

Real-time Observation of Anisotropic Structure of Aggregates in Stretched Rubber by 2D-USAXS

Yuya Shinohara^a, Hiroyuki Kishimoto^b, Yasuo Ogawa^a, Yoshio Suzuki^c, Kentaro Uesugi^c, Naoto Yagi^c, Tetsuro Mizoguchi^b, and Yoshiyuki Amemiya^a, ^a*Department of Advanced Materials Science, The University of Tokyo, Kashiwa, Chiba, Japan.* ^b*SRI Research & Development Ltd., Kobe, Hyogo, Japan.* ^c*JASRI, 1-1-1 Kouto Mikazuki-cho Sayo-gun Hyogo 679-5198, Japan.* E-mail: shinohara@x-ray.k.u-tokyo.ac.jp

Addition of filler such as carbon black and silica to an elastomer shows the reinforcement effects [1]. The mechanism of the reinforcement has not yet been clarified in spite of numerous studies. Two-dimensional Ultra-Small-Angle X-ray Scattering (2D-USAXS) has a large potential as a tool for the observation of structural change in a size scale of 100 nm - 10 μ m. In the present study, we have performed the 2D-USAXS of filled rubber under elongation and investigated structural changes of the filler aggregation.

Experiments were performed at BL20XU, SPring-8 (Hyogo, Japan). The camera length was 160.5 m and an X-ray CCD detector coupled with X-ray Image Intensifier [2] was used as the detector. The combination of the high-brilliance X-ray source, the sensitive 2D-detector, and the long camera length enables us to observe 2D-USAXS patterns in a real-time mode. Samples used were Styrene-Butadiene Rubber filled with silica particles. The 2D-USAXS images showed corresponding hysteresis to that of stress-strain curve, which suggest the morphology of the aggregate affects the viscoelasticity of rubber. The 2D-USAXS clarified the aggregate structure in stretched rubber for the first time, which had been only speculated based on viscoelastic experiments.

[1] Ferry J.D., *Viscoelastic Properties of Polymers*, John Willy & Sons, New York, 1980. [2] Amemiya Y., et al., *Rev. Sci. Instrum.*, 1995, **66**, 2290-2294.

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