MAR11-2010-008138

Abstract for an Invited Paper
for the MAR11 Meeting of
the American Physical Society

Vibrational modes identify soft spots in a sheared model glass

M. LISA MANNING, Princeton Center for Theoretical Science, Princeton University

Both solids and fluids can flow under applied stress. In crystalline solids, flow occurs via particle rearrangements controlled by a population of dislocations, while in fluids, particle rearrangements occur everywhere throughout the material. In disordered solids, flow generally occurs via localized rearrangements, but no one has been able to identify a population of flow defects, analogous to dislocations, that are structurally different from the rest of the system and more susceptible to flow. It has therefore remained unclear whether a solid-like or fluid-like description is more appropriate for describing flow in such systems. By analyzing the low-energy vibrational modes in a model glass, we have identified a population of structural "soft spots" and have shown that particle rearrangements are initiated at these spots. Thus, these spots serve as good candidates for flow defects. We analyze statistical and structural features of the spots and find that the density of spots decreases with increasing packing fraction and that the population of spots changes slowly compared to the time between particle rearrangements. These results support a solid-like description of flow controlled by a population of localized flow defects in glassy materials.