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Twinkling Fractal Analysis of PolyVinyl Acetate (PVAc) YUTAO ZHANG, RICHARD P. WOOL, Department of Chemical and Biomolecular Engineering, University of Delaware, Newark DE 19716 — In amorphous polystyrene melts we have shown by Atomic Force Microscopy (Height and Phase) that dynamic rigid fractal clusters form in equilibrium with the fractal liquid and their relaxation behavior determines the kinetic nature of T_g [J. Non Cryst Solids 357(2): 311-319 2011]. The fractal clusters of size R $\sim$ 1-100 nm have relaxation times τ $\sim R^{1.8}$ (solid-to-liquid) where the exponent is related to the Fractal dimension D_f and Fracton dimension d_f via Df/d_f =1.8. Israeloff et al (2006) showed nanoscale spatio-temporal thermo fluctuations in PVAc using a non-contact Dielectric Force Microscopy technique; PVAC shows similar dynamic clustering using both phase and height tapping AFM modes. The dynamic clusters are clearly evident in the range 1-700 nm. The cluster relaxation behavior was explored in both height and phase modes and found to be different. The fractal clusters have a TFT vibrational density of states $G(w) \sim w^{df-1}$ with eigenvalues (frequencies) and eigenvectors (displacements) and these are expected to manifest differently in these AFM studies on PVAc thin films. We examine the cluster relaxation functions $C(t) \sim t^{-4/3}$ predicted by the TFT and look for the presence of highly mobile layers near surfaces and holes in nanothin films. These results are in accord with computer simulations of anharmonically interacting particles and the recent observation of "Dancing Molecules" in strained ceramic glass (Huang et al, Science Oct 2013), as predicted by the TFT.

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