Self-assembly in nature: using the principles of nature to create complex nanobiomaterials - DTU Orbit (08/08/2019)

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Self-assembly is a ubiquitous process in biology where it plays numerous important roles and underlies the formation of a wide variety of complex biological structures. Over the past two decades, materials scientists have aspired to exploit nature's assembly principles to create artificial materials, with hierarchical structures and tailored properties, for the fabrication of functional devices. Toward this goal, both biological and synthetic building blocks have been subject of extensive research in self-assembly. In fact, molecular self-assembly is becoming increasingly important for the fabrication of biomaterials because it offers a great platform for constructing materials with high level of precision and complexity, integrating order and dynamics, to achieve functions such as stimuli-responsiveness, adaptation, recognition, transport, and catalysis. The importance of peptide self-assembling building blocks has been recognized in the last years, as demonstrated by the literature available on the topic. The simple structure of peptides, as well as their facile synthesis, makes peptides an excellent family of structural units for the bottom-up fabrication of complex nanobiomaterials. Additionally, peptides offer a great diversity of biochemical (specificity, intrinsic bioactivity, biodegradability) and physical (small size, conformation) properties to form self-assembled structures with different molecular configurations. The motivation of this review is to provide an overview on the design principles for peptide self-assembly and to illustrate how these principles have been applied to manipulate their self-assembly across the scales. Applications of self-assembling peptides as nanobiomaterials, including carriers for drug delivery, hydrogels for cell culture and tissue repair are also described. (C) 2013 Wiley Periodicals, Inc.