Color Coding Titanium Components

Automated anodizing makes it easier

From the complex world of electronic and aerospace assembly to the sterile intensity of hospital operating rooms, the array of colors made possible by titanium color anodizing is in high demand these days.

The reason for the demand is that titanium anodizing color-codes components for easy product identification without dyes or coatings and without significant dimensional or chemical change. An orthopedic surgical team, for example, can select the correct bone screw by its color—magenta, green or bronze to name a few possibilities—and the instrument used to install that particular bone screw can also be color-coded to match.

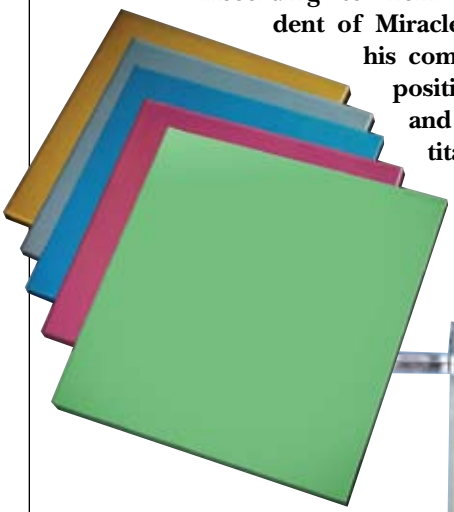
Titanium color anodizing has been around for years and shares some similarities with electroplating. What's different now is that the production titanium anodizing process has been successfully automated.

According to Tom Pembridge, president of Miraclean (Ashville, NY), his company was uniquely positioned to develop and launch automated titanium anodizing. Miraclean is a division of Chautauqua Chemicals Co. Inc., a company that supplies both chemistries and equipment to electroplaters, including multistation plating lines and the chemistries and accessories they require, from acids and anodes to mixers and rectifiers. The company also develops ultrasonic parts-cleaning, passivating, and electropolishing systems.

"There has been a major trend over the past few years to automate processes, both new and existing, especially in the medical device industry," says Pembridge. "The driving forces behind this are standardization, verification and certification of processes, as well as operator safety when dealing with hazardous materials."

The titanium color anodizing process is one that requires particular attention to detail, making it labor-intensive in manual mode. The process does not color the titanium itself; rather, anodizing creates a stable oxide layer on the titanium surface through the application of current. Different voltages produce discretely different oxide layer thicknesses, which in turn result in different color effects. The "colors" produced are actually interference perceived when wavelengths of light refract through the oxide layer and reflect off the substrate below it.

Time, temperature and voltage all have a critical impact on the color effect produced. So does



Automated titanium anodizing line incorporates a color management system that checks parts to user specifications. Part color is controlled by processing time, temperature and voltage as well as chemistry concentration.

the concentration of chemistry in the bath. AMS 2488D, an aerospace specification for Type II titanium anodizing, also requires agitation during the anodize step to prevent air pockets which can lead to variability in the oxide layer.

In the Miraclean automated titanium anodizing line, all the process parameters once handled manually—time, temperature, voltage, and agitation—are introduced and controlled by automation. Parameters are also monitored by feedback to a programmable logic controller (PLC), which will not advance a load into the anodize station unless all parameters are within acceptable ranges.

Titanium color anodizing in production is typically a multiple-stage process. In the Miraclean system, loads of parts automatically advance through clean and rinse steps that are time-, temperature- and concentration-controlled and monitored as required. After anodizing, parts automatically move through multiple rinses that are time-controlled and monitored for concentration where appropriate.

To complete the automated process, each load is evaluated for acceptable color range by a color management system that is integrated with the system PLC and customized to meet user specifications. Out-of-range loads are managed automatically according to parameters determined by the user, which may include repetition of the anodizing step or stripping and repetition of the entire process. In the case of medical devices, accepted loads typically proceed through a passivation process before a final rinse and drying step.

Miraclean's first automated titanium color anodizing line has been in production for almost a year. The line's automated color acceptance test assures that each load conforms to color specifications. With critical process parameters monitored and controlled by the system, the automated line is consistently meeting throughput goals. Operators, meanwhile, are free to load and unload parts and perform other tasks while the machine handles the anodize process.

The automation controls, monitors, and integrates process parameters and process steps, and features in-house programming, touch screen operation, and modem-based troubleshooting. ■