S-LAYER BASED NANOSTRUCTURES

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The study of biological self-assembly systems is a new and rapidly growing scientific and engineering field that crosses the boundaries of existing disciplines. The attractiveness of such bottom up processes lies in their capability to build uniform, ultrasmall functional units and the possibility to exploit such structures at meso- and macroscopic scale. In this context, two-dimensional bacterial surface layer proteins (S-layer proteins) represent very versatile assembly systems with unique features as structural basis for a complete supramolecular construction kit.

S-layers are the most commonly observed cell surface structures in prokaryotic organisms (bacteria and archaea). They are composed of a single protein or glycoprotein species (Mw = 40 to 200 kDa) and exhibit either oblique, square or hexagonal lattice symmetry with unit cell dimensions in the range of 3 to 30 nm. S-layers are generally 5 to 10 nm thick. They represent highly porous protein meshworks with pores of uniform size and morphology in the 2 to 8 nm range. One of the key features of isolated S-layer proteins is their intrinsic tendency to self-assemble into two-dimensional arrays in suspension and at various interfaces.

The wealth of information accumulated on the general principles of S-layers led to a broad spectrum of potential applications in many areas of both life and materials sciences. The possibility to change the natural properties of S-layer proteins by genetic manipulation opens a new horizon for the tuning of their structural and functional features. Functionalized S-layer proteins that maintain their propensity for self-assembly have led to new affinity matrices, diagnostic tools, vaccines, or biocompatible surfaces, as well as to biological templating or specific biomineralisation strategies at surfaces.