METALLIC POWDERS THERMAL DEGRADATION: INFLUENCE ON SPREADABILITY, PACKING DYNAMICS AND ELECTROSTATICS

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Abstract
Regarding raw materials characterization, few relevant measurement methods are available in the market to answer the needs of Additive Manufacturing (AM). Indeed, the stress state (ambient and/or thermal) and the flow field of the powder should be comparable in the measurement cell and in the process. With this information in mind, GranuTools has developed a workflow for powder characterization. Our main goal is to have one instrument per geometry that mimics the process. In the present paper, we have shown how this range of instruments can be used to follow the quality evolution of a powder after several printing processes. First, the standard aluminium alloys are selected and placed under different thermal stresses. The powders spreadability (GranuDrum Instrument), the packing dynamics (GranuPack Instrument) and the electrostatic behaviour (GranuCharge Instrument) were then analysed. This analysis is showing that it is possible to monitor thermal degradation by analyzing the ability of the powder to build-up electrical charge. Indeed, on one hand, a low Cohesive Index is observed for a powder easy to spread and a fast packing dynamics yield a mechanical piece with a lower porosity. However, on the other hand, the powders with high cohesive index at ambient temperature are showing better spreadability and high compaction after thermal degradation, which is highly desirable for the AM.

1. Introduction

Products mass productions are migrated towards the developing countries. Therefore, European and US manufacturer companies have compulsion to rapidly switch towards the more innovative, sustainable, and customized products. To compete in such turbulent environment, producers have attempted to find new fabrication techniques for increased flexibility and to enable economic low volume production. One such emerging technique is Additive Manufacturing (AM)[1, 2].
In AM processes, adding one by one superfine layer at a time creates a three-dimensional object. Therefore, the term AM implies adding material to create the object. In contrast, if an object is created by classical means, it is often necessary to remove material through milling, machining, etc. However, despite AM is more economic than classical machining. In most cases, only a small proportion of powder that is laid down in a build process are welded into a component. The rest is then unfused and consequently available for reuse. Nonetheless, powders properties should be the first considerations are they govern machine parameters[3]. Indeed, if we consider the unfused powder as contaminated and not adapted for reuse, the cost of AM will not be economic enough. Powder deterioration results in two phenomena: