

Specific adsorption of Fibronectin on modified titanium surfaces

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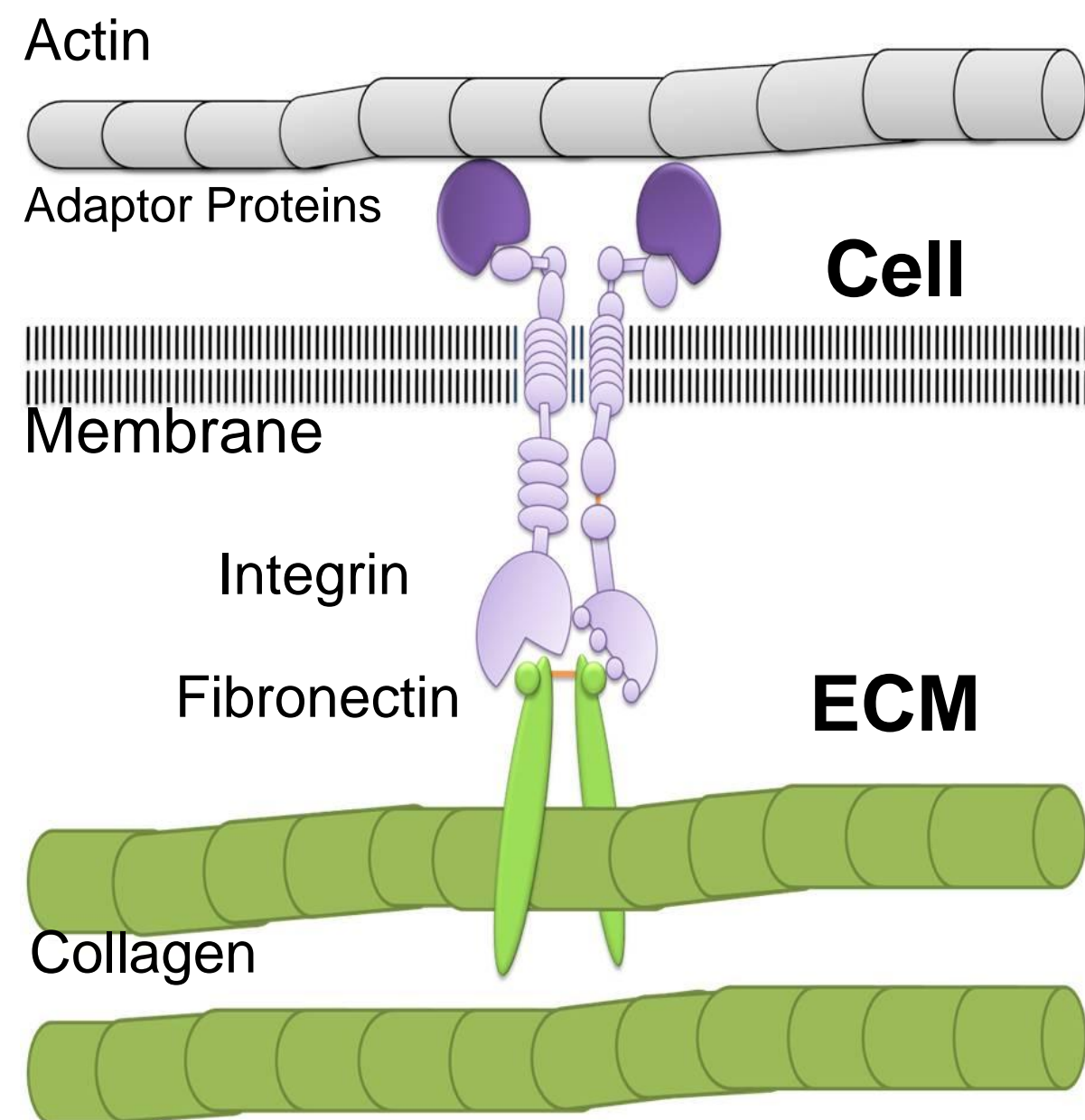
