Characterisation of triboelectrically charged additive manufacturing metal powders using the rotating drum technique

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ABSTRACT

Some of the key factors in the success of powder bed fusion technique in additive manufacturing are the quality of powder feedstock and a uniform powder bed layer. The latter, which is essential in obtaining high-quality build part, is dictated by the powder flowability. There is evidence that steps prior to fabrication, such as shipping, may alter the flow characteristics of the powders. Considering that no significant surface chemistry change should be occurring during the transport due to minimal oxygen and moisture exposure (Ar packaging), it is likely that other factors such as triboelectric charging from frictional contact could affect the powder. In this regard, the rotating drum technique was utilized to investigate the dynamic behavior of IN625, Ti-6Al-4V and SS316L for various simulated shipping conditions. The dynamic angle and cohesive index of the powders were investigated using the GranuDrum^{TM} instrument with a newly designed plastic cell avoiding charge neutralisation. Relationships correlating the charged powder behavior on spreadability will be presented.

1. INTRODUCTION

For the past 20 years, additive manufacturing (AM) has been around and still increasingly becoming popular due to its design flexibility allowing fabrication of complex geometries, with no tooling requirements. Among the most popular is the laser powder bed fusion (LPBF) technology which is a layer-by-layer deposition of powder bed, fused using a laser heat source until a pre-programmed geometry is complete [1]. The success of a build in LPBF-AM relies in part on the powder feedstock quality which entails good spreadability - even spreading and high packing density. Interestingly, the powder flow behavior can change within the various processing steps leading to a part: upon atomisation, during transportation, its storage and even when inserted in the silo. Understanding the complexities of the powder feedstock and its evolving behavior remain a significant challenge in LPBF.

Several standard methods are currently being employed to characterise the powder feedstock such as the Hall/Carney funnel flow, Hausner's ratio, apparent density measurements, rotating drum technique, etc. These techniques help define the main features of the metal powder and many of these tests are applied on