IOCM 2025 Conference

The 4th International Online Conference on Materials

3–6 November 2025 | Online

MDPI

Characterization of additively manufactured parts of Inconel 718

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INTRODUCTION

- Inconel 718 is a high-strength, corrosion-resistant nickel-based superalloy.
- Inconel 718 contains a high Nb concentration and is primarily strengthened by γ''-Ni_3Nb and slightly by γ'-Ni_3Al, which precipitate coherently in γ matrix.
- DMLS involves using a laser to melt and fuse metal powders.

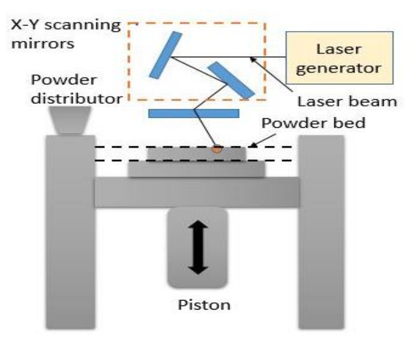


Fig. 1. Schematic diagram of DMLS Process

OBJECTIVES

- Analyze the microstructure of Inconel 718 parts produced through powder bed fusion
- Evaluate the mechanical properties
- Identify the factors affecting the microstructure and mechanical properties.
- Contribute to the knowledge base on additive manufacturing of Inconel 718 parts and provide insights into the potential applications of this technique in the aerospace, energy, and biomedical industries.
- Investigate the performance of Inconel 718 parts under different loading conditions, such as creep, fatigue, and corrosion resistance.

