

Combining Competencies for **Process Excellence**

Comprehensive Platinum based solutions for the special glass industries



Contents

Introduction	2	High-Tech PGM Materials	12
Process Excellence Model	3	Technology Development	15
Process Excellence Portfolio	5	PGM & Non-PGM Recycling	20
Application Know-How	6	Consulting & Training	21
Sophisticated Engineering	8	Global Presence	23
High-Quality PGM Components	11		

» Why take the time to read these pages?

The main concerns of the special glass industries – being it in the Display, Technical, Optical, Crystal or Fiber Glass segment – are the highly volatile PGM (Platinum Group Metals) prices and tremendous costs of energy that challenge the industry to keep their manufacturing processes at an economical scale. Additionally, the end user markets do dictate a permanent increase for the quality standards of the glass products, and also ecological drivers are considerable additional challenges for the industry.

Already several years ago we have realized how these demands do translate into our strategy and started to adapt our portfolio of products and services according to the needs of the supply chain. Nowadays it takes far more than excellent PGM components made of sophisticated materials to increase the functionality of the PGM component. It has also become our duty to support our customers to better understand how the PGM component and its periphery do interact. Only by perfectly synchronising the boundary conditions and the PGM component a status can be reached that yields maximum efficiency, stability and security – and this is what we name Process Excellence!

We bring value to our customers by supporting them to manage the crucial interface of the PGM component and its immediate periphery within their glass manufacturing process. Joint learning and development enables our customers to better understand and to finetune the process to a maximum extent, which translates into economical and technical advantages for their products – and hence makes them more competitive.

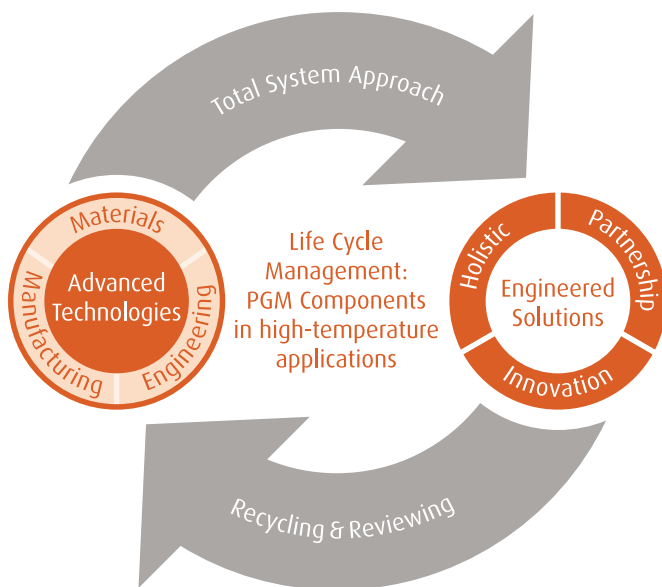
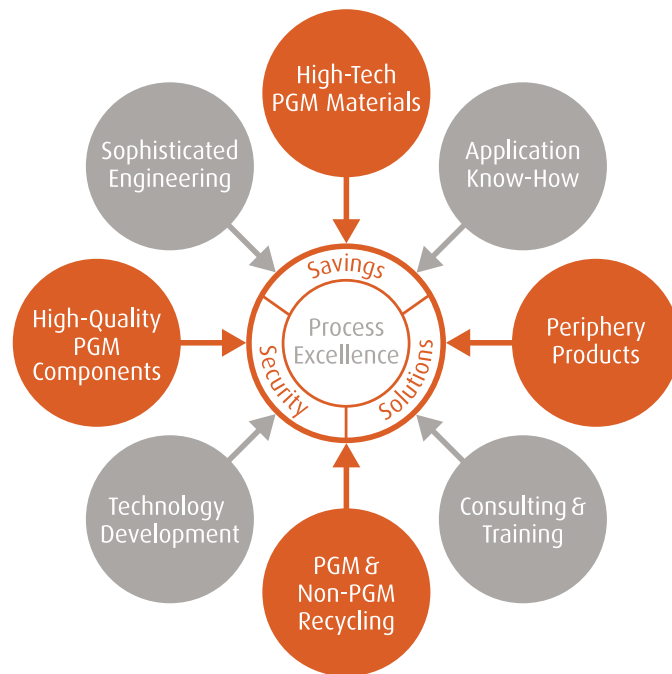


» A total system approach by a unique single-source portfolio

The PEM Process Excellence Model

To support our customers in managing the trade off between cost savings to remain competitive, while at the same time complying with increasingly demanding requirements from their target markets, the business unit Platinum Engineered Materials (PEM) applies solutions that are mainly based on innovation and technology.

We have evolved from a mere PGM component supplier to the only provider of single-source solutions utilizing a sophisticated toolbox: spanning everything from engineering & designing, advanced engineered materials, manufacturing technologies, as well as services like state-of-the-arts analytics, consulting and training, up to complementary non-PGM products to round off what is necessary to come up with holistic solutions. Of course, we do also close the loop in terms of material flows, and do provide recycling of both, PGM and non-PGM materials.



Cooperations with shared objectives

Looking at the process from the core competence that we have built around the PGM component, as well as from the core competence our customers have built in their field, is a powerful and sustainable approach to a bright future for both parties: Combining Competencies for Process Excellence!

And what is even more important: there are hardly any one-time tasks. Our people understand that we can only be successful in case of long-term considerations that benefit from the results and experience that we have gained in close partnerships with our customers. Consequently to manage this complexity we repeat the loop each time a campaign is finished, and restart the procedure to bring the process to the next level of excellence: Life Cycle Management.

Closing the loop not only on the material side, but also on the experience side, makes it possible to jointly work towards Process Excellence as a shared objective with our customers. Hence Process Excellence translates as much into total cost reduction for our customers as it does into efficiency, stability, and security.



» Achieving sustainable results by tailor-made & individual solutions

From the earliest time of glass production right up until today, progress in the special glass industries has revolved predominantly around progress in addressing the problem of managing heat in the production of immaculate and perfect glass types.

Knowledge essential to production processes has become increasingly important to answer questions like: What is the best production process setting for a specific type of glass – technically and economically? Which materials can best withstand the heat? And how should the most suitable material be aligned with the production facilities to be established?

Platinum – a key element

Over the last 100 years, one material has played a crucial role in the manufacture of new kinds of

special glass and for improved or even completely new applications: platinum and derivative Platinum Group Metals (PGM) such as mainly rhodium, but to a certain extent also iridium and palladium. Originally starting with pure platinum and cast platinum alloys, today engineered materials like oxide-dispersion strengthened platinum materials do play an increasingly important role for manufacturing of special glass types.

Technology – a key driver

The before mentioned cost drivers towards today's glass manufacturing processes and the complex nature of this business have substantially triggered the necessity for more sophisticated PGM components, better conceptional solutions and more comprehensive considerations than ever before. Hence a technology mindset has become crucial to correlate the various parameters that

finally determine the performance of such processes. Though it's unlikely to find more suitable elements, the development of improved technologies is something we can certainly offer.

Innovation – a key solution

Special glass types are fascinating products that enable inexhaustible possibilities for today's and future applications. We are proud to be an expert partner for the glass industries in supporting them to convert their glass innovations into tangible achievements by making use of our innovation potential related to our core competence around PGM. Our greatest achievements usually remain classified because often they are individually designed for customers with very specific proprietary requirements. This innovation process is based on precise calculations, verifiable scientific data, and creative thinking – but not on trial and error.

