

Heraeus



Worldwide Competence in Precious Metals and Special Materials



It all began with the melting of platinum

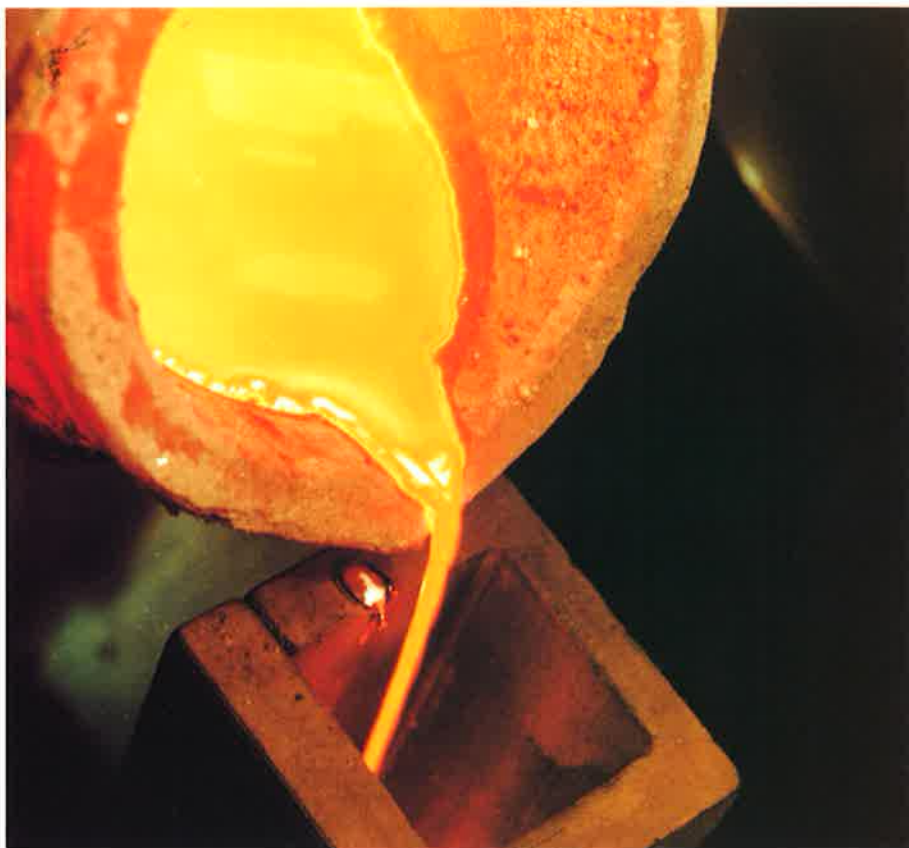
What we now accept as everyday technology was once regarded as pioneering – the high technology of another age.

Take, for instance, the melting of platinum on a kilogram scale. In 1856 the chemist and pharmacist Wilhelm Carl Heraeus was the first person in Germany to succeed in doing this, five years after taking over the Unicorn Pharmacy in Hanau from his father. He thereby provided the foundation for the industrial use of platinum.

Since that time Heraeus has been at the forefront of innovation, transforming unusual technologies into viable industrial processes, and has been responsible for writing a large part of the history of technology.

Right from the start precious metals have been at the heart of our activities. Today the various divisions of W.C. Heraeus GmbH are, amongst other things, active in:

- Acquisition of and trading in precious metals
- Manufacture, processing and fabrication of precious and special metals
- Reprocessing of products containing precious metals and recycling of precious metals
- Manufacture of precious metal catalysts for the chemical industry and the environment
- Manufacture of chemicals and pharmaceutical agents containing precious metals
- Development of new products for electrochemical applications and production techniques for the manufacture of anodes and cathodes
- Manufacture of chemical electrolytes, e.g. precious metal electrolytes, cleaning and brightening salts, and non-precious metal electrolytes

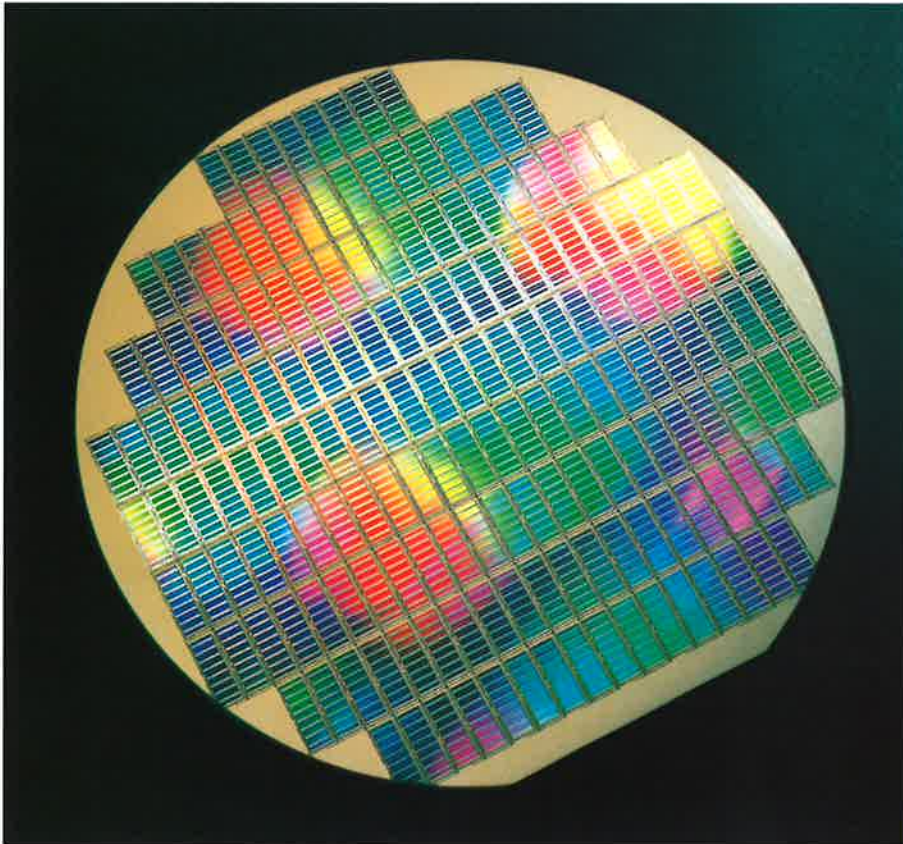


- Development, design and manufacture of electroplating plants and equipment for surface finishing
- Surface finishing of products for application in jewelry, watches, optics, writing utensils and electronics with our state of the art, environmentally friendly, toll electroplating service
- Manufacture of precision semi-products for many applications in particular for the jewelry, watch-making, writing utensil and optics industries
- Manufacture of ceramic colours for decorating porcelain, bone china, stoneware, ceramics and glass

- Manufacture of products for electronic circuits, e.g. conductor, resistance, dielectric and polymer pastes as well as fluxes, solder materials, adhesives and solder pastes for SMT technology
- Processing and injection moulding of high value, finished metal components with technical plastics for automobile electronics and for industrial, control and sensor technologies

W.C. Heraeus belongs to the leading addresses in the industrial precious and special metal business worldwide.

A consortium of businesses in Europe, North America and Asia maintains production capacities for all stages of precious metal extraction and processing.



Wafer with finished chips which have been created in numerous process stages from a variety of different metal layers with specific electrical functions

Concentrated in the Electronic Materials Division are all the activities of those sections of W.C. Heraeus GmbH which are principally concerned with the manufacture of products for the semiconductor industry. The so-called "direct materials" arise from these production processes.

The products which Heraeus offers cover the whole range from "front end" to "back end" with the main activities in the following fields:

- Sputtering targets
- ITO targets
- SMT adhesives

- Solder pastes
- Fluxes
- Solder balls
- Cleaning agents
- Bonding wires
- Leadframes
- IC frames for Smart Cards

Our customers profit from the decades of experience that Heraeus has accumulated in the research and development of materials and the subsequent applications technology. Analytical processes complete the technological leadership as the basis of our worldwide market presence.

