Diamonds are a doctor's best friend

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British scientists have developed a way of using diamond to help make low-friction medical implants, which could also help reduce infections due to superbugs such as MRSA.

Speaking at an Institute of Physics conference in Chester, Joe Franks from Brunel University , outlined a new method of coating plastics, metals and collagen with a diamond-like carbon material. According to Franks, the invention will have important applications in aerospace, engineering and medicine.

At the conference Novel Applications of Surface Modification, organized by the Applied Physics and Technology Division of the Institute of Physics , Professor Joe Franks revealed how medical implants and engineering components can be coated with a diamond-like carbon (DLC) material to make them harder wearing, reduce friction between components, and provide lightweight corrosion protection. Importantly, DLCs, unlike diamond and other coating materials, can be deposited on a surface without having to heat the component to several hundred degrees. This means plastics, as well as metals and ceramics can be coated with DLCs.

The Brunel team have developed new DLC coatings for mechanical and biomedical applications. Mechanical applications include new coatings for drill bits and abrasive materials, non-clogging tungsten carbide milling inserts for engineering applications, and more efficient, lower friction, automotive components that are more fuel efficient.

DLC coatings are also biocompatible and unlike other types of coating don't trigger the coagulation of blood. Franks reported that they have already provided surgeons at the Royal National Orthopaedic Hospital (RNOH) with DLC-coated knee implants for patients allergic to the metal used.

Professor Joe Franks said: "We've also developed coatings that can be used for catheters and various medical implants that go through the skin. The coating is important because it prevents colonization of the tissue by bacteria, such as the superbug MRSA ."

DLC was first produced in 1971 in a vacuum chamber using a technical and costly method that involved spraying charged carbon atoms at the surface to be coated. Subsequent techniques have improved on this. However, Franks and his colleagues have developed a more effective still method known as 'plasma-assisted chemical vapour deposition' (PACVD). The component to be coated is mounted in a vacuum chamber on an electrode connected to a high-energy radio wave transmitter. A hydrocarbon gas, such as methane or natural gas, is pumped into the chamber and the radio waves tear apart the hydrocarbon molecules and strip off the electrons from its carbon atoms to produce positive carbon ions. These are attracted to the negatively charged component to produce the coating.

Franks said: "The advantage of this method is that the ionized plasma surrounds the component, which means it does not need not to be manipulated inside the chamber to get an even and uniform coating. The ion energy can be varied as can the composition of the gases in the chamber to vary the properties of the coating, explained Franks.

Franks and his colleagues are working on ways to optimize the coating for specific applications. An optimum DLC for knee prostheses is not necessarily the same as one for lining an artificial artery, for instance.

Indeed, the Brunel researchers are developing DLC coatings to line hydrated collagen, a natural protein found in the body, which can be used to construct bypass arteries. Because collagen can more naturally be incorporated into the body than synthetic materials the graft should be more successful. Lining it with DLC allows blood to flow without causing it to clot.

Franks added: "Collagen can also be used as a patch graft in repair operations. However, it is porous, which can cause the repair to be degraded by the acidic or alkaline chemistry of the body. By using a DLC coating, which is chemically inert and forms an atomically dense layer, a strong chemical barrier is formed."

The researchers are patenting DLC coating of collagen and preparing to publish details of their results.

Source: Institute of Physics