Laser powder bed fusion of Ti-22Al-25Nb at low and high pre-heating temperatures

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Titanium alloys based on the orthorhombic Ti_2AlNb phase are being considered as potential structural lightweight alloys since the early 1990s due to their favourable mechanical performance, i.e., balanced strength and ductility at room and high temperatures as well as high oxidation and creep resistance [1]. With the emergence of additive manufacturing these alloys become particularly interesting again as the microstructures and properties differ considerably from conventionally processed materials [2]. In our work, we consider the whole process chain including the powder production and explain the microstructure formation of the orthorhombic alloy Ti-22Al-25Nb and the effects of in situ and intrinsic heating during laser powder bed fusion with differing energy densities at low and high pre-heating temperatures by means of state-of-the-art characterization techniques such as in situ high energy synchrotron X-ray diffraction and advanced electron microscopy [3]. Fast cooling rates during low-temperature LPBF lead to metastable weakly ordered β phase. For high-temperature LPBF a Widmanstätten microstructure was observed with lenticular O phase precipitates within the β matrix (Figure 1).

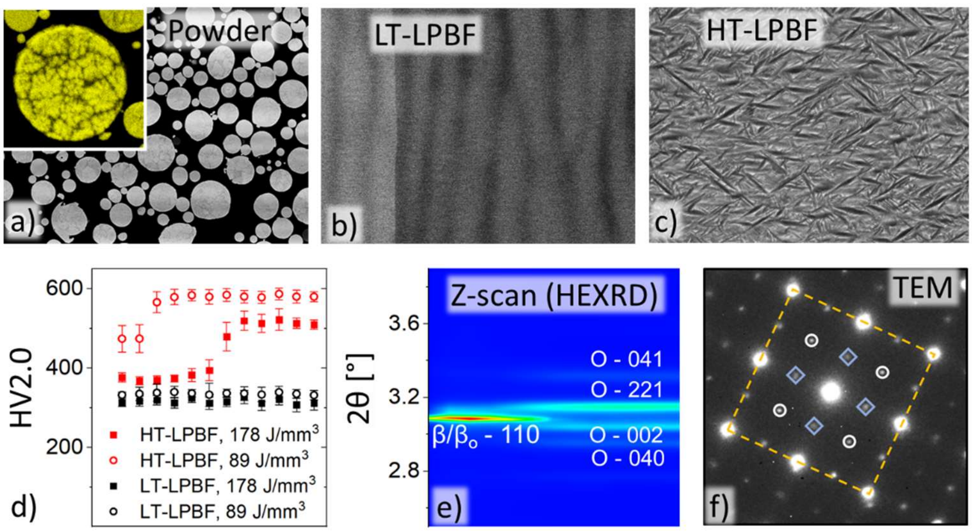

Figure 1. a) Powder of Ti-22Al-25-Nb. b) Microstructure of low-temperature LPBF. c) Microstructure of Microstructure of high-temperature LPBF. d) Subsurface gradient (hardness). e) Subsurface gradient (phase inventory). f) Selected area electron diffraction pattern.

References

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