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How do cosolutes stabilize polymers? From bridging to depletion attraction

Solution composition is known to strongly influence the stable state of macromolecules, with important practical applications ranging from colloidal dispersions to solvated synthetic polymers or proteins. Cosolutes with different affinities to specific macromolecular states can shift equilibrium towards the thermodynamically preferred state with lower free energy. Solutes preferentially excluded from macromolecules drive depletion forces and stabilize the compact macromolecular state. To contrast, cosolutes preferentially included around the macromolecule usually destabilize the compact state, effectively stabilizing the extended state of the macromolecule, as in the case of protein denaturants. However, in certain cases preferentially included cosolutes stabilize another compact state through bridging interactions. By using a simple mean field model that contains only few interaction parameters, we demonstrate the possible mechanisms by which preferentially interacting cosolutes affect macromolecules. Specifically, depletion interactions, bridging stabilization, and macromolecular destabilization, all emerge in a single model as concentration, interaction parameters, and cosolute size are varied. The theory also highlights the possible sources of energetic and entropic contributions to these mechanisms of stabilization.

Preferred topic

Conformation of polymers in solvents

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