

TRAITEMENTS THERMIQUES ET DE SURFACE SUR LES PIÈCES EN INCONEL 625® PRODUITES PAR FABRICATION ADDITIVE

THERMAL AND SURFACE TREATMENTS ON INCONEL 625® PARTS PRODUCED BY ADDITIVE MANUFACTURING

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PARTENAIRES / PARTNERS

PROJECT GOALS

- Study the effect of post-processing thermal and HIP treatment on the microstructure and mechanical properties of laser powder-bed fused (L-PBF) IN625 alloy parts.
- Develop new technologies for surface finishing of L-PBF-built IN625 parts.

IMPACTS


- Interrelations between the various sequences of post-processing thermal/HIP treatments, the alloy microstructure and the mechanical behavior of L-PBF-built parts at room and elevated temperatures were established.
- Two finishing technologies, electropolishing and chemical-mechanical polishing, have been developed and experimentally validated for the exterior and interior finishing of IN625 parts.

INNOVATIVE POTENTIAL

This study laid down the foundations for the next phase of the project (MANU-1625), which is divided in two main phases:

- The improvement of the high-temperature mechanical behavior of L-PBF parts via the optimization of their post-processing thermal/HIP treatments.
- The optimization and technological scaling-up of the surface polishing technologies for tubular L-PBF components.

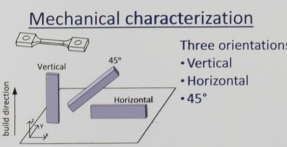
L-PBF process



- Machine: EOSINT M 290;
- Powder: EOS Inconel 625;
- Fabrication parameters: EOS IN625 Perf. (40 μm layer thickness).

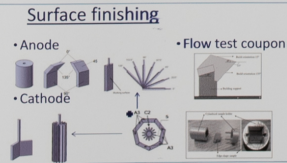
Specimens

Mechanical characterization



Three orientations:
• Vertical
• Horizontal
• 45°

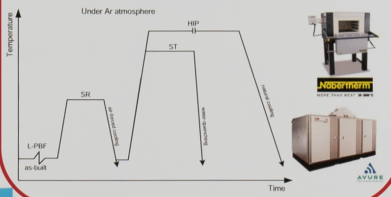
Surface finishing



- Anode
- Cathode
- Flow test coupon

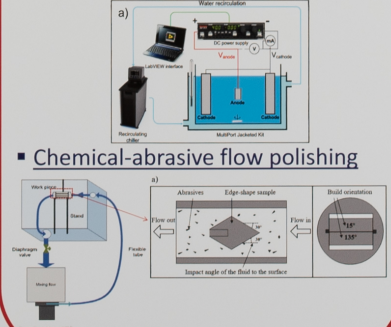
Thermal treatments

- Stress relief annealing (SR);
- Solution treatment (ST);
- Hot isostatic pressing (HIP).

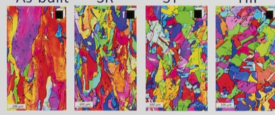


Surface treatments

- Electropolishing
- Chemical-abrasive flow polishing



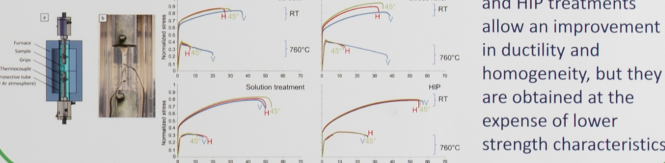
Microstructure



- KREITZBERG A, BRAILOVSKI V, TURENNE S, MATER, SCI. ENG. A (FEB., 2017)
- KREITZBERG A, BRAILOVSKI V, TURENNE S, MATER, SCI. ENG. A (MAY, 2017)

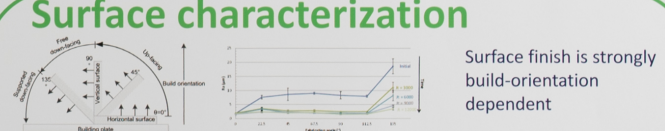
- L-PBF processing results in the formation of a columnar microstructure.
- ST and HIP treatments lead to the formation of an isotropic equiaxed microstructure.

Mechanical properties



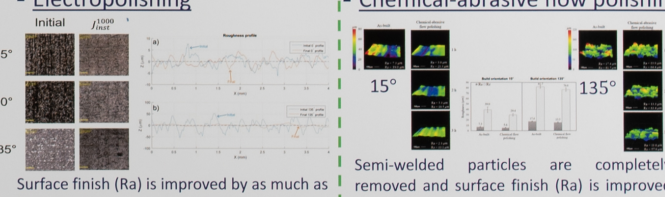
Low-temperature ST and HIP treatments allow an improvement in ductility and homogeneity, but they are obtained at the expense of lower strength characteristics.

Surface characterization



Surface finish is strongly build-orientation dependent

- Electropolishing
- Chemical-abrasive flow polishing



Surface finish (Ra) is improved by as much as 82% to reach a close to uniform roughness.

Semi-welded particles are completely removed and surface finish (Ra) is improved by 45% (15°) and by 20% (135°).

- URLEA V, BRAILOVSKI V, ADV. MANUF. TECH. (APRIL 2017)
- MOHAMMADIAN N, TURENNE S, BRAILOVSKI V, JMPT (MARCH 2017)