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Kolloquium für Mechanik

Referee:	**Prof. Erica Lilleodden** Institute of Materials Research, Materials Mechanics Helmholtz-Zentrum Geesthacht, Germany
Date:	Monday, July 8, 2019, 11:30h
Location:	Bldg. 10.50, R 602
Title:	**Exploring strength at the nanoscale**

Abstract

While implicit size effects in mechanical behavior are well known to materials scientists, as exemplified in the equations relating yield strength to grain size or dislocation spacing, the mechanical response of materials is typically modeled as a continuum, with the inherent microstructural heterogeneities smeared out into an effective homogeneous structure. Here we explore the fundamental characteristics of metal plasticity using nanoindentation-based techniques, where the deformation is localized, and boundary conditions can be tailored to address both finite size effects as well as the transition to continuum behavior. Observations from conventional nanoindentation experiments show discrete, jerky flow initiated at near theoretical strengths followed by strain softening [1, 2], while microcompression experiments share the high strengths found in nanoindentation but indicate that deformation proceeds with increasing flow stress [2, 3]. Varying the initial dislocation structures show that the flow stress required to initiate plasticity typically decreases with increasing dislocation density [4], for both types of experiments. All observations are consistent with a view of metal plasticity, which embraces its discrete nature and its dependence on long-range internal stresses. This informs an improved picture of plasticity as “punctuated equilibrium” - a collective process marked by discrete characteristics -, rather than as conventional viscous flow evolving at equilibrium.

References
[1] E.T. Lilleodden and W.D. Nix, “Microstructural Length-Scale Effects in the Nanoindentation Behavior of Thin Gold Films” Acta Materialia vol. 54 (2006) pp. 1583-1593.
[2] W. D. Nix, J. R. Greer, Gang Feng and Erica T. Lilleodden, “Deformation at the Nanometer and Micrometer Length Scales: Effects of Strain Gradients and Dislocation Starvation”, Thin Solid Films vol. 515 (2007) pp. 3152-3157.
[3] C.V. Volkert and E.T. Lilleodden, “Size Effects in the Deformation of Sub-Micron Au Pillars”, Philosophical Magazine vol. 86 (2006) pp. 5567-5579.
[4] P.O. Guglielmi, M. Ziehmer, E.T. Lilleodden, “On a novel strain indicator based on uncorrelated misorientation angles for correlating dislocation density to local strength”, Acta Materialia vol. 150 (2018) pp. 95-105.

Alle Interessenten sind herzlich eingeladen.
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