Semiflexible Chain Networks Formed via Self-Assembly of Beta-Hairpin Molecules

BULENT OZBAS, DARRIN POCHAN, Materials Science and Engineering Department, Delaware Biotechnology Institute, University of Delaware, KARTHIKAN RAJAGOPAL, JOEL SCHNEIDER, Chemistry and Biochemistry Department, University of Delaware — We present experimental results from a de novo designed oligopeptide that intermolecularly self-assembles into rigid hydrogel networks after an intramolecular folding event. The effect of ionic strength and beta hairpin peptide strand length on beta-sheet formation, self-assembly and resultant rheological properties were studied. The peptide molecules are locally amphiphilic with two linear strands of alternating hydrophobic valine and hydrophilic lysine amino acids flanking a central turn sequence. The beta-sheet formation of 24, 20, 16 and 12 amino acid long beta-hairpin molecules were studied by CD spectroscopy. The network properties and the nanostructure of the hydrogels were studied by rheology, TEM and SANS. The hydrogel network is composed of semiflexible fibrillar assemblies with viscoelastic behavior that follows the theoretical prediction for heavily crosslinked, semi-flexible polymer networks. SANS results show that the cross-sectional diameter of the fibrils, and thus, the bending modulus of the chains can be varied by changing the number of amino acids of strands of the molecules. Rheological measurements reveal that rigidity, creep and relaxation behavior of the hydrogels vary with the magnitude of stimulus and with the cross-section diameter of the chains.

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