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SURFACE ENGINEERING FOR METAL PARTS MADE BY ADDITIVE MANUFACTURING

Abstract

In the frame of ESA's General Support Technology Programme (GSTP 6 E. 1 Clean Space Initiative), focus was set on the surface preparation of metal parts made by additive manufacturing (AM). AM is a process in which parts are built layer by layer, thus skipping the conventional casting and machining steps. Various materials are concerned, from plastics (PEEK, ABS, PC...) to metals (aluminum, titanium, stainless steel...) or even ceramics (Al2O3, TiC, SiC...). AM raised a significant interest in the space community due to the versatility of the method. Indeed, it can produce complex shapes (heat exchangers, RF supports, optical parts...) with integrated functions; like conformal cooling channels, clips, hinges, etc. Another advantage is the customizable material composition, i.e. functionally graded materials, which could not be made using standard methods. This opens the door for lightweight parts which are of prime importance for space applications.The potential of the AM technologies is however impeded by the quite rough surface finish that is observed on the as-manufactured material. It is known that such a finish is likely to impact the performance of the parts but the influence of the successive post-processing steps on the final properties is not well established.

Therefore, a better understanding of the impact of surface characteristics on the material behaviour is needed to expand the use of AM for high performance parts. The objective of the study, supported by ESA, is to propose and evaluate various surface finishing techniques for parts made by the AM technologies, in

order to check their compatibility, evaluate their properties and derive guidelines for future applications. The study focuses on metal.

This paper is devoted to the early results of the first steps of surface preparation, namely material removal from the surface of the produced parts. As a first phase, several mechanical and chemical surface finishing techniques (e.g. tribo-finishing, chemical etching...) were evaluated. Some surface parameters were analyzed like achieved roughness, material removal rate, etc., as well as limitations in terms of geometry and applicability. Then, the selected methods were tested on prototype parts to check their capabilities.