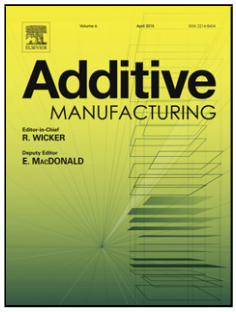

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Novel Method for Additive Manufacturing of Metal-Matrix Composite by Thermal Decomposition of Salts

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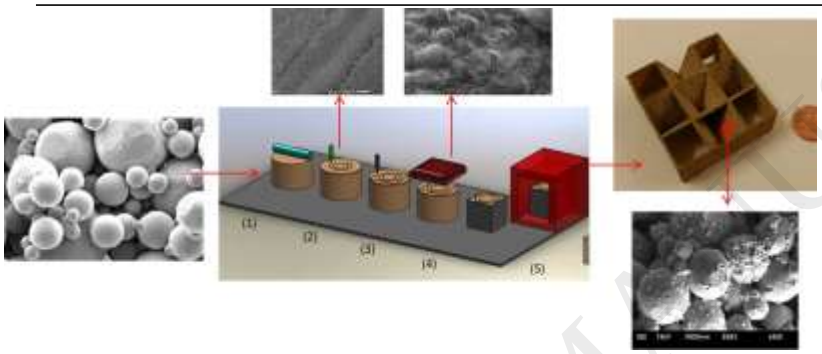
Graphical Abstract



Abstract

Very limited Additive Manufacturing (AM) processes have been developed for production of Metal Matrix Composites (MMCs) reinforced by ceramic. Most of these processes use different mixing techniques to mix metal and ceramic powder particles in order to be used in an existing AM process such as Selective Laser Melting (SLM) process. The current AM techniques for MMCs fabrication have limitations due to material mixing and the AM process limitations itself. This paper introduces a novel AM method for fabrication of MMCs by Thermal Decomposition of Salts (TDS). In this method inorganic salts are printed on metal powder bed to fabricate green part. The green part undergoes bulk sintering. During bulk sintering the printed inorganic salts are decomposed to fine ceramic particles to form MMC. This process is capable of generating MMC structures with uniformly distributed and dispersed ultra-fine ceramic particles in the metal matrix with less limitations and lower cost compared to other existing AM techniques. In this paper, bronze-alumina MMC was fabricated and studied by the TDS process to validate the proposed process. It was also shown that the TDS process can be used to fabricate other types of MMCs besides bronze-alumina due to the nature of the process. Design of Experiments methodology was used to study and model the effects of sintering parameters on the properties of the bronze-alumina fabricated by the TDS process. Due to MMCs unique properties combined with AM benefits, this novel method will be of great interest to various industries such as aerospace applications.

Keywords: Additive Manufacturing; Metal Matrix Composite; Ceramic Reinforcement; Sintering.

INTRODUCTION

Fabrication of metallic parts by Additive Manufacturing (AM) techniques have been of great interest to various industries in recent years. According to 2018 Wohlers Report, in the last five years there has been an 875% growth in sales for AM machines that are capable to fabricate metallic parts [1]. Due to this recent increase in demand,