Simulation for Additive Manufacturing
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Predictive Numerical Simulations of Processing Windows for Powder Bed Based Additive Manufacturing

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Additive manufacturing processes inhere the opportunity to tailor the properties of parts for specific requirements. These properties are strongly connected with the porosity, local composition and microstructure of the parts. Effects such as channel-like cavities with heights up to several millimeters, changes in the composition due to evaporation or anisotropic properties due to a textured microstructure may arise. These phenomena observed in experiments are combined into a processing window. Our simulation tool has the predictive capability to reproduce these effects. The results show the unique power of simulating macroscopic millimeter sized domains with a mesoscopic approach [2, 3]. This approach is capable of resolving the stochastic powder bed, the hydrodynamics of the melt pool and the microstructure evolution. Regular porosity, the stochastics of channel-like porosity, composition changes and grain structure evolution can be revealed simultaneously, which is not accessible with macroscopic setups.

The main objective of this work is to show the influence of stochastics on the final samples that trigger e.g. the evolution of channel-like cavities (as described by Bauereiß et al. [1]). The numerical investigation reflect the primary experimental results of sample processing windows of selective electron beam melted Ti-6Al-4V. This demonstrates the predictive capability of our simulation tool and simplifies the determination of suitable processing windows.

References

[1] A. Bauereiß, T. Scharowsky, and C. Körner. Defect generation and propagation mechanism during additive manufacturing by selective beam melting. Journal of Materials Processing Technology, 214(11):2522 – 2528, 2014.

[2] C. Körner, E. Attar, and P. Heinl. Mesoscopic simulation of selective beam melting processes. Journal of Materials Processing Technology, 211(6):978 – 987, 2011.

[3] A. Rai, M. Markl, and C. Körner. A coupled cellular automaton-lattice Boltzmann model for grain structure simulation during additive manufacturing. Computational Materials Science, 124:37 – 48, 2016.