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Optimization of post-processing parameters for enhanced characterization in metal extrusion 3D printing of copper-polymer composites

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Abstract	The high costs associated with metal additive manufacturing methods including expensive feedstock, energy-intensive lasers, and controlled environments have limited their widespread adoption in industries like aerospace and automotive, despite powder bed fusion success in producing intricate and high-precision components. As a cost-effective alternative, material extrusion 3D printing enables the fabrication of metal-polymer composites using simpler equipment. However, challenges remain in optimizing post-processing parameters to enhance mechanical performance and microstructural integrity. This study focuses on improving the post-processing of copper-filled PLA parts fabricated with an Artillery Sidewinder X1 material extrusion printer. A Taguchi design of experiments approach using an L8 orthogonal array was employed to investigate the effects of debinding time, sintering time, and layer thickness. Results showed that shorter debinding compromised structural integrity in 25% of samples, while optimized settings achieved a 30.59% shrinkage and a 12.5% hardness increase. These findings highlight the significance of proper thermal post-processing in controlling dimensional changes and improving part quality.
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Data is provided within the manuscript or supplementary information files.

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