Abstract Submitted
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Can a material clock based model describe highly non-linear creep?[1] GRIGORI MEDVEDEV, JAMES CARUTHERS, Purdue University — Most constitutive models developed to date assume that the non-linear behavior observed in glassy polymers it is due to a deformation dependent material clock, where the challenge is to find the correct functional form of how the rate of relaxation depends upon structural variables. A two order-of-magnitude change in mobility upon deformation has been observed experimentally [1], confirming that a material clock is a necessary component of any constitutive description. A non-linear viscoelastic constitutive theory [2], where the clock is configurational energy based, captures with a single parameter set a wide variety of phenomena, including yield, stress/ volume/ enthalpy relaxation, and physical aging. The model is also successful in describing linear creep and recovery; however, it fails dramatically in case of highly non-linear creep in the glass transition region. No change in the functional form of the material clock can significantly improve the prediction of the model for non-linear creep. We postulate that spatial dynamic heterogeneity of glassy materials, which is well established experimentally, must be incorporated into the constitutive model in order to describe non-linear creep. [1] Ediger, et al., APS Meeting - Denver, CO March, 2007. [2] Caruthers, et al., Polymer, 45, 4577-4597, 2004.

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Grigori Medvedev
Purdue University

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