Influence of titanium surface modifications on formation of composite calcium phosphates / silver nanoparticles coatings

Suzana Inkret[1], Dr. Ina Erceg[1,2], Prof. Dr. Silke Christiansen[2,3], Dr. Maja Dutour Sikirić[1]

[1]Department of Physical Chemistry, Ruđer Bošković Institute, Zagreb, Croatia, [2]Fraunhofer Institute for Ceramic Technologies and Systems IKTS, Forchheim, Germany, [3]Innovation Institute for Nanotechnology and Correlative Microscopy – INAM, Forchheim, Germany

Background incl. aims
Due to their chemical and mechanical stability, as well as biocompatibility titanium and its alloys are among most frequently used materials for hard tissue implant materials [1]. However, they are biologically inert, a problem which is usually surpassed by coating them with bioactive calcium phosphates, which results in improved adhesion of coating material and cells [2]. As major problem in orthopaedic surgery are implant associated infections, the coatings should in addition have antimicrobial properties. One way of achieving this is incorporation of antimicrobial components in calcium phosphate coatings. In this sense, silver nanoparticles attract attention due to the fact that silver exhibits a broad spectrum of antimicrobial activity and is unlikely to cause bacterial resistance [3].

Methods
The titanium surface was chemically modified using two different methods using strong acids, namely hydrochloric acid previously described by Lu et.al. [4] and using a mixture of hydrochloric and sulfuric acid previously described by Wang et.al. [5]. After modification of the titanium surface, composites of silver nanoparticles and calcium phosphates were coated by wet chemistry method. The influence of the different surface modifications on the formation of the composites was investigated by scanning electron microscopy (SEM), energy dispersive X-ray spectroscopy (EDS), Raman spectroscopy and atomic force microscopy (AFM).

Results
The modification of titanium surfaces changes surface properties such as roughness and wettability, as shown by AFM and contact angle measurements. Composites of calcium phosphates and silver nanoparticles formed on treated, but also on untreated titanium surfaces. SEM and EDS measurements showed that the morphology and uniformity of the coatings change depending on the surface modification.

Conclusion
Surface modification of titanium is an important step in a process for coating titanium with functional materials such as composites of calcium phosphates and silver nanoparticles, as it modifies surface properties and thus influences the deposition of coatings. The results obtained can contribute to the development of an ideal procedure for the preparation of antimicrobial coatings on titanium surfaces.

Keywords:

composites, titanium implants, surface modification

Reference:

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