

FRAUNHOFER INSTITUTE FOR MANUFACTURING ENGINEERING AND AUTOMATION IPA

ELECTROPLATING PROCESSES AND EQUIPMENT FOR UNIQUE PRODUCTS



ELECTROPLATING IN PRODUCTION

YOUR PARTNER FOR PROJECTS AND DEVELOPMENTS AROUND ELECTROPLATING

Electroplating processes are attaining a key position in the value chain, especially where complex components with high demands are concerned. Consequently, electroplating is being used in many branches of industry such as in mechanical engineering, the automotive and printing industries and in medical technology. As a result, the development of plating technology solutions using standardized tools and methods is a frequent challenge.

In contrast with competing technologies in the field of inorganic plating, electroplating processes have significant advantages with regard to cost-effectiveness. Besides this relatively well-known aspect, electroplating processes have also advantages in their energy and resource efficiency. In combination with modern engineering methods, electroplating today clearly represents an overall system which can be described as "green chemistry". For example, a hard chromium plating plant developed by the Fraunhofer IPA has been awarded with the environmental prize "KUMAS Leitprojekt".

Therefore, electroplating is not only an established technology but also a technology of the future.

How we operate

The main focus of our work is on electroplating. Our fields of activity range from developing new layer materials together with the necessary deposition processes and process chains, through failure analysis and right up to industrial plants engineering. Thus we can offer our customers support throughout the entire development process from the initial idea right up to its implementation in production. To deliver this wealth of services, we employ staff from the fields of material science, chemistry, mechanical engineering, chemical engineering and design engineering.





OUR AREAS OF WORK

Layer materials

Demands for ever more specific functional characteristics of plated layers require more and more special solutions through customized layer design. Besides classical aspects of protection against wear and corrosion, more and more specific demands need to be met, for example with regard to residual stresses. The improvement or new development of layer materials enables our customers to fulfill the requirement profiles of modern products.

We offer our customers:

- Functional improvement and adaption of well-known electroplating layer metals such as chrome, nickel, copper and zinc,
- Innovative electro deposition systems the inclusion of specific additional phases in metallic layers,
- Development of layer materials based on alloy deposition, multi-layer platings and the deposition of metals which were previously not plateable.

Processes and process chains

Our development work is concerned with the development of processes capable of fulfilling the demands of three-dimensional components on an industrial scale instead of sticking to simple flat samples in the lab. Important aspects to be considered during development include:

- Process window tolerances,
- Throwing power and
- The parallel development of processes and analytical specifications for process control.

To achieve this, we offer experimental expertise and the necessary technical lab equipment as well as chemical and metallographic analyses. In our laboratories we operate specially-developed electroplating equipment and all the necessary testing techniques. module
Plating of inner
surfaces with high
geometric precision
Plating reactor
for hard chromium
plating of inner
surfaces (source:
Topocrom)
Image of a layer
failure analysis
Dispersion plating
of nickel-diamond

1 Automated

brush-plating supply

Failure analysis

Component failures in the field due to rapid wear or corrosion and production downtimes, e.g. due to inadequate plating properties, need fast and reliable measures to remove the underlying cause. We provide companies with the rapid reaction they need in such situations. We offer the characterization of samples, on-site analysis of failures and the identification of corrective measures with regard to materials or manufacturing processes.



KNOW-HOW ALONG YOUR PROCESS CHAIN

Plant engineering

As well as planning conventional electroplating equipment and managing projects associated with it, we also supply industrial users with special equipment solutions which are becoming more and more important due to increasing requirements. Today there is an increasing trend towards energy efficiency, precision plating, high-speed plating, emission-free systems and selectivity. For such types of plants, knowledge about the applied processes needs to be taken into consideration right at the start of the design phase. Therefore, such plating plants can only be realized successfully if competencies covering all aspects of the development chain are available. Through close collaboration between our design engineers and process developers, we can provide you with the ideal solution.

1 Planning, designing and realizing new electroplating plants and optimizing existing ones are core competencies of our experts working at the Fraunhofer IPA. Minimal faults in electroplating processes or defects in the electroplated layers of individual parts can lead to expensive supply bottlenecks or even stop production. We support companies in identifying problem sources and in improving their production along the entire process chain.

