A Material Binning Approach to Laser Powder Manufacturing of Multi-Material Composition Structures

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Abstract

In this study, a novel multi-material powder binning method was implemented in a laser powder bed fusion (L-PBF) machine. This innovative approach involves dividing the powder material into discrete regions that remain separated during the powder spreading process. Thus, by using this technique, it is possible to rapidly screen various combinations of material composition with additive manufacturing (AM) suitable deposition parameters. Furthermore, this method allows for the creation of spatially graded structures or components with multi-material interfaces. The effectiveness of this approach was demonstrated using an EOS M290 L-PBF machine to print a range of materials including Steel (1018, 316, 17-4), Cobalt-Chrome (Co-Cr), and Nickel-based (Ni) alloys. Further, the above-mentioned concept was validated on Cu-based alloys using the Alpha 140 PBF platform. Tensile testing of multi-material interfaces was also carried out to relate deposition conditions to interfacial strength. Lastly, proof-of-concept parts for target applications using the multi-material binning approach are provided.

Biography of Presenter

Suyash Niraula is a Ph.D. candidate at the University of Louisville with the Berfield Research Group, where he does his research on the applied mechanics of materials and studies the residual stress of additively manufactured metals and materials. His current research also deals with the characterization of these materials. His prior research deals with studying the Electrolytic in-process dressing (ELID) grinding process. Suyash received his B.S. in Mechanical Engineering from Kathmandu University in 2016, and his M.S. in Mechanical Engineering from the University of Toledo in 2020.

Naiyer Shokri is a Ph.D. fellow at the University of Louisville with Berfield Research Group at the AMIST lab, where she studies the mechanical properties and characterization of additively manufactured NiTi implants. Her prior research deals with NiTi orthopedic implants' enhanced corrosion protection by highly crystalline hydroxyapatite deposited by spin coating. Naiyer received her B.Sc. and M.Sc. in Materials Science and Engineering from Sahand University of Technology in 2016 and 2019 respectively.