Masters Defense

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CORRELATION BETWEEN DAMAGE AND MICROSTRUCTURE IN SHOCK LOADED COPPER MULTICRYSTALS

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Abstract

Correlations between damage and local microstructure were investigated in multicrystalline copper samples via impact tests conducted with laser-driven plates at low pressures (2-6 GPA). The samples had a large grain size (450 μm) as compared to the thickness (1000 μm), to isolate the effects of microstructure on the local response. Velocity interferometry was used to measure the back-surface velocity history of the samples and Electron Backscatter Diffraction (EBSD), both in-plane and through-thickness, was used to relate crystallography to the presence of porosity around microstructural features such as grain boundaries and triple points. Both intergranular and transgranular damage modes were observed in these samples and the density of intrinsic defects, such as grain boundaries and triple points seemed to play a large role in the determination of the damage mode. A transition from transgranular to intergranular damage was observed within the cross-sections in regions where the local grain size was smaller than the average. Potential sites for preferred damage nucleation and strain localization were studied in terms of their crystallography via statistical sampling in serial sectioned specimens. The results showed that terminated twin boundaries are preferred sites of intergranular damage localization. Comparison among the statistical distributions of misorientation angles for the as prepared samples, the boundaries that localized damage and the Meckenzie distribution indicated that the fraction of damaged boundaries for a given misorientation angle is related to the original proportion of the boundaries themselves, except for twin boundaries. The statistics also showed that the more developed damage tends to be close to triple points.