To ensure smooth electroplating processes, know-how on processes, systems engineering, general requirements and possible interactions is necessary besides knowledge on chemical processes. As part of our service area Line Assessment, we analyze the whole production chain – from the electrochemical process engineering to industrial equipment engineering.

Demand focused consulting

An objective and thorough analysis of your electroplating process chain or that of your supplier enables to secure your production. This is further supported by the choice of suitable suppliers and the quality increase of your end products. Line Assessment means for us to support you if you are responsible for the quality of coatings that you purchase externally.

We'll give you comprehensive advice on investment decisions, production assessments and supplier evaluations.

AN OVERVIEW OF OUR SERVICES

We see ourselves as being your service provider in the field of electroplating. Our range of services includes consulting, process development, the design and realization of plants in cooperation with plant engineering partners and also the seamless integration of new technologies into your production.

Our services:

- Process development and modification ranging from basic development right up to product launches based on plating and manufacturing requirements,
- Design of efficient process chains, adaptation of process interfaces,
- Process quality control, development of analysis methods,
- Analysis of component failure by carrying out material tests, determination of failure causes and planning of corrective measures,
- Planning and design of special plating equipment based on process requirements and simulations,
- Analysis of plating plants with regard to process reliability, capacity increase and identification of savings potentials,
- Consulting services with a focus on investment decisions, production assessments and supplier evaluations and
- Carrying out feasibility studies.

Transparency and neutrality

During the course of the project, we keep you informed about current work progress and give neutral advice.

WE ADAPT OUR RANGE OF ELECTROPLATING SERVICES TO YOUR COMPANY REQUIREMENTS.



EXAMPLES OF PROJECTS



ÖKOXAL – hard anodization on a new level of efficiency

As an important lightweight construction material, in its pure state aluminium lacks the ability to resist wear and corrosion. To compensate for this, in the past a protective coating has been applied using the energyintensive method of hard anodization.

With "ÖKOXAL" it's now possible to reduce overall energy consumption by approx. 60 % compared to conventional methods. The savings are achieved in two ways: firstly, because special pulse parameters allow the temperature of the electrolytes used to be increased while keeping the quality of coatings constant. Secondly the pulse anodization process lowers the thermal energy input, thus enabling higher deposition rates.

POSEIDON – highly corrosion-resistant alloy coatings for bearings

Funded by BMWi, the "POSEIDON" project pursues the aim of developing coatings for bearings, for example roller bearings, that are highly resistant to corrosion and also meet high tribological requirements.

In this way, the resulting systems no longer need a seal that reduces efficiency. Nickelbased alloy layers, such as nickel-tungsten, nickel-tin and nickel-copper, form the basis of coating systems intended for use in seawater environments or in the petrochemical industry.

Dispersion coatings – small particles with a big impact

Solid particles and specially-filled nano capsules are integrated into a metal layer applied by electroplating. The spectrum ranges from micro to nano, from diamond to PTFE and from corrosion inhibitors right up to indicators. The specific modification of the layer allows the adaption to specific requirements and enables new application potentials.

Plant design – planning a new energy-efficient hard chrome plant

A specific plant design enables to significantly increase the energy efficiency in hard chrome plating processes. A decrease in voltage led to a reduction of energy consumption by 30 %. With an optimized plant design, the efficiency and capacity of any electroplating system can be increased.

In 2009, the plant concept developed at Fraunhofer IPA for hard chrome plating was implemented at the Thoma Metallveredelung Company and distinguished as a KUMAS flagship project.

Automated brush plating – selective and repair coating

The rising prices of raw materials demand a resource-preserving usage of materials. Automated brush plating enables not only coatings to be applied selectively by robot but also coatings to be repaired automatically. The controlled supply and removal of electrolytes combined with an integrated rinsing technology enables a residue free application of the coatings while improving occupational safety levels at the same time. Furthermore, an independent plating unit offers the possibility of using very small volumes of electrolytes.

1 ÖKOXAL – hard anodization at a new level of efficiency

- 2 POSEIDON highly corrosion-resistant
- alloy coatings for bearings
- 3 Project example: automated brush plating



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