DIPARTIMENTO DI FARMACIA E BIOTECNOLOGIE

Life & Chemical Sciences Seminars

Nanostructures made of spider silk-hybrid materials

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(ospite Giampaolo Zuccheri)

Abstract

Self-assembly of recombinant spider silk proteins into nanofibrils is specifically triggered by low concentrations of phosphate ions. Such mild self-assembly conditions allow incorporation of functional bio-macromolecules onto the silk nanoscafold. We demonstrated on DNA-spider silk conjugates, in which a recombinant spider silk protein and DNA oligonucleotides were combined in one chemical entity that self-assembled fibrils of the hybrids exposed nucleic acid strands on their surface suitable for specific fibril labeling. Moreover, hybridization of the DNA-silk hybrids into linear or branched assemblies allowed controlled hierarchical self-organization of the conjugate fibrils into nano-ribbons and microscopic rafts. The DNA-spider silk hybrids could also be immobilized on complementary modified surfaces. This strategy we used for initialization of the silk fibril self-assembly on defined spots allowing patterning of nanofibrils across multiple length scales. We exploited also genetically approach to fuse the recombinant spider silk protein with either hydrolytic enzyme Esterase 2 or green fluorescent protein GFP. Respective catalytic and light emitting properties of the functional moieties in the fusions were comparable to that of the unmodified precursors in solution. This activity was even maintained upon self-assembly of the spider silk domain into fibrils and hydrogels.

These examples demonstrate that self-assembly properties of spider silk proteins combined with functionalities of biomacromolecules allow potentially nanostructured hybrid materials with on demand set-up of functions localized in 1D along the fibril, 2D on surfaces or 3D in hydrogels.

Biosketch

Martin Humenik received his Ph.D. from the Safarik University (Slovakia) also working at the University of Milan. He then did his post-doc at the University Bayreuth working on Protein and nucleic acid modifications, synthesis of protein-DNA conjugates and their application in biochip development for bacterial RNA detection on BioChip in cooperation with Siemens. He is now a staff scientist at the University Bayreuth at the Chair for Biomaterials with the Research group of Prof. Scheibel. His scientific interests cover the topics of site-specific modification of proteins and nucleic acids, synthesis of protein-nucleic acid conjugates, protein and DNA self-assembly, Nanostructured materials, DNA and Protein immobilization on surfaces.

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