

A product's surface finish says more than you think

Increase the value of medical devices with thin film finishes from Vapor Tech

Surface finishes determine how a medical device looks and feels, but their value extends far beyond appearance. With the right surface properties, medical device manufacturers can improve usability, functionality, durability, and even give substrates attributes they don't normally possess. In other words, finishes aren't so superficial. They can increase the value of devices and instruments and propel manufacturers to greater profits.

A finish can leave a powerful first impression

The surface of a medical device is the first thing people see, and that initial look can convey a whole host of things about the product. How will the device be used? Does it seem like it was well made? Will it be easy to clean and sterilize? Because a finish provides medical devices and instruments with both decorative and informational value, designers should select a finishing technology that will deliver the best performance and properties.

The requirements for medical device finishes vary widely. What a surgical instrument needs isn't always necessary for an implant, and vice versa. However, there are commonalities in how surface finishes add value to products, and the number-one similarity is ensuring predictable performance.

For example, a surface treatment must withstand application wear and tear without pitting or corroding, and the finish itself should not affect conformal properties, like an edge or contour. A surface's hardness and toughness have long-term implications. Hardness predicts how an interface will yield under pressure, while toughness is an indication of how much a material can yield before breaking. These properties are prime predictors for the durability and abrasion resistance of a product.

Since a device's color is often used to indicate purpose and aid in identification, manufacturers must also be able to apply a colorfast finish that tolerates sterilization techniques, as well as bodily fluids.

Considerations for selecting the right finish

Designers should consider these manufacturing properties when choosing a surface finish application method:

- / Surface materials should match those in use in the medical community today (i.e., zirconium, carbon, titanium, chromium, silver).
- / Interface and bonding should be tightly integrated at an atomic level so the finish becomes an extension of the surface material.
- / The surface structure should align with the application. For example, if the instrument will interact with tissue, the surface should be porous. For devices exposed to abrasion and corrosive elements, a dense surface is needed.
- / The surface finish must be compatible with the substrate and enable modification to metals, ceramics, plastics, and other polymers.
- / The method should evenly coat complex shapes without compromising a product's edges or contours.

How Vapor Tech surface finishes enhance products

The Vapor Tech Low-Temperature Arc Vapor Deposition™ (LTAVD) and RAAMS™ systems enable manufacturers to enhance the surface performance and appearance requirements for all types of medical device finishes. The beauty of Vapor Tech's systems lies in their ability to strengthen surface properties without changing the product's functionality.

Through the LTAVD and RAAMS processes, the final surface materials are atomically bonded to the substrate as an extension of the base material. This means the surface finish will not delaminate or fracture as might an anodized or organic coating. Deposition approximates atom-by-atom control of the materials added to the surface for consistent performance and reliable surface properties and coverage. This feature is especially important with the Food and Drug Administration (FDA) calling for increased attention on color additives and hydrophilic and hydrophobic coating separation.¹

Since medical professionals rely on color to identify instruments and surgical sequence, using one system to apply stable, precise, and reliable finishes in a vast array of colors is extremely beneficial. Further, color coding with zirconium-based compounds reacted with simple elements (oxygen, nitrogen, and carbon) can replace the need for surface-hardening additives and provide a tougher finish than achieved with typical anodized hardening methods. These colorfast finishes do not wear off or fade, even as they are run through autoclave and gamma sterilization processes.²



LTAVD and RAAMS processes can be applied to a wide variety of materials, such as steel, titanium, plastics, and aluminum. Taking advantage of the surface properties enabled by LTAVD and RAAMS, manufacturers can replace heavy steel and iron with finished light metal alloys, thereby making medical devices easier to use. They can also alleviate other common problems related to friction, hardness, and abrasion. Medical devices, particularly orthopedic implants, must withstand long-term friction. Vapor Tech finishes have been used on metal valves in automotive engines – some of the highest-friction sensitive machines anywhere – so the properties that make them successful in cars are transferable to a wide variety of applications.

Beyond the metal-ceramic surface enhancement treatments traditionally used for medical devices, diamond-like carbon (DLC) is another option. Finishes labeled DLC have diamond- and graphitic-like properties with the smoothness of ceramics, which allows the device to resist chemicals and abrasions. For example, reacted metal and DLC surface enhancements have been shown to improve durability and performance of cutting tools by up to 10 times that of non-coated tools.

¹ U.S. Food & Drug Administration. "Color Additives for Medical Devices."

² Mark Pellman. "PVD Coatings for Medical Device Applications." Products Finishing, July 2000.

Better bionics

The demand for higher-performing implants, such as hip joint replacements, has led to the use of surface treatments that increase the device's lifetime and durability. Vapor Tech's systems can deposit thin film surface-enhancing materials that increase the hardness and wear resistance of orthopedic implants, pacemakers, dental implants and more. Ultimately, with thin film applications, manufacturers can give their devices greater functionality, performance, and longevity by:

- / Reducing the chance of rejection and infection through the use of biocompatible materials
- / Decreasing friction between device and surrounding body parts³
- / Minimizing irritation and inflammation⁴
- / Extending device's life⁵ and improving patient outcomes

Specific materials, such as titanium with defined surface structures (i.e., porosity), can be used to improve integration between bone and implant, eliminate leaching from the base material, and allow an implant to be made with multiple substrates.⁶ Vapor Tech's team of highly skilled service engineers and finishing experts can help manufacturers identify the right solution for their application.

A healthy business decision

By incorporating LTAVD or RAAMS into the manufacturing process, medical device manufacturers can improve usability, functionality, and durability to differentiate their instruments and implants from others in the market. But in the end, it's not just about differentiation; it's about delivering the devices that will improve care and outcomes for patients around the world.

Benefits of Vapor Tech thin film surface finishes

- / Improved wear resistance
- / Easy sterilization and cleaning
- / Reduced friction
- / Wide variety of color options
- / Long-lasting performance
- / Permanence
- / Durable, colorfast appearance
- / Protection for critical dimensions

³ "Medical and Biomedical Thin Film Materials: Prosthetic Implants." Materion.

⁴ Marc Thomsen, Matthias Rozak, and Peter Thomas. "Pain in chromium-allergic patient with total knee arthroplasty: disappearance of symptoms after revision with a special surface-coated TKA – a case report." Acta Orthop, June 2011.

⁵ R. Lappalainen and SS Santavirta. "Potential of coatings in total hip replacement." Clinical Orthopaedics and Related Research, January 2005.

⁶ "Medical and Biomedical Thin Film Materials: Prosthetic Implants." Materion.



About Vapor Tech

For more than 25 years, companies in a variety of industries have relied on Vapor Tech's industry-leading coating technologies to ensure their products feature premium surface finishes and functional surface finishes. Vapor Tech is a subsidiary of Masco Corporation.

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