S-Layers as Basic Building Block for a Molecular Construction Kit

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ABSTRACT

Crystalline bacterial cell surface layer (S-layer) proteins have been optimized during billions of years of biological evolution as constituent elements of one of the simplest self-assembly systems [1]. Isolated S-layer proteins have the intrinsic property to recrystallize into two-dimenisonal arrays at a broad spectrum of surface (e.g. silicon, gold, glass, polymers) and interfaces (e.g. planar lipid films). S-layer lattices, composed of a single species of protein or glycoprotein subunits, reveal a center-to-center spacing of the morphological units in the range of 3.5 to 35 nm [1,2]. The well defined arrangement of functional groups on S-layer lattices allows the binding of molecules and particles in defined regular arrays. S-layers with immobilized functional molecules were used for dipstick and biosensor development, as affinity separation structures and as carrier / adjuvant for conjugated vaccines [2]. S-layers self-assembled on solid supports can be patterned in the sub-micrometer range using standard or soft lithography (e.g. micromoulding) [3]. Furthermore, S-layer proteins stabilize lipid membranes and act as nanometer-thick intermediate layer between the inorganic support (electrode or sensor surface) and the lipid membrane providing an ionic reservoir space and natural environment for incorporated membrane proteins. Reconstituted in these biomimetic structures, membrane-active peptides and transmembrane proteins, including responsive ion channels and receptor proteins, may be utilized as rapid and sensitive biosensor device [3].

1 Sleytr, U.B., P. Messner, D. Pum, M. Sára. 1999. Crystalline bacterial cell surface layers (S-layers): from supramolecular cell structure to biomimetics and nanotechnology. Angew. Chem. Int. Ed. 38:1034-1054.

2 Sleytr, U.B., M. Sára, D. Pum, B. Schuster. 2001. Characterization and use of crystalline bacterial cell surface layers. Prog. Surf. Sci. 68:231-278.

3 Sleytr, U.B., E.-M. Egelseer, D. Pum, B. Schuster. 2004. S-Layers. pp. 77-92. In: C.M. Niemeyer, C.A. Mirkin (Eds.) NanoBiotechnology: Concepts, Methods and Perspectives. Wiley-VCH Verlag, Weinheim, Germany.