

The effect of cross-link density and liquid crystal content on the dynamic mechanic properties of PnBA networks

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During the past years, one of the major challenges of condensed matter physics has been to understand the nature of the mesoscopic structure and molecular dynamics of glass forming liquids and polymers [1]. Molecular reorientational motions in polymer network and network containing liquid crystal may be studied by dielectric spectroscopy and dynamic mechanic analysis.

Rheology allows investigating the deformation and flow of materials. Materials respond to the applied strain or stress by dissipating energy in the form of heat (viscous dissipation), storing the energy elastically, or through a combination of these two mechanisms. Dynamic mechanical testing enables to measure these properties. In this communication we present the dynamical mechanical properties of polymer networks using the rheology technique, yielding informations about the segmental relaxation and their dependence of the cross-link density of the polymer network and the added liquid crystal. The dynamic glass transition will be compared with the thermal one found by Differential Scanning Calorimetry.

Measurements were performed using an ARES mechanical spectrometer. Shear deformation has been applied under the condition of controlled deformation amplitude, always remaining in the range of the linear viscoelastic response of the material.

Poly(n-Butyl-Acrylate) (PnBA) networks and PnBA networks containing 5% and 20% of commercial low molecular weight liquid crystals 5CB and E7 were prepared under UltraViolet-curing with different cross-link densities, using a comonomer exhibiting a second acrylic function.

The mechanic behaviour of PnBA networks swollen at thermodynamic equilibrium in 5CB and E7 will be presented. Master curves for G' and G'' at a reference temperature of $-45\text{ }^{\circ}\text{C}$ have been obtained using the time temperature superposition principle, i.e., shifting the data recorded at various temperatures along the frequency coordinate. With decreasing frequency a single mechanical transition was obtained, marked by a severe drop of G' and G'' in all systems which can be attributed to the α relaxation process at the glass transition. With increasing amount of crosslinker the G'' curves of the PnBA networks shift to higher frequencies which is related to the increasing glass transition temperature with increasing crosslink density.

References

[1] M. Massalska-Ardoz et al., *J. Chem. Soc.*, Vol. 94, 387 (1998)