School for Additive Manufacturing

iPeG Institut für Produktentwicklung & Gerätebau

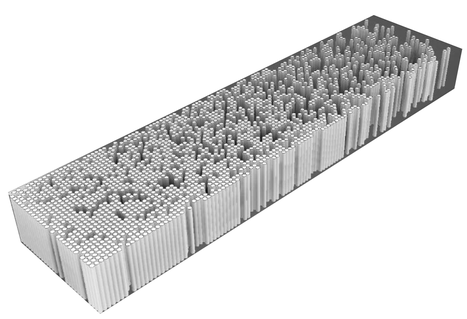
Additive Manufacturing of Metallic Multi-Material Parts:
Local Conductivity Adjustment through Functionally Graded Material Transitions of 316L and CuCrZr

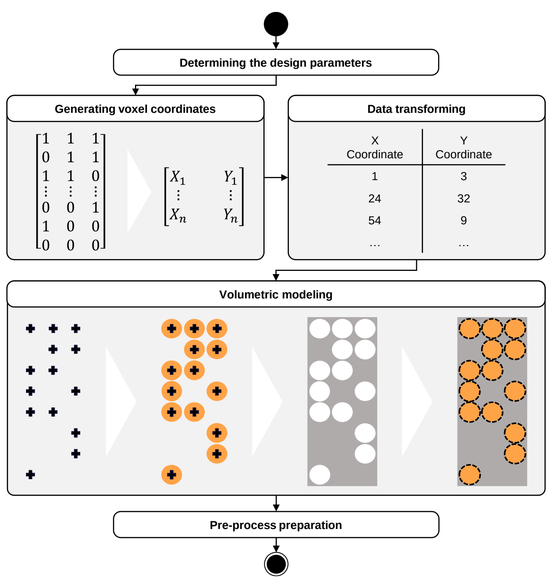
Motivation and Goal

Precise adjustment and control of physical properties by varying material ratios by

- Deriving a method to model specimens of functionally graded materials (FGM)
- Verifying the manufacturability of FGM specimens using powder bed fusion of metals using a laser beam
- Increasing electrical conductivity by heat treatment

Methods and Materials



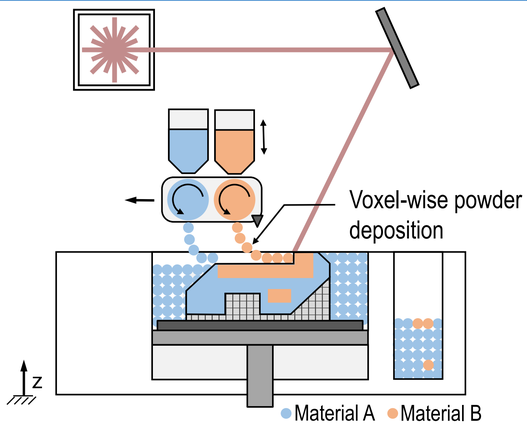


- Materials used: 316L/ CuCrZr
- Methodological generation of different FGM specimens
- Electrical conductivity measurement according to eddy-current-method (FOERSTER Sigmatest 2.069)
- Two-stage heat treatment (solution annealing and age hardening) to increase conductivity

Experimental Setup

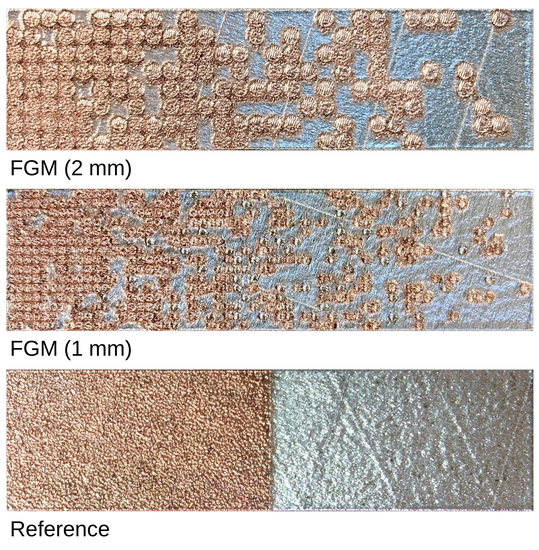
Aconity MIDI+ with integrated multi-material Aerosint SPD Recoater V1.0

