Development of reactive biohybrid-sensor-systems for the detection of environmentally relevant resources and pollutants in aqueous systems

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The aim of the project is to develop a sensor-system utilizing S-layer proteins to detect analytes with special industrial interest, e.g. copper and rare earth elements and aqueous environments.

Surface layer (S-layer) are the outermost structure in many bacteria and archaea species. They contain of subunits of identical (glyco-) proteins, which can self-assemble to form a highly-ordered crystalline structure of varying symmetry. After extraction from cultivated cells isolated S-layers can be used for a broad range of nanotechnology applications [1]. Furthermore, studies have shown different binding capacities for metal-ions for different S-layers [2]. This together with the possibility to self-assemble on different surfaces leads to the possible development of varying specific sensor-systems.

For this use two sensor-platforms are investigated. The first is a colorimetric-based system using gold nanoparticles (AuNP) functionalized with S-layer proteins [3]. The specific binding properties of the S-layers lead to an aggregation of the AuNP when in contact with the detectable analyte (Figure 1). This is visible as a color-shift and can be measured by UV-vis spectroscopy. Using different s-layer proteins for the functionalization a sensor-array can be developed to detect different analytes.

The second sensor system uses surface-plasmon-resonance (SPR) to self-assemble S-layer on a gold surface and detect the binding of the analytes to the protein layer (Figure 2). Using a broad range of s-layer proteins leads to a sensor array for the specific detection of analytes.

References

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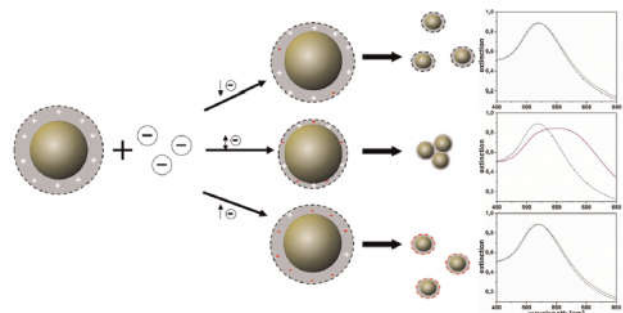
Figures

Figure 1. Interaction modes of S-layer functionalized AuNP for different concentrations of the analyte (from Lakatos et al. 2015).
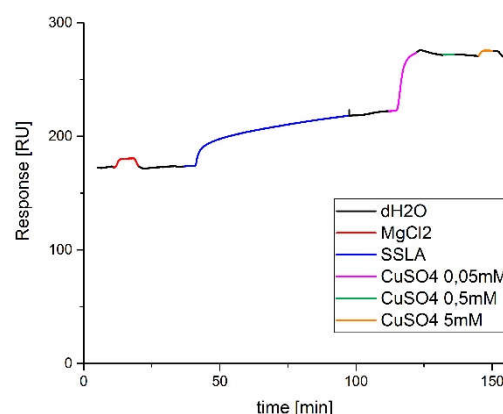

Figure 2. SPR-measurement of the binding of isolated *SslA* protein on gold and the interaction with CuSO4 in increasing concentrations.