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Unique Plastic and Recovery Behaviour of Nano-Filled Elastomers and Thermoplastic Elastomers DIDIER LONG, CNRS/Rhodia Saint Fons, SAMY MERABIA, CNRS/Université de Lyon, PAUL SOTTA, CNRS/Rhodia Saint Fons — We have proposed recently that the mechanical properties of nano-filled elastomers are governed by the kinetics of rupture and re-birth of glassy bridges which link neighboring nanoparticles. We show that this death and re-birth process allows for predicting unusual plastic behaviour for these systems. We study the behaviour after large deformation amplitude cycles. At some point we put the systems at rest under large applied deformation, and let the stress relax in this new deformed state. During this relaxation process the life-time of glassy bridges increases progressively. The systems thus acquire a new reference state very different from the initial one, which corresponds to a plastic deformation. The stretching energy of the polymer strands of the rubbery matrix is larger than in the initial undeformed state, but this effect is compensated by a new configuration of glassy bridges. For deformation amplitudes (as compared to the initial state) of less than about 10%, the new system acquires mechanical properties around this new reference state which are very close to those of the initial system, regarding the elastic and dissipative moduli and the non-linear behaviour (e.g. same amplitude for Payne effect). This recovery takes place in a relatively short period of rest time (e.g. from a few hundred to a few thousand seconds).

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