Selected production facilities:

**W.C. Heraeus GmbH,
Electronic Materials Division
Hanau, Germany**

- Sputtering targets
- ITO targets
- SMT adhesives
- Solder pastes
- Fluxes
- Solder balls
- LTCC materials
- Thick film pastes
- Precious metal powders
- Bonding wires
- Leadframes
- IC frames for Smart Cards

Heraeus Inc., Chandler, AZ, USA

- Semiconductor targets
- Disk targets
- Precision stamped parts

**Heraeus Inc., Cermalloy Division,
West Conshohocken, PA, USA**

- Solder pastes
- SMT adhesives
- Fluxes
- Thick film pastes
- Capacitor pastes
- Precious metal powders

**Heraeus Oriental HiTec Co. Ltd.,
Seoul, Korea**

- Bonding wires

**Heraeus Precision Engineering
Pte. Ltd., Singapore**

- Stamped and etched leadframes
- Sputtering targets

**Heraeus Electronic Materials
Philippines, Inc., Cavite,
The Philippines**

- Bonding wires
- Leadframes

**Heraeus Zhaoyuan Precious Metal
Materials Co. Ltd., Zhaoyuan City, China**

- Bonding wires

The products of the Electronic Materials Division are presented on the following pages.

Thick film pastes for the manufacture of miniaturized circuits and materials for the manufacture of LTCC circuits and for SMD technology are an essential part of Heraeus' commitment to the electronics sector. The Thick Film Department develops and produces these materials at its facilities in Philadelphia (USA), Hanau (D) and Hongkong.

In thick film technology, thick film pastes are screen printed onto a ceramic substrate, dried and burnt in at high temperatures. Depending on the composition of the paste, finely structured films can be achieved with a wide range of physical properties which are needed for instance in conductor lines, resistances and insulating layers. Due to the manufacturing process, these films are characterized by their high quality and reliability. They can fulfil the highest demands which are required of precision circuits.

Flexible dielectric foils (tapes) are printed individually for the manufacture of LTCC (Low Temperature Cofired Ceramic) circuits and are fitted with vias, i.e. contacts passing through the tape. The resulting single layers are stacked on top of each other, laminated under pressure and fired at approx. 850°C.

For SMD technology the Thick Film Department produces

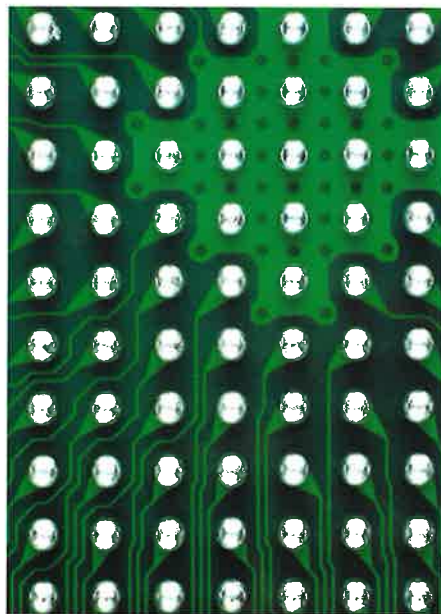
- Solder pastes
- SMT adhesives
- Fluxes

This programme is supplemented by soldering materials such as

- Solder balls
- Cleaning agents



Presentation of the PDF product range



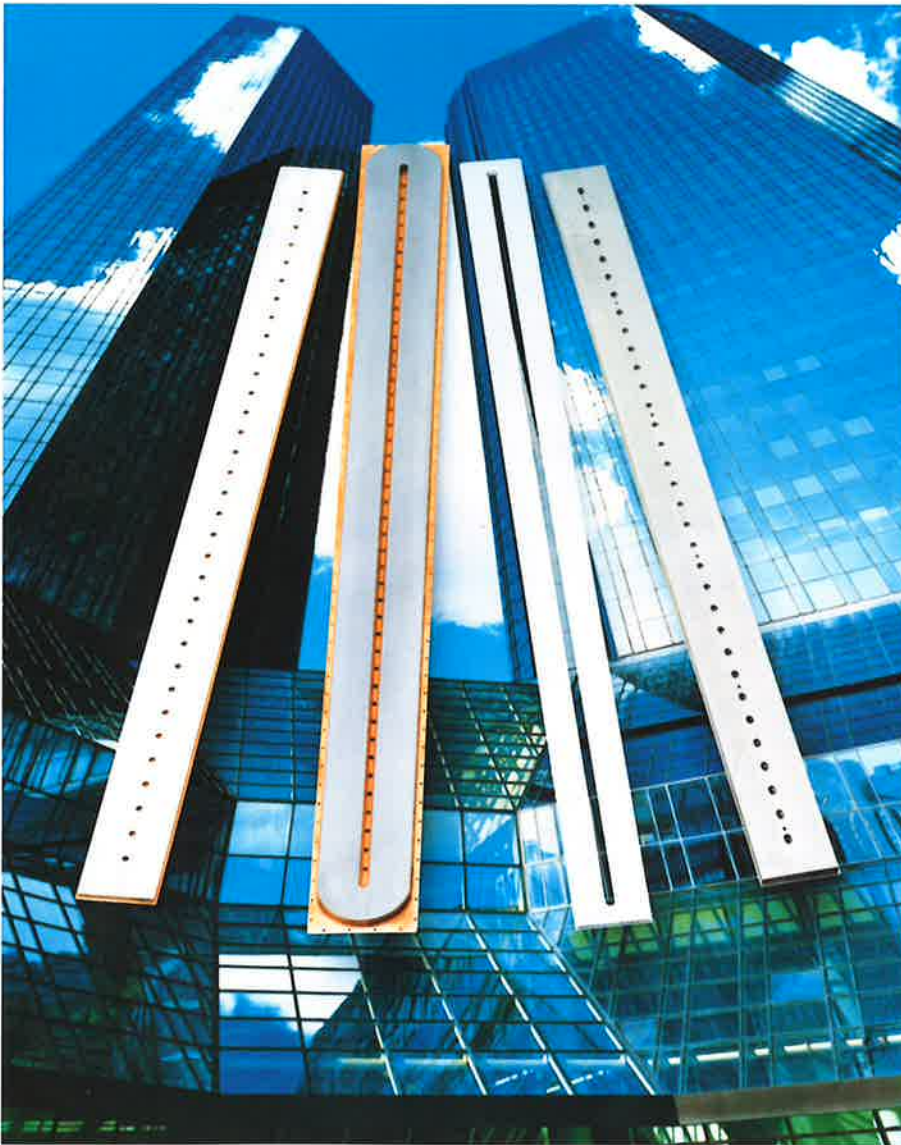
Solder balls for ball grid arrays



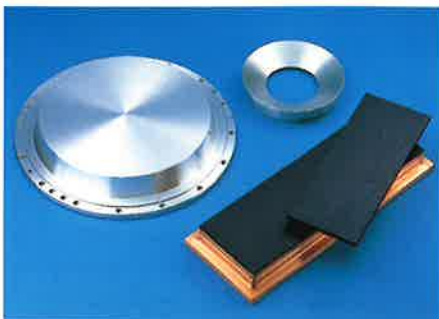
Cadmium-free gold paste G5007, bonded with 30 µm gold wire

The Thick Film Department is supported by marketing subsidiaries in Austria, the Netherlands, Spain, France, Great Britain, Italy, China,

Japan, Singapore and South Africa as well as by contract agencies in Korea, Australia, Scandinavia and Eastern Europe.



Sputtering targets for coating large surface areas



Sputtering materials for LCD flat panel displays and for semiconductor technology

Heraeus' leading position as a world-wide supplier of sputtering targets and evaporation materials in the Product Line Thin Film Technology is based on production facilities in:

- Hanau (Germany)
- Chandler (USA)
- Shanghai (China)
- Singapore

Tailor-made product programmes stand at the centre of the various market segments of thin film technology. The technical optimization of the materials, based on the specific requirements of each application, is carried out in close cooperation with the customers and equipment manufacturers. The high degree of material specialization is demonstrated by the following major products:

- Materials for data storage technology:
[CoCr(Ta,Pt), Cr, Cu, Al, CuAl, Au]
- Materials for flat glass coating
[Ag, Sn, Cr, Zn, Ti, NiCr, SS, ITO]
- Materials for LCD flat panel displays:
[ITO, Al, Cr...]
- Semiconductor technology materials:
[Ti, Al-alloys]
- Materials for electronics:
[Au, Ag, Pt, Pd, Ru, Ir, Rh]
- Tribology and decorative materials:
[Ti, TiAl, AlCr, Al, Cr, Au, AuNi, AuPd, Pt...]