» A wide range of possibilities: our unique portfolio



Technology Development

- › Automated Routines
- › CAM & CAD Excellence
- › Patented Techniques
- › Skilled Manufacturing
- › Process Development
- › Applied Technology

High-Quality PGM Components

Reliable Designs for defined campaign times

- › Bushings
- › Crucibles
- › Danner Pipes
- › Electrodes
- › Feeder Cells
- › Gob & Stream Feeders
- › Orifice Rings
- › Plungers
- › Refiners
- › Stirrers & Stirring Cells
- › Tube Mandrels

Sophisticated Engineering

- › Total System Approach
- › Physical Modeling
- › Mathematical Simulations
 - Mechanical Engineering
 - Electrical Engineering
 - Thermodynamics
 - Fluid Dynamics
- › Light-Weight Systems
- › Patented Constructions
- › Bionic Shape Designs
- › Periphery Correlation
- › Life-Time Calculation

Periphery Products

- › Adjusted Ceramic Stones
- › Refractories
- › Base Metal Accessories
- › Engineering of Adapted Steel Frames

High-Tech PGM Materials

- › Engineered ODS Materials
 - FKS® Agilit® (Pt PtRh)
 - FKS® Rigilit® (Pt PtRh PtIr PtAu)
 - FKS® Saeculit® (Pt PtRh)
- › Cast Pt Alloys (Rh Ir Au)
- › Material Science (R&D)
- › Metallurgy
- › Chemistry

Application Know-How

Inhouse Expertise of Special Glass Industries

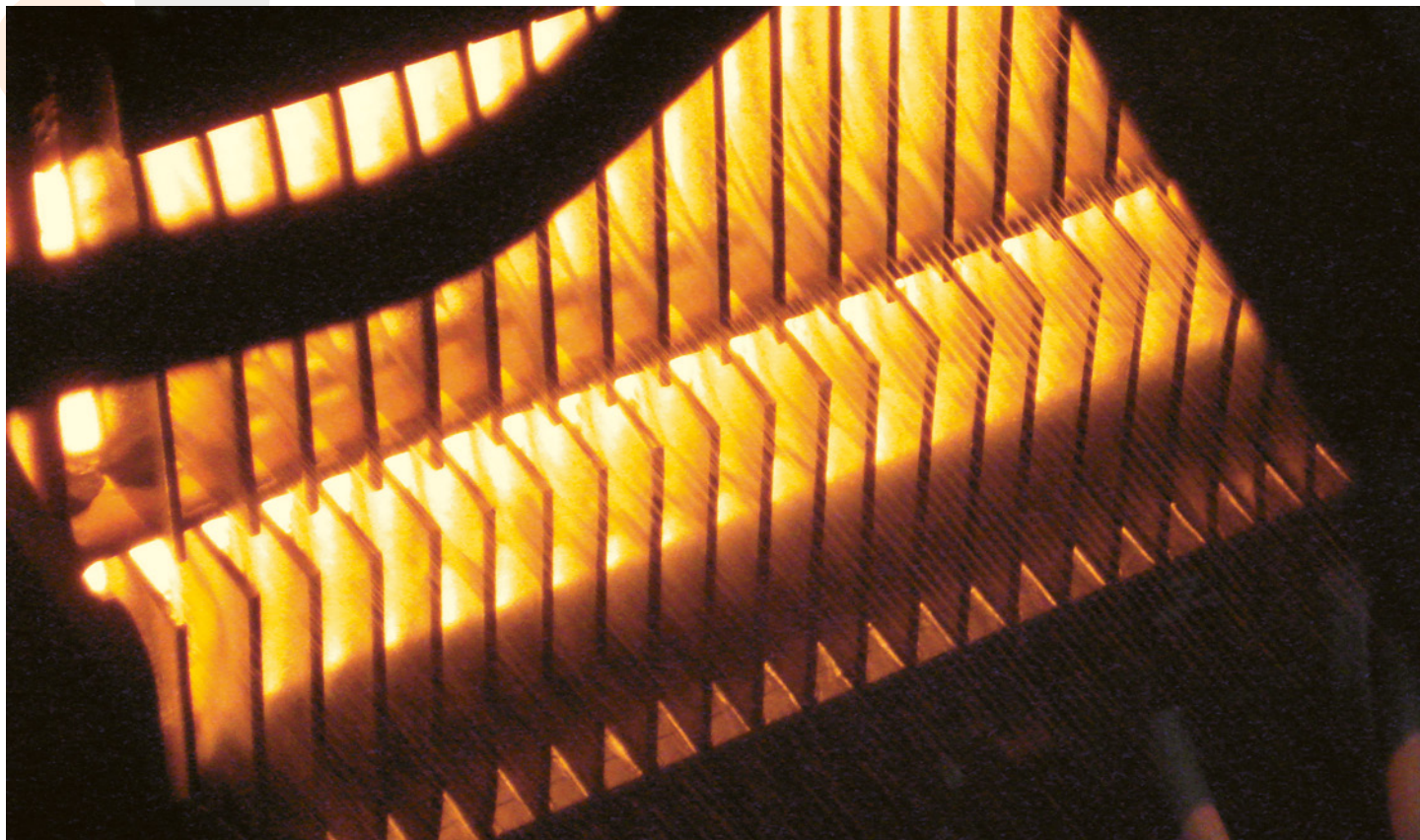
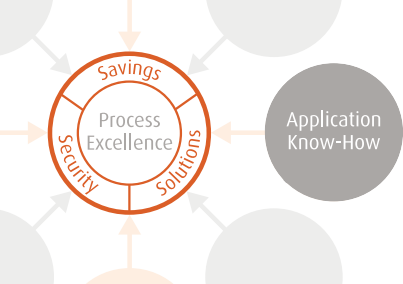
- › Technical Glass
- › Optical Glass
- › Fiber Glass
- › Display Glass
- › Crystal Glass

PGM & Non-PGM Recycling

- › Pyrometallurgy
- › Hydrometallurgy
- › Low Content Scraps
- › High Content Scraps

Consulting & Training

- › Life Cycle Management
 - Continuous Improvements
 - Technical Reports
 - Campaign Reviews
- › Sophisticated Analytics
- › Metals Management
- › On-Site Support
- › Troubleshooting



» Supporting zero fault production

The glass melting process for special and high purity glass types generally comprises five different manufacturing steps: primary melting, refining, conditioning, feeding, and shaping. Depending on the market segment, either the entire manufacturing process or only parts of it do require platinum based components instead of ceramic parts. While in the optical glass industry exclusively components made of platinum are suitable – due to the high requirements of optical glass in terms of its sensitivity towards potentially coloring impurities – the range of components for the other industry segments does differ from case to case. What all these industries however do have in common is the need for engineered PGM component solutions tailored to the respective glass type.

