Investigation and Improvement of Processing Parameters of a Copper-Filled Polymer Filament in Fused Deposition Modeling as a Basis for the Fabrication of Low-Porosity Metal Parts

E. Moritzer[1], C.L. Elsner[1,2,*]
[1]*Paderborn University, Kunststofftechnik Paderborn (KTP), Warburger Straße 100 – 33098 Paderborn, Germany*
[2]*Paderborn University, Direct Manufacturing Research Center (DMRC), Mersinweg 3 – 33100 Paderborn, Germany*

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Abstract.
Additively manufactured metal components are increasingly used in industrial environment for the production of complex geometries, small series or individualized products. One possibility to manufacture such metal components is the Fused Deposition Modeling (FDM) process. Here, a metal powder-filled polymer filament is processed (green part). For the realization of purely metallic components, the FDM-manufactured components are subjected to a post-process, which corresponds to the Metal Injection Molding (MIM) process chain. In a first step, the polymer binder contained in the components is removed (brown part). Afterwards, the metal particles are sintered (white part). For the production of high-quality components, the porosity of the components must be considered. Essentially, the porosity of the components results from the characteristic FDM structure caused by the deposition of single strands. This has a direct influence on the porosity of the white parts and accordingly on the resulting part properties. Within this study, a filament consisting of copper particles and a polymer binder matrix of polylactide acid (PLA) is used. This filament offers the possibility to produce complex, thermally conductive and electrically conductive components. During the examinations, the influence of the FDM-specific process parameters on the manufactured green parts is investigated. For this purpose, the stationary and non-stationary extrusion areas will be considered. The aim is to achieve a homogeneous strand geometry and thus the highest possible part density. This should lead to the reliable processing of copper-filled polymer filaments in FDM and provide a good basis for the production of pure copper components.