実験番号：202405113（4 シフト）

BL8S3

セグメント化ポリウレタンの SAXS 測定

SAXS measurement of segmented polyurethane

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Keywords：thermoplastic polyurethane, permanent strain, SAXS, hard segment

1. Background and research objectives

The mechanical properties and permanent strain after repeated elongation of segmented polyurethane (TPU) strongly depend on the structure of the hard segments of R_2 (Fig. 1). Therefore, SAXS measurements were performed on segmented polyurethanes with different proportions of hard segments.

2. Experimental

The proportion of hard segments in the TPU used was varied between 30% and 50%. Measurements were performed at the Aichi Synchrotron Radiation Facility BL8S3 using small-angle X-ray scattering (wavelength 1.50 Å (8.2 keV), camera length: 6.4 m, detector: PIRATAS 2M, exposure time 20 s).

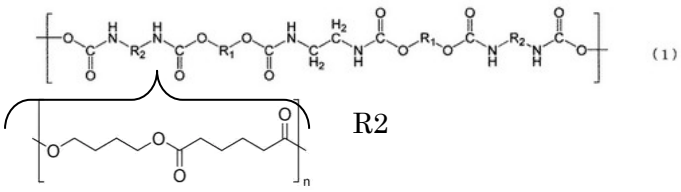

Fig.1 polyerethane

3. Result and discussion

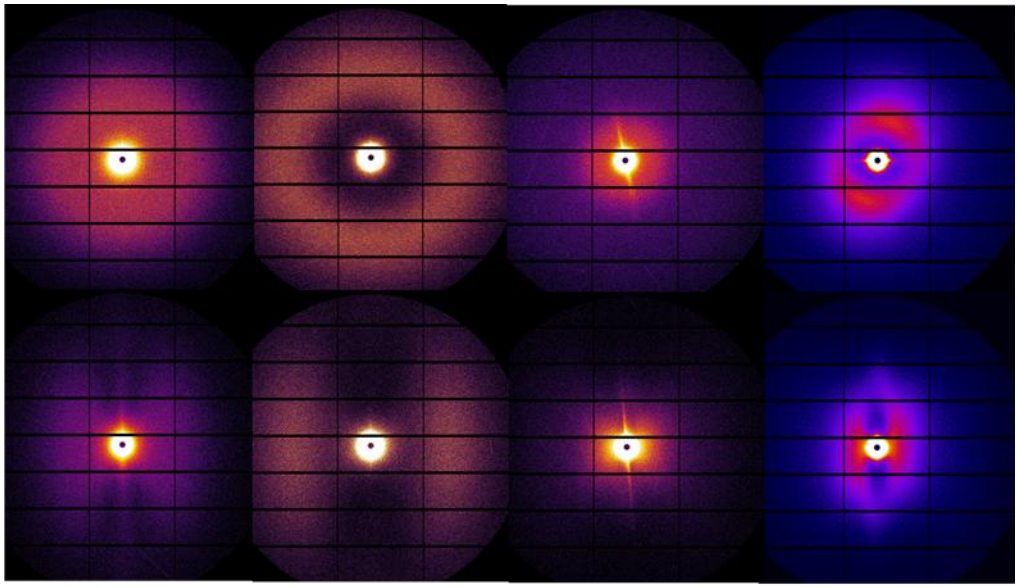

Fig.2 SAXS profiles of TPU

Figure 2 shows the SAXS patterns of TPU with different hard segment ratios when unstretched (top) and stretched to 400% (bottom). Permanent strain is the value after three cycles of stretching. From these results, it was found

that a hard segment ratio of 50% or higher is necessary to observe a clean SAXS pattern. Additionally, this pattern suggests that the rod-like structure formed by alternating hard and soft segments maintains its segment spacing even after stretching, and that the rod-like structure aligns in the stretching direction. Furthermore, even after elongation, only two patterns were observed, and no four-pattern clover or butterfly patterns were confirmed[1)], suggesting that the segments are stacked perpendicular to the elongation direction, with a stacking angle close to 0°. The reason why a clean pattern was not observed when the hard segment ratio was 50% or less remains unclear, but we speculate that structural changes due to relaxation during the 20-second exposure time may also contribute to the blurring of the SAXS pattern.

4. References

1.Simulation of SAXS patterns from oriented lamellar structures and their elliptical trajectories
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https://doi.org/10.1016/j.polymer.2021.123566