

Preferential absorption of longer alkanes for Isotactic Poly(4-methyl-1-pentene) Film

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ABSTRACT: Syndiotactic polystyrene (SPS) preferentially absorbs decane when immersed in an alkane mixture of decane and hexane.¹ Similarly isotactic poly(4-methyl-1-pentene) (P4MP1) shows a similar preferential absorption of longer alkanes.² Then, how and where such preferential absorption phenomena occurs in the semi-crystalline polymer? Generally, solvent absorption into semi-crystalline polymers is mainly to the amorphous region. As for P4MP1, however, it is known that the density of the amorphous region is slightly larger than that of the crystalline region, and also there may be a pore spaces of about 4 Å between the main chains in the crystalline region.³ So there is a possibility that solvent molecules could be absorbed in the crystalline region as well.

Our wide-angle x-ray diffraction results showed that some diffraction peak shapes became sharp and shifted to lower angles with the solvent absorption.² For example, the 200 peak, which reflects the main-chain distance, became sharper as the solvent was absorbed, and the peak position was shifted to a lower angle by 0.8%. This result may indicate the absorption into the crystalline region. Then which is more prominent, the absorption into the amorphous region or to the crystalline region?

Our x-ray small angle scattering results showed that solvent molecules were preferentially absorbed in the amorphous region of P4MP1. Specifically, a lamellar-long-range peak appeared at 0.16 nm⁻¹ when the solvent was added and disappeared with the desorption of the solvent. This result shows the absorption is mainly to the amorphous region.

Note that since the density is similar between crystal and amorphous regions, the peak is absent before the solvent absorption.

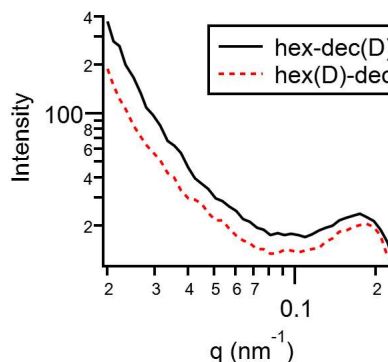


Fig. 1: SANS profile of the as-cast P4MP1 films immersed in hexane (deuterated, D)-decane mixture and hexane-decane(D) mixture.

Then does the preferential absorption of longer-chain molecules result from the absorption into the amorphous region? To clarify this question, we carried out small-angle neutron scattering measurement. The P4MP1 films were immersed in the hexane-decane(deuterated) mixture and hexane(deuterated)-decane mixture, for which the concentration is the same except for the deuteration. As a result, we found a difference between the results of those two films immersed in the two solvents. Note that the as-cast films show almost no signal. Both films show clear signal after immersion (Fig. 1). The preferential absorption is probably not happening in the amorphous region, i.e., not seen at the range around 0.16 nm⁻¹, but seems to occur in rather longer (i.e., lower wavenumber) range.

KEY WORDS: P4MP1, preferential absorption, alkane, SANS, SAXS, IR

References

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