

MAR12-2011-000460

Abstract for an Invited Paper  
for the MAR12 Meeting of  
the American Physical Society

**Shear-Transformation-Zone Theory of Glassy Diffusion, Stretched Exponentials, and the Stokes-Einstein Relation**  
JAMES LANGER, University of California, Santa Barbara

The success of the shear-transformation-zone (STZ) theory in accounting for broadly peaked, frequency-dependent, glassy viscoelastic response functions is based on the theory's first-principles prediction of a wide range of internal STZ transition rates. Here, I propose that the STZ's are the dynamic heterogeneities frequently invoked to explain Stokes-Einstein violations and stretched-exponential relaxation in glass-forming materials. I find that, to be consistent with observations of Fickian diffusion near  $T_g$ , an STZ-based diffusion theory must include cascades of correlated events, but that the temperature dependence of the Stokes-Einstein ratio is determined by an STZ-induced enhancement of the viscosity. Stretched-exponential relaxation of density fluctuations emerges from the same distribution of STZ transition rates that predicts the viscoelastic behavior.