

Figure 1

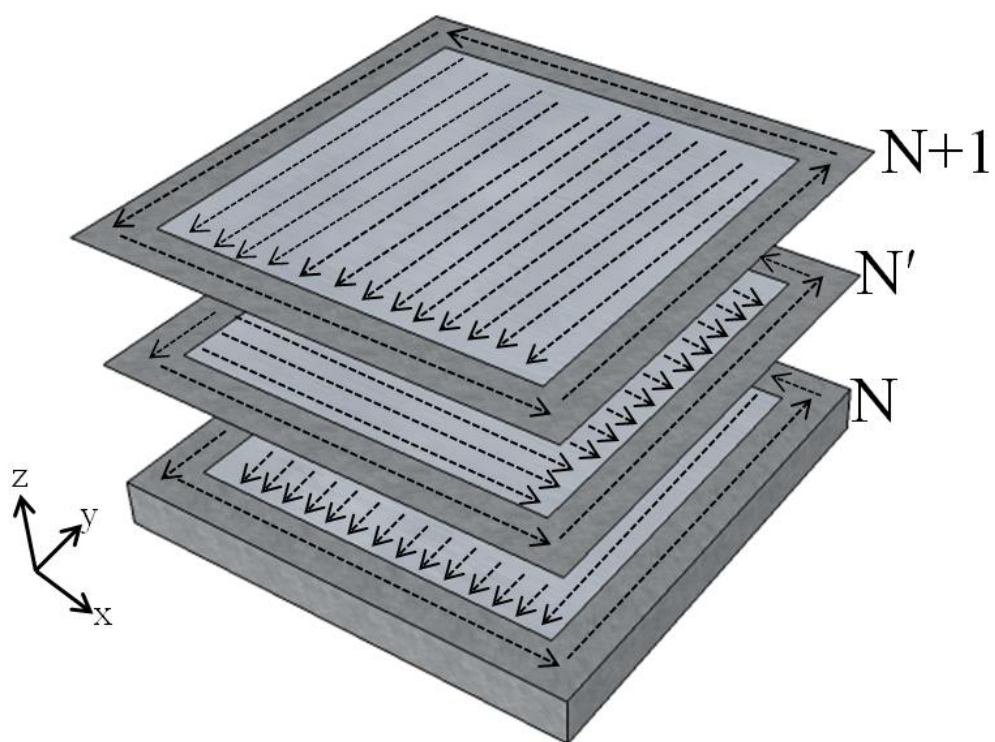


Figure 2

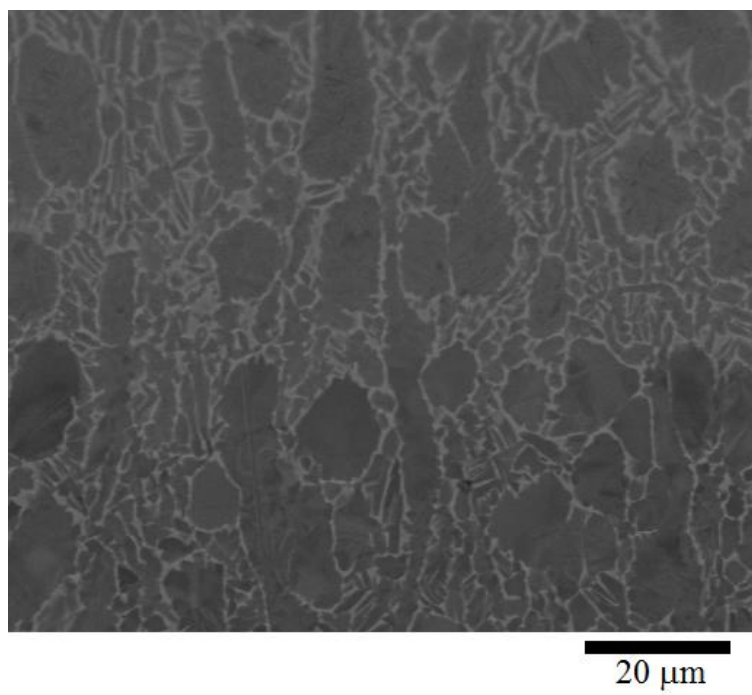


Figure 3

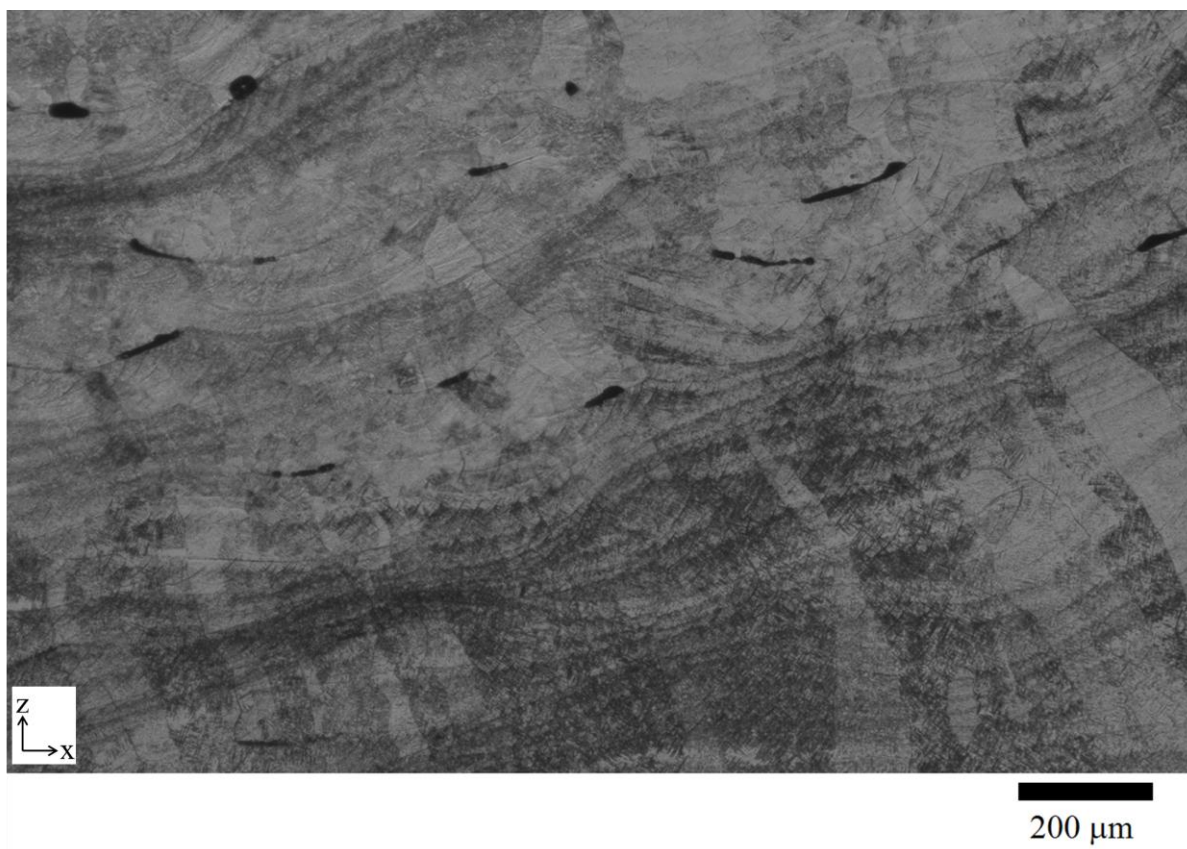


Figure 4

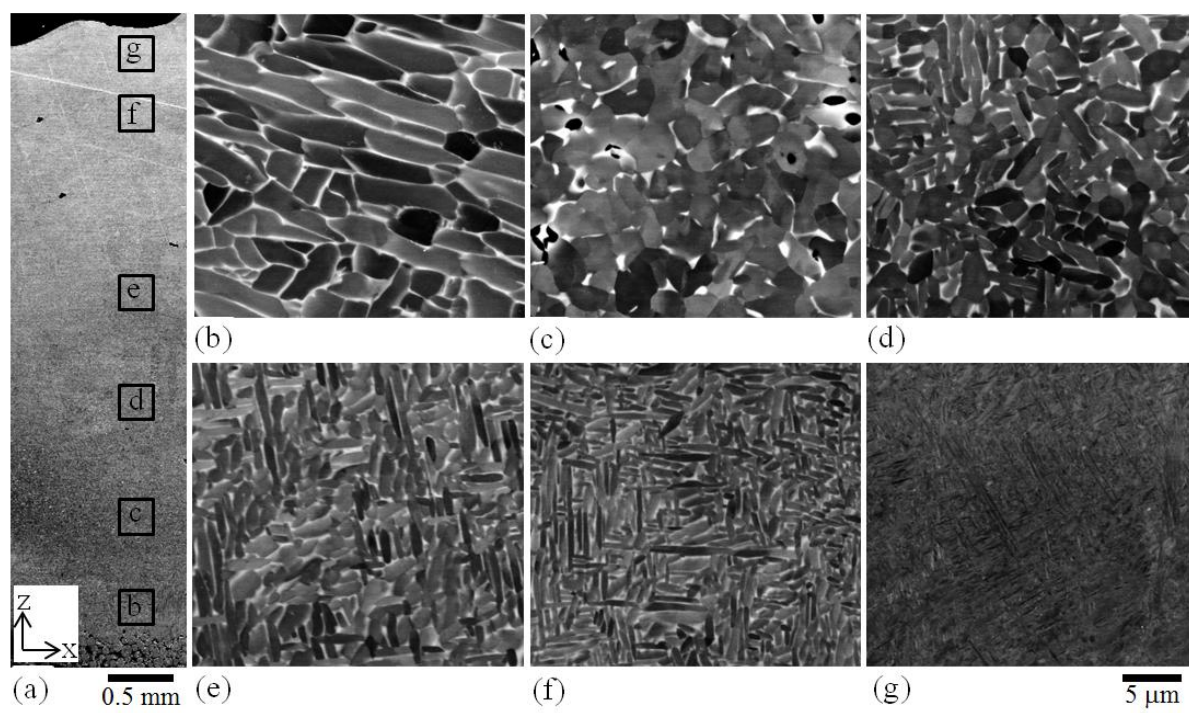


Figure 5

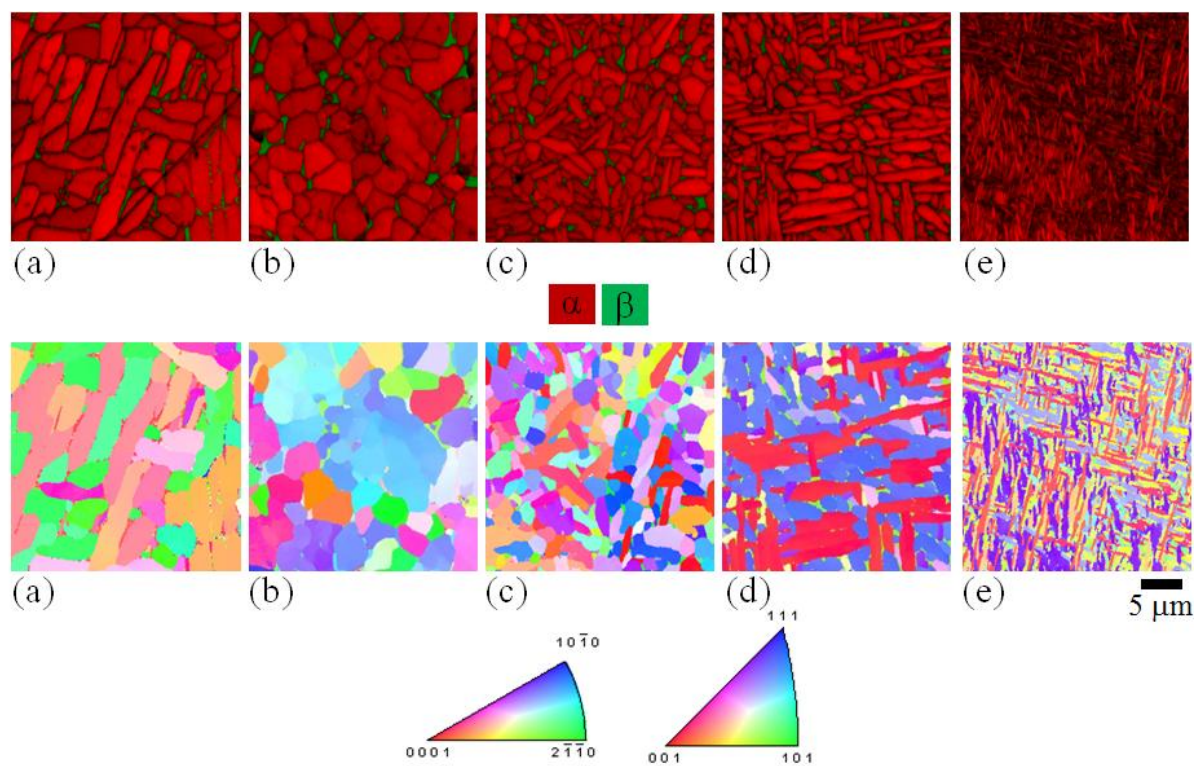


Figure 6

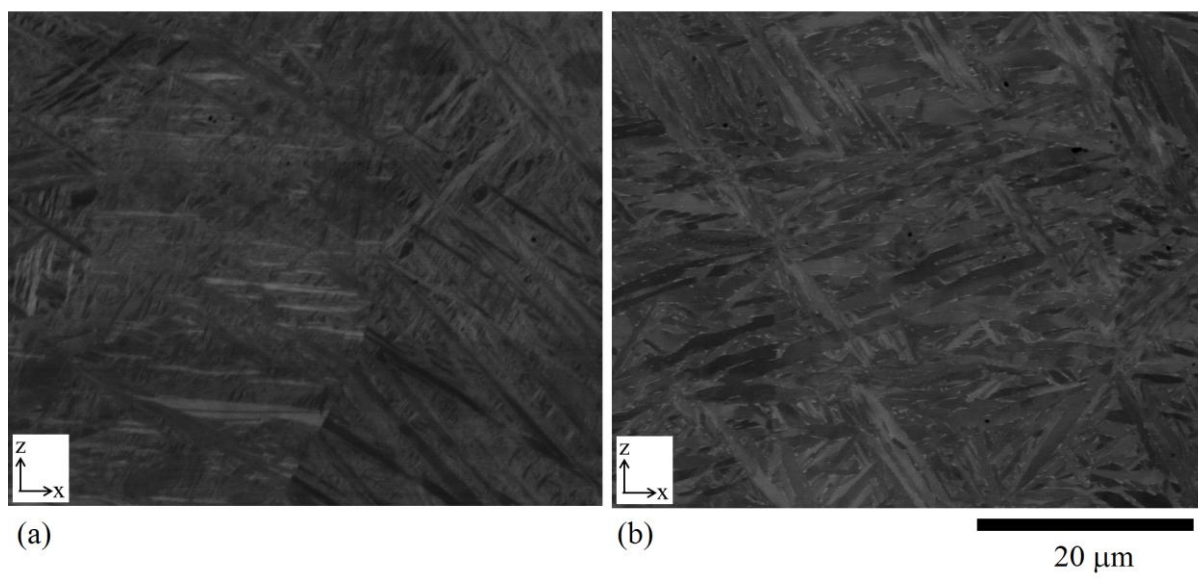


Figure 7

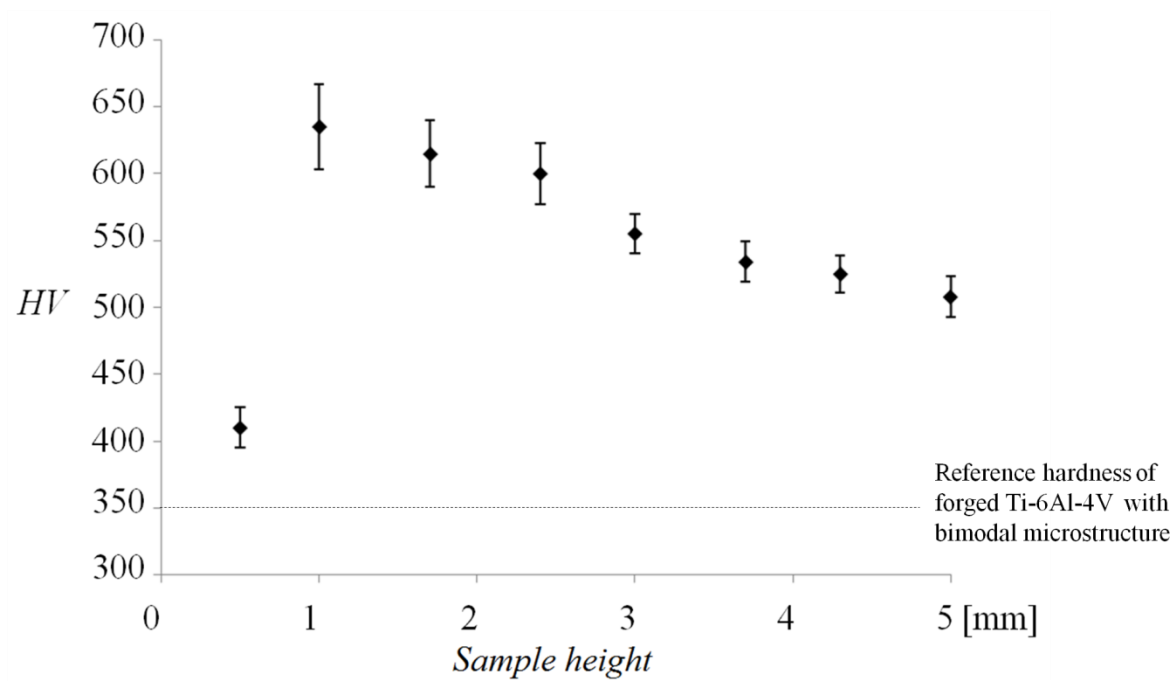


Figure 8

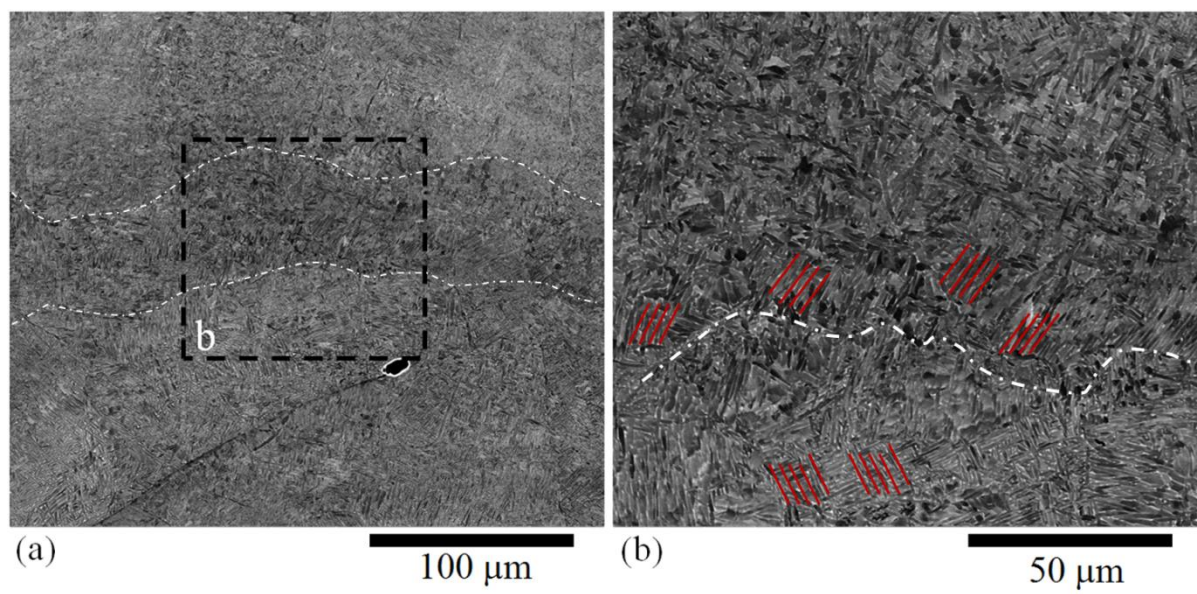


