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ADDITIVE LAYER MANUFACTURING OF POLYMERIC NANOSAT: AN HOLISTIC APPROACH

Abstract

The recent improvements in additive layer manufacturing (ALM) have provided new designs of geometrically complex structures with lighter materials and lower processing costs with respect to conventional manufacturing technologies. The use of additive manufacturing in spacecraft production is opening up many new possibilities in both design and fabrication, allowing for the reduction of weight of the structure subsystems, particularly in view of the incoming production of the constellations of micro/nanosatellites (nanosats). In this aim, polymeric ALM structures can become a choice, in terms of lightweight and demisability, as far as good thermomechanical properties can be assured. The choice of the material is, however, a crucial step of the process, as the final performance of the printed parts is strongly dependent on three pillars: design, material and printing process. The work was aimed to emphasize the importance of a holistic approach to reach the final goal. Two thermoplastic materials (i.e. polyetheretherketone PEEK and polyetherimide PEI) has been evaluated as possible candidates (according to ECSS-70), to highlight the influence of the material selection on the design optimization. Then, sample of both polymers were FDM printed to verify to effective mechanical properties reachable in printed structures, as it is well known that printing strongly affects the mechanical performance. The results showed that, choosing the right printing settings in terms of printing direction, nozzle temperature, chamber and bed temperature, nozzle velocity, layer height, allows to obtain the values of tensile strength and stiffness in good accordance with the material data sheets. A PEEK nanosat was, then, printed accordingly, demonstrating the feasibility to use high performance ECSS compliant polymers in the production of space components via ALM.