Applicability of Lattice Based Thermodynamic Models on the Various Types of Swelling Behavior of Hydrogel

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Various types of swelling behaviors, such as LCST type, UCST type, and reentrant type are investigated with lattice based thermodynamic model. Interestingly, reentrant type swelling behaviors can be induced by some factors, such as thermal stimuli and reciprocal solvent-solvent interaction related to co-solvency or co-nonsolvency effect. Especially, thermally induced reentrant swelling behaviors are described with corresponding linear polymer solutions which are rarely reported, such as closed miscibility loop, hourglass, and both LCST and UCST. In this correlation, the close relationship between the miscibility of linear polymer solution and state of cross-linked polymer solutions is studied within the molecular thermodynamics. To analyze the various types of swelling behaviors theoretically, we adopt the two kinds of lattice based thermodynamic models, MDL and Xin models with Flory-Erman for elastic nature of cross-linked polymer. Model parameters obtained from binary linear polymer solutions are employed to describe corresponding swelling behavior of cross-linked polymer solution. The calculation results confirm the reliability for applying lattice based thermodynamic model to various types of swelling behaviors.