PREPARATORY INDUSTRIAL PROJECT

How large scale facilities can be used to investigate the Bactiguard coating

THE INDUSTRIAL CHALLENGE

The Swedish medtech company Bactiguard offers a solution that prevents health care associated infections, reduces the use of antibiotic and spread of multi-resistant bacteria. This is done by a technique where a thin noble metal coating is attached to the surface of medical devices. This coating prevents bacteria from adhering. As a result, biofilm formation is hindered and the risk of infections reduced. However, more knowledge is needed about the coating and what happens on the surface when in contact with different artificial body fluids. We want to gain more knowledge on the thickness of the surface, the relative amount of the metals in the alloy and their distribution in the coating. Additionally, we are interested in what happens on the surface when in contact with different artificial body fluids. Does it corrode, and if so, is the corrosion occurring evenly over the surface or in patches?

WHY USING A LARGE SCALEFACILITY?

Our hypothesis was that several different techniques at large scale facilities could provide us with information about our coating. Much of this information can be achieved by regular laboratory-based techniques, but one of the main pros with synchrotrons is the high intensity, and thus the potential to give a higher resolution and lower detection limits. This is important for us, since our coating is thin (just a few nm) and the metal content is expected to be extremely low.

THE RESULTS AND EXPECTED IMPACT

The first step was identifying appropriate technologies and experimental stations on the respective facility, and to identify if and how the considered techniques can be used.

We initially wanted to investigate if our research questions regarding the surface can be targeted with *e.g.* reflectometry or GISAXS. The GI-SAXS technique can be used to study nanostructured surfaces and thin films, and is typically used to characterize interface roughness and the nanoscale in thin films. This is very useful since we want to investigate a thin surface and see a material distribution which have been indicated to be in form of patches/islands on the surface, for us. This technique can *e.g.* be performed at beamline ID01 at ESRF in Grenoble, at beamlines BL 1-5 at SSRL in Stanford or at beamline 12-ID-B at APS in Argonne.

Reflectometry can be used for similar things as GI-SAXS, but with focus on the density profile in terms of thickness and surface roughness. This can be done for example at beamline P02 at Desy in Hamburg or beamline ID01 at ESRF in Grenoble.

We also looked into the possibility to use XPS to measure the elemental composition, depth profile and what the elements are bounded to in outermost 5-10 nm. Some pilot XPS tests were also performed on a labscale XPS instrument at KTH in Stockholm. The outcome from this was that high vacuum is needed which makes it hard to use our regular silicon tubes etc since they gas a lot. This would be a problem also at a synchrotron XPS. We found two ways of solving this – developing another substrate to examine (this we did by coating titanium instead), or to turn to a beamline we found, where you do not use vacuum. This beamline is the ISSIS beamline at BESSY II in Berlin. At BESSY II there are also several other beamlines that can be used for regular vacuum XPS, where you have high intensities and selectable photon energies which makes it better than the lab XPS.

To summarize, the outcome from this project provided us with knowledge about the available techniques, and made us develop appropriate surfaces and systems to use in future research at such facilities, and none the least, strengthen the collaboration between industry and academia.

Contacts: Sara Skoglund – Bactiguard AB, sara.holmerin@gmail.com
German Salazar Alvarez – Stockholm University, german.salazar.alvarez@angstrom.uu.se

Vinnova's project No: 2019-02557 **Duration:** Sep 2019 -- Nov 2019

Funded by Sweden's Innovation Agency, Vinnova, in order to build competence and capacity regarding industrial utilisation of large-scale research infrastructures such as MAX IV and ESS.