

Enhancement of Long-Term Stability of Implants by High-Tech Coatings

Biocompatible Wear Resistant Coatings

Material developments of the past decades caused an enormous progress concerning orthopaedic applications and allow the implantation of different endoprothesis today. But the durability in human bodies is still too low due to the occurring high stresses and strains. Wear induced loosening of endoprothesis is the result after less than 10 - 15 years in many cases. Moreover, the possibilities for bone anchorage in a following replacement surgery are worse. The modern coating technology can strongly contribute to enhance the life-time stability of implants.

Increasing requirements to the surface

Sustainable success of implanted total joint prothesis in the reconstruction of human joints depends on the one hand on an anatomical correct motion free of pain and on the other hand particularly on the biocompatibility and stability of the substitution material. High tribological stress during motion can cause abrasion and corrosion particles accumulating in the human body resulting in a rejection of the implant. Wear appears not only in the joint, but also at the contact implant/bone and implant/bone-cement, respectively. Despite of a successful adherence process with or without cementation a relative movement on the micrometer scale can occur. In

case of titanium implants the natural and biocompatible thin oxide top layer will be annihilated. A first consequence is the generation of abrasion particles on

both sides of the friction pair. Moreover, these particles contain also metal. Both, abrasion quantity as well as metal content can induce a rejection process in the



Low-friction and wear resistant DLC-coating (axyprotect®) on a titanium hip shaft ■

body. This influence is also topic of current studies. A further consequence after a break down of the passivating oxide layer is the beginning corrosion of the metal (titanium). Thus further titanium ions will be released into the human body. In addition also the arising local electrical fields can influence human proteins and enhance the rejection of the immune system as well. ■

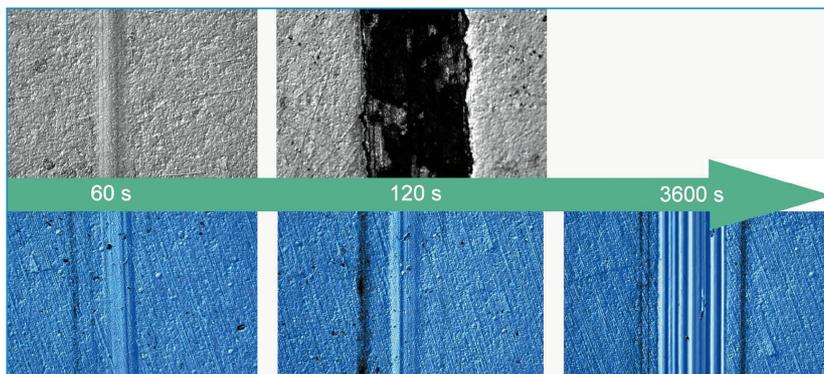
Innovative surface and coating technologies

Modern surface and coating technologies can provide solutions for such applications. The increasing requirements concerning biocompatibility, wear and corrosion resistance to the surface as well as stability and ductility to the bulk material can only be solved by an effective combination of substrate and coating. With the modern Plasmaimpax technology, which combines Plasma-CVD and ion implantation, extremely low-fric-



Plasmaimpax coating system for deposition and ion treatments of implants and components for medical as well as automotive and engineering applications ■

Tribological tests moving the titanium shaft against bone cement have shown that the quantity of abrasion can obviously be reduced. Moreover the metal content decreases drastical-



Wear tracks on an uncoated (top) and DLC-coated (bottom) steel sample after a tribological lubricant-free test against a steel ball (100Cr6). The uncoated surface shows already after 2 minutes a obvious wear trench. Already after a 30-times longer test period the DLC-coated (axyprotect®) sample shows only a light surface polishing, which only can be seen in a special microscope contrast (differential interference contrast, DIC) ■

tion and hard coatings on base of diamond like carbon (DLC) can be generated on a special manner. This technology allows the production of compact and with it corrosion as well as wear resistant coatings with lowest surface roughness. Additionally the DLC-coating is biocompatible, achieving all conditions for an application as human implant.

ly due to the DLC-coating by 85 %. Finally this coating is suitable for a wide range of medical applications. For some special cases the coating system will be proved in current studies and further modified, respectively. For a lot of applications also in the non-medical wear protection the coating can already be achieved commercially today. ■

AxynTeC – the company

AxynTeC Dünnschichttechnik GmbH is a technology provider in the field of surface and coating technologies. With its innovative coating technologies – laser deposition and Plasmaimpax – the company offers consulting, development of customer specific coatings as well as job coating and the accordant coating systems including the necessary process technology. This is a one-stop solution for the customer. ■

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