10C/2009G622

# Coagulated structure of NBR/SBR blends by SAXS

Junhyeok JANG, Hirohisa YOSHIDA*
Department of Applied Chemistry, Graduate School of Environmental Science, Tokyo Metropolitan University, Hachiouji, Tokyo 192-0397, Japan

## Introduction

Acrylonitrile-co-butadiene rubber (NBR) and styrene-co-butadiene rubber (SBR) are key amorphous components in the rubber industry. NBR/SBR blend are immiscible blend, the mixing state in NBR/SBR blend solution influences the phase separation structure and the mixing state of NBR/SBR blend solid film [1]. In this study, NBR/SBR blend films with various fractions and temperature were investigated by SAXS.

## Experiments

SBR (Zeon Co., Nipol 1502, styrene composition 23.5 %) and NBR (Zeon Co., Nipol 1042, acrylonitrile composition 33.5 %) were mixed in THF and toluene solutions with 3 wt%. NBR/SBR blend film was prepared by casting from each solution. THF was good solvent for NBR and toluene was good solvent for SBR. Blend fraction was indicated by SBR weight fraction as $\phi_{SBR}$.

Small-angle X-ray scattering (SAXS) experiments of PMMA and PMMA-$SiO_2$ composites were performed at 25 °C using the SAXS optics at the beam line 10C, Photon Factory, High Energy Accelerator Research Organization, Tsukuba, Japan. The wavelength of X-ray ($\lambda$) used was 0.15 nm. The accumulation time of SAXS measurement was 300 sec. The scattering vector ($q = (4\pi \sin\theta)/\lambda$) covered from 0.02 to 5 $nm^{-1}$, $2\theta$ was the scattering angle. The simultaneous DSC [2] was setting on the optics.

## Results

SAXS profiles of NBR on heating were shown in Fig.1. SAXS profiles were obtained at 70, 80, 90, 100, 110, 120, 130, 140, 150 and room temperature after cooling form 150 °C from the top. SAXS profile of NBR at room temperature indicated single scattering peak at $q$ = 2.24 $nm^{-1}$, and the peak shifted to the low $q$ side with the increase of temperature up to 70 °C. The peak shift stopped above 70 °C, and the small peak appeared at 2.05 $nm^{-1}$. The new peak shifted to the low $q$ side and the peak intensity decreased with the increase of temperature and varnished at 120 °C. After cooling the scattering peak scarcely observed at room temperature.

SAXS profiles of NBR/SBR blends prepared by solvent casting from THF solution were shown in Fig.2. NBR and NBR/SBR blends had the scattering peak at 2.24 $nm^{-1}$ and the scattering peak at around 2 $nm^{-1}$, the peak position depended on $\phi_{SBR}$, in the $\phi_{SBR}$ range from 0.1 to 0.6. SAXS profiles for NBR/SBR blends prepared from toluene showed one broad scattering peak at 2.4 $nm^{-1}$ in the $\phi_{SBR}$ range from 0.1 to 0.6. From these results suggested that the scattering peak was due to the coagulation of acrylonitrile sequences.

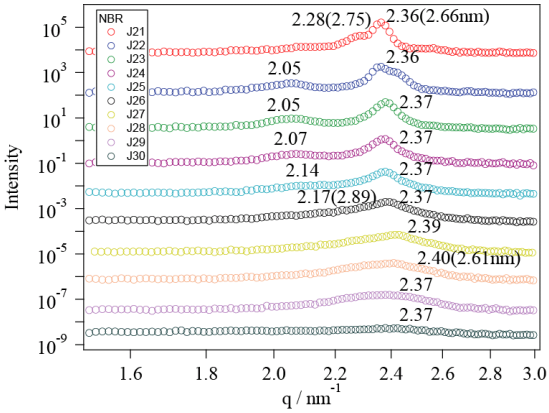


**Fig1. SAXS profiles of NBR at various temperature from 70 to 150°C.**

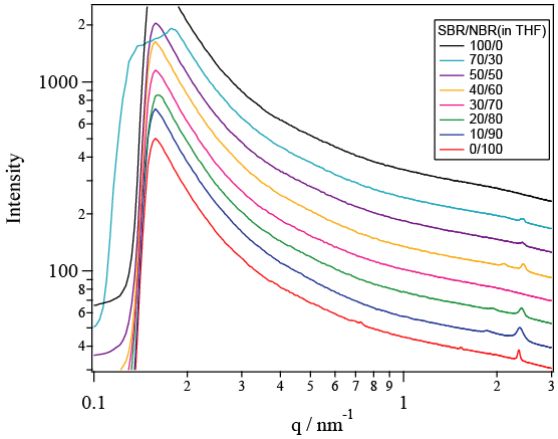


**Fig2. SAXS profiles of NBR/SBR blend with various blend fraction prepared from THF solution.**

## References

[1] J. Jang, H. Yoshida, M. Kawazoe, *Netsu Sokutei*, **W39**, 33-39 (2012)
[2] H. Yoshida, R. Kinoshita, Y. Teramoto, *Thermochimica Acta*, **264**, 173-183 (1995)

* yoshida-hirohisa@tmu.ac.jp