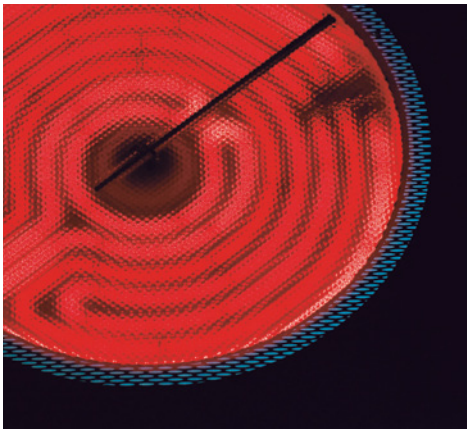
High purity glass – also referred to as special glass – usually consists of borosilicate blends and hence needs to be distinguished from conventional soda-lime glass and lead glass. The main applications for this kind of glass can be found in the following five market segments:

- › **Display Glass:** flat screens for televisions, monitor screens, handheld devices
- › **Technical Glass:** lighting equipment, household appliances
- › **Optical Glass:** lens systems for any kind of camera
- › **Fiber Glass:** composite materials like reinforced plastics, yarns for electronics
- › **Crystal Glass:** consumer & decorative applications

Apart from its high melting point well above 1,700 °C, pure platinum is strongly resistant to oxidation, corrosion and aggressive glass melts. It demonstrates a very low dissolution rate in glass melts even under high temperatures, and possesses high electrical conductivity, which is a basic prerequisite for its use as directly electrically heated equipment. However, even pure platinum loses some of its mechanical strength at high temperatures and tends toward an unfavorable accumulation of grain, even when stabilized with elements like rhodium. Hence the right material choice is one of the very critical parameters that have to be taken into account when it comes to usage of platinum equipment in the special glass manufacturing process.



» Our Markets: Adding value to the special glass industries



Technical Glass



Optical Glass



Fiber Glass



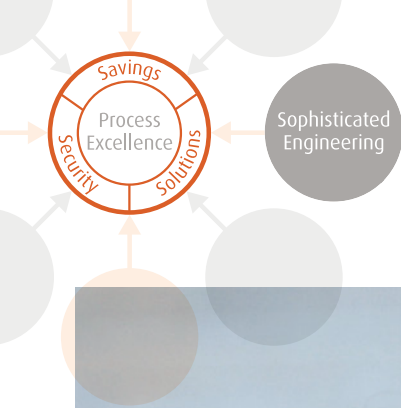
Display Glass



Crystal Glass



Special Glass Inhouse Expertise



» Engineering is the key

For us engineering means customization: The process always begins with the description of our customers' objectives, needs and wishes. This task is our challenge and our engineers invest all their expertise in the development of a solution that meets or even exceeds this goal.

Engineering can be executed in various scopes, ranging from a rather basic approach up to a comprehensive total system approach that invents a completely new solution to a defined task. While basic engineering actually means to adapt a given PGM component execution to different manufacturing technologies, a comprehensive system approach includes the selection, definition and calculation of both, PGM component and its periphery. It also includes complex simulation procedures and their practical validation.

A comprehensive approach

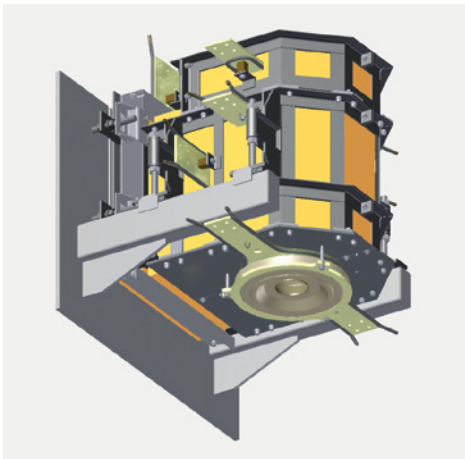
Our component design is always based on engineering. Mathematical calculations and advanced methodologies for simulations and numerical analyses ascertain the properties of all critical parameters, such as periphery, mechanics, thermodynamics, electrics, and fluid dynamics. Our engineers take into account all aspects relevant to the working life and steady function of a PGM component, such as the construction of the steel frame, insulation, temperature distribution and thermal expansion. To assure a comprehensive approach to the evaluation of the overall system, we design the whole system and provide an accurate assessment of the fundamental dimensions along with a detailed and in the majority of cases also 3-dimensional PGM component illustration for precise understanding.

Interdisciplinary tasks

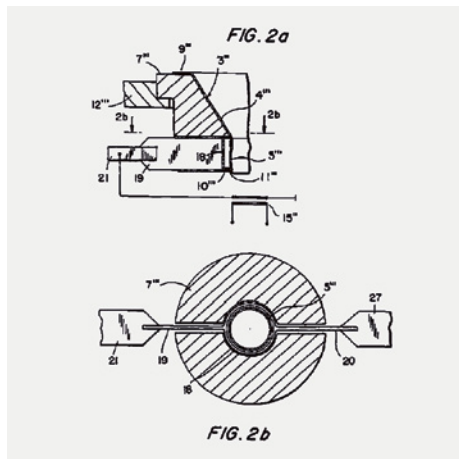
Smart solutions can be achieved only by integrating all aspects of our customers' manufacturing processes. As they are determined by a wide range of parameters it is of utmost relevance to understand the system as a whole. The correlation of thermodynamic, mechanical, electrical and fluid dynamics parameters related to both, the PGM component and the glass melt, is crucial to come up with results that are outstanding and sustainable. Umicore offers mathematical calculation tools in combination with physical modeling. This unique modeling capability is the result of many years of intense scientific developments aligned with field research and it correlates all above mentioned parameters. This sophisticated toolbox makes it even possible to come up with life-time calculations for our component designs.



