Thesis Planning Documentation

Subject: *'Tolerances and Defects analysis of an innovative Additive Manufacturing MMC Cu174PH(65-35)'*

Relator: Prof. Raffaella Sesana.

Tutor: Ing. Matteo Crachi**.**

Starting Time: As soon as possible.

Working Time: 6 months**.**

Partners: Politecnico di Torino – Sophia High tech s.r.l. (https://www.sophiahightech.com/) – Italian Space Agency (ASI).

Contest: The present Master thesis is an important brick of a more complex project between Politecnico di Torino, Sophia High Tech s.r.l. and the Italian Space Agency (ASI). In particular, results will be able to provide a better explanation of the thermo-mechanical behaviour of a new patented innovative metal matrix composite material. Nowadays liquid rocket engines are looking for high thermal conductivity and high strength Additive Manufacturing materials. The New Space Economy is growing day by day and the scientific community need to keep updating skills and knowledges respect to both, new process technologies such as additive manufacturing and new superalloys such as Copper-Steel. The present master thesis aims to provide to the scientific community a deep study about achievable tolerances and defects analysis (geometry, distribution) in order to improve the process parameters of a new Copper-Maraging steel metal matrix composite material processed by SLM Additive Manufacturing.

Previous knowledge*: Additive Manufacturing Process, Science of Metals, Heat treatment for Metals alloys, Basic Material Mechanics**.**

Theoretical Activities:

- State-of-the-art of Additive Manufacturing Copper/Copper alloys and Additive Manufacturing Maraging steel alloys mechanical behaviour;
- State-of-the-art of Additive Manufacturing Copper/Copper alloys and Additive Manufacturing Maraging steel alloys thermal behaviour;
- State-of-the-art of Additive Manufacturing Copper-steel composites interface behaviour;
- State-of-the-art of common Additive Manufacturing defects (Lakes of fusion, porosities);
- CT scan analysis;

Experimental activities:

- CT scan results post processing:
    - As-build vertical (ZX/ZY planes) specimens;
    - As-build Liquid Rocket Engine cooling system representative sample (Figure 1);

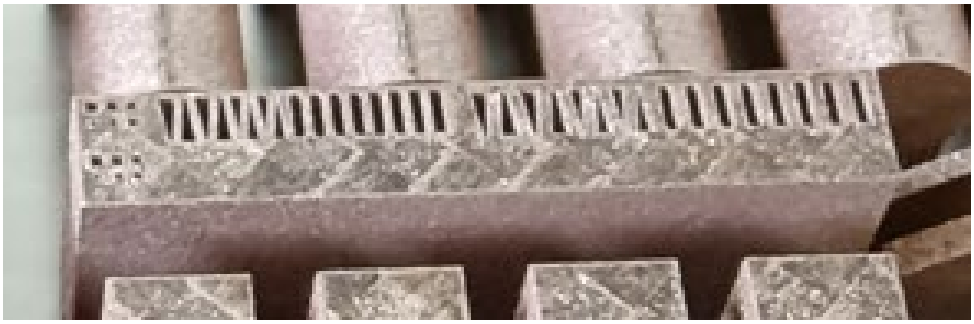

Figure 1

- Optical Microscope Defects analysis:
    - As-build ZX/ZY plane;
    - As-build XY plane;
    - Heat-treated ZX/ZY plane;
    - Heat-treated XY plane;

Aims:

- Identify defects geometry:
    - Shape/morphology;
    - Dimension;
    - Position;
- Propose new process parameters in order to reduce defects;

*Previous knowledge are not compulsory. However the candidate should consider additional time in order to study theoretical gaps.

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