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Real time small angle X-ray scattering from cyclically stretched nanoparticle-filled siloxane elastomers ARTHUR K. SCHOLZ, University of California, Santa Barbara, CA, HUAN ZHANG, ESPCI Paris Tech, Paris, France, ELAINE R. CHAN, ALEXANDER HEXEMER, Advanced Light Source, Lawrence Berkeley Labs, Berkeley, CA, EDWARD J. KRAMER, University of California, Santa Barbara, CA — The origin of the cyclic softening and hysteresis (the well known "Mullins effect") observed in nanoparticle-filled elastomers is still debated. To probe this question we used synchrotron-based, time resolved, small angle x-ray scattering (SAXS) to observe changes in the structure of silica-filled siloxane elastomers with different filler loading and surface treatments under step cycle tensile deformation. We perform reverse Monte Carlo (RMC) simulations using graphical processing units (GPUs) to infer the real space configuration of the filler network that gives rise to the SAXS pattern and we compute the scattering invariant to quantify any void formation. We observe that the deformation is non-affine on length scales corresponding to the filler particles. The particles collect in "rafts" perpendicular to the tensile axis such that most of the deformation occurs in the elastomer-rich regions between rafts. At the largest deformations a scattering streak appears in a direction normal to the tensile axis at very small diffraction vectors (0.01 nm-1) which we attribute to the formation of elliptical voids whose long axis lies in the tensile direction.

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