

surface performance

Advanced Nanochemistry Allows Stunning Reductions in Precious Metal Use

Proprietary organic molecule has unique affinity for electrodeposition – and unrivaled process flexibility

Manufacturers of leather goods, jewelry, hardware and other consumer goods seek long-protection for precious metal components: a treatment that is invisible, yet prevents oxidation and discoloration over a long service life. They also seek to limit the amount of precious metals they consume. With both objectives, the challenge is to do so without detracting from product appearance, feel and overall value perception. That requirement precludes the use of liquid plastic coatings for all but lower-end goods.

Enter Antitarnish 616 PLUS. Originally developed for preventing tarnish on silver and silver plate, Umicore Antitarnish 616 is a nanocoating that has proved highly successful for protecting yellow and rose gold, copper and tin as well.



Antitarnish 616 PLUS provides permanent protection from tarnish and wear for gold and silver jewelry. Here, application prevents the formation of stains in low carat red gold layers, and minimizes fingerprinting on the black-ruthenium layers. 616 PLUS resists scratches, and is hypoallergenic and dirt-repellent.

Engineered nanopolymers absorb on the metal surface, crosslinking to form an invisible, undetectable layer. And while a layer of protection a few nanometers thick is what's most often specified, the use of current allows the building of a layer many molecules thick.

Antitarnish 616 PLUS protects, and permanently preserves, metal brightness and luster, on high-end jewelry, handles, rivets and other decorative metal components. It also seals thin gold's inherent porosity more effectively than alternatives. By penetrating the grain structure, it prevents oxidation of the underlying nickel or copper, so when gold is applied, plated parts exhibit high levels of corrosion resistance.

Global consumer goods manufacturers find that gold alone often fails to meet a high corrosion specification; the application of 616 PLUS allows product to pass these metrics easily.

616's aqueous formula is chrome-free and RoHS compliant; it is also hypoallergenic and stain repellent. It will not compromise solderability or bonding capacity, has low contact resistance, and preserves the inherent lubricity of the metal, making it suitable for electronic applications, such as plug connectors, as well as decorative ones.



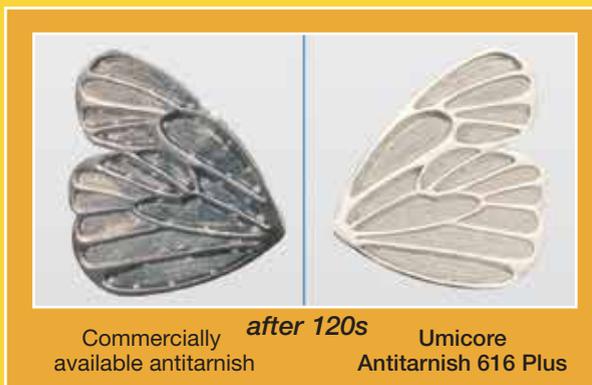
DWELL TIME GOAL: 5 SECONDS OR LESS

A proven success when applied using rack, barrel or belt systems, Antitarnish 616, with a proprietary accelerator, is now in the final stages of testing with reel-to-reel systems. Beta site data indicates dwell time can be shortened from its present 30 seconds to 5 seconds or less – a benchmark that makes it highly desirable for microelectronics and many other applications.

