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Introduction: Different from the traditional subtraction manufacturing, the metallic additive manufacturing (AM) is a novel technology that joins materials to generate three-dimensional parts directly from CAD models based on the discrete-stacking principle. In this work, the systematic studies were made on the microstructure characteristics and mechanical performance of SLM C-X stainless steel under different conditions. Profound discussion was made to enhance the understanding of relationship between the underlying

### SLM fabrication procedure







#### • Figure 2

Microstructure of the horizontal crosssections of the SLM samples under: (a) AB and different heat treatments: (b)solution, (c) aging, (d) solution-aging. Table 2 Phase composition within the SLM C-X samples **Solution** Solution AB Aging +aging  $\alpha$  phase 99.7 100.0 95.5 96.5 (%) γ phase 0.3 0.0 4.5 3.5 (%)

## TEM observation on the as-built sample





• Figure 4



**(a)** 



- Figure 3
- BFI of the C-X steel under AB condition illustrating the existence of
- (a) parallel strip martensites with corresponding inserted SAED pattern,
- (b) nanoprecipitates (white arrowed),
- (c) nanoparticle of region 1 and (d) amorphous-nanocrystalline composite microstructure of region 2.



of the nanoparticle marked in Region 2 (a); (c) high-resolution TEM (HRTEM) image of the partial coherence interface; NiAL (d) HRTEM of the coherence interface without elastic a-Fe strain corresponding to the region 2 marked in (a). 0d=1.98 nn

#### Tensile properties, microhardness and Fracture observation



![](_page_0_Figure_27.jpeg)

![](_page_0_Picture_28.jpeg)

![](_page_0_Picture_29.jpeg)

![](_page_0_Picture_30.jpeg)

![](_page_0_Picture_31.jpeg)

- Figure 5 Mechanical properties of the C-X steel SLM parts after different heat treatment:  $\bullet$ (a) representative engineering stress-strain curves; (b) average microhardness.
- Figure 6 Fracture microstructure of the C-X steel SLM parts under conditions of: (a) as-built, (b) solution; (c) aging; (d) solution-aging.

![](_page_0_Picture_34.jpeg)

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