Table 1

Table 1: Chemical composition of the powders used in this study

Element	N	C	H	Fe	O	Al	V	Ti
wt%	0.01	0.01	0.0051	0.25	0.13	6.5	4.5	balance

Table 2

Table 2: Comparison of the process parameters used in this research and those typical used for SLM of Ti-6Al-4V

	Present research	[ref 4]	[ref 5]	[ref 8]	[ref 10]
Laser Power [W]	42	200	100	42	157
Hatch Spacing [μm]	30	200	100	75	100
Scan Speed [mm/s]	58	500	150	200	225
Platform Temperature [K]	473	773	n/a	n/a	343
Oxygen Level [%]	2×10^{-4}	$< 1 \times 10^{-2}$	n/a	n/a	5×10^{-4}
Scan Strategy	double	Single	Single	Single	Single
Layer Thickness [μm]	50	30	50	30	50
Spot Size [μm]	30	220	180	52	120
Part Size [order]	mm	mm	mm	mm	mm

Table 3

Table 3: Chemical composition (weight %) of the different microstructures observed in the SLM Ti-6Al-4V and the reference material.

	Average area	α phase	β phase		Morphology	Sample height
Ti	90.7 \pm 0.1	91.7 \pm 0.1	88.6 \pm 0.2		lamellar	0.5 mm
Al	5.3 \pm 0.1	5.8 \pm 0.1	3.6 \pm 0.1			
V	4.0 \pm 0.1	2.5 \pm 0.4	7.8 \pm 0.3			
	Average area	α phase	β phase		equiaxed	1.5 mm
Ti	90.0 \pm 0.1	93.5 \pm 0.5	75.5 \pm 0.5			
Al	5.4 \pm 0.1	4.5 \pm 0.4	7.4 \pm 0.2			
V	4.6 \pm 0.1	2.0 \pm 0.3	17.1 \pm 0.5			
