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 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 polyethylene glycol monomer and 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.

15. The process according to claim 12, wherein said alcohol is selected from the group consisting of menthol, eugenol and phenol.

16. The process according to claim 12, wherein said aldehyde is selected from the group consisting of benzaldehyde, cinnamic aldehyde and perillaldehyde.

17. The process according to claim 12, wherein said ketone is selected from the group consisting of carvone, menthone and cyclohexanone.

18. The process according to claim 8, wherein said cosmeceutical is selected from the group consisting of carotenoids, polyphenols, therapeutic plant essential oil and extracts.

19. The process according to claim 18, wherein said carotenoid is selected from the group consisting of beta-carotene, lycopene, lutein, zeaxanthin, and astaxanthin.

20. The process according to claim 18, wherein said polyphenol is selected from the group consisting of anthocyanidins, catechins, flavonoids, tannins, and procyanidins.

21. The process according to claim 18, wherein said therapeutic plant essential oil and extract is selected from the group consisting of eucalyptus oil, lavender oil, tea tree oil, green tea oil, rosemary oil, patchouli oil, cedarwood atlas oil, clove leaf oil, palmarosa oil, grapefruit oil, bergamot calabrian oil, pine oil, cardamom oil, peppermint oil, cinnamon leaf oil, and ylang ylang oil.

22. A polymer nanoparticle obtainable by the process according to any of claims 6 to 21, wherein said nanoparticle comprises a branched copolymer, said branched copolymer comprising a polyethylene glycol monomer and a polymer monomer selected from the group consisting of dimethylamino ethyl methacrylate, diethylamino ethyl methacrylate and derivatives thereof.

23. The polymer nanoparticle according to claim 22, wherein said polymer nanoparticle exhibits characteristic pH-responsiveness.

24. The polymer nanoparticle according to claim 23, wherein said pH-responsiveness is across the pH range of 3.0 to 12.0.

25. The polymer nanoparticle according to claim 22, wherein said polymer nanoparticle has an average particle size of 60 to 1600 nm.

26. Use of the polymer nanoparticle according to any of claims 22 to 25 for the slow release of a hydrophobic compound in neutral or alkaline environment.

27. Use of the polymer nanoparticle according to any of claims 22 to 25 for the fast release of a hydrophobic compound in an acidic environment.