Planar elongation of soft elastomeric networks

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Mechanical characterization of soft elastomers is usually done either by traditional shear rheometry in the linear viscoelastic regime (i.e. low strains) or by extensional rheology in the nonlinear regime. However, in many commercially available rheometers for nonlinear extensions the measurements rely on certain assumptions such as a predefined shape alteration and are very hard to perform on soft elastomers - due to sticky nature and the low tear strength - in most cases. The linear viscoeleastic data provides information on important rheological parameters such as the elastic modulus and the tendency to viscous dissipation but provides no information on the strain hardening or softening effects at larger strains. Therefore it is obvious that LVE can not be used as the single mechanical characterization tool in large strain applications. We evaluate the mechanical performance of several soft elastomers such as poly(propyleneoxide) (PPO) networks and traditional unfilled silicone (PDMS) networks.

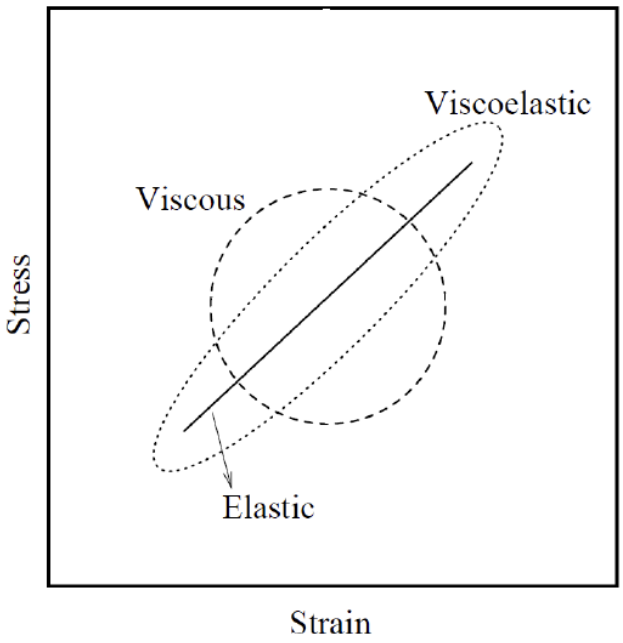

Figure 1: The stress-strain behavior during steady-state cycles of oscillation for different categories of materials, namely purely elastic and purely viscous with the viscoelastic material combining the features of the two before-mentioned materials. Most soft elastomers are highly viscoelastic.