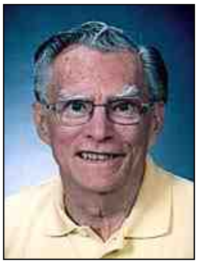

Do's & Don'ts

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Do's and Don'ts of Soldering, DI and Wire Bonding to Electroless Nickel Plated Deposits

It is generally thought that it is not possible to solder to electroless nickel (EN) plated deposits unless a strong acid flux is used. The fluxes can be harmful to other components in an assembly, particularly if it is an electronic device. So, soldering is often avoided where electroless nickel could provide many advantages. Likewise DI attachment and or wire bonding are not considered due to the fear of the use of electroless nickel plated surfaces. Nickel and electroless nickel are good conductors compared with thick films used to metallize ceramic devices.

Electroless nickel deposits also provide good corrosion resistance, good adhesion and have excellent uniformity of thickness.

Soldering to electroless nickel

When soldering, intermetallic compounds form to provide high adhesion values. Compounds such as Ni_3Sn, Ni_3Sn_2 and Ni_3Sn_4 are formed that provide excellent adhesion. Also nickel-gold, nickel-silver and nickel-copper compounds can form, although slowly.

Typical surface films that interfere with adhesion are soils, phosphorus and oxide. Electroless nickel deposits contain phosphorus or boron and oxides. To form good bonding to electroless nickel-phosphorus, soils, oxides and surface phosphorus must be removed. For electroless nickel-boron deposits, the boron aids soldering (Adding boron to the electroless nickel-phosphorus solution, the NiB-P deposit aids soldering.). Nickel-boron electroless nickel solders easily, but is much more expensive. Low boron content EN-B works best. To make electroless nickel-phosphorous plated deposits easy to solder requires a strong acid flux or a heat-treat process. There are several heat-treat processes that can remove phosphorus from the surface along with oxide to make EN-P solderable. At 600°C, the phosphorus begins to migrate to the surface. In moist hydrogen, the phosphorus is removed at 600 to 800°C. The moist hydrogen atmosphere is reducing for the nickel, and phosphorus is oxidized by the oxygen supplied by the dissociation of the water and is vaporized from the surface, leaving a pure nickel surface.

Solder fluxes

Solder fluxes are many. They are classified by their degree of activity, inorganic being the strongest and resin the weakest. Fluxes are used to remove surface oxides and sulfides, reduce the surface tension of molten solder and prevent oxidation during the heating cycle. R fluxes are rosin, RMA are rosin-mildly activated and RA fluxes are the most active. Soluble organic acid and inorganic acid fluxes complete the list.

A suitable inorganic flux is sulfamic acid. In tests, a dilute solution of sulfamic acid did indeed act as a suitable flux alone. R, RMA, RA and organic acid fluxes can be used in addition to the sulfamic acid film that was left on the item for long times (several months.) Any water soluble flux can activate the sulfamic acid, including DI water. If sulfamic acid is applied the unit to be later soldered should be stored in a dry atmosphere. Sulfamic acid is a solid when dry and becomes an acid when water is added.

Di bonding

Di bonding to electroless nickel-phosphorus plated deposits requires a heat excursion above 700°C, usually 800°C for 8 to 10 minutes in a nitrogen/hydrogen atmosphere. This treatment leaves pure nickel on the surface that is needed for good bonding. An electroless gold or gold electroplating will minimize oxidation of the nickel so that Di bonding can take place by forming a nickel silicide intermetallic. Phosphorus inhibits the formation of nickel silicide, and/or gold-phosphorus-silicide. The result is a brittle joint that could cause delamination from the silicon device.

Electroless nickel-boron deposits do not need the thermal excursion to form good quality bonding to silicon chips.

Wire bonding onto electroless nickel-boron plated surfaces

Electroless nickel plated deposits wire bond well using aluminum wire and ultrasonic bonding systems. Higher ultrasonic energy is required for bonding to electroless nickel than for gold plated deposits. Bonding gold wire to electroless nickel-boron requires a thermosonic technique and higher energy. Long term reliability of wire-bonded joints using aluminum wire 0.000125 in. in diameter wire bonded to electroless nickel-boron deposits were run by destructive pull tests at time zero and after 2000 hr at 85°C and 81% relative humidity. The Mil standard requires a pull strength of 3.0 g. The samples tested ranged from 13.5 to 14 g at time zero. At the end of 2000 hr test, all samples recorded pull strength values within range.

