Effect of N-Isopropylacrylamide on the Structure and Swelling Behavior of Microporous Polyurethane Film

Journal	Advanced Materials Research (Volumes 148 - 149)
Volume	Manufacturing Processes and Systems
Edited by	Xianghua Liu, Zhengyi Jiang and Jingtao Han
Pages	1652-1655
DOI	10.4028/www.scientific.net/AMR.148-149.1652
Citation	Hai Ning Lv et al., 2010, Advanced Materials Research, 148-149, 1652
Online since	October, 2010
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Keywords	Microporous, N-Isopropylacrylamide, Polyurethane, Solvent, Swelling

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First page example

Advanced Materials Research Vols. 148-149 (2011) pp 1652-1655
Online available since 2010/Oct/27 at www.scientific.net

doi:10.4028/www.scientific.net/AMR.148-149.1652

Effect of N-isopropylacrylamide on the Structure and Swelling Behavior of microporous polyurethane film

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Keywords: N-isopropylacrylamide microporous polyurethane swelling solvents

Abstract. Preparation of membranes from stimuli-responsive polymers, copolymers, and polymer-additive mixtures is an important approach in the design of responsive membranes. N-isopropylacrylamide(NIPPAm) was dispersed in polyurethane(PU) solution, crosslinked with N,N'-methylene bisacrylamide(BIS) and then cast in bathes to get a thermosensitive microporous film. The ratio of NIPAAm with BIS amount and the cast medium were varied. The structure, surface and cross-section images of polyurethane/poly(N-isopropylacrylamide) (PU/PNIPPAm) semi- interpenetrating networks (semi-IPNs) were characterized by FT-IR and SEM. The swelling behavior of pure PU films and PU/PNIPPAm semi-IPNs were compared. The results showed that incorporation of PNIPPAm had great effect on the structure and swelling behavior of composite films. This approach enables fabrication of membranes with the desired pore structure.

Introduction

Over recent years, applications of temperature-responsive membranes as drug delivery systems[1,2], sensors[3], and solute separation systems[4] have been investigated widely by many groups. PNIPAAm is among the polymers that is well known to respond to changes in temperature and has been applied broadly to develop temperature-responsive membranes[5,6]. Preparation of membranes from stimuli-responsive polymers enables fabrication of membranes with the desired mechanical properties, pore structure (porosity, pore size and pore-size distribution), and barrier structure (symmetric versus asymmetric)[7] . In this paper, we present the synthesis and characterization of a new temperature and humidity sensitive amphiphilic polyurethane membranes and demonstrate the important role played by PNIPAAm and the solvents on the structure and properties of the networks formed.

Experimental

Materials. N-isopropylacrylamide (NIPAAm) was purchased from Tokyo Chemical Industry Co.,Ltd.(TCI) and was used directly. Thermoplastic polyurethane (TPU) was obtained from Lubrizol Advanced Materials, Inc. N,N'-methylene bisacrylamide (BIS) and azobisisbutyronitrile (ABIN) were purified with methanol by recrystallization and dried at 40°C for 48h in a vacuum oven. Tetrahydrofuran(THF), N,N'-dimethylformamide (DMF) and anhydrous ethyl alcohol of analytical reagents were dried over 4Aºmolecular sieve before use.

Film preparation. Thermoplastic polyurethane was dissolved in 30% tetrahydrofuran(THF) and 70% N,N'-dimethylformamide(DMF) mixture solvent to obtain a 10% polyurethane (PU) solution. NIPAAm was then added to the PU solution. Under nitrogen atmosphere, BIS (2,5,8wt% based on NIPAAm) as a crosslinker and ABIN (6 wt% based on NIPAAm) as an initiator, were added to the solution. The reaction was carried out at 70°C for 6 hours. Later, the solutions were cast into glass plate under 15°C and 55% relative humidity and then put into water and ethanol bathes for 5mins.