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**Challenges in predicting non-linear creep and recovery in glassy polymers** GRIGORI MEDVEDEV, JAMES CARUTHERS, Purdue University — The phenomenon of non-linear creep of amorphous polymeric glasses is difficult to predict using the traditional viscoelastic and viscoplastic constitutive frameworks, where two features present a particular challenge: (i) the tertiary stage of the creep and (ii) the recovery from large creep upon removal of the load. Representative examples of these two nonlinear responses will be shown for lightly cross-linked PMMA and an epoxy material, where the creep and recovery behavior has been studied as a function of temperature and aging time. The acceleration of creep during the tertiary stage is not caused by damage since the original dimensions of a cross-linked sample are fully recoverable by annealing above Tg. The assumption that the relaxation time is a function of strain runs into qualitative problems when predicting multi-step constant strain rate loading experiments. Recovery from creep as predicted by the constitutive models where the relaxation time depends on the deformation history is too abrupt compared to the experiment - this known as the "accelerated aging" problem. A recently developed Stochastic Constitutive Model that acknowledges dynamic heterogeneity in the glass state naturally predicts both the tertiary creep and the smooth recovery from creep.

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