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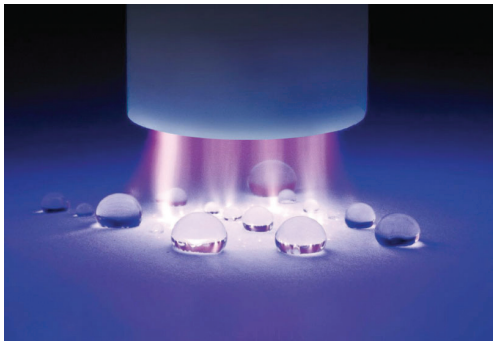
Surface Engineering in Medical Technology

From DLC to Plasma and Beyond

New materials and technological advances continue to proliferate the medtech industry at a rapid rate and suppliers strive to offer innovative solutions to meet the demands of increasingly complex components and devices. A wide range of specialized materials are used today and many of those materials are suitable for the intended finished use only after the application of a customized surface treatment. These treatments can result in reduced friction, improvement of haptic properties, the introduction of chemical functionalities, and improved medium resistance of the materials. To meet this growing demand, Freudenberg Medical utilizes traditional coating methods like wet chemicals and state-of-the-art methods such as plasma treatments in order to alter the surface properties of medical components.



Surface modifications allow a variety of unique customer needs to be addressed. For example, color coating is a surface modification which enables control of the base materials' transparency and optical properties. A plasma treatment is another option which will reduce friction; silicone itself has a high friction coefficient and a plasma treatment will modify its friction properties. This can improve silicones manufacturability (particularly in automated assembly lines) and its ability to be used in low friction applications where gliding is necessary – such as with endoscopic catheters and the internal coating of flexible tubes used in cardiac pacemakers.

Surface modifications such as plasma coating directly influence the surface energy of a component; this allows control and adjustment of the hydrophilic properties. Plasma processes enable multiple functionalities to be implemented within a single process; for example plasma enables a bioactive layer with good adhesion to be applied to a substrate in a single step. The surfaces are plasma coated, activated, or plasma etched using environmentally-friendly processes. A variety of component geometries can be altered with vacuum or atmospheric pressurized plasma, without solvent emissions or a time-consuming drying process. Small parts can be handled in bulk goods processes under a vacuum, while atmospheric pressure plasmas are well-suited for integration into existing process chains. Different systems for handling and coating are utilized depending on the specific geometry requirements of the component.

Another newer surface coating technology is diamond-like carbon or DLC, which is biocompatible, amorphous, and can be produced by plasma-supported processes. It has a very low friction coefficient, good wear resistance, and a high layer of hardness resulting in a significantly higher stability for long-term implantable devices. By incorporating different chemical elements, DLC can be further adapted to special requirements. One example is an antibacterial effect which can be achieved via the infusion of metal particles such as silver.

Parylene coatings are another medically approved surface coating. These coatings are hydrophobic, inert, transparent, non-porous, biocompatible, biostable, and have an outstanding barrier effect against moisture, chemicals, and gases. These coatings also have a high dielectric barrier effect. Four different types of Parylene are produced. The basic type is Parylene N (poly-para-xylene), which is characterized by a good gap penetration capability and a low friction coefficient. Parylene C has high chemical resistance and provides an excellent barrier effect against gases and moisture. Parylene D has long been used as a high-temperature Parylene due to its continuous use at a temperature of 100º C. A new, fluorinated Parylene, Parylene HT®, is used at even higher temperatures (up to 350º C) and has the highest gap penetration capability, a high UV resistance, and the lowest friction coefficient.

Dr. Mark Ostwald, Vice President and General Manager of Freudenberg Medical – Carpinteria notes, “In many cases, our customers require specific material properties for their device and due to regulatory aspects we cannot modify the material chemistry. In these situations a customized surface treatment allows us to provide customers with individualized solutions.”

The medtech field continues to expand to meet the demands of new treatments and the complexity of devices that are part of those solutions. Unfortunately, there are no universal answers, it is important to find a production partner with the experience and technical capabilities to provide the right solution for these specialized needs. Surface engineering is one of the many areas in which Freudenberg Medical is maximizing the flexibility of its processes and services to achieve continuous innovations that keep pace with the ever growing challenges of the healthcare industry.

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About Freudenberg Medical

Freudenberg Medical is a global partner for the design, development and manufacture of medical devices and components. With 11 manufacturing operations and more than 1,500 associates worldwide, Freudenberg Medical offers a wide range of manufacturing capabilities from high precision silicone and thermoplastic components and tubing to coatings, finished devices and subassemblies for catheters and minimally invasive devices. www.FreudenbergMedical.com

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