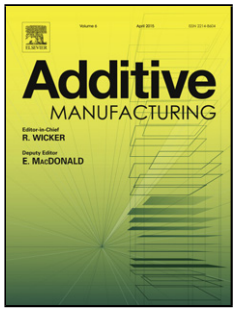

Title: Numerical modelling of the impact of energy distribution and Marangoni surface tension on track shape in selective laser melting of ceramic material

Authors: Qiang Chen, Gildas Guillemot, Charles-André Gandin, Michel Bellet

PII: S2214-8604(17)30467-0
DOI: https://doi.org/10.1016/j.addma.2018.03.003
Reference: ADDMA 299

To appear in:

Received date: 12-10-2017
Revised date: 29-11-2017
Accepted date: 2-3-2018

Please cite this article as: Qiang Chen, Gildas Guillemot, Charles-André Gandin, Michel Bellet, Numerical modelling of the impact of energy distribution and Marangoni surface tension on track shape in selective laser melting of ceramic material (2010), https://doi.org/10.1016/j.addma.2018.03.003

Numerical modelling of the impact of energy distribution and Marangoni surface tension on track shape in selective laser melting of ceramic material

Qiang Chen, Gildas Guillemot, Charles-André Gandin and Michel Bellet*

MINES ParisTech, PSL Research University,

CEMEF – Centre de mise en forme des matériaux, CNRS UMR 7635,

1 rue Claude Daunesse, CS 10207, 06904 Sophia Antipolis Cedex, France

Highlights

- A 3D finite element modelling of the SLM process at the track scale is considered.
- Heat transfer and fluid flow are simulated for different material and process conditions.
- The influence of energy input and Marangoni effect is tested.
- Scan speed, laser interaction and Marangoni effect have a clear impact on track shape.

Abstract: The present study is based on a formerly developed 3D finite element modelling of the selective laser melting process (SLM) at the track scale. This numerical model is used to assess the impact of two phenomena on the shape of the elementary track resulting from SLM processing: laser interaction on one hand, and Marangoni effect on the other hand. As regards laser interaction, it is modelled by a Beer-Lambert type heat source, in which lateral scattering and material absorption are considered through two characteristic parameters. The impact of these parameters is shown in terms of width and depth of melted zone. The Marangoni effect caused by tangential gradients of surface tension is modelled to simulate the fluid dynamics in the melt pool. The resulting convection flow is demonstrated with surface tension values either increasing or decreasing with temperature. The influence of energy distribution, surface tension effects, as well as laser scanning speed on temperature distribution and melt pool geometry is investigated. The stability and regularity of the

* Corresponding author

Tel.: +33 (0)4 93 95 74 61

Email address: michel.bellet@mines-paristech.fr