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Mechanical tuning of elastomers via peptide secondary structure
NANDULA WANASEKARA, J. CASEY JOHNSON, LASHANDA T.J. KORLEY, Case Western Reserve University — Nature utilizes an array of design tools for engineering materials with multiple functions and tunable mechanical properties. The precise control of hierarchical structure, self-assembly, and secondary structure is essential to achieve the desired properties in bio-inspired materials design. We have developed a series of peptidic-poyurea hybrids to determine the effects of peptide secondary structure and hydrogen bonding arrangement on morphology, thermal and mechanical properties. These materials were fabricated by incorporating peptide segments containing either poly(β-benzyl-L-aspartate) or poly(ε-carbobenzyloxy-L-lysine) into non-chain extended polyureas to form either β-sheets or α-helix conformations based on peptide length. Infrared analysis proved the retention of peptide secondary structure when incorporated into peptidic-polyureas. The polymers containing β-sheet forming peptide blocks exhibited higher modulus and toughness due to intermolecular H-bonding. Additionally, higher peptide weight fractions lead to higher plateau moduli due to a transition of continuous domain morphology from a soft segment continuous to a fibrous and interconnected stiffer peptide domain. All the polymers exhibited microphase separated morphology with nanofibrous or ribbon-like structures. It is observed that fiber aspect ratio and percolation were influenced by the peptide secondary structure and the weight fraction.

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