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Direct Ink Writing of Complex 3D Structures from Titanium Alloy

Abstract:

Titanium alloys are popular in aerospace and biomedical industries due to their low cost and high strength-to-weight ratio. These alloys are conventionally manufactured using CNC machining, casting, and additive manufacturing techniques such as powder bed fusion and direct energy deposition. These 3D printing techniques repeatedly expose manufactured parts to heating and cooling cycles that result in residual thermal stress causing the printed parts to have poor mechanical properties, moreover, they require high energy inputs which result in expensive production costs. A direct ink writing technique was developed to overcome these challenges, enabling cost-effective and straightforward manufacturing of titanium parts at room temperature. This technique also facilitates the printing of self-supportive inclined tubes at various angles, offering the possibility of printing more intricate 3D structures in the future such as producing titanium turbine blades, wing brackets, and other aerospace components used in aircraft and spacecraft.