Modelling and Simulation of Selective Laser Sintering of Polyamid 12 - Investigating the Quasi-Isothermal Assumption

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ABSTRACT

In powder bed-based additive manufacturing complex part geometries are realised in a layer-by-layer fashion via the fusion of powdered material in locally defined regions. For Selective Laser Sintering (SLS) of polymers this is accomplished by means of a local energy source in form of a laser beam. Simulating these manufacturing processes from a macroscopic point of view often leads to computational expensive models. Adaptivity methods in both space and time are therefore necessary to reduce the computational burden [2].

The SLS process is broadly understood as an quasi-isothermal process. During the building process the molten material remains as melt captured in the powder bed, until the whole part is built. This is known as operating within the so-called process window, i.e. working between the melting and the crystallisation temperature. Thereafter, the cooling stage is induced which leads to the crystallisation of the melt.

In the present study numerical and experimental data [1] of the temperatures, measured by a thermocamera and thermocouples, are used to gain a deeper understanding of the SLS process. It will be shown that the assumption of an quasi-isothermal process does not hold and that crystallisation may begin during the building process. Further, a geometry dependent adoption of process parameters is proposed to obtain homogeneous morphologies.

REFERENCES

[1] Drummer, D. and Greiner, S. and Zhao, M. and Wudy, K., A novel approach for understanding laser sintering of polymers. *Additive Manufacturing* (2019) **27**:379-388.

[2] Soldner, D. and Mergheim, J., Thermal modelling of selective beam melting processes using heterogeneous time step sizes *Computers and Mathematics with Applications* (2018).