Abstract Submitted
for the SHOCK17 Meeting of
The American Physical Society

Direct Numerical Simulations of Microstructure Effects During High-Rate Loading of Additively Manufactured Metals[1] CORBETT BATTAILE, STEVEN OWEN, NATHAN MOORE, Sandia National Laboratories — The properties of most engineering materials depend on the characteristics of internal microstructures and defects. In additively manufactured (AM) metals, these can include polycrystalline grains, impurities, phases, and significant porosity that qualitatively differ from conventional engineering materials. The microscopic details of the interactions between these internal defects, and the propagation of applied loads through the body, act in concert to dictate macro-observable properties like strength and compressibility. In this work, we used Sandia's ALEGRA finite element software to simulate the high-strain-rate loading of AM metals from laser engineered net shaping (LENS) and thermal spraying. The microstructural details of the material were represented explicitly, such that internal features like second phases and pores are captured and meshed as individual entities in the computational domain. We will discuss the dependence of the high-strain-rate mechanical properties on microstructural characteristics such as the shapes, sizes, and volume fractions of second phases and pores. In addition, we will examine how the details of the microstructural representation affect the microscopic material response to dynamic loads, and the effects of using "stair-step" versus conformal interfaces smoothed via the SCULPT tool in Sandia's CUBIT software.

[1]Sandia is a multiprogram laboratory operated by Sandia Corporation, a Lockheed Martin Company, for the US DOE NNSA under contract DE-AC04-94AL85000.

Corbett Battaile
Sandia National Laboratories

Date submitted: 24 Feb 2017 Electronic form version 1.4