poly-L-lysine. Microbeads formation is simpler than larger beads, which comprise only aqueous solutions [60].

10.4 Alginate Hydrogels

Alginates are unbranched polysaccharides consisting of 1,4-linked b-D mannuronic acid (M) and a-L-guluronic acid (G) units. Depending on the alginate source, alginates are covalently linked in sequence and in different manner with their polymer chain [46]. The function of alginate depends on the sequence, range of molecular weight (typically 101–103 kDa), and monomer composition such as MG blocks (MGMGMGM), which form the most flexible chains, and G blocks (GGGGGGG), which form stiff chains [1, 47]. At present, alginates are used in certain clinical applications such as in heartburn treatment, acid reflux, appetite suppressant, weight control, and type I diabetes treatment, and are also used in cardiac remodeling [48–50].

Alginate is considered to be nonimmunogenic and has shown great potential as a cell delivery vehicle [46, 50–53]. The formation of hydrogels (with water) *in situ* with gelling process can be accomplished in physiological condition by using nontoxic solvents. These hydrogels maintain softness in gel that their physical property is very similar to native tissues [54]. The major drawback of alginate hydrogels is that they are noninteractive to delivered cell and show slow biodegradation [55]. Despite this fact, the chain of alginate cannot cleave by mammalian enzymes, but alginate can be degradable in *in vivo* condition by alginate partial oxidation applying sodium periodate, altering the chain confirmation by cleavage in carbon–carbon bond in urinate residue [55]. The degradation rate of oxidized alginate can be regulated by adjustment of molecular weight without disruption in flexibility and gel formation ability [35]. The oxidized binary hydrogels improved the formation of bone tissue compared to nonmodified alginate, since a faster degradation occurs that facilitates the formation of new bone tissues [35]. There is a vast application of oxidized hydrogels such as helping in the formation of bone tissue by addition of regenerative cells; additionally, alginate hydrogels help in easy incorporation of biochemical substances to help engineer specific cell responses. Sometimes, cell has no specific receptor for attachment to the alginate beads; in such condition, several methods to promote cell attachment to alginate matrices have been developed. One of these methods is coupling of ECM proteins that are not fully integrated proteins because the entire protein leads to nonspecific interaction that may enhance immune response to those specific cells. Examples of ECM proteins are laminin, collagen, and fibronectin that couple with alginate [56–59]).