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Influence of Grain Boundary Crystallography on the Nucleation Characteristics of of Dynamic Failure MUKUL KUMAR, ROGER MINICH, Lawrence Livermore National Lab — The scaling of mechanical properties with a microstructural length scale such as grain size is well known. However, the role of grain boundary crystallography is only recently starting to emerge. For instance, it has been shown recently that the Hall-Petch scaling of yield stress with grain size needs to be reformulated to take into account a parameter called grain boundary character distribution, which is related to the frequency of crystallographically "special" boundaries in the microstructure. Less well developed is an understanding of the role of microstructures in the process of void nucleation and growth leading to failure during shock loading of materials. In this paper, we shall report on the scaling recently observed in the case of dynamic failure or spall under shock deformation conditions for different microstructures in high purity copper. The spall strength is observed to increase as the length scales coarsen, which is counter to the Hall-Petch relationship, eventually leveling off for single crystals. The role of nucleation site density and grain boundary character distribution in understanding this behavior as a function of impact pressure will be explored in the context of the scaling laws that emerge from this data. This work was performed under the auspices of the U.S. Department of Energy by University of California, Lawrence Livermore National Laboratory under contract No. W-7405-Eng-48.

Roger Minich
Lawrence Livermore National Lab

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