Carbon Nanotube/β-Cross Sheet Peptide Biohybrids: Dispersive Properties, Assembly, and Potential Applications

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Abstract

The ability of selected peptides to efficiently disperse carbon nanotubes in aqueous media [1] may eventually facilitate carbon nanotube processing and their incorporation in biological systems, as well as their use as components for a variety of technological bioapplications[2]. Moreover, peptide self-assembly eventually enable the incorporation of carbon nanotubes into supramolecular architectures and hierarchical superstructures, therefore opening fascinating routes for directed carbon nanotube manipulation [3].

We here report on the abilities of a family of tau-protein-related amphiphilic peptides (N-acetyl-VQIVXK-NH_2 (X = F, L, V, W, Y, A, K)) to disperse SWCNTs.[4] Circular dichroism (CD) spectra of one of the peptides having a high propensity to form an amyloid (N-acetyl-VQIVYK-NH_2 (AcPHF6)) showed that this peptide exists as a random coil in water but assumes a β-sheet conformation when sonicated with SWCNTs. To date, our hexapeptides based on the AcVQIVXK framework are structurally the simplest peptides that have been found to disperse CNTs. Additionally, we have shown that the amyloidogenic propensity and hydrophobicity weigh nearly equally in determining their efficiency to disperse CNTs, and these findings may be used to design even more efficient peptides for these purposes. Further processing of stable peptide/SWCNT dispersions led to the formation of singular, unique supramolecular network architectures. An understanding of the interactions which determine the ability of these amphiphilic β-sheet peptides to disperse SWCNTs may open new opportunities for use of these biohybrids as scaffolds, the development of new functional materials (such as supercapacitors and artificial muscles), or their incorporation into carbon nanotube-based devices [4].

References

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