The expertise for complex production technologies such as melting and powder metallurgy, thermo-mechanical microstructure processing, machining and bonding together with our efficient R & D facilities and global representation guarantee optimum customer service in the field of materials for thin film technology.

The Product Line Packaging Materials manufactures products for the so-called "back end". These are:

- Bonding wires
- Leadframes
- IC frames for Smart Cards

Bonding wires serve as the electrical connection from the chip to the lead-frame and are manufactured from doped gold and from both high-purity and alloyed aluminium. The most commonly used diameters range from 24 µm Au (e.g. for memory components) to 800 µm Al for heavy duty applications (e.g. in the automobile field).

Heraeus has in-house access to all necessary production steps in the manufacture of leadframes. This is a basic prerequisite in order to be able to react quickly to customer requirements and to guarantee process reliability. The complete service includes our own toolmaking, including servicing and maintenance, the manufacture of photographic tools, stamping and etching, electroplating, downsetting and taping (including LOC taping). Copper and ferrous materials are etched on two separate etching lines.

Smart Cards, such as the telephone card and the German health insurance card, represent a rapidly expanding European market. Heraeus has developed IC frames for card modules. They are stamped and then laminated with a precisely matched polymer foil. Subsequently, this composite is electroplated in-house according to customer specifications for instance with nickel and gold or with nickel, palladium and gold. These strips are available in endless form. This new procedure permits the manufacture of functional multiple-layer constructions from different materials which are customer-specific, economical and environmentally friendly.



Bonding wires of Au, Pd and Al

To ensure short reaction times in this rapidly changing market, Heraeus manufactures products not only in Germany but also in Asia.

Selected production facilities:

Heraeus Oriental HiTec Co. Ltd., Seoul, Korea

- Bonding wires

Heraeus Precision Engineering Pte. Ltd., Singapore

- Stamped and etched leadframes

Heraeus Electronic Materials Philippines, Inc., Cavite, The Philippines

- Bonding wires
- Leadframes

Heraeus Zhaoyuan Precious Metal Materials Co. Ltd., Zhaoyuan City Shandong Province, China

- Bonding wires



Stamped laminated IC frames for Smart Cards

The Materials Technology Division manufactures, processes and fabricates high-value materials for technical applications, especially materials requiring complex processing techniques.

The central competence of this division lies in the industrial application of precious metals and their alloys either in solid form or as surface films which we can also structure, if required. Additionally, we master the technical usage of special metals such as tantalum, niobium, zirconium, beryllium, and the manufacture of high purity materials. With our intensive research work we are continually extending our range of competence.

Our products, which meet the most exacting demands, find applications in industries such as :

- Electronics
- Telecommunications
- Data processing
- Computer technology
- Medical technology
- Buildings
- Glass manufacture
- Chemical industry
- Automobile industry
- Electrical technology
- Mechanical engineering
- Lighting technology

and last, but not least, in research centres around the world.

The DIN EN ISO 9001 certificate was awarded the Quality Management of the Materials Technology Division in 1994. It guarantees that the material qualities of Heraeus are always characterized by reproducible optimum microstructures and metallurgical features, and purities into the ppb range.

The range of the services offered by GBM:

- The development of new alloys and material combinations together with inspections and analyses in our own laboratories prove our **competence in materials technology**
- The development of customer-specific products, starting with the characterization and manufacture of the precursor material, the choice of the optimum process parameters right through to the qualification of the specific production route generates **optimum customer benefit**
- Our expertise in complex production technologies including powder and melting metallurgy, forming, joining technology and machining, together with the well-known surface finishing processes such as roll cladding, electroplating, evaporative coating, resistance welding ensures **production competence**
- Modern, efficient research, development and testing laboratories establish the basis for elaborate production processes and a constant high level of quality, and also offer the customer an **optimum advisory and service package**
- Worldwide production facilities guarantee **closeness to the customer**

Selected production facilities:

**W.C. Heraeus GmbH,
Materials Technology Division
Hanau, Germany**

- Precious metal semiproducts
- Laboratory equipment
- Glass fibre bushings
- Catalyst gauzes

- Writing utensil products
- Thermo-wires, sheathed wires, fuse wires and potentiometer wires
- Clad strips, full surface or in stripes
- Foils and ribbons
- Implant materials, medical parts
- Beryllium products
- Contact profiles
- Welded contacts
- Precision stamped parts for semiconductor and electronics industries
- Impact extruded parts
- Plastic-metal composite components for automobile electronics and for industrial, control and sensor technologies

**Heraeus Inc.,
Chandler, AZ, USA**

- Sputtering targets
- Precision stamped parts

**Heraeus Materials Technology
Shanghai Ltd., China**

- Glass fibre bushings
- Sputtering targets
- Tungsten carbide balls (TC-balls)
- Products for writing utensils
- Precious metal chemicals

**Ravindra Heraeus Ltd.,
Udaipur, India**

- Laboratory equipment
- Catalyst gauzes

**Choksi Heraeus Ltd.,
Udaipur, India**

- Contact materials by powder and melting metallurgy
- Semiproducts containing precious metal

Everywhere in the world, the customer benefits from this global production strategy with consistently high quality.

The five Product Lines which form the Materials Technology Division are presented on the following pages.

The industrial application of platinum and its alloys forms the central part of the Product Line Precious Metals Technology. Platinum alloys are excellent materials everywhere when stability, high temperatures or purity are essential. When more than one of these criteria has to be fulfilled simultaneously they become irreplaceable.

Complicated platinum products, claddings and linings for equipment find application both in analytical chemistry for use into the ppb range and in high temperature technology and glass making.

Only gauzes of platinum wire possess the desired catalytic and mechanical properties which permit the synthesis of nitric acid. A broad spectrum of applications results from the metallurgical processing of the other platinum group metals rhodium, iridium, palladium, ruthenium, rhenium and osmium – specialities of the Product Line Precious Metals Technology.



Crucibles, dishes, XRF equipment and other laboratory utensils made of precious metals and alloys, iridium and rhenium

A summary of the PET products:

- Precious metal semiproducts in various dimensions and forms
- Catalyst gauzes
- Catchment systems
- Laboratory equipment
- Precious metal products for the glass industry, e.g. glass fibre bushings, drain bushings, linings and claddings of platinum and platinum alloys, Pt tools for the manufacture of special glass, thermocouple thimbles, etc.
- Customer-specific components of precious metals and their alloys
- Products for writing utensils
- High purity, homogeneous metallic fluxes for gas analysis



Precious metal products for the glass industry



Warp knitted catalyst gauzes for ammonia oxidation to nitrogen oxides



Electrode tips for cardiac pace makers

Technological progress in medical and beryllium applications is supported by the Product Line Medical Technology with its specialized materials. The competence, recognized on all sides by our customers, is apparent in

- platinum and other precious metals and their alloys
- the manufacture of micro-precision parts
- surface finishing with functional films
- high-vacuum joining technology
- our role as the leading beryllium processor in Europe

Take, for example, the development of rhodium foils with a thickness of only 25 μm . These are used as radiation filters in mammography equipment and reduce X-ray exposure for women by 50% while at the same time markedly improving the resolution of the X-ray image.

Cardiac pacemaker electrode tips are coated with micro-porous layers which increase the pacemaker's operational life and enable it to measure cardiac activity more precisely.

Beryllium windows for X-ray tubes are used both in the highest grade medical equipment for cancer examination and in X-ray applications with extremely high radiation intensities.

The product range of PME:

- Implantable electrodes
- Rhodium filters
- Medical radiation sources
- Micro-precision parts
- Beryllium radiation windows
- Beryllium mask-blanks for LIGA technology
- Beryllium formed parts for aerospace applications



Beryllium radiation windows for X-ray tubes

Decades of experience in manufacturing semiproducts for further processing in-house is reflected in production expertise, high quality standards and comprehensive applications technology in the Product Line Semi-Finished Products. This experience can be used to the advantage of our customers when they manufacture finished products for especially demanding areas of application. The Product Line has therefore become a valuable partner in finding solutions in materials and other customer-specific problems in the semiproduct sector. Semiproducts comprise wires, tubes, profiles, foils and strips which are tailor-made to meet special purposes and applications. In cooperation with the customer these are developed further and optimized.

