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X-ray scattering studies of ordered block copolymer melts during uniaxial extensional flow WESLEY BURGHARDT, RUINAN MAO, ERICA MCCREADY, Northwestern University — We present the design and implementation of a new apparatus for in situ x-ray scattering studies of polymer melts during homogenous uniaxial extensional flow. The instrument is based on the commercial SER extensional flow fixture, which employs counter-rotating drums to deform a strip of polymer melt, which is incorporated into a custom-built convection oven designed to facilitate x-ray access to the sample and operation in a synchrotron environment. Here we report measurements of extensional flow-induced structural changes in a cylindrically ordered styrene-ethylene butylene-styrene triblock copolymer melt. At early stages, SAXS data reveal that the ordered microstructure deforms affinely until Hencky strains of ~ 0.2. A global re-orientation process leads to alignment of microdomains predominantly along the stretching direction after Hencky strains of ~ 1. Further stretching does not lead to further qualitative changes in 2-D SAXS patterns. Relaxation of both microdomain orientation and d-spacing is observed following cessation of extensional flow, albeit with different characteristic time scales. In situ x-ray scattering data are compared with off-line measurements of transient extensional viscosity, performed using the SER fixture in a rotational rheometer.

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