systems are commonly composed of monomers, water, water-soluble initiator and surfactant (emulsifier). However, this method requires the removal of the surfactant either by dialysis or desorption, which may lead to coagulation or flocculation of the latex. Thus, there is a need for a method for preparing pH-responsive polymers that does not require the use of surfactants that have to be removed thereafter.

Alternatively, pH-responsive polymers can be synthesized using polymerization techniques such as anionic polymerization and group transfer polymerization (GTP). However, these polymerization techniques often require stringent reaction conditions and are restricted to a limited number of relatively non-functional monomers. Thus, there is a need for a method for preparing pH-responsive polymers that is simpler to operate and easier to scale up. There is also a need for a method for preparing pH-responsive polymers that is suitable for various functional monomers.

There is therefore a need to provide a method to synthesize pH-responsive polymers that overcomes, or at least ameliorates, one or more of the disadvantages described above.

Summary

According to ~~a first aspect~~the disclosure, there is provided a process for making a branched copolymer comprising reacting polymer monomers with macro-azo polyethylene glycol (PEG) initiators and cross-linkers, in the presence of a chain transfer agent, wherein said process comprises the step of traditional radical polymerization (TRP).

According to a first aspect, there is provided a process for making a branched copolymer comprising

reacting polymer monomers with macro-azo polyethylene glycol (PEG) initiators and cross-linkers, in the presence of a chain transfer agent, wherein said process comprises the step of traditional radical polymerization, wherein said polymer monomer is selected from the group consisting of dimethylamino ethyl methacrylate, diethylamino ethyl methacrylate and derivatives thereof.

This process may allow the preparation of pH-responsive branched copolymers directly from various functional polymer monomers that have well-controlled

The process may further comprise a step of dialysis to obtain polymer nanoparticles. The resultant branched copolymer nanoparticles may exhibit strong pH-responsiveness and may be stable across a wide pH range. Advantageously, the process may be a direct preparation of pH-responsive branched copolymer nanoparticles that does not require a self-assembly step.

The process may further comprise the step of loading the polymer nanoparticles with a hydrophobic compound.

In ~~a second aspect~~the disclosure, there is provided a polymer nanoparticle obtainable by the process as defined above. The polymer nanoparticle may be used for the slow release of a hydrophobic compound in a neutral or alkaline environment or the fast release of a hydrophobic compound in an acidic environment. Consequently, the polymer nanoparticle may exhibit good controlled-release of hydrophobic compounds. The polymer nanoparticle may have a higher loading capacity compared to highly cross-linked micro/nano gels.

According to another aspect, there is provided a polymer nanoparticle obtainable by the process as defined above, wherein said nanoparticle comprises a branched copolymer, said branched copolymer comprising a polymer monomer selected from the group consisting of dimethylamino ethyl methacrylate, diethylamino ethyl methacrylate and derivatives thereof.

According to another aspect, there is provided the use of the polymer nanoparticle as defined above for the slow release of a hydrophobic compound in neutral or alkaline environment.

According to another aspect, there is provided the use of the polymer nanoparticle as defined herein for the fast release of a hydrophobic compound in an acidic environment.

Definitions

The following words and terms used herein shall have the meaning indicated:

The word "polymer" or "polymeric" refers to a molecule having two or more monomeric repeat units. It includes linear and branched polymer structures, and also encompasses cross-linked polymers as well as copolymers (which may or may not be cross-linked), thus including block copolymers, alternating copolymers, random copolymers, and the like.

As used herein, macro-azo PEG initiators comprise macro-azo initiators linked with "PEG" chains of various molecular weights.