Chair of Metal Forming and Casting
TUM School of Engineering and Design
Technical University of Munich

Incremental Casting

Support Material and Close-Loop Control of Layer Height for Direct Metal Printing with Aluminium – Project Continuation

Motivation

"Incremental casting" is the name of an additive manufacturing process that has been studied for several years at the Chair of Metal Forming Casting (utg) at the Technical University of Munich (TUM). In the first part of this DFG project, water-soluble support structures made of salt were produced for the first time for the droplet-based additive manufacturing (Material Jetting; MJT) of metals. Figure 1 shows an additively manufactured aluminum part with an overhang. The overhang is supported by a monolithic salt support structure.

Figure 1 Aluminum component with monolithic salt support structure. Height of the component: approx. 5 mm.

The low thermal conductivity and high solidification shrinkage of salts limit the height of monolithic salt support structures. The use of salts only as a thin release layer minimizes the influence of the thermophysical properties of the salt on the process. In this continuation of the project, release layer support structures made of salt in MJT will be investigated. Figure 2 shows monolithic support structures (left) compared to release layer support structures (right).

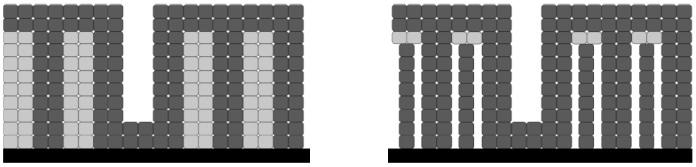

Figure 2 Monolithic salt support structure (left) and release layer support structure (right). The use of salts only as a thin release layer minimizes the influence of the thermophysical properties of the salt on the process.

Both the first part of the project and the continuation of the project are done in collaboration with the Chair of Microtechnology and Medical Device Technology (MIMED) at TUM. In the first part of the project, MIMED created the basis for geometric deviation compensation by implementing a height sensor and coupling it with the printing parameters. In principle, the droplet size control now also allows the local adaptation of the droplet size in the component, e.g. for better realization of component features. Furthermore, the implementation of an inline calibration for the identification of optimal start parameters is imaginable. Both points are investigated as part of the project continuation.

Approach

First, utg will carry out a process simulation in order to show the limits of monolithic support structures and to determine reasonable release layer thicknesses. Subsequently, the focus will be on the process development of the interface support structure. For this purpose, aluminum components are printed-on with salt at different parameters and the adhesion is characterized mechanically. Finally, test specimens are printed on salt and then subjected to tensile tests to determine their mechanical strength. MIMED will first develop the inline calibration to identify optimal starting parameters. In order to investigate the droplet size variation in the component, an algorithm is developed which, starting from STL files, generates G-code with a selectable droplet size. Finally, parts with variable droplet size are investigated with respect to their geometry and mechanical properties.

Outlook

The implementation of this project will extend the 3D capability of metal MJT and enable a more detailed part geometry as well as a more stable process.

Benedikt Kirchebner, M.Sc.
Walther-Meißner-Straße 4
85748 Garching
GERMANY

Tel. +49 89 289 14 539
Fax +49 89 289 13 738
benedikt.kirchebner@tum.de
https://www.mec.ed.tum.de/en/utg/

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