Micromechanisms Involved in the Atypical Tensile Behavior Observed in Polyamide 11 at High Temperature

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ABSTRACT: Even far above the glass transition temperature, the amorphous phase in semicrystalline polymers is known to be constrained by crystals and less mobile than a pure amorphous polymer close to its equilibrium rubbery state. The aim of this paper devoted to Polyamide 11 was to investigate the existence and significance of a relaxed state in the amorphous phase of a semicrystalline polymer far above T_g. It focuses on the high temperatures, low strain-rates, and small deformation ranges. A nonstrain-rate dependent tensile curve (called "*asymptotic curve*") was evidenced below a critical strain-rate, consistently with reaching a fully relaxed state of the rubbery amorphous phase. Nevertheless, paradoxical mechanical features were observed at the same time (nonstrain-rate dependent but hysteretic unloading, relaxation, and creep involving same strain-rates as the asymptotic loading regime). Micromechanisms (orientation of primary crystals, creation of local hexagonal arrangements, orientation, and relaxation of the amorphous phase) were analyzed from DSC and X-ray experiments. It suggested distinct amorphous and crystalline contributions depending on the loading path and therefore highlighted paradox of the mechanical behavior.
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