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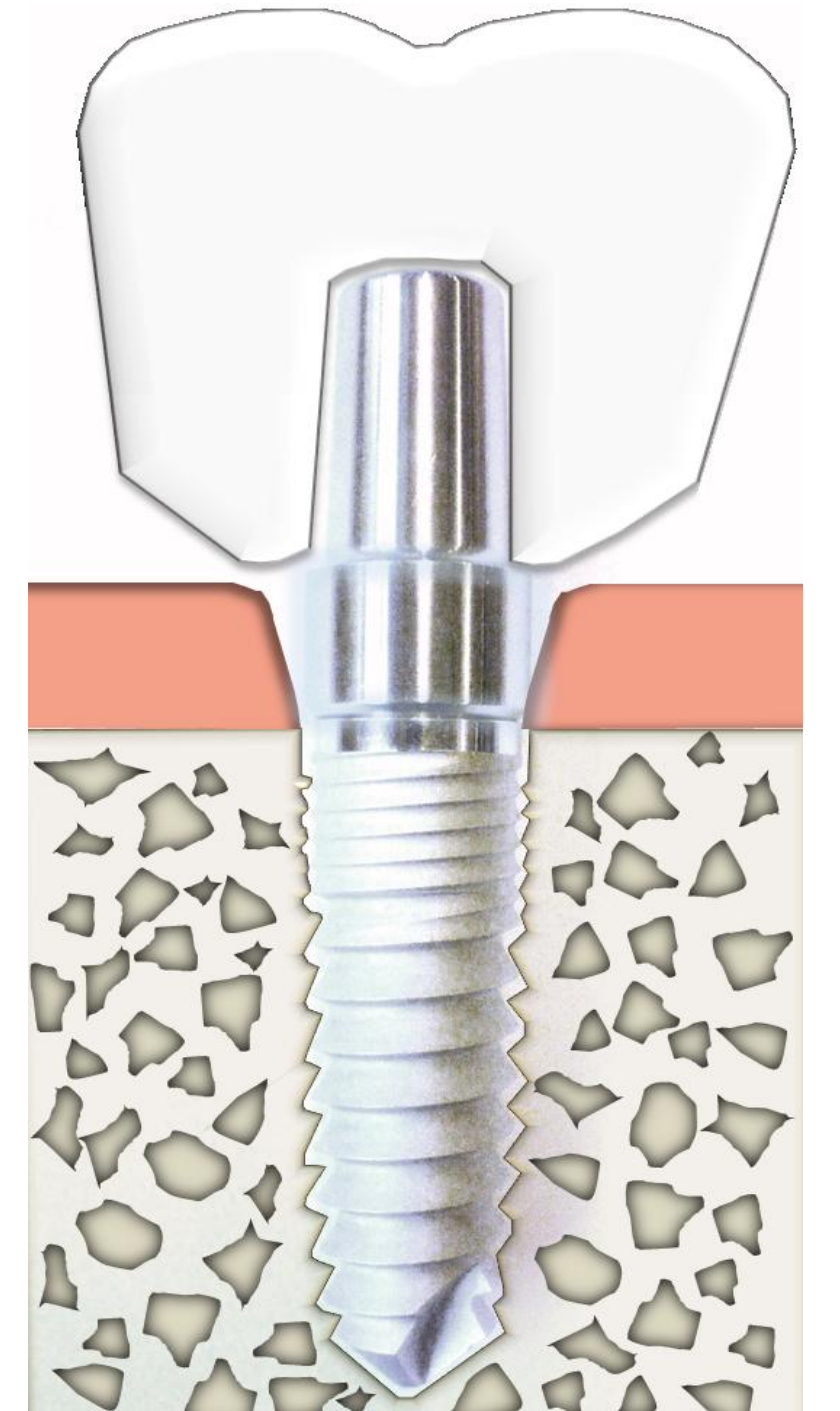
Introduction



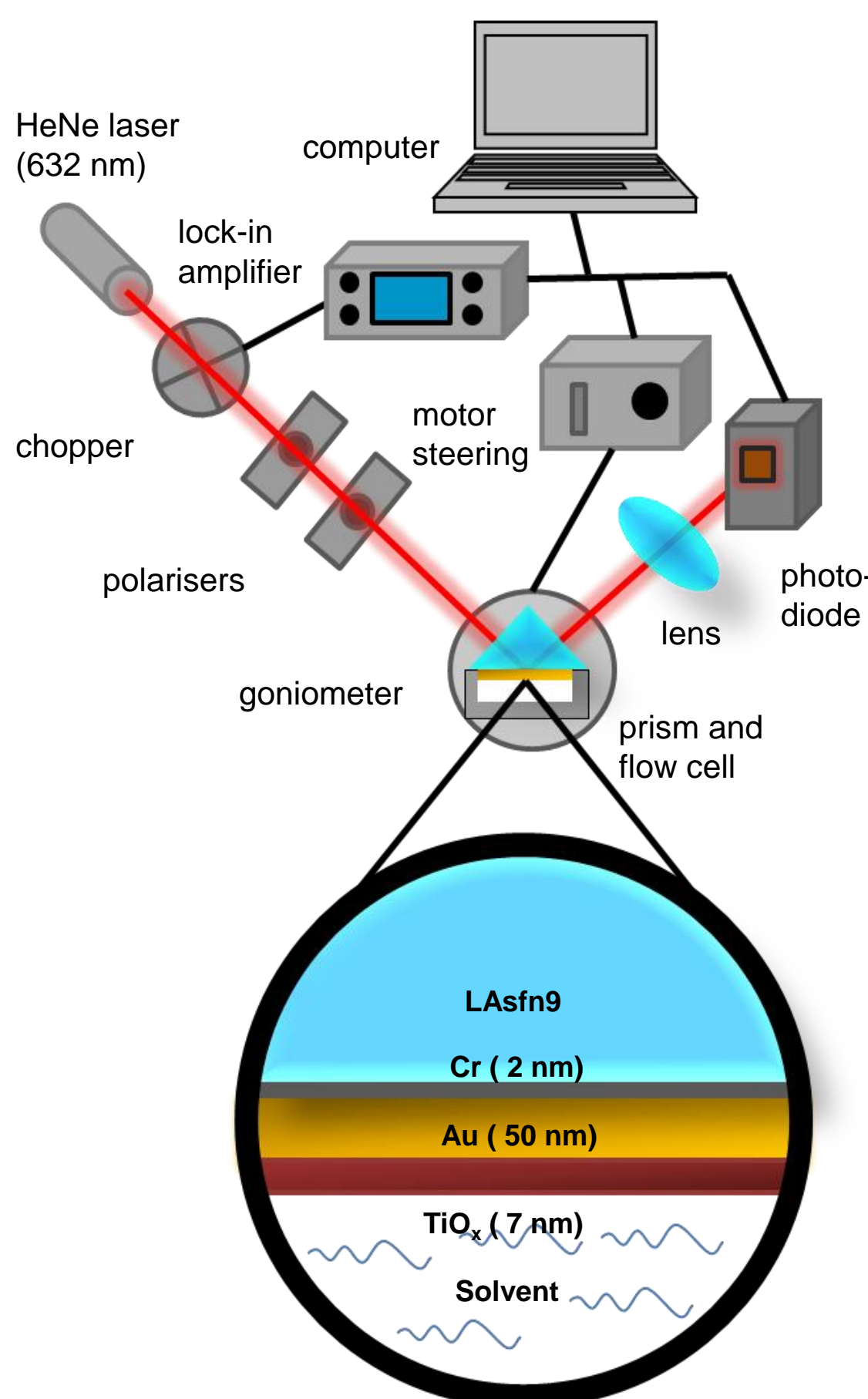
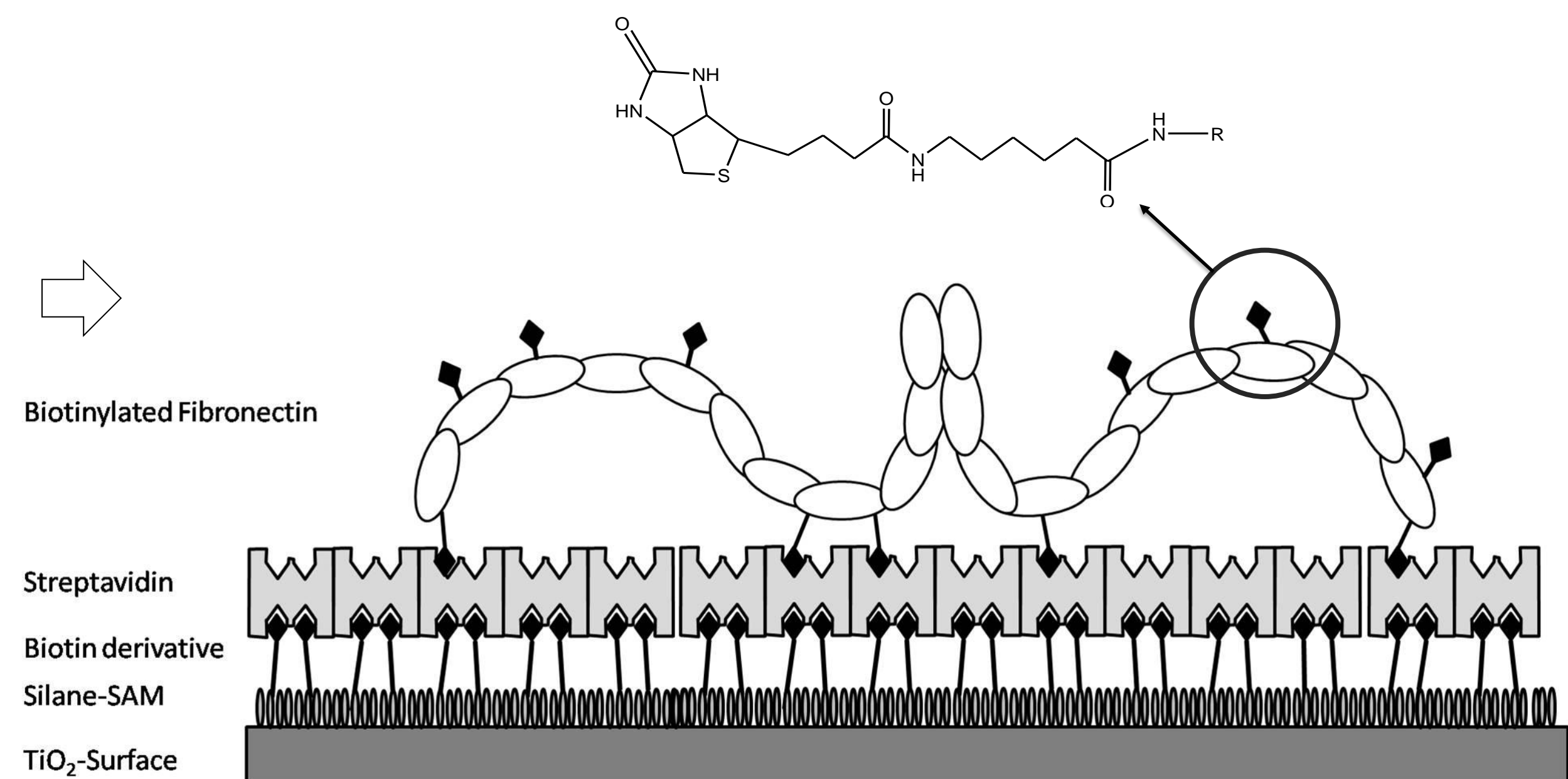
