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Additive manufacturing of copper materials via material jetting (MJT)

Final Report

Motivation

The processing of pure copper, which is mainly used due to its thermal and electrical properties, has so far proven to be problematic in additive manufacturing processes. Currently, processes that are classified as powder bed fusion in accordance with DIN EN ISO 17296-2:2016 are the most common. The lasers used in industry mostly work in the infrared range, in which pure copper only has a low absorption coefficient. The additive processing of copper materials using the material jetting process offers potential advantages in terms of construction speed as well as semi-finished product and system costs. In material jetting, a wire-shaped semi-finished product is melted in a print head and dispensed droplet by droplet onto a build platform, where it solidifies. The component is built up layer by layer through the defined deposition of droplets.

Approach

At the beginning of the research project, a print head and a heated construction platform were developed. Various materials for the crucible and the nozzle, which are essential for droplet generation, were investigated. The system set up was used to produce test specimens at various process parameters. The test specimens were then characterized in order to identify the influence of the varied parameters on the component properties. In addition, a simulation model was set up to model the process virtually and a system-specific slicer was developed.

Results and Outlook

The project was able to demonstrate the processability of copper materials using material jetting. It was shown that the properties of the printed components, such as the relative component density, the surface quality and the mechanical characteristics, depend significantly on the thermal process variables during drop deposition. Figure 1 shows two components produced by MJT from technically pure copper and a copper-tin bronze.

Figure 1: Components made from technically pure copper and a copper-tin bronze using the MJT process.

Publications

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Partnerships

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