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Biodegradation of anti-microbial titanium-magnesium-silver coatings on polyetheretherketone for bone-contact applications

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Abstract

In addition to high bonding between bone and implant, suppressing bacterial infection at the implant site is an extremely high surgical request. For spinal implants the effects of infection can be much worse due to risks for the patient by nerve damage resulting in paralysis. The main problem of nosocomial multiresistant bacteria is connected to biofilm formation, which efficiently protects against infiltration of pharmaceutical antibiotic drugs. In such a case, a fast revision surgery for exchange of the implant is mandatory, because osseointegration is stopped by bacterial endotoxins. Mostly silver is used on the market, possessing a wide spectra of anti-microbial activity for the majority of nosocomial bacteria and viruses at very low ppb concentration by destroying their cell walls. In this study, it is aimed to improve the antibacterial behavior of PEEK implants by developing a layered, biofunctional coating which consists of titanium as a stiff and osteoconductive base layer, magnesium as bioresorbable intermediate layer to increase the bioactivity and silver as an antibacterial top layer. Platinum is doped to silver to increase the release of silver. XRD, SEM/EDS and AFM, ultra-micro hardness indentation test and immersion tests are carried out to identify the coating properties. In order to clarify the release mechanism, electrochemical tests are also performed. Results