S-Layer Based Nanostructures

Dietmar Pum and Uwe B. Sleytr

Center for NanoBiotechnology, University of Natural Resources and Applied Life Sciences, Vienna, Austria

One of the most challenging research areas is currently found at the interface between biology and physics. In particular, the technological utilization of self-assembly systems wherein molecules spontaneously associate under equilibrium conditions into reproducible supramolecular aggregates has grown into a scientific and engineering discipline that crosses the boundaries of several established fields.

Two-dimensional bacterial surface layer proteins (S-layer proteins), isolated from prokaryotic organisms (bacteria and archaea), have the intrinsic tendency to self-assembly into two-dimensional arrays in suspension, at solid supports (e.g. silicon wafers), at the air-water interface, at floating lipid monolayers and at vesicles (liposomes and nanocapsules) [1].

This presentation is focussing on the reassembly of native and genetically functionalized S-layer proteins on solid supports and, in particular, on their use as matrices for the templated assembly of molecules and nanoparticles into highly ordered superlattices. The incorporation of single or multifunctional domains in S-layer lattices opened a new horizon for the tuning of their structural and functional features. Proof-of-principle was shown for genetically engineered S-layer streptavidin fusion protein which was capable to bind biotinylated ferritin molecules (12nm diameter) into ordered arrays. Based on this work a broad range of S-layer fusion proteins with different functionalities, such as metal binding peptides, has already been developed. This concept is of a more general nature and is currently used in the development of new biological templating and specific biomineralisation strategies on surfaces.

1. Sára, M., Pum, D., Schuster, B., Sleytr, U.B. 2005. S-layers as patterning elements for application in nanobiotechnology. J. Nanosci. Nanotechnol., 5:1939–1953