Functional Nanostructures by Short β-Helical Heteropeptides

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The self-assembly of short peptide building blocks into well-ordered nanostructures is a key direction in bionanotechnology. The formation of β-sheet organizations by short peptides is well explored, leading to the development of a wide range of functional assemblies. Likewise, many natural proteinaceous materials, such as silk and amyloid fibrils, are based on β-sheet structures. In contrast, collagen, the most abundant protein in mammals, is based on helical arrangement. Similar to β-sheet structures, short helical heteropeptides have been discovered to possess a diverse set of functionalities with the potential to fabricate artificial nanomaterials. Alternating D,L peptides are able to assume various kinds of single and double stranded β-helical structures. β-Helix conformations share an important number of structural features with β-sheet ones, as a set of hydrogen bonds between amino and carbonyl backbone groups, and ϕL, ΨL, ϕD, and ΨD values in poly-L and poly-D-oligopeptides. Here we focus on the double-stranded β-helix and outline the functional roles of self-assembled nanostructures formed by short helical peptides and their potential as artificial materials. We focus on the association between self-assembled mesoscale structures and their material function and demonstrate the way by which this class of building blocks bears the potential for diverse applications, such as the future fabrication of smart devices. Solvent interactions were found to have a significant effect on the molecular folding and structural diversity that lead to a change in the initial helical conformation. By changing the solvent from methanol to chloroform, the higher order assembly of the helical strand changed from supramolecular sheet to double helical structure. The nanostructures obtained from different solvents also showed significant diversities in morphology.

References

[1] Aulisa L., He Dong, Jeffrey D. Hartgerink, Biomacromolecules (2009), 10, 2694-2698

Topics

- Structure and conformational studies of peptides