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Modeling the Heat Capacity of Spider Silk Inspired Di-block Copolymers[1] W. HUANG, S. KRISHNAJI, D. KAPLAN, P. CEBE, Tufts University — We synthesized and characterized a new family of di-block copolymers based on the amino acid sequences of Nephila clavipes major ampulate dragline spider silk, having the form HABn and HBAn (n=1-6), comprising an alanine-rich hydrophobic block, A, a glycine-rich hydrophilic block, B, and a histidine tag, H. Using temperature modulated differential scanning calorimetry (TMDSC), we captured the effect of bound water acting as a plasticizer for copolymer films which had been cast from water solution and dried. We determined the water content by thermogravimetry and used the weight loss vs. temperature to correct the mass in TMDSC experiments. Our result shows that non-freezing bound water has a strong plasticization effect which lowers the onset of the glass transition by about 10°C. The reversing heat capacities, Cp(T), for temperatures below and above the glass transition were also characterized by TMDSC. We then calculated the solid state heat capacities of our novel block copolymers below the glass transition (Tg) based on the vibrational motions of the constituent poly(amino acid)s, whose heat capacities are known from the ATHAS Data Bank. Excellent agreement was found between the measured and calculated values of the heat capacity, showing that this model can serve as a standard method to predict the solid state Cp for other biologically inspired block copolymers.

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