Finishers' Think Tank



Marty Borruso 26 Flagship Circle Staten Island, NY 10309 Phone: 1-500/FINISH1 Internet: dpjh50a@prodigy.com

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Carbonates in Alkaline Zinc Plating Solutions

Q. Because we use an alkaline non-cyanide zinc plating solution, we were not expecting problems with carbonates, which are usually generated by the breakdown of cyanide in the solution. Why are carbonates causing efficiency problems and porosity in the deposit of our alkaline solutions, and how can we prevent this?

Carbonates in alkaline zinc A. solutions can build up to rather high levels in the plating process, and can be attributed to two reasons. First, carbonates are generated by absorption of carbon dioxide in the atmosphere, which exists in the atmosphere as carbonic acid and forms carbonates in the alkaline solution through a neutralization process. This problem is relatively uncontrollable, and depends on the concentration of carbon dioxide in the atmosphere and its propensity to mix with the plating solution. Air agitation, or violent mixing of solution with the atmospheric air, will also increase the rate of carbonate buildup.

The second reason is the fact that the final fate of any hydrocarbon species in the plating solution is the production of carbonates. Carbonates are formed at the anode surface particularly the surface of insoluble anodes, because of the generation of oxygen at the anodic surface, which causes oxidation of the hydrocarbon materials. The rate of carbonate buildup depends on the anodic current density—the rate can be reduced by dropping the overall anodic current density in the system. Insoluble anodes are common in alkaline zinc solutions because the metal tends to rise in the solution.

Efficiency of the deposit drops as the concentration of carbonates in the plating process increases. This situation will continue to affect the rate of deposition and the quality of the deposit, because as solution efficiency drops, carbonates are generated at higher rates. Carbonate production rate, by the oxidation of hydrocarbon materials, can be influenced by the surface area of insoluble anodic materials. Increasing the total surface area of the anodes, or dropping the anodic current density. will decrease the rate of carbonate production. There is also a minimum threshold current density that must be met to generate anodic forms of carbonates from organic species.

Problems resulting from high levels of carbonates include physical, chemical and electrical.

- Physical—The insoluble carbonates are absorbed into the deposit, yielding a porous deposit that will reduce its protective nature.
- Chemical—By interfering with the complexers in the plating bath and the reaction of the materials in the solution.
- Electrical—By increasing the electrical resistance of the solution and requiring an increase in current density at the anode surface, which therefore increases the rate of carbonate production.

Ideally, the plating solution should be operated as efficiently as possible so that the rate of carbonate generation is kept low. The current should be applied with the lowest voltage and highest current possible (*i.e.*, the highest anodic surface area that is physically possible).

Carbonates must be treated on a regular and continual basis to keep them at a low, steady-state level. This is accomplished by taking advantage of the solubility of carbonates and carbonate species, by freezing the solution to drop out the carbonates, or by adding carbonate removers that drop out the carbonates as insoluble salts. Both treatments require attention and can be very messy, but are necessary to successful operation of the solution.

Proper Racking of Parts

Q. We are installing an overhead hoist and need to consider how to rack the parts to maximize the number of parts processed at one time.

A On the surface, your question seems easy—design the racks so that they will hold as many parts as possible. The other consideration, however, must be efficiency of the plating process.

When considering rack design, first examine the configuration of the parts and how they will interact with the anodes and with other parts being processed in terms of current density application. Each part on the rack should receive the same current density and the distribution of the deposit should be the same, part-topart. Without these considerations, the thicknesses will differ from one part to the next, and from one area on the rack to the next, resulting in overplating or underplating. This equates to a poor rate of production, poor quality control and erratic results.

Racking technique should be integrated into the entire production process. Parts can be racked at work stations, rather than racking areas, and can fit into the manufacturing process to aid in production efficiency. You can also open up the areas on the rack to increase the distribution and uniformity of the deposit, avoiding overplating and increasing the total number of parts plated at one time.

When appraising the production process, it may be advantageous to put fewer parts on the rack and reduce the time or total current application to the load. This could increase total productivity of the process and will certainly allow for better quality and consistency of production.

The design of the rack is something a plater must live with for a long time. Future problems can be prevented or resolved, and long-term costs decreased and advantages increased. As an added suggestion, there are computer programs that can model and simulate the effects of a particular racking technique. This, in combination with advice from experienced platers and rack builders, can help you properly design the best rack possible. Plating in Non-targeted Areas When plating copper, we sometimes get copper plating on top of our photoresist. The problem most often occurs in highcurrent-density areas. What causes this and how can we prevent it?

A. When trying to plate onto nonconductors, using too high of a concentration of sensitizers can cause plating in non-targeted areas. I have found that a quick wash in 1-2percent hydrochloric acid will remove excess sensitizers and limit the plating to desired areas.

If you are applying relatively high current densities, keep in mind that most copper solutions will attempt to bridge over the high-current areas. The total current density applied, as well as the specific current densities, in all areas of the component plated must be considered. The edges of the components will demonstrate very high current densities, and will tend to nodule, tree and plate over the described edges. A good interpretation of the current density applied will greatly help the process effectiveness. Your process supplier can help appraise your production sequence.

In conclusion, before attempting to process the components, you should learn as much as possible about the system you are using, and should consult with others who are familiar with the system to shorten the learning curve associated with applying the coating. **Pasf**

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- Industrial Achievement Award

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