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Controlling surface strain distribution in copper using plane strain wedge sliding

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ABSTRACT

Utilizing plastic strain to modify surface attributes is a common way to improve the functional performance of engineering components. The ability to control the strain distribution in the surface layer is critical for controlling the microstructures and properties of the processed surface. This paper explores the possibility of controlling the surface / subsurface strain distribution in copper by using a wedge-shaped sliding tool of large negative rake angle (≤ -60°). The surface flow and deformation at various sliding conditions are characterized *in situ* using high speed imaging and image analysis techniques. Deformation fields like flow velocity, strain rate and strain are quantified. It shows the sliding can result in two modes of surface deformation: (1) steady prow deformation with laminar flow and (2) unsteady prow deformation with sinuous flow and surface folding. The former creates a uniformly strained subsurface layer while the latter creates surface defects and inhomogeneous strain field. Utilizing the steady prow deformation and multi-pass sliding technique, the subsurface strain in copper can be controlled in a large strain range (>10).