CHAPTER 15

Preparation of Photocurable Hydrogels

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Introduction

Hydrogels are three-dimensional (3D) polymeric networks confining a substantial fraction of water within the structure (Ahmed 2015); hydrogels are attractive materials for various biomedical applications because they exhibit their structural, compositional similarity to natural tissues (Caló and Khutoryanskiy 2015; Peppas et al. 2006; Van Vlierberghe et al. 2011). They can be divided into reversible physical hydrogels and irreversible chemical hydrogels. Physical hydrogels are formed by non-covalent interactions between molecules such as hydrophobic associations, hydrogen bonding interactions, and ionic interactions, being relatively weak in mechanical strength. In contrast, chemical hydrogels have intermolecular covalent bonds, displaying stable and robust mechanical properties (Ghobril and Grinstaff 2015). In general, chemical hydrogels are prepared by radical photopolymerization or addition/condensation polymerization as presented in Fig. 1.

Photocurable polymers can be polymerized upon light (ultraviolet [UV] or visible) exposure for a few minutes in the presence of a small amount of initiators. This photopolymerization has many advantages over chemical addition/condensation crosslinking method, including a fast and high polymerization, good spatio-temporal control over hydrogel formation, and mild reaction conditions at room temperature in physiological aqueous solutions (Fedorovich et al. 2009; Ki et al. 2013; Mironi-Harpaz et al. 2012). The mechanical properties of photopolymerized hydrogels can be tailored through manipulating their crosslinking density. The degree of crosslinking

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