Do's and Don'ts of soldering to electroless nickel

Do

Know that phosphorus in the deposit causes poor soldering, wetting and adhesion and therefore must be removed from the surface before soldering. Boron in nickel-boron deposits does not have to be removed for soldering.

To solder, oxides on the surface must be removed from both nickel-phosphorus and nickel-boron deposits. Select active rosins, or mild acid such as sulfamic acid to remove oxides, or heat at 600 to 800°C (1110 to 1471°F) in a moist hydrogen

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factant blends also soften and lift buffing and polishing compounds.

Recycling and purification of cleaners have become wise investments to extend bath service life. Acknowledged cost savings are infrequent cleaner dumps, less downtime, reduced demands in waste treatment, less sludge and, most importantly, satisfactory cleaning on a per-shift basis. Sophistication of mechanical filtering aids range from simple belt and disk skimmers to coalescers to micro- and ultrafiltration. Based on the specific user's operating cost data and cleaning application, the capital expense and maintenance of these devices can be readily justified. During recent years, oil displacement has become a more popular method of alkaline cleaning, thereby increasing the useful application of mechanical filtering devices. Many of the oils can be recycled by certified firms (costing as low as just a freight charge to haul off the oils) used as an additive with fuel oil in plant boilers.

Liquid products have really contributed to improving the overall technology of aqueous cleaning. Concentrated blends, as the name implies, are not bulk water-based, but rather water present in just sufficient quantity for blending. Additives, such as alkalis, conditioners and surfactants, are the heart of these concentrates - just as they are in powdered blends. Many liquid concentrates are equal in dry weight of certain additives to their powdered counterparts. This even includes caustics. Liquid cleaners are just as effective as powders. Field benefits that are attributed to liquid cleaners include:

- Safer, easier to handle; can be pumped through pipes to the process tank from another plant location.
- No dust, caking, splash-back or localized boiling when making additions.
- Analysis can be accurately and quickly determined by measuring the cleaner's conductivity, a direct function of the concentration. Conductivity or toroidal probes activate a pump, which dispenses a sufficient quantity of the concentrate. Desired cleaner concentration is maintained at the set point.
- A 75 - 85 percent reduction in sludge.
- Tank dumps and new makeups are quicker.
- In many waste treatment applications, metals flocculate and settle faster as a result of reduced dissolved salts in the cleaner solution.
- OSHA-compliant because of reduced worker direct contact.

Unlike standard cleaner blends available in the past, today's powder and liquid concentrates offer different additive packages to meet specific requirements. These include surfactants only, or surfactancy/additive systems. The finisher can maintain a cleaning system with additional detergency, as needed, without exceeding alkalis or other constituents. To optimize the cost of cleaning, proprietary concentrates can be added in ratio with the finisher's source of caustic.

Some cleaners are formulated to be used in both soak and electrocleaning. This simplifies application, inventory and analysis control. Other concentrates improve rinsing characteristics, silicates, chelates, complexors or other targeted components.

Many of the changes in soak cleaning technology, therefore, are the result of meeting a new range of requirements: operations, environmental and health-related. These items continue to foster change and improvement in the science of soak cleaning. In the shadow of the 21st century, the first step in many metal finishing processes definitely has "the right stuff." *P&SF*

Do's & Don'ts

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atmosphere for 12 to 15 min. Solder using RMA flux. The same is true for Di bonding except flux is not used. Wire bonding to EN requires higher energy, not more pressure.

Add boron to the EN solution for soldering of nickel phosphorus plating systems. This adds cost but aids activated rosin fluxes in oxide removal without the high temperature excursion. Boron is added by including a small amount of dimethyamine boron in addition to the usual sodium hypophosphite. This adds cost.

Use electroless nickel-boron deposits for soldering, wire and Di bonding (more expensive than Ni-P).

Don't

Delay attaching after the heat treat process.

Delay after fluxing for soldering.

Use fluxes for wire bonding or for Di bonding. *P&SF*

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