Low temperature oxidation and photocatalytic activity of Ti-6Al-4V

Erik Unosson,* Cecilia Persson,* Ken Welch* and Häkan Engqvist*

*Applied Materials Science, Department of Engineering Sciences, Uppsala University, Sweden
*Nanotechnology and Functional Materials, Department of Engineering Sciences, Uppsala University, Sweden
Contact: erik.unosson@angstrom.uu.se

Summary
A simple and straightforward chemical method was used to modify the surface of Ti-6Al-4V. The treatment led to an increasingly porous and nanofeatured surface with increased photocatalytic activity (PCA). Photocatalysis can be used to kill bacteria.

Background
Photocatalysis on TiO₂ generates reactive oxygen species (O₂⁻ and •OH), which can react with and decompose organic material [1]. Biomedical implants and devices are easily infected with bacteria, and skin-penetrating systems such as dental implants are particularly vulnerable [2]. A photocatalytic surface could add an on-demand, in situ, antibacterial feature to implants and devices.

The current study was aimed at optimizing a chemical oxidation technique of Ti-6Al-4V for high photocatalytic activity.

Materials & Methods
Discs of Ti-6Al-4V were oxidized in 30 w% H₂O₂ for up to 24 h, followed by aging for crystallization in H₂O for up to 72 h, all at 80°C [3]. PCA was determined by measuring degradation of the organic dye rhodamine B.

SEM and GI-XRD were used to characterize resulting surface structures.

Results & Discussion
PCA was shown to have a near linear relationship with total treatment time (Fig. 4b).

A homogeneous, nanoporous coating was observed after longer treatments (Fig. 3), linked with a gradual decrease in crystallinity of the surface layer (Fig. 4a).

The increase in surface area, rather than anatase formation, is suggested to be responsible for the increase in PCA.

Conclusions
H₂O₂ oxidation and hot water aging was used to modify the surface of Ti-6Al-4V substrates.

Long term treatments (up to 96 h) were required to obtain satisfactory PCA.

The treatment offers simple modification of complex geometries, generating a photoactive surface with the potential to reduce bacteria on demand.

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References