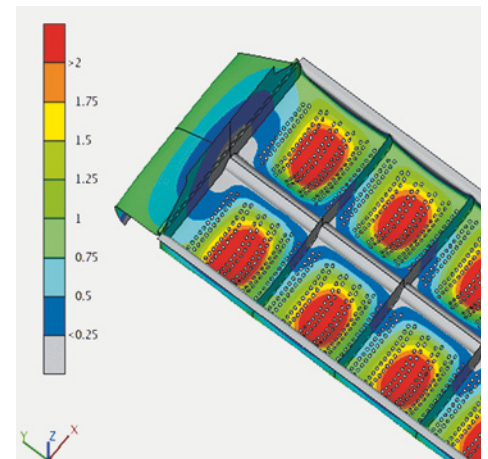
» Managing complexity



Periphery Correlation



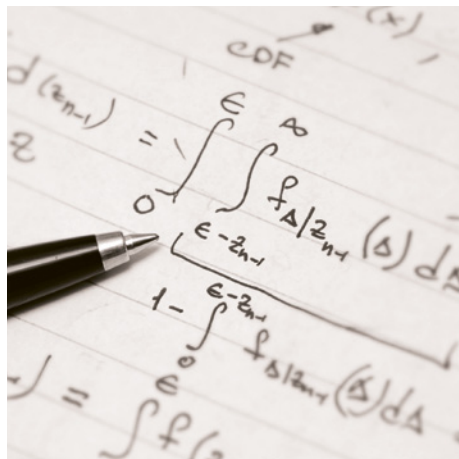
Patented Constructions



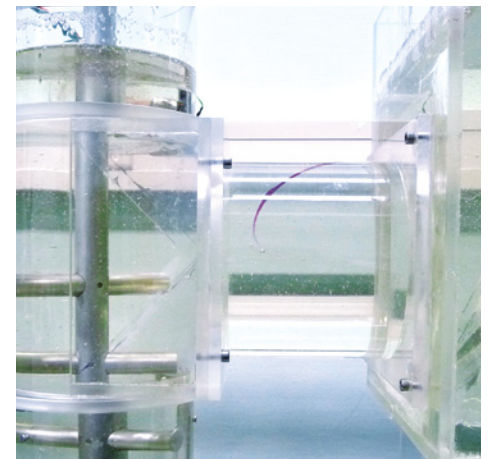
Mathematical Simulation



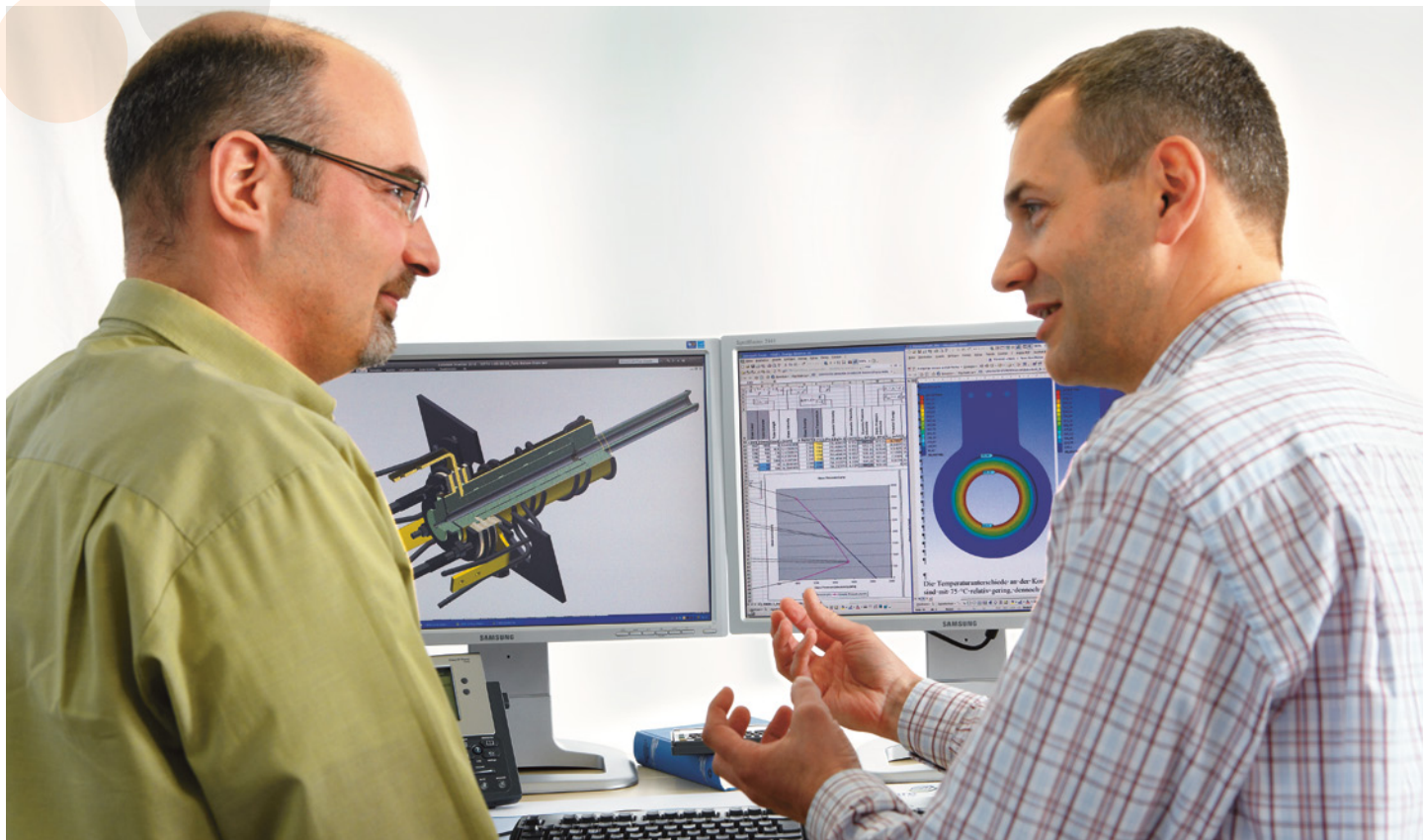
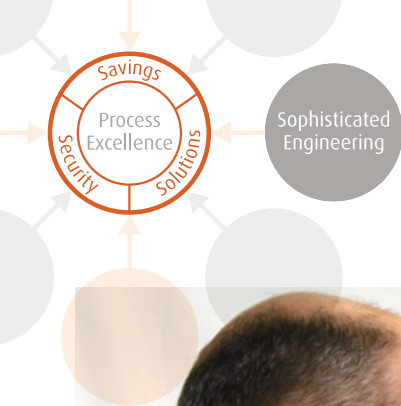
Bionic Shape Design



Life-Time Calculation



Physical Modeling



» Sophisticated engineering enables smart designs

We can offer a wide range of features due to our sophisticated engineering capabilities, our long-lasting experience, and inhouse expertise of our target industries.

Patented constructions

The engineering of thin-walled sheet metal constructions for temperatures of up to 1,650° C is a demanding task. While thin means less expensive, it does also mean the near impossible – unless the advantageous properties of the material are combined with advanced shaping methods and joining techniques during component manufacturing. Umicore has developed components with corrugated tubes based on patented hydraulic forming methods. Here the component geometry extenuates most of the elongation, thus increasing the strength of thin-walled components.

Our patented directly heated orifice ring maintains the quality of the glass melt right up to the last stage at which glass formation begins. It heats the outlet edge which is the area subject to the highest loss of heat, a major challenge in high-temperature processes in terms of energy costs and smooth process setting. The orifice itself comprises a minimum amount of PGM, it has a simplistic design and contributes considerably to an extended working life.

Bionic shape designs

Umicore is in the position to implement vault-corrugated shapes for thin PGM components dedicated to the special glass industries. This buckling structure is reminiscent of honeycomb cells that mimic naturally occurring phenomena. This revolutionary innovation is based on self-organized processes and enables manufacturing of PGM

components with significantly improved properties, such as increased shape stability, decreased wall thickness and thus PGM installation weight, compensated thermal expansion in all directions, improved heat transfer, and finally a prolonged working life of such PGM components.

Self-supporting designs

The excellent mechanical and chemical properties of our different FKS® material grades enable revolutionary unsupported PGM constructions applicable to stirrers and plungers that resist high temperatures. Such free-standing component designs are unique for the industry and can only be achieved by smart design solutions based on in-depth knowledge of the respective PGM material properties. These advantages relate to cost savings and process security: less heat loss, shorter in- and out-times, prolonged working life.



» Smart designs for excellent components



Bushings



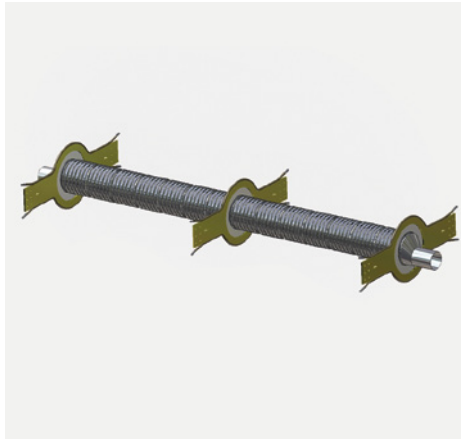
Orifices



Danner sleeves



Stirrers



Refiners



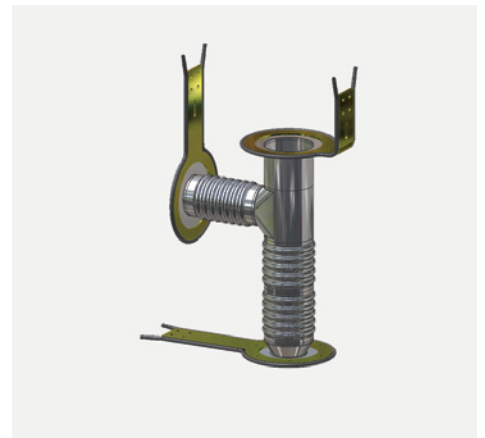
Plungers



Stirrer cells



Crucibles



Feeder cells



» FKS® Performance Materials

All our FKS® grades do have one unique strength in common: Their defined material properties will never change anymore during the entire life time in a high-temperature cycle – no matter how long the cycle lasts.

