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Shearing Resistance of Aluminum at High Strain Rates and at Temperatures Approaching Melt STEPHEN GRUNSCHEL, ASML Lithography Co., RODNEY CLIFTON, TONG JIAO, Brown University — High-temperature, pressure-shear plate impact experiments have been conducted to investigate rate-controlling mechanisms for plastic deformation of high-purity aluminum at high strain rates ($10^6 s^{-1}$) and at temperatures approaching melt. The objective of these experiments was to look for a possible change in the rate-controlling mechanism of dislocation motion from thermally activated motion of dislocations past obstacles to phonon drag as the temperatures becomes high enough that thermal activation becomes relatively unimportant. The experimental results show an upturn in shearing resistance with increasing temperature at high temperatures, suggestive of a change in rate-controlling mechanism. However, the upturn is too steep to be described by a usual phonon drag model with a drag coefficient that is proportional to temperature. Simulated results show that the modeling of strain rate hardening based on a phonon drag model leads to too strong an increase in flow stress with increasing strain rate in the drag-dominated regime.

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