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Cavitation in Filled Styrene-butadiene Rubber: A Real Time SAXS Observation HUAN ZHANG, ESPCI ParisTech, Paris, France, ARTHUR K. SCHOLZ, MRL-UC Santa Barbara, CA, FABIEN VION-LOISEL, Michelin, Clermont-Ferrand, France, EDWARD J. KRAMER, MRL-UC Santa Barbara, CA, COSTANTINO CRETON, ESPCI ParisTech, Paris, France — Cavitation of filled and unfilled elastomers under confinement at the macroscopic scale has been experimentally reported and theoretically modeled. However, cavitation occurring at the nanometer length scale has not yet been demonstrated conclusively in rubbers. Real time SAXS with synchrotron radiation was employed to probe the structure changes in carbon black filled styrene-butadiene rubber (SBR) under uniaxial loading. The scattering invariant was calculated and increased sharply at a critical extension depending on both filler content and crosslinking density around q = 0.1 nm-1, which we attributed to the formation of voids. At very large strains, a sharp and wide streak developed perpendicular to the tensile axis in reciprocal space, suggesting the deformation of the voids in elliptical voids along the tensile direction. In step cycle test, we observed that voids only appeared when the current strain exceeded the maximum historical strain (Mullins effect) and attributed the increase of the scattering invariant outside the Mullins region to the creation of new voids rather than to the reopening of old ones.

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