Strain induced crystallisation in PET experimental analysis and modelling using revisited network theory

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1 Abstract

Some experimental analysis either using synchrotron facilities or taking advantages of specific protocols allows drawing a schematic of the microstructure evolution in PET during mechanical loading.
So-called strain induced crystallisation does not obey classical nucleation- growth processes as described in static conditions.
Mechanical strain hardening is related to organisation of polymers which is only a precursor for crystal such that a main physical process which is involved seems to be an increase in cooperativity of chains interactions.
Based on this physical understanding, a thermomechanical modelling is proposed with an account of the strain-induced-crystallization (SIC). Starting from previous works [1], [2] an equivalent hyperelastic network, whose internal energy is ruled by the Edwards-Vilgis strain energy density, was associated to the polymer and the contribution of the development of the crystalline phase under loading was added accounting for hardening and energy dissipation. The modelling enabled to take into account the chains network reorganization with the introduction of evolutions of the internal state variables representing changes in microstructure as can be disentanglement and break or formation of weak bonds between polymeric chains.
The crystalline phase, developing during loading, was considered as equivalent to reversible "crosslinks nodes" and an internal state variable was related to this in order to take into account SIC. The modelling is finally compared to experimental results obtained in uniaxial tension

Références

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