Nanorough titanium surfaces reduce adhesion of *Escherichia coli* and *Staphylococcus aureus* via nano adhesion points

Lüdecke C, Roth M, Yu W, Horn U, Bossert J, Jandt KD (2016) Nanorough titanium surfaces reduce adhesion of *Escherichia coli* and *Staphylococcus aureus* via nano adhesion points *Colloids Surf B Biointerfaces* 145, 617-625.

Details

PubMed

Abstract

Microbial adhesion to natural and synthetic materials surfaces is a key issue e. g. in food industry, sewage treatment and most importantly in the biomedical field. The current development and progress in nanoscale structuring of materials surfaces to control microbial adhesion requires an improved understanding of the microbe-material-interaction. This study aimed to investigate the nanostructure of the microbe-material-interface and link it to microbial adhesion kinetics as function of titanium surface nanoroughness to gain new insight into controlling microbial adhesion via materials‘ surface nanoroughness. Adhesion of *Escherichia coli* and *Staphylococcus aureus* was statistically significantly reduced ($p \leq 0.05$) by 55.6 % and 40.5%, respectively, on physical vapor deposited titanium thin films with a nanoroughness of 6 nm and the lowest surface peak density compared to 2 nm with the highest surface peak density. Cross-sectioning of the microbial cells with a focused ion beam (FIB) and SEM imaging provided for the first time direct insight into the titanium-microbe-interface. High resolution SEM micrographs gave evidence that the surface

peaks are the loci of initial contact between the microbial cells and the material‘s surface. In a qualitative model we propose that the initial microbial adhesion on nanorough surfaces is controlled by the titanium surface peak density via nano adhesion points. These new understanding will help towards the design of materials surfaces for controlling microbial adhesion.

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doi: 10.1016/j.colsurfb.2016.05.049

PMID: 27288816