# Investigations on the local structure of liquid sulfur at photo-induced polymerization transition II

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It is well known that sulfur consists of $S_8$ ring molecules just above the melting point (112.8°C) and changes to be a mixture of long polymeric chains with $10^5$ atoms and $S_8$ ring molecules at 159°C. We found from the laser-excited optical absorption measurements using a nanosecond pulsed laser and the specially designed quartz glass container that stably maintains the thin liquid film less than 1μm that the polymerization occurred by also the laser illumination [1, 2]. In addition, we found that there are intermediate products between $S_8$ rings and the polymeric chains, which are supposed to be the $S_8$ chains and the tadpole-shaped $S_7$-S molecules [2, 3]. Moreover, the ordered macroscopic molecules were observed by the strong pulsed laser illumination more than 60 mJ/cm$^2$ in the confined liquid sulfur film with the thickness less than a few micrometers [2, 4]. These results indicate that the molecular structure flexibly changes by the light illumination, and it is interesting to investigate how the local structure changes by the light illumination. Neutron diffraction is a powerful technique to clarify the local structure of liquid, and we performed the neutron diffraction measurement on HERMES.

To realize high temperature experiments more than 125°C and a light illumination, we use the SANS, WANS furnace used in the MLF [5]. Sulfur sample was sealed in the quartz tube with the thickness of 0.3 mm at the measurement position. The thin quartz tube was specially fabricated by the glass shop in Institute of Multidisciplinary Research for Advanced Materials (IMRAM), Tohoku University. The wavelength of the neutron beam was 1.34 Å.

Figure 1 shows the neutron diffraction pattern of liquid sulfur at 130°C obtained by the difference between the scattering data from the sample with the quartz tube and those from the empty tube. The data acquisition time for the sample was about 8 hours. The diffraction peak position around 1.8 Å is consistent with the previous data measured by Winter *et al*. [6]. Since the signal from the sample was weak in the present study, we need to improve the measurement conditions such as the selection of the neutron wavelength, the sample volume, and the requesting beam time.

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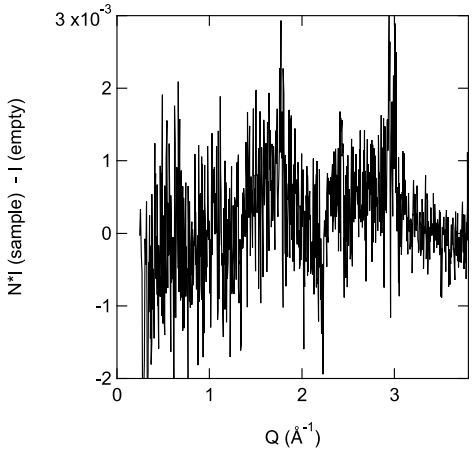


Fig. 1. Neutron diffraction pattern of liquid sulfur at 130°C.