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Polymer Prize: The Many Varied Phenomena of Equilibrium Self-assembly/polymerization

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The self-assembly of molecules to form large clusters under equilibrium conditions is a ubiquitous phenomenon that impacts numerous systems of interest in physics, chemistry, and biology. While not a true phase transition, equilibrium self-assembly bears similarities to phase transitions but requires quite separate treatment. The simplest theory of self-assembly is provided by Flory-Huggins theory in which structureless monomers assemble into clusters of i-monomers, i=2,. . . ,∞. Despite its simplicity, the theory explains many experimental findings for a rich variety of different self-assembling systems, including the polymerization of actin, the influence of thermal activation, chemical initiation, hierarchical self-assembly, ring formation, soft interactions, crowding, and adsorption onto surfaces on the thermodynamics of self-assembling systems, the interplay between self-assembly and phase separation, the nature of cooperativity, and more. Extensions of the simplest theory are being developed for strongly interacting systems and for describing the evolution of non-equilibrium systems.