Semiproducts are supplied for the following areas of application and industrial sectors:

- Semiconductor industry
- Electronics and electrical engineering
- Heating technology
- Temperature sensors
- Electrical fuse technology

To ensure optimum customer advice and support service, the efficient development, testing and inspection laboratories in the Materials Technology Division can be used for the solution of problems.

The main products in the range of semiproducts are:

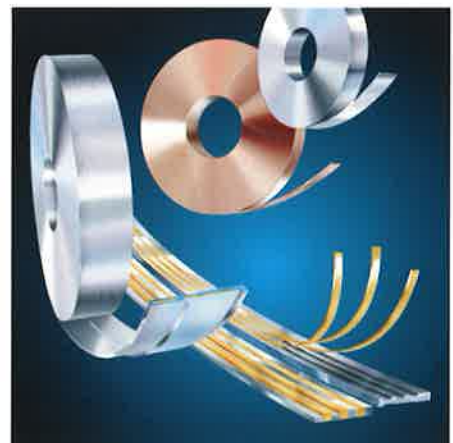
- Thermo-wires, sheathed wires, fuse wires, potentiometer wires and wires for spark-plug electrodes
- Contact profiles
- Clad strips, full surface or in stripes
- Foils and ribbons



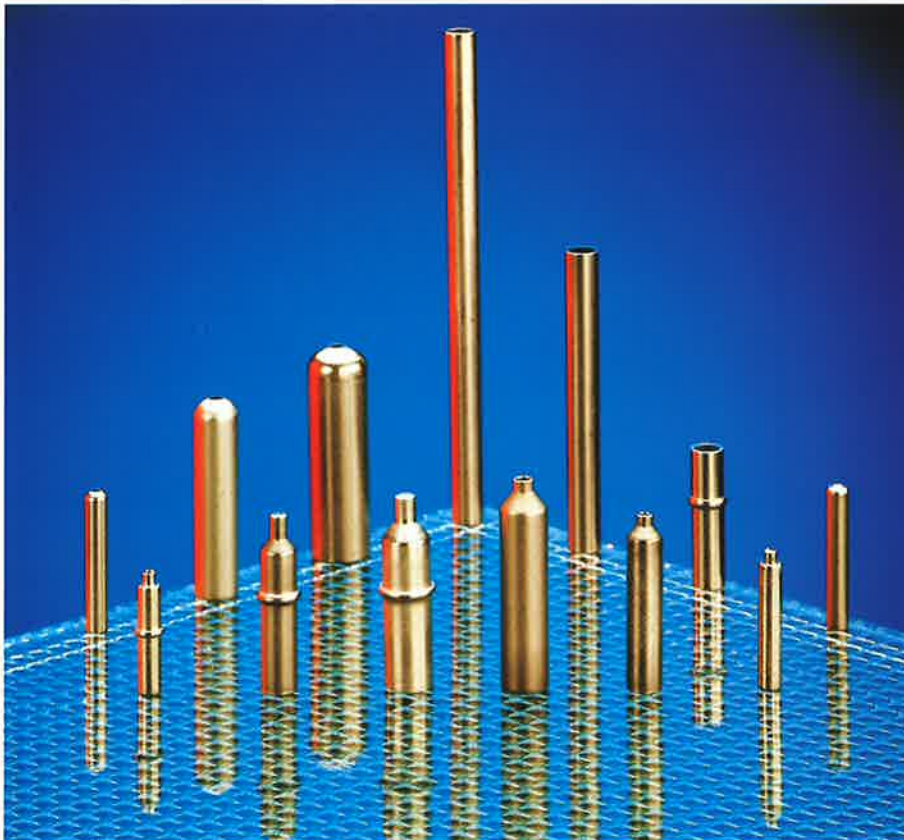
Microcontact profiles



Thermo-wires of Pt and PtRh, fuse wires of AgCu alloys



Cold roll-clad composite materials as strips and profiles

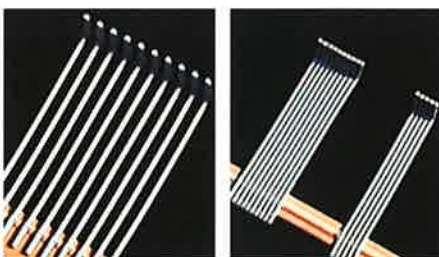


Precision parts of Nb 1%Zr for lighting technology

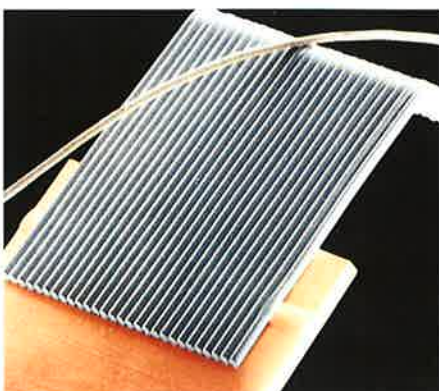
The Product Line Precision Technology produces stamped parts, stamped and bent parts and impact extruded parts for technically complex applications in the following fields:

- Electrical contact technology
- Lighting technology
- Miniature mechanics
- Measuring and control technology
- Superconductor technology

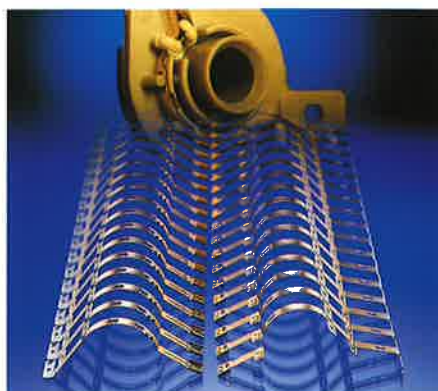
Copper, nickel, steel, aluminium and their alloys are used as precursor materials as well as special metals such as niobium, tantalum and their alloys. These are used either on their own or in the form of composite layers in order to combine, for example, optimum spring properties with high electrical conductivity and good corrosion resistance. In many cases it is necessary to apply functional layers of tin, lead-tin or precious metals. In the case of precious metal layers of gold, palladium, platinum or silver, particular care is taken to ensure the most economical use of these costly materials by selective or partial coating using only the film thickness which is absolutely necessary. For this purpose modern roll-cladding, electroplating, sputtering and welding processes are available.



Individual welding of microcontact profile parts



Multi-wire wipers



Contact springs for electro-mechanical switches

A selection of PPT products:

- Multi-wire wipers
- Switching and plugging contact parts
- Stamped sliding contacts
- Precision stamped parts
- Shaped pins (also partially coated)
- Electroplated products
- Precision parts and semiproducts of special metals, e.g. tantalum and niobium

The main emphasis of the Product Line Metal-Plastic Technology is the injection moulding of high-value finished metal parts with technical polymers.

Great value is laid on close cooperation and agreement with the customer in the development of these products for specific applications.

Individual advice in the selection of suitable polymers, metals and surfaces and in the choice of designs which are best suited to assembly takes the foremost place in the service provided by our dialogue-oriented customer support.

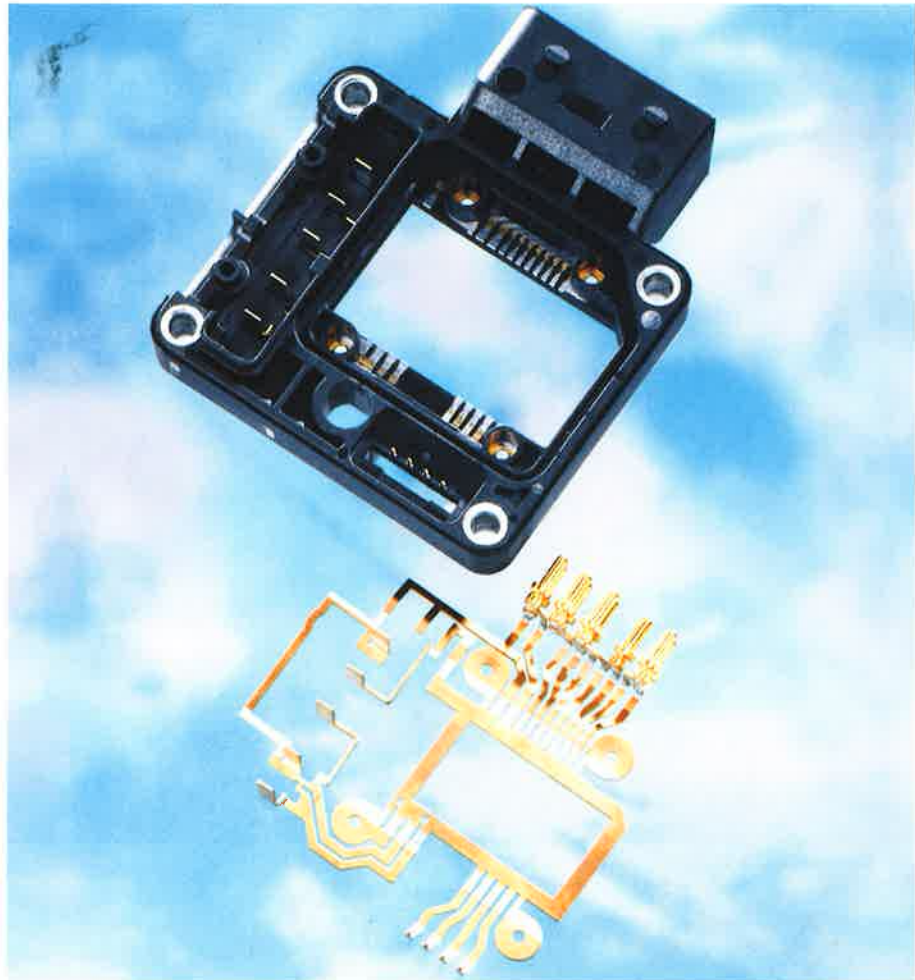
Products are manufactured either manually or using fully automated processes for:

- Automobile electronics
- Industrial, control and sensor technologies

By linking the systems in the production process, on-line surveillance and recording of the most important test parameters are being increasingly employed with the aim of achieving the minimum possible defect quotas.

The product range includes:

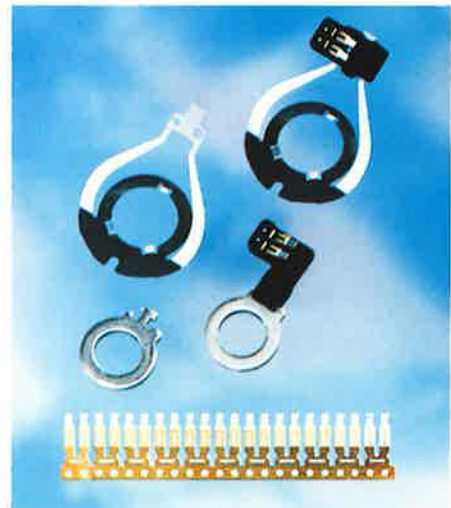
- Bondable hybrid casings
- Sensor casings
- Premould package for semiconductor applications
- Injection moulded sliding, plugging and switching contacts



Electronic diesel pump controller



Hybridized valve controller



Injected multi-wire wipers



Material from the jewelry industry for refining

water emissions ensure the compatibility of this installation with neighbouring housing areas.

The reprocessing programme includes, for example:

- Catalysts from mineral oil processing and petrochemistry, chemistry, the pharmaceutical industry and exhaust gas purification
- Materials containing precious metals from chemistry, the pharmaceutical industry and electroplating technology
- Electronic waste products: Contact and stamping scrap, materials from thick film technology, electronic components and circuit boards from the recycling of old computer equipment
- Precious metal apparatus and laboratory equipment
- Alloys and old materials from the fields of jewelry and dentistry

The reclaimed precious metals are used in pure form as precursor materials for new products.

Besides the production facilities in Hanau and Pforzheim, Germany, further refineries are to be found in the USA, Hongkong and Switzerland (joint venture).

Heraeus Precious Metals Management Inc.
Newark, NJ, USA

Heraeus Ltd.
Hongkong

Argor-Heraeus S.A.
Mendrisio, Switzerland

The Precious Metals Chemistry Division at Heraeus thus makes an important contribution to ensuring the supply of precious metals throughout the world.



Reaction vessel for precious metal processing

Heraeus has invested in a modern refinery to extract precious metals from primary and secondary raw materials and for the manufacture of new products.

Besides the precious metals gold and silver, the platinum group metals, i.e. platinum itself, palladium, rhodium, iridium, ruthenium and osmium, are extracted from primary and secondary raw materials.

As well as the well-known classical aqueous chemical procedures and melting processes we utilize electrochemistry, solvent extraction and other methods. Comprehensive investments in the purification of air and

Heraeus precious metal chemicals are used throughout the world as raw materials and additives in essential industries: Exhaust gas purification, surface technology, electronics, the chlorine-alkali industry, pharmaceuticals and the catalyst industry to name but a few. Furthermore our precious metal compounds are used in broad areas of research and development in these branches of industry.

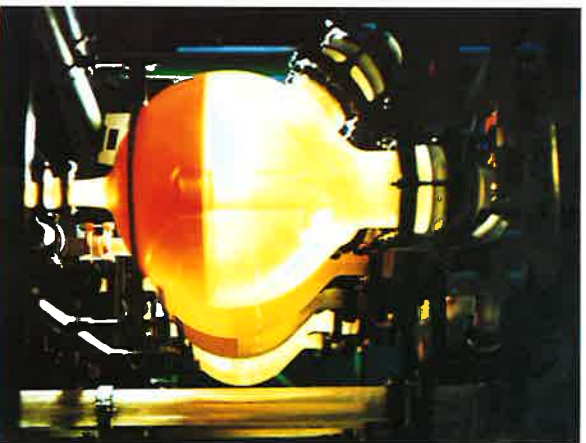
The products, which are supplied in the form of salts and solutions, cover a broad spectrum of chlorides, nitrates, sulphates, iodides, metal-organics and other materials. Together with a comprehensive range of standard compounds we develop and produce special compounds suitable for particular applications in close cooperation with our customers.

All the operational groups involved in the manufacturing process work according to the strictest quality requirements and are certified according to DIN ISO 9001. The current GMP and FDA regulations are observed especially for pharmaceutical raw materials, e.g. in the form of platinum compounds.

Besides our high value products we offer our customers a reliable delivery service and additionally a professional precious metal management. In close cooperation with the Precious Metal Recycling Department we set up customer-specific cycles, which permit the reprocessing and re-use of precious metal residues and old materials.



Selected pharmaceutical agents



Glass equipment for dissolving precious metals



Professional handling of aggressive media

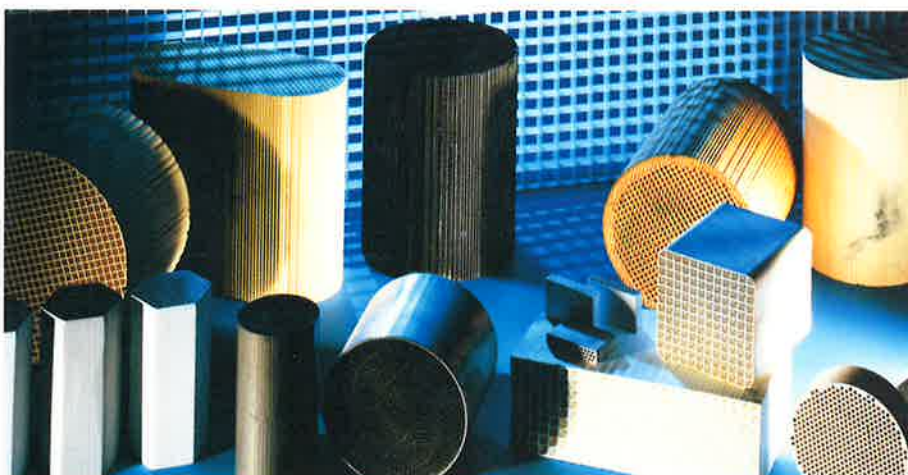


Process catalysts

Support catalysts as well as ceramic and metallic honeycombs coated with precious metals are used for exhaust gas purification.

We currently supply:

- Catalysts for petrochemical and pharmaceutical processes
- Toll manufacture of catalysts
- Catalysts for the purification of pure gases
- Catalysts for special vehicles and stationary engines
- Catalysts for the purification of industrial emissions
- Catalysts for catalytic post-combustion equipment (VOC)
- Catalysts for catalytic burners
- Particle filters for stationary and mobile diesel engines



Exhaust and air catalysts

Heraeus catalysts are in use throughout the world. They find application in special vehicles, for instance fork-lift trucks, and also in the home where they are an integral part of self-cleaning ovens. Catalytic coatings in household and industrial burners effect the flameless combustion of natural gas and thus avoid the formation of nitric oxides. The catalysts are used in large-scale chemical processes as well as in the manufacture of high quality pure chemicals and pharmaceuticals. They purify industrial exhausts and the emissions from power stations for urban heating, thus contributing their part to keeping the environment clean. The combined effect of the supports and the precious metals has a very profound influence on the efficiency of the catalysts. Defining the parameters is an essential part of Heraeus' expertise. Comprehensive knowledge, experience and frequent new test sequences guarantee the optimum of current possibilities.

Precious metal catalysts have been manufactured by Heraeus since 1914 – initially in the form of fine woven gauzes and since the 1970's also in the form of support catalysts.

The current product programme covers the wide range from standard chemistry

and exhaust catalysts to special catalysts which are developed and manufactured to meet customers' specifications and application requirements.

Active carbon, Al_2O_3 and SiO_2 are used as supports. These are available as powders, spheres, pellets or monoliths.

The Ceramic Colours Division is one of the world's leading manufacturers of decoration media for porcelain, bone china, stoneware, ceramics and glass. Products for customers throughout the world are manufactured at three production facilities:

W.C. Heraeus GmbH
 Ceramic Colours Department
 Hanau, Germany

Heraeus Schauer GmbH
 Vienna, Austria

PT. Heraeus Ceramic Colour Indonesia
 Cikande, Serang, Indonesia

Modern decoration media are expected to fulfil a wide variety of requirements and must achieve more than merely permitting attractive, aesthetic decoration. Users expect environmentally friendly products which can be processed rationally. The consumer at the end of the chain wants decorations which have good resistance to wear and which are suitable for dishwashing machines. Aesthetics alone are no longer enough!

With improved products and new decoration ideas, the Heraeus applications technicians and development specialists are making their contribution to the improvement of the decoration of ceramics and glass.

Examples of Heraeus innovations are:

- Bright gold for dishwasher-proof decorations on glass
- Silk finish gold colours
- Bright gold pastes for heat-release transfer pictures
- Microwave-proof bright gold colours
- Glaze-protected precious metal decorations
- Matt gold systems
- UV hardening bright gold pastes and lustres
- Lead-free glass colours
- Lead-free colours: porcelain, bone china

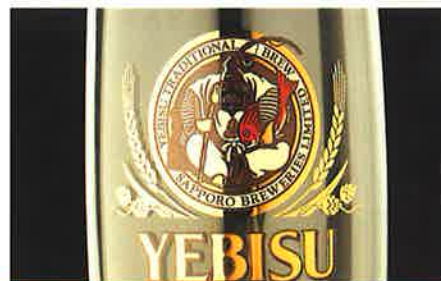
A comprehensive service is an essential part of the programme we offer.



Cosmetic bottles, decorated with precious metal preparations



Tile decoration with "Vetrosa" lustre and bright gold



UV hardened bright gold paste for glass decoration.

The Ceramic Colours Division has representatives in more than 50 countries worldwide. Local experts are able to advise customers, particularly in cases regarding applications technology. For especially difficult problems our representatives can refer back to the central applications technology department in Hanau.

Heraeus offers a broad range:

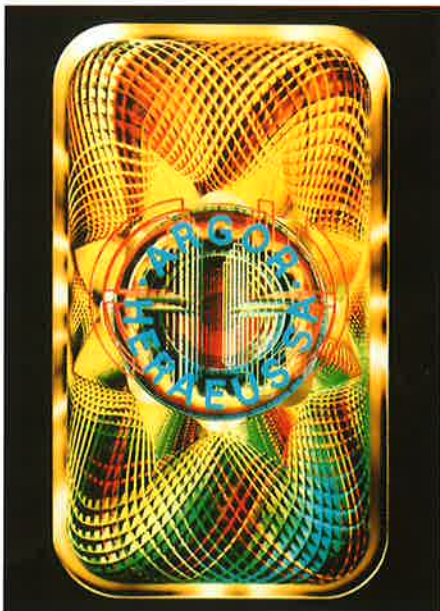
- Precious metal preparations: bright gold, platinum and palladium, silk finish gold and platinum,

burnish gold and platinum, high temperature gold

- Lustres
- Decoration colours: onglaze colours, inglaze colours, underglaze colours, metallic and interference metallic colours, solution colours, crinkle colours, glass colours
- Paints, oils and auxiliaries
- Resinates for technological applications
- Special products from Heraeus Schauer: Enamels for jewelry, binder frits for grinding discs, glazes for stove tiles and ceramics



Precious metal bars and gold grains



The new gold bar kinebar™ with engraved safety element, the KINEGRAM™, which shines in different colours depending on the incident light conditions, giving the bars an unusually aesthetic appearance.

(KINEGRAM™ is a registered trade mark of Landis & Gyr Communications.)

The acquisition of the precious metals needed for production is of central importance to a leading manufacturer of high quality and technologically demanding products. Within the Heraeus Group this function is carried out by the Heraeus Metallhandels-

gesellschaft. This company is also responsible for national and international trading in precious metals. It maintains connections with producers in all countries which have supplies of raw materials and with partners in the most important trading centres of the world.

These connections, in addition to its knowledge, its experience and its service through its presence in all important regions, make the staff of the Precious Metals Trading Division competent partners in all questions concerning precious metals.

Trading sites in Europe, the Far East and the USA:

**Heraeus Metallhandels-
gesellschaft mbH**
Hanau, Germany

**Heraeus Precious Metals
Management, Inc.**
New York, NY, USA

Heraeus Ltd.
Hunghom, Kowloon, Hongkong

Heraeus Kulzer GmbH
Jewelry Semi-Products Division
Pforzheim, Germany

Heraeus S.p.A.
Milan, Italy

The requirements made on precious metal products which are used today throughout the world in electronics, measurement technology and increasingly also in medicine are growing ever more demanding. Gold consumption in dental alloys and in the jewelry industry has been increasing for many years. Gold as an investment has also become very popular again. For these reasons a comprehensive advisory service and a global delivery service based on precise logistics are absolutely essential. The staff of the Heraeus Precious Metals Trading Division have the expertise and are present during local business hours. They can, therefore, offer on the spot the complete spectrum of services: quickly, competently and reliably. Heraeus has been the leading address for precious metal products for nearly 150 years.

The Jewelry Semi-Products Division of Heraeus Kulzer GmbH was operatively integrated into W.C. Heraeus GmbH in 1996, thus strengthening its worldwide activities. The system we offer is customer-oriented – “everything from one hand.” It ranges from the production and processing of alloys to the preparation and recycling of diverse precious metals and is made to measure for essentially all specific problem areas relating to precious metals.

