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Swelling behavior of Poly (N-cyclohexylacrylamide-co-acrylamide/ AMPS Ionic Liquid) Hydrogels

KEYWORDS

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ABSTRACT *Ionic Hydrogels were synthesized using N-cyclohexylacrylamide , acrylamide and AMPS Ionic Liquid by free radical polymerization at 60°C. The swelling behavior increased with increasing amount of AMPS IL. The SEM analysis showed that the hydrogels are in rod like shape .XRD pattern exhibits more amorphous in nature.*

Introduction

Hydrogels are three-dimensional polymer networks that are capable of absorbing large amount of water or aqueous solvent. They are insoluble because of the presence of cross-links, entanglements or crystalline regions. [1] There are a wide variety of natural and synthetic hydrogels. Their ability to absorb water is due to the presence of hydrophilic groups such as -OH,-CONH,-CONH ,-COOH,-SO H etc. [2] Hydrogels can classify into non-ionic and ionic materials. The ionic types comprise anionic (–CO_2–, –SO_3–) orcationic pendants (–NR_3+). The presence of these ionic groups in the hydrogels opens potential area of application that is related to remove pollutants from wastewater [3] .Hydrogels may be chemically stable or may degrade and eventually disintegrate and dissolve. To avoid this dissolution/ degradation, controlled crosslinking is introduced within the hydrogels. Depending on the nature of side groups along the polymer chains, hydrogels have the ability to respond to their environmental changes such as pH, ionic strength or temperature. In recent years, these stimuli sensitive hydrogels have proved to be important carriers for the development of drug devices. [4] . In the present study we described the preparation and swelling behavior of Poly (*N*-cyclohexylacrylamide-*co*-acrylamide/ AMPS Ionic Liquid) Hydrogels.

Experimental

Preparation of Hydrogels

Free-radical cross linking copolymerization was carried out in methanol /water mixture as the polymerization solvent, at 60 ^{0}C in the presence of APS as initiator and MBA as crosslinker. Aqueous solution containing NCA (0.7g), AM (0.3g), 0.045g MBA 0.005 g APS , AMPSIL (0.00, 0.10, 0.30 and 0.50) were prepared in methanol water mixture . After bubbling nitrogen for 15 min, the contents were placed in thermostatic water bath at 60 ^{0}C and the polymerization was conducted for 1 day. After the reaction, the hydrogels were cut into pieces 3-4 mm long. The extracted hydrogels were dried in vacuum oven at 50 ^{0}C to constant weight for further use (Scheme-1).

Swelling behavior

The swelling characteristics were measured by immersing weighed samples of dry hydrogels in double distilled water. The degree of swelling (Ds%) most commonly described as swelling ratio is expressed as increase in weight / gm of dried hydrogel after keeping in contact with water for selected period of time.

$$(Ds\ \%) = [(W_s - W_d / W_d)] \times 100 \text{ ---------- (1)}$$

Where, W_s is the weight of the swollen gel at a given time and W_d is the weight of the dry gel.

SEM Analysis

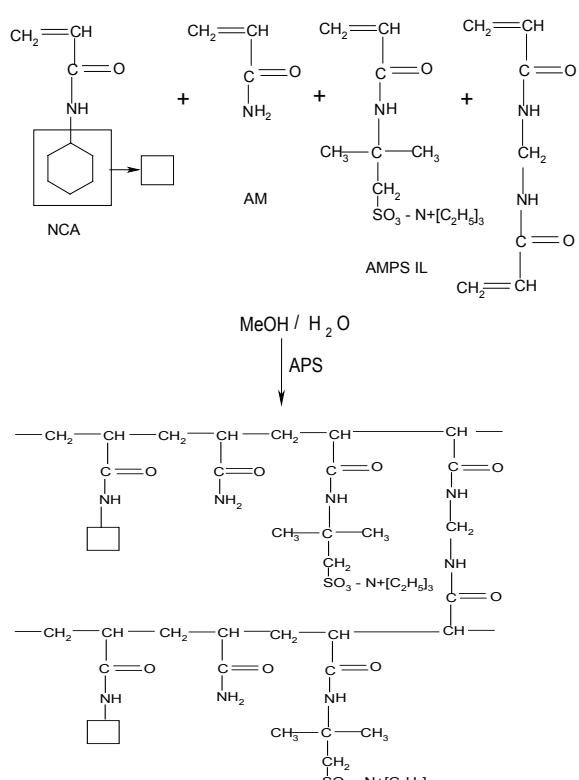
The Micro structure of Hydrogels were studied by Scanning electron Microscopy hydrogels were performed using Hitach, model-JSM-5000 imaging mode at 30 kV with varying levels of magnification.

XRD Study

X-ray powder diffraction (XRD) patterns were collected using a Philips X-Pert automatic diffractometer operating at 40 kV and 40 mA in theta–theta configuration, secondary monochromator with Cu Ka radiation (k = 1.5418 A °) and a PIXcel solid state detector. The samples were mounted on a zero background silicon wafer fixed in a generic sample holder.

Results and Discussion

The schematic representation of hydrogel preparation is as follows



Scheme- 1. Poly (*N*-cyclohexylacrylamide-*co*-acrylamide/ AMPS Ionic Liquid) Hydrogels

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The swelling behavior of the hydrogels was carried out in water at room temperature and is depicted in the Figure -1.The swelling is driven by repulsion of hydrophilic groups such as NH_2 , C=0 NH_2 ,–NR_3+ , SO_3– inside the network and osmotic pressure difference between the gels and the external solution. As the concentration of AMPS IL increases the swelling behavior also increases and it is due additional osmotic pressure develops that expands the gel network further [5, 6].

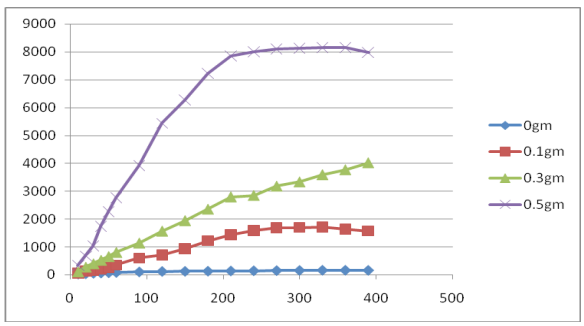

Figure-1. Swelling behavior of poly (*N*-cyclohexylacrylamide-*co*-acrylamide/ AMPS Ionic Liquid) Hydrogels

The Surface morphology of hydrogels was studied under a scanning electron microscope (SEM). The rods like structure are seen in the matrix (Figure-2a). In the XRD study, broad peaks are obtained, which conforms more amorphous region and less crystallinity. It showed that the more the amorphous region in the matrix more will be the swelling.

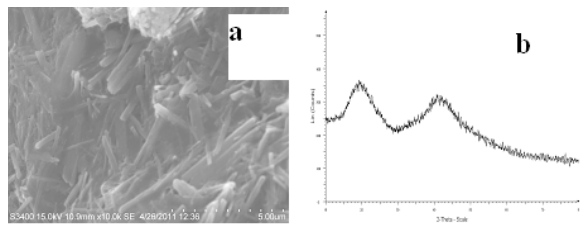

Figure-2. SEM image (a), XRD pattern (b)

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