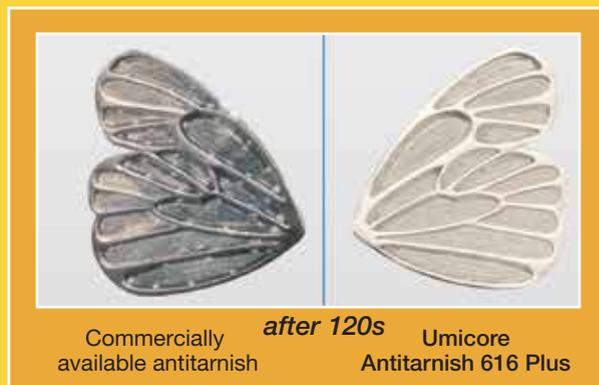


Comparative Test of Antitarnish 616

5% ammonia sulfide solution at 25°C



2% ammonia sulfide solution at 25°C



What's Old is New Again

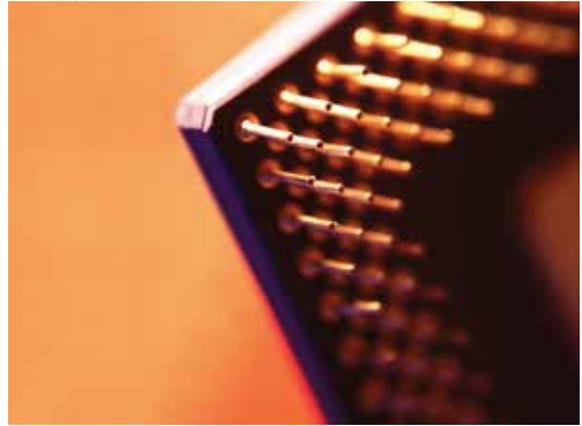
ONLY BETTER

Attendance at a Sur-Fin talk on electrolytic nickel was expected to be modest; in fact the talk, delivered by Uyemura Business Development Manager, Rich DePoto, drew a crowd of more than 100 – and seemingly as many questions, both in the Q&A, and afterwards.

Electroless nickel is the standard for many because it plates uniformly, no matter how complex the part geometry. The downside: compared with electrolytic nickel, it is more challenging to run, and more costly. It is also more difficult to maintain and is shorter-lived. Although each instance differs due to how it is used, electroless baths last, on average, 8-10 metal turnovers.

Electrolytic baths, on contrast, are virtually unlimited in terms of metal turnover. They have no fixed life, and can last for years, because unlike electroless, electrolytic does not spawn byproducts - and byproducts are what kills baths. As a result, waste treatment for electroless is always higher, and so is energy cost, due to EN's higher operating temperature, and what immediately precedes it: the hours needed for ramp-up for baths that do not run continuously.

Is electroless worth its premium? "If parts have ID holes, odd right angles and other intricate anatomy, yes," says DePoto. "But piston rods, shock absorbers, and virtually anything with a relatively simple shape is tailor-made for today's electrolytic processing. For many common applications," he says, "electroless is a costly overkill. And exploring that idea is what filled the conference room – and our Sur-Fin booth, for the better part of 2 days."



Niphos gives manufacturers of semiconductor chips and lead frames, and other products processed reel-to-reel, an alternative plating option and substantial cost reductions compared with palladium or typical gold thicknesses.

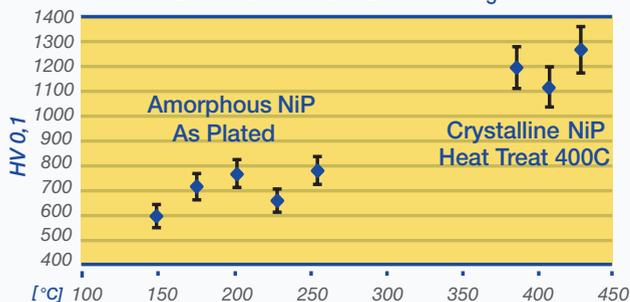
The operative phrase, of course, is "today's" electrolytic processing. "Niphos, the electrolytic nickel phos I described in my talk, has been re-energized, so it does what electrolytic baths of a decade ago never could. The savvy shop owners who sought us out were genuinely excited about it –one said it was like driving a classic, reliable old car. And since many of them have usable equipment around, no capital investment is needed. Which is even better."

The key to electrolytic nickel's unexpected revival is its phos component. "For the piston rods and shocks I mentioned," says DePoto, "the phosphorus contributes great hardenability." Niphos doubles the hardness for many applications. "Specifically," says DePoto, "the Vickers goes from 600 to over 1200 when parts are heat treated at 400°C for 30 minutes."

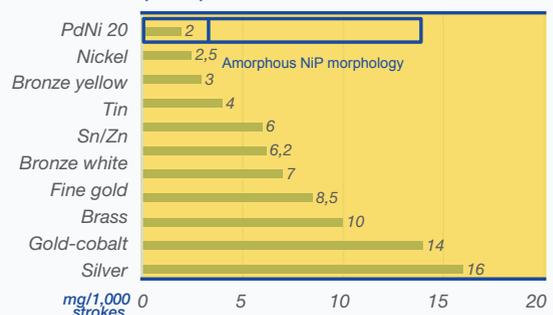
Niphos also contributes lubricity, and significantly enhances corrosion resistance. "Of course, electroless delivers great corrosion properties, too," acknowledges DePoto, "but it does not do so as cheaply, or as well, as electrolytic."

