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Laser Speckle Interferometry for Measuring Three-Dimensional Mesoscopic Deformations in Polycrystalline Surfaces TIMOTHY SMITH, LORI BASSMAN, ZAMIR LALJI, ERIC FLYNN, TOMMY LEUNG, SEAN CRAMER, NICK VONGERSDORFF, Harvey Mudd College, SCOTT GREENFIELD, AARON KOSKELO, Los Alamos National Laboratory — A speckle interferometric microscope has been constructed to simultaneously measure mesoscopic deformations in all three directions at a surface. The purpose is to understand mesoscale mechanics in polycrystalline materials using direct observation. The microscope uses three different wavelength lasers to separate dimensional data (out-of-plane and two in-plane directions) while capturing the intensity of speckle reflected from a surface as a function of position and time. Images are captured before and after deformation, with an intermediate image taken before deformation but with a mirror in one arm of each interferometer tilted. Post-processing exploits the mirror tilts to produce carrier fringes that isolate deformation data in Fourier space and increase sensitivity by orders of magnitude over traditional interferometry. Data are taken with 1 μm spatial resolution, and 10 nm deformations have been resolved. Experiments underway are using the system to study polycrystalline creep.

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