

Novel pH/Temperature Sensitive Hydrogels of Poly (ethylene glycol)-Poly (caprolactone) –Poly (β -amino ester) (PAE-PCLA-PEG-PCLA-PAE) Biodegradable Polyester Block Copolymer

Dai Phu Huynh, Doo Sung Lee.

Department of Polymer Science and Engineering,

SungKyunkwan University, 300 Chunchun-dong, Jangan-gu, Suwon, Gyeonggi-do 440-746, Korea

Tel: +82-31-290-7282

Fax: +82-31-292-8790

Email: dslee@skku.edu

Abstract

Poly (ethylene glycol)(PEG) – Poly (ϵ -caprolactone(CL)) - Poly (D,L lactide(LA) (PCLA-PEG-PCLA) was synthesized by ring-opening polymerization to form temperature sensitive hydrogel triblock copolymer. The triblock copolymer was acrylated by acryloyl chloride. β - amino ester was used as a pH sensitive moiety,^{1, 2, 3} in this study β - amino ester obtained from 1,4-butandiol diacrylate, and 4, 4' trimethylene dipiperidine, it have pK_b around 6.6. pH/temperature sensitive penta-block copolymer (PAE-PCL-PEG-PCL-PAE) was synthesized by addition polymerization from acrylated triblock copolymer, 1,4-butandiol diacrylate, and 4, 4' trimethylene dipiperidine. Their physicochemical properties of triblock and penta-block copolymers were characterized by ¹H-NMR spectroscopy and gel permeation spectroscopy. Sol-gel phase transition behavior of PAE-PCL-PEG-PCL-PAE block copolymers were investigated by remains stable method. Aqueous media of the penta-block copolymer (at 20 wt%) changed from a sol phase at pH 6.4 and 10°C to a gel phase at pH 7.4 and 37°C. The sol-gel transition properties of these block copolymers are influenced by the hydrophobic/hydrophilic balance of the copolymers, block length, hydrophobicity, stereo-regularity of the hydrophobic of the block copolymer, and the ionization of the pH function groups in the copolymer depended on the changing of environmental pH, respectively. The degradation and the stabilization at pH 7.4 and 37°C, and the stabilization at pH 6.4 and 10°C, 5°C, 0°C of the gel were determined. The results of toxicity experiment show that the penta block copolymer can be used for injection drug delivery system. The sol –gel transition of this block copolymer also study by in vitro test (200 μ l aqueous solution at 20wt% polymer was injected to mouse). Insulin loading and releasing by in vitro test was investigated, the results showed that insulin can loading easily into polymer matrix and release time is around 14-16 days. The PAE-PCL-PEG-PCL-PAE can be used as biomaterial for drug, protein, gene loading and delivery.

Keywords: Biodegradable block copolymer; sol-gel transition; pH sensitive; temperature sensitive; β -amino ester.

References

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