Degradable Model Networks from ATRP & Click Chemistry

Technology #m06-067

Lead Inventors: Nicholas J. Turro, Ph.D.; Jeffrey T. Koberstein, Ph.D.

Model Networks (MNs) require Complex Chemical Degradation Techniques Synthetic polymer networks have been the subject of extensive research over the past century. The structurally simplest polymer networks are termed "model networks" (MNs), which are unique because the crosslink functionality is constant and predetermined. The resultant well-defined pore sizes and homogeneous materials with respect to crosslink density provide potential advantages for a broad range of applications. However, due to their insolubility in all solvents, it is very difficult to characterize MNs by common chemical techniques. One way to verify the network structure is to utilize degradation techniques and size exclusion chromatography of the degradation products. To achieve this, a synthetic route capable of yielding MACs of low polydispersity that possesses orthogonal cross-linking and various degradation functionalities is required.

On the other hand, synthetic degradable polymers possess many potential applications, such as drug delivery, medical devices, environmentally-friendly plastics, and temporary adhesives or coatings. Degradability can be engineered into polymers by the introduction of labile chemical linkages such as anhydride, ester, or amide bonds, etc. Finding a method of yielding low polydispersity MACs with orthogonal cross-linking and various degradation functionalities represents a worthwhile endeavor in order to further exploit the potential of degradable model networks.

Degradable Model Network Preparation Technology This technology provides convenient methods for preparing degradable model networks by click chemistry from macromonomers (MACs) of presumably any monomer functionality and structure accessible by Atom Transfer Radical Polymerization (ATRP). It is based on the discovery that ATRP can be used to synthesize MACs of low polydispersity that contain orthogonal cross-linking and degradation functionalities. Moreover, the procedures to synthesize MACs suitable for preparing degradable polymers and model networks are described.

Applications: The materials produced by this technology have a broad range of applications:
• Drug delivery materials
• Tissue engineering scaffolds
• Coatings
• Absorbents
• Membrane polymers

Advantages:
• A general route to a previously rare class of materials: end-linked model networks
• Better-defined starting polymers
• More control over network structures
• Degradation can be achieved by ozonolysis or photodegradation
• Enables elucidation of network structures by size-exclusion chromatography of the degradation products; offers insights into certain network parameters


Licensing Status: Available for Licensing and Sponsored Research Support


**Inventors**

Jeffrey Thomas Koberstein