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INVITED SPEAKER: The yielding transition in amorphous solids

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Abstract content
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Amorphous solids are ubiquitous in nature and among man made materials. Glasses, gels, and granular matter offer broad classes of examples. Many other soft materials, such as foams, emulsions, pastes, dense colloidal suspensions, biological assemblies such as the cytoskeleton in cells, and geophysical bodies such as the earth's crust, indicate the range and variety of matter in amorphous solid forms. Since many types of glasses, e. g. polymer glasses and metallic glasses, are used as structural materials, the mechanical behavior of glasses under application of external stresses is a very important characteristic to understand. In the context of both crystalline and amorphous solids, mechanical response is sought to be understood in terms of reversible, elastic response to applied stress, and irreversible, plastic deformations. In the context of crystalline solids, plasticity has been analyzed and understood as arising from the presence of dislocation defects in the crystal structure. In the case of amorphous solids, since the microscopic structure is disordered, there is no meaningful way in which defects analogous to dislocations can be identified. An aspect of the mechanical response that is of particular significance is yielding. From a theoretical point of view, much interest has also focused on whether one may understand yielding in amorphous solids as a non-equilibrium phase transition in a driven system. Many investigations have addressed plasticity, and the nature of yielding, in amorphous solids through atomistic computer simulations. A particular approach has been to consider amorphous solids subjected to large amplitude oscillatory strain in the limit of zero temperature and strain rates. Results from extensive simulations exploring the dependence of system size and amplitude of the cyclic deformation on the steady state of the deformed amorphous solids, and what the reveal about the nature of the yielding transition, will be discussed.

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