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Functional Plating—Applications for 16 Deposits

Functional plating is a specialized application for depositing metallic coatings. It provides unique benefits to the base metal, such as improved service life, corrosion protection, and by facilitating post treatments. Functional deposits are typically electrolytic and autocatalytic (electroless). As the designation indicates, functional deposits are not meant to be aesthetically pleasing, bright or leveled. Instead they have been developed to meet given engineering or wear resistance requirements. In this respect, "beauty is, indeed, in the eye of the beholder."

Several industries that make our daily lives possible depend on functional plating, as do core industries that comprise worldwide manufacturing. These include: aerospace, agriculture, aircraft, automotive, chemical, communications, computers, drilling, electronics, fabrication, instrumentation, machine, marine, medical, military, mining, rail transport, and wire goods.

The various functional metallic coatings available provide a wide range of beneficial properties, such as: abrasion resistance, anti-fouling, anti-seizing, corrosion resistance, ductility, elasticity, hardness (including tensile), mold release, and solderability. Desired wear characteristics, depending on the application or cycle, can be achieved by deposition of one or more metals.

There is almost no limit to the base metals that can be processed in a functional plating cycle. These include: aluminum, brass, bronze, copper alloys (including beryllium copper), gold, inconel, invar, kovar, molybdenum, monel, nickel alloys, silver, stainless steels, steel, tungsten, and zinc die castings. Unique diverse materials, such as metallized ceramics and powdered metals, are also subject to functional plating applications.

Plated Deposits

Some of the more common and important types are described in general.

Functional Plating Specifications

Plated Deposit	Specification
Copper	MIL-C-14550, ASTM B 734-97
Electroless Nickel	MIL-C-26074, AMS-2404, 2405, 2433, ASTM B656, B733
Electrolytic Nickel	QQ-N-290, , ASTM B488, 495
Nickel Sulfamate	MIL-P-27418, AMS 2403
Rhodium	MIL-R-46085
Silver	QQ-P-35, QQ-S-365, AMS 2412, ASTM B700, 97
Tin	MIL-T-10727, ASTM B545-97
Tin-Lead	MIL-P-81728, ASTM B579-73

Hard Chrome

The deposit is very hard and highly corrosion resistant. Its wear resistance is very good and coefficient of friction is low. Applications are numerous, including machine parts, drilling equipment, tools, and dies. Worn parts may also be restored with hard chrome.

Copper

The chemical constituents and balance of the sulfate bath can be modified, along with organic additives, to vary deposit hardness characteristics. This is especially important to the gravure printing industry. The acid sulfate bath is also a mainstay for processing in the printed circuit board industry. Copper forms an excellent barrier to prevent zinc migration in brass and other zinc containing metals. Sulfate- and cyanide-based plating solutions meet this application. Pyrophosphate baths have been popularly used for electroforming. Cyanide copper plating offers functional applications, particularly for electrical contacts and where low resistance is necessary.

Electroless Copper

The main uses of this deposit are for plating on plastics and metallizing holes in printed circuit boards.

Electroless Nickel

Properties of the deposit such as hardness, corrosion, resistance, low friction, and release are well known. EN formulations, based on the finishing requirements, meet several high tech specifications. Information technology, computers, electronics, automotive, and transportation, are some of the industries served by EN.

Hard Gold

This type of gold provides the requirements for electrical contacts. It may be alloyed with trace amounts of metals such as cobalt and nickel, to modify physical properties of the contact deposit.

Soft Gold

The deposit imparts resistance to corrosion, oxidation, and tarnish. Solderability and welding characteristics are very good.

Nickel

There are several coatings of functional nickels. Major requirements include ductility and corrosion resistance. Important to the electronics industry is the effective barrier layer that nickel provides. It prevents migration and diffusion of base metal and other coatings. Worn parts may also be restored with nickel.

Sulfamate Nickel

It's an excellent initial deposit or barrier layer. Deposit ductility is very good, mainly because the additives promote a fine-grained, dull to marginally bright deposit. This nickel also protects the base metal from physical exposure to temperature and pressure, in the subsequent end use or service life of the part.

Soft Nickel

For electronic parts and related use, this deposit offers exceptional ductility. Plated parts are more conducive to mechanical forming and shaping.

Palladium

Provides a superior contact deposit. Temperature exposure, solderability, and bonding to wire are very good. Because of palladium's superior hardness, it has replaced gold in some plated contact finishes.

Rhodium

The deposit exhibits excellent wear resistance. Functional rhodium plating is therefore very good in electrical contacts.

Silver

No other deposit matches silver for conductivity. Many electrical connectors are silver plated. The requirement must compensate for corrosion resistance, for which other precious metals, such as gold, are better.

Tin

The semi-bright or matte deposit offers solderability and contact. Common finishes are applied to wire, strip, connectors, and alkaline etch resist on printed circuit boards. Certain automotive, engine, and mechanical finishes include functional tin, especially when superior lubricity of the deposit is concerned. Tin plating has been a fixture in the food processing industry for decades. Because of its conductance and corrosion protection, tin is an important deposit in aerospace and communications.

Tin Lead

Functional deposits include plating on wire, to improve solderability and oxidation protection. Other applications include corrosion protection, improve solderability of electrical contacts, and for etch resist.

Zinc

It continues to provide the most economical corrosion protection for steel. Automotive, plumbing, hardware, and metal stampings before assembly are some of the popular zinc finishes.

Zinc Alloys

Corrosion protection and wear resistance can be markedly improved by plating in solutions of zinc alloyed with specific metals. These include cobalt, iron, nickel, and tin. Selection of the alloy and type of bath permit the finisher to meet a wide range of deposit specifications.

Some of the required functional plating specifications are listed in the accompanying table.

Functional plating is a very important complement to industrial metal finishing. Base metals from aluminum to steel require deposits to meet a wide selection of specification finishes. All the industries, as described earlier, depend heavily on functional plating. Our daily lives and all segments of manufacturing depend on it. ***P&SF***