Synthesis of new degradable 2-hydroxyethyl methacrylate hydrogels for biomedical applications

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The research of degradable hydrogel materials with high water content and mechanical properties similar to tissues is crucial for the development of new drug delivery systems, tissue engineering, medical devices, and biomedical healthcare sensors. Specifically, synthetic hydrogels based on polymethacrylates are cost-effective and widely used in medical applications. Moreover, they can be easily modified. We offer the synthesis of degradable hydrogels based on a copolymer of 2-hydroxyethyl methacrylate and zwitterionic 2-methacryloyloxyethyl phosphorylcholine via reversible addition-fragmentation chain transfer polymerization (RAFT). Two synthesis strategies were used and compared. First, low-molecular-weight water-soluble copolymers containing 2-(acetylthio)ethyl methacrylate were synthesized, and then hydrogels were formed by a polymer-analogous reaction involving the deprotection of thiol groups with triethylamine, which was followed by disulfide bond formation using 2,2'-dithiodipyridine or 6,6'-dithiodinicotinic acid. The second strategy involved preparing hydrogels by block RAFT polymerization using the degradable crosslinker bis(2-methacryloyloxy)ethyl disulfide. Finally, to make the hydrogels attractive for cell attachment, interpenetrating or semi-interpenetrating networks with water-soluble collagen I were prepared using both strategies. Optionally, collagen crosslinkers, such as genipin or dithiobis(succinimidyl propionate) were used to improve the mechanical properties of the resulting hydrogels. All hydrogels containing reductively degradable disulfide bridges were compared in terms of their compositions, degradability, and mechanical properties.

Keywords: HEMA, degradable, disulfide, hydrogel

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