Paper ID: 88135
oral
student

IAF MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Advancements in Materials Applications, Additive Manufacturing, and Rapid Prototyping Manufacturing and Rapid Prototyping (8)

Author: Mr. Davide Zuin
Politecnico di Milano, Italy

Mr. Simone La Luna
Politecnico di Milano, Italy
Ms. Ludovica Cavallucci
Politecnico di Milano, Italy
Dr. Filippo Maggi
Politecnico di Milano, Italy

ADDITIVE MANUFACTURING OF SPACE PROPULSIVE COMPONENTS: CHARACTERIZATION OF IN718 POWDER RECYCLING ON FINAL SAMPLE PROPERTIES

Abstract

The recent proliferation of Additive Manufacturing (AM) in the space sector has been significant, primarily due to the possibility of printing complex shapes that would not be feasible with conventional methods. However, standardization of these productions is necessary, particularly when dealing with critical parts such as space propulsion components, where quality assurance is mandatory. This necessity becomes even more pronounced if the feedstock consists of recycled metal powder, whose properties may be altered by previous recycling cycles. Feedstock recycling process can be convenient for environmental footprint reduction and cost savings, although criticalities caused by potential changes in the material shall be controlled. Quality assurance analyses by means of printing verification campaigns allow to comprehend these alterations and their effects on the manufacturing of the final samples. As a result, full knowledge of the supply chain process verification becomes pivotal to ensure that the resulting printed objects meet the established manufacturing requirements.

The present work focuses on the characterisation of recycled Inconel 718 (IN718) powders and samples printed through Selective Laser Melting (SLM). The work is based on the evaluation of a design of experiment (DoE) exploring the manufacturing cycle of space propulsive components. The work starts with an overview of the machines and the facility implemented in the DoE; then, details on the involved tailoring process for AM of propulsive components is presented. A resume of the powder supply chain is highlighted as well, while the identification of specific samples aimed at the tracking of properties modifications through recycling steps is proposed. Through the recycling of the powder up to 11 recycling steps, samples characteristics and modifications are detailed such as dimensional errors, surface roughness values, internal channel cleanliness variations and others. By means of mechanical samples, variations on the metallurgical sample properties, such as tensile values and inner porosities percentage, are tracked as well.

The results of dimensional error analyses show slight deviations with respect to the expected set of tolerances. On the other side, surface roughness measurements on inclined surfaces show that changes in the microscopical deviations are limited and consistent with thermal and "staircase" effects on overhanging surfaces, even though the feedstock has been reused for a significant number of times. Nevertheless, coherent yet unpredictable trends linking the measured average surface roughness on the inclined surfaces and the printing cycles are observed and detailed.