



**Heraeus Precious Metals –**  
Your Partner for Tolling and Customized Catalyst Development

## Increase your Profitability, Manufacturing Efficiency and Flexibility

The resource-efficient production of chemicals, as well as the mitigation of harmful emissions, are largely enabled by heterogeneous catalysts. The large-scale production of catalysts, however, can be a challenge for companies and research institutes due to a lack of adequate production facilities, technological expertise and raw material supply chains.

Heraeus Precious Metals, as a leading catalyst producer, can manufacture your supported precious metal-based catalysts under toll contracts. Profit from a partner with decades of experience in the development and upscaling of precious metal-based catalysts. Heraeus is well-equipped to scale-up your intellectual property (IP) from the bench scale to the level of a commercial product.

Outsourcing your company's catalyst production to an experienced catalyst production specialist cannot only help you to focus on your core competencies but can also improve your short- and long-term profitability.

In general, production procedures can be adapted to your specific needs. If desired, the experts of Heraeus assist with the development of catalysts in joint catalyst development programs. By fostering a strong collaboration at all stages of development, testing and production, Heraeus guarantees high-quality catalyst products that are fine-tuned to your demands and applications.



### YOUR ADVANTAGES

- ✓ Access to a large-scale catalyst production, leading to overall reduced manufacturing costs
- ✓ Delivery of customized, high-quality catalyst products within an accelerated time to market
- ✓ Short scale-up times and product qualification via inhouse analytics and testing facility
- ✓ Optimizing costs by avoiding investments into capital-intensive production facilities and operations
- ✓ A reliable supply of precious metal precursors through our precious metal supply chain and chemicals production
- ✓ Further development and optimization of your IP together with experienced R&D
- ✓ Opportunities to recycle your precious metal-based materials via Heraeus' sophisticated recycling infrastructure and expertise
- ✓ With its fully integrated manufacturing and recycling infrastructures, Heraeus represents a one-stop solution. We keep all IP-related know-how under one roof.
- ✓ Multiple financing options via our precious metal trading department



## Catalyst Production Capabilities

The production of catalysts is a sensitive process, in which each step has a direct effect on the quality and performance of the catalyst. During the manufacture of a catalyst, a support material is coated with the catalytically active substance in an aqueous solution.

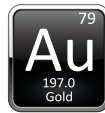
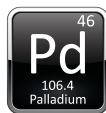
Heraeus' precursors for the catalytically active species are mainly based on Platinum Group Metals (PGMs), which offer excellent activities and selectivities. These include platinum (Pt), palladium (Pd), rhodium (Rh), iridium (Ir), ruthenium (Ru), but also on the elements gold (Au), silver (Ag), and rhenium (Re).

Different materials can be used to support the precious metal species, ranging from aluminas, zirconias, titanias and other



metal oxides to zeolites. These often come in various shapes and geometries, such as rings, pellets, extrudates, monoliths and powders. We also employ a variety of metallic and ceramic monoliths and foam structures.

Heraeus offers extensive technical capabilities to produce a variety of catalysts. Customized production processes can be developed to suit your requirements.



### COMPONENTS

- › Precious metals: Pt, Pd, Rh, Ir, Ru, Au, Ag, Re
- › Base metals
- › Promotors and dopants
- › Various supports

### SYNTHESIS

- › Impregnation
- › Adsorption
- › Precipitation (supported & unsupported systems)

### POST-TREATMENT

- › Drying
- › Calcination
- › Reduction
- › Passivation

### WHY HERAEUS PRECIOUS METALS?

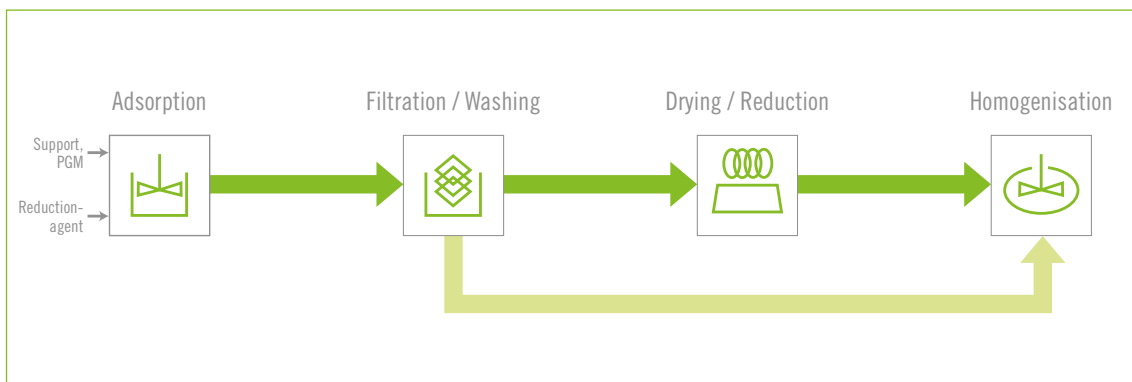
With extensive expertise in the design, scale-up, manufacturing and recycling of precious metal catalysts, Heraeus is an ideal partner to help you accelerate your catalyst development and commercialization.

By establishing long-term cooperations, based on mutual trust and customer centricity, Heraeus turns your challenges into success. Heraeus is committed to your precious needs!

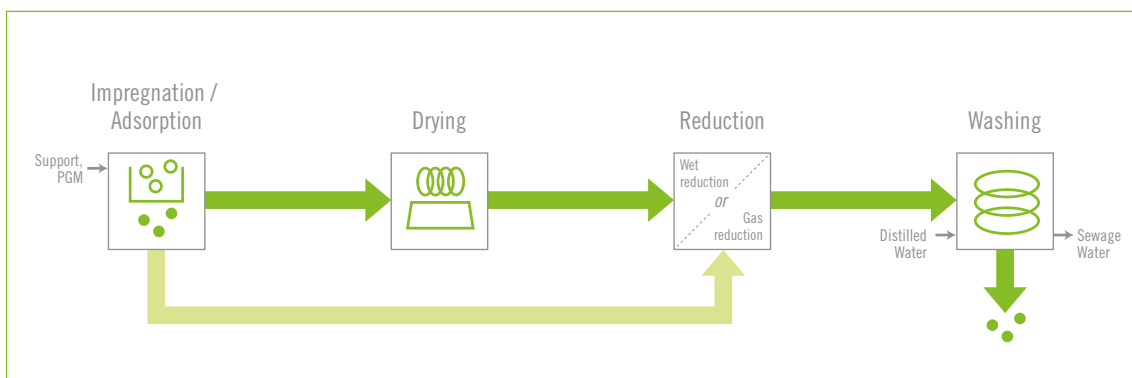
## OUR CAPABILITIES

- ✓ Homogeneous impregnation of extrudates, spheres or powders with precious or base metals via incipient wetness or adsorption techniques
- ✓ Calcination of powders and pellets up to 700 °C in air or inert atmosphere (stationary or continuous flow)
- ✓ Reduction under hydrogen atmosphere and an optional selective afterwards passivation
- ✓ Drying of powders and pellets under mild conditions
- ✓ Regeneration (e.g., drying, washing with water and acids)

## Production of Powder-based Catalysts



## Production of Supported Catalysts for Fixed Bed Applications



## The Right Manufacturing Model to Help You Meet Your Needs

Each customer has unique requirements. Therefore, Heraeus provides a range of development options for custom catalyst formulation and manufacturing.

At every stage of the collaboration process, from project initiation to product delivery, we prioritize our customers' needs. Our commitment to reliability and integrity is reflected in our reputation.

### TOLL MANUFACTURING

The procedure for manufacturing your catalyst has been defined. Heraeus produces the catalyst according to your specifications.



**Catalyst formulation**  
**Intellectual property**



**Catalyst production**

### CUSTOM MANUFACTURING

Your catalyst has been developed but has not yet been manufactured on a commercial scale? Heraeus will assist you with upscaling your catalyst.



**Catalyst formulation**  
**Intellectual property**



**Catalyst production**  
**+ Fine-tuning**

### CUSTOM DESIGN AND JOINT DEVELOPMENT

Do you have an existing commercial application or a process that is under development, but you have not yet developed a final catalyst for it? Let us work closely together on your catalyst and process. With our proprietary knowledge of catalyst development and design, we can develop a new catalyst for you.



**Catalyst design**



**Catalyst optimization**



**Catalyst production**



## CLOSING THE LOOP WITH PRECIOUS METALS RECYCLING

As specialists in the handling of spent precious metal catalysts, Heraeus offers the fastest possible precious metal recovery and the highest yield. The reclaimed precious metal can be re-used for the manufacture of new catalysts. Catalyst recycling is not only cost competitive, but also ecological. The recycled secondary precious metal can reduce the carbon footprint by up to 98% in comparison to primary precious metal from mining.

## ABOUT HERAEUS PRECIOUS METALS

Heraeus Precious Metals is globally leading in the precious metals industry. The company is part of the Heraeus Group and covers the value chain from trading to precious metals products to recycling. It has extensive expertise in all platinum group metals as well as gold and silver.

With about 3,000 employees at 15 sites worldwide, Heraeus Precious Metals offers a broad portfolio of products that are essential for many industries such as the automotive, chemicals, semiconductor, pharmaceutical, hydrogen and jewelry industry.

By 2025 Heraeus Precious Metals will be the first company in the industry that operates carbon neutral.

### Heraeus Precious Metals

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