Coatings with Identification Properties

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Before you buy a set of golf clubs you're counting on to take 5 strokes off your game, wouldn't you like to know its the real deal and not some knock off made in Taiwan with an inferior alloy and weighting?

Before you get on an airplane you're trusting to stay in the air, wouldn't you like to know the maintenance crew was able to verify that all spare parts installed on your plane are OEM approved parts?

Before you splurge on an extravagant watch, piece of name brand jewelry, sunglasses, or electronics, wouldn't you like to be sure that its not actually one of the cheap imitations you'd expect from a street vendor?

Before you pop a pill to help your blood pressure, cholesterol, erectile dysfunction, or other ailment, wouldn't you like to have the confidence that it was made in a pill press that is certified and current?

These are all too common examples of the $512 billion global counterfeit epidemic cited by the World Customs Organization.

So, before you call on your customer's wouldn't you like to be able to offer them a coating process that can serve all these needs and more?

And before the next time you have your staff strip the ten thousand parts returned by your customer for out of spec plating, wouldn't you like to know for sure that the parts were actually plated in your shop, and not the customer's inferior second source plater?

The following paper illustrates a new coating technology that can serve these important needs.

Increasingly companies are looking to protect their brands, intellectual property, and market share. The new coating technology discussed in this paper is a powerful tool for coaters and their customers in this important regard. When small quantities of certain

novel "markers" are incorporated into a coating, their presence can be detected quickly in a non-invasive manner with a portable electronic device.

Such markers therefore allow companies to verify the authenticity and source of a product as well as many other inventory tracking and control factors. Manufacturers can reliably demonstrate for themselves and to end users that parts are truly original equipment and not counterfeit. Coaters can use the technology to identify which coated parts were, and hence were not, processed in their shops. Dozens of unique markers have been developed which expand the number and varieties of this new technology, equivalent to a chemical barcode within a coating.

Composite electroless nickel (EN) is a well established field in our industry. For decades composite EN coatings have been developed and utilized in now countless applications around the world. The most common have been composite EN coatings with hard particles like diamond for exceptional wear resistance, and composite EN coatings with PTFE or BN for low friction and release properties.

These composite EN coatings demonstrate the key advantage of the composite technology which is the ability to add a new or improved feature to the inherent properties of EN. All composite EN coatings are perfectly conformal to the substrate's geometry with strong adhesion, and provide hardness, corrosion resistance, etc. Composite EN coating processes are also consistent with regular EN in terms of pre-treatment, ability to do selective coating, bath operation, strip-ability, and waste treatment.

Over the decades in which composite EN has been used primarily in wear resistant and low friction applications, new particulate materials have been incorporated into EN to yield interesting and useful features. For example, particles that provide high friction, heat transfer, fire retardation, and even medicinal properties have been used successfully.

In addition, particles with light emitting properties have been used previously within EN coatings. These novel coatings appear like normal EN under traditional lighting (sun, incandescent, fluorescent, etc.), but under an ultraviolet (UV) light, these coatings emit a distinct brightly colored light. As there are a number of materials that fluoresce under UV light, it is possible to produce a variety of EN coatings that each give off a different color glow when a UV light source is shined on the coating. The technology of these light emitting coatings is further described in US Patents 5,514,479, 5,516,591, and 5,834,065.

Photograph 1 – Three metal letter substrates coated with three different varieties of composite EN with light emitting particles and photographed under ultraviolet light to reveal red, blue, and white luminescence.

The use of such coatings falls into two categories: indication and authentication.

Indication: Composite EN with light emitting particles serves a valuable role on any type of machinery part, mold or other apparatus subject to wear conditions. These parts are commonly coated with a functional coating such as nickel or chrome. Such a coating makes it possible to determine when these functional coatings have worn through to avoid wear or damage to the part itself, thereby preventing inferior or out of tolerance products from being produced from a worn part. With a thin layer of a light emitting coating between the substrate and the functional coating an operator may then inspect the part periodically with a portable UV light, often while the part is still in use. Once colored light is observed, it is known that the functional coating has worn away. The part can then be recoated and reused before substrate damage to the part itself occurs and before inferior product is produced.

