INFLUENCE OF THE PREPARATION METHOD ON THE MECHANICAL PROPERTIES OF MONO-DOMAIN SIDE CHAIN LIQUID CRYSTAL ELASTOMERS: GAUSSIAN VERSUS NON-GAUSSIAN ELASTICITY

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We present a comparative study of the shear modulus *G* performed on the dry and swollen states of two types of monodomain Nematic Side Chain Liquid Crystal Elastomers, which differ by the method used to obtain a macroscopic orientation of the mesogens. In one of these systems, the macroscopic orientation is obtained before cross-linking, by orienting the mesogens of a liquid-crystalline polymer with an electric or a magnetic field and by cross-linking the oriented polymer with UV irradiation. In the other system, the macroscopic orientation is obtained by a mechanical stretching of the network formed after the first cross-linking step in the usual two-step cross-linking method. *G* was measured in the linear response regime with the piezo-rheometer we have developed these last ten years, allowing very small strains (~ 10^{-4}) to be applied to the sample in a wide frequency range from 0.2 Hz to 10 kHz. The three main shear moduli $G_{//}$, $G_{\perp}$ and G_{nor} were studied. $G_{//}$ and $G_{\perp}$ correspond to a shear applied in a direction respectively parallel or perpendicular to the director for the planar geometry (director in the plane of the elastomer film), and G_{nor} to a shear perpendicular to the director for the normal geometry (director normal to the plane of the film). The shear measurements performed on the dry elastomers show that the mechanical anisotropy is much smaller for the elastomers prepared with the electric or the magnetic field and cross-linked with U.V irradiation than for the elastomers prepared with the two-step cross-linking method. The large difference in the mechanical anisotropy between the two systems suggests that the nature of their elasticity is not the same. The shear measurements performed as a function of their swelling by a low molecular weight nematic solvent show that the elasticity of the network is Gaussian for the elastomers oriented before cross-linking and non-Gaussian for the elastomers oriented after cross-linking with the usual two-step cross-linking method. As a consequence, the neoclassical model based on Gaussian rubber elasticity cannot be used to describe the mechanical properties of the usual systems prepared with the two-step cross-linking procedure, contrary to the current believe.