Platinised Titanium Anodes offer a variety of benefits and process improvements in Hard Chrome Plating

Titanium and niobium anodes activated with platinum or platinum metal oxides have been used as insoluble anodes in electroplating for many years. Recently, platinised titanium and niobium anodes have been used more and more in fluoride free hard chrome plating baths, replacing the common lead and lead alloy anodes.

Platinised titanium anodes offer the following advantages over conventional lead anodes:-

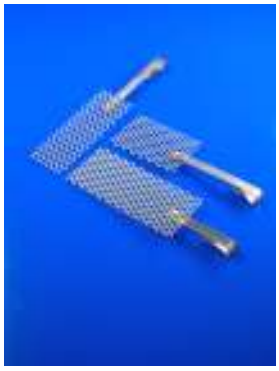
- Increased throughput with reduced plating times
- Reduction or elimination of secondary processes, such as grinding
- Anode geometry remains constant over time, allowing consistent optimised plating results
- Long operating life, very low maintenance
- Increased bath life

Platinised Titanium Anodes

The change from lead anodes to platinised titanium anodes was promoted by the introduction of high efficiency fluoride free baths, which attacked lead anodes more severely than traditional hard chrome plating chemistries. Initially lead rod anodes were replaced with titanium rod anodes, which had a copper or aluminium core for high current applications, and over time further advantages of platinised titanium anodes have been recognised.

In order to utilise platinum's exceptional conductive properties and corrosion resistance yet still remain economical, anodes are created by electroplating a very thin layer (typically 2-5µm) of platinum onto a specially treated activated substrate such as titanium or niobium. Pure titanium is often the first choice of substrate as it provides excellent corrosion resistance in many environments, including oxidizing acids and chlorides.

Platinised titanium anodes are available in a wide range of shapes and sizes including wire, rods, tubes, sheets and in the widely used expanded mesh form. Mesh anodes provide very efficient use of platinum and are available with surface factor of 0.5-2.3dm^2 (1dm^2 of mesh has a total surface area of 0.5-2.3dm^2).



Benefits of Platinised Titanium over Lead Anodes for Hard Chromium Plating Anodes

Long life, dimensionally stable and easily fabricated into any shape
When used in the plating process lead anodes change dimensionally - and therefore in surface area - due to the loss of the lead oxide which is formed on the anode during operation. Also, larger lead anodes can lengthen under their own weight whereas titanium anodes are dimensionally stable throughout their operating life and can easily be manufactured, even in complex shapes and lengths, up to 4m. Consequently, shaped anodes can be manufactured very accurately to allow consistent plating to small tolerances, often making a further honing step unnecessary.

Homogeneous and long-lasting active surface
When lead anodes are not in use the lead oxide layers change to lead sulphate and lead chromate which are not good conductors and consequently do not perform consistently. Platinised titanium anodes, operated correctly, remain deposit free and therefore perform constantly well throughout the whole anode life.

Energy savings with shaped anodes and small anode/cathode distances
Small electrode gaps reduce electrical resistance losses in the plating bath and produce energy savings. In the case of lead anodes, which cannot be formed as accurately as a mesh, resistance losses result in bath heating, requiring further energy for cooling. Therefore, platinised titanium anodes can provide energy savings both in heating and cooling which, in turn, allows the plating chemistry to be easier to manage and maintain.

Reduced environmental burden and reduced maintenance
No chemical cleaning or brushing of passivated areas is necessary. Bath life is increased as there is no formation of lead sludge - lead anodes produce about 3g of lead sludge for every 1kg of chromium deposited in sulphuric acid type baths and even higher in other baths. Furthermore, the reduced resistance losses and subsequent need for cooling allow for easier maintenance and control of the plating chemistry.

Mesh anodes provide excellent throwing and can be used at high current densities
In electrolysis, corners and edges are preferred reaction sites; an expanded mesh has edges evenly distributed across the anode surface, thus producing uniform current density and excellent plating results. Large area mesh anodes improve throwing power and the mesh structure allows good solution movement and electrolyte exchange and plating with high current densities.

Easier handling and recoating
Positioning of lead anodes for optimising chrome plating is often awkward due to their weight, whereas spot welded or bolted mesh anodes are very light by comparison and allow safer and easier handling. Furthermore, they can be easily removed and / or replaced whenever necessary. This often allows a re-use of expensive anode materials and designs, and reduces operational costs.

Considerations when converting from Lead to Platinised Titanium anodes

Where platinised titanium anodes are used as a replacement for lead anodes consideration must be given to several factors to ensure that the technology is utilised to its full potential – a change in plating process is necessary and, as such, the whole plating set-up and its costs need to be considered to maximise the return on the investment in these anodes.

Consideration should be given to:-

- Thorough cleaning of the plating tank and associated equipment with an adjustment of the residual lead concentration
- Bath/Electrolyte composition and operating conditions
- Current Density and operating Voltage
- Anode design

The service life of platinised titanium depends on both the electrolyte matrix and the applied current density. Therefore, in fluoride containing baths and at current densities >75 A/dm^2 platinised niobium is recommended in preference to platinised titanium.

Platinised titanium and niobium anodes are completely or partially covered with a few microns of platinum (usually 2.5µm). Where the platinum is consumed after years of use, the underlying titanium or niobium passivates and the bath voltage rises at constant current operation. The base metals are not attacked at the usual operational voltages, in fluoride free chromium baths.

For most applications the platinum wear rate is very low and the corresponding anode life time high. In sulphuric acid chromium baths the platinum consumption is between 1g and 4g platinum per million amp hours.

Careful design of the platinised anodes will increase their benefit and maximise their life span.

Production Examples of the Benefits of Platinised Titanium Anodes

A hydraulic piston manufacturer needed to scale up production but had restricted space in the electroplating department that would require major investment to expand the plating area to increase the number of plating baths. With lead anodes the customer plated 6 pieces per batch, by using cylindrical shaped platinised titanium mesh anodes the customer was able to increase the loading per batch to 14 pieces. After successfully converting one plating bath the customer converted the remaining baths at his facility and ran the operation for 10 shifts per week for 5 years before it became necessary to replace any platinised titanium anodes. This conversion has lead to considerable cost saving in both capital investment and operating cost.

Another company had a requirement to coat six small cylindrical faces of varying diameters distributed along the axle of an aircraft landing gear. Traditionally the

customer masked the areas that should not be chromium plated and then used a secondary grinding operation to achieve the required specification for chromium thickness. To eliminate the masking operation a platinised titanium anode was constructed that consisted of six individual cylindrical mesh anodes. For all areas to be plated equally the distance between anode and cathode is the same and therefore a uniform thickness of Chromium is deposited at every cylindrical face, significantly reducing the secondary grinding operation. Following the success of the first anode the customer has subsequently replaced all their lead anodes for specially constructed platinised titanium anodes reducing throughput time and the number of manufacturing operations.

Summary

Platinised titanium anodes provide a cost effective replacement for lead anodes in hard chromium plating. They provide superior quality deposition and consistency resulting in increased productivity and throughput. Cost benefit analysis demonstrates that the higher initial investment in this technology can be recouped within a short period of time.

Composite Metal Services and Metakem GmbH have operated in partnership for over 20 years, supplying high-performing anodes for specialist plating applications throughout the UK. Tel. +44 (0) 870 240 7620, www.cms-ukltd.com, www.metakem.com