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Solution assembly of charged block copolymers and block copolypeptides¹

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By considering peptidic or charged, synthetic polymers in the materials self-assembly design process, one can take advantage of inherently biomolecular attributes; intramolecular folding events, secondary structure stabilized by hydrogen bonding, and electrostatic interactions; in addition to more traditional self-assembling molecular attributes such as amphiphilicity, to define hierarchical material structure and consequent properties. The solution assembly behavior of two charged block copolymers will be discussed. First, diblock copolypeptides consisting of a hydrophilic, charged block and a hydrophobic block were designed to self-assemble due to their amphiphilic nature. The defined helical secondary structure of the leucine hydrophobic block forces these molecules to form a membraneous local nanostructure. However, diverse materials, ranging from rigid hydrogel, vesicle suspension, or hexagonal single crystal, can be formed depending on assembly pathway. Second, synthetic triblock copolymers with charged corona blocks can be assembled in dilute solution with multivalent organic counterions to produce complex micelle structures such as toroids and discs. Nanostructure can be tuned with different concentrations or molecular volumes of organic counterion. Transmission electron microscopy, small-angle neutron scattering, multiphoton confocal microscopy, dynamic light scattering, and atomic force microscopy results will be discussed.

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