6th European Conference on Computational Mechanics (ECCM 6)
7th European Conference on Computational Fluid Dynamics (ECFD 7)
11 – 15 June 2018, Glasgow, UK

COMPUTATIONAL SBM-BASED ADDITIVE MANUFACTURING

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Key Words: *Selective Beam Melting, Additive Manufacturing, Computational Methods.*

Selective beam melting (SBM) processes like e.g. selective laser melting (SLM) of polymers or selective electron beam melting (SEBM) of metals are additive manufacturing processes to successively build geometrically complex parts from thin layers of powder material. Due to the high energy of the beam extreme temperatures and temperature gradients occur, which may result in residual stresses upon solidification and eventually in distortions of the produced parts.

The aim of this contribution is the modelling and simulation of SBM-based additive manufacturing processes at the macro and the meso scale to predict transient temperature distributions during the process and to capture residual stresses in the produced part.

At the macro scale, we invoke a thermomechanical model, which accounts for temperature-dependent material behavior, phase-transitions between powder, melt and solid material, energy input by a moving heat source and thermo-viscoplastic material behavior.

For additively produced metallic materials, in particular, we will consider mesoscopic modelling and simulation using a gradient crystal plasticity model. When determining the resulting macroscopic material behaviour, the process-induced mesostructured carefully is taken into account based on experimental findings.

We compare our modelling and simulation results to a variety of experimental data from the CRC 814 “Additive Manufacturing” established in Erlangen [1-3].

REFERENCES

[1] Riedlbauer D.R., Scharowsky T., Singer R., Steinmann P., Körner C., Mergheim J., Macroscopic simulation and experimental measurement of melt pool characteristics in selective electron beam melting of Ti-6Al-4V, *International Journal of Advanced Manufacturing Technology* (2017), DOI: 10.1007/s00170-016-8819-6.

[2] Riedlbauer DR., Drexler M., Drummer D., Steinmann P., Mergheim J., Modelling, simulation and experimental validation of heat transfer in selective laser melting of the polymeric material PA12, *Computational Materials Science* (2014), DOI: 10.1016/j.commatsci.2014.06.046.

[3] Riedlbauer DR., Steinmann P., Mergheim J., Thermomechanical finite element simulations of selective electron beam melting processes: Performance considerations, *Computational Mechanics* (2014), DOI: 10.1007/s00466-014-1026-0.