Being a leading materials technology group Umicore continuously develops new and improves existing material solutions based on the competence fields chemistry, material science, and metallurgy. These intelligent material solutions with their tailored material properties do serve as the basis for the majority of our engineering and design solutions.

Already many decades ago, Umicore designed its own brand of an oxide dispersion strengthened (ODS) material: FKS® was born. Due to the fact that even cast platinum alloys do not sufficiently

withstand any kind of high-temperature application due to unfavorable grain growth, the necessity to stabilize the grain boundaries of platinum in a different way than simply alloying it with other PGMs occurred.

FKS® stands for “Fein Korn Stabilisiert” which translates into “Fine Grain Stabilized”. All our FKS® material families follow sophisticated powder metallurgical manufacturing processes with unique nano-sized particles that completely inhibit any grain growth during high-temperature use. The materials’ high-temperature mechanical strength is 4 to 8 times higher compared to identical cast alloys, while the creep resistance of FKS® PtRh10 grades is up to 10,000 times higher than that of an identical cast alloy. Besides, high chemical resistance against aggressive glass melts make it even more attractive, and another strong point

is the superior forming behaviour that enables fabrication of very complex geometries based on these material grades.

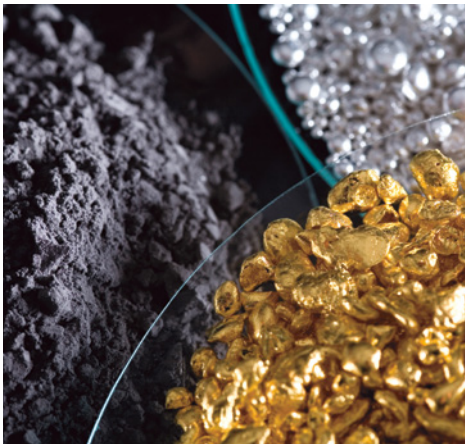
FKS® material grades are applicable to a wide range of alloys, such as PtRh, PtIr, PtAu, and even enable the usage of pure Pt systems in high-temperature applications, hence avoiding the requirement of even more expensive rhodium as an alloying component for specific applications.

Umicore’s current scope of material families combined with the commonly used alloy types perfectly covers the range of demanding applications within the special glass industries:

- › FKS® Agilit® (Pt PtRh)
- › FKS® Rigilt® (Pt PtRh PtAu PtIr)
- › FKS® Saeculit® (Pt PtRh)



» Ultimate material solutions



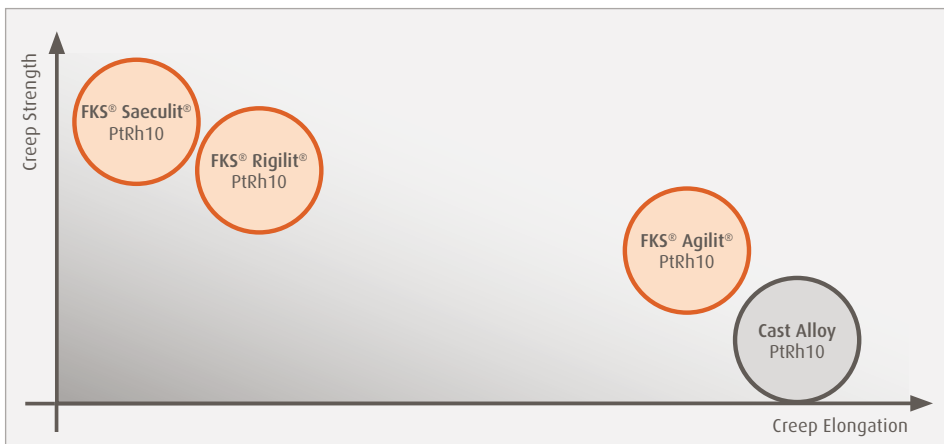
Metallurgy



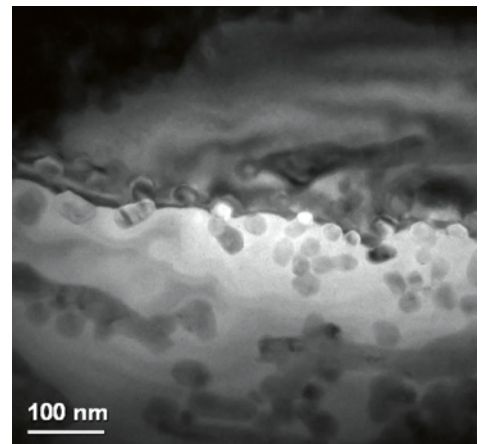
Chemistry



Material Science



Correlation of different material grades @ 1400°C



FKS® Nano-Technology



» Powder metallurgy enables customized material properties

Advanced materials right on target need to be based on the capability to understand and master naturally given mechanisms and pattern. Umicore's excellent and well-organized research and development center presently employs more than 500 people in functions organized around four main competency platforms:

- › Fine Particle Technology
- › Recycling and Extraction Technology
- › Analytical Competencies
- › Environment, Health, and Safety Competencies

These scientific resources in combination with the ideas of our people and decades of experience enables us to develop unique materials as a solid basis for our PGM component solutions. Our long-lasting experience as a materials technology group is the basis for groundbreaking processes like fine

powder metallurgy to come up with material solutions that set new quality and design standards throughout the industry.

The resulting technical advantages, like free-standing components with lowest variation limits during operation, immediately translate into high value in use by total cost savings – all triggered by our FKS® material grades: advanced design solutions with decreased overall PGM requirements, reduced PGM losses in operation, as well as distinctly increased service times of the FKS® components.

FKS® Agilit®

The perfect choice for high creep elongation while maintaining reasonable creep rupture strength. This material is perfectly suitable for components that are subject to frequent temperature cycling.

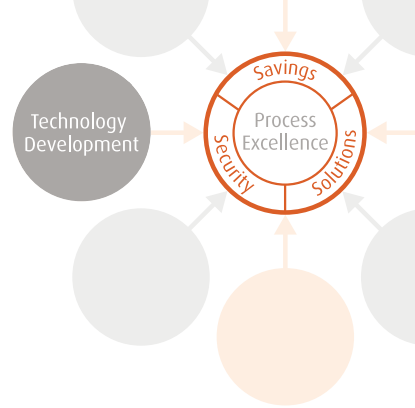
It is furthermore applicable to components that are partially blocked due to their geometry and thus the material needs to deform without to crack, such as stirrer cells.

FKS® Rigilit®

The perfect choice for high creep rupture strength at acceptable creep elongation. This material is perfectly suitable for components that are subject to normal operational loads and conventional local stress areas, such as refiners.

FKS® Saeculit®

The perfect choice for extraordinarily high creep rupture strength combined with a rather low relevance regarding creep elongation. This material is perfectly suitable for components that are subject to very high operational loads, such as bushing base-plates.