METHODOLOGY

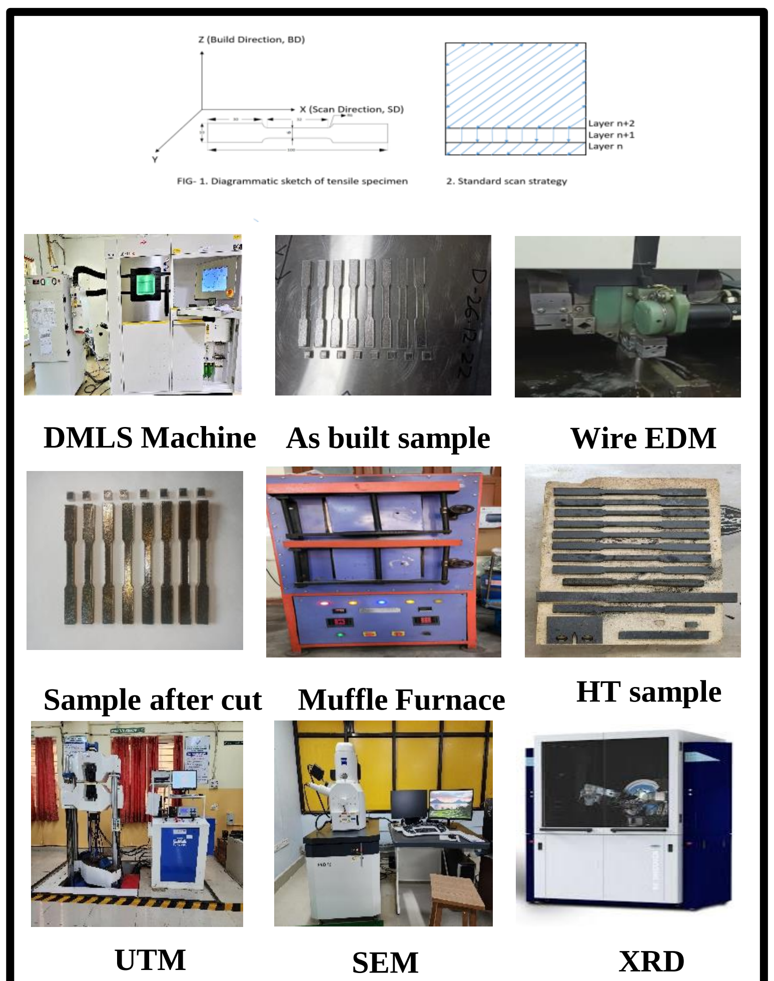


Fig. 2. Experimentation and characterization

RESULTS

Tensile test and Surface Roughness

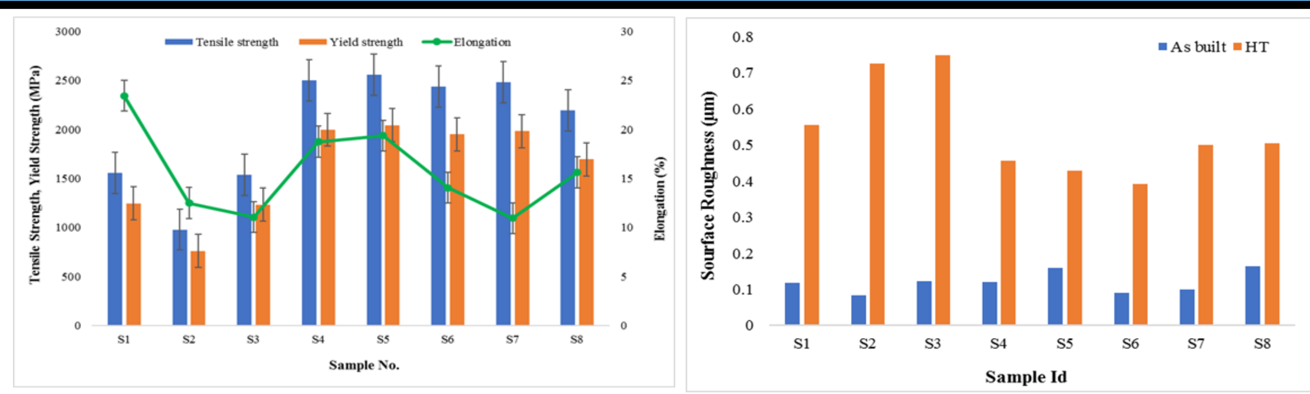


Fig. 3. Tensile test and surface roughness of Inconel 718

XRD and FESEM Analysis

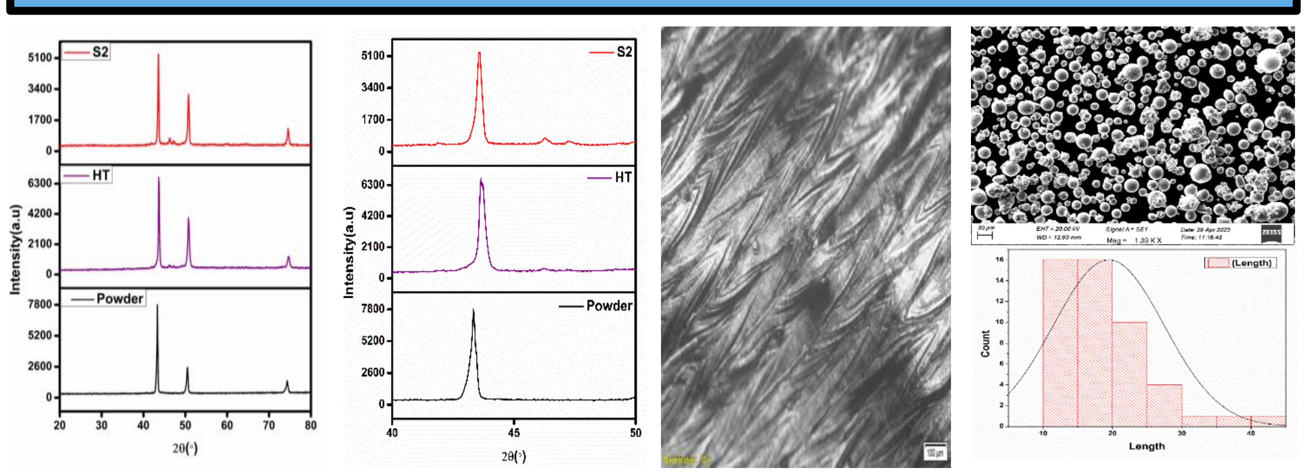


Fig. 4. XRD pattern and FESEM micrograph with grain size distribution plot of Inconel 718

