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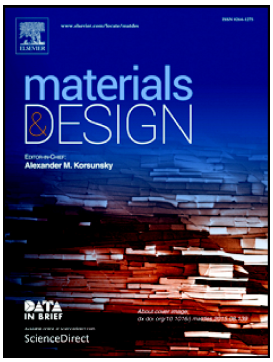

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3D printing of large, complex metallic glass structures

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ABSTRACT

Metallic glasses (MGs) or amorphous alloys although have superior mechanical properties their products are limited to simple geometries such as foils/plates or rods with thin section-thickness due to the requirement of high cooling rates. In this study, 3D, large dimensions of amorphous structures with complex geometry are manufactured by our newly developed Laser Foil Printing (LFP) technology. Zr-based (LM105, provided by Liquidmetal Technologies, Inc.) amorphous foils of 100 μm thickness are used as feedstock, and they are laser welded, layer-by-layer, to become 3D amorphous structures. Test results by X-Ray diffraction (XRD), differential scanning calorimetry (DSC), and micro-hardness confirm that the printed structures at selected process parameters achieve the same or better degree of amorphization as the raw foils. A mathematical model was developed to calculate the heating and cooling rates during structure manufacturing which helps the selection of process parameters. This study expands MG products to 3D arbitrary geometries with large dimensions due to the inherited advantages of the LFP technology which would open many potential applications.

Keywords:
Bulk metallic glasses (BMGs), amorphous alloys, additive manufacturing, 3D printing, rapid prototyping, layer manufacturing.