	Average area	α_{lamellar} phase	β phase	α_{equiaxed} phase	bimodal	3 mm
Ti	90.0 \pm 0.1	92.0 \pm 0.7	87.0 \pm 0.9	93.5 \pm 0.7		
Al	5.4 \pm 0.1	6.0 \pm 0.4	5.1 \pm 0.5	4.4 \pm 0.4		
V	4.6 \pm 0.1	2.0 \pm 0.2	7.9 \pm 0.2	2.1 \pm 0.2		
	Average area	α' phase			martensite (fine lamellar)	5 mm
Ti	87.4 \pm 0.4	87.3 \pm 0.7				
Al	8.8 \pm 0.2	8.7 \pm 0.1				
V	3.8 \pm 0.3	4.0 \pm 0.7				
	Average area	α_{equiaxed} phase	β phase		reference forged Ti- 6Al-4V with bimodal microstructure	
Ti	85.3 \pm 0.4	87.2 \pm 0.5	81.5 \pm 1.1			
Al	6.4 \pm 0.3	11.0 \pm 0.5	6.4 \pm 0.3			
V	3.9 \pm 0.3	1.8 \pm 0.5	12.1 \pm 0.9			

Table 4

Table 4: Tensile properties of as-built and stress relieved SLM Ti-6Al-4V (zx-orientation)

	E [GPa]	σ_y [MPa]	UTS [MPa]	ϵ fracture [%]
as-built	119 ± 7	967 ± 10	1117 ± 3	8.9 ± 0.4
stress relieved	117 ± 6	937 ± 9	1052 ± 11	9.6 ± 0.9