Modelling the phase behaviour of 3D tissue mimics

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Intelligent micro-scale tissue scaffolds have been attracting significant interests in the fields of bioengineering and regenerative medicine, due to their physiological sensitivity and active responsivity with respect to external stimuli [1]. For explaining such responsivity in terms of polymer gel thermodynamics, classical mean-field Flory theory has been conventionally used with various analytical and numerical modifications [2-3]. In this talk, we present a novel mathematical model on the volume phase transition of biopolymeric gel spheres and films as a function of temperature and pH. In order to mimic soft tissues in the human body, the biological microgels are considered to be composed of elastic 3D network of protein chains such as collagen and gelatin, which are covalently crosslinked and fully hydrated in aqueous media. Within the network, it is supposed that stimuli-responsive synthetic polymer chains are doped and mixed together through physical entrapment [4]. Based on the Flory-Huggins-Rehner framework, our analytical model phenomenologically predicts a well-defined volume phase behaviour of the viscoelastic tissue mimics with response to the change in ambient physicochemical parameters.

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