» Our Technologies: Tailored to individual needs



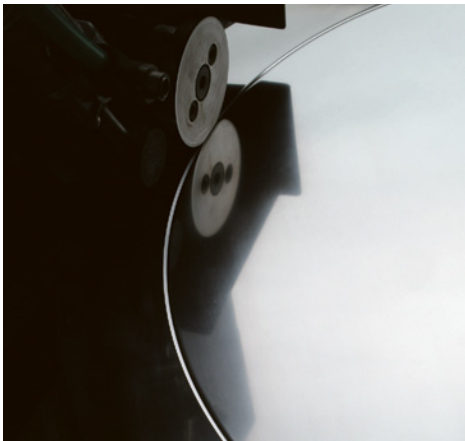
Melting Technology



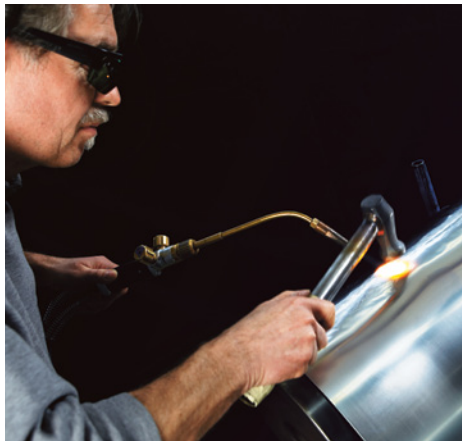
Forging Technology



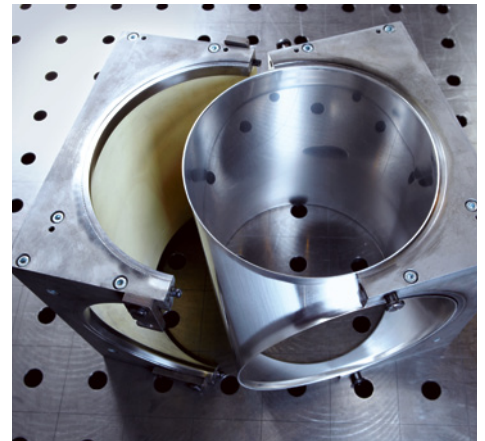
Rolling Technology



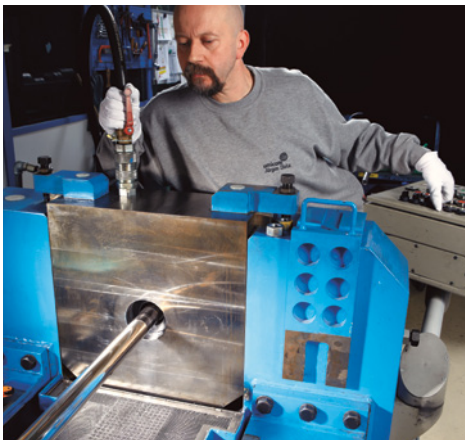
Cutting Technology



Hammer Welding Technology



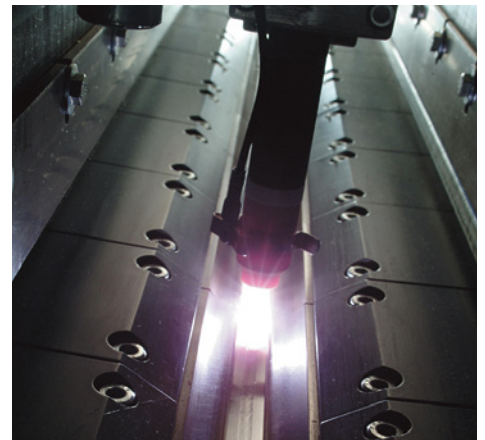
Forming Technology



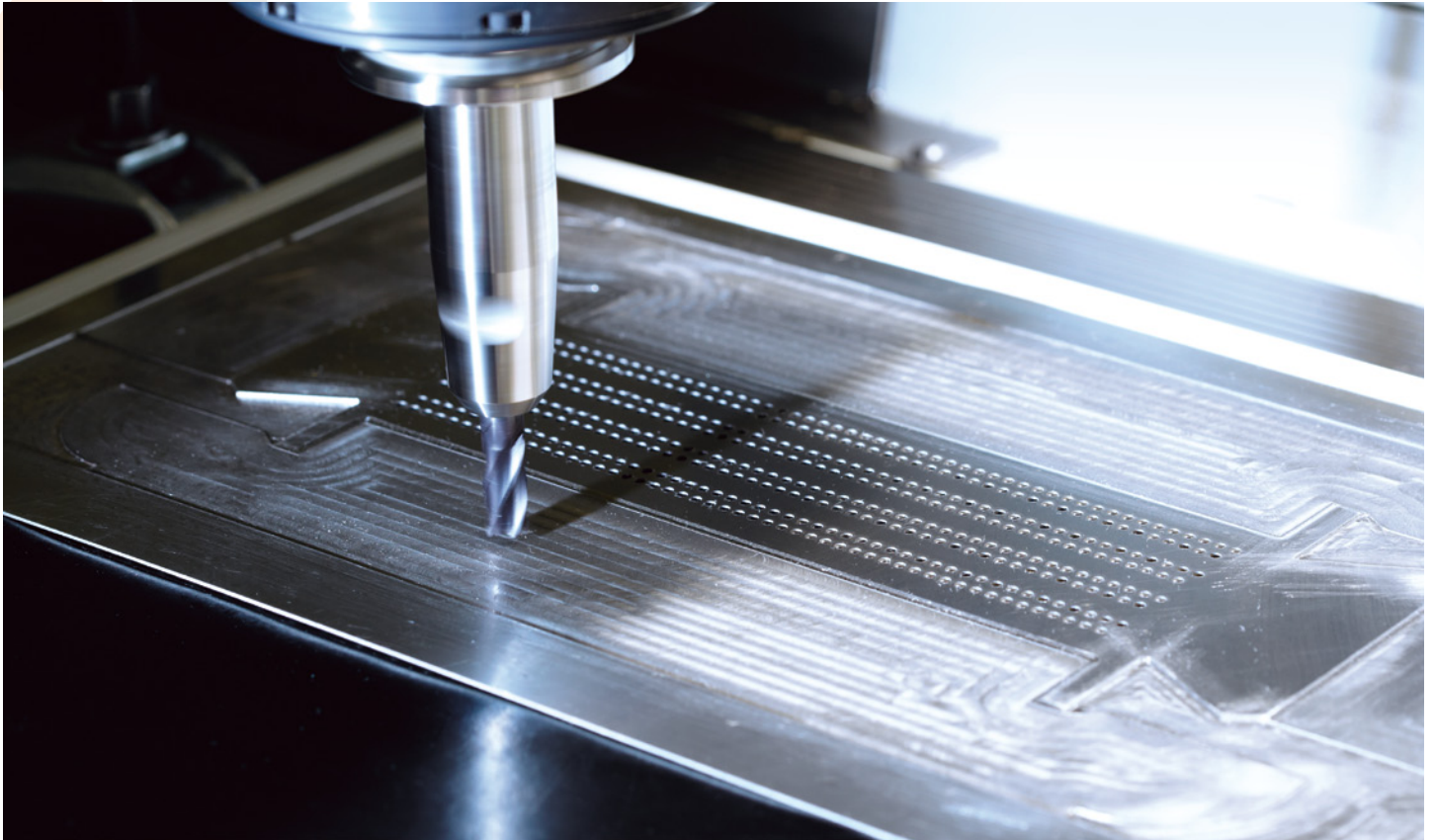
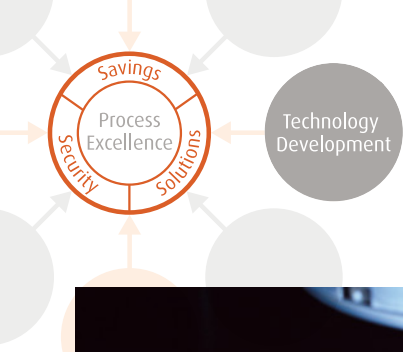
Drawing Technology



Mortising Technology



Welding Technology



» High added value creation by technology leadership

No tube, no welding seam, no connection, no branch or any other part must have a weak spot – certainly not at normal temperatures, but for sure not during operation at very high temperatures and for very long service times.

