Additive Manufacturing of Aluminum Alloy by Metal Fused Filament Fabrication (MF^3)

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Abstract

This research investigated additive manufacturing of Al-6061 aluminum alloy via metal-fused filament fabrication (MF3). This work focused on using the MF3 process to fabricate Al-6061 test coupons and optimize the MF3 process parameters to obtain improved mechanical properties. Feedstock with 57 vol.% solids loading Al-6061 was prepared by mixing Al-6061 powders and a polymer binder, followed by extrusion to fabricate a filament with a 1.75 mm diameter. The 57 vol.% Al-6061 powder-polymer filament was used to print green tablets and tensile bars with a Prusa MK3S+ 3D printer. Experiments were designed to optimize the 3D printing process parameters to obtain parts with the highest green densities. The green parts were subjected to solvent debinding, thermal debinding, and, finally, sintering processes to remove polymer content and become dense Al-6061 tablets and tensile bars. The sintered parts were characterized for grain structure, sintered density, and mechanical properties, and their prosperities were compared to metal injection molded (MIM) specimens. This work aims to enable rapid, predictable, reproducible, low-cost, and accurate production of metal parts with 3D features, thereby significantly expanding the current additive manufacturing capability.

Biography of Presenter

Sihan Zhang is a PhD candidate at University of Louisville in Dr. Atre and Dr. Kate's Materials Innovation Guild. He received his MS degree from Arizona State University and BEng degree from Zhejiang University. He is currently working on developing Metal Fused Filament Fabrication (MF3) technology. His current research focuses on applying Al alloy in MF3 process for metal additive manufacturing. He plans to work in additive manufacturing industry to develop materials and processing after graduation.