

Cold Spray and Friction Stir Processing: A Novel Hybrid Additive Manufacturing of Aluminum 6061-T6 alloy

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Abstract

This study suggests a novel strategy to get beyond the drawbacks of conventional fusion-based additive manufacturing (AM) techniques, which are restricted by weak bonding and inferior mechanical strength as a result of material melting and solidification. The suggested procedure combines cold spray (CS) and friction stir processing (FSP), two solid-state fabrication processes, to create an aluminum 6061-T6 alloy (Al-6061) build. To achieve uniformity, the initial material build-up is accomplished with CS, while the final consolidation and thermomechanical deformation are achieved using FSP. The final Al-6061 AM build demonstrates higher microstructural quality and refined microstructure, resulting in superior mechanical properties including significantly increased impact toughness and tensile ductility, even in the build direction. The FSP method results in grain refinement and stronger bonding due to considerable plastic deformation and complicated material flow. This hybrid AM process has the potential to enhance the mechanical properties and load-bearing capacity of AM-fabricated parts, providing a feasible solution to the problems with traditional AM methods.

Keywords: Additive manufacturing; Cold spray; Friction stir processing; Grain refinement; Impact toughness; Mechanical properties.