hard chromium process and platinum-plated anodes. Here are just some of the cost factors that are taken into account:

- Costs for constructing and assembling the anodes
- Current platinum costs, including coating
- Operational time
- Maintenance costs
- Downtime costs
- Energy consumption
- Price of electricity
- Disposal costs

You can get more exact individual values when speaking with the Umicore engineer.

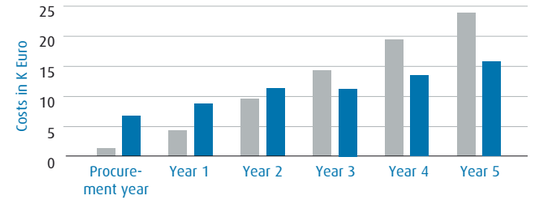
Thomas Ebert
Tel.: +49 7171 607-259
hte@eu.umicore.com

Frank Friebel
Tel.: +49 7171 607-292
hte@eu.umicore.com

Cost Comparison Between Lead and Pt/Ti Anodes

Platinized titanium anodes often pay off in less than three years: energy cost savings, production downtime, waste charges, disposal costs and mechanical reworking costs are generally not calculated in thorough detail. This graph illustrates that you can break even after two to three years.

Lifetime-cost comparison: Pt/Ti anodes are cheaper as of year three than lead anodes



- Lead anodes: costs for purchase, additional costs for electricity, maintenance/production downtime and waste disposal, costs not taken into account for mechanical reworking of the chromium layer or benefits that are difficult to quantify (image, occupational safety, environmental protection, improved coating quality etc.)
- Pt/Ti anodes: costs for purchase and yearly depreciation for recoating

Reiner Maier, Thomas Ebert and Frank Friebel of the HTE-team.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