CARBON NANOTUBE/β-CROSS SHEET PEPTIDE DISPERSIONS AND ASSEMBLIES: PREPARATION, CHARACTERIZATION, AND POTENTIAL BIOSENSOR APPLICATIONS

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The ability of a variety of different proteins and peptides to bind to carbon nanotubes leading to stable nanotube aqueous dispersions offers wide opportunities for nanotube processing in biological systems and in the development of carbon nanotube-based bio-devices. It has been thus demonstrated that peptide coating facilitates carbon nanotube uptake by cells.[1] On the other hand, these nanotube dispersions have efficiently been employed in the coagulation spinning of macroscopic carbon nanotube biocomposite fibers.[2] Moreover, peptide-coated carbon nanotubes can self-assemble into supramolecular architectures and hierarchical structures such as microfibers,[3] fractal-like structures,[4] and liquid crystal ordered domains.[5].

We here report on the interactions between single-walled carbon nanotubes (SWNTs) and a short hexapeptide homologous to a portion of the tau, a protein known to form amyloid helical filaments in the brains of Alzheimer's diseased patients. We here show that the employed hexapeptide is capable of efficiently dispersing SWNTs. The ability of various single site mutants to disperse SWNTs in water and the resulting strong peptide/SWNT interaction was characterized using electron microscopy, NIR and CD spectroscopies, and mechanical and electrical properties of peptide-impregnated SWNT free-standing films. In order to more thoroughly understand the nature the binding interaction we used optical difference spectroscopy to study the adsorption kinetics of several proteins and peptides onto these SWNT films. The results indicate that the hexapeptide ability to disperse SWNTs is a function of the hydrophobicity of the introduced side-chains. Further processing of stable hexapeptide/SWNT dispersions led to the formation of supramolecular bionanocomposite networks. For most proteins adsorption follows a first order kinetic model. We attempt to correlate rate constants and equilibrium loadings of the proteins onto the SWNT films with surface hydrophobicity, measured using a fluorescent probe. We demonstrate that peptide-coated SWNT films may be used as substrate for immunochemical ELISA assays.[6]

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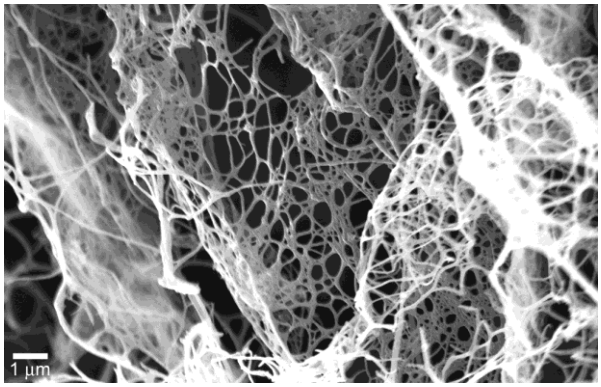

SEM micrograph of a hexapeptide/SWNT composite network.