Investigation of the Selective Laser Melting Process for AlSi10Mg and Al-Mg-Si alloys Fabricated at High Laser Power

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Abstract

Selective Laser Melting of AlSi10Mg and Al-Mg-Si (AA6061) alloys is challenging in producing sound parts due to low powder flowability and high thermal conductivity of aluminum alloys. 3-D printing in machines with higher laser powers creates new microstructures, which are not fully understood. This project investigates aluminum powders printed parts using laser ranging from 200 to 350 Watts. The research objective is to establish the relationship between laser power and the resulting microstructure obtain using Renishaw AM400 unit. 10 mm x 10 mm x 10 mm solid cube samples were printed from AlSi10Mg and Al-Mg-Si powders with variation in laser power, point spacing, and dwell time. Density of each sample was determined using the Archimedes method and light optical microscopy. Metallographic analysis determined optimum build parameters and characterized the melt pool boundaries and porosity formed in the SLM process using light optical microscopy. Microhardness tests were performed to determine mechanical properties.

Introduction

Additive manufacturing (AM) is a manufacturing process where near-net dense, three dimensional components are fabricated, traditionally in a layer-by-layer method. Numerous AM technologies exist today; this project incorporates Selective Laser Melting (SLM), which falls into the category of powder-bed fusion (PBF). AM technologies offer greater potential in resource utilization, freedom of design, and reduction in toxic chemicals, but has mainly been used in research and design and product development rather than production due to its slow manufacturing speeds. New technologies like SLM are slowly enhancing production capabilities due to its ability to manufacture complex components from computer-aided design (CAD) models in a variety of different materials. [1]