Self Assembly of $\beta$-Hairpin Peptides into Hydrogel Networks: Tuning Supramolecular Properties Through Molecular Design

TUNA YUCEL, Materials Science and Engineering, University of Delaware, CHRISS MICKLITSCH, JOEL SCHNEIDER, Chemistry and Biochemistry, University of Delaware, DARRIN POCHAN, Materials Science and Engineering, University of Delaware — Monomeric peptides were designed to undergo reversible, intramolecular folding with external stimuli (e.g. pH, temperature, salt) to form $\beta$-hairpins that consequently self assemble into a hydrogel network rich in $\beta$-sheet. The design was composed of a turn sequence (VDPPT) flanked by extended strands containing alternating lysine and valine residues. The hydrophobicity of the peptides was altered through replacing valine residues in the arms with residues such as, norvaline, norleucine and isoleucine. Circular dichroism spectroscopy illustrated that random-coil to $\beta$-sheet transition could be tuned from $35^\circ$C to below $5^\circ$C at pH 9, while the transition pH at $T_{room}$ could be shifted from pH 9 down to pH 7. TEM illustrated that all peptides self-assembled into fibrilar networks. Single fibril dimensions were 3 nm as measured using TEM and small-angle neutron scattering, consistent with the proposed self-assembly mechanism of fibrils with a molecular bilayer cross-section. There was a direct correlation between fibril morphology and consequent changes in the nature of junction points and gel rigidity as observed by TEM, and oscillatory rheology, respectively.

Tuna Yucel
Materials Science and Engineering, University of Delaware

Date submitted: 03 Dec 2005

Electronic form version 1.4