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On the Role of Texture and Precipitate Orientation in Spall Failure of a Rolled Magnesium Alloy DEBJOY MALLICK, Johns Hopkins University, Department of Mechanical Engineering, SUHAS ESWARAPPA-PRAMEELA, Johns Hopkins University, Department of Materials Science and Engineering, VIGNESH KANNAN, MENG ZHAO, Johns Hopkins University, Department of Mechanical Engineering, JEFF LLOYD, U.S. Army Research Laboratory, Aberdeen Proving Ground, MD, TIM WEIHS, Johns Hopkins University, Department of Materials Science and Engineering, KT RAMESH, Johns Hopkins University, Department of Mechanical Engineering — Magnesium alloys are an attractive material system for protection applications owing to their high specific strength and stiffness, but have low ductility in this application. The plastic anisotropy from the low-symmetry HCP crystal structure together with defects in the microstructure, such as voids and second phase particles, may all play roles in spall (dynamic tensile failure at high strain rates). We present a large number of spall experiments on Mg-9Al (wt.%) thin film specimens performed with a laser-driven micro-flyer apparatus. The Mg-9Al alloy is warm-rolled and processed in two conditions: (a) fully solutionized at 450^oC for 24 hours with no second phase particles and (b) peak aged to generate high aspect-ratio lath precipitates ($Mg_{17}Al_{12}$) with thicknesses on the order of nanometers and lengths on the order of microns on the basal plane. The loading direction is varied between the normal-to and transverse-to rolling directions of the specimen in order to interrogate the effects of plastic anisotropy of the matrix material and geometric anisotropy of the precipitates on the spall strength. We compare the experiments to numerical simulations using crystal plasticity and realistic precipitate geometries and spacings from TEM observations.

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