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Reinforcement in Natural Rubber Elastomer Nanocomposites: Breakdown of Entropic Elasticity PAUL SOTTA, ROBERTO PEREZ-APARICIO, ARNAUD VIEYRES, LPMA CNRS/Solvay, PIERRE-ANTOINE ALBOUY, LPS CNRS/Universite Paris-Sud, LOIC VANEL, LPMA/Universite de Lyon, DIDIER R. LONG, OLIVIER SANSEAU, LPMA CNRS/Solvay — Understanding reinforcement mechanisms, which are responsible for the remarkable mechanical properties of elastomers filled with nanometric particles, implies combining complementary techniques. Here, we propose an approach based on the combination of different experiments in order to discriminate various reinforcement effects in elastomers filled with carbon black or silica: mechanical response, independent measurements of the crosslink density by multiple-quantum proton NMR and of chain segment orientation under stretching by X-ray scattering, in unfilled and filled vulcanized natural rubbers with various crosslink densities. In unfilled materials, all measurements are nicely correlated, in agreement with rubber elasticity theory. In filled materials, analyzing the deviations with respect to the behavior of the pure unfilled elastomer matrix allows discriminating various physical mechanisms. We demonstrate that the mechanical response at medium/large strains is essentially driven by strain amplification effects, while, in the linear regime, there is a strong additional reinforcement which is not related to the properties of the elastomer matrix. [R. Perez-Aparicio et al., Macromolecules 2013].

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