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Chemical bonding structures of SBR/BR interfaces

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1 Introduction

Tire manufacturers often incorporate multiple elastomers into rubber materials to achieve specific physical characteristics. The combination of styrene-butadiene rubber (SBR) and butadiene rubber (BR) can enhance resistance to skidding and rolling, but increasing the amount of styrene can compromise performance at low temperatures. However, by substituting BR with high cis-1,4 BR and introducing it to SBR, it becomes possible to regulate the glass transition temperature (Tg) and enhance performance in low-temperature conditions [1-3]. Present study employed SBR and BR to construct interface structures, which were then analyzed using NEXAFS spectra to elucidate the chemical bonding states. Gaining a comprehensive understanding of these states can shed light on the intricate properties of elastomers.

2 Experiment

The samples were prepared by compounding SBR-A, SBR-B, and BR using a 75 ml plast mill (Toyo Seiki). The difference between the types of SBR lies in their crosslink density: SBR-A is a standard type, while SBR-B has a higher crosslink density. After preparation, the samples were cut into sheet shapes, and these sheets were then layered together to create an SBR-A/BR interface sheet and an SBR-B/BR interface sheet. Additionally, a sample of SBR-B/BR was obtained by kneading SBR-B and BR in a 70:30 ratio. Subsequently, the resulting SBR-A/BR and SBR-B/BR interface sheets, along with the kneaded SBR-B/BR sheet, were sliced using an ultramicrotome, placed onto an electron microscope grid, and affixed to a dedicated STXM sample holder. The sample thickness was fixed at 100 nm.

3 Results

The soft X-ray image of the SBR-B/BR interface sample shows the existence of a region near the interface that exhibits a spectral structure different from that of the SBR-B and BR used to prepare the sample The two-dimensional (2D) soft X-ray absorption distributions of the SBR-B phase, the BR phase, and the residual phase are shown in Fig. 1(a). In the figure, the absorption intensity of the BR phase is shown in red, the SBR-B phase in blue, and the residual phase in green. The respective absorption intensities are represented by the respective color gradations. The simultaneously obtained spectra of the BR phase, the SBR-B phase, and the residual phase are shown in Fig. 1 (b). The color of the spectra corresponds to the color in the soft X-ray image of Fig. 1(a). The spectral intensities are normalized by the background before and after the absorption edge.

Acknowledgement

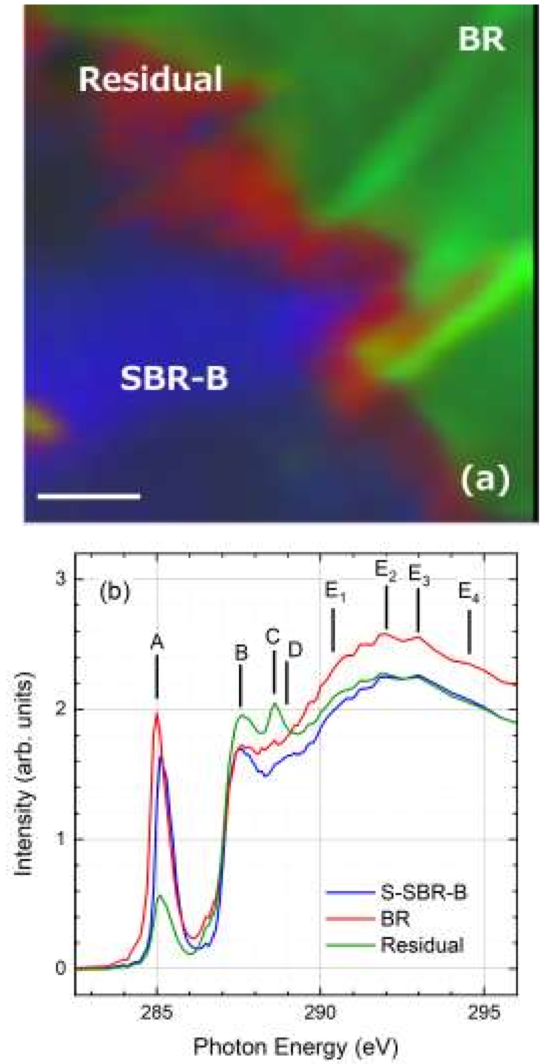

Fig. 1. (a) Material separation image of S-SBR-B/BR interface sample, (b) NEXAFS spectra of each material obtained in (a). Scale bar in (a) is 1um.

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References

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