MATERIALS ENGINEERING SEMINAR

"ADVANCING ADDITIVE MANUFACTURING OF NICKEL-BASED SUPERALLOY 718 AND OXIDE DISPERSION STRENGTHENED VARIANTS"

By
Benjamin Stegman

Purdue MSE Ph.D. Final Exam

Advisor: Professor Xinghang Zhang

ABSTRACT

Laser powder bed fusion (LPBF), a subset of additive manufacturing, is a high-precision metal powder processing technique that has gained immense attentions in the past decade. The layer-by-layer densification technique provides a unique set of abilities that permits the large-scale production of geometrically complicated structures that simultaneously have highly tunable microstructures. Alloy 718 (718) is one of the most studied materials within the LPBF field due to its extraordinary printability. Although it has become an industrial-academic focal point, there are significant questions that still need to be addressed because of the immense design space offered by LPBF.

Our works demonstrate the multiple pathways that an alloy system like 718 can be optimized for specific applications by altering the processing parameters or by the addition of oxide particles to create a fine dispersion for high temperature capabilities. Room temperature tensile tests revealed that the processing parameters directly controlled the mechanical properties, allowing the tensile strength and elongation to be tailored to needs of specific applications. Similar experiments were conducted to exhibit the flexibility of LPBF by incorporating a wider, more economic, bimodal powder size distribution that maintained similar mechanical properties. Additions of oxide particles enabled the findings of the reactive nature within this welding process, which ultimately led to a refined oxide dispersion strengthened (ODS) 718 matrix with superior mechanical properties up to 900°C. This novel ODS alloy was lastly showcased by producing a complex microlattice structure to reveal an underlying crystallographic reorientation to control the deformation behaviors.

Date: Monday, July 17, 2023
Time: 2:00 P.M.
Place: ARMS 1028 or via this link: https://purdue.webex.com/meet/xzhang98

PURDUE UNIVERSITY | School of Materials Engineering