AAMS 2025, Christian Haase

Presentation title:

Design of alloys for additive manufacturing via solidification-induced microstructure heterogeneities

Abstract:

Additively manufactured metallic components are heterogeneous on multiple length scales due to the layer-wise material deposition and process-inherent thermal conditions that strongly influence the underlying liquid-solid and solid-solid phase transformations. At the microstructural scale, multimodal grain structures, microsegregation and dislocation patterns are often considered detrimental. This presentation will show how such microstructural heterogeneities can be exploited for local microstructure control and alloy design.

For the design of new materials, this results in a high dimensional design space for the identification of optimal composition-process parameter combinations. Exploration of the design space requires fast yet robust methods. The use of high-throughput experiments and simulations to narrow down the possible solutions plays a key role. Furthermore, the data obtained can be used to apply machine learning methods to better understand the process-structure-property relationships and to identify optima via inverse design. To this end, a combination of high-throughput material synthesis using high-speed laser cladding, multi-scale material simulations and data-driven models will be presented and discussed.