

Master thesis

Testing of a new titanium oxy carbide material as an implant material: a spectroscopic study of the protein adsorption process

Recently, a new material composed of titanium oxy carbide (TiO_xC_y) has been synthesized.^[1] It has semimetallic properties and can be used as an electrode material. In contrast to titanium oxide, the TiO_xC_y has electrochemical properties of a metal electrode, with the capacity only weakly dependent on the applied potential. Moreover, it reflects the IR light. Therefore, it is a promising new material for in situ IR studies under electrochemical control. This work will be performed in collaboration with Prof. Dr. J. Kunze-Libhäuser at the University of Innsbruck, Austria.

On the one hand titanium with its native titania layer belongs to the most successful medical implant materials. On the other hand glassy carbon had good conductive properties and it reflects the IR light. Combination of these properties in the new composite material is interesting for in situ biomimetic investigations of this new model implant surface.

In this work, the adsorption of proteins from extracellular matrix such as collagen, fibronectin will be studied. In addition, in a comparative study the adsorption of blood plasma proteins such as albumin and fibrinogen will be conducted. It was recently suggested in the literature that the presence of Ca^{+2} and Mg^{+2} ions influences the adsorption process of proteins on the titanium surface and the stability of adsorbed films.^[2] The adsorption process will be studied in the presence and absence of these important ions in the electrolyte solution.

The process of adsorption of proteins will be studied using the polarization modulation infrared reflection-absorption spectroscopy (PM IRRAS). Proteins have a distinct IR spectrum.^[3] Analysis of a so called amide I mode provide valuable information about the secondary structure of the adsorbed protein. The PM IRRAS allows studies in the electrolyte solution, being a powerful method for in situ studies of the protein structure.

The spectral properties of the new material titanium oxy carbide (TiO_xC_y) will be compared to spectral properties of the glassy carbon.

Supervision: Dr. Izabella Brand; e-mail: izabella.brand@uni-oldenburg.de; tel: 0441 798 3973

- [1] R. Hahn, S.-S. F., J. Salonen, S. Thiemann, Y. Y. Song, J. Kunze, V. P. Letho, P. Schmuki, *Angew. Chem. Int. Ed.* **2009**, 48, 7236.
- [2] N. Ren, J. Li, J. Qiu, Y. Sang, H. Jiang, R. I. Boughton, L. Huang, W. Huang, H. Liu, *Small* **2014**, 10, 3169.
- [3] S. A. Tatulian, in *Lipid-protein interactions. Methods and protocols* (Ed. J. H. Kleinschmidt), Springer, New York, **2013**, p. 177.