Authentication: Important parts or components can be coated to designate their authenticity as O.E.M. (Original Equipment Manufacturer) approved. The aircraft industry is one example where the need exists to prevent the substitution of counterfeit parts. Technicians simply need to shine a hand held, battery operated UV light on parts to display the light emission of a composite EN coating, and thereby confirm the authenticity of the parts prior to use. There are, of course, countless other industries in which companies desire to mark their parts as authentic and reduce loss of business to competitors.

While the existing composite light emitting EN coatings have represented a useful technology for many applications, a need for coatings with even greater indicating properties has still existed. The new technology described in this paper serves these needs by allowing coatings with many more levels and varieties of identification with more convenience to the plater and end-user.

This technology employs a family of materials that have been developed using unique nano-scale substances that each can be detected by a simple electronic meter. The test is non-invasive, instantaneous, and infinitely repeatable. These materials are chemically inert, safe and strong enough to persist in almost any conditions including an EN plating

bath and heat treatment. Only small amounts of the ceramic based materials need to be co-deposited into the EN coating to make their properties evident to the electronic meter. Therefore the slight presence of the material in the coating is not readily visible and essentially does not affect the performance of the coating in other regards. The material used in this technology is non-hazardous, but not approved for food applications other than secondary packaging.

There are dozens of such materials, which can be used alone or in combination to create a unique marking or tracking system that can be embedded in almost any material or coating including EN. This makes possible remarkable new opportunities for product management, manufacturing process and logistics control, inventory management and control, quality assurance management and control, pollution control and for verifying the authenticity of products and materials.

Photograph 2 – A detector displaying the presence of material “STI-8” in the coating on a golf club, one example of the products that can be enhanced with this composite identification technology.

Each detectable material can be assigned a number or a name. The electronic detector can be programmed to recognize each material and indicate the presence of one or multiple materials according to the pre-assigned number or name. For example, if a composite EN coating is produced with material “1” within the EN, the detector will report the presence of “1” in the coating when it is pointed on the surface of the coating. If the coating contains material “2”, the detector will report “2”. If the coating contains both “1” and “2”, the detector will report both “1” and “2”.

While this sounds simple, something we prefer in technology, the implication is significant. This ability of the detector to detect multiple materials and the existence of dozens of such proprietary materials means that hundreds of combinations can be employed within an EN coating, thereby allowing the plater the opportunity to have coatings with embedded “codes” that indicate:

Parts that were plated:

- In their shop,
- In an affiliated shop, or
- In a certain day, month, year, or other time period or lot

And end-users have the opportunity to verify coated parts as:

- Authentic,
- Coated in one or more authorized shops
- Coated in a certain day, month, year, or other time period or lot.

This information is very useful to manufacturers both at the time of manufacture before product is shipped to their customers, as well as later on if and when any product is returned by a customer to a manufacturer as a way for the manufacturer to prove if, in fact, the product is theirs or not. This can be particularly valuable for a manufacturer in warranty situations, especially if the product returned can be proven to not be authentic.

Numerous security measures are even incorporated into the digital meter itself. Special circuitry has been installed so the device cannot be reverse engineered, and it will shut down and lock out if any unauthorized programming or inspections are made.

Patent coverage further extends the ability to control this technology and use of it in coordinated ways for multiple authorized platers and manufacturers according to materials employed, combinations thereof, applications, and security level.

While the primary application of this indication technology is via electroless nickel, it should be noted that many other forms of plating (other electroless alloys, electrolytic, brush, immersion) and other coatings including non-plating varieties can be enhanced by this technology. And the traceable materials can even be used on their own, i.e. not in a coating. These materials can be incorporated into many raw materials including paper, ink, textiles, glass, chemicals, and more.