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 by the Chair of Metal Forming and 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. A monolithic salt support structure supports the overhang.

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 the second part 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).

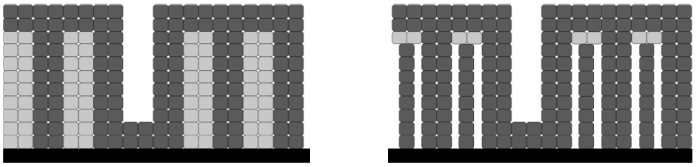

Figure 2 Monolithic salt support structure (left) and release layer support structure (right). The use of salts only as a thin release layer minimizes the influence of the thermophysical properties of the salt on the process.

Both the project's first and second part is a 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 in the second part of the project.

Approach

First, utg will conduct a process simulation to show the limits of monolithic support structures and 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 imprinted with salt at different parameters and the adhesion is characterized mechanically. Finally, test specimens are printed on salt and subjected to tensile tests to determine their mechanical strength. MIMED will first develop the inline calibration to identify optimal starting parameters. An algorithm is developed to investigate the droplet size variation in the component. Starting from STL files G-code with a selectable droplet size is generated. Finally, parts with variable droplet sizes are investigated concerning their geometry and mechanical properties.

Outlook

The implementation of this project extends the 3D capability of Incremental Casting and enables a more detailed part geometry and a more stable process.

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