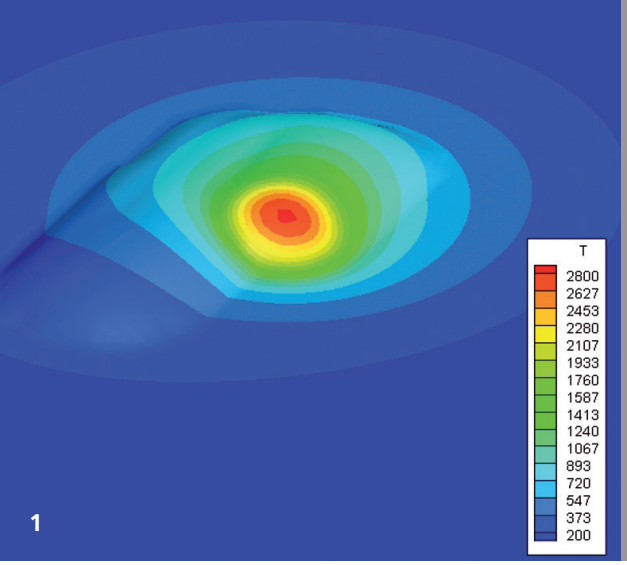
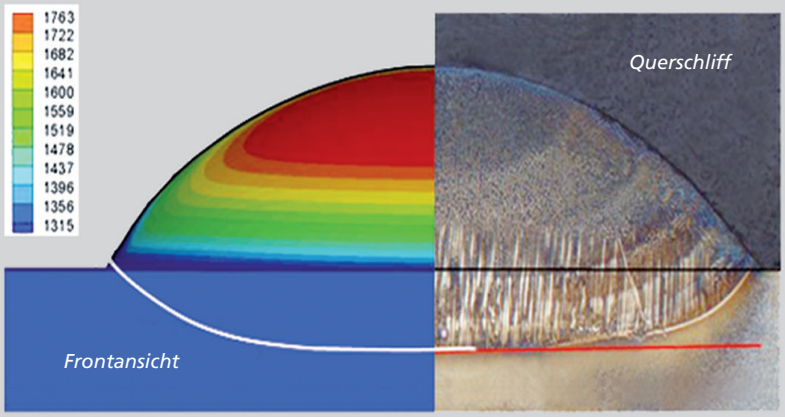


1



2

PROCESS SIMULATION FOR LASER METAL DEPOSITION

Task

For the powder-based Laser Metal Deposition (LMD), the current state of research and technology has not yet created a basic methodological approach that limits materials and components specific to process strategy and parameters so that experimental costs can be reduced significantly.

Therefore, a simulation tool for LMD should be created. With this tool, the user should be able to simulate a process under different process strategies and parameter settings for a concrete task in advance; based on these results, a process window should be narrowed down so that the remaining experimental development costs can be significantly reduced.

Method

LMD creates a free boundary problem mathematically, whose solution is based on integrating the transient heat conduction equation and the pressure balance equation. All the while, a mass balance must be taken into account with respect to the powder particles captured by the melt per unit of time. For the simulation tool, two modules have been created. With the first, the interaction of the particles with laser radiation is analyzed, and the transmitted laser radiation and particle temperature are calculated as input for the second module.

With the second module, the track geometry and the temperature distribution are time-resolved as a function of the process strategy and parameters, and the thermo-physical material properties are calculated (Figure 1).

Result

The simulation tool is currently in the validation phase, and initial comparisons show good agreement between experimental and theoretical results (Figure 2).

Applications

The simulation tool can be used for tasks that require a material and component-specific adaptation of the process control.

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1 Track geometry and temperature distribution.

2 Comparison of experiment and model calculations.

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