MM 16: Invited talk Derlet

Time: Tuesday 9:30–10:00 Location: H38

Invited Talk MM 16.1 Tue 9:30 H38

Critical stresses in intermittent plasticity and the transition to macroscopic yield — •Peter Derlet[1] and Robert Maass[2] — [1]Condensed Matter Theory Group, Paul Scherrer Institut, CH-5232 Villigen PSI, Switzerland — [2]Department of Materials Science and Engineering, University of Illinois at Urbana-Champaign, 1304 West Green Street, Urbana, Illinois 61801, USA

A dislocated crystal will locally undergo discrete plastic deformation at virtually any applied stress. High resolution extensometry on bulk crystals or small scale deformation experiments display such discrete plasticity in stress-strain data. This talk focuses on the statistics of such plastic events in the regime prior to macroscopic yield. Extreme value theory is applied to the critical stresses at which discrete intermittent plasticity occurs. It is found that when the same deformation is repeated many times in both experiments and dislocation dynamics simulations with strongly varying microstructures, the average of the critical stress and the Weibull fluctuations around it, is related to the deforming crystal volume via a truncated power-law. It's applicability across a rich data set suggests that a quite general phenomenon is at play. The identified truncated power-law is found to uniquely define an underlying master distribution of critical stresses present in the deforming crystal, and also the density of discrete plastic events available to the system. It therefore provides a procedure to experimentally characterize a material's microstructure both prior to loading and in the microplastic regime to yield.