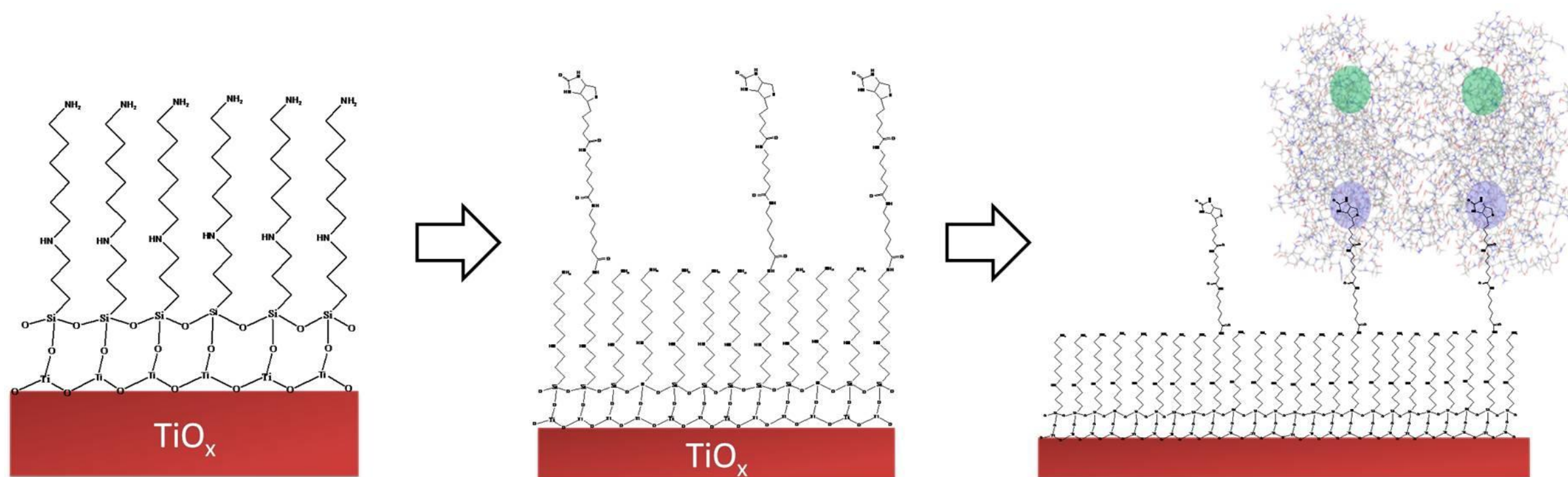
The missing link between the titanium surface of dental implants and the gingival is a big issue in dental implant integration (right). In this pocket bacteria intrude and cause infections which can lead to an implant rejection

By mimicking the natural-environment (the extra cellular matrix, ECM), 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 TiO₂-surface with Biotin derivatives to create a Streptavidin 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.