Fractography Analysis

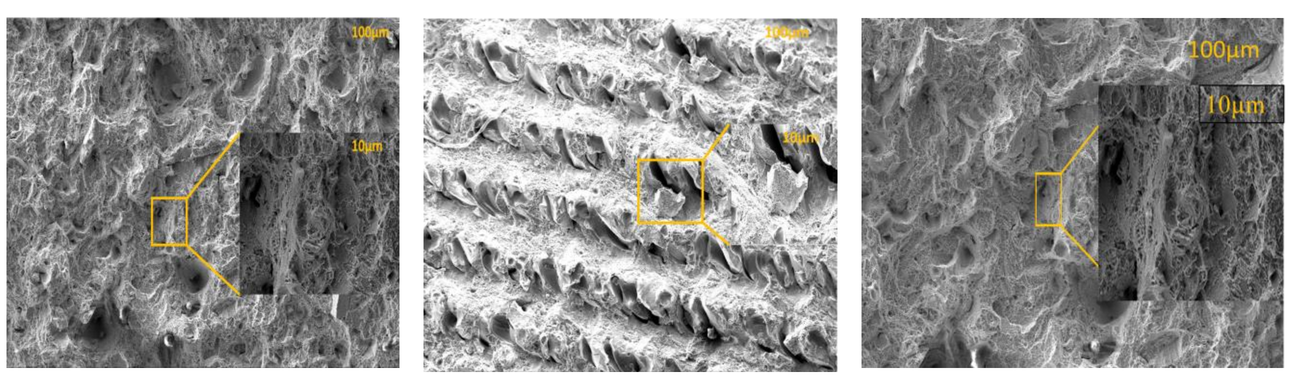


Fig. 5. Fracture surface of tensile specimen

Surface Morphology

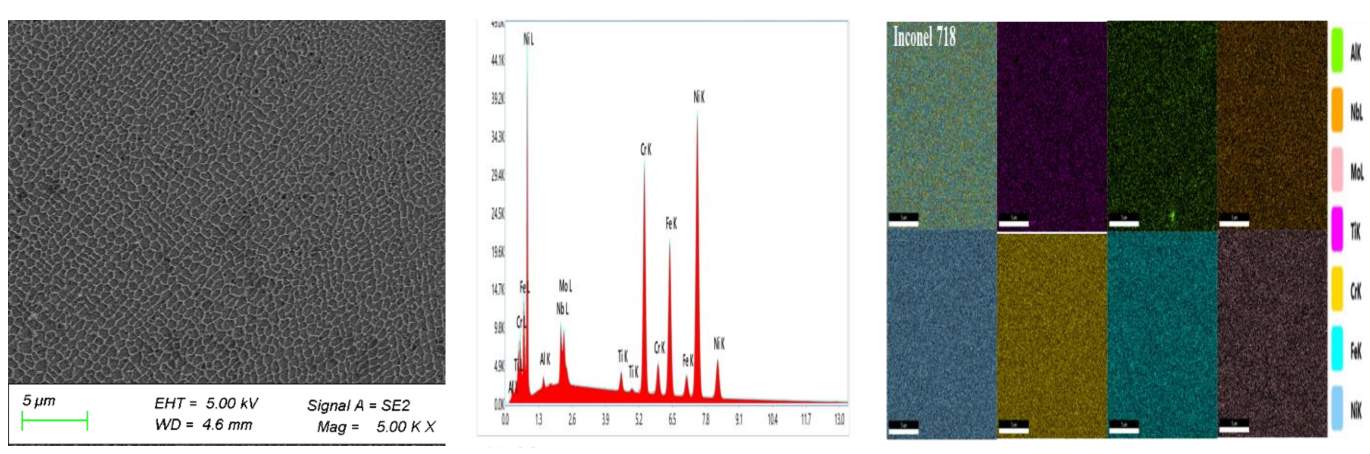
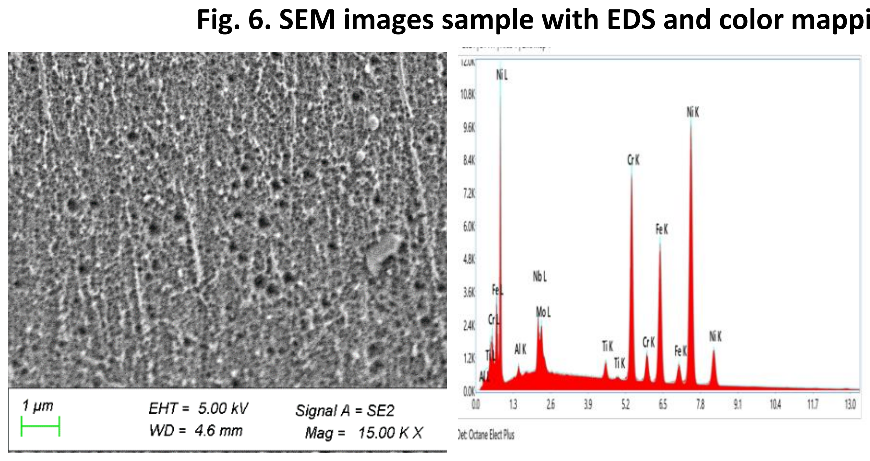


Fig. 6. SEM images sample with EDS and color mapping of as-built Inconel 718



	Without heat treatment		After heat treatment	
Element	Weight %	Atomic %	Weight %	Atomic %
Al K	0.5	1.0	0.5	1.0
Ti K	1.2	1.5	1.2	1.4
Cr K	18.8	21.0	18.8	21.0
Fe K	17.8	18.5	17.7	18.4
Ni K	53.7	53.1	53.7	53.2
Nb L	4.9	3.1	5.2	3.2
Mo L	3.1	1.9	2.9	1.8

Fig. 7. SEM images of heat treated sample with EDS map analysis

CONCLUSIONS & FUTURE SCOPE

- Heat treatment processes increased the tensile strength and decreased the ductility of L-PBF IN718 at room temperature.
- Negligible change in overall diffraction pattern.
- Dendrite structure was developed in a direction parallel to the build direction.
- The columnar pattern in the XY cross-section along few characteristic directions corresponded to the scan rotation.
- Performing mechanical and microstructural tests using other variable parameters can be analyzed.
- The effect of corrosion and erosion test can be performed.
- The conventional machining Inconel 718 can be compared with DMLS fabricated Inconel 718.

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