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Specific adsorption of Fibronectin on modified titanium surfaces

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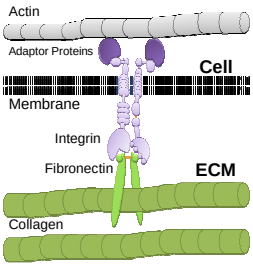
BioNanotechnology

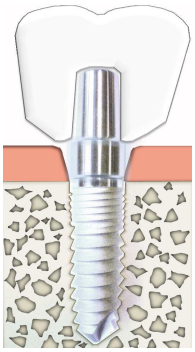
Introduction



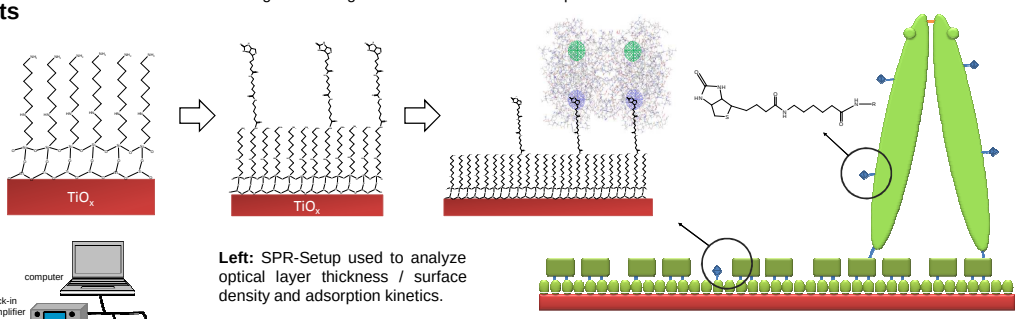
The missing link between the titanium surface of dental implants and the gingival is a big issue in dental implant integration (right). In this gingival pocket bacteria can intrude and cause infections which often lead to an implant rejection .

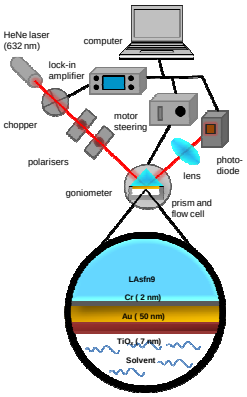
By mimicking the natural-environment of fibroblasts (the extra cellular matrix, ECM), these gingival cells should adhere to the surface and hence the pocket can be closed before an infection can occur. We are focussing on key matrix proteins like fibronectin (left) and on a specific immobilization in order to keep these proteins in a functional state.

Self assembly techniques were used to modify a TiO_X-surface with Biotin derivates to create a Streptavin monolayer (bottom). Because of its four tetraedric binding sites for Biotin, immobilized Streptavidin functions as a coupling agent for biotinylated proteins. They are adsorbed specifically through the strong and non-covalent Biotin-Streptavidin-Interaction.



Results

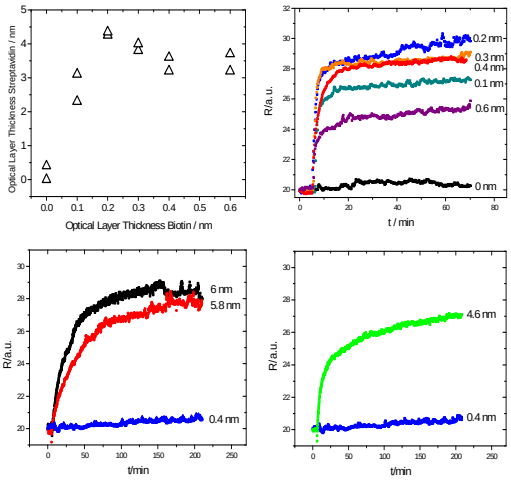




Left: SPR-Setup used to analyze optical layer thickness / surface density and adsorption kinetics.

Right Top: Optical thickness correlation between Streptavidin and Biotin derivatives layer on TiO_X(left). Corresponding Streptavidin adsorption kinetics (right). Numbers indicate Biotin derivatives optical layer thickness.

Right Bottom: Adsorption of non-biotinylated Fibronectin on pure (black), amino-activated (red) and Streptavidin (blue) modified TiO_X surfaces (all left). Adsorption of biotinylated Fibronectin (green) on a streptavidin modified TiO_X surface (right). Numbers indicate Fibronectin optical layer thickness after rinsing.



Conclusion

For the creation of a Streptavidin monolayer on TiO_x the same criteria apply as for gold or SiO_2 surfaces. The Biotin derivatives have to be presented with a certain distance to each other on the surface for optimal acceciblity to Streptavidin. Due to this a further increase in optical layer thickness of Biotin after the peak at 0.2 nm leads to a decrease in optical Streptavidin layer thickness. This Streptavidin monolayer prevents any non-specific adsorption and enables only biotinylated Fibronectin to adsorb on the surface.

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We would like to thank Gabriele Hermann and Andreas Scheller from the Max Planck Institut for Polymer Research in Mainz for their technical support during the last two years. This project is supported by a grant (FKZ1775X05) from the FH³ BMBF program in the context of cooperative project „Bionanofunktionalisierte Oberflächen“.

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AiF Ideen eine Zukunft geben

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