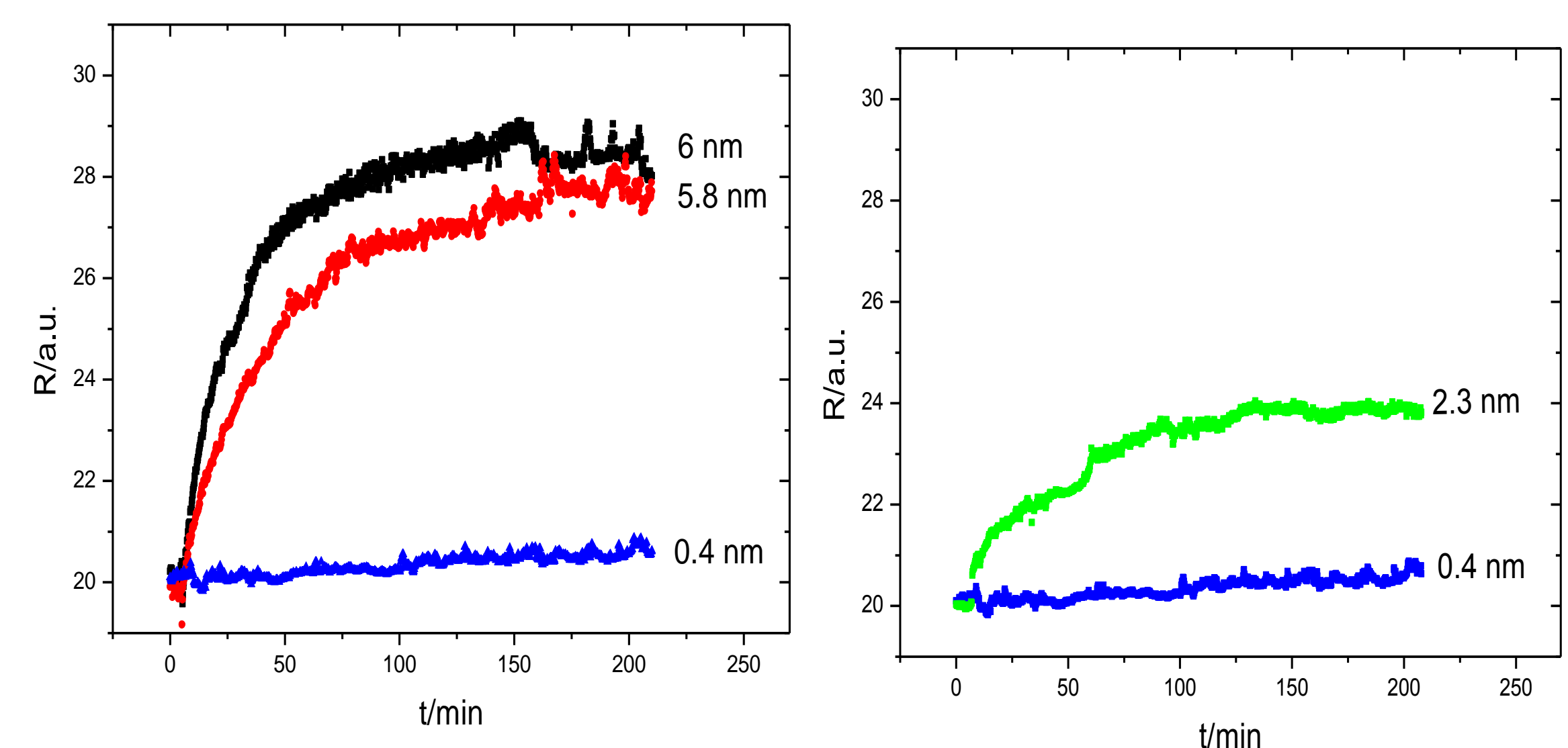
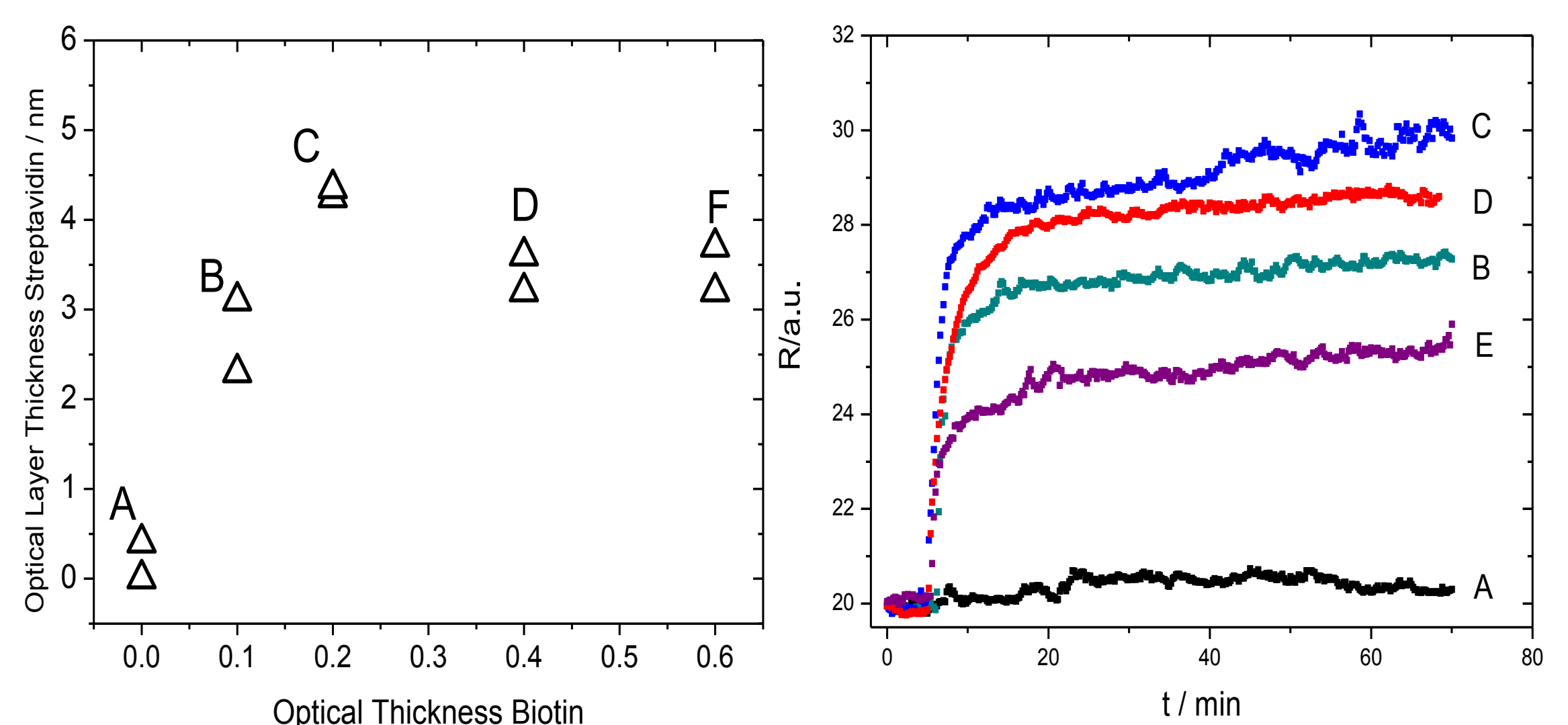
Results



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 TiO₂ the same criteria apply as for gold or SiO₂ surfaces. This Streptavidin monolayer prevents non-specific adsorption and enables only biotinylated Fibronectin to adsorb on the surface. The thickness of 2.3 nm indicates a linear conformation of fibronectin, similar to the conformation inside the ECM.

References:

- [1] Lehnert, M.; Gorbahn, M; Rosin, C.; Köper, I.; Knoll, W. and Veith, M.: Self assembled Biotinylated Fibronectin adsorbs linear on Streptavidin modified TiO₂ surfaces in higher activity than non-biotinylated Fibronectin. In preparation
- [2] Gorbahn M.; Klein M.; Lehnert M.; Brüllmann G.; Köper I.; Wagner W.; Al-Nawas B.; Veith M.: Promotion of osteogenic cell response via quasi-covalent immobilized fibronectin on titanium surfaces: Introduction of a novel biomimetic layer system. Submitted to Clinical Oral Investigation, 2009

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