せん断流動結晶化過程におけるポリエチレンの固体構造形成に関する研究

The research on shear-flow induced crystallization behavior of polyethylene blend

瀬野　修一郎[1)]　野末　佳伸[1)]　桜井　孝至[1)]　笠原　達也[1)]　山口　登[1)]
能田　洋平[2)]　元川　竜平[2)]　小泉　智[2)]

Shuichiro Seno　Yoshinobu Nozue　Takashi Sakurai　Tatsuya Kasahara　Noboru Yamaguchi
Yohei Noda　Ryuhei Motokawa　Satoshi Koizumi

[1)]住友化学株式会社　石油化学品研究所　　[2)]日本原子力研究開発機構

In this work we studied shear-induced crystallization behavior of linear low-density (LLDPE) and low-density (LDPE) polyethylene blend by small-angle neutron scattering (SANS-J). The shear-induced phase separation was observed in the binary system.

キーワード：polyethylene、shear-induced crystallization

１．目的

The comprehensive understanding of shear-induced crystallization from a melt is very important for both industrial application and its inherent scientific interest. In polyolefin's materials, a slight difference of molecular structure such as long-chain branch plays an important role in the crystallization behavior.

The purpose of this study is to investigate the effect of the long-chain branch on shear-induced crystallization behavior. The 2D-SANS pattern with and without shear flow was measured in the LLDPE and LDPE binary blend.

２．方法

The used samples are listed in Table 1. The D-LLDPE prepared from a deuterated polybutadiene was purchased from sowa-kagaku Co., Ltd. The H-LDPE was obtained by a solvent fraction of SUMIKATHENE F101 supplied by Sumitomo Chemical Co., Ltd. The D-LLDPE and H-LDPE were mixed in hot *o*-xylene, precipitated with methanol and dried *in vacuo* at 80 ℃. D/H composition of blend samples was 90/10 in wt%. The SANS measurements were performed with a spectrometer SANS-J at research reactor JRR-3M of JAERI. Camera length was set to 2.5 m and 10.2 m. The static experiments were carried out at room temperature and 130 ℃, and those under shear-flow were performed at 130 ℃. A shear cell installed in the SANS-J was Linkam Cambridge Shearing System CSS 450. Shear mode was steady and the shear rate was 1.0 sec^{-1}, respectively.

３．研究成果

The static SANS profiles at room temperature and 130℃ are shown in Figure 1. Both profiles indicate the dependency of q^{-2} in measured q range. This means that the binary system used in this study is miscible. Figure 2 shows the 2D-SANS patterns with (b) and without (a) shear flow. Under shear flow, SANS pattern like abnormal butterfly pattern[1] was observed in the parallel to the flow direction in lower q region (Figure 2 b).

４．結論・考察

The SANS measurements present that LLDPE and LDPE binary blend is miscible in molten static state. On the other hand, it is considered that the shear-induced phase separation occurs in the binary system before crystallization. The SANS pattern like abnormal butterfly pattern was observed under shear-flow, and stopping shear flow led to the disappearance of this pattern. Further investigation is needed to clarify the

shear-induced crystallization.

５．引用(参照)文献等

1) Koizumi, S. *J. Appl. Cryst.* **2003**, *36*, 381.

Table 1. Characteristic of D-LLDPE and H-LDPE.

	D-LLDPE	H-LDPE
Mn	98000	61401
Mw	101000	167831
Mw/Mn	1.03	2.7
SCB(/1000C)	20.4	-

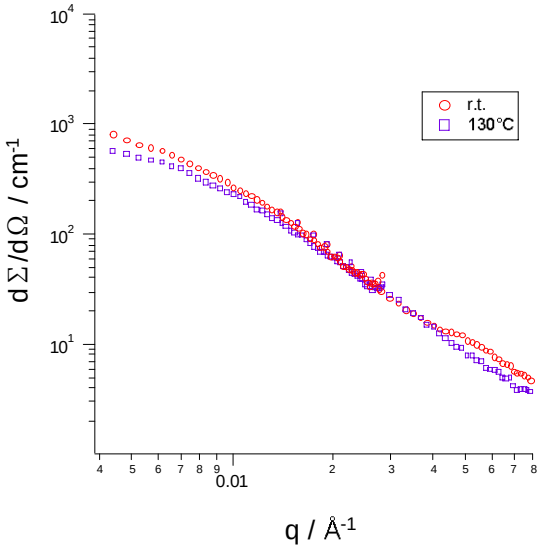

Figure 1. Small angle neutron scattering profile for D-LLDPE/H-LDPE(90/10) at room temperature and 130 ℃.

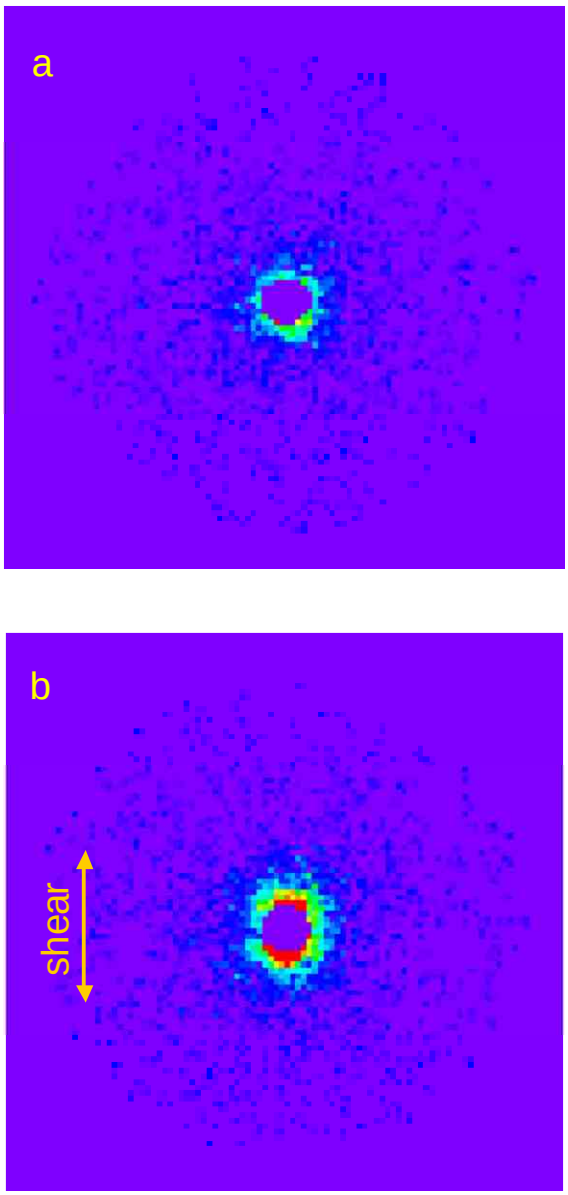

Figure2. Small angle neutron patterns of D-LLDPE/H-LDPE(90/10). Patterns taken under non-shear(a); shear(b). The Arrow indicates the shear direction.