


# Chapter 6

## Studies on

### Microstructure, Microhardness and Wear Behavior of L– PBFed 18Ni(300) Maraging Steel Part: Effect of Post–Heat Treatment

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## ABSTRACT

*This study explores the fabrication of Maraging Steel 18Ni(300) using Laser-Powder Bed Fusion (L-PBF) and examines its microstructural evolution, microhardness, and dry sliding wear behavior before and after post-heat treatment. The heat treatment includes solution treatment (ST) at 840 °C for 2 h followed by oil quenching, then ageing (AT) at 492 °C for 2 h with final oil quenching. The as-built L-PBF specimen exhibits a fine microstructure with columnar dendritic grains and cellular lattice morphologies due to high undercooling. Nital etching reveals fish-scale-shaped Melt Pool Boundaries (MPBs), while Fry's reagent highlights martensitic morphology. Solution annealing dissolves micro-segregation, enhancing precipitate formation during ageing, which strengthens the material. Microhardness increases from  $\sim 397 \pm 14.1$  HV0.5 (as-built) to  $\sim 587 \pm 13.5$  HV0.5 (aged). XRD confirms retained austenite in the as-built and martensite in the heat-treated specimen. The post-heat-treated specimen also exhibits lower wear rates.*

## 1. INTRODUCTION

Additive Manufacturing refers to the fabrication of a 3D part in a layer-upon-layer fashion based on the model's CAD data (Gibson et al., 2021). The seven broad classifications of AM techniques are – vat photo-polymerization, binder jetting, material jetting, sheet lamination, material extrusion, powder bed fusion and direct energy deposition. This amazing technique can efficiently be utilized for a variety of materials including polymers, metals, ceramics, composites, etc. Three important categories of metal-based AM techniques are – powder bed, powder feed and wire feed systems (Frazier, 2014). Recently, titanium-based alloys, nickel-based superalloys, aluminium alloys, stainless steels, maraging steels, etc. have become popular in the context of additive fabrication (Lewandowski and Seifi, 2016). Laser-Powder Bed Fusion (L-PBF) is nowadays attempted to fabricate metallic components for many industries such as aerospace and biomedical. During L-PBF, laser acts as a power source. Laser energy is utilized to selectively fuse and melt the evenly distributed powder layer. The molten regions solidify very quickly and a fresh powder layer is created upon lowering the build platform down. These process-sequences are repeated until required built height is achieved (Kizhakkinan et al., 2023). L-PBF is appropriate to manufacture *small-to-medium* sized components with very high

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