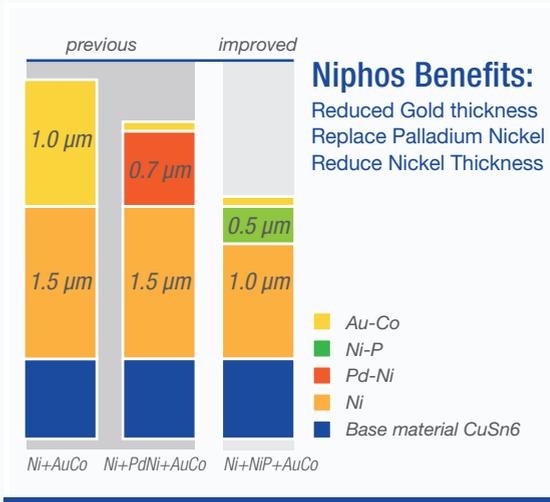
(cont'd next page)

Heat treating produces crystalline Niphos which doubles hardness to 1200 HV or higher.



Nickel phos provides unrivaled wear resistance.





Niphos electrolytic nickel, which is also referred to as “metallic glass” due to its amorphous structure, accommodates up to 13% phosphorus – “a very desirable concentration,” says DePoto, “and one that is, from a practical standpoint, unachievable with electroless chemistry.” One metal finisher who forced it, shortened the life of the bath, finished the job, but then could not back down to a conventional concentration.

“With electrolytic processing, you dial-in the phosphorus concentration, with no permanent effect. As you modify the current, the phos moves with it – without changing the chemistry. You could even plate a gradient phosphorus content if you needed two different phos layers on the same component.”

Electrolytic nickel has a long track record. “We’ve built on that history with a phosphorus component that makes Niphos ideal for many uses,” says DePoto. Chief among them is high frequency electronics. Explains DePoto, “all high frequency applications need diamagnetic properties, and to achieve it with nickel is very cool.”

All of this aside, many Sur-Fin attendees were most interested in the fact that if they ran electrolytic gold, they could also run electrolytic nickel, in sequence.

“The ability to add nickel phos to an existing electrolytic gold line, so that it became a simple drop-in process was a big idea this year,” says DePoto. “No matter what size the shop, they could all do the math on having one line do both, while eliminating an un-racking and re-racking operation, and all the costs that go with it.”

Nickel Phos in the Oil Patch

One of the most important – and timely – applications for electrolytic nickel phosphorus is the coating of pipes and rods in the oil and gas industries. Here, electrolytic nickel phos inhibits corrosion caused by exposure to brines containing CO₂ and H₂S.



A recent patent application described significant cost savings realized by using electroplated nickel-phosphorus alloy over regular carbon steel alloy components, replacing components made of stainless steels or nickel base alloys.

The inventor developed a method for lower cost and faster plating of NiP coating onto oil and gas components; the cost, produce these coatings for such applications is significantly less than high phosphorus electroless nickel coatings. Deposits can be heat treated to improve the hardness and wear resistance in the same way high phosphorus electroless nickel deposits are heat treated.

As with electroless nickel, the heat treating of electrolytic NiP deposits results in the formation of crystalline nickel phosphides within the deposit structure. The electrolytic NiP deposit also provides a hard, corrosion resistant under-layer to other wear coatings used in oil patch applications, such as hard chromium, at a much lower cost than electroless nickel coatings.

NEW Nickel-Phos Electrolytes Debut

On September 25, two important new Niphos were announced, both of which generate huge energy savings as EN replacements, and exhibit less internal stress compared with existing Niphos electrolytes. The superior hardness, abrasion and corrosion properties inherent in Niphos products are identical.

- **NIPHOS® 967** plates via rack or barrel, was engineered for connectors. Used in combination with hard gold, it allows substantial reductions in gold thickness.
- **NIPHOS® 968** for barrel plating was developed to plate steel rods in hydraulics and shock absorbers: nickel-phosphorus layers are combined with chromium as a final layer. This combination allows lower thicknesses of the chromium and dramatically improves wear properties of the complete system.

For details or test processing, contact your Uyemura representative.

UYEMURA INTERNATIONAL CORPORATION

Corp HQ: 3990 Concours, #425 • Ontario, CA 91764 • ph: 909.466.5635

Tech Center: 240 Town Line Road • Southington, CT 06489 • ph: 860.793.4011

www.uyemura.com

