S-layer proteins appear to be suitable for wide variety of different technical applications due to their distinctive physico-chemical properties and their multifunctional importance. Since several years the focus has been placed especially on their potential use for biosensor applications. There are many approaches under investigation to develop sensors that are highly specific and sensitive as well as robust, reliable and not expensive. Optical methods currently appear an attractive solution. Colloidal gold nanoparticle suspensions as sensory active systems, for instance, have been the subject of intensive investigations for many years. For the development of potential metal-selective biosensors two different approaches of gold nanoparticles based systems in combination with S-layer proteins are presented. Chemically pre-fabricated gold nanoparticles can be stabilized by various simple or more complex organic molecules such as S-layer proteins. Additionally to the stabilization, the S-layer can serve as capture structure for respective ionic analytes. The interaction of the analyte with the S-layer results in the agglomeration of the gold nanoparticles. Due to the plasmonic activities of the metal nanoparticles this can cause a color change of the solution, which can be detected colorimetrically. This sensor principle has been applied successfully for the detection of arsenic (V). Another promising approach is the use of S-layers as template structures for the production of highly fluorescent, size-controlled gold nanoclusters. These gold nanoclusters can be synthesized directly at the protein by a simple chemical reaction. In combination with the known S-layer-mediated selective and specific binding of ionic analytes, e.g. rare earth elements as surrogates/analogues for intrinsic protein bound Ca\(^{2+}\), a subsequent analyte-induced change in the fluorescence intensity of the gold nanoclusters might be used as sensory system for the detection of such strategic relevant elements.

**Keywords:** S-layer proteins, gold nanoparticles, bio-sensing

**Presenting author's email:** s.matys@hzdr.de