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Universality of Deformation Down to the Nanoscale

NIR FRIEDMAN, Department of Physics, University of Illinois at Urbana-Champaign, ANDREW T. JENNINGS, Division of Engineering and Applied Sciences, Caltech, GEORGIOS TSEKENIS, Department of Physics, University of Illinois at Urbana-Champaign, JU-YOUNG KIM, Division of Engineering and Applied Sciences, Caltech, MOLEI TAO, Department of Computing and Mathematical Sciences, Caltech, JONATHAN T. UHL, None, JULIA R. GREER, Division of Engineering and Applied Sciences, Caltech, KARIN A. DAHMEN, Department of Physics, University of Illinois at Urbana-Champaign — Deformation on macroscopic scales is often modeled as a continuous process, which in reality occurs via a sequence of nanometer-sized discrete slips. We report statistical analyses of slip size distributions obtained by uniaxial compression experiments on nano-crystals of different crystal structures and sizes down to 75 nm. We show that a simple mean field theory (MFT) correctly predicts the statistical behavior by collapsing data using the MFT exponents and scaling function. This study demonstrates that a simple model captures the statistics and universality class of discrete deformation events in a variety of metallic nano-crystals down to the smallest experimentally accessed length scales.

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