Designing biomolecular scaffolds for hybrid functional materials and nano-sensors

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Self-assembly of biological molecules into defined functional structures has a tremendous potential in nanopatterning, and the design of novel biomaterials and functional devices. Molecular self-assembly is a process by which complex three-dimensional structures with specified functions are constructed from simple molecular building blocks. We present the supramolecular assembly of modular repeat proteins, in particular designed consensus tetratricopeptide repeats (CTPRs), and their application as building blocks for the generation of functional nanostructures and biomaterials. CTPR proteins can be assembled into self-standing thin films,[1] monolayers,[2] and thin nanometer fibers.[3] In this work, we show the use of CTPRs as scaffolds to template: (1) Photoactive organic molecules.[4] In particular, CTPR proteins are used to organize organic chromophores, while preserving their structure. The unique self assembly properties of CTPRs have been exploited to generate ordered photoconductive films of the protein-porphyrin conjugates. (2) Gold Nanoparticles.[2] CTPR are used to template gold nanoparticles into ordered monolayers, and into structured thin films providing conductivity properties to the materials. (3) Fluorescent nanoclusters.[5] We show the ability of CTPR proteins to stabilize fluorescent gold nanoclusters. Since the structural and functional integrity of the protein template is critical for applications, protocols that retain the protein structure and function have been developed. A CTPR module with specific binding capabilities has been successfully used to stabilize nanoclusters and tested as a sensor.

References

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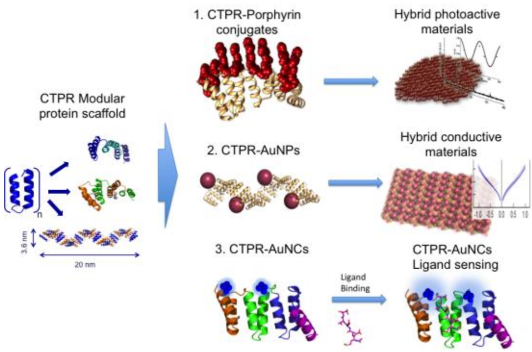

Figure 1: Shematic representation of hybrid protein based materials and nanostructures