Hybrid Additive Manufacturing Approach for Rapid Manufacturing of Larger Parts with Geometrically Complex Structures – Recent Trends in the Aerospace Engineering Industry

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Recent trends in the aerospace engineering industry are focusing on extending the range capability of aircrafts by implementing additional fuel tanks. Such optimization of an aircraft is in the first place expected to shorten travel time, which reduces total flight costs, maintenance costs and prolongs aircraft life expectancy. The longer-range capability has also beneficial influence on the environment. It leads to less fuel stops with less additional landing and take-off cycles where engines work at maximum power and therefore reduces exhaust emission.

The advantages of additional fuel tanks on the other hand bring challenges concerning aircraft performance and stability. Aircrafts are already optimized to their maximum. Therefore, special emphasis should be paid on location, size and shape optimization of extra fuel tanks in order not to interfere with the final flying capability. However, the complexity of the design of such products cannot be achieved by conventional manufacturing methods. Additive manufacturing (AM) of metal components has thus gained increasing interest in aerospace sector in the recent years due to the freedom of shape and design combined with high performance and low cost.

The main goal of the proposed project is the development of Ti6Al4V Hybrid AM advanced fuel system components by combining SLM and DED technology. Ti6Al4V alloy is the most dominant titanium alloy in aerospace engineering industry due to its high strength, low density, high fracture toughness and superior corrosion properties. We focus on optimization of process parameters of both AM techniques. The influence of different process parameters, such as laser power, scan spacing, scan strategy, scan speed, powder flow rate and layer thickness, on the microstructure, corrosion and mechanical properties has to be evaluated in order to ensure optimal printing conditions. On the other hand, heat treatment of Ti6Al4V printed parts is considered as well. To improve the ductility, reduce thermal stresses and to achieve anticipated mechanical properties of Ti6Al4V AM manufactured products suitable heat treatments is assessed. Furthermore, surface plasma treatment is employed to additionally improve corrosion resistance trough surface oxide layer thickening.