Rheological Characterization of the Thermal Gelation of Poly(n-isopropylacrylamide) and Poly(n-isopropylacrylamide) Co-acrylic Acid

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Abstract:
The combined effect of charged addition and molecular weight, M_w, on the thermal gelation and gel dissolution of poly(N-isopropylacrylamide) chains was explored by using Rheological techniques. The synthesized charged derivative is poly(N-isopropylacrylamide co-Acrylic acid). The rheological behavior of the two macromolecules is clearly different: the thermal gelation of the high M_w and charged macromolecule is much more accentuated. This suggests that the gelation at high temperatures only occurs when the inter polymer aggregate distance is sufficiently short to allow polymer bridging; this situation can be achieved by different approaches, such as increasing polymer concentration and increasing polymer persistence length and polymer M_w.

Zusammenfassung:
Der kombinierte Einfluss von geladenen Zusätzen und Molekulargewicht M_w auf die thermische Gelbildung und die Auflösung des Gels von Poly(N-isopropylacrylamid)-Ketten wurde mit Hilfe rheologischer Techniken untersucht. Das synthetisierte geladene Derivat ist Poly(N-isopropylacrylamid-coacrylsäure). Das rheologische Verhalten dieser zwei Makromoleküle unterscheidet sich deutlich: die thermische Gelbildung des hochmolekularen und des geladenen Makromoleküls tritt in einer wesentlich klareren Weise auf. Diese Beobachtung führt zu der Vermutung, dass die Gelbildung nur dann bei hohen Temperaturen auftritt, wenn der Abstand zwischen den Polymeraggregaten ausreichend kurz ist, um die Bildung von Polymerbrücken zu erlauben. Diese Situation kann durch verschiedene Ansätze erreicht werden, wie z. B. eine steigende Polymerkonzentration, eine höhere Persistenzlänge und ein höheres Molekulargewicht.

Résumé:
L'effet combiné de l'addition de charges et de la masse moléculaire sur la gélation thermique et la dissolution de gels de chaînes de poly(N-isopropylacrylamide), a été étudié au moyen de techniques rhéologiques. Le composé dérivé chargé synthétisé est un poly(isopropylacrylamide co-acide acrylique). Le comportement rhéologique des deux composés est clairement différent: la gélation thermique de la macromolécule chargée et de haut poids moléculaire est beaucoup plus accentuée. Cela suggère que la gélification à hautes températures s'effectue quand la distance entre agrégats polymériques est suffisamment courte pour permettre un pontage polymérique; cette situation peut être obtenue en suivant différentes approches telles que une augmentation de la concentration en polymères et l'augmentation de la longueur de persistance et de la masse moléculaire du polymère.

Key words: thermalgelation, PNIPAA, PNIPAAcoAAc, polymeric networks, rheology

1 INTRODUCTION

Some systems show high miscibility in water at low temperatures while they phase separate at high temperatures. Before the macroscopic phase separation there is a strong turbidity, defined as clouding [1, 2]. At certain circumstances, namely above a critical concentration, the polymer system stays turbid with a gel-like appearance, without any macroscopic phase separation [3]. Gels defined in terms of rheological characteristics can be considered as two component systems exhibiting a solid-like behaviour under small deformation. Thermal reversible gelation

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