Rapid Manufacturing of Lightweight Structures of Aluminum and/or Titanium

Lukas Löber

The aerospace industry has a typical demand on mass optimisation of all constructional and functional parts. The optimal design of these lightweight parts is not always possible for conventional machining. Furthermore, complex parts are made via many operations and different specialized fixtures, which are very costly, even if the high cost per mass is considered.

Selective laser melting (SLM) allows manufacturing porous 3D parts with customized near-net shape and internal geometry. With this Rapid Manufacturing (RM) technique, extremely complex parts for acceptable costs and small lot size can be produce by additive layered manufacturing. Starting from a CAD model of a 3D object, 2D cross sections are produced and fused together. Compared with conventional material removal techniques, this material growth technique offers unlimited possibilities of geometrical complexity, like lightweight parts with hollow cellular structures (Fig. 1).

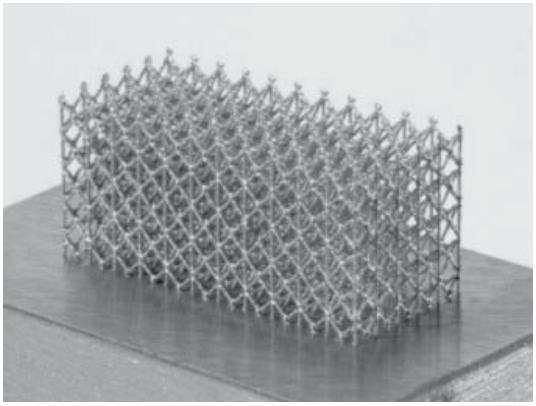

Fig. 1: Lightweight structure with periodic ordered cellular structures produced by SLMTM.

Even if powders of titanium and aluminium alloys are commercially available, the research is situated on different levels. Fundamental research aims at understanding the sub processes to be able to control the complete process more accurately. The influence of different process parameters, like laser power, scan speed, layer thickness, working gases, additives, orientation etc. has to be studied. Finally, the optimization of the structural analysis and design synthesis of cellular structures inside the design domain of some aerospace applications has to be carried out.

The determination of specific strength/mass will be investigated mechanical characterization by comparison of dense of various hollow structures.