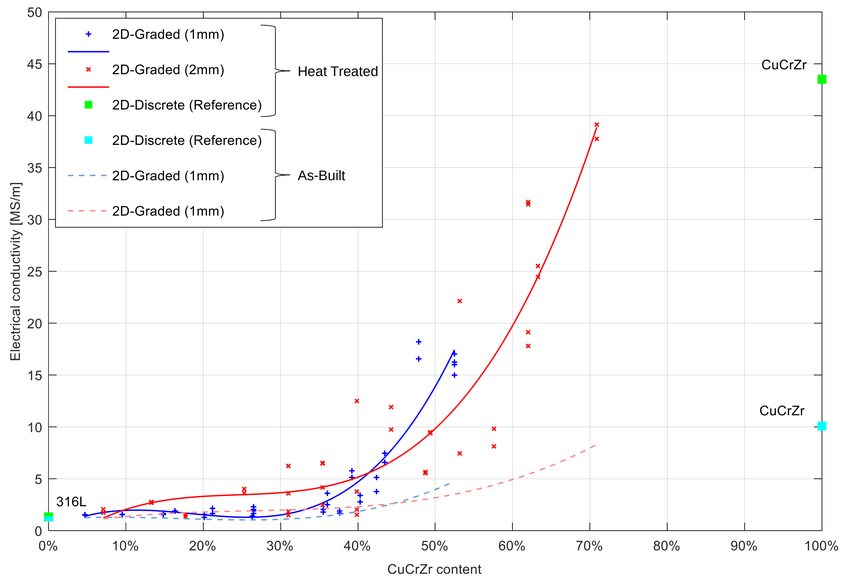
- Specimen size: 60 x 15.4 x 4 mm³
- Laser power: 150 W (316L), 500 W (CuCrZr)
- Scan speed: 600 mm/s (316L), 550 mm/s (CuCrZr)
- Focus diameter: 80 µm
- Voxel size: 500 µm
- Layer thickness: 40 µm

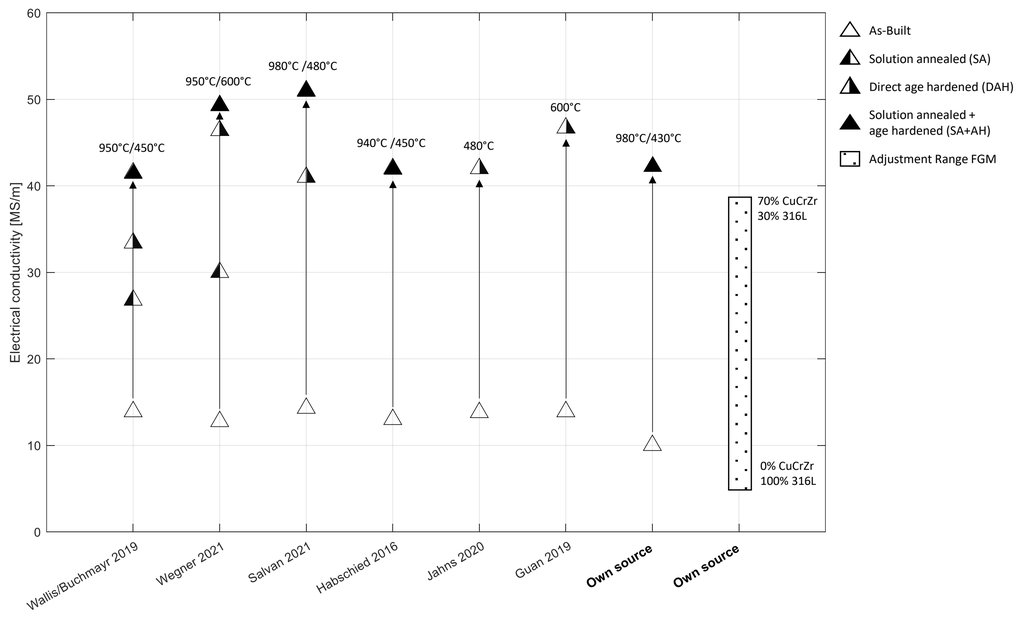


Multi-Material PBF-LB/M Process

Results







- Adjustment of the electrical conductivity by varying the material ratios
- Conductivity increases with increasing copper content from 1.3 MS/m up to 8.6 MS/m (as-built, voxel size: 2 mm)
- A two-stage heat treatment leads to a four-fold increase in electrical conductivity (from 10,1 MS/m up to 43,5 MS/m)

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