The range supplied for the jewelry, watch, optics and writing utensil industries is covered by six product lines:

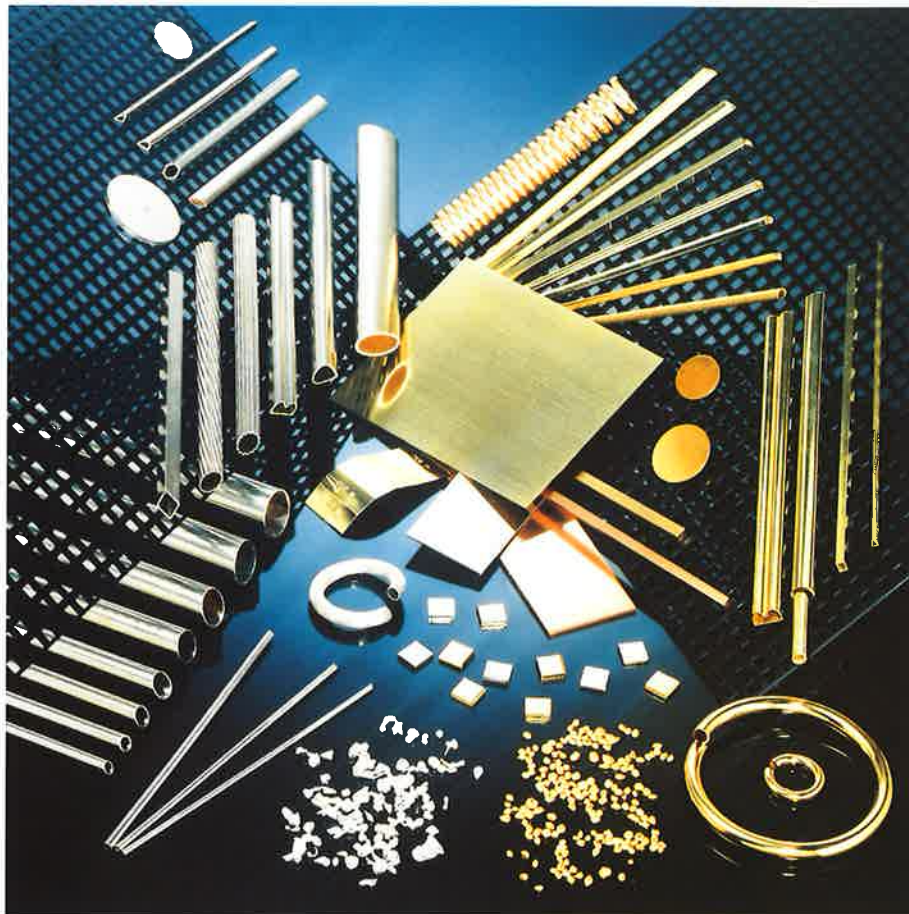
Product Line Semi-Products

Our decades of experience and the continuous development work of our metallurgists have enabled us to steadily improve quality levels. Today, our semiproducts not only increase the value of the end product but also reduce the costs for the customer in his production processes.

In the Product Line Semi-Products casting materials, sheets, wires, tubes and other product forms are manufactured in a wide range of precious metal and non-precious metal alloys.

For instance:

- Small remelting ingots
- Sheets with or without solder layer
- Wires with or without solder core
- Creole earrings and bracelet segments
- Tubes with or without seam
- Solders as wire, sheet or powder
- Rounds



Semiproducts for a wide variety of customer requirements

Precious Metal Trading

Through worldwide connections and constant observation of the markets we offer important help in making decisions for your precious metal planning. The precious metals are available in various forms for delivery.

Precious Metal Recycling

Using state-of-the-art technologies in waste incineration and in our refinery, environmental standards are set which ensure the clean and reliable recycling of your precious metals from old gold, tailings, filings, sweepings, sludge, etc.



Tube profiles for special requirements



Universal electroplating unit for all conventional electroplating chemicals (with waste water re-circulation)

Product Line Electrolyte Chemicals

Well tried Heraeus electrolyte chemicals together with our comprehensive service and competent advice ensure successful surface finishing in the customer's plant. The main features of the products offered in the Product Line Electrolyte Chemicals are:

- Ultrasonic cleaning salts and solutions
- Gold and silver brightening salts
- Electrolytic degreasing baths
- Rhodium, palladium, platinum electrolytes
- Bright silver electrolyte Scandia
- Gold plate electrolytes
- Colour gold electrolytes
- Non-precious metal electrolytes
- Jewelry cleaning baths

Product Line Electroplating Systems

All the requirements of the work procedures involving surfaces are covered, i.e. cleaning, brightening, electroplating and drying.

A comprehensive programme of individually conceived electroplating equipment and plant is available for jewelry manufacturers and watchmakers, jewellers, technical colleges and universities as well as for industrial laboratories and production areas.

A selection of equipment from the Product Line Electroplating Systems:

- Ultrasonic cleaning units
- Gold and silver brightening equipment
- Chain electroplating equipment
- Electroplating equipment and plant
- Hot air drying centrifuges
- Pin electroplating equipment
- Special equipment for the solution of application problems

Product Line Toll Electroplating

Toll electroplating is available to our customers as a service for the surface finishing of products from the fields of jewelry, optics, writing utensils and electronics. Its efficiency and variety is based on the electroplating systems and electrolyte chemicals described above and represents state-of-the-art environmental technology.

Selected production facilities:

Heraeus Kulzer GmbH
Jewelry Semi-Products Division
Jewelry Semi-Products Department
Pforzheim, Germany

Heraeus Kulzer GmbH
Jewelry Semi-Products Division
Product Line Jewelry Semi-Products
Hanau, Germany

Argor-Heraeus S.A.
Mendrisio, Switzerland



Warm air centrifuge for fast stain-free drying of parts wet with water

The original and at the same time one of the most successful products of Heraeus Elektrochemie is the Dimensionally Stable Anode (DSA), an activated titanium anode for the production of chlorine and sodium hydroxide.

In the meantime we have developed a broad range of new products, the greater part in the field of electrochemistry. In particular, production technologies for the manufacture of anode and cathode chambers for membrane cells have been developed which will, in the medium to long term, replace amalgam and diaphragm cells for the production of chlorine and sodium hydroxide. The environmentally friendly membrane cell technology has now been adopted by many other areas of application in electrochemistry.

We also offer our customers special engineering services from the modernization of amalgam cells and optimization of membrane cells to the construction of customer-specific cells for example for the depletion of heavy metals and complexing agents from process solutions.

We meet the increasing demands of the chemical industry with the application of new materials and the most modern processing techniques. We have succeeded in including materials in our production processes which only a few years ago were limited to very specialized areas due to their elaborate processing requirements and high cost.

We are concentrating increasingly on the development of new anode and cathode technologies and the optimization of cell design for high temperature electrolysis processes (in particular for the molten salt electrolysis of aluminium). We are, therefore,

concerned with extending our electrochemical business internationally, particularly in North America and the Far East.

The Rodenbach Production Facility, Germany

The activities here are concentrated on the manufacture of:

- Dimensionally stable titanium electrodes with precious metal activation for various electrochemical applications, cathode coatings, and the reactivation and repair of these electrodes
- Cells and cell elements, particularly for application in membrane cell technology
- Activation and reactivation of electrodes for application in membrane cell electrolysis
- Plant and processes for environmental technology
- The recycling of pollutants from processes and effluents.

Additionally we manufacture surveillance systems, current measurement clamps, electrodes for cathodic corrosion protection, e.g. for steel in concrete, and electrodes for the electroplating industry and the zinc-plating of steel strip.

Bitterfeld Production Facility, Germany

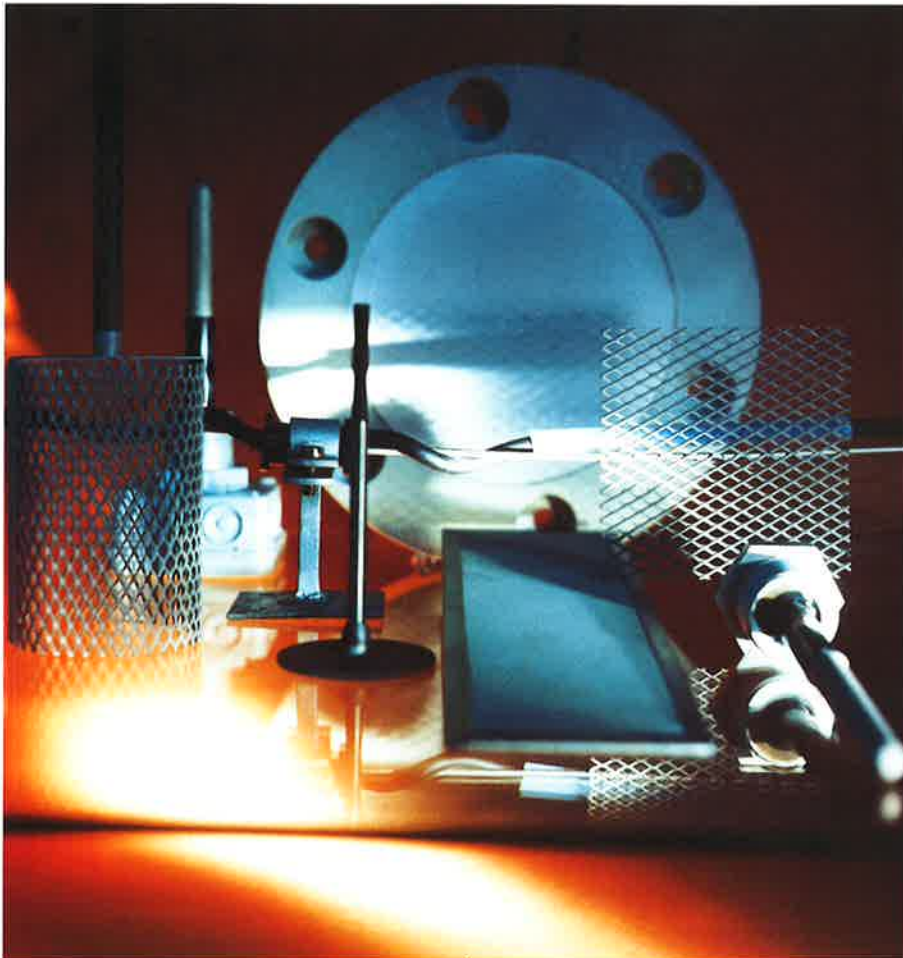
Heraeus Elektrochemie Bitterfeld GmbH is a test centre with a small production facility, in particular for optimization in the field of diaphragm and membrane cell technology.



