Properties of Binder Jet Aluminum 6061 Sintered by Continuous Belt Furnace

Nicholas Murphy, Miranda Moschel, James Taylor, Joe Croteau
Kymera International/SCM Metal Products, Inc.
Research Triangle Park, NC

Special thanks to our colleagues at ExOne
North Huntingdon, PA

Abstract

Metal binder jet printing is expected to greatly increase in market value in the coming years, and a key player in the development of binder jet technology is aluminum. Prized for its excellent strength to weight ratio and low cost, aluminum has been proven to be viable for use in binder jet printing. What follows is a review of mechanical performance of binder jet aluminum 6061 parts printed and sintered at Kymera International RTP in the as-sintered state, the T4, and the T6 heat treatment condition. We will also quantify the distortion behavior of Al6061 parts that occurs during sintering.

Introduction

Additive manufacturing (AM) processes have revolutionized the manufacturing industry by enabling the production of complex geometries with reduced lead times and material waste. Among various AM techniques, binder jetting (BJ) has gained attention due to its potential for higher throughput than laser AM technologies. Aluminum alloys are highly desirable for many applications owing to their excellent mechanical properties, lightweight nature, and corrosion resistance. Aluminum 6061 (Al6061) is a particular alloy of aluminum with added Mg, Si, Cu, and Cr that is used widely in aerospace, automotive, and other structural applications [1]. Al6061 is traditionally used and found in wrought form, but it has been demonstrated to be suitable for metal binder jet printing. It achieves near full density upon sintering and has binder jet properties comparable to that of the wrought material.

In this paper, we present the mechanical properties of Al6061 parts binder jet printed at Kymera International RTP and sintered in a continuous belt furnace. Parts tested will be in the as-sintered, T4, and T6 heat treat conditions. We will also be examining the distortion behavior of Al6061 binder parts and discussing factors that contribute to distortion during sintering.

Method

All printing took place on an ExOne Innovent printer (enclosed in an Inert glovebox filled with N_2 gas) using ExOne's solvent based FluidFuse binder. Three basic specimens were manufactured for testing: a rectangular transverse rupture strength (TRS) bar, a dog bone style