



Finishers' Think Tank

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Electroless Nickel On Copper Alloys

Q. We need to deposit electroless nickel onto copper-based alloys. What cycles should we use?

A. Electroless nickel is also called *autocatalytic* nickel. The nickel is deposited by a chemical reaction that is catalyzed by the characteristics of the surface of the part being plated, if the surface is catalytic. Common metals that are catalytic to electroless nickel include most of the iron alloys, nickel and aluminum. Metals that are not catalytic to electroless nickel require special surface preparation to allow deposition. Metal surfaces that are not catalytic include lead, copper alloys, and other nonferrous materials. Because copper is not catalytic to electroless nickel, the surface must first be covered with a material that is catalytic to the plating solution, or that will cause the surface to become catalytic. This is typically accomplished by placing a cathodic charge on the copper part in the electroless nickel bath, and using a stainless steel or nickel anode to place a thin catalytic coating on the surface. Making the part cathodic causes the electrolytic reduction of nickel onto the surface. Because the nickel-coated part becomes catalytic, the chemical reduction of nickel from the electroless nickel solution (plating) will continue to occur, and greater thicknesses will be attained.

Another methodology that could be used is the sensitization of the copper part's surface with a material that will cause the initial reduction of the nickel at the surface. Palladium chloride in a solution of hydrochloric acid will sensitize the surface of copper parts. This initial reduction of nickel onto the surface will allow further deposition by the autocatalytic electroless nickel process. Palladium is widely used for electroless nickel plating in the manufacture of printed circuit boards. In this case, it is necessary to have deposition occur only on the areas coated with copper,

and not on the plastic associated with the boards. With printed circuit boards, the copper is infinitely more sensitive to activation by palladium than the plastic, allowing plating to occur in just the intended areas.

Electroless Nickel Plate-out On Electric Heaters

Q. We are having problems with heating of the plating solution in our electroless nickel process system. The nickel metal occasionally plates out onto our stainless steel electric heaters. How can we prevent this?

A. Electroless nickel is an autocatalytic plating process, and will plate on any sensitized surface. Electric heaters present a problem, because the activity of the solution increases as the temperature of the plating solution rises. The cause of the plate-out may be localized heating of the solution near the heaters, up to a point where activity is extremely high, causing plate-out to occur onto surfaces not typically active to electroless nickel.

A good prevention is to use fluid-flow or airflow techniques to minimize the localized overheating. In other words, the plating solution should never be allowed to remain stagnant in the presence of heater surfaces. Fluid-flow techniques use directed flow systems, or a sparger placed under the heater elements, to move the solution rapidly past the heaters. Airflow uses air agitation to move the solution, but it is less intense than fluid-flow techniques. If employed properly, however, with attention to the disposition of airflow patterns and air line placement, airflow can be very effective for moving the solution.

Passivation of Heaters

To prevent plating onto the heater surface, make certain that the heater surface is properly passivated so that plating does not occur. Passivation of stainless steel must be accomplished with 50 percent nitric acid for at least one hour to achieve proper passivation. Most operators fail to keep the

concentration of nitric stripping solution at or above the all-important 50 percent level. They may start at 50 percent, but after the solution is used several times, the concentration will drop, so passivation will not occur properly.

Information has appeared in recent literature concerning the use of anodic protection to prevent plating on stainless steel surfaces by imparting a 10W, constant DC anodic charge to the surface. This has shown great promise and will be used more as the technique is developed.

Zinc Over Zinc Diecast

Q. We plate zinc over zinc diecast parts. When parts are stored for six months or more, they tend to change color to an irregular deep blue. What causes this, and how can we correct it?

A. This has been encountered before, and can be directly related to a diffusion problem. The zinc deposit will diffuse into the diecast component, causing color change. The diffusion is slow and the problem is insidious, because it may occur long after the part is processed and delivered. Because of that, many poor quality parts may be produced, but the magnitude of the problem may never be known.

Unfortunately, the only real solution to the problem is to use a barrier layer on the parts prior to zinc plating. The barrier is usually a cyanide-based copper strike. Advocating a cyanide solution is not usually part of this column, but in this case, it is the only reliable, consistent process to provide the proper diffusion barrier.

To assure that the problem is eliminated, and the diffusion is halted, a significant coating thickness must be applied. A copper coating thickness minimum of 0.00025 in. is recommended. This could be a complication to what may have appeared at first to be a very simple process of plating zinc on a zinc-based substrate.

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Pollution Prevention:

Membrane Recovery Systems

Membranes may be used to conserve systems in several different formats: Microfiltration, ultrafiltration and reverse osmosis. Each has its place, its benefits and limitations.

Reverse Osmosis

Reverse osmosis (RO) is a pressure-driven membrane separation technique. RO uses a semi-permeable membrane that permits the passage of water and doesn't allow other components to pass through the membrane. The system allows for the concentration of dilute solutions, which may be concentrated for return to the process system or made easier to have hauled away to a treatment facility. Some of the limitations of RO are based on the efficiency of the membrane to completely reject some non-ionized organic materials, and its ability to withstand pH extremes. When the membrane is damaged, its excursions of the process system go either extremely alkaline or acidic. RO membranes may also be fouled or irretrievably damaged by some materials, such as iron and manganese.

Another area in which RO has found a role is in the production of high purity water. Ion exchange systems have found great use in creating high purity water, but they tend to be service-intensive and complex to operate. The use of RO as a source of purified water may be enough for most process systems, but the use of RO prior to a good mixed-bed ion exchange system will allow the resin to last longer and put more time and flow through the resin before regeneration of the resin.

Reverse osmosis has been used extensively to close the loop on nickel plating systems, and has shown to be effective in complete solution recovery. RO has been effective in recovering all the components in a nickel system, from the metal ions to the physically large organic molecules that are associated with the additive packages.

Next month, we'll discuss micro- and ultrafiltration. ○