Foreword

Additive Manufacturing: Building the Pathway Towards Process and Material Qualification

The potential benefits of metal additive manufacturing, as compared with more traditional, subtractive-only approaches, has created excitement within design circles seeking to take advantage of the ability to build and repair complex shapes, to integrate or consolidate multiple parts and minimize joining concerns, and to locally tailor material properties to increase functionality. Tempering the excitement of designers, however, has been concerns with the material deposited by the process. It is not enough for a part to 'look' right from a geometric perspective. Rather, the metallurgical aspects associated with the material being deposited must 'look' and 'behave' correctly along with the aforementioned geometric accuracy. Without elucidation of the connections between processing, microstructure, properties, and performance from a materials science perspective, metal additive manufacturing will not realize its potential to change the manufacturing world for property and performance-critical engineering applications.

The intent of this symposium was to provide a forum for discussion of two very important topics in assisting metal additive manufacturing achieve its maximum application space: process qualification and material qualification. How can designers design parts if the properties of the material being deposited are not known, understood, and predictable? How can the properties of the material be predictable if the process is insufficiently controlled as a function of time or part geometry?

Encompassed within these larger questions are several smaller questions that constitute clear research plans. How can one ensure that the process used is consistently correct with deposition strategies employed by the designer? What are the linkages between processing parameters and feedstock materials with microstructure? How do the various microstructural features such as pores, lack-of-fusion defects, grain size variation, phase distribution, and precipitates interact with applied environments to yield certain properties and performances? The organizers of this symposium believe that the answers to these questions can be found through a combined in situ diagnostic, post-build characterization, and modeling approach.

The symposium entitled 'Additive Manufacturing: Building the Pathway to Material and Process Qualification' was held at the 2016 TMS Annual Meeting in Nashville, TN, USA, with approximately 60 talks and 20 posters presented dealing with subjects ranging widely from polymer- to metal-based feedstocks as well as machine design to material performance. Speakers came from across the world allowing for a truly 'global' meeting of the minds. This new and successful meeting could not have taken place without the sponsorship of the Mechanical Behavior of Materials Committee, Powder Materials Committee, Process Technology & Modeling Committee, Extraction & Processing Division, Structural Materials Division, Materials Processing & Manufacturing Division, and, finally, TMS.

The organizers for this symposium are grateful to all the participants and attendees for helping this symposium at a TMS Annual Meeting to be successful. A special appreciation from the organizers is expressed to those individuals who lent their talents to writing the publications in the following pages. All manuscripts within this special section in Metallurgical and Materials Transactions A were subjected to the standard peer review process. The organizers recognize and are appreciative of the sacrifice of time made by the reviewers and the staff of Metallurgical and Materials Transactions A in helping to bring this set of papers to publication.

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