Plant for membrane cell electrolysis



Aluminium production in an electrolysis shop



Different types of anodes

**Heraeus De Nora Inc.,
USA (HDN)**

In 1992 Heraeus Elektrochemie GmbH (HEL) began marketing its technology in North America in a joint venture with Engelhard Corporation.

With effect from 2nd January 1997 this joint venture has been transferred to a joint venture with the same business aims between the Oronzio De Nora Group and Heraeus. The headquarters and production facilities are in Union, New Jersey/USA.

The joint venture produces and installs electrodes, cells and cell elements for electrochemical production processes such as chlorine / alkali and chlorate manufacture and for the zinc-plating of steel strip, etc. Additionally studies into energy saving and environmental protection are carried out in production plants and put into effect. The area served by the joint venture covers the USA, Canada and Mexico.

**Heraeus Ltd. Electrochemistry
Division, Hongkong**

The Electrochemistry Division which was founded in 1995 has its headquarters in the Heraeus Technology Centre, Hongkong.

As a sales and production site it is based on the technology of the parent company HEL and its research and development work.

The Electrochemistry Division concentrates its activities principally in the countries Korea, China, Taiwan, Indonesia, Malaysia, Thailand, Vietnam, the Philippines, Australia, the Middle East and – for zinc-plating steel strip – Japan.

● Wijk bij Duurstede, THE NETHERLANDS

● Courtaboeuf Cédex, FRANCE

● Byfleet, ● Longton, Stoke-on-Trent, GREAT BRITAIN

● Madrid, SPAIN

● Cacèm, PORTUGAL

■ ● Newark, NJ ■ ● Union, NJ ● New York, NY, USA

Conshohocken, PA, USA

Chandler, AZ, USA

■ ● Mendrisio ● Zurich, SWITZERLAND

● Cavenago Brianza, Milan, ITALY

● Sofia, BULGARIA

■ Production Facilities

● Sales Offices

■● Hanau ■● Pforzheim ■● Rodenbach ■ Bitterfeld, GERMANY

● Prag, CZECH REPUBLIC

■● Vienna, AUSTRIA

● St. Petersburg, RUSSIA

● Riga, LATVIA

● Minsk, BELORUSSIA

Zhaoyuan City, Shandong Province, CHINA

Seoul, KOREA

Toki, Gifu, JAPAN

Tokyo, JAPAN

Shanghai, CHINA

■● Fanling ■● Hunghom, Kowloon, HONGKONG

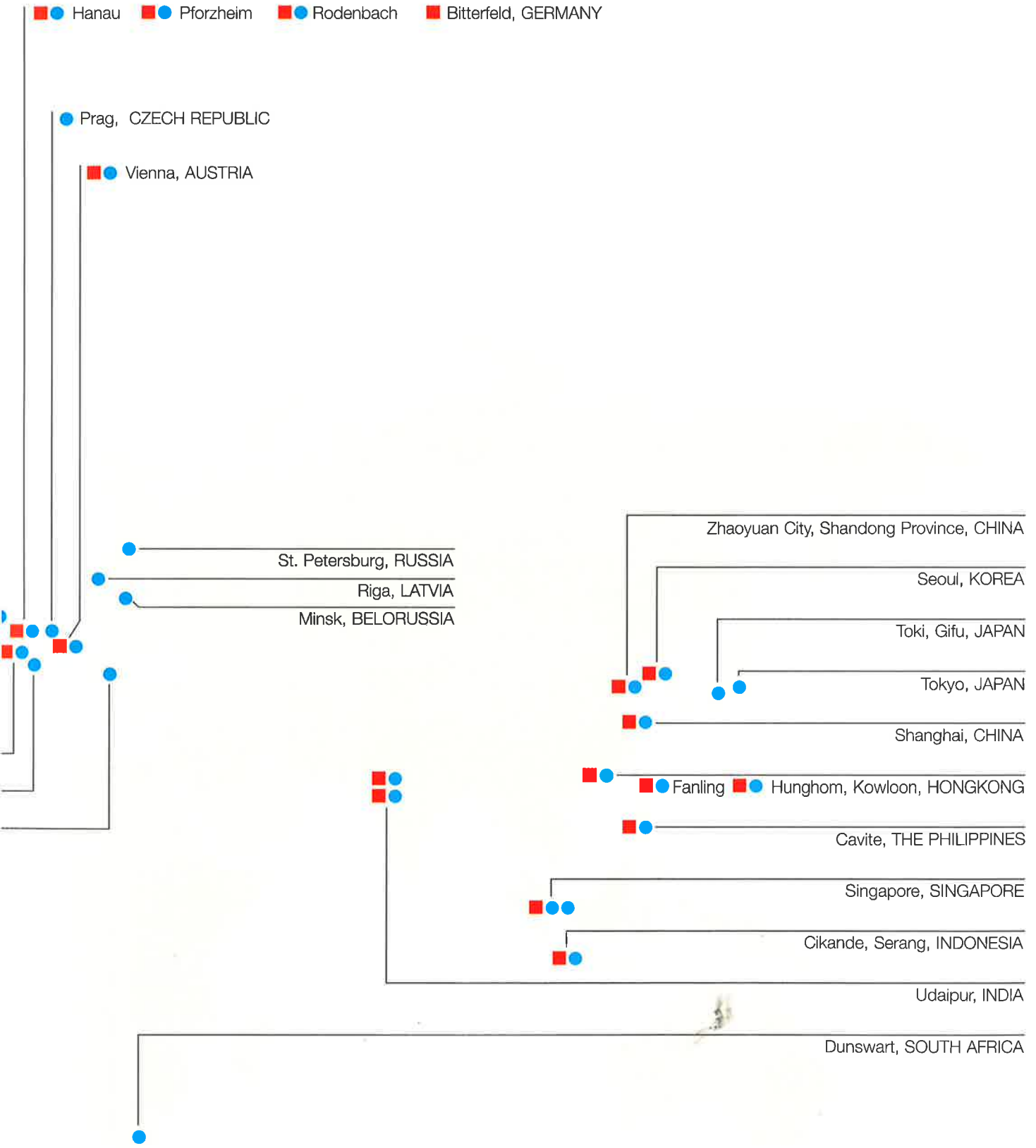
● Cavite, THE PHILIPPINES

Singapore, SINGAPORE

● Cikande, Serang, INDONESIA

Udaipur, INDIA

● Dunswart, SOUTH AFRICA



Heraeus

W.C. Heraeus GmbH
Heraeusstrasse 12-14
D-63450 Hanau
GERMANY
Telephone (0 61 81) 35-1
Telefax (0 61 81) 35-313

W.C. Heraeus GmbH
P.O. Box 1553
D-63405 Hanau
GERMANY
Telephone (0 61 81) 35-1
Telefax (0 61 81) 35-313

The data given here are correct for May 1997.
We reserve the right to make technical
alterations as necessary.

Layout: Kreatives Büro Koch, Munich

Printed in Germany

7M 05.97/VN Ca