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Silica-filled SBR: filler structure evolution under quasi-static deformation

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In this contribution, an investigation on the deformation mechanism of S-SBR/silica composites (0-90 phr of silica) by Small Angle Neutron Scattering (SANS) is presented. The study aims at a microscopic understanding of the filler aggregate structure and its evolution under uniaxial stress. A home-built stretching apparatus, employed at small-angle scattering instrument KWS-2 at MLZ in Garching, allowed in situ, time-resolved data acquisition during a programmed, quasi-static strain profile.
2D scattering patterns, for samples with filling degree above 60 phr, showed a butterfly-like, anisotropic pattern already in the undeformed state. The pattern became almost isotropic at intermediate strains (ϵ~20%). A change of the scattering pattern occurred at high strains (ϵ~60%), yielding a shape rotated by 90° compared to the pattern of the undeformed sample. The evolution of the anisometric scattering pattern with the applied deformation, could be explained by initial breaking-up of pre-oriented silica aggregates, promoted by occluded rubber inside. At higher strain, the compressing rubber matrix (perpendicular to strain) leads to additional alignment of latter smaller components. The alignment of fragmented clusters perpendicular to strain results in a rotation of the original pattern by 90°. An initial structural model to describe the scattering pattern evolution will be introduced in this contribution. Financial support by the FNR is acknowledged.

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