One may ask how we manage to master all the various specific and novel challenges regarding PGM component quality, reliability, and durability. The answer is actually quite simple: by applying the best technologies that are available, by continuously working on innovating and fine-tuning them, or even by inventing new ones in case no solution is available yet. But the challenge is even more demanding: in the majority of projects we need to develop individual solutions for our customers, so we don't take components off the shelf. Each of these projects yields a technology

based prototype, that needs to work instantly once installed in the process. Hence our adaptability can only be based on technology leadership.

We apply a wide scope of sophisticated manufacturing technologies: starting with various melting, rolling, spinning, and drawing techniques, up to state-of-the-art machine cutting, punching and welding techniques, complemented by specialised forging technology, and materials technology like powder metallurgical routines. Further prominent examples are hydraulic forming and hydroforming techniques. Some of our routines are patented so we can make sure that our leadership position cannot easily be attacked. The recipe to success lies in our unique combination of skilled manufacturing and fully automated routines executed with pioneering equipment.

Skilled people with long-lasting experience cannot be replaced by machines in our business. In contrast, they contribute substantially to the high intrinsic quality standards of our products due to the know-how they carry in their heads and hands. We do also engineer our tooling devices inhouse which gives us further flexibility related to technology. The majority of our automated processes is supported by our strong inhouse process engineering & development, all based on CAM Excellence. This way we can assure that despite a high portion of hand-made work we do still comply with competitive delivery times. All our manufacturing technologies are accommodated with the properties of the materials they deal with and with our strong applied technology capabilities. Repeated reflexion of how we do things is the key to excellence in our manufacturing technology.



» Example Fiber Glass: Bushing redesign for high value in use

Original Design

- Base-plate alloy PtRh20
- Upper structure PtRh10
- High number of welding seams in critical areas
- Insufficient correlation with process boundary conditions
- Poor design configuration

Low value in use

- Service time limited to 300 days
- High rhodium content
- High total bushing weight
- Severe base-plate sagging
- High degree of tip corrosion
- Inhomogeneous temperature distribution

Umicore Design

- Base-plate material FKS® Rigilit® PtRh10
- Adapted upper structure PtRh10
- Improved welding configuration for the entire bushing
- Reduction of base-plate thickness
- Correlation of design and boundary conditions

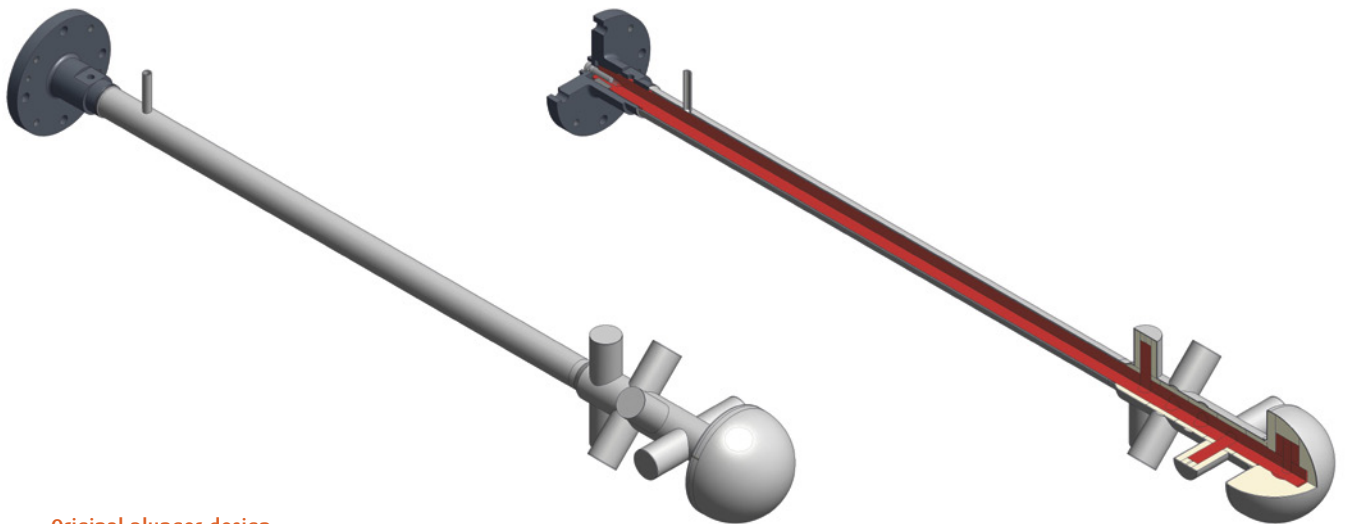
Process Excellence

- Service time increased to 480 days
- Reduction of rhodium content by 10%
- Total bushing weight maintained
- No sagging problems and tip corrosion
- Reduced start-up temperature
- Annual total cost saving of about 50 kEUR per bushing





Example Technical Glass: Plunger design with low value in use



Original plunger design

- Stainless Steel
- Molybdenum
- Refractory
- PGM

Original Design

- Component design is based on cast PtRh10 alloy
- Molybdenum core is required to assure the mechanical stability of the component
- Ceramic layer is required to separate the molybdenum core from the PGM alloy to prevent intermetallic diffusion
- Evacuated inner core of the component
- Complicated layer structure
- High number of welding seams in critical areas

