Abstract Submitted
for the SHOCK19 Meeting of
The American Physical Society

Explosive Compaction of Additively Manufactured Material PHILLIP MULLIGAN, CODY LOUGH, DOUGLAS BRISTOW, Missouri University of Science and Technology, ED KINZEL, University of Notre Dame, CATHERINE JOHNSON, Missouri University of Science and Technology — Selective Laser Melting (SLM) is an additive manufacturing (AM) technique that uses a laser to locally fuse material in a metal-powder bed. The process is performed in layers enabling significant geometric freedom over traditional manufacturing techniques. During the deposition process, the metal is locally melted and rapidly self-quenched, leading to rapid solidification with well-defined melt-pool boundaries. Analogies are often drawn to the microstructure created in welding, albeit extending to the entire part. The SLM process parameters are optimized to produce full density metal parts. The process parameters can be adjusted to produce local regions that are of un-melted or partially melted powders. The ability to tailor the density (and corresponding modulus, yield strength, and ductility) continuously on a volumetric basis, has significant potential to engineer effective properties. This paper reports on an experimental study of AM metal components subjected to dynamic loading by detonating an explosive in intimate contact with the material. The crystallographic structural behavior of the parts is characterized before and after explosive loading in an explosive compaction test. The results are compared to previous metal powder compaction studies and predictive equations for material strength. The findings will aid in designing AM components for explosively loaded systems.

Phillip Mulligan
Missouri University of Science and Technology

Date submitted: 03 Jun 2019 Electronic form version 1.4