MAR12-2011-020365

Abstract for an Invited Paper
for the MAR12 Meeting of
the American Physical Society

Functional Hydrogel Materials Inspired by Amyloid

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Protein assembly resulting in the formation of amyloid fibrils, assemblies rich in cross beta-sheet structure, is normally thought of as a deleterious event associated with disease. However, amyloid formation is also involved in a diverse array of normal biological functions such as cell adhesion, melanin synthesis, insect defense mechanism and modulation of water surface tension by fungi and bacteria. These findings indicate that Nature has evolved to take advantage of large, proteinaceous fibrillar assemblies to elicit function. We are designing functional materials, namely hydrogels, from peptides that self-assembled into fibrillar networks, rich in cross beta-sheet structure. These gels can be used for the direct encapsulation and delivery of small molecule-, protein- and cell-based therapeutics. Loaded gels exhibit shear-thinning/self-healing mechanical properties enabling their delivery via syringe. In addition to their use for delivery, we have found that some of these gels display antibacterial activity. Although cytocompatible towards mammalian cells, the hydrogels can kill a broad spectrum of bacteria on contact.