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Deformational Behavior of Segmented Block Copolymers Using Synchrotron Small Angle X-ray Scattering

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1. Introduction

Segmented block copolymers have the microphase separated structure due to the thermodynamic incompatibility between the two segments.[1-2] The domain structure such as the degree of phase separation, the size and the shape of the domains and the perfect of the domains is very important factor to determine the properties of these materials,[3-5]. Therefore the studies on the structural change during deformation can be very useful for the understanding of the physical properties and the design of the segmented block copolymers. In the present study, an attempt was made to characterize the domain structure change during uniaxial deformation using synchrotron radiation.

2. Experimental

In addition to the synchrotron source, we used the mechanical stretcher and one dimensional diode array detector at the Pohang Accelerator Laboratory. For the deformation behavior of the domain structure, data was collected at three directions with respect to the stretching direction. For the samples polyurethanes based on 4,4′ -methylenebis(phenyl isocyanate) (MDI), diol and poly(tetramethylene oxide)(PTMO) of 650, 1500, 2500g/mol molecular weight were prepared.

3. Results and Discussion

We investigated the domain structure change during uniaxial extension at three directions

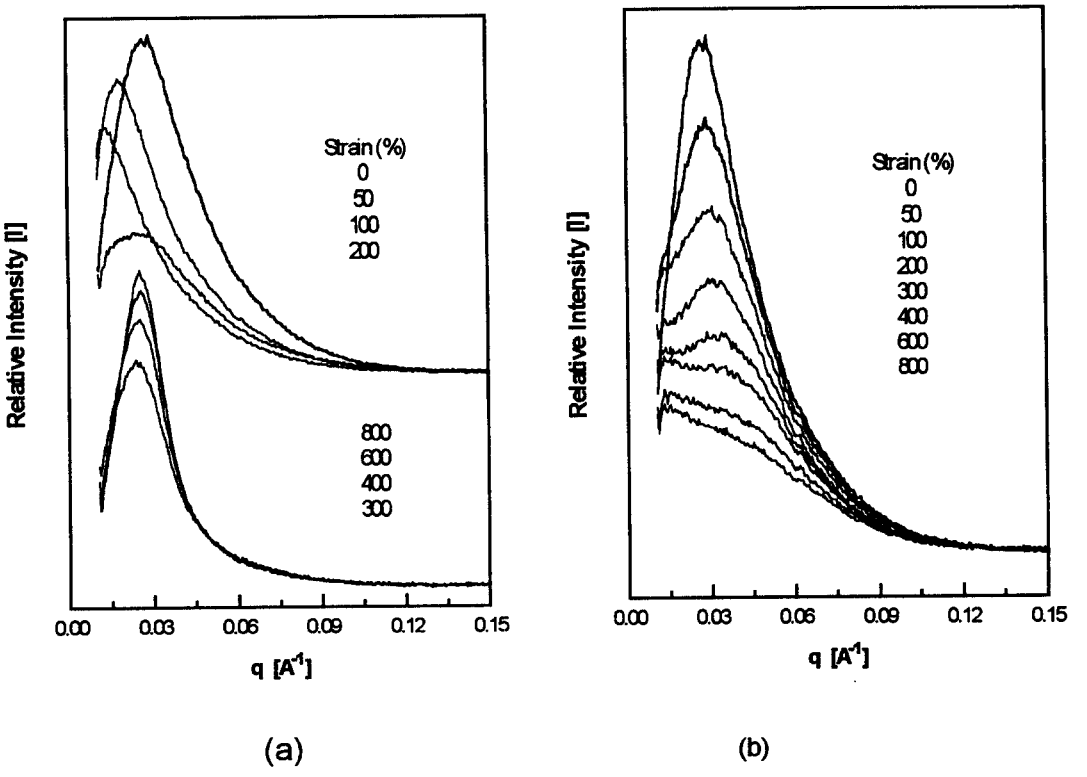

Figure 1. SAXS profiles (a) 0 degree (b) 90 degree with deformation direction

(parallel, 45 degree and perpendicular with respect to stretching direction). Figure 1 shows the SAXS profile of polyurethane having soft segment of 2500 mol. wt. with parallel and perpendicular directions at various strain levels.

Affine increase of the long spacing with deformation were observed at low strains indicating the stretching of soft segment along the deformation direction. The deformation behavior of the hard segment was mainly determined by the relative orientation of the domain with respect to the deformation direction. At high strain the restructuring of the hard domain was observed in the sample containing the soft segment of high molecular weight. The orientational dependency of the domain deformation will be explained in terms of the deformation model proposed in the study. The results obtained with SAXS experiment was further supported by the infrared dichroism results showing the segmental orientation behavior.

4. References

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