However, compared to natural polymers, synthetic polymers are more attractive, because of the efficient control over their physical and chemical properties. Synthetic polymers offer improved control over the architecture of the hydrogel structure, by utilising specific block copolymers with defined molecular weight and compositions. Synthetic polymer PNIPAAm has been widely used as cell culture substrates. Physiological cells preferentially adhere to hydrophobic surfaces due to their high affinity. PNIPAAm being a thermosensitive polymer, its hydrophobicity can be switched with change in temperature. PNIPAAm exhibits its hydrophobic behaviour above its LCST and therefore is an ideal substrate for cell/tissue culture. PNIPAAm is used to coat tissue culture plates and when exposed to physiological temperature it promotes cell attachment and proliferation. Cultured cells can then be easily detached from the substrate by lowing the temperature below LCST making the substrate more hydrophilic (Klouda and Mikos 2008). Surface modification of PNIPAAm with cell adhesive peptides resulted in increased cell adhesion and proliferation thereby reducing the culture time (Hatakeyama et al. 2006). It also enhanced the interaction of the hydrogels with the cells at molecular level (Stile and Healy 2001).

Injectable PEG/PCL hydrogels have been used as antiadhesive materials, specifically to prevent post-surgical abdominal adhesion (Yang et al. 2010; Gao et al. 2013). Postsurgical tissue adhesion is common problem after abdominal surgeries and is associated with pain, functional obstruction and difficulties in re-operative procedures. A novel thermosensitive PEG/PCL/PEG hydrogel composite was developed which combined dual properties, anti-adhesion barrier with controlled release of anti-adhesion drug dexamethasone (Wu et al. 2015). As mentioned earlier, synthetic hydrogels provide the flexibility for chemical and structural modifications to enhance the overall performance of the hydrogel network. Imran et al. (2014) reported the development of extremely stretchable PNIPAAm hydrogels composite with enhanced toughness by using polyrotaxane derivatives composed of α cyclodextrin and PEG as crosslinkers. The excellent mechanical properties of this novel composite hydrogel showed promising applications in tissue engineering and as artificial muscles (Bin Imran et al. 2014).

Commercial Formulations at a Glance

ReGel™

ReGel is based on a triblock copolymer, composed of PLGA-PEG-PLGA (Ramesh and Kirk 2008). The polymer composite is specifically designed to achieve an adequate hydrophilic/hydrophobic balance, making it free flowing at or below room temperature for easy handling and transform into a stable gel at body temperature (Zentner et al. 2001). It is available in various grades that offer a range of gelation temperatures, degradation rates and release profiles as a function of molecular weight, degree of hydrophobicity and polymer concentration. The availability of various grades provides broad formulation capability. ReGel formulations have been developed to deliver various small molecules, hydrophobic drugs, proteins and peptides (Choi and Kim 2003; Vukelja et al. 2007). The drug release mechanism through this formulation is