MATERIALS AND STRUCTURES SYMPOSIUM (C2)
Specialised Technologies, Including Nanotechnology (8)

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NEW APPLICATIONS OF ADVANCED MANUFACTURING METHODS FOR SPACE INSTRUMENTATION AND SYSTEMS OF NANOSPACECRAFT.

Abstract

In the frame of an ESA TRP project, CSL, SIRRIS, ALMASpace and TAS-F have investigated the possibility to use advanced manufacturing methods for application to space hardware. After a review of the state of the art of the new manufacturing methods, including additive manufacturing but also advanced bonding, joining and shaping techniques has been performed, several case studies have been realised. These new techniques imply a different approach already at the design phase since the manufacturing constraints can be completely different. The goal of the project was to evaluate the different technologies from the conception to the realisation and learn how the classical design and development of such parts shall be adapted to take into account the different specificities of the new techniques. Three types of case studies have been developed successively. The first type was a re-manufacture of an existing piece of hardware using advanced techniques to evaluate if there is some potential improvement to be achieved (cost, production time, complexity reduction). The second level was to design and manufacture a part based on the application requirements. The last level was to design and manufacture a part taking into account in addition the subsystem to which it belongs. All case studies have been tested in terms of achieved performances and resistance to the mechanical and thermal environment. For each level, several case studies were proposed by ALMASpace and TAS-F and a pre-selection (down to 2 parts) was performed to verify the feasibility and the interest of the proposed part for the project. For the first 2 levels, the 2 selected case studies have been designed, built and tested. A single case study was built for last level. The cases studies of level one were an aluminium inertial wheel housing (using electron beam welding to connect simple machined parts) and a mechanism housing fully made by additive manufacturing (electron beam melting of Titanium). The ones of level two were an aluminium tray for nanosatellite structure (assembled by salt dip brazing) and an antenna support bracket (designed by topological optimisation and manufactured by laser beam melting of aluminium). The third level case study is a Sun Sensor for nanosatellite designed by topological optimisation and including electronic circuit

(optical detector and proximity electronic) deposited by aerosol jet printing directly on the aluminium structure. All case studies have been manufactured and tested and all part manufactured, despite including some imperfections, fulfilled all performance requirements. Some of the case studies have already been followed by additional development directly between the manufacturer and the end-user. The paper will list the different techniques that have been applied for the design and manufacturing of the case studies and will then present all case studies with their conclusions in terms of performances, improvement of design flexibility, cost and lessons learnt.