

Tunable Thermosensitivity of Core-Shell Nanoparticle Gels in Mixed-Solvent

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Doubly thermosensitive core-shell nanoparticle gels, composed of poly(methyl methacrylate) (PMMA) core and poly(2-hydroxyethyl methacrylate) (PHEMA) shell, have been prepared via seed and feed precipitation polymerization, and the influence of co-solvents on the swelling behavior of the core-shell has been investigated experimentally and theoretically. Thermal sensitivities of the core and shell networks are affected by the addition of co-solvents in different ways, resulting in highly controllable swelling properties of the core-shell gels. To examine the tunability, thermo-optical analysis and photon correlation spectroscopy have been employed. The results show that the small addition of cyclohexane, 1,3-propanediol, and water respectively induces the “lower/upper”, “even/upper”, and “lower/lower” volume transition temperature of the core/shell networks. For theoretical treatment, a multi-component lattice theory of mixing is combined with the Flory-Rehner chain model to calculate the net free energy of mixing. Required interaction parameters are obtained from the binary and ternary phase diagrams of linear polymer solutions and directly applied to swelling calculation of the cross-linked core-shell network solutions.