

***In-situ* Elastomer Structure Analysis on the Deformation Process
by Synchrotron Radiation X-ray Scattering**

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Introduction

The performance degradation of elastic sealing materials by the exposure to hydrogen on energy-related products is a serious problem for the practical appreciation. Device performance of organic elastic materials depends on the molecular aggregation structure. The hierarchical structure of elastic materials has been investigated by X-ray scattering techniques. However, the X-ray scattering of polymeric materials are relatively weak in intensity because the main chemical component of polymers generally consists of the light elements, so that it is quite difficult to perform the *in-situ* rapid measurement of small angle X-ray scattering (SAXS)/ wide angle X-ray diffraction (WAXD) in laboratory equipment. Synchrotron radiation X-ray source has high brightness, and makes it possible to carry out above-mentioned *in-situ* simultaneous SAXS/WAXD measurement.

Results and Discussion

In-situ simultaneous SAXS/WAXD measurements of segmented polyurethane (SPU) elastomers under stretching were carried out at BL40B2 in SPring-8 using an X-ray source with a wavelength of 0.1 nm and a sample-to-detector distance of 2230 mm (**Figure 1**). Two-dimensional scattering data were recorded with a 3000 × 3000 pixel imaging plate. The long period along the meridional (elongation) direction increases with increasing strain and becomes constant, whereas the long period along the equatorial direction decreases with increasing strain. Further deformation induces a butterfly pattern or a four-point pattern depending on the chemical structure, then the two-point pattern appear at the meridian. The SAXS pattern of highly elongated SPU exhibits broad streak scattering on the equatorial axis. These SAXS pattern development clearly indicates the hard domain lamellar orientation and formation of the nanofibril structure on the stretching process.

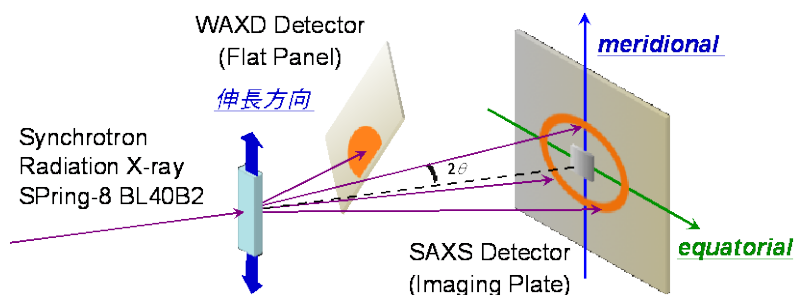


Figure 1. Schematic illustration of SAXS measurement system built-up at the BL40B2 in SPring-8.