Title:	A Strategy to Functionalize Polyproline and Examine the Role of its Secondary Structure in Thermal Phase Transitions and Bulk Phase Separations
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Abstract:	Proteins and peptides are nature's own building blocks having responsiveness to subtle changes in physical parameters including concentration, temperature, and pH, which emerge as promising candidates for biomedical and pharmaceutical applications. Despite the numerous advantages of protein/peptides-based materials, their utility for large-scale material production has been limited due to inherent challenges such as poor stability and high production cost. In this context, synthetic polypeptides are attractive because of their structural resemblance to proteins, sharing a common peptide backbone. Polyproline is unique among other polypeptides due to its cyclic side chain and lack of an amide backbone that donates H-bonds. It is common for polypeptide backbones to assume trans conformation, while polyproline can assume both cis and trans conformations. The conformation around the tertiary amide bonds in polyproline is crucial to the formation of their secondary structures. When the backbone amides are exclusively cis or trans, polyproline assumes a PPI (right-handed helix) or PPII (left-handed helix) secondary structure. The ring-opening polymerization (ROP) of NCA is the most economical and frequently employed method for synthesizing high molecular weight polypeptides and their hybrid materials. The goal of this thesis is the design and synthesis of clickable polyprolines and hybrid block copolymers of polyproline (polypeptide-synthetic polymers) via a combination of ring-opening polymerization of NCAs and other living/controlled polymerizations. Our investigation explores the influence of secondary structures on the solution and bulk phase separation of polyproline and polyproline hybrid block copolymers. We also prepared an amphiphilic polyproline via post-polymerization modification through orthogonal click and explored the aqueous self-assemblies.
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