A thermodynamic model of phase transition of physical gels

Tao Wu, Hua Li*

School of Mechanical and Aerospace Engineering,
Nanyang Technological University, Singapore, 639798

* Email address of corresponding author: lihua@ntu.edu.sg

A gel is often formed when polymer chains are cross-linked in a network, if immersed in a designed liquid environment. In general, the gel may be categorized as the chemical gel if the macromolecular chains are cross-linked by chemical bonds, or the physical gel if cross-linked by the weaker physical bonds such as van der Waals interactions or hydrogen bonding. The physical gel can change its state between liquid and solid since the cross-links of physical gels can be created and broken dynamically under influence of various environmental factors. In this paper, a thermodynamic model is developed for analysis of the phase transition of physical gels. This model includes a sharp interface developed between the solution and gel network matrix phases. Apart from the classical bulk and interfacial equations describing the force balance and mass conservation, an additional configurational force balance is considered on the interface. The phase change between liquid and solid states and the evolution of the phase interface are studied in details.

Keywords: physical gel, phase change, interface, configurational force