Title and Research Team

Title: Modeling of Microstructure Formation in Additively Manufactured IN718

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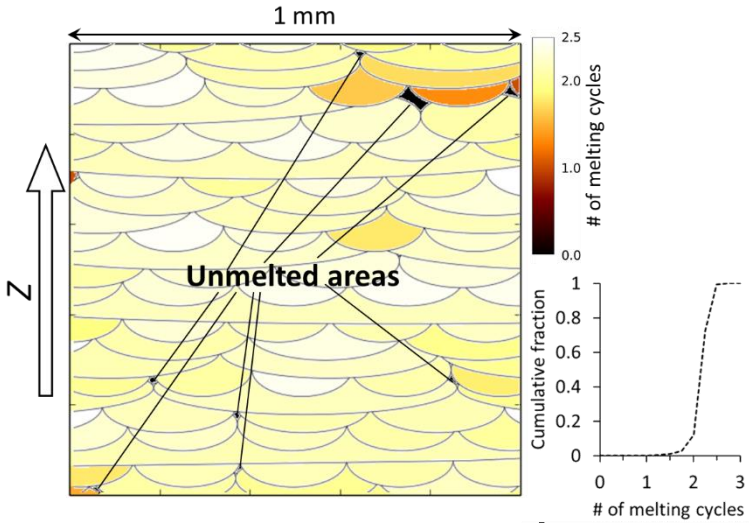
SOA: Models for por
and materials properti
currently lacking



Innovation

Implementation of new ideas for predicting the defect structure in additive manufacturing

Approach

- Three major components of the project:
- An incomplete melting model is based on scan geometry, powder layer thickness and melt pool dimensions
- A gas bubble in melts model that is based on a hybrid of the Potts model with the cellular automaton method
- A model for hardness that is based on combining a computational thermodynamics package, such as Thermo-Calc, with kinetics, e.g. from available TTT data, with thermal histories, measured or computed).

Research Objectives

- Demonstrate that our model for incomplete melting is valid for IN 718
- Demonstrate that grain-scale modeling of solidification with bubbles is valid for powder particle porosity
- lidate a model for hardness based on available ermodynamic, kinetic and cooling history data

The figure (left) illustrates how combining the shape and dimensions of the melt pool with the scanning geometry enables prediction of unmelted areas, which correlate with porosity.

TRL

- We expect to go from level 1 to level 4

Potential Impact

- Development of a validated model for 3D printing of IN718 parts with known porosity and strength will increase confidence in manufacturability via additive processes that use metal powders thereby enabling use in space science & exploration
- Major impact on metals additive because of the obvious need for specialized, low production volume parts
- Public dissemination of the models will allow for application to essentially all additive powder bed methods and materials.