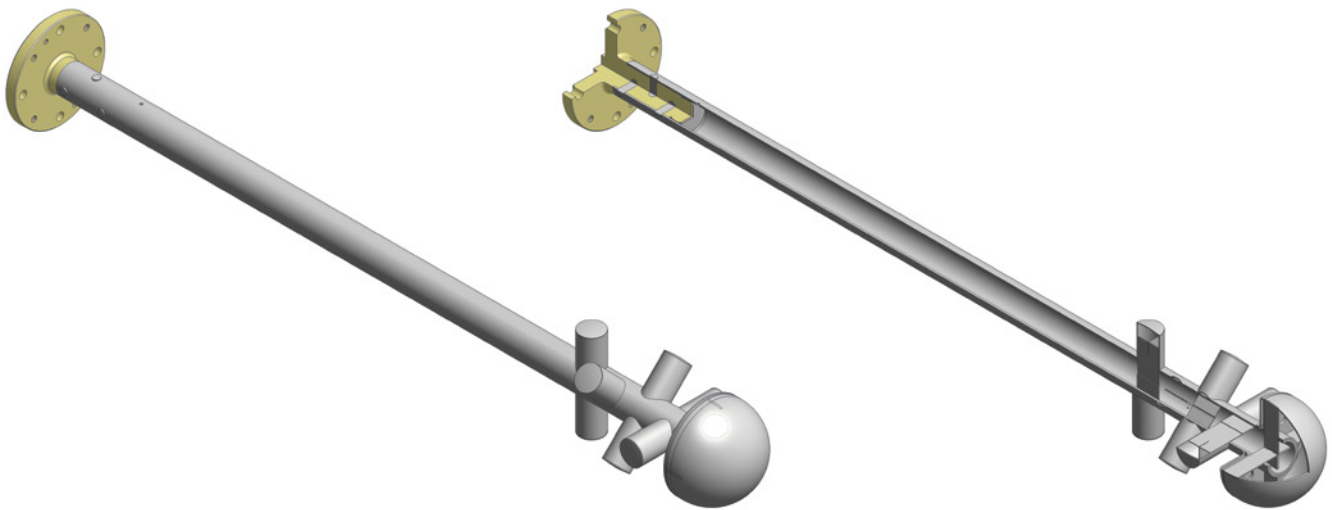


Low value in use

- High risk of component failure as molybdenum is a potential platinum poison that can weaken the mechanical stability of the plunger
- High risk of glass purity contamination due to PGM cladding damage by intermetallic diffusion
- Internal mechanical friction that reduces mechanical stability of the component due to various different expansion coefficients of the different respective materials
- High overall PGM weight of cast alloy is required to cladd the core of the component
- Plunger service time is limited to maximum 3 years
- High manufacturing cost of component due to layer structure



>> Example Technical Glass: Plunger design with high value in use



Umicore plunger design

- PGM
- Inconel

Umicore Design

- Unique FKS® material properties enable revolutionary design features
- Applied shaping & welding technologies are perfectly adjusted to FKS® material properties
- Distinctly reduced number of welding seams
- Partially seamless shank
- Welding seams only in non-critical areas like low-stress or stress-free zones with sealing properties instead of supporting properties
- Entire component is made of one homogeneous material for smooth operation behaviour



Process Excellence

- Predictable and distinctly increased service time of up to 5 years
- Reproducible glass gob weight during glass forming process with very low tolerances
- Energy savings during glass forming process due to the fact that the component does extract less heat from the glass melt system
- Possibility to transfer torques of 10–100 Nm at temperatures of 1,000–1,500°C to the component without any mechanical damage
- Less process losses of platinum due to decreased vapourisation of FKS® material compared with cast alloys
- Simplified construction design with substantially increased functionality



» Closing the loop: a must have in the PGM world

As always in life, every coin has two sides. One may use the most economic and optimized PGM system solution that one can think of, but without a sophisticated and accurate refining process at the end these benefits could quickly get lost. Umicore is the world's largest recycler of precious metals from either spent catalyst materials or used ceramics, spanning everything from high content PGM scrap to very low content PGM scraps.

The cost of financing the precious metals is however only a tiny fraction of the total cost of PGM. Although it is possible to calculate realistic PGM

losses during the glass melting, feeding and forming processes, some PGM component manufacturers tend to widen the range of expected PGM losses in their commercial offers. The objective is to cover all likely operating conditions which impact PGM losses. The real PGM loss however can only be determined after sampling and in-depth analysis of the used PGM component. Knowing these factors, it is advisable to either have a very trustworthy refiner and PGM component supplier at hand, or to always use the services of a so called inspector, who will be present during sampling to take samples of the homogenized fraction of the precious metals and will analyze those by

comparing his analysis results with those determined by the refiner.

Using the services of an approved inspector will minimize the risk of losing PGM after refining and will further eliminate the possibility of a mixed calculation which influences the pricing of new PGM components. Umicore offers completely transparent and traceable documentation in this regard, which is not only in line with our work ethics but also clearly stipulated in our code of conduct and the values we are living up to. Trust is an important basis when dealing with products that are solely based on precious metals.



» Long-term partnerships for sustainable results

Our solid market position not only reflects the continuous high quality of our products and services. It's as much a consequence of our approach to work in long-term partnerships towards shared objectives with our customers. Providing single-source engineered solutions to our customers automatically triggers a higher level of commitment, as we do not walk away after the service is completed, we stick to our Life Cycle Management approach.

We never underestimate the economics of peace of mind: A good partnership ensures against unexpected problems or emergencies. The benefits of such a partnership are hard to quantify. The certainty to have a trustworthy partner is an achievement just as valuable as the services and the products we offer. And as we are used to working on total cost calculations we have even found a way to express these benefits in facts and figures.

To consult our customers in the best possible way by a wide range of services has always been an integral part of our business model. The scope spans everything from metals management, logistics, market analysis, troubleshooting, on-site support up to specific services on demand. Technically we provide trainings, identify strong points as well as areas of improvement related to the conditions the PGM component is confronted with in the process.



Secure Packaging



Tooling Design



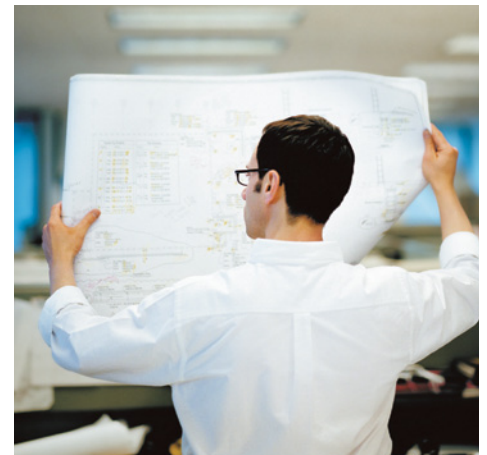
Component Inspection



Metals Management



Campaign Reviews



Troubleshooting



» Close to our markets: local support

France (Bagnole)

Umicore France
+33 1 4972 4308

Thailand (Bangkok)

Umicore Thailand
+66 272 702 34

USA (Glens Falls)

Umicore North America
+1 508 639 5299

Germany (Hanau)

Umicore Germany
+49 6181 59 5287

Australia (Melbourne)

Umicore Australia
+61 3 9514 1100

India (Mumbai)

Umicore India
+91 22 6627 5656

Brazil (Sao Paulo)

Umicore Brazil
+55 11 2421 1147

Korea (Seoul)

Umicore Korea
+82 2 522 2291

China (Shanghai)

Umicore China
+ 86 21 2411 6814

Taiwan (Taipei)

Umicore Taiwan
+886 2 2739 3297

Japan (Tokyo)

Umicore Japan
+81 3 5413 9334

Austria (Vienna)

Ögussa Ges.m.b.H.
+43 1 866 464 411



» Global manufacturing presence

Hanau (Germany)

Umicore AG & Co. KG
Headquarters & Competence Center
Rodenbacher Chaussee 4
63457 Hanau-Wolfgang
Germany

Vienna (Austria)

Ögussa Ges.m.b.H.
Part of the Umicore Group
Liesinger Flur Gasse 4
A - 1235 Vienna

Manaus (Brazil)

Coimpa
Avenida Rodrigo Otavio 3047
Distrito Industrial
CEP 69077-000 – Manaus
Amazonas

Sao Paul (Brazil)

Umicore Brazil Ltda.
Rua Barao do Rio Branco nº368
Itapegica – Guarulhos
CEP 07042-010 – Guarulhos Sao Paulo

Yokohama (Japan)

Umicore Japan, German Industry Park
1-18-2 Hakusan, Midori-Ku
Yokohama, Kanagawa 226-0006
Japan (as of end 2011)

Umicore AG & Co. KG
Platinum Engineered Materials

Rodenbacher Chaussee 4
63457 Hanau-Wolfgang
Germany

Tel. +49 (0) 61 81-59-52 87
Fax +49 (0) 61 81-59-52 04

E-mail: platinum@eu.umicore.com
www.umicore.com
www.platinum-engineered-materials.com