Advancements in metal binder jetting of pure Cu

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ABSTRACT

Additive manufacturing of pure copper has been gaining attention from different industries in the consumer, automotive and industrial sectors. Pure Cu components manufactured with traditional methods offer excellent thermal and electrical conductivity, but their performance can be further enhanced with 3D printing by optimizing part geometry, gaining higher effective performance, weight savings and reduced material waste.
Metal binder jetting (MBJ) allows the production of pure Cu isotropic parts with high conductivity. During printing, a binder is deposited layer by layer on a powder bed at room temperature, allowing the excess powder to be fully recirculated. The part properties are achieved during sintering, where densification occurs.
In order to achieve high levels of thermal and electrical conductivity, it is necessary to rigorously control the powder contamination levels and to achieve a high final component density. Hot isostatic pressing (HIP) can further boost the component performance thanks to porosity-free parts and marginal grain growth.
In this paper, we present the advances of MBJ production of high conductivity parts in the as-sintered state and with HIP post processing, modeling their electrical and thermal conductivity based on density, chemical and metallographic analysis.

INTRODUCTION

The additive manufacturing of pure copper (Cu) has a great potential due to the combination of excellent thermal and electrical conductivity of such material with the freedom of design enabled from additive manufacturing . While the high conductivity of pure copper is common for all the pure products, independently from the manufacturing technique, the freedom of design enables optimized components, with focus on enhanced performances and weight reduction [1,2].
Potential fields of applications for Cu additive manufactured components are heat exchangers [3], rocket engine components with intricate cooling channels [4] and antennas for special applications [5]. To fully unlock the additive manufacturing potential, these components need to be reproduced reliably and include