Interpolymer association between hydrophobically modified poly(sodium acrylate) and poly(N-isopropylacrylamide) in water: The role of hydrophobic interactions and polymer structure

Y. Mylonas a, G. Bokias b,*, I. Iliopoulos c, G. Staikos a

a Department of Chemical Engineering, University of Patras and Institute of Chemical Engineering and High Temperature Chemical Processes, ICE/HT-FORTH, P.O. Box 1414, GR-26504 Patras, Greece
b Department of Chemistry, University of Patras, GR-26504 Patras, Greece
c Matière Molle et Chimie, UMR-7167, ESPCI-CNRS, 10 rue Vauquelin, F-75231 Paris cedex 05, France

Received 10 June 2005; received in revised form 1 August 2005; accepted 22 September 2005
Available online 9 November 2005

Abstract

The association between hydrophobically modified poly(sodium acrylate) (HMPA) and poly(N-isopropylacrylamide) (PNIPAM) in aqueous solution was studied using turbidimetry, viscometry and fluorescence measurements. Both the polymeric and the amphiphilic nature of the HMPA influence the association process. The tendency for association, as reflected by the increase in the cloud point and the reduced viscosity of PNIPAM, increases with the length of the alkyl group and the degree of substitution of HMPA. The fluorescence study, using pyrene as a probe, ascertains that the association is of hydrophobic nature and the association process is gradual and less cooperative than the association of PNIPAM with ionic surfactants. When high molar mass HMPA is used, the hydrophobic association between HMPA and PNIPAM leads to the formation of a reversible network with significantly enhanced thickening properties as compared to the thickening ability of the corresponding pure HMPA in aqueous solution.

© 2005 Elsevier Ltd. All rights reserved.

Keywords: Hydrophobically modified poly(sodium acrylate); PNIPAM; Hydrophobic association; Thickening properties

1. Introduction

Hydrophobically modified water-soluble polymers (HMWSP) are increasingly used as rheology modifiers in aqueous formulations and present great experimental and theoretical interest [1–7], as they find applications in various fields, such as enhanced oil recovery, cosmetics, etc. The aqueous solutions of HMWSP exhibit high viscosities above a threshold polymer concentration, $c^0$. This viscosity enhancement, in comparison to the unmodified precursor, is due to the strong tendency of the hydrophobic parts of HMWSP to form intermolecular aggregates in aqueous solutions. The hydrophobic