HYBRID SPIDER SILK NANOSTRUCTURES

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The attractiveness of self-assembly in material science is based on its autonomy requiring no external energy sources, as well as on unlimited “bottom up” dimensional scaling of stable structures. Self-assembled protein cross-β fibrils represent environmentally, chemically and mechanically robust building blocks for nanostructured materials. Since recombinant spider silk proteins self-assemble into nanofibrils under mild conditions, specifically controlled by low phosphate concentration, they represent a highly suitable system for incorporation of further functional bio-macromolecules, as we demonstrate here with DNA or enzymes.

We prepared DNA-spider silk hybrids, in which self-assembly properties of a recombinant spider silk protein and hybridization properties of DNA were combined in one chemical entity, using a copper catalyzed “click” reaction. We demonstrated that short nucleic acid moieties did not disturb the self-assembly mechanism of the silk moiety, and corresponding silk fibrils exposed nucleic acid strands suitable for specific fibril labeling. Moreover, hybridization of the DNA-silk hybrids into linear or branched constructs allowed controlled hierarchical self-organization of the conjugate fibrils into nano-ribbons and microscopic rafts using controlled temperature conditions (1, 2).

In another approach, a recombinant spider silk protein was genetically combined with either the 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. They further maintained their activities upon spider silk self-assembly into fibrils.

\textbf{Keywords:} spider silk, fusion